Increased impact of Arctic observations during Scandinavian Blocking episodes

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Linkages to mid-latitudes: what if our forecasts were perfect in the Arctic?

Day 4-7

Day 8-14

Jung et al. (2014) and Semmler et al. (2018)
Challenge 1: simulating Arctic processes

Pithan et al. (2018)
Challenge 2: observing

- SYNOP
- SHIP
- TEMP
- AIRCRAFT

Jung et al. (2016)
Challenge 3: Initialisation

[Diagram showing the concept of initialisation in weather forecasting, with terms such as "Initial conditions", "Obs", "Corrected forecast", "Previous forecast", and "Assimilation window".]
Observing System Experiments (OSEs)

- OSEs have been used to determine the importance of extra observations for improving the skill of case studies in mid-latitudes.
- Not been done in operational systems with a “full” observing system.
- Hard to know if extra observations will really improve skill in mid-latitudes.

Sato et al. (2016)
Observing System Experiments (OSEs)

OSE’s removing polar observations for:

- Microwave (MW)
- Infrared (IR)
- Conventional (Conv)
- GPSRO (bending angles)
- Polar AMVs
- Extra observations during SOPs

Experimental set-up:

2 x 4 months, 2 seasons, TCo399 (25 km)

June – September 2016

December – March 2017/2018 (includes SOP1)
Degraded forecast skill in the North Pole and Northern Mid-latitudes

**Summer:**
- Microwave
- Conventional
- Infrared
- GPSRO, AMVs

**Winter:**
- Conventional
- Less impact overall from each observation type
Spatial extent of errors

Day 1

Conventional OSE

Relaxation

Day 4

$\text{Normalised error difference} - \text{N. Asia}$

$RMSE_{OSE} - RMSE_{CTRL}$

$\frac{RMSE_{OSE} - RMSE_{CTRL}}{RMSE_{CTRL}}$
Episodic impacts over North-West Asia

h500-asW_IC_anomaly_highrmsdiff
Case Study: initial conditions

2m temperature & MSLP

Total Column Water & Z500
Case Study: error growth

Increase in absolute error (OSE-CTRL): Day 2

Increase in absolute error (OSE-CTRL): Day 4
Is the impact of the observations also regime dependent?
Do periods of blocking lead to faster error growth?
Conclusions

• Forecast errors associated with denial of Arctic observations during winter significantly impact skill over Northern Asia.

• The impact of Arctic data denial and relaxation on N. Asia is largest during periods of Scandinavian Blocking, when high amplitude waves allow errors to propagate out of the Arctic.

• Arctic observations also play a more important role in constraining the initial state during periods characterised by Scandinavian Blocking, where warm-moist intrusions lead to higher baroclinicity and error growth within the Arctic.

• Could increasing Arctic observation density during blocking episodes improve skill? → Possible idea for SOP3.
Key questions:

• How are field campaigns making use of ECMWF data? Are there any obstacles to the use of this data?

• How can observational campaigns help to identify and diagnose problems in models, observation operators, etc.?

• How can knowledge and diagnosis of NWP problems help define future field campaigns?

• How can observational campaigns learn from each other in terms of their usage and diagnosis of ECMWF forecasts?

Deadline for registration and Abstracts: 1 March
https://www.ecmwf.int/en/learning/workshops/workshop-observational-campaigns-better-weather-forecasts
Challenges in the use of observations

Less conventional data above 70N than Northern mid-latitudes

Also larger model errors & too much confidence in the model in the lower-troposphere

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Challenges in the use of observations

- better coverage from polar orbiting satellites than anywhere else
- more challenges with their use (model errors, radiative transfer modelling)
- more data rejected for tropospheric channels in winter

NOAA-15
AMSU-A channel 5
(peaks 500-700hPa)

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Impact of denial and relaxation

Day 2

a) CTRL-an 20180113, 12+48
b) abs(gy51-an)-abs(CTRL-an) 20180113, 12+48
c) abs(RELAX-an)-abs(CTRL-an) 20180113, 12+48

Day 4

d) CTRL-an 20180113, 12+96
e) abs(OSE-an)-abs(CTRL-an) 20180113, 12+96
f) abs(RELAX-an)-abs(CTRL-an) 20180113, 12+96