

The ECCO Consortium: A comparison of atmospheric re-analysis products for the ocean and associated uncertainties in atmospheric forcing fields

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Errors in ocean circulation estimates can be caused by errors in the surface forcing fields. The ECCO solutions are optimized partly by allowing adjustments in the "first-guess" forcing fields, usually derived from a given atmospheric re-analysis product, within their specified uncertainties. Accurate knowledge of those uncertainties is important for the ECCO optimization procedures. Here four re-analysis products, namely, (1) European Centre for Medium-range Weather Forecasts (ECMWF-Interim), (2) Common Reference Ocean-Ice Experiments (CORE-2), (3) Japanese Reanalysis Project (JRA-25) and (4) National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) Re-analysis Project are evaluated against satellite-derived observations for eight different fields. These fields include zonal and meridional wind stress, precipitation, specific humidity, river runoff, surface air temperature, downwelling longwave and shortwave radiation fluxes. Taking the satellite observations as ground truth, time-mean errors and time-variable errors are estimated separately and mapped globally in space. Results indicate that time-variable errors are always greater than time-mean errors in all the variables. Normalized error estimates, which can be used to compare variables, show that the largest uncertainties are present in the precipitation fields and smallest uncertainties are present in the specific humidity field. The largest errors occur at the high latitudes for most variables. Furthermore, no single product seems to agree better in all variables with the satellite-derived observations. Uncertainties estimated from these analyses are compared to similar estimates obtained using different methodologies (e.g., by differencing any two re-analysis products), in the context of deriving the most appropriate weights for the adjustments in the forcing fields that are part of the ECCO optimized solutions.