



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).

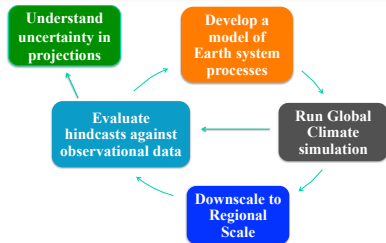


Figure 1. The role of model evaluation in the model development process and uncertainty estimations.

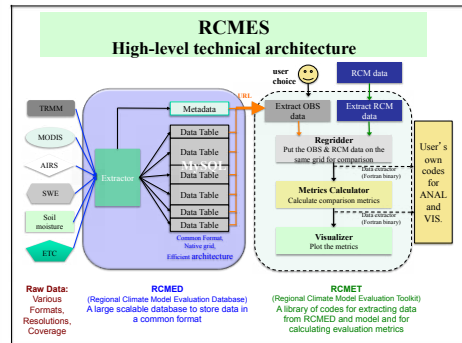
Regional Climate Model Evaluation System (RCMES):

- 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

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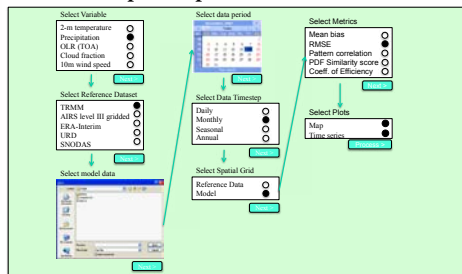
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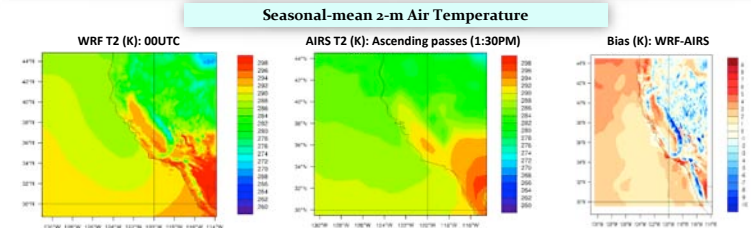
RCMES overview:

- Large database (MySQL + Apache Hadoop):**
 - Multiple reference datasets from:
 - Satellite remote sensing
 - TRMM (1998-2010)
 - AIRS (2002-2010)
 - MODIS Cloudiness
 - Analysis
 - CPC precipitation, CRU precipitation, 2-m air temperatures
 - 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).

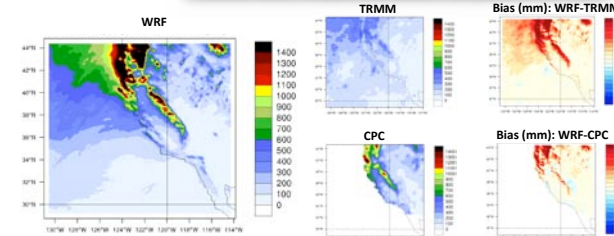
Sample Graphical User interface



Evaluation of the Simulated Cold Season Hydrology in California WRF; Oct 2008 – Mar 2009; NCEP Final Analysis forcing



Season-total Precipitation (mm): Multiple Reference Data

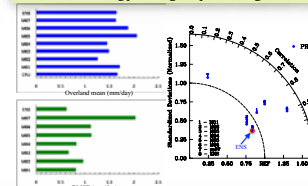


Issues:

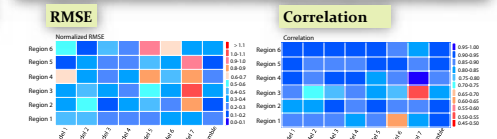
- Remote sensing data:**
 - Satellite fly-over timing
 - Sensor footprints
- Multiple REF data:**
 - Differences between REF datasets
 - Reference data intercomparison
 - Observational uncertainty

Evaluation of the CORDEX-Africa Multi-Model Ensemble Preliminary 20-year runs; 1989 – 2008

Spatial Variability of the Precipitation Climatology using Taylor diagram



Precipitation Annual Cycle in 6 Regions using Portrait diagram



Intuitive presentation schema can facilitate intercomparison of multiple models

Future works:

- Add additional reference datasets (e.g., other reanalysis, satellite data, in-situ)
- Examine remote sensing data for evaluating fine-scale (<10km) regional climate data.
- Additional metrics calculations and visualizations
- Improve GUI
- Use the system to evaluate regional/global climate models associated with National Climate Assessment (NCA), NARCCAP, CMIP5 and CORDEX (Africa and Asia).

Reference

Hart, A.F., C.E. Goodale, C.A. Mattmann, P. Zimdars, D. Crichton, P. Lean, J. Kim, and D.E. Waliser, 2011: A cloud-enabled regional climate evaluation system. SECL0UD'11, May 22, 2011, Waikiki, Honolulu, HI, USA.