ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms (AC)³

Synoptic situation overview during the field campaigns ACLOUD and PASCAL near Svalbard spring 2017

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Outline

- Introduction and Data
- Time Series Variability
- Key Period Characteristics
- Conclusions

Introduction and Data

Background

Manuscript idea:

- An overview of the weather experienced during ACLOUD and PASCAL
- Atmospheric properties in regional and climatological aspects
- Reference manuscript to the background air flow and properties impacting all observations
- Addition to the ACLOUD and PASCAL set-up overview manuscript by Wendisch et al.[1]

Author roles:

- Main contributions by Erlend & Bernd (Longyearbyen meteorologists) and Sandro (Ny-Ålesund observer)
- Additional contributions from Marion (Ny-Ålesund data), Holger (Polarstern data), Georg (sea ice data), Susanne & Mario (cloud data) and Annette (introduction text)
- Suggestions from André, Andreas, Christof and Manfred in addition to the above-mentioned

Data

Spatial and temporal frames:

- The Nordic Seas, with a special focus on the Fram Strait
- May 23 – June 26, 2017

Surface-based measurements:

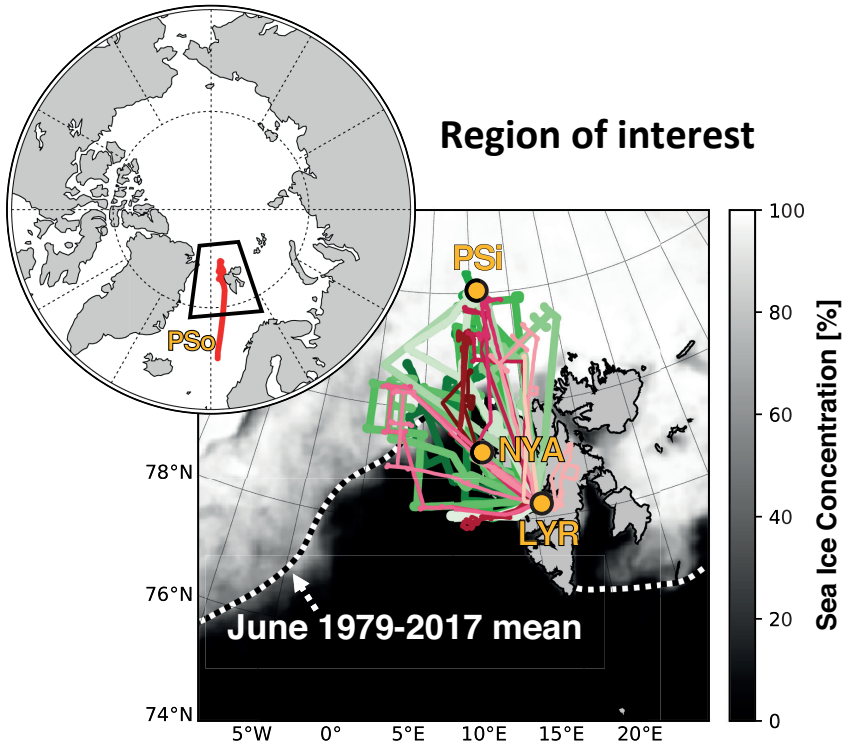
- Ny-Ålesund (AWIPEV; 79°N, 12°E)[2,3,4]
- Polarstern (AWI;
  ocean-crossing > 67°N and
  ice-locked 82°N, 10°E)[5,6]

Reanalysis:

- ERA-Interim (ECMWF)[7]

Satellite:

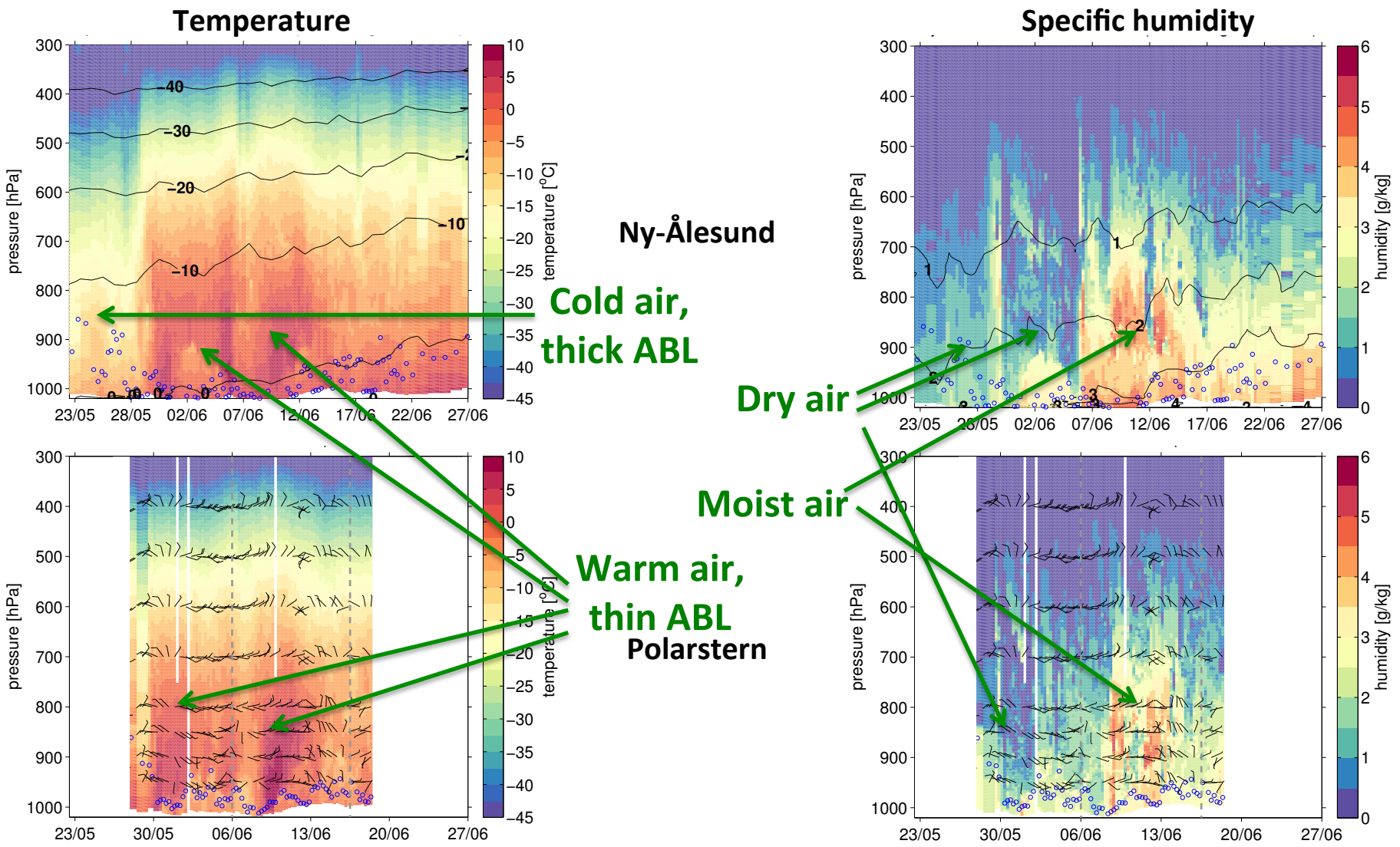
- IASI (EUMETSAT)[8]



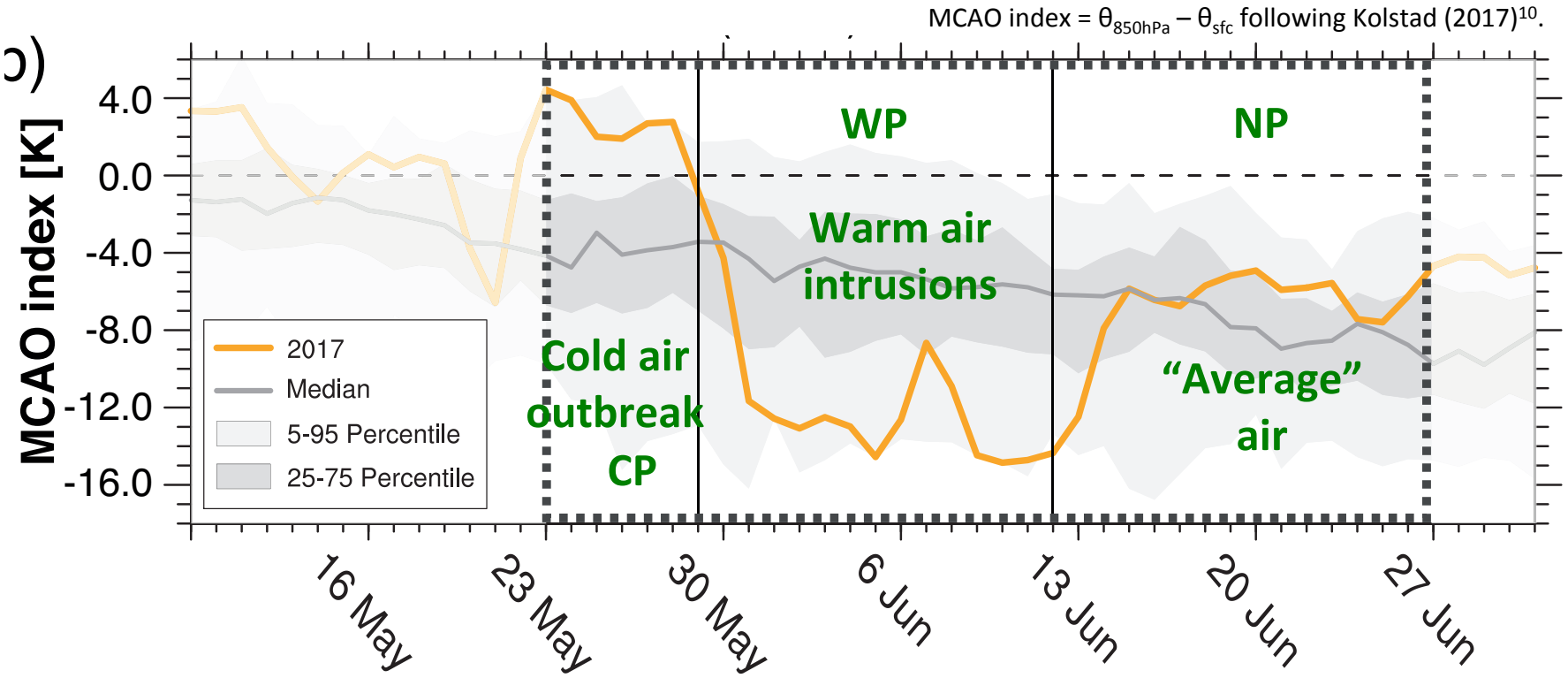
Trajectories: ACLOUD aircrafts Polar 5 and Polar 6.
Shading: the University of Bremen[9] sea ice concentration.
LYR: Airport base Longyearbyen. NYA: Research base Ny-Ålesund.
PSi & PSo: PASCAL icebreaker Polarstern ice-locked and ocean-cruising.

Time Series Variability

Time Series from Radiosondes



Time Series of Marine Cold Air Outbreaks (MCAOs)



Three key periods:

1. The cold period (CP): May 23–29, 2017 (7 days)
2. The warm period (WP): May 30 – June 12, 2017 (14 days)
3. The neutral period (NP): June 13–26, 2017 (14 days)

Key Period Characteristics

Key Period Air Mass Trajectories

Cold period (CP):

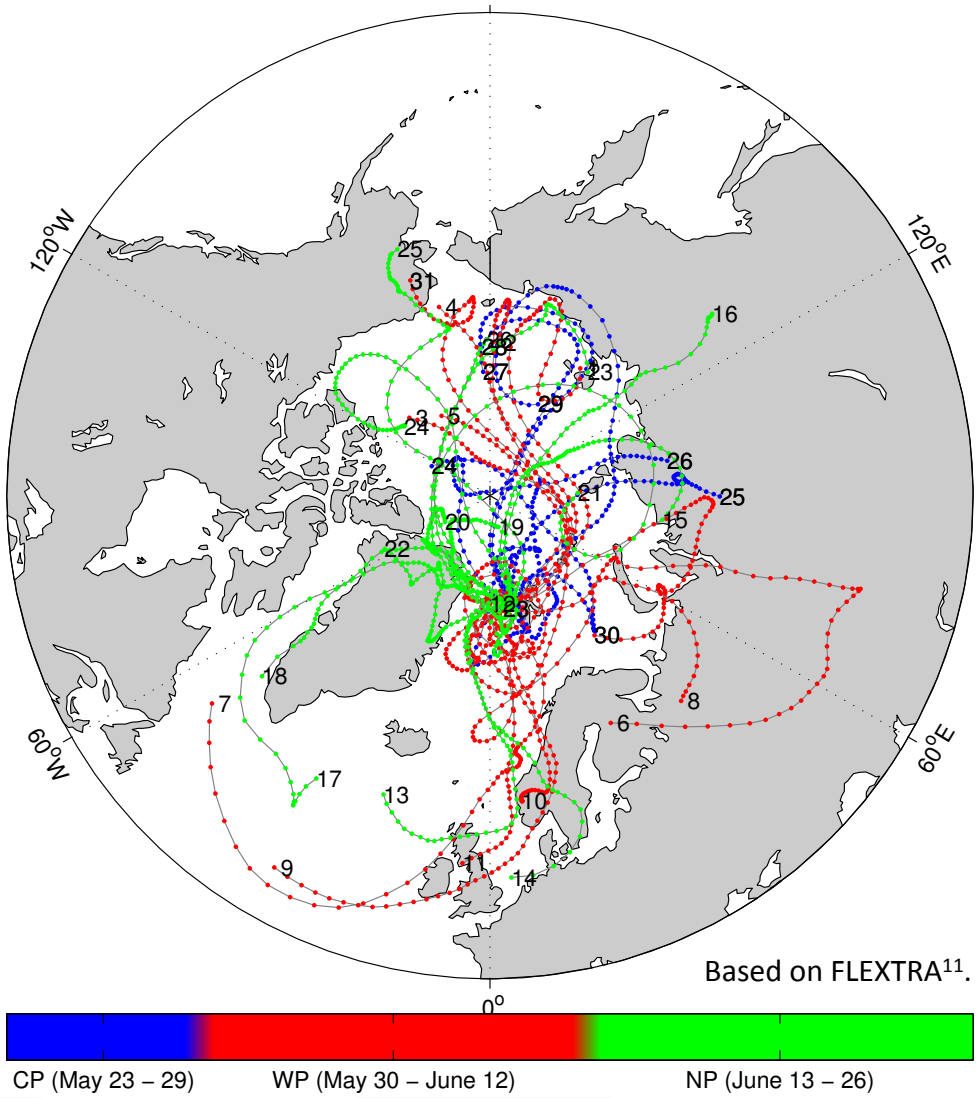
- Air from the north (Arctic)

Warm period (WP):

- Air from the east (over Spitsbergen) or south/southwest (over the Nordic Seas)

Neutral period (NP):

- Air from the north (Arctic) or west (Greenland ice sheet)



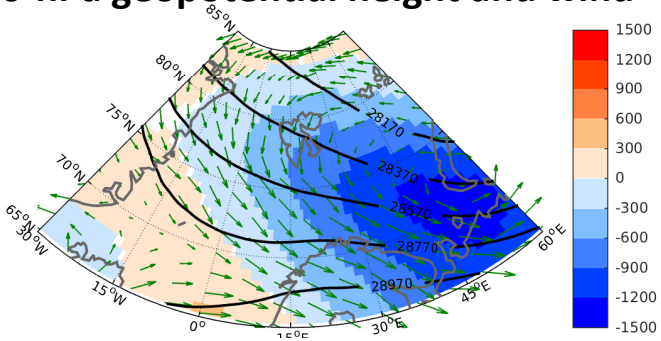
Based on FLEXTRA[11].

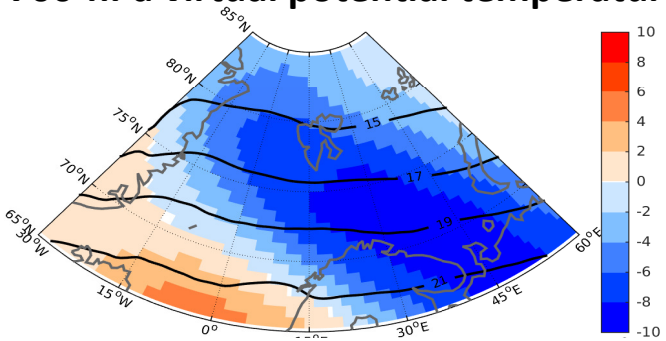
Key Period Circulation and Virtual Temperature

700-hPa geopotential height and wind

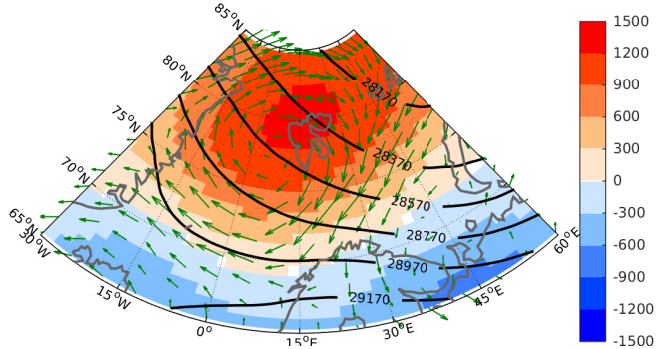
700-hPa virtual potential temperature

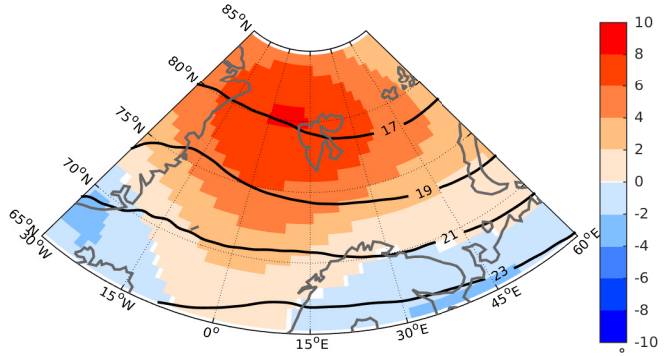
Cold period



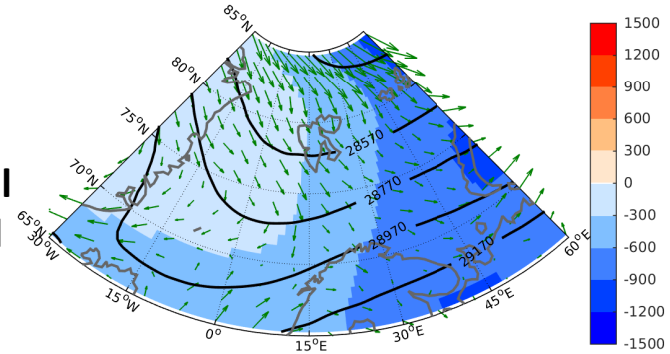


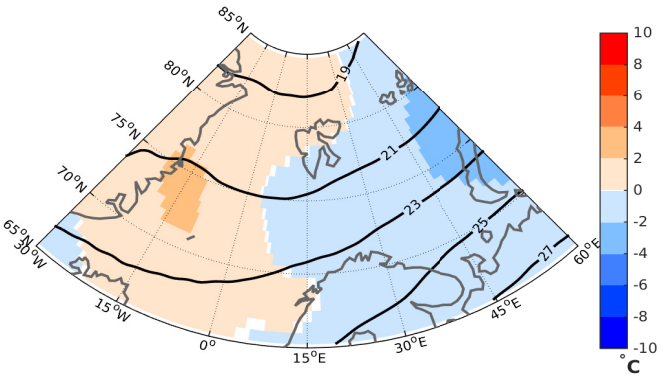
Warm period





Neutral period





Cyclonic circulation

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Cold and dry Arctic air

Anticyclonic circulation

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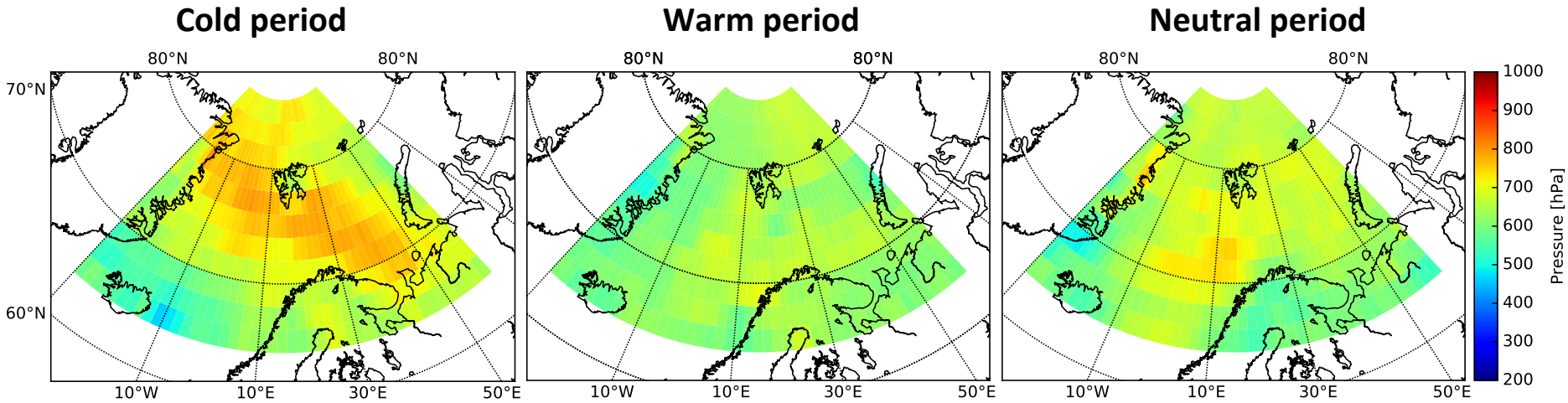
Warm and moist maritime air

Zonal divide

↓

Mixed, average air

Key Period Cloud Top Pressures (CTPs)



Low-level clouds, with mean CTP of ≈800 hPa

High-level clouds, with mean CTP of ≈600 hPa

Mid-level clouds, with mean CTP of ≈700 hPa

↑

Mixture of low-, mid- and high-level clouds, but mid-level clouds dominating

Conclusions

Conclusions

Thank you for your attention!

- Short-term variability in atmospheric circulation dominated over the long-term forcing of the Arctic amplification.

- Three key periods:
  1. The cold period (CP; May 23–29, 2017; 7 days), characterized by cold and dry Arctic air from the north associated with low-level clouds.
  2. The warm period (WP; May 30 – June 12, 2017; 14 days), characterized by warm and moist maritime air from the south and east associated with high-level clouds.
  3. The neutral period (NP; June 13–26, 2017; 14 days), characterized by close-to-average temperate and moist air from a mixture of regions (but dominated by adiabatically-warmed air from the west) associated with mid-level clouds.

References

References

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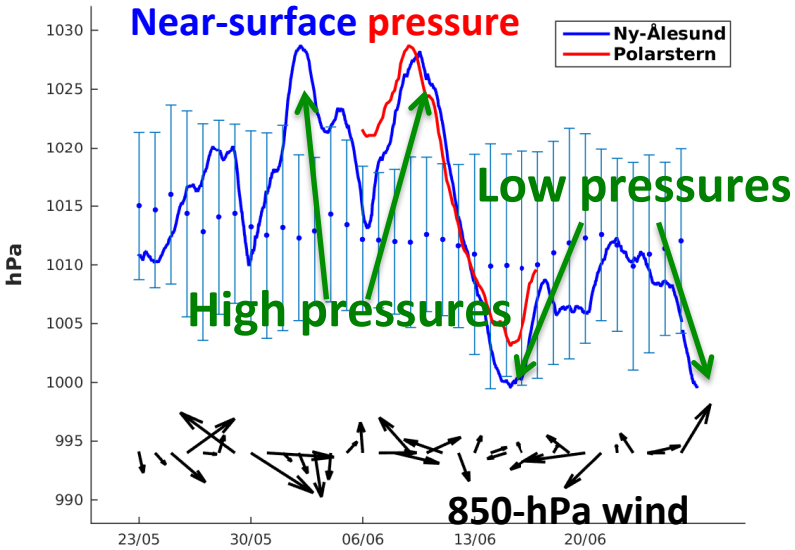
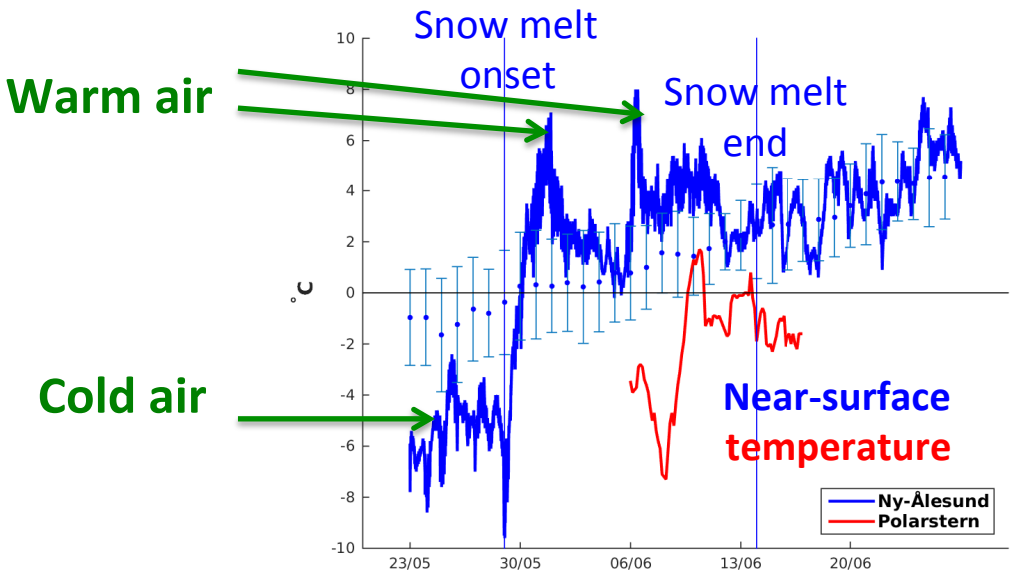
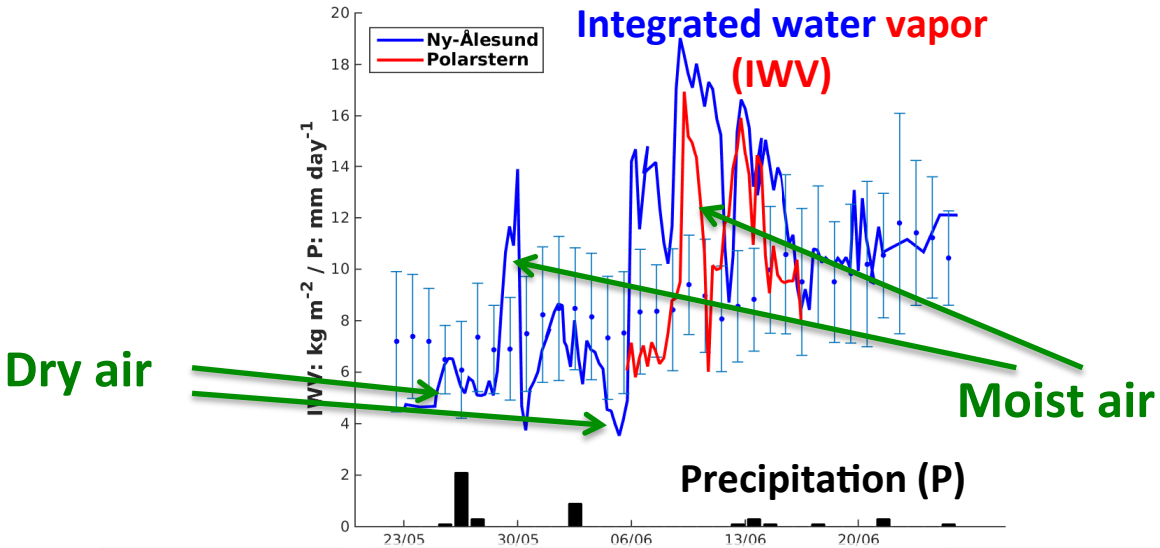
More of the Good Stuff

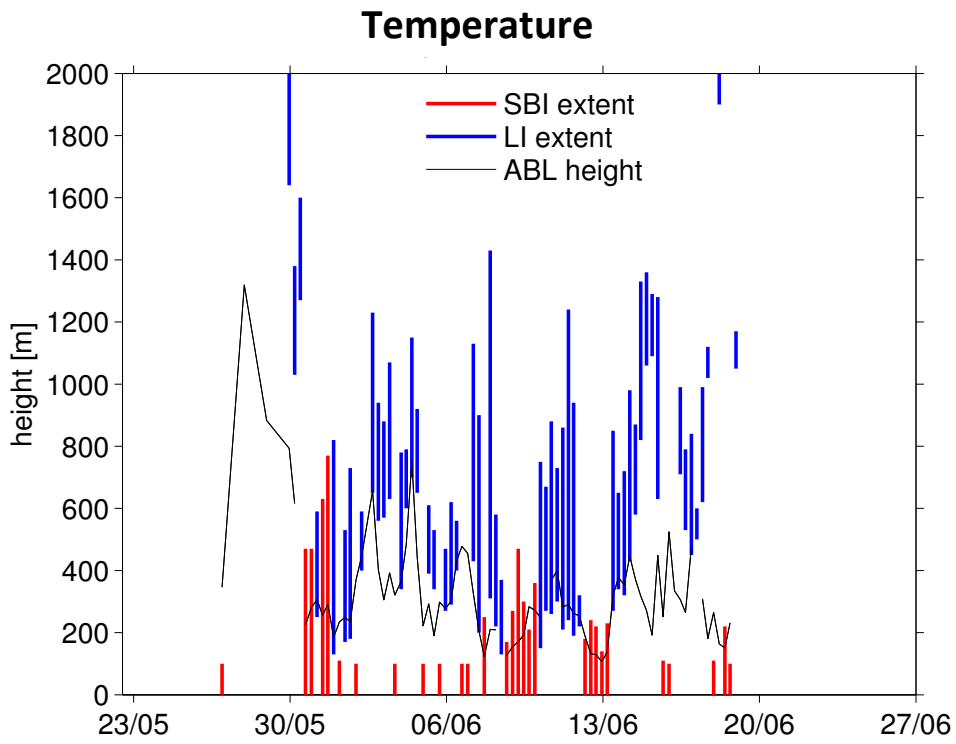
Time Series from SYNOP

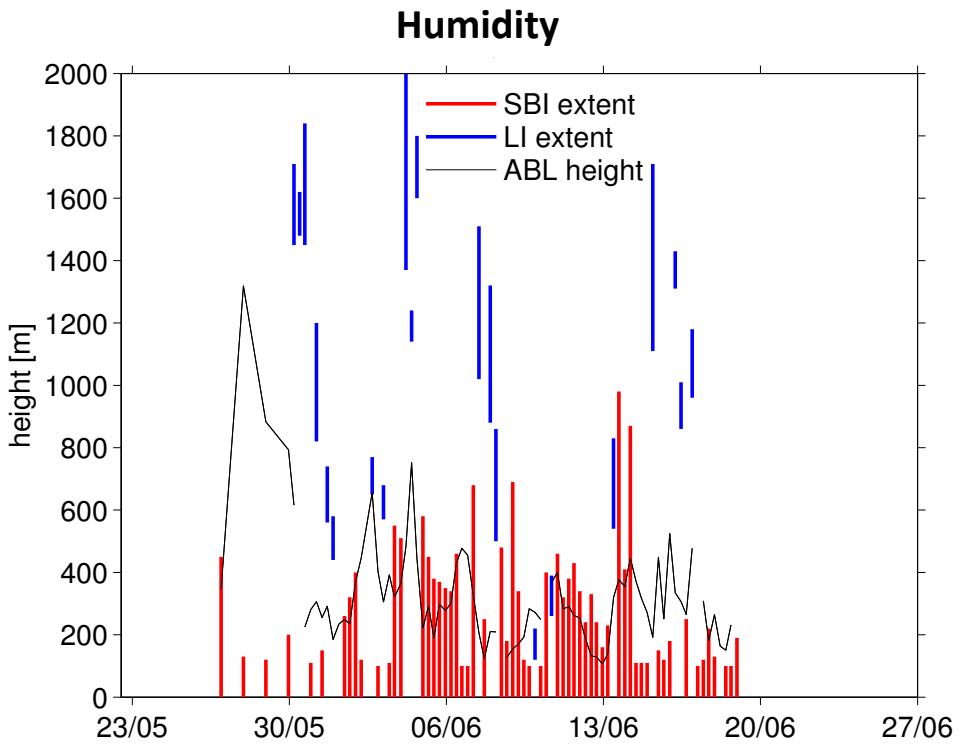






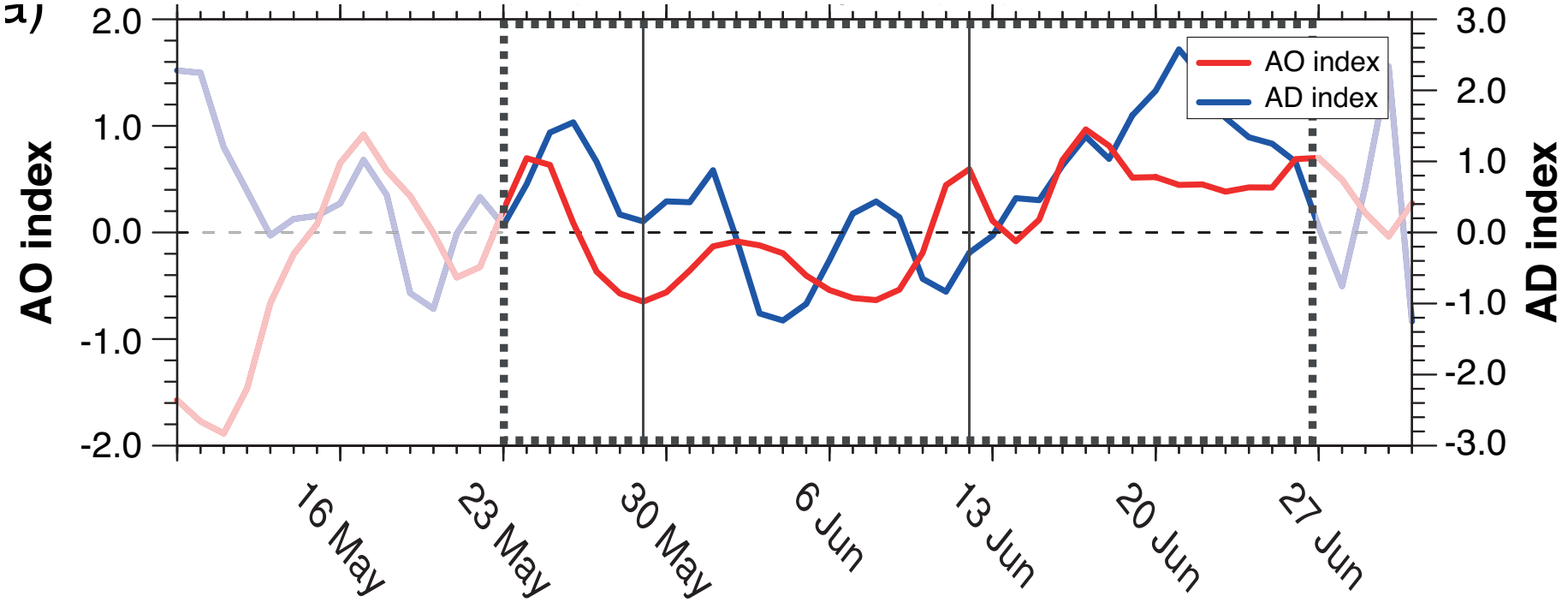
Time Series of Inversions



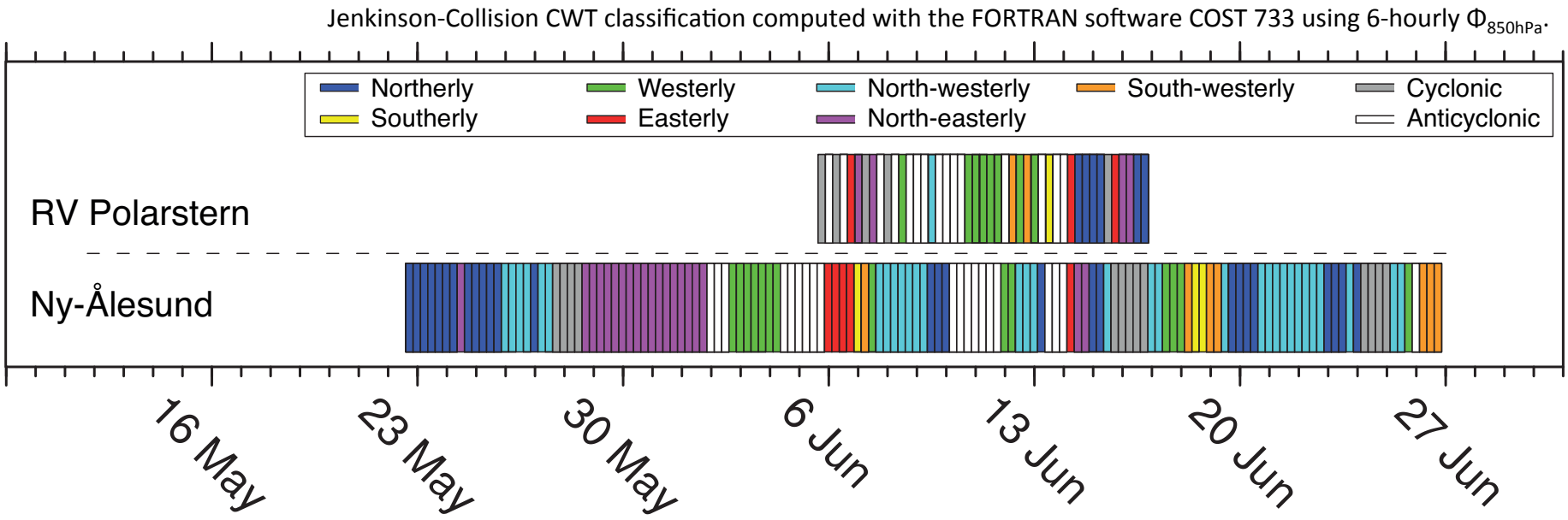


Time Series of Arctic Oscillation and Dipole Indices

Arctic Oscillation (AO) = 1st leading EOF mode of the daily 1000-hPa geopotential height anomalies > 20°N.
Arctic Dipole (AD) = 2nd leading EOF mode of the daily 1000-hPa geopotential height anomalies > 70°N.



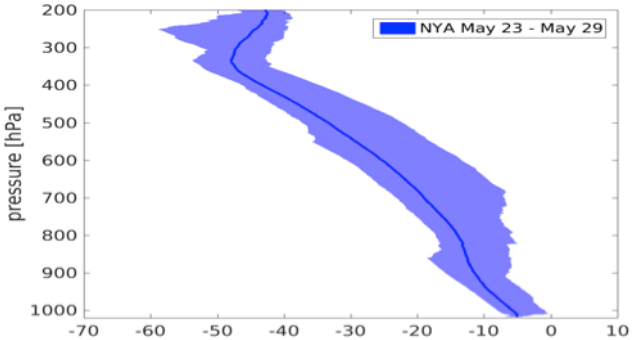
Time Series of Circulation Weather Types (CWTs)

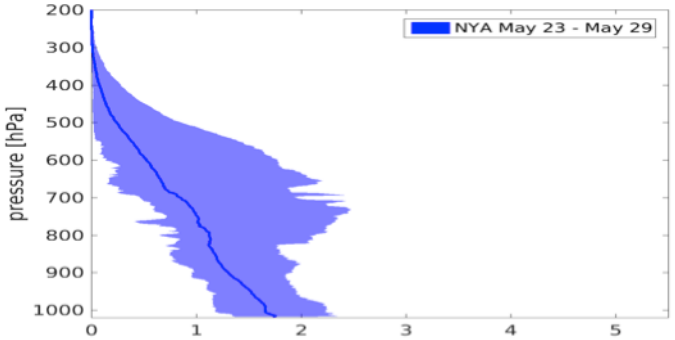


Key Period Temperature and Humidity Profiles

Temperature | **Specific humidity**

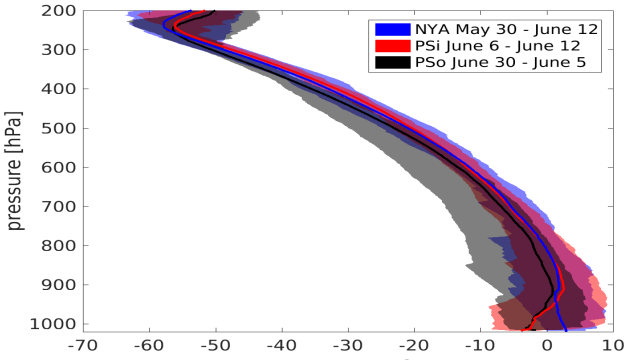
Cold period

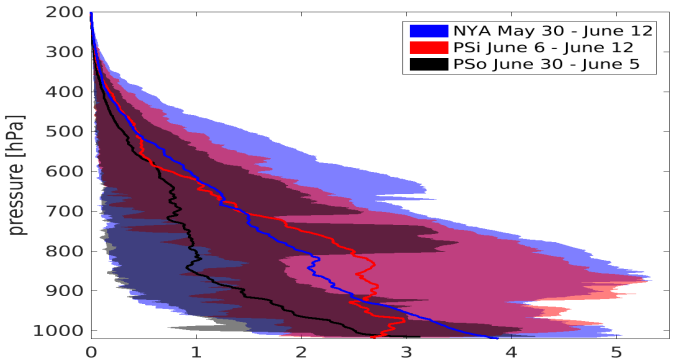




Cold and dry air, low variability

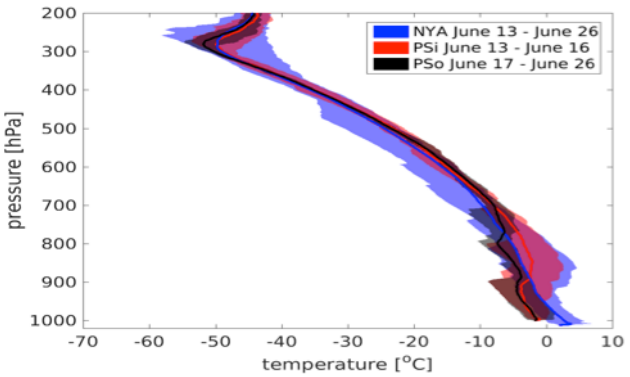
Warm period

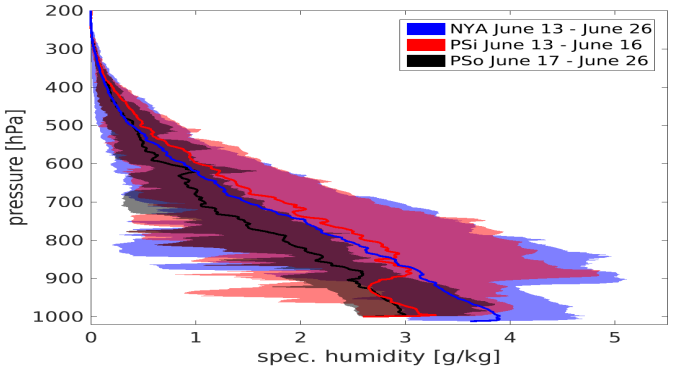




Substantial warming and moistening below 500 hPa, large variability

Neutral period





Similar to the warm period, but lower variability