Environment and Climate Change Canada | Environnement et Changement climatique Canada

Canada

PARCOF-2: Verification of the JJA18 and Seasonal forecast for the first part of the winter: NDJ18/19

Marko Markovic, Eivind Støylen, John Parker, Katherine Wilson, Bertrand Denis, Adrien Tivy and Gabrielle Gascon

WMO

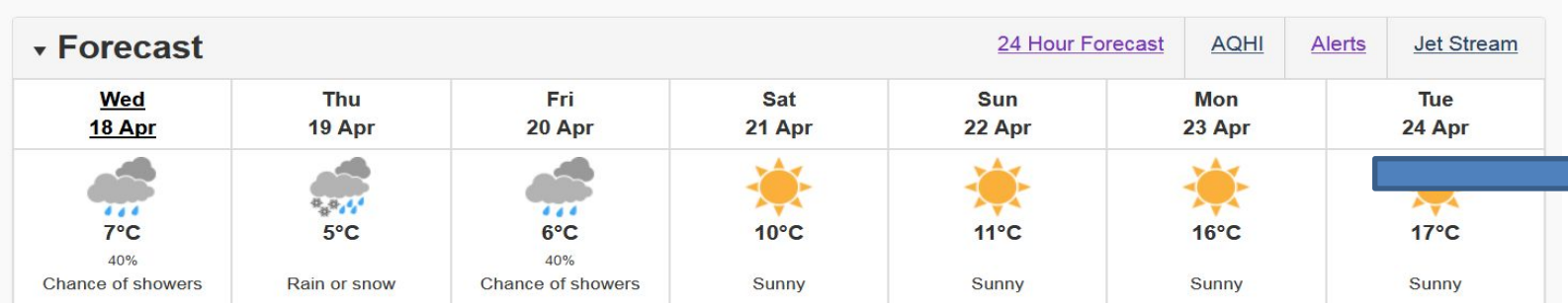
Plan

- Brief reminder on the seasonal forecasting (e.g. models, climatology, probabilities).
- Last JJA2018 forecast, a reminder.
- Introduction on a verification method.
- Verification JJA2018: temperature and precipitation.
- Real time forecasts for the first part of the winter NDJ 2018/2019.
- Consensus statement.
- Conclusions

Introduction to Seasonal Forecasting
What is Seasonal Forecast?

- If we take a ***weather forecasting*** model and we add to it an ***ocean forecasting*** model we will obtain a ***climate forecasting*** model.

- **Seasonal Forecast** is a climate forecast ranging up to 1 year ahead.



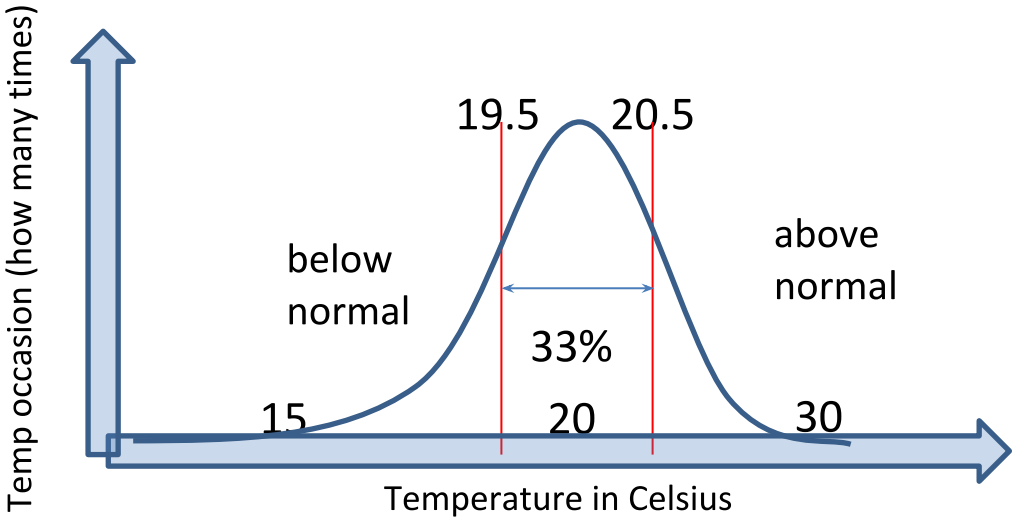
1 year

- **Seasonal Outlook** represents a 90-day average of the seasonal forecast's daily realisations.

Seasonal forecast over the Arctic, JJA 2018
A reminder:

- To calculate seasonal forecasts we use:
  - Climate models with ensemble prediction
  - International Multi model ensemble (US, Russia, Canada, Europe, …)

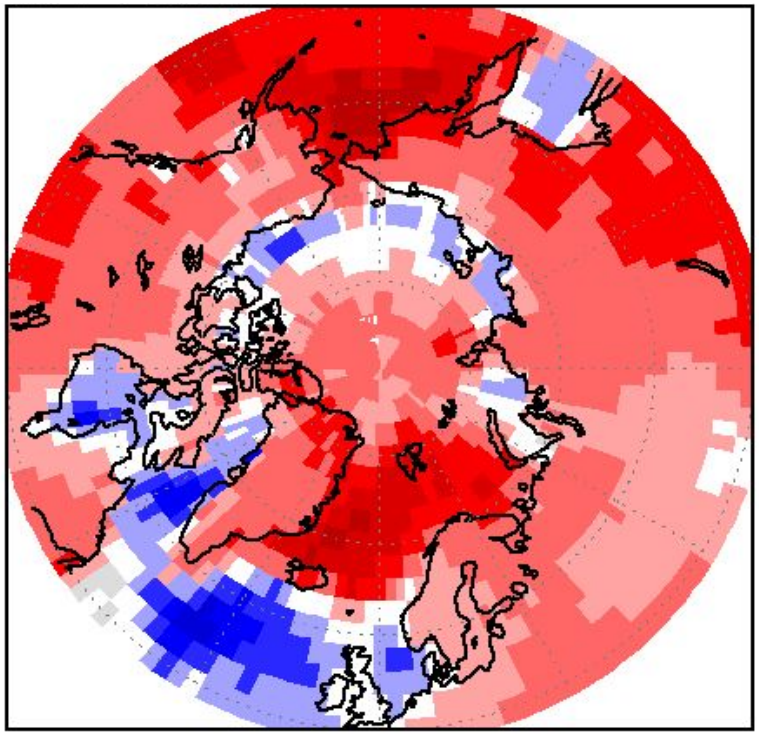
- We need ensembles to assess the probability for the certain outcome (e.g. how many ensemble members are above normal).
- We communicate seasonal forecast results in terms of probabilities (e.g. There is a 50% probability that the summer will be above normal).



- If the forecast for temp is higher than 20.5 we declare it **above normal.**
- Lower 19.5 degrees is **below normal.**
- In between is **near normal.**

Seasonal forecast over the Arctic, JJA 2018

A reminder

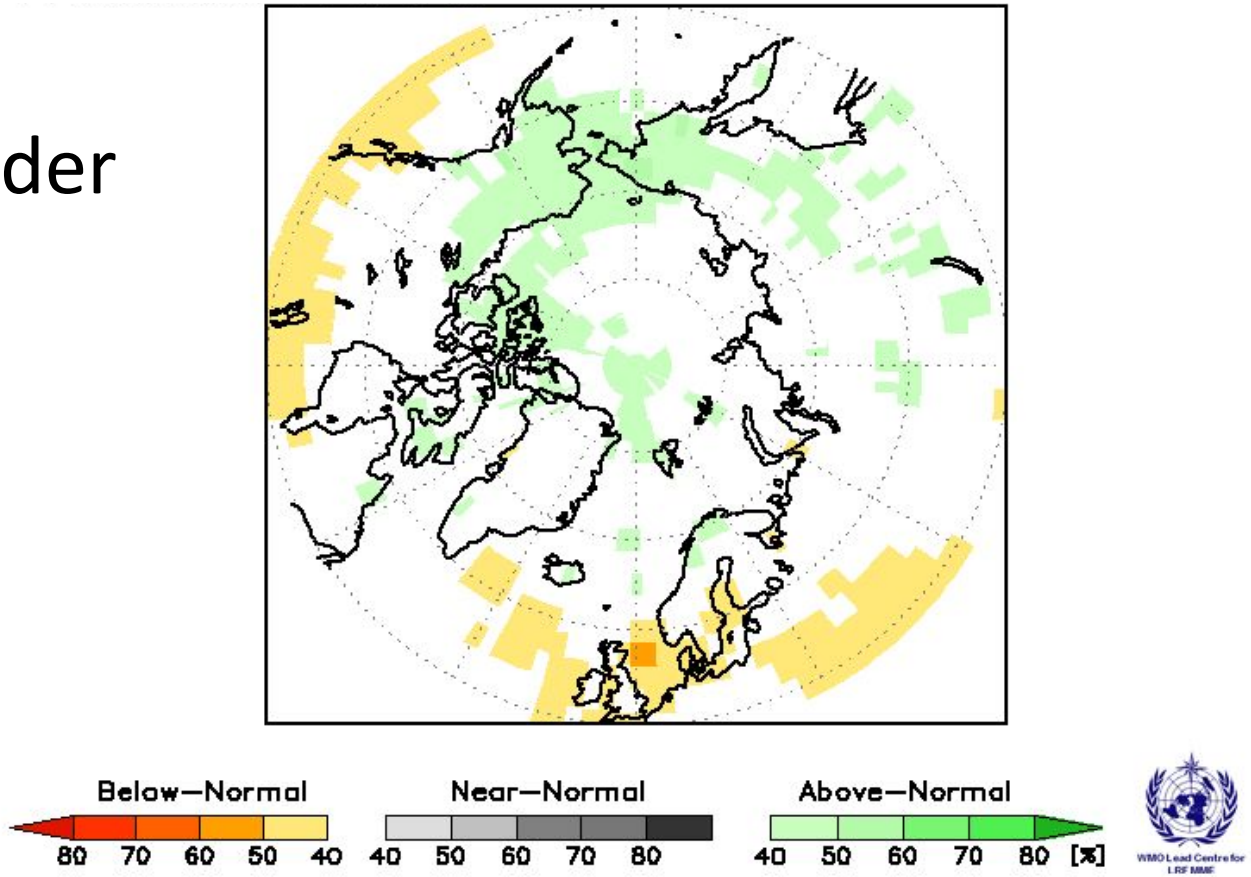


Considering multi-model ensemble forecast and a limited model skill over the Arctic:

Temperature: There is probability of at least 40% or more that the temperature will be above normal in the Arctic region

Seasonal forecast over the Arctic, JJA 2018

A reminder



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

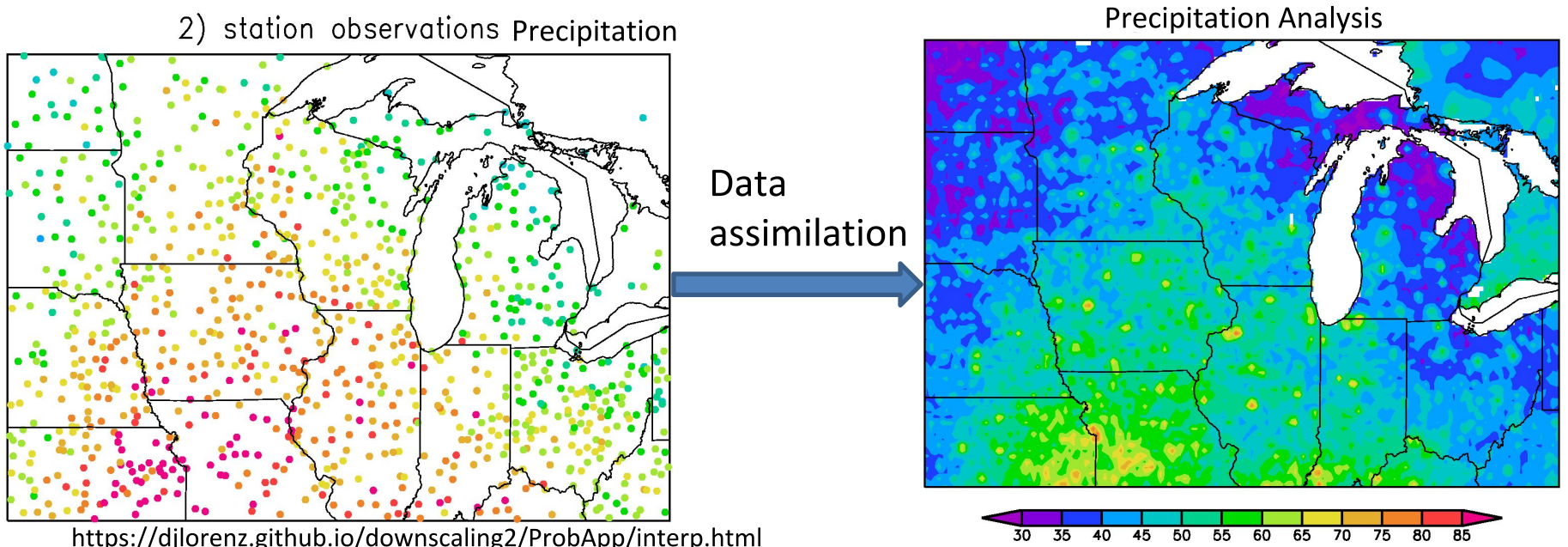
Precipitation: Mostly equal chances were expected with some exception in the Alaska, Eastern Russia and Norther Scandinavia.

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 analysis**.

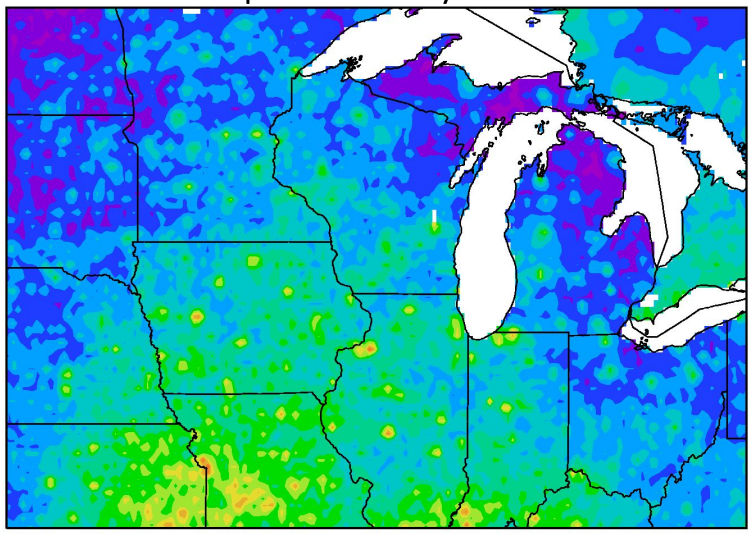


https://dilorenz.github.io/downscaling2/ProbApp/interp.html

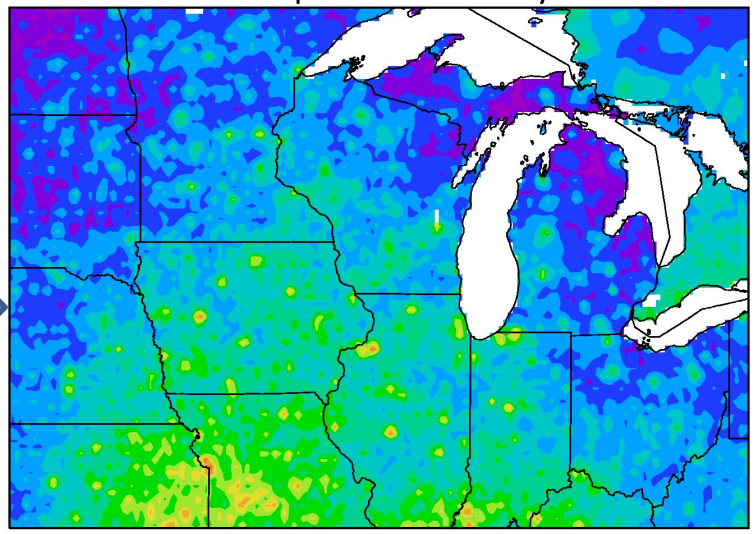
How do we verify seasonal forecasts?

- Since the data assimilation techniques can vary from one variable to another and due to the fact that they are constantly improving we use meteorological model to avoid inconsistences between them.
- This is how we get reanalysis.
- We will use NCAR CFSR (Climate Forecast System Reanalysis) to be the “truth”.
- Reanalysis are not observations, they suffer from imperfections but they are our best guess.

Precipitation Analysis



Precipitation Re-analysis



6-hour Model Simulation

Similar result but no Inconsistency Between the Assimilation techniq.

30 35 40 45 50 55 60 65 70 75 80 85

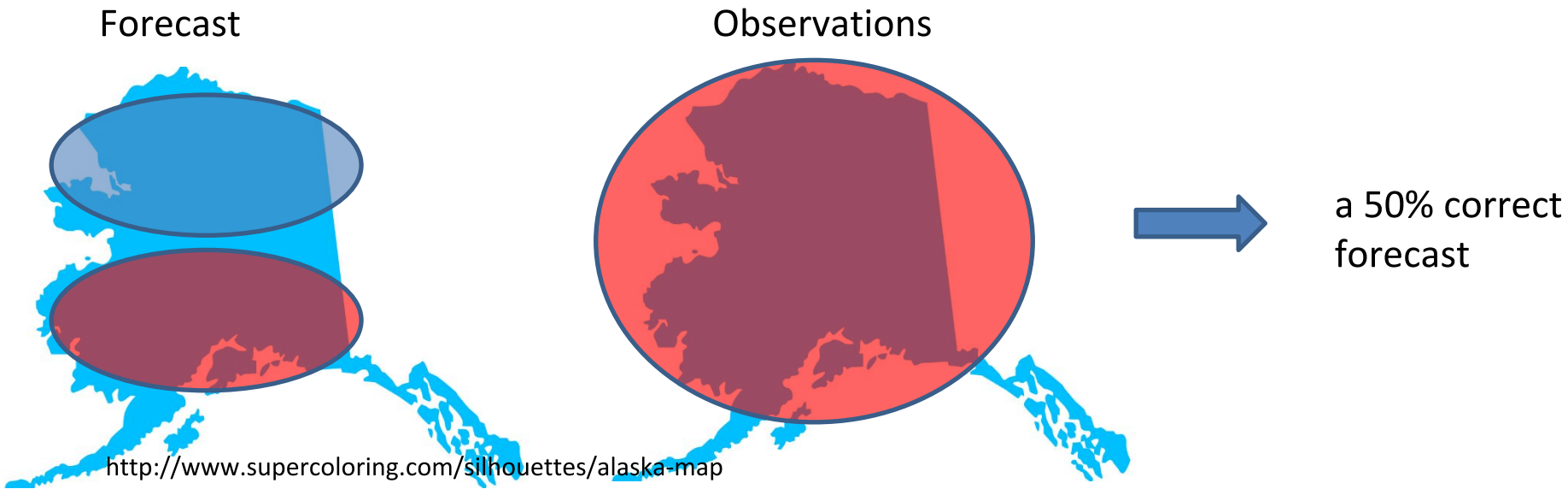
30 35 40 45 50 55 60 65 70 75 80 85

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

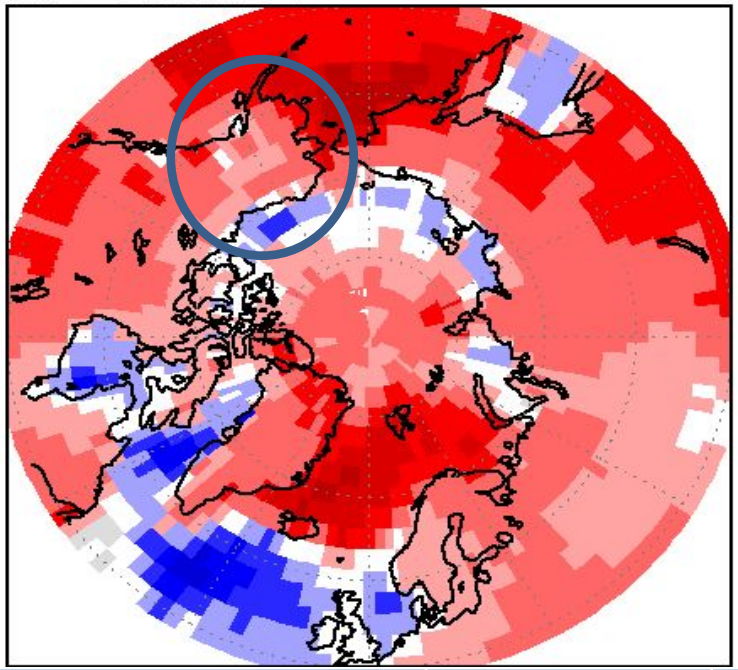
How do we verify seasonal forecasts?

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

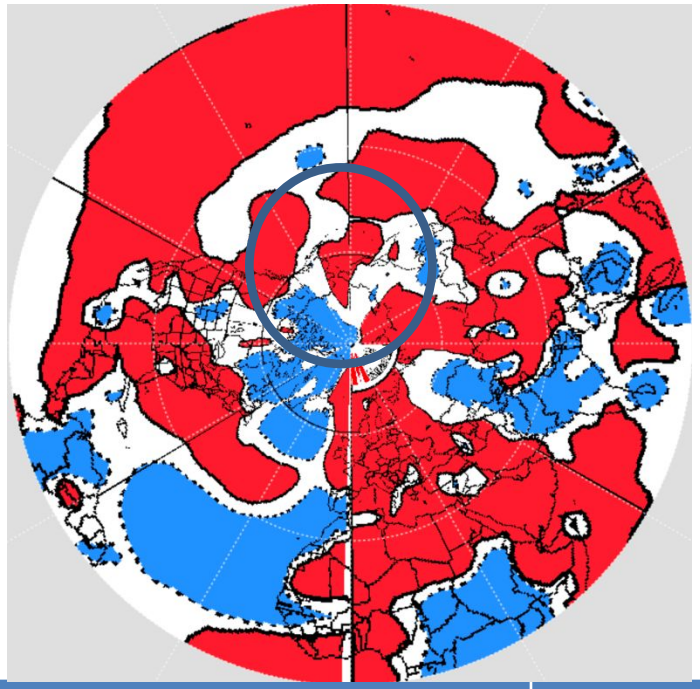
- For the verification over the Arctic we will use a subjective score: a percentage of the correct forecast over a selected region in the Arctic.



Forecast, temp JJA 2018



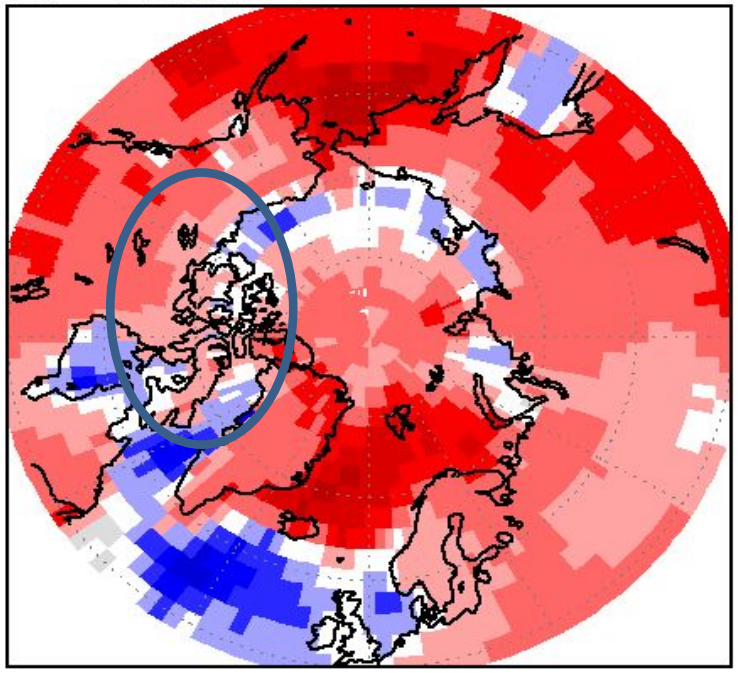
CFSR Reanalysis JJA 2018



Verification Temperatur e

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	**above**	**only far west, otherwise near normal**	**1/3 hit, 2/3 miss**
Canadian Arctic			
Greenland			
North Atlantic			
European Arctic			
Central Russia			
Eastern Russia			

Forecast, temp JJA 2018



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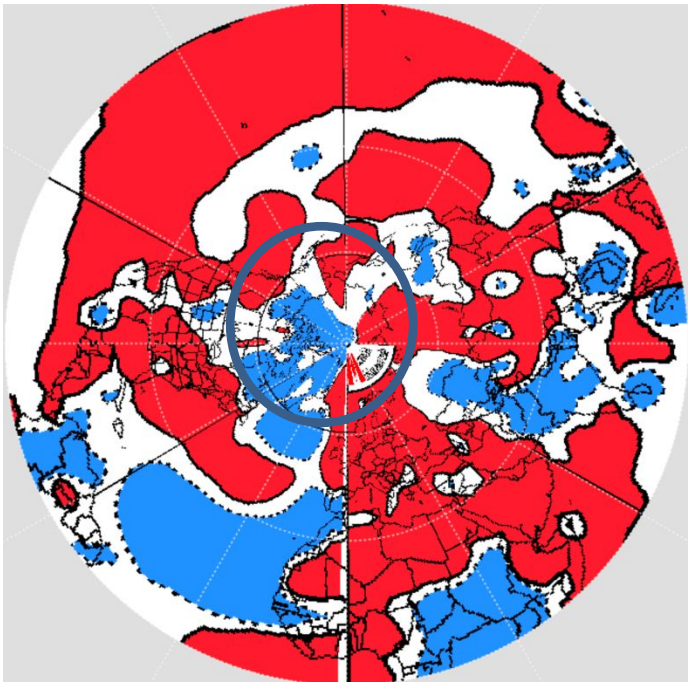
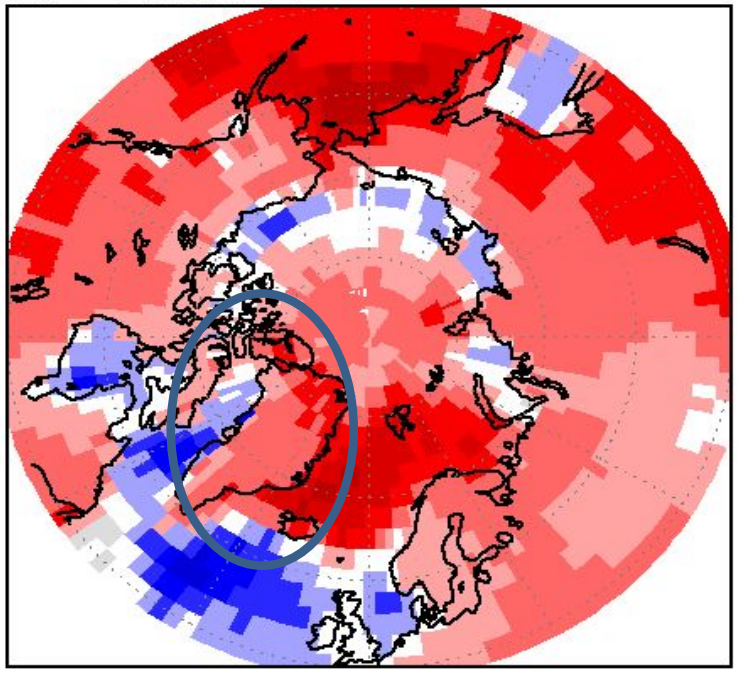


Verification Temperature

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	above	only far west, otherwise near normal	1/3 hit, 2/3 miss
Canadian Arctic	**Above**	**Below or near normal**	**miss**

Forecast, temp JJA 2018



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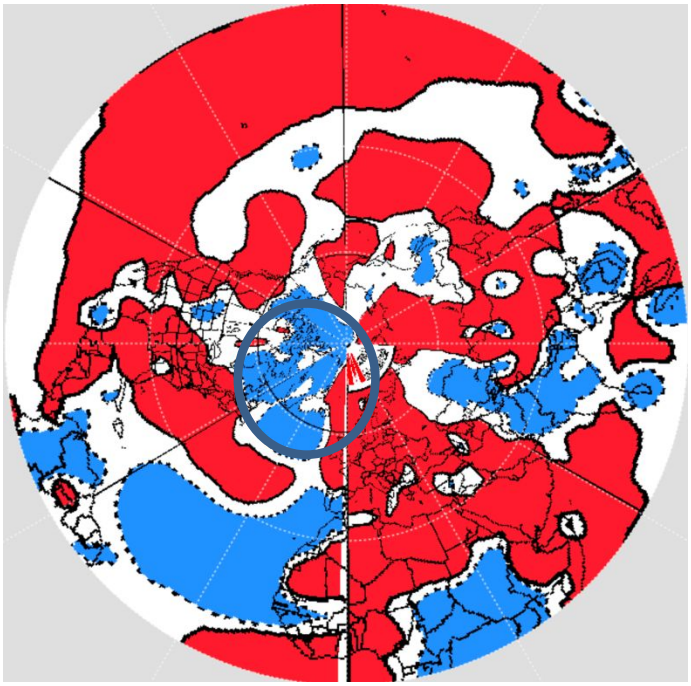
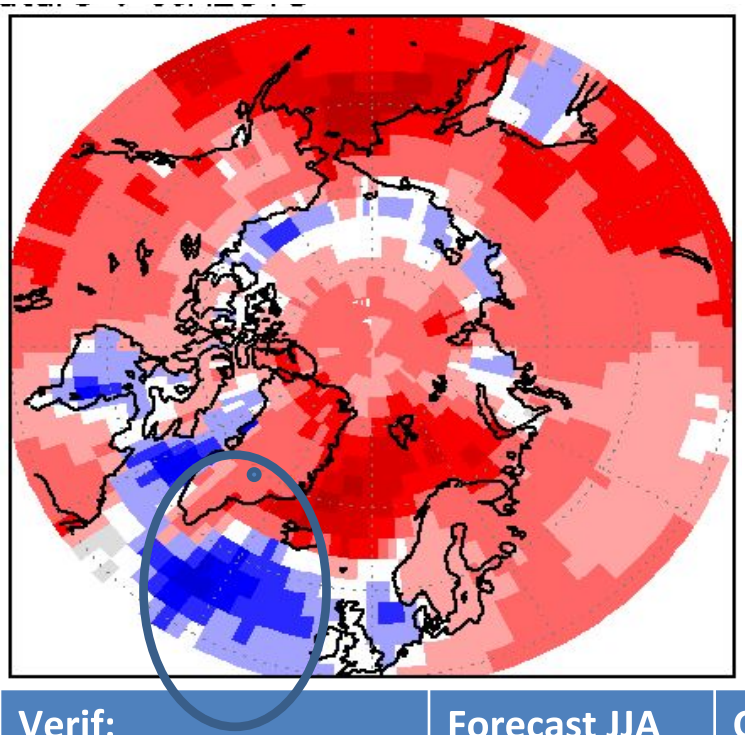


Verification Temperature

Verif:	Forecast JJA	CFS Reanalysis	Subjective Result
Alaska	above	only far west, otherwise near normal	1/3 hit, 2/3 miss
Canadian Arctic	Above	Below or near normal	miss
Greenland	**Above**	**Below**	**miss**

Forecast, temp JJA 2018



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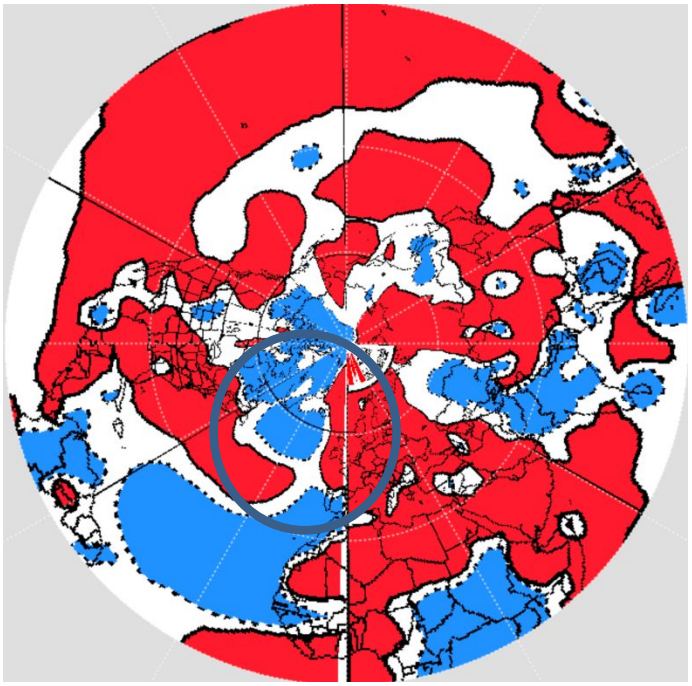
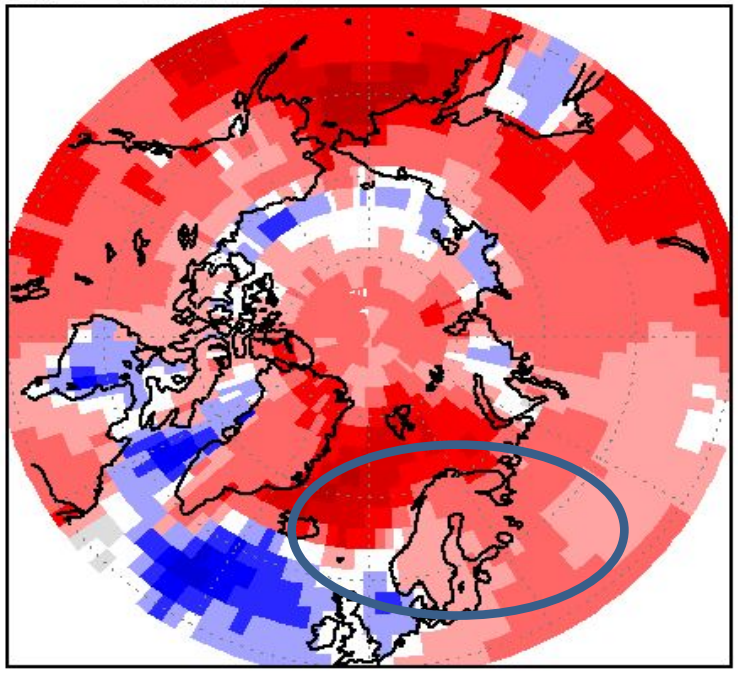


Verification Temperature

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	above	only far west, otherwise near normal	1/3 hit, 2/3 miss
Canadian Arctic	Above	Below or near normal	miss
Greenland	Above	Below	miss
North Atlantic	**Below**	**Below**	**hit**

Forecast, temp JJA 2018



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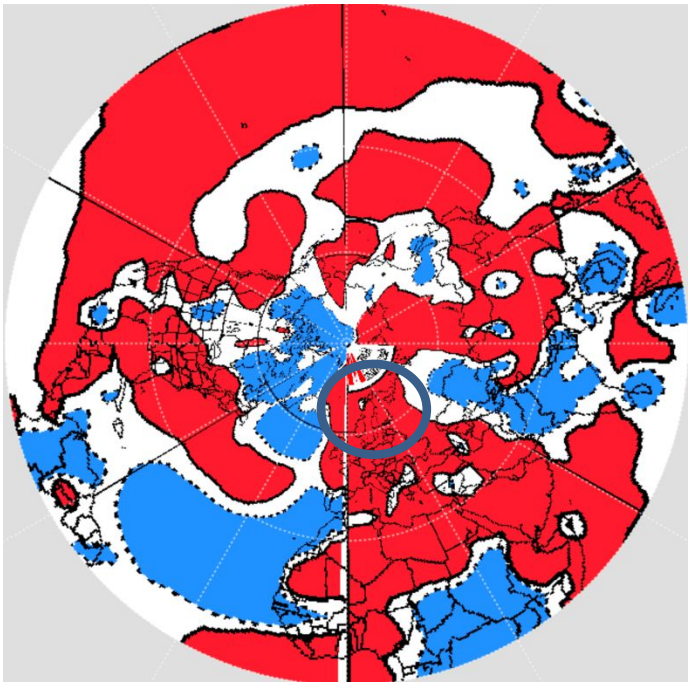
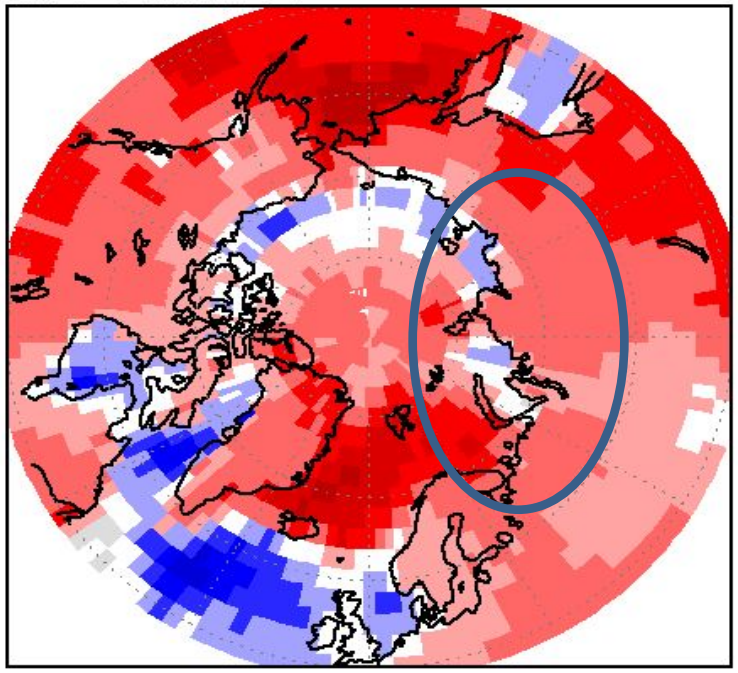


Verification Temperature

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	above	only far west, otherwise near normal	1/3 hit, 2/3 miss
Canadian Arctic	Above	Below or near normal	miss
Greenland	Above	Below	miss
North Atlantic	Below	Below	hit
European Arctic	**Above**	**Above**	**hit**

Forecast, temp JJA 2018



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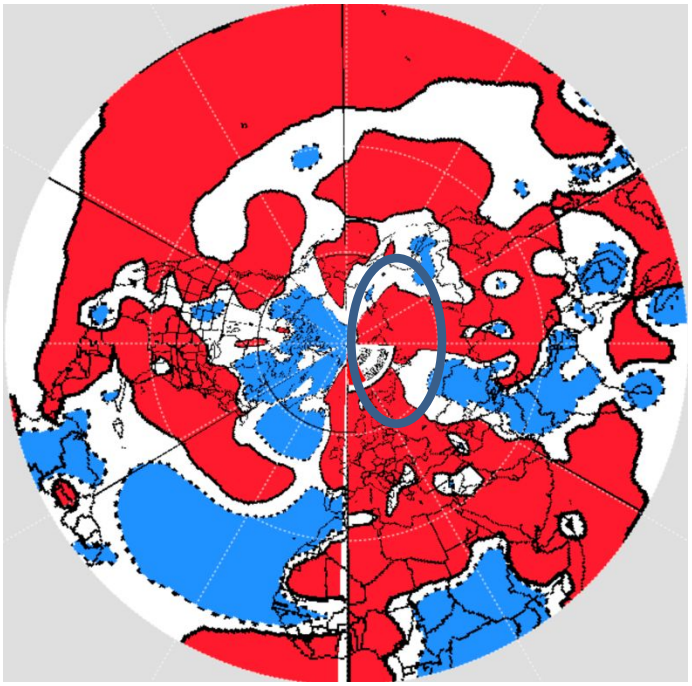
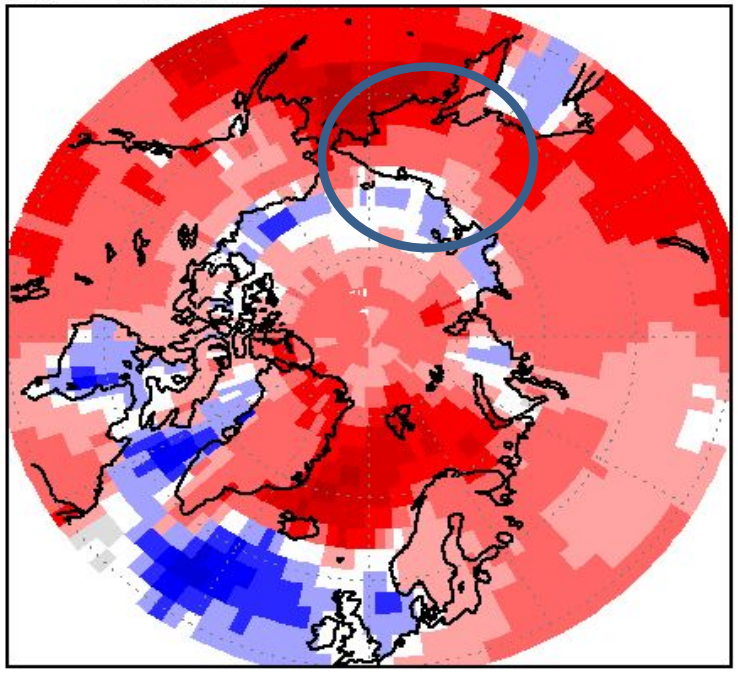


Verification Temperatur e

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	above	only far west, otherwise near normal	1/3 hit, 2/3 miss
Canadian Arctic	Above	Below or near normal	miss
Greenland	Above	Below	miss
North Atlantic	Below	Below	hit
European Arctic	Above	Above	hit
Central Russia	**Above**	**Above**	**hit**

Forecast, temp JJA 2018



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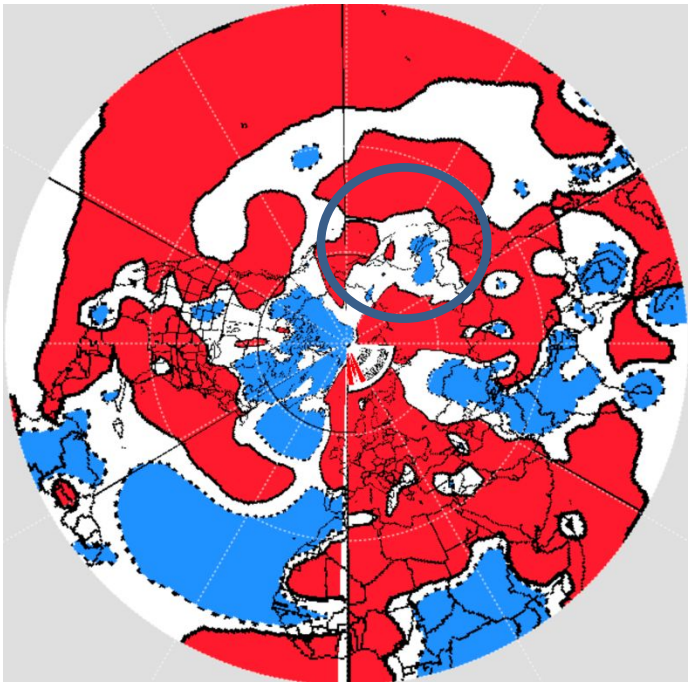
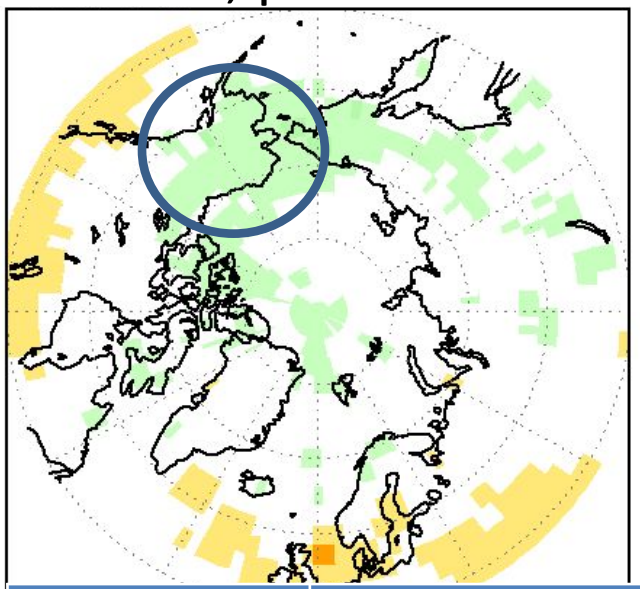


Verification Temperatur e

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	above	only far west, otherwise near normal	1/3 hit, 2/3 miss
Canadian Arctic	Above	Below or near normal	miss
Greenland	Above	Below	miss
North Atlantic	Below	Below	hit
European Arctic	Above	Above	hit
Central Russia	Above	Above	hit
Eastern Russia	**Above**	**Above and near normal**	**1/3 hit, 2/3 miss**

Forecast, prec JJA 2018



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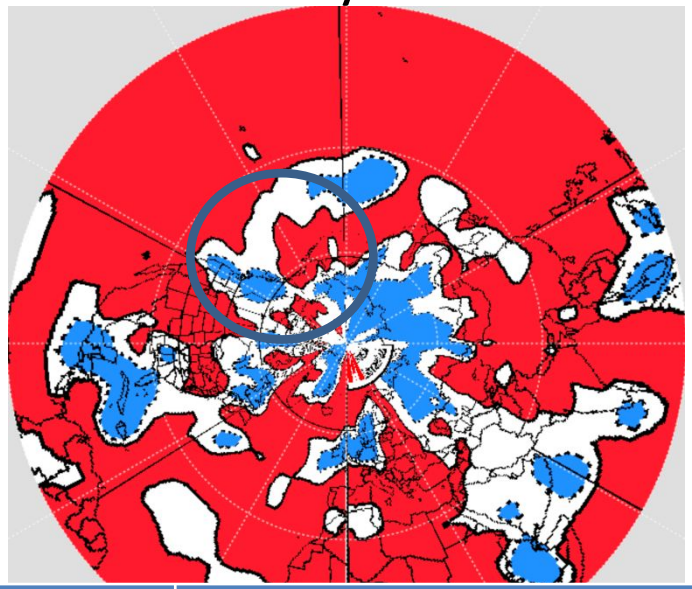
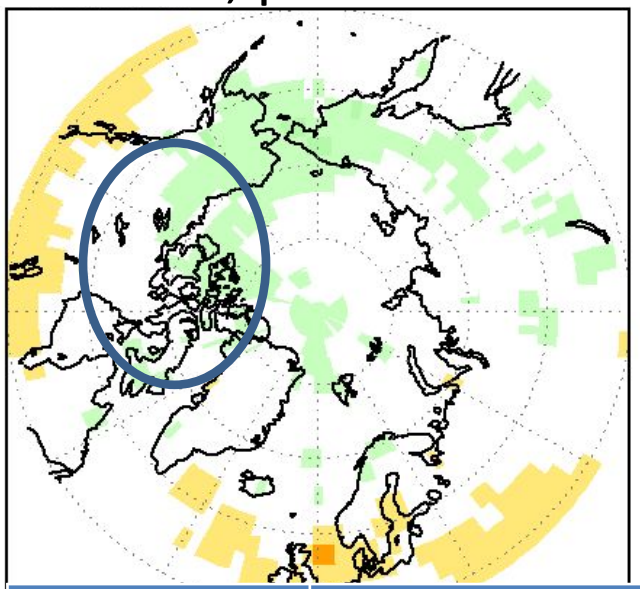


Verification Precipitation

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	**Above normal**	**Above in the south, below in the north**	**1/2 hit, 1/2 miss**
Canadian Arctic			
Greenland			
North Atlantic			
European Arctic			
Central Russia			
Eastern Russia			

Forecast, prec JJA 2018



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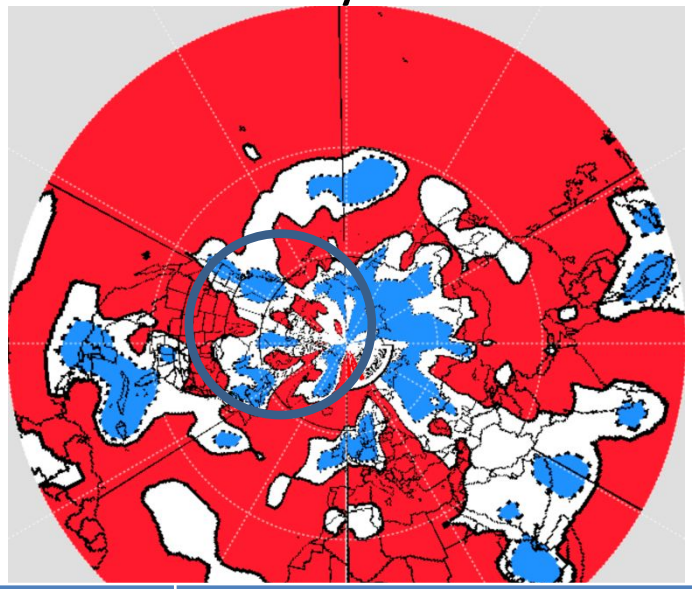
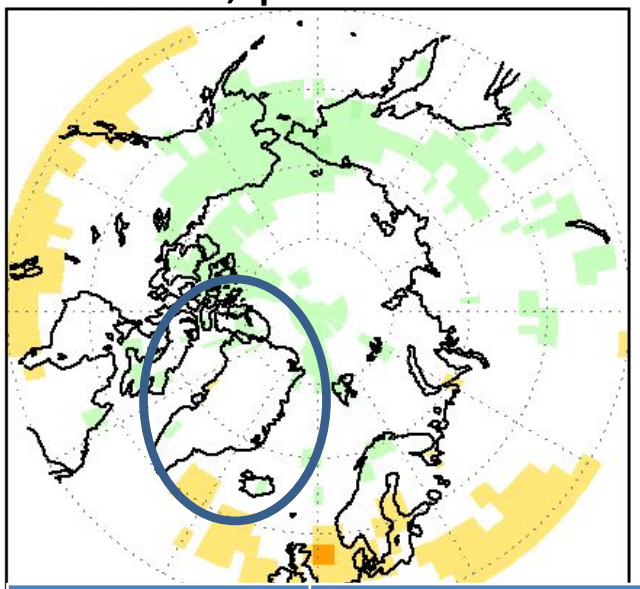


Verification Precipitation

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	Above normal	Above in the south, below in the north	1/2 hit, 1/2 miss
Canadian Arctic	**Above far north, equal chances**	**Mostly above and near normal**	**2/3 hit, 1/3 miss**

Forecast, prec JJA 2018



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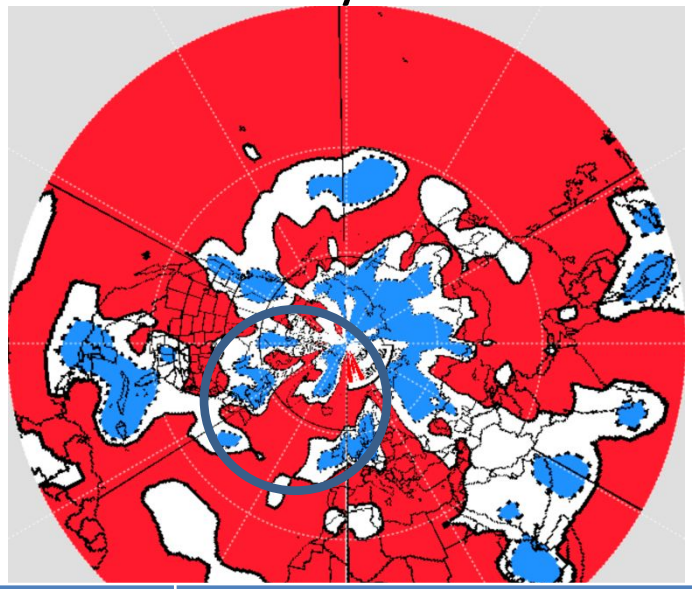
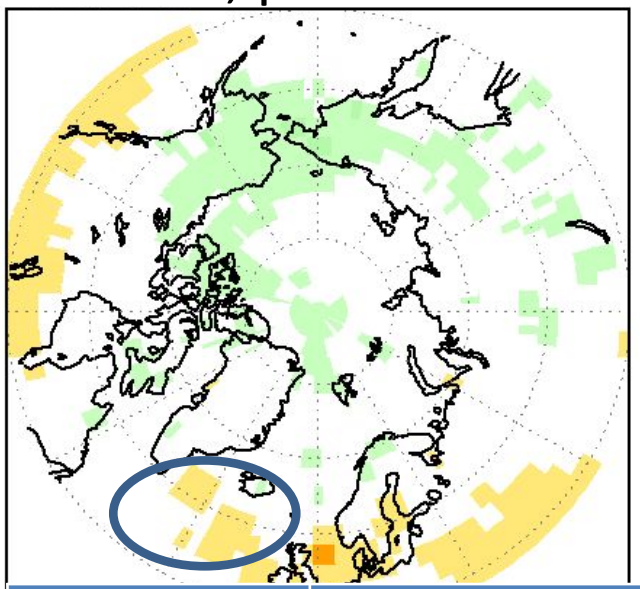


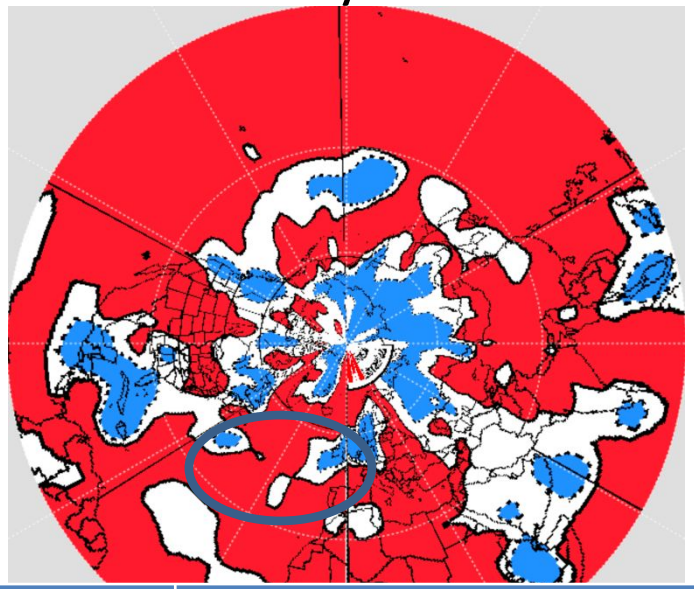
Verification Precipitation

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	Above normal	Above in the south, below in the north	1/2 hit, 1/2 miss
Canadian Arctic	Above far north, equal chances	Mostly above and near normal	2/3 hit, 1/3 miss
Greenland	**Equal chances**	**Below in the north and center, above in the south**	**%**

Forecast, prec JJA 2018



CFSR Reanalysis JJA 2018



Verification Precipitation

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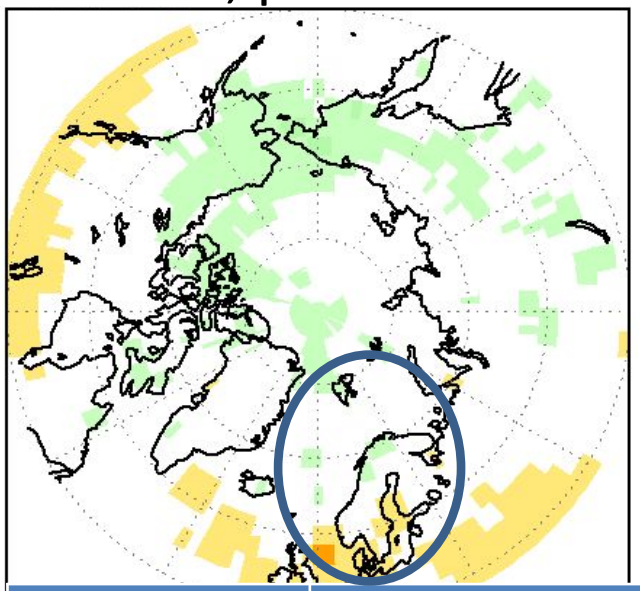
Canadian Arctic	Above far north, equal chances	Mostly above and near normal	2/3 hit, 1/3 miss
Greenland	Equal chances	Below in the north and center, above in the south	%
North Atlantic	**Mostly equal chances, below towards east**	**above**	**%**

Forecast, prec JJA 2018



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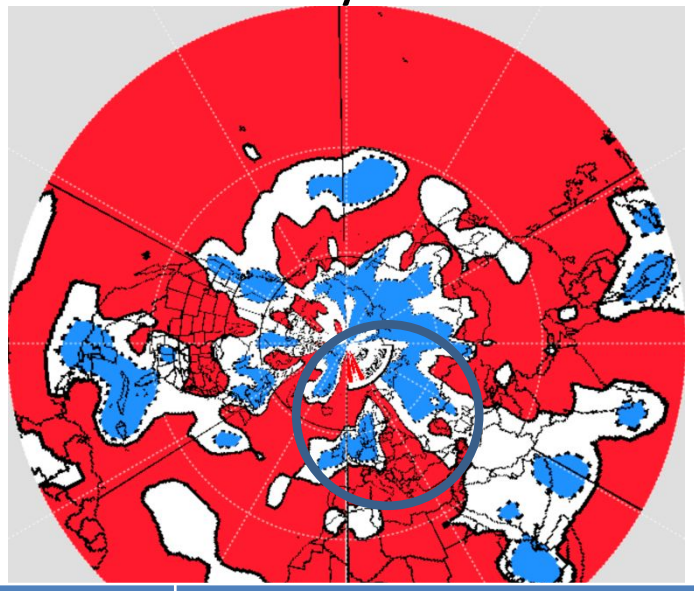
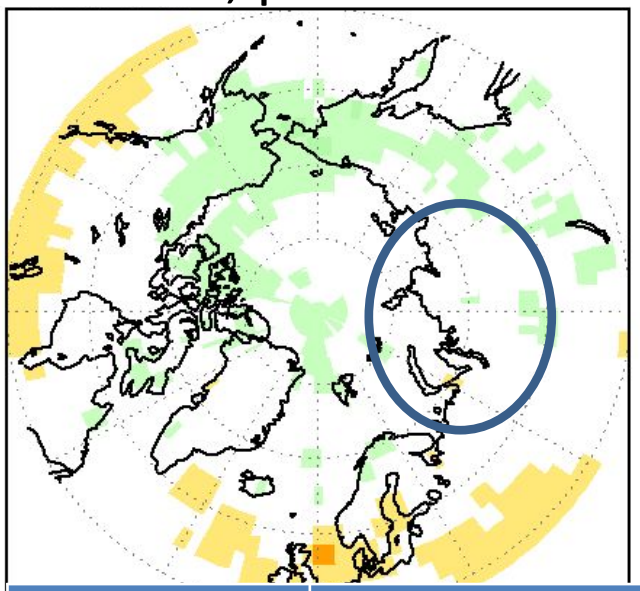


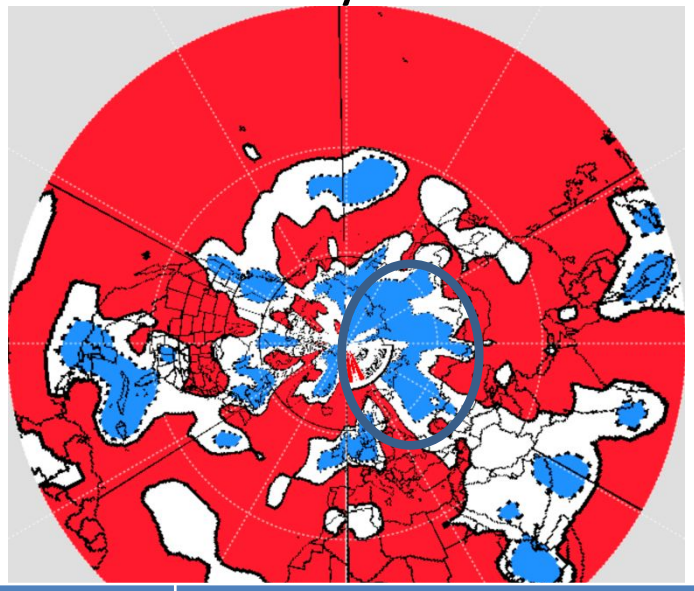
Verification Precipitation

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	Above normal	Above in the south, below in the north	1/2 hit, 1/2 miss
Canadian Arctic	Above far north, equal chances	Mostly above and near normal	2/3 hit, 1/3 miss
Greenland	Equal chances	Below in the north and center, above in the south	%
North Atlantic	Mostly equal chances, below towards east	above	%
European Arctic	**Equal chances, above over Northern Norway and Sweden, below in Baltic sea**	**above over Northern Norway and Sweden, below in Baltic sea**	**2/3 hit, 1/3 miss**

Forecast, prec JJA 2018



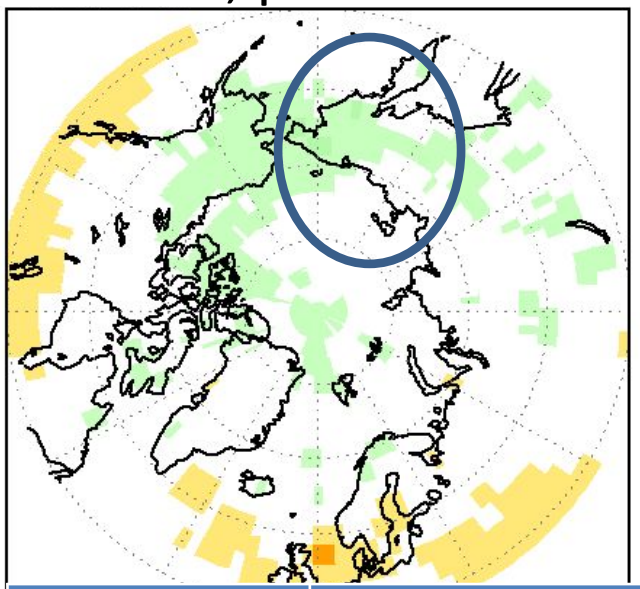
CFSR Reanalysis JJA 2018



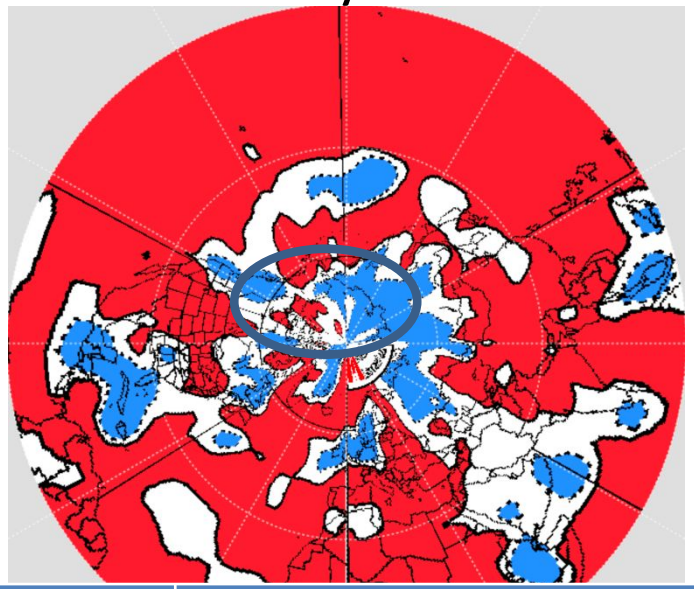
Verification Precipitation

Verif:	Forecast JJA	CFS Reanalysi	Subjective Result
Alaska	Above normal	Above in the south, below in the north	1/2 hit, 1/2 miss
Canadian Arctic	Above far north, equal chances	Mostly above and near normal	2/3 hit, 1/3 miss
Greenland	Equal chances	Below in the north and center, above in the south	%
North Atlantic	Mostly equal chances, below towards east	above	%
European Arctic	Equal chances, above over Northern Norway and Sweden, below in Baltic sea	above over Northern Norway and Sweden, below in Baltic sea	2/3 hit, 1/3 miss
Central Russia	**Equal chances**	**below**	**%**

Forecast, prec JJA 2018



CFSR Reanalysis JJA 2018



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Canadian Arctic	Above far north, equal chances	Mostly above and near normal	2/3 hit, 1/3 miss
Greenland	Equal chances	Below in the north and center, above in the south	%
North Atlantic	Mostly equal chances, below towards east	above	%
European Arctic	Equal chances, above over Northern Norway and Sweden, below in Baltic sea	above over Northern Norway and Sweden, below in Baltic sea	2/3 hit, 1/3 miss
Central Russia	Equal chances	below	%
Eastern Russia	**Above**	**Below, above over the small territory in the south**	**Mostly miss**

Overall result, subjective verification

- **Temperature**: ~50% of the Arctic territory had a correct forecast, this is far better than a pure chance which would be a 33% (due to the three categories we are trying to forecast).

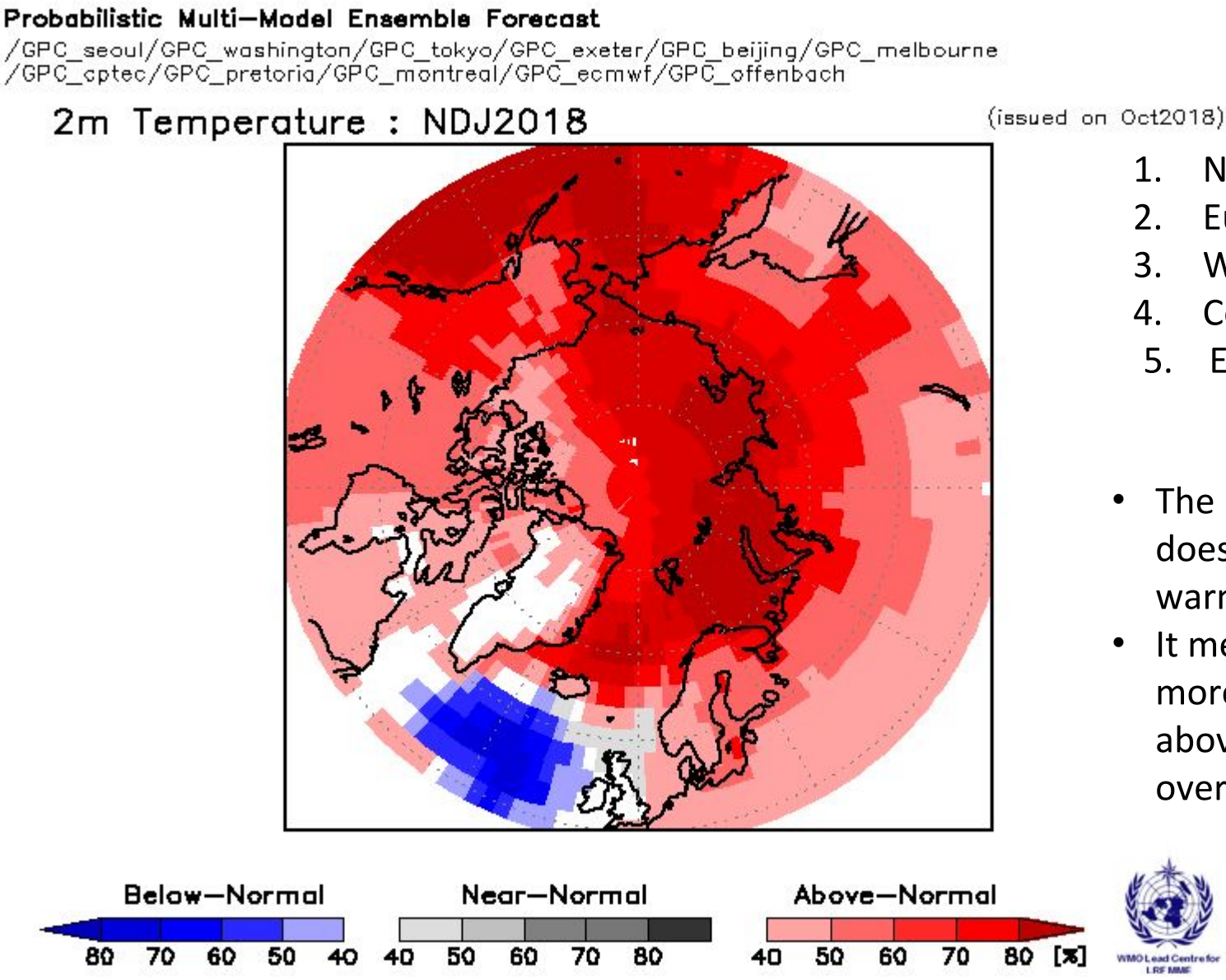
- **Precipitation**: mostly equal chances. In the regions where the models did not predict equal chances we had a very good forecast, also ~50% of the territory had a good percent correct score.

- **N.B.**: We know from the literature that models tend to be over-predictive for the higher observed frequencies and under-predictive for the lower, if we perform a calibration procedure on MME our results would be more correct.

Actual (real time)seasonal forecasts over the Arctic NDJ 2018/2019:

- temperature
- precipitation

Temperature outlook over the Arctic: November-December-January 2018/2019



1. North America
2. European Arctic
3. Wester Russia
4. Central Russia
5. Eastern Russia

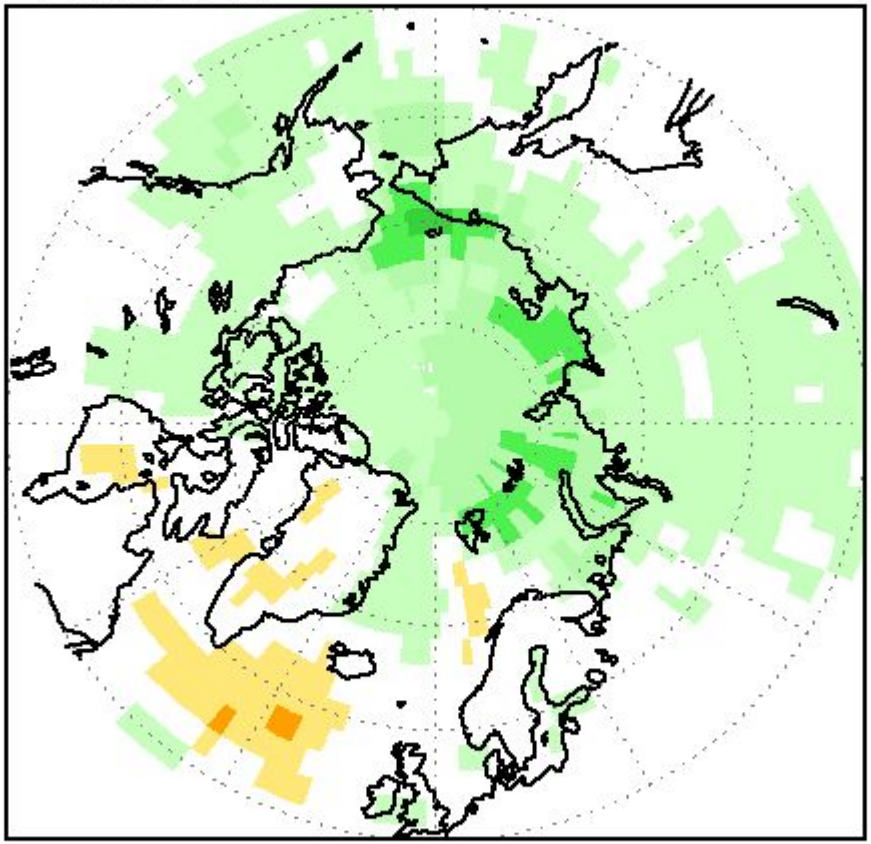
- The redder the color does not mean it is warmer.
- It means we have more confidence in above normal forecast over that region.

Precipitation outlook over the Arctic: November-December-January 2018/2019

Probabilistic Multi-Model Ensemble Forecast

/GPC_seoul/GPC_washington/GPC_tokyo/GPC_exeter/GPC_beijing/GPC_melbourne
/GPC_cptec/GPC_pretoria/GPC_montreal/GPC_ecmwf/GPC_offenbach

Precipitation : NDJ2018 (issued on Oct2018)



1. North America
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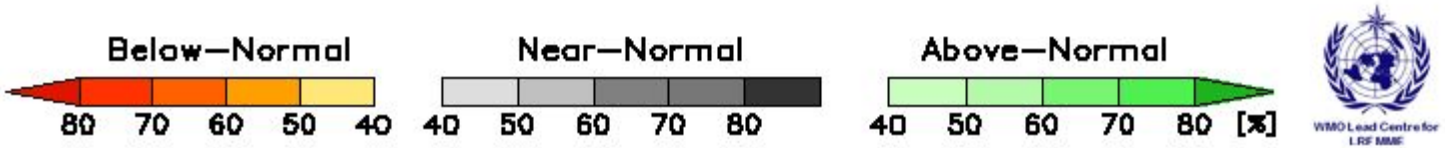
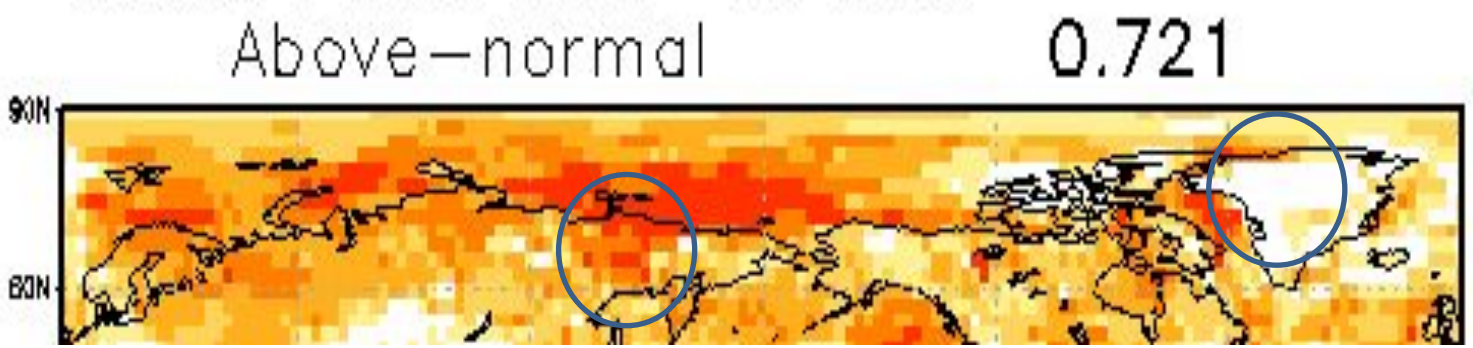
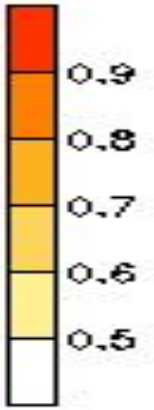
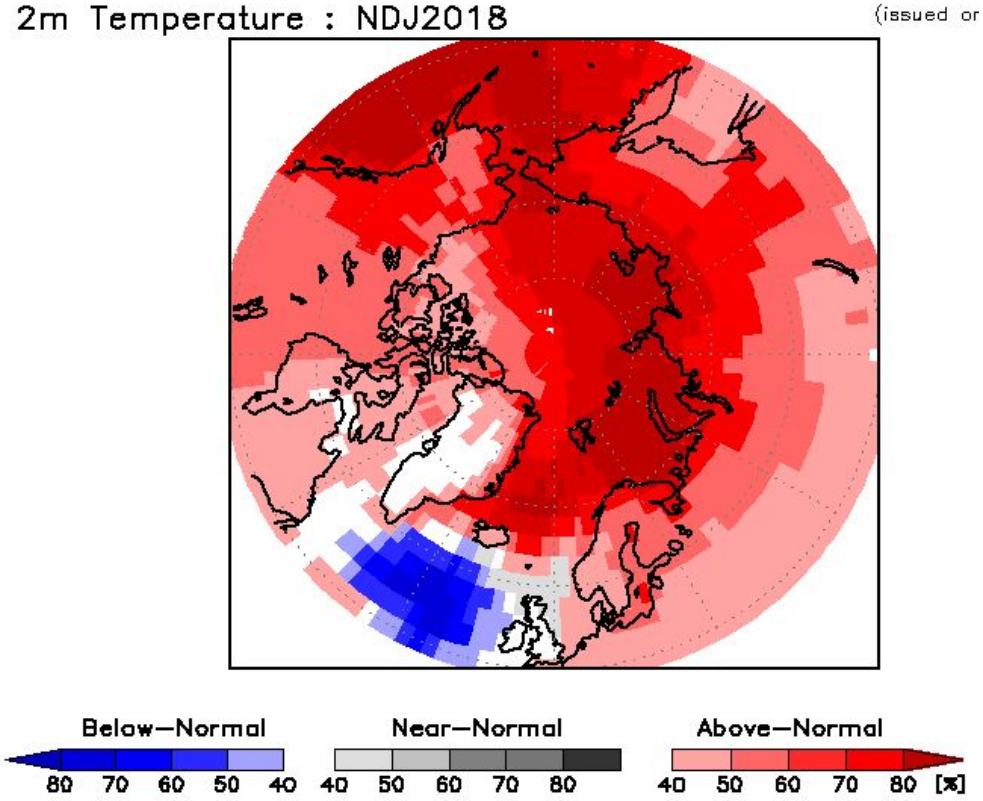


WMO Lead Centre for LRF MME

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

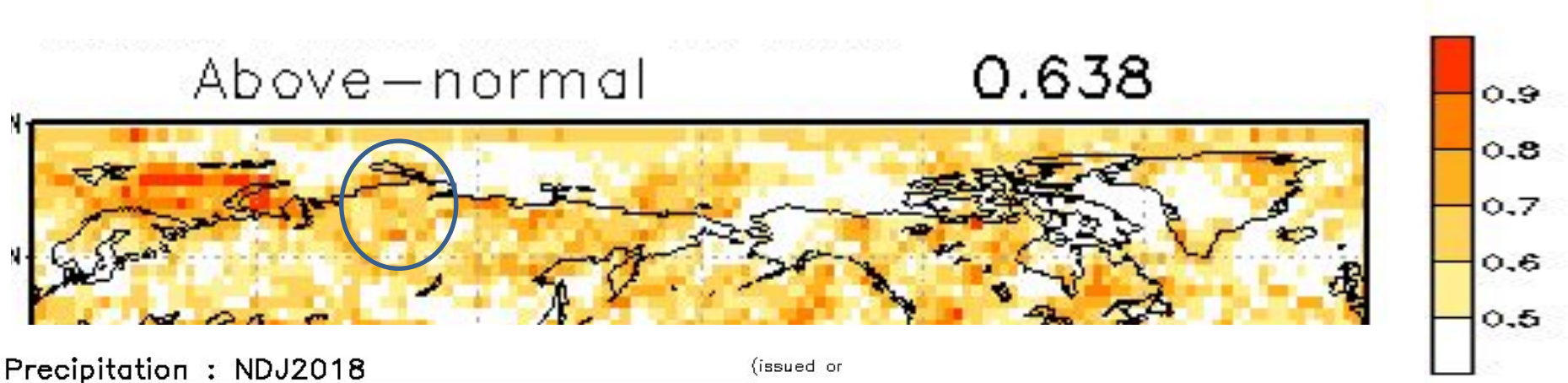


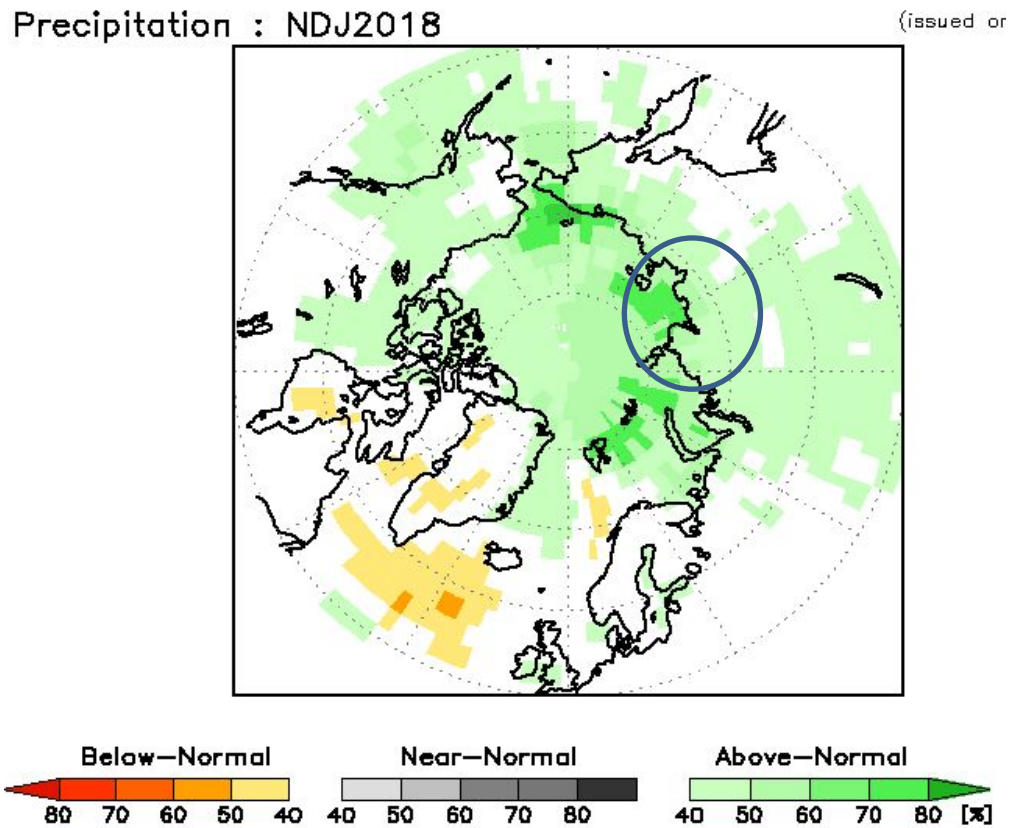




- If a historical skill was good over a certain region (e.g. colored region on the upper figure) we are more confident about the forecast results over the same region
- Overall confidence is good over the Arctic in NDJ with the exception of the Norther Alaska and central Norway.

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



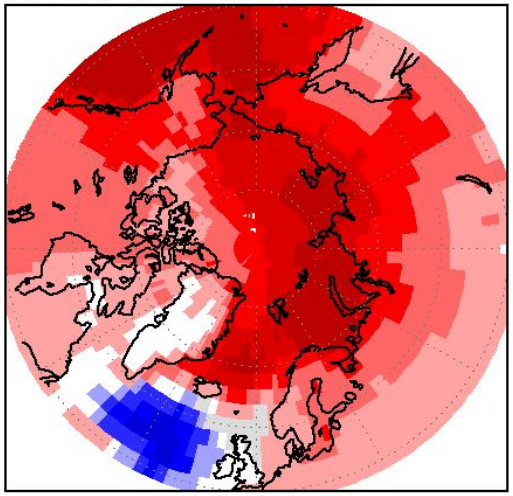


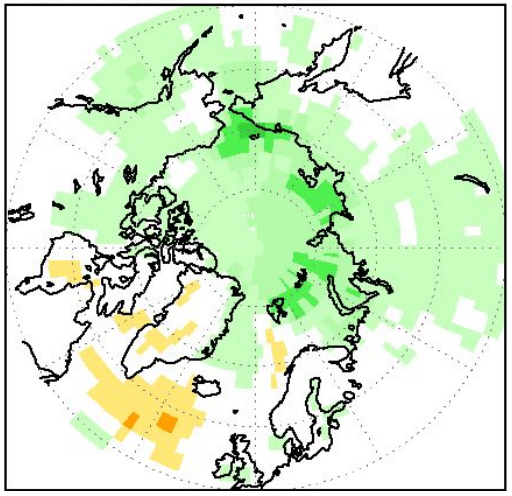
- The highest confidence for an above normal precipitation we have over: The Canadian Arctic, Central and Eastern Russia.

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.
- JJA2018 MME 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 over the Arctic in NDJ2018/19
- We expect above normal precipitation over the Arctic with and exception of Scandinavia, eastern Russia, Alaska and eastern Canadian Archipelago.
- **On the 15th January 2019 there will be an update on the winter forecast for the FMA2019 season.**

So, what can we conclude for the NDJ 2018/2019 seasonal forecast over the Arctic?





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

Temperature: There is probability of at least 50% or more that the temperature will be above normal in the Alaskan region. Over most of the continental Canadian Arctic this probability is rather smaller, around 40% chance for above normal temperature. Equal probability is forecasted over Greenland with an exception of the northern region where we have ~40% for above normal temp. Over the Scandinavian region and over Iceland there is at least ~40% for above normal temperatures. Somewhat higher probabilities (~60%) are expected over the northern Norway and Finland. Over the entire Russian Arctic above normal temperatures are expected for NDJ2018. Highest probabilities for this outcome are over the central and western Russian Arctic ~70%. Over the eastern Russia there is at least 50% chances for above normal temperatures.

Precipitation: there is a probability of at least 40% or more for above normal precipitation over the entire Canadian and Russian Arctic with some exceptions over the eastern Russia, Baffin Island and Hudson Bay where equal precipitation chances are expected. Over the Scandinavia, Iceland, Greenland and over most of the Alaskan region we expect equal probability chances. In the norther Atlantic there are ~40% for below normal precipitation which is likely linked to high probabilities for below normal temperatures over this region.