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Solar active region emergence and flare productivity

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Abstract. We use the workflow capabilities of the AstroGrid Virtual Observatory system (<http://www.astrogrid.org>) to analyse the relation between flare productivity and location of Active Region (AR) emergence on the Sun. Specifically, we investigate whether emergence of a new region near existing ones results in increased productivity of the new and/or pre-existing AR. To address this question, we build a series of workflows that perform queries to catalogues of regions and flares, and operations on the results of the queries. There is a strong East-West asymmetry in the location of emergence of new regions. We do not find a significant difference between the flaring rate of paired and isolated regions, when we choose a value of 12° as the cutoff between the two populations.

Keywords. Sunspots, Sun: magnetic fields, Sun: flares

Emergence of magnetic flux through the solar photosphere creates new Active Regions, identified from sunspot, magnetogram and Hα observations. New flux emergence has been recognised as an important trigger of solar activity, including solar flares.

We analyse a large sample of regions, by means of AstroGrid workflows that retrieve information from separate catalogues of regions and flares, identify newly emerged regions, establish whether they emerged paired or isolated, and evaluate flare productivity. We use the USAF/Mt Wilson catalogue of sunspot regions (24 years of data, starting in 1981) and the NOAA Solar Region Summary (from 1986 onwards, available via the EGSO Solar Event Catalogue). Results of workflows are visualised with Topcat.

Using the Mt Wilson catalogue, we identify 3212 new regions that emerged in view from Earth, with strong asymmetry in their location of emergence: 825 regions emerged in the longitude bin E60–E40, and 177 in the bin W40–W60. This finding may be related to previously reported asymmetries in the total number of sunspots (Maunder 1907).

We divide our sample of newly emerged regions into paired and isolated, by calculating the distances of the new region to all pre-existing ones: we call a region paired if it emerged within 12° of another one. We evaluate the flare productivity of each new region using the GOES Soft-X-Ray flare catalogue (via EGSO/SEC). Here flare productivity is defined as the number of medium to large flares (class $>$ C1.0) produced in the first 4 days since emergence. We find no clear indication that being 'paired' makes a region or its companion more flare productive.

Reference

Maunder, A. S. D. 1907, *MNRAS*, 67, 451