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ACCEPTED MANUSCRIPT

The accuracy of mid-Pliocene $\delta^{18}O$-based ice volume and sea level reconstructions

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Abstract

Understanding the sensitivity of the polar ice caps to a modest global warming (2-3°C above preindustrial) is of paramount importance if we are to accurately predict future sea level change, knowledge that will inform both social and economic policy in the coming years. However, decades of study of the Pliocene (2.6-5.3 Ma), an epoch in recent Earth history characterized by atmospheric CO_2 levels similar to today, have so far failed to provide definitive sea level and ice volume estimates for that time. Here we review the sources of uncertainty in the paired Mg/Ca-$\delta^{18}O$ methodology used to estimate past sea level, ice volume, and ocean temperature, as well as discuss common assumptions that may bias our interpretation of ocean geochemical records including the LR04 benthic-$\delta^{18}O$ stack, a global compilation of 57 oxygen isotope records that forms the standard template of climate change history for the last 5.3 million years.

Keywords: sea level, ice volume, paleoceanography, paleoclimate, geochemistry

1. Introduction

The degree of polar ice sheet decay that occurs during periods slightly warmer than today has been the subject of much scrutiny within the paleoclimate and sea level research community in recent years [*Kopp et al.*, 2009; *Naish et al*., 2009; *Blanchon et al.,* 2009; *Raymo & Mitrovica*, 2012; *Cook et al.*, 2013; *Rohling et al*., 2014; *Dutton et al*., 2015; and *Kemp et al*. 2015, among others]. In particular, many researchers have focused their attention on the Mid-Pliocene Warm Period (MPWP; ~3.2 to 2.9 m.y., Figure 1), an interval characterized by a climatic regime ~2-3°C warmer on average than preindustrial values

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