UTILIZING REMOTE SENSING DATA TO ASCERTAIN SOIL MOISTURE APPLICATIONS AND AIR QUALITY CONDITIONS

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Gregory Leptoukh

NASA/Goddard Earth Sciences Data and Information Services Center (GES DISC)

Steven Kempler (NASA/GES DISC)

William Teng (NASA/GES DISC SESDA2)

Lawrence Friedl (NASA/HQ)

Christopher Lynnes (NASA/GES DISC)

Agenda

- NASA Earth Science Applications
- Utilizing NASA Earth Science Data in Societal Applications
- Lessons Learned – Challenges, Mitigations, and Metrics for Success

Abstract

- Recognizing the significance of NASA remote sensing Earth science data in monitoring and better understanding our planet's natural environment, NASA Earth Applied Sciences has implemented the 'Decision Support Through Earth Science Research Results' program.
- Several applications support systems through collaborations with benefiting organizations have been implemented.
- The GES DISC has participated in this program on two projects (one complete, one ongoing), and has had opportune ad hoc collaborations utilizing NASA Earth science data.
- GES DISC's understanding of Earth science missions and resulting data and information enables the GES DISC to identify challenges that come with bringing science data to research applications.
- In this presentation we describe applications research projects utilizing NASA Earth science data and a variety of resulting GES DISC applications support system project experiences. In addition, defining metrics that 'really' evaluate success will be exemplified.

NASA's Earth Sciences Applications Program

- NASA's Applied Research Program focuses on extending Earth science research results to decision making activities.
- Through the 'Decision Support Through Earth Science Research Results' proposal solicitation, NASA strives to develop and demonstrate innovative and practicable applications utilizing NASA Earth science observations and research.

NASA's 7 Earth Science Application Areas

Agricultural

Air Quality

Natural Disasters

Ecological Forecasting

Public Health

Water Resources

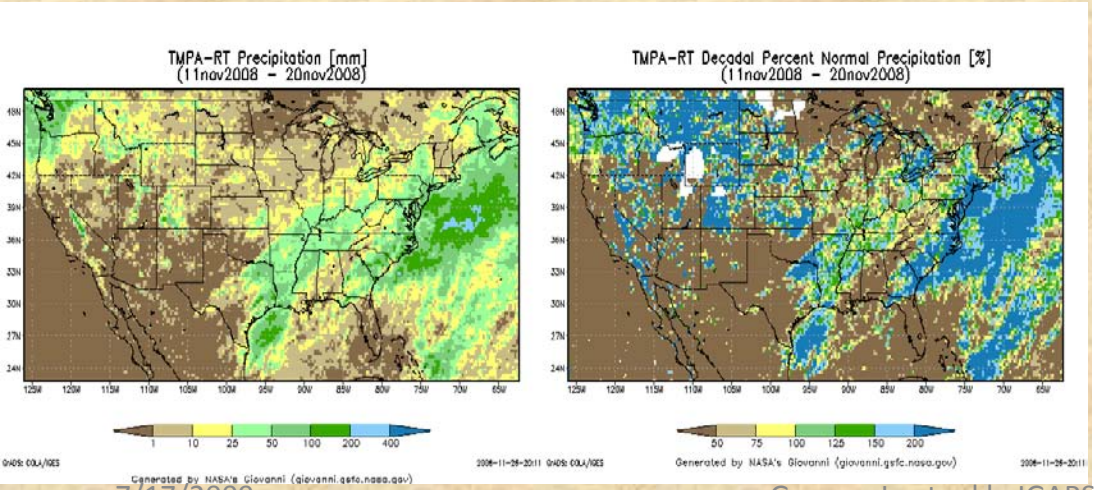
Weather

http://nasascience.nasa.gov/earth-science/applied-sciences

Using NASA TRMM Precipitation Data for Monitoring Crop Conditions

http://daac.gsfc.nasa.gov/agriculture/ (Funded by NASA's REASoN CAN-02-OES-01

The GES DISC **Agricultural Information System (AIS)** provides NASA environmental data to support global crop monitoring at the U. S. Department of Agriculture (USDA) Foreign Agricultural Service (FAS) and the U.N. World Food Program (WFP). FAS improves foreign market access for U.S. agricultural products. WFP uses food monitoring to meet emergency needs and to economic and social development.



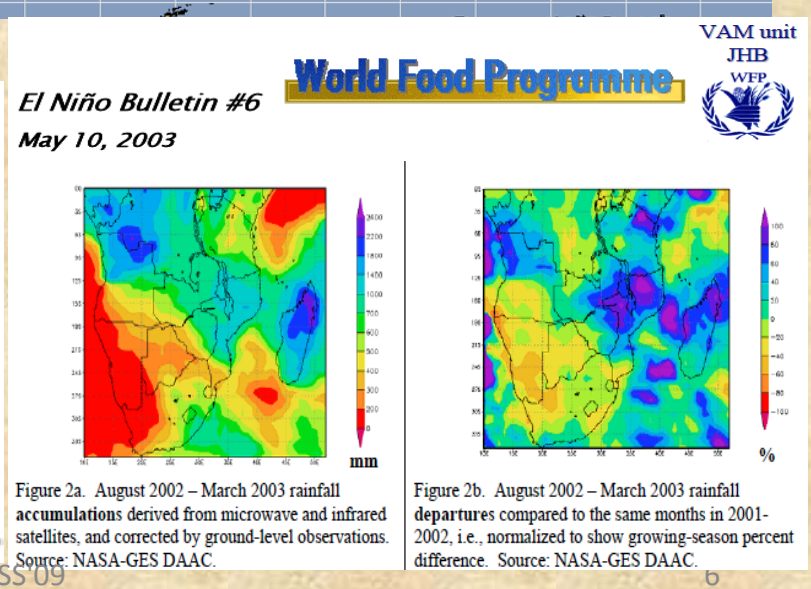


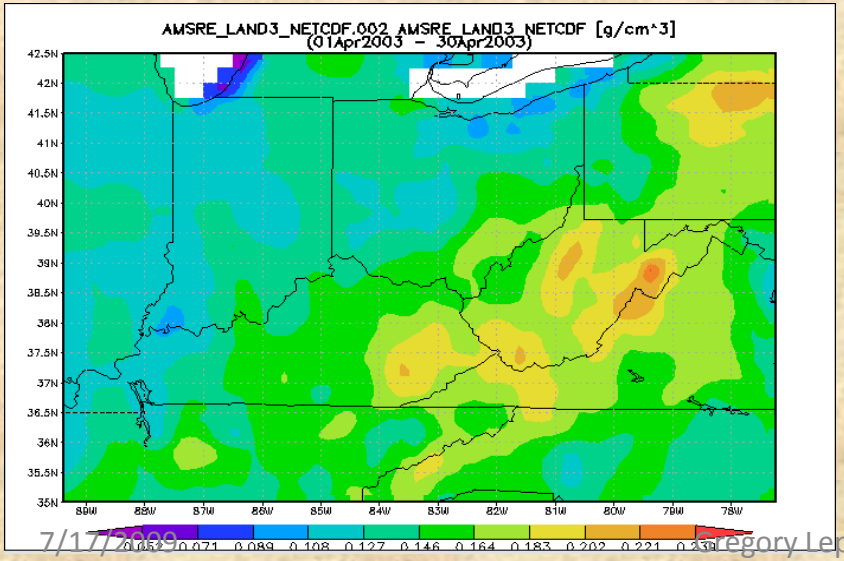
Figure 2a. August 2002 – March 2003 rainfall **accumulations** derived from microwave and infrared satellites, and corrected by ground-level observations. Source: NASA-GES DAAC.

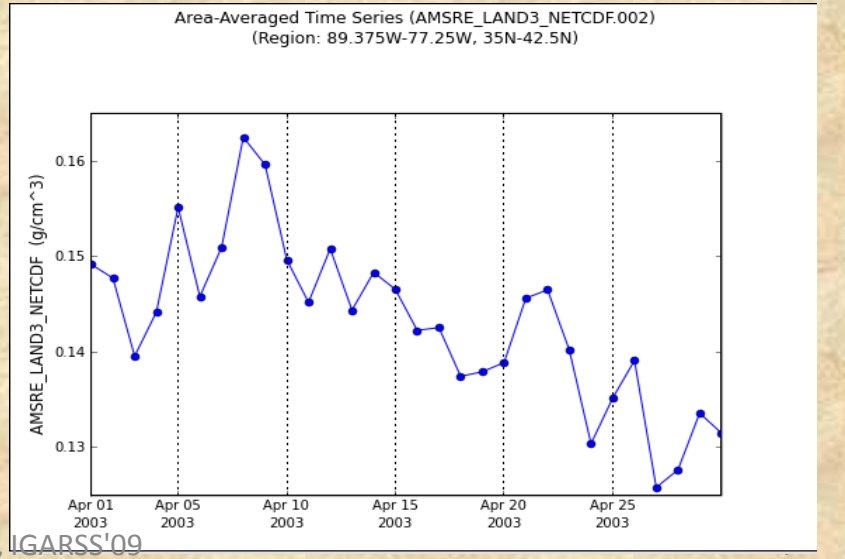
Figure 2b. August 2002 – March 2003 rainfall **departures** compared to the same months in 2001-2002, i.e., normalized to show growing-season percent difference. Source: NASA-GES DAAC.

Using NASA Soil Moisture Data in NASA/ NOAA Land Surface Models to Enhance the National Weather Service River Forecast System (NWSRFS)

(Funded by NASA's ROSES 2005 -DECISIONS NNH05ZDA001N, Yao Liang, PI, currently with the Indiana University Purdue University Indianapolis)

This project focuses on improving evapotranspiration (ET) input to the NWSRFS, a sub-Decision Support System of the NWS's Advanced Weather Interactive Processing System (AWIPS). By integrating NASA's Aqua/AMSR-E and TRMM/TMI soil moisture products into land surface models that provide improved ET data seamlessly to the NWSRFS, the capability for flood and drought forecasting and disaster management is expected to be greatly enhanced.

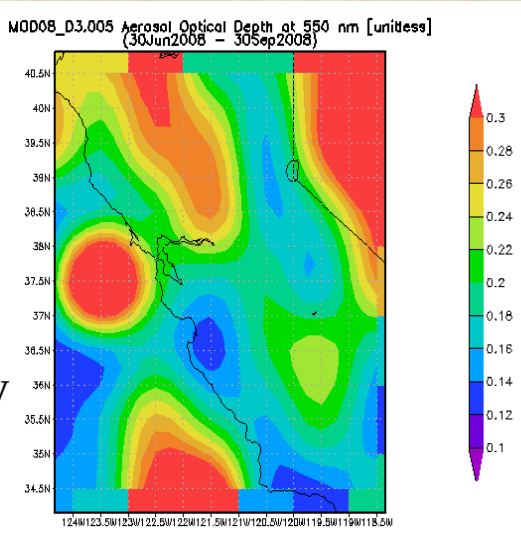


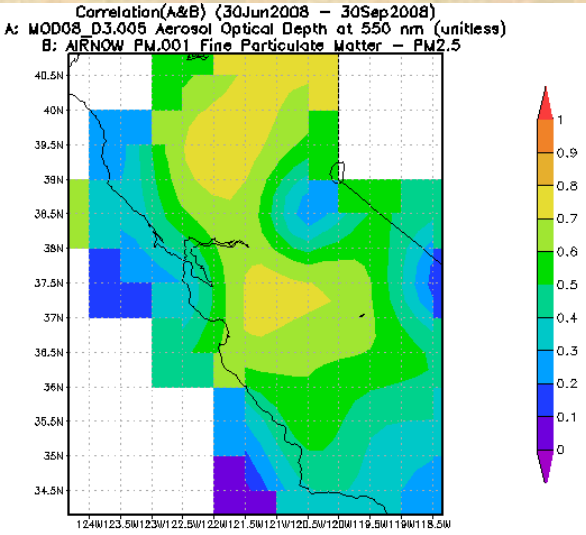


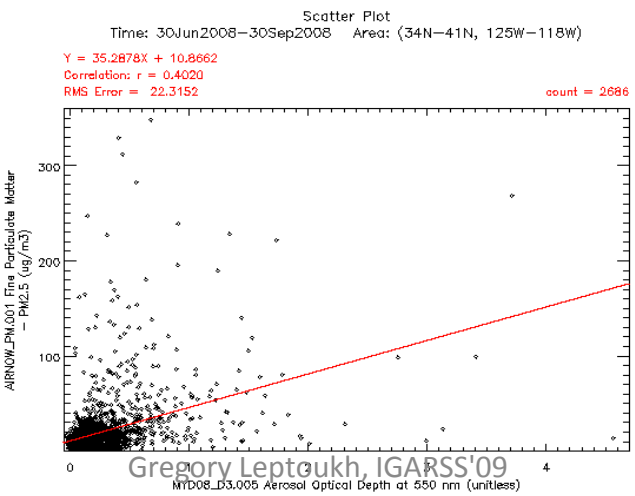
Using NASA Atmospheric Data for Air Quality Monitoring

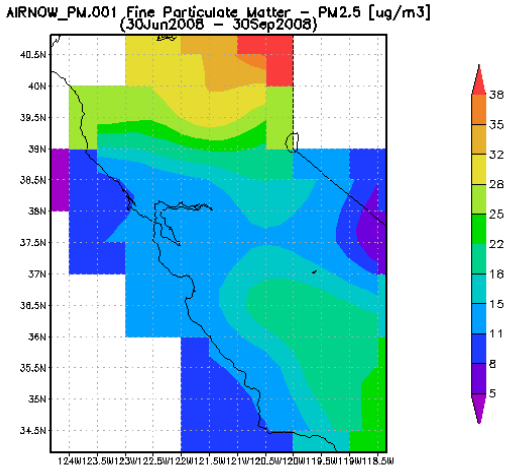
http://disc.sci.gsfc.nasa.gov/giovanni/giovanni_air_quality_instance.shtml

The **Giovanni Air Quality Instance** provides visualization and exploration of remotely-sensed and *in situ* data products related to air quality. The Air Quality instance features Environmental Protection Agency AIRNow $PM_{2.5}$ data, aerosol and cloud data products from the Moderate Resolution Imaging Spectroradiometer (MODIS), and aerosol products from the Ozone Monitoring Instrument (OMI). Lat-long and correlation maps, animation, time series, scatter plots, and statistics are available through the use of Giovanni.









Satellite data for applications

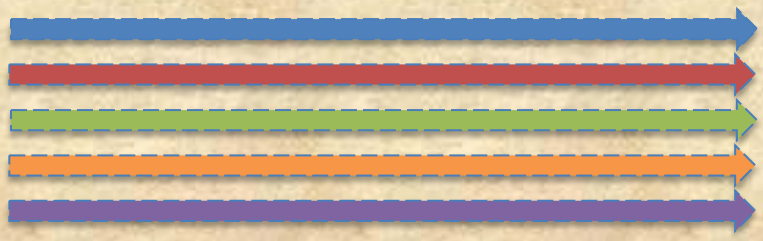
What is expected from satellites?

Provide “yes” or “no” recommendations to decision makers

Satellite data for applications

Satellites

TRMM
Aura
Terra
Aqua
CALIPSO

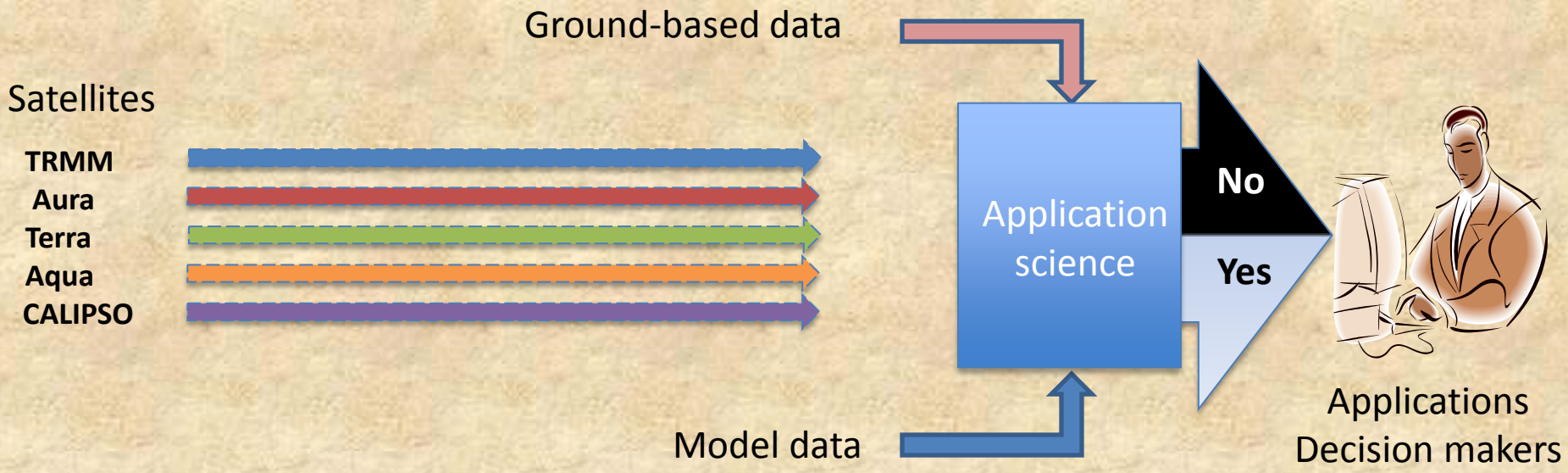


Void

Applications
Decision makers

Reality without magic (in many cases)

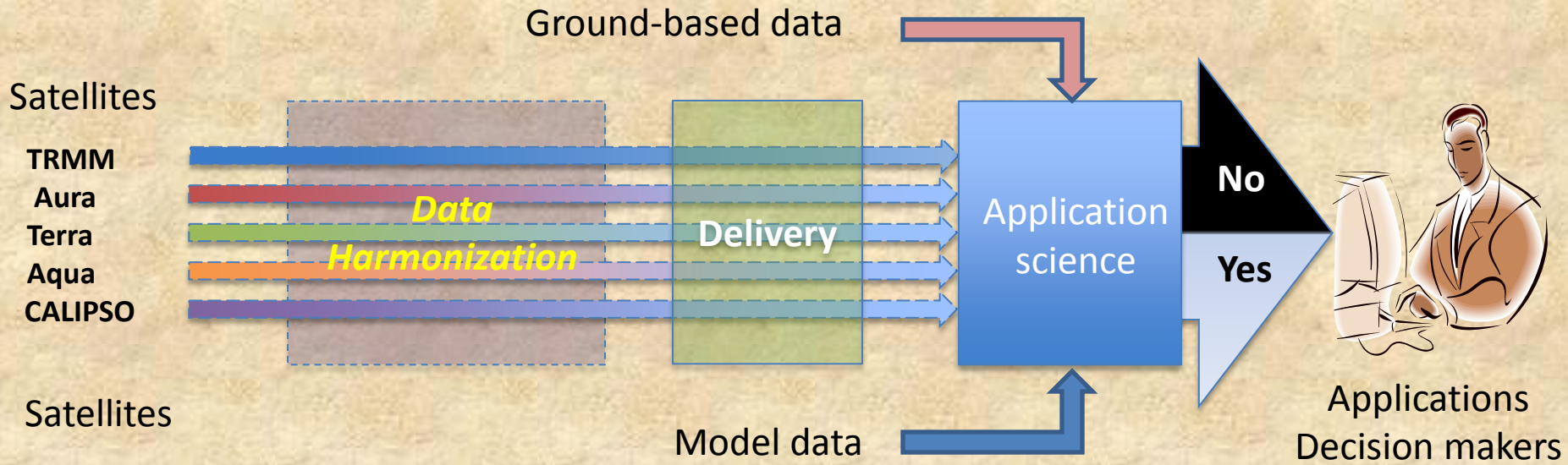
Satellite data for applications



Satellite data can't be readily used due to complexity of remote sensing formats, lack of convenient delivery

Applications scientists traditionally use ground-based data and model forecast to come up with "yes" or "no" recommendations for decision makers

Satellite data for applications



No magic – just working together

Data for Science vs. Applications

	For Science	For Applications
Timeliness of availability	Not urgent for science research	When needed
System Sustainability	Part of Science Mission	Often negotiated
Data Documentation	Algorithms; production; product descriptions; product validation and limitations	Interpretation of products for application; Relationship of new products to existing products
Data Requirements	Clear science goals at project conception	Science data to support application
Desired Data Representation	Data for precise analysis; Images for browse	Images for data display, plots, and reporting; Sometimes data for statistical analysis
Spatial and Temporal Data Resolution	Dependent on science research	The higher the resolution the better
Data Validation	Data must be of the highest quality	Data must be of the highest quality, but quality may be traded for timeliness

Using Science Research Data for Applications - Challenges

- Translating science data for application systems
  - Understanding the application to determine relevant science data inputs
  - Determining the best way to communicate science content to application researchers
  - Determining the appropriate level of detail
  - Providing data formats that can be easily understood and transparently used
  - Co-registering science data with applications data (often collected on boundaries)
- Determining the right balance: Highly validated data vs. acquisition timeliness of data.
  - How highly validated do NASA data NEED to be for applications?
  - How will data (or images) be used?
- Meeting required spatial and temporal resolution to facilitate application data usage
- Changing the application tools paradigm by demonstrating the benefits of employing new tools and technologies
- Maintaining continuous near real time science data inputs (i.e., timeliness).
- Overcoming inertia in the current applications research environment.
- Integrating new data and technologies seamlessly into an operational environment
- Maintaining resources needed to sustain the operational application data system: New data sets, new tools, new technologies
- Continuity of NASA data

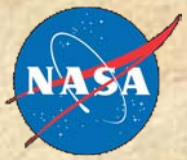
Using Science Research Data for Applications – Challenge Mitigations

- Keep data transfer methods flexible using the latest technology
- Acquire deep understanding of the application environment (AE) and needs (i.e., follow the consumption chain from usage scenarios back to relevant data)
- Strive for as seamless integration of project data and services into existing AE.
- Get stakeholders to really feel they have a stake in the project. The raison d'être for the project should come from the AE as well as data
- Plan for changes : AEs are operational and their needs could change.
- Involve the expertise of science data providers (e.g., algorithm developer), preferably as members of the collaboration.
- Plan for training in use of science data and services by AE personnel.
- Transition AE into a sustainable framework
  - Build for low maintenance costs
  - Understand upfront, with the application organization, how to sustain the AE
  - Design for integration with the applications organization systems
  - Document the AE, development and operations

Using Science Research Data for Applications – Metrics for Success

- Science data arrives on time to the application at a **percent of the time** to be specified by the application organization
- Science data utilization in application data system results in a marked **improvement in prediction** correctness. Before and after prediction analysis should be planned
- Science data are **routinely used** by a specified percent of the applications organization's staff
- **Number of references, reports, or publications** that cite science data as input to application
- **Reuse is success**: Number of new potential applications users of NASA science data based on previous success
- Applications users seeking to **further collaborate** (e.g., requesting additional useful science data products)

E-mail suggestions to: Steven.J.Kempler@nasa.gov, Gregory.Leptoukh@nasa.gov



Thank you