Estimate of the solar luminosity variability for cycles 23 and 24

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The effect of the solar activity on the solar luminosity, which is the total electromagnetic solar output, is one of the fundamental questions in solar physics. Changes of the solar luminosity can arise from changes of the energy flux in the convection zone that can also affects other solar parameters such as the surface temperature, the apparent radius and shape, and the symmetry of the radiative field itself. Additionally, understanding the latitudinal distribution of the flux density is needed to compare the solar variability and its stellar analogues. Nevertheless, our observations of the solar flux density are limited to a region near the ecliptic plane, which have provided just a raw estimate of the variability of the solar luminosity. Here we present a reconstruction of the solar flux density and solar luminosity for the solar cycle 23 and ascending phase of cycle 24. The reconstruction is based on a combination of a state-of-art solar surface magnetic flux transport model and a semi-empirical total and spectral irradiance model. The flux transport model is based on assimilation of MDI/SOHO and HMI/SDO magnetograms. The irradiance model's free parameters are estimated by minimizing the difference between the model's output and the PMOD Composite of TSI measurements. We have obtained a good agreement between the model's output and the measurements. The distribution of active regions leads to a clear low latitude brightening during the solar maximum. This brightening results from the balance of the contributions from bright (faculae and network) and dark features (sunspots) located in the solar surface, which peaks near the solar equator. As the effects of dark features are limited to a narrower region, the variability of the flux density at the poles is dominated by the evolution of faculae and network. The preliminary results indicate that the heat flux blocked by sunspots is lower than the flux leaked by bright features. Consequently, an increase of the luminosity through the cycle is observed as previously estimated based on near ecliptic measurements. This work also enables an assessment of the properties of solar variability when viewed from out of the ecliptic, i.e., such as

we might be viewing other stars of solar activity level. Finally, the limitations of the model and future strategies to extend the reconstruction of the flux density and solar luminosity will be presented.

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