**Saharan Dust Observations Over the Tropical North Atlantic during the 2004 Aerosol and Ocean Science Expedition (AEROSE)**

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**AEROSE 2004 Overview**

- **Principle:** AVHRR IR channels do not provide information to correct for both water vapor and aerosol. Therefore, ancillary aerosol information is used to provide bias-correction.

- **Predictor:** Slant Path AOD

- **SST Error Due to Aerosol** is expressed as:

  \[ \theta = \theta_t + \delta \]

  where coefficients \( \delta \) are determined from global training data samples.

- **Aerosol-Corrected SST** is given by:

  \[ \theta = \theta_t + \delta \tau \]

  where \( \tau \) is the MCSST retrieval.

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**The “Problem” of Atmospheric Aerosol**

- **Example:** AVHRR sea surface temperature (SST) bias

  - **Principle:** Aerosol effects on AVHRR are known to be complex and dependent on aerosol type, size, and optical properties.
  - **Predictor:** Slant Path AOD
  - **SST Error Due to Aerosol** is expressed as:

    \[ \theta = \theta_t + \delta \]

    where coefficients \( \delta \) are determined from global training data samples.

  - **Aerosol-Corrected SST** is given by:

    \[ \theta = \theta_t + \delta \tau \]

    where \( \tau \) is the MCSST retrieval.

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**NOAA-14 Dust Correction – July 1998/99**

- **Principle:** NOAA-14 dust correction is designed to improve AVHRR SST retrieval accuracy over aerosol-rich regions.

- **Predictor:** Slant Path AOD

- **SST Error Due to Aerosol** is expressed as:

  \[ \theta = \theta_t + \delta \]

  where coefficients \( \delta \) are determined from global training data samples.

- **Aerosol-Corrected SST** is given by:

  \[ \theta = \theta_t + \delta \tau \]

  where \( \tau \) is the MCSST retrieval.
AEROSE Data Supporting Satellite Remote Sensing and Cal/Val

- Marine Atmospheric Emitted Radiance Interferometer (MAERI)
  - Shipboard FTS designed to sample atmospheric and surface IR emissions
  - Al timewise derive skin SST (<0.1 K), emissivity and BL profiles
- Calibrated In situ Measurement System (CIRIMS)
  - Reduced complexity & cost; autonomous
  - Designed solely for providing accurate radiometric SST ground truth
- Vaisala RS80/90 RAOBs
  - ~3 Hourly throughout cruise, including AIRS overpasses
- Microtops handheld sunphotometer
  - Surface based measurements of aerosol optical depth (AOD)
- Oceanographic/meteorological surface data

MAERI and CIRIMS during AEROSE

SST Ground Truth for Cal/Val

- IR and MW detectors remotely sense radiometric skin temperature
- Skin SST differs from bulk SST measured in situ (e.g., buoys ~ -0.1 ±1 K)
- This uncertainty imposes significant limits upon satellite cal/val efforts – radiometric ground truth is essential
- MAERI and CIRIMS are examples of shipboard instruments capable of obtaining accurate radiometric SST

AEROSE MAERI versus CIRIMS

- MAERI and CIRIMS are two distinctly different IR sensors with different algorithms
- During AEROSE, sustained Trade winds yielded a skin SST systematically cooler than the 2 m in situ measurement
- There were some systematic differences between CIRIMS and MAERI; the cause is under investigation
7 Mar 04 Dust Event at NOAA's RHB

17:00 UTC, 6 March 04
11:00 UTC, 7 March 04

7 Mar 04 Dust Event from AIRS

Dust Event IR Spectra

AEROSE 3-Hourly RAOBs (Leg 1)
Conclusions and Future Work

- Aerosols are known to be a source of systematic error in standard IR satellite retrieval algorithms.
- Data collected during AEROSE will facilitate satellite Cal/Val efforts and allow empirical studies of dust aerosol radiometric properties.
- A follow-up expedition (AEROSE II) is being sought for 2005 during the month of July. The data compliment would be optimized by including LIDAR and O3 sondes.

Acknowledgements

- R. Knuteson & W. Feltz (UW-Madison) for funding sondes during AIRS Aqua overpasses.
- Personnel supporting 3-hourly, 24-7 sonde operations throughout cruise:
  - Students (Anna, Veronica, Ahira, Lizette, Michelle, Francis)
  - E. Joseph (HU), R. Armstrong & Y. Detres (UPRM)
  - Jonathan Shanohoff (NOAA Survey Team) for providing instruction and guidance on conducting sonde ops.
- Entire NOAA Ronald H. Brown Crew.