

Datasets across CTSM-FATES

Thanks to: FATES development team and CTSM software engineers



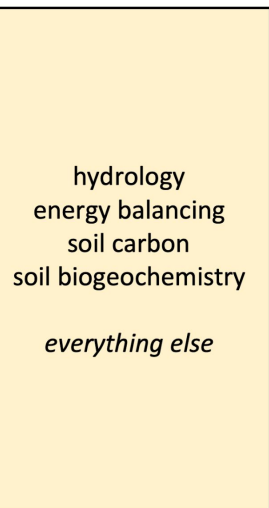
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June 16, 2020

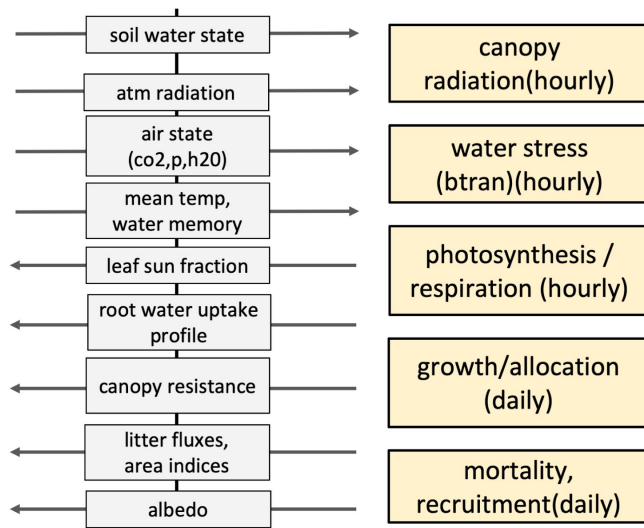


CTSM-FATES datasets

Host Land Model



FATES

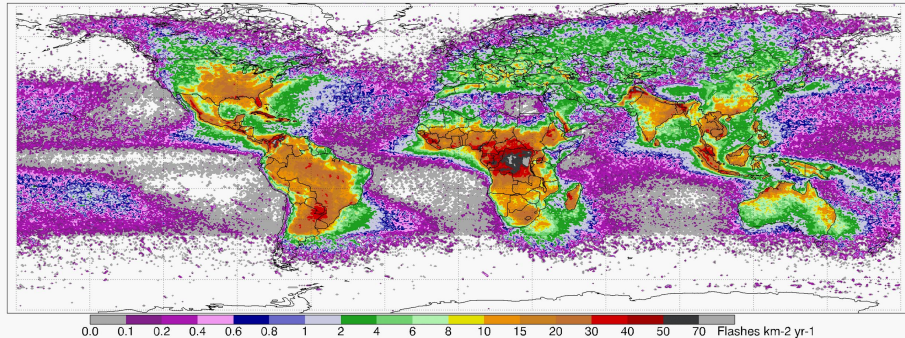


- HLM provides climate and site conditions. Current HLMs: CLM, ELM, NorESM, ATS.
- All HLMs use netCDF to read/write datasets
- FATES handles vegetation structure and physiology, seeds and litter.

- FATES is a module, and must be associated with HLM
- FATES is HLM agnostic
 - Supplemental data not required for all HLM
- Questions for when you add data:
 - What are dimensions and attributes of data?
 - Will FATES adjust units per HLM format?
 - Or force expected units?

Methods of reading data

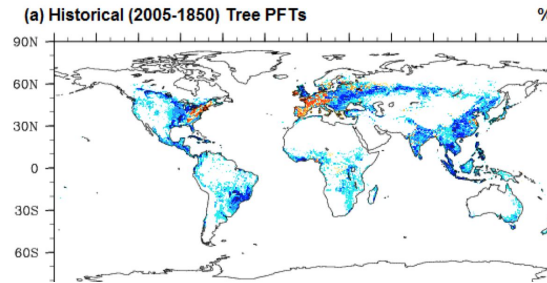
NASA LIS/OTD lightning strikes (flashes $\text{km}^{-2} \text{yr}^{-1}$)



- Streamfiles

- Data format for controlling input data as part of CIME
- Power and flexibility without custom code
- Interpolate spatially and in time
- Existing user-defined interpolation options

(a) Historical (2005-1850) Tree PFTs



FATES-fixed biogeography uses PFT fraction map from surface dataset

- Surface dataset

- Data fixed on file at read time
- Data is at model resolution
- Fixed in time

“Essential” datasets global simulation

Description	Use	Type	Status
PFT fractions	FATES-SP & FATES-fixed biogeography	surface dataset	operational
LAI (climatology or data)	FATES-SP	surface dataset or streamfile	to-test
Land use history	Transient change	Landuse timeseries	V1 in-testing V2 to-test
Lightning strikes	FATES-SPITFIRE	streamfile	operational
Population Density	FATES-SPITFIRE	streamfile	to-test
GDP	FATES-SPITFIRE	surface dataset	to-test

Adding new datasets to FATES

- Generic template for adding datasets as streamfiles
 - Example: Lightning strike data owned by HLM and passed into FATES (CTSM PR #991) <https://github.com/ESCOMP/CTSM/pull/991>
 - Adaptable as framework for other dataset cases
 - HLM evolves dataset and methods independent of FATES
(HLM reads the data both when running with FATES and without)
 - Uses CIME streams capability
- What about data owned exclusively by FATES?
 - Benefits: data available regardless of HLM
 - FATES must perform dataset management
 - FATES would need to add an efficient I/O library

optional datasets

Description	Use	Type	Status
Veg structure	initialization	netCDF Text file (set of points)	to-create txt point set: operational
wind	wind module, dispersal	datm forcing, streamfile	to-create
seeds	dispersal	Streamfile, model informed per year?	to-create
prescribed burned area	FATES-SPITFIRE	streamfile	to-create
prescribed albedo	Potential reduced-complexity mode. Unsure if feasible	streamfile, FATES-SLIM model?	to-create
Prescribed soil moisture	Potential reduced-complexity mode.	Streamfile (CTSM history file)	to-test

Optional cases comments

- Wind (dispersal, wind damage/mortality)
 - Format: datm forcing only (if read as separate file could conflict with datm forcing)
 - Need direction (datm fixed NE) (currently have 10m speed)
 - Need daily “intensity/gustiness” (time at speed in direction)
 - Use CAM or CPLHIST to include forcing direction & pass to FATES
 - How to best capture “intensity/gustiness” from half-hourly data?
- Prescribed burned area
 - Format: streamfile, similar to prescribed soil moisture (history file)
 - Useful in CTSM and to inform FATES
 - Benefits: HLM research informs/updates dataset and is available to FATES
- Prescribed albedo
 - Format: streamfile? (current is part of BGC and created for each subgrid type)
 - Potential of using SLIM model to run with FATES?

CTSM gridcell-level balance checks

- C Mass balance checks at gridcell-level in addition to column (CTSM PR #984)
 - <https://github.com/ESCOMP/CTSM/pull/984> and <https://github.com/ESCOMP/CTSM/issues/201>
(note water and energy balance checks PR in progress)
- Balance checks span dynamic landcover change along with physics
 - Trigger model stop with mass balance fail at grid cell OR column level
 - Check balance treats whole land system as black box
 - Handles pools and fluxes that interact between grid cell and atmosphere
 - Harvested wood and crops removed from land model (use and consumption)
 - “Dribble” terms apply annual transient update across time steps
- May catch issues with FATES integration

gridcell C balance = gridcell C + Wood production C + Crop harvest C +

```
grc_endcb(g) = totgrcc(g) + tot_woodprod_grc(g) + cropprod1_grc(g) + &
```

```
hrv_xsmrpool_amount_left_to_dribble(g) + &
```

```
dwt_conv_cflux_amount_left_to_dribble(g)
```

←←←← Maintenance respiration

←←←← Conversion pool

Final thoughts

- “Essential” datasets
 - Many are operational or ready for testing
 - Small amount of development for fire datasets (GDP, pop density)
- Optional datasets
 - Generic framework for adding streamfiles
 - Expands user-defined possibilities for testing/exploration
- Gridcell-level balance checks
 - Higher level of mass-balance testing across landcover change with physics response
- FATES connection to MEGAN needs development (not functional)
 - CTSM issue #115 <https://github.com/ESCOMP/CTSM/issues/115#event-3439492456>

Thank you!



You will find only
what you bring in.

-Yoda

WellQuo

Empire Strikes Back