Project: **1006**

Project title: **Simulations of the Mid-Piacenzian Warm Period (~3.3-3.0 Ma BP) in the framework of the Pliocene Model Intercomparison Project Phase 2 (PlioMIP2)**

Project lead: **Gerrit Lohmann**

Report period: 01.07.2020 – 30.06.2022

Over the last allocation period we have further analyzed a large set of simulation output from a predecessor model. This culminated in two first author publications (Stepanek et al., 2020; Samakinwa et al., 2020) and in total eleven co-author publications in the context of PlioMIP2 and beyond that project. The co-author publications aimed at exploring the large scale patterns and dynamics of mid-Pliocene climate via means of model-model and model-data comparison. Topics addressed include large-scale climate patterns and climate sensitivity of the mid-Pliocene (Haywood et al., 2020), a quantification of model-data agreement between the PlioMIP2 mid-Pliocene model ensemble and various types of SST reconstructions and a discussion of apparent model-data discords (McClymont et al., 2020), characteristics of the El Nino Southern Oscillation during the mid-Pliocene (Oldeman et al., 2021), Arctic warming in the mid-Pliocene relative to modern climate and global mean (de Noijer et al., 2020), extent, intensity and position of the West African Monsoon (Berntell et al., 2021), a quantification of precipitation patterns across the tropical and suptropical Southern Hemisphere (Pontes et al., 2020) and an analysis of the mid-Pliocene hydrological cycle (Han et al., 2021) and hydroclimate of the mid-Pliocene (Ran et al., 2022), as well as a study of characteristics of meridional transport of mass and heat via the Atlantic Ocean Meridional Overturning Circulation (Zhang et al., 2021). We have extended our PlioMIP2 inspired modelling work also beyond the direct framework of the model-intercomparison project. As a spinoff of our contribution to PlioMIP2 we employed the reference mid-Pliocene setup of PlioMIP2 to investigate importance and impact of overflow of Mediterranean water on the circulation of the Atlantic Ocean together with scientists from University of Potsdam and University of Heidelberg and their team (Kaboth-Bahr et al., 2022) - our contribution consisted of simulation, analysis and discussion of Mediterranean Overflow Water in the mid-Pliocene. Collaborating scientists provided an analysis of proxy data and of proxy-based interpretation of large scale circulation in the Atlantic Ocean / Mediterranean realm during the mid-Pliocene. None of the collaborating scientists were related or affiliated to PlioMIP2 in any way. One important publication that paves the way for the ba1006 project proposal for allocation period 2022/2023 is the study by Lohmann et al. (2022) where we have analyzed the impact of uncertainty in ocean model vertical mixing parameters on large scale climate of Miocene and mid-Pliocene - and in particular on the extent of warming provided by the models at high latitudes and in the deep ocean (see application document). In these regions current PlioMIP2 simulations still show a considerable degree of disagreement with respect to proxy-based reconstructions of high latitude sea surface and deep ocean temperature, respectively. Results and inferences derived from that study, and reflection on the work done by Streffing et al. (2022), have provided our rationale for devising a proposal for an AWI-INSPIRES PhD-project. In this project we aim to study sensitivity of the AWI-CM3 to variations in model parameters and quantifying the related uncertainty in simulated Mid-Pliocene climate. The AWI-INSPIRES project has been successfully evaluated and will start

in summer 2022. We are currently selecting from two remaining very qualified candidates with experience in climate modelling. The main investigating scientist Christian Stepanek has just come back from a prolonged paternal leave. He will supervise the prospective PhD-student in the modelling work.

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