

Time of Emergence Model Intercomparison Project for Ocean Biogeochemistry

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ABSTRACT • Anthropogenically-forced changes in the ocean’s biogeochemical processes and properties are underway and critical for the ocean’s role as a carbon sink and marine habitat. Detecting such changes in ocean biogeochemistry will require quantification of not only the magnitude of the change (anthropogenic signal) but also the natural background variability inherent to the climate system (noise). Here we use Large Ensemble (LE) experiments from 4 Earth System Models (ESMs) to estimate the Time of Emergence (ToE) for anthropogenic signals in five biogeochemically-important upper-ocean variables. We find ToEs are robust across models of different climate sensitivities for variables that are tied directly with the rise in atmospheric CO₂ – namely rising sea surface temperature and the invasion of anthropogenic carbon into the ocean which emerge within 20-30 years. For the export of organic carbon, ocean color, and sea surface salinity, emergence timescales are longer (50+ years), less robust across the ESMs, and more sensitive to the forcing scenario considered. Our findings provide important lower bounds for the maintenance of a sustained multi-platform marine carbon observing system.
