

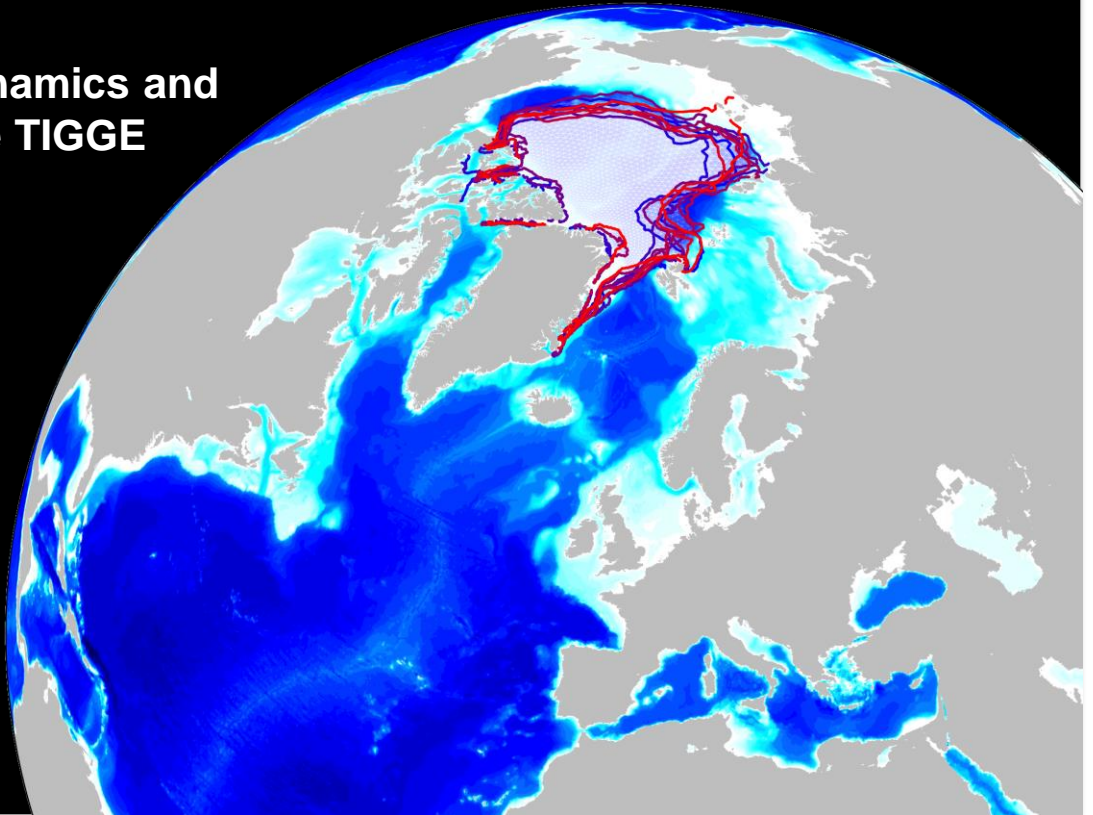
# Prospects for subseasonal sea ice prediction at both poles

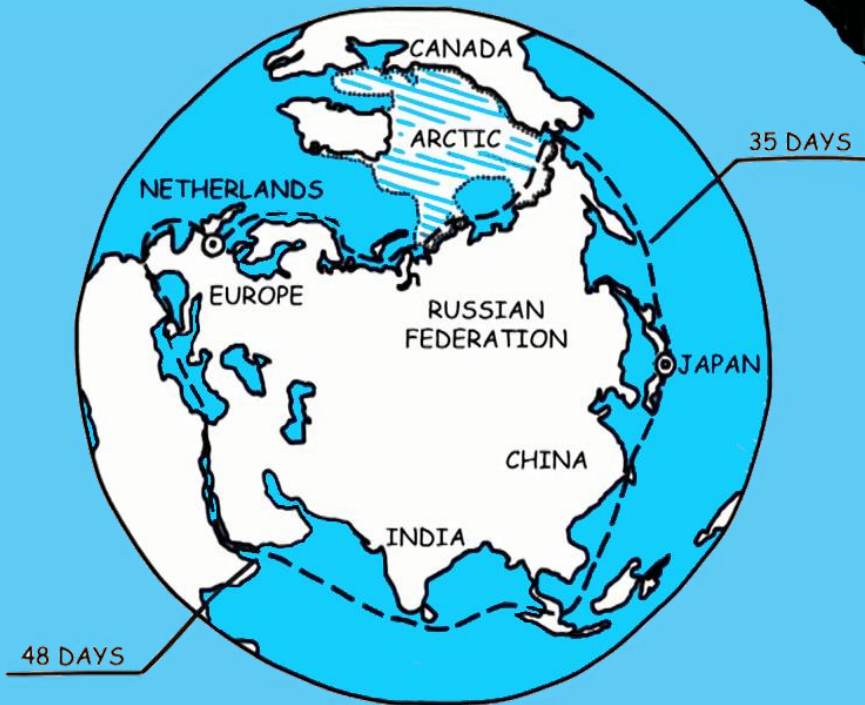
Workshop on Predictability, dynamics and applications research using the TIGGE and S2S ensembles  
April 3<sup>rd</sup>, 2019

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Images from the YOPP Promotional Video



**S2S**

Subseasonal to Seasonal  
Prediction Project

## **Focus on 6 S2S models**

**ECMWF**

**CMA**

**UKMO**

**Météo France**

**KMA**

**NCEP**

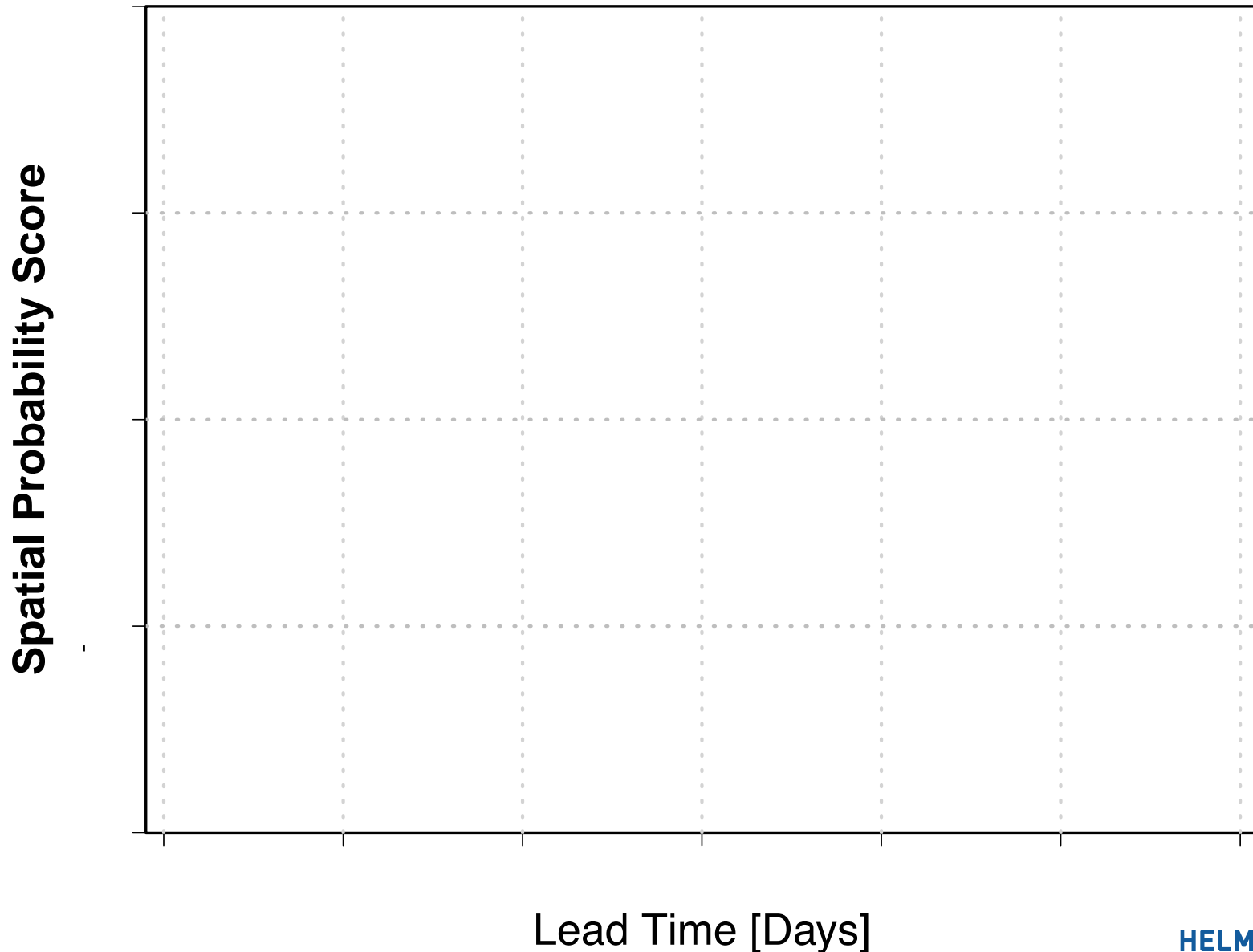
## **12 years of forecasts**

**1999 - 2010**

## **Forecasts cover the whole seasonal cycle**

Characterization goes beyond specific  
events such as the September minimum

# Design of the verification study

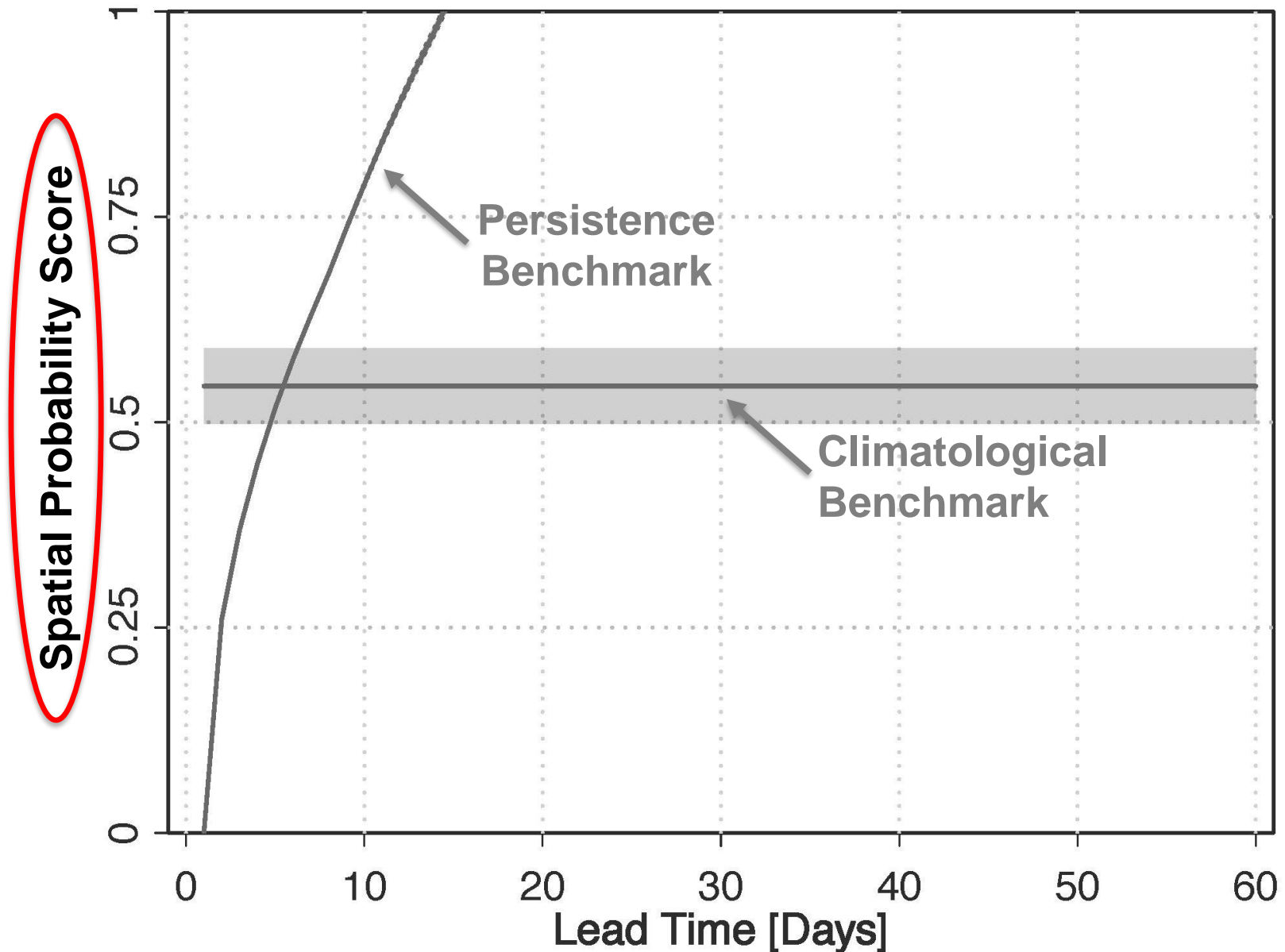


## Spatial Probability Score

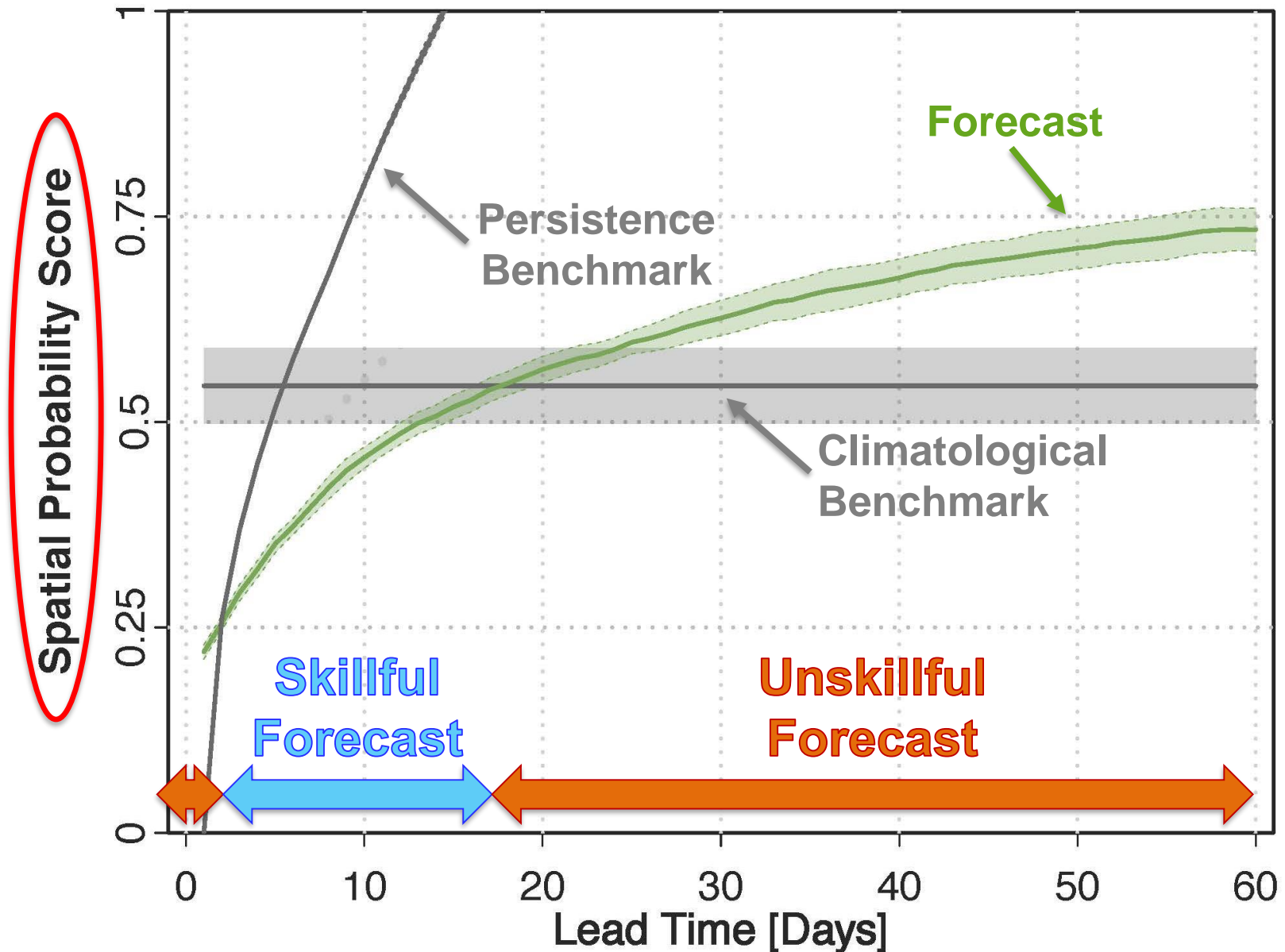
$$SPS = \iint_A (p_{f[sic>15\%]} - p_{o[sic>15\%]})^2 dA$$

Goessling, H. F., & Jung, T. (2018). A probabilistic verification score for contours: Methodology and application to Arctic ice edge forecasts. *Quarterly Journal of the Royal Meteorological Society*, **144** (712), 735–743.

# Design of the verification study



# Design of the verification study



# Method Summary

UKMO  
ECMWF  
KMA

CMA  
MF  
NCEP

Ensemble S2S  
sea-ice forecasts



Verification against  
satellite observations  
using the SPS



Compare forecast  
SPS to the  
benchmarks



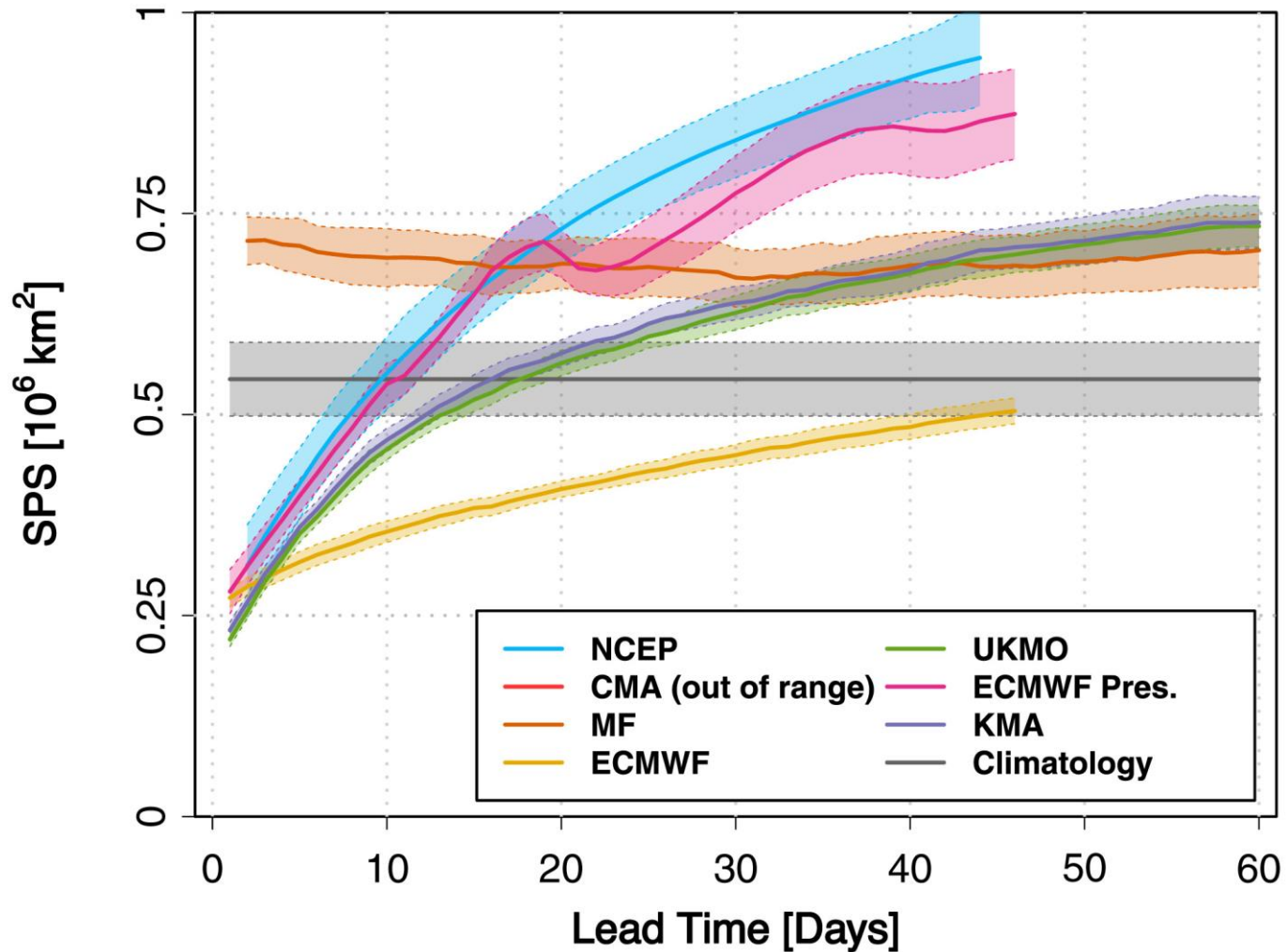
Assessment of the  
forecast  
predictive skill



Indications about  
errors and biases

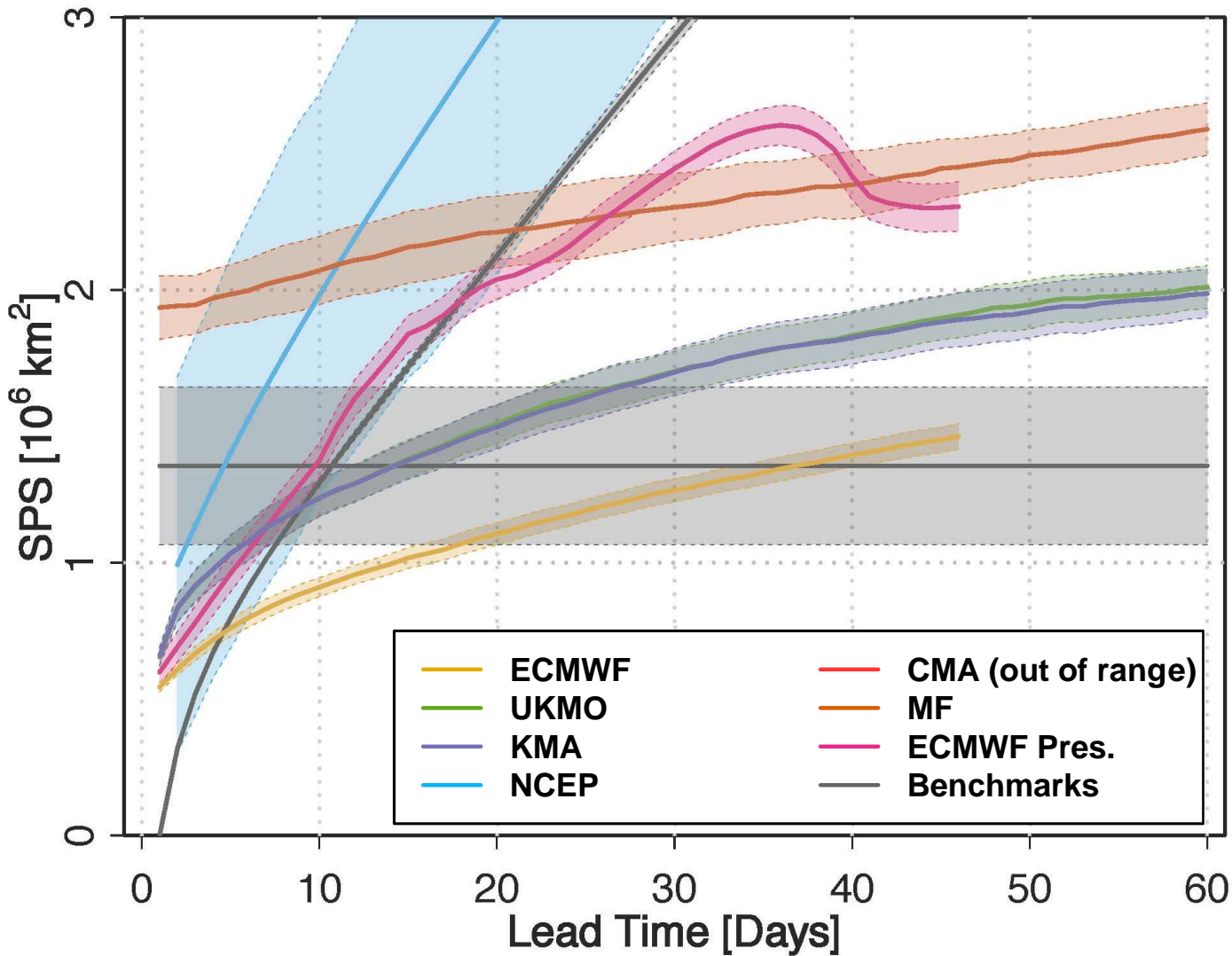


# Arctic sea ice forecasts (1999-2010)



Zampieri, L., Goessling, H. F., & Jung, T. (2018). Bright prospects for Arctic sea ice prediction on subseasonal time scales. *Geophysical Research Letters* **45**, 9731–9738.

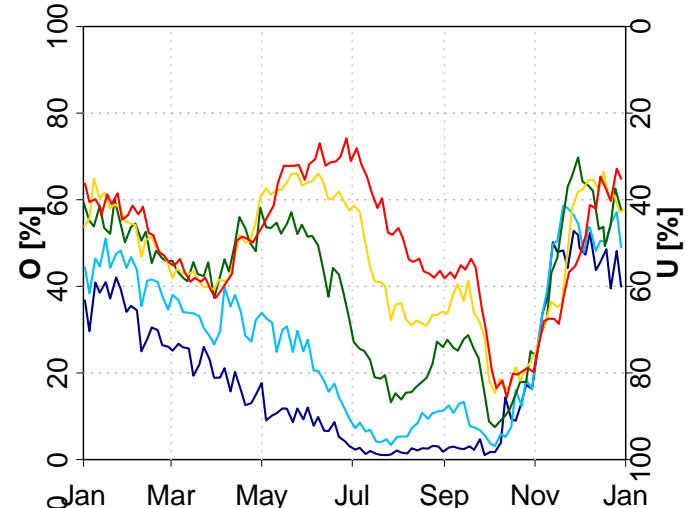
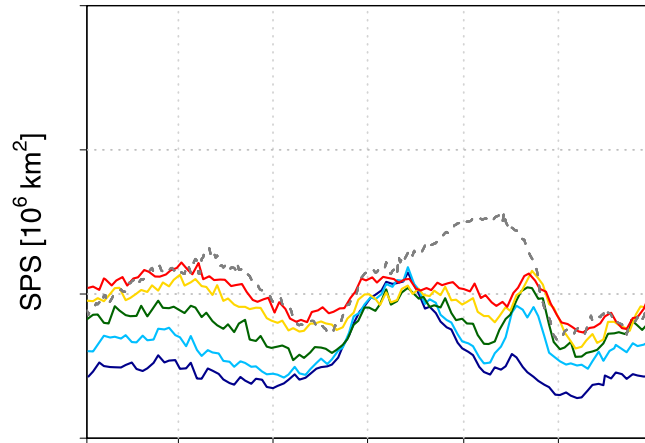
# Antarctic sea ice forecasts (1999-2010)



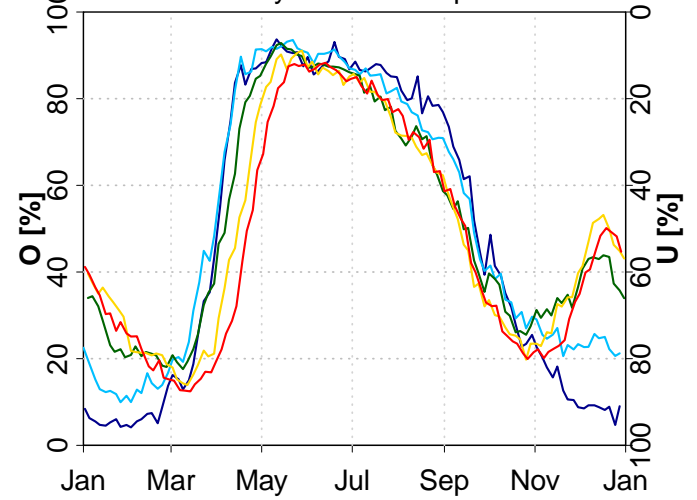
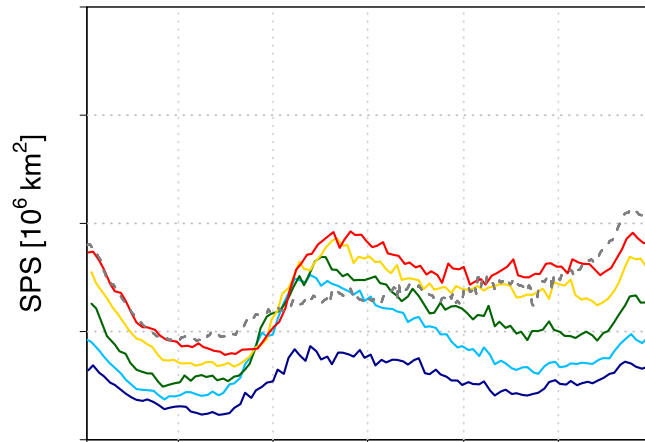
# Seasonality of ECMWF skill



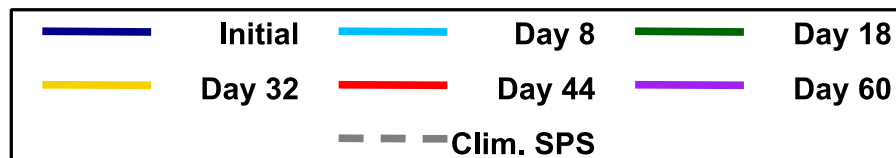
Arctic



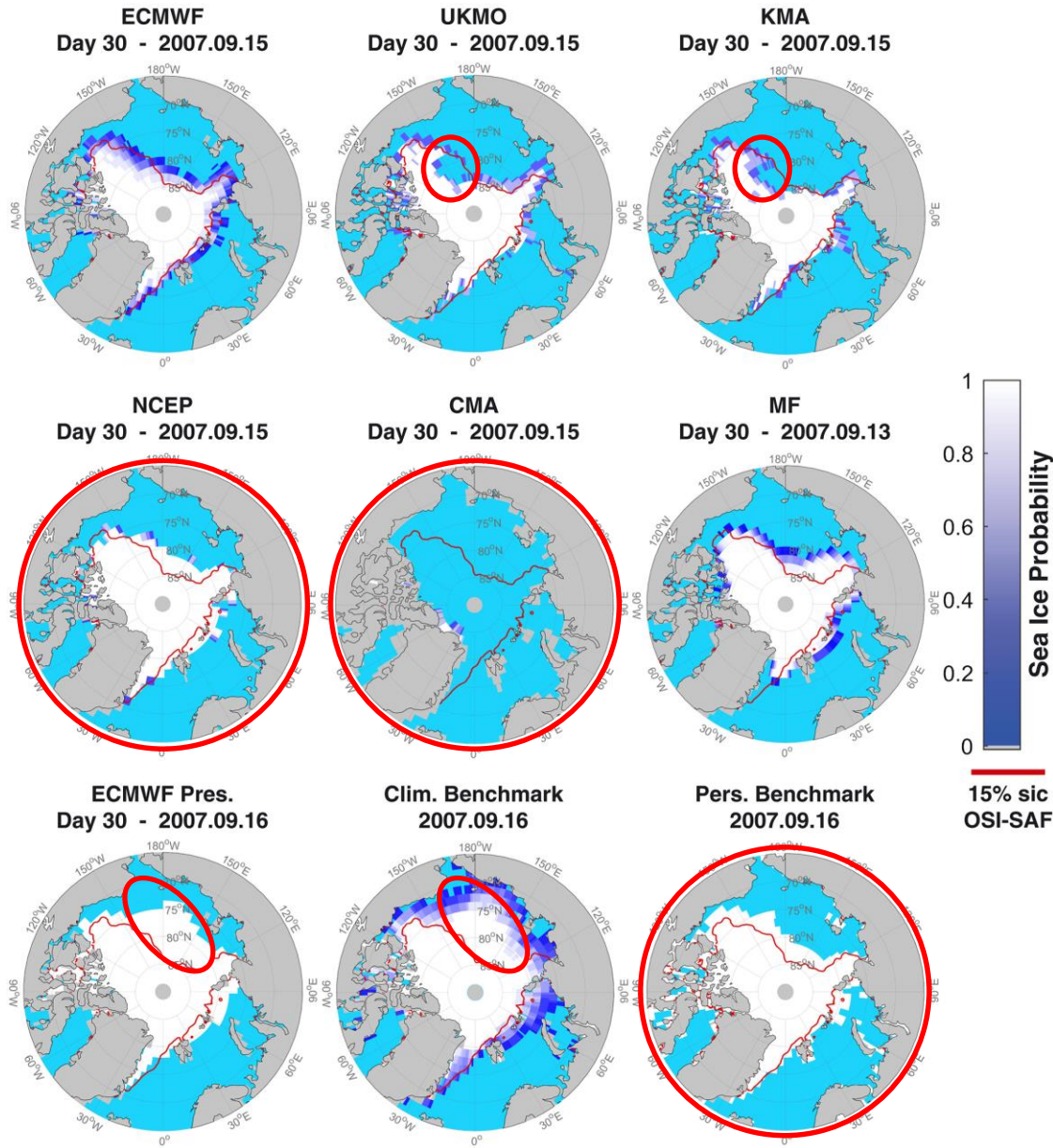
Antarctic



Target Time



# Forecasting the 2007 minimum



Underestimation of ice extent  
 due to lack of data and  
 systematic errors in  
 the sea ice edge  
 processes

# Summary

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Big skill difference among different forecast systems.

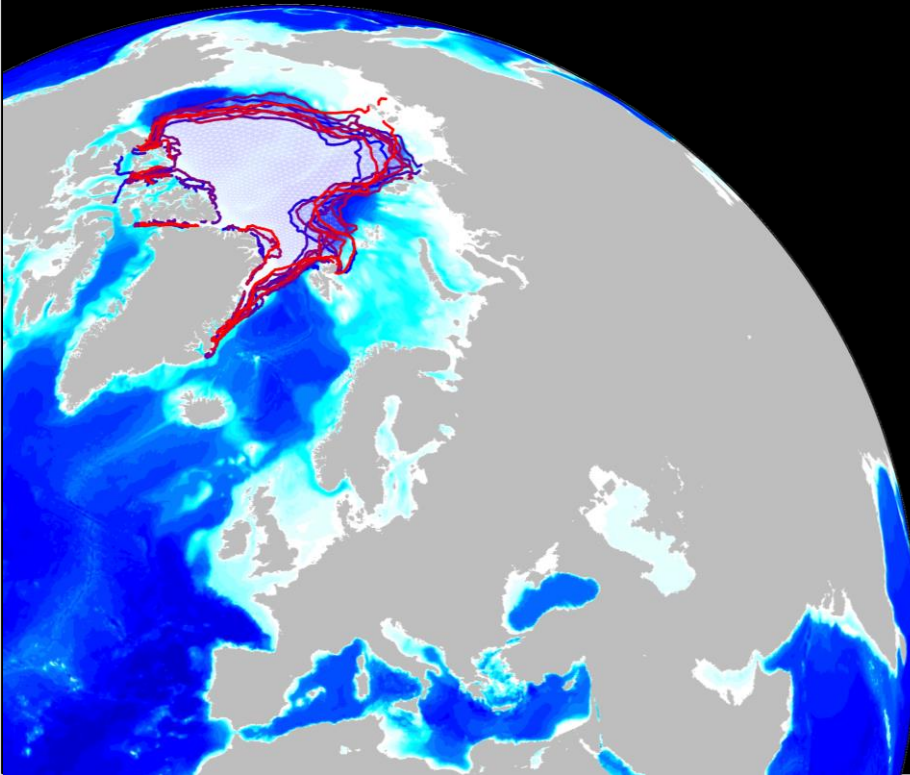
Similar model ranking for the two hemispheres.

Evidences of skillful Arctic sea ice forecast up to 1½ months in advance.

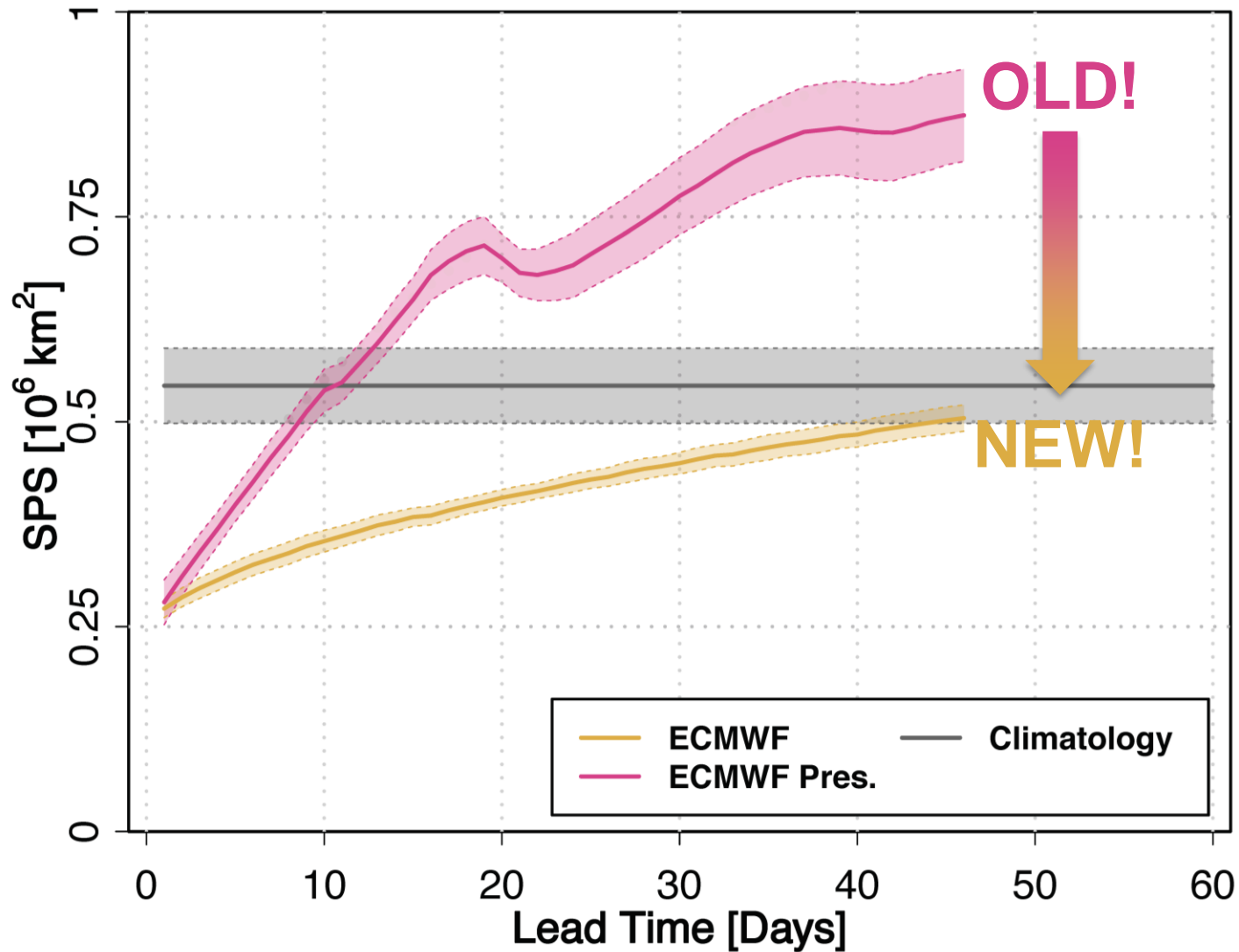
Substantial errors associated with model biases and data assimilation procedure.

A **(well formulated)** dynamical sea ice model is beneficial to the forecast skills.

# Thank you!



# Improvements in ECMWF forecast system



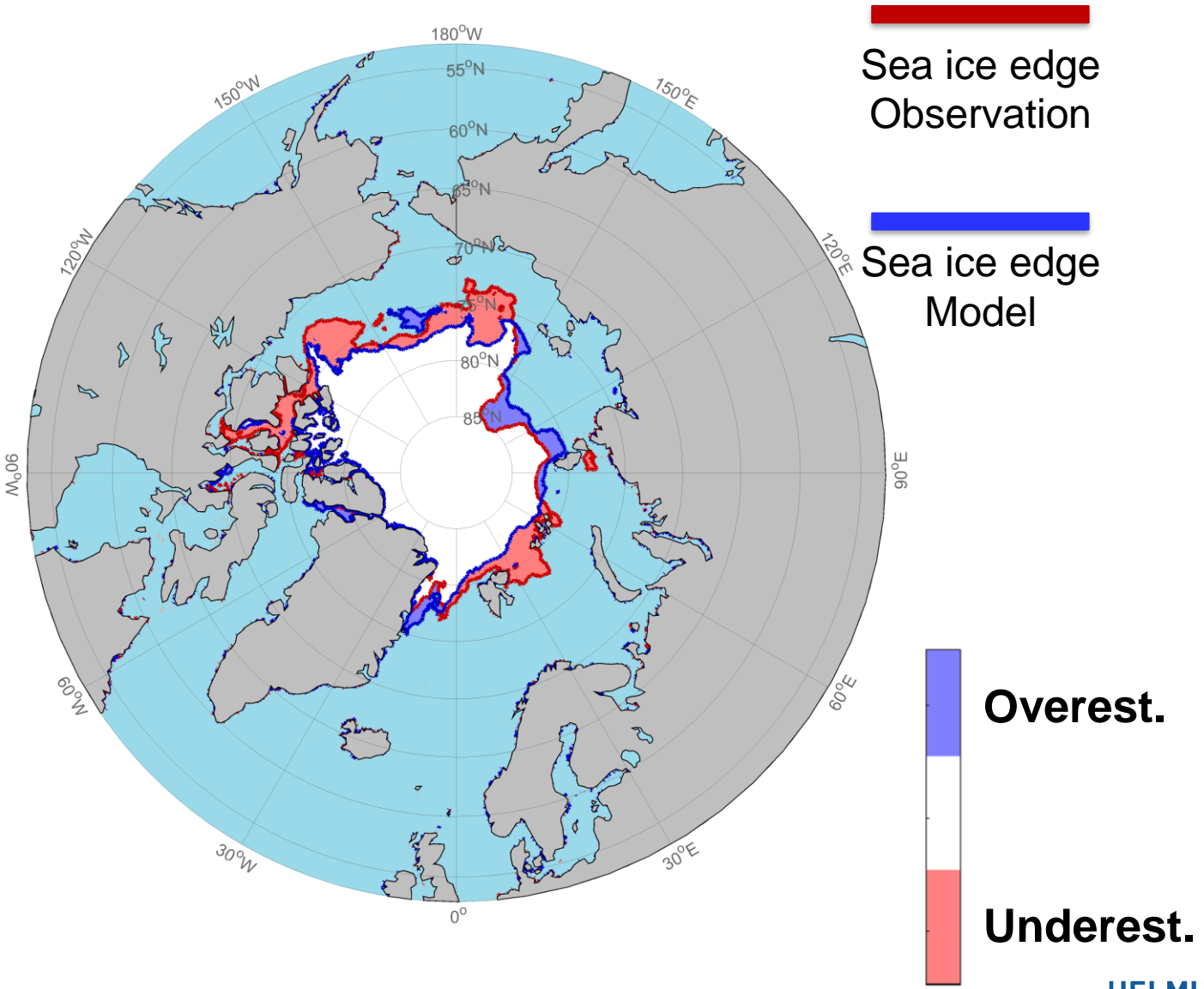
# Model details



| Forecast System | Initialisation Freq. | Ensemble Size        | Range   | sea ice Model | SIC Assimilated |
|-----------------|----------------------|----------------------|---------|---------------|-----------------|
| ECMWF           | ×2 weekly            | 10+1                 | 46 days | LIM 2         | yes             |
| UKMO            | ×4 monthly           | 6+1                  | 60 days | CICE 4.1      | yes             |
| KMA             | ×4 monthly           | 2+1                  | 60 days | CICE 4.1      | yes             |
| NCEP            | daily                | 3+1                  | 44 days | GFDL SIS      | yes             |
| MF              | ×2 monthly           | 14+1                 | 61 days | GELATO 5      | no              |
| CMA             | daily                | 3+1                  | 60 days | GFDL SIS      | no              |
| ECMWF Pres.     | ×2 weekly            | single sea ice state | 46 days | none          | no              |



# The sea ice edge position



# The Spatial Probability Score

Ensemble forecasts

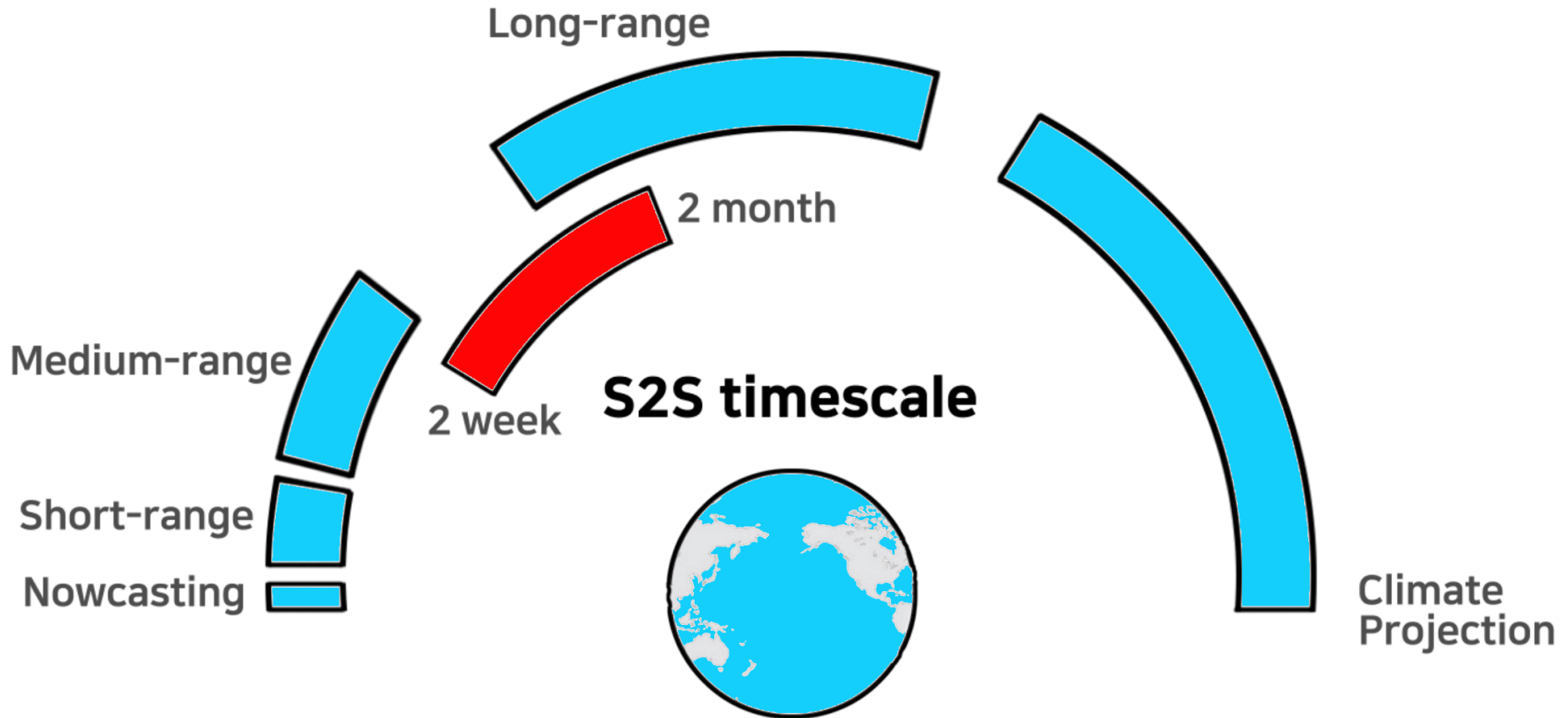


Probabilistic verification metric required

## Spatial Probability Score

$$SPS = \iint_A (p_{f[sic>15\%]} - p_{o[sic>15\%]})^2 dA$$

# The S2S time scale



## Prediction forecast timescale

Image from the S2S Promotional Video