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Over 100 scientists

ns

1 mission

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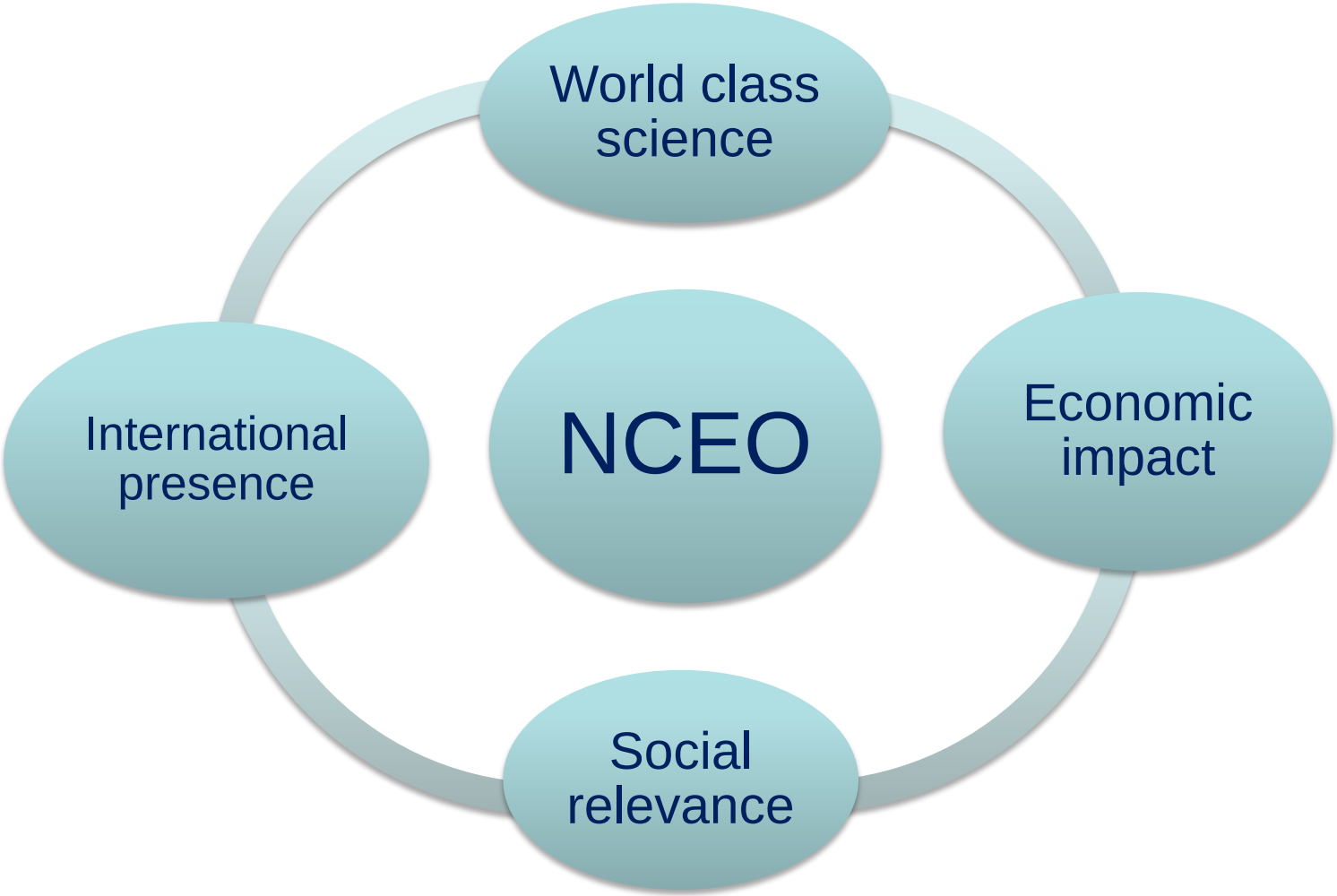

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"Our core activity is fundamental science: the challenge of understanding and predicting the behaviour of planet Earth as a complex, multi-component coupled system using observations from space and mathematical models"

Alan O'Neill - Director

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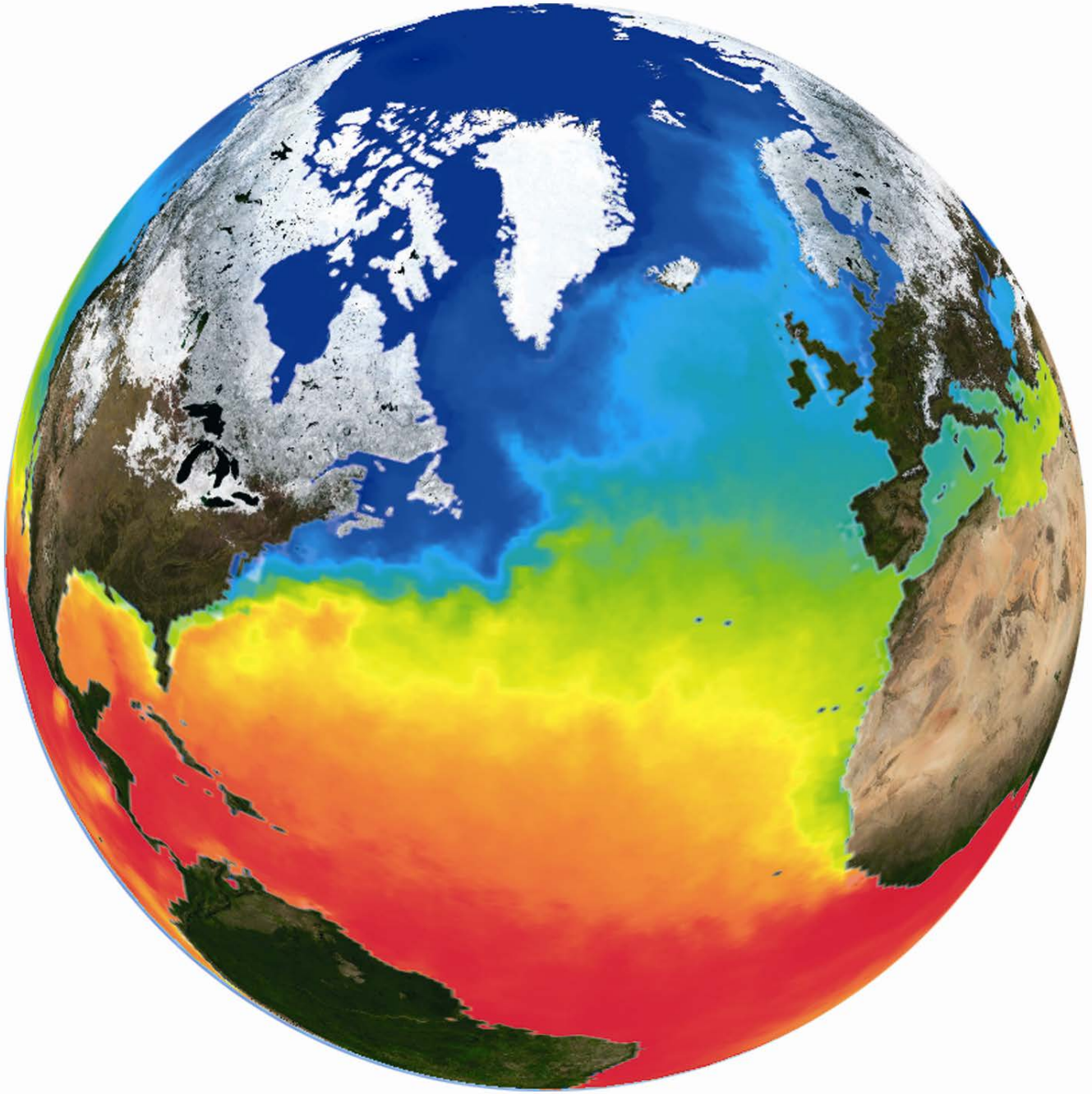

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Theme 1: Climate

CLIMATE

Earth Observation data provide new insights into the working of the Earths climate on large and small scales

Earth Radiation budget, **Clouds** and Water vapour

Ocean **surface temperatures**, heat content, sea level and circulation revealed by **Ocean Reanalysis**

Sea and Land (glacial) ice distributions are changing

Land surface properties (**moisture**, snow, **vegetation**) and **feedbacks on atmosphere** and climate models

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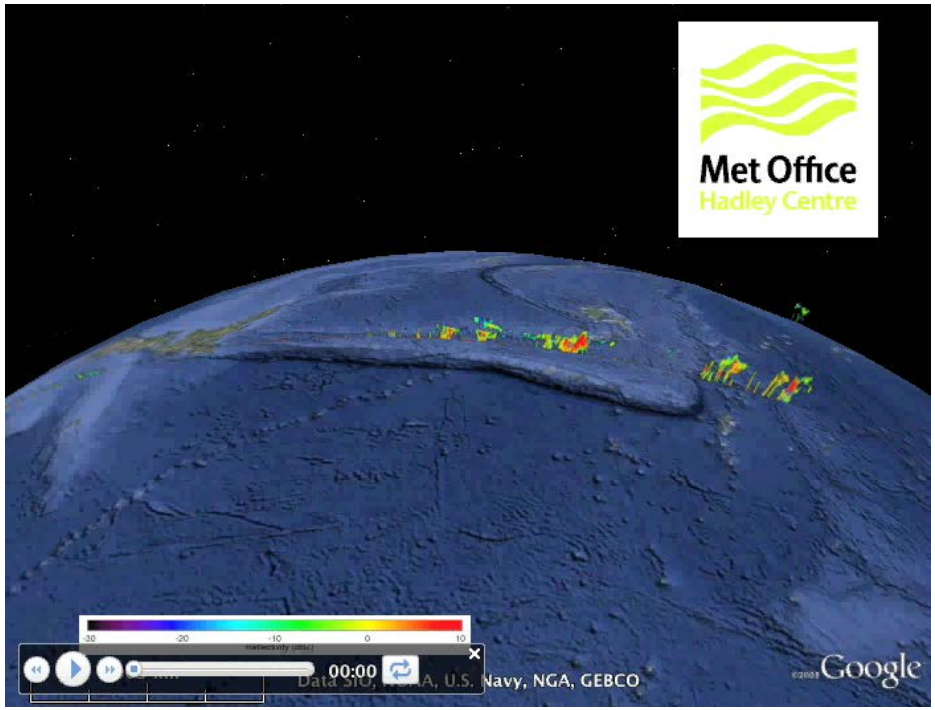
COSP
A satellite simulation tool for model assessment

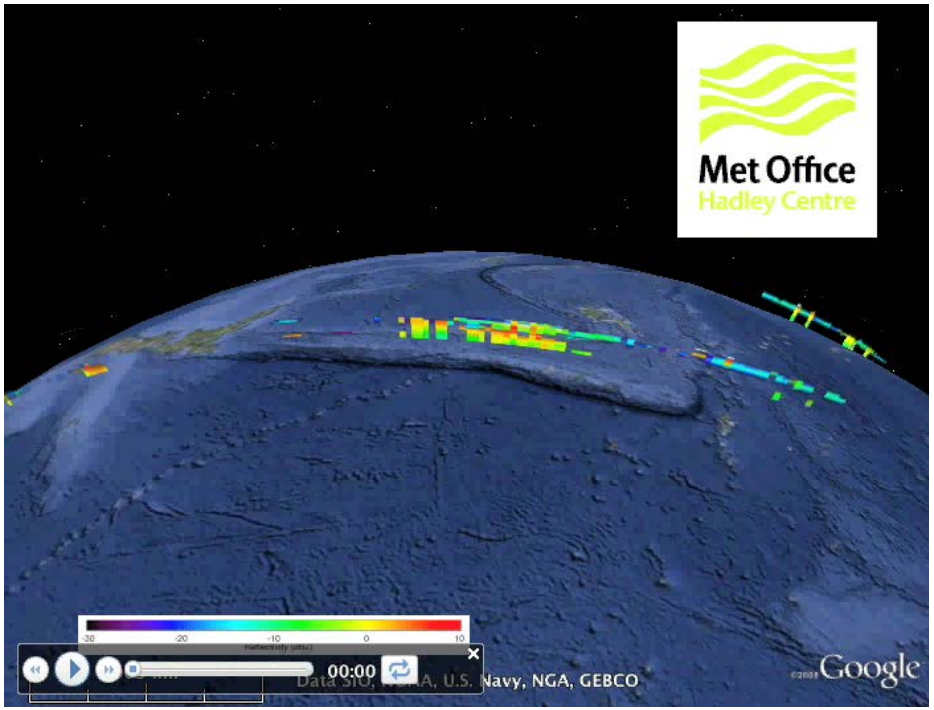
CLIMATE

Sampling the models in the same way as satellites observe allows more robust assessment of model errors and provides the “Observation Operator” for data assimilation.

Observations from CloudSat Radar



Equivalent Simulations from the Met Office Unified Model



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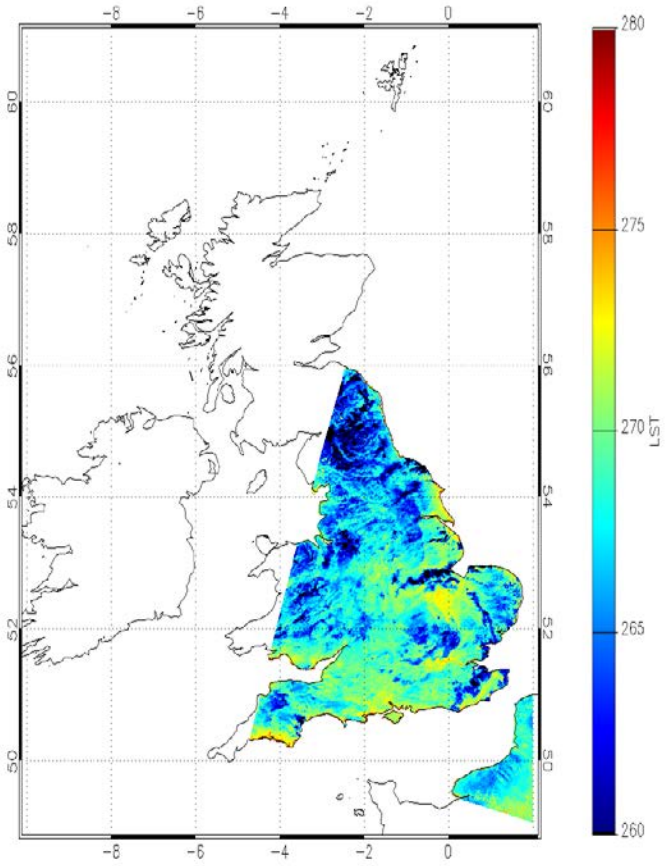
Realising long-term data sets of land surface temperature

CLIMATE

"Research in NCEO is identifying some of the key factors that govern the ability to model evapotranspiration correctly"

John Remedios



Land surface temperature from AATSR

John Remedios, Olof Zeller, Ed Comyn-Platt, Darren Ghent, University of Leicester
Chris Taylor, Heather Ashton and Richard Ellis, Centre for Ecology and Hydrology, Wallingford

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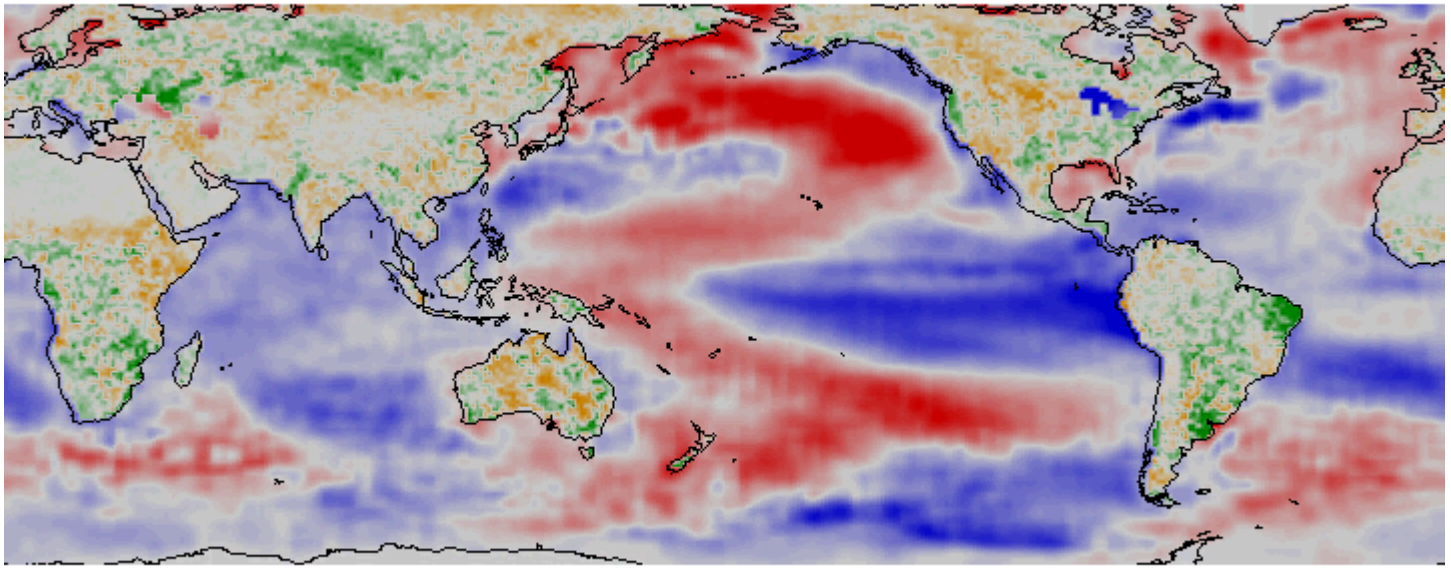
Vegetation anomalies are clearly linked to Climate modes such as El Nino

CLIMATE

FASIR NDVI & Reynolds SST Anomalies



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Theme 2: Carbon Cycle

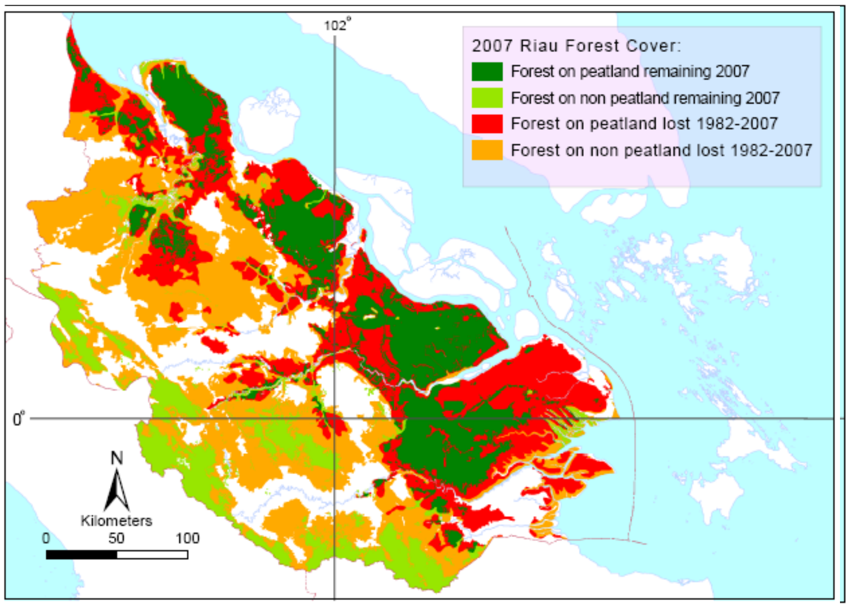
Combining Earth Observation with state-of-the-art Climate Modeling to understand the flow of carbon between oceans, land and air

Terrestrial Carbon

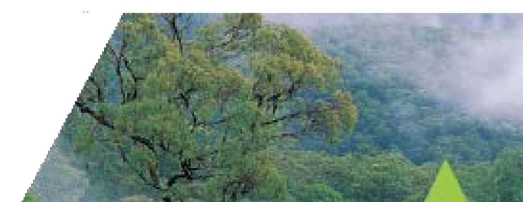
Land-atmosphere interactions

Ocean Carbon

Riau deforestation



2005
Total forest cover: 2,415,693 ha (38%)
Non-peat forest:loss:6,176,508,249 ha
Peat forest:loss:1,904,208 ha



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Terrestrial Carbon

Indonesian tropical peatland forest fires are major sources of carbon emissions

16th August 2005: “Smoky haze chokes Southeast Asia …. Again hundreds of fires burn deep into the underlying peat spreading smoke across the region”

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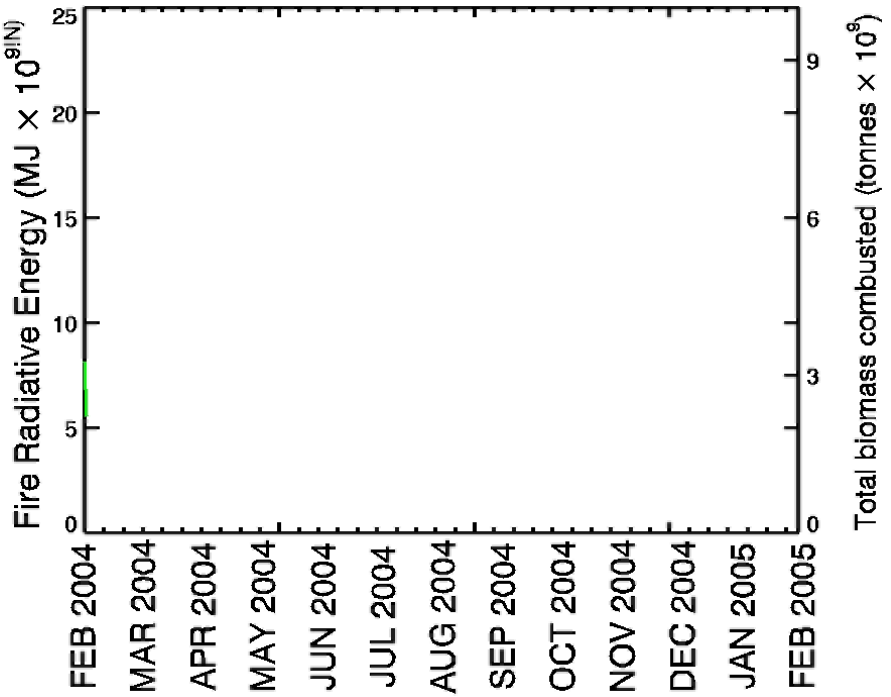
Land-atmosphere interactions

Carbon emissions from fire



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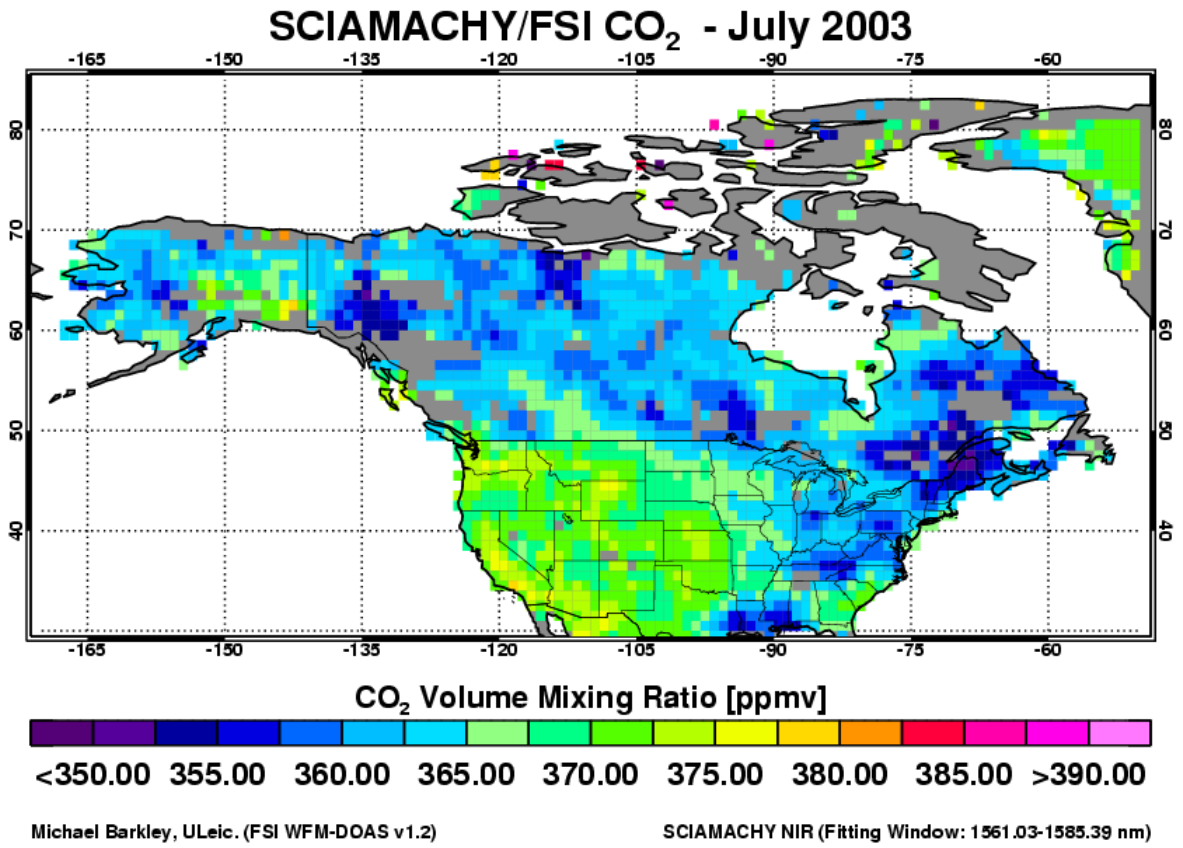
Land-atmosphere interactions

Seasonal variations of atmospheric CO_2 from space using FSI-WFM-DOAS, linking emissions with land coverage



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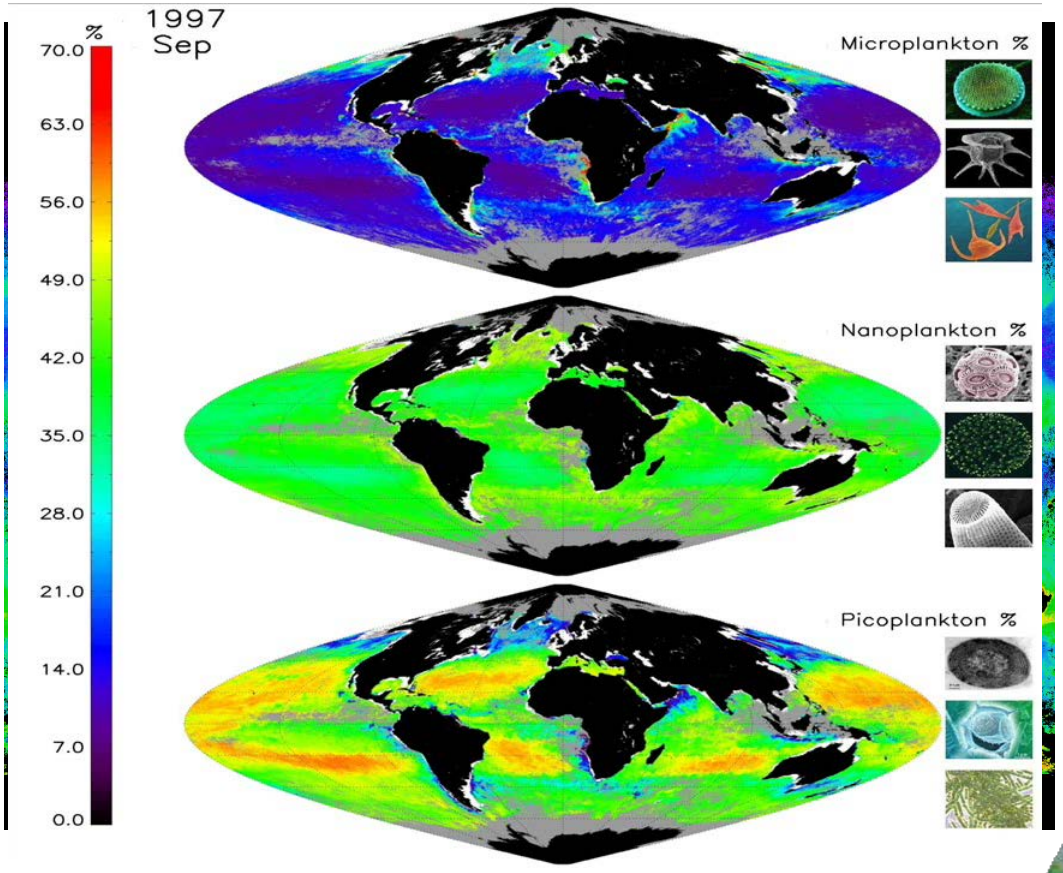
Ocean Carbon

Changing size-class structure of phytoplankton from SeaWiFS, the Sea-viewing Wide Field-of-view Sensor instrument



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Theme 3: Atmosphere

Developing an integrated approach to the analysis of satellite measurements, to provide new information on atmospheric composition and its role in climate.





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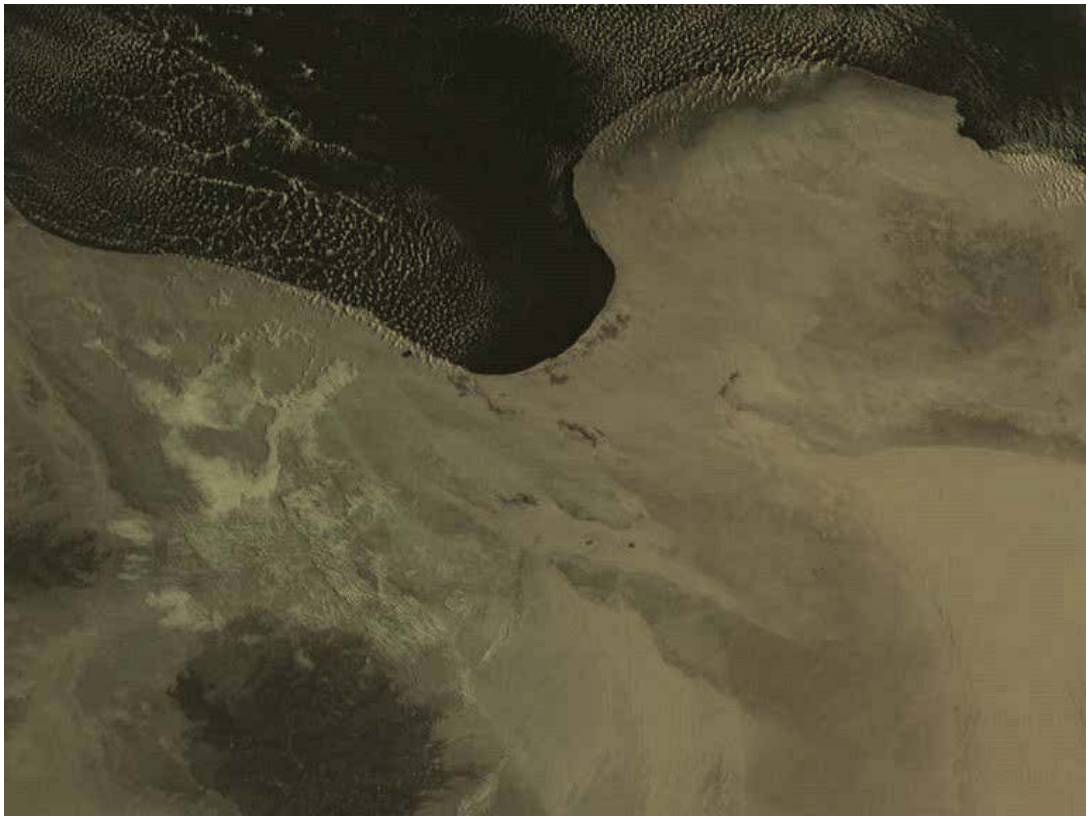
ATMOSPHERE

Libyan oil fire seen from space



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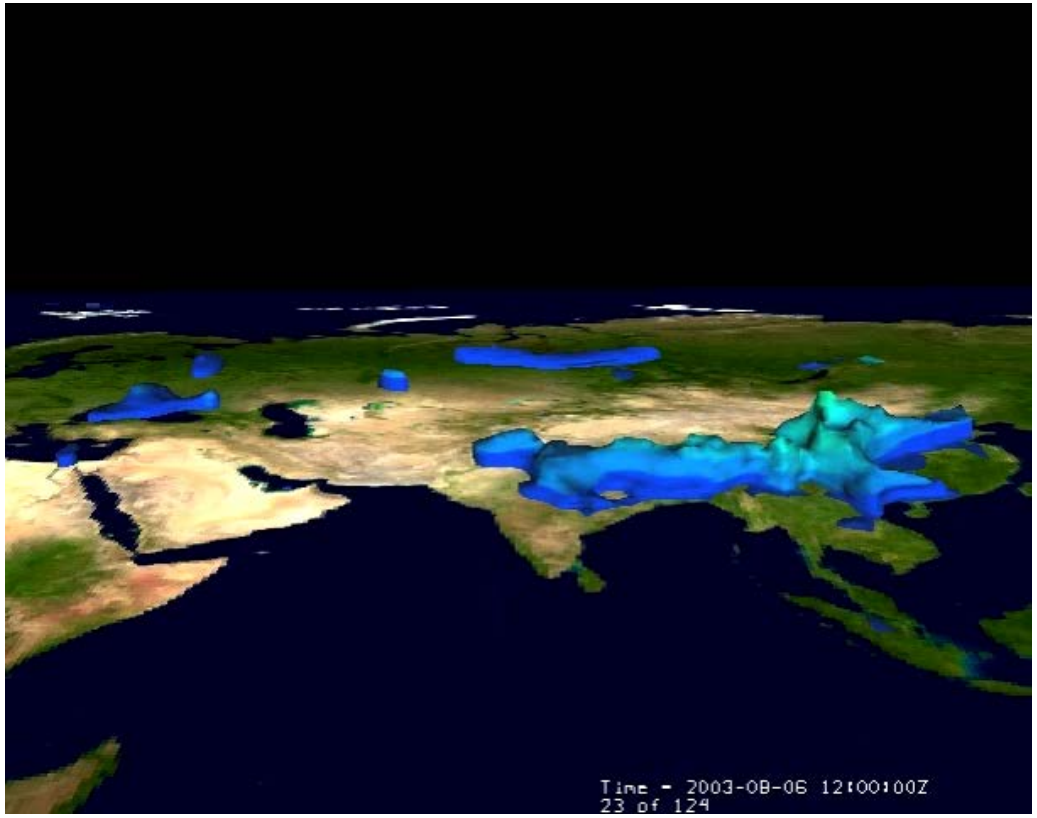
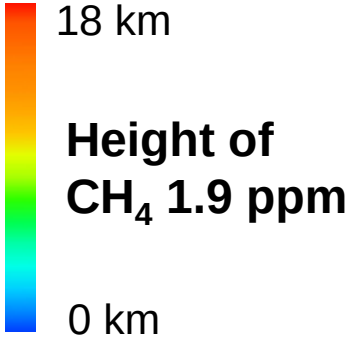
Methane convective uplift in the Indian monsoon

ATMOSPHERE

Bangladesh wetland biogenic emissions are lofted into the region important to climate by convection in monsoon circulation



3-D distribution can affect methane global radiative forcing



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ATMOSPHERE

Improving quantitative understanding of

distributions and emissions &

processes in global chemistry-transport models

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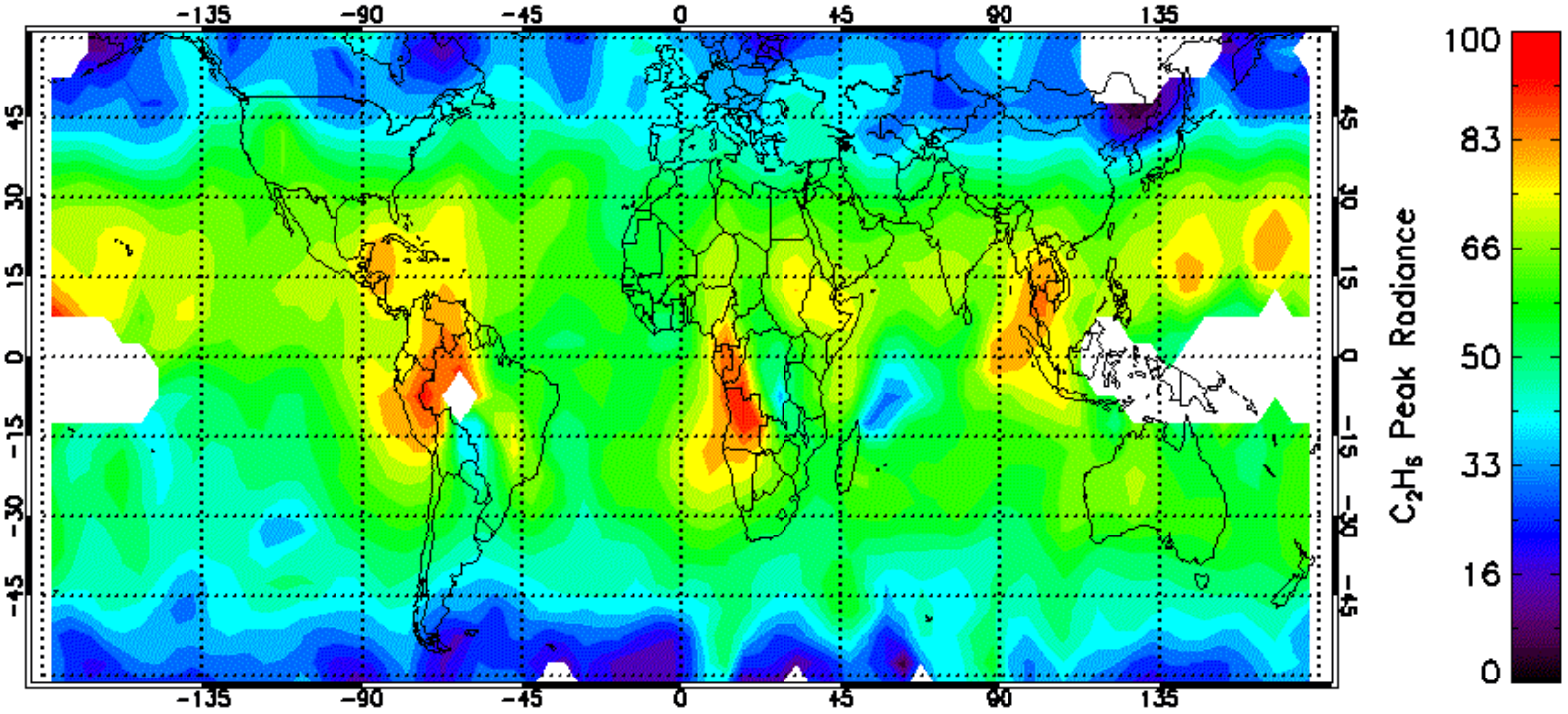
Monthly ethane (C_2H_6) distribution in the upper troposphere from MIPAS

ATMOSPHERE

From tropical biomass burning and northern hemisphere industrial emissions



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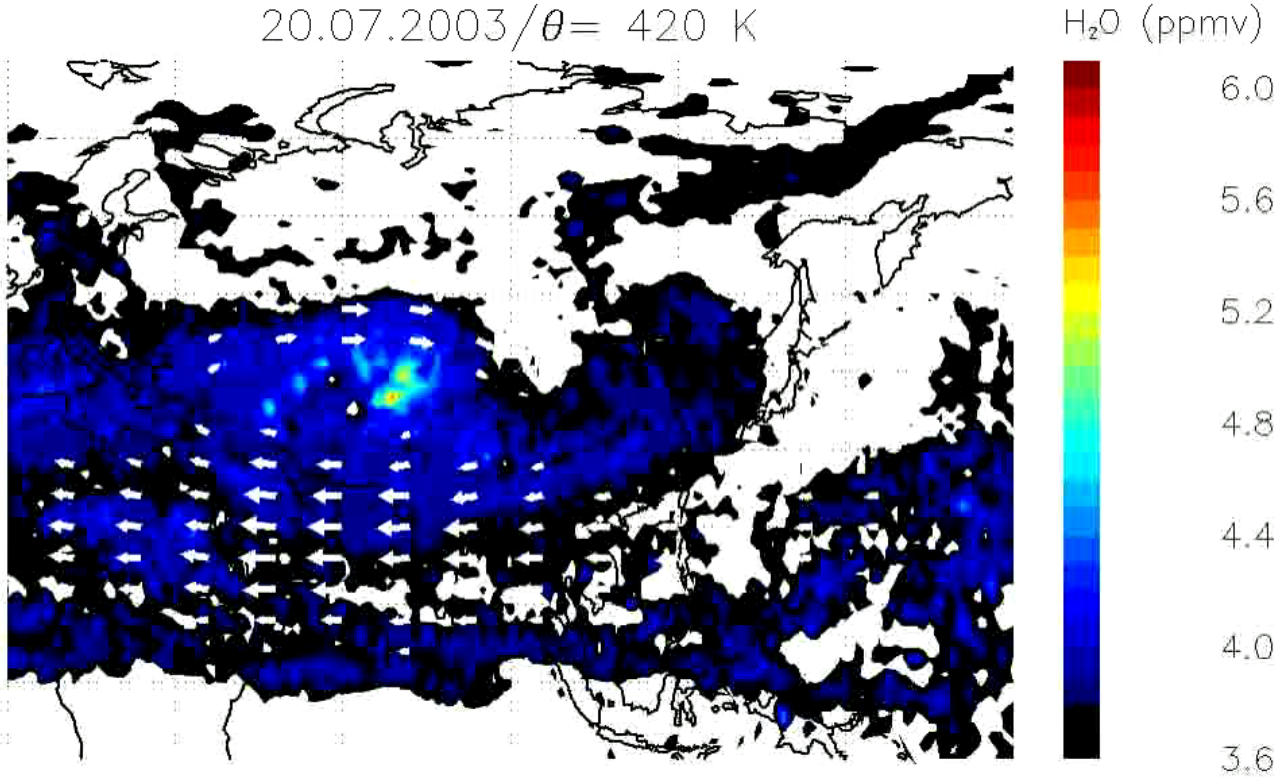
Transport through the Tropical Tropopause Layer

ATMOSPHERE

Water vapour and ozone distributions in the tropical tropopause layer are controlled by complex interplay between convection and other processes operating at fine scales.



Model H_2O ~18km – July to Dec'03

JÜLICH FORSCHUNGSZENTRUM

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ATMOSPHERE

Synergistic use of satellite observations

new, *integrated* approach

trace gases and aerosol in the troposphere and lower stratosphere

links between climate and to pollution and air quality

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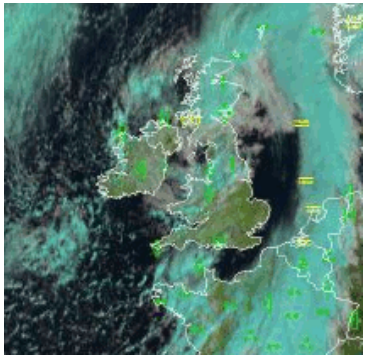
Synergy from observation techniques

ATMOSPHERE

Improve troposphere / stratosphere trace gas separation e.g. O3, HNO3, NO2 & CH4

Limb-emission sounding

– for vertical profiling



Nadir-sounding

– Near-surface layer seen

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Bridging the gap in scales from satellite to surface networks…

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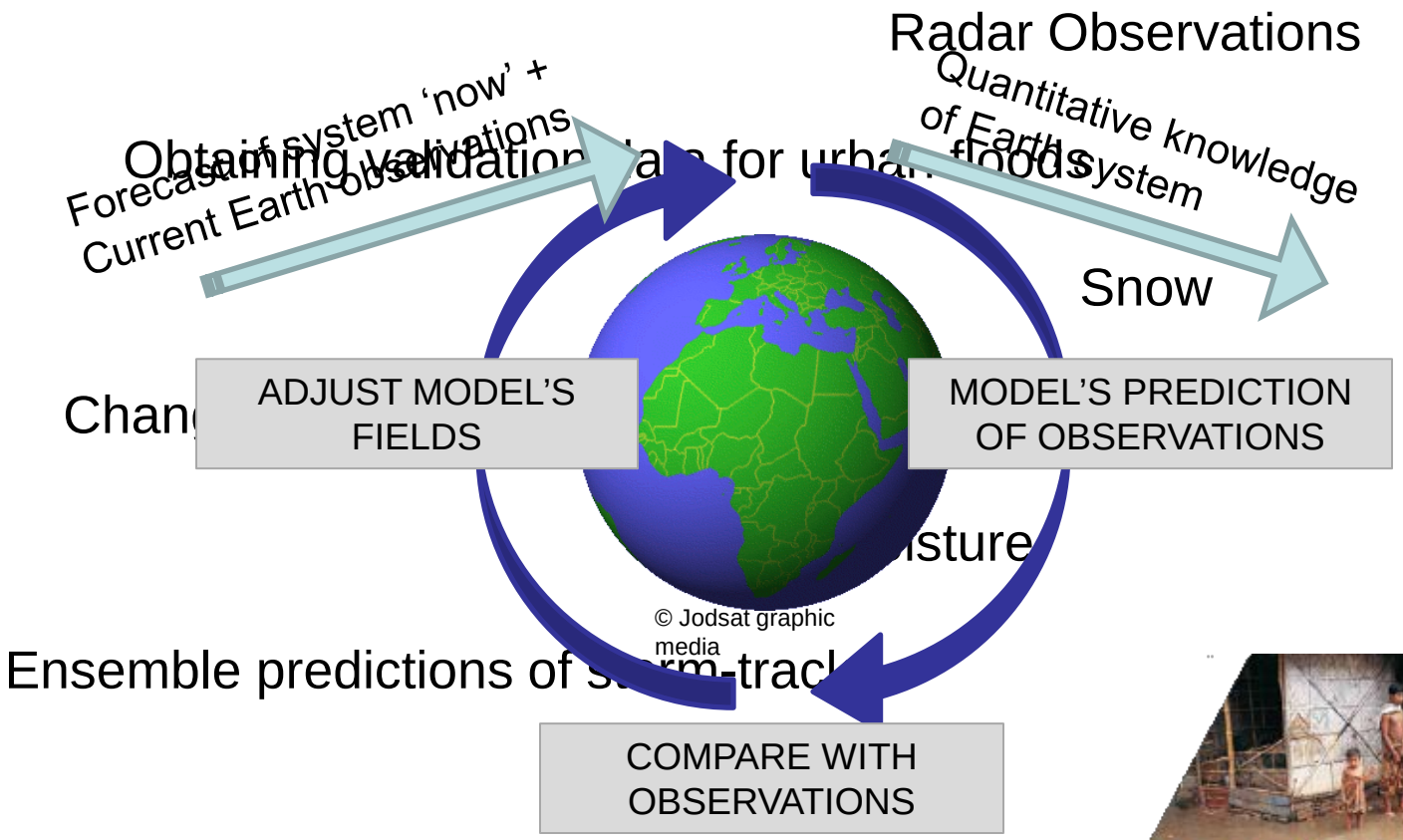
Theme 4: Changing Water Cycle and Hazardous Weaher

Data Assimilation – the key to unlocking observations of the Earth



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Development of a convective-scale ensemble prediction system

"Over the last few years, the meteorological community has been trying to improve the skill of quantitative predictions of precipitation, with a particular focus on hazardous weather such as severe thunderstorms and flash floods"

Stefano Migliorini and Ross Bannister

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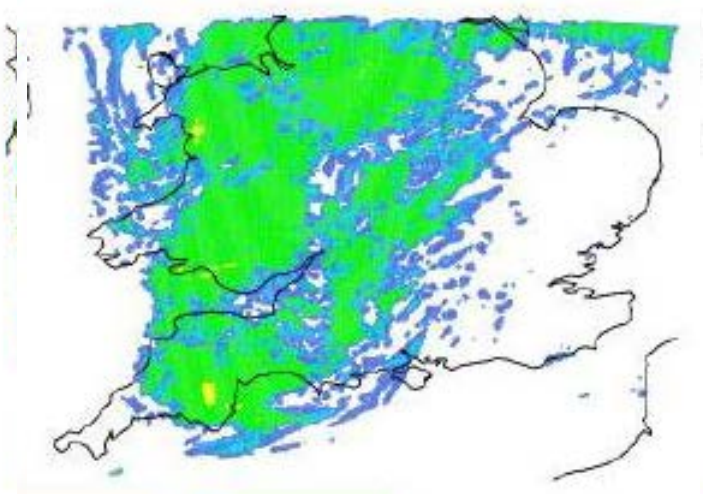
Deterministic forecast of precipitation rate



Ensemble derived probability of precipitation at three thresholds

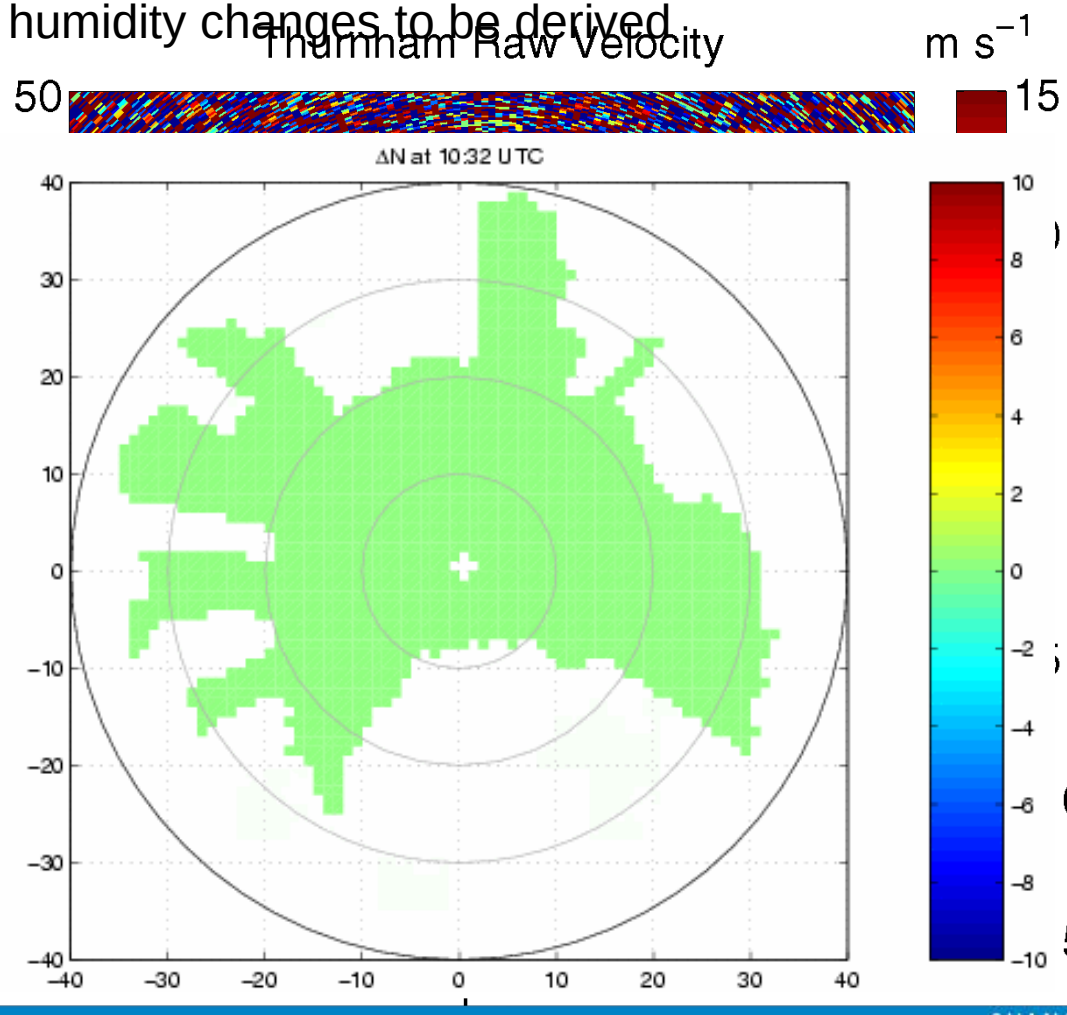
A simple deterministic forecast of precipitation rates over southern UK in summer 2007 (left panel) determined from the best knowledge available an hour before; predictions of probability of precipitation rates valid at the same time (right panels) for three different precipitation intensity thresholds (0.125mm/h, 1.0mm/h, 5.0mm/h) derived from an ensemble of forecasts.

Radar Observations

Mapping refractivity changes from static ground targets provides surface wind observations

Echoes from insects provide surface wind observations

humidity changes to be derived



CHANGING WATER CYCLE & HAZARDOUS WEATHER

Data in collaboration with the Met Office & NERC FREE programme

Courtesy NERC FREE programme and NCAS

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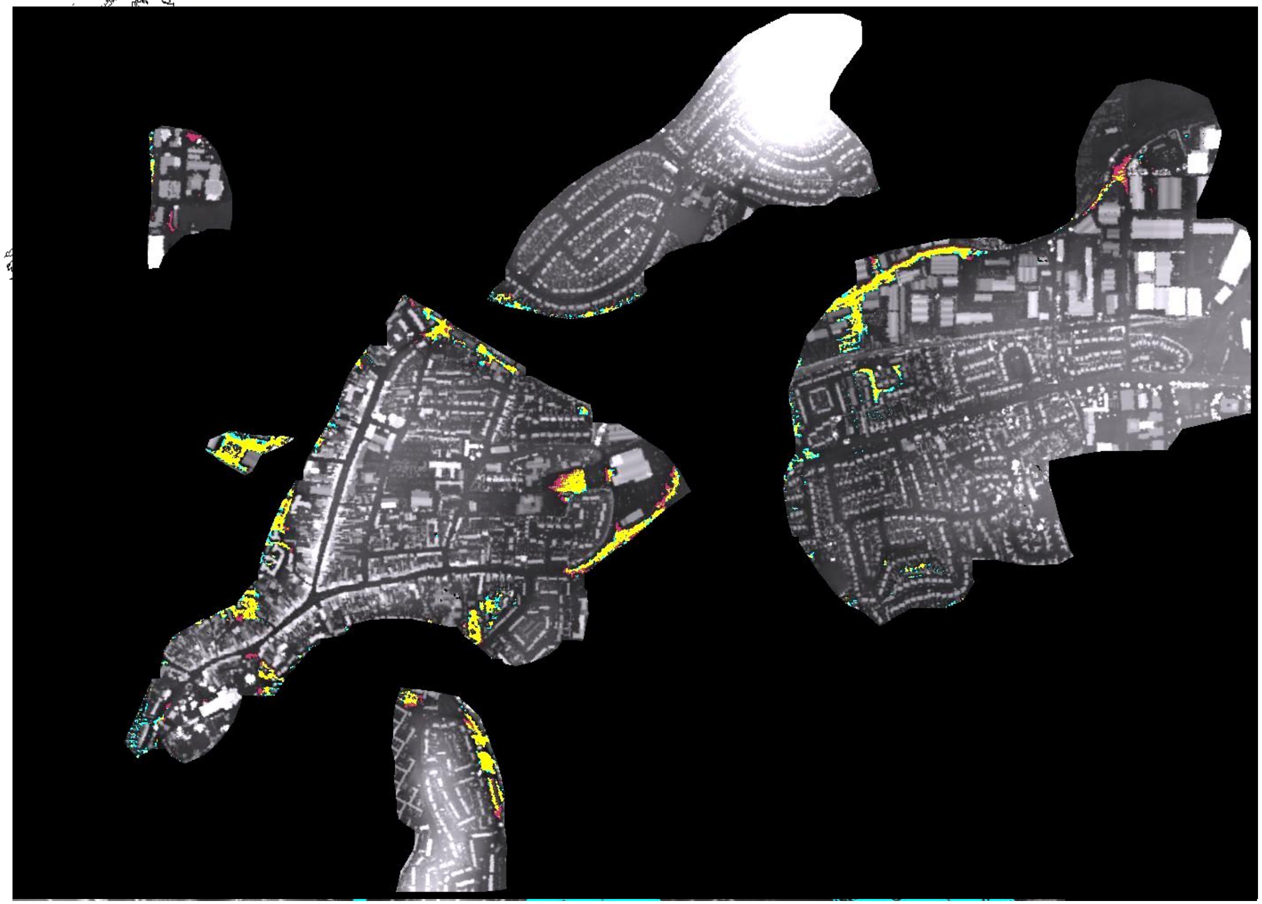
Obtaining validation data for urban floods

Flood Detection in Urban Areas Using TerraSAR-X
Tewkesbury 2003



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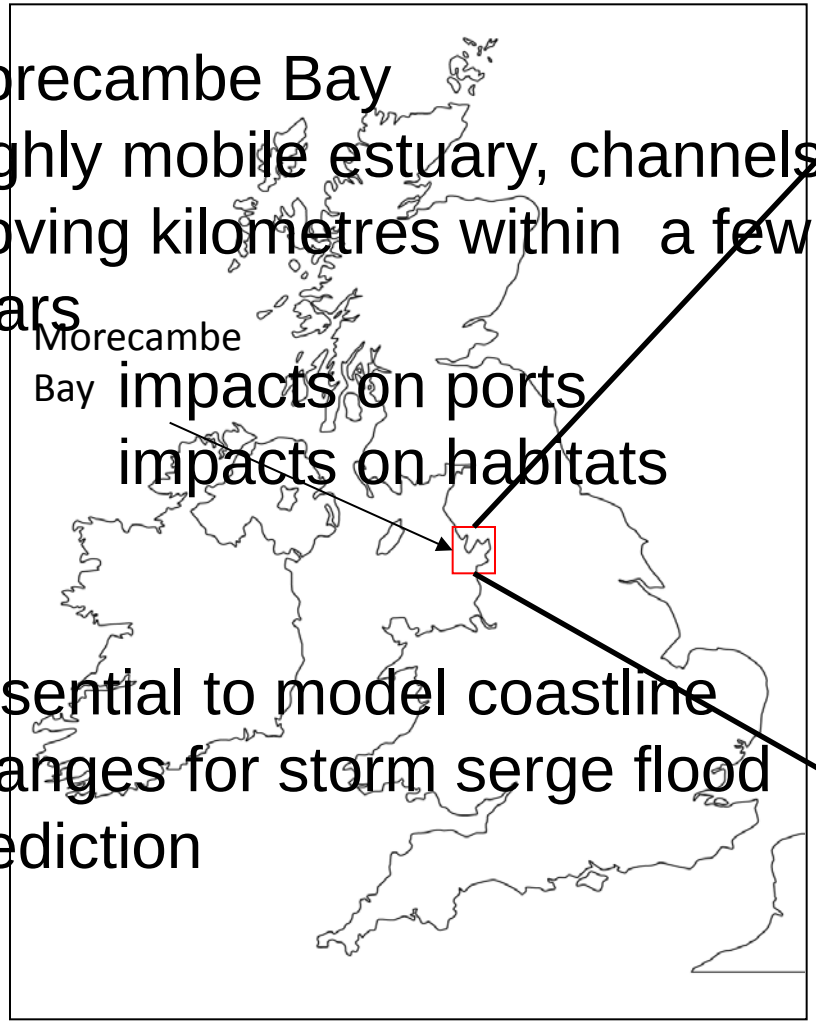
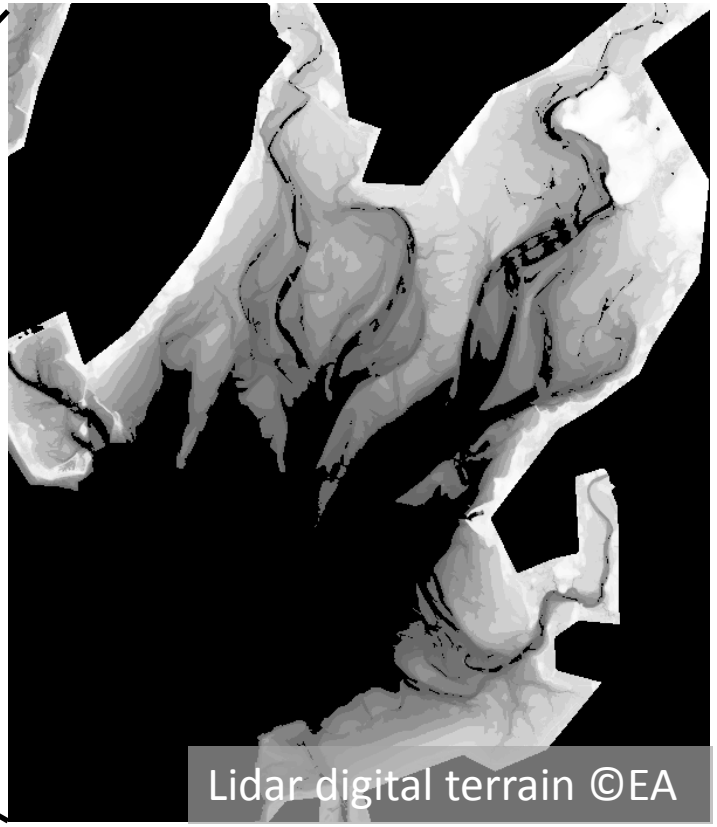
Changing coastlines

Morecambe Bay
Highly mobile estuary, channels moving kilometres within a few years



impacts on ports
impacts on habitats

Essential to model coastline changes for storm serge flood prediction



Lidar digital terrain ©EA

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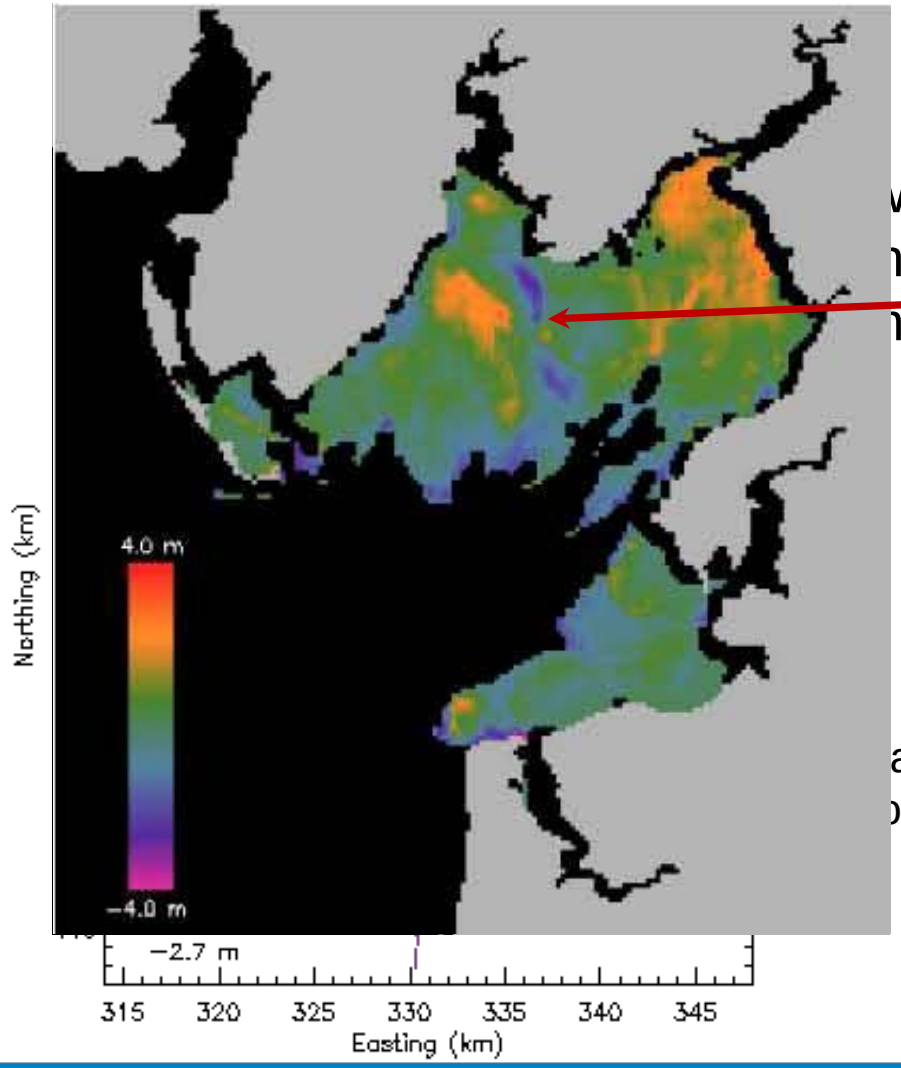
Changing coastlines



Observed change in

Qualitative assessment: data assimilation successfully introduced erosion along the Ulverston channel

data assimilation

Modelled change in

Quantitative assessment: data assimilation improved both the current bathymetry and the predictive performance of the model

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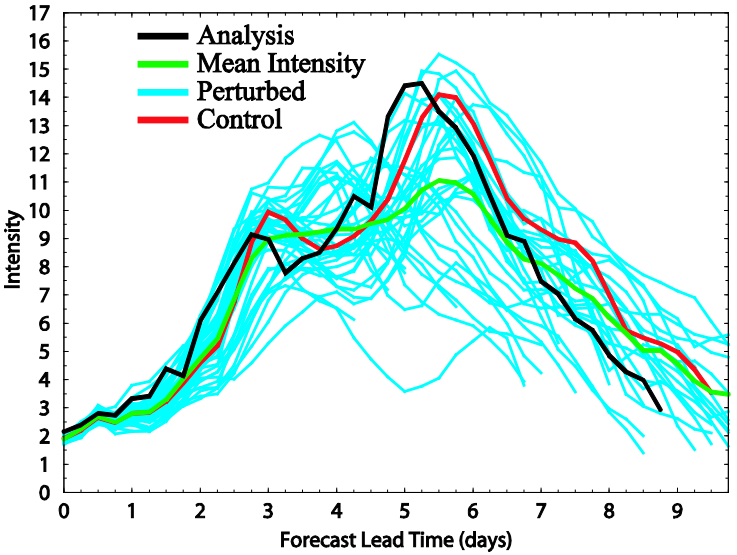
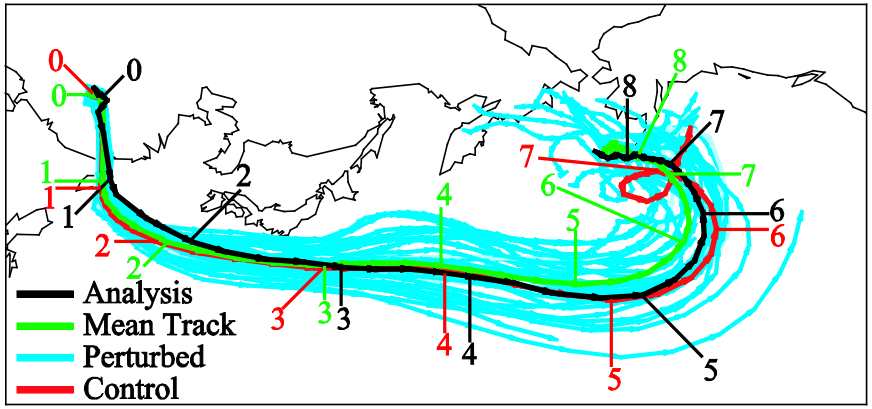
Prediction of storms by ensemble predictions systems

"Extra-tropical cyclones are the main natural hazard of north-west Europe causing large amounts of damage via strong winds and flooding... they can also be beneficial, providing the majority of the precipitation received in the mid-latitudes and are therefore vital to activities such as agriculture. The accurate prediction of these weather systems is therefore of key importance."

Lizzie Froude





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Theme 6: Cryosphere & Polar Regions

CRYOSPHERE & POLAR REGIONS

Quantifying and understanding marine and land cryosphere changes

Exploiting satellite observations to constrain Arctic ocean circulation and global sea-level models

Developing models examining ice and climate interactions

Setting IPY data into historic and future perspectives

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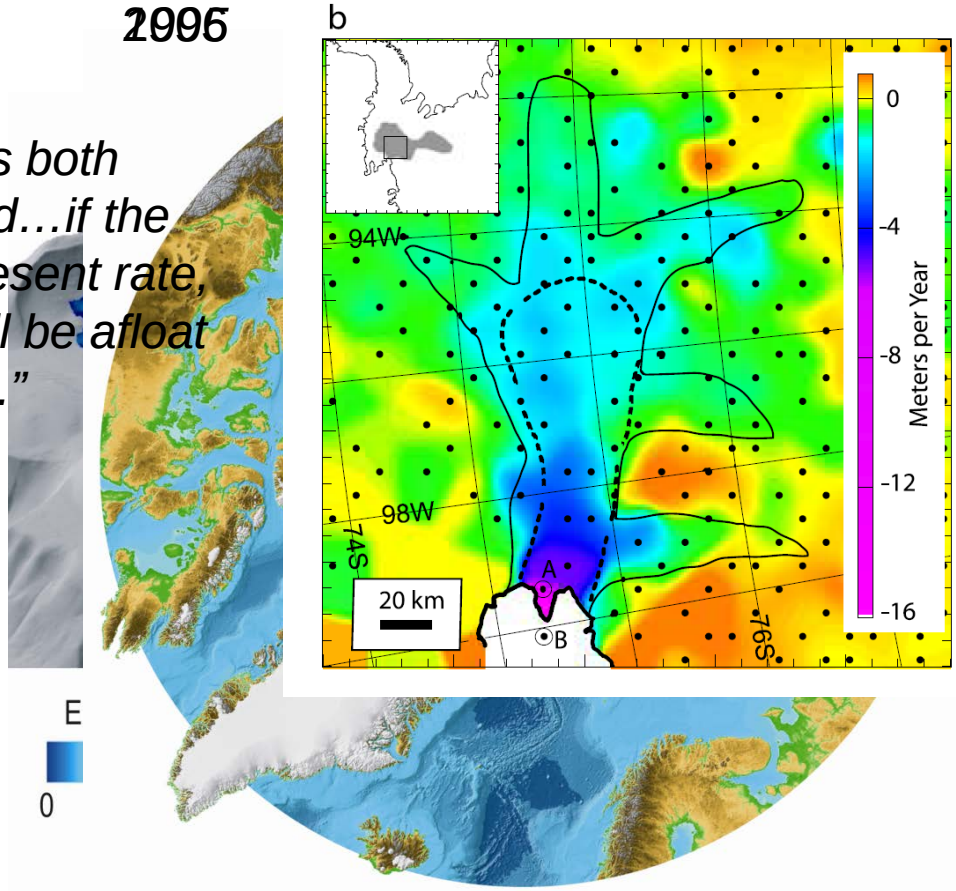
Accelerated thinning of Pine Island glacier

CRYOSPHERE & POLAR REGIONS

From Polar to ocean to glacier

"The pattern of thinning has both accelerated and spread inland…if the acceleration continues at its present rate, the main trunk of the glacier will be afloat within some 100 years."

Andrew Shepherd



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Theme 6: Dynamic Earth and Geohazards

Using regional faulting and deformation modelling to unlock deep activity in earthquake zones

Volcanic hazard assessment from deformation, lava, thermal radiation, gas and particle emission studies

Improving surface deformation measurements

Realising seismology information from GPS

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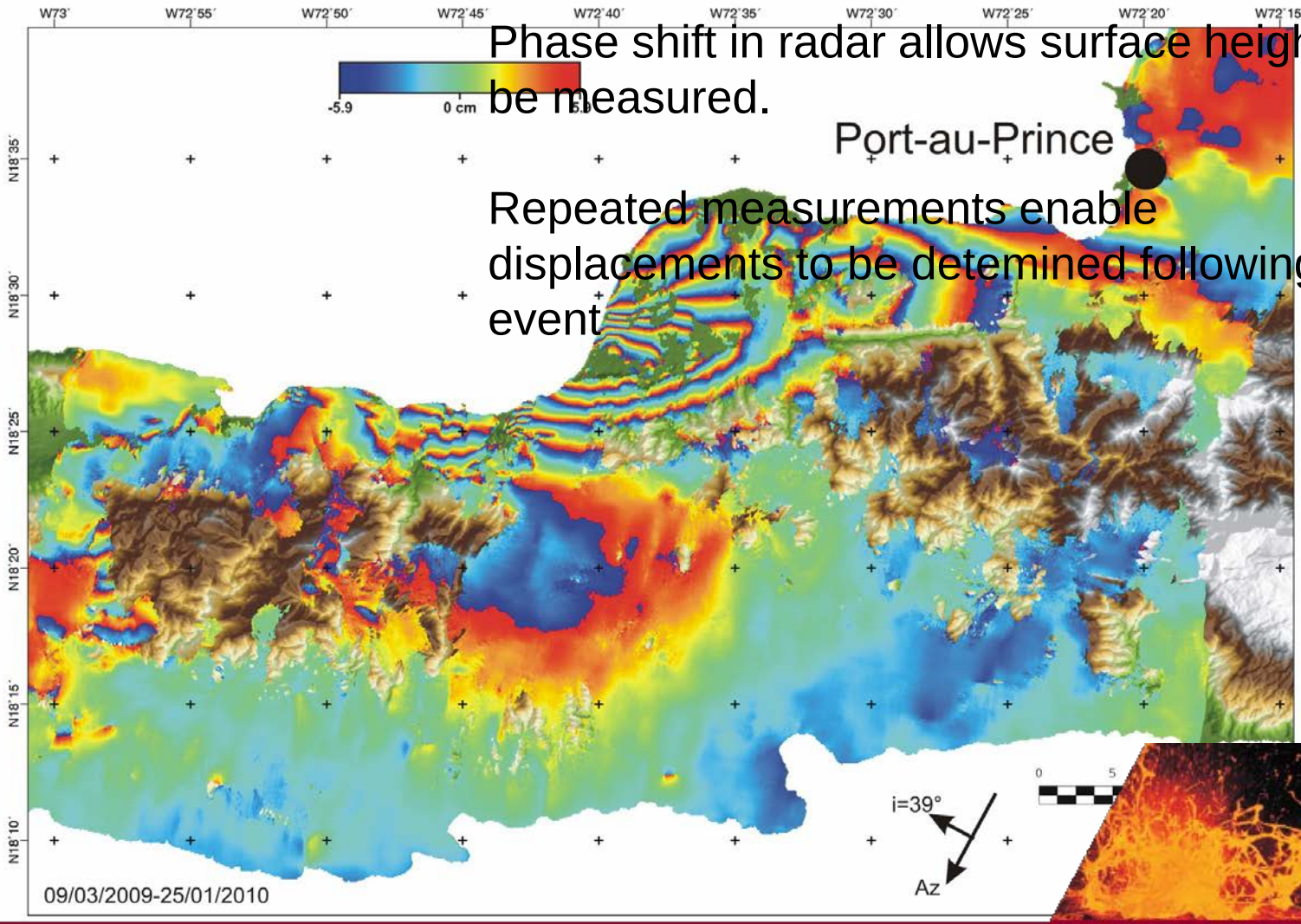
Measuring Surface Displacements with Satellite Radar

The 2010 Haiti earthquake: InSAR constraints of fault slip extent & future seismic hazard

Phase shift in radar allows surface height to be measured.

Repeated measurements enable displacements to be detemined following an event



DYNAMIC EARTH & GEOHAZARDS

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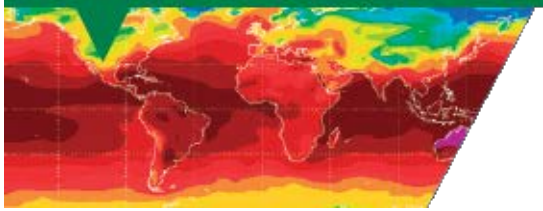
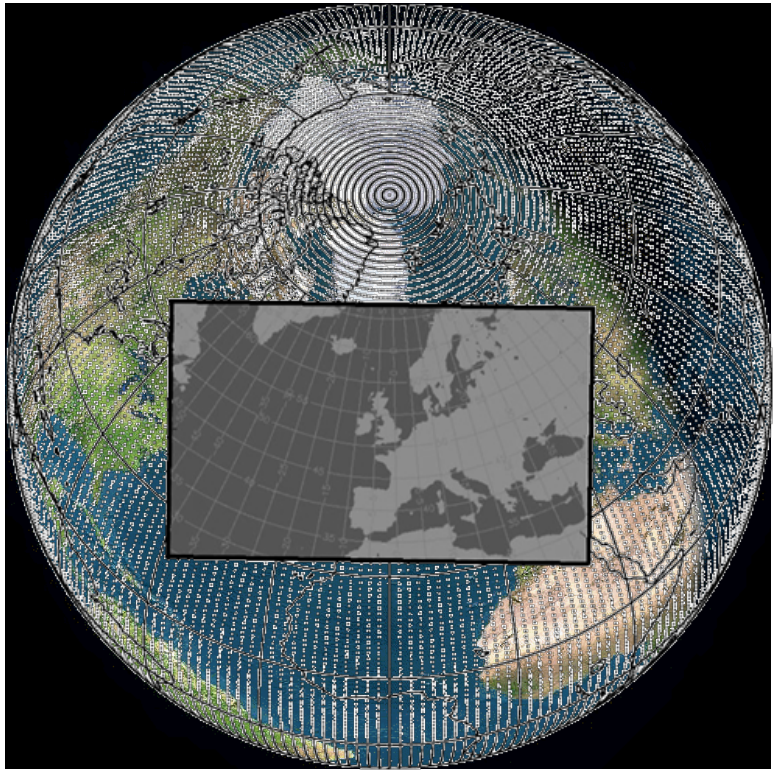
Theme 7 – Data Assimilation



Harvesting Earth Observations for computer modelling through improved Data Assimilation techniques



Creating new data assimilation techniques for couple, multi-scale Earth system models

Representing uncertainty in models & observations

Quantifying the impact of observations

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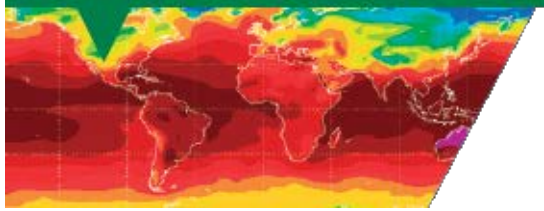
DATA ASSIMILATION



1. Mathematical theory and understanding

2. Development of assimilation algorithms

3. Demonstration on simple systems

4. Implementation in real applications

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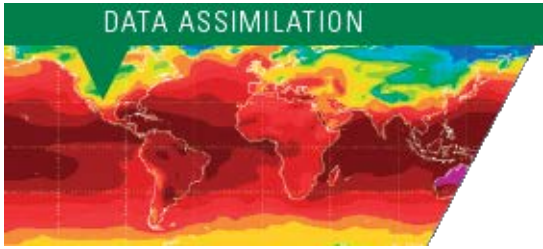
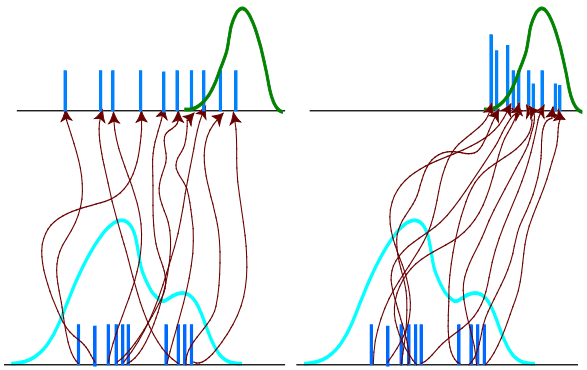
Efficient nonlinear data assimilation

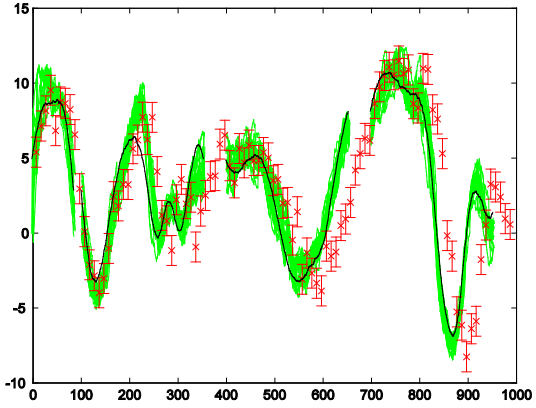


"With ever increasing resolution in numerical models and more advanced observations the data assimilation problem is becoming more and more nonlinear"

Peter Jan van Leeuwen



Traditional and new Particle Filters techniques applied to ensemble members.



New Particle Filter applied to Lorenz 1996 model

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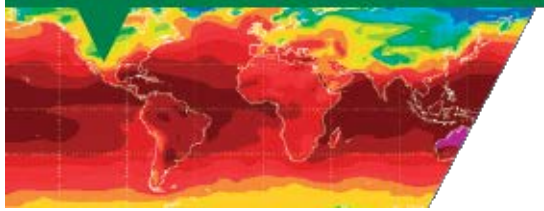
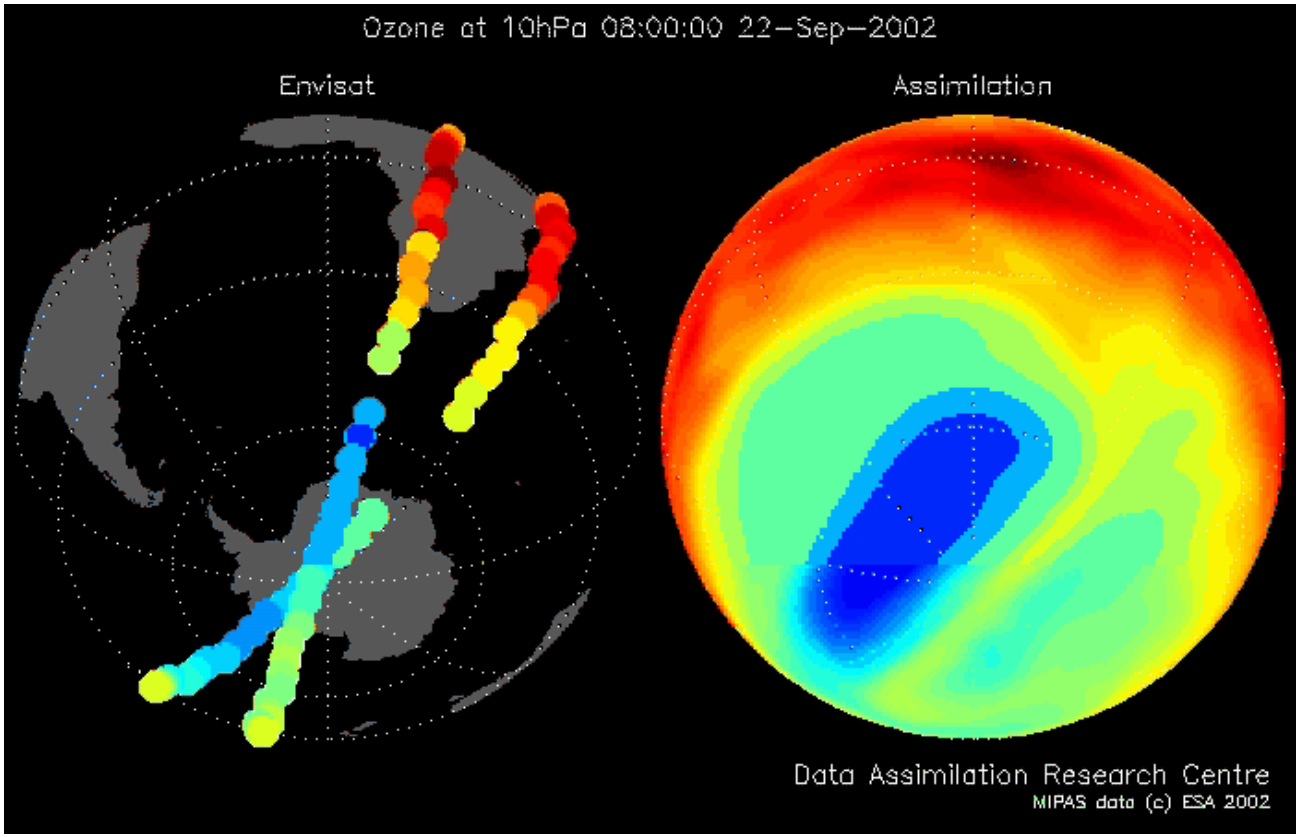
Example

DATA ASSIMILATION



Analysis of ozone hole split in September 2002 from sparse satellite observations



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Theme 8: Informatics

Supporting the community through

Services provided by

Data acquisition

Pres

Discovery

NERC's Earth Observation Data Centre

Dissemination

INFORMATICS

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Archive and Catalogue

Over 222 Tb of data

24 key EO datasets

Serving a diverse user community

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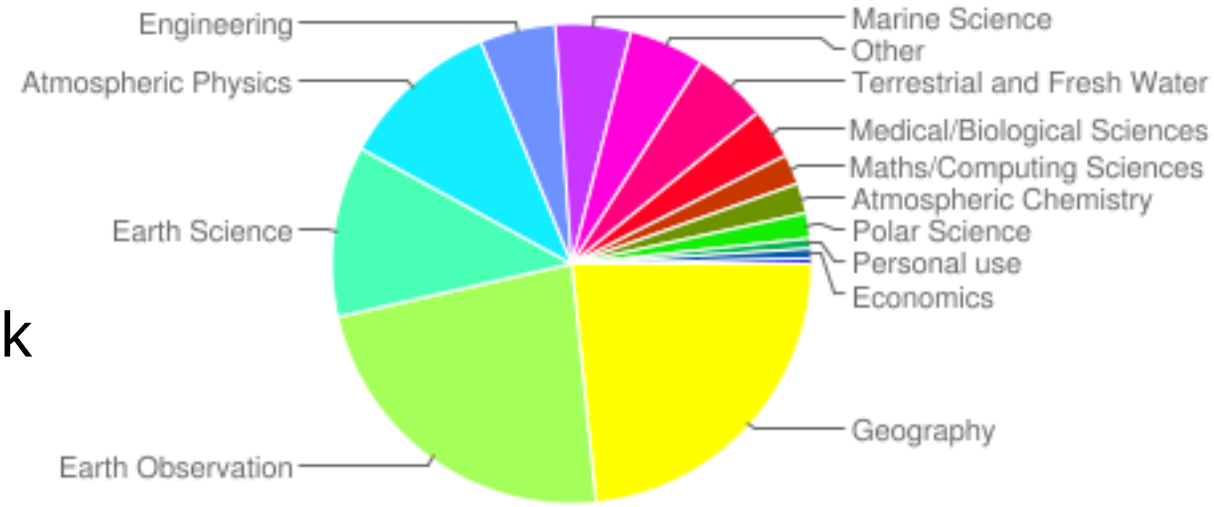
- **Satellite Data**

(A)ATSR
FASIR
Metop AVHRR-3
ESA (A)SAR



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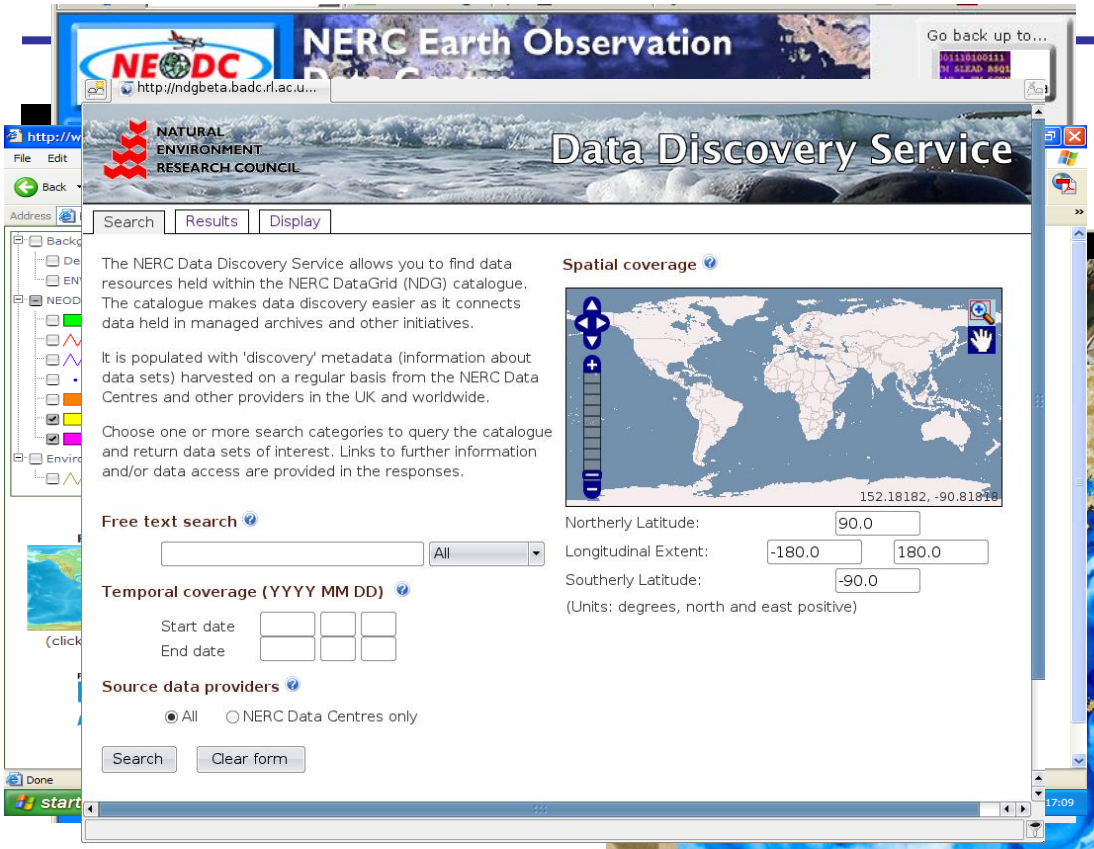
Data access



Multiple datasets

Easily access via NEODC website or by FTP

Discovered through Interactive Map ..

or NERC Discovery Service

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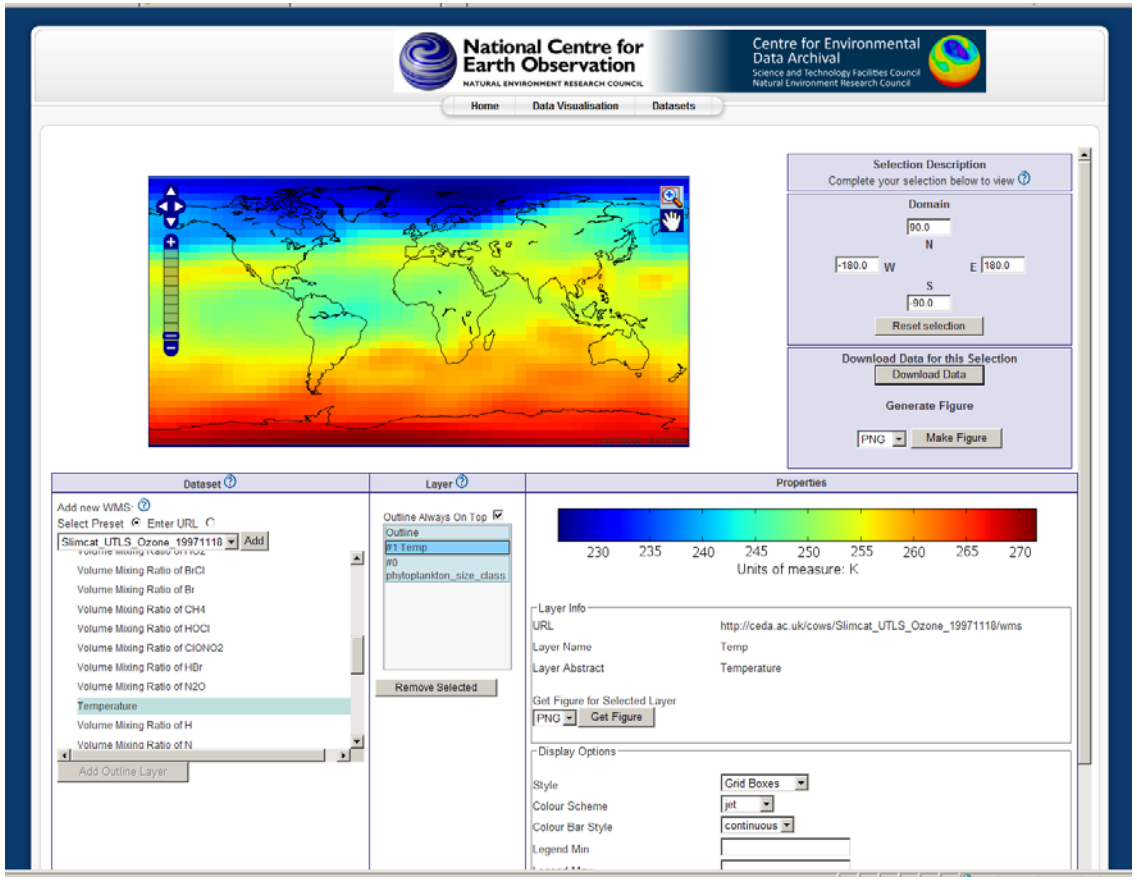
Visualisation

NCEO data visualisation service



Quick, easy visualisation of large datasets

Sub-setting

Plot generation

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NERC National Centre for Earth Observation

NATURAL ENVIRONMENT RESEARCH COUNCIL

Unlocking the full potential of Earth Observation

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NERC Services & Facilities

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Field Spectroscopy Facility
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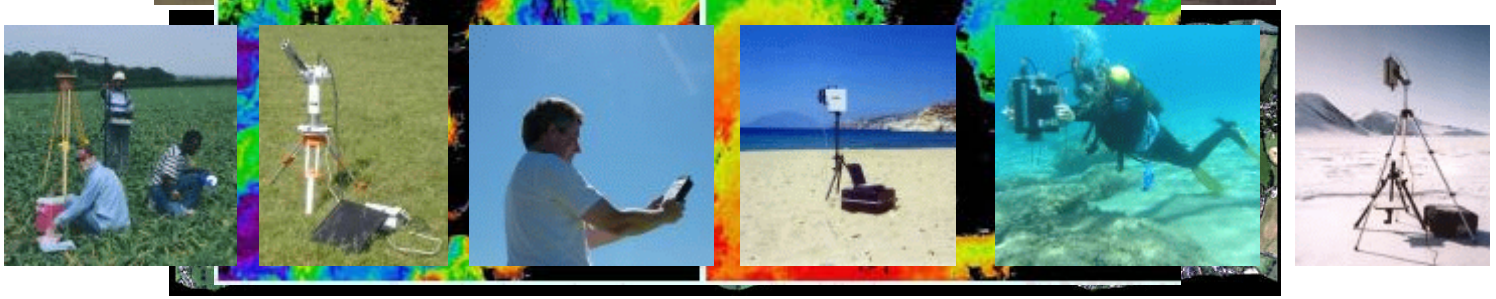
tility (ARSF)

Analysis Service

Maintaining, calibrating and supporting a pool of spectroradiometers for community use

http://fsf.nerc.ac.uk/
fsf@nerc.ac.uk
+44 (0)131 650 5926



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NCEO and the Wider Community

International Space & Innovation Centre at Harwell

"Space is entering a new phase of technical and market development. Exciting science and commercial opportunities exist for the UK that demand greater levels of collaboration and cooperation, nationally and internationally than ever before. By providing the conditions for innovation and a marketplace for UK science and technology, ISIC will play a major role in fulfilling UK ambitions in space."

Andy Shaw, NCEO
Knowledge Exchange Director

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NCEO and the Wider Community

Centre for Earth Observation Instrumentation

2009-10 developments:

Passive Microwave developments (STFC-RAL with Astrium)

CompAQS UVN compact spectrometer (University of Leicester with SSTL)

Hollow wave guides for Laser Heterodyne Radiometer (STFC-RAL with QinetiQ)

GNSS-Reflectometry for measuring sea-surface state (SSTL with NOC, Universities of Surrey and Bath

Thermal IR detectors and on-board processing (Astrium with Selex Galileo, STFC-RAL and University of Leicester)

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