Forecasting equatorial spread F

- While the Rayleigh Taylor-type plasma instabilities mainly responsible for ESF are well understood, forecasting irregularities and scintillations remains an unsolved problem.
- Models tend to predict modest growth most of the time after sunset, whereas nature is much more bimodal, producing either no irregularities or well-developed irregularities shortly after sunset on a given day.
- Preconditioning or “seeding” may therefore contribute to day-to-day variability. While atmospheric gravity waves have been postulated as a seeding mechanism, ionospheric processes warrant investigation.

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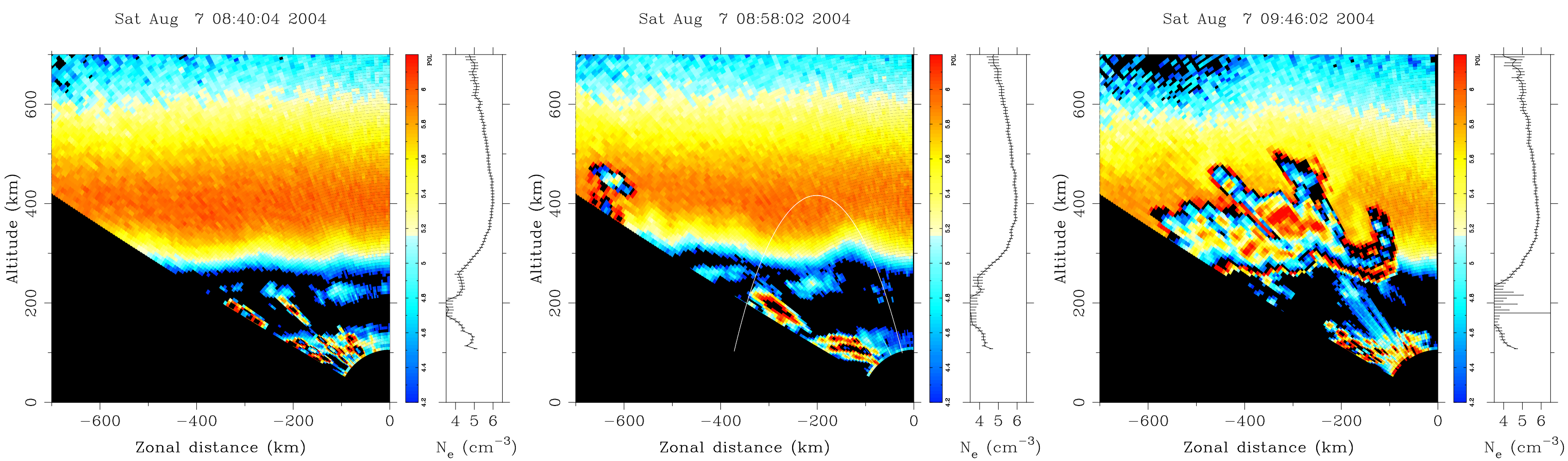
EQUIS II results



- Shear flow has been identified as a source of free energy, able to drive robust Kelvin Helmholtz-like instabilities in the plasma.
- Sounding rocket experiments suggest that this mechanism generates large-scale waves in the bottomside. Rayleigh Taylor-type instabilities then take over.
- Collisional shear instabilities benefit from the same conditions as Rayleigh Taylor-type instabilities but also require rapid, retrograde plasma flows in the bottomside.

Ground-based campaign

- Important parameters for shear instabilities can be modeled in three dimensions, constrained by measurements from Jicamarca, the South American GPS receiver/ ionosonde chain, and COSMIC.
- Precursor bottom-type layers can also be monitored autonomously with the JULIA radar at Jicamarca. Structure in the layers seems to be the first indication that large-scale waves are forming.
- Traditional forecast models can be modified to incorporate shear-inability growth rate calculations.