ROSES Selections and the MODIS and VIIRS Science Teams

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National Aeronautics and Space Administration HQ
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- **A.28 – The Science of Terra and Aqua - recompetition in ROSES 2016**
  - **2.1 Science Data Analysis**
  - **2.1.1 Multiplatform and Sensor Data Fusion**
  - **2.2 Algorithms – New Data Products**
  - **2.3 Real- or Near-Real-Time Data Algorithms**
  - **Statistics - A. 28 Proposals Recommended: 56/212 ($34.96M/3 yrs selected - $11.5 /11.7 / 11.75M)**

- **A.46 - Terra and Aqua Algorithms – Existing Data Products (4-year)**
  - **Evolution and migration to the Senior Review proposals (2017)**
  - **Statistics - A. 46 Proposals Recommended: 32/38 ($19.4M/4 yrs selected - $5.2/5.4/5.0/3.8M)**

- **Total budget profile of $16.7M / 17.1 / 16.75 / 3.8M**
  - **Advertised $14M / yr combined.**
  - **Profile we were given was $23 / 14 / 14 / 3.8M**

  - **Historical data:**
    - **2003: 566 proposals received – 192 selected - $66M/yr advertised**
    - **2006: 322 proposals received – 121 selected - $25M/yr advertised**
    - **2009: 325 proposals received – 101 selected - $17M/yr ($15M Adv)**
    - **2013: 248 proposals received – 88 selected - $23/14/14/3.8M /yr**

- **Algorithm history not always clear**

- **One proposal does not necessarily equal one algorithm**

- **Transition core standard algorithms to the Senior Review - examine and understand why there is such a huge range of cost ($50-550K/yr) associated with the individual core algorithm proposals and MINOR associated calibration/validation activities**

- **Historical and long-time input from the reviewer communities that existing algorithm/ data product production should not be competing with new research ideas. Example: in 2009 there was up to $15M/yr available, 21 algorithm proposals were selected (out of 101 total selections) and this accounted for over 1/3 of the available budget.**

- **Example: is it worth 500K/yr to get an eighth significant digit on SST?**

Scientific Issues from T&A Program Elements

- **Reviewer feedback:**
  - **"incremental improvement" – what is this? Is it quantified? What's the cost associated with progress relative to the science return?**
  - **Innovation – maybe, maybe not, but is the work plan justified?**
  - **"approach far from state of the art" – is there a better approach/data product NASA should be considering?**
  - **Continued work showing no history or progress or improvement to uncertainty(ies) in core algorithm(s)**
  - **All proposals submitted in response to T&A and S-NPP solicitations must quantify errors and uncertainties associated with proposed efforts (e.g., the data products themselves, any scientific data analysis, etc.). The error and uncertainty discussion must be clearly identifiable in a separate section within the proposal body. Explicit attention will be given to this section during the review process**
  - **Relevance weak – we know people will use the product, but does the author say anything about it? "x product important for a CDR", but the authors do not describe**
  - **Link to current and future sensors, Suomi-NPP or JPSS or other mission for continuity?**
  - **Cal/Val work – probably the *in situ* component is important but team may not give details or say why**

- **Orphaned algorithms and other activities that were not recommended:**
  - **MODIS Oceans NPP**
  - **MODIS Near-IR water vapor and cirrus reflectance**
  - **Validation of VI (MOD13)**
  - **Evaluate / improve MOD16 ET product**
  - **AIRS NH3**
  - **MODIS Angstrom Exponent**
  - **Surface Emissivity**

- Since 2008 NASA HQ and the science team have discussed the inclusion of "Algorithms – Existing Data Products" with the Senior Review Proposals

- Plan is to do this in the next two to four years, need to sync with Senior Review cycle

- No dissenting opinions thus far from HQ or ST

- For ST benefit, we are doing a two step transition: 1) ROSES 2013 A.46 "Terra and Aqua - Algorithms – Existing Data Products" (four year proposals), 2) Senior Review sync

- **Terra's fuel reserves will drive a question we need to answer by 2017: how important is it to continue the Terra data record (which of course includes MODIS) with a tightly-controlled 10:30 MLT?**

- **Current plan: lower Terra 10km below the morning/afternoon constellation when it's time to passivate the mission (~2020's). To reserve the fuel for that orbit lower, we will have to stop doing inclination maneuvers in 2017. Once we stop the inclination maneuvers, the MLT will start to drift off the 10:30 MLT crossing we've been maintaining. Requirement allows drift to 30min MLT window - maintained it within 2min since 2001. We will still have several years of Terra data within the 30min window, but consistency and quality of the data record for climate studies is expected to be less than ideal.**

- **ESMO team has come up with a way to lower the s/c which leaves it closer to the constellation, but still safe – BUT needs additional waivers for violating international orbital debris standards. If we get waivers, ESMO's new approach will continue to maintain 1030 MLT until 2021, which would give us a 20-year data record with a tightly-controlled, consistent MLT. Total operational lifetime of Terra would be the same (whatever approach used) - post-mission lifetime will increase by 20 years.**

- **There is a lot of international attention to the orbital debris issue these days, and asking for a waiver will be scrutinized by many - need a strong case. Senior Review panel recommended NASA quantify the impact to the CDR quality of the Terra datasets if the MLT drifts off 1030 beginning in 2018, compared to 2021.**

- A preliminary version of the panel finding on this topic:

- Fate of the waiver to extend the Terra mission at the current 705 km altitude.
  - Waiver is approved - Terra will maintain the 10:30 MLT for 3 additional years and continue to provide a long term uninterrupted data record.
  - Waiver is denied - Terra would continue to collect high quality data of sufficient value to the science community to warrant extension - orbital change would compromise continuity of the stable long term climate record at some level, but additional information necessary to fully assess the significance of this degradation (workshop of stakeholders)

- Sum:
  - Terra beyond 15 years of continuous morning-orbit data collection
  - Five sensors (ASTER, CERES, MISR, MODIS, and MOPITT) collectively contribute to 81 calibrated and validated core data products.
  - International mission (US, Japan, and Canada) with broad participation among three NASA centers (JPL, Langley, and Goddard)
  - One significant source of uncertainty - fate of the waiver
    - Original MLT requirement - stay in 30min window- since 2001 stayed within a 2 min window.
    - Baseline plan - MLT will approach 10:15am in 2019, Terra will lower orbit by about 10km, bring MLT back up, repeat pattern is broken (looking at different ground track at a different time of day).
    - Other plan: keep MLT in 2min window through 2020, then lower orbit by 4km in August 2022.

- **Flag Ship Mission in the A-Train constellation**
- **Spacecraft is going strong after 13 years**
- **Four instruments (AIRS, AMSU, CERES), and the MODIS**
- **High quality climate data records - continuity of this time series is critical for the scientific community, government agencies and the international operational user community.**

National Interests Panel (Terra and Aqua):

- **MODIS was high to very high utility across the board for ALL organizations**

- **What do we do for a MODIS-quality instrument in the morning orbit when Terra is done?????)**

NASA Suomi NPP VIIRS Science Status

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Suomi NPP Proposals Solicited

This solicitation requested:

1. Proposals from members of the scientific community to participate in the NASA Suomi NPP Science Team

❖ Development of science quality standard data products using Suomi NPP measurements that will enable continuity of key standard Earth system data records from NASA's EOS Terra, Aqua, and/or Aura satellites

❖ Development and demonstration of innovative and practical applications of Suomi NPP measurements

❖ Development of other new science data products from Suomi NPP measurements that will meet high-priority Earth science needs

❖ Suomi NPP Science Team Leader and Discipline Leads

2. Proposals for the establishment of Science Investigator-led Processing Systems (SIPS) to produce NASA Suomi NPP standard and experimental science data products

Discipline Leads for VIIRS: Bryan Baum (atm), Chris Justice (land), Carlos DelCastillo (oceans)

ROSES-2013 A.29 Suomi NPP Statistics

Proposals Due: March 10, 2014
Number Proposals Received: 119
Selection Date: August 12, 2014
Proposals Selected: Science Team - 40 of 113; SIPS - 5 of 6

Science Team PI Distribution (35% success rate):

Universities	17	Other Gov't. Agency	3
NASA Centers	15	Non-Profit:	1
For-Profit Corp.	4		

Product Type Distribution:

EOS Continuity Products (includes cal/val)	35
Innovative and Practical Applications:	2
Other Products	3

SIPS PI Distribution (83% success rate):

Universities	1	NASA Centers	4

Balance Across Science Team Topics

1. **Standard Products from Suomi NPP for EOS Continuity: 35 proposals (including 4 focused on cal/val)**

   1. Land; including Snow/Ice: 11 proposals
   2. Ocean; SST: 3 Ocean Color: 6 including atmospheric correction
   3. Atmosphere (Clouds & Aerosols) 7 proposals
   4. Ozone; 3 proposals
   5. Sounder; 4 proposals

2. **Innovative and Practical Applications of Suomi NPP Data: 2 proposals; Agricultural Monitoring, Air Quality & Public Health**

3. **Other Data Products: 3 proposals, VIIRS Night Lights, CrIS NH_3 & CO, Ocean Color Data Assimilation**

Standard Products (Land)

EOS Standard Level 2 and Level 3 Land Data Products Selected for Suomi NPP:

- **Surface Reflectance (Vermote - #86; Next Generation: Lyapustin - # 96)**
- **Snow Cover (Hall, D. - # 49)**
- **Land Surface Temperature and Emissivity (Hulley - # 106)**
- **Land Cover and Dynamics (Dynamics only: Zhang, X - # 87)**
- **Vegetation Indices (Didan - # 68)**
- **Fire and Thermal Anomalies (Schroeder - # 29)**
- **Leaf Area Index (LAI) and Fraction Absorbed Photosynthetically Active Radiation (FPAR) (Myneni - # 9)**
- **Sea Ice Cover and Ice Surface Temperature (Hall, D. - # 49)**
- **BRDF (Bi-directional Reflectance Distribution Function) / Albedo (Schaaf - # 94)**
- **Vegetation Continuous Fields No selection**
- **Burned Area (Giglio - # 35)**

Standard Products (Ocean)

EOS Standard Level 2 and Level 3 Ocean Data Products Selected for Suomi NPP:

❖ **Sea Surface Temperature (Minnett - # 79; Next Generation: Harris - # 41 and Wentz – # 19)**

❖ **Aerosol Angstrom Exponent (Franz - #77)**

❖ **Aerosol Optical Thickness (Franz - #77)**

❖ **Subsurface Chlorophyll *a* Concentration (Gregg - # 38; Hu - # 64; Franz- # 77)**

❖ **Diffuse attenuation at 490 nm (Lee - # 56; Franz - # 77)**

❖ **Photosynthetically Available Radiation (Frouin - # 3)**

❖ **Particulate Inorganic Carbon (Balch - # 33)**

❖ **Particulate Organic Carbon No selection**

❖ **Remote Sensing Reflectance (Hu - # 64; Franz - # 77)**

Standard Products (Atmosphere)

EOS Standard Level 2 and Level 3 Atmosphere Data Products (from MODIS) Selected for Suomi NPP:

❖ **Aerosol Product (Levy - # 43; Hsu - # 20; Next Generation: Lyapustin - # 96)**

❖ **Total Precipitable Water (Water Vapor) (Borbas - # 73)**

❖ **Cloud Product (Platnick - #26; Baum - #1; Gao - # 45)**

❖ **Atmosphere Gridded Product No selection**

❖ **Cloud Mask (Platnick - # 26)**

Instrument and Science Measurement Teams

- Additional detailed guidance for the Instrument and Science Measurement Teams were provided in the disciplinary Sections.

- Proposed studies may be relevant to more than one team. Proposals should request membership on the team that, to the best of their knowledge, is most relevant to their research.

- Specific guidance was in each section, and identify if the proposer called out membership in a particular science team

  - Land Measurements Team

  - Ocean Biology and Biogeochemistry Measurement Team (OCRT)

  - Cryospheric Sciences Measurement Team

  - Atmospheric Sciences Measurement Team

  - Geodynamics and Geohazards Research Team

  - Biodiversity and Ecological Forecasting Team

  - Sea Surface Temperature Science Team

Move from Missions to Measurements due to Mission and Science Maturity

ATBD/Data Product Reviews, Documentation

- **ATBD/Data Product Reviews:** Review of algorithms for new & alternative MODIS (VIIRS) algorithms
  - Is the structure of the original EOS ATBDs needed? Is there an alternative approach and would one approach for documenting data products (provisional or continuity) serve all disciplinary communities?
  - New algorithms/data products – draft new proposals, documentation and requirements, follow with review and endorsement by user communities (benchmarking)
  - Is there a need for periodic review of ATBDs/Algorithms off-cycle of the competition?
  - Documentation on web sites lacking for Sensor/Team/ATBDs/Data – new users (applied)

- Could we envision something like this on line:
- MODIS PRODUCT / CORRESPONDING VIIRS PRODUCT / COMMENTS / NASA funded & RELATED RESEARCH / REFERECES
  - Snow Cover (MOD10A) / Snow Cover (VIIR99) / Loss of spatial resolution, no loss of accuracy / D. Hall currently doing VIIRS error assessment
  - Surf. Temp (MOD11x) / Surf Temp (VIIR00) / Loss of spatial resolution, some increase in error / USDA working on merging w/Microwave sensors to create enhance product

  MUST list key references – ex. Snow cover see Hall et al 2014, Painter et al 2015
  - PI's maintain algorithm data on central page (MODIS? VIIRS? pointers)

MODIS-VIIRS Measurement Teams

Historical Philosophy: Continuing/evolving measurement streams, there should be one science team, competed periodically, that provides scientific guidance to present and future missions and for the utilization of past data sets

- Support and focus on Earth System Data Records

- Data system to ensure a "seamless" time series

- Scientific guidance and priorities must represent broad user community (including outside of NASA/U.S.)

- Suomi NPP VIIRS continuity, DS missions, CI missions, international missions
  - Thought to jointly compete MODIS and Suomi NPP next round

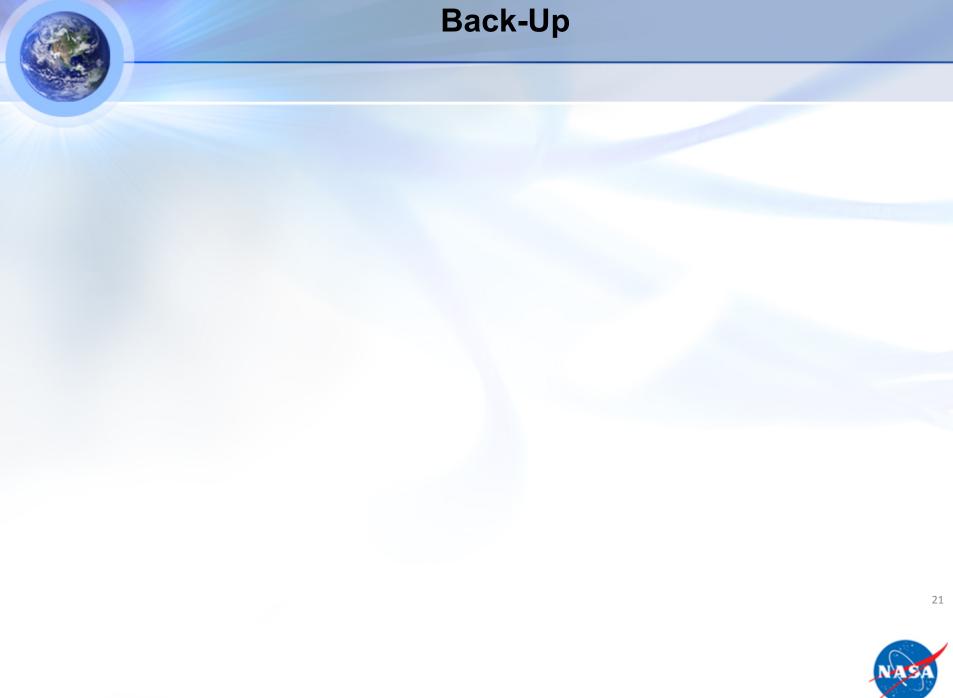- Plans for JPSS – VIIRS continuity out to 2038, but plans for a NASA-based Science Team?

Issues for MODIS-VIIRS Science Team

- Terra's future data quality for MODIS assessment in community workshop (waiver on MLT/altitude adjustment)
- Evolution/migration of Existing Algorithms to Senior Review (2013 program element, A.46 as intermediate step) – we have to weigh investments versus potential outcomes
- Continuity of orphan products (from MODIS and VIIRS)
- Algorithm developers and validation investigators should continue to address important deficiencies in key data products (uncertainties)
- Algorithm developers need to represent broader community needs by working with them
- How best to facilitate interdisciplinary science and algorithm development approaches, Terra/Aqua intersensor science (2.1.1)
- Established web site(s)/process for regular data product and algorithm reviews -need to maintain, evolve, refine, review data products as needed (but can no longer say "go to the literature")
- Evolution to measurement teams and blend with MODIS-VIIRS Team (w/other mission teams)
- MODIS and Suomi NPP VIIRS website and data product documentation – updated and coordinated with discipline leads, team leader, project scientists, and PIs – more user friendly

Back-Up

Standard Products (Ozone)

EOS Standard Level 2 and Level 3 Atmosphere Data Products (from OMPS) Selected for Suomi NPP:

- Total Column Ozone **(McPeters - #72)**
- Ozone Concentration Vertical Profiles **(Bhartia - #21, McPeters - #72)**
- Aerosol Concentration Vertical profiles **No selection**
- NO_2 Total Column **(Yang - #13)**
- Sulfur Dioxide Total Column **(Yang - #13)**
- Aerosols Total Column (UV) **No selection**

Standard Products (Sounder)

EOS Standard Level 2 and Level 3 Sounder Data Products Selected for Suomi NPP:

- **Atmospheric Temperature (vertical profiles) (Barnett - # 28, Susskind - # 99, Lambrigtsen, #39; Next Generation: Moncet - # 82)**

- **Atmospheric Moisture (vertical water vapor profiles, total precipitable water, total cloud liquid water) (Barnett - # 28, Susskind - # 99, Lambrigtsen, #39; Next Generation: Moncet - # 82)**

- **Atmospheric Pressure Vertical Profiles (None)**

- **Surface Temperature (Barnett - # 28, Susskind - # 99, Lambrigtsen, #39; Next Generation: Moncet - # 82)**

- **Cloud Properties (fractional cover, cloud top temperature, cloud top height) (Barnett - # 28, Susskind - # 99, Moncet - # 82)**

Cal/Val, Applications & New Products

- ❖ **Calibration and validation of VIIRS Surface Reflectance product (Czapla-Myers, #66)**
- ❖ **Validation of VIIRS thermal infrared data and products (Hook, #6)**
- ❖ **Calibration of VIIRS against the moon (Stone, #104)**
- ❖ **CrIS radiometric calibration under cloudy conditions (Aumann, #27)**

- ❖ **Agricultural Monitoring Applications (Justice, #58)**
- ❖ **Air Quality and Public Health Applications (Wang, J., #67)**

- ❖ **VIIRS Nighttime Lights (Elvidge, #120)**
- ❖ **NH_3 and CO from CrIS (Cady-Pereira, #4)**
- ❖ **Combine Data Assimilation with an Algorithm to Improve the Consistency of VIIRS Chlorophyll (Gregg, #38)**

Standard Products Not Selected

- ❖ **Atmosphere Gridded Product**
- ❖ **Land Cover**
- ❖ **Vegetation Continuous Fields**
- ❖ **Atmospheric Pressure Vertical Profiles**
- ❖ **Particulate Organic Carbon**
- ❖ **Aerosols from OMPS**