Environment and Climate Change Canada | Environnement et Changement climatique Canada

Canada

# ACF - 7: Verification of the FMA2021 season
# ACF - 7: Seasonal forecast for the JJA2021 season

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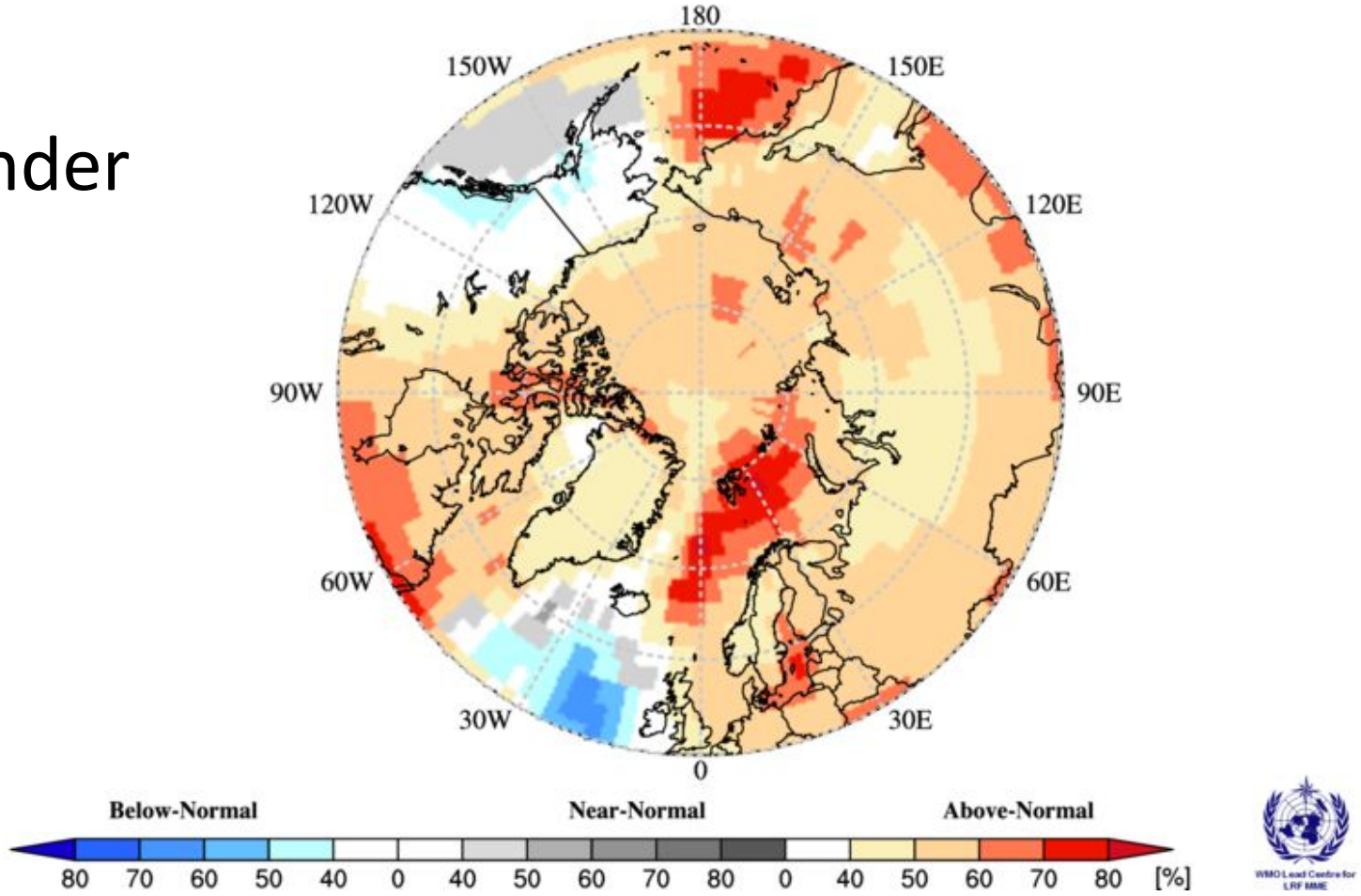
Meteorological Service of Canada

WMO

# Seasonal forecast over the Arctic, FMA 2021

## A reminder

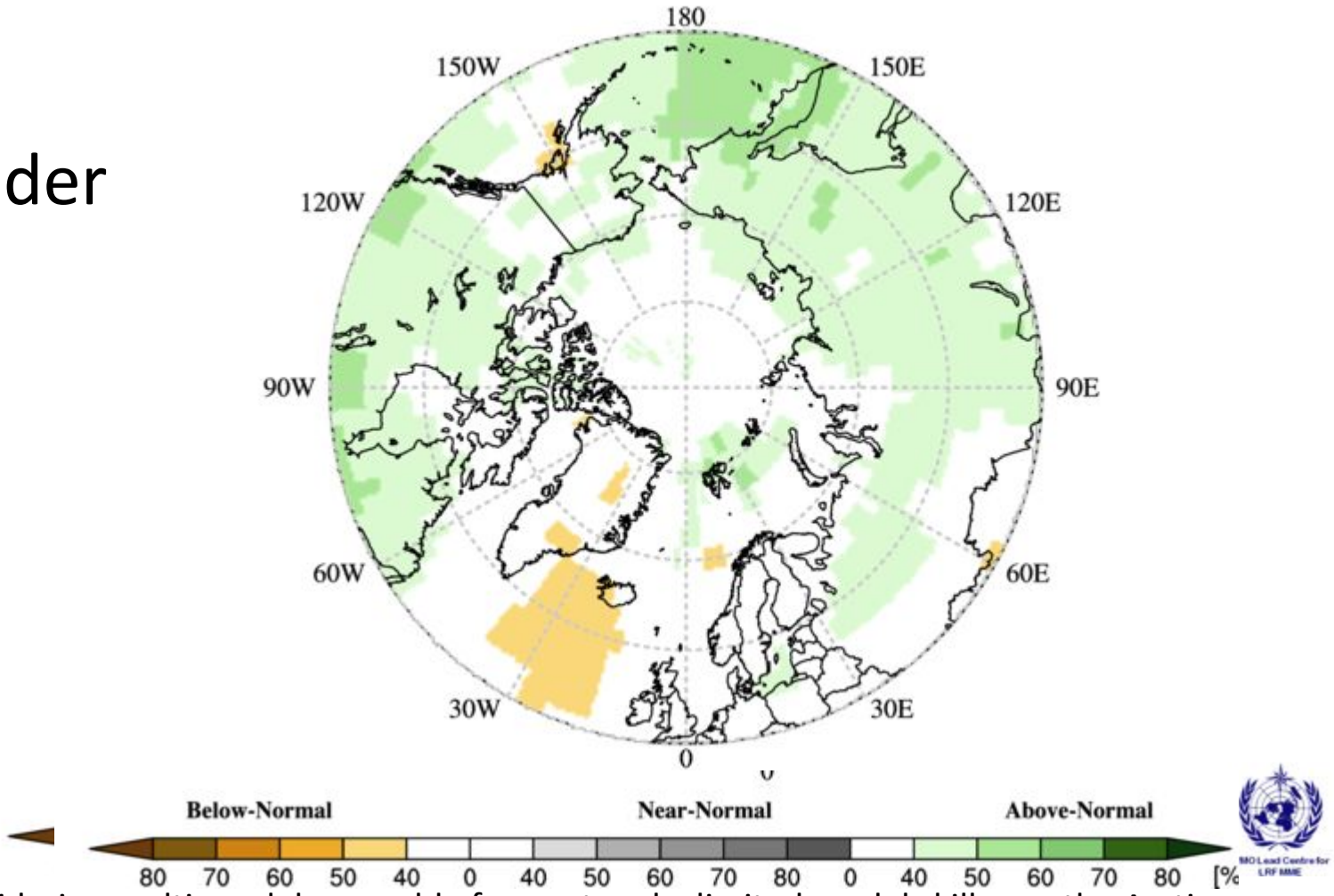



Considering multi-model ensemble forecast and a limited model skill over the Arctic:

**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 are expected over W. Nordic, E. Siberia, Chukchi and Bering and E. Canada. Over Alaska and W. Canada MME approach was mostly not decisive.

# Seasonal forecast over the Arctic, FMA 2021

## A reminder




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

**Precipitation:** Mostly above normal precipitation were expected over most of the Arctic regions with an exception of Eastern Nordic region where equal probability chances were expected.

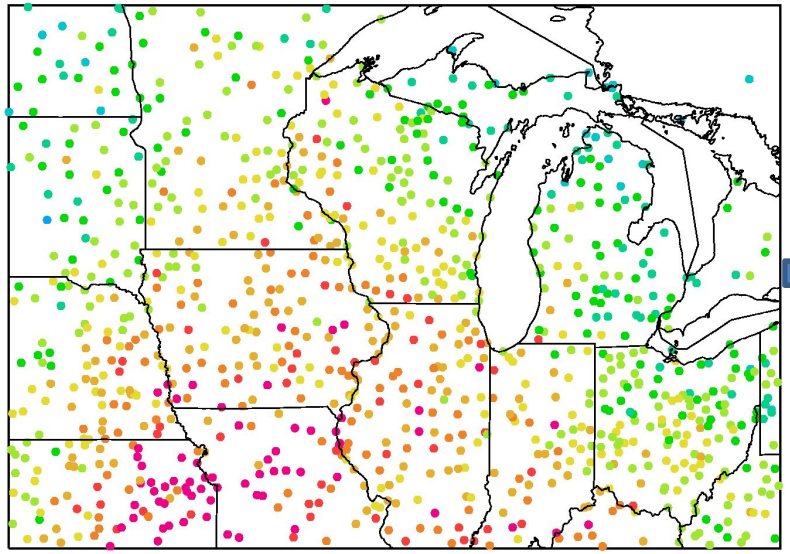
# How do we verify seasonal forecasts?

- 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**.

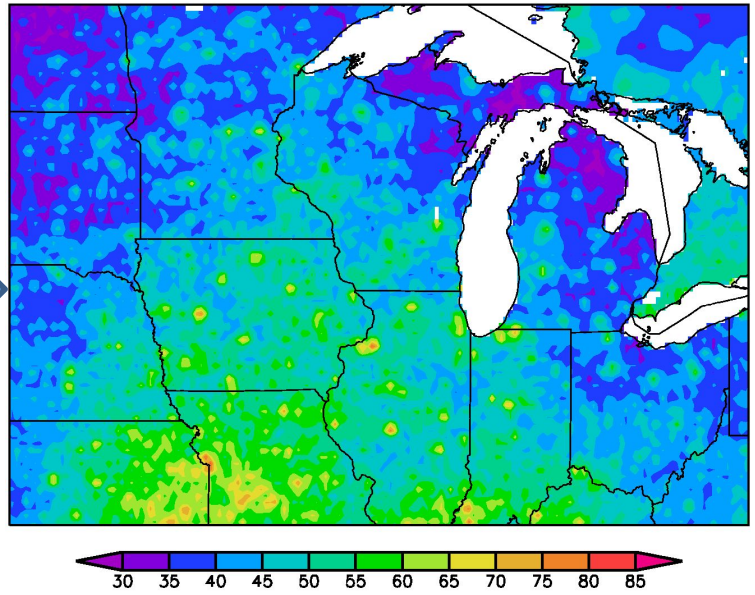
2) station observations Precipitation



Data Assimilation

+ numerical modeling

Precipitation Re-Analysis

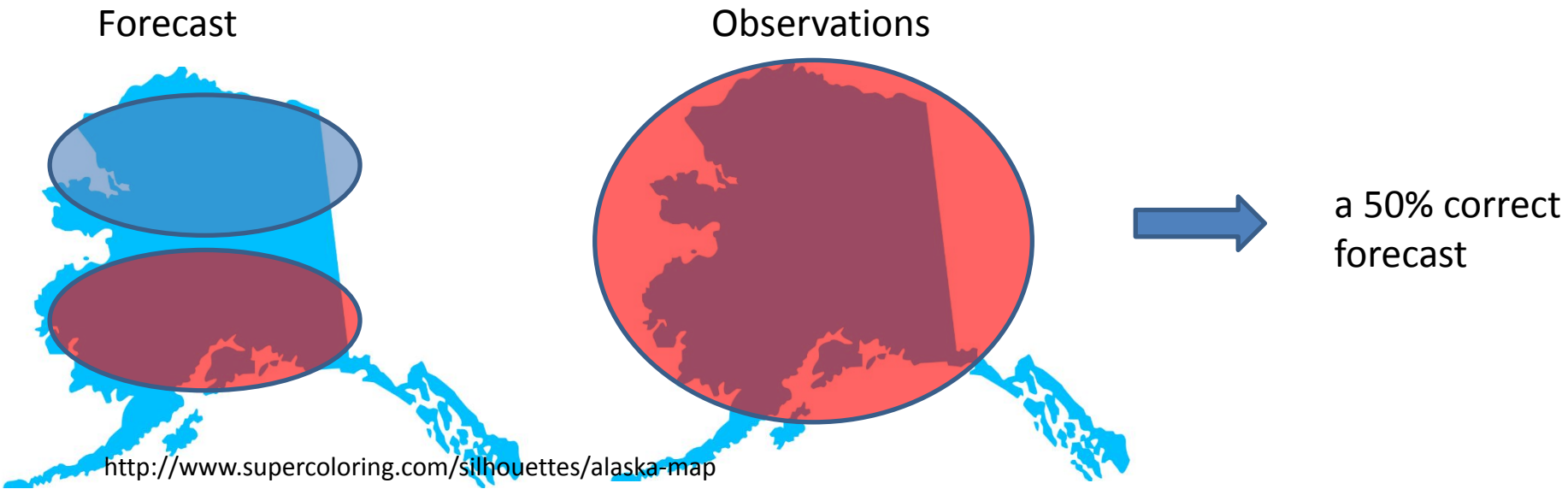



https://dilorenz.github.io/downscaling2/ProbApp/interp.html

# How do we verify seasonal forecasts?

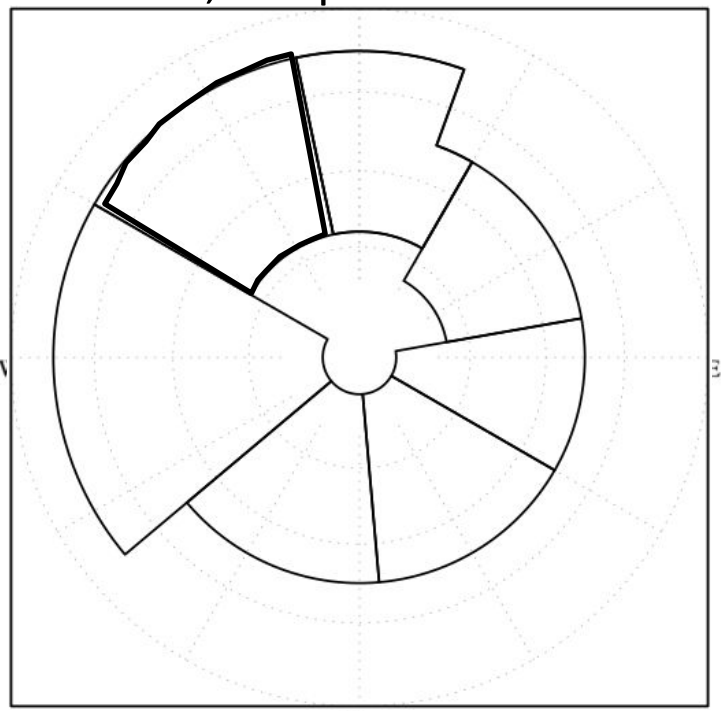
- We need some metric, some number to quantify the verification result
- We call this metric a score

- 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.

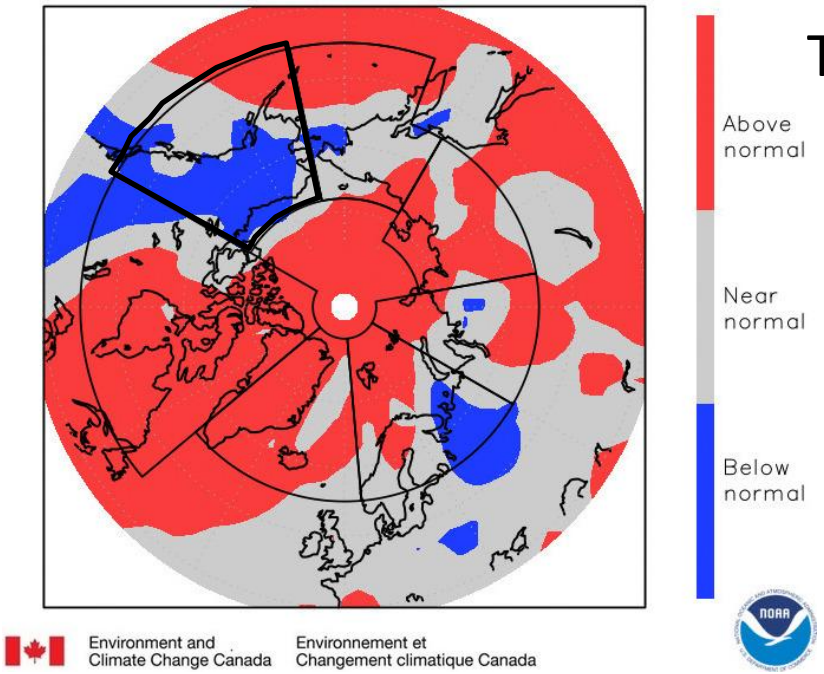


# Verification Temperature

Forecast, temp FMA 2021



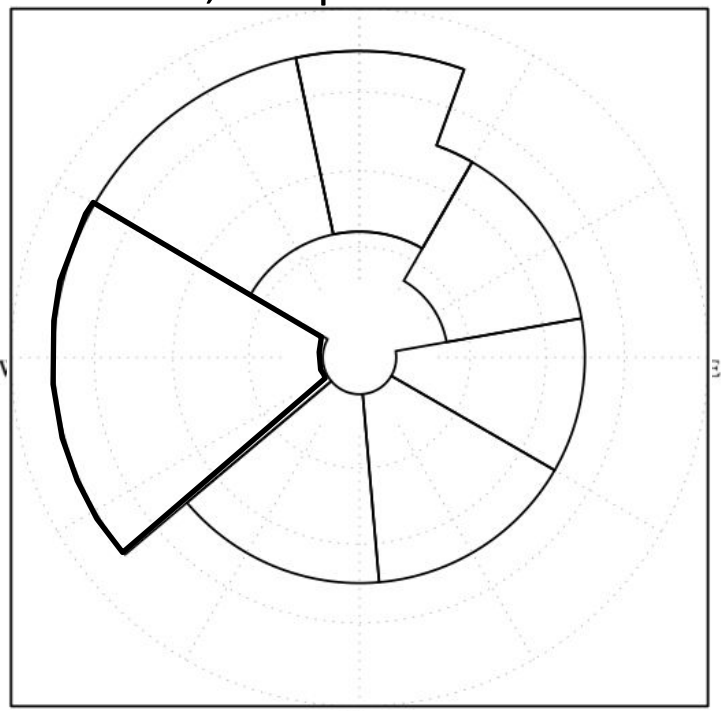
CFSR Reanalysis, Temperature FMA2021



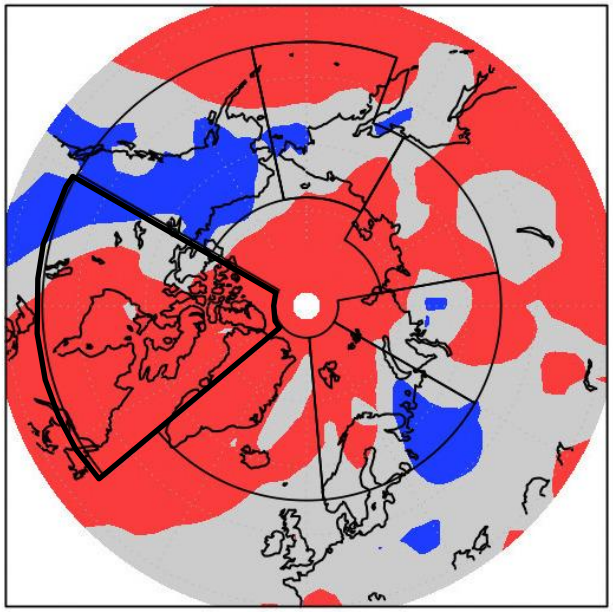

| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| **Alaska, W. Can** | **Mostly equal, below normal in the south and SW** | **Mostly below normal** | **50% where forecast** |
| C. - E. Canada | | | |
| W. Nordic | | | |
| E. Nordic | | | |
| W. Siberia | | | |
| E. Siberia | | | |
| Chukchi-Bering | | | |

# Verification Temperature

Forecast, temp FMA 2021



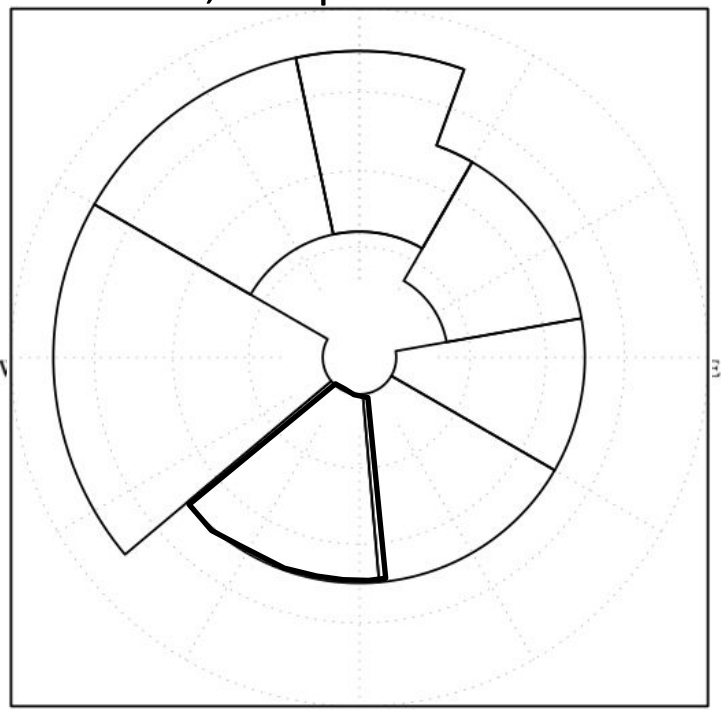
CFSR Reanalysis, Temperature FMA2021

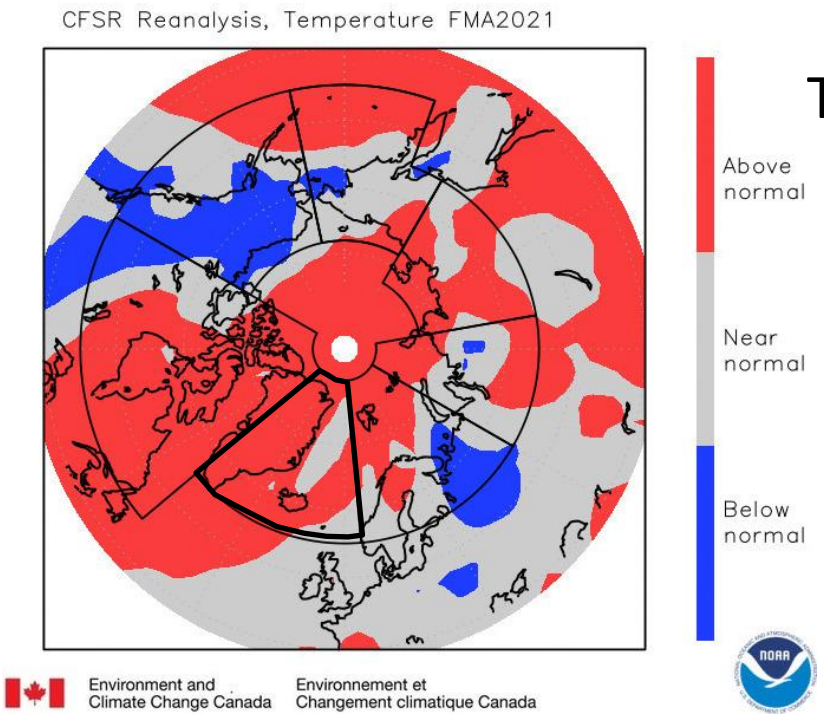



| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Mostly equal, below normal in the south and SW | Mostly below normal | 50% where forecast |
| **C. - E. Canada** | **Above in central and east** | **Above in central and east, below and near normal in the west** | **100% where forecast** |
| W. Nordic | | | |
| E. Nordic | | | |
| W. Siberia | | | |
| E. Siberia | | | |
| Chukchi-Bering | | | |

# Verification Temperature

Forecast, temp FMA 2021

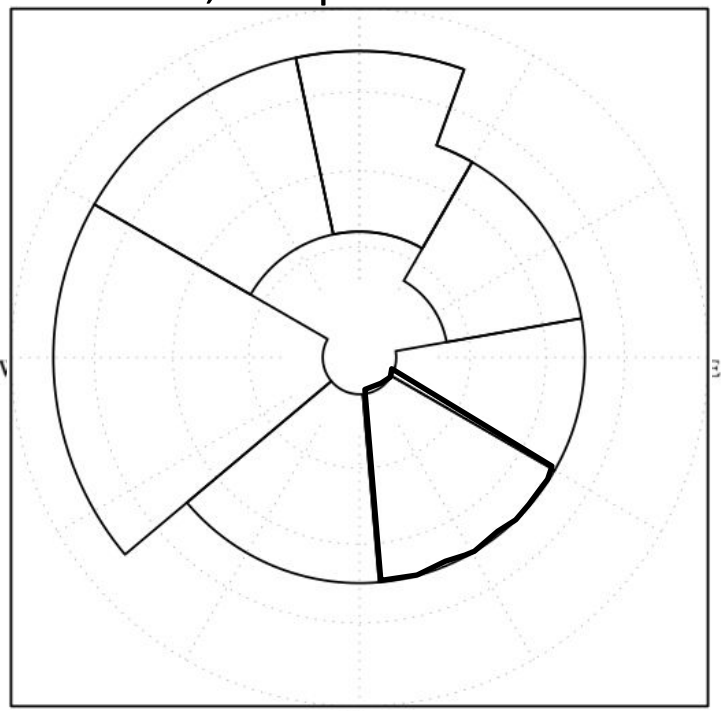


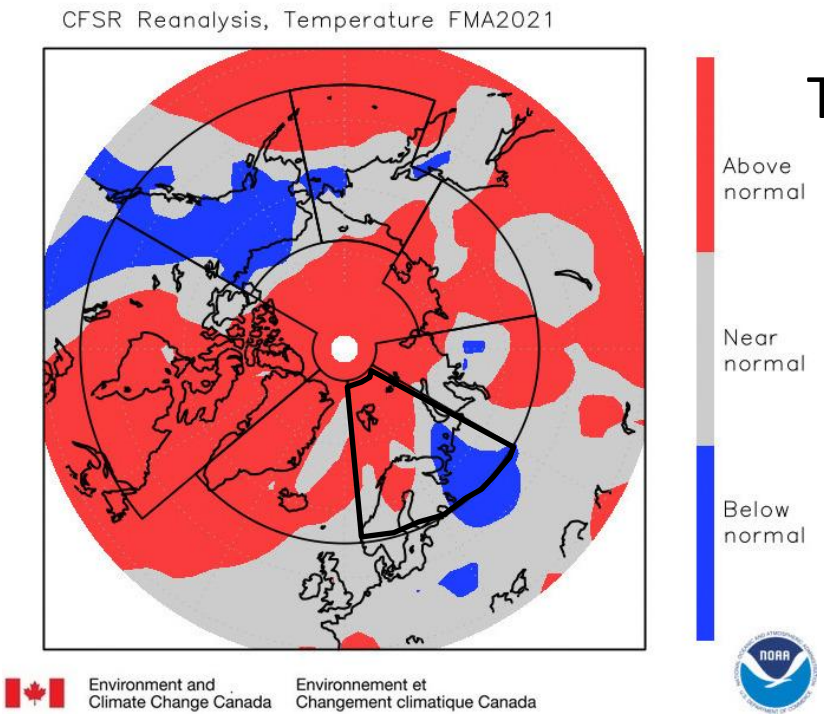



| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Mostly equal, below normal in the south and SW | Mostly below normal | 50% where forecast |
| C. - E. Canada | Above in central and east | Above in central and east, below and near normal in the west | 100% where forecast |
| **W. Nordic** | **Above normal** | **Mostly above normal** | **70% correct** |
| E. Nordic | | | |
| W. Siberia | | | |
| E. Siberia | | | |
| Chukchi-Bering | | | |

# Verification Temperature

Forecast, temp FMA 2021

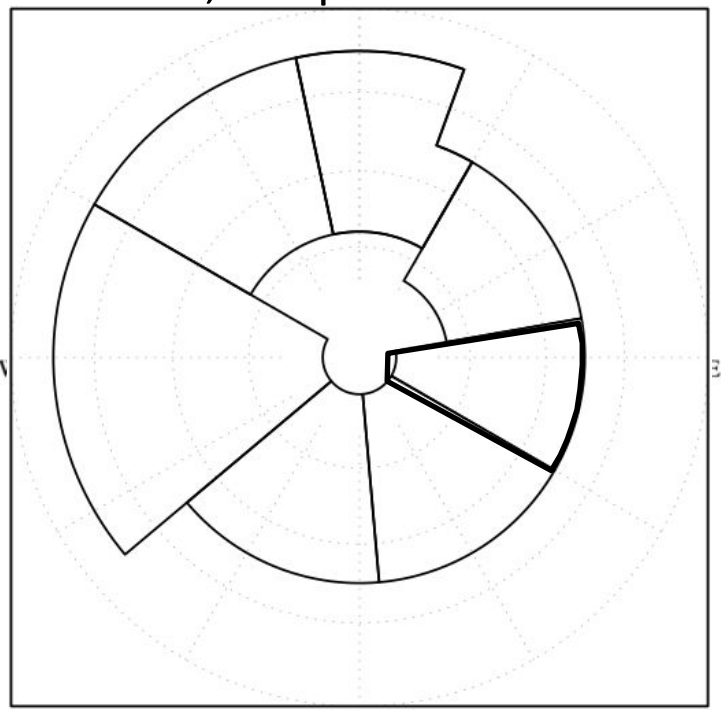




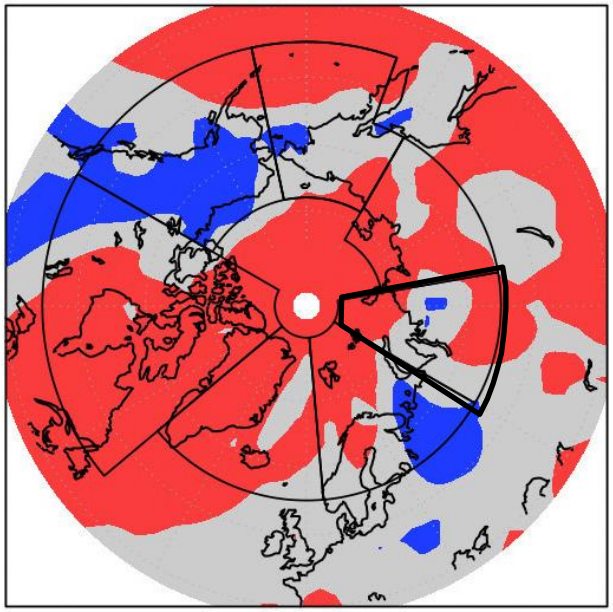

| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Mostly equal, below normal in the south and SW | Mostly below normal | 50% where forecast |
| C. - E. Canada | Above in central and east | Above in central and east, below and near normal in the west | 100% where forecast |
| W. Nordic | Above normal | Mostly above normal | 70% correct |
| **E. Nordic** | **Above normal** | **Above normal in northern central Scandinavia, below in the east** | **40% correct** |
| W. Siberia | | | |
| E. Siberia | | | |

# Verification Temperature

Forecast, temp FMA 2021



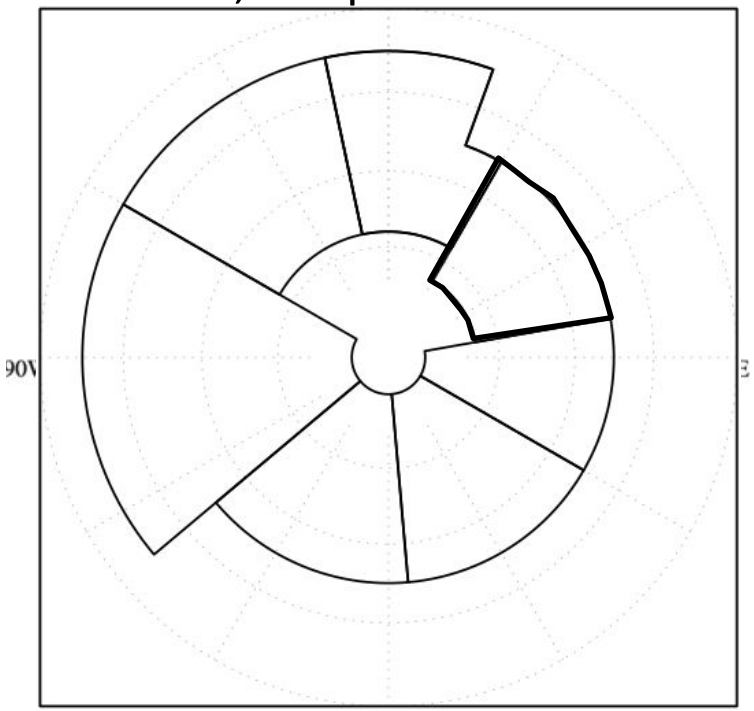
CFSR Reanalysis, Temperature FMA2021



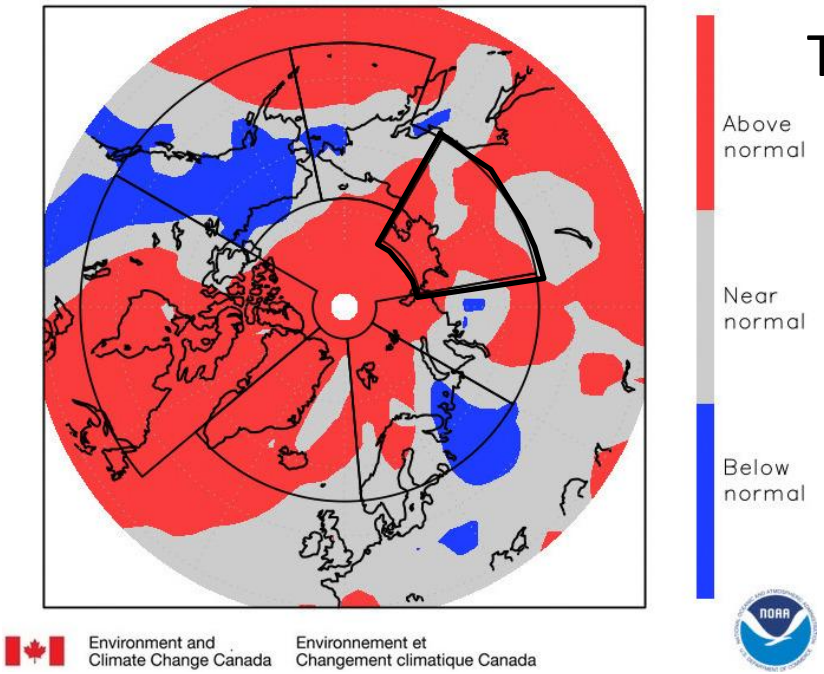

| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Mostly equal, below normal in the south and SW | Mostly below normal | 50% where forecast |
| C. - E. Canada | Above in central and east | Above in central and east, below and near normal in the west | 100% where forecast |
| W. Nordic | Above normal | Mostly above normal | 70% correct |
| E. Nordic | Above normal | Above normal in northern central Scandinavia, below in the east | 40% correct |
| **W. Siberia** | **Above normal** | **Above in the South and North, near normal in the center and SW** | **30% correct** |
| E. Siberia | | | |

# Verification Temperature

Forecast, temp FMA 2021



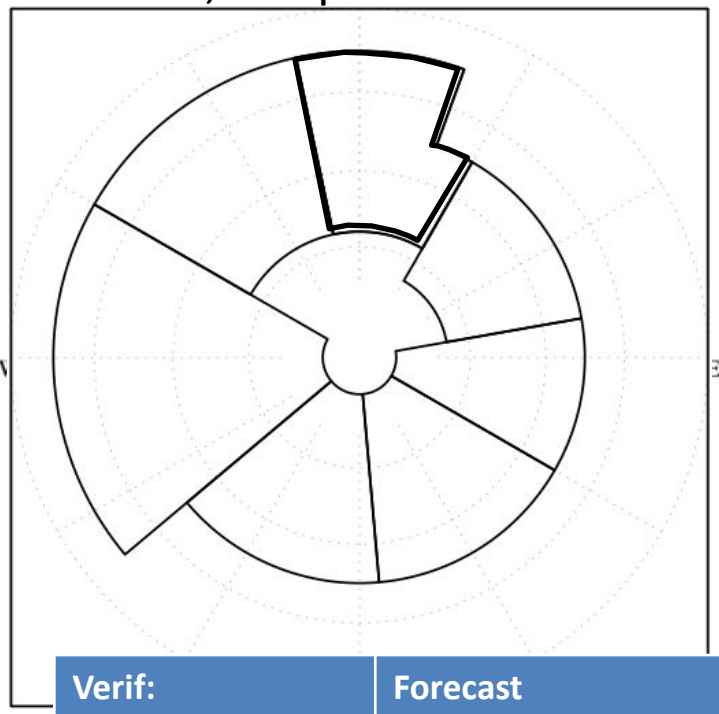
CFSR Reanalysis, Temperature FMA2021



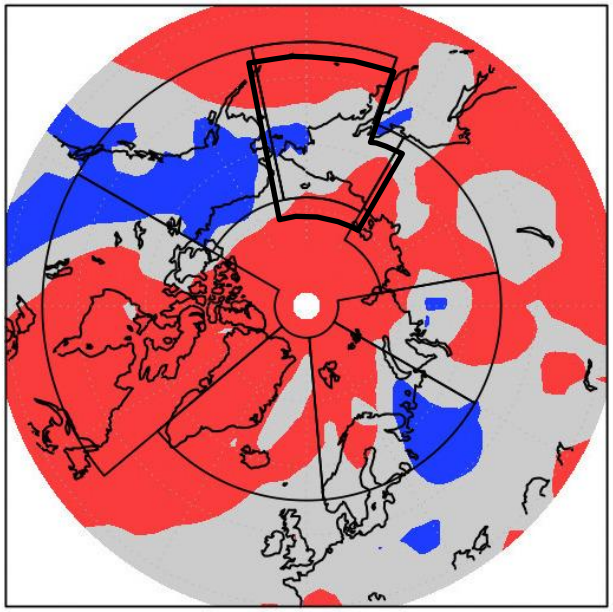

| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Mostly equal, below normal in the south and SW | Mostly below normal | 50% where forecast |
| C. - E. Canada | Above in central and east | Above in central and east, below and near normal in the west | 100% where forecast |
| W. Nordic | Above normal | Mostly above normal | 70% correct |
| E. Nordic | Above normal | Above normal in northern central Scandinavia, below in the east | 40% correct |
| W. Siberia | Above normal | Above in the South and North, near normal in the center and SW | 30% correct |
| **E. Siberia** | **Above normal** | **Mostly above normal** | **80% correct** |

# Verification Temperature

Forecast, temp FMA 2021



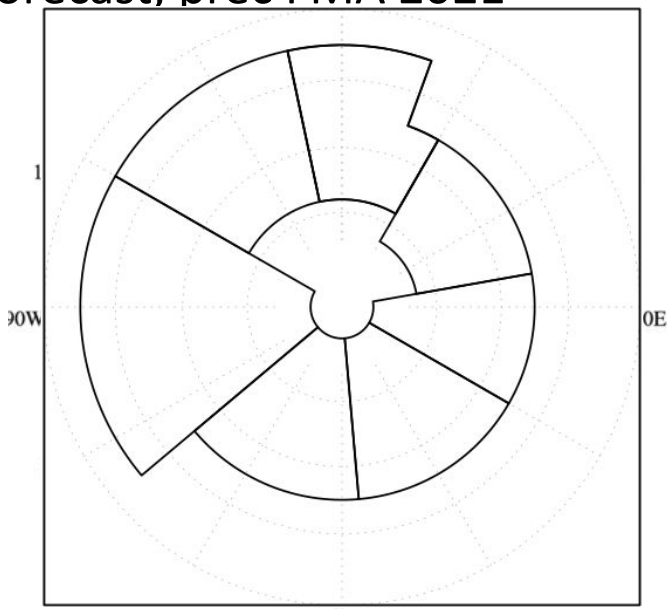
CFSR Reanalysis, Temperature FMA2021

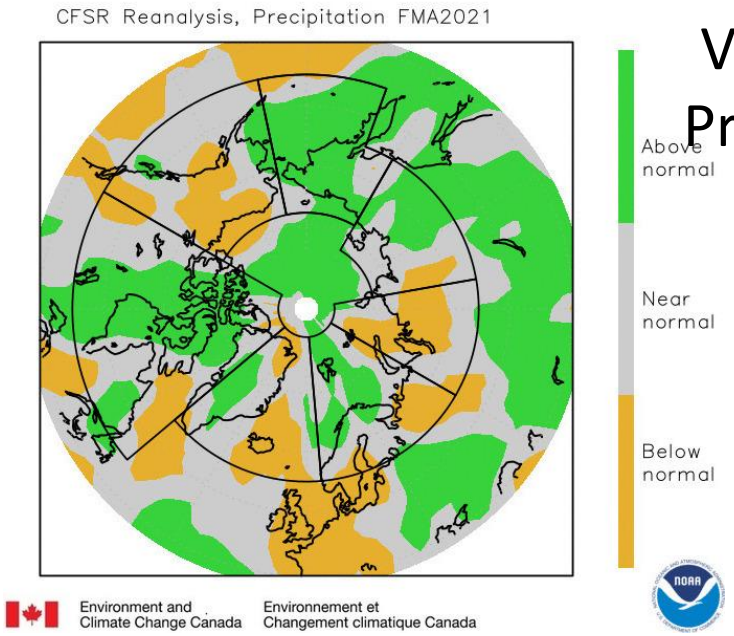



| Verif: | Forecast | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Mostly equal, below normal in S and SW | Mostly below normal | 50% where forecast |
| C. - E. Canada | Above in central and east | Above in central and east, below and near normal in the west | 100% where forecast |
| W. Nordic | Above normal | Mostly above normal | 70% correct |
| E. Nordic | Above normal | Above normal in northern central Scandinavia, below in the east | 30% correct |
| W. Siberia | Above normal | Above in the South and North, near normal in the center and SW | 30% correct |
| E. Siberia | Above normal | Mostly above normal | 80% correct |
| Chukchi-Bering | Above normal | Nera normal in the continental parts | 10% correct |

# Verification Precipitation

Forecast, prec FMA 2021




| Verif: | Forecast FMA | CFS Reanalysis | Subj. Result |
|---|---|---|---|
| Alaska, W. Can | Above normal | Mostly below and near normal | miss |
| C. - E. Canada | Above normal | Above over the continental central parts,and over the Archipelago | 50% where forecast |
| W. Nordic | Mostly equal chances | Below over Island, near normal | % |
| E. Nordic | Mostly equal chances | Near normal and below normal over the continental parts | % |
| W. Siberia | Above normal | Below normal in the North, near normal in the South | miss |
| E. Siberia | Above normal | Above in the SE, near normal in the North and West | 40% correct |
| ChukchiBering | Above normal | Above normal mostly | 90% correct |

# Overall result, subjective verification

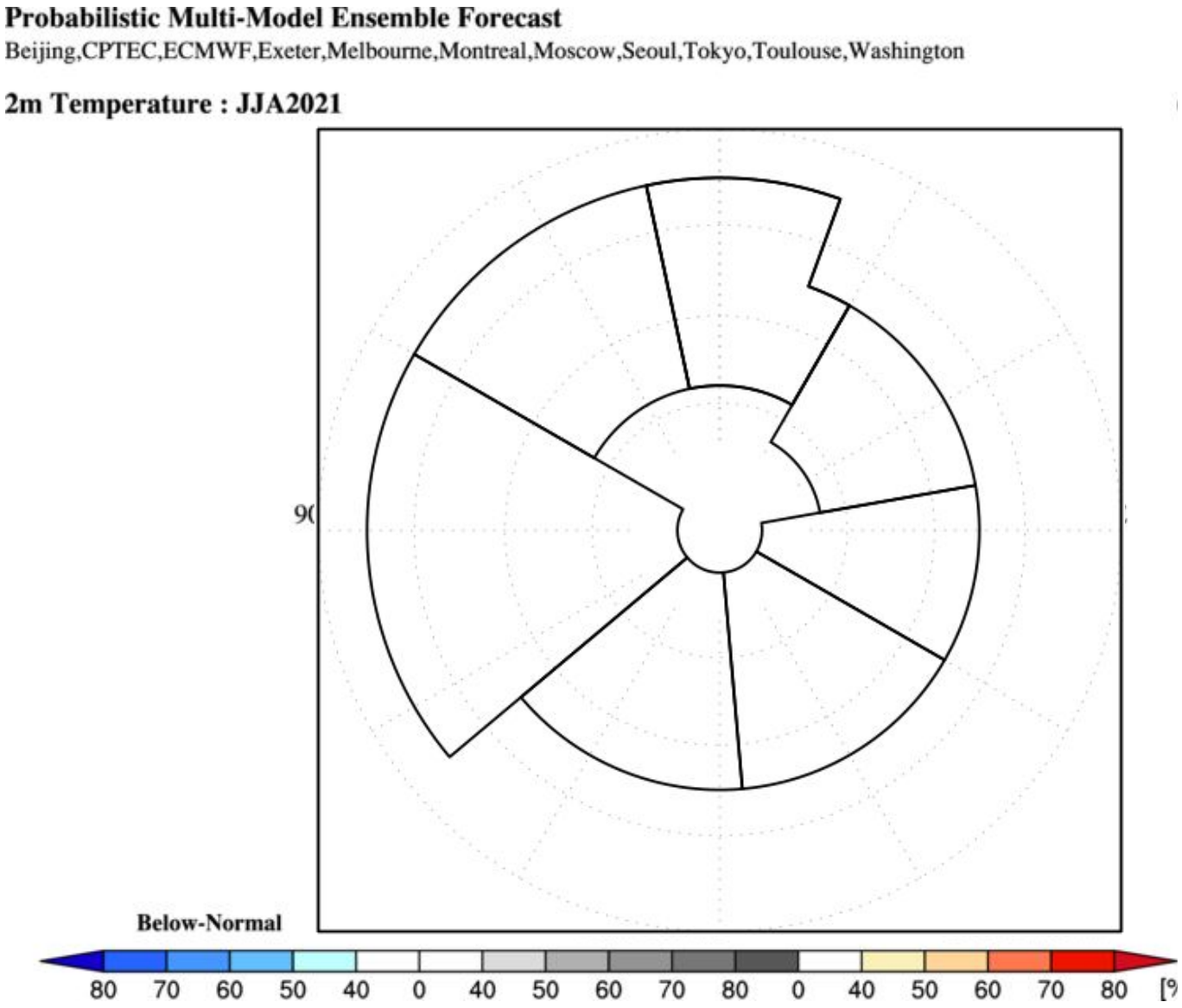
- **Temperature**: Considering all Arctic regions the subjective score is ~50 %. This is a good score considering that everything below or equal 33% is considered worse than a pure chance.

- **Precipitation**: In the regions where the models were decisive, the forecast subjective score is 40%. The best scores were over Chukchi & Bering, E. Canada and W. Siberia regions. Given the historical skill scores we know that precipitation forecasts are usually not this skilful over the Arctic.

Actual (real time )seasonal forecasts over the Arctic JJA 2021

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

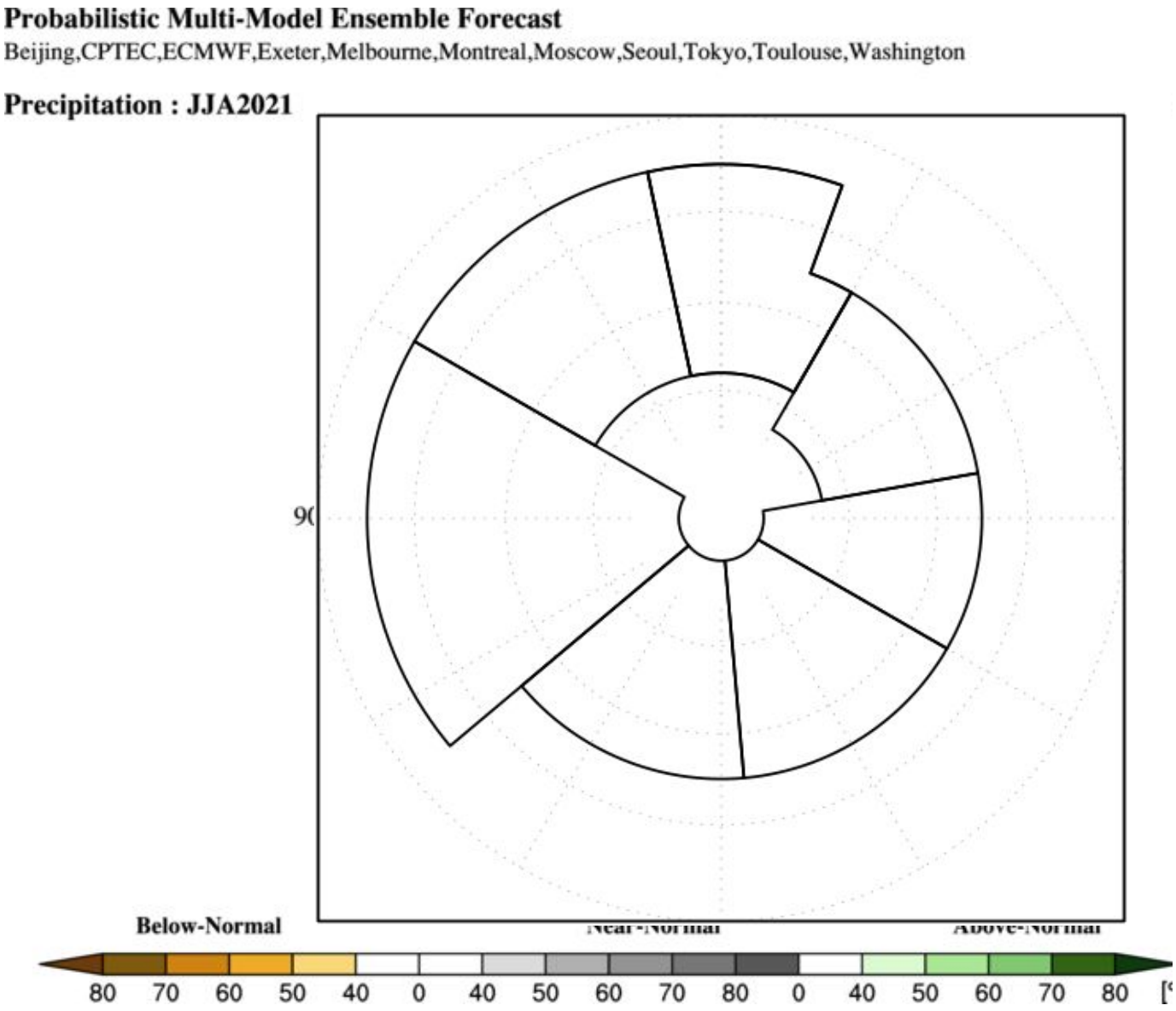
# Temperature outlook over the Arctic: June-July-August 2021




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.

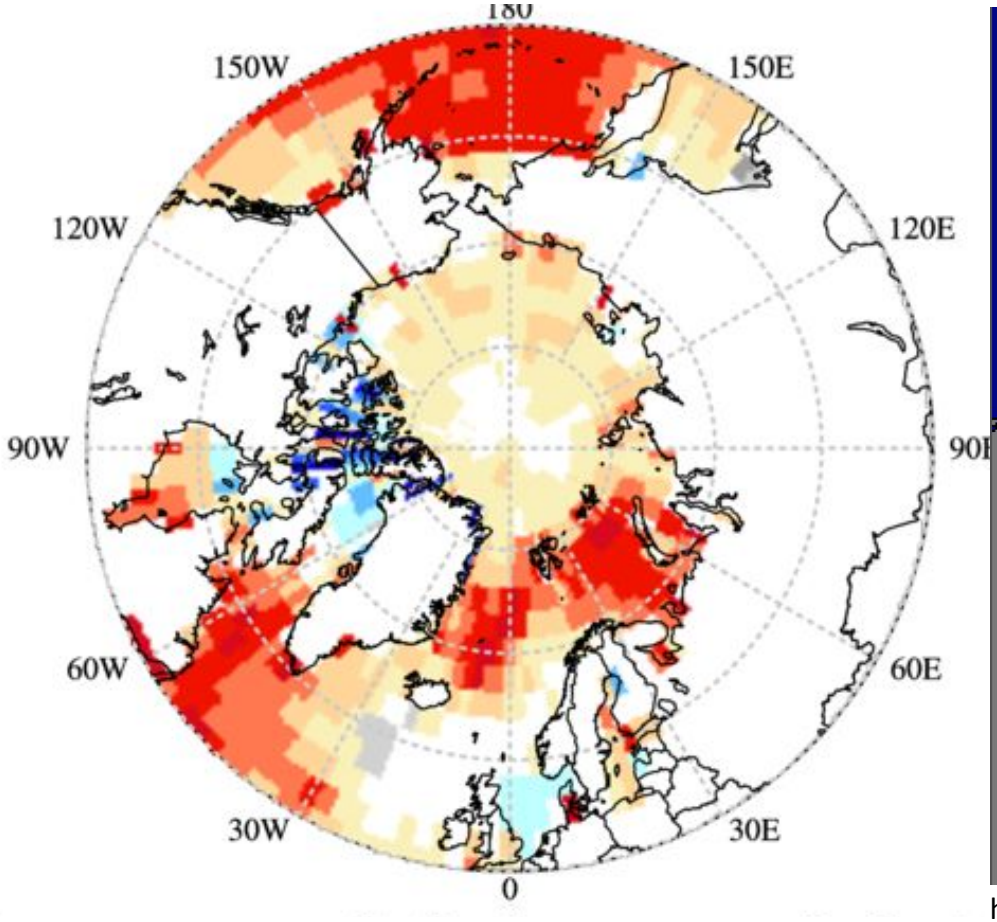
# Precipitation outlook over the Arctic: June-July-August 2021



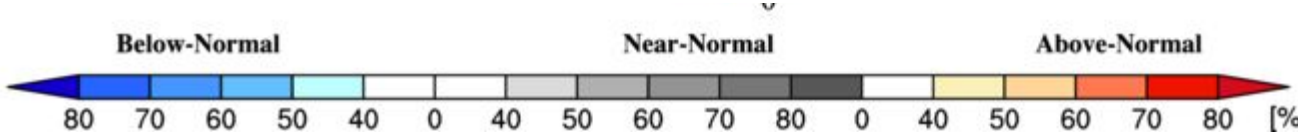

1. Alaska W. Canada
2. Eastern Canadian Arctic
3. Western Nordic
4. Eastern Nordic
5. West Siberia
6. East Siberia
7. Chukchi and Bering

- 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: June-July-August 2021

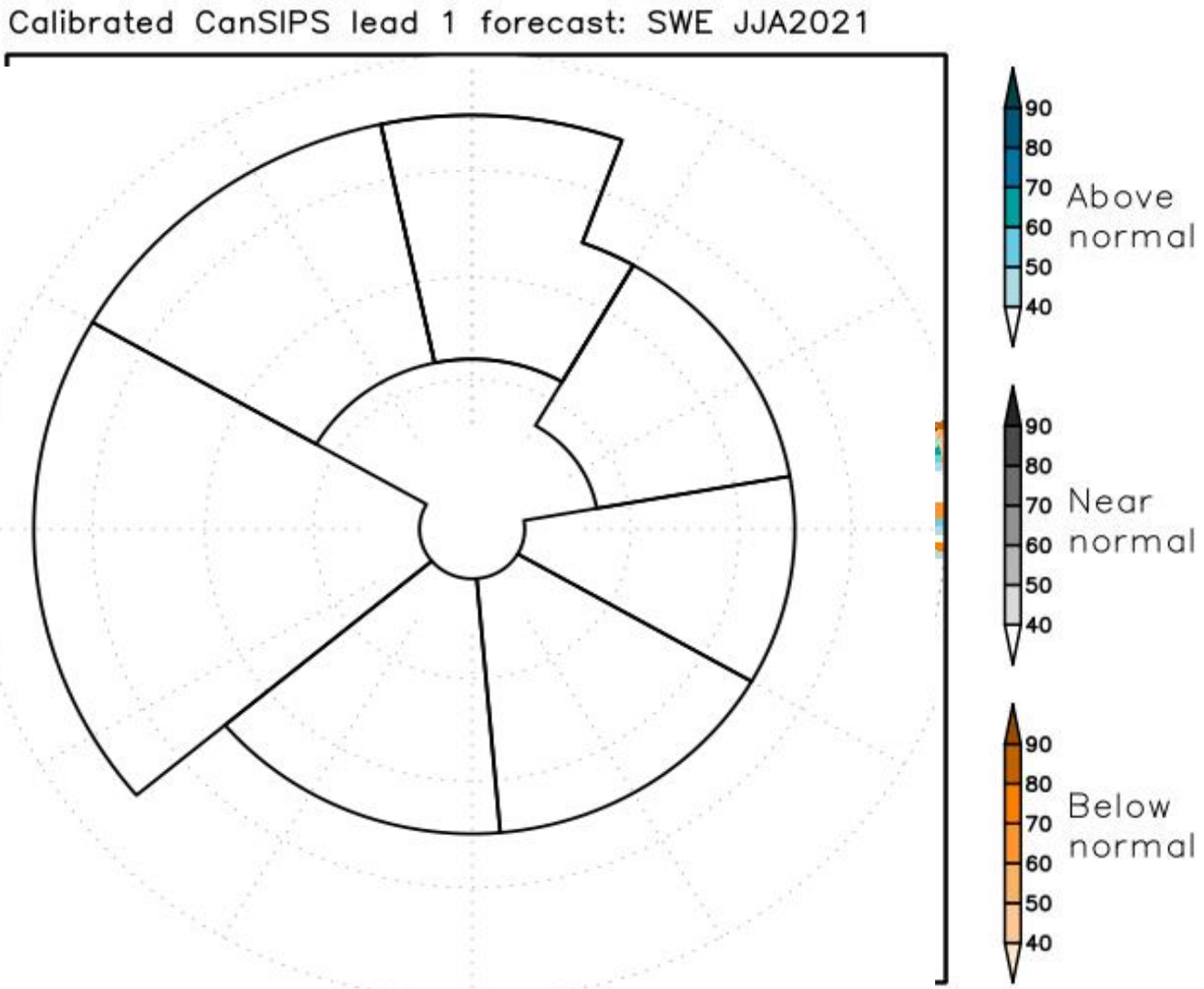


https://nsidc.org/arcticseaicenews/map-of-the-arctic-ocean/



# Snow Water Equivalent outlook over the Arctic: June-July-August 2021

Experimental product




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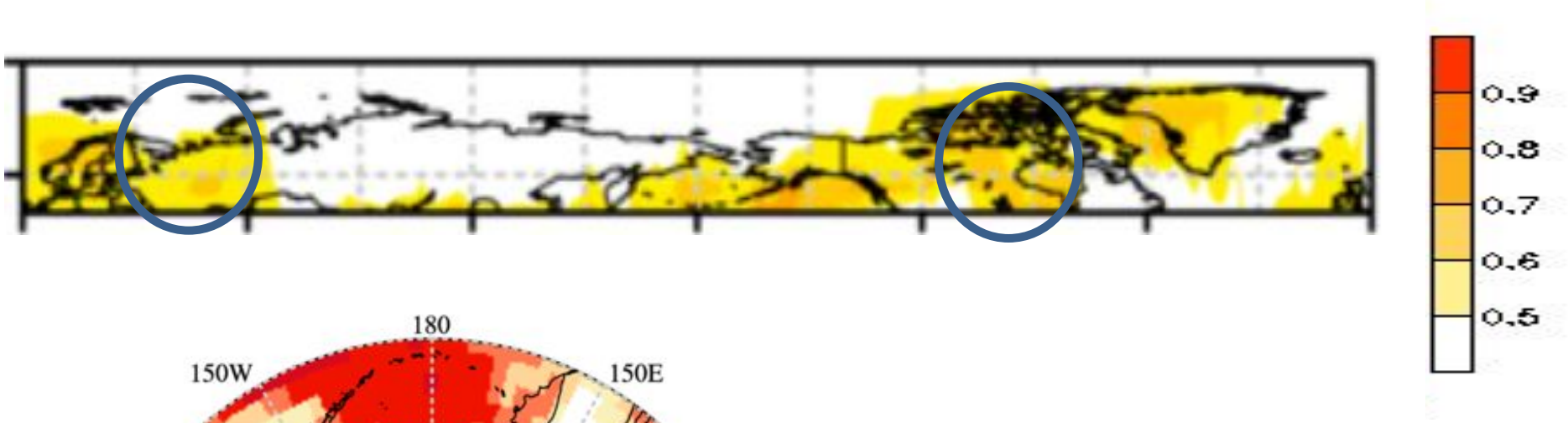
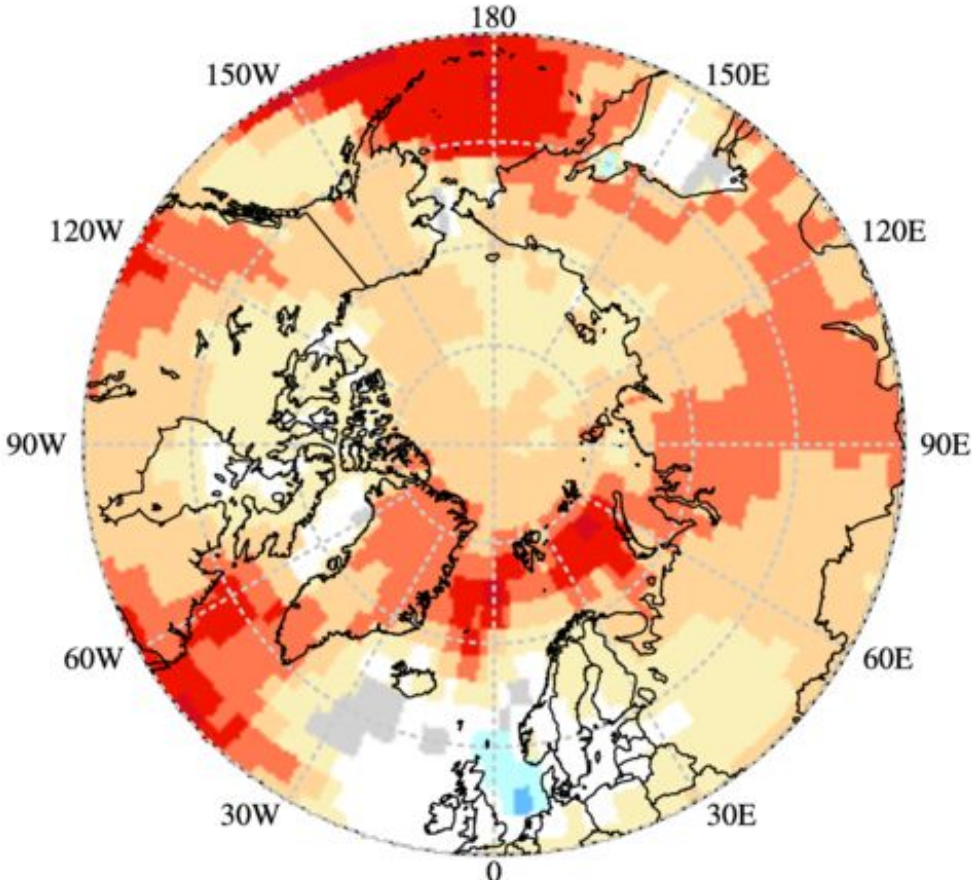
# Discussing historical skill over the Arctic, Temperature

(confidence with respect to the historical skill)

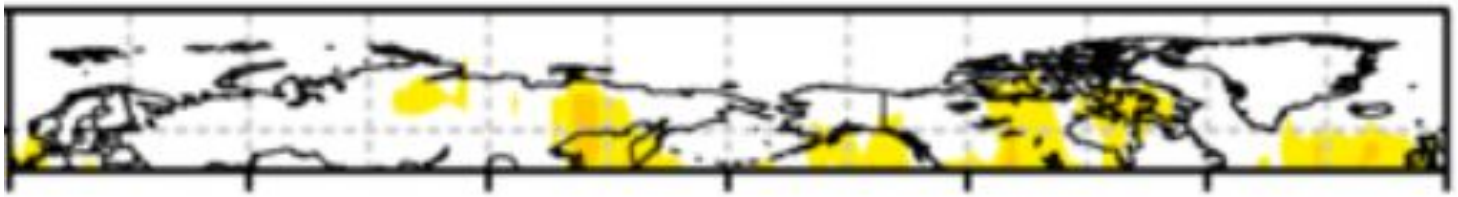


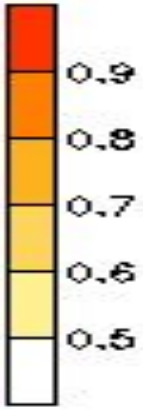



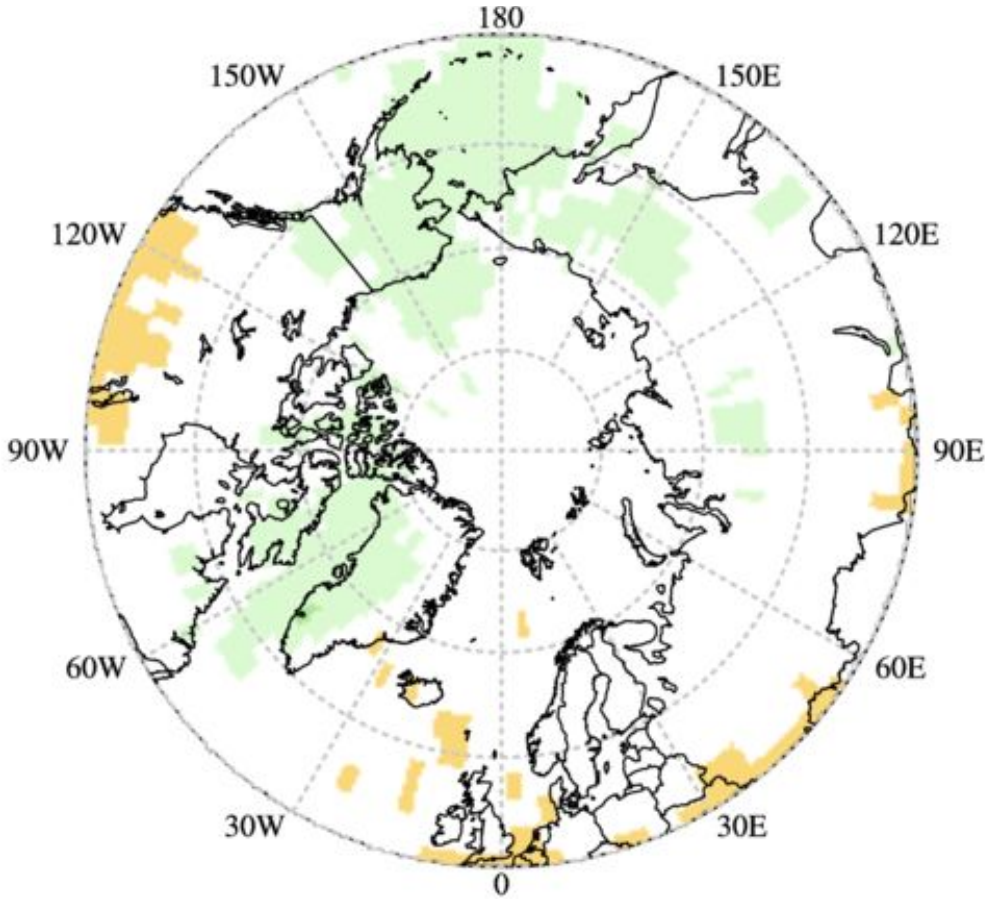

- If a historical skill was good over a certain region (e.g. colored region on the upper figure) we are more confident about the forecast results over the same region
- Overall confidence is weak in JJA over the Arctic.

# Discussing historical skill over the Arctic, Precipitation

(confidence with respect to the historical skill)

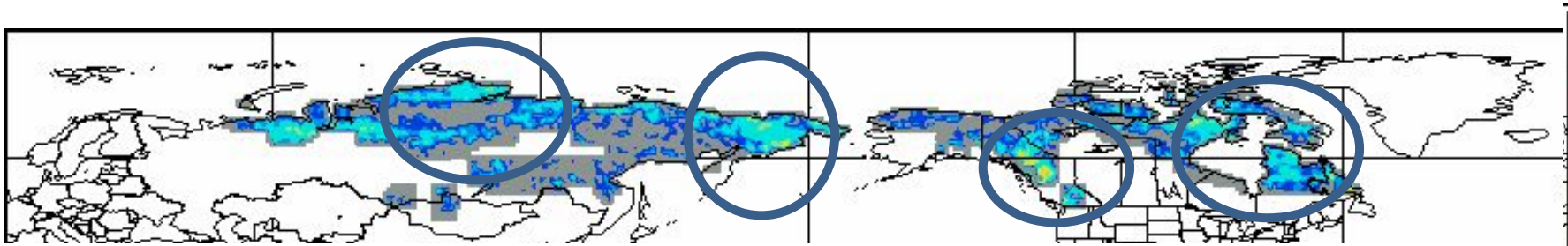


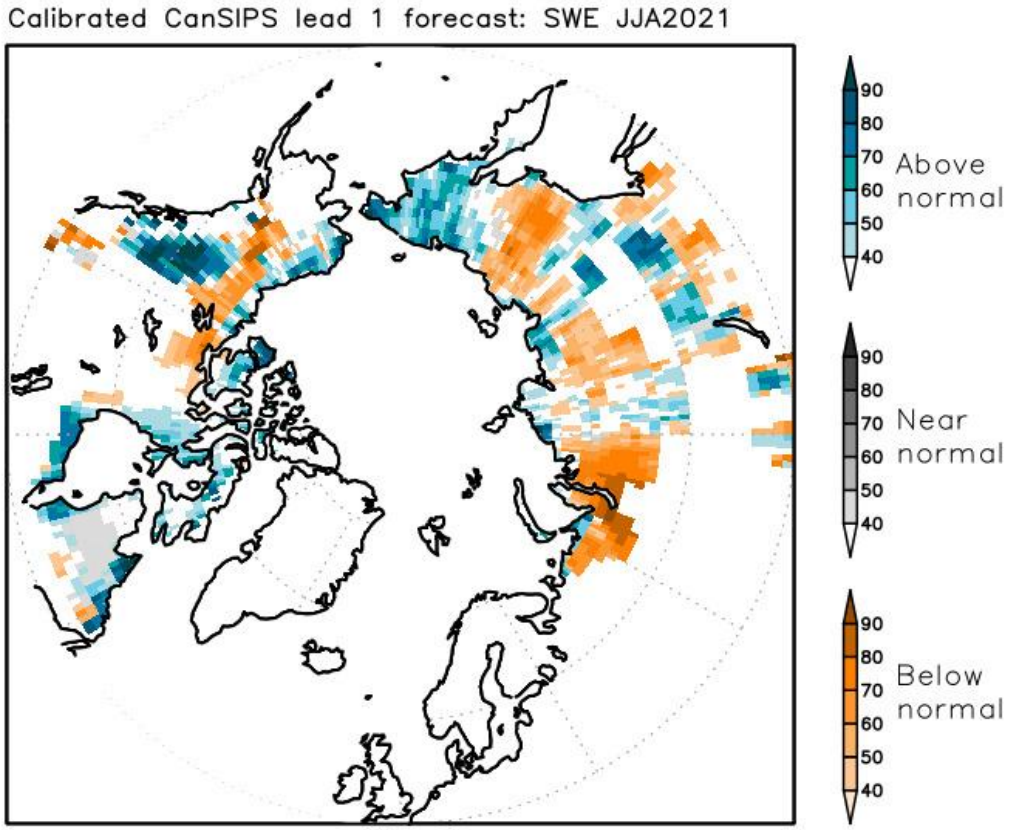



- We don’t have a very high confidence in precipitation skill over the Arctic in JJA.

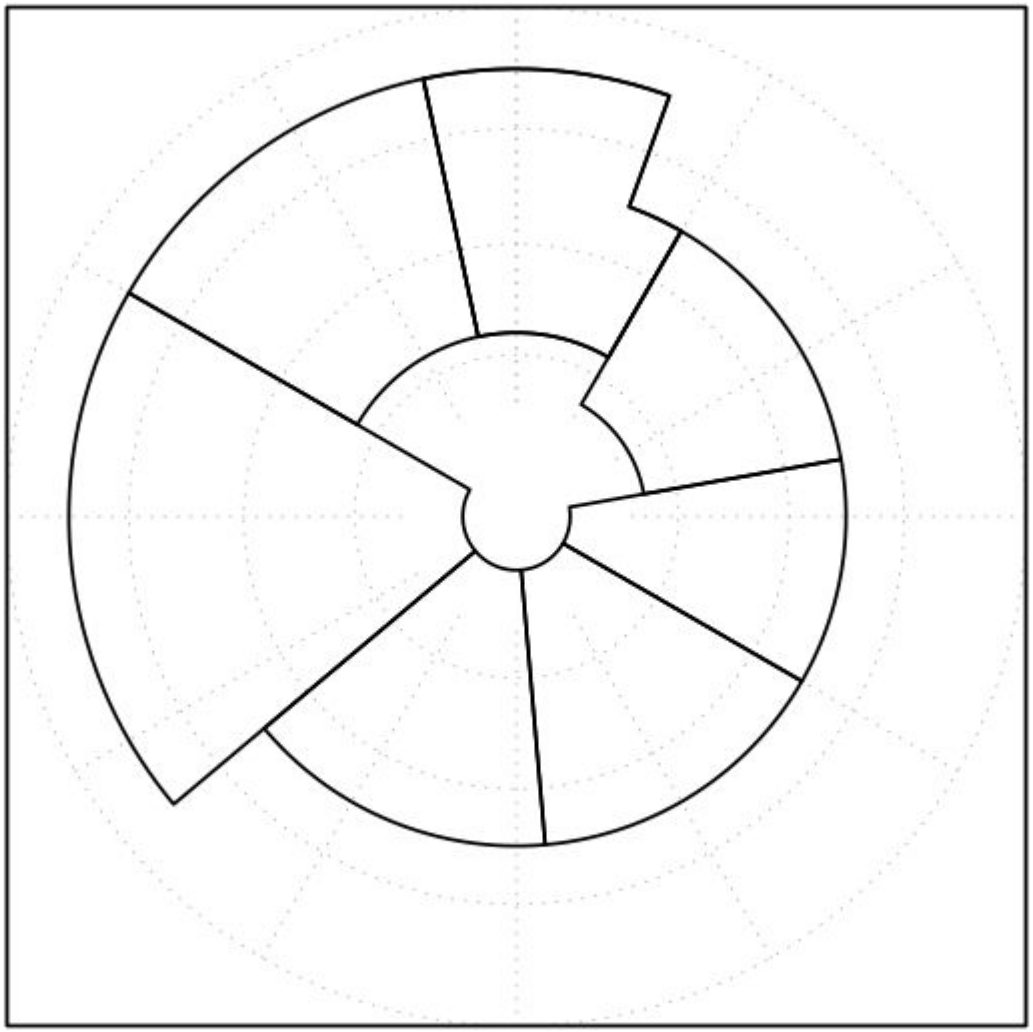
# Discussing historical skill over the Arctic, Temperature
(confidence with respect to the historical skill)




- 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

# 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.
- JJA2020 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 JJA21.
- We expect above normal precipitation over several Arctic regions: Chukchi and Bering, Alaska E. Canada and Canadian Archipelago. Historically, we do not have a high confidence in precipitation forecast over the Arctic in JJA.

# Thank you!