

EVALUATION OF THE VIIRS LAND ALGORITHMS AT LAND PEATE

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ABSTRACT

The Land Product Evaluation and Algorithm Testing Element (Land PEATE), a component of the Science Data Segment (SDS) of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP), is being developed at the NASA Goddard Space Flight Center (GSFC). The primary task of the Land PEATE is to assess the quality of the Visible Infrared Imaging Radiometer Suite (VIIRS) Land data products made by the Interface Data Processing System (IDPS) using the Operational (OPS) Code during the NPP era and to recommend improvements to the algorithms in the IDPS OPS code. This paper describes the Land PEATE system and the approach to evaluating the VIIRS Land algorithms during the pre-launch period of the NPP mission and the proposed plan for long term monitoring of the quality of the VIIRS Land products post-launch.

1. INTRODUCTION

NPOESS Preparatory Project (NPP) is a joint mission among the three agencies, the National Oceanic and Atmosphere Administration (NOAA), and the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD). The purpose of the mission is to provide NASA with a bridge for continuing the global change observations of the Earth Observing System (EOS). It will also provide the NPOESS operational community, including NOAA and DOD, with a pre-operational risk reduction demonstration and validation for selected NPOESS instruments, science algorithms, and ground processing. The NPP satellite is scheduled to be launched into a circular sun-synchronous polar orbit similar to that of the current EOS satellites in late 2011. The VIIRS on-board NPP will acquire measurements from land, ocean and atmosphere in 16 moderate resolution bands (750m), 5 image resolution bands (375m) and one day/night band (750m) providing daily global coverage.

The raw sensor data acquired by these instruments are ingested and processed using the operational software at the IDPS to produce various types of science data records. These data records are distributed to the meteorological centers and archived at the Archive and Distribution Segment (ADS) of the NPP system. The Science Data Segment of the NPP system provides the NPP mission with the capability to assess the quality of the Raw Data Records (RDR) it receives from the IDPS and the quality of the Science Data Records (SDR) and the Environmental Data Records (EDR) it receives from the ADS for climate research. The SDS consists of five

separate Product Evaluation and Algorithm Test Elements (PEATEs) dedicated to assessing the quality of products from the Land, Ocean, Atmosphere, Ozone, and atmospheric Sounder disciplines.

3. LAND PEATE SYSTEM ARCHITECTURE

The Land PEATE consists of a processing facility called the NPPDAPS, modeled on the MODIS science data processing system (MODAPS) and shares the MODIS Land Data Operational Product Evaluation (LDOPE) team for evaluation of the VIIRS Land data products generated by the NPPDAPS.

Figure 3.1 shows a high level interface of Land PEATE to external NPP mission segments and other elements within the SDS. Land PEATE will receive the IDPS operational algorithm codes

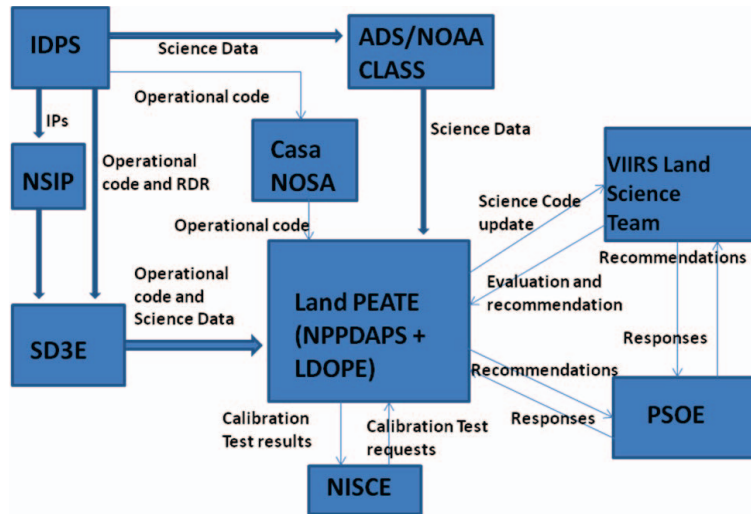


Fig 3.1 Interface of Land PEATE with SDS Elements and External Segments

from a repository in CasaNOSA, and acquire data records from the SDS Data Depository and Distribution Element (SD3E) and also from the ADS on ad_hoc basis. SD3E provides temporary local storage for a minimum of 32 days of xDR data and 7 days of Intermediate Products (IPs). Land PEATE will coordinate with the NPP Instrument Calibration Support Element (NICSE) to run tests to verify the calibration enhancements. Land Science Team members can receive the operational land algorithms and the tests results from the Land PEATE for evaluation and also can submit improved algorithms for testing and evaluation at Land PEATE. Algorithm and calibration change recommendations are reviewed by the Project Science Office Element (PSOE) prior to submitting them to the NPOESS Algorithm Change Control Board (CCB).

The MODAPS data processing software developed to produce global MODIS science product is being used to process the VIIRS data for the Land PEATE. IDPS OPS software modules are repackaged into Product Generation Executives (PGEs) to produce the VIIRS science data products using the MODAPS data processing software. The IDPS OPS software modules are designed to run in a large shared memory system, reading and writing data entirely in memory and passing pointers to memory structures between software modules. One step in the conversion of OPS software to PGEs is to add wrapper software to each module that writes intermediate products to disk rather retaining them in memory so that the OPS code can run on small Linux servers with limited memory. In order to meaningfully compare output to the heritage MODIS products, the Land PEATE will generate products in HDF4 formats. Land PEATE will also perform temporal aggregation of the IDPS-size swath granules containing 48 scans with temporal coverage of about 86 seconds into swath granules containing about 144 scans with temporal coverage of approximately 5 minutes.

4. TESTING AND EVALUATION OF THE VIIRS LAND ALGORITHMS

During the pre-launch period, Land PEATE is using the MODIS proxy data as input in the integration testing of the individual PGEs and the science tests run to evaluate the IDPS OPS algorithms. The MODIS proxy data is generated by a proxy generator which samples the MODIS Level 1B data into VIIRS geometry and maps the MODIS bands to the nearest VIIRS bands. Land PEATE now has 51 days of MODIS proxy data enough to test all of the IDPS OPS PGEs. Land PEATE also produces a VIIRS equivalent of the MODIS Level 3 daily and multi-day gridded products, Diagnostic Data Records (DDRs) to facilitate comparison and trending between the two instruments.

Land PEATE recently completed integration of the build 23 version of the IDPS OPS algorithms and ran a 51-day chain test generating full suite of the VIIRS Land products globally. The products included land surface reflectance, land surface temperature, land albedo, vegetation index, active fires, snow/ice cover, ice surface temperature, ice age, ice quality, cloud mask, and aerosol particles. Performance of the algorithms was evaluated by comparing the test results to the Collection 5 MODIS products using the QA tools developed by LDOPE.

Figure 4.1 is an example of a comparing the VIIRS Land LST to the MODIS LST by computing the histogram of difference in LST. The average difference in LST is less than 1° K. VIIRS LST algorithm uses the dual

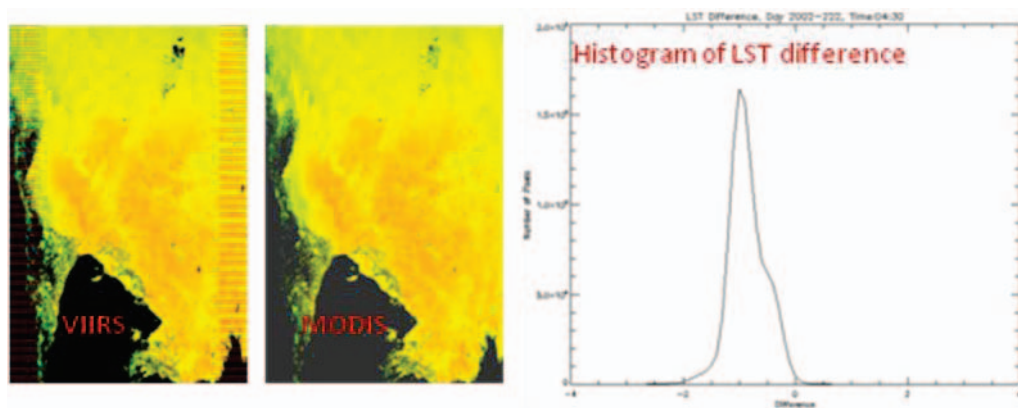


Fig 4.1 Comparison of Day time LST for a granule passing over Australia

split window algorithm as the main algorithm and the general window algorithm as back-up. Note that this example is for illustration purpose only. The final version of the VIIRS algorithm will not be available until after the post launch calibration and validation period.

The LDOPE team adopts the Quality Assessment (QA) approach used for operational QA of the MODIS Land Data products [1, 2] to evaluate the quality of the VIIRS products generated at Land PEATE. Global browses of the products are generated by projecting the coarse data into a global coordinate system. These global browses are posted on a QA web site [3] to provide rapid synoptic product assessment via the internet. Figure 4.2 illustrates global browse of the daily surface reflectance IP produced by the IDPS OPS algorithm relaxed to retrieve reflectance over cloud and aerosol. The instrument sensing geometry and cloud cover are evident in the global browse image. In addition the global view of the product provides the production status and allows detection of gross product problems.

Product quality issues found by the LDOPE during their evaluation process are posted as known issues on the QA web site. These issues are tracked and are updated as new versions of the algorithms are tested and verified by the Land PEATE. LDOPE develops and maintains a set of tools for use in QA of the VIIRS Land Data products. These QA tools are very generic and are designed to manipulate

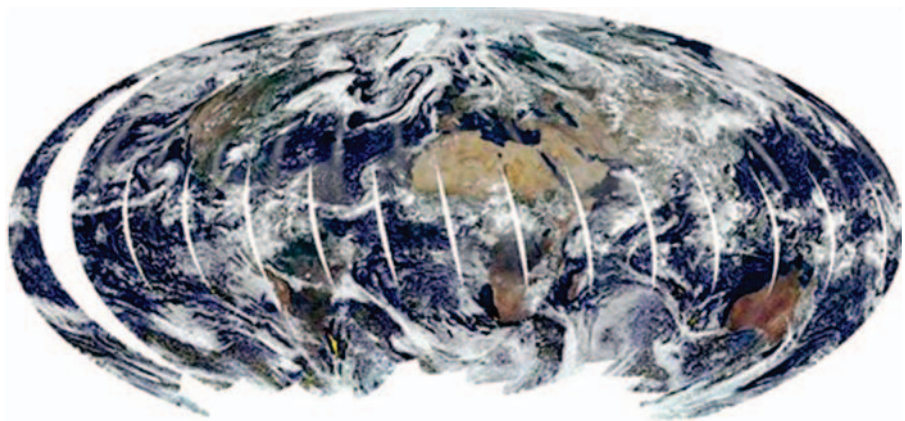


Fig 4.2 Global browse of Surface Reflectance from day 2003-193

and analyze data products in HDF file format generated from different instruments such as MODIS, VIIRS and the Advance Very High Resolution Radiometer (AVHRR).

Post-launch LDOPE will monitor the long term quality of the VIIRS Land data products by monitoring time series statistics of the science data at a number of fixed sites distributed across the globe. These product time series analyses capture algorithm sensitivity to surface (e.g. vegetation phenology), atmospheric (e.g., aerosol loading) and remote sensing (e.g., sun-surface-sensor geometry) conditions that change temporally, and they also allow changes in the instrument characteristics and calibration to be examined.

5. SUMMARY

The Land PEATE is an important element of the NPP Missions fulfilling the goal of continuing the evaluation of the products that are main source of the global change observation that began with the MODIS Land data from the Terra and Aqua satellites. Land PEATE so far has successfully integrated and tested two incremental build versions of the IDPS OPS algorithms and is currently working to integrate the recently released build 48. Land PEATE is expected to be fully functional meeting all the requirements and play an important role in the development of the VIIRS algorithm to generate the EDRs equivalent to the Climate Data Records (CDRs).

6. REFERENCES

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