A Regional Climate Model Evaluation System based on Satellite and other Observations for Application to CMIP and Climate Assessment Downscaling

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Background: Why model evaluation?
• Climate model projections play a crucial role in developing plans to mitigate and adapt to climate variations and change for sustainable developments.
• Assessing model performance is an important step in linking climate simulation quality to projection uncertainty and then to climate change impacts assessments.
• Uncertainties propagate according to model hierarchy
• Bias correction is based on model evaluation
• Determination of the weights in multi-model ensemble
• Model evaluation is also a fundamental part of model development and improvement (Figure 1).

Regional Climate Model Evaluation System (RCMES):
• Provide a fast, flexible, comprehensive system to allow easy comparison of climate models with observations.
• Enable researchers to handle a large volume of data and reduce time taken for model evaluation studies from weeks to hours.
• Help model developers with cutting-edge observations and diagnostics to evaluate and improve their models.
• Help end-users understand the uncertainties in climate projections for the regions of interest.
• Efficient: Fast access to reference data and toolkit
• User Friendly: Intuitive and transferrable GUI
• Flexible: Cloud-based architecture
• Expandable:
  • Easy to add new data/analysis tool
  • Scalable storage solution

RCMES overview:
• Large database (MySQL + Apache Hadoop):
  • Multiple reference datasets from:
    • Satellite remote sensing
      • TRMM (1998-2010)
      • AIRS (2002-2010)
      • MODIS Cloudiness
    • Assimilation
      • SWR (SNODAS; JPL&U. Colorado)
      • Reanalysis
      • ERA-Interim (e.g. U(p), V(p), q(p), T(p), SLP)
• Extractors:
  • Process data from various data formats into a common database schema.
• Library of statistical metrics:
  • Python routines with plug-ins in other languages (Fortran, c, idl) to calculate and plot standard metrics of model performance. (e.g. Bias, RMS error, Anomaly Correlation, Probability Distribution Functions).

Future works:
1. Add additional reference datasets (e.g., other reanalysis, satellite data, in-situ)
2. Examine remote sensing data for evaluating fine-scale (-cokm) regional climate data.
3. Additional metrics calculations and visualizations
4. Improve GUI
5. Use the system to evaluate regional/global climate models associated with National Climate Assessment (NCA), NARCCAP, CMIP5 and CORDEX (Africa and Asia).

Reference