Impact of Arctic sea-ice changes on oceanic physical-biological characteristics

in the Arctic Ocean

The unprecedented changes in the Arctic sea-ice in the recent years have significant impact on the circulation pattern, physical and biological parameters in the northern high latitudes. One of the important implications of the ice-melt is the variation in upper-oceanic freshwater content. The air-sea exchange of gases in the Arctic Ocean found to have important contribution in regulating carbon between atmosphere and ocean. The excess load of anthropogenic carbon dioxide (CO2) into the ocean affect biogeochemistry of the surface waters and may lead to oceanic acidification. The difference in partial pressure of CO2 (DpCO2) between the atmosphere and ocean determines the oceanic uptake of CO2. The seawater temperature, and turbulence in upper ocean affect the solubility of CO2 in ocean. The dissolved inorganic carbon (DIC) supports the growth of phytoplankton. A larger melting of sea-ice alter the oceanic stratification, mixed layer depth and significantly impact the oceanic DpCO2. The continental freshwater discharge adds nutrients to the seawater which are crucial for the oceanic primary productivity. The variability of freshwater discharge into the Arctic Ocean due to climate change would, therefore, impact the biological productivity of northern high latitude.

Using the climate model data from the Community Earth System Model (CESM) with the biogeochemical module (CESM1-BGC), the changes in physical and biological parameters in the Arctic oceanic regions are analysed for the years 1850-2100. Different processes responsible for the variations in oceanic parameters are explained in view of ice-melt, freshwater transport, and warming of the Arctic Ocean in the changing climate. The differences in the DpCO2, surface

temperature, Chlorophyll, Phytoplankton concentration, and DIC are analysed over the Arctic Ocean for the past (historical), present, and future climatic scenario. The time-series analysis carried out over the Bering strait, Barents Sea, and at the location of cold dense water formation in the north Atlantic Ocean. In response to the warming surface waters, the model shows a decline in CO2 flux after year 2050. The enhanced oceanic stratification due to accelerated melting of sea-ice may lead to weakening of density driven overturning circulation. The oceanic productivity reduces in most of the Arctic Ocean as the chlorophyll concentration reduces up to -2 mg m-3 in the future climate as compared to the present climate.