Evaluation of the Present Antarctic Weather Station Network in Monitoring the Intra-seasonal to Decadal Climate Variability

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Outline

• Why we want to evaluate the Present Observation Network.

• Data & Methods

• Evaluate and Optimize the Network
I. Motivation

Uncertainty in the Satellite Observation and Reanalyses

( Bracegirdle & Marshall, 2012 )
1. Motivation

Uncertainty in the Satellite Observation and Reanalyses
I. Motivation

Lack of In-situ Observations

>300  ~100 still work  ~30 with >90% OBS
1. Motivation

Evaluate the weather station network

- Evaluate the weather station network,
  - Monthly / Yearly time scales (Interannual Variability)
  - Decadal and Longer time scales (Climate Change and long-term Variability)

- Look for the Optimized Network
II. Data & Method
I. Motivation

Ensemble Kalman Filter / Bayesian Method

\[ x^a(j) = x^b(j) + K(j) \left( y(j) - H x^a(j) \right) \]

Optimize the Expectation

\[ P^a = \left[ I - \frac{P^b H^T H}{HP^b H^T + R} \right] P^b \]

Estimate the Uncertainty of the Expectation
1. Motivation

Ensemble Kalman Filter / Bayesian Method

Li et al. 2012
Li et al. 2016
Hakim et al. 2020
II. Data & Method

Represent the Uncertainty using reanalysis datasets.

Evaluate the Covariance Matrix Using Reanalysis Datasets:

- MERRA2
- ERA5
- ERA-Interim
- JRA55
- NCEP2
II. Data & Method

Represent the **Uncertainty** using reanalysis datasets.

Evaluate the **Covariance Matrix** using reanalysis datasets:

- MERRA2
- ERA5
- ERA-Interim
- JRA55
- NCEP2

**Spread Among Different Reanalysis Datasets**
II. Data & Method

Seasonality of the Uncertainty (SLP)

SON

MAM

DJF

JJA
II. Data & Method

Seasonality of the Uncertainty (SAT)

SON

MAM

DJF

JJJA
II. Data & Method

In-Situ Observations

- Reader
- AWS
- WMO Stations
- Australian Met-Office
How does this method work?
II. Data & Method

Spatial Correlation of Panda S, SLP
II. Data & Method

**In-situ observation help to constrain the Uncertainty around the Station**

Uncertainty of the Original Ensemble
In-situ observation help to **Constrain** the Uncertainty around the Station

- Uncertainty of the Original Ensemble
- Uncertainty after adding Panda S Station
II. Data & Method

In-situ observation help to **Constrain** the Uncertainty around the Station

Uncertainty of the Original Ensemble

Uncertainty after adding Panda S Station

Contribution of the Panda S Station
II. Data & Method

**Incremental of an in-situ observation**

Incremental of the Panda S Station

Contribution of the Panda S Station
II. Data & Method

Contribution from different stations

Panda S  Margaret  DOME C

0 (hPa)
III. Evaluation of the Observation Network
III. Evaluation of the Network

Strategy

>300

~100 still work

~30 with >90% OBS
III. Evaluation of the Network

Contribution of the 30 Stations
III. Evaluation of the Network

Contribution of the 30 Stations

0 Stations

30 Stations
III. Evaluation of the Network

Evaluating the present network (118)
III. Evaluation of the Network

Contribution of the 118 Stations

SLP
III. Evaluation of the Network

Contribution of the 337 Stations

337 Stations

118 Stations

SLP

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III. Evaluation of the Network

Optimized network (118)
III. Evaluation of the Network

Contribution of the Selected 80 Stations

337 Stations
~80 Selected Stations
118 Stations

SLP
III. Evaluation of the Network

Contribution of the Selected 80 Stations

337 Stations

~80 Selected Stations

118 Stations

SLP
III. Evaluation of the Network

Contribution of the 30 Stations

337 Stations  ~80 Selected Stations  118 Stations

SAT
On decadal timescales
III. Evaluation of the Network

Contribution of the 30 Stations

~50 Stations

SLP

SAT

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Thank you so much! 😊