On Surface fluxes and Clouds/Precipitation in the Tropical Eastern Atlantic

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with contributions from Peter Minnett & Erica Key

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- flux tower
- scanning Doppler 5-cm precipitation radar
- cloud radar
- micropulse lidar

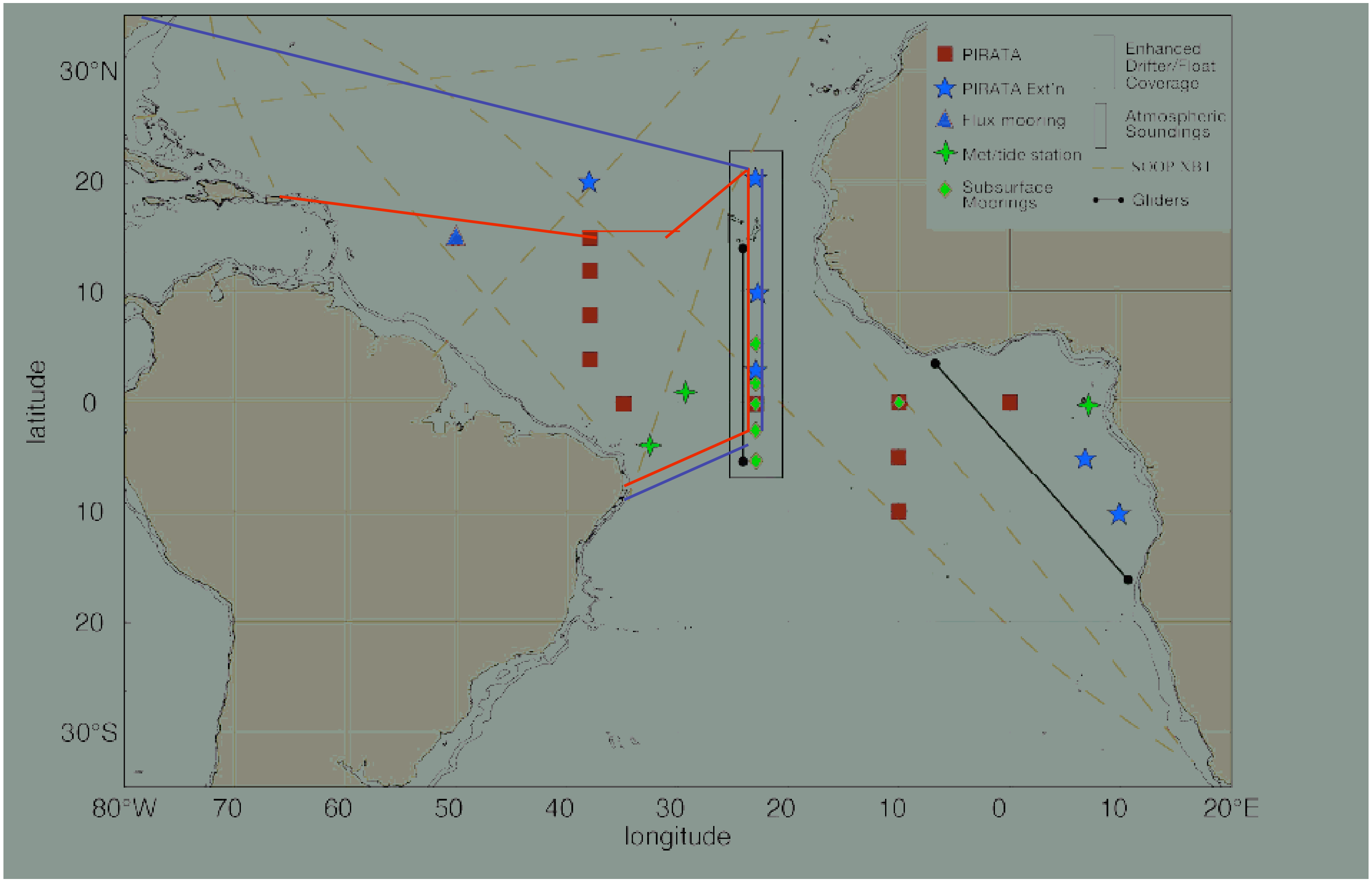
Roles:

1. Downstream observation
2. Ocean/climate monitoring
3. Aerosol&cloud radiation

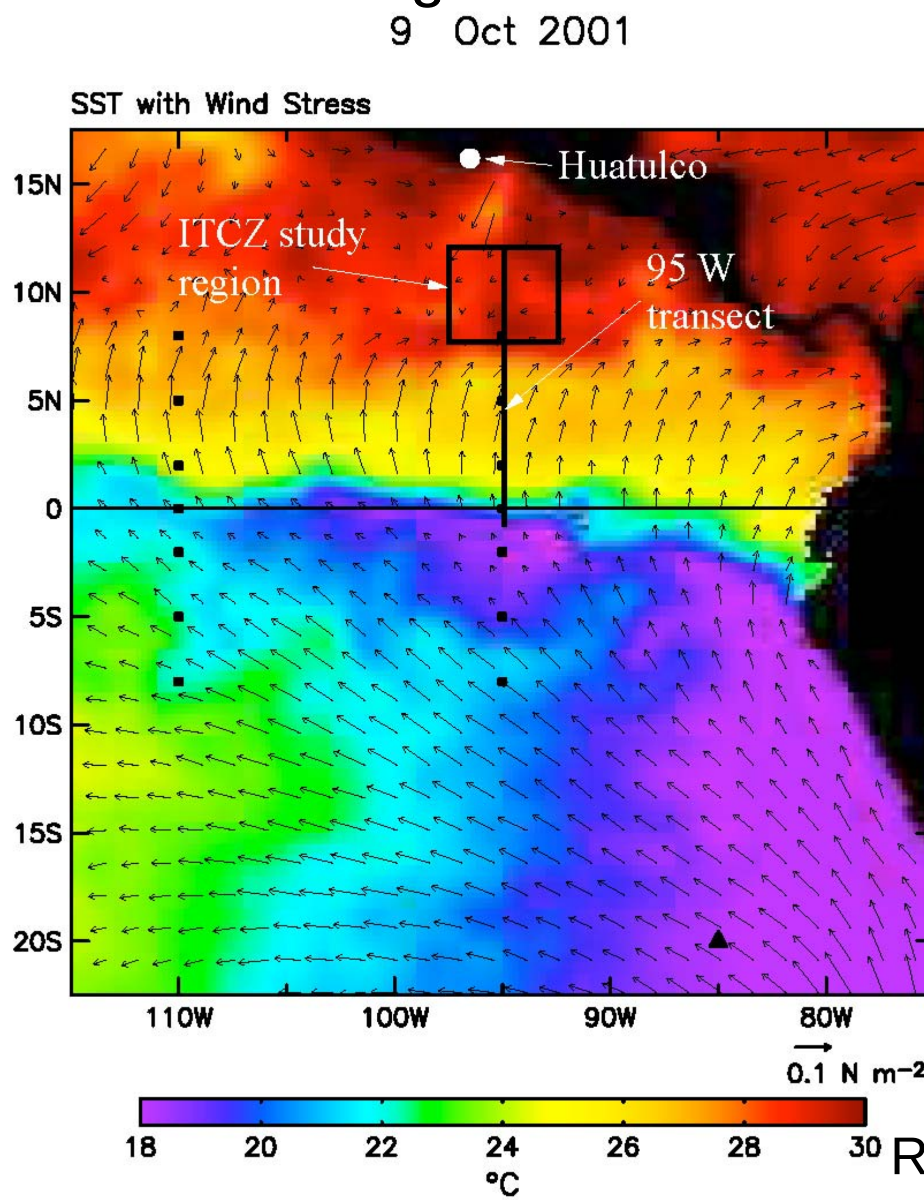
1st leg; 5/23 - 6/18

2nd leg; 6/22 - 7/16

Two 20N-5S transects at 23 W, ~ 2 weeks each



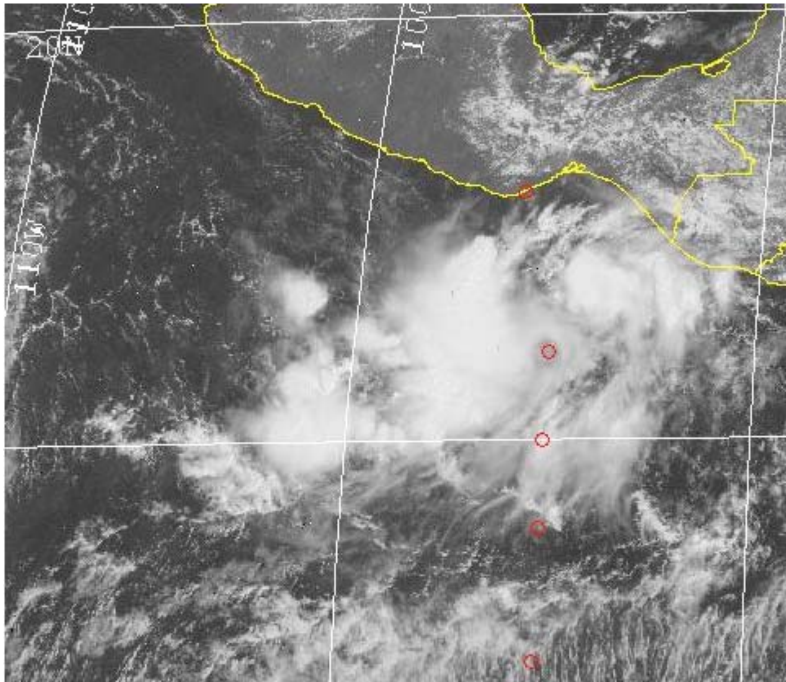
Eastern Pacific Investigation of Climate: Sept. 2001



SST + QuikSCAT winds

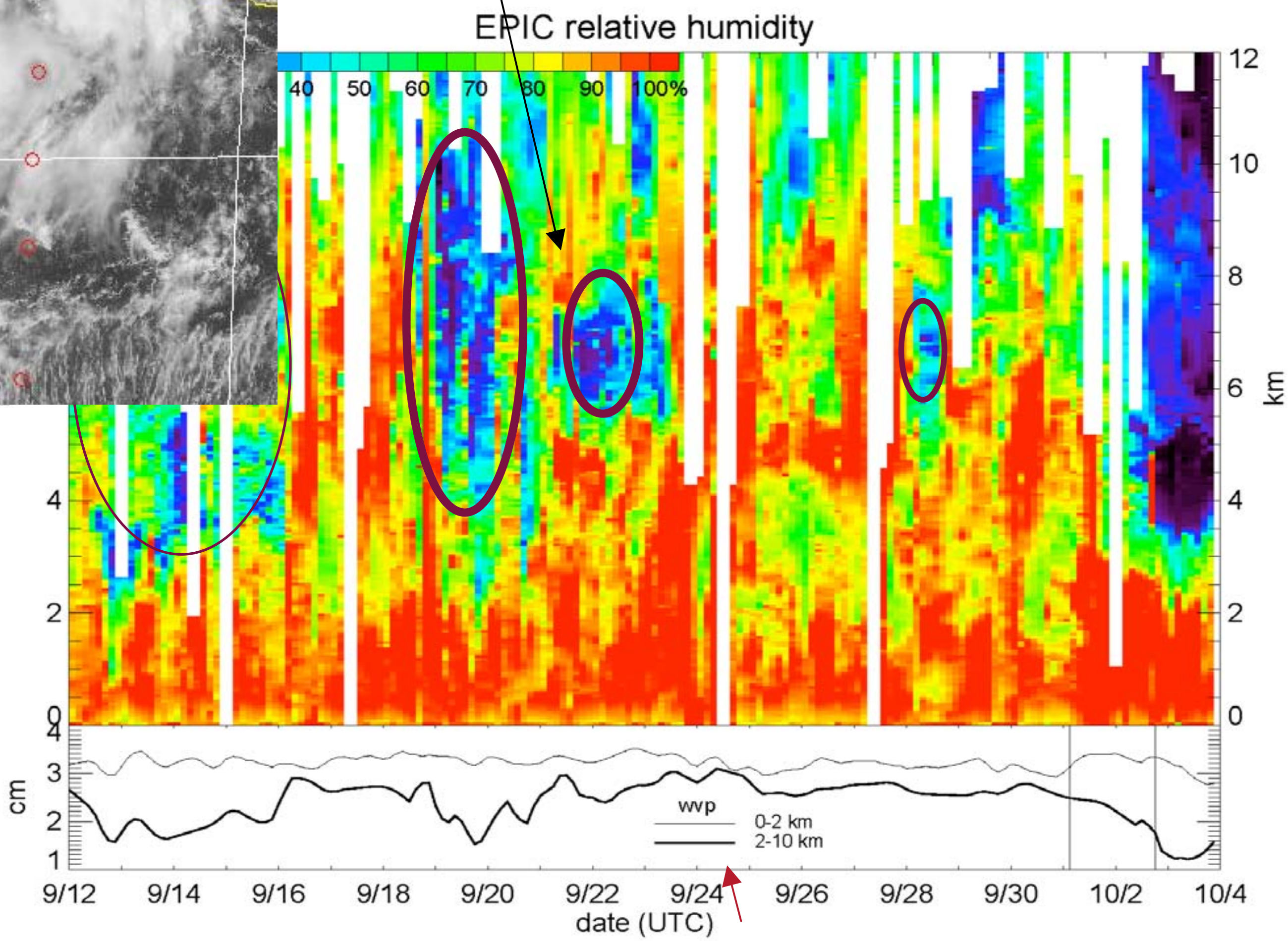
Raymond et al., 2004

Sept. 21



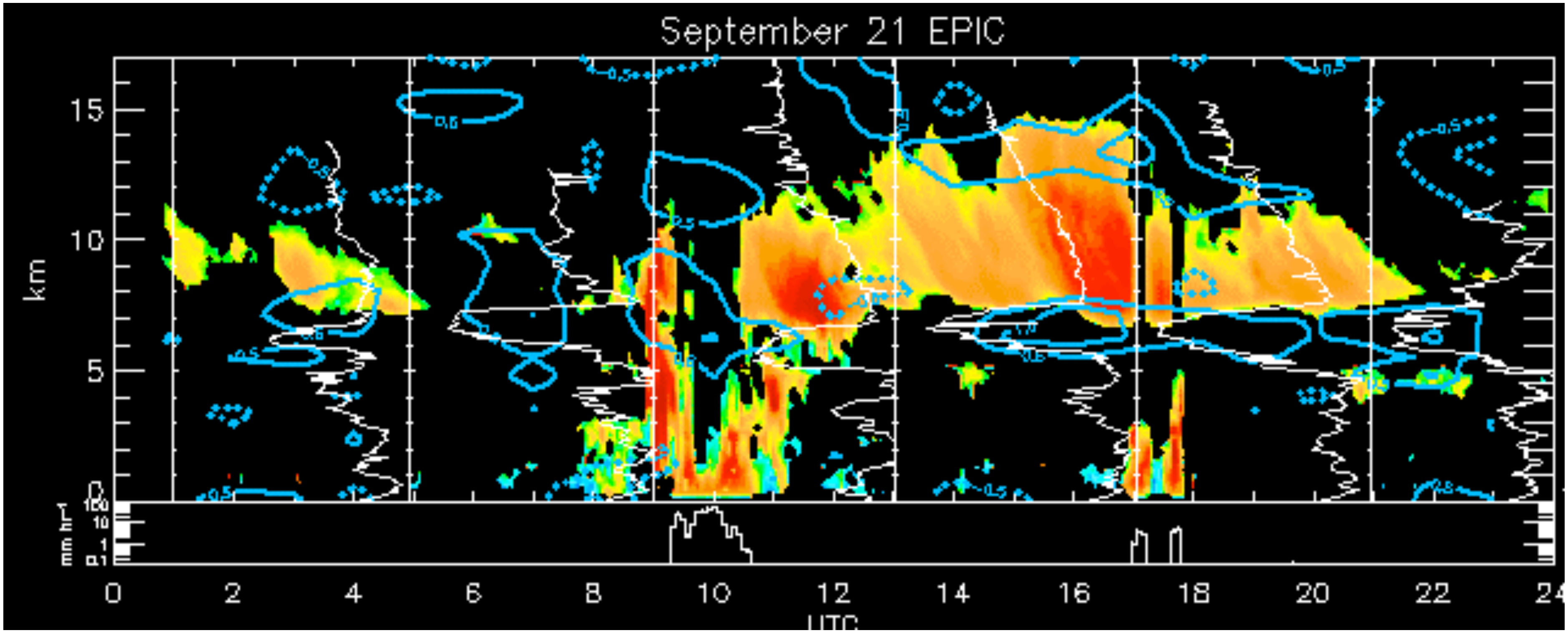
Time series of sonde RH at 95W, 10N

TS Juliette



cloud radar reflectivity

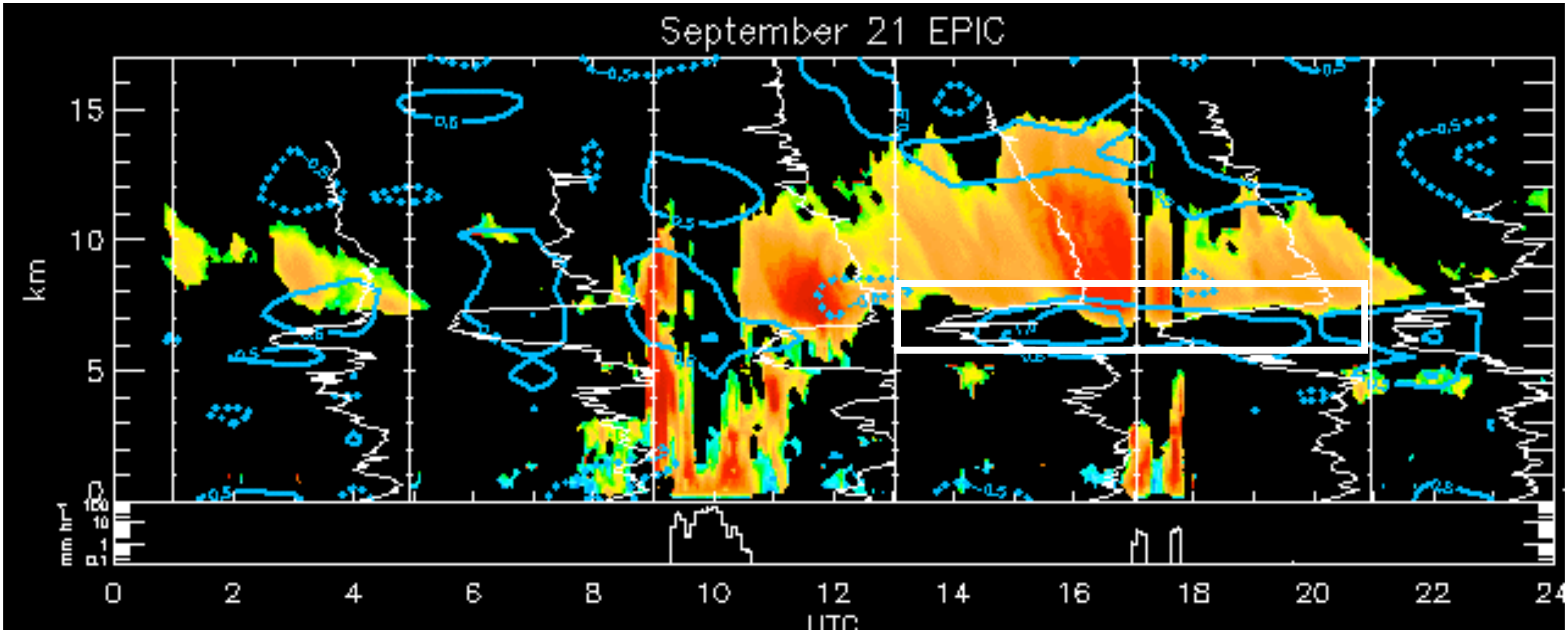
precipitation radar divergences (Mapes & Lin, 2005)



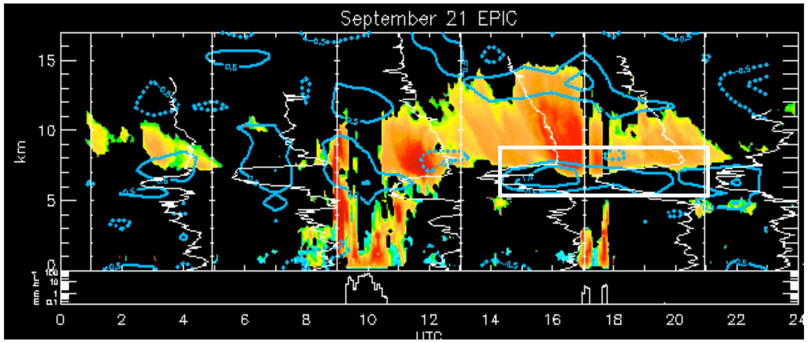
surface rainfall

cloud radar reflectivity

precipitation radar divergences (Mapes & Lin, 2005)



surface rainfall



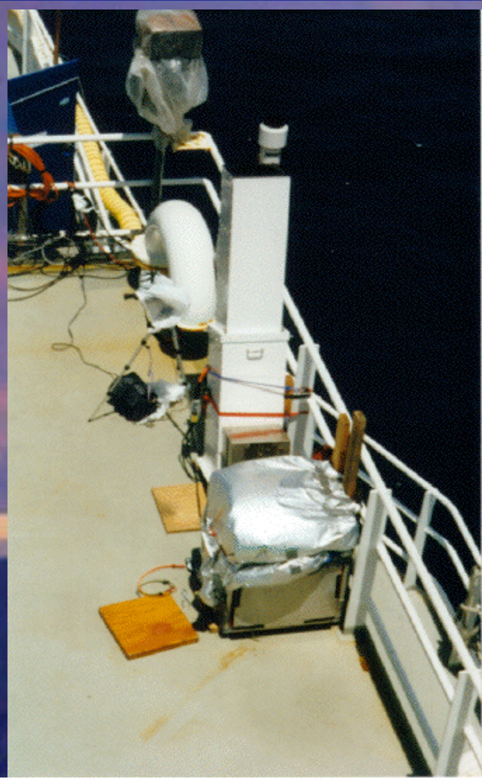
• able to quantitatively relate precipitation-radar inferred divergence to the sublimation of snowing ice inferred from cloud radar

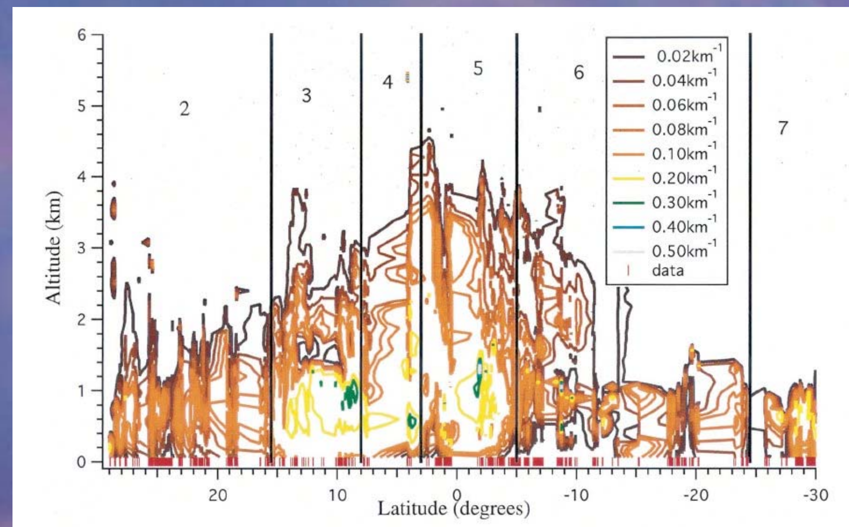
• thermal impact upon surface-based convection is a positive feedback, may enhance cirrus cloud lifetime

• similar data integration could prove useful to AMMA objectives

Micropulse LIDAR

- $\lambda = 0.523 \mu m$
- Eye-safe LIDAR to measure aerosol vertical structure (75m resolution).





Lidar-derived extinction coefficients along the cruise track of the *Ronald H Brown* during *Aerosol99*

From Voss, K. J., E. J. Welton, P. K. Quinn, J. Johnson, A. M. Thompson, and H. R. Gordon, 2001: Lidar measurements during Aerosols99. Journal of Geophysical Research, 106, 20821-20832. doi: 10.1029/2001JD900217.

RSMAS

*Spring and Fall cruises (99-02)

*Fall Tao and WHOI stratocumulus (03 on)

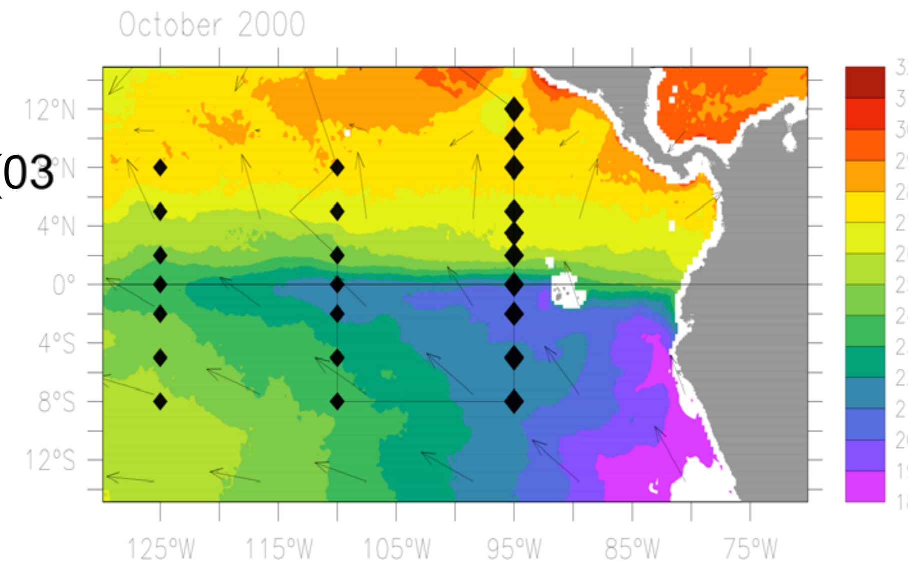
*Buoy data quality assurance

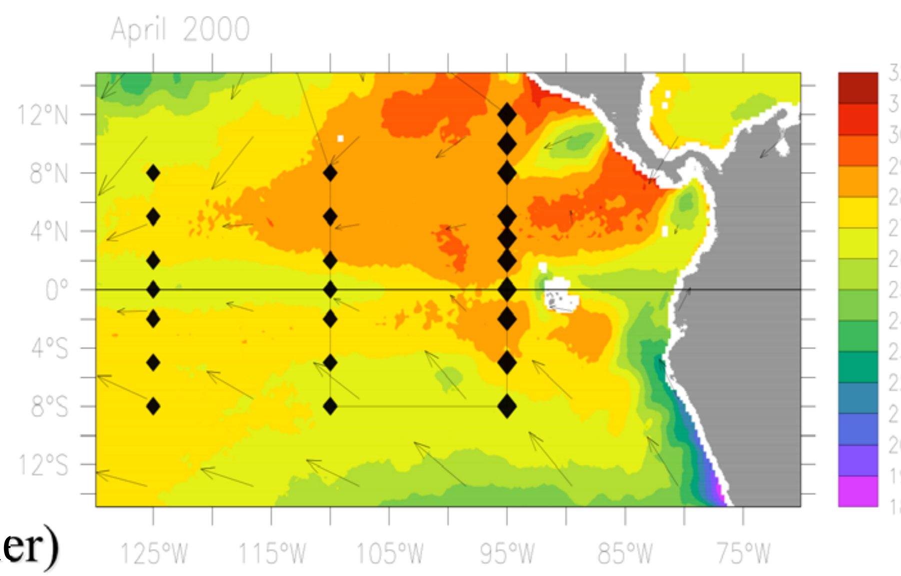
*Direct/more comprehensive data

*Comparisons satellite, NWP

*Fluxes and Cloud/PBL processes

*’Bootstrap’ buoy data

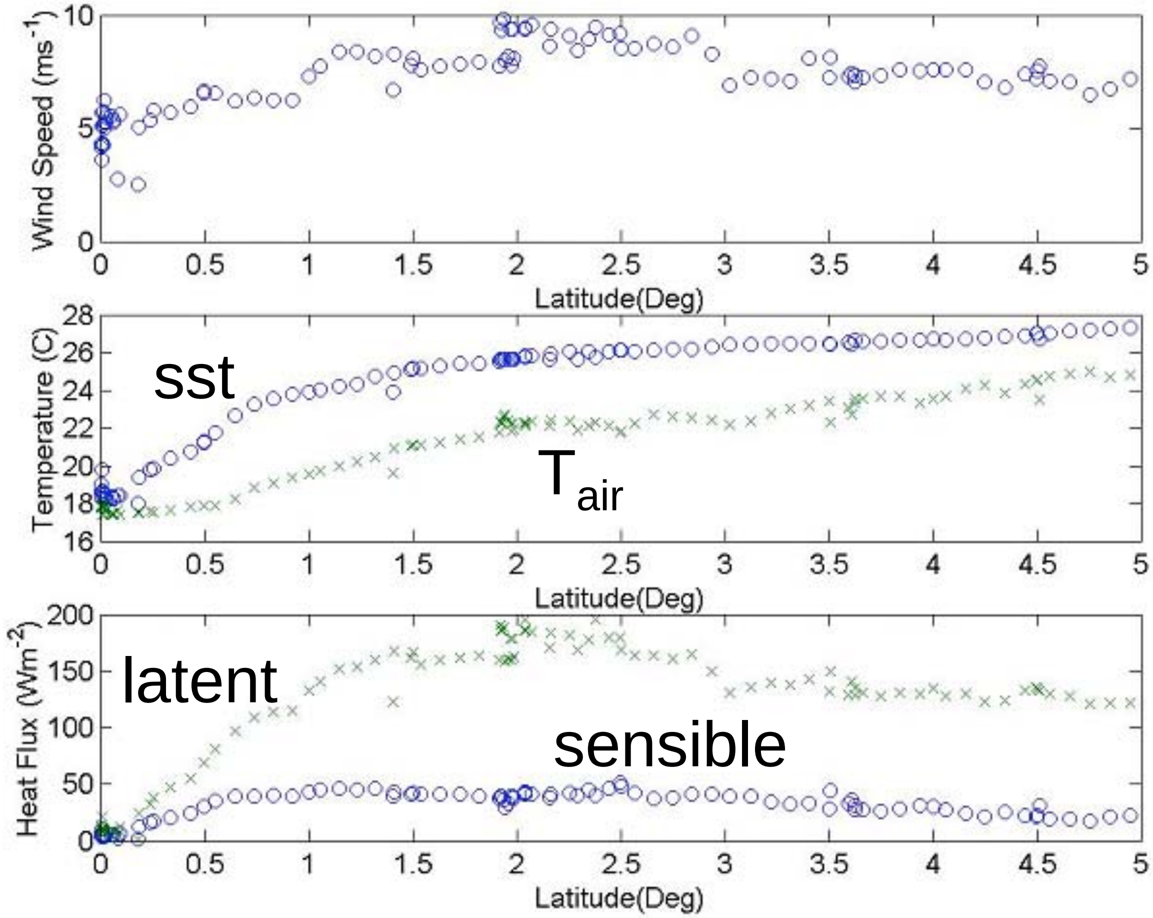




Measurements:

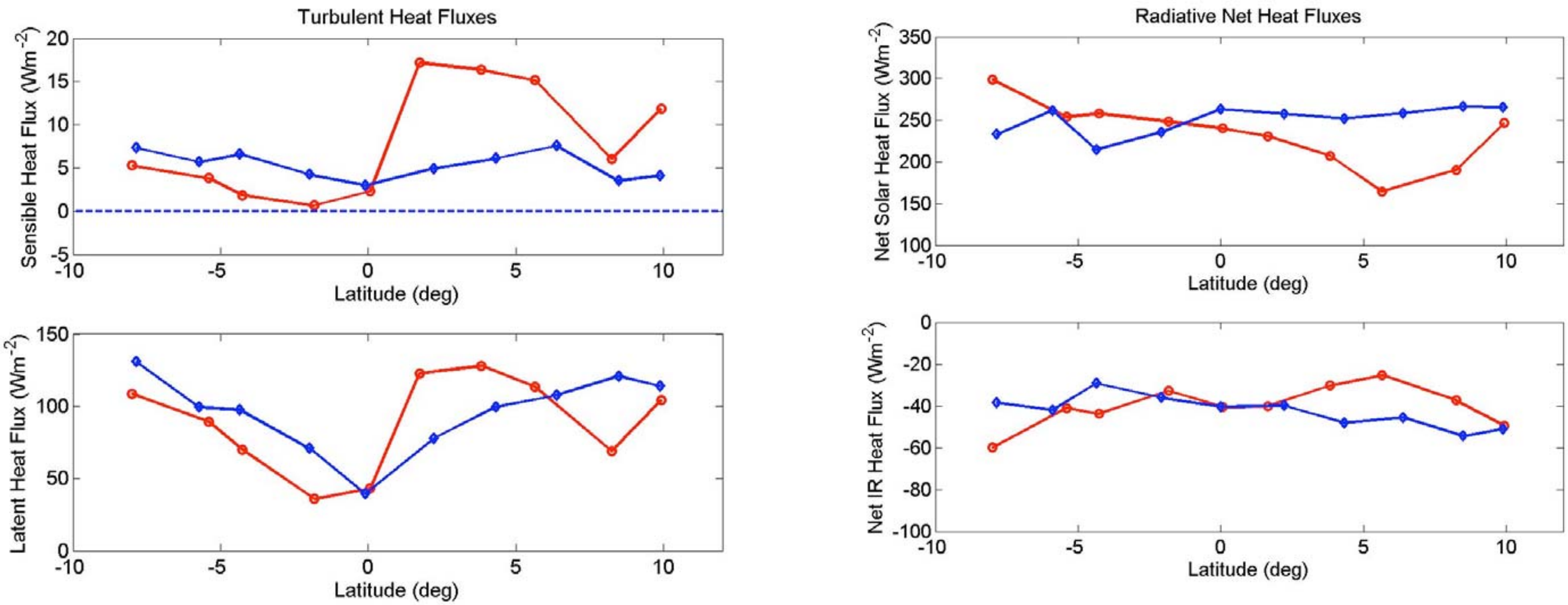
- Near-surface bulk meteorology
- Direct radiative fluxes
- Direct turbulent fluxes
- Basic profiles (sondes, wind profiler)
- Basic cloud (base ht, fraction, LWP)

Eastern Pacific cold tongue + ITCZ, transect @95W



SST gradient max @ ~0.5N, winds, latent heat flux max @ 2 N

Surface Energy Fluxes

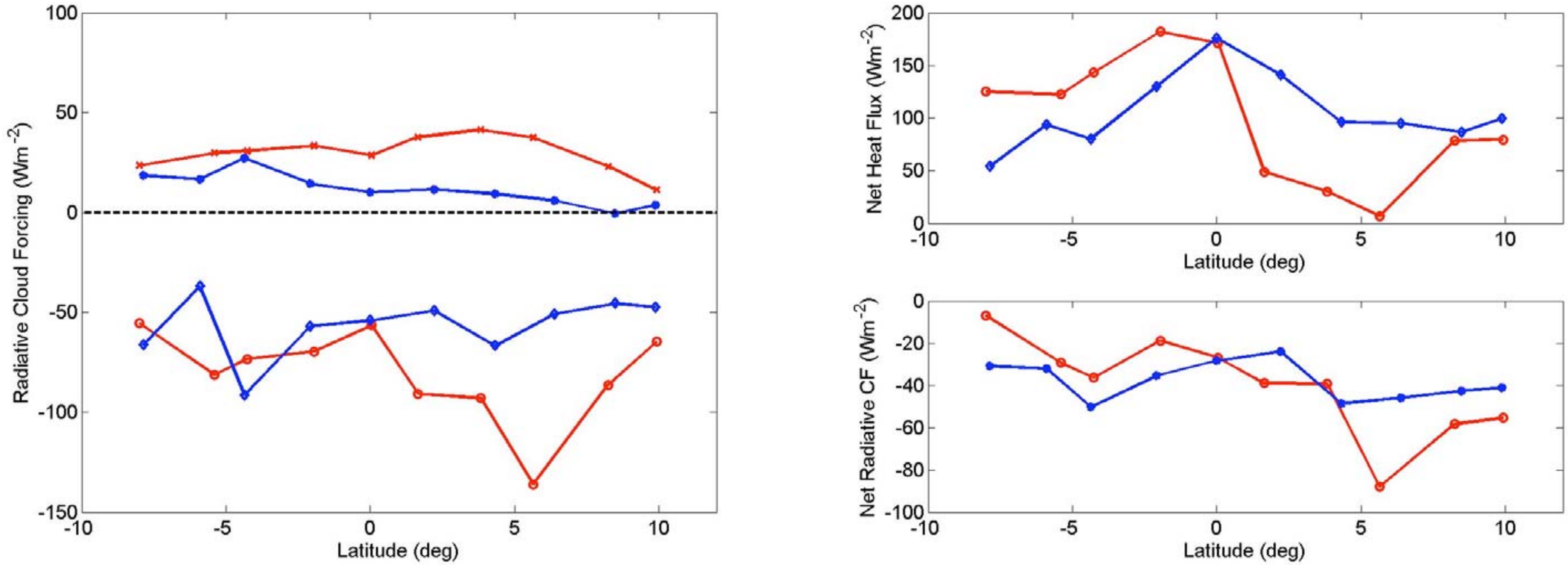


Average surface energy fluxes for spring (blue) and fall (red) cruises: left panel is sensible and latent heat flux; right panel is net solar and net IR radiative fluxes.

Cloud Radiative Forcing and Net Heat Fluxes

Cloud Forcing = Mean Measured Radiative Flux – Mean Clear Sky Radiative Flux.

Thus, cloud forcing is the net effect the cloud have on the surface radiative fluxes. For IR flux it is positive (clouds warm the surface) while for solar flux it is negative (clouds cool the surface).

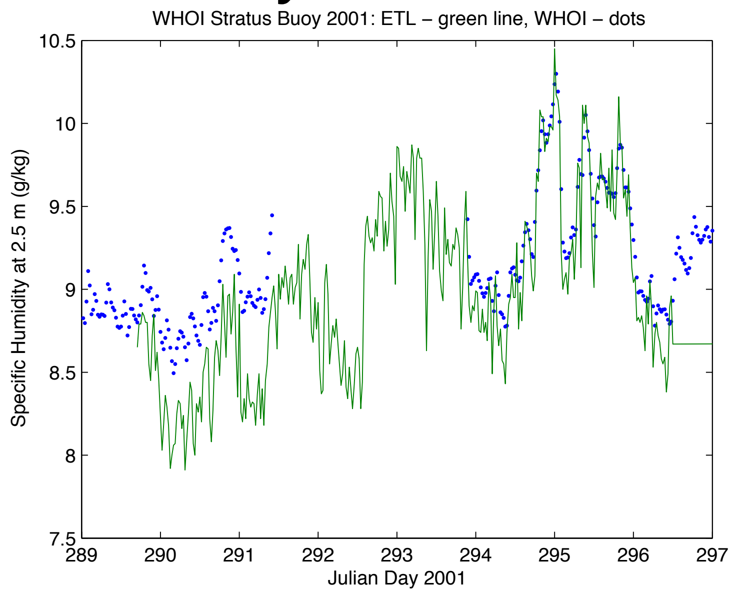


Average surface heat fluxes for the 7 cruises (blue=fall; red=spring). The left panel is for the IR cloud forcing (upper) and solar cloud forcing (lower). The right panel shows the net surface heat flux (upper) and the cloud forcing contribution to that flux (lower)

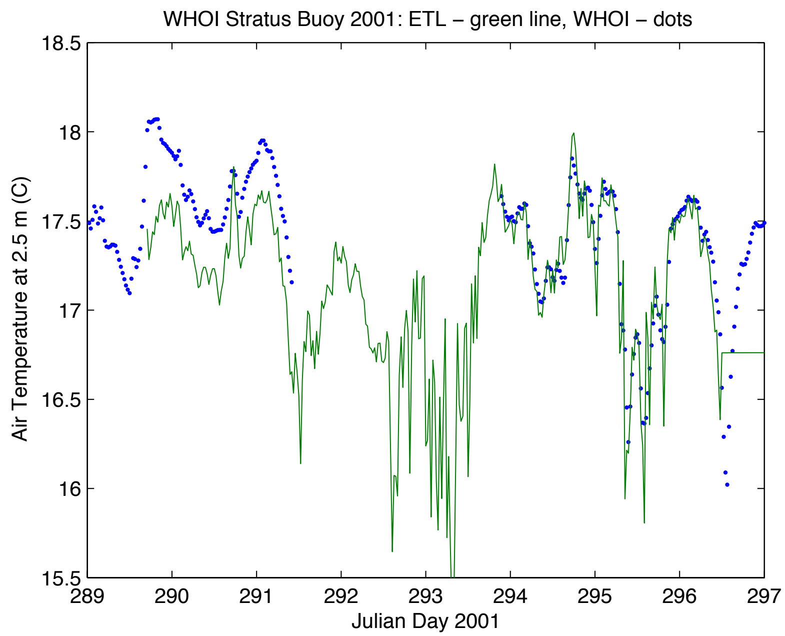
Buoy-ship intercomparison

Blue - buoy
Green - ship

Specific humidity



air temperature



Ship-based measurements during AMMA by the University of Miami M-AERI group

Peter Minnett,
Erica Key (on *L'Atalante*)
& Goshka Szczodrak (on *Ronald H Brown*)
RSMAS
University of Miami

AMMA Team Meeting
Leeds, UK. April, 2006

Objectives

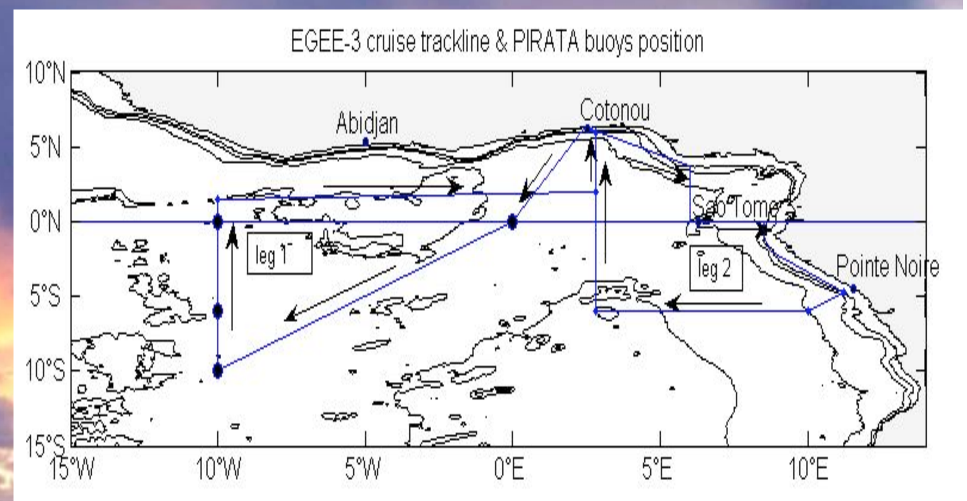
- To validate satellite measurements of the Sea-Surface Temperature in regions of strong aerosol loading; improve satellite retrieval algorithms (MODIS on *Terra* and MODIS, AMSR-E & AIRS on *Aqua*, AATSR on *Envisat*).
- To obtain data to validate satellite retrievals of atmospheric temperature and humidity profiles (AIRS on *Aqua,* TES on *Aura*).
- To study cloud and aerosol radiative forcing at the surface.
- To study effects of Saharan Air Layer (SAL) on the infrared radiation budget at the sea-surface.
- To provide data for the study of the role of the SAL on hurricane development (in conjunction with aircraft flights of the Hurricane Research Division of NOAA Atlantic Oceanographic and Atmospheric Laboratory).

RSMAS

L'Atalante

- EGEE 3 cruise
- Cotonou – Cotonou (May 23 – July 6).
- Instrumentation – critical subset of *Ronald H Brown*

Cruise track



What do we expect to learn during AMMA:

Downstream of Africa:

• improved characterization, understanding of SAL & convection interaction, water cycle

Ocean/climate variability:

• improved characterization of the equatorial-ITCZ gradient In air and ocean properties/fluxes

• leading to improved bulk parameterizations, understanding, particularly under deep convection

• improved utility of buoy & satellite observations