Advancing Environmental Intelligence via Next-Generation Satellite Observations

Steven D. Miller

Cooperative Institute for Research in the Atmosphere

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Colorado State University, Ft. Collins CO (96)
Earth Systems Research Lab, Boulder CO (50)
David Skaggs Research Center
Connecting Models and Observations
Aviation Weather Center, Kansas City MO (12)
Aviation Weather Center
Terrace
NOAA Center for Weather and Climate Prediction, College Park MD (14)
NOAA Center for Weather and...
5830 University Research Ct

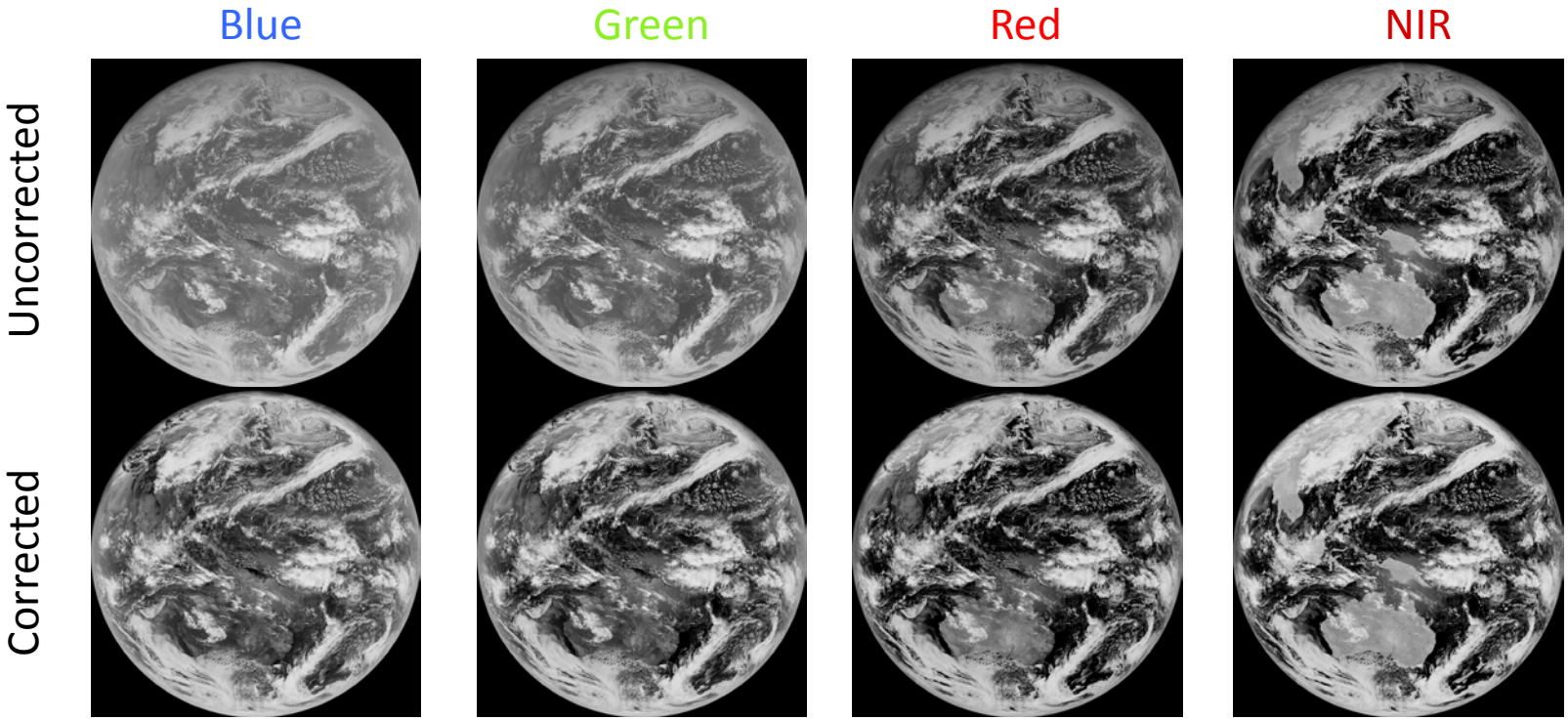
Satellite Research

- Instrument Check-Out: Calibration/Validation
  Evaluate on-orbit performance of operational satellite data and products
- Current Satellite Systems: Operational Algorithm Development
  Exploiting satellite data for hazards and other user-defined needs
- Future Satellite Systems: Algorithm Working Groups and Risk Reduction
  Designing improved operational algorithms, high-risk/high-reward applications
- Training on Meteorological Satellite Data/Products
  Regionally-dependent forecaster needs (domestic and international)
- Data Assimilation Research
  New observational operators, assimilation techniques, for improved analyses
- Proving Ground Demonstrations
  A "Research to Operations to Research" (R2O2R) framework for user engagement

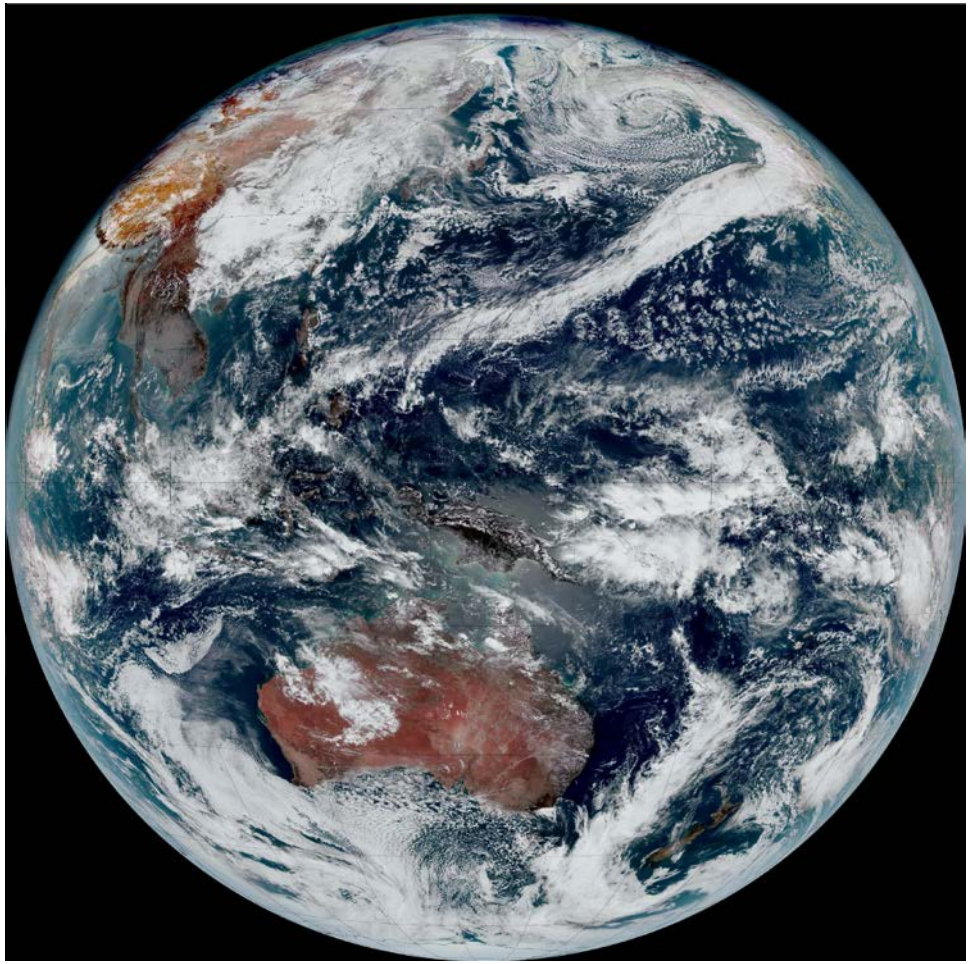
→ *We'll focus on a few examples of satellite algorithm development in the next several slides.*

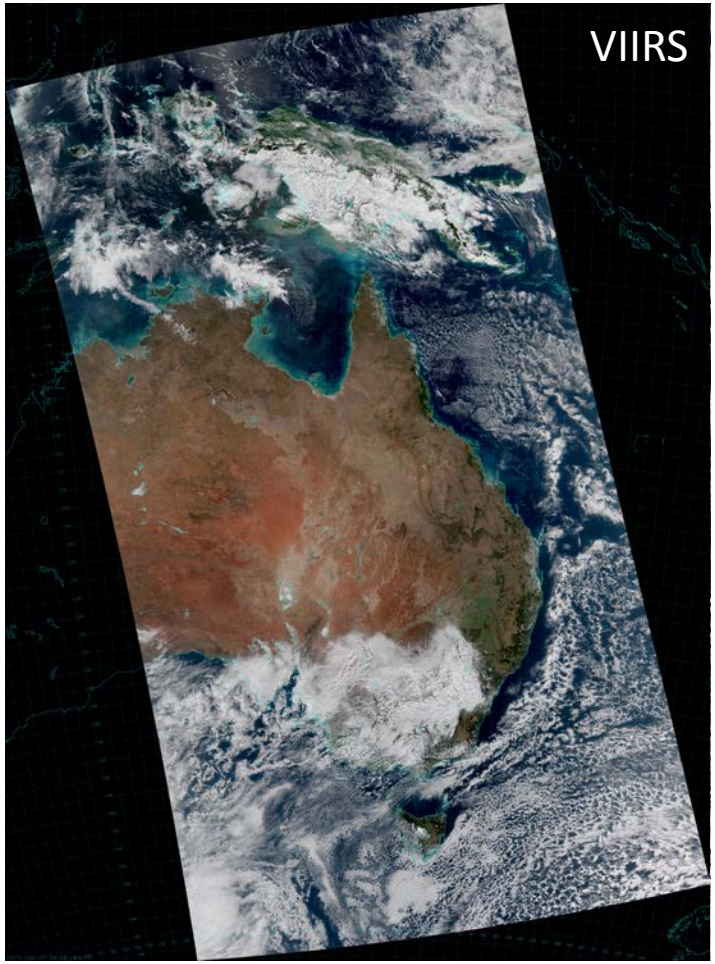
Making AHI True Color Imagery

- Molecular scatter of the gaseous atmosphere is significant, especially in the blue-band (proportional to λ^{-4})
- The correction is a function of solar/satellite geometry, using pre-computed rayleigh reflectance from radiative transfer calculations (stored in look-up tables):



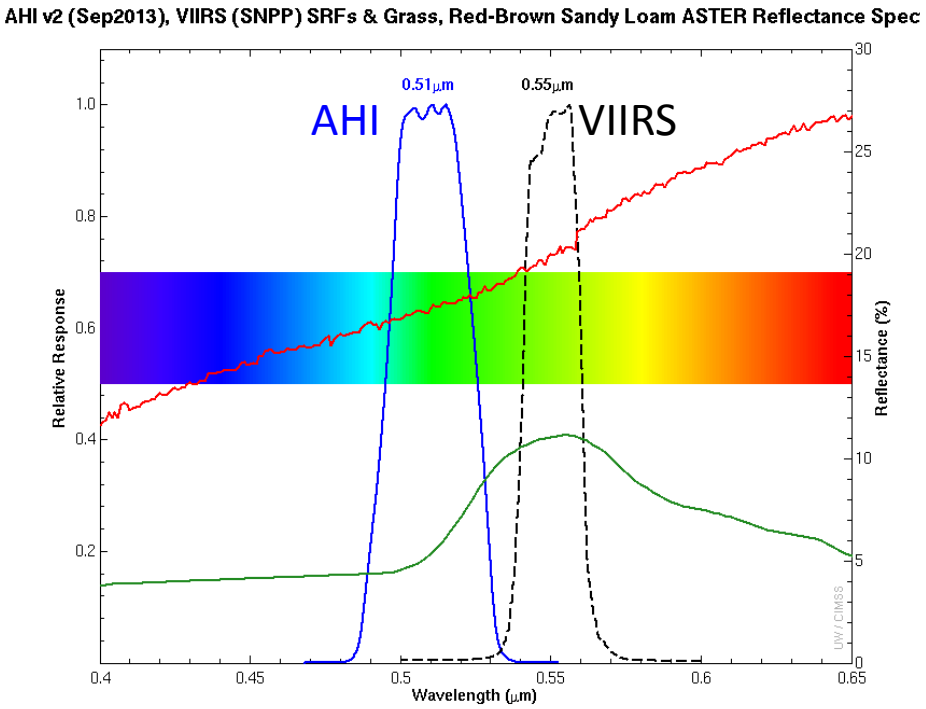
Atmospheric Correction Results: An Issue Arises…

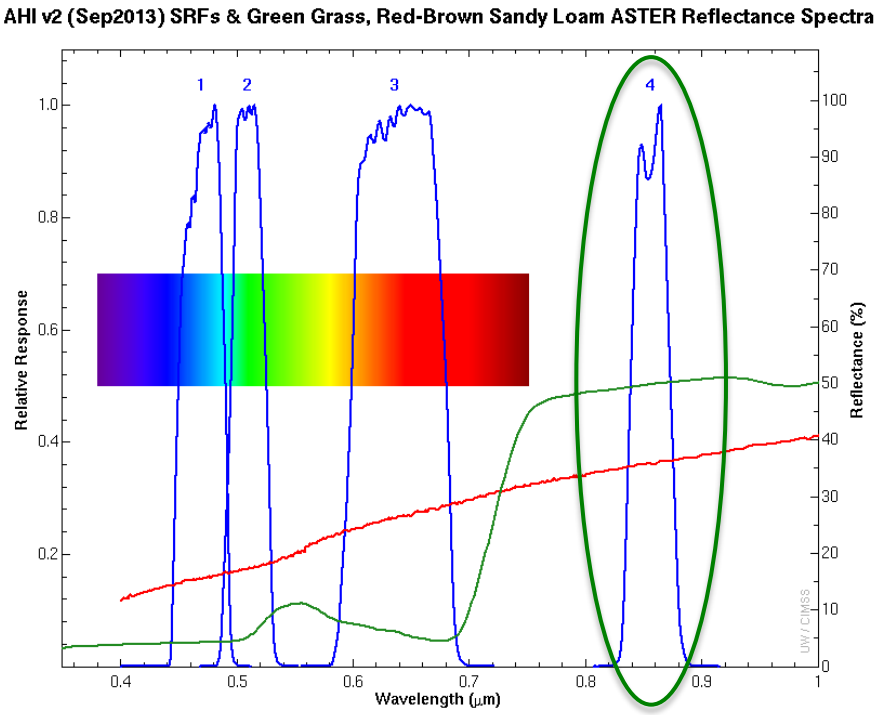




→ *Why isn't AHI's vegetation green, like legacy VIIRS/MODIS?*

A Solution: Hybrid Green for AHI





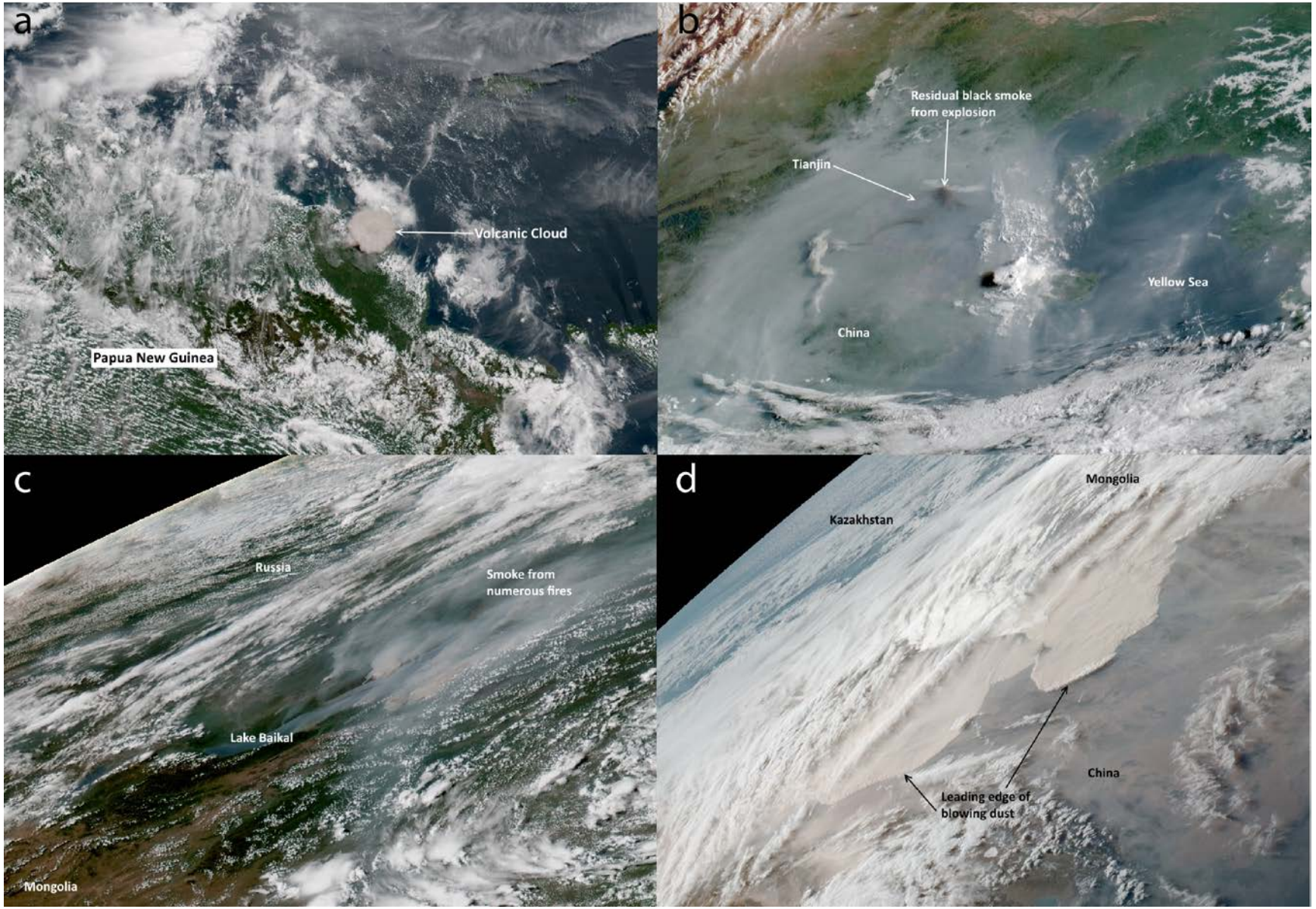
Blend native green with vegetation-sensitive NIR to produce a hybrid green band (G'):

G' = * R_510 + (1-F) * R_856

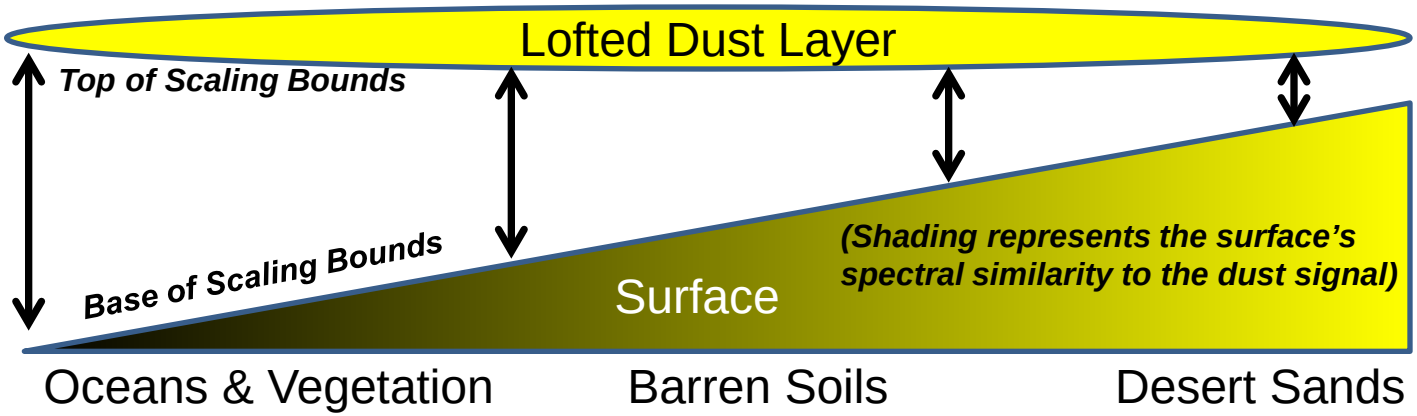
F ~ 0.93 (determined experimentally vs. MODIS/VIIRS)

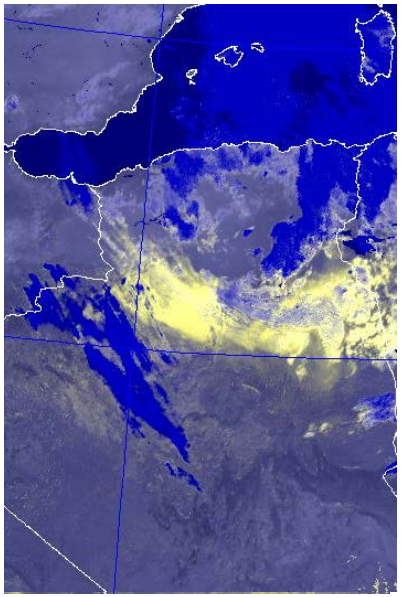
→ Boosts green vegetation and mineral signal, leaving clouds and oceans unaffected.

Hybrid True Color Results



Dust Enhancements

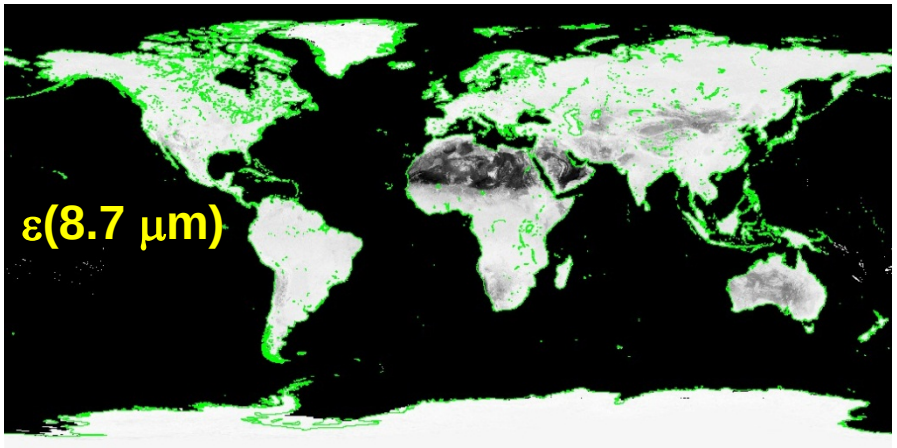




→ *Dynamic enhancement suppresses false alarms and maintains feature continuity across complex land surface backgrounds.*

Uses Global Land Surface Emissivity Data

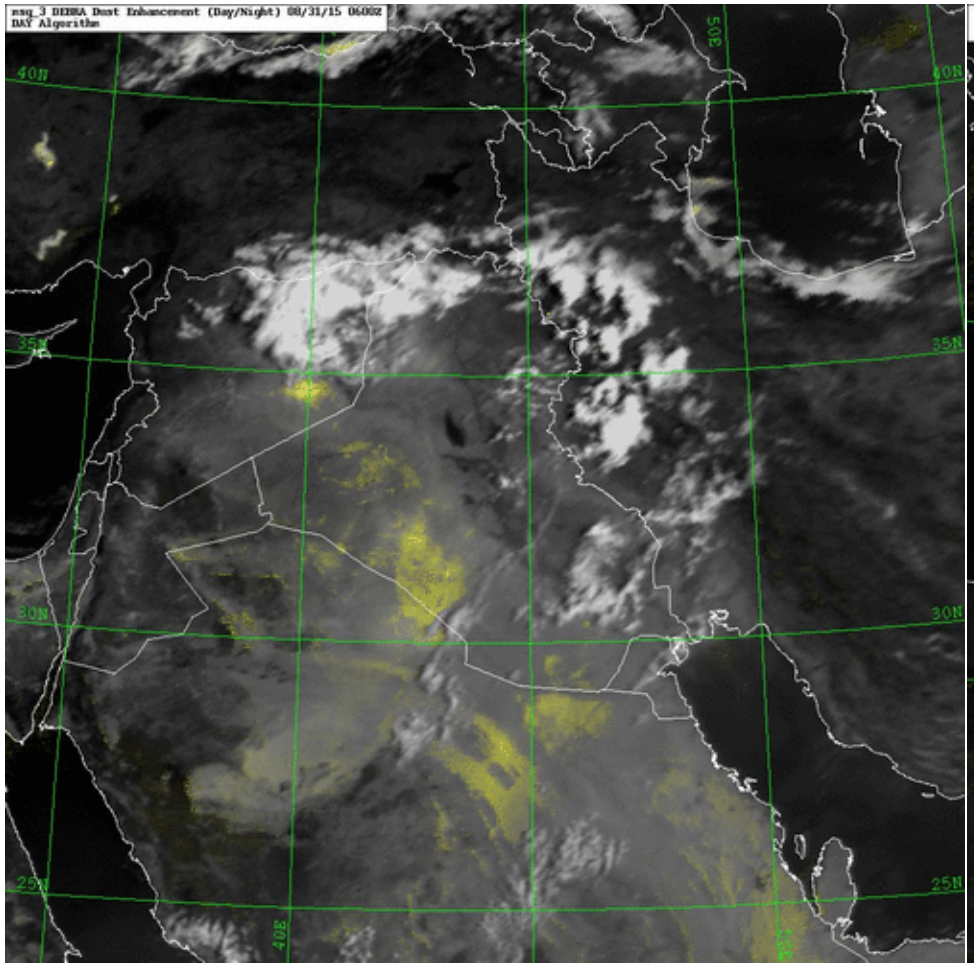
- UW-BF surface emissivity database (global, monthly), interpolated to MSG/SEVIRI bands; (Seemann *et al*., JAM-C, 2008).
- Estimate hourly land skin temperature from NASA/MERRA analysis.
- Calculate 12-11, 8.7-11 BTD which form a baseline clear-sky signal reference.



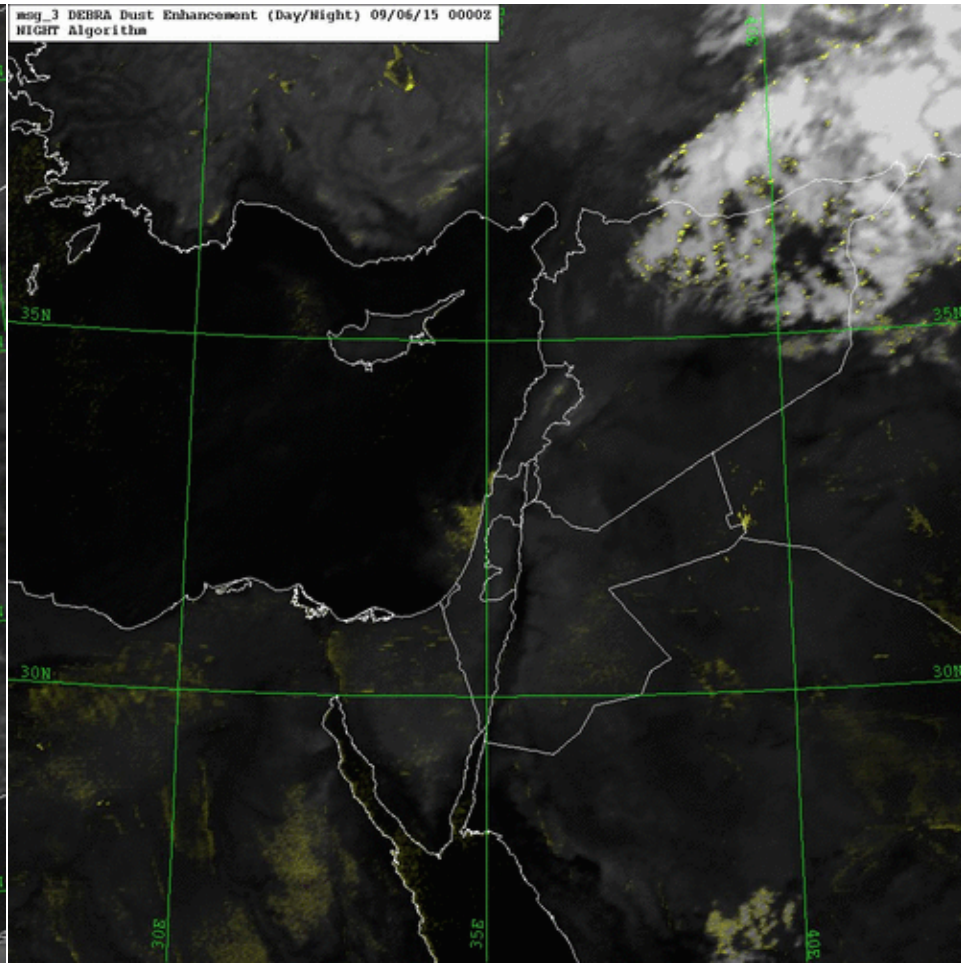
→ *Couple with land surface temperature (e.g., model analysis) to specify backgrounds dynamically.*

Examples of Recent Dust Storms

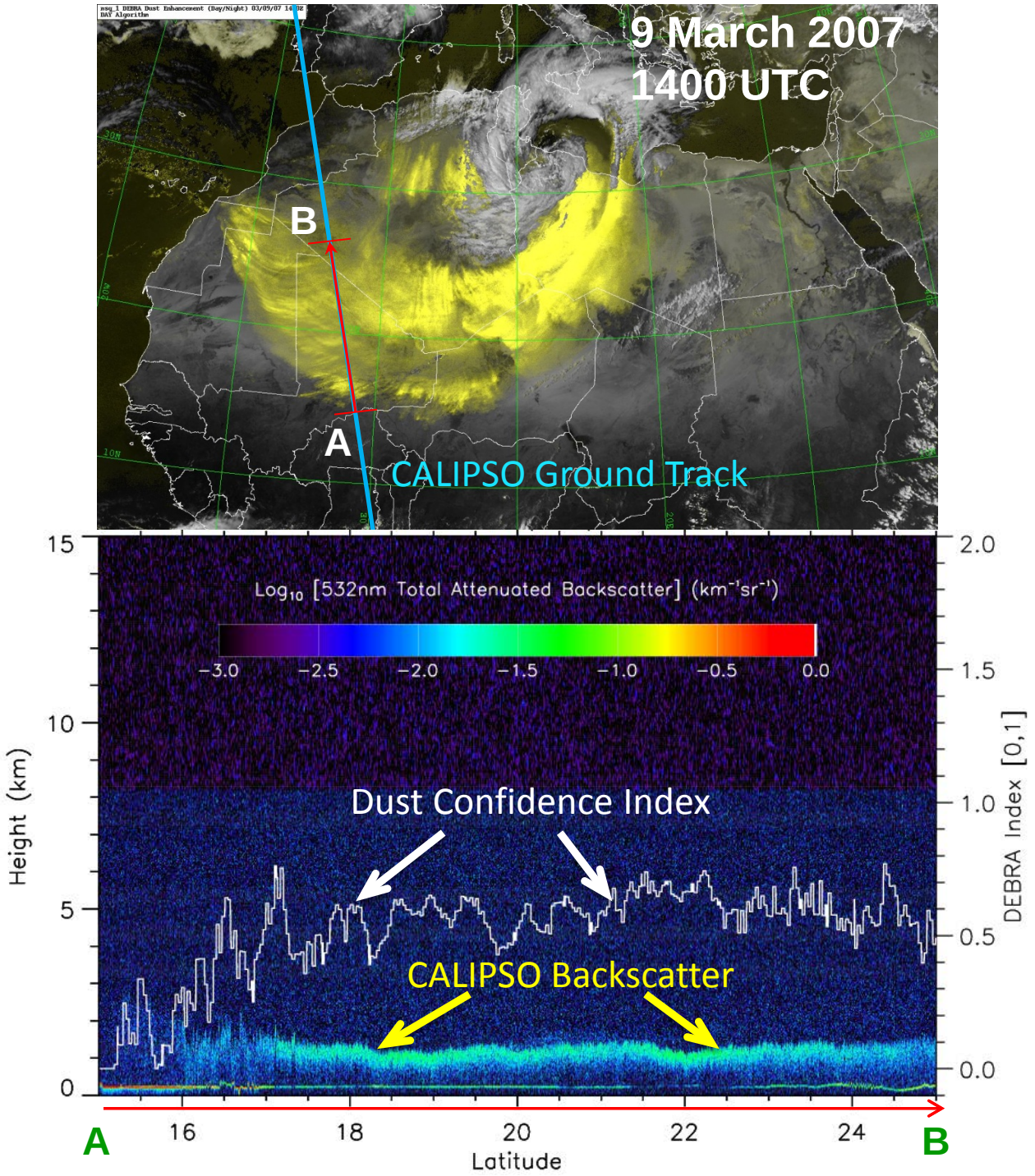
Iraq : 31 Aug – 1 Sep 2015



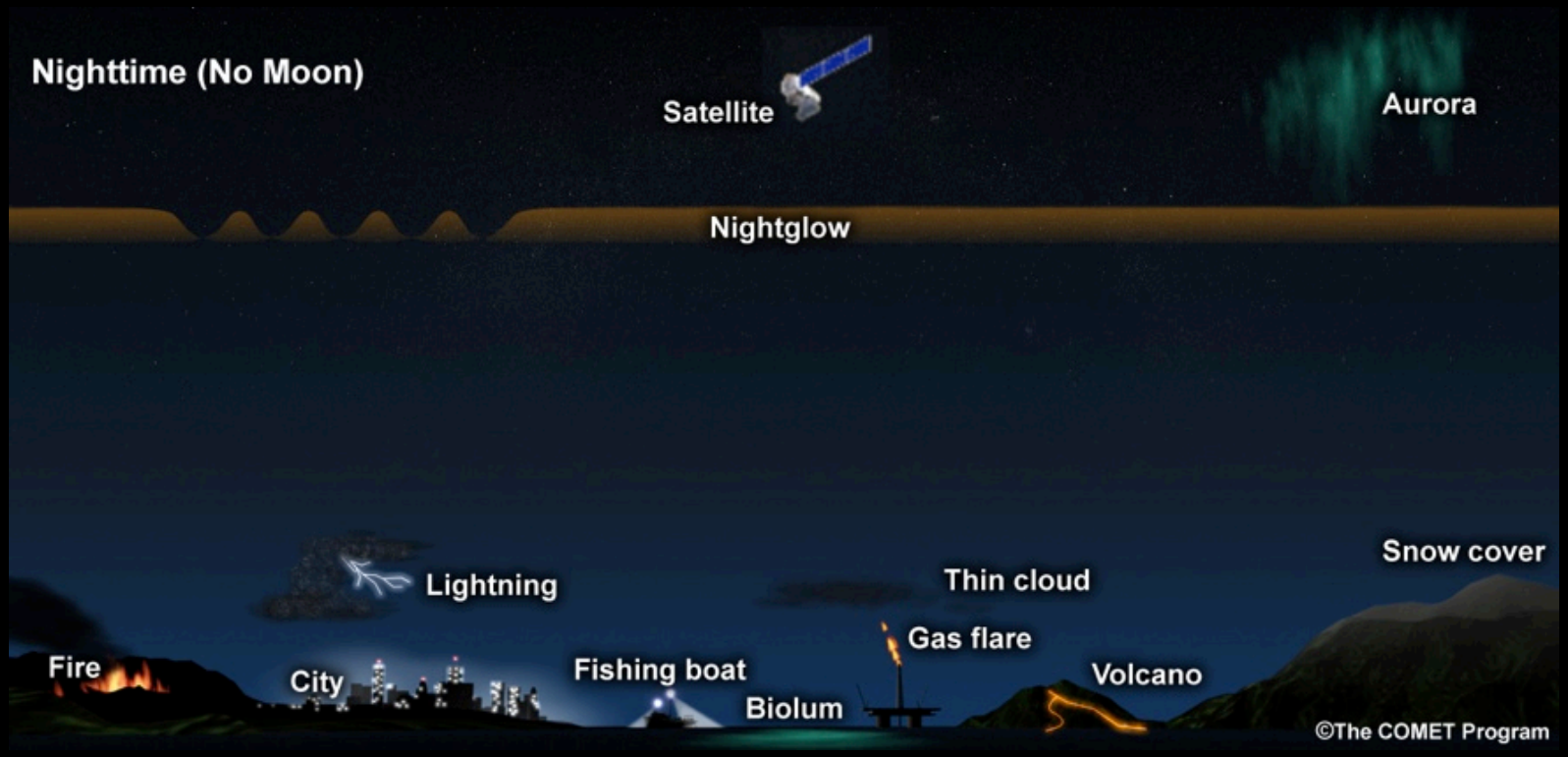
Syria: 6-9 Sep 2015



→ The yellow areas denote higher confidence factors for lofted dust

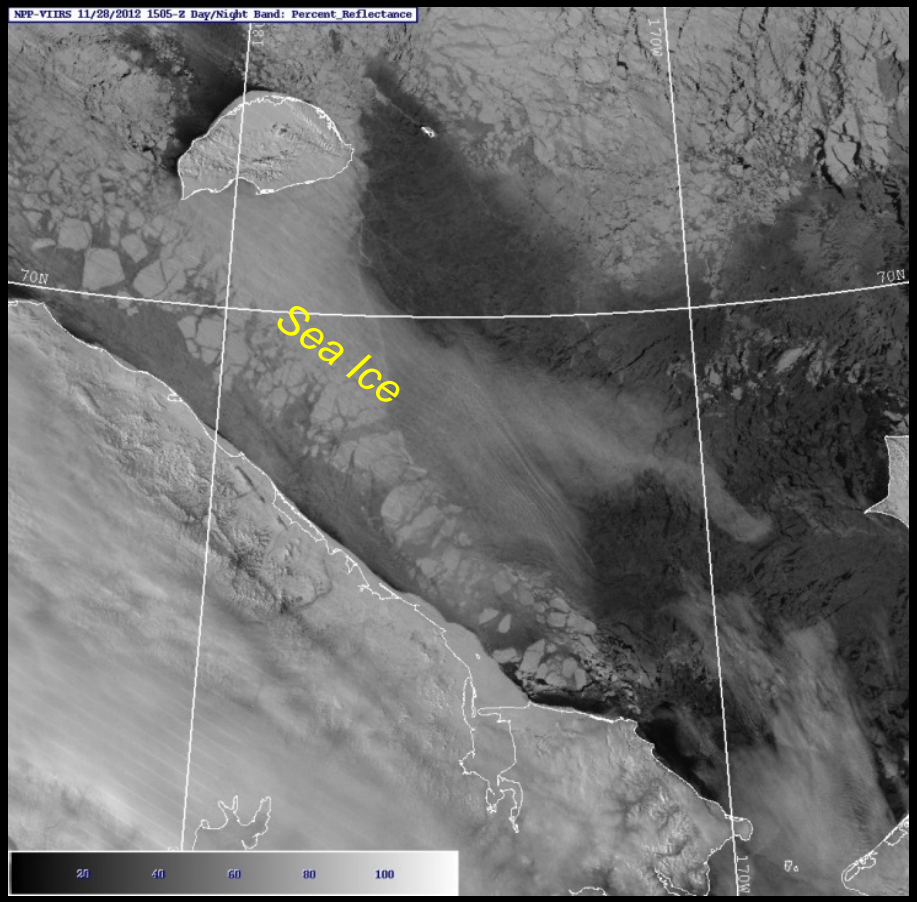

9 March 2007
1400 UTC
B
A
CALIPSO Ground Track
Log10 [532nm Total Attenuated Backscatter] (km-1sr-1)
−3.0
−2.5
−2.0
−1.5
−1.0
−0.5
0.0
Dust Confidence Index
CALIPSO Backscatter
Height (km)
DEBRA Index [0,1]
15
10
5
0
2.0
1.5
1.0
0.5
0.0
A
16
18
20
22
24
B
Latitude

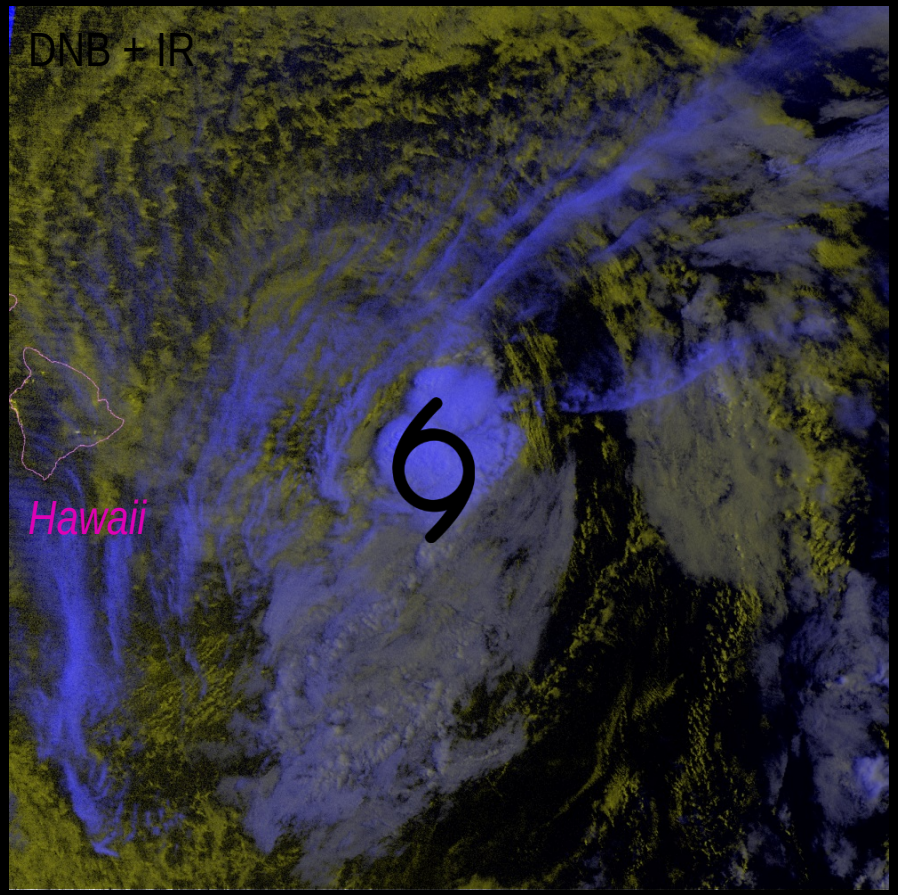
Shedding Light on the Night with the VIIRS Day/Night Band



*Miller et al., Remote Sens. 2013, **5**, 6717-6766; doi:10.3390/rs5126717*

By the Light of the Moon

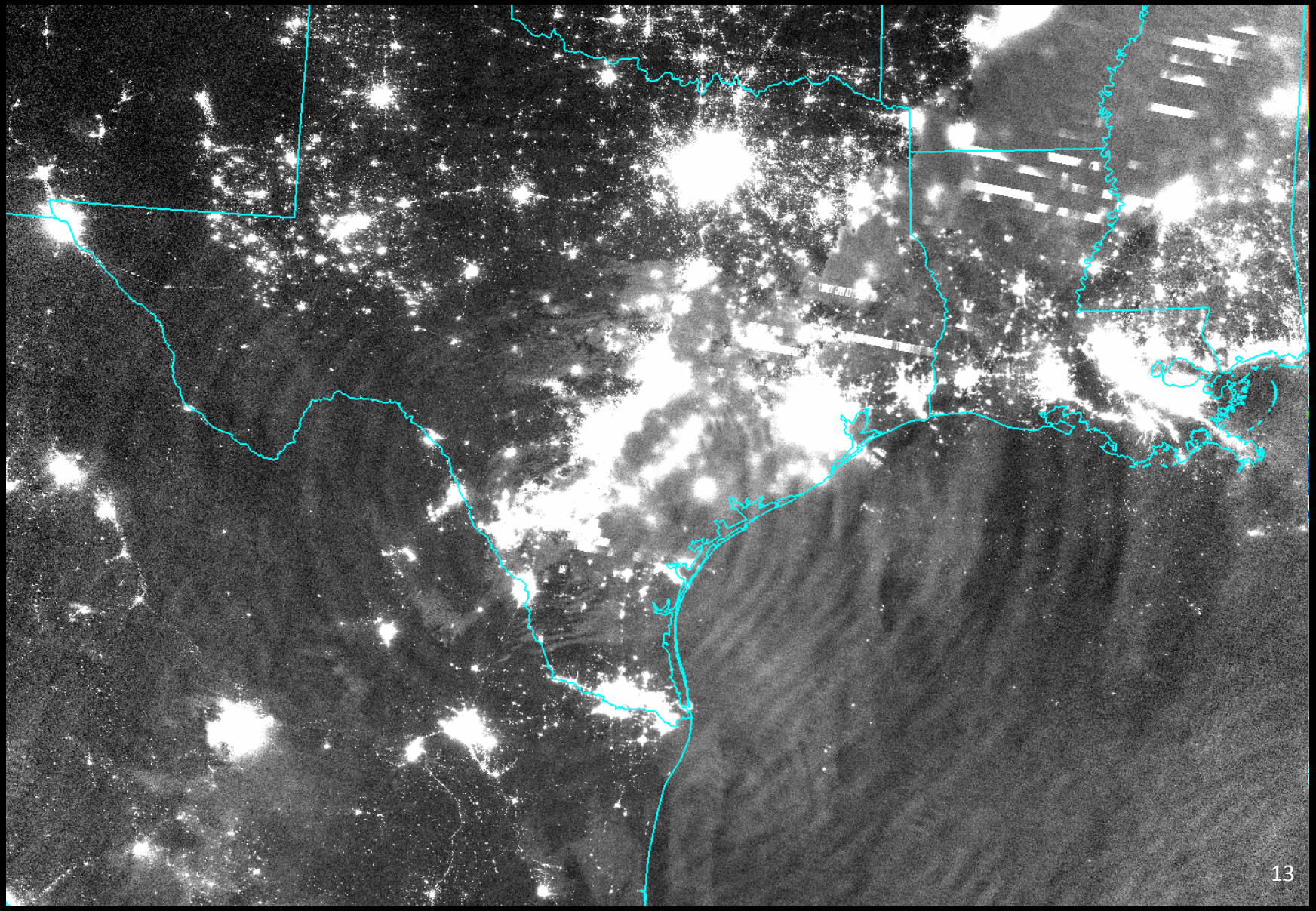




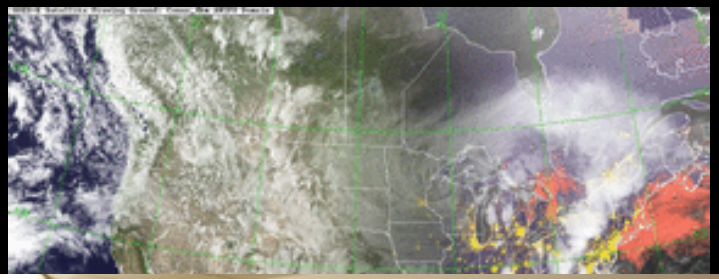
→ Strong scattering of visible light allows DNB to probe the clouds

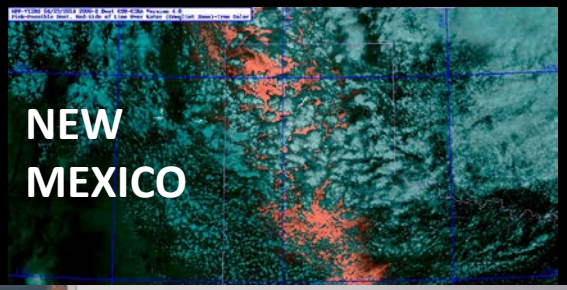
→ We have developed a lunar model enabling cloud property retrievals

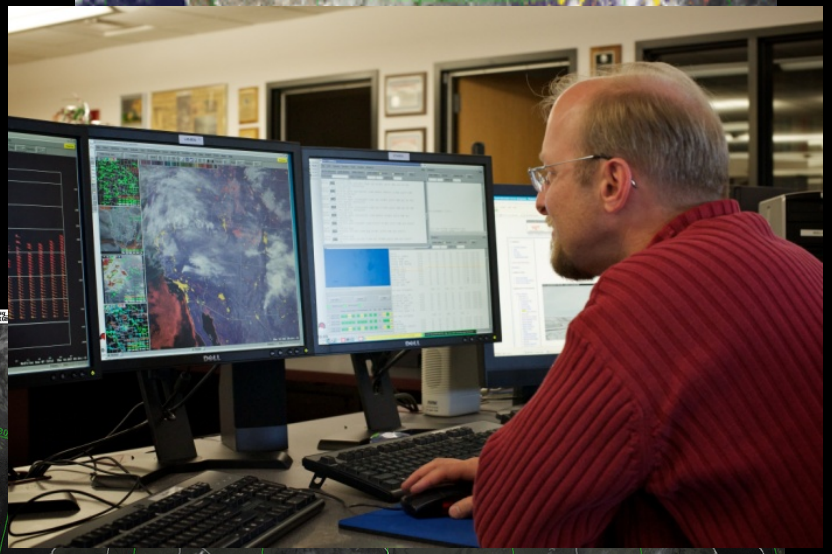
By the Light of the… *Sky??*

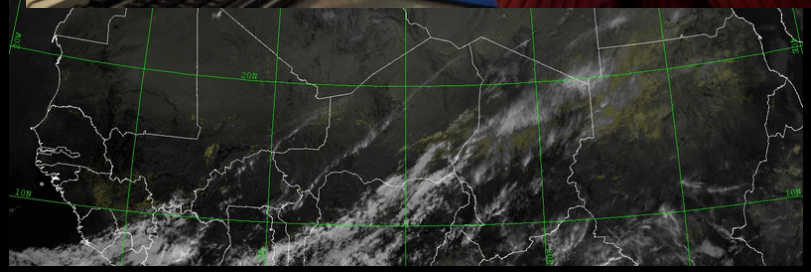


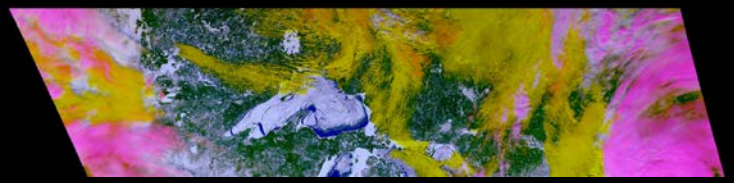
Connecting with the Forecasters: '*Proving Ground*' Activities











Conclusions

- AHI provides a looking-glass into the future GOES-R Advanced Baseline Imager capabilities.
- Dynamic enhancements offer a way to extract the salient information from complex backgrounds.
- The VIIRS Day/Night Band holds tremendous potential for revolutionizing the way we observe the nocturnal environment.
- Engaging operational end-users via Proving Ground demonstrations is key to realizing the potential of these exciting new sensors and capabilities!

Thanks!