

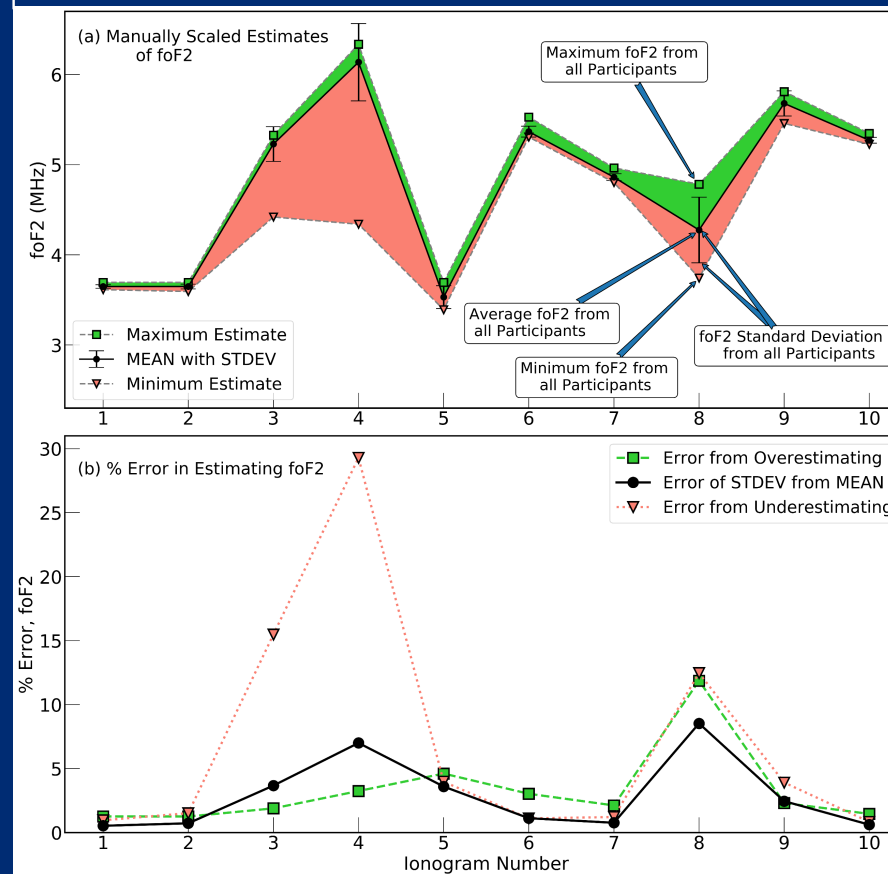
# An Estimation of Human-Error Contributions to Historical Ionospheric Data

- Ground-based radar sounders are used to characterize the dynamics and chemistry of Earth's ionosphere.
- Manual analyses of older/analog (pre-digital age) radar ionograms to derive ionospheric characteristics was a tedious procedure and susceptible to human error.
- In this study, a team of ionospheric researchers hand-scaled radar ionograms repeatedly, providing multiple estimates of the same ionospheric parameters. This was done to estimate the amount of human variability in the hand-scaling process.
- The resulting variability was then added & subtracted from the mean parameter values - and used to drive physics models that use the ionospheric parameters as input. This was done to estimate downstream impacts on physics modeling.

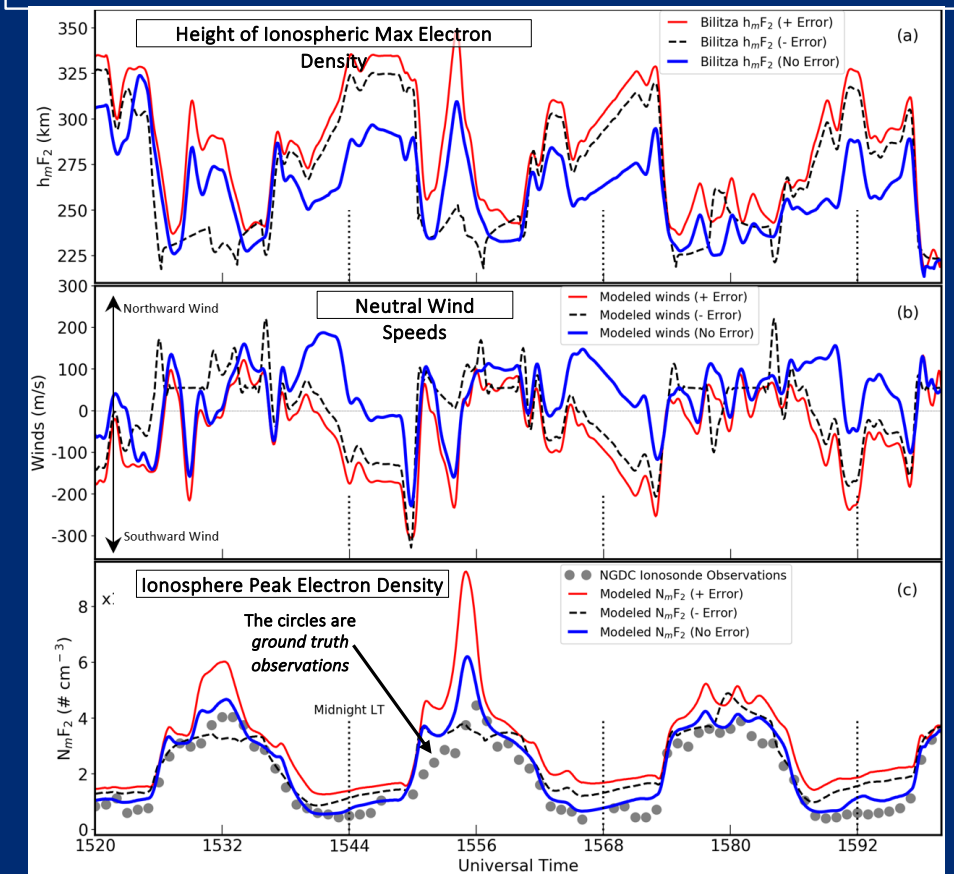
**RESULTS: The variability due to human-scaling of radar ionograms can be very significant!**

- Long-term (months/years) modeling results showed a low sensitivity to human-related errors, but short-term analyses (hours/days) showed very different results when small errors were applied to the input parameters.

Variability of the foF2 ionospheric parameter; from 10 ionograms; each ionogram was hand-scaled 20 times.



Modeling results with no error imposed on the parameters, and with  $\pm$  errors imposed; short-term analysis.



*The variability of manually scaling ionospheric properties from radar ionograms can be large. The downstream effects of this on long-term modeling are small, but the downstream effects on short-term modeling can be very significant.*