

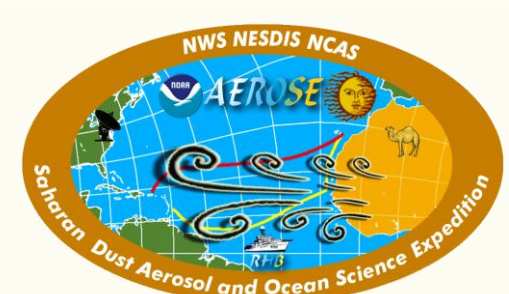
# 2010 NOAA Aerosol and Ocean Science Expedition (AEROSE) for CrIMSS Marine Proxy Data

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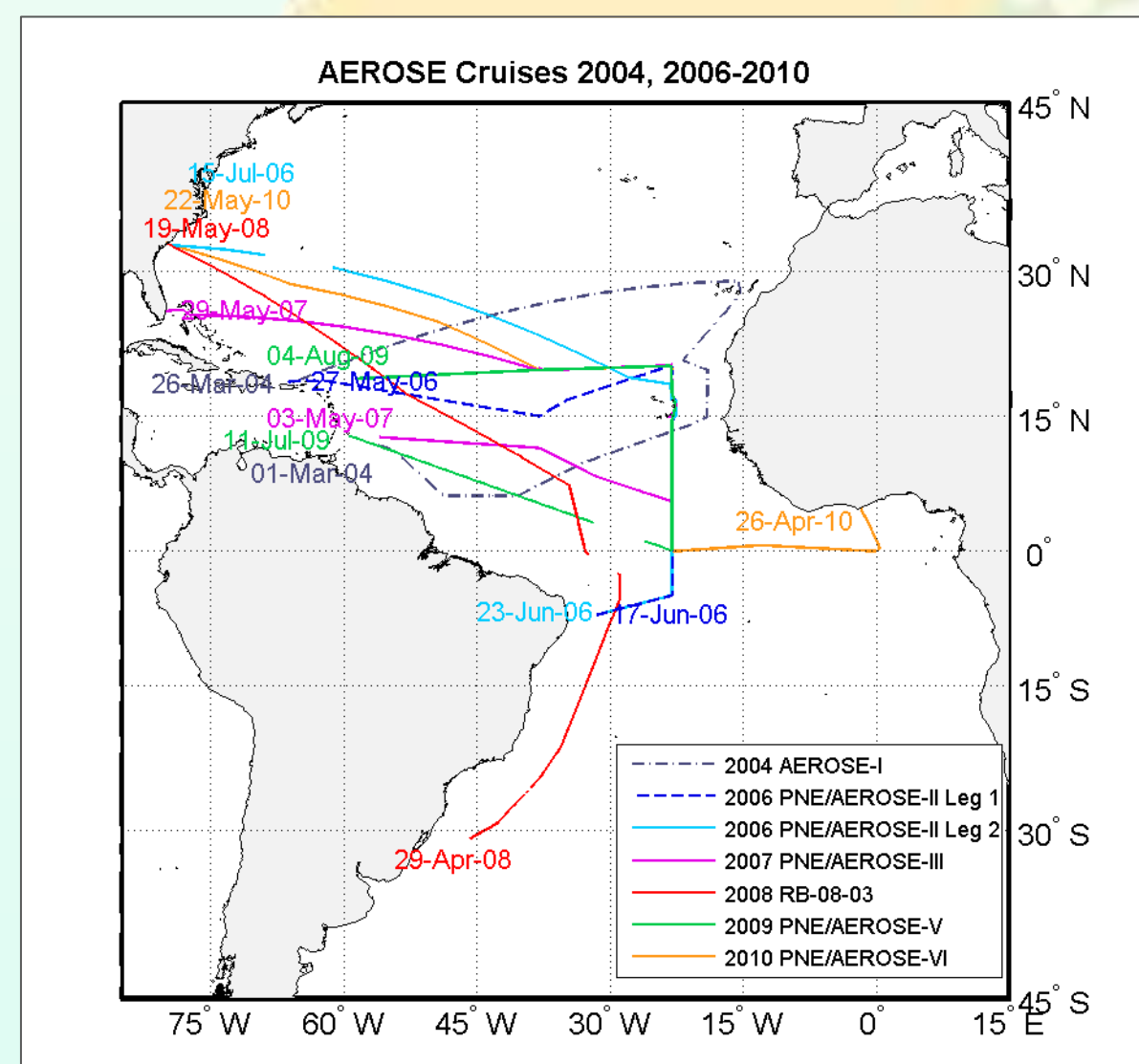
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## AEROSE



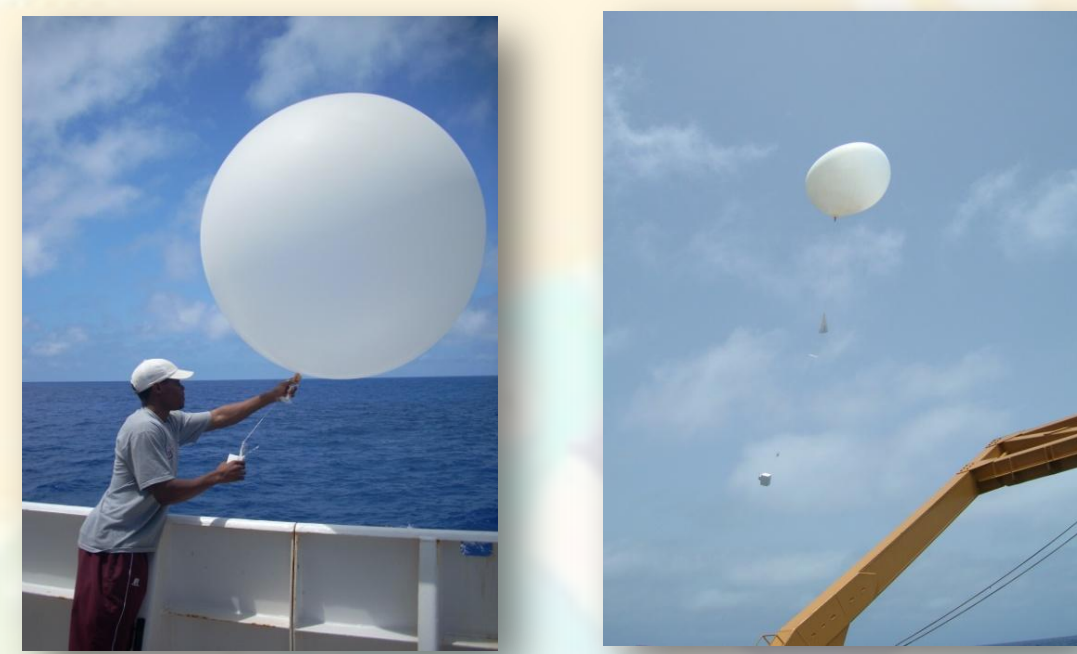
- The **Aerosols and Ocean Science Expeditions (AEROSE)** are a series of trans-Atlantic intensive atmospheric field campaigns conducted aboard the NOAA Ship *Ronald H. Brown (RHB)* (Morris et al. 2006).
  - AEROSE-I (March 2004; 4 weeks)
  - PNE\*/AMMA\*/AEROSE-II (June-July 2006)
    - Leg 1 (4 weeks)
    - Leg 2 (4 weeks)
  - PNE/AEROSE-III (May 2007; 4 weeks)
  - RB-08-03 Interhemispheric Transit descope mission (Apr-May 2008; 3 weeks)
  - PNE/AEROSE-V (July-August 2009; 4 weeks)
  - PNE/AEROSE-VI (Apr-May 2010; 4 weeks)
- As part of the **NOAA/PNE** mission, AEROSE has grown to become 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

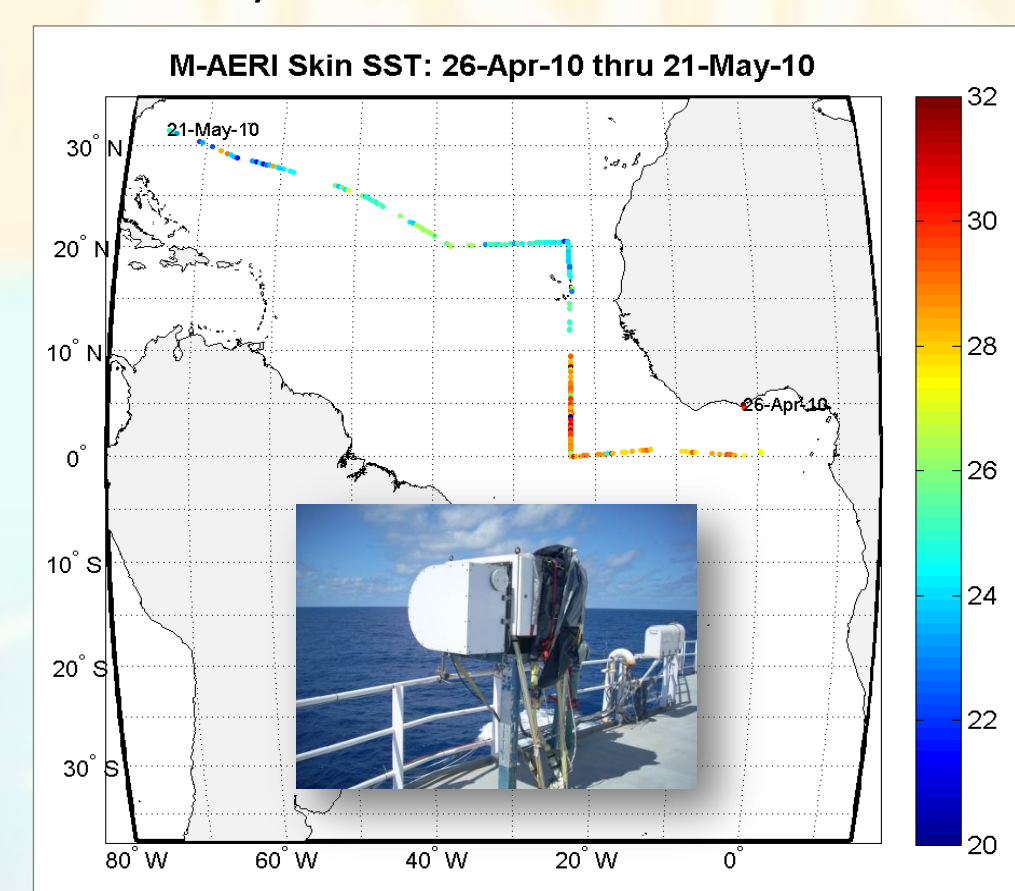
### Dedicated Radiosonde Observations (RAOBs)

- Vaisala RS92 GPS rawinsondes** (RS80/90 in 2004) launched coinciding with LEO environmental satellite overpasses (viz. Aqua and MetOp)
  - RS92 sondes measure
    - 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, 2008–2010 not uploaded into GTS (i.e., **not assimilated**)
  - 578  $PTU$  soundings to date (75 successful '10 launches)
- Ozonsondes** interfaced with RS92
  - Measure  $O_3(z)$  partial pressure
  - ~1/day during MetOp/Aqua overpasses
  - 89  $O_3$  soundings to date (19 successful '10 launches)



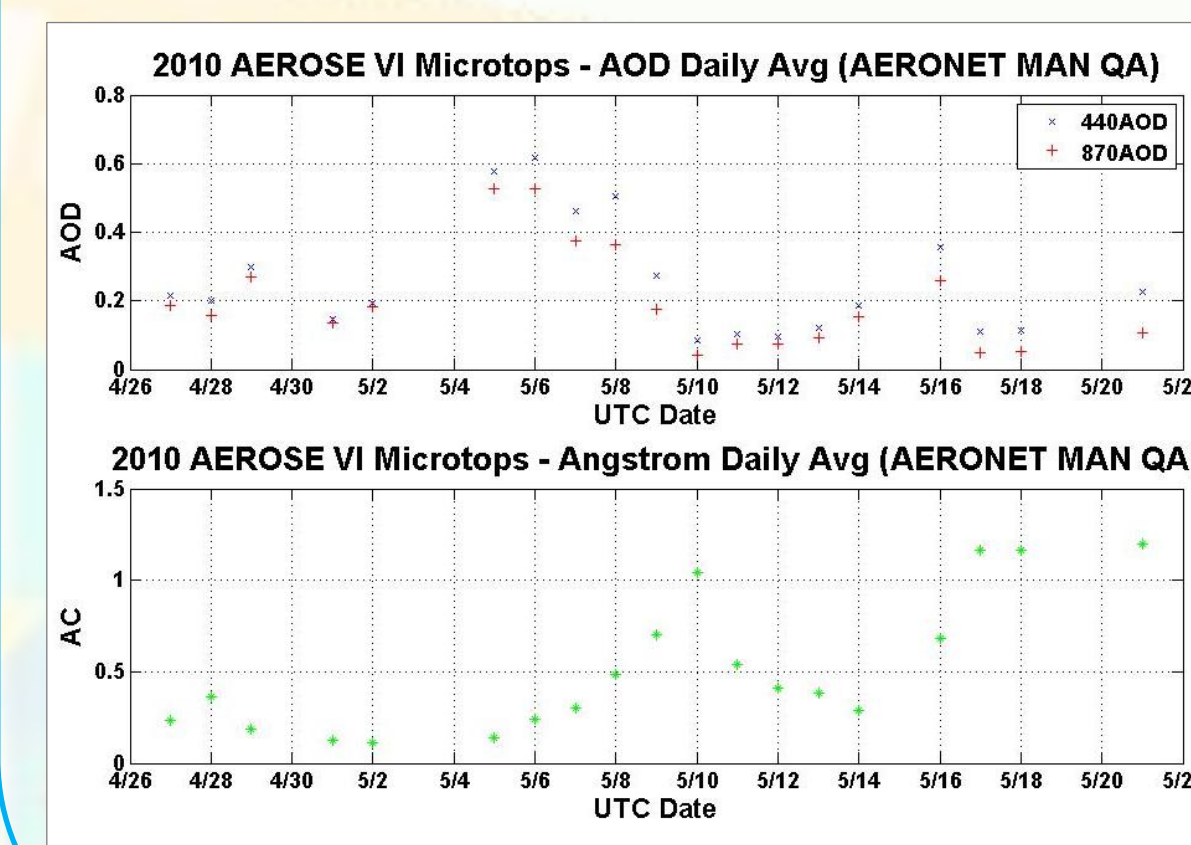
### Marine Atmospheric Emitted Radiance Interferometer (M-AERI)

- Ship-based **FTS** systems designed to sample downwelling and upwelling calibrated IR spectra near the surface (Minnett et al. 2001).
- High accuracy **calibration** is achieved using 2 **NIST-traceable blackbodies**.
- Derived products
  - High accuracy skin SST derived from semi-opaque spectral region (~7.7  $\mu m$ ) (Smith et al. 1996)
    - Skin SST is a state parameter necessary for forward calculations.
  - Continuous retrievals of lower tropospheric profiles at turbulent time scales (e.g., Szczodrak et al. 2007)
  - Retrieval of 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**.
- Ceiliometer** (basically a low power lidar) backscatter measurements provide information about aerosol vertical distributions
- Broadband pyranometers and pyrgeometers (downwelling LW and SW Fluxes)
- In situ* gas & particle measurements
- Ship meteorological and oceanographic measurements



## 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 2010 campaign added to the current data inventory from 2004, 2006–2009
- 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.
  - There are 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.
- 2010 AEROSE highlights** include
  - 2 zonal and 1 meridional cross-sections
  - Unique sampling of the Gulf of Guinea
  - Preliminary **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 intensive campaign data are being used for constructing **empirical marine proxy data for NPP CrIMSS EDR** and **GOES-R ABI pre-launch validation**.

## Future Work

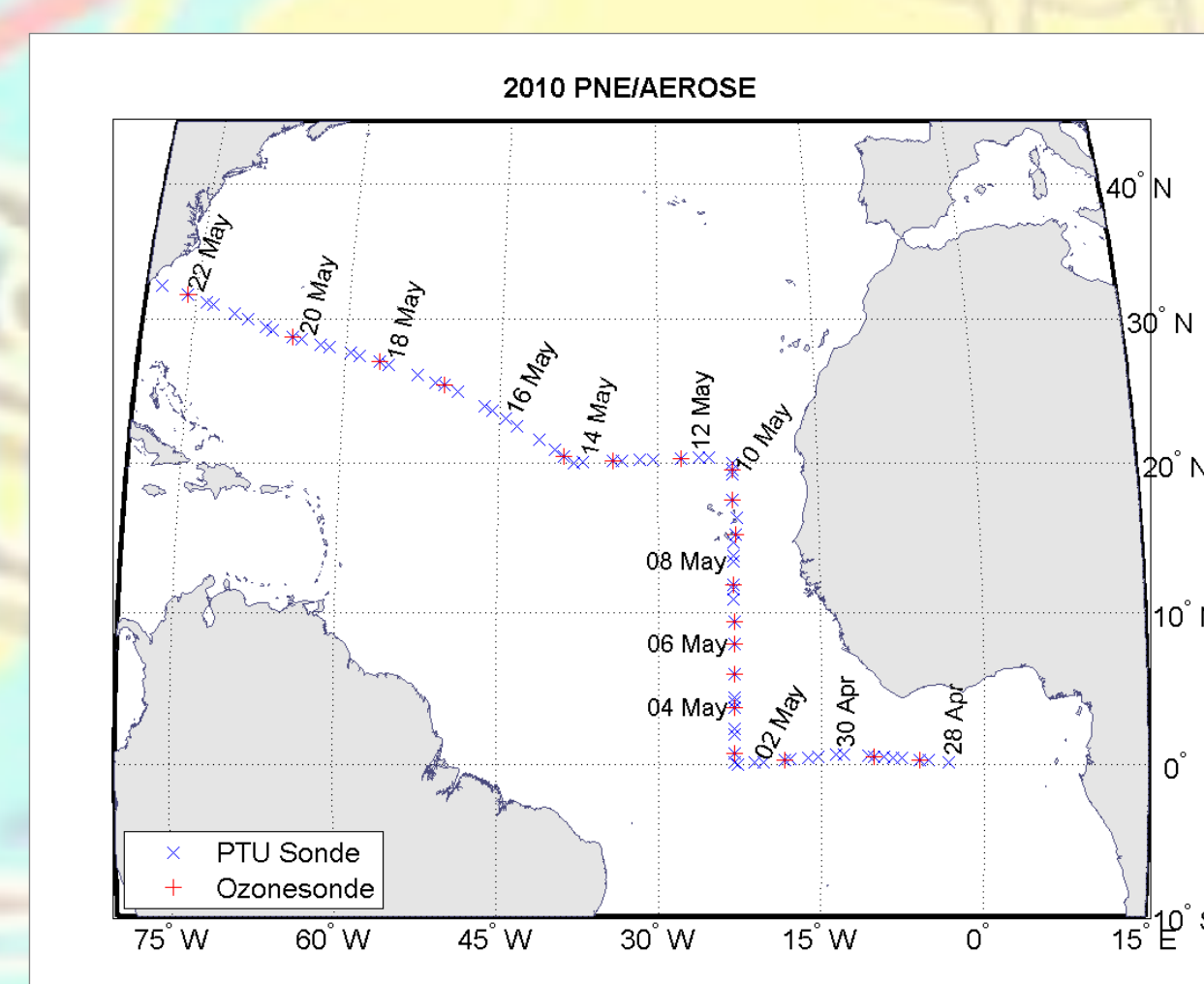
- Manuscript on PNE/AEROSE campaigns** (general overview with emphasis on meteorological highlights and sounder cal/val) in 2<sup>nd</sup> review for **BAMS** (Nalli et al.).
- Construct 2010 AEROSE CrIMSS Marine Proxy Data Set (w/ G. Guo, M. Divakarla, T. King).
  - AVTP, AVMP validation over open ocean, within and without Saharan air layer, dust, smoke
  - IP validation: vertical ozone profiles, skin SSTs
- Completion of 2010 AEROSE GOES-R Proxy Data Set, including SEVIRI, AIRS/IASI granules (w/ H. Xie, T. Zhu).
  - SEVIRI/GOES-R ABI legacy profile TPW validation and demonstration; SAL detection (w/ H. Xie, J. Li)
- Unfortunately, plans for the 2011 PNE/AEROSE have become less certain due to budget shortfalls leading to suboptimal rationing of sea time on the *Ron Brown*.

## 2010 Trans-Atlantic Cross-Sectional Analyses

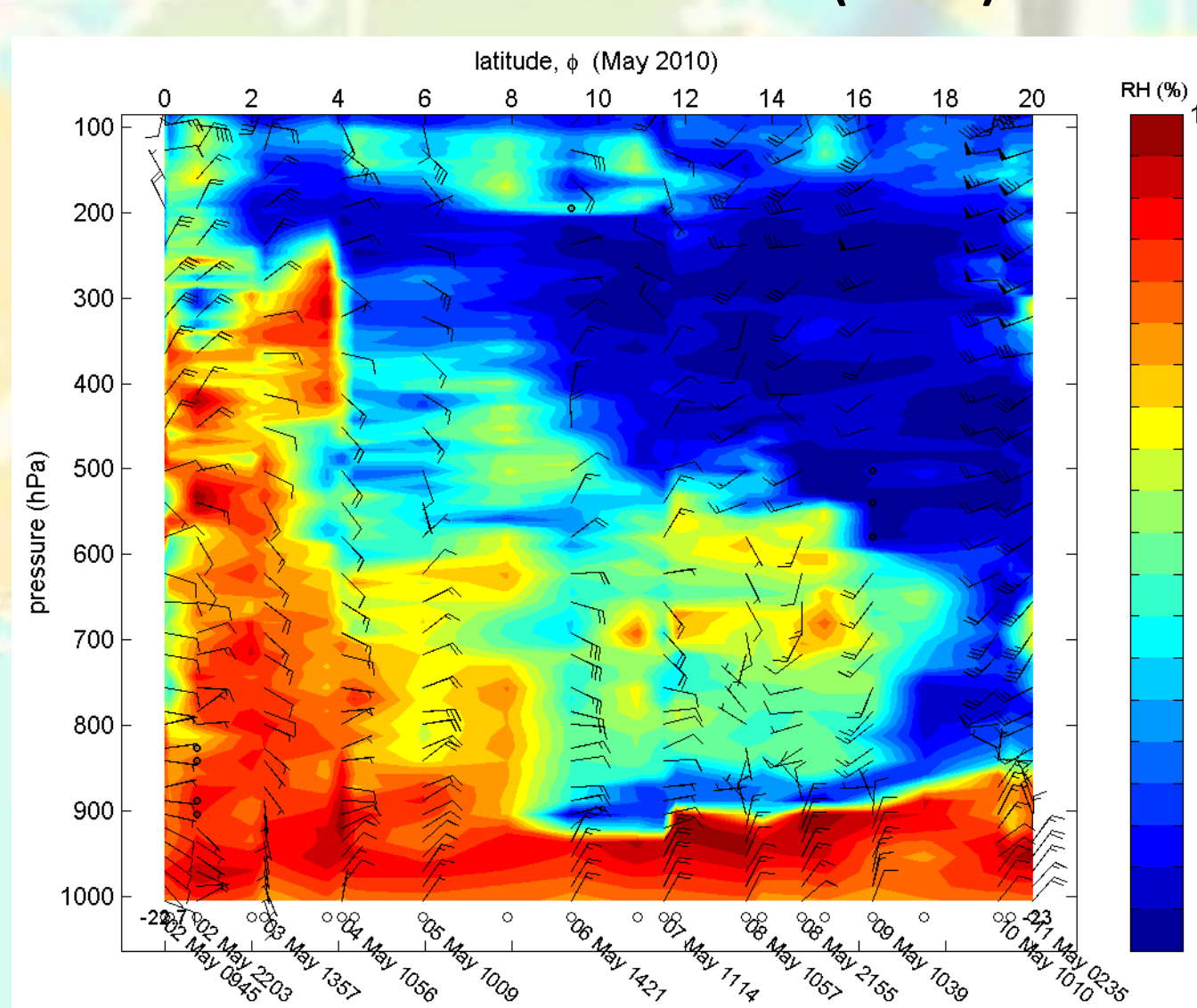
### AEROSE Proxy Dataset

- JPSS CrIMSS EDR Validation** (cf. Poster #633, Barnett, Nalli et al.)
  - AEROSE 2010 has been selected for a pre-launch phase test of deployment of **scientific validation campaigns** of opportunity, and to be used as a field campaign proxy dataset to be developed by NOAA/MIT/LaRC.
  - CrIMSS SDR proxy data** will be derived from IASI matchup granules (see figures) that have been obtained from the **NESDIS/STAR IASI Operational Product Processing System**.
  - 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
- The figures below show **trans-Atlantic RH and  $O_3$  cross-sections** obtained from RAOB (top row) alongside those obtained from STAR IASI retrieval matchups (bottom row), revealing the ability of hyperspectral IR sounders for observing meteorological features of interest as a qualitative validation demonstration.

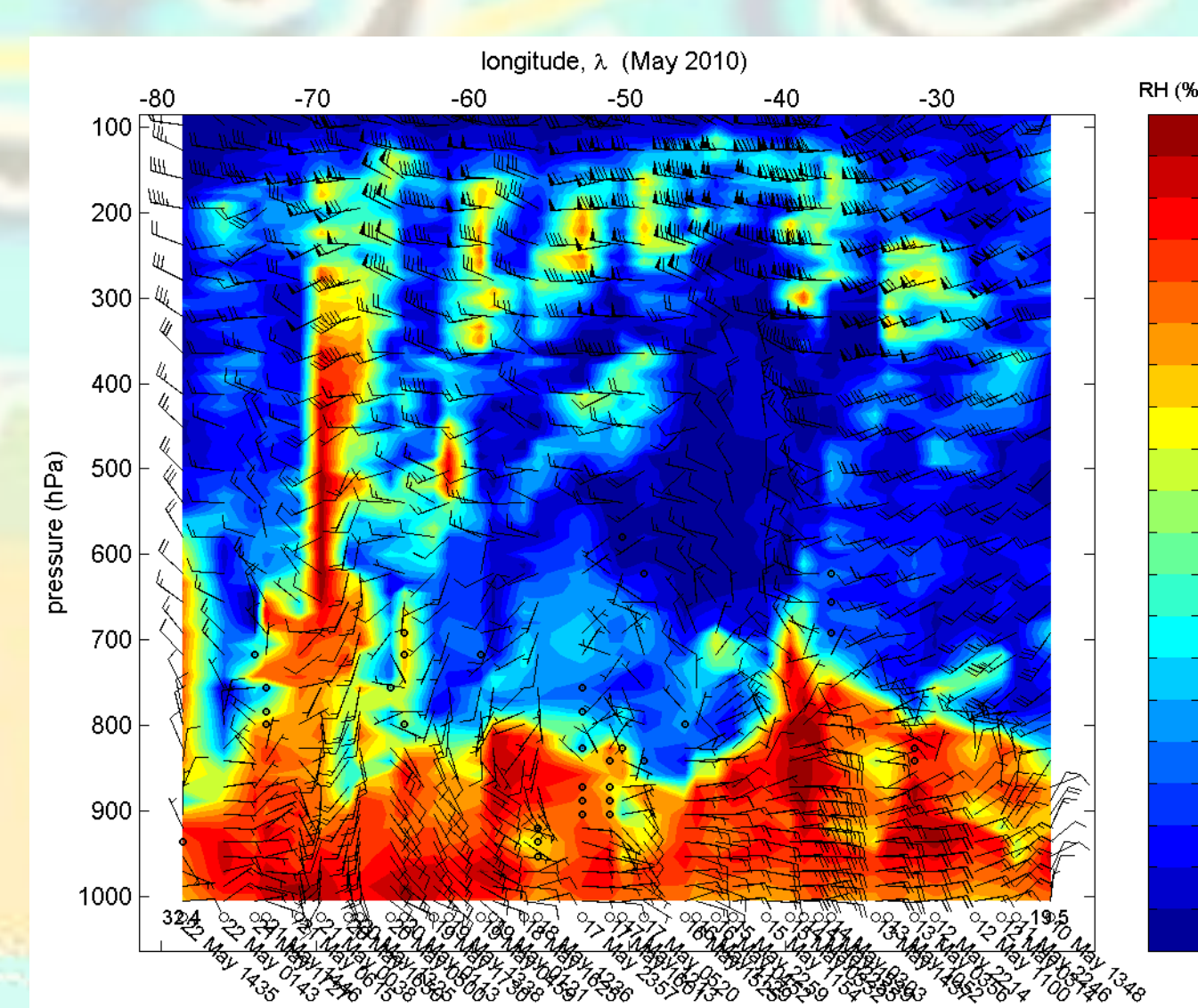
### RAOB Launches



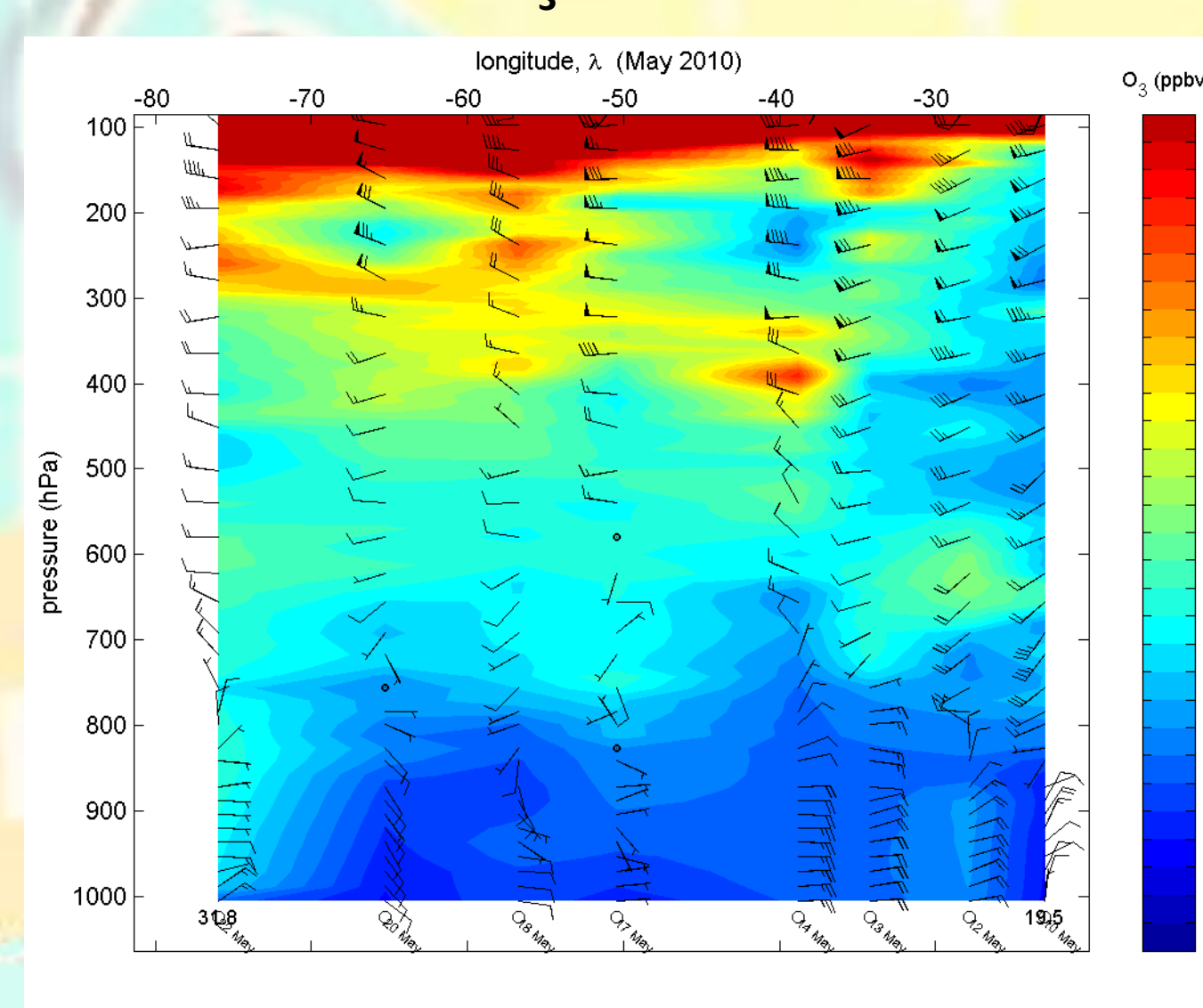
### RAOB RH – S-N Transect (23°W)



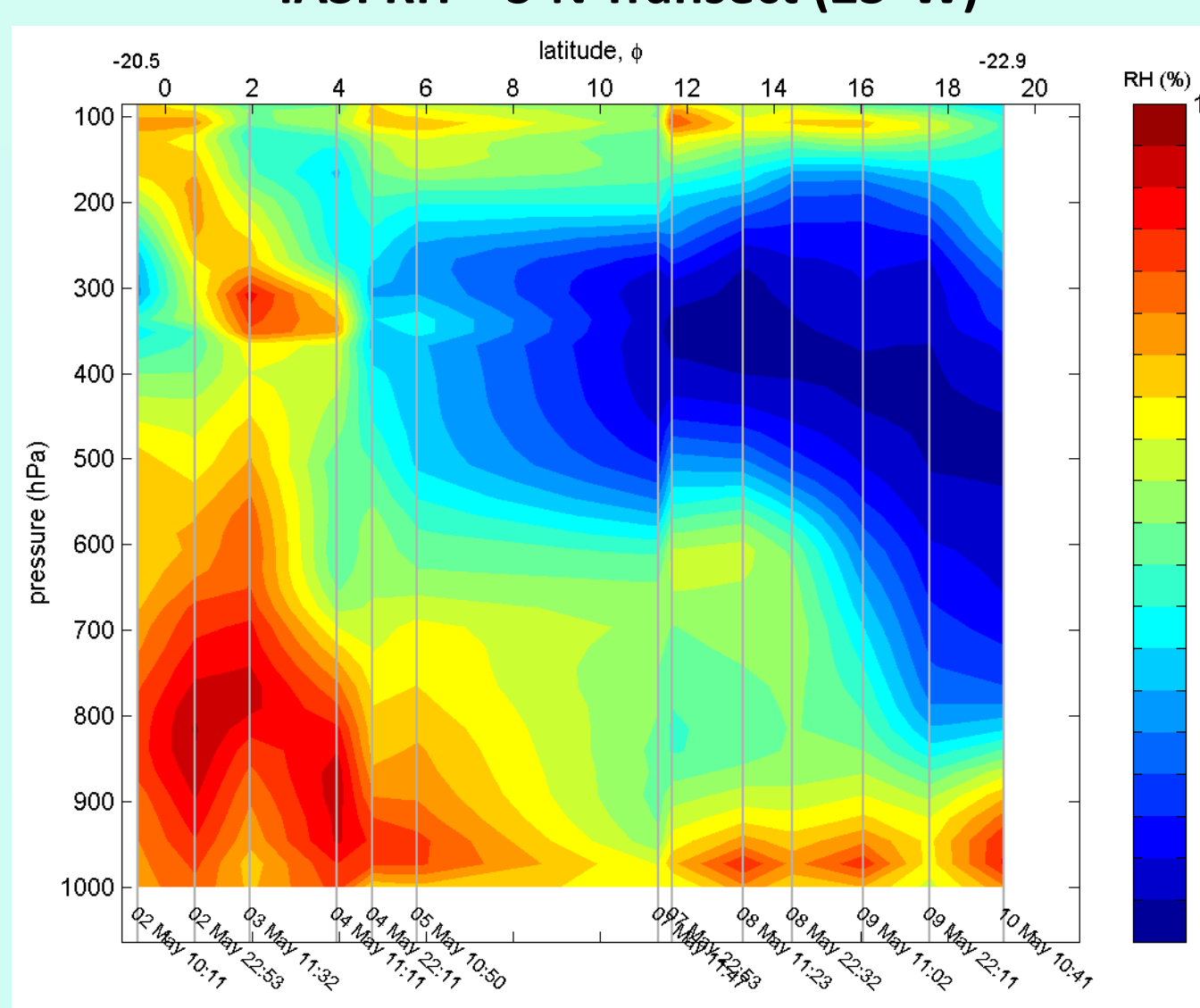
### RAOB RH – E-W Transect



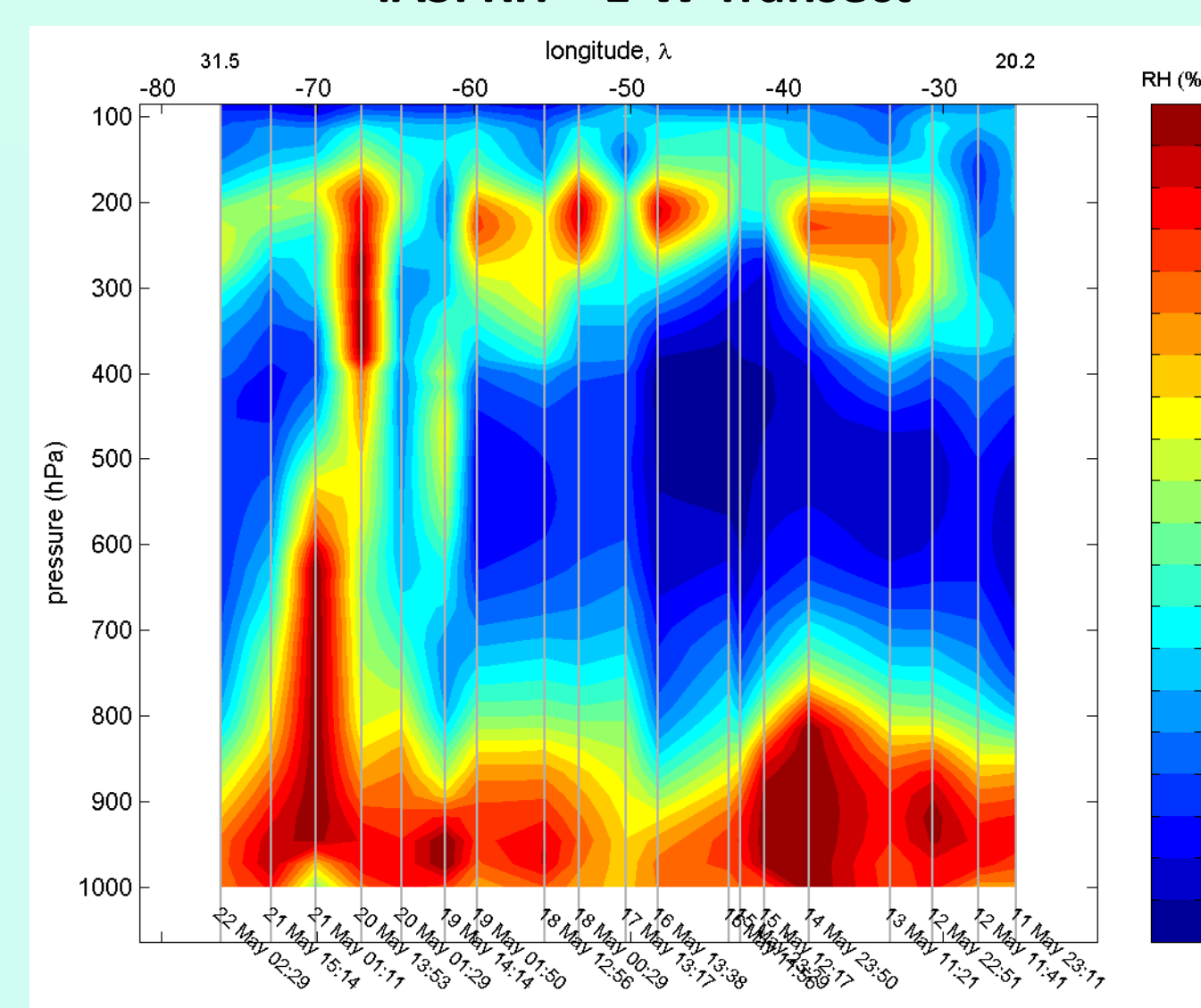
### RAOB $O_3$ – E-W Transect



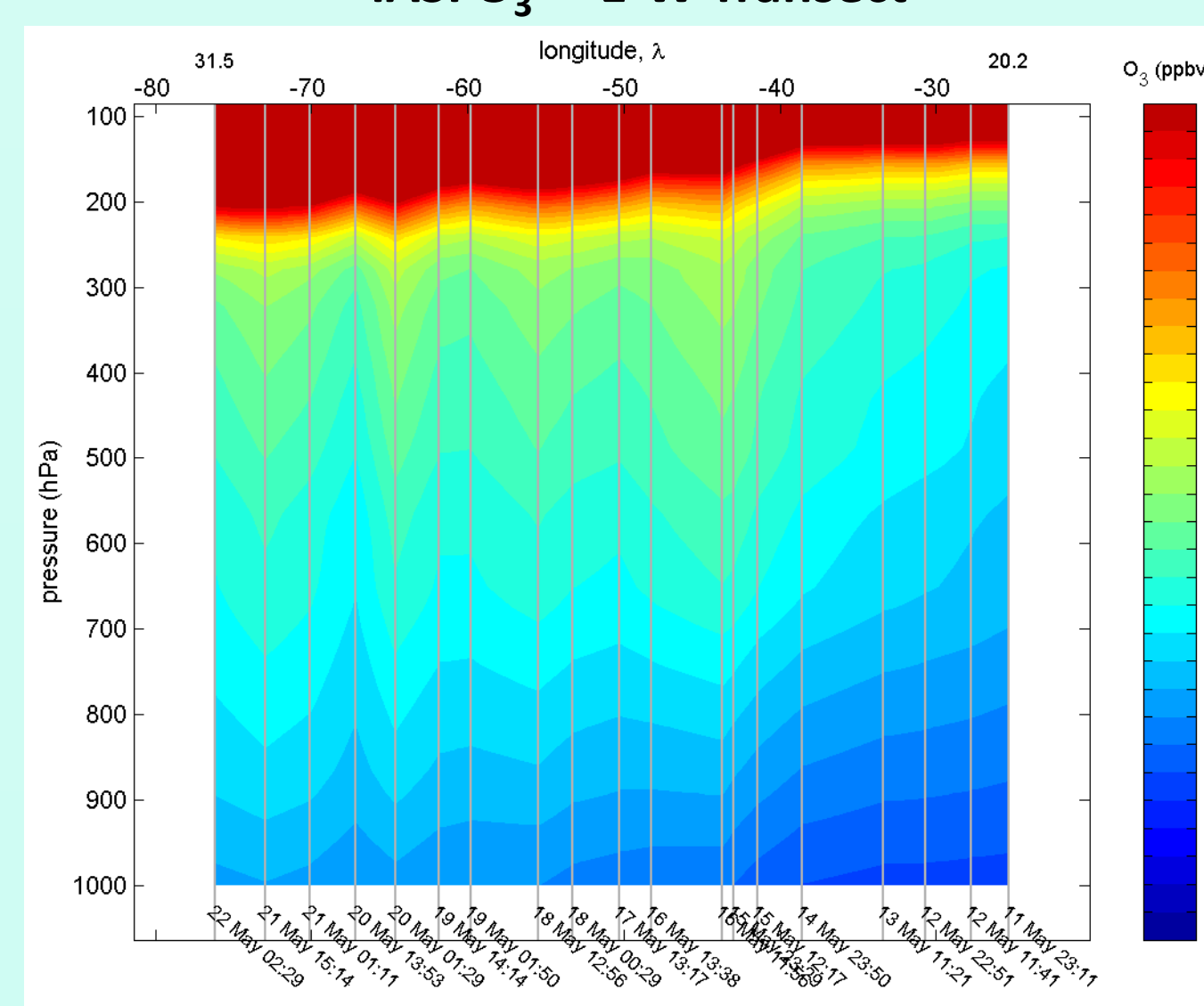
### IASI RH – S-N Transect (23°W)



### IASI RH – E-W Transect



### IASI $O_3$ – E-W Transect



## PNE/AEROSE Collaboration

- 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.

NAME	INSTITUTION	COLLABORATION
N. Nalli, C. Barnett, H. Xie, T. King, G. Guo, M. Divakarla, T. Reale, J. Wei, W. Wolf, M. Goldberg, et al.	NOAA/NESDIS/STAR	RS92 Rawinsondes; CrIMSS/GOES-R Proxy Data and Pre-launch EDR Validation; NPRODS
E. Joseph, V. Morris	HU/NCAS	Aerosols; Chemistry; Radiation Budget; Ozonsondes; Helium
R. Lumpkin, C. Schmid	NOAA/AOML	PNE Chief Scientists; TAG Moorings; CTD, XBTs
P. Minnett, M. Szczodrak, M. Izaguirre	UM/RSMAS	M-AERI Measurements; MW Radiometer; All-sky camera
D. Wolfe, B. Otto	NOAA/OAR/ESRL/PSD (formerly NOAA/ETL)	Vaisala sounding system; Surface Flux Measurements; C-Band Radar; Wind Profiler; Sea Space Satellite Uplink
T. Pagano, E. Fetzer, AIRS Science Team, W. Feltz, R. Knutson	JPL, AIRS Science Team, UW/CISS	AIRS/IASI validation rawinsonde support (07-08); AIRS validation rawinsonde support (04, 06)

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- The **NOAA GOES-R Algorithm Working Group** (M. D. Goldberg)
- The **PIRATA Northeast Extension Project**; R. Lumpkin and C. Schmid (NOAA/AOML)
- W. W. Wolf, T. King** and P. Clemente-Colón (NOAA/NESDIS/STAR)
- T. Pagano** (JPL) and the **AIRS Science Team**
- M. Szczodrak** and M. Izaguirre (UM/RSMAS); E. Roper (Lincoln Univ.)
- The many students**, who participated in, and contributed to, the success in the campaigns, especially **A. Flores, C. Stearns, M. Oyola**
- 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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