Northwest South America

Overview

Northwest South America covers roughly 3000 km of the South American coast along Colombia, Ecuador and Peru (5°N to 20°S). The continental shelf in the region is small, extending slightly more than 100 km offshore at its maximum. Upwelling occurs off the coast of Peru year-round driven by wind and the cold, low salinity waters of the Humboldt Current that flows north towards the Equator. However, periodically the upwelling is disrupted by El Niño-Southern Oscillation (ENSO) events [LME 2004].

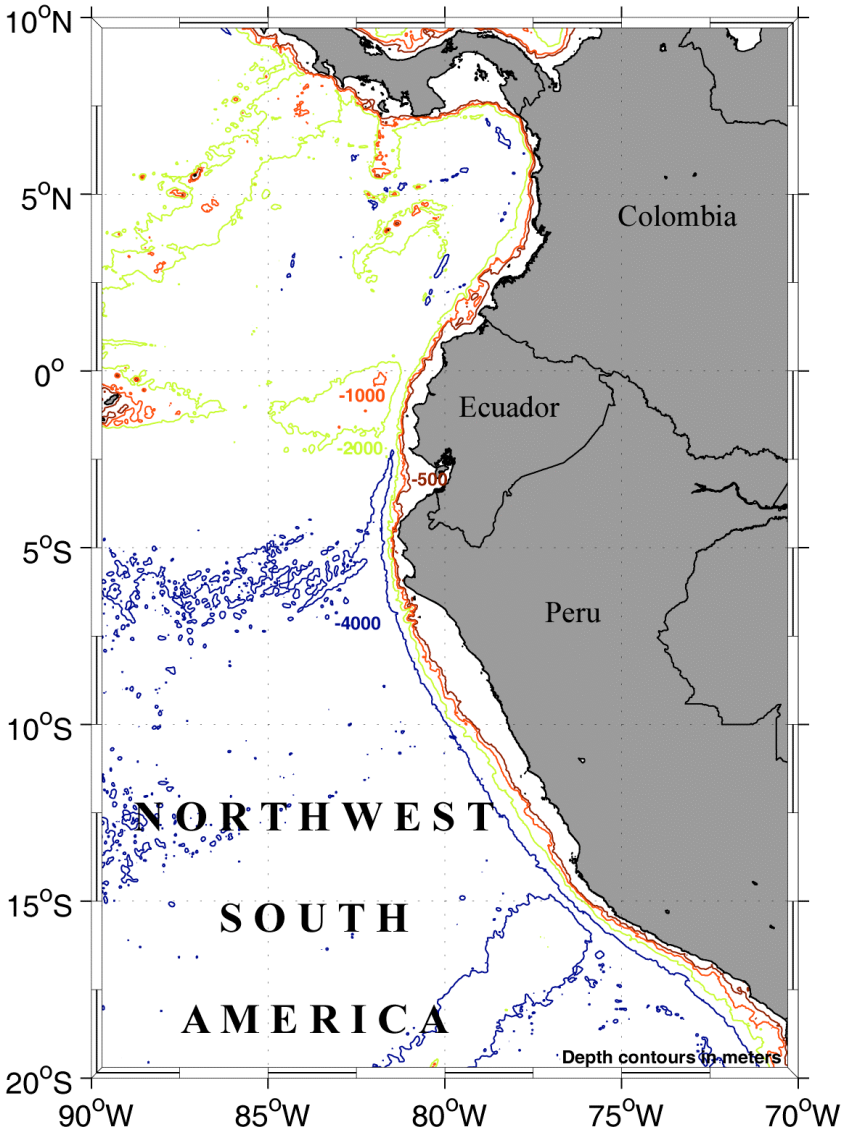


Figure 1. Bathymetry of the Northwest South America [Smith and Sandwell, 1997].

Observations

There has been little scientific study of internal waves along the northwest coast of South America. Satellite imagery shows wave occurrences over the entire region but more prevalent in the areas where the continental shelf is broadest. In addition to tidally forced shelf break internal waves, there is evidence that in the shelf region internal waves are generated by both upwelling and atmospheric forcing (passage of a pressure front or strongly variable winds). The imagery shows weak internal wave signatures seaward of the shelf and propagating shoreward, suggesting a current driven generation mechanism further out to sea. River outflows in the region also produce seaward propagating internal waves. Table 1 shows the months of the year when internal wave observations have been made.

Table 1 - Months when internal waves have been observed along Northwest South America.
(Numbers indicate unique dates in that month when waves have been noted)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
14	6	8	8	3	1			1	9	6	11

The signatures internal wave packets generated at the shelf break appear to be characteristic of continental shelf generated waves that occur elsewhere in the world. Packet separation ranges from approximately 15 km to 20 km (implying a phase speed of 0.35 to 0.45m/s). Separation between the first two solitons in the wave packets ranges between 0.8 and 1.5 km.

References

Large Marine Ecosystems of the World: LME #13: Humboldt Current; January 2004
http://na.nefsc.noaa.gov/lme/text/lme13.htm

Smith, W. H. F., and D. T. Sandwell, Global seafloor topography from satellite altimetry and ship depth soundings, Science, v. 277, p. 1957-1962, 26 Sept., 1997.
http://topex.ucsd.edu/marine_topo/mar_topo.html

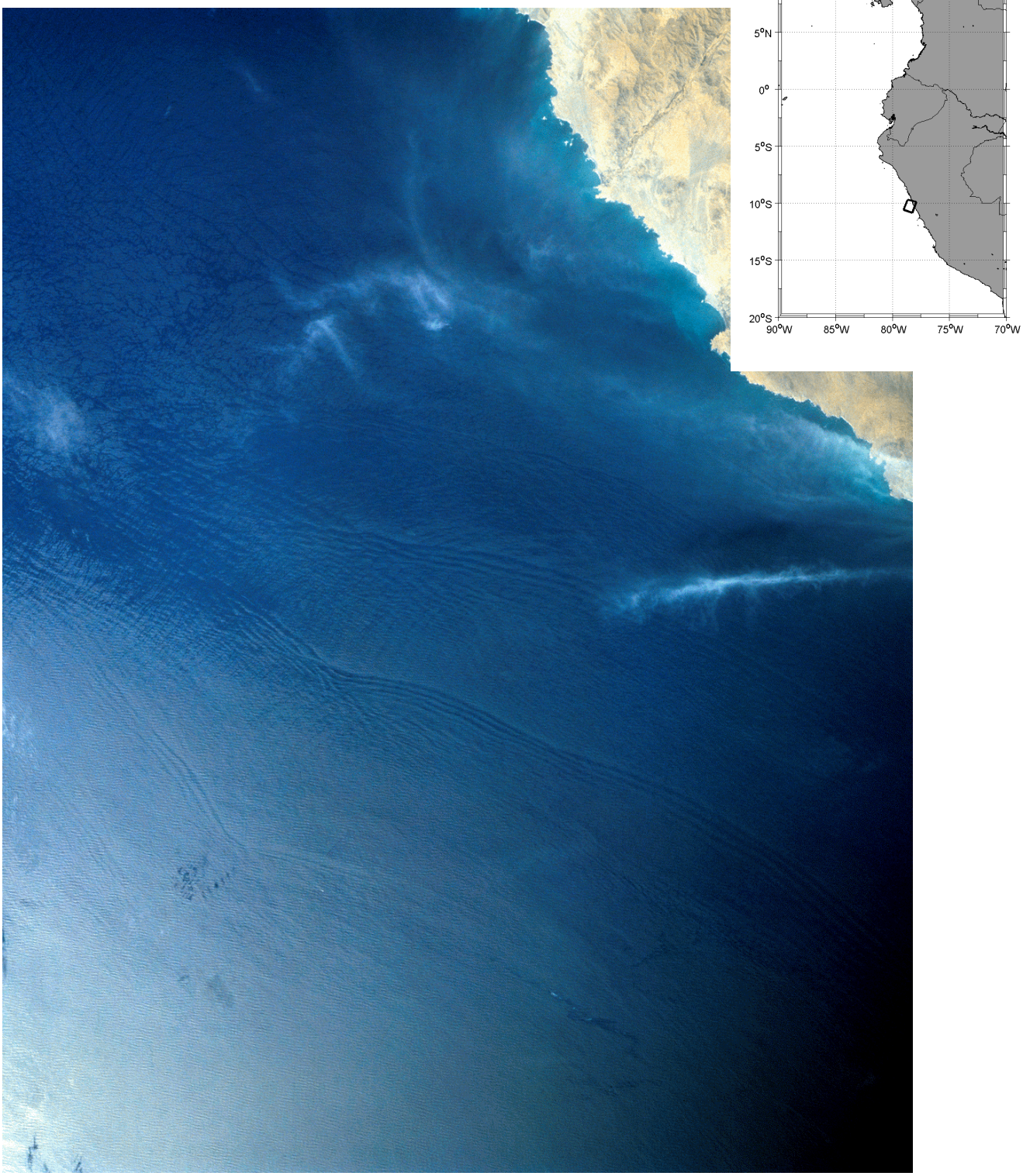


Figure 2. Astronaut photograph (STS054-151-71) acquired in January 1993 near the central part of the coast of Peru. The image shows typical shelf break generated internal wave packets propagating shoreward. Imaged area is approximately 85 km x 110 km. [Image Courtesy of the Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center (http://eol.jsc.nasa.gov)]

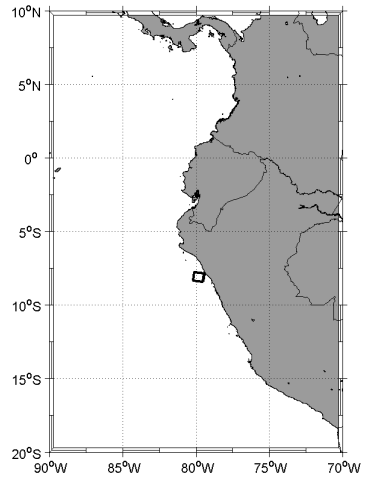
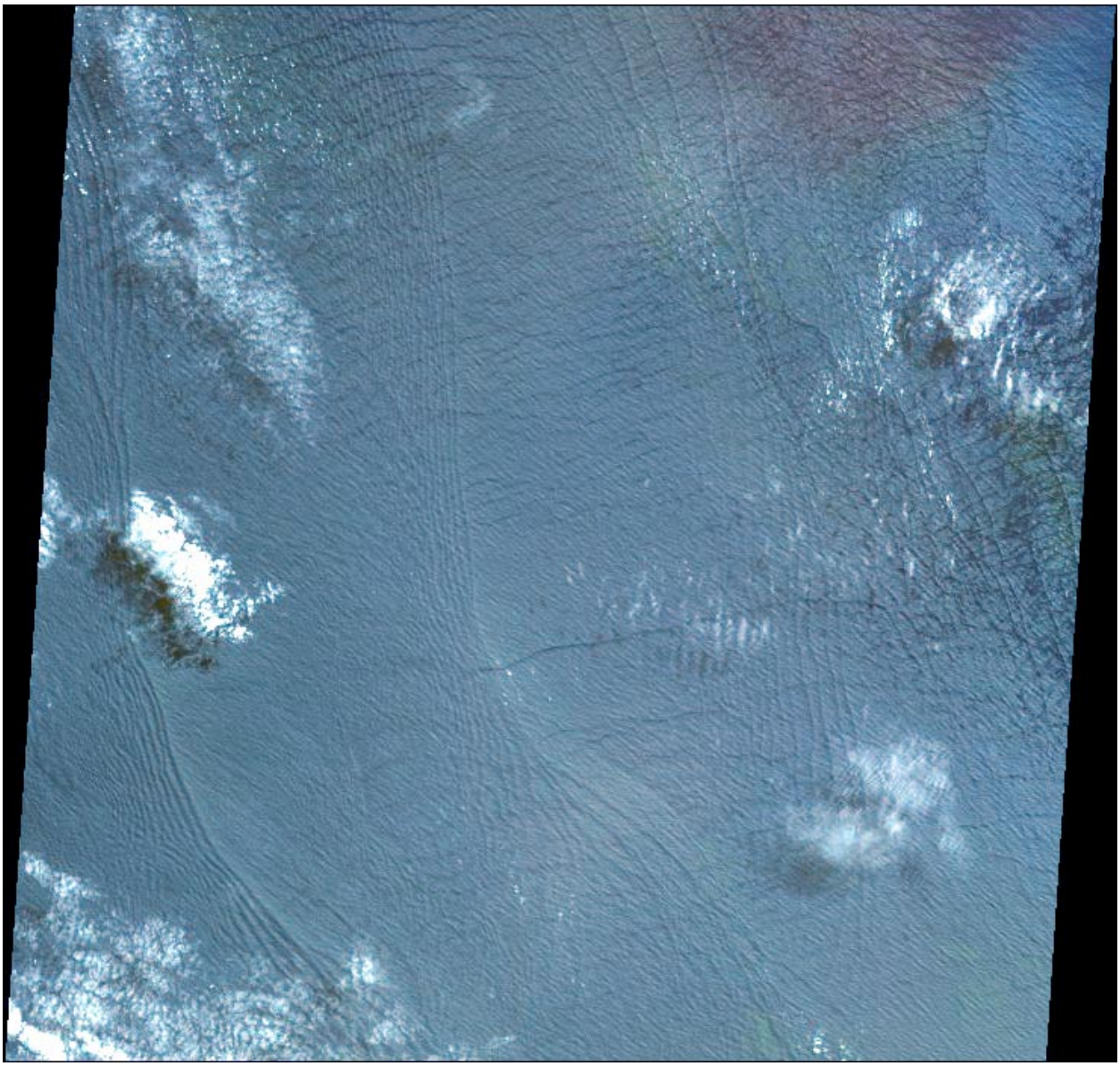


Figure 3. ASTER false-color VNIR image acquired on 9 April 2001 at 1556 UTC off the coast of Peru. The image shows typical shoreward propagating internal waves generated at a shelf break. Also visible throughout the image are internal wave signatures from waves propagating perpendicular to the shelf break waves. Imaged area is 60 km x 60 km.



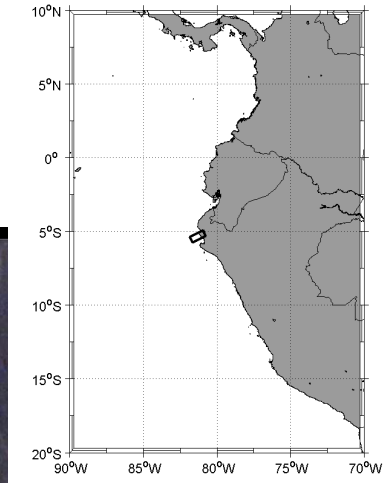
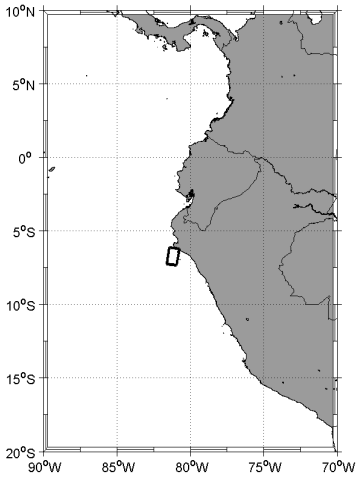


Figure 4. Astronaut photograph (STS103-726-1) just outside the Bay of Sechura acquired on 25 December 1999 at 1642 UTC. The image shows the signature of internal wave packets propagating shoreward from a variety of directions creating a very complex wave-interference pattern. Imaged area is approximately 90 km x 54 km. [Image Courtesy of the Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center (http://eol.jsc.nasa.gov)]



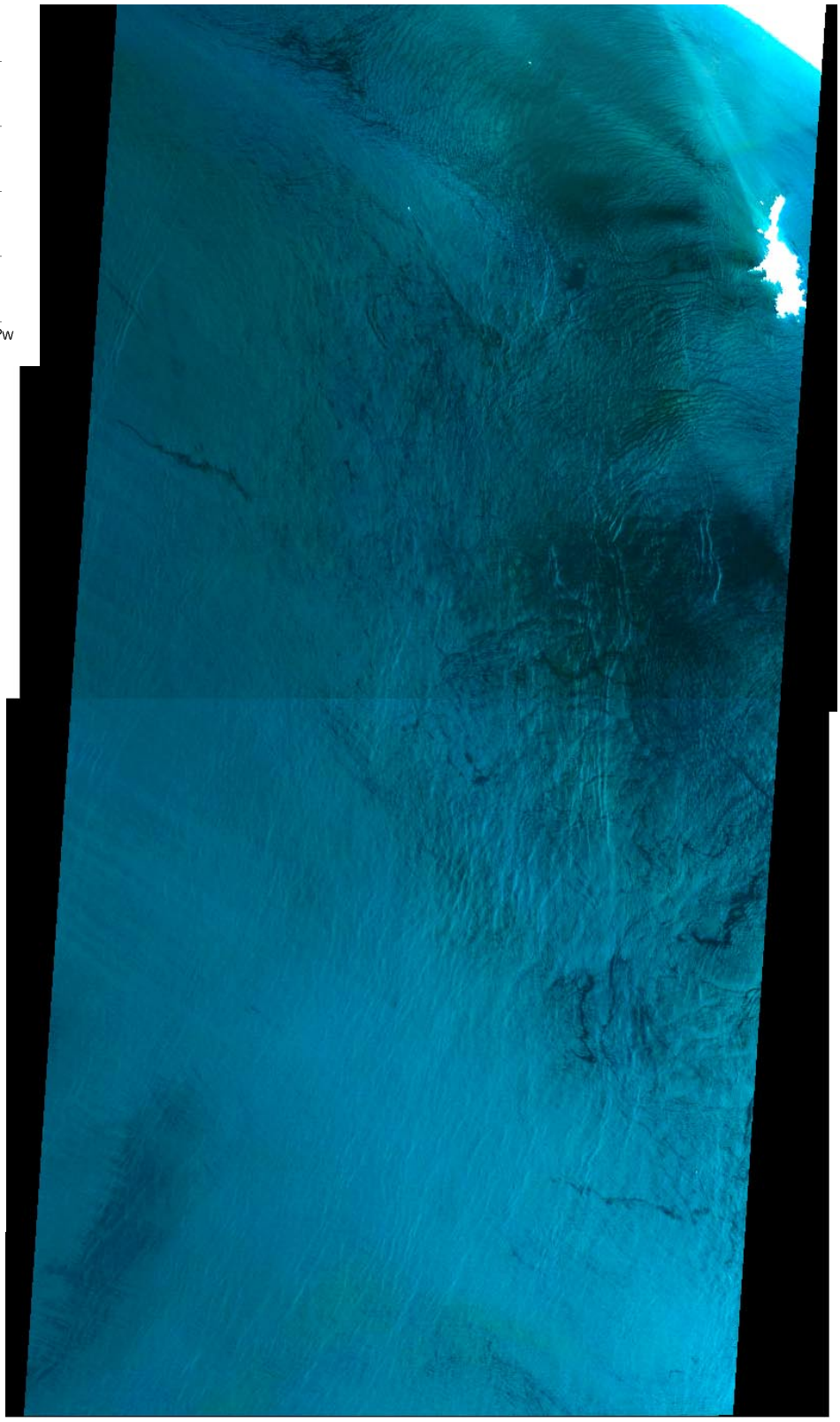
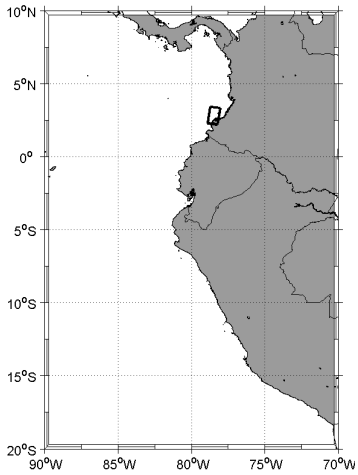


Figure 5. ASTER false-color VNIR image off the coast of Peru acquired on 29 January 2002 at 1554 UTC. The image shows a weak wave field propagating across the image (left to right) generated seaward of the shelf break. Strong winds at the time of the image are evidences by the wind steaks above the island in the upper right. Additional internal wave fronts are visible propagating along the wind direction. Surface slicks and the dark area (right-center) indicates the presence of upwelling activity, possibly inducing the internal wave activity. Imaged area is 60 km x 120 km.



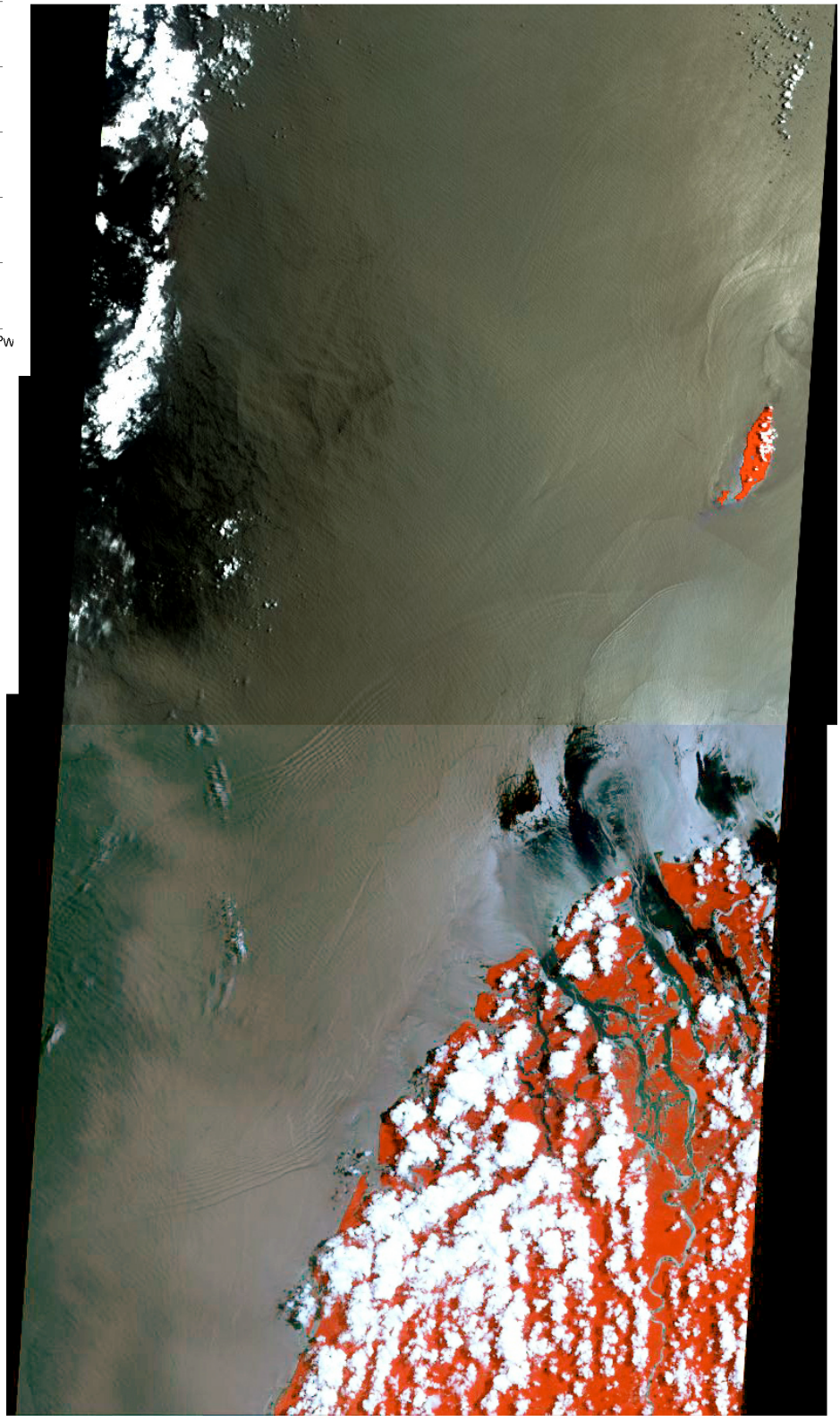
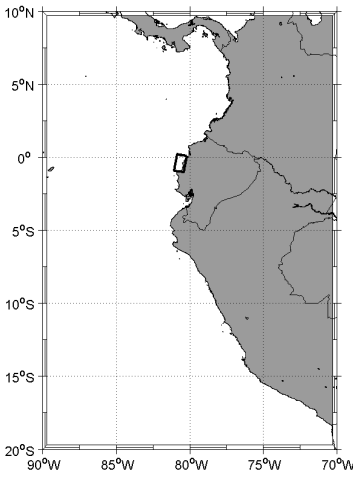


Figure 6. ASTER false-color VNIR image off the coast of Columbia acquired on 6 April 2003 at 1549 UTC. The image shows seaward propagating internal wave packets generated by the river outflow in addition to a shoreward propagating packet. Imaged area is 60 km x 120 km.



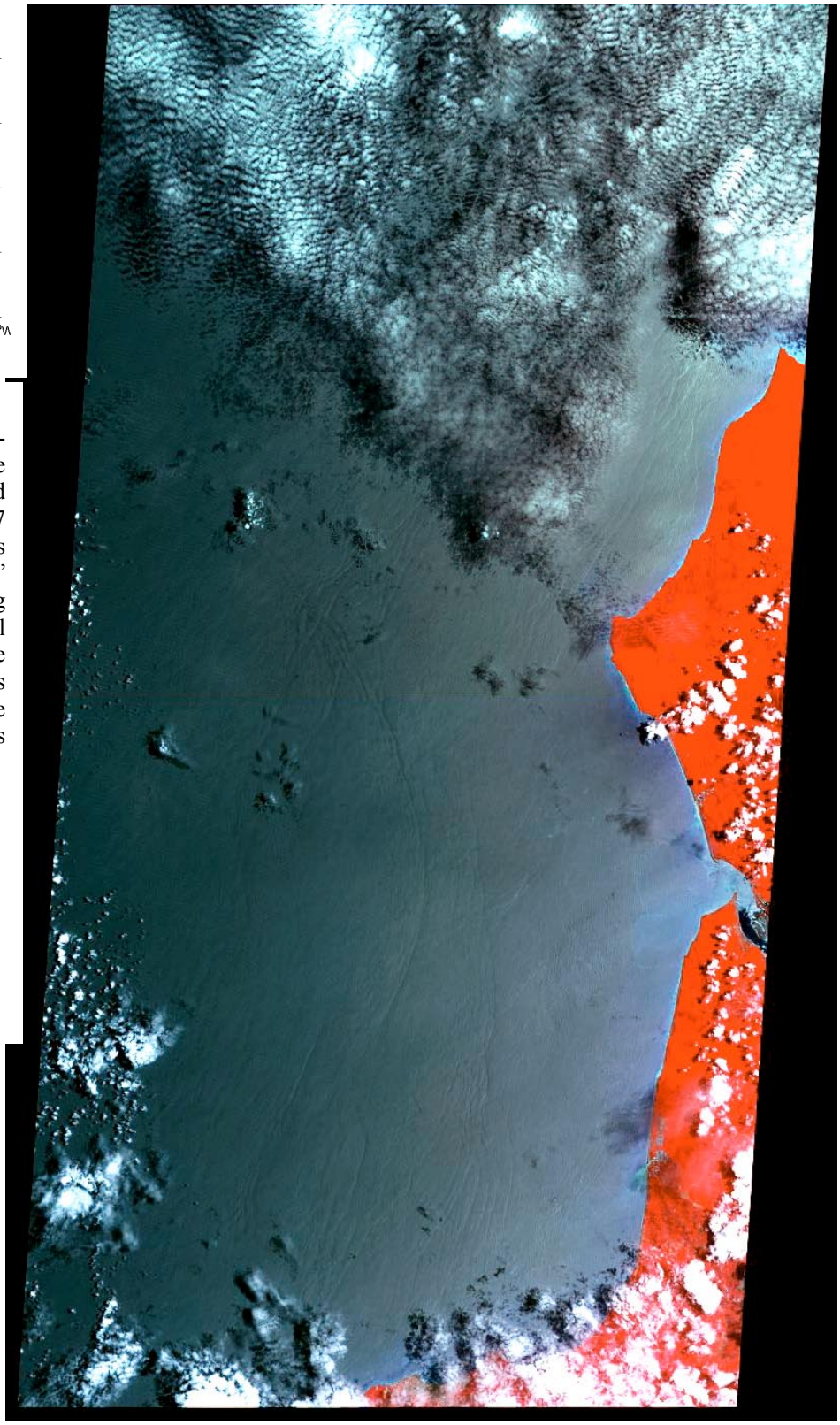


Figure 7. ASTER false-color VNIR image off the coast of Ecuador acquired on 22 March 2001 at 1607 UTC. The image shows several "typical" shoreward propagating internal waves. The well ordered packet structure breaks down as the waves shoal and dissipate close to shore. Imaged area is 60 km x 120 km.