Surface pH in the global ocean

The ocean currently takes up ~26% of anthropogenic carbon dioxide every year, effectively slowing down the global climate change. However, by doing so, the ocean is acidifying, making it harder for marine calcifers to form a shell. This phenomenon is commonly referred to as "Ocean Acidification (OA)". Under the IPCC business-as-usual scenario (RCP 8.5), the acidity of the ocean would increase by over 150% by the end of 2100, severely threatening the marine ecosystem.

Two of the most important indicators of ocean acidification are calcium carbonate saturation state and pH, for both of which the higher the better. In this study, we describe the global surface pH distributions and discuss the mechanisms that control them based on the recently released Global Ocean Data Analysis Project Version 2 (GLODAPv2) database. Surface pH corrected to February and August of 2000 in the global ocean are presented. Unlike calcium carbonate saturation states, which show large latitudinal variations (> 4.0 in the equatorial region and close to 1.0 towards the poles), pH shows a much small latitudinal gradient. Surface pH is even lower in the equatorial region due to upwelling activities. The surface pH distribution is mainly controlled by the latitudinal gradient of water temperature and the subsequent differences in total alkalinity and dissolved inorganic carbon (TA/DIC) ratio at air-sea exchange equilibrium, as well as the temperature effect on the carbonic system equilibrium. Freshwater input/output and air-sea gas disequilibrium also affect surface pH to a lesser degree. In addition, we discuss the seasonal pH changes, and demonstrate that pH is occurring on a global scale based on a decadal pH change analyses. We also projected global surface pH distributions in all decades of the 21st Century and show areas that are subject to largest pH change.