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Radiocarbon production over the Holocene - Influence of carbon-cycle variations

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Variations in reconstructions of cosmogenic nuclides, most prominently ^{10}Be and radiocarbon, have been used to infer solar variability. However, the relationship between measured records of the cosmogenic nuclides and its production rate and thus solar irradiance is complex.

The variability of the atmospheric radiocarbon signal recorded in tree rings is dominated largely by three parameters. First, the solar magnetic activity modulates the flux of galactic cosmic rays producing radiocarbon in the atmosphere. Second, the geomagnetic field strength modulates the shielding of galactic cosmic rays. Third, atmospheric radiocarbon is affected by carbon cycle dynamics.

Here, we extend our previous reconstructions of the radiocarbon production rate over the Holocene. The reconstruction is based on the analysis of recent reconstructions of atmospheric radiocarbon from tree rings for both hemispheres, using the Bern3D model, a 3-dimensional ocean - carbon cycle model, coupled to a four box representation of the land biosphere. The sensitivities of the production record to key carbon-cycle processes for the cycling of radiocarbon, among which are the air-sea gas exchange of CO_2, the strength of oceanic transport, and net primary production are examined.

Then, using a radiocarbon production model and a record of the geomagnetic field intensity, the influence of uncertainties in the carbon-cycle formulation on the inferred solar irradiance is estimated.