

Monthly fossil fuel CO₂ fluxes: Impact on
atmospheric CO₂ seasonal cycles and
implications for models of the terrestrial
biosphere (and more....)

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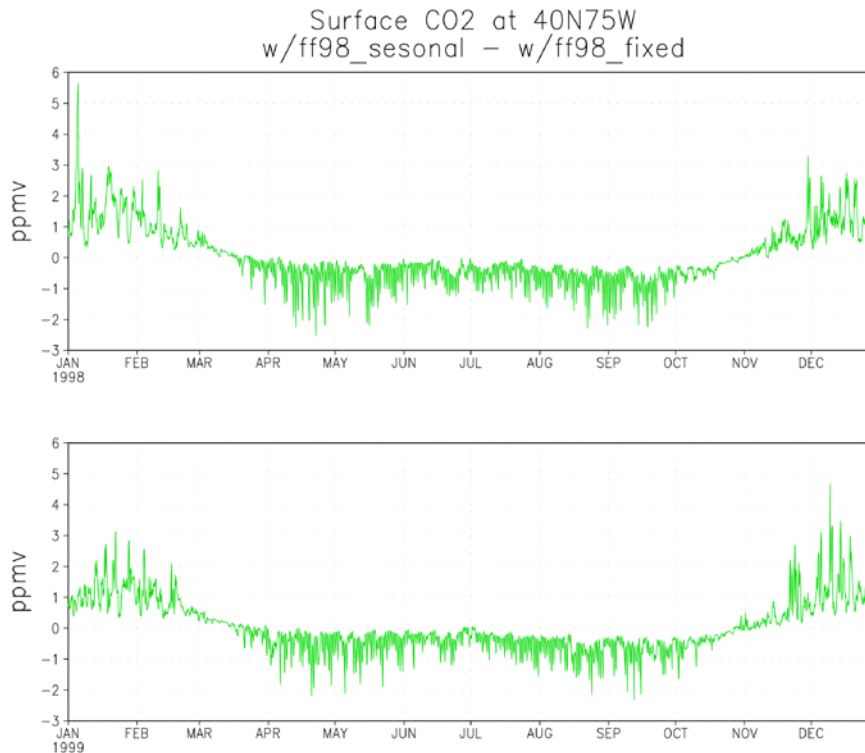
**Climate and Earth System Modeling PI meeting
Washington, DC**

Sep. 21, 2011

Carbon cycle simulations with monthly varying anthropogenic (FF) CO₂ fluxes

1) Initial FF CO₂ simulation with just FF
in CAM (1850-2008)

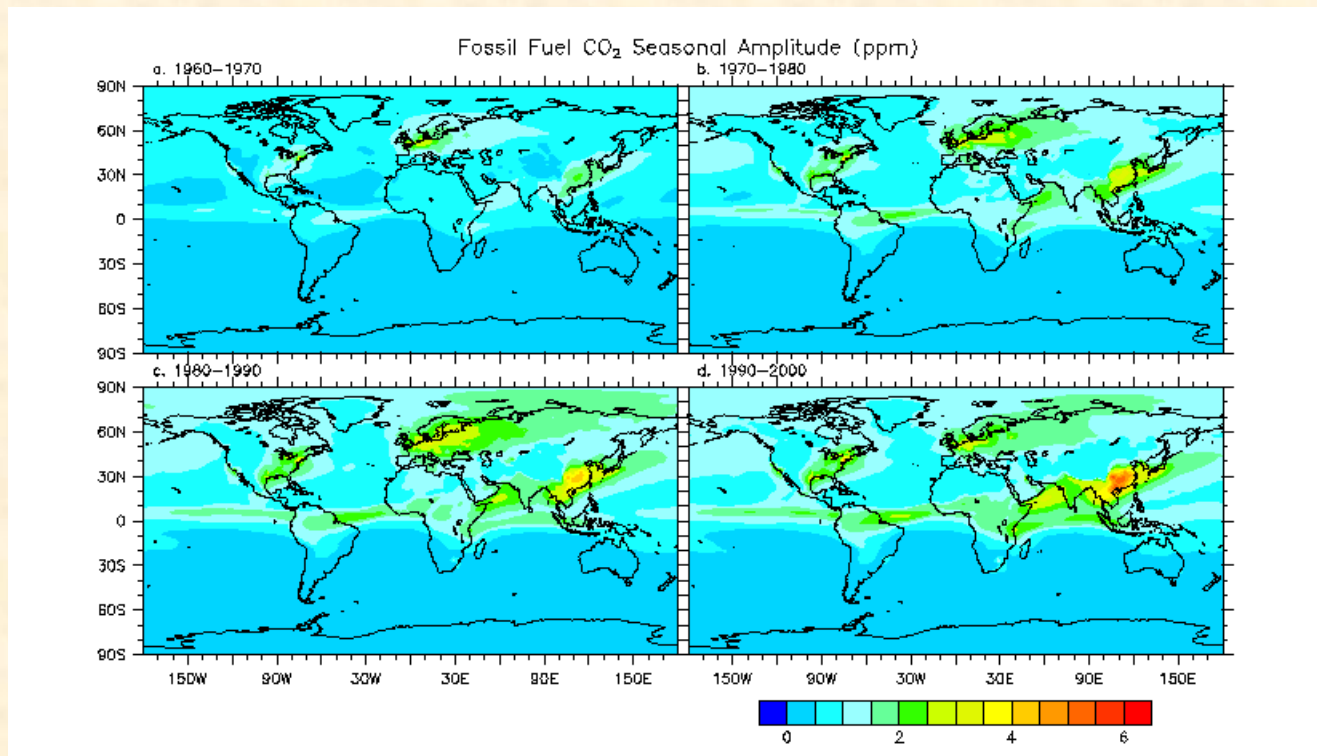
2) AR5 fully coupled with CN, ocean
and monthly FF CO₂

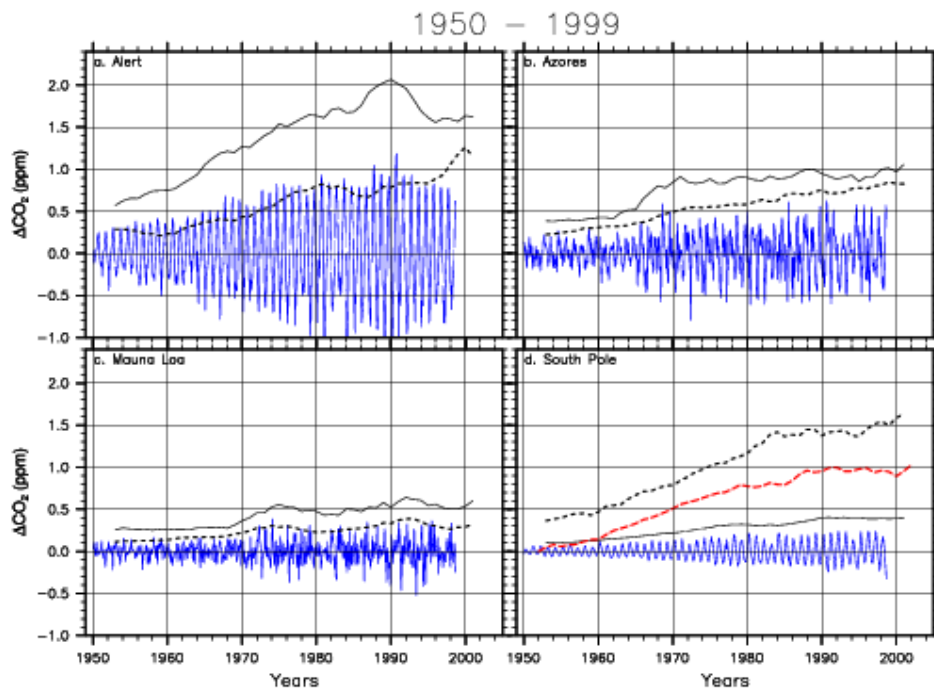


The difference between the atmospheric CO₂ concentrations computed with an annual mean CO₂ flux and the monthly resolved fluxes computed as above for a location at 40N, 75W and at 52N, 8W. Note the seasonality of the deviations from the general trend of concentrations.

Erickson, D. J., III, R. T. Mills, J. Gregg, T. J. Blasing, F. M. Hoffman, R. J. Andres, M. Devries, Z. Zhu, and S. R. Kawa (2008), "An estimate of monthly global emissions of anthropogenic CO₂: Impact on the seasonal cycle of atmospheric CO₂", *J. Geophys. Res.*, 113, G01023, doi:10.1029/2007JG000435, (2008).

Amplitude of atmospheric CO₂ tracer (CAM4.7) due only to monthly anthropogenic CO₂





Amplitude of atmospheric CO₂ due to
monthly varying anthropogenic CO₂
emissions

Earth System Modeling (ESM)/ Carbon Cycle/SCIDAC Conclusions

Seasonality on anthropogenic CO₂ emissions can contribute 5-40% of measured amplitude on atmospheric CO₂

Amplitude of fossil fuel CO₂ emissions and atmospheric concentrations has been increasing 1950-2010

Preliminary AR5 analysis is consistent

Implications for inversions seeking source/sink estimates (Carbontracker)

Implications for validating terrestrial biosphere models to observed CO₂ seasonal cycles

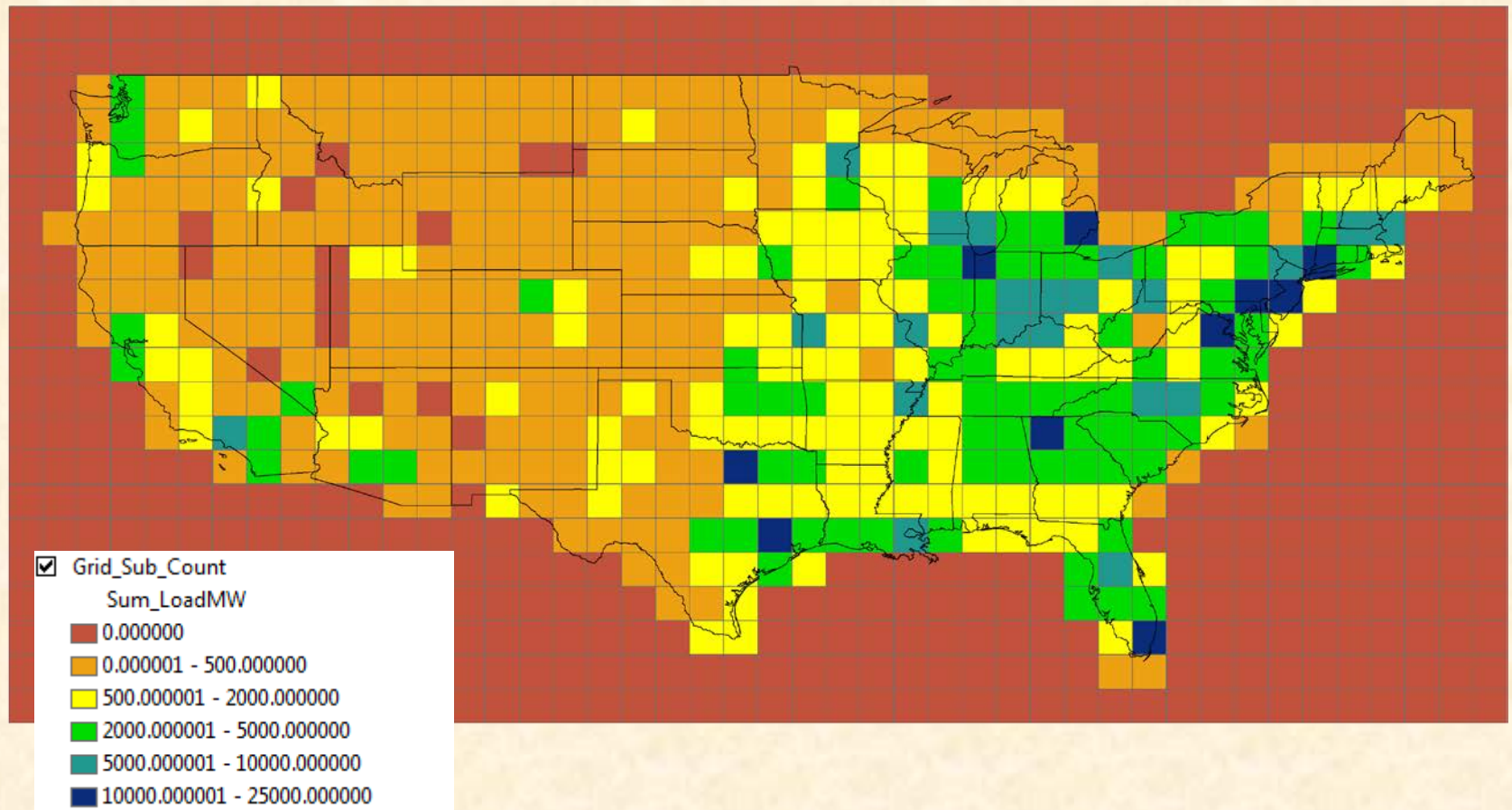
The more...

- **Climate/carbon induced feedbacks on energy demand**
- **Climate extremes prediction**
- **Quantitative energy portfolio evaluation**

Climate change impacts on Energy Infrastructure

- **26,500 electric sub-stations, 6,000 power plants (T85 grid at the moment....)**
- **Ensembles of heat waves 2000-2050-2100**
- **Populations shifts/coal-oil supply**
- **How do energy requirements change?**
- **How would different energy generation portfolios alter energy requirements and CO₂ emission?**

Total Substations Capacity per Climate Grid (MW)

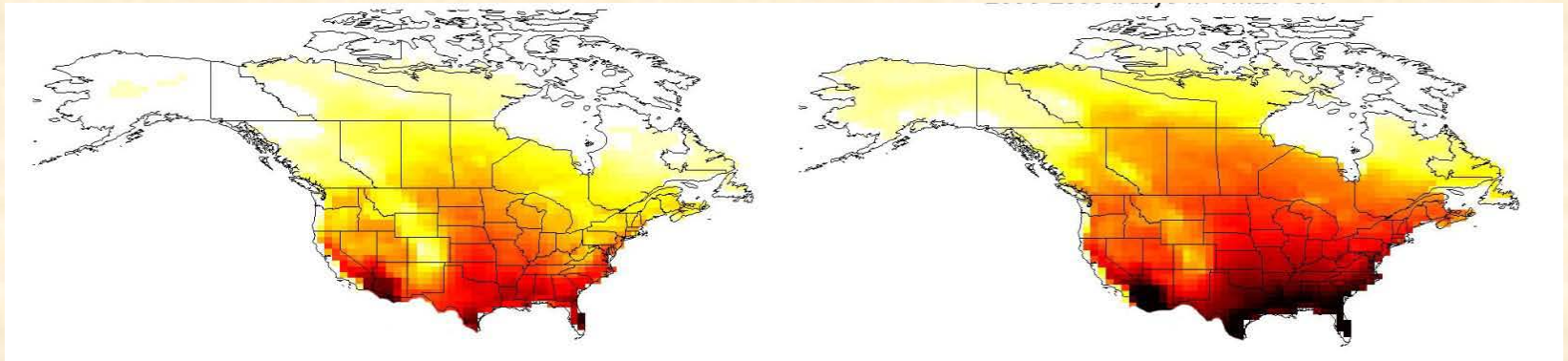


Number of days greater than 80°F (A) and greater than 100°F (B)

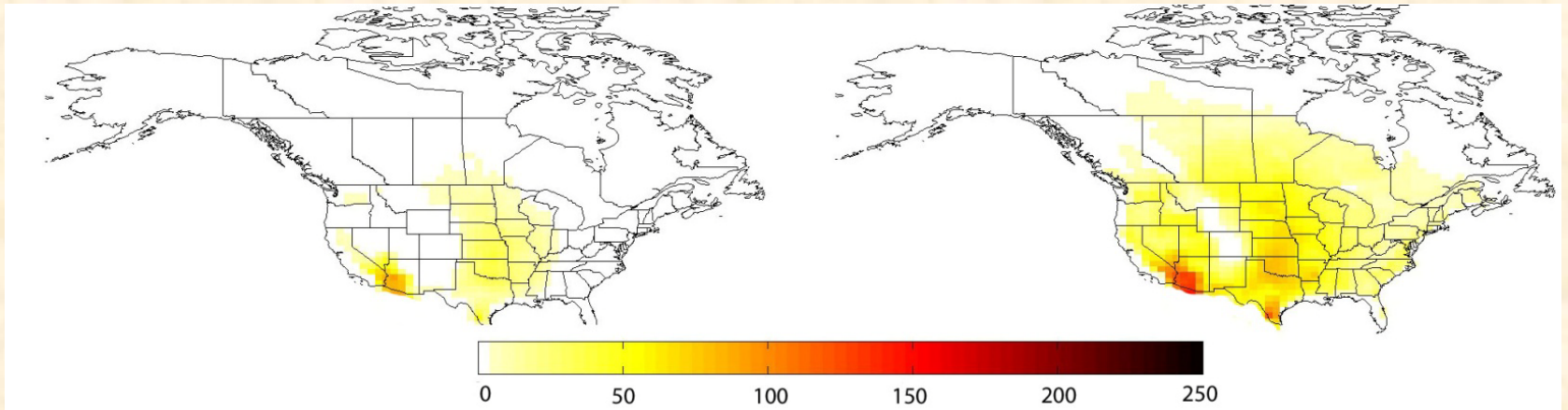
2000

2050

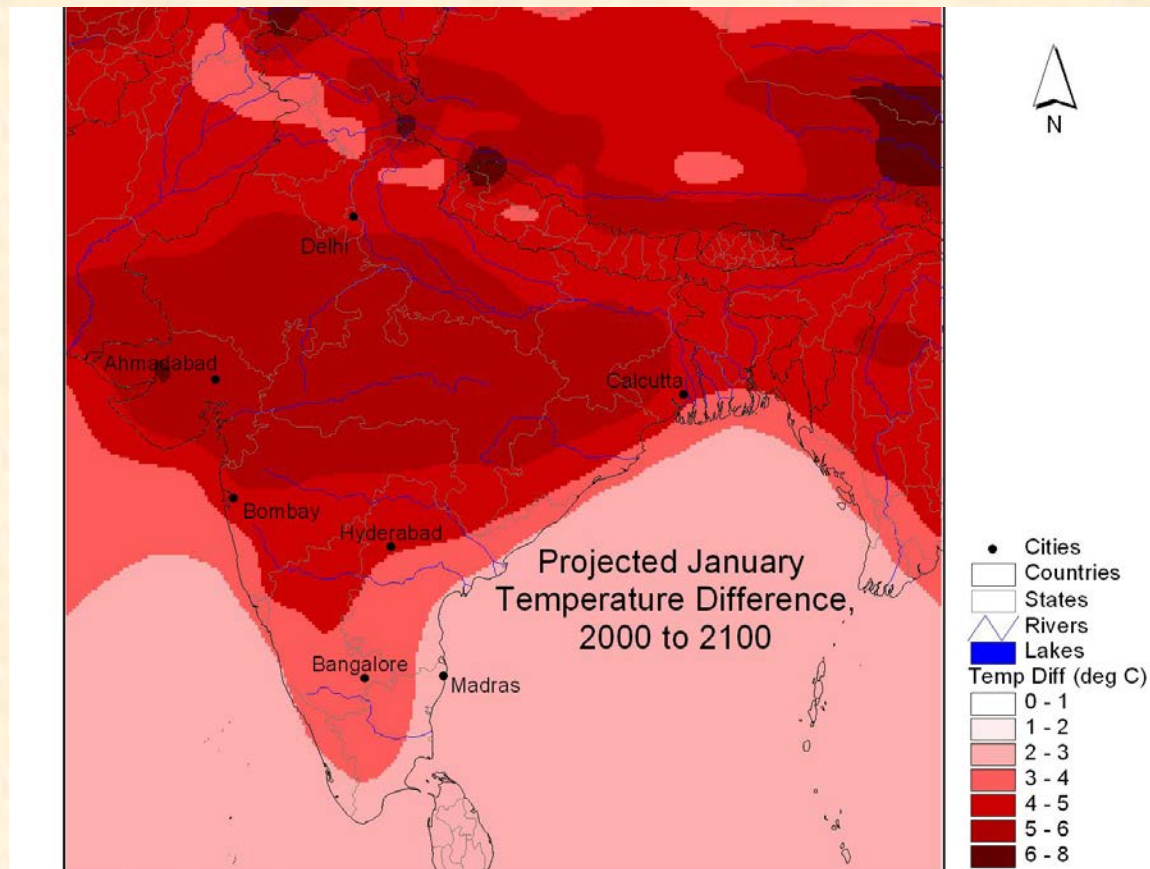
A



B

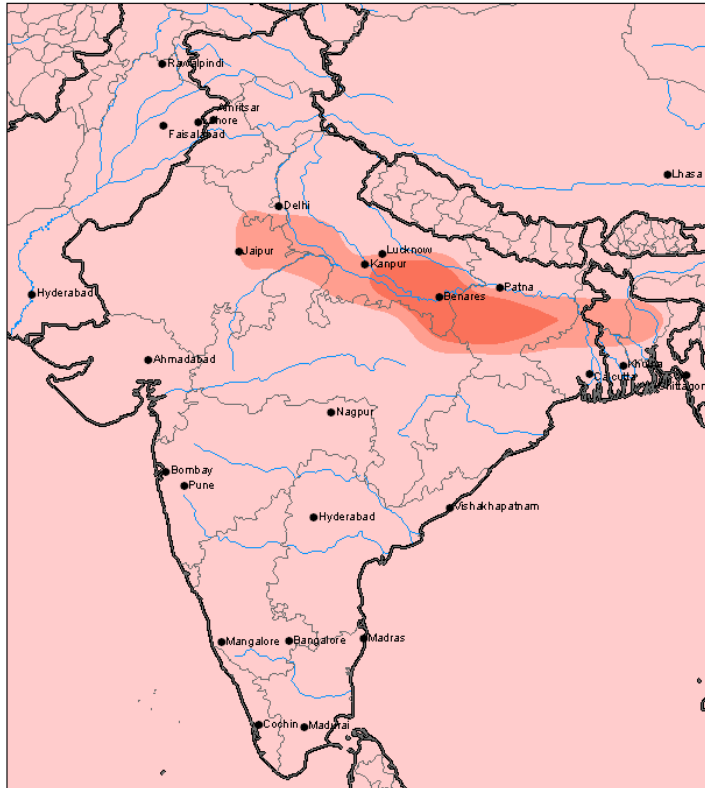


0 50 100 150 200 250



Ganguly, A. R., K. Steinhaeuser, D. J. Erickson III, M. Branstetter, E. S. Parish, N. Singh, J. B. Drake, L. Buja, “Higher trends but larger uncertainty and geographic variability in 21st century temperature and heat waves”, *Proceedings of the National Academy of Sciences of the United States*, 10.1073/pnas.0904495106, 2009.

Extreme Temperature for July in India



“Energy demand as a function of climate tendencies/anthropogenic emissions” conclusions

- **Electric substations on a climate model grid (T85) for U.S. completed**
 - **Heat waves/higher moment statistical characteristics of climate change critical to energy demand prediction and planning**
- **Feedbacks between climate statistic tendencies and CO₂ impact atmospheric CO₂ fluxes/emissions and the fundamental understanding of the geophysical carbon cycle**

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