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Sensitivity of the late Eocene asian climate and vegetation to orbital and CO_2 forcing: a model-data comparison

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The middle to late Eocene period has been often referred to as the « doubthouse », as it represents the transition between the Paleocene/early Eocene warm and ice-free «greenhouse» and the colder and dryer Oligocene «icehouse». This transitional period was marked by a decrease in pCO_2, oceanic circulation modifications and the inception of the Antarctic ice sheet and is coeval with important paleogeographic changes, notably the retreat of the proto-Paratethys sea and the uplift of the Tibetan Plateau.

These different factors most probably may have had a role in regional climatic changes observed in Asia across this interval, such as a marked continental aridification and the possible inception of monsoon-like climatic patterns, as recent data seems to suggest (Licht et al., 2014, Spicer et al., 2017). However, possible causes of the onset of Asian monsoons in conditions such as those in the late Eocene (40–34 Myr ago) are still poorly understood and challenge the commonly accepted monsoonal onset in way colder conditions around the Early Miocene (Guo et al., 2002). Moreover, little is known about the Eocene climate sensitivity to orbital forcing, although sedimentary formations in China seem to record very clearly an orbital forcing at that time (Abels et al., 2011; Dupont-Nivet et al., 2007).

We present here a global late Eocene model-data comparison realized with the fully coupled IPSL-CM5A2-VLR model, and the dynamic vegetation facility of the ORCHIDEE model. A first quantitative comparison is realized with continental and oceanic proxy data in order to assess the overall ability of the model to reconstruct the late Eocene climatic conditions. We then focus on Asia, using more qualitative arguments, in order to compare biome reconstruction from palynological studies and the results obtained with the dynamic vegetation model. In the light of these results, we evaluate the likelihood of the existence of a monsoonal circulation at this time and its sensitivity to orbital forcing and CO_2 atmospheric concentrations.