Aircraft Observations for ONR DRI and DYNAMO

(NOAA/ONR/NSF)

Coupled Air-sea processes:
Q. Wang, D. Khelif, L. Mahrt, S. Chen

Deep convection/MJO initiation:
Dave Jorgensen, S. Chen, R. Houze

Aerosol/Cloud Microphysics: D. Noone, C. Fairall

Status of Aircraft Request to NOAA

NOAA WP-3D

AIRCRAFT CHARACTERISTICS
Crew: 18-20
Cruise Speed: 300 Knots
Max Take off Weight: 135,000 lbs.
Service Ceiling: 27,000 Feet
Low Altitude Range: 2,500 Nautical Miles (4600 Km)
High Altitude Range: 3,600 Nautical Miles
Max Endurance: 11 Hours

Coupled Air-Sea Processes

To better understand the physics of air-sea coupling and improve physical parameterization of the air-sea coupled processes associated with MJO;

To obtain coincident measurements of the lower atmosphere, air-sea interface (fluxes and wave field), and the upper ocean (AXBTs) adequate for coupled model evaluation

Convective Processes

Pre-MJO moistening, environmental control of convection (e.g., surface fluxes, boundary layer structure, humidity, shear, etc.)

What can we do differently from COARE?
Concurrent Measurements With New Capabilities

The middle atmosphere (dropsondes, aircraft soundings, airborne radar)

The atmospheric boundary layer (aircraft soundings and stacks of level legs)

The turbulence fluxes at the interface (flux mapping)

The surface wind (SFMR)

Surface wave characteristics (scanning lidar)

The ocean mixed layer structure (AXBT)

Required Aircraft Measurements

- Mean and turbulent 3-D wind fully corrected for aircraft motion
- Mean and turbulent state variables (temperature, humidity and pressure)
- SST
- Basic cloud microphysics and aerosol concentration
- Upward/downward solar and infrared irradiance
- Surface waves field (Riegl LMS Q240i scanning LiDAR, UCI)
- GPS Dropsondes and AXBTs

UCI will also contribute fast humidity and temperature sensors, a Heiman KT19.85 IR radiometer for redundant SST measurements, a C-MIGITS III INS/GPS unit and high-resolution miniature radar altimeters to complement the WP-3D instrumentation.

NOAA/AOC WP-3D

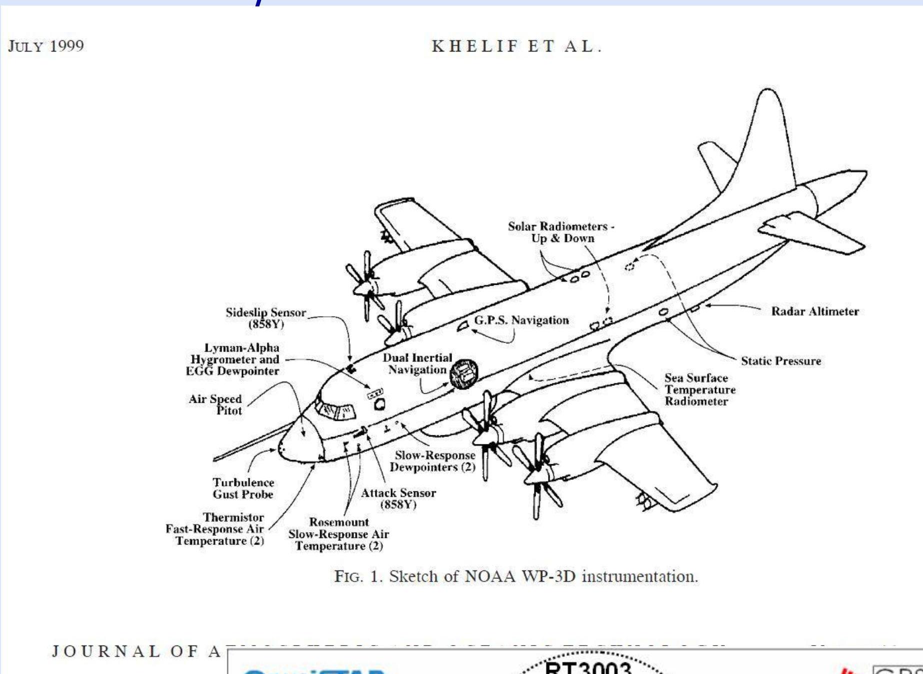
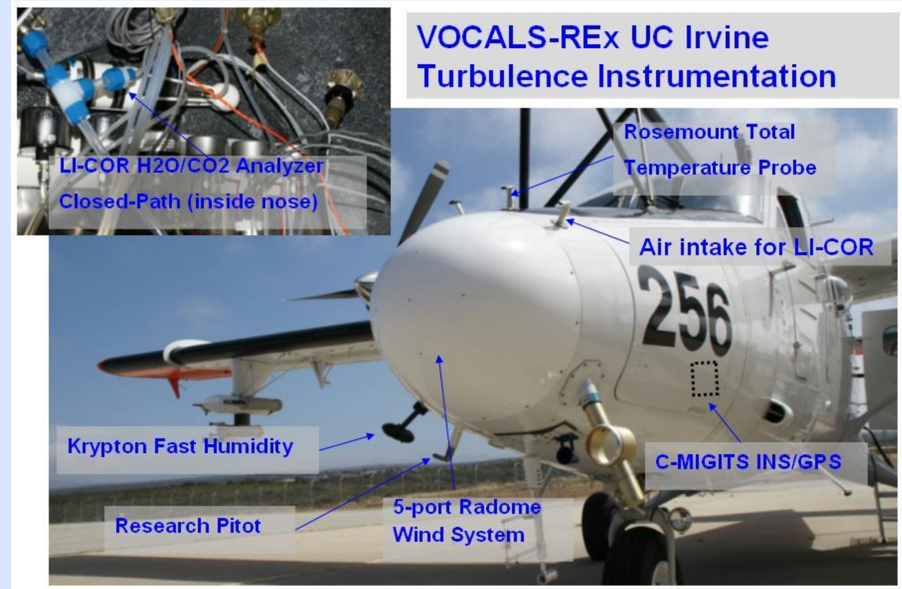
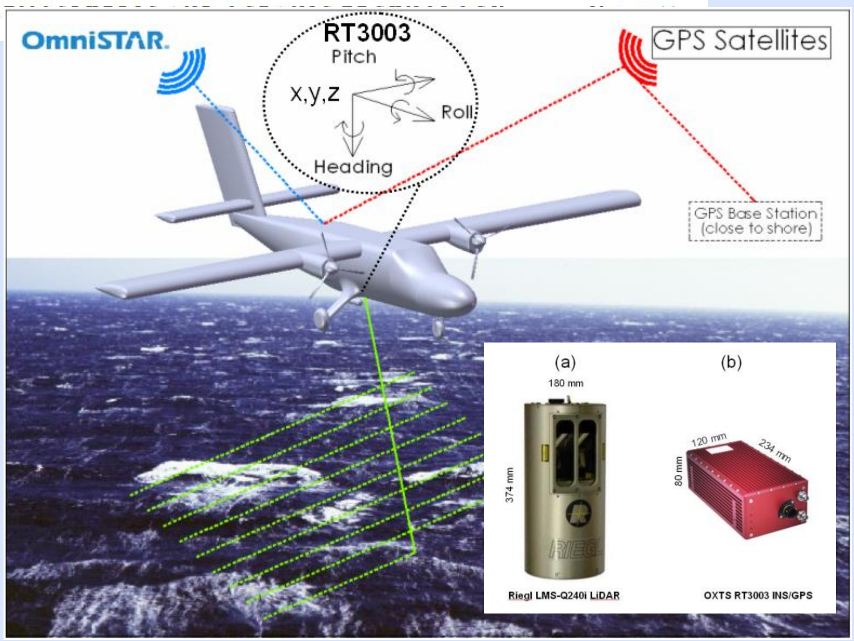


FIG. 1. Sketch of NOAA WP-3D instrumentation.

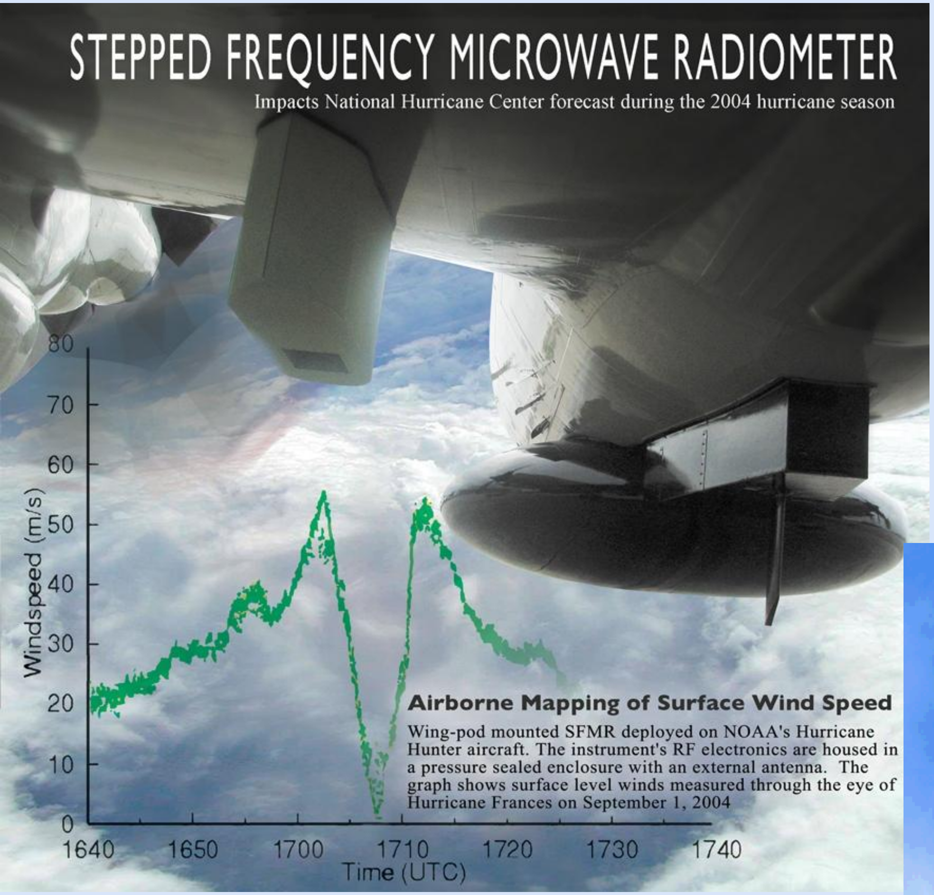


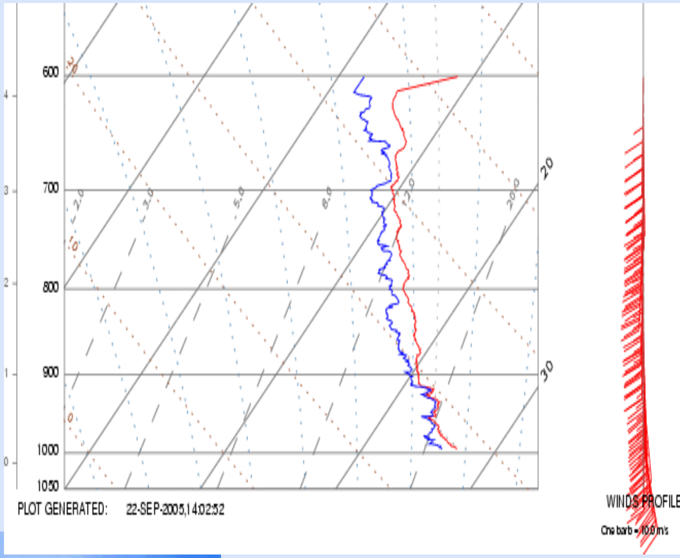
NPS/CIRPAS Twin Otter

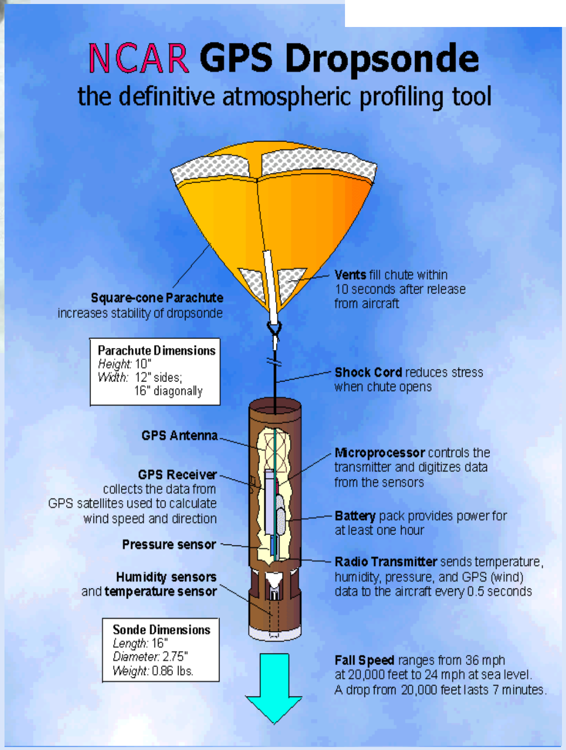


DURIP: Airborne Scanning LiDAR for 3-D wave mapping

Post-COARE instruments: SFMR, GPS dropsondes, turbulence, etc.







Flight Pattern Modules

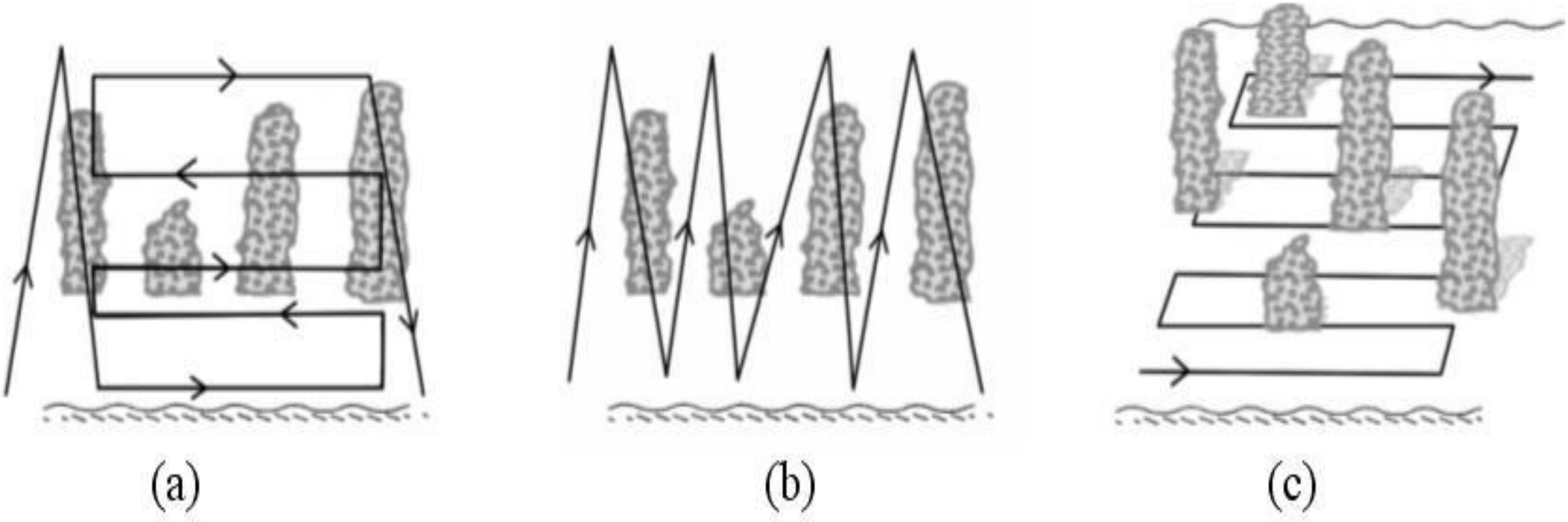


Figure 2: Flight patterns: (a) Cross-wind vertical stack, (b) cross-section slant path and (c) surface flux mapping.

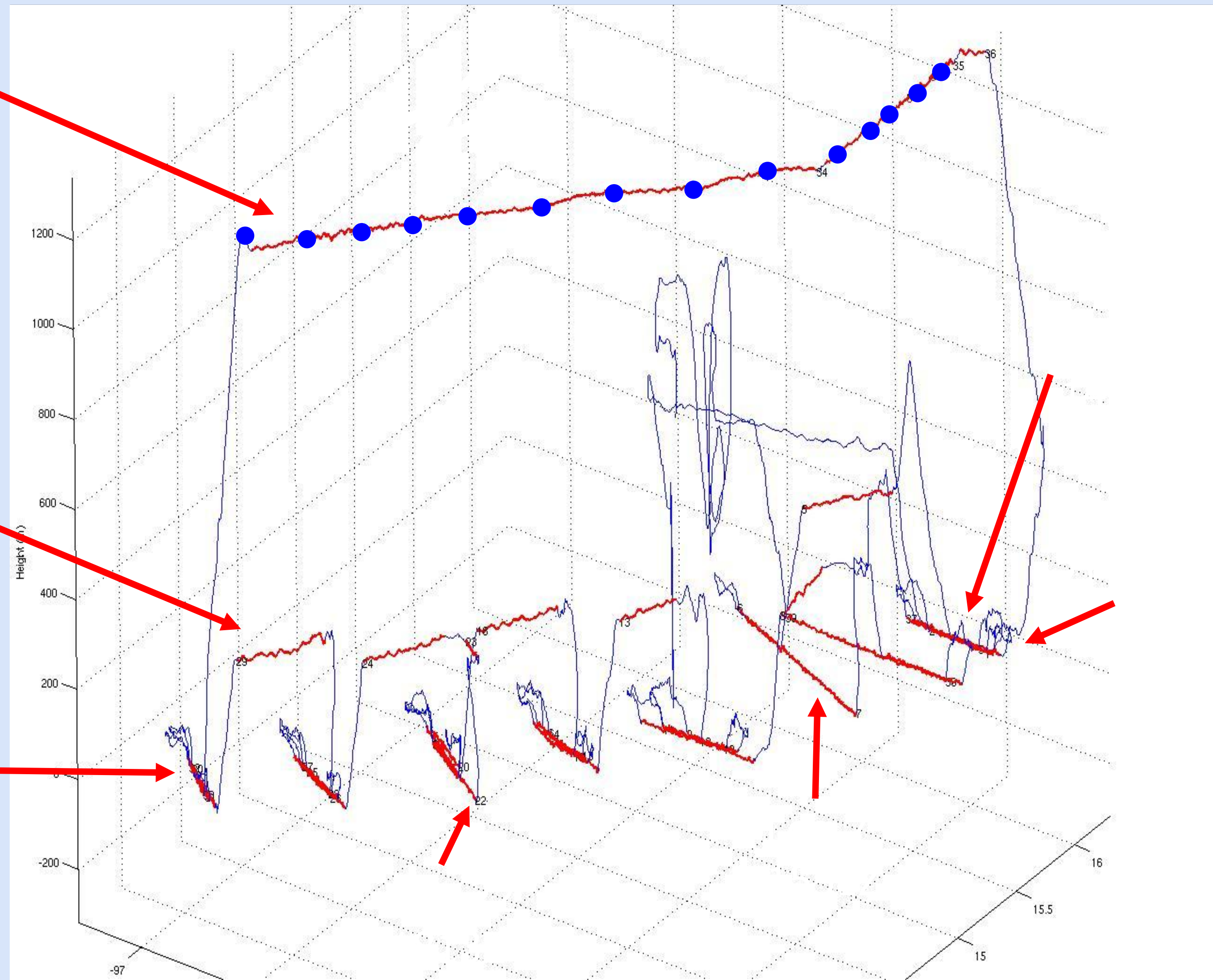
Aircraft Flight Track in GOTEX

RF09: 14Z – 22Z 26 February 2004

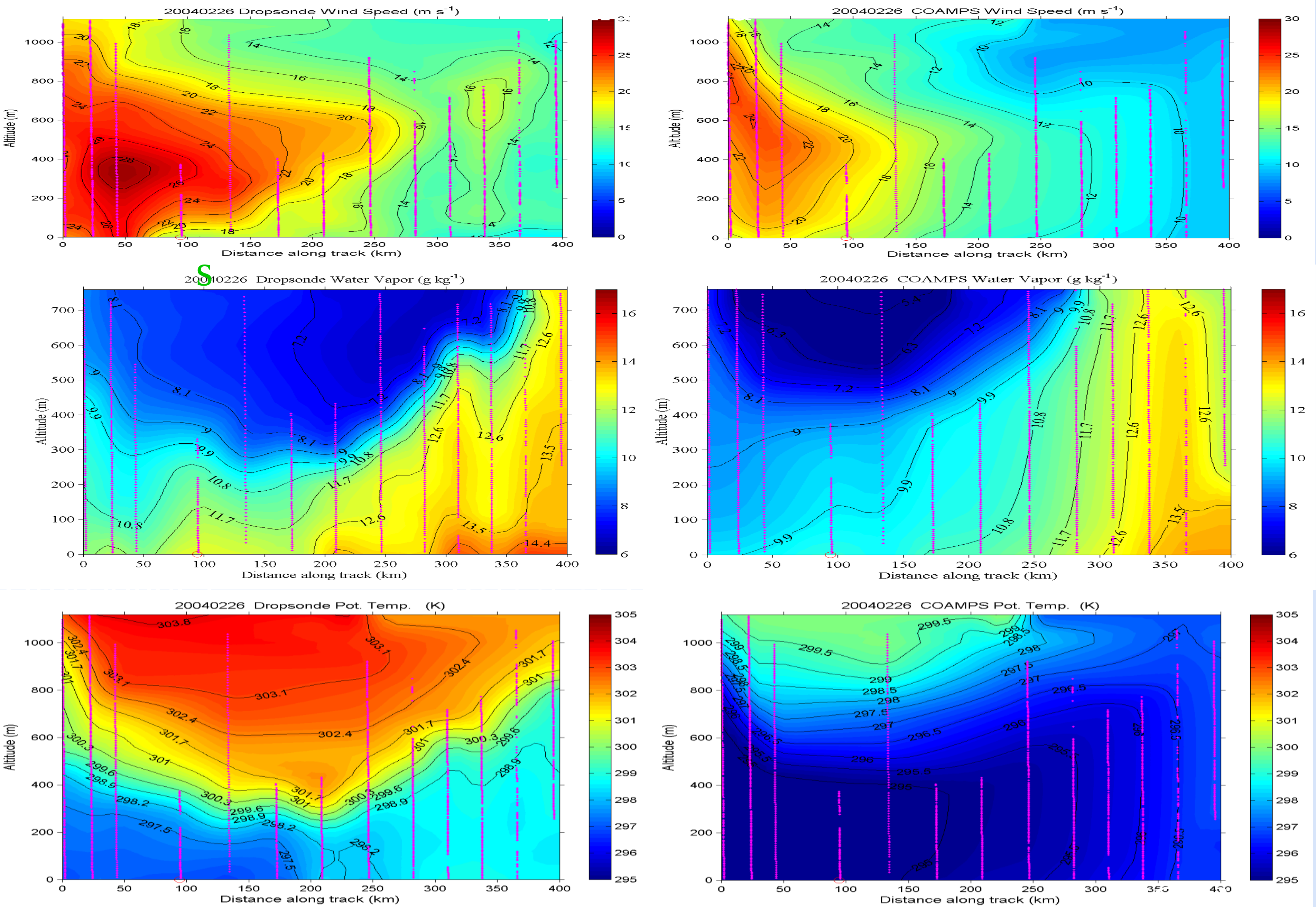
14 Dropsondes
from 1200 m
(2000Z – 2100Z)

7 Mid Level Legs
at 400 m

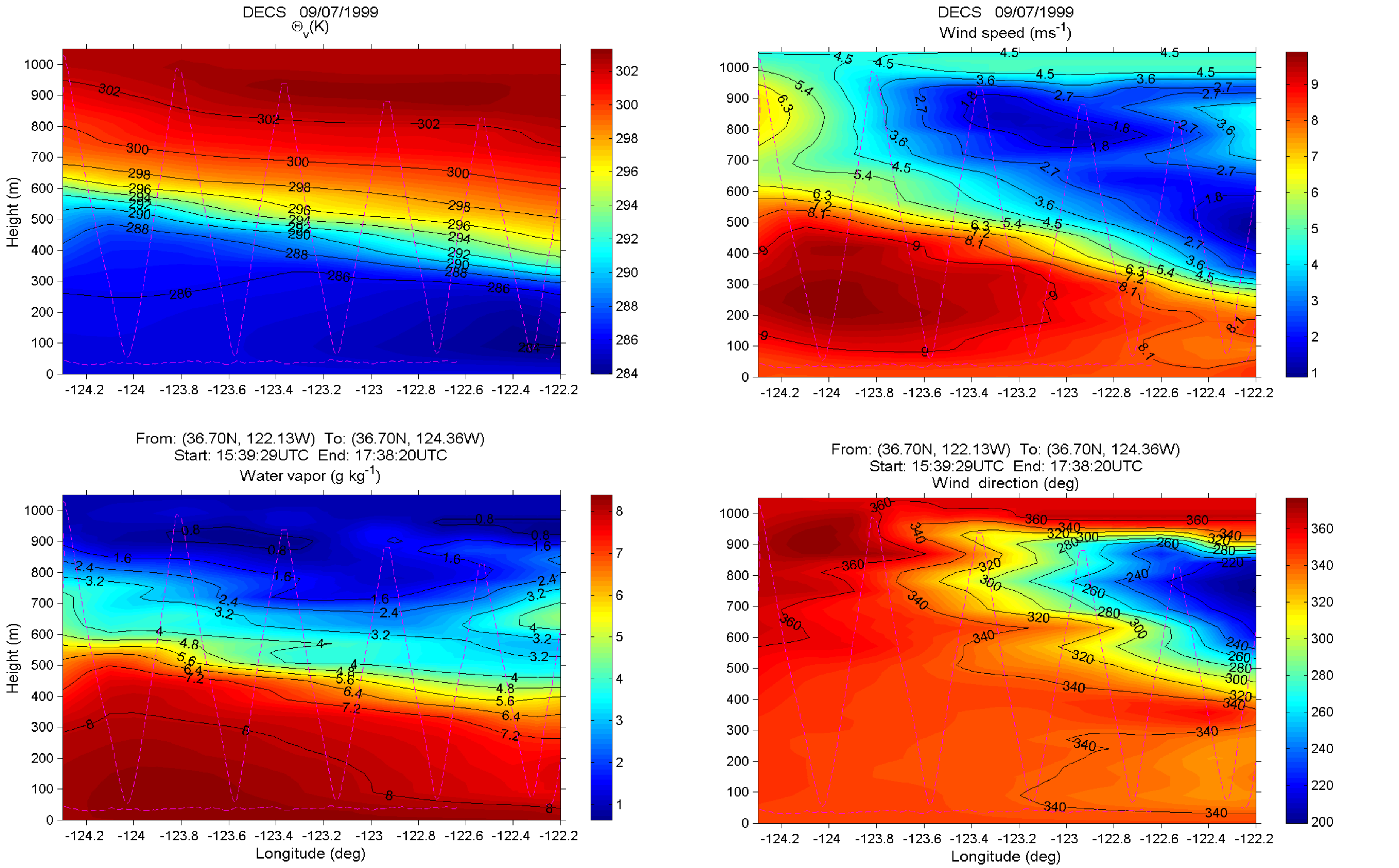
27 Low Level Legs
at 40 m



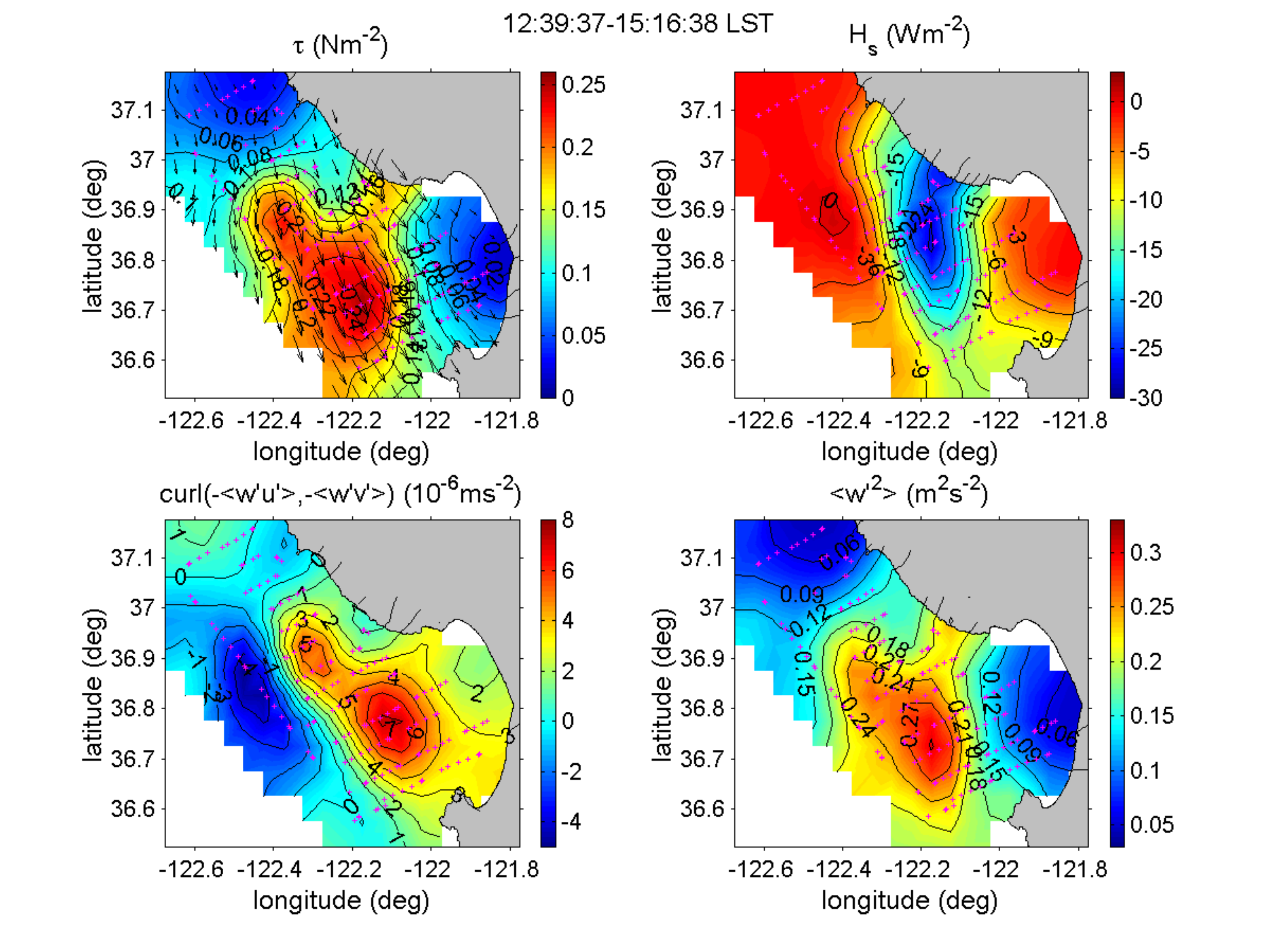
Dropsondes-COAMPS Comparison



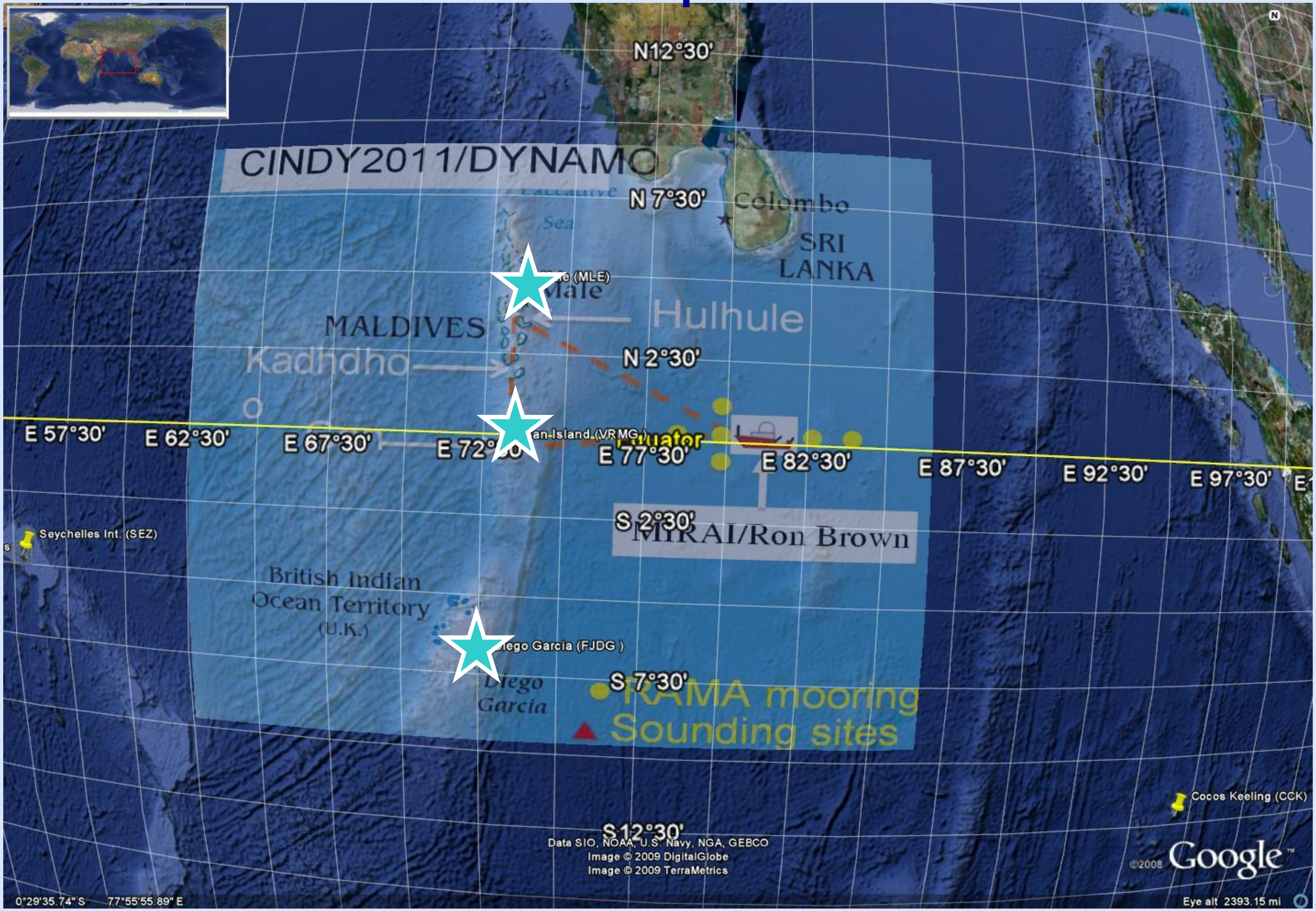
Saw-tooth Soundings



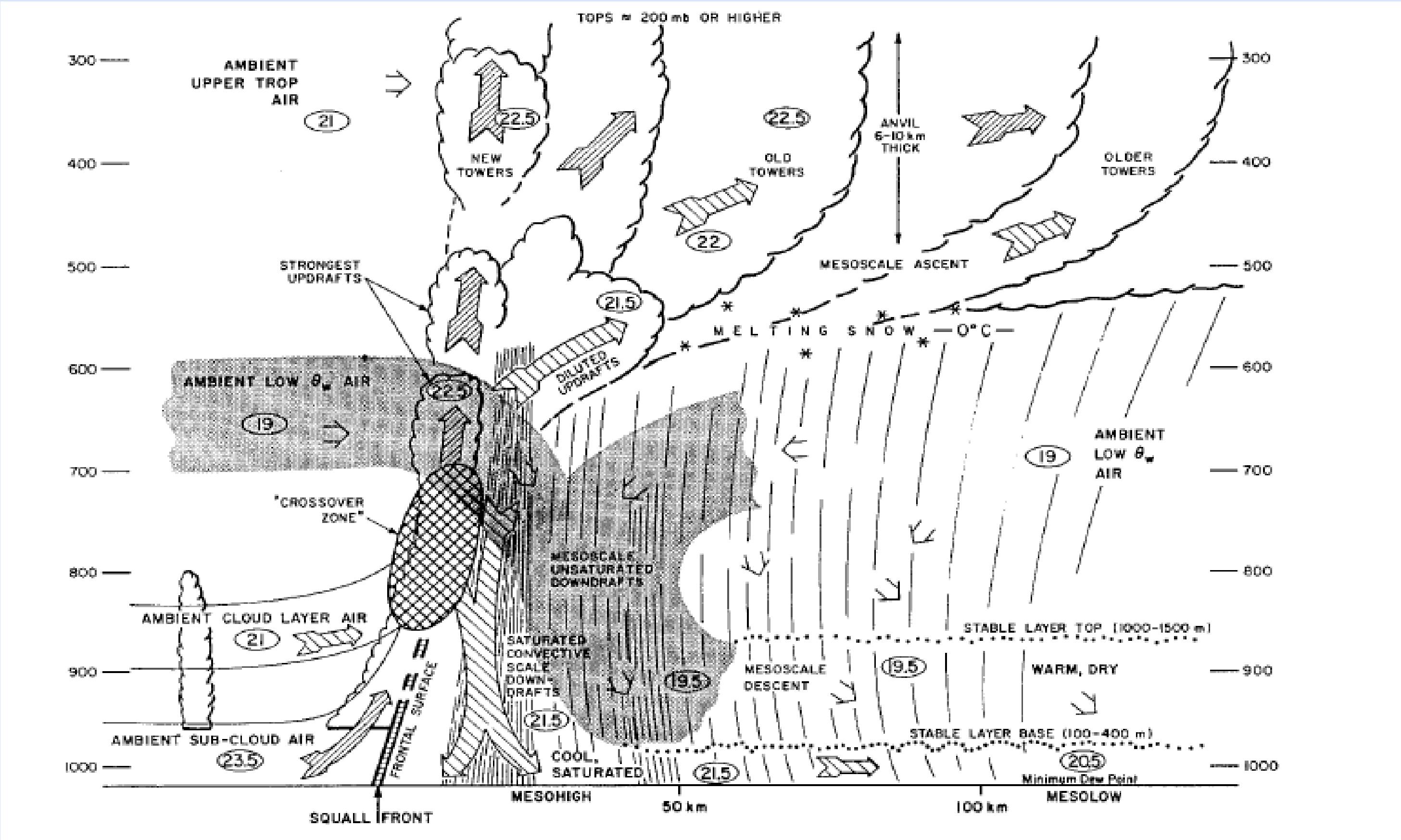
Surface Flux Mapping



Aircraft Operation



5-6 weeks field phase in Nov-Dec 2011



- Strong mesoscale variability
- Complicated vertical structure in disturbed and undisturbed boundary layer
- Responses in ocean mixed layer

Specific Scientific Questions

- the mesoscale variability of surface fluxes near the convective system?
- the spatial variability of the ocean surface affected by tropical precipitation and how does this variability affect the mesoscale surface flux?
- the spatial variations of the SST and surface fluxes in the undisturbed cumulus-topped boundary layer?
- the effects of ocean mixed layer diurnal variation on the atmospheric boundary layer and cloud structure in the suppressed phase of MJO? And what are the effects of diurnal variations of the cloud fields on the ocean mixed layer?
- What is the time and spatial evolution of the boundary layer affected by the deep convective activities and how one should quantify these temporal and spatial variations?
- How is the vertical turbulence structure in the boundary layer affected by convective downdraft and precipitation?
- the dominate length scale in the disturbed and undisturbed boundary layers and how does it vary with altitude? And at what grid resolution should one consider a scale-dependent boundary layer parameterization for simulating the boundary layers over the tropical Indian Ocean?
- What is the entrainment rate at the top of the disturbed mixed layer and how does this parameter affect the subcloud-cloud layer interaction and the surface fluxes?
- How does the evaporation of the precipitation droplets affect the moisture and thermodynamics balance of the boundary layer behind the convective system?
- How do the enhanced fluxes affect the ocean mixed layer below and at what horizontal scale is the ocean mixed layer affected?
- What are the dominate wave characteristics behind the convective system and how do surface waves affect surface stress?