THE EVOLUTION OF NASA'S LAND, ATMOSPHERE NEAR REAL-TIME CAPABILITY FOR EARTH OBSERVING SYSTEMS (LANCE) TO SUPPORT AN INCREASINGLY DIVERSE RANGE OF USER NEEDS

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ABSTRACT

NASA's Land, Atmosphere Near Real-Time Capability for Earth Observing Systems (LANCE) supports a host of near real-time (NRT) monitoring applications from air quality to wildfires to flooding to droughts to severe storms. LANCE distributes 40-75 TB of data per week from 13 instruments to a wide range of users in over 200 countries. Most of the data and imagery served through LANCE are available within three hours of satellite overpass. Leveraging the existing NASA infrastructure and science teams has made LANCE unique in its ability to provide data from instruments onboard Earth observing satellites rapidly, accurately, and consistently. LANCE continually ensures these data are findable, readily accessible, and freely available. The evolution of LANCE is ongoing, as it strives to enable researchers and applications users to quickly incorporate the latest satellite data into their work, leading to more timely and accurate understanding of the Earth's land and atmosphere.

***Index Terms*—**LANCE, Near Real-Time, Worldview, FIRMS, Disasters

1. INTRODUCTION

The evolution of what would become known as the Land, Atmosphere Near Real-Time Capability for Earth Observing Systems (LANCE) began after the launch of Terra, the first satellite in the Earth Observing System (EOS) platform. Terra, carrying the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument, was launched in 1999. Two new systems were developed based on MODIS data to provide information to users within 3 hours of satellite observation. At the request of the USDA Forest Service (USFS), NASA and the University of Maryland collaborated to create the MODIS Land Rapid Response System, providing imagery to support wildfire response and suppression. Additionally, NASA, the National Oceanic and Atmospheric Administration (NOAA), and the Department of Defense (DoD) created the Near Real-Time Processing Effort (NRTPE) system, supporting DoD operations and forecasting of weather events in the Middle East as well as disaster relief efforts across the globe. Following the launch of the Aqua satellite in 2002, a second MODIS instrument, plus the Atmospheric Infrared Sounder (AIRS) and Advanced Microwave Scanning Radiometer for EOS (AMSR-E) instruments were added to the list of NRTPE products.

2. RESPONDING TO THE GROWING DEMAND

By 2008, a growing demand for NRT data spurred a NASA Headquarters initiative to build a new, more robust system to process and distribute NRT data. This new system, LANCE, was formally established by NASA in September 2009 [1, 2]. LANCE was designed as a virtual system, leveraging the existing Earth Observing System Data and Information System (EOSDIS) science processing and archive elements in the NASA ecosystem. Through this design, LANCE minimizes latency, a key consideration for time-dependent users [3]. In addition to the products produced by NRTPE, LANCE also added the Microwave Limb Sounder (MLS) and Ozone Monitoring Instrument (OMI) instruments aboard NASA's Aura satellite.

3. RESPONDING TO THE GROWING DIVERSITY OF USERS

LANCE initially supported the advanced user needs of researchers, modelers, and scientists. However, NASA concurrently recognized the increasingly diverse user stakeholder groups accessing LANCE to support an increasing range of needs [4]. In 2011, to facilitate analysis and visualization of satellite imagery, without the need for traditional remote sensing software, LANCE helped pioneer NASA's Global Imagery Browse Services (GIBS) and Worldview, the data visualization portal that enables users to interactively browse over 1000 global, full-resolution satellite imagery layers and then download imagery or the underlying data [Figure 1]. GIBS and Worldview serve both NRT and standard imagery products.

Recognizing the needs of users in low bandwidth settings, in 2022 Worldview Snapshots was added to further facilitate use. The Worldview Snapshots module allows users to quickly generate and download subsets of MODIS and VIIRS global imagery based on user-defined geographic

areas; these are downloadable in multiple user-friendly formats with options to overlay active fires, coastlines, borders, and roads.

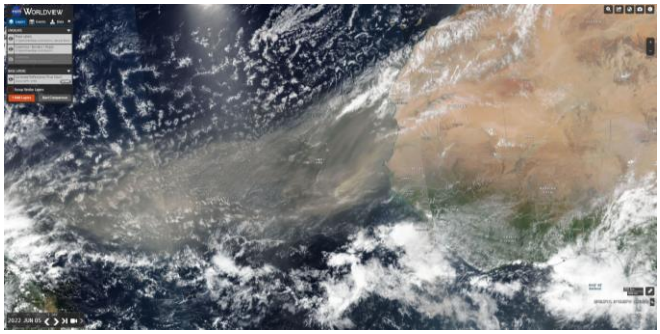

Figure 1: NASA Worldview showing a Corrected Reflectance true color composite image from the VIIRS instrument onboard Suomi NPP over Western Africa on June 05, 2022. This image shows dust airlifted from the Sahara and moving over the North Atlantic Ocean.

4. LEVERAGING PARTNERSHIPS

Monitoring fires has always been a key component of LANCE. In 2012, the Fire Information for Resource Management System (FIRMS), providing global active fire data through an online mapping interface, fire alerts and GIS downloads, was integrated into LANCE. In 2021, leveraging the continuing partnership between the USFS and NASA, FIRMS US/Canada was launched [Figure 2]. Building on FIRMS Global, FIRMS US/Canada provides multiple enhancements, ultra real-time active fire data and imagery, and additional contextual information for the US and Canada.

Figure 2: FIRMS US/Canada Fire Map displaying active fire detections observed on May 05, 2023 over Alberta, Canada. The active fire detections are derived from the VIIRS instrument onboard NOAA-20. The active fire detections are displayed on a VIIRS NOAA-20 Corrected Reflectance true color composite imagery showing dense smoke eminating from the active fires.

5. USER DRIVEN GUIDANCE

Throughout its evolution, LANCE has been guided by a User Working Group (UWG). This group of subject matter experts (SMEs), spanning atmospheric researchers to interagency representatives to non-profit applications users, provides active and unique insight, recommendations, and suggestions on potential enhancements to the system based on the current and emerging needs of the multiple stakeholder groups they represent. Through this model of SME guidance, LANCE aims to holistically capture and reflect the needs of its increasingly diverse user base, continuing to lessen the gap between NRT remote sensing data products and user needs in support of a host of geospatial applications.

6. RECENT PRODUCT ADDITIONS TO LANCE

In addition to consistently seeking to make data more accessible, through GIBS, Worldview and FIRMS, LANCE, under the guidance of the LANCE UWG, has also continued to incorporate new products for time-sensitive applications, including disasters. Over the last five years LANCE has added: a NRT global flood product; an enhanced aerosol index product from the Ozone Mapping and Profiler Suite (OMPS) for detecting PyroCumulonimbus events caused by extreme wildfires; NRT MODIS thermal alerts to serve the volcano monitoring community; and a new Black Marble Nighttime Blue/Yellow composite product to detect power outages more easily. In 2022, ICESat-2 Quick Look products were added to LANCE as part of a trend to integrate expedited products that extend beyond the original 3-hour latency requirement.

These products were added at the recommendation of the Satellite Needs Working Group (SNWG). The SNWG, is a part of the U.S. Group on Earth Observations (USGEO) and it includes multiple federal agencies. The SNWG surveys these federal agencies every two years to identify their Earth observation data needs, assesses the available satellite products to meet these needs, and to inform future mission development. NASA leads a tri-agency assessment with USGS and NOAA to identify and address the needs of these federal agencies and presents solutions to the Executive Branch. Those solutions are then evaluated by the Executive Branch for funding and implementation.

7. CONCLUSION

The success of LANCE, seen by the diverse range of time-sensitive applications supported, has been made possible through NASA's investment in algorithm development, science applications development and the LANCE NRT infrastructure that leverages the existing science processing and distribution systems. Looking forward, LANCE will continue to evolve. As Aqua, Aura and Terra reach their end

of mission life, LANCE will need to look beyond the EOS instruments that have been the mainstay of LANCE's most popular products. As NASA designs a new array of cutting edge satellites, brought together into the Earth System Observatory (ESO), and collaborates on the development of the Landsat Next constellation, LANCE will need to concurrently evolve to continue to support the increasingly diverse range of time-sensitive users of NRT data products.

8. REFERENCES

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