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Reconstruction of Heinrich events characteristics by means of isotopic modelling in a coupled model of intermediate complexity

D. M. Roche (1,2), D. Paillard (1), E. Cortijo (1), V. Brovkin (3)

(1) IPSL/Laboratoire des Sciences du Climat et de l'Environnement, CEA-CNRS bat. 701, Orme des Merisiers, 91191 Gif s/s Yvette Cedex (2) Department of Paleoclimatology and Geomorphology, Faculty of Earth and Life Sciences, Vrije Universiteit Amsterdam, De Boelelaan 1085, NL-1081 HV Amsterdam (Didier.Roche@falw.vu.nl) (3) Potsdam Institut fuer Klimafolgenforschung, Pf. 60 12 03, D-14412 Potsdam

The presence of layers rich in Ice Rafted Debris (IRD) in sediment cores retrieved throughout the north Atlantic during the last glacial period has long been linked to the melting of icebergs. These abrupt events, the Heinrich events, persisted during the whole of the last glacial period. If there is a general agreement on the fact that large-scale instabilities of the Laurentide (and Fennoscandian) ice-sheets is the likely physical mechanism which leads to Heinrich Events, there is no such agreement on the characteristics of the events themselves. In particular evaluations of the duration and amount of freshwater released in the ocean are quite different when taken from different sources in the literature. Using a climate model of intermediate complexity, CLIMBER-2, including the oxygen isotope 18 and the carbon isotope 13, we simulate Heinrich event 4 (ca. 40 kyrs B.P.) and compare directly the obtained results with data from oceanic sediment cores. As the model used is of intermediate complexity and is therefore fast to run, we compare the results of a large ensemble of simulations covering a wide range of possible estimates for the duration and the amount of freshwater release to a comprehensive set of sediment cores data from the North Atlantic. The direct comparison between simulated oxygen-18 and oxygen-18 data from foraminiferal calcite through statistical analysis enables us to diagnose the duration and contribution of iceberg release with greatly reduced uncertainties. We show in particular that Heinrich Event 4 is likely to have lasted 250$\pm$ 150 years and contributed 2$\pm$1 meters to the sea-level rise. The result in duration is in good agreement with much sedimentological

evidence showing that Heinrich events where shorter than a millenium. We also compare the sea-level rise result with other estimations and discuss the reasons for likely discrepancies. To pursue further the data–model comparison, we also analyse the simulated carbon 13 isotope ratios with respect to sediment core data. An interpretation of this comparison is suggested in terms of oceanic circulation changes.