

Gulf of Mexico

Overview

The Gulf of Mexico is a semi-enclosed basin located along the western side of the North Atlantic (Figure 1). Atlantic Ocean water enters the Gulf through the Yucatan Strait and exits through the Straits of Florida. The region is influenced by loop currents, upwelling and fresh water outflows from rivers in the United States and Mexico [LME 2004].

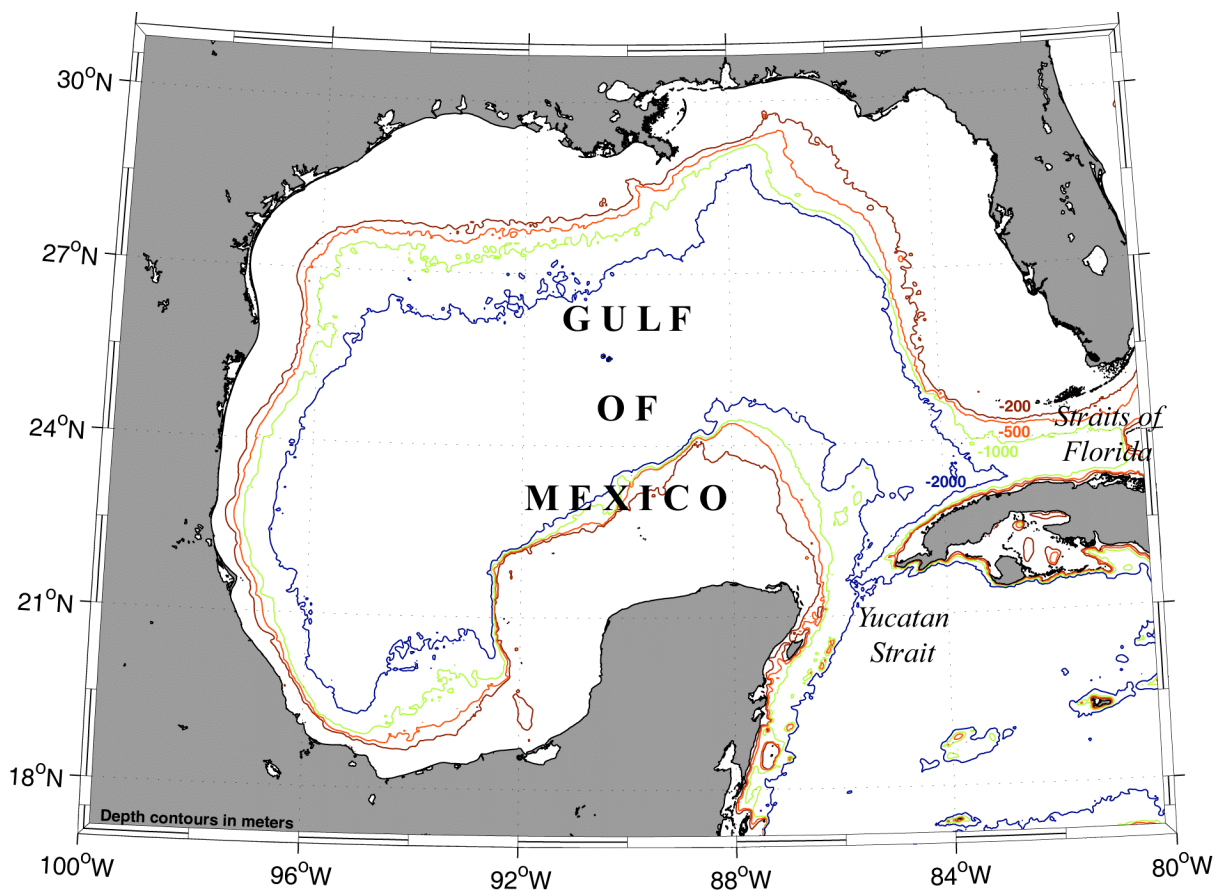


Figure 1. Bathymetry of the Gulf of Mexico. [Smith and Sandwell, 1997]

Observations

There has been some study made of internal waves in the Gulf of Mexico. Rubenstein [1999] collected in situ measurements during 1995 on the Florida continental shelf in approximately 185 meters of water. The observed internal waves propagated in the upslope direction with peak-to-trough amplitudes of 2 to 10 meter and uniform wavelength (on the order of 500 meters). The occurrences lasted about three hours and always at the same time of day [Rubenstein, 1999]. Satellite observations of waves in this area (Figures 5 – 7) show similar characteristics.

Table 1 - Months when internal waves have been observed in the Gulf of Mexico.
 (Numbers indicate unique dates in that month when waves have been noted)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
				1	1	3	3	1		3	

Figure 2 shows a typical density profile for the area derived from temperature and salinity data collected on 13 September 1969 at 22.55°N, 86.66°W. The normalized Mode 1 and Mode 2 eigenfunctions have been evaluated for $\lambda = \frac{2\pi}{k_0} = 640m$, with $H = 275$ m. For long waves ($k \rightarrow 0$) the maximum first mode wave speed (c_0) is computed to be 0.86 m/s without the effect of current shear. Figures 2e and 2f show the phase velocity and dispersion relations for the data. Figure 2 also presents the environmental coefficients and KDV parameters evaluated at wavenumber k_0

References

- Large Marine Ecosystems of the World: LME #5: Gulf of Mexico; January 2004
<http://na.nefsc.noaa.gov/lme/text/lme5.htm>
- Rubenstein, D. 1999: Observations of Cnoidal Internal Waves and Their Effect on Acoustic Propagation in Shallow Water. *IEEE J. Oceanic Eng.* **24** (3) 346-357
- Smith, W. H. F., and D. T. Sandwell, 1997; Global seafloor topography from satellite altimetry and ship depth soundings, *Science*, v. **277**, 1957-1962
http://topex.ucsd.edu/marine_topo/mar_topo.html

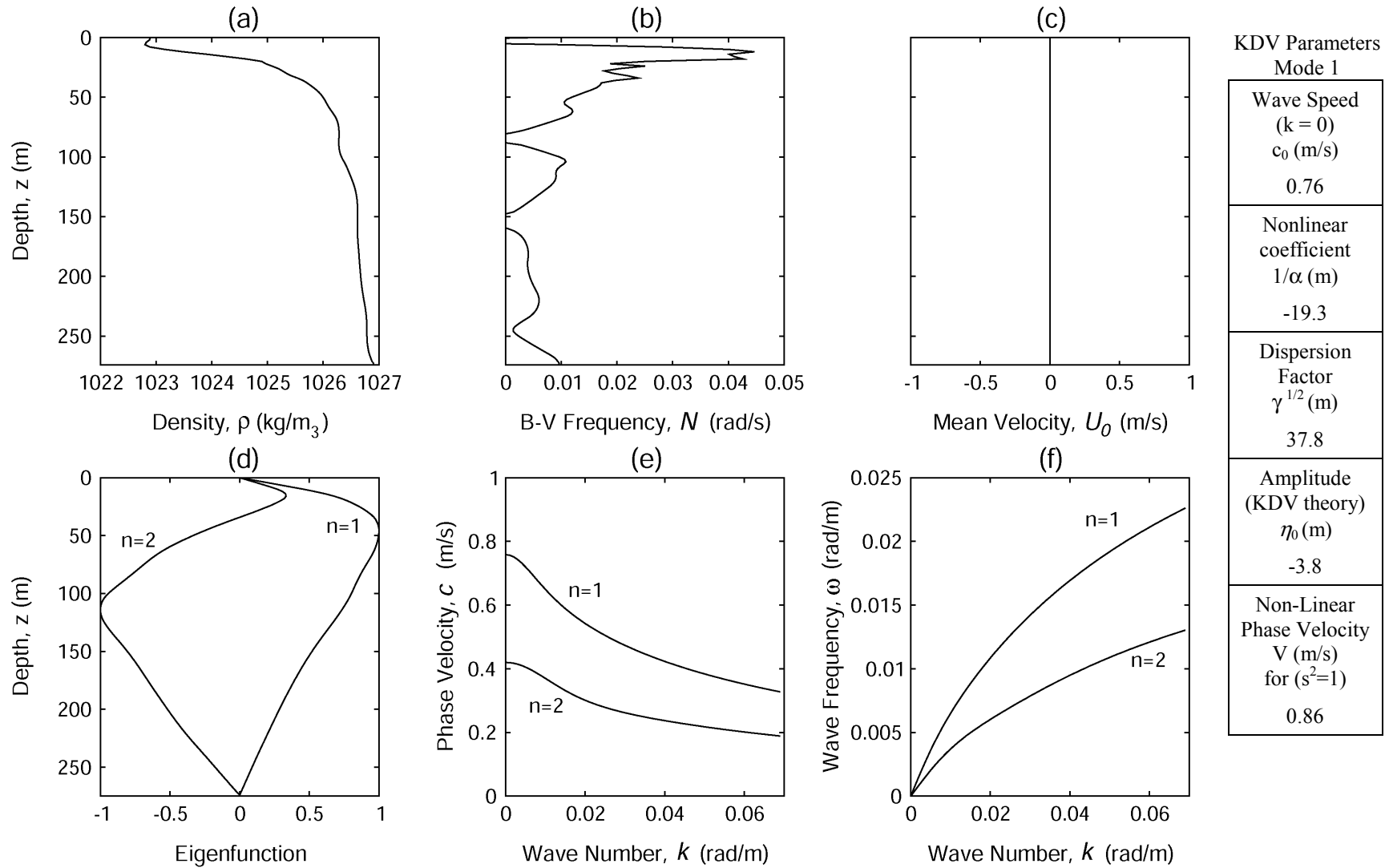


Figure 3. a) Density profile derived from SD2 data collected on 13 September 1969 at 22.55°N, 86.66°W, depth = 275 m (Source NODC Global Ocean Temperature and Salinity Profiles (June 1991) b) derived Brunt-Väisälä frequency $N(z)$ c) zero flow current profile d) Normalized vertical eigenfunctions (mode 1 & 2) for $2\pi/k_0 = 640$ m, $H = 275$ m for density and velocity profiles shown e) phase velocity f) dispersion relations.

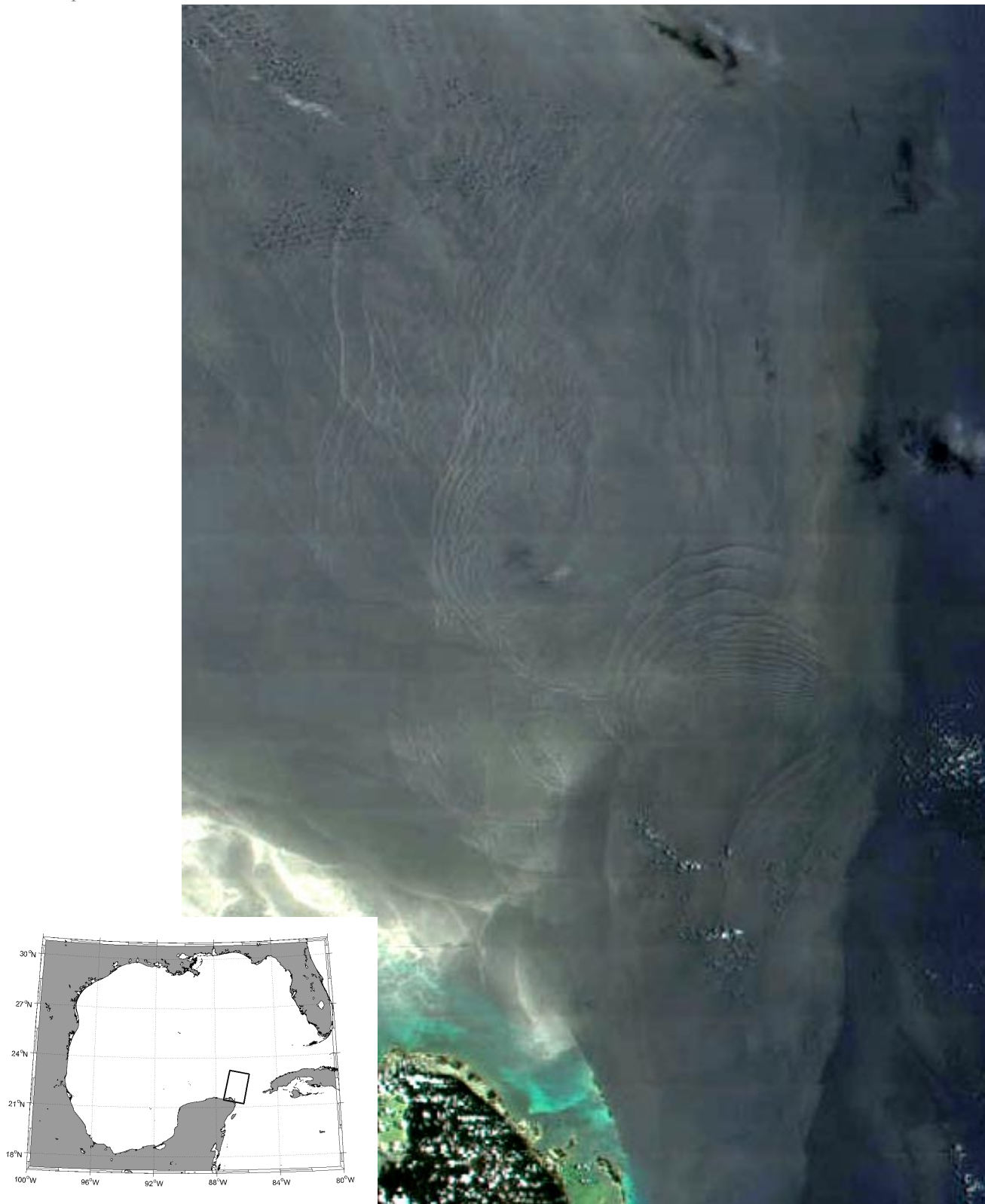


Figure 3. MODIS (Bands 1,3,4) 250-m resolution visible image of the Yucatan Strait acquired on 4 July 2001 at 1645 UTC. The image shows the signature of four packets of internal waves propagating the northwest near the Yucatan Peninsula. Imaged area is approximately 115 km x 175 km.

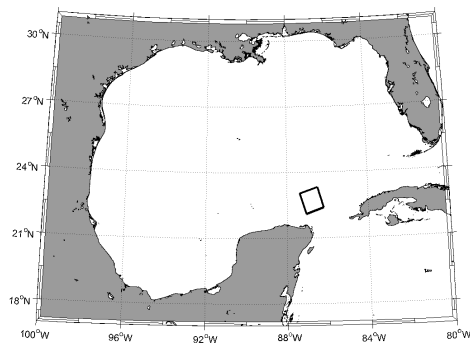


Figure 4. SEASAT (L-band, HH) SAR image of the Yucatan Strait acquired on 24 August 1978 at 0122 UTC (Rev 838). The image shows a very strong signature of an internal wave packet propagating to the northwest over the continental shelf. Imaged area is 100 km x 100 km. [Image courtesy of Ben Holt NASA JPL]



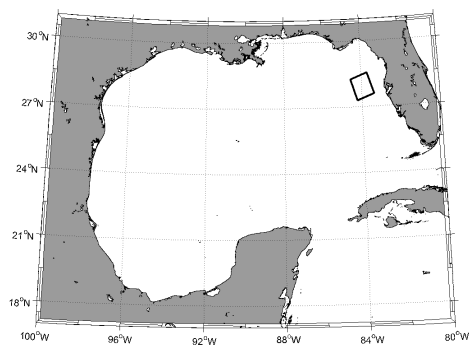
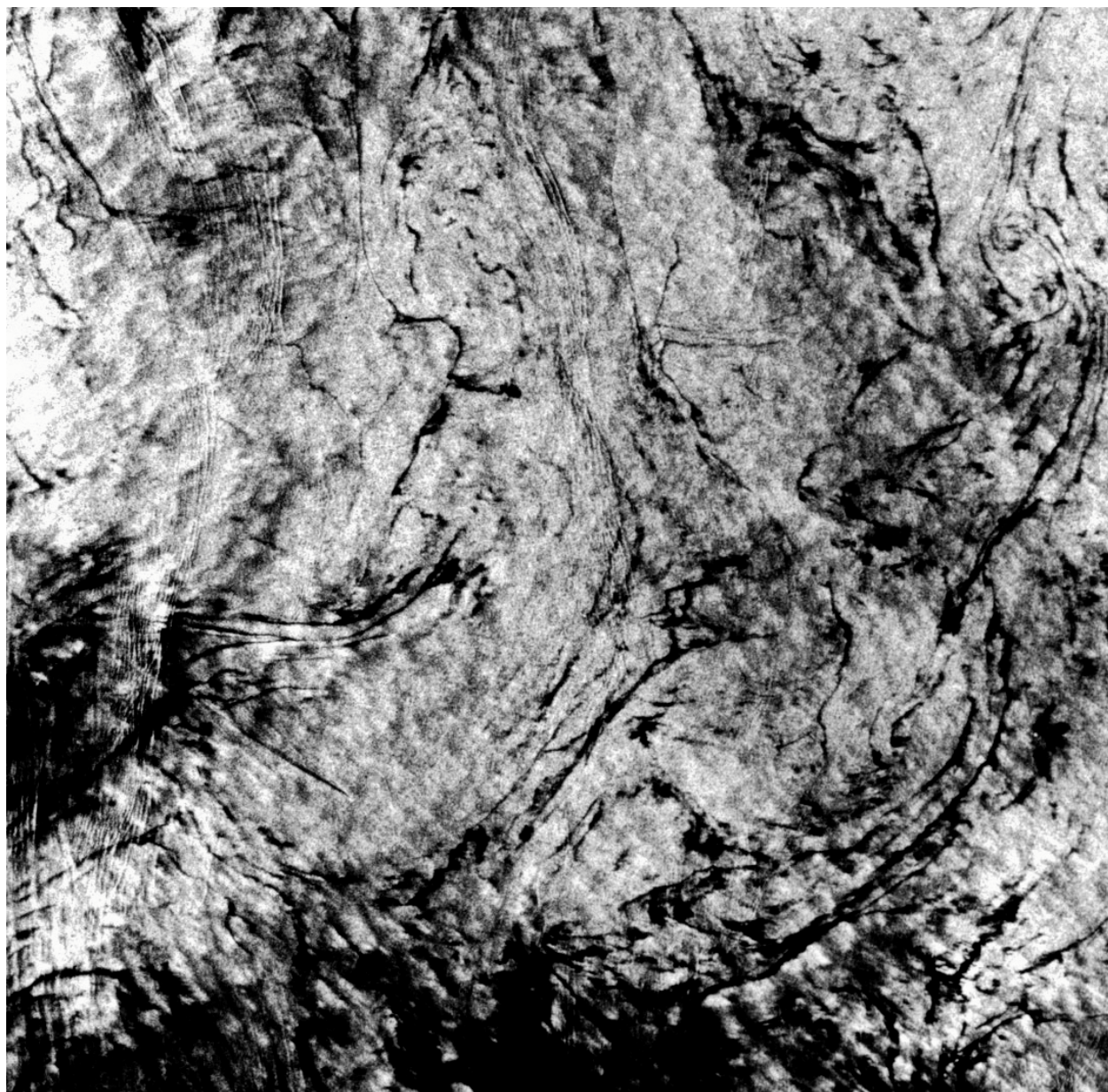


Figure 5. SEASAT (L-band, HH) SAR image over the Gulf of Mexico off the west coast of Florida acquired on 19 August 1978 at 0122 UTC (Rev 766). The image shows the signature of very fine scale (~250 m wavelength) internal waves propagating shoreward. Imaged area is 50 km x 50 km. [Image courtesy of NASA JPL]



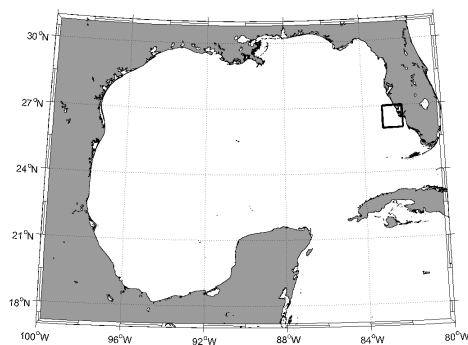
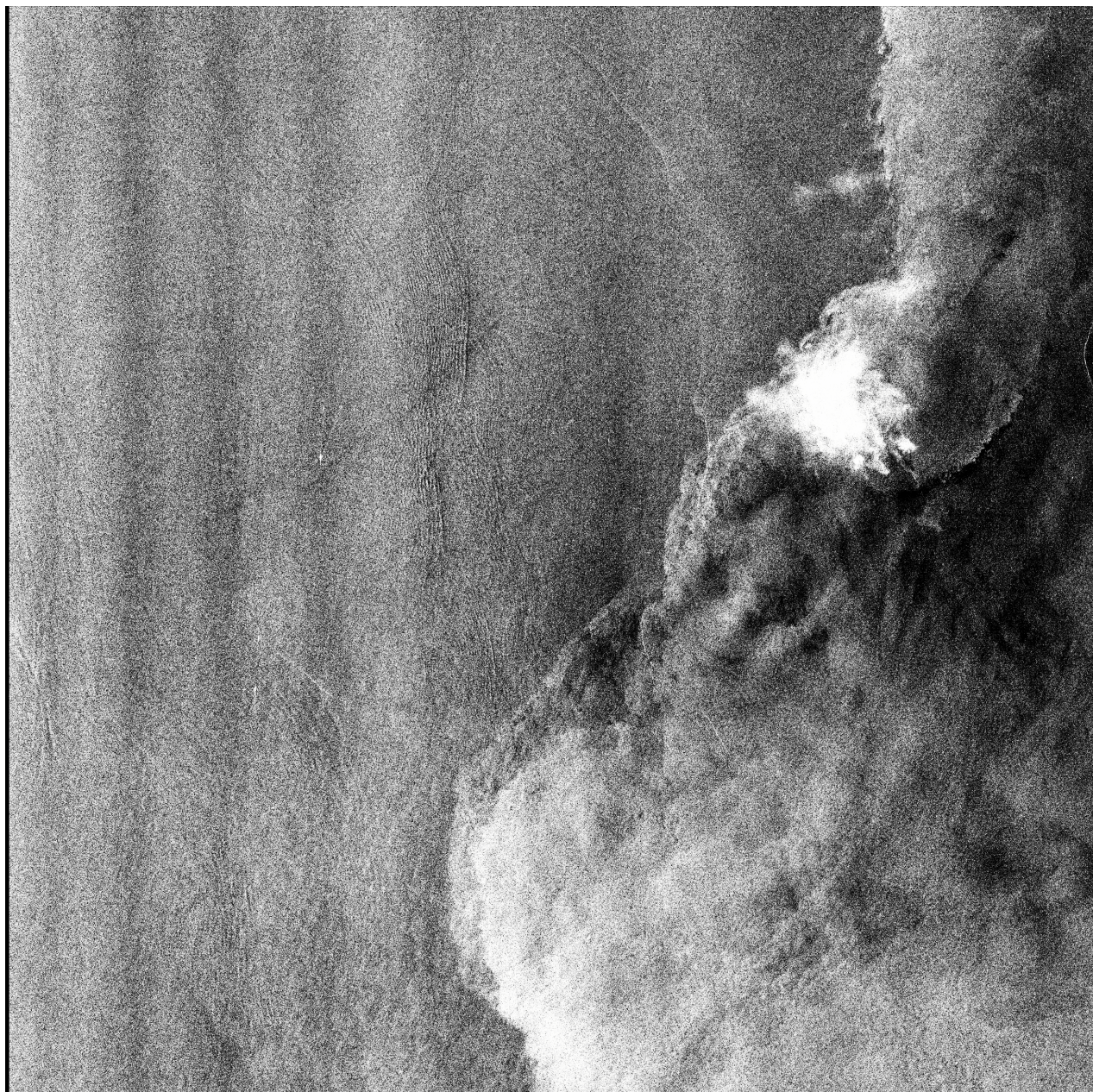


Figure 6. RADARSAT-1 (C-band, HH) SAR over the Gulf of Mexico off the west coast of Florida acquired 25 August 1997 at 2335 UTC. The image shows the signature of very fine scale (~250 m wavelength) internal waves propagating shoreward. The signatures along the right side of the image are atmospheric, most likely associated with a thunderstorm. Imaged area is 100 km x 100 km. ©CSA 1997.



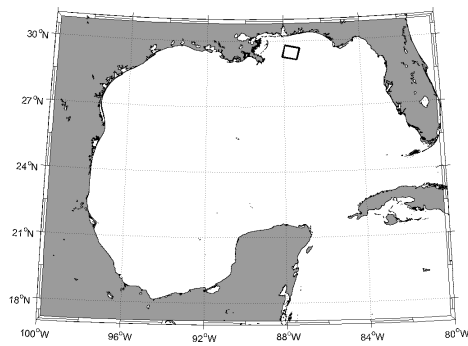


Figure 7. ASTER false-color VNIR image over the Gulf of Mexico near the Mississippi Delta acquired on 25 June 2001 at 1652 UTC. The image shows the signatures of four internal wave packets (two propagating shoreward, two seaward). Imaged area is 60 km x 60 km.

