Fractal analysis of solar active regions

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Abstract

The solar activities which cause the occurrences of flares, coronal mass ejection events, magnetic storms and substorms in Earth's magnetosphere are closely related to the dynamical evolution of active regions of strong magnetic field on the solar surface. The detailed configurations and morphological structures might give important hints to their formation history and possible evolutionary tracks. A statistical analysis of the shapes and sizes of active regions could allow prediction of the magnitudes of the solar activities which might take place later. We are in the process of developing an algorithm to perform fractal analysis of a sample of active regions in the last decade observed by the Michelson Doppler Imager (MDI) on the SOHO spacecraft. The numerical procedure and preliminary results will be presented.

Introduction

Due to the morphological development of the solar active regions is much complex, it is difficult to use mathematical formulas for detailing them. In this case, the fractal is one well-studied to measure the active region's complexity. There were many papers (McAteer 2005) mention it, so we want to apply Minkowski-Sausage Method (Russ 2002) and designed a procedure to automatically processing images from MDI (Michelson Doppler Imager).

MDI is an instrument of the SOHO (Solar and Heliospheric Observatory) and taking a image every 96 minutes, 15 images a day. Those image data are release on the database web after calibrating.

Here we take the active region AR10930 as an example to demonstrate how the program works to process MDI images. AR10930 appeared on the solar surface from 2006 12/6 to 12/18 and MDI took the 155 frames of effective images. We use these data to get the perimeter, area and drive the relative fractal dimension.

References

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