Prospective Changes in Climatology of the CORDEX Domain of Australasia: A Dynamical Downscaling Approach Using RegCM4.6

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Abstract

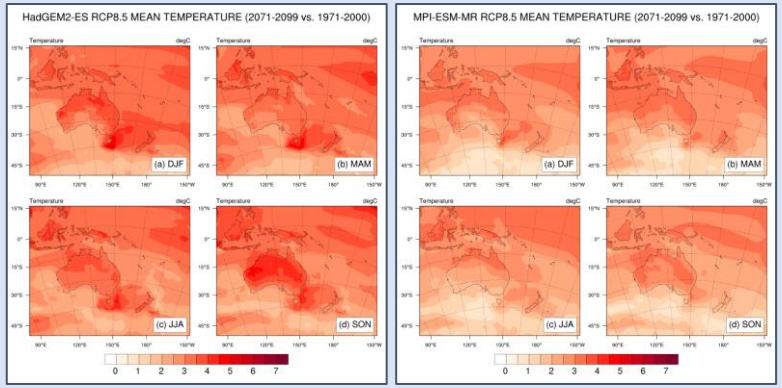
Although there are increasingly various studies within the frame of CORDEX initiative, most of these studies mainly focus on the domains of Africa, Europe, and the Mediterranean. Therefore, this study presents the regional climate projections for the CORDEX-Australasia domain using RegCM4.6. Projected changes in merely mean temperature and precipitation climatology during the periods of 2011-2040 (near-term), 2041-2070 (mid-term), and 2071-2099 (long-term) with reference to the period of 1971-2000 have been examined for the CORDEX-Australasia domain via regional climate model. Regional climate model runs were employed by using the best parametrizations suggested in the evaluation part of the study. The outputs of two global circulation models (i.e., HadGEM2-ES of the Met Office Hadley Centre, MPI-ESM-MR of the Max Planck Institute for Meteorology) were dynamically downscaled to 50 km under two different Representative Concentration Pathways (RCPs), namely RCP4.5 and RCP8.5. In this respect, seasonal changes in temperature and precipitation climatology of the CORDEX-Australasia domain were analyzed in a higher resolution. The results of the analysis show that there will be increasingly higher temperatures in Australasia towards the end of the century. It is concluded that the mean temperature increase expectation of approximately 1.5-3 ℃ may be around 5 ℃ at the end of the century. On the other hand, the change in precipitation varies greatly depending on the period and sub-region. Average ±20% change in precipitation may occur as 50% or more increases or 30% or more decreases in some places.

Experimental Design & Data

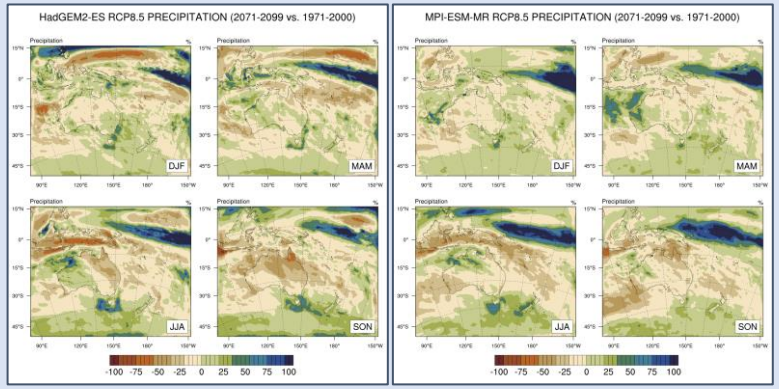
Domain: CORDEX-Region 9
GCMs: HadGEM2-ES & MPI-ESM-MR
RCM: RegCM4.6
Land-Surface Scheme: BATS
PBL Scheme: Holtslag
Convection Scheme: Emanuel over ocean
Tiedtke over land
Horizontal Resolution: 50 km
Scenarios: RCP4.5 & RCP8.5
Variables: Mean Temperature
Total Precipitation
Periods: 1971 - 2000 (reference)
2011 - 2040 (near-term)
2041 - 2070 (mid-term)
2071 - 2099 (long-term)

Results

Seasonal Changes (℃) in Mean Temperature



Seasonal Changes (%) in Total Precipitation



Conclusions

- RegCM4.6 model results can be said to be of acceptable accuracy and reliability for the CORDEX-Australasia domain.
- RegCM4.6 results driven with HadGEM2-ES project a slightly higher warming than RegCM4.6 results driven with MPI-ESM-MR.
- There may be increasingly higher temperatures in Australasia towards the end of the century. It is concluded that the mean temperature increase expectation of approximately 1.5-3 ℃ may be around 5 ℃ at the end of the century.
- In general, it is seen that the increases in temperature may be more significant in tropical regions and around Tasmania.
- It is clear that the change in precipitation according to the change in temperature values shows a very heterogeneous pattern.
- Considering the whole region, it can be said that these decrease and increase rates may be around 20% on average and may occur as 50% or more increases or 30% or more decreases in some parts.
- It is even seen that these increases are striking particularly along the equatorial belt.

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