Climatology of ionospheric HF propagation at high latitudes from SuperDARN Canada observations

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Saskatoon, Canada

Outline

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- Issues with conventional forecasting of HF propagation at high latitudes

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- Summary and future work

Conventional HF propagation forecast

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Model ionosphere
(e.g. IRI)

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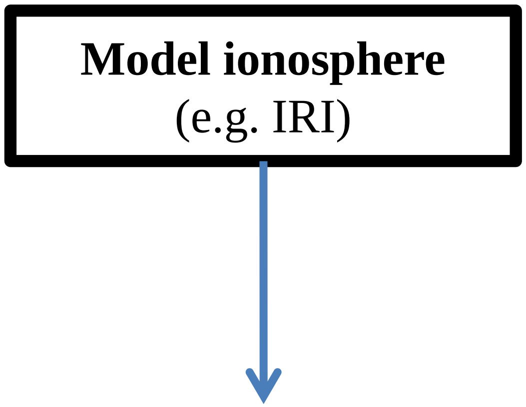

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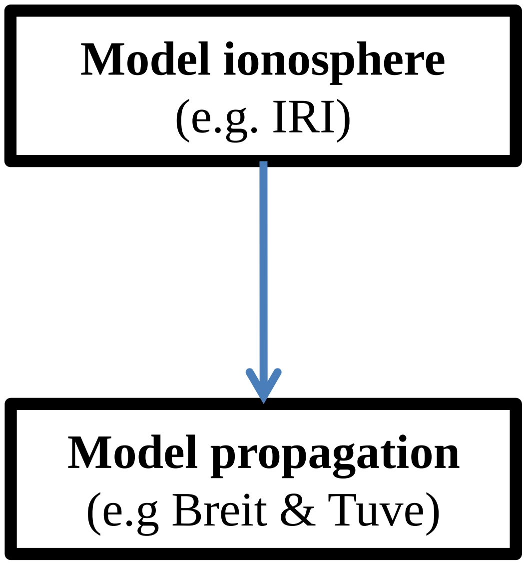

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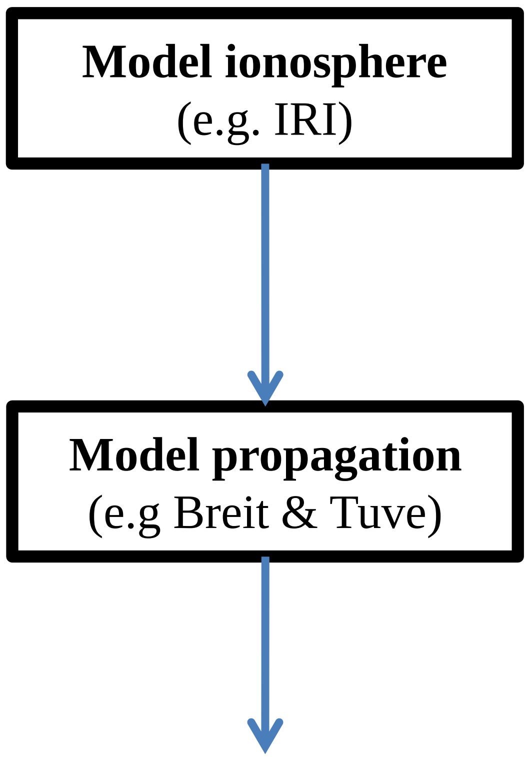

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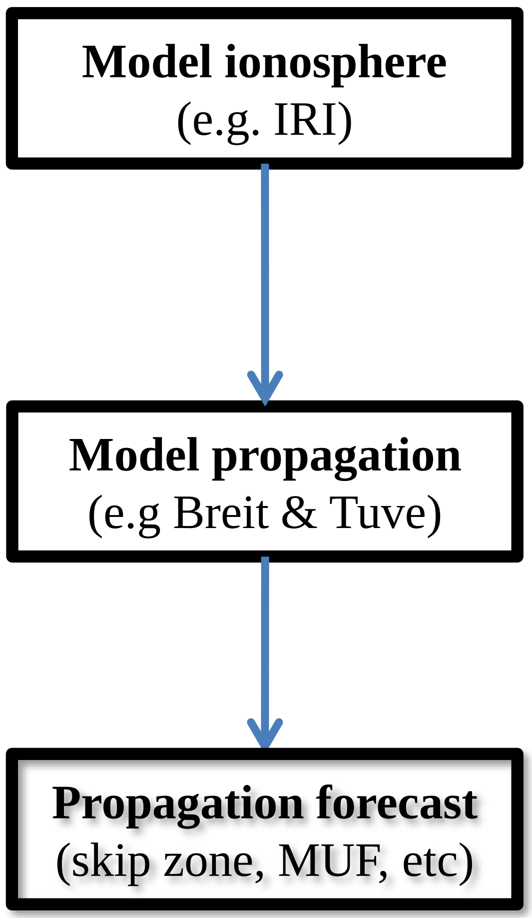

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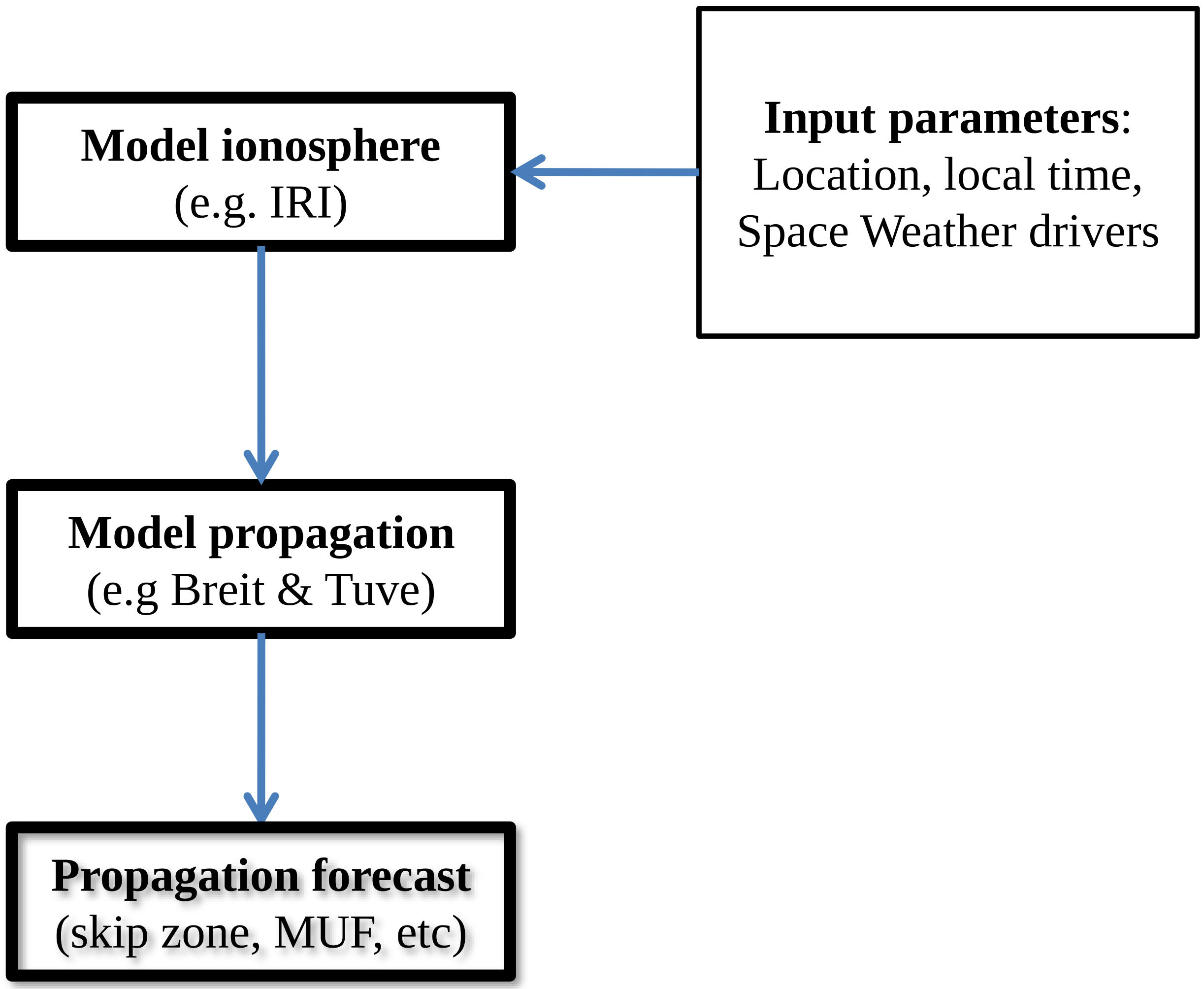

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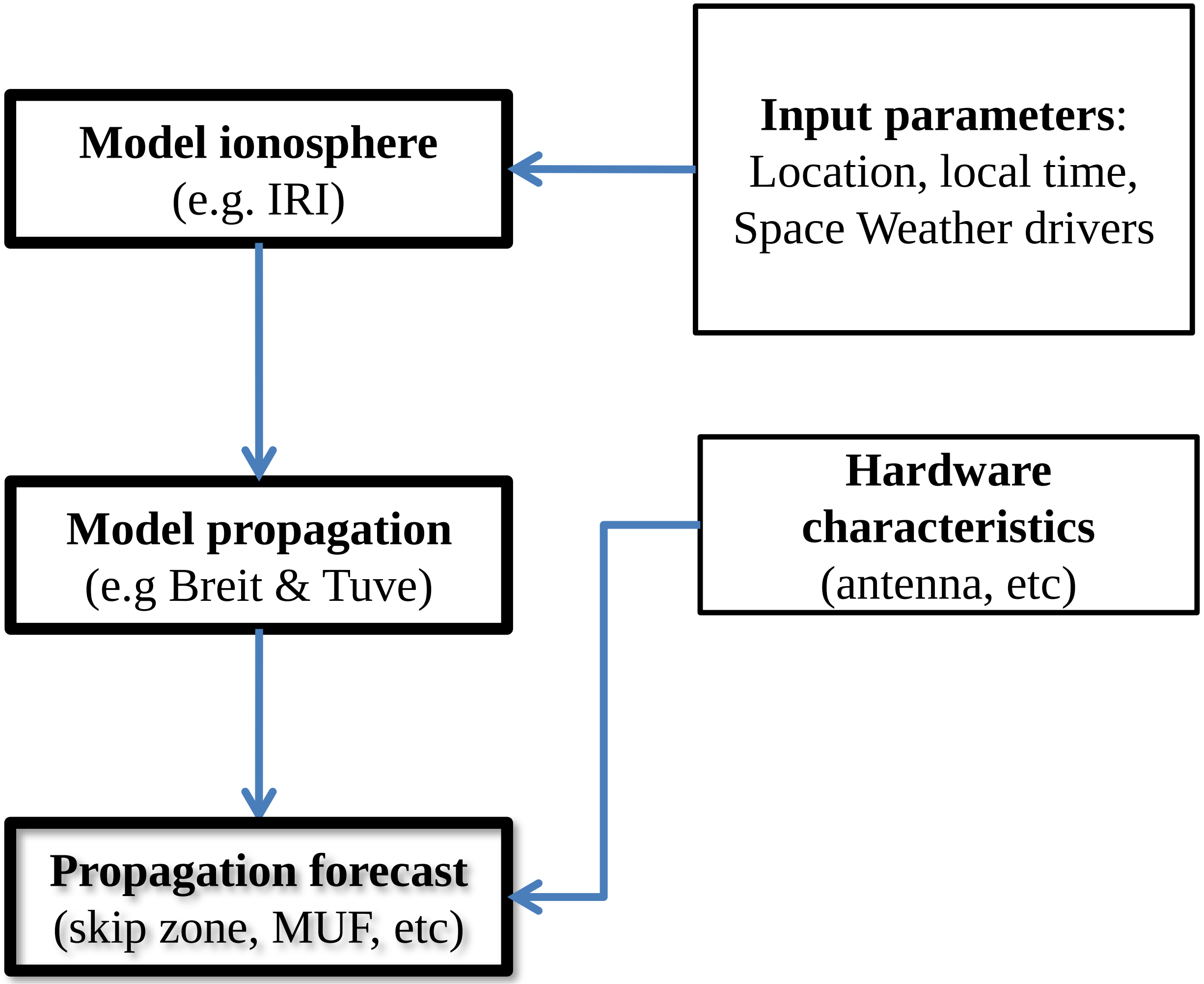

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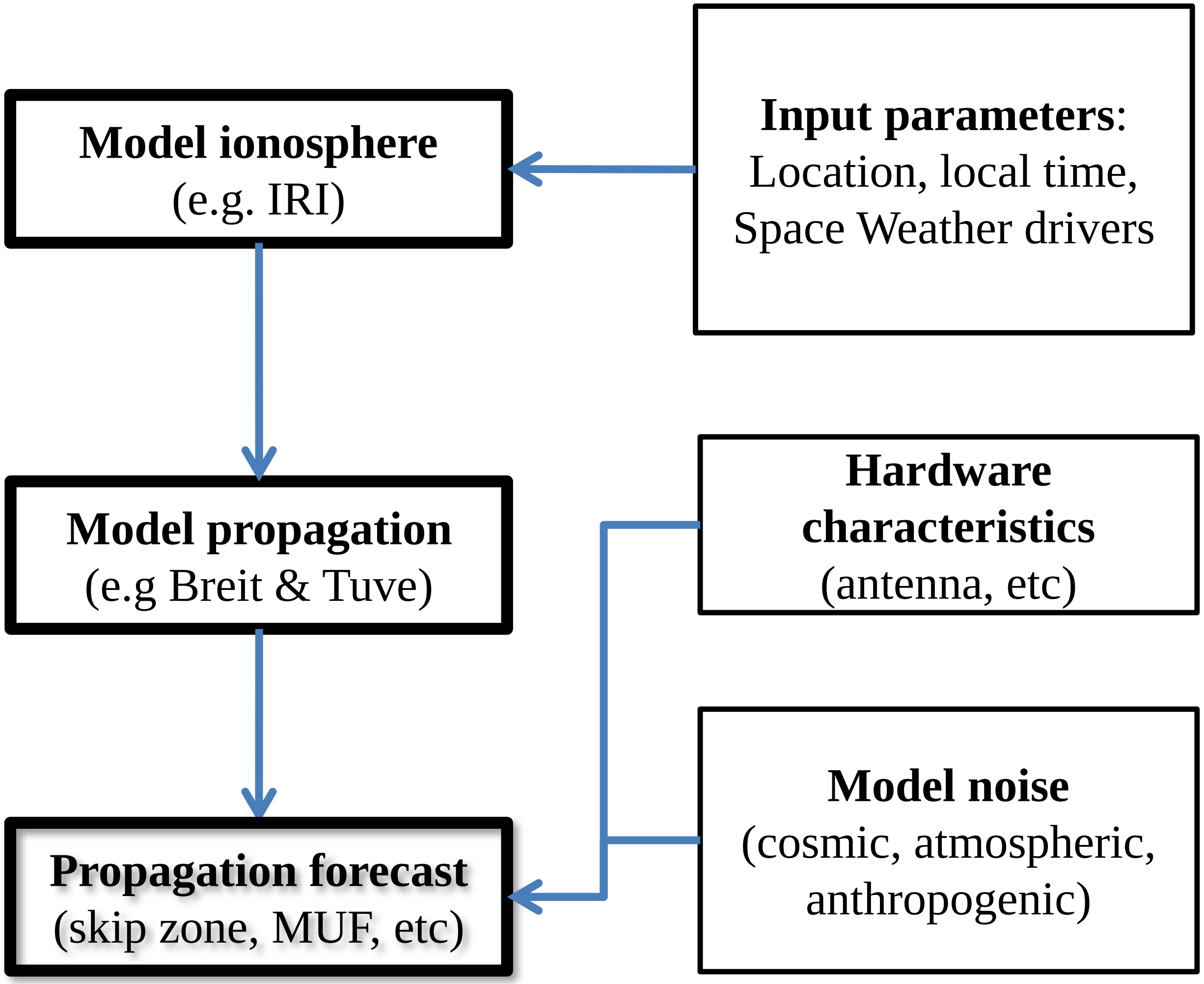

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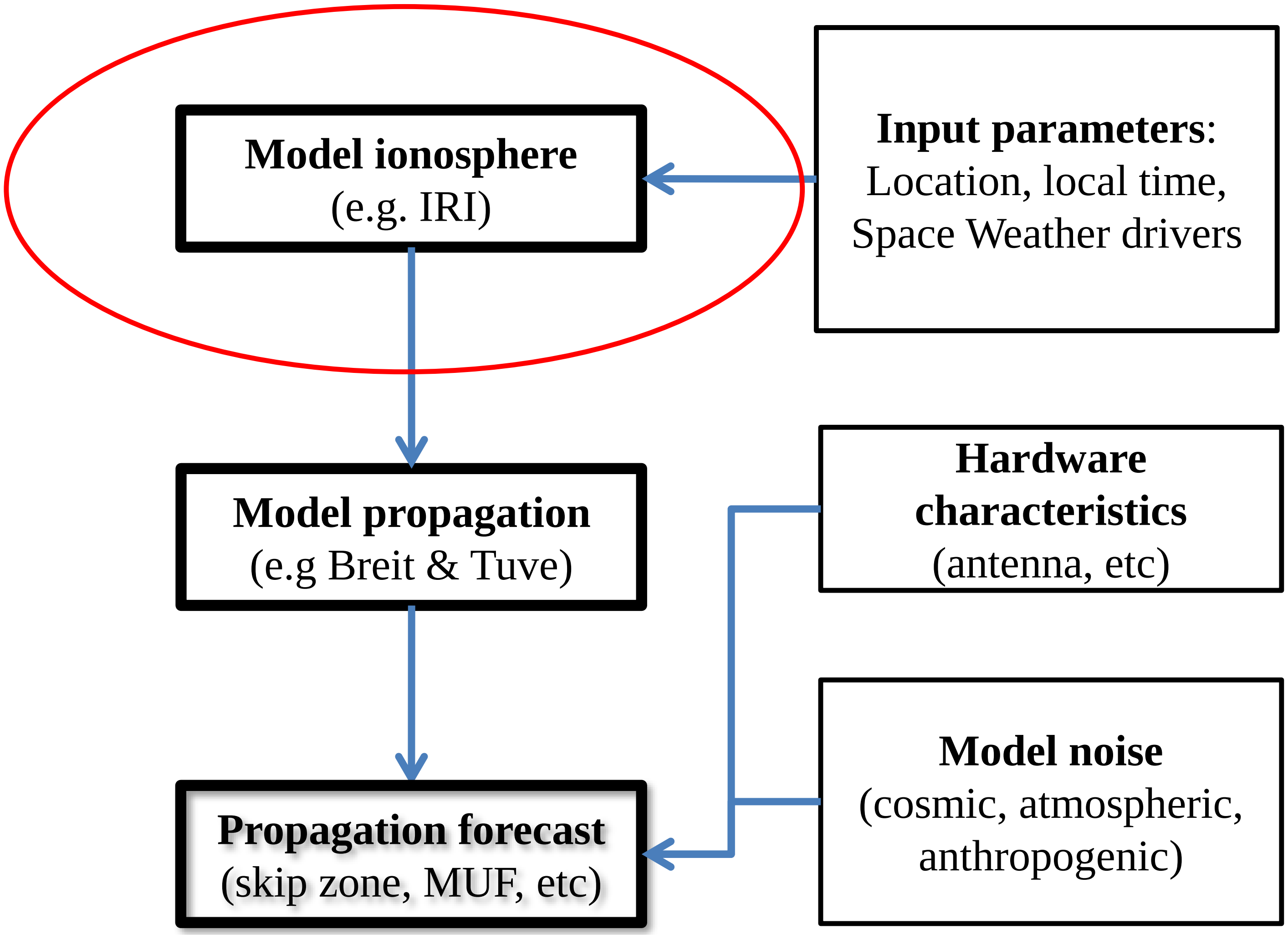

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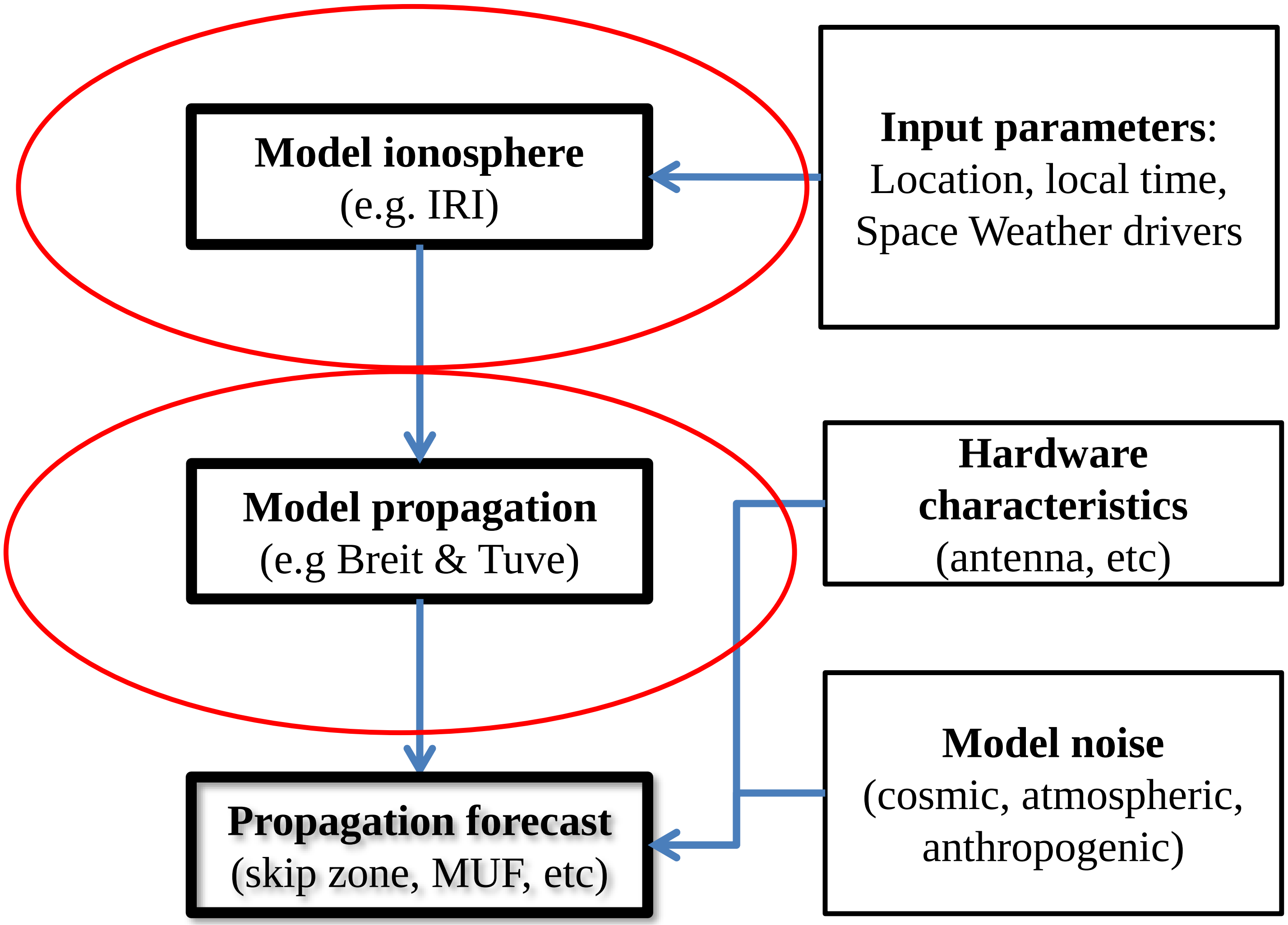

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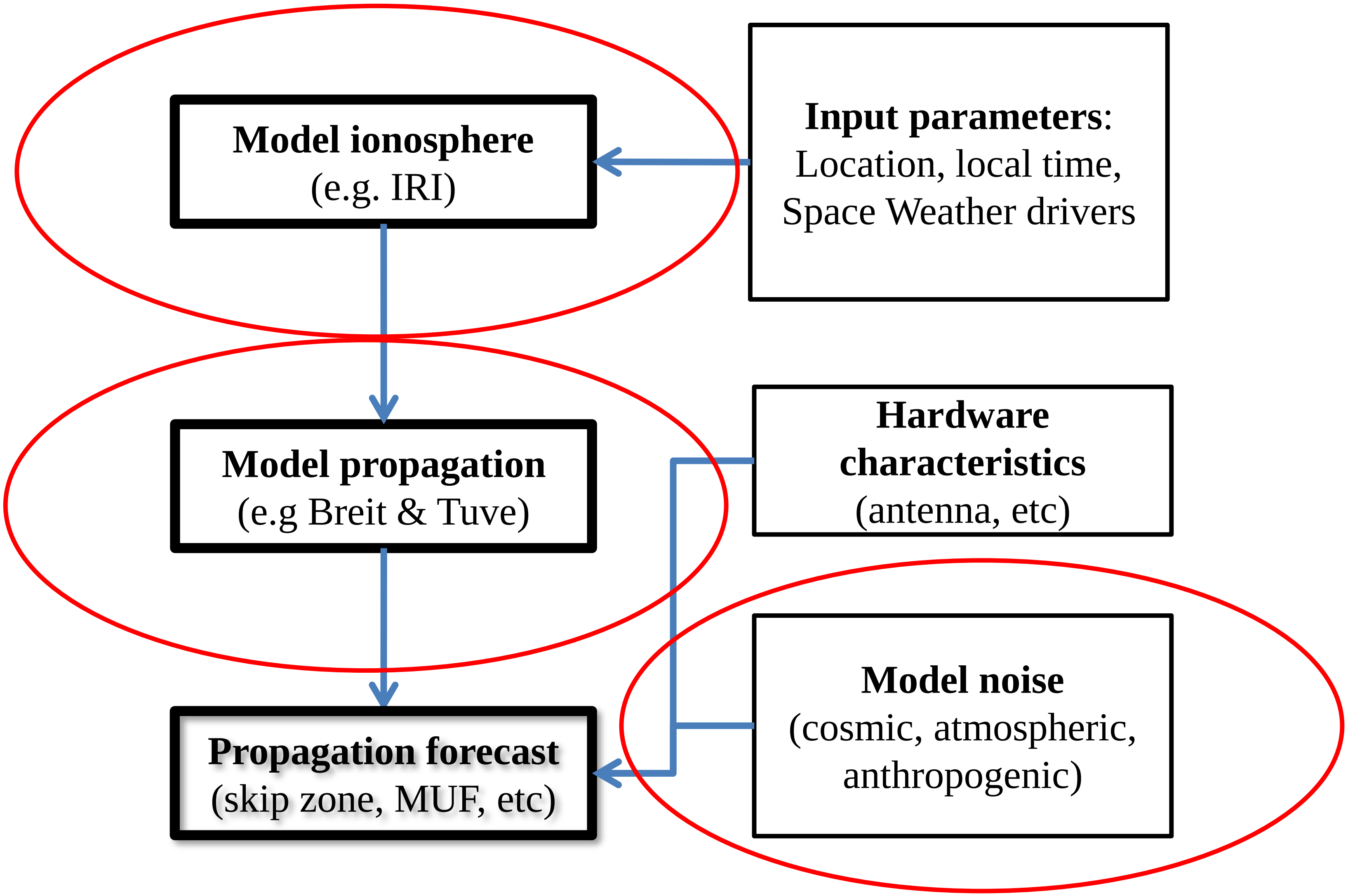

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- We suggested an **alternative approach** based on direct observations of HF propagation characteristics by SuperDARN radars which would allow to bypass the ionospheric and propagation models.

SuperDARN as a tool for monitoring HF propagation at high latitudes

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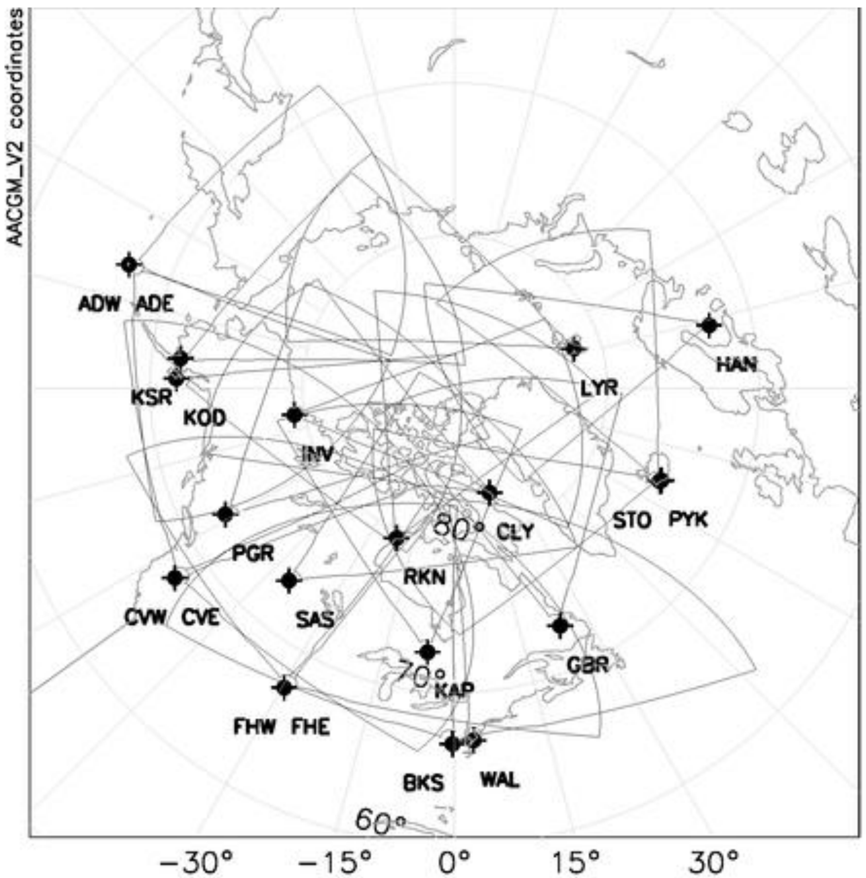

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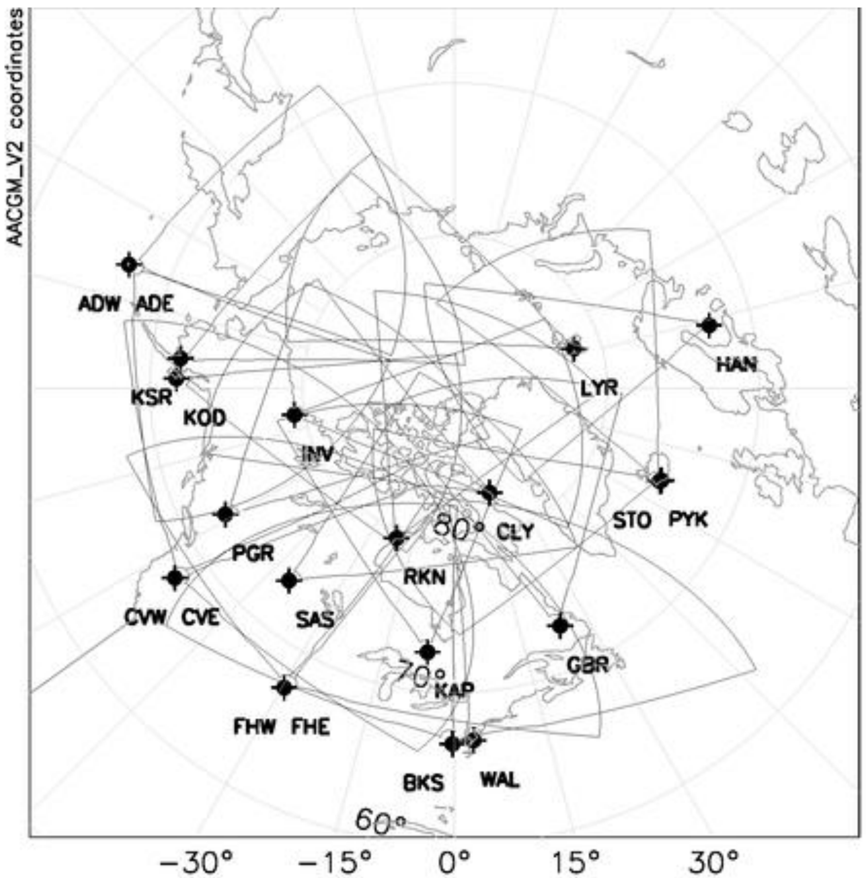

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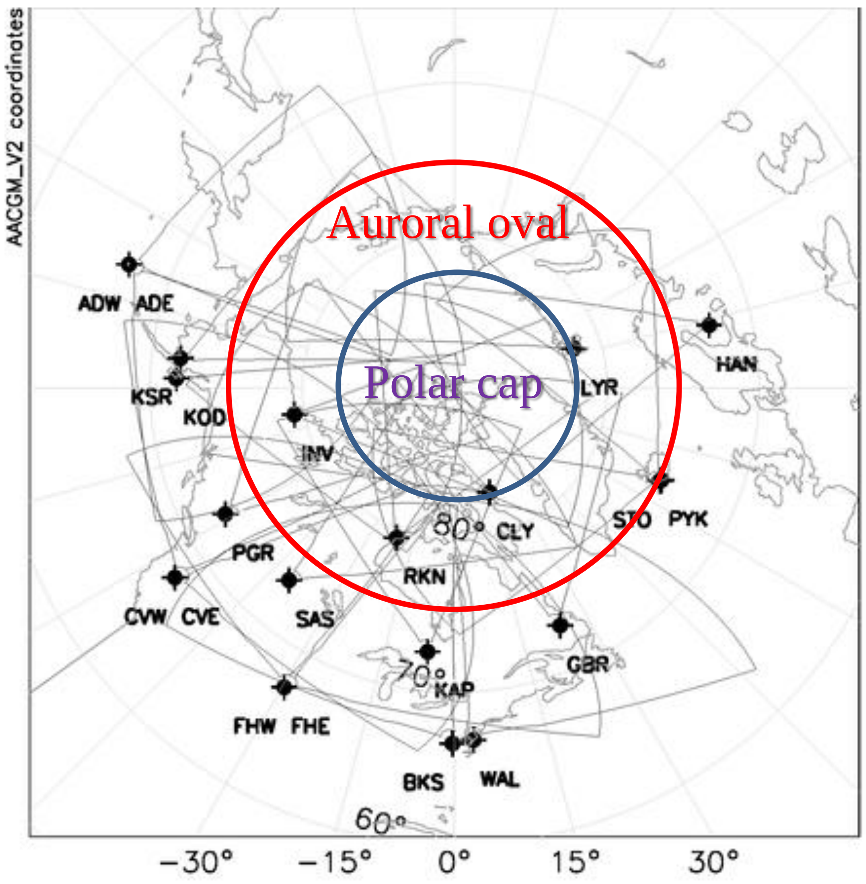

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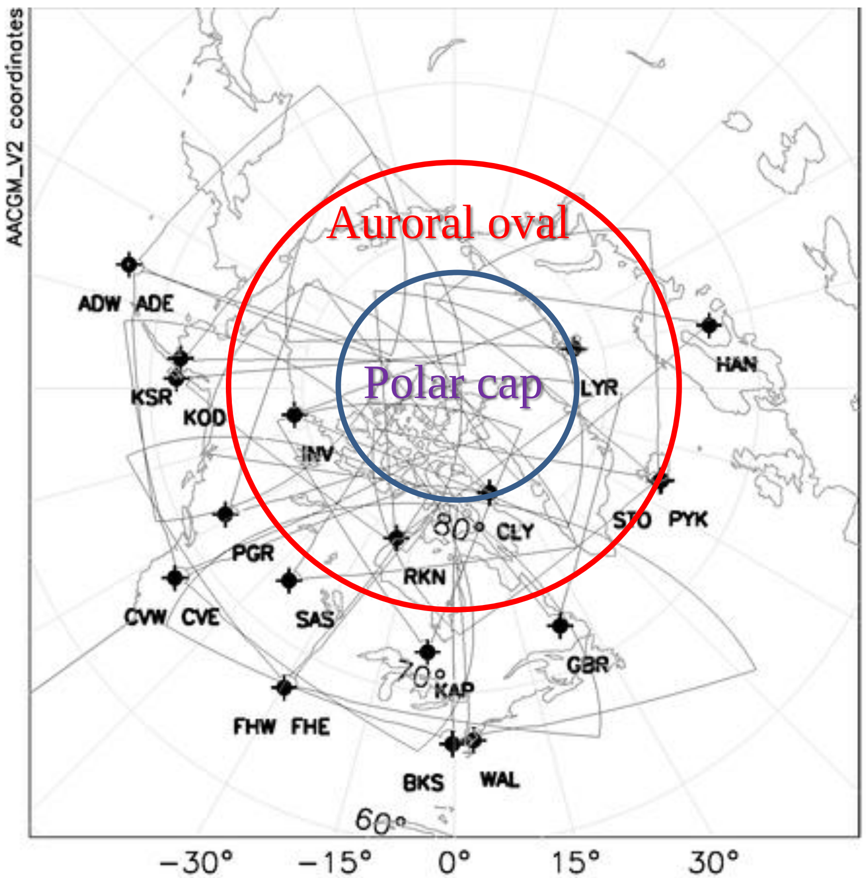

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- We utilise **elevation angle** (vertical angle of arrival) for direct characterisation of HF propagation.
  - This approach was enabled by a recent progress in SuperDARN elevation angle calibration

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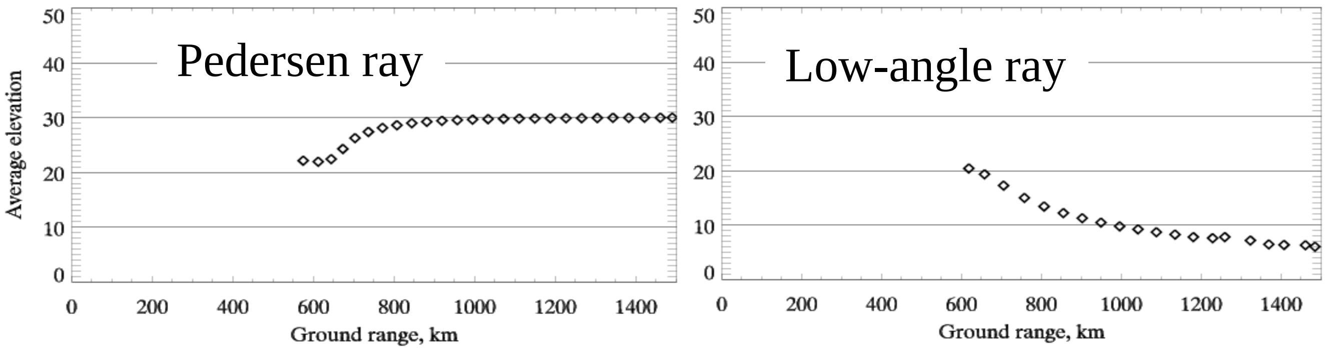

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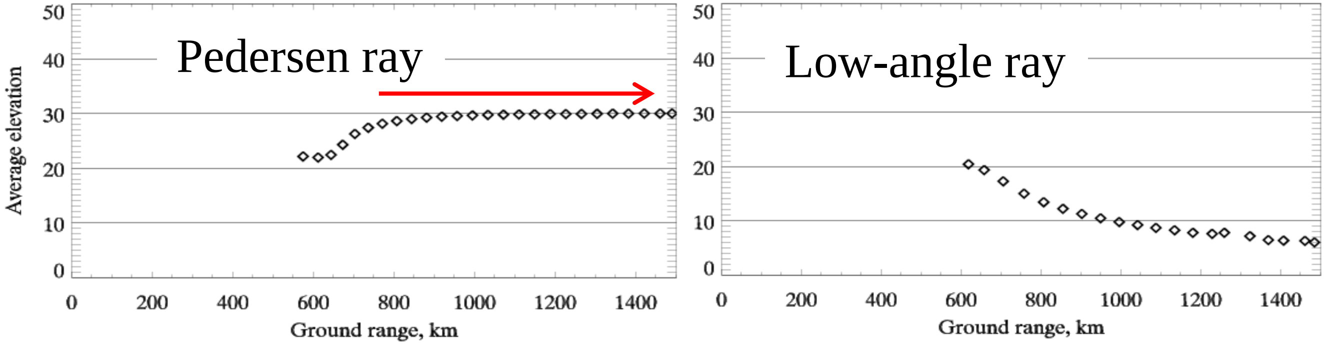

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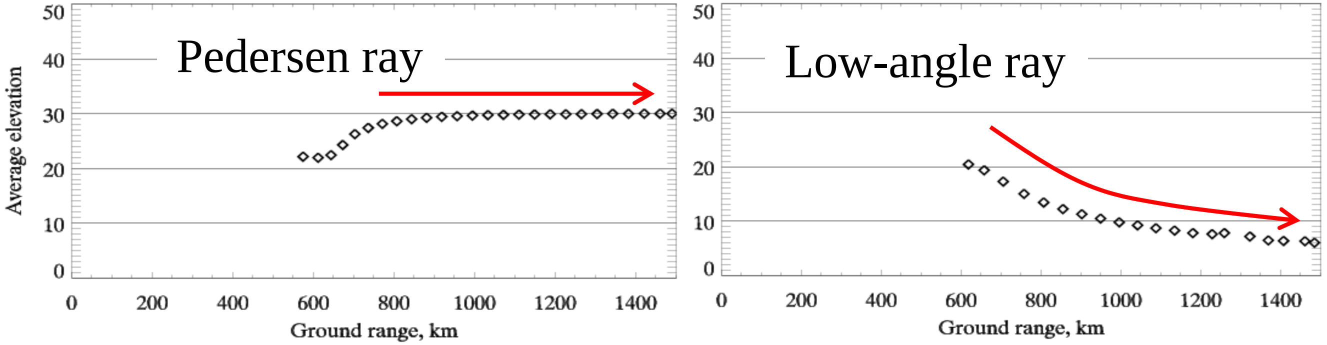

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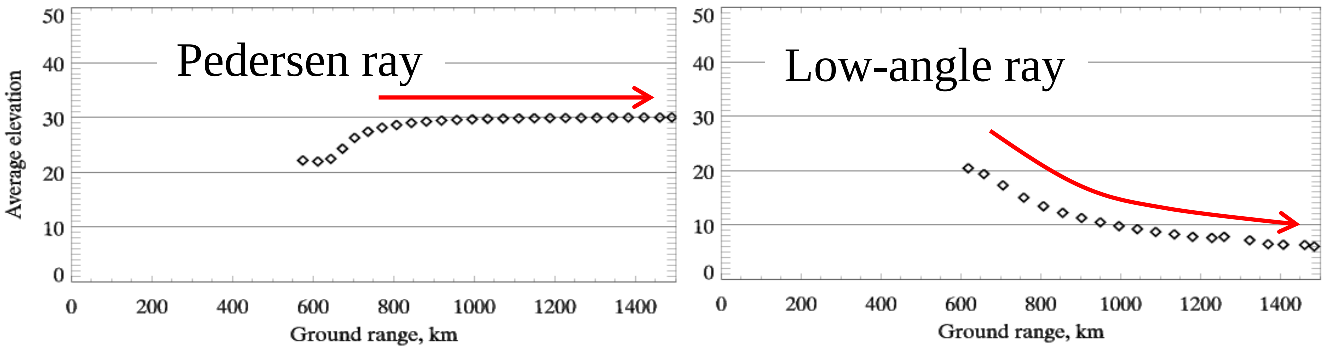

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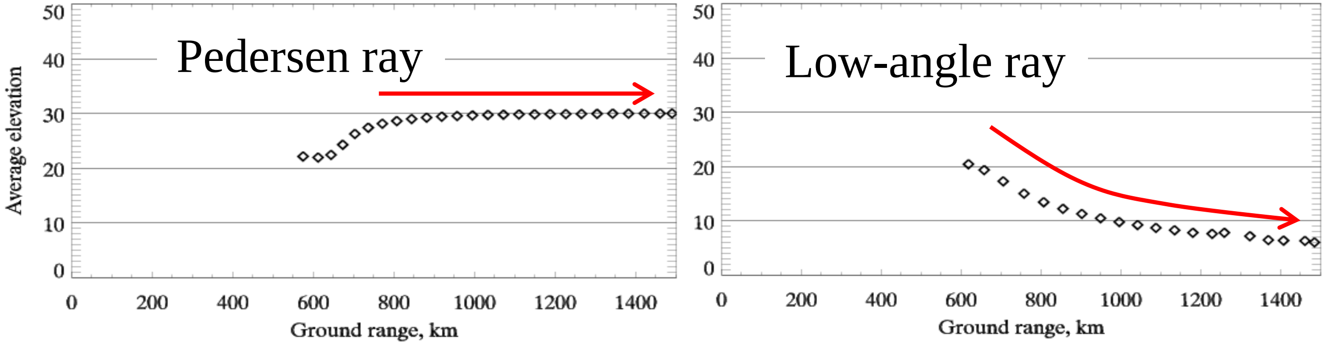

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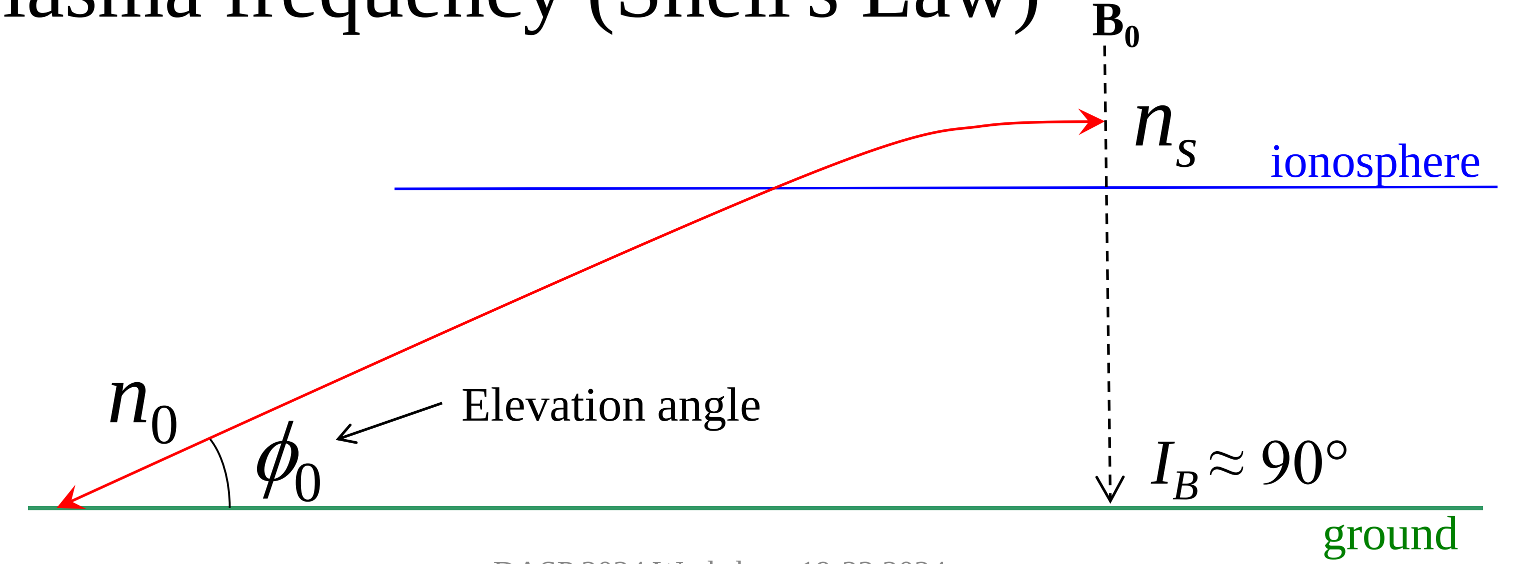

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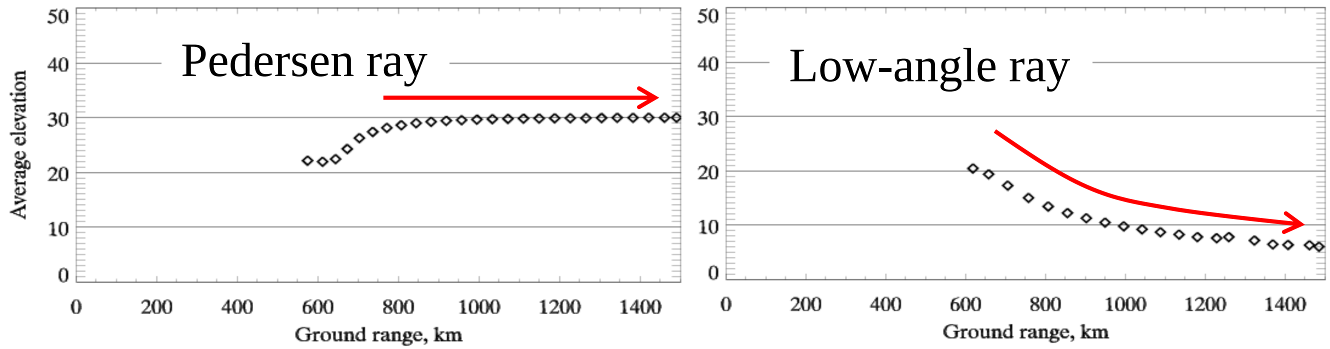

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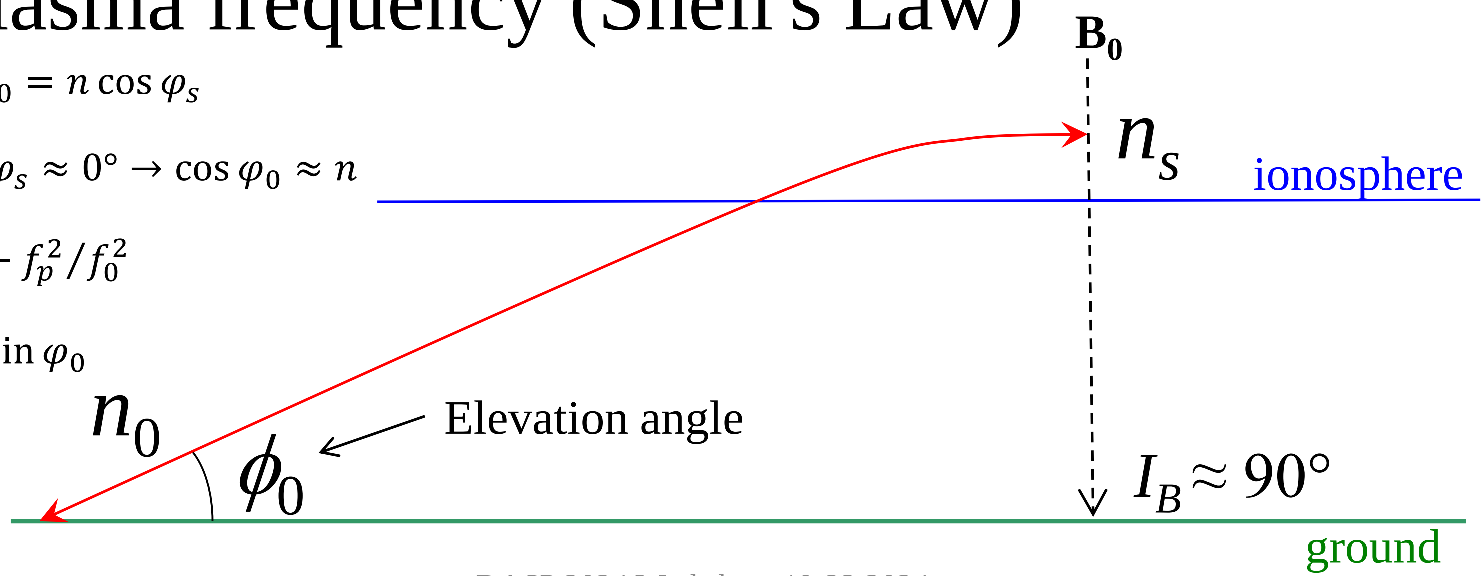

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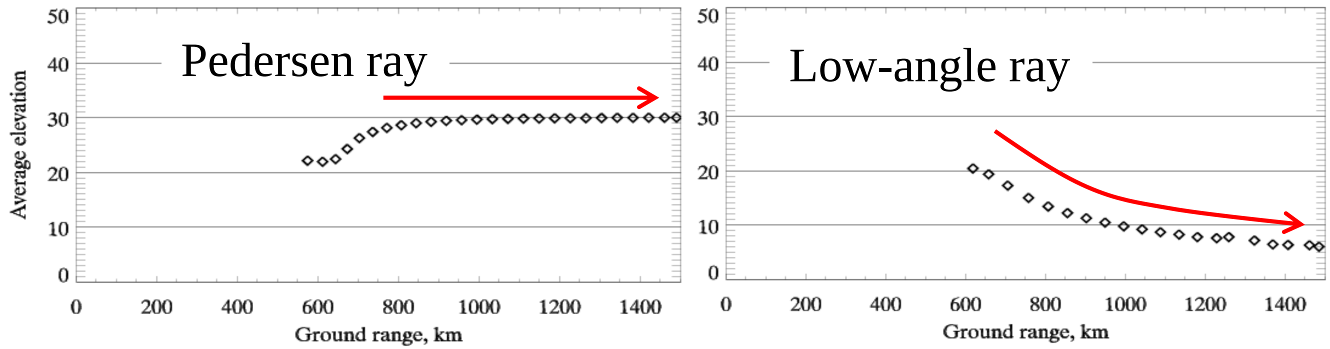

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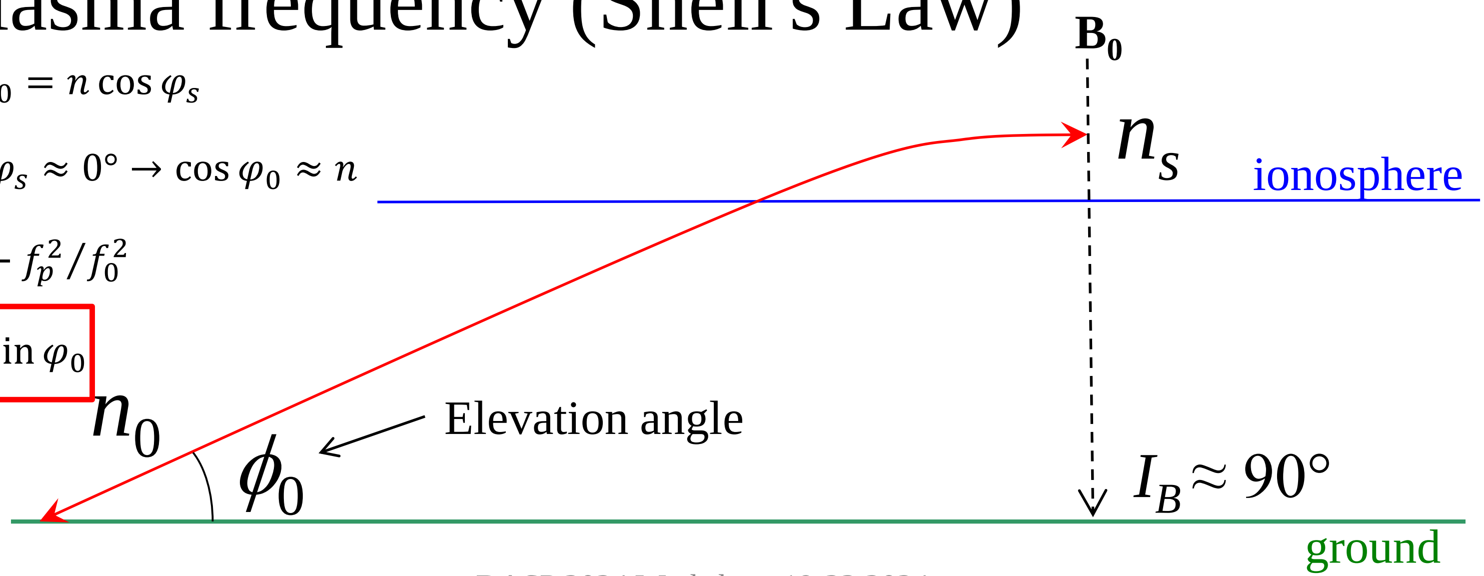

Core dataset selection: SuperDARN CANADA data 2009-2018

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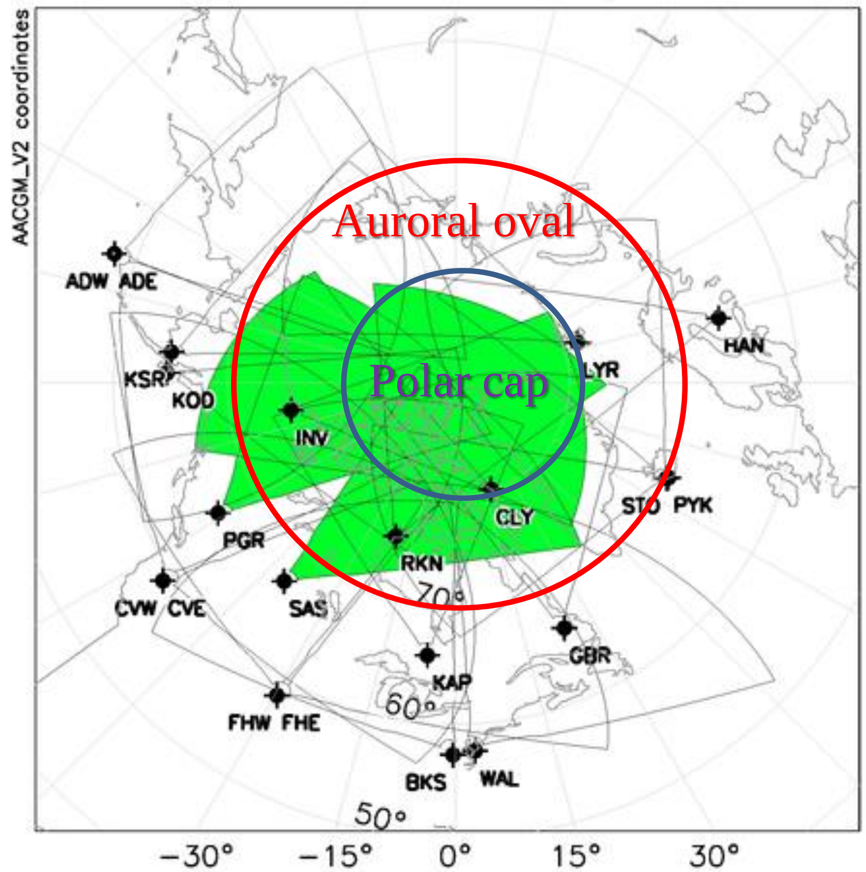

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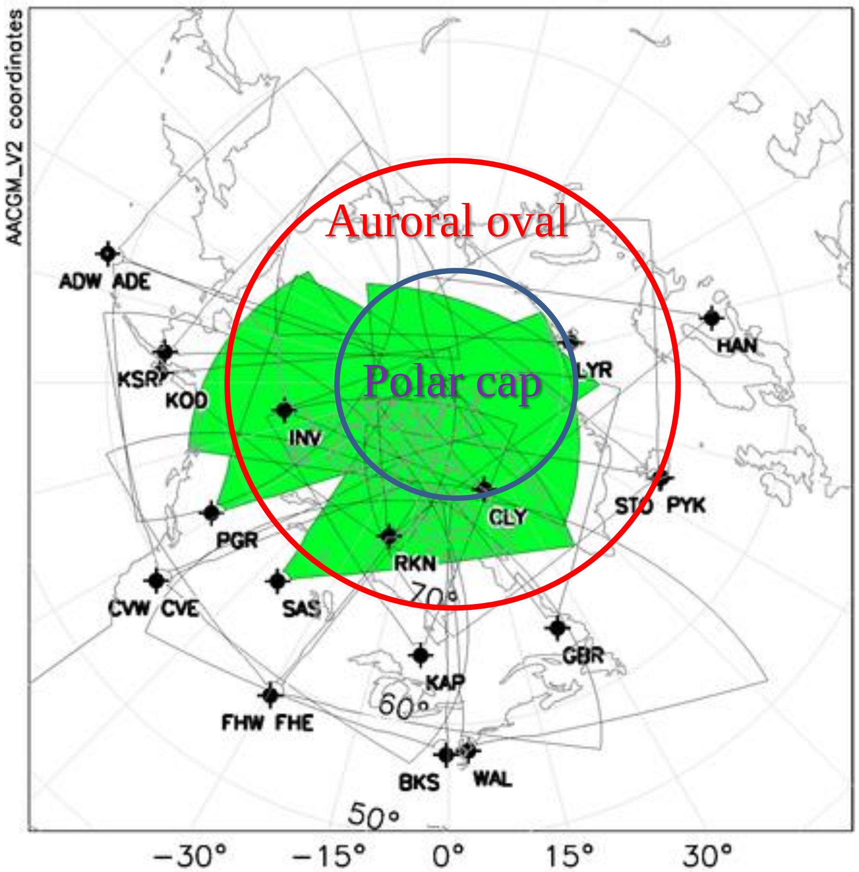

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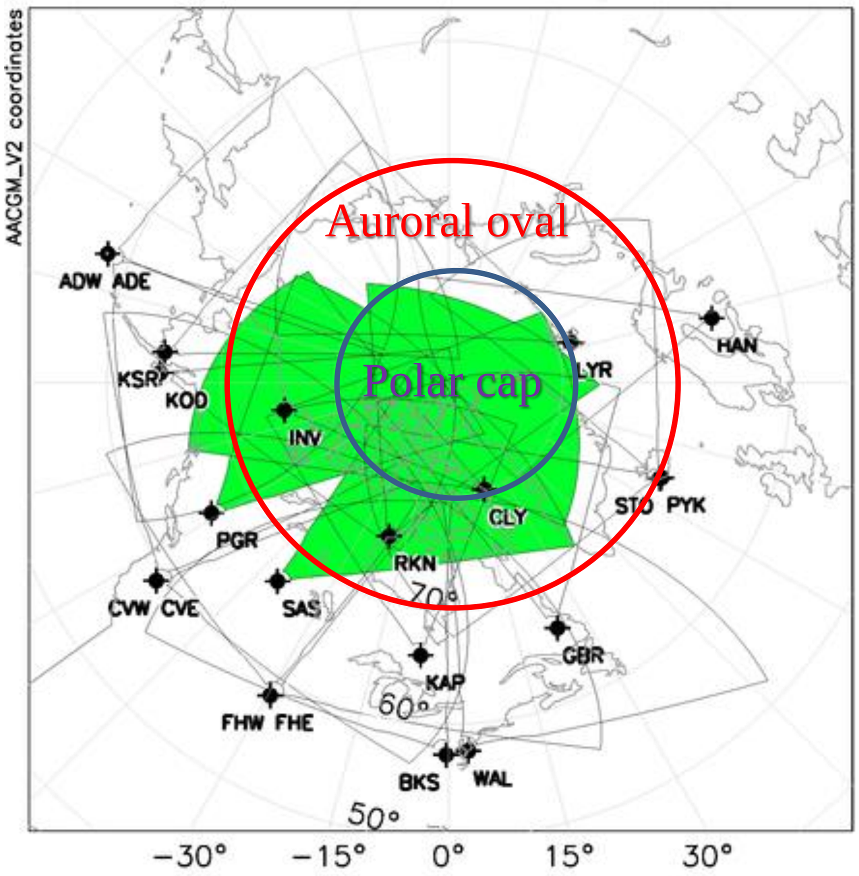

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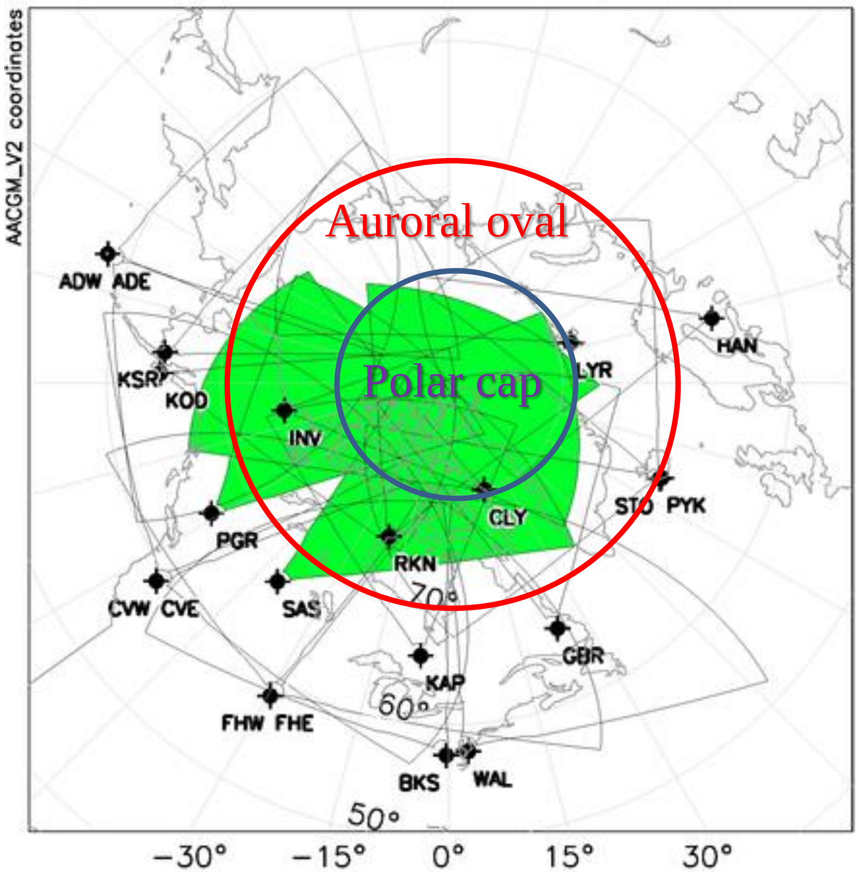

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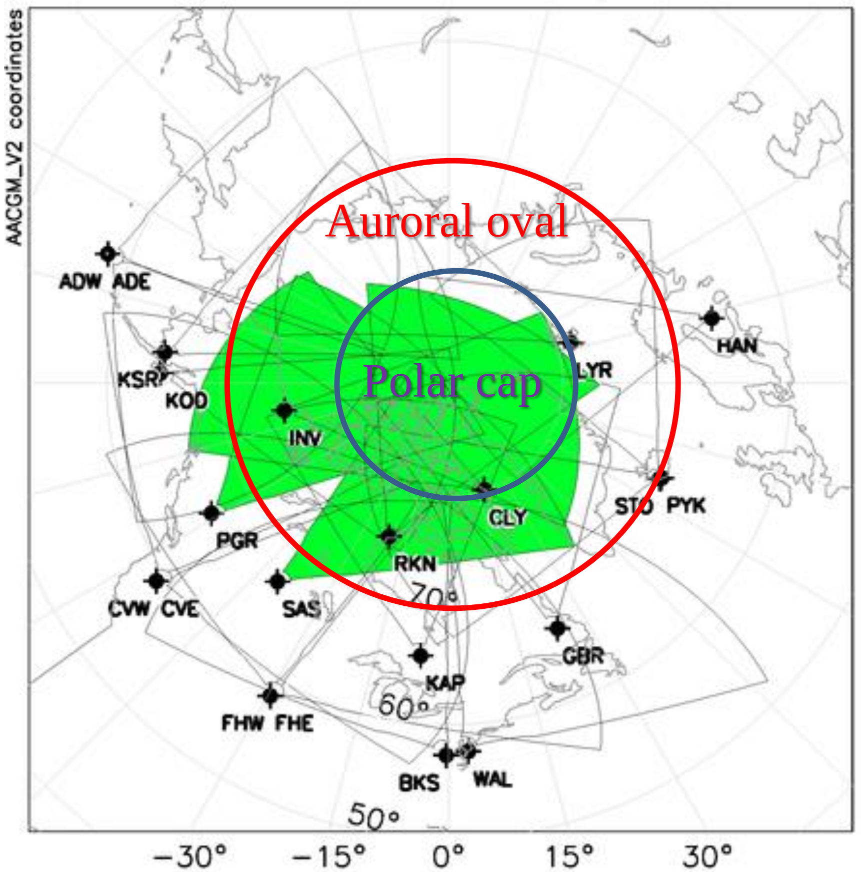
- Operation at two frequency bands (2011-2019) :
  - 10-11 MHz
  - 12-13.5 MHz



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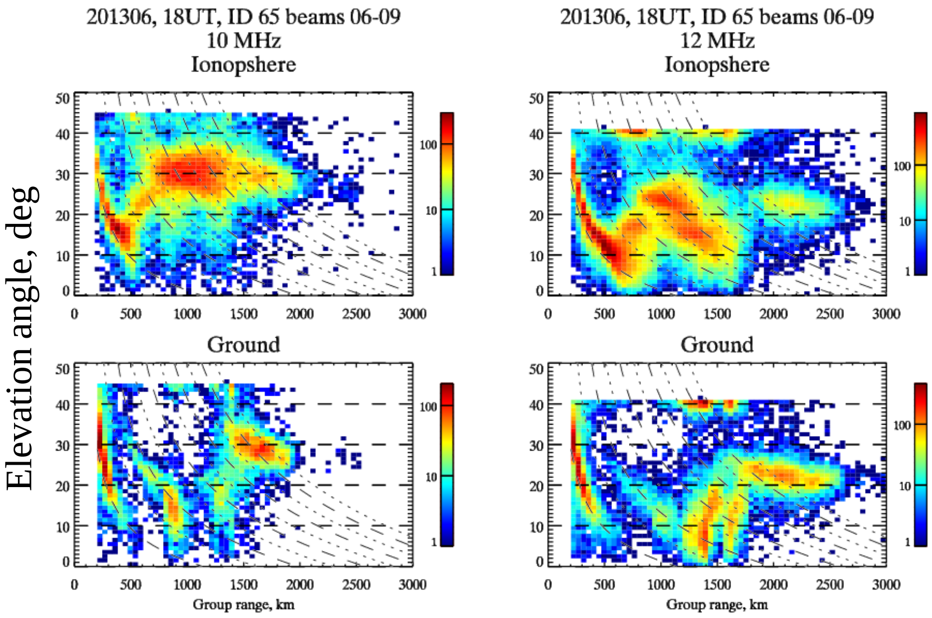
Rankin Inlet (summer, local noon)



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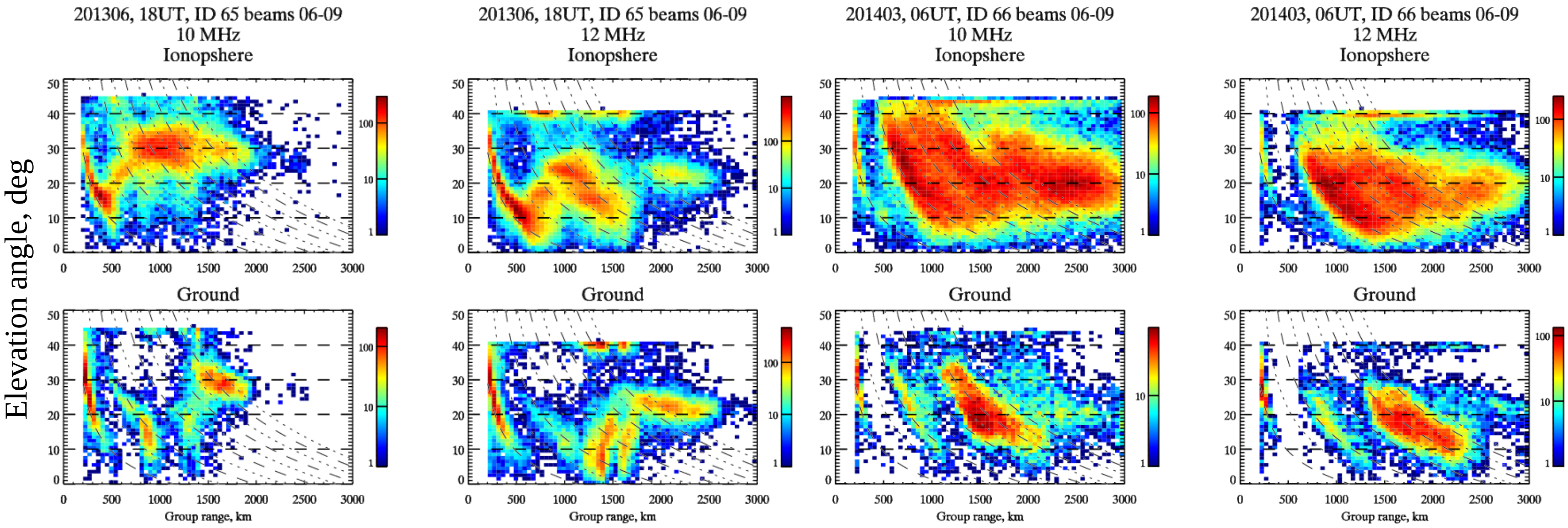

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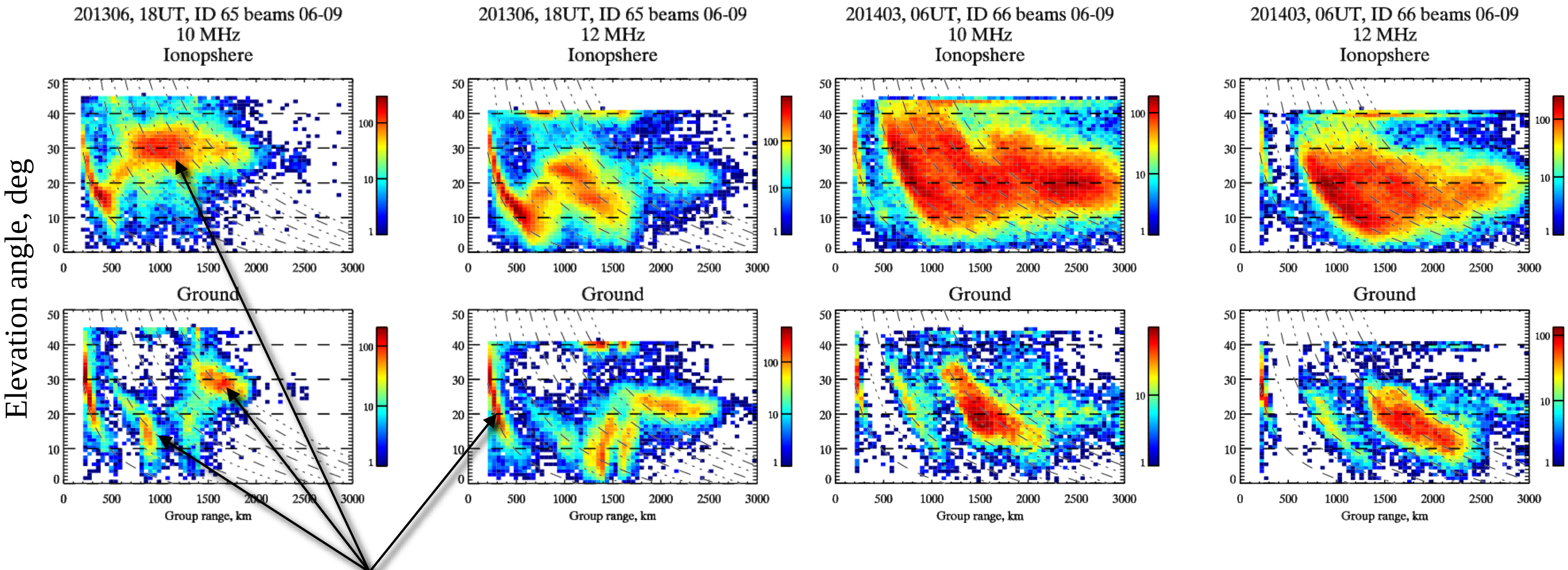

Each echo population corresponds to a specific propagation mode.

Propagation mode identification

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Rankin Inlet

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Summer noon

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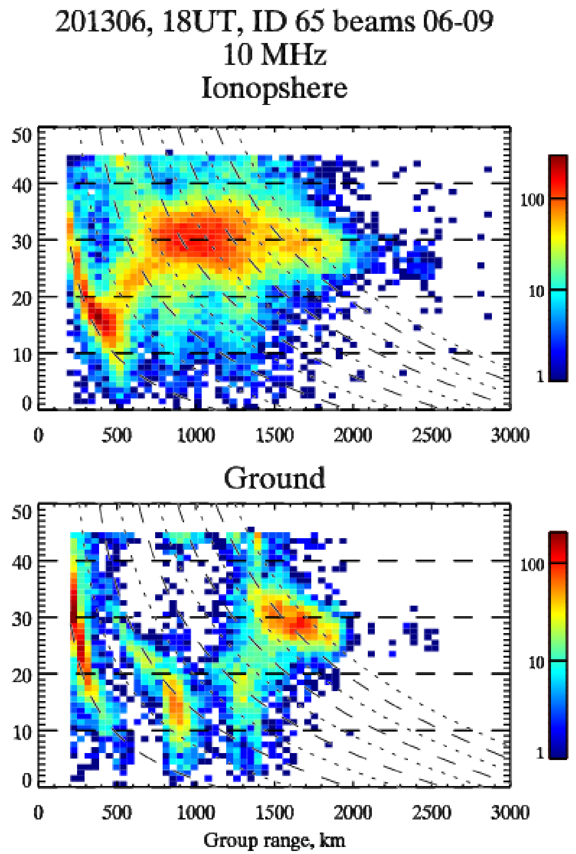

Propagation mode identification

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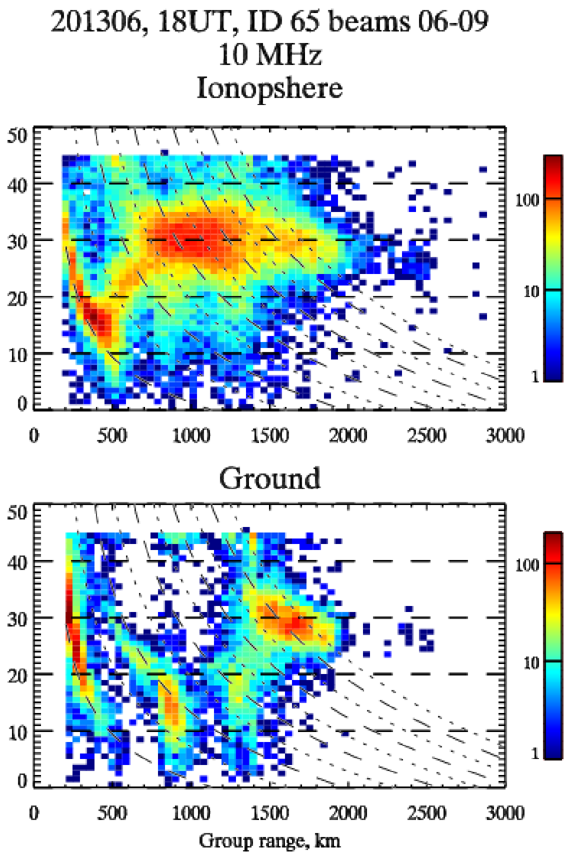
Summer noon

Winter noon



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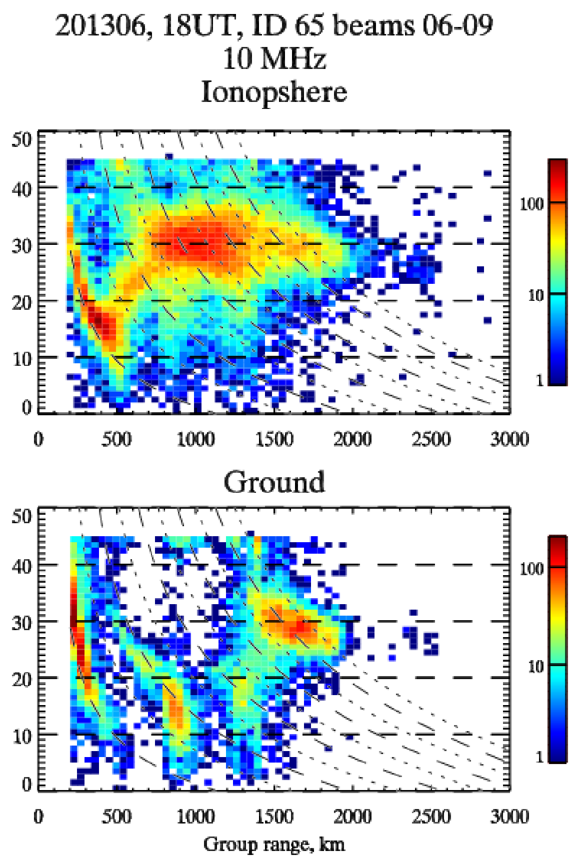

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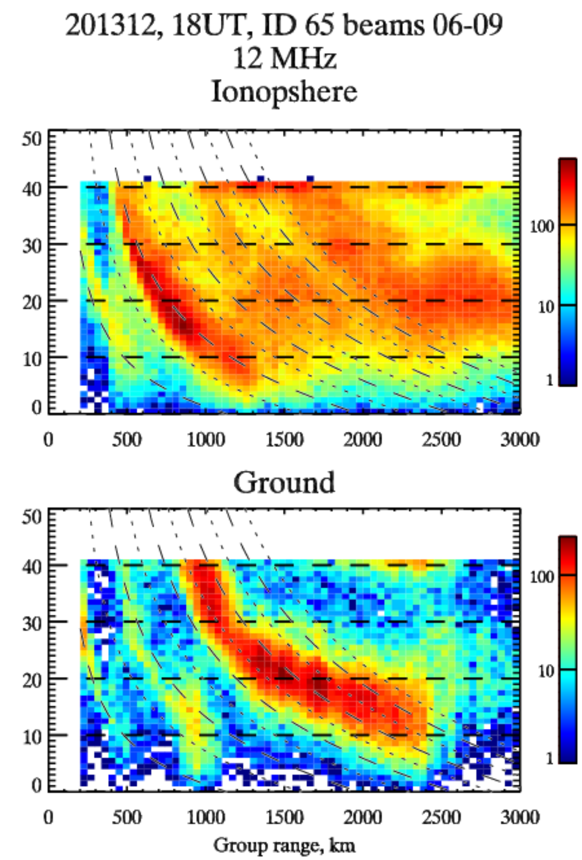

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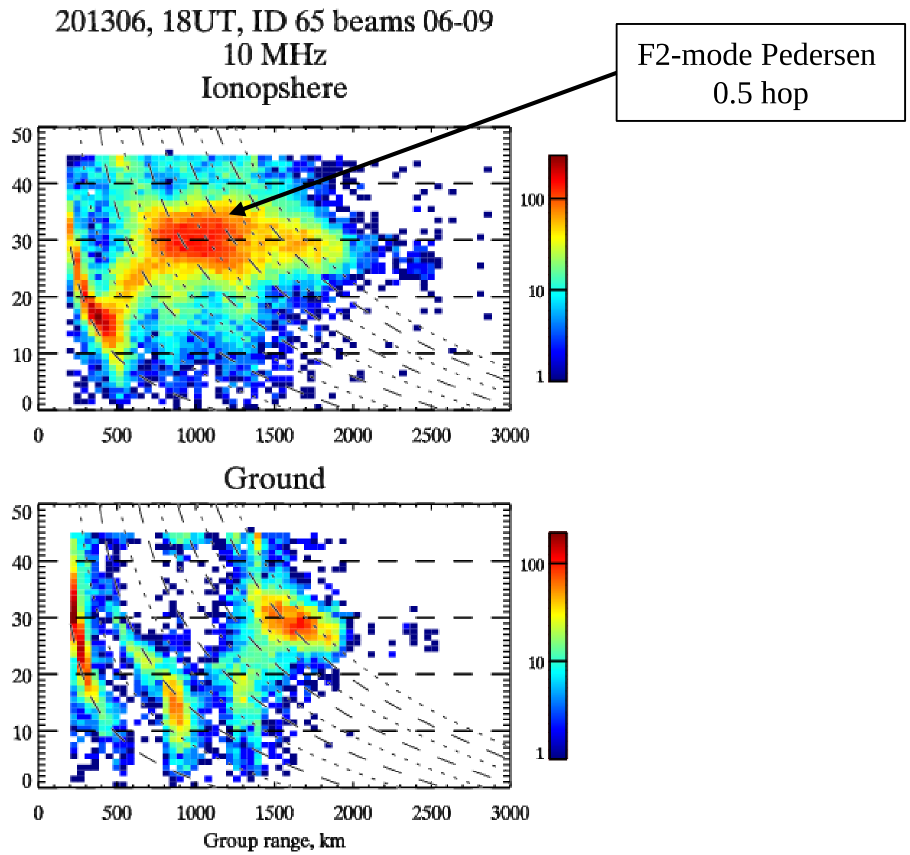

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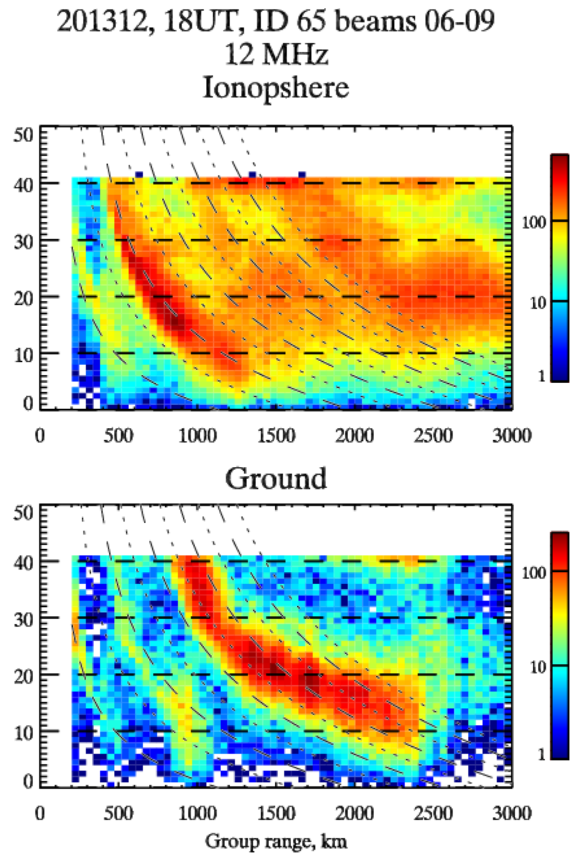

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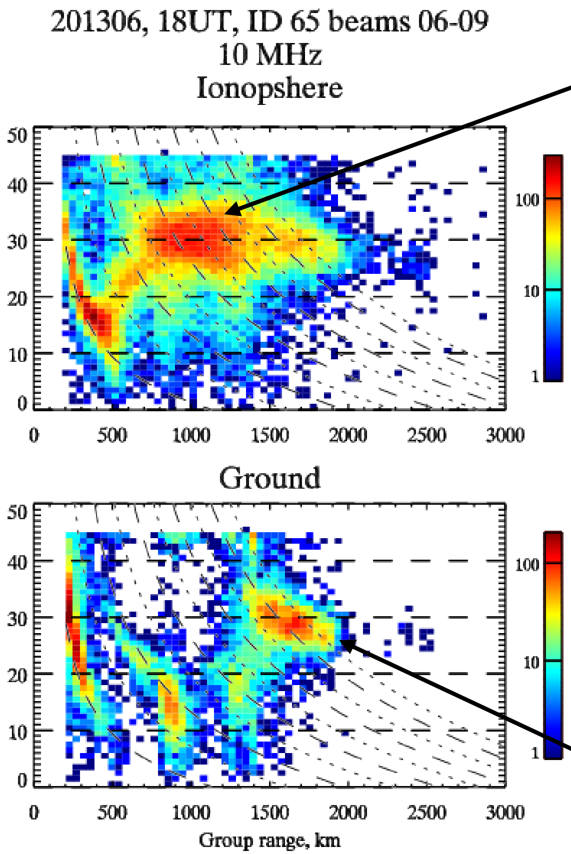
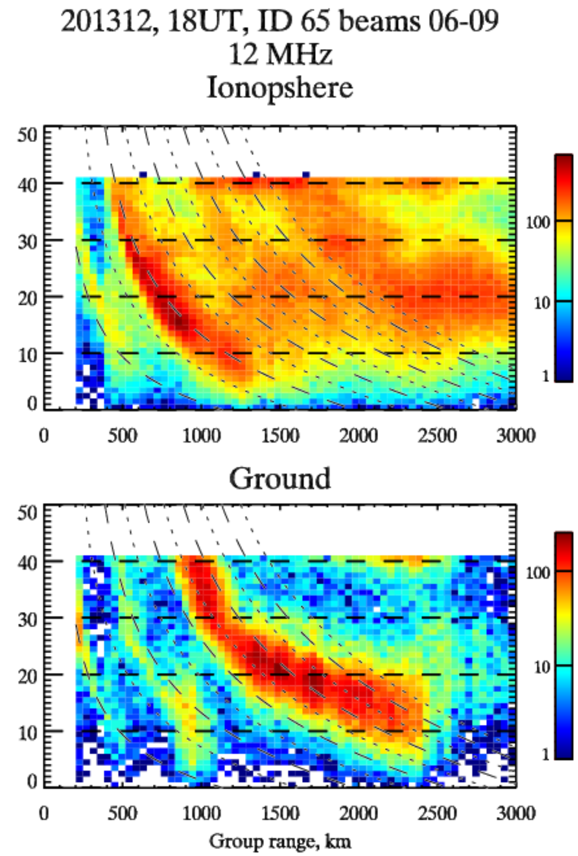


F2-mode Pedersen
0.5 hop

F2-mode Pedersen
1 hop

Winter noon



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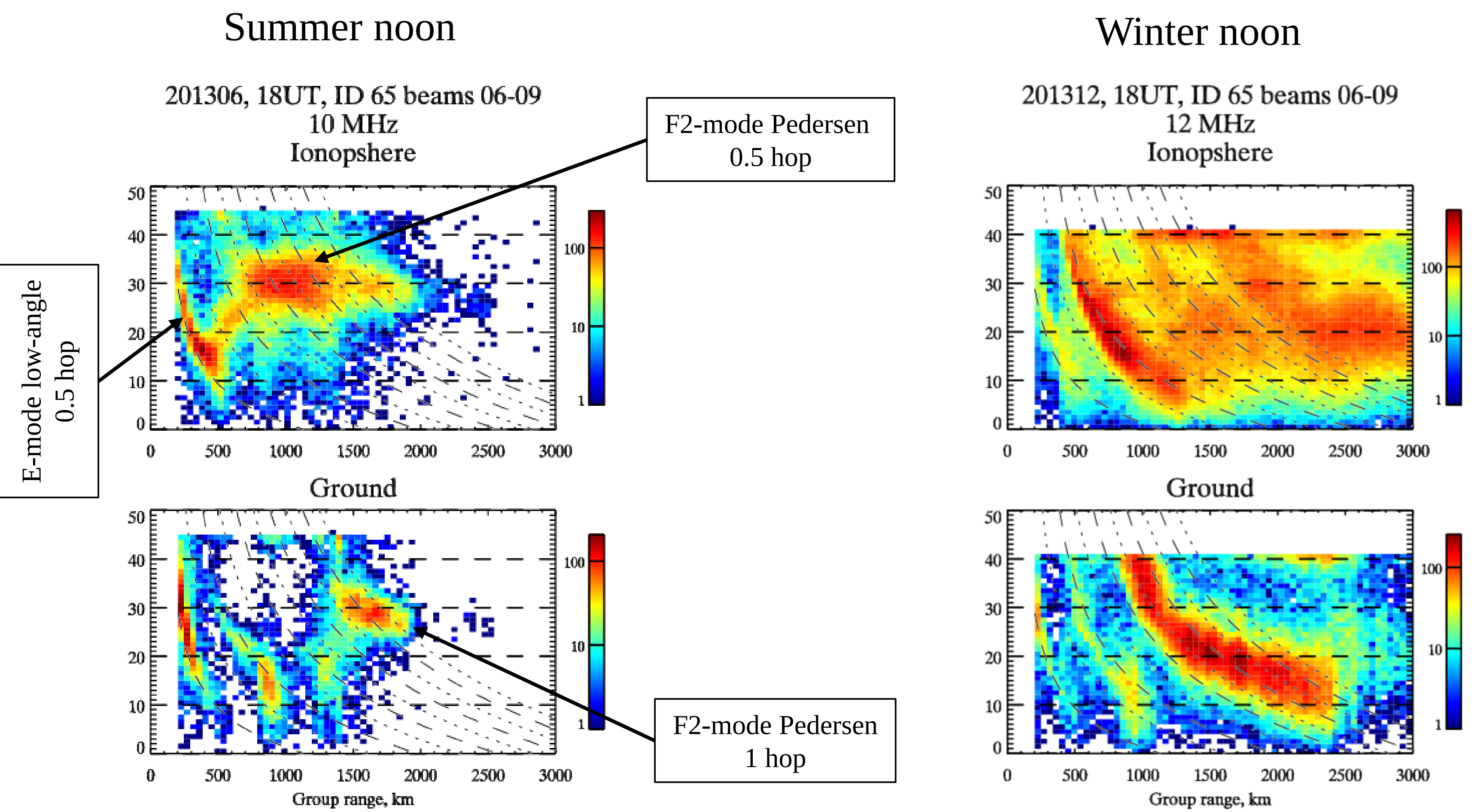

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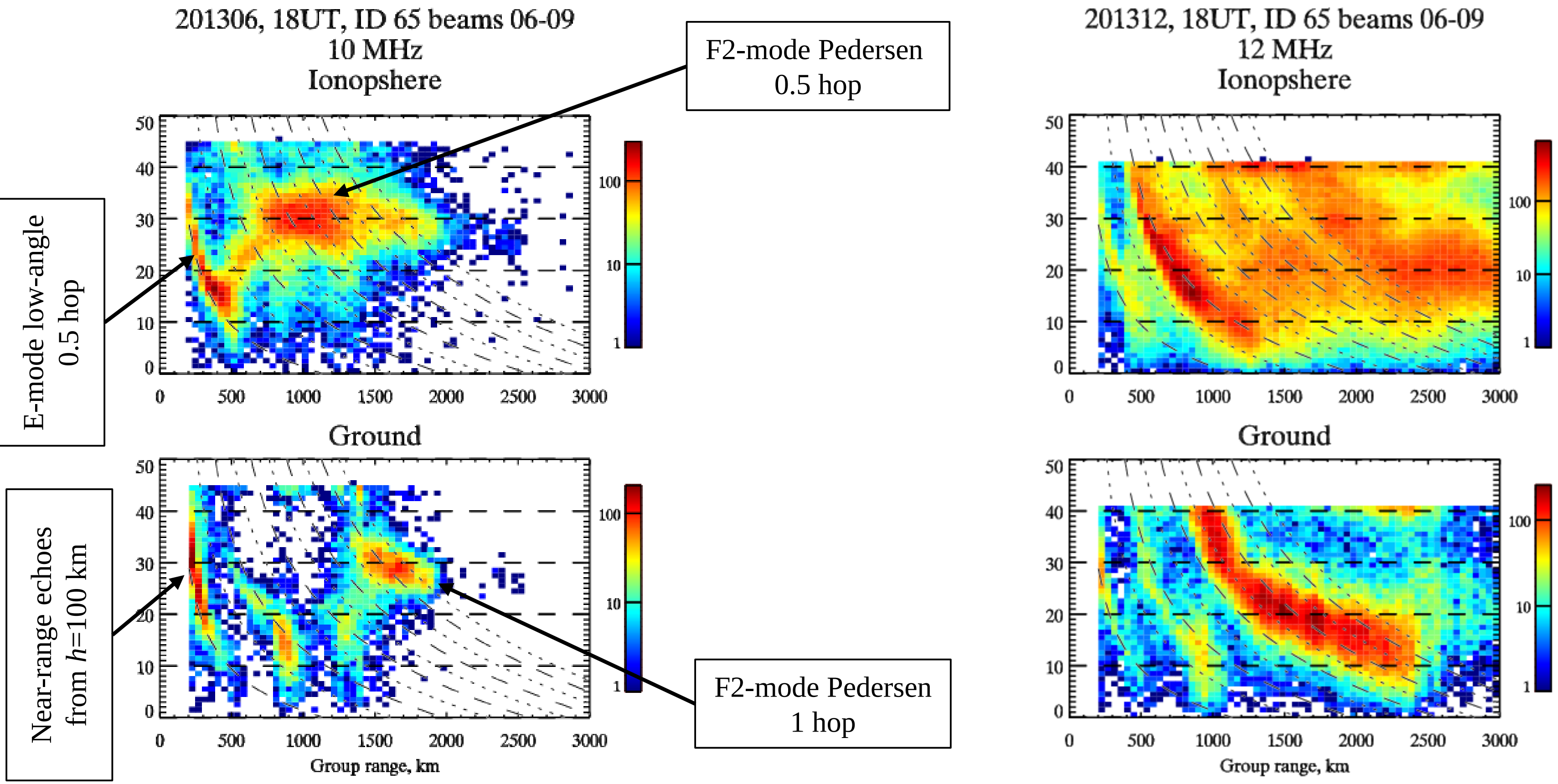

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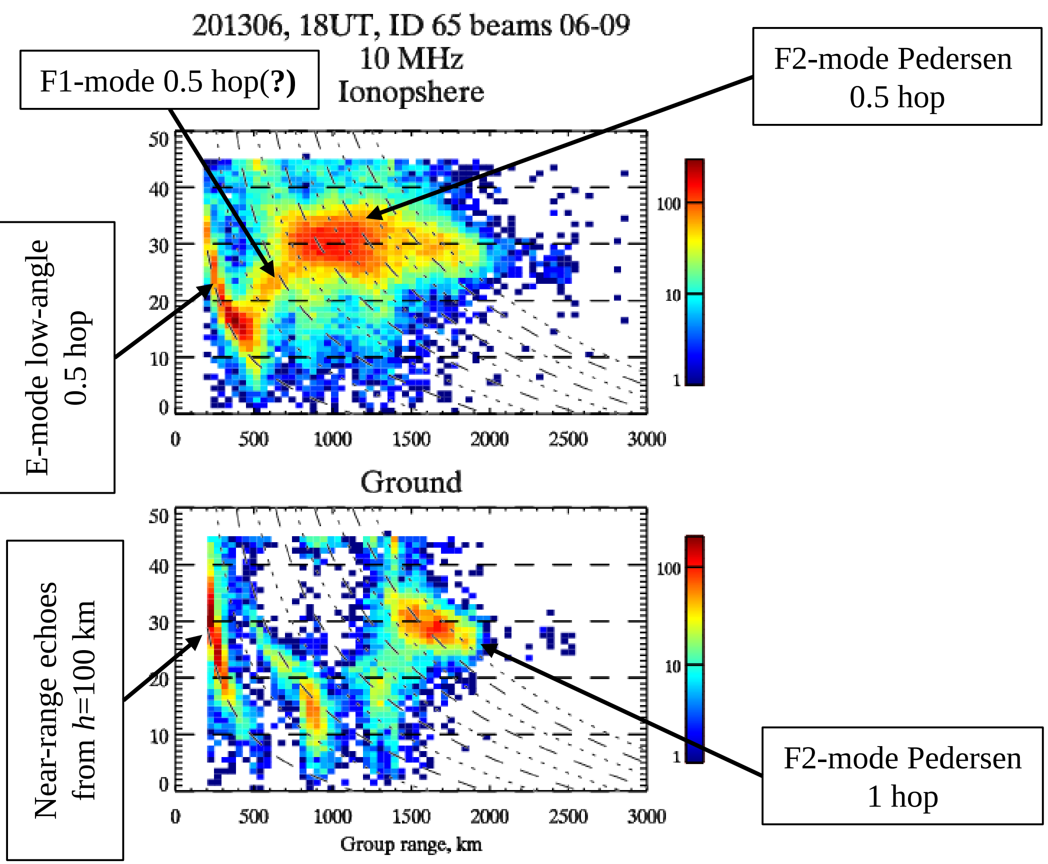

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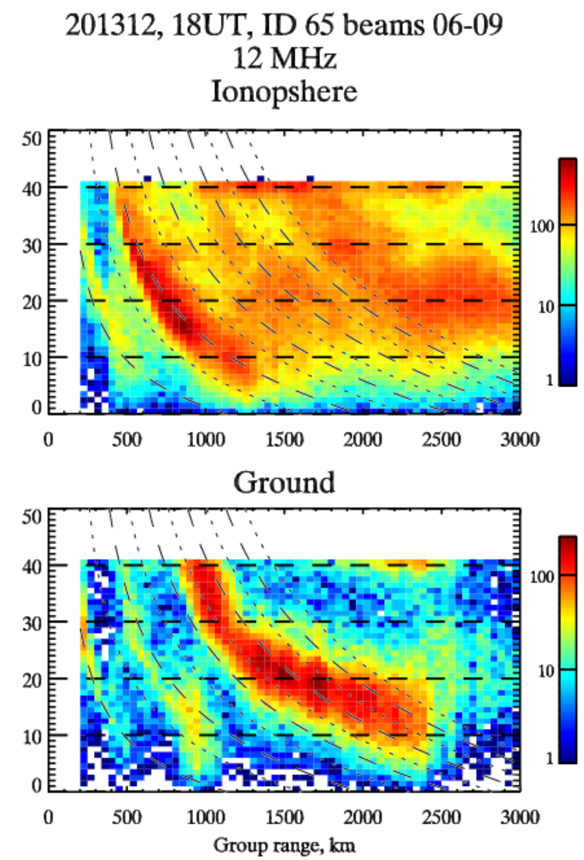

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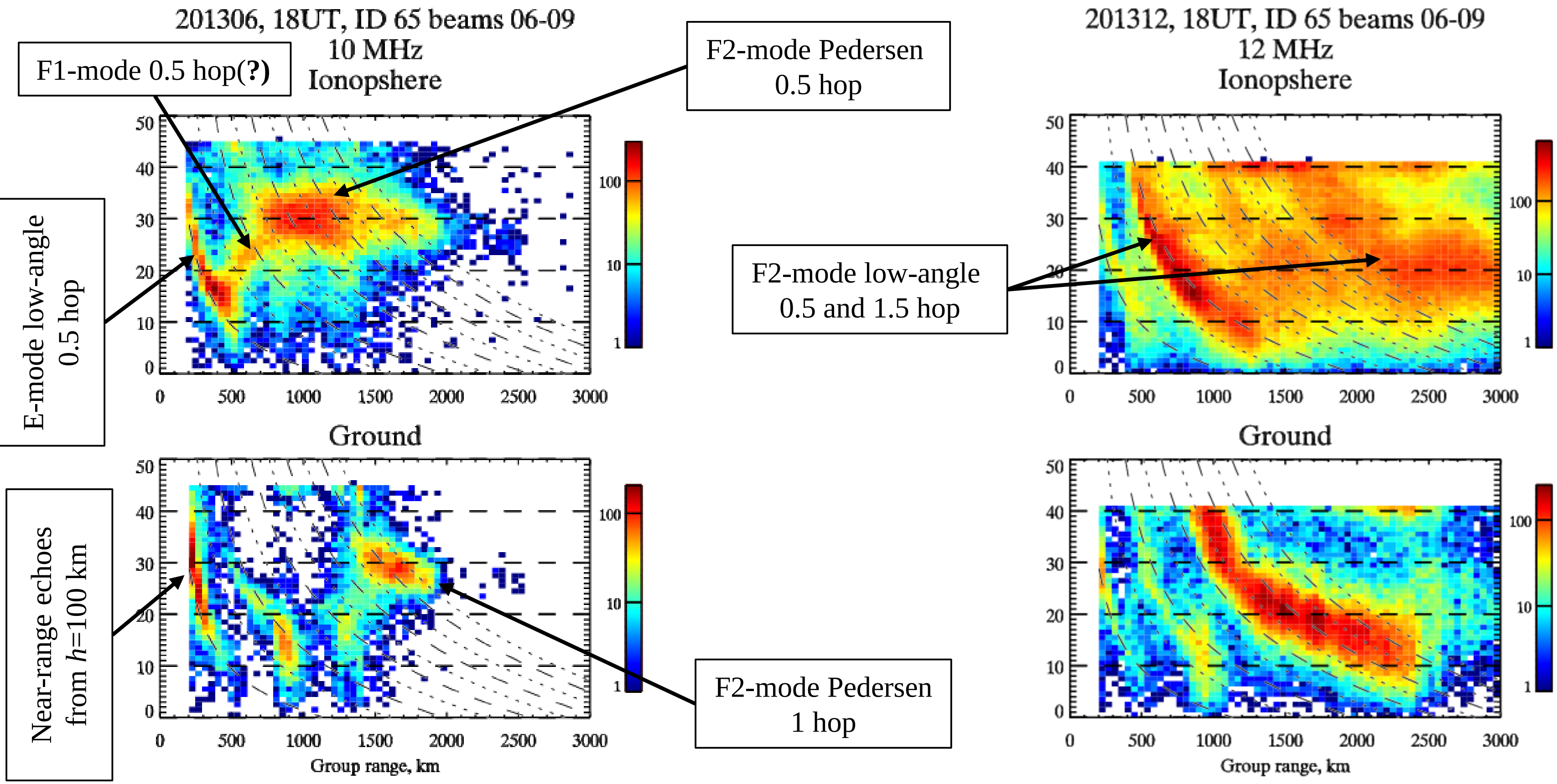

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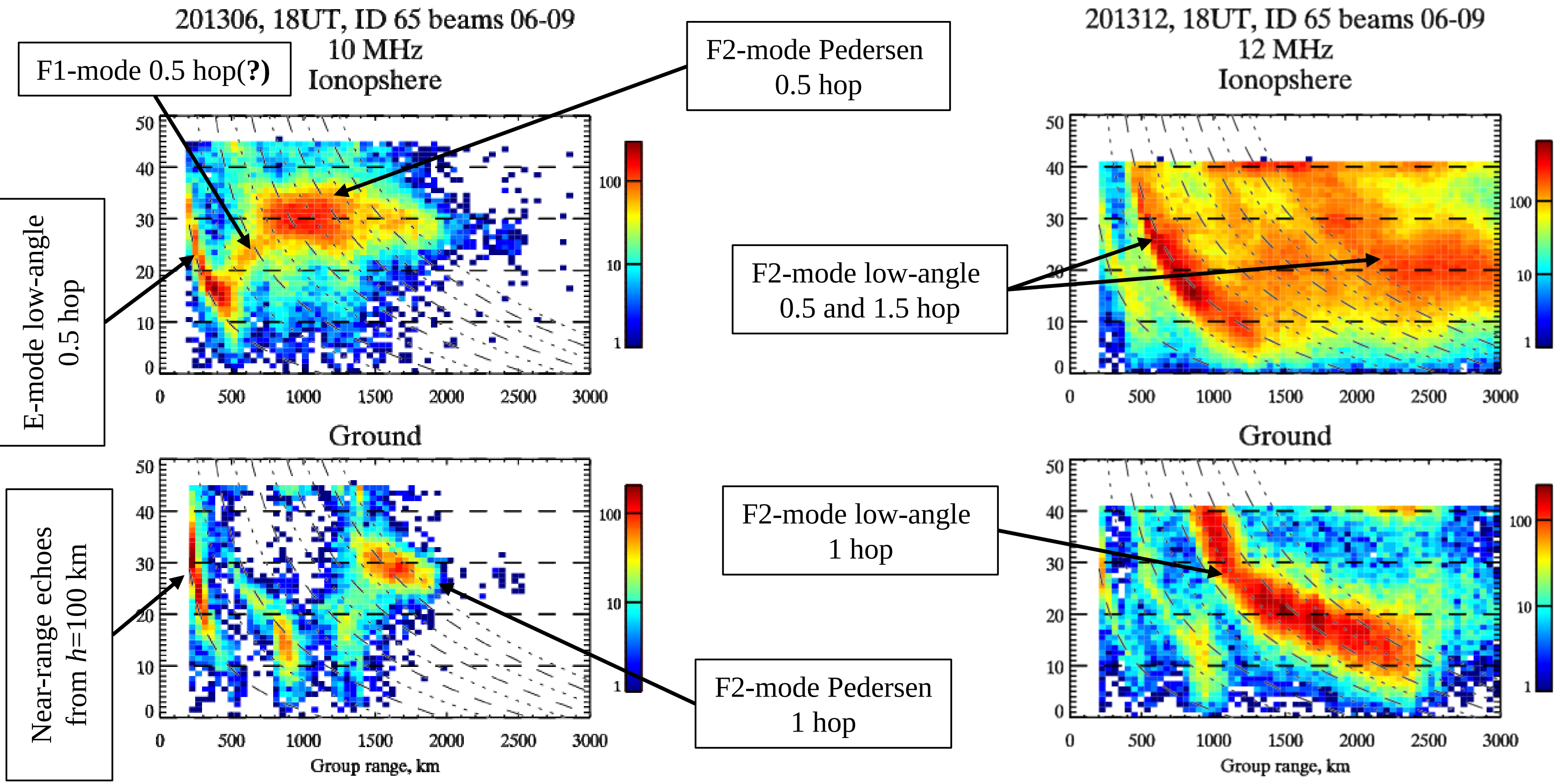

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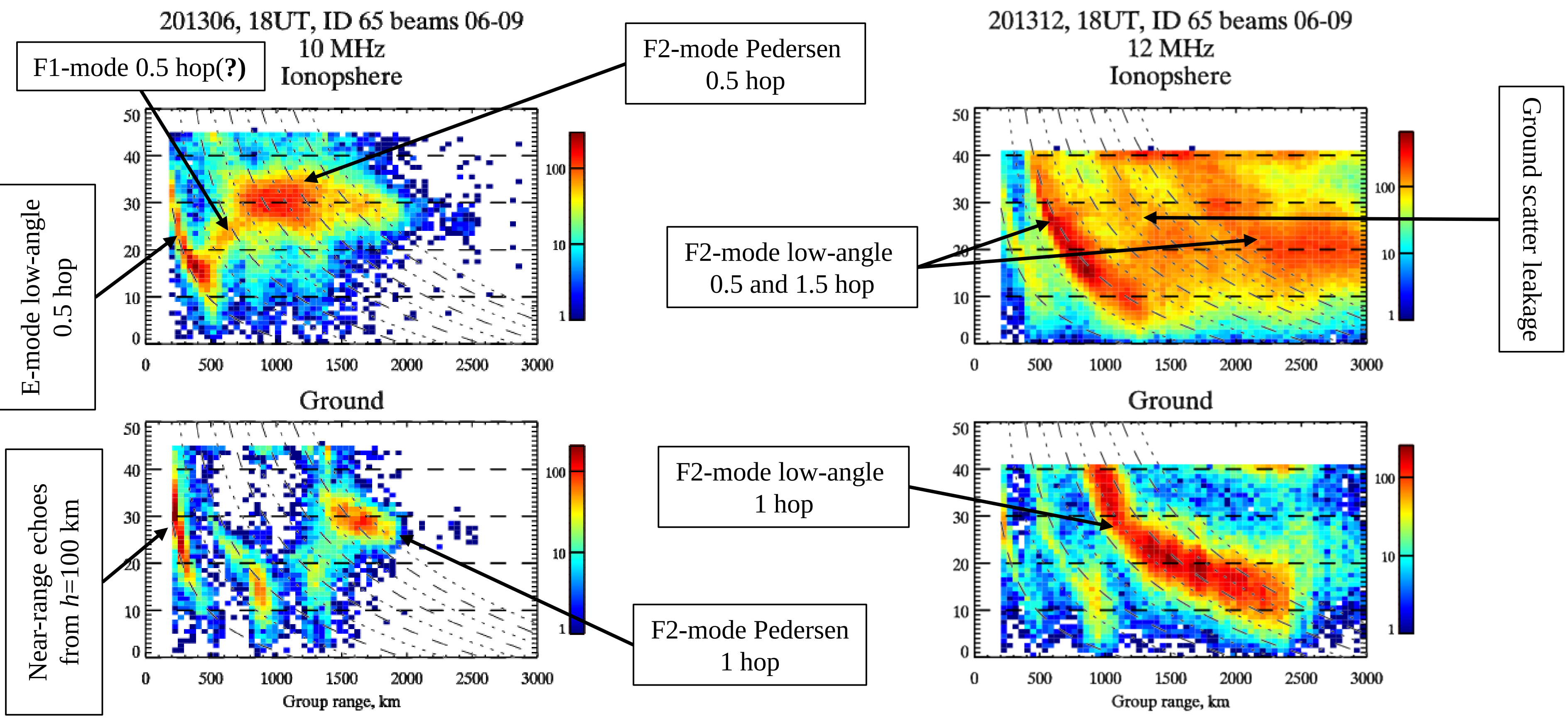

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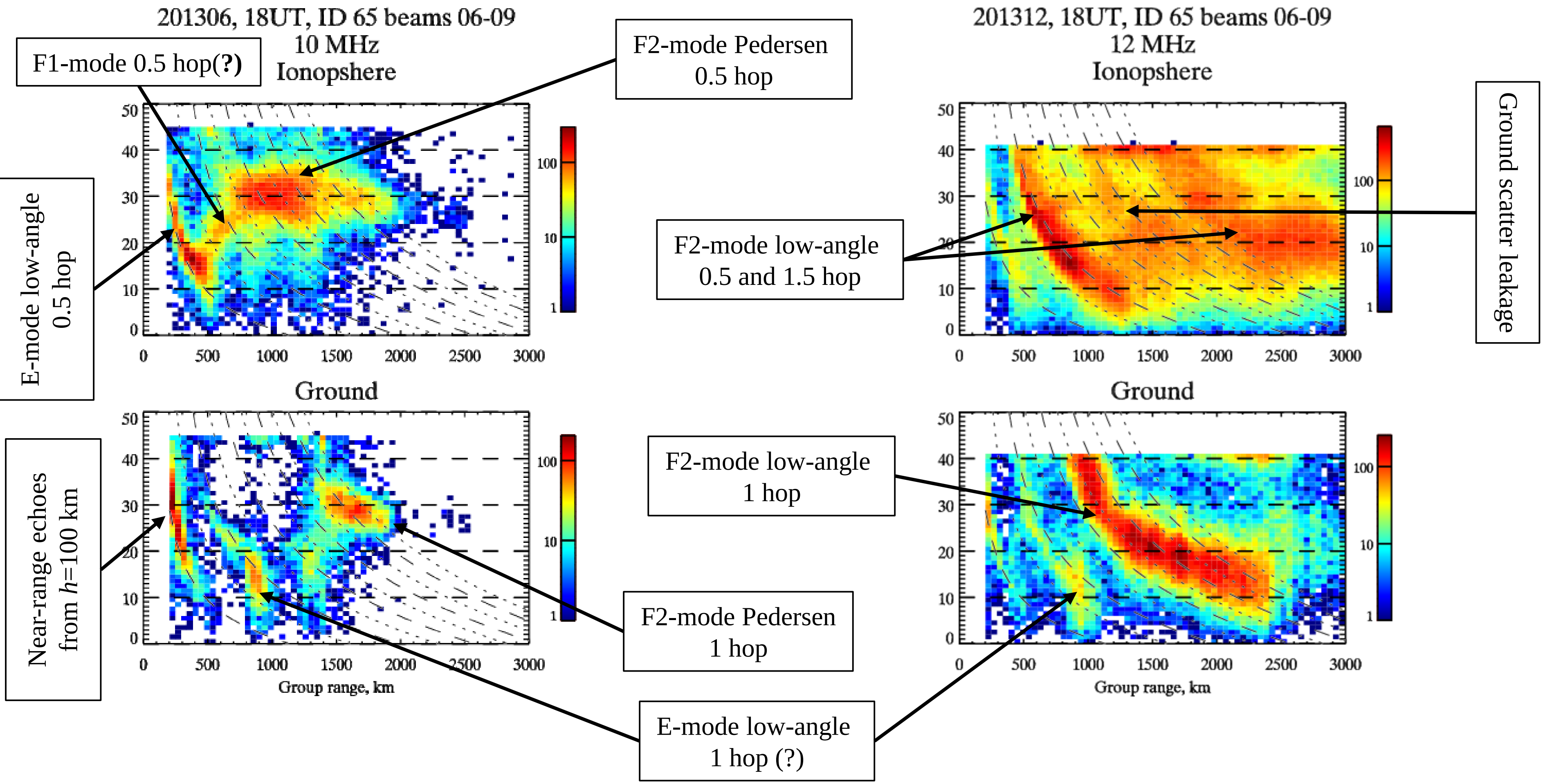

Seasonal/solar cycle variations at noon

Rankin Inlet

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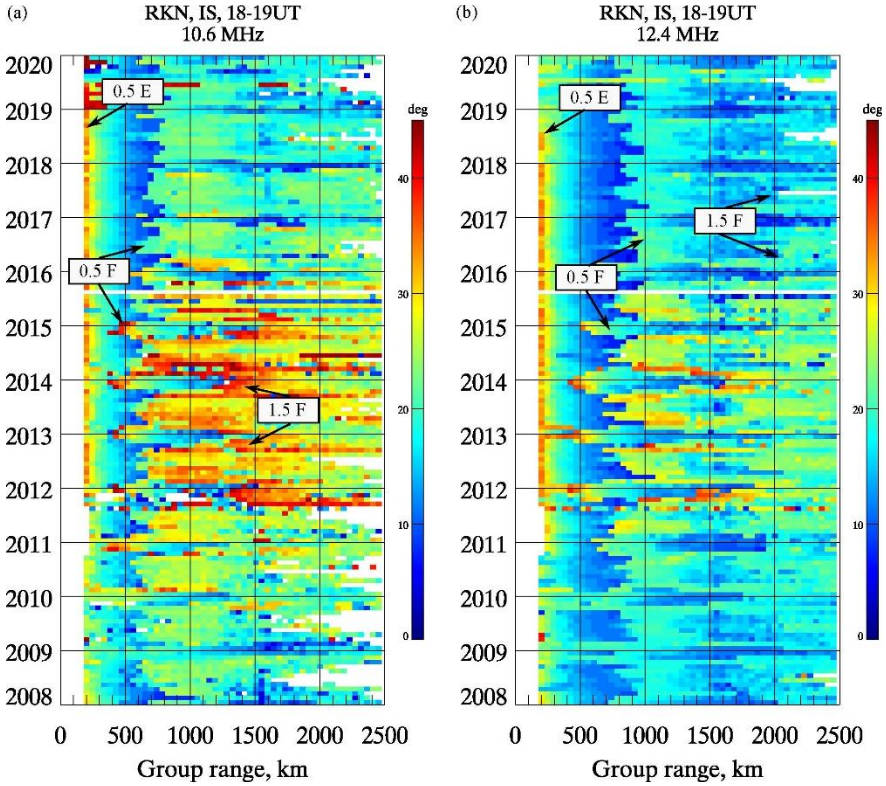
Ionospheric scatter



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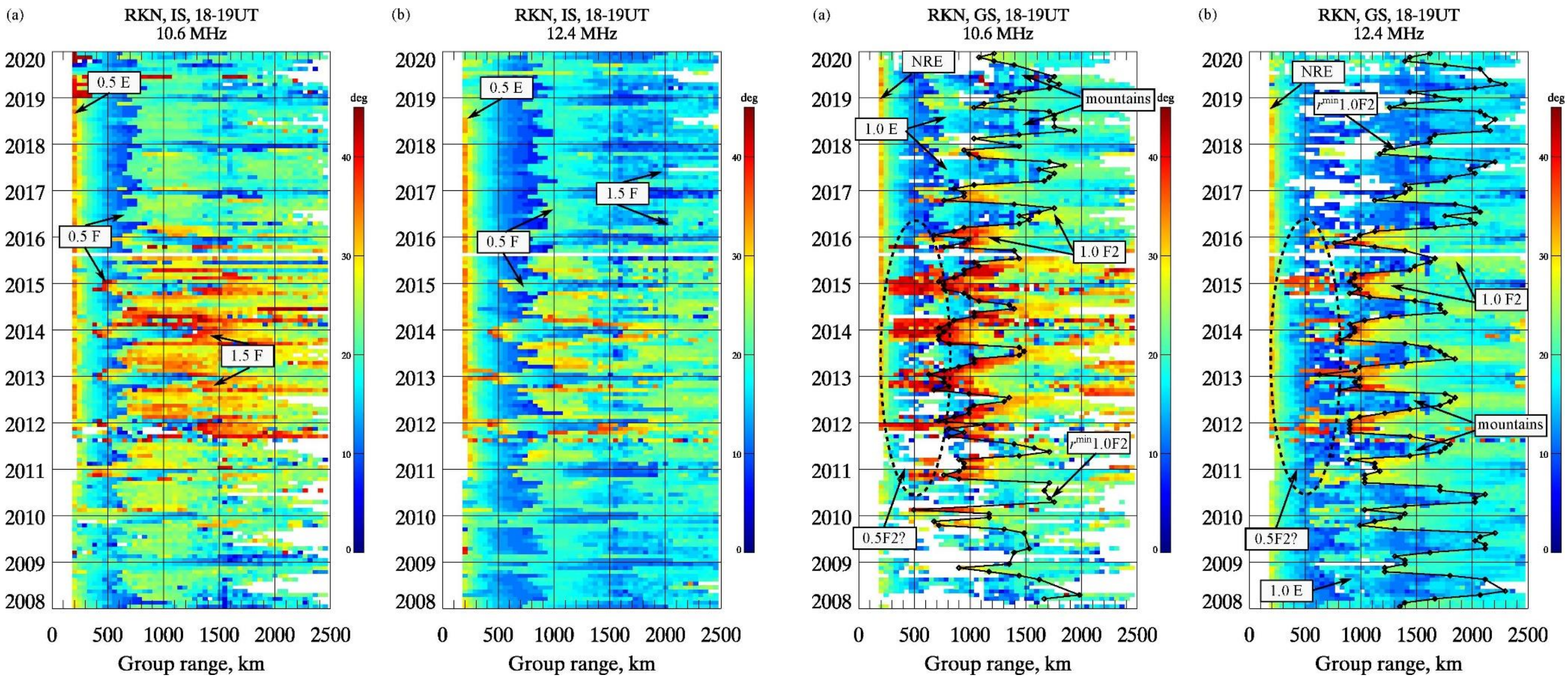

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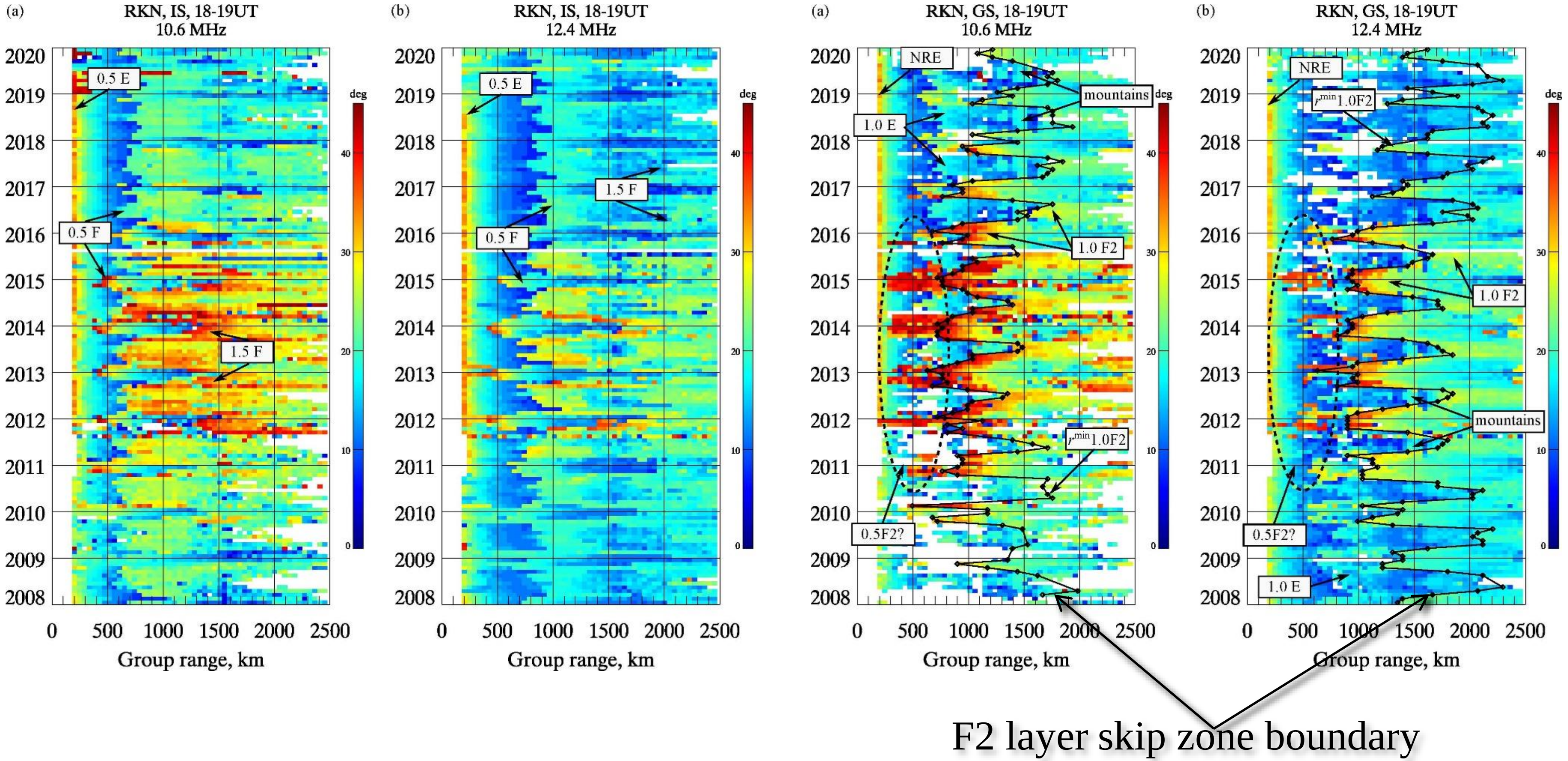
Ionospheric scatter | Ground scatter



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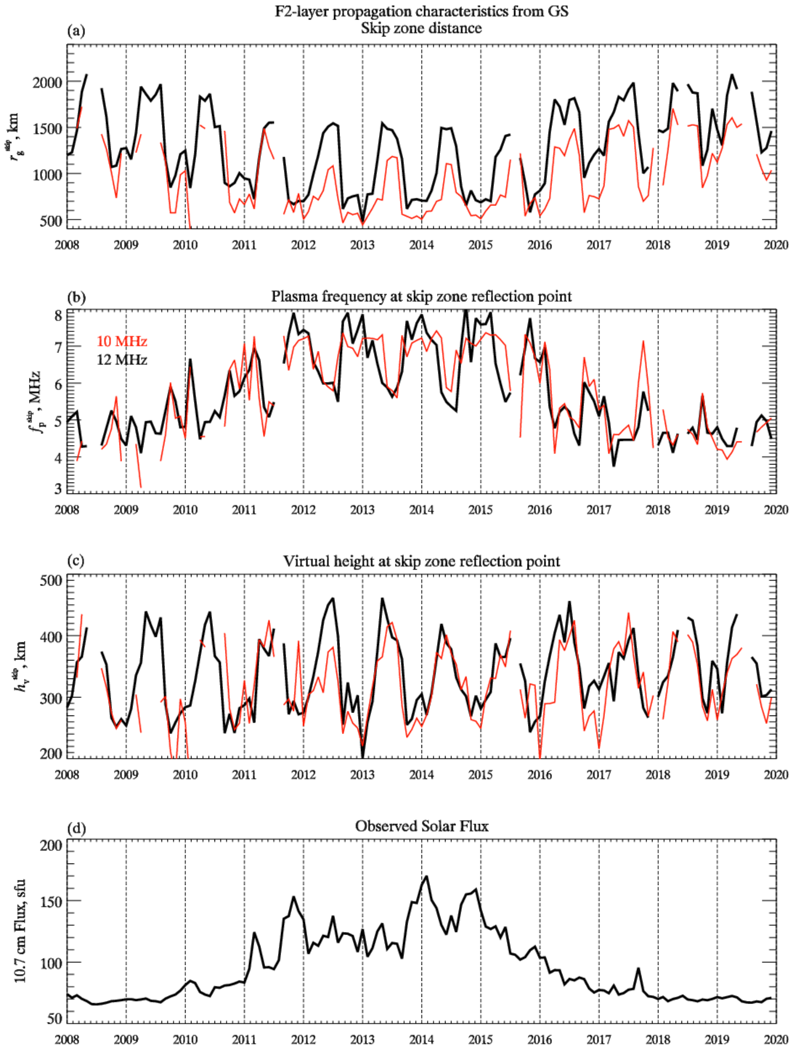
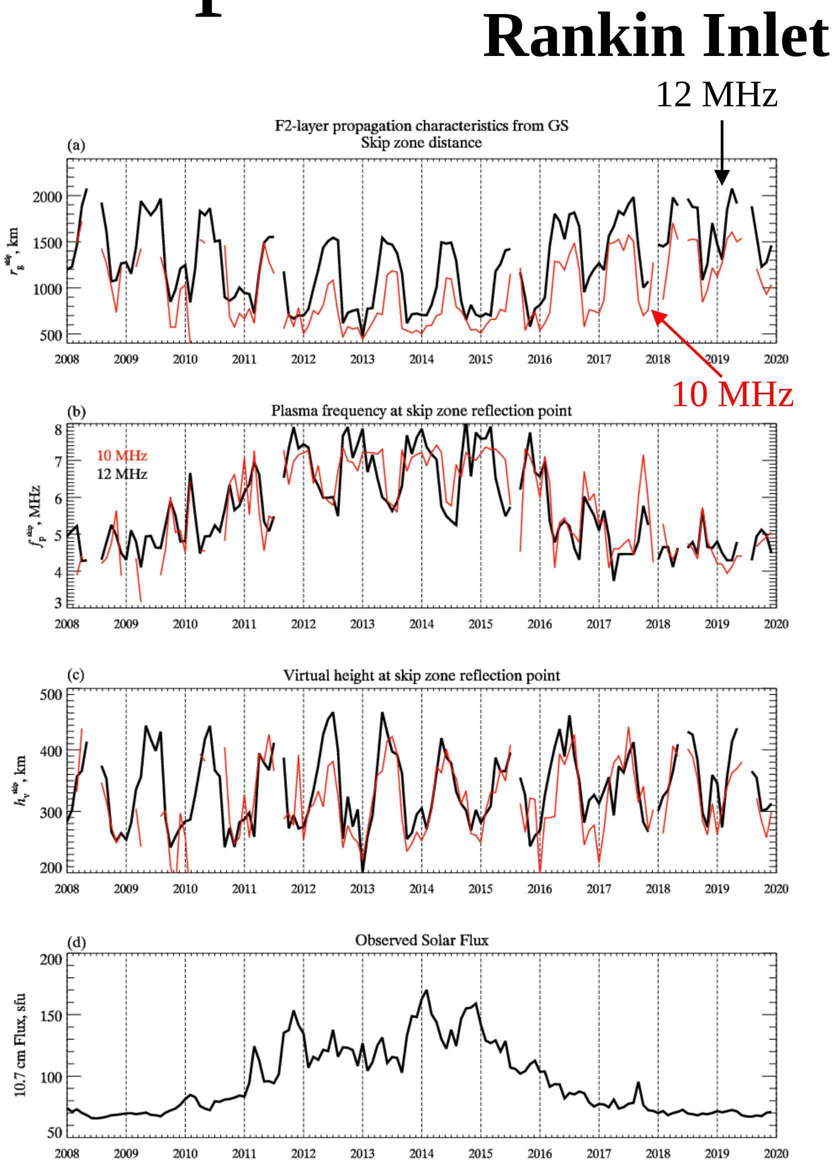


Deriving propagation parameters

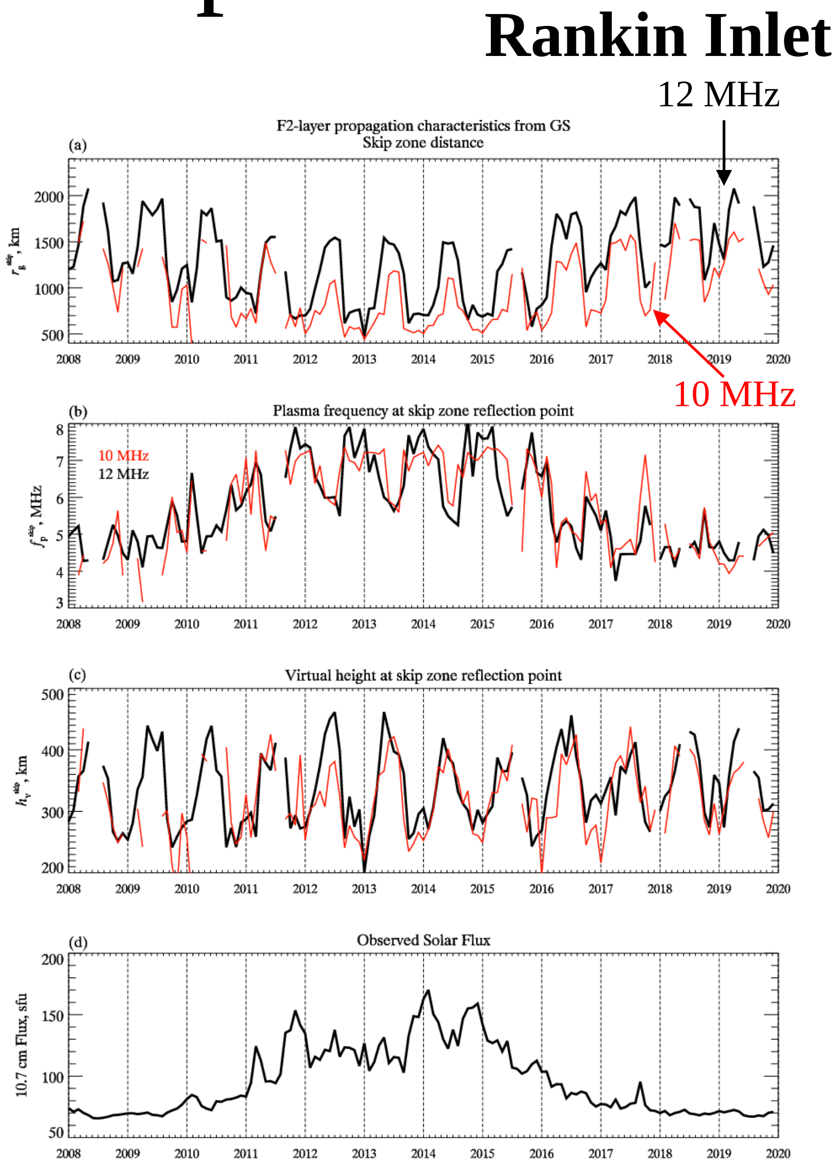
Estimated F2 layer parameters:



Deriving propagation parameters

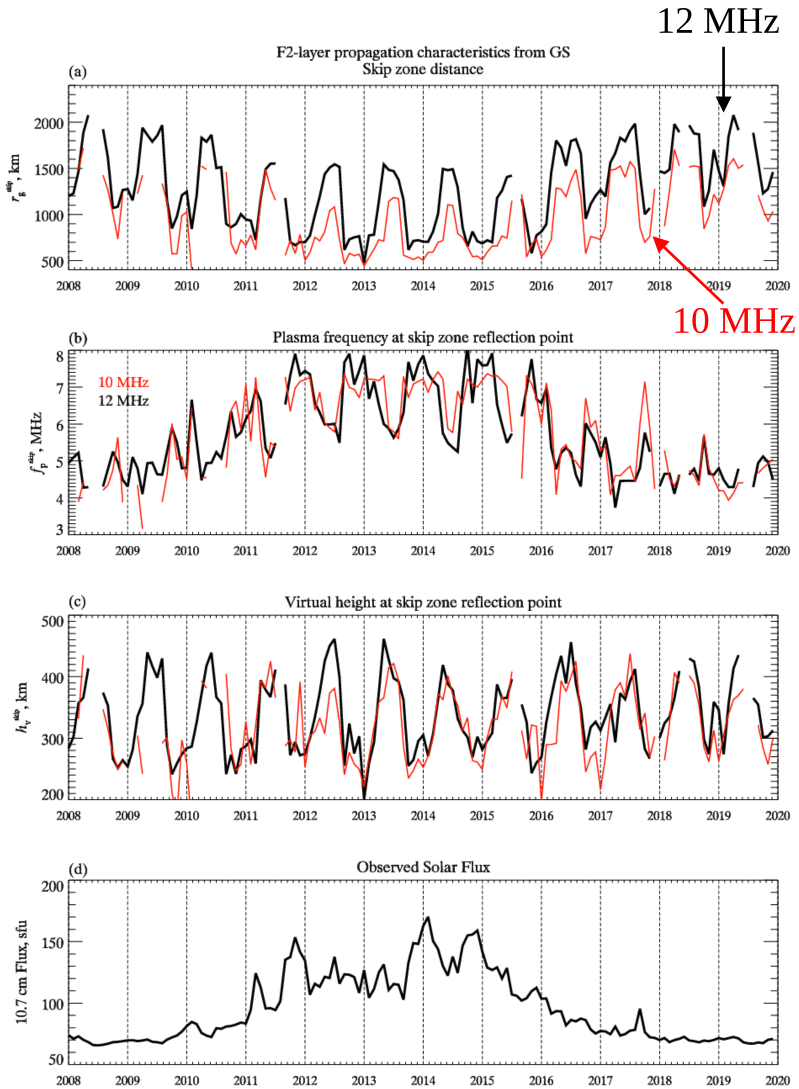
Estimated F2 layer parameters:

- Skip zone distance



Deriving propagation parameters

Rankin Inlet



Estimated F2 layer parameters:

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- Skip zone distance
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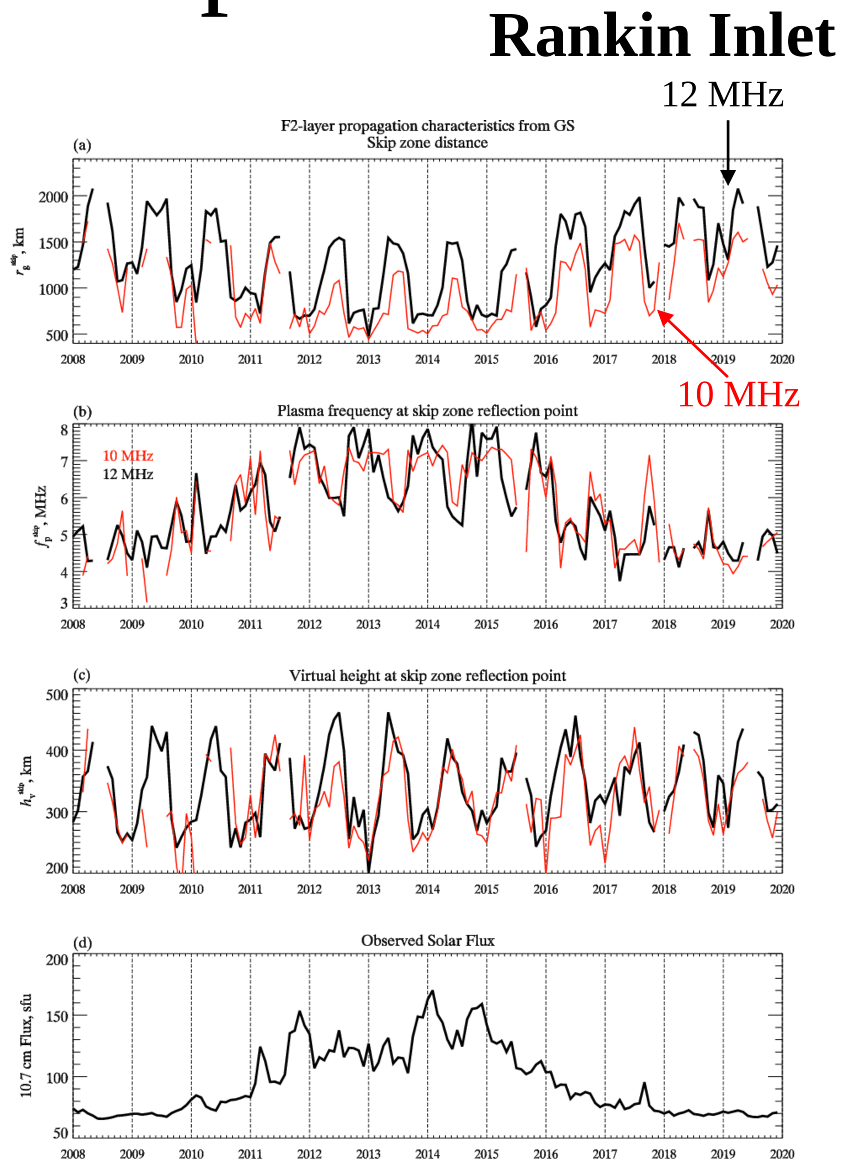
- Virtual height



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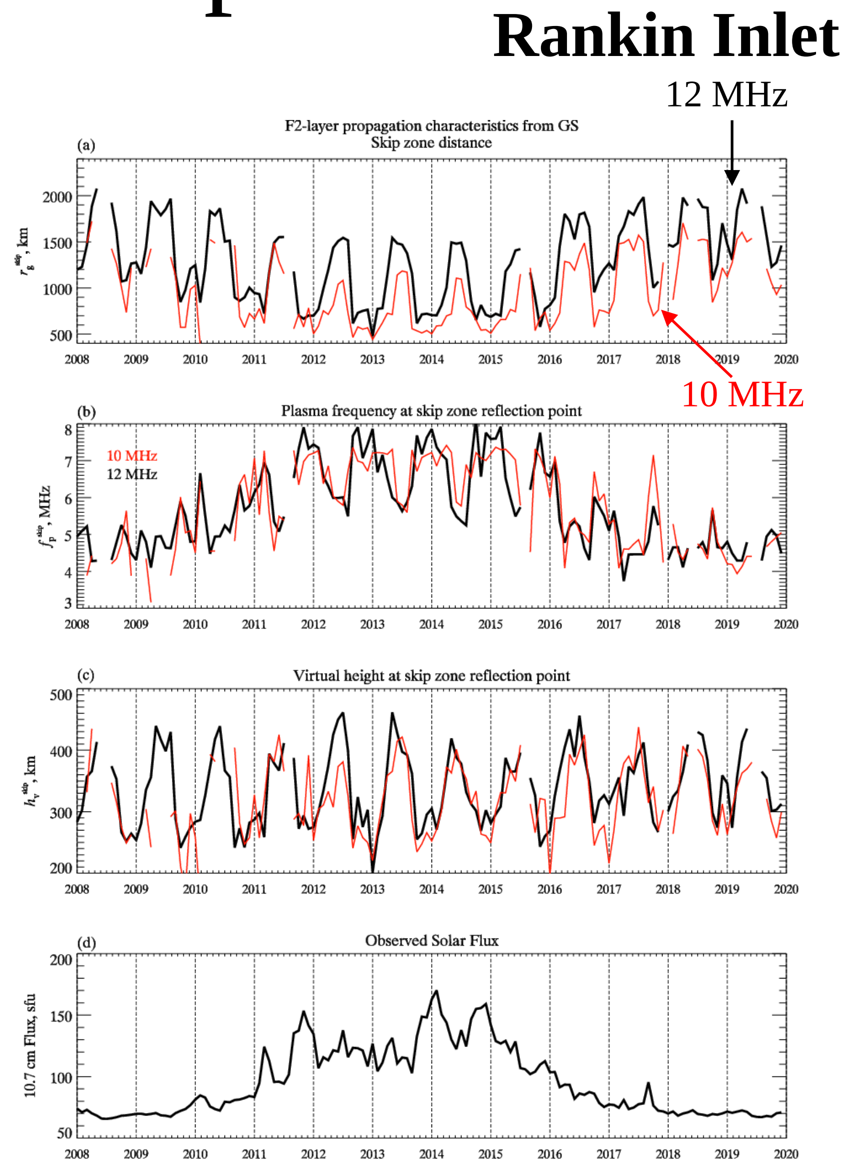
10.7 cm solar flux



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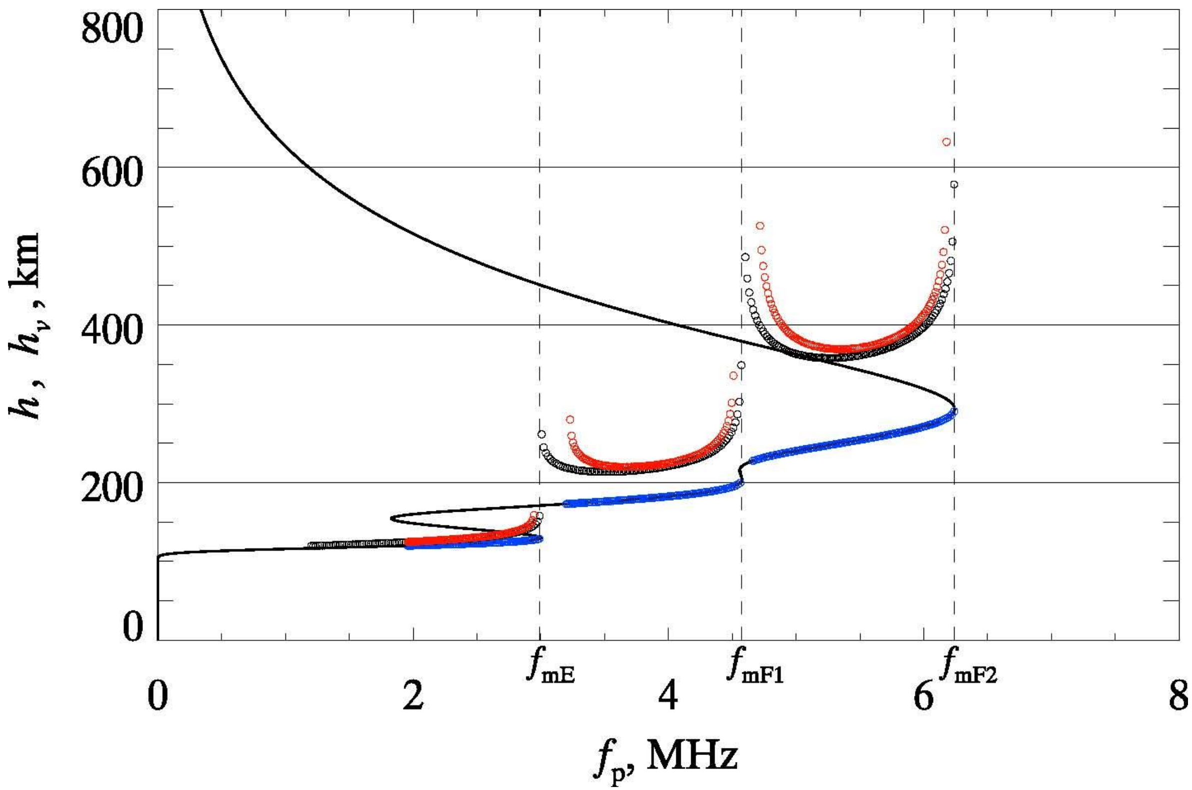

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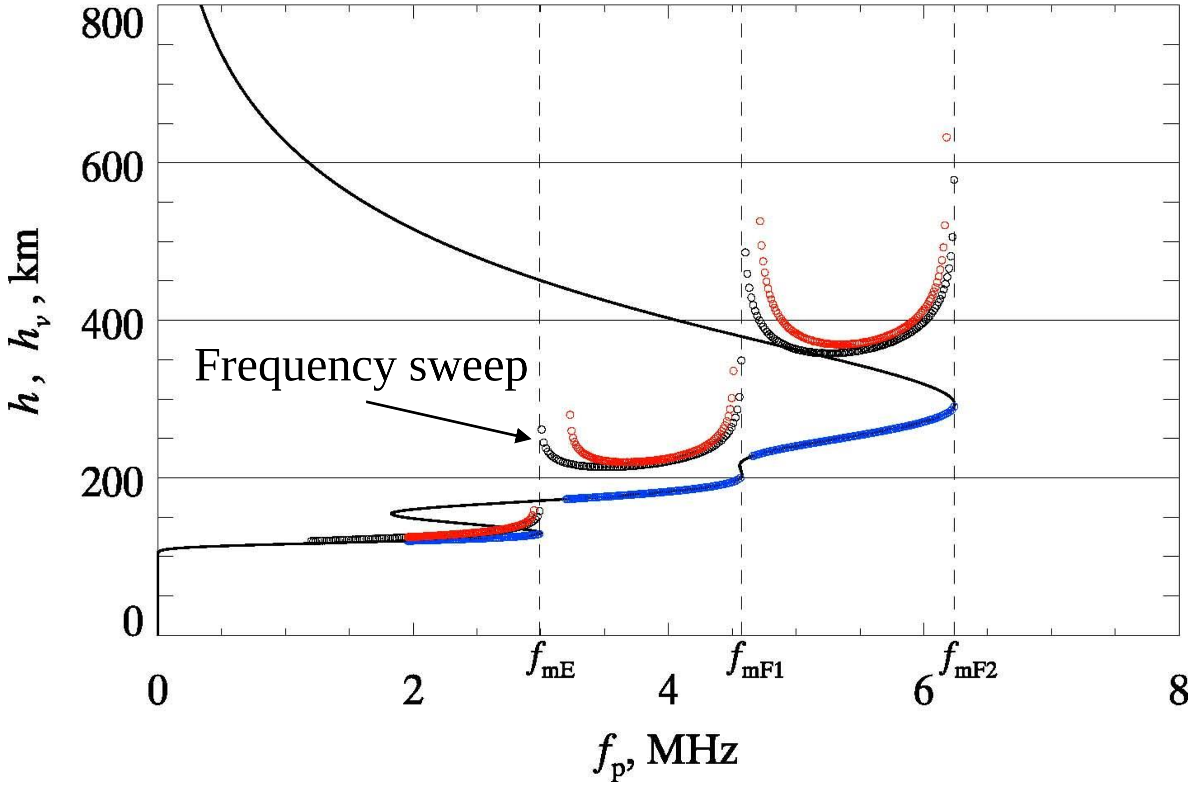

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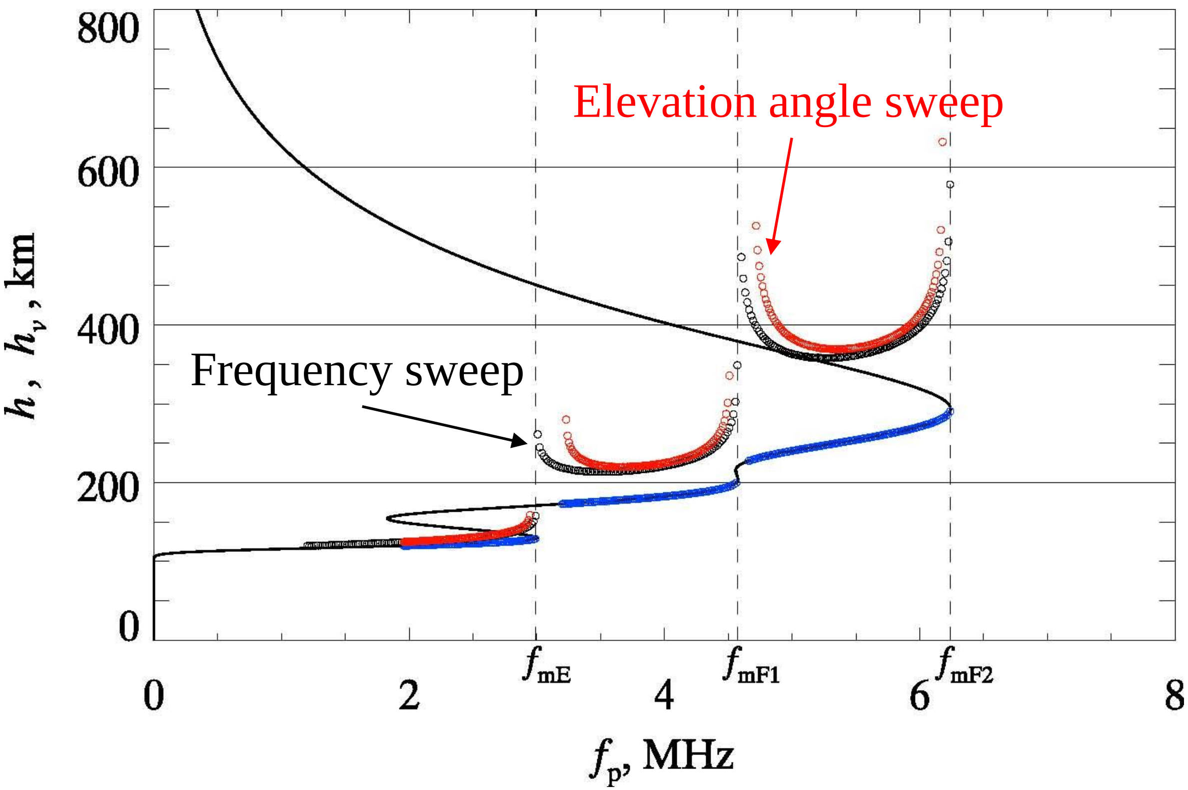

Summary and future work

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