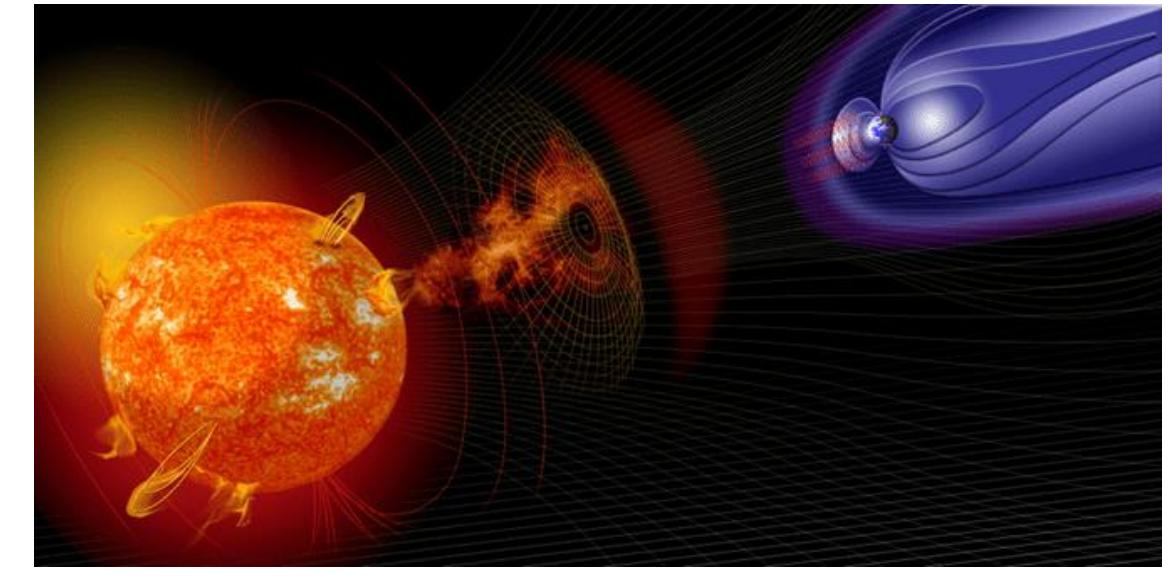


The History and Performance of MSFC's Modified McNish & Lincoln Solar Activity Prediction Model

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Skylab (438km, 50°) May 14, 1973 – July 11, 1979

Deher et al. 1980 [1]: “One of the primary factors influencing orbital lifetime is the solar activity prediction. This is the reason ranges based on statistical data are given, rather than an answer. It is usually adequate unless a Skylab comes along, and then we would conclude that much additional work should be done on short (<1 year) to intermediate (1 to 5 years) solar activity predictions.”

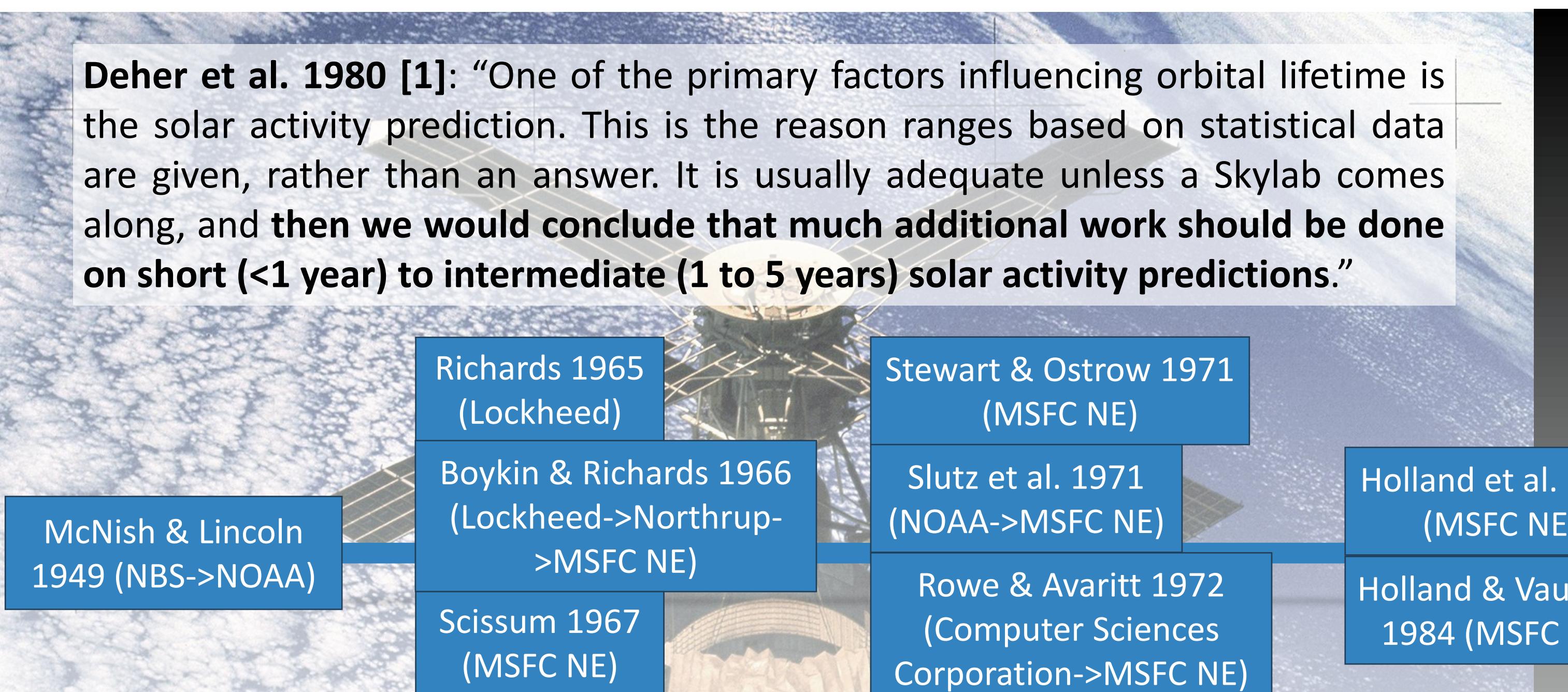
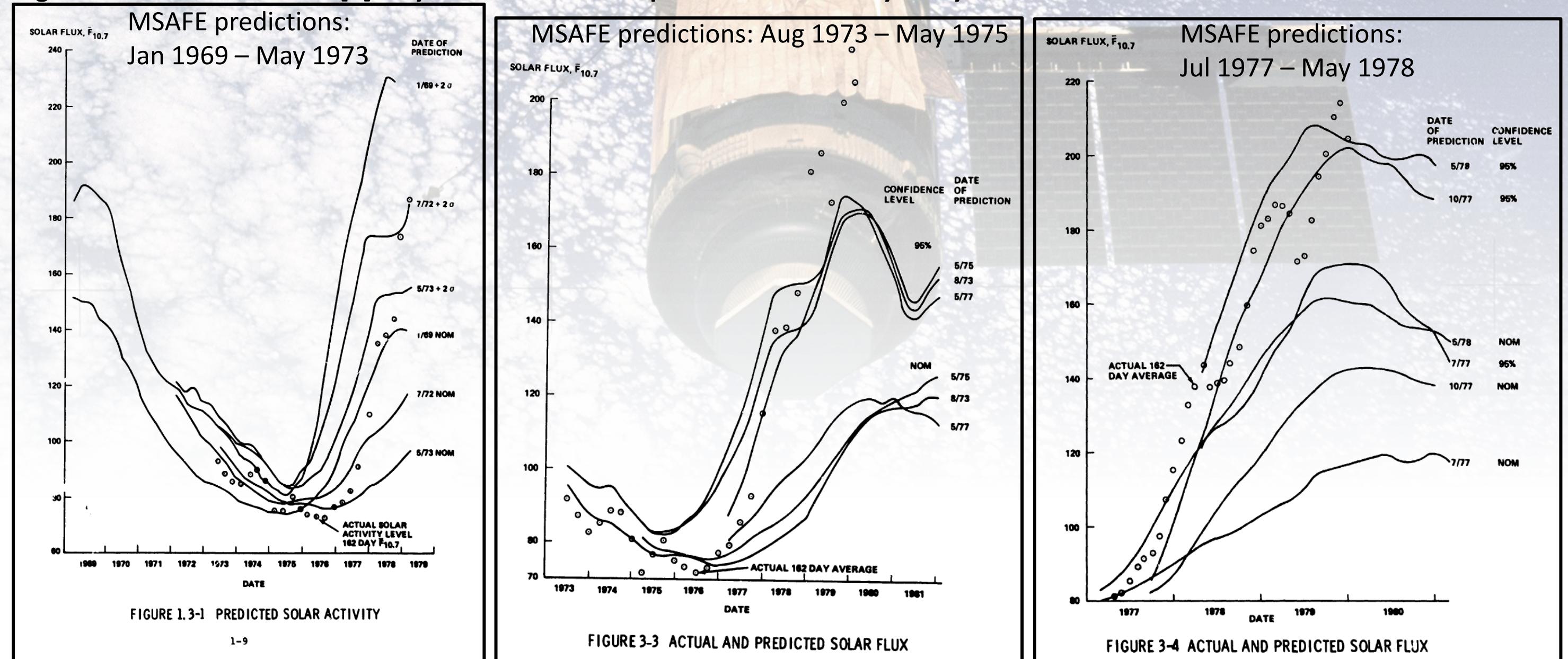


Figure 1: Dreher et al. 1980 [1]: Skylab orbital lifetime prediction and decay analysis



- MSAFE [2] underpredicted solar cycle 21 (Mar 1976 – Jul 1986)
- Rapid changes in solar activity over a few days are not accounted for in the atmosphere density model and are attributed to deviation of predicted orbital decay after about two months [1]
- In general, McNish & Lincoln [3] predictions are completely unreliable over the last two years preceding the end of solar min into the first 12 months after the minimum [4]

International Space Station (418km, 51.6°) November 20, 1998 – Current

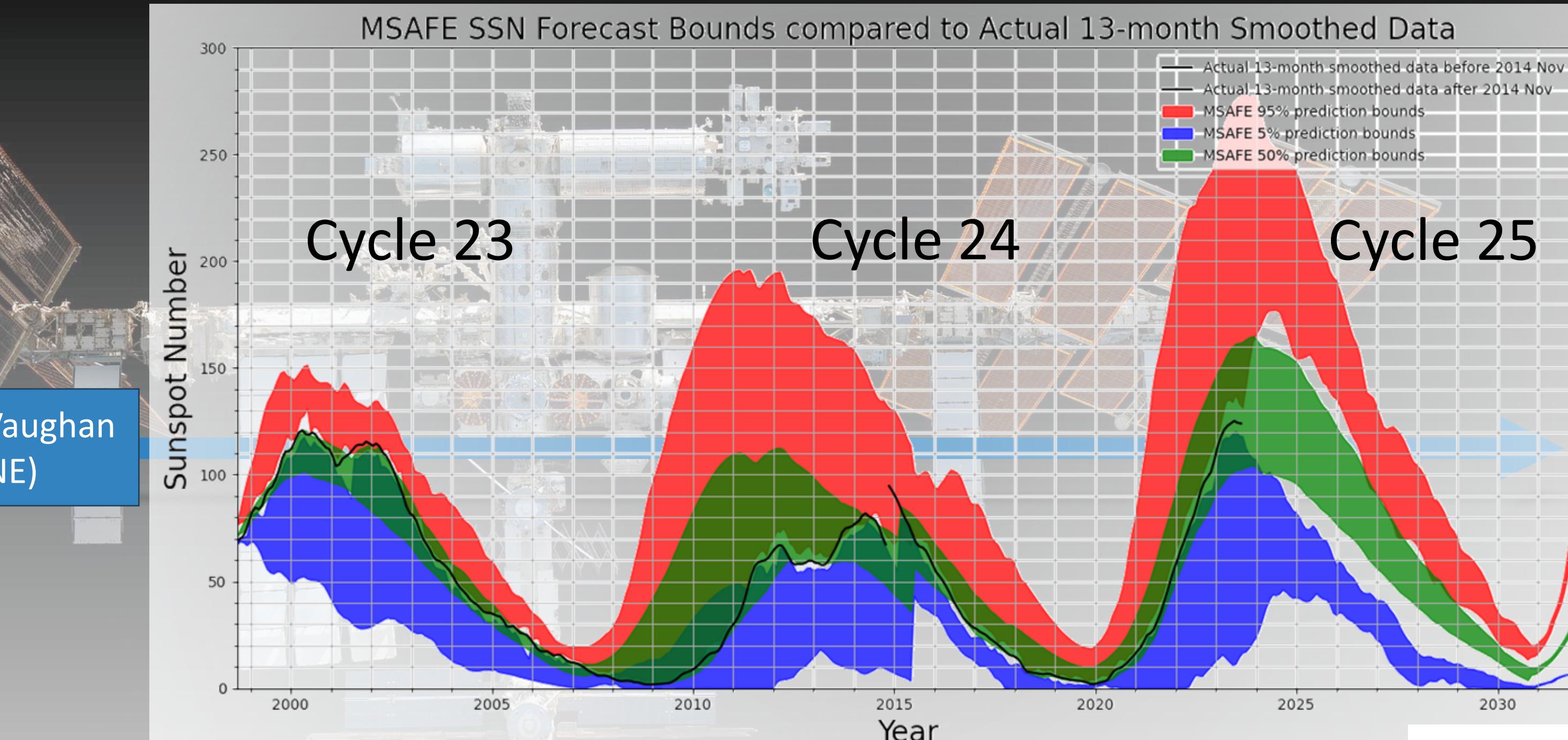


Figure 2: Range of MSAFE (<https://www.nasa.gov/solar-cycle-progression-and-forecast/archived-forecast/>) predictions from 1999 through 2024 for the 95% (red), 50% (green), and 5% (blue) with the observed 13-month smoothed sunspot number (version 1 before November 2014 and version 2 after).



Post-ISS Solar Activity Prediction Suggestions

- Monthly and daily variations of F10.7 would aid in estimates of uncertainty in orbit decay predictions
- Use current state of solar active regions and chance of flaring events
- If available, use real-time in situ estimates of neutral density from (V)LEO constellations to aid in correcting solar input dependencies

Acknowledgements

Support for the monthly MSAFE solar forecasts is provided by the ISS Program Office. Additional support for MSFC space weather SBIR and related activities is provided by the NASA Space Weather Program.

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