LANCE Enhancement Request
Near-Real Time Data from the Lightning Imaging Sensor

Overview:

The purpose of the suggested enhancement is to generate Lightning products from the Lightning Imaging Sensor (LIS) instrument on the Tropical Rainfall Measuring Mission (TRMM) satellite on a near-real time basis, display the products on the LANCE LIS web sites, and create browse for the LANCE Rapid Response System.

Required Information for Enhancement Request:

1. Identify and summarize the effort.

1a. Who is requesting the effort? (User)

- David Bright, NOAA NWS Aviation Weather Center

1b. Who is completing the effort? (Provider)

- GHRC DAAC, repurposing LANCE AMSR-E equipment

1c. Is there a HQ or Science sponsor?

- Richard Blakeslee, NASA MSFC, PI for the Lightning Imaging Sensor
- Frank Lindsay, NASA Headquarters, Disasters Program Manager

2. Scientific and/or application objective achieved through enhancement:

2a. Say a few words about how this enhancement will improve science or contribute to the application of the NRT data?

The Lightning Imaging Sensor is a space-based instrument used to detect the distribution and variability of total lightning (cloud-to-cloud, intracloud, and cloud-to-ground) during both daytime and nighttime. Lightning detection from space allows monitoring of areas that have few ground stations. While the primary goal of the LIS has been to create long-term climate data records of lightning around the world for research, generating lightning products in near-real time and combining them with other sensor data could certainly enhance rapid response systems in such areas as forest fire detection, severe thunderstorms, and possibly as a precursor to tornado development. Currently there are no lightning products in the LANCE or Rapid Response systems.

Products from the LIS are currently generated in two ways:

1. Standard, non-quality controlled (non-QC), daily products generated with Level 0 science files and definitive ephemeris. These non-QC data are typically available within 16 hours of the last observation.
2. Monthly quality controlled (QC) products (man in the loop inspected) are generated with Level 0 science files and definitive ephemeris as time permits and after all products have been received for the month.

These QC products are typically available one month after last data acquisition.

These products have been generated at the GHRC since the launch of TRMM. We propose to provide the near-real time LIS products for LANCE within 2 hours (~90 minutes) of data observation, thereby reducing the delay in generating science-quality lightning products by 16 hours.

In addition to the existing LIS on TRMM, there are plans underway to fly the LIS flight spare for TRMM on the International Space Station. This ISS LIS will provide real time lightning data (one to a few minutes latency) using the ISS Low Rate Telemetry channel. This capability was desired by NASA Headquarters and strongly endorsed by a number of NOAA operational partners, including the National Weather Service (NWS) Pacific Region, NWS Ocean Prediction Center, the NWS Aviation Weather Center, and the NOAA National Hurricane Center. The ISS LIS will provide real time lightning for data sparse regions, especially over the ocean. The ISS LIS is expected to be approved for the International Space Station in early April 2013, with launch and operations in late 2015. The LANCE ISS lightning product could also support Fire Weather in the data spare regions of the western United States. These data will be used for storm warnings, oceanic aviation safety and international SIGMETs, long-range lightning system validation, and hurricane rapid intensification evaluations. Prior to the availability of ISS LIS real time data, TRMM LIS data (quick look latency on the order of 90 minutes) can be used to develop and test the real time lightning products in LANCE so that the products will be immediately available to users upon the launch of ISS LIS in late 2015. In addition, the GOES-R Geostationary Lightning Mapper (GLM) will be launched in late 2015. GLM data could also be used to support a real time LANCE lightning product, since it will provide continuous observations over all its coverage regions.

3. Concept of operations:

We note that the LIS science processing software currently runs on the Silicon Graphic Inc. SGI IRIX operating system. The LIS Science Team has provided an adaptation of this software for “quicklook” processing, using near real-time (NRT) Level 0 science data as downlinked from the satellite (not aggregated into daily granules) and predictive ephemeris. Because the remaining SGI IRIX servers are approaching end of life, the Science Team plans to port both versions of the LIS algorithm to Linux during 2013. Therefore, we would need to implement LANCE for LIS in two phases, first using the GHRC’s LIS SGI for processing, then transitioning to the repurposed LANCE AMSR-E Linux processing servers when a Linux version of the algorithm is available. In both phases, the LANCE AMSR-E FTP servers would be used for data distribution.

3a. Location of functionality

The functionality will be co-located with the GHRC DAAC and initially will leverage the existing LIS SGI processing system, as shown in Figure 1. We plan to repurpose the LANCE AMSR-E Linux data distribution system to host the LANCE LIS data and web servers. Imagery will be provided through the LANCE Rapid Response system and other visualization capabilities. The GHRC DAAC will provide user services.

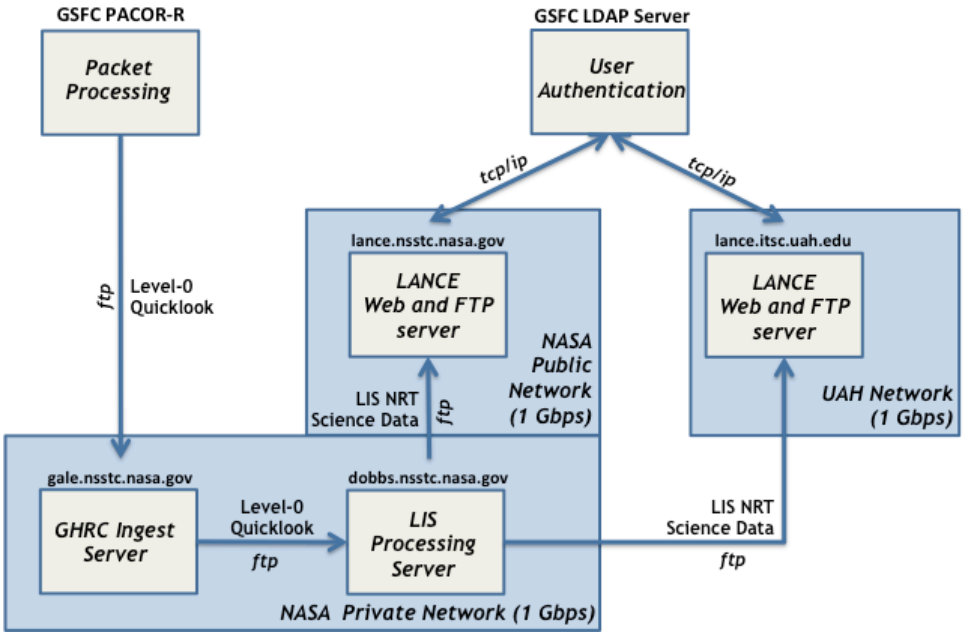

Figure 1. LANCE LIS proposed system architecture and data flow

3b. Development, integration and testing process

Migration of the quicklook science processing code from the LIS SCF to the GHRC LIS processing systems should be very straightforward. The LIS Science Team has developed and tested the software. The GHRC will need to implement ingest software for the NRT data and predictive ephemeris files from PACOR, as well as code to transfer the lightning products available to the repurposed LANCE AMSR-E Linux system. We will work with ESDIS engineers to determine what lightning products might enhance the Rapid Response system.

The LIS Science Team plans to port the LIS processing software to Linux in FY13. In FY14 the GHRC will migrate the LANCE LIS processing from the LIS SGI system to the repurposed LANCE AMSR-E backend processing systems.

3c. Support (FTEs) for development and sustaining engineering

LANCE LIS will leverage the considerable systems engineering, design and processes that went into developing LANCE AMSR-E, product generation software from the Science Team, and operations experience with LIS standard products. The following is a breakout of the effort in full time equivalent (FTEs) for the development of the requirements and the development, implementation, and testing of the data flows in LANCE LIS:

- Development of detailed requirements (senior systems engineering and development teams)
- Development, integration, and testing of NRT ingest stream from PACOR (development and operations teams)
- Installation, configuration and testing of LIS quicklook software (development and operations teams)
- Coordination with LANCE Central for new data products (systems engineering and user services)
  - Latency metrics reporting
  - Rapid Response imagery
  - User registration
- System and user documentation, FAQ, web pages (user services)
- Routine operations (operations team, systems administrator)
- Sustaining engineering (senior programmer/system administrator)

We expect the total level of effort to establish the LANCE LIS system, leveraging existing infrastructure and processes, to be 1 FTE for 6 months. Sustaining operations are estimated at 1.2 FTE per year.

3d. What is the plan for approving the work is completed?

The LIS Science Team will validate and approve the NRT lightning products generated by LANCE LIS.

4. Notional schedule:

4a. How long will it take to complete this work? When would it start?

The GHRC will begin work on this task as soon as we receive approval to start. We expect to make LIS NRT data available through LANCE within two months, and browse imagery available through the Rapid Response system within four months. The LANCE LIS effort will continue as long as the instrument remains operational.

5. Cost Implications:

5a. What is the cost of the change?

We propose to reprogram remaining LANCE AMSR-E funds, already at UAH, for initial development and operation of LIS LANCE through FY13.

For sustaining engineering and continued operation of LIS LANCE through end of the TRMM mission, we will require approximately $200K/year. A detailed budget will be provided on request.

6. Endorsements *(Attached):*
David Bright, Aviation Weather Center

From: David Bright - NOAA Federal <david.bright@noaa.gov>
Subject: Re: Seeking Letters of Endorsement for TRMM LIS follow-on on the ISS
Date: March 1, 2013 4:41:10 PM CST
To: "Harrison, Sherry" <SHarrison@itsc.uah.edu>
Cc: Bruce Entwistle - NOAA Federal <bruce.entwistle@noaa.gov>, "Conover, Helen" <HConover@itsc.uah.edu>, "Regner, Kathryn" <kregner@itsc.uah.edu>, Bob Maxson - NOAA Federal <bob.maxson@noaa.gov>

The NOAA/NWS Aviation Weather Center (AWC) along with the NOAA/NWS Aviation Weather Testbed (AWT) strongly supports your proposal to produce lightning products from the Lightning Imaging Sensor (LIS) instrument currently on TRMM, and making those data available to the AWC and AWT through the NASA Lance system. The AWC is responsible for providing weather forecasts and warnings to the U.S. and international aviation communities to support safe and efficient flight. Convection and lightning are particularly hazardous to aviation and important to air traffic flow management and flight planning. If the LIS data can be made available to the AWT for testing and evaluation, and then the AWC for operations via the NASA LANCE system, there are potentially huge near-term benefits to both aviation safety and efficiency.

We wish you much success with this important proposal and look forward to future collaboration.

Sincerely,

David R. Bright

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