An Update on Software Developments in the FATES

Ryan Knox (rgknox@lbl.gov), Charles Koven, Benjamin Andre, Rosie Fisher, Gautam Bisht,
Mariana Vertenstein, William Riley, William Sacks, Erik Kluzek and David Lawrence

An Interface Between FATES and a Host Land Model (HLM)

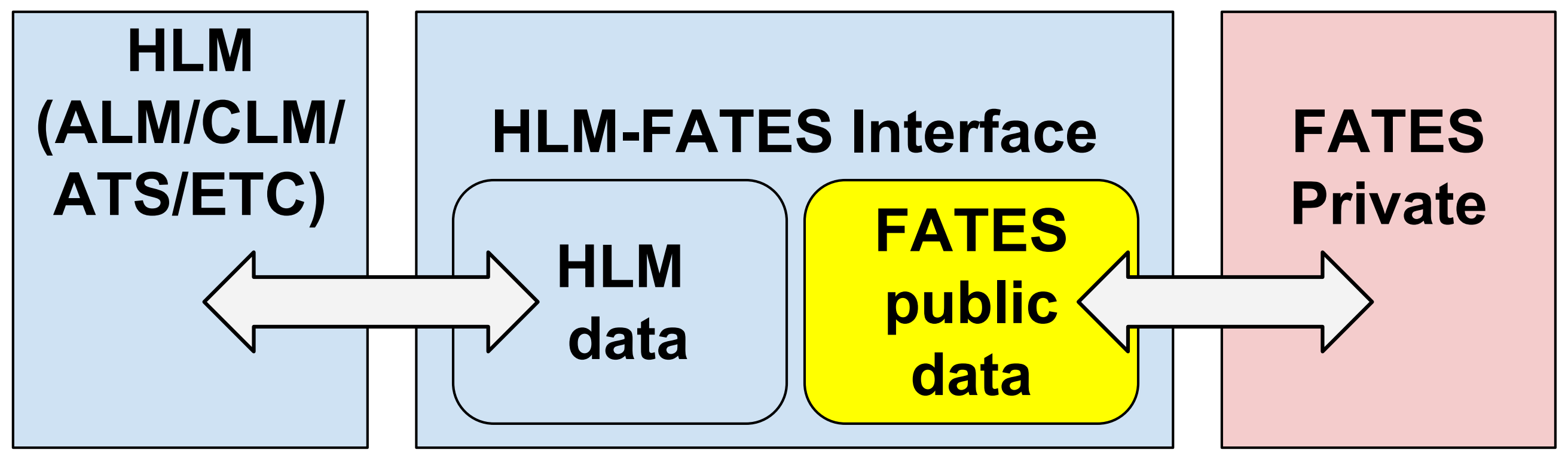
Interface?
Software that allows modules (eg. FATES and the HLM) to communicate.

Why do we need a (good) interface?

1) enable an easier connection of FATES with other/new models/modules
2) buffer FATES engineers and scientists from having to change/adapt our model when someone changes something in the host model
3) constrain and identify the flow of information/data into and out of our module

V1 Design Factors:

1) Create an isolated portion of code in the HLM where HLM-allowed and FATES-allowed data structures can interact
2) Create data structures in FATES specifically for input and output to a host model (boundary conditions, IO)
3) Use modern Fortran "class" structures which help to further protect how/where data are used and allow for object oriented programming
4) The FATES should be able to compile stand-alone and act as a library (if desired)
5) "Thread safe" design
6) A comprehensive and challenging suite of tests
7) Utilize the HLM's "low level" IO software (instead of self)


HLM (ALM/CLM/ ATS/ETC)

HLM-FATES Interface

HLM data

FATES public data

FATES Private

FATES Development At a Glance

- Conceived December 2015
- >22,000 lines of code added
- >15,000 lines of code removed
- 33 Separate Issues Have Been Completed
- 49 Separate Submissions have been integrated
- 7 People have contributed to code
- 595 commits (change groups) to the master branch
- 17 forks (personal copies) of the repository itself

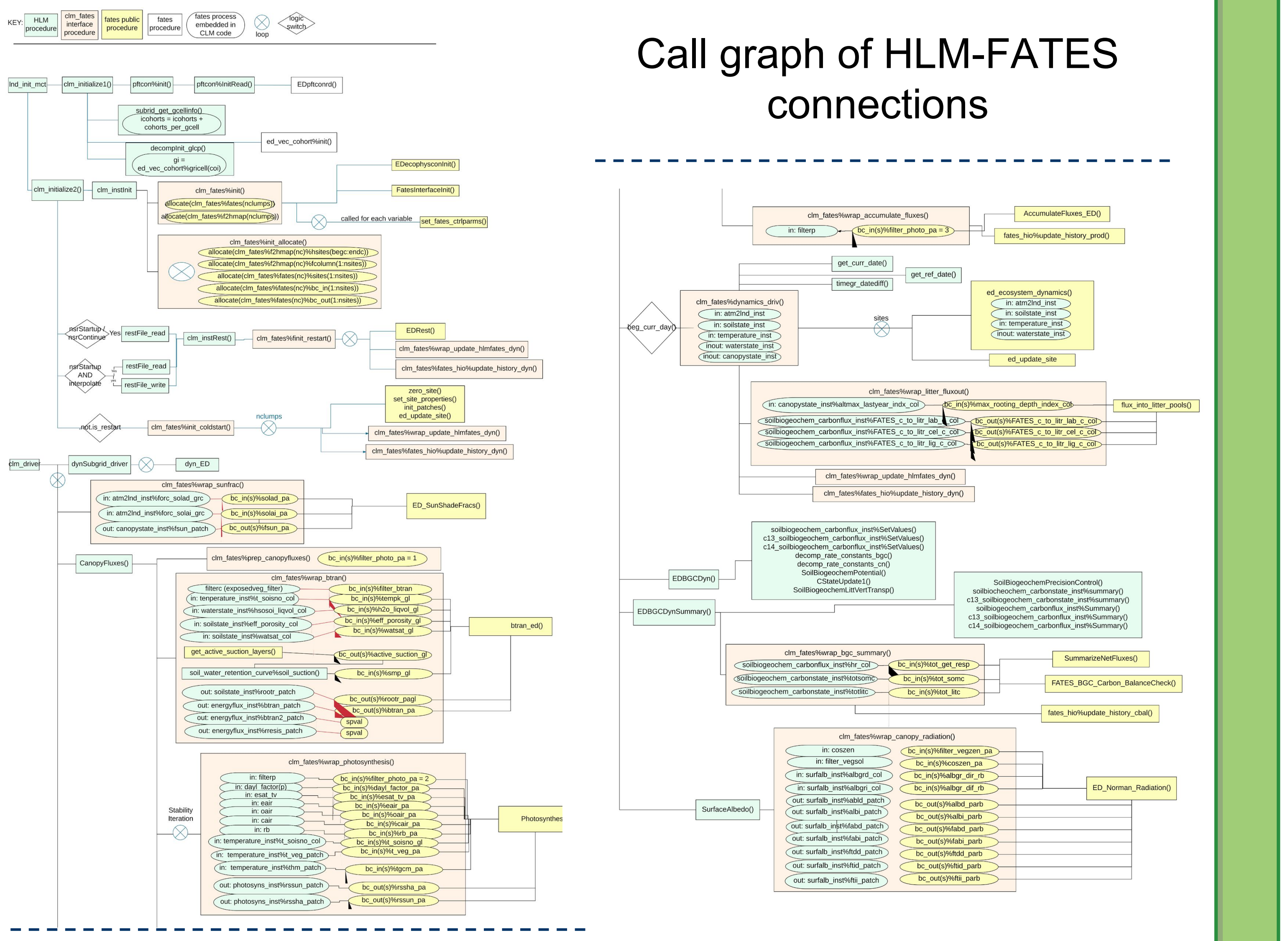
Milestones Completed

- **Created a new repository from CESM trunk 121**
- **Unified pre-existing developments from NCAR/LBNL/LANL**
- **Ported code to lawrencium, wolf, conejo and PCLinux machines**
- **Added Linkages between ED and HLM soil BGC**
- **Numerous bug fixes**
- **Expanded diagnostics to included size/pft dimensioning and higher frequency flux variables**
- **Converted FATES memory structure - sites aligned to columns**
- **General structure of the HLM-FATES API**
- **General structure of the FATES public API**
- **Cold-start interface**
- **Partial completion of restart interface**
- **Interface for photosynthesis**
- **Interface for radiation**
- **Interface for hydraulics**
- **Interface for soil BGC**
- **Partial completion of interface for ED driver**
- **Interface for History IO diagnostics**
- **Interface/cleaning of phenology**
- **Interface communicator for global variables**

Milestones Until V1.0

- **Complete interface to model restarting**
- **Interface and separate FATES parameter input**
- **Complete interface and boundary conditions to ED driver**
- **Final pass-through for CLM/CESM globals**
- **Naming conventions, documentation general code cleaning**
- **Refactor build and module control system**
- **Implement HLM-side interface into ACME**

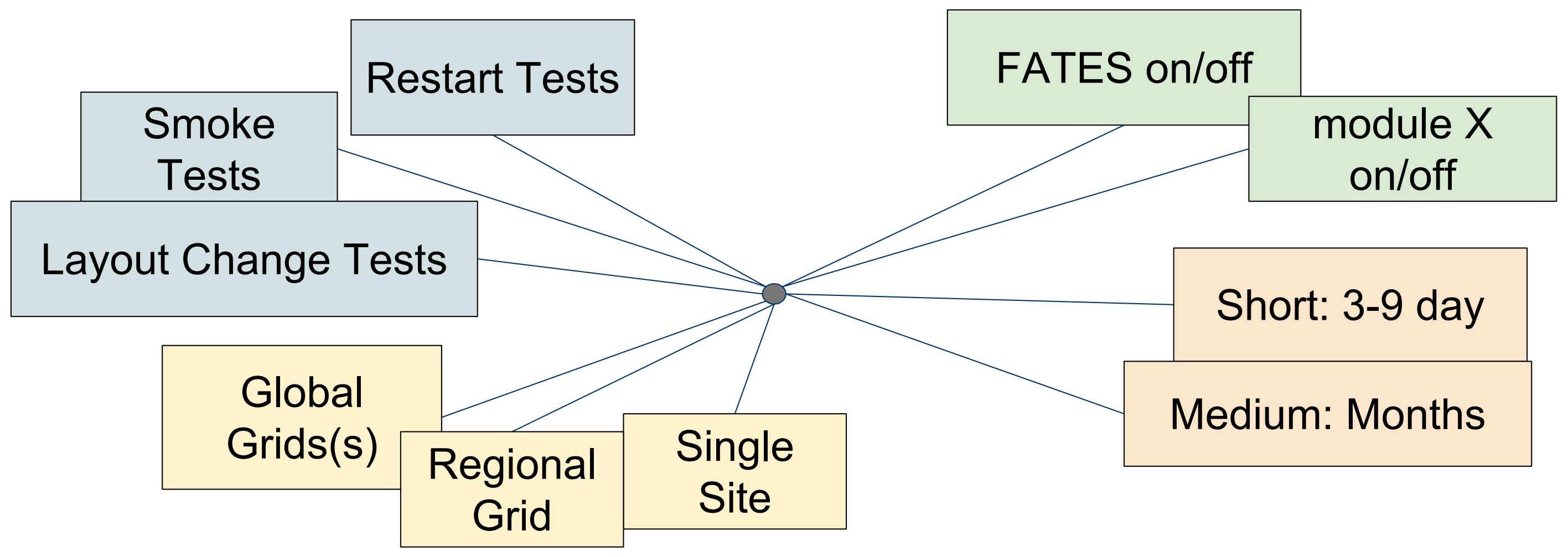
Cross Project Development Liasing


Call graph of HLM-FATES connections

Model Testing

All requests to update the code are tested on 2+ machines (NCAR-yellowstone, LBNL-lawrencium and periodically NCAR hobart) with a total of 4 compiler combinations (intel,gnu,pgi and NAG!). We have protocols for submitting and describing changes, and peer review.

CIME (Common Infrastructure for Modeling the Earth) build and test system. PASS/FAIL software tests:


Smoke Tests

Restart Tests

Layout Change Tests

Global Grids(s)

Regional Grid

Single Site

FATES on/off

module X on/off

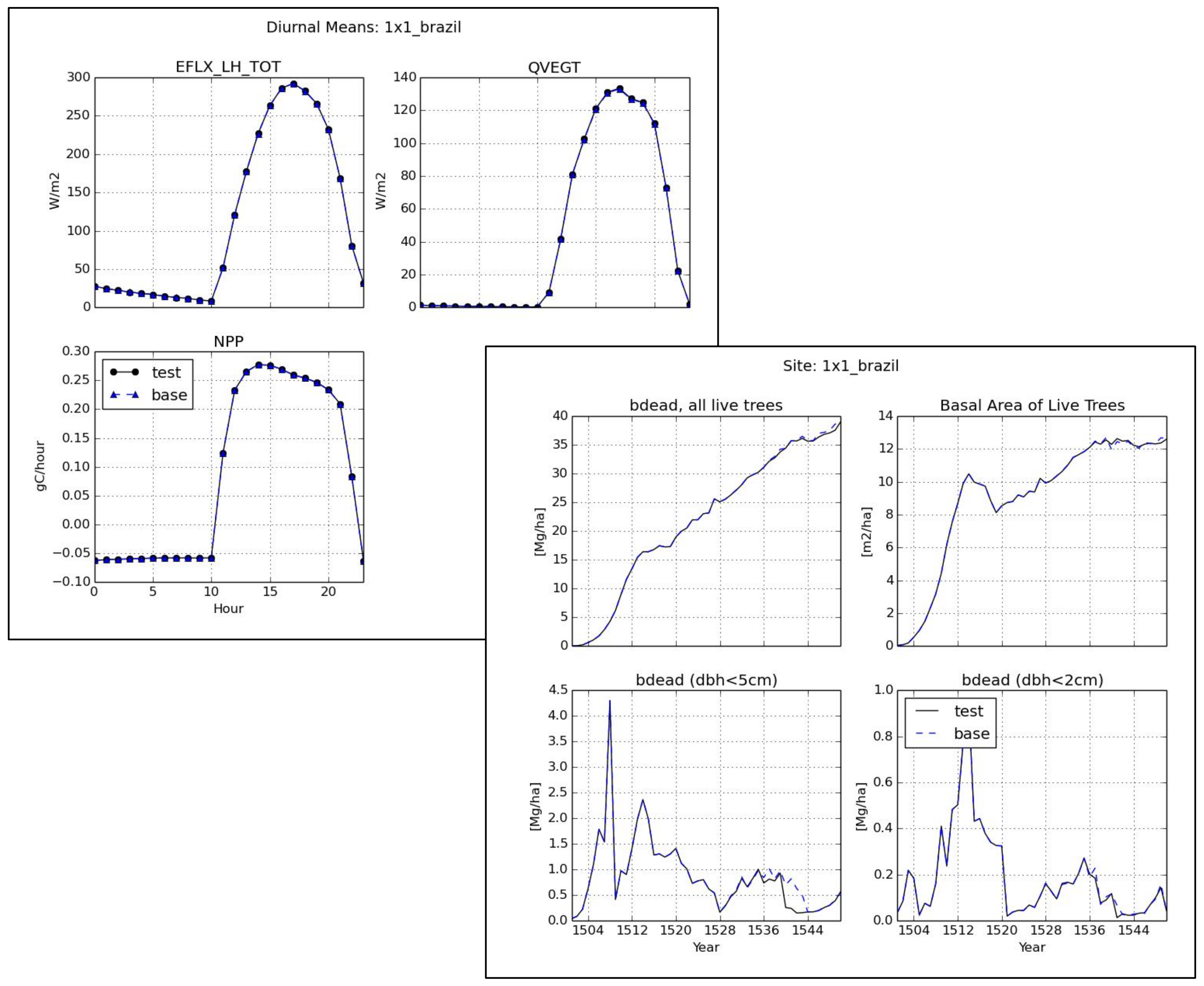
Short: 3-9 day

Medium: Months

Model Science Testing

Some changes to the model should give identical results as its basis (regression tests), **sometimes changes will impact outcomes and need some basic scientific evaluation** and sanity testing.

Toolset: "rapid science checking (RSC) tool", written in python, uses minimal libraries (matplotlib, netcdf), controlled via command-line arguments and an XML, designed for automated use. Evaluates time-series projections of flux, and forest structure and composition.



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