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On the determination of ENVISAT SLA analytical covariance functions and correlation with climate indexes

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Since the early 80's remote sensing of the Earth's oceans with satellite altimetry offered an abundance of sea surface height measurements. The availability of instantaneous variations of the sea surface is crucial to both oceanographic and geodetic applications, so that, through combination with GOCE and GRACE gradiometric and range-rate data of the Earth's gravity field, new frontiers are envisaged. The latter refer to the estimation of sea level and dynamic ocean topography trends as well as to monitoring the dynamic ocean environment and climate change through rigorous heterogeneous data combination. In related studies, even though the data combination and processing strategies have been carried out carefully with proper control, error propagation through analytical data variance-covariance matrices has been given little attention. This is of importance since it can provide reliable estimates of the output signal error within an optimal operator used in physical geodesy, i.e. least squares collocation. In this study, the raw data used are Sea Level Anomaly (SLA) values from ENVISAT for the entire duration of the satellite mission (2002-2011). Along-track records of the SLA have been used both to derive linear trends of the SLA variation in the area under study and come to some conclusions on the Mediterranean variability at short scales. Moreover, results on the determination of analytical covariance functions for the sea level anomalies in the Mediterranean Sea are presented, using for their estimation 2nd and 3rd order Gauss-Markov models and exponential ones. Conclusions based on prediction errors with LSC are drawn, while evidence of the cyclostationarity of the SLA is deduced. The covariance functions estimated are then employed to investigate possible correlations with climate change indices over the Mediterranean Sea (Southern Oscillation Index-SOI, North Atlantic Oscillation-NAO index and Mediterranean Oscillation Index-MOI) and conclude on climate forcing to sea level change.