

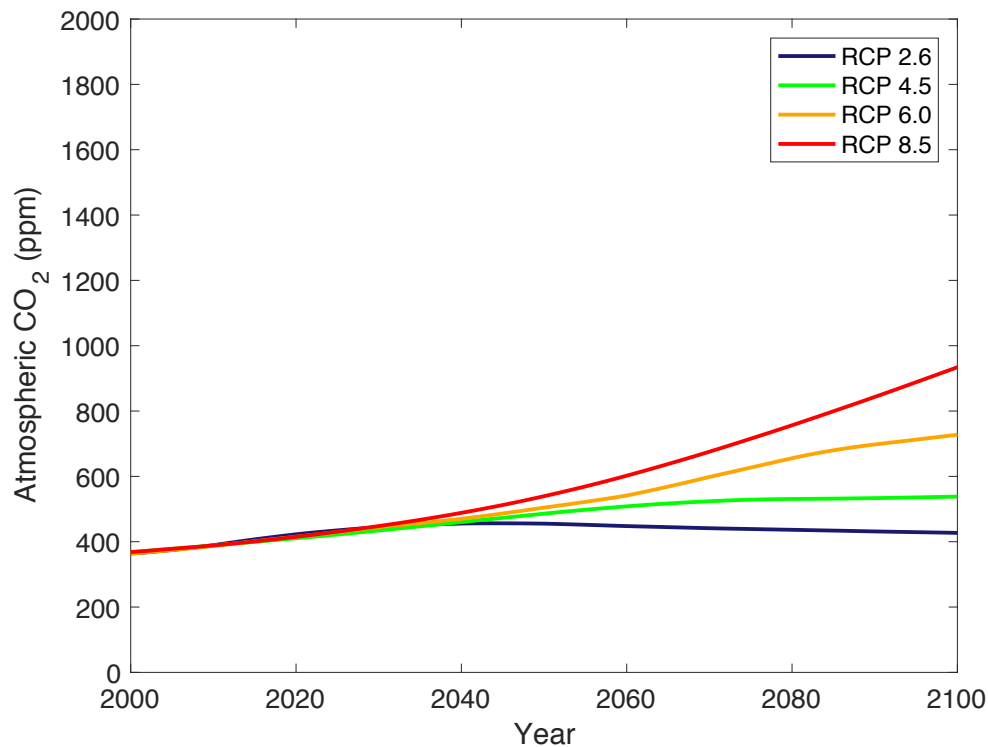
# Modeling transient climate events to approximate proxy records

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UC Riverside



HEISING - SIMONS  
FOUNDATION

# What about after 2100?

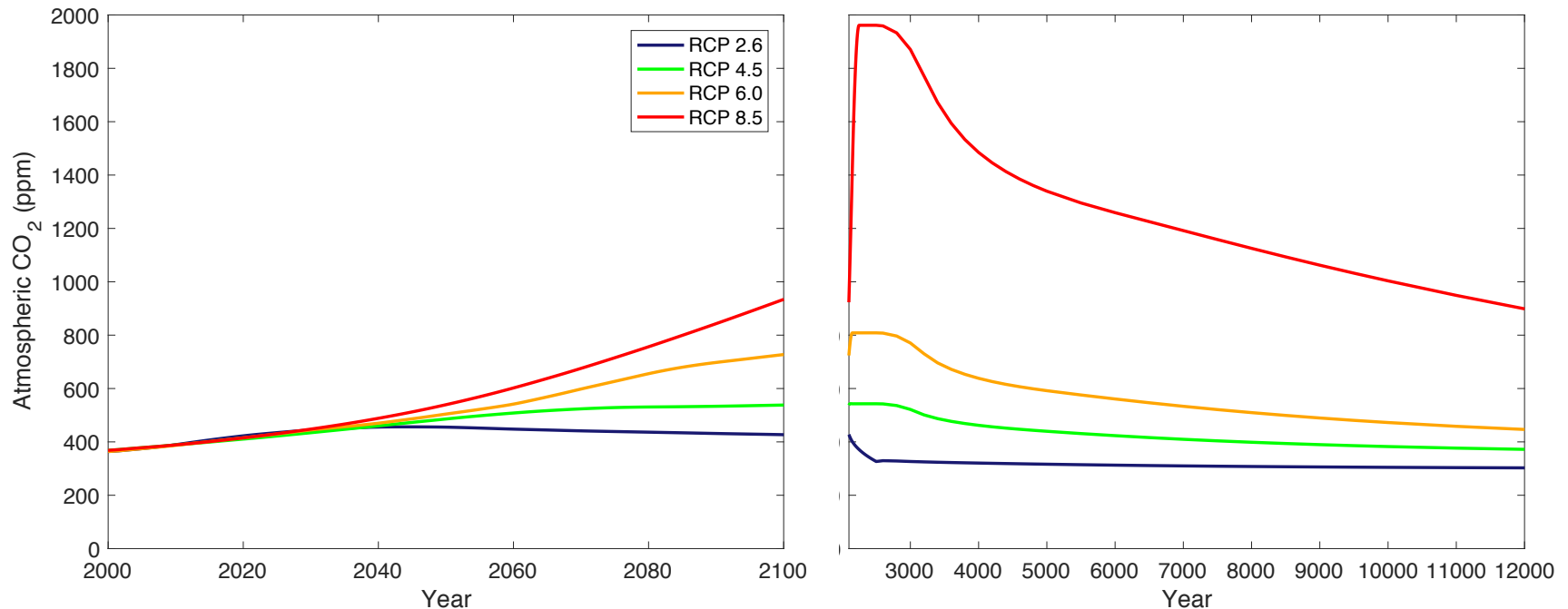


RCP =  
Representative  
Concentration  
Pathway

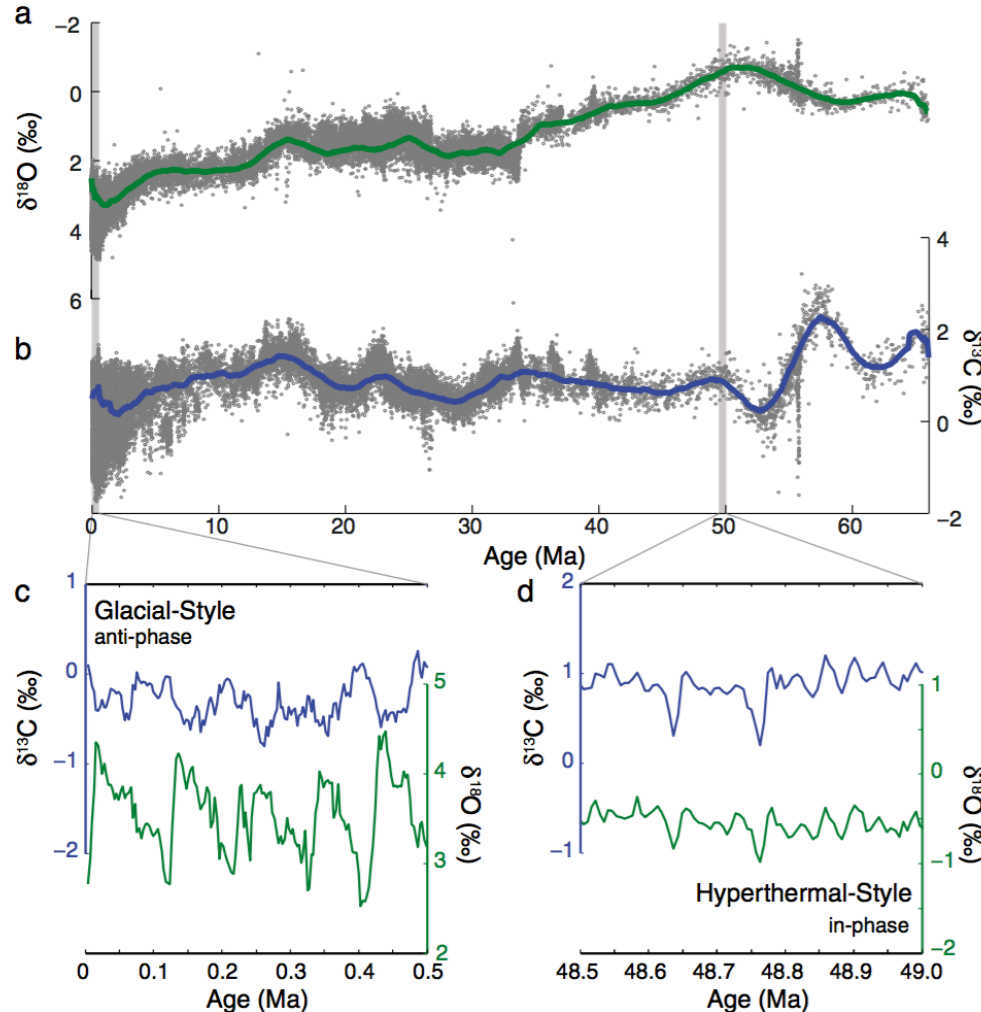
(possible  
futures)

# Long tail of atmospheric CO<sub>2</sub>

cGENIE model results for atmospheric CO<sub>2</sub> over the next 10,000 years



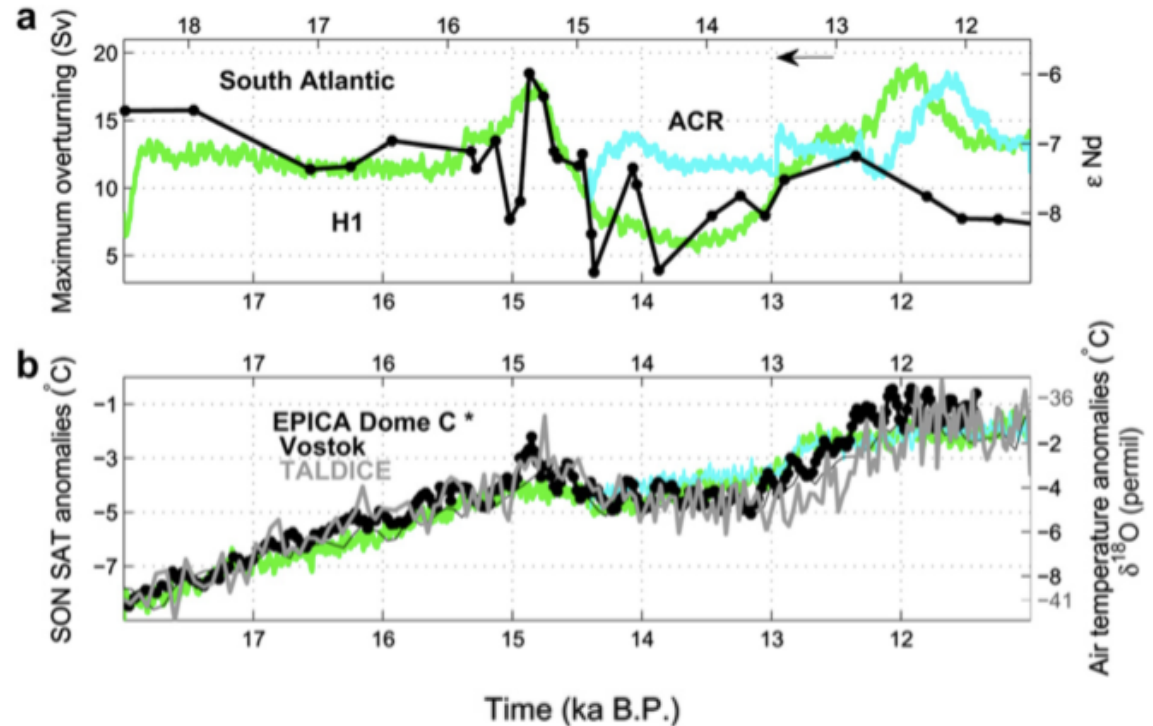
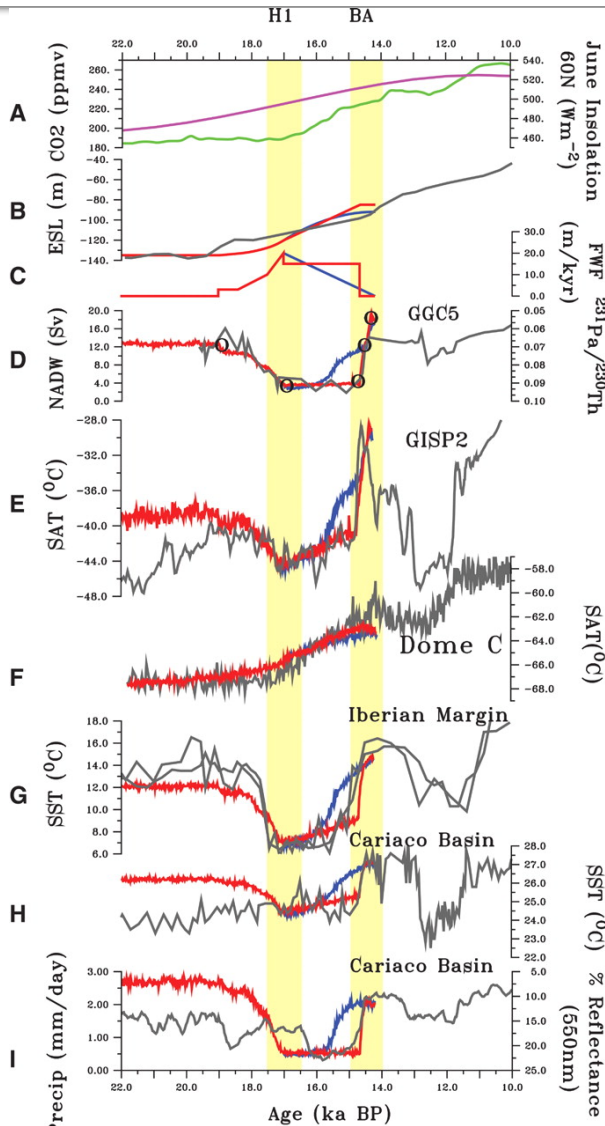
# Temporal variability in paleoclimate data



Orbital forcing of the climate is pervasive in proxy records across the Cenozoic but the amplitude and frequencies evolve

Comparison of glacial-interglacial cycles of the Pleistocene to hyperthermals of the Early Eocene

# Modeling transients: Deglaciation

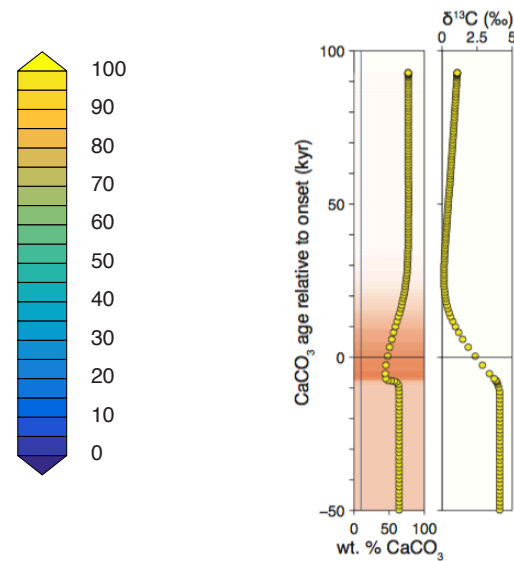
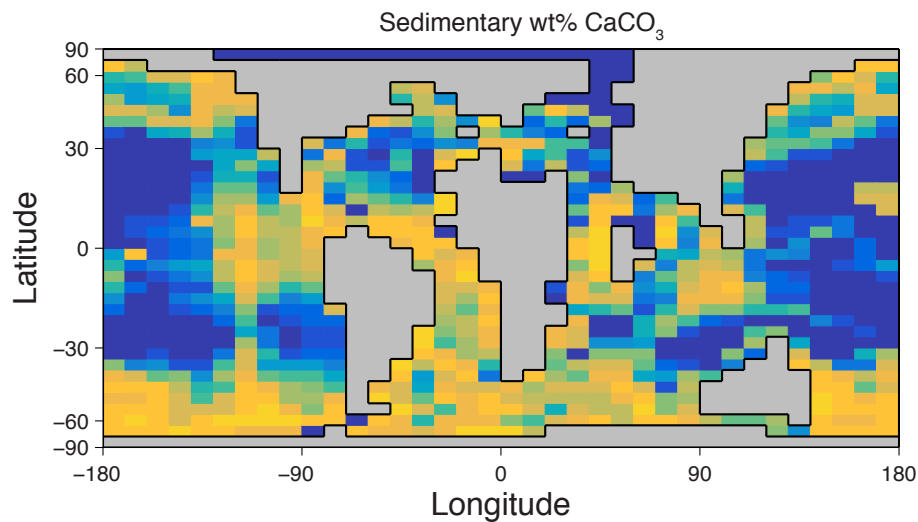
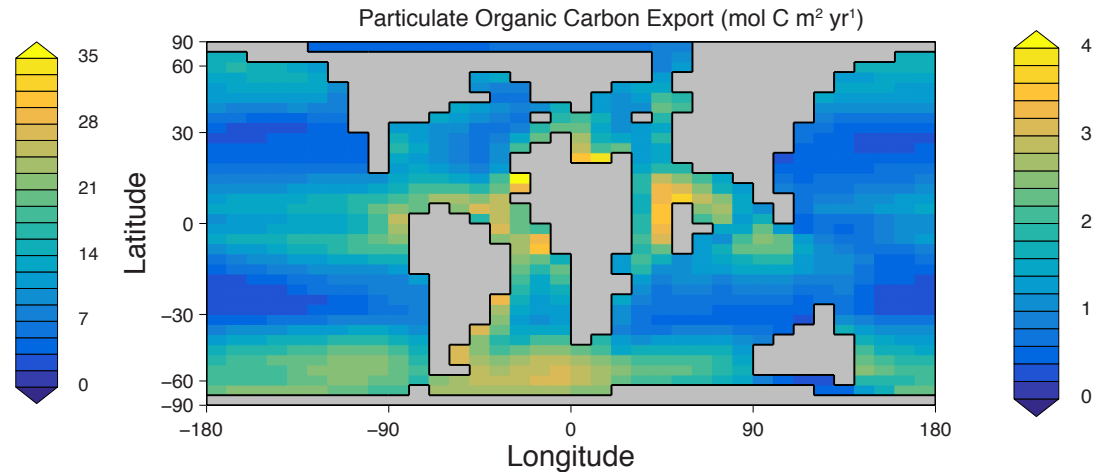
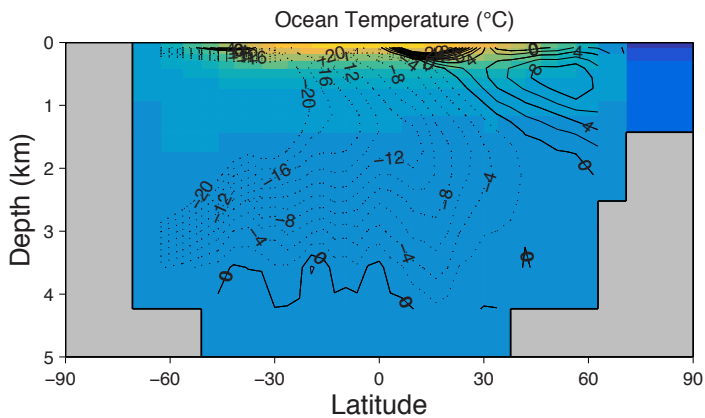


Menviel et al., 2011

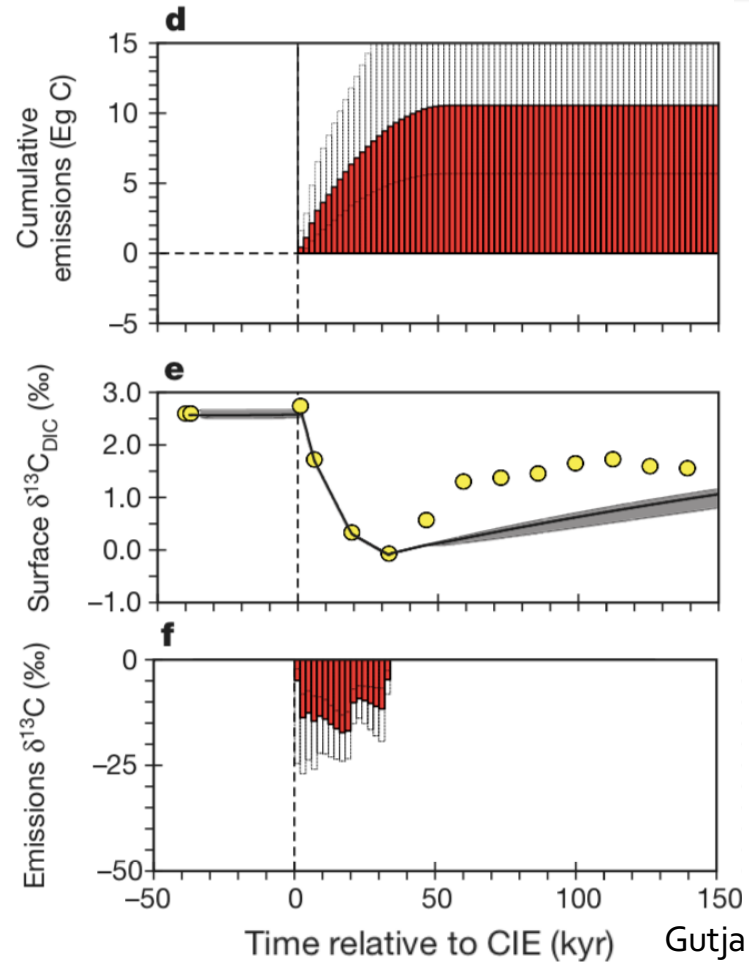
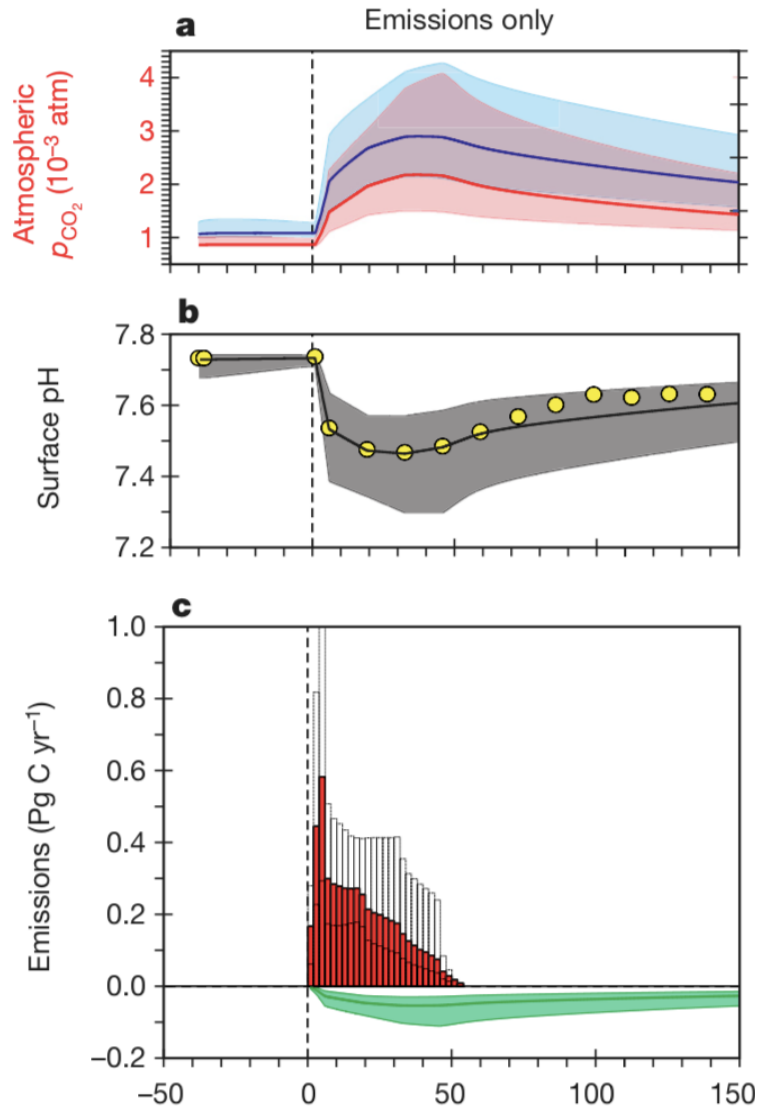
Simulations using CCSM<sub>3</sub> (left) and LOVECLIM (top)

Liu et al., 2009

# cGENIE model



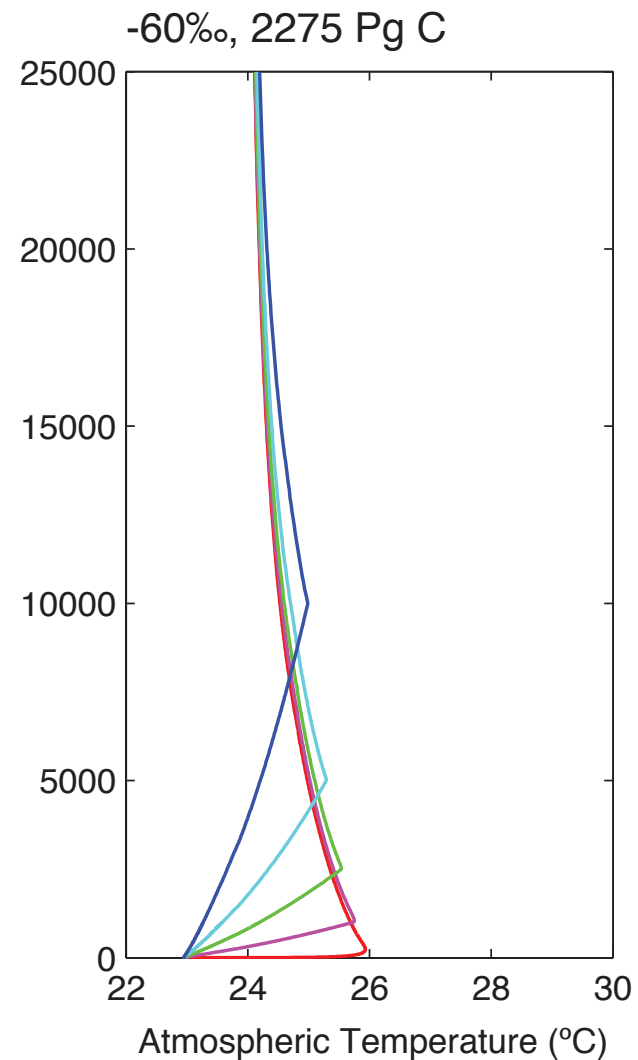
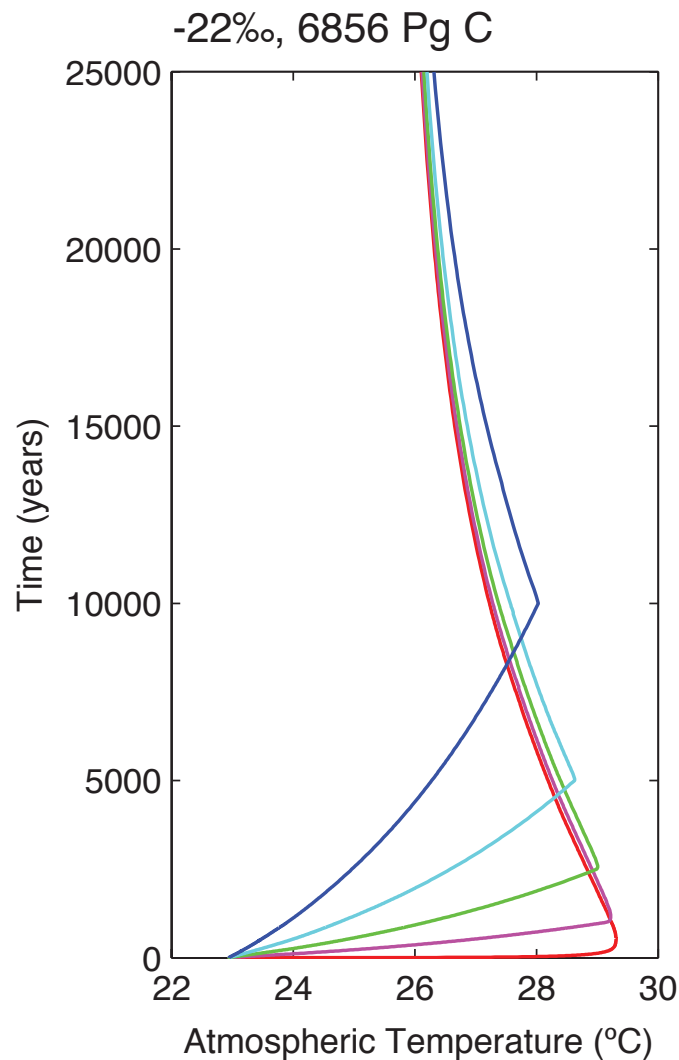
# Modeling transients: PETM



Gutjahr et al., 2017

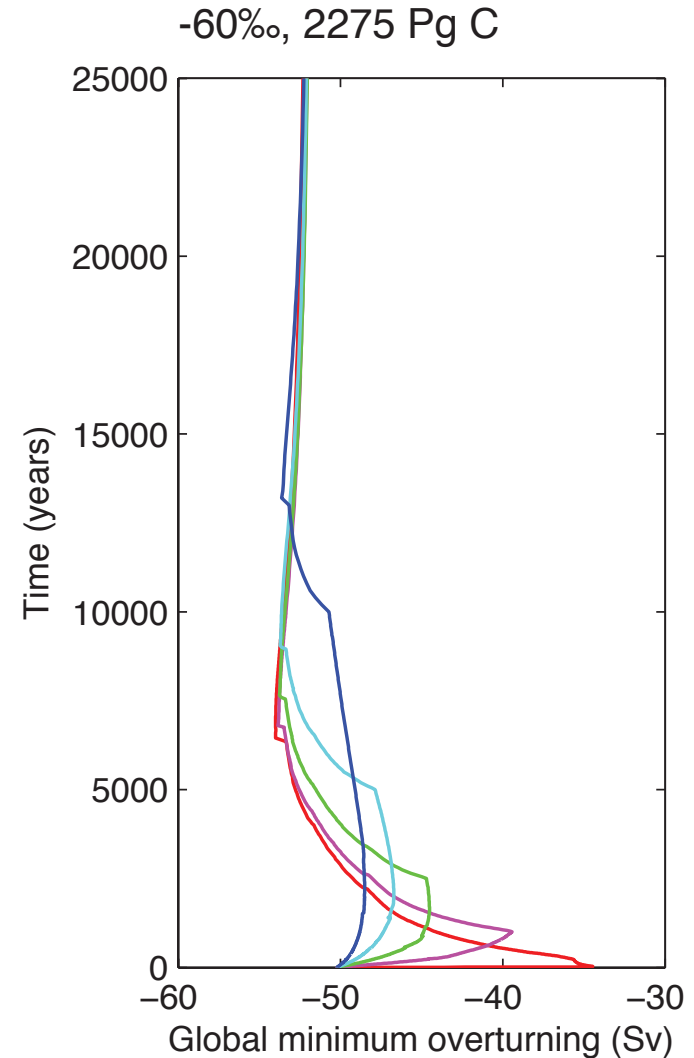
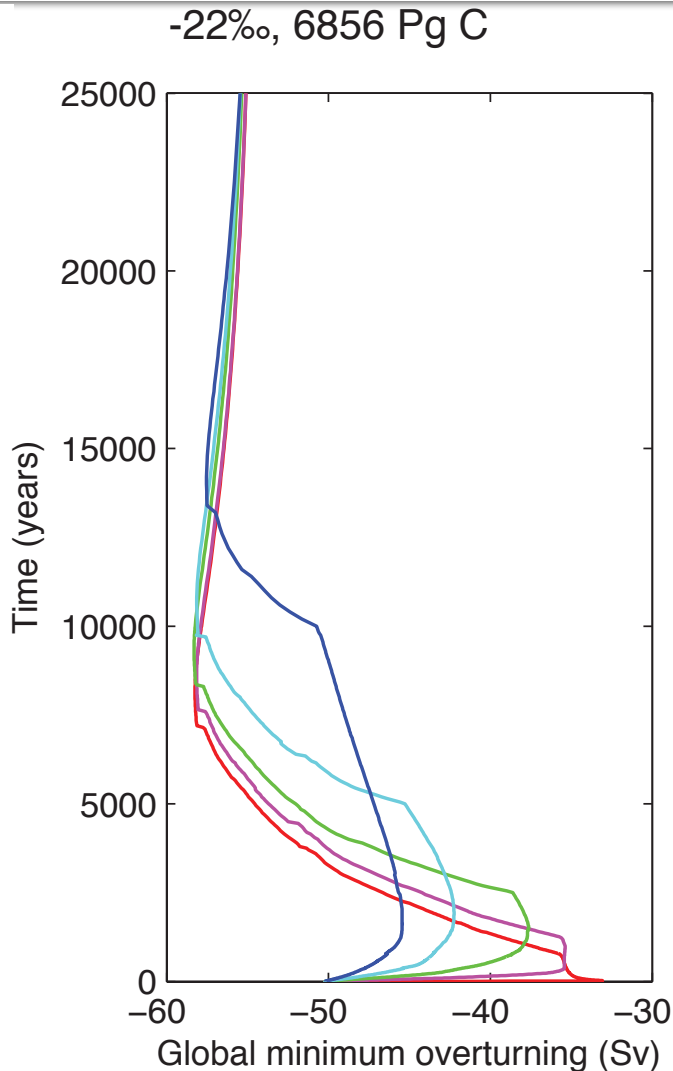
Simulation using cGENIE

# Sensitivity to timescale of forcing

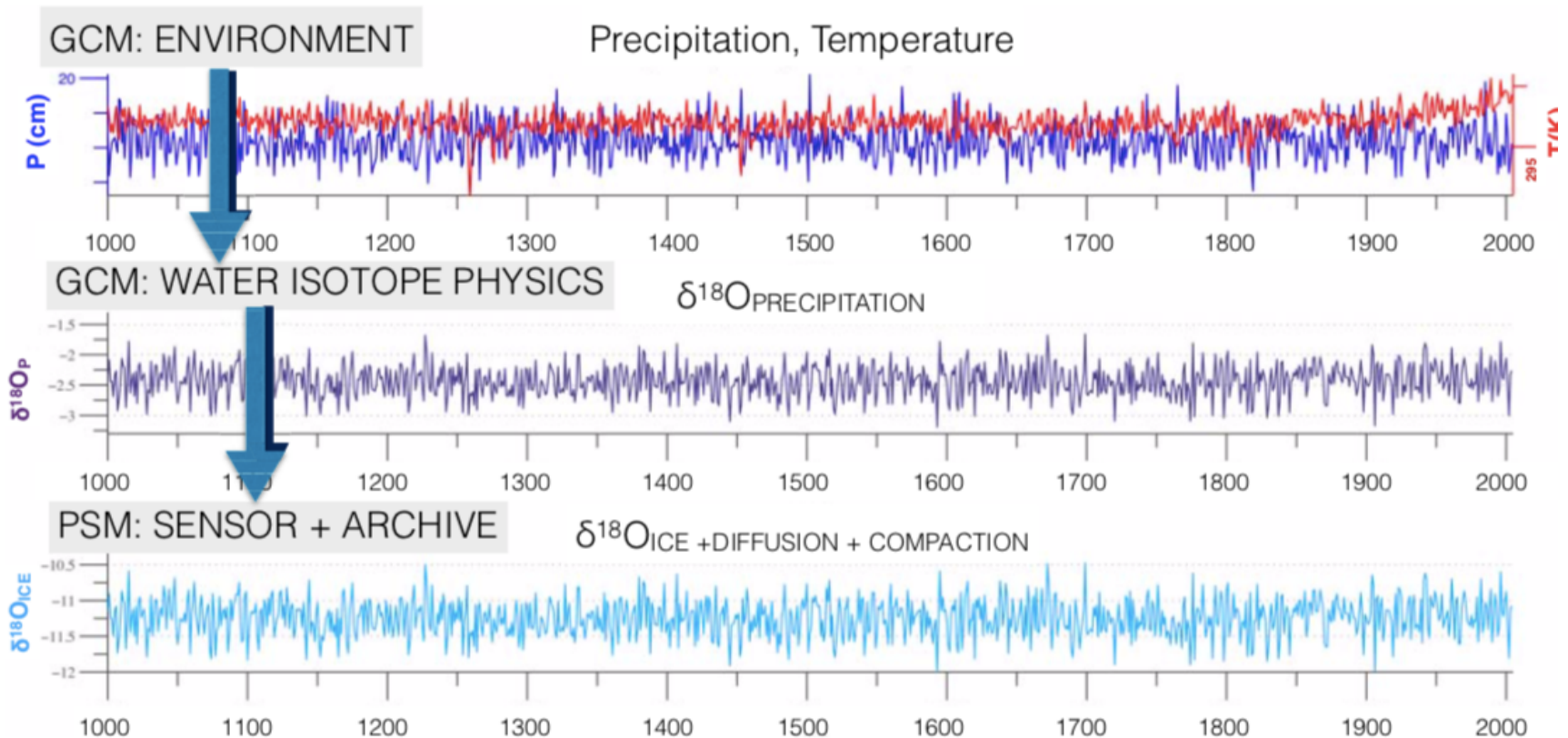




# Sensitivity to timescale of forcing

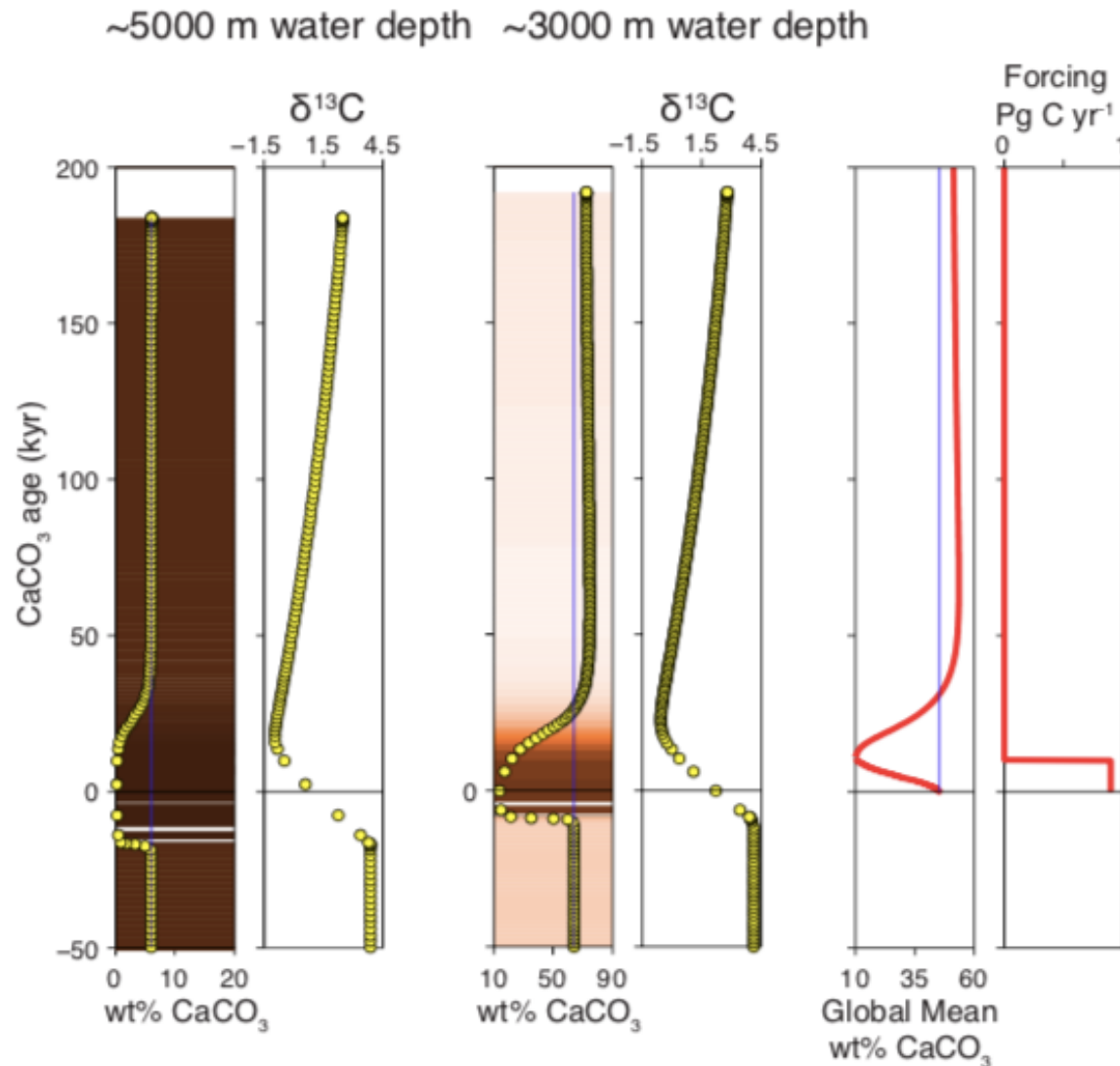


# Modeling archive formation



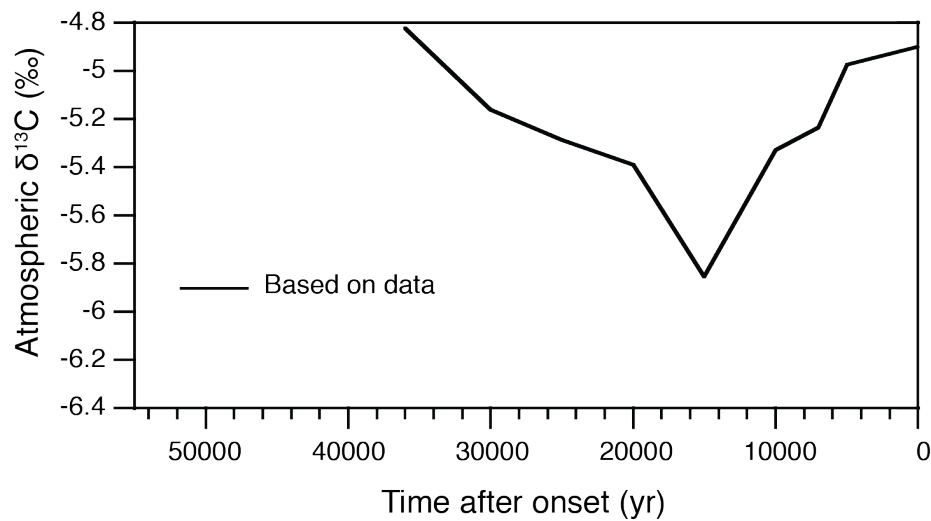
Dee et al., 2016

# Modeling the sedimentary record

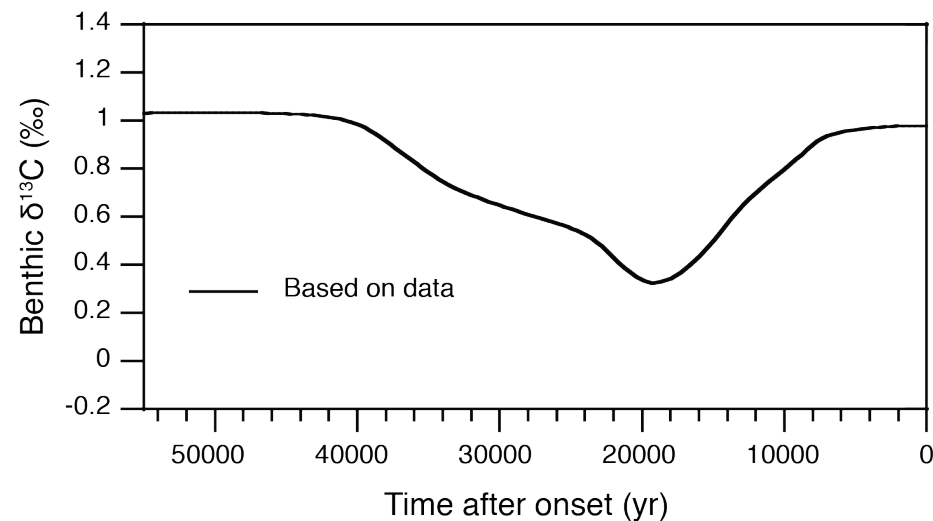


# Modeling the sedimentary record

## Applied atmospheric forcing



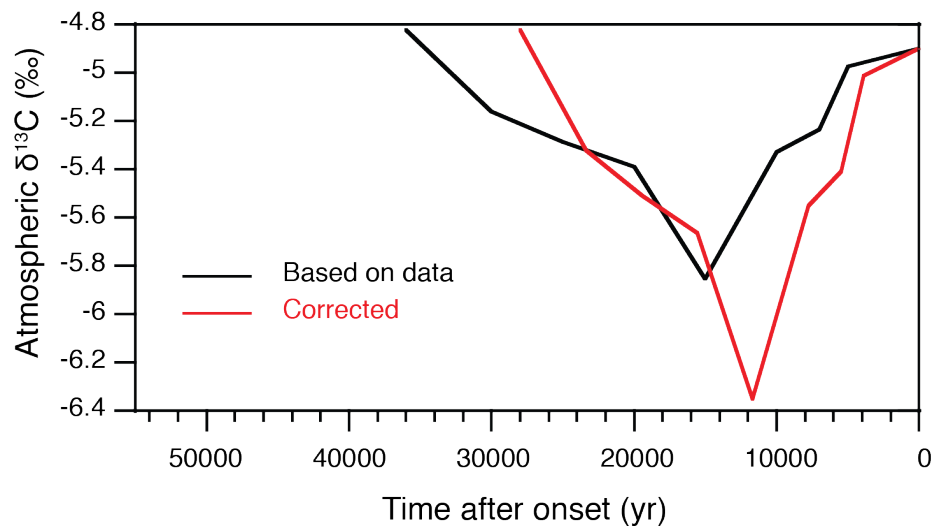
## Modeled sediment response



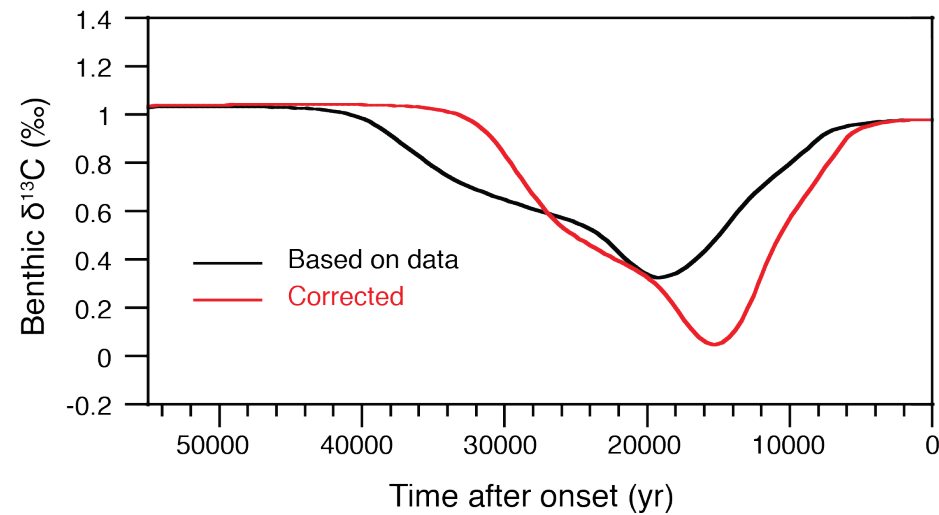
Example: modeling an Early Eocene hyperthermal based on a benthic foraminiferal record

# Modeling the sedimentary record

## Corrected atmospheric forcing

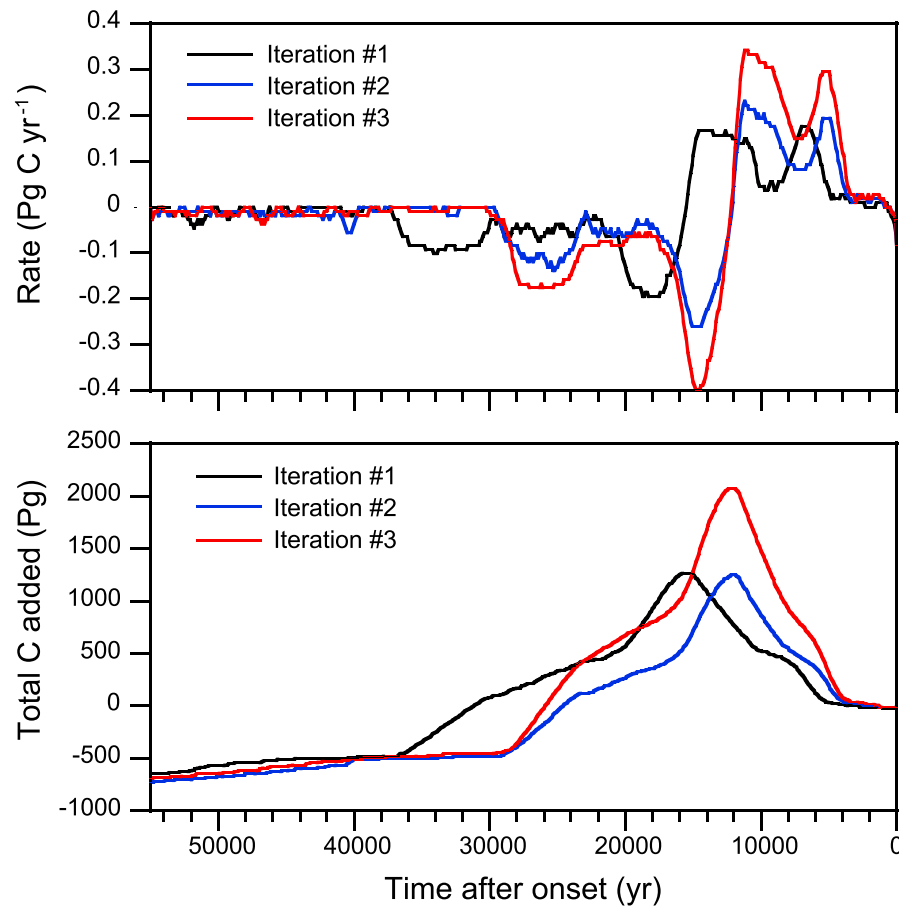


## Modeled sediment response



Method: use the model-data difference to correct the model forcing

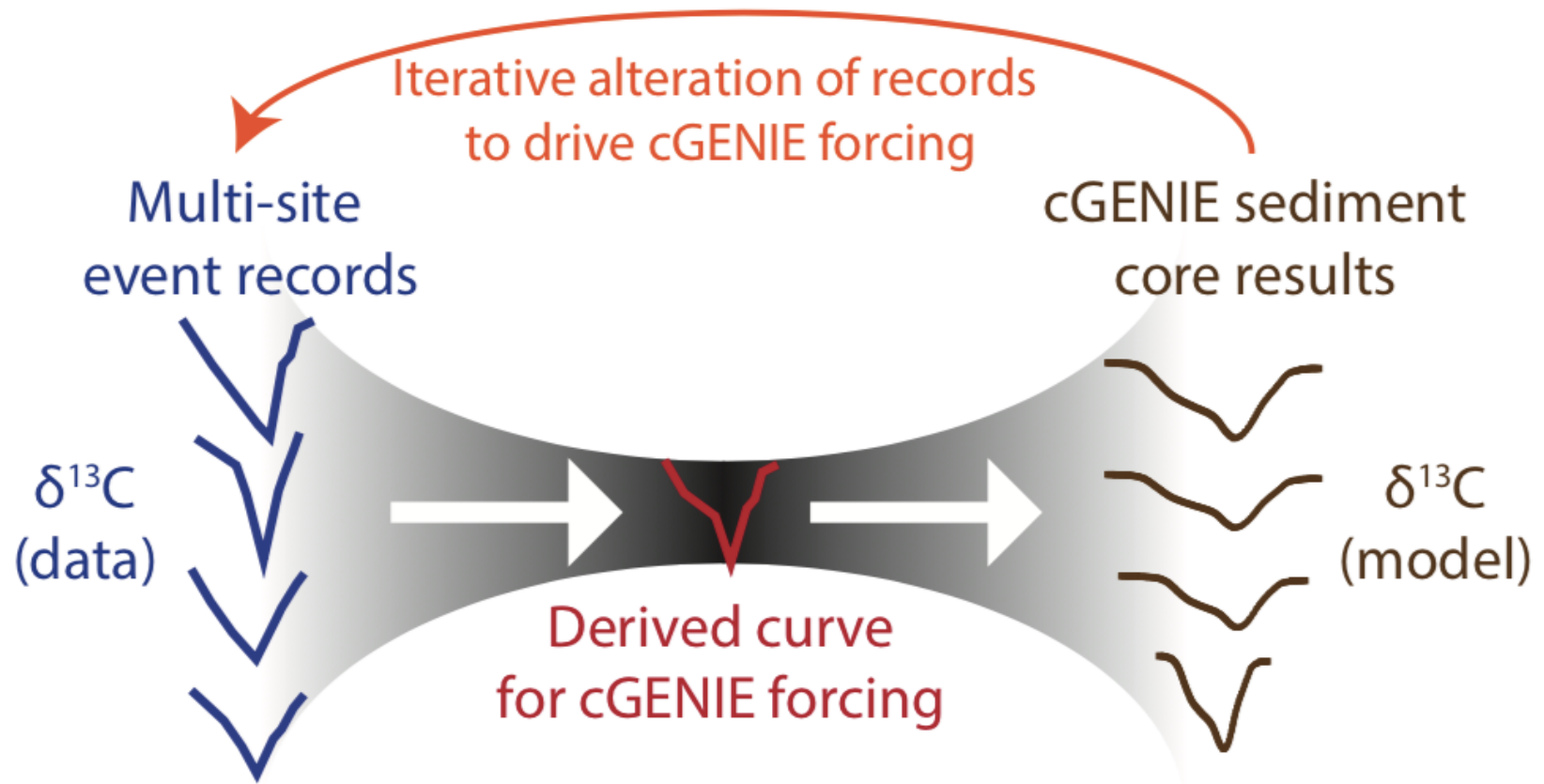
# Modeling the sedimentary record



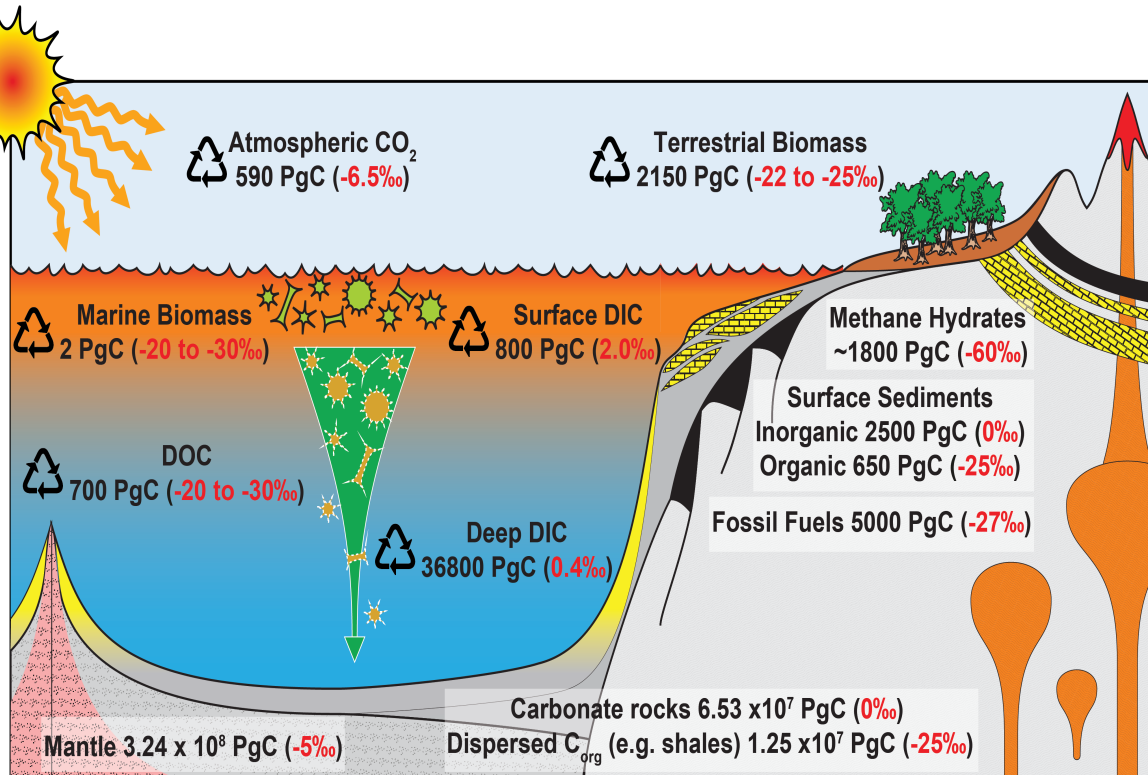
Result:

The larger amplitude and shorter duration of the corrected forcing leads to greater mass and flux of required carbon input

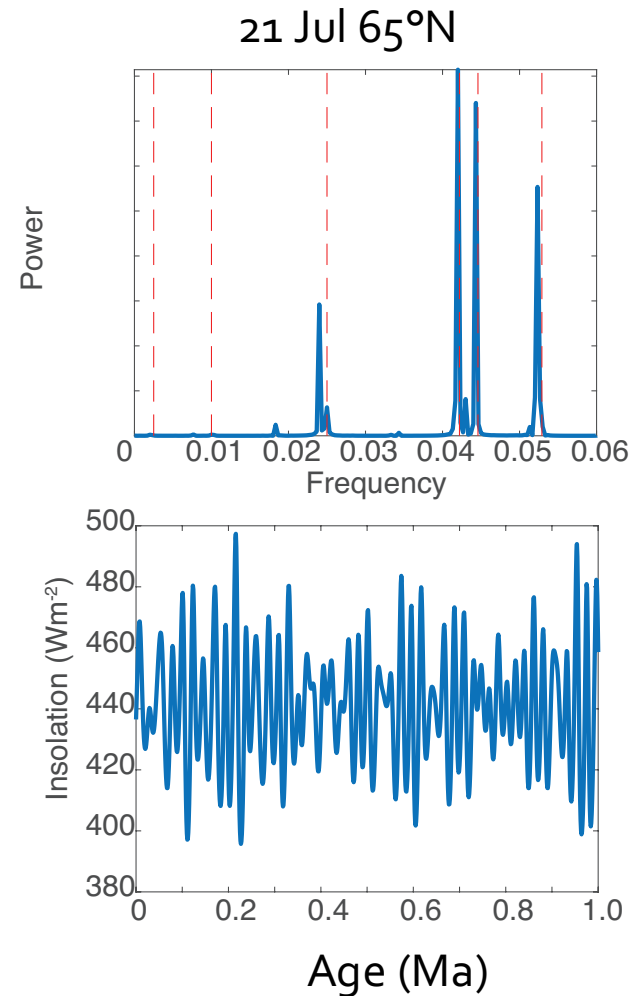
# Transient modeling strategy



# What else is missing?



Adapted from Hönlisch et al., 2012





# Questions

- What is the most effective way to combine results from steady state and transient simulations?
- What critical processes and/or systems are we missing from models to simulate paleo-data?
- What is the most useful way to combine results from models with varying degrees of complexity?