CLM modeling and global data development

Xubin Zeng

Department of Atmospheric Sciences
University of Arizona

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xubin@atmo.arizona.edu

CLM-related work

Atmospheric forcing data development
　　T_{2m}

Land and vegetation data development
　　land cover type, fractional cover, leaf-area index;
　　bedrock depth and other soil properties

Model evaluation
　　carbon-nitrogen cycle; skin temperature

CLM development
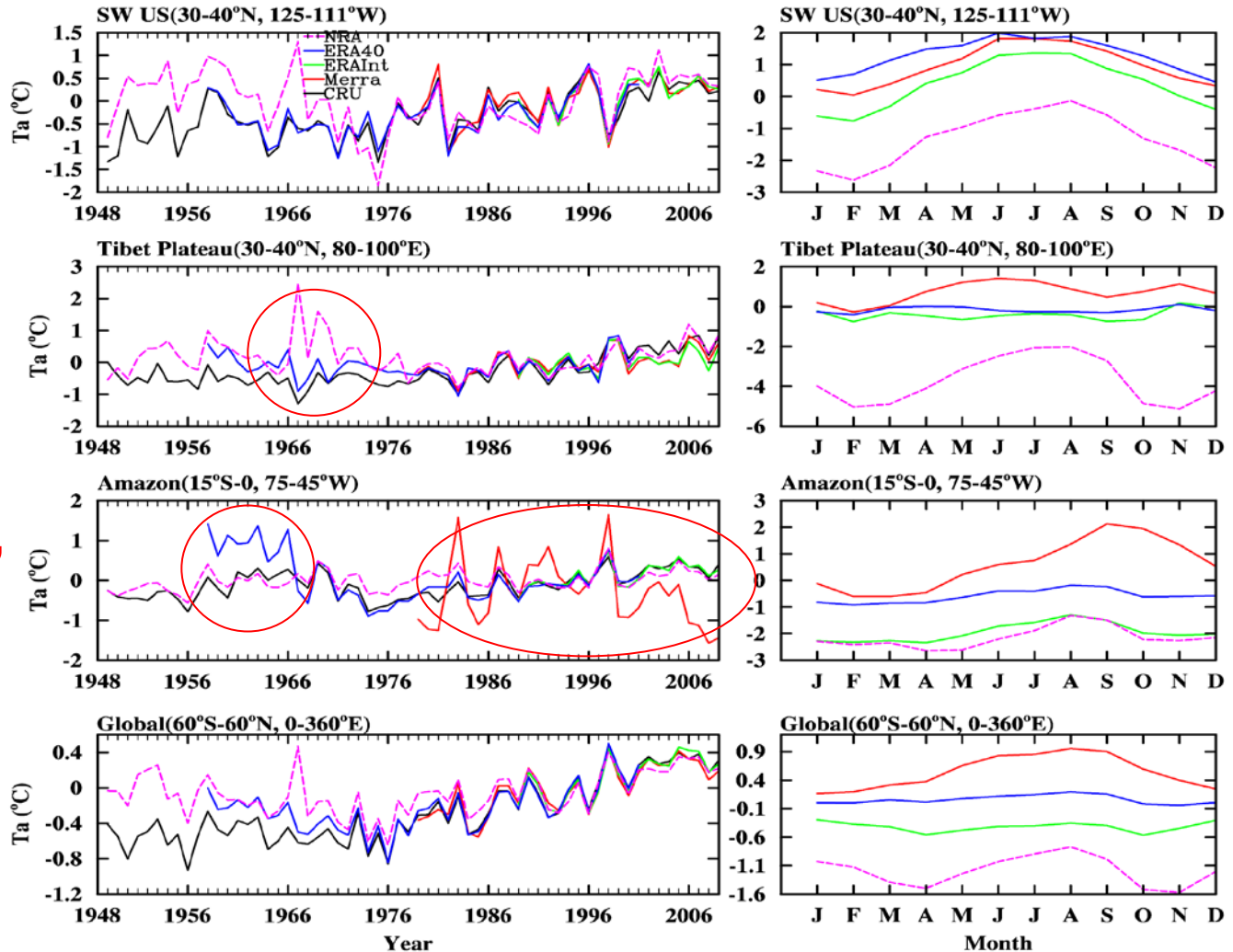　　global 1–km hybrid 3-D hydrological model;
　　roughness length; groundwater

Evaluation of reanalysis T$_{2m}$ with CRU data (with respect to 1989-2001 climatology)

Anomalies   Clim. Diff.
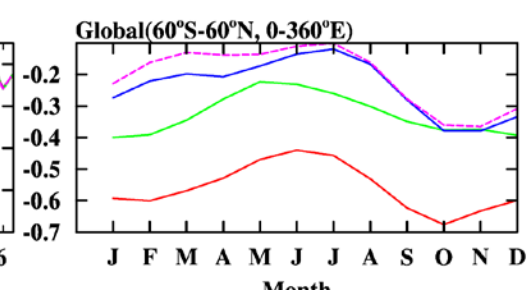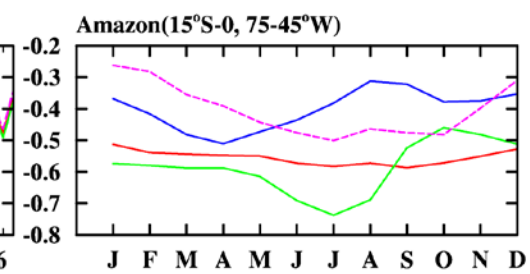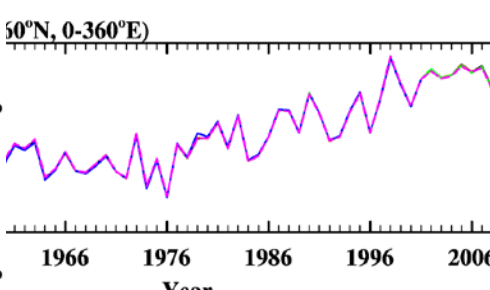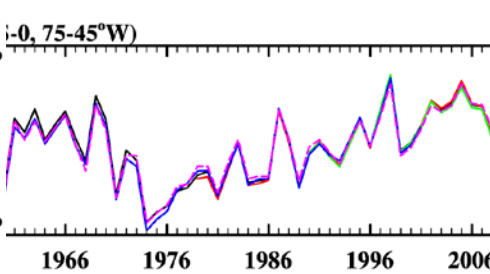
Wang and Zeng (2013a, in press)

Evaluation of our developed hourly T2m with CRU data
(with respect to 1989-2001)

Anomalies

Clim. Diff.
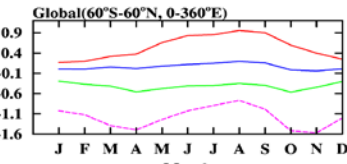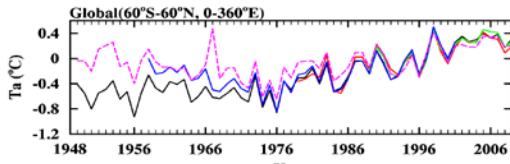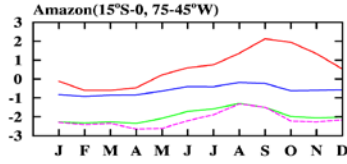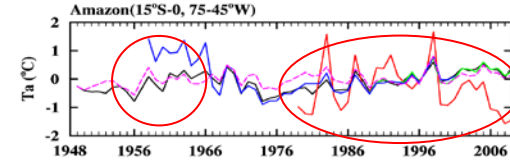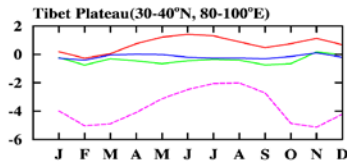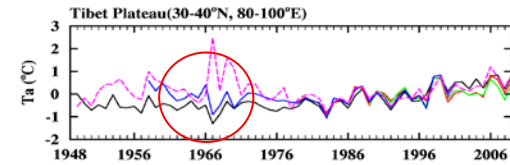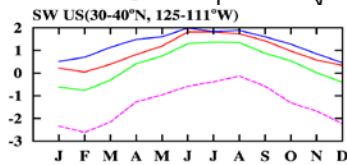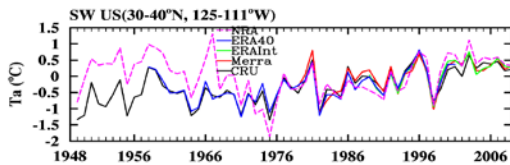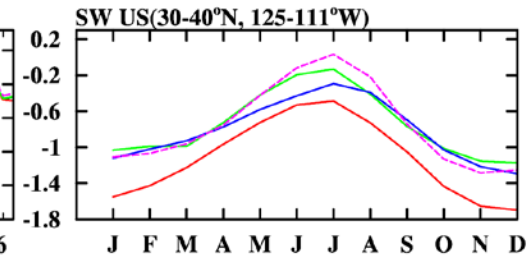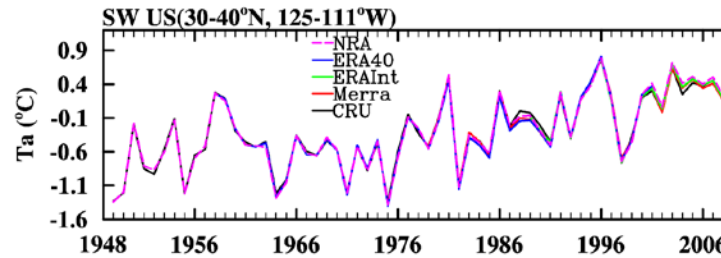
DTR: monthly average of daily ($T_{max} - T_{min}$)
DTRh: amplitude of monthly averaged hourly T_{2m} diurnal cycle
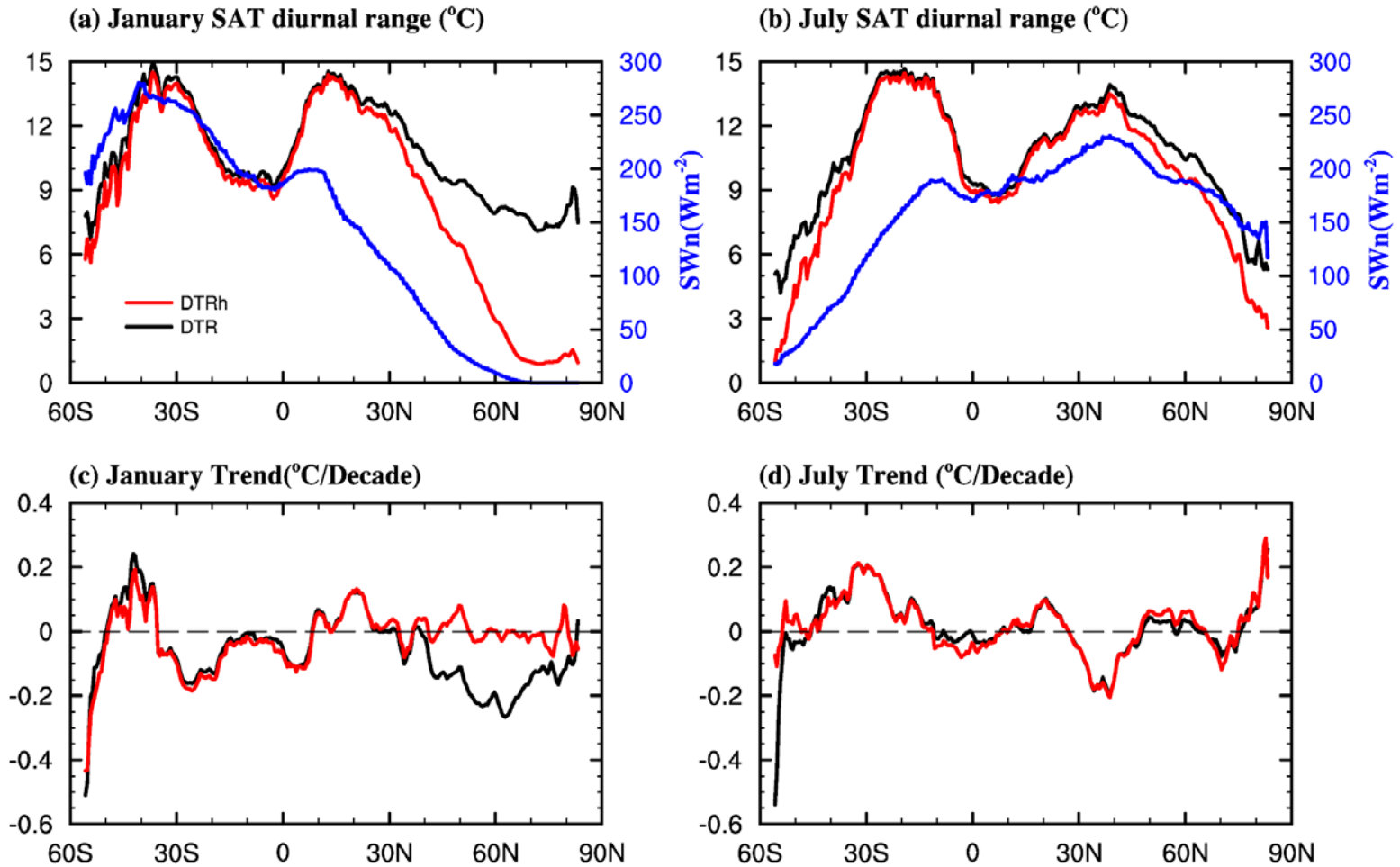
Wang and Zeng (2013b, submitted)

5

CMIP5 Carbon Cycle Intercomparison
Shao et al. (2013, in press)

Net ecosystem production (NEP)

Net biome production NBP=NEP-D at end of 20th century.
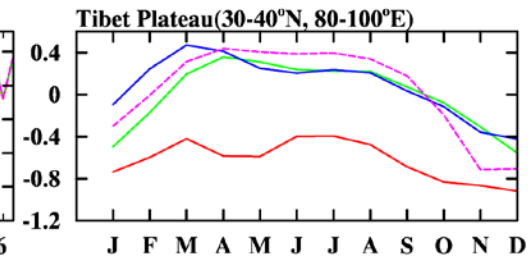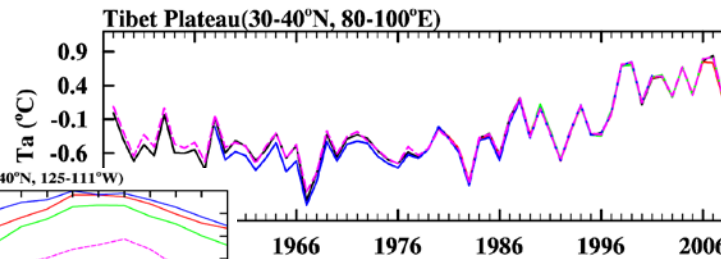

Top two rows: most land regions are carbon sinks (+ values); Bottom two rows: many land regions become carbon sources (- values) when disturbances (e.g., land use, fire) are included

Sensitivity of the land carbon to $[CO_2]$ and T

Total emission (C_E) partitioning

$$C_E = \Delta C_A + \boxed{\Delta C_L} + \Delta C_O \qquad \Delta C_L = \boxed{\beta_L}\Delta C_A + \boxed{\gamma_L}\Delta T_L$$
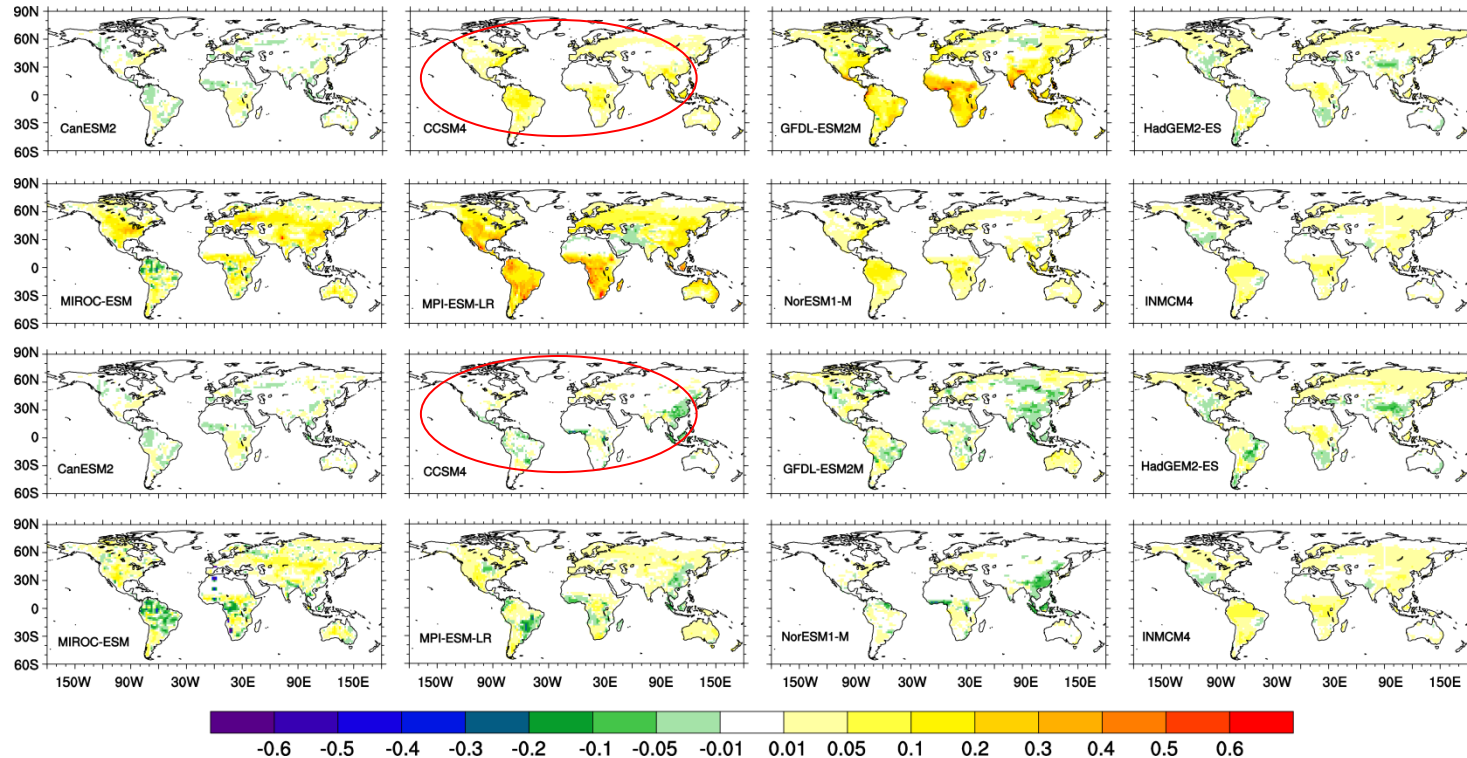

$$\beta_L = \frac{\partial C_L}{\partial [CO_2]}$$

$$\gamma_L = \frac{\partial C_L}{\partial T_L}$$
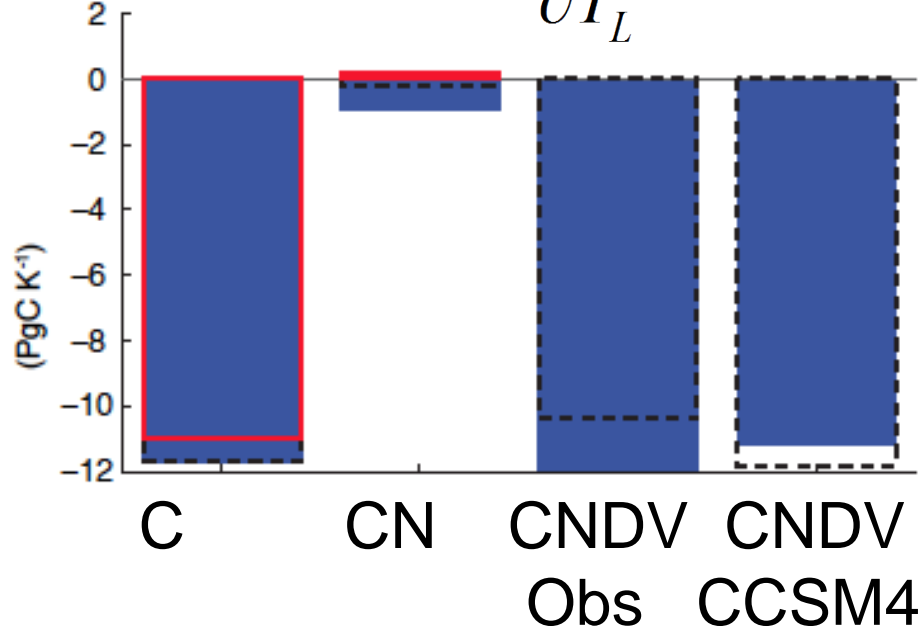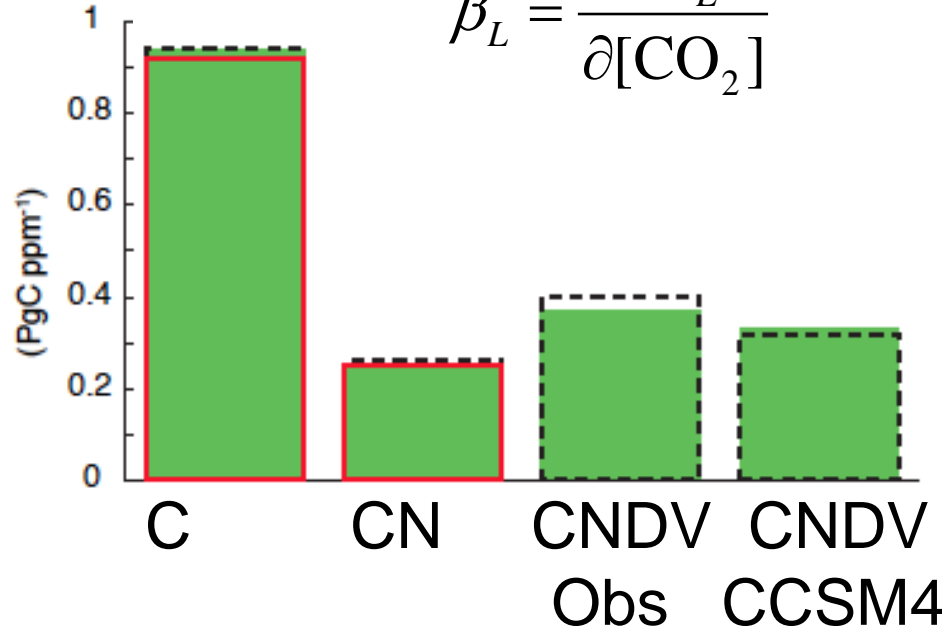
Bonan and Levis (2010): C and CN

Sakaguchi et al. (2013, to be submitted)

β_L & γ_L : Linear approximation and time period

Linear term used

Linear term + 2nd order derivative included

based on CNDV
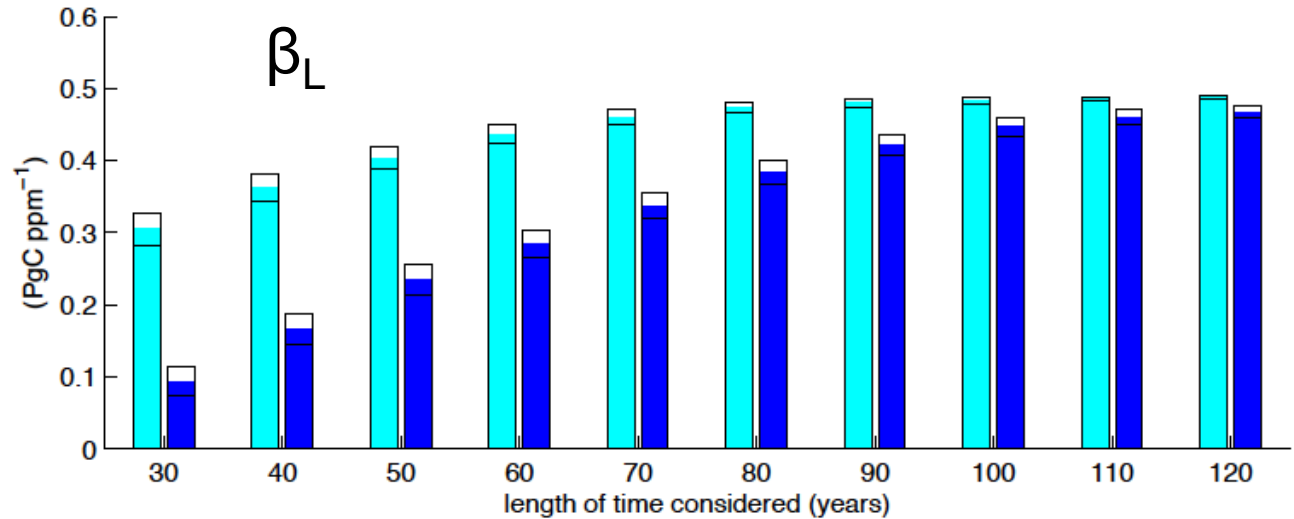
3. Global 1-km hybrid 3-D hydrological model

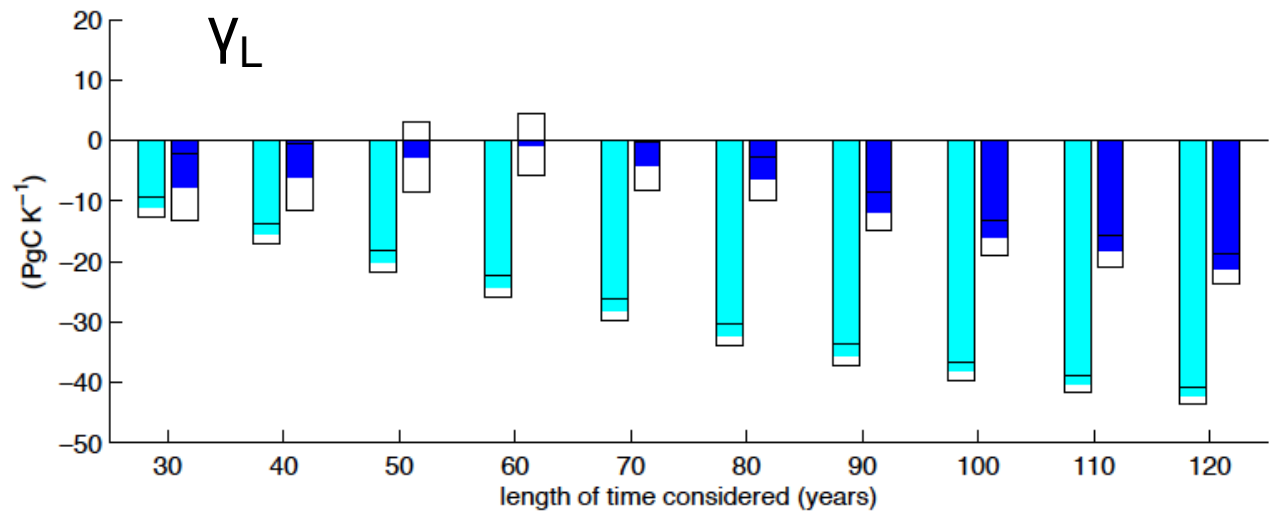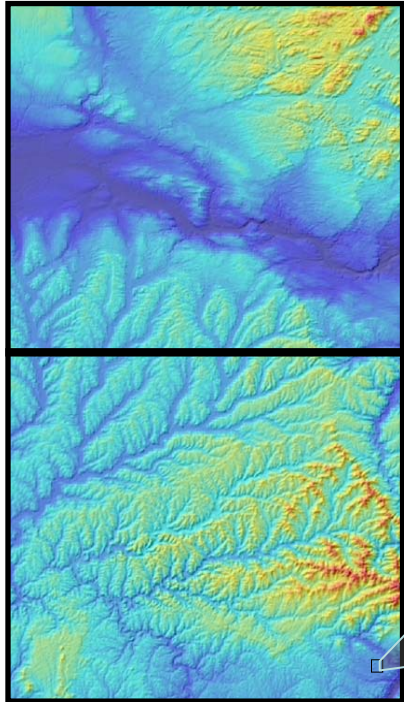**CESM Grids**   **Hydrologic Units**   surface flow and groundwater depth
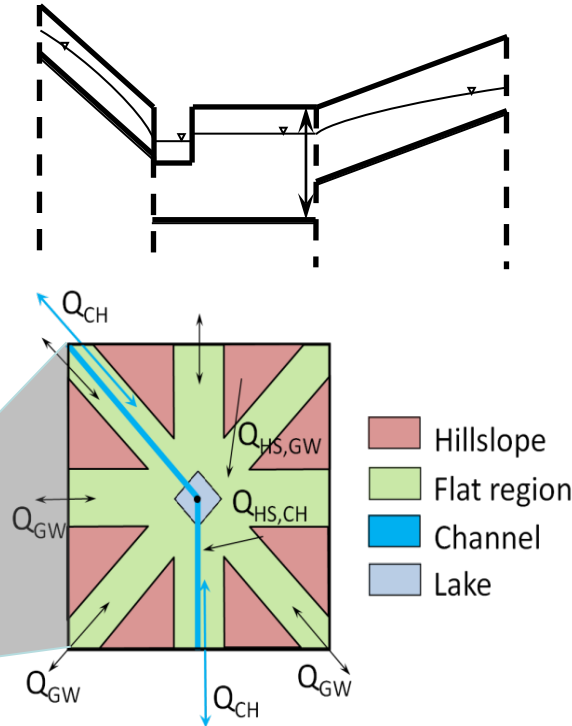
Q_{CH}

$Q_{HS,GW}$

Q_{GW} $Q_{HS,CH}$

Q_{GW} Q_{CH} Q_{GW}

- Hillslope
- Flat region
- Channel
- Lake
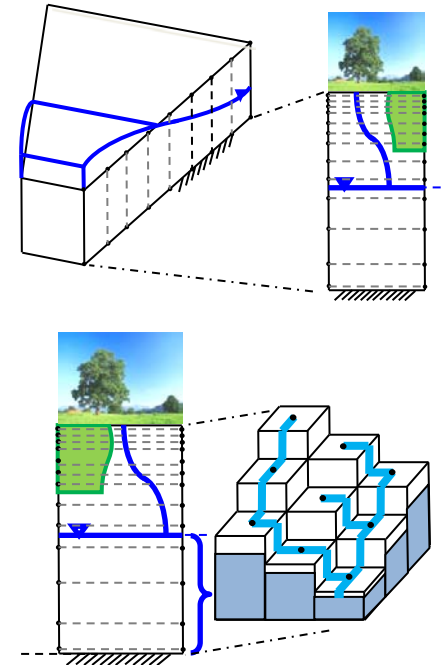
- vertical direction: CLM
- horizontal: 1 km; hybrid 2-D; computationally efficient
- horizontal/vertical coupling: CLM-consistent interface
- 1 km land and vegetation data development

4. Land data (bedrock depth, percentage areas of hillslopes, channels, flat areas, and lakes)

Pelletier et al. (2013, in preparation)

Global map of wetland extent
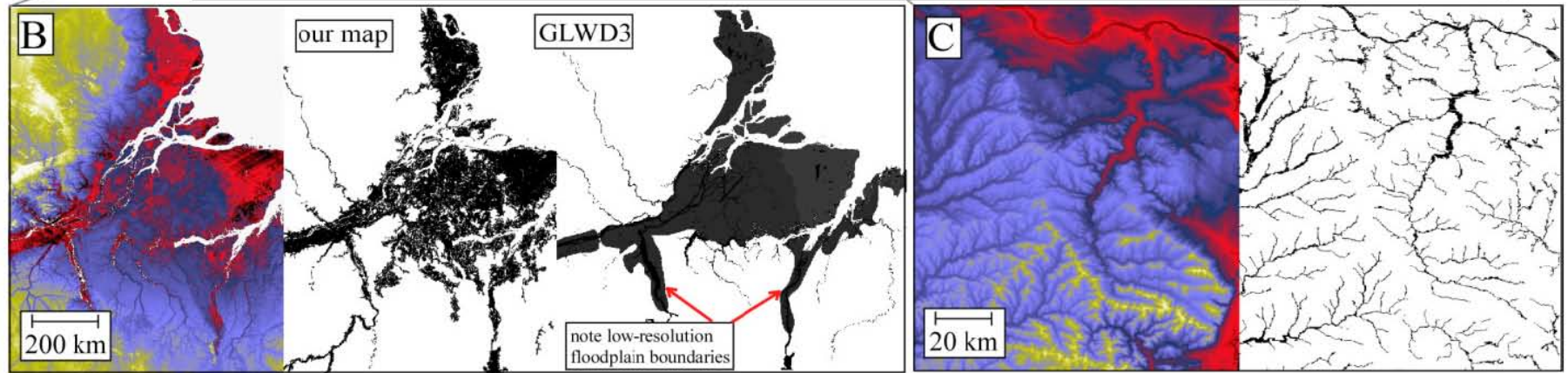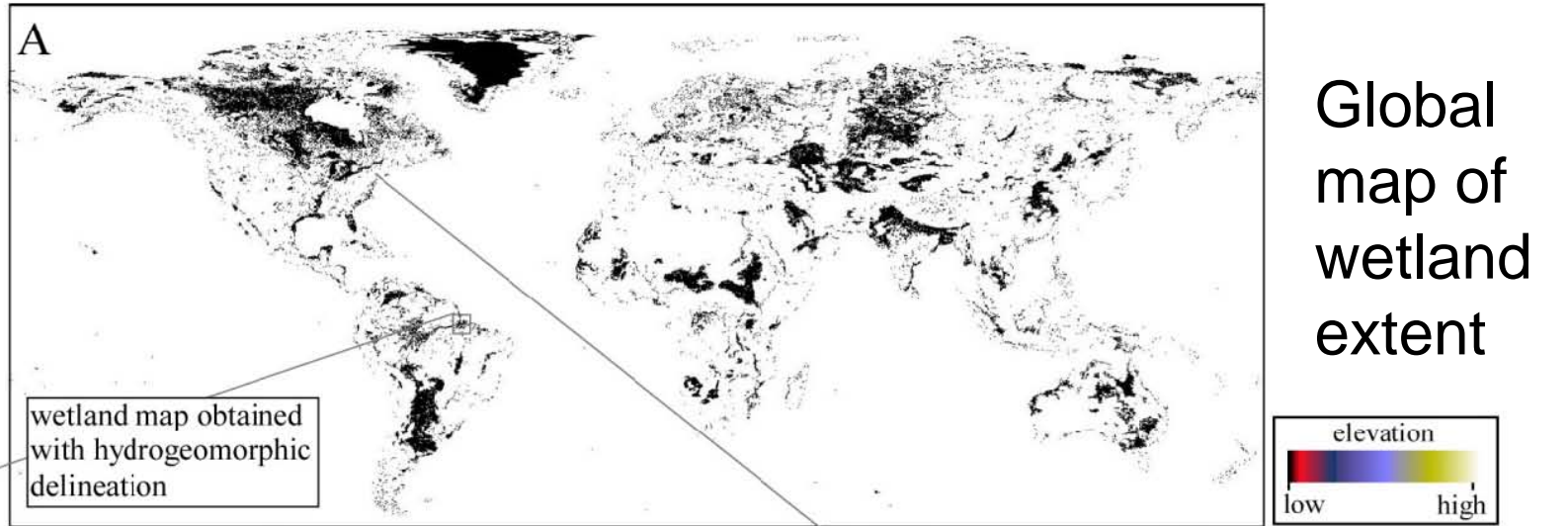
Elevation   Our wetland   Wetland Database   Elevation   Our wetland

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A proposed intercomparison of hydrological models for the horizontal movement of water in earth system models

Three steps:
- two 1° x1^o grid cells (i.e., two CESM grid cells)
- continental U.S.
- Global

If interested, let me know. We will decide:
- who will provide the atmospheric forcing data?
- who will provide the land and vegetation data?
- who will provide the validation data (e.g., river flow, seasonal wetland extent, …)?
- what are the comparison metrics (computational efficiency, science metrics)?
- ...