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Precipitation patterns for different circulation types over Svalbard and possible future changes

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Our questions

- **What do the circulation types around Svalbard look like?**

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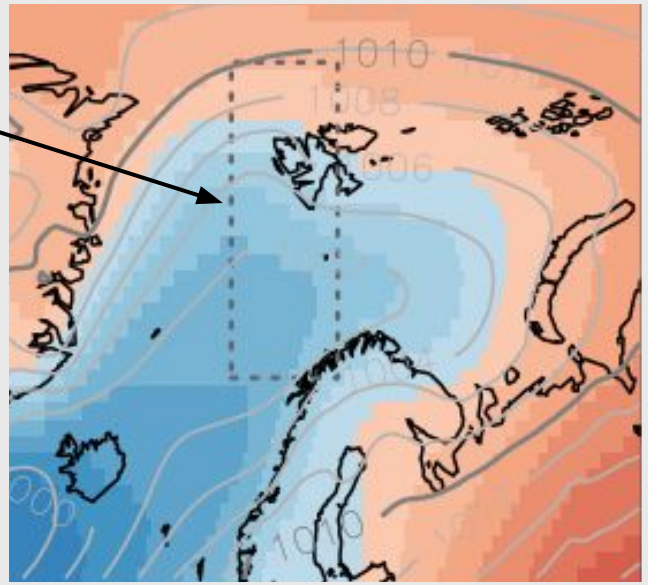
- What do the circulation types around Svalbard look like?
- How well are they represented in the MPI-ESM-LR simulation?
- How do the differences affect the COSMO-CLM simulations?
- How do the circulation types change in the RCP8.5 projection?
- What is the effect of the changes on the COSMO-CLM simulations?

Circulation type classification

Method

- Classification according to Jenkinson and Collison (JCT)
- Objective scheme that (acceptably) reproduces the subjective Lamb method
- Based on variability of pressure in 16 selected grid points
- 19 types:
  1-16: Dominant wind directions (N, NE, E, ...) plus cyclonic/anti-cyclonic
  17-18: Pure cyclonic or anti-cyclonic
  19: undetermined (light indeterminate flow)
- Available (among many more) through the cost733class package (FORTRAN)
- Classification area 3.75:21°E x 69:83.25 °N



Data

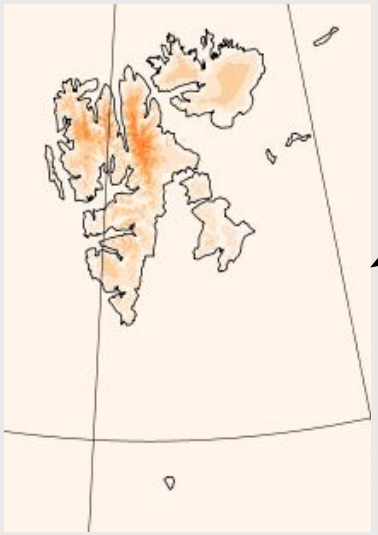
ERA-Interim (1979-2008) & MPI-ESM-LR (‘71-’00)
mean sea level pressure

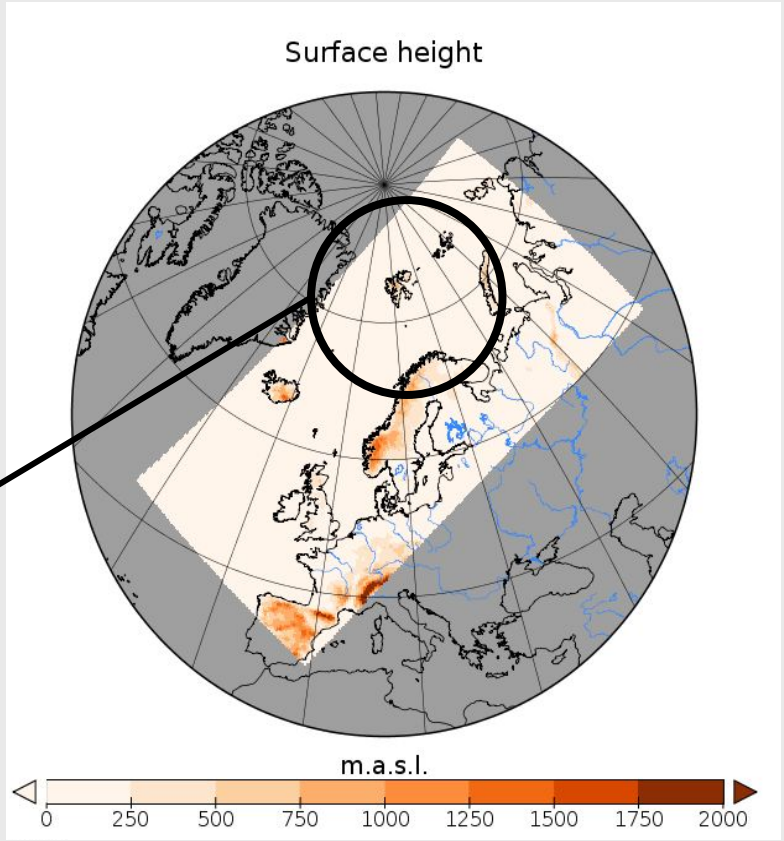
COSMO-CLM setup

High-resolution (2.5km) climate simulations for Svalbard

- COSMO-CLM regional climate model
- ERA-Interim driven: 2004 - 2017 (evaluation run)
- MPI-ESM-LR driven
  1971-2000 (“current climate”)
  2071-2100 (“future climate”)

- Intermediate 25 km nesting step
- No nudging etc.





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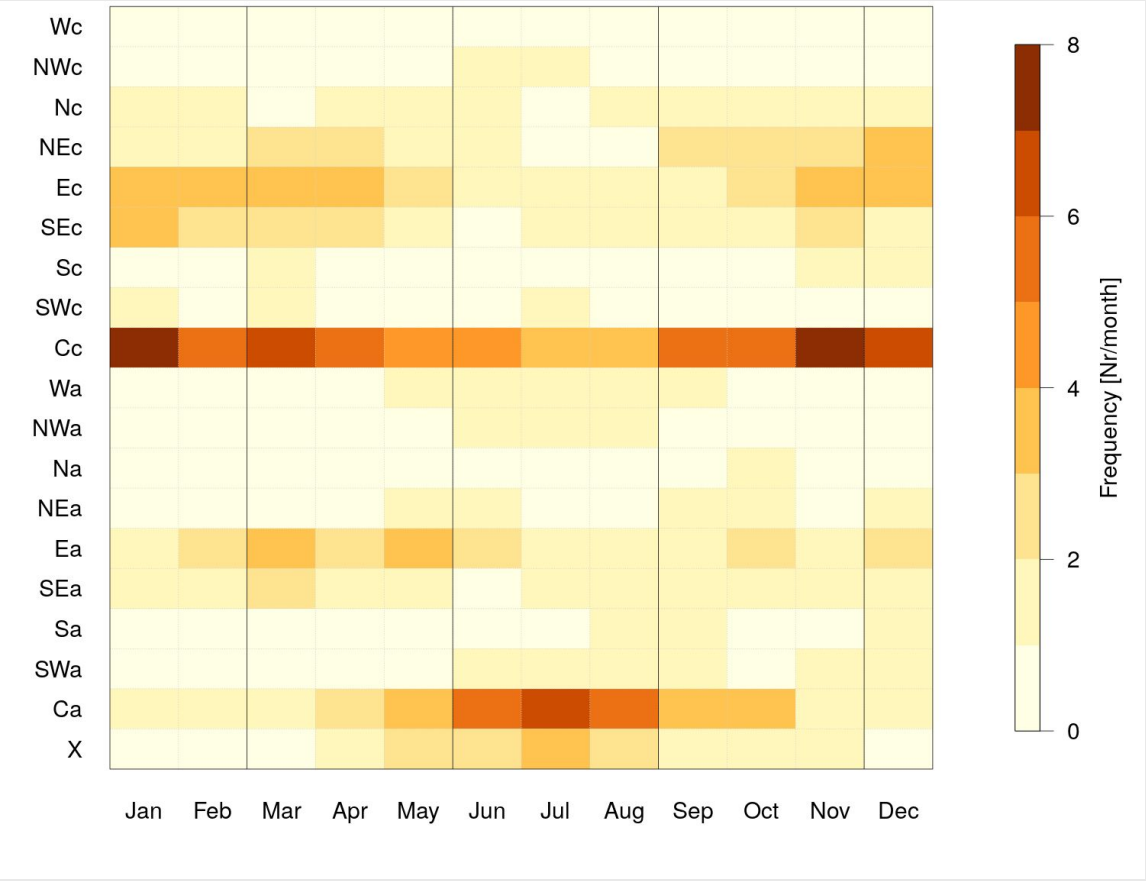
Monthly frequencies (ERA-Interim)



Highest frequency: pure cyclonic (Cc)

N, NE, E and SE flows dominate

Autumn/Spring/Winter

- NEc, Ec and SEc most frequent after Cc
- Cyclonic types more frequent than anticyclonic

Summer:

- Pure anti-cyc. most frequent
- Lowest cyc. frequencies esp. with eastern advection
- Highest freq. of anti-cyc. and undefined

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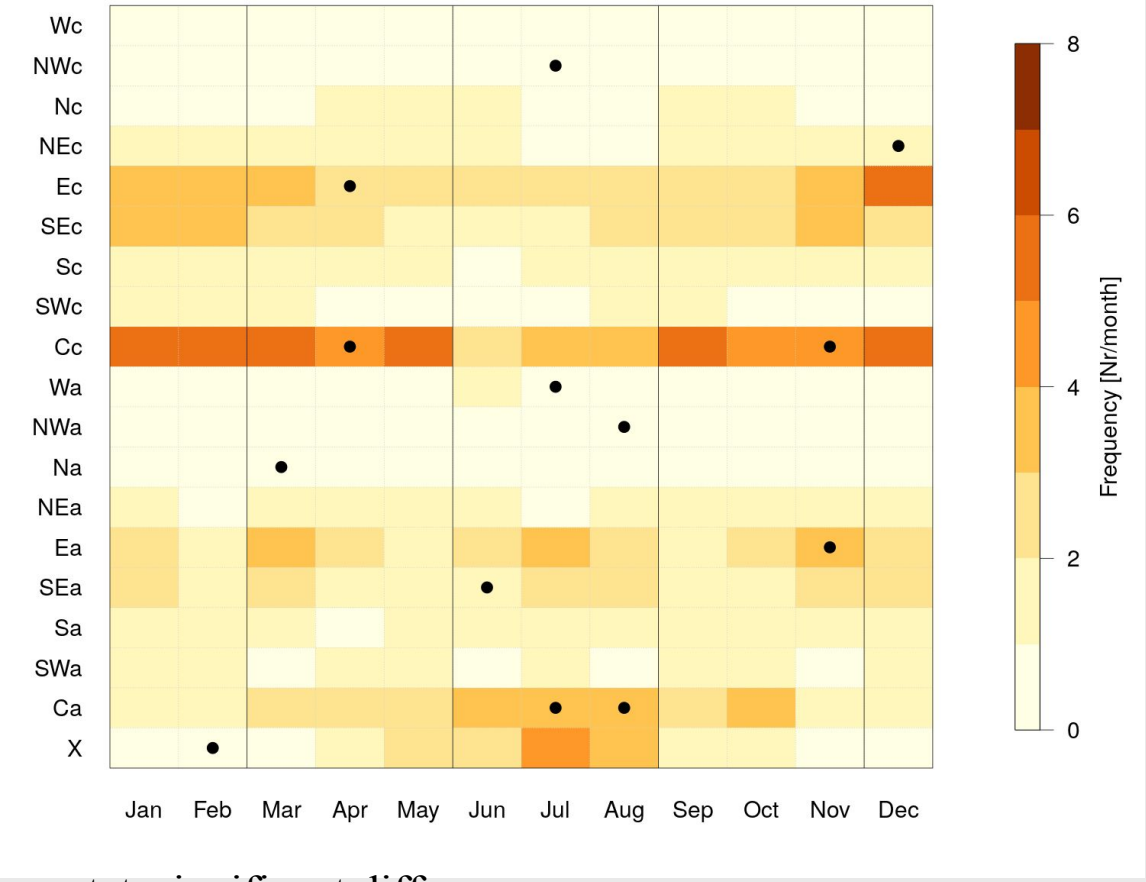
Monthly frequencies (MPI-ESM-LR)



●: stat. significant differences

Highest frequency: pure cyclonic (Cc)

Only a few stat. significant differences, mostly in summer

More equally distributed

Higher anticyclonic frequencies

–> Generally good representation of frequencies

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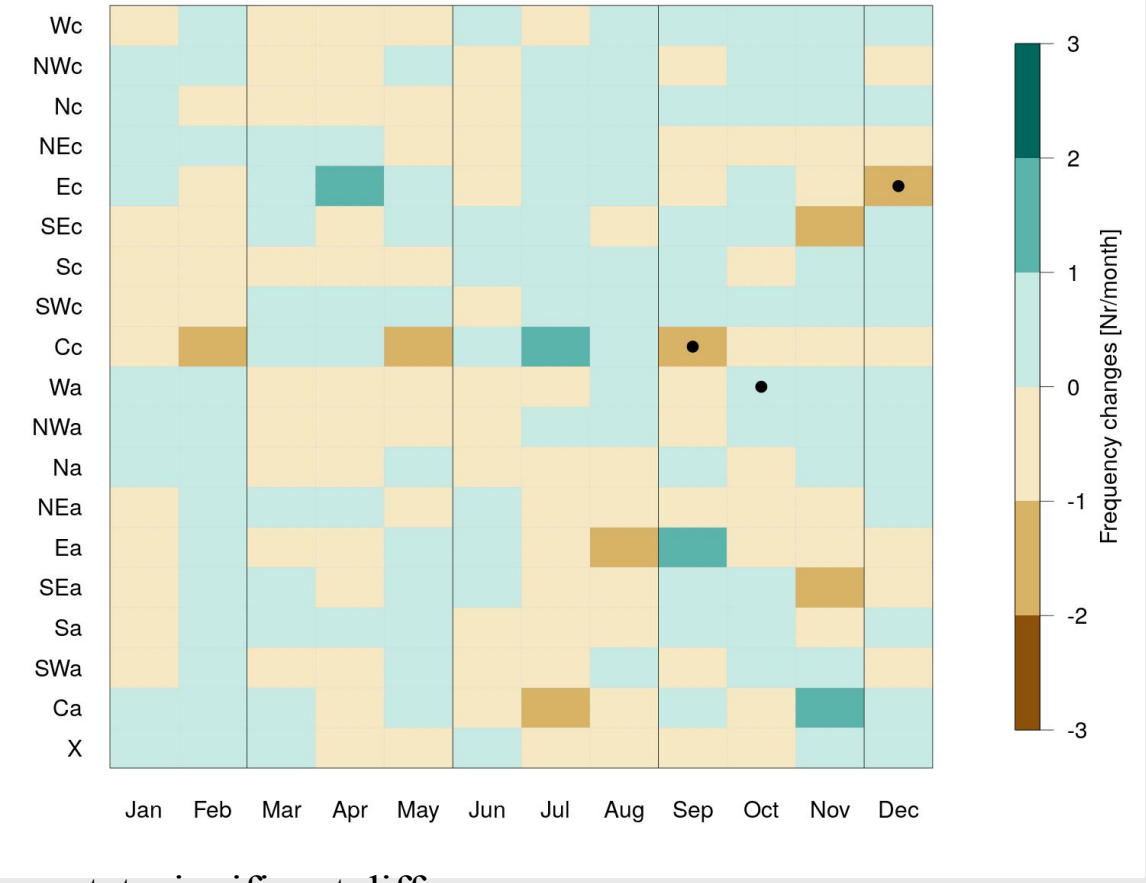
Monthly frequencies in RCP8.5



●: stat. significant differences

Only three stat. significant changes

- Cc in September: -1.9
- Ec in Dec: -1.8
- Wa in Oct: +0.3

Some non significant tendencies:

- Summer: more Cc, less Ca
- Other seasons: vice versa

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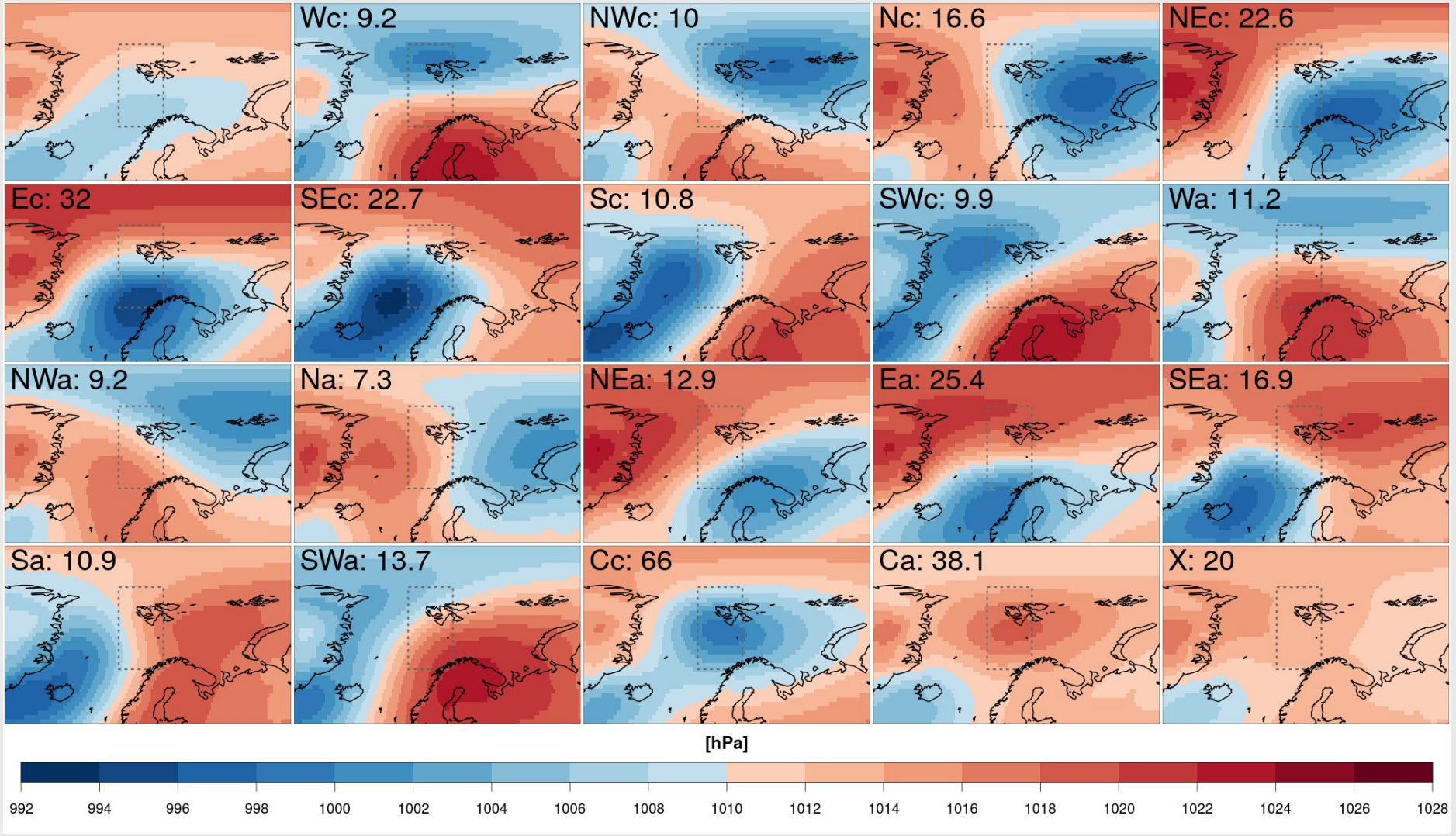
Mean sea level pressure (ERA-Interim)



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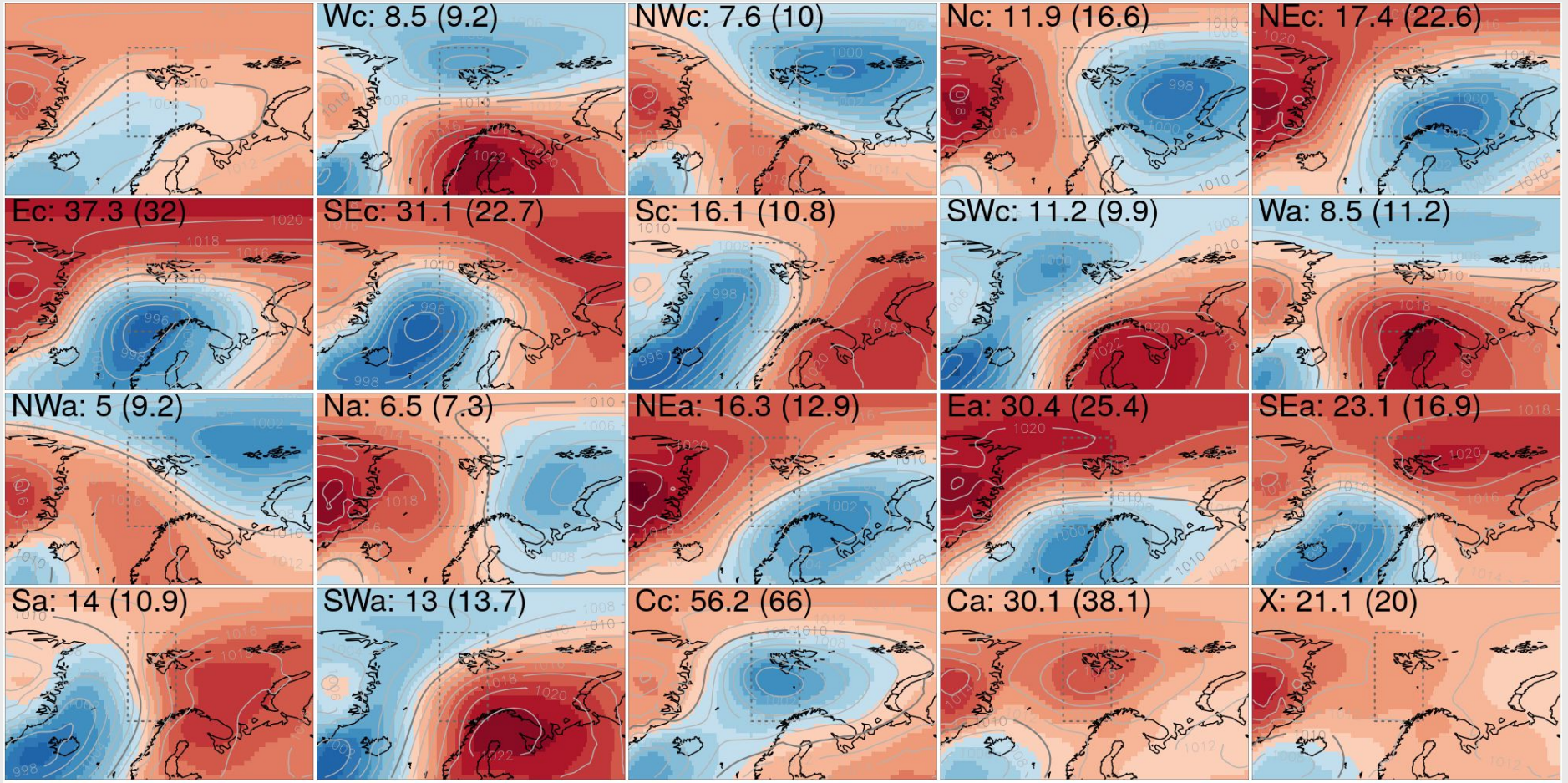
Mean sea level pressure (MPI-ESM-LR)



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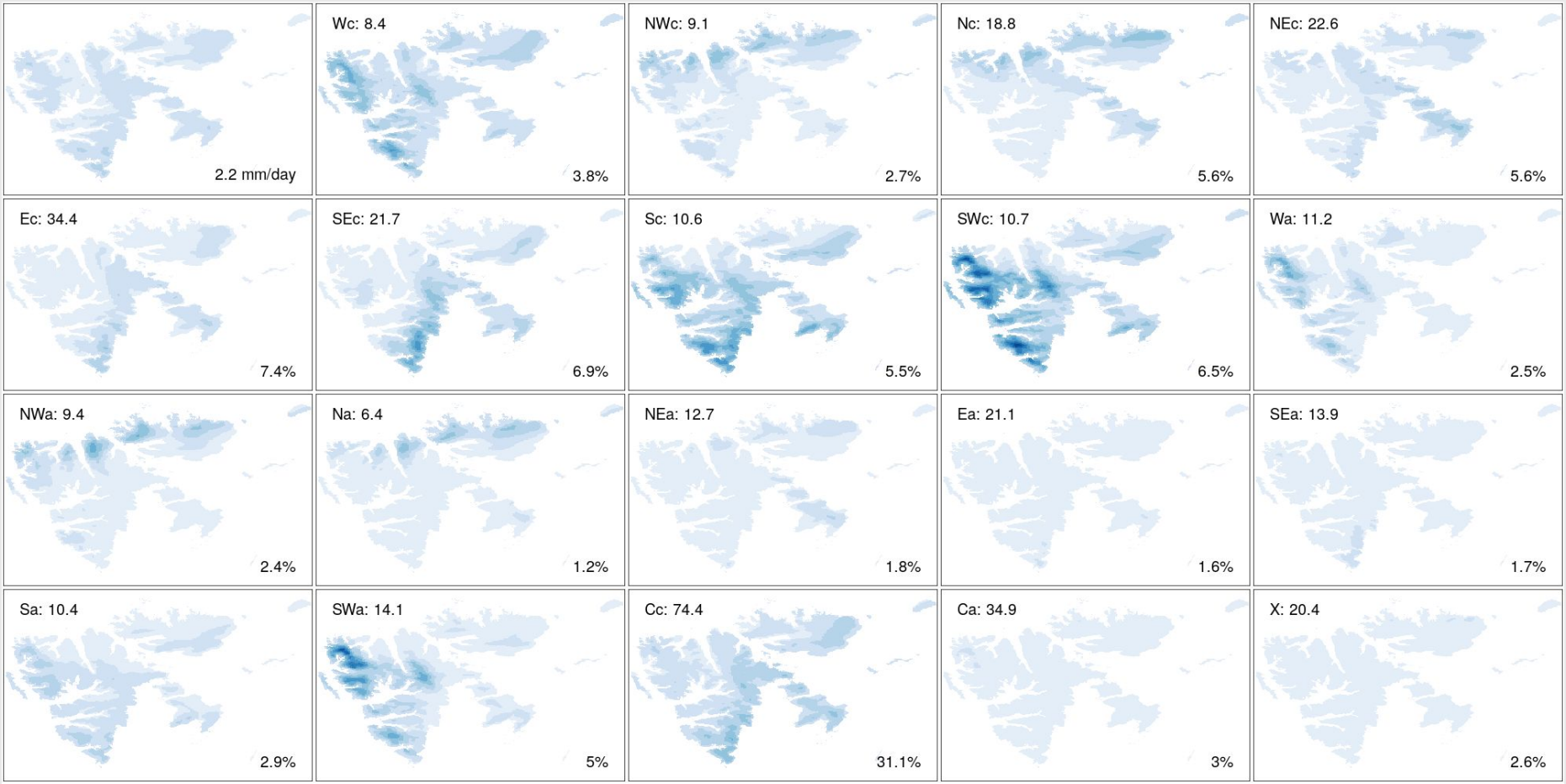
Circulation specific mean precipitation



CLM driven by ERA-Interim (2004-2017)

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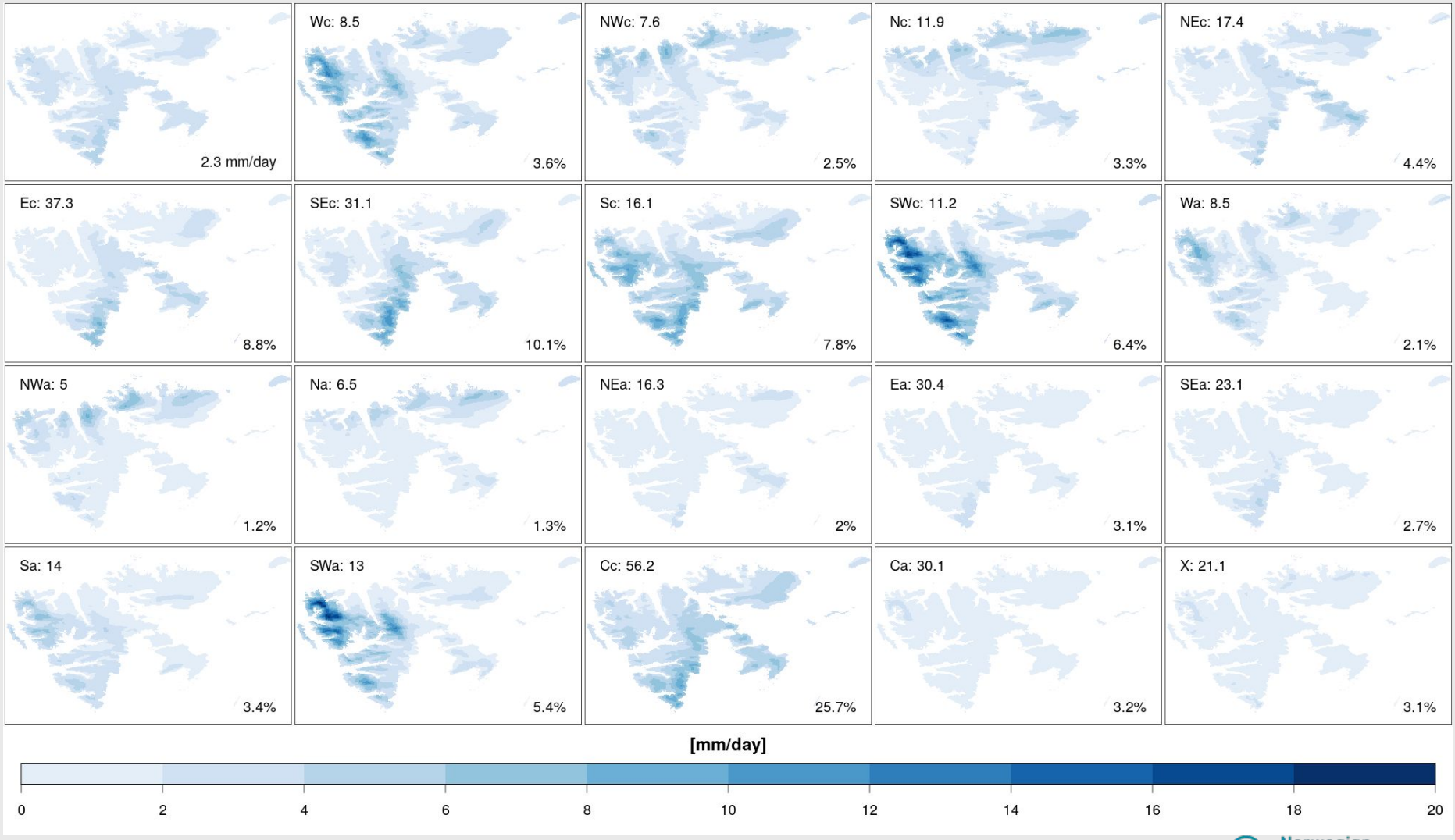
Circulation specific mean precipitation



CLM driven by MPI-ESM-LR (1971-2000)

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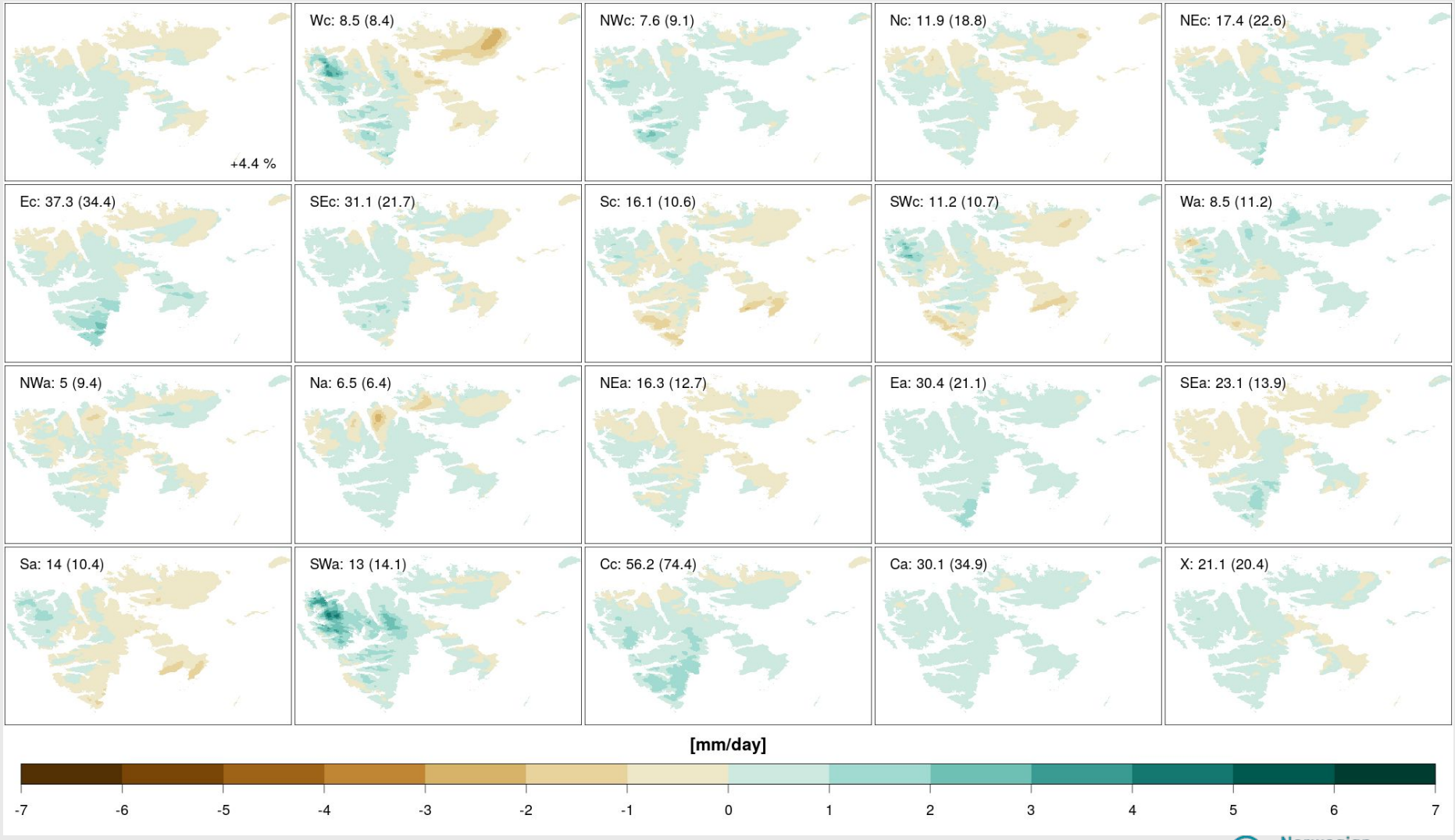
Precipitation differences due to GCM



CLM driven by MPI-ESM-LR - CLM driven by ERA-Interim

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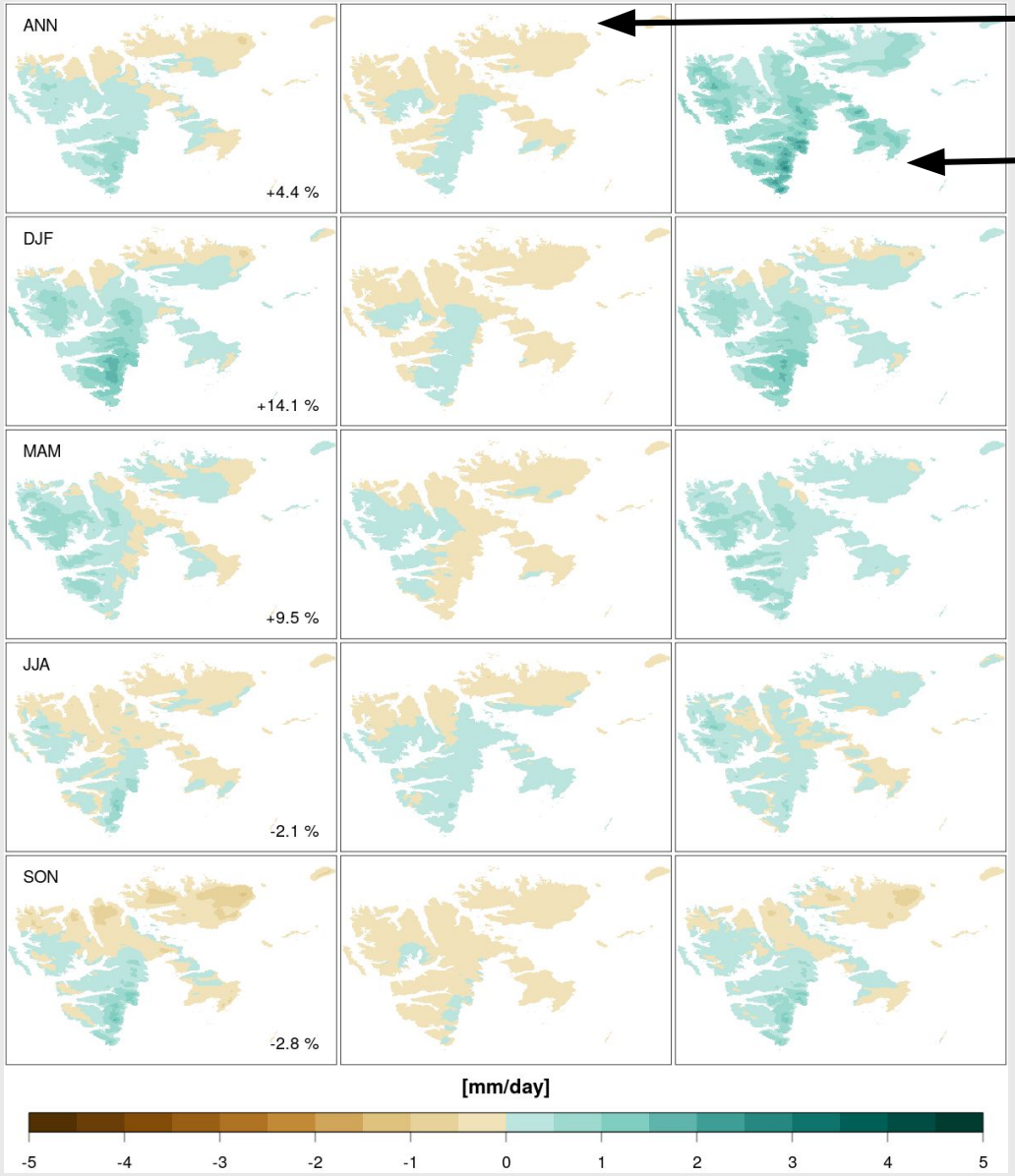

Parts from frequency difference

Parts from large-scale conditions diff.

Differences are mostly due to differences in large-scale conditions

Part from frequency diffs is small
For northern part and summer:
Frequency differences partly compensate large-scale conditions.

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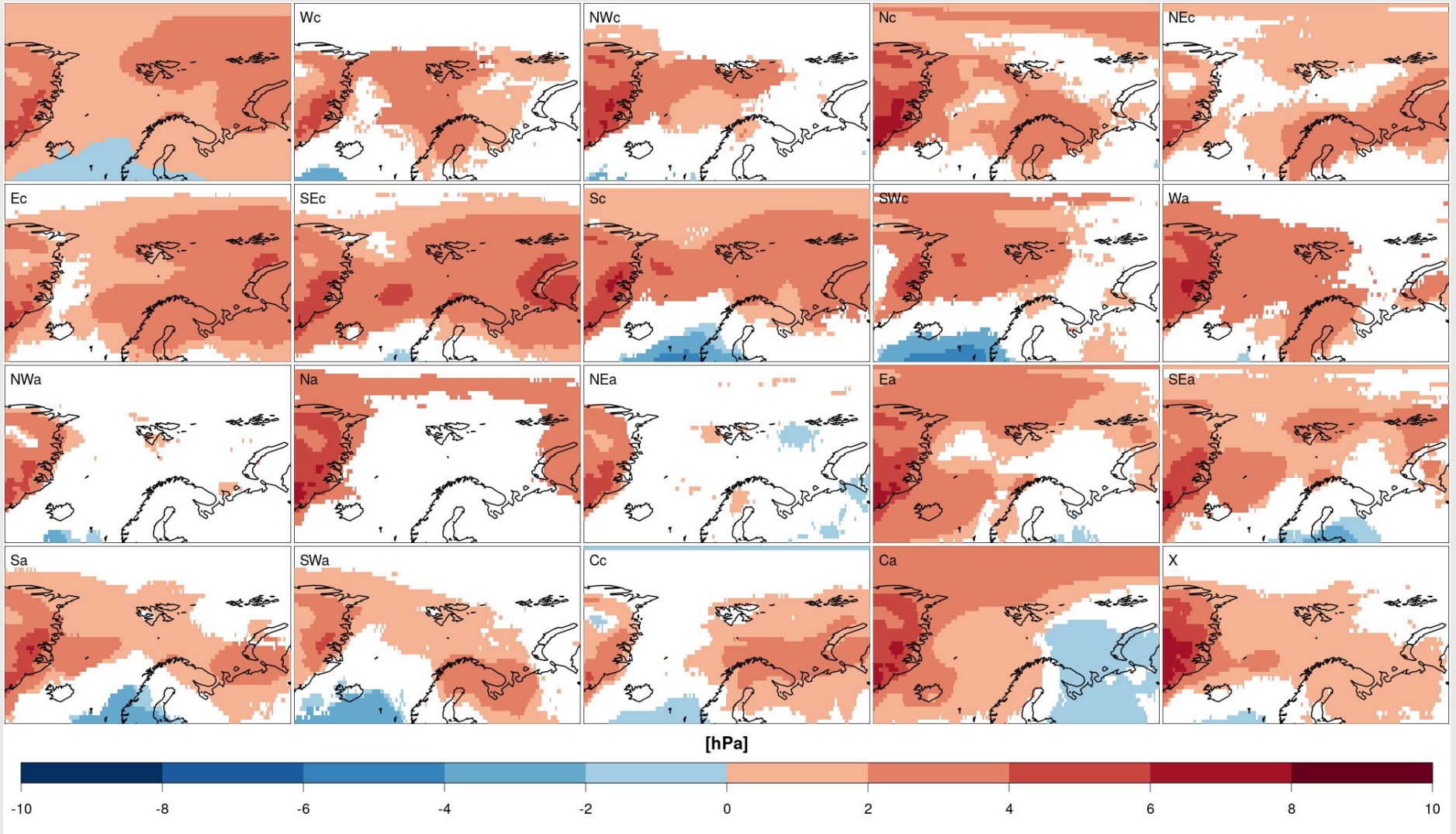
Mean sea level pressure bias



stat. significant differences

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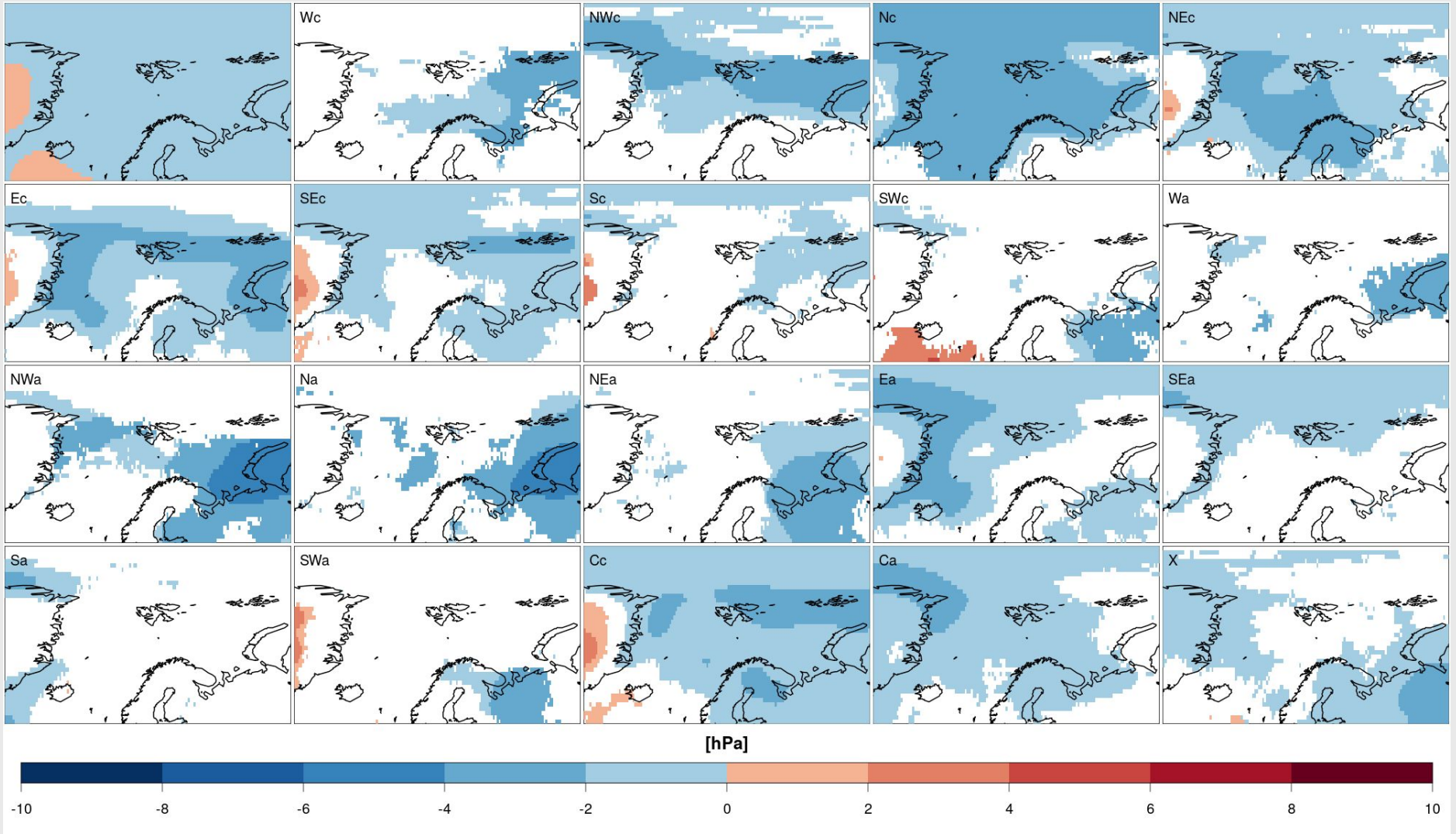
Mean sea level pressure changes



stat. significant changes

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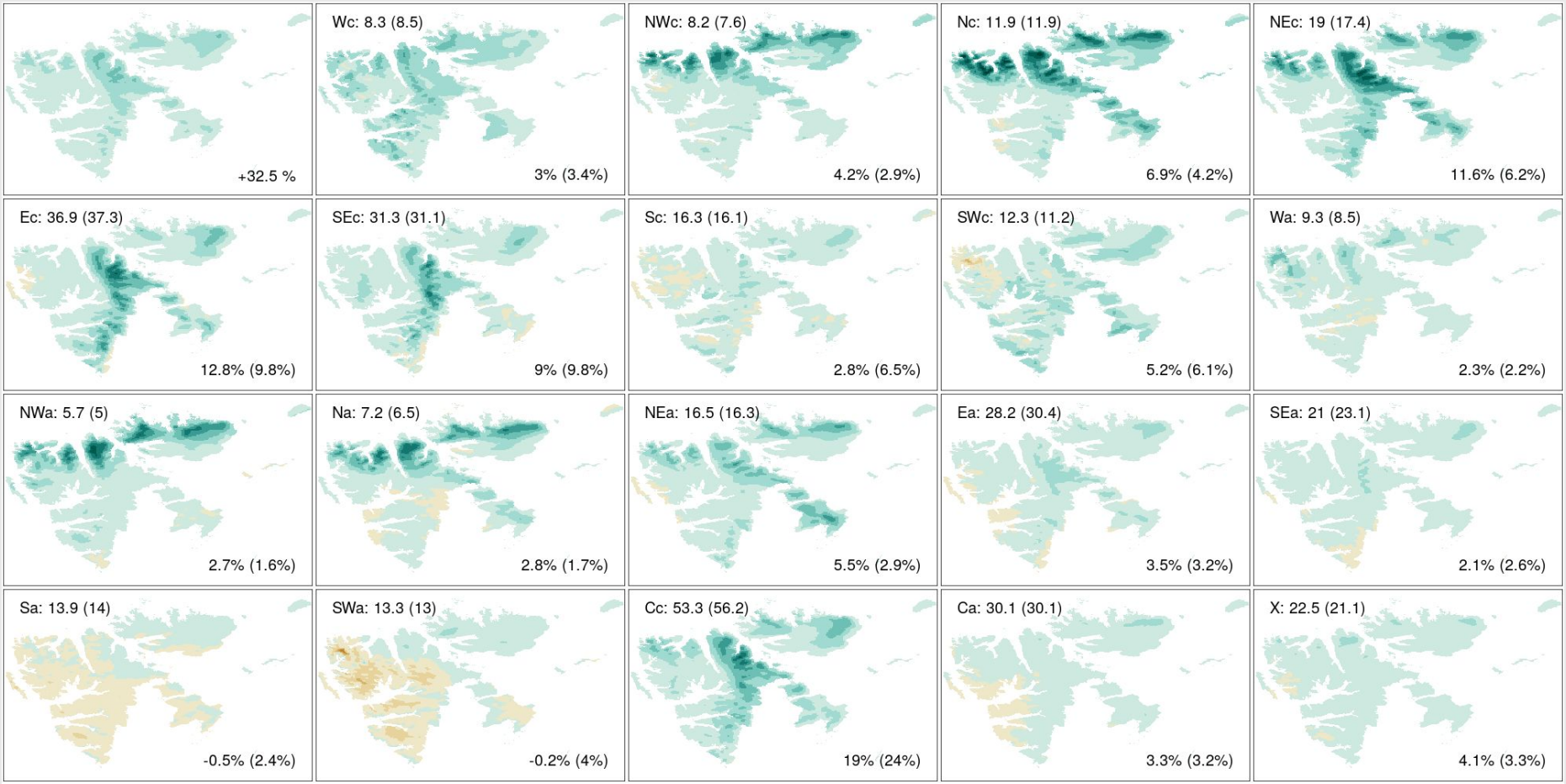
Precipitation changes



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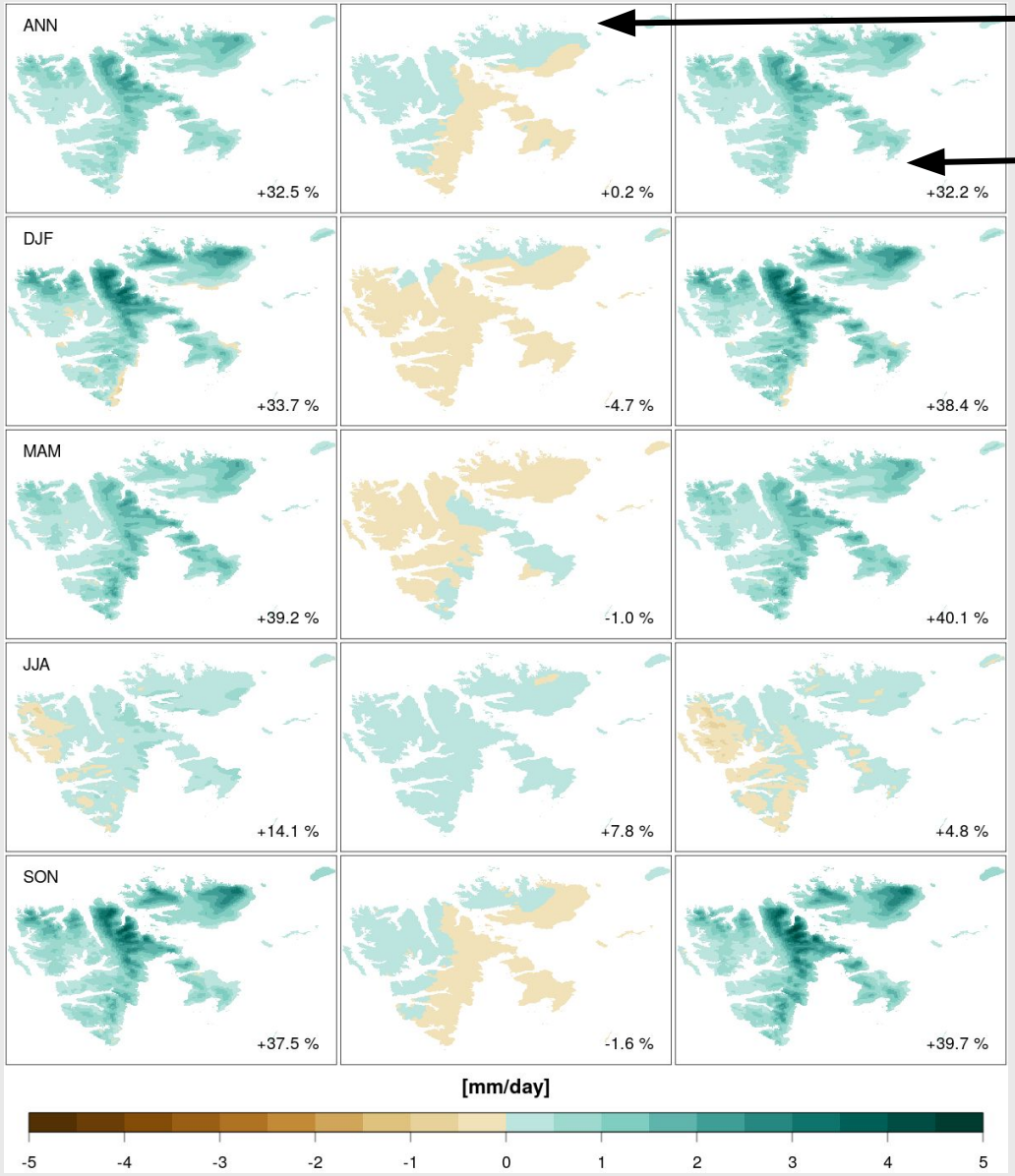
Precipitation changes



Parts from frequency difference

Parts from large-scale conditions diff.

Changes are mostly due to differences in large-scale conditions

Part from frequency changes is small except for summer.

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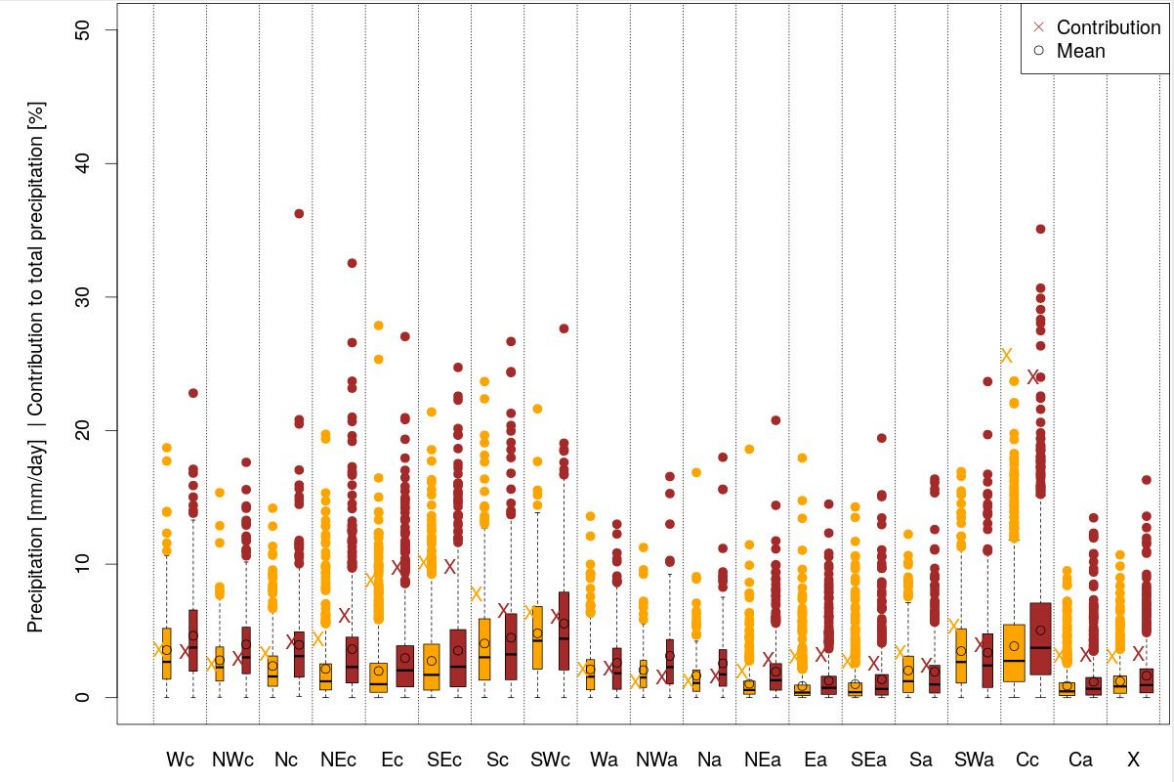
Precipitation changes



Mean precip increasing
Except: Sa and SWa

Contribution from northerly and easterly flows increasing.

Contribution from southerly flows is decreasing (!)

Frequencies do not change much.

The most extreme events (for Svalbard as a whole) are shifting to NEc and Nc.

The most extreme events are increasing for all ACs except Ea, Ec and Wa
–> although the southerly events may be less extreme than the eastern ones in the future (and happen a bit less often), they are still getting more extreme

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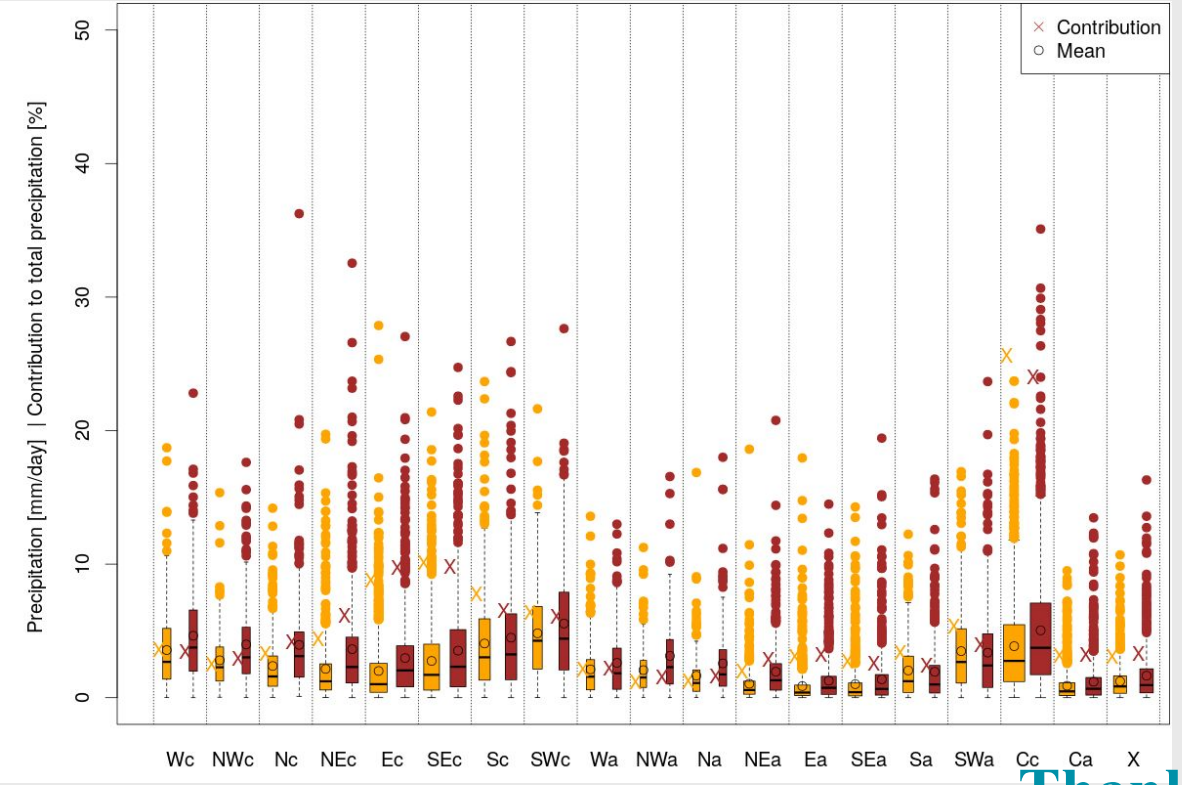
Precipitation changes



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Thank you for your attention!

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