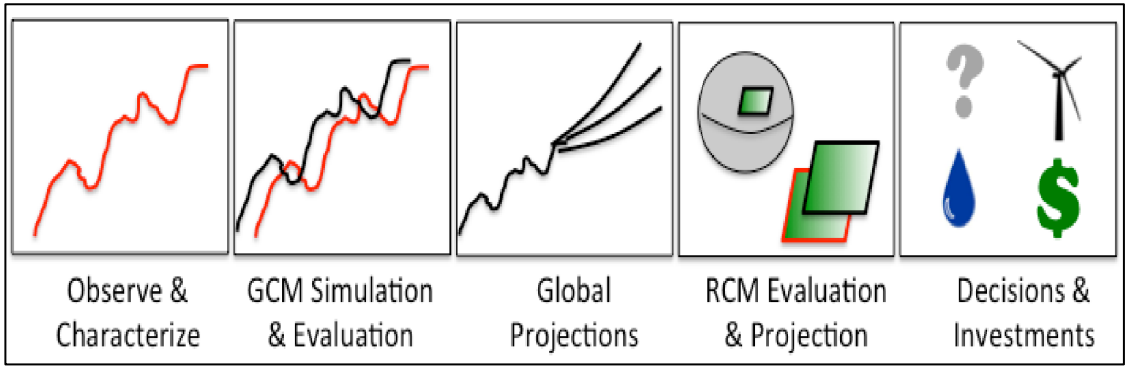
Jet Propulsion Laboratory
California Institute of Technology

Scientific Applications of the Regional Climate Model Evaluation System (RCMES)

Paul C. Loikith, Duane E. Waliser, Chris Mattmann, Jinwon Kim, Huikyo Lee, Paul M. Ramirez, Andrew F. Hart, Cameron E. Goodale, Michael J. Joyce, Shakeh E. Khudikyan, Maziyar Boustani, Kim Whitehall, Alex Goodman, Jesslyn Whittell, and Paul Zimdars



WCRP VAMOS/CORDEX Workshop of Latin-America and Caribbean CORDEX
Phase 1-South America
September, 11-13, 2013
Lima, Perú

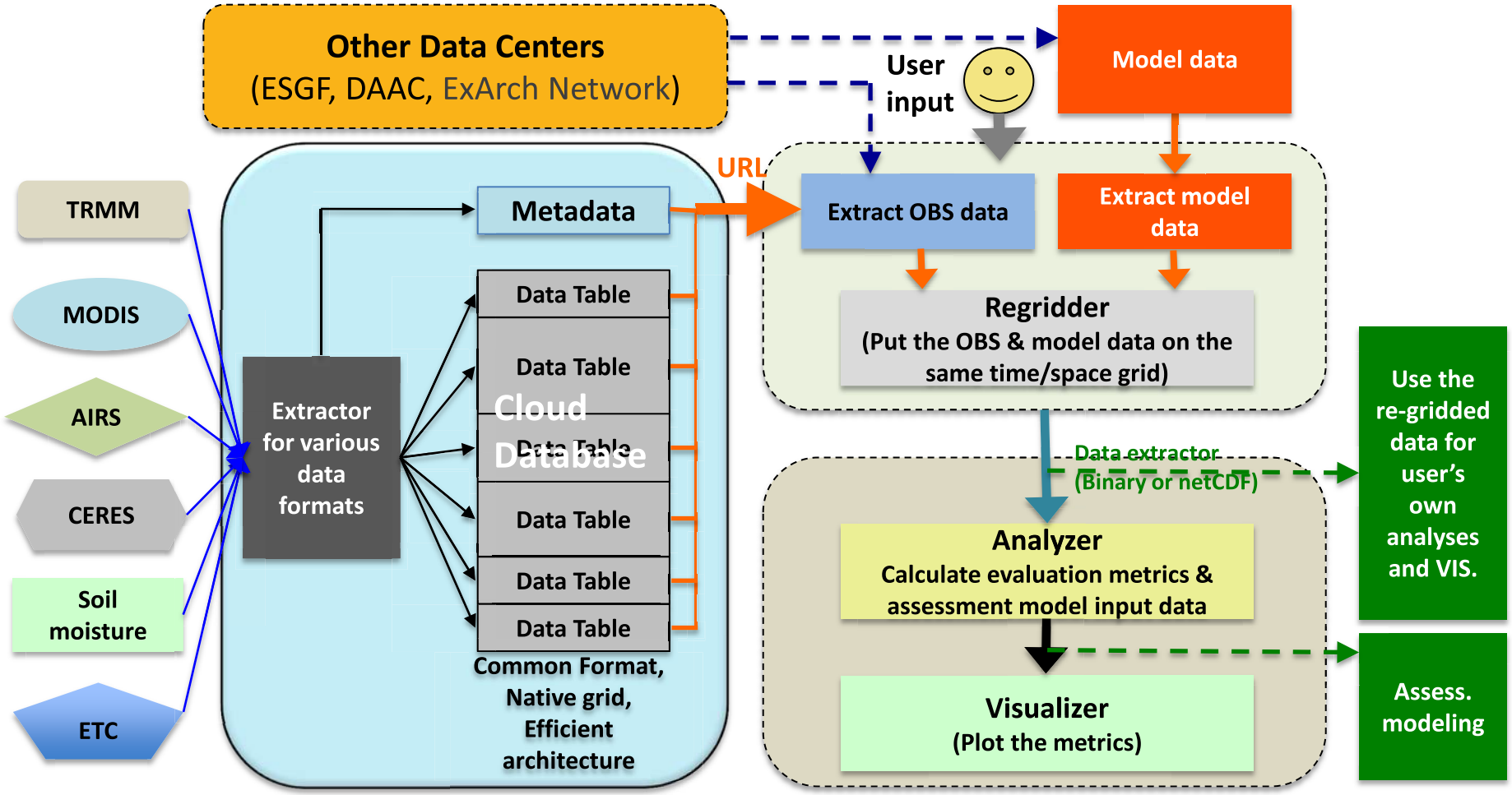
rcmes.jpl.nasa.gov

The Regional Climate Model Evaluation System (RCMES)

- Joint collaboration: JPL/NASA, UCLA
- Designed to facility model evaluation and decision making
  - Provides access to numerous (NASA) observation datasets (RCMED)
  - Python-based built-in toolkit (RCMET) has regridding capabilities and calculates and visualizes several common metrics (RMSE, Bias)
- Initial target: CORDEX

RCMES Architecture

(http://rcmes.jpl.nasa.gov; Powered by *Apache Open Climate Workbench*)



Raw Data:
Various sources, formats, Resolutions, Coverage

RCMED
(Regional Climate Model Evaluation Database)
A large scalable database to store data from variety of sources in a common format

RCMET
(Regional Climate Model Evaluation Tool)
A library of code for extracting data from RCMED and model and for calculating evaluation metrics

Meet the RCMES Team

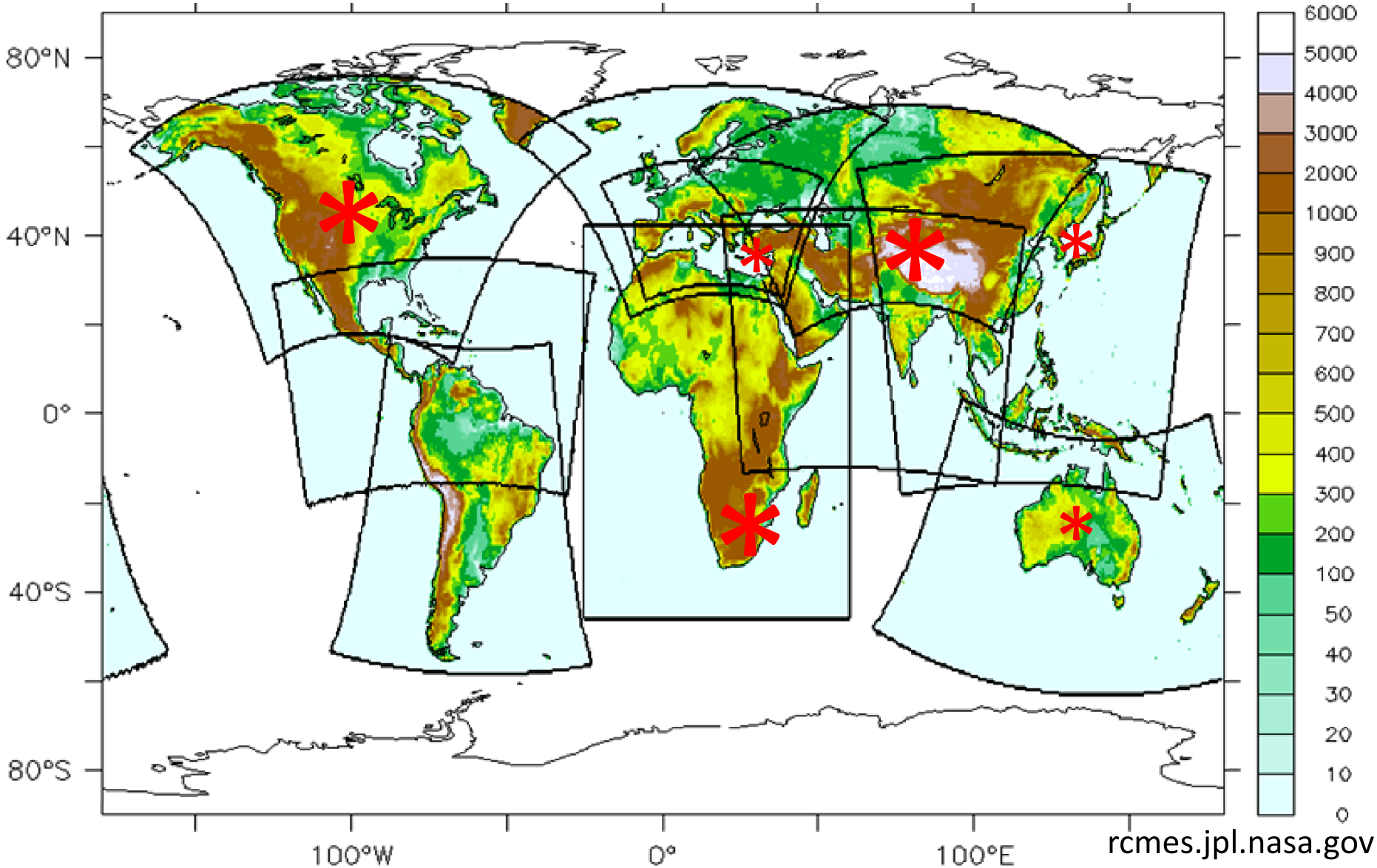
Science Team:

Duane Waliser (PI, JPL/Caltech, UCLA), Jinwon Kim (UCLA),
Paul Loikith (JPL/Caltech), Huikyo Lee (JPL/Caltech),
Kim Whitehall (Howard University)

IT Team:

Chris Mattmann (PI, JPL/Caltech, UCLA), Paul Ramirez (JPL/Caltech),
Cameron Goodale (JPL/Caltech), Michael Joyce (JPL/Caltech),
Maziyar Boustani (JPL/Caltech), Andrew Hart (JPL/Caltech),
Shakeh Khudikyan (JPL/Caltech),
Jesslyn Whittel (University of California, Berkeley),
Alex Goodman (Colorado State University)

Active CORDEX Collaborations



Observations

Remote Sensing, In Situ, Reanalysis

- Temperature (AIRS, CRU, UDEL)
- Precipitation (TRMM, CRU, UDEL, CPC, GPCP)
- Radiation/clouds (CERES, MODIS)
- Sea surface height (AVISO)
- Sea surface temperature (AMSRE)
- Winds (QuikSCAT)
- Multivariate reanalysis (MERRA, NARR, NLDAS ERA-Interim)
- More to come…

Please see poster by Kim Whitehall *today* for further details

RCMET Evaluation UI

See youtube video:
http://rcmes.jpl.nasa.gov/training/videos

Start Date
End Date
North
East
South
West
Select Dataset

Once users have selected models and/or observations to work with in this area we will display auto-detected model Lat/Long/Time parameters that overlap and will allow the user to edit the values.

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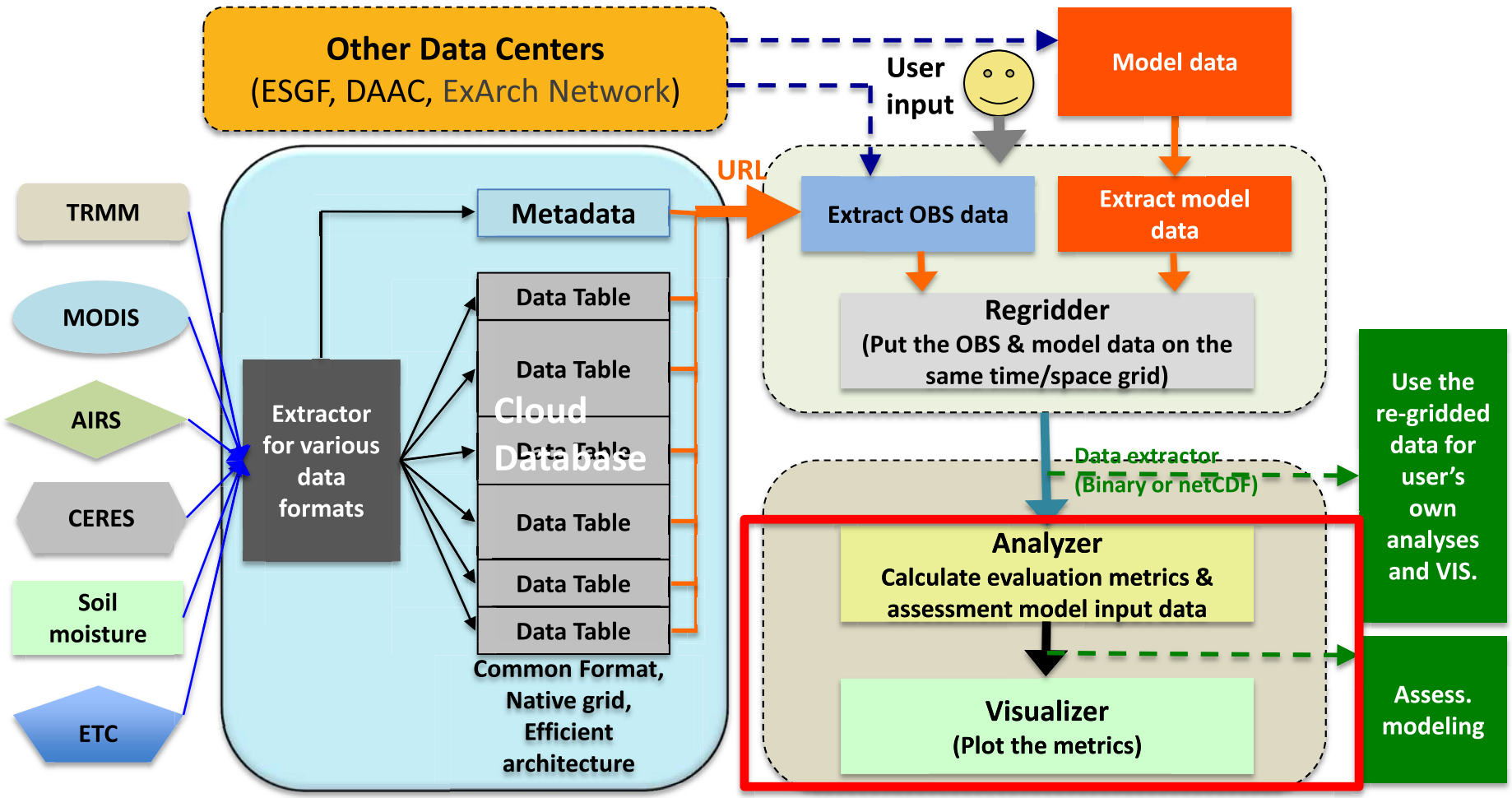

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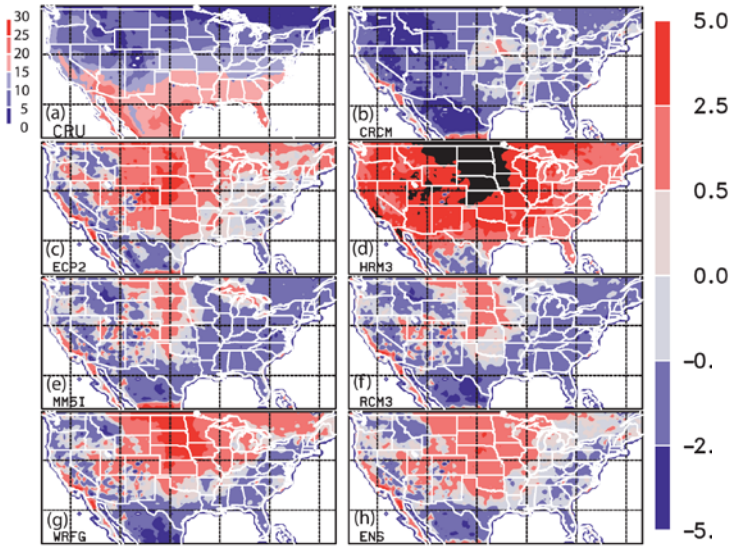
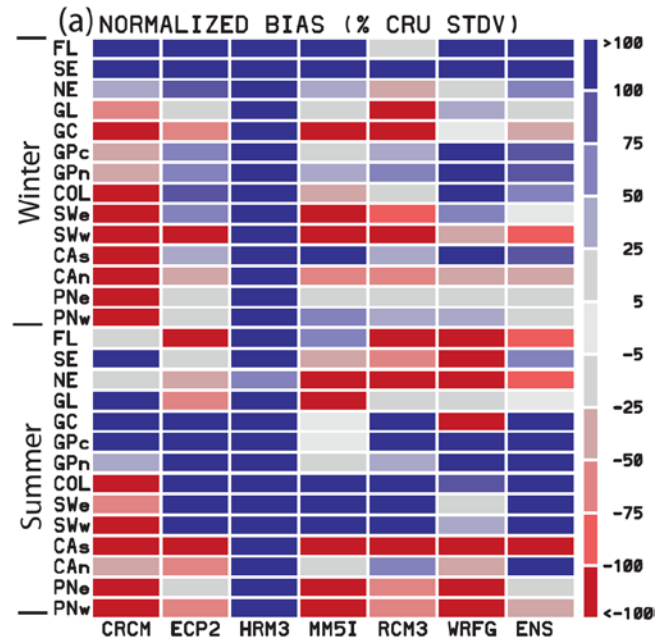
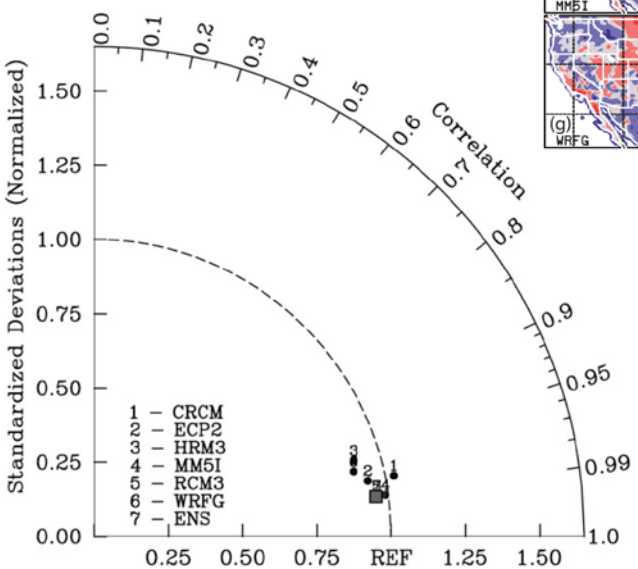
Metrics and Visualizations: NARCCAP Temperature Bias

Bias Maps



Portrait Diagrams





Taylor Diagrams

Kim, J., D. E. Waliser, C. A. Mattmann, L. O. Mearns, C. E. Goodale, A. F. Hart, D. J. Crichton, S. McGinnis, H. Lee, P. C. Loikith, and M. Boustani, 2013: Evaluation of the Surface Air Temperature, Precipitation, and Insolation over the Conterminous U.S. in the NARCCAP Multi-RCM Hindcast Experiment Using RCMES, *J. Climate*, **26**, 5698-5715.

rcmes.jpl.nasa.gov

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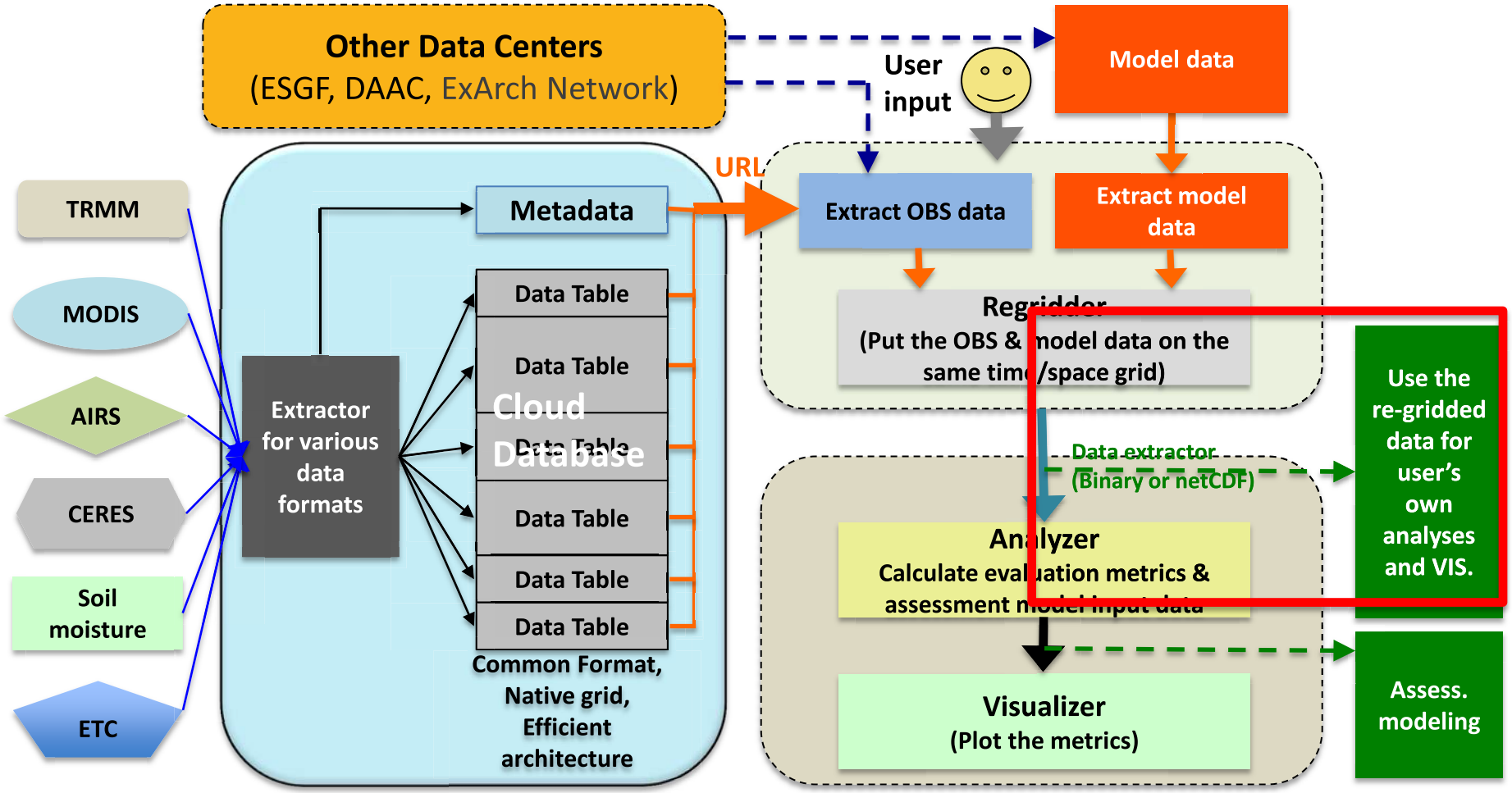

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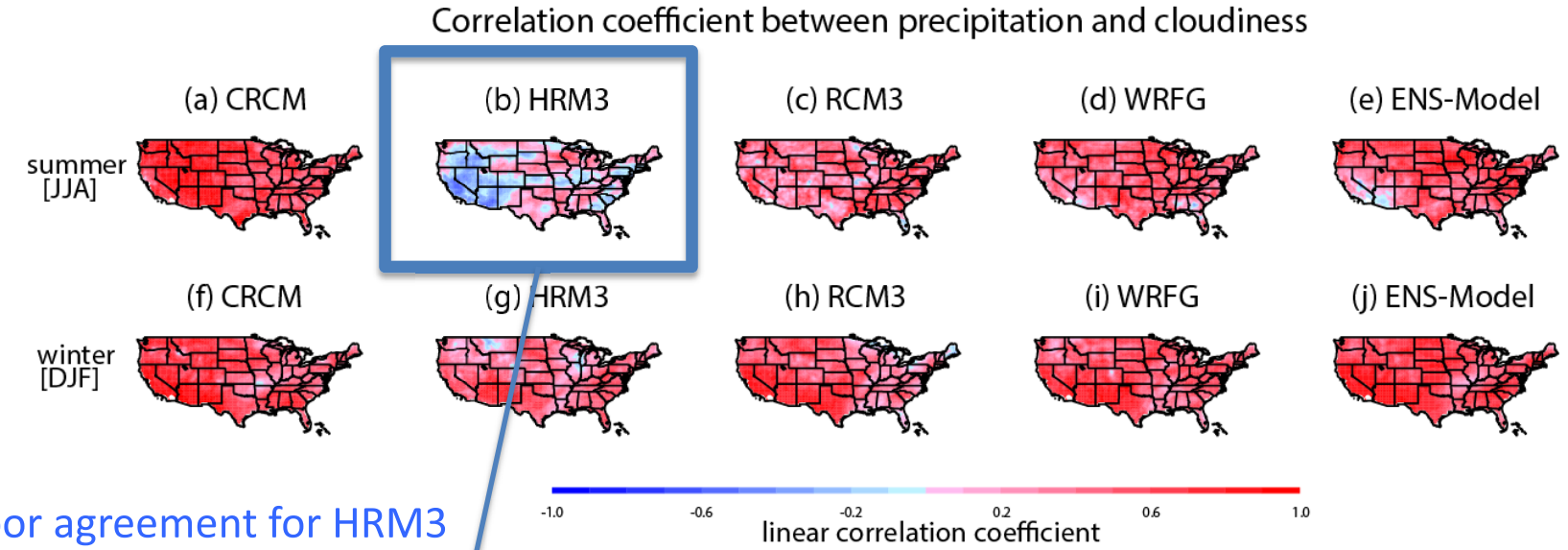
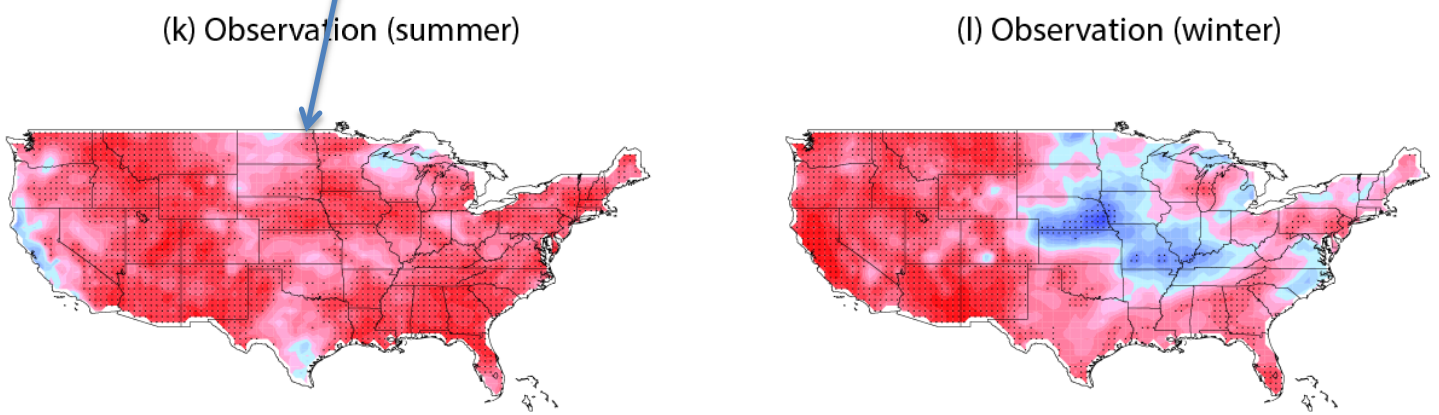
NARCCAP Cloud-precipitation-radiation relationship



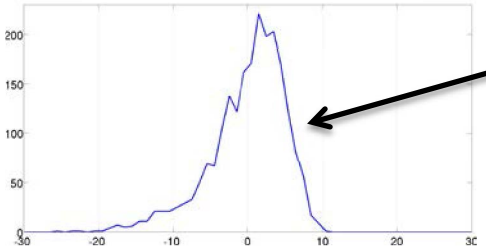
Poor agreement for HRM3

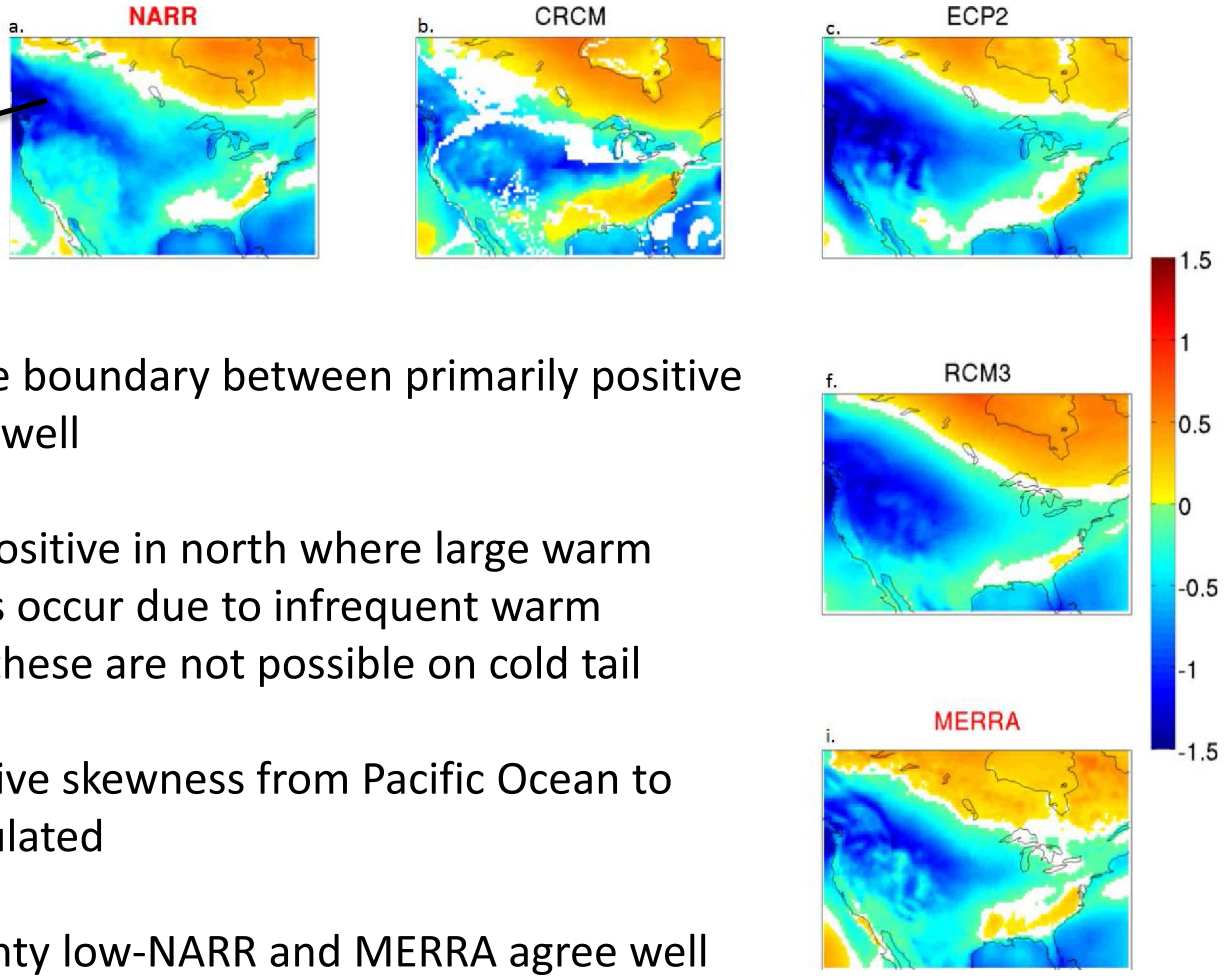


Lee, H., J. Kim, D. E. Waliser, P. C. Loikith, C. A. Mattmann, and S. McGinnis, Evaluation of simulation fidelity for precipitation, cloud fraction and insolation in the North America Regional Climate Change Assessment Program (NARCCAP), *submitted to J. Geophys. Res.*, August, 2013.

Evaluation of NARCCAP Temperature PDFs and Extremes

Skewness=-1

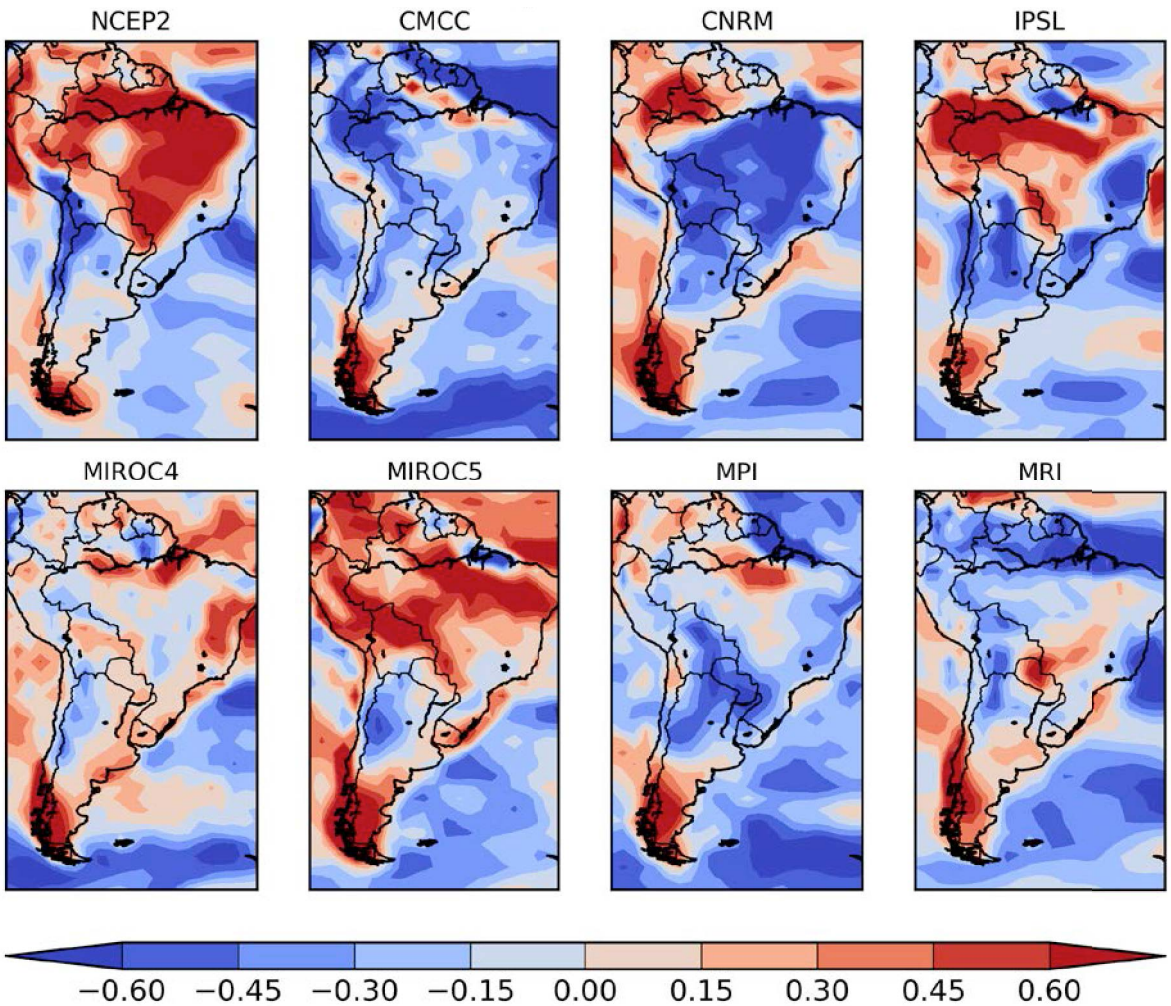




- Most models reproduce boundary between primarily positive and negative skewness well
- Skewness is primarily positive in north where large warm temperature excursions occur due to infrequent warm advection from south, these are not possible on cold tail
- Coherent area of negative skewness from Pacific Ocean to Great Lakes is well simulated
- Observational uncertainty low-NARR and MERRA agree well

Loikith, P. C., D. E. Waliser, J. Kim, H. Lee, B. R. Lintner, J. D. Neelin, S. McGinnis, C. Mattmann, and L. O. Mearns, Surface Temperature Probability Distributions in the NARCCAP Hindcast Experiment: Evaluation Methodology, Metrics and Results, *submitted to J. Climate, July 2013*.

Skewness of January Surface Temperature



- RCMES allows for regional analysis of global models
- Possible to compare CMIP5 simulations to CORDEX downscaled model simulations
- Results show substantial model-reanalysis disagreement in daily temperature skewness
- Suggestive of improper simulation of temperature extremes where disagreement is high

Future Direction

- Observations and metrics continue to be added to RCMES
  - Community can contribute to RCEMT via the Apache Open Climate Workbench (http://climate.incubator.apache.org/)
- Regional Evaluation of CMIP5, including linkage to ESGF
- Developing new and novel evaluation metrics for the evaluation
  - Large-scale meteorological patterns associated with extremes
  - Using k-means clustering to evaluate temperature PDFs
  - Develop optimal multi-model ensemble techniques
- Expanding user community and fostering new collaborations within CORDEX

Please see poster by Kim Whitehall *today* for further details

How do I get RCMES?

- General information: rcmes.jpl.nasa.gov
- Download RCMES virtual machine
  - rcmes.jpl.nasa.gov/training/downloads
- Open source at Apache Open Climate Workbench
  - http://climate.incubator.apache.org/
- General inquiries please email: rcmes-general@jpl.nasa.gov

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Thank you!

Contact information:

Paul Loikith: paul.c.loikith@jpl.nasa.gov
Duane Waliser: duane.e.waliser@jpl.nasa.gov (science PI)
Chris Mattmann: chris.a.mattmann@jpl.nasa.gov (IT PI)
General questions: rcmes-general@jpl.nasa.gov

Websites:

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Questions?

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