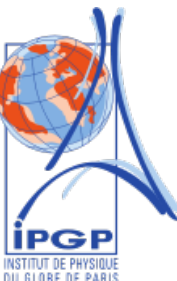
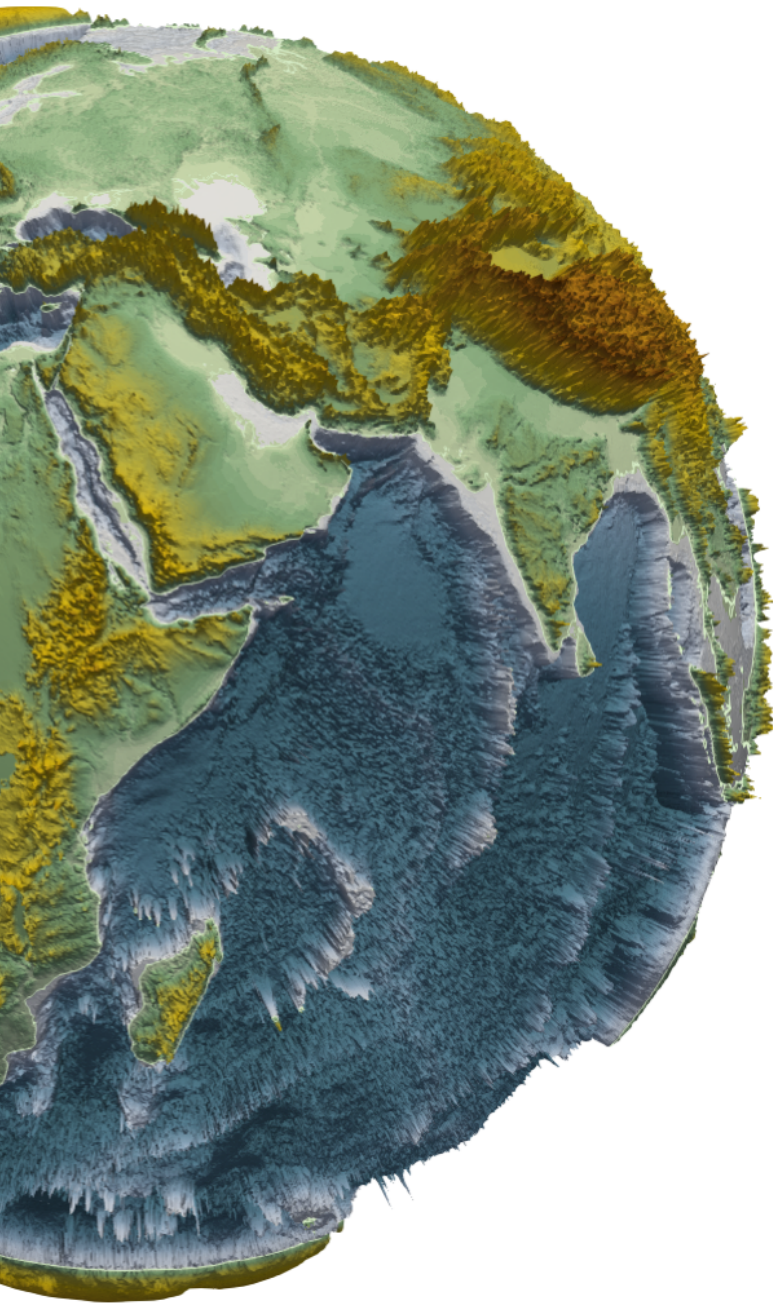


# Reconciling South Asian Monsoon Winds and Rainfall

*... histories during the Miocene*

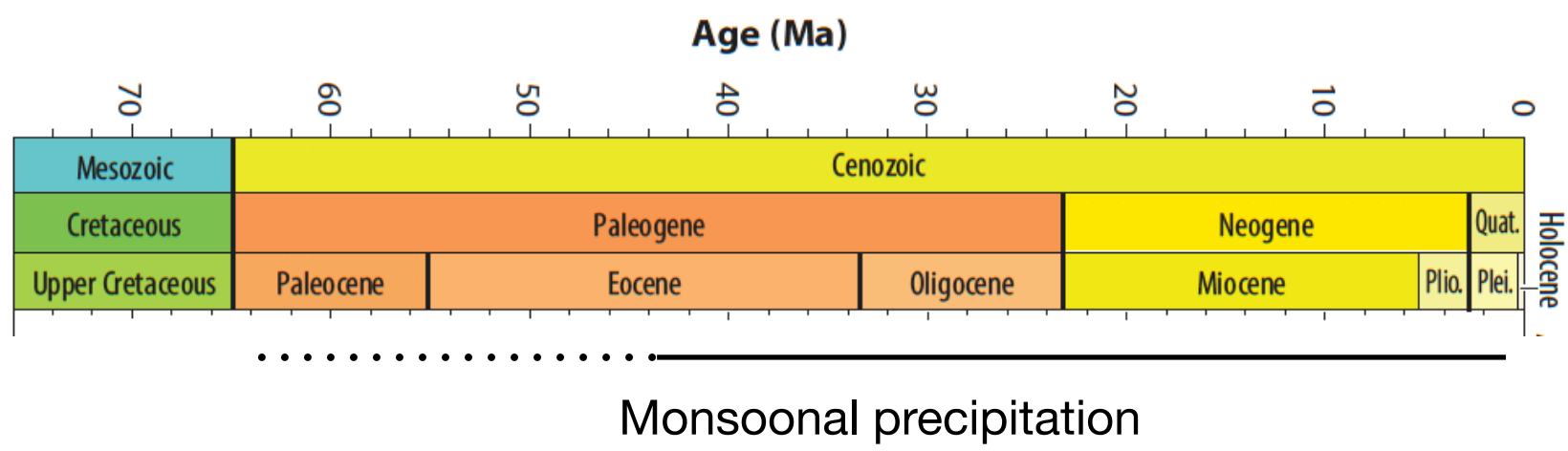
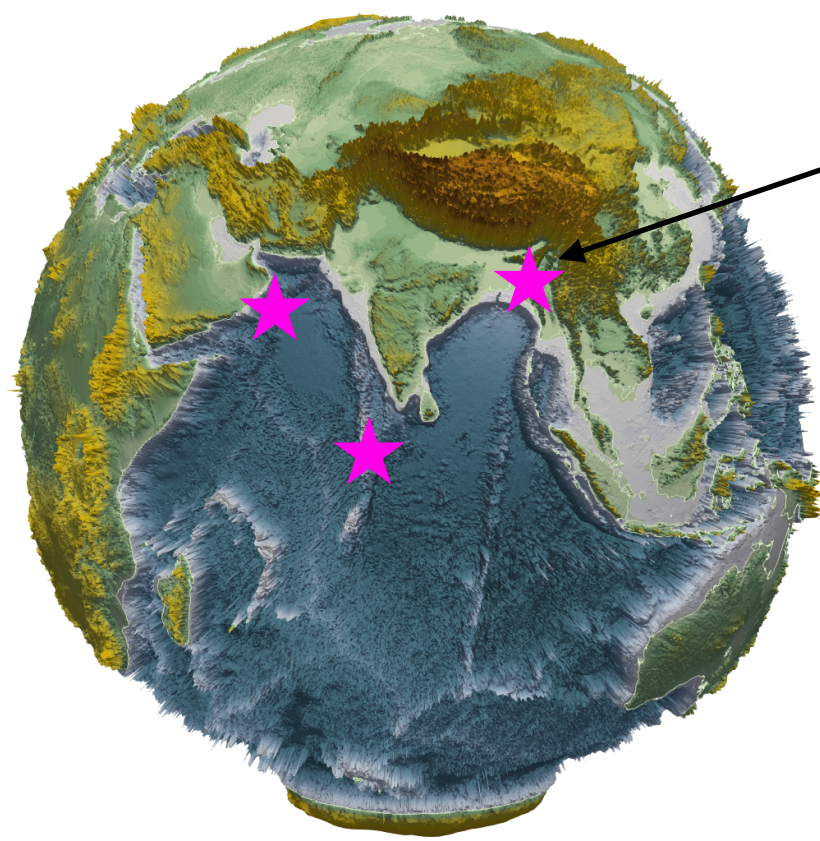
EGU 2022 - May, 23rd

**A-C. Sarr**, Y. Donnadieu, C. Bolton, F. Fluteau, J-B. Ladant, A. Licht, M. Laugié, D. Tardif, G. Dupont-Nivet



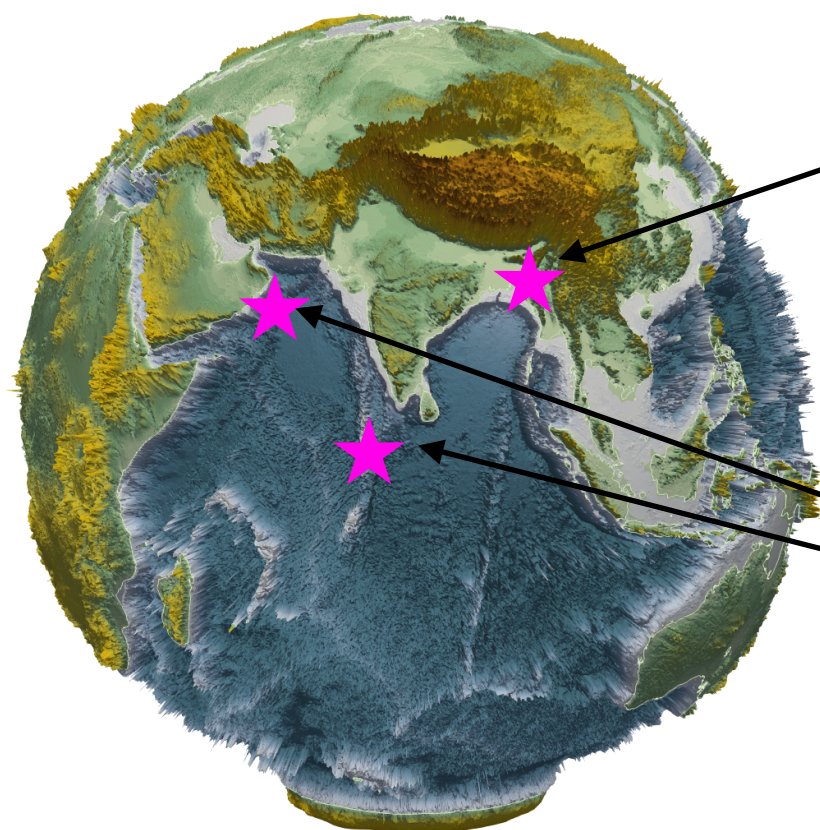
# A Miocene change in monsoon dynamics ?

‘Modern-like’ monsoonal precipitation strength and seasonality already in the **Eocene** (eg. *Licht et al. 2014*)



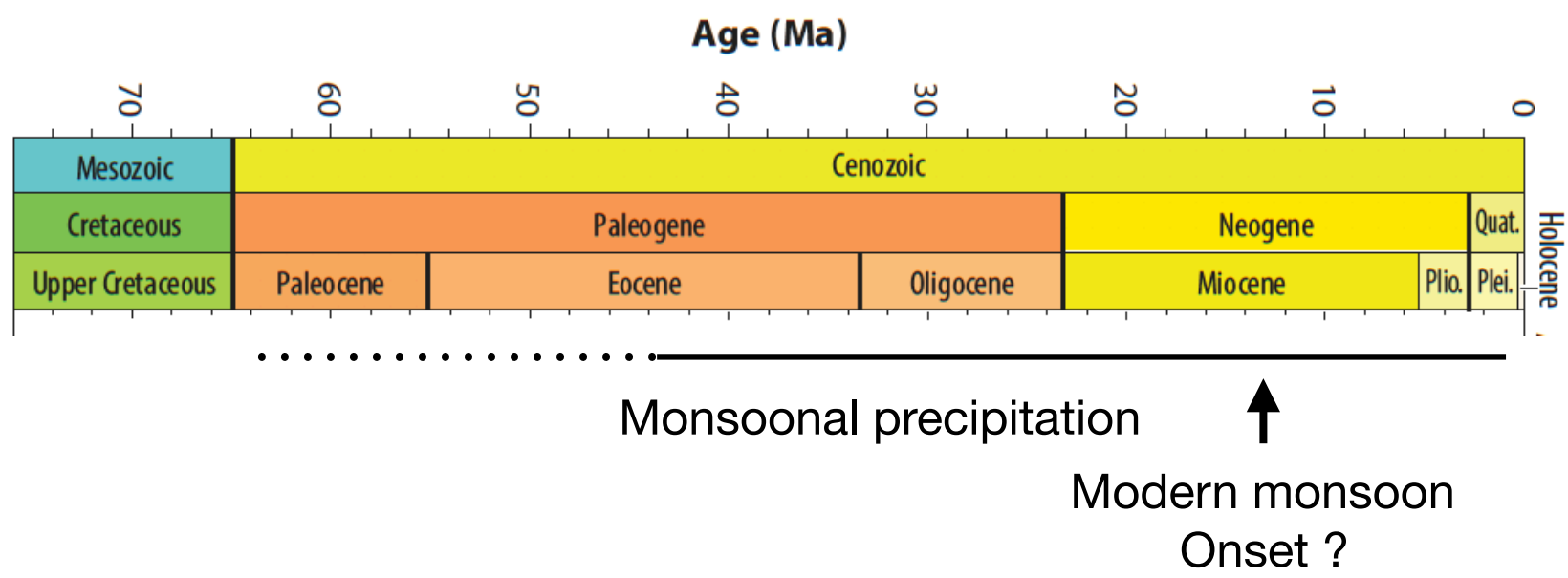


A Miocene change in monsoon dynamics ?

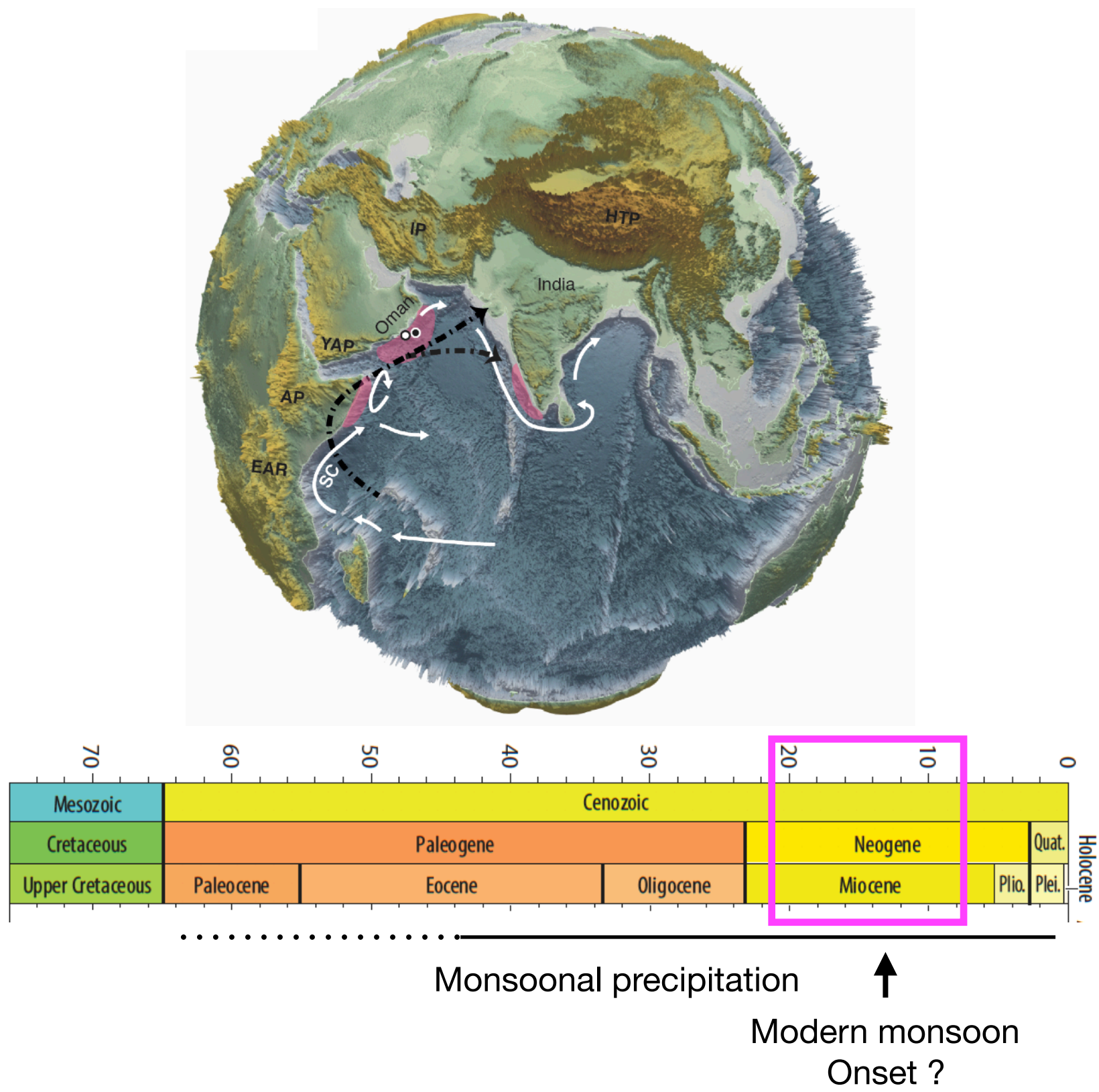


‘Modern-like’ monsoonal precipitation strength and seasonality already in the **Eocene** (eg. *Licht et al. 2014*)

Upwelling onset/intensification linked to ‘modern-like’ monsoon onset around **13Ma**  
(*Kroon et al., 1991 ; Gupta et al. 2015 ; Bialik et al. 2020 ; Betzler et al. 2016*)



A Miocene change in monsoon dynamics ?

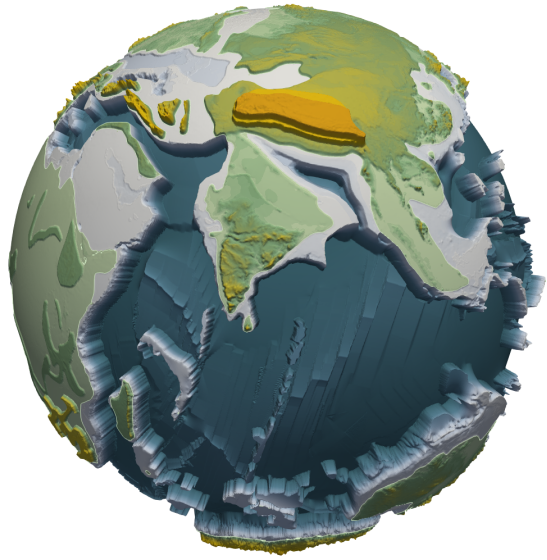


Can models help reconcile these two visions of the monsoon evolution ?

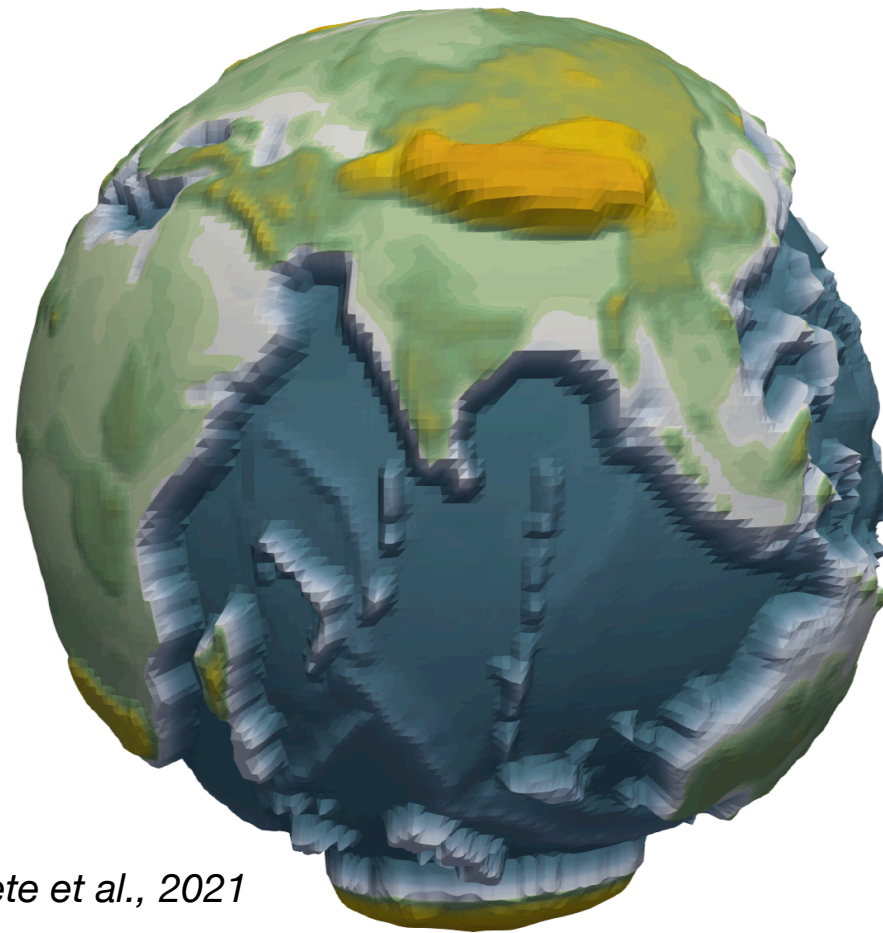


A closer view of the Miocene ....

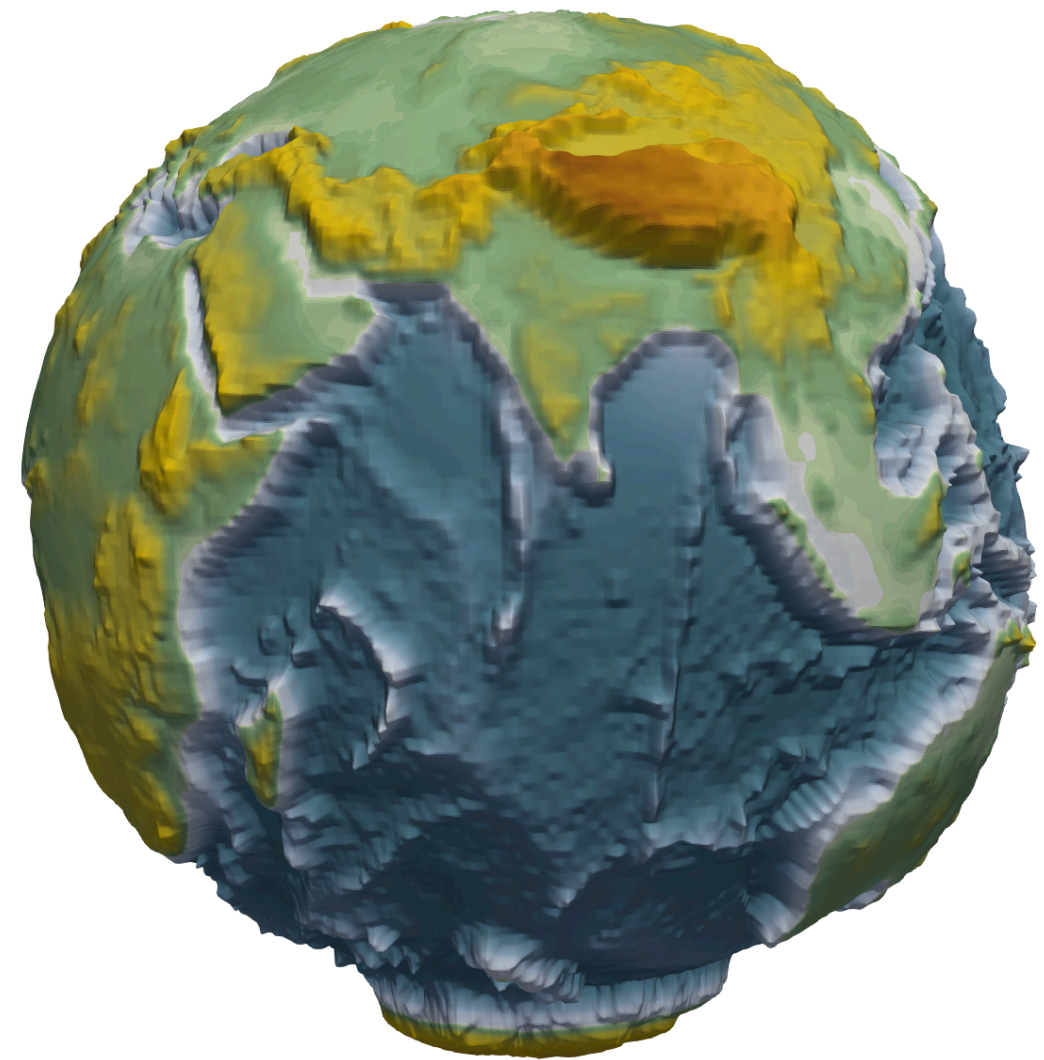
Can it help understand the upwelling records ?



*Poblete et al., 2021*



*Poblete et al., 2021*

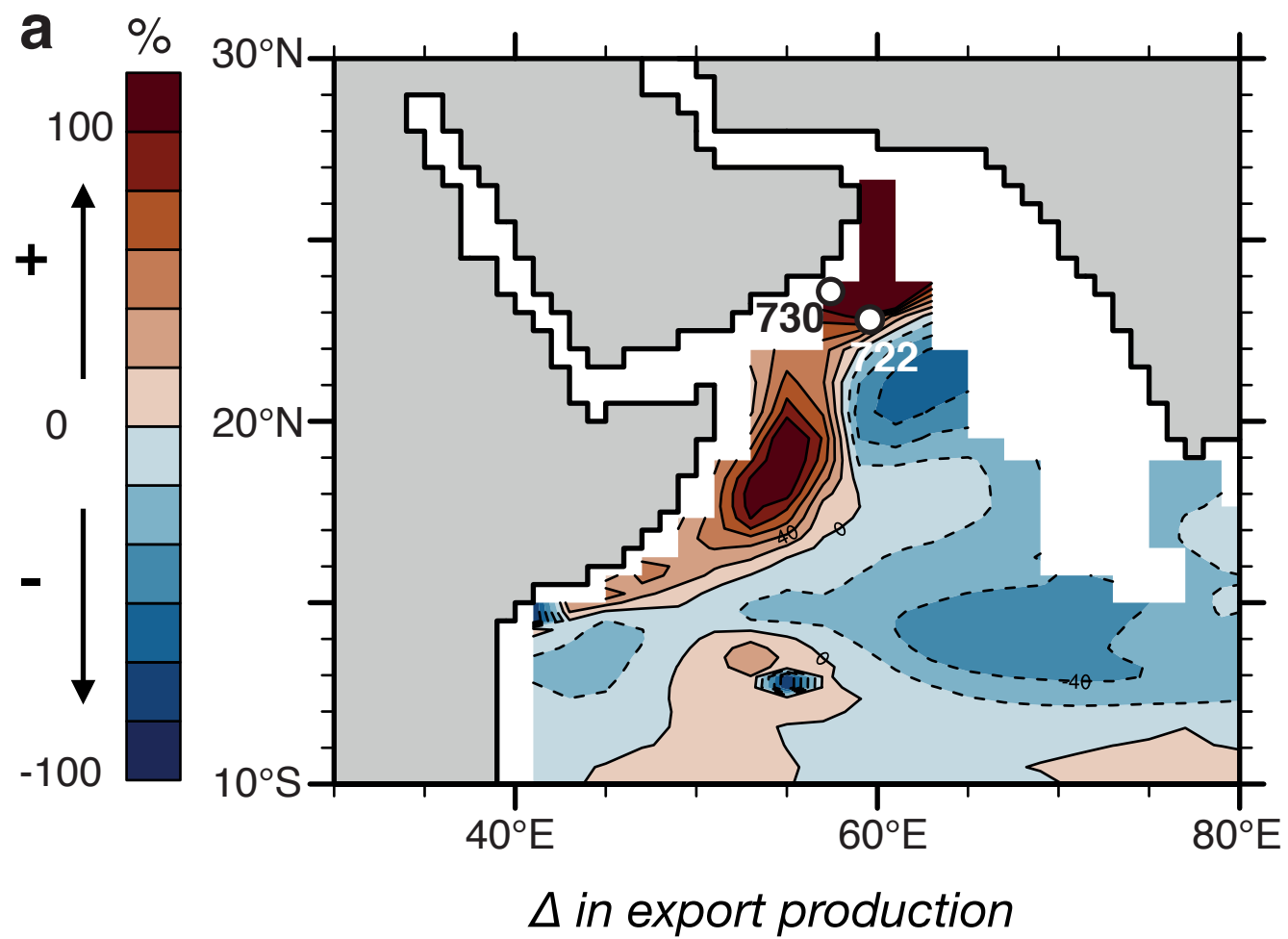
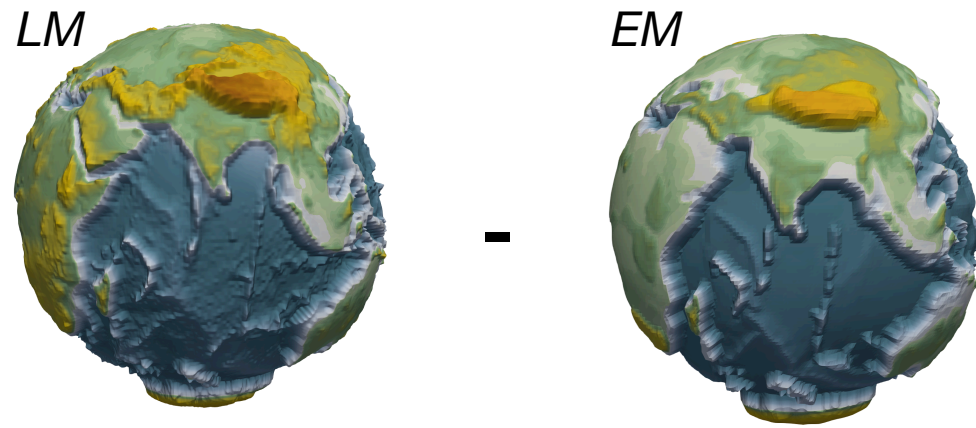


*Sarr et al., 2022*

### **Fully- coupled Ocean-Atmosphere model :**

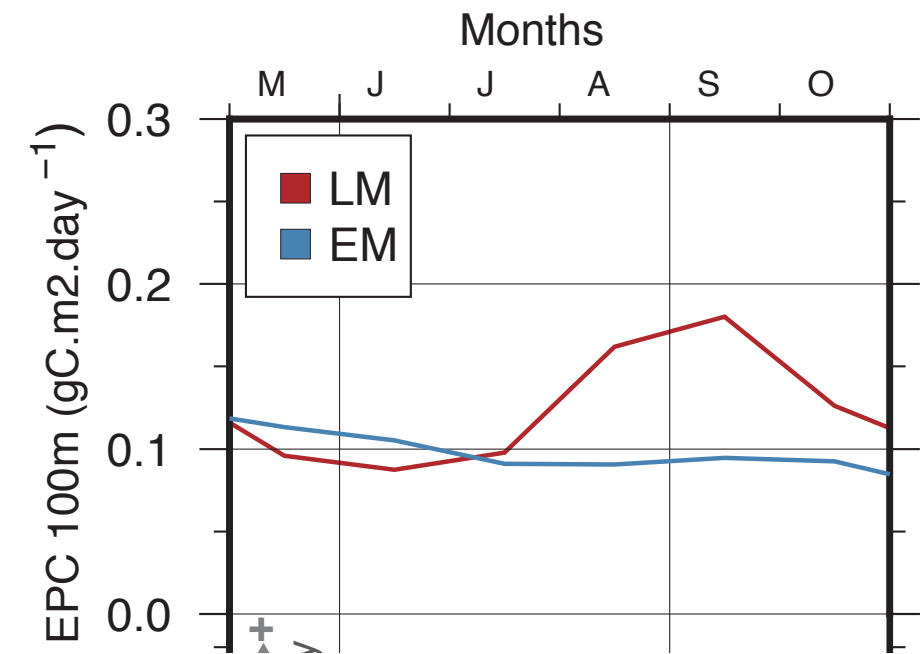
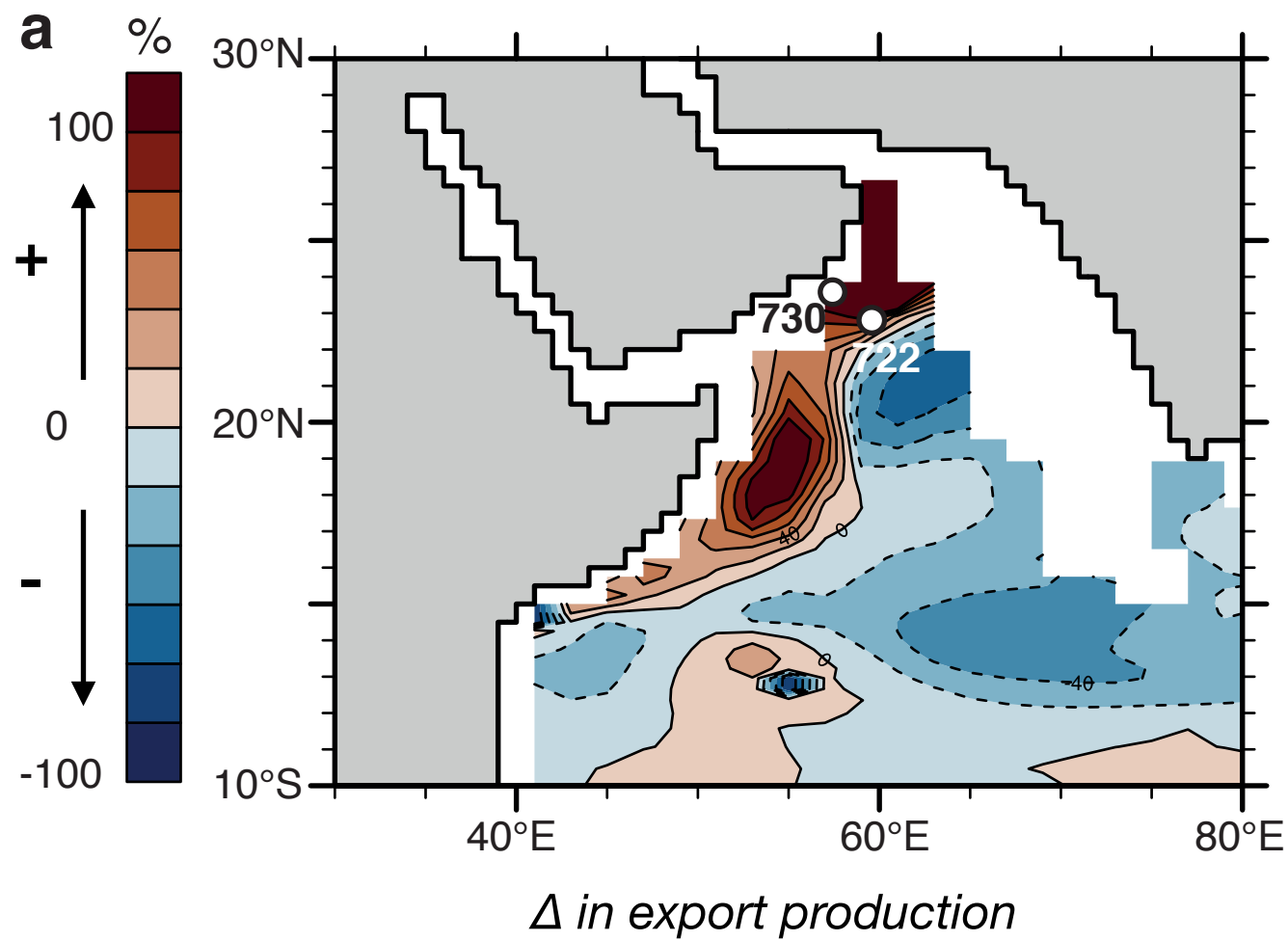
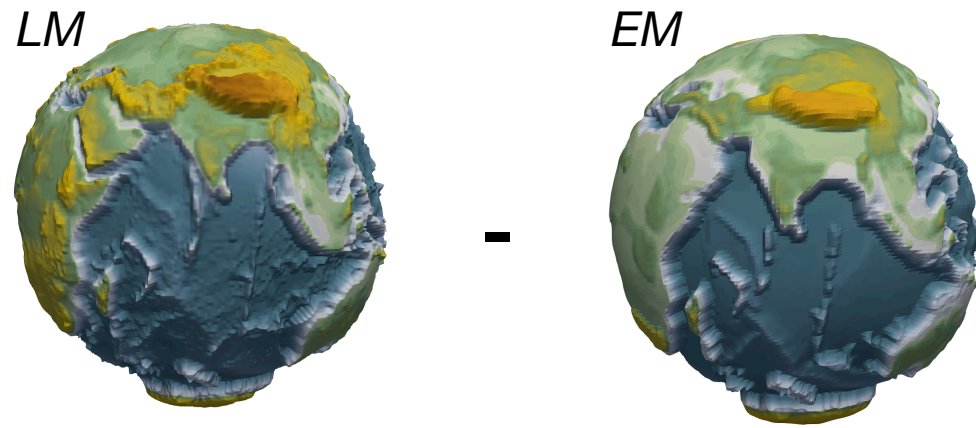
- ➔ IPSL-CM5A2 (Sepulchre et al. 2020, GMD)
- ➔ Ocean biogeochemistry model PISCES (Aumont et al., 2015, GMD)

# Productivity and upwelling variations

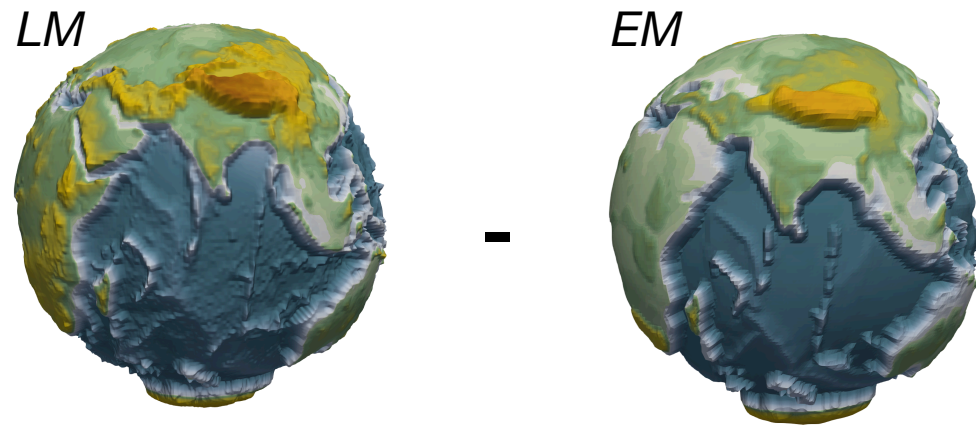




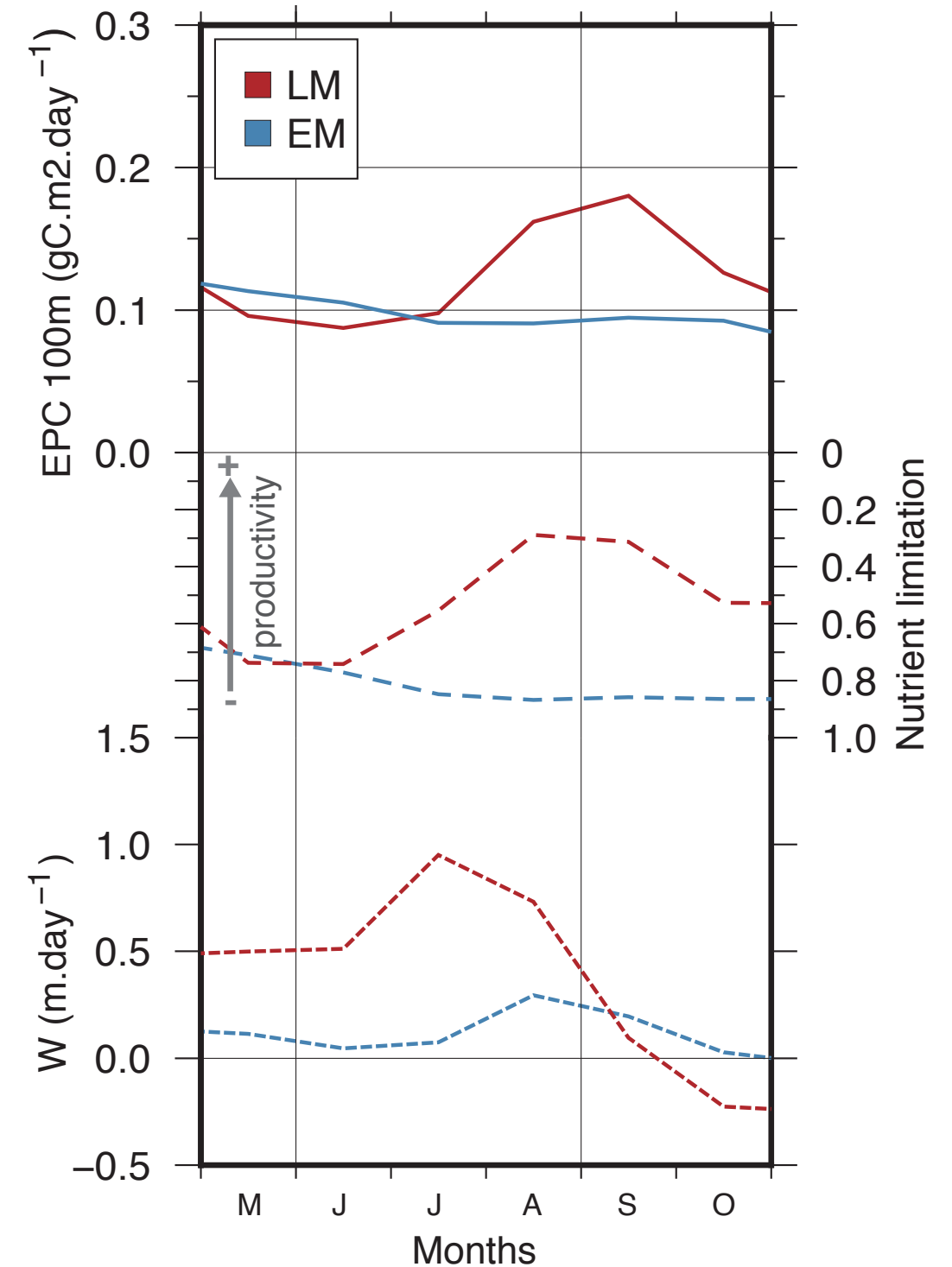
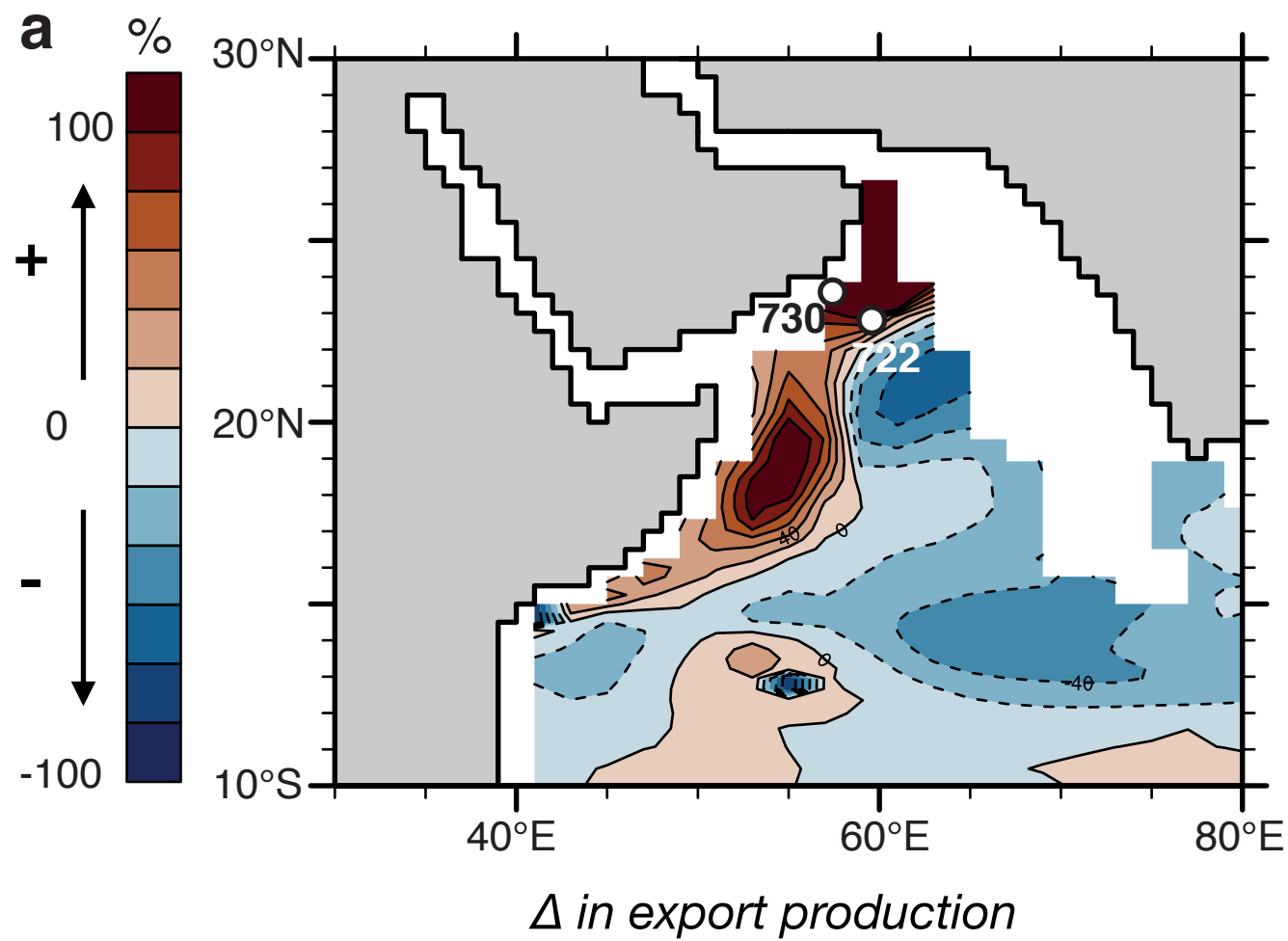
# Productivity and upwelling variations



# Productivity and upwelling variations

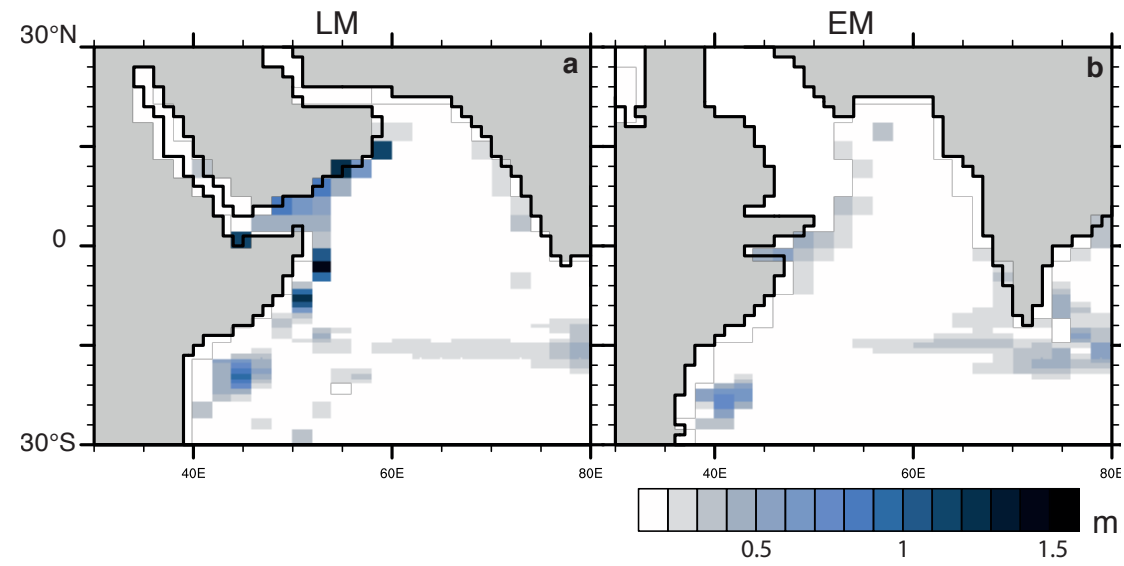


Change in upwelling velocity drives productivity bloom in Western Arabian Sea

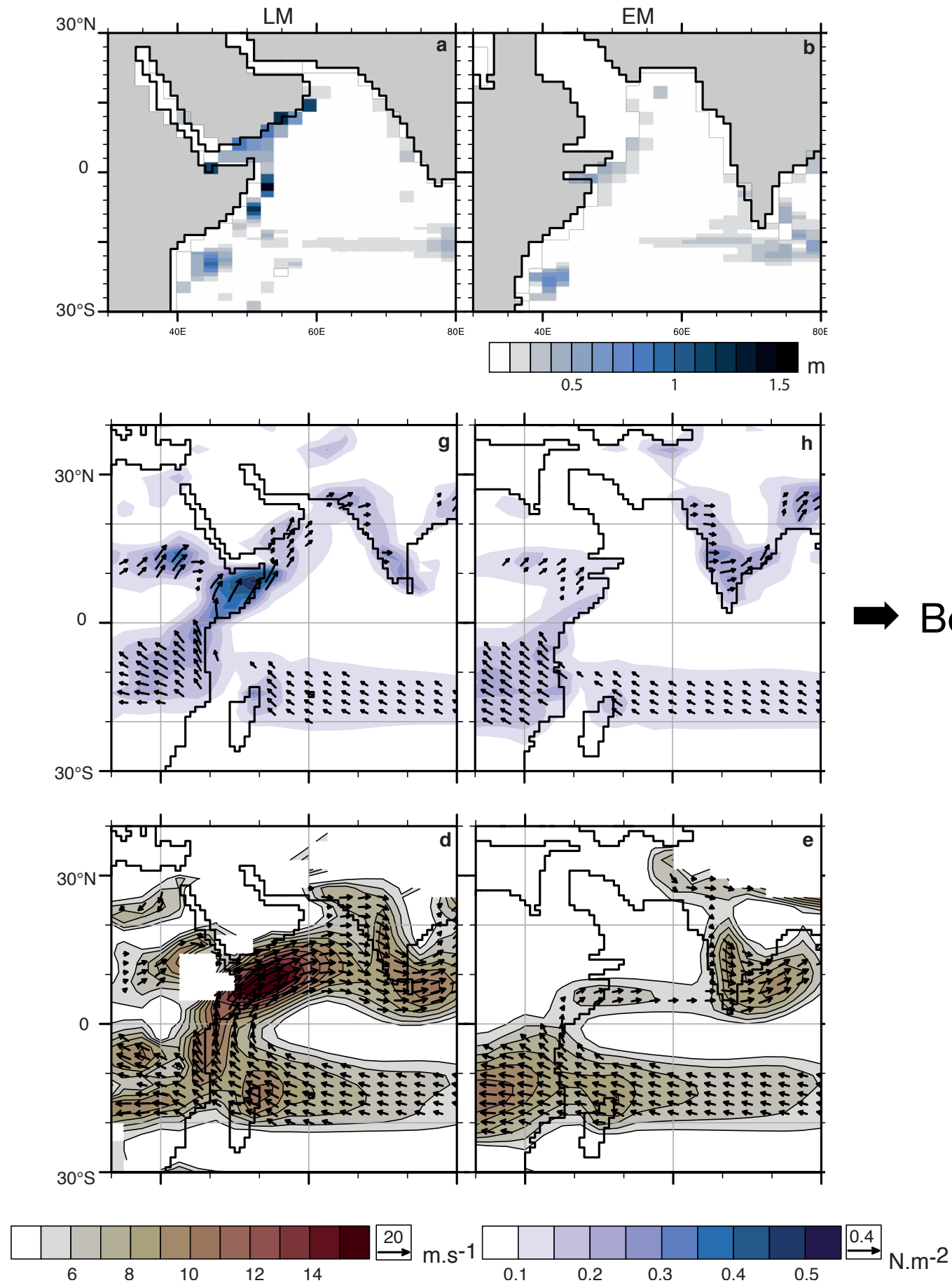




# Upwelling and atmospheric forcing



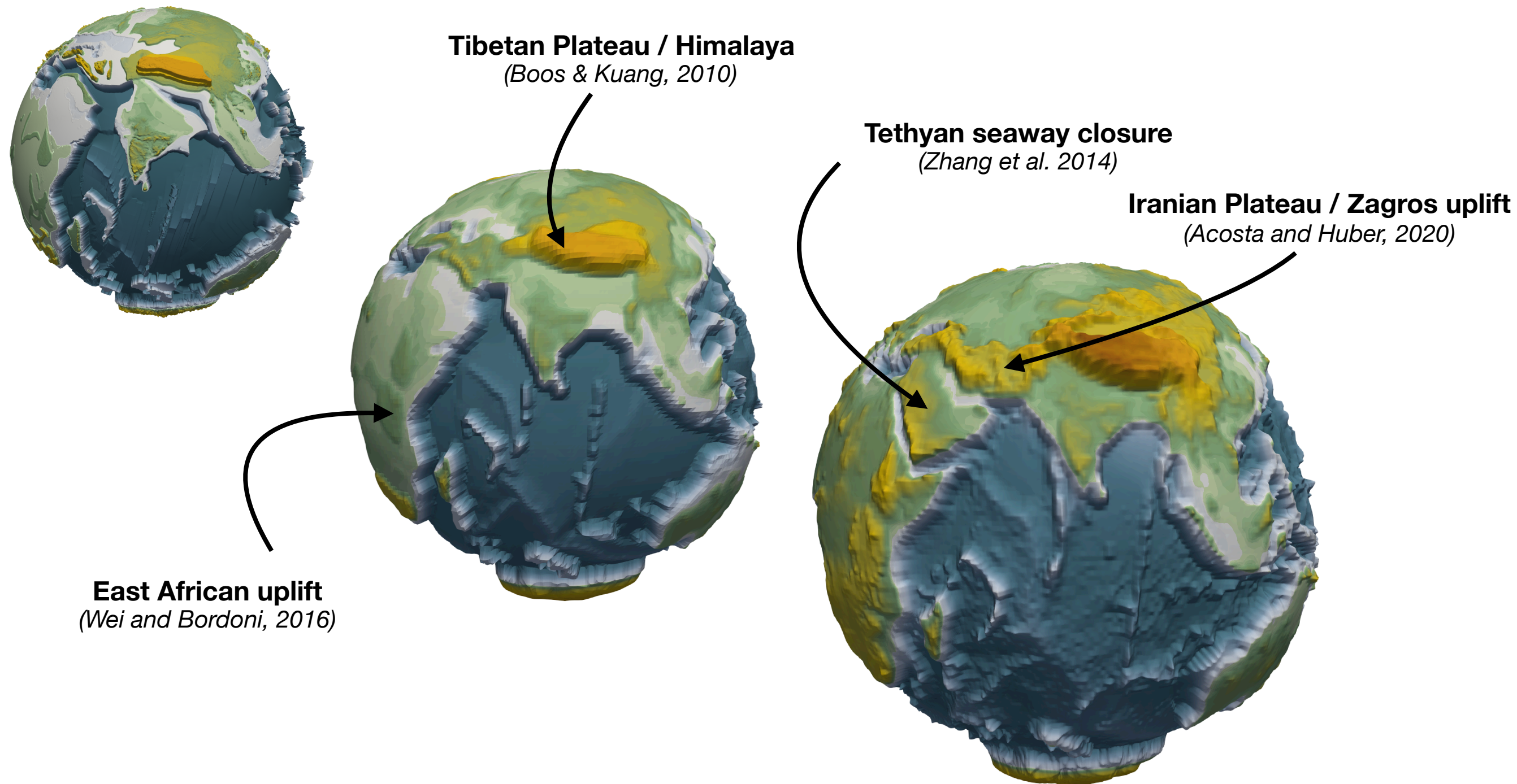
# Upwelling and atmospheric forcing



➡ Both Somali Jet **curvature** and **strength** changed during the Miocene

Sarr et al., 2022

# Topographic control on monsoon characteristics

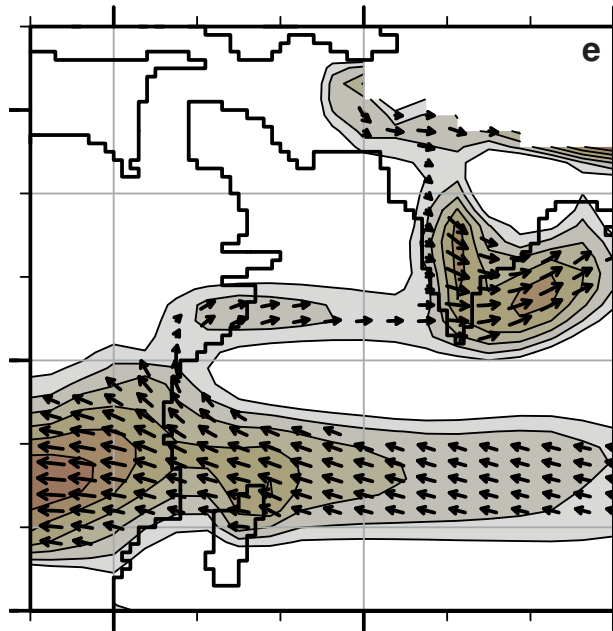


**Does topography outside HTP region matter ?**

Sensitivity experiments to topography and land-sea mask on late and early Miocene geography



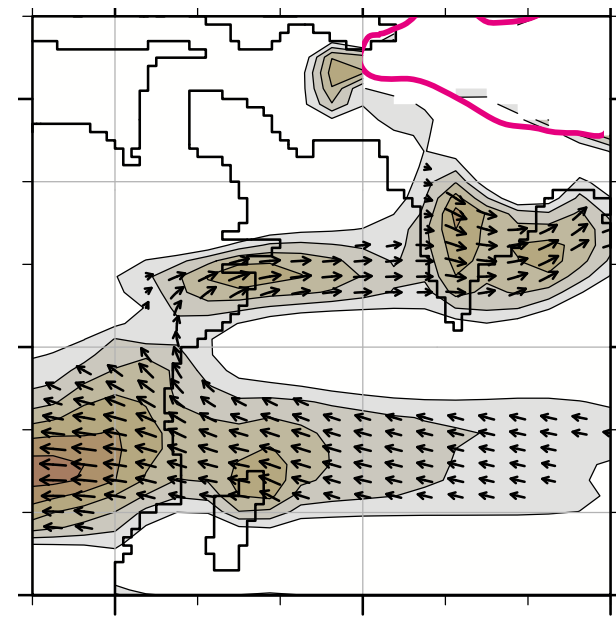
## Higher Himalaya



✗ Weak and zonal  
Somali Jet

✗ No Oman  
Upwelling

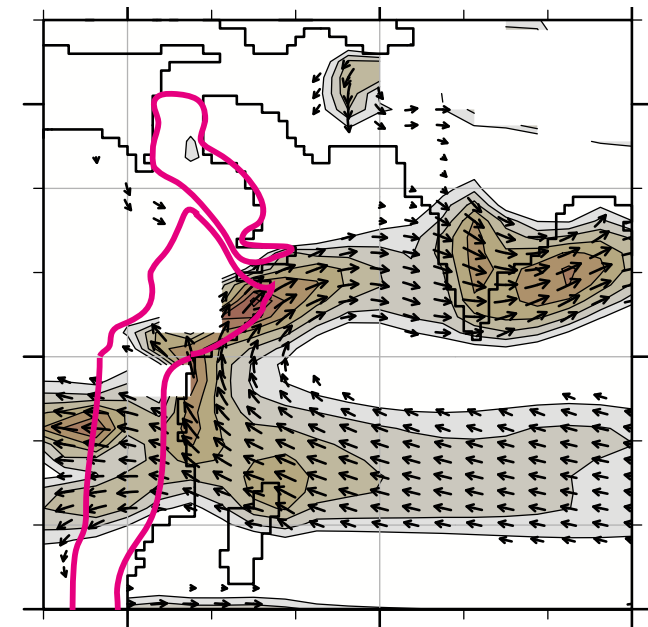
✓ SAM precipitation  
& seasonality



✗ No Oman  
Upwelling

➔ Increases SAM  
precipitation

## Full East African Topography



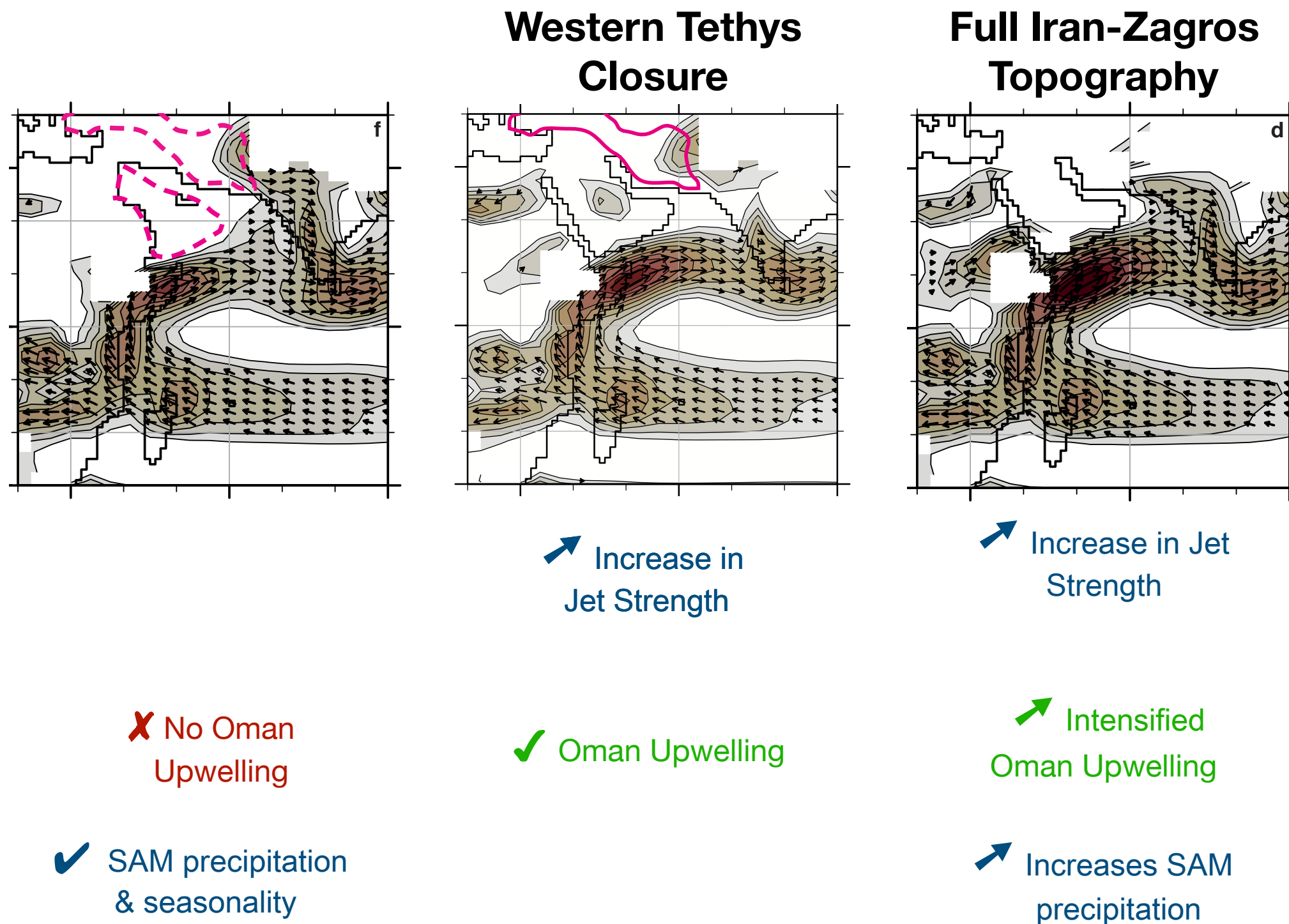
➔ Increase in Jet  
Strength + curvature

✗ No Oman  
Upwelling

➔ Decrease SAM  
precipitation

➔ **HTP** has limited effect on the Jet, but **strengthens precipitation**

➔ **East African Topography** increases **jet curvature and strength**



➡ **Arabian Peninsula** modulates Oman **upwelling**

➡ **Iran-Zagros** Topography increases **jet curvature and strength & precipitation**

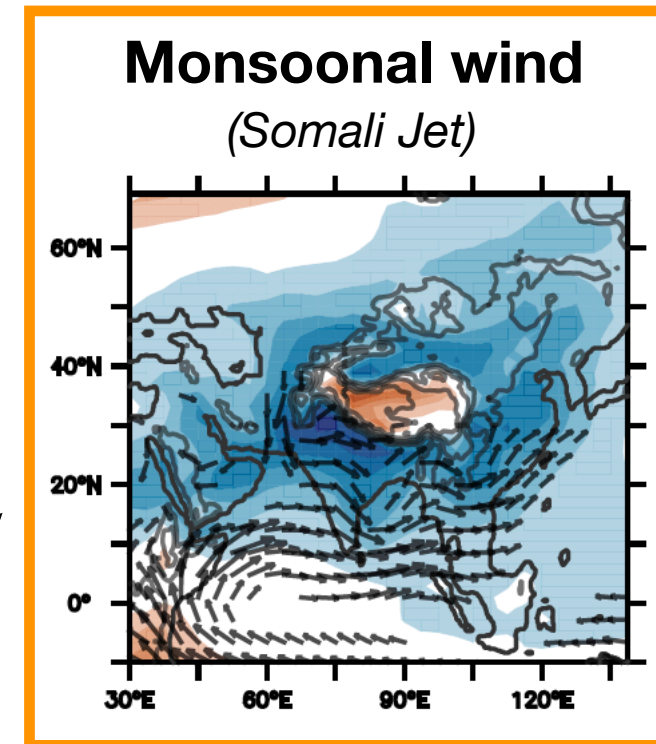
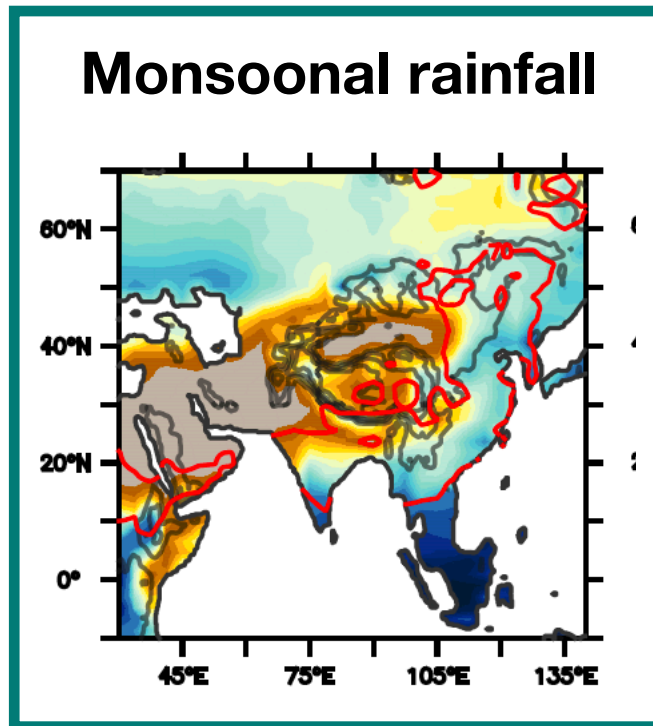
## Decoupling between winds and precipitation due to different paleo-geographic control

We need to clearly define what we mean by 'monsoon' on geological timescales - is it wind ? Is it precipitation or both ?

HTP configuration  
Himalaya elevation

Iran-Zagros elevation

Oman Upwelling



West Tethys  
platform

East African topography  
(threshold at ~1,200 m)

**Read more :** Sarr et al., 2022 - Neogene South Asian Monsoon Wind and Rainfall history diverged due to topographic effects. Nature Geoscience





