## The influence of



#### EARTH SCIENCES

# Tethys and Central

American Seaways on

climate during the

Miocene Climatic

Optimum

<u>Hamida Ngoma Nadoya<sup>1</sup></u>, Clay Tabor<sup>1</sup> <sup>1</sup>Department of Earth Sciences, University of Connecticut, Storrs, USA

CESM Workshop, Paleoclimate Working Group June 11<sup>th</sup> 2025

### Background

- Several gateway changes during the Miocene that could affect ocean circulation
- Central American Seaway
   (CAS): restricted flow by ~12 Ma
- Tethys Seaway (TES): closed

between 15 and 14 Ma



Burls et al., 2021

### Methodology

- iCESM1
  - Fully coupled
  - 1.9° x 2.5° resolution
- Mid-Miocene boundary conditions
  - Frigola et al. (2018) topography
  - 570 ppm CO<sub>2</sub>
- 3 gateway experiments with closed TES, closed CAS, or both
- Compare with proxy reconstructions

#### Surface temperature





- TES closure shows less impact
- CAS closure results in widespread warming in the SH and cooling in the NH
- Closure of both CAS and TES reduces the cooling in the NH but more warming over north equatorial Atlantic and South America

#### Precipitation





- TES closure shows less impact
- Drying of Arctic, North Pacific and North Africa with CAS closure
- Wetter equatorial Atlantic, eastern Pacific and Indian
- Wetter north Atlantic with CAS and TES closure

### Precipitation $\delta^{18}O$





- TES closure 
   less impact except in the Mediterranean region
- Closing both CAS and TES 
   less signal of enriched isotopes
   over the North Atlantic and depleted over the south

#### Surface salinity



- Saltier Pacific, Indian and south Atlantic with TES closure
- Saltier Atlantic and Arctic with CAS closure
- Fresher Pacific with closure of both CAS and TES

### Energy balance decomposition



NH cooling from CAS closure
primarily attributed to increased
surface albedo feedback from
reduction in total northward ocean
heat transport

#### Meridional ocean heat transport



- CAS closure reduces NH and increases SH Pacific ocean heat transport
- CAS closure increases NH and decreases SH Atlantic ocean heat transport

#### Meridional Overturning Circulation



• Loss of a shallow southward heat transport in South Atlantic with CAS

#### Comparison with proxy reconstructions



#### Comparison with Late Miocene Cooling



- Small differences in RMSE
- Less spatial coverage of proxies
- Will compare individual sites for biases between MCO and Late Miocene

#### Conclusions

- Ocean gateways can impact large scale circulation and climate
- Closure of the Tethys Seaway has smaller effect on climate than closure of the Central American Seaway
- Study supports the claim that closure of the Central American Seaway could have initiated NH glaciation (Molnar et al., 2008; Lunt et al. 2008)
- Comparison with proxies shows better agreement with the control experiment which could imply open gateways during the MCO

## Acknowledgements



# THANK YOU!!!!!!!!!!!

Email: hamida.nadoya@uconn.edu