A Regional Climate Model Evaluation System based on satellite and other observations for application to CMIP/AR downscaling

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What Problem are we Solving?

- Make Climate Model Evaluation Easier

- Develop a Rich Pool of Observations
  - Catalog and Archive Datasets from different agencies and sources and bring them together in an accessible format
- Provide Analysis Tools that can Expand
  - Regridding, Bias Estimation, Daily and Monthly processing, RMSE, etc...
- Distributed
  - Are stored all over the country and the world with EOSDIS being a principal infrastructure
- Analysis
  - Access and computational capabilities are needed to assemble and perform analysis "on-the-fly"

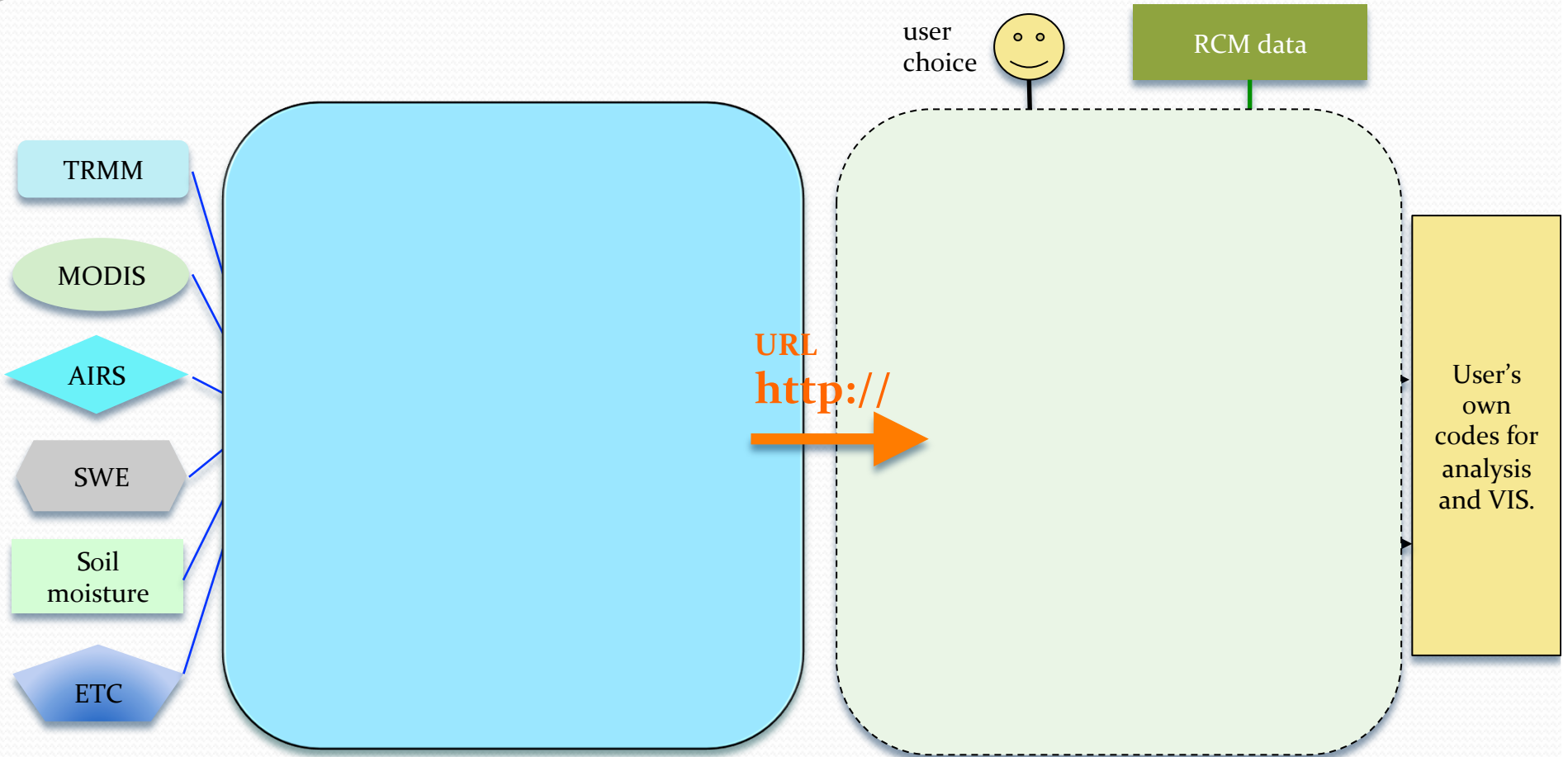# JPL Regional Climate Model Evaluation System (RCMES)

- A JPL-UCLA team has been developing RCMES for the past 1.5 years to facilitate model evaluation
  - Reference database (Regional Climate Model Evaluation Database: RCMED)
  - Evaluation toolkit (Regional Climate Model Evaluation Tool: RCMET)

- RCMES architecture
  - *Efficient*
    - Fast access to the reference data
  - *User friendly*
    - Intuitive GUI
  - *Flexible*
    - Extractors for multiple data formats (netCDF, HDF, Grib, Ascii)
    - Extract partially processed data for users' own analysis
  - *Expandable*
    - Easy to add new data and/or analysis tool
    - Apache Hadoop and MySQL are used to provide scalable storage solution
    - Cloud-based architecture for storage and user interface is being explored.

Background

- March 2010 - JPL and UCLA started working on the RCMES
  - Commitment to using Open Source Software
  - Originally designed for California State Policy Makers
  - Presented in September 2010 to California Leaders
- December 2010 – Project Restarted
  - Expanded the scope to a Global Scale
  - Build a User Facing Toolkit
- March 2011 – Presented the System to CORDEX Africa
  - Collaborating with University of Cape Town

RCMES
High-level technical architecture

TRMM

MODIS

AIRS

SWE

Soil moisture

ETC

user choice

RCM data

URL
http://

User's own codes for analysis and VIS.

Raw Data:
Various 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 codes for extracting data from RCMED and model and for calculating evaluation metrics
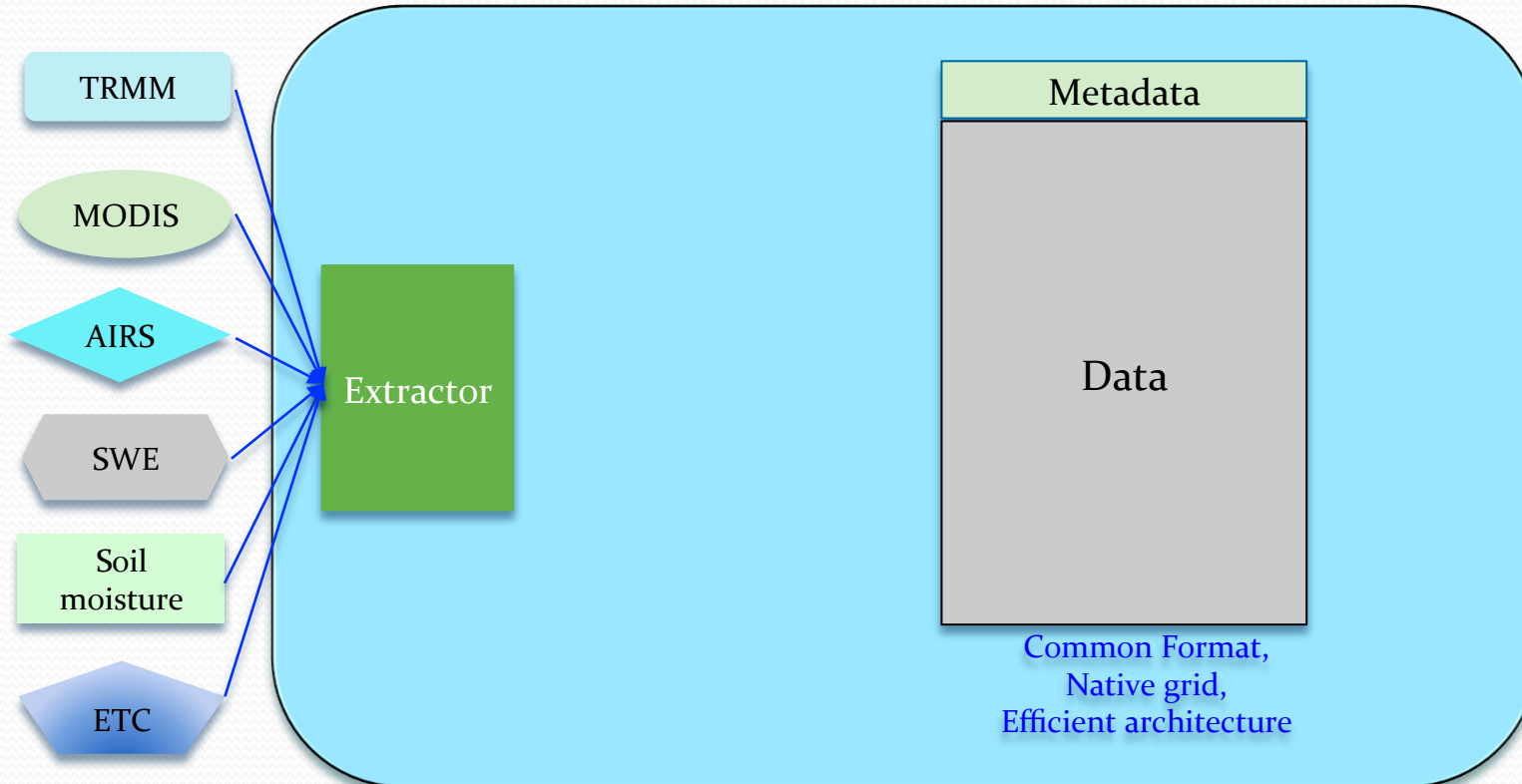
PROBLEM: Raw Data

| TRMM | MODIS | AIRS | SWE | Soil moisture |

- Spatial Resolution (1 degree gridded, ½ degree, swath data)
- Time Resolution (Daily, 8-Days, Monthly)
- Lat/Lon (0 to 360 vs. -180 to 180)
- File Formats:
  - NetCDF3/4
  - Grib
  - HDF4/5
  - ASCII
- Parameters
  - Temperature (tmax, tmin, tavg, SurfAirTemp_A...)
  - Precipitation
  - Humidity

SOLUTION: Apache OODT
## (TAKES 7 min to get here with all the previous content)

TRMM

MODIS

AIRS

SWE

Soil moisture

ETC

Extractor

Metadata

Data

Common Format,
Native grid,
Efficient architecture

Raw Data:
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RCMES
High-level technical architecture
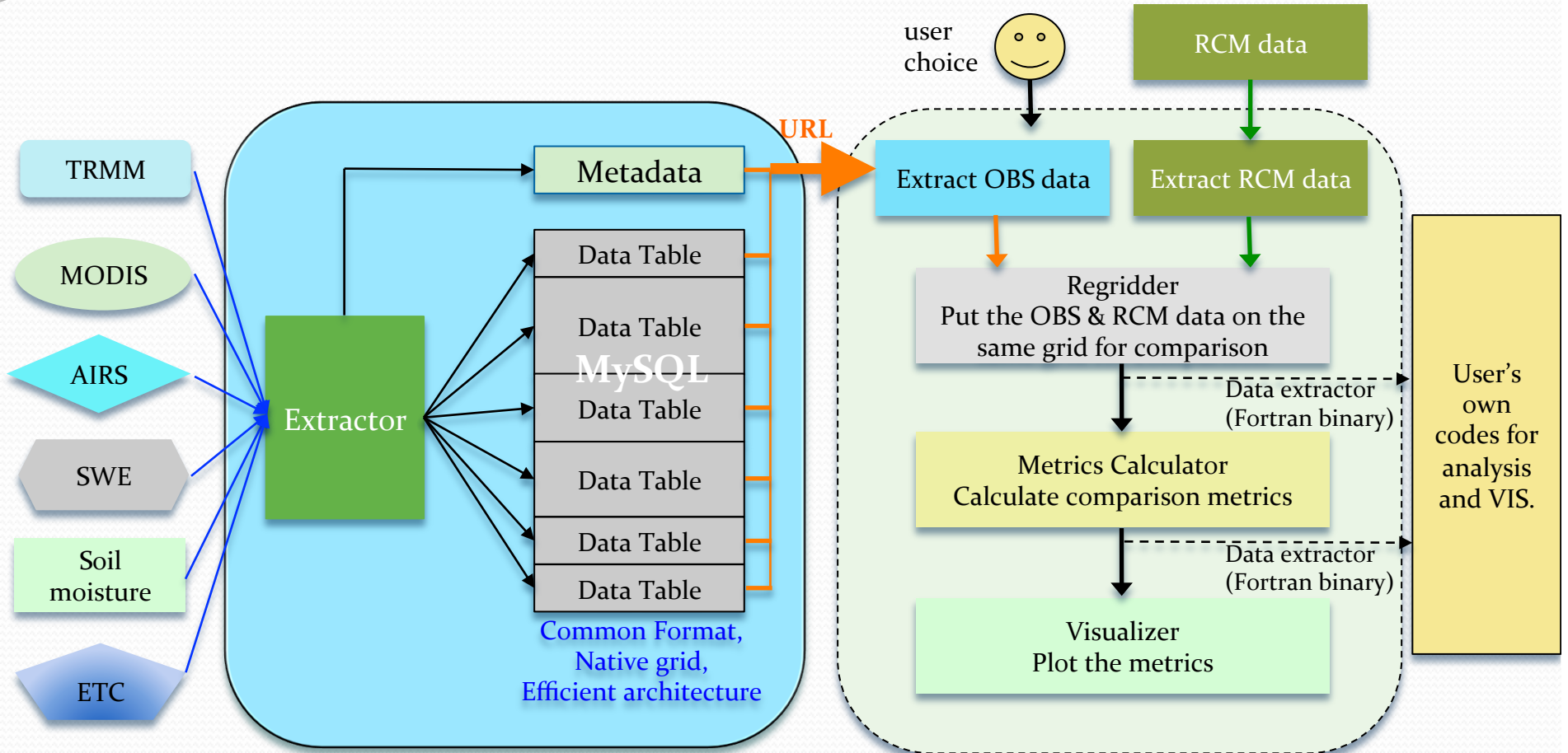
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Summary

- Evaluation of climate models is a fundamental step in projecting climate variations and change and assessing their impacts.
- RCMES has been under development at JPL to facilitate RCM evaluation
  - User friendly, flexible, and expandable
- Monthly precip, temp and cloudiness from multiple RCMs participating in the CORDEX-Africa project are evaluated against available observations.
  - All RCMs successfully simulate qualitative features of the observed climatology in the Africa domain.
  - Performance of individual models vary widely.
  - Ensembles of all RCMs are generally closer to obs data than individual RCM, especially in the climatological means.
- Care must be taken in estimating temporal variability using multi-model ensembles
  - Multi-model ensemble may systematically underestimate the observed temporal variability.
- Differences between obs datasets may be a source of uncertainties.
  - Model errors measured against CRU precip are similar to those against TRMM
  - Differences between the CRU and TRMM precip are observed in some regions.
  - Obs datasets need be cross-examined.

- RCMES for evaluation of today's fine-resolution RCM simulations.
  - The CORDEX RCM runs are coarse and can be evaluated using conventional observational data.
  - Today's contemporary observational data are not sufficient for evaluating fine resolution RCM runs that are made at sub-10km spacing.
  - Need to examine available remote sensing data

- Collect quality control information of observations.
  - Some satellite data are continuously revised and updated (e.g., TRMM).
  - Quality of observational data cannot be overemphasized.

- The user interface and metrics library of RCMES will be updated with user inputs and collaborations.

Acknowledgements

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  - Andrew Hart (Developer and UI Designer)
  - Paul Zimdars (System Administrator)

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