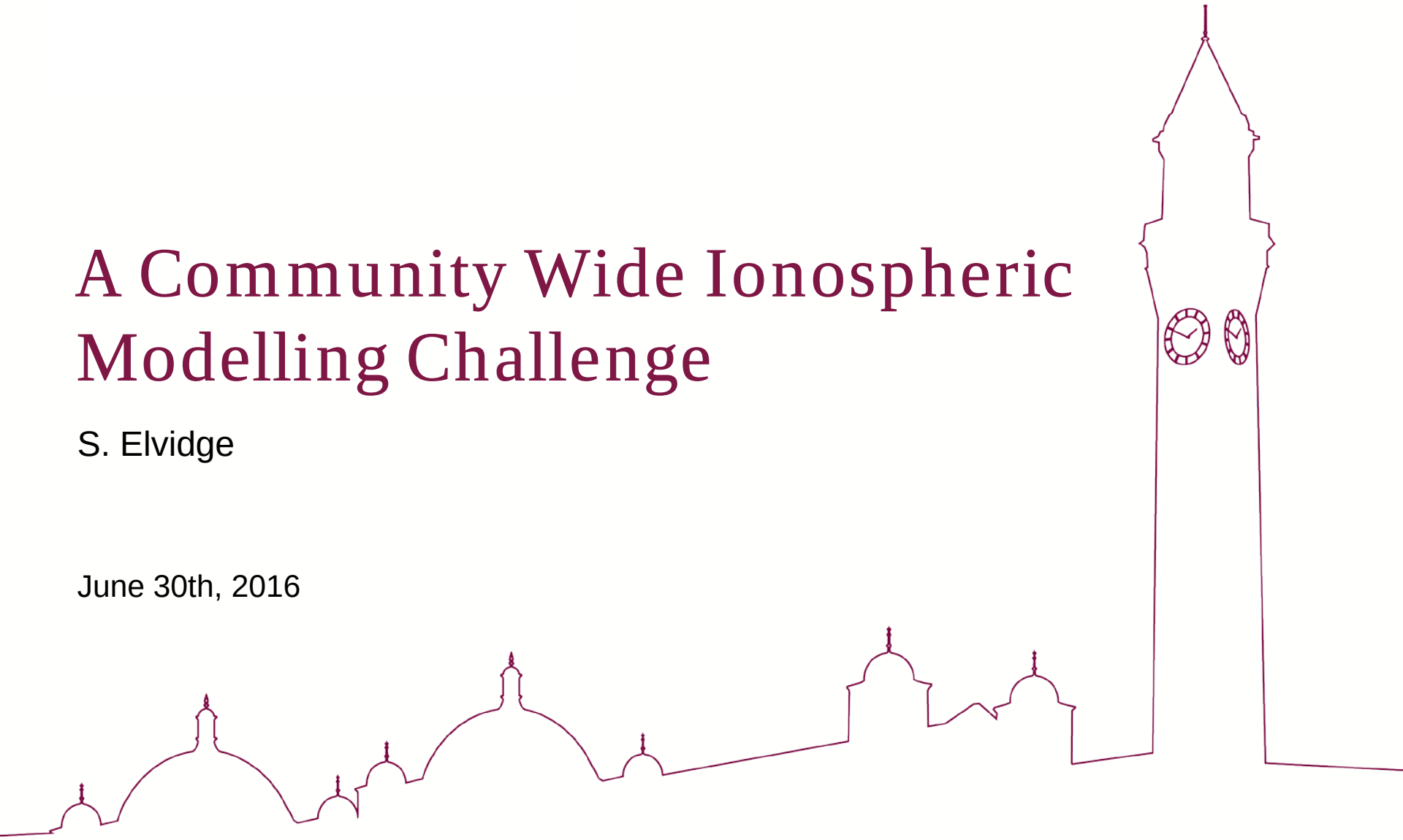
# A Community Wide Ionospheric Modelling Challenge

S. Elvidge

June 30th, 2016



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# Co-Authors & Acknowledgements

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  **A. Ridley** – University of Michigan, Michigan, USA

- Acknowledgements:
  **B. Foster** & **S. Solomon** – NCAR, USA
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  **J. Hubba**, **G. Joyce** & **M. Swisdak** – Naval Research Laboratory, USA
  **Community Coordinated Modeling Center**

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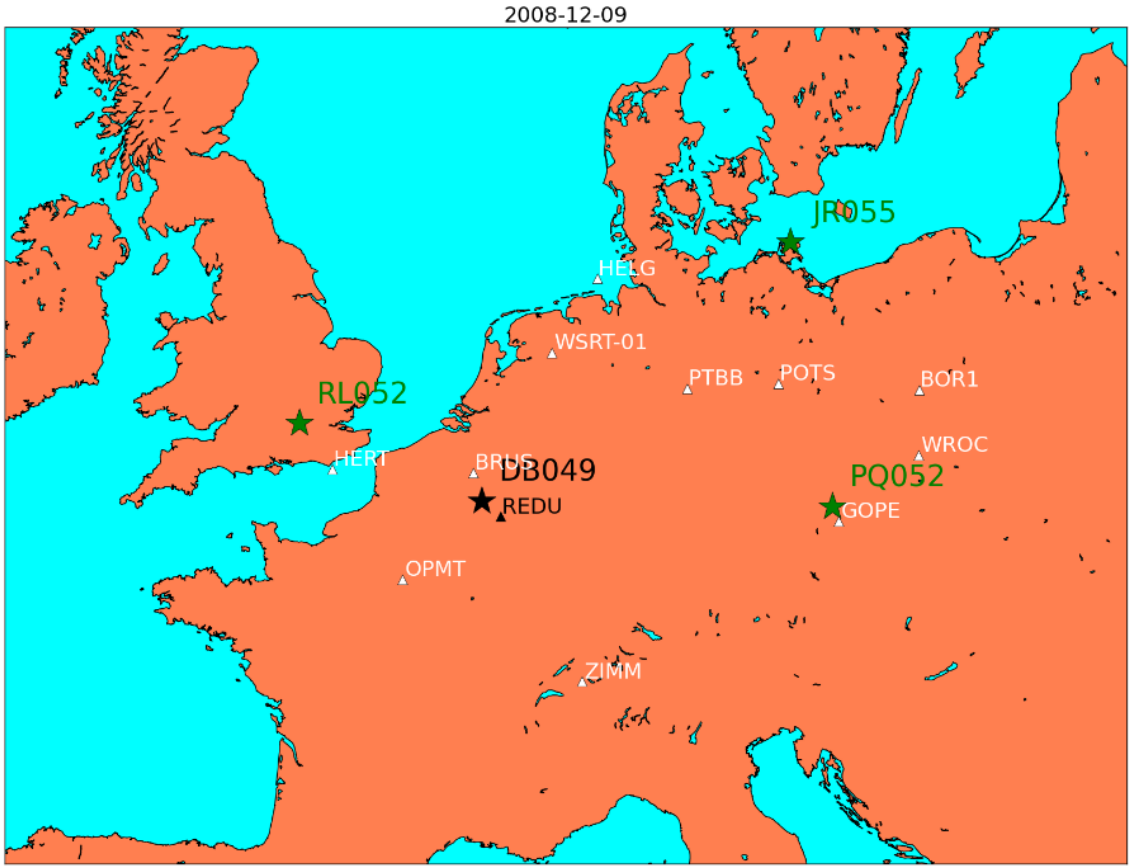
# Test Dates: December 8th 2008 – January 7th 2009

Assimilated Ionosondes:

Chilton (RL052)
Juliusruh (JR055)
Pruhonice (PQ052)




Test station: Dourbes (DB049)

Assimilated GNSS:

BOR1
BRUS
GOPE
HELG
HERT
OBEC
OPMT
POTS
PTBB
WROC
WSRT
ZIMM

Test station: REDU

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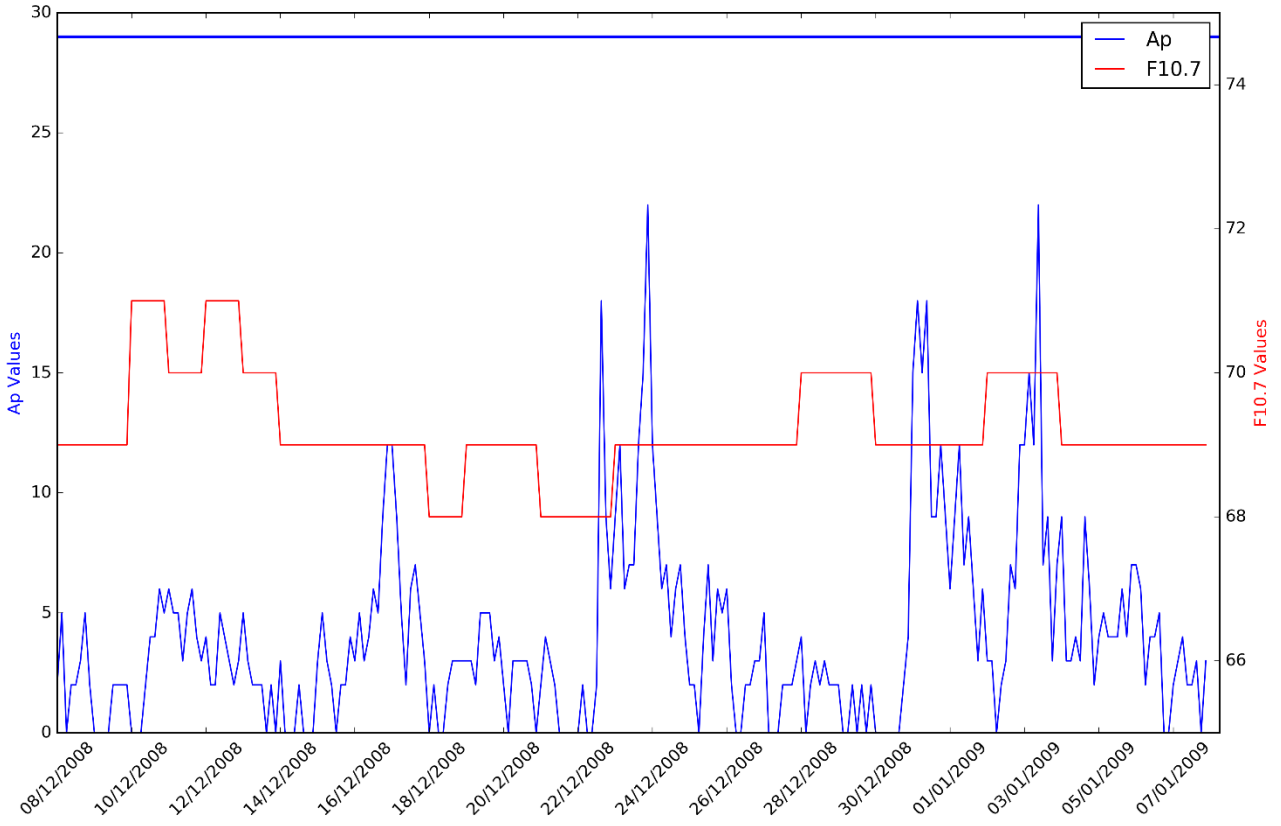


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# Extremely Quiet

- Average monthly Sunspot number of 1
- Thermosphere cooler and lower in density than expected
- F10.7 “not representative” of thermospheric conditions
  - Solomon et al. 2010, 2011, 2013
- All models struggle during this extreme space weather event
  - Empirical models not tuned for such quiet times

# Models Under Test

**Empirical**

- IRI-2007
- IRI-2012
- NeQuick v2

**Physics (ion/therm)**

- TIE-GCM
- GITM
- CTIPe
- *CMAT2*

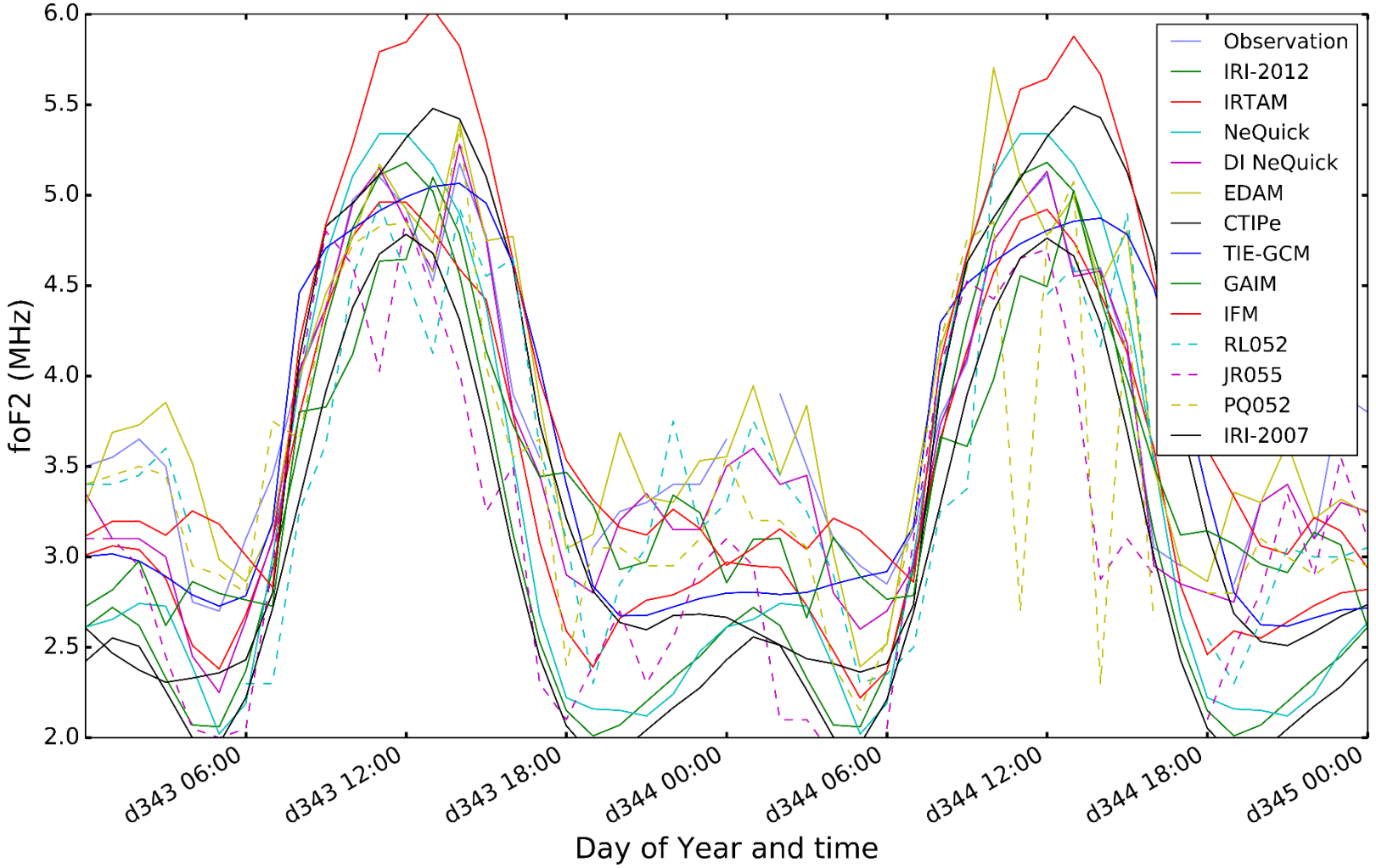
**Physics (ion)**

- IFM
- *SAMI3*

**Data Assimilation**

- EDAM (IRI-2007)
- IRTAM
- D.I. NeQuick
- USU-GAIM (IFM)
- *TOMION*

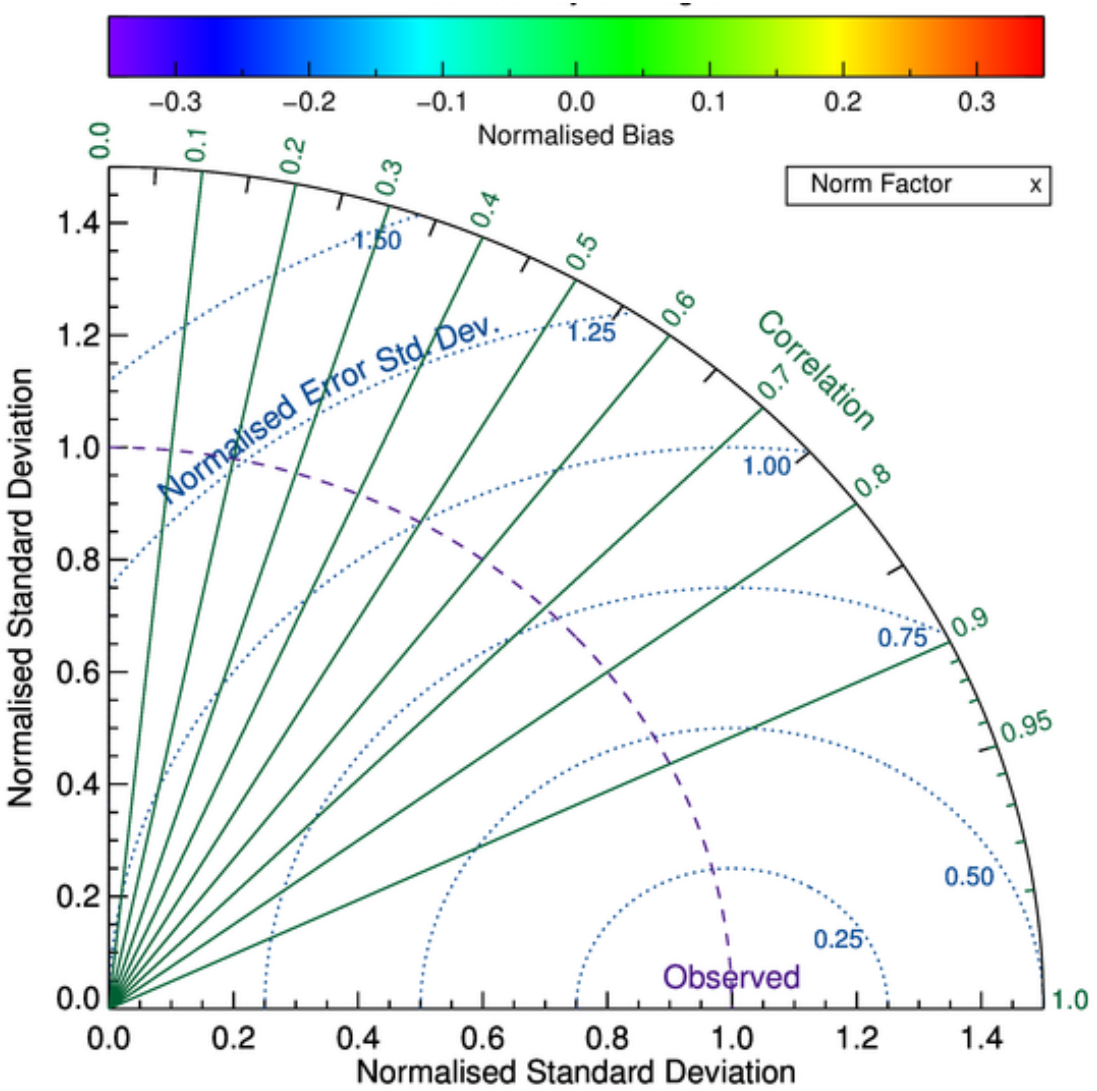
# Impossible Time Series



# Quick Introduction to Modified Taylor Diagrams

Elvidge, S., Angling, M.J. and Nava, B., 2014. On the use of modified Taylor diagrams to compare ionospheric assimilation models. *Radio Science*, *49*(9), pp.737-745.

tinyurl.com/modtaydiag

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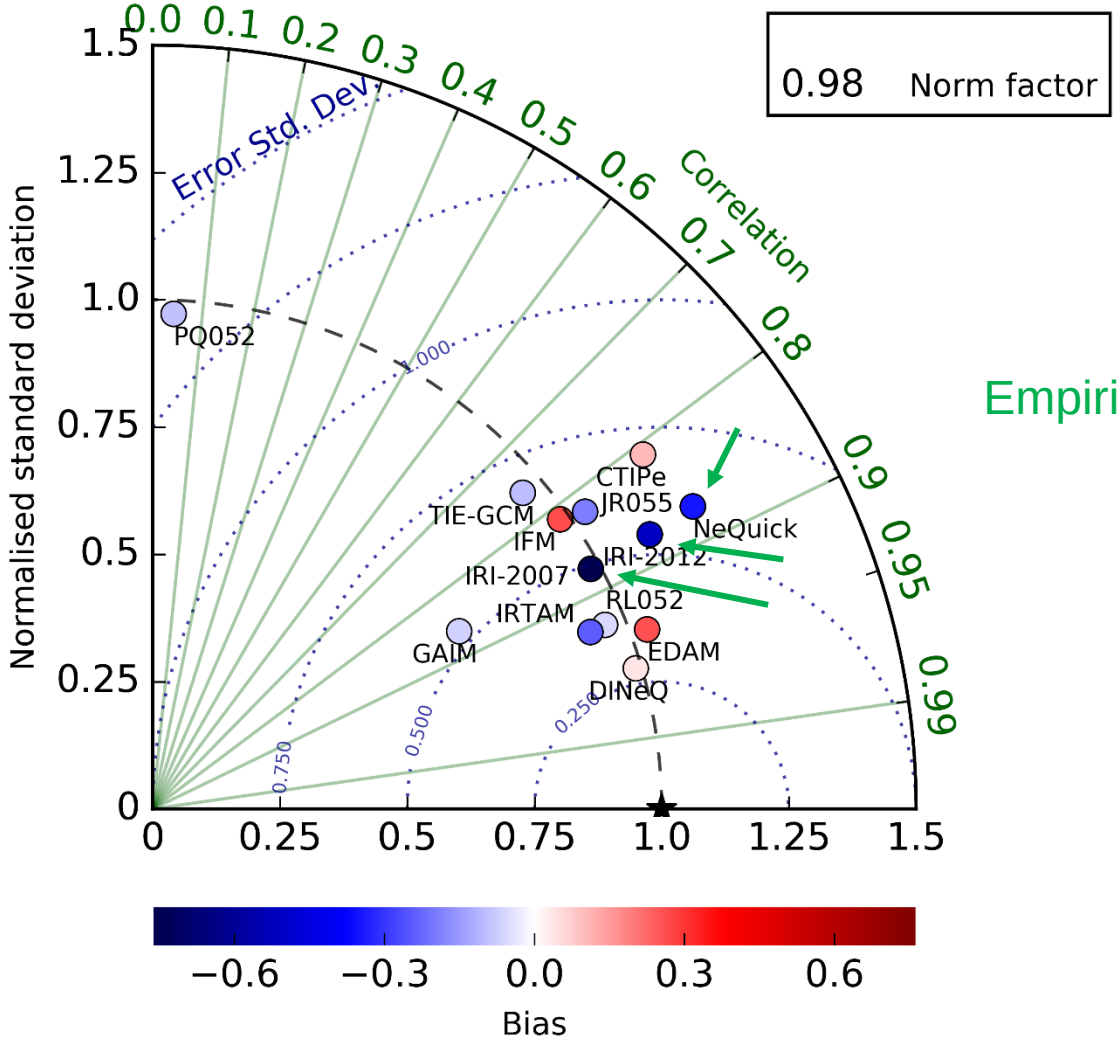
# foF2 Results (all times)




Empirical Models

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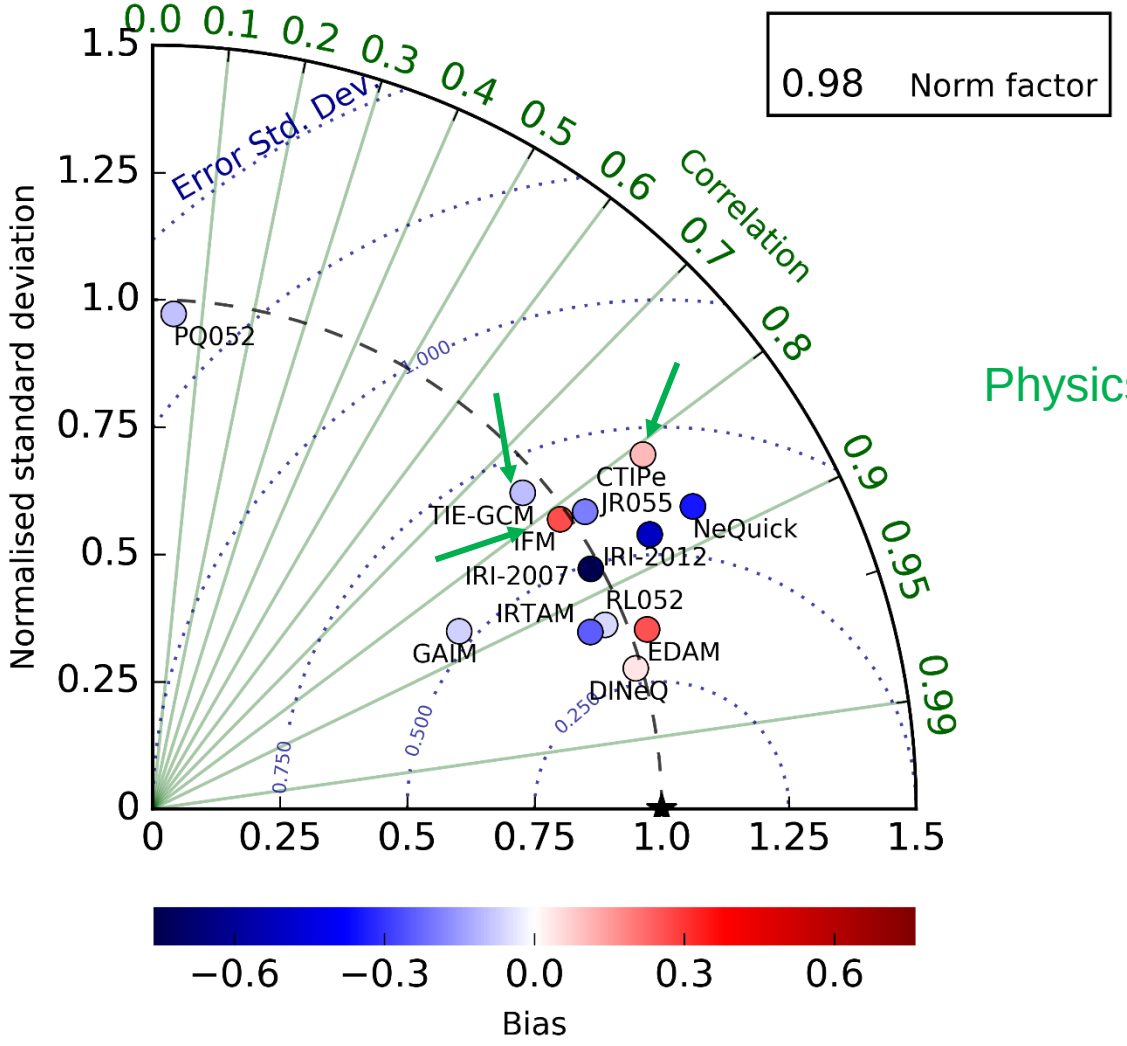
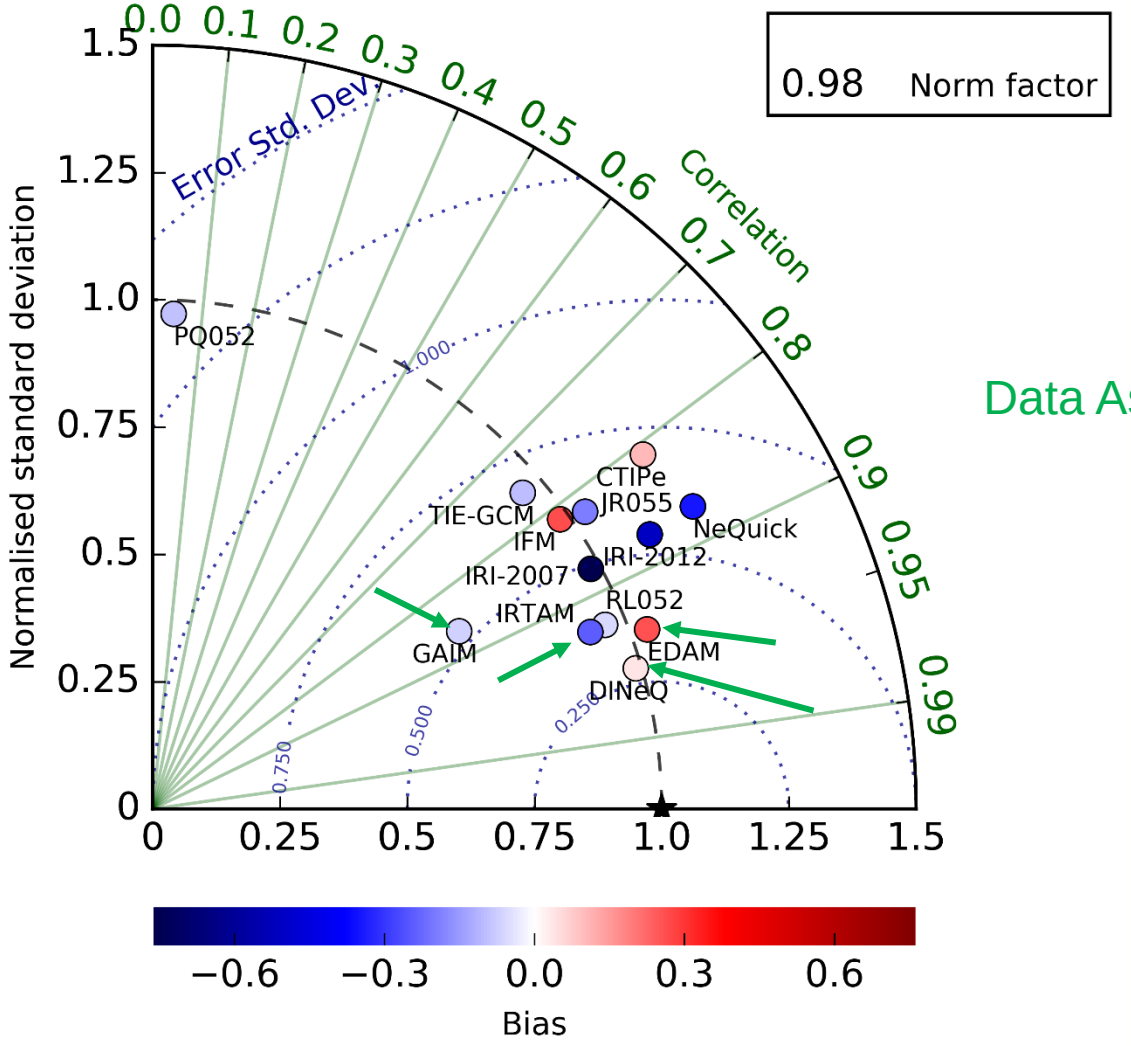
# foF2 Results (all times)



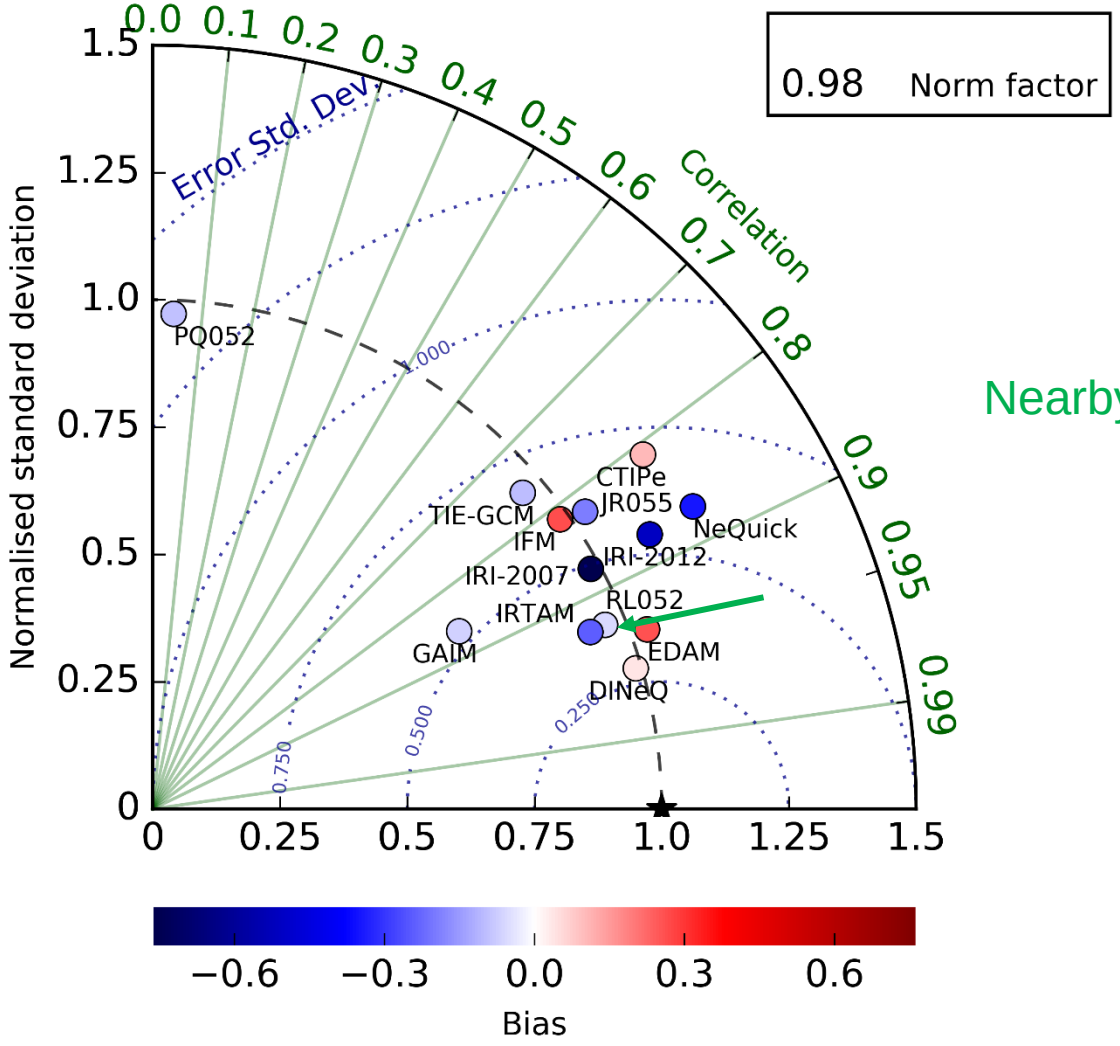

Physics Models

# foF2 Results (all times)



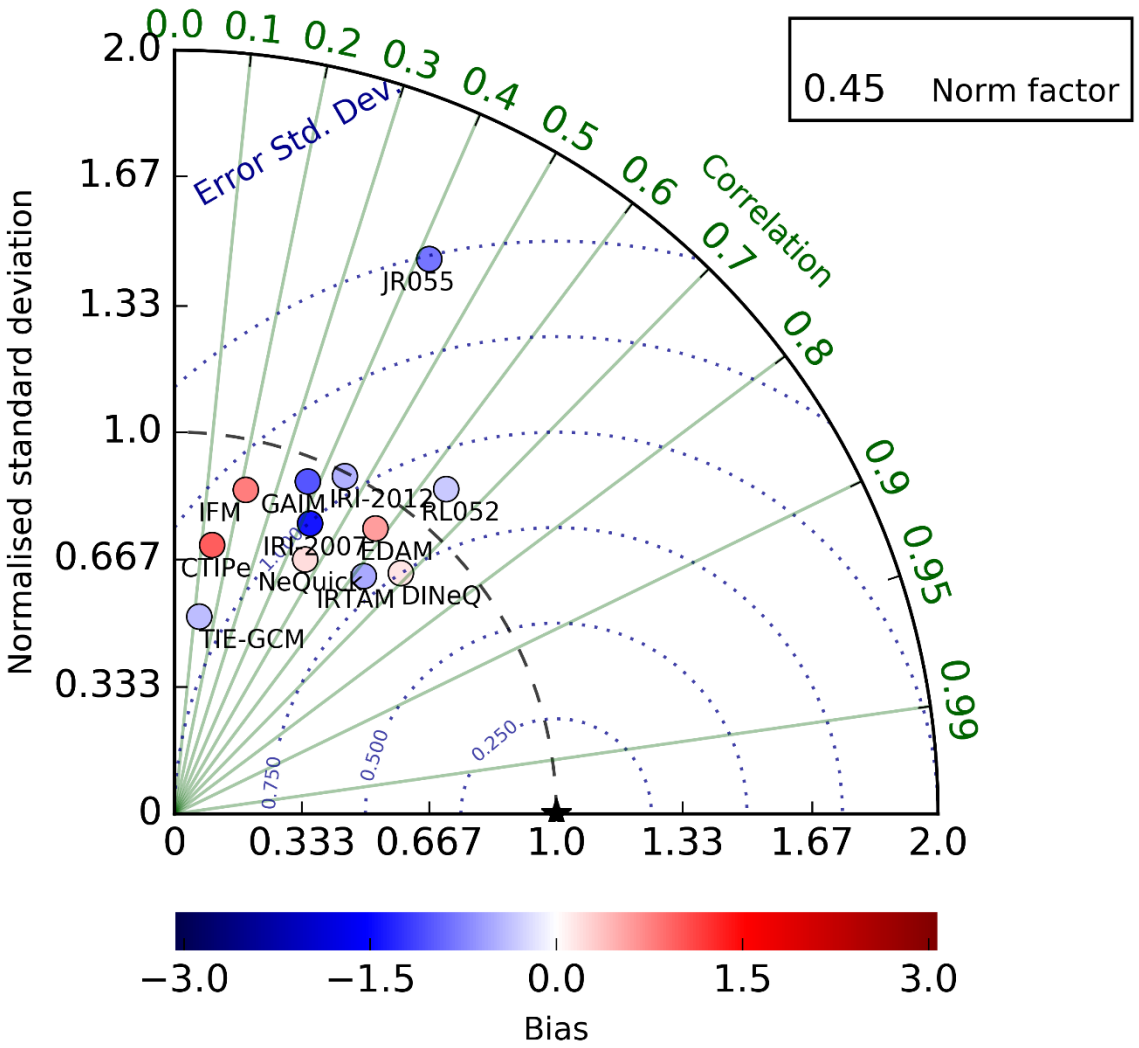

Data Assimilation Models

# foF2 Results (all times)




Nearby Ionosonde

# foF2 Results (day time 0900 – 1500 LT)

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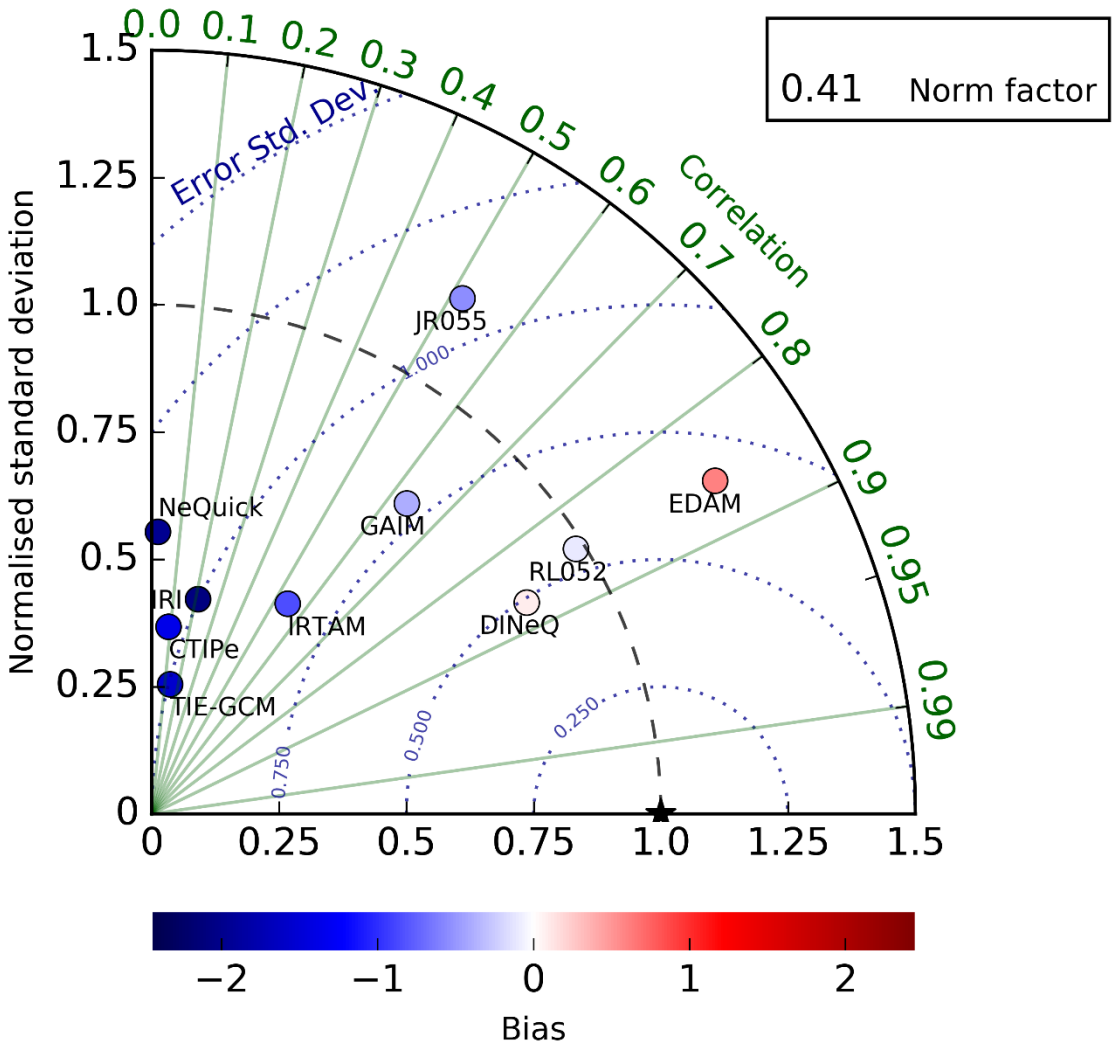
# foF2 Results (night time 2100 – 0300 LT)

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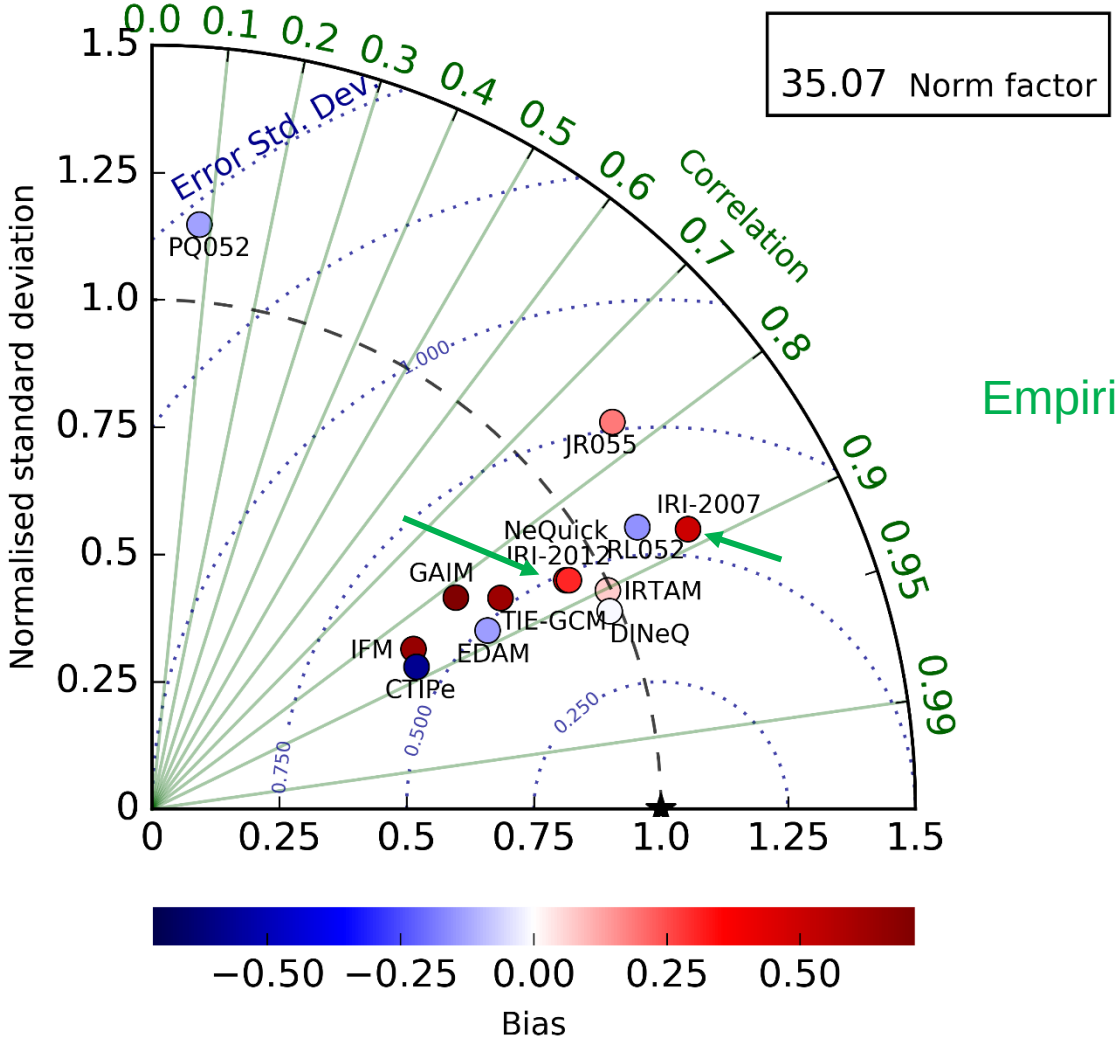
# hmF2 Results (all times)




Empirical Models

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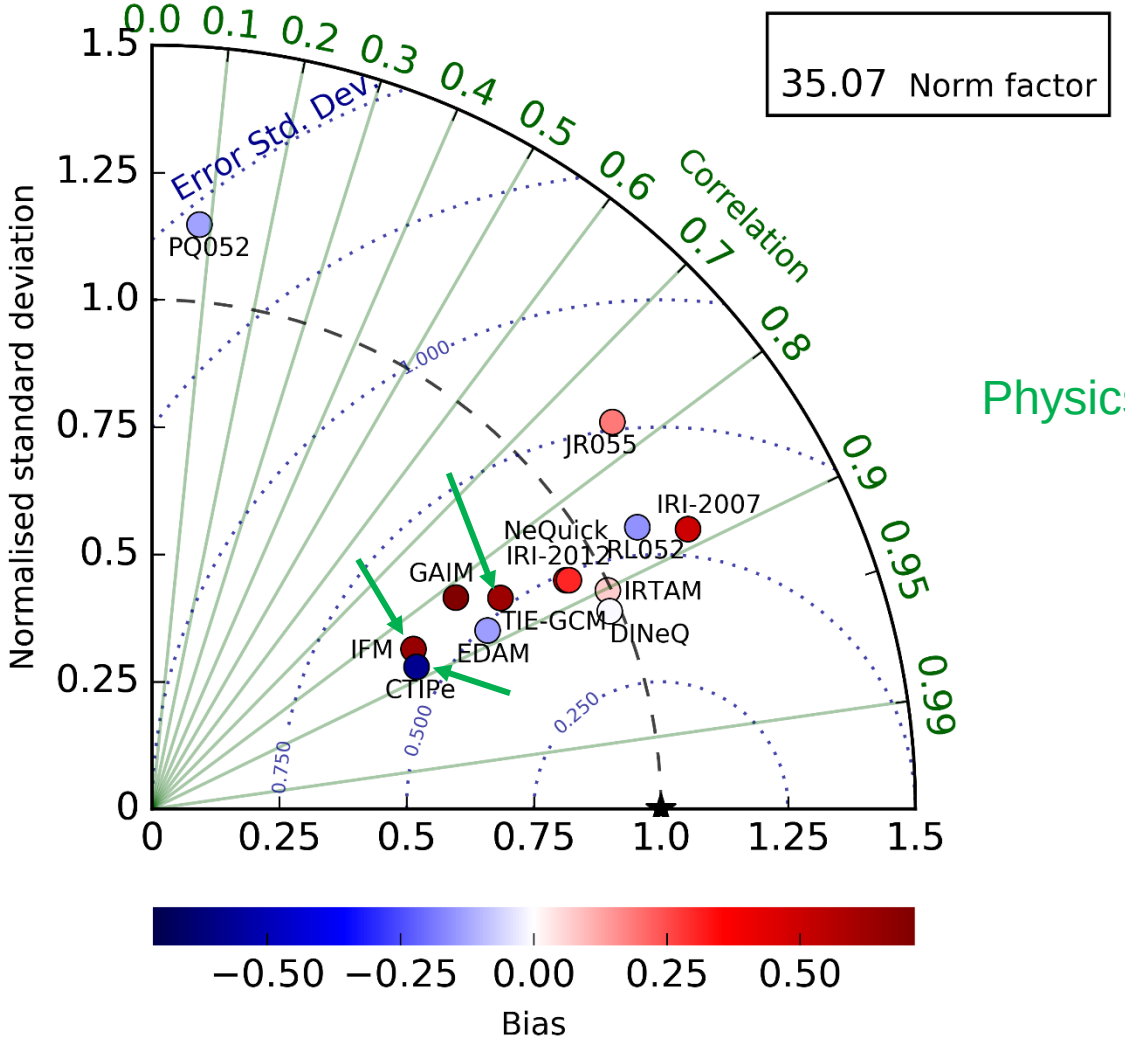
# hmF2 Results (all times)




Physics Models

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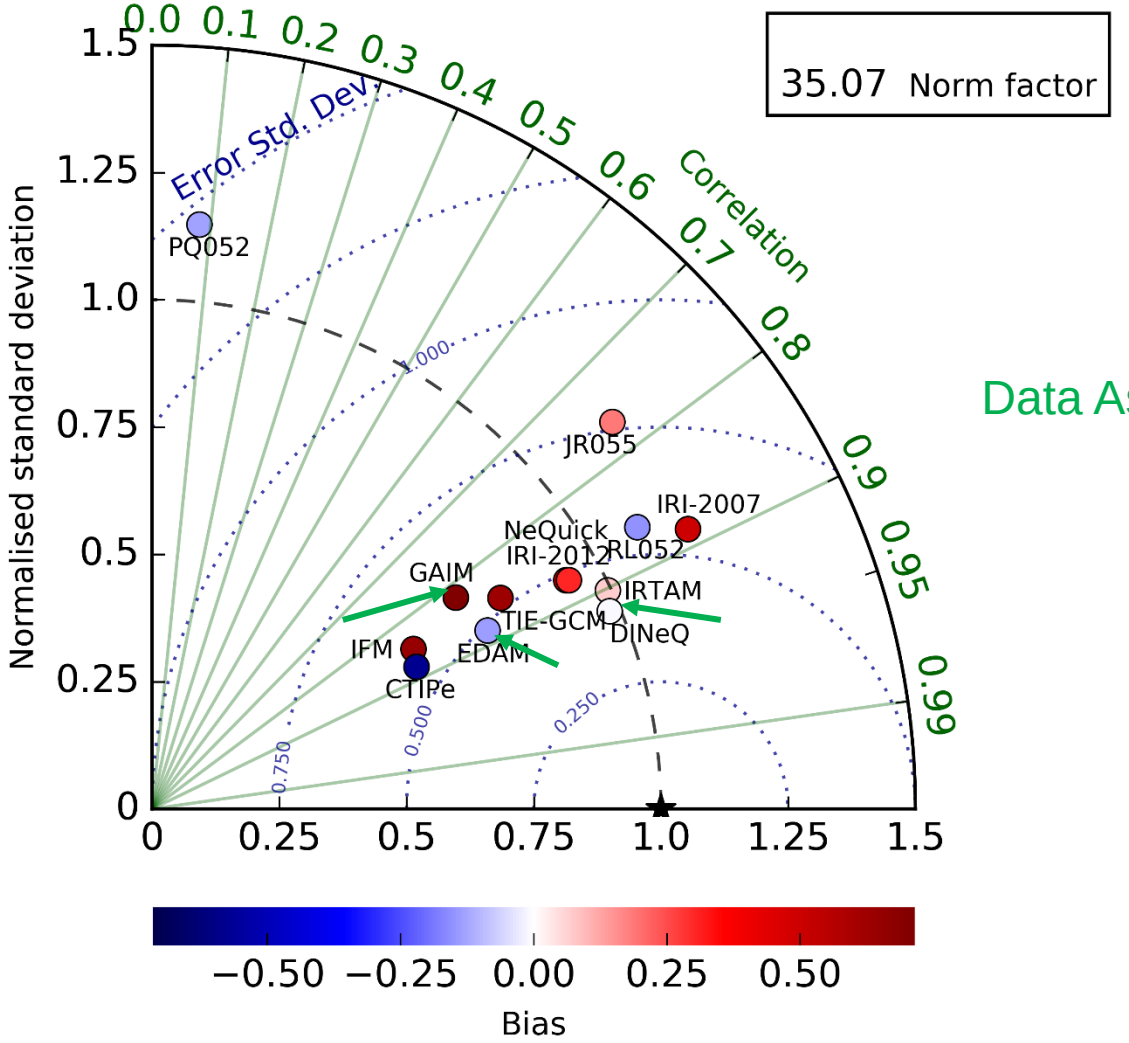


Data Assimilation Models

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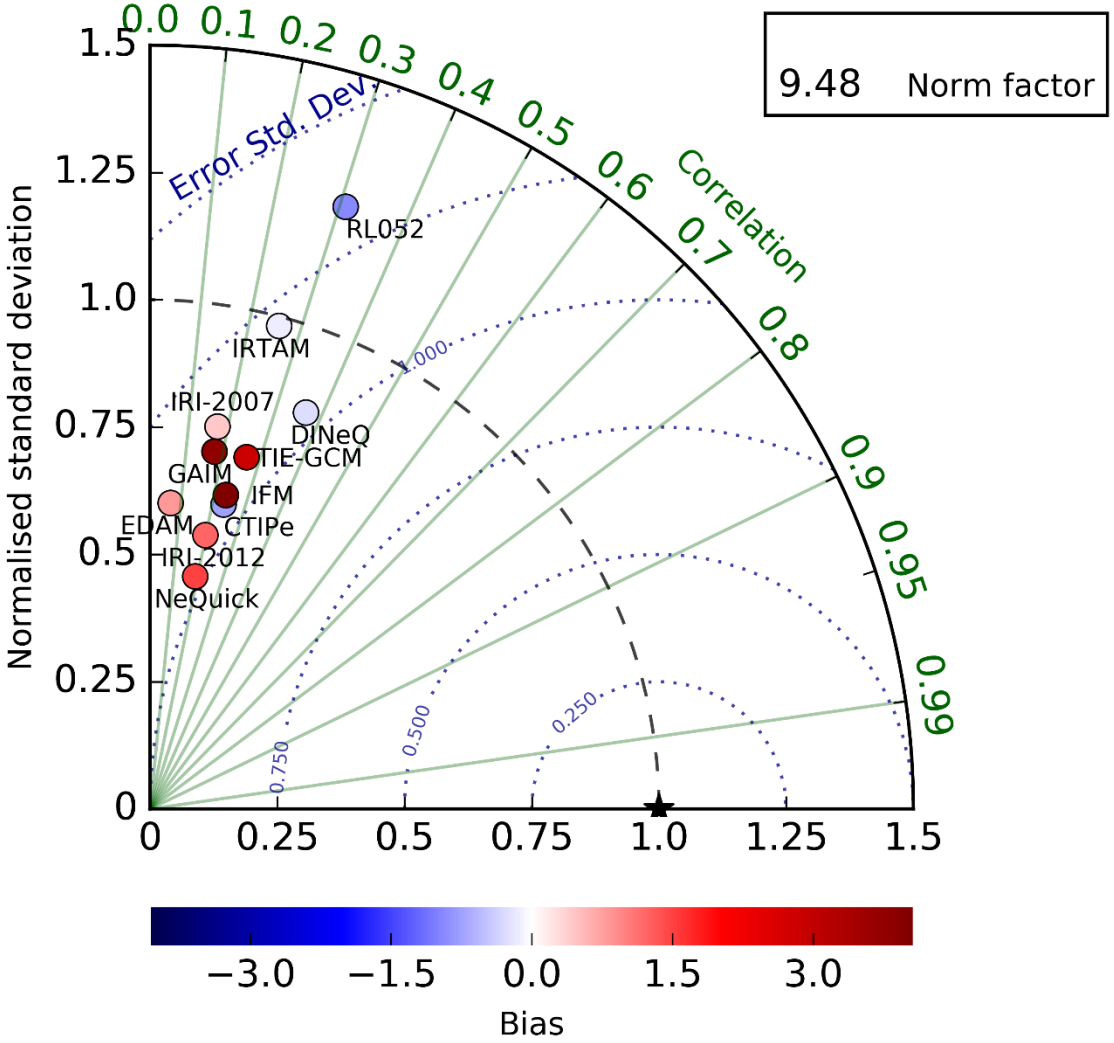


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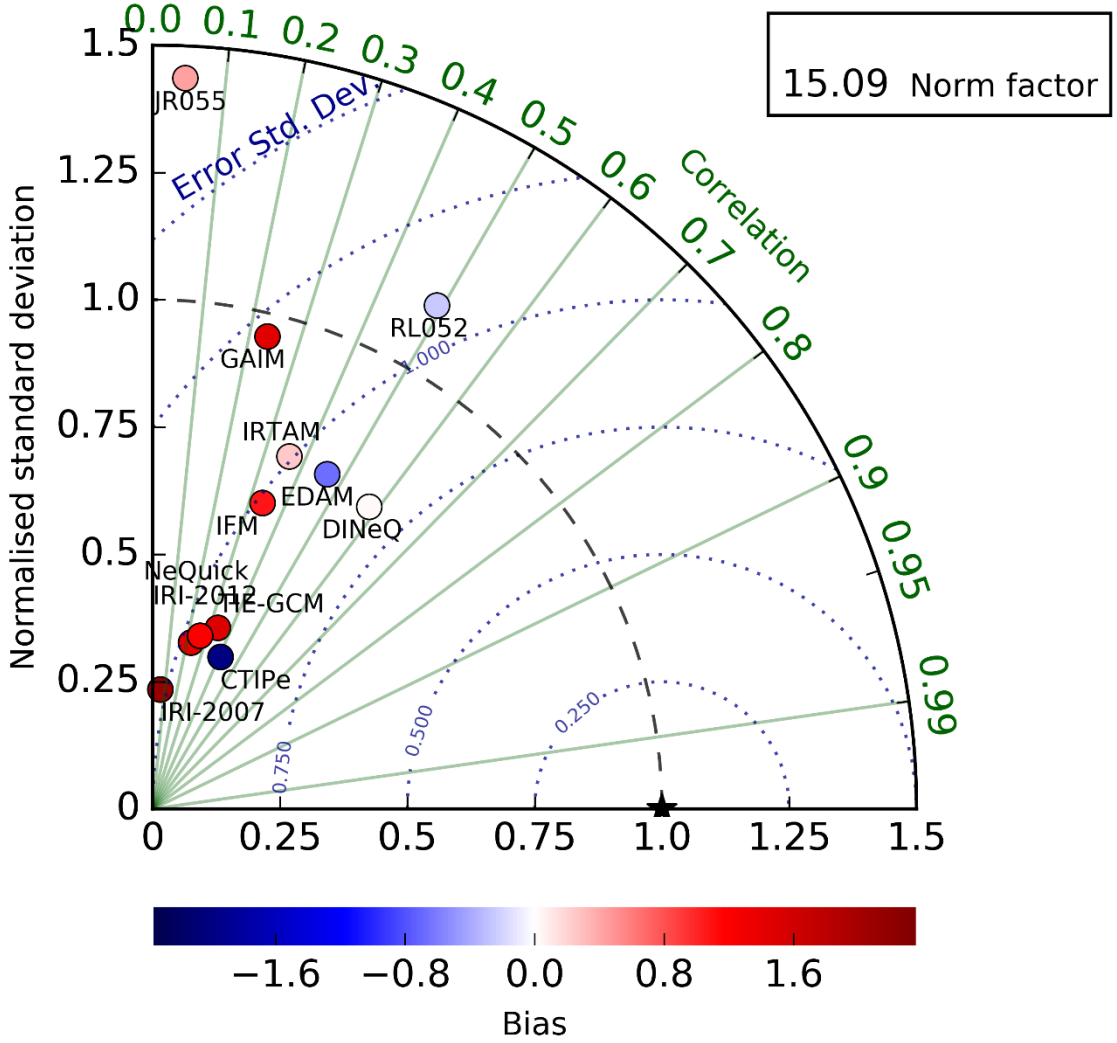


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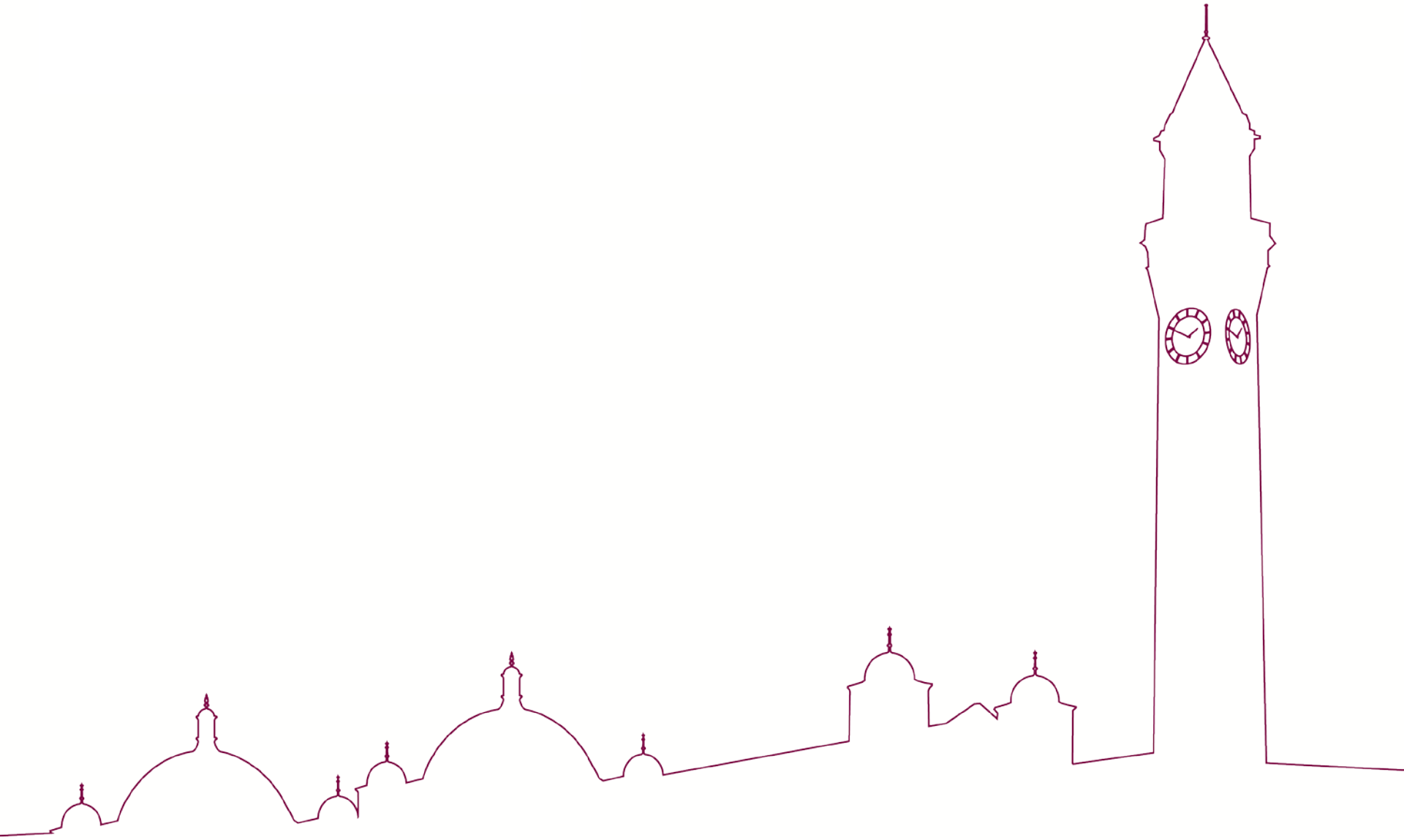
# Conclusions

- Time period represents extreme space weather
  - No model does very well during this period
  - For similar future times models may need re-tuning
    - Coming extended solar minimum?

- Cyclostationarity obscures correlation of models with observations
  - Testing should move away from contiguous time periods

# Join the test

- Information about the test, including Python code to download the required data is available at: **tinyurl.com/testscenario**
- If you are interested in performing the test please speak to me afterwards or email me: **s.elvidge@bham.ac.uk**
- My python code to create modified Taylor diagrams is available from: **tinyurl.com/modtaydiag**



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