Proxy System Modeling:
Characterizing Uncertainty in Proxy Records
Climate Data-Model Integration

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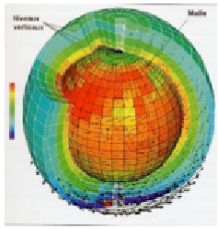
Climate Models

PMIP3, PMIP4
CCSM3 (TRACE)
LOVECLIM
FAMOUS

input: BCs, ICs

model:



output: $T, P, q, \vec{u}$

Lake Proxy System Model

Environment Model

- Lake Energy Balance
  - Temperature Profile
  - Seasonality
  - Mixing

Sensor Model

- Proxy - Temperature response
- Calibration Uncertainty

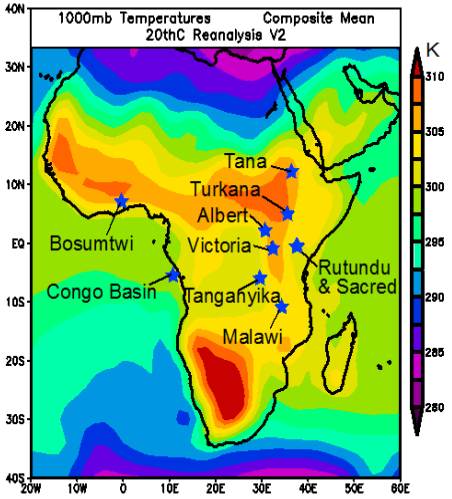
Archive Model

- Sedimentation
- Compaction
- Bioturbation (TURBO2)

Observation Model

- Chronological & Analytical Uncertainty
- BCHRON

Temperature Observations



brGDGTs, $\delta^{18}O$, δD_{wax},
multivariate response, dating errors
+ Proxy Response Uncertainties +

Used for:
Lake level, temperature, mixing, salinity, lake water and $CaCO_3$ isotopes (need isotope-enabled model), leaf wax dD (need isotopes + veg)
Flood deposits?

Inputs:
Climate-model-grade inputs of surface mass and energy fluxes
Lake characteristics and sed rate information

Value:
Characterize and quantify multiple sources of uncertainty of reconstruction (chronologic, proxy calibration, environmental and sedimentary modification of proxy)
Sensitivity testing of proxy to climate (perturbation experiments)
Data-model integration