Two-way Coupled Air-Ocean Interaction in the VOCALS area using COAMPS/NCOM

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Objectives and Approaches

Understand the feedback among coastal jet, oceanic upwelling, mesoscale eddies and clouds

Coupled Ocean and Atmospheric Mesoscale Prediction System (COAMPS®)

--- Atmospheric component

Navy Coastal Ocean Model (NCOM)

--- Oceanic component

Navy Coupled Ocean Data Assimilation (NCODA)

--- multivariate optimum interpolation

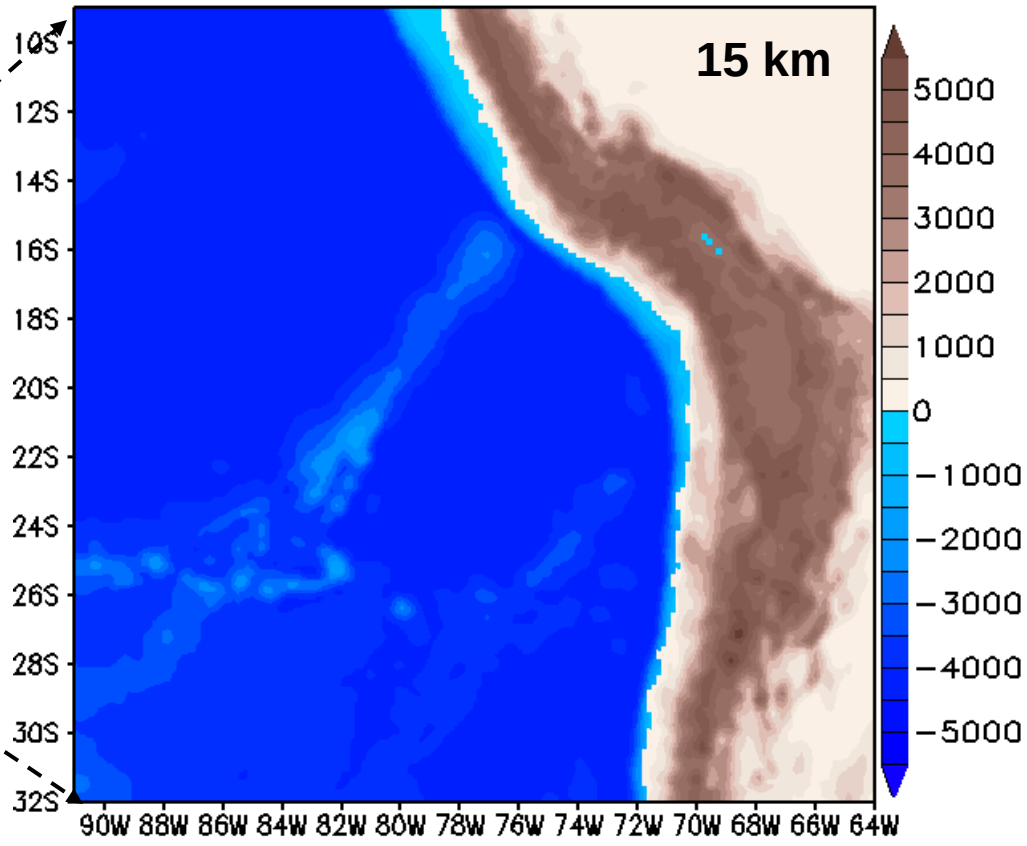
VOCALS Regional Experiment (Rex) October 20 – November 30, 2008

--- Verification with the observations

Nested Grids for COAMPS, NCOM and NCODA

COAMPS Domain

NCOM and NCODA Domain



COAMPS
Grid 1: 151 x 151 x 45
Grid 2: 199 x 181 x 45
Grid 3: 181 x 181 x 45

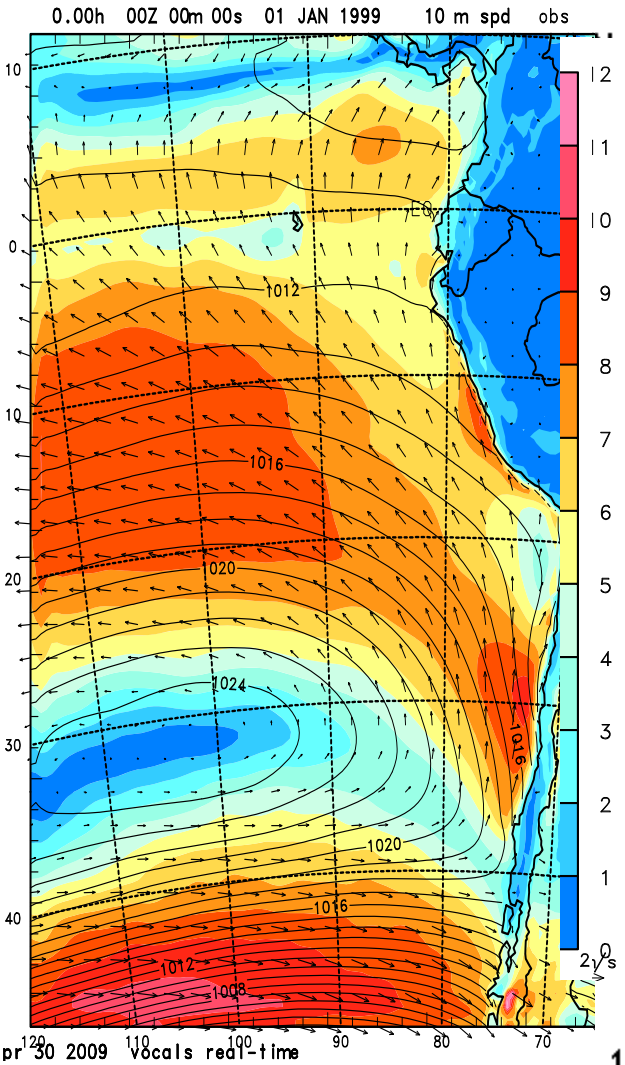
NCOM
Grid: 199 x 181 x 41

NCODA
Grid: 199 x 181 x 30

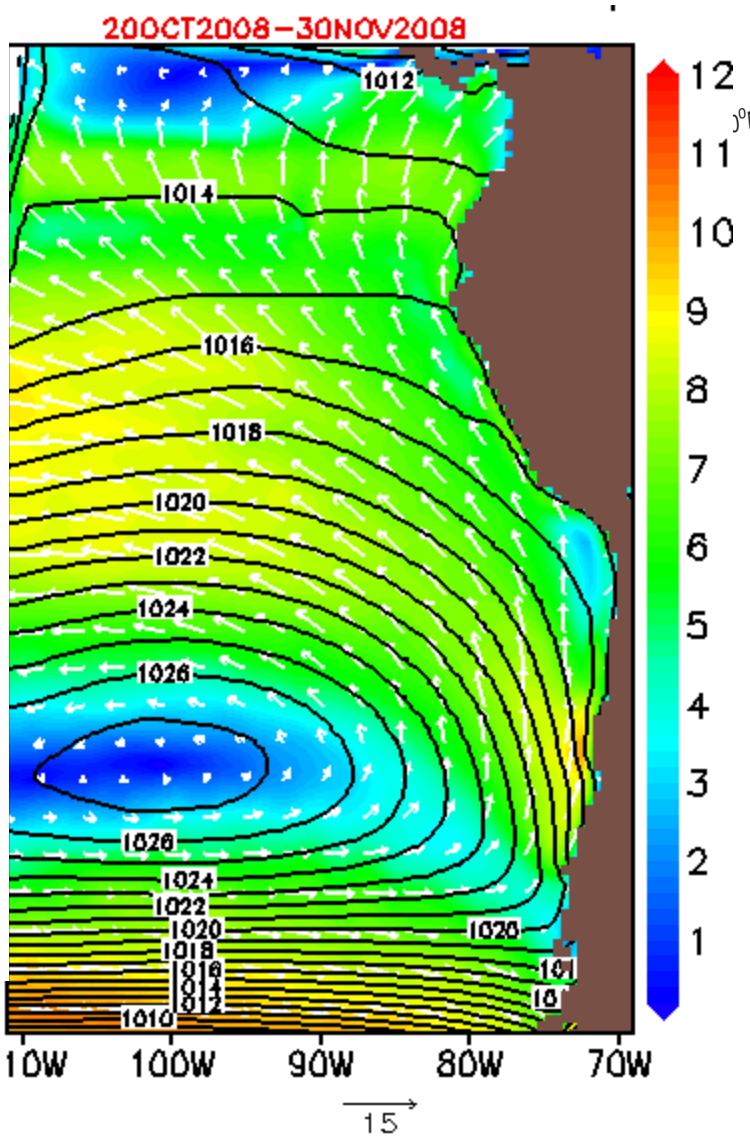
COAMPS and QuikSCAT Mean Surface Fields

10-m wind and sea level pressure (Oct 20 – Nov 30, 2008)

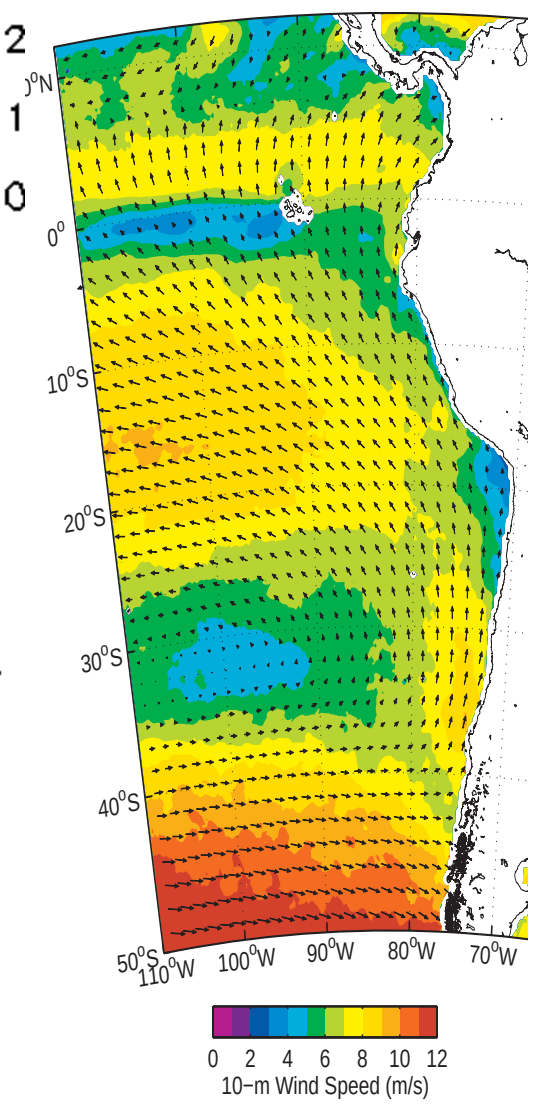
COAMPS uncoupled

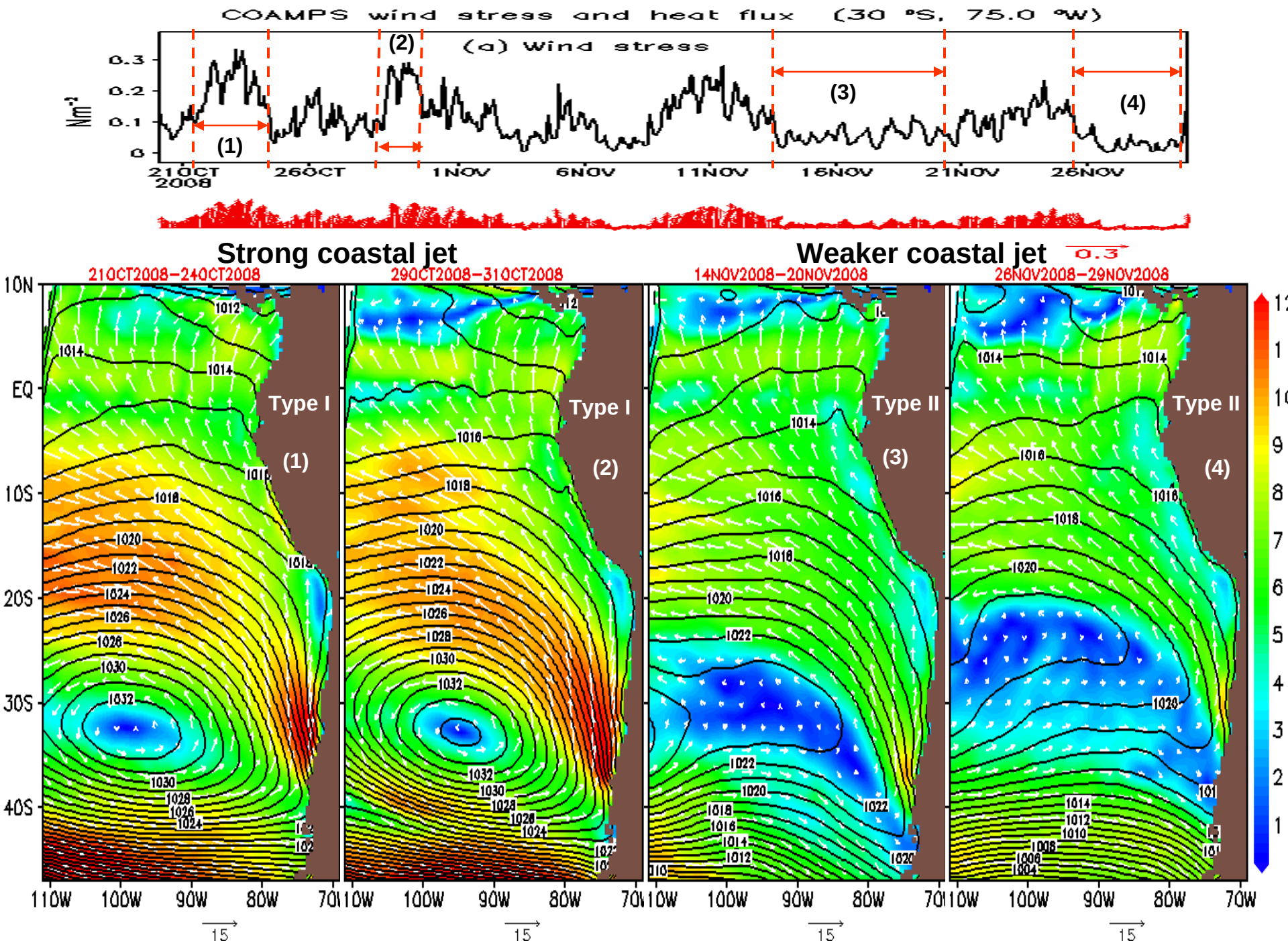


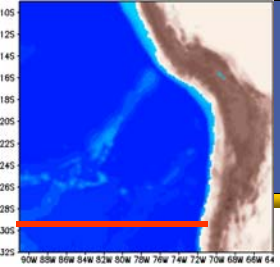
COAMPS two-way coupled



QuikSCAT



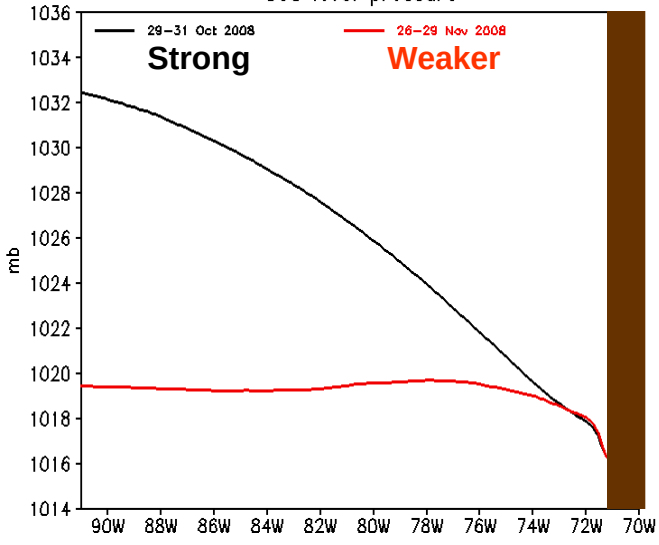

COAMPS wind stress and heat flux (30 °S, 75.0 °W)
(a) Wind stress
Nm-2
0.3
0.2
0.1
0
(1)
(2)
(3)
(4)
21OCT 2008
26OCT
1NOV
6NOV
11NOV
16NOV
21NOV
26NOV
Strong coastal jet
Weaker coastal jet
0.3
21OCT2008–24OCT2008
29OCT2008–31OCT2008
14NOV2008–20NOV2008
26NOV2008–29NOV2008
Type I
Type I
Type II
Type II
(1)
(2)
(3)
(4)
10N
EQ
10S
20S
30S
40S
110W
100W
90W
80W
70W
15



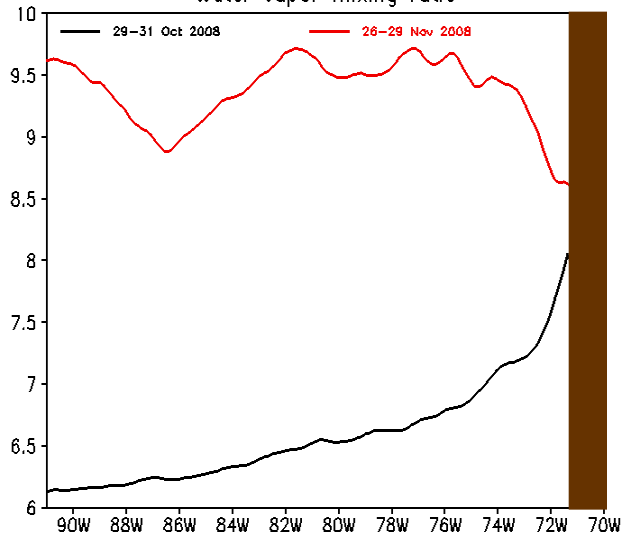
COAMPS Surface Fields

29-31 Oct (Strong coastal jet) vs. 26-29 Nov (Weaker coastal jet)

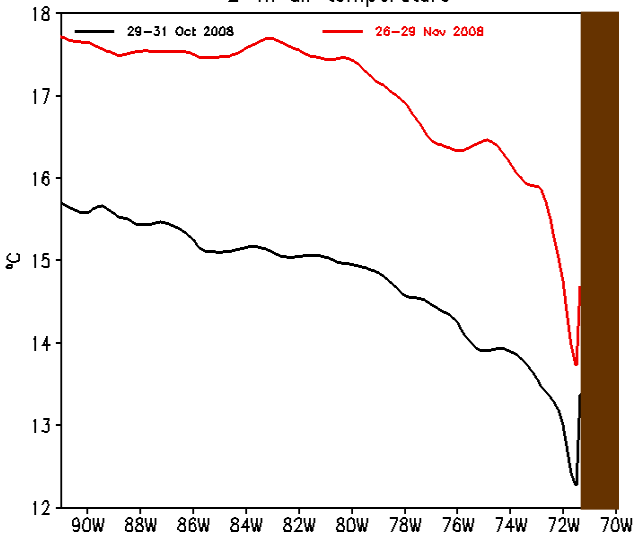
Sea level pressure



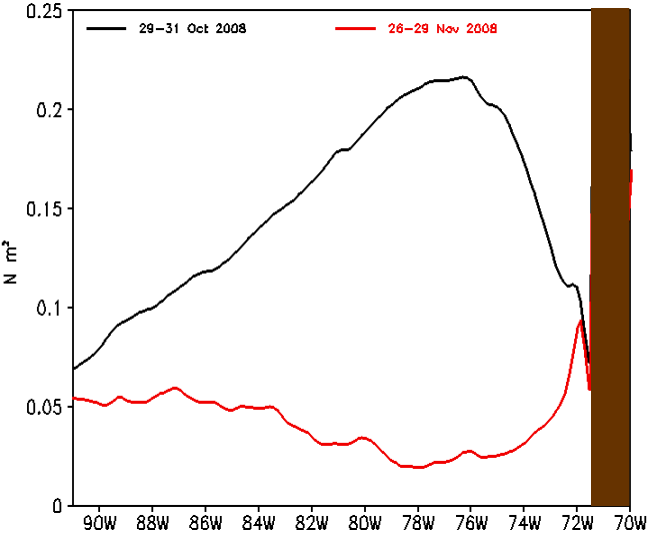
Water vapor mixing ratio



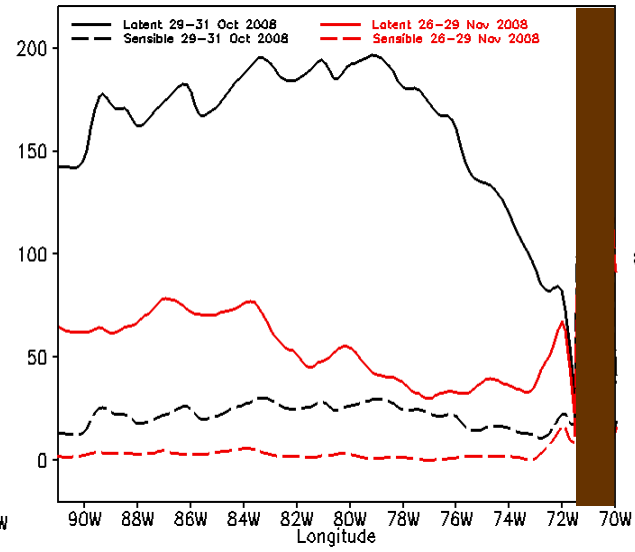
2–m air temperature



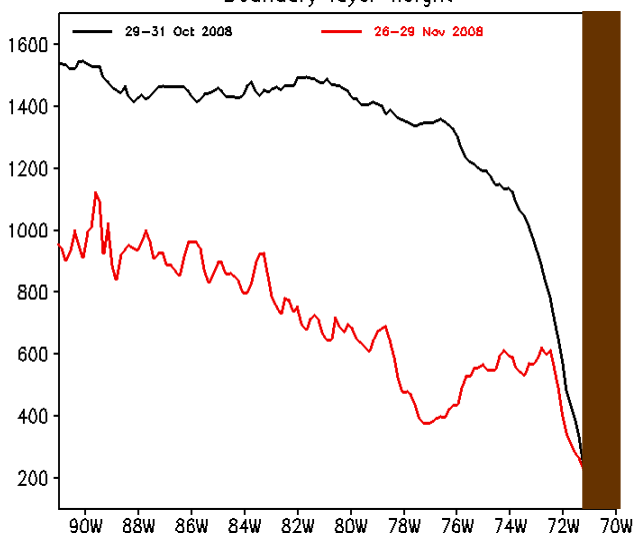
Wind stress



Latent and sensible heat fluxes



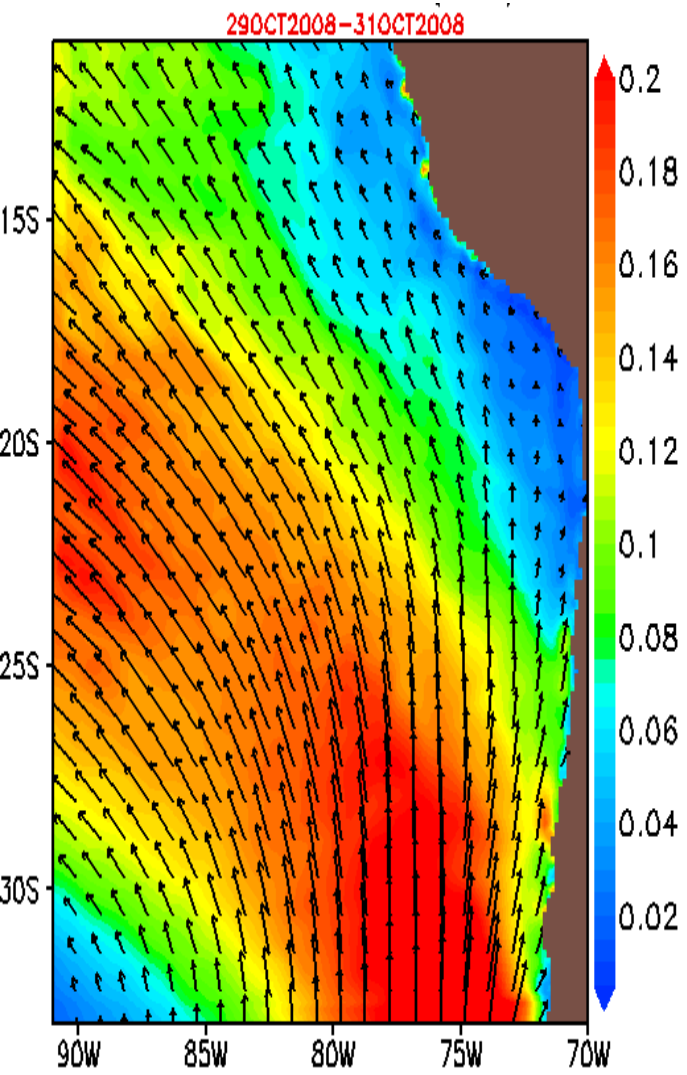
Boundary layer height



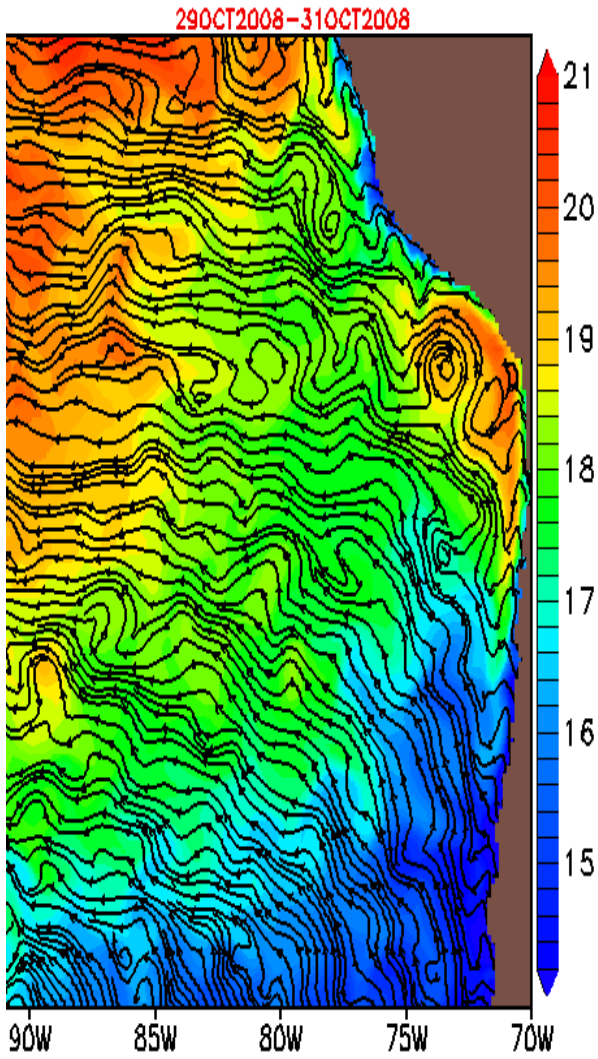
COAMPS and NCOM Mean Surface Fields

Oct 20 – 31, 2008 (Strong coastal jet)

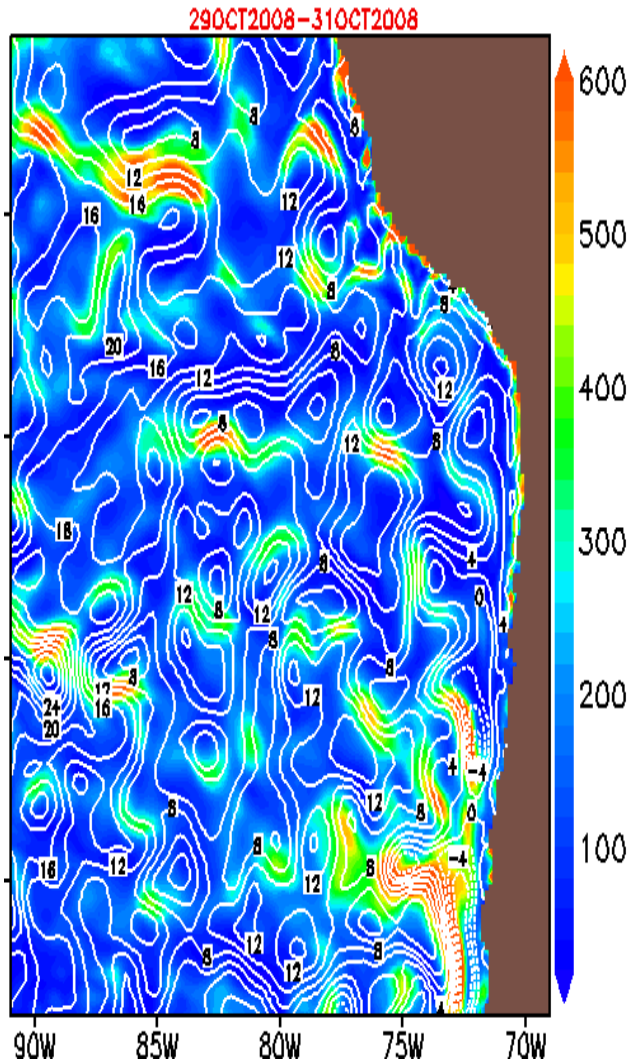
COAMPS wind stress



NCOM surface current & temperature



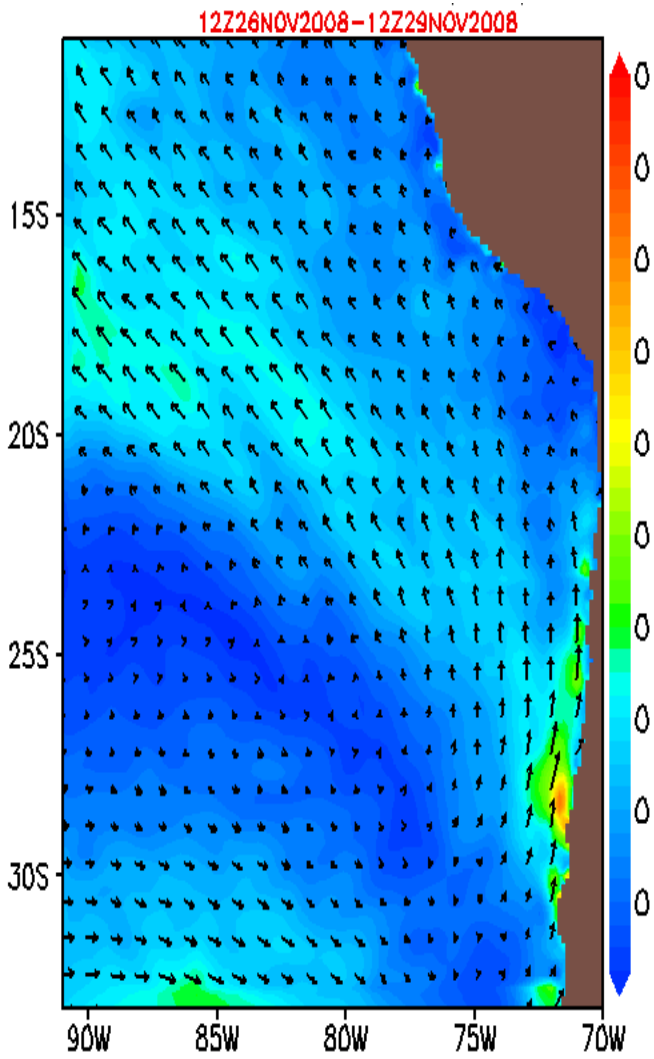
NCOM Kinetic Energy & surface height



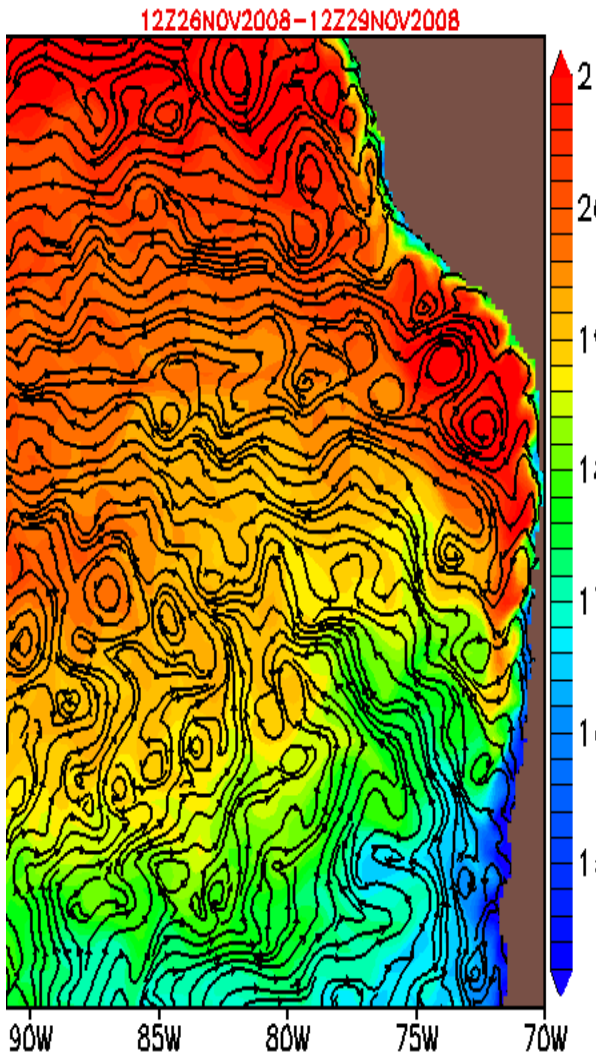
COAMPS and NCOM Mean Surface Fields

Nov 26 – 29, 2008 (Weaker coastal jet)

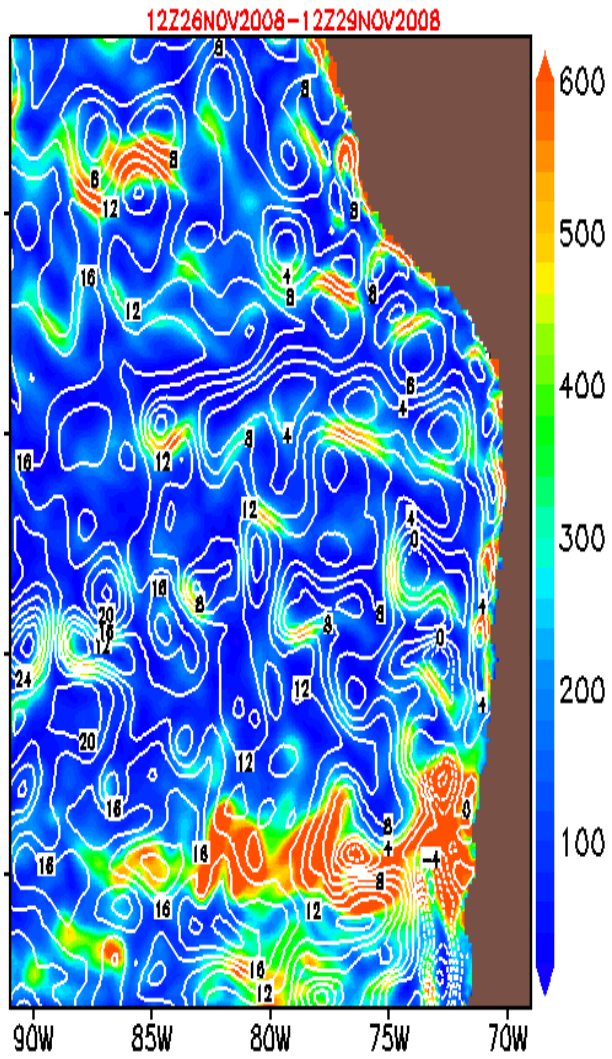
COAMPS wind stress

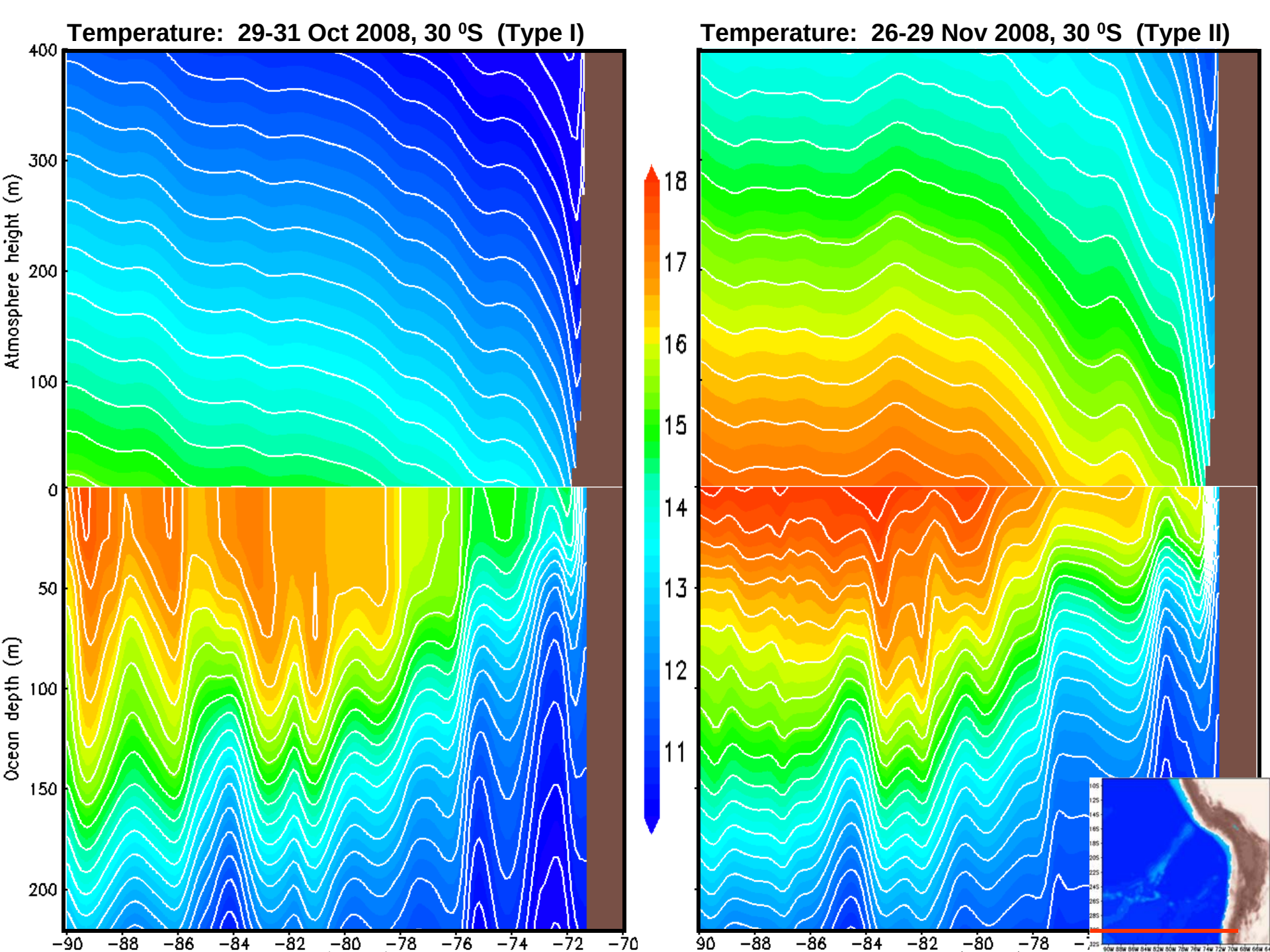


NCOM surface current & temperature



NCOM Kinetic Energy & surface height

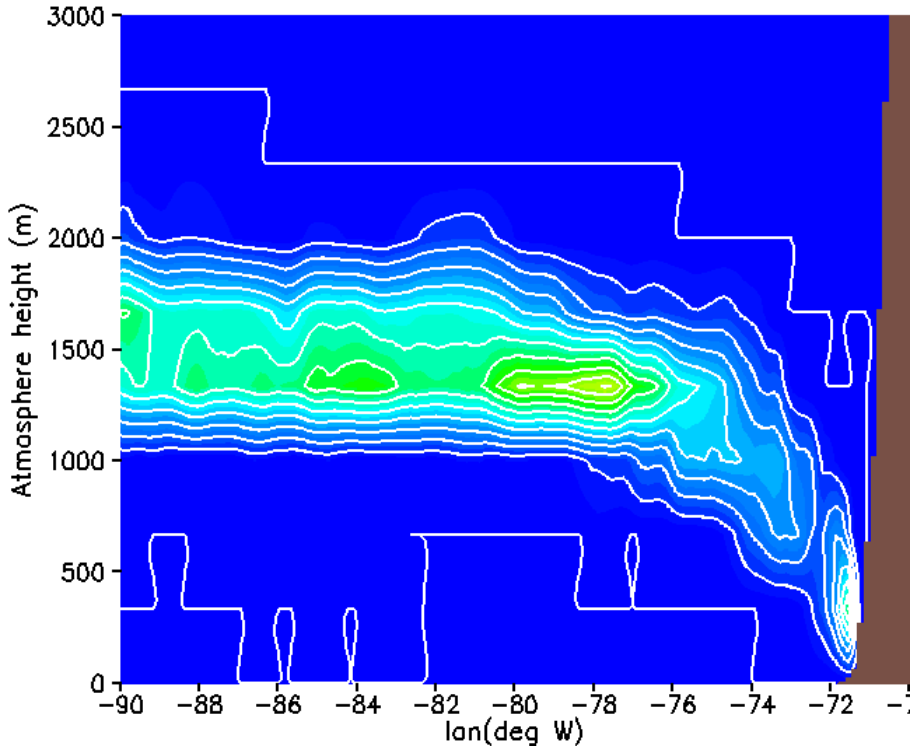



Temperature: 29-31 Oct 2008, 30 ⁰S (Type I)
Temperature: 26-29 Nov 2008, 30 ⁰S (Type II)
Atmosphere height (m)
Ocean depth (m)
400
300
200
100
0
50
100
150
200
18
17
16
15
14
13
12
11
−90
−88
−86
−84
−82
−80
−78
−76
−74
−72
−70
90
−88
−86
−84
−82
−80
−78

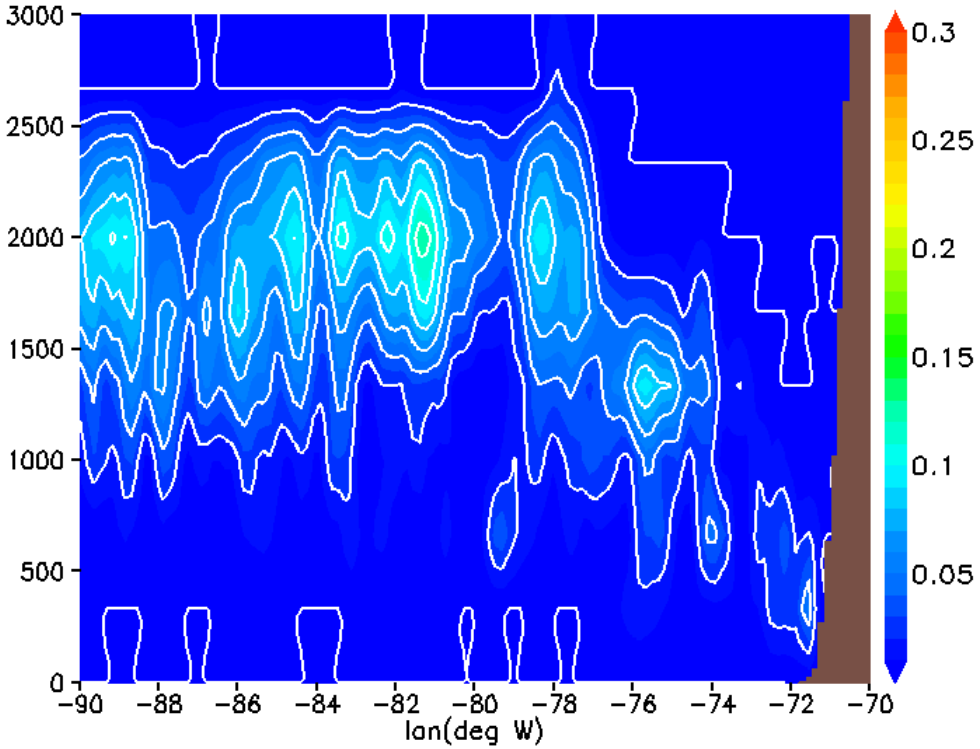
COAMPS Cloud Water Mixing ratio

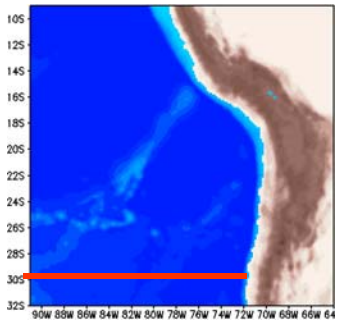
Feedback from the ocean to the atmosphere

29OCT2008 – 31OCT2008 30 ^{0}S (Strong)



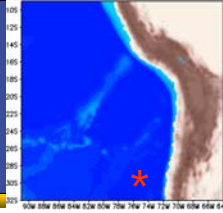
26NOV2008 – 29NOV2008 30 ^{0}S (Weaker)

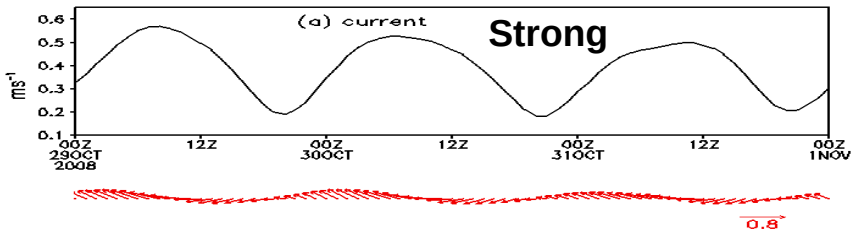


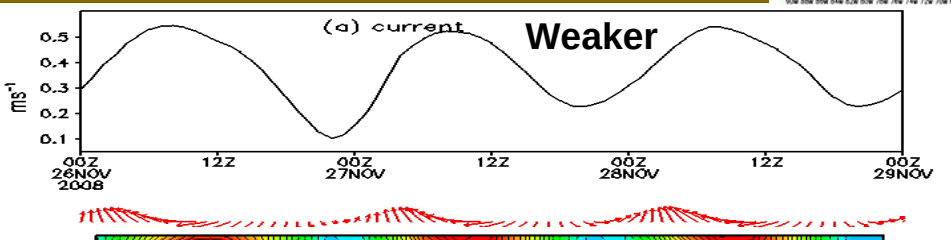


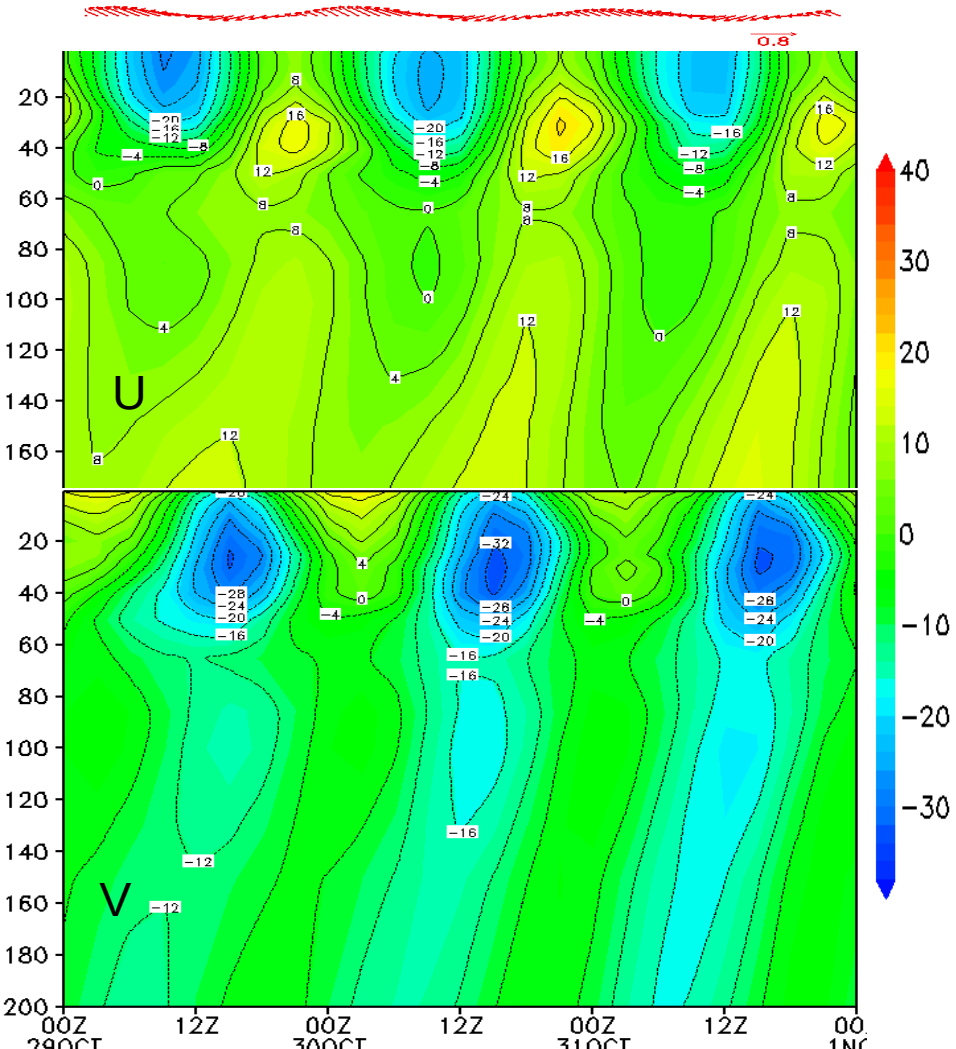
NCOM Current Inertial Oscillations

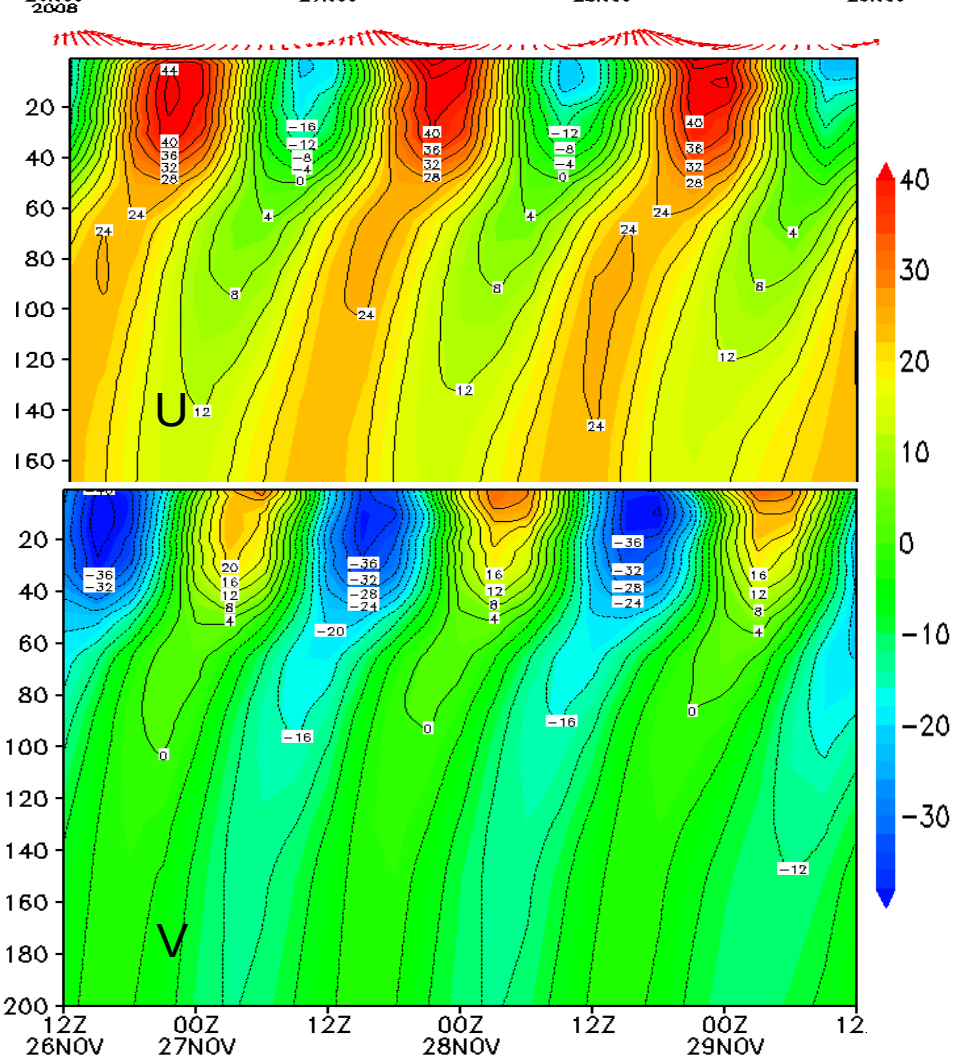
29-31 Oct (Strong) vs. 26-29 Nov (Weaker) (30 ^{0}S, 75 ^{0}W)











Summary

- Two-way coupled COAMPS and NCOM are used to studied the feedback among coastal jet, oceanic upwelling, mesoscale eddies and clouds.
- Mean surface wind from the coupled simulation is more comparative to the QuikSCAT observation.
- Large variation in the coastal jet associated with the strength and the location of subtropical high-pressure system along the Chilean coast.
- Stronger coastal jet brings colder and drier air to the coast and offshore of Chile. This results larger surface heat fluxes and higher boundary layer height.
- Stronger coastal jet induces stronger upwelling and the upwelled cold water extends farther offshore.
- Oceanic eddies are propagated westward during the weaker coastal jet period.
- Strong unstable condition in the atmospheric boundary layer is generated during the strong coastal jet period. This results more and organized clouds.
- Inertial oscillation increases its strength during the weaker coastal jet period.