Project Details

ROSES ID: NNH08ZDA001N
Selection Year: 2009
Program Element: Focused Science Topic

Topic: Measure the properties of the solar dynamo that affect solar irradiance and active region generation.

Project Title:
Facular Studies to Understand Solar Dynamo and Irradiance Behavior

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Summary:
Digitization of the archival plates at Mt Wilson and Kodaikanal Observatories now provides a continuous record of white light faculae since 1907. We propose to measure facular areas to investigate a relation reported between the (facula/ spot) area ratio at the onset of a solar cycle, and that cycle s peak amplitude. This relation, if verified, suggests a predictively useful and dynamically interesting connection between the spatial structure of photospheric magnetic fields, and solar dynamo efficiency.

These recent digitizations also provide extended time series of Ca K plage areas. We have used these to reconstruct solar UV flux variation, pointing out that it correlates only weakly with 20th century global temperature, thus calling into question UV driving of global warming. Reconstruction of total solar irradiance (TSI) variation poses a tougher challenge, because the contributions of spots and faculae tend to cancel so they must be known accurately to provide confidence in the calculation of their small difference . We propose to apply the extended plage area record, together with broad band facular contrasts from the balloon borne Solar Bolometric Imager, to improve TSI reconstruction back to 1907.

We also propose to extend this irradiance reconstruction yet further back in time using recent modeling of active region evolution, which indicates that plage area variations can be reconstructed usefully from spot and white light facular areas. To do this, we will develop a simplified kinematical model to improve irradiance reconstructions to the beginning of the Royal Greenwich Observatory records in 1874.

Finally, we propose to investigate whether the unusually low TSI values measured during the present sunspot minimum might be explained by declining numbers of polar faculae. If not, new TSI variation mechanisms not associated with photospheric magnetism might be required, with profound implications for Sun climate driving.

Publication References:

Summary: no summary

Reference:
Foukal, Peter; Bertello, Luca; Livingston, William C.; Pevtsov, Alexei A.; Singh, Jagdev; Tlatov, Andrey G.; Ulrich, Roger K.; (2009), A Century of Solar Ca ii Measurements and Their Implication for Solar UV Driving of Climate, Solar Physics, Volume 255, Issue 2, pp.229-238, doi: 10.1007/s11207-009-9330-0

Summary: no summary

Reference: Foukal, Peter; (2010), Comment on “A homogeneous database of sunspot areas covering more than 130 years” by L. A. Balmaceda et al, Journal of Geophysical Research, Volume 115, Issue A9, CiteID A09102, doi: 10.1029/2010JA015293

Summary: no summary

Reference: Foukal, Peter; Ortiz, Ada; Schnerr, Roald; (2011), Dimming of the 17th Century Sun, The Astrophysical Journal Letters, Volume 733, Issue 2, article id. L38, 4 pp. (2011), doi: 10.1088/2041-8205/733/2/L38

Summary: no summary

Reference: Foukal, Peter; (2012), A New Look at Solar Irradiance Variation, Solar Physics, Volume 279, Issue 2, pp.365-381, doi: 10.1007/s11207-012-0017-6