Future Climate Projections for Svalbard

High-resolution insights using the HARMONIE-Climate model

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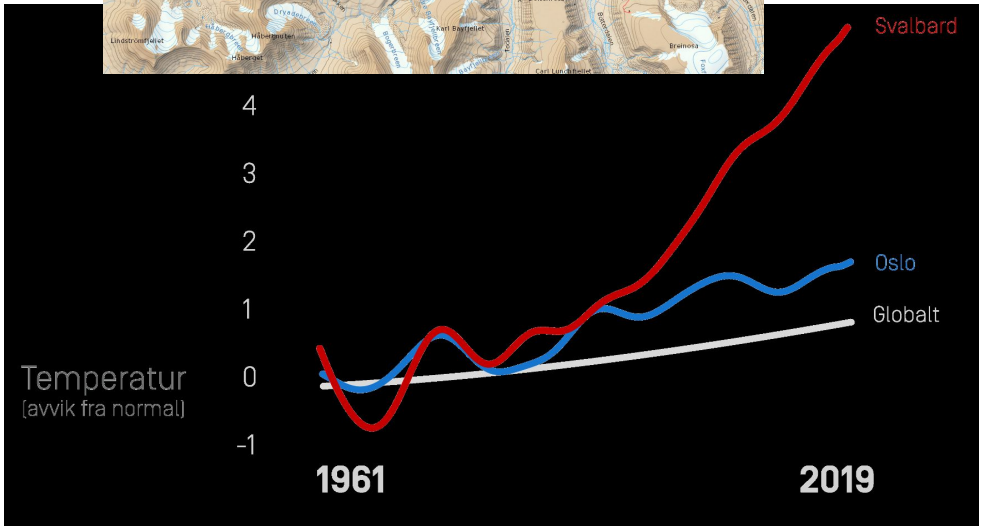
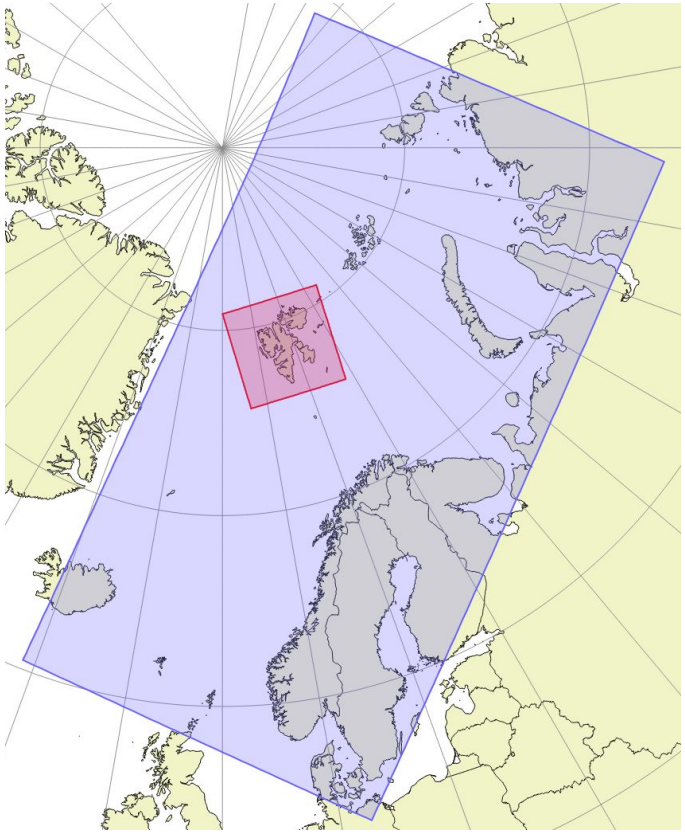
Why high-resolution matters?

- **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



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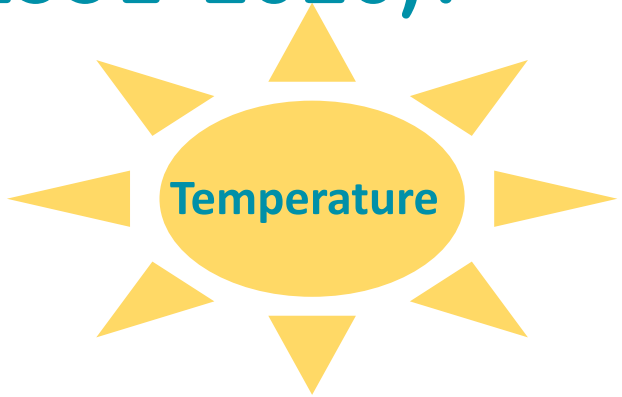

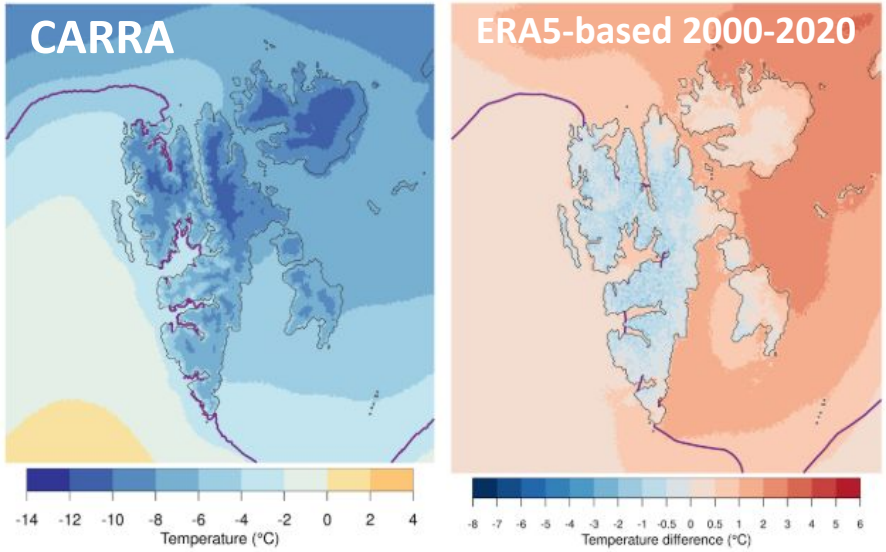

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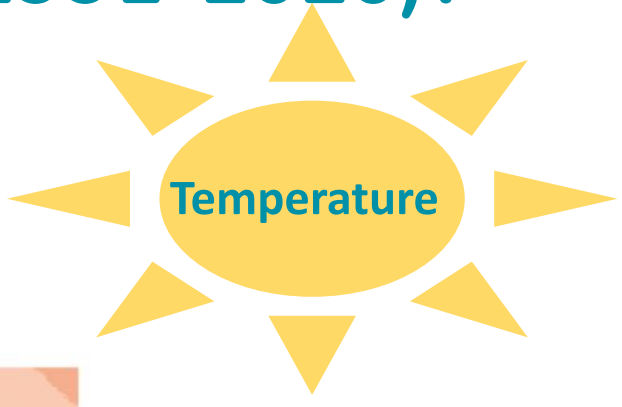

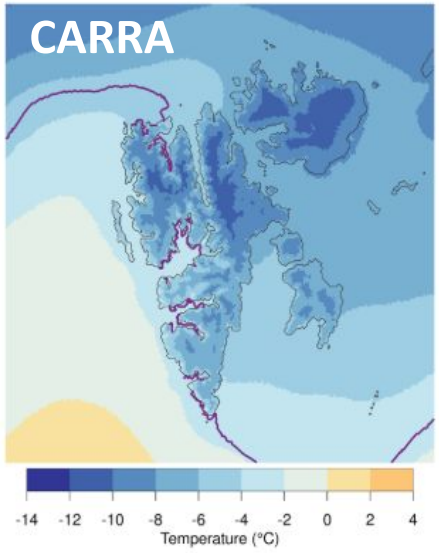

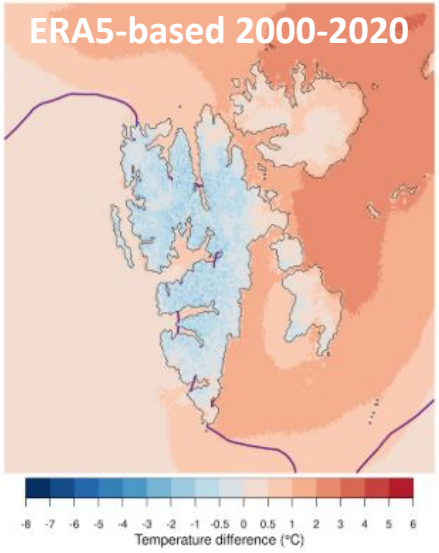

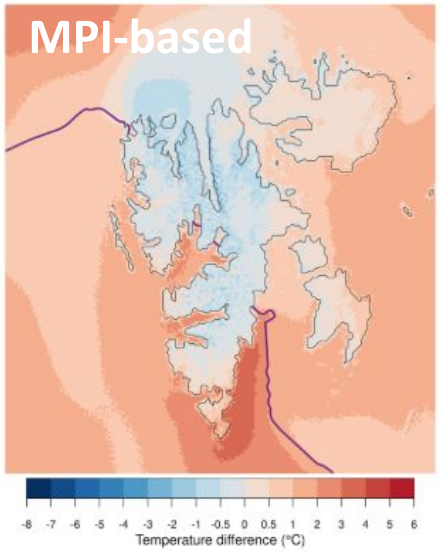

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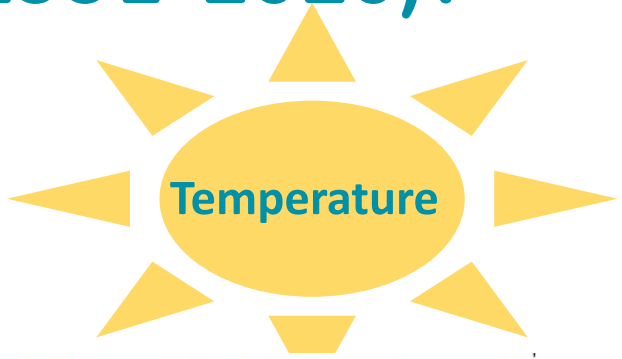

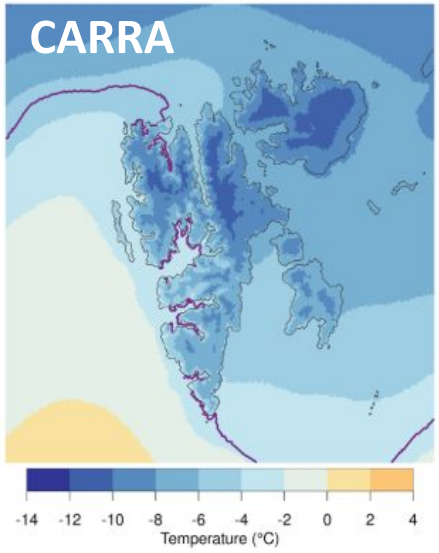

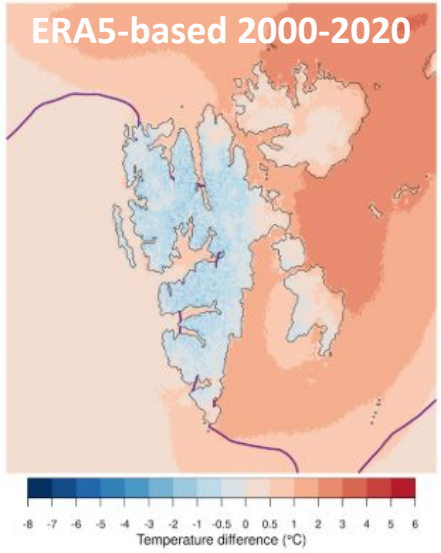

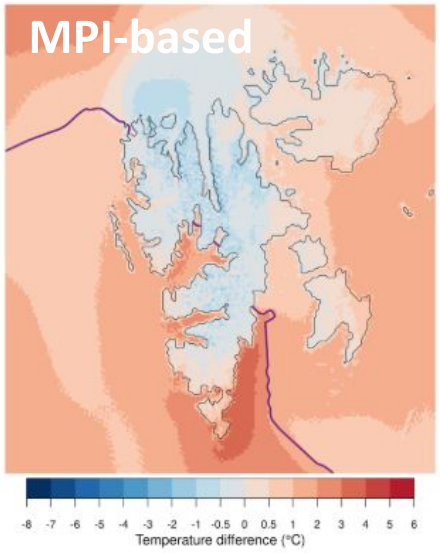

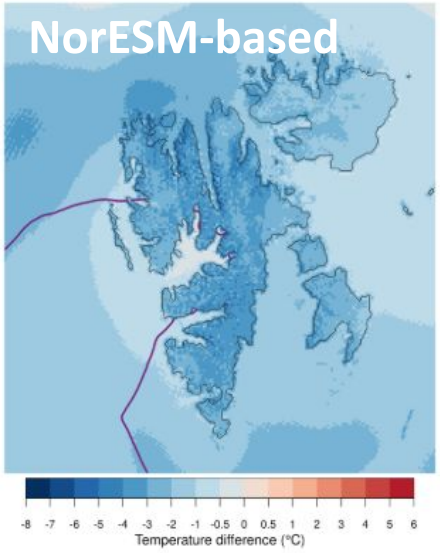

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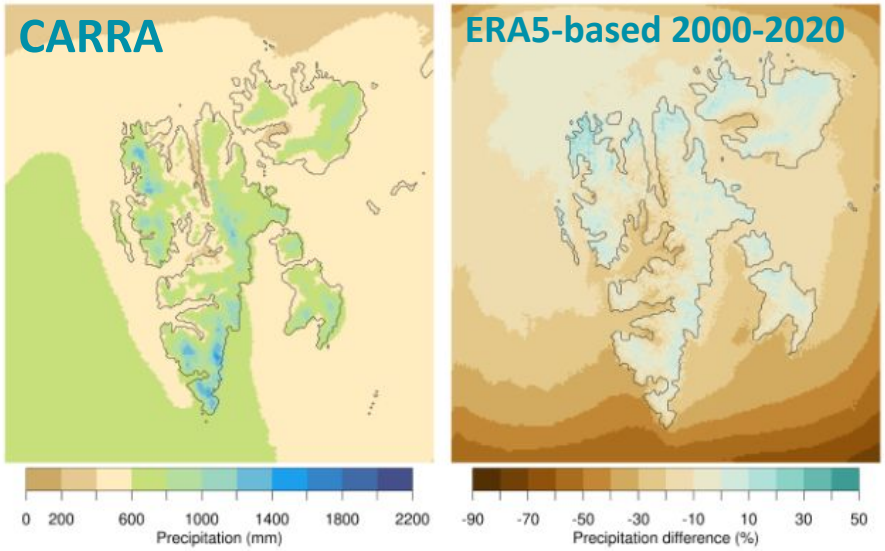
Precipitation



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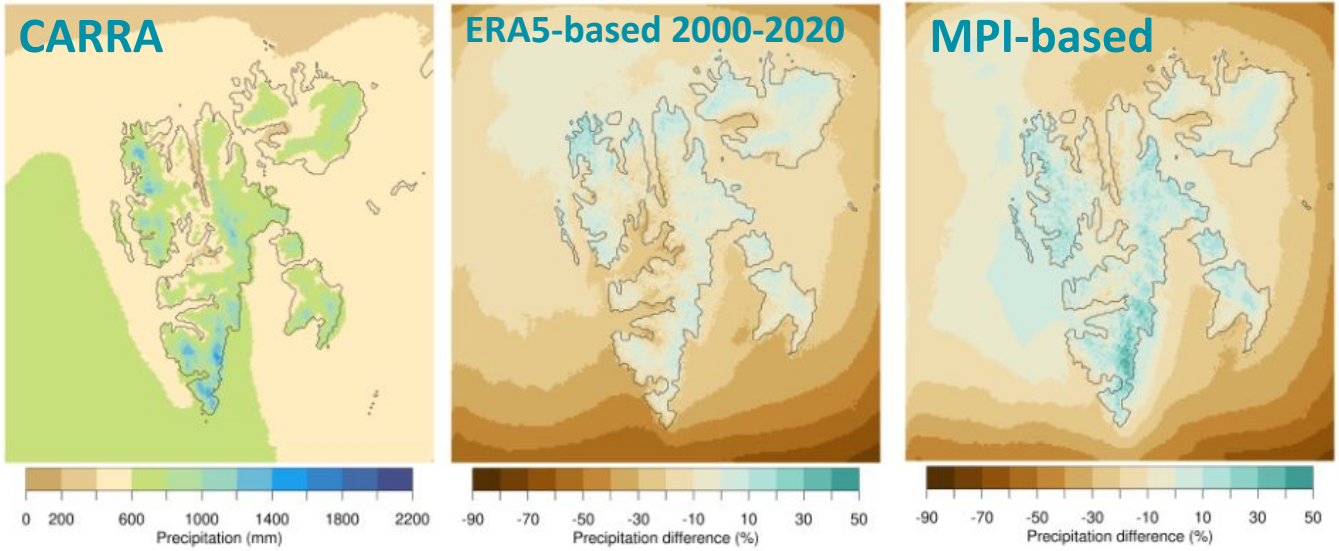

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- **NorESM** generally underestimates precipitation

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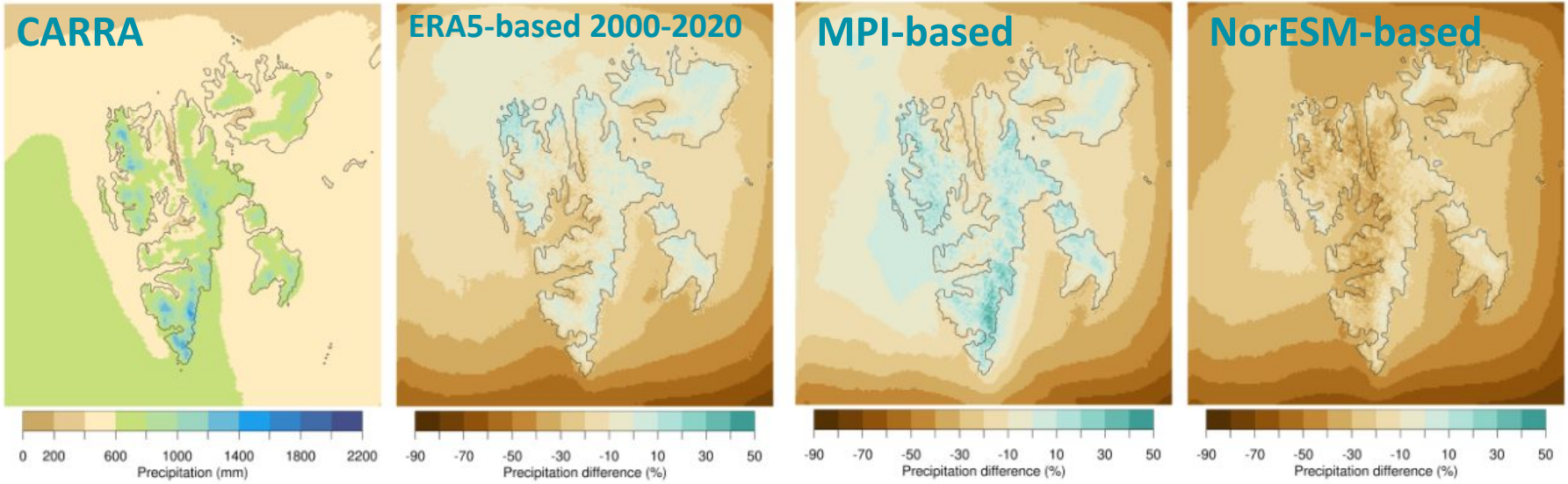

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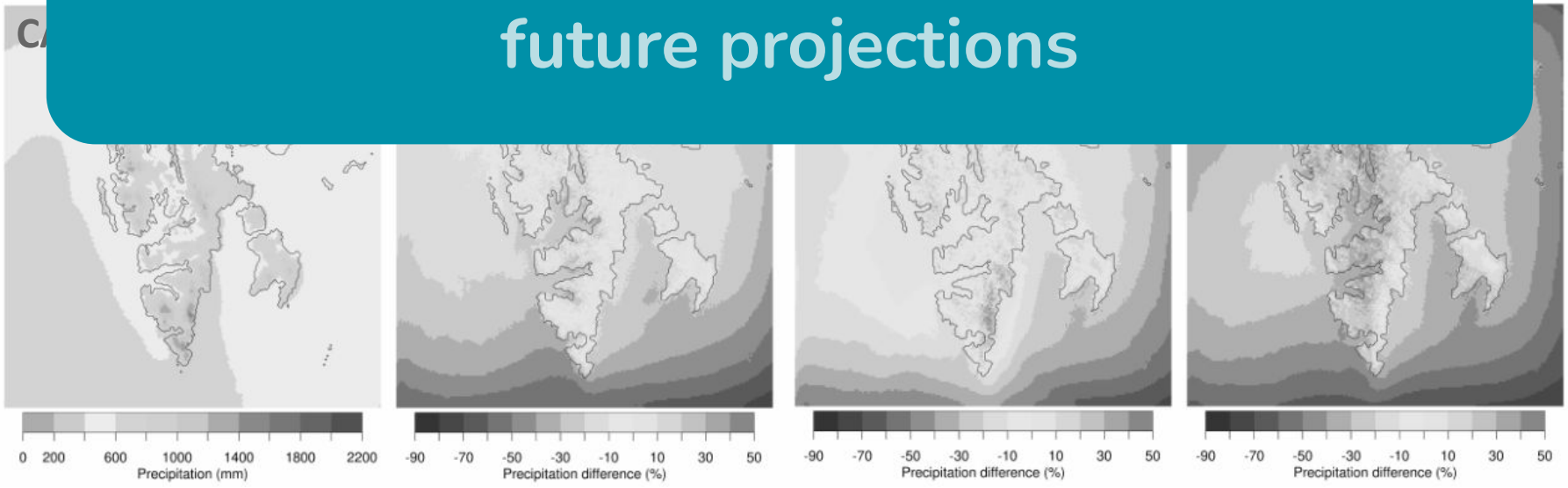
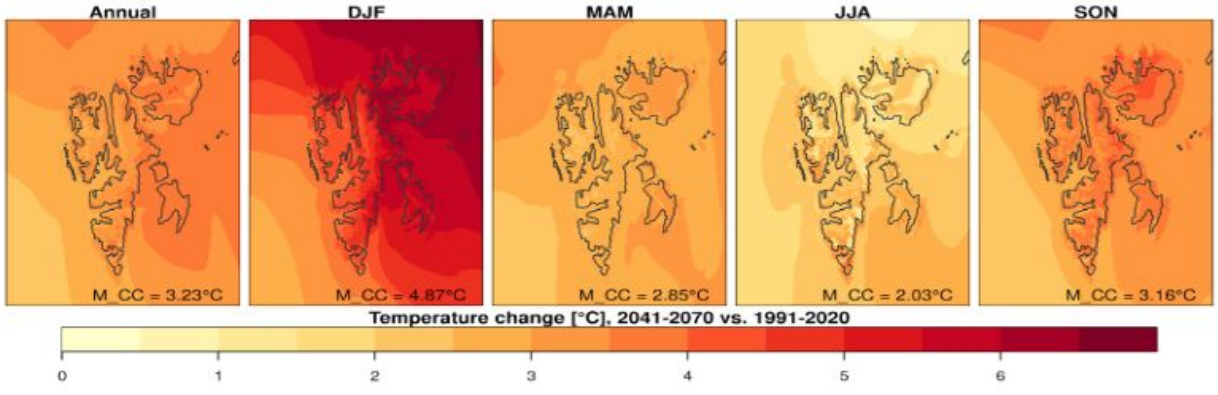
Simulations based on MPI-ESM chosen for future projections



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



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

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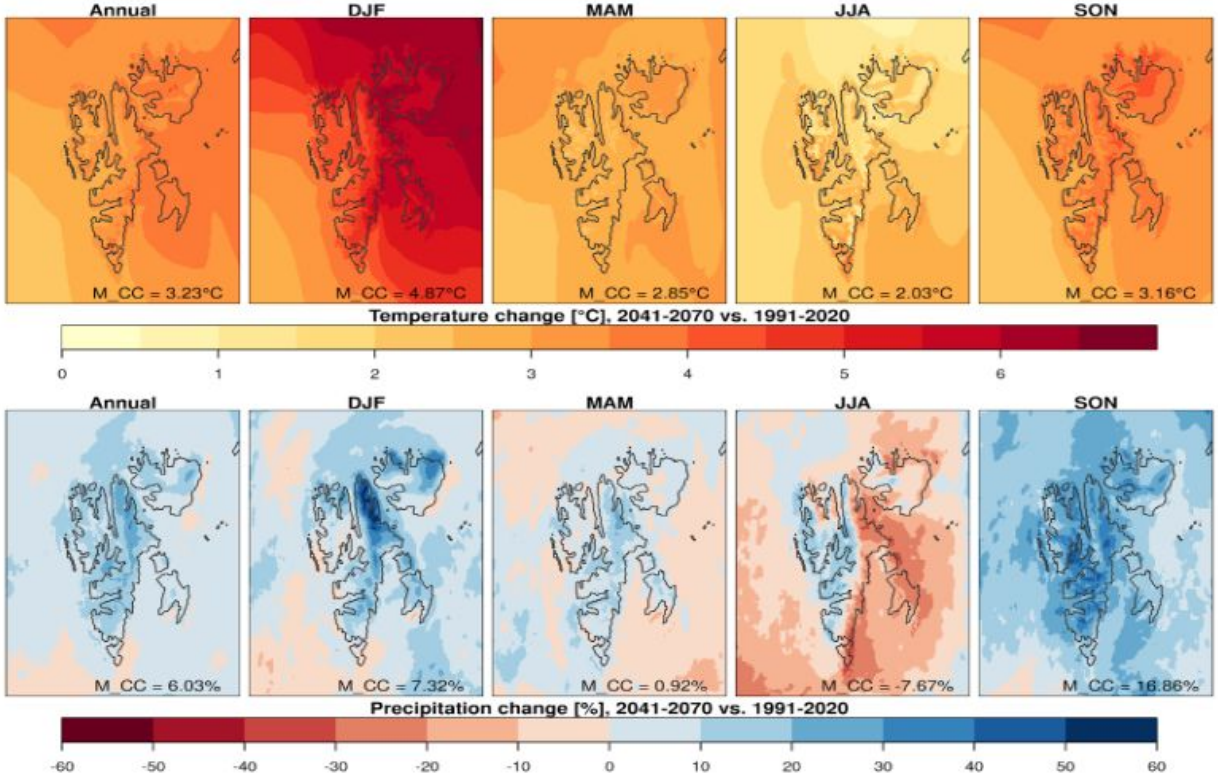

- **Temperature** increase: 3.2 °C
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- **Precipitation** increase: 6%
- **largest** precipitation increase: **autumn** (17%)

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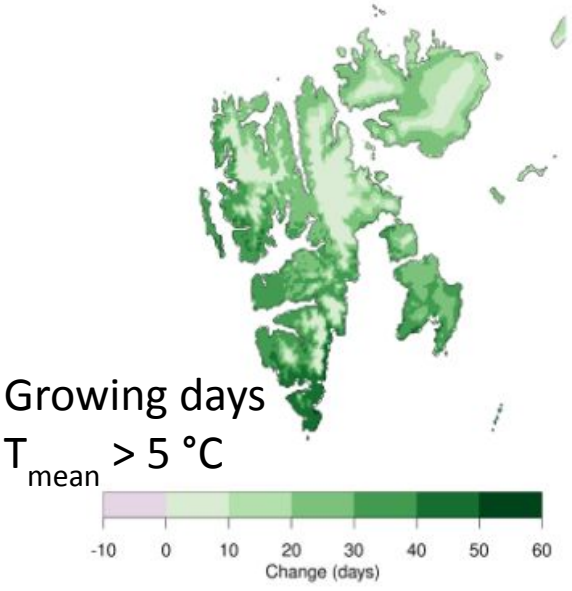
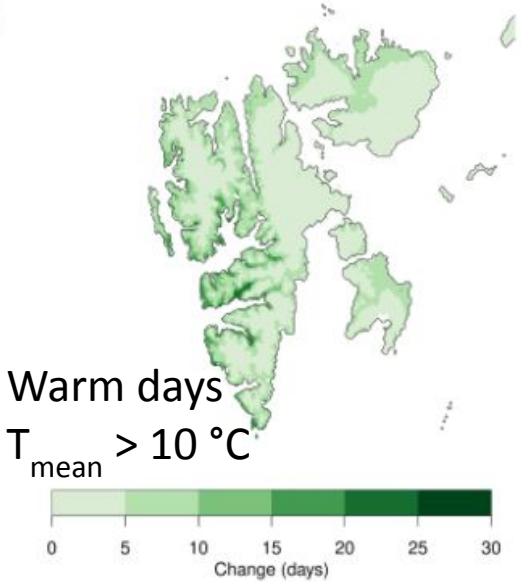
Growing, warm & frost days
2041–2070 vs. 1991–2020

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





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Growing, warm & frost days
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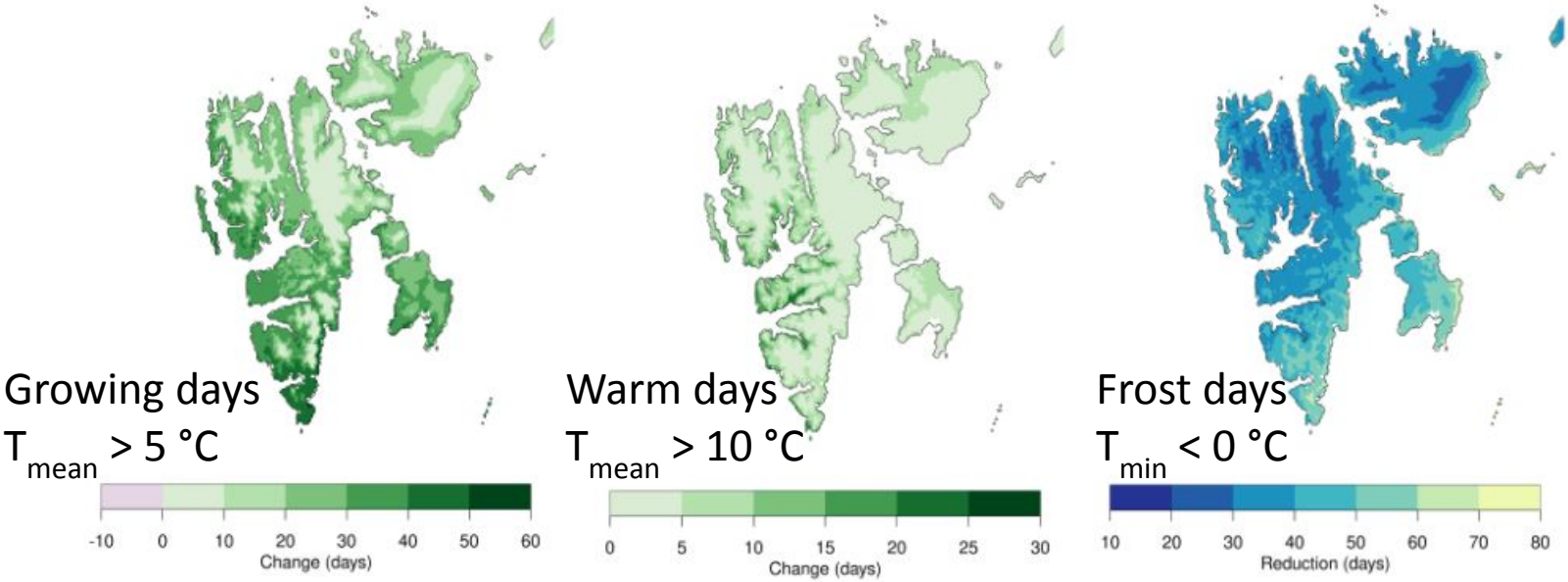
\+ **Zero crossing days** increase in colder areas

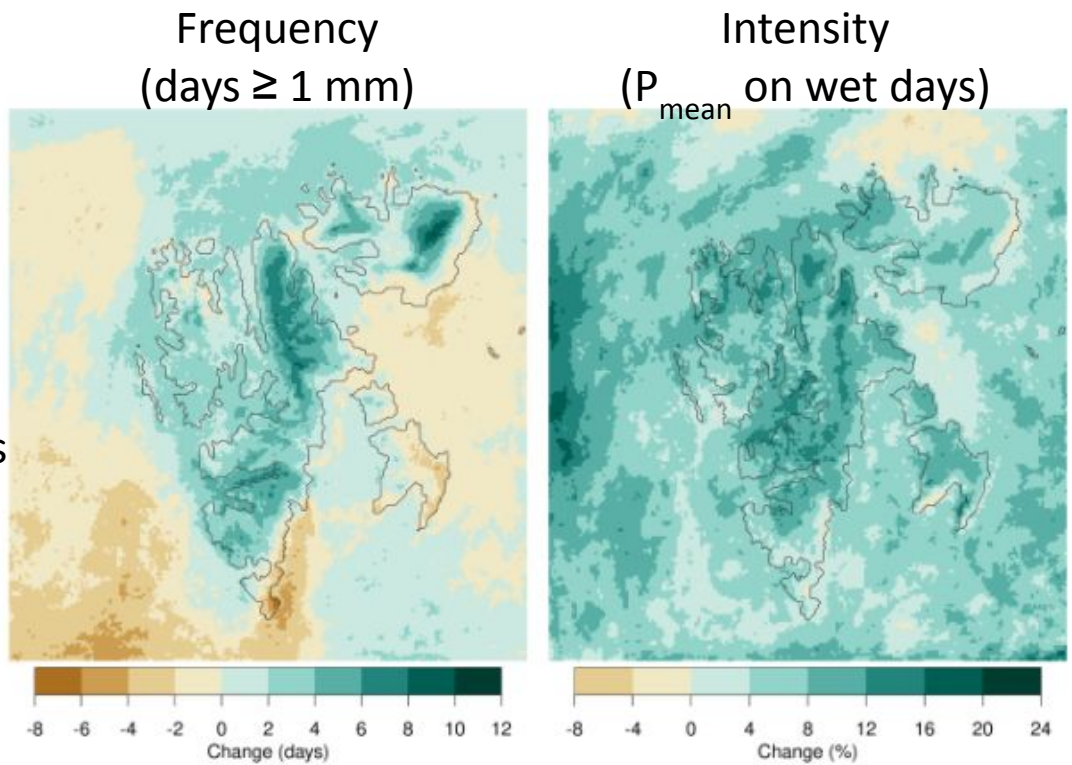
\- Fewer **frost days**, esp. southern Svalbard



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



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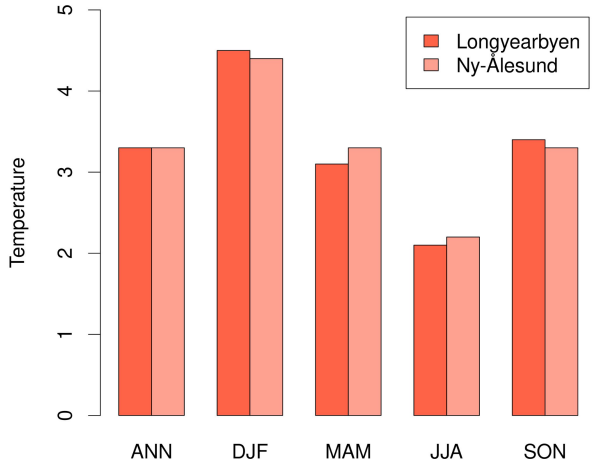
+ **highest** temperature increase in **winter** (4.5 °C & 4.4 °C)



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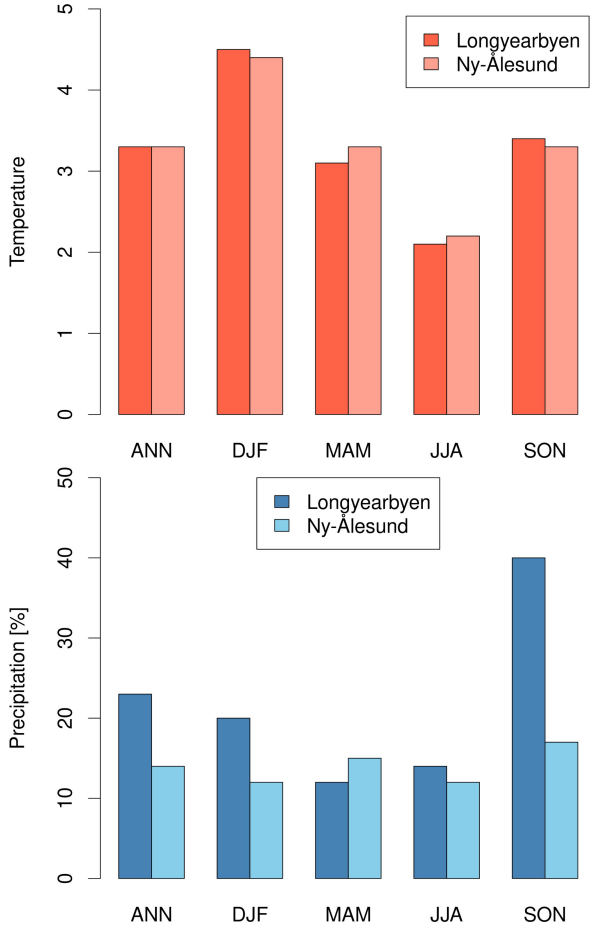

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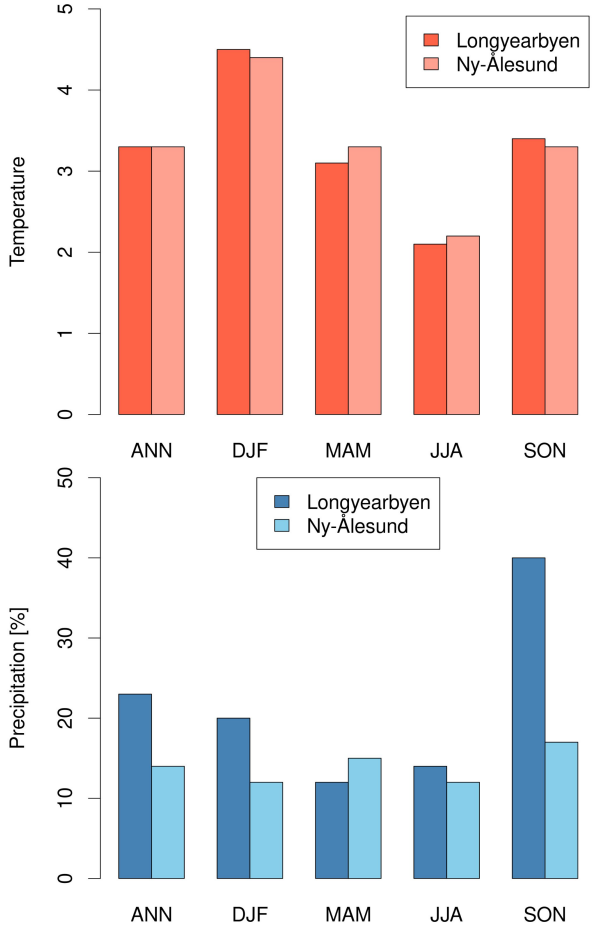
- **Snow fraction** 2041–2070: 37% (-14%) & 32% (-13%)



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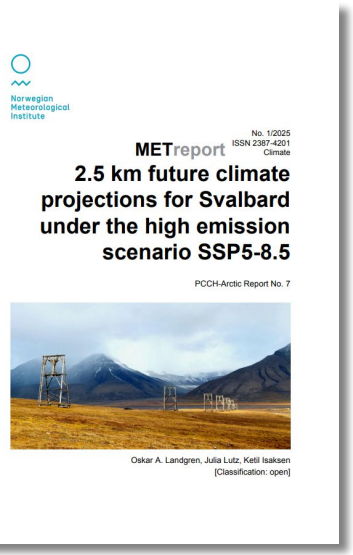

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- Data available online for download
- Encouraged to combine with other models