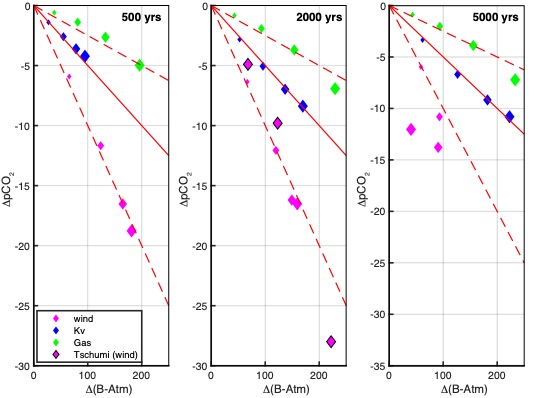
**Table S1.** B-Atm and atmospheric CO2 anomalies obtained for sensitivity experiments, evaluated at a series of time intervals, using the Bern3D model under varying Southern Ocean wind, Southern Ocean gas-exchange, vertical diffusivity, or all combined (as illustrated in Figure 9 of the main text). INT refers to runs with prescribed atmospheric radiocarbon (as per Intcal20 (Reimer et al., 2020)), FIX refers to runs with fixed atmospheric radiocarbon, and CONST refers to runs with constant radiocarbon production rates*.*

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**Figure S1.**

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**Figure S1.** Theoretical and modelled sensitivity of atmospheric CO2 anomalies and mean ocean radiocarbon ventilation age (B-Atm) anomalies to changing air-sea gas exchange and transport changes, as driven by step changes under PI conditions for: Southern Ocean winds (purple diamonds); Southern Ocean gas exchange (green diamonds); vertical diffusivity (green diamonds). Purple diamonds with black outline indicate results from (Tschumi et al., 2011). Panels indicate the response after 500, 2000 and 5000 years of equilibration. Red lines indicate a theoretical range of sensitivities, as described in the main text.

**Figure S2.**

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**Figure S2.** As for Figure 5 of the main text, but for the ‘high sedimentation’ (>10cm/kyr) data flag scenario. Zonally averaged interpolated B-Atm radiocarbon age offsets for the LGM, HS1, BA, and YD (Pacific zonal averages at left, Atlantic at right). Filled circles and shading indicate input data and values*.*

**Figure S3.**

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**Figure S3.** As for Figure 7 of the main text, but for the ‘high sedimentation’ (>10 cm/kyr) data flag scenario. Zonally averaged interpolated B-Atm offsets for the LGM, BA, EHOL and HOL (Pacific zonal averages at left, Atlantic at right). Filled circles and shading indicate input data and values.

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