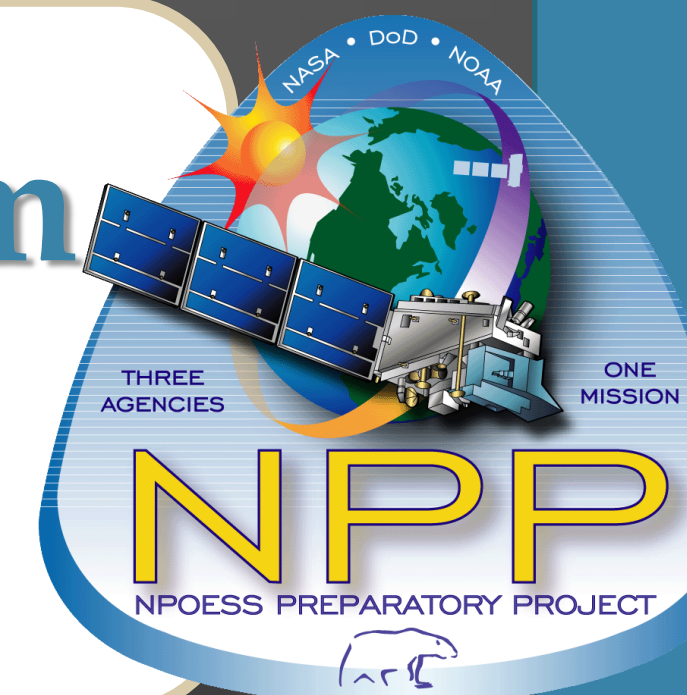# NPOESS Preparatory Project (NPP) Validation Program for Land Data Products from the Visible Infrared Imager Radiometer Suite (VIIRS)
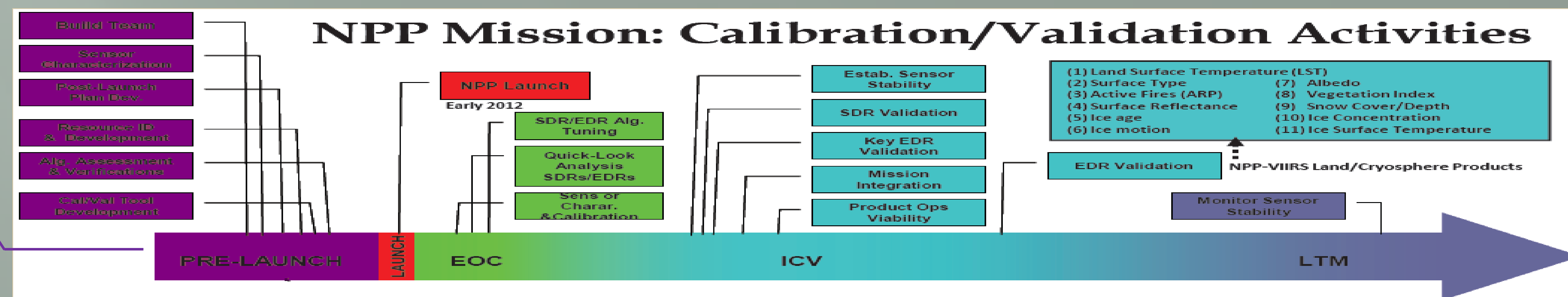
Jeff Privette (NOAA/NESDIS National Climatic Data Center) and the VIIRS Land and Cryosphere Validation Team
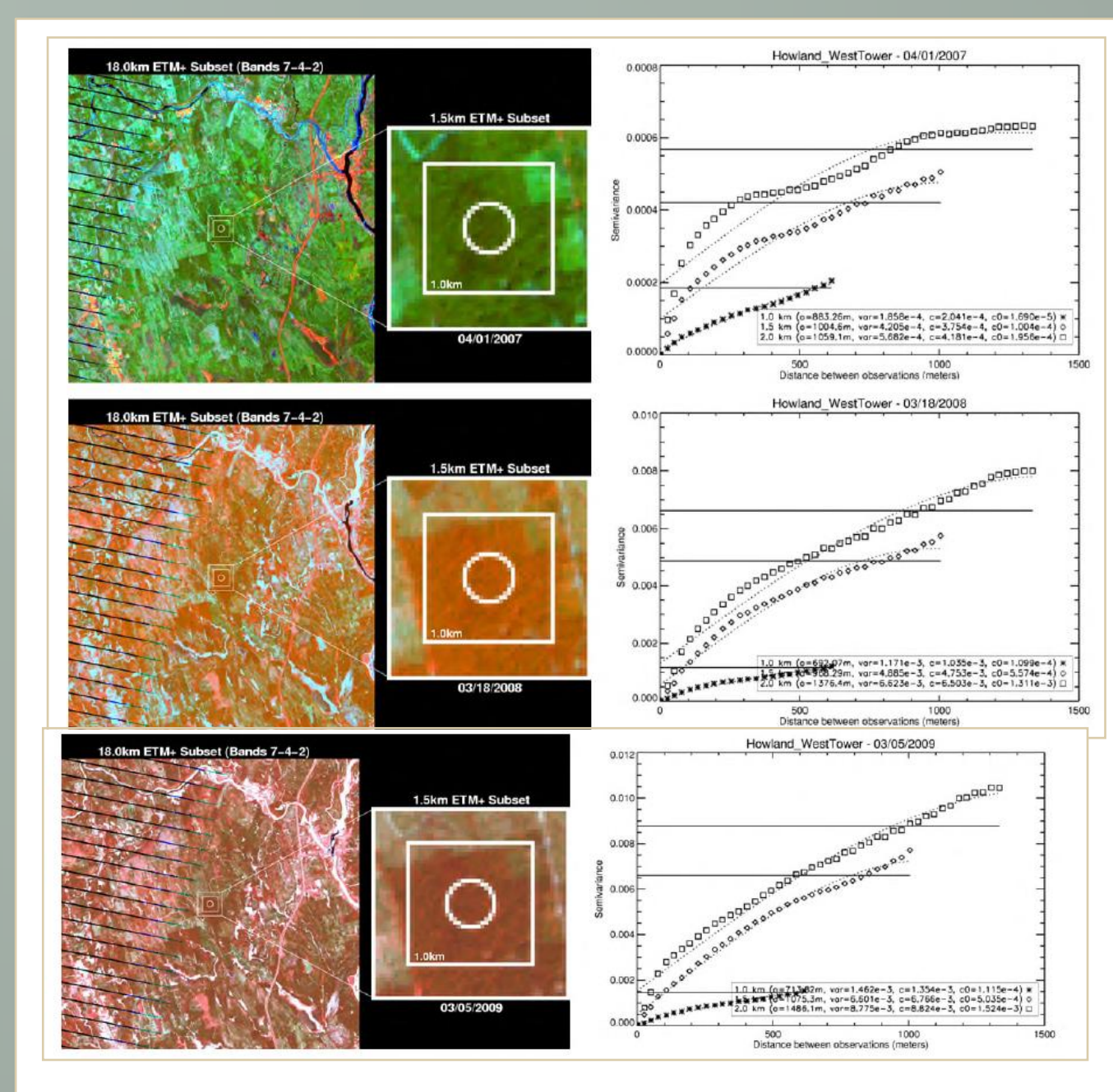
Overview

- The Joint Polar Satellite System (JPSS) Program, in partnership with NASA, will launch the NPOESS Preparatory Project (NPP), a risk reduction and data continuity mission, prior to the first operational JPSS satellite launch. Data from the NPP Visible/Infrared Imager/Radiometer Suite (VIIRS) will be used to produce Environmental Data Records (EDR), Application Related Products (ARP), and Intermediate Products (IP) of Land and Cryosphere variables. The products include Snow Cover and Depth, Land Surface Temperature, Vegetation Index, Surface Albedo, Ice Surface Temperature, Sea Ice Characterization, Surface Reflectance and Active Fire. Because Land and Cryosphere products concern society's immediate living environment, they are particularly important to understand and correctly characterize.

- The Land Validation Program is a multifaceted effort to characterize and validate these data products. The program involves systematic comparison of VIIRS products with heritage satellite products (e.g., MODIS) and field data. In the prelaunch era, the Team works closely with NASA's Land PEATE to assess NPP-like products generated from MODIS-derived VIIRS proxy data. Because the VIIRS Land and Cryosphere products are so diverse (from sea ice characterization to active fire identification) and numerous (14 unique products), their validation requires a broad set of activities and expertise. Their validation is particularly challenging due to the routine and non-routine changes in spectral and structural properties associated with vegetation phenology, episodic snow/fire/water inundation, snow/water/ice transitions, rapid changes in sea ice cover, and other physical state changes.

- To address these challenges, the Land Team has developed a plan that leverages existing Earth Observation System (EOS) and operational program investments and, during the NPP era, seeks to defines a path towards more operational and cost-effective validation throughout the JPSS era (~2015-~2026). Besides ensuring the operational utility and quantitative performance of the products, the Land Team Plan builds toward the new CEOS validation protocols as defined through the Working Group for Calibration and Validation and its subgroups. This provides a medium for broad community interaction, as well as insights into state of the art methods, data sharing, tools, data handling and collaboration opportunities.

Specific Activities for Land Team Pre-Launch Phase:

- Assess EDRs using MODIS-derived VIIRS Proxy Data
- Priority Products Matchup Processing Ready
- Demonstrate assessment capability using MODIS Land Products
- Deliver large volumes of granule and match-up proxy datasets in HDF format
- Demonstrate capability to exercise algorithm change process
- Deliver EDR and IP matrix evaluation report using proxy data

NPP Mission: Calibration/Validation Activities

Plans and Status of Land & Cryosphere EDR Validation

Surface Albedo

- **Post-Launch Approach**: Evaluate globally at spatially-representative BSRN and SurfRAD field sites. Assess against MODIS products.
- **Status**: Statistically evaluated spatial representativeness of 56 field sites with Landsat data during leaf-on and leaf-seasons. Representativeness is lower at leaf-off due to exposed structure, snow, soil and understory
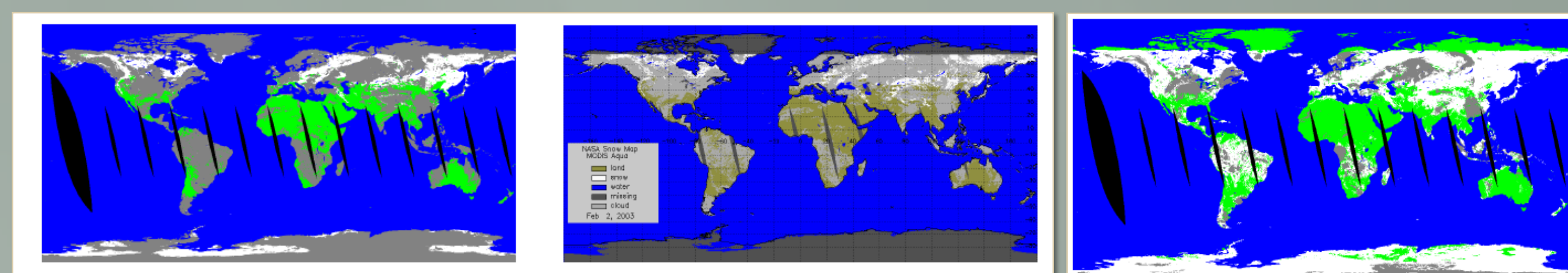- **Lead**: Crystal Schaaf (schaaf@bu.edu)

Figure caption: Temporal variability in geostatistical measures of spatial representativeness at the FLUXNET site in Howland, Maine.

Vegetation Index

- **Post-Launch Approach**: Evaluate at 40+ AERONET + BSRN/FLUXNET sites using rigorous atmospheric correction. Assess against MODIS products.
- **Status**: Selected global field sites that represent range of land covers under various atmospheric, climatic and geographic conditions. Analyzing uncertainty for bidirectional and nadir-view directions. Testing with MODIS-derived VIIRS proxy data
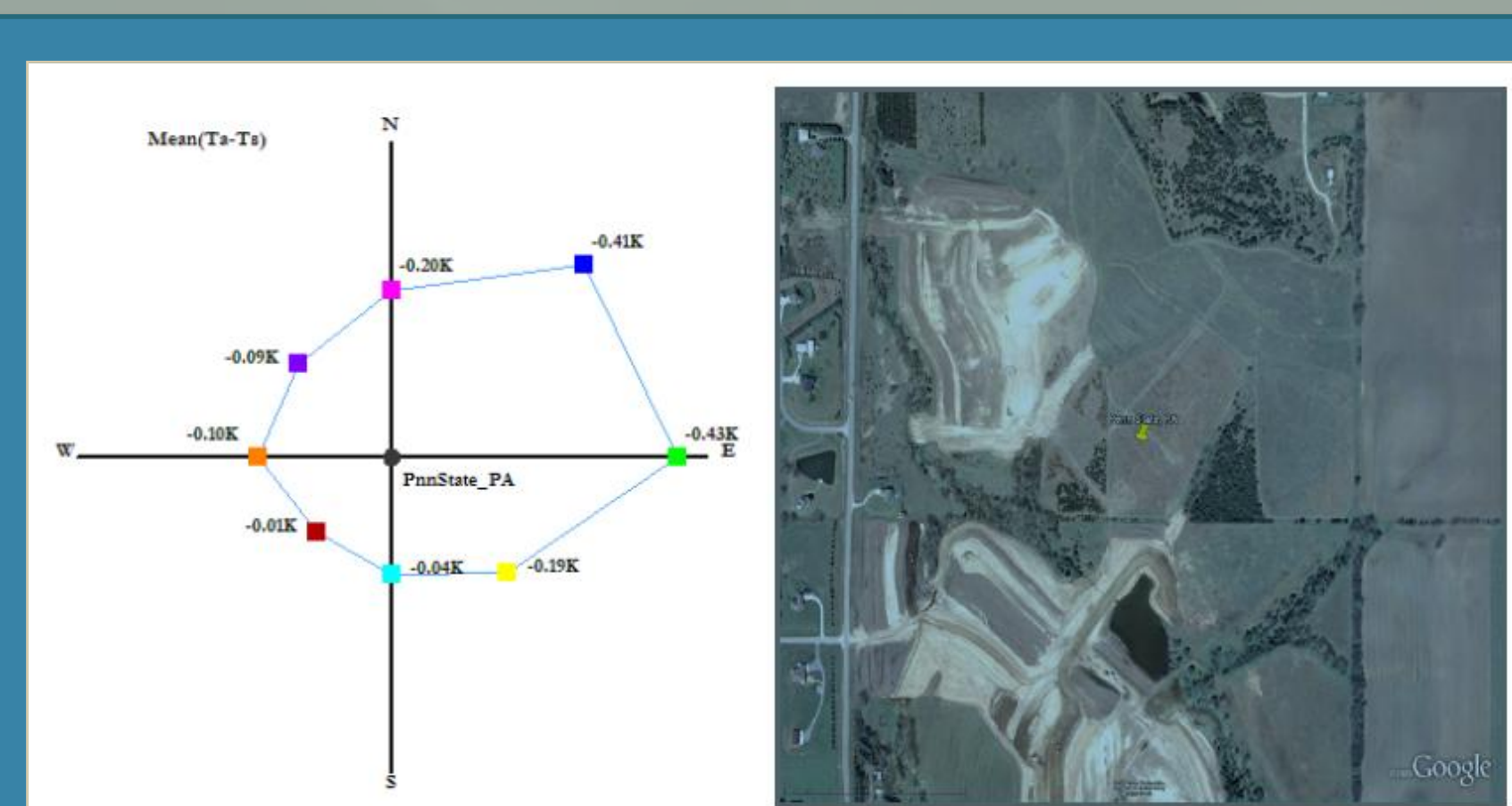- **Lead**: Alfredo Huete (ahuete@email.arizona.edu)

Figure caption: Map of 40 AERONET sites where VIIRS vegetation index products will be validated.

Surface Reflectance (Intermediate Product)

- **Post-Launch Approach**: Evaluate over AERONET sunphotometer sites using rigorous radiative transfer model & comparison tool (ASRVN). Assess with MODIS product.
- **Status**: Adapted ASRVN for VIIRS data and to allow stratification by zenith angle, aerosol loading, and surface brightness. Testing ASRVN against ground measurements; Prototyping with MODIS product.
- **Lead**: Alexei Lyapustin (Alexei.Lyapustin@nasa.gov)

Surface Type

- **Post-Launch Approach**: Evaluate against MODIS product and more than 500 global Landsat-classified sites.
- **Status**: Developed new random stratified site network by merging global climatology and population information. Validation with MODIS and GlobCover products demonstrate statistical robustness.
- **Lead**: Mark Friedl (friedl@bu.edu)

Figure caption: Map of global validation site sample. Points identify site locations; colors indicate different strata reflecting a combination of climate and population.

Snow Cover and Depth

- **Goal**: Evaluate with WMO station observations and NOAA's IMS Interactive Snow Maps. Assess against MODIS and fine resolution satellite products.
- **Status**: Testing with MODIS-derived VIIRS proxy data sets (5 km) and comparing against MODIS product indicates VIIRS cloud mask issues.
- **Leads**: Peter Romanov (peter.romanov@noaa.gov)

Figure caption: Maps identifying 30 km cells with appearance of snow (white), cells without snow cover (green), and cells completely covered by cloudiness (gray) for the day February 2, 2003 from the focus period.
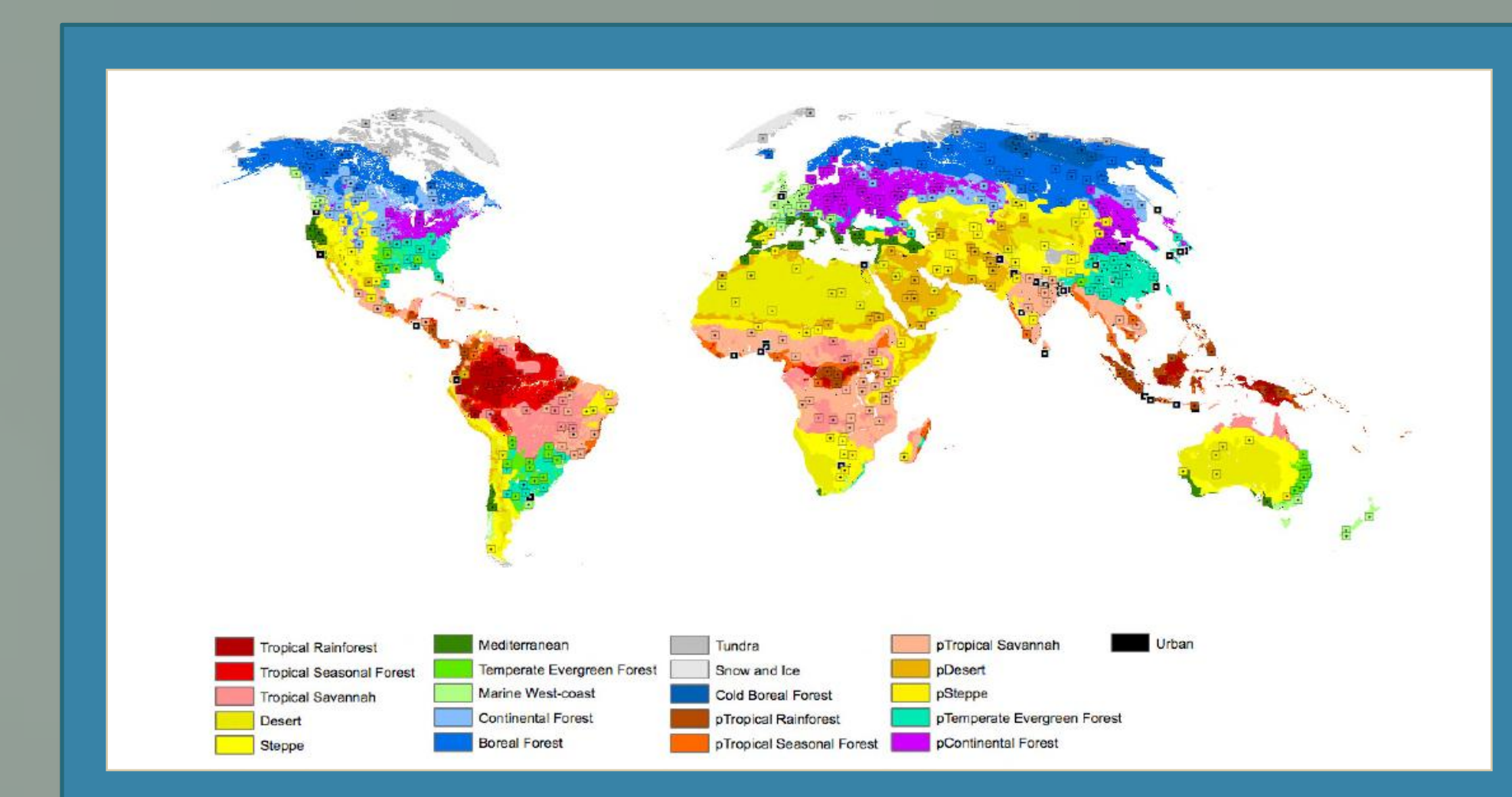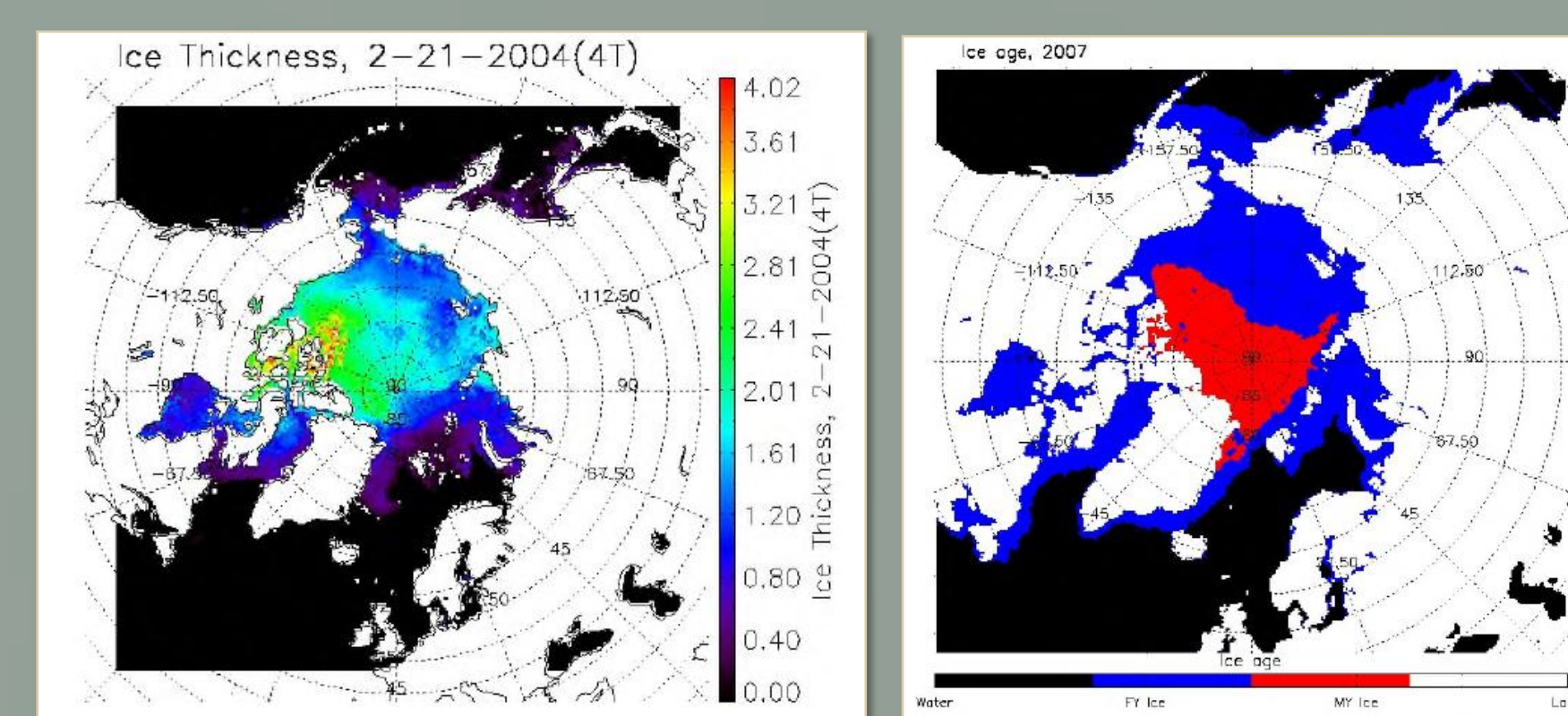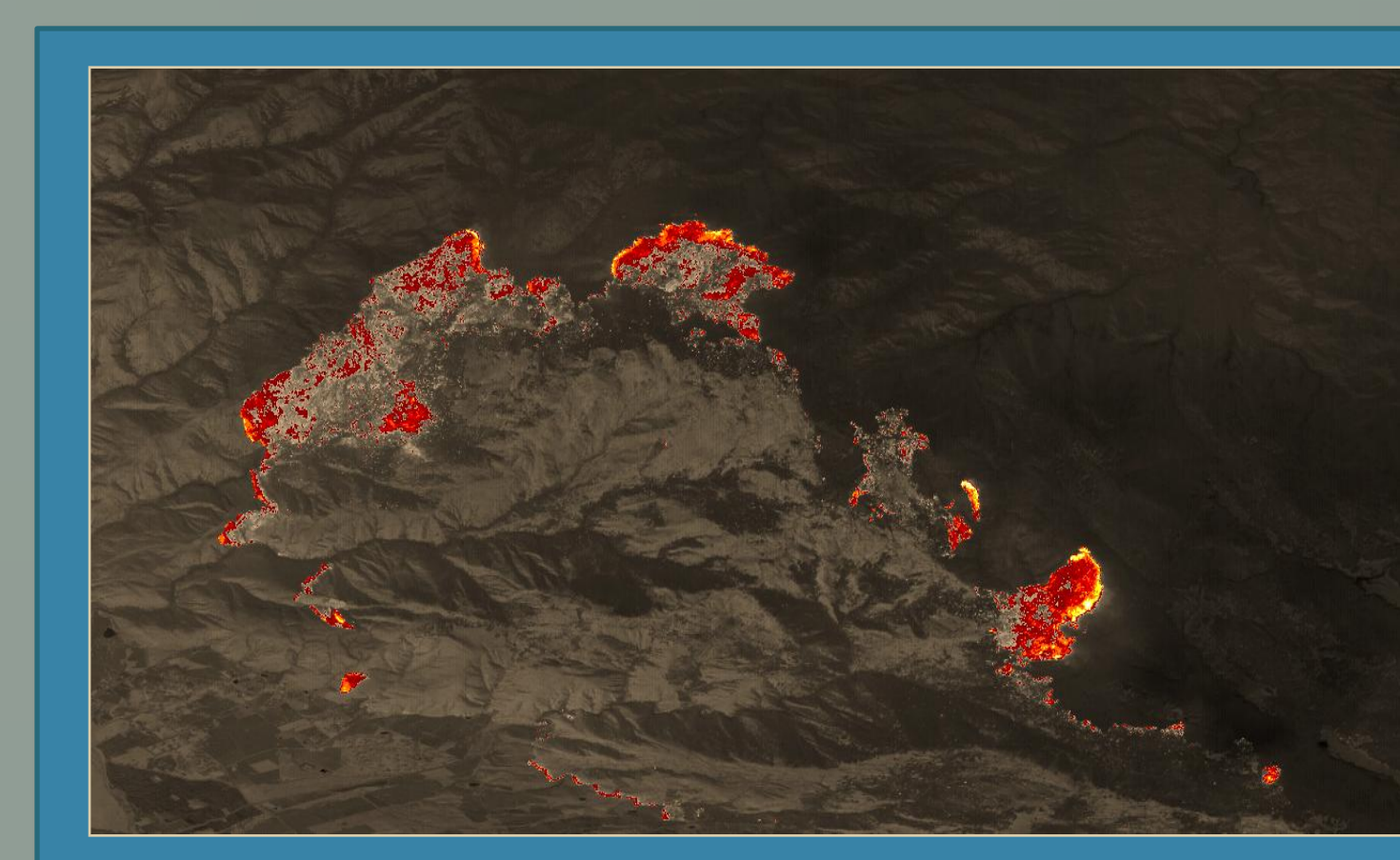

Ice Surface Temperature/Sea Ice Characterization

- **Post-Launch Approach**: Evaluate against internal and standard products from other satellites. Evaluate against in situ and aerial data sets as available.
- **Status**: Products have been generated and compared with buoy observations, AMSR-E imagery, upward-looking submarine sonar (SCICEX), in situ measurements.
- **Leads**: Jeff Key (Jeff.Key@noaa.gov) and Jim Maslanik (James.Maslanik@colorado.edu)

Figure caption: Left image shows Ice thickness from AVHRR on February 21, 2004; Right image shows Ice age from passive microwave data

Land Surface Temperature (LST)

- **Post-Launch Approach**: Evaluate over NOAA SurfRad, CRN and global field sites using statistical and physical model up-scaling techniques. Assess against MODIS product.
- **Status**: Developing statistical and model scaling techniques. Evaluating site heterogeneity for scaling applicability. Testing with MODIS-derived VIIRS proxy data;. Several issues identified in VIIRS baseline algorithm
- **Leads**: Bob Yu (yunyue.yu@noaa.gov), Pierre Guillevic (pierre.guillevic@nooa.gov)

Figure caption: Assessment of spatial representativeness of tower data using ASTER (right image). Left image: Polar plot of deviation of simulated VIIRS LST around center point (distance) vs. Cardinal direction (angle).

Active Fires (Application-Related Product)

- **Post-Launch Approach**: Evaluate against MODIS standard product and aerial and fine resolution imagery as available.
- **Status**: Testing subpixel fire analysis with ASTER- and MODIS-derived VIIRS proxy data. Saturation issue with VIIRS 10.8 mm band (M15).
- **Lead**: Ivan Csiszar (Ivan.Csiszar@noaa.gov)

Figure caption: Poomacha Fire, San Diego County, California, 27 October 2008, as viewed at 10.5-μm wavelength in the thermal infrared by the NASA Autonomous Modular System (AMS) aboard the Ikana UAV (U.S. Forest Service image). The FireMapper color scheme has been applied.

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