The Impact of Cenozoic Cooling on the Diversity of Planktonic Foraminifera

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Studying Diversity in Space and Time

Species richness of birds

Time / Mya

Sepkoski (1984) *Paleobiology*
What is the Latitudinal Diversity Gradient?

- The LDG is found in many taxa, both marine and terrestrial
- Species richness is higher near the equator
- Many explanations, no clear consensus as to the cause
Aims

1. What drives the species richness of ocean plankton today?
2. Have those drivers remained constant through time?
Observed Recent Richness
Predicted Recent Richness
(Spatial autoregressive models; SST a third-order polynomial; first order interactions)

Spatial model $R^2 = 0.89$
Aims

1. What drives the species richness of ocean plankton today?
2. Have those drivers remained constant through time?
Observed Eocene Richness

Fenton et al. (2016) PhilTransB
Comparison of Predicted and Observed Diversity

Late Eocene

Middle Eocene

Early Eocene

Predicted data
Tectonics GCM
CO₂ GCM

Northern hemisphere
Southern hemisphere

Fenton et al (2016) PhilTransB
Discrepancies

Possible explanations:

- Model missing a relevant variable
- The relationship between diversity and environment has changed
- GCM early Eocene temperature estimates are inaccurate

Inglis et al (2015) *Paleoceanography*
Lunt et al (2010) *Geology*

Conclusions

• Present day diversity of PFs is mainly driven by temperature, although other variables also contribute

• By the end of the Eocene, a latitudinal diversity gradient had developed

• Mismatch between predicted and observed diversity in early Eocene
  – Proxy records suggest these GCMs produce poor environment estimates
Modelling

• Using Spatial Autoregressive Models to account for spatial autocorrelation
• SST modelled as a third order polynomial (complexity level suggested by GAMs)
• First order interactions between all variables
• Exclude points with delta carbonate ion $<-10.9$ to reduce effect of dissolution