Forest ecosystem modeling

From theory and development to calibration and testing

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cohort-specific model 30-minute photosynthesis and fluxes daily growth and allocation





FATES operates at multiple scales of a forested ecosystem









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Legacies of forest types in boreal North America



Wildfire severity impacts post-fire organic layer depth and forest regrowth





post-fire organic layer depth

burn severity



Differences in forest type feed back to climate



tundra



Incorporation of vegetation feedbacks improves model performance





Foster et al. 2019



Incorporation of vegetation feedbacks improves model performance





Foster et al. 2019



Incorporation of vegetation feedbacks improves model performance





Applying these concepts with FATES



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Simulations with FATES





Plot Observations



Simulations with FATES





Differing forest types





Plot Observations



Belowground conditions – soil moisture





Belowground conditions – soil temperature





FATES and Hillslope Hydrology



Sean Swenson, in prep swensosc@ucar.edu





125 n1/hg

Solomon & Webb 1985



FATES and Paleoecology



Bonan & Hayden 1990



Difficult to calibrate across all scales



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FATES complexity modes



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Calibration cascade



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FATES Satellite Phenology PPE

Objectives:

- 1. Sanity check on which parameters actually have an effect in SP mode
- 2. Sensitivity to parameters

Methods:

Borrow from CLM PPE methodology:

- 1. Initial one-at-a-time min/max sensitivity experiment
- 2. Use "sparse grid" to save on time





Parameters

fates Parameter Group fates maintresp allocation allometry canopy CNP hydrology leaf litter mortality patch/cohort fates leaf phenology radiation recruitment respiration turbulence fates_allom_g turnover 2.0 т 1.5 0.5 0.0 1.0 $p_{max} - p_{min}$ $\frac{p_{max}+p_{min}}{2}$

117 parameters photosynthesis radiation leaf traits phenology allometry demographics

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Parameters

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117 parameters photosynthesis radiation leaf traits phenology allometry demographics



Many parameters had no effect

117 total parameters36 had an impact:

- GPP
- transpiration/LH
- soil temperature
- soil moisture
- albedo



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Changes in GPP

Grid cell average



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Changes in GPP

Grid cell average

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Parameter effect – top 20



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Thank you!





