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Detection timescale of anthropogenic climate change signals in the global ocean

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Robust detection of anthropogenic climate change is a necessary prerequisite in developing reliable climate change mitigation and adaptation plans. Here, we use simulation data from a suite of latest Earth system model projections to establish the detection timescale of anthropogenic signals in the global ocean under a strong future climate change scenario. We focus on projections of temperature, salinity, oxygen, and pH changes from surface to 2000 m depths. Despite lack of direct interaction with anthropogenic forcing, climate changes in the interior ocean are projected to be detectable earlier than on the surface. This general feature is primarily due to the low background natural variability in the subsurface depths. Acidification signals will occur earliest, followed by warming and oxygen changes. Consistent with the global overturning circulation pathway, the interior of the Atlantic basin will experience earlier detectable signals than the Pacific and Indian basins. The model ensemble projects the subsurface tropical Pacific as the domain least susceptible to exposure of anthropogenic climate change signals over the 21st century. Our study suggests earliest detectable anthropogenic exposure can be expected in the Southern Ocean and the North Atlantic. Sustained deployment of monitoring systems, such as ARGO floats equipped with biogeochemical sensors, in these domains would be highly pertinent to timely detect the early emergence of anthropogenic climate change signals.