Environment and Climate Change Canada | Environnement et Changement climatique Canada

Canada

# ACF - 8: Verification of the JJA2021 season
# ACF - 8: Seasonal forecast for the NDJ2021/22 season

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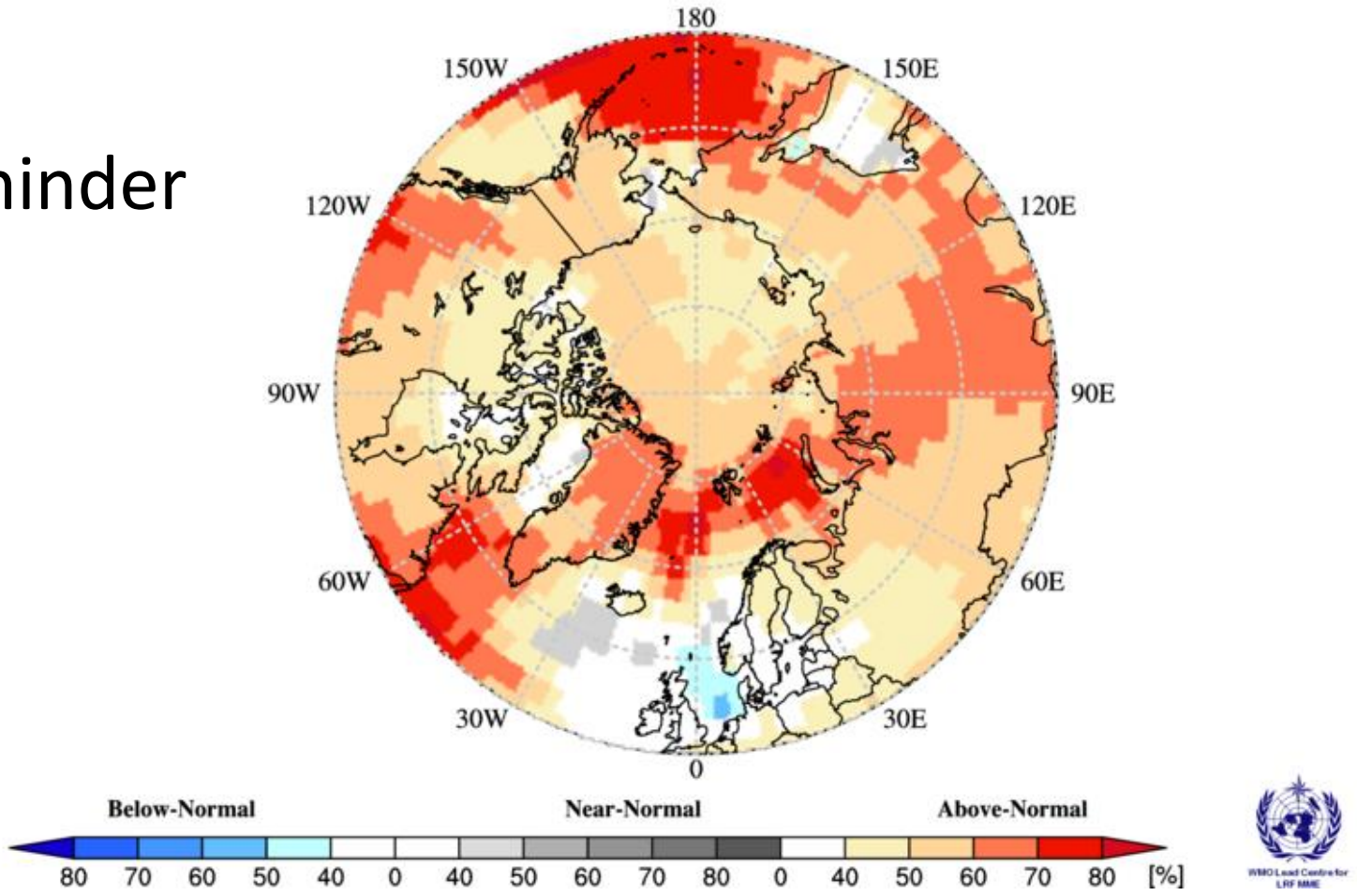
Environmental and Climate Change Canada

WMO

ACF
Arctic Climate Forum

# Seasonal forecast over the Arctic, JJA 2021

## A reminder

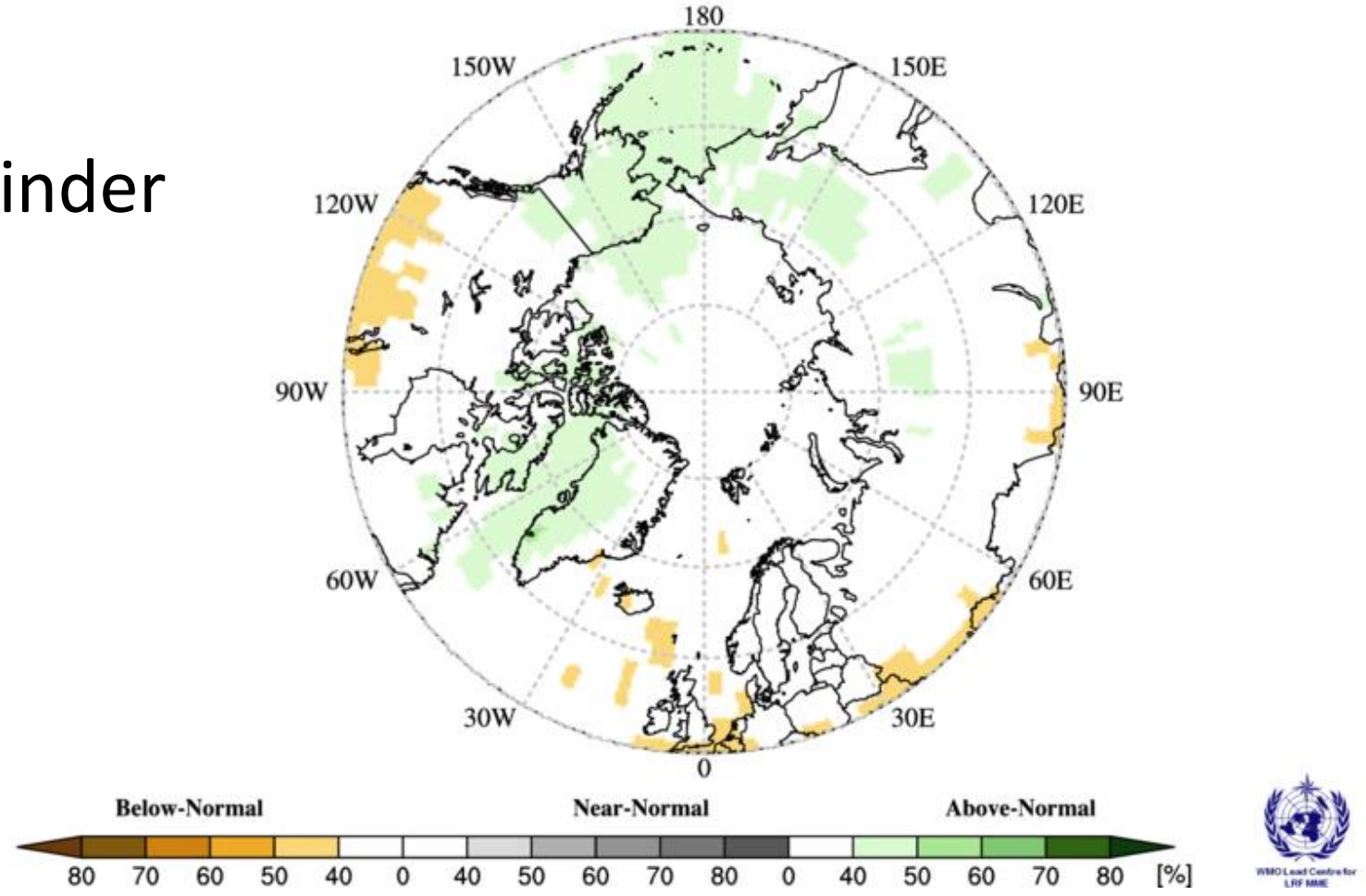



Considering multi-model ensemble forecast and a limited model skill over the Arctic:

**Temperature:** there is probability of 40% or more that temperatures will be above normal over most of the Arctic regions. The highest probabilities for this forecast were expected over Eastern Siberian region, southern Chukchi and Bering and southwestern portions of Alaska and western Canada region.

# Seasonal forecast over the Arctic, JJA 2021

A reminder




Considering multi-model ensemble forecast and a limited model skill over the Arctic:

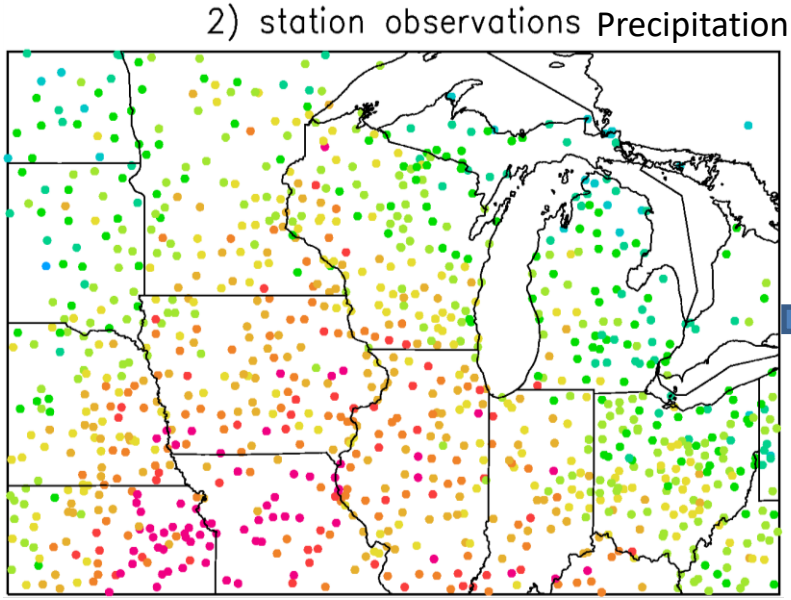
**Precipitation:** Mostly above normal precipitation were expected over western Sibirian, Chukchi and Berind and Alaska western Canada regions. Over other Arctic region, equal probability chances were expected.

# How do we verify seasonal forecasts?

- We need observations!

- Unfortunately we can not measure temperature or precipitation on every single point over the globe.

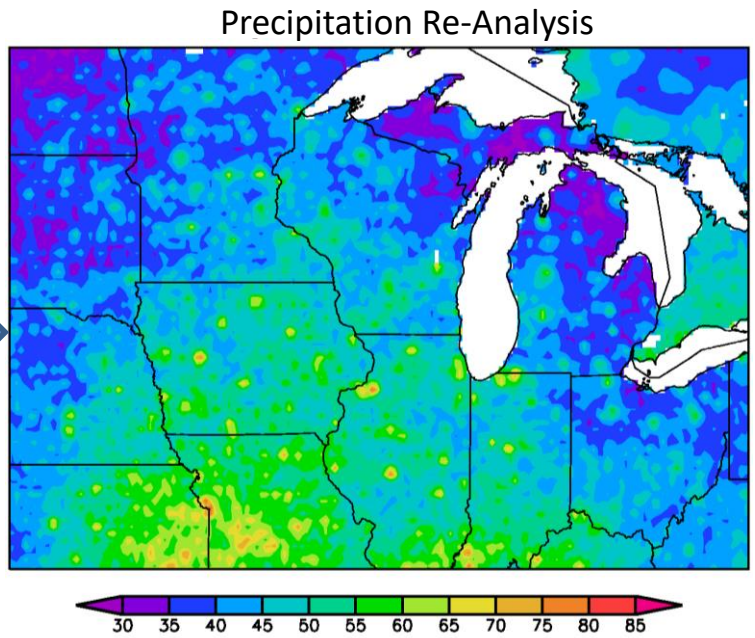
- This is why we use statistical techniques to interpolate measured variables over the regions where we can measure. The results is called **the re-analysis**.




https://dilorenz.github.io/downscaling2/ProbApp/interp.html

Data Assimilation

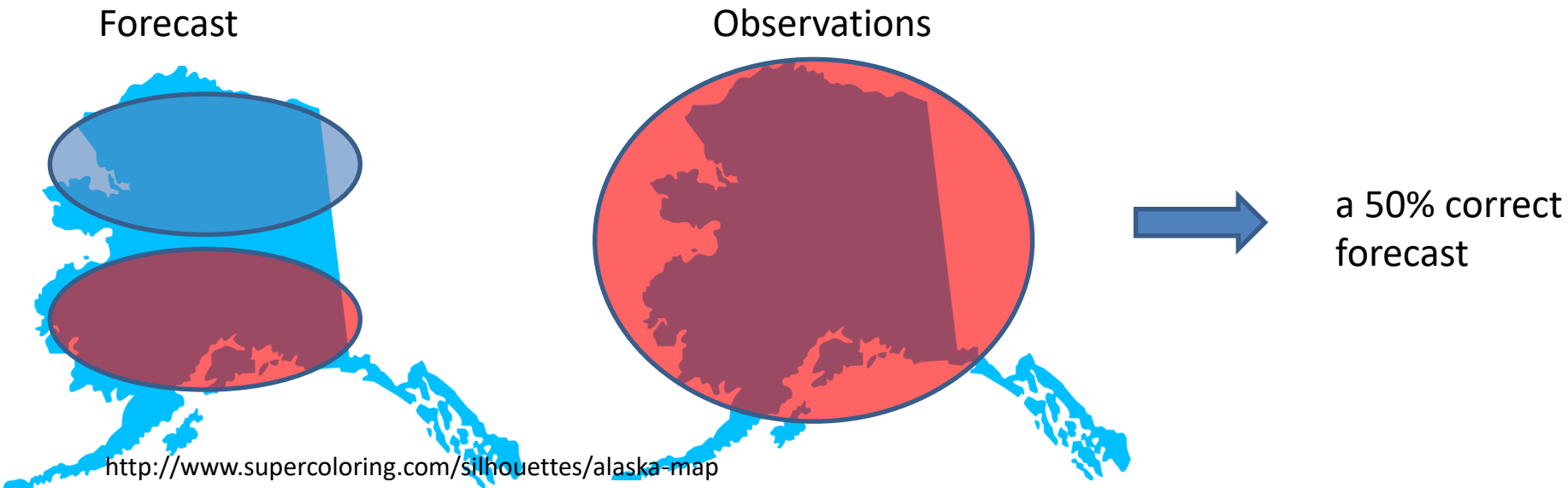
+ numerical modeling



# How do we verify seasonal forecasts?

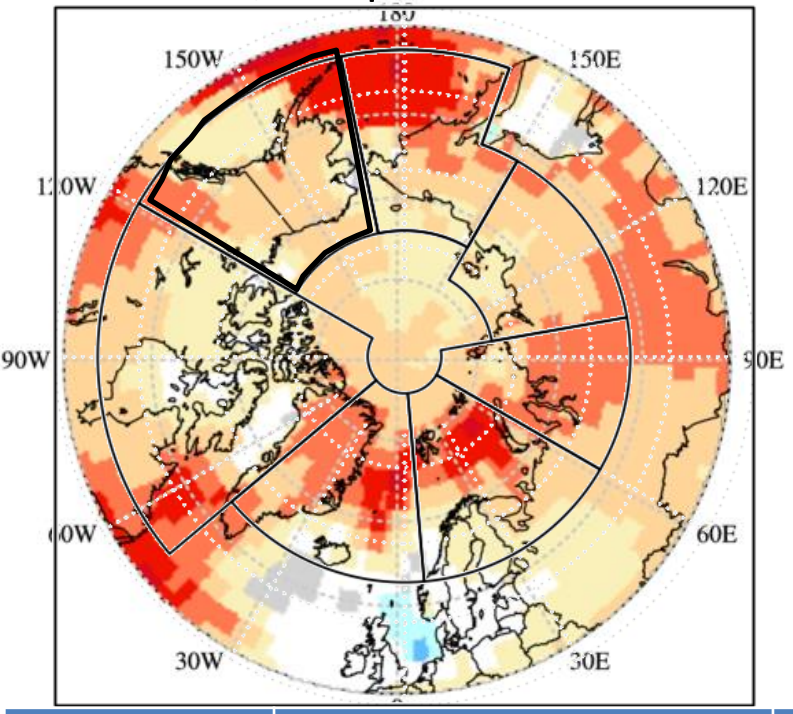
- We need some metric, some number to quantify the verification result
- We call this metric a score

- For the verification over the Arctic we will use a subjective score: a percentage of the correct forecast over a selected region in the Arctic.

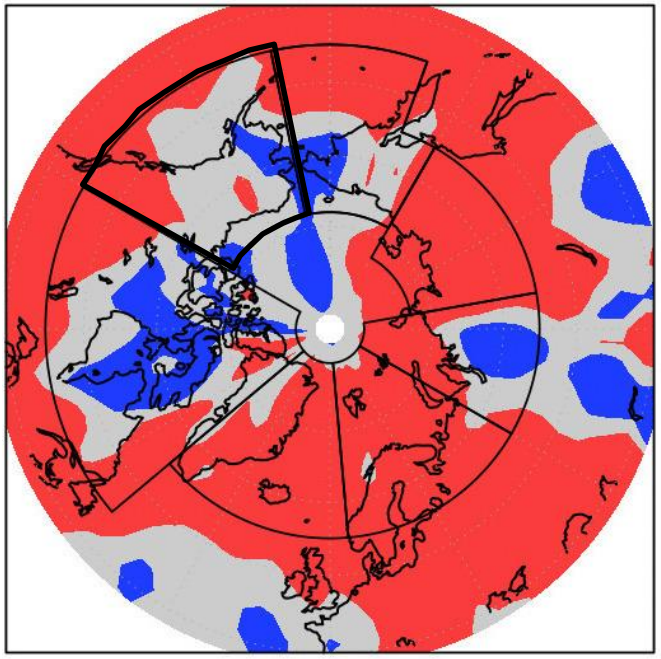


# Verification Temperature

## Forecast, temp JJA 2021




CFSR Reanalysis, Temperature JJA2021



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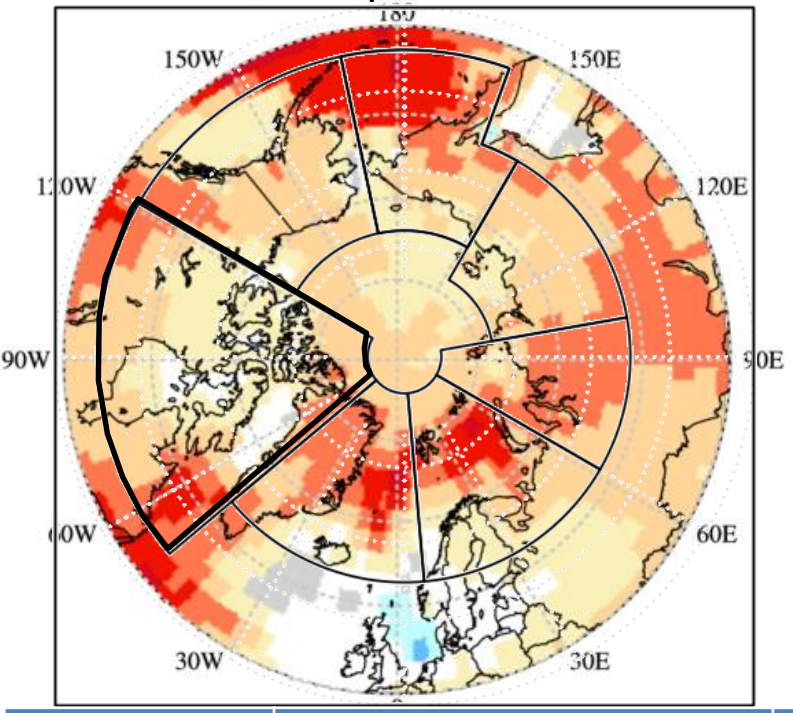
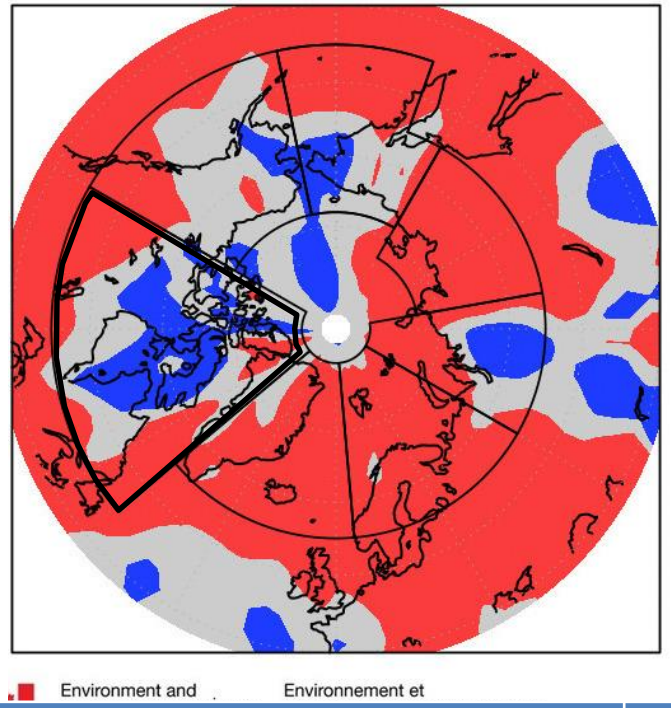
| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| **Alaska, W. Can** | **Mostly equal, below normal in the south and SW** | **Mostly near normal** | **20% hit, 80% miss** |
| C. - E. Canada | | | |
| W. Nordic | | | |
| E. Nordic | | | |
| W. Siberia | | | |
| E. Siberia | | | |
| Chukchi-Bering | | | |

# Verification Temperature

Forecast, temp JJA 2021




CFSR Reanalysis, Temperature JJA2021

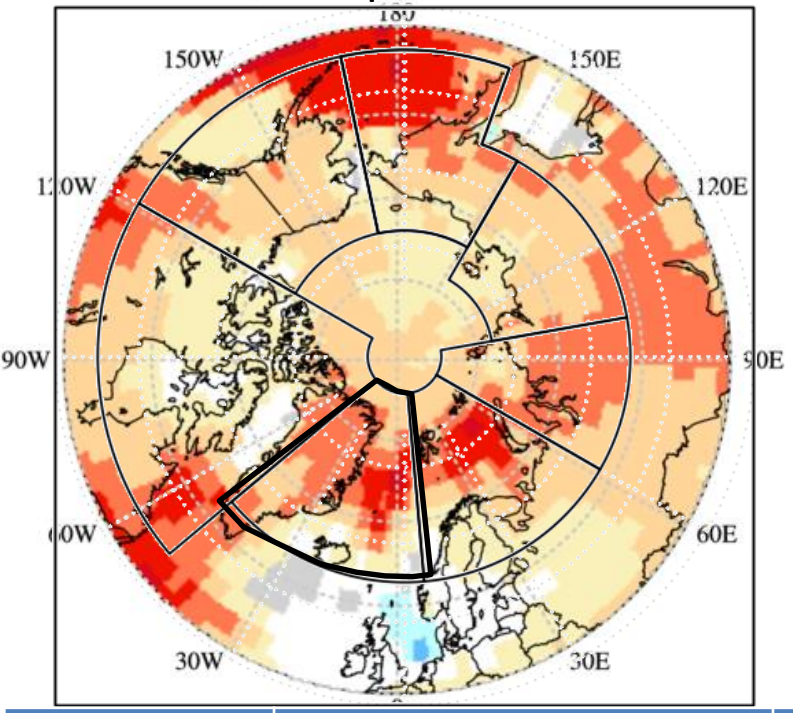


Environment and Environnement et

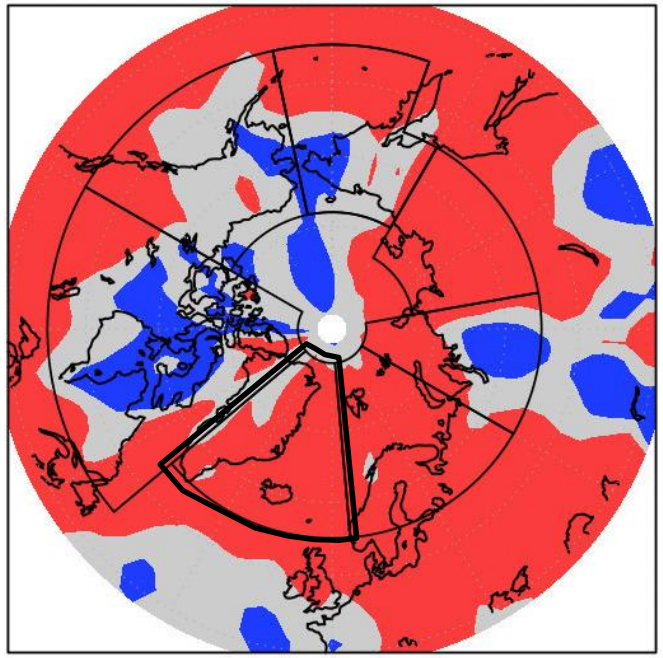
| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Above normal | Mostly near normal | 20% hit, 80% miss |
| **C. - E. Canada** | **Above normal** | **Below and near normal in the region's center. Above in the east and west.** | **20% hit, 80% miss** |
| W. Nordic | | | |
| E. Nordic | | | |
| W. Siberia | | | |
| E. Siberia | | | |
| Chukchi-Bering | | | |

# Verification Temperature

Forecast, temp JJA 2021




CFSR Reanalysis, Temperature JJA2021



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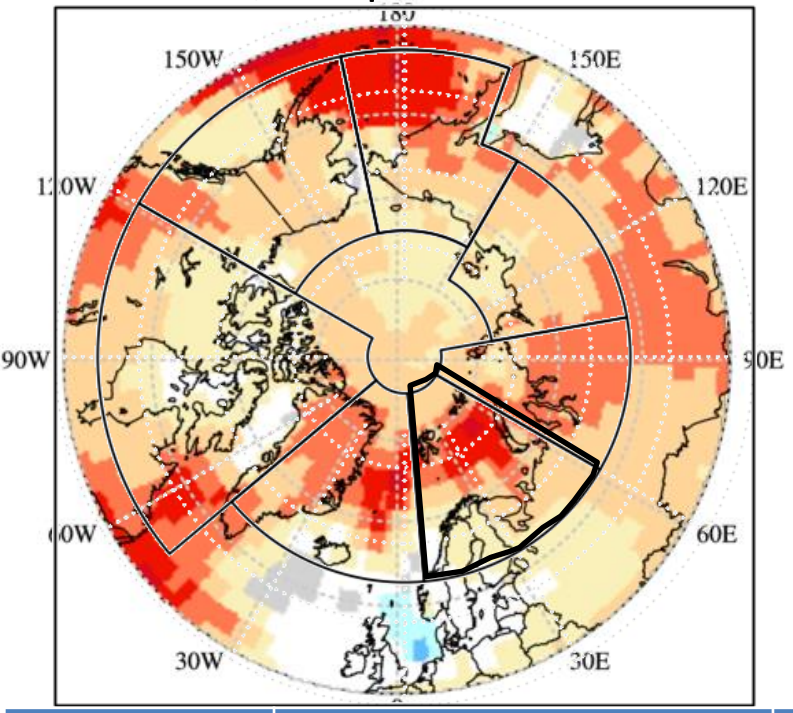
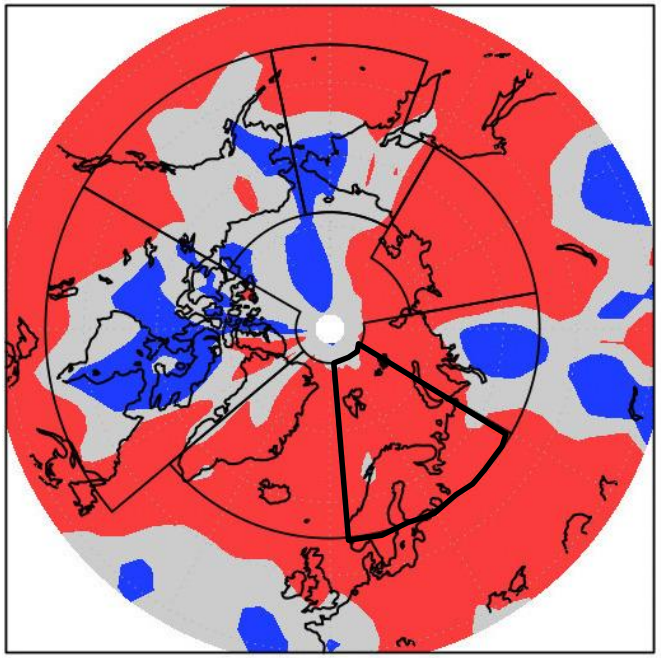
| **W. Nordic** | **Mostly above, near normal in the south** | **Above normal** | **90% hit** |
| E. Nordic | | | |
| W. Siberia | | | |
| E. Siberia | | | |

# Verification Temperature

Forecast, temp JJA 2021




CFSR Reanalysis, Temperature JJA2021



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| **E. Nordic** | **Above normal** | **Above normal** | **hit** |
| W. Siberia | | | |
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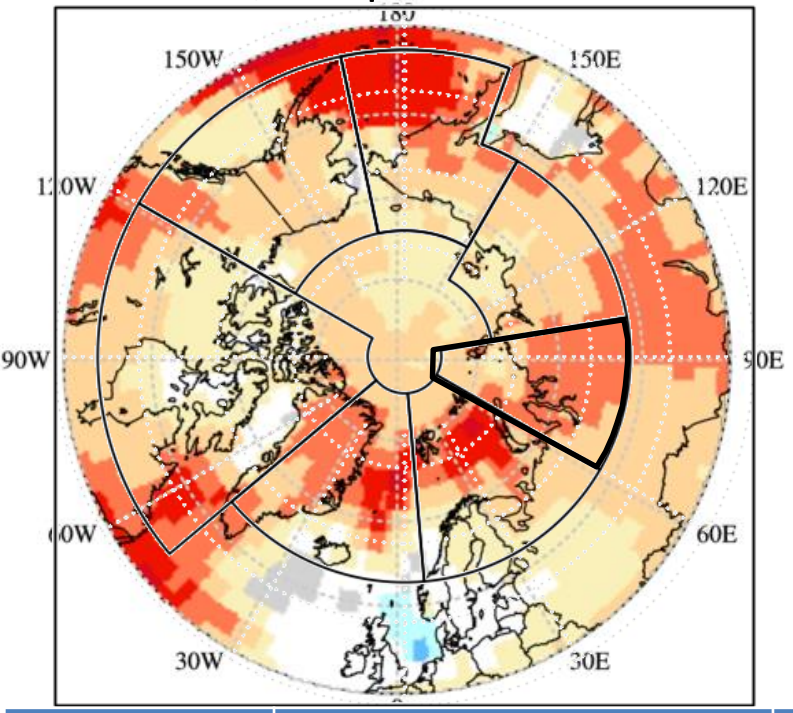
# Verification Temperature

Forecast, temp JJA 2021

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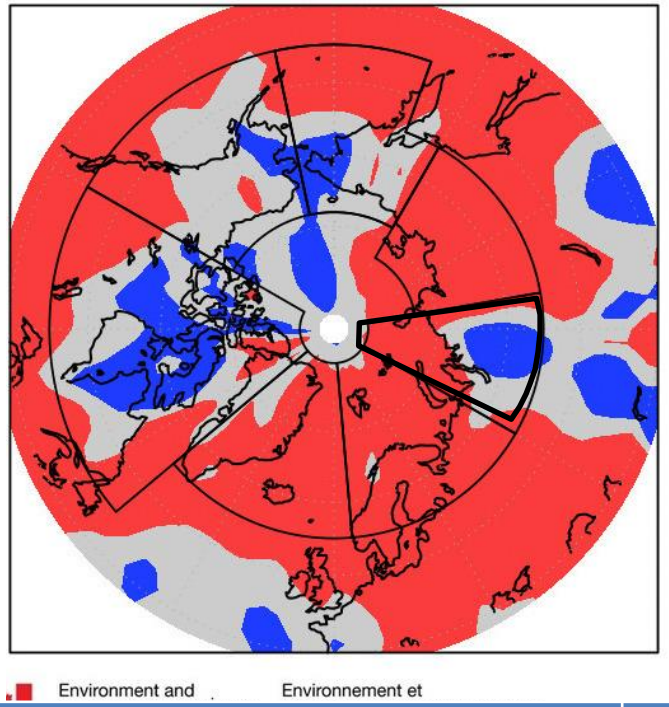


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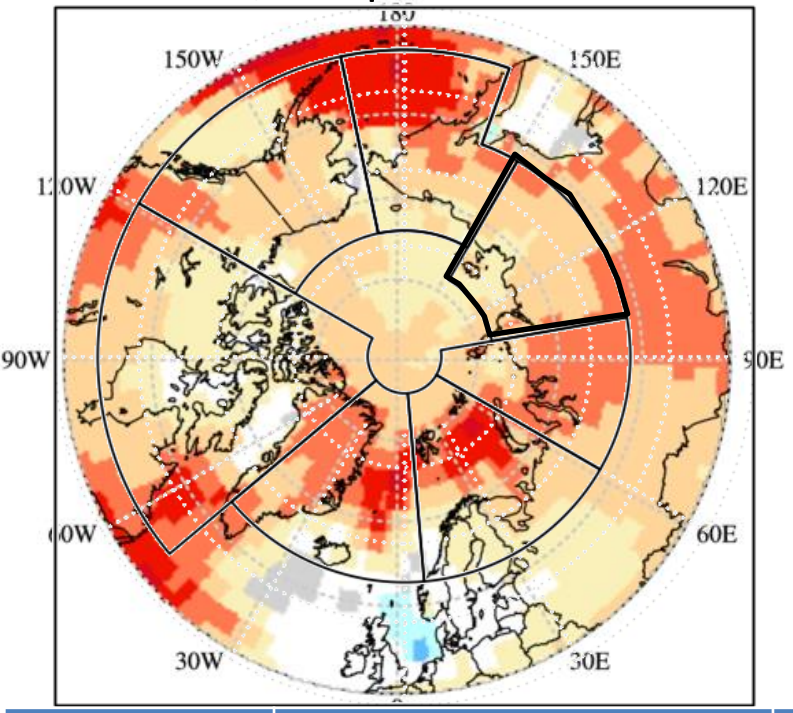
| W. Nordic | Mostly above, near normal in the south | Above normal | 90% hit |
| E. Nordic | Above normal | Above normal | hit |
| **W. Siberia** | **Above normal** | **Below and near normal in the south and center, above in the north** | **Miss (over the land)** |
| E. Siberia | | | |

# Verification Temperature

Forecast, temp JJA 2021

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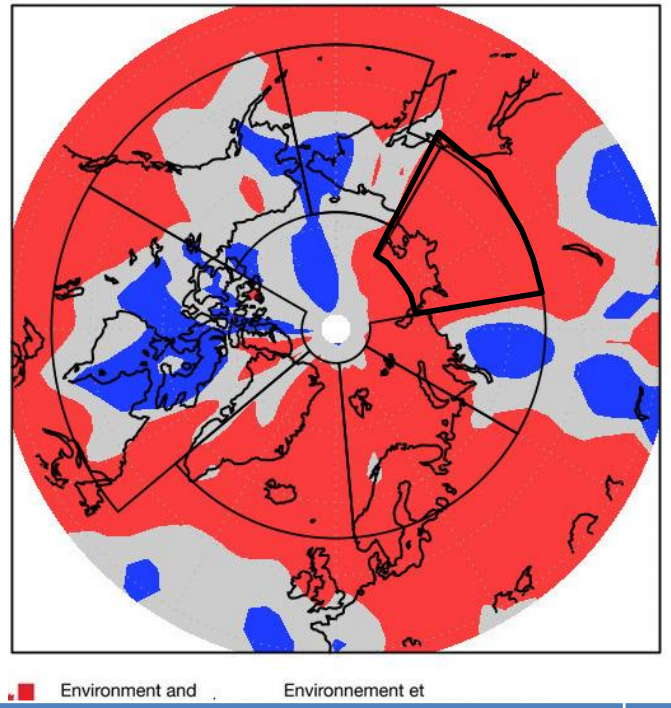

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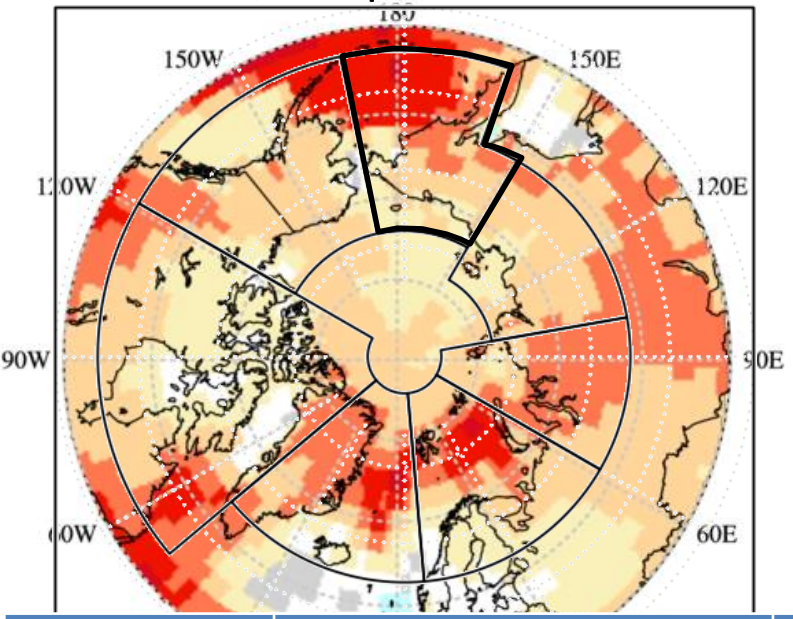
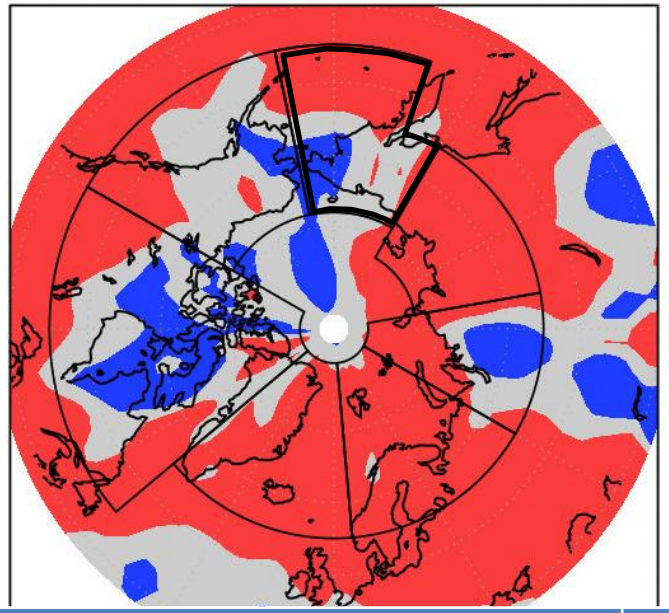
| W. Nordic | Mostly above, near normal in the south | Above normal | 90% hit |
| E. Nordic | Above normal | Above normal | hit |
| W. Siberia | Above normal | Below and near normal in the south and center, above in the north | Miss (over the land) |
| **E. Siberia** | **Above normal** | **Above normal** | **hit** |

# Verification Temperature

Forecast, temp JJA 2021




CFSR Reanalysis, Temperature JJA2021



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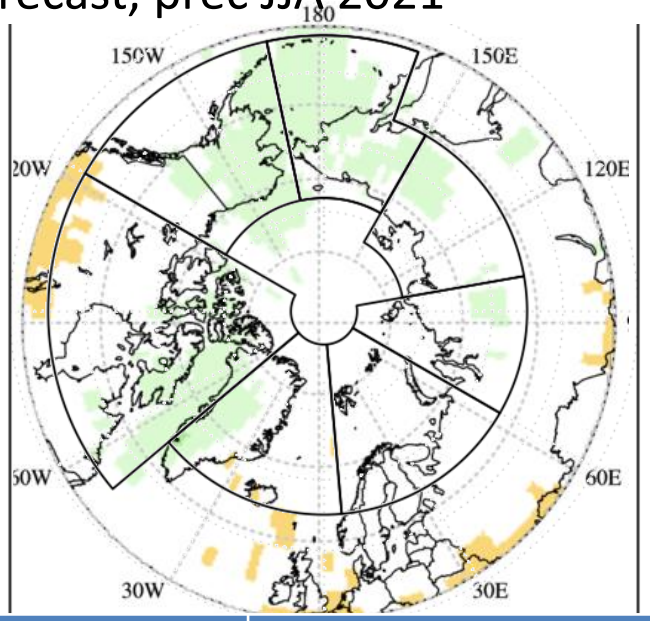
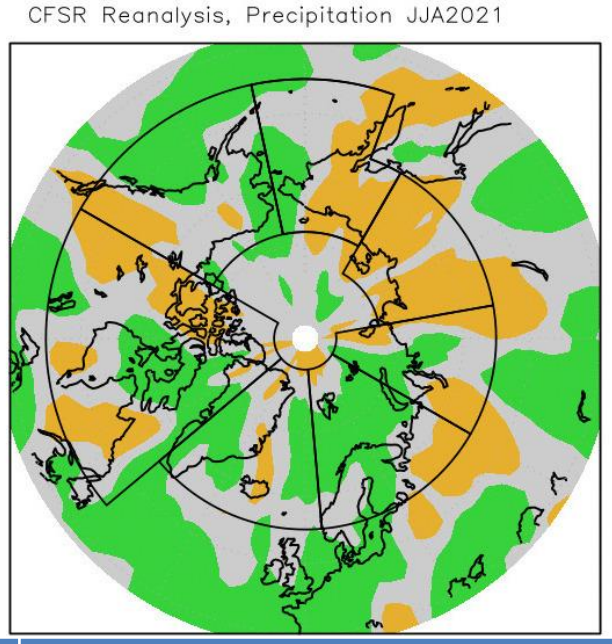
| W. Nordic | Mostly above, near normal in the south | Above normal | 90% hit |
| E. Nordic | Above normal | Above normal | hit |
| W. Siberia | Above normal | Below and near normal in the south and center, above in the north | Miss (over land) |
| E. Siberia | Above normal | Above normal | hit |
| **Chukchi-Bering** | **Above normal** | **Near and below normal over the continental parts** | **Miss (over land)** |

Forecast, prec JJA 2021




# Verification Precipitation

Above normal

Near normal

Below normal

| Verif: | Forecast FMA | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Above normal | Mostly below and near normal | 90% miss |
| C. - E. Canada | Above normal in the west | Below and near normal over the continental parts. | 50% where forecast |
| W. Nordic | Mostly equal chances | Below over Island, above over the central Greenland | % |
| E. Nordic | Mostly equal chances | Near and above normal in Scandinavia, below and near nomal in the eastern parts | % |
| W. Siberia | Mostly equal chances, above normal in south east | Near normal and below normal over the continental southern parts | % |
| E. Siberia | Above normal in the east | Mostly below normal | miss |
| ChukchiBering | Above normal | Mostly below normal | miss |

# Overall result, subjective verification

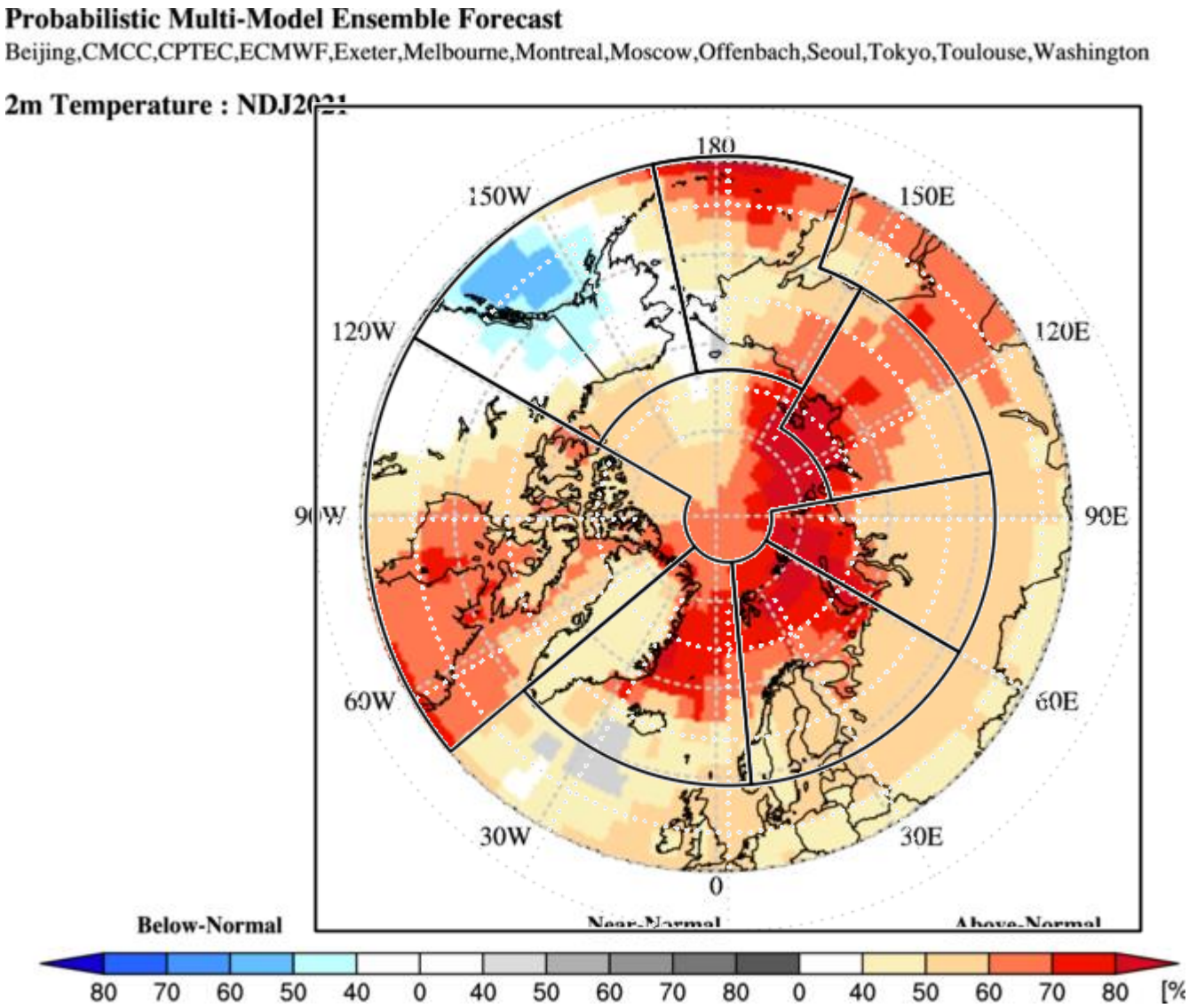
- **Temperature**: Considering all Arctic regions the subjective score is ~50 %. This is a good score considering that everything below or equal 33% is considered worse than a pure chance.

- **Precipitation**: In the regions where the models were decisive, the forecast did nor perform well. Given the historical skill scores we know that precipitation forecasts are usually not vey skilful over the Arctic.

Actual (real time )seasonal forecasts over the Arctic NDJ 2021/22

- Temperature
- Precipitation
- Sea Surface Temperature
- Snow Water Equivalent

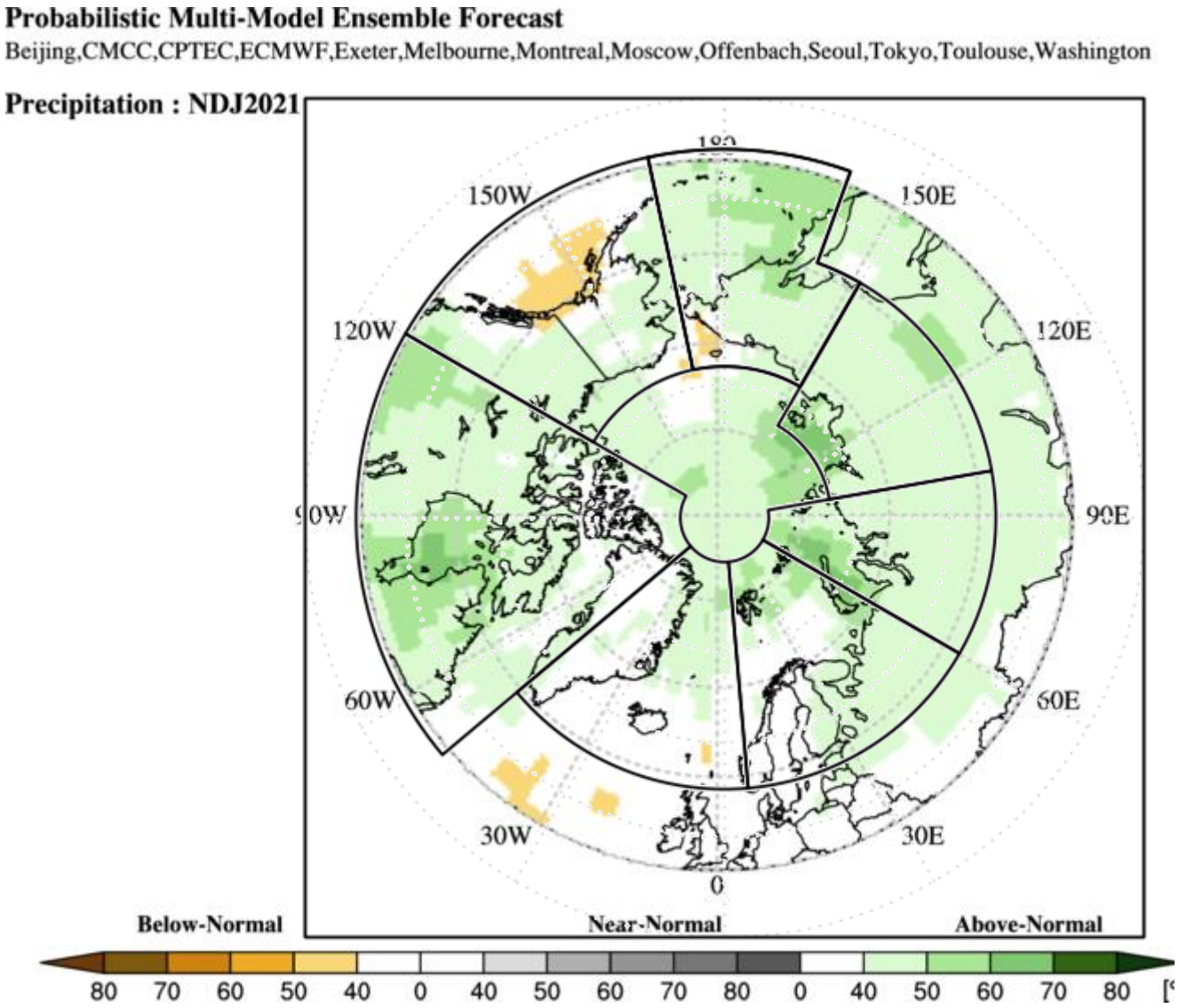
# Temperature outlook over the Arctic: November-December-January 2021/22




1. Alaska W. Canada
2. Eastern Canadian Arctic
3. Western Nordic
4. Eastern Nordic
5. West Siberia
6. East Siberia
7. Chukchi and Bering

- The redder the color does not mean it is warmer.
- It means we have more confidence in the above normal forecast over that region.

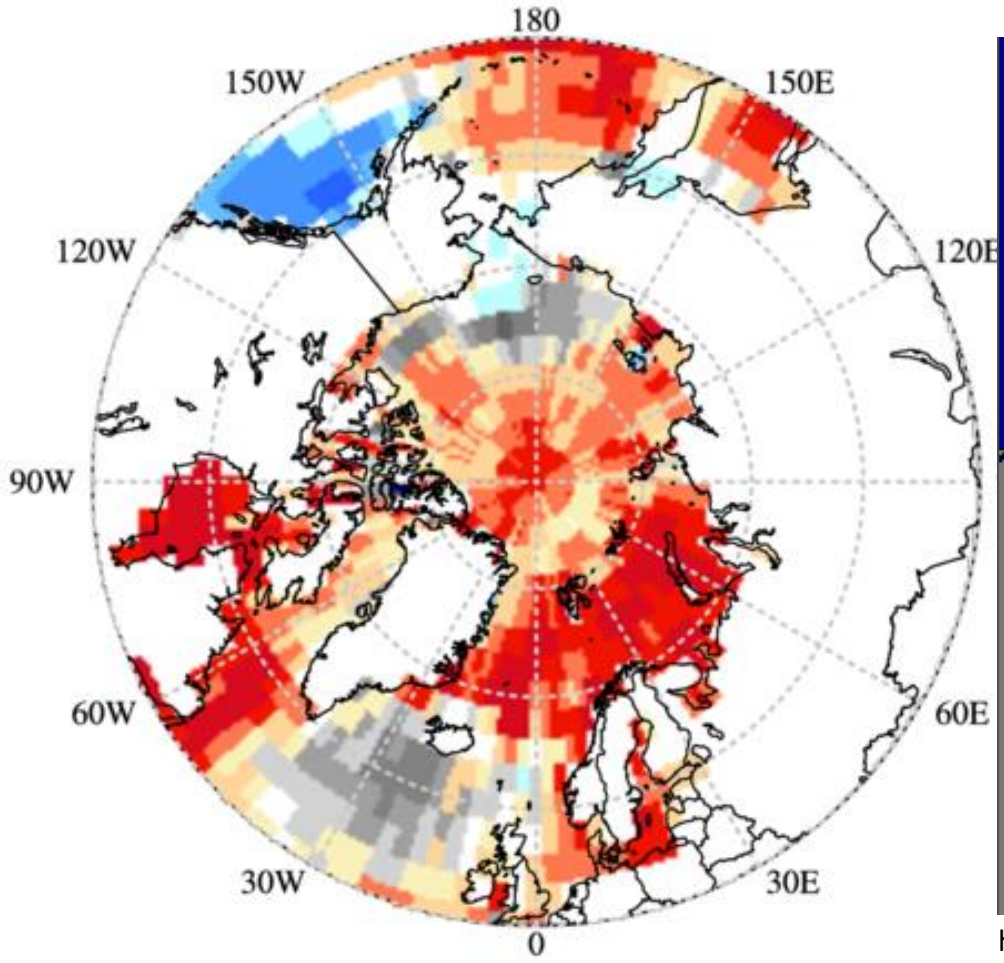
# Precipitation outlook over the Arctic: November-December-January 2021/22



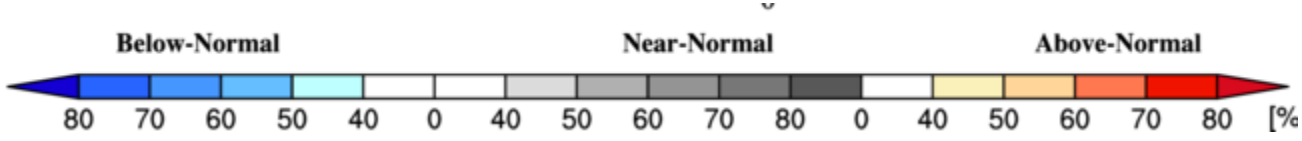

1. Alaska W. Canada
2. Eastern Canadian Arctic
3. Western Nordic
4. Eastern Nordic
5. West Siberia
6. East Siberia
7. Chukchi and Bering

- The greener the color does not mean it will precipitate more.
- It means we have more confidence in the above normal precipitation forecast over that region.

# Sea Surface Temperature outlook over the Arctic: November-December-January 2021/22

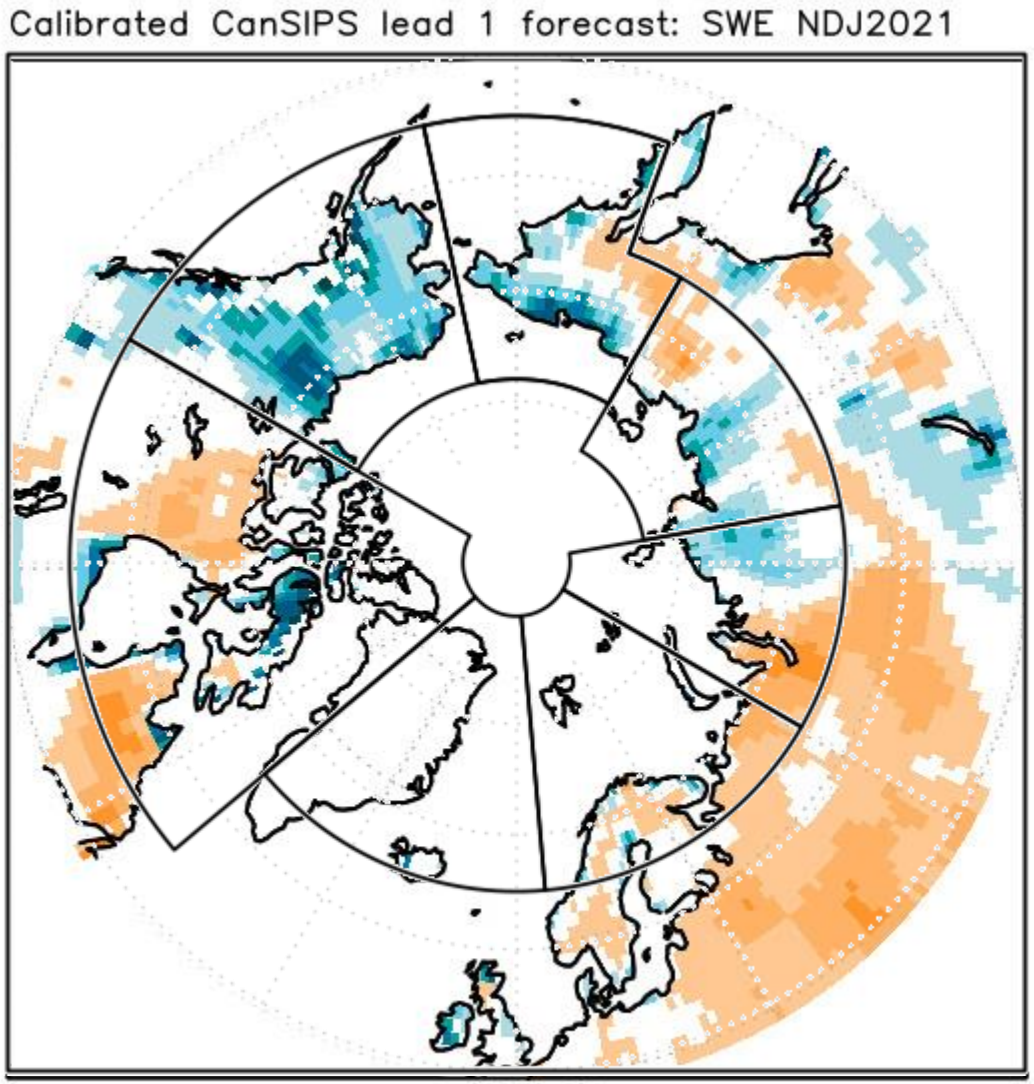


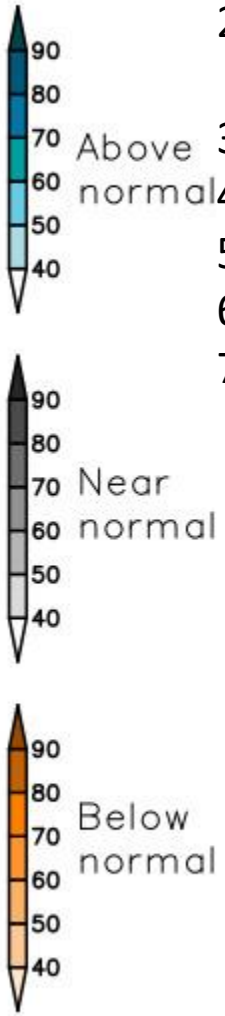
https://nsidc.org/arcticseaicenews/map-of-the-arctic-ocean/



# Snow Water Equivalent outlook over the Arctic: November-December-January 2021/22

Experimental product




1. Alaska W. Canada
2. Eastern Canadian Arctic
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5. West Siberia
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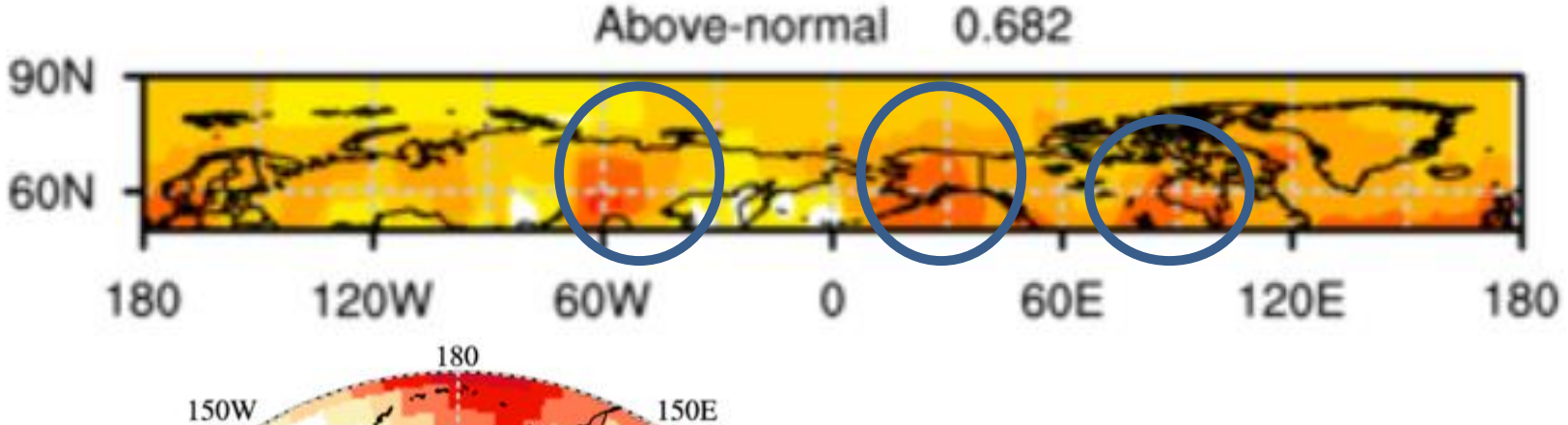
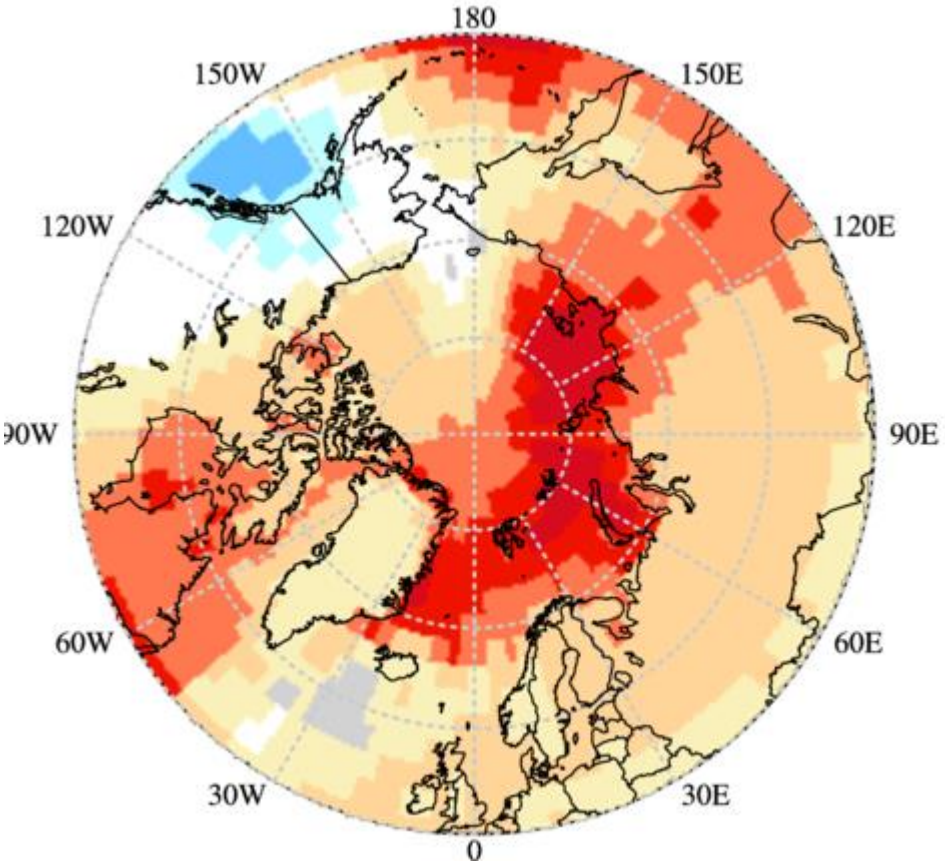
# Discussing historical skill over the Arctic, Temperature

(confidence with respect to the historical skill)

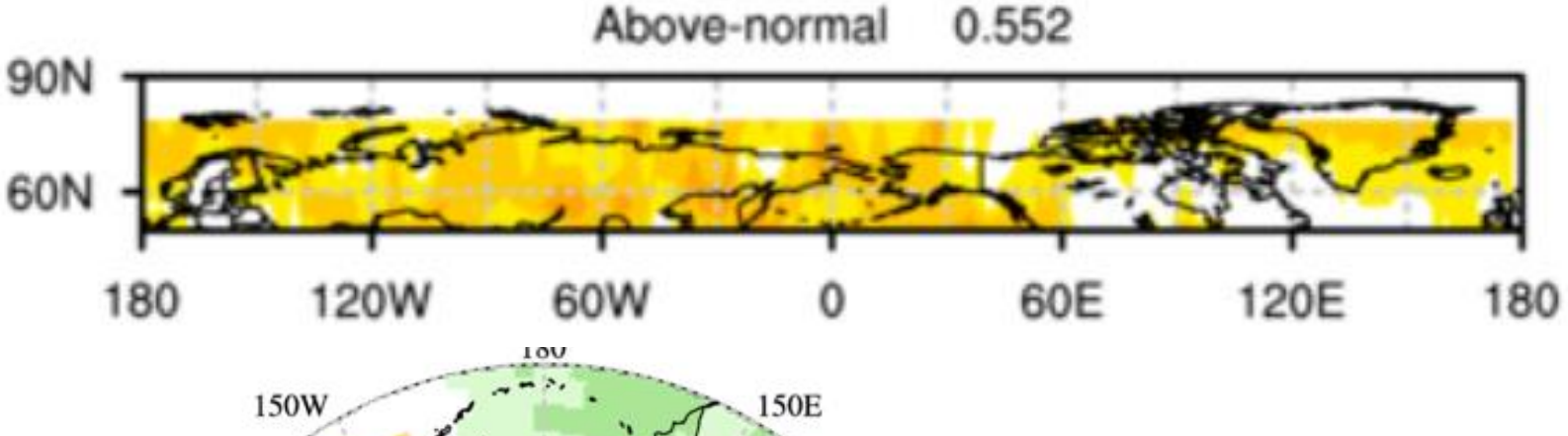


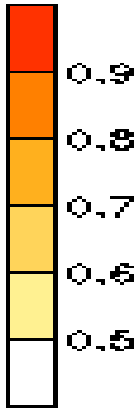



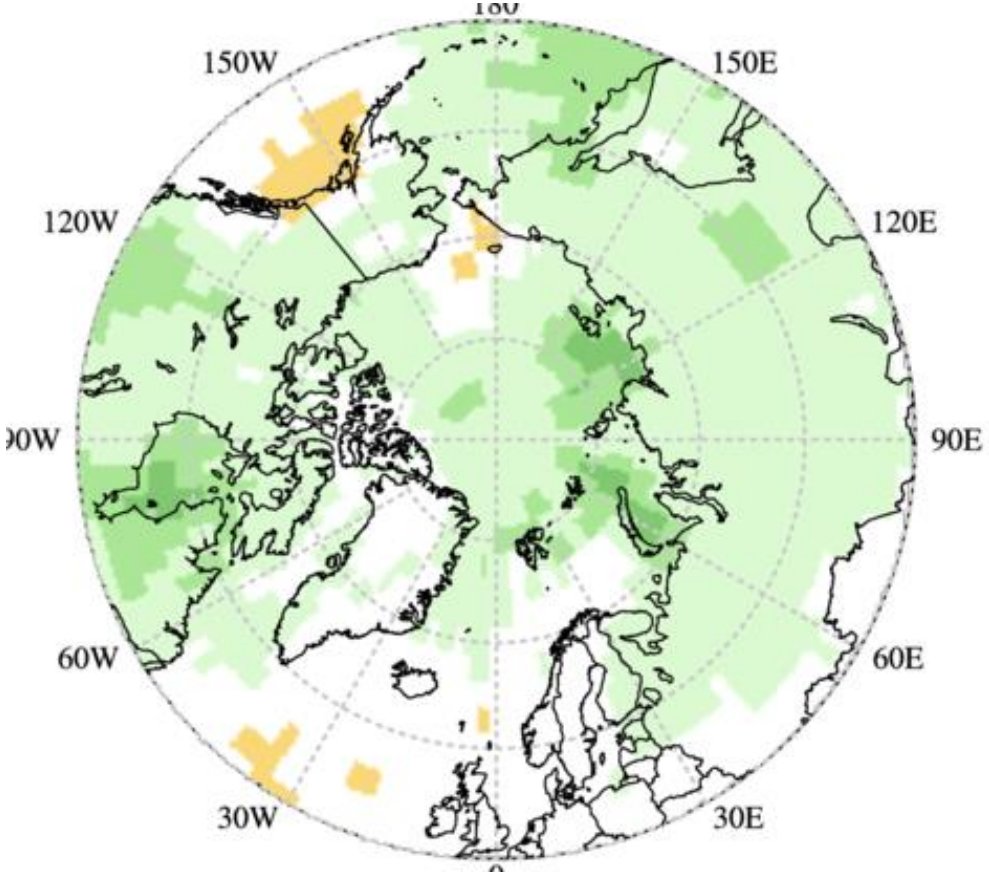

- If a historical skill was good over a certain region (e.g. colored region on the upper figure) we are more confident about the forecast results over the same region
- Overall confidence is weak in NDJ over the Arctic.

# Discussing historical skill over the Arctic, Precipitation

(confidence with respect to the historical skill)

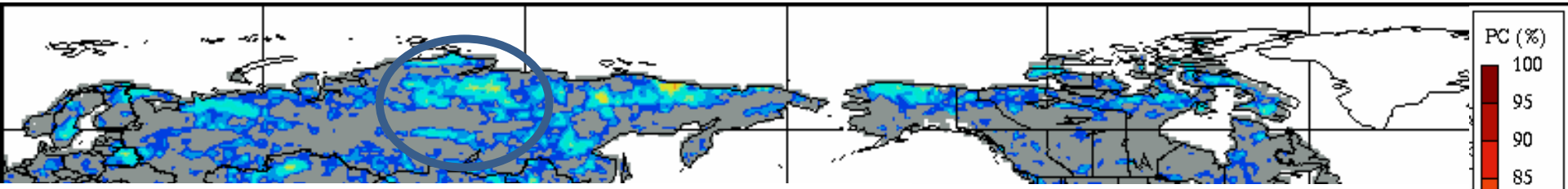


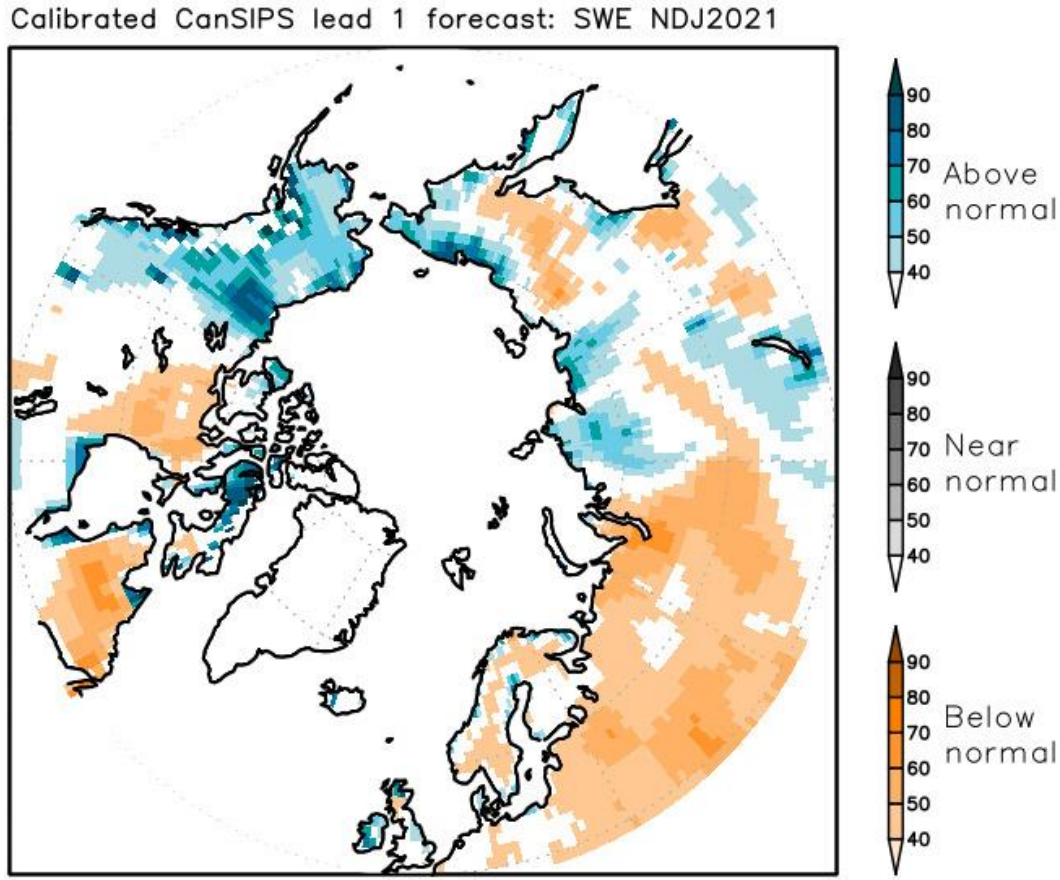




- We don’t have a very high confidence in precipitation skill over the Arctic in NDJ.

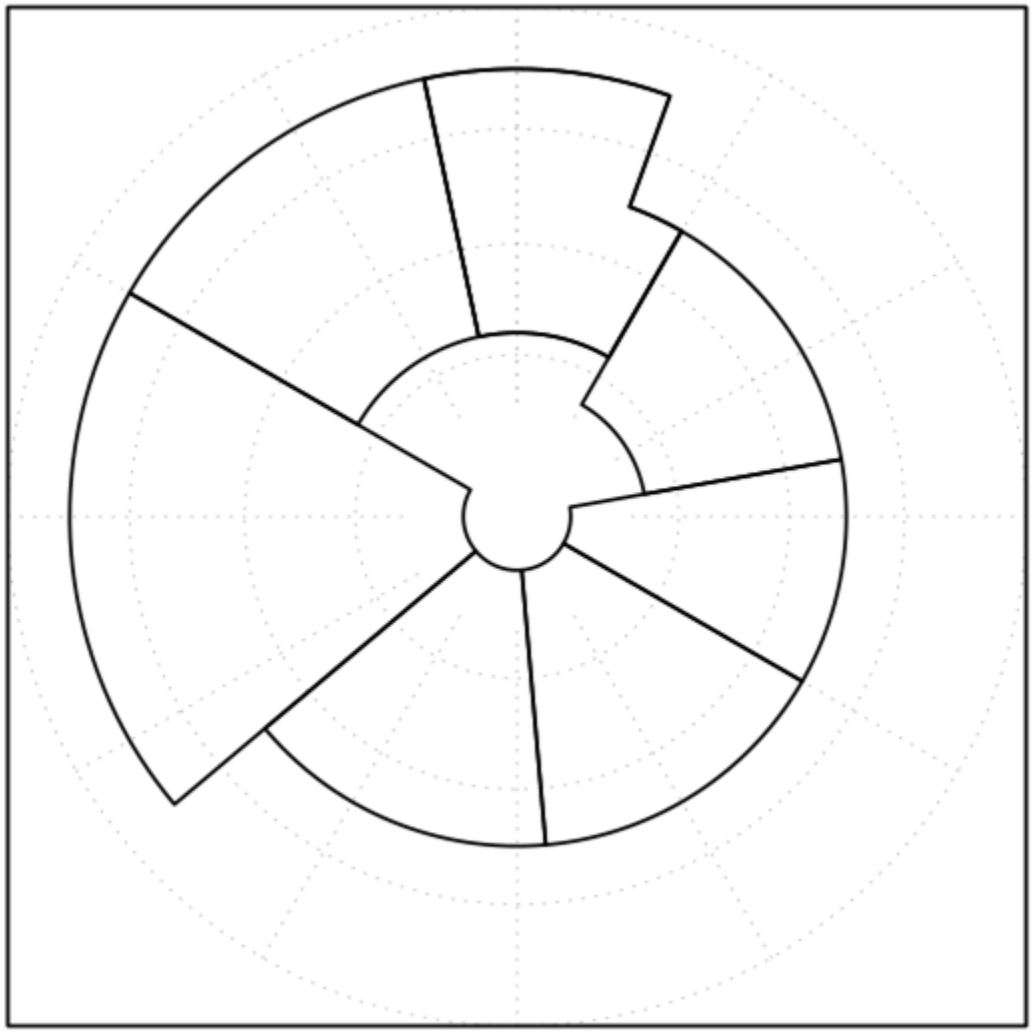
# Discussing historical skill over the Arctic, SWE
(confidence with respect to the historical skill)




- If a historical skill was good over a certain region (e.g. colored region on the upper figure) we are more confident about the forecast results over the same region

# Conclusions

- We use Multi Model Ensemble (MME) approach to calculate seasonal forecast.
- We use probabilistic approach to communicate seasonal forecast results.
- For evaluation over the Arctic we use a combination of observations and model results called re-analysis.
- JJA2021 MME temperature forecast over the Arctic region was ~50% correct, which is generally good result and much higher than a pure chance (i.e. 33%).
- We expect above normal temperatures and sea-surface temperatures over majority of the Arctic regions in NDJ21/22.
- Above normal SWE is expected over Alaska W Canada and northern and western Chukchi and Bering regions while below normal snow is forecast for western Nordic and east Siberian regions.
- We expect above normal precipitation over several most Arctic regions with an exception of Nordic regions where equal probability chances are mostly forecast.

Thank you!