

Association of Polar Faculae with the Polar Magnetic Patches as Revealed with Hinode Observations

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Polar faculae are small bright features in the polar region of the Sun. They are observed with concentrations of magnetic fields. Previous studies have shown that the number of polar faculae observed at latitudes greater than 60 degree has 11-year periodicity like the sunspot cycle and that their occurrence maximum is anti-correlated with the solar cycle. The aim of this study is to understand the properties of polar faculae, which are believed to be associated with the polar magnetic patches. We analysed data of the north polar region taken by the Hinode/SOT spectropolarimeter (SP) in September 2007. Accurate measurements of vector magnetic fields at high spatial resolution by Hinode/SP for the first time allow us to compare polar faculae with polar magnetic fields in detail. The continuum intensity map is corrected for limb darkening. There are many patchy magnetic field structures in the polar region and thresholds on both size and intensity for the patches are applied to automatically choose polar faculae pixels. The definition of magnetic patch is same as in Shiota et al. (2012 ApJ). We find that: (1) magnetic patches are not uniformly bright but contain smaller faculae inside. (2) polar faculae tend to have stronger and more vertical magnetic fields than their surrounding within the magnetic patches. (3) almost all magnetic patches with total magnetic flux greater than 10^{18} Mx are associated with polar faculae. From Shiota et al. (2012), such magnetic patches vary with the solar cycle. (4) polar faculae flux accounts only for less than 12% of the total vertical magnetic flux of the polar region observed in this study. But as polar faculae are associated with large magnetic flux concentrations they can be considered as good proxy of the cycle varying component of the polar magnetic field.

Furthermore, we confirm two previous studies: (5) The contrast of polar faculae decreases towards the limb (Okunev and Kneer, 2004). (6) Polar faculae with polarity opposite to that of the polar magnetic field exist, but they are very small in number which is consistent with the result by Blanco Rodriguez et al. 2007.

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