Interannual variability of summer precipitation over northern Eurasia in multiple climate models

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Global warming is projected to be amplified in high-latitude region. Because the Arctic sea ice loss has been already beginning to appear, hydrological cycle in the northern part of Eurasia may be affected by the global warming and the Arctic sea ice reduction. Fujinami et al. (2016) showed summer precipitation increased after 1980 in northern Eurasia, and Hiyama et al. (2016) discussed a possible effect of the recent Arctic sea ice reduction on the modulation of interannual variability of summer precipitation. Such changes are important issues for the current environment including the ecosystem over northern Eurasia In addition, the reliable future projection and understanding of the hydrological cycle system are also important for mitigation and adaptation of future environmental changes.
In this study, we investigated characteristics of interannual variability of summer precipitation in northern Eurasia in 16 climate/earth system models, which have been used for the projection of future climate change, to assess whether recent global warming and the Arctic sea ice reduction affect realistically the northern Eurasian environment in the models. To reduce uncertainty related to oceanic change, we used data of the historical simulations of CMIP5 from 1979 to 2008 with observed sea surface temperature (SST) and sea ice conditions.
The spatial distribution of precipitation averaged for summer (June-July-August) in northern Eurasia in each model is similar to the observed one. Unlike the observed increase in summer precipitation in Siberian region (Fujinami et al. 2016), there is no model showing a remarkable increase trend of summer precipitation averaged over Siberian region. EOF analysis was performed for each model to extract the leading modes of interannual variability of summer precipitation in northern Eurasia. Although the EOF spatial patterns differs among the models, the first three EOF patterns of many models includes a pattern similar to the east-west seesaw pattern, which is a leading mode of the observed interannual variability. Furthermore, Hiyama et al. (2016) showed difference in the interannual variation pattern of observed summer precipitation in the northern Eurasia between the two periods before and after 1990, and also discussed the relationship between this difference and the Arctic sea ice reduction. Then we compared the frequency of EOF score values between the first 10 years (1979-1988) and the last 10 years (1999-2008) in each model. In many models, the mean or variance of score values at an EOF mode changed significantly between the periods. However, the spatial pattern of the EOF where the frequency change of the score value occurred was not similar between models.
As a result, the characteristics of interannual variability in northern Eurasia differ greatly among the models. However, it turned out that the observed east-west seesaw mode was included as one of the interannual variability in almost all of the models. In addition, some models revealed that the interannual variability of summer precipitation in northern Eurasia modulated after 1980, as discussed in Hiyama et al. (2016). In this presentation, atmospheric circulations related to the EOF modes are also shown.

References

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