

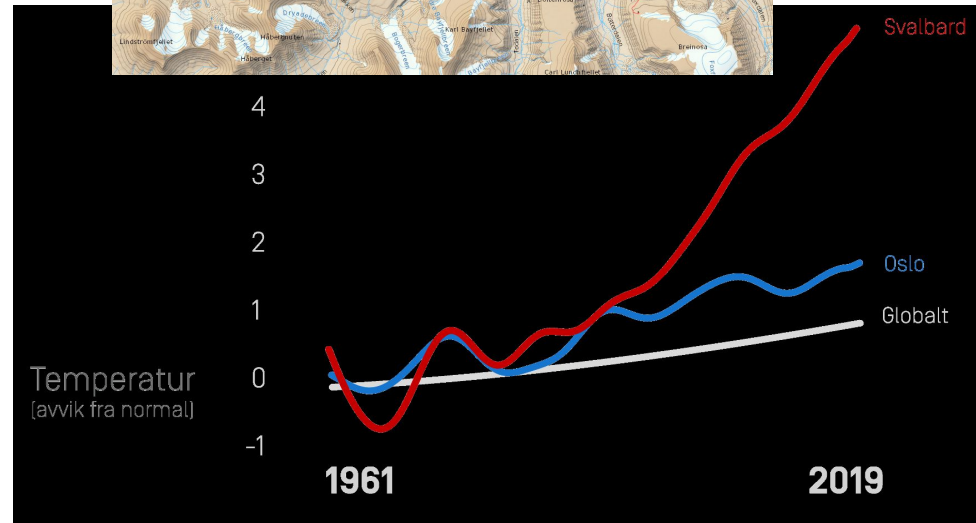
Future Climate Projections for Svalbard

High-resolution insights using the HARMONIE-Climate model

Julia Lutz, Oskar Landgren

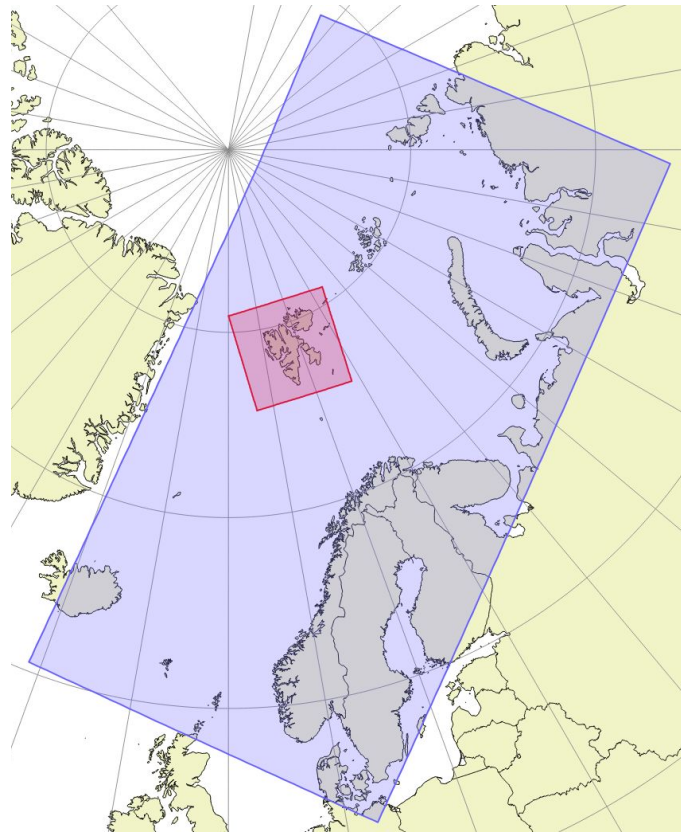
Why high-resolution matters?

- **Arctic hotspot:** warming much faster than global average
- Impacts: permafrost thaw, glacier melt, ecosystem impacts, infrastructure damage
- Past models lacked spatial or temporal detail
- Objective: deliver precise local climate projections



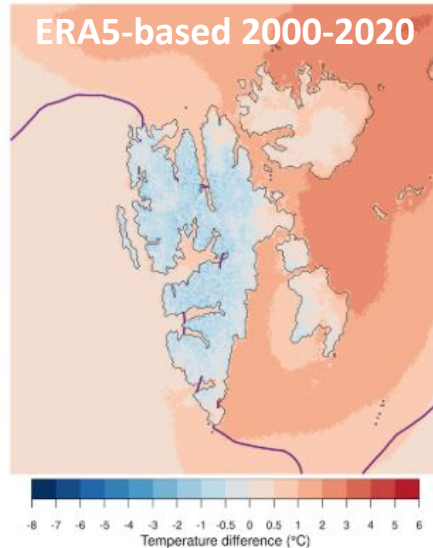
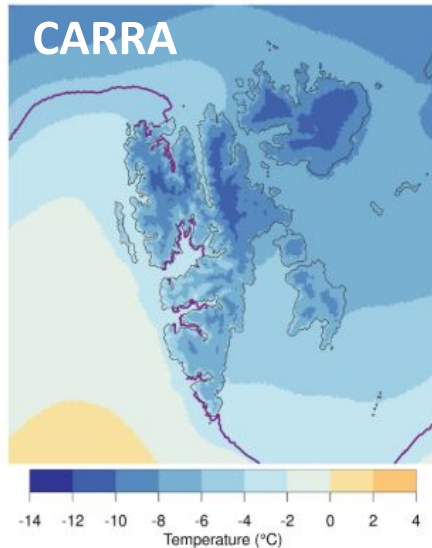
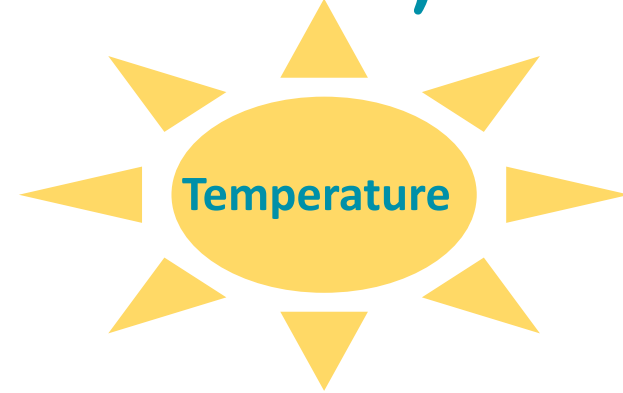
Methodology & Scenario

- Model: **HCLIM43** with 2.5 km resolution
- Scenario: **SSP5-8.5** (high emissions)
- Input: MPI-ESM1-2-LR & NorESM2-MM (**CMIP6**)
- Evaluation: **ERA5** & **CARRA** datasets



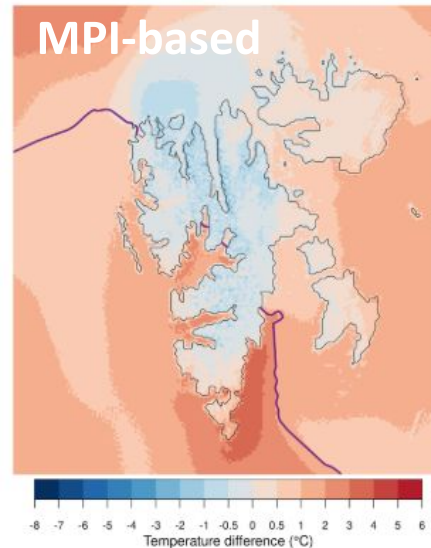
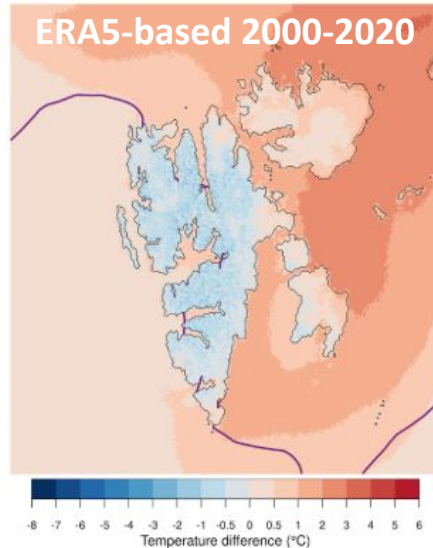
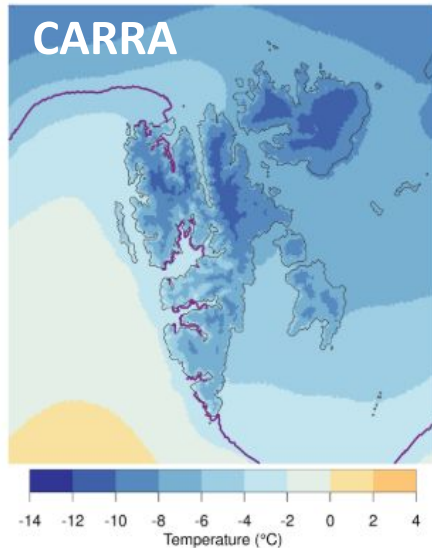
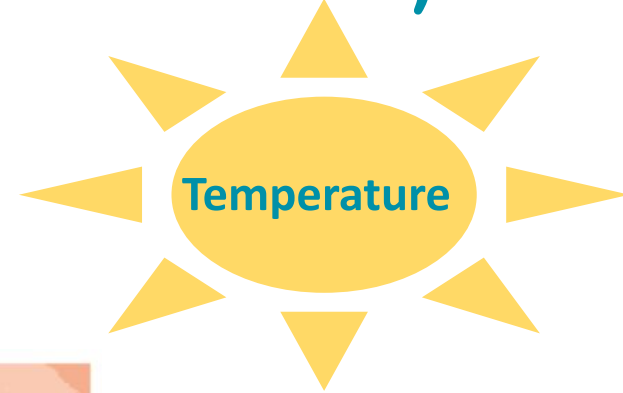
How accurate are the models (1991-2020)?

- **ERA5** shows sea-ice-related warm bias



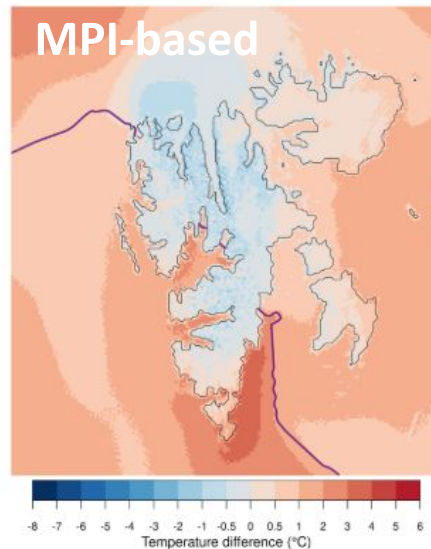
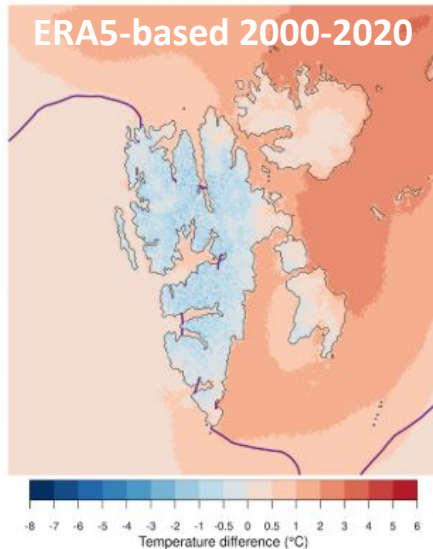
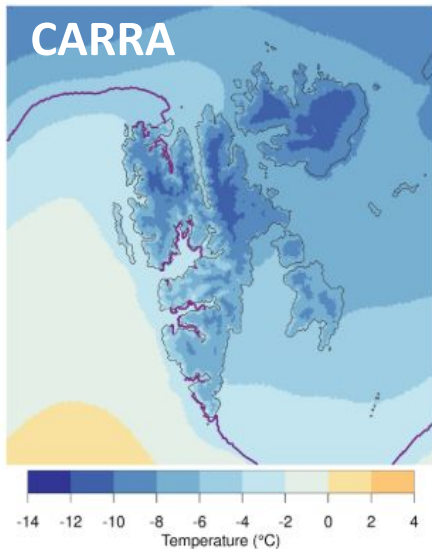
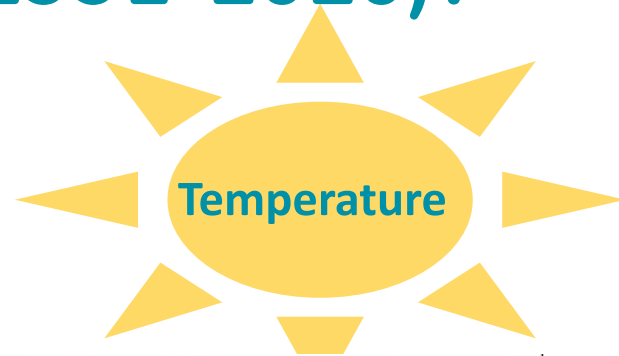
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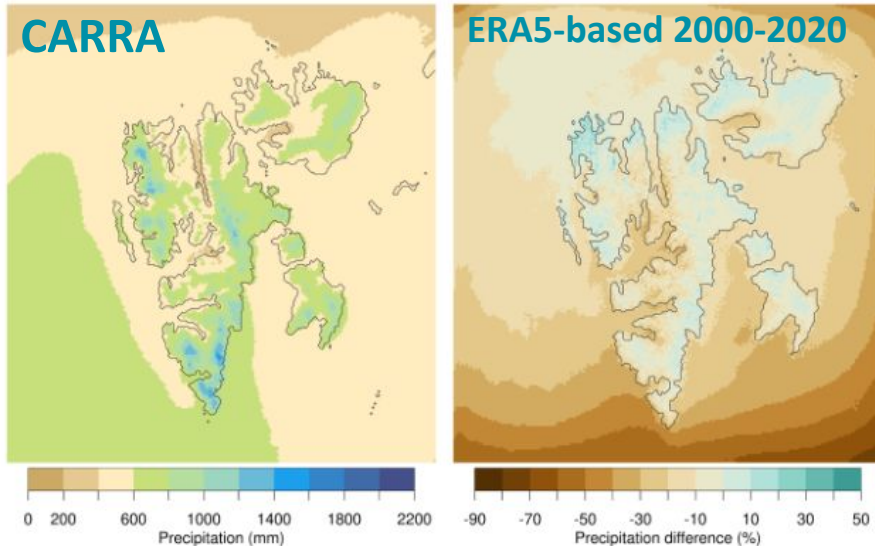
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- **NorESM** underestimates temperature



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- ERA5 shows small wet bias along the coasts

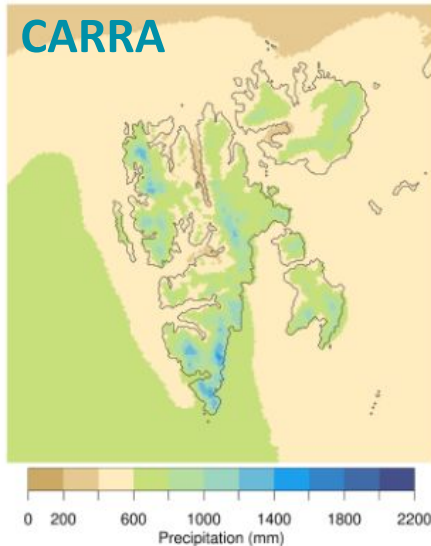
Precipitation



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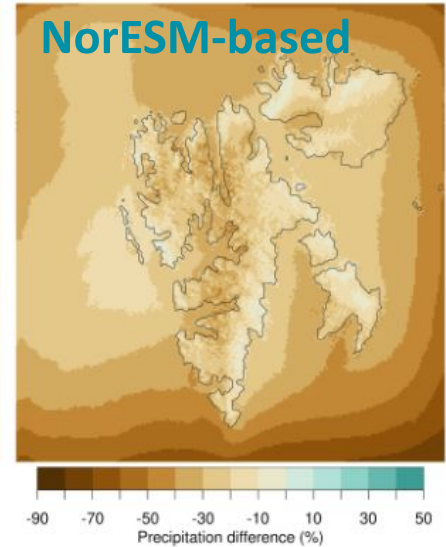
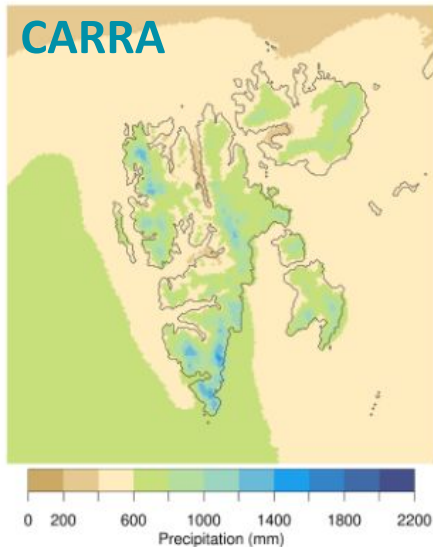
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- **NorESM** generally underestimates precipitation

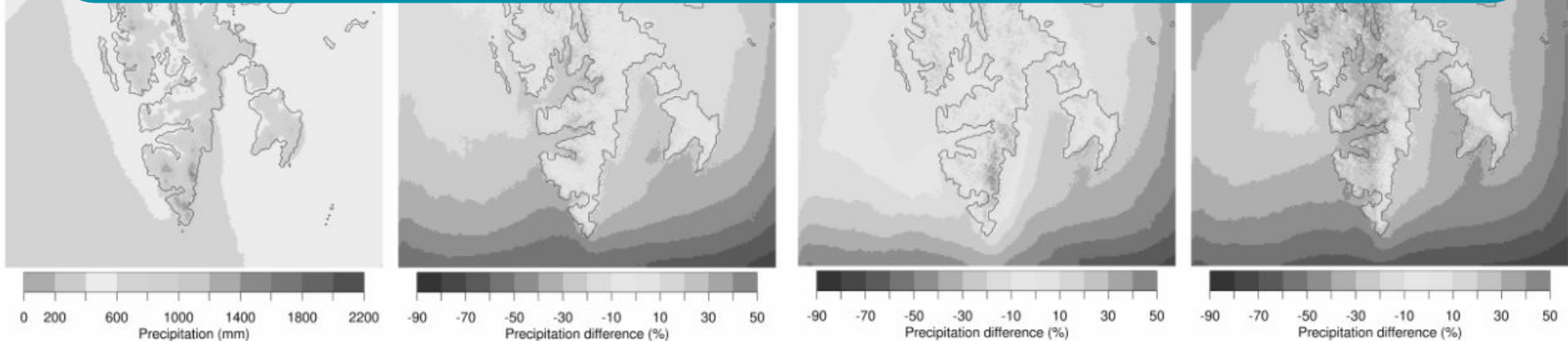
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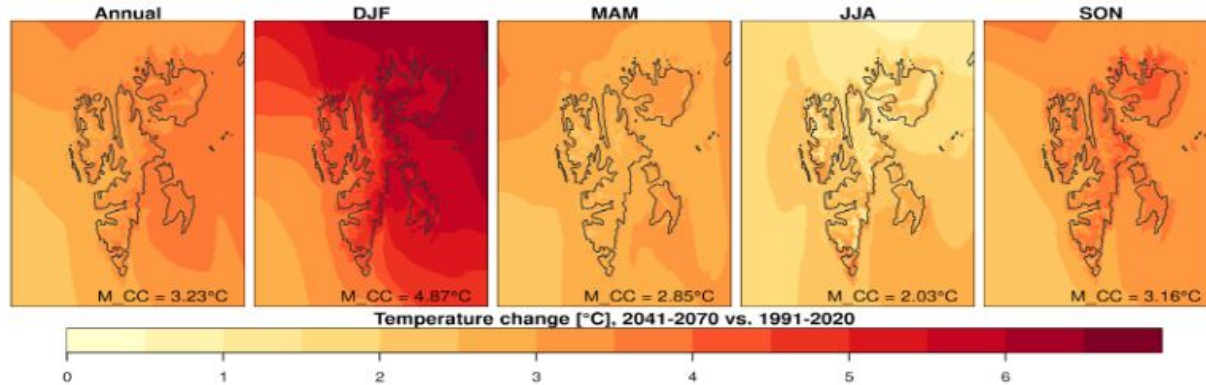
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Simulations based on MPI-ESM chosen for future projections

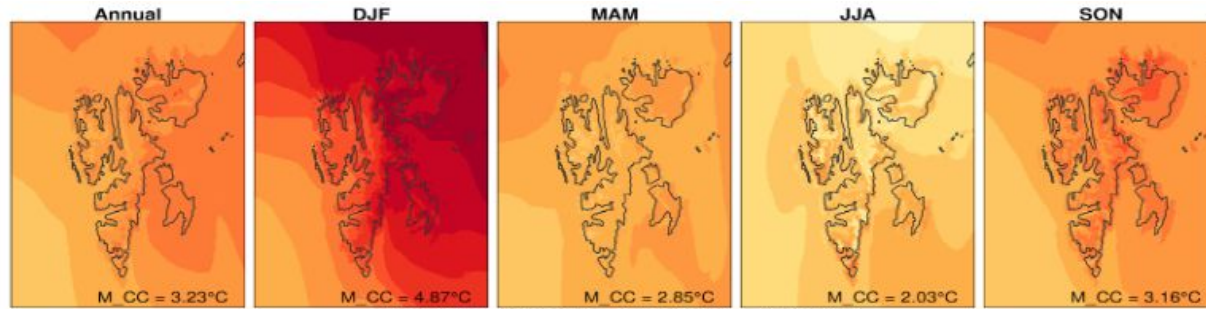


Changes in the future (2041–2070 vs. 1991–2020)

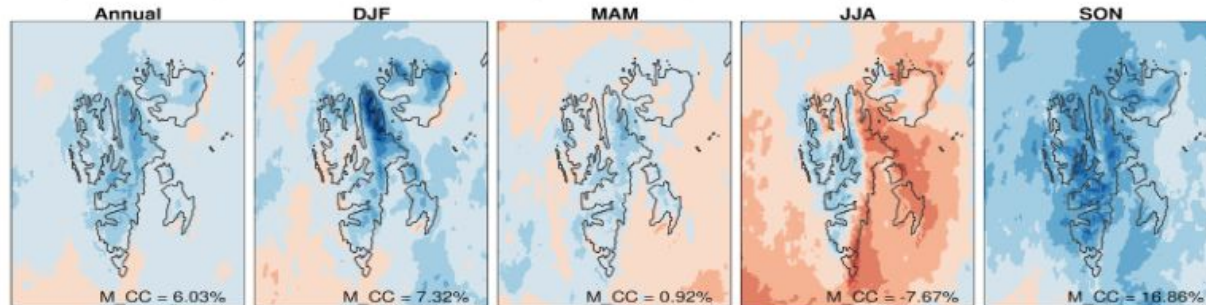


- **Temperature** increase: 3.2 °C
- **strongest** warming: **winter** (4.9 °C)

Changes in the future (2041–2070 vs. 1991–2020)



Temperature change [°C], 2041–2070 vs. 1991–2020

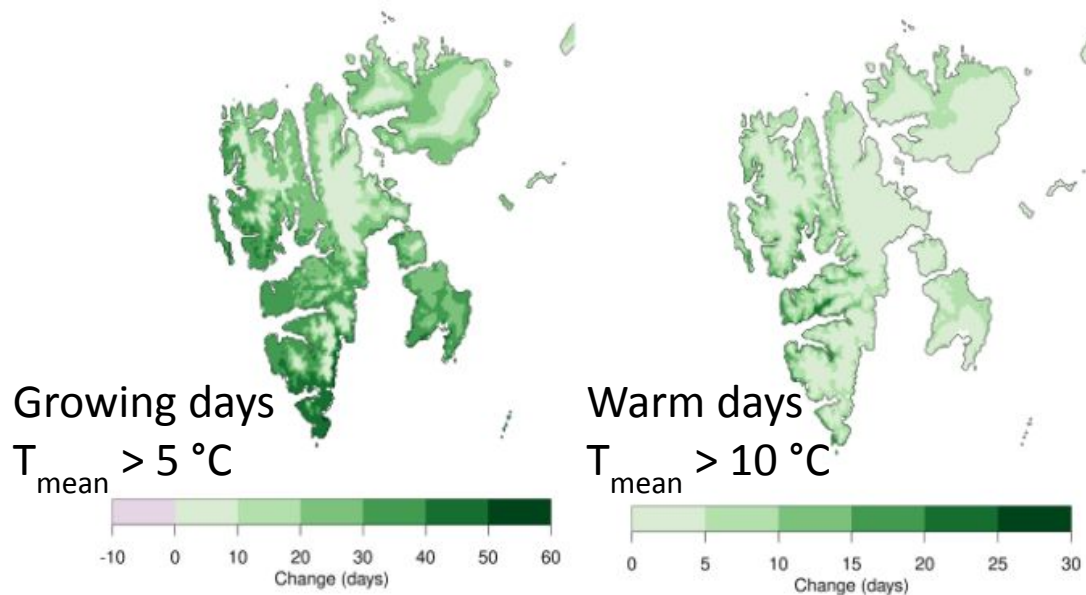


Precipitation change [%], 2041–2070 vs. 1991–2020

- **Temperature** increase: 3.2 °C
- **strongest** warming: **winter** (4.9 °C)
- **Precipitation** increase: 6%
- **largest** precipitation increase: **autumn** (17%)

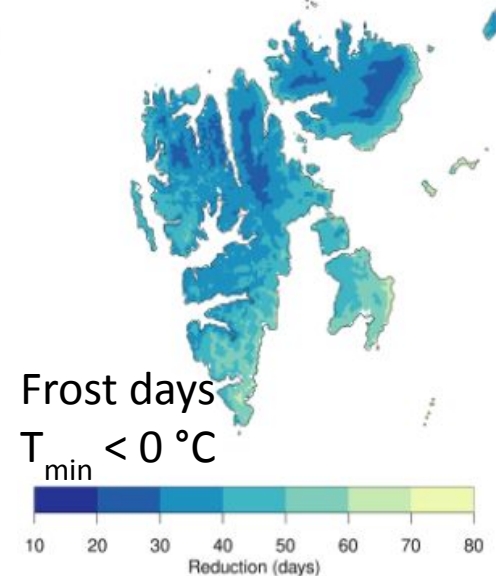
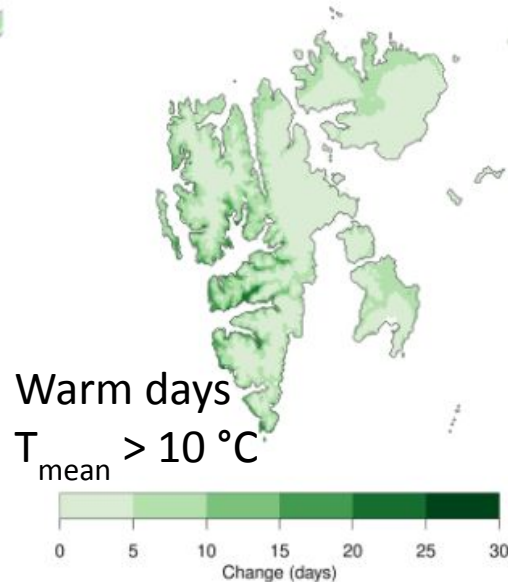
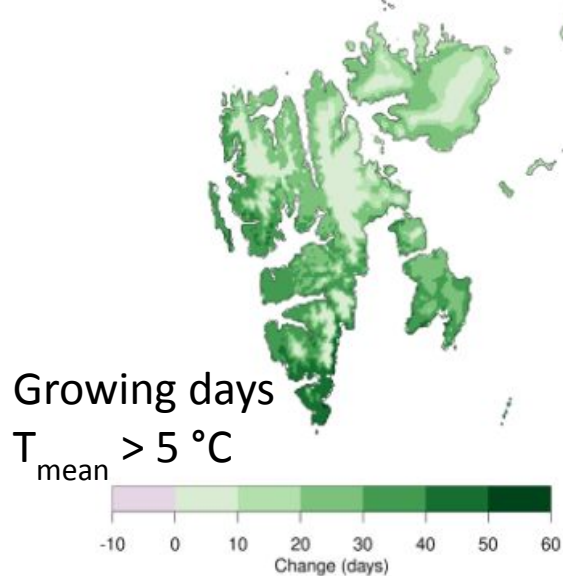
Growing, warm & frost days 2041–2070 vs. 1991–2020

+ More **growing** & **warm days** on coasts



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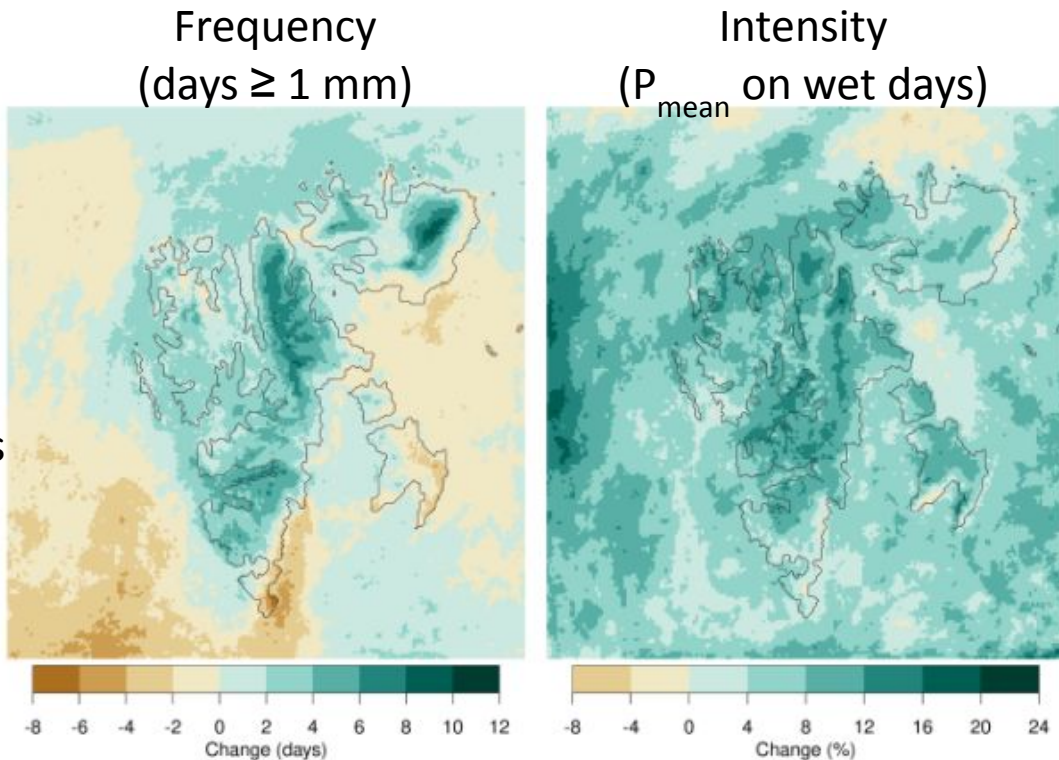
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- + **Zero crossing days** increase in colder areas
- Fewer **frost days**, esp. southern Svalbard



Precipitation: frequency & intensity

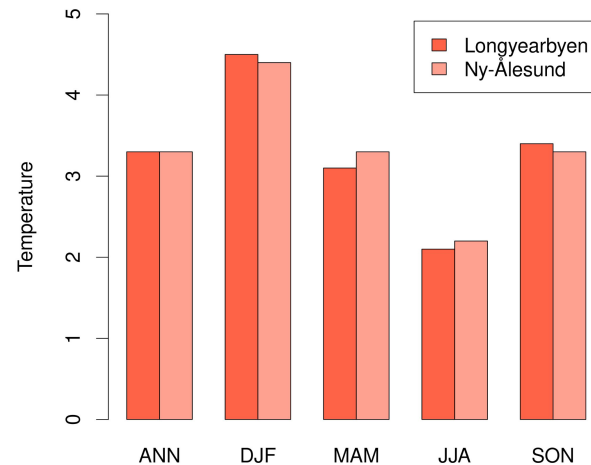
2041–2070 vs. 1991–2020

- + Increase in **wet days** (+10–12 days in northeastern areas)
- + More **intense rainfall** (+10–20% in central and northeastern Spitsbergen)
- + More **heavy precipitation** events (esp. eastern Spitsbergen)
- **Autumn snow fraction** declines in southwestern Svalbard



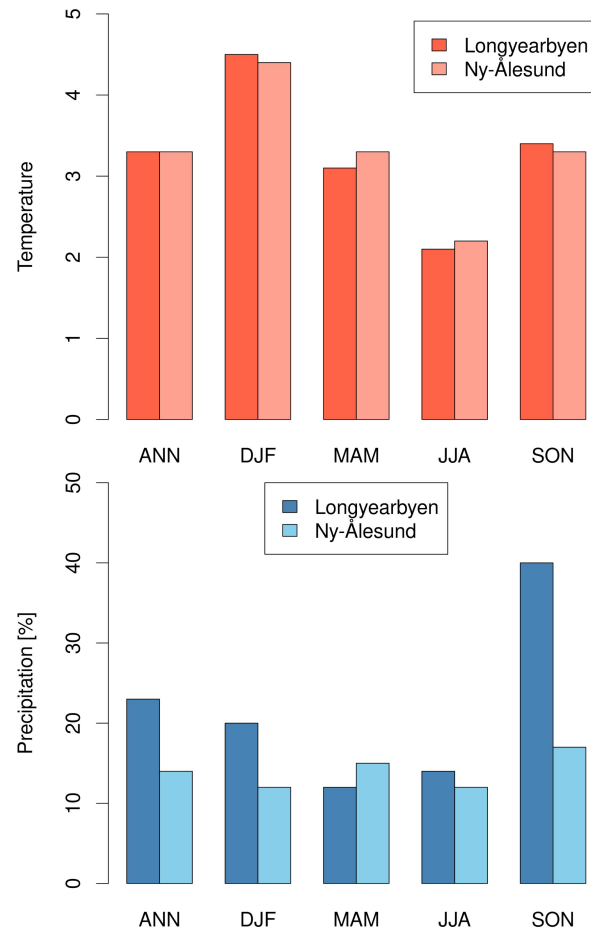
Local impacts on Longyearbyen & Ny-Ålesund

- + 3.3 °C **warming** by 2041–2070
- + **highest** temperature increase in **winter** (4.5 °C & 4.4 °C)



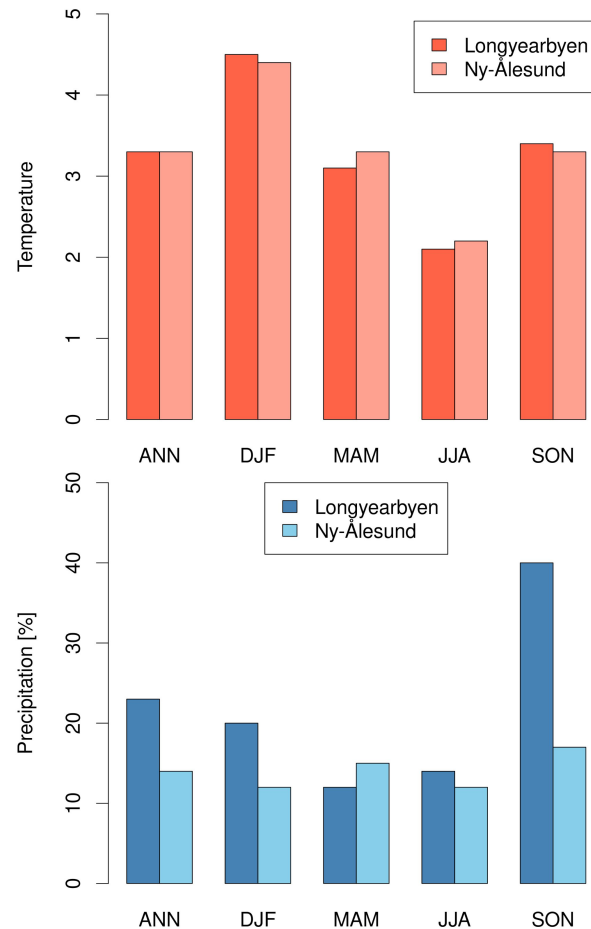
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- + **highest** precipitation increase in **autumn** (40% & 17%)
- **Snow fraction** 2041–2070: 37% (-14%) & 32% (-13%)



Summary

- **Interpret results cautiously**
 - Limited number of simulations
 - supplement with Arctic CORDEX data or empirical-statistical downscaling

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 - supplement with Arctic CORDEX data or empirical-statistical downscaling
- Warming strongest in **winter**
- **Wet days** more frequent, precipitation on those days **more intense**
- Largest precipitation increase in **autumn**
- Data available online for download
- Encouraged to combine with other models


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