URSI GASS 2023, Sapporo, Japan, 19 – 26 August 2023

The Challenges of Using F10.7 Operationally

Sean Elvidge*[(1)], David R. Themens[(1)], Elizabeth Donegan-Lawley[(1)], Matthew K. Brown[(1)]
(1) SERENE, University of Birmingham, UK, e-mail: s.elvidge@bham.ac.uk

The solar radio flux at 10.7 cm, known as F10.7, is one of the most commonly used indices of solar activity. It is used to drive both statistical and first principles models of the ionosphere and thermosphere and finds use in a wide range of applications spanning radio communications and navigation modelling, remote sensing, solar physics and space environment climate and modelling. F10.7 is used as a proxy for the solar extreme ultraviolet (EUV) forcing of the upper atmosphere and has been measured since 1947.

The use of F10.7 in such a broad range of models, from research to operations, can at least partially be ascribed to the fact that it is a stable, long-term, ground-based observation that has been used to investigate variations over a wide range of timescales. From 1947 to 1991 the F10.7 was measured in Ottawa, Canada when the site was moved to the Dominion Radio Astrophysical Observatory (DRAO) in Penticton, Canada. The DRAO, which provides the F10.7 data freely to the community, is supported by National Research Council (NRC) of Canada in partnership with Natural Resources Canada (NRCan). This data stream is used globally for operational space weather products including those from the US Space Weather Prediction Center and the UK Met Office Space Weather Operations Centre. Thus, it is critical for operational space environment monitoring, forecasting, and mitigation services. However, this critical reliance of a wide variety of operational systems on a steady stream of F10.7 measurements poses a risk to the performance of these systems, should the F10.7 data stream be interrupted, particularly if such an interruption lasts more than a few days.

Such an interruption occurred on March 18th, 2022, when a cyberattack caused a network interruption at the NRC, which resulted in an F10.7 outage that lasted over a month. Without redundant systems, many critical space weather architectures suddenly become unavailable, or, perhaps worse, generate output using “default values” of F10.7 (for example an F10.7 of 100 sfu) which can also be used for forcings in forecasts, potentially producing substantial errors without suitable warnings. In this paper we explore the impacts of having to mitigate the F10.7 interruption experienced in March 2022 using a number of methods and investigate their suitability as an F10.7 redundancy, including using the solar radio flux at other wavelengths, the sunspot number as well as ‘simple’ rotation approaches.

Often PF10.7 (defined as the average of the daily F10.7 with the 81-day centered mean) is used in upper atmosphere models since it correlates well with changes in EUV. However, in an operational setting, the centered 81-day average is not available (since 40 days in the future would be required). The paper also describes alternative approaches (non-weighted, and weighted, right aligned means of various timespans) which can be implemented to minimize potential errors in operational models.