



Data quality in different paleo archives and covering different time scales: a key issue in studying tipping elements.

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Although the Earth system is described to react relatively abruptly to present anthropogenic forcings, the notion of abruptness remains questionable as it refers to a time scale that is difficult to constrain properly. Recognizing this issue, the tipping elements as listed in Lenton et al. (2008) rely on long-term observations under controlled conditions, which enabled the associated tipping points to be identified. For example, there is evidence nowadays that if the rate of deforestation from forest fires and the climate change does not decrease, the Amazonian forest will reach a tipping point towards savanna (Nobre, 2019), which would impact the regional and global climate systems as well as various other ecosystems, directly or indirectly (Magalhães et al., 2020). However, if the present tipping elements, which are now evidenced, are mostly related to the present climate change and thus directly or indirectly related to anthropogenic forcing, their interpretation must still rely on former cases detected in the past, and especially from studies of abrupt climatic transitions evidenced in paleoclimate proxy records. Moreover, recent studies of past changes have shown that addressing abrupt transitions in the past raises the issue of data quality of individual records, including the precision of the time scale and the quantification of associated uncertainties. Investigating past abrupt transitions and the mechanisms involved requires the best data quality possible. This can be a serious limitation when considering the sparse spatial coverage of high resolution paleo-records where dating is critical and corresponding errors often challenging to control. In theory, this would therefore almost limit our investigations to ice-core records of the last climate cycle, because they offer the best possible time resolution. However, evidence shows that abrupt transitions can also be identified in deeper time with lower resolution records, but still revealing changes or transitions that have impacted the dynamics of the Earth system globally. TIPES Work Package 1 will address these issues and collect paleorecords permitting to evidence the temporal behavior of tipping elements in past climates, including several examples.

Lenton T. et al. (2008). PNAS 105, 1786-1793.

Nobre C. (2019). Nature 574, 455.

Magalhães N.d. et al. (2020). Sci. Rep. 16914 (2019) doi:10.1038/s41598-019-53284-1

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