History of the Australian region since the Cretaceous: Assimilation plate tectonic data into a regionally-globally coupled geodynamic model

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Australia experienced first order, broad-scale vertical motions since the Cretaceous that were likely related to the horizontal motion of the continent over slabs (DiCaprio, et al., 2009). To more closely link the geological evolution of the continent over the mantle, we developed a new method based on a plate tectonic system and a model of mantle convection. First, we assimilated realistic boundary conditions: Plate kinematics, the evolving ages of oceanic plates, the lithospheric structure of continents, low viscosity within mantle wedges, and large-scale geochemical domains. Second, to provide the requisite high resolutions needed for the previous data sets, we used high-resolution regional models that were coupled into a low-resolution global model using framework-based *CitcomS* solvers (Tan, et al., 2006). We investigated the passage of subducted material beneath the South West Pacific since 140 Ma. These multi-scale resolution models use the deformation field of the global model as the boundary condition on the embedded solver which provides more natural boundary conditions on the regional solver than reflecting or periodic boundary conditions. We constrain the layered viscosity and initial conditions of the model to match geologic observations of dynamic topography (DiCaprio, et al., 2009) and seismic tomography. Our preferred model reproduces the expected tilt of the Australian continent as it approaches the subduction realm in South East Asia. The passage of the slab satisfies geological observations and predicts patterns of inundation and uplift across the Australian continent from 140 Ma to present.

We use the finite element package *CitcomS Version 2.2*, with coupled solvers, particle tracers and global mantle flow available from the Computational Infrastructure for Geodynamics (CIG).

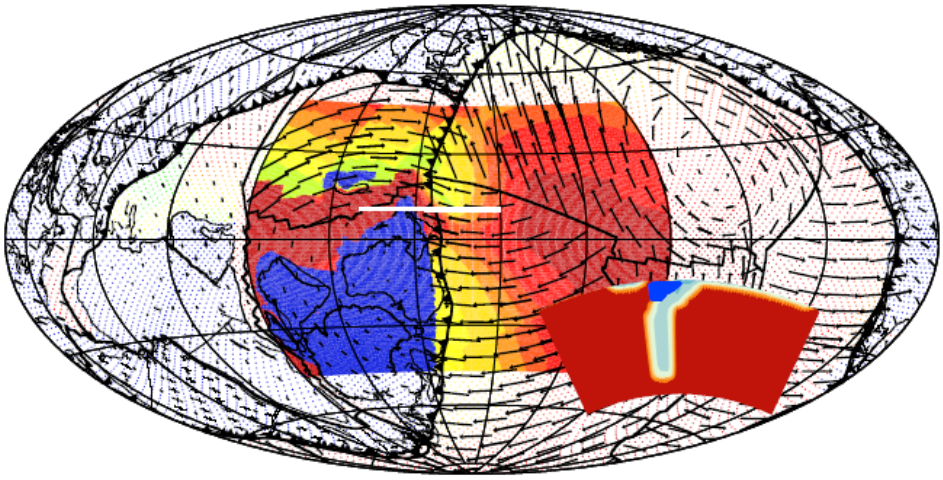

Figure 1: The assimilation of data into multiscale geodynamic models includes lithospheric age (colored background), plate velocity (vectors) and an initial subducting slab (inset) with a low viscosity mantle wedge (dark blue) and buoyant continents.

References

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