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Retrieving past climates from fossil floras: combination of variational data assimilation and coexistence approach.

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The aim of this research work is the development of a methodology for drawing past vegetation maps and palaeoclimatology reconstruction using observation based on fossil floras. For this purpose we use the coexistence approach (Mosbrugger and Utescher 1997), a well-established method for reconstructing past climate, and we develop a variational data assimilation system based on the CARAIB global dynamic vegetation model (Otto et al., 2002; François et al., 2006; Galy et al., 2008).
The coexistence approach has been applied to numerous fossil floras of the Cenozoic and has proven to produce very reliable results (e.g., Mosbrugger et al. 2005). It follows the nearest living relative concept and is based on climatic requirements of extant plants identified as representatives of the fossil taxa. These are obtained by listing the climatic conditions of the areas in which these extant representatives exist today. By using a database of extant taxa and their climatic requirements, "coexistence intervals" of different climatic parameters can be calculated that allowed the majority of considered plant taxa to exist at that location.
The variational data assimilation system is designed to use climate inputs reconstructed from the proxies by the coexistence approach as a background knowledge of the (unknown) control variable, and the observations from fossil floras for the "system cost function" formulation.
Here we present a preliminary study, in applying the methodology on present-day conditions and a Tortonian time slice. First floras are simulated with the CARAIB model using global paleoclimatic model simulations (A. Micheels et al. 2007) for the studied period. In a next step the coexistence approach is applied to the simulated floras and the reconstructed climate is then used to initialise the variational data assimilation system, employing the simulated floras as "observation".
This preliminary study allows on the one hand to quantify how reliable the climate reconstruction obtained from the present method on the other hand, approximations of error matrices for applications on poorly known paleoclimatic time intervals can be derived.