Model Evaluation Discussion

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Group Charge

Topic of Group Discussion

How can we properly evaluate our land-surface models (DGVMs) **when they are embedded within climate models***? By what means? What are the proper experiments to design?*

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Clarification

We took these questions to refer to land surface models in general, not just dynamic vegetation/biogeography models.

Limits of Land Surface Models/Schemes

- What are the spatial and time scales involved?
- Should we try to restrict or limit the use of models?
- Development and evaluation of models is driven primarily by the desired applications.
- What are the acceptable limits of model assumptions?
- Is peer review an acceptable method of establishing or maintaining these limits?
- It is dangerous to "over tune" models in offline mode, possibly breaking the coupled model.
- It is dangerous to tune for the wrong time or spatial scale or for a specific region or continent.

Steps for Model Evaluation

- **Protocol** - designed to elucidate performance under past, present, and future climate across all space and time scales
- **Metadata Standards** - for simplified manipulation and analysis, especially in preparation for AR5 and beyond
  - mapping PFTs to standard biome types?
  - mapping carbon pools to standard pool types?
- **Metrics** - based on comparison with best available satellite- and ground-based observational datasets
- **Diagnostics** - standard, open source package supporting all the metric comparisons
- **Scoring** - community-developed weighting of performance on metrics based on metric importance and data uncertainty
- **Distribution** - open distribution of model results to support related science by others, using the same Earth System Grid (ESG) system as IPCC

Prospects for Model Evaluation

- Many variables are needed to comprehensively evaluate processes in models.
- There are many ways to get the right answer for the wrong reason.
- It is important to 1) combine many datasets of similar observations for comparison with model results, and 2) these datasets must be processed in the same way for consistency.
- Fluxes are easier to validate than pools.
- We should frame our analysis in terms of processes (*i.e.*, photosynthesis, phenology, etc.).

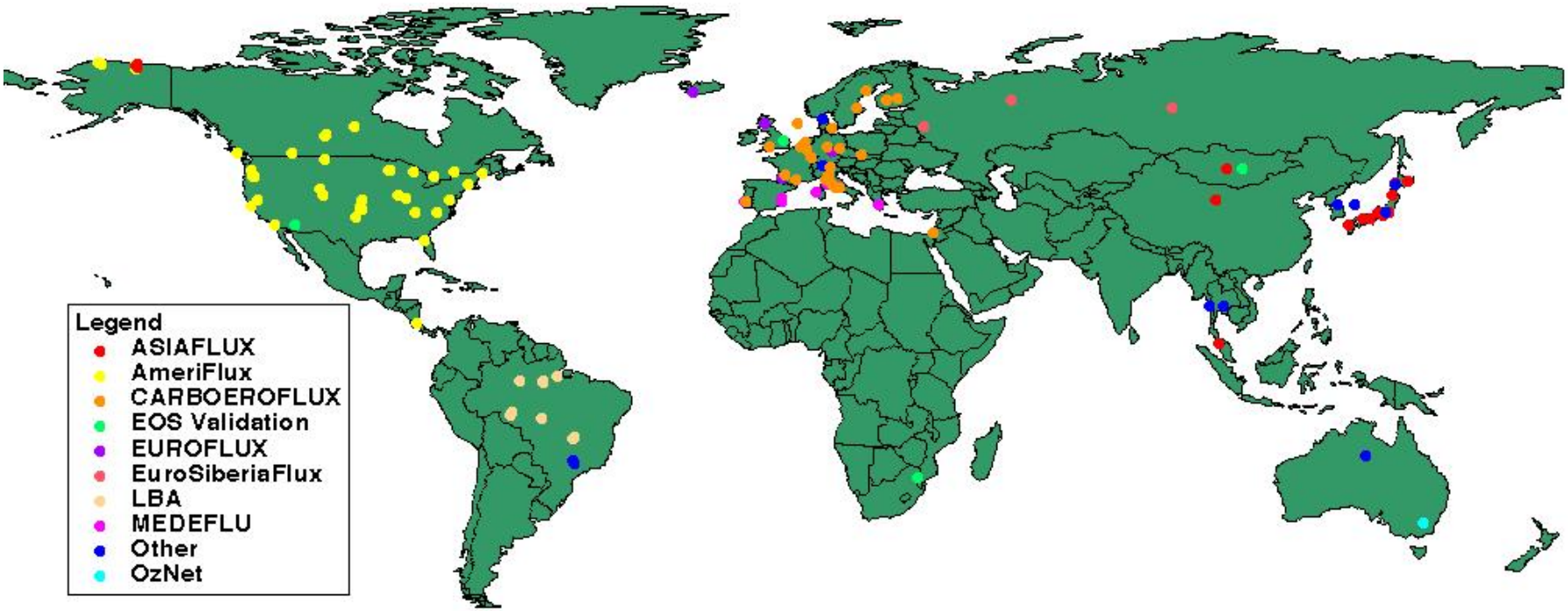
Forcing and Evaluation Datasets

- FluxNet - latent & sensible heat (Effort to use GEWEX)
- Model farm - Reto Stöckli's system for running many models offline with FluxNet site data
- AmeriFlux and FACE sites
- River gauges - integrative (Trenberth & Dai 2002), GRACE
- NOAA GMD flasks for CO_2 seasonal cycle
- MODIS - pattern, phase ("modeled observations")
- Tree rings and other proxies

Forcing/Met:

- NLDAS Forcing: 1985–present ($\frac{1}{8}^\circ$, US only)
- ISLSCP II: 1980s
- NCEP/NCAR reanalysis: 1948–2004 (Qian *et al.*)
- CRU (East Anglia): 2002 (more will come soon)
- NCC (NCEP Corrected with CRU): 1949–2000
- ERA interim: 1989–2008 (New version of ECMWF reanalysis)

Global FluxNet Sites



Processes

Processes - FluxNet, satellites, tree rings, NPN		
photosynthesis	short t	small
phenology	short t	small
land cover	long t	small and large
snow	short and long t	small and large
fire	short t	small and large
other disturbances	short and long t	small and large
climate response	short and long t	small and large
response to extreme events	short and long t	small and large

Variables

Surface energy fluxes - FluxNet, GEWEX, MODIS, others		
temperature (2m–80m)	short t	small
evapotranspiration	short t	small
albedo	short and long t	small and large
Hydrology - FluxNet, river gauges, GRACE		
surface water fluxes	short t	small
soil moisture (+ deep soil)	short and long t	small and large
snow	short and long t	small and large
permafrost	long t	large and large

Variables

Biogeochemistry - FluxNet, flasks, MODIS, OCO		
gross primary productivity	short t	small
net primary productivity	short t	small
respiration	short t	small
net ecosystem exchange	short t	small
CO_2 & CH_4 emissions	short t	small
CO_2 seasonal cycle	long t	large
C pools (+ slow pools)	short and long t	small and large
Land cover - AVHRR, MODIS, tree rings, DesDynI (future)		
leaf area index	short t	small
NDVI	short t	small
biomass/yield	short and long t	small and large
vegetation distribution	long t	small and large
land use	long t	small and large

Recommendations

- Write a review paper on the current state of best available datasets for model evaluation?
- Compare with what is available (considering scales of space/time). Can community develop "best" datasets?
- Better document model processes (useful for understanding analyses of model results).
- Offline improvements may not improve the coupled model; they may make it worse! (*e.g.*, Sam's talk)
- **Closer collaboration between measurement and modeling communities!**
- **Closer collaboration between modeling groups!**
- We will establish a mailing list to continue discussions and invite others to participate.

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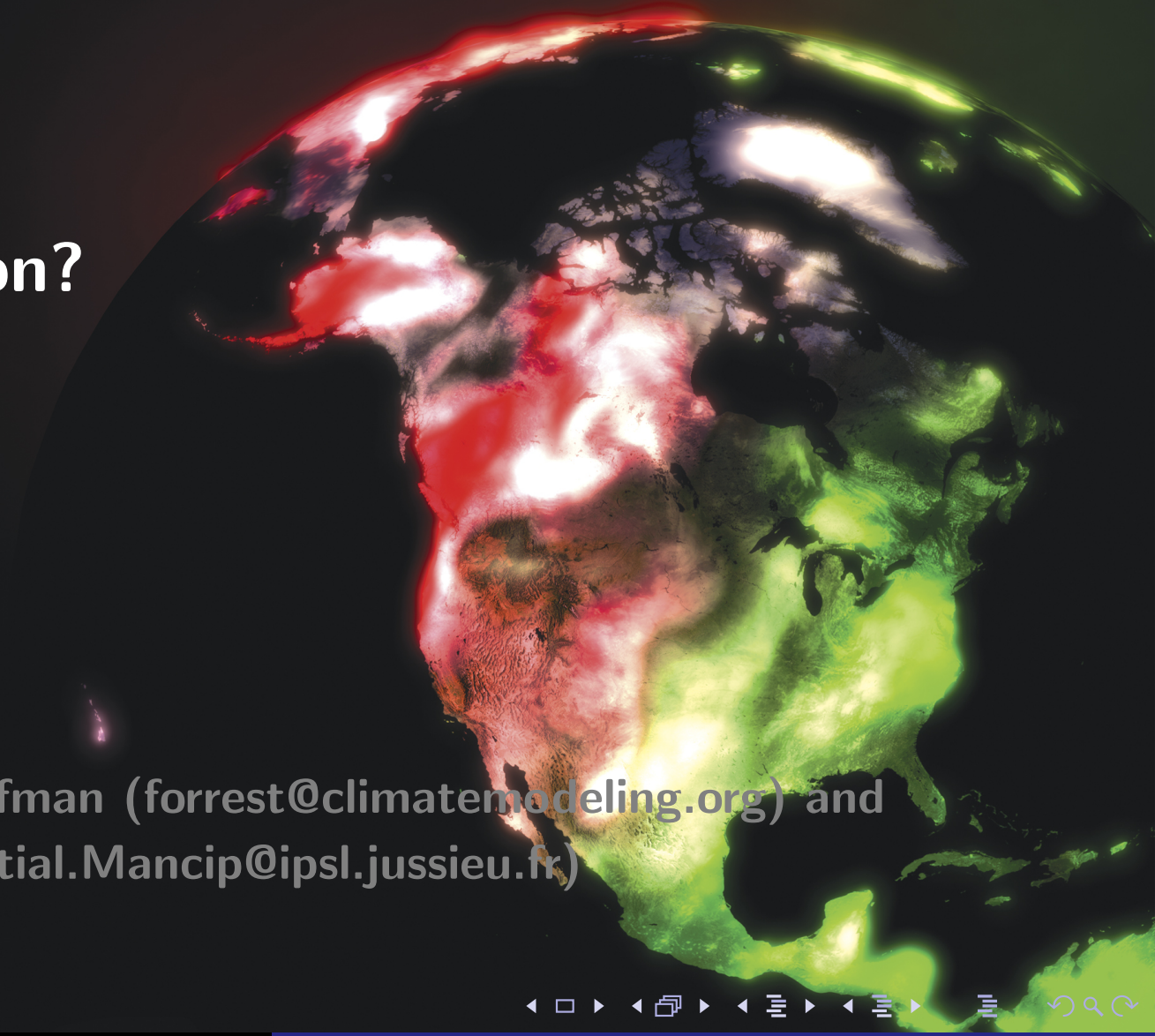
- Experiments should include historical, present-day, and future time periods.
- **This is hard!** But we could take advantage of each others' work.

Thank you!

Questions?

More Discussion?



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