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The Southern Ocean as a driver of centennial to millenial timescale radiocarbon variations

K.B. Rodgers (1), D. Bianchi (1), E. Galbraith (1), A. Gnanadesikan (2), D. Iudicone (3), S. Mikaloff Fletcher (1), J.L. Sarmiento (1), and R.D. Slater (1)

(1) AOS Program, Princeton University, Princeton, USA (krodgers@princeton.edu), (2) Geophysical Fluid Dynamics Laboratory (GFDL), Princeton USA, (3) Stazione Zoologica "A.Dohrn", Naples, Italy

Paleo-proxy records reveal large delta-c14 variations for both the atmosphere and the ocean on centennial to millenial timescales. One of the most pronounced examples is the onset phase of the Younger Dryas, when atmospheric delta-c14 rose by 70 per mil in only 200 years. Another is the most recent deglaciation (and the associated "Mystery Interval"). Many of the significant centennial to millenial transients in atmospheric delta-c14 are reflected in ocean interior delta-c14 at intermediate depths in the Pacific over the last 50kyrs. An ocean model has been used to test the idea that only modest perturbations to Southern Ocean winds provides a means to link the oceanic and atmospheric delta-c14 variations. Perturbations to the winds over the Southern Ocean are able to drive sizable decoupling of the fluxes of 14CO2 and 12CO2 over the Southern Ocean, thus modifying atmospheric delta-c14. These same perturbations are able to perturb rapidly the depth of intermediate water horizons in the North Pacific through the passage of baroclinic planetary (Rossby) waves. This sensitivity is significantly stronger than what previous studies have found for perturbations to the Meridional Overturning Circulation (MOC) in the North Atlantic. It is suggested that delta-c14 may provide a powerful tracer for understanding past variations in the climate system.