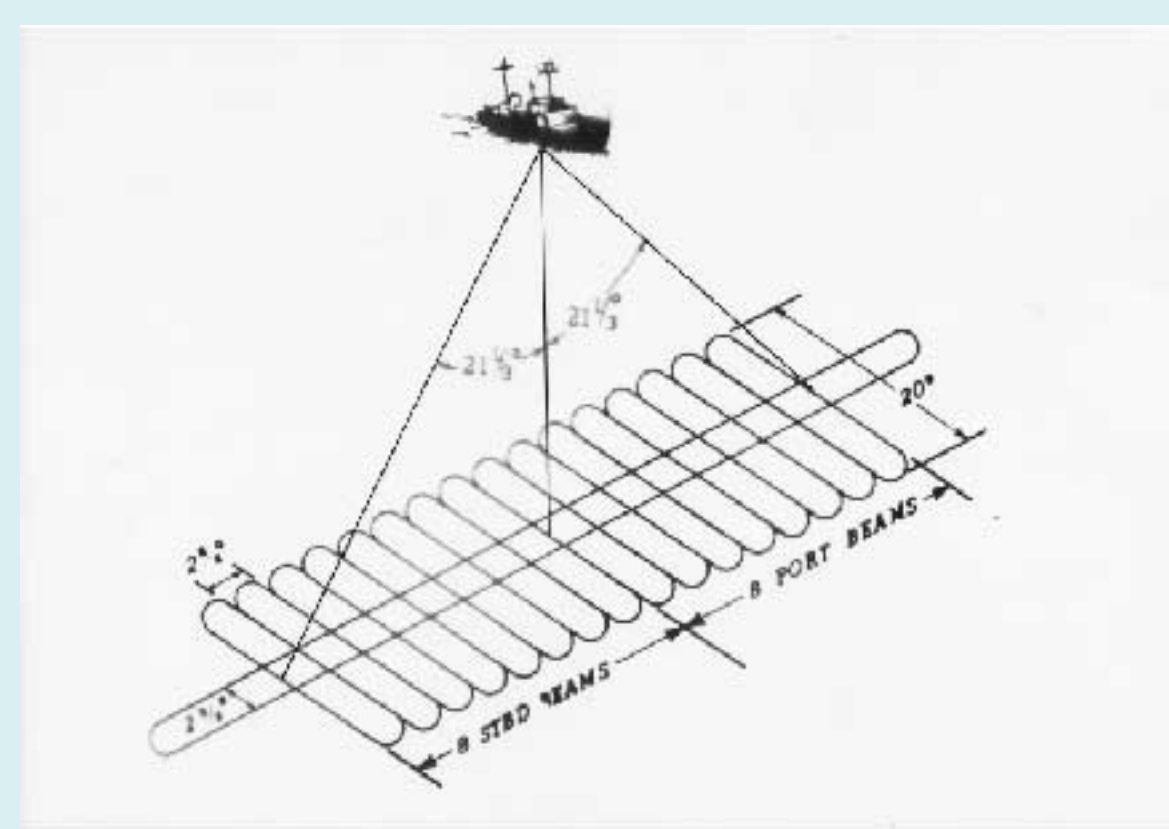
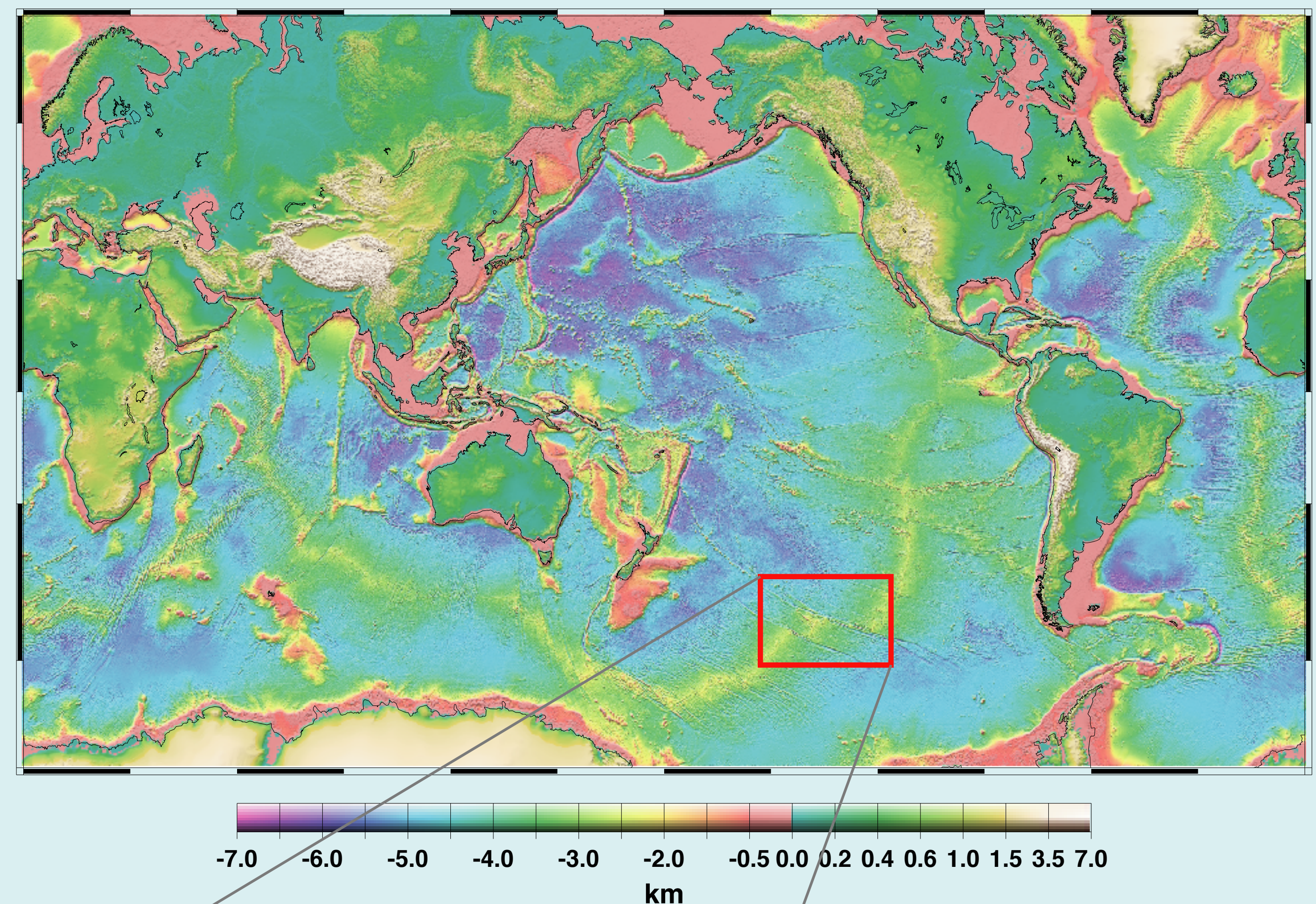
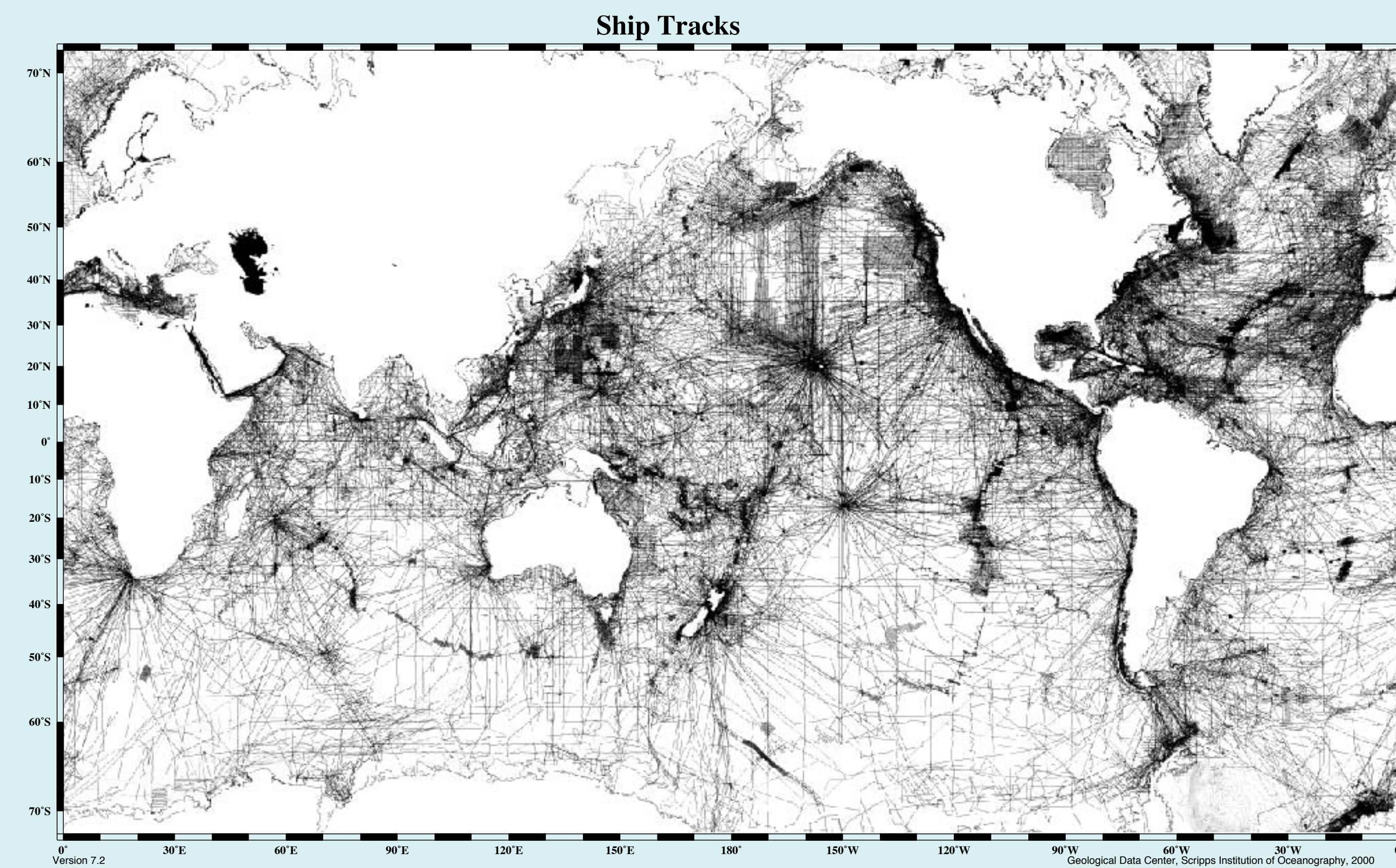


# Bathymetry from Space

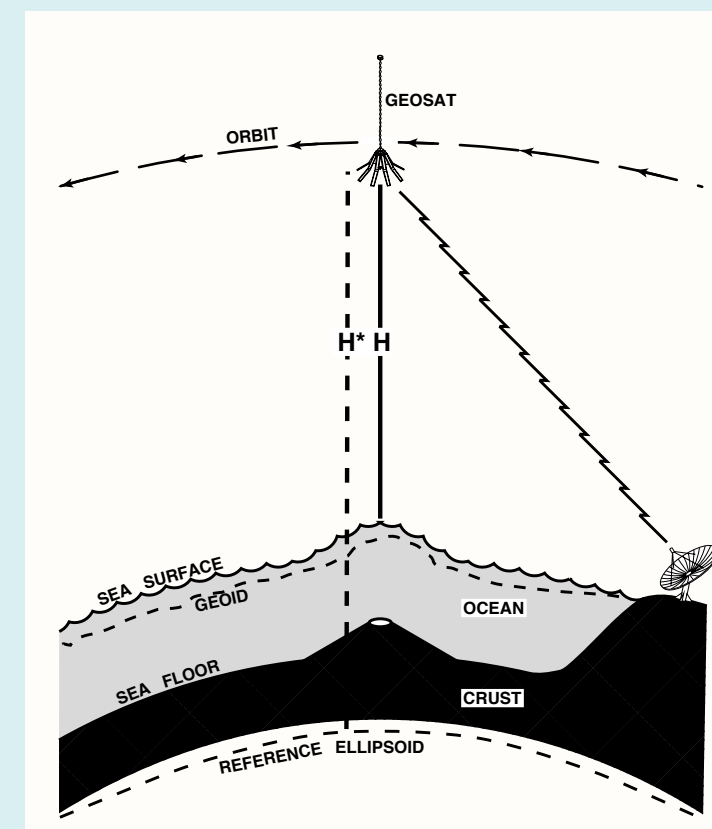
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Why is the topography of Mars, Venus, and the Moon known much more accurately than the topography of the **Ocean Floor**?

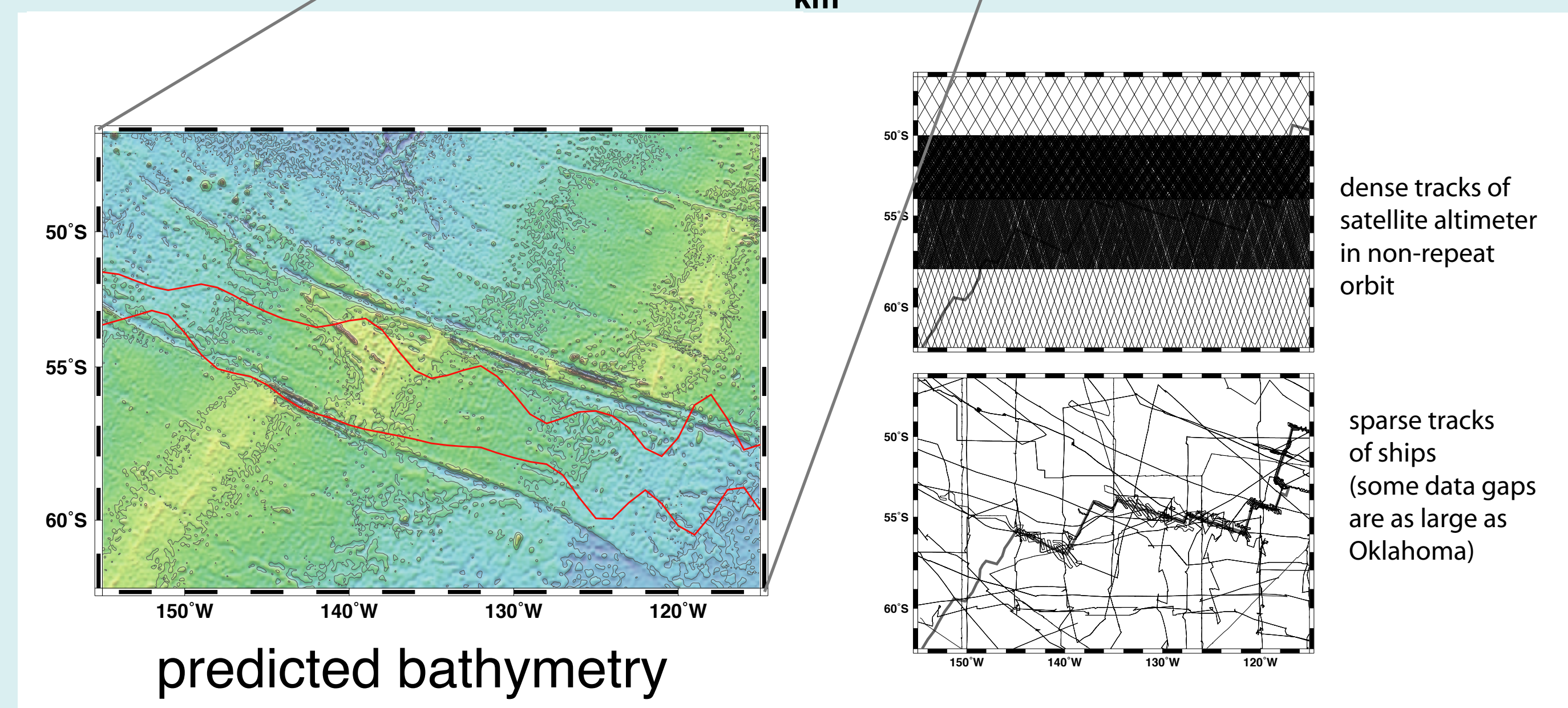
## (1) Current knowledge of bathymetry



ship soundings



radar altimetry  
 (Geosat, ERS,  
 Topex/Poseidon,  
 Jason, . . .)



## (2) Applications of high resolution altimetry

Topography Applications:
fiber optic cable route planning
tsunami propagation and hazard models
hydrodynamic tide models and tidal friction
coastal tide model improvements
ocean circulation models
tidal role in ocean mixing
understanding seafloor spreading ridges
identification of linear volcanic chains
education and outreach (i.e. geography of the ocean basins)
law of the sea
fisheries management

Gravity Applications:
inertial guidance of ships, submarines, aircraft, and missiles
planning shipboard surveys
mapping seafloor spreading ridges and microplates
continental margin structure
petroleum exploration
plate tectonics
strength of the lithosphere
search for meteorite impacts on the ocean floor

## (3) Possible improvements

(ABYSS proposed for 2005-2011 ride on the ISS)

A new mission called ABYSS (Altimetric Bathymetry from Surface Slopes) has been proposed to NASA. It would map the bathymetry from space by placing an altimeter aboard the International Space Station to observe the sea surface slopes caused by seafloor topography. The refined topographic map would be used to study how the ocean steers currents and creates turbulence that mixes the deep ocean. The mission addresses science issues related to global climate change although it has numerous other applications.

Mission requirements for Bathymetry from Space are different from physical oceanography-type missions such as Jason. Long-term sea-surface height accuracy is not needed; the fundamental measurement is the slope of the ocean surface to an accuracy of ~1 mrad. This can be achieved without application of the usual environmental corrections. The main requirements are:

**Improved range precision** -- A factor of 2 or more improvement in altimeter range precision, with respect to Geosat and Topex, is needed to reduce the noise due to ocean waves. The footprint of the radar should be less than 6 km to recover wavelengths as short as 12 km.

**Fine cross-track spacing and long mission duration** -- A ground track spacing of 6 km or less is required (non-repeat orbit for at least 1.2 years). The Geosat Geodetic Mission (1.5 years) provides a single mapping of the oceans at ~5 km track spacing. Since the measurement noise scales as the square root of the number of independent measurements, a 6-year mission would reduce the error by another factor of 2.

**Moderate inclination** -- Current non-repeat orbit altimeter data have high inclination (72° Geosat, 82° ERS) and thus poor accuracy of the E-W slope at the equator. The new mission should have an inclination of ~50° or 125° degrees to improve E-W slope recovery.

**Near-shore tracking** -- For applications near coastlines, the ability of the instrument to track the ocean surface close to shore, and acquire the surface soon after leaving land, is desirable.

The Wide Swath Ocean Altimeter concept cannot recover our signal with the required precision because the resolution cell size is 15 km and the off-nadir beams are less accurate than a conventional radar altimeter. A delay-Doppler altimeter in a non-repeat orbit of moderate inclination (50 or 125 degrees) for more than 3 years would meet our science objectives.

