AI-Enabled Space Weather Predictions

The Sun constantly sheds solar material into space, both in a steady flow known as the “solar wind,” and in shorter, more energetic bursts from solar eruptions. When this solar material strikes Earth’s magnetic environment (its “magnetosphere”), it sometimes creates so-called geomagnetic storms. The impacts of these magnetic storms can range from mild to extreme, but in a world increasingly dependent on technology, their effects are growing ever more disruptive.

Geomagnetically induced currents (GICs) result from the interaction of the solar wind with Earth’s magnetosphere and are catastrophic to our technologically dependent society. Since GIC data is proprietary, the time variability of geomagnetic perturbations is used as a proxy, and forecasting these perturbations at high spatial resolution and time cadence is important.

This work developed a deep learning-based model to forecast these perturbation measurements at arbitrary spatial resolutions and at high time cadence, using only solar wind measurements. The model outperforms, or at worse has consistent performance with benchmark models, and can provide quick, accurate forecasts at high time cadence across the whole globe.