Evaluating the Antarctic Observational Network with AMPS

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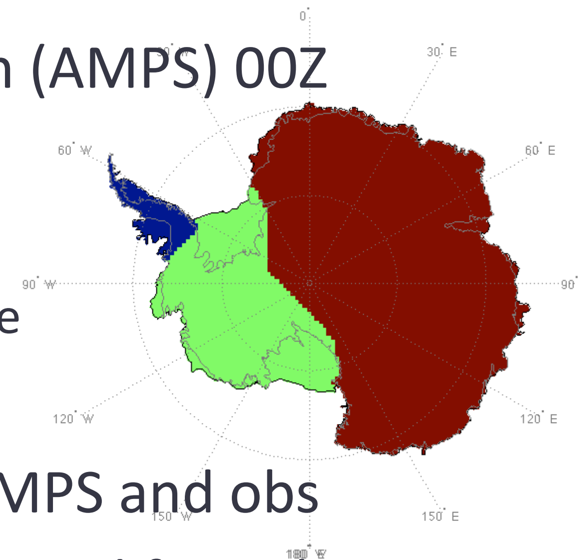
Motivation

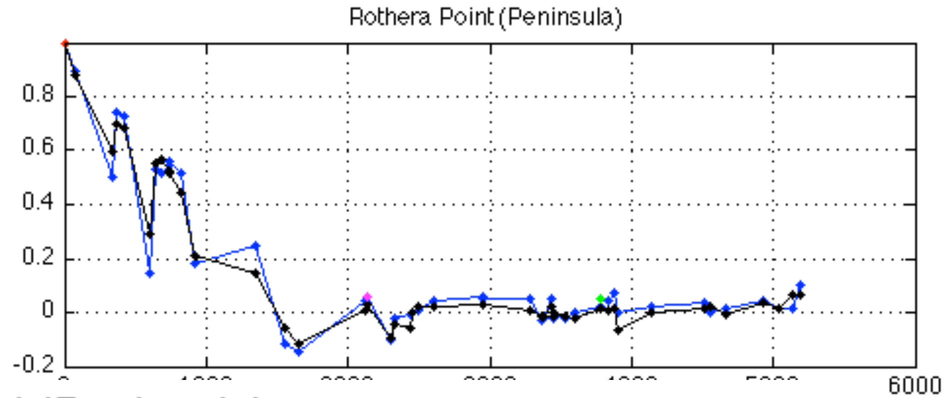
- Environmental observing networks are often subjective
  - Monitoring goal may never be clearly defined
  - Grow organically over time (perhaps with available funding)
- Practical considerations often constrain the network
  - Access to power, land ownership issues, accessibility for maintenance, where people live (e.g., US Cooperative Observer Program), etc.
- In Antarctica, harsh weather conditions amplify difficulties
- Objective optimal network design method (Huntley and Hakim, 2009; Mauger et al. [in review]) to meet monitoring goal(s) cost effectively
- Evaluate the current network as a first step

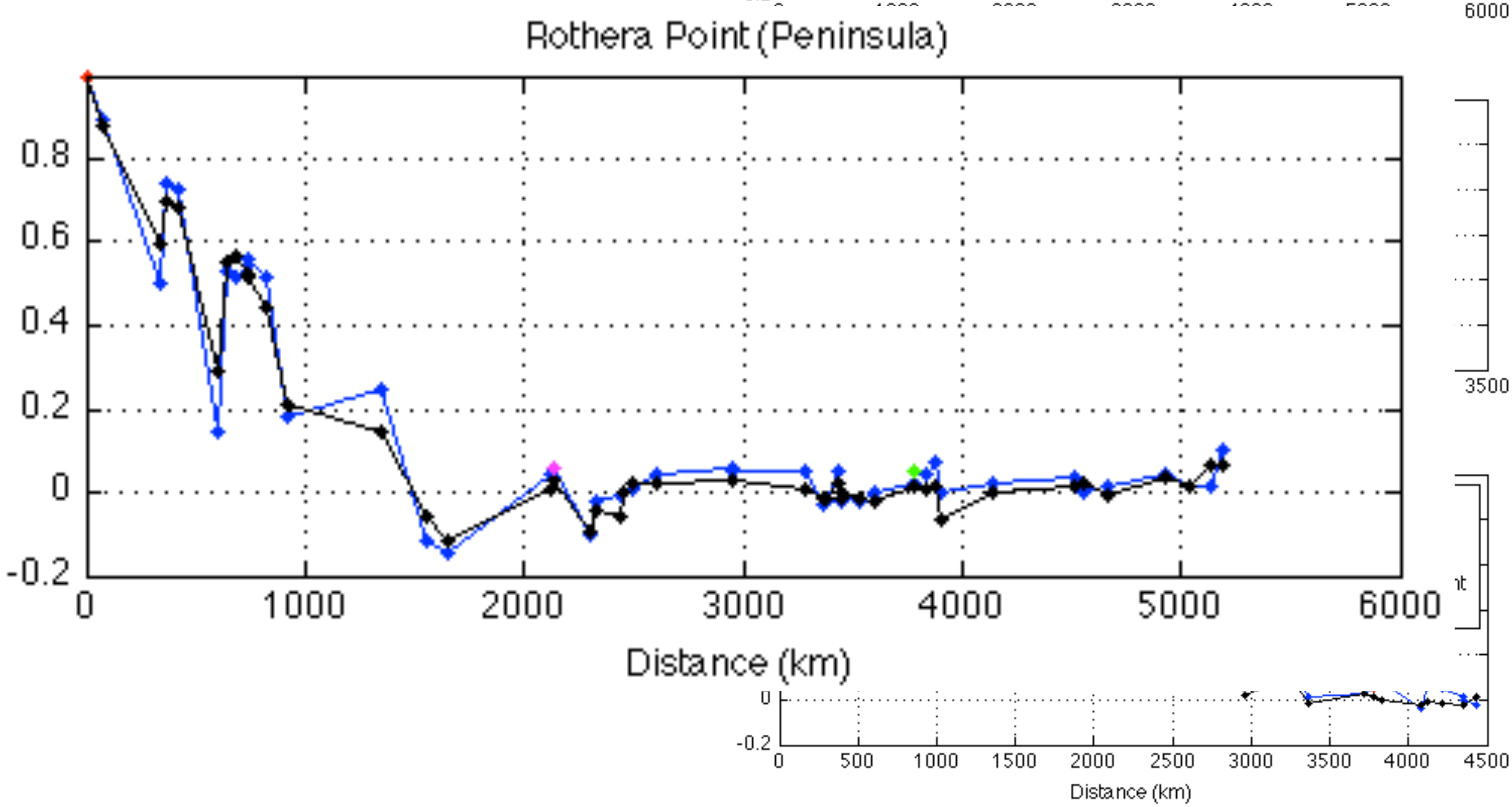
Evaluate current network

- Examine spatial station influence through a correlation length scale
- 15 km Antarctic Mesoscale Prediction System (AMPS) 00Z analysis for 2008-2012 (NCAR)
- Daily surface observations (NCAR)
  - Focus on surface pressure and 2 meter temperature
- Basic quality control on observations
- Removed seasonal cycle in temperature in AMPS and obs
- Divided the observations into those that reported for at least 75% (CD75) and at least 90% (CD90) of the period
- Analysis separated into 3 regions



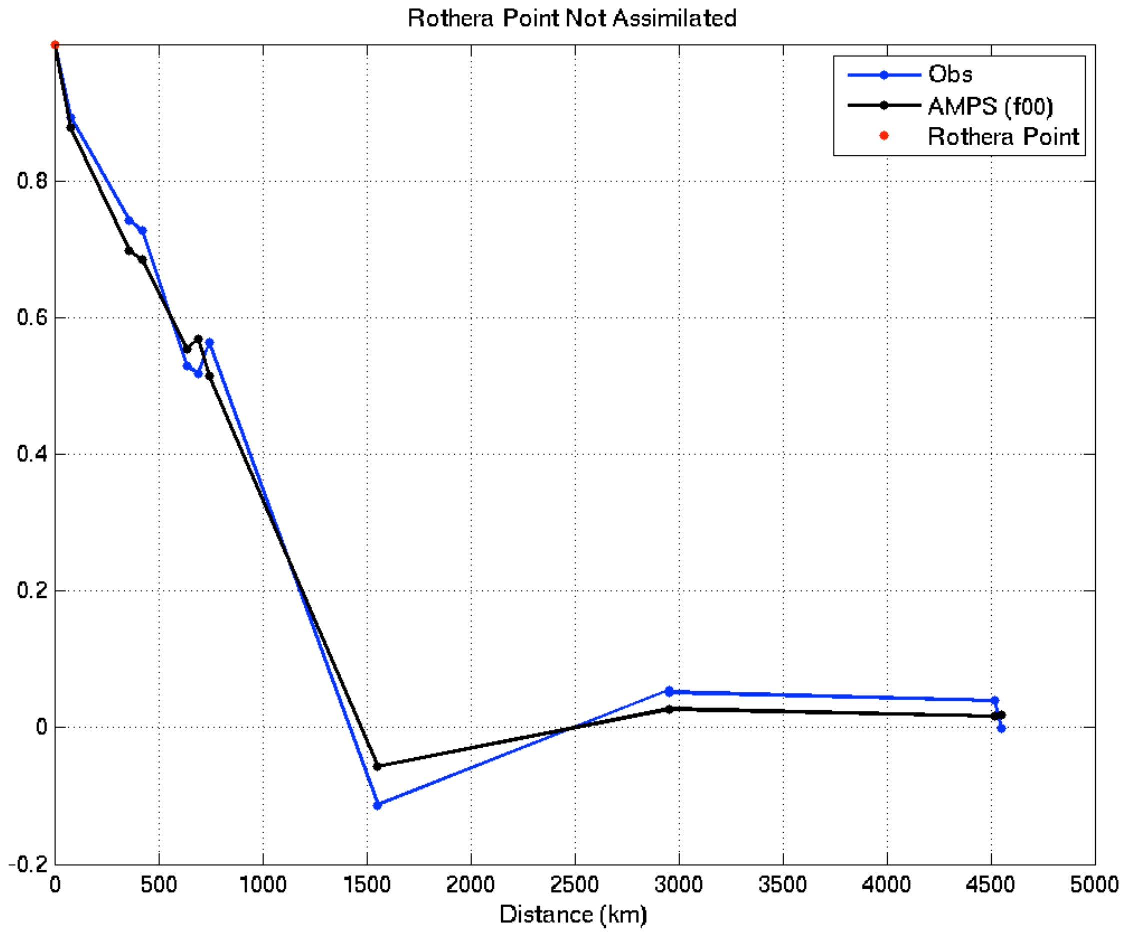
Temperature Spatial Correlation: obs vs. AMPS

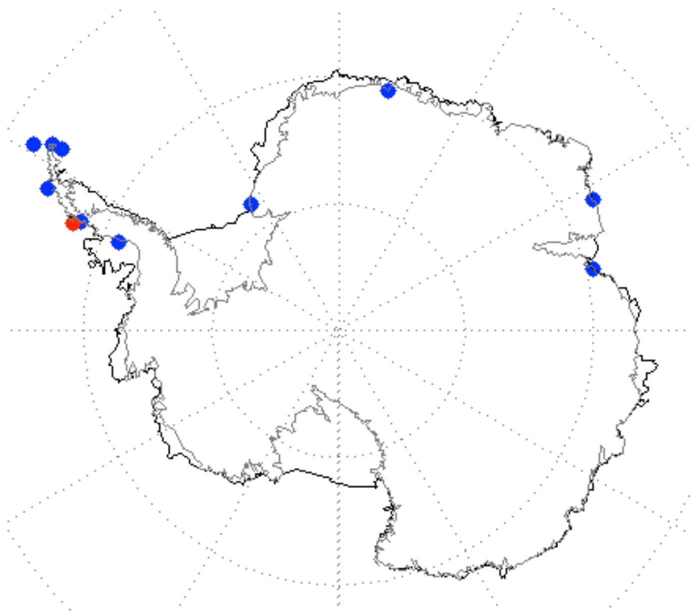




Temperature Correlations

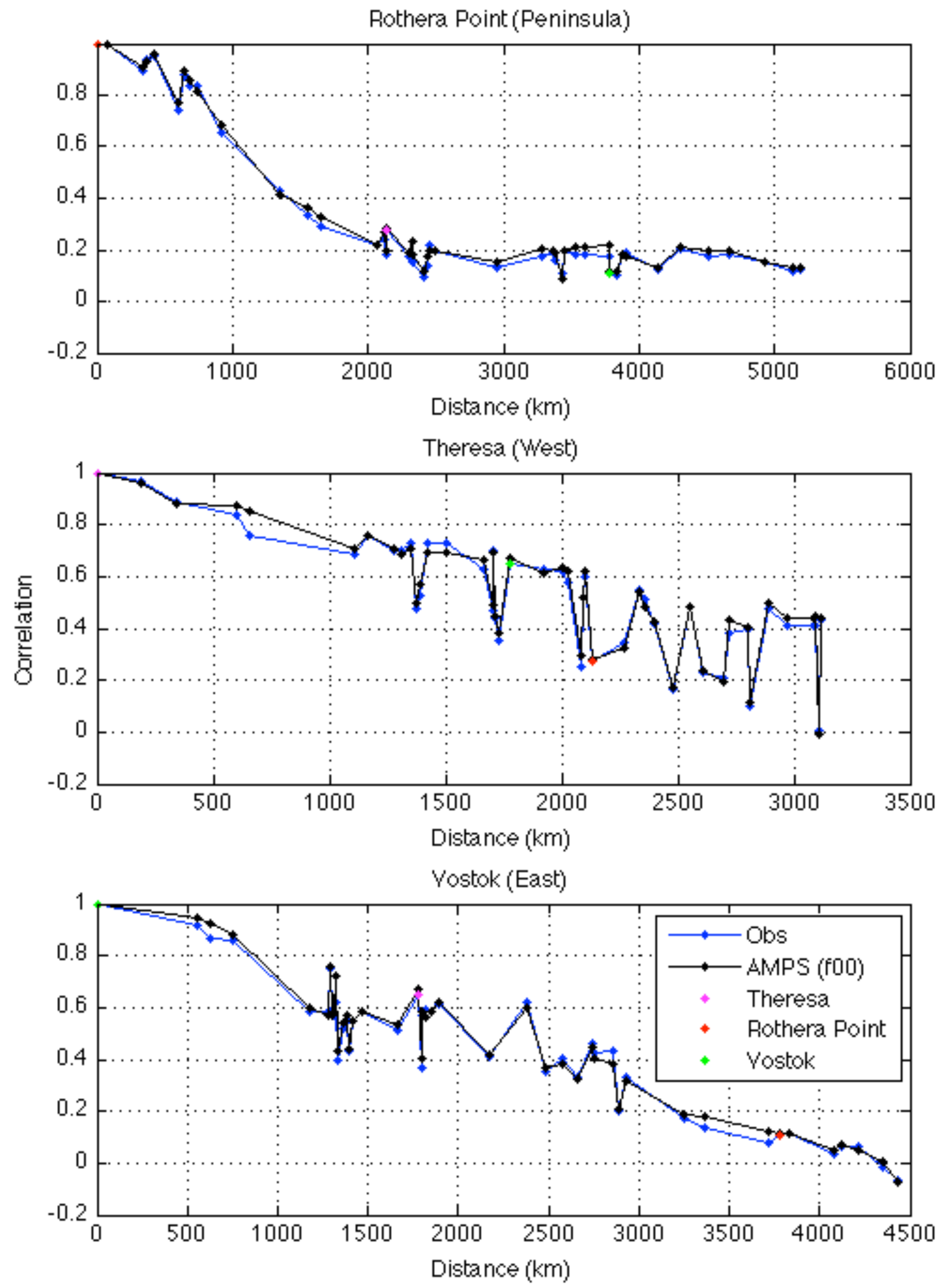
- Test using temperature observations that are not assimilated into AMPS (< 1% of the time)



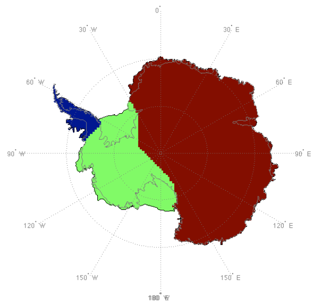


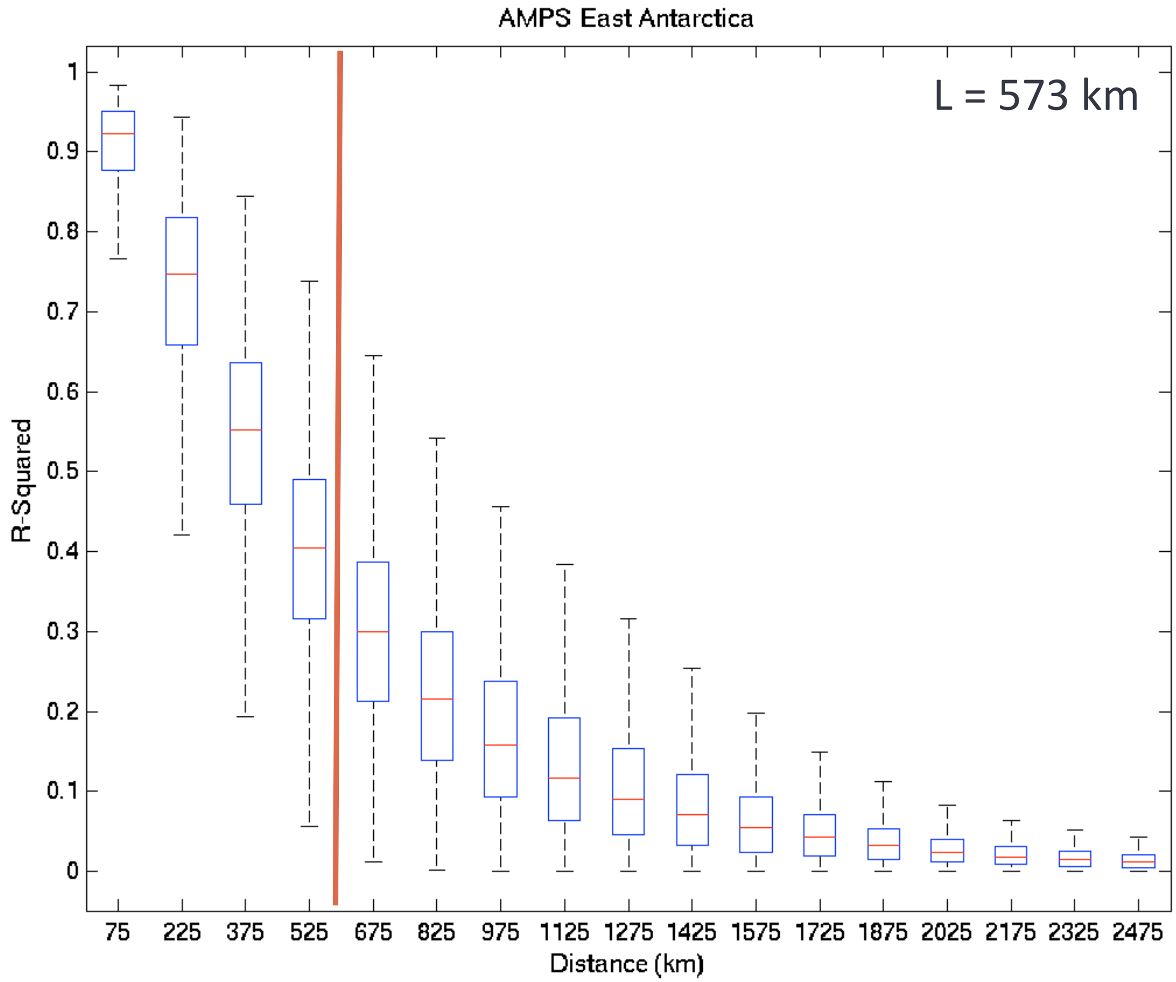
Pressure Spatial Correlation: obs vs. AMPS

- Even better agreement between observations and AMPS
- Much higher correlations than temperature
- Correlations decrease more quickly for the Peninsula site



AMPS Temperature Correlation

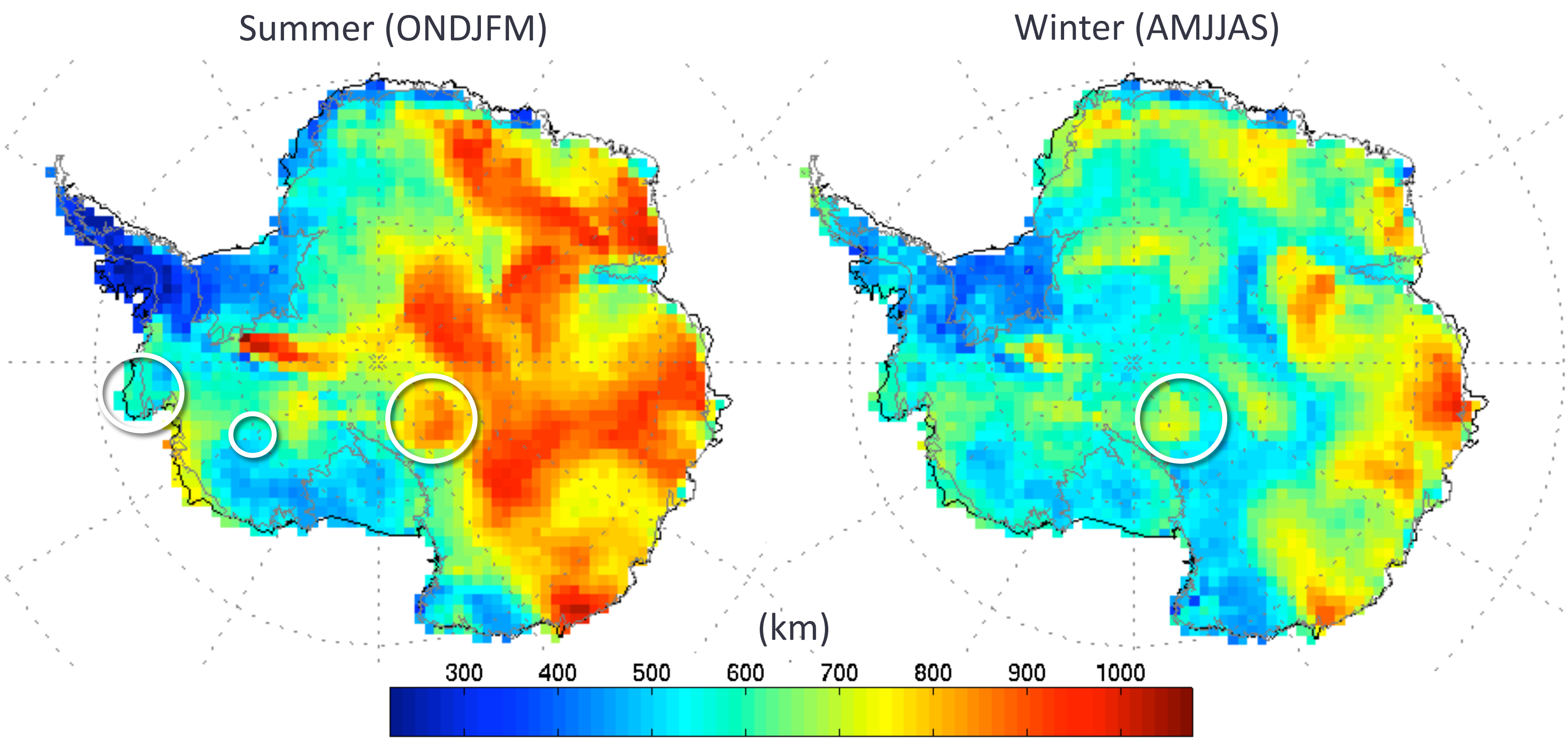




calculated e-folding length assuming R^2 is an exponential distribution

- East Antarctica has the longest correlation length scale, suggesting that the area needs fewer stations per unit area

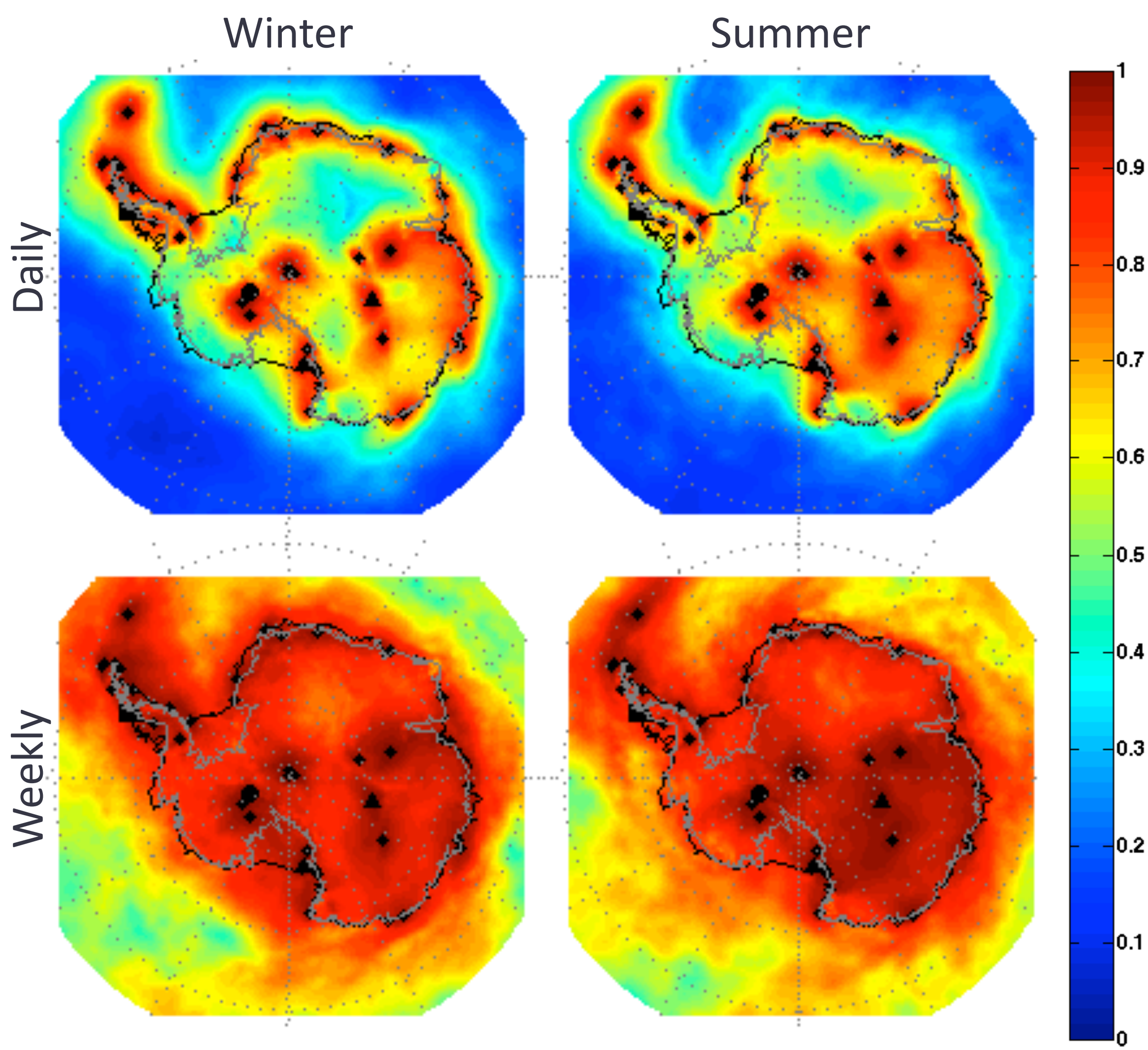
Correlation Length Scale



- Longer CLS in summer and in east Antarctica
- Higher station density needed in west Antarctica and Peninsula where CLS are shorter

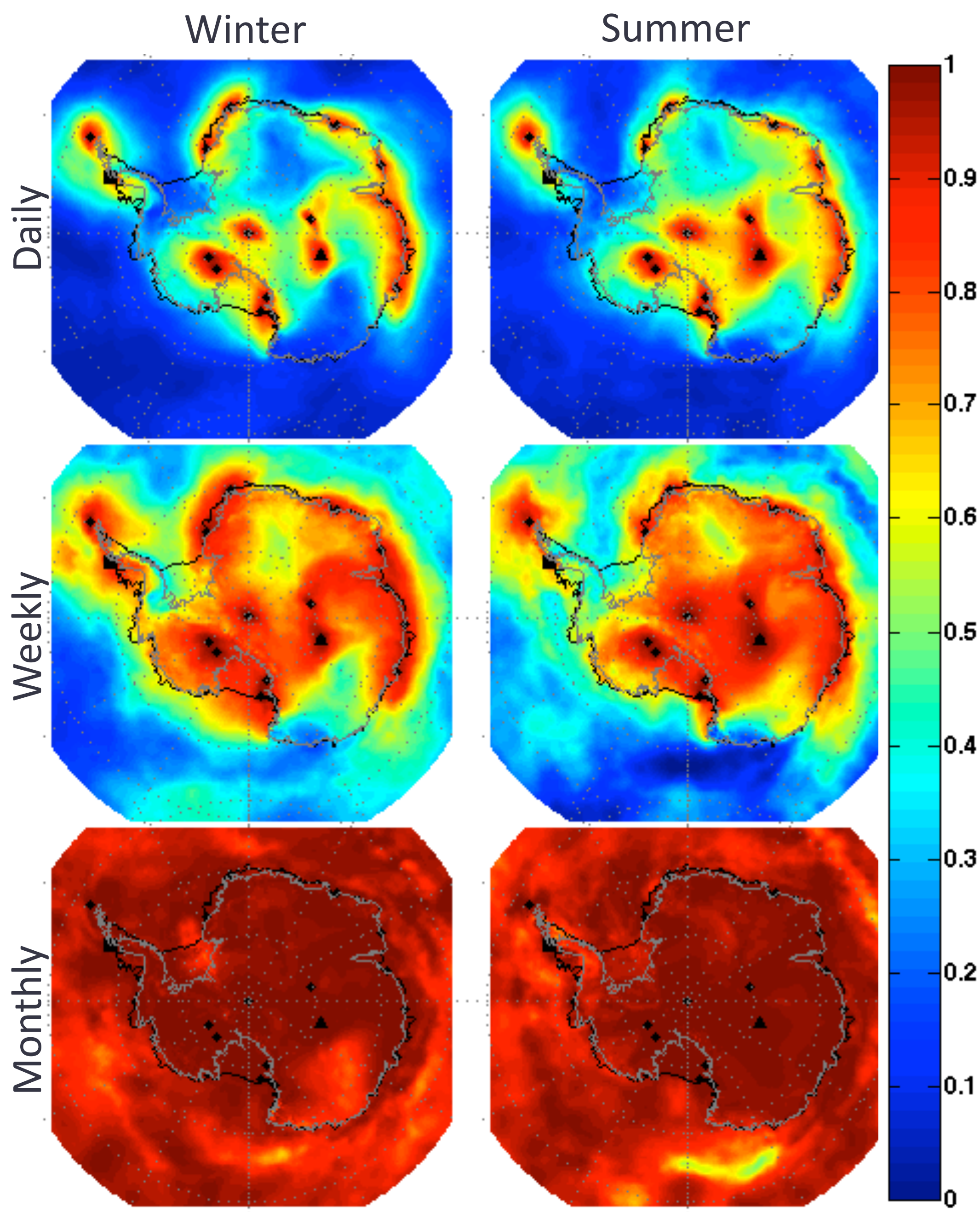
Variance Explained by Current Network

- For CD75
- Closest AMPS grid pt to station location
- Variance in temperature explained at each AMPS grid point by a multiple linear regression on 46 stations



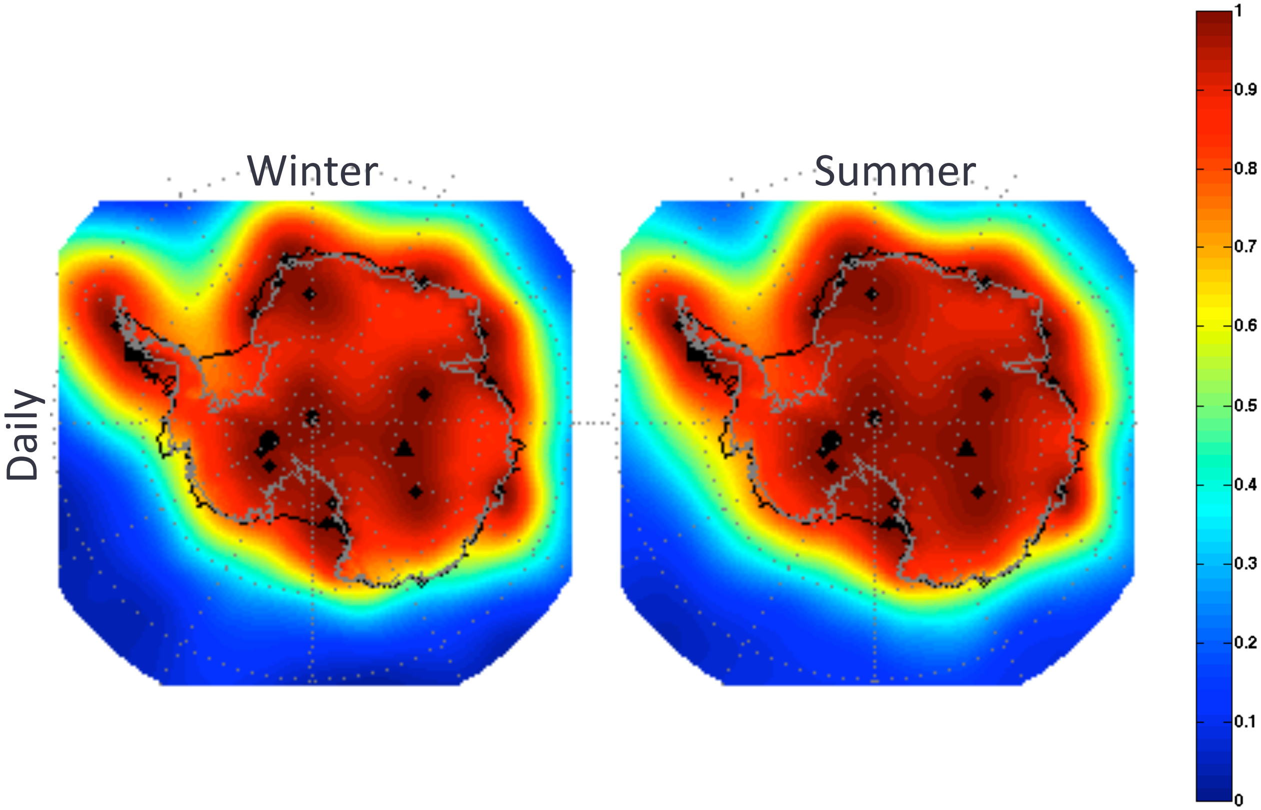
Variance Explained by Current Network

- For CD90
- Larger coastal influence in winter; not isentropic
  - Katabatic winds
- Larger interior influence in summer
  - Weaker inversion
- Coverage improves substantially as we move to monthly time scales
- Still, there are gaps in the current network



Pressure Variance Explained

- CD90
- Each pressure station has a larger influence; as expected



Conclusions

- Pressure has much higher correlations throughout the continent compared to temperature
- AMPS represents the temperature and pressure correlations well over the continent; ok to use for network design
- East Antarctica has the longest temperature correlation length scales; implications for station density
- Regions with short length scales require higher station density
- There are differences in correlation length scale seasonally
  - Longer in winter on coast; longer in summer in interior
- Gaps in the current network coverage, particularly on daily time scales, motivate network design

Thank You!

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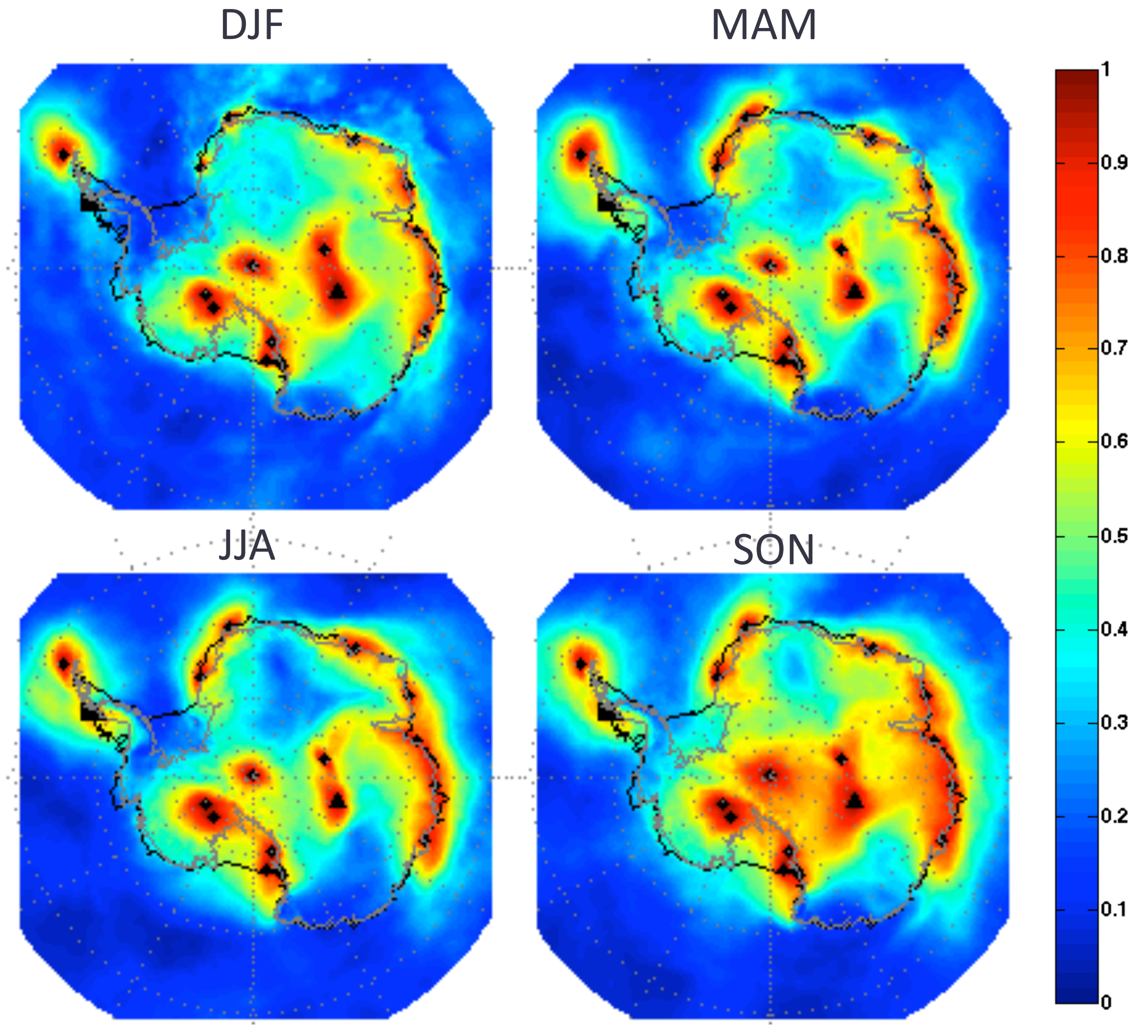
3-month Seasonal T Variance Explained

- CD90; daily



3-month Seasonal T Variance Explained

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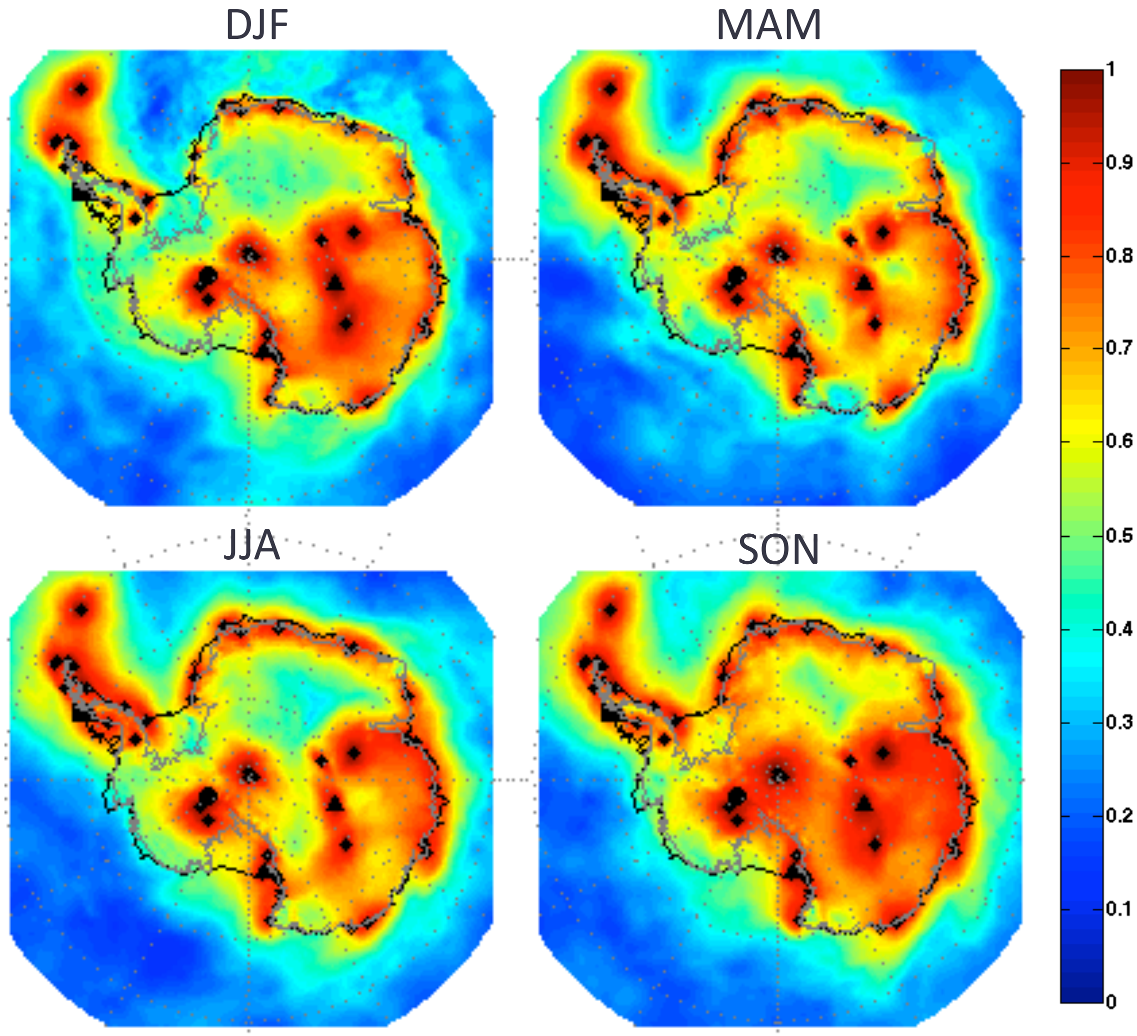

More info on assimilation statistics

- For temperature; and had to be in CD75 set

Station Name	ID	# days valid T	# days assimilated	Fraction assimilated
Base Jubany/Argentina Stn	89053	817	18	0.02
Progress/Russian Federation Stn	89574	863	0	0
Rothera Point/UK Stn	89062	864	0	0
Mawson/Australia Stn	89564	864	0	0
Base Marambio	89055	813	0	0
Fossil Bluff/UK Stn	89065	776	0	0
Novolazarevskaja/Russian Federation Stn	89512	867	0	0
Maitri/India Stn	89514	825	0	0
Base Esperanza/Argentina Stn	88963	816	16	0.02
Base San Martin/Argentina Stn	89066	808	0	0
Base Belgrano II/Argentina Stn	89034	818	0	0
Palmer Station/US Stn	89061	867	0	0