

NOAA Aerosols and Ocean Science Expeditions (AEROSE) for Cal/Val of CrIMSS EDRs



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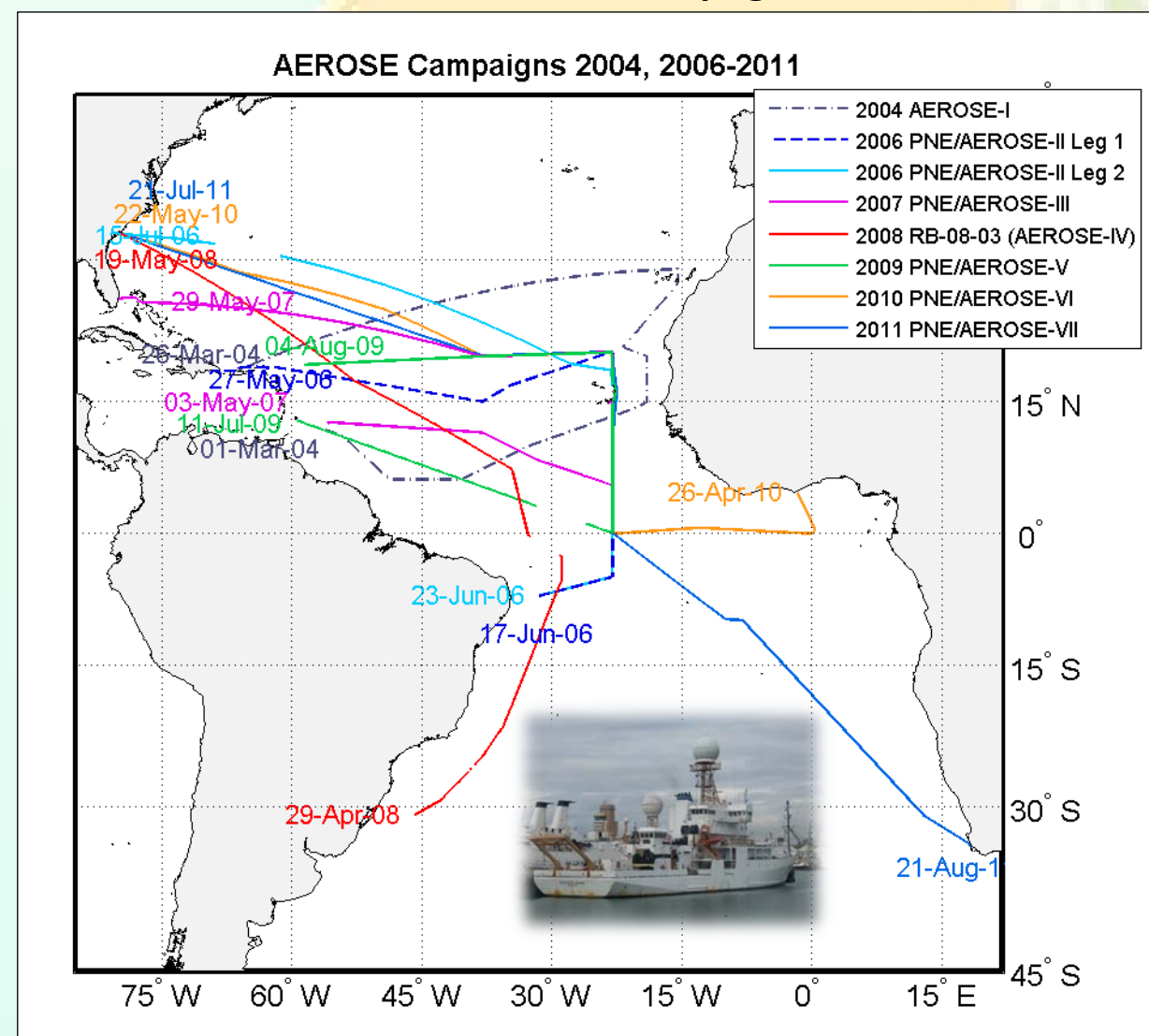
AEROSE



- The NOAA Aerosols and Ocean Science Expeditions (AEROSE) are a series of trans-Atlantic intensive atmospheric field campaigns conducted aboard the NOAA Ship Ronald H. Brown (Morris et al. 2006; Nalli et al. 2011).
 - AEROSE-I (March 2004; 4 weeks)
 - PNE/AMMA/AEROSE-II (Jun-Jul '06)
 - Leg 1 (4 weeks)
 - Leg 2 (4 weeks)
 - PNE/AEROSE-III (May '07; 4 weeks)
 - RB-08-03 Transit (AEROSE-IV) (Apr-May '08; 3 weeks)
 - PNE/AEROSE-V (Jul-Aug 09; 4 wks)
 - PNE/AEROSE-VI (Apr-May 10; 4 wks)
 - PNE/AEROSE-VII (Jul-Aug 11; 5 wks)

- As part of the NOAA/PNE project, AEROSE has yielded an unprecedented collection of *in situ* measurements of the Saharan air layer (SAL) and associated African dust and smoke outflows over the tropical Atlantic Ocean, including
 - Transport, microphysical evolution and regional impacts
 - Regional atmospheric chemistry and marine meteorology
 - Correlative data for environmental satellite cal/val

AEROSE Cruise Tracks – “Spaghetti Plot”



Correlative Data

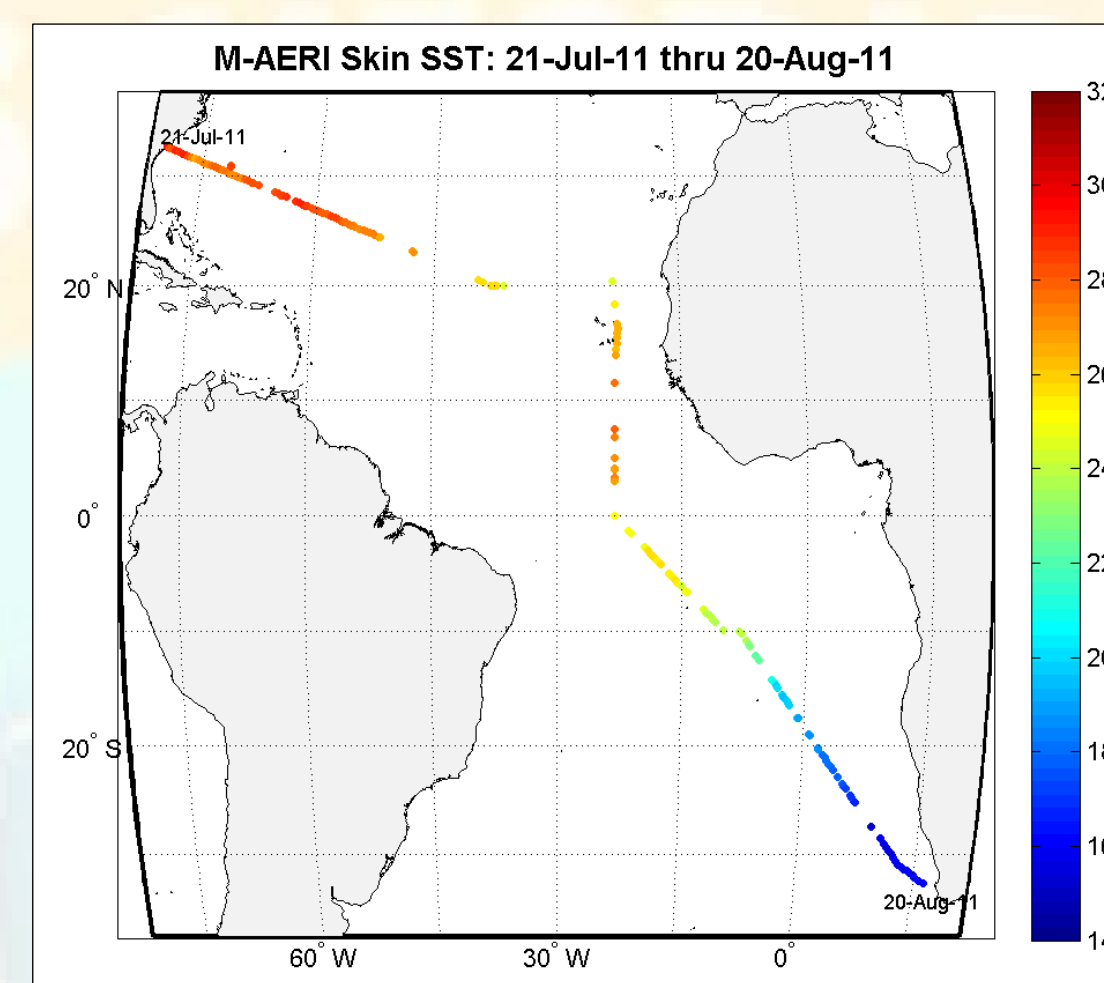
Dedicated Radiosonde Observations (RAOBs)

- Vaisala RS92 GPS rawinsondes launched coinciding with Aqua AIRS (A-Train) and MetOp IASI overpasses
 - Pressure, temperature, humidity, PTU(z)
 - Wind speed and direction, u(z), v(z)
 - GPS altitude, z(t)
 - Typically ~4/day (~01:30, 09:30, 13:30, 21:30)
 - 2004, 2008–2011 not uploaded into GTS (i.e., not assimilated)
 - 680 PTU soundings to date (102 successful 2011 launches)
- Ozoesondes interfaced with RS92
 - Measure O₃(z) partial pressure
 - ~1/day during MetOp/Aqua overpasses
 - 113 O₃ soundings to date (24 successful 2011 launches)



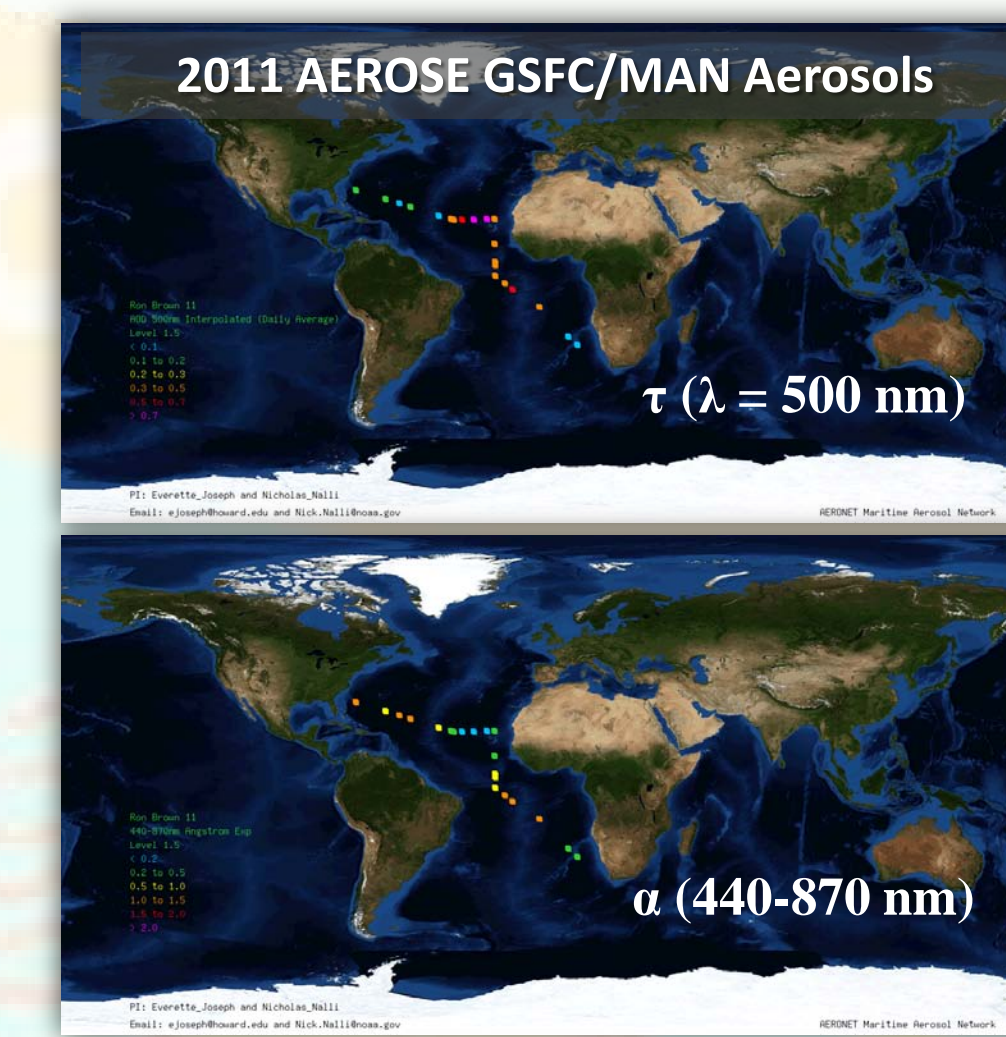
Marine Atmospheric Emitted Radiance Interferometer (M-AERI)

- Ship-based FTS that measures downwelling and upwelling calibrated IR spectra (Minnett et al. 2001)
- High accuracy calibration using 2 NIST-traceable blackbodies
- Derived (EDR) products
 - High accuracy skin SST derived from semi-opaque spectral region (~7.7 μm) (Smith et al. 1996)
 - Skin SST is an important state parameter and “ground truth”
 - Retrievals of lower tropospheric profiles at turbulent time scales (e.g., Szczodrak et al. 2007)
 - Ocean surface spectral emissivity (e.g., Hanafin and Minnett 2005; Nalli et al. 2008b)



Other Shipboard Data

- Microtops Sunphotometer
 - Multi-channel raw data provides information on changes in total column aerosols
 - Since 2009, the AEROSE Team collaborated with the NASA/GSFC AERONET Maritime Aerosol Network (Smirnov et al. 2011).
- Vaisala Ceilometer (low power lidar) attenuated backscatter for aerosol vertical distribution
- Broadband pyranometers and pyrgeometers (downwelling LW and SW Fluxes)
- In situ gas & particle measurements
- Research-vessel meteorological and oceanographic measurements



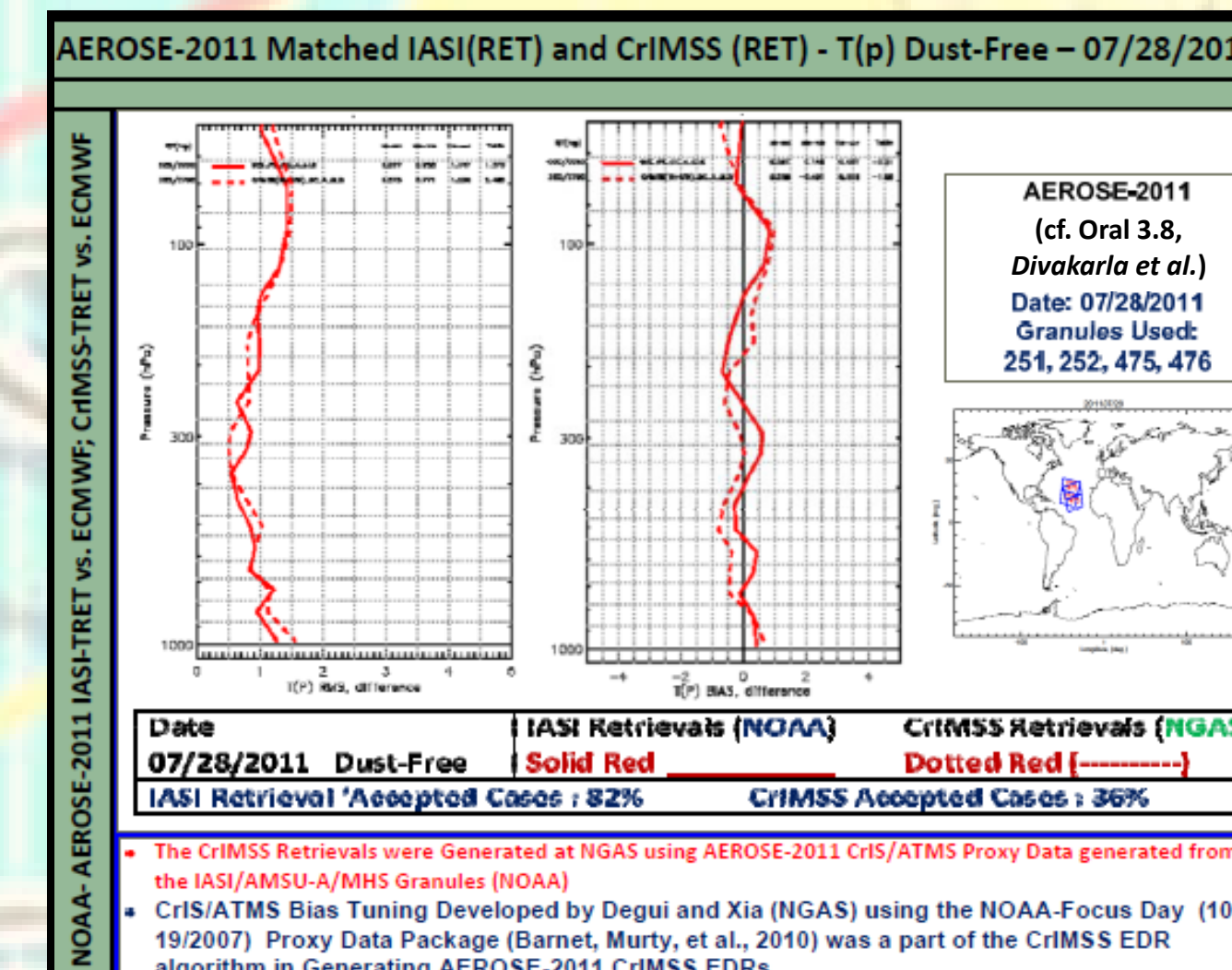
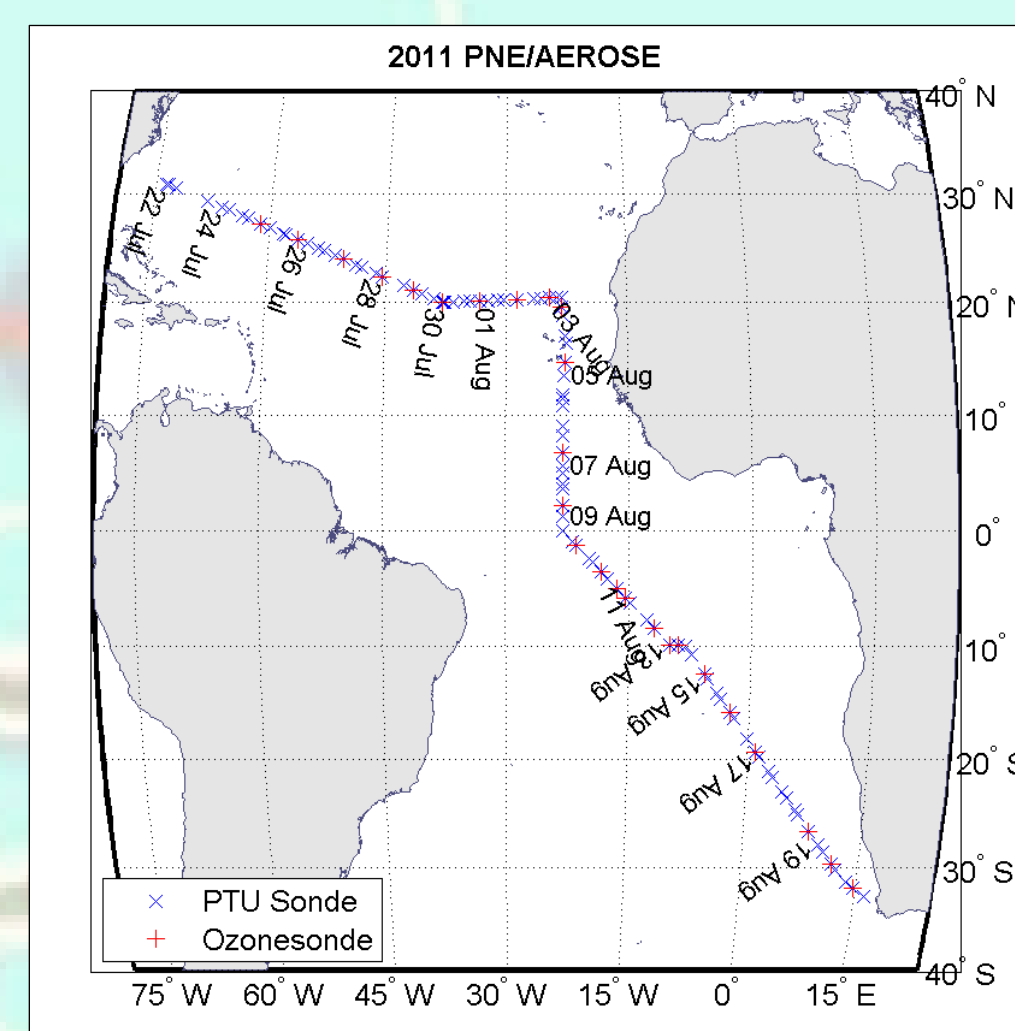
2011 AEROSE Trans-Atlantic Profile Analyses

AEROSE Proxy Datasets

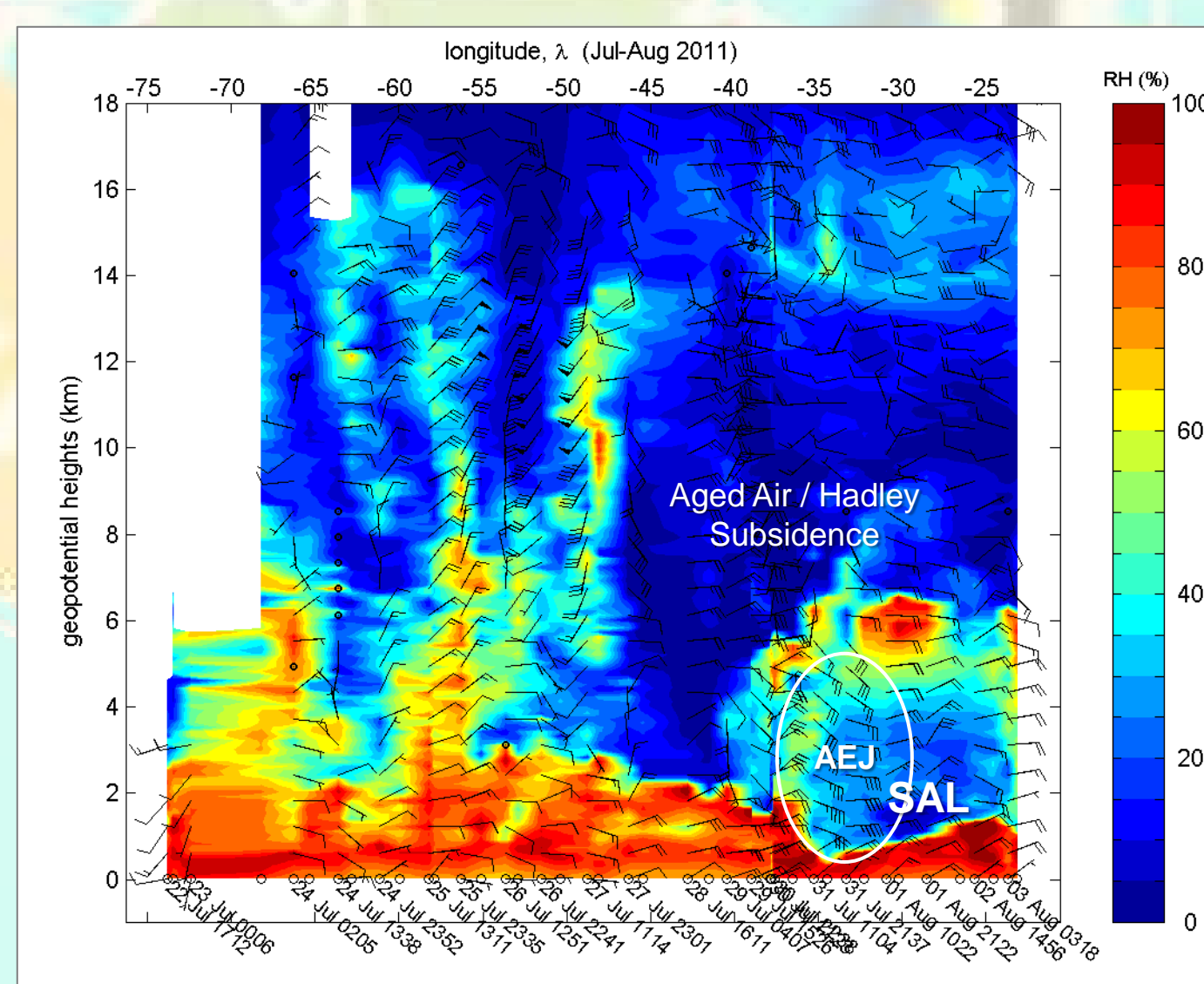
- JPSS CrIMSS EDR Validation
 - AEROSE 2011 has been used for a pre-launch phase scientific validation campaign of opportunity (Figure to right shows RAOB launches)
 - CrIMSS SDR proxy data has been derived from NOAA-unique IASI matchup granules (cf. Oral 3.8, Divakarla et al. – rightmost Figure)
 - The AEROSE domain is of scientific interest germane to the CrIMSS mesoscale-synoptic observing mission.
 - Saharan air layer (SAL) and distribution of tropical water vapor
 - Dust and biomass burning aerosols
 - Tropospheric ozone dynamics
- Figures below show trans-Atlantic RH and O₃ cross-sections obtained from RAOB (top row) alongside those obtained from NOAA/STAR IASI retrieval matchups (bottom row), revealing the ability of hyperspectral IR sounders for observing meteorological phenomena of interest.



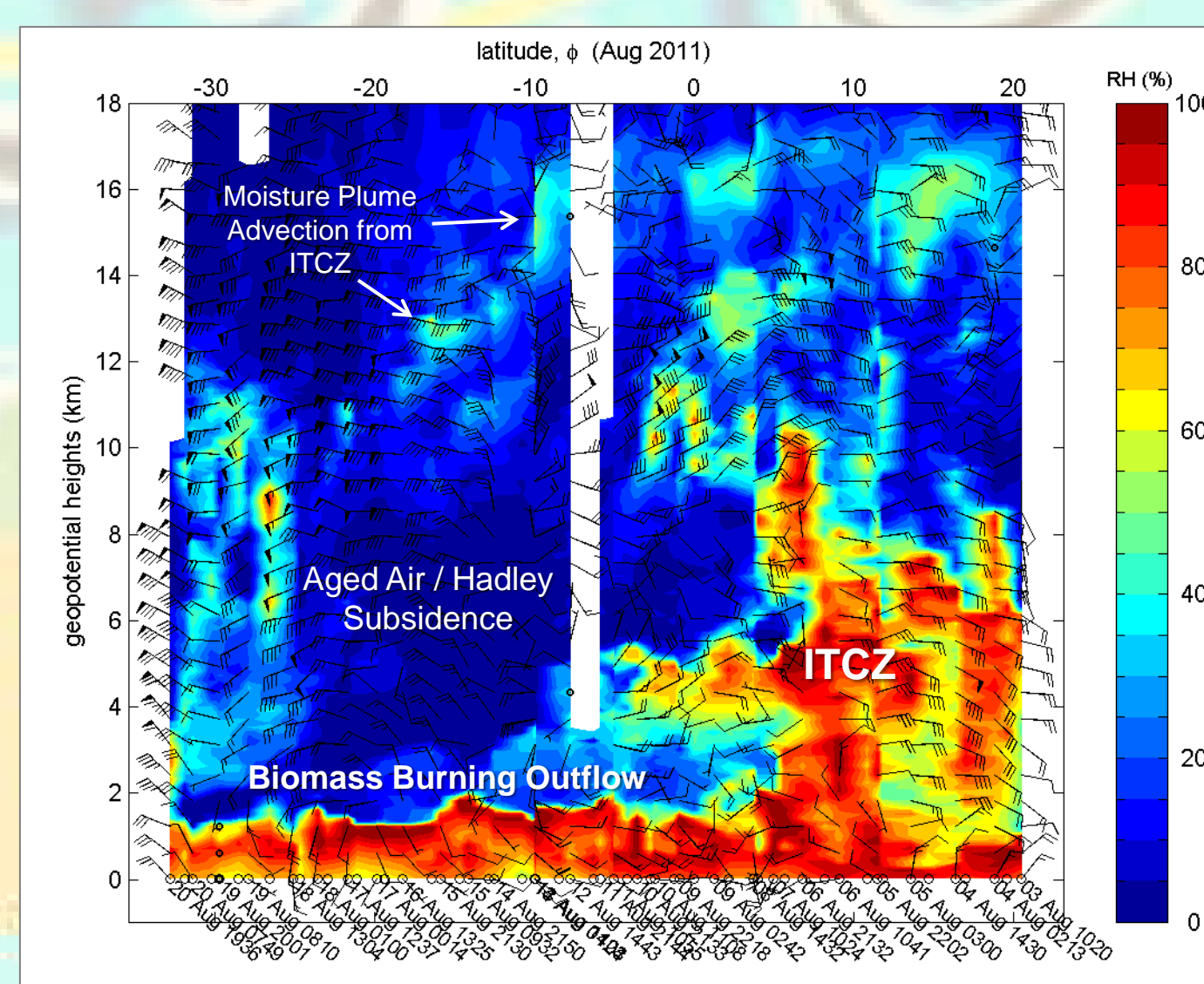
RAOB Launches



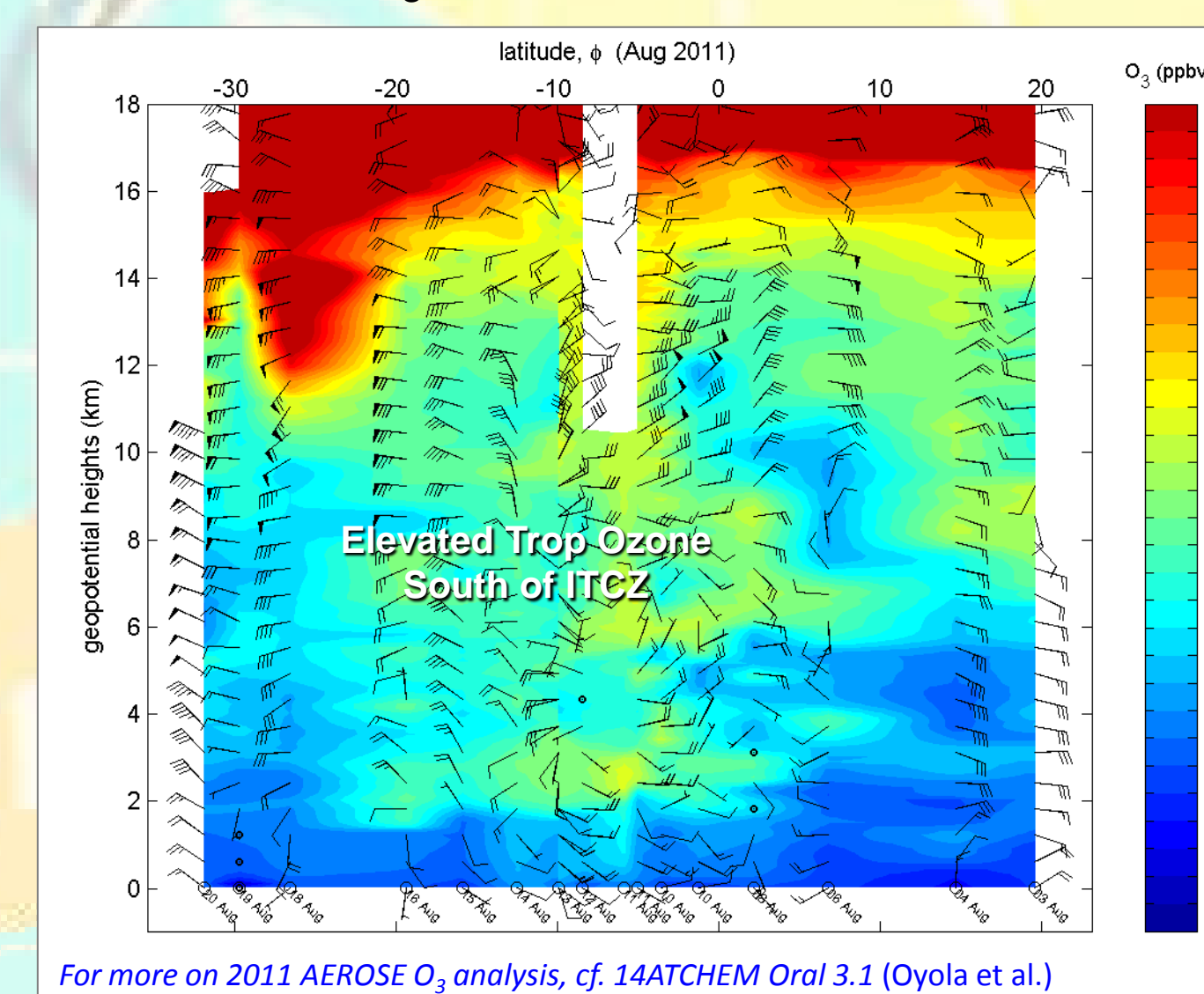
RAOB RH – W-E Transect (20–32°N)



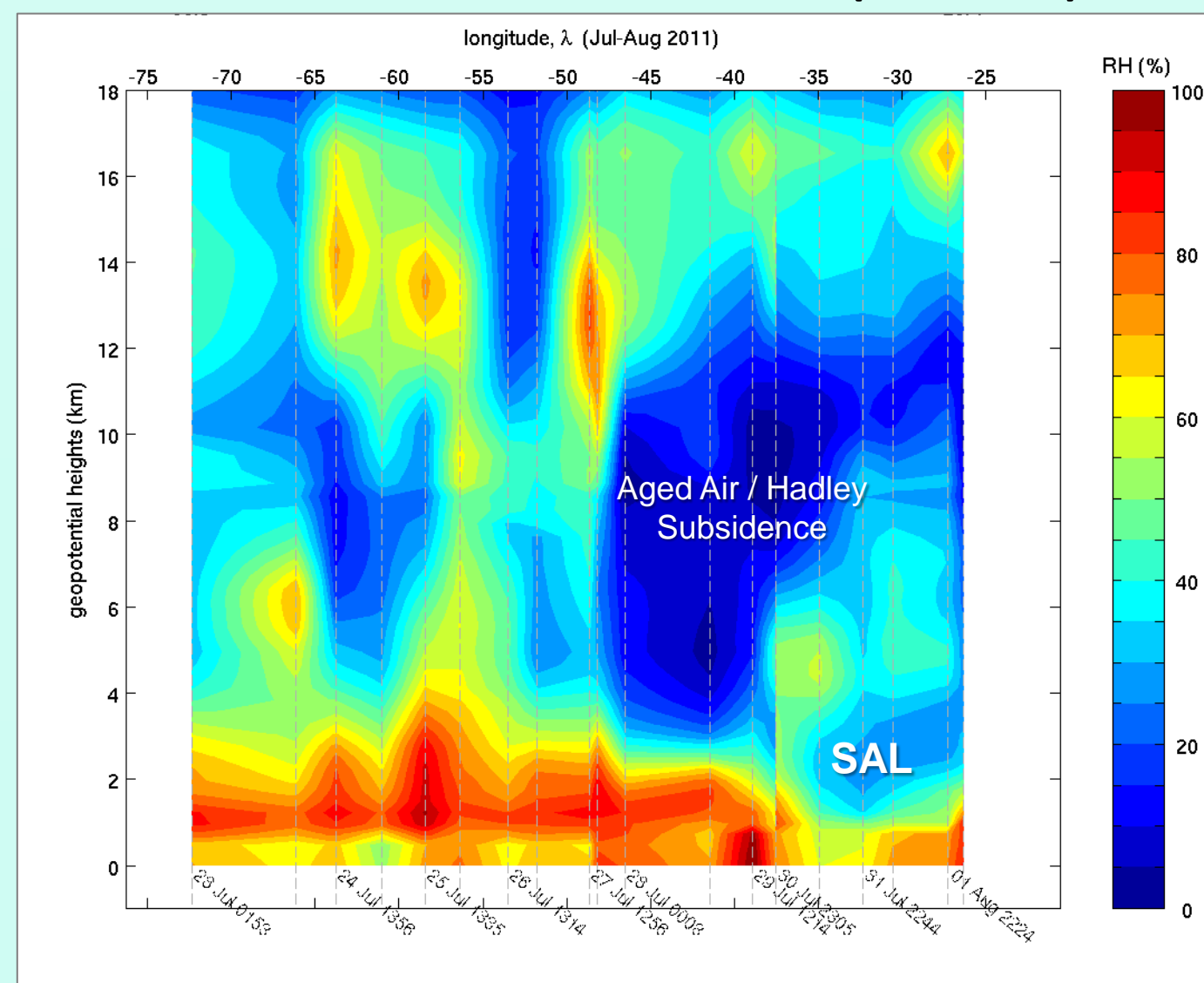
RAOB RH – N-S Transect (23°W–16°E)



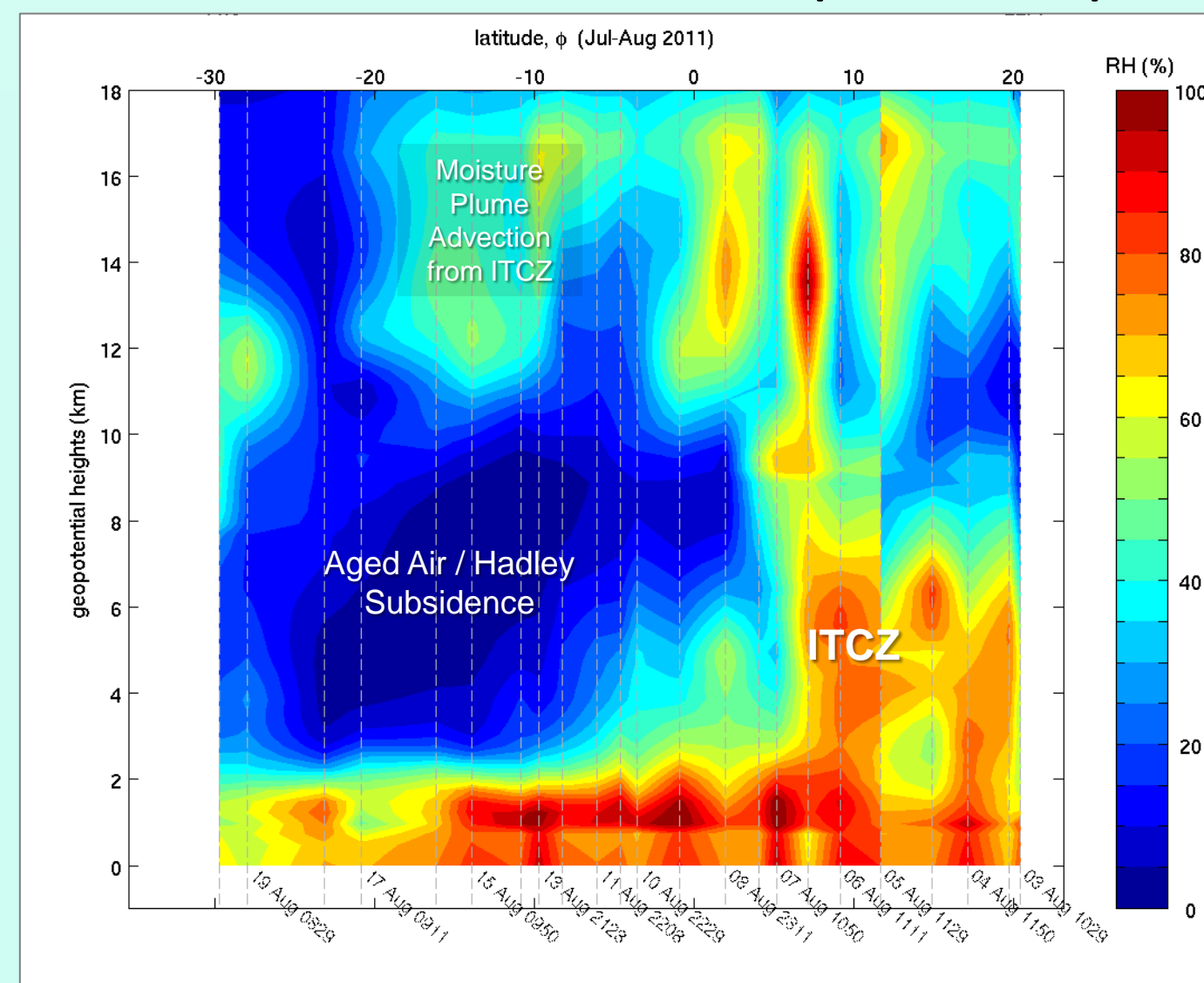
RAOB O₃ – N-S Transect (23°W–16°E)



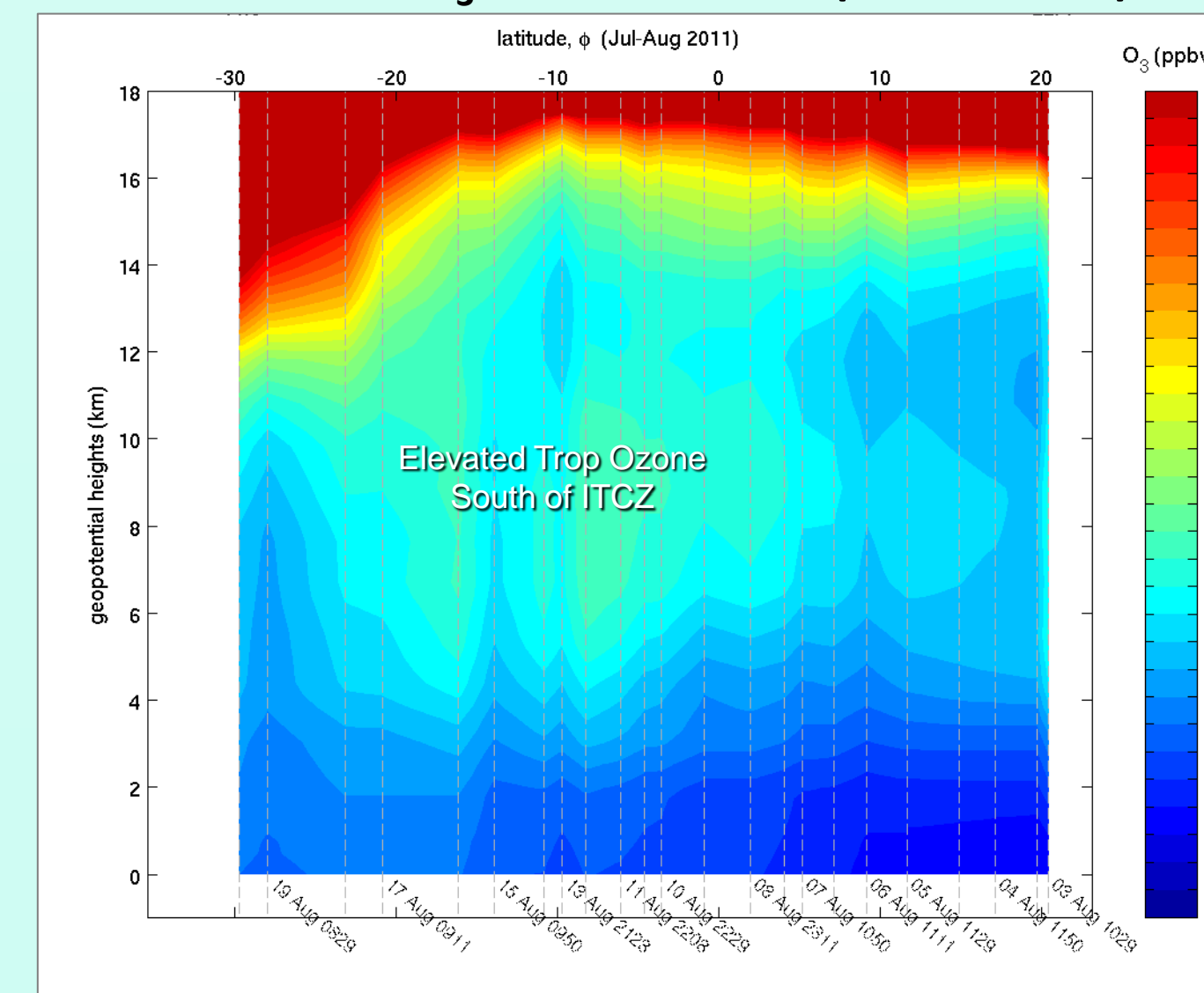
NOAA IASI RH – W-E Transect (20–32°N)



NOAA IASI RH – N-S Transect (23°W–16°E)



NOAA IASI O₃ – N-S Transect (23°W–16°E)



PNE/AEROSE Partnership

- Participating Institutions
 - Howard University NOAA Center for Atmospheric Sciences (HU/NCAS)
 - NOAA/NESDIS/STAR
 - University of Miami/RSMAS
 - NOAA/ESRL/PSD (formerly NOAA/ETL)
 - NOAA/OAR Atlantic Oceanographic and Meteorological Laboratory (AOML)
 - NOAA Pacific Marine Environmental Laboratory (PMEL)
- Synergism
 - Low Cost – Low Risk
 - Engages broader science community on specific problems.
 - All parties gain access to all data.
 - AEROSE is a key component of the PNE cruises. NOAA's allocation of ship time onboard the Ronald H. Brown for PNE/AEROSE cruises is fully optimized.

AEROSE EDR Cal/Val Contributors		
NAME	INSTITUTION	COLLABORATION
N. Nalli, C. Barnett, T. King, H. Xie, T. Reale, M. Divakarla, E. Maddy, G. Guo, A. Gambacorta, W. Wolf, M. Goldberg, et al.	NOAA/NESDIS/STAR	RS92 Rawinsondes CrIMSS/GOES-R EDR Cal/Val ASL, AIRS Cal/Val IR Radiative Transfer NPROVS
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R. Lumpkin C. Schmid	NOAA/AOML	PNE Chief Scientists TAO Moorings CTDs, XBTs
P. Minnett, M. Szczodrak, M. Izaguirre	UM/RSMAS	M-AERI MW Radiometer All-sky camera
D. Wolfe	NOAA/OAR/ ESRL/PSD	Vaisala Sounding System; Surface Flux Measurements; Vaisala Ceilometer

Summary

- The PNE/AEROSE intensive campaigns continue to compile a multiyear set of ship-based, marine *in situ* cross-sectional correlative measurements over the tropical Atlantic Ocean.
 - The 2011 campaign added to the current data inventory from 2004, 2006–2010
- The cruise domains span a region of meteorological interest in terms of the SAL, tropical storm formation, and tropospheric ozone/carbon/aerosol chemistry and transport.
 - Numerous interdisciplinary applications of these data
 - These features are objects of interest for the satellite sounder missions, thus validation is desirable.
 - Ocean-based correlative data has distinct advantages for satellite cal/val.
- AEROSE 2011 highlights include
 - An interhemispheric trans-Atlantic transect similar to the Aerosols99 cruise, albeit with improved eastern basin sampling
 - IASI L2 x-sections show reasonable coherent space-time agreement w RAOB x-sections
 - Surprisingly good tropospheric ozone agreement – appears legit
 - Not surprisingly, a very shallow (~0.5 km) SAL “dry filament” was missed
- The AEROSE 2010 and 2011 campaigns have provided correlative data needed for the successful generation of ocean-based proxy datasets for NPP CrIMSS EDR and GOES-R ABI pre-launch validation.

Future Work

- NPP CrIMSS EDR Intensive Cal/Val (ICV) Phase activities
 - AVTP, AVMP validation over open ocean, within and without Saharan air layer, dust, smoke
 - Dusty scene risk reduction
 - SAL detection
 - IP validation: Vertical ozone profiles, skin SSTs
 - Cloud impact, including angular effects (cf. 16SMOI Oral 3.5, Nalli et al.)
- Results using AEROSE GOES-R Proxy Data Set, including SEVIRI, AIRS/IASI granules (w/ T. Zhu)
 - SEVIRI/GOES-R ABI legacy profile TPW validation and demonstration over open ocean (w/ J. Li)
- The next PNE/AEROSE is tentatively scheduled for September 2012
 - Will provide dedicated RAOB matchups over open ocean for ICV phase of NPP CrIMSS cal/val
 - September is during the peak of the Atlantic hurricane season
 - We hope this will not be impacted by budget shortfalls leading to rationing of sea time on the Ronald H. Brown

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- The NOAA GOES-R Algorithm Working Group (M. D. Goldberg)
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- T. Pagano (JPL) and the NASA Sounder Science Team
- The many students, who participated in, and contributed to, the campaigns over the years
- The officers and crew of the Ronald H. Brown

The views, opinions and findings contained in this report are those of the authors and should not be construed as an official NOAA or U.S. Government position, policy or decision.

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