Evaluation of the influence of the next solar cycle by sunspots using surface flux transport model

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Predicting the next solar cycle and finding its schemes are a key for the long-term space weather research. Recent studies suggest that there is the correlation between polar magnetic field at the solar minimum and the next solar activity. Iijima et al. (2017) calculated the polar transport of the sunspots by using the surface flux transport model (SFT) and predicted the polar magnetic field at the solar minimum concluded that next solar cycle is weaker than the present. To evaluate their result, we have calculated the time evolution of the solar magnetic field for specific active region by SFT, and discussed the discrepancy between the model result and observations obtained by Helioseismic and Magnetic Imager (HMI). The peculiar example of the observation data is the active region AR12673 which occurred X9.3 solar flare on September 6, 2017 and played a role of weakening the negative magnetic field in the southern polar region. Meanwhile, AR12674 which appeared at the same time strengthened the positive magnetic field in the northern polar region, so we found the prediction result is different before and after the appearance of these active regions. Regarding the active regions after these, it is thought the influence is small because the transport to the polar region cannot be completed in time to the solar minimum. We confirmed reproducibility of polar transport in the model continuously using the actual magnetic field distribution from 2010 to the end of 2018 and the reproducibility 80 %, and found the activity of the next solar cycle is to be about 5 to 10 % stronger than present.

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