



Australian Government

Department of Defence

Defence Science and Technology Group

JORN and the Ionosphere

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High-Frequency Radar Branch

National Security, Intelligence, Surveillance and Reconnaissance Division

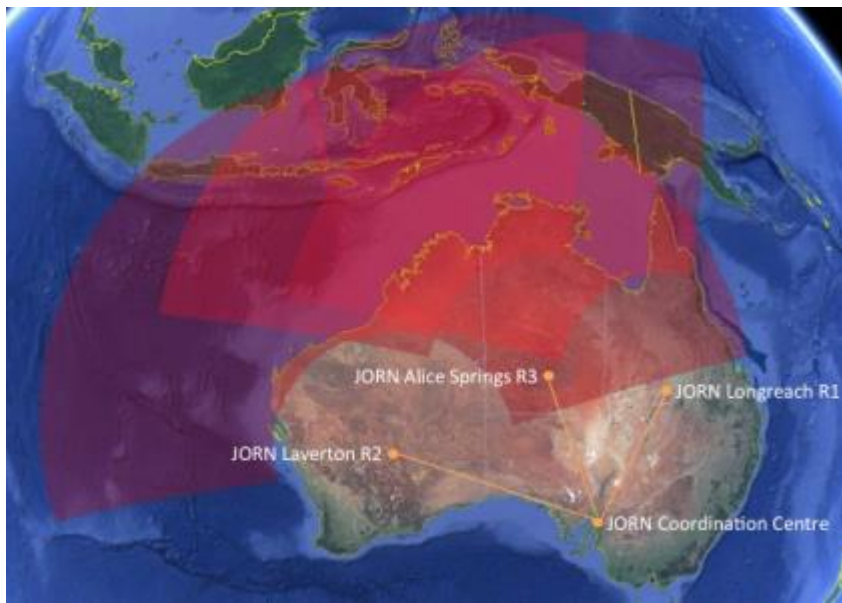
Defence Science and Technology Group

*Department of Defence,
Commonwealth of Australia*

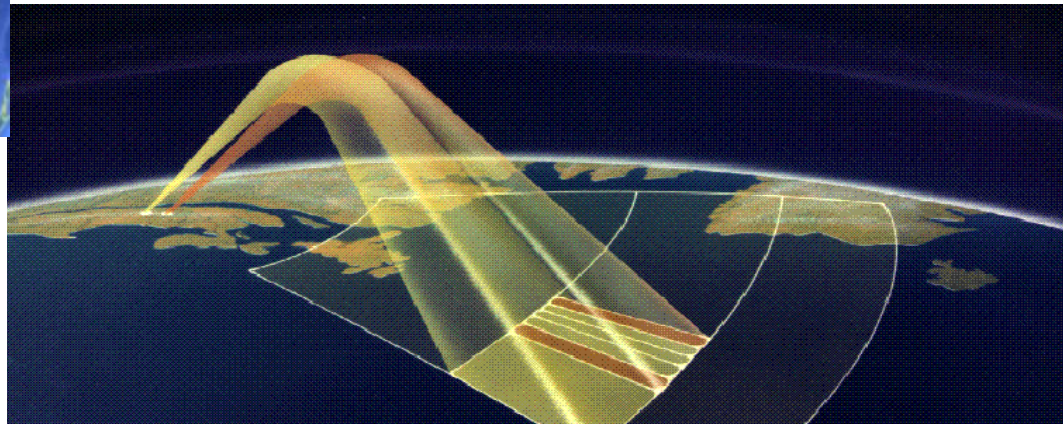
Introduction

- **JORN: Jindalee Operational Radar Network**
- **Ionosphere;**
 - how it affects and controls JORN;
 - how JORN monitors and maps it;
 - and the role of DST ionospheric research.

JORN: Jindalee Operational Radar Network



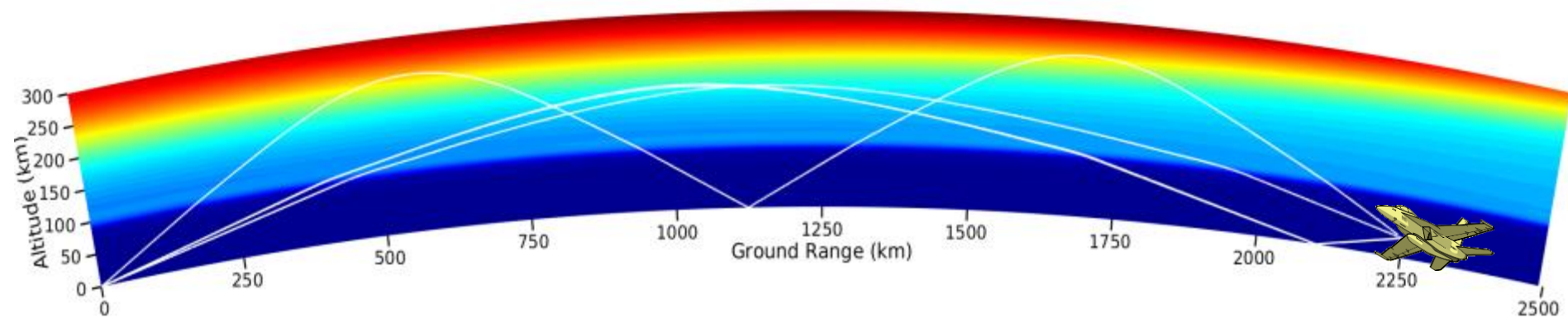
- A network of HF radars
- Monitor northern approaches to Australia.
- Based on “Jindalee” radar at Alice Springs
- Developed by the DST Group (was DSTO)



- Rely on refraction of HF radio signals through the ionosphere
- Over-the-horizon radar (OTHR) coverage.

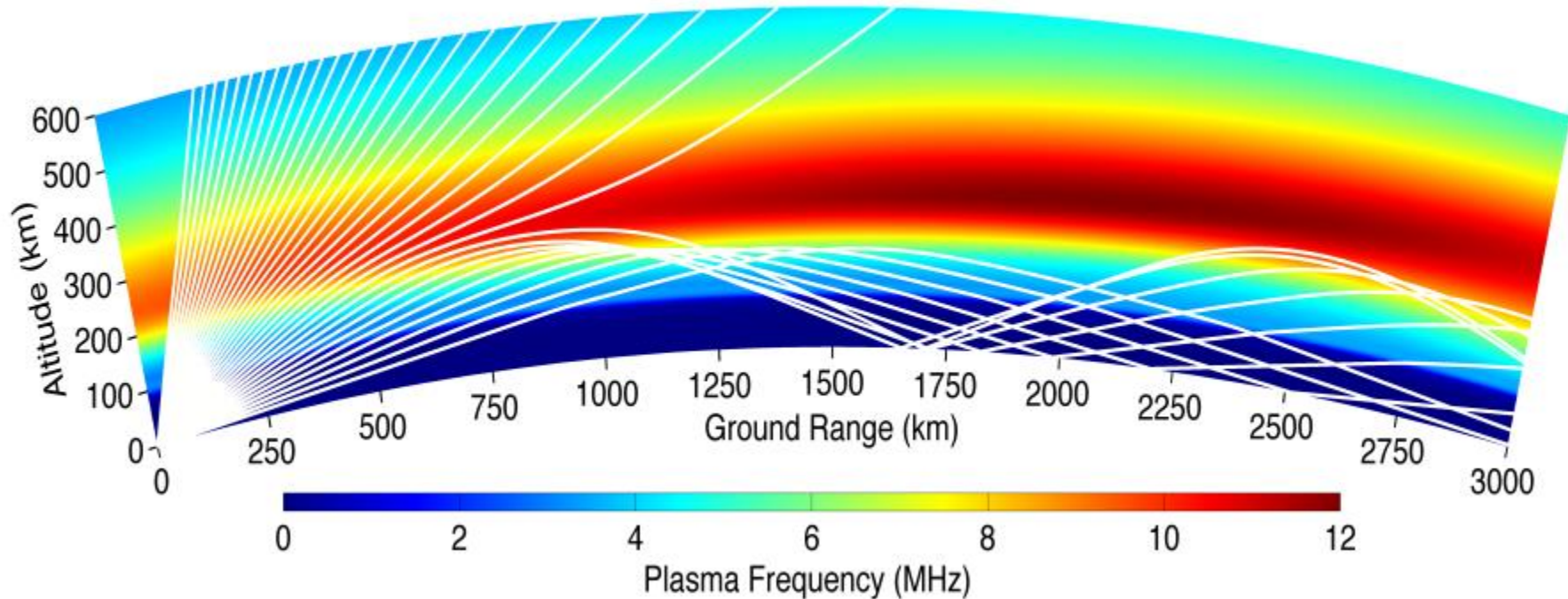
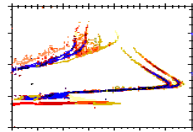
The Basic Equation

1. Create a model ionosphere that matches reality
2. Trace ray trajectories to target and back

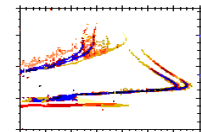


Choose a frequency !

Ray trajectories, single frequency, all elevations

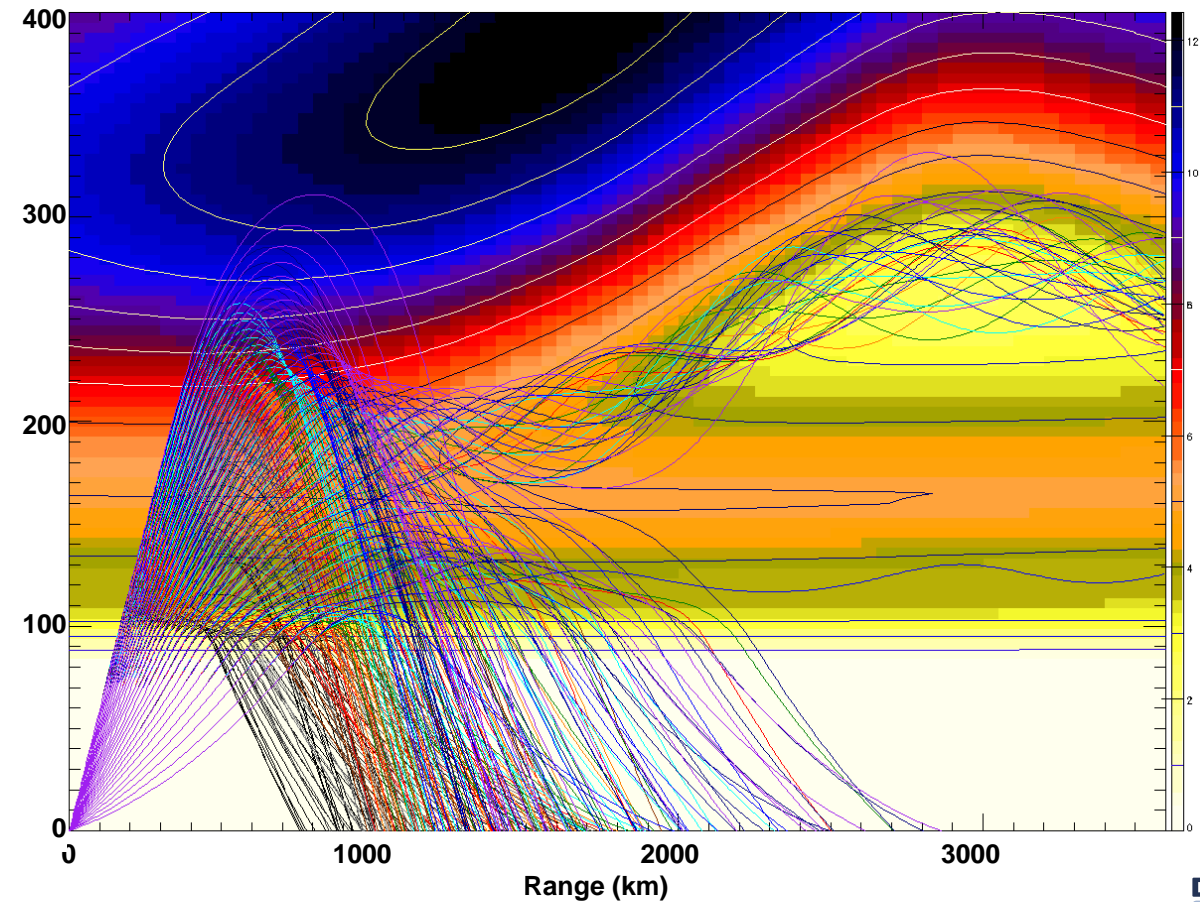
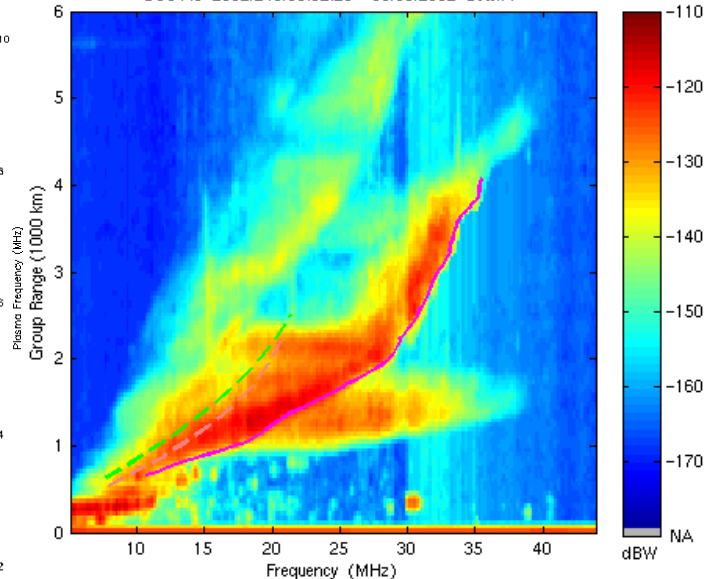


Ray trajectories, all frequencies and elevations

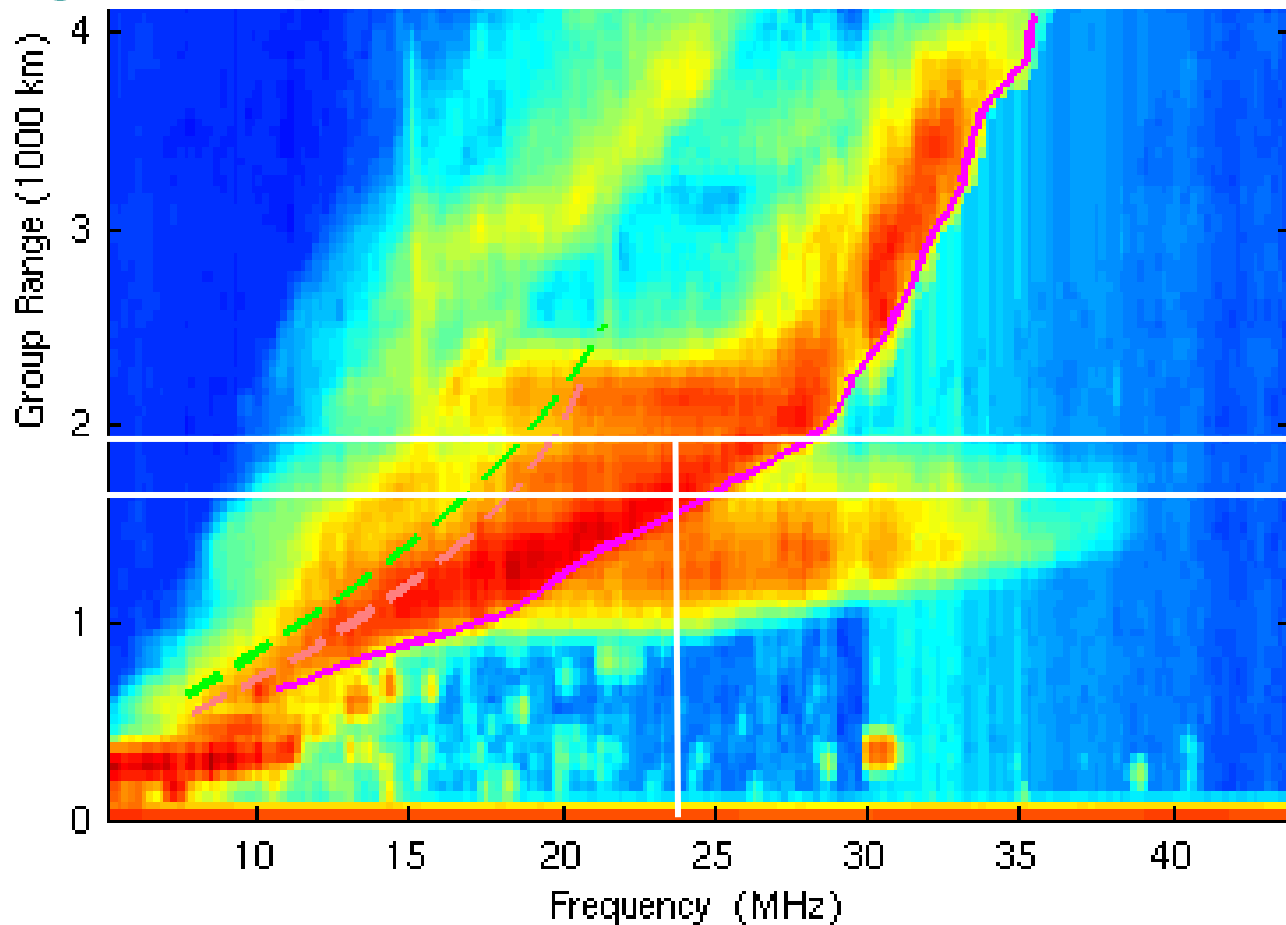


Backscatter Sounder

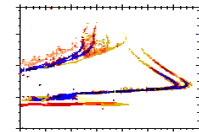
BSS AS 2002/246/03:02:25 03/09/2002 Beam 7



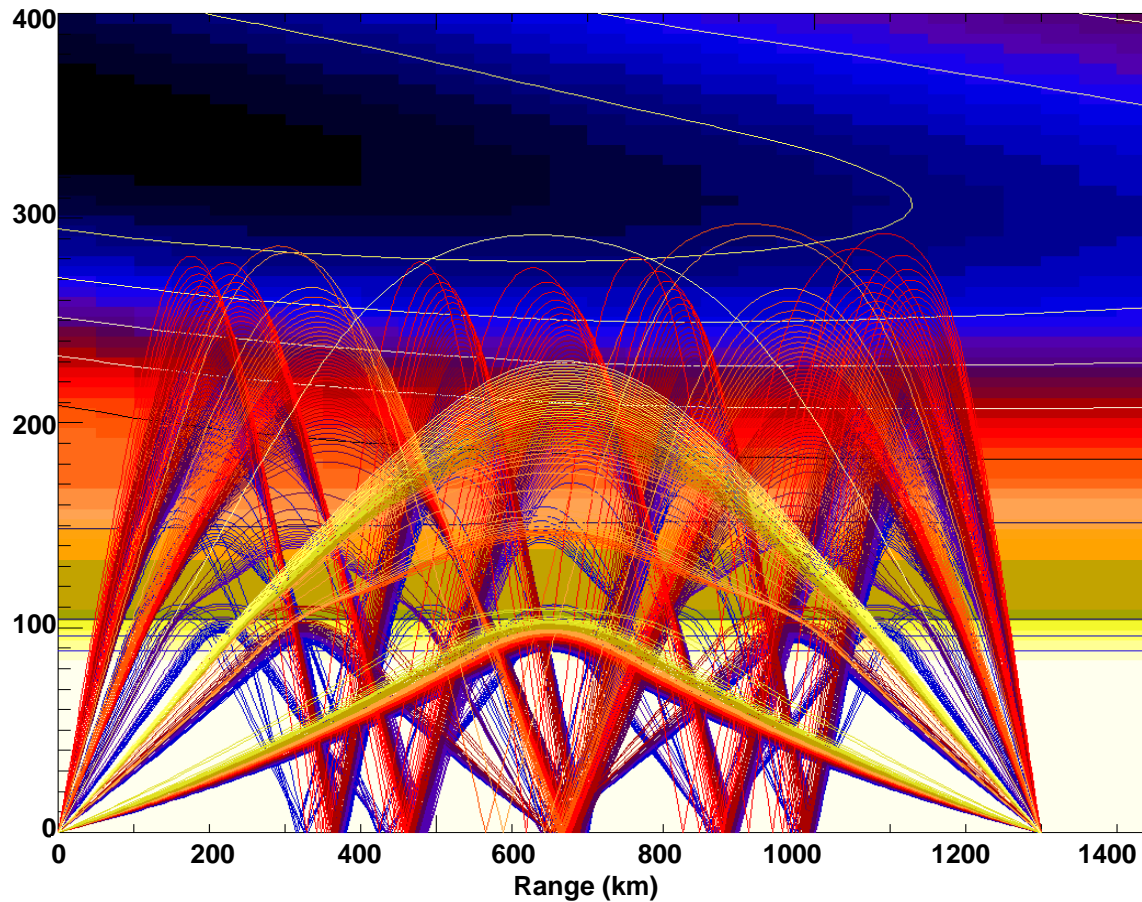
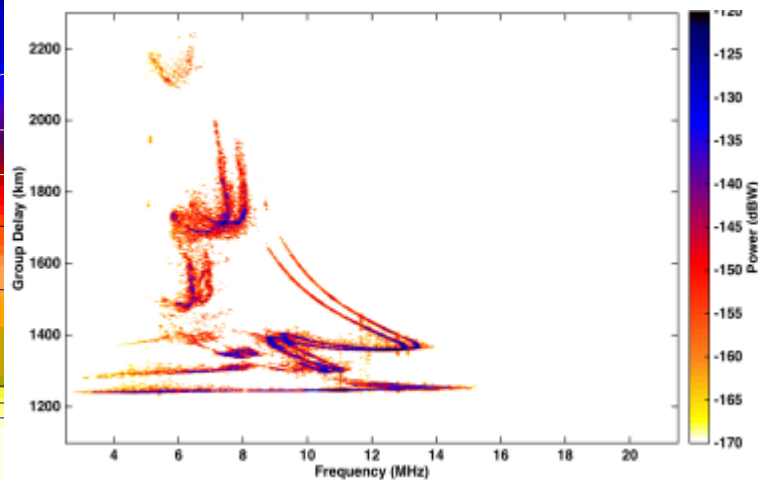
Choosing a Frequency: Backscatter Sounder

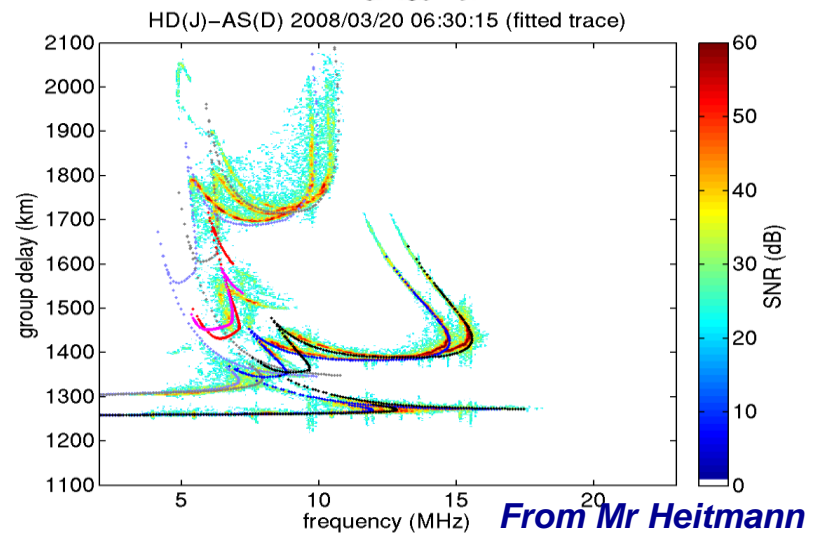
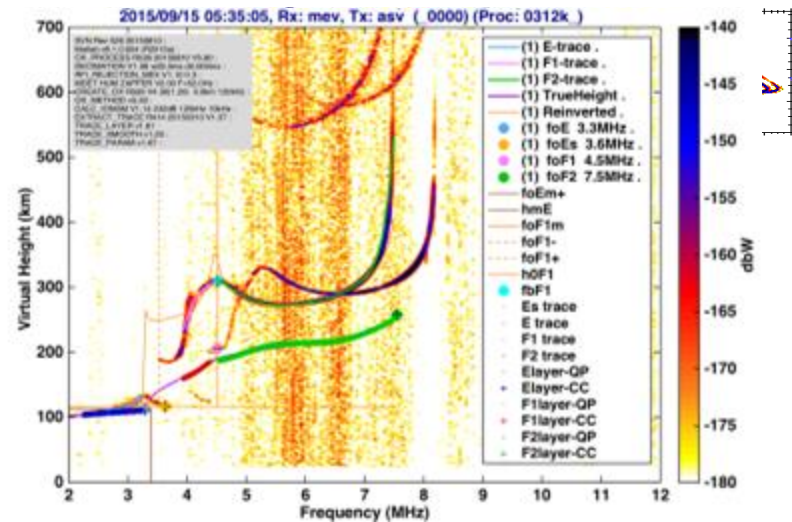
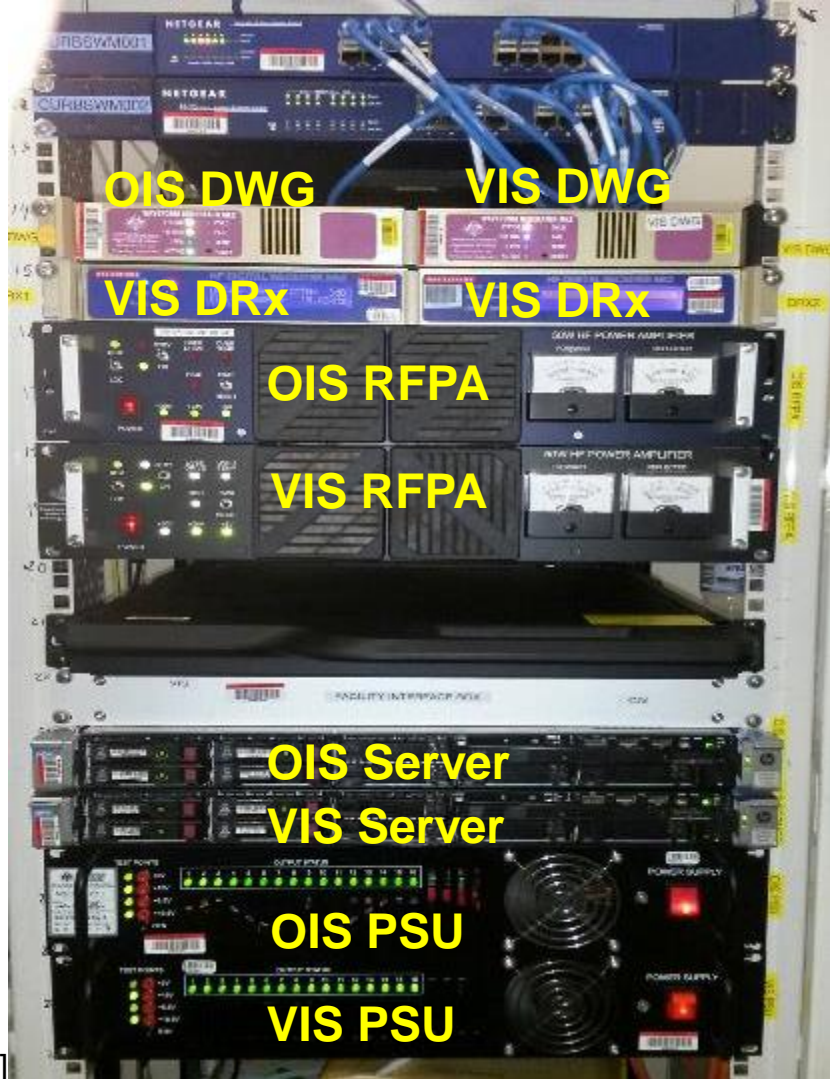


Ray trajectories (Darwin→R3Rx), all frequencies

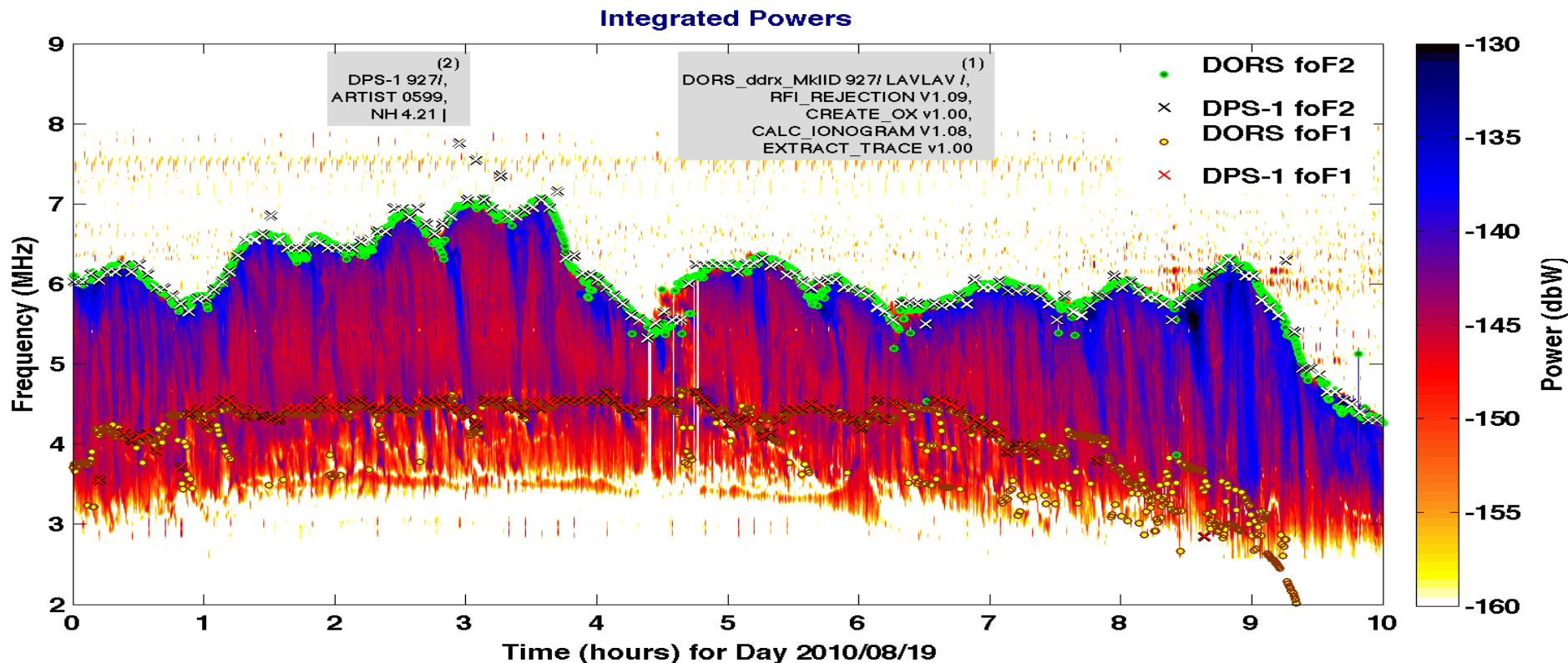
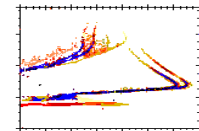


Oblique Incidence Sounder (Cur→R2Rx)



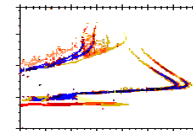


Parameter Validation

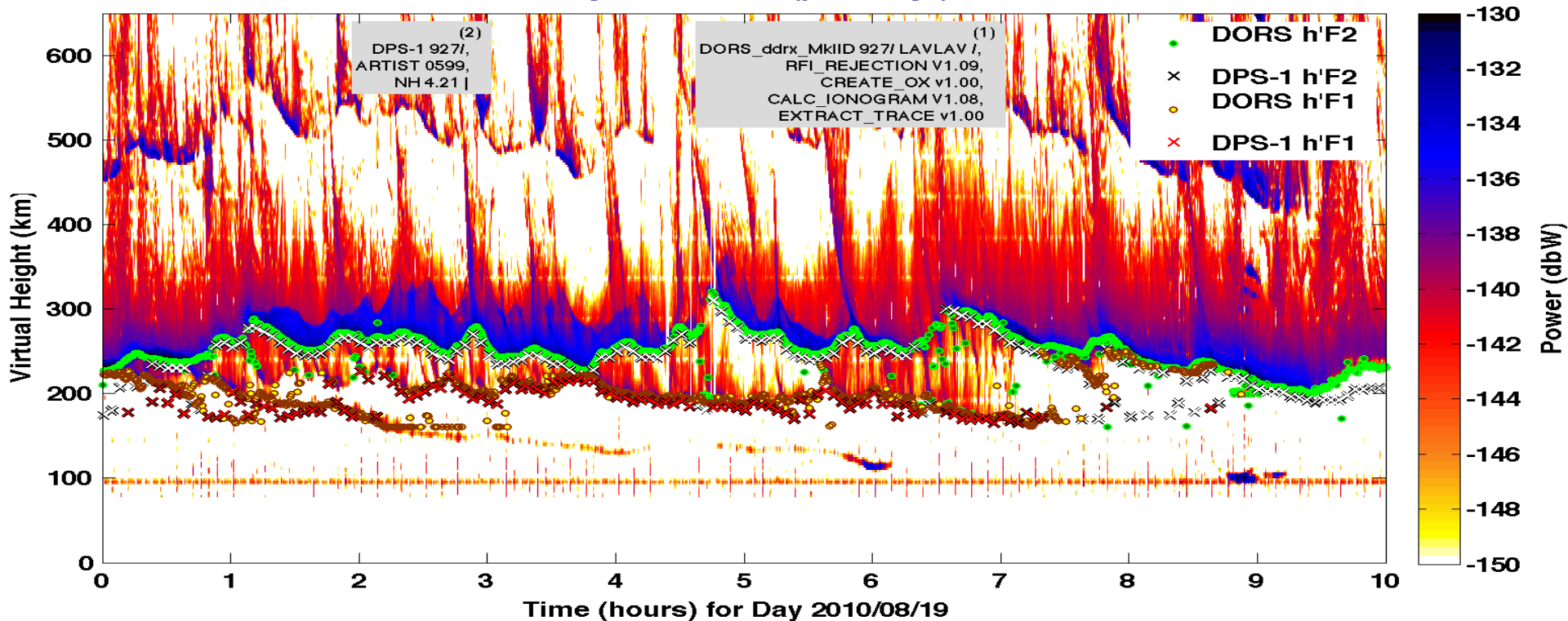


Frequency-Time-Intensity plot

Parameter Validation



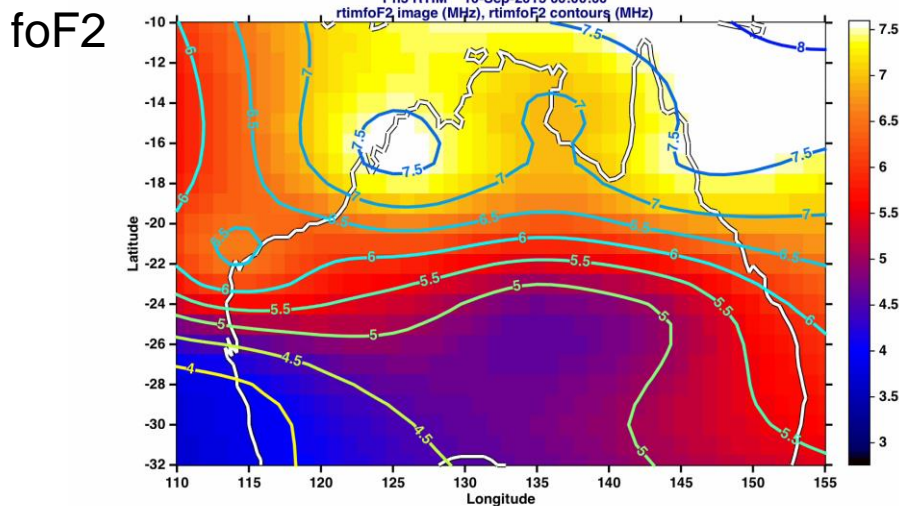
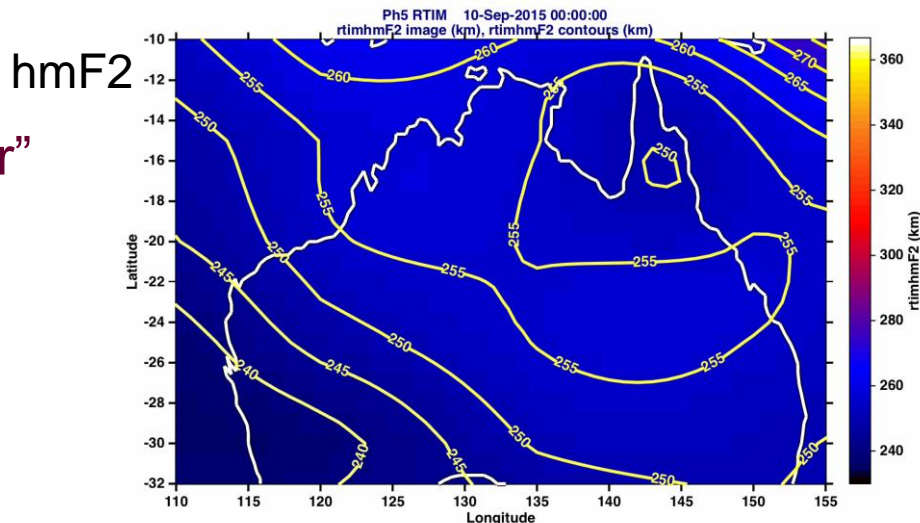
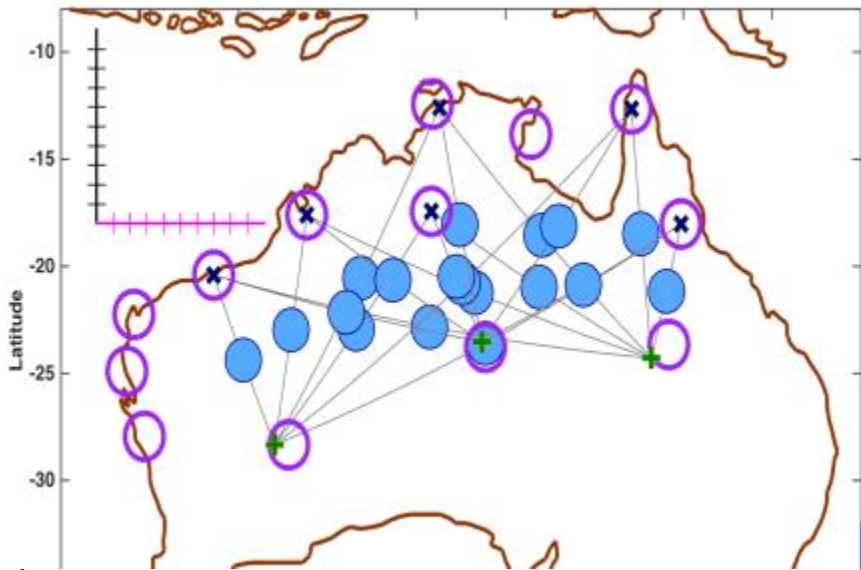
Integrated Powers (per Range)



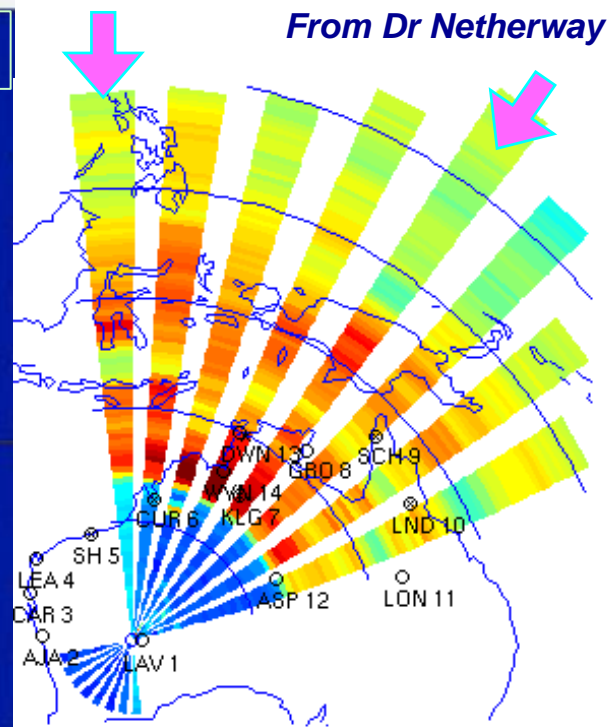
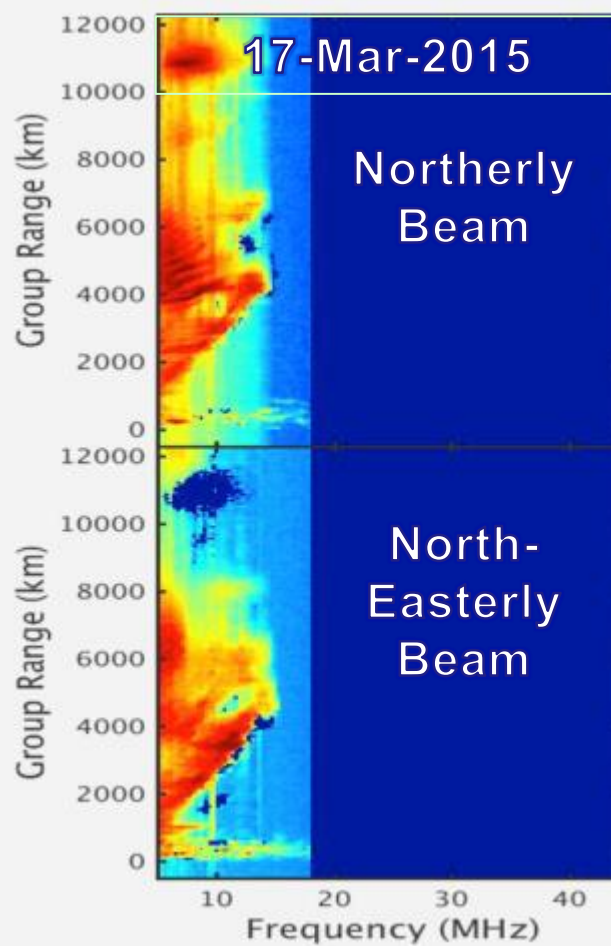
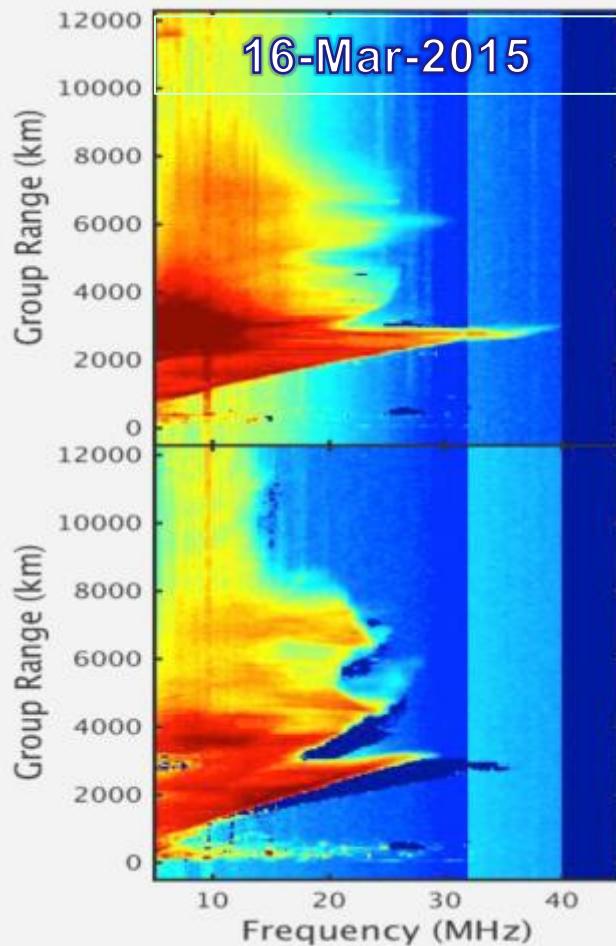
Range-Time-Intensity plot

JORN RTIM

- For JORN to perform its duties a “near” real-time model of the ionosphere is generated. (RTIM)
- The primary source of data
 - 13 VI sounders.
 - 18 OIS paths



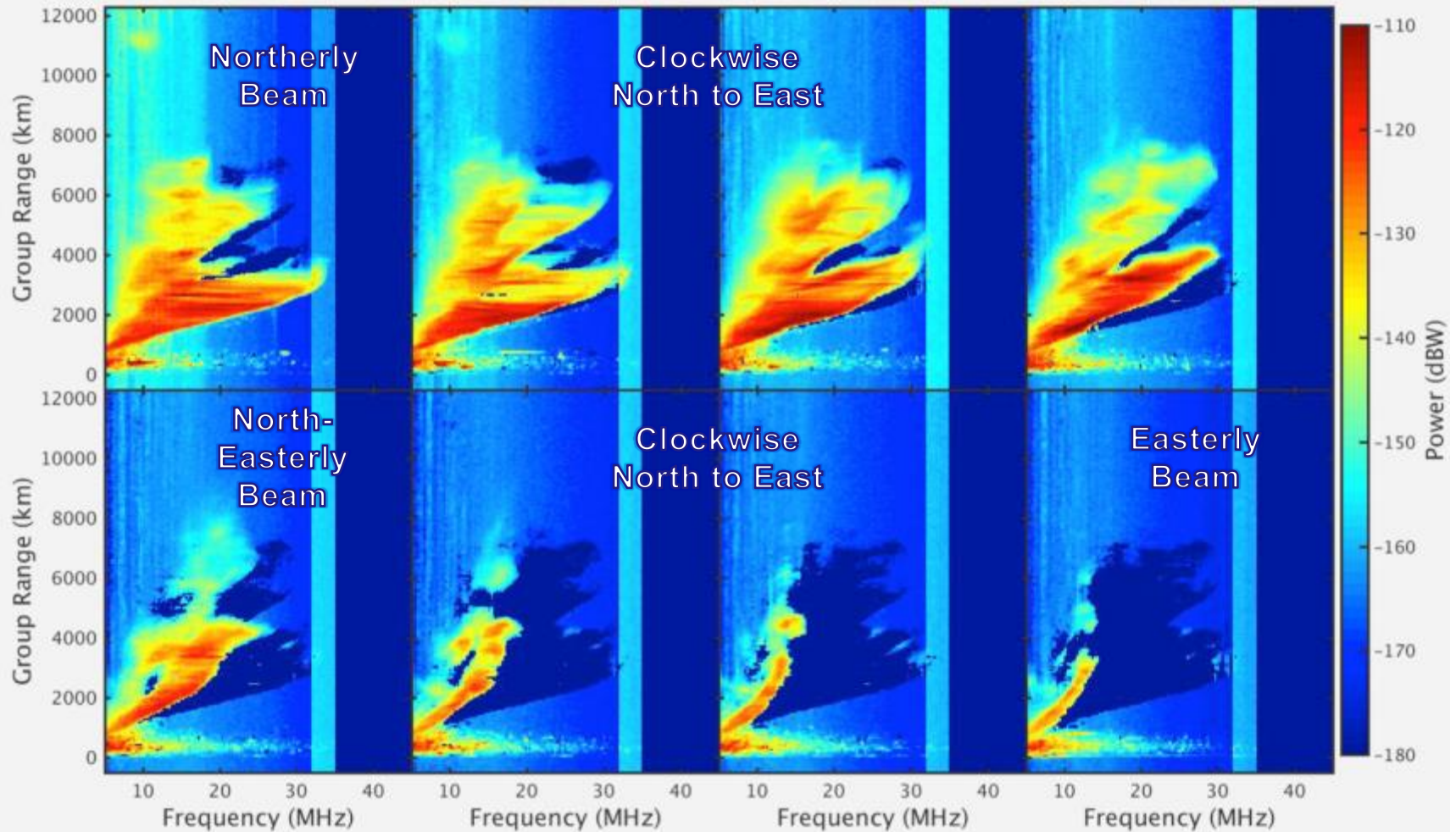
Storm Effect, R2E - Laverton East Array @ 16:00 UT



St Patrick's Day Event
DST = -223 nT

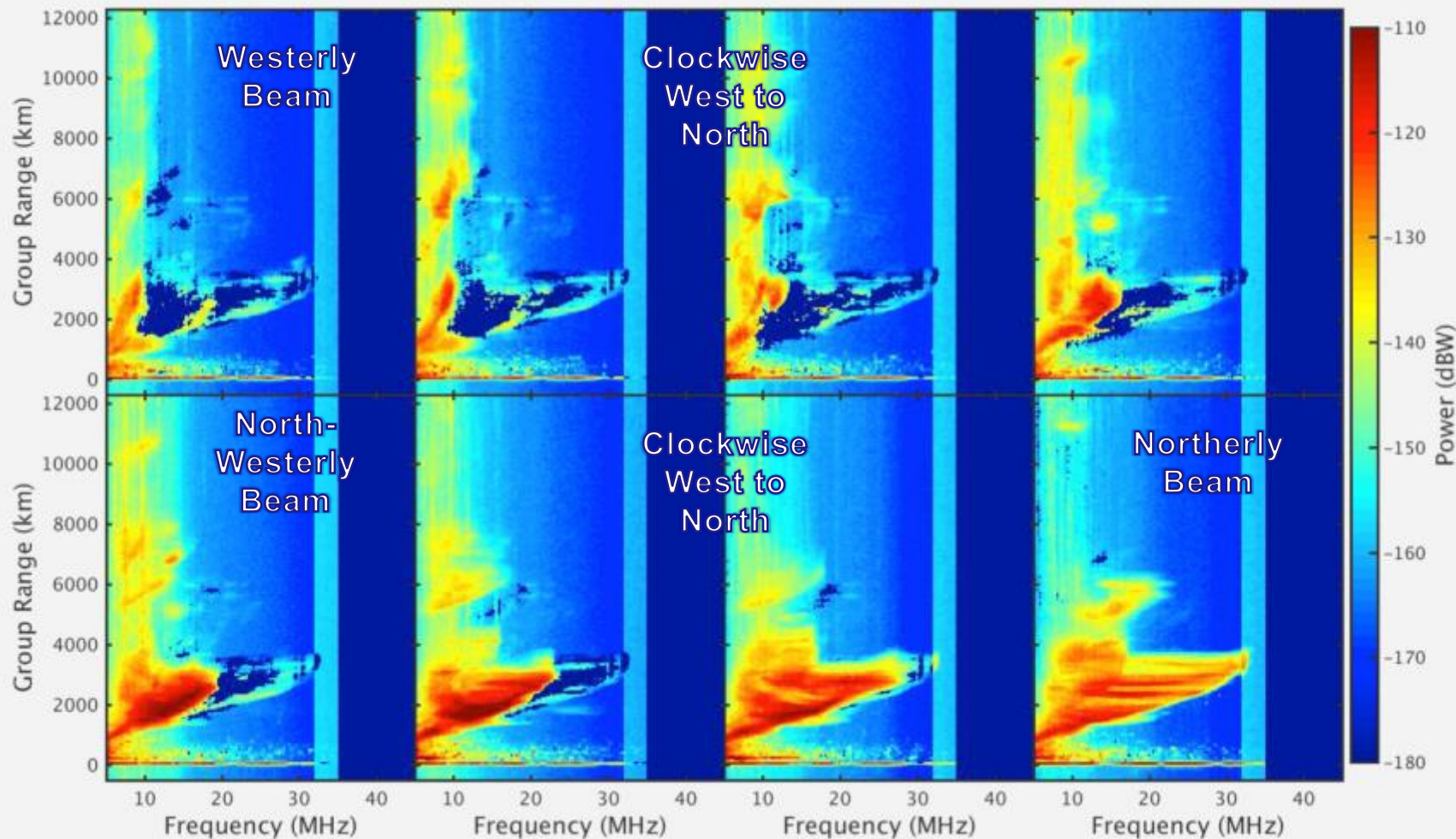
R2E 2015-03-17 22:45:58

From Dr Netherway



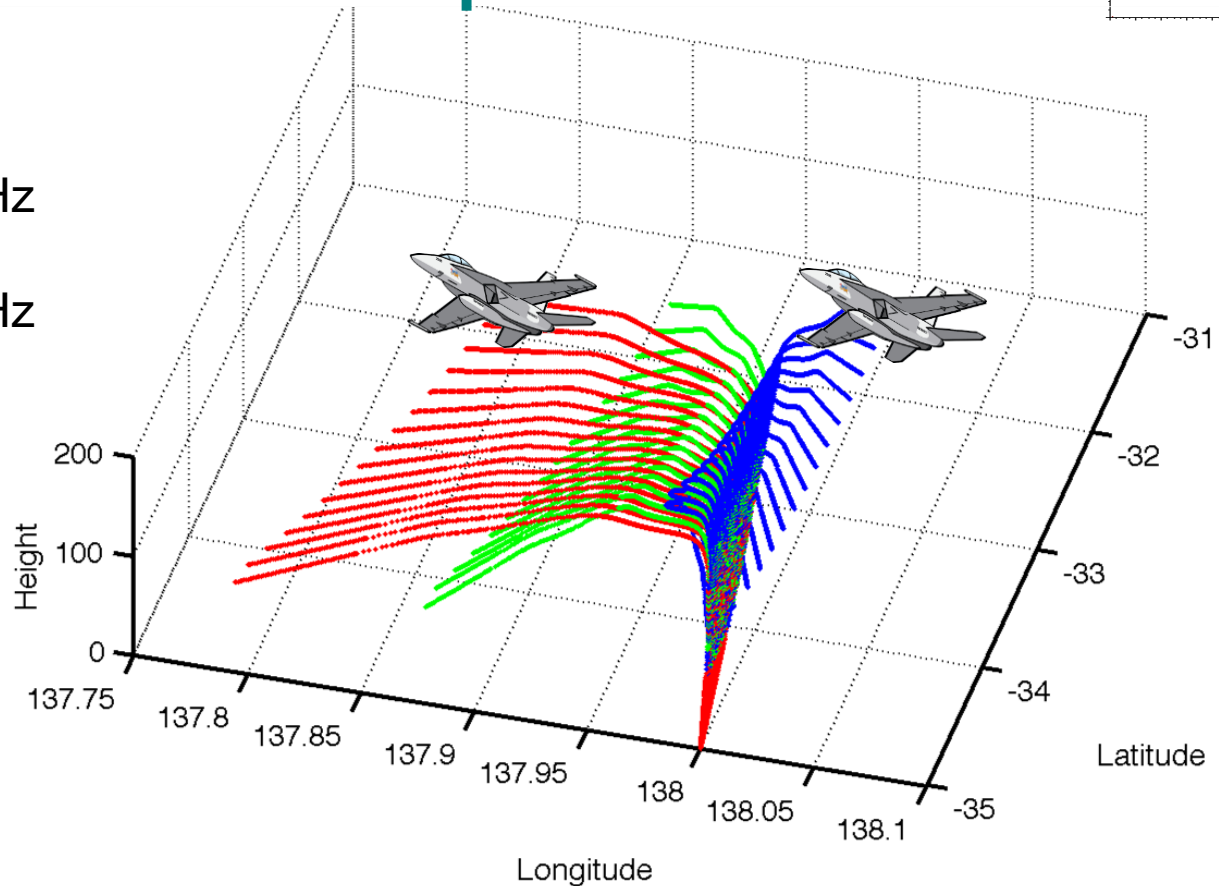
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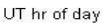
From Dr Netherway



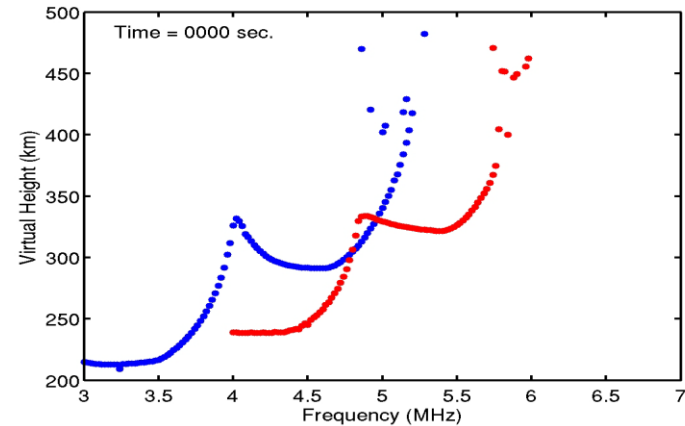
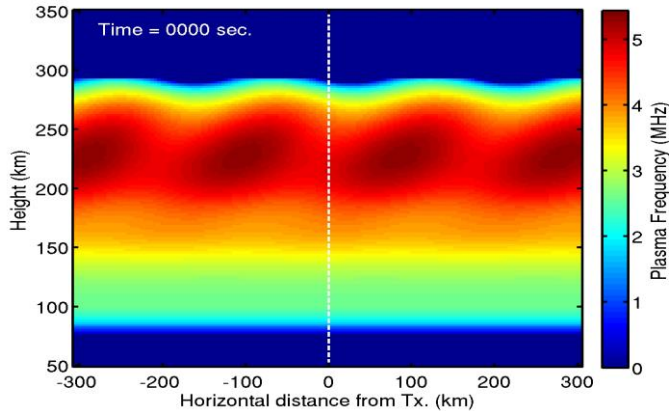
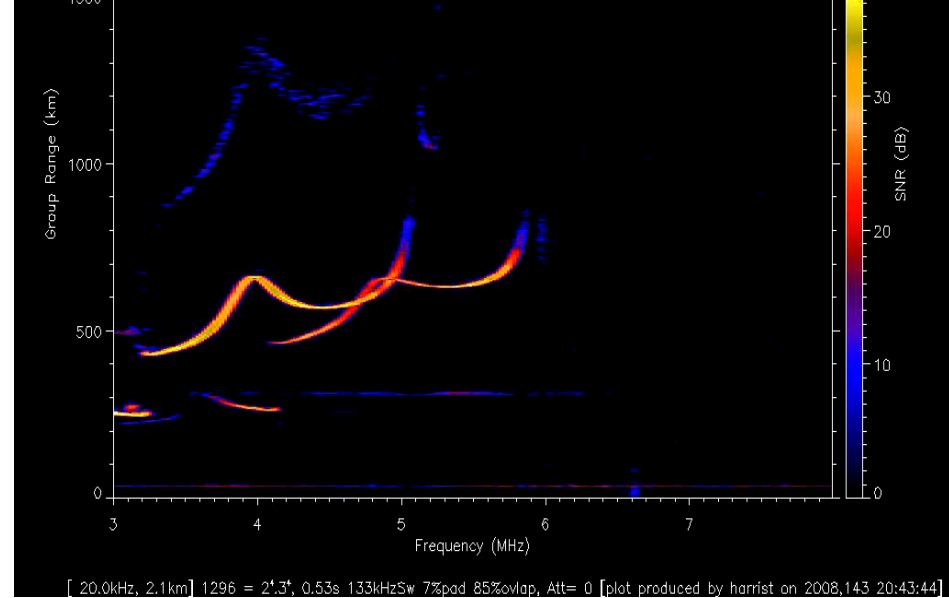
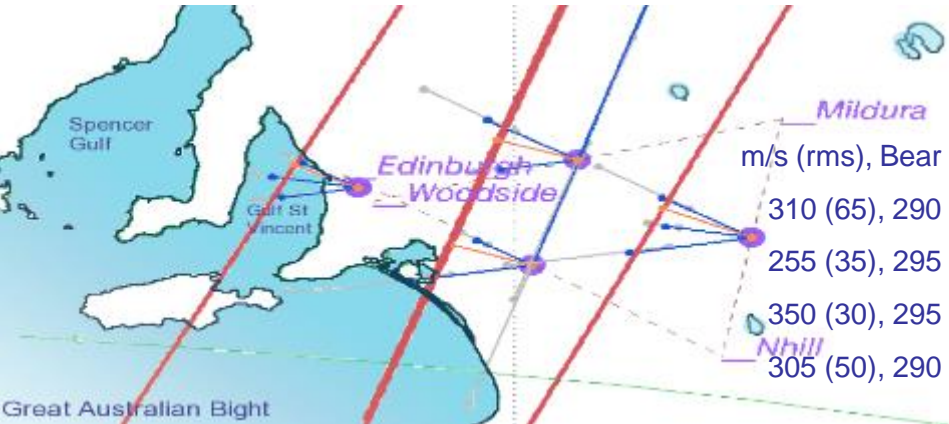
Effect of Tilts in the Ionosphere

- “Flat” ionosphere
- foF2 increase 0.03MHz per deg. longitude
- foF2 increase 0.07MHz per deg. longitude



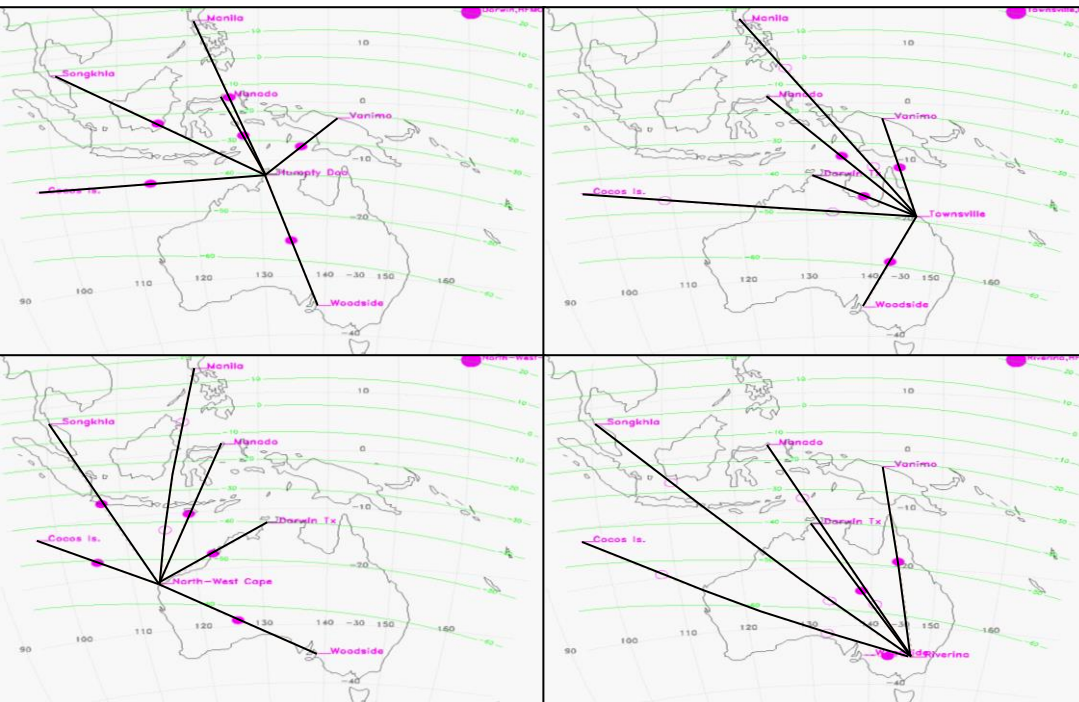
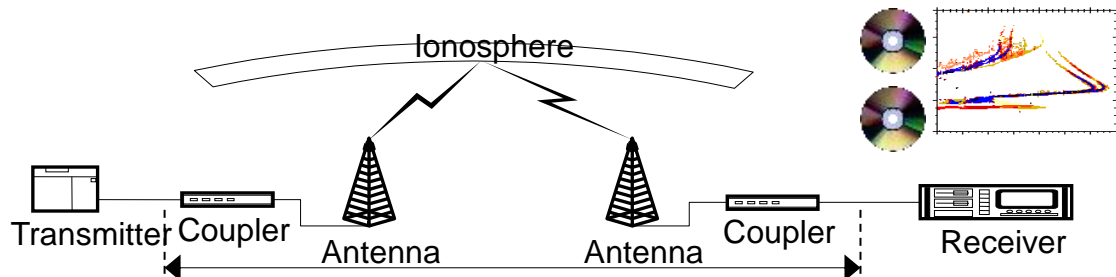


Small-Scale Disturbances

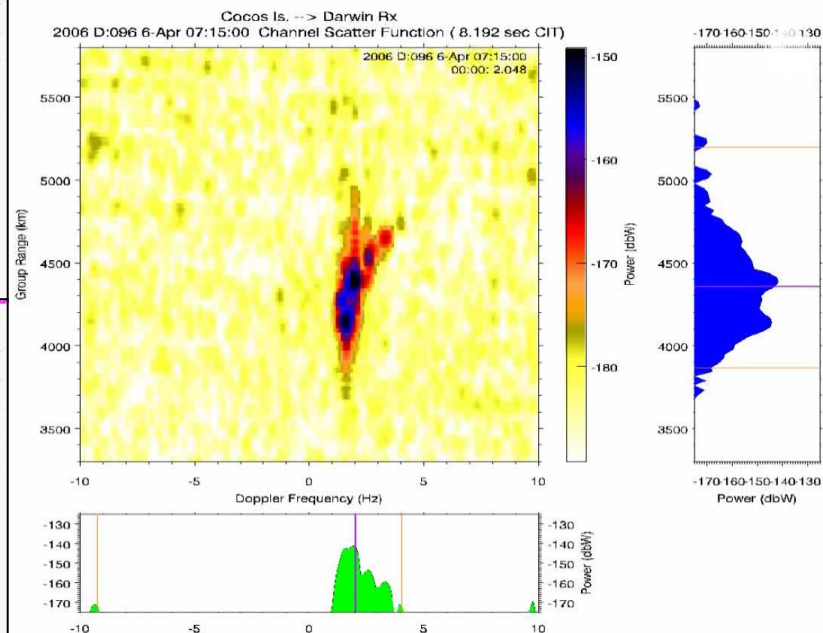


Cervera & Harris (2014), 'Modeling ionospheric disturbance features ...', JGR, vol. 119, pp. 431–440.

HF Channel Characterisation Trial (2006)



Channel Scatter Function





Questions?

JORN:

er Network

