Trend Emergence and Extreme Events in Marine Ecosystem Stressors under 21st Century Climate Change

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How will future climate change impact ocean ecosystems? Over the last decade Earth System Models (ESMs) have been increasingly applied to project changes in major marine stressor fields (acidification, warming, and de-oxygenation), with the focus being on changes for the surface (acidification and warming) and near-surface (de-oxygenation). Both large ensemble simulations and CMIP5 inter-comparisons with ESMs have proven valuable in exploring uncertainties, and facilitating analyses of time-of-emergence diagnostics for anthropogenic trends. However, far less attention has been devoted to identifying how the frequency of extreme events may be impacted by climate change. Here we consider for a large ensemble suite of runs with GFDL's ESM2M under RCP4.5 forcing (30 members) how the frequency of occurrence of extreme events in marine ecosystem stressors at the base of the ocean's euphotic zone will change over the 21st century. This is considered within the broader context of emergence timescales of anthropogenic trends in annual mean fields. Preliminary results indicate that natural variability is significantly larger at the euphotic zone base than at the sea surface for stressors, with this having important implications for both extreme events and sustained anthropogenic trends.