第32回
極域宙空圏シンポジウム

プログラム＆予稿集

The 32nd Symposium on
Space and Upper Atmospheric Sciences
in the Polar Regions

Programme and Abstracts

2008年 8 月 4 日（月）～ 8 月 5 日（火）
August 4-5, 2008

大学共同利用機関法人
情報・システム研究機構
国立極地研究所

Research Organization of Information and Systems
National Institute of Polar Research
Tokyo, Japan

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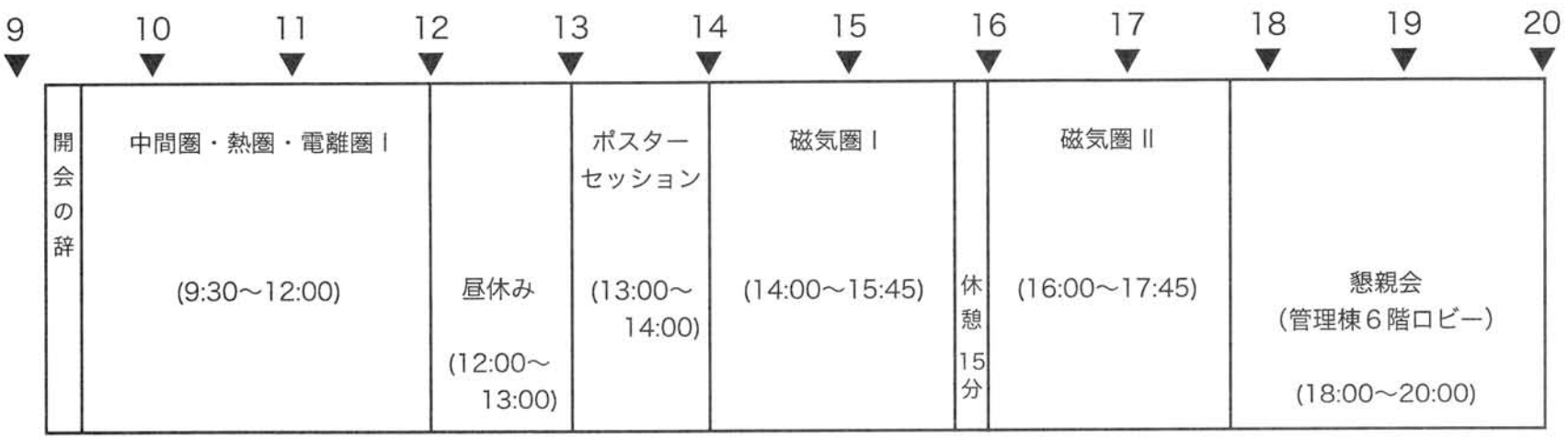
Time Table

◆ 8月4日（月） 9:25～17:45



◆ 8月5日（火） 9:00～17:50

国立極地研究所
第32回極域宙空圏シンポジウム

開催日：２００８年８月４日－８月５日
場　所：国立極地研究所管理資料棟６階講堂

プログラム

口頭発表時間：通常講演は質疑応答も含めて15分（12分発表+ 3分質疑応答）
国内招待講演は20分（15分発表+ 5分質疑応答）
海外招待講演は30分（25分発表+ 5分質疑応答）

ポスター発表：すべて１日目午後のポスターセッションで
ポスター貼り出し可能期間：８月４日 9:00～８月５日 17:00

８月４日（月）９：２５～１７：４５

【開会の辞】

０９：２５～０９：３０
司会：山岸久雄（極地研）

開会の辞　　藤井理行（極地研）

【１．中間圏・熱圏・電離圏 I 】

０９：３０～１２：００
座長：元場哲郎（極地研）

9:30　1-1
田口 真（立教大）、鈴木秀彦（極地研）
南極昭和基地におけるOH大気光観測の初期結果

9:45　1-2
冨川喜弘、堤 雅基（極地研）
南極昭和基地MFレーダーデータを用いた大気潮汐波の解析

10:00　1-3
行松 彰、西村耕司、小川泰信、堤 雅基、佐藤夏雄（極地研）、Mike T. Rietveld（EISCAT科学協会）、
Darren M. Wright、Tim K. Yeoman、Terry R. Robinson、Mark Lester（英国レスター大学）
SuperDARN及びEISCATによる人工励起電離層沿磁力線不規則構造の観測(2)

10:15　1-4
小川忠彦、西谷 望、大塚雄一、塩川和夫（名大STE研）、津川卓也（情報通信研究機構）
SuperDARN北海道レーダーで観測された夜間の中規模伝搬性電離圏擾乱とE層エコー

10:30　1-5
渡邉穣次（首都大学東京）、石井 守（情報通信研究機構）、松田佳久（東京学芸大学）
イオノゾンデを用いたオーロラサブストーム時の電離圏変動

10:45　1-6
津田卓雄、野澤悟徳、大山伸一郎（名大STE研）、元場哲郎、小川泰信（極地研）、品川裕之（NICT）、西谷 望
（名大STE研）、細川敬祐（電通大）、佐藤夏雄（極地研）、Mark Lester（レスター大 ）、藤井良一（名大STE研）
極域下部熱圏における高速中性風の加速機構

11:00　1-7
藤原 均（東北大）、三好勉信（九州大）
GCMシミュレーションに見られる極域熱圏大気変動の特徴

11:15　1-8
西谷 望、小川忠彦、菊池 崇、堀 智昭（名大STE研）、亘 慎一（NICT）、北海道-陸別HFレーダー研究グループ
SuperDARN Hokkaido / King Salmon radar で観測された磁気嵐開始時における昼間側対流領域の拡大

11:30　1-9
藤田 茂（気象大学校・JST）、品川裕之（情報通信研究機構・JST）、田中高史（九州大・JST）
熱圏-電離圏-磁気圏結合数値シミュレーションの試み

11:45　1-10
源 泰拓（気象庁地磁気観測所）
昭和基地における大気電場観測

■■ 昼休み　12：00～13：00 ■■

【ポスターセッション】

13：00～14：00

P1
小川泰信、麻生武彦、宮岡 宏（極地研）、藤井良一、野澤悟徳、大山伸一郎（名大STE研）、平原聖文（東大）、
I. Haggstrom、A. Westman (EISCAT本部)
EISCAT スヴァールバルレーダーを用いた極冠域電離圏における極風の観測的研究

P2
市原章光、西谷 望、小川忠彦（名大STE研）
北海道-陸別HFレーダーで観測された中規模伝搬性電離圏擾乱の初期解析結果

P3
Hosokawa, Keisuke (UEC) and Nozomu Nishitani (STEL, Nagoya U.)
Mid-latitude dusk scatter event as observed with Hokkaido SuperDARN radar

P4
Hosokawa, Keisuke (UEC), Y. Ogawa, A. Kadokura, and N. Sato (NIPR)
Electron density modulation associated with pulsating aurora

P5
北野谷有吾（東京大学）、阿部琢美、向井利典（宇宙航空研究開発機構/宇宙科学研究本部）
極冠域電離圏におけるプラズマ密度の上昇について

P6
栗原宜子（名大STE研）、Wlodek Kofman（Laboratoire de Planetologie de Grenoble）、大山伸一郎、野澤悟徳、
藤井良一（名大STE研）
極域電離圏の電子エネルギー収支における沿磁力線電流の影響

P7
Yoshikawa, Akimasa (Kyushu U.)
Formation of Cowling channel in the global ionosphere

P8
油 祐樹、尾崎光紀、八木谷 聡、長野 勇（金沢大）、山岸久雄（極地研）
VLFエミッションと銀河背景雑音吸収の関連性

P9
尾崎光紀、八木谷 聡、長野 勇（金沢大）、山岸久雄（極地研）、笠原禎也（金沢大）、佐藤夏雄、門倉 昭（極地研）
ホイスラモード波の衛星–地上観測結果に基づいた理論伝搬解析

P10
阿部愛美、田口 聡、西沢 諒、細川敬祐（電通大）、M. R. Collier、T. E. Moore（NASA/GSFC）
北向きIMF時におけるカスプインジェクション領域の特性

P11
徳永旭将、吉川顕正、魚住禎司、湯元清文（九州大）、MAGDASグループ
サブストームに伴う昼側磁気赤道Pi 2型地磁気脈動のICAに基づく定量的評価

P12
長妻 努（情報通信研究機構）、三好由純（名大STE研）
極冠電位差非線形発達のAlfven Mach数依存性

P13
三宅 亙*、陣 英克（情報通信研究機構; *東海大）
リアルタイムTECマップによる宇宙天気モニタリング

P14
Nakata, Hiroyuki (Chiba U.) and Takashi Tanaka (Kyushu U.)
Three-Dimensional Distribution of the Ionospheric Electric Potentials Determined by a Global MHD Simulation

P15
髙﨑聡子（新領域融合研究センター）、門倉 昭、佐藤夏雄（極地研）、藤田 茂（気象大）、田中高史（九州大）、海老原祐輔（名古屋大）、村田健史、松岡大祐（愛媛大）
Global MHD シミュレーションによる地磁気共役点位置の時間的トレース

P16
Miyake, Taketoshi (Toyama Prefectural U.), Masaki Okada (NIPR), Hideyuki Usui (RISH, Kyoto U.), Takeshi Murata (Ehime U.), and Yoshiharu Omura (RISH, Kyoto U.)
Time evolution of three-dimensional spatial structure of beam instabilities

P17
巻田和男、星野光男（拓殖大）、西野正徳、加藤泰男（名大STE研）、田中良昌（極地研）、大川隆志（地磁気観測所）
磁気異常帯およびその関連域でのリオメータ観測

P18
豊永雅美（総合研究大学院大学）、山岸久雄（極地研）、田中良昌（情報・システム研究機構）
太陽プロトン現象時の2周波イメージングリオメータ観測から求めた吸収スペクトル指数の変化特性

P19
宮岡 宏、小川泰信（極地研）、野澤悟徳（名大STE研）
大磁気嵐に伴う夜側高緯度電離圏の電子密度上昇とイオン上昇流 - EISCATレーダーで観測した2003年11月20日イベント -（2）

P20
宮岡 宏（極地研）、藤本泰弘（フジ理研）、源 泰拓（気象庁地磁気観測所）、門倉 昭（極地研）
昭和基地地上観測およびDMSP衛星データによるオーロラストリーマーのダイナミクス

P21
杉田理恵、細川敬祐（電通大）、門倉 昭、佐藤夏雄（極地研）、S. E. Milan、M. Lester（レスター大）、G. Bjornsson、T. Saemundsson（アイスランド大）
アイスランドにおける SuperDARN と全天 TV カメラを用いたオーロラ爆発の高時間分解能観測

P22
田中良昌（情報・システム研究機構）、麻生武彦（極地研）、Bjorn Gustavsson（トロムソ大学）、田邉國士（早稲田大学）、門倉 昭、小川泰信（極地研）

一般化オーロラトモグラフィ法の再構成アルゴリズムの比較

P23
伊藤祐毅（東大）、浅村和史（ISAS/JAXA）、坂野井 健（東北大）、海老原祐輔（名大高等研究院）、
山崎 敦（ISAS/JAXA）、平原聖文（東大）、小淵保幸（ジェネシア(株)）、藤本正樹（ISAS/JAXA）
れいめい衛星で観測したオーロラ微細構造形成

P24
西山尚典、坂野井 健（東北大）、海老原祐輔（名大高等研究院）、浅村和史、山崎 敦（宇宙科学研究本部）、
岡野章一（東北大）、平原聖文（東大）
Search for the source regions of precipitating electrons which generate pulsating aurora based on REIMEI observations

P25
Motoba, Tetsuo, Akira Kadokura (NIPR), Yusuke Ebihara (Nagoya U.), and Natsuo Sato (NIPR)
Antarctic optical observations of dayside aurora during a geomagnetic sudden commencement

P26
吉田明夫（総合研究大学院大学）
昭和基地、Hermanus、柿岡における地磁気活動の日・季節・年々変動

P27
吉田明夫（総合研究大学院大学）
2007年の地磁気活動は次の太陽黒点サイクル24の振幅がそれほど大きくならないことを示す

P28
木村哲士、坂野井 健（東北大）、田口 真（立教大）、岡野章一（東北大）
フリッカリングオーロラの高速撮像観測計画の現状

P29
山岸久雄、堤 雅基（極地研）、田中良昌、西村耕司（情報・システム研究機構 新領域融合研究センター）、
藤井智史（琉球大）、巻田和男（拓殖大）、豊永雅美（総研大）
多周波デジタルイメージングリオメータの開発（2）

P30
山岸久雄、岡田雅樹（極地研）、高崎聡子（情報・システム研究機構 融合研究センター）
西オングル電磁波動観測エリアの基盤整備（3） –自然エネルギー電源とデータ通信–

P31
西村耕司（極地研/新領域融合研究センター）、佐藤 亨（京大院・情）
多周波・多サブアレイMSTレーダーを用いた3次元高分解能イメージング観測

P32
堤 雅基（極地研）、佐藤 薫（東大院理）、佐藤 亨（京大院情）、齊藤昭則（京大院理）、冨川喜弘、西村耕司、
山内 恭、山岸久雄、麻生武彦、江尻全機、佐藤夏雄（極地研）
昭和基地における下部熱圏探査レーダー観測計画

P33
村田千紘、市川 隆、Ramsey Lundock、谷口友一郎、沖田博文（東北大）、 石川 勇（IK技研）、稲岡精晃
（エックス電子設計）
南極40cm赤外線望遠鏡

【2．磁気圏 I 】

14：00～15：45
座長：藤田 茂（気象大）

14:00　2-1
大山伸一郎、津田卓雄（名大STE研）、浅村和史（宇宙科学研究本部）、平原聖文（東大）、山崎 敦（宇宙科学研究本部）、坂野井 健、笠羽康正（東北大）、藤井良一、野澤悟徳（名大STE研）
非干渉散乱レーダーとれいめい衛星との同時観測データを用いたオーロラアーク近傍での電流系微細構造の研究

14:15　2-2
Yamazaki, Yosuke, Kiyohumi Yumoto, Akimasa Yoshikawa (Kyushu U.), Shinich Watari (NICT), and Hisashi Utada (ERI, U. Tokyo)
SFE*s Observed at Dip-equator CPMN Stations

14:30　2-3
Shinbori, Atsuki, T. Kikuchi (STEL, Nagoya U.), T. Ono, M. Iizima, A. Kumamoto, Y. Nishimura (Tohoku U.), and A. Matsuoka (JAXA/ISAS)
あけぼの衛星によって内部磁気圏で観測されるSCに関連した電磁場変動現象

14:45　2-4
Ikeda, Akihiro, K. Yumoto, T. Uozumi, M. Shinohara (Kyushu U.), K. Nozaki (NICT), A. Yoshikawa (Kyushu U.), and K. Shiokawa (STEL, Nagoya U.)
FM-CW Radar Observations of Pi 2 Ionospheric Electric Fields at Low Latitude

15:00　2-5
Fujimoto, Akiko, Hironori Eto, Manabu Shinohara, Kiyohumi Yumoto (Kyushu U.), and MAGDAS/CPMN Group
The low-latitude Pc5 index for estimating the solar wind velocity

15:15　2-6
Sakurai, Tohru (Tokai U.), T. Kikuchi (STEL, Nagoya U.), K. Hashimoto (Kibi International U.), Y. Tonegawa, Y. Kajikawa, and K. Sakata (Tokai U.)
Solar wind driven periodic radar echoes and Pc5 oscillations during the magnetic storm on 14 December 2006

15:30　2-7
N. Maeda (Kyushu U.), S. Takasaki (TRIC,ROIS/NIPR), Kawano, Hideaki (Kyushu U.), S. Ohtani (JHU/APL), P. M. E. Décréau, J. G. Trotignon (Laboratoire de Physique et Chimie de l'Environnement, Centre National de la Recherche Scientifique, Orléans, France), S. I. Solovyev, D. G. Baishev (Yu.G.Shafer Institute of Cosmophysical Research and Aeronomy, Yakutsk, Russia), and K. Yumoto (Kyushu U.)
CPMN - Cluster conjugate observations of the magnetospheric plasma density

■■ 休憩　15：45～16：00 ■■

【3．磁気圏 II 】

16：00～17：45
座長：能勢正仁（京都大）

16:00　3-1
菊池 崇、新堀淳樹、辻 祐司（名大STE研）、橋本久美子（吉備国際大）、亘 慎一（情報通信研究機構）、荒木 徹（京都大）、M. A. Abdu（INPE, Brazil）
磁気嵐急始インパルスの昼夜半球赤道への瞬時伝播

16:15　3-2
Hashimoto, Kumiko K. (Kibi International U.), T. Kikuchi (STEL, Nagoya U.), S. Watari (NICT), and M. A. Abdu (INPE, Brazil)
Overshielding at sub auroral -equatorial latitudes at onset of substorm

16:30　3-3
Sakaguchi, Kaori, K. Shiokawa, A. Ieda, A. Nakajima, R. Nomura (STEL, Nagoya U.), M. Greffen, and E. Donovan (U. Calgary, Canada)
Microstructures of initial brightenings at substorm onsets observed by 30-Hz all-sky TV cameras during the THEMIS-ground campaign

16:45　3-4
Taguchi, Satoshi, S. Suzuki, K. Hosokawa, M. Morimoto (UEC), Y. Ogawa, A. S. Yukimatu, N. Sato (NIPR), M. R. Collier, and T. E. Moore (NASA/GSFC, USA)
Zonal flow jet in the cusp: Simultaneous observations from spacecraft, radars, and ground magnetometer network

17:00　3-5
Morioka, Akira (Tohoku U.), Y. Miyoshi (STEL, Nagoya U.), F. Tsuchiya, and H. Misawa (Tohoku U.)
Substorm onset as derived from AKR breakup

17:15　3-6
Kataoka, Ryuho (RIKEN), Yoshizumi Miyoshi (STEL, Nagoya U.), and Keiji Hayashi (Stanford U.)
Numerical space weather forecast of the solar wind and radiation belts

17:30　3-7
能勢正仁、家森俊彦、竹田雅彦、藤 浩明（京都大）、國武 学、亘 慎一 (情報通信研究機構)、AE観測所ネットワーク
AE指数算出の現状と展望

■■　懇親会　18：00～20：00　■■
(於：管理資料棟6階講堂前ロビー)

8月5日（火）　9：00～17：50

【4．中間圏・熱圏・電離圏 II、将来計画 I 】

09：00～10：45
座長：藤原　均（東北大）

9:00　4-1
三好勉信（九州大）、藤原 均（東北大）
熱圏の日没直後に現れる大気波動と潮汐波との関連について

9:15　4-2
大山伸一郎、津田卓雄、岩田陽介、野澤悟徳、藤井良一（名大STE研）、小川泰信（極地研）
EISCATレーダーと多波長フォトメータを用いた電離圏電気伝導度推定手法の開発

9:30　4-3
大山伸一郎、栗原純一、津田卓雄（名大STE研）、前田佐和子（京都女子大）、野澤悟徳、藤井良一（名大STE研）
EISCATレーダーで観測された極域下部電離圏における鉛直イオン速度の高周波変動

9:45　4-4
野澤悟徳、大山伸一郎、藤井良一（名大STE研）、小川泰信（極地研）
北極域における各種レーダーを用いた極域下部熱圏・中間圏の研究

10:00　4-5
栗原純一、大山伸一郎、野澤悟徳、藤井良一（名大STE研）、小川泰信（極地研）、岩上直幹（東大）、阿部琢美（宇宙航空研究開発機構 宇宙科学研究本部）
DELTA-2 campaign: 極域下部熱圏の力学とエネルギー収支の総合観測計画

10:15　4-6
Kawahara, Takuya D. (Shinshu U.), Norihito Saito, Satoshi Wada (RIKEN), Satonori Nozawa, and Ryoichi Fujii (STEL, Nagoya U.)
Development and current status of the new Na temperature lidar deployed in Tromso

10:30　4-7
前澤裕之、水野 亮、長濱智生、森部那由多、水野陽治、水野範和、大西利一、福井康雄 (名古屋大学)、中井直正、瀬田益道、山倉鉄屋 (筑波大学)、山本 智、芝 祥一 (東京大学)、笠井康子 (NICT)
ミリ・サブミリ波/THz波帯電波望遠鏡による地球・惑星大気観測

■■ 休憩　10：45～11：00 ■■

【5. オーロラダイナミクス】

11：00～12：30
座長：田中良昌（極地研）

11:00　5-1
岩田陽介、野澤悟徳、大山伸一郎、藤井良一、津田卓雄（名大STE研)、小川泰信（極地研）
多波長光学観測機器およびEISCATレーダーを用いた磁気圏-電離圏結合におけるプロトンオーロラの研究

11:15　5-2
門倉 昭（極地研)、原口祐樹、穂嶋宏昭、山本博聖（立教大)、平原聖文（東大）
パルセーティングオーロラの地上一衛星同時観測

11:30　5-3
平原聖文 (東大・院・理)、坂野井 健 (東北大・PPARC)、小川泰信 (極地研)、浅村和史、山崎 敦 (ISAS/JAXA)、関 華奈子（名大STE研)、海老原祐輔（名大高等研究院）
電子・イオンのエネルギー・ピッチ角分布とオーロラ発光との関係：れいめい衛星観測

11:45　5-4
坂 翁介（オフィス ジオフィジク)、林 幹治（東京大学）
オーロラの Poleward expansion に伴って発生する二つの伝播方向を持つ Surface wave

12:00　5-5
中川道夫（大産大工)、内田正美（大阪信愛)、江尻全機（極地研)、海老原祐輔（名大高等研究院)、小野 孝（大産大工)、門倉 昭（極地研)、籠谷正則（大産大工)、斉藤芳隆（宇宙研)、佐藤夏雄（極地研)、鈴木裕武（立教大理)、綱脇恵章、友淵義人（大産大工)、中村智一（名大理)、中村康範（大産大工)、並木道義（宇宙研)、平田憲司、福田真実（大産大工)、松坂幸彦（宇宙研)、村上浩之（立教大理)、山内 誠（宮崎大工)、山上隆正（宇宙研)、山岸久雄（極地研)、山本幹生（宮崎大工）
ＰＰＢ8号機と10号機によるオーロラＸ線について

12:15　5-6
菊地 聡、櫻井敬久、乾 恵美子、郡司修一、門叶冬樹 (山形大・理)、佐藤夏雄、門倉 昭 (極地研)、T.Saemundsson（アイスランド大学）
アイスランドと日本の大気中での宇宙線生成核種Be-7濃度日変動の比較IV

■■ 昼休み　12：30～13：30 ■■

【6．磁気圏 III、将来計画 II（英語限定)】

13：30～15：05
座長：佐藤夏雄（極地研）

13:30　6-1（海外招待講演）
Kirsti Kauristie (FMI, Finland), A. Weatherwax (Siena College, USA), and R. Harrison (Rutherford Appleton Laboratory, UK)
Heliosphere impact on geospace: Solar-terrestrial and aeronomy research during the fourth Polar Year campaign

14:00　6-2（国内招待講演）
Yumoto, Kiyohumi, Teiji Uozumi, Shuji Abe, Akihiro Ikeda, Misaki Ito (Kyushu U.), and MAGDAS Group
MAGDAS Project and Its Preliminary Results

14:20　6-3
T. Ono, Y. Kasaba, A. Kumamoto (Tohoku U.), Y. Miyoshi, K. Seki, K. Shiokawa (STEL, Nagoya U.), Hirahara, Masafumi (U. Tokyo), K. Takashima, K. Asamura, A. Matsuoka (JAXA/ISAS), and ERG working group
The ERG Project: Japanese geospace exploration to elucidate the dynamics of the inner magnetosphere during the next solar maximum period

14:35　6-4
Watanabe, Takashi (STEL, Nagoya U.)
New Data-Center System of ICSU（World Data Services?）

14:50　6-5
Lundock Ramsey Guy and T. Ishikawa (Tohoku U.)
Observations of solar system planets with Antarctic Infra-Red Camera (AIR-C)

■■　休憩　15：05～15：20　■■

【7．中間圏・熱圏・電離圏 III、将来計画 III（英語限定）】

15：20～17：45
座長：堤　雅基（極地研）

15:20　7-1（海外招待講演）
D. J. Murphy (Ice, Ocean Atmosphere and Climate, Australian Antarctic Division, Australia), T. Aso (NIPR), D. C. Fritts (CoRA/NorthWest Research Associates, USA), R. A. Hibbins (BAS, UK), A. J. McDonald (U. Canterbury, New Zealand), E. Merzlyakov, Yu. I. Portnyagin (IEM, Russia), D. M. Riggin (CoRA/NorthWest Research Associates, USA), M. Tsutsumi (NIPR), and R. A. Vincent (U. Adelaide, Australia)
Radar studies of the large-scale dynamics of the mesosphere and lower thermosphere above Antarctica

15:50　7-2（国内招待講演）
Sato, Kaoru (U. Tokyo), Masaki Tsutsumi (NIPR), Toru Sato, Akinori Saito (Kyoto U.), Yoshihiro Tomikawa (NIPR), Koji Nishimura (TRIC, ROIS), Hisao Yamagishi, Takashi Yamanouchi, Takehiko Aso, and Masaki Ejiri (NIPR)
Program of the Antarctic Syowa MST/IS Radar

16:10　7-3（国内招待講演）
Abo, Makoto (Tokyo Metropolitan U.), Masaki Tsutsumi, Yoshihiro Tomikawa (NIPR), Kaoru Sato (U. Tokyo), Takuji Nakamura (RISH, Kyoto U.), and Takuya D. Kawahara (Shinshu U.)
Development of remote controlled lidar system for observations of daytime middle-atmosphere temperature over Syowa station

16:30　7-4（国内招待講演）
Mizuno, Akira, Tomoo Nagahama, Hiroyuki Maezawa, Toshihisa Kuwahara (STEL, Nagoya U.), Yasuo Fukui, Norikazu Mizuno (Nagoya U.), Atsushi Morihira (ULVAC), Makoto Taguchi, Masaki Tsutsumi, Hisao Yamagishi, Natsuo Sato, and Space and Upper Atmospheric Science Group (NIPR)
Millimeter-wave observations of the stratospheric and mesospheric chemical composition change over Syowa station

16:50　7-5
Nakamura, Takuji (RISH, Kyoto U.), Makoto Abo, Yasukuni Shibata (Tokyo Metropolitan U.), Takuya D. Kawahara (Shinshu U.), Tsukasa Kitahara (Toba National College of Maritime Technology), Kazuyo Sakanoi (Komazawa U.), Kaoru Sato (U. Tokyo), Mitsumu K. Ejiri (RISH, Kyoto U.), Masaki Tsutsumi, and Yoshihiro Tomikawa (NIPR)
An observation plan of dynamics and constituents in the polar middle and upper atmosphere with a multi-functional resonance lidar system

17:05　7-6
Xiao Zuo (Peking U.)
Conjugate study of polar upper atmosphere and KuaFu project

17:25　7-7
Liu Ruiyuan, Xu Zhonghua, Liu Shunlin, Zhang Beichen, and Hu Hongqiao（Polar Research Institute of China）
Variations of the Ionospheric F2-layer at Zhongshan Station, Antarctica

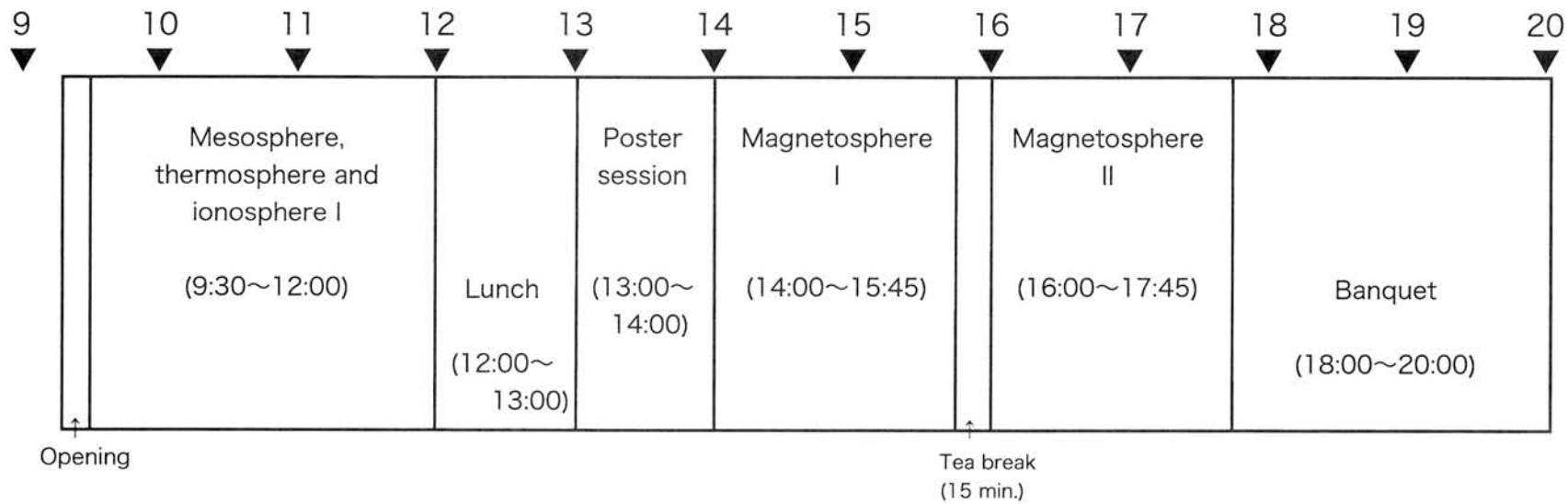
【閉会の辞】

１７：４５～１７：５０

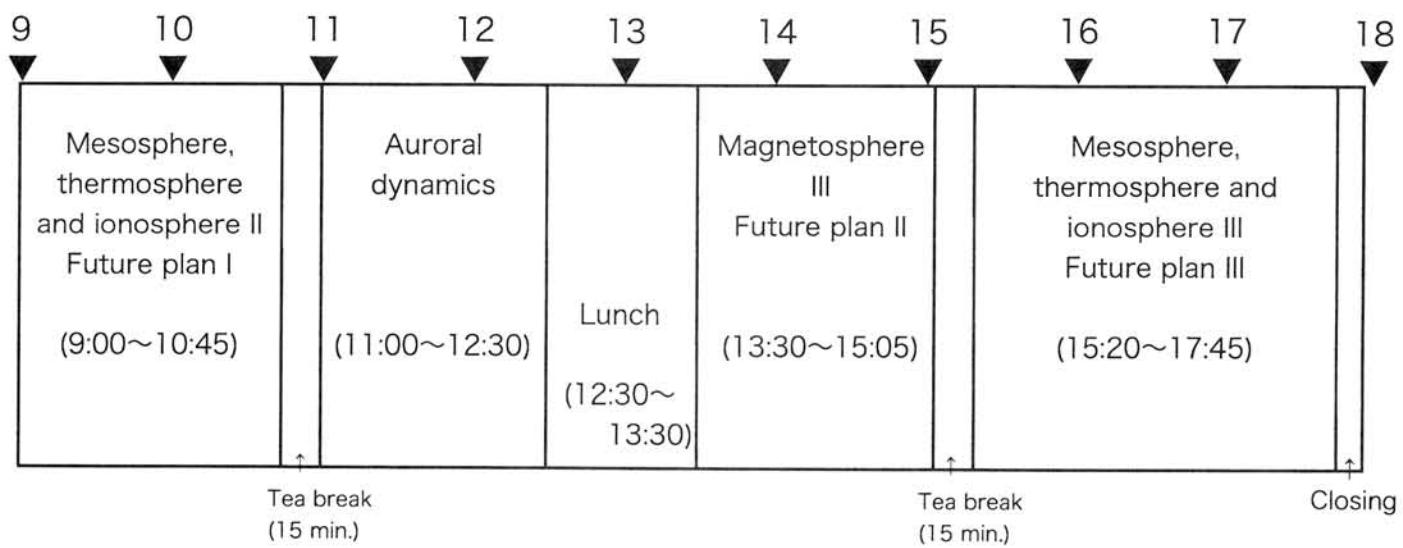
閉会の辞　　佐藤夏雄（極地研）

Time Table

◆ Monday, August 4th (9:25 - 17:45)



◆ Tuesday, August 5th (9:00 - 17:50)



National Institute of Polar Research
The 32nd Symposium on Space and Upper Atmospheric Sciences in the Polar Regions

Date: August 4th -5th, 2008
Venue: Auditorium in National Institute of Polar Research, Tokyo

Programme

Oral presentation: total 15 min. including 12 min. talk and 3 min. discussions except for invited speakers

Poster session will be held on August 4th

Monday, August 4th 9:25 - 17:45

【Opening sessions】

9:25 - 9:30
Chair: Yamagishi, Hisao (NIPR)

Opening Fujii, Yoshiyuki (NIPR)

【1. Mesosphere, thermosphere and ionosphere I 】

9:30 - 12:00
Chair: Motoba, Tetsuo (NIPR)

9:30 1-1
Taguchi, Makoto (Rikkyo U.) and Hidehiko Suzuki (NIPR)
Initial results of OH airglow observation at Syowa Station in Antarctica

9:45 1-2
Tomikawa, Yoshihiro and M. Tsutsumi (NIPR)
Tidal wave analysis based on the MF radar data at Syowa Station

10:00 1-3
Yukimatu, Akira Sessai, K. Nishimura, Y. Ogawa, M. Tsutsumi, N. Sato (NIPR), M. T. Rietveld (EISCAT Sci. Association), D. M. Wright, T. K. Yeoman, T. R. Robinson, and M. Lester (U. Leicester, U.K.)
SuperDARN and EISCAT observation of artificially induced FAIs (2)

10:15 1-4
Ogawa, Tadahiko, N. Nishitani, Y. Otsuka, K. Shiokawa (STEL, Nagoya U.) , and T. Tsugawa (NICT)
SuperDARN Hokkaido Radar Observations of Nighttime Medium-Scale Traveling Ionospheric Disturbances and E-Region Echoes

10:30 1-5
J. Watanabe (Tokyo Metropolitan U.), Ishii, Mamoru (NICT), and Y. Matsuda (Tokyo Gakugei U.)
Variations in the ionosphere during the aurora substorm as observed by an ionosonde

10:45 1-6
Tsuda, Takuo T., S. Nozawa, S. Oyama (STEL, Nagoya U.), T. Motoba, Y. Ogawa (NIPR), H. Shinagawa (NICT), N. Nishitani (STEL, Nagoya U.), K. Hosokawa (UEC), N. Sato (NIPR), M. Lester (U. Leicester), and R. Fujii (STEL, Nagoya U.)
Acceleration mechanism of high-speed neutral wind in the polar lower thermosphere

11:00 1-7
Fujiwara, Hitoshi (Tohoku U.) and Y. Miyoshi (Kyushu U.)
Characteristics of the variation of the polar thermosphere found in GCM simulations

11:15 1-8
Nishitani, Nozomu, T. Ogawa, T. Kikuchi, T. Hori (STEL, Nagoya U.), S. Watari (NICT), and Hokkaido HF Radar Group
SuperDARN observation of equatorward progression of dayside merging flows during a geomagnetic storm

11:30 1-9
Fujita, Shigeru (Meteorological College), H. Shinagawa (NiCT), and T. Tanaka (Kyushu U.)
Development of the thermosphere – ionosphere – magnetosphere coupled numerical model

11:45 1-10
Minamoto, Yasuhiro (Kakioka Magnetic Observatory, Japan Meteorological Agency)
Observations of the atmospheric electric field at Syowa station, Antarctica

■■ **Lunch 12:00- 13:00** ■■

【Poster session】

13:00 – 14:00

P1
Ogawa, Yasunobu, T. Aso, H. Miyaoka (NIPR), R. Fujii, S. Nozawa, S. Oyama (STEL, Nagoya U.), M. Hirahara (U. Tokyo), I. Haggstrom, and A. Westman (EISCAT HQ)
Study on the polar wind in the polar cap ionosphere using the EISCAT Svalbard Radar

P2
Ichihara, Akimitsu, N. Nishitani, and T. Ogawa (STEL, Nagoya U.)
Initial result of analyzing MSTIDs observed by Hokkaido HF radar

P3
Hosokawa, Keisuke (UEC) and N. Nishitani (STEL, Nagoya U.)
Mid-latitude dusk scatter event as observed with Hokkaido SuperDARN radar

P4
Hosokawa, Keisuke (UEC), Y. Ogawa, A. Kadokura, and N. Sato (NIPR)
Electron density modulation associated with pulsating aurora

P5
Kitanoya, Yugo (U. Tokyo), T. Abe, and T. Mukai (JAXA/ISAS)
Plasma density increase in the high altitude polar cap

P6
Koizumi-Kurihara, Yoshiko (STEL, Nagoya U.), W. Kofman (Laboratoire de Planetologie de Grenoble), S. Oyama, S. Nozawa, and R. Fujii (STEL, Nagoya U.)
Effect of the field-aligned current on the electron energy budget in the polar ionosphere

P7
Yoshikawa, Akimasa (Kyushu U.)
Formation of Cowling channel in the global ionosphere

P8
Abura, Yuki, M. Ozaki, S. Yagitani, I. Nagano (Kanazawa U.), and H. Yamagishi (NIPR)
The relationship between the VLF emission and the Cosmic Noise Absorption

P9
Ozaki, Mitsunori, S. Yagitani, I. Nagano (Kanazawa U.), H. Yamagishi (NIPR), Y. Kasahara (Kanazawa U.), N. Sato, and A. Kadokura (NIPR)
Theoretical calculation of VLF whistler mode wave propagation based on the satellite-ground observation results

P10
Abe, Manami, S. Taguchi, R. Nishizawa, K. Hosokawa (UEC), M. R. Collier, and T. E. Moore (NASA/GSFC)
Characteristics of the cusp injection region for northward IMF

P11
Tokunaga, Terumasa, A. Yoshikawa, T. Uozumi, K. Yumoto (Kyushu U.), and MAGDAS Group
Quantitative evaluations of substorm-associated Pi 2 magnetic pulsations observed at dayside equatorial latitudes by means of ICA

P12
Nagatsuma, Tsutomu (NICT) and Y. Miyoshi (STEL, Nagoya U.)
Alfven Mach number dependence for saturation of the polar cap potential

P13
Miyake, Wataru* and H. Jin (NICT; *also Tokai U.)
Space weather monitoring wth TEC maps

P14
Nakata, Hiroyuki (Chiba U.) and Takashi Tanaka (Kyushu U.)
Three-Dimensional Distribution of the Ionospheric Electric Potentials Determined by a Global MHD Simulation

P15
Takasaki, Satoko (ROIS), A. Kadokura, N. Sato (NIPR), S. Fujita (Meteorological College), T. Tanaka (Kyushu U.), Y. Ebihara (Nagoya U.), T. Murata, and D. Matsuoka (Ehime U.)
Temporal trace of geomagnetic conjugate point by a global MHD simulation

P16
Miyake, Taketoshi (Toyama Prefectural U.), M. Okada (NIPR), H. Usui (RISH, Kyoto U.), T. Murata (Ehime U.), and Y. Omura (RISH, Kyoto U.)
Time evolution of three-dimensional spatial structure of beam instabilities

P17
Makita, Kazuo, M. Hoshino (Takushoku U.), M. Nishino, Y. Kato (STEL, Nagoya U.), Y. Tanaka (NIPR), and T. Ookawa (Geomagnetic Obs.)
Riometer observation at Brazilian Geomagnetic Anomaly and its related region

P18
Toyonaga, Masami (Grad. Univ. Adv. Studies), H. Yamagishi (NIPR), and Y. Tanaka (ROIS)
Changes of spectral index of absorption observed by two-frequency imaging riometers at the time of solar proton event

P19
Miyaoka, Hiroshi, Y. Ogawa (NIPR), and S. Nozawa (STEL, Nagoya U.)
EISCAT radar observation of positive storm effect and ion upflow in the pre-midnight polar ionosphere associated with the superstorm on 20 November 2003 (2)

P20
Miyaoka, Hiroshi (NIPR), Y. Fujimoto (Fuji Riken), Y. Minamoto (Kakioka Geomagnetic Observatory/JMA), and A. Kadokura (NIPR)
Dynamical feature of auroral streamers observed by ground-based and DMSP satellite data at Syowa Station, Antarctica

P21
Sugita, Rie, K. Hosokawa (UEC), A. Kadokura, N. Sato (NIPR), S. E. Milan, M. Lester (U. Leicester), G. Bjornsson,

and T. Saemundsson (U. Iceland)
High time resolution measurements of auroral breakup with all-sky TV camera and SuperDARN over Iceland

P22
Tanaka, Yoshimasa (ROIS), T. Aso (NIPR), B. Gustavsson (U. Tromso), K. Tanabe (Waseda U.), A. Kadokura, and Y. Ogawa (NIPR)
Comparison of reconstruction algorithm for the Generalized Computed Aurora Tomography

P23
Ito, Yuki (U. Tokyo), K. Asamura (ISAS/JAXA), T. Sakanoi (Tohoku U.), Y. Ebihara (Nagoya U.), A. Yamazaki (ISAS/JAXA), M. Hirahara (U. Tokyo), Y. Obuch (Genesia), and M. Fujimoto (ISAS/JAXA)
Auroral fine-scale structures observed by REIMEI satellite

P24
Nishiyama, Takanori, T. Sakanoi (PPARC, Tohoku U.), Y. Ebihara (Nagoua U., IAR), K. Asamura, A. Yamazaki (ISAS/JAXA), S. Okano (PPARC, Tohoku U.), and M. Hirahara (U. Tokyo)
Search for the source regions of precipitating electrons which generate pulsating aurora based on REIMEI observations

P25
Motoba, Tetsuo, A. Kadokura (NIPR), Y. Ebihara (Nagoya U.), and N. Sato (NIPR)
Antarctic optical observations of dayside aurora during a geomagnetic sudden commencement

P26
Yoshida, Akio (Grad. Univ. Adv. Studies)
Diurnal, Seasonal and year to year variations in geomagnetic activity at Syowa Station, Hermanus and Kakioka

P27
Yoshida, Akio (Grad. Univ. Adv. Studies)
Geomagnetic activity in 2007 indicates rather small amplitude for the next sunspot cycle 24

P28
Kimura, Satoshi, T. Sakanoi (Tohoku U.), M. Taguchi (Rikkyo U.), and S. Okano (Tohoku U.)
The actual status of high-speed imaging observation plan for flickering aurora

P29
Yamagishi, Hisao, M. Tsutsumi (NIPR), Y. Tanaka, K. Nishimura (TRIC, ROIS), S. Fujii (U. Ryukyus), K. Makita (Takushoku U.), and M. Toyonaga (Grad. Univ. Adv. Studies)
Development of a multi-frequency digital imaging riometer

P30
Yamagishi, Hisao, M. Okada (NIPR), and S. Takasaki (TRIC, ROIS)
Improvement of the electromagnetic wave observation platform in West Ongul (3) – Power supply from natural energy and data transfer –

P31
Nishimura, Koji (NIPR/ROIS) and Toru Sato (Kyoto U.)
High-resolution 3-dimensional imaging of the atmosphere with multiple-frequency and multiple-subarray MST radar

P32
Tsutsumi, Masaki (NIPR), K. Sato (U. Tokyo), T. Sato, A. Saito (Kyoto U.), Y. Tomikawa, K. Nishimura, T. Yamanouchi, H. Yamagishi, T. Aso, M. Ejiri, and N. Sato (NIPR)
Lower-thermosphere research radar observations over Syowa station

P33
Murata, Chihiro, T. Ichikawa, R. Lundock, Y. Taniguchi, H. Okita (Tohoku U.), I. Ishikawa (IK-tech), and K. Inaoka (X-tron)
A 40cm Infra-Red Telescope in Antarctica

【2. Magnetosphere I 】

14:00 - 15:45
Chair: Fujita, Shigeru (Meteorological College)

14:00 2-1
Oyama, Shin-ichiro, T. T. Tsuda (STEL, Nagoya U.), K. Asamura (ISAS/JAXA), M. Hirahara (U. Tokyo), A. Yamazaki (ISAS/JAXA), T. Sakanoi, Y. Kasaba (Tohoku U.), R. Fujii, and S. Nozawa (STEL, Nagoya U.)
A study of the fine structure in the arc-associated current system using data from the IS radar and REIMEI satellite

14:15 2-2
Yamazaki, Yosuke, K. Yumoto, A. Yoshikawa (Kyushu U.), S. Watari (NICT), and H. Utada (ERI, U. Tokyo)
SFE*s Observed at Dip-equator CPMN Stations

14:30 2-3
Shinbori, Atsuki, T. Kikuchi (STEL, Nagoya U.), T. Ono, M. Iizima, A. Kumamoto, Y. Nishimura (Tohoku U.), and A. Matsuoka (JAXA/ISAS)
SC Related Electric and Magnetic Field Phenomena in the Inner Magnetosphere Observed by the Akebono Satellite

14:45 2-4
Ikeda, Akihiro, K. Yumoto, T. Uozumi, M. Shinohara (Kyushu U.), K. Nozaki (NICT), A. Yoshikawa (Kyushu U.), and K. Shiokawa (STEL, Nagoya U.)
FM-CW Radar Observations of Pi 2 Ionospheric Electric Fields at Low Latitude

15:00 2-5
Fujimoto, Akiko, H. Eto, M. Shinohara, K. Yumoto (Kyushu U.), and MAGDAS/CPMN Group
The low-latitude Pc5 index for estimating the solar wind velocity

15:15 2-6
Sakurai, Tohru (Tokai U.), T. Kikuchi (STEL, Nagoya U.), K. Hashimoto (Kibi International U.), Y. Tonegawa, Y. Kajikawa, and K. Sakata (Tokai U.)
Solar wind driven periodic radar echoes and Pc5 oscillations during the magnetic storm on 14 December 2006

15:30 2-7
N. Maeda (Kyushu U.), S. Takasaki (TRIC, ROIS/NIPR), Kawano, Hideaki (Kyushu U.), S. Ohtani (JHU/APL), P. M. E. Décréau, J. G. Trotignon (Laboratoire de Physique et Chimie de l'Environnement, Centre National de la Recherche Scientifique, Orléans, France), S. I. Solovyev, D. G. Baishev (Yu.G.Shafer Institute of Cosmophysical Research and Aeronomy, Yakutsk, Russia), and K. Yumoto (Kyushu U.)
CPMN - Cluster conjugate observations of the magnetospheric plasma density

■■ **Tea break 15:45- 16:00** ■■

【3. Magnetosphere II 】

16:00 - 17:45
Chair: Nosé, Masahito (Kyoto U.)

16:00 3-1
Kikuchi, Takashi, A. Shinbori, Y. Tsuji (STEL, Nagoya U.), K. K. Hashimoto (Kibi International U.), S. Watari (NICT), T. Araki (Kyoto U.), and M. A. Abdu (INPE, Brazil)
Instantaneous propagation of the preliminary impulse of geomagnetic sudden commencement to the geomagnetic equator both on the day- and night-side

16:15 3-2
Hashimoto, Kumiko K. (Kibi International U.), T. Kikuchi (STEL, Nagoya U.), S. Watari (NICT), and M. A. Abdu

(INPE, Brazil)
Overshielding at sub auroral -equatorial latitudes at onset of substorm

16:30 3-3
Sakaguchi, Kaori, K. Shiokawa, A. Ieda, A. Nakajima, R. Nomura (STEL, Nagoya U.), M. Greffen, and E. Donovan (U. Calgary, Canada)
Microstructures of initial brightenings at substorm onsets observed by 30-Hz all-sky TV cameras during the THEMIS-ground campaign

16:45 3-4
Taguchi, Satoshi, S. Suzuki, K. Hosokawa, M. Morimoto (UEC), Y. Ogawa, A. S. Yukimatu, N. Sato (NIPR), M. R. Collier, and T. E. Moore (NASA/GSFC, USA)
Zonal flow jet in the cusp: Simultaneous observations from spacecraft, radars, and ground magnetometer network

17:00 3-5
Morioka, Akira (Tohoku U.), Y. Miyoshi (STEL, Nagoya U.), F. Tsuchiya, and H. Misawa (Tohoku U.)
Substorm onset as derived from AKR breakup

17:15 3-6
Kataoka, Ryuho (RIKEN), Y. Miyoshi (STEL, Nagoya U.), and K. Hayashi (Stanford U.)
Numerical space weather forecast of the solar wind and radiation belts

17:30 3-7
Nosé, Masahito, T. Iyemori, M. Takeda, H. Toh (Kyoto U.), M. Kunitake, S. Watari (NICT), and AE ground observatory network
Present status and future perspective of AE index derivation

■■ Banquet 18:00 - 20:00 ■■
(At Auditorium Lobby in NIPR)

Tuesday, August 5th 9:00 - 17:50

【4. Mesosphere, thermosphere and ionosphere II, Future Plan I 】

09:00 – 10:45
Chair: Fujiwara, Hitoshi (Tohoku U.)

9:00 4-1
Miyoshi, Yasunobu (Kyushu U.) and H. Fujiwara (Tohoku U.)
Atmospehric waves after the sunset in the thermosphere and its relation with atmospheric tides

9:15 4-2
Oyama, Shin-ichiro, T. T. Tsuda, Y. Iwata, S. Nozawa, R. Fujii (STEL, Nagoya U.), and Y. Ogawa (NIPR)
Methodology of the ionospheric-conductivity estimation using data taken with the EISCAT radar and the multi-wavelength photometer

9:30 4-3
Oyama, Shin-ichiro, J. Kurihara, T. T. Tsuda (STEL, Nagoya U.), S. Maeda (Kyoto Women's U.), S. Nozawa, and R. Fujii (STEL, Nagoya U.)
High-frequency oscillations of the vertical ion speed measured with the EISCAT radar in the polar lower ionosphere

9:45 4-4
Nozawa, Satonori, S. Oyama, R. Fujii (STEL, Nagoya U.), and Y. Ogawa (NIPR)
Research on the wind dynamics in the polar MLT region by using radars

10:00 4-5
Kurihara, Junichi, S. Oyama, S. Nozawa, R. Fujii (STEL, Nagoya U.), Y. Ogawa (NIPR), N. Iwagami (U. Tokyo), and T. Abe (ISAS/JAXA)
DELTA-2 campaign: Coordinated observations of the dynamics and energetics in the polar lower thermosphere

10:15 4-6
Kawahara, Takuya D. (Shinshu U.), N. Saito, S. Wada (RIKEN), S. Nozawa, and R. Fujii (STEL, Nagoya U.)
Development and current status of the new Na temperature lidar deployed in Tromso

10:30 4-7
Maezawa, Hiroyuki, A. Mizuno, T. Nagahama, N. Moribe, Y. Mizuno, N. Mizuno, T. Onishi, Y. Fukui (Nagoya U.), S. Yamamoto, S. Shiba (U. Tokyo), N. Nakai, M. Seta, T. Yamakura (Tsukuba U.), and Y. Kasai (NICT)
Observations of Earth's and Planetary Atmospheres by Utilizing Millimeter -Submillimeter Wavelength/Terahertz Frequency Band Telescopes

■■ **Tea break 10:45- 11:00** ■■

【5. Auroral dynamics】

11:00 – 12:30
Chair: Tanaka, Yoshimasa (NIPR)

11:00 5-1
Iwata, Yosuke, S. Nozawa, S. Oyama, R. Fujii, T. T. Tsuda (STEL, Nagoya U.), and Y. Ogawa (NIPR)
Study of the Proton Aurora in the Magnetosphere-Ionosphere coupling region by using optical instruments and the EISCAT UHF radar

11:15 5-2
Kadokura, Akira (NIPR), Y. Haraguchi, H. Hojima, H. Yamamoto (Rikkyo U.), and M. Hirahara (U. Tokyo)
Ground-satellite simultaneous observation of pulsating aurora

11:30 5-3
Hirahara, Masafumi (U. Tokyo), T. Sakanoi (Tohoku U.), Y. Ogawa (NIPR), K. Asamura, A. Yamazaki (JAXA), K. Seki (STEL, Nagoya U.), and Y. Ebihara (Nagoya U.)
Energy-pitch angle properties of electrons and ions and their relationship with auroral emissions: Reimei observations

11:45 5-4
Saka, Osuke (Office Geophysik) and K. Hayashi (U. Tokyo)
Excitation of Kelvin-Helmholtz instabilities with two propagation directions during auroral breakup and their role in poleward expansion of aurora

12:00 5-5
Nakagawa, Michio (Osaka Sangyo U.), M. Uchida (Osaka Shinnai), M. Ejiri (NIPR), Y. Ebihara (Nagoya U.), T. Ono (Osaka Sangyo U.), A. Kadokura (NIPR), M. Kagotani (Osaka Sangyo U.), Y. Saito (ISAS), N. Sato (NIPR), H. Suzuki (Rikkyo U.), M. Tsunawaki, Y. Tomobuchi (Osaka Sangyo U.), T. Nakamura (Nagoya U.), Y. Nakamura (Osaka Sangyo U.), M. Namiki (ISAS), K. Hirata, M. Fukuda (Osaka Sangyo U.), Y. Matsuzaka (ISAS), H. Murakami (Rikkyo U.), M. Yamauchi (Miyazaki U.), T. Yamagami (ISAS), H. Yamagishi (NIPR), and M. Yamamoto (Miyazaki U.)
Feature of Hard X-ray of auroral origin with PPB#8 and #10

12:15 5-6
Kikuchi, Satoshi, H. Sakurai, E. Inui, S. Gunji, F. Tokanai (Yamagata U.), N. Sato, A. Kadokura (NIPR), and T. Saemundsson (Iceland U.)
Comparison between daily variations of Be-7 concentration in air in Japan and Iceland IV

■■ **Lunch 12:30 – 13:30** ■■

【6. Magnetosphere III, Future plan II (English only)】

13:30 - 15:05
Chair: Sato, Natsuo (NIPR)

13:30 6-1
Kirsti Kauristie (FMI, Finland), A. Weatherwax (Siena College, USA), and R. Harrison (Rutherford Appleton Laboratory, UK)
Heliosphere impact on geospace: Solar-terrestrial and aeronomy research during the fourth Polar Year campaign

14:00 6-2
Yumoto, Kiyohumi, T. Uozumi, S. Abe, A. Ikeda, M. Ito (Kyushu U.), and MAGDAS Group
MAGDAS Project and Its Preliminary Results

14:20 6-3
T. Ono, Y. Kasaba, A. Kumamoto (Tohoku U.), Y. Miyoshi, K. Seki, K. Shiokawa (STEL, Nagoya U.), Hirahara, Masafumi (U. Tokyo), K. Takashima, K. Asamura, A. Matsuoka (JAXA/ISAS), and ERG working group
The ERG Project: Japanese geospace exploration to elucidate the dynamics of the inner magnetosphere during the next solar maximum period

14:35 6-4
Watanabe, Takashi (STEL, Nagoya U.)
New Data-Center System of ICSU (World Data Services?)

14:50 6-5
Lundock Ramsey Guy and T. Ishikawa (Tohoku U.)
Observations of solar system planets with Antarctic Infra-Red Camera (AIR-C)

■■ Tea break 15:05- 15:20 ■■

【7. Mesosphere, thermosphere and ionosphere III, Future plan III (English only)】

15:20 - 17:45
Chair: Tsutsumi, Masaki (NIPR)

15:20 7-1
D. J. Murphy (Ice, Ocean Atmosphere and Climate, Australian Antarctic Division, Australia), T. Aso (NIPR), D. C. Fritts (CoRA/NorthWest Research Associates, USA), R. A. Hibbins (BAS, UK), A. J. McDonald (U. Canterbury, New Zealand), E. Merzlyakov, Yu. I. Portnyagin (IEM, Russia), D. M. Riggin (CoRA/NorthWest Research Associates, USA), M. Tsutsumi (NIPR), and R. A. Vincent (U. Adelaide, Australia)
Radar studies of the large-scale dynamics of the mesosphere and lower thermosphere above Antarctica

15:50 7-2
Sato, Kaoru (U. Tokyo), M. Tsutsumi (NIPR), T. Sato, A. Saito (Kyoto U.), Y. Tomikawa (NIPR), K. Nishimura (TRIC, ROIS), H. Yamagishi, T. Yamanouchi, T. Aso, and M. Ejiri (NIPR)
Program of the Antarctic Syowa MST/IS Radar

16:10 7-3
Abo, Makoto (Tokyo Metropolitan U.), M. Tsutsumi, Y. Tomikawa (NIPR), K. Sato (U. Tokyo), T. Nakamura (RISH, Kyoto U.), and T. D. Kawahara (Shinshu U.)
Development of remote controlled lidar system for observations of daytime middle-atmosphere temperature over Syowa station

16:30 7-4
Mizuno, Akira, T. Nagahama, H. Maezawa, T. Kuwahara (STEL, Nagoya U.), Y. Fukui, N. Mizuno (Nagoya U.), A. Morihira (ULVAC), M. Taguchi, M. Tsutsumi, H. Yamagishi, N. Sato, and Space and Upper Atmospheric Science Group (NIPR)

Millimeter-wave observations of the stratospheric and mesospheric chemical composition change over Syowa station

16:50 7-5
Nakamura, Takuji (RISH, Kyoto U.), M. Abo, Y. Shibata (Tokyo Metropolitan U.), T. D. Kawahara (Shinshu U.), T. Kitahara (Toba National College of Maritime Technology), K. Sakanoi (Komazawa U.), K. Sato (U. Tokyo), M. K. Ejiri (RISH, Kyoto U.), M. Tsutsumi, and Y. Tomikawa (NIPR)
An observation plan of dynamics and constituents in the polar middle and upper atmosphere with a multi-functional resonance lidar system

17:05 7-6
Xiao Zuo (Peking U.)
Conjugate study of polar upper atmosphere and KuaFu projec

17:25 7-7
Liu Ruiyuan, Xu Zhonghua, Liu Shunlin, Zhang Beichen, and Hu Hongqiao (Polar Research Institute of China)
Variations of the Ionospheric F2-layer at Zhongshan Station, Antarctica

【Closing】

17:45 - 17:50

Closing remarks Sato, Natsuo (NIPR)

第32回
極域宙空圏シンポジウム

予稿集

The 32nd Symposium on
Space and Upper Atmospheric Sciences
in the Polar Regions

Abstracts

2008年 8 月 4 日（月）～ 8 月 5 日（火）

August 4-5, 2008

大学共同利用機関法人
情報・システム研究機構
国立極地研究所

Research Organization of Information and Systems
National Institute of Polar Research
Tokyo, Japan

1-1

南極昭和基地における OH 大気光観測の初期結果

Initial results of OH airglow observation at Syowa Station in Antarctica

°田口 真 （立教大学理学部）、鈴木秀彦 （国立極地研究所）

°Makoto Taguchi (Rikkyo University) and Hidehiko Suzuki (National Institute of Polar Research)

Measurements of OH rotational temperature derived from a vibration-rotation spectrum of OH airglow have been widely used as a conventional and reliable method of temperature measurement in the mesopause region. However, it has been regarded that this method is not valid in the polar regions, because auroral emissions contaminate OH airglow spectra. There are only few examples of OH rotational temperatures derived in the Antarctica using spatially or temporally selected spectra free from auroral emissions.

OH rotational temperature measurements have been introduced at Syowa Station in Antarctica in order to study the dynamics in the polar mesopause region and its relation with auroral activities. Firstly as a result of survey observations an OH (8-4) band was selected as the most suitable vibration-rotation band for observation in the polar region. Then a new spectrograph has been developed consisting of a fast optical system with an operating spectral region of OH (8-4) band (900～990 [nm]), a moderate spectral resolution ($\Delta\lambda = 0.27$ [nm]) and a transmission grating. A back-illuminated CCD with an infrared enhanced QE is used as an imaging device.

The instrument was installed in the Optical Building at Syowa Station in February, 2008. The field-of-view ($4.5^\circ \times 0.007^\circ$) is fixed at the local magnetic zenith. Nominal exposure time is 1 minute. The instrument has been operated automatically without any trouble as expected. Initial results of OH airglow spectra and rotation temperatures along with auroral activities will be presented.

OH 大気光振動回転帯の分光観測から OH 回転温度を導出する手法は、中間圏界面付近の温度を観測する確かな手段として広く利用されてきた。しかし、極域ではオーロラ発光が測定の邪魔をするため、あまり利用されてこなかった。南極地域では過去にオーロラ発光がない時間帯や視野方向を選んで行った OH 大気光観測例が数例あるのみである。

極域中間圏界面付近のダイナミクスとオーロラ活動との関連を研究することを目的として、南極昭和基地にて OH 回転温度の連続観測を目指した。ます、オーロラ発光の影響が最も少なく、極域での OH 回転温度観測に適した振動回転帯として OH(8-4)帯を選んだ。そして、OH(8-4)帯観測に特化した分光波長帯域（900～990 [nm]）と適度な波長分解能（$\Delta\lambda = 0.27$ [nm]）、透過型回折格子を用いた F1.7 の明るい光学系、赤外領域の感度を強化した背面照射型 CCD カメラを備えた新型観測装置（図 1）を開発した。

観測装置は 2008 年 2 月に昭和基地の光学観測棟内に設置された。視野（$4.5^\circ \times 0.007^\circ$）は天井のガラス窓を通して磁気天頂方向に固定されている。通常観測時の露出時間は 1 分で、自動的に連続してスペクトル画像を取得する。2008 年 6 月まで、新型観測装置は予想通りの性能を発揮して順調に稼動している。講演ではこれまでに得られている代表的な大気光スペクトルと OH 回転温度の時間変化の例を示す。

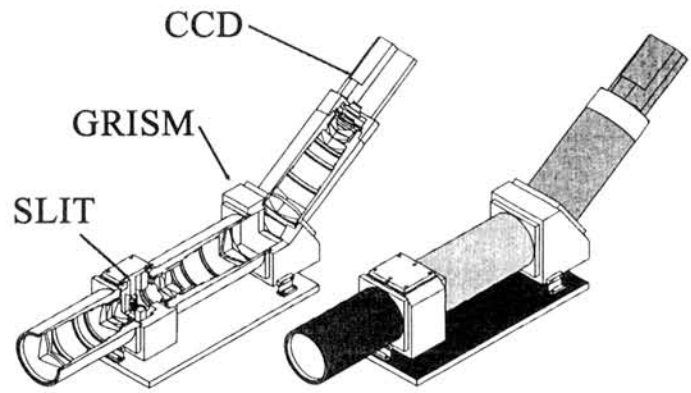


図 1. OH(8-4)帯に観測を絞った新型分光器の外観と内部構造。

1-2

南極昭和基地 MF レーダーデータを用いた大気潮汐波の解析

°冨川喜弘、堤雅基（国立極地研究所）

Tidal wave analysis based on the MF radar data at Syowa Station

°Y. Tomikawa and M. Tsutsumi (National Institute of Polar Research)

A Medium-Frequency (MF) radar, which measures horizontal wind velocities at a height region of 70-95 km, has been continuously operated at Syowa Station (69°S, 39.6°E) since its beginning in March 1999, except for a long gap in October-November 2005. In this study, diurnal and semidiurnal components extracted in the Syowa MF radar data using the Lomb-Scargle periodogram were analyzed. Our analysis showed that the semidiurnal tide was dominant throughout the year unlike the diurnal tide observed only in austral summer. In addition, the semidiurnal tide varies with a time scale shorter than one month. Characteristics of the diurnal and semidiurnal tides will be discussed in detail at the symposium.

南極昭和基地（69°S、39.6°E）では、高度 70～95km の水平風速を測定する MF レーダーを、1999 年 3 月より現在に至るまで、2005 年 10 月から 11 月にかけての長期の欠測を除いてほぼ連続的に運用している。本研究では、1999 年から 2006 年までの南極昭和基地 MF レーダーデータに Lomb-Scargle 法に基づくスペクトル解析を適用し、1 日、及び半日周期の潮汐成分について調べた。その結果、1 日潮汐が南半球の夏期間にのみ明瞭に捉えられるのに対して半日潮汐は年間を通じて観測されること、半日潮汐の位相が 1 ヶ月以下程度の時間スケールで変動することなどがわかった。シンポジウムでは、1 日潮汐、及び半日潮汐の示す特長について詳細に議論する。

SuperDARN 及び EISCAT による人工励起電離層沿磁力線不規則構造の観測(2)

○行松 彰[1]、西村耕司[1]、小川泰信[1]、堤雅基[1]、佐藤夏雄[1]、Mike T. Rietveld[2]、
Darren M. Wright[3]、Tim K. Yeoman[3]、Terry R. Robinson[3]、Mark Lester[3]
[1]国立極地研究所/総研大、[2]EISCAT科学協会、[3]英国レスター大学

SuperDARN and EISCAT observation of artificially induced FAIs (2)

A. Sessai Yukimatu[1], K. Nishimura[1], Y. Ogawa[1], M. Tsutsumi[1], N. Sato[1],
M. T. Rietveld[2], D. M. Wright[3], T. K. Yeoman[3], T. R. Robinson[3], and M. Lester[3]
[1]ROIS/NIPR and SOKENDAI, [2]EISCAT Sci. Association, [3]Univ. of Leicester, U.K.

Ionospheric field aligned irregularities (FAIs) are targets from which SuperDARN HF radars receive backscatter echoes, and their creation and decay processes have been investigated by many researchers long years but not fully understood yet. To reveal the physical processes, FAIs artificially induced by EISCAT Tromso heater facility have been observed by CUTLASS Finland and Iceland East SuperDARN radars and EISCAT Tromso UHF radar. Raw IQ time series observation and analysis method (TMS method) [Yukimatu and Tsutsumi, GRL, 2002] was applied to SuperDARN observation and 3 spectral components were identified and found that their temporal evolutions differ when the heater is turned on and off. Large echo amplitude fluctuation and phase 'leaps' are also found, which suggest that a limited number of soliton-like FAIs exist within an observed range-bin and are created and decayed intermittently and long lived (~ or >> 10 sec) FAIs also coexist in the same heated region. To investigate whether the speculation is valid, multi-frequency frequency domain interferometer (FDI) method was firstly and successfully applied to SuperDARN observation. To improve the temporal resolution of the FDI observation, single- and double-pulse FDI observation is also made this time. The simultaneous EISCAT UHF radar observation detected the heated region in 2-dimensional space and also showed at least 2 examples of large amplitude fluctuation of echo power from the heated region, suggesting ion acoustic wave activities. The observation results, including careful trial of separation of physical information from FAIs and fading effect, will be shown and the physical processes of FAIs will also be discussed.

SuperDARN 短波レーダーは、電離圏沿磁力線不規則構造（FAI）からの後方散乱波を受信し、極域の広大な範囲の主に電離圏 F 層のプラズマ対流、或いは、電離圏電場といった電離圏～磁気圏の研究に重要な基本的物理量の観測を行ってきた。しかし、レーダー波の散乱体である FAI については、その生成消滅素過程等は、未だに十分には解明されていない。EISCAT では、Tromso に大電力の電離圏加熱装置（ヒーター装置）があり、これにより、人工的に電離圏を加熱し、FAI を発生させることができる為、FAI の生成消滅機構の研究が盛んに行われてきた。我々も、Tromso 加熱装置上空を観測視野に含む、CUTLASS Finland 及び Iceland East SuperDARN レーダー、及び、EISCAT Tromso UHF レーダーを用いて、この研究を進めつつある。

SuperDARN レーダーは、従来、不等間隔マルチパルス法により、受信信号の自己相関関数(ACF)を求めることで、ドップラースペクトルを求めてきた。Yukimatu and Tsutsumi, GRL, 2002 では、これを改良し、全 IQ サンプルデータも記録し、マルチパルス法による観測レンジ以外のレンジからの信号の影響（cross range noise）を除去した上で、各レンジにおける受信信号の生時系列解析(TMS 手法)を可能とし、流星風観測の高精度化を図った。この新しい TMS 観測・解析手法の電離圏観測への応用として、高時間分解能の人工 FAI 観測を行った。通常の単一周波数による高時間分解能 FAI 観測により、エコー強度振幅が、数 Hz 程度の速さで大きく変動していること、位相の「飛び」が同程度の間隔で断続的に発生していること、また、ドップラースペクトルや ACF の高時間分解能の観測を行うことで、FAI のドップラースペクトルに、比較的短命の成分と、10 秒或いはそれ以上の長寿命の、3 種類の異なる成分が同一加熱領域に共存することが同定され、ヒーターの ON/OFF 直後に各成分の振舞が異なることがわかり、FAI の生成消滅素過程の研究に重要な知見をもたらすものと考えられた。また、EISCAT UHF レーダーの特別観測モードによる加熱域の詳細観測も実施し、電離圏加熱領域が 2 次元で明瞭に捉えられ、一部でエコー強度振幅の短時間変動が観測され、イオン音波擾乱の発生が示唆された。

15~45km 程度の通常のレンジ分解能を向上する為に、周波数領域干渉計(FDI)観測法を SuperDARN に初めて導入することも試みられ、更にこの時間分解能の向上の為、今回は、シングルパルスやダブルパルス法を用いた FDI 観測も実施した。しかし、FAI の理解の為には、ターゲット（人工 FAI）の情報と電波伝播（fading）の効果を分離できるかが本質的に重要である。今回は、この高レンジ分解能観測手法の検証を行うとともに、SuperDARN 及び EISCAT 観測から得られる結果についての議論を行う。

SuperDARN 北海道レーダーで観測された夜間の中規模伝搬性電離圏擾乱と E 層エコー

°小川 忠彦[1]、西谷 望[1]、大塚 雄一[1]、塩川 和夫[1]、津川 卓也[2]
1) 名大 STE 研　2) 情報通信研究機構

SuperDARN Hokkaido Radar Observations of Nighttime Medium-Scale Traveling Ionospheric Disturbances and E-Region Echoes

T. Ogawa[1], N. Nishitani[1], Y. Otsuka[1], K. Shiokawa[1], and T. Tsugawa[2]
1) STE Lab., Nagoya Univ.　2) NICT

The midlatitude SuperDARN Hokkaido HF radar at Rikubetsu in Hokkaido, Japan (43.5°N, 143.6°E; 36.5°N geomagnetic) can cover a wide area to the northeast of Hokkaido, and is very suitable for the studies of high- and midlatitude ionospheric disturbances. In this paper, we focus on radar echoes from nighttime medium-scale traveling ionospheric disturbances (MSTIDs) in the F-region and decameter-scale field-aligned irregularities (FAIs) in sporadic E (Es) layers appearing near the radar site. To investigate the MSTID and Es-FAI characteristics, HF radar data are compared with data from a 630-nm all-sky imager at Rikubetsu and GEONET (GPS Earth Observation Network), consisting of about 1200 GPS receivers distributed in Japan, that provides an ionospheric total electron content (TEC) map over Japan every 30 s. Some features, including new ones, revealed by the Hokkaido radar, GEONET and airglow observations are as follows:

1) Radar echoes from nighttime MSTIDs are mostly due to F-region FAIs and partly due to ground (sea) scatter.

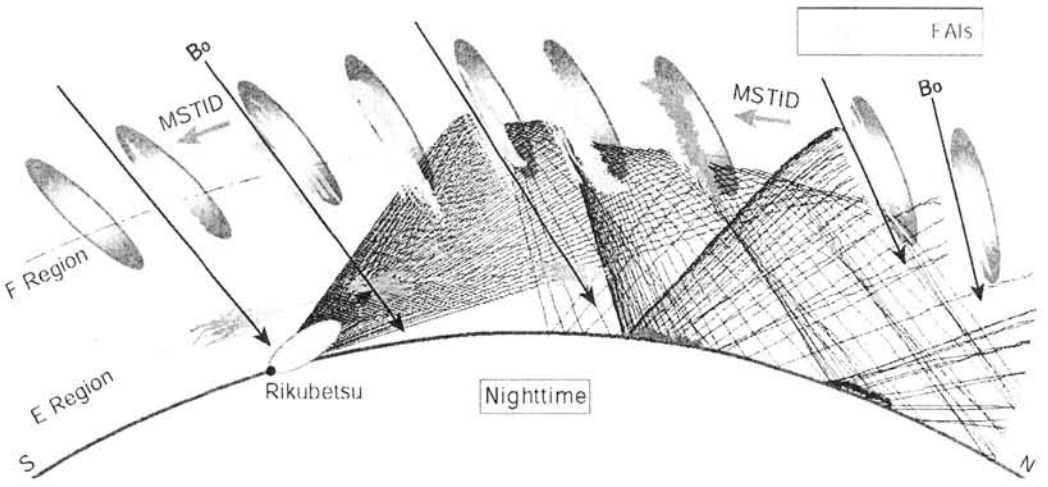
2) These MSTIDs, maybe generated at high-latitudes, propagate southwestward from Kamchatka at about 100 m/s and then are observed with the all-sky imager and GEONET.

3) Some MSTIDs propagate from Kamchatka to the southwest of Japan through Hokkaido over 5500 km or more. Such a feature is consistent with previous observations over Japan using GEONET and all-sky imagers.

4) The radar can also observe nighttime and daytime coherent echoes from Es-FAIs also to the northeast of Hokkaido.

5) In some cases the radar observes echoes simultaneously from MSTIDs in the F-region and Es-FAIs. MSTID-associated echoes at night can be closely related to Es-FAI echoes, suggesting a strong electrical coupling between the E- and F-region along the geomagnetic field. The existence of such coupling has been recently found over the central Japan by means of the 46.5-MHz MU radar and all-sky imager at Shigaraki and GEONET.

6) Peculiar quasi-periodic (QP) echoes from nighttime Es-FAIs were first found by the MU radar. First examples of MSTID-associated QP echoes, very similar to the MU QP echoes, from Es-FAIs detected by the Hokkaido radar are also shown.



Schematic illustration to explain nighttime radar observations. Southwestward-propagating MSTIDs cause echoes due to F-region FAIs and ground scatter (sea scatter) echoes. MSTID echoes are often accompanied by Es-FAI echoes that are closely connected with MSTID structure through the geomagnetic field (Bo).

1-5

イオノゾンデを用いたオーロラサブストーム時の電離圏変動

渡邊穣次(首都大学東京大学院)、○石井守(情報通信研究機構)、松田佳久(東京学芸大学)

Variations in the ionosphere during the aurora substorm as observed by an ionosonde

Joji Watanabe (Graduate School Tokyo Metropolitan University),
Mamoru Ishii (National Institute of Information and Communications Technology),
Yoshihisa Matsuda (Tokyo Gakugei University)

Abstract: In order to better understand the influence that the precipitating particles gives the ionosphere, we tried to verify the influence of the precipitating particles appeared on the Ionosonde observation data (Ionogram) during the aurora substorm. For the analysis we used 72 aurora substorm events based on the geomagnetic variation in one year period covered from 1st October, 1997. We normalized the time axis through 3 different phases, e.g., the growth phase, the expansion phase, and the recovery phase. We arranged the simultaneous observed Ionogram data (fmin,ftEs,h'Es) with the normalization time axis and examined the features at each phase. As a result, the mean value of fmin and ftEs increased, and the mean value of h 'Es descended from the growth phase to the expansion phase. We concluded that there is a high possibility of an increase in the amount of high energy precipitating particles from the growth phase to the expansion phase.

降下粒子が電離圏に与える影響をよりよく理解するため，本研究では，オーロラサブストーム時の降下粒子の影響が，イオノゾンデ観測データ(イオノグラム)にどのように現れるのか検証を試みた．1997 年 10 月 1 日からの 1 年間を対象として，地磁気変動をもとにオーロラサブストームのイベントを 72 例選出し，成長相，爆発相，回復相の各フェーズで時間軸を規格化した．選出した全イベントと同時観測されたイオノグラム読み取りデータ(fmin，ftEs，h' Es)を規格化された時間軸で整理し，それぞれのフェーズでの特徴を検討した．その結果，成長相から爆発相にかけて，fmin と ftEs の平均値は増加し，h' Es の平均値は下降する傾向が見られた．以上のことから，イオノグラムにみるオーロラサブストーム時の電離圏変動は，爆発相にかけて高エネルギー粒子の降下量の増大を反映した可能性が大きいと結論した．

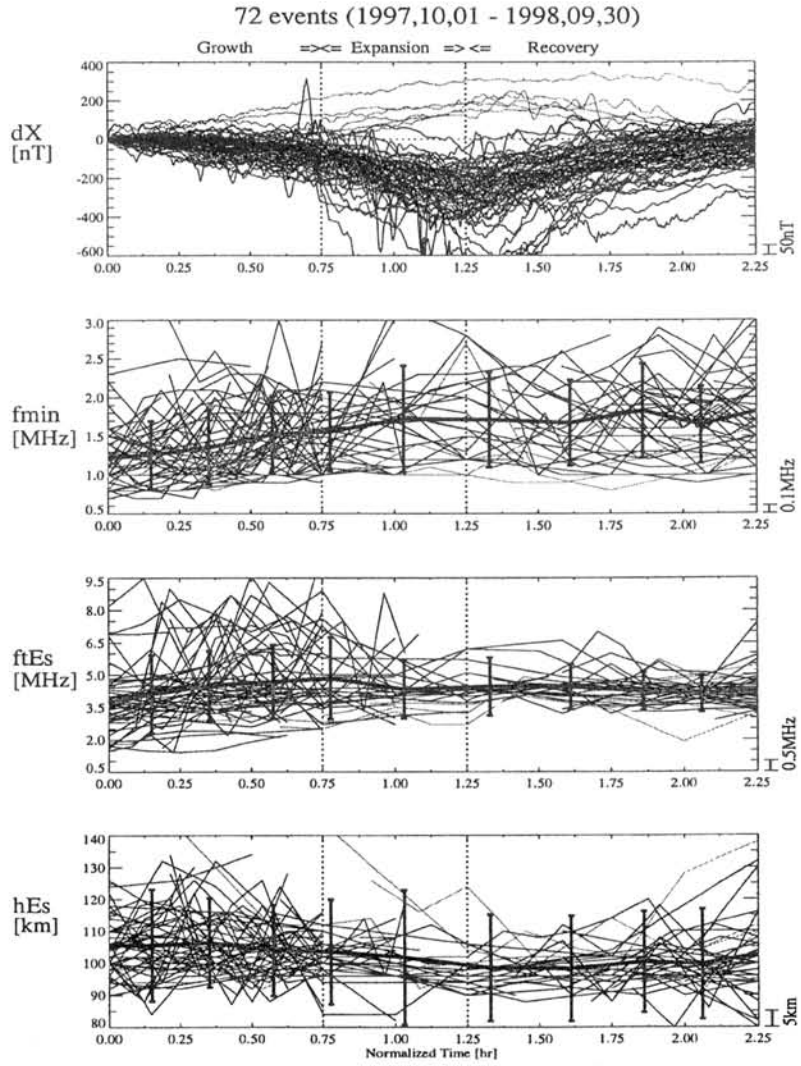


図. 72 例のオーロラサブストーム時の電離圏変動

1-6

極域下部熱圏における高速中性風の加速機構

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Acceleration mechanism of high-speed neutral wind in the polar lower thermosphere

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We analyzed data obtained on 16 June 2005 with the EISCAT Svalbard Radar (ESR) at Longyearbyen (78.2° N, 16.0° E, 75.2° N invariant latitude) in order to advance our understanding regarding acceleration mechanisms of the lower thermospheric high-speed neutral wind associated with the strong ionospheric convection. The ACE satellite observed a southward turning in the interplanetary magnetic field (IMF) at 0843 UT. After that, the *F* region ion velocity and the neutral wind (at 118 km) observed with the ESR began to enhance in the westward and northwestward direction, respectively. The neutral wind was remarkably accelerated within one hour and became a high-speed neutral wind of ~500 m s^{-1} at 1000 UT. We evaluated the ion-drag contribution to the neutral-wind acceleration by using the ESR data. Our evaluation suggested that the major force to cause the neutral-wind acceleration was not the ion drag but the horizontal pressure gradient force in association with the Joule heating. We estimated the horizontal pressure gradient by combining the ESR and SuperDARN data, and discussed its contribution to the neutral-wind acceleration.

太陽風起源のエネルギーが磁気圏を経て極域電離圏や熱圏で消費されるとき、その一部は熱圏中性大気の運動エネルギーに転嫁される。中性大気へ働く直接的な加速（運動エネルギー注入）過程として、電離圏電流と関わる２つの過程が挙げられる。１つは、中性大気に働くローレンツ力である。この過程は本質的にイオンドラッグと等価で、直接的に中性風を駆動する。もう１つは、ジュール熱による大気加熱に起因した効果で、局所的な加熱が起ると圧力勾配が変化し、結果として中性風が駆動される。このように、太陽風エネルギーの一部は、熱圏中性風を駆動する要因となり得る。特に、太陽風磁場（惑星間空間磁場：IMF）が南向きのときには、磁気圏への注入エネルギー増加に伴って中性風へのエネルギー供給も増え、結果として、静穏時の風速（一般に 200 m s^{-1} 以下）と比較して高速の中性風が生成されることが考えられる。中緯度の非干渉散乱(IS)レーダーは、磁気嵐時に700-800 m s^{-1} の下部熱圏中性風(高度 120-130 km)を観測している。このような高速中性風の加速要因として、風系と電離圏対流のパターンがしばしば類似することから、イオンドラッグが考えられることが多いが、これを明らかにするには、中性風加速時におけるイオンドラッグの観測的定量評価が必要である。

そこで本研究では、電離圏対流増大と関連した下部熱圏高速中性風の加速機構の解明を目的に、ロングイアビン（北緯 78.2 度、東経 16.0 度、磁気緯度 75.2 度）にある EISCAT スヴァールバルレーダー（ESR）が 2005 年 6 月 16 日に観測した、下部熱圏高速中性風イベントを解析した。1998-2005 年に、下部熱圏中性風速度が導出可能な ESR CP2 モード観測で得られた約 63 日分のデータの内、中性風速度(高度 117-118 km)が 500 m s^{-1} 以上のデータは 4％以下しか存在しない。しかし本イベントはその希有な例に含まれ、且つ地磁気静穏時に発生した IMF の急激な南向き変化に呼応して下部熱圏で中性風加速が発生した特別なイベントである。この特徴を活かし、中性風の加速時における加速機構の定量的な評価を行った。

ACE 観測によると、イベント前の時間帯（0800 UT 以前）は、10 時間以上北向き IMF が継続し、この間は磁気圏–電離圏活動は比較的静穏であったと考えられる。この時間帯に ESR が観測した下部熱圏中性風（高度 118 km）は、比較的低速（200 m s^{-1} 以下）であった。0843 UT の IMF 南向き変化に伴い、その後、電離圏西向き対流の増大が起った。さらに、電離圏対流増大と時間的に対応して、下部熱圏中性風が北西方向に加速される様子が見られた。中性風は加速開始から約 1 時間の内に著しく加速され、1000 UT には 500 m s^{-1} 程度の高速中性風が観測された。この中性風加速へのイオンドラッグによる寄与を評価したところ、イオンドラッグ加速では説明できない事が判明した。従って、ジュール加熱に伴う効果が、中性風速加速の主要因であった事が示唆される。講演では、これらの結果を示すと共に、ESR・SuperDARN データから見積もった、ジュール加熱が生成し得る圧力勾配と観測された中性風加速について議論する。

GCM シミュレーションに見られる極域熱圏大気変動の特徴

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Characteristics of the variation of the polar thermosphere found in GCM simulations

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It is well-known that various disturbances are generated in the polar region of the upper thermosphere. For example, European incoherent scatter (EISCAT) radar and Super Dual Auroral Radar Network (SuperDARN) observations have revealed ionospheric/thermospheric variations, which would be caused by the energy inputs from the magnetosphere. In addition to the geomagnetic activity, simulations by a whole atmosphere general circulation model (GCM) show day-to-day and seasonal variations in the upper thermosphere. In particular, various types of disturbances appear in the polar thermosphere. We will describe characteristics of the variation of the polar upper thermosphere mainly caused by coupling between the lower and upper atmospheres.

上部熱圏領域における様々な大気擾乱の存在が近年の観測によって明らかとなっている。例えば、EISCAT やSuperDARN といったレーダー観測では、磁気圏からのエネルギー流入に伴って励起されていると考えられる電離圏/熱圏擾乱をモニターすることに成功している。さらに、観測によって示されている地磁気擾乱時の変動以外にも、短周期・微小スケールの変動や日々変動等の大気変動が上部熱圏領域においても常に存在することを大気大循環モデル(GCM)による数値シミュレーションが示している。特に、極域での大気変動は、冬極では明瞭な日変化を示す一方で夏極ではそれ以上に短周期の変動が顕著になるなど複雑多様な振る舞いを示すことが GCM シミュレーションから予測される。本講演では、極域での上部熱圏大気変動の特徴、特に、下層大気と上部熱圏大気との結合過程によって生じていると考えられる変動について述べる予定である。

1-8

SuperDARN Hokkaido / King Salmon radar で観測された磁気嵐開始時における昼間側対流領域の拡大

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北海道-陸別 HF レーダー研究グループ

SuperDARN observation of equatorward progression of dayside merging flows during a geomagnetic storm

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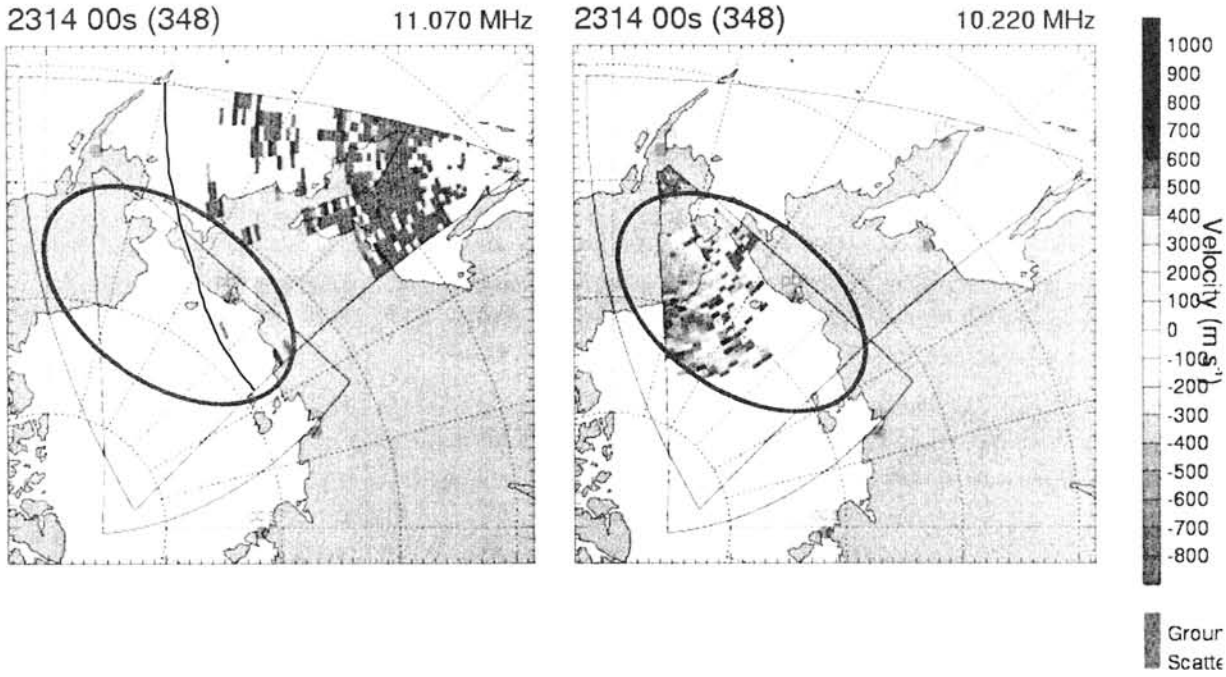
S. Watari (NICT), and Hokkaido HF Radar Group

We study the poleward flows in the dayside region and their equatorward progression observed during a large storm on December 14-15, 2006. The Dst index was as low as -147 nT when the Hokkaido radar (geographic coordinates: 43.53° N, 143.61° E), as well as the King Salmon radar (geographic coordinates: 58.68° N, 156.65° W), was in the dayside region. By using the Hokkaido and King Salmon radar data, it is possible to monitor the two-dimensional equatorward progression of the fast flows associated with the dayside merging from about 70° to 60° between 23 to 24 UT on December 14. The radars observed intense poleward flows up to 1000 m/s, and the flow region was up to 58° geomagnetic latitude. Detailed analysis of the radar data during this storm will be presented.

2 基目の中緯度 SuperDARN レーダーであり、同時に初めての極東域 SuperDARN レーダーである北海道-陸別 HF レーダー(地理座標: 43.53°N, 143.61° E、図)は、2006 年 11 月の稼働開始以来、ほぼ順調にデータを取得してきている。このレーダーはアラスカ King Salmon レーダー(58.68° N, 156.65° W、同図)と組み合わせることにより、極域からサブオーロラ帯まで幅広い領域を連続してカバーすることができる。

本講演では、2006 年 12 月 14-15 日の地磁気嵐の開始時に観測された昼間側対流領域の拡大の初期結果について報告する。下の図に示されているように、Hokkaido radar および King Salmon レーダーは昼間側に位置しており(プロットでは noon が上)、両者の観測視野で IMF の南向き変動に伴って、昼間側磁気圏海面磁力線再結合に関連した極方向高速流の発生およびその低緯度側への拡大を捕らえることができた。拡大後最も低い地磁気緯度で 58 度まで高速流が拡大することが観測されており、これは統計モデルからかなりかけ離れたものである。この様な対流分布の生成過程を捕らえることは、磁気圏・電離圏システムの IMF への応答過程の解明にとってきわめて重要である。講演ではこのイベント解析の詳細について報告する予定である。



1-9

熱圏—電離圏—磁気圏結合数値シミュレーションの試み

○藤田茂（気象大学校・JST）・品川裕之（情報通信研究機構・JST）・田中高史（九州大・JST）

Development of the thermosphere – ionosphere – magnetosphere coupled numerical model

S. Fujita (Meteorological College), H. Shinagawa (NiCT), and T. Tanaka (Kyushu University)

The magnetosphere and the ionosphere are electromagnetically coupled. Traditional global MHD simulations in which the ionosphere is assigned as the lower boundary take this interaction into account. However, at the ionosphere altitudes, significant amount of neutral atoms in the thermosphere play some role for behavior of ionospheric plasmas. Thus the ionospheric electromagnetic behavior is affected by the thermospheric neutral winds, which results in modification of the magnetospheric dynamics.

In order to investigate the interaction between the neutral winds in the thermosphere and the plasmas in the ionosphere-magnetosphere region, we need to construct a coupled model of the thermosphere-ionosphere-magnetosphere system. The interaction is invoked by the neutral wind-driven ionospheric current induced through drag between ionospheric plasmas and the thermospheric neutral wind. In the numerical model, first, FAC from the magnetosphere determines the ionospheric electric field in the magnetosphere model. Second, the wind-driven ionospheric current is calculated in the thermosphere-ionosphere model. Since the time step of the magnetosphere model is much smaller than that of the thermosphere-ionosphere model, the wind-driven FAC from the thermosphere-ionosphere model is referred to by the magnetosphere model only at the time step that matches to the ionospheric time step.

The final goal of the present attempt is to install this coupled model into the space weather realtime simulation conducted by NiCT. However, we have not yet completed the final model. In the talk, we present a preliminary result from the newly developed coupled simulation based on the artificial magnetospheric condition.

昭和基地における大気電場観測

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近年、大気電場観測は、グローバルサーキットのモニターする手段として注目されている。ここでは、昭和基地において、第 46 次および第 48 次日本南極地域観測隊によって観測された大気電場データについて紹介する。

大気電場観測値と地上風速と比較したところ、ブリザード等が観測されている期間を除けば、大気電場と平均風速の間には正の相関があった。一方、ブリザードなど、地上気象による擾乱がある期間は、グローバルサーキットをモニターするという目的に鑑みれば、排除すべき期間である。

大気電場観測値の度数分布を調べたところ、たとえば 0-300V/m の観測値は、第 48 次隊の観測（2007 年 2 月～2008 年 1 月）では全体の 29%、および第 46 次隊の観測（2005 年 1 月～2006 年 1 月）では全体の 57%であった。

Observations of the atmospheric electric field at Syowa station, Antarctica

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At Syowa Station, located on East Ongul Island near the continent of Antarctica, an electric field mill has been making observations of the atmospheric electric field by the Japan Antarctica Research Expedition (JARE).

Comparing the atmospheric electric field with wind speed, in some case during blizzards, negative values of the atmospheric electric field are observed. However, to monitor the global circuits, these time periods should be not used. Except for these time periods, positive correlations have been obtained between atmospheric electric field and wind speed.

Frequency distributions show the atmospheric electric field data between 0[V/m] and 300[v/m] are 29% of all data from February 2007 to January 2008, 57% of all data from February 2005 to January 2006.

2-1

非干渉散乱レーダーとれいめい衛星との同時観測データを用いたオーロラアーク近傍での電流系微細構造の研究

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A study of the fine structure in the arc-associated current system using data from the IS radar and REIMEI satellite

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An important aspect of the coupled magnetosphere-ionosphere system at high latitudes is to know the arc-associated current system. While much is already known about the average characteristics of the system in this field, the subject has not yet been adequately investigated, in particular, the horizontal fine structure. We conducted simultaneous observations with the REIMEI satellite and the Sondrestrom Incoherent-Scatter (IS) radar at Greenland in order to measure the ionospheric plasma velocity around the auroral arc. A simultaneous observation on 3 October 2007 provided a good event, which showed an auroral arc taken with the camera on the REIMEI satellite together with ion-velocity enhancements measured with the IS radar around the arc. The paper will present the result on 3 October 2007 along with other IS-radar results.

SFE*s Observed at Dip-equator CPMN Stations

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Many scientists have shown that variations in the geomagnetic field during solar flares (geomagnetic Solar Flare Effects or SFEs) were similar in direction and magnitude to the Sq vector [e.g. Mc Nish, 1937]. Therefore, SFEs observed in the equatorial region during daytime periods are usually positive(negative) veriations in geomagnetic field H component during normal(counter) electrojet conditions [Rastogi et al, 1999].

In this paper, we will show two interesting SFE events in which SFE (H) at equatorial stations indicated negative variation around local noon. We named these negative variations " SFE*s " to distinguish them from the ordinary SFEs. The features of SFE*s and possble causes of them are discussed from a view point of the ionosphere-magnetosphere coupling.

SC Related Electric and Magnetic Field Phenomena in the Inner Magnetosphere Observed by the Akebono Satellite

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Electric and magnetic field variations in the inner magnetosphere associated with sudden commencements (SCs) have been analyzed using the Akebono satellite observation data within a period from March 1989 to January 1996. For 153 SC events, electric field data show an abrupt change of intensity as well as direction within a few minutes in the inner magnetosphere (L<5). The temporal variations showed a bipolar waveform with the amplitude range from 0.2 [mV/m] to 38 [mV/m]. The electric field signature is followed by a dumping oscillation with a period of Pc3-4 ranges. On the other hand, the magnetic field variations for 33 SC events also show an abrupt increase by 0.2-65 [nT] within a few minutes, which indicate a sudden compression of the magnetosphere due to an abrupt increase of solar wind dynamic pressure associated with the solar wind shock or discontinuity. The initial excursion of the electric field during SCs tends to be directed westward in the inner magnetosphere. The amplitude does not show a clear dependence on magnetic local time as has been observed at the geostationary orbit [Schmidt and Pedersen, 1987]. The amplitude of the electric field tends to be proportional with the power of 0.65 to that of the magnetic field. The Poynting vector of the initial SC impulse is directed toward the earth, which suggests that energy of magnetic disturbances associated with SCs propagates toward the earth in the inner magnetosphere with the refraction due to the plasma density gradient proposed by Wilken et al. [1982]. One of the most interesting results from the present study is that a DC offset of the Ey component of the electric field appears after the initial electric field impulse associated with SCs. This signature indicates that a magnetospheric convection electric field penetrates into the inner plasmasphere (L=2.5). The intensity of the Ey field gradually increases by 0.5-2.0 [mV/m] about 1-2 minutes after the onset of the initial electric field impulse and persists about 10-30 minutes.

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FM-CW Radar Observations of Pi 2 Ionospheric Electric Fields at Low Latitude

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At the onset of magnetospheric substorms, impulsive hydromagnetic oscillations occur globally in the magnetosphere with a period range from 40 to 150 seconds [e.g. Saito, 1968]. They are called Pi 2 magnetic pulsations. Pi 2 has been studied with arrays of magnetometers on the ground and with in-situ observation by satellites [e.g. Yumoto, 2001]. However characteristics of Pi 2 electric pulsations in the low-latitude ionosphere have not been clearly identified yet. We have focused on measuring the Pi 2 electric pulsations by an FM-CW (Frequency Modulated Continuous Wave) radar and clarify their characteristics.

In order to detect the ionospheric electric fields, we built a FM-CW (HF) radar at Sasaguri (Magnetic Latitude: 23.2 degree, Magnetic Longitude: 199.6 degree, LT=UT+9 hrs), Fukuoka, Japan in 2002. The radar provides the Doppler shift of launched wave frequencies, which corresponds to the height variation of the ionosphere, with a high-time resolution of 3 sec. When the eastward (westward) electric field penetrates into the low-latitude ionosphere, it drifts upward (downward) through the $\boldsymbol{E} \times \boldsymbol{B}$ drift. Thus, using the FM-CW radar we can measure east-west electric fields (Ey) in the ionosphere [see Ikeda et al., 2008]. In this study, we also used geomagnetic field data BH at Kujyu (KUJ; M. Lat. 23.6 degree, M. Lon. 203.2 degree, LT=UT+9 hrs), a part of Circum-pan Pacific Magnetic Network (CPMN) stations [cf., Yumoto et al., 2001].

The first Pi 2 event was observed at KUJ and Sasaguri simultaneously at 13:32 UT (22:32 LT) on 6 November, 2003. Also positive bay was detected in the H-component (BH) at KUJ. The dominant frequencies of the electric field Ey and magnetic field BH were identical. From a cross-correlation analysis between the BH at KUJ and Ey at Sasaguri, we found that the correlation coefficient is 0.80 and phase delay is about -100 degree. Takahashi et al. (JGR, 2001) showed the expected phase relation between magnetic field of cavity-mode Pi 2 and associated electric field. Based on their result, we suggest the phase delay of -100 degree indicates that the first Pi 2 event shows a radial mode structure of cavity-mode Pi 2.

The second Pi 2 event was observed at 14:15 UT (23:15 LT) on the same day 6 November, 2003. The dominant frequency of Ey and BH were the same and phase delay is -148 or 39 degree. Since the phase delay is almost -180 or 0 degree, this Pi 2 event can be described by $\omega\delta\boldsymbol{B} = \pm\boldsymbol{k} \times \delta\boldsymbol{E}$.

Further we analyzed 26 Pi 2 events that were recorded by a CPMN magnetometer at KUJ or Kagoshima (KAG; Magnetic Latitude: 21.9 degree, Magnetic Longitude: 203.2 degree, LT=UT+9 hrs) and the FM-CW radar simultaneously within a period from Nov. 2003 to Apr. 2004. The criteria of the analyzed Pi 2 events are that Pi 2 magnetic amplitude range of the BH is more than 1 nT at KUJ or KAG. In 12 of all 26 Pi 2 events, the dominant frequency of Ey and BH are identical. Moreover we examined the phase delay of 12 Pi 2 events, and found that the only 3 events in midnight sector show the radial mode structure of cavity-mode Pi 2. Other 9 events show a propagating mode of Pi 2. The observed low-latitude Pi 2s are concluded not to be described as a simple standing or propagating mode.

The low-latitude Pc5 index for estimating the solar wind velocity

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MAGDAS/CPMN Group

We develop the low-latitude Pc5 index for estimating the solar wind velocity, and provide it on following the web site, http://www.serc.kyushu-u.ac.jp/pc5/index_e.html. Pc5 pulsations in frequency band between 1.67 and 6.67 mHz are also observed at mid and low latitudes (Ziesolleck and Chamalaun, 1993) and equatorial latitudes (Saito, 1969; Reddy et al., 1994) as well as high latitudes. We use the hourly mean amplitude of low-latitude Pc 5 observed at one station as a local low-latitude Pc 5 index. At low latitude, we can find several nT Pc5 activity throughout the day.

Our recent study shows that a comparison between solar wind velocities (Vsw) estimated by Pc5 index and taken from ACE satellite during 1998 – 2005. The estimated solar wind velocity by the low-latitude Pc5 index is good agreement with the solar wind velocity observed by the ACE satellite (http://www.srl.caltech.edu/ACE).

We also found that the local time dependence of low-latitude Pc5 exists, by investigating for the relationship of Pc5 H-component amplitudes at two ground stations (SMA, G.M. Lat = = -19.27 and KAG G.M. Lat. = 24.37). The Pc5 amplitude is enhanced at noon. Therefore the standard deviation of the Vsw versus the Pc5 amplitude taken from noonside station is the smallest. This result indicates that the noonside low-latitude Pc5 index is more useful than any other local time for estimating the solar wind velocity.

In order to minimalize the effect of local time dependence for monitoring the solar wind velocity with high accuracy, we will establish the global Pc5 index taken from the mean value of local Pc5 indices at 4 low-latitude MAGDAS stations.

Solar wind driven periodic radar echoes and Pc5 oscillations during the magnetic storm on 14 December 2006

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Abstract

We have examined causal relationships between solar wind density variations and periodic radar echoes and associated geomagnetic ULF waves observed on the ground, and in the magnetosphere. The radar echoes were observed at King Salmon (KSM) during a period of the magnetic storm recovery phase on 14 December 2006. The storm began at 14:14 UT on 14 December 2006, which was caused by a high speed solar wind shock (900 km/s) , accompanied a magnetic sheath turbulence of high frequency interplanetary magnetic field (IMF). The magnetic sheath turbulence brought a large Dst disturbance in the magnetosphere, and produced the main phase of the magnetic storm continuing for about 4-5 hours. The succeding interplanetary condition accompanying large solar wind density fluctuations and strong northward IMF Bz drastically changed the magnetic condition of the magnetosphere and brought the recovery phase filled up with a high-frequency turbulence in the magnetosphere. The period of radar echoes was about 3-4 m, which was similar to the solar wind density variations. The radar echoes were observed in the geomagnetic latitudes from 63 to 67 CGM, and showed a westward propagation from the noon to the morning-side with a speed of about 200 m/s. Pc 5 oscillations of the magnetic field were simultaneously observed with almost same period of about 4 min on the ground over the large area from the high to low latitudes extending to the magnetic equator and further from the day-side to the night-side on the ground and in the magnetosphere. These observed facts imply that the oscillations observed in the radar echoes and in the Pc 5 ULF waves on the ground and in he magnetosphere were directly driven by the solar wind density oscillations, suggesting a strong coupling of the solar wind, the magnetosphere and the ionosphere even in a period of the northward IMF condition.

CPMN – Cluster conjugate observations of the magnetospheric plasma density

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By taking differences of simultaneously observed data from two ground magnetometers, separated by ~100km, we can identify the frequency of the field line resonance (FLR), or the field-line eigen-frequency, for the field line running through the midpoint of the two magnetometer locations. From thus identified FLR frequency we can estimate the equatorial plasma mass density along the same field line (ρ) by using the T05s magnetospheric field model (Tsyganenko et al., 2005) and the equation of Singer et al. [1981].

In this study we compare ρ estimated from magnetometer data at two stations in the CPMN (Circum-pan Pacific Magnetometer Network) chain, Tixie (TIK, geographic coordinates: 71.59° N, 128.78° E, L=6.05) and Chokurdakh (CHD, geographic coordinates: 70.62° N, 147.89° E, L=5.61), with the plasma electron number density (*Ne*) observed by the WHISPER (Waves of HIgh frequency Sounder for Probing the Electron density by Relaxation) instrument onboard the Cluster satellites. For the interval of Jan. 1, 2001 - Dec. 31, 2005, we have identified 19 events in which the Cluster spacecraft were located on the field line running through the midpoint of TIK and CHD when they observed FLR, and compared the simultaneously observed ρ and *Ne*. In 15 out of the 19 events the ratio of ρ to *Ne* falls into a realistic range. It is also found that the contribution of heavy ions is large when the geomagnetic activity is high.

3-1

磁気嵐急始インパルスの昼夜半球赤道への瞬時伝播

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Instantaneous propagation of the preliminary impulse of geomagnetic sudden commencement to the geomagnetic equator both on the day- and night-side

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The preliminary reverse impulse (PRI) of the geomagnetic sudden commencement (SC) appears simultaneously at the dayside geomagnetic equator and afternoon high latitude within the temporal resolution of 10 sec as found by Araki (1977). These latitude and local time features were explained by means of the DP2-type ionospheric currents driven by the dusk-to-dawn electric field impressed from the magnetosphere. Araki et al. (1985) further found that a positive impulse preceding the SC (PPI) appeared at the nightside geomagnetic equator when the PRI was observed on the dayside, implying that the dusk-to-dawn PRI electric field drove eastward currents at the nightside equator. In this paper, we examined the simultaneity of the PRI and PPI at high latitude and equator with the GPS controlled high time resolution data, to confirm more accurately the instantaneous transmission of the polar electric field/currents to the equator. We found simultaneity within a few seconds of the onsets of the PRI and PPI at the equator and of the PRI at afternoon high latitude. This finding leads to a scenario that positive/negative electric potentials were transmitted to the equator instantaneously along the dusk/dawn terminator, and drove ionospheric currents along the equator both on the day and nightside. Considering that the fast mode waves in the ionosphere would need several 10s of second to propagate to the equator, we conclude that the PRI electric field was transmitted by the TM0 mode waves propagating at the speed of light in the Earth-ionosphere waveguide (Kikuchi et al., 1978; Kikuchi and Araki, 1979).

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3-2

Overshielding at sub auroral – equatorial latitudes at onset of substorm

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The dawn-to-dusk convection electric field propagates instantaneously from the polar ionosphere to the equator, and causes the DP2 current system consisting of two-cell current vortices at high latitude and eastward current amplified by the Cowling effect at the dayside geomagnetic equator. Reversed currents have often been observed at subauroral-equatorial latitudes, when the convection electric field reduces its intensity because of northward turning of the IMF. The reverse current has been explained by means of an overshielding electric field due to the Region-2 field-aligned current (R2 FAC) that overwhelmed the convection electric field when the R1 FAC decreased its intensity. In this paper, we show a new type of overshielding that initiated at the substorm expansion onset, accompanying an increase in the DP2 currents at auroral latitudes as observed with the IMAGE and Greenland magnetometer arrays. With the SuperDARN convection map, we confirmed that reversed current corresponded to an anti-sunward convection flow equatorward of the sunward auroral flow. We further confirmed that the counter-electrojet was superimposed on the equatorial eastward electrojet caused by the quiet-time dynamo. All these data infer that both the R1 and R2 FACs were intensified at the onset of the substorm, and that the electric field associated with the R2 FACs overcame that of the R1 FACs at mid-equatorial latitudes. In addition to these features, the overshielding had new features that its onset was a few minutes earlier than the onset of the positive bay in the midnight. Considering that the R2 FAC is connected with the partial ring current, we suggest that a current circuit is created between the inner magnetosphere and the subauroral – equatorial ionosphere a few minutes prior to formation of the substorm current wedge.

3-3

Title:

Microstructures of initial brightenings at substorm onsets observed by 30-Hz all-sky TV cameras during the THEMIS-ground campaign

Authors:

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Abstract:

During the tail-aligned phase of the THEMIS satellites we have conducted a campaign observation of aurora at Gillam (56.4N, 265.4E) and Fort Smith (60.0N, 248.1E), Canada. The observations were carried out using two all-sky TV cameras (180 degree field of view (FOV)) with a sampling rate of 30 Hz and two narrow FOV cameras (~50 degree FOV) with a sampling rate of ~1 s.

In this presentation, we show microstructures of four characteristic brightening arcs observed at auroral substorm onsets. Two of them were observed at ~2148 LT (~0448 UT) and ~0130 LT (~0830 UT) on January 8 at Fort Smith. Although the onsets probably started from out of FOV of cameras for these two events, azimuthal development edges of initial brightenings were seen with characteristic structures. The former auroral expansion occurred after several auroral arcs flowing periodically (period: ~15s) from east to west with velocities of 20-40 km/s (increasing with time). The latter was characterized by a peal-beading structure moving eastward with a velocity of ~800 m/s. The other two onsets occurred just in the FOVs of the cameras at ~0041 LT (~0741 UT) on January 7 at Fort Smith and at ~2155 LT (~0455 UT) on January 15 at Gillam. Both of initial brightenings developed with velocities of more than 50 km/s in longitudinal direction. In detailed view, the former event had arc-like brightening features, while the latter event had ray-like structures. From these four microscale structures of initial brightenings at substorm onset, we will discuss possible instabilities that triggered auroral expansion for each event.

3-4

Zonal flow jet in the cusp: Simultaneous observations from spacecraft, radars, and ground magnetometer network

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Y. Ogawa[2], A. S. Yukimatu[2], N. Sato[2]
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When the magnitude of IMF By is large, a burst of east/west flow is often observed in the low-altitude cusp. This zonal flow jet typically lasts between 5 and 15 min, and tends to have a pulsed nature. Because of its large speed the jet heats the ionosphere to a great extent. The jet is also an important factor for the formation of a polar patch. While the driver of the flow, i.e., the By-controlled tension force on the newly reconnected field lines, is widely accepted, its pulsed nature is still a controversy. In this study we present the characteristics of the zonal flow burst from a case study based on simultaneous observations from the DMSP/IMAGE/Polar spacecraft, the SuperDARN/EISCAT radars, and the ground magnetometer network. During this event observations from the radars and ground magnetometer network show the occurrence of three flow jets. IMF observations by the Polar spacecraft in the magnetosheath show a modest tilting of the By-dominated IMF at the timing of each flow jet. Seemingly, this appears to indicate that the pulsed nature can be ascribed to quasi-steady reconnection with the modest change of the sheath magnetic field. For one of the flow jets, however, two DMSP satellites, which fly through magnetic local noon roughly longitudinally along similar paths, show that the ion injection has rather complicated signatures, as opposed to the expectation from quasi-steady reconnection. Temporal enhancements of the ion injection, which are superimposed on quasi-steady ion injection, occur in with the flow jet. Simultaneous observations of the high-altitude cusp from the low energy neutral atom images on IMAGE support these temporal enhancements. We present the detailed results of the analyses of the data from this hard-to-find simultaneous observation, and discuss how the results can fit in one unified view of the zonal flow jet.

Substorm onset as derived from AKR breakup

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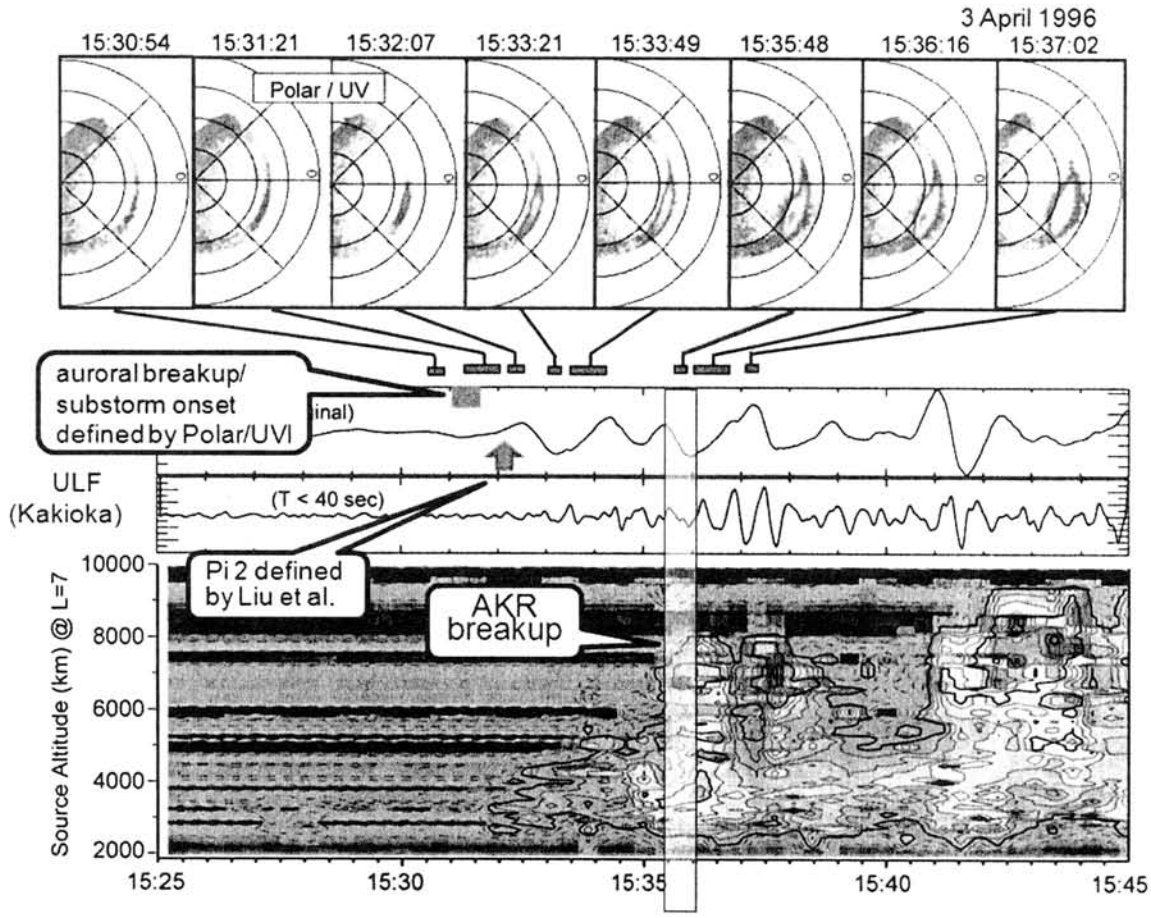
The dynamical behavior of auroral kilometric radiation (AKR) is investigated in connection with auroral particle acceleration at substorm onsets using high-time resolution wave spectrograms provided by Polar/PWI electric field observations. AKR develops explosively at altitudes above a preexisting low-altitude AKR source at substorm onsets. This "AKR breakup" suggests an abrupt formation of a new field-aligned acceleration region above the preexisting acceleration region. The formation of the new acceleration region is completed in a very short time (amplitude increases 10,000 times in 30 sec), suggesting the explosive development is confined to a localized region. AKR breakups are usually preceded (1-3 minutes) by the appearance and/or gradual enhancement of the low-altitude AKR. This means that the explosive formation of the high-altitude electric field takes place in the course of the growing low-altitude acceleration. In this paper, we discuss the relationship between the newly termed "AKR breakup" and traditional "substorm onset".



Numerical space weather forecast of the solar wind and radiation belts

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[3]*W.W.Hansen Experimental Physics Lab., Stanford University*

Large-scale solar wind structures and the magnetohydrodynamics (MHD) parameters at the Earth's position are essentially important for driving the space weather phenomena such as geomagnetic storms, geomagnetically induced currents, and radiation belt enhancement. We report our recent progress on the space weather modeling of the solar wind and radiation belts. The simulation code couples the global MHD solar wind model and the Fokker-Planck type radiation belt model via the time-varying solar wind MHD parameters at the Earth's position to give a quantitative estimate of the outer belt electron flux for a week in advance. The probability forecast of the flux enhancement alert at geosynchronous orbit (GEO) also works at the same time using the information of stream interface and interplanetary shock arrivals. We show the model performance via some examples, including the extreme flux enhancement event at GEO associated with the solar wind rarefaction due to a very fast coronal mass ejection.

3-7

AE 指数算出の現状と展望

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Present status and future perspective of AE index derivation

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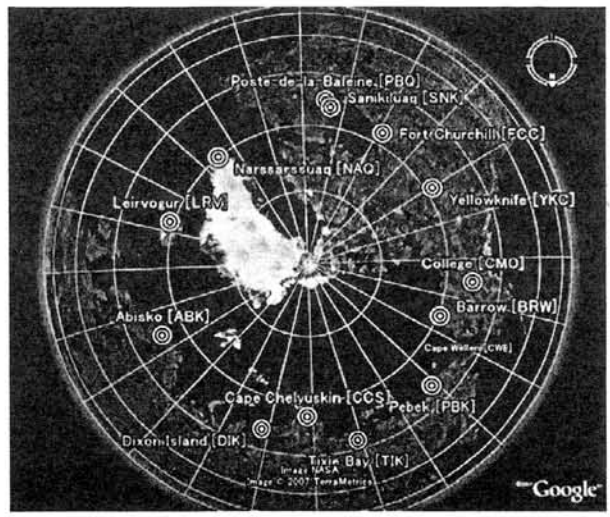
The AE index has been used to identify substorms or to estimate magnitude of ionospheric convection for more than three decades. This index is derived from the horizontal component of the magnetic field variations from 10 stations in auroral latitude (64°-70° geomagnetic latitude) and 2 stations in sub-auroral latitude (61°-64° geomagnetic latitude). These stations are Abisko [operated by SGU, Sweden], Dixon Island, Cape Chelyuskin, Tixie, Pebek [AARI, Russia], Barrow, College [USGS, USA], Yellowknife, Fort Churchill, Sanikiluaq (Poste-de-la-Baleine) [CGS, Canada], Narsarsuaq [DMI, Denmark], and Leirvogur [U. Iceland, Iceland]. Most of the stations are operated rather well and keep sending data to Kyoto University in quasi-real-time, which make it possible to provide the real-time AE index with science community. However, Russian stations had problems in operation since 1995 because of lack of finance and severe weather conditions. To solve the problems, we have been working in international partnership project, RapidMAG (Russian auroral and polar ionospheric disturbance magnetometers), which follows the PURAES (Project for Upgrading Russian AE Stations) project. These projects succeeded in resuming observations in most of Russian stations.

One of the latest news on the AE stations is that Poste-de-la-Baleine was closed in November 2007 and replaced with a new station, Sanikiluaq. This station is located at ~1° higher in geomagnetic latitude than Poste-de-la-Baleine, which data users may want to pay attention to. At present, the provisional AE index is calculated by a few month delay, because it takes time to receive definitive data or visually check artificial noises with baseline correction. The provisional AE index is available by digital data from our WWW page.

In the talk, we will review the present status and future perspective of AE index derivation.



Location of the 12 AE stations

熱圏の日没直後に現れる大気波動と潮汐波との関連について

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Atmospheric waves after the sunset in the thermosphere and its relation with atmospheric tides

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Wave structure after the sunset in the thermosphere was revealed by using the CHAMP satellite (Forbes et al., 2008). In order to investigate excitation mechanism of wave structure after the subset (Terminator Wave, hereafter), we performed a series of GCM (general circulation model) experiments. The result indicates that the TW in the thermosphere is mainly generated by upward propagating tides. In particular, migrating tides with zonal wave-number (s) ≥ 4 which propagates upward from the stratosphere and mesosphere plays an important role in generating the TW. We discuss dynamical coupling between the lower atmosphere and the upper atmosphere by upward propagation of tides.

CHAMP 衛星観測により、熱圏において日没直後に波状の構造が現れることが明らかとなった(Forbes et al., 2008)。本講演では、この日没直後に現れる波動の励起源について、大気大循環モデルを用いた数値実験により調べた結果について報告する。例期限を特定するために、下層大気を排除した実験（下層大気からの大気波動の影響を調査）、熱圏の電子密度を一様にした実験（イオン抗力の影響を調査）、熱圏の日変化を無くした実験（熱圏で励起される潮汐の影響を調査）などの仮想的な条件において数値実験を行い、結果を比較することにより励起源を調べた。 その結果、下層大気を排除した実験で再現された波動の振幅は、他の実験で再現された波動の振幅に比べてかなり小さい（特に冬半球側では 10%以下）ことがわかった。このことから、熱圏の日没直後に現れる波動は、下層大気起源の波動が影響していることがわかった。詳細な解析により、熱圏の日没直後に現れる波動は、下層大気起源の大気潮汐波のうち周期の短い成分（東西波数（s）≥4）と深く関連していることがわかった。下層大気起源の大気潮汐波のうち周期の短い成分が鉛直伝播し、さらに下部熱圏で一日潮汐波や半日潮汐波の砕波による高波数成分（短周期成分）との相互作用により増幅した結果であることが明らかとなった。この結果は、下層大気起源の潮汐波が、熱圏上部の大気大循環変動を引き起こすことを示唆しており、下層大気と超高層大気との大気上下結合の重要な一例であると考えられる。

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EISCAT レーダーと多波長フォトメータを用いた電離圏電気伝導度推定手法の開発

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Methodology of the ionospheric-conductivity estimation using data taken with the EISCAT radar and the multi-wavelength photometer

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An important aspect of the coupled magnetosphere-ionosphere system at high latitudes is to know horizontal two-dimensional distributions of the electron density or the conductance in the ionosphere. This is because the energy deposition in the coupled magnetosphere-ionosphere system is characterized by the fine structure, which tends to vary with time. Many researchers proposed methodology to estimate the two-dimensional distribution by using optical data taken with various wavelengths. While these researching activities allowed us to estimate the horizontal map of the ionospheric conductance with some confidence, the methodology has not yet been in complete agreement with results from the incoherent-scatter (IS) radar, which can provide height-resolved ionospheric data with better quality but in a restricted area. One of important issues to reduce the discrepancy is to develop more sophisticated method to be employed for estimating the ionospheric parameter from optical data.

To improve the method, we believe that the best way is to conduct experiment with the IS radar and the multi-wavelength photometer by fixing both line-of-sights along a magnetic field line. The experiment provides data taken in the same volume and at a same time resolution. Since this method can reduce uncertainty associated with spatiotemporal discrepancies in the monitored area with two instruments, differences between results from the two instruments should be attributed to the method employed on analyzing optical data.

In this paper we analyzed data sets obtained for simultaneous observations between the European Incoherent Scatter (EISCAT) radar and the multi-wavelength photometer collocated at Tromsø, Norway (69.6 N, 19.2 E). The data sets were taken at 14 dark-nights with clear-sky. The presentation will address dependencies of the emission intensity measured with the photometer on the height-integrated conductivity or conductance from the EISCAT radar.

4-3

EISCAT レーダーで観測された極域下部電離圏における鉛直イオン速度の高周波変動

○大山伸一郎[1], 栗原純一[1], 津田卓雄[1], 前田佐和子[2], 野澤悟徳[1], 藤井良一[1]
[1]名古屋大学太陽地球環境研究所, [2]京都女子大学

High-frequency oscillations of the vertical ion speed measured with the EISCAT radar in the polar lower ionosphere

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Vertical component of the ion velocity measured with the European Incoherent Scatter (EISCAT) Tromsø UHF radar (69.6°N, 19.2°E) in the *E* region (from 95 to 130 km) has been found to be characterized by notably large variances at oscillation periods of 2-8 minutes. Of particular interest is the geomagnetic-activity dependence above 106 km, which shows larger variances during geomagnetically disturbed condition than quiet. Below this height the variance looks insensitive. Height profile of the variance shows abrupt increase with heights above 106 km then reaching a peak around 125 km, at which the ion gyrofrequency is equal to the ion-neutral collision frequency. Theoretical prediction well reproduces the height profile for relatively disturbed condition by assuming meridional electric-field oscillations in the ion-momentum equation; but it is not the case below 106 km. The theoretical study suggests that the electric-field oscillation is a possible mechanism to generate such large variances of the vertical ion-speed in the polar lower ionosphere. However, below 106 km other mechanisms need to do so.

4-4

北極域における各種レーダーを用いた極域下部熱圏・中間圏の研究

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Research on the wind dynamics in the polar MLT region by using radars

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In this paper, we report our latest results of the wind dynamics in the polar lower thermosphere and mesosphere. Two topics will be presented. (1) Characteristics of the wind in the lower thermosphere derived from long-run data obtained by the EISCAT UHF radar at Tromsø (69.6°N) over 22 days from September 7 to 29, 2005 will be presented together with those from the Tromsø MF radar. We found a mode change of the semidiurnal tide in the lower thermosphere. (2) Initial results from the new meteor radar in Bear Island will be presented. The Bear Island meteor radar begun to make continuous measurements of the wind between 70 and 110 km on November 1, 2007. Up to now, we have collected 8-month of wind data.

我々は北欧において、EISCATレーダー、MFレーダー、流星レーダーを用いて、極域下部熱圏・中間圏の大気ダイナミクスの解明を進めている。今回は、最近の２つの結果について報告する。

（１）EISCATレーダー22日間連続観測データによる下部熱圏大気ダイナミクス

2005年9月7日から29日の約22日間において、中性風速度導出可能なモノスタティックモード(CP-2)による観測が、EISCAT Trosmø UHFレーダー(69.6°N, 19.2°E)にて、連続して行われた。期間中、1日程度のブレークが発生しているが、おおむね質の高い電離圏データが90-500 kmにおいて連続的に取得された。このEISCATデータと、EISCATトロムソサイトに設置されているMFレーダーデータを併用して、この期間における、高度70 kmから 120 kmまでの大気ダイナミクスを調べた。半日潮汐波について調べたところ、この期間の前半と後半で鉛直波長の変化が観測された。トロムソMFレーダーの観測結果を含めて、このモード変化を中心に報告する。

（２）ベアアイランド流星レーダーによる初期結果

2007年7月からベアアイランド（74.5°N, 19.0°E）において、流星レーダーが稼働を開始した。今回は、2007年11月から2008年6月までの８月間のデータを解析した初期結果についても報告する。特に、平均風、準２日波、一日潮汐波、半日潮汐波について、トロムソMFレーダーとの比較を行いつつ紹介する。

DELTA-2 campaign: 極域下部熱圏の力学とエネルギー収支の総合観測計画

○ 栗原純一, 大山伸一郎, 野澤悟徳, 藤井良一（名古屋大学 太陽地球環境研究所）,
小川泰信（国立極地研究所）, 岩上直幹（東京大学）,
阿部琢美（宇宙航空研究開発機構 宇宙科学研究本部）

DELTA-2 campaign: Coordinated observations of the dynamics and energetics in the polar lower thermosphere

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In order to investigate the dynamics and energetics in the polar lower thermosphere, coordinated sounding rocket observation with ground-based Fabry-Perot Interferometers (FPIs) and the European Incoherent Scatter (EISCAT) radar was successfully conducted during the Dynamics and Energetics of the Lower Thermosphere in Aurora (DELTA) campaign on 13 December 2004. In the DELTA campaign, the vertical profile of neutral temperature in the lower thermosphere was obtained by the sounding rocket experiment, the time variations of neutral temperature and winds at the auroral emission altitudes were measured with two FPIs, and the vertical and temporal profiles of ionospheric parameters and neutral winds were observed by the EISCAT radar. Although the upward vertical winds up to 40m/s were observed at an altitude of 120 km associated with the strong Joule and particle heating event during the campaign, vertical profile and horizontal distribution of this upwelling is unknown. For a better understanding of the spatial structure and source mechanism of such large vertical wind events, neutral wind observation that measures vertical and horizontal profiles with high spatial resolution is required.

Based on the results from the DELTA campaign in 2004, the DELTA-2 campaign is being planned for January 2009. In the next campaign, the rocket will release Trimethyl Aluminum (TMA) along the trajectory and high-resolution neutral winds are derived from the TMA trails by observing with ground-based cameras. The neutral wind measurement will be made simultaneously with neutral temperature measurement by a rocket-borne instrument. Many ground-based instruments such as the EISCAT radar, FPIs, and networks of all-sky cameras and magnetometers will provide comprehensive information on the thermospheric response to auroral energy inputs.

4-6

Development and current status of the new Na temperature lidar deployed in Tromso

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Satonori Nozawa (STE lab. Nagoya University), Ryoichi Fujii (STE lab. Nagoya University)

A new all-solid state, high power, injection seeded, narrow-band sodium lidar is proposed for the purpose of the long-term temperature observation in EISCAT radar site, Tromso (69.6N, 19.2E). It is based on two injection-seeded, LD-pumped Nd:YAG oscillators using sum frequency generation (SFG) technique to produce the laser at sodium D2 resonance line. The lidar is an upgraded version of the one deployed at Syowa station, Antarctica, by Shinshu University group, which consists of flush lamp pumped Nd:YAG lasers. The Nd:YAG sodium laser is the only all solid-state laser to produce sodium resonance line based on most stable and reliable laser technique. The advantage of the laser was proved because the lidar observation in Antarctica had been carried out without any operational troubles for full observation years (3 years). Based on this technology, we develop an LD-pumped Nd:YAG sodium lidar as a more robust and easily operational lidar for the long-term continuous observation in Arctic region. This LD-pumped high power SFG laser was already developed and applied to a laser guide star for Subaru telescope in Hawaii. In the seeder part, two techniques that established by Colorado State University (CSU) group are used; one is absolute frequency monitoring technique using cw 589 nm light with a heated sodium cell, the other is acousto optic frequency shifter. Thus the upgraded items of the laser includes: (1) producing higher pulse laser output, 4W (previously 0.2W), (2) high beam quality (M^2 <1.3) which LD-pumping Nd:YAG have made, (3) precise frequency locking using sodium cell Doppler free feature, (4) acousto-optic frequency shift technique. This proposed lidar, comprised of proven and robust all solid-state technologies, is suitable for deployment to remote locations with harsh environments.

4-7

ミリ・サブミリ波/THz 波帯電波望遠鏡による地球・惑星大気観測

前澤裕之、水野亮、長濱智生、森部那由多、水野陽治、水野範和、大西利一、福井康雄（名古屋大学）、
中井直正、瀬田益道、山倉鉄屋（筑波大学）、山本智、芝祥一（東京大学）、笠井康子（NICT）

Observations of Earth's and Planetary Atmospheres by Utilizing Millimeter – Submillimeter Wavelength/Terahertz Frequency Band Telescopes

Hiroyuki Maezawa, Akira Mizuno, Tomoo Nagahama, Nayuta Moribe, Yoji Mizuno, Norikazu Mizuno, Toshikazu Onishi, Yasuo Fukui (Nagoya University), Satoshi Yamamoto, Shoichi Shiba (University of Tokyo), Naomasa Nakai, Masumichi Seta, Tetsuya Yamakura (Tuskuba University) , Yasuko Kasai (NICT)

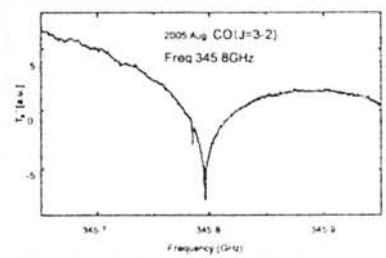
The group of Nagoya university have carried out the millimeter – submillimeter wave band observations of earth's and planetary atmospheres by using NNTENII (Nagoya University) and ASTE (NAOJ) telescopes at Atacama highland, Chile. The Dome Fuji in Antarctica is excellent site especially for terahertz (THz) frequency band heterodyne observations because of the good atmospheric transparency. The group of Tsukuba University is now planning to construct a THz band telescope for radio astronomy at the Dome Fuji.

Here we propose to perform the periodical and long-term monitoring of the earth's and planetary atmospheres simultaneously by utilizing the THz band telescope, which will provide us important information about the influence of solar activities on their atmospheric compositions as well as about the photochemistry and the meridional dynamics unique to the polar region.

名古屋大学のグループは、南米チリ共和国アタカマ高地(標高 4800m)に建設された ASTE 電波望遠鏡(国立天文台) や NANTEN2(名古屋大学)を用いて、惑星大気の微量分子ガスからのミリ波・サブミリ波帯スペクトル線の超高周波分解能ヘテロダイン観測を行っている。また同サイトには、ミリ波放射分光装置を設置し、24時間連続で地球の中層大気微量分子の観測を行い、オゾン層破壊や温室効果関連ガス、太陽活動によって磁気圏で誘発される加速電子が大気組成に与える影響などについて研究を行っている。

こうしたなか、現在、筑波大学のグループが中心となって、南極に電波望遠鏡を建設する計画を推進している。南極内陸部の高原地帯は、大気透過度・晴天率が高く、とくにサブミリ波や THz 波といった高周波帯の電波観測においても大変貴重な観測サイトでもある。

申請者らはミリ波～THz 波帯ヘテロダイン超伝導検出素子・検出器を独自に開発しており、これを筑波大学が南極ドームふじに建設予定の電波望遠鏡に搭載する可能性を検討している。これらが実現すれば、電波天文学の展開のみならず、そのシステムをそのまま用いて、惑星と地球の成層圏/中間圏における CO、水蒸気、オゾンなどの長期的モニタリングも可能になると期待される。さらに火星と地球の高層・中層大気を11年スケールで同時観測できるようになると、太陽活動が地球型の惑星大気の力学的な過程や化学組成変動に与える影響について重要な知見が得られるものと期待される。本講演では、これら一連の研究・開発についてご紹介をさせて頂く。



ASTE 望遠鏡を用いた火星・地球大気の CO(J=3-2,345GHz) スペクトル線

多波長光学観測機器およびEISCATレーダーを用いた磁気圏-電離圏結合におけるプロトンオーロラの研究

○岩田陽介、野澤悟徳、大山伸一郎、藤井良一、津田卓雄（名大STE研）、小川泰信（極地研）

Study of the Proton Aurora in the Magnetosphere-Ionosphere coupling region by using optical instruments and the EISCAT UHF radar

Y. Iwata, S. Nozawa, S. Oyama, R. Fujii, T. T. Tsuda (STEL, Nagoya University), Y. Ogawa (NIPR)

In order to understand the Magnetosphere-Ionosphere coupled system in more detail, we analyzed simultaneous observation data obtained on 20 October 2006 with the EISCAT UHF radar and optical instruments located at the EISCAT Tromsø site. Data obtained with the all-sky proton imager, the four-wavelength photometer, the all-sky digital camera, the all-sky TV imager, the wide-view TV imager were analyzed to find the proton-aurora event. An event on 20 October 2006 showed that the electron density decreased dramatically in the height range between 100 and 300 km. The ionospheric density is reduced by two processes: one is the increased recombination rate in association with Joule heating, and two is the upward transport of electrons and perpendicular transport of ions due to the Pedersen current, which closes the current circuit in the ionosphere. To do so the amplitude of the electric field should increase in the downward field-aligned current region. This result suggested a possible interaction between proton precipitation and the downward field aligned current in association with the downward field-aligned electric field.

磁気圏−電離圏結合の理解を進めるうえで、オーロラ活動は磁気圏から電離圏へのエネルギー供給（粒子加熱）や、電離圏電気伝導度を変化させる点で重要な現象である。特にオーロラアーク近傍では、沿磁力線電流が人工衛星によって観測されてきたが、その電流系の解明には未だ至っていない。名古屋大学太陽地球環境研究所と国立極地研究所のグループは、北欧トロムソにてEISCATレーダー、および光学観測機器を運用して、オーロラ活動領域のオーロラ発光、電離圏電場の変化等の諸現象の観測を通して、磁気圏−電離圏結合過程の解明を進めている。一つの電流系のモデルとして、上下方向２つの沿磁力線電流が電離圏ペダーセン電流との繋がりによって閉じた電流系を作ると考えた場合、下向き沿磁力線電流の降り込み領域では、加速されたプロトンによるプロトンオーロラ発光や、磁場に垂直方向の電場の増加を観測できることが期待される。名古屋大学太陽地球環境研究所は、プロトンイメージャ（波長 486.1 nm）、4 波長フォトメーター（427.8 nm, 557.7 nm, 630.0 nm, 844.6 nm）を、国立極地研究所のグループは、全天デジタルカメラ、全天高感度TVイメージャー、広視野高感度TVイメージャーを運用している。これらの観測機器を相補的に用いることにより、下向き沿磁力線電流領域における、降り込みプロトン粒子の効果を考えることが可能となる。2006年10月20日のイベントではプロトンオーロラの発光を捉える事に成功した。このイベントではプロトンオーロラの発光と同時に、約100-300kmの広い高度領域における急激な電子密度の減少と、電離圏電場の増加に起因するイオン温度上昇が観測された。これらの結果は、沿磁力線電流と電離圏ペダーセン電流による閉電流系が成り立つモデルを示唆する証拠として考えられる。

5-2

パルセーティングオーロラの地上ー衛星同時観測

○門倉　昭（極地研）、原口祐樹、穂嶋宏昭、山本博聖（立教大）、平原聖文（東大）

Ground-satellite simultaneous observation of pulsating aurora

○Akira Kadokura (NIPR), Yuki Haraguchi, Hiroaki Hojima, Hiromasa Yamamoto (Rikkyo Univ.) and Masafumi Hirahara (Univ. of Tokyo)

Energy characteristics of the precipitating electrons responsible for the pulsating aurora were investigated by using the ground-based auroral observation at Syowa Station in 2003 and the data from the low-altitude satellite such as DMSP. Following results were obtained from the six cases of the simultaneous observation:

(1) Energy flux in the higher energy range above 3~14 keV clearly increases at the time of the pulsation ON, in comparison with the OFF time.

(2) Variation of the total energy flux is positively correlated with that of the average energy, but sometimes inversely correlated with that of the total number flux, which suggests that the increase and decrease of the pulsating auroral emission intensity should be mainly caused by the increase and decrease of the average energy of the precipitating electrons. This result is consistent with the result obtained by the ground-based optical observation.

We will investigate the variations of the electric field and magnetic field around the pulsation aurora by using the ion driftmeter and magnetometer data of the DMSP satellites, and we will also survey such simultaneous observations with other satellites, e.g. FAST, Cluster, and Geotail.

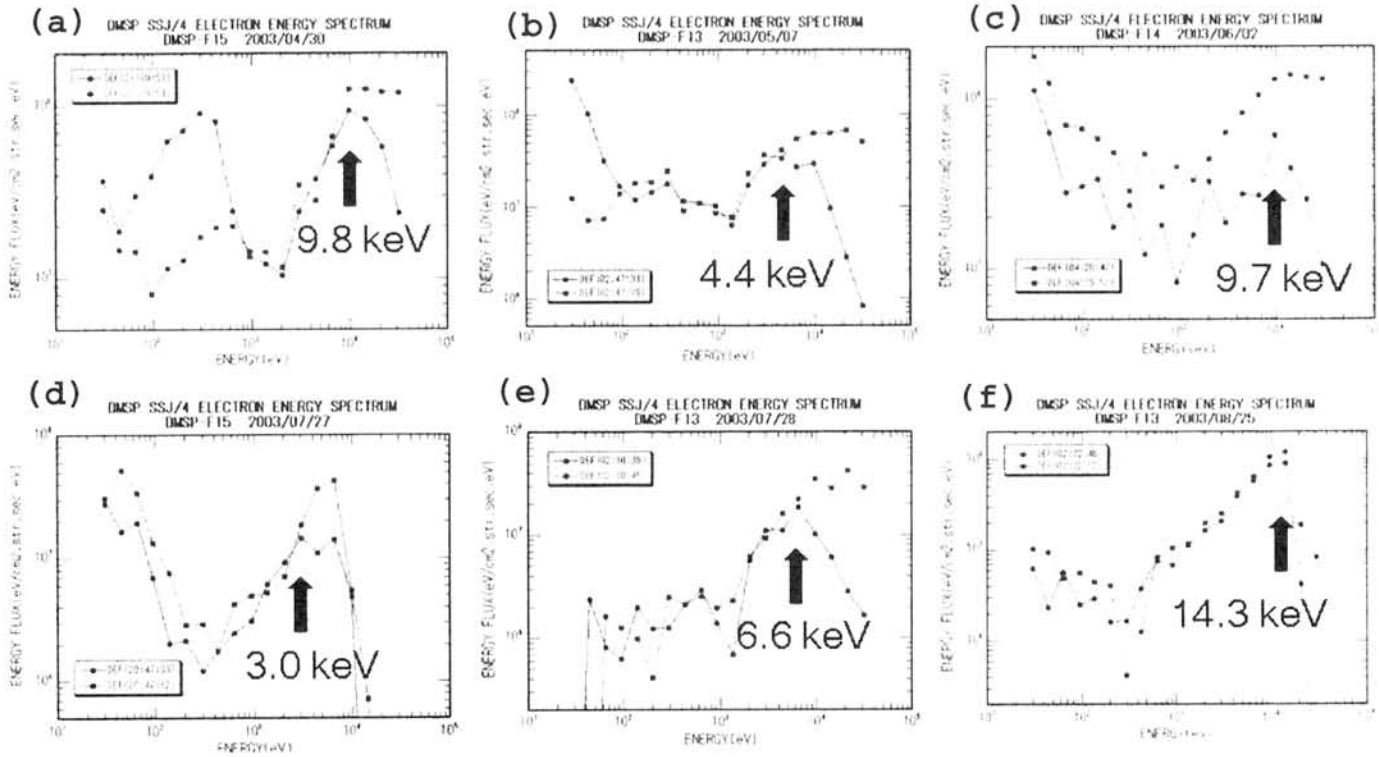


Fig.1. Energy spectrum of the differential energy flux of the precipitating electrons observed by the DMSP satellite for six pulsating auroral cases in 2003: (a) 30 April, (b) 7 May, (c) 2 June, (d) 27 July, (e) 28 July, (f) 25 August. Red and Blue curves in each panel correspond to the data during pulsating aurora "ON" and "OFF" periods, respectively.

5-3

電子・イオンのエネルギー・ピッチ角分布とオーロラ発光との関係：れいめい衛星観測

○平原 聖文（東大・院・理）、坂野井 健（東北大・PPARC）、
小川 泰信（極地研）、浅村 和史（ISAS/JAXA）、山崎 敦（ISAS/JAXA）、
関 華奈子（名古屋大学 STE 研）、海老原 祐輔（名古屋大学高等研究院）

Energy-pitch angle properties of electrons and ions and their relationship with auroral emissions: Reimei observations

○Masafumi Hirahara (Univ. Tokyo), Takeshi Sakanoi (Tohoku Univ.),
Yasunobu Ogawa (NIPR), Kazushi Asamura (JAXA), Atsushi Yamazaki (JAXA),
Kanako Seki (Nagoya Univ.), Yusuke Ebihara (Nagoya Univ.)

The scientific purpose of the micro-satellite, Reimei, launched on August 23, 2005 into a sun-synchronous orbit in a noon-midnight meridian with an altitude of about 640 km, is fine-scale investigations for the auroral phenomena mainly by using three-channel monochromatic auroral imaging camera and plasma energy analyzers with high time/spatial resolutions. Through the precise satellite attitude control, the auroral camera with a projected imaging area of 70 km x 70 km at the 110-km altitude can often capture the footprint of the satellite along the geomagnetic field line in order to perform the simultaneous observations for both imaging of auroral emissions and particle measurements of energy-pitch angle distribution functions. A number of the image-particle measurements have brought new findings on the auroral emission and particle correlations. In particular, this presentation shows some results in the Reimei observations for discussing the auroral phenomena from viewpoint of Energy-pitch angle properties of electrons and ions and their relationship with auroral emissions.

Reimei has been revealing several types of correlations among auroral activities and particle dynamics. Quite active auroral variations like rotating/flashing rays and streaming fireballs are very well corresponding to the field-aligned electron beams accelerated by dispersive Alfven waves just above the satellite. It is usual that both active auroras and "Alfvenic" electron accelerations occur poleward of the inverted-V signatures or the auroral oval. In contrast to the reflected (upward) components in the inverted-V electron signatures, number flux of secondary and lower-energy electrons with the ionospheric origin due to the "Alfvenic" electron precipitations is much intense, indicating that the production rate of the secondary electrons is higher by the "Alfvenic" electron components than in the inverted-V electrons.

オーロラのPoleward expansionに伴って発生する二つの伝播方向を持つSurface wave

○坂　翁介　(オフィス　ジオフィジク)、林　幹治　(東京大学)

Excitation of Kelvin-Helmholtz instabilities with two propagation directions during auroral breakup and their role in poleward expansion of aurora

O. Saka (Office Geophysik), K. Hayashi (Univ. Tokyo)

Poleward expansion of aurora is defined as formation and subsequent poleward propagation of poleward arc separated from the surge. The onset of poleward expansion of aurora thus defined was accompanied by the development of surface waves with two propagation directions; one is eastward in the east of poleward arc and the other is westward in the west of poleward arc, and by periodic ignition of poleward arc in Pi2 band frequencies, which is referred to as periodic aurora. Periodic aurora was positioned in the magnetotail (20-40Re from the Earth) when it was mapped by T96_01 model [Tsyganenko, 1995]. It is conceivable that the surface waves with two propagation directions were caused by Kelvin-Helmholtz instabilities (K-H instabilities) associated with flow divergence of fast earthward flow. Because the surface waves are not localized mode, Pi2 band frequencies may appear in various phenomena in magnetotail, such as "periodic aurora", "modulation of fast earthward flow" and "magnetotail Pi2".

オーロラはQuiet arcのSudden brighteningから始まりSurgeへと発展して行く。Surgeの極側が本体から離れPoleward Arcとなってさらに極側へ伝播してゆくが、このとき磁気圏静止軌道ではオーロラ領域を挟んで東と西に対になったプラズマの回転運動がPi2周期で現れる。それと同時にSurgeから分離して極側に移動した Poleward Arcが同じ周期で明滅する。この明滅は磁気圏尾部に投影すると地球より20-40Re 離れた場所に位置する。これをPeriodic auroraと呼んでみる。

回転運動はオーロラの東と西で反転するためFLR (Field Line Resonance) を想像するが、主軸方向の分布からそれは考え難い。この回転の反転は、Fast earthward flowの朝夕分岐によるK-H instabilityが原因でその結果二つの伝播方向を持つSurface waveが磁気圏内に発生するためと考えるのが最も自然である。

Surface waveの特徴からこの回転運動は局所化されていないだろうし、二つの伝播方向を持つため磁気圏尾部夜側は極めて圧縮性となるであろう。それらが原因となって"Periodic aurora"、"Fast earthward flowの速度変調"、"Magnetotail Pi2"などに代表されるPi2帯周期を磁気圏尾部内にひろく分布させていると考えるのはそれほど不自然な事ではない。

ＰＰＢ８号機と１０号機によるオーロラＸ線について

中川道夫(大産大工)、内田正美(大阪信愛)、江尻全機(極地研)、海老原祐輔(名大高等研究院)、
小野孝(大産大工)、門倉昭(極地研)、籠谷正則(大産大工)、斉藤芳隆(宇宙研)、佐藤夏雄(極地研)、
鈴木裕武(立教大理)、綱脇恵章(大産大工)、友淵義人(大産大工)、中村智一(名大理)、
中村康範(大産大工)、並木道義(宇宙研)、平田憲司(大産大工)、福田真実(大産大工)、
松坂幸彦(宇宙研)、村上浩之(立教大理)、山内誠(宮崎大工)、山上隆正(宇宙研)、山岸久雄(極地研)、
山本幹生(宮崎大工)

Feature of Hard X-ray of auroral origin with PPB#8 and #10

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Y. Ebihara (Nagoya U.), T. Ono (Osaka Sangyo U.), A. Kadokura (NIPR),
M. Kagotani (Osaka Sangyo U.), Y. Saito (ISAS), N. Sato (NIPR), H. Suzuki (Rikkyo U.),
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H. Murakami (Rikkyo U.), M. Yamauchi (Miyazaki U.), T. Yamagami (ISAS),
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PPB No.8 and 10 were launched in rapid succession to form a cluster of balloons during their flight at Jan. 13, 2003 from Syowa Station, Antarctica by the 44th Japanese Antarctica Research Expedition (JARE-44). During from 15th to 28th Jan. 2003, about 30 auroral events are detected by X-ray sensors on each balloon. The relation of kT and intensity with these events are derived and these relations are added in AE index, too.
In this paper, we present the feature of these events in detail.

同一性能を持つ硬Ｘ線撮像装置をそれぞれ搭載した２機の大気球（８号機と１０号機）は２００３年１月１３日に約６時間差で続けて放球され、高度３１ｋｍを保ちながら南極大陸を半周し、８号機は２月８日に１０号機は１月３１日に実験を終了した。その間、両機が同時にまたは単独で、３０例前後のオーロラからのＸ線を観測した。これらのオーロラＸ線イベントは最大強度の前後で数時間輝いている場合と、これより短い時間（１時間以下）で輝いている場合がある。これらのイベントについて、ｋＴとその明るさとの相関を求め、これらとＡＥインデックスとの関係を調べた。今回は、オーロラＸ線イメージとこの結果について述べる。

アイスランドと日本の大気中での宇宙線生成核種 Be-7 濃度日変動の比較IV

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Comparison between daily variations of Be-7 concentration in air in Japan and Iceland IV

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Be-7 is produced by interaction between cosmic rays and nitrogen or oxygen in the atmosphere. The variation of its concentration indicates the variation of cosmic-rays intensity. Cosmic rays which reach the earth are modulated by the solar activities in the heliosphere.

Daily Be-7 concentrations (BEC) in air have been being observed at Yamagata (38° N), Japan since 2000 to study the relationship between cosmogenic nuclide and solar activity. To investigate the latitude effect of the periodic variation of BEC related to the rotation of the sun, we have set up the same daily observation system of Be-7 concentration at Husafell in Iceland located at high latitude (64° N) and have been observing it there since September 2003.

Fig1 shows the yearly variation of the each BEC, the sunspot numbers (SSN) and the neutron intensity observed on the ground at Apatity (67.6° N). The SSN decease because of the solar activity decline. The each BEC and the neutron intensity are anti-correlated to the SSN. Especially, the BEC observed in Iceland correlate inversely more strongly with SSN than at Yamagata. The rates of variability of the each BEC between the maximum and minimum are greater than that of the neutron intensity.

宇宙線生成核種の濃度変動は原理的には地球全体へ降り注ぐ宇宙線の強度変動を表しており、全強度測定として重要である。しかし、宇宙線生成核種の地表への降下は成層圏・対流圏での大気循環などの気候変動や地表付近での気象に影響されるため、宇宙線生成核種の濃度変動と宇宙線強度変動の関係を調べるためには多地点での長期連続観測により、局地的変動と全地球的変動の要因を区別して明らかにする必要がある。このため、2003 年秋よりアイスランドと山形の 2 地点で大気中浮遊塵（エアロゾル）を同時収集し、Be-7 濃度変動の連続観測を継続している。

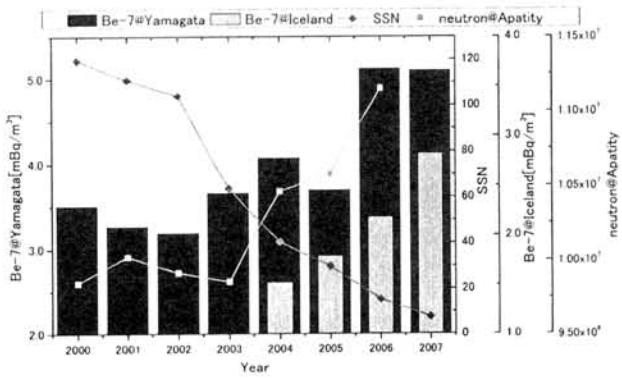

Fig1.アイスランドと山形の Be-7 濃度、太陽黒点数、地上中性子強度の年変動

Fig1 は、アイスランドと山形での大気中 Be-7 濃度、太陽黒点数（SSN）、Apatity（北緯 67.6°）での地上中性子強度の年変動である。2004 年から 2006 年の最大の変動率は、アイスランド Be-7 で 30.1%、山形 Be-7 で 27.8%、SSN で 81.4%、地上中性子強度で 6.2%であり、地上中性子強度変動に比べて、両 Be-7 濃度変動は大きい。また、同じ Be-7 濃度でもアイスランドと山形では変動のパターンが異なっている。

今回は、前年度で終了した共同利用研究のまとめを中心に、最近の現状についても報告する。

Heliosphere impact on geospace: Solar-terrestrial and aeronomy research during the fourth Polar Year campaign

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The IPY project 63 ("Heliosphere Impact on Geospace") conducts multinational research on solar-generated events which affect the composition and dynamics of the atmosphere in the terrestrial polar areas. This cluster runs versatile bi-polar space research instrumentation to support the IPY campaign. The activity is led by two complementary initiatives: the International Heliophysical Year (IHY) programme coordinates the use of spacecraft missions with ground-based observatory instruments to study the Sun's influence on the heliosphere, including effects at the Earth; ICESTAR, endorsed by SCAR (Scientific Council of Antarctic Research), coordinates research on magnetospheric and upper atmospheric responses to solar inputs, with emphasis on inter-hemispheric relationships. Several groups of Cluster 63 have recently installed new instrumentation to the polar regions in order to improve the spatial coverage and resolution and to provide pairs of geomagnetically conjugate observations from both hemispheres. The resulting observations and value-added data products are used together with state-of-the-art models and simulations to improve our quantitative understanding of the near-Earth space environment.

The scientific work of Cluster 63 can be categorized under three main themes:

(i) Coupling processes between the different atmospheric layers and their connection with the solar activity (E.g. effects of extreme solar activity on the content of stratospheric ozone).

(ii) Energy and mass exchange between the ionosphere and the magnetosphere (E.g. tomographic studies of ionospheric phenomena).

(iii) Inter-hemispheric similarities and asymmetries in geospace phenomena (E.g. comparison studies of southern and northern auroral structures).

In the presentation we will give a review of the most interesting scientific findings by Cluster 63 and discuss the most important future challenges now as we are approaching the next sunspot maximum.

6-2

MAGDAS Project and Its Preliminary Results

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The Space Environment Research Center (SERC), Kyushu University is installing the MAGnetic Data Acqusition System (MAGDAS) at 50 stations in the Circum-pan Pacific Magnetometer Network (CPMN) region, and several FM-CW radars along the 210-degree magnetic meridian. The MAGDAS project has the potential to contribute greatly to IHY/CAWSES by supporting ground-based magnetometer array for worldwide studies, and by demonstrating the beauty, importance, and relevance of space science to the world. Nearly 20 and 10 MAGDAS units were installed in collaborations with 30 organizations in the world, respectively, along the 210-degree magnetic meridian in 2005 and along the magnetic dip equator in 2006. In the year 2007, 10 MAGDAS units were deployed in places such as South Africa, India, and Antarctica. The goal of MAGDAS is to become the most comprehensive ground-based monitoring system of the earth's magnetic field.

In the present paper, we will introduce preliminary results obtained from MAGDAS Project; (1) From analysis of SC-associated electric fields observed by FM-CW radar at Sasaguri, we found a superimposed effect of the polar electric field and the westward electric field of earthward compressions, which were caused simultaneously by the interplanetary shocks. (2) 160 quasi-periodic DP2 fluctuations are observed at the dip equator in daytime during December, 2006-March 2007, which were associated with the southward IMF. It is found that 36% of all the events show simultaneous DP2 fluctuations in the nightside, and in-phase relationship to those in the dayside. Most events of the nighttime DP 2 cannot be explained why magnetic fields increase in the nightside. (3) Pi 2 pulsations at the world-widely separated stations near the dip equator are found to show an amplitude enhancement around each 10:00-13:00 local time. Low-latitude Pi 2 electric and magnetic pulsations observed by MAGDAS and FM-CW radar show characteristics of radially propagating compressional and radially standing cavity modes. (4) Long-term spectrum peaks of solar surface, solar wind parameters, geomagnetic indices, and MAGDAS data are compared to understand couplings of the solar wind-magnetosphere- ionosphere-atmosphere system. The spectrum peaks of 7.5, 15, 22, and 36-day period on the equatorial MAGDAS data mean a strong interaction of the atmospheric neutral wind with, and direct influence of solar radiations to the ionospheric Sq current system.

6-3

次期太陽活動期におけるジオスペース探査： ERG プロジェクト

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三好由純、関華奈子、塩川和夫（名古屋大学太陽地球環境研究所）
平原聖文（東京大学大学院理学研究院）
高島健、浅村和史、松岡彩子（ＪＡＸＡ宇宙科学研究本部）
ERG ワーキンググループ

The ERG Project: Japanese geospace exploration to elucidate the dynamics of the inner magnetosphere during the next solar maximum period

For the purpose to study the unresolved major problems underlying in Geospace, ERG (Energization and Radiation in Geospace) project has been proposed being focused on the evolution of radiation belts associated with geomagnetic storms. The project consists of three parts; the ERG satellite, the ERG ground network, and the ERG modeling/data center. The ERG satellite is designed to make in-situ observation of the storm-time particles and fields to evaluate the adiabatic and non-adiabatic processes which control the dynamics of relativistic particles. The instruments on-board are assigned as: (i) measurement of the distribution functions of electrons and ions in wide energy range such as 10eV to 10MeV for electrons and 10eV to 1MeV for ions, (ii) measurement of DC electric and magnetic fields with resolution of 0.1mV/m and 0.1nT, and (iii) measurement of electric and magnetic components of plasma waves in a frequency range from 1Hz to 5MHz. The ERG project also involves ground-based network facilities of optical instruments, Super-DARN HF radars, and magnetometers, making it possible to obtain two-dimensional distribution of ionospheric and magnetospheric disturbances. The ERG modeling/data center is the facility to examine these comprehensive satellite and ground data by comparing with the results of computer simulation of particles and fields in the Geospace. The ERG project team is also planning to collaborate with THEMIS, RBSP (NASA) and ORBITALS (Canada) missions. The ERG proposal was submitted to ISAS/JAXA in 2007 as a category of small-scale satellite mission. Feasibility studies in pre-phase A are currently carried out.

地球をとりまく放射線帯は、1950 年代後半に発見され、時間変動が少なく安定な領域と考えられてきた。しかし、1990 年代における新たな衛星観測により、この領域が宇宙嵐に伴って激しく変動していることが再発見された。放射線帯は、木星などにも応用が可能な「天体磁気圏の高エネルギー現象」を追求する科学面、「高エネルギー現象が人工衛星に及ぼす影響（性能劣化・機能喪失）」といった実用面の双方から、近年注目されている。地球周辺の宇宙空間「ジオスペース」は、この放射線帯も含め、6 桁以上のエネルギー幅を有するプラズマが共存している。しかし、このジオスペースの変動を作り出す現場となる内部磁気圏赤道面付近での粒子・電磁場・波動の総合観測はこれまで実現しておらず、その加速変動メカニズムについては諸説並立の状態にある。提案されている諸説を検証し、実証的に変動メカニズムを解明してゆくために、大規模な宇宙嵐が多発する次期太陽活動極大期（2011 年頃）に向けて、放射線帯の中心部を含むジオスペース赤道面における粒子・電磁場・波動の総合観測の実現が、喫緊の要請となっている。本 ERG 計画は、このジオスペース赤道面における「広いエネルギー範囲の粒子」と「広帯域の電磁場・波動」の総合観測を世界で初めて実現し、宇宙嵐に伴うジオスペースの大変動とそれに伴う相対論的粒子生成の物理プロセスを探ることを目的としている。本計画では、「新領域の探査」から「高精度観測による理解の深化」へとフェーズが移行しつつある太陽地球系物理学において、物理プロセスの深い理解を実現する新たな方法論を開拓し、小型衛星で中型計画クラスの科学成果を得ることを目指している。そのために、地上ネットワーク観測との連携を含む多点観測の活用、および数値モデリングを組み込んだ統合データ解析ツールの開発を計画の重要な一部として組み込んでいる。この多点観測、数値モデルを用いて衛星観測データを最大限に活かすスタイルは、SCOPE/Xscale などの次世代探査に向けて今後必須となってゆくものである。また、本計画で得られる成果はジオスペースの環境予測を目指す「宇宙天気」研究に応用が可能である。

世界資料センター（WDC）システムの改革について

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New Data-Center System of ICSU (World Data Services?)

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The Strategic Committee on Information and Data (SCID), which was established by ICSU to advise on the future organization and direction of its activities in relation to scientific data and information, has proposed to facilitate a new, coordinated global approach to scientific data and information, through reorganization of WDC (World Data Center) and FAGS (Federation of Astronomical and Geophysical Data analysis and Services) systems of ICSU. After proposal to create the new World Data Services system (WDS) by SCID, we discuss future contribution of the present WDC system in Japan (Airglow, Aurora, Cosmic Rays, Geomagnetism, Ionosphere, Space Satellites, and Solar Radio Emissions) to the new WDS system.

IGY を期に世界資料センター（WDC）システムが設立されて以来、現在我が国では、大気光（国立天文台）、電離層（NICT）、宇宙線（名大 STE 研）、地磁気（京都大）、太陽電波（国立天文台）、オーロラ（NIPR）、科学衛星（JAXA）の７センターが稼働している。しかし設立以来半世紀が経過した今日、同じく ICSU の傘下にあるデータ・情報関連組織である FAGS (Federation of Astronomical and Geophysical Data analysis and Services)と CODATA (Committee on Data for Science and Technology)とともに、改革の機運が高まり、ICSU に設置された検討委員会である SCID (Strategic Committee on Information and Data)による改革案が、2008 年 3 月に公表された。それによると、主としてデータベースの構築と流通を行う WDC と、解析データや研究情報を扱う FAGS とを統合し、ICSU の新しいデータ・情報システムとして、WDS (World Data Services)を創設することが提案された。これを受けて WDC、FAGS 関係者による意見交換が行われたが、提案された組織の名称を含めて異論が多く、まだ新システムの具体像について、共通の理解に達しているとは言えない。そこで本年 10 月の ICSU 全体会議におけるこの改革案の承認後に設置される見込みの、「移行委員会」の役割が大変重要となる。この講演では、上記の動きの概要を紹介するとともに、これまでの WDC 活動の実績を踏まえ、我が国における太陽・地球科学分野における今後のデータセンター活動の方向について議論する。

6-5

ドームふじ天文学観測

ランドック　ラムゼイ　ガイ　　市川隆

「Antarctic Infra-Red Cameraによる惑星の観測計画」

ランドック　ラムゼイ　ガイ　　市川隆

Tohoku University hopes to establish a telescope at Dome Fuji (also known as Dome F) for observations. The 40 cm Antarctic Infra-Red Telescope (AIR-T-40) could begin observations as early as 2010. AIR-T-40 is primarily an engineering telescope to pave the way for the possibility of a larger telescope, but it will still be capable of meaningful scientific observations. The Antarctic Infra-Red Camera (AIR-C) is designed for use with AIR-T-40. A 40 cm telescope is sufficient to observe the solar system planets, and Antarctica's unique observing conditions allow for research which is literally impossible from more temperate observatories.

We expect a resolution using AIR-C of about 5 arc-second in the k-band (2.0-2.4 micron light). For comparison, the angular sizes of the visible planets are: Mercury 4.5-13"; Venus 9.7"-66.0"; Mars 3.5"-25.1"; Jupiter 29.8"-50.1"; Saturn 14.5"-21.1". For Mercury and Venus, the largest angular size occurs when the planet is between Sol and the Earth. It is impossible to observe at these times because of scattered light from Sol. Antarctica has the lowest levels of airborne particulate matter of any place on Earth, so it should also have the lowest levels of scattering. Until we have a chance to observe from Dome Fuji, we won't know how close to Sol we can observe the planets. Under the right conditions, we will be able to observe the planets with orbits outside of Earth at their largest angular size.

One of the areas of interest for modern planetary astronomy is monitoring changes with time. These observations are complicated by the Earth's own rotation. From temperate observatories, each planet is visible for about 12 hours at a time. At Dome Fuji, during the White Night and the months of winter darkness, the planets have the potential to be visible for months at a time.

The 2010-11 season is an excellent chance to observe Venus. It will be visible continuously for over two months from early September to mid November. More exciting is when it will be visible again from mid December until late March. Towards the end of this second window, Venus will be nearing its largest angular separation from Sol; thus will have greater contrast. For both of these continuous observation chances, Venus will be on the near side of Sol and have an angular size greater than 14".

Currently Jupiter and Saturn are at inconvenient places in the Zodiac. Rather than being visible for weeks at a time, they will rise and set each day. During the 2010-11 season, Mars will be visible during the White Night. Unfortunately, this is when Mars is at its smallest angular size and its dimmest. We will have to wait until 2018 for the best conditions to observe these three planets uninterrupted for weeks at a time.

There is a scientific need uninterrupted observations of Venus. The solid planet rotates once every 243 days, but the atmosphere superrotates with a period of roughly 5 days. This superrotation remains poorly characterized because of the difficulty of observing on this time scale from temperate observatories. Uninterrupted observations from Dome Fuji will help to shed light on the cause of the superrotation and the mechanisms which sustain it.

7-1

Radar studies of the large-scale dynamics of the mesosphere and lower thermosphere above Antarctica

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Atmospheric radars of various kinds have been used to study the mesosphere and lower thermosphere (MLT: 70-100 km) above Antarctica for many years. These radars use differing detection methods and operate at different frequencies, but share ability to measure the wind speed and direction. In recent times, the number of concurrently operating radars has increased to the point where, during the IPY interval, up to nine radars will be observing the MLT from the Antarctic continent.

Access to concurrent radar data from the same and from different stations allows studies to be conducted that would not be possible with single systems. In particular, atmospheric waves that span the Antarctic continent can be characterized using combinations of observations. The long duration of Antarctic observations also allows trends in large scale waves and mean winds to be investigated.

This presentation will briefly describe the middle atmosphere radar systems operating in Antarctica using those at Davis as specific examples. The theory of large-scale waves (tides and planetary waves) will be reviewed and the development of an analysis method for extracting tidal information in the polar regions will be described. The results of the application of this method to data from the Davis, Syowa, Rothera and Scott Base MF radars will be presented along with other large scale wave observations.

7-2

Program of the Antarctic Syowa MST/IS Radar

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Syowa Station is one of the distinguished stations where various atmospheric observations for research purposes by universities and institutes as well as operational observations by Japan Meteorological Agency and National Institute of Information and Communications Technology are performed continuously. National Institute of Polar Research plays a central part in the operations. The observation of the Antarctic atmosphere is important in two senses. First, it is easy to monitor weak signal of the earth climate change because contamination due to human activity is quite low. Second, there are various unique atmospheric phenomena in the Antarctic having strong signals such as katabatic flows, the ozone hole, noctilucent clouds, and auroras. The middle atmosphere is regarded as an important region to connect the troposphere and ionosphere. However, its observation is sparse and retarded in the Antarctic compared with the lower latitude regions; nevertheless the vertical coupling is especially important in the polar region.

Since 2000, we have developed an MST/IS radar which is operational in the Antarctic and have made feasibility studies including environmental tests at Syowa Station. Various significant problems have been already solved, such as treatment against low temperature and strong winds, energy saving, weight reduction, and efficient construction method. A current configuration of the planned system is a VHF (47MHz) Doppler pulse radar with an active phased array consisting of 1045 yagis. As an activity of JARE49 (the 49th Japanese Antarctic Research Expedition) and JARE50, a pilot radar system which consists of newly developed antennas and T/R modules is being installed at Syowa Station, to know the overall performance of the radar system. This pilot system is being used for IPY (International Polar Year) 2007-2008 as a meteor radar to monitor winds in the lower thermosphere which are hard to be performed by existing observation facilities.

The value of the PANSY project has been approved internationally and domestically by resolution and recommendation from international scientific organizations such as IUGG, URSI, SPARC, SCOSTEP, and SCAR. The scientific research objectives and technical developments have been frequently discussed at international and domestic conferences and at a scientific meeting at NIPR organized by the PANSY group every year. In this fiscal year, we will summarize the results of these discussions and feasibility studies as a few booklets. Special sessions for PANSY will be also organized at related scientific societies such as MSJ and SGEPSS to deepen the discussion with an eye to submission of our proposal.

7-3

Development of Remote Controlled Lidar System for Observations of Daytime Middle-Atmosphere Temperature over Syowa Station

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Kaoru Sato (Univ. of Tokyo), Takuji Nakamura (RISH, Kyoto Univ.),
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We have been promoting a new lidar project at Syowa station (69S), Antarctica. Earth's atmosphere has a characteristics temperature structure, which is thought to be generated and maintained by various atmospheric waves such as gravity waves, but is still not understood quantitatively due to the lack of observations, especially in polar regions.

The new lidar system is now being designed and constructing for both nighttime and daytime temperature observations in the wide height range from stratosphere to the lower thermosphere. For daytime measurement, we use a Fabry-Perot etalon filter to reduce background noises. The most parts of this lidar system will be remotely controlled via the Internet from Japan. The lidar system is basically self-controlled and the remote control functions are limited. We are developing automatic adjustment system of the overlap between the field of view of the receiver-optics and the area of laser illumination using a gated high-sensitivity ICCD camera and image processing technique.

7-4

Millimeter-wave observations of the stratospheric and mesospheric chemical composition change over Syowa station

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It is well known that energetic particle precipitation (EPP) such as energetic electron precipitation and solar proton events (SPEs) near the solar maximum period causes changes of chemical composition in the upper atmosphere. Especially NO_X produced via ionization of the nitrogen molecule is supposed to influence the ozone chemistry in the mesosphere and sometimes in the stratosphere. From the chemical point of view, it is interesting to clarify how much such EPP events influence the ozone distribution. In addition, we think that we can use the vertical change of ozone and NO_X as a probe to study the dynamical connection between the upper and middle atmosphere. Actually some previous observational studies (e.g., Randall et al. 2007) suggest that the change of NO_X vertical profiles in the upper polar stratosphere with a time scale of a few months is related with the downward motion of the polar night atmosphere as well as EPP events. However, the most of the previous observations were made by solar occultation satellites that observe ozone and/or NO_X only at dusk and dawn when the ozone and NO_X are photo-chemically unstable. In addition, we cannot obtain the observational data during the night in the polar winter by such solar occultation measurements. To overcome the lack of polar night data, we planned to make ground-based observations of ozone and NO_X by using a spectroscopic millimeter-wave radiometer from Syowa station. The molecular spectral lines in the millimeter-wave length are observable through day and night because those spectra are thermally excited "emission" lines, and this is one of the significant advantages of the millimeter-wave observations compared with other remote sensing techniques.

To operate a millimeter-wave radiometer in Syowa station, the most serious problem was its large electric power consumption. Our radiometer is equipped with a superconductive receiver whose sensitivity is very high compared with a conventional cooled Schottky-receiver. In order to measure the very weak spectral lines of NO_2 and NO, such a high sensitivity of the superconductive receiver is essentially important, but a power-consuming cryogenic refrigerator was necessary to cool the receiver down to 4 Kelvin at which it becomes to the superconductive state. We developed a new cryogenic system for the radiometer using a small refrigerator made by ULVAC Inc and have succeeded in reducing the power consumption by 1/3 compared with the previous one. We made a test run of the new radiometer and succeeded in obtaining an ozone spectrum in 110GHz. We are now improving the optical part of the radiometer for 250GHz operation aiming at the observation at Syowa station since 2010.

In my talk, I will present the scientific targets of this project in more detail and report the current status of the hardware development.

The new small millimeter-wave spectroscopic radiometer

The development of the new radiometer system was supported by SORST program (P.I. Yasuo Fukui) of Japan Science and Technology Agency (JST).

7-5

高機能ライダーシステムを用いた極域中層大気・超高層大気の力学・組成の研究計画

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川原琢也(信州大学・工学部)
北原司(鳥羽商船高専)
坂野井和代(駒澤大学・総合教育研究部)
佐藤薫(東京大学・理学系研究科)
江尻省(京都大学・生存圏研究所)
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An observation plan of dynamics and constituents in the polar middle and upper atmosphere with a multi-functional resonance lidar system

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Takuya D. Kawahara (Faculty of Engineering, Shinshu University)
Tsukasa Kitahara (Toba National College of Maritime Technology)
Kazuyo Sakanoi (Komazawa University)
Kaoru Sato (Graduate school of science, Univ. of Tokyo)
Mitsumu K. Ejiri (RISH, Kyoto University)
Masaki Tsutsumi, Yoshihiro Tomikawa (National Institute of Polar Research)

The tropopause and the mesopause are similar in temperature profiles, but are significantly different since the mesopause region is highly more variable. Although the stratosphere-troposphere exchange has been studied intensively, the interaction and the exchange between the mesosphere and the thermosphere, or the middle atmosphere and the upper atmosphere is still kept unrevealed. Therefore, observational study of mesosphere and lower thermosphere (MLT) variability is important in order to understand variability of the middle and the upper atmospheres. Furthermore, the mesosphere in the polar region is of particular interest because of very cold summer temperature, causing PMC (polar mesospheric clouds) and related phenomena (PMSE, NLC), a large summer-winter temperature difference and associated changes of atmospheric stability, and effect of aurora and high-energy particles.

We propose a six year project of the study of interactions between the polar middle and the upper atmospheres using a state-of-art resonance lidar system which will be collaboratively operated with existing optical and radar instruments in and around Syowa, as well as a huge atmospheric radar, PANSY, to be installed at Syowa. The lidar consists of a Rayleigh lidar and two resonance scatter lidars, observing temperature profiles and variations of minor constituents such as Fe, K, Ca, Ca+ etc. Outline of the project will be presented in the talk.

Conjugate study of polar upper atmosphere and KuaFu project

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Abstract:

In the first part of the presentation, some results of data analysis of energetic particle detector on board CBERS-01 and -02 for the past five years are introduced to show the general features of MeV electrons and protons along a solar synchronous orbit at a height of 780km. Emphasis is put particularly on the asymmetrical features of the energetic electrons at northern and southern polar region. The possible effects of the different distribution of energetic electrons on the middle atmosphere at high latitude regions are discussed.

In the second part, a Sun-Earth System Explorer Project named KuaFu is introduced. Kuafu is a planed space mission initiated by Chinese scientists and cooperated with scientists from more than ten European countries and Canada. Now this project is completing its comprehensive study phase and to be turned to the next phase. This project is consisted of three satellites, one will be launched to the L1 point and the other two are in polar orbit with a phase difference so that at any time there will be one above northern aurora. Such a configuration will continuously observe the complete chain of actions/reactions from the solar atmosphere to geo-space, including solar source of the disturbances such as solar flares, CMEs, energetic particles and their transportation in the interplanetary space by interplanetary clouds, radio emissions, shock waves and finally, the geo-responses in aurora activities, sub-storms and magnetic storms. Thus it presents a global end to end imaging as a space storms, aurora and space weather Explorer.

7-7

Variations of the Ionospheric F2-layer at Zhongshan Station, Antarctica

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Abstract: Digital ionosonde data of one solar cycle (Feb., 1995-Dec., 2004) at Zhongshan Station (*69°22'24"S, 76°22'40"E*), Antarctica are used to study the ionospheric variations in the critical frequency of the F2 layer, foF2. In the daily variation the diurnal component is dominant compared to the semi-diurnal one. In the seasonal variation the annual component is larger than the semiannual one. There is a "magnetic noon anomaly" in the daily variation of foF2, which means the maximum value of foF2 occurs at magnetic noon rather than local noon. There is no obvious "seasonal anomaly" in the seasonal variation of foF2 during lower solar activities, but there is "semiannual anomaly" during higher solar activities. The mechanisms of the phenomena are discussed in the paper. The solar zenith angle effect, the magnetospheric driven factors (particle precipitation and polar convection electric field), and the ambient atomic/molecular concentration are considered to explain the observed phenomena. A three dimensional time-dependent model of the polar ionosphere was developed. The model calculations are compared with observations and the results support the physical explanation to some extent.

EISCAT スヴァールバルレーダーを用いた極冠域電離圏における極風の観測的研究

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Study on the polar wind in the polar cap ionosphere using the EISCAT Svalbard Radar

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M. Hirahara (Univ. of Tokyo), I. Haggstrom, and A. Westman (EISCAT HQ)

We present characteristics of the polar wind in the polar cap ionosphere, using the EISCAT Svalbard radar (ESR), in a campaign between June 2007 and January 2008.

The polar wind has been thought that ionospheric ions, such as H^+, He^+, and O^+, continuously escape without any special heating in the polar cap. This phenomenon has been known since the late 1960s, and during the last three decades it has been extensively studied both theoretically and using satellite data above 1000 km altitude.

The aims of this paper are to clarify height distributions of O^+ and H^+ densities and velocities at altitudes between 400 and 1000 km, and to investigate contribution of the photoelectrons to the polar wind in the polar cap ionosphere. Initial results using ESR data obtained between June 23 and September 20, 2007 indicate that a ratio of the H^+ density to the total ion density begins to increase at about 400 km altitude, and it increases with altitude: about 4 % at 500 km and about 9 % at 700 km, which are about 3 times higher than those from the IRI2001 model. In this paper, we will discuss seasonal and geomagnetic activity dependence of the polar wind based on results obtained from the 8-month ESR campaign observations.

P2

北海道-陸別 HF レーダーで観測された中規模伝搬性電離圏擾乱の初期解析結果

○市原　章光・西谷　望・小川忠彦（名大 STE 研）

Initial result of analyzing MSTIDs observed by Hokkaido HF radar

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Hokkaido HF radar, which is the second mid-latitude SuperDARN radar and the first SuperDARN radar in the Far East region, started its operation in November 2006. Hokkaido radar can observe medium-scale traveling ionospheric disturbances (MSTIDs) from northern edge of Japan to Polustrov Kamchatka. Initial result of analyzing MSTIDs observed by the Hokkaido radar will be presented.

2006年11月、名古屋大学太陽地球環境研究所は北海道の陸別町において、SuperDARN(Super Dual Auroral Radar Network)レーダーを設置し、観測を始めた。これは世界で二番目の中緯度SuperDARNレーダーかつ、極東アジア領域では初のSuperDARNレーダーであり、今後の電離圏、熱圏、上部中間圏ダイナミクスの研究のために多大なる力を発揮することが期待されている。

中規模伝搬性電離圏擾乱（Medium-Scale Traveling Ionospheric Disturbance : MSTID）は電離圏F領域において頻繁に観測される普遍的な構造である。オーロラ帯から中緯度にわたる広範囲の緯度帯において、様々な観測システムを用いた研究がおこなわれ、日本でも、GPSや全天イメージャー等を用いて日本上空のMSTIDの研究がおこなわれてきた。斜めのマルチビームを有する北海道-陸別HFレーダーでは、MSTID に伴うF 層エコーとE 層コヒーレントエコー、あるいは海上散乱エコーの２次元分布の観測が可能であり、これらの観測データを用いることで北海道沖からカムチャッカ半島にかけてのMSTIDの解析が可能となった。すなわち、北海道-陸別HFレーダーで観測されたMSTIDの解析をすることにより、同半島から日本南端（与那国島）に至る約5000kmにも及ぶ伝搬過程や物理過程の解明をおこなうことが可能となり、日本上空のMSTIDに関する新しい知見を与えてくれることが期待される。

本公演では、北海道-陸別HFレーダーで観測されたMSTIDの地方時依存性、季節依存性等に関する解析の初期結果について報告する予定である。

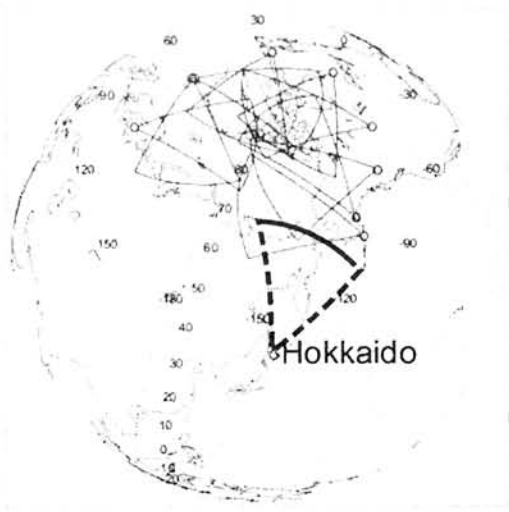

図1 北海道-陸別HFレーダーの観測範囲

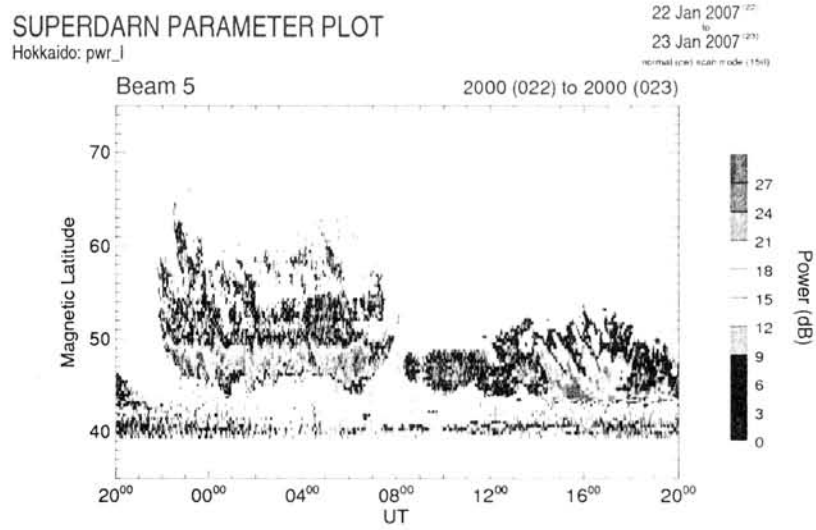

図2 北海道-陸別HFレーダーで観測されたMSTIDの例

Mid-latitude dusk scatter event

as observed with Hokkaido SuperDARN radar

- new category of mid-latitude decameter scale irregularities? -

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Dusk Scatter Event (DUSE: *Hosokawa et al.* [2001, 2002]) is one of the most prominent backscatter targets for the coherent HF radars of Super Dual Auroral Radar Network (SuperDARN). During geomagnetically quiet conditions, they appear immediately after the local sunset at the subauroral latitudes and last for 1-2 hours. *Hosokawa et al.* [2002] associated occurrence of DUSE with the sunward edge of the mid-latitude trough and claimed that an appearance of DUSE can be used for monitoring the local time extent of mid-latitude trough. However, the SuperDARN radars at the auroral latitudes are not suitable for observing irregularities in the subauroral latitudes. Thus, latitudinal profile of DUSE has been uncertain (i.e. lower latitude boundary of DUSE is still unclear).

The second mid-latitude SuperDARN radar has been operative in Hokkaido since December 2006. The radar was found to be a powerful diagnostic tool for monitoring strom-related high-speed subauroral flow [*Ebihara et al.*, 2007; *Kataoka et al.*, 2007] and some thermospheric waves [*Ishida et al.*, in press]. The radar field-of-view well covers the source of DUSE at the subauroral latitudes, thus is expected to clarify latitudinal distribution of DUSE.

Recently, we have started examining backscatter occurrence statistics from the Hokkaido SuperDARN radar. Consequently, latitudinal distribution of DUSE is clearly visualized. Not only that, other type of dusk side backscatter is newly found (hereinafter we call this echo as "mid-latitude DUSE"). They appeared around the local sunset, which is very similar to the DUSE at the subauroral latitudes. However, the mid-latitude DUSE appears at 10° lower latitude region than the subauroral DUSE. In this paper, we summarize statistical characteristics of DUSEs. Also, possible generation mechanism of the mid-latitude DUSE will be discussed in terms of ionospheric instability process such as gradient-drift instability.

Electric Density Modulation Associated with Pulsating Aurora

- Simultaneous observations with all-sky TV camera and EISCAT in Tromsoe -

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Pulsating auroras are very popular phenomena which are almost always observed during the recovery phase of auroral substorms. Most of the past studies of pulsating aurora claimed that the precipitating high-energy electrons were produced by pitch angle scattering through wave-particle interactions near the equatorial plane of the magnetosphere. Most of the conjugate observations of pulsating aurora, however, demonstrated that pulsating aurora appears in both hemispheres but the shapes are not necessarily the same and the pulsation periods are in many instances different between the two hemispheres, which cannot be explained by the traditional scenario only. *Stenbaek-Nielsen* [1980] proposed active ionospheric processes which probably play an important (not crucial) role in causing pulsating auroras or characterizing their structures. However, the exact role played by the ionosphere is still uncertain. To date, variation of ionospheric electron density, which is one of the most important parameters to describe the conditions of the auroral ionosphere, associated with pulsating aurora has not been investigated.

In order to clarify how electron density structure changes in association with an appearance of pulsating aurora, simultaneous campaign measurement of pulsating aurora with an all-sky TV camera and EISCAT was conducted at Tromsoe (69.6° N, 19.2° E) in March 2008. During the campaign period, EISCAT was operated in CP1 mode with arc1 pulse scheme (minimum integration time for electron density is 0.44 s). Combination of the arc1 pulse scheme and the ground-based optical measurements with an all-sky TV camera (temporal resolution: 1/30 s) enables us to examine rapid variations of the electron density structure associated with pulsating auroras.

During the interval between 0250 and 0330 UT on March 8, 2008, pulsating aurora was continuously observed with all-sky TV camera at Tromsoe. The EISCAT radar observed layer of enhanced electron density at altitudes from 94 to $\approx$ 140 km from the region adjacent to the pulsating aurora. We will report the relationship between the electron density structure inferred from the radar observations and visual pulsating aurora.

極冠域電離圏におけるプラズマ密度の上昇について

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Plasma density increase in the high altitude polar cap

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In general situation, the electron density in the ionosphere decreases with altitude. As for the latitudinal variation, the electron density is generally smaller in the polar cap than in the mid- or low-latitude region. Few reliable measurements have been made to estimate thermal electron density and temperature with a simple instrument such as Langmuir probe in the high-altitude polar cap region. For example, only the limited amount of the electron temperature and density data are available above altitude of 3000 km, where the density is generally less than 2.0×10^3 /cm^3. Since the plasma density significantly correlates with the solar activity, the general density profile becomes smaller for the minimum solar activity period.

Thermal Electron energy Distribution (TED) instrument onboard "AKEBONO" (EXOS-D) satellite is operated in two modes; 1) DC mode to obtain the probe characteristic such as Langmuir probe, 2) SH (second harmonic) mode to estimate the electron energy distribution function based on Druyvesteyn method. In the SH mode, the electron temperature and density can be estimated even on the condition of low electronic density.

On the basis of statistical study of the Akebono observation for over 10 years, it is found that the electron number density occasionally increases up to $3.0\sim4.0\times10^3$ /cm^3 above altitude of 3000 km, where it is usually much smaller than 2.0×10^3 /cm^3 in the polar cap ionosphere. While the electron temperature is believed to be about 8000 K at such a high altitude, the temperature in the high density region is observed to be lower than that by several thousand degrees. It is noticeable that such an enhancement of the electron density is observed along with the occurrence of the geomagnetically active at solar maximum period. The high density region is observed to locally exist somewhere in the polar cap. In addition, it is obvious from the Suprathermal Mass Spectrometer (SMS) observations that the H+ velocity parallel to the upward field aligned direction is observed to be lower than the average at the same altitude. Also it is significant from the Low Energy Particle (LEP) observations that the downward flux of electrons with energy range of 15 - 50eV is smaller compared to that in the adjacent region. Additionally, it is obvious from the Drift Meter (DM) onboard DMSP satellite observations that the anti-sunward convection is observed when the high density region above altitude of 3000km in the polar cap is generated

A characteristic feature of the high density plasma observed in the high-altitude polar cap is summarized as follows:

1) It is more frequently observed on the solar maximum condition.
2) The electron density enhancement is observed during the geomagnetically active period.
3) The high density region is observed to locally exist only in a part of the polar cap region.
4) The electron temperature inside the high density plasma region is lower than the averaged temperature at the same altitude.
5) The H+ ion velocity in the upward field-aligned direction is lower than the averaged velocity at the same altitude.
6) The downward electron flux in the energy range below 50eV is observed to be lower than that in the adjacent region.
7) The anti-sunward convection is observed when the high density region is generated

Such high density plasma in the polar cap may be generated by plasma transport process. We would suggest the possibility as follows: The high density plasma at almost the same altitude in the mid latitude is transported to the polar cap by the anti-sunward convection during the geomagnetically active times, plasma is transported to the polar cap from the dayside of middle latitude. Then, high-density and low-temperature plasma will be observed at high-altitude polar cap. However, number of the high density region generation is very few compared with number of which the anti-sunward convection has occurred. Therefore, it is thought that there is a factor besides the anti-sunward convection.

In the presentation, we discuss the generation mechanism as well as more detailed result of the analysis.

P6

極域電離圏の電子エネルギー収支における沿磁力線電流の影響

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Wlodek Kofman（Laboratoire de Planetologie de Grenoble）
大山 伸一郎, 野澤 悟徳, 藤井 良一（名古屋大学太陽地球環境研究所）

Effect of the field-aligned current on the electron energy budget in the polar ionosphere

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Wlodek Kofman(Laboratoire de Planetologie de Grenoble)
Oyama Shin-ichiro, Satonori Nozawa, Ryoichi Fujii(STEL, Nagoya University)

The electron fluxes precipitating at the top of the high latitude ionosphere contribute to the production of ionization, to the excitation of atmospheric constituents, and to the heating of the ambient electrons directly or by the secondary electrons. The precipitated electrons lose their energy by ionization creating the secondary electrons, by heating of the ambient electrons and neutrals until they are assimilated into the ambient electrons. The heated ambient electrons transport this energy to the neutral gas and ambient ions. As a result, the temperature gradient produced in the ionospheric plasma induces a heat flux. For stationary conditions, the budget equation determines the balance between the heating rate, the cooling rate, and the heat conduction. The electron energy budget in the ionosphere is important for the interaction between ionized and neutral atmosphere and have been studied theoretically, but there is almost no studies based on long, continuous observations.

We estimated the intensity of the cooling rate and the heat conduction quantitatively as a function of altitude in the ionosphere using the European incoherent scatter (EISCAT) radar data and NRLMSIS-2000 model. From the results of the analysis for the disturbed conditions, the region where the heating rate is negative exists because the cooling rate is small compared to the heat conduction. This is caused by neglecting the terms including field-aligned current, such as adiabatic expansion, heat advection and divergence of the electron heat flow. We evaluate these terms quantitatively assuming the field-aligned current in this region, and the result indicates that the downward current of about 10^{-4} A/m^2 is required to achieve a quasi-steady state. In this presentation, we discuss the effects of the processes including field-aligned current on the electron energy budget.

P7

Formation of Cowling channel in the global ionosphere

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Formation of Cowling current system is a fundamental response of Earth's ionosphere, where there existence of Hall current divergence.

In this study we will show that Cowling effect is not a special effect in the auroral and equatorial electrojet regions, but universal mechanism not only qualitative bout also quantitatively important involving in the Sq-current system, connection current system between polar and equatorial ionosphere, thermospheric wind-driven flywheel effect and ionospheric induction effect. Description method of such universal Cowling current system will be also discussed.

P8

VLFエミッションと銀河背景雑音吸収の関連性

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[3]国立極地研究所

The relationship between the VLF emission and the Cosmic Noise Absorption

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The cyclotron resonance interaction between high energy particles and whistler-mode waves generates VLF emissions around the equatorial magnetosphere. At this time, the electrons are pitch-angle scattered. Moreover the precipitating particles would be poured down to the lower-ionosphere, where the degree of ionization rises, thus Cosmic Noise Absorption (CNA) in the ionosphere would increase. Therefore, the VLF emission and the CNA would have positive correlation.

In this study we have analyzed quantitatively relation between the VLF emission and the CNA, by using both ground-based observations of natural VLF waves conducted during the action period of JARE47 near the Syowa station and CNA observed by the imaging riometer at Syowa station, in Antarctica. It is noted that at nighttime the VLF emission of magnetospheric origin cannot penetrate down into the ionosphere caused by the electron density enhancement by aurora, so that we cannot obtain the precise relationship between the VLF activity and the CNA. Therefore, we take only the daytime chorus events. In this presentation, we will discuss the relationship between the VLF emissions and the CNA.

VLFエミッションは磁気圏赤道付近において、高エネルギー粒子と雷放電に起因するホイスラモード波によるサイクロトロン共鳴相互作用が原因で発生するといわれている。このとき、電子から波動へエネルギーが移行する際に、電子のエネルギーは等方的には変化せず、磁力線に垂直な方向のエネルギーは減少し、一方で磁力線に平行な成分のエネルギーは増加する。これによりVLFエミッションの発生時は磁気圏赤道付近の降下粒子が地球電離圏に降下しやすくなると考えられている。そのため、この降下粒子が電離層に降り注ぐと電離層の電離度が上昇し銀河電波雑音の電離層吸収(CNA)が起こる。上記の理由でVLFエミッションとCNAの関連性は正の相関を持つと考えられる。

そこで我々は、JARE47の観測期間中、昭和基地周辺において行われた自然ELF/VLF波動の地上観測と昭和基地のイメージングリオメータで得られたCNAを用いて、VLFエミッションとCNAの関係を定量的に明らかにすることを目指す。ここで注意しなくてはならないのは、極域では夜間にオーロラが発生するため下部電離層の急激な電離により、磁気圏・電離圏起源のVLFエミッションは地上に到達できず、地上観測では検出が不可能なことである。このことを考慮して本解析では昼のコーラスに注目し、CNAとの関係を見出す。

P9

ホイスラモード波の衛星－地上観測結果に基づいた理論伝搬解析

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Theoretical calculation of VLF whistler mode wave propagation based on the satellite – ground observation results

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In order to evaluate polar ionospheric penetration characteristics of VLF whistler mode waves, we conducted simultaneous observations of natural VLF waves by using multipoint ground-based stations in Antarctica and by Akebono satellite during 2006. We can calculate the wave normal vector and the Poynting flux of the natural VLF waves in the ionosphere by using the VLF instruments onboard Akebono satellite above the ground-based stations. The satellite and ground observations showed the possible and impossible situations for the ionospheric penetration of VLF down-going whistler mode wave. The ionospheric penetration depends on the "transmission cone angle", which is calculated by the ionospheric refractive index. However, it is not enough to have the evidence of the ionospheric penetration of VLF whistler mode waves only by the observation results of the wave intensity at an ionospheric altitude and on the ground.

In this study, we try to theoretically calculate the down-going whistler mode wave propagation based on the satellite observation result of the wave normal vector. In general, ray tracing analysis is used for the theoretical calculation of the wave propagation, but it cannot rigorously calculate the wave propagation in our study including the sharp variation of the electron density such as the ionospheric *D*-layer. So, by using full-wave analysis, we theoretically evaluate the ionospheric penetration characteristics of the VLF whistler mode waves. The calculation results strongly indicate that the VLF whistler mode waves simultaneously recorded by Akebono satellite and on the ground station have the wave normal vectors included in the transmission cone angle.

極域電離圏から地上までのホイスラモード波の伝搬過程を詳細に調べるために，我々は JARE47 行動期間中の 2006 年において，昭和基地周辺での自然 VLF 波動の地上多点観測，さらに電離圏を飛翔する科学衛星あけぼのとの同時観測を行っていた．あけぼの衛星搭載の VLF 波動観測装置により，我々は電離圏中の自然 VLF 波動の波動強度，波動伝搬ベクトルやポインティングベクトルを知ることができる．今回我々のあけぼの衛星—地上同時観測の一部には，あけぼの衛星が明らかに VLF エミッションを捕らえているにも関らず，地上観測ではいずれの観測地点でもノイズレベルとなっているようなケース，一方であけぼの衛星と地上で非常によく似た周波数特性で同時観測に成功したケースなど興味深い観測事実が得られた．このようなホイスラモード波に対する電離層透過もしくは非透過の現象は，理論的には電離層屈折率，地球磁場で決まるトランスミッションコーン内に波動伝搬ベクトルが捕捉されるか，されないかで決まる．しかし，ある電離層高度（衛星）で観測された波動が，本当にトランスミッションコーンに捕捉されて下部電離層を突き抜け地上にまで伝搬できたのかを立証するには，衛星－地上観測による波動強度の比較だけでは不十分である．

我々は，あけぼの衛星の VLF 波動観測装置のサブシステムの一つである PFX より，電離層高度で観測されたホイスラモード波の伝搬ベクトルを求め，衛星高度での観測結果を初期値に地上までの伝搬過程の理論計算を行った．波動伝搬路の理論解析にはレイトレーシング解析がよく用いられるが，電離層 D 層などの急激な電子密度が変化する媒質を含む今回の問題においては，レイトレーシング解析は適用できない．我々は，電子密度などの媒質変化を均質な層の集まりとして考え，各均質媒質において Maxwell の方程式を直接解き境界条件で各層の解を接続し不均質媒質中の波動伝搬を解く full-wave 解析を行い，地上までの伝搬過程を理論的に評価した．その結果，あけぼの衛星—地上観測で波動強度の周波数特性が非常に類似したイベントは，確かに電離層高度の波動伝搬ベクトルがトランスミッションコーン内に捕捉され地上にまで伝搬できていたことを強く示唆する結果を得た．本発表では，上記あけぼの衛星－地上観測を元に波動伝搬を理論解析した結果について詳細に報告する．

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北向き IMF 時におけるカスプインジェクション領域の特性

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Characteristics of the cusp injection region for northward IMF

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The Low-Energy Neutral Atom (LENA) imager on the IMAGE spacecraft observes neutral atom emissions in the direction of the high-latitude magnetopause for northward IMF. These emissions have been interpreted to be due to the ion injection from cusp reconnection. We examined relations between the count of these LENA cusp signals and the IMF clock angle. Results of analyses from the events during March – April 2001 show that the injection region tends to be located somewhat on the prenoon side for zero clock angle, i.e., when IMF is purely northward. We discuss the IMF clock angle dependence of the cusp reconnection, and compare with models in previously published papers.

最近の研究により，IMAGE 衛星に搭載された低エネルギー中性粒子撮像観測器（LENA）でカスプのイオンインジェクション領域をリモートセンシングできることがわかってきた．北向き IMF 時におけるカスプのインジェクションは，カスプの極側で起きているリコネクションに起因しており，その場所は IMF の B_y 成分によって変化することがわかっている．すなわち，B_y 成分が正の時には，postnoon 側で起こり，B_y 成分が負になると prenoon 側に移る．しかしながら，IMAGE 衛星の FUV データを用いたカスプのプロトンオーロラの最近の研究［Bobra et al., GRL, 2004］では，B_z>0 かつ By>0 の時には，prenoon から postnoon の広い範囲でリコネクションが起こっていることを示す結果が出ている．一方このデータには，B_z>0 あっても昼間側のリコネクションに起因するプロトンオーロラが含まれていることも示唆されており［Suzuki et al, GRL, 2008］，北向きリコネクション領域の IMF 依存性についてはさらなる研究が必要である．

本研究では 2001 年 3 月から 4 月の間の IMF B_z>0 の期間に同定された LENA カスプイベントの解析を行った．特に，LENA のエミッションのカウントと北向き IMF のクロックアングルの関係を調べた．その結果，クロックアングルが 0° の時のインジェクション領域は Y_{GSM}<0 側に現れる傾向が見られた．Y_{GSM}=0 からずれる意味を過去の研究との関連において考察した結果も報告する．

P11

サブストームに伴う昼側磁気赤道 Pi 2 型地磁気脈動の ICA に基づく定量的評価

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Quantitative evaluations of substorm-associated Pi 2 magnetic pulsations observed at dayside equatorial latitudes by means of ICA

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Recently, *Tokunaga et al.*, [2007] have introduced Independent Component Analysis to analyze Pi 2 pulsations globally observed on the ground. By means of the ICA, we extracted the Pi 2 component whose waveform was coherent with that at auroral latitudes from dayside equatorial region. This fact suggests transient electromagnetic disturbances associated to the substorm can penetrate instantaneously from nightside auroral region to dayside equatorial region via ionosphere. However, it is unclear the coupling system between the regions and therefore more comprehensive statistical research is needed. In this paper, we will analyze substorm-associated Pi 2 pulsations simultaneously observed at THEMIS ground-magnetometer chain and MAGDAS equatorial chain and evaluate quantitatively the effect of substorms at dip-equator by applying ICA.

近年、*Tokunaga et al.*, [2007]は、地上で汎世界的に観測された Pi 2 型地磁気脈動の解析に独立成分分析(ICA)を応用し、昼側磁気赤道域に夜側高緯度帯とコヒーレントな Pi 2 成分が存在することを報告した。この事実は、サブストームに関連して夜側オーロラ帯で発生した突発的な電磁擾乱が、夜側オーロラ帯電離層から昼側磁気赤道域電離層まで瞬時伝搬していることを示唆している。しかしながら、これら２つの領域がどのようなシステムで結合しているのかよく分かっておらず、従ってより包括的・統計的な解析が必要である。磁気赤道域で観測される substorm 起源の磁場変動は微小であるため、信号のパワーに依存しない「統計的独立性」を利用した ICA は、それらを抽出するのに有効な手法といえる。本研究の目的は独立成分分析を含む多変量解析を応用し、オーロラジェット電流の影響がどの程度昼側磁気赤道磁場変動に及んでいるか定量的に評価することで、夜側オーロラ帯から昼側磁気赤道域への電場侵入機構を解明することである。また本研究は、九州大学が磁気赤道沿いに展開している MAGDAS equatorial chain の地上磁場データから、どの程度オーロラ活動をモニタリングできるかを検証するという目的も兼ね備えている。データセットとして2008年4月にTHEMIS Canadian chain の all-sky camera で同定した substorm event に対し、同じく THEMIS の地上磁場観測網および MAGDAS の(磁気赤道域を含む)低緯度観測点で同時観測された Pi 2 event を使用した。講演ではその初期結果について報告する。

P12

極冠電位差非線形発達の Alfven Mach 数依存性

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Alfven Mach number dependence for saturation of the polar cap potential

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Polar cap potential, which is a manifestation of S-M-I coupling, tends to be saturated when the value of the solar wind electric field is high. This non-linear development of S-M-I coupling also shows a dependence of ionospheric conductivity within the polar cap. These characteristics can be interpreted that the development of the region 1 current plays a significant role in regulating polar cap potential [*Siscoe el et al.*, 2002].

From the event study on November 20-21, 2003, we have found that the efficiency of S-M-I coupling decreases rather than that we expected from previous idea, when the Alfven Mach number is less than two. Based on this result, we have done a statistical study for Alfven Mach number dependence of S-M-I coupling using solar wind parameter and PCN index. We have confirmed that the efficiency of S-M-I coupling tend to be low when Alfven Mach number is decreasing. Recently, *Kivelson and Ridley* [2008] tries to explain the saturation of the polar cap potential from the point of view from Alfven wing arguments. We will examine whether the Alfven Mach number dependence can be explained by this idea.

太陽風－磁気圏－電離圏複合系の基本過程である磁気圏対流（極冠電位差）は、ICME 等の到来に伴う強い太陽風電場に対しては非線形に応答し、その発達が頭打ちとなること、及び極冠域の電離層電気伝導度の大きさに依存して発達の効率が変化することが観測的に明らかになってきている [*Nagatsuma*, 2002, 2004]。この事実の解釈として、*Siscoe et al.*, [2002]が示すように Region 1 電流系の発達が dayside merging の効率を変化させ、極冠電位差の発達を抑制しているという考え方があり、この考え方と我々の結果は概ね整合している。しかしながら、Alfven Mach 数が低い時に、更に極冠電位差の発達の効率が低下する傾向があることが 2003 年 11 月の地磁気嵐のイベント解析で示されている[*Nagatsuma et al.*, 2008]。

極冠電位差の非線形発達の Alfven mach 数依存性を調べるために、PCN 指数を用いた統計解析を行った。PCN 指数は極冠電位差と良い対応関係があり、長期間にわたるデータセットが利用できるという利点がある。その結果、一定の太陽風電場を与えた場合の極冠電位差(PCN 指数)の Alfven Mach 数依存性は、Alfven Mach 数が小さくなるにつれて、極冠電位差の値が小さくなる傾向があることが示された。このため、従来の太陽風電場が強まると極冠電位差の発達が頭打ちになることに加え、Alfven Mach 数の低下によっても太陽風－磁気圏－電離圏相互作用の効率が低下していることが明らかになりつつある。

また最近、*Kivelson and Ridley* [2008]は非磁化天体と太陽風の相互作用で生成される Alfven wing の考え方を適用した新しい極冠電位差のサチュレーションの説明を試みている。この説明の妥当性について検討した結果についても紹介する。

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リアルタイムTECマップによる宇宙天気モニタリング

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Space Weather Monitoring with TEC maps

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The world-wide use of global navigation satellite system such as GPS offers the unique chance for a permanent monitoring of the total electron content (TEC) of the ionosphere. We have developed a system of rapid derivation of TEC from GEONET (a dense GPS receiver network in Japan). We use a plot of TEC temporal variation over Japan and two-dimensional TEC map developed recently in our daily operation of Space Weather Forecast Center at NICT (Regional Warning Center Tokyo of International Space Environment Service). The system has a capability of monitoring the ionospheric disturbances over Japan, including spatial and temporal development of ionospheric storms, large-amplitude TID, and unusual extension of equatorial anomaly and plasma bubbles in it. We are now ready for large ionospheric disturbances expected in the next solar maximum. The plot and maps are open for public and are available at http://wdc.nict.go.jp/IONO/index_E.html.

P14

Three-Dimensional Distribution of the Ionospheric Electric Potentials Determined by a Global MHD Simulation

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In recent global MHD simulations of Earth's magnetosphere, the ionosphere is treated as a thin layer. The purpose of this study is to determine the three-dimensional distribution of the ionospheric electric potential. In this study, a solver of the three-dimensional distribution of the ionospheric electric potential is adopted in the M-I coupling process of the numerical MHD scheme developed by Tanaka (1995). The electric potential is determined from field-aligned currents mapped from the inner boundary of the magnetosphere and the ionospheric conductivity distribution. The horizontal distributions of FAC and the ionospheric conductivity are determined by the global MHD simulation. It is assumed that the height profile of the ionospheric conductivity is proportional to that determined by IRI and MSIS models. The calculation area covers the polar region which expands 40 degrees in colatitude. At the side surface boundaries, the gradients of the potential perpendicular to the surfaces are zero. As for the lower boundary condition, the horizontal potential maps determined by the original global simulation scheme are applied to the lower boundary. The altitudes of upper and lower boundaries are 400 km and 80 km, respectively.

In this presentation, we examine the variation of M-I system due to southward turning of northward IMF. It is found that cross polarcap potential is almost constant in all altitude except around the lower boundary. In addition, the divergence of the Pedersen current is larger than that of the Hall current although the intensity of the Hall current is much higher than that of the Pedersen current. This means that the parallel currents are mainly connected to the Pedersen currents. Since the vertical profile of the potential is affected by those of the conductivities, it is important to estimate the exact height profiles of the conductivities. It would be more realistic if the distribution of the ionospheric conductivities is improved.

Global MHD シミュレーションによる地磁気共役点位置の時間的トレース

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Temporal trace of geomagnetic conjugate point by a global MHD simulation

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It is generally considered that the auroral particle guided along the geomagnetic field lines falls to Earth's atmosphere. Thus we can expect that nightside auroras appear simultaneously at both the conjugate points. However, simultaneous observations in both the hemispheres have shown that auroras do not always appear at the predicted conjugate pointes..

Previous observations [e.g., Sato et al., 1998; Østgaard et al., 2005] have shown that the IMF penetrates the magnetotail and that IMF orientation affects the location of the nightside aurora. Østgaard et al. [2005] have demonstrated that IMF orientation act as the main controlling factor of the relative displacement of the aurora in the conjugate hemispheres on the statistical basis. Comparing their results with the displacement predicted by empirical magnetospheric models (T96, & T02), these models have indicated a strong observational support, but underestimated this effect by an order of magnitude. The distortion of the magnetospheric magnetic field line geometry by the penetrated IMF By is inversely proportional to the strength of the ambient geomagnetic field. The geomagnetic field lines extended from active auroral arc are most likely mapped into the transient regions of low magnetic field. These transient and spatially localized substorm-related depressions of B are not adequately reproduced by these models.

In this study, we tried to trace geomagnetic conjugate points on a global MHD simulation model. In the future, this allows us to replicate more precisely the IMF induced asymmetries.

地球磁気圏の磁力線に沿って動く性質を持つ荷電粒子は、赤道域から磁力線沿いに地球大気に到達して大気中の分子に衝突し発光させることでオーロラ現象を発生させる。そのため、磁力線で結ばれた南北両半球上の地点（地磁気共役点）から、対称的な形のオーロラが同時に観測されると一般的に考えられている。

しかし、地磁気共役点からは形や動き、出現領域が一致しないオーロラも多く観測されている。こうしたオーロラの非共役性を生む主要な要因の１つとして、地磁気共役点位置の変動が考えられる。Sato et al.[1998]やØstgaard et al.[2005]らは、惑星間空間磁場（Interplanetary Magnetic Field；以下IMF）の地球磁場に対する傾きとオーロラの発生位置の関係について議論している。オーロラ発生位置のIMFの傾きに対する相関性について、地磁気共役点からの同時観測による統計結果と、経験的な地球磁気圏モデル（Tsyganenko model; T96, T02）を比較したところ、IMFの傾きに対する共役点位置の移動傾向は同じだが、モデルから見積もられた相関性は観測による統計結果の1/10にとどまった（Østgaard et al., 2005)。オーロラ発生領域の磁力線は非常に磁場の低い過渡的な領域に分布し、サブストームのように過渡的に局所化された現象は経験値モデルでは再現不可能であろうと考えられる。

本講演では、IMFに対する地磁気共役点の移動をより正確に再現するための先行研究として、Global MHDシミュレーションから太陽風による地球磁気圏形成を再現し地球磁気圏へのIMFの侵入による地磁気共役点位置の変動の定量的見積もりを試みた結果について報告する。

P16

Time evolution of three-dimensional spatial structure of beam instabilities

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To explore and utilize the geospace environment efficiently, it is very important to understand interactions between spacecrafts and electromagnetic environment around themselves. Recently, influences of spacecrafts on space electromagnetic environment are gradually increasing due to new space technologies such as ion engines used in various spacecrafts. When the ion engine emit a large quantity of accelerated heavy ions into the space, these heavy ion beams interact with space plasmas around the spacecraft, which can excite various kind of beam instabilities and plasma waves. These kind of beam instabilites and plasma waves become serious noises in observing electromagnetic environment in space by scientific satellites. In addition, electron beam instabilities are also important in space plasma. According to our PIC simulations, ESW(Electrostatic Solitary Wave) is generated due to electron beam instabilities. We know ESW is composing the upper frequency part of BEN(Broadband Electrostatic noise) which is frequently observed in space plasma. The generation mechanism of the lower frequency part of BEN, however, is still unexplained. To clarify whether such low frequency waves are generated by electron beam instabilities, we have to perform a series of long-term simulations of beam instabilities with different parameters, and observe time evolutions of these beam instabilities.

In order to investigate time evolutions of beam instabilities, we are performing three-dimensional computer experiments of beam instabilities, and demonstrate nonlinear evolutions of beam instabilities, in time as well as in space. Simulation study of beam instabilities are difficult because these instabilities are very sensitive to numerical thermal noises in full-particle simulations. We developed, therefore, three-dimensional particle simulation code which is specialized to parallel computing on large-scale super computers. In the present study, we perform three-dimensional particle simulations of the most fundamental beam instabilities excited by a spatially uniform beam at first. Next, we perform simulations of localized beam instabilities excited by a spatially localized beam particles, and investigate on the interaction between beam particles and space electromagnetic environment. Especially, we focus on the spatial characteristics on the perpendicular plane against the ambient magnetic field. In analyzing time evolutions of three-dimensional spatial structure of potential, electric fields, magnetic fields, electron densities, etc., it is essential how to visualize these three-dimensional spatial structures. We are developing various visualization tools for three-dimensional spatial structures with using AVS. With our visualization tools, we can see spatial structures with stereoscopic vision, in addition can observe their time evolutions in animation. These visualization tools are useful to analyze time evolutions of three-dimensional spatial structures of various phsical parameters.

磁気異常帯およびその関連域でのリオメータ観測

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Riomter observation at Brazilian Geomagnetic Anomaly and its related region

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In order to study the characteristics of particle precipitation in the Brazilian Geomagnetic Anomaly Region (the South Atlantic Anomaly.), riometer observation was carried out in Brazil, Chile and Japan since 2000. Recently, single beam riometer was also installed at Trelew, Argentina(43° 16′ S, 65° 23′ W) for development of multiple point observations. In the next February 2009, we are planning to install imaging riometer at Trelew where is the middle point between Southern Space Observatory, Brazil and Punta Arenas, Chile. Since the observed riometer data at Trelew showed a good quality, so we also expect to obtain a good imaging riometer data in this region.

On the other hands, we recently started new observation for examining the polarization of 38.2MHz wave at geomagnetic observatory, Kakioka. So far, we did not observe the polarization of cosmic noise. From 38.2MHz polarization data at Kakioka, cosmic noise showed almost the linear polarization (Fig.1). However, we consider that a part of 38.2MHz wave may show the right or left hand polarization, if such wave is excited by electron or proton through synchrotron radiation near the earth. We intend to install also this polarization detector at Brazilian geomagnetic anomaly region and distinguish between cosmic noise and emissions associated with particle excitation.

In this paper, we also showed the observation results of imaging riometer at the South America and Kakioka during the storm period. On the basis of imaging riometer data, we examined F-region disturbances at mid latitude. We developed new data analysis program for calculating cosmic noise absorption (CNA) more easily. We are also constructing homepage of South America Riometer Network (SARINET) for publicity of riometer data. We hope many scientists will use SARINET data for study of the Brazilian Geomagnetic Anomaly Region.

2008 / 06 / 14

Kakioka

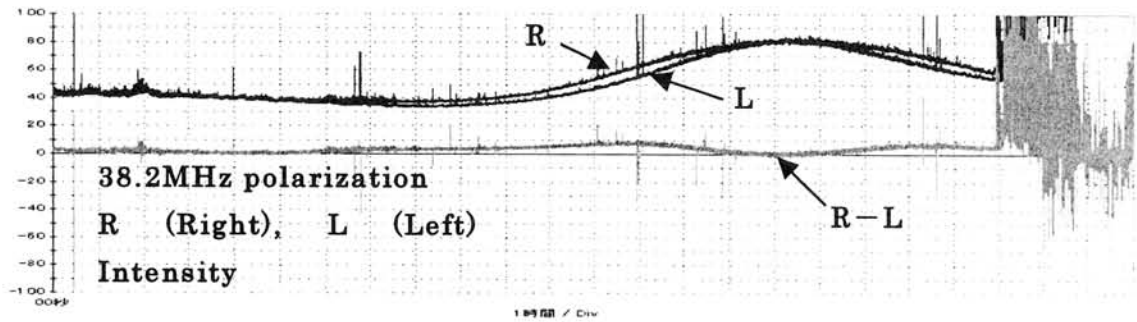

Fig 1

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太陽プロトン現象時の2周波イメージングリオメータ観測から求めた吸収スペクトル指数の変化特性

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Changes of spectral index of absorption observed by two-frequency imaging riometers at the time of solar proton event

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We have been monitoring spacial distribution of energetic particle precipitation at Syowa Station, Antarctica (69.0°S, 36.6°E, L=6.1), using two imaging riometers operated at 30.0 and 38.2 MHz. Spectral index of absorption "n", obtained from $A_{30}/A_{38}=(38.2/30)^n$, where A_{38} and A_{30} are absorption rate observed at 38.2MHz and 30MHz, usually equals to 2 when the absorption layer is formed above 80 km where collisional effect between neutral atom and electron is relatively small. However, if the energy spectrum of precipitation is very hard, absorption layer can be formed well below 70 km, and n becomes smaller than 2 due to increased collisional effect in this altitude range. The spectral index is therefore useful to detect very energetic precipitations such as those observed at solar proton events. However, we must be careful that n can be smaller than 2 by an apparent effect for a localized absorption whose spatial extent is comparable to, or smaller than, the antenna beam width, as pointed out by Rosenberg et al. (1991).

南極昭和基地では、30MHzと38.2MHzイメージングリオメータにより、高エネルギー粒子降り込みの空間分布をモニターしている。ソーラープロトン現象のようにMeV帯の高エネルギー粒子降り込みがあると、吸収層が通常よりも低高度(60~70km付近)に形成され、多周波で観測すると観測周波数により吸収量の変化がみられることが期待される。そこから導かれる吸収スペクトル指数の変化から、高エネルギー粒子の降込みの空間構造などを調べることができるであろう。しかし、それぞれの周波数でのアンテナビームを吸収領域がどの程度覆うかにより、吸収スペクトル指数の変化は見掛け上変化してしまう。このため、吸収層の広がりがイメージングリオメータのアンテナビームよりも十分広いと考えられる吸収イベントに対して、吸収スペクトル指数を求めた。南極昭和基地の30MHz、38.2MHzのイメージングリオメータでは、ビーム配列が2周波で異なるため、それぞれのイメージングリオメータについて、各ビームの指向性が最大となる点を70km高度へ投影し、両アンテナの視野が重なり合う100km×100kmの範囲において20×20点で内挿を行い、その中央付近の領域において吸収スペクトル指数を求めた。その結果2005年1月17日のソーラープロトンイベント時、14時UTから、翌日22時UTまで吸収スペクトル指数が通常の値である2よりも小さくなる現象が見られた。このとき、静止軌道衛星GOESの高エネルギー粒子(10MeVプロトンフラックス)も10^2/cm^2/s/sr以上と大きな値であった。そのため、高エネルギー粒子の降り込みによる低高度電離により、吸収スペクトル指数が通常の値よりも小さくなったと考えられる。またこのとき、サブストームも発生していた。そのため、高エネルギー粒子の寄与による吸収スペクトル指数の変化についての検証を行うため、GOES衛星の高エネルギー粒子観測データから計算によって吸収スペクトル指数を求め　観測結果との比較を行った。

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大磁気嵐に伴う夜側高緯度電離圏電子密度上昇とイオン上昇流
— EISCAT レーダーで観測した 2003 年 11 月 20 日イベント —（2）

宮岡　宏、小川泰信、麻生武彦（極地研）、野澤悟徳（名大・太陽地球環境研）

EISCAT radar observation of positive storm effect and ion upflow in the pre-midnight polar ionosphere associated with the superstorm on 20 November 2003 (2)

Hiroshi Miyaoka, Yasunobu Ogawa, Takehiko Aso (NIPR) amd Satonori Nozawa (STE Lab./Nagoya Univ.)

EISCAT/UHF radar data and optical aurora observations are coordinately analyzed to investigate positive ionospheric storm effects and the ion upflow in the dusk to pre-midnight sector F-region in the polar cap during the super storm on 20 November 2003.

磁気嵐は、大規模電場や荷電粒子の降り込みなどを通して電離圏、熱圏・中間圏領域に大きな影響を及ぼしている。特に電離圏内では、古くから「電離圏嵐」として様々な擾乱現象が報告されているが、同じ磁気嵐でも観測する緯度、地方時、高度により、その応答は多様であることが知られている。 中・低緯度や昼側カスプ域近傍における電離圏応答に関してはこれまでも多くの観測や解析研究が行われているが、高緯度（極冠域）夜側の電離圏については現象間の因果関係や物理過程についても依然多くの課題が残されている。

2003年11月20日に発生した磁気嵐は、最小Dst −472nTを記録し、史上最大級の大磁気嵐となった。その主相を含む時間帯にノルウェー・トロムソ観測所（磁気緯度66.2° ）において、EISCAT/UHFレーダーと光学機器によるオーロラ特別観測を実施しており、この大磁気嵐に伴う高緯度電離圏擾乱の様相を広い高度領域にわたり詳細に観測することに成功した。UHFレーダーでは、磁気天頂方向に固定したレーダービームに沿って、電子密度、電子温度、イオン温度、イオン速度を高い時間・高度分解能で計測した。観測された現象の主な特徴は、次の通りである。

- 高度 300km～700km 以上で 10^{12} m^{-3} を越える電子密度の急増（継続時間： 約 2 時間 40 分）
- イオン温度上昇およびイオン上昇流（～200m/s）を伴う
- DMSP 衛星粒子データより、粒子降下のない極冠域に対応
- 赤いオーロラが低緯度側（オーロラオーバル）で発生
- SuperDarnデータより、強い反太陽方向のプラズマ対流に同期

同時観測データの解析から、この広い高度領域にわたる特異な電子密度の急増現象は、磁気嵐中の強いプラズマ対流に伴い、昼側電離圏から極冠域に流出した高電子密度領域（電離パッチ）を観測した可能性が高いと考えられる。これらの電離圏擾乱の成因について詳しく議論する。

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昭和基地地上観測およびDMSP衛星データによるオーロラストリーマーのダイナミクス

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Dynamical feature of auroral streamers observed by ground-based aurora camera and DMSP satellite at Syowa Station, Antarctica

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The DMSP/OLS auroral images with a spatial resolution of 2.75km have been continuously accumulated since 1997 at Syowa Station (69.0S, 39.6E), Antarctica. In spite of the poor time resolution of OLS(15-20min/picture), multiple N-S auroral streamers with narrow longitudinal scale-size are identified clearly around the nightside auroral oval during disturbed magnetospheric conditions. Omega-bands and/or torch are also identified as large-scale wavy structures occasionally appeared on the poleward boundary of the diffuse auroral region in the midnight/morning sectors.

We present here characteristic features of multiple N-S auroral streamers based on high-resolution auroral images from the DMSP satellites, all-sky camera recorded at Syowa Station. Torch structures are found strongly enhanced during the period of a magnetic storm, and the activations in cases spatially correspond to multiple N-S auroral streamers moving equatorward from high latitudes.

High time resolution measurements of auroral breakup with all-sky TV camera and SuperDARN over Iceland

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アイスランドにおけるSuperDARNと全天TVカメラを用いたオーロラ爆発の高時間分解能観測

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Simultaneous measurements of fine-scale auroral structure with all-sky TV camera at Tjornes (66.20N, 17.12W) in Iceland and SuperDARN Iceland East radar (63.77N, 20.54W) were conducted in September 2006. On two nights during the campaign (September 23 and 24), clear poleward expansions were observed by the ATV and SuperDARN simultaneously. We report here the spatial relationship between the background electric field structure inferred from the radar observations and visual aurora forms.

2006年9月19日から27日の9日間、アイスランドにおいて、SuperDARN (Super Dual Auroral Radar Network) レーダーと全天TVカメラ (ATV) を用いたオーロラ微細構造のキャンペーン観測を実施した。Tjornes (北緯 66.20 度 , 西経 17.12 度) において、ATVによる可視オーロラの高時間分解能観測を行い、同時にSuperDARN Iceland East レーダー (北緯 63.77 度, 西経 20.54 度) では、E 特別領域モード (Stereo Myopic モード) による特別観測を実施した。このStereo Myopic モードは、時間分解能 2 秒、空間分解能 15 km × 15 km で近距離レンジから到来する E 領域エコーを重点的に観測するものである。F 領域通常観測モード (時間分解能 7 秒 , 空間分解能 45 km × 45 km) よりもはるかに高い時空間分解能でオーロラからの散乱波を得ることができるため、変化の速いオーロラ現象 (ブレイクアップに伴う極方向伝搬など) の背景にある電場変動を明らかにすることが可能となった。9日間の観測期間中、23日、24日の2晩において、オーロラ活動が激しい時間帯に、オーロラに伴う E 領域プラズマイレギュラリティからの散乱エコーを得ることができた。通常、極方向伝搬時などオーロラ活動が激しいときには、高いエネルギーの降下粒子が D 領域まで到達し異常電離を引き起こすため、レーダー電波が吸収されてしまい (ブラックアウト)、散乱ターゲットである E 領域イレギュラリティまで電波を到達させることができない。しかし、今回紹介する2例に関しては、レーダーサイトの直上を避けるようにしてオーロラが発生したため、オーロラ粒子が降り注ぐ領域をその低緯度側から観測することができた。オーロラ爆発時の E 領域エコーを捉えた貴重なイベントと言えるだろう。今回の発表では、このオーロラ爆発時のレーダー観測が示す複雑な電場構造と、ATVによって捉えられた激しく変化するオーロラの空間構造を直接比較した結果を報告する予定である。

P22

一般化オーロラトモグラフィ法の再構成アルゴリズムの比較

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田邉國士（早稲田大学）、門倉昭（極地研）、小川泰信（極地研）

Comparison of reconstruction algorithm for the Generalized Computed Aurora Tomography

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Kunio Tanabe (Waseda University), Akira Kadokura (NIPR), and Yasunobu Ogawa (NIPR)

We have developed the Generalized - Aurora Computed Tomography (G-ACT). The G-ACT is a method to reconstruct incident auroral electrons from a variety of observational data, such as auroral monochromatic images taken from multi-station camera network, electron density enhancement from the EISCAT radar, and cosmic noise absorption (CNA) from imaging riometer. Since recent observations are conducted with various instruments, the G-ACT is expected to become an important analytical method in the near future.

The feasibility of the G-ACT has been tested by numerical simulation. Assuming the spatial and energetic distributions of incident electrons at 300 km over the EISCAT radar site, we solved the forward problem and obtained the observational data. The incident electrons were reconstructed from the observational data by Bayesian inversion method. The results from this study indicated that the incident electrons can be nearly reconstructed using the multiple auroral images and the EISCAT electron density profile.

However, there still remain some problems in this method, for example, it is difficult to retrieve the electrons with energies lower than 1keV. These problems strongly depend on the reconstruction algorithm. In order to find the optimal algorithm for the G-ACT, we compare some algorithms such as the CG (Conjugate Gradient) method, SIRT (Simultaneous Iterative Reconstruction Technique), and the Gauss-Newton method for the nonlinear least squares problem with the nonnegative constraints.

我々は、現在、一般化オーロラトモグラフィ（Generalized Aurora Computed Tomography: G-ACT）の開発を進めている。一般化オーロラトモグラフィとは、多点観測網で得られたオーロラ 2 次元画像や、EISCAT レーダー観測による電子密度増加、イメージング・リオメータ観測による銀河雑音吸収（CNA）等の複数の異種のデータを融合させて、オーロラ入射電子を再構成する手法である。近年、複数の観測装置によるオーロラの総合観測が主流になっていることから、この手法は、将来的に重要な解析手法となることが期待される。

この一般化オーロラトモグラフィの可能性を調べるために、数値シミュレーションによるテストを行ってきた。まず、高度 300km における入射電子の空間・エネルギー分布を仮定して順問題を解き、模擬的な観測データを得た。得られた模擬的な観測データからベイズ推定を利用して逆問題を解き、入射電子フラックスの再構成を行った。その結果、ALIS オーロラ画像と EISCAT レーダー電子密度高度分布を組み合わせた場合には、ある程度良い再構成ができることを確認した。

しかしながら、現時点では、入射電子の特性エネルギーが 1keV より低いときには電子フラックスがうまく再構成できないといったいくつかの問題点も残っている。このような再構成の良否は、再構成アルゴリズムに強く依存する。そこで、再構成アルゴリズムとして、共役勾配法や SIRT（Simultaneous Iterative Reconstruction Technique）法を使用した場合、さらに、電子フラックスの非負条件を加え非線形最小化問題に対してガウス・ニュートン法を使用した場合等について試し、一般化オーロラトモグラフィに最適な再構成アルゴリズムについて検討する。

れいめい衛星で観測したオーロラ微細構造形成

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Auroral fine-scale structures observed by REIMEI satellite

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Optical fine-scale structures in auroral arcs often drift toward arc-aligned direction. In northern hemisphere, most of the structures in poleward arc move eastward, and those of equatorward arc move westward. These directions are consistent with directions of ExB drift, when U-shaped potential structure is assumed above the arcs.

Electron acceleration in field-aligned direction due to dispersive Alfven waves is considered to be one of mechanisms to generate fine-scale optical auroral emissions. Numerical simulations show that the dispersive Alfven waves can make energy-time dispersions of precipitating electrons. We selected events of the electron energy-time dispersions from Reimei data set and examined drift directions of the auroral arcs at geomagnetic footprint.

We will present results of statistical analysis on the plasma structures related with the dispersive Alfven waves and correspond-

ing optical auroral emissions. More than 70% of the selected period, which contain electron energy-time dispersions, have auroral arcs with fast flow of fine-scale structures at the footprint. When acceleration altitude is estimated with the energy-time dispersions, source altitudes of electrons are calculated to be 1400-6200km. Furthermore we calculated the velocity vector of optical fine-scale structures in auroral arcs by using cross-correlation method. Calculated velocities are 5-25km/s, which are much faster than typical drift velocity of ionospheric plasmas. Instead, these velocities are approximately agree with the order of ExB drift speed at the source region, indicating that the flows are produced by plasma motions in the source region.

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Search for the source regions of precipitating electrons which generate pulsating aurora based on REIMEI observations.

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Pulsating aurora is a phenomenon which shows periodic emission variation in diffuse aurora. The emission is characterized by not sinusoidal change but pulsation, and its typical period ranges from a few seconds to a few tens of seconds. Energy range of precipitating electrons which generate pulsating aurora was estimated from a rocket observation by Sandahl et al., [1980]. Because pulsating aurora appears in diffuse aurora, electrons are thought to undergo cyclotron resonance with whistler mode waves in the equatorial region of the magnetosphere and to precipitate into Earth's upper atmosphere by pitch angle scattering. This concept is widely accepted, but there is a few demonstration by observation in past. Sato et al., [2004] recently suggested that the source region of pulsating aurora is located earthward, far from the equatorial plane, raising a question about the source region of pulsating aurora.

The purpose of this study is to search for the source regions of pulsating aurora using simultaneous image and particle observation data from REIMEI satellite in statistical basis. A great advantage of REIMEI is simultaneous observation of aurora image and particle flux by attitude control that makes it possible to point the field of view of Multi-spectral Aurora Camera (MAC) to a footprint of magnetic field line threading the satellite. We used mainly MAC and Electron/Ion energy Spectrum Analyzer (E/ISA) in this study. MAC takes a picture with three wavelengths; 427.8 (N_2^+ 1st Negative Band), 557.7 (O Green line) and 670.0 (N_2 1st Positive Band) nm. The field of view is 7.6 degrees and the time and spatial resolution are 120 ms and 1 km, respectively. E/ISA is top-hat type electrostatic analyzer with energy range from 10 eV to 12 keV and time resolution of 40 ms. In observation of pulsating aurora, energy dispersion of electron flux associated with pulsating aurora is seen. From the difference of energy and time, we carried out Time of Flight analysis and calculated a distance of the source region from REIMEI. The distance was traced along a magnetic field line using Tsyganenko-89 model and the source regions were identified.

We analyzed 15 paths from November 2005 to November 2007 and 39 source regions were identified. The results revealed that the source regions are not necessarily located close to the equatorial plane but distribute continuously in an extent of 30 degrees from the equatorial plane. Because the source regions are almost correspondent to the where of chorus occurrence, we think that chorus plays an important role in a pulsating aurora through wave-particle interactions such as a cyclotron resonance. In order to examine the results, we carried out numerical calculation for linear cyclotron resonance between Lower-band chorus and electrons. As a result, the energy satisfying the resonance condition in a source region ($0 < \lambda m < 30$) ranges from a few keV to about 100 keV. This suggests the resonance occurs in the equatorial region and supports the model that pulsating aurora is produced near the equatorial region by interactions between whistler mode waves and electrons.

P25

Antarctic optical observations of dayside aurora during a geomagnetic sudden commencement

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Ground observations of the optical aurora in the cusp region have the distinct advantages of continuity of coverage and sufficient temporal-spatial sensitivity to monitor dayside signatures of solar wind/magnetosphere/ionosphere interaction mechanisms.

In this paper, we present a case study of dayside aurora during a geomagnetic sudden commencement (SC) on 17 August 2003, using Antarctic ground-based optical observations. According to data from the ACE satellite, an interplanetary (IP) shock was recorded at 1341 UT. This IP shock took place following a long period (over 12 hours) of positive IMF Bz (5~8 nT) and zero or weak negative By (-5~0 nT). After the IP shock, IMF Bz dramatically increased to about 15 nT and IMF By decreased to about -15 nT. The low-latitude ground magnetograms indicated that an SC occurred at 1421 UT. Before the SC onset, the all-sky imager operated at the South Pole Station (geographic latitude = -90.00, geomagnetic latitude (GMLat) = -74.02) showed a weak emission of 557.7 nm localized latitudinally around the pre-noon (-75~-77 GMLat). At 1421:45 UT near the SC onset, the all-sky imager at the South Pole Station detected a sudden enhancement of the 557.7 nm emission over a wide latitude rage from the auroral zone to the polar cap. At this time the strongest emission was seen at almost the same latitudes as the pre-SC 557.7 nm emission. The intensity of the SC-related 557.7 nm emission reached a peak about 2 minutes (1423:27 UT) after the SC onset. In addition, we found that an isolated bright area appeared at -73~-75 GMLat in the 10.5~11.5 MLT sector. After 1428 UT, the 557.7 nm emission at equatorward latitudes of -75 GMLat weakened or disappeared. On the other hand, although the auroral emissions in the pre-noon cusp or higher latitudes slightly weakened around 1427~1428 UT, their intensity was higher than the pre-SC level by a factor of 2~3. In this talk, we will discuss generation mechanism for explaining ground-based optical features of the SC-related dayside aurora by comparing them with other ground-based and satellite-based observations.

P26

昭和基地、Hermanus、柿岡における地磁気活動の日・季節・年々変動

吉田明夫（総合研究大学院大学）

Diurnal, Seasonal and year to year variations in geomagnetic activity at Syowa Station, Hermanus and Kakioka

Akio Yoshida (The Graduate University for Advanced Studies)

Diurnal, seasonal and year to year variations in geomagnetic activities at Syowa Station, Hermanus and Kakioka are studied based on *K* indices. In carrying out the analyses we converted the *K* index to the *am*-like index that represents amplitude of the geomagnetic disturbance in a linear scale.
We found that the yearly average at Syowa Station has been increasing relative to the *am* index. The increase is especially distinct at day time in the summer season in the Antarctica. On the other hand a relative decrease is seen for the geomagnetic activity at Hermanus till mid 1980s. No secular change is observed at Kakioka.
Year to year variations in the geomagnetic activity are alike for all Stations. Interestingly, a clear 11-year variation is seen in the ratio between Syowa Station and *am*, where the maximums in the ratio correspond to the minimums in the Sunspot number.
The diurnal and monthly changes in the magnetic disturbance at Hermanus and Kakioka are nearly the same as those in the *am* index. On the other hand, the seasonal variation at Syowa Station, especially at the day time, differs apparently from that in *am* by showing maximums in January and November. Probably, the dominant factor in making the seasonal variation in the geomagnetic activity in day time at Syowa Station is the change in the conductivity in the ionosphere, not the equinoctial and Russell-McPherron effects..

南極の昭和基地、Hermanus、柿岡で観測された *K* index を基に、地磁気擾乱の日、季節、年々変動を調べ、相互に比較を行った。レファレンスとして *am* index を用いた。解析にあたっては、それぞれの観測点について、*K* index から *am* index に相当する磁気擾乱の振幅を表す指数に変換し、日、月、年平均値を求める際には、それを用いた。
am index の年平均値と比較すると、昭和基地では特に昼の時間帯で磁気擾乱が相対的に年々増大してきている様子が見える。一方、Hermnus では逆に 1980 年代半ばまで、*am* に相対的に減少している。これに対して柿岡では一定方向への継続的な変化は見られない。昭和基地での磁気擾乱の経年的な増大は、南極の初夏から夏にかけての季節で明瞭である。
各観測点の地磁気擾乱強度の年々変動は *am* での年々変動と似ている。ただし、年平均値について *am* との比をとると、昭和基地の夜及び Hermanus の昼の時間帯で、太陽活動の 11 年周期変動と同期した変動が、特に 1980 年代以降、明瞭に見られる。その周期変動の位相は、磁気擾乱自体の変動とは異なって、むしろ太陽黒点の周期変動の位相と合っている。その位相は昭和基地と Hermanus では逆で、昭和基地の夜の場合、比の極大は黒点数の極小に対応する。
昭和基地の観測データが存在する 1966 年以降の 41 年間における各観測点の日、月平均値の分布パターンを、同じ期間の *am* index のそれと比べると、Hermanus、柿岡は *am* とほぼ似ているのに対して、昭和基地では、昼間の時間帯において擾乱が最大となる月が、春では 1 月に、秋では 11 月にずれて、見かけ上かなり様相が異なる。高緯度における昼間時での季節変化には、equinoctial effect や Russell and McPherron effect よりも電離層の電気伝導度の年変化の影響が大きく出ていると考えられる。

2007年の地磁気活動は次の太陽黒点サイクル24の振幅がそれほど大きくならないことを示す

吉田明夫（総合研究大学院大学）

Geomagnetic activity in 2007 indicates rather small amplitude for the next sunspot cycle 24

Akio Yoshida (The Graduate University for Advanced Studies)

Geomagnetic activity in the declining phase of a sunspot cycle has been shown to be a good indicator for the maximum sunspot number of the next cycle. Based on the empirical relationship we estimate the sunspot maximum in the next cycle to be around 122 regarding the geomagnetic activity in 2007 as the minimum in the preceding cycle. This figure is considerably smaller than the previous estimates that were derived by using similar methods. If the notable decrease of the interplanetary magnetic field in recent years is taken into consideration, it is further supposed the level of solar activity during the following cycle would be still lower.

地磁気活動は太陽活動サイクルに伴って変化する。地磁気活動がそのサイクルの中で極大を示す時期は太陽黒点数が極大となる時より２～３年遅れるが、極小となるときは、ほぼ黒点数が極小となる時期に一致する。地磁気活動の強さは、その時の太陽活動、より直接的には太陽風に大きな影響を受け、その変動は太陽風の速度とその中の磁場、特に地球の双極子磁場と逆向きの磁場の成分の大きさの変動によって決まるといってよい。その意味で、リアルタイム的には太陽風の状況を事前に知ることができれば、それが地球に到達するときの磁気擾乱の強さを予測することが可能である。この意味での宇宙天気予測の研究が現在、精力的に進められているが、興味深いことに、これとは逆の関係、すなわち地磁気活動の強さが次のサイクルの太陽黒点数の極大値と良い相関を示すことが経験的に知られている。その物理的意味は未解明であるが、そうした経験則を用いた太陽活動の予測は、宇宙天気の中・長期予測ともなることから、これまで多くの研究が行われてきた。
磁気活動の極大が太陽黒点の極大に遅れるのは、強い磁気擾乱の原因として、太陽の活動域で発生する爆発現象のほかにコロナ・ホールからの高速風があるためで、この後者によって生じる磁気活動の強さが、次の太陽活動の強さと関係すると考えられている。観測される磁気活動から、コロナ・ホールからの高速風に起因する成分を分離して取り出すのは簡単ではないが、いくつか試みがあって、例えばサイクル23の磁気活動を基に、サイクル24の最大黒点数としてHathaway and Wilson (2006) は160、Kane (2007) は142の予測値を提示している。2007年に磁気活動が前サイクルで最小を示したことから、その値を用いてサイクル24の太陽黒点数の最大値を推定すると122となる。この値自体、上記の予測値よりも小さいが、2006年、2007年の惑星間空間磁場がその前の極小期における惑星間空間磁場に比べて著しく小さかったことから、実際には次のサイクルの太陽活動は更に低いものとなることが予想される。

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フリッカリングオーロラの高速撮像観測計画の現状

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The actual status of high-speed imaging observation plan for flickering aurora

Satoshi Kimura, Takeshi Sakanoi (Tohoku Univ.), Makoto Taguchi (Rikkyo Univ.), Shoichi Okano (Tohoku Univ.)

Since flickering auroras were first well defined by Beach et al. [1968], several works on flickering aurora have been reported. Optical observations of flickering aurora used to be carried out using TV cameras or photometers in the past [e.g. Oguti, 1978; Berkey et al., 1980; Sakanoi et al., 2005]. They showed the basic characteristics of flickering aurora. The frequencies of the modulation are usually 10±3 Hz and the width and vertical length of each flickering column are in the ranges of 1-10 km and >40 km, respectively. By coordinated ground-based optical imaging observations and sounding rocket particle measurements, intensity variations of flickering aurora are found to be produced by periodic modulations of precipitating electron fluxes. Temerin et al. [1986, 1993] proposed a model of field-aligned electron flux acceleration by electromagnetic ion cyclotron (EMIC) waves, which produces flickering aurora.

We are developing high speed imaging CCD camera with high temporal resolution (~100Hz) and high spatial resolution (~ about 260m at 100 km altitude) in order to observe the high speed component and the fine structures of flickering aurora. We expect that the high speed flickering aurora will be obtained by this observation and the condition for producing of flickering aurora will be more deeply understood. In this presentation, current status on the development and a strategy for the observation will be given.

形状・時間変動によって様々な分類をされるオーロラ現象の中に、フリッカリングオーロラと呼ばれる現象があり、Beach et al. [1968]によってその性質について詳細に述べられて以来、様々な研究が行われている。フリッカリングオーロラ観測では、主に TV カメラやフォトメータを用いた観測が行われてきた[e.g. Oguti, 1978; Berkey et al., 1980; Sakanoi et al., 2005]。これらの観測により、フリッカリングオーロラは主に周波数 10±3Hz の発光強度変動、直径 1～10km のスポット（コラム）形状、高さ方向に＞40km といった特徴を持つことが分かった。さらに、早い周期での明滅を生み出すメカニズムとして、オーロラ加速領域より下の高度 2000-5000km で生成される電磁イオンサイクロトロン波や慣性アルフヴェン波によって粒子フラックスに変動が与えられる過程が提唱されている。

これまで行われてきた観測では、検出器として TV カメラやフォトメータが用いられてきたが、それぞれ時間分解能(~30Hz)・空間分解能(~数 km)と制限されてきた。そこで我々は、高感度 CCD カメラを用いる事によって従来実現出来なかった高速サンプリングかつ高空間分解能での観測を計画し、これまでフリッカリングオーロラの観測準備を行ってきた。本計画では、観測する微弱信号を 1000 倍にまで増幅可能である EMCCD (Electron Multiplying CCD)カメラを用いる事で、高度 100km において 100Hz の高サンプリングかつ高空間分解能~260m でフリッカリングオーロラを捉える事が可能であると考えている。本観測により、フリッカリングオーロラの今まで得られなかった高い周波数成分と微細空間構造を捉える事で、フリッカリングオーロラのソース領域においてどのような条件が必要であるのかを明らかにしようとしている。本発表では観測に用いる装置の開発状況と観測計画について報告する。

P29

多周波デジタルイメージングリオメータの開発（２）

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藤井智史（琉球大学工学部)、巻田和男（拓殖大学基礎教育系列)、
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Development of a Multi-frequency Digital Imaging Riometer

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Multi-frequency imaging riometer observation is proposed to detect MeV range proton precipitation such as those observed in solar proton events. It is advantageous to adopt digital beam forming in multi-frequency observation because of the flexibility in allocating the beam directions.

Lerfald 等(1964)は多周波リオメータ観測による吸収スペクトル指数が通常の値（2.0）からずれる事例を、オーロラ電子の高エネルギー成分やオーロラX線による低高度電離であると解釈した。しかし、その後、吸収領域の空間構造をイメージングリオメータで詳しく測定できるようになると、アンテナ視野を吸収領域が覆う度合いによって、見かけ上、吸収スペクトル指数が変化することが明らかになり（Rosenberg et al., 1991)、Lerfald 等の解釈は否定された。しかし、吸収領域の広がりよりも十分狭いアンテナビームで多周波リオメータ観測を行なえば、Lerfald 等のアイデアは復活できるのではないか？これが多周波イメージングリオメータ観測を行なおうとする理由であり、太陽フレア時の高エネルギー（MeV 帯）プロトン降込みの空間構造などが調べられると期待される。

しかし、多周波イメージングリオメータ観測を同一のアレイアンテナで行なおうとすると、従来のアナログ技術(バトラーマトリクス）では問題が起こる。周波数を変化させると、形成されるアンテナビームの方向も太さも変わり、異なる対象を見てしまうからである。この不都合を解消するために、計算機上で各アンテナ信号の位相合成を行い、任意方向にビームを形成するデジタルビーム形成が必要となる。現在、情報・システム研究機構、新領域融合研究センターの育成融合プロジェクト研究課題「超高層遠隔探査装置のデザインと性能評価における数値シミュレーション的アプローチ」の経費により、多周波イメージングリオメータ観測システムの開発を進めている。

開発中の観測システムは15本のシングルダイポールアンテナを0.5波長程度の間隔で2次元的に配置し、それぞれに利得48dBのプリアンプを取り付け、20～40MHzの広帯域で受信する。受信信号はデジタル受信基板マーキュリー社ECDR-GC314-PCI-FSにより100MHzでA/D変換され、受信帯域中の任意の3周波数成分について同時観測を行なうことができる。ビーム形成にあたり、リアルタイムでは各アンテナ信号の位相を合成するFFT法を用いるが、オフラインでは各アンテナ信号の振幅と位相を調整し、空間分解能を上げるアダプティブアンテナ手法の導入を検討している。

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西オングル電磁波動観測エリアの基盤整備（3）

- 自然エネルギー電源とデータ通信-

山岸久雄、岡田雅樹（極地研）、高崎聡子（情報・システム研究機構 融合研究センタ）ー）

Improvement of the Electromagnetic Wave Observation Platform in West Ongul (3)
- Power supply from natural energy and data transfer-

H. Yamagishi, M. Okada (NIPR), S. Takasaki (Transdiscip. Res. Integ. Center, ROIS)

West Ongul Island is electromagnetically very quiet and important for passive electromagnetic wave observations. We are planning to improve the observational environment of this unique site by introducing wind generator and wireless LAN. Some trial experiments by JARE 49 are reported along with discussion for future prospect.

昭和基地では近年、消費電力の増大と電波送信装置の増加により微弱な電磁波動の観測には不適な環境となっている。西オングル島の宙空テレメータ施設付近は今後、電磁波動を観測する静穏エリアとして重要度を増すと思われ、観測を実施するための基盤（電力供給、データ伝送）の計画的整備が必要である。48次隊に引き続き、49次隊では風力発電とデータ通信に係わる新たな試みが行われたので報告し、併せて、今後の整備の方向について検討する。

1．電力供給

1985年以来、太陽電池が用いられているが、極夜の4ヶ月は太陽発電が不能なため、毎月1回、隊員がディーゼル発電機で蓄電池の充電を行なっており、大きな負担となっている。また、極夜期の電力供給のため、大量の蓄電池を使用しており（24Wの消費電力に対し、12V, 200Ahの鉛蓄電池42個、重量約3トン）、その保守も大きな負担である。極夜期に数Wでも発電できれば、上記の負担を軽減できるとの考えに基づき、風力発電機の野外試験装置を西オングル島に設置した。48次隊では英国Forgen社製のサボニウス型（定格20W）4基を試験したが、2ヶ月余りで風車の羽根が折損し、南極の強風に耐えないことが判明した。49次隊では気象部門での使用実績がある英国Rutland社のFM910(定格70W）を試験中であり（図1）、期待通りの発電特性が得られている（図2）。

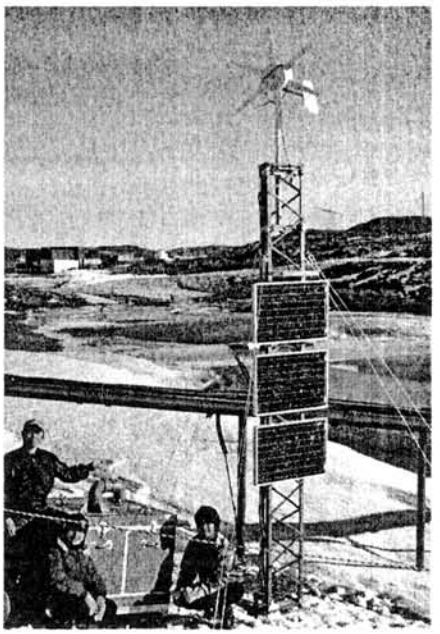

図1　風力発電試験装置

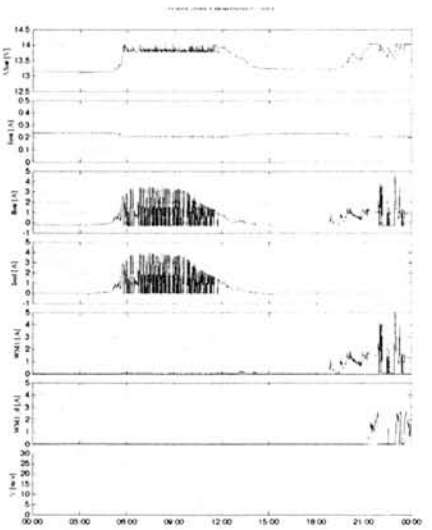

図2　風力発電試験装置による試験データ

2．データ伝送

1981年以来、西オングルでの観測データはPCM−FMテレメータ（ULF-ELF波動、CNA）とFMテレメータ（VLF波動）で伝送されてきたが、PCMシステムは故障した場合の修理経費が高く、専門的な技術も必要とされるため、将来は無線LANによる伝送に置き換える予定である。そのためには、観測現場でデータをパソコンに入力し、一次処理したファイルの形で無線LANに乗せる必要があり、そのために野外仕様のパソコン、及びそこに搭載するデータ処理プログラムの開発を49次隊で試みている。

多周波・多サブアレイMSTレーダーを用いた3次元高分解能イメージング観測

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High-resolution 3-dimensional imaging of the atmosphere with multiple-frequency and multiple-subarray MST radar

Koji NISHIMURA (NIPR/ROIS) and Toru SATO (Kyoto Univ.)

Abstract

In MST radar observations, spatial resolution is limited by the size of the antenna array and the bandwidth which the radar can use. In this study, an resolution-enhanced imaging scheme is present for observing the atmospheric turbulence employing multiple-frequency and multiple-subarray interferometry. In order to apply an interferomeric method to the atmosphere, persistent phase rotation in the echo signals caused by the horizontal advection must be compensated. We have proposed a compensating algorithm and verified that it functions as it is expected. We have applied an interferometric method with the support of this algorithm and successfully obtained 3D images of the turbulence. To clarify the dynamics of the turbulence, however, it is needed organically to combine temporal and spatial information. We present an attempt on 4D data processing.

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昭和基地における下部熱圏探査レーダー観測計画

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Lower-thermosphere research radar observations over Syowa station

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A small VHF radar system for Antarctic lower thermosphere observations was developed and is to be installed at Syowa station (39E, 69S) in the coming Austral summer. The radar is an active phased array system, which consists of 4 sets of three-element crossed Yagi antennas. Each of the antennas is equipped with an independent TR module with a maximum Tx power of 500W placed directly under the antenna. The radar system is to be operated as a meteor radar system, which has never been introduced to Syowa station, and will provide polar lower thermosphere wind information. Combined with the collocated MF radar system installed for mesosphere observations in 1999, the height region from 60 to 100 km will be almost continuously observed under various ionospheric conditions. The VHF radar has another important role as a demonstration system of PANSY (Program of Antarctic Syowa MST/IS radar) after several years of development of light-weight and robust aluminum antennas and power efficient class-E amplifiers.

第 50 次南極地域観測隊により 2009 年 1 月に昭和基地に設置予定の下部熱圏探査レーダー観測計画について紹介する。現在、南極地域観測第 VII 期計画の重点プロジェクト研究観測のサブテーマである「極域の宙空圏—大気圏結合研究」が実施されており、これまで観測が余り充実していなかった成層圏から中間圏・下部熱圏にかけての領域を重点的に観測する準備が進んでいる。OH 回転温度観測装置、下部熱圏探査レーダー、レイリーライダー、ミリ波観測装置が順次開発、製作され昭和基地に導入される予定である。中間圏界面領域の温度をモニターする OH 観測装置は 49 次観測隊により 2008 年に設置され、観測を開始した。

下部熱圏探査レーダーは、下部熱圏の流星観測や FAI(Field Aligned Irregularity)エコーの観測に適した VHF 帯の電波を使用する。昭和基地の既設設備への影響を起こさないよう電波使用状況を考慮し、中心周波数に 47MHz を採用した。4 本の 3 素子直交八木アンテナそれぞれの直下に送受信モジュール(ピーク出力 500W)を配したフェイズドアレイシステムの構成であり、送受信ビームの高速走査が可能である。昭和基地には未導入の流星レーダーシステムとして 50 次夏期間からの運用を予定している。昨年度はレーダー本体の製造を国内で行うとともに、昭和基地では 49 次隊の夏期間(2007 年 12 月から 2008 年 2 月)に小屋及びアンテナの設置を行った。昭和基地は MF レーダー(主に高度 60-90km)による中間圏観測が 1999 年より行われているが、低い周波数を使用しているためオーロラ出現時にはデータ品質が著しく低下する事が問題であった。VHF 帯の流星エコー観測を同時に行うことでオーロラの影響をはるかに小さくすることができ、中間圏から下部熱圏域(60-100km)を電離層の状態によらず連続観測して上下結合研究の推進にあたる。南極のいくつかの外国基地にも近年、流星レーダーが導入されており、既存の MF レーダーネットワークと合わせ、南極域中間圏・下部熱圏領域大気の大規模構造についても探る予定である。

また本レーダーは、別途、昭和基地での建設が検討されている昭和基地大型大気レーダー計画(PANSY:佐藤薫代表)の実証システムとしての側面も持つ。大型レーダーの実現のために、軽量(設置作業が小)かつ丈夫(十分な耐環境性)な八木アンテナ、およびその基礎設置工法(砂利地でも可)、さらに高効率送信機(E 級送信技術を用い、消費電力が従来型の半分以下)の開発が過去 5 年ほどかけて行われた。下部熱圏探査レーダーのアンテナと送受信機には、これらの開発技術が採用されている。

現在、下部熱圏探査レーダーは国内試験を滋賀県甲賀市信楽町の京大 MU レーダー観測所内で行い、ソフトウェア整備など南極設置に向けた準備を行っている。発表では初期データを含め、システムの紹介を行う。

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南極 40cm 赤外線望遠鏡

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A 40cm Infra-Red Telescope in Antarctica

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In Antarctica the cold, dry air is predicted to provide the best observing conditions from infra-red to sub-millimeter on the Earth. To enjoy the advantages in Antarctica, we have a plan to make astronomical observations at Dome Fuji, also known as Dome F, which is located at inland Antarctica. However, the harsh environment is very problematic. For example, the temperature comes down to as low as -80 degrees Celsius in winter, where instruments designed for temperate environment would not work. In this context, we have developed a 40 cm infra-red telescope, which is dedicated for the use even in winter at Dome Fuji. We also report the experiment that we have done at Rikubetsu (the coldest city in Japan) in February 2008.

南極は、地球上で宇宙に開かれた最後の窓と言われている。極端に温度が低く水蒸気量が少ないため、大気からの赤外線雑音が非常に小さく、赤外線からサブミリ波における大気の透過率が極めて高い。さらに、私たちが南極天文台を構想している南極大陸の氷床ドームふじは、標高 3810m の高気圧帯に位置し、安定した大気により晴天率が高く、地上で最も観測条件の良いサイトであると期待されている。

しかし南極に望遠鏡を設置するにあたり、極地特有の課題がある。そこで、私たちは試験観測用に 40cm 赤外線望遠鏡を開発した。望遠鏡がドームふじの冬の気温である－80℃でも正常に駆動するよう、望遠鏡は用いた材料の熱収縮率の差を考慮して設計されている。また、モーターなどの回転部分は一度分解し、内部のグリスを洗い落とし－80℃対応のグリスやドライスライドに付け替えた。昭和基地から内陸側約 1000km にあるドームふじまで雪上車で運搬しやすいよう、架台をはじめ、望遠鏡の大部分をアルミで製作し軽量化に成功した。また、冷却実験を進めるとともに、2008 年 2 月には、日本一寒い町、北海道陸別町で望遠鏡の寒冷地実験を行った。

このように工夫された極寒仕様の 40cm 望遠鏡と私たちの活動について報告する。