Observing system simulation experiments for an observational testbed off the southeastern Arabian Sea

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Abstract

Observing system simulation experiments (OSSEs) provide a cost-effective approach to estimate the impending potential impact of new observing systems. OSSE, based on the fraternal twin framework, is used in the present study to find the optimal location of four proposed buoys off the southeastern Arabian Sea (70:77^{o}E, 6:13^{o}N) for process studies and improvement of ocean analysis and hence forecasts. A fraternal twin framework has three essential components – Nature Run representing truth, Synthetic Observations (SynOPs) mimicking real observations and a Reference System playing the role of a forecast system. A high resolution ocean model coupled to a data assimilation system serves as the Nature Run for this study. Daily SynOPs of temperature and salinity are simulated from Nature Run at 16 regularly spaced locations within the proposed region. The Reference System comprising a coarser resolution model coupled to an inferior data assimilation system is designed following the fraternal twin prescription. Sixteen experiments are conducted corresponding to each SynOP by augmenting the Reference System with the corresponding SynOP. The impact of each SynOP is assessed through a newly introduced metric named composite impact assessment parameter that evaluates the holistic impact of a SynOP on the analysis. This metric delineates the hierarchy of impact of SynOP on ocean analysis. We find that the SynOPs lying in the north and close to the coast are not beneficial thereby narrowing down the search area for the optimal locations. New six SynOPs are generated in the narrowed down subregion and the impacts of every combination of four SynOPs out of six are evaluated to find the optimal locations of the four proposed buoys. The study finds that the SynOPs located at the southern edge of the proposed region are most optimal in improving ocean analysis.