**MEMORANDUM FOR:** The Record

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**SUBJECT:** NPP VIIRS LSA EDR beta status

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The successful launch of the Suomi National Polar-orbiting Partnership (SNPP) Spacecraft on 28 October 2011 with the Visible Infrared Imaging Radiometer Suite (VIIRS) ushers in a new generation of capabilities for operational environmental remote sensing for weather, climate, ocean, and other environmental applications. VIIRS succeeds the NOAA AVHRR and NASA EOS MODIS with 22 spectral bands covering wavelengths from 0.41 to 12.5 µm, providing data for the production of 22 Environmental Data Records (EDRs) with its calibrated and geolocated Sensor Data Record (SDRs).

Among them is the combined surface albedo EDR (VIIRS-SA-EDR). Surface albedo is defined as the ratio between shortwave radiation (0.4-4.0µm) reflected by Earth’s surface and incident shortwave radiation at the surface. It is a function of both solar illumination and reflective properties of the surface. The surface albedo EDR has the global coverage and consists of ocean surface albedo (OSA) and sea/ice surface albedo (ISA), in addition to land surface albedo (LSA). The beta maturity status of the combined surface albedo EDR (VIIRS-SA-EDR) is based on validation of the LSA, which is the most dynamic component of VIIRS-SA-EDR

Two algorithms (Dark Pixel Sub-Algorithm (DPSA) and Bright Pixel Sub-Algorithm (BPSA)) are proposed to generate LSA from VIIRS top-of-atmosphere reflectance. The DPSA algorithm derives the LSA from a surface bi-directional reflectance distribution function (BRDF) that is derived from the VIIRS measurements, while the BPSA roots in the direct estimation method, which directly link the variables of interest with the satellite observations (TOA reflectance) through statistical modeling. The training data used to establish the models are obtained through simulation of physical models. An updated Look-Up Table (LUT) has been developed and implemented after launch, which applied the latest VIIRS spectral response functions.

An LUT approach is applied for OSA, using solar zenith angle, aerosol optical thickness, wind speed and chlorophyll concentration as input parameters.

The BPSA algorithm is used to generate LSA and ISA for this beta version. BPSA roots in the direct estimation method, which directly link the variables of interest with the satellite observations (TOA reflectance) through statistical modeling. The training data used to establish the models are obtained through simulation of atmospheric radiative transfer models. LSA is a swath-based product. TOA reflectance at nine VIIRS bands (1,2,3,4,5,7,8,10,11) are used as the inputs of BPSA to estimate LSA for each land pixel with the clear-sky condition.

An updated BPSA LUT was implemented after launch, which used the new VIIRS spectral response functions. Evaluation results indicate the products from the updated LUT show better agreement with the MODIS albedo data. Another version of BRDF LUT has been developed after that and is ready for implementation. This new LUT considers surface BRDF and reduces significantly the problem of angular dependency. The validation results also show the BRDF LUT further improves the accuracy of LSA retrievals.

VIIRS-SA-EDR is a swath based product. For each daytime clear-sky pixel of VIIRS images, an instantaneous value of albedo will be generated. A single observation is thus used by BPSA to retrieve LSA. The instantaneous retrieval of LSA has its advantage of being able to capture rapidly-changing surfaces. Meanwhile, it also has two shortcomings: 1) Some random factors affect the temporal stability of LSA retrievals; 2) Undetected cloud and cloud shadow will result in errors of LSA retrieval. To address these two problems, a post processing of the instantaneous LSA retrievals is a desired strategy. In addition to reduce temporal variation and remove spurious retrievals, post processing technique such as temporal filter will be able to generate a gap-free data set, which will be extremely convenient for the user community.

The status of the surface albedo EDR was presented at the AERB meeting on June 26 2013. Validations are performed with comparisons to MODIS LSA, in-situ LSA, LSA map monitoring, evaluation of LSA temporal stability. Continuous efforts have been put to improve the BPSA LSA retrievals. The latest LUT with BRDF as inputs improves accuracy and addresses the problem of angular dependency. It is ready for implementation. The definition of achieving beta includes that following considerations: initial calibration has been applied, it is minimally validated but may contain significant errors, users may gain familiarity with it, and it is not yet ready for formal publications or quantitative analysis. Pre-launch albedo BPSA LUTs were updated based on on-orbit RSR values in IDPS Build Mx6.7. Based on analysis of the LSA component of the VIIRS-SA-EDR with the post-launch BPSA LUT in place, LSA achieved all the beta criteria, and beyond in some cases, effective as of the Mx6.7 transition to operations on 4 April 2013.

We expect the implementation of the BRDF LUT will further improve the quality of LSA retrievals. Surface albedo EDR is heavily dependent on the upstream SDRs and cloud/snow mask EDRs. As calibration of the VIIRS SDRs and the quality of cloud/snow mask EDRs improve, surface albedo EDR will also achieve higher accuracy. The definition of provisional includes that the product may “not be optimal” but it is ready for “operational assessment”. We are continuing to improve the quality of VIIRS LSA data with extensive evaluation and validation of VIIRS-SA-EDR ongoing to ensurean on-time release of provisional status of VIIRS-SA-EDR.

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