# Modelling Solar Ca II H&K Emission Variations

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- The *S*-index quantifies the emission in the near UV Ca II H&K lines and is a prime proxy of solar and stellar magnetic activity.
- To study the dependence of *S*-index on the inclination angle (i) between the stellar rotation axis and the direction to the observer, we developed a physics-based model and validated it against the available solar *S*-index measurements (Figure 1).

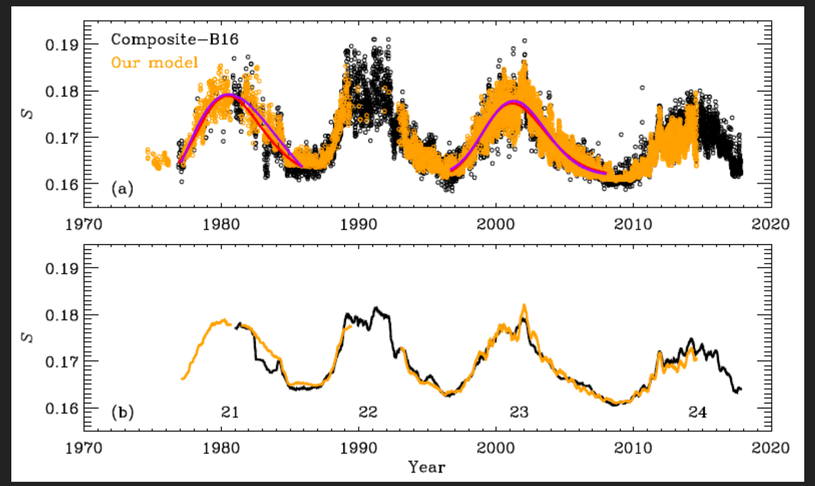


Figure 1: Validation of our model calculations (orange) against the ground-based solar observations (corresponding to i~90°; black). Panel a - daily values; panel b - 81-day smoothed values.

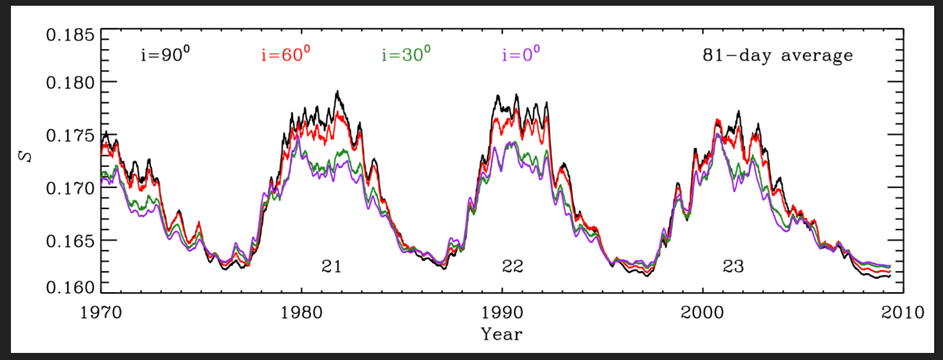


Figure 2: Inclination dependence of the *S*-index. 81-day averaged *S*-index values for solar cycles 21-23 for inclinations ranging from 90° (equator-on view; black curve) to 0° (pole-on view; purple curve).

- We used the distributions of solar magnetic features derived from the surface flux transport simulations together with the non-LTE spectra of Ca II H&K lines.
- We showed that the *S*-index values obtained by an out-of-ecliptic observer are different from those obtained by an ecliptic-bound observer (Figure 2).
- This indicates that it is important to consider the inclination effect on *S*-index while comparing the magnetic activity of the Sun to other stars.

- Depending on the inclination and period of observations, the activity cycle in solar *S*-index can appear weaker or stronger (as shown by the red symbols in Figure 3) than in stars with a solar-like level of magnetic activity.
- Solar chromospheric emission variation is absolutely normal in comparison to other stars with near-solar magnetic activity.

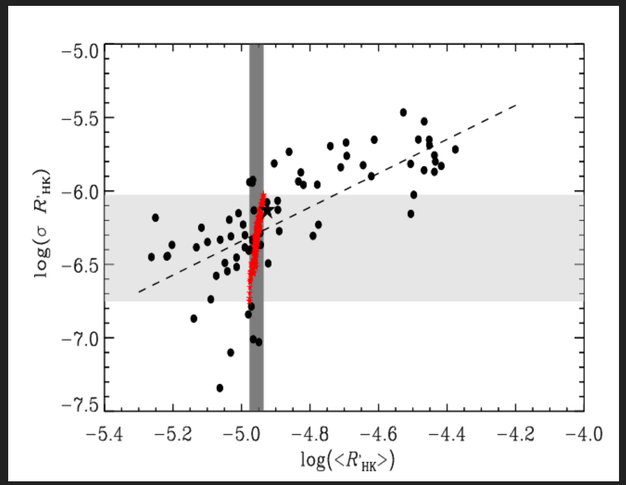


Figure 3: Chromospheric emission variations (y-axis) vs. the mean chromospheric activity (x-axis) for the Sun (black star and red symbols) and other Sun-like stars (black circles). Red symbols show our calculations. Grey shaded regions indicate the spread due to inclination and strength of the activity cycle.

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