Influences of the equatorward SuperDARN* expansion on data coverage and measured parameters

Maria-Theresia Walach[1], A. Grocott[1], F. Staples[2], E. G. Thomas[3]

Motivation

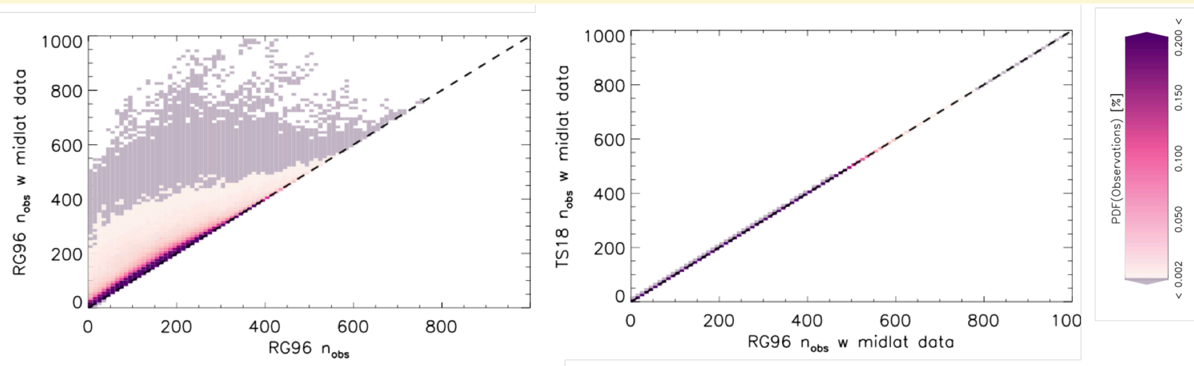
- SuperDARN* was built to study high latitude ionospheric convection
- Radio signals are backscattered by magnetic field-aligned ionospheric irregularities
- Doppler shift is used to calculate ionospheric convection velocities
- SuperDARN's addition of mid-latitude radars allows us to study the effects of additional data on the high-latitude ionospheric convection pattern
- What effect do the mid-latitude radars have on e.g. data coverage?
- What effect does an updated baseline model have (i.e. a model with mid-latitude radars vs one without)?

Method

- A large dataset (2 min cadence, 2012-2018) allows us to statistically study the impacts of adding mid-latitude data & changing the background convection model (fitting methods)
- We create 3 versions of the SuperDARN* maps and statistically compare the differences:
  1) Ruohoniemi & Greenwald (1996) background model **without** mid-latitude data
  2) Ruohoniemi & Greenwald (1996) background model **with** mid-latitude data
  3) Thomas & Shepherd (2018) background model with mid-latitude data

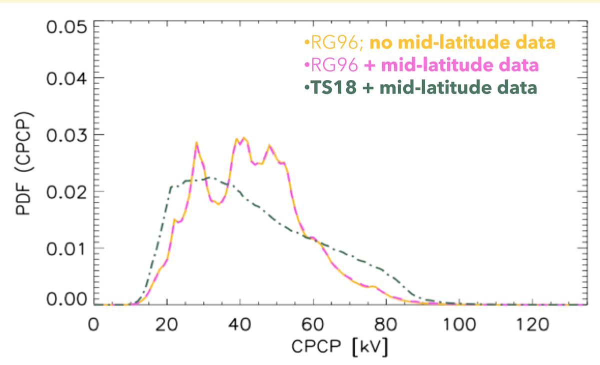
Results I:

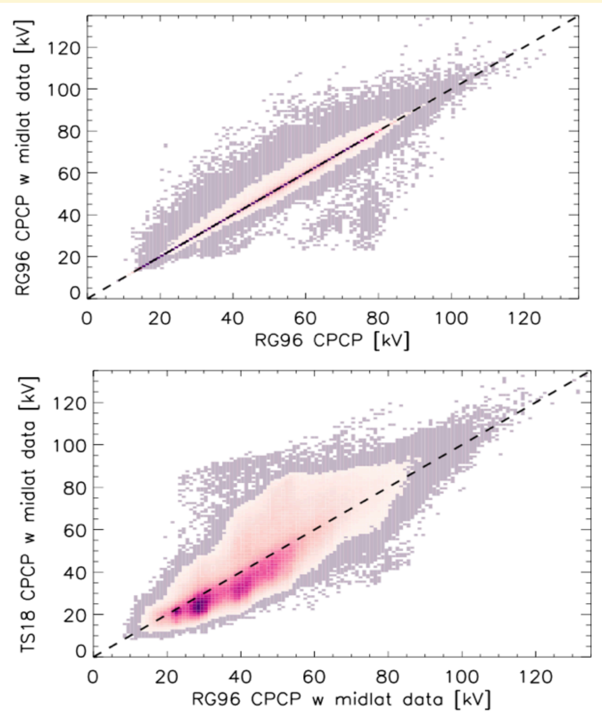
Number of backscatter echoes:



- More likely to see increase in n for maps with low scatter
- Changing the background model has no impact on n

Cross Polar Cap Potential (CPCP):





- Model has a bigger impact on the fitted potentials than extra data (globally!)
- Differences are small —> matches results from Cousins & Shepherd 2010 (~10% change in potentials when introducing a new model)

High-latitude ionospheric convection morphologies change with expanded radar network*:

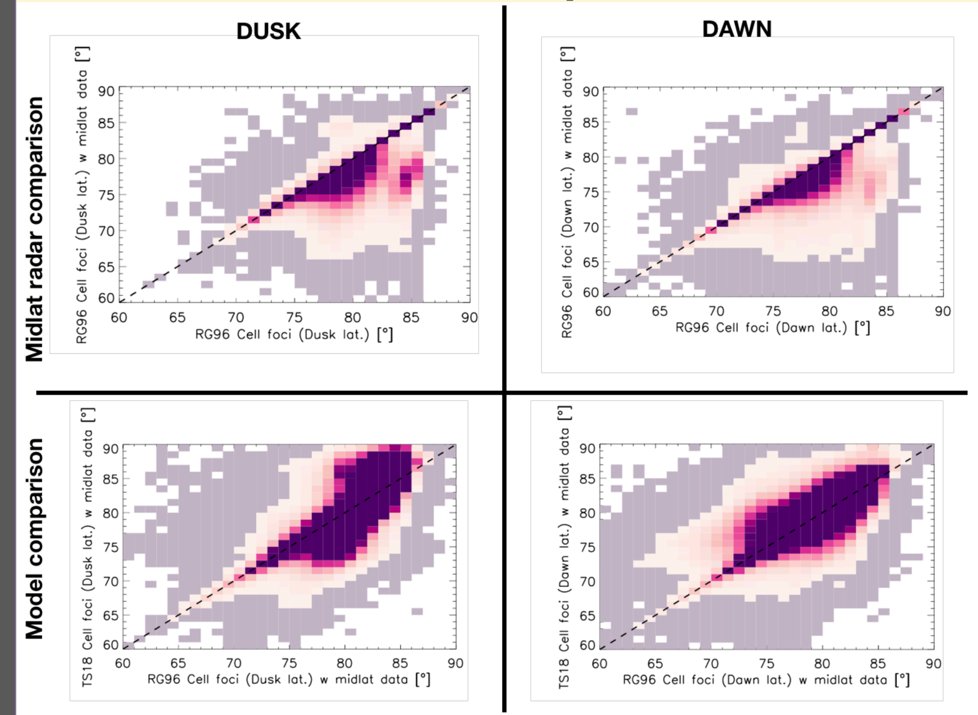
Adding mid-latitude data does not change overall convection strength, but expands convection pattern

*Super Dual Auroral Radar Network (SuperDARN)

Image credit: Kathryn McWilliams

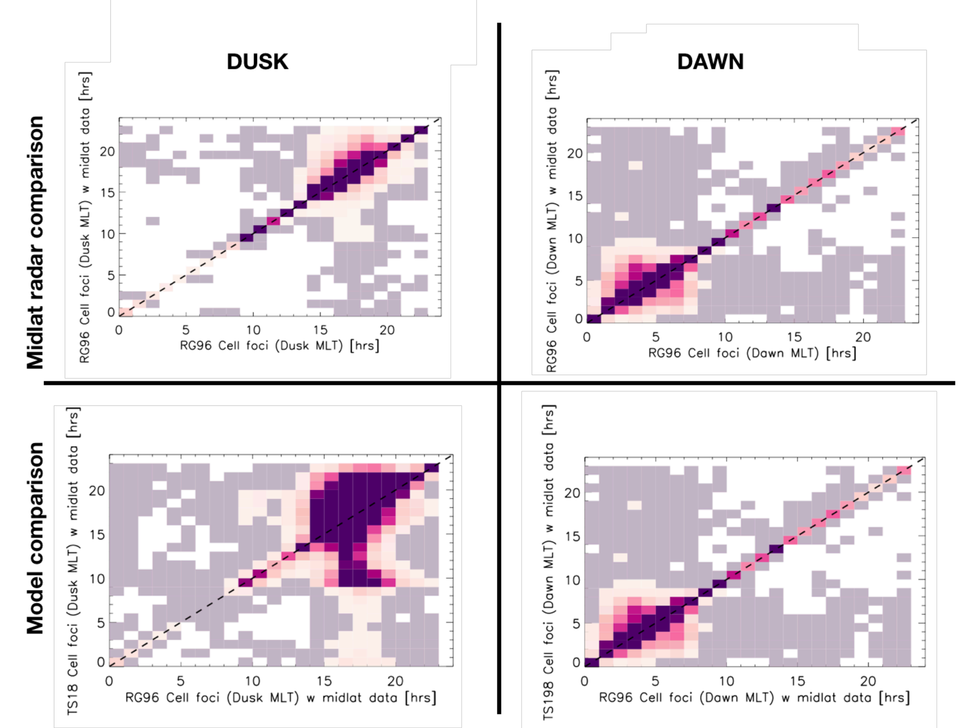
Results II:

Convection morphology – cell foci:



- Adding mid-latitude data moves convection cells equatorward
- Changing model can shrink or expand convection cells

- Adding mid-latitude data has a symmetric effect in terms of changes in MLT location of convection cells
- Changing background model is more likely to have large effect on convection map on dusk side



Supporting Information:

SuperDARN* coverage, Jan. 2018:

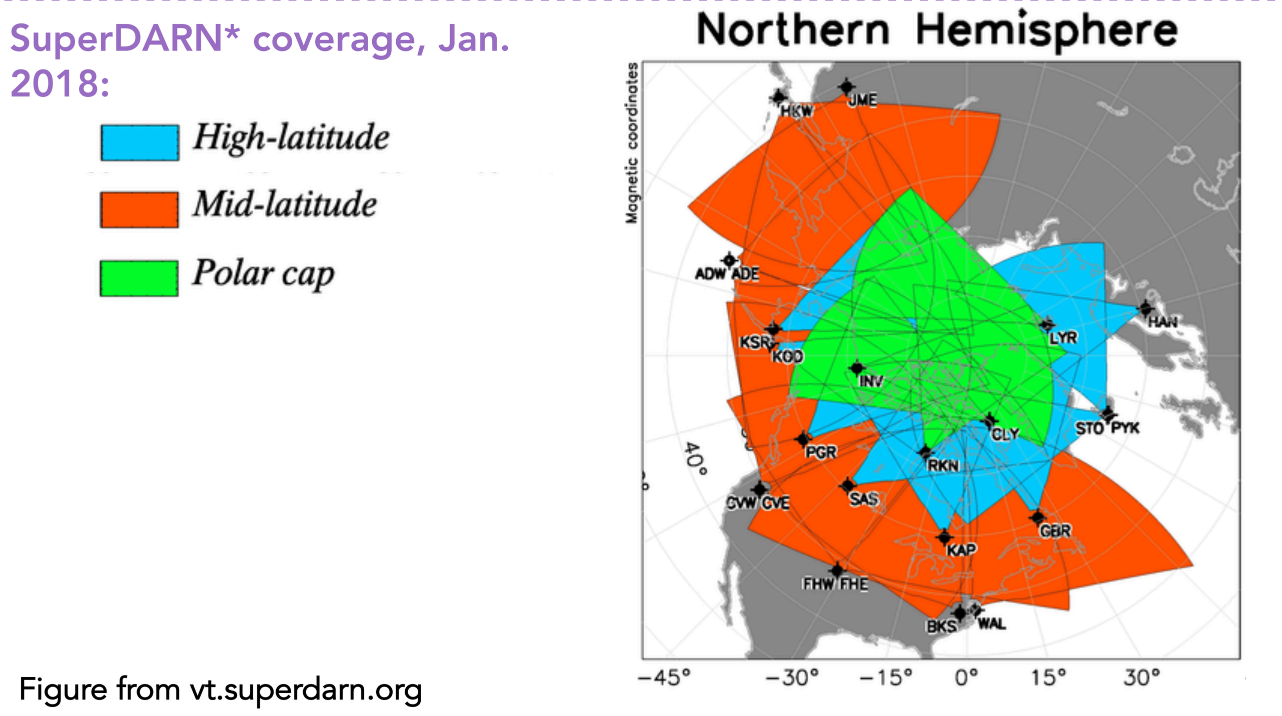


Figure from vt.superdarn.org

Data and background models as a function of solar cycles:

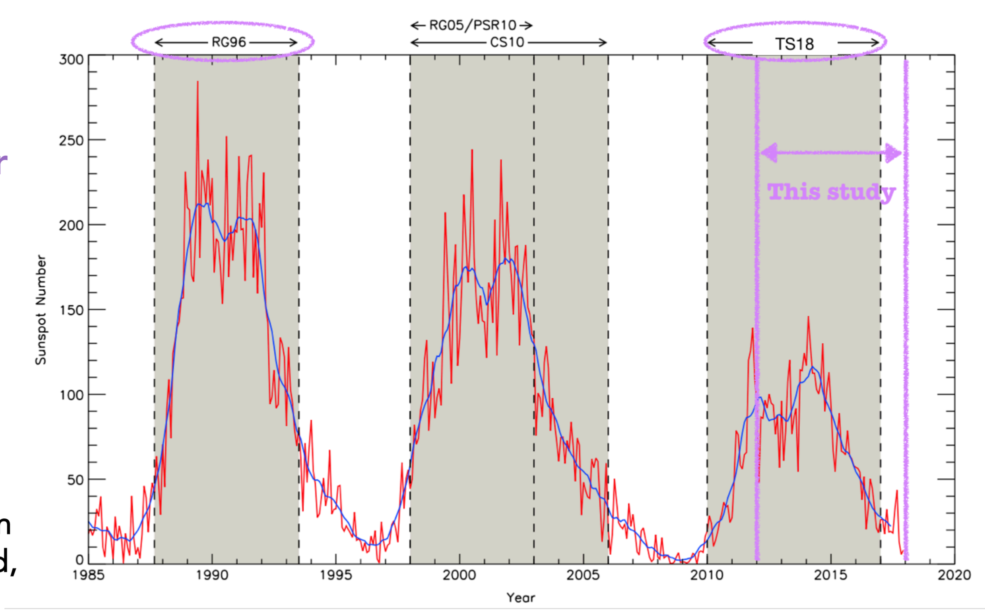


Figure adapted from Thomas & Shepherd, 2018

1: Lancaster University
2: Mullard Space Science Laboratory, UCL
3: Thayer School of Eng., Dartmouth College, US

m.walach@lancaster.ac.uk

Funded by NERC #NE/P001556/1

Space & Planetary Physics | Lancaster University