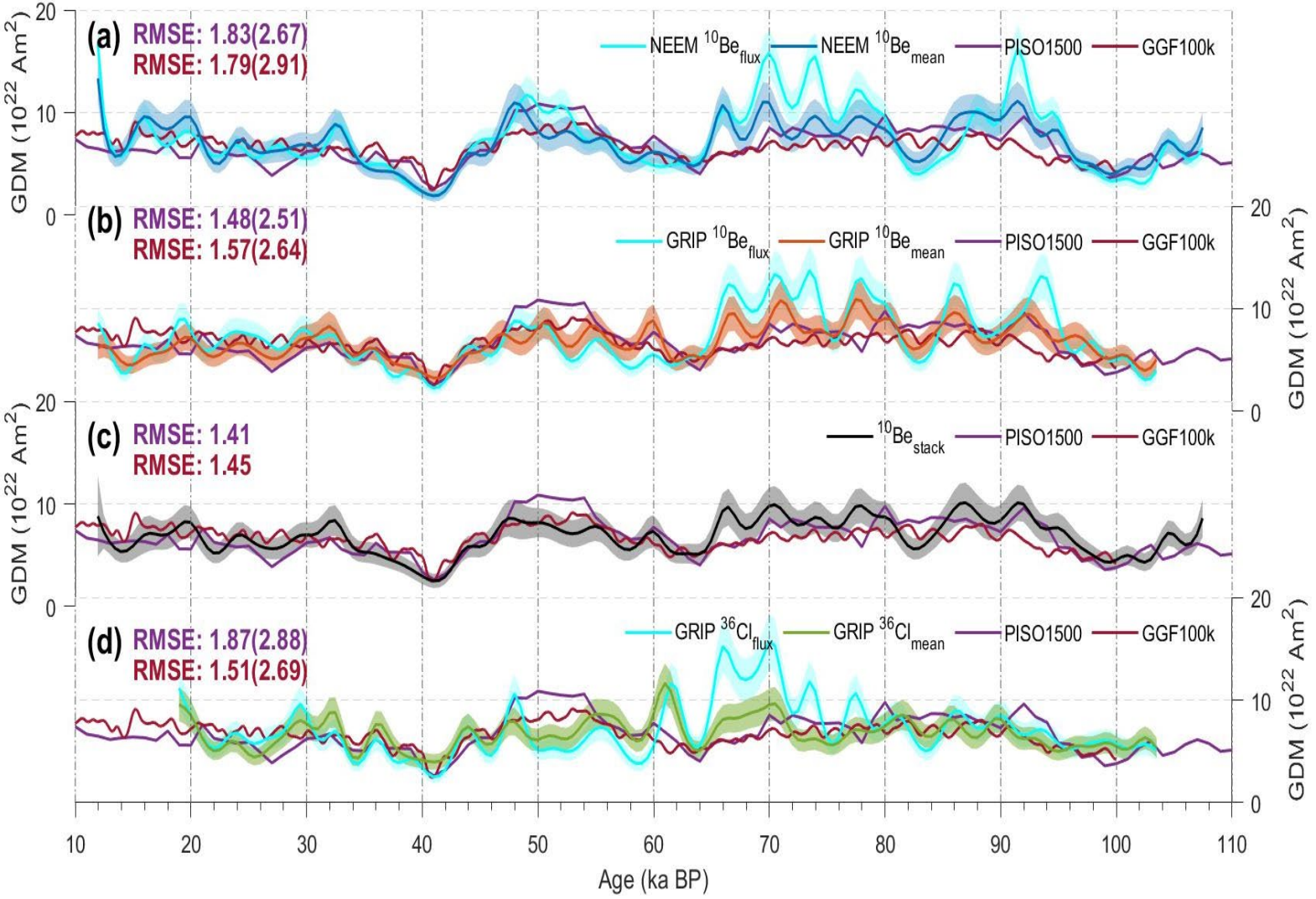
Introduction

The cosmogenic radionuclides provide a complementary method compared to traditional geomagnetic studies.

Highlights

- We present a new continuous ^{10}Be record from the NEEM ice core for 11.7-108 ka
- We assess and reduce the climate signal in the cosmogenic records by a multi-linear correction method
- The "climate correction" reconstructions ($^{10}Be_{mean}/^{36}Cl_{mean}$) lead to an improved agreement with independent reconstructions compared to simply using radionuclide fluxes

Fig 1. Comparison of averaged climate corrected records $^{10}Be_{mean}/^{36}Cl_{mean}$-based Geomagnetic Dipole Moment (GDM) reconstructions with the GGF100k [1] and PISO1500 [2]. The RMSE (Root Mean Square Error) is for $^{10}Be_{mean}/^{36}Cl_{mean}$ based GDM with PISO1500 (purple) and GGF100k (red) while in the bracket is for uncorrected $^{10}Be/^{36}Cl$ flux based GDM. The shaded area presents its 2 standard error based on uncertainties in the average GDM



Assess/Reduce the Climate Signal

- The $^{10}Be/^{36}Cl$ records from ice cores suggest a changing relationship with climate proxies, reflecting a mixture of climate and production signal on data that require separation to evaluate the changes in the GDM

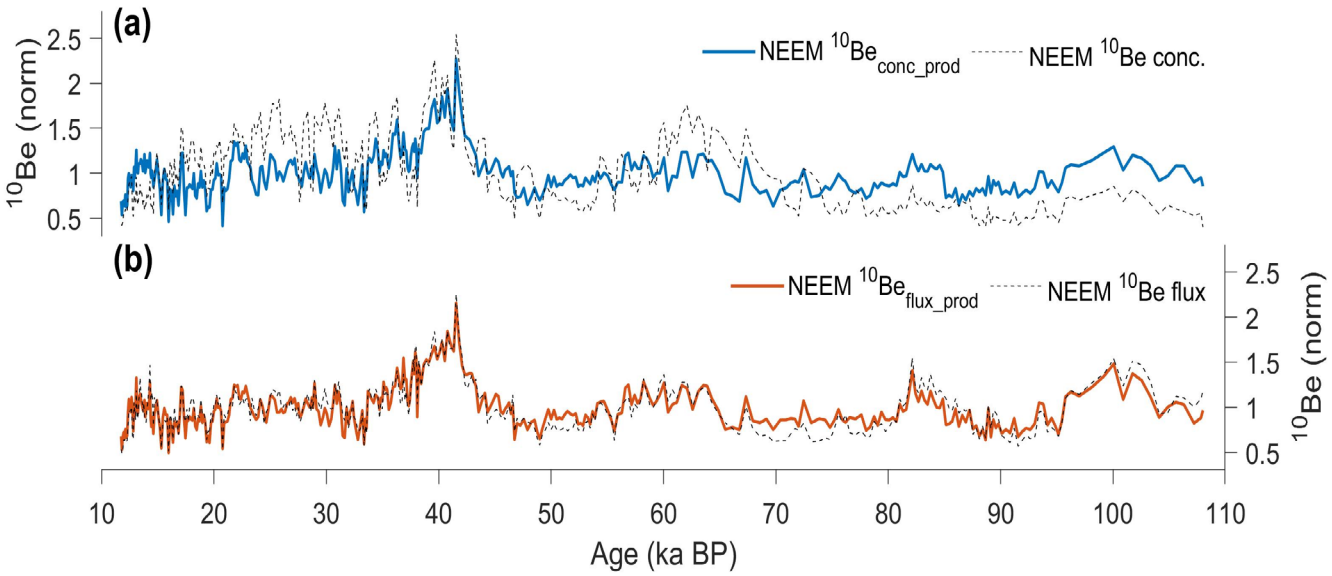
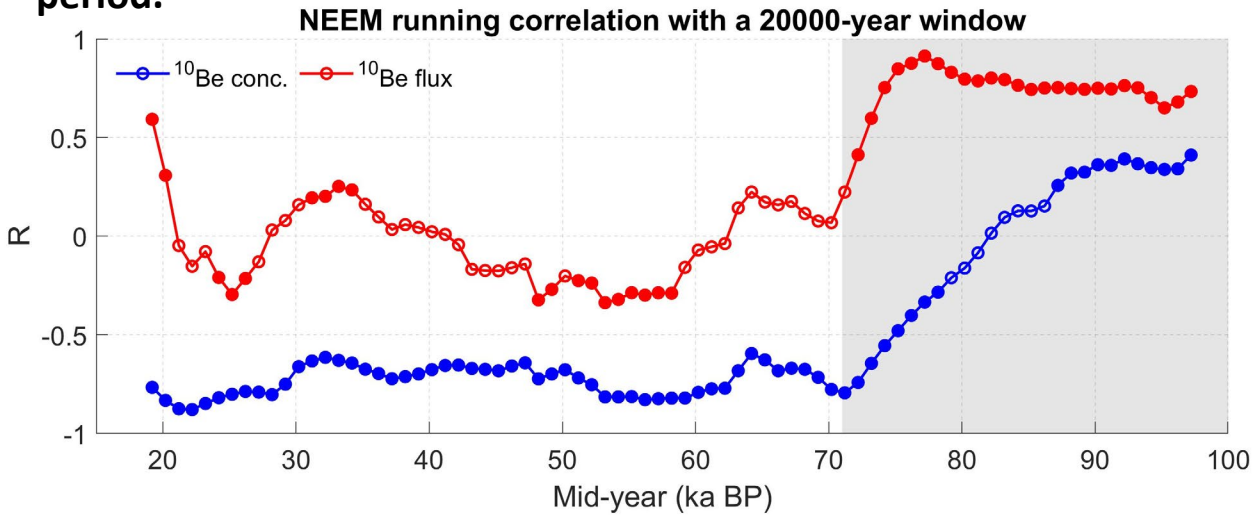


Fig 3. An example of NEEM climate-corrected records with the original records: (a) $^{10}Be_{conc\_prod}$ with concentration (b) $^{10}Be_{flux\_prod}$ with flux

Fig 2. An example of moving correlation between NEEM accumulation rates and ^{10}Be concentration/flux. The shaded area indicates MIS5 period.



To reduce the climate bias, we created the "climate corrected" records

- First, construct multi-linear regression between climate proxies and cosmogenic radionuclides data (e.g. ^{10}Be)
- Then, subtract this model dependency from the ^{10}Be, and denote the residuals as the climate corrected records ($^{10}Be_{flux\_prod}$ and $^{10}Be_{conc\_prod}$)
- We create the $^{10}Be_{mean}$ by averaging the $^{10}Be_{flux\_prod}$ and $^{10}Be_{conc\_prod}$

^{10}Be Conversion to Geomagnetic Dipole Moment

By assuming that climate corrected ^{10}Be is proportional to the global changes in ^{10}Be production rate, we can transfer the $^{10}Be_{mean}$ to the past GDM changes according to the production relationship[3]

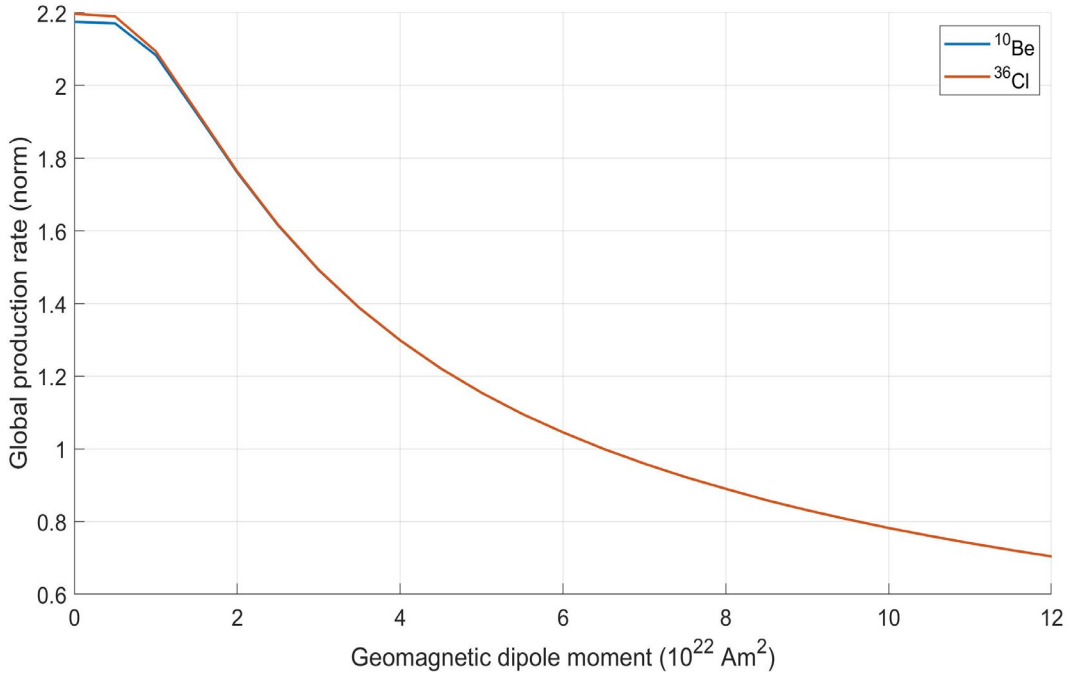


Figure 4. Dependence of relative ^{10}Be and ^{36}Cl global average production rate on GDM

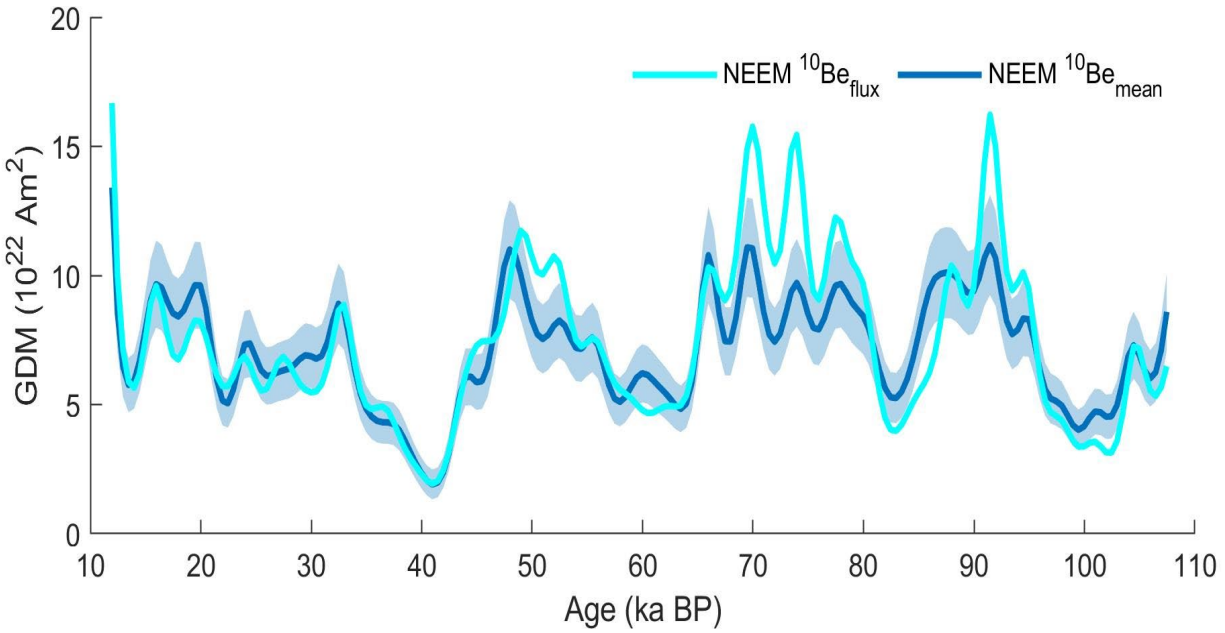


Figure 5. An example of GDM reconstruction based on averaged climate-corrected NEEM ^{10}Be records (NEEM $^{10}Be_{mean}$) and based on ^{10}Be flux ($^{10}Be_{flux}$).

Reconstruction of the geomagnetic dipole moment variation for the last glacial period based on cosmogenic radionuclides from Greenland ice cores

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[References]

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[1] Channell, J.E.T., Xuan, C., Hodell, D.A., 2009. Stacking paleointensity and oxygen isotope data for the last 1.5 Myr (PISO-1500). Earth and Planetary Science Letters 283, 14-23.

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