Locating Activity Nests in Solar Cycle 24 using Data from the Helioseismic Magnetic Imager

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Abstract
We analyze data from the SPEAR (Solar Plage, Ephemeral & Active Region) Catalog created from Spaceweather HMI Active Region Patch (SHARP) data. We identify the activity nest locations in each hemisphere during Solar Cycle 24 to examine how prevalent nests are in structuring the Sun’s magnetic flux emergence. From 2010 to 2019, we identify 54 (56) activity nests in the North (South) Hemisphere containing ~80% of all sunspot magnetic flux, which is higher than previously reported. On average, there were 7 active region members in each nest with a nest lifetime of 6 months and with the nest rotating slightly faster than the average Carrington Rotation rate.

Introduction
Active region nests are locations on the Sun where sunspots repeatedly emerge month after month. Other stars show similar nesting behavior of magnetic activity1. The precise physical mechanism that causes nests is unknown but it could be an instability acting on the magnetic field in the interior of the Sun or it could be due to low fields such as giant convection cells2 causing preferred locations of magnetic flux emergence. Activity nests host a great majority of solar energetic events and as such, are crucial to our understanding of space weather.

Methods
The criteria that must be met to be an activity nest3 is as follows:
1) At least 3 sunspot groups emerge.
2) Within 15˚ longitude and 10˚ latitude of each other.
3) With a nest lifetime that is a minimum of 4 months.

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Results

- Active nests in the Northern Hemisphere
- Active nests in the Southern Hemisphere

Figure 2. Plots separating the Northern and Southern hemispheres show unique activity nests which are grouped by color and symbol and plotted as a function of longitude (x-axis) and Carrington Rotation number (y-axis). Each point on the plots represents an active region with a NOAA number. The symbol size is proportional to the magnetic flux in the region. The nest noted by the red ellipse correlates to the nest shown in the grayscale magnetogram maps in Figure 1.

References