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Constraining carbon inputs during the onset of OAE 1a via inverse modelling

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The Aptian Oceanic Anoxic Event (OAE) 1a (~120 Ma) represents a major disruption of the global carbon cycle and is recorded in marine sediments from all major ocean basins. Stable carbon isotope ($\delta^{13}C$) records, a widely used proxy for carbon cycle changes, show a significant decrease during the onset of OAE 1a, followed by a broad positive excursion. The initial negative $\delta^{13}C$ excursion suggests an input of isotopically-depleted carbon into the Earth system at the onset of OAE 1a. However, interpretation of the nature of the OAE 1a carbon cycle perturbation (carbon source, carbon flux, and environmental effects) is complicated by uncertainty as to the duration of the different stages of OAE 1a, particularly the negative $\delta^{13}C$ excursion. To constrain the magnitude and source of the OAE 1a carbon input, we test the implications of the proposed OAE 1a timescales and their reconcilability with other proxy data using the biogeochemical ocean model of intermediate complexity cGENIE. In a series of experiments using a variety of OAE 1a timescale assumptions, our model will be forced to follow the proxy reconstructed atmospheric CO_2 concentration and $\delta^{13}C$ evolution throughout the onset of the OAE. The results will allow us to extract for each timescale assumption the magnitude and $\delta^{13}C$ signature of carbon inputs required to reproduce the recorded $\delta^{13}C$ and pCO_2. Furthermore we investigate the impact of the OAE1a onset timescale on other aspects of the Earth's system (anoxia, pH and carbonate saturation state).