A Satellite and Model Study of the Oceanic Surface Circulation in the Southeast Pacific

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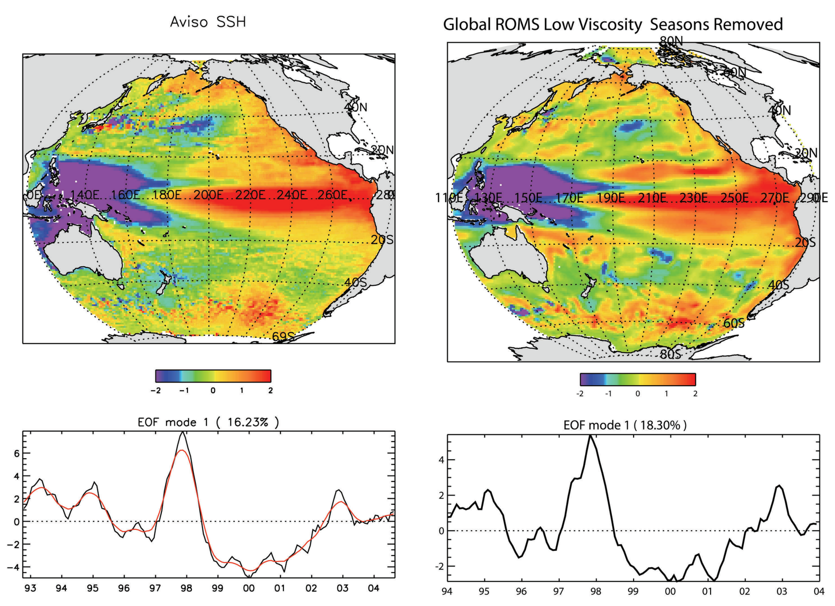
Global ROMS Model - 1st SSH EOF
Model vs Altimeter: Spatial and temporal patterns are very similar (more so than SST) and clearly describe the ENSO signal.



GOAL

Describe and understand the seasonal and interannual variability in the Humboldt Current System's (HCS) surface circulation.

Compare the Humboldt Current Systems characteristics to those of the California Current Current System

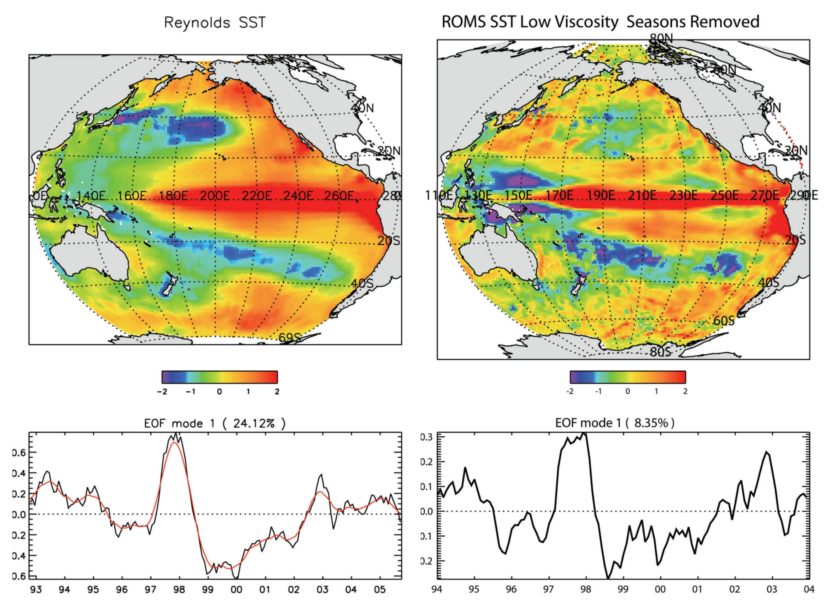
METHODS

Use the Regional Ocean Model System (ROMS) to simulate the Humboldt Current System, nested within a basin-scale model (also ROMS).

By varying the boundary conditions of the regional model, separate the effects of regional wind forcing and distant forcing.

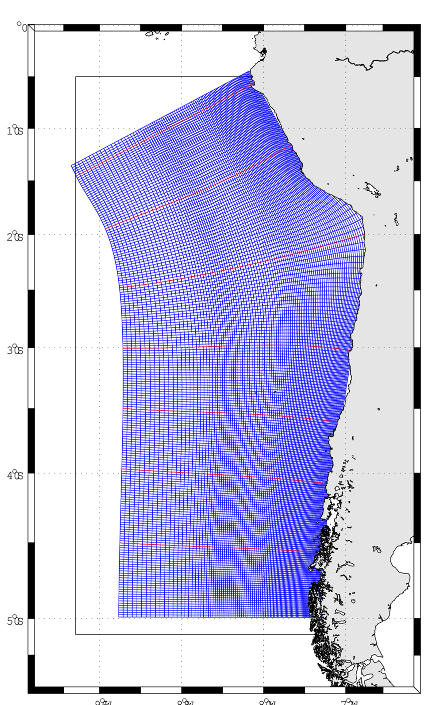
Compare the satellite-derived SSH and SST to evaluate model realism.

Global ROMS Model - 1st SST EOF
Model vs Reynolds SST: Spatial patterns are moderately similar and the time series does pick out the ENSO signal.



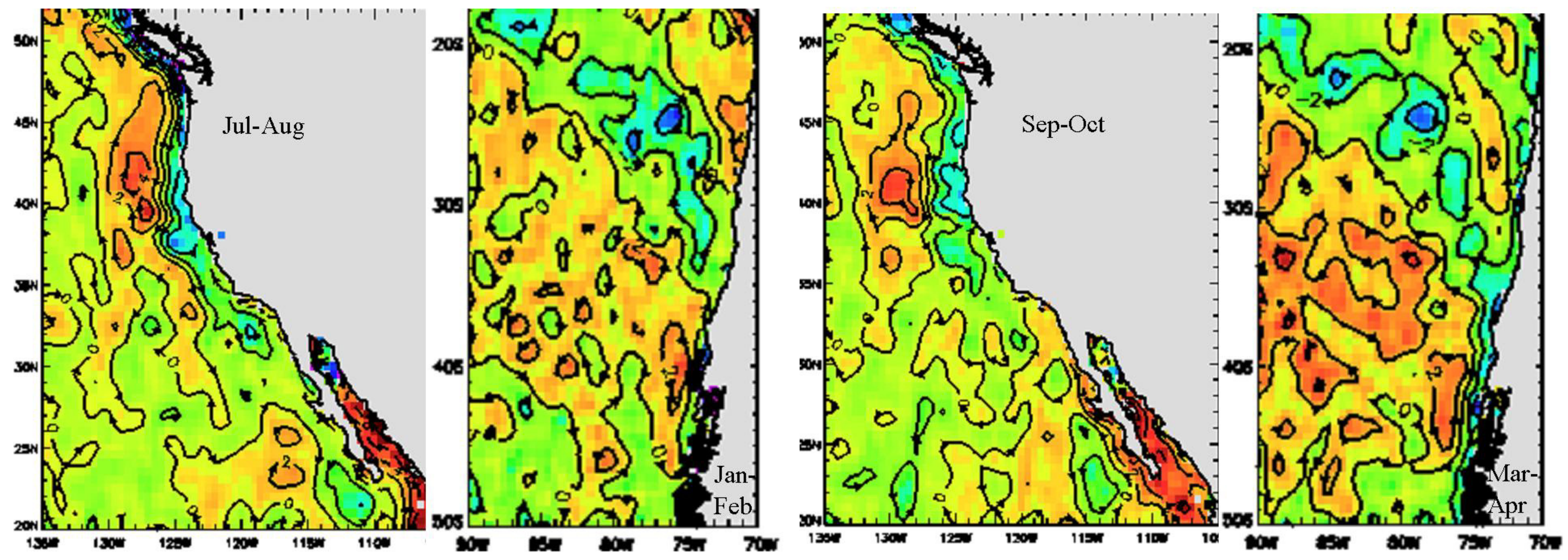
MOTIVATION

The altimeter shows a much weaker seasonal cycle in SSH in the Humboldt Current System than in the California Current System, where a band of low SSH accompanies the beginning of upwelling in spring. The low SSH (blue in the figures to the right) is well developed by July-August off North America, the equivalent of January-February in the Southern Hemisphere. It does not develop until March April off Chile at similar latitudes to North America. Does the equatorial connection act to suppress the SSH seasonal cycle?



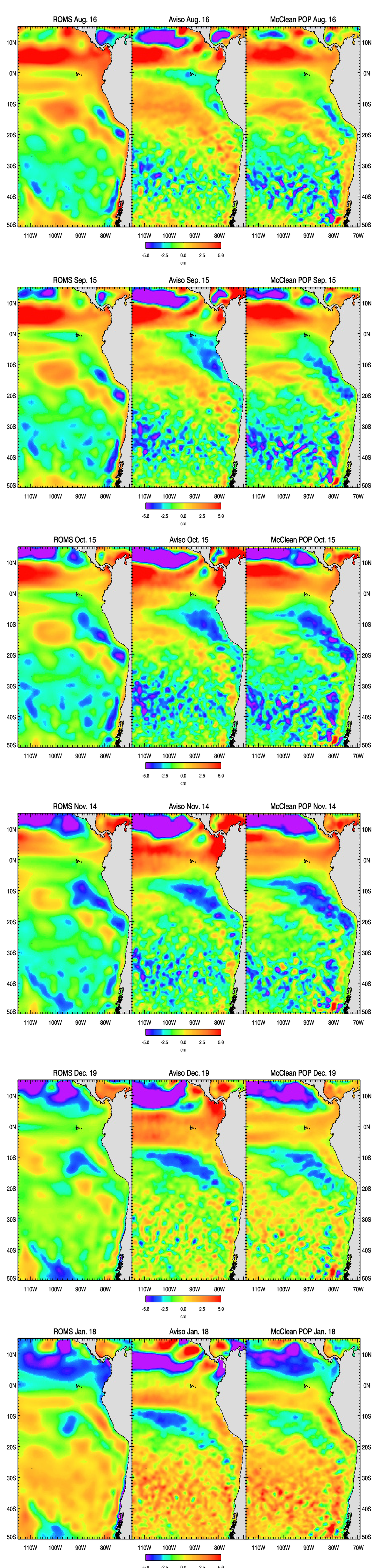
The global ROMS model was run by Guillermo Auad at Scripps: 0.8° longitude; 0.5° latitude; NCEP wind stress and heat flux.

The regional ROMS model (grid shown on the left) was run by Elbio Palma and Ricardo Matano at COAS: 0.1° horizontal resolution (which is being improved). Two different runs used different boundary conditions - one including forcing by the global model on the regional model and another without the boundary forcing, including only forcing by the winds over the regional model.



PROGRESS TO DATE

SSH Seasonal Cycle: The altimeter (center, below) shows a seasonal collapse of the cold tongue, resulting in high SSH along Peru and northern Chile in December and Jauary (summer). Another, weaker high SSH signal occurs in June-August (winter), creating a semi-annual nature to the seasonal cycle. The global ROMS model emphasizes the winter signal. The altimeter emphasizes the summer signal. A new run of the global POP model appears to simulate the altimeter signal better.

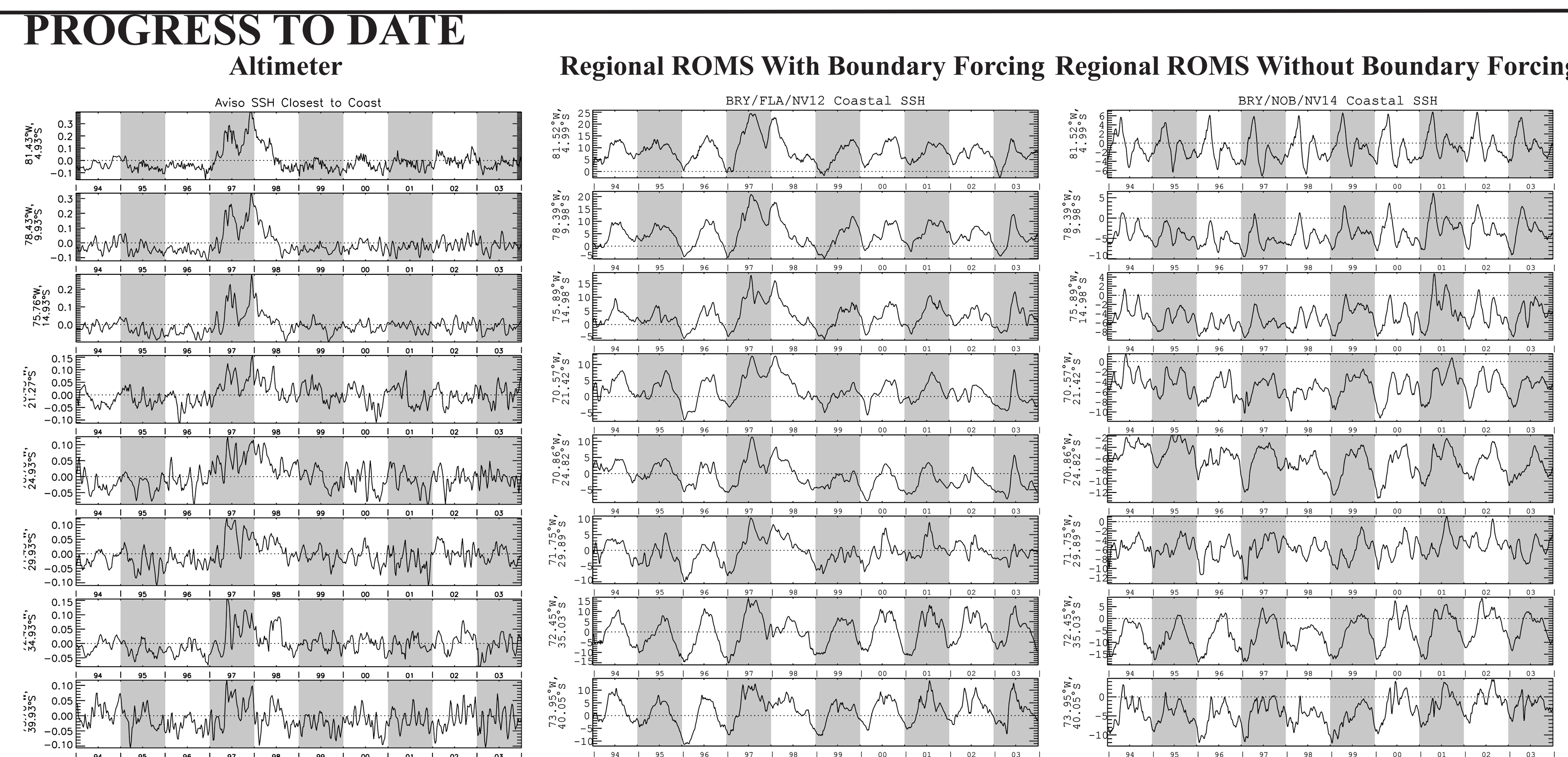


Coastal SSH Time Series:

Without removing the seasonal cycle, the ***altimeter*** time series has only a weak seasonal cycle at low latitudes, where the signal is dominated by ENSO. At around 20°S, there is a tendency for high SSH in austral winter. At higher latitudes (35°-40°S), the seasonal upwelling often produces low SSH in austral summer.

The regional ***ROMS model with boundary forcing*** from the global model produces an ENSO signal and a regular seasonal cycle with highs in austral winter and lows in austral summer. The seasonal cycle is stronger than in the altimeter data and different in phase.

The regional ***ROMS model without boundary forcing*** does not include the ENSO signal and produces a semi-annual seasonal cycle at low latitudes and a seasonal cycle (wind-driven) with low SSH in summer and high SSH in winter.

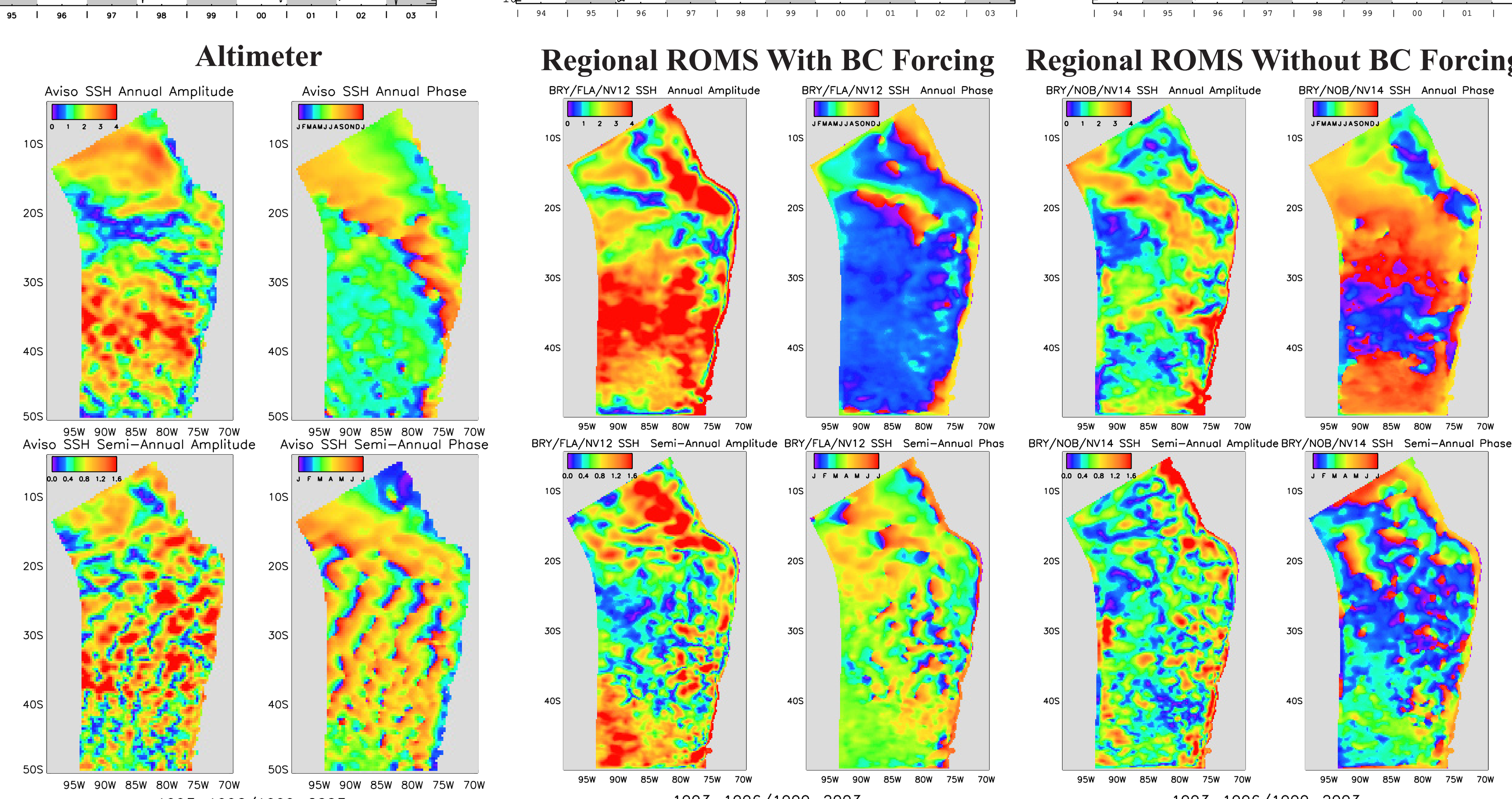


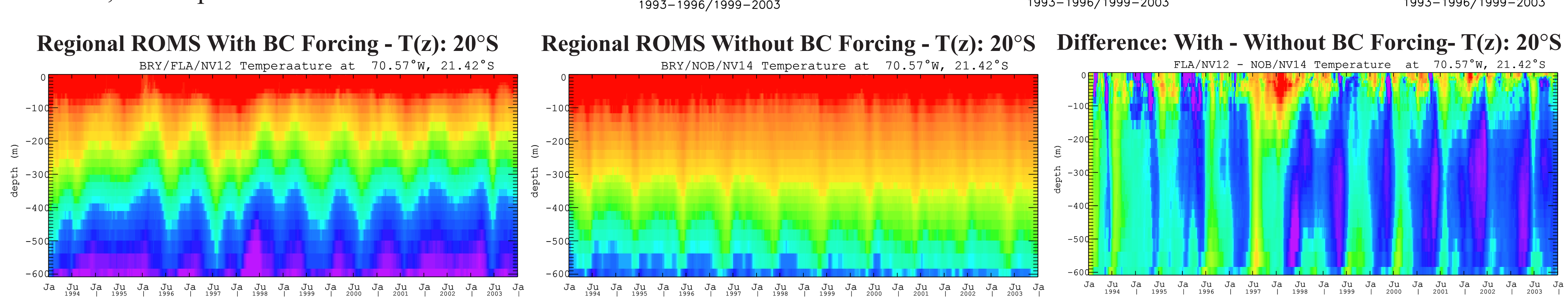
Fits of Annual and Semi-annual Harmonics - Amplitude and Phase, Removing 1997-1998 (ENSO):

For altmeter SSH, the seasonal cycle is weak and patchy. Next to the coast, the lack of an annual harmonic is somewhat surprising. There is a stronger semi-annual harmonic, with peaks in January and July.

The regional ROMS with BC forcing has a strong annual harmonic along the coast, with a peak in austral winter. the semi-annual harmonic is weaker, with peaks in austral winter and summer.

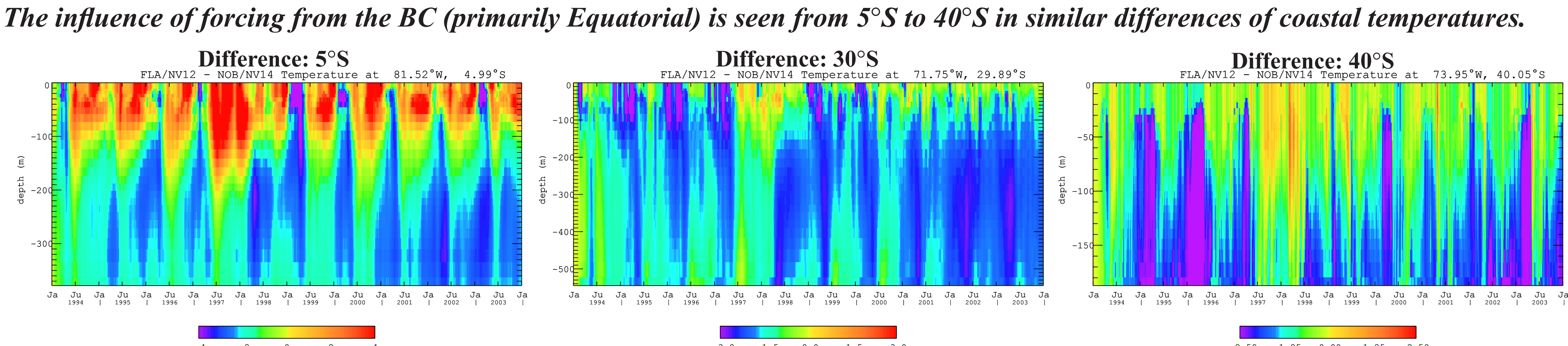
The regional ROMS without BC forcing has a stronger semi-annual harmonic at low latitudes, with peaks in winter and summer. At higher latitudes, the signal becomes more annual, with a peak in winter.





Coastal Profiles of Temperature: At 21°S, The profiles of temperature at a model grid point next to the coast are shown as a function of time for the model with BC forcing (left), without BC forcing (middle) and the difference between the two (right). Without BC forcing the El Nino of 1997-98 is not present. Temperatures below 200m are also two warm. The phase of the seasonal cycle deepens the surface layer too early without BC forcing, missing the deepening in austral winter. The BC forcing also produce a shallow warming in austral summer.

The influence of forcing from the BC (primarily Equatorial) is seen from 5°S to 40°S in similar differences of coastal temperatures.



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