EGU2020-596
https://doi.org/10.5194/egusphere-egu2020-596
EGU General Assembly 2020

Back to the future 3: Analysing tectonically induced tidal resonance with conceptual models

Hannah Davies[1,2], J.A. Mattias Green[3], and Joao C. Duarte[1,2,4]
[1]Lisbon University, Faculdade de Ciências, Departamento de Geologia, Campo Grande, 1749-016, Lisboa, Portugal (hdavies@fc.ul.pt)
[2]Instituto Dom Luiz (IDL), Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016, Lisboa, Portugal
[3]School of Ocean Sciences, Bangor University, Askew St, Menai Bridge LL59 5AB, UK
[4]School of Earth, Atmosphere and Environment, Monash University, Melbourne, VIC 3800, Victoria, Australia

Recent research of coupled tidal and tectonic modelling has found that during periods in an ocean's Wilson cycle, (i.e. during dispersal, and subsequent convergence of oceans due to plate tectonic movement), oceans occasionally become resonant for the semi-diurnal component of the tide (M_2). This results in an approximately 20-Million-year long period of enhanced tidal dissipation in the resonant ocean (assuming continental plate drift rates of ~5 cm yr^{-1}). This resonant "Super-tide" has been simulated in numerical tidal models for both past and future tectonic scenarios, and they show that the current tides are among the most energetic found.

Here we use an established tidal model to analyse the conditions required for open ocean tidal resonance. Our conceptual "Earths" consist of two or more simplified oceans, which are shaped to represent conceptual versions of oceans of the past, present, and future: triangular (Tethys ocean), circular (Pacific and Arctic oceans), rectangular (Southern and Indian oceans), and rhomboid shaped (North, and South Atlantic Ocean). Each scenario was conducted using ocean bathymetry ranging from a "bathtub" ocean (a uniformly deep flat abyssal plane from coast to coast), to a continental shelf with no abyssal bathymetry, to a "realistic" ocean with ocean shelves, ridges, and subduction zones. The global ocean land ratio and ocean volume was conserved to present-day in most conceptual scenarios however, to investigate the maximum tidal dissipation possible on Earth, some scenarios deviated from the ocean volume and global coverage. In every scenario, ocean width is progressively increased relative to the predominant ocean boundaries, simulating plate tectonic opening of each ocean.

The aim of the work was to assess the frequency of the occurrence of resonance in the open ocean, and the upper limit for tidal dissipation of the semi-diurnal tide on Earth. We found that super-tides are common in the results with their dissipative strength varying from weaker than present day to five times present day.

The occurrence of tidal resonances in modelled conceptual oceans further confirms the link between tectonics and tidal evolution. These super-tidal periods of markedly increased tidal dissipation alter the ocean's energy budget, nutrient dispersal and the carrying capacity of coastal

and oceanic ecosystems.

How to cite: Davies, H., Green, J. A. M., and Duarte, J. C.: Back to the future 3: Analysing tectonically induced tidal resonance with conceptual models, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-596, https://doi.org/10.5194/egusphere-egu2020-596, 2019