Adapting MODIS Dust Mask Algorithm to Suomi NPP VIIRS for Air Quality Applications

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Topics: Exploratory Science

Program: JPSS RR/PG

2. Introduction

- VIIRS Suspended Matter (SM) product indicates the presence of dust, smoke, volcanic ash, sea salt, and unknown aerosol types in a given pixel, relying on the information from AOT retrievals.
- Comparisons of VIIRS SM to CALIPSO Vertical Feature Mask (VFM) aerosol type product indicate that the Probability of Detection (POD) is at ~10% and the product is not mature for operational use.
- Dust detection algorithm based on VIIRS deep blue channel has been developed for MODIS observations. This algorithm became operational for NWS dust forecast verification applications.

3. Methodology/Expected Outcomes

In deep-blue wavelength region:

- Dust absorption (darkening) increases with the decreasing wavelength length
- Rayleigh scattering (brightening) increases with the decreasing wavelength length
- Surface is relatively dark

DBDI: Deep Blue Dust Index. It is defined as:

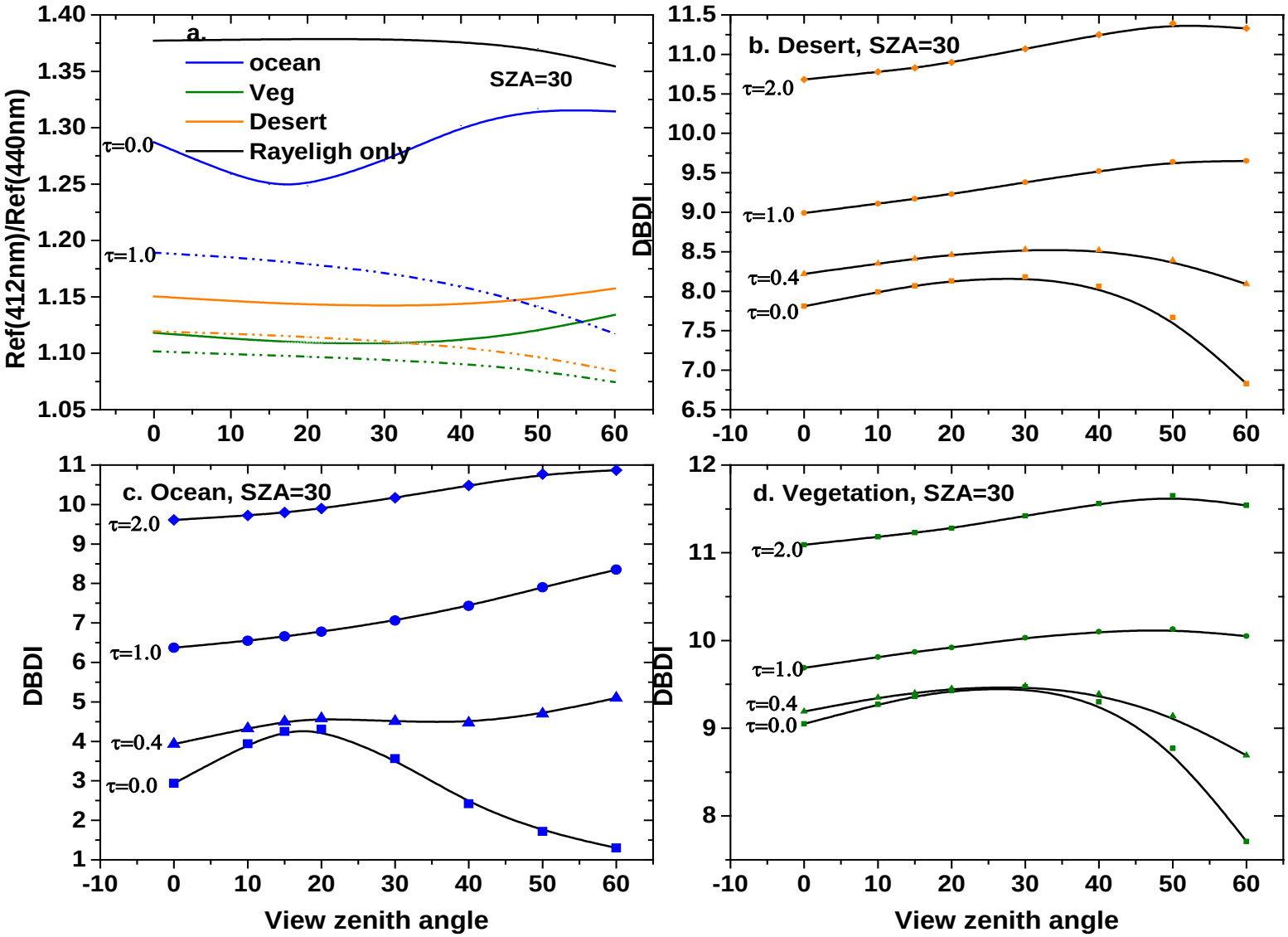
$$DBDI = -100[\log_{10}(R_{412nm} / R_{440nm}) - \log_{10}(R'_{412nm} / R'_{440nm})]$$

Where *R* is TOA reflectance, *R´* is the reflectance from Rayleigh scattering.

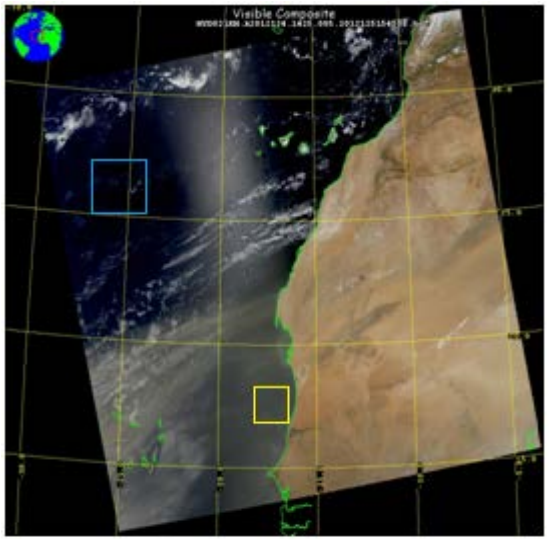
NDI: Non-dust Aerosol Index. It is defined as:

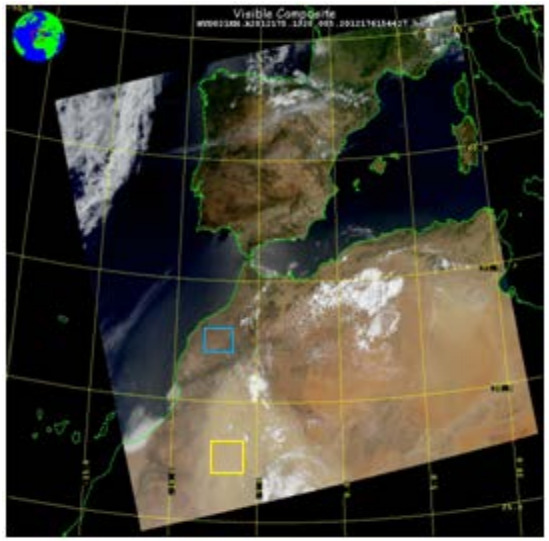
$$NDAI = -10[\log_{10}(R_{412nm} / R_{213nm})]$$

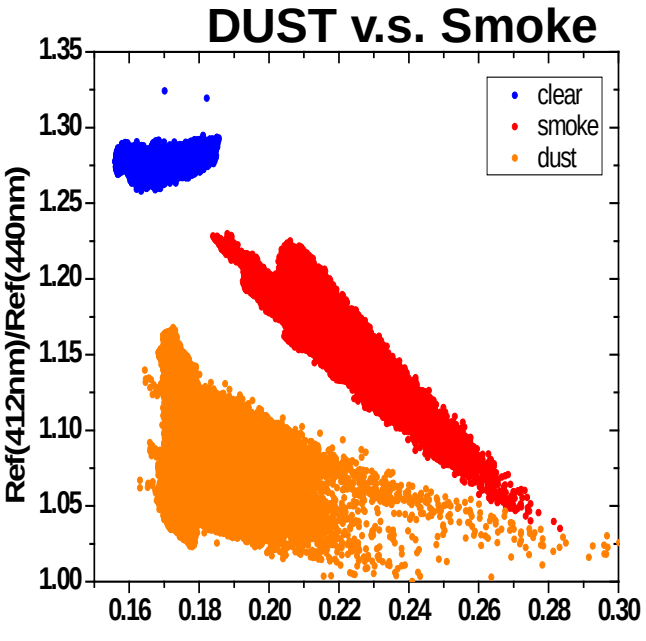
6S Radiative Transfer Model Simulations?

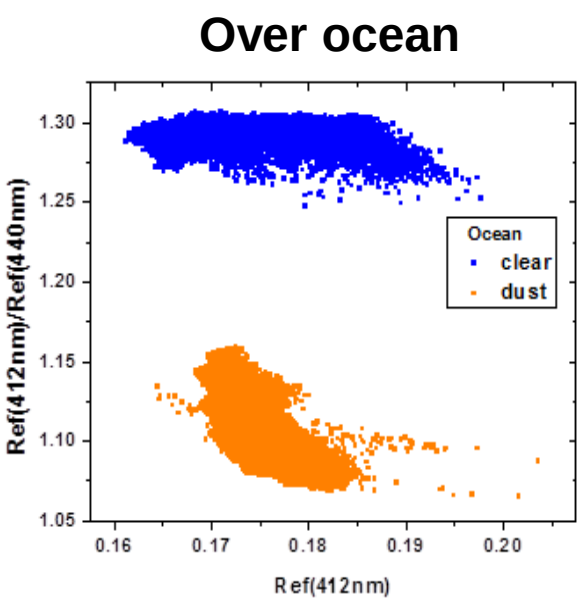


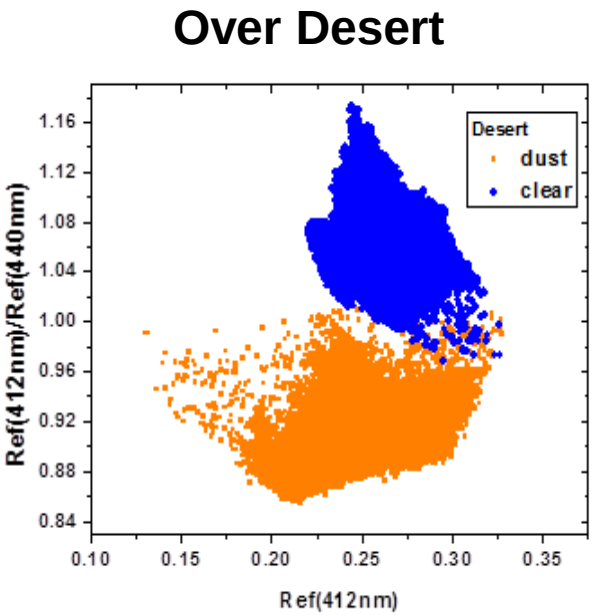
Discrimination of Dust and Smoke with DBDI and NDAI?

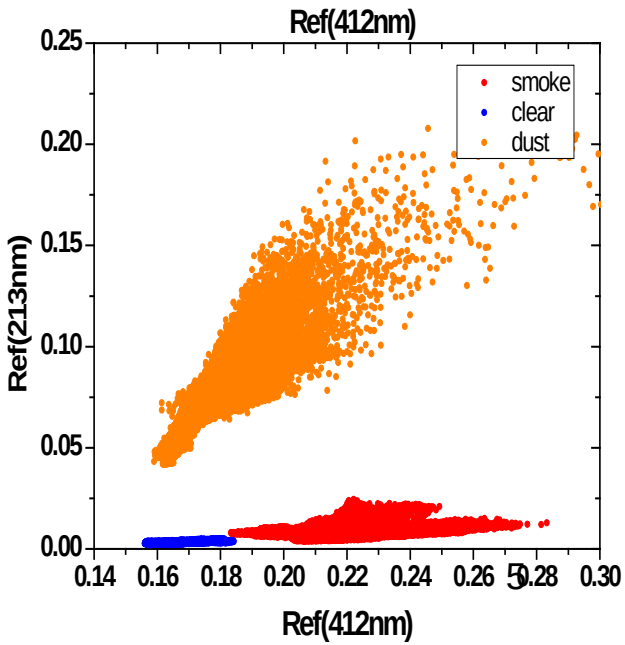




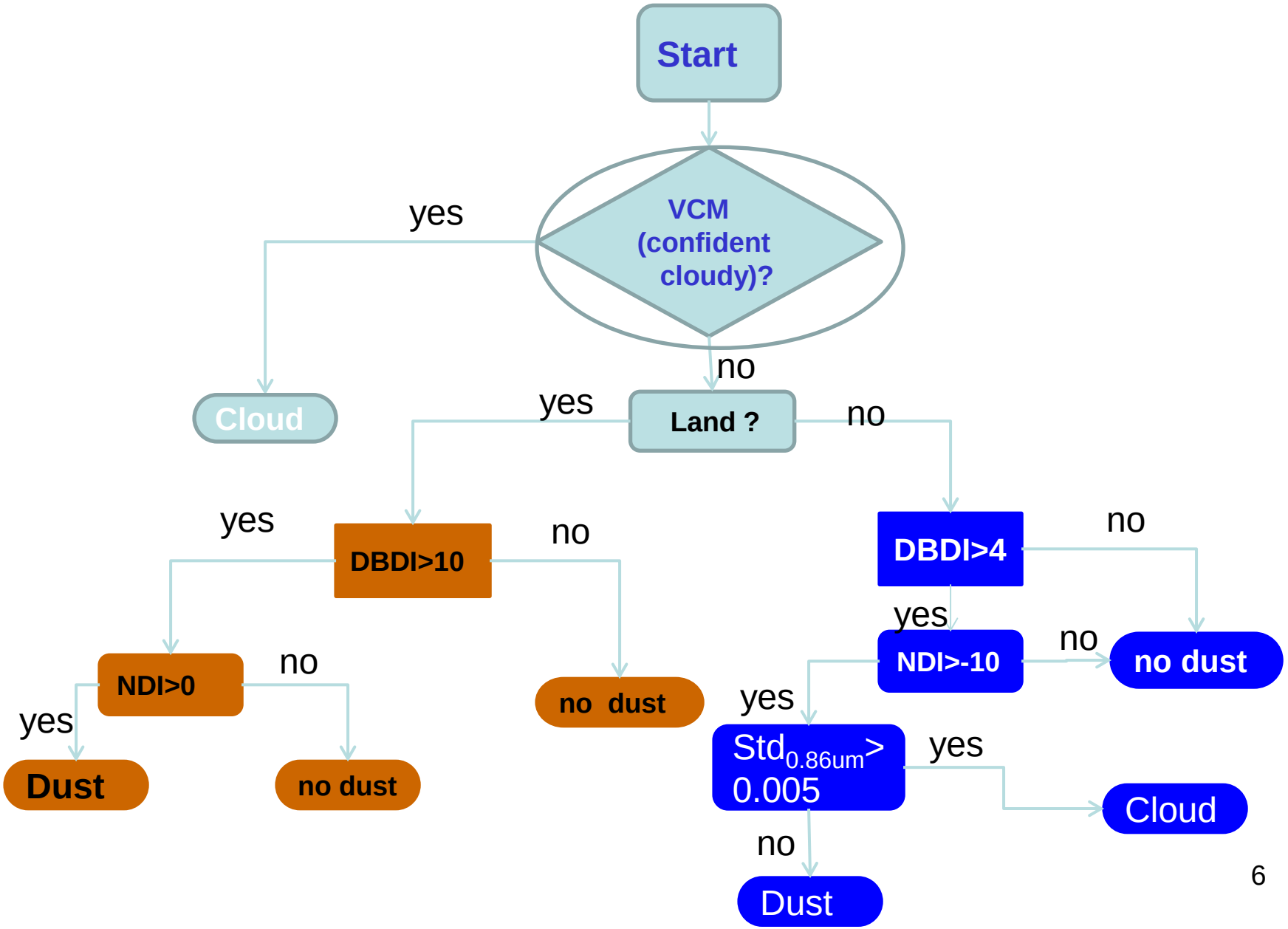




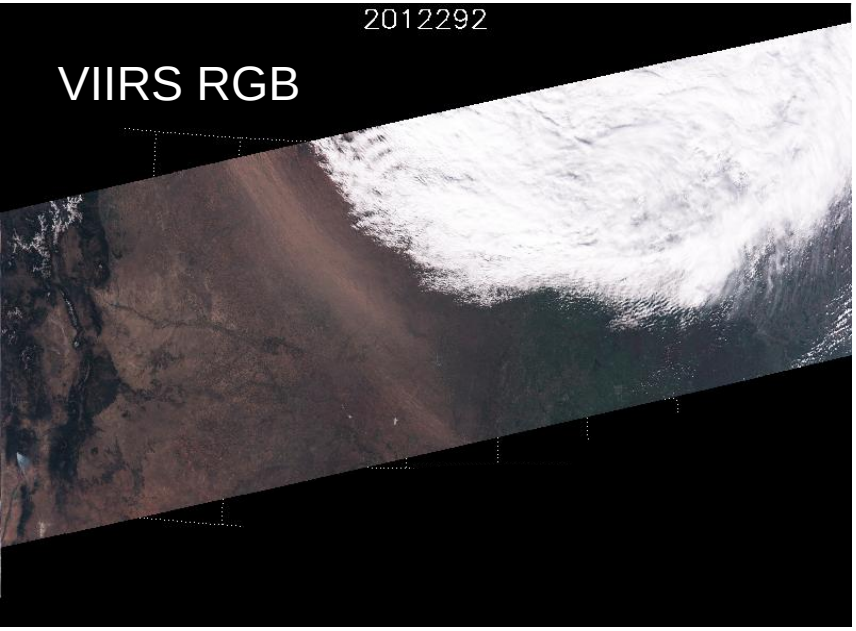


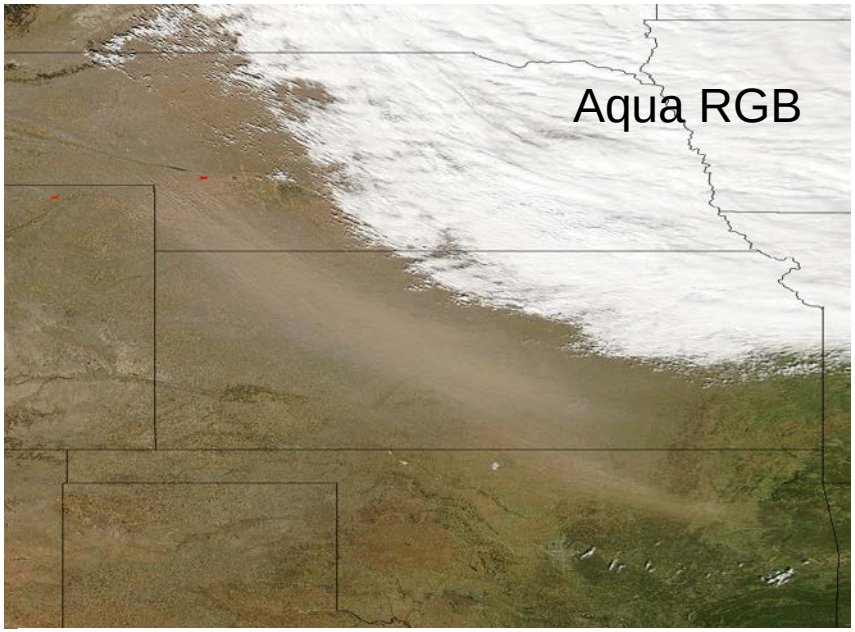


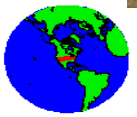
Flow chart of Deep-blue dust index algorithm



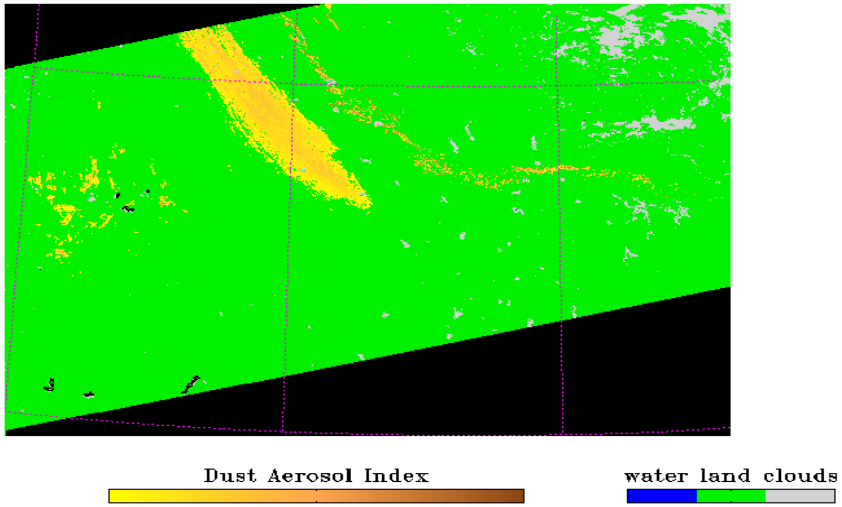
Dust storm over great plains in U.S.



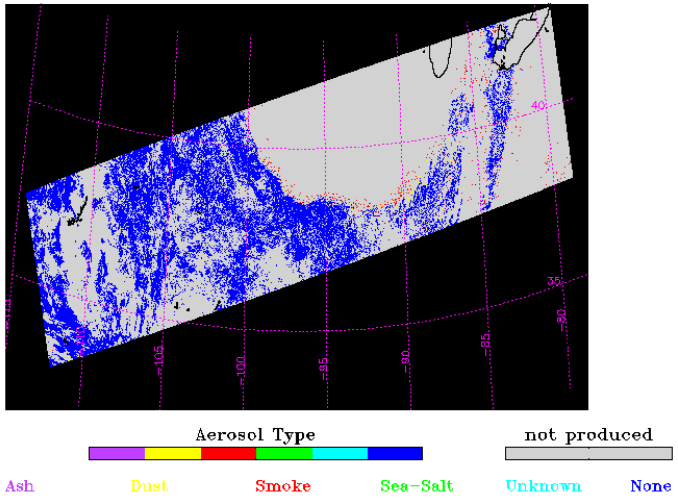




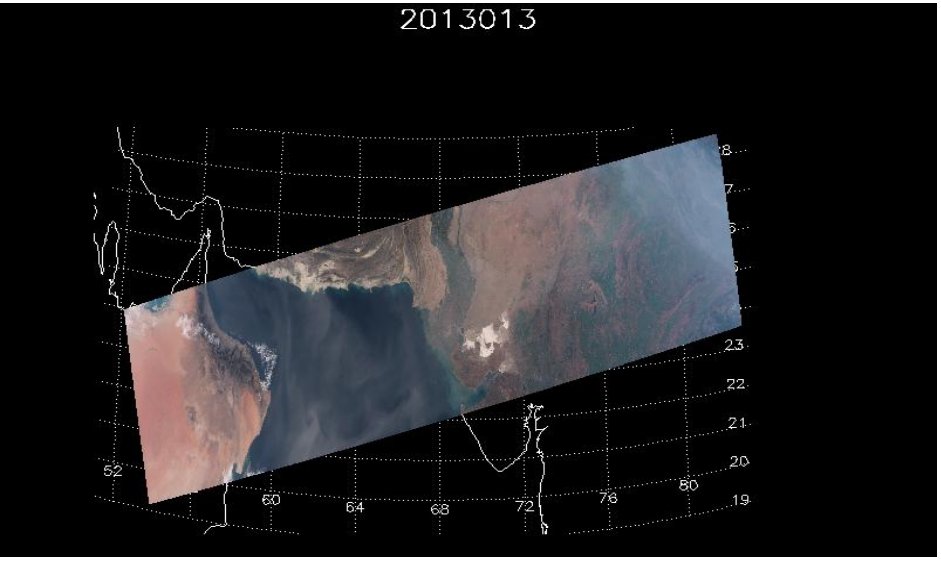
NPP VIIRS Dust Aerosol Index



NPP VIIRS SM/Aerosol Type

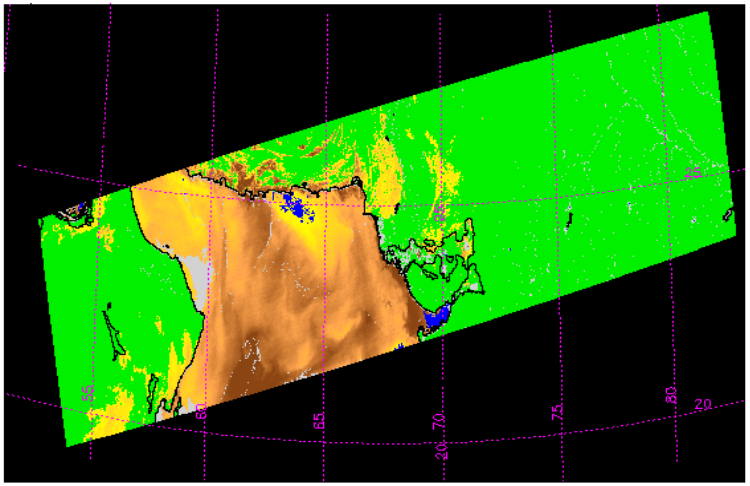


Dust over Arabian sea



A large dust plume appeared over Arabian ocean as on RGB was detected as dust with DBDI Algorithm, While NPP VIIRS SM/Aerosol Type indicated as not produced, or unknown

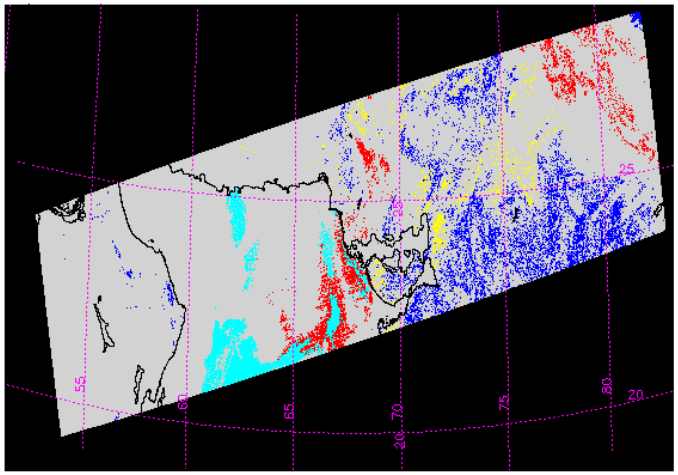
NPP VIIRS Dust Aerosol Index



Dust Aerosol Index

water land clouds

NPP VIIRS SM/Aerosol Type

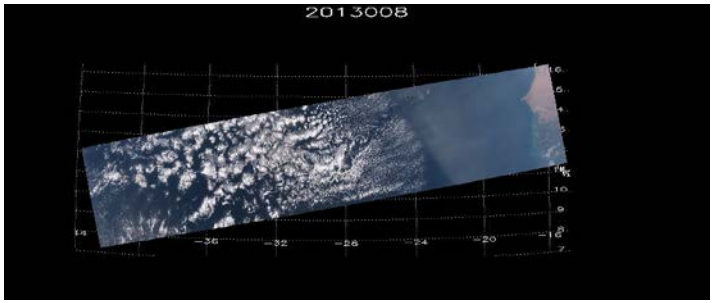


Aerosol Type

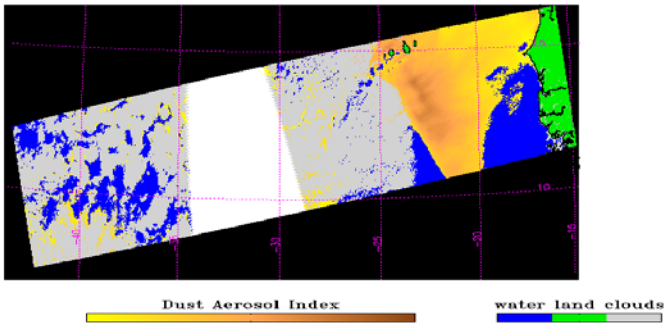
not produced

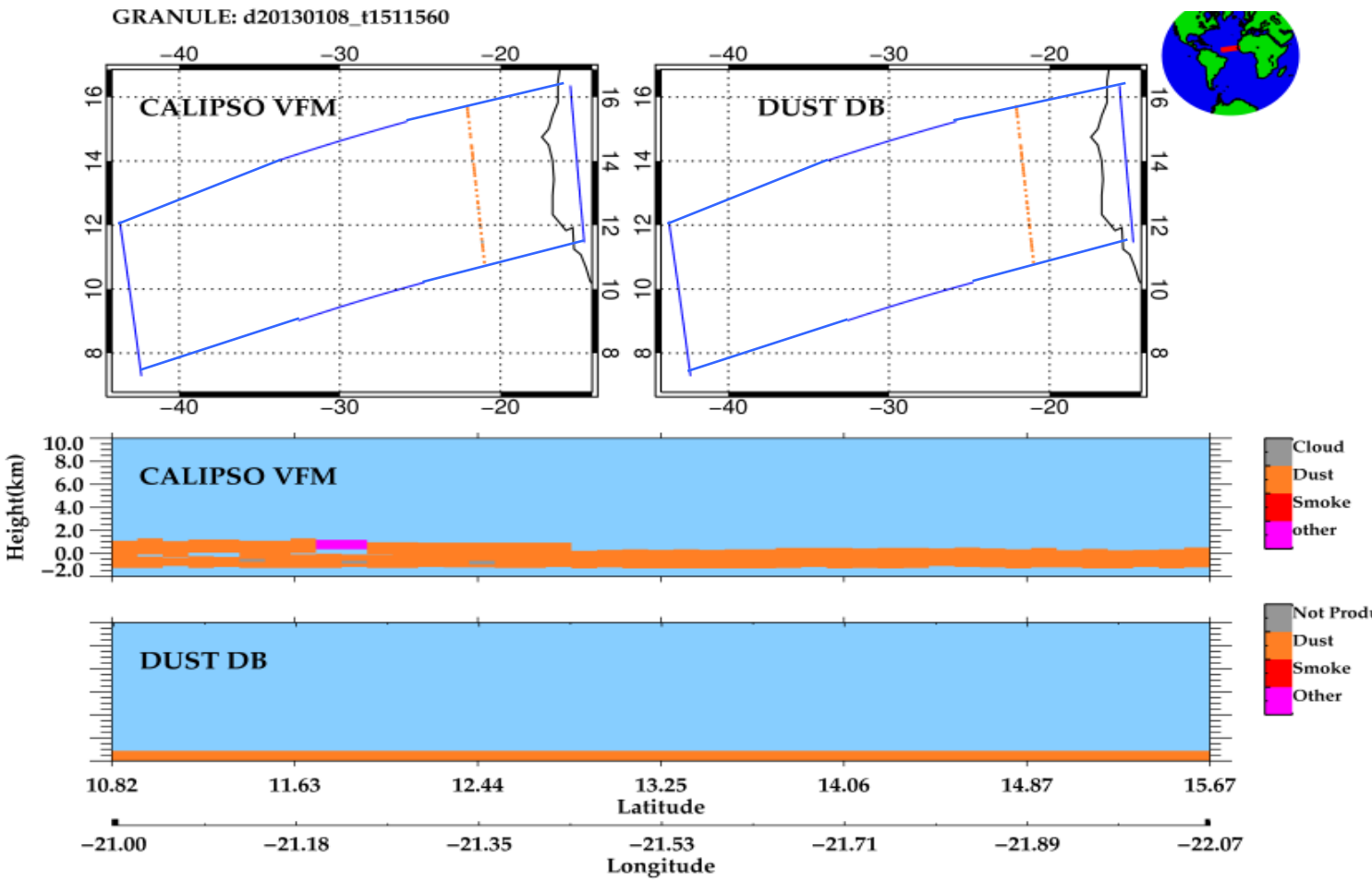
Ash Dust Smoke Sea-Salt Unknown None

VIIRS RGB



NPP VIIRS Dust Aerosol Index





Accuracy=93%
POD=100.0 %
FAR=7%

CALIPSO VFM v.s. DBDI Dust

5. Possible Path to Operations

- This algorithm for MODIS is operational at NOAA.
- Applying the algorithm to VIIRS observations will ensure continuity of the product in NPP/JPSS era.

6. Future Plans

- Reducing false alarm rate over bright surfaces and developing NDVI based thresholds for DBDI.
- Develop real-time validation and monitoring tools.