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DOT and SLA stationary and time-varying analytical covariance functions for LSC-based heterogeneous data combination

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With the availability of an abundance of earth observation data from satellite altimetry missions as well as those from the GOCE satellite, monitoring of the sea level variations and the determination of functionals of the Earth's gravity field are gaining increased importance. One of the main issues of heterogeneous data combination with stochastic methods is the availability of appropriate data and error covariance and cross-covariance matrices. The latter needs to be determined for all input data within a LSC-based combination scheme based on some analytical global covariance function models, which interconnect observations and signals to be predicted. Given the availability of altimetric sea surface heights, GOCE observations of the second-order derivatives of the Earth's potential, geoid height variations from GRACE and marine gravity anomalies, one can employ all such available information within LSC to estimate the mean dynamic ocean topography (DOT) as well as its dynamic, i.e. time-varying part. In this work, we present some analytical covariance function models for the DOT in the Mediterranean Sea based on empirical values from altimetry- and GOCE-derived DOT. Various options for the analytical models are tested, from exponential to the well-known Gauss-Markov ones, along with a model similar to the Tscherning and Rapp model for the Earth's gravity field. All available covariance function model choices are tested within a LSC-based prediction scheme in order to conclude on the one that provides the most rigorous results in terms of prediction error. Moreover, modifications of the standard stationary covariance functions are investigated in order to determine time-varying analytical models which are used to model the sea level anomaly (SLA) and DOT variability within the entire Mediterranean Basin. The analysis is carried out over a period of 5 years (2008-2013), during which Jason-2 SLA data are employed in order to derive analytical covariance functions describing the SLA variability over time.