CMIP5 モデルによる北ユーラシア大陸上の夏季降水日変動の再現性

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Reproducibility of summertime diurnal precipitation over northern Eurasia simulated by CMIP5 climate models

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Reproducibility of diurnal precipitation over northern Eurasia simulated by CMIP5 climate models in their historical runs were evaluated, in comparison with station data (NCDC-9813) and satellite data (GSMaP-V5). We first calculated diurnal cycles by averaging precipitation at each local solar time (LST) in June-July-August during 1981-2000 over the continent of northern Eurasia (0-180E, 45-90N). Then we examined occurrence time of maximum precipitation and a contribution of diurnally varying precipitation to the total precipitation.

The diunal cycles of precipitation in NCDC-9813, GSMaP-V5, and 26 CMIP5 climate models are shown in Fig. 1. The contribution of diurnal precipitation was about 21% in both NCDC-9813 and GSMaP-V5. The maximum precipitation occurred at 18LST in NCDC-9813 but 16LST in GSMaP-V5, indicating some uncertainties even in the observational datasets. The diurnal contribution of the CMIP5 models varied largely from 11% to 62%, and their timing of the precipitation maximum ranged from 11LST to 20LST. Interestingly, the contribution and the timing had strong negative correlation of -0.65 as shown in Fig. 2. The models with larger diurnal precipitation showed precipitation maximum earlier around noon.

Next, we compared sensitivity of precipitation to surface temperature and tropospheric humidity between 5 models with large diurnal precipitation (LDMs) and 5 models with small diurnal precipitation (SDMs). Precipitation in LDMs showed high sensitivity to surface temperature, indicating its close relationship with local instability. On the other hand, synoptic disturbances were more active in SDMs with a dominant role of the large scale condensation, and precipitation in SDMs was more related with tropospheric moisture. Therefore, the relative importance of the local instability and the synoptic disturbances was suggested to be an important factor in determining the contribution and timing of the diurnal precipitation.

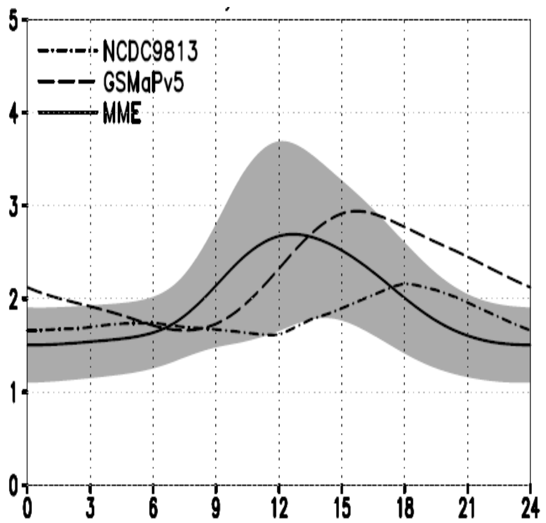

Figure 1. The diunal cycles of precipitation (mm day^{-1}) in NCDC-9813, GSMaP-V5, and 26 CMIP5 climate models.

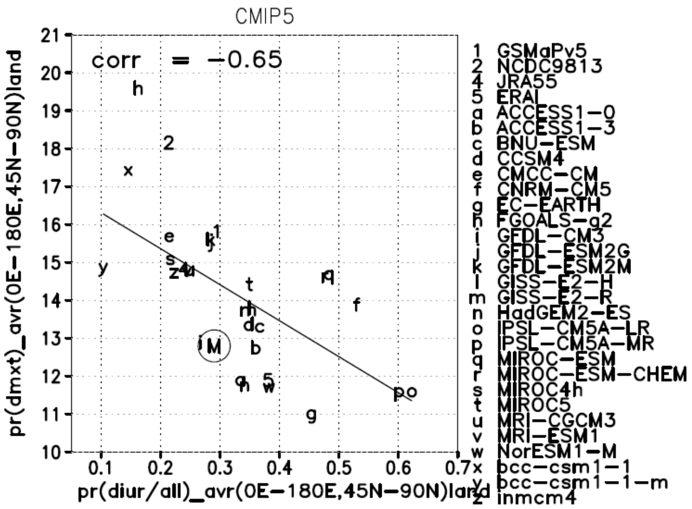

Figure 2. A scatter plot of the contribution of diurnal precipitation (ordinate) and the local solar time (abscissa) of the precipitation maximum for GSMaPv5, NCDC-9813, and the CMIP5 climate models.