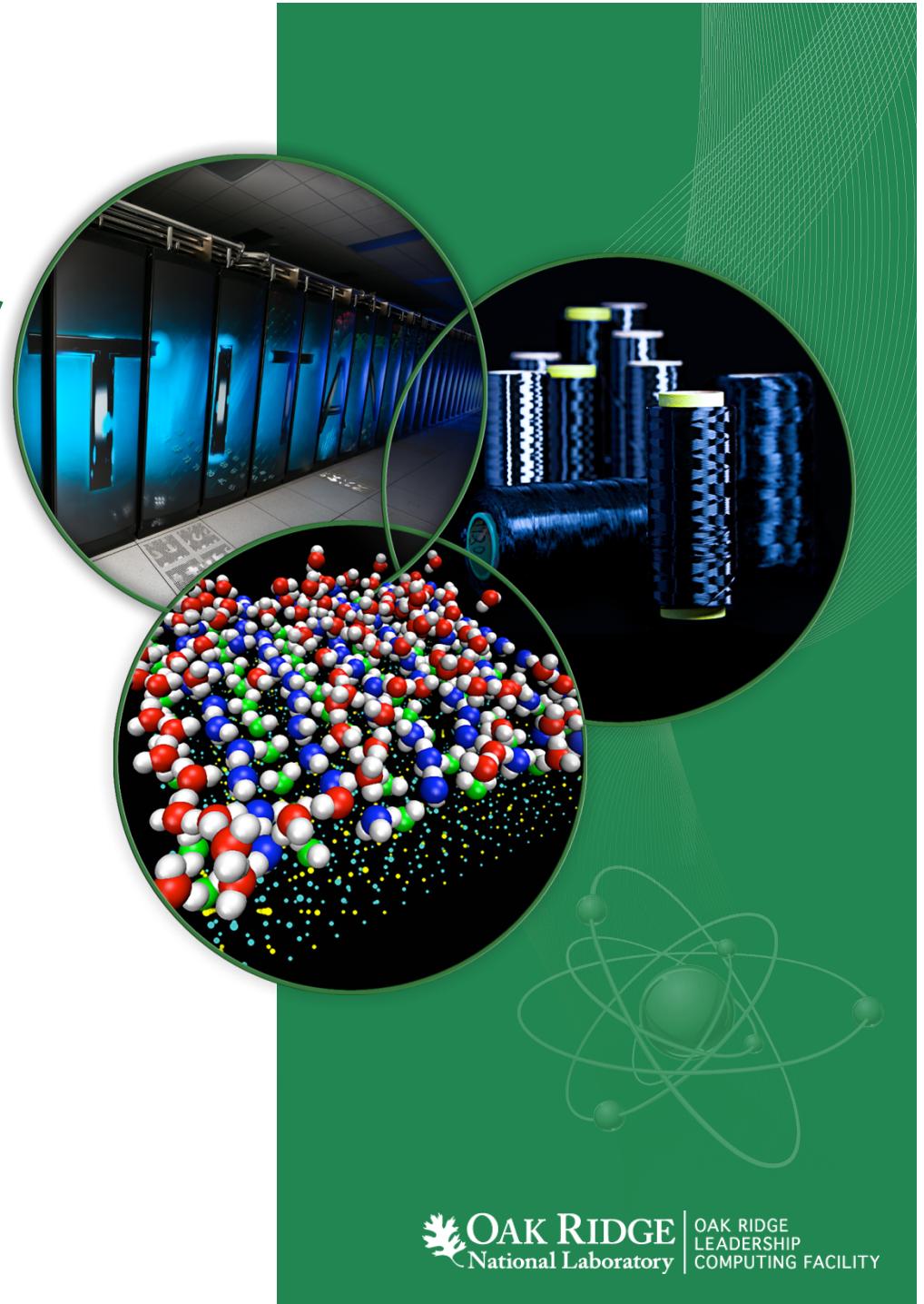


ACME Exploratory Analysis and “Classic” Diagnostics Viewer

Raymond Borges
Marcia Branstetter
Katherine Evans
John Harney
Brian Jewell
Benjamin Mayer
Jeff Painter
Galen Shipman
Brian Smith
Chad Steed
Dean Williams

ORNL is managed by UT-Battelle
for the US Department of Energy



What is the Accelerated Climate Model for Energy (ACME)?



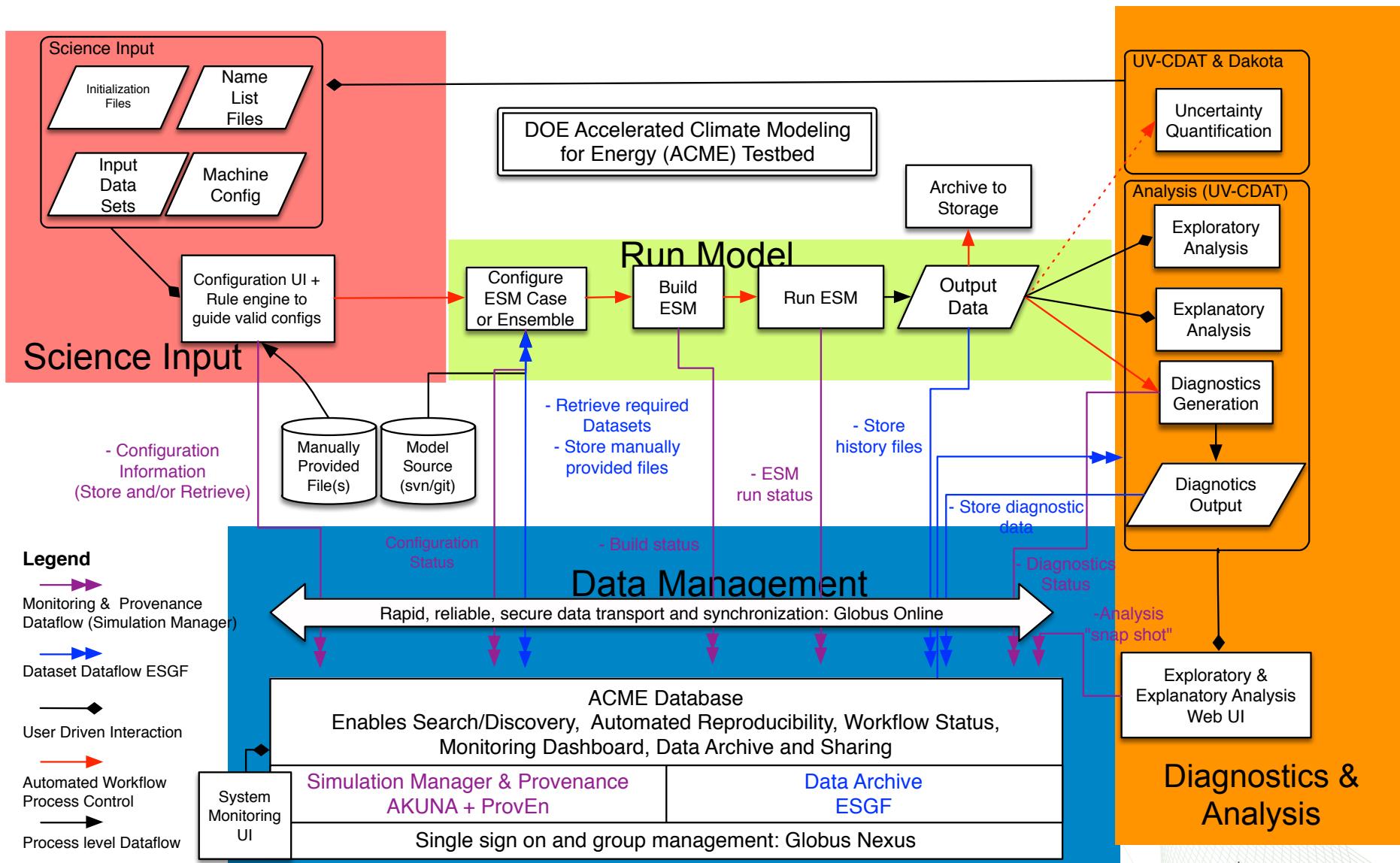
- ***Science Drivers:***

- How do the hydrological cycle and water resources interact with the climate system on local to global scales?
- How do biogeochemical cycles interact with global climate change?
- How do rapid changes in cryospheric systems interact with the climate system?

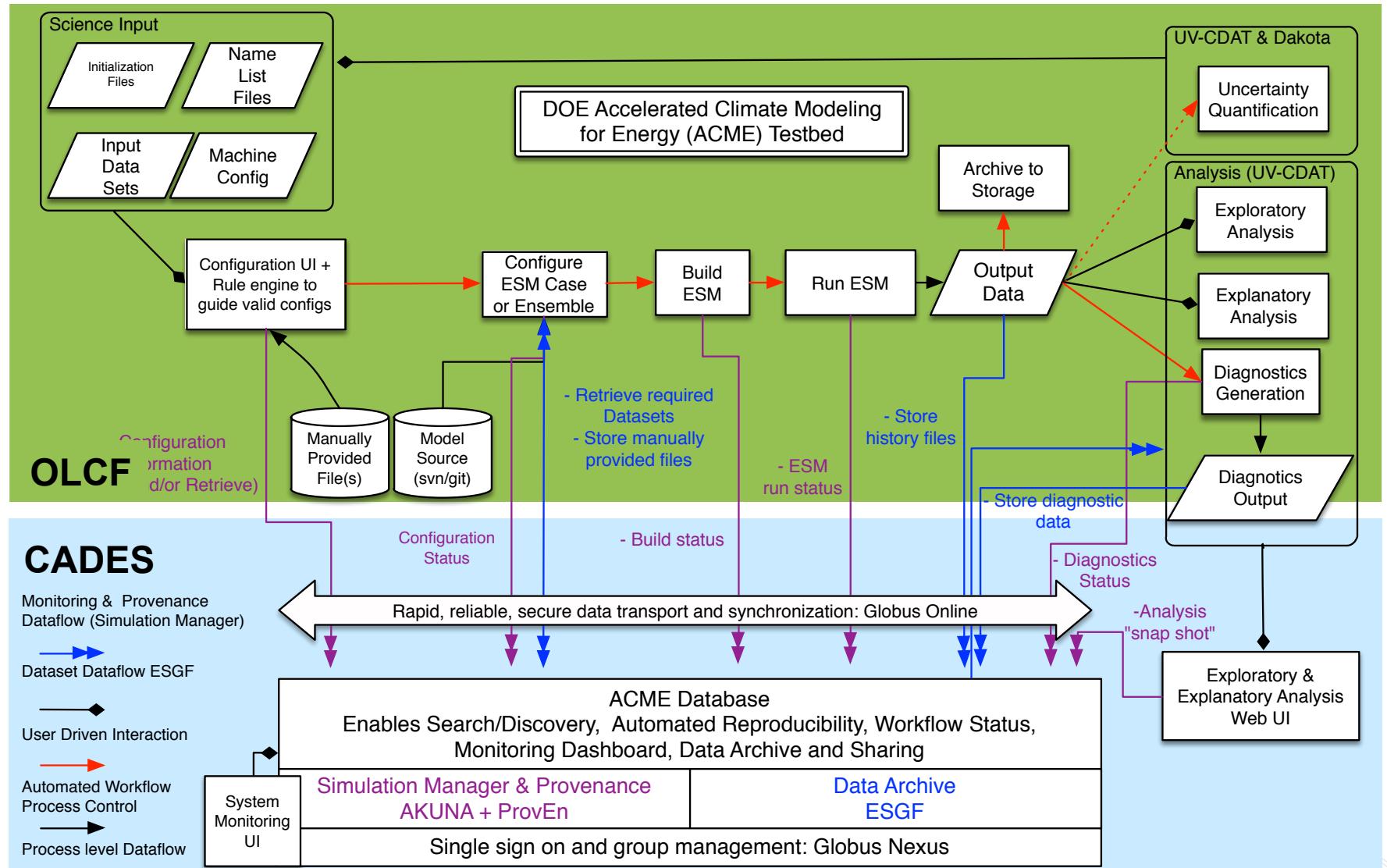
- ***Science Needs:***

- Support of wide range of model runs and workflow types
- Capture of model runs, settings and data during development
- Quickly evaluate and validate model behavior
- Publish, archive and share models

ACME End-to-end workflow



End-to-end workflow and infrastructure

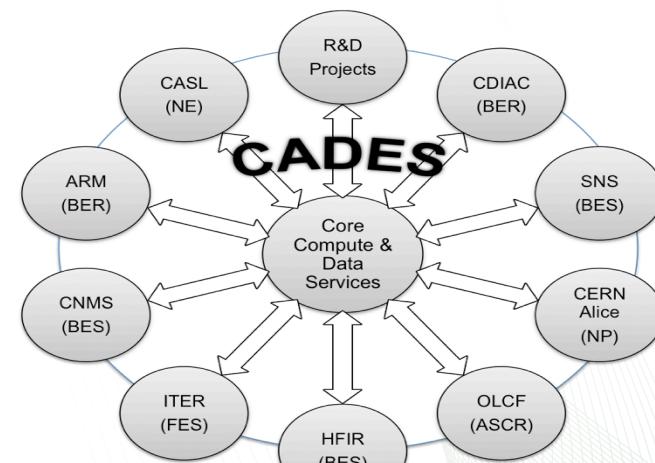
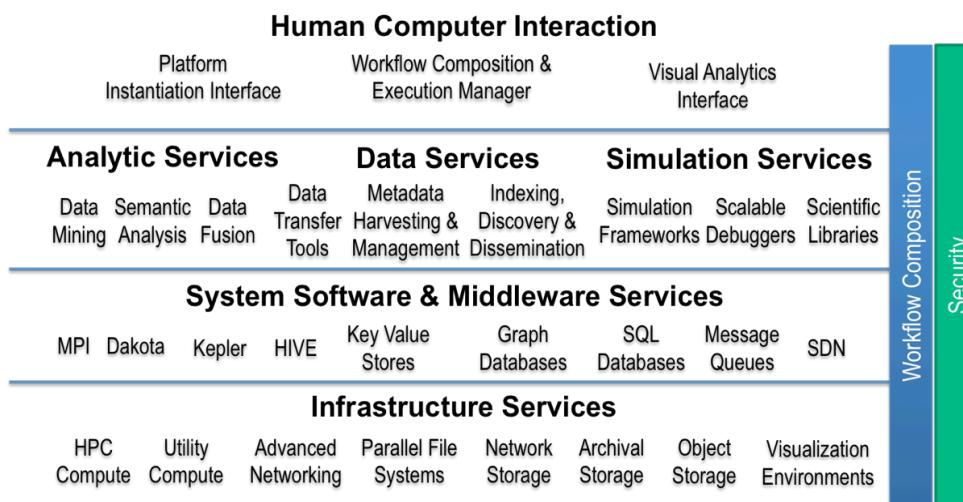




CADES provides core compute and data services required by major science facilities, large projects, small teams, and single principal investigators

CADES is a cross-cutting center: it shares both data infrastructure and compute & data science expertise with and among many projects

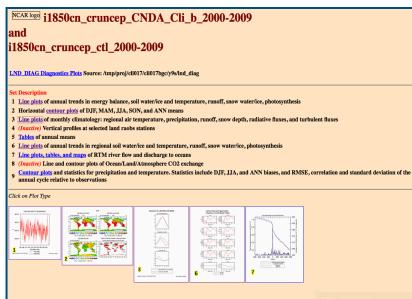
A rich set of flexibly composable services coupled with experts in data science partnering with domain scientists on their challenges



Diagnostics and Analysis

- Diagnostics
 - Used to quickly evaluate models and validate their results
 - Traditional CESM NCL scripts from NCAR produce static HTML and plots (gif, jpg, etc)

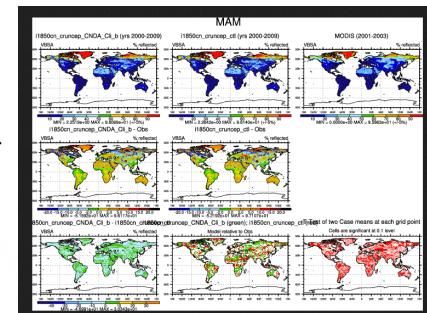
Diagnostics Home (Plot types of realms)



Variable List

i1850cn_crunccep_CNDA_Cli_b_2000-2009 and i1850en_crunccep_ctl_2000-2009																																									
Back to diagnostic sets																																									
Set 2 Description: Horizontal contour plots of DJF, MAM, JJA, SON, and ANN means																																									
Lookup Table: Set 2 Variable Definition																																									
<table border="1"><thead><tr><th>Variable</th><th>DJF MAM JJA SON ANN</th></tr></thead><tbody><tr><td>WINDS-Mature</td><td>plot plot plot plot plot</td></tr><tr><td>air temperature</td><td>plot plot plot plot plot</td></tr><tr><td>precipitation</td><td>plot plot plot plot plot</td></tr><tr><td>GRDC</td><td>plot plot plot plot plot</td></tr><tr><td>Rain gauge registration</td><td>plot plot plot plot plot</td></tr><tr><td>USAFETAC - FOSTER-DAY</td><td>plot plot plot plot plot</td></tr><tr><td>snow height</td><td>plot plot plot plot plot</td></tr><tr><td>CME</td><td>plot plot plot plot plot</td></tr><tr><td>snow height</td><td>plot plot plot plot plot</td></tr><tr><td>total snow water equiv (SNOWICE + SNOWLIQ)</td><td>plot plot plot plot plot</td></tr><tr><td>NOAA-AVHRR</td><td>plot plot plot plot plot</td></tr><tr><td>FNSO</td><td>plot plot plot plot plot</td></tr><tr><td>ratio of ground covered by snow</td><td>plot plot plot plot plot</td></tr><tr><td>MODIS</td><td>plot plot plot plot plot</td></tr><tr><td>visible black-sky albedo</td><td>plot plot plot plot plot</td></tr><tr><td>near-IR black-sky albedo</td><td>plot plot plot plot plot</td></tr><tr><td>visible white-sky albedo</td><td>plot plot plot plot plot</td></tr><tr><td>near-IR white-sky albedo</td><td>plot plot plot plot plot</td></tr><tr><td>all-sky albedo@SR-PDS</td><td>plot plot plot plot plot</td></tr></tbody></table>		Variable	DJF MAM JJA SON ANN	WINDS-Mature	plot plot plot plot plot	air temperature	plot plot plot plot plot	precipitation	plot plot plot plot plot	GRDC	plot plot plot plot plot	Rain gauge registration	plot plot plot plot plot	USAFETAC - FOSTER-DAY	plot plot plot plot plot	snow height	plot plot plot plot plot	CME	plot plot plot plot plot	snow height	plot plot plot plot plot	total snow water equiv (SNOWICE + SNOWLIQ)	plot plot plot plot plot	NOAA-AVHRR	plot plot plot plot plot	FNSO	plot plot plot plot plot	ratio of ground covered by snow	plot plot plot plot plot	MODIS	plot plot plot plot plot	visible black-sky albedo	plot plot plot plot plot	near-IR black-sky albedo	plot plot plot plot plot	visible white-sky albedo	plot plot plot plot plot	near-IR white-sky albedo	plot plot plot plot plot	all-sky albedo@SR-PDS	plot plot plot plot plot
Variable	DJF MAM JJA SON ANN																																								
WINDS-Mature	plot plot plot plot plot																																								
air temperature	plot plot plot plot plot																																								
precipitation	plot plot plot plot plot																																								
GRDC	plot plot plot plot plot																																								
Rain gauge registration	plot plot plot plot plot																																								
USAFETAC - FOSTER-DAY	plot plot plot plot plot																																								
snow height	plot plot plot plot plot																																								
CME	plot plot plot plot plot																																								
snow height	plot plot plot plot plot																																								
total snow water equiv (SNOWICE + SNOWLIQ)	plot plot plot plot plot																																								
NOAA-AVHRR	plot plot plot plot plot																																								
FNSO	plot plot plot plot plot																																								
ratio of ground covered by snow	plot plot plot plot plot																																								
MODIS	plot plot plot plot plot																																								
visible black-sky albedo	plot plot plot plot plot																																								
near-IR black-sky albedo	plot plot plot plot plot																																								
visible white-sky albedo	plot plot plot plot plot																																								
near-IR white-sky albedo	plot plot plot plot plot																																								
all-sky albedo@SR-PDS	plot plot plot plot plot																																								
View Variable																																									

Plot



- Need a more scalable, dynamic and intuitive diags package so results can be ascertained and validated quickly
- Need to create a visualization component that can easily be integrated into the ACME workflow

ACME EA Classic Viewer

UV-CDAT:EA Prototype

acme-dev-0.ornl.gov/exploratory_analysis/classic/jfharney/#

Most Visited Getting Started Optimistic Conc...

UV-CDAT:EA Classic Logout

user: https://esg.ccs.ornl.gov/esgf-idp/openid/jfharney

Classic View

Dataset: ne30_tuning8

Package: amwg

Variables: 17 selected

Times: 17 selected

Plot Dataset

Back to Atm Home

ne30_tuning8 and OBS data

DIAG Set3 Line plots of DJF, JJA and ANN zonal means

Variables:

- PREC
GPCP 1979-2003
Precipitation rate
- NVAP 1988-1999
TGCLDLWP Cloud liquid water
- PREH2O Total precipitable water
MODIS Mar2000-Aug2004
- TGCLDLWP Cloud liquid water
- PREH2O Total precipitable water
CERES 2000-2003
- FSNTOA TOA new SW flux
- LWCF TOA longwave cloud forcing
- FSNTOAC TOA clearsky new SW flux
- FLUTC TOA clearsky upward LW flux
- SWCF TOA shortwave cloud forcing
- FLUT TOA upward LW flux
IPCC/CRU Climatology 1961-90
- TREFHT 2-meter air temperature (land)
ISCCP D2 1983-2001
- Q10MERR Mid-latitude convective QD albedo

Plots:

- DJF JJA ANN plot plot plot

set3 FSNOBONADON difference

W/m²

lat

80S 60S 40S Eq 20N 40N 60N 80N

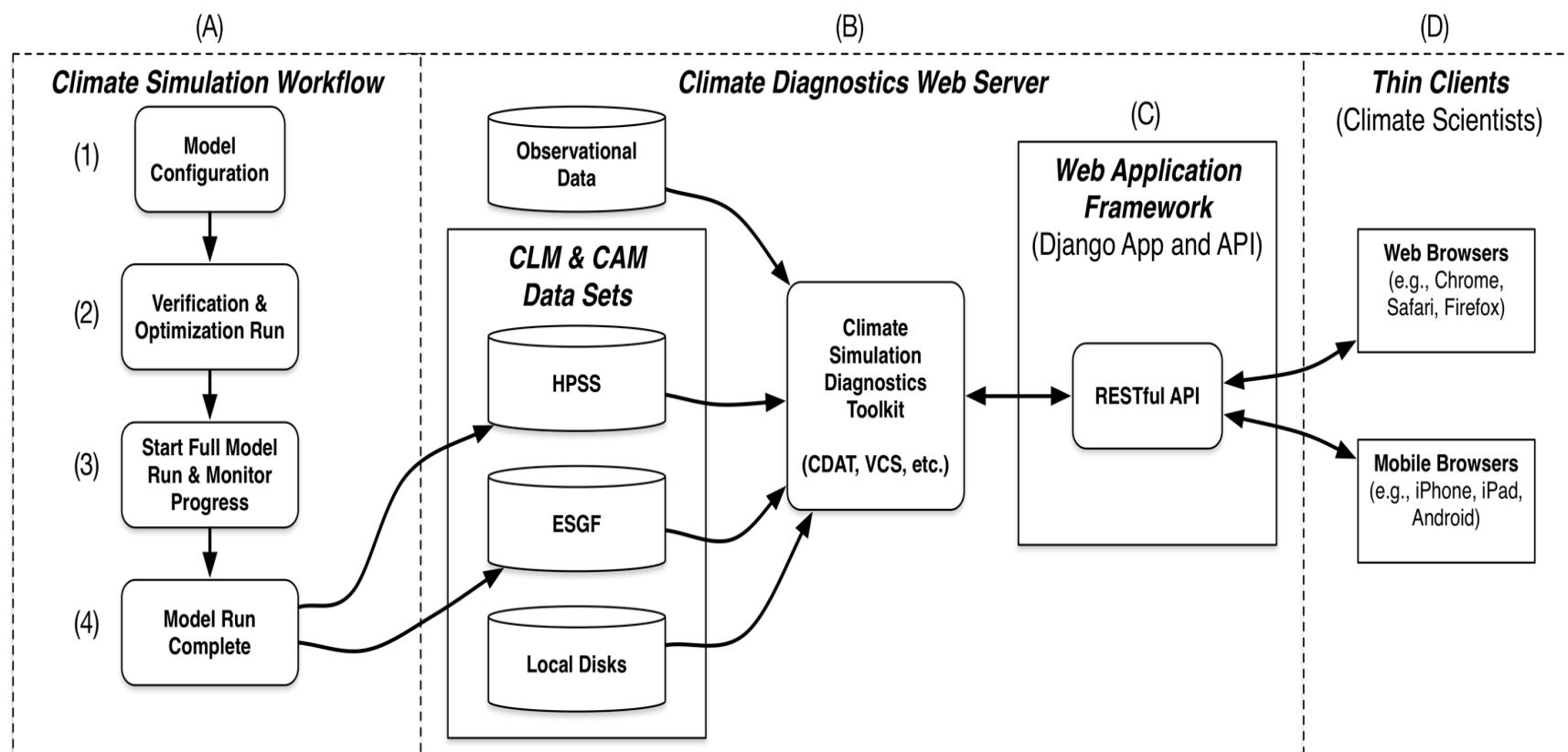
80S 60S 40S Eq 20N 40N 60N 80N

UV-CDAT

Unlock

How does it work?

- The “Classic” View is the alpha production view of the Exploratory Analysis (EA) toolkit
- EA Architecture



How does it work?

- Requires only 4 simple steps from a user:
 1. *Acquire an ESGF account (the viewer uses ESGF credentials for authentication AND group access)*
 2. *When model is complete, run the metadiags.py script on an OLCF cluster (i.e. Rhea)*
 - Generates climatologies and diagnostics figures (with the UVCDAT packages as the backend)
 3. *Run the rundiagtransfer.py script*
 - Moves the model output files (climos, figs, etc) from high security enclaves to externally facing low security enclave (i.e. “CADES” infrastructure)
 - Populates the Classic Viewer database with important properties of each dataset (user/group info, packages, variables, time epochs, etc)
 4. *Navigate to acme-dev-0.ornl.gov/exploratory_analysis and login*

ACME EA Classic Viewer

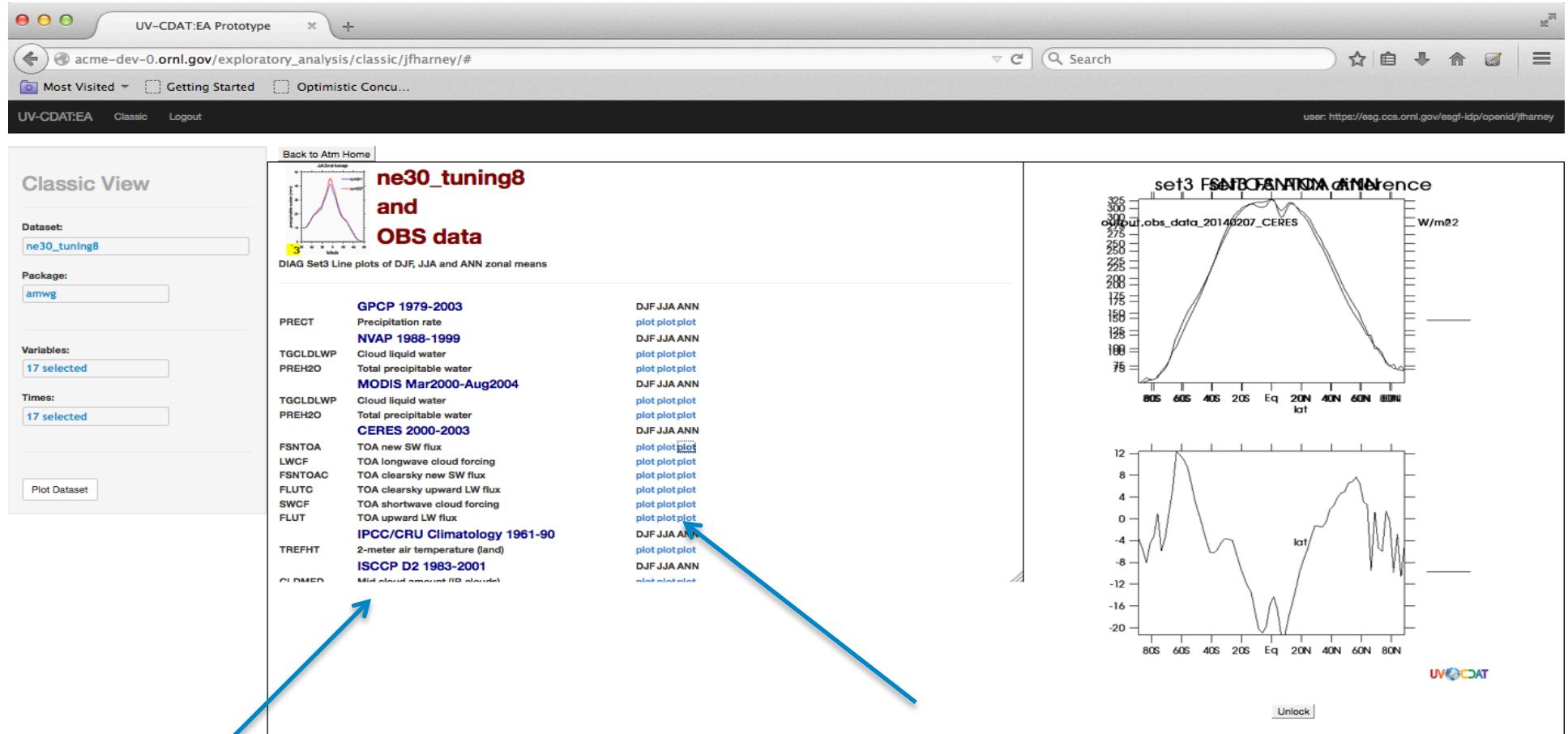
The screenshot shows the ACME EA Classic Viewer interface. On the left, there's a 'Classic View' sidebar with input fields for 'Dataset' (b1850c5_t2), 'Package' (amwg), 'Variables' (106 selected), and 'Times' (17 selected). Below these is a 'Plot Dataset' button. The main area is divided into three sections: 'Set Description' (containing 15 numbered plot types from 0 to 14), 'Plot for Selected Dataset' (with a 'Selected Plots' link and an 'Unlock' button), and a large empty space for visualizations. Three blue arrows point upwards from the labels below to the corresponding sections in the interface.

Dataset Selection Menu

Diags Set Selection

Visualization Pane

ACME EA Classic Viewer



Individual set selection provides links to figures per dataset selection menu (left)

Hovering over links allows user to view figures quickly

Future plans and releases

- **Classic Viewer**
 - Climo Download Utility
 - Publishing climos to ESGF
 - Bookmarking/Virtual Collections
- **Diagnostics Tree Viewer**
 - Allows users to view diags hierarchy as a tree
 - Gives context to diags figure searches
 - Enables the ability to add social capabilities (e.g. bookmarking)
- **Heatmap correlation matrix**
 - Color codes strength of correlation between variables (Pearson product-moment)

Diagnostics Tree Viewer

UV-CDAT:EA Home Geo Diagnostics Tree Heatmap Logout

Create Tree Bookmarks ▾ Saved Images ▾

Tree Name: tropics

Diagnostics Tree

Dataset: tropics_warming_th_q_co2

Package: lmwg

Variables: 6 selected

Times: 17 selected

tropics

Save

Diagram description: A hierarchical tree diagram showing variable relationships. The root node 'tropics' branches into two sets: 'set1' and 'set2'. 'set1' further branches into 'ER', 'GPP', 'HR', 'NPP', 'QSOIL', and 'TLAI'. 'set2' also branches into the same six variables. Each variable is represented by a small blue circle.

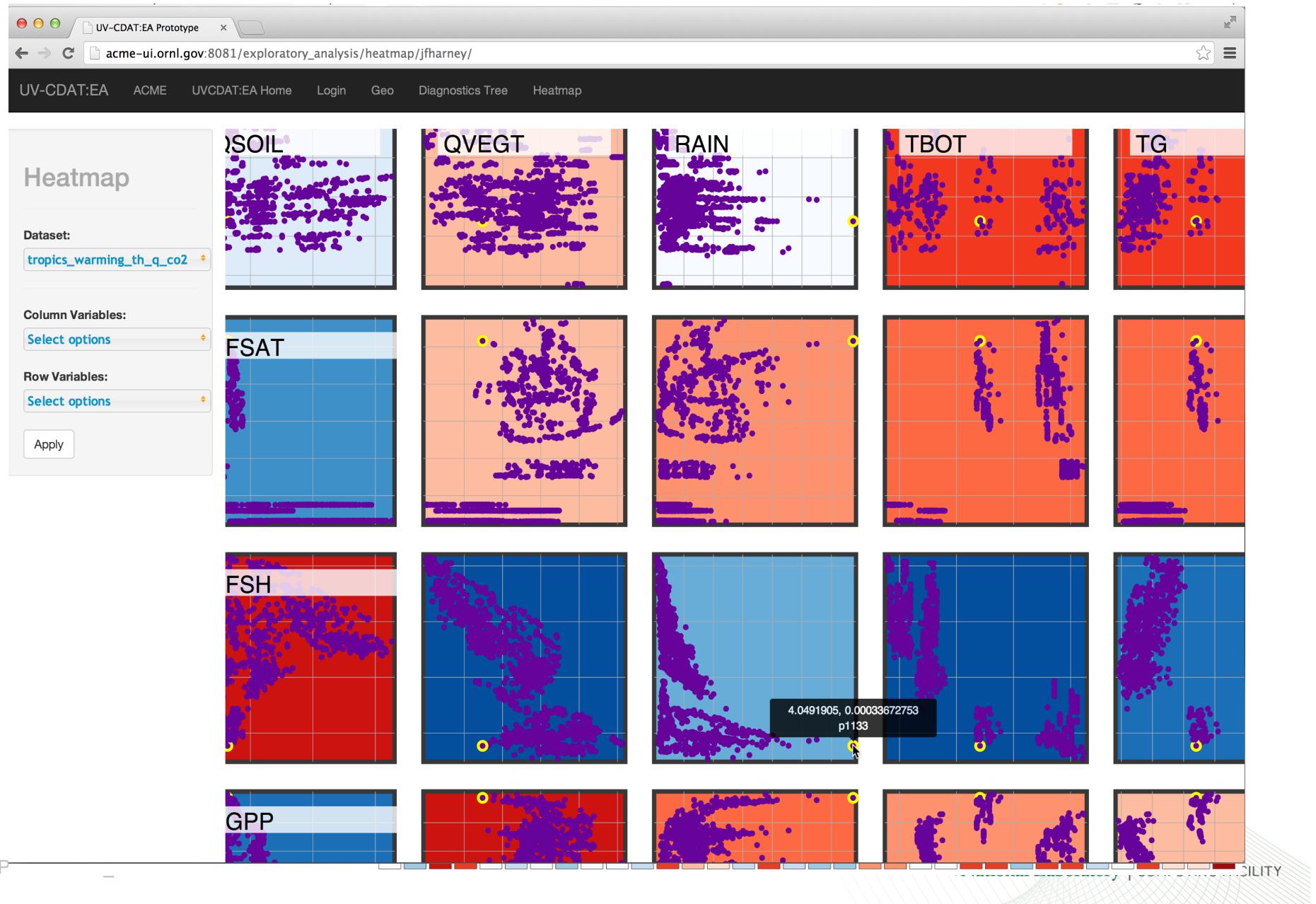
land_lmwg_set2_JAN_HR.png Remove View

land_lmwg_set1_AUG_HR.png Remove View

land_lmwg_set1_NOV_HR.png Remove View

Diagram description: Three panels showing spatial maps of HR for different months. The top panel shows January (land_lmwg_set2_JAN_HR.png), the middle panel shows August (land_lmwg_set1_AUG_HR.png), and the bottom panel shows November (land_lmwg_set1_NOV_HR.png). Each panel includes a 'Remove' button and a 'View' button.

Heatmap – “Micro” view



Acknowledgements

- This research is sponsored by the U.S. Department of Energy, Office of Science, Biological and Environmental Research (BER) program and performed at Oak Ridge National Laboratory (ORNL). The work was performed at the Oak Ridge National Laboratory, which is managed by UT Battelle, LLC, for the Department of Energy, under Contract No. DEAC0500OR22725

Questions?

