VOCALS Winds, Clouds and the Surface Heat Budget

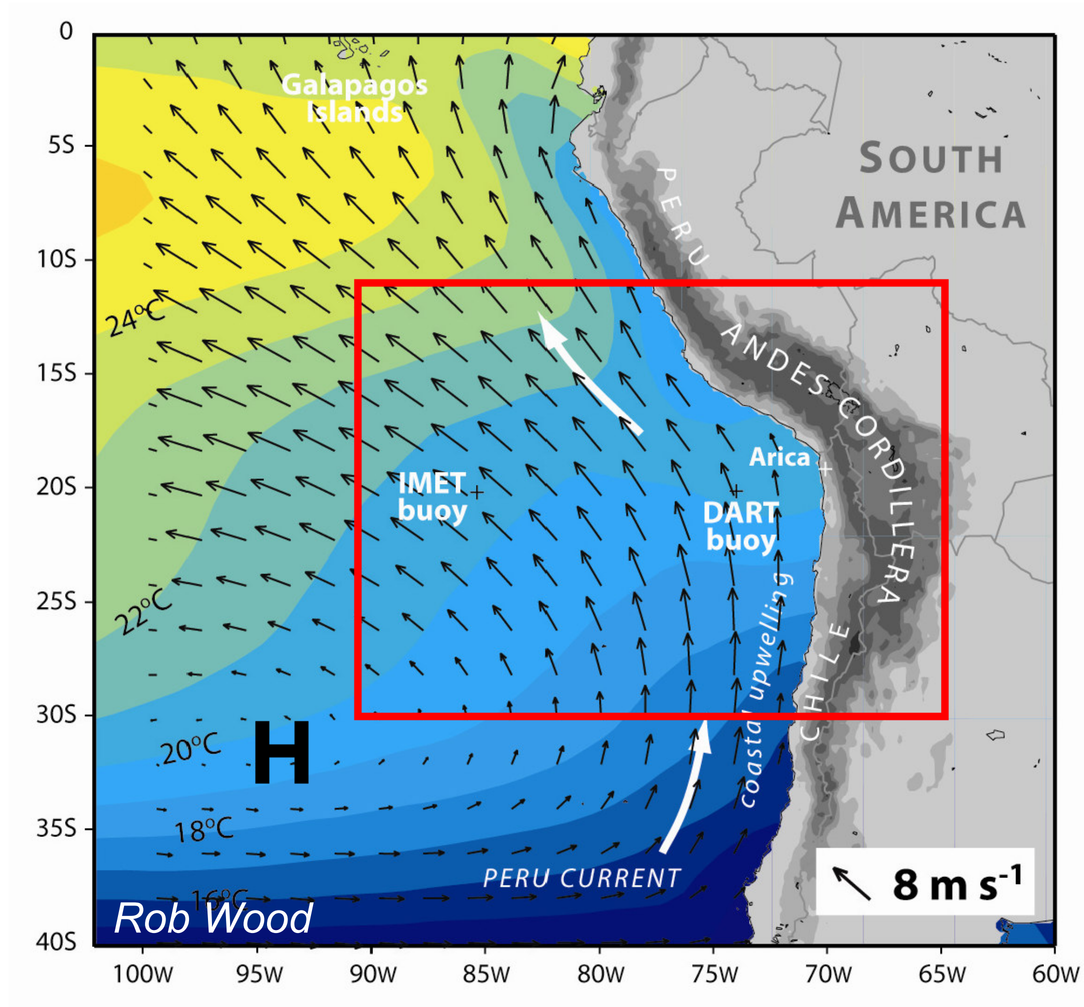
Simon de Szoeke

Rob Wood, Clayton Paulson, Larry O'Neill, Peter Gaube

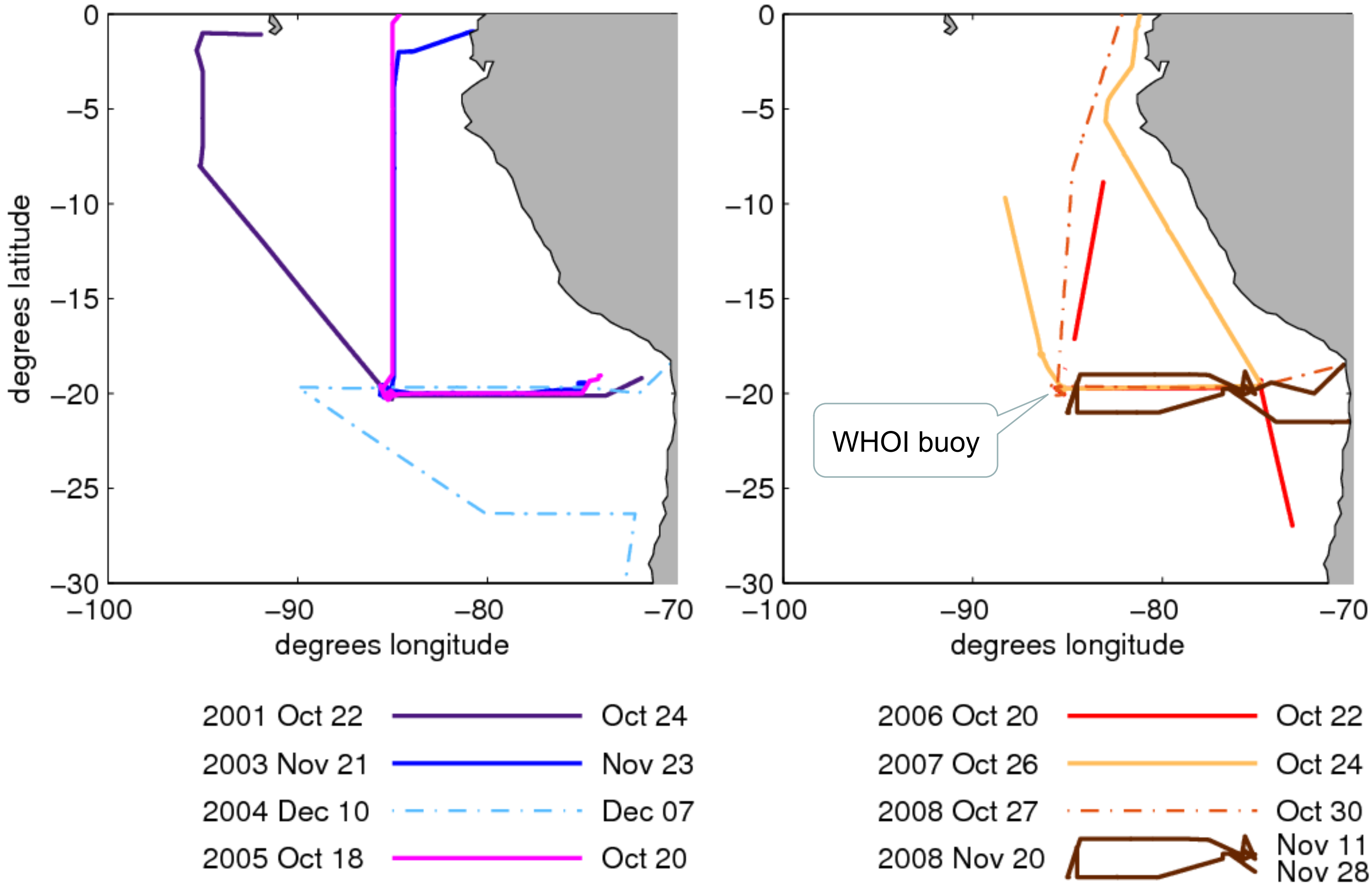
Ocean Vector Winds Science Team meeting

Boulder, CO

May 2009



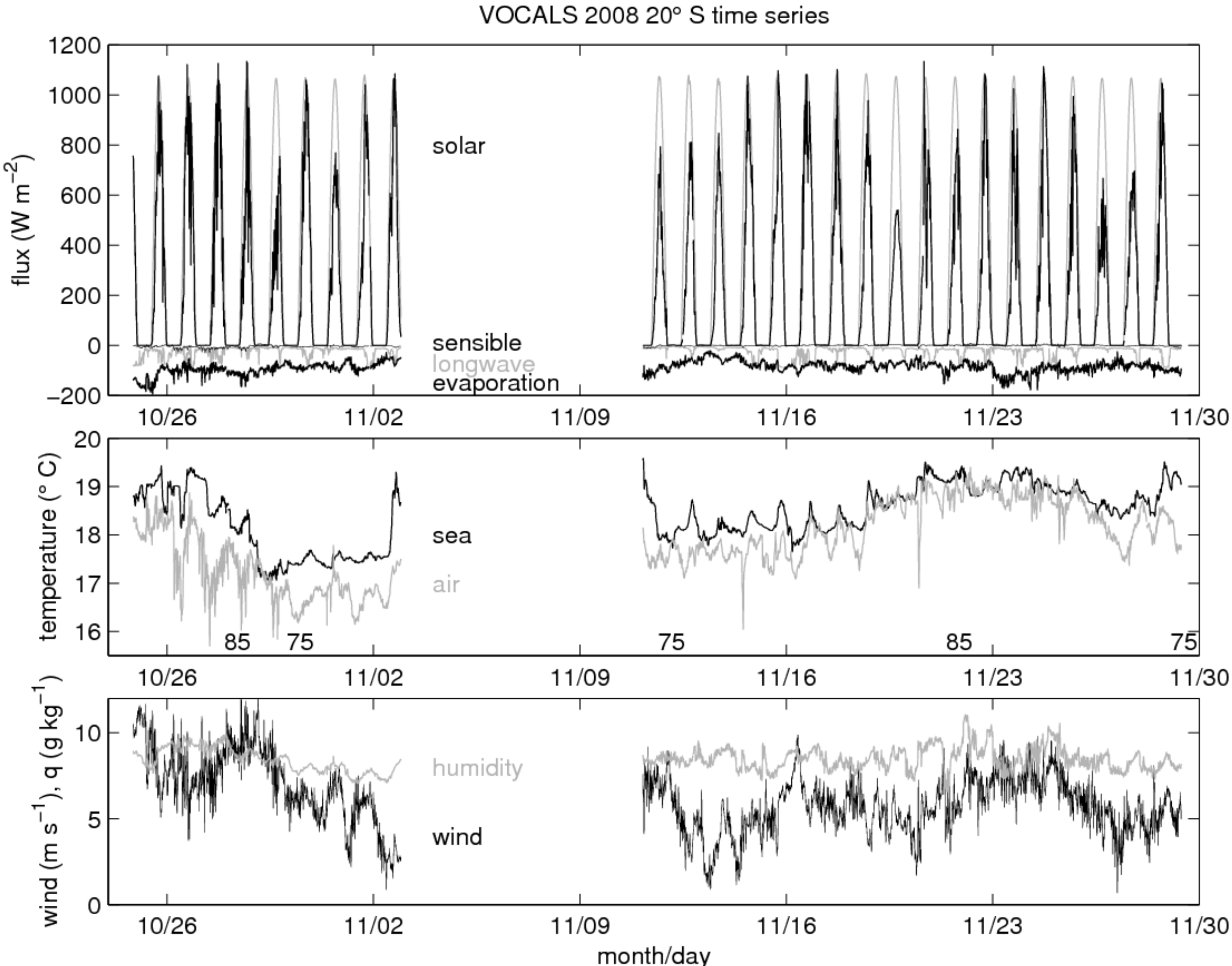
7 years of Stratus/VOCALS cruises



Stratus synthesis of NOAA ship observations

http://www.esrl.noaa.gov/psd/psd3/synthesis

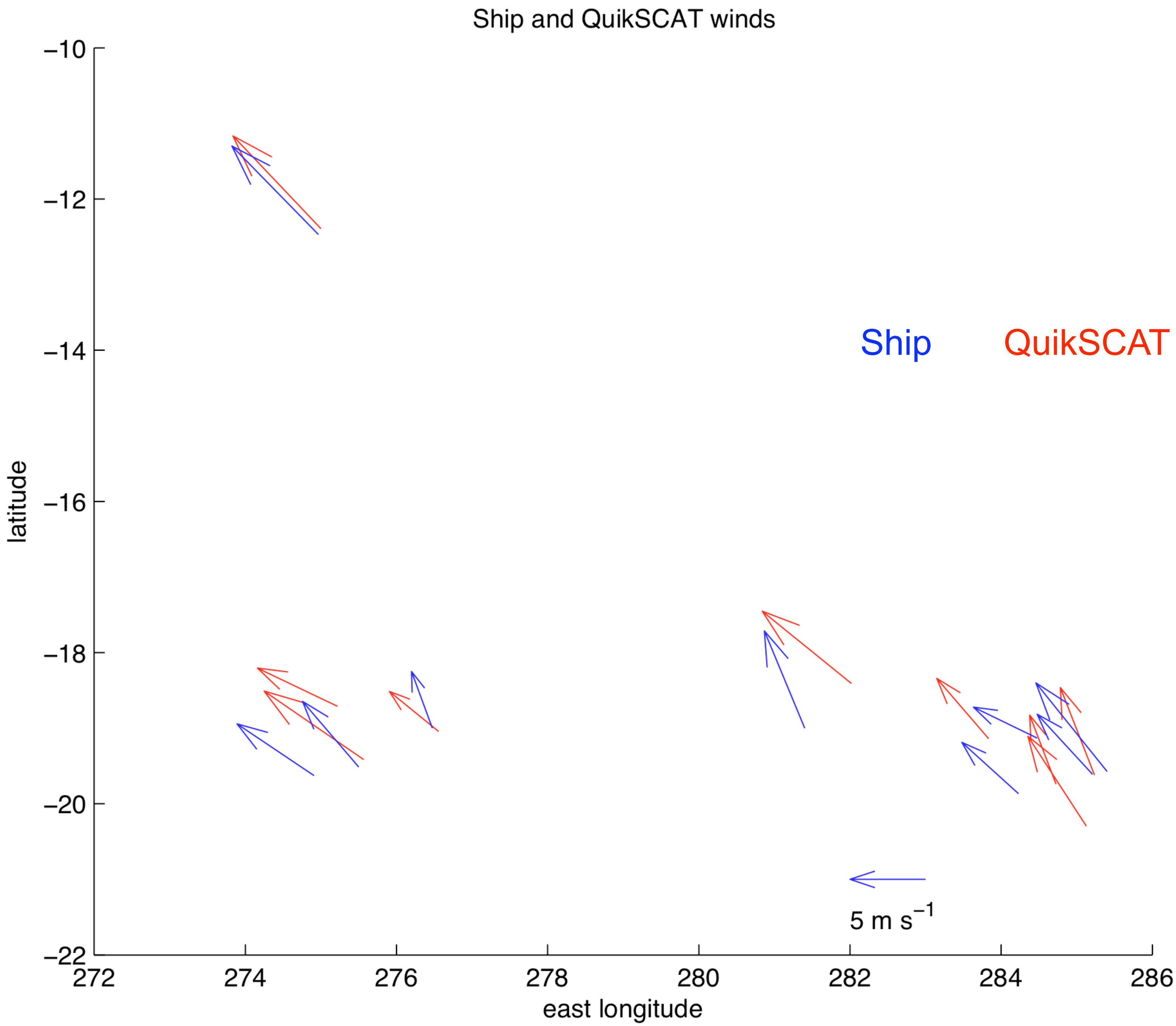
- Fall 2001, 2003-2008 (7 years) 20˚S, 75-85˚W.
- Integrate measurements of
  - Surface meteorology
  - Turbulent and radiative fluxes
  - Cloud vertical structure: top, base, and LCL.
  - Doppler cloud radar (VOCALS 2008)
  - Column water vapor and liquid water path
  - Rawinsonde profiles
  - Aerosols
- Assess model and gridded products from in situ observations.



de Szoeke et al. 2009

VOCALS ship/QuikSCAT comparison

- 132 QuikSCAT independent wind pixel retrievals from 10 hours fall within 100 km of the ship.
- Do ship and QuikSCAT agree?
  - systematic differences
- How representative are ship-QuikSCAT coincidences?

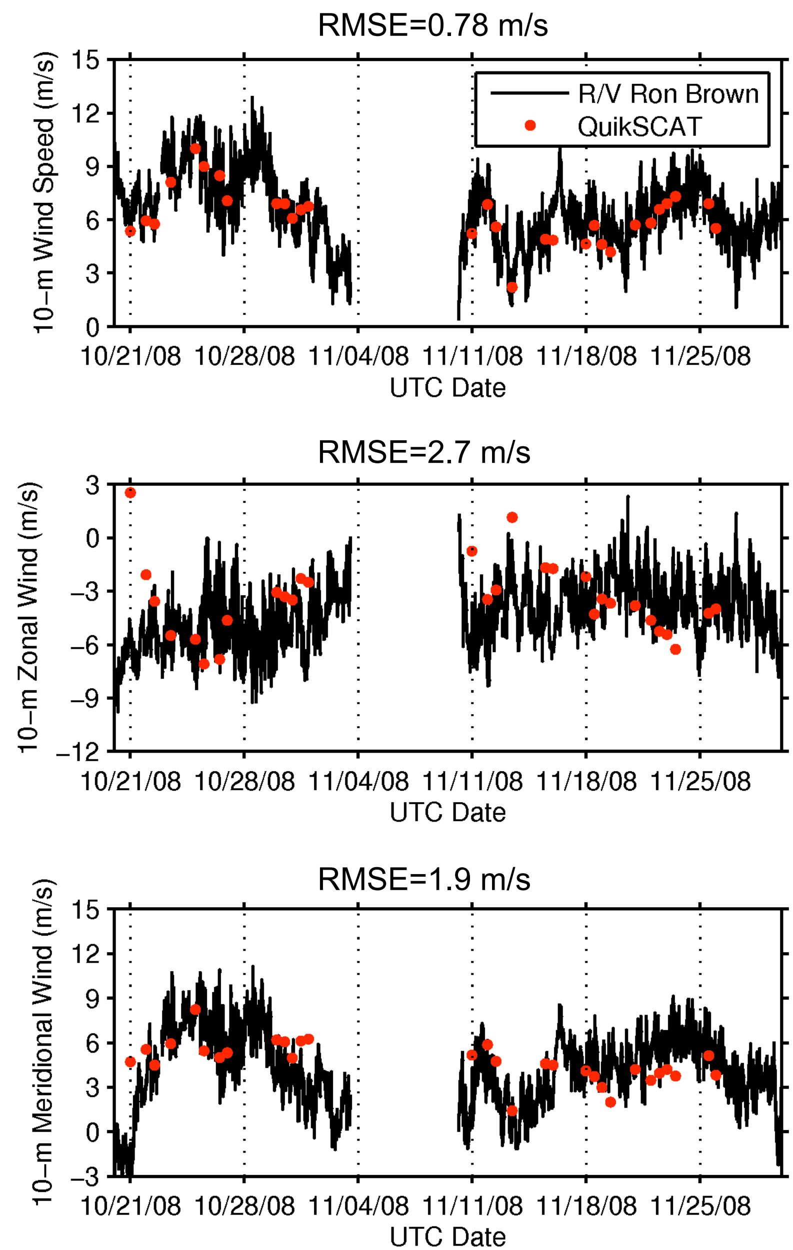


Ship and QuikSCAT winds
−10
−12
−14
−16
−18
−20
−22
latitude
272
274
276
278
280
282
284
286
east longitude
Ship
QuikSCAT
5 m s−1

VOCALS **ship** observations compared with QuikSCAT gridded wind

Wind speed agrees well.

Wind direction agrees poorly.

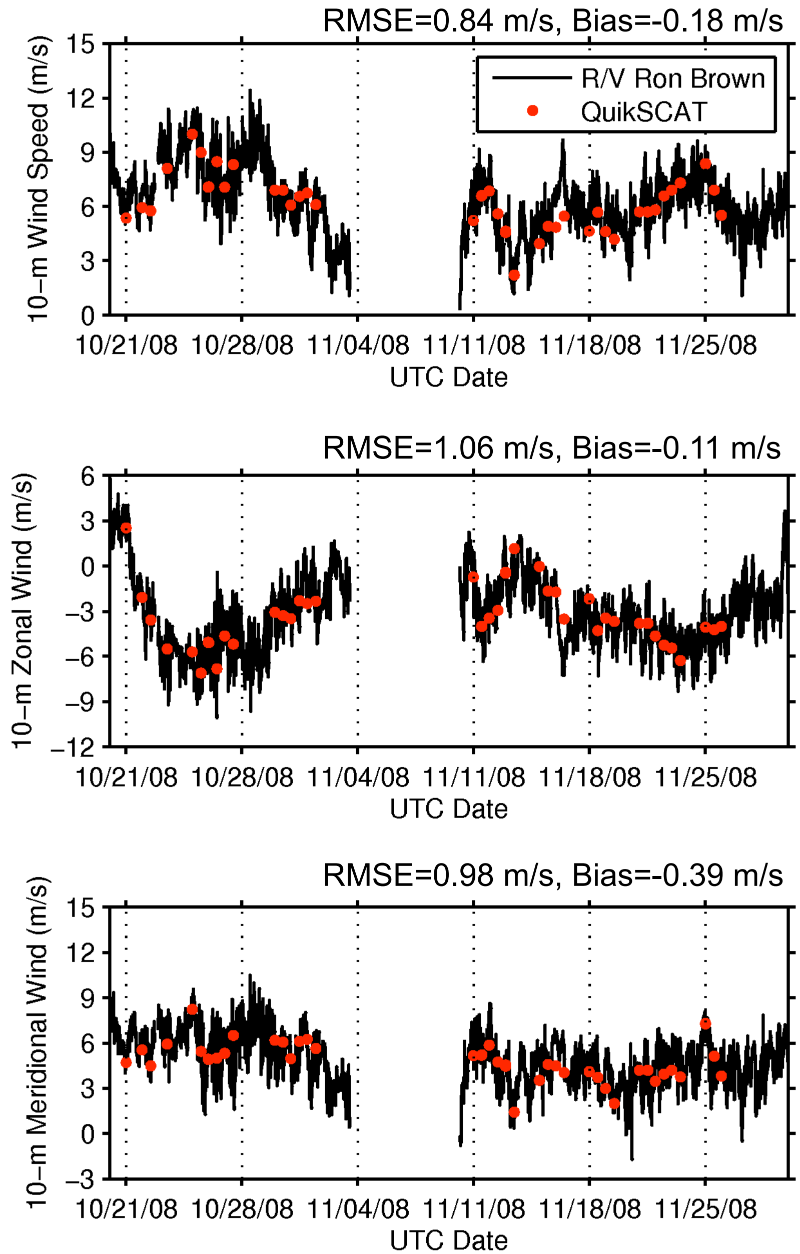


Larry O'Neill

VOCALS ship observations compared with QuikSCAT gridded wind

Wind speed agrees well.

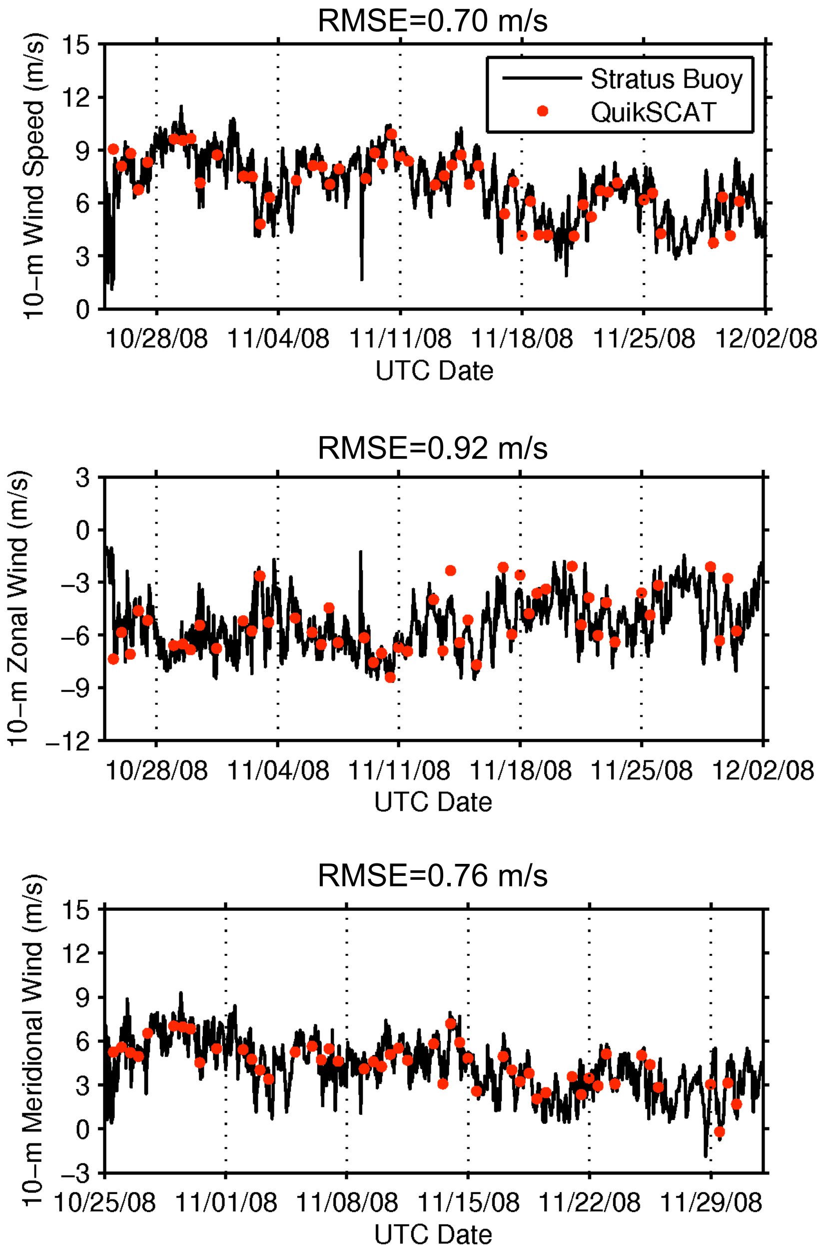
Wind direction correction not understood.



Larry O'Neill

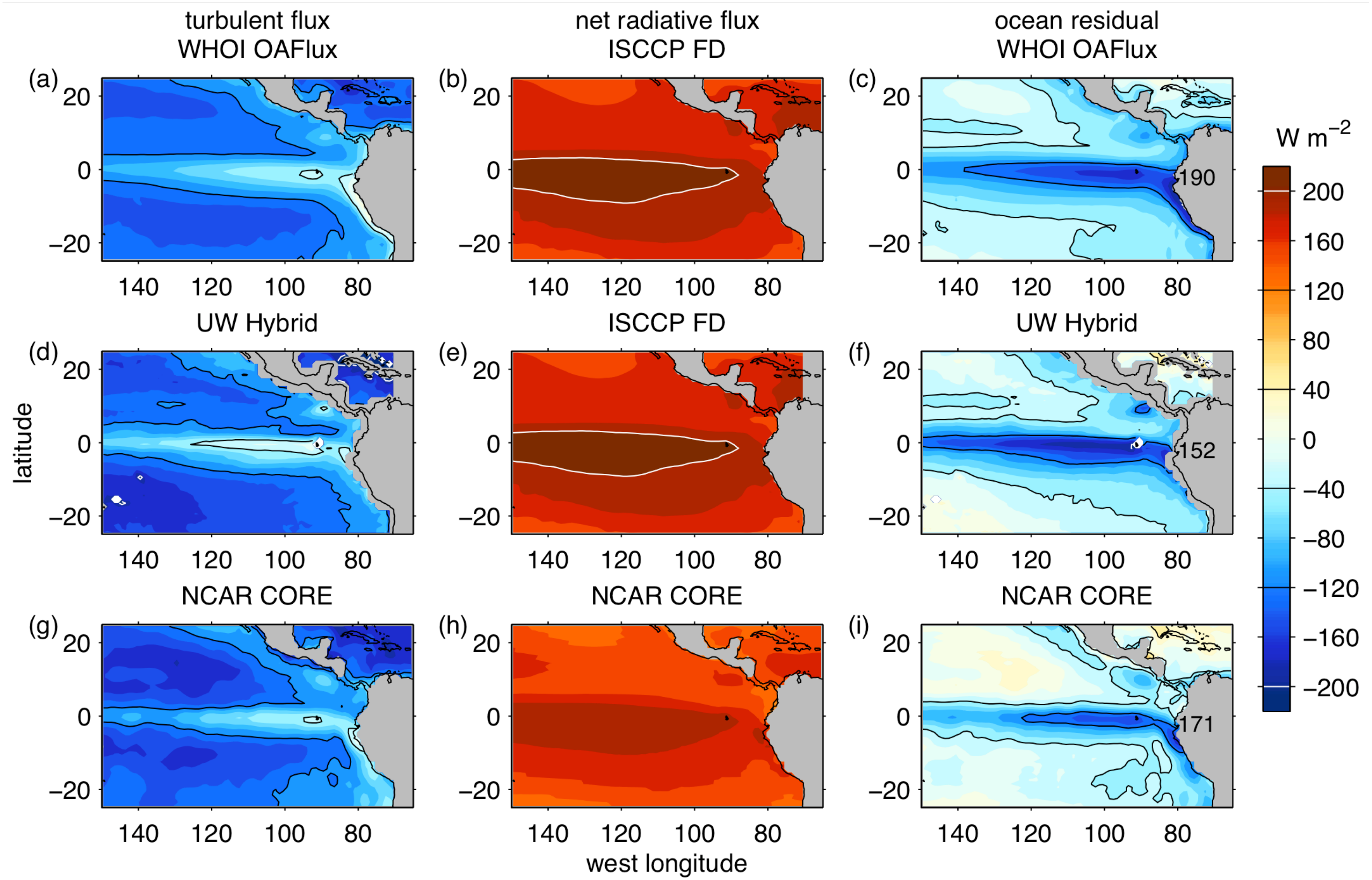
VOCALS **IMET buoy** observations compared with QuikSCAT gridded wind

Wind speed and direction agree well.

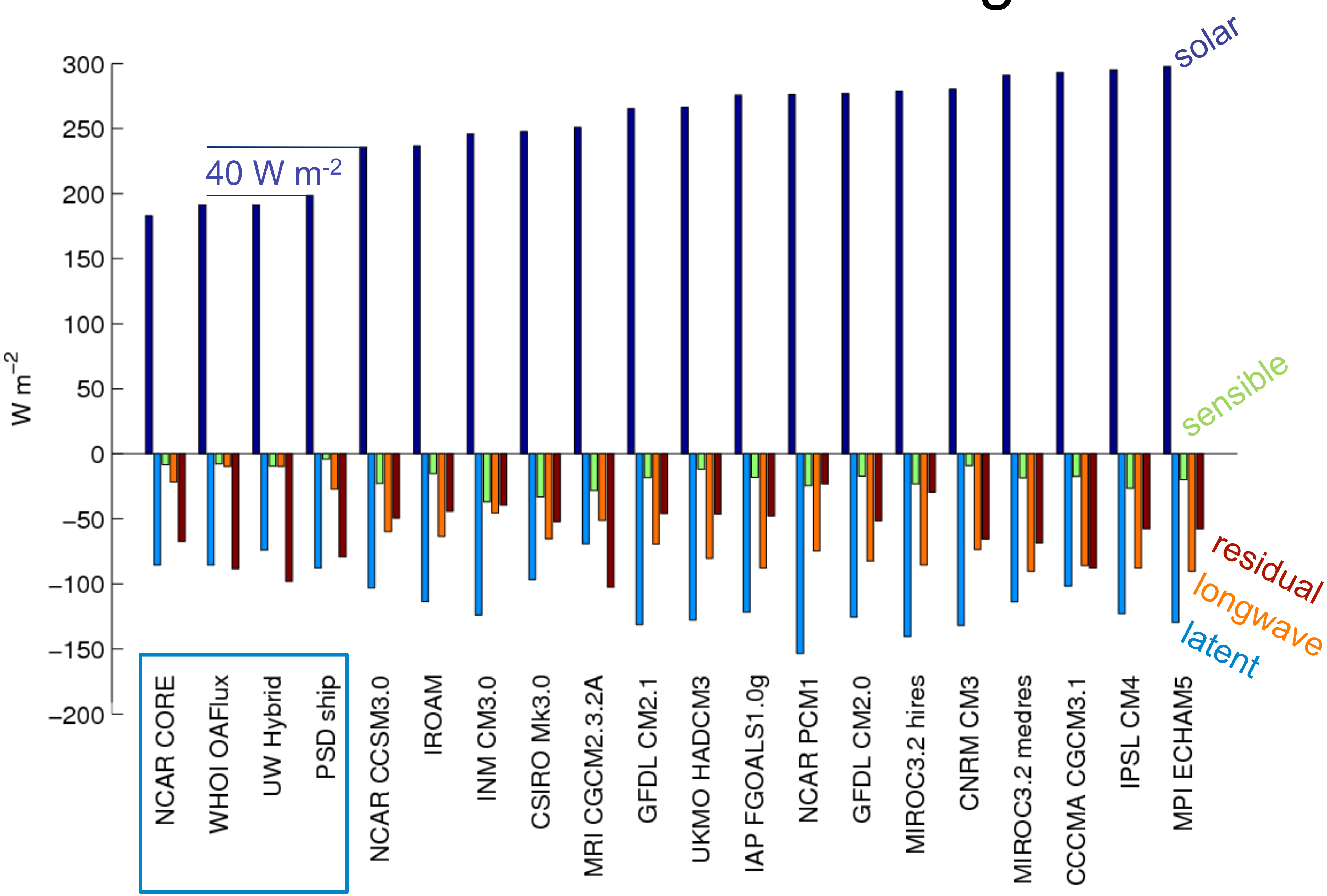


Larry O'Neill

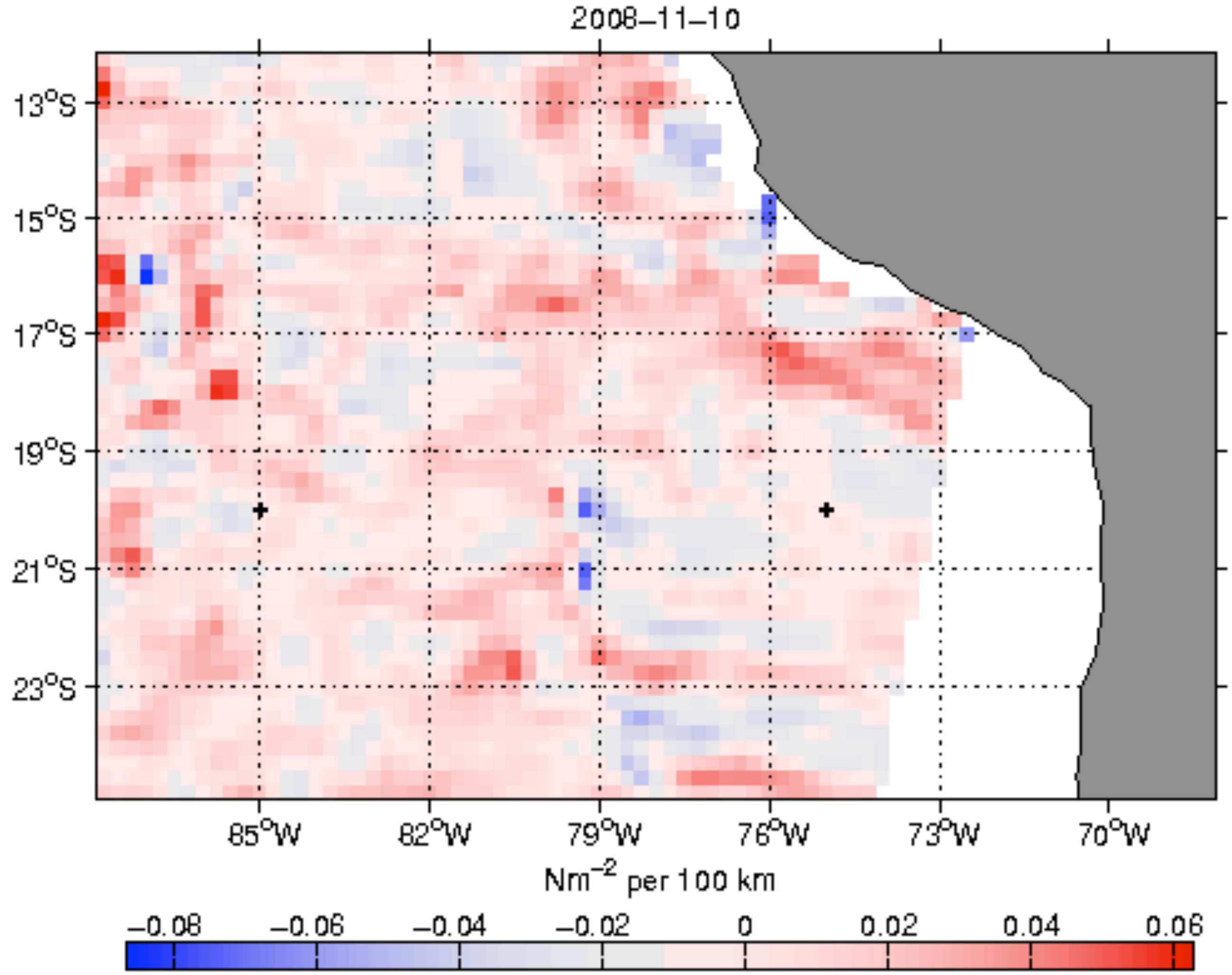
Fluxes in the surface heat budget



Surface heat balances along 20°S

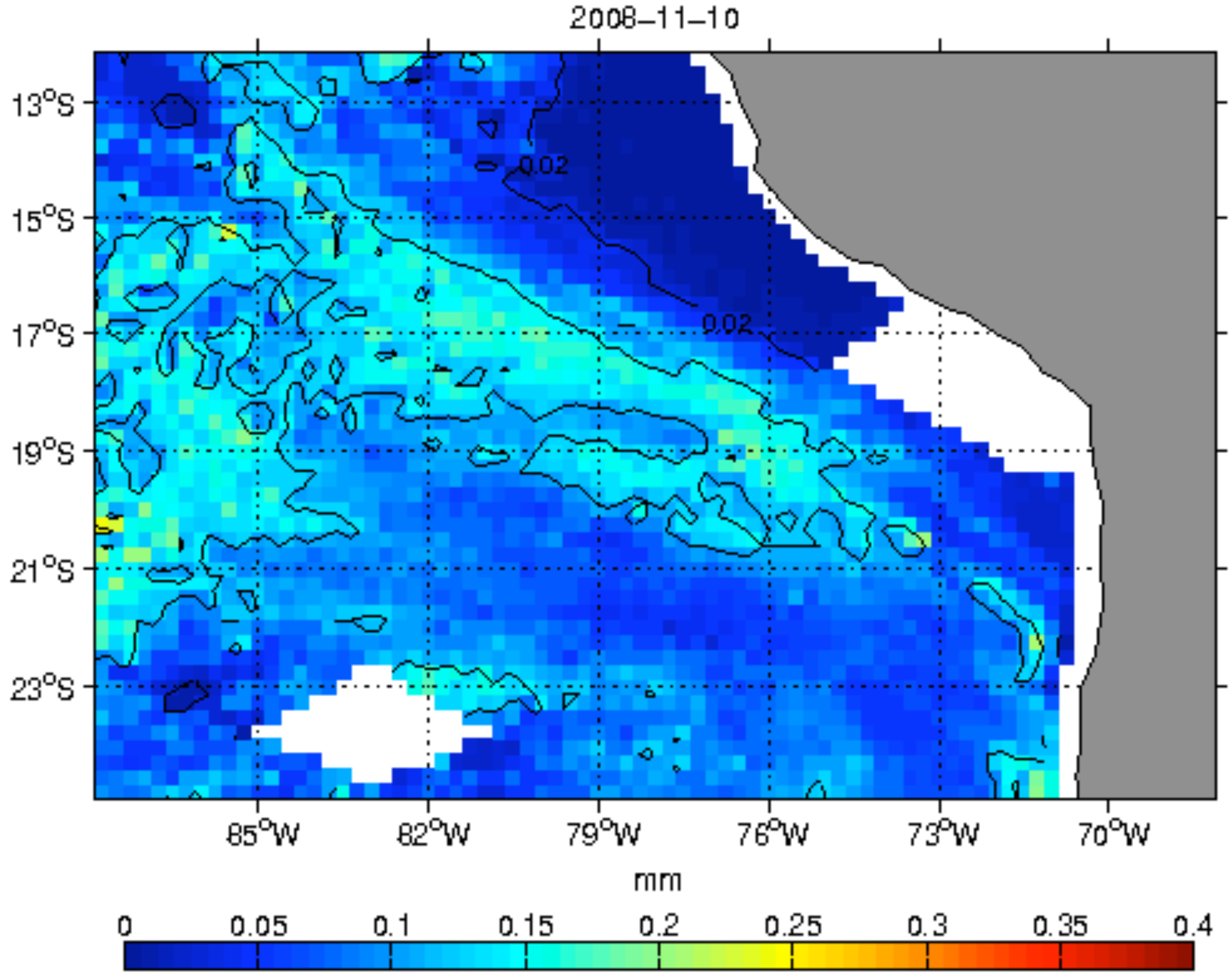


QuikSCAT wind stress divergence

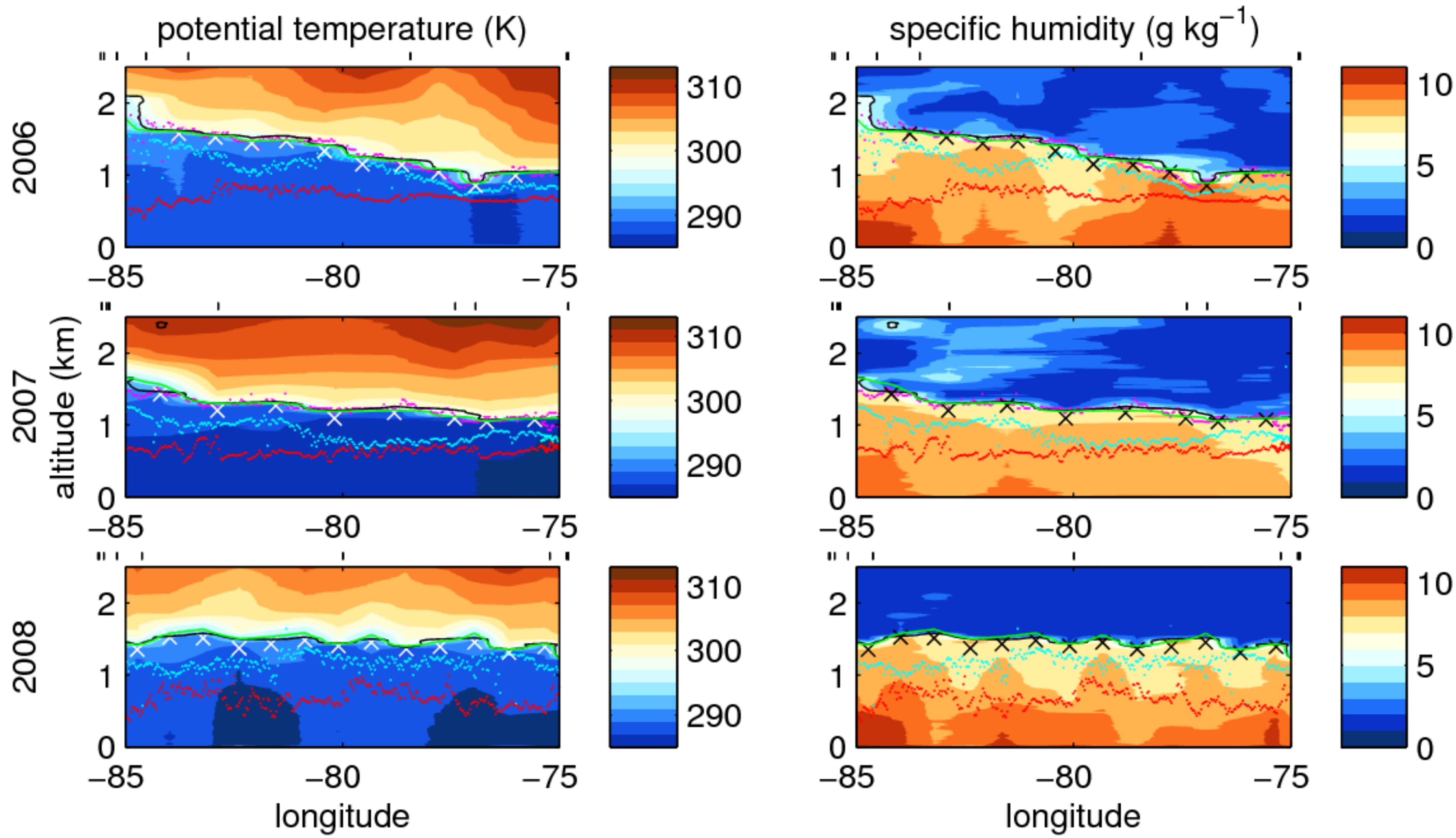


Peter Gaube

TMI cloud liquid water



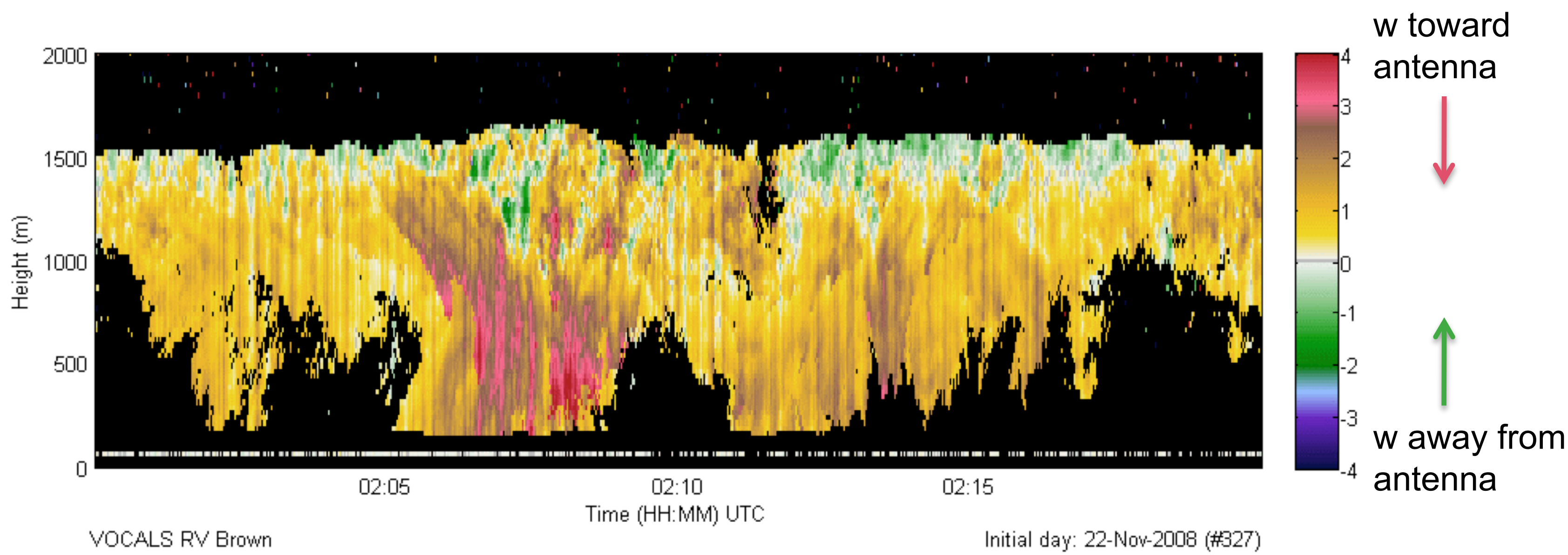
Radiosonde profiles along 20˚S



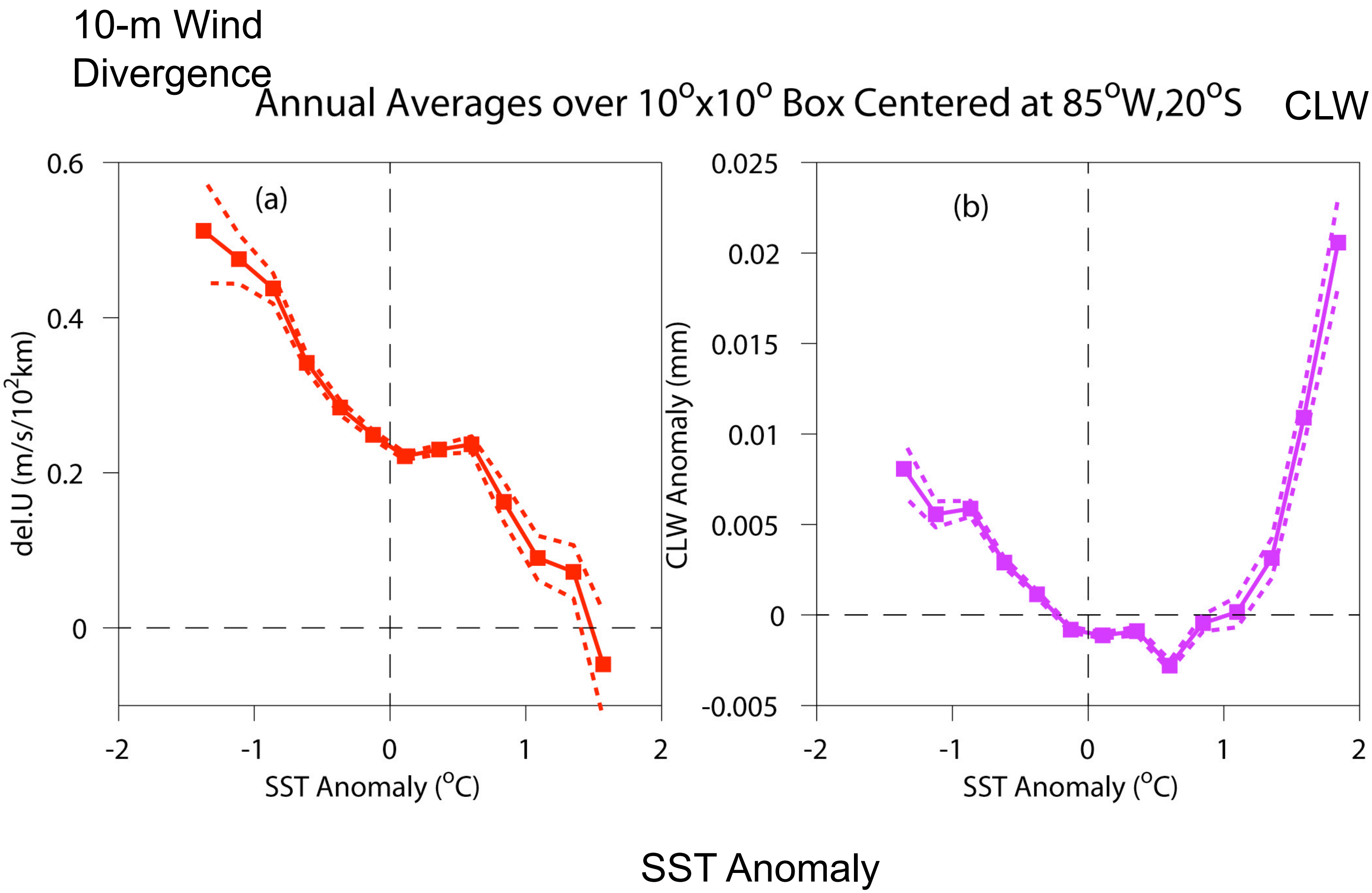
PBL height tilted west in 2001, 2005, 2006, 2007;
no tilt in 2003, 2004, 2008 (leg 1).

C-130 85˚ W sections can identify if this is synoptic variability.

Ship-based 3.2-mm cloud radar Doppler vertical velocity



Divergence and CLW vs. SST



Paulson and Wijesekera

Summary

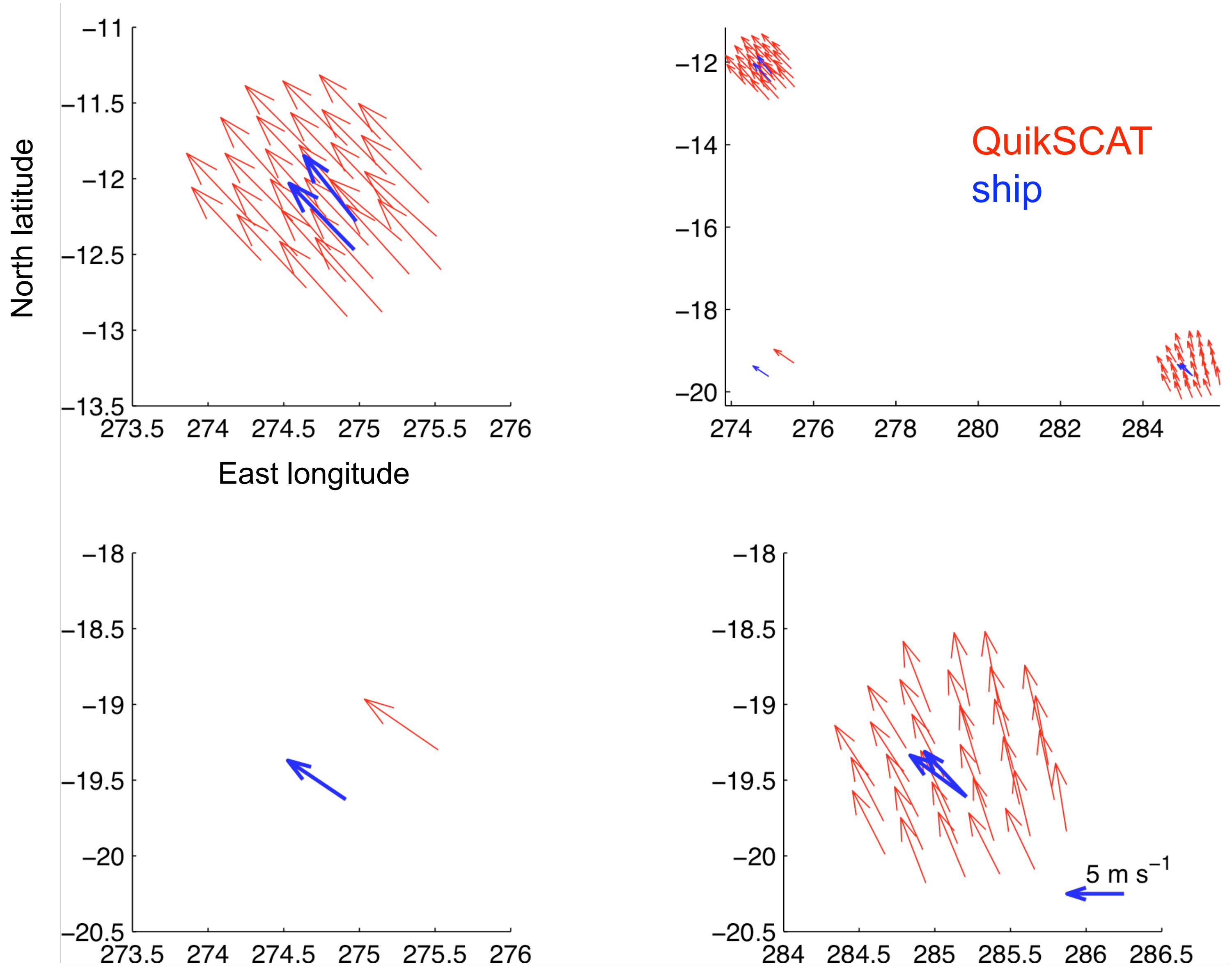
- Flux and cloud model errors in the southeast Pacific
- VOCALS REx ship, buoy, aircraft observations
- Diagnose surface heat budget
- Challenge: upscale fine in situ observations to regional and global scales.
- Satellite observations for VOCALS

  Wind agrees with buoy; speed agrees with ship.
- Synoptic variability in wind, cloud, & SST:

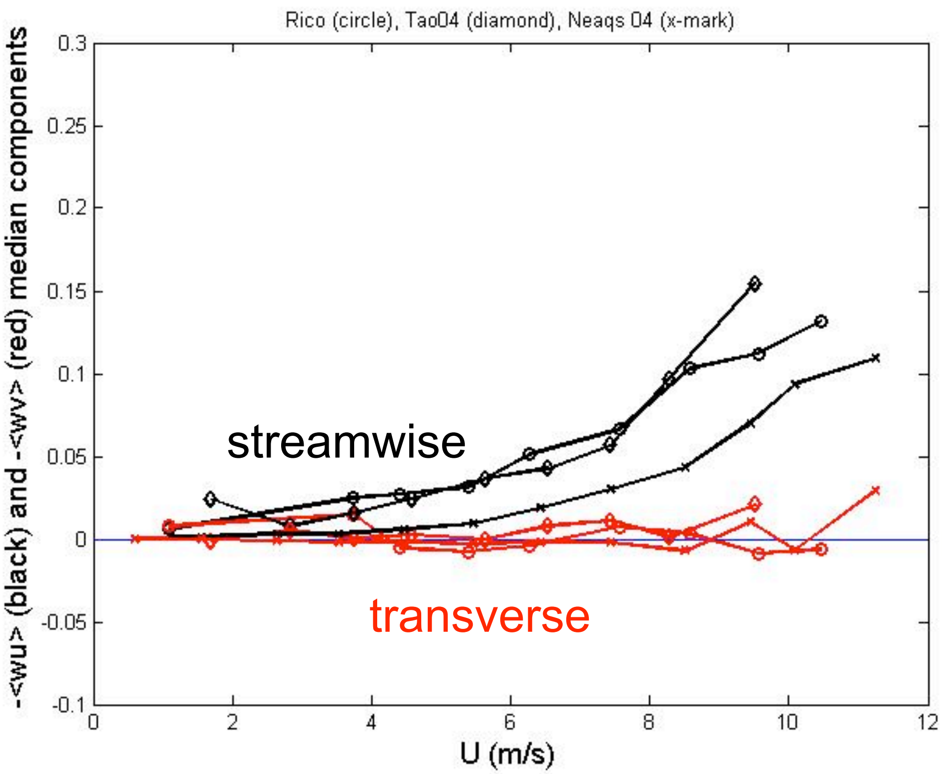
  weak divergence → convective cloud

  strong divergence → stratiform cloud

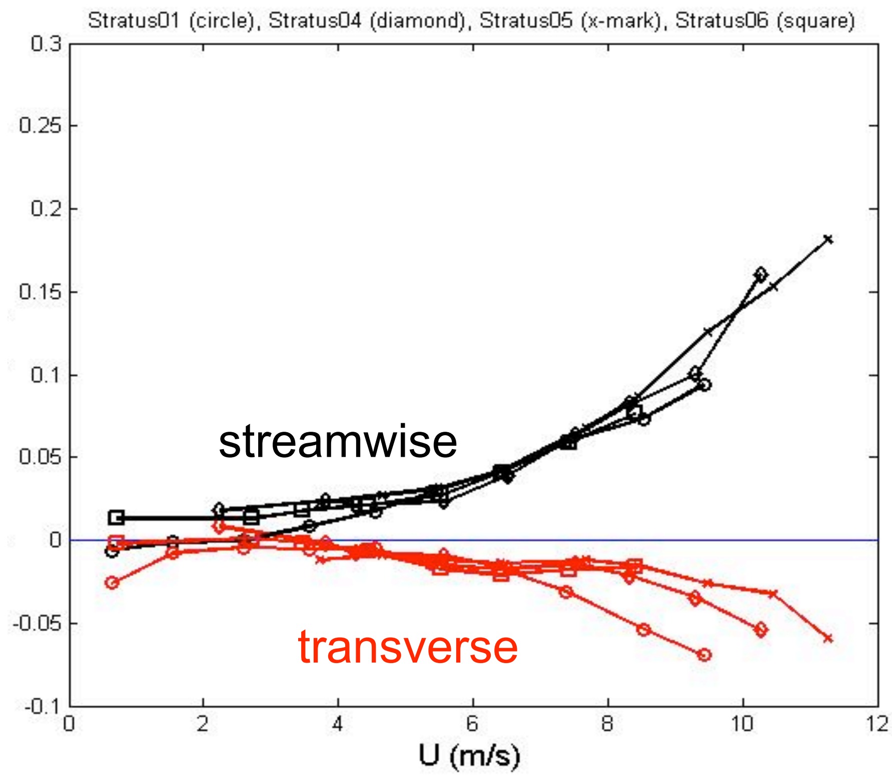
VOCALS ship wind and coincident QuikSCAT swath observations



Direct measurement of turbulent stress components

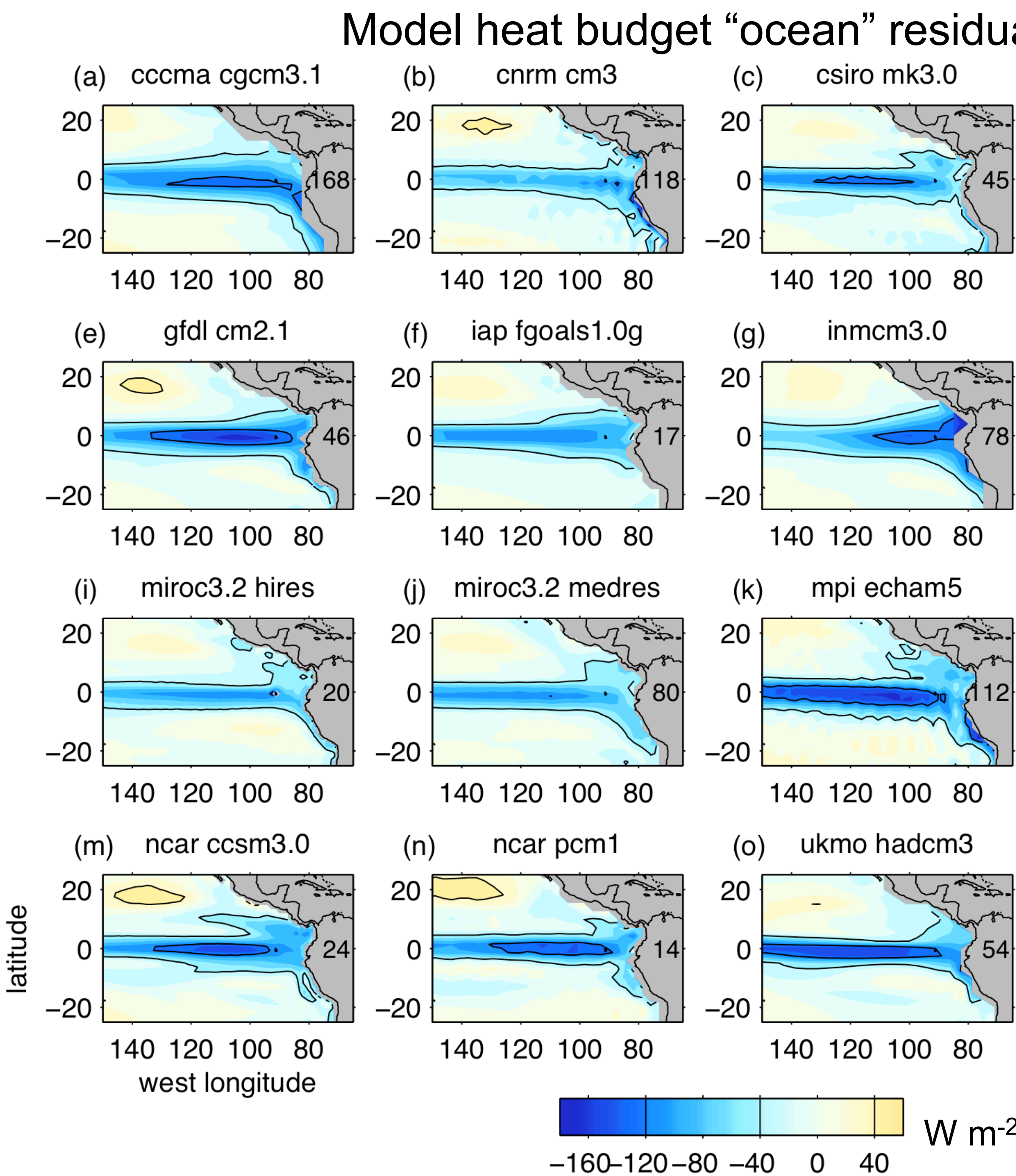


Other cruises

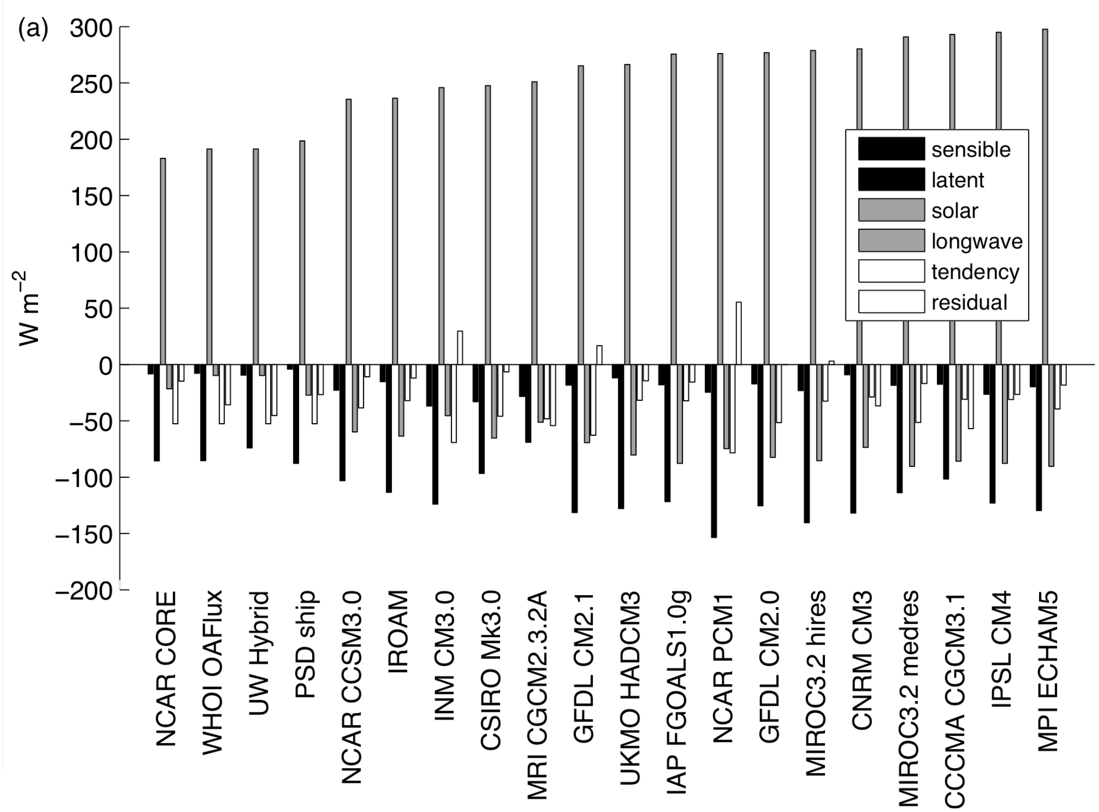


Stratus (VOCALS) cruises

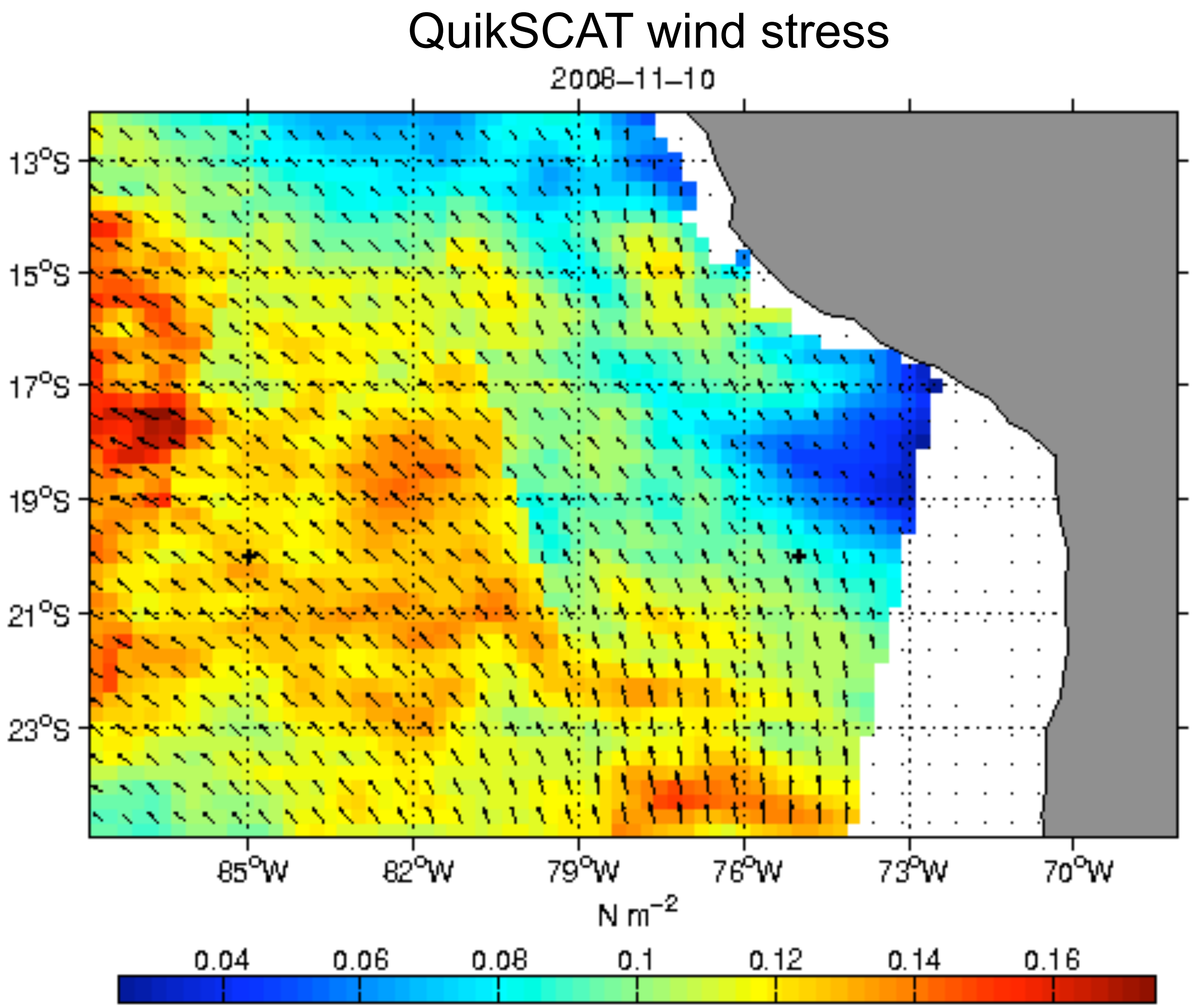
Jeff Hare


Model heat budget "ocean" residual
(a) cccma cgcm3.1
(b) cnrm cm3
(c) csiro mk3.0
(d) gfdl cm2.0
(e) gfdl cm2.1
(f) iap fgoals1.0g
(g) inmcm3.0
(h) ipsl cm4
(i) miroc3.2 hires
(j) miroc3.2 medres
(k) mpi echam5
(l) mri cgcm2.3.2a
(m) ncar ccsm3.0
(n) ncar pcm1
(o) ukmo hadcm3
(p) iroam
168
118
45
47
46
17
78
48
20
80
112
172
24
14
54
98
latitude
west longitude
20
0
−20
140 120 100 80
−160 −120 −80 −40 0 40
W m-2

October balance



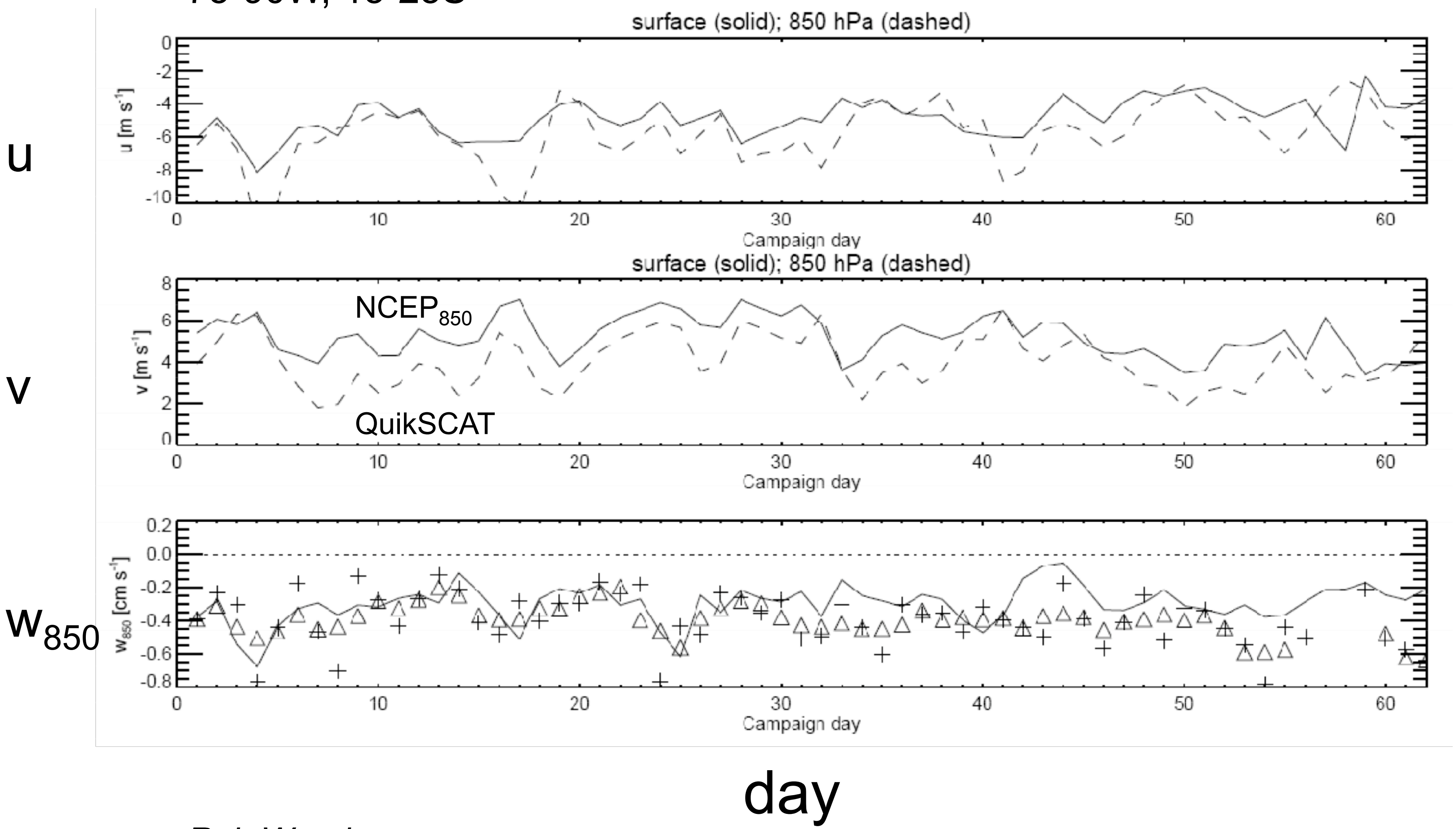
Satellite data support for VOCALS Regional Experiment at
http://numbat.coas.oregonstate.edu/vocals/



Peter Gaube

Synoptic atmospheric variability in VOCALS REx

75-90W, 15-25S



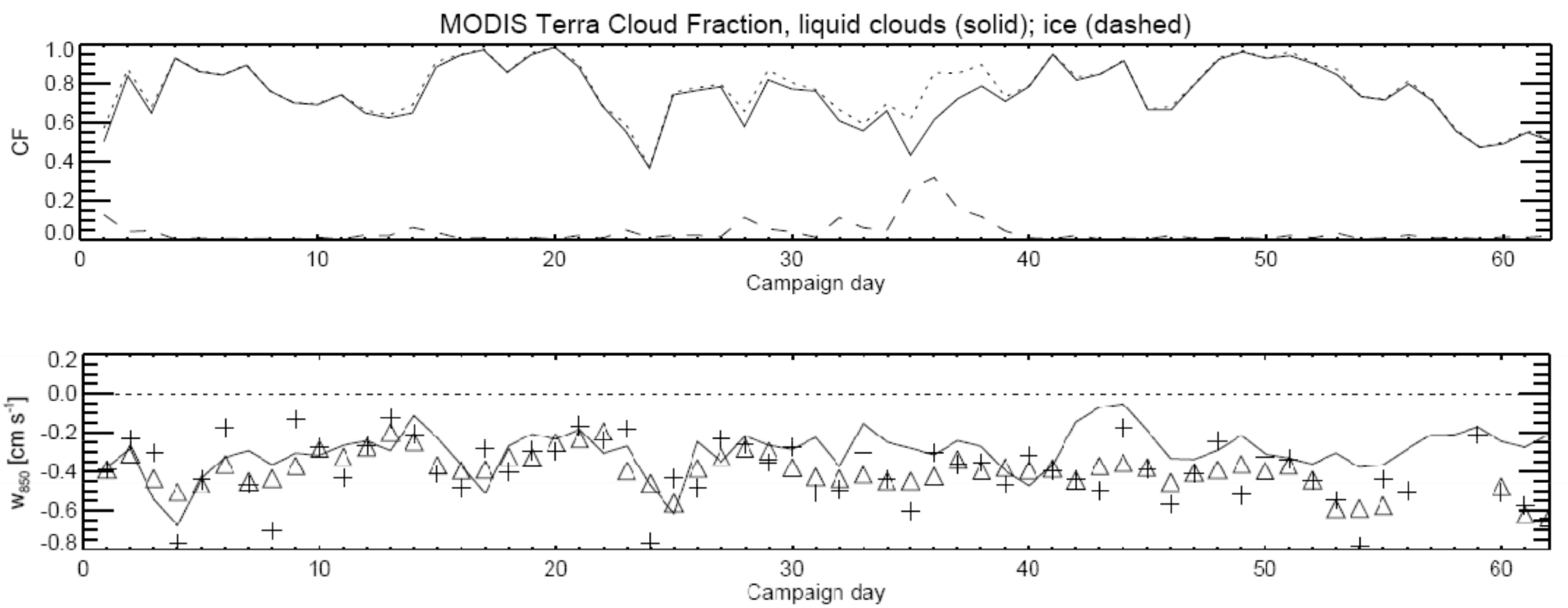
Rob Wood

Synoptic atmospheric variability in VOCALS REx

75-90°W, 15-25°S

cloud

w_{850}



day

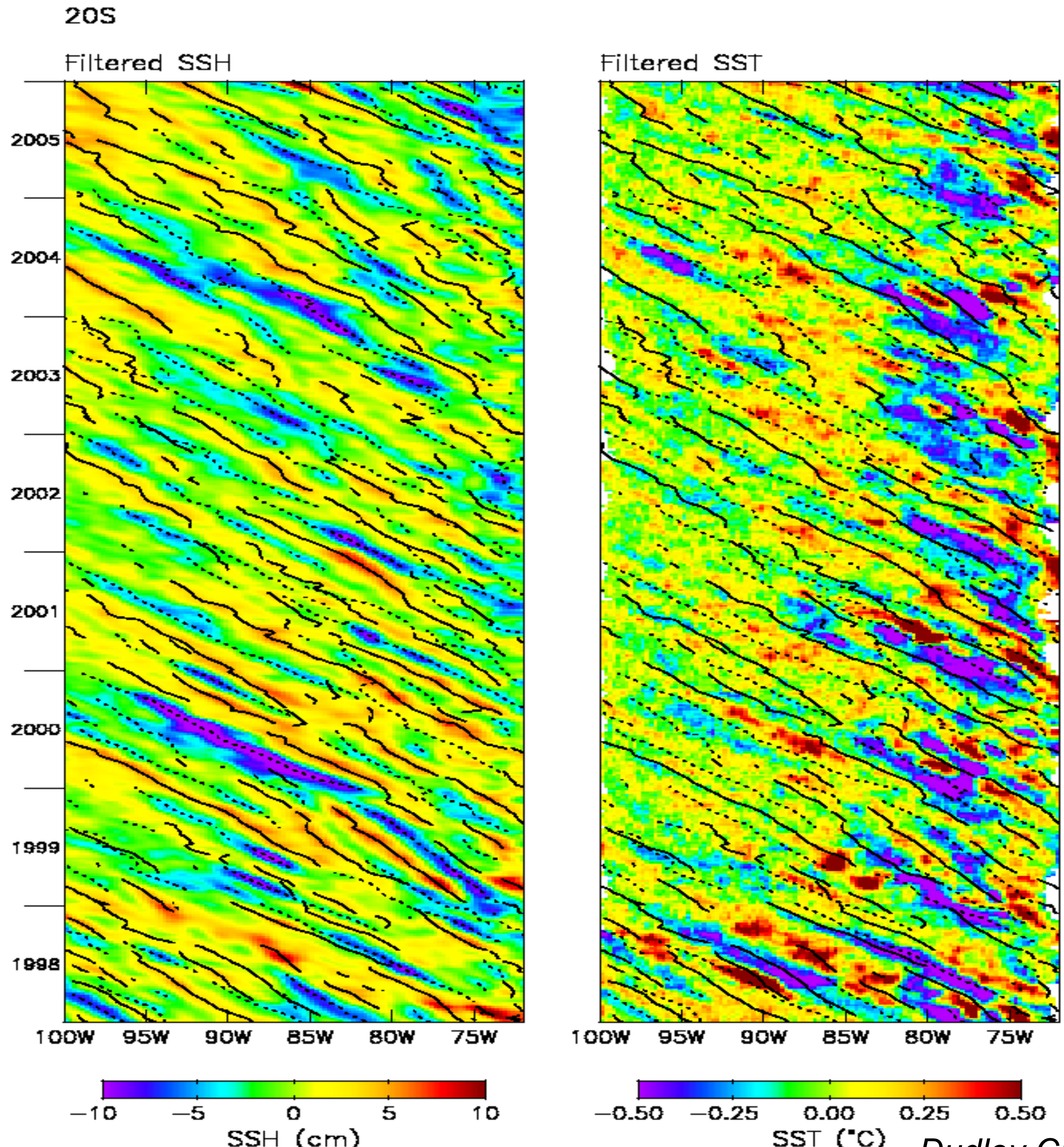
Rob Wood

Time-longitude plots of high-pass filtered SSH and SST along 20S

cyclonic..........
anticyclonic___

•Eddies transport heat

•Wind-SST coupling



Dudley Chelton