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Active Region Contributions to the Solar Wind Over Multiple Solar Cycles

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Both coronal holes and active regions are source regions of the solar wind. The distribution of these coronal structures across both space and time is well known, but it is unclear how much each source contributes to the solar wind.

We have used photospheric magnetic field maps from the past four solar cycles to estimate what fraction of magnetic open solar flux is rooted in active regions, a proxy for the fraction of all solar wind originating in active regions. The fractional contribution of active regions to the solar wind varies between 30% to 80% at any one time during solar maximum and is negligible at solar minimum, showing a strong correlation with sunspot number. While active regions are typically confined to latitudes $\pm 30^\circ$ in the corona, the solar wind they produce can reach latitudes up to $\pm 60^\circ$. Their fractional contribution to the solar wind is also highly variable, changing by $\pm 20\%$ on monthly timescales within individual solar maxima.

These results quantify the importance of active regions as solar wind sources, providing motivation for understanding active region solar wind heating and acceleration using Parker Solar Probe and Solar Orbiter during solar cycle 25.

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