NOAA SWPC Proton Prediction Model

- Operational proton prediction model currently used by the NOAA SWPC forecast office (Balch 99, Balch 08).

- Statistical model based on the association of flares with SEP events (>1 pfu for >10 MeV protons measured at GOES). Trained on events from 1986 to 2004.

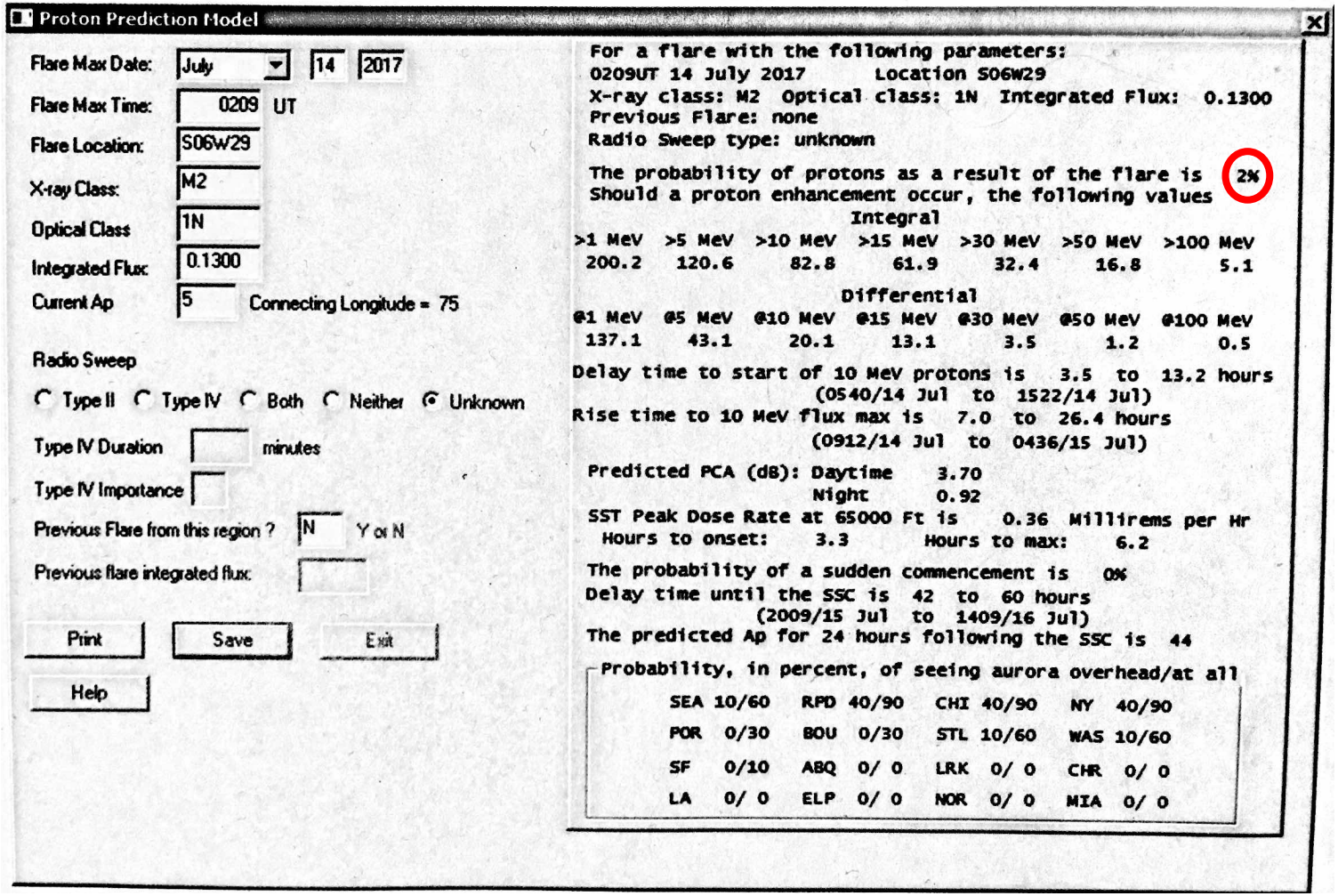
- Input parameters:
  - peak soft X-ray flux
  - integrated soft X-ray flux
  - flare location
  - occurrence of metric Type II and Type IV radio bursts.

- Model output: probability of proton event, predicted max flux at 10 MeV and time of max flux.

- Prediction of max flux from statistical relationship between log integrated X-ray flux of the associated flare with log peak flux of proton event.

- Rise time prediction (time difference between the X-ray max and proton max) from empirical relationship with the location of the flare on the solar disk.

Model results: July 2017

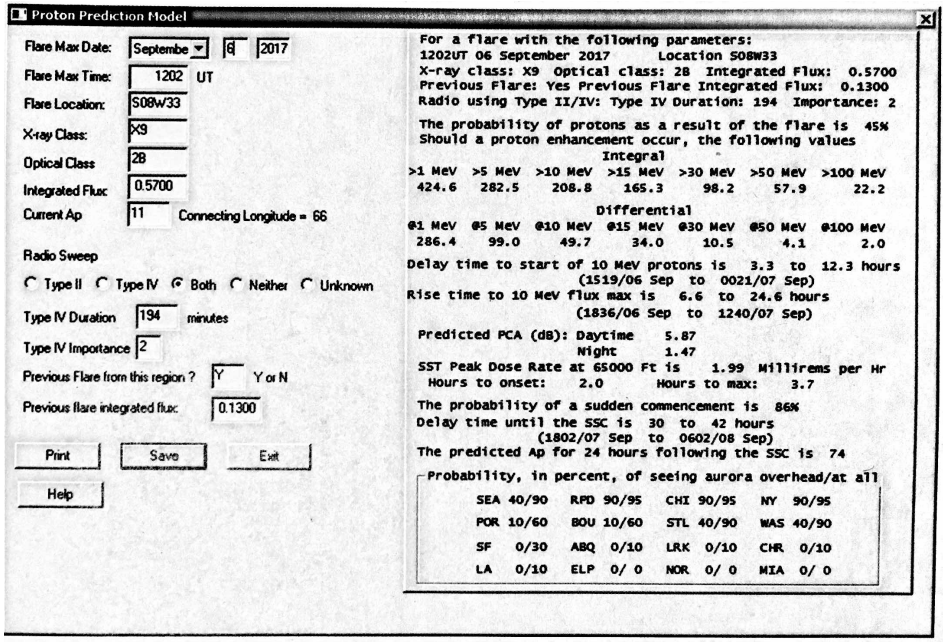


- MISS
- Probability of proton event: 2%

Model results: September 2017

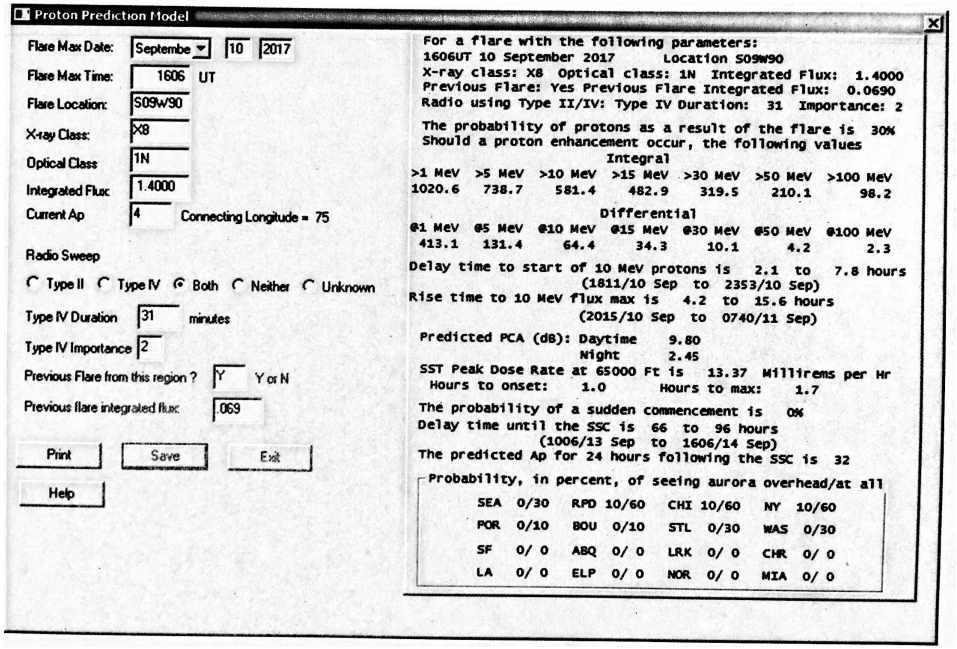
Sept 6th 2017

- **HIT**
- Probability of proton event: 45%
- 10 MeV max: 49.7 pfu
- Time to start: 3.3 – 12.3 hours



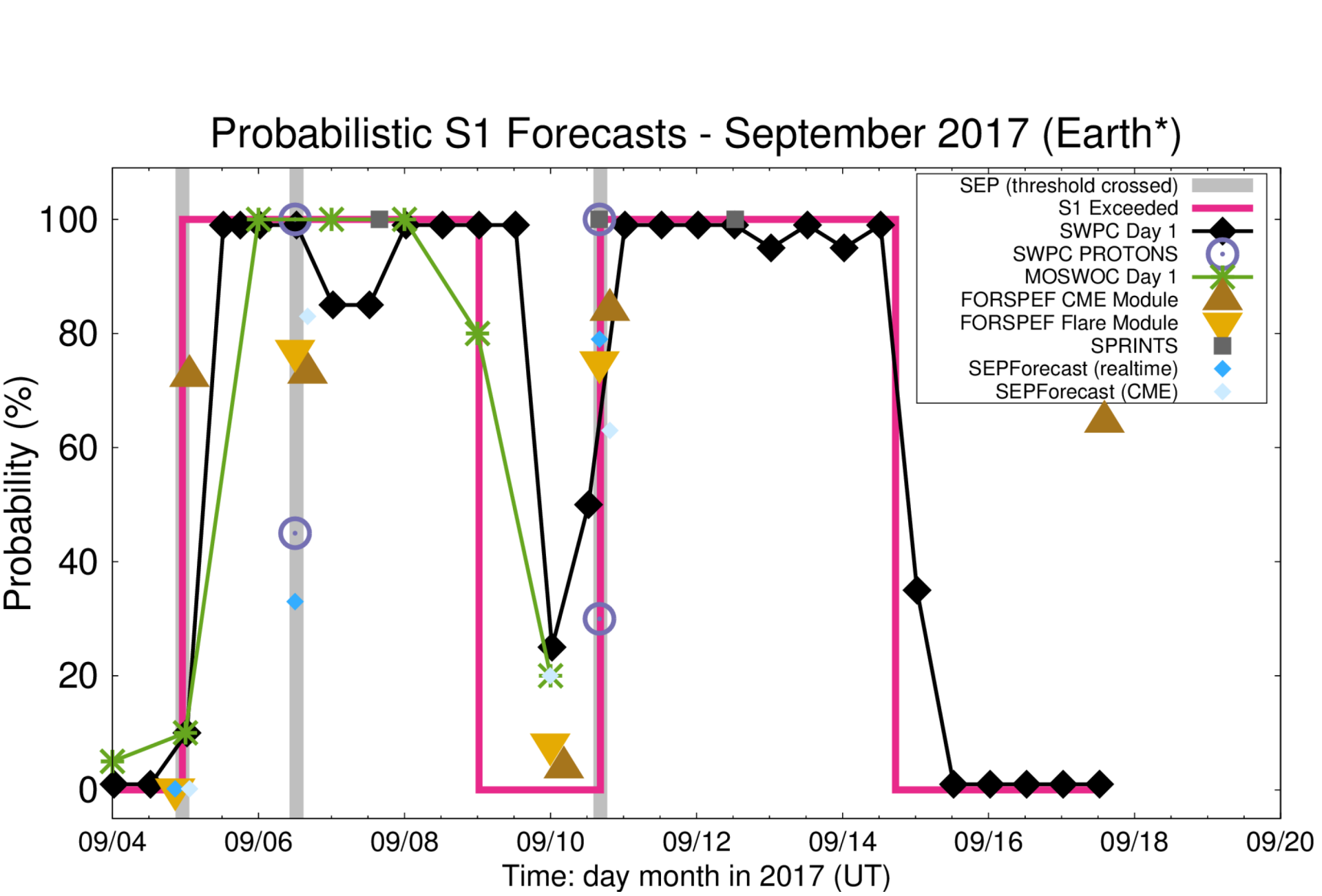
Sept 10th 2017

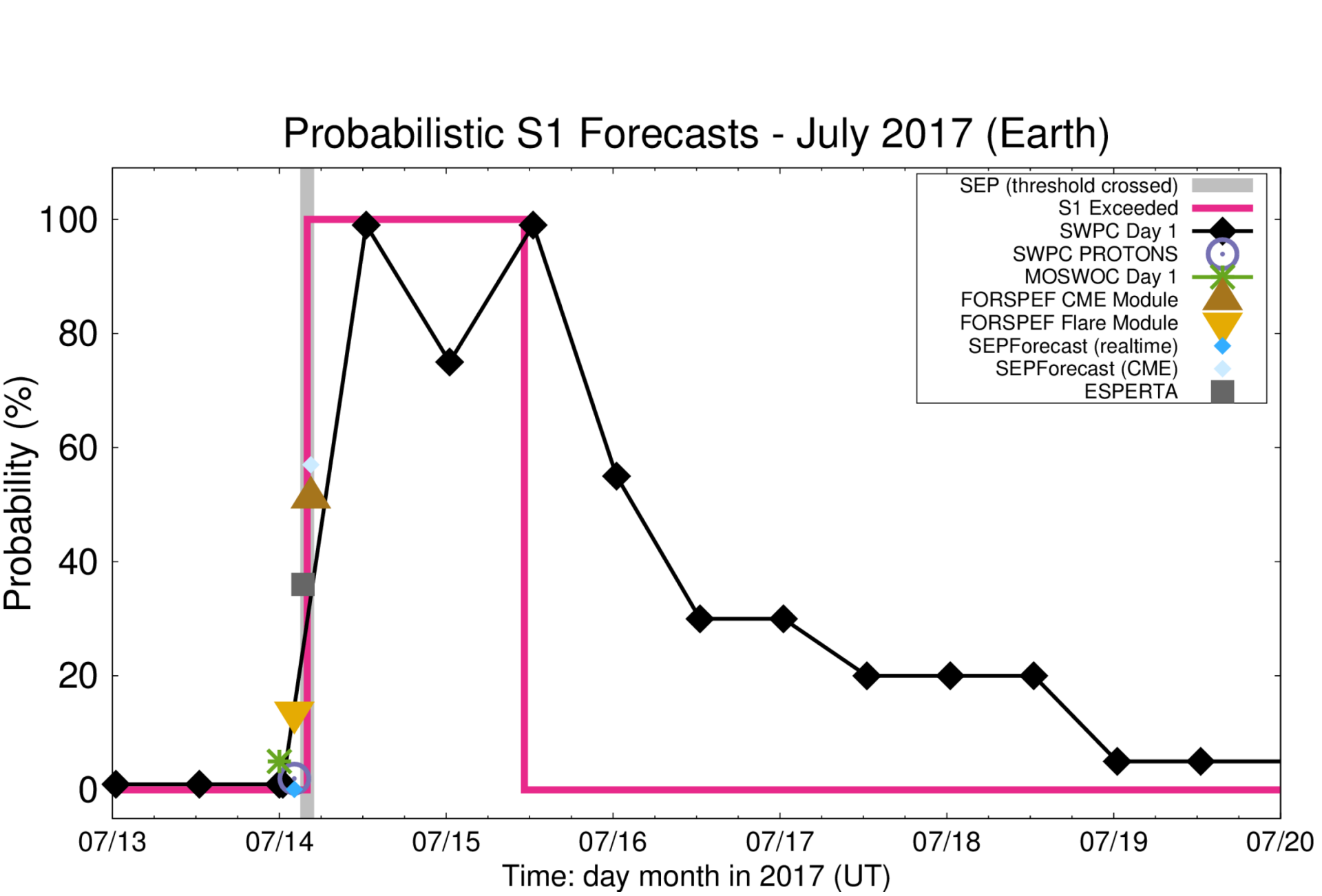
- **HIT**
- Probability of proton event: 30%
- 10 MeV max: 64.4 pfu
- Time to start: 2.1 – 7.8 hours



Discussion questions

- How did your optimized run results differ from the initial run?
    - Single run based on flare parameters.
- What aspects of the event does your model capture well, and what aspects were more difficult to capture?
    - Used only for proton event prediction at Earth.
    - Flares occurring behind the limb automatically count as a miss.
    - POD: 0.57, FAR: 0.55
- What are the next steps for your modeling technique?
    - Many potential improvements could be made to the model.
    - Currently investigating a machine learning classification approach for probability of event occurrence. Includes more features than original model.
    - Extension of statistics to the current solar cycle.


Probabilistic S1 Forecasts - September 2017 (Earth*)
SEP (threshold crossed)
S1 Exceeded
SWPC Day 1
SWPC PROTONS
MOSWOC Day 1
FORSPEF CME Module
FORSPEF Flare Module
SPRINTS
SEPForecast (realtime)
SEPForecast (CME)
Probability (%)
100
80
60
40
20
0
09/04
09/06
09/08
09/10
09/12
09/14
09/16
09/18
09/20
Time: day month in 2017 (UT)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