Remote Sensing Applications for Improved Water Resources Management

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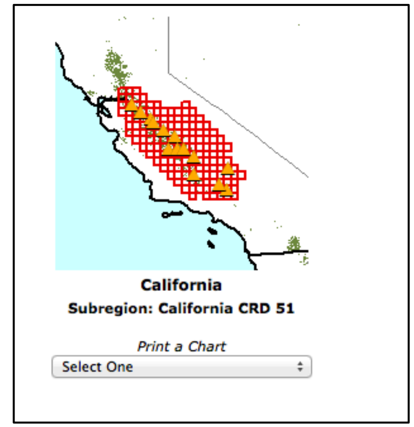
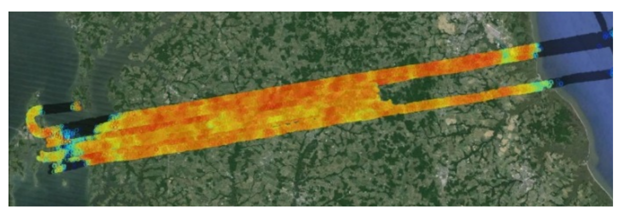
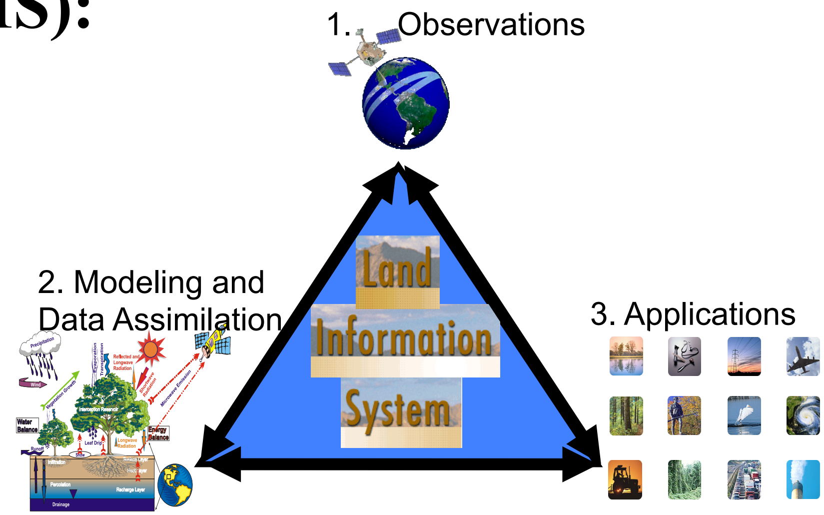
Water Science Activities at NASA Goddard Space Flight Center

- Observational Hydrology
- Hydrologic Modeling
    - Precipitation
    - Soil moisture
    - Terrestrial Water Storage
    - Evapotranspiration
    - Flow Routing
  - Snow cover and amount
  - Surface water height
  - Irrigation
- Algorithm Development
- Sensor Development
  - Calibration and Validation
- Data Assimilation
- **Applications**

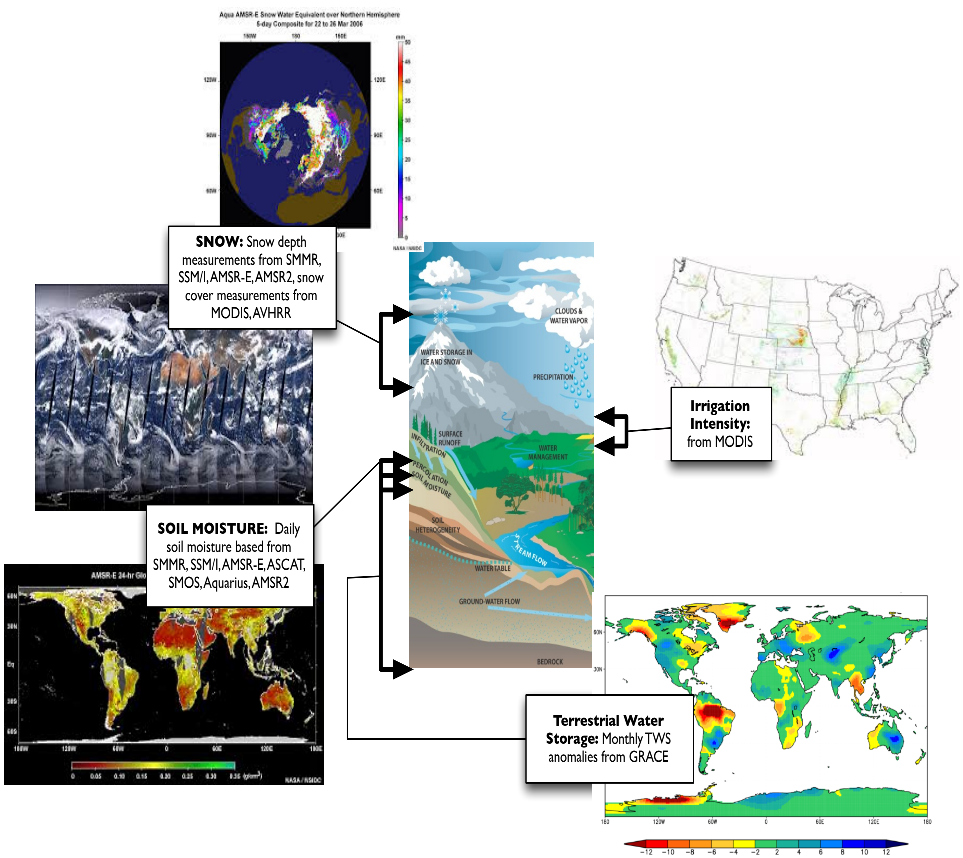




Land Information System (LIS): A modeling and data assimilation environment



LIS provides a comprehensive environment for land surface modeling and assimilation of remote sensing observations and connects them to real-world applications



Example of a LIS modeling scenario : Enabling data assimilation in the North American Land Data Assimilation System (NLDAS)

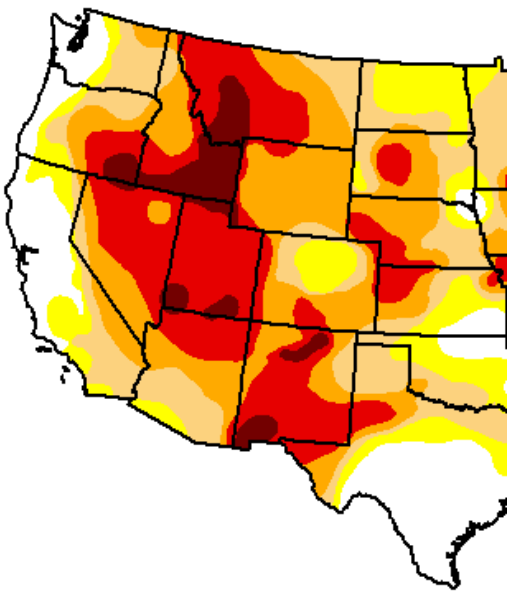
LIS incorporates soil moisture, snow depth, snow cover, irrigation intensity and terrestrial water storage information from a variety of sensors.

C. Peters-Lidard, NASA GSFC

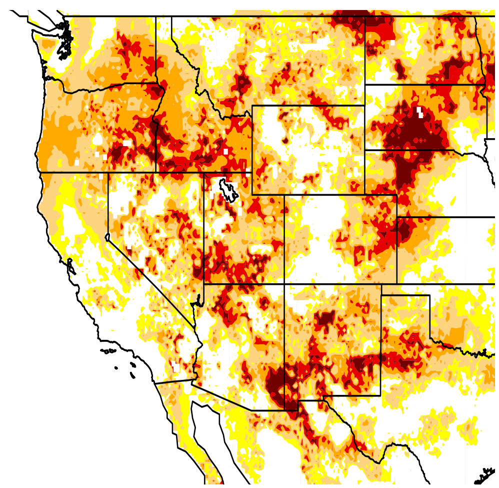
Example comparison of drought estimates from various NLDAS/LIS data assimilation scenarios

Nov 2003

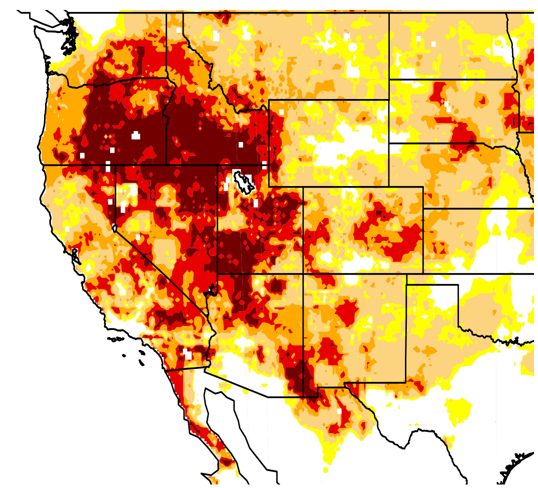
US Drought Monitor

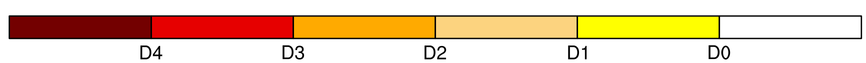


Data Assimilation (soil moisture) with Noah LSM



Data Assimilation (TWS) with Catchment LSM





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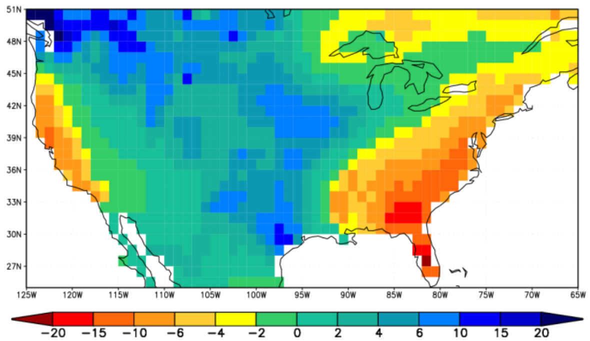
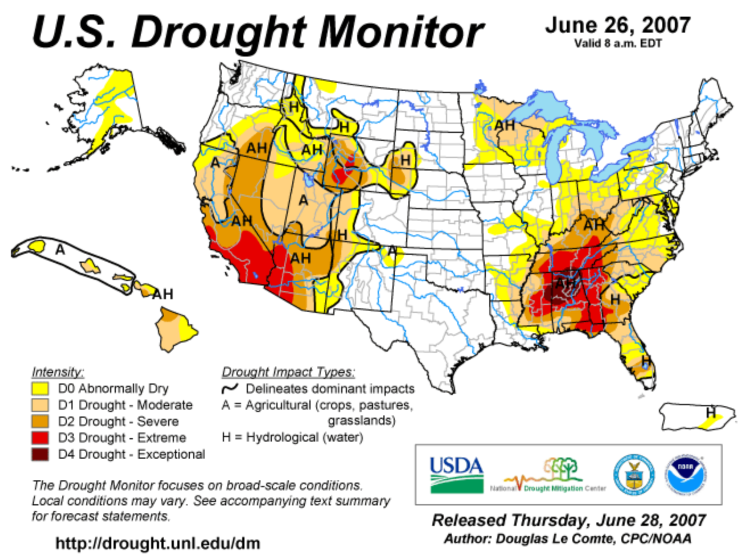
GRACE Application for Drought Monitoring

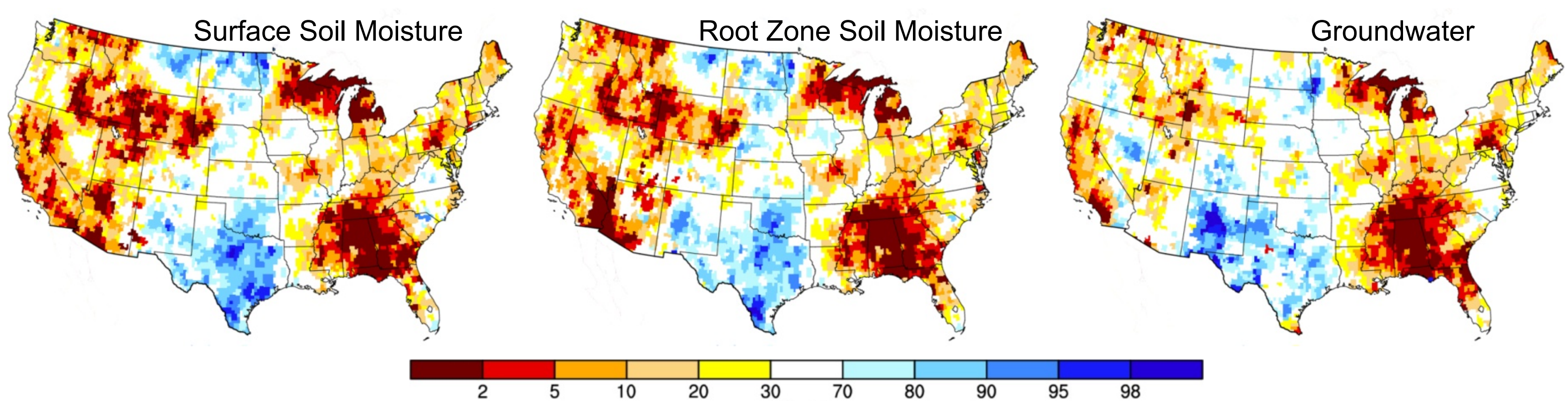


GRACE terrestrial water storage anomalies (cm equivalent height of water) for June 2007.



U.S. Drought Monitor product for 26 June 2007.

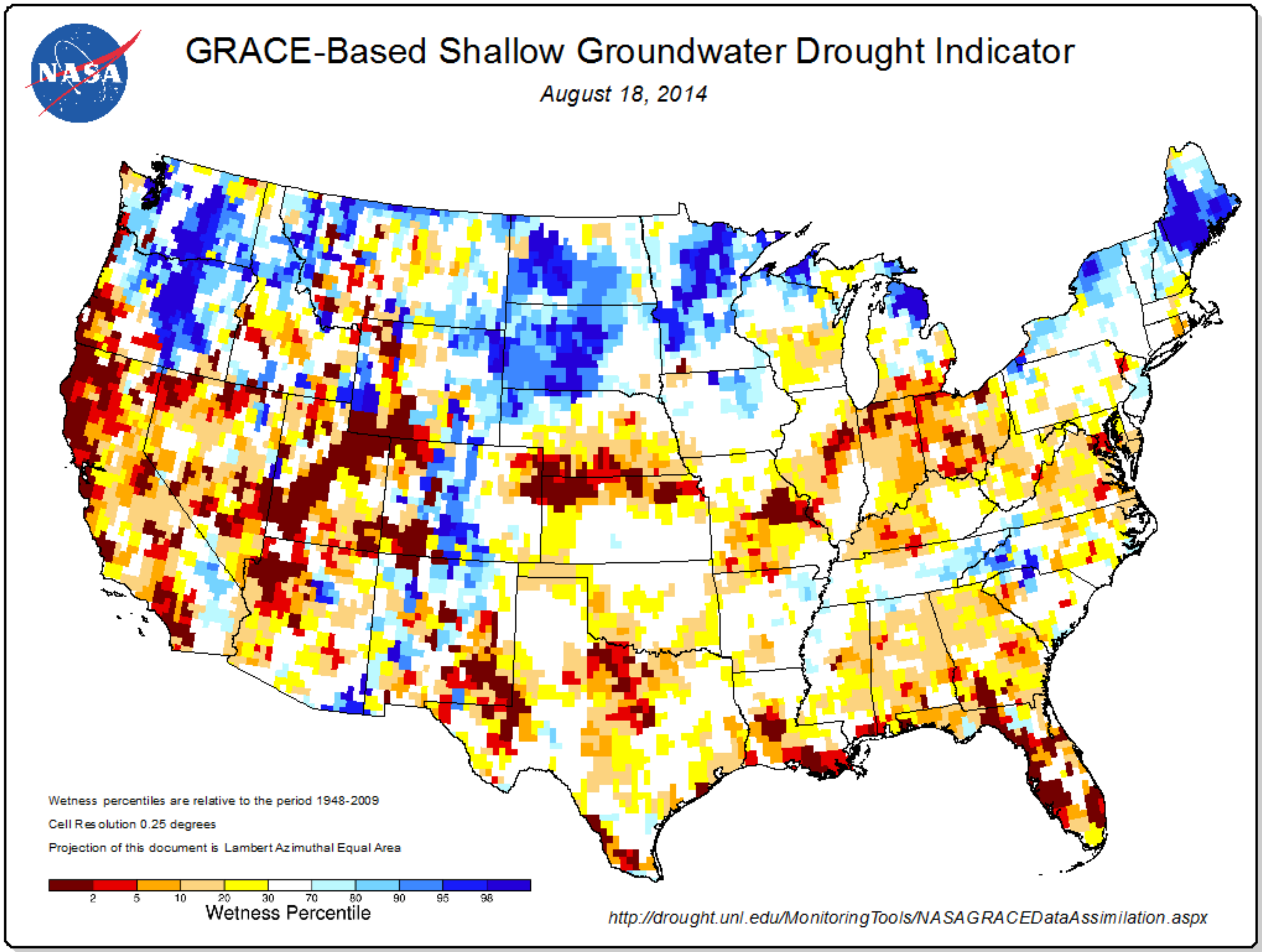
New process integrates data from GRACE and other satellites to produce timely information on wetness conditions at all levels in the soil column, including groundwater. For current maps and more info, see http://www.drought.unl.edu/MonitoringTools.aspx



Drought indicators from GRACE data assimilation (wetness percentiles relative to the period 1948-present) for 26 June 2007.

M. Rodell, NASA GSFC

GRACE Data Assimilation for Drought Monitoring



http://drought.unl.edu/MonitoringTools/NASAGRACEDataAssimilation.aspx

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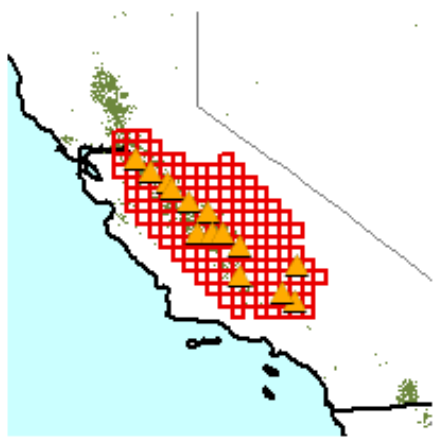
Global Soil Moisture Product Operationally Applied by USDA Foreign Agricultural Service

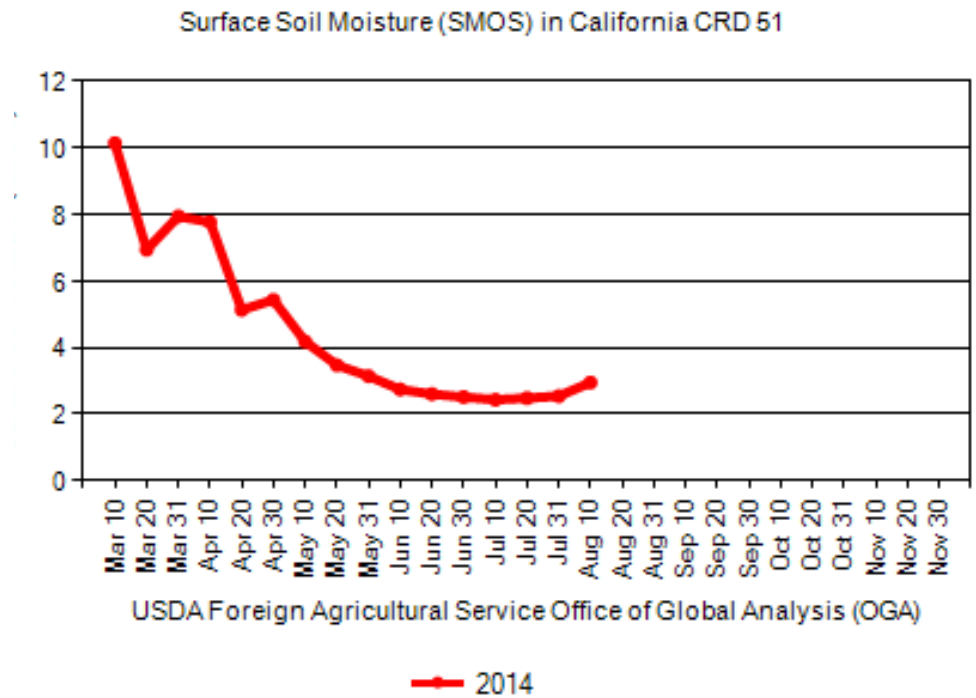
Toolbox | Weather | Soil Moisture and Crop Models | Vegetation Index | Growing Season | Additional Resources

Western United States, South West
2014 Summer Crop (Mar - Nov)
(Last Chart Update - 8/10/2014)



California
Subregion: California CRD 51

Print a Chart
Select One



http://www.pecad.fas.usda.gov/cropexplorer/

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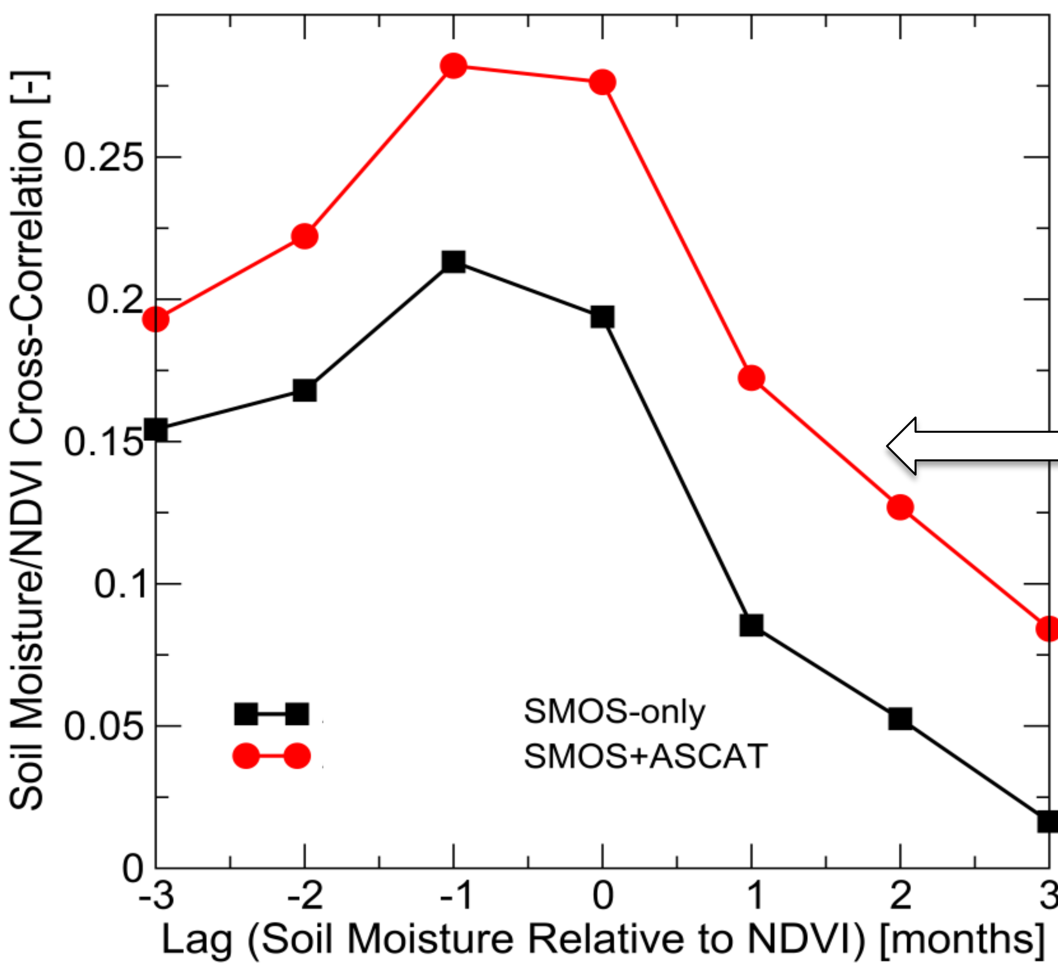
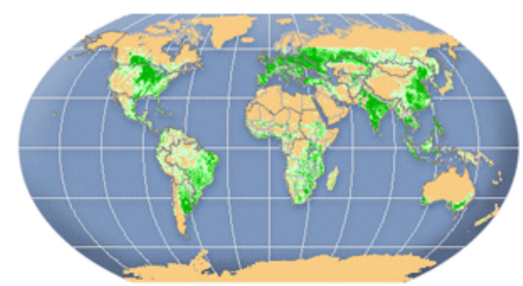
Improved Agricultural Drought Forecasting Using a Soil Moisture Active Passive Compliant Prototype System



"SMAP Active" = ASCAT Scatterometer

"SMAP Passive" = SMOS Radiometer

Clear benefits to integrating both active and passive soil moisture products!

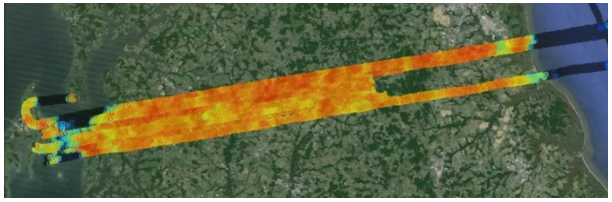


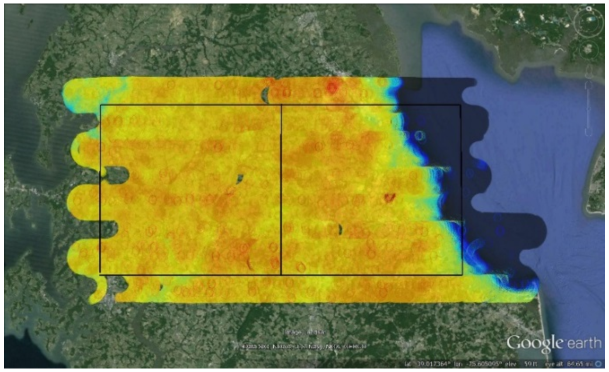
W. Crow, USDA ARS
J. Bolten, NASA GSFC

Scanning L-band Active Passive (SLAP): a new Goddard airborne simulator for SMAP

Ed Kim/617, Tammy Faulkner/ASRC & 617, Albert Wu/ASRC & 617, Hemanshu Patel/Emergent & 617

- SLAP is an airborne simulator for SMAP, with both passive and active microwave imaging capability that matches SMAP's channels and scan geometry…plus enhanced capabilities not found in SMAP.
- SLAP can observe soil moisture, soil freeze/thaw state, ocean salinity, sea ice, & ice sheets.
- Compatible with several new aircraft plus the usual P-3, C-130, & C-23; it is currently installed on a King Air from NASA Langley (top photo).
  - Radiometer is 4-pol (same as SMAP); Radar is quad-pol (SMAP is tri-pol).
  - Equivalent of SMAP Radio Frequency Interference (RFI) processor.
- Example radiometer images from first flights in Dec, 2013 (middle & bottom images) demonstrate typical capabilities: 2 flights in 1 day.
- 1st flight (middle image): low altitude/high resolution—200m resolution/2000ft AGL.
- 2nd flight same day (bottom image) mid-altitude (11000 ft) mapping of two SMAP 36 X 36 km grid cells in <3 hrs with 1km resolution.
- SLAP made soil moisture observations for the GPM iPHEX campaign in May 2014. SLAP is preparing to support SMAP post-launch cal/val in the summer of 2015.





For more info, contact ed.kim@nasa.gov

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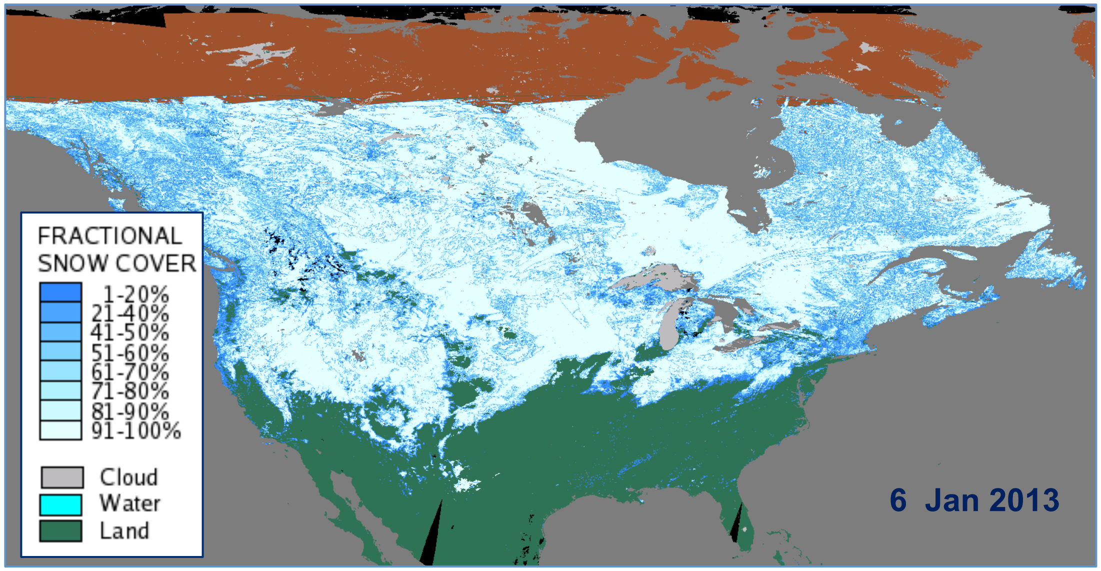
Standard MODIS Snow-Cover Map Products



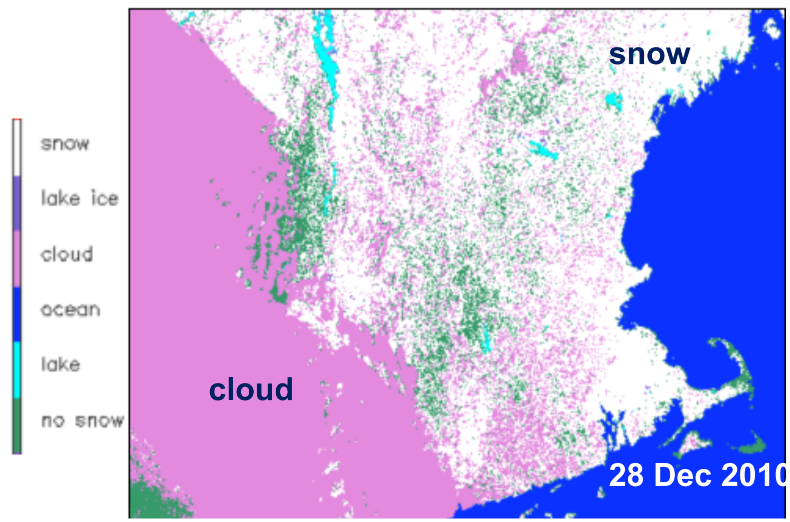
MODIS cloud gap filled (CGF) fractional snow cover map

MODIS snow-cover maps have been used for:

•Stream-discharge modeling to support drought and flooding decisions;
•Updating land-surface models, including calculating snow-water equivalent in the models;
•Validating model results;
•Monitoring snow-cover changes over time at regional and hemispheric scales;
•Developing climate-quality data records of snow cover.

Ordering Statistics: 7,417,521 MODIS snow product granules ordered in first 6 mos. of 2014 (NSIDC).

•Products are available daily at up to 500-m resolution (2000 – present);
•Dataset and algorithms were developed in the Hydrological Sciences and the Cryospheric Sciences Laboratories.



MODIS binary snow map shows the result of a major snowstorm in the northeastern U.S.

Hall & Riggs, 2007; Hall et al., 2010

D.K. Hall & G.A. Riggs, NASA GSFC

Land and Atmospheres Near-real-time Capability for EOS (LANCE-MODIS) system

GSFC 614.5

MODAPS-MODIS
L2:STD

LANCE-MODIS
L2:NRT

GSFC 614.4

GIMMS GLAM
L3:NRT+STD

Server Nodes (3 for 2)
Intel X5667+X5677
≤ 144 GB RAM

RAID Subsystems
8 Gb FC
200 TB

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LANCE-MODIS

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About

LANCE-MODIS will operate on a 7x24 hour basis. LANCE-MODIS has two standalone systems that use different network routes. It is expected that this redundancy will reduce the system downtime to less than 1%.

Whereas the standard MODIS forward processing acquires 2-hour L0 files for Aqua and Terra from EDOS within 7-8 hours of real time, LANCE-MODIS acquires session-based L0 files from EDOS and the end of the session is available within 10-30 minutes after real time. LANCE-MODIS uses the Terra attitude and ephemeris data entrained in the L0 data. However, for Aqua the attitude and ephemeris data are acquired from the EDOS rate buffer. All of the MODIS Level 1 (L1), L2, and L3 products generated by LANCE-MODIS have been modified to add "NRT" metadata to the filenames to enable the products to be distinguished from the MODIS standard forward-processed products. LANCE-MODIS acquires all of the ancillary products from the data suppliers. The production rules for some of the science codes have been relaxed with respect to these ancillary data to allow the data products to be generated within 3 hours of real time.

Data products are archived in a rolling archive for 7+ days and are available for distribution by direct access to the FTP sites.

LANCE-MODIS Details:

- Hardware Configuration
- Data Flows for MODIS
- Distribution and Latency Metrics

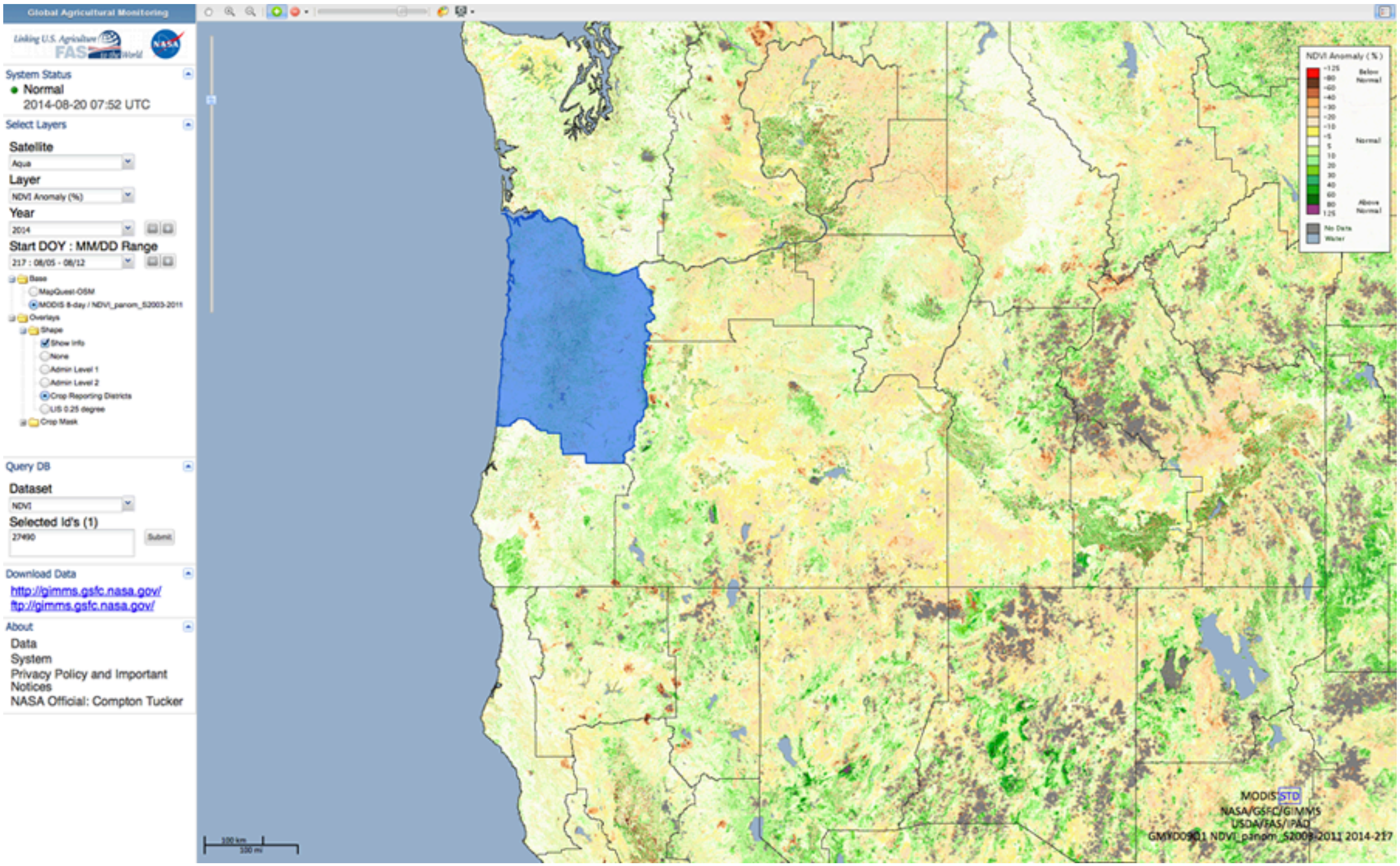
+ Privacy Policy and Important Notices

Webmaster: Karen Horrocks
NASA Official: Ed Masuoka

http://lance-modis.eosdis.nasa.gov/about/

C. Tucker, NASA GSFC

Multiple shape composites with mask selected



Can choose to query for either NDVI or NDWI

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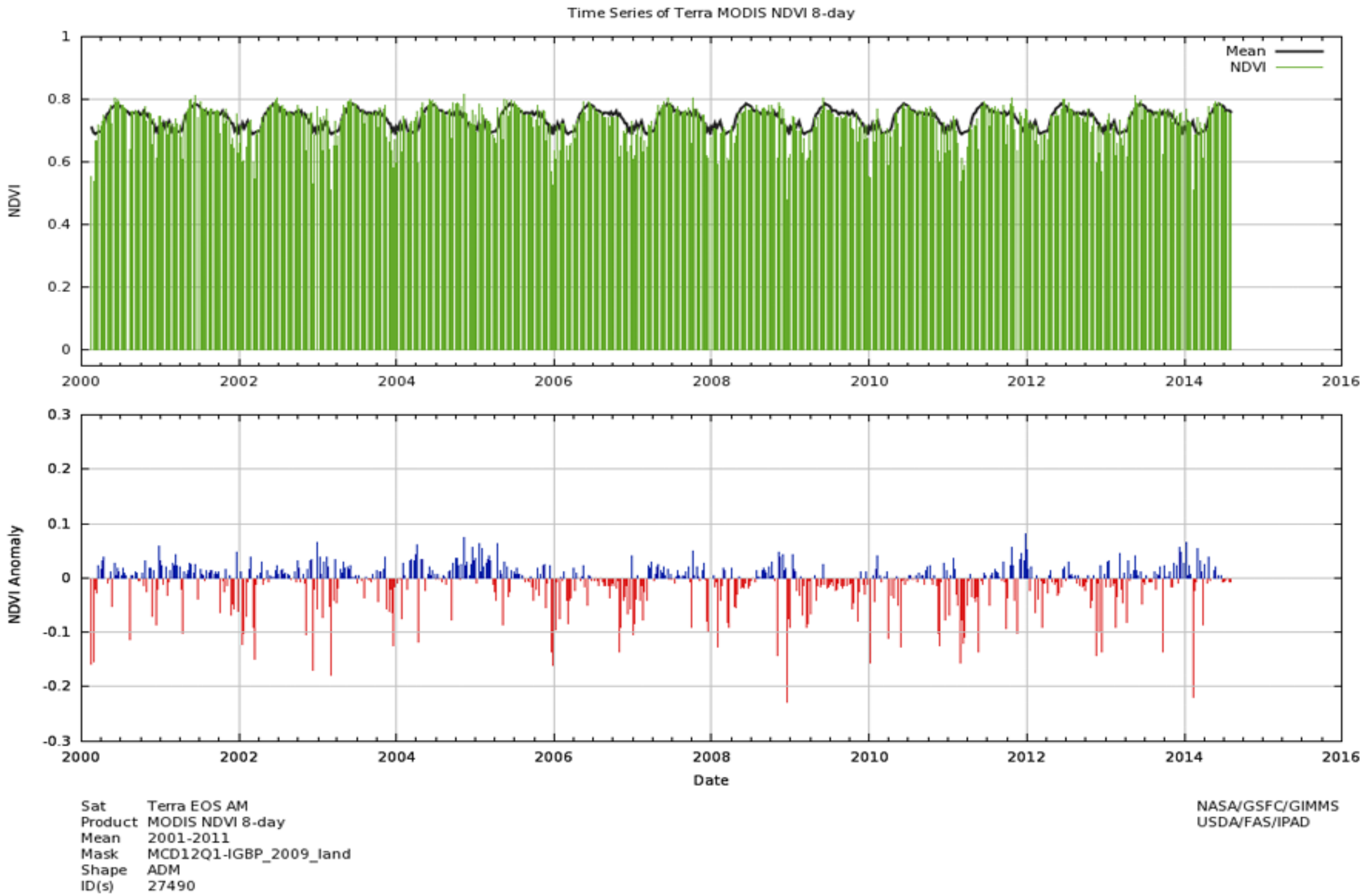
NDVI Time Series and Anomalies



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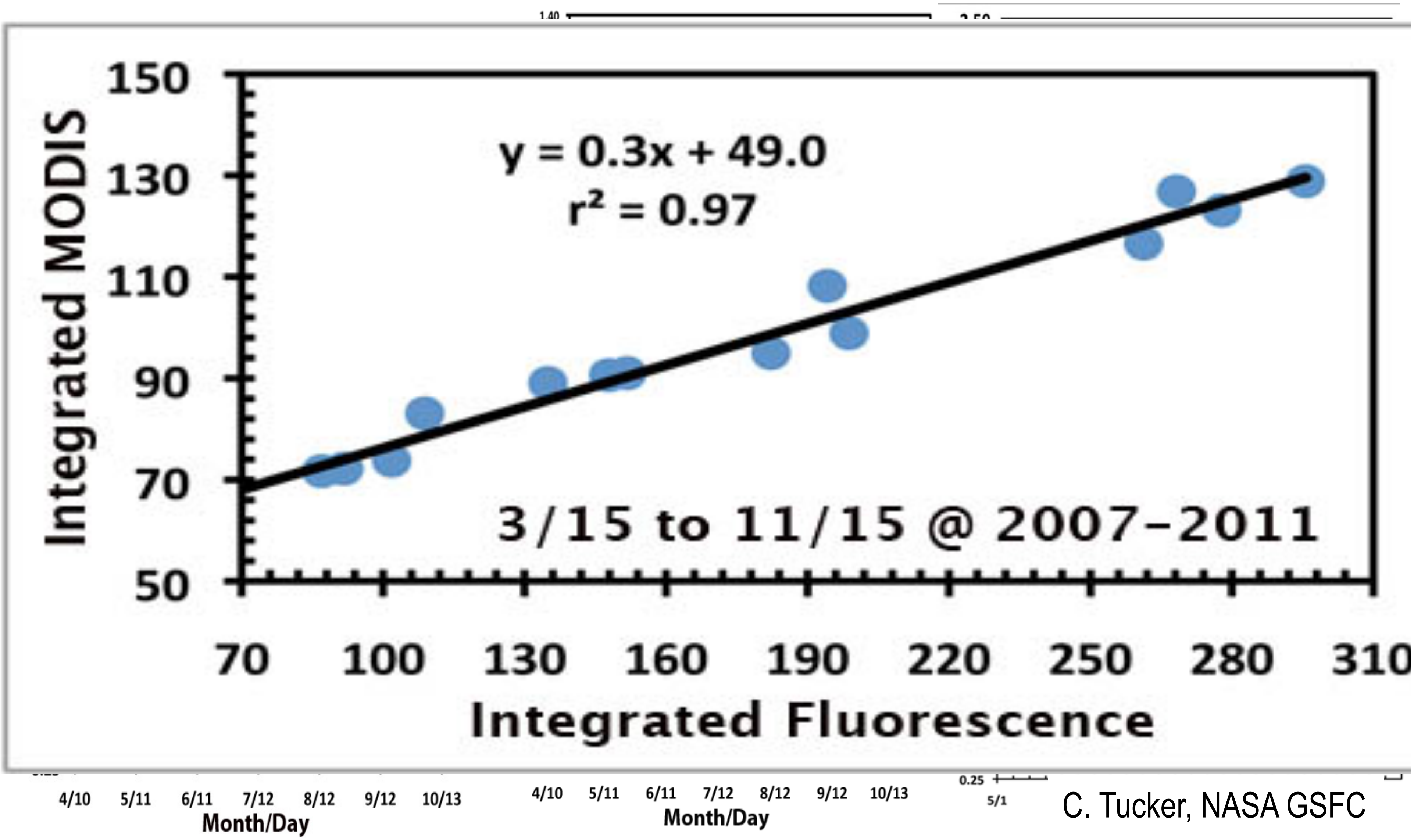
2010 Russian Drought Monitored by GOME2 Integrated Chlorophyll Florescence

(Global Ozone Monitoring Experiment–2)



C. Tucker, NASA GSFC

Thank You

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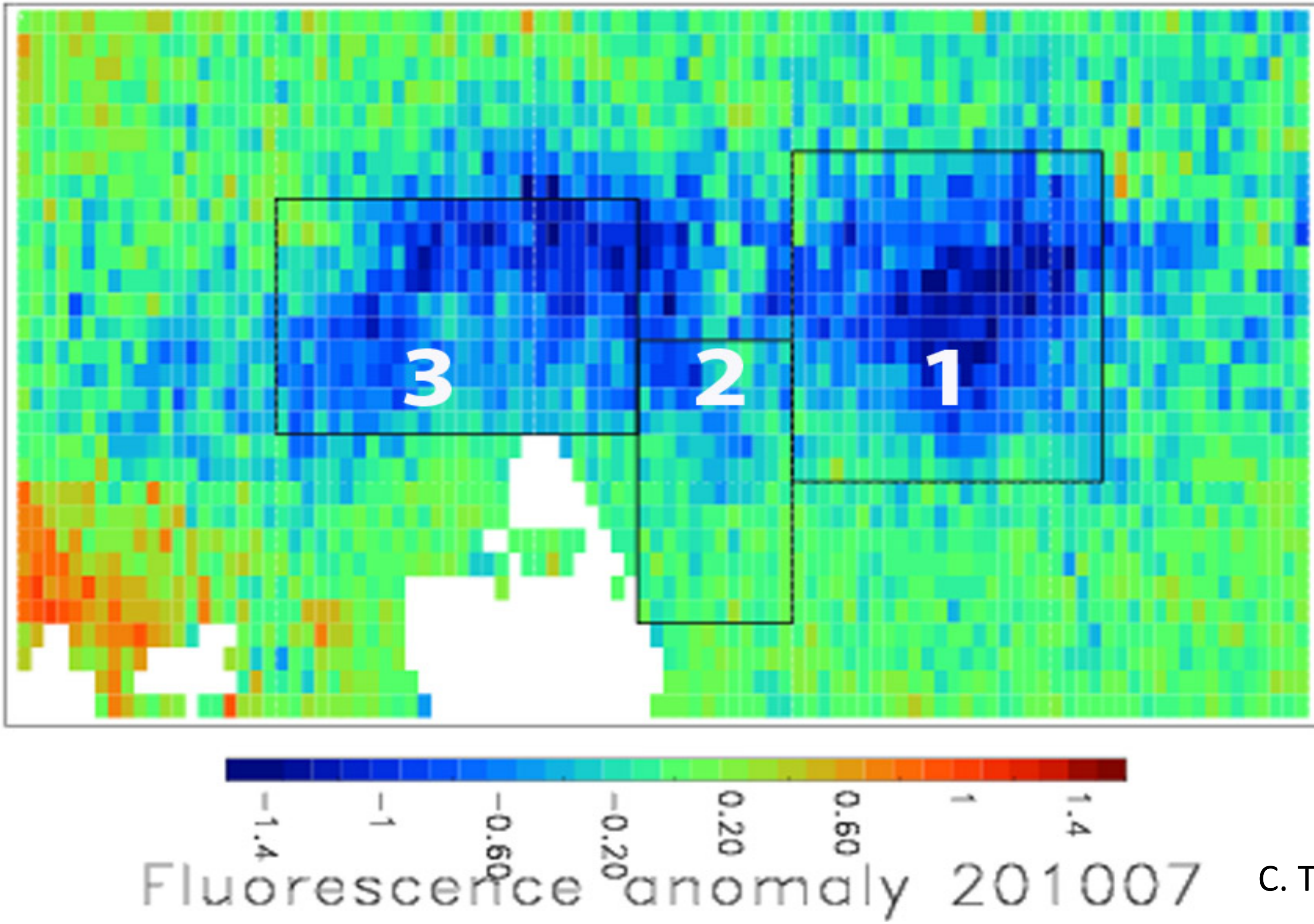
Extra Slides

2010 Russian Drought Monitored by Integrated Florescence

GOME-2 data



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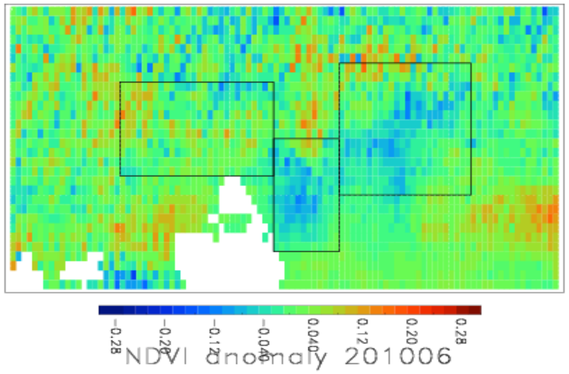
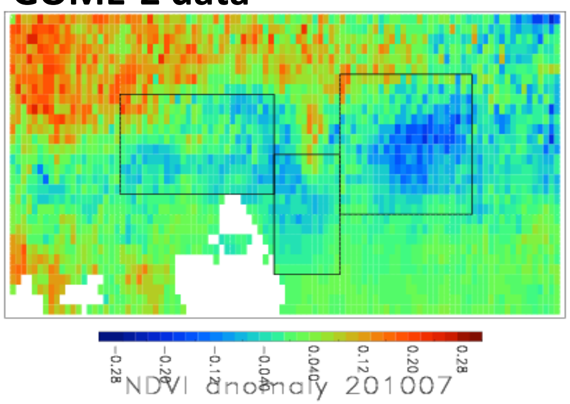
2010 Russian Drought

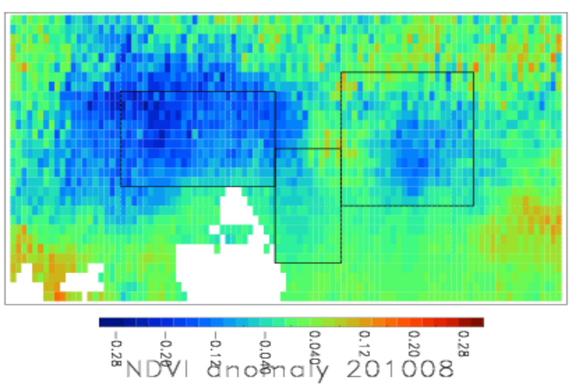
GOME-2 data

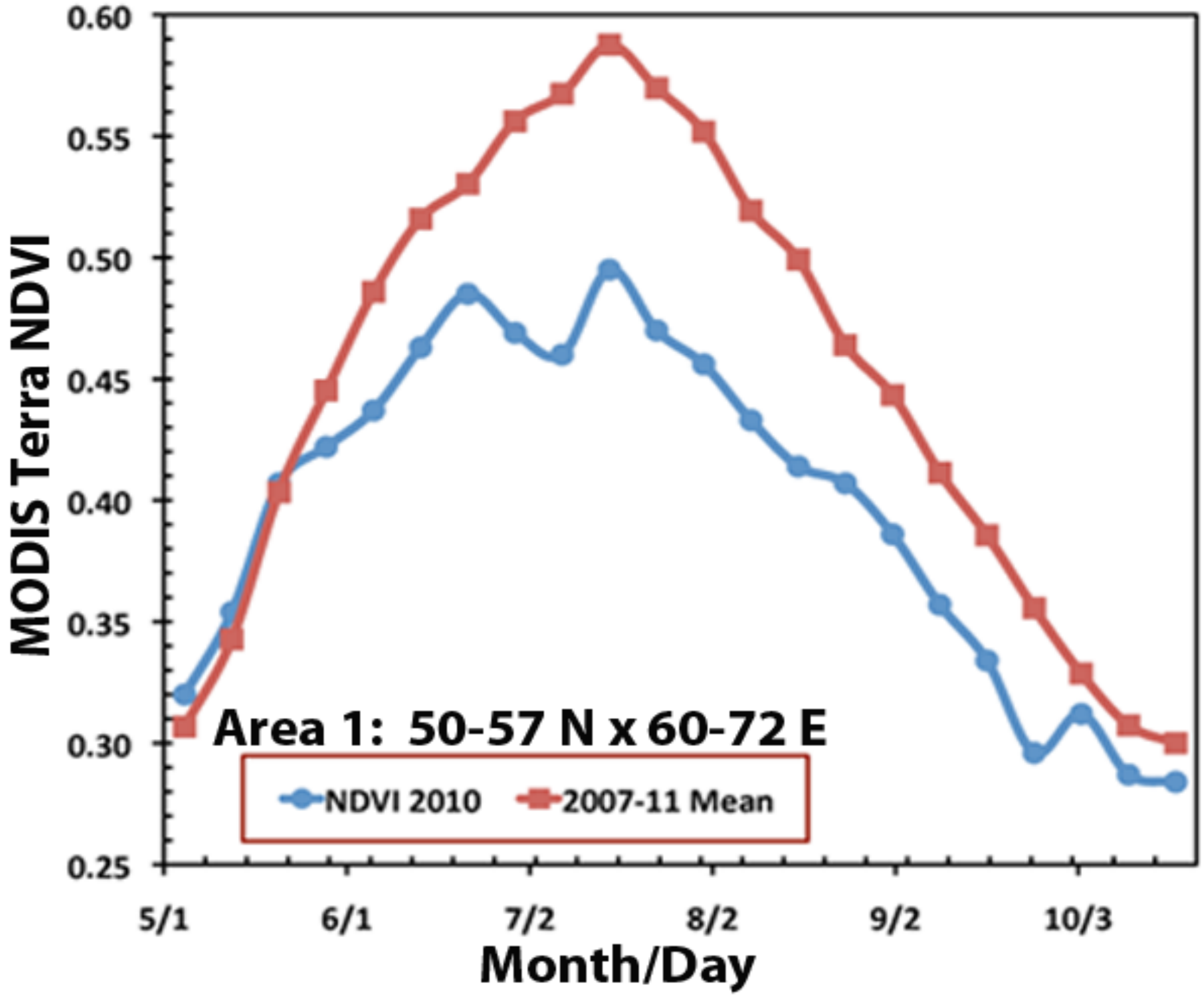


GOME-2 data



GOME-2 data





GOME-2 NDVI ≠ MODIS NDVI C. Tucker

Given MODIS $10^2 \geq$ fluorescence spatial resolution with 250 m NDVI, what can chlorophyll fluorescence contribute to Earth & Space science?

- Coarse resolution (10^1-$10^2 \geq$ NDVI data) from cloudy areas e.g., tropical forests in rainy season, Arctic summer, etc.
- Investigate spectral character of fluorescence?
- Compare derivatives of fluorescence & NDVI?
- Space science exobiology uses – Fraunhofer line emissions on exoplanets?
- Better measurements of fluorescence
- Build something and test it!

C. Tucker