Investigating long-term changes and their uncertainty over a 60-year time period and longer

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An ocean reanalysis – merging observational data, a state-of-the-science numerical ocean-sea-ice model, and boundary conditions coming from the best estimates of the atmospheric state and freshwater inflow from land – is used to investigate the ocean warming over 60+ years, its acceleration and uncertainty, and rank the main sources of uncertainty. Results indicate a 62-year warming of $0.43 \pm 0.08\,\mathrm{W\,m{-}2}$, and a statistically significant acceleration rate equal to $0.15 \pm 0.04\,\mathrm{W\,m{-}2\,dec{-}1}$, locally peaking at high latitudes. The 11.6% of the global ocean area reaches the maximum yearly OHC in 2022, almost doubling any previous year. At the regional scale, major OHC uncertainty is found in the Tropics; at the global scale, the uncertainty represents about 40% and 15% of the OHC variability, respectively before and after the mid-2000s. The uncertainty of regional trends is mostly affected by observation calibration (especially at high latitudes), and sea surface temperature data uncertainty (especially at low latitudes). The same system has been recently extended to cover the period from 1876, forced by the 20CR atmospheric historical reanalysis. Our system will us quantify the centennial global and regional ocean warming rate, the major ENSO events from the end of XIX century onwards, and a number of selected anomalously warm events. The large ensemble size allows us to associate a confidence level to each event.