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Climate variability, primary productivity and export fluxes on the Canadian shelf of the Beaufort Sea: a modelling study

D. Lavoie (1,2), K.L. Denman (3,4) and R.W. Macdonald (4)

(1) University of Victoria, British-Columbia, Canada, (2) Now at Maurice Lamontagne Institute, Mont-Joli, Canada, (lavoied@dfo-mpo.gc.ca / Fax: 1-418-775-0546 / Phone: 1-418-775-0608), (3) Centre for Climate Modelling and Analysis, Victoria, Canada, (4) Institute of Ocean Sciences, Sidney, Canada

Sea ice exerts an important control for primary production on Arctic shelves: by providing a substrate for algal growth at the bottom of the ice, by limiting the availability of solar irradiance to primary producers, by limiting the development of thermal or freshwater stratification, and by shielding the underlying water column from wind-driven vertical mixing and shelf-break upwelling. The distribution of sea ice cover varies strongly on interannual, decadal, and multi-decadal scales. A major reduction in marginal ice cover has recently been observed and even greater changes are predicted as a consequence of global warming. The decline in sea ice extent and thickness is expected to promote increased primary production, but this increase will result not so much from an increase in light availability as from an increased nutrient supply through wind mixing and shelf-break upwelling. It is uncertain, however, to what extent the supply of nutrients to the mixed layer will increase in this highly stratified environment. To examine this uncertainty, we report on projections for the 21^{st} century of future primary production and export fluxes generated with a one-dimensional sea ice-ocean model coupled to a marine ecosystem model. Forcing is based on observations plus projected future climate change generated by the Canadian General Circulation Model (CGCM2), applied to the local area with a simple down-scaling technique. We explore the sensitivity of the projections to uncertainties in future forcing and in key parameterizations.