Project Details

ROSES ID: NNH07ZDA001N
Selection Year: 2008
Program Element: Focused Science Topic

Topic: Focused science topics for Strategic Goal 2 (Sun-Climate): Solar Modulation of the galactic cosmic rays and the production of cosmogenic isotope archives of longterm solar activity, used to interpret past climate changes.

Project Title:
The Long-Term Evolution of the Sun's Open and Closed Magnetic Flux and Its Relation to Cosmogenic and Geomagnetic Activity Records

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Summary:
OBJECTIVES: Cosmogenic isotope abundances are widely used to infer long-term changes in solar activity and solar irradiance, and thus in Earth's past climate. However, the cosmic rays that produce cosmogenic isotopes are modulated by the Sun's open magnetic flux, whose variation is not the same as that of the closed flux which controls the total irradiance. We intend to exploit our recent finding that it is the nonaxisymmetric component of the open flux that correlates best with the cosmic ray modulation. Our objectives are (1) to derive the variation of the Sun's open and closed flux from the Maunder Minimum to the present, using a realistic source term based on historical sunspot records; (2) to predict the long-term variation of geomagnetic activity, cosmogenic isotope abundances, and solar irradiance; and (3) to compare these predictions with observations.

APPROACH: Building on our earlier modeling efforts, we will evolve the photospheric magnetic field using a transport code that includes the effects of emerging flux (in the form of active and ephemeral regions), differential rotation, supergranular diffusion, and meridional flow. The idealized source term that we have used previously will be replaced by one in which the strengths, pole separations, axial tilts, and locations of the bipolar magnetic regions are derived from sunspot data from 1610 to the present. The open flux will be calculated via a source surface extrapolation of the photospheric field. Long-term cosmic ray modulation will be inferred from the nonaxisymmetric component of the open flux, and total solar irradiance will be derived from the simulated photospheric field. The predictions will be compared with cosmogenic isotope and cosmic ray data, as well as with auroral and geomagnetic activity records.

RELEVANCE: The proposed cross-disciplinary research directly addresses the LWS TR&T program's Focused Science Topic for Strategic Goal 2 (Sun-Climate): "Solar modulation of galactic cosmic rays and the production of cosmogenic isotope archives of long-term solar activity, used to interpret past climate changes."

Publication References:

no references