Predicting the solar-cycle activity based on the photospheric magnetic field

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We present our new prediction scheme of the next solar cycle activity using the solar photospheric magnetic field in combination with the surface flux transport model.

Predicting the decadal variation of the solar activity is an important task for the long-term space weather. One successful prediction method is called precursor method. This method is based on the high correlation between the polar magnetic field strength in the solar cycle minimum and the maximum sunspot number in the next cycle. The correlation is observationally confirmed at least in the past 100-years. The precursor method allows us to predict the solar activity several years before the next solar cycle maximum.

Our prediction scheme is an extension of the precursor method. We predict the precursor, the polar field strength at the cycle minimum, based on the Surface Flux Transport (SFT) model. The SFT model describes the evolution of the solar magnetic field based on the observed magnetic field in the solar photosphere. Although several predictions based on this model are reported, the large uncertainty on the modeling of future sunspot emergence remains. In this study, we investigate the contribution of the new sunspot emergence on the formation of the polar magnetic field. We especially focus on the predictability of the polar magnetic field during the several years before the cycle minimum. We find that the newly emerged sunspots rarely contribute the build-up of the polar field during the period. In the presentation, we will present the possible origin of this weak contribution to the polar magnetic field and the application to the next solar cycle prediction.

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