



The CNR ISMAR Global historical Reanalysis (CIGAR): status, perspectives and challenges

A large ensemble (32 members) ocean reanalysis that merges observational data, a state-of-the-science numerical ocean-sea-ice model is produced in CNR-ISMAR. We use optimal ensemble generation with stochastic physics, boundary conditions coming from the best estimates of the atmospheric state and freshwater inflow from land, and multiple bias correction schemes. The advantages of this ensemble reanalyses compared to existing ocean reanalyses are robust ensemble dispersion estimates and long-term coverage (1960-2022), which can be used in different ocean and climate studies and applications. For example, the first use case of these data is to investigate ocean warming over 60+ years, its acceleration and uncertainty, and rank the main sources of uncertainty. The same system has been recently extended to cover the period from 1876 to the present with the same ensemble generation methods, forced by the 20CRv3 atmospheric historical reanalysis. Our system helps quantify the centennial global and regional ocean warming rate, the strongest ENSO events, and their remote impacts, etc. Here we discuss the main challenges and the way forward to develop and produce long-term reanalyses for climate monitoring purposes, including extension of stochastic physics for enhanced uncertainty quantification, and use of deep learning models to correct systematic model errors in data-scarce periods.

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