Air Temperature and Precipitation Trends in Svalbard
Affected by Sea Ice Decline and Changes in Atmospheric Circulation
Svalbard and the European Arctic

- Svalbard and the Barents Sea are have experienced the fastest winter warming globally.
- An approximately 6 °C winter (DJF) warming is observed in Longyearbyen since 1980.
Svalbard and the European Artic

Sea ice

• The warming co-occurs with a winter sea ice decrease.
Regional trends in temperature and precipitation

Extended winter (NDJFM) trends 1979-2020

dashes indicate significant trend (95 percentile)
Svalbard and the European Artic

Atmospheric and oceanic poleward heat transport

Figure 3 in Carmack et al 2015
Svalbard and the European Artic

Increasing cyclone densities over Svalbard

• The position of The North Atlantic storm track controls weather and climate in Svalbard

• An increasing trend in cyclone density over Svalbard and decreasing trend in Southern Barents Sea in the period 1979-2016 (Wickström et al 2020)
Svalbard and the European Artic

More meridional wind directions

• The position of The North Atlantic storm track controls weather and climate in Svalbard

• An increasing trend in cyclone density over Svalbard and decreasing trend in Southern Barents Sea in the period 1979-2016 (Wickström et al 2020)

• Increasing trend in zonal wind directions (Niedźwiedź, 2013)
Regional trends in temperature and precipitation

Extended winter (NDJFM)
Regional trends in temperature and precipitation

Which circulation types drive the precipitation changes?

Large-scale winds from the north

- Station N: Trend = 5.74 mm/decade
- Station E: Trend = 5.19 mm/decade
- Station S: Trend = 4.73 mm/decade
- Station C: Trend = 5.67 mm/decade
Regional trends in temperature and precipitation

Which circulation types drive these precipitation changes?

Large-scale winds from the northeast
Regional trends in temperature and precipitation

NE atmospheric circulation contributes most to the warming

Large-scale winds from the northeast
Changing air mass or atmospheric circulation?

Temperature and accumulated precipitation

- Temperature and precipitation seems to be driven by changes in airmass properties.
- Precipitation changes have more regional variability

Following Isaksen et. al 2016

\[ T_{ac} = \sum_{i=1}^{n} \Delta f_i \times T_i \]

\[ T_{am} = \sum_{i=1}^{n} \Delta T_i \times f_i \]
Changing air mass or atmospheric circulation?

• Temperature and precipitation seems to be driven by changes in airmass properties.
• Precipitation changes have more regional variability.
• Sea ice decrease modifies the upwind conditions and hence the air masses reaching Svalbard.

14 August 2016
Earth slide

https://geo365.no/geofarer/jordskred-pa-svalbard/