
Marine productivity response to Heinrich events: a model-data comparison

Véronique Mariotti^{*1}, Laurent Bopp², Masa Kageyama³, Alessandro Tagliabue⁴, and Didier Swingedouw⁵

¹Laboratoire des sciences du climat et de l'environnement (LSCE) – CEA, CNRS, UVSQ, CEA, CNRS
– LSCE-Vallée Bât. 12, avenue de la Terrasse, F-91198 GIF-SUR-YVETTE CEDEX, France

²Laboratoire des sciences du climat et de l'environnement (LSCE) – CEA, CNRS, UVSQ, CEA, CNRS
– LSCE-Vallée Bât. 12, avenue de la Terrasse, F-91198 GIF-SUR-YVETTE CEDEX, France

³Laboratoire des sciences du climat et de l'environnement (LSCE) – CEA, CNRS, UVSQ, CEA, CNRS
– LSCE-Vallée Bât. 12, avenue de la Terrasse, F-91198 GIF-SUR-YVETTE CEDEX, France

⁴Laboratoire des sciences du climat et de l'environnement (LSCE) – CEA, CNRS, UVSQ, CEA, CNRS
– LSCE-Vallée Bât. 12, avenue de la Terrasse, F-91198 GIF-SUR-YVETTE CEDEX, France

⁵Laboratoire des sciences du climat et de l'environnement (LSCE) – CEA, CNRS, UVSQ, CEA, CNRS
– LSCE-Vallée Bât. 12, avenue de la Terrasse, F-91198 GIF-SUR-YVETTE CEDEX, France

Résumé

Marine sediments records suggest large changes in marine productivity during glacial periods, with abrupt variations especially during the so-called Heinrich events. Here, we study the response of marine biogeochemistry to such an event using a biogeochemical model of the global ocean (PISCES) coupled to an ocean-atmosphere general circulation model (IPSL-CM4). We conducted a 400-year transient simulation under glacial climate conditions with a freshwater forcing of 0.1 Sv applied to the North Atlantic to mimic a Heinrich event, alongside a glacial control simulation. To evaluate our numerical results, we realized a compilation of all the available marine productivity records covering Heinrich events. We find that simulated primary productivity and organic carbon export decrease globally (15% for both) during a Heinrich event, albeit with large regional variations. The North Atlantic displays a significant decrease, whereas the Southern Ocean shows an increase, in agreement with paleo-productivity reconstructions. In the Equatorial Pacific, the model simulates an increase in organic matter export production but decreased biogenic silica export. This complex behaviour results from changes in relative uptake of carbon and silicic acid by diatoms. This study highlights the necessity of comparing marine biogeochemistry models under different climatic conditions with available data. For Heinrich events, it shows reasonable agreement for the large-scale response, giving confidence both in the model and in the paleo-productivity records.

*Intervenant