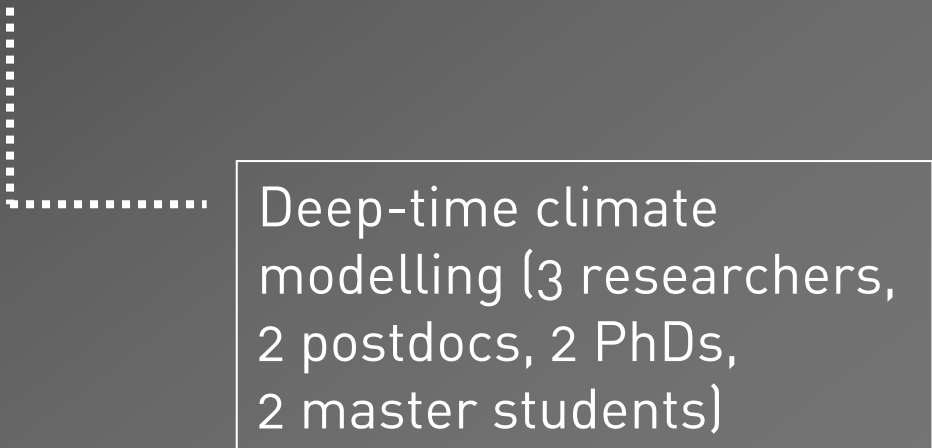


Linking deep-time climate modelling and long-term biological changes

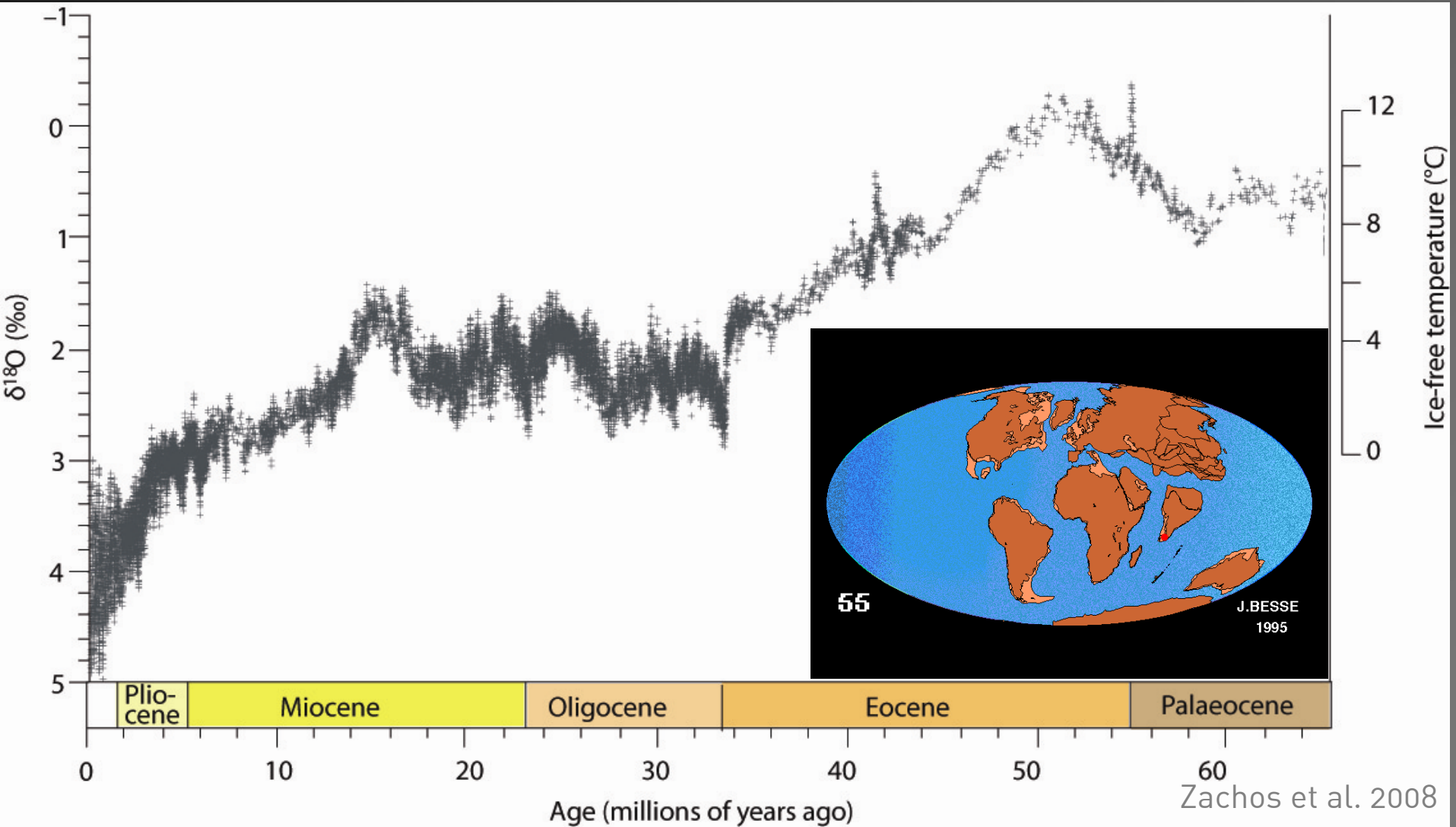
Pierre Sepulchre | [LSCE](#), Gif-sur-Yvette | 15 février 2011

- Climate Modelling Theme (P. Braconnot) : 5 teams



- What we aim at :
 - Understanding long-term processes governing climate change at geological timescales
 - Quantifying long-term evolution of the carbon cycle
 - Quantifying the links between climate and biological evolution during the last 50 million-years.

Evolution of climate during the last 65 Ma



Early studies... (Ramstein et al., Nature, 1997)

articles

Effect of orogeny, plate motion and land–sea distribution on Eurasian climate change over the past 30 million years

Gilles Ramstein^{*}, Frédéric Fluteau^{*†}, Jean Besse[†] & Sylvie Joussaume^{*‡}

^{}Laboratoire de Modélisation du Climat et de l'Environnement, DSM CEN Saclay, Bât. 709, 91191 Gif-sur-Yvette cedex, France*

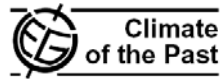
[†]Laboratoire de Paléomagnétisme, Institut de Physique du Globe de Paris, [‡]Laboratoire d'Océanographie Dynamique et de Climatologie, CNRS/ORSTOM/Université P. M. Curie, 4 place Jussieu, 75252 Paris cedex 05, France

The Eurasian climates of today, 10 million and 30 million years ago are simulated using an atmospheric general circulation model that incorporates realistic continental geography and epicontinental sea distributions. The resulting climates compare well with various palaeoclimate records. The retreat of the Paratethys—an epicontinental sea—shifts the central Asian climate from temperate to continental conditions, and plays as important a role as uplift of the Himalayan/Tibetan plateau in driving the Asian monsoon changes.

Using GCMs to constrain the impact of tectonics on Asian monsoon :
In 1997 : Low-res GCMs, lack of continental data

New palaeoenvironmental datasets (Guo et al., 2008)

Clim. Past, 4, 153–174, 2008
 www.clim-past.net/4/153/2008/
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A major reorganization of Asian climate by the early Miocene

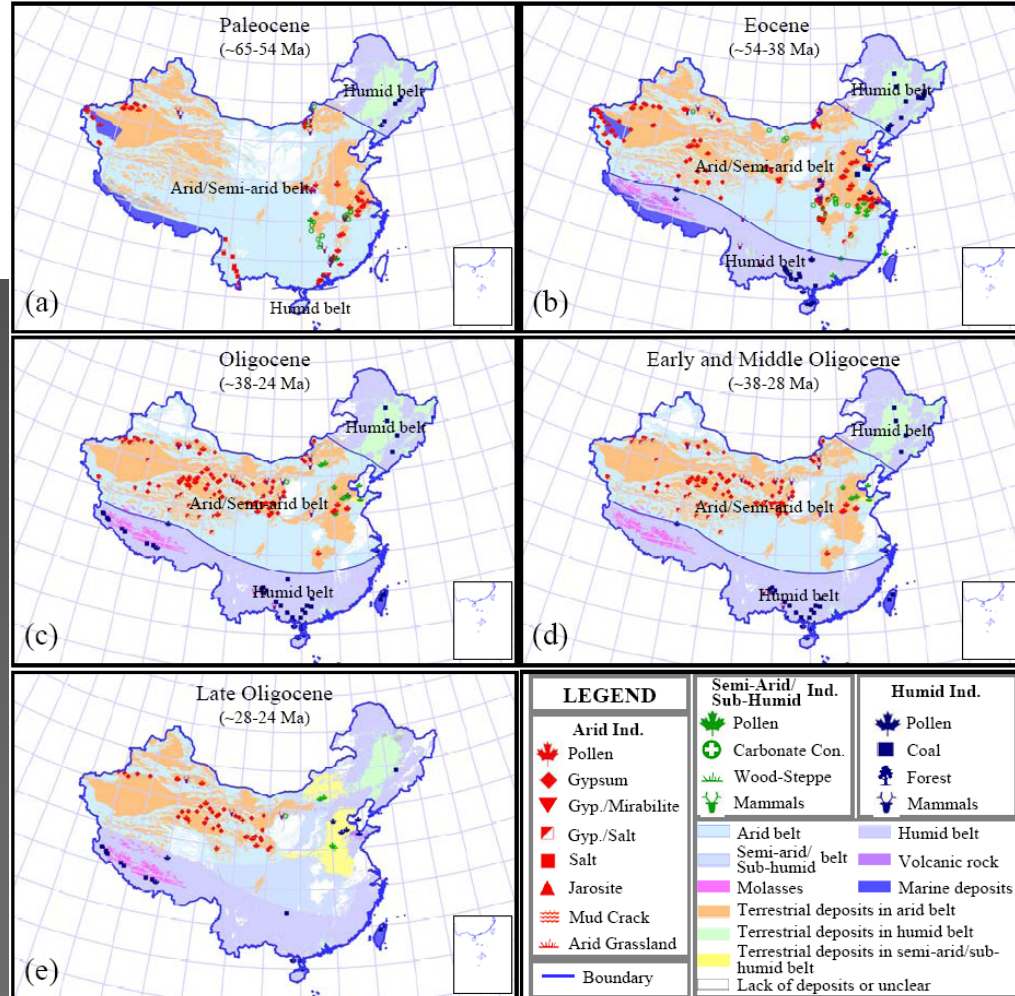
Z. T. Guo¹, B. Sun^{1,2}, Z. S. Zhang^{1,3}, S. Z. Peng¹, G. Q. Xiao⁴, J. Y. Ge⁴, Q. Z. Hao¹, Y. S. Qiao¹, M. Y. Liang¹,
 J. F. Liu¹, Q. Z. Yin¹, and J. J. Wei¹

¹Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, P.O. Box 9825, Beijing, 100029, China

²Shandong Institute and Laboratory of Geological Sciences, Jinan, 250013, China

³Nansen-Zhu International Research Center, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, 100029, China

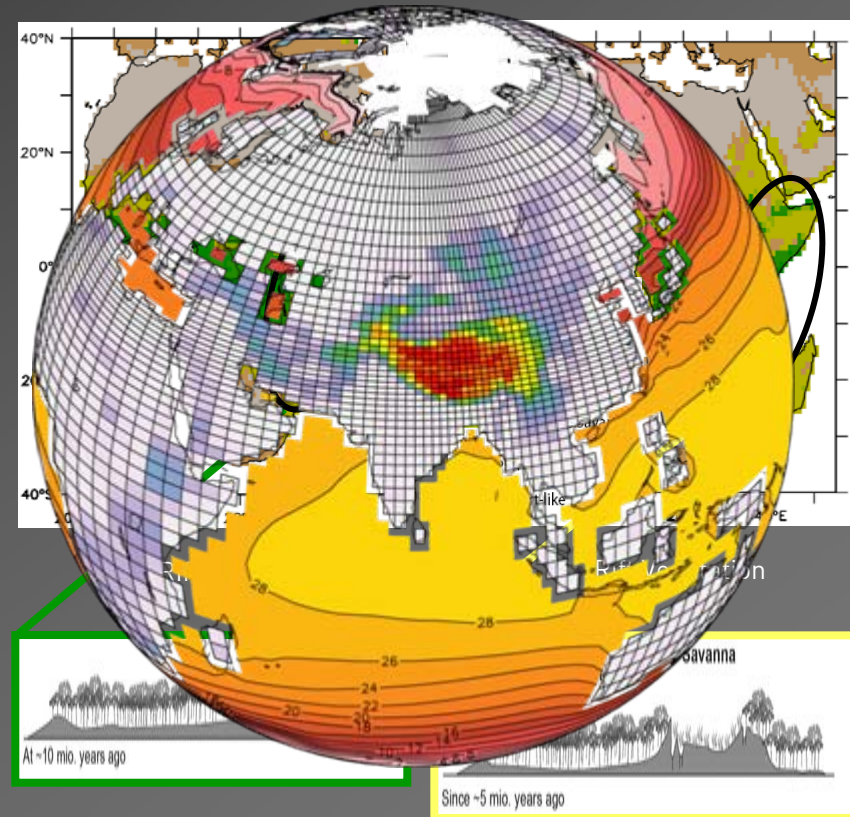
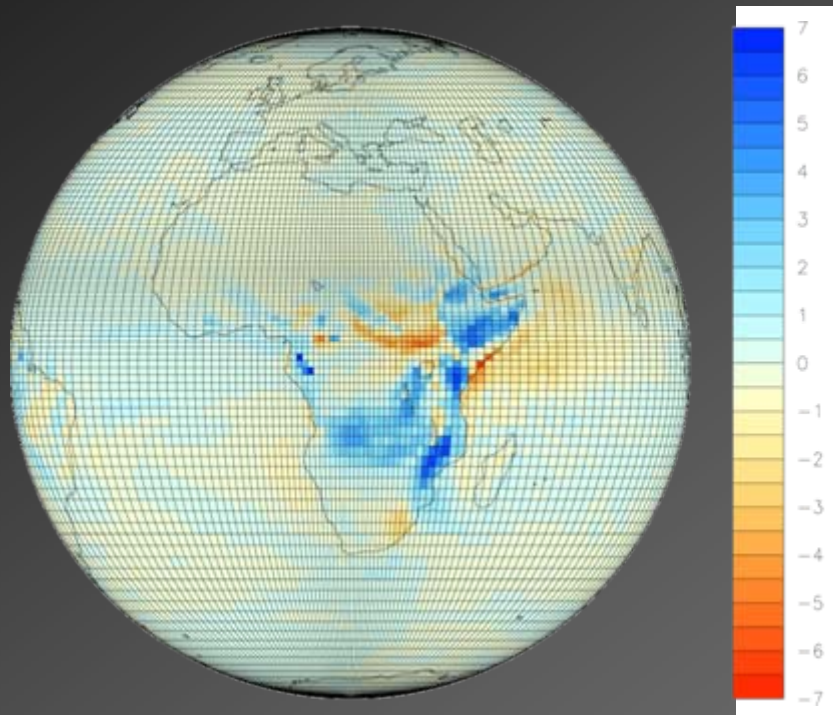
⁴State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences, P.O. Box 17, Xian, 710075, China



Higher resolution climate & vegetation models

Eastern Africa aridification & tectonic uplift (Sepulchre et al., Science 2006)

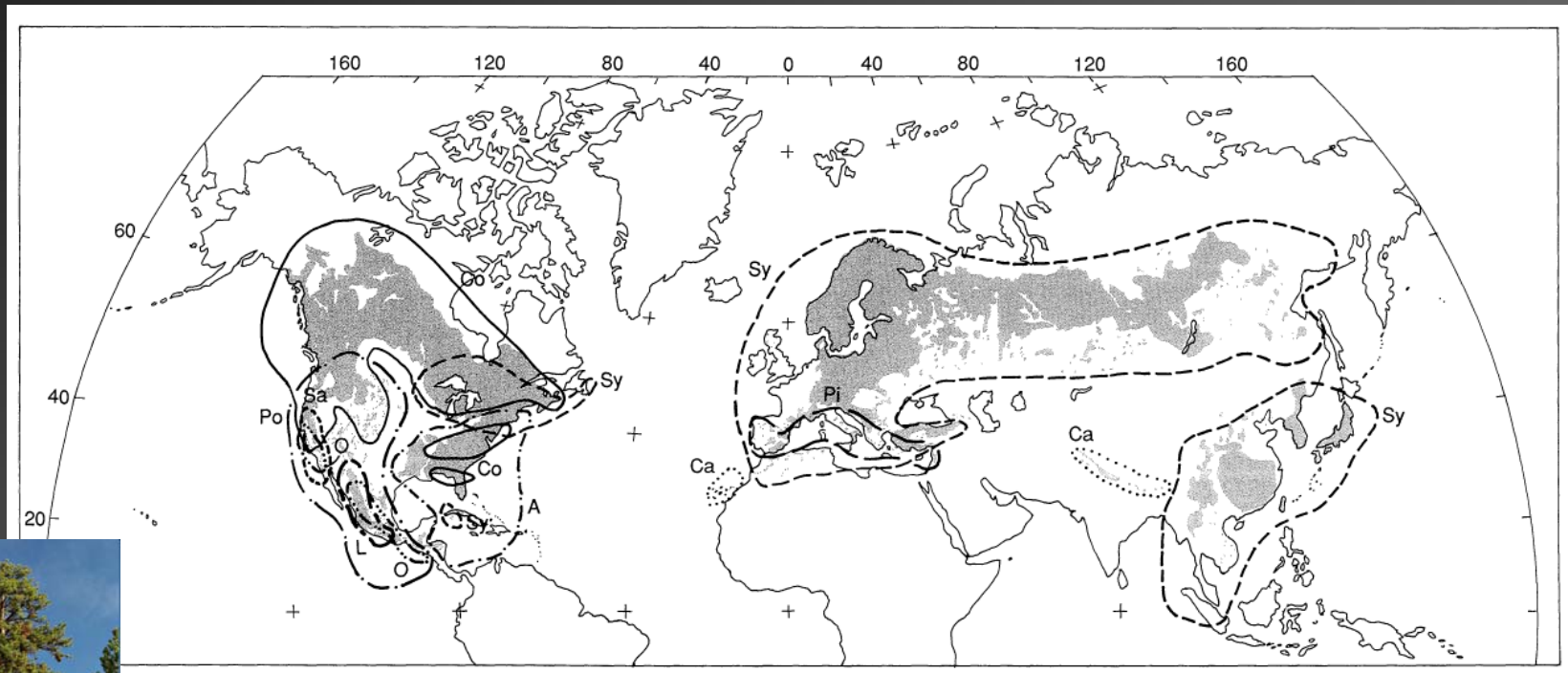
Annual rainfall (mm/j)
[No topography – present-day topography]



Using GCMs to constrain the impact of tectonics on climate & vegetation evolution



« To associate phylogenies & biogeography to better constrain the impact of climate on communities »



- Pines : ~114 species

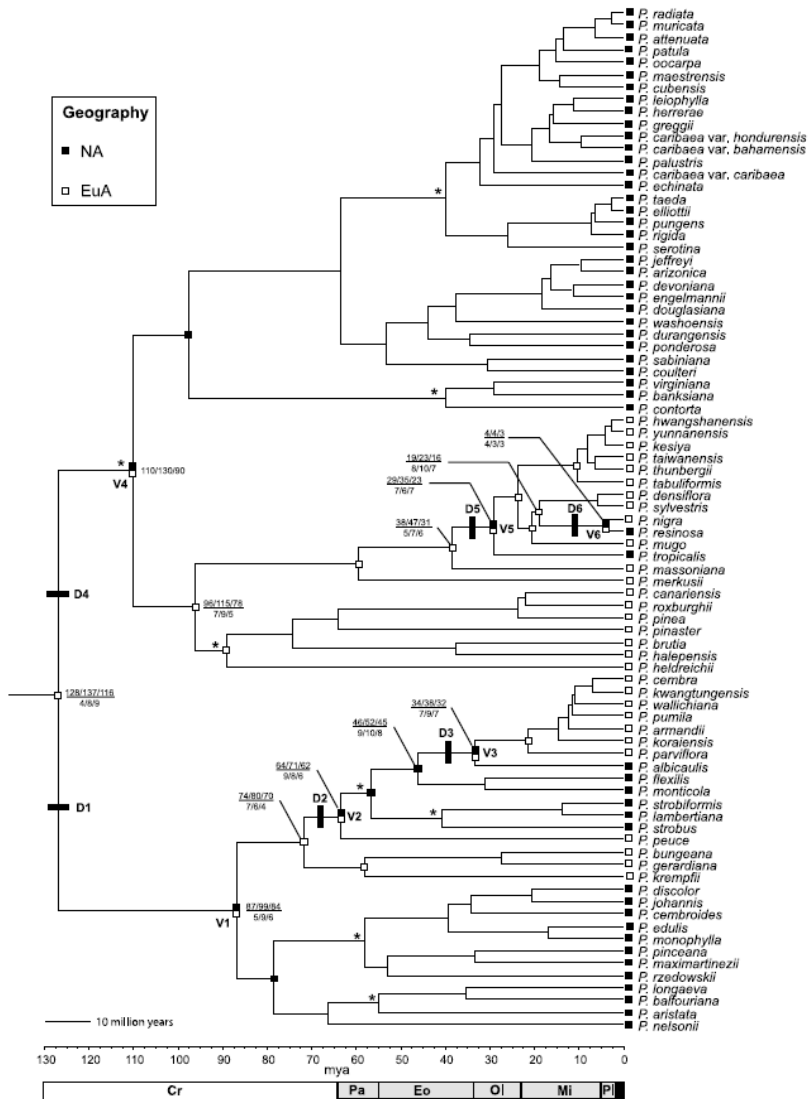
Millar, 1993

- Oldest fossil: 130 Myr

PHYLOSPACE – ANR funded project – Alain Franc – INRA Bordeaux

« To associate phylogenies & biogeography to better constrain the impact of climate on communities »

A.J. Eckert, B.D. Hall / Molecular Phylogenetics and Evolution 40 (2006) 166–182

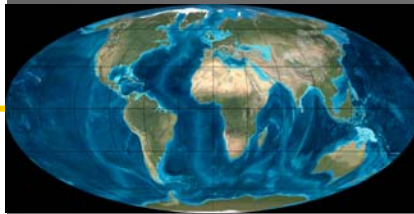
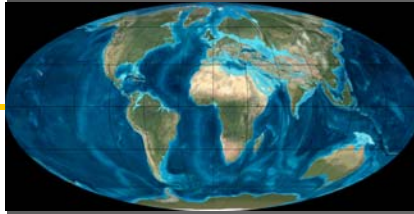
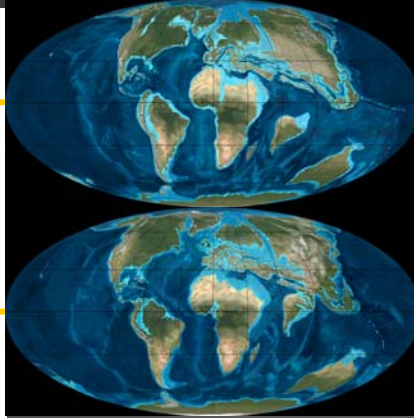
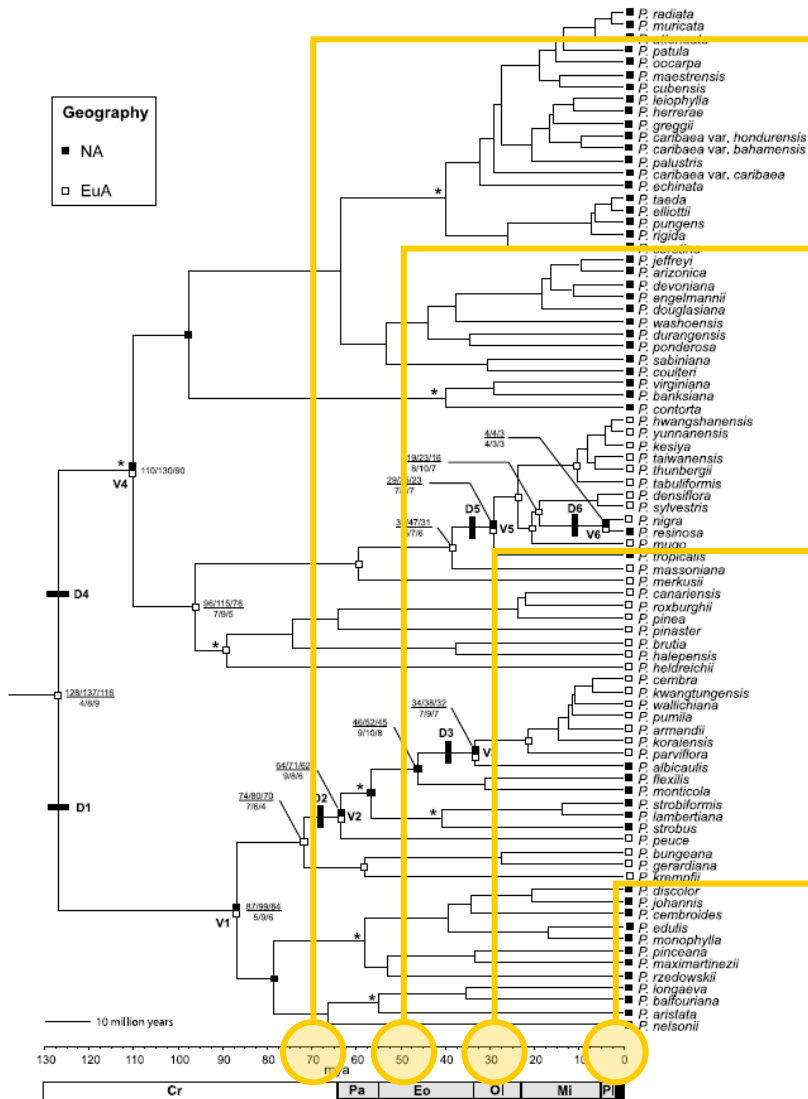


Climate constraints are necessary to decipher between different migration scenarios

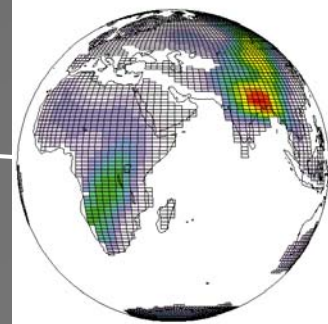
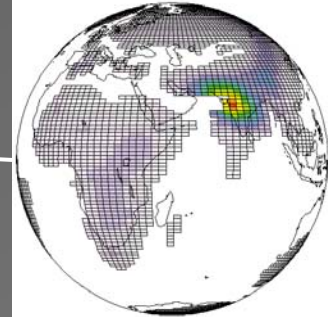
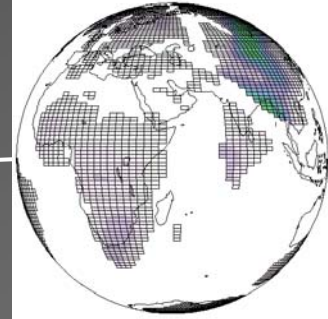
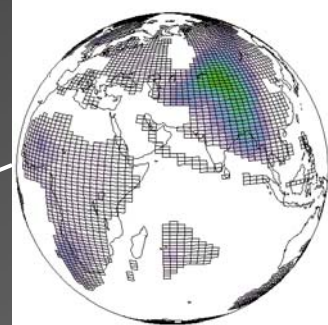
PHYLOSPACE – ANR funded project – Alain Franc

Our strategy : Time-slices modeling | Postdoc Guillaume Dera

A.J. Eckert, B.D. Hall / *Molecular Phylogenetics and Evolution* 40 (2006) 166–182



courtesy R. Blakey



To summarize...

-Expertise in deep-time climate modelling... with focus on :

Impact of paleogeography on climate processes

Developing collaborations to :

-Constrain paleogeography

-Develop new methods to link climate-life evolution through time