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Assimilation of Sea Level Anomaly Data

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Common problem in oceanographic modelling is that areas of interest are scarcely covered with in-situ tide gauges. Most of the tide gauges are situated in shallow areas directly along the coast or in estuaries, not representing the offshore hydrodynamics in deeper open waters. One option is to match the hydrodynamic model with the tide gauge data, leaving it up to the model dynamics to resolve sea level heights and current predictions in the deeper parts. Another option is to utilise modern satellite altimetry data in order to accurately model dynamics of deep ocean. This contribution explores utilisation of satellite altimetry in connection with oceanographic models and particularly in data assimilation sense. The principle of satellite altimetry is that of an orbiting nadir-looking radar system. By means of such a system the response of the ocean is measured from a short hypothetical EM pulse that bounces off the sea surface. The received information on board the satellite consists of radar waveform samples. These are basically histograms describing the distribution of power against time of the reflected signal. All information retrieved from the altimeter measurements are derived from the radar waveform samples or auxiliary information, either directly observed by instruments on satellite or obtained from geophysical models. Directly derived from the waveform samples are: the range between the phase centre of the radar antenna and the mean range to the footprint on the ocean, the significant wind-wave height in the footprint illuminated by the radar, the signal strength of the radar pulse that bounces off the ocean surface. The altimeter signal can be further analysed in order to obtain sea surface anomaly patterns (SSA). With SSA it is possible to take into account seasonal water level variations due to long term meteorological setup, such as monsoon. This setup is often referred to as tilting. Without tilting, the simulated wind-driven flow is not in geostrophic balance i.e. the mean gradient in simulated water level is not in equilibrium with the Coriolis force. The simulated flow exhibits rotation and occasionally short-cuts, so that inflow and outflow can occur simultaneously through one and the same open-sea sections. For a given current vector and (uniform) wind vector, a geostrophic balance can be achieved by appropriately tilting the mean water level at the four corners of the open-sea boundary segments. The contribution describes an application of data assimilation to combine satellite altimetry with oceanographic models in order to arrive at more accurate oceanpographic models.