Scientific Rationale

The Pliocene epoch (~ 5.33 to 2.59 Ma) is the last sustained interval of geological time when global climate (marine and terrestrial) was significant warmer than today (Haywood et al., 2009; Naafs et al., 2010; Dowsett et al., 2012). During the late Pliocene the warm and relatively stable climate of the Pliocene ended as the glaciation of the Northern Hemisphere intensified and large continental circum-North Atlantic ice sheets developed.

The latest reconstructions of atmospheric pCO_2 concentrations indicate that during the Pliocene pCO_2 was higher than pre-industrial and comparable or slightly higher than current (anthropogenic) values (Pagani et al., 2010; Bartoli et al., 2011; Badger et al., 2013). At the same time, global sea level was significantly higher, indicating much smaller continental ice sheets compared to the present (Raymo et al., 2011). Proxy data and modeling results suggest that the warm Pliocene climate was characterized by a more extreme climate state with permanent El Niño-like conditions and more frequent and/or intense hurricanes (Wara et al., 2005; Fedorov et al., 2010). This is in-line with recent observations and a predicted outcome of anthropogenic warming (Meehl et al., 2007). As such the Pliocene is considered as a good potential analogue for a globally warmer planet. The advantage of the Pliocene over other periods of global warmth (e.g., PETM) is that during the Pliocene the configuration, vegetation cover, and large-scale circulation patterns were broadly similar to today (Salzmann et al., 2008; Salzmann et al., 2011).

However, the precise dynamics of the climate system during the Pliocene warm period are still poorly understood and constrained. Crucial gaps in our current knowledge involve the precise modes of (deep) ocean circulation, extent of warming in the high-latitudes, the magnitude of glacial/interglacial variations in atmospheric pCO_2, and ice sheet extent in both hemispheres during the Pliocene. In addition, the causes for the termination of the Pliocene warmth and onset of Quaternary climate during the intensification of Northern Hemisphere glaciation is still debated. Determining the complete response of the climate system to prolonged periods of elevated pCO_2 and overall warm conditions, especially within the high-latitudes, is crucial for our understanding of future anthropogenic climate change and a key challenge for the new phase of ocean drilling (Science Plan Writing Committee, 2011).

Following the successful Pliocene workshop in Bordeaux in 2009, the aim of this workshop is to bring together approximately 40 scientists from both the international proxy data and modeling communities in order to define and discuss the most prominent outstanding research questions regarding Pliocene climate. Recent data-model comparisons have highlighted the importance of the Pliocene to provide new perspectives and insights into the predictive abilities of models in simulating warm climates (Dowsett et al., 2012; Haywood et al., 2013). However a focused and coordinated effort is needed to collectively tackle gaps in both models and proxy data and increase our understanding of this critical interval in Earth history.

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