Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

History of GCAM: 2015—2017 (approx.)

ROBERT LINK

December 2, 2015

Topics

- Recent GCAM upgrades
- Announcing GCAM-hector
- Water in GCAM
- Regional Modeling in GCAM
- GCAM performance / Large-scale GCAM
- Visualization
- Hindcasting and Backtesting
- Community-oriented development

GCAM 4.2

- Significant solver improvements
  - Reduction in solver failures
  - Fewer iterations to solution
  - Optional LAPACK libraries provide even greater improvement
- Flexible discrete choice mechanism
  - Classic “relative-cost logit” still the default
  - New “absolute-cost logit” available through XML config
  - Extensible design makes it easy to add new ones as needed
- Improved output databases
- Revised cost structure in Electricity sector
- Overhaul refining sector
- Numerous bug fixes, and minor tweaks to individual sectors and countries

Agriculture and Land Use Upgrades

- **Management Options (irrigation & fertilizer)**
- **Planting & harvesting sub-steps**
- And more:
  - Albedo
  - Alternative Socioeconomic Pathways
  - Updated historical land cover data
  - Ability to include agricultural impacts through the use of statistical climate-yield response functions
  - Inclusion of grain stockpiles
  - Improved demand representation
  - Improved trade representation

The Hector Climate Model

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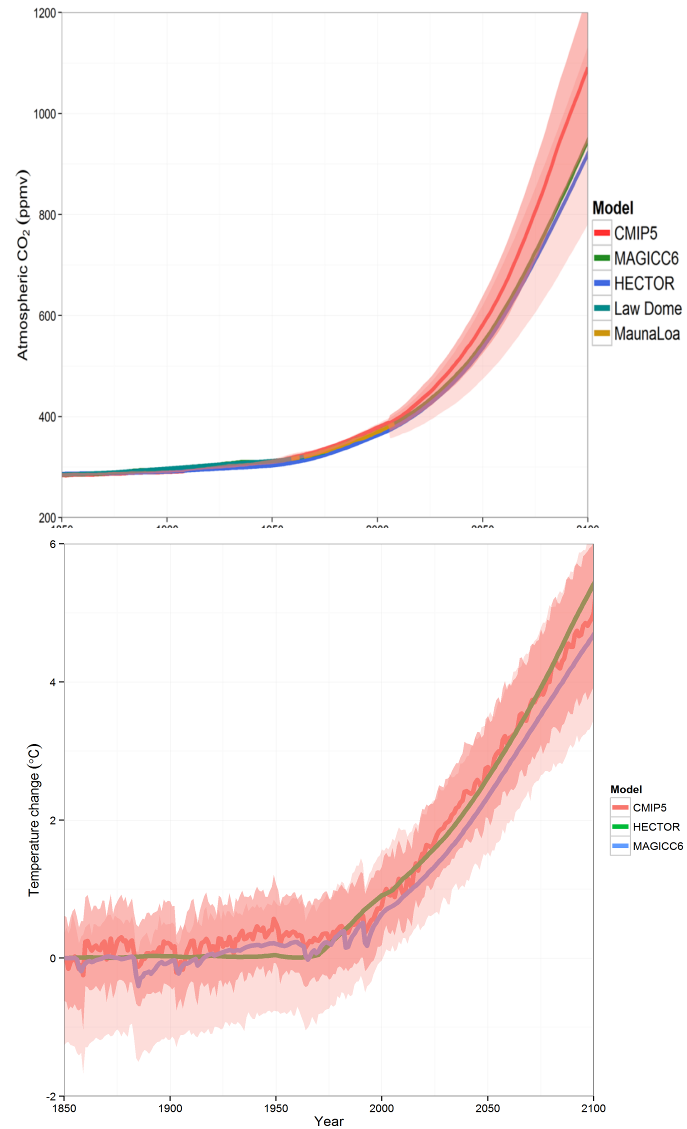
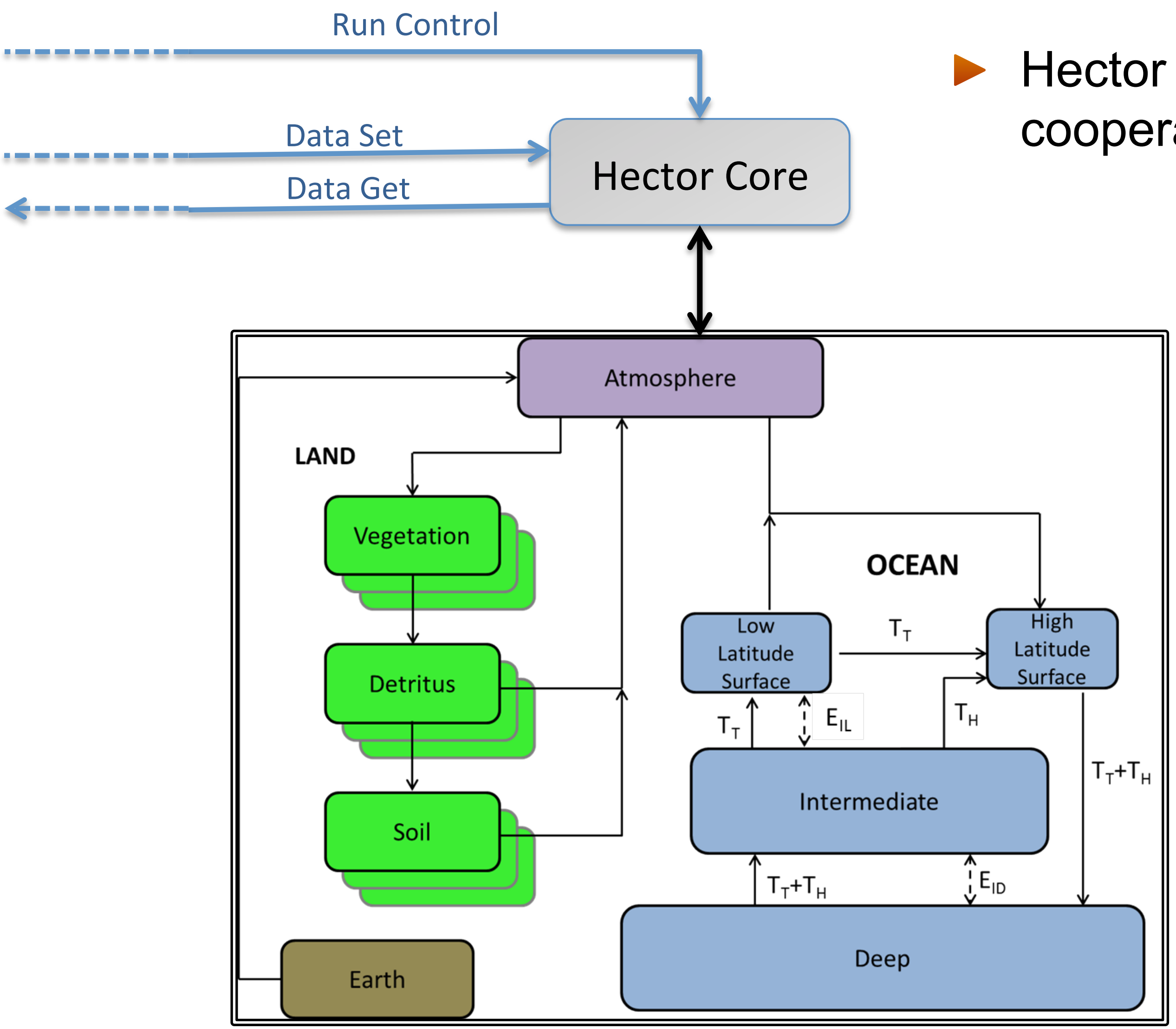
- Fast executing
- Free and open source
  - www.github.com/JGCRI/hector
- Modular to facilitate community development
- Easy to use & well documented
  - Hartin et al., 2015 – GMD
  - Hartin et al., in prep - BGS
- Easy integration with IA models

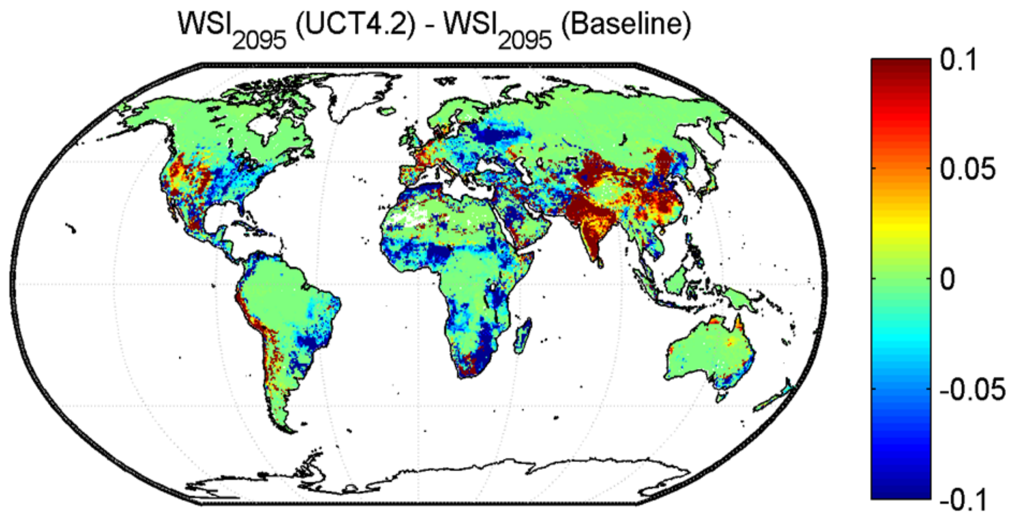


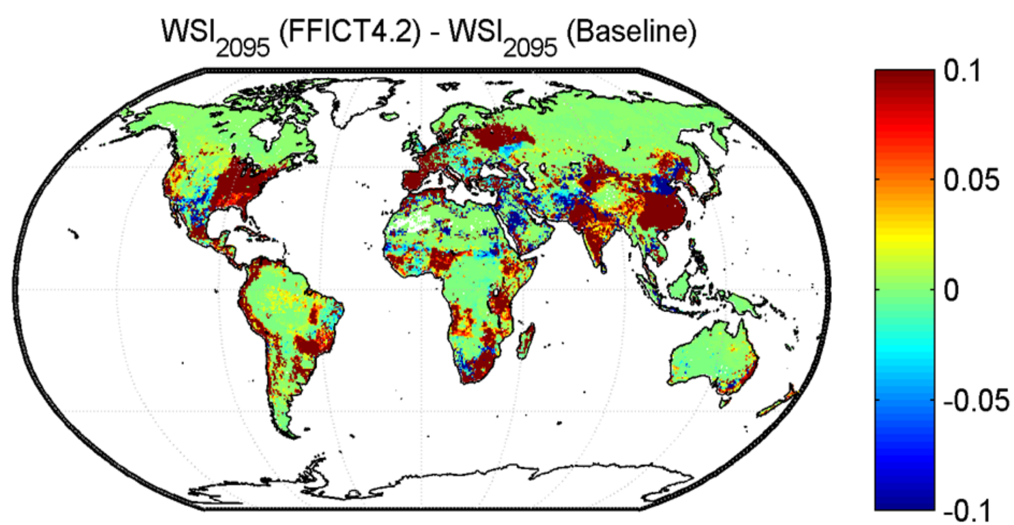
GCAM-hector (or <your-model>-hector)



- Hector is designed to cooperate with other models

Water in GCAM

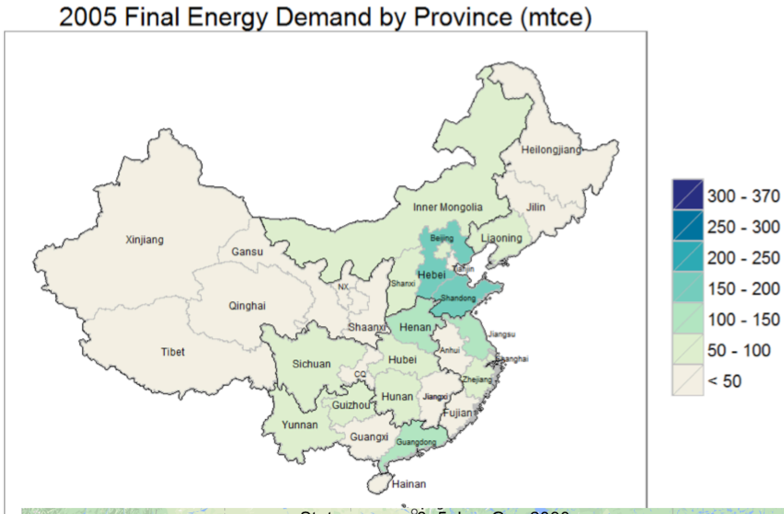


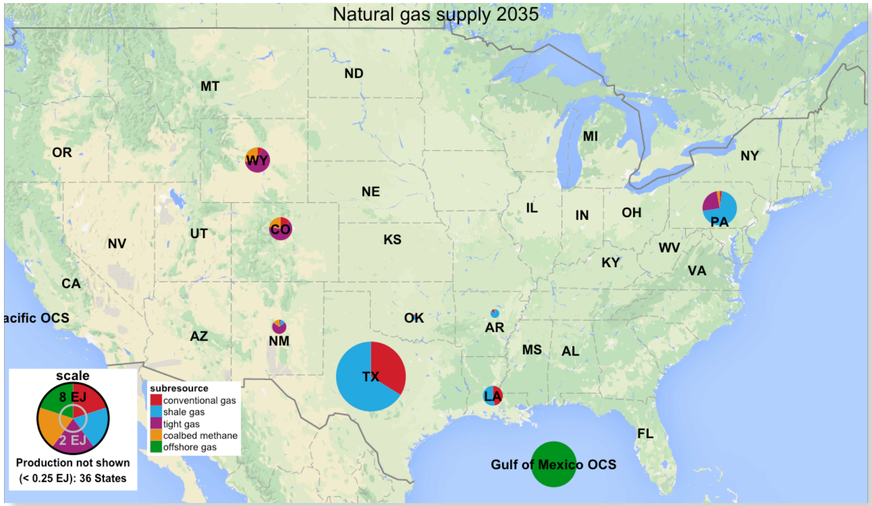


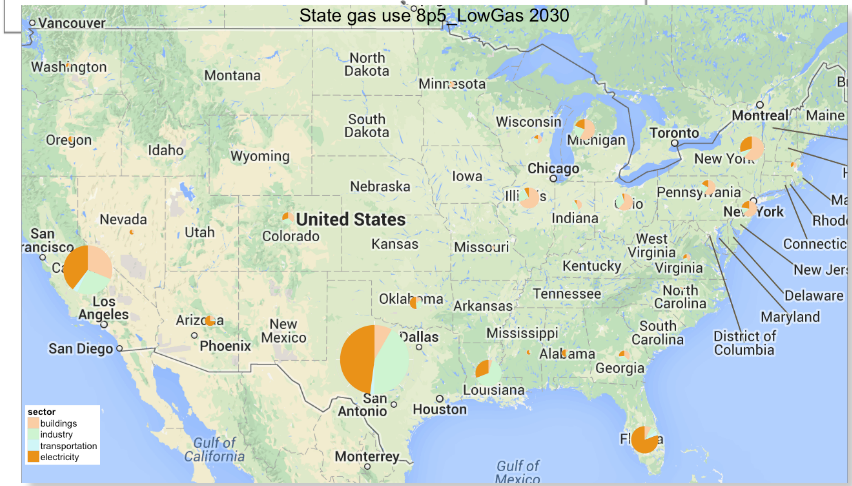
- The GCAM water demand module produces water usage as a byproduct of economic activity.
- Changes in demographics and economics can produce dramatic differences in water outcomes.
- In these calculations water has been a *passive* player in the scenario.
- In reality, water will be an *active* driver in future scenarios.
- New GCAM modules allow human systems to respond to water scarcity.

Regional Modeling

- Disaggregate large countries to show regional detail
- GCAM-USA, GCAM-China
- Additional countries under consideration

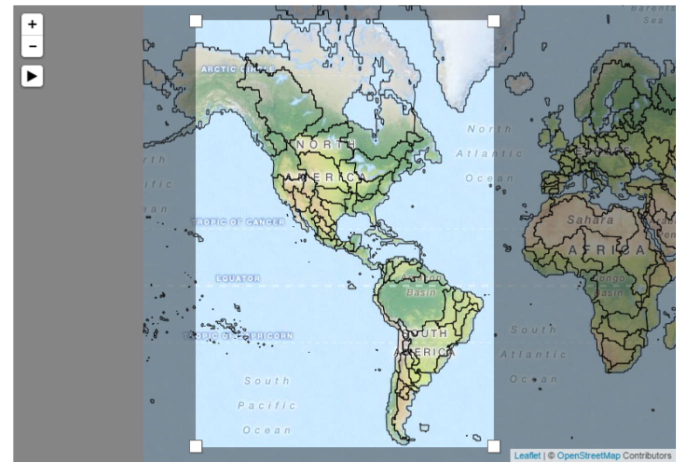


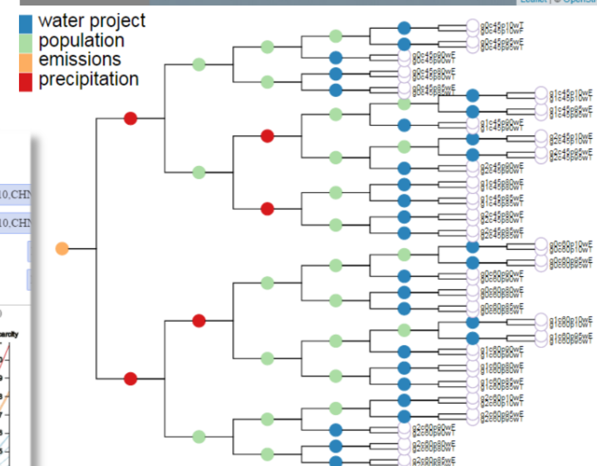


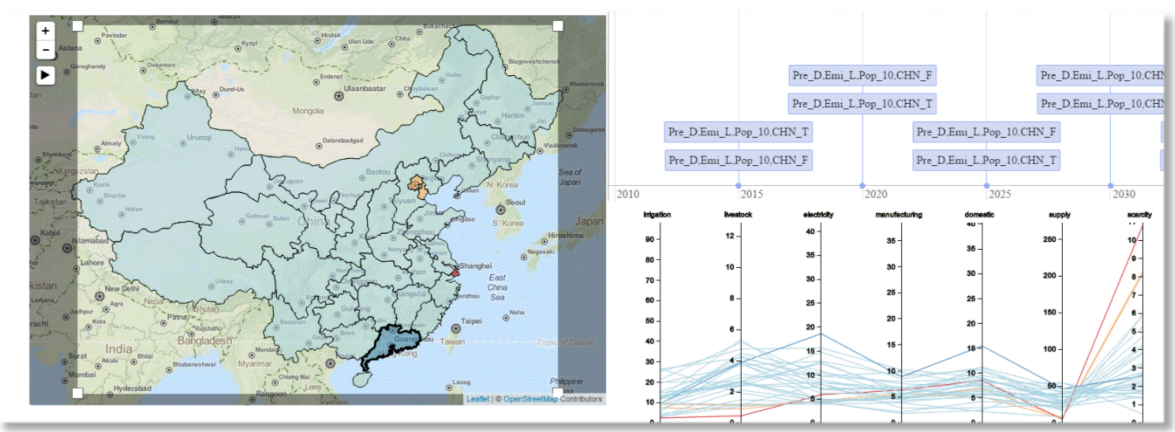


Visualization

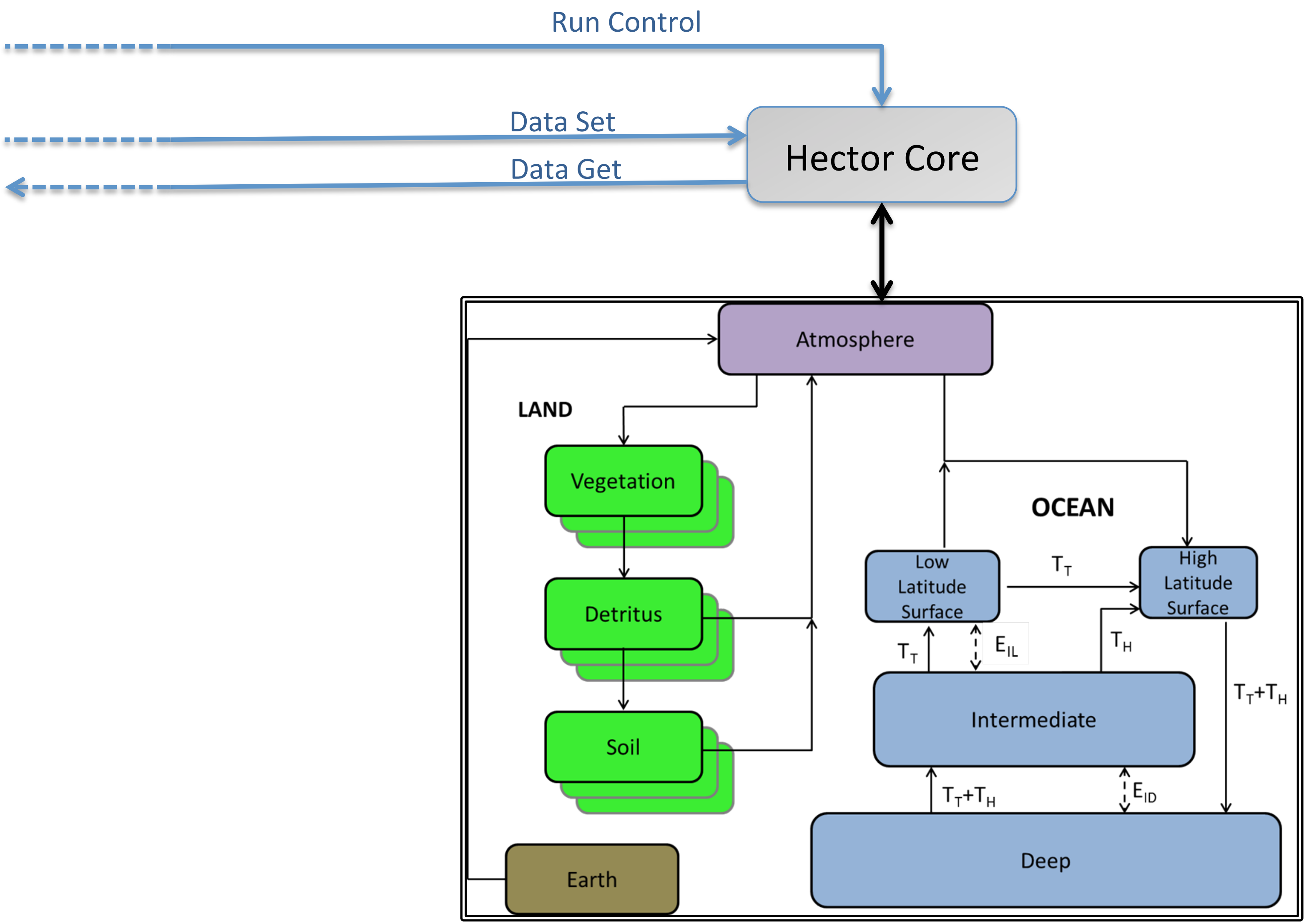
- Visualization development will be an area of emphasis
  - More efficient and user-friendly ways to visualize model output
  - Tools for putting results in a geographic context
- Visual Analytics tools will help extract insight from complex data sets
  - Ensembles of scenarios
  - Intra-scenario comparisons







Support for Interacting with Other Models



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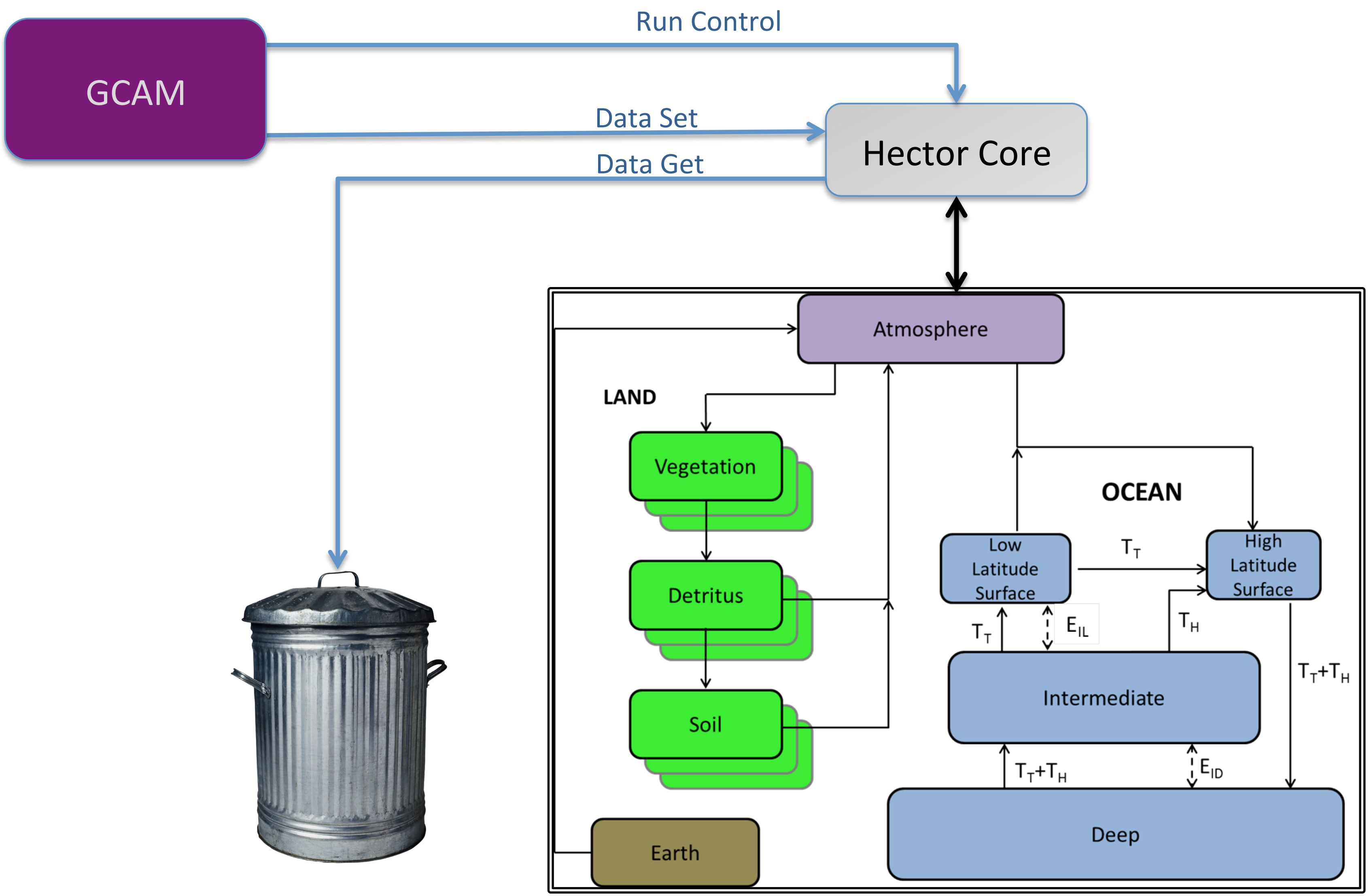

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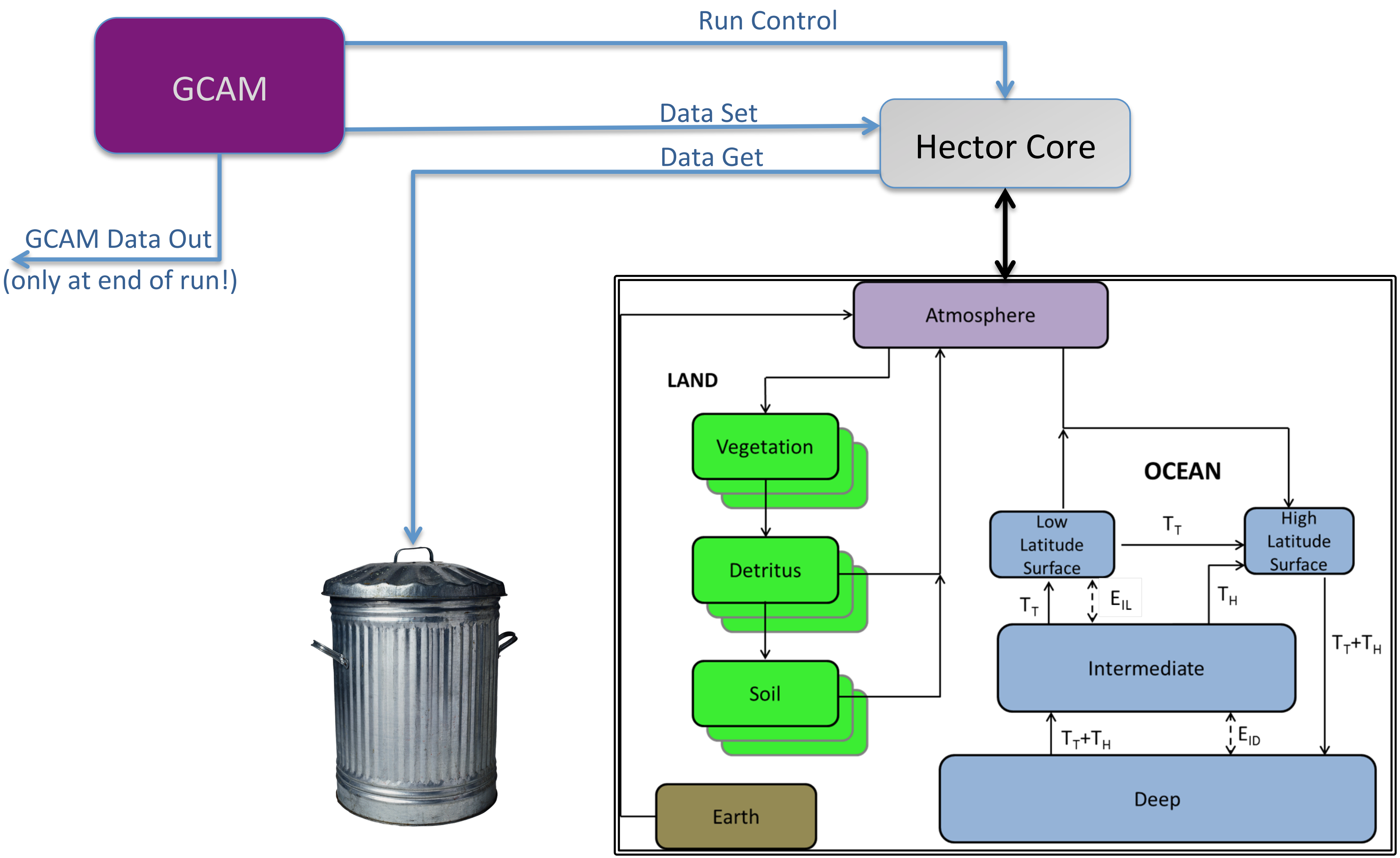
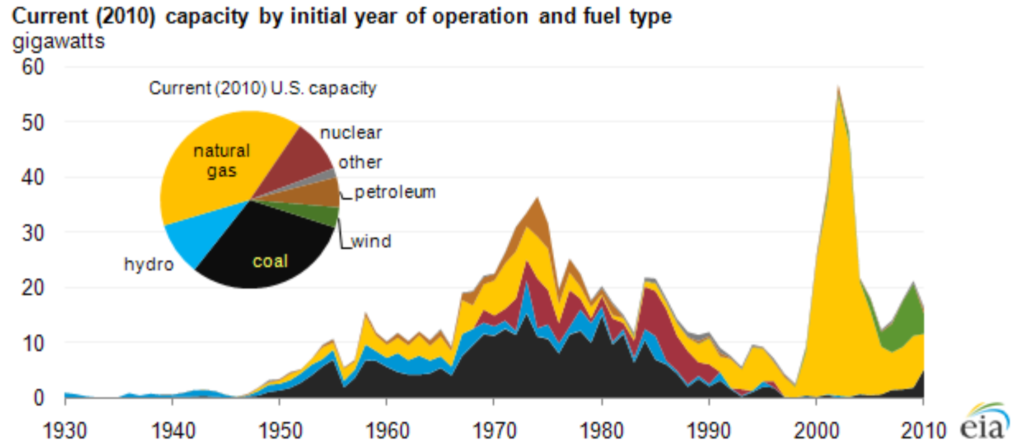


Hindcasting and Backtesting

- GCAM behavior is driven by structural parameters that are not anchored to history.
- To connect to real-world behavior we need:
  - Relevant historical data
  - Ability to run over a historical period
- Even better: do the historical runs under control of MCMC algorithm.



$$f(x;\mu,s) = \frac{e^{-\frac{x-\mu}{s}}}{s\left(1+e^{-\frac{x-\mu}{s}}\right)^2} = \frac{1}{4s}\operatorname{sech}^2\left(\frac{x-\mu}{2s}\right).$$