

# A central Arctic **extreme** aerosol event triggered by a **warm air-mass** intrusion



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VERT Forum, EMPA

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**nature communications**

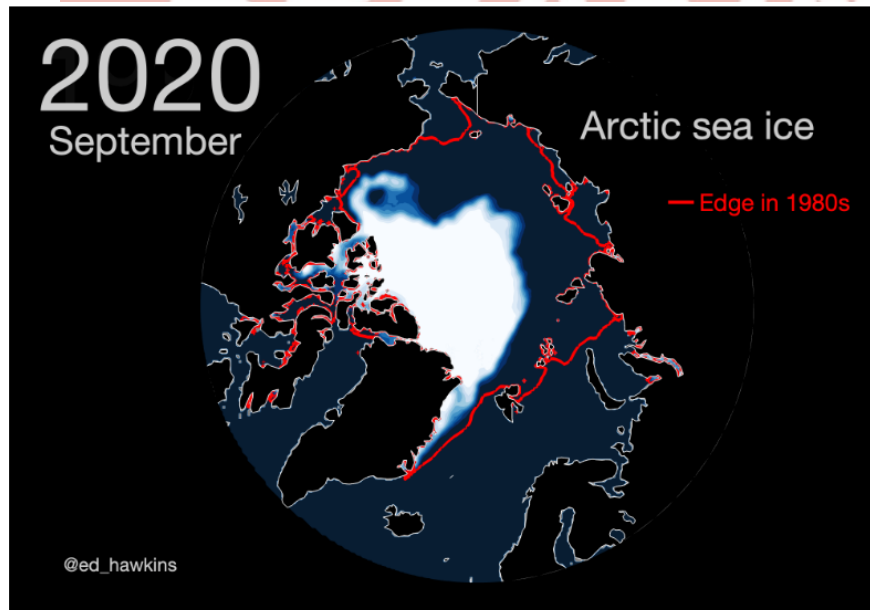
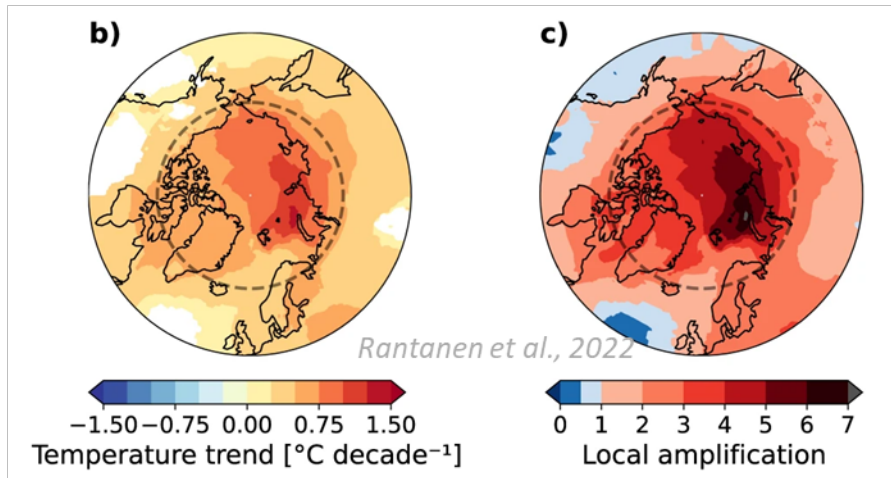
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**A central arctic extreme aerosol event triggered by a warm air-mass intrusion**

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# The Arctic has warmed nearly four times faster than the globe since 1979



An animation created by Professor Ed Hawkins of how summer Arctic sea ice extent has varied from 1979 to 2022, using data from the National Snow and Ice Data Center.

2020 WAS ARCTIC'S SECOND-WARMEST YEAR ON RECORD

## Arctic Sea Ice Shrinks to Second-Lowest Extent Amid Record High Temperatures



Research icebreaker *Polarstern* passing through broken ice en route to the North Pole in August 2020. (Source: Courtesy AWI/Steffen Graupner)

Published at: Sep 22 2020 - 10:47 / Updated at: Sep 22 2020 - 10:47

Following the warmest summer on record in the Arctic, just 3.74 million square kilometers of Arctic sea ice remain. This is the second-lowest ice extent since satellite observations began in 1979 and only the second time that sea ice shrank below 4 million square kilometers.

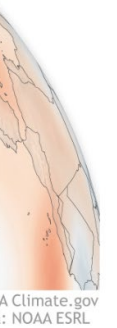
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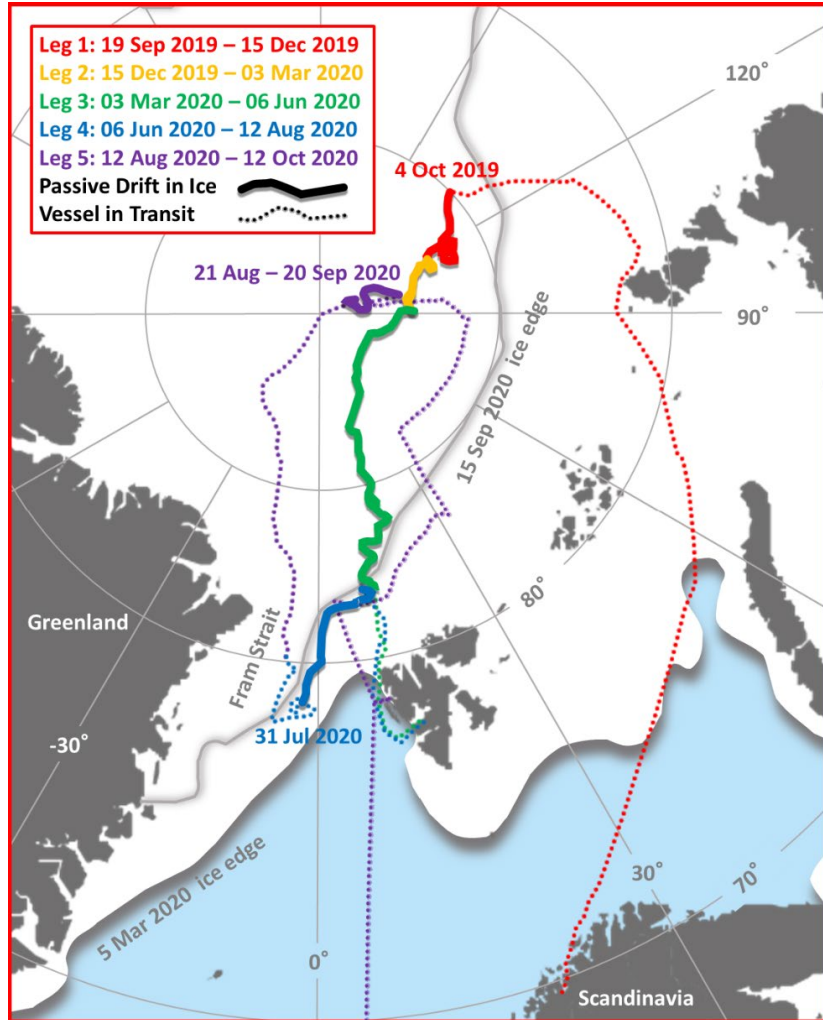
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# Multidisciplinary drifting Observatory for the Study of Arctic Climate



Shupe et al., 2020




Photo: Michael Gutsche

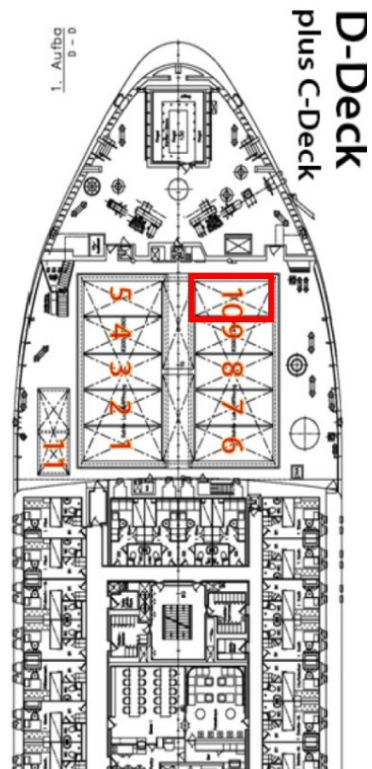
lubna.dada@psi.ch

# Measurement of chemical and physical properties of atmospheric aerosols



L.L.J. Quéléver

 container location

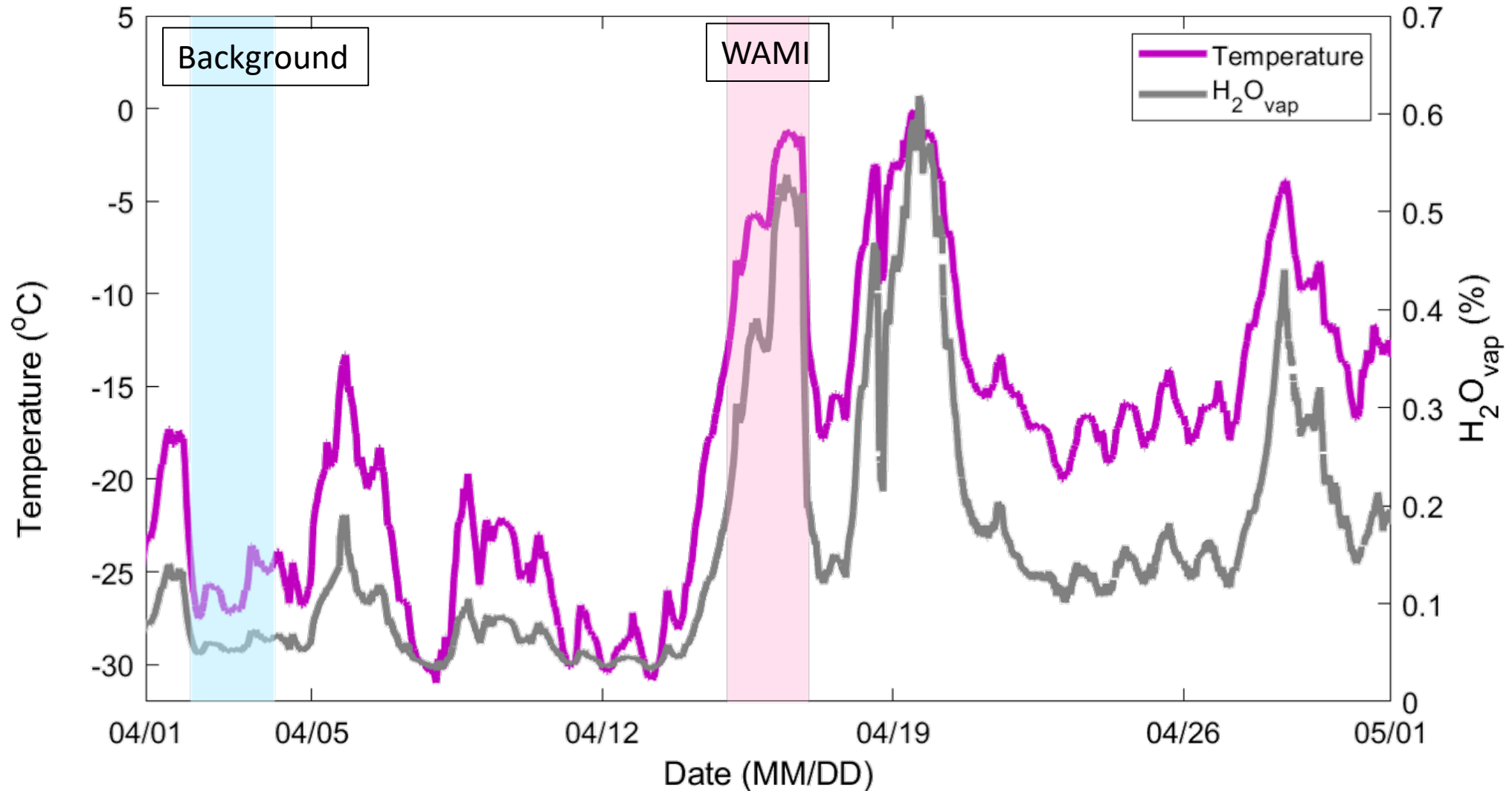


Polarstern

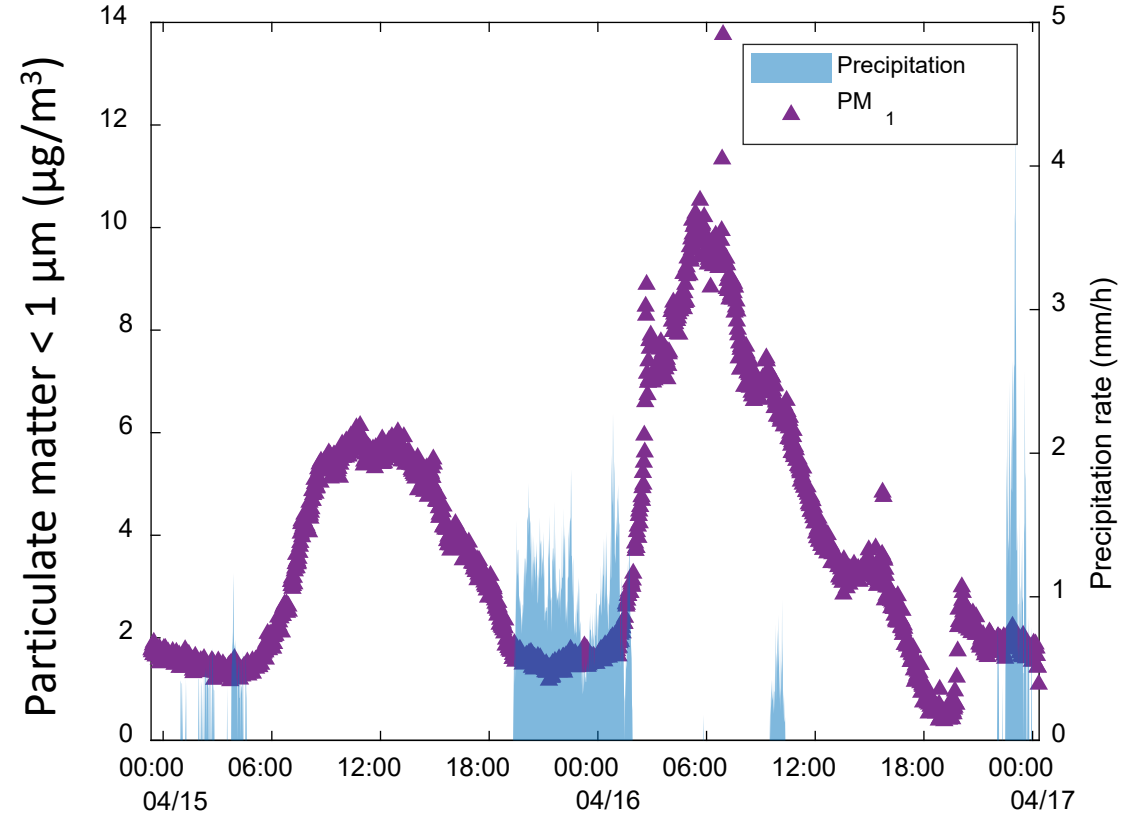
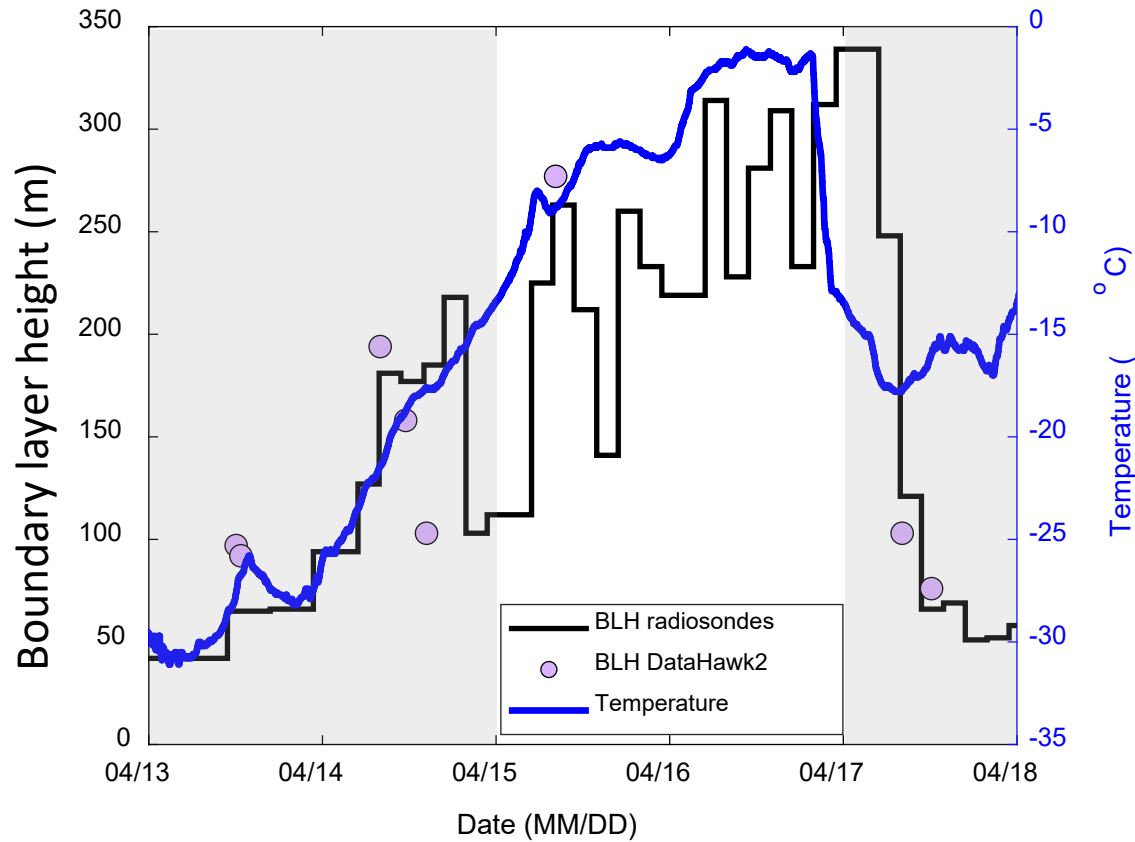


L.L.J. Quéléver

In April 2020, the surface temperature in the central Arctic ocean increased by **30 °C** in less than **48 hours**.



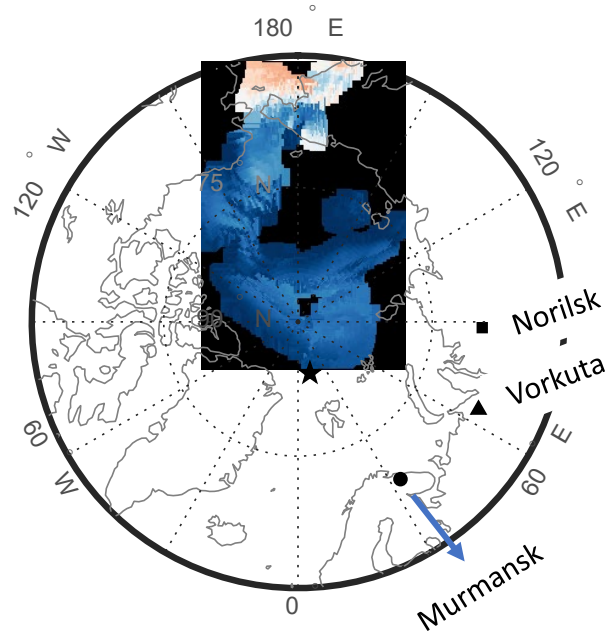
This increase was caused by an **extreme** warm and moist air-mass intrusion.



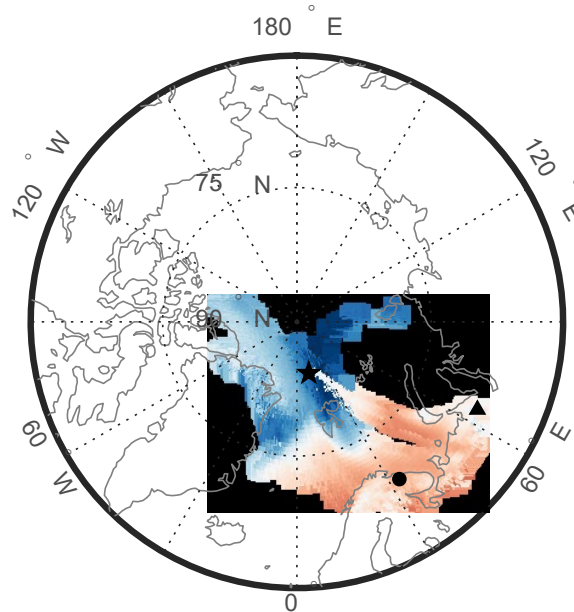
Warm intrusion divided into two peaks

# Origin of the intrusions

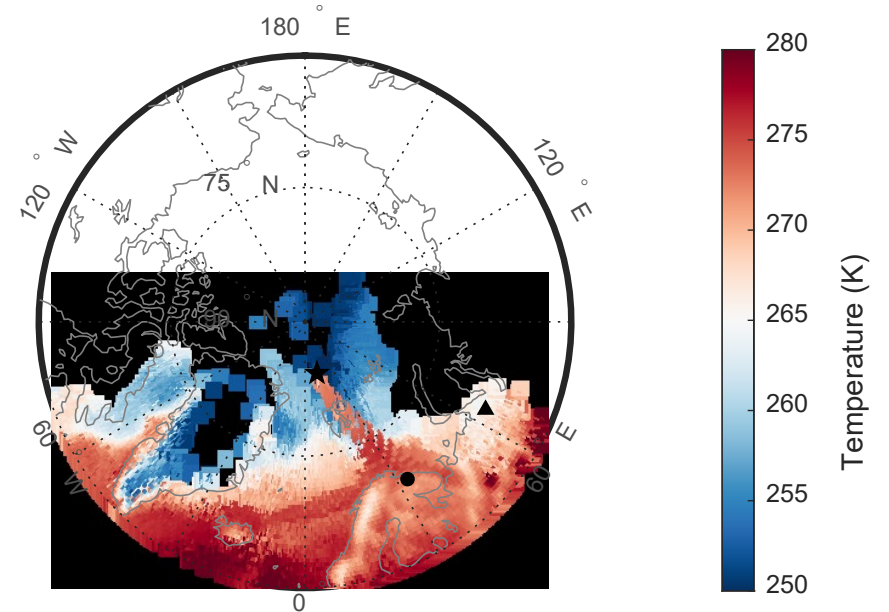
## Background



## First Peak



## Second Peak

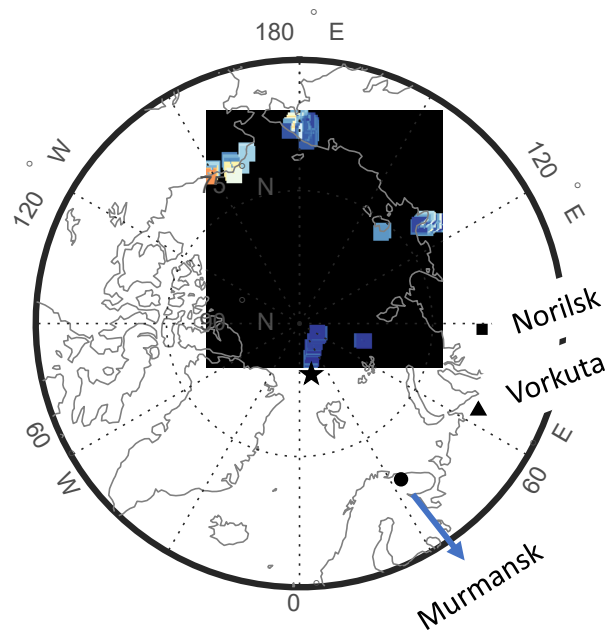


- Norilsk (coal and metal mining and smelting)
- ▲ Vorkuta (coal-mining)
- Murmansk (mining and metallurgy)

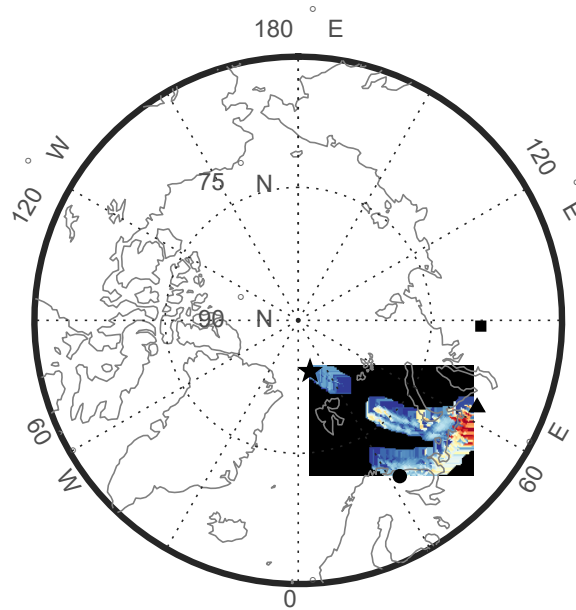
Travel time < 48 hours

# Origin of the intrusions

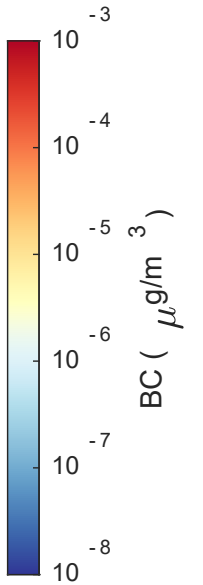
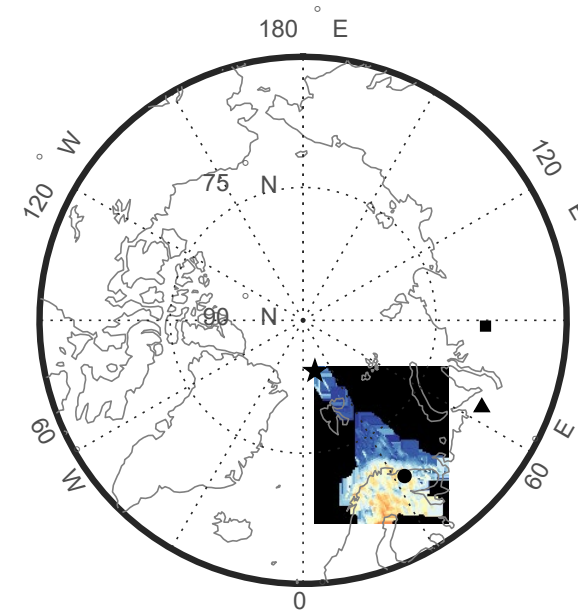
## Background



## First Peak



## Second Peak

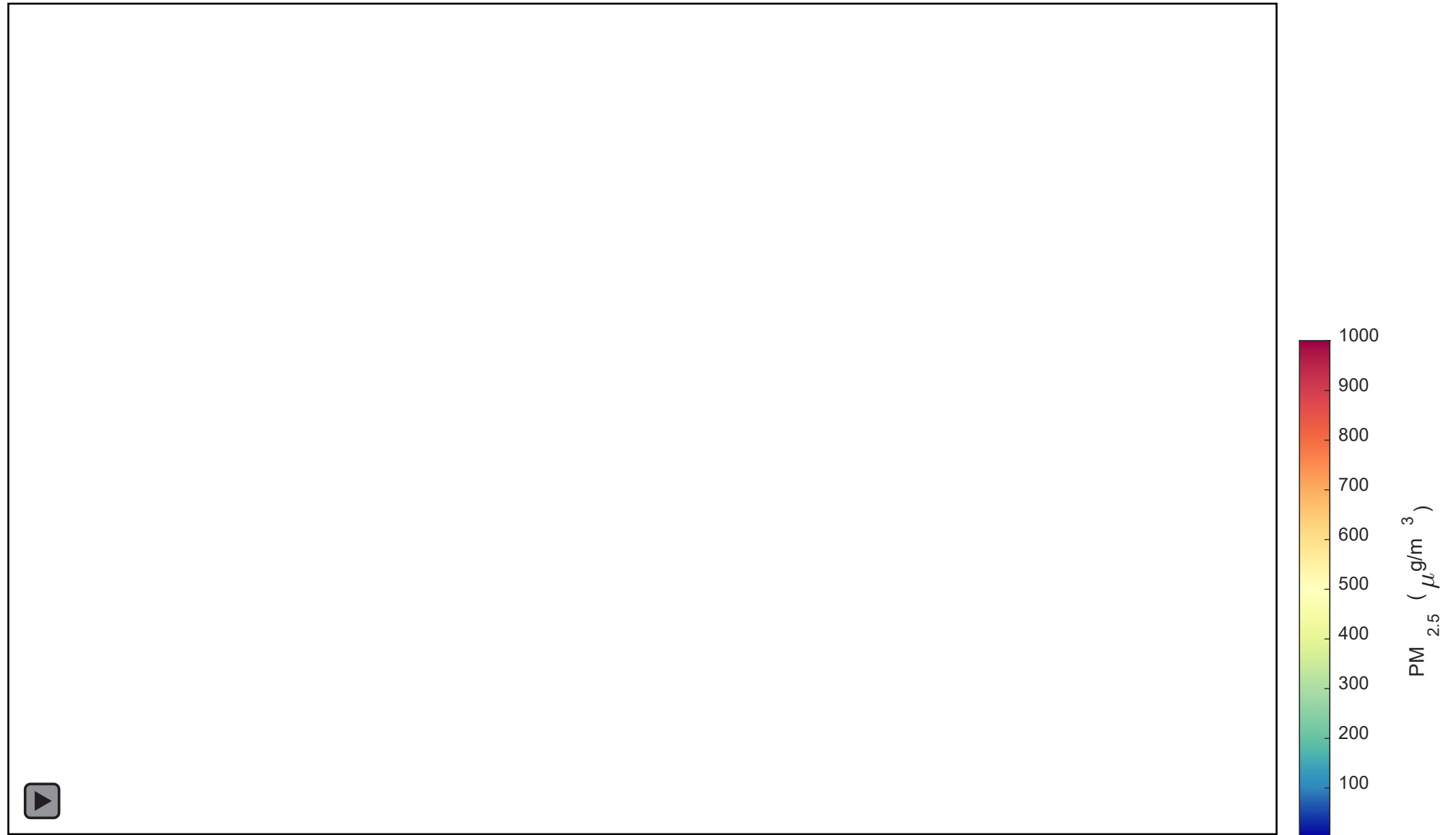


- Norilsk (coal and metal mining and smelting)
- ▲ Vorkuta (coal-mining)
- Murmansk (mining and metallurgy)

Travel time < 48 hours

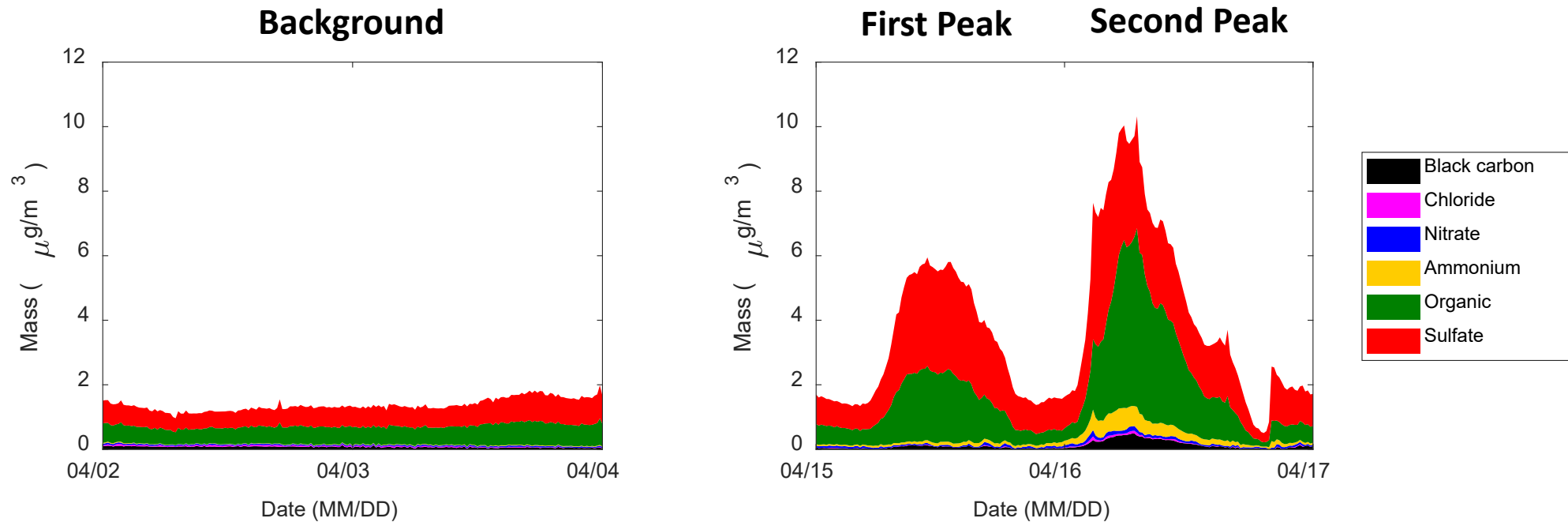


# Are we part of this?

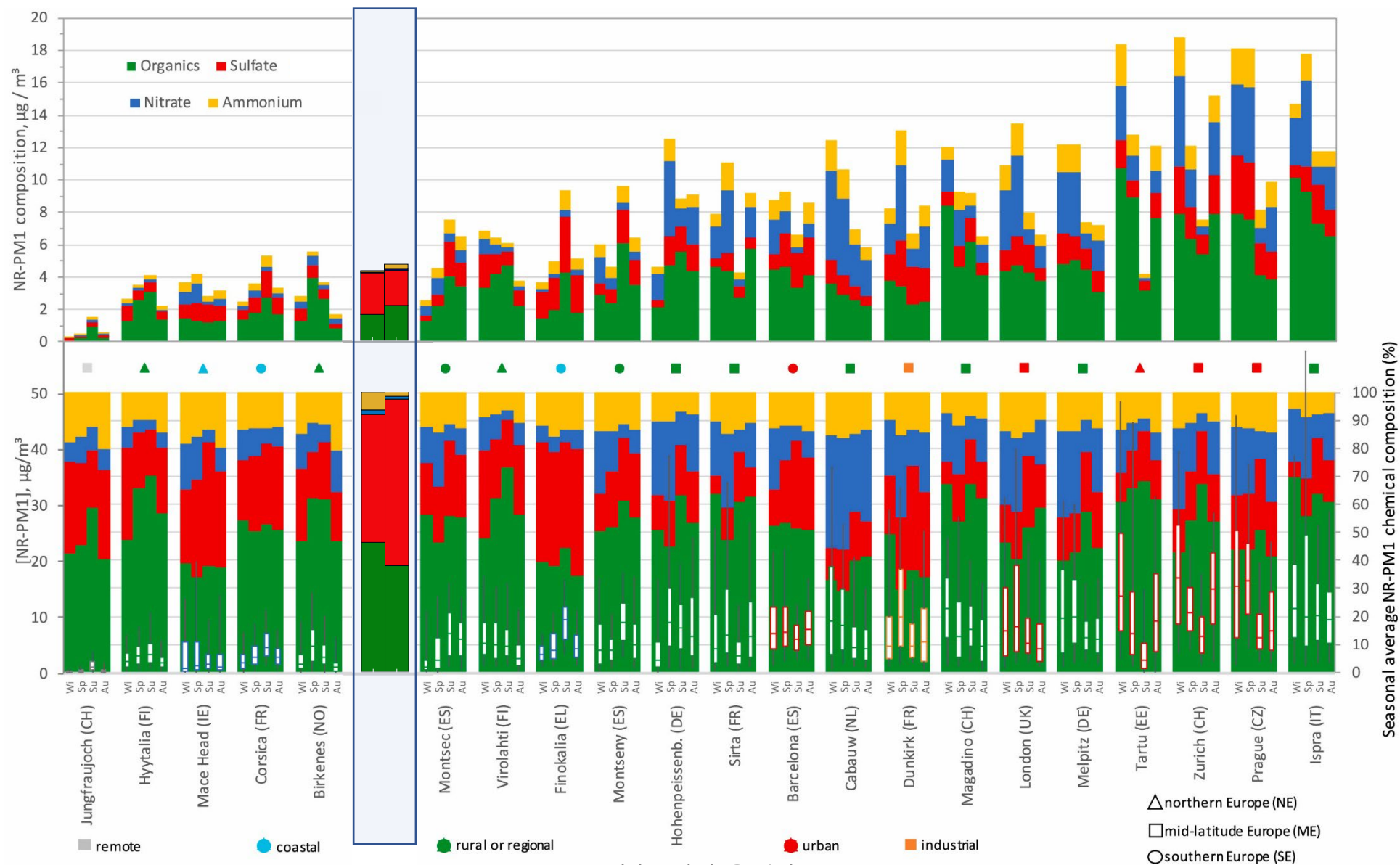


Source: CAMS/Copernicus/ECMWF

# Chemical composition of the aerosol associated with the air-mass intrusions.



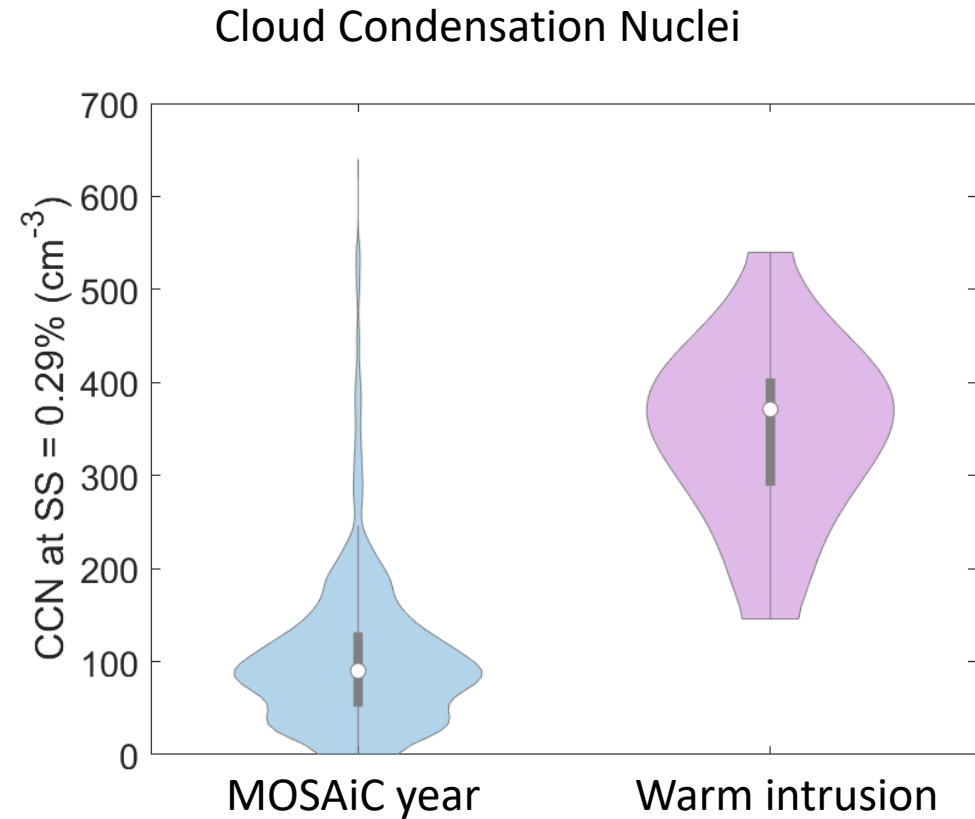
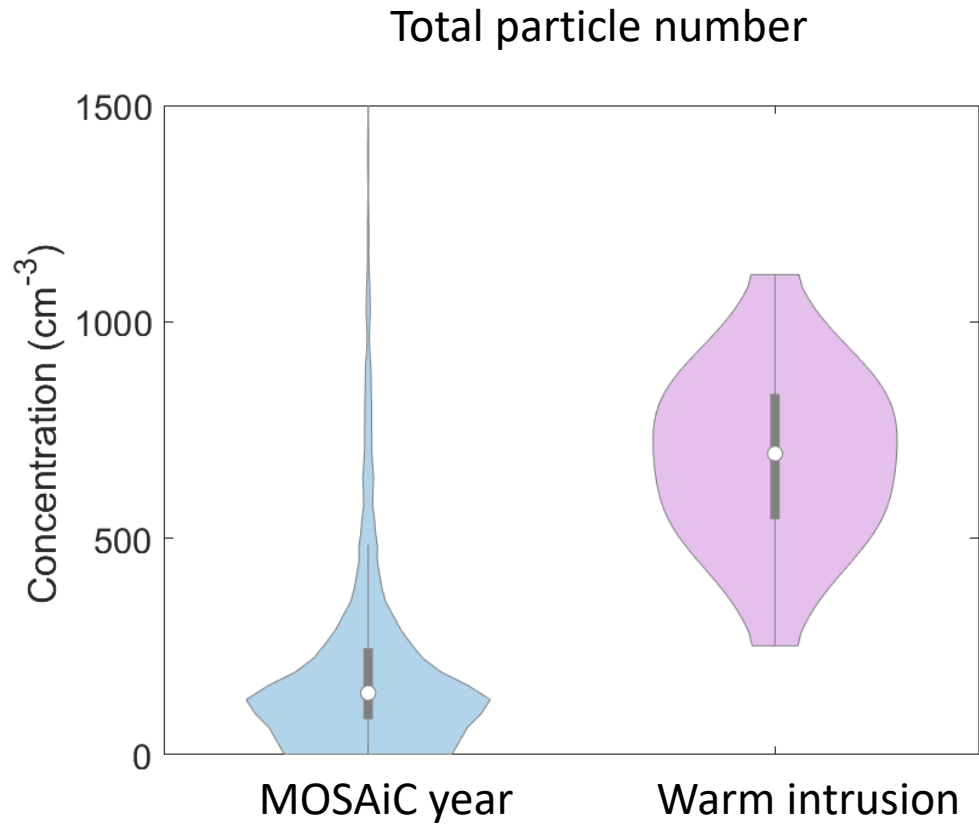
# Intrusion aerosol in perspective.



# Intrusion aerosol in perspective.

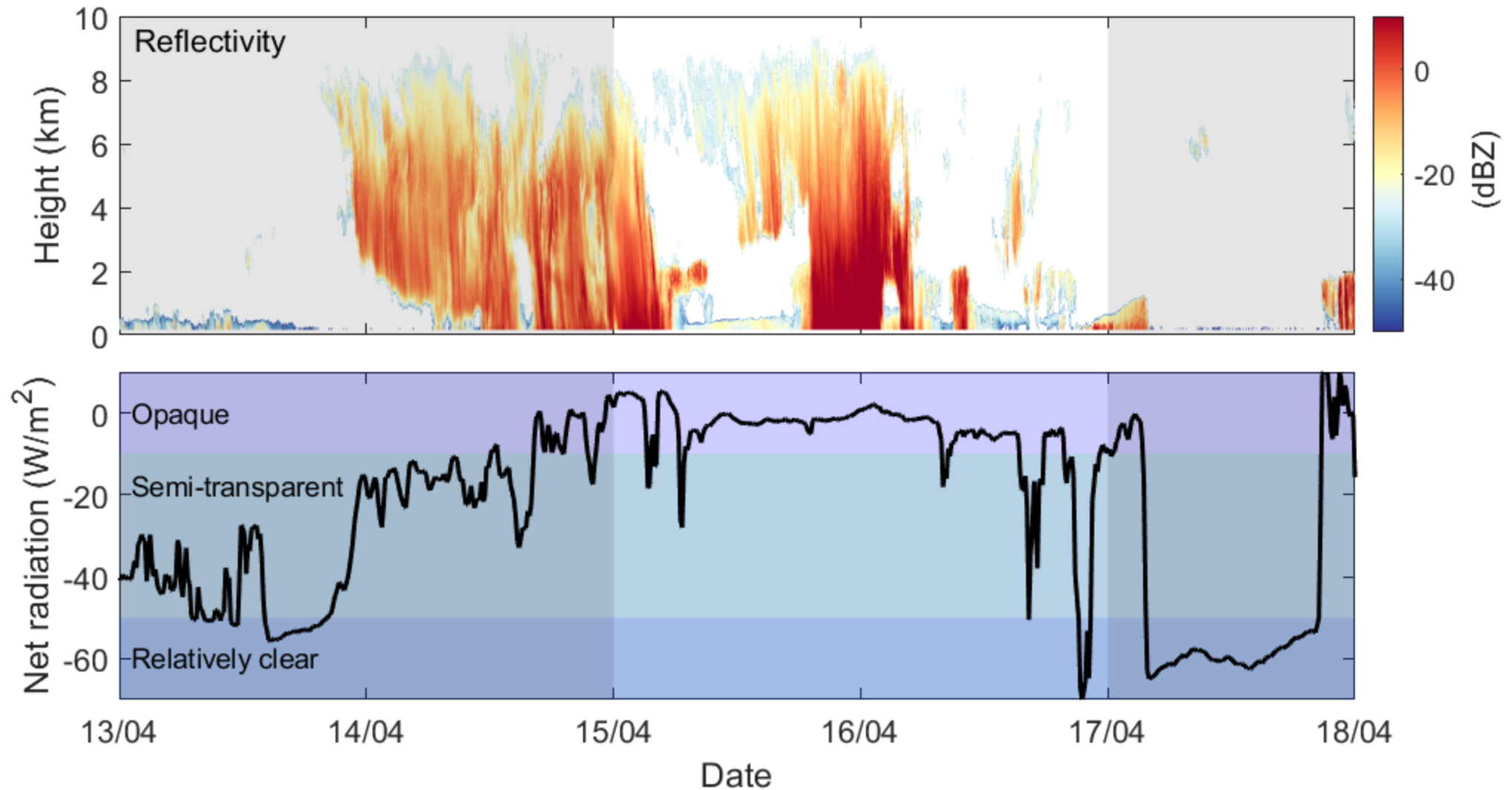


# Aerosol particles are cloud seeds.

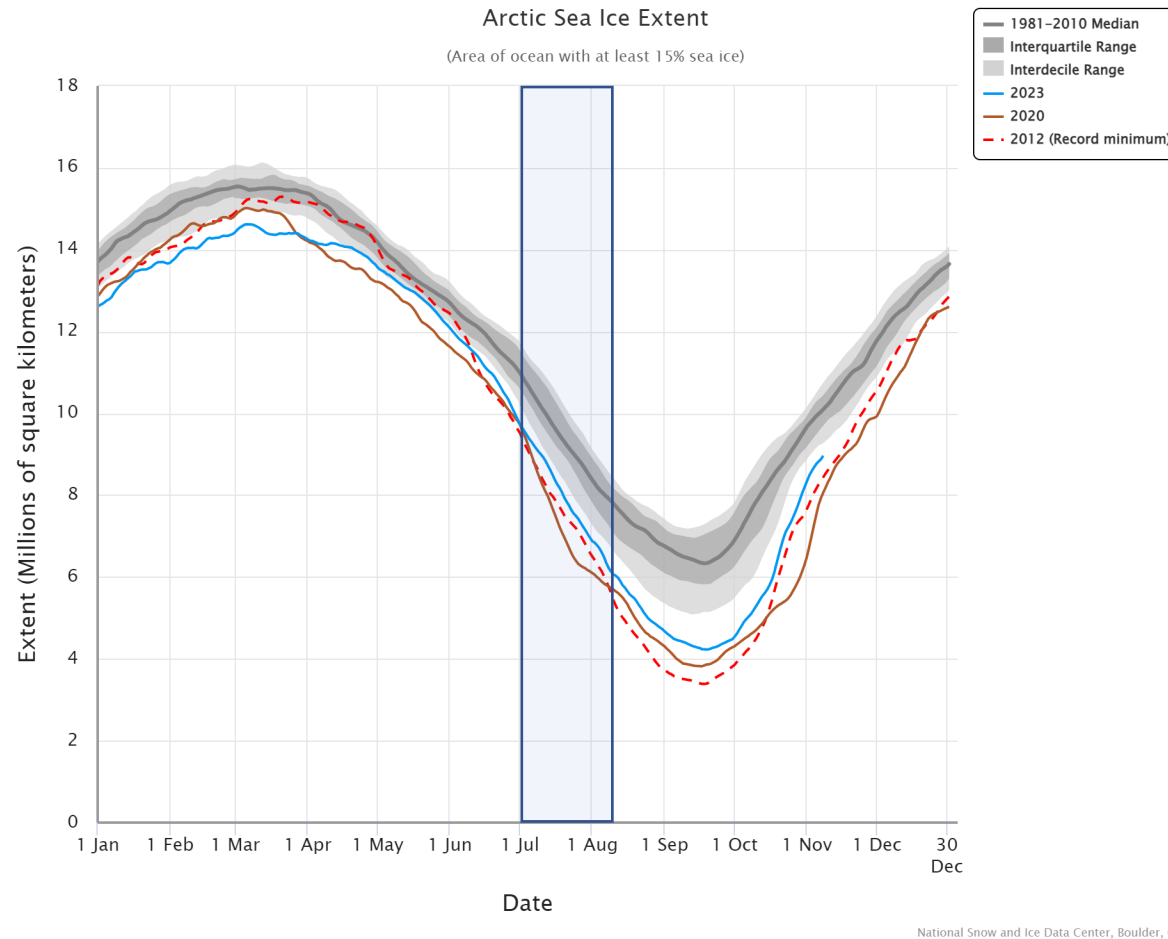


# Clouds act as warming blankets: low level and opaque.

Warm intrusion



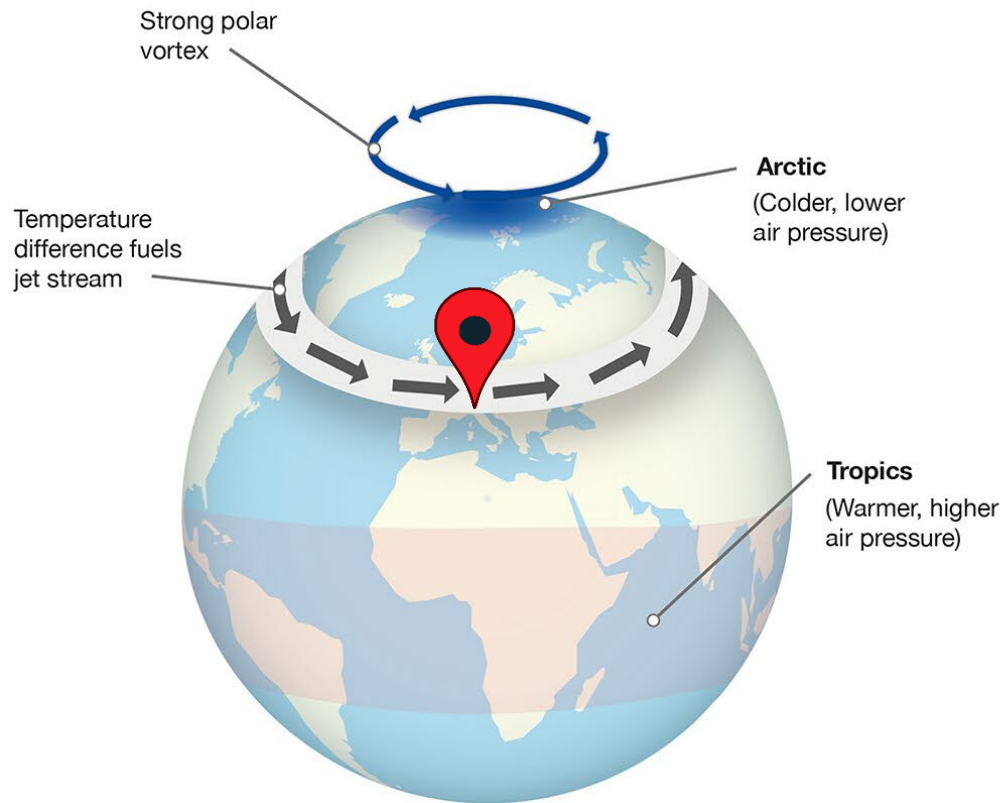
# Implications on sea-ice extent.



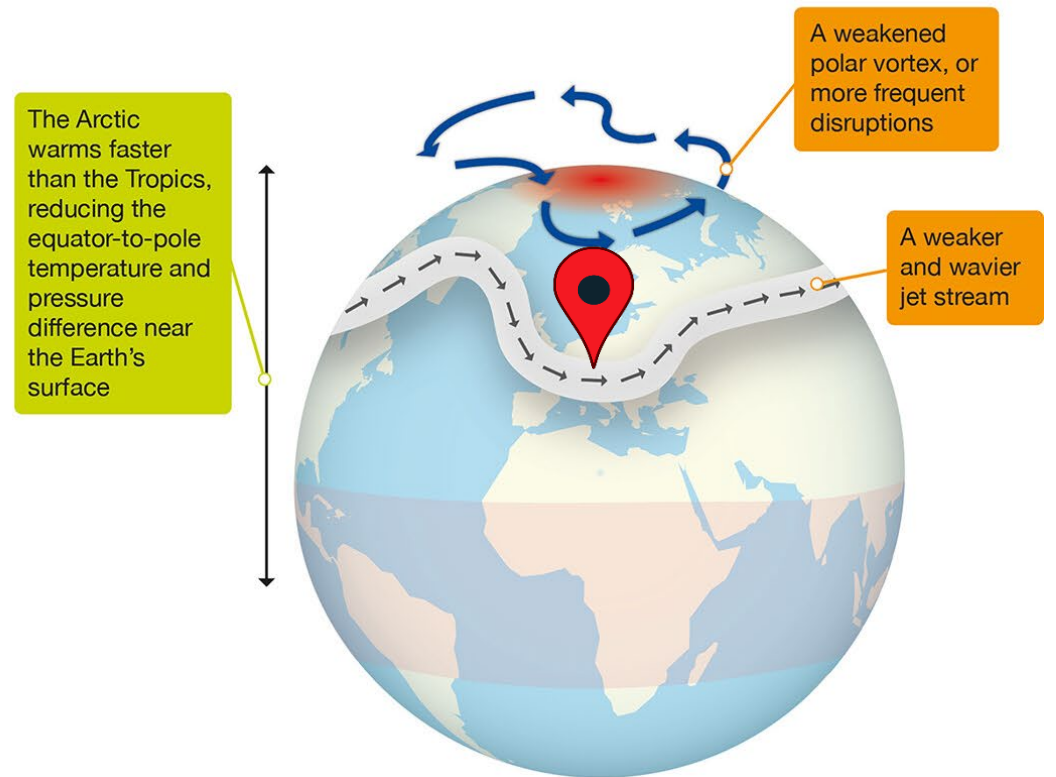
The extreme air-mass intrusion has been associated with the **lowest Arctic sea ice extent** in the last 40 years!

# Why do we care?

## Normal



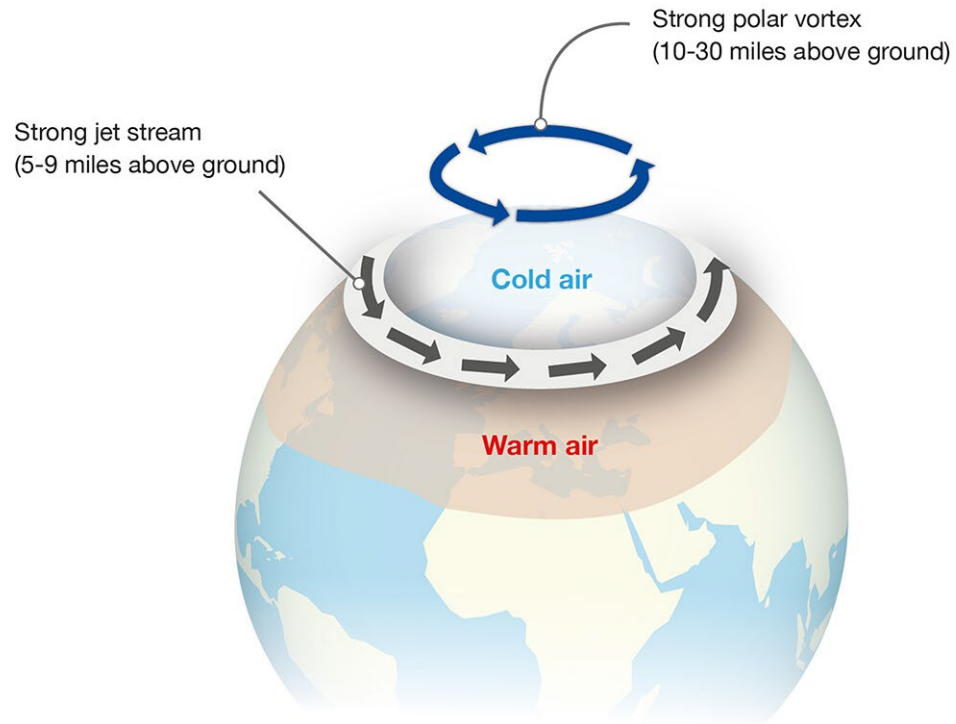
## Warm Arctic



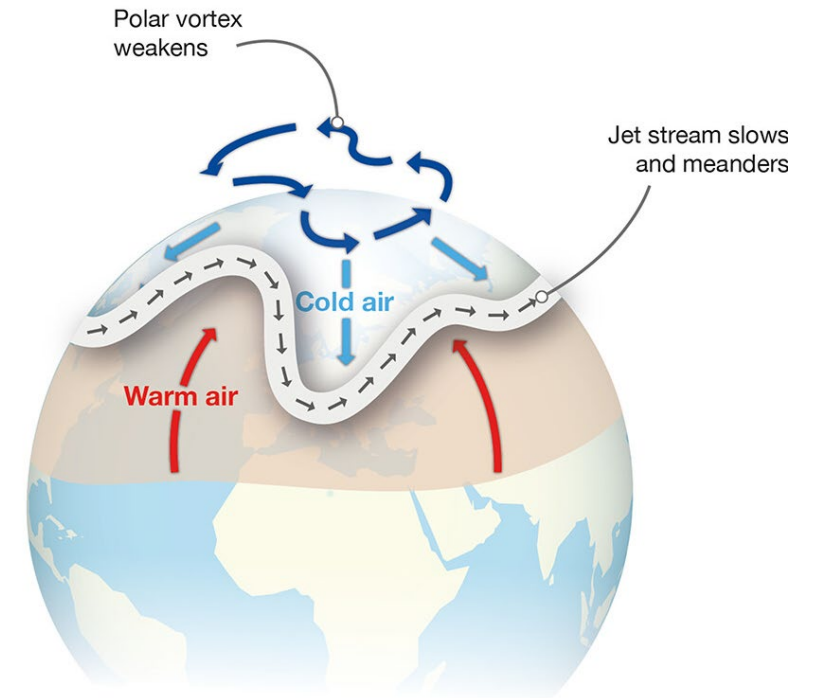


# Why do we care?

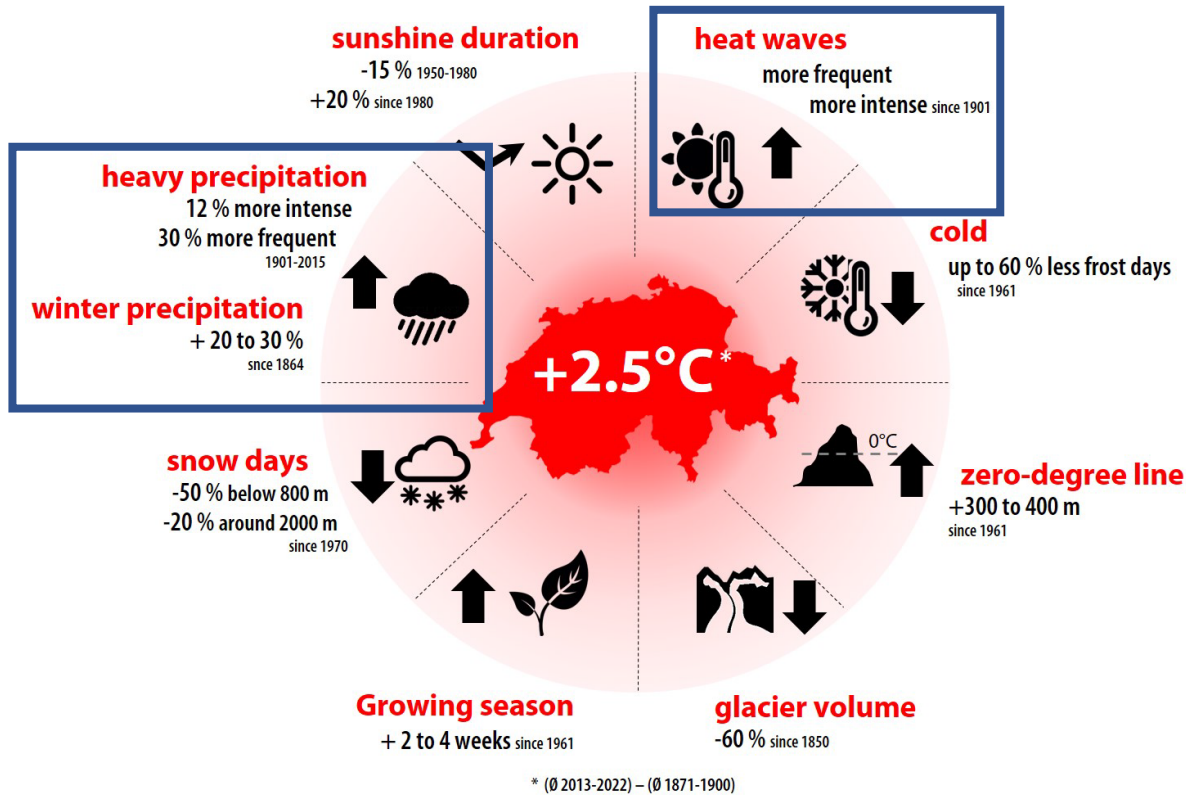
## Normal



## Warm Arctic

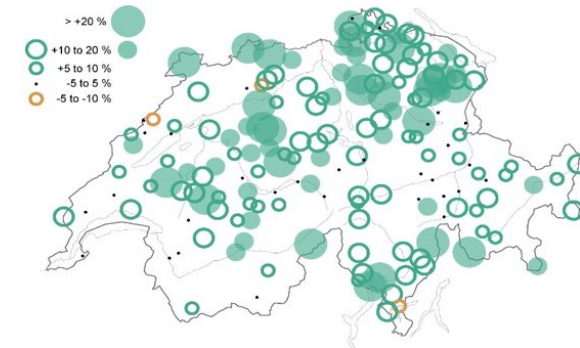


# Increase in **extreme** weather events in Switzerland

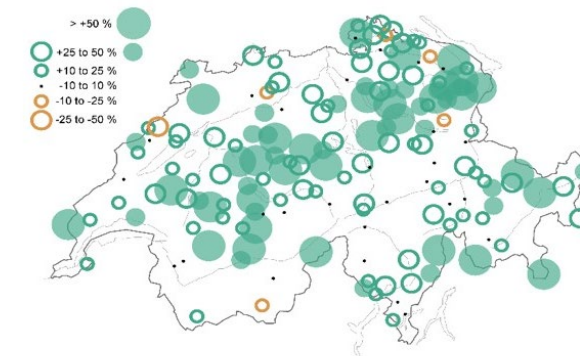


## Observations

1901-2015



**+12%  
more  
intense**



**+30%  
more  
frequent**

**Heavy precipitation**

**In the future:  
more frequent  
and longer  
WAMIs**

