Weile Wang
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Uncertainty Assessment of the NASA Earth Exchange Global Daily Downscaled Climate Projections (NEX-GDDP) dataset

The NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) dataset is comprised of downscaled climate projections that are derived from 21 General Circulation Model (GCM) runs conducted under the Coupled Model Intercomparison Project Phase 5 (CMIP5) and across two of the four greenhouse gas emissions scenarios (RCP4.5 and RCP8.5). Each of the climate projections includes daily maximum temperature, minimum temperature, and precipitation for the periods from 1950 through 2100 and the spatial resolution is 0.25 degrees (~25 km x 25 km). The GDDP dataset has received warm welcome from the science community in conducting studies of climate change impacts at local to regional scales, but a comprehensive evaluation of its uncertainties is still missing. In this study, we apply the Perfect Model Experiment framework (Dixon et al. 2016) to quantify the key sources of uncertainties from the observational baseline dataset, the downscaling algorithm, and some intrinsic assumptions (e.g., the stationary assumption) inherent to the statistical downscaling techniques. We developed a set of metrics to evaluate downscaling errors resulted from bias-correction ("quantile-mapping"), spatial disaggregation, as well as the temporal-spatial non-stationarity of climate variability. Our results highlight the spatial disaggregation (or interpolation) errors, which dominate the overall uncertainties of the GDDP dataset, especially over heterogeneous and complex terrains (e.g., mountains and coastal area). In comparison, the temporal errors in the GDDP dataset tend to be more constrained. Our results also indicate that the downscaled daily precipitation also has relatively larger uncertainties than the temperature fields, reflecting the rather stochastic nature of precipitation in space. Therefore, our results provide insights in improving statistical downscaling algorithms and products in the future.

Authors

- Weile Wang
  - CSUMB & NASA/AMES
- Ramakrishna R Nemani
  - NASA Ames Research Center
- Andrew Michaelis
  - California State University Monterey Bay
- Hirofumi Hashimoto
  - California State University Monterey Bay
- Jennifer L Dungan
  - NASA Ames Research Center
- Bridget L Thrasher
  - Self Employed
- Keith W Dixon
  - NOAA