

Very long term change in oceanic through flow

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Abstract

1 Introduction

In the last 65 Ma in our history major changes have occurred in the climate of the earth. One of the changes that is studied intensively is the change in geometry of the earth. In this period the earth moved from having one major oceanic system in the Atlantic to having the 3 oceanic systems we now know. The exact timing of passage openings in the worlds oceans is a topic of rigorous debate[2][3]. Studying the effects of this change in geometry has in the past resulted in major challenges changing the bathymetry in many models is exceedingly difficult. Papers often focus on simplified geometries taking instead using records on temprature and CO2 data to model the changes in the climate.[4].

This paper will focus solely on changes in bathymetry using very simplified zonally averaged global forcings to estimate global changes in oceanic through flow and strength of the meridional overturning currents (MOC).

Ocean modeling has long been an area of continued progress. The resolutions of the models has been increasing steadily since the inception of the first digital models. However, due to the age of some of these models and the continued adaptation of often old legacy Fortran code, the older models have become enormous hurdles to get started. The Veros [Hafner2018Aug] ocean model is trying to tackle this problem with a totally new code base written entirely in Python. Veros allows easy editing of forcing and geometry input and infinite flexibility in the model's setup.

The earth's geometry has undergone massive changes since it's inception. One of the major

changes in the oceanic bathymetry is the inception and expansion of the Atlantic ocean and the resulting decrease in size of the Pacific oceanic basin. The inception of the Atlantic has had major effects on the earth's climate and might explain

2 Methods

About veros Parameters chosen Highly idealised oceanic basin Highly idealised oceanic forcing About the overturning currents

converting the data from [1] to veros

ignoring many things idealized global temprature profile idealized global salinity idealized global wind stress

3 Results

4 Summary

References

- [1] R. Dietmar Müller et al. "Long-term sea-level fluctuations driven by ocean basin dynamics". In: *Science* 319.5868 (2008), pp. 1357–1362. ISSN: 1095-9203. DOI: 10.1126/science.1151540.
- [2] Howie D. Scher and Ellen E. Martin. "Timing and Climatic Consequences of the Opening of Drake Passage". In: *Science* 312.5772 (2006), pp. 428–430. ISSN: 0036-8075. DOI: 10.1126/science.1120044.

- [3] D. N. Schmidt. “The closure history of the Panama Isthmus: Evidence from isotopes and fossils to models and molecules”. In: *ResearchGate* (2007), p. 429444. URL: https://www.researchgate.net/publication/282323290_The_closure_history_of_the_Panama_Isthmus_Evidence_from_isotopes_and_fossils_to_models_and_molecules.
- [4] M. Tigchelaar, A. S. von der Heydt, and H. A. Dijkstra. “A new mechanism for the two-step $\delta^{18}\text{O}$ signal at the Eocene-Oligocene boundary”. In: *Clim. Past* 7.1 (2011), pp. 235–247. ISSN: 1814-9324. DOI: 10.5194/cp-7-235-2011.