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Interpreting Be-10 records from ice cores: modelling of the atmospheric transport using the ECHAM5-HAM general circulation model

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The concentrations of the cosmogenic radionuclide Be-10, measured in ice cores, provide unique information about the past solar activity and geomagnetic field intensity. So far, it has been generally assumed that the deposition of Be-10 in polar regions is not much influenced by the climate. However, different records from Greenland and Antarctica deviate in detail indicating that the atmospheric transport of Be-10 from its origin to the archives needs to be investigated in more detail. To investigate to what extent climatic changes influence the Be-10 measured in ice we have simulated the atmospheric transport and deposition of Be-10 using the ECHAM5-HAM general circulation model during the Maunder Minimum period (MM), 1645-1715 AD, when solar activity was very low and the climate was colder (little ice age). Due to the low solar activity during the MM the mean global Be-10 production was higher by 32%. Our results show that the zonally averaged modelled Be-10 deposition flux deviates by only 8% from the average increase of 32%, indicating that climatic effects are much smaller than the production change. Due to increased stratospheric production, the Be-10 content in the downward fluxes is larger during MM, leading to larger Be-10 deposition fluxes in the subtropics, where stratosphere-troposphere exchange (STE) is strongest. These findings indicate that climate changes do influence the Be-10 deposition fluxes, but not enough to significantly disturb the production signal. Climate-induced changes remain small, especially in polar regions.