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Supporting the NWS in San Juan, Puerto Rico with VIIRS-derived Products

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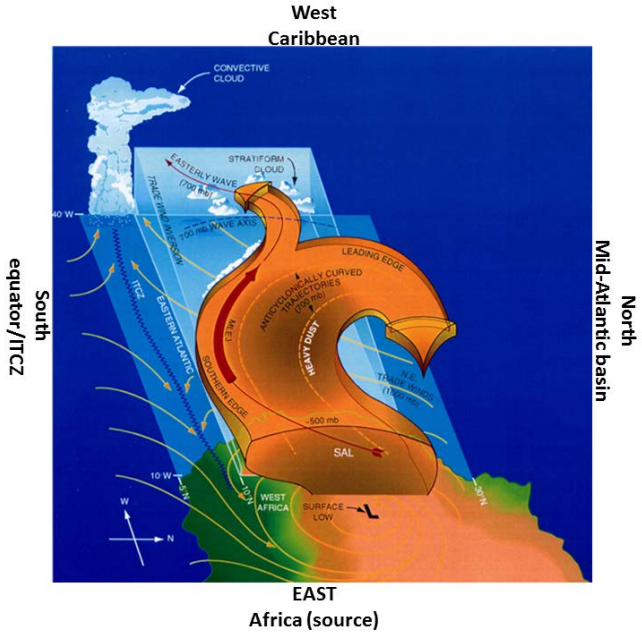
Outline of Saharan Air Layer (SAL) project

Improvements in Predicting Saharan Air Layer (SAL) Events over the Greater Caribbean using Modeling and Satellite Resources

1. **Project description & recent activities**
   - What is SAL?
   - Milestones during 2017
2. **Customer interaction**
   - NWS San Juan, Puerto Rico site visit
   - SAL event: a) operational perspective b) NRL resources
3. **Current and planned activities**
   - Modeling
   - Satellite products
   - JPSS instruments

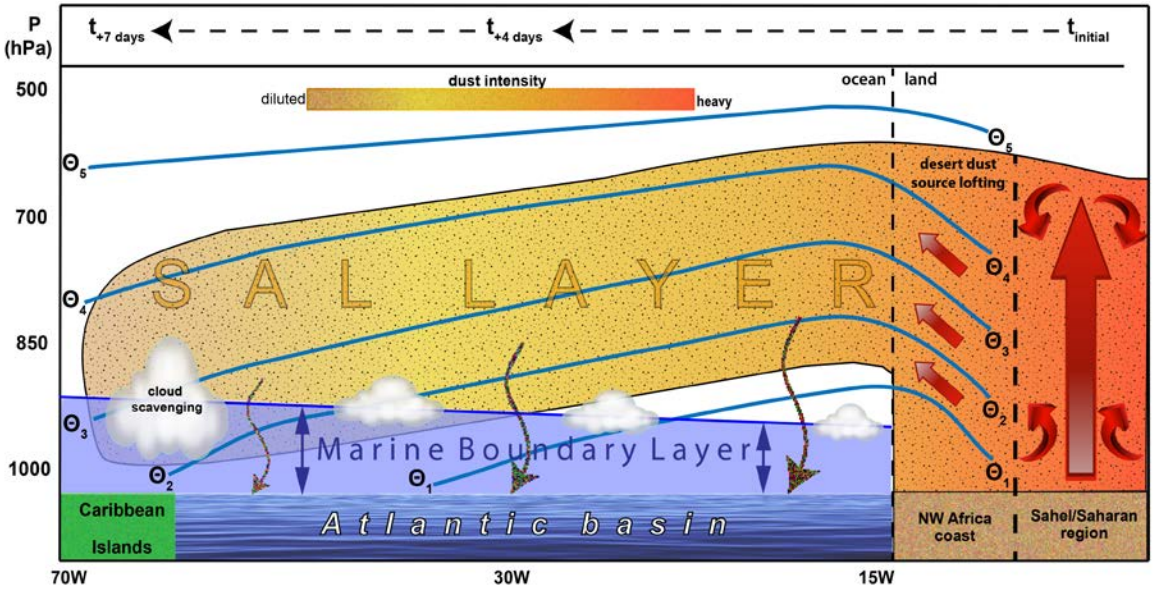
Defining SAL

3D cutout



Karyampudi and Carlson, J. Atmos. Sci., 1988

Isentropic diagram



Kuciauskas et al., BAMS, 2017 (accepted for publication)

NRL-MRY SAL website

"SAL-WEB"

www.nrlmry.navy.mil/SAL.html

Product suite

Satellite Imagery:

- Visible
- IR
- True & Natural and GEO Color
- Nocturnal Low Clouds
- Dust (Bluelight, DEBRA, AOD, RGB)
- TPW (NRL, NESDIS/CIRA, MIMIC)
- Water Vapor

Lidar Instruments: * currently unavailable

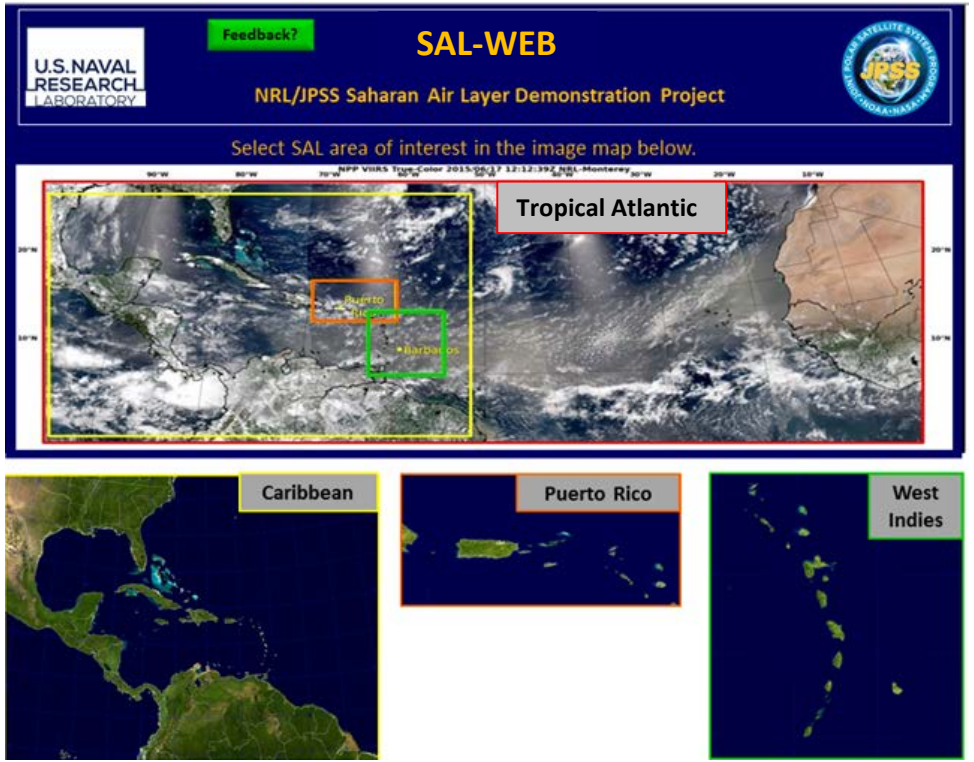
- CALIPSO/CALIOP *
- MPLNET *

Ground-based instruments:

- AQ ($PM_{2.5}$, PM_{10}, pollution level measurements)
- AERONET

Modeling (dust):

- NAAPS MODIS + VIIRS AOD
- Navy NWP Model wind overlays
- CIMH (WRF-Chem), ICAP, NGAC



Project Recent Activities

- R&D: SAL chemistry, thermodynamics, predictability, public impacts
  - ✓ Satellite-based product development (focus: VIIRS)
  - ✓ Model-based forecast products (focus: VIIRS AOD as Data Assimilation)
  - ✓ In-situ measurements that are not readily available
  - ✓ Hosted (near real time) and maintained on NRL website (SAL-WEB)
  - ✓ BAMS Publication: project summary
- Conducted NWS site visit (31 July – 03 August)
  - ✓ Overview of forecast operations: weather impacts, social interaction
  - ✓ Product feedback
  - ✓ SAL impacts
  - ✓ Forecaster needs outside of AWIPS-II
  - ✓ Future collaboration, including other Caribbean agencies
- Blend environment with health aspects
  - ✓ Puerto Rico/West Indies: among the world's worst asthma conditions
  - ✓ Participated with various environment/health agencies throughout Greater Caribbean
    - o Caribbean Institute for Meteorology and Hydrology, Barbados (CIMH)
    - o Caribbean Aerosol and Health Network (CAHN)
    - o University of Puerto Rico

Customer Interaction: NWS Site Visit
San Juan, Puerto Rico



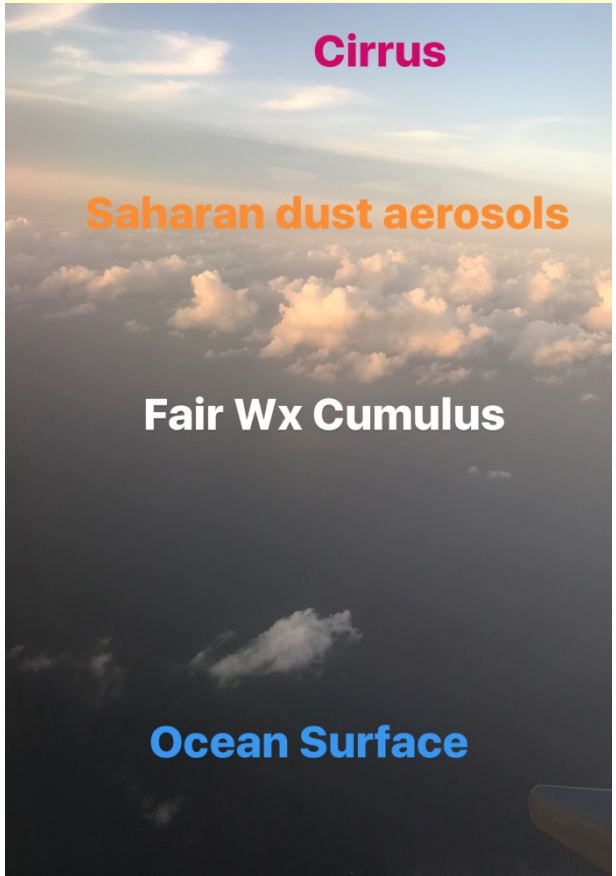
Highlights of Site Visit

- Overall, very positive feedback
  - ✓ SAL-WEB applied as resource of daily analysis
  - ✓ Growing interest/concern during SAL events, mainly during summertime
- AQ/Dust Aerosol Modeling
  - ✓ No aerosol model in AWIPS-2
  - ✓ NWS, San Juan unaware of NGAC dust model
  - ✓ NWS has been reliant on NAAPS and GEOS-5
  - ✓ NAAPS will be 1st to incorporate Enterprise VIIRS AOD into data assimilation (DA)
- Surface observations
  - ✓ Greater access to site containing AQ measurements in NRT
  - ✓ Lidar (MPLNET): *currently unavailable*
    - Backup in Key Biscayne
- Public Awareness/Social media
  - ✓ SAL has gained notoriety, but concepts are distorted
    - Need better definition
    - NWS is evolving toward Facebook, Twitter, media interaction
- Environment & Health impacts of SAL
  - ✓ Dr. Olga Mayol-Bracero, Professor at U of P.R.
    - Widely known as expert in Caribbean environment
    - Lidar installation in Capo San Juan (northeast P.R.)
    - Wealth of instruments throughout P.R.
  - ✓ Dr. Bolaños, Professor at U of P.R. 13 year study
    - little correlation between African dust events and respiratory ailments
    - spore production within rain forests major asthma contributor during fall/winter & nighttime conditions
    - African dust can act as an irritant for the respiratory system
- Future support
  - ✓ Satellite needs: Atmospheric profiling
    - GOES-16 products
    - JPSS-1 launch
    - Ozone (pollution) research: OMPS
    - CrIS sensing
  - ✓ Training: “Just-in-time” as SAL events occur

SAL Case Study:
An Operational Perspective

Clouds and Aerosols over Puerto Rico

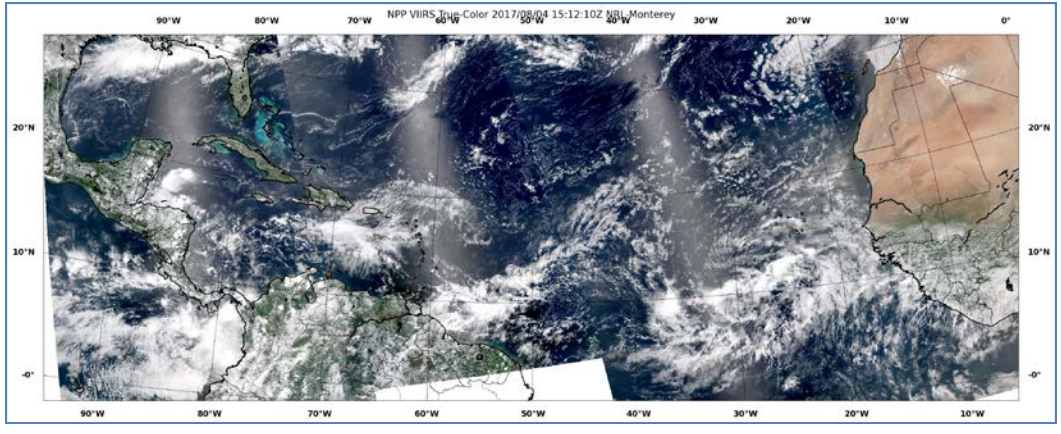
takeoff from San Juan a/p, 02 August



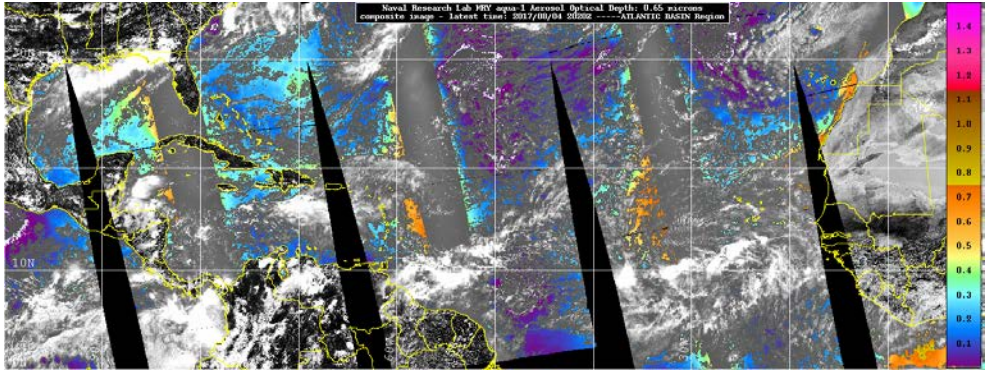
29 July – 04 August

Showcase NRL resources

Case Study: 29 July – 04 August 2017



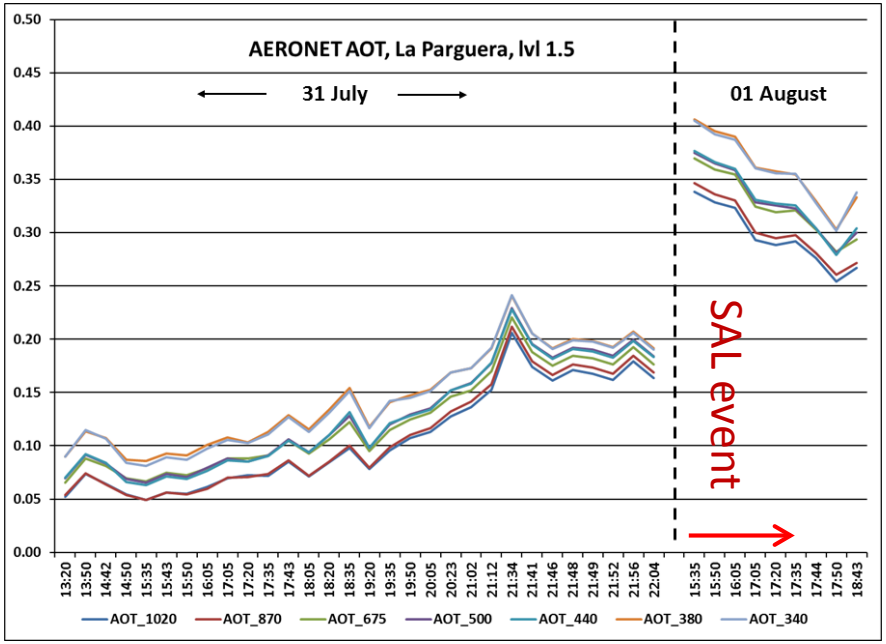
VIIRS true color



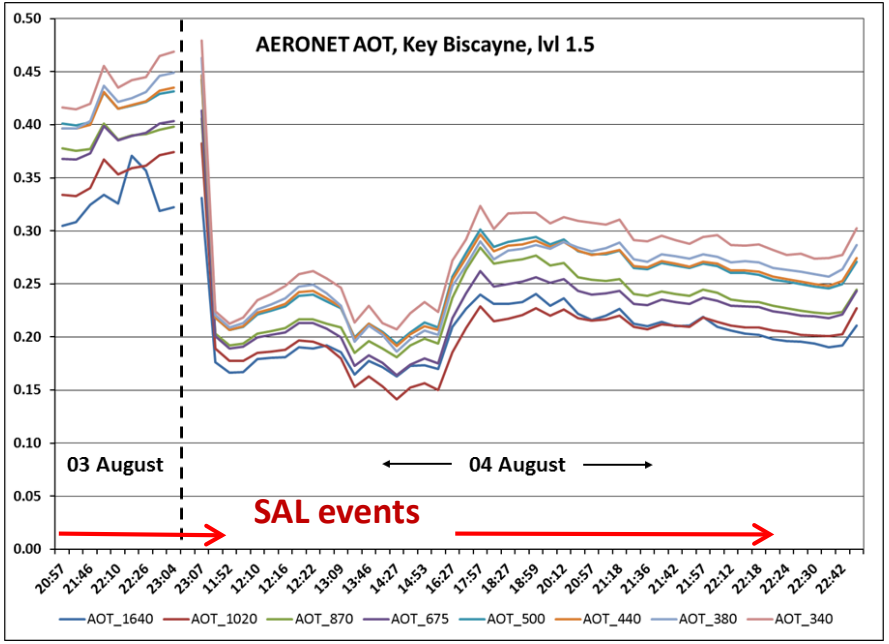
MODIS AOD

SAL impacts: AERONET

Puerto Rico

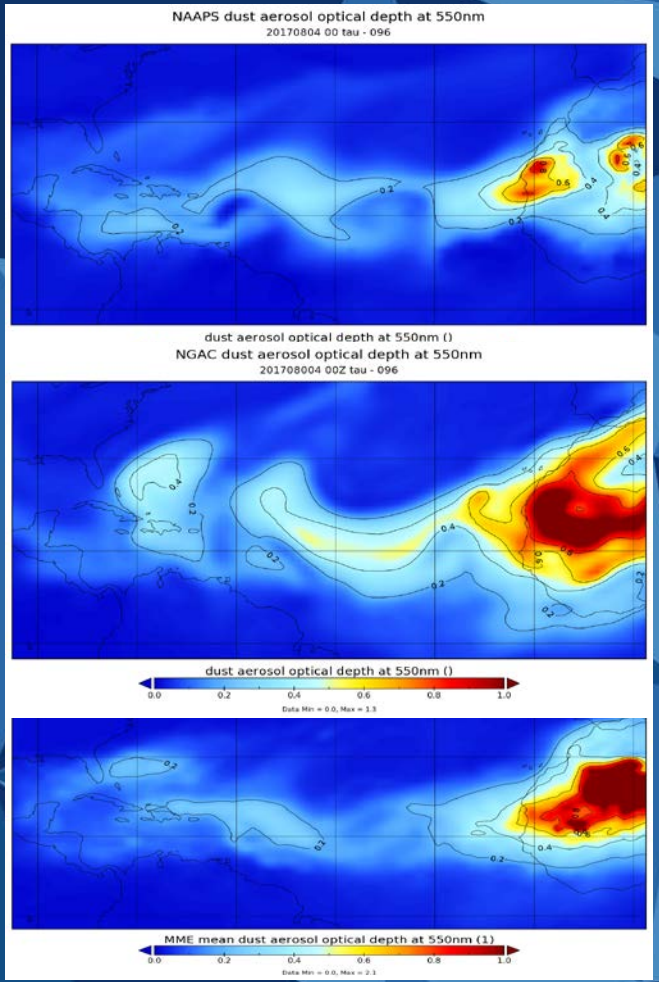


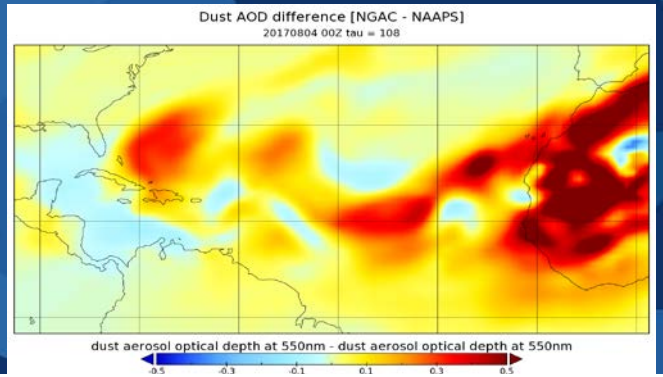
Key Biscayne, FL

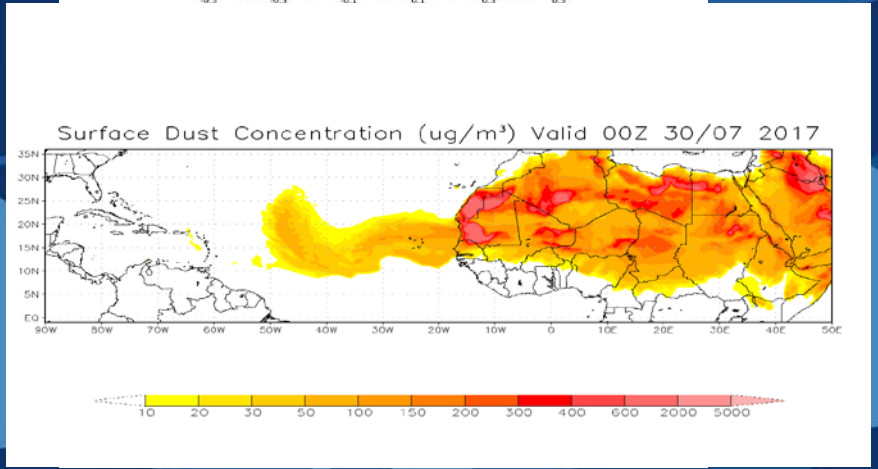


AERONET courtesy: Brent Holben

Model Perspective

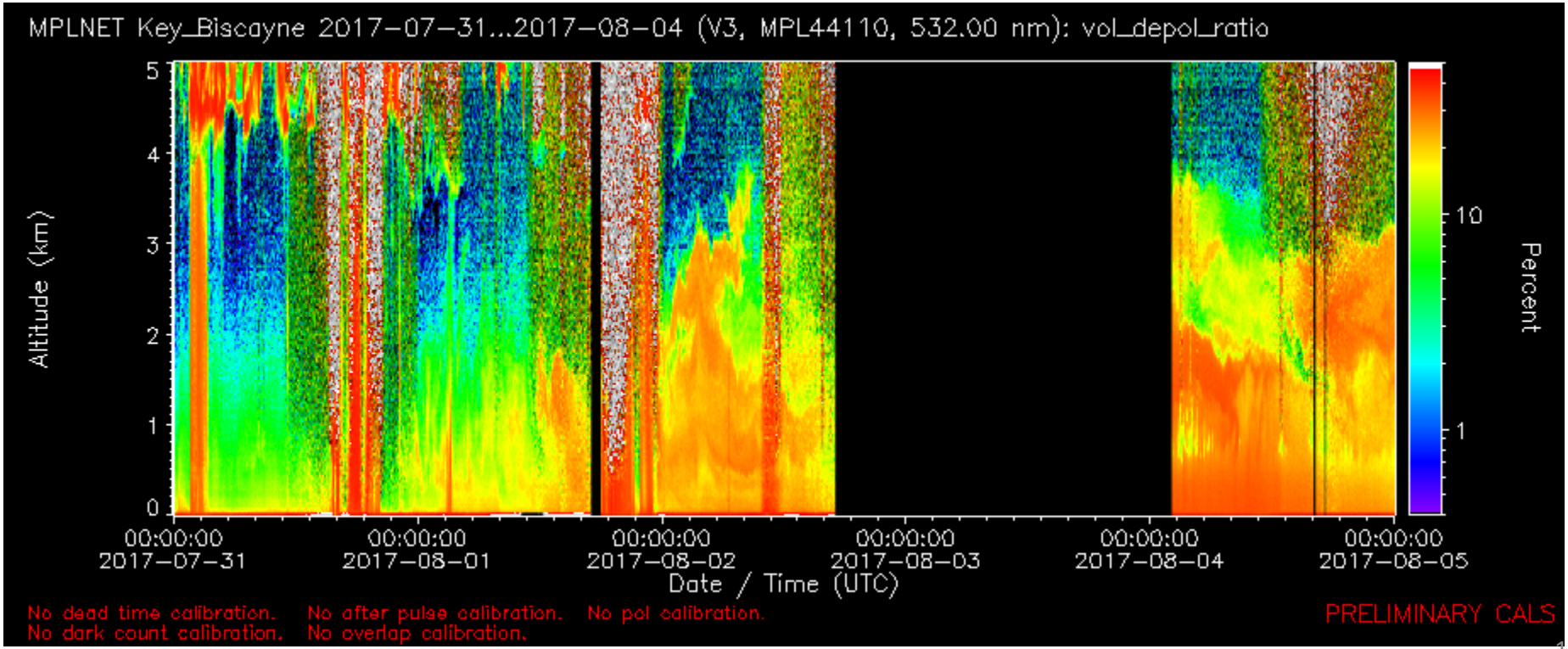




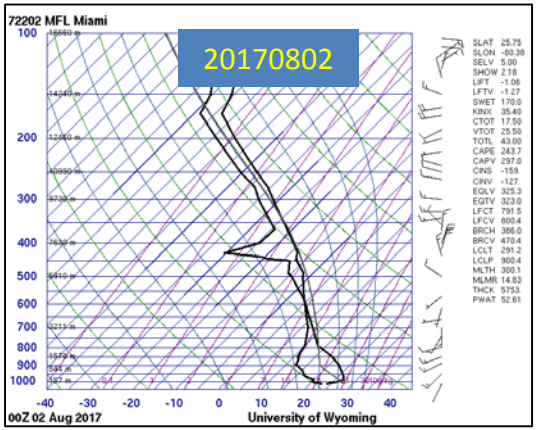


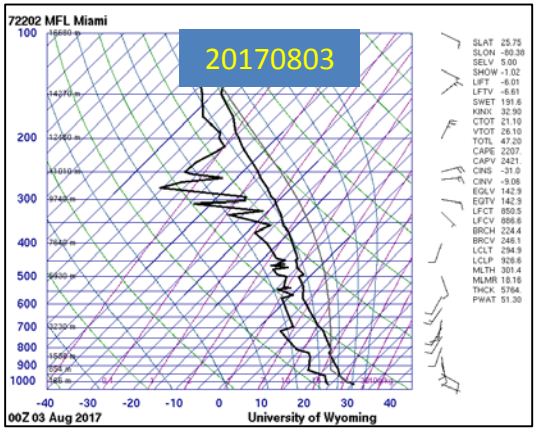
Case Study: Lidar sensing Key Biscayne, FL

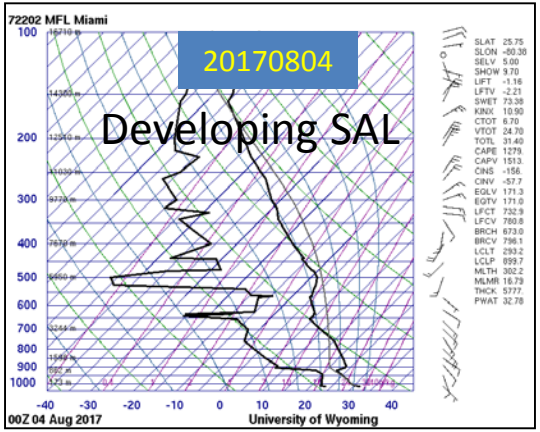
31 July – 04 August

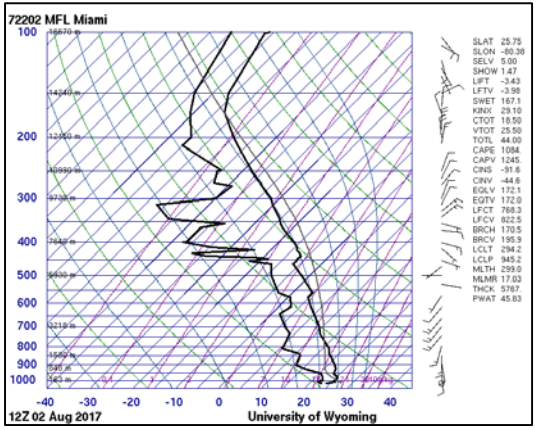


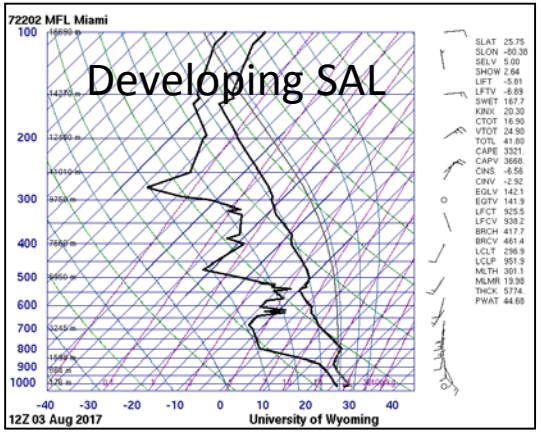
Evolving SAL Over Miami

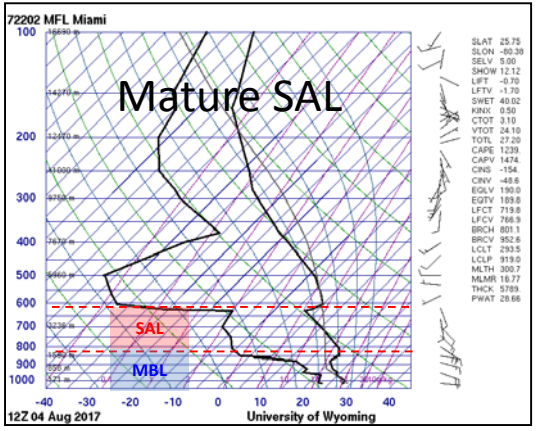




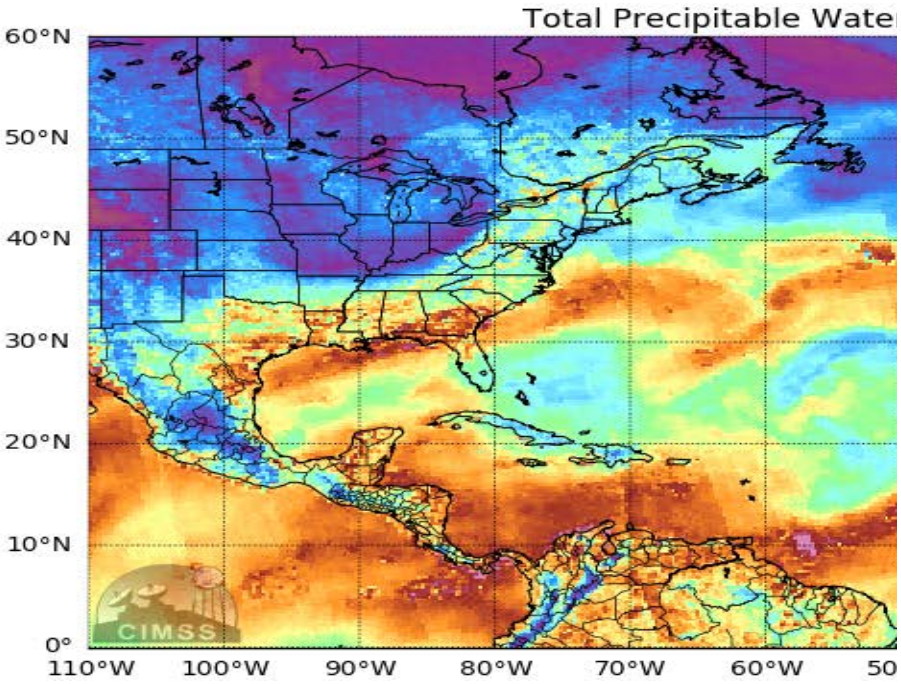


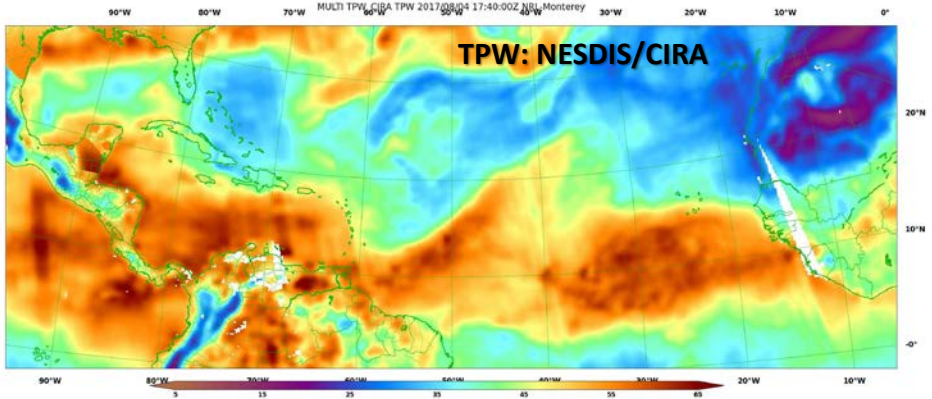


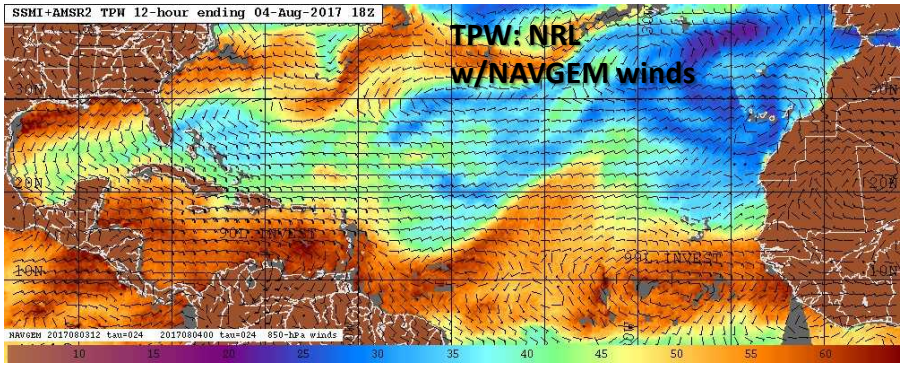




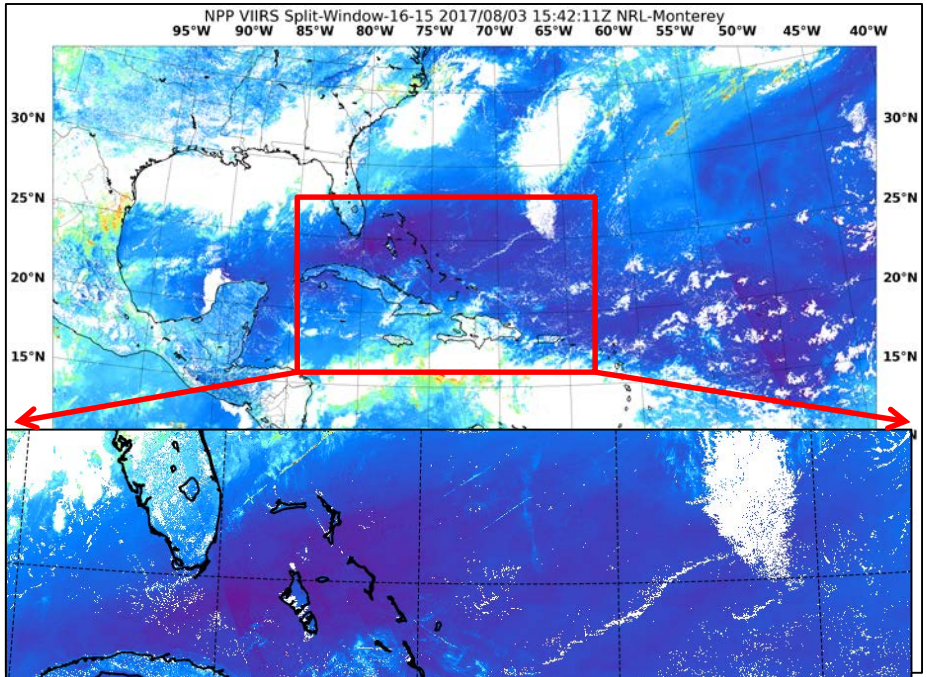
TPW Perspective
03 – 04 August 2017

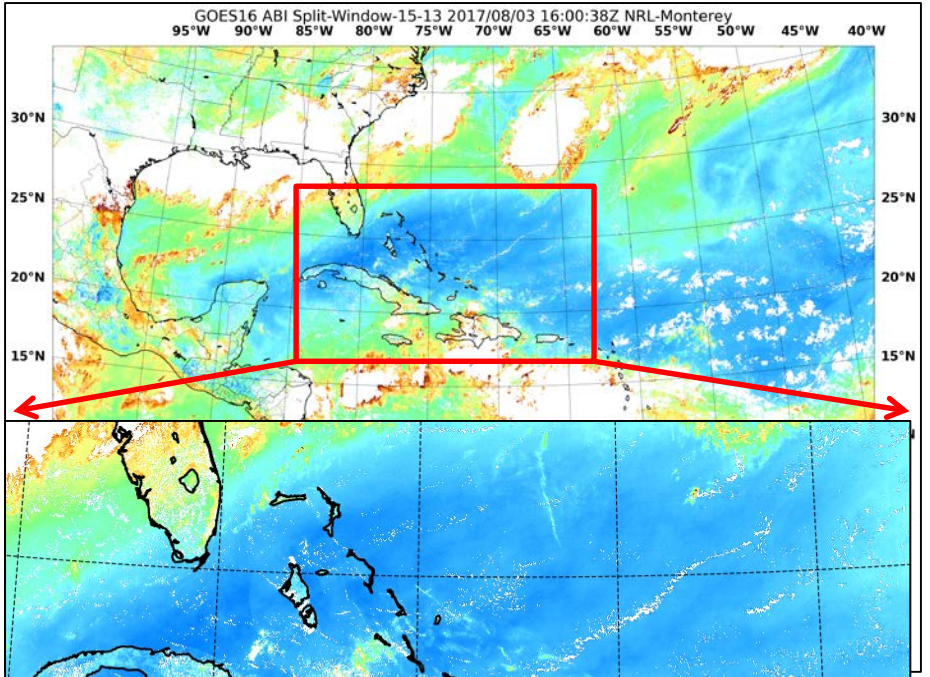






Split Window SAL Views

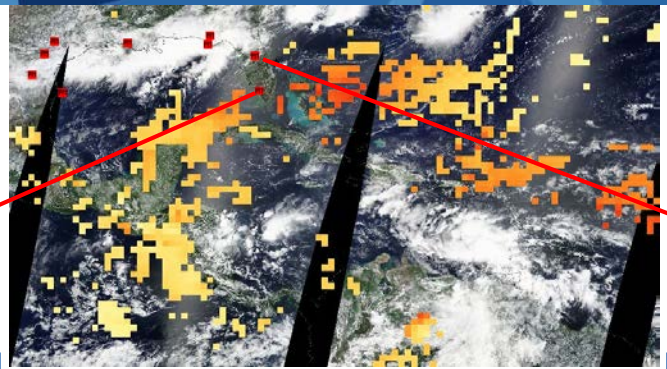


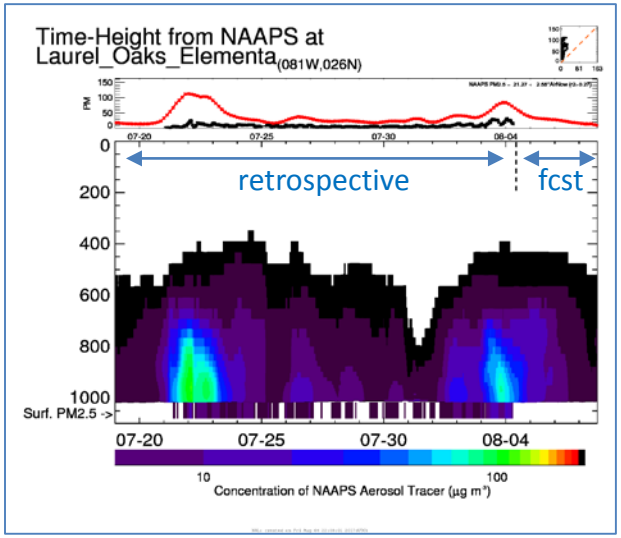


Better spectral/spatial resolution

NAAPS Vertical Profile Forecasts during SAL

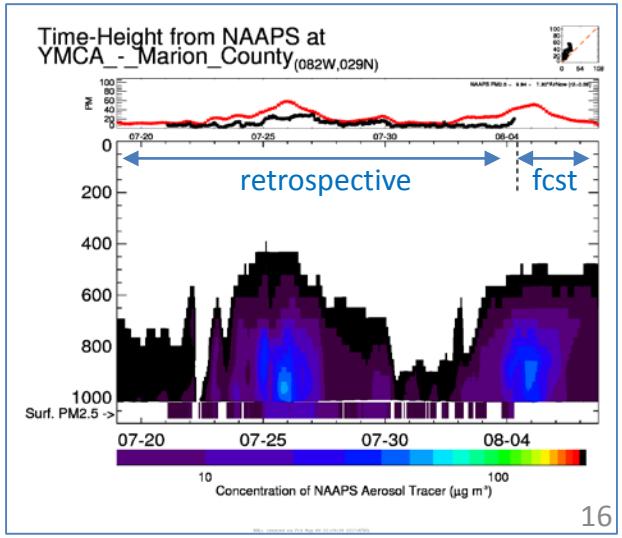
Florida EPA AirNow Sites ($PM_{2.5}$)



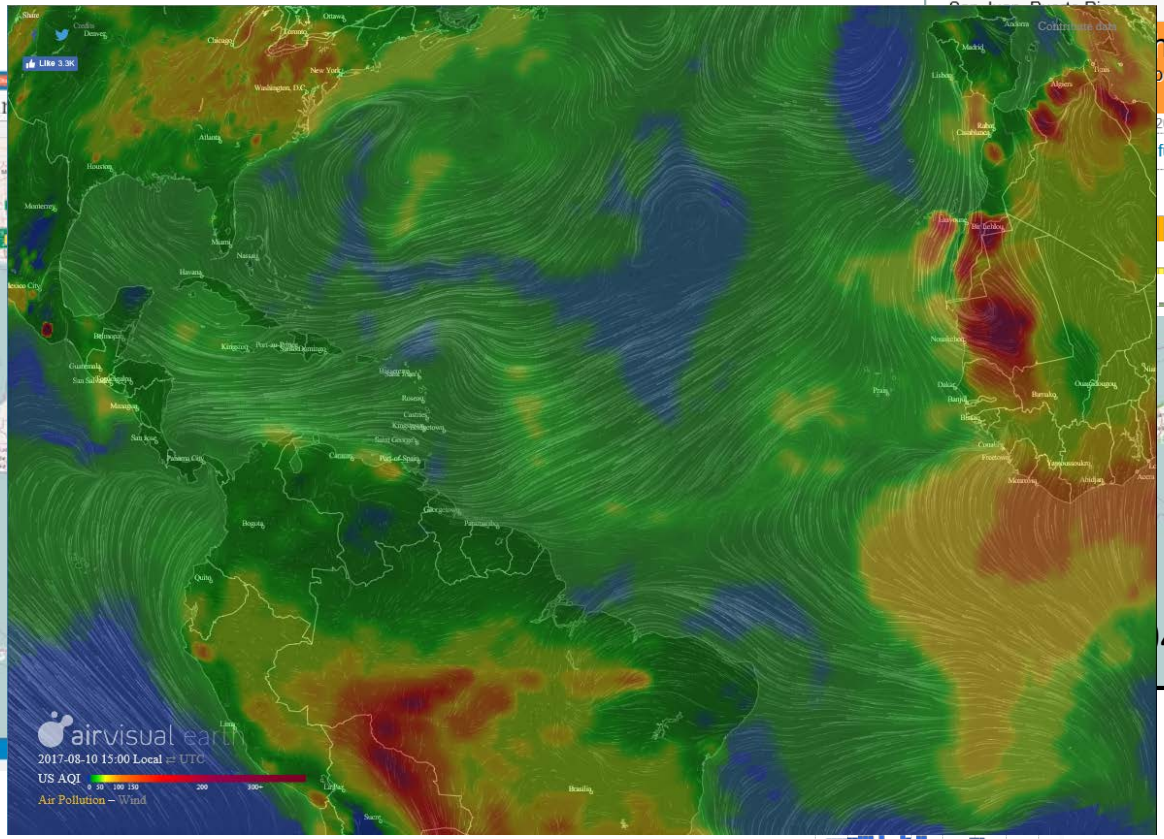


NAAPS (red) vs sfc TEOM sites (black)

NAAPS profile: total PM mass concentration from dust, smoke, sea salt, and anthropogenic aerosol tracers



Global Air Quality Resources



4 Aug 2017

Summary

1. Coordination with NWS:
    a) Evolve SAL into higher impact status -> forecast discussions, social media
        i. Better understanding of SAL
        ii. Training => forecasters/public/gov. agencies: weather & health impacts
        iii. Beyond VIIRS: acquire additional resources from NEXGEN sensors
            - GOES-16 fusing with polar orbiters, models, in-situ measurements

2. Improve Navy dust model:
    a) Incorporate Enterprise VIIRS AOD into NAAPS
    b) Integrate international dust models (ICAP)

3. Leverage Navy funding: R&D toward Caribbean dust/pollution/health:
    a) SAL dust vs localized pollutants characterization
        i. Ozone studies related to detecting/discriminating pollution from dust
        ii. Apply OMPS retrievals
    b) Visibility aspects related toward trafficability

Summary

US Navy Requirements Related to the Tropical Atlantic Environment



Support tactical and operational environment

- Trafficability
- Helicopter operations
- UAV operations
- Search and Rescue
- Reconnaissance
- Weapons systems

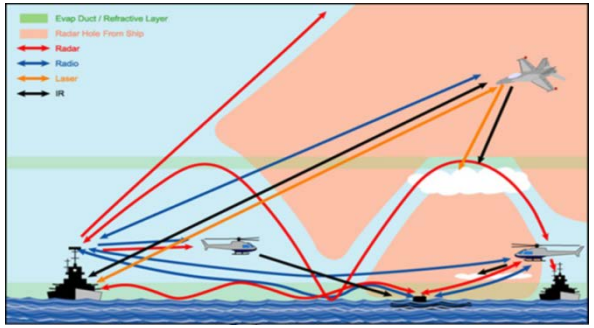


Improve tactical prediction of near-surface weather

- Boundary Layer Clouds
- Fog
- Aerosol Loading
- Visibility

"We must *advance* our technological expertise to predict how electromagnetic waves will move through the physical battlespace."

~ RDML Tim Gallaudet, USN



Clouds affect, or are indicators of, tropospheric boundary layer conditions and EM/EO propagation.