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Satellite remote sensing of the marine carbonate system for reef conservation and monitoring wild fisheries

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Anthropogenic emissions of carbon dioxide (CO_2) levelled out in 2016, but have since begun to increase again. This continued increase in anthropogenic emissions means that it is now critical to monitor ocean carbon uptake. This long-term uptake of carbon dioxide (CO_2) by the oceans is reducing the ocean pH, a process commonly known as ocean acidification. The uptake is also altering the ocean chemistry and ecology, impacting marine ecosystems on which we rely. Recent work has begun to investigate the use of satellite Earth observation, exploiting empirical methods and salinity and sea surface temperature data, to monitor surface-ocean carbonate chemistry. These techniques complement in situ approaches by enabling the first synoptic-scale observation-based assessments of the global oceans and are particularly well suited to monitoring large episodic events. The nine year time series (May 2010-present) of observations of ocean salinity from space now provides the potential for time series analyses.

We will first present results from a completed European Space Agency (ESA) project, Pathfinders Ocean Acidification. We will demonstrate that observations from space can be used to estimate surface total alkalinity and total dissolved inorganic carbon with performance (accuracy) comparable to that of in situ driven empirical approaches. The results and animations will then show how observations from space can be used to monitor the interactions between surface dissolved inorganic carbon concentrations from the Amazon outflow and regional tropical reefs. Example satellite derived estimates of upwelling due to surface winds, including those from hurricanes and cyclones, will also be presented. We will then present early results from the ESA Satellite Oceanographic Datasets for Acidification (OceanSODA) project demonstrating how this upwelling (of low pH waters) and compound events and their subsequent impact on the carbonate system can also be inferred from satellite observations. Our intended exploitation of these advancements for supporting coral reef conservation, the designation of marine protected areas and investigating the health of wild fisheries will be presented. These routes for exploitation are being co-developed with the U.S. National Oceanic and Atmospheric Administration (NOAA) and the World Wide Fund for nature (WWF).