

Surface fluxes in the VOCALS region



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Physics of air-surface interactions and coupling to ocean-ice/atmosphere BL

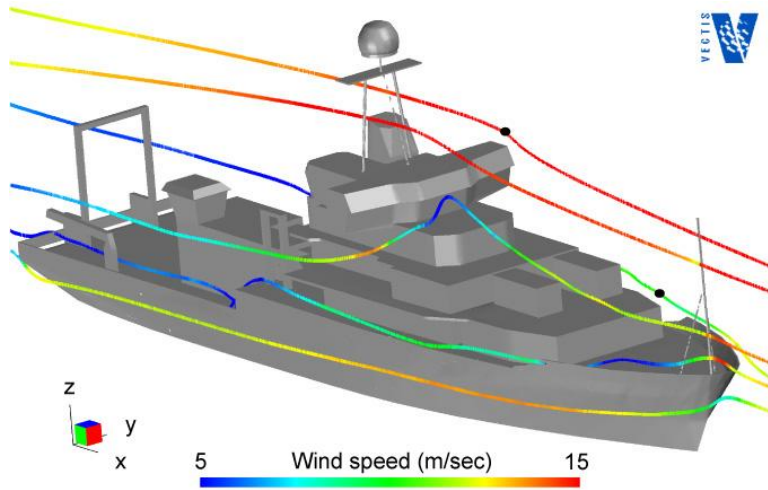
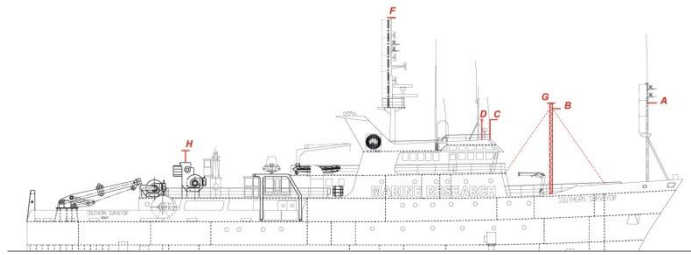
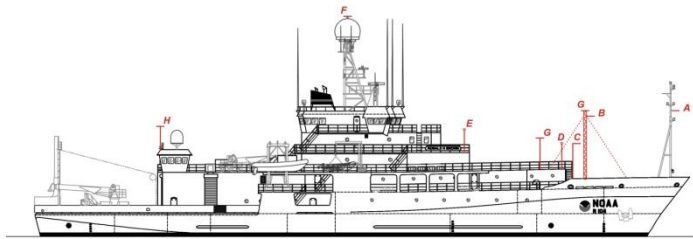
Aspects:

- Emphasize surface fluxes
- Similarity Scaling
- Bulk Flux Parameterizations
- Surface/subsurface processes
- Improve Observing Technologies
- Flux climatologies

Applications:

- Model lower BC (PBL, Meso, NWP, GCM)
- Ocean budgets (stress, heat, waves, sea-ice)
- Carbon budgets
- Pollution deposition (particle, ozone)
- Cloud microphysics (aerosol source, DMS)
- Atmos Propagation (Cn^2 , ducting, extinction)
- Hurricane intensity

Turbulence Measurements from Ships



Energy Budget

$$Q_{\text{NET}} = Q_{\text{S}\uparrow} + Q_{\text{S}\downarrow} + Q_{\text{L}\uparrow} + Q_{\text{L}\downarrow} + H_{\text{S}} + H_{\text{L}} + \text{Storage}$$

Net at the surface

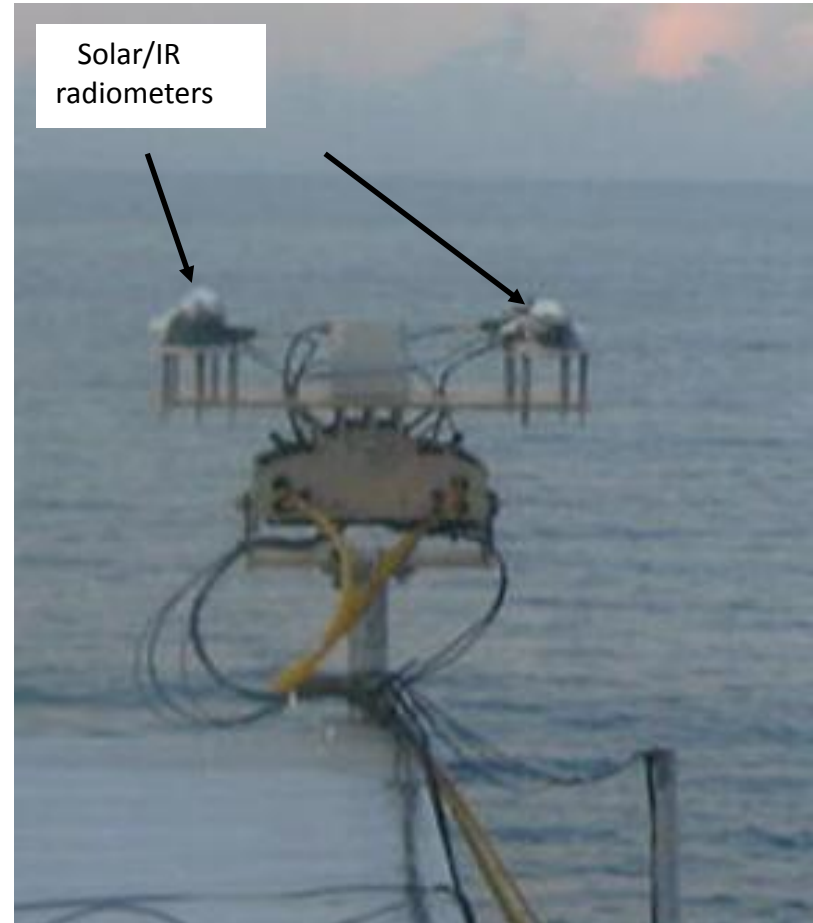
Shortwave up/down (albedo)

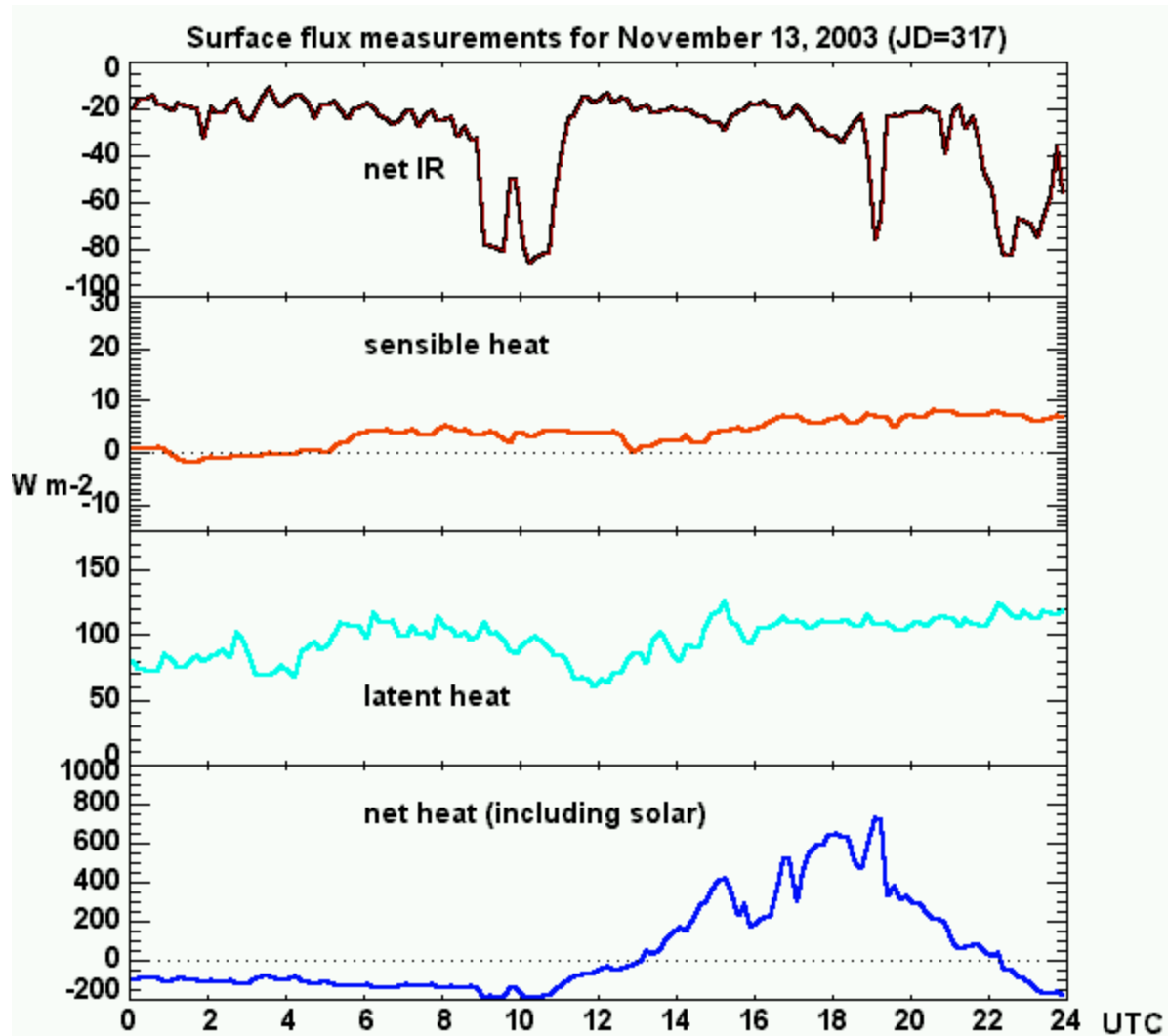
Longwave up/down

Sensible turbulent heat flux

Latent turbulent heat flux

$$Q_{\text{L}\uparrow} = \varepsilon(\sigma T^4 - Q_{\text{L}\downarrow})$$

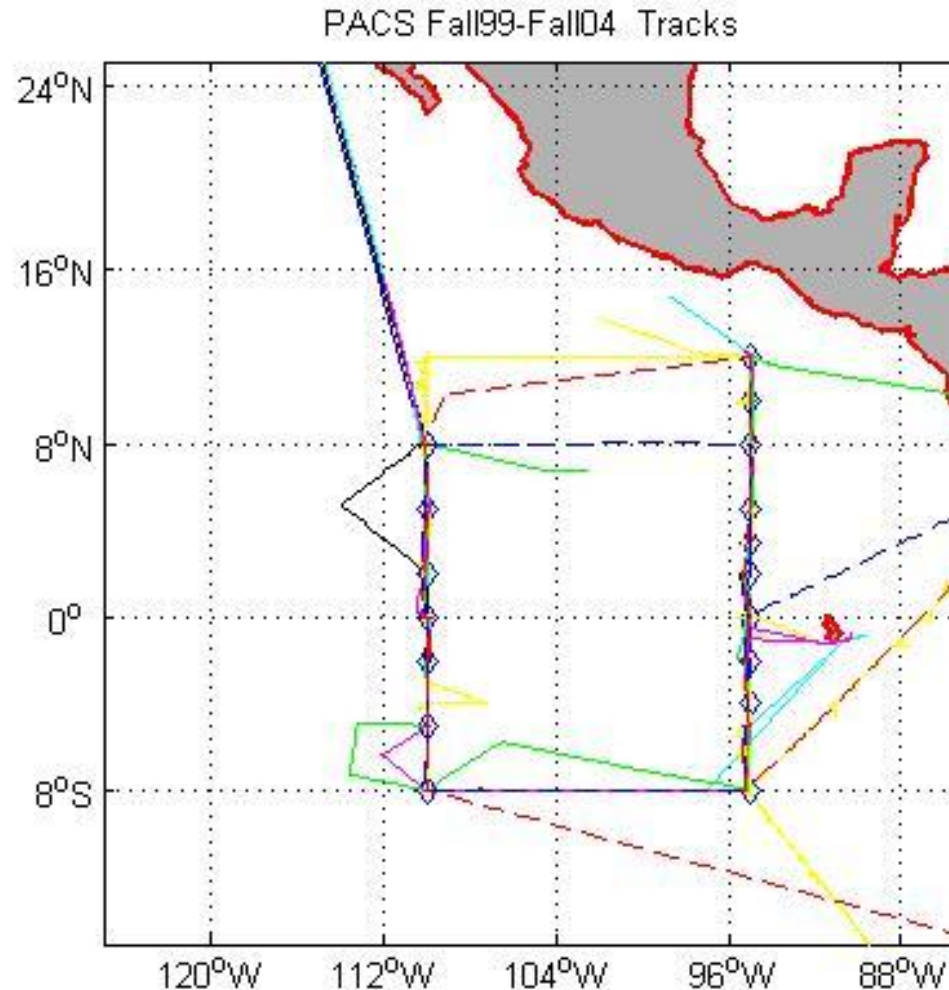




Surface energy budget study from Stratus 2003

PACS cruise tracks

9 PACS Cruises Conducted Before Stratus Cruises



TAO/PACS Heat Fluxes

95 & 110°W

— Model

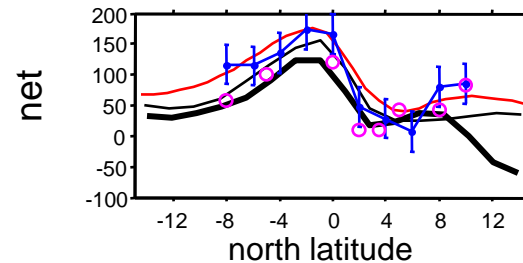
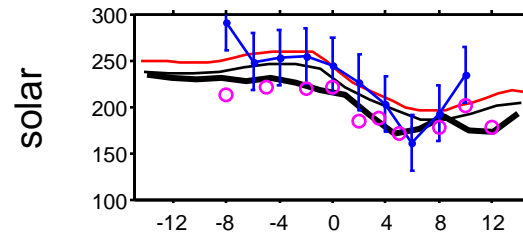
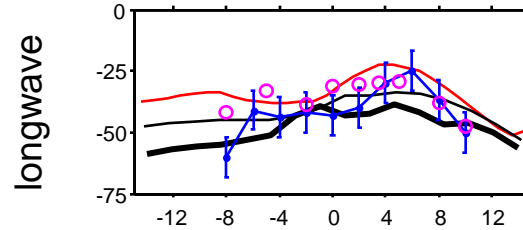
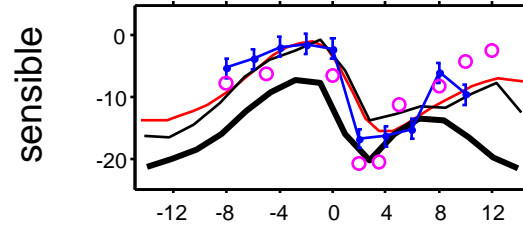
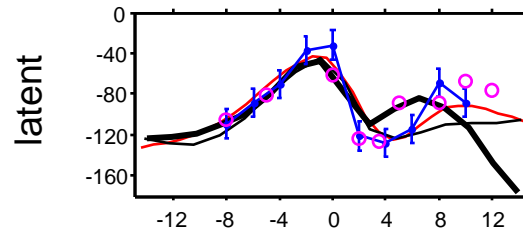
○ TAO buoy

— WHOI (1984-2002)
[Yu and Weller 2007]

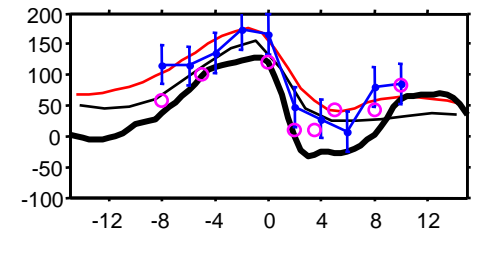
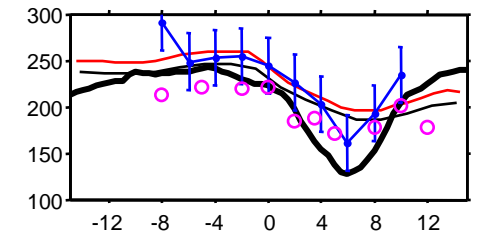
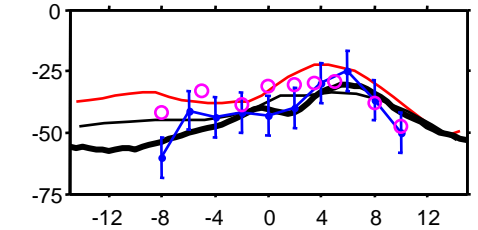
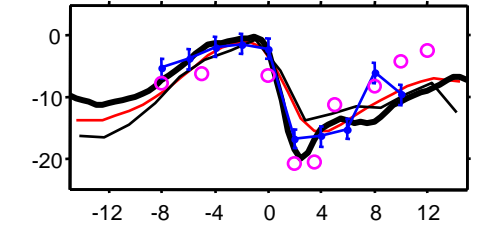
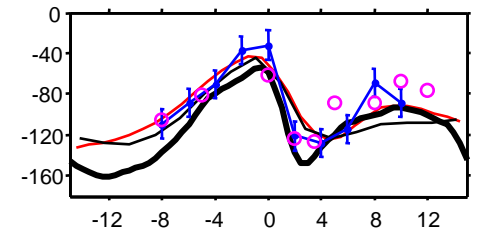
— CORE (1984-2004)
[Large and Yeager 2004]

⊥ NOAA ship observations
(1999-2002) [Fairall et al.
2008]

GFDL CM2.1

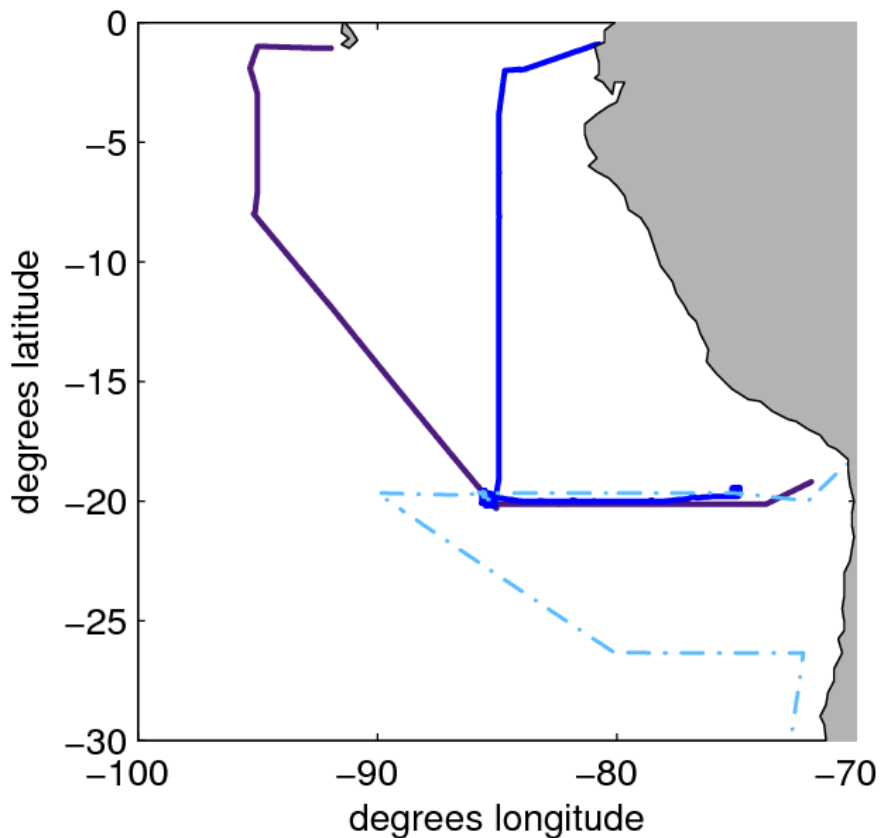


IROAM



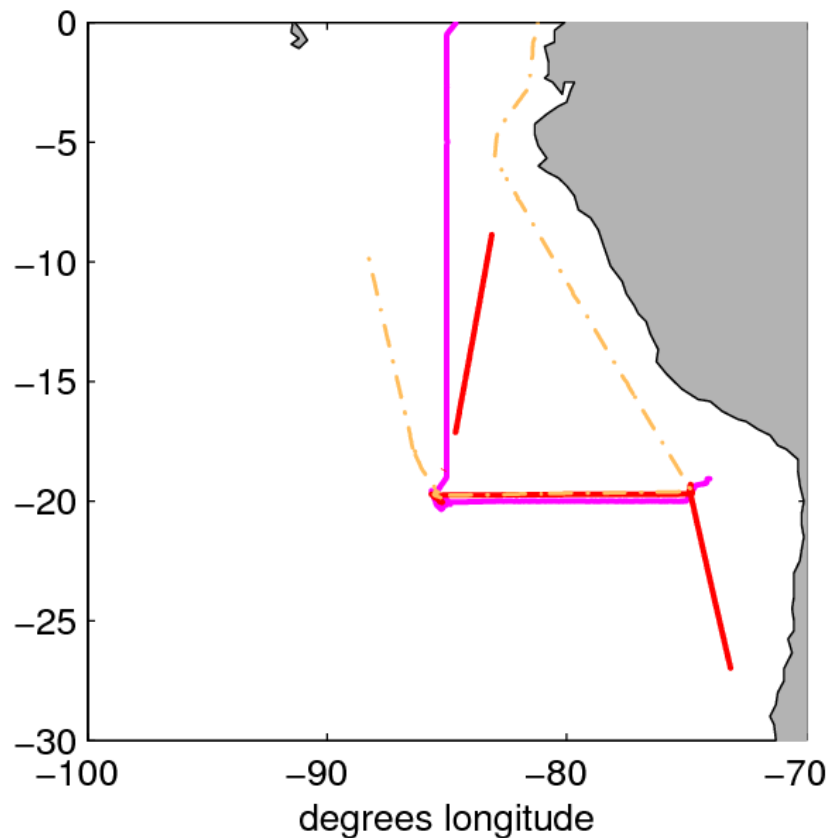
Stratus cruise tracks

2001, 2003, 2004 cruise tracks



2001 Oct 22 ——— Oct 24
2003 Nov 21 ——— Nov 23
2004 Dec 10 ····· Dec 07

2005, 2006, 2007 cruise tracks

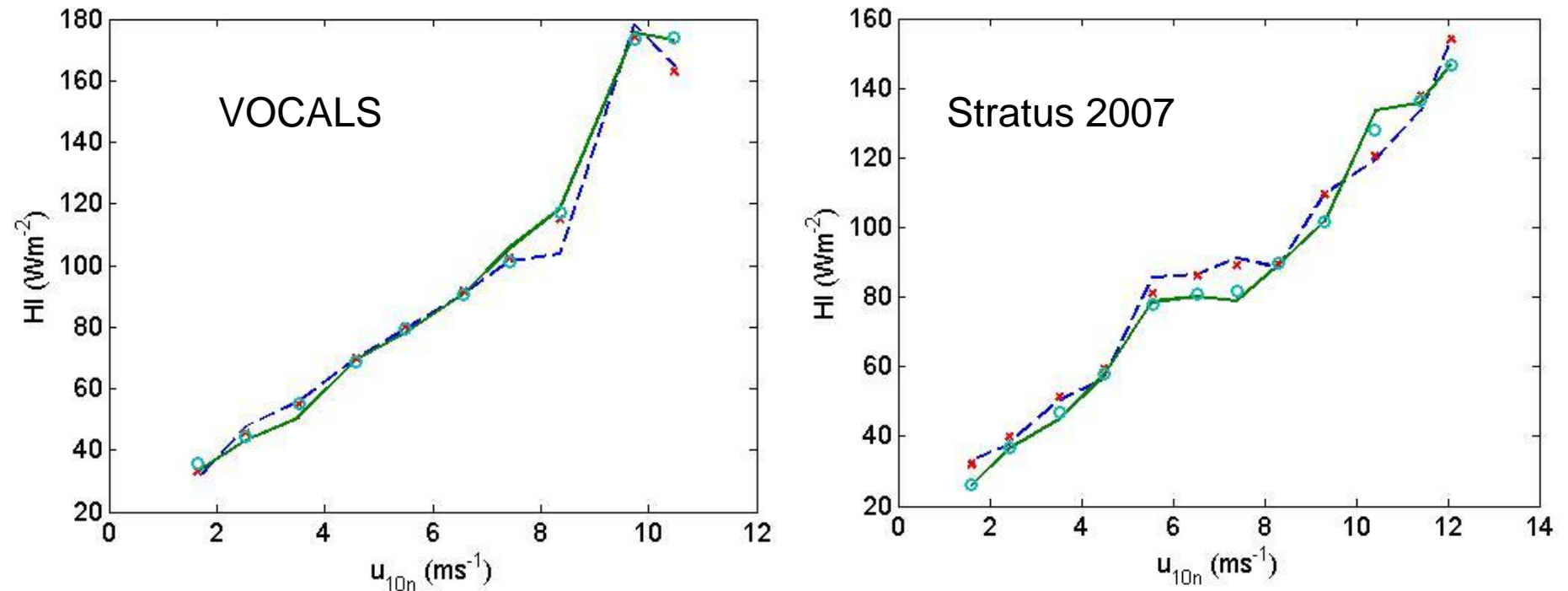


2005 Oct 18 ——— Oct 20
2006 Oct 20 ——— Oct 22
2007 Oct 26 ····· Oct 24

Bulk Flux Parameterizations: COARE 3.0

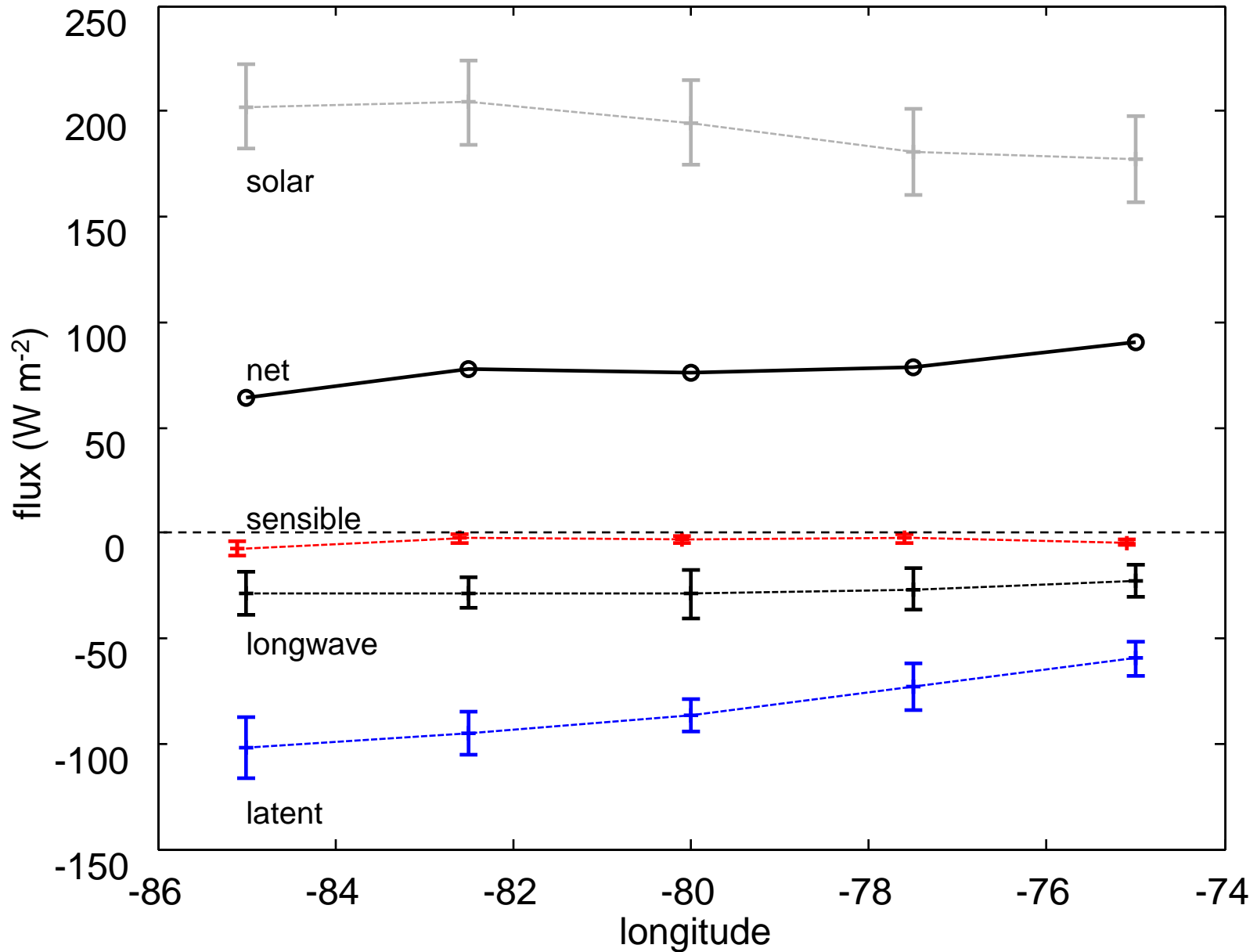
Intercomparison of Fluxes and Context of VOCALS within the 2001-2007 Climatology

$$H_L = \rho_a L_e C_E U (q_{SAT}(SST) - q_a)$$



Latent heat fluxes averaged in 10-m neutral wind speed bins:
COARE3.0 (dashed line – median; x – mean) and Direct Measurements (solid line – median; circle – mean). Left panel is VOCALS and right panel is Stratus2007.

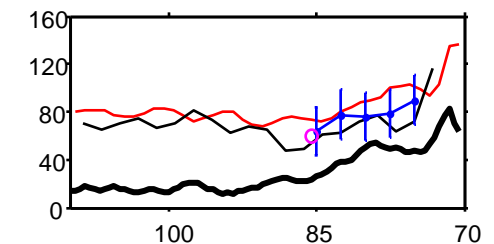
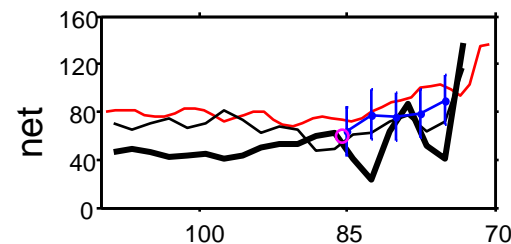
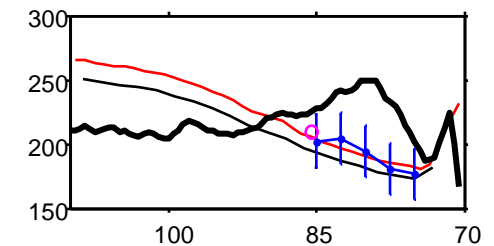
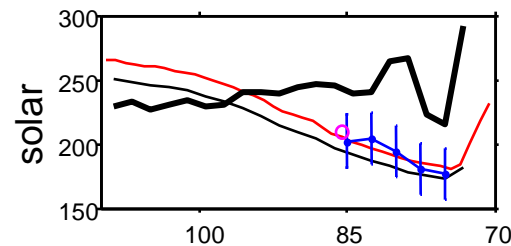
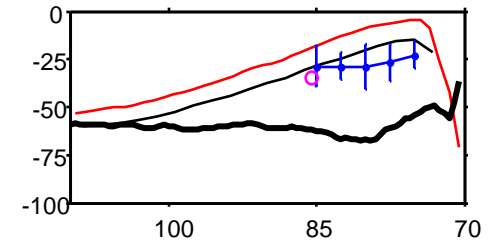
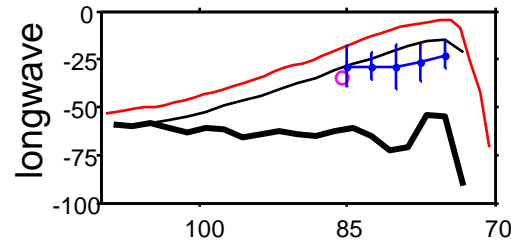
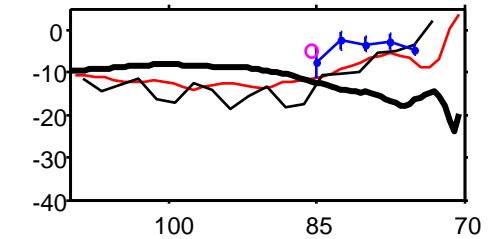
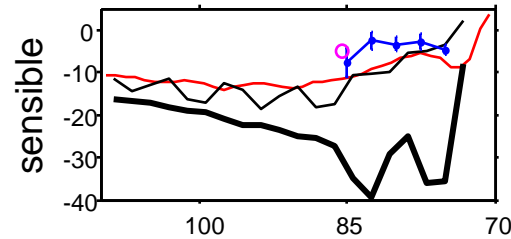
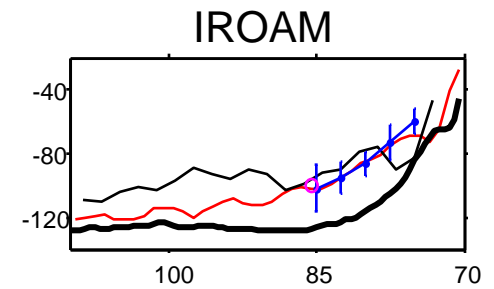
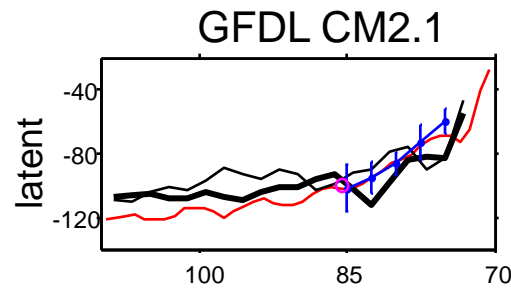
20°S surface heat budget



October heat fluxes at 20°S:

assess
analyses and
models

- Model
- WHOI ORS buoy
- WHOI (1984-2002)
- CORE (1984-2004)
- ||| NOAA ship observations



west longitude