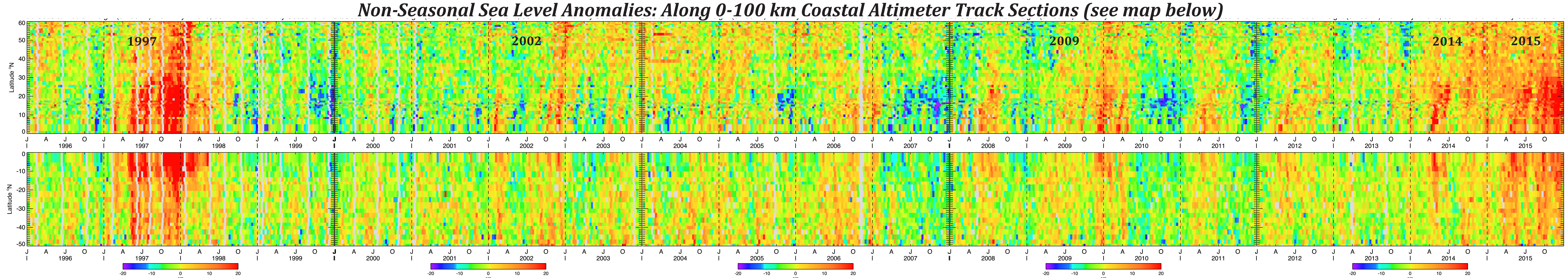
Tropical Connections to the Eastern Pacific Warm Anomalies

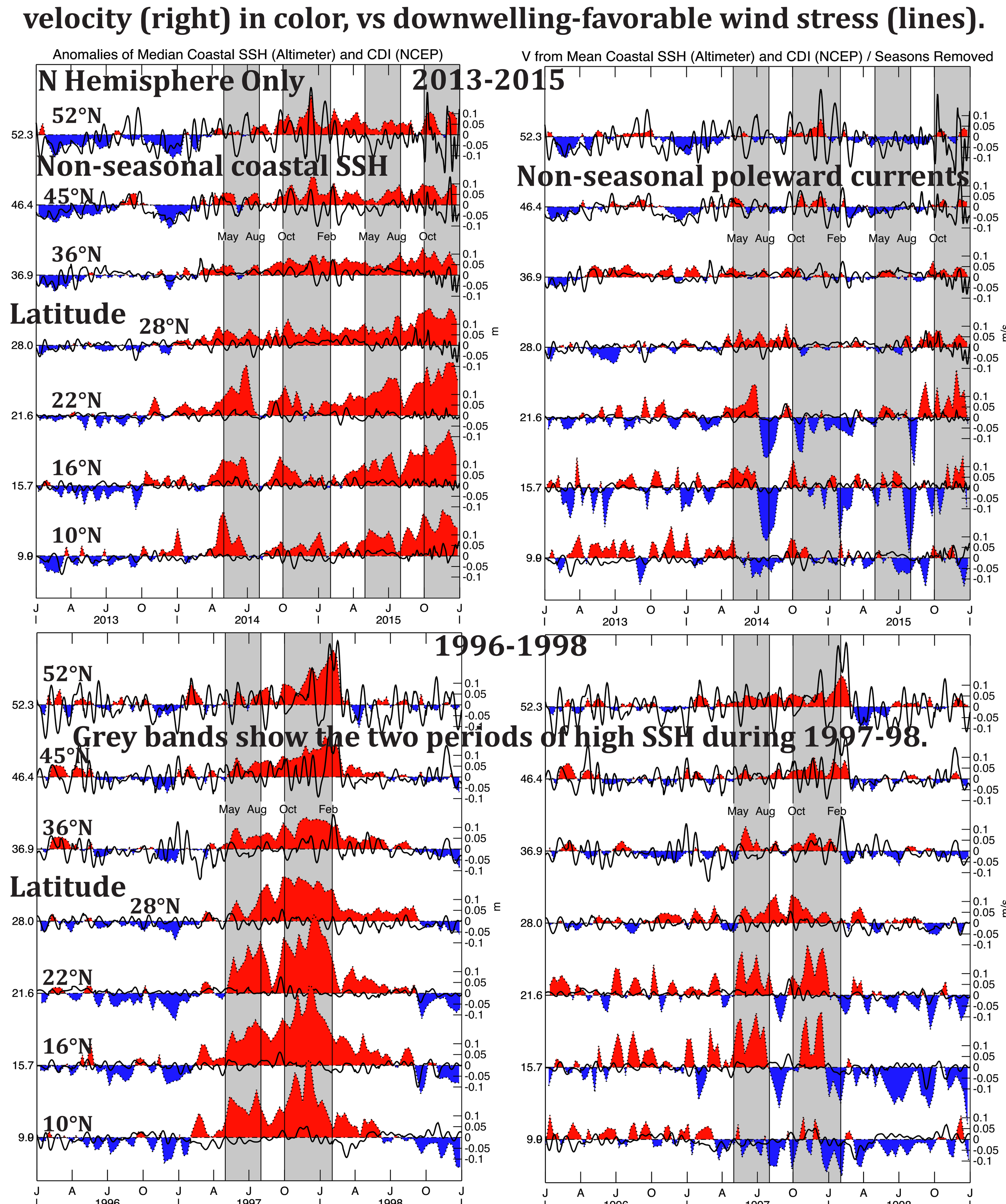
Ted Strub & Corinne James

College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR U.S.A.

Non-Seasonal Sea Level Anomalies: Along 0-100 km Coastal Altimeter Track Sections (see map below)

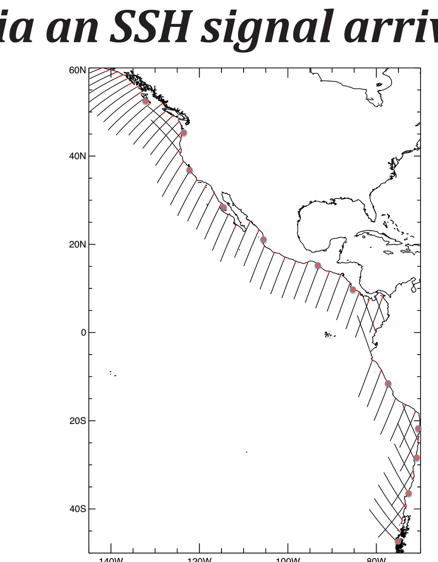


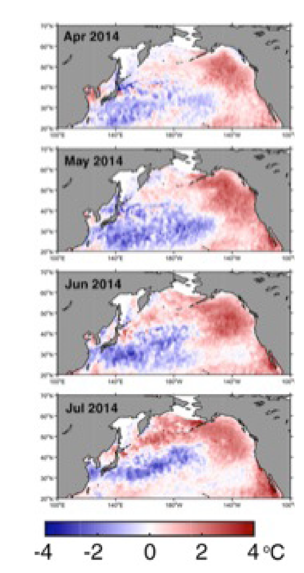
Below: Time series for anomalous non-seasonal SSH (left) and poleward velocity (right) in color, vs downwelling-favorable wind stress (lines).

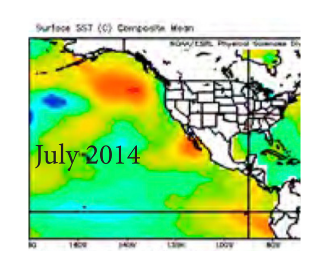


Tropical Contributions to the Warm Anomalies ?

The Gulf of Alaska warm anomaly was established before anomalous SSH appeared along the equator in March 2014. However, along Baja California an SSH signal arrives during the development of warm SST's in July 2014.







Above, we show the non-seasonal sea level anomalies of sea surface height along the 100 km next to the coast of North (figure) and South America, from 50°S to 60°N. We use only the standard tracks from the precision reference missions: TOPEX, Jason-1 and Jason-2. Showing signals that spread into both hemispheres identifies the most robust signals.

One can clearly see the El Niño events of 1997-98 (strong), 2002-03 and 2009-10 (moderate) and 2014-15 (interupted and then strong).

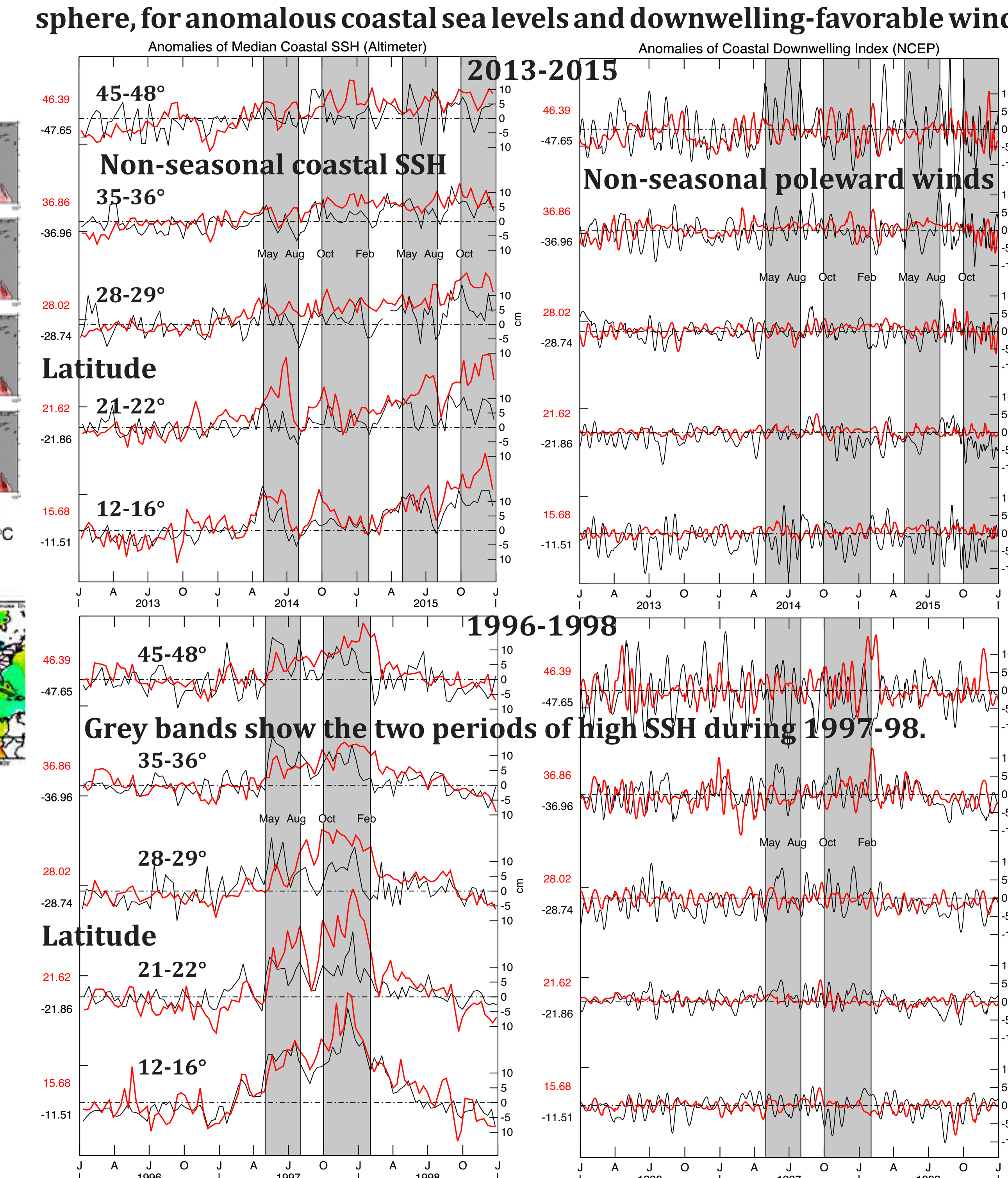
During the strong event of 1997-1998, there were two pulses of high SSH that reached the eastern Equatorial Pacific, one in May-July and another in October-February. Both of these propagated into the two hemispheres, the first moving more easily down South America and the second affecting North America more strongly. In each case the winter poleward winds of the hemisphere helped the movement into higher latitudes. Although the 2014 event is often dismissed, its signal moved into each hemisphere to around 20°-30° latitude.

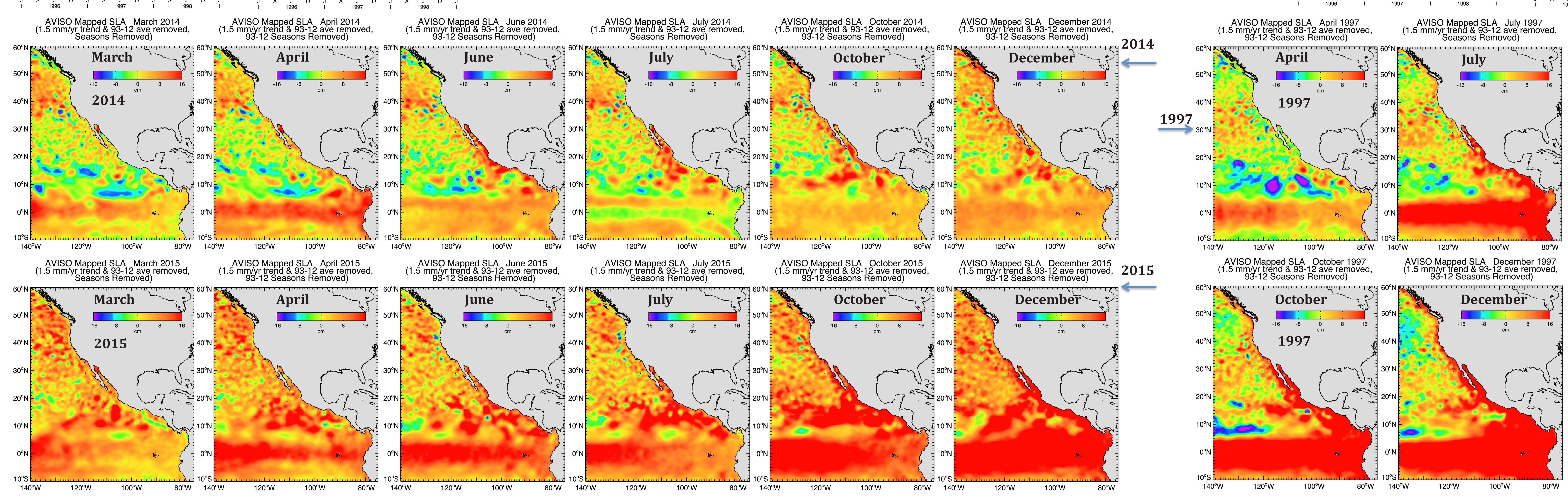
On the right we show the anomalous coastal SSH and poleward wind stress (a coastal downwelling index, CDI, positive for poleward winds) from similar latitudes in both hemispheres (red for the northern hemisphere). On the left we show the northern hemisphere anomalous coastal SSH and the poleward coastal surface geostrophic velocities, both compared to the anomalous CDI.

Below, we show maps of the gridded altimeter non-seasonal sea level anomalies for selected months during 2014, 2015 and 1997. Off Baja California and farther south, high SSH and poleward velocities are found, during two periods in 2014 similar to 1997. In 2015, the coastal SSH signals are less well defined.

These fields support the hypothesis that tropical signals contributed to the anomalous conditions off Baja California as early as April 2014. In situ water properties need to be examined for further evidence.

Below: Time series from the northern (red) and southern (black) hemisphere, for anomalous coastal sea levels and downwelling-favorable winds.





Compared to 1997, in 2014 the first pulse reached Baja California by April-June, but did not have a strong equatorial second pulse.

In 2015, a strong second pulse has developed along the equator and spread northward. However, it is difficult to separate the signals arriving from the south from the high SSH anomalies that have persisted in the offshore region since 2014.

During October-December 2015, the midlatitude rise in coastal SSH is still less than in December 1997.

In addition, the poleward winds in December 2015 have not reached the strengths of 1997-98.