

ISS-34 Mission Astronauts Photograph Internal Waves off Northern Trinidad

Edwin Alfonso-Sosa, Ph.D.

Ocean Physics Education, Inc. (June-14-2013)

Astronaut Photography

Astronaut photograph [ISS034-E-32377](#) was acquired on January 18, 2013 16:16:48 GMT, with a Nikon D3S digital camera using a 180 millimeter lens, and is provided by the ISS Crew Earth Observations experiment and Image Science & Analysis Laboratory, Johnson Space Center. The image was taken by the [Expedition 34 crew](#). The image can be downloaded from the NASA/JSC [Gateway to Astronaut Photography of Earth](#).

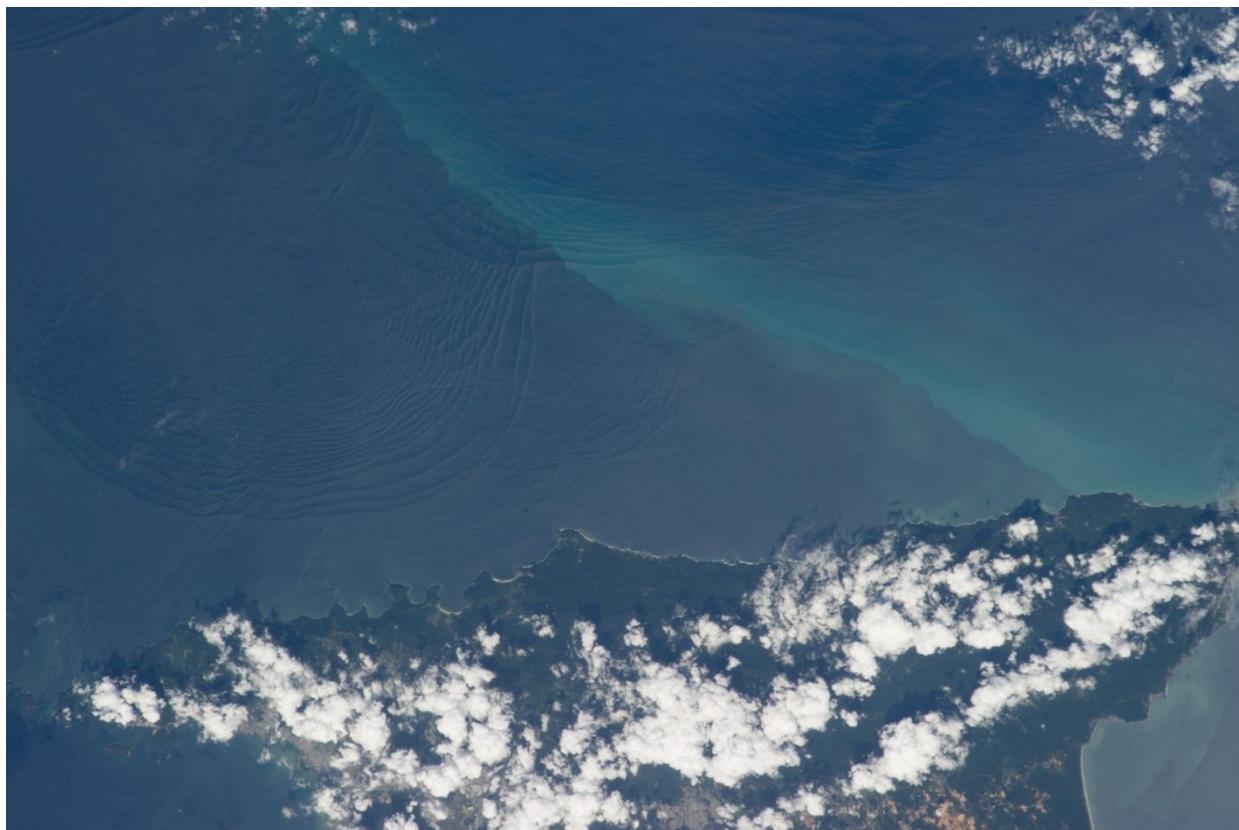
Date: **20130118** (YYYYMMDD) GMT Time: **161648** (HHMMSS)

Nadir Point Latitude: **9.0**, Longitude: **-58**. Nadir to Photo Center Direction: **Northwest**

Sun Azimuth: **186** (Clockwise angle in degrees from north to the sun measured at the nadir point)

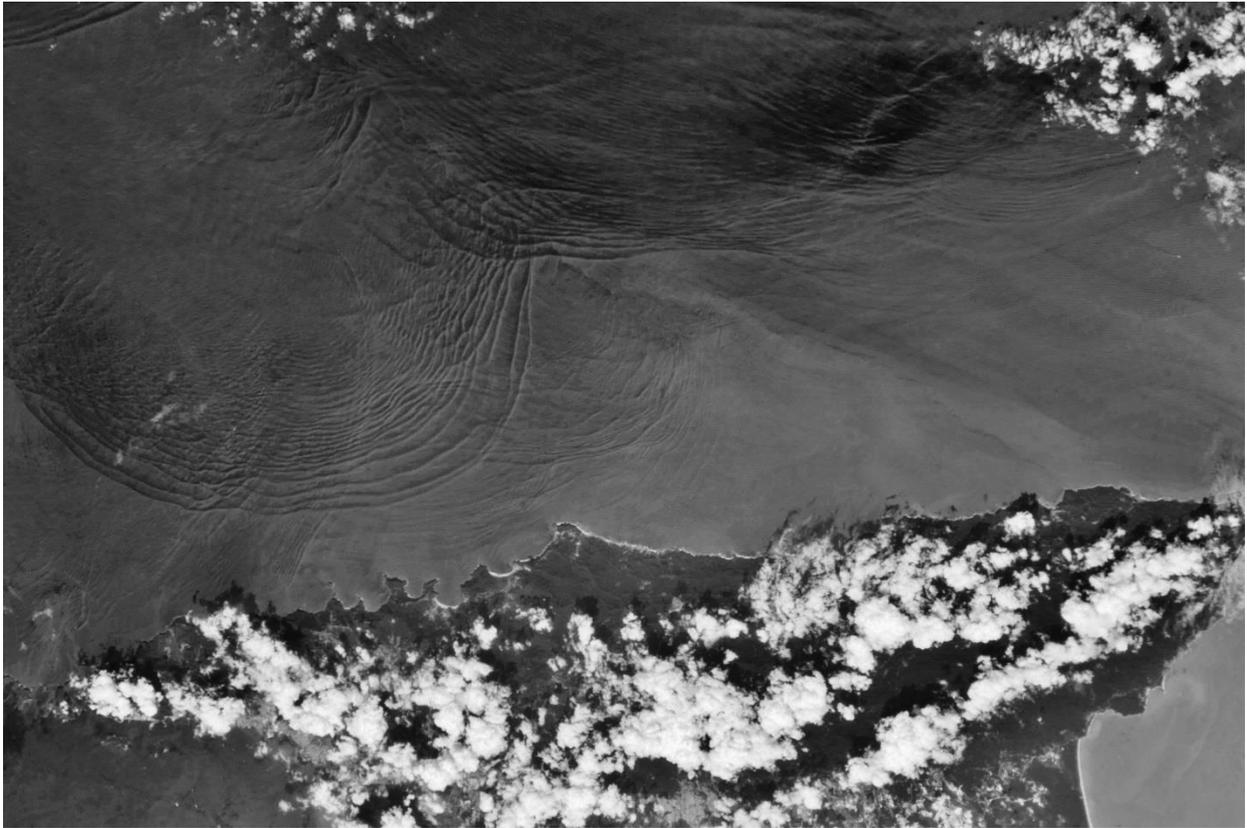
Spacecraft Altitude: **217** nautical miles (402 km)

Sun Elevation Angle: **60** (Angle in degrees between the horizon and the sun, measured at the nadir point)



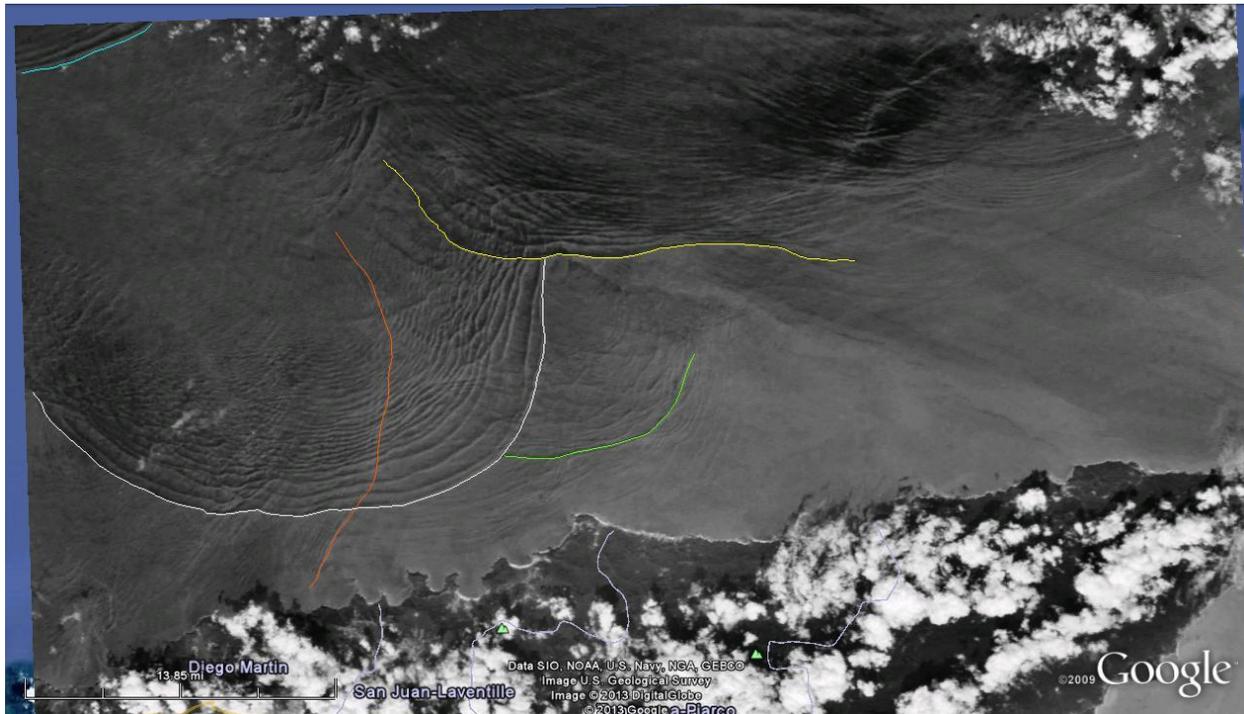
Contrast Enhanced Image

The image was red filtered and contrast stretched to enhance the surface signal of the internal waves. At least 10 internal wave groups can be seen in this image.



Wave fronts and wavelength

The image was georeferenced using Google Earth and five distinct wave packets were measured using the rule application. The leading wave front of each group was colored. First we measured the full arc extension of the leading wave front, second the separation distance between the leading wave fronts and finally the separation distance between the trailing wave fronts of the packet. The inter packet distance between Wave packet 1 (white) and Wave packet 5 (blue) is 39 km. Wave packet 1 (white) and Wave packet 2 (yellow) interact at the sediment plume drifted by the Guyana Surface Current.



The following table shows the results:

Name	Color	Wave front length	Leading Wavelength	Trailing Wavelength
Wave packet 1	white	52.5 km	1.3-0.9 km	400-350 m
Wave packet 2	yellow	36.9 km	1.3 km	340 m
Wave packet 3	green	17.2 km	1.0-0.9 km	200 m
Wave packet 4	orange	27.9 km	300 m	150 m
Wave packet 5	Blue	> 9.9 km	700 m	500 m

Distance from Continental Shelf Edge and Speed

The shelf edge distance covered by the Wave packet 1 was 80 km. Wave packet 5 covered 44 km. The inter packet distance was 36 km. If the packets were generated by semidiurnal currents at the shelf edge every 12 hours (44712 s) then the speed is estimated as 0.81 m/s. It takes about 29 hours (1.2 d) to cross the Trinidad's northern shelf. Similar speeds (0.77, 0.79 m/s) have been estimated in the same location using MODIS/terra images corresponding to March 18-19, 2011.

