Sea Ice Changes during the Early 20th Century Arctic Warming in an Earth System Model

Takuro Aizawa[1,2], M. Ishii[1] , S. Yukimoto[1] and H. Hasumi[2]
[1]*Meteorological Research Institute, Tsukuba, Japan*
[2]*Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Japan*

The Arctic has experienced a remarkable warming comparable to a recent warming during the first half of the 20th Century. Although sea ice changes in the pre-satellite era have a large uncertainty, a reconstructed sea ice dataset indicates relatively smaller sea ice extent in the middle of 20th Century in response to the Arctic warming.

A series of experiments required by Coupled Model Intercomparison Project Phase 6 (CMIP6) and Detection and Attribution MIP (DAMIP) was conducted by a new climate model Meteorological Research Institute Earth System Model version 2.0 (MRI-ESM2.0) to identify the external climate factors in the historical temperature and Arctic sea ice changes. The MRI-ESM2.0 reproduced realistically the historical change in the Arctic temperature including the warming in the first half of the 20th Century. This study suggests that the sea ice extent in the period from the end of the 19th Century to the first half of the 20th Century could have been decreased in response to the rising Arctic surface air temperature resulting from the increase of greenhouse gas concentration, the increasing solar activity and the reduced volcanic activity.

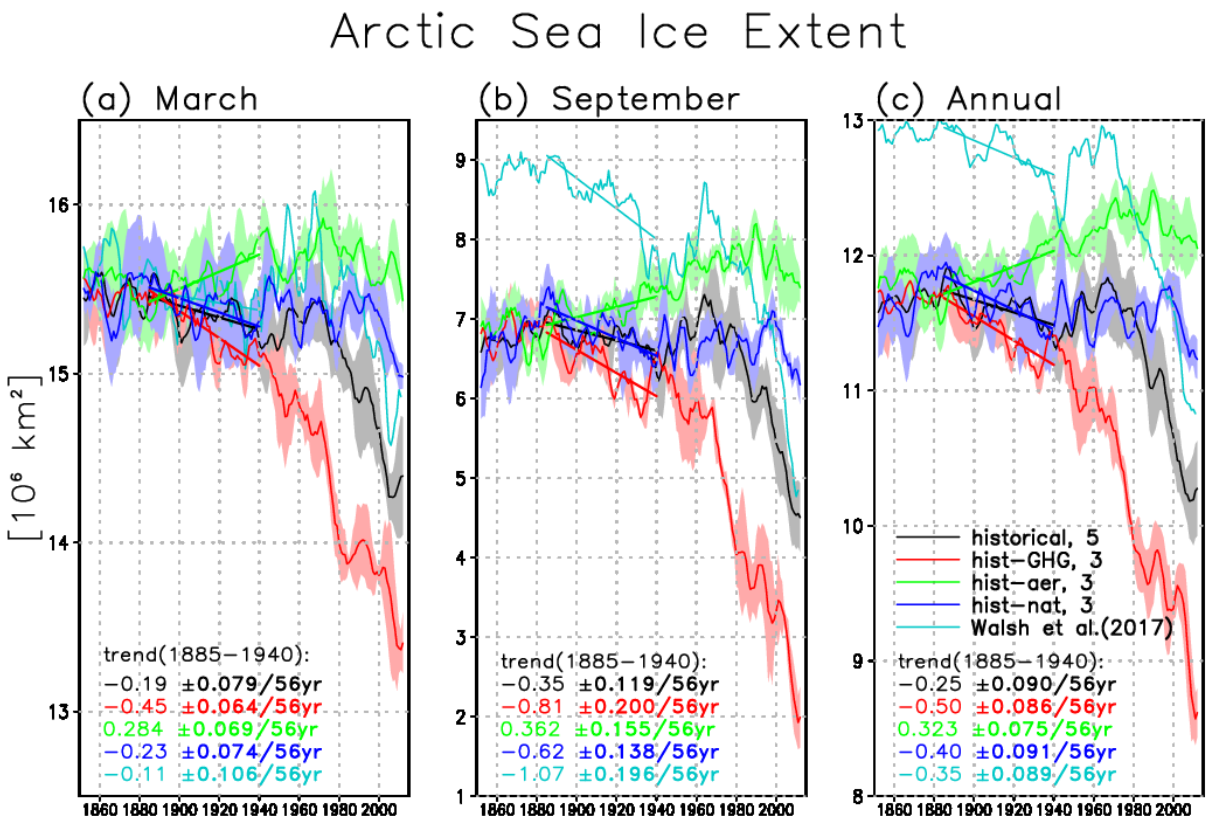

Figure 1. Time series and trend of 10-year moving mean (a) March, (b) September and (c) Annual mean Arctic sea ice extent (10^6 km^2).. The black, red, green, blue solid and light blue curves indicate the ensemble means of historical runs, hist-GHG runs, hist-aer runs, hist-nat runs, and observation, respectively. The solid lines and digits in the figures indicate trends between 1885 and 1940 t (10^6 km^2). The shadings indicates standard deviations from the sensenble means.