
# Increasing the horizon of the Sheffield GEO radiation belt electron flux forecasts.

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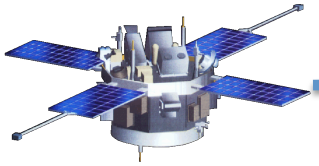
# Abstract

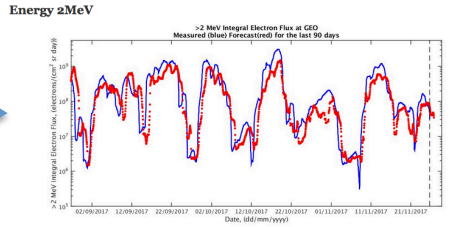
Accurate and timely forecasts for the electron environment at GEO are required in order to mitigate adverse effects and protect hardware assets. The greater the lead time, the more mitigation options are available. The Sheffield GEO electron flux forecast model is currently driven by measurements of the solar wind parameters at L1, providing a lead time of between 16 and 24 hours (depending upon particle energy). In this poster presentation we discuss early results based of driving the Sheffield model using forecasts of the solar wind at L1 resulting from the AWSOM/SWIFT model, developed within the Horizon 2020 project PROGRESS. Since these solar wind forecasts are based on observations of the Sun, the forecasting time horizon is further increased by 24-48 hours.

# Overview

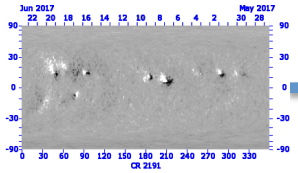
Current forecasts from Sheffield NARMAX electron flux models (SNB$^3$GEO) are based on measurements of solar wind parameters ay L1 by the satellites ACE/DSCOVR. This provides a forecast horizon of 24-28 hours.



SNB$^3$GEO

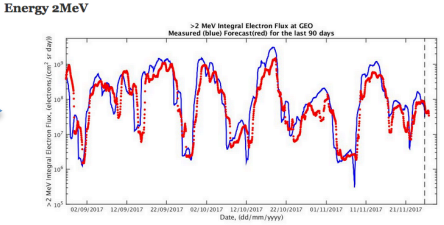



The EU Horizon 2020 funded project PROGRESS has developed a solar wind model to provide forecasts of solar wind parameters at L1 based on observations of the Sun. This could increase the forecast horizon up to 96 hours.




AWSoM
SWIFT

SNB$^3$GEO

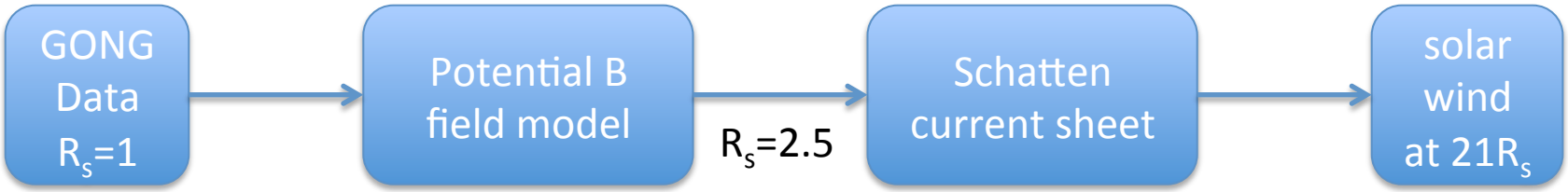


# AWSoM/SWIFT

PROGRESS has developed a coupled model of the solar wind based on the Alfven Wave Solar Model (AWSoM) from U. Michigan and of the newly developed Solar Wind Field Transport model (U. Warwick)

**AWSoM**

2 temperature, radiative loss MHD model with heating from Alfven waves.




**SWIFT**

2 temperature , MHD model driven by AWSoM, propagating solar wind parameters to L1

This coupled model was described in the poster by Arber et al. and displayed in Session 2.

# SNB$^3$GEO

**SNB$^3$GEO** is a set of models for forecasting daily electron fluxes at Geostationary orbit. It is based on the Systems Science methodology NARMAX.

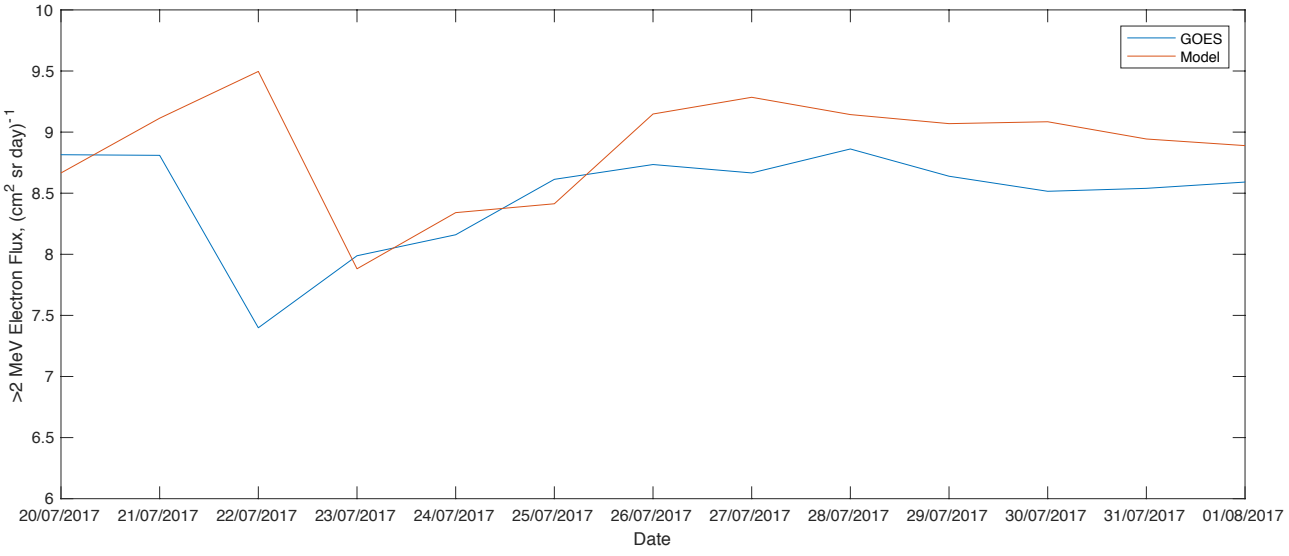

In current, normal operation these models are driven by measurements of the solar wind from ACE/DISCVR. The forecasts generated are more accurate than those generated by the NOAA REFM. The results of these models are available at https://ssg.group.shef.ac.uk/progress/html/

The Horizon 2020 funded project PROGRESS recently began to generate forecasts of the solar wind parameters at L1. These L1 forecasts may be used to drive SNB$^3$GEO.

# First results

New forecasts of the solar wind parameters at L1 from the PROGRESS model AWSoM/SWIFT are available. These parameters have been used to drive the SNB$^3$GEO model for the >2Mev electron flux at GEO. The first results of the forecasts are shown below.

These forecasts (red) are very similar to actual measurements from the GOES spacecraft (blue). The main discrepancy on 21-22 July is due to a dropout of electrons at this energy. The model, however, recovers afterwards.



# Conclusions

- The Sheffield SNB$^3$GEO models for forecasting the electron fluxes in various energy ranges are used to provide 24-48 hour ahead forecasts of fluxes at geostationary orbit. These models are driven using measurements of the solar wind parameters at L1 by ACE/DISCVR.
- Recent results from the PROGRESS project provide forecasts of the solar wind parameters at L1 based on GONG magnetograms.
- A test data set has been used to drive the SNB$^3$GEO >2MeV electron flux model.
- The resulting forecasts are very similar the measured fluxes.
- This methodology appears to have great potential to increase the forecast horizon of radiation belt electron fluxes up to 4 days.

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