Climatic changes in the Northern Hemisphere have led to remarkable environmental changes in the Arctic Ocean, including significant shrinking of sea-ice cover in summer, increased time between sea-ice break-up and freeze-up, and Arctic surface water freshening and warming associated with melting sea-ice, thawing permafrost, and increased runoff. These changes are commonly attributed to the greenhouse effect resulting from increased carbon dioxide (CO₂) concentration. The greenhouse effect should be most pronounced in the Arctic where the largest air CO₂ concentrations and winter-summer variations in the world for a clean background environment were detected (www.noaa.gov). Some increased seasonal variation may be a consequence of increasing summer CO₂ assimilation by plants in response to higher temperature and longer growing season. The Arctic Ocean’s role in determining regional CO₂ balance has been ignored [Feely et al., 2001], because continuous sea-ice cover is considered to impede gaseous exchange with the atmosphere so efficiently that no global climate models include CO₂ exchange over sea-ice. However, measurements by Gosink and Kelley in the 1960-70s [Gosink et al., 1976] and our data [Semiletov et al., 2004] showed one year sea-ice was highly permeable to CO₂ at temperatures above –15°C through numerous tiny channels. Mechanism involved in this process has been roughly discussed. In this paper we show that sea-ice melt ponds and open brine channels form an important spring/summer air CO₂ sink that also must be included in any Arctic regional CO₂ budget; both the direction and amount of CO₂ transfer between air and sea during open water season may be different from transfer during freezing and thawing, or during winter when CO₂ accumulates beneath Arctic sea-ice.

REFERENCES.