



The GCAM Ecosystem of Models and Tools

October 17, 2018

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on behalf of the GCAM team

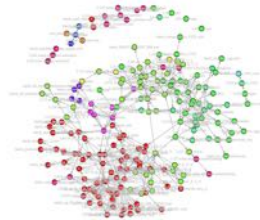


PNNL is operated by Battelle for the U.S. Department of Energy

GCAM is a suite of models and tools

Data Development

GCAM DS

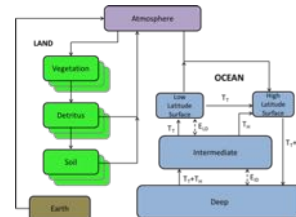


Moirai

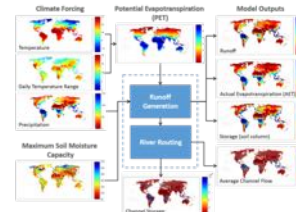


Single System

Hector



Xanthos

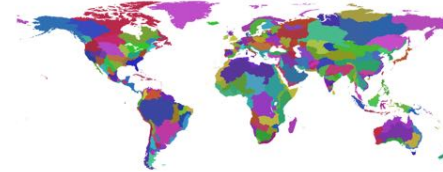


Dynamic Integration

GCAM-core



32 Energy Economy Regions



235 Water Basins



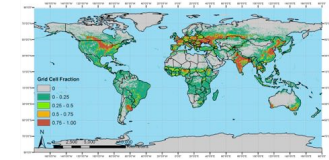
384 Land Regions



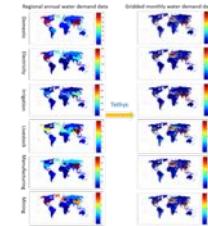
Province-Level Energy Economy Regions

Disaggregation

Demeter

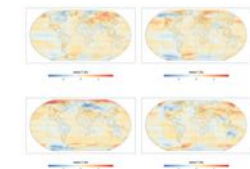


Tethys

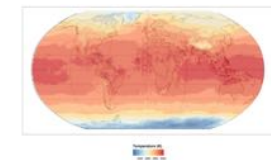


Statistical Emulators

fldgen



dnnclim



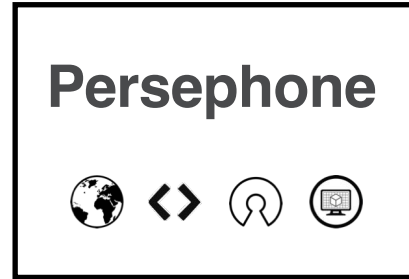
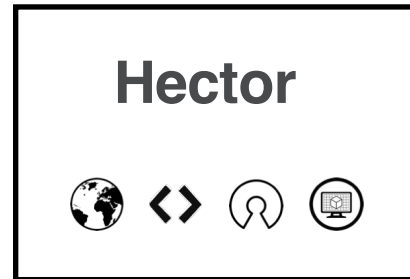
The GCAM Ecosystem - Goals

**“Be stubborn on vision
and flexible on journey”
– Noramay Cadena**

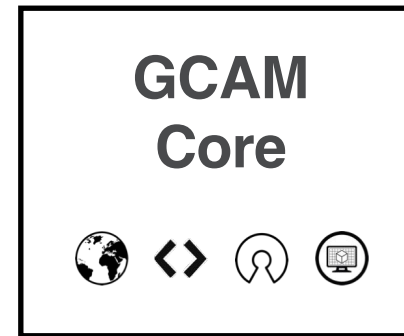
- **Exposure** – strive to maximize use of resources and capabilities for all collaborators
- **Usability** – generate functional, well documented models and tools
- **Efficiency** – identify bottlenecks and improvement areas for experimental modeling
- **Robustness** – support multiple scales, sectors, and platforms
- **Reproducibility** – utilize versioned models, tools, and data in modeling efforts

Models and Tools by Type

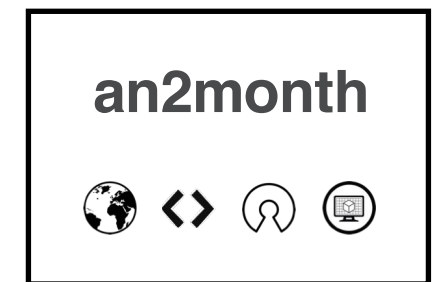
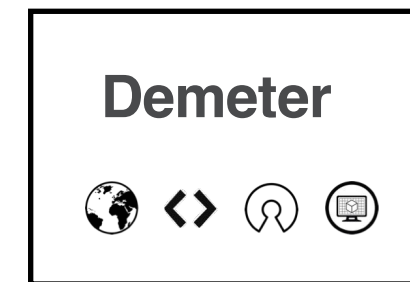
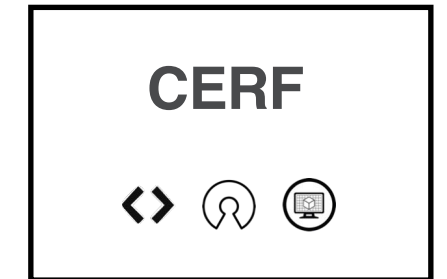
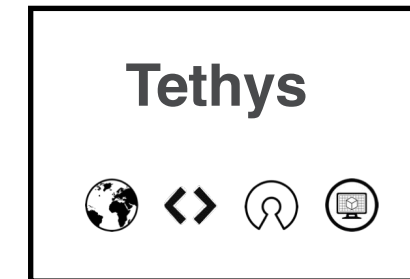
Single System



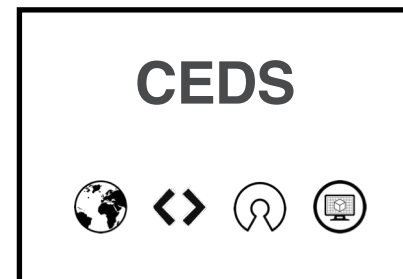
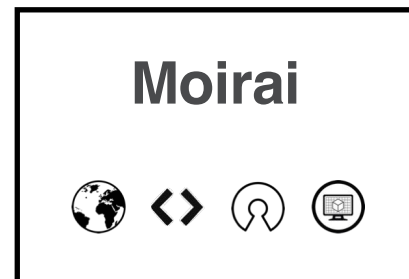
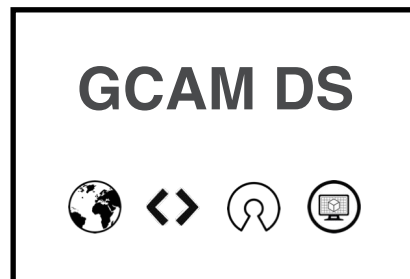
Dynamic Integration



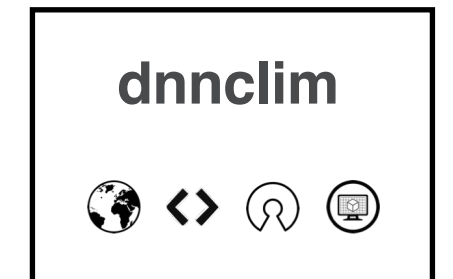
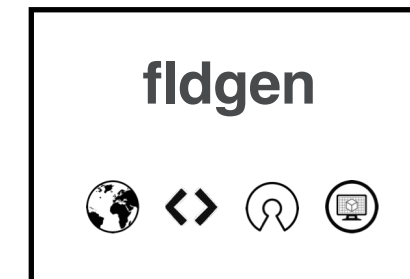
Disaggregation



Data Development



Statistical Emulators



Models and Tools by Type (continued)

Query/ Conversion

rgcam



gcam-reader



gcamlrpt



Analysis

GCAM
analysis



rgis



gcamlnd



Interface

pygcam



pyhector



model
interface



Visualization

maptools



dashboard



Overview of Component Characteristics and Capabilities

Model	Monthly	Yearly	Aggregated Outputs	Gridded Outputs	Graphical Output	Open Source	User Guide	Published
GCAM		✓	✓			✓	✓	✓
Moirai		✓	✓	✓	✓	✓	✓	✓
CEDS	✓	✓	✓	✓	✓	✓	✓	✓
GCAM DS		✓	✓			✓	✓	✓
Xanthos	✓	✓	✓	✓	✓	✓	✓	✓
HCDD	✓	✓	✓					
Hector		✓	✓	✓	✓	✓	✓	✓
Tethys	✓	✓		✓		✓	✓	✓
Demeter		✓		✓	✓	✓	✓	✓
Persephone	✓	✓	✓	✓		✓	✓	✓
CERF	✓	✓	✓	✓	✓	✓	✓	✓
fIdgen	✓	✓	✓	✓		✓	✓	✓
dnnclim	✓	✓	✓	✓		✓	✓	✓

Overview of Component Characteristics and Capabilities (continued)

Tool	R	Python	Aggregated Outputs	Gridded Outputs	Graphical Output	Publically Available	User Guide	Published
rgcam	✓		✓			✓	✓	
gcam-reader		✓	✓			✓		
gcamrpt	✓		✓			✓	✓	
fldgen	✓		✓	✓	✓	✓	✓	✓
GCAM analysis	✓		✓		✓	✓	✓	
model interface			✓		✓	✓	✓	
gcamland	✓		✓			✓	✓	✓
pygcam		✓	✓		✓	✓	✓	
pyhector		✓	✓		✓	✓	✓	✓
maptools	✓		✓	✓	✓	✓	✓	
dashboard	✓		✓	✓	✓	✓	✓	

GCAM scale



GCAM core

Global



GCAM-USA

82 Energy Economic Regions



GCAM-China

62 Energy Economic Regions



GCAM-IIM

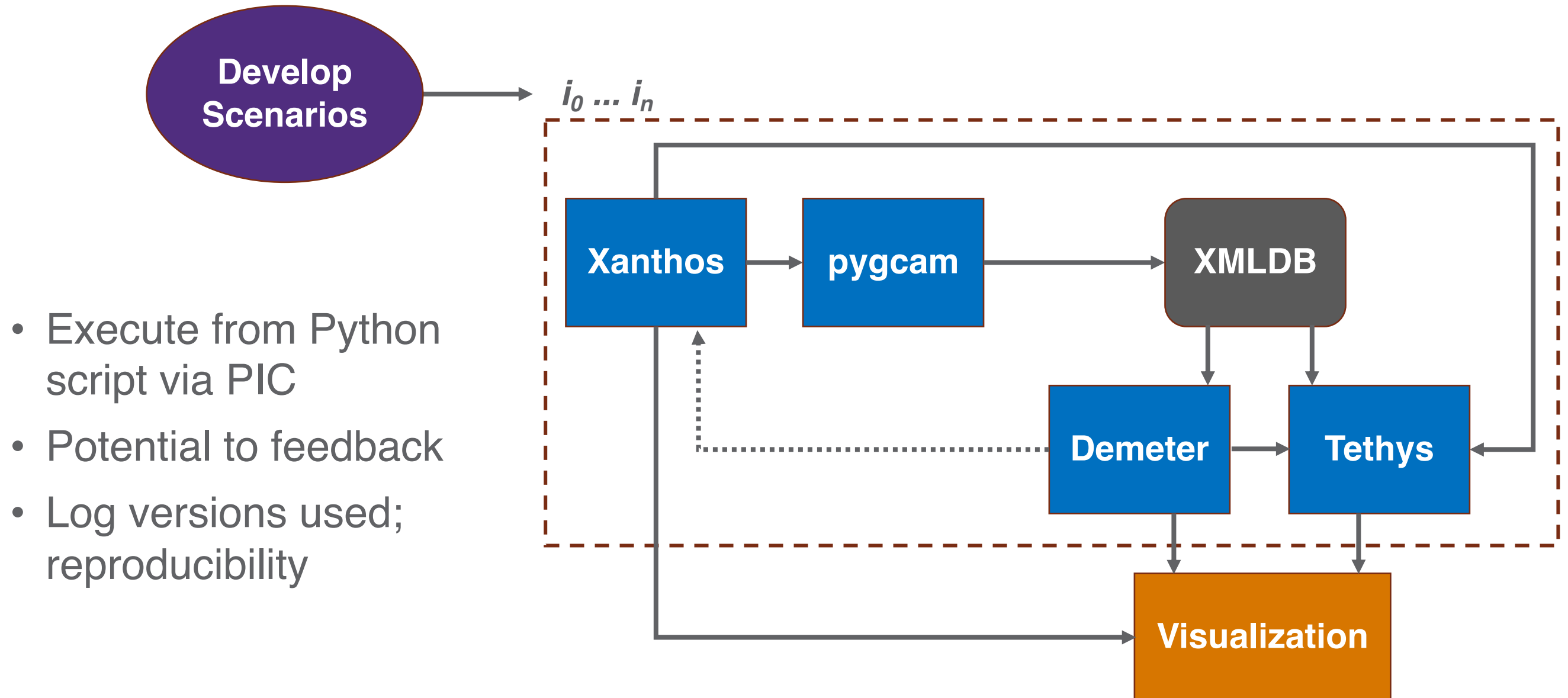
India-Specific Assumptions



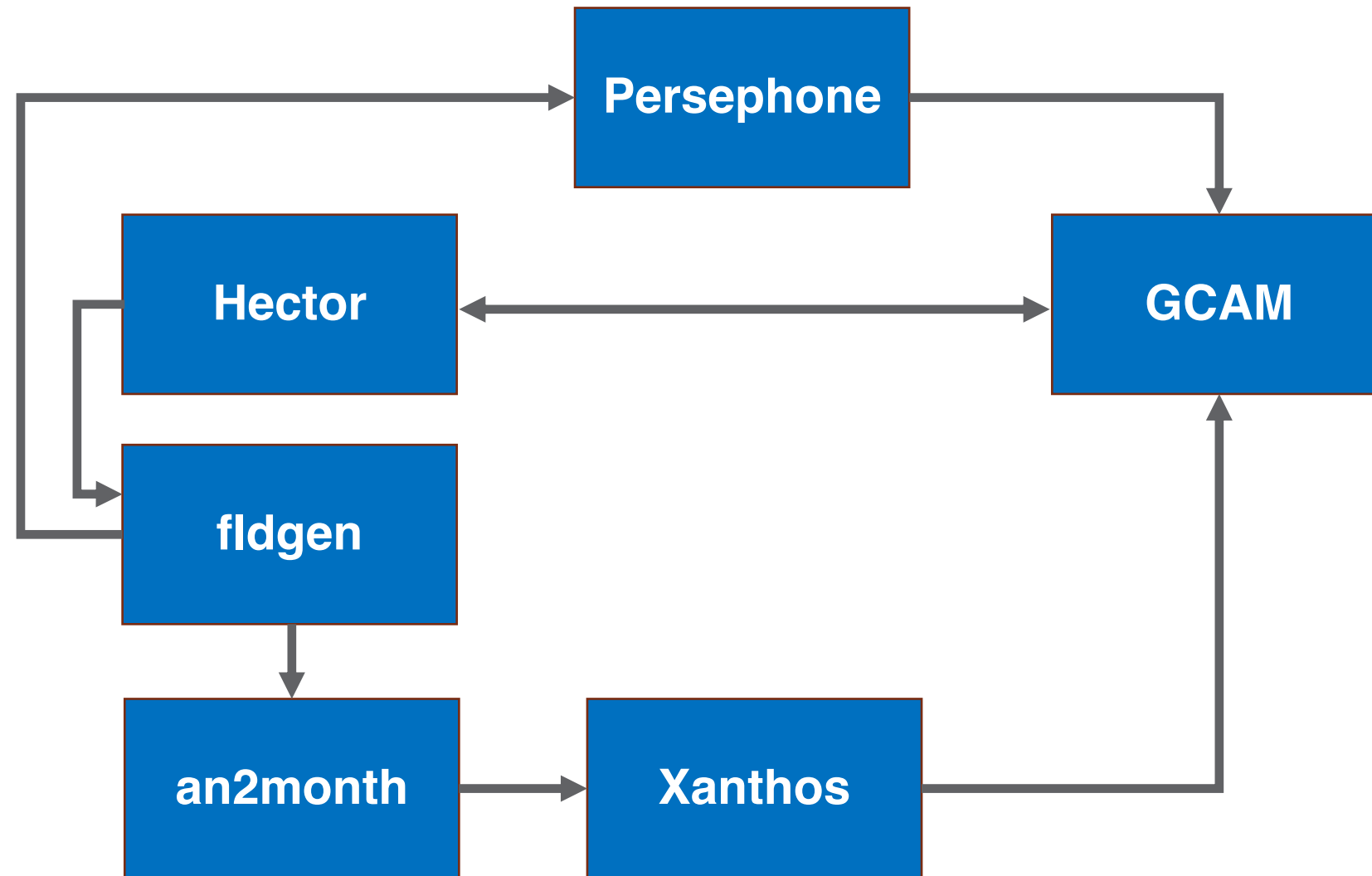
GCAM-LAC

In development

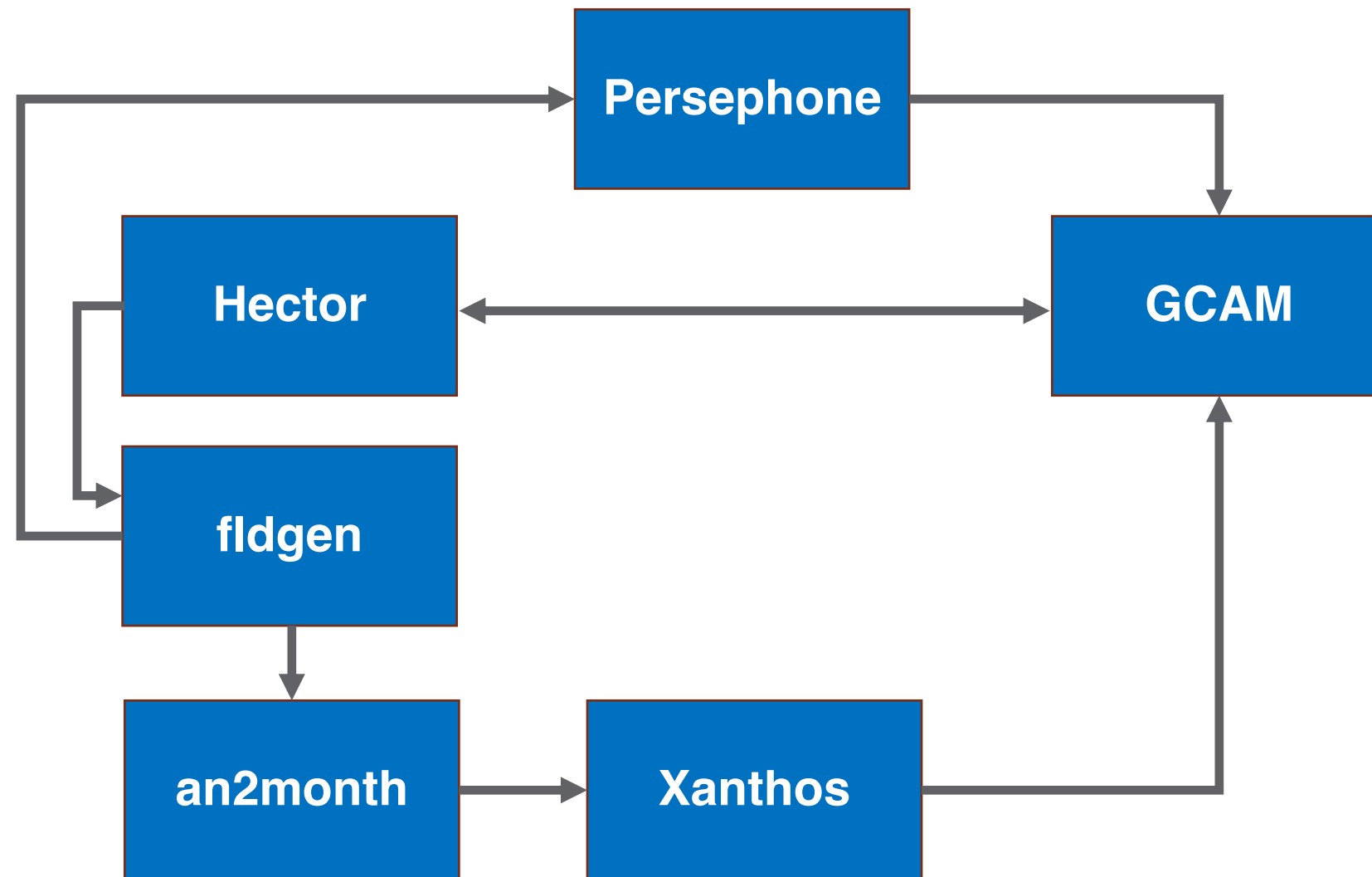
Project Workflows



Grand Experiment – with arrows

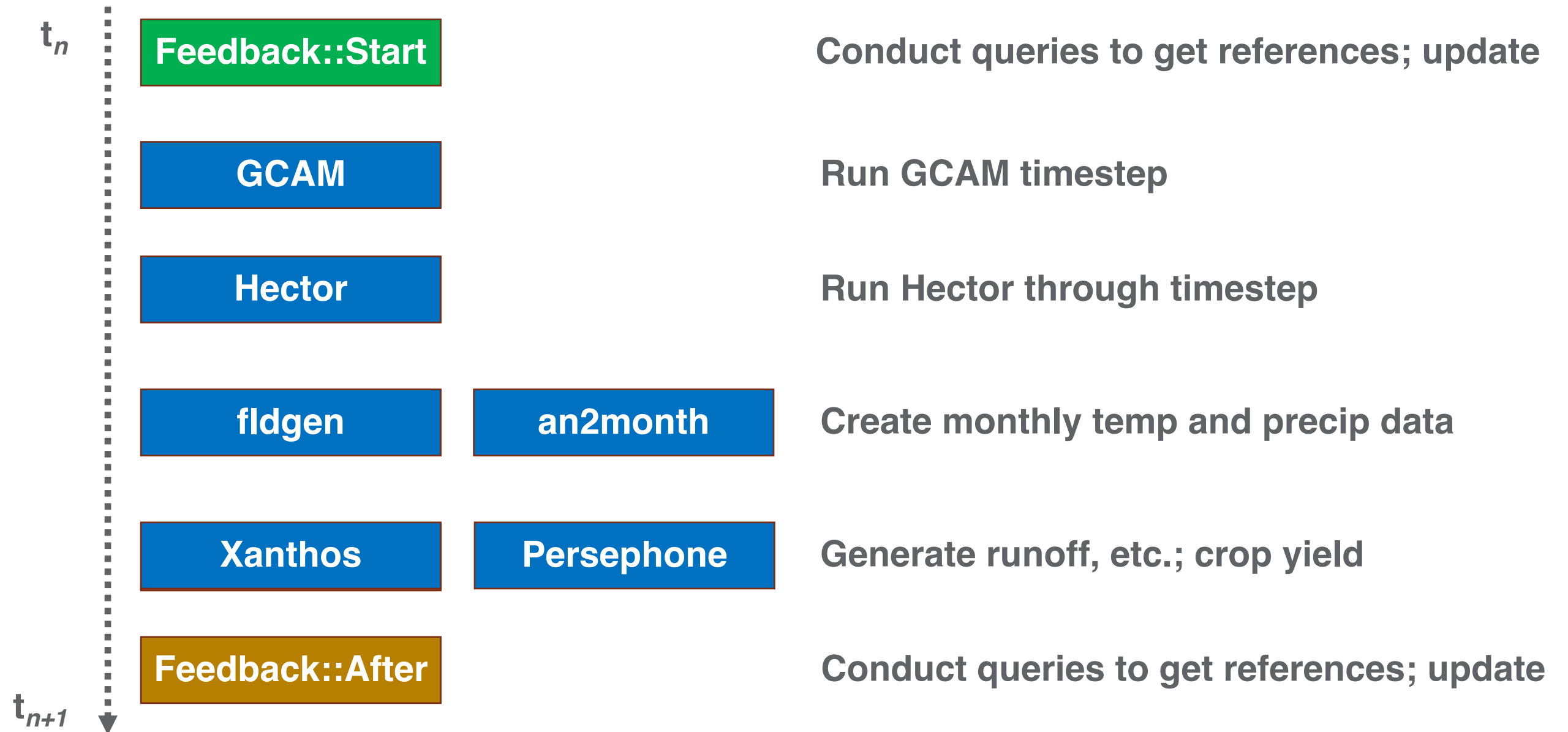


Grand Experiment – with arrows

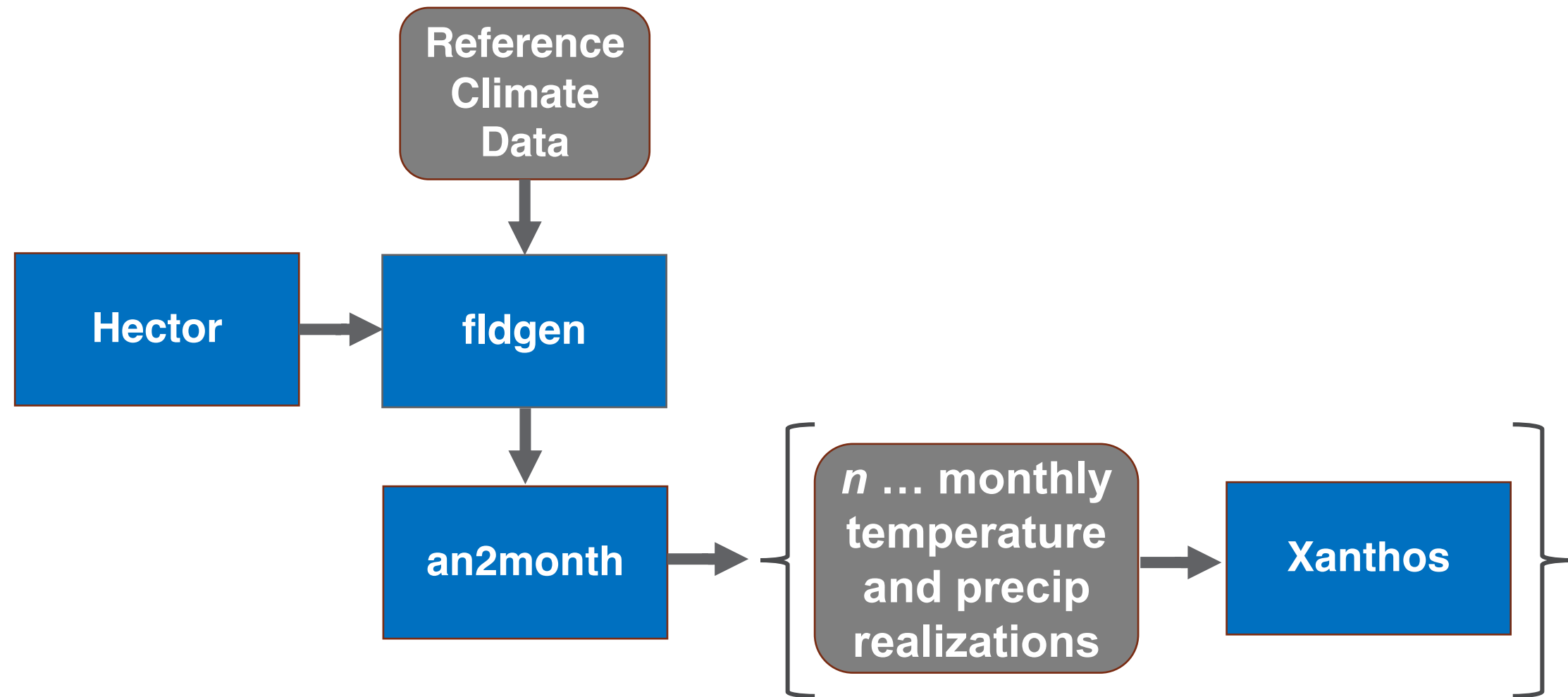


A system of autonomous systems – by design

Grand Experiment – GCAM Fusion



Towards the goal...Hector to Xanthos



Final Thoughts

- Created by design to be compatible with one another
- Built around GCAM-core; but maintain autonomy
- Promote harmonized large-scale scenario and uncertainty analysis

Thank you