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The future evolution of the auroral zones

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The auroral zones indicate the locations on the Earth's surface where, on average, it is most likely to spot aurorae as a consequence of increased solar activity. The shape of the auroral zones and, similarly, the geographical locations most vulnerable to extreme space weather events are modulated by the geomagnetic field of internal origin. As the latter evolves in time, the formers will be subject to variations on the same timescales.

From available geomagnetic field forecasts (which provide an estimate of the future evolution of the geomagnetic field of internal origin) we derive AACGM latitudes and estimate the future evolution of the auroral zones. The novel aspect of this technique is that we make use of all available Gauss coefficients to produce the forecasts, while the majority of present techniques estimate the location of the auroral zones based on the dipolar coefficients only. Our results show that, while the shift of the geomagnetic dipole axis has a first order contribution, higher order Gauss coefficients contribute significantly to the location and shape of the auroral zones.

The same technique is then extended to estimate the future location of the geographical location that would be, on average, most exposed to extreme space weather event. We find that the space-weather related risk will not change significantly for the UK over the next 50 years. For the Canadian provinces of Quebec and Ontario, however, we predict a significant increase in the risk associated to extreme solar activity.