Minutes of the Land, Atmosphere Near real-time Capability for EOS (LANCE) User Working Group (UWG)

May 3-4, 2022
Virtual Meeting

Date: 27 May 2022

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1 LANCE UWG Members and Attendees

Ten members of the Land, Atmosphere Near real-time Capability for EOS (LANCE) User Working Group (UWG) were in attendance (Table 1). There were additional attendees representing the Near real-time (NRT) user community, representatives of the individual LANCE elements, NASA Headquarters (HQ), and NASA's Earth Science Data and Information System (ESDIS) (see Appendix 1).

NAME	Email	ORGANIZATION
Miguel Román (UWG chair)	miguel.o.roman@leidos.com	Leidos HQ
Arlindo da Silva	arlindo.m.dasilva@nasa.gov	NASA GSFC
Brad Quayle	bquayle@fs.fed.us	US Forest Service
Patrick Duran	patrick.t.duran@nasa.gov	NASA/MSFC/SPoRT
Maggie Glasscoe	margaret.t.glasscoe@nasa.gov	NASA MSFC
Mike Budde Jim Rowland	mbudde@usgs.gov rowland@usgs.gov	USGS
Josh Cossuth*	Joshua.Cossuth@nrlmry.navy.mil	NRL/Washington DC
Mark Trice	MTrice@dnr.state.md.us	MD DNR

Mike Fromm	mike.fromm@nrl.navy.mil	NRL
Steve Miller	Steven.Miller@colostate.edu	CIRA/Colorado State
Robert Brakenridge*	Robert.Brakenridge@Colorado.edu	Dartmouth Flood Observatory
Sean Helfrich	sean.helfrich@noaa.gov	NOAA / NESDIS
Vanessa Escobar*	vanessa.m.escobar@nasa.gov	NOAA/NASA GEO-XO

*Table 1: LANCE UWG Members that attended the UWG *denotes UWG members that were unable to attend*

2 Introduction and General Status

2.1 Welcome and Status, Karen Michael (ESDIS LANCE Manager)

Karen opened the meeting. Karen presented organizational changes, including the selection of Katie Baynes as NASA's Deputy Chief Science Data Officer, and Miguel Román's position as Senior Director and Chief Scientist of Leidos Civil Group. Shanna McClain was introduced as the Disasters Program Manager, and David Green is now Wildfires Program Manager at NASA Headquarters.

Karen presented LANCE general status. She summarized the goals and recommendations of the recently completed Data Latency and Ground Segment Study, which focused on identifying ways of reducing the data latency of the future Earth System Observatory (ESO) missions. Karen also reported on new LANCE products coming out of the Satellite Needs Working Group efforts, including ICESat-2 Expedited/Quick Look data, now available 3 days from observation, versus the standard Level 3 product, which has a 45-day latency. The Harmonized Landsat Sentinel-2 (HLS) False Color composite is now available in FIRMS beta version; this is , the result of teamwork between IMPACT, HLS/MSFC, LANCE FIRMS, GIBS, LPDAAC and the USFS.

Karen summarized the current plans for decommissioning Terra, Aqua, and Aura in the next 2 years, and the impacts this will have on LANCE data availability. Products from 7 instruments: MODIS (AM), MOPITT, MISR, MODIS (PM), AIRS, OMI, and MLS will no longer be available. VIIRS will provide continuity with MODIS (PM), and OMPS will provide continuity for OMI. Karen noted that ATMS and CrIS, which could provide continuity with AIRS, are available in NRT from NOAA, but to a limited customer base.

2.2 UWG Chair Perspective, Miguel Román (Leidos)

Miguel Román thanked the UWG members for their participation. He asserted LANCE is a major player in Earth Science, and has been instrumental in building a community around high priority areas. Miguel emphasized the importance of continuity, and stressed the value of the upcoming ESO missions providing near-real-time data.

3 NASA Headquarters Remarks

3.1 NASA HQ Perspective, Katie Baynes (NASA HQ)

Katie Baynes provided a NASA Headquarters perspective, explaining their focus on Open Source Science, with the goal of fostering a collaborative culture, enabled by technology – opening the entire science process, from start to finish. She briefly discussed the Science Mission Directorate (SMD) Strategy for Data and Computing, the Transformation to Open Science (TOPS) initiative, and SMD's Science Data Policy 41, which applies to all future SMD-funded efforts. Katie also addressed NASA and SMD's commitment to support Environmental Justice, providing links to ESD's Equity and Climate Justice web page, and Environmental Justice Data Backgrounder, which explains how NASA data are being used in these areas.

Katie briefly reviewed ESD's Commercial Smallsat Data Acquisition (CSDA) program, which started as a pilot project in 2017, and has blanket purchase agreements with Planet, Spire Global Inc., Maxar Technologies, Teledyne Brown Engineering, and EarthDEM. Data is available to all NASA-funded researchers.

Katie concluded with her thoughts on future directions for LANCE. Katie favors relaxing guidelines on data sources for LANCE, saying the acronym should not preclude data from sources other than EOS missions, and encouraged LANCE to engage with the upcoming ESO missions. Katie recommended considering a "one-stop-shop" location for all LANCE products. Katie also challenged the LANCE UWG to consider how to "fill the NRT data pipeline", potentially including expedited or developmental products. Sadashiva Devadiga/MODAPS raised concern about ensuring the quality of developmental products. Traditionally LANCE products have been derived from standard products supported by science team PIs and with known data quality. Katie suggested the UWG introduce a concept for elevating experimental/developmental products.

Katie's briefing allowed time for discussion of benefits and barriers to Open Source Science. Christine Lee reported encountering barriers in getting tutorials and code cleared for release. UWG member Steve Miller mentioned that "technology translators" for science data publications may be needed for applications users – technical language can be a barrier. Miguel expressed the hope that in the future, we will be able to conduct global intercomparisons of different approaches/products, using different retrieval algorithms, as called upon by CEOS best practices. Sean Helfrich, UWG member from NOAA/NESDIS/STAR, would like to see more collaboration between LANCE and NOAA CoastWatch – which are, in some cases, using the same satellite data but with different algorithms (e.g., Sea Surface Temperature). He would like to leverage synergies between CoastWatch and LANCE. Karen and Sean agreed to schedule a follow-up meeting, and Sean will invite the CoastWatch Director, Veronica Lance.

3.2 Applied Sciences Perspective, David Green (NASA HQ)

David began with the Applied Sciences Program (ASP) perspective on LANCE, from Lawrence Friedl, Christine Lee, and the other members of the ASP team. While LANCE has been highly responsive to other government agencies and universities, Lawrence would like to see more interaction with NGOs and industry organizations and proposed an action for the UWG to engage with NGOs to collect their user needs. The ASP is also concerned about the continuity of NRT data products after the decommissioning of Terra, Aqua, and Aura, recommending the UWG develop a transition plan, which may require user training and capacity development. David provided a comment from Lawrence Friedl (NASA HQ) that LANCE could benefit from the feedback that has been received from ECOSTRESS users, that placed priority on shortened latency due to the urgency of managing fire operations.

David went on to discuss the reconstituted Wildfire Program, that is supported by initiatives within all program areas of ESD. With this expanded focus on wildfires, there has been more attention and highlighting of LANCE, and in particular FIRMS at NASA Headquarters. The Wildfire Program is developing a five-year plan, and David recommended that the Wildfire Program and LANCE address what should be done collectively over the next 5 years.

David provided examples of missions that did not initially plan for low-latency data, but there has been considerable interest and demand, with NISAR being a prime example. David said there is a NISAR Early Adopter initiative to prepare for NISAR, and provide feedback to the NISAR team regarding the needs of their applications. Miguel raised a data continuity concern that NISAR will only be providing coverage twice every 12 days. David's response was that NISAR will augment, not replace, the more frequent fire data currently available, and other sources will need to be sought. He mentioned the recently approved Canadian WildFireSat, that will carry a VIIRS-like instrument, and is expected to launch in 2028, as an asset that should be investigated. Christine Lee asked that the UWG take an action to identify additional needs or questions regarding NISAR data latency. TROPICS was another example David gave of a mission that did not have low-latency built into their original operations concept. However, a successful NOAA-funded demonstration of low-latency operations was recently conducted.

David wrapped up by commenting on Katie's discussion of Environmental Justice and Climate, noting that underserved communities are particularly exposed and vulnerable. Data access and utility are challenges, but there is also need for sensitivity to the timeliness needs of those user communities. David's program is working with the NSF to determine how to have the most impact in this area.

4 Continuity of products post Terra and Aqua

4.1 Terra and Aqua End of Mission, Robert Wolfe (NASA GSFC)

Robert Wolfe, (Chief of the Terrestrial Information Systems Laboratory (Code 619)) provided a comprehensive presentation on the plans for termination of Terra (launched in 1999) and Aqua (launched in 2002), primarily based on presentations from the April 2022 MODIS Land

Workshop. Terra's final inclination maneuver was in March 2020, and the spacecraft is now drifting, and will reach its lower limit (10:15 a.m.) in October 2022, when it will exit the 705 km constellation. In the absence of overguide funding, which appears unlikely, the Terra mission will end in December 2023, and Aqua will stop science data collection in August 2023. For Land science, Aqua MODIS PM observation will have continuity with Suomi NPP, NOAA-20, and NOAA-21, but there are no U.S. observations to provide continuity for Terra MODIS AM.

Robert discussed potential options through international cooperation that could provide AM continuity. One possibility is the Sentinel 3 Ocean and Land Color (OLCI) instrument and Sea and Land Surface and Land Temperature Radiometer (SLSTR) which are planned to operate through 2031. Sentinel-3 has a 10 a.m. overpass, and near-real-time OLCI and SLSTR products (less than 3 hours from observation) are distributed by ESA. (Note: the NASA Sentinel Gateway currently acquires the OLCI NRT data, and distributes it to the OB DAAC in less than 3 hours from observation. If requested, the SLSTR NRT data can also be acquired and distributed by the NSG in less than 3 hours from observation.) However, the accuracy performance of the SLSTR does not meet the suggested performance specification. Another option presented by Robert is EUMETSAT's MetOp Second Generation (MetOp-SG), which will include MetImage, a VIIRS-like instrument. MetOps-SG will have a 9:30 a.m. overpass. A series of 6 satellites are planned, to be launched between 2024 and 2039. The MetImage instrument has some shortcomings relative to VIIRS: no blue band for atmospheric correction; lower saturation than VIIRS for 3740nm band, which will impact fire detection; and does not aggregate pixels across the scan. Still, it appears to be the best alternative for providing Terra MODIS AM continuity.

Robert reported on recommendations made to NASA Headquarters by the Land Science Team in September 2021. This included evaluating the utility of Sentinel-3 to replace Terra in interim; pursuing future access to the MetImage Level 1 data; establishing partnership/agreement with EUMETSAT/DLR/JRC and NOAA for MetImage instrument calibration and characterization, using NASA MCST/WGC as appropriate; designating a technical discipline POC to the CEOS-WGCV to foster early Cal/Val and intercomparison efforts; and evaluating whether there would be value in generating NASA products from MetImage. Miguel confirmed that these efforts have already started. However, it should be noted these recommendations did not address near-real-time products.

Robert concluded with a request that the LANCE UWG evaluate the impact of switching off Terra and Aqua. A strong case for MODIS AM Land product continuity needs to be made. Users need to be notified, and concerns should be voiced by both the LANCE UWG and the Satellite Needs Working Group (SNWG).

4.2 Global Satellite-based Flood Monitoring Post-MODIS, Guy Schuman (ImageCat Inc)

Guy Schumann/A37 presented information on users and uses of MODIS and VIIRS daily Global Flood Maps. Users include research studies, as well as applications users, such as the UN World Food Program, which rely on them for analytics and operations. Usage includes situational

awareness, providing advisories, warnings and alerts, and impact assessments. As users become aware of the plans to turn off Terra and Aqua MODIS, concerns are being raised. While VIIRS NRT water mapping is useful, MODIS is demonstrably better for flood mapping. Guy recommended considering the Sentinel-3 instruments as possible replacements for MODIS, and to complement VIIRS NRT water mapping. Sean Helfrich commented that some of these products are being evaluated by NOAA, and going to the National Water Center. Guy mentioned that the Dartmouth Flood Observatory is acquiring and using the MODIS Flood maps, along with other products. The advantage of MODIS and VIIRS is that they provide daily global coverage in near-real time.

4.3 Fire Monitoring Post-MODIS, Brad Quayle (USFS)

Brad Quayle presented a Fire Service perspective on using satellite data for active fire detection and monitoring. FIRMS Global and FIRMS US/Canada are strategic tools used to increase situational awareness, inform resource allocation decisions, focus tactical scale fire mapping assets, and inform the public. FIRMS products are integrated with other decision support capabilities. Brad discussed current and planned Fire products for FIRMS. In addition to the MODIS and VIIRS active fire data, the USFS is interested in incorporating real-time Direct Readout data for FIRMS US/Canada. They have been working on this with the University of Wisconsin. Under the auspices of the NASA Applied Sciences Program, Landsat active fire detection algorithms and processing latency have been improved, such that fire products from Landsat 8 and 9 will be available for the US and Canada in under 30 minutes from acquisition. FIRMS is also working on integrating the near-real-time harmonized Geostationary product from GOES, Meteosat, and Himawari.

In terms of potential products to provide continuity for the AM Orbit after Terra is decommissioned, USFS is, as other have mentioned, looking at Sentinel-3 SLSTR and the future MetOp/SG MetImage fom EUMETSAT. The USFS is also interested in exploring use of the Sentinel-2A and B active fire algorithm/product, which will require coordination with ESA. For the PM Orbit, they are already reaching out to the Canadian Space Agency, seeking access to data from their future WildFireSat microsat constellation, scheduled for launch in 2028. Its VIIRS-like resolution and 6:00 p.m. equatorial crossing that makes this data highly desirable.

New and planned Imagery products for FIRMS include the Harmonized Landsat Sentinel-2 (HLS) True Color and False Color products, which are now available, as well as the NRT GOES Geocolor imagery provided by GIBS. For the future, imagery from the European Sentinel-3 and MetOp SG MetImage , are desired, as well as the Canadian WildFireSat VNIR imaging capabilities. Brad is also investigating access to Japan's Himawari-8 Geocolor imagery.

Miguel and Brad agreed that it would be very worthwhile for NASA to invest in standard Land science products from geosynchronous satellites like GOES.

5 Satellite Needs Working Group (SNWG), Cerese Albers (IMPACT/MSFC)

Cerese presented a summary of the SNWG, which was created in 2016 by the US Group on Earth Observations (USGEO) to identify high-priority, unmet needs for satellite data. The SNWG is comprised of representatives from civil federal departments and agencies. Cerese gave an overview of the SNWG lifecycle and processes. The SNWG formulates and conducts a biannual survey to formally capture, document, and communicate satellite Earth-observing needs to NASA. The surveys occurred in 2016, 2018, 2020, and the next survey will be released in Fall of 2022. NASA then conducts a detailed assessment of the expressed needs and responds to each with proposed potential solutions to multiple high-priority needs. Responsibility for the SNWG Management Office is assigned to the Interagency Implementation and Advanced Concepts Team (IMPACT) at MSFC. The SNWG Management Office supports all phases of the SNWG lifecycle. SNWG cycles overlap. The SNWG cycle creates a new, long-term plan for development new solutions, their technical implementation, support for routine operations. There were five solutions provided for cycle 2016, nine for 2018, and 14 for 2020. Solutions, including budget requirements, are presented to OSTP and OMB, and are carried as a proposal for congressional funding in the President's budget. If funded, solutions move from formulation to implementation to operations. Four of the 2016 solutions are operational, with the additional NISAR Downlink station in implementation. Highlights from this cycle include the Harmonized Landsat Sentinel-2 (HLS) data; Access to Commercial Satellite Products; and Curation of Suborbital Field Campaigns. One of the 2018 solutions is fully operational (Water Quality Products from Sentinel-3); five are in implementation (highlights include Global surface water extent, global land surface disturbance, and surface displacements in North America); three are in formulation (highlights include Animal Tracking). The number of survey responses increased dramatically from 2018 (80) to 2020 (123). The Assessment Teams identified 458 potential solutions, that reduced to 165 unique solutions, with 44 that were satisfied with existing NASA solutions. Headquarters down-selected the highest priority solutions, seeking cross-cutting solutions. An announcement of OMB Direction is expected from NASA Headquarters in May 2022.

Cerese described how the SNWG Management Office espouses and fosters Open Source Science policy, including a program of dedicated stakeholder engagement, that includes Online training materials.

Cerese concluded with a briefing on the status of SNWG-2022 preparations. The survey will be released by USGEO on June 1, conclude in August, and survey results will be forwarded to NASA in September 2022.

6 Atmosphere Observing System Mission Overview, Emily Berndt (MSFC)

Emily provided an overview of the Atmosphere Observing System (AOS) mission, one of the ESO missions coming from the Decadal Survey recommendations for targeted observables of aerosols and cloud convection and precipitation. Emily started with an explanation of why AOS will be studying Aerosol-Cloud interactions: Aerosols are critical to the formation of clouds; Interactions are a key driver of uncertainty in radiative forcing climate; Aerosol concentrations and properties impact cloud properties and interaction with radiation; Aerosols may modify convection. Emily presented the science goals and objectives defined by the Aerosol, Cloud, Convection and Precipitation (ACCP) Study Team:

1. Low Clouds and High Clouds
2. Convective Storms
3. Air Quality and Aerosol Attribution; Aerosol Redistribution Processing
4. Aerosol Direct Effects
5. Aerosol Indirect Effects

Emily then presented five potential "First Evers" from the AOS mission:

1. Global Observations of **Convective** Vertical Air Motion
2. Global Profiles of **Aerosol Properties** (absorption, type, size, number)
3. **Co-located** Dynamics, Cloud AND Precipitation Microphysics, Aerosol Characteristics, and Radiation
4. **Evolution** of Cloud and Aerosol Processes
5. **Diurnal Variability** of Cloud and Aerosol Profiles

The ACCP Architecture envisioned one large polar satellite, and 2 smaller inclined satellites. AOS is in Pre-Phase A, and some adjustments are being considered to stay within the budget profile. These include reducing the number of NASA instruments, and eliminating one of the NASA inclined platforms. Emily showed what will potentially be *lost* from the ACCP Study Architecture as a result of the proposed adjustments:

- Polar: SW spectrometer, lidar photon detector
- Inclined: only 1 platform vs. original planned 2; removal of U.S. Ku, W-band radar, Polarimeter, Tandem stereo cameras

However, there are some *gains* from international collaboration, e.g.:

- Polar: Canadian Space Agency (CSA) providing aerosol, moisture limb sounding
- Inclined: JAXA platform with wide-swath Ku radar and CNES tandem radiometers

The AOS Applications Impact Team is charged with ensuring that Applications are considered to the greatest extent possible in mission design and implementation. It is anticipated that AOS will provide key information to support decision-making at timescales ranging from hours to decades. AOS Applications thematic areas include:

- Weather, Air Quality and Climate Modeling and Forecasting

- Disaster Monitoring and Modeling
- Water Resources
- Infrastructure and Development
- Public Health and Ecosystem Health

The AOS Applications Impact Team has actively engaged the community, and sought and received feedback. There were over 250 attendees and various workshops, including targeted workshops on Weather and Air Quality Modeling, and Transportation and Logistics. Over 60 independent interviews were conducted, and extensive engagement with National and International agencies, as well as the private sector. Emily presented a graphic depicting the ACCP study proposed latency for AOS support to stakeholder needs. Data relating to long-term decisions would be available within 6 hours of observation; data needed for short-term decisions would be available within 3 to 4 hours; and for time-critical decisions, a stretch goal is 1 hour latency. The formal requirements have been relaxed to:

- 75% of radiometer data downlinked in <3 hours
- 85% available in < 4 hours
- 95 – 100% available in < 5-6 hours

Emily reported on the AOS Community Assessment Report (CAR), which is not yet available to the public. The purpose of the document is to synthesize relevant applications communities, including current and potential communities of practice. The CAR makes recommendations and offers suggested guidelines for how AOS mission components could be optimized for enhanced applications value. The CAR categorizes and assesses factors impacting value. E.g., capacity and capabilities vary – they are largely dependent on organizational resources; measurement uncertainty is important – accuracy and knowledge of uncertainty will be major drivers impacting the likelihood of product use for decision making; intermediate data products and services will be vital – many stakeholder communities rely on value-added service providers, rather that than going directly to the data sources.

Emily briefly summarized the current status of the mission and the significant advances over prior missions that can be expected. After her presentation there was some discussion about building capacity and increasing utility of the data. A suggestion was made that data from the EVM-3 INCUS mission might be useful in building capacity prior to AOS, with which Emily agreed. Sean Helfrich/NOAA stressed that the utility of AOS data would increase if latency could be lowered, at least over timeframes or places of interest. Miguel concluded with an observation that the aerosols community has been asking for multi-angular and polarimetry as an extension of the ESO, and asked if that was still on the table for AOS. Emily replied it was still unclear, but will maybe clearer after the upcoming MCR.

7 Surface Biology and Geology (SBG) Mission Overview, Christine Lee (JPL)

The SBG mission will consist of 2 primary platforms: SBG Heat, with a wide-swath TIR imager (5 bands are being considered) and ASI VNIR camera; and SBG Light, with a wide-swath VSWIR spectrometer. In addition, a third platform, a VSWIR SmallSat, is envisioned. The SBG is planning on-orbit international partnerships with ESA, the Italian Space Agency, CNES, and ISRO. Three additional platforms with thermal and VSWIR instruments are anticipated. SBG has been working with these agencies to ensure mission coordination and data product harmonization. SBG aims to be the premier observing system for understanding the impact of climate change. SBG science and applications objectives are highly aligned with the other ESO missions (NISAR, MC, AOS) as well as associated marine missions (GLIMR and PACE). Benefits for both science and applications are anticipated from this synergy.

SBG Applications sectors include:

- Agriculture, Food Security, and Surface Water Management
- Water Quality and Coastal Zone
- Conservation
- Wildfire Risk and Recovery
- Disasters and Natural Hazards
- Geology Applications

SBG Algorithm/Product Classes include:

- Core Products
    - Earth Surface Temperature and Emissivity
    - VSWIR Reflectance
    - Cover Classifications
- Product Algorithms:
    - Terrestrial Ecosystems
        - Vegetation Traits
        - Evapotranspiration
        - Proportional Cover
    - Geology/Earth Surface
        - Substrate Composition
        - Volcanic Gases and Plumes
        - High Temperature Features
    - Aquatic and Coastal Ecosystems
        - Water Biogeochemistry
        - Water Biophysics
        - Aquatic Classification
    - Snow and Ice
        - Snow Albedo

The SGB Space-based Imaging Spectroscopy and Thermal pathfinder (SISTER) is a collaboration between JPL, ARC, GSFC, industry, academic institutions, and non-profit organizations. The objective is to prototype data system architectures and workflows to test candidate research and applications algorithms through prototype high-dimensional, high-value SBG data. A variety of data sources will be used, including EMIT and ECOSTRESS. The protype data will be distributed to both research and applications communities for assessment. This will also provide a springboard for an early adopters' program.

Christine cited a recent research article, "Systematic Integration of Applications into the SBG Earth Mission Architecture Study", as evidence of the benefits and commitment to emphasizing the importance of Applications from the beginning of a mission. Key points are:

- Science and applications can be considered synergistically at the start of the mission lifecycle
- Applications and science integration produced a more representative and tailored set of needs driving mission architecture
- Applications conferred unique technical needs, particularly around latency

Christine highlighted other impacts Applications had on the SBG Architecture Study:

- Developed an Applications Traceability Matrix (ATM) which was integrated into the Science and Applications Traceability Matrix (SATM)
- Application temporal revisit needs helped bolster discussions with international partners
- Application (as well as science) reinformed the need to add a VNIR camera to the TIR configuration
- Applications and science needs helped articulate mid-IR channel on TIR
- Applications analysis identified different categories of "low latency"

Two different latency "buckets" were identified for SBG:

- "Routine" < 24 hours for Level 2+ products – driven by Agriculture and Food Sector, e.g., low-latency evapotranspiration to inform water allocation is desirable but must have very high accuracy. The SBG Applications team's analysis shows that 78% of SBG applications needs can be met by this latency
- < 6 hours – for detection and response to disasters

Christine stressed that the SBG team is fully committed to NASA's Open Source Science, and this is being addressed in the architecture studies. SBG mission planning is also taking lessons learned from ECOSTRESS. She shared a few experiences, including use of ECOSTRESS data in working with their partner IrriWatch to produce Irrigation Advisories. In conclusion, Michelle reported on the SBG Community Assessment Report, for which they are receiving excellent support from RTI International.

Miguel asked Michelle's thoughts on working with commercial sector partners, like IrriWatch who are motivated to reduce latency in order to be able to sell their products. How can we balance private sector goals with NASA's Open Source Science policy? Michelle said that while she believes that some commercial partners (probably Irri) will be willing to share some elements of their workflows, other will be less likely.

8 TROPICS Low Latency Study, Vince Leslie (MIT-Lincoln Labs)

Vince reported on a recent low-latency demonstration for the upcoming Time Restored Observations of Precipitation Structure and Storm Intensity with a Constellation of SmallSats (TROPICS) mission. TROPICS is a constellation of CubeSats, each carrying passive microwave radiometers, with a heritage in AMSU and ATMS. Three Astra launch vehicles will carry a total of 6 CubeSats into a low-inclination orbit, between mid-June and mid-August. TROPICS main mission is science research, so it did not have a low latency requirement. However, positive results with a Pathfinder resulted in NOAA's interest in funding a low-latency demonstration. The baseline ground system for the pathfinder supported 3 passes per day, with a data latency of 6 to 13 hours (latency defined as half the time between contacts and ground latency). The low latency demonstration increased the number of contacts to 18 per day. Improvements were also made in the MOC software and Level-1 radiance algorithm. The demo ran April 25 – 29. While the report is still in preparation, preliminary analysis indicated that the low latency should reduce average latency from 6 hours to 1 hour. The Pathfinder demonstration results are being mapped to the constellation orbit to understand potential constellation low-latency performance. (The Pathfinder is in a polar orbit, whereas TROPICS will have an inclination of 40 degrees)

Vince reported current status. Astra is still working through their license approval, so the launch dates are fluid. TROPICS is still working constellation frequency approval. The TROPICS team is also investigating the option of prioritizing particular hurricane basins to reduce latency for those locations, and overall cost. Preliminary Pathfinder analysis indicate that the low latency for the constellation is very manageable, and latency is expected to be close to an average of 45 minutes, but funding is not yet clear.

Miguel initiated a discussion on how TROPICS was able to go from Science only to include low-latency applications support and interest from NOAA. Vince said the success of the Pathfinder and initial calibration were factors. Emily Berndt added that MSFC has been running a TROPICS Early Applications Adopters program, and there has been close collaboration between the TROPICS team and the community of stakeholders. Information from their workshops had been presented to NOAA at NASA Headquarters.

Day 2

9 Introductory Remarks for Day 2, Miguel Román

Miguel reflected on what was covered on Day 1. The end of Terra and Aqua was discussed at length, and he observed there seems to be a mixed approach for continuity in terms of preparedness and transition to follow-on instruments. Operational agencies have been using LANCE data for a long time. Miguel felt Brad Quale's presentation provided insight into how a low latency capability can be maintained beyond just NASA-EOS sourced data. His vision for the future is integrating low latency resources from various agencies. He cited NOAA CoastWatch as an example.

Many LANCE user communities, particularly international users, may not be aware of the upcoming changes within NASA. In the future, they will be expected to go to the cloud, where the products upon which they relied may no longer available. This calls for a strategy for building capacity through training of these communities that depend on low latency data.

Day 2 will look at innovations and new ways of handling NRT data as the UWG thinks about the future of LANCE. Miguel again emphasized the need for UWG input.

10 AI/ML for near real-time data, Manil Maskey (NASA MSFC)

Manil is the lead for Artificial Intelligence / Machine Learning (AI/ML) for NASA SMD under the Open Science initiative, as well as managing the GHRC DAAC at MSFC, that produces LANCE AMSR2 and LIS ISS products. Manil provided a brief overview of AI and Deep Learning using advanced algorithms such as neural networks. He gave examples of the complicated problems that can be solved using AI. Asking the right questions and having good data are key.

The Earth Science Data Systems (ESDS) AI strategy has five goals.

1. Augment data stewardship processes – leverage AI to achieve consistent and efficient results – e.g., Provide consistent keywords.
2. Maximize information and knowledge discovery capabilities (e.g. training a machine to detect a fire and track the smoke plume in NRT).
3. Enable sharing and interoperability of Earth Science AI training data and models (e.g., creating large scale data sets).
4. Increase partnerships with academia, industry, other agencies and international partners and,
5. Foster AI expertise within the program.

Opportunities for applying AI to automate processes for NRT data are: validation, anomaly detection, data quality, and metadata consistency.

Manil concluded with an example of seeding an algorithm with phenomena imagery (e.g., a hurricane), and searching the entire archive for similar images. He clicked on an example tile from GIBS, and the algorithm returned all the imagery tiles in the archive that looked like the selected tile. Miguel asked the UWG to consider how AI might be applied to LANCE / NRT.

11 Updates on ongoing work

11.1 Dynamic HLS imagery in FIRMS for rapid burned area assessment, Brian Freitag (NASA MSFC IMPACT) and Brad Quayle (USFS)

Brian Freitag presented a new dynamic Harmonized Landsat Sentinel-2 (HLS) false color composite that has been added to LANCE FIRMS. HLS takes data from Landsat 8 OLI and Sentinel 2A and 2B MSI, which have similar spectral ranges, and harmonizes them so the 2 products can be used interchangeably.

When combined, it provides global land surface reflectance coverage (excluding Antarctica) every 2-4 days with a spatial resolution of 30m. Cloud cover is a problem and areas that are more than 98% cloudy are not processed, so this reduces the revisit time in tropical areas. The capability was requested by Brad Qualye (USFS) in October 2021. Adding it into GIBS as a static layer was considered but it was decided to dynamically visualize this data, so data is pulled directly from the cloud when a user requests it. Data is available from March 15, 2022. This HLS layer uses false color composite for Landsat Bands 7, 5, and 4 and Sentinel bands 12, 8a and 4.

Brad Quayle presented a quick overview of how to access the data in FIRMS[1] and showed some examples of recent fire events as well as examples of flood.

Fritz asked what the latency was. Brian stated that is on the order of 2-4 days; this is because of the latency of the data needed for atmospheric correction. Miguel observed that FIRMS is using data from MODIS, VIIRS, and now HLS, with commercial data and new NASA data on the horizon. Users have to decide which products to use, and which layers to open. He asked whether there is a strategy with respect to integration of all these different data sources? Brad acknowledged there is still a hurdle to help users understand the data sources, including their temporal, spatial and spectral resolution. Additional training, tutorials, etc. will be needed.

[1] Instructions on how to access the HLS FCC in FIRMS can also be found on the FIRMS Blog https://wiki.earthdata.nasa.gov/pages/viewrecentblogposts.action?key=FIRMS

11.2 LANCE Metrics and Updates, Diane Davies (NASA ESDIS)

Diane acknowledged all the people working on LANCE. The FIRMS team was a recipient of the Goddard Team Award for Engineering. She presented a summary of latency over the last year. Overall, the latencies are within the 3 hour requirement, with some exceptions where there were system failures, upgrades, or issues or delays with receiving the data. Diane presented metrics on the number of registered users accessing LANCE data through Earthdata Login (not including imagery from FIRMS/Worldview or GIBS). The number of users continues to increase each year. Yearly number of files distributed is increasing but in 2021 there was more than double the amount of data distributed in 2020. While it is not entirely clear why, there has been a lot of MODIS/Terra and Aqua Level 1 data being pulled and a lot of AIRS data being pulled by NOAA after they decommissioned their NRT system at NOAA Satellite Operations Facility (NSOF). Over the last year we are still seeing MODIS/Terra and Aqua making up nearly 80% of total data downloaded, with a small increase in VIIRS data downloads.

Google Analytics were used to show visits to LANCE webpages and FIRMS since the last UWG. Peaks are seen where there are major fire events. There were a large number of news articles on fires in Colorado, Argentina and India featuring imagery from FIRMS. FIRMS was also used to track the invasion of Ukraine, with the largest peak coming within days of the start of the invasion in February. FIRMS continues to be used to track the invasion, see war fires, and verify event on the ground. Numerous media outlets have used and cited FIRMS imagery. There was a high percentage of new users of LANCE during this period, Diane showed a Google Analytics map of where users come from: excluding US, a lot of users came in from Sweden, Argentina, India and Poland. Ukraine and Russia were also in the top 10 users. The uptick in Sweden seems to be based on a newspaper article that referenced FIRMS used to track events in Ukraine. Another example in Japan, a financial newspaper showed damage to airfields and residential areas using FIRMS hot spots. Another chart showed how users access LANCE: 40% come in directly and the other 60% are from Google searches.

Diane presented LANCE FIRMS Outreach plans, including links to online information. She also provided updates on FIRMS. In addition to the HLS False Color imagery, there are other new data sources in FIRMS coming for the U.S./Canada Fire season, including real-time MODIS and VIIRS direct readout data, NRT Landsat-8/9 data, and a NRT Geostationary product with data from GOES, Himawari, and Meteosat. There are also improvements being made to the user interface.

11.3 Feedback on LANCE Products from Applied Science Community, Tian Yao (NASA AS/LANCE)

Tian provided feedback regarding LANCE NRT data from three surveys conducted by the Applied Science Program. The first surveyed NASA SERVIR and Applied Remote Sensing Training (ARSET) teams. They want GIS friendly formats covering fires, air quality, flood and severe weather, with GeoTIFF being the favored format. The SERVIR Water-Related Disasters lead

reported that low-quality information overload is an issue. Cloudy optical images are not useful. They look forward NISAR data products, which will have the advantage of being able to image through clouds and smoke for flood and fire applications.

The second surveyed group were users in Latin America and Caribbean (LAC) that are currently using the following from LANCE through Worldview and the NASA Disasters portal: VIIRS nighttime lights, MODIS/VIIRS active fire data, and products related to volcanic eruptions. They are also interested in the ICESat-2 expedited Quick Look land and vegetation height products for monitoring land use and land cover change and expressed interest in the upcoming products from NASA ROSES: VIIRS global flood, HLS false color composite, VIIRS burned area and new versions of active fire data. The LAC users said 1-3 hours is good for disaster response but less than 1 hour would be ideal for forest fires; they would like user-friendly formats. The third survey group was from the Volcanic Ash Advisory Centers (VAACs). They said latency is most useful within 1-3 hours for disaster response and within 12 hours for is critical for operational use. Data from geostationary satellites with approximately 15-minute latency would be welcome. Their product needs are for detection of ash cloud, products to differentiate between ash and SO2, ash and dust and satellite imagery to fill gaps in GOES-17. They would also welcome training on NASA data, and generating products from the data.

11.4 Worldview/GIBS updates including update on granule viewer, Ryan Boller (NASA GSFC)

Ryan provided an overview of how the GIBS/Worldview architecture works. He then highlighted new and updated features, including: a Progressive Web Application that allows for full screen mode on phones; the ability to add multiple markers/locations to the map; a settings panel which allows users to change displayed Temperature units and toggle date lines (more features will be added); more features from EONET (Earth Observatory Natural Event Tracker) such as magnitude field for severe storms (e.g., average wind speed) and sea ice (e.g., surface area).

Ryan provided an update on the Granule/Swath Visualization prototype, requested by the UWG, and nearing readiness for evaluation. As a reminder, currently the mosaic approach limits users' ability to access "everything" that a given satellite has acquired, especially in regions where there are likely to be swath overlap from previous overpasses (e.g., near the poles). The vision is to have "**no pixel left behind**" to better support NRT and science users who monitor rapidly evolving events like fire, cloud, or volcanic activity. Ryan demonstrated how the prototype interface works – these are currently set up as a different layer to the mosaics. Users will be able to select the number of granules that can be viewed for corrected reflectance imagery both in geographic and polar projections. Ryan reported on the features that have been added since the last UWG: MODAPS and GIBS pipeline for NOAA-20 VIIRS imagery as granules; streamlining the Worldview UI/UX. Next step is to share the protype and solicit feedback. Ryan asked UWG members to contact him if they want to test the final prototype.

Ryan briefly reviewed metrics. Worldview had an uptick around the Tonga volcano eruption, and general usage has increased since the Russian invasion of Ukraine.

The new NRT updates include: MODIS combined flood products are now updated every half hour. Version upgrades include:

- AMSR Rain NRT vR01 to vR02
- SNPP/VIIRS Aerosol Deep Blue NRT v1.0 to v1.1
- MLS NRT v4 to v5

Upcoming GIBS/Worldview product updates

- SNPP / VIIRS v2 L2+L1 granules NRT/STD
- SNPP / VIIRS C2 L2 Land NRT
- JPSS-1 / VIIRS C2.1 L2 NRT / STD
- MAIAC NRT 8-day to daily

GIBS is in the process of migrating to the cloud (GIBS in the Cloud – GITC). For most users the transition is seamless and users won't notice any difference. NRT MISR and SPoRT geostationary have moved to the cloud, and a road map for the Spring/Summer 2022 will see MODIS and VIIRS NRT products added to the cloud, as well as additional functionality such as improved geostationary and HLS performance via ZenJPEG and support for vector streamlines (e.g., ocean currents).

Ryan also mentioned that now that they are moving to the cloud there are opportunities to dynamically visualize data ("maps with knobs") through custom color palettes, custom band combinations and custom visualization of specific parameters. They are working with Manil and the IMPACT team on this and it is expected that this approach will be useful for the new higher-volume datasets such as HLS, SWOT and NISAR. Ryan mentioned feedback from UWG scientist Steve Miller, who is looking at Day/Night bands, trying to pull as much precision as possible. He is working at the edge of precision for the sensor, which will be facilitated by the dynamic visualization capabilities.

11.5 MODIS and VIIRS and New NRT Products from ROSES-2020, Sadashiva Devadiga (NASA GSFC)

Since last meeting VIIRS L1 processing transitioned to C2 for Suomi NPP and C2.1 for NOAA-20 in February 2022. Work in progress includes:

- C2 Land reprocessing and forward processing of standard products in the OPS processing stream is expected to start in July. VIIRS NRT Land processing expected to transition to C2 in Aug/Sept 2022 timeframe.
- GIBS global browses for full suite of VIIRS land products to be operational in NRT after transition to C2.

- Granule browses are being generated on the nrt3 processing system (Corrected Reflectance product from Suomi NPP and J1/NOAA-20) and under testing with GIBS.
- MODAPS/NRT currently participating in the GIBS testing of GIBS in the Cloud (GITC)

Sadashiva provided an update on the MODIS flood map product (MCDWD). While the final Beta version has been available publicly since January 2021, work is ongoing to generate the flood product in the operational system to more readily test improvements, process the historical data for an updated reference layer, and create an archive version of the product. Ongoing updates are being made to the Height Above Nearest Drainage (HAND) terrain mask which will remove terrain shadow false-positives. Spectral mapping between MODIS and VIIRS has started to enable a continuity product from VIIRS.

Sadashiva provided an update on the potential new NRT products from ROSES 2020 A.33 proposals. These are listed in table 2.

Proposal Title	**Principal Investigator**	**Data product**	**Instrument**	**Status**
A new satellite data product for studying fire combustion efficiency, fire emission speciation, and fire weather at night and beyond	Jun Wang (U. Iowa)	Fire location Fire Radiative Power Fire Temperature Visible Light Power Visible Energy Fraction	VIIRS	In testing at the Science Facility
VNP21IMG Land Surface Temperature 375-m NRT product	Glynn Hulley (JPL)	Land Surface Temperature	VIIRS	In testing at JPL
Snow Cover and Snow Albedo in Near Real Time from SPIRES for MODIS and VIIRS	Karl Rittger	Snow Cover Dust Concentration Albedo Grain Radius	MODIS, VIIRS	Production, Archive and distribution from NSIDC (48 tiles)
A New Near-Real-Time Volcanic Eruption Monitoring Algorithm for Suomi NPP and JPSS VIIRS, Providing Continuity with the MODIS/EOS Era MODVOLC System	Robert Wright (U of Hawaii)	Volcanic Eruption Detection Volcanic Thermal Emission	MODIS, VIIRS	In development at SCF
Daily Global Flood Maps and Potential Flood Alert based on Machine Learning and Computer Vision	Fritz Policelli (NASA GSFC)	Potential Flood location Map	Changed from MODIS -> VIIRS	In development at SCF

Table 2: Potential new NRT products from ROSES 2020 A.33 proposals.

Miguel said that for anyone that wants to know more about the new products, they can take a look at the slides presented at the MODIS Science Team meeting.

11.6 Update on BRDF, NBAR and Albedo products in LANCE, Crystal Schaaf (UMB)

MODIS Bidirectional Reflectance Distribution Function (BRDF), Albedo, and Nadir BRDF-Adjusted Reflectances (NBAR) C6.1 daily NRT products (MCD43A1N, MCD43A3N, MCD43A4N) are now available from LANCE. Daily C2 NRT VIIRS Albedo, BRDF, and NBAR products (VNP43*N) will also be available soon. Crystal suggested LANCE try and do a better job of encouraging the use of the extensive flags provided, particularly for snow or non-snow retrieval. She thanked the LANCE MODIS team for their help in figuring out what was wrong with the initial MODIS C6.1 products and requests the GIBS team run imagery products by the PIs as well as the MODAPS QA team before making them available.

11.7 SMAP Updates – Lala Pashaian (JPL)

Lala gave the UWG a brief overview of the project. The 3-year primary mission ended in June 2018 and was awarded a 3 year extension followed by a 6 year extension which will take the mission through to September 2026. The first NRT products were made available to select users on the JPL side at the end of 2015 due to high demand. The NRT system sacrifices some quality; it uses some predicted data e.g. attitude, and processing the data as it is received rather than waiting for the half orbit to be fully completed. Products are: L1A Radiometer, L1B_TB, L1C_TB and L2_SM_P. SMAP products are used for monitoring droughts and crops, predicting floods, weather forecasting and linking water, energy and carbon cycles. Existing users are NOAA, REMMS, the Canadian Government and the US Air Force. The US Navy are currently evaluating the SMAP NRT products.

Funding for SMAP in LANCE was made available in 2020. SMAP NRT data will be produced at JPL and distributed through NSIDC. A number of delays have hindered progress but they are on schedule to be operational in LANCE from the primary instance at the end of May 2022. The secondary system will also run out of JPL with plans to operate from the cloud in the Fall of 2022.

Miguel suggested some lessons might be learned from the SMAP experience, possibly improving the enhancement request and implementation process to make sure things run smoothly for other new LANCE elements.

12 Update on Real-Time Detection of Active Fires using VIIRS and MODIS, Liam Gumley, SSEC, UW-M

The University of Wisconsin-Madison Space Science and Engineering Center (SSEC) has developed a system to receive, decode and process MODIS and VIIRS data to produce active fire data for CONUS within 60 seconds using direct broadcast. Liam explained that SSEC has access

to multiple DB antennas in CONUS, as well as Puerto Rico, and Hawaii, for which they have been able to install software systems to stream the DB data in real-time from each antenna to a central collection point (currently at the university.) Their software ingests, merges and de-duplicates the packets in real-time. The software is set up to process micro-granules through Level 1 to active fire Level 2 products using the same version of code that LANCE uses. The active fire data are converted to CSV and provided to LANCE/FIRMS via a Web API. The MODIS latency is approximately 25 seconds and VIIRS latency is approximately 50 seconds for data ingested and processed in real time. Affordable X-band antennas, freely available software for decoding and processing data, and their micro-granule processing strategy are key to their success. Currently ultra-low latency data are received from DB antennas in Madison (x2), Hampton and Mayaguez (Puerto Rico). Standard low latency data are being received from Honolulu and Monterey 1-2 minutes after the over pass is complete. SSEC are testing VIIRS data ingest from two antennas in Brazil in collaboration with INPE (Brazilian Space Agency) and have requested VIIRS data from University of Alaska Fairbanks.

Miguel asked Liam's vision for scaling up or going beyond the Americas? What could the community do to help take that next step? Liam answered that fire seems to have global application, and that for the weather community they are working on a real-time CrIS product to provide stability indices for potential thunderstorm activity. He said he was not sure every product needs real-time – and would be looking for guidance from the community as to which applications would provide benefits from real-time data availability. For going beyond the Americas, Liam said the Direct Broadcast Network (DBNet), run by World Meteorological Organization (WMO) since 2005/6, could possibly be used. He suggested there would need to be an overarching organization that would provide coordination – not necessarily a funding organization – but one that could provide guidance on how the DB communities could work together.

Karen asked if SSEC had software to process data they collect that is not NASA or JPSS. Liam said they have some software for all the satellites mentioned on the reception schedule in his slides; for example, they have software to process GCOM W-1 software from JAXA through NOAA to process AMSR2 microwave data to L1B and retrieval algorithms for AMSR2 developed by NESDIS. For FengYun-3 (FY-3)-D, the China Meteorological Administration (CMA) provides L1 processing software to make L1B and imagery. Currently they do not provide physical retrieval software for FY-3D or FY-3E, but Liam thinks this will come with time.

13 Identifying a NRT Path to Assimilate Geostationary Aerosol Data, Arlindo da Silva (NASA GSFC)

Arlindo highlighted the value and long term record of the integrated Dark Target / Deep Blue standard aerosol products found in MODIS with continuity from VIIRS in progress. Recently, the algorithm has been applied to geostationary data; it has been applied to GOES East and West and Himnawari 8 and it is extensible to other advanced geostationary imagers. After 2022 the

nominal locations of the Advanced Imagers will provide almost global coverage in the co-called *GEO-ring*. Arlindo pointed out that having regular aerosol observations throughout the day, using geostationary data to complement MODIS and VIIRS will enable better monitoring of the diurnal cycle. Arlindo asked the International Cooperative for Aerosol Prediction (ICAP) that represents the major centers and establishes best practices for making scientific recommendations, for their feedback on a prospective geostationary aerosol product and it was very positive. In summary members of the US and international aerosol prediction community were in agreement about the urgent need to add geostationary data in NRT. Specific comments can be found in Arlindo's presentation from representatives of GMAO and the AOS (NASA), ECMWF, NRL and JMA.

Arlindo said that although other MODIS-heritage aerosol algorithms exist (e.g., MAIAC), the Dark Target/Deep Blue algorithms offer the breadth of sensors and maturity for NRT implementation of geostationary aerosol retrievals. He added that over time other algorithms could be integrated as well. Following Liam's presentation was timely as the University of Wisconsin/SSEC has access to ABI and AHI data in NRT and have experience deploying the Dark Target algorithm for LEO and GEO sensors. The extension to Meteosat Third Generation, when launched in 2022, will provide much needed GEO-ring global coverage.

Arlindo concluded by asking if LANCE would consider facilitating the implementation of NRT GEO aerosol data.

Miguel said LANCE has discussed the use of NRT geostationary data on several occasions and NASA HQ has funded several R&A projects (funded by Tsengar Lee and Jack Kaye) to demonstrate the utility. Arlindo's presentation provided a clear need from the user community so the action goes back to NASA HQ to see if they will fund this. Miguel would like to see some progress before the next LANCE UWG. Arlindo said that he sees LANCE as an enabling arm of the applied sciences and reminded the group that the investment it would take to make this happen is very modest.

14 AWS Ground Station Update, Matt Bialas (Element 84)

As a reminder, the main goal of this study was to evaluate the AWS Ground Station service as an option for near real-time data acquisition. This presentation provided an update on phase 3 goals which were to: produce products for NASA's Disasters Mapping Portal and NASA LANCE-FIRMS, make performance and cost control improvements with the processing pipeline, and provide a risk assessment and production viability study.

Matt reported on the improvements made to the process. Latency times to produce Level 2 MODIS products using IPOPP have been reduced from ~23 minutes to ~ 8 minutes 30 seconds and VIIRS Level 2 products have been reduced from ~17 minutes using CSPP to 11 minutes 30 seconds. In terms of viability, there are still gaps in ground station coverage, however AWS has added are more downlink stations; the newest at Punta Arenas in Chile but gaps still remain,

noticeably at the poles. Regarding costs, Matt showed that the antenna time accounts for nearly 98% of total costs. On-demand use (not scheduling in advance) is far more expensive than reserved pricing. If it is possible to estimate the number of passes likely to be required over a year, then (based on 1000 reserved passes) it is possible to unlock almost a 70% discount ($32k vs $102k).

Data has been delivered and ingested in to FIRMS using AWS S3 data bucket and testing with the NASA Disasters Portal is ongoing. In terms of risks: there have been some AWS outages (six between 2015 to 2020, and five in 2021 but none so far in 2022) so this should be taken in to account. Possible future work could support additional instruments and products, trigger commercial pipelines or explore other antenna / cloud providers.

Miguel noted that AWS downtime could be compensated by using other downlink providers as back up. Matt said Azure offers similar services so providers outside AWS could be used. Karen mentioned that Azure has asked to work with NASA but Karen declined for now until a specific use case can be identified. She noted that Azure group is working with EDOS, and it will be interesting to see the outcome of that work. Her understanding is that Azure has more partners and so likely to have more coverage. Miguel agreed that this is an interesting topic and said we could have an entire session on that ground segment and it would be good to explore with the UWG how to help LANCE succeed. What kind of pilot studies are we doing in preparation for the ESO, how are we going to bring NRT hyperspectral data into LANCE, what would the ground segment look like and with whom should we be talking, to have access to those tools. This would be very different from what LANCE currently does. Miguel recommended ESDIS look into this.

15 STREAM (Satellite-based analysis Tool for Rapid Evaluation of Aquatic EnvironMents), Nima Pahlevan (NASA GSFC)

Nima provided some background on STREAM; its inception and evolution. It has been designed to improve water quality monitoring and engage with end users and the UN Environment Program. STREAM has been supported from NASA Applied Sciences, built on FIRMS interface, and established to complement CyAN (NOAA). STREAM identifies water quality hotspots to trigger field studies which in turn can lead to shutting off drinking water intakes or providing water quality advisories. It uses data from Landsat 8/9 and Sentinel 2A/B and SeaWiFS Data Analysis System (SeaDAS). Currently the system provides chlorophyll-a, Total Suspended Solids (TSDs) and RGB images. Data can be viewed as a time series analysis through pixel or lake-wide queries. Notifications are new. Data are accessible to the water authorities of Peru and Uruguay and data are available for San Francisco Bay. The next steps are to expand and improve STREAM to provide other products (including water clarity), expand the coverage, possibly include commercial data as an input, and transition the backend to MODAPS or the Cloud.

Nima is planning to complete an enhancement request to the LANCE. Miguel said he is looking forward to seeing the request.

In conclusion Miguel said he had no additional comments, as had made comments throughout the meeting. Karen and Diane closed the meeting by thanking everyone for their participation.

16 Actions and Recommendations

1. Karen Michael and Sean Helfrich agreed to schedule a follow-up meeting to explore how synergies between CoastWatch and LANCE might be leveraged. Sean will invite the CoastWatch Director, Veronica Lance to the meeting.
2. David Green recommended that LANCE UWG engage with NGOs to collect user needs.
3. David Green recommended that the Wildfire Program and LANCE address what should be done collectively over the next 5 years.
4. Christine Lee asked that the UWG take an action to identify additional needs or questions regarding NISAR data latency.
5. Robert Wolfe requested the LANCE UWG evaluate the impact of switching off Terra and Aqua. Concerns should be voiced by both the LANCE UWG and the Satellite Needs Working Group (SNWG). UWG members should consider:
    a. Making a strong case for MODIS Terra (AM) Land product continuity needs.
    b. Notifying users.
6. Miguel asked the UWG to consider how AI/ML might be applied to LANCE / NRT.
7. Arlindo asked if LANCE would consider facilitating the implementation of NRT GEO aerosol data. Diane / Karen to follow up.
8. Ryan Boller asked UWG members to let him know if they want to test the final GIBS/Worldview Granule/Swath Visualization prototype.

Notes for further consideration.

- The NASA Sentinel Gateway currently acquires the OLCI NRT data, and distributes it to the OBG DAAC in less than 3 hours from observation. If requested, the SLSTR NRT data can also be acquired and distributed by the NSG in less than 3 hours from observation.
- Look into what can be done in the way of additional training

Appendix 1: List of Other Attendees

Name	Email
Alexey Shiklomanov	alexey.shiklomanov@nasa.gov
Arif Albayrak	rustem.a.albayrak@nasa.gov
Bandana Kar (Ext)	karb@ornl.gov
Brian Freitag	brian.m.freitag@nasa.gov
Brian Servia	bservia@gmail.com
Bruce Mclemore	bruce.d.mclemore@nasa.gov

Cerese Albers (IMPACT SNWG MO)	cerese.m.albers@nasa.gov
Christina Moats xavier	christina.d.moats-xavier@nasa.gov
Christine Lee	christine.m.lee@jpl.nasa.gov
Colin Seftor	colin.seftor@ssaihq.com
Crystal Schaaf	crystal.schaaf@umb.edu
Dan Ziskin	ziskin@ucar.edu
Daniel Slayback	dan.slayback@nasa.gov
David Green	david.s.green@nasa.gov
Dawn Lowe	dawn.r.lowe@nasa.gov
Diane Davies	diane.k.davies@triggdavies.com
Edward Hyer	edward.hyer@nrlmry.navy.mil
Emily Berndt	emily.b.berndt@nasa.gov
Feng Ding	feng.ding@nasa.gov
Fritz Policelli	frederick.s.policelli@nasa.gov
Garrett Layne	garrett.w.layne@nasa.gov
Guy Schumann	gjpschumann@gmail.com
Jeffrey Reid	Jeffrey.reid@nrlmry.navy.mil
Jennifer Brennan	jennifer.l.brennan@nasa.gov
Jennifer Wei	jennifer.c.wei@nasa.gov
Jess Braun	jessica.braun@ssec.wisc.edu
Jesslyn Brown	jfbrown@usgs.gov
Jim Rowland	rowland@usgs.gov
Joseph Smith	joseph.m.smith-1@nasa.gov
Karen Michael	karen.a.michael@nasa.gov
Kathleen Baynes	kathleen.baynes@nasa.gov
Lala Pashaian	lala.pashaian@jpl.nasa.gov
Leigh Sinclair	slb0012@uah.edu
Liam E Gumley	legumley@wisc.edu
Lindsay Parker	lindsay.parker-1@nasa.gov
Manil Maskey	manil.maskey@nasa.gov
Margaret Glasscoe	margaret.t.glasscoe@nasa.gov
Marseille Bunk	marseille.bunk@nasa.gov
Matt Bialas	mbialas@element84.com
Min Wong	min.m.wong@nasa.gov
Nga Chung	nga.t.chung@gmail.com
Otmar Olsina	otmar.olsina@nasa.gov
Phil Durbin	pdurbin@sesda.com
Ranjay Shrestha	ranjay.m.shrestha@nasa.gov
Robert Wolfe	robert.e.wolfe@nasa.gov

Ryan Boller	ryan.a.boller@nasa.gov
Sadashiva Devadiga	sadashiva.devadiga-1@nasa.gov
Sarah Milkovich	sarah.m.milkovich@jpl.nasa.gov
Shanna McClain	shanna.n.mcclain@nasa.gov
Sheila Berrios	sberriosnazario@element84.com
Sudipta Sarkar	Sudipta.Sarkar@nasa.gov
Tandi Vettel	tandi.vettel@nasa.gov
Terri Wood	terri.wood-1@nasa.gov
Tian Yao	tian.yao@nasa.gov
Vince Leslie	lesliev@ll.mit.edu