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The face of the Earth and the changing sea surface

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During the last decades, altimeter satellites have provided high-resolution mapping of the sea surface height, with high-precision and global coverage. The sea surface height above a reference ellipsoid consists of two components: a permanent component, called 'mean sea surface' that coincides with the geoid (an equipotential surface of the Earth's gravity field) and a time-variable component above the geoid, resulting from ocean dynamics (tides, currents, etc.). Altimeter satellites have revealed that at short and medium wavelengths ($\sim$ 500 km or less), highs and lows of the mean sea surface reflect seafloor tectonic features, hence ocean bottom topography. Satellite-based mean sea surface data have thus been used to provide global, high-resolution bathymetric maps. With the ever increasing precision of altimetry-based sea surface height measurements (now on the order of 1-2 cm) and of space-based geoid models, it has become possible to measure the so-called 'ocean dynamic topography' (the sea surface topography above the geoid caused by large-scale ocean circulation), hence ocean currents. Since the early 1990s, altimeter satellites also measure global mean sea level rise due to ocean warming and land ice melt (two consequences of present-day anthropogenic global warming). They also provide unique information on the regional variability in sea level change. Regional trend patterns in sea level result from a variety of factors, including non-uniform thermal expansion of sea waters and changes in ocean salinity, as well as deformations of ocean basins (and gravitational changes) due to the viscous/elastic response of the solid Earth to changing loads, in particular those associated with last deglaciation and current land ice melt.