

Cenozoic changes in the Indonesian Throughflow and their impact on global climate: first steps

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NCAR Community Climate System Model (CCSM3)

Atmosphere & Land Surface

- T42 (~2.8° lat-lon), 26 levels



Coupler



Ocean & Sea Ice

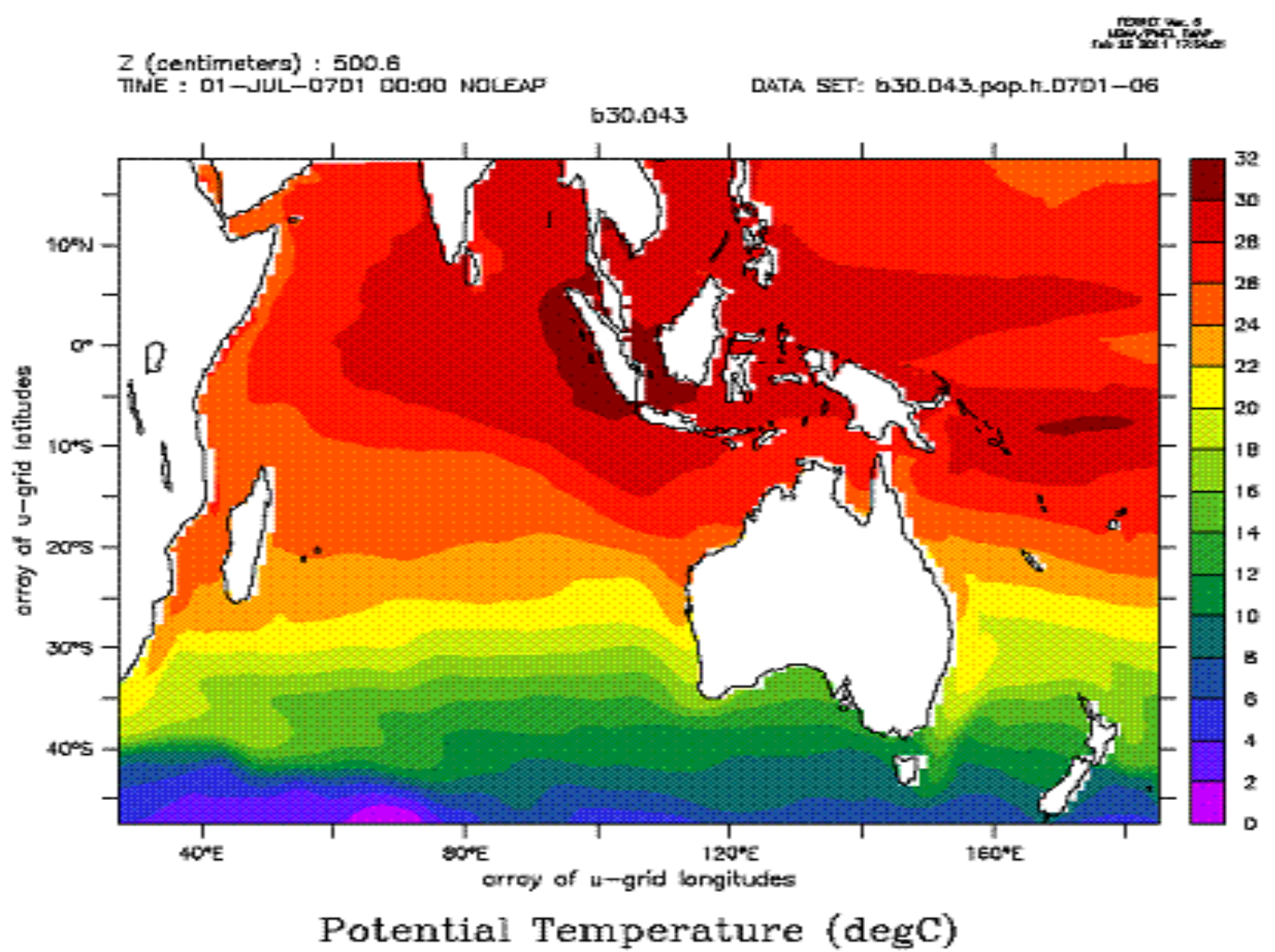
- longitudinal resolution: ~1°
- latitudinal resolution: $\leq 1^\circ$, 0.3° in the tropics (incl. ITF)
- vertical resolution: 40 levels, to 5.5 km depth



Ocean component: main output variables

- UVEL zonal velocity
- VVEL meridional velocity
- WVEL vertical velocity
- TEMP temperature
- SALT salinity
- PD density
- ROFF_F runoff flux
- PREC_F precipitation flux
- HMXL mixed-layer depth

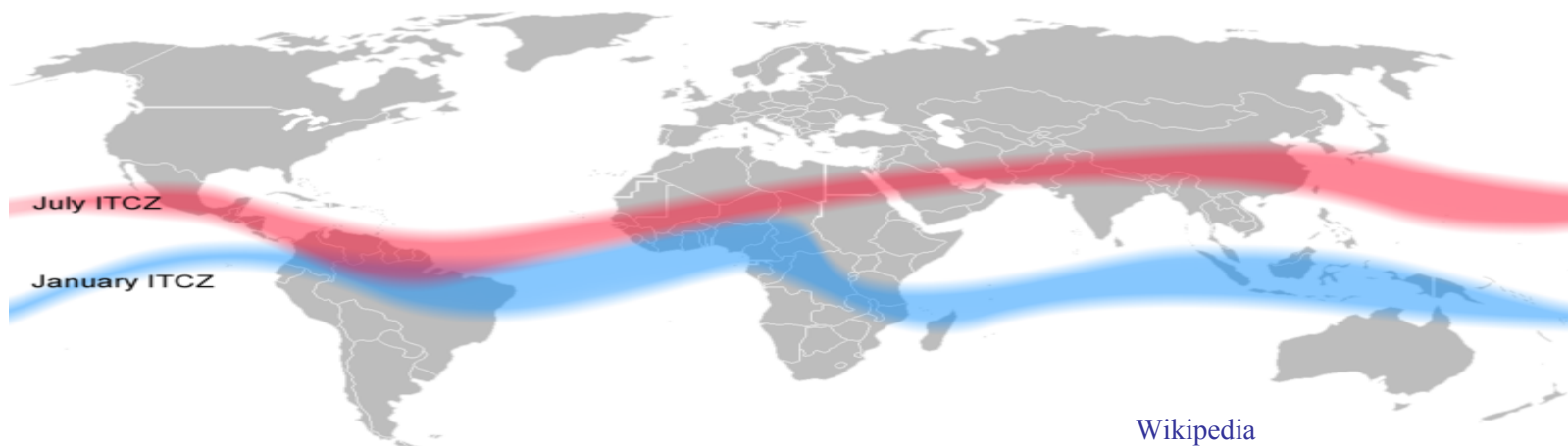
Sea Surface Temperature output (pre-industrial run)



Effects of glaciation on the tropical rain belt position

To test if increasing glaciation in Antarctica lead to a northward shift of the tropical rain belt in the ITCF region (Holbourn et al., 2010).

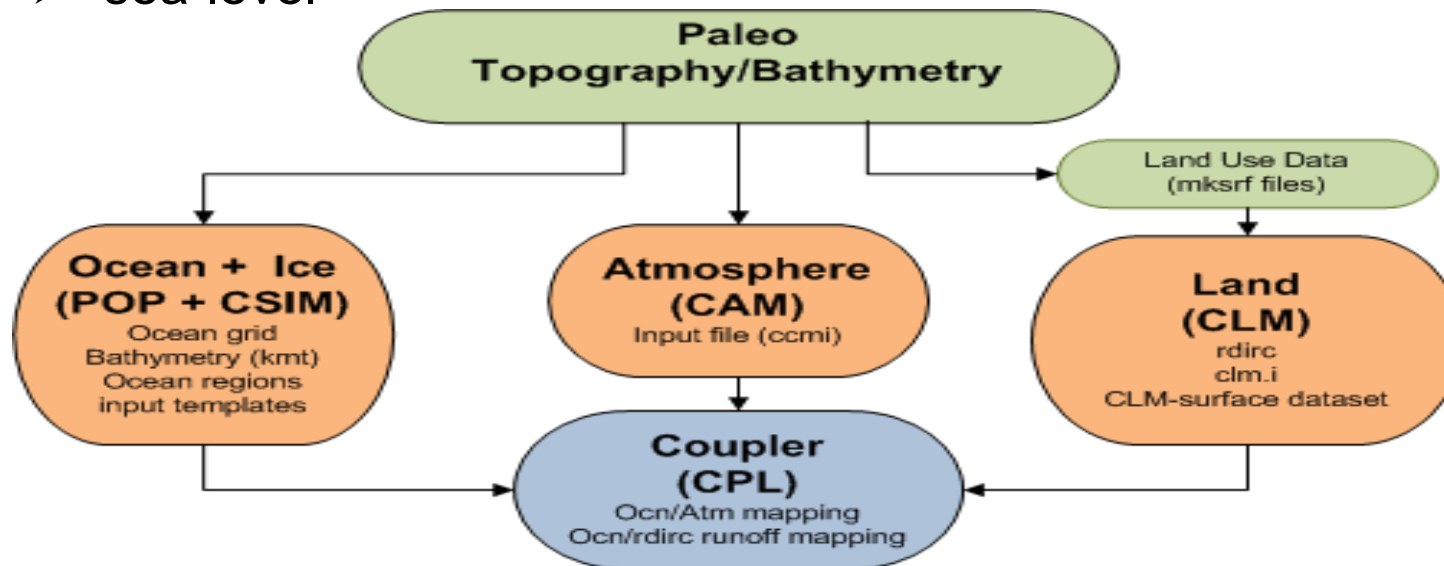
- CCSM experiment for 14 Ma with perturbations by prescribed Antarctic ice sheets of different volume and extent and different sea levels.
- Compare results with proxy data: especially salinity proxies.



Current work

Period: Middle-Miocene

- CCSM3 run with pre-industrial boundary conditions.
- Generating input files relative to 14 Ma:
 - global and local bathymetry (Hall and Gaina reconstructions)
 - global orography
 - ice-sheets
 - sea-level



Schematic of PaleoCCSM3 initial and forcing files. Green boxes represent user-provided topography, bathymetry, and land use files. Orange and blue boxes represent files generated using setup tools and guidance outlined in this document.

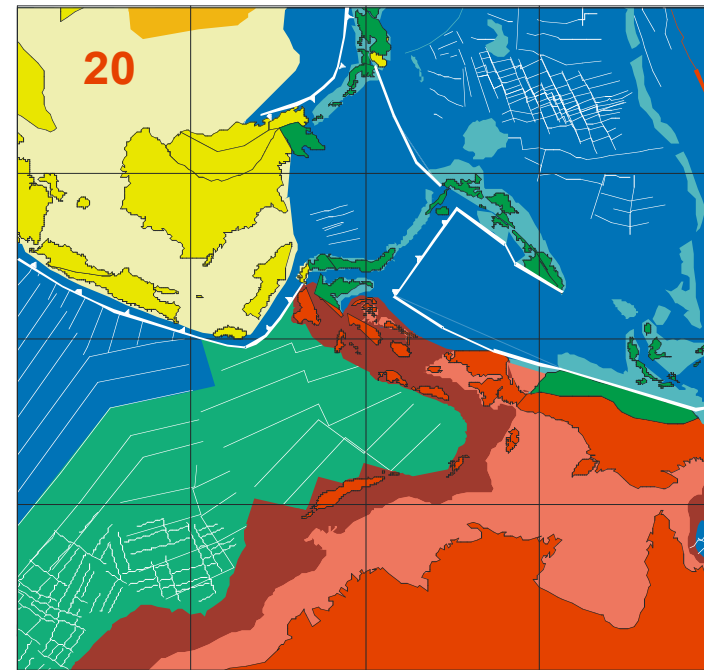
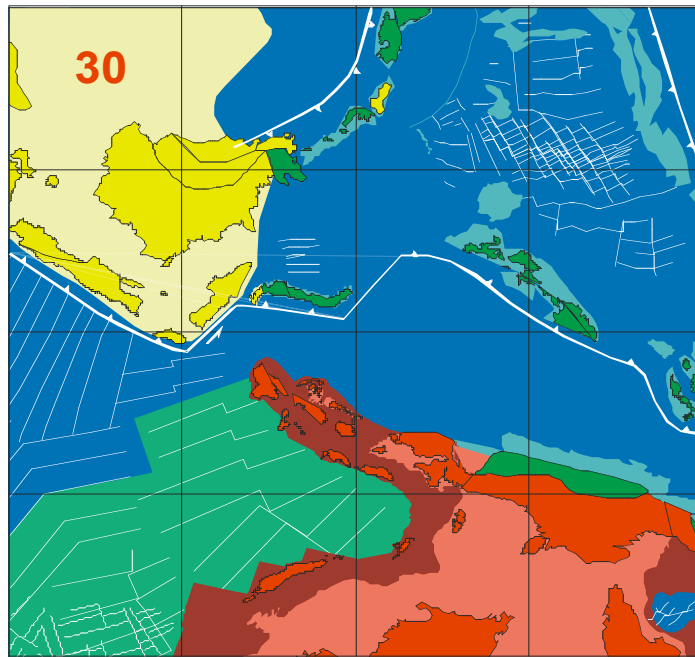
Figure extracted from "CCSM3 for paleoclimate applications" (NCAR)

Impact of the deep water passage closure (~25 Ma)

To test the impact on the ITF and global climate of the deep passage closure.

- Strategy: CCSM experiments for 30 and 20 Ma with realistic tectonic boundary conditions and fixed CO₂ concentration.

R. Hall,
NTA1, Royal Holloway 2010

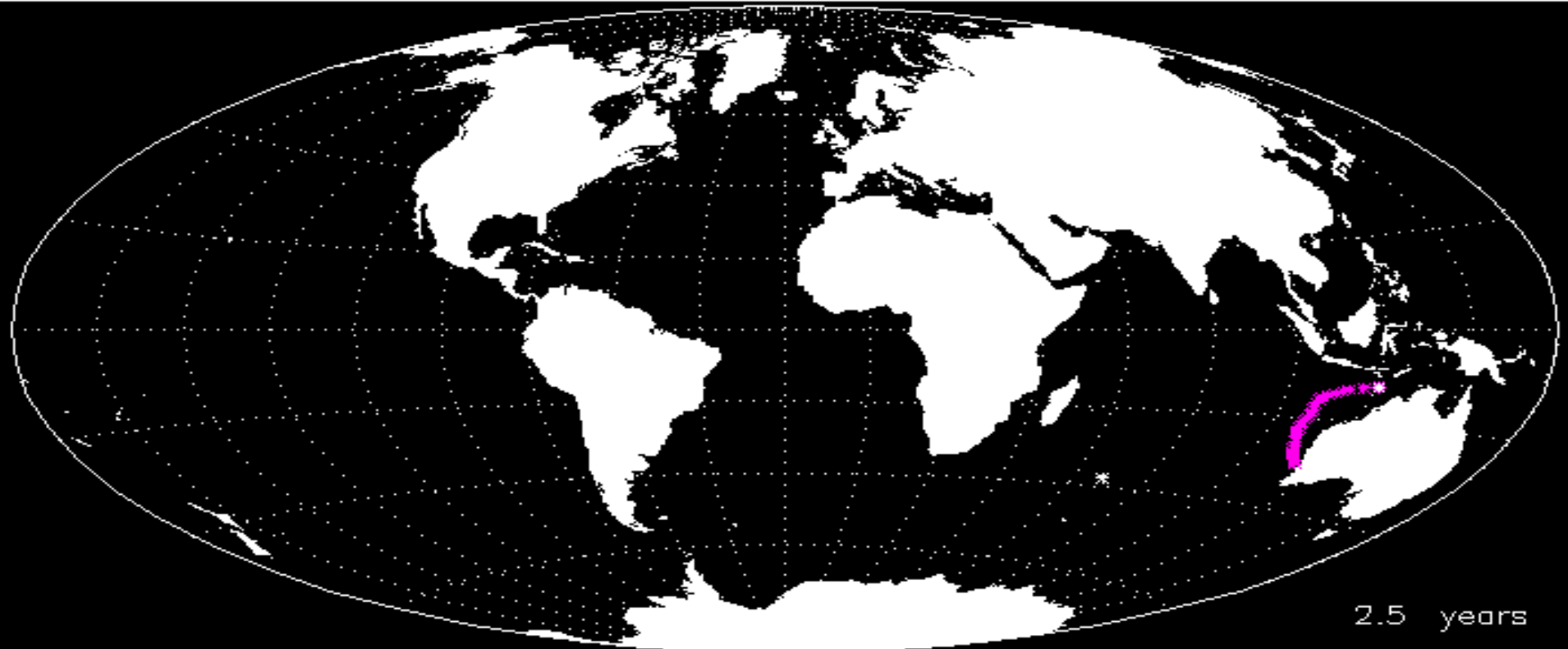


Ariane

Period: Oligocene and Miocene

"Global" trajectory in the OPA model

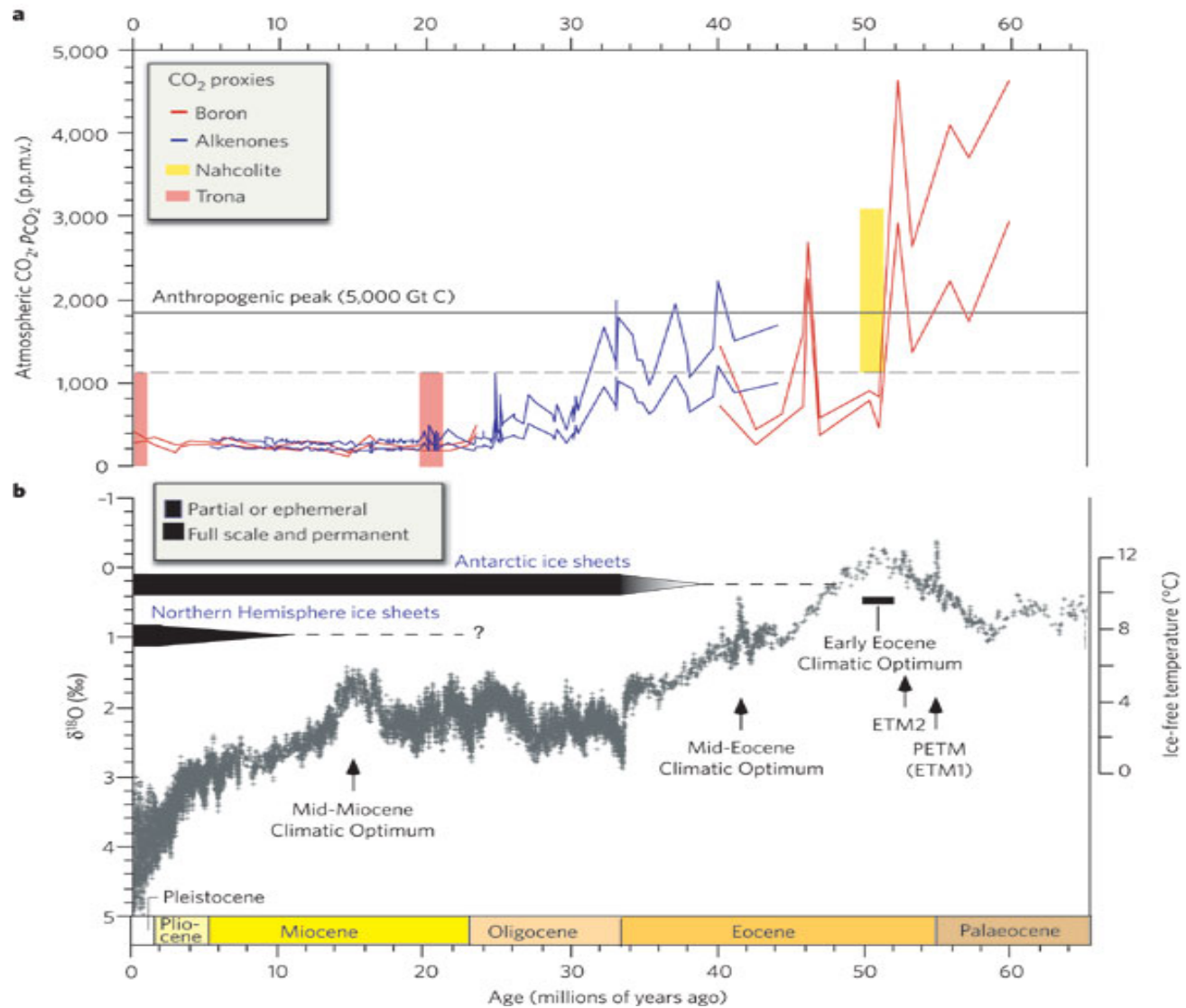
<http://www.univ-brest.fr/lpo/ariane>



<http://stockage.univ-brest.fr/~grima/Ariane/ariane.html>

Period: Oligocene

Influence on the Indonesian Throughflow and climate of changes in CO₂ during the Oligocene



Zachos, Dickens, Zeebe (2008)

Potential collaborations

- Elena Lo Giudice and Nick Fraser: proxies for temperature, salinity, rainfall, transport, water mass mixing.
- Bill Wood and Emanuela di Martino: seasonality and interannuality.

Bibliography

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- C. Gaina, D. Müller, *Cenozoic tectonic and depth/age evolution of the Indonesian gateway and associated back-arc basins*, *Earth-Science Reviews*, vol. 83, issues 3-4, pp. 177-203, 2007.
- J.C. Zachos, G.R. Dickens, R.E. Zeebe, *An early Cenozoic perspective on greenhouse warming and carbon-cycle dynamics*, *Nature*, vol. 451, pp. 279-283, 2008.
- A. Holbourn, W. Kuhnt, M. Regenberg, M. Schulz, A. Mix, N. Andersen, *Does Antarctic glaciation force migration of the tropical rain belt?* *Geology*, vol. 38, no. 9, pp. 783-786, 2010.
- CCSM3 (Community Climate System Model, version 3), NCAR:
<http://www.cesm.ucar.edu/models/ccsm3.0/>
- CCSM3 for Paleoclimate applications:
<http://www.cgd.ucar.edu/ccr/paleo/Notes/PaleoCCSM3.pdf>
- Ariane (*Université de Brest*):
<http://stockage.univ-brest.fr/~grima/Ariane/>

Questions



