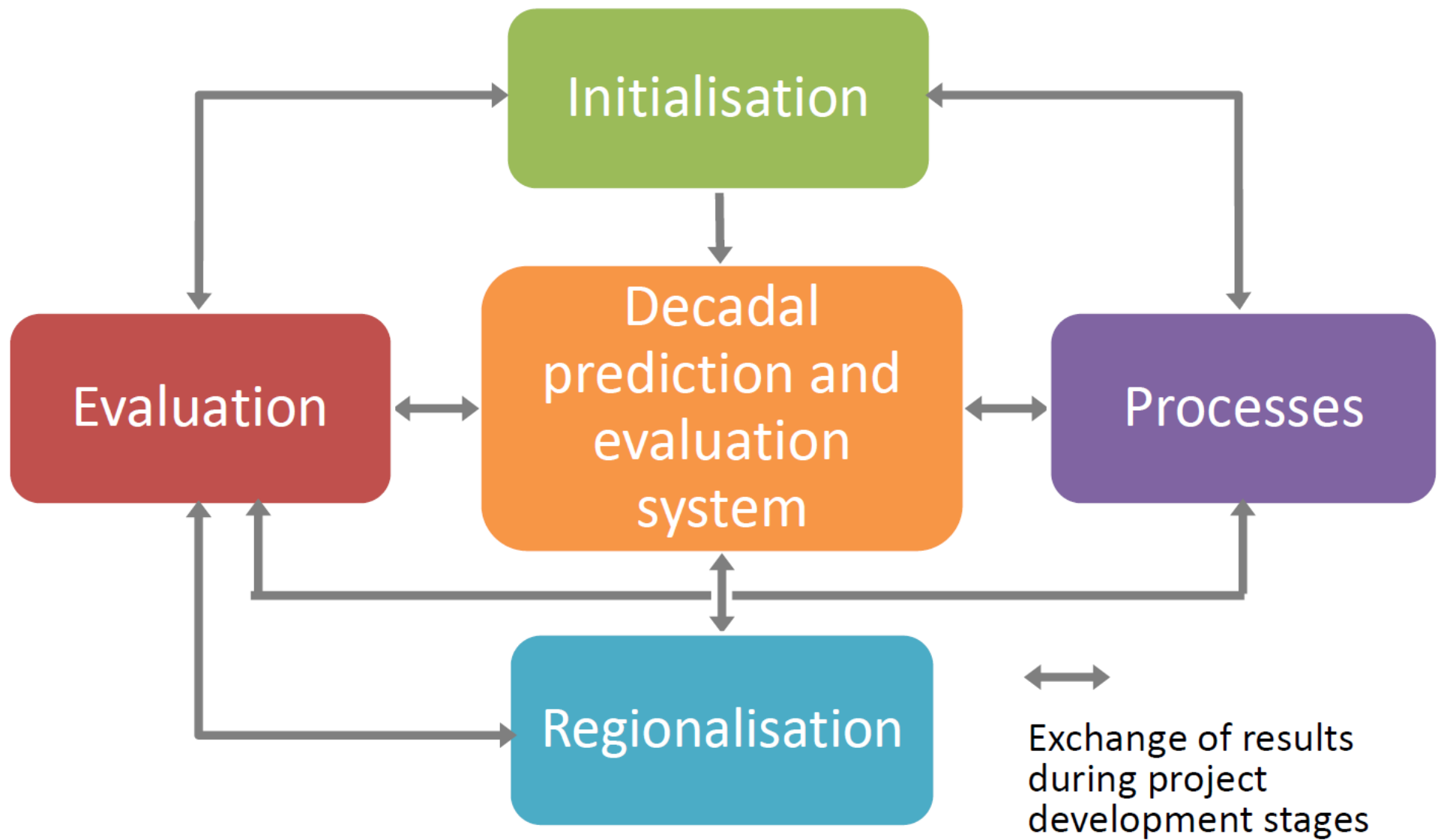


# MiKlip - Decadal Prediction Project - FU Berlin

Christopher Kadow, Sebastian Illing, Igor Kröner, Uwe Ulbrich, and Ulrich Cubasch

**Can decadal climate predictions be improved by ocean  
ensemble dispersion filtering?  
Any impact on seasonal predictions?**



**Question:** How good is a forecast? **Answer:** Evaluate the hindcast **MiKlip**

## Global Mean Temperature

*"Global mean temperature is a key metric for measuring how our climate is changing."* (NCAS)

1979 to 2013 Yearly

**MPI-ESM-LR** [Atm: T63L45 Ini: ERA-40/Int; Oce: 1.5°/L40 Ini: ORAS4]

RAW Temperature

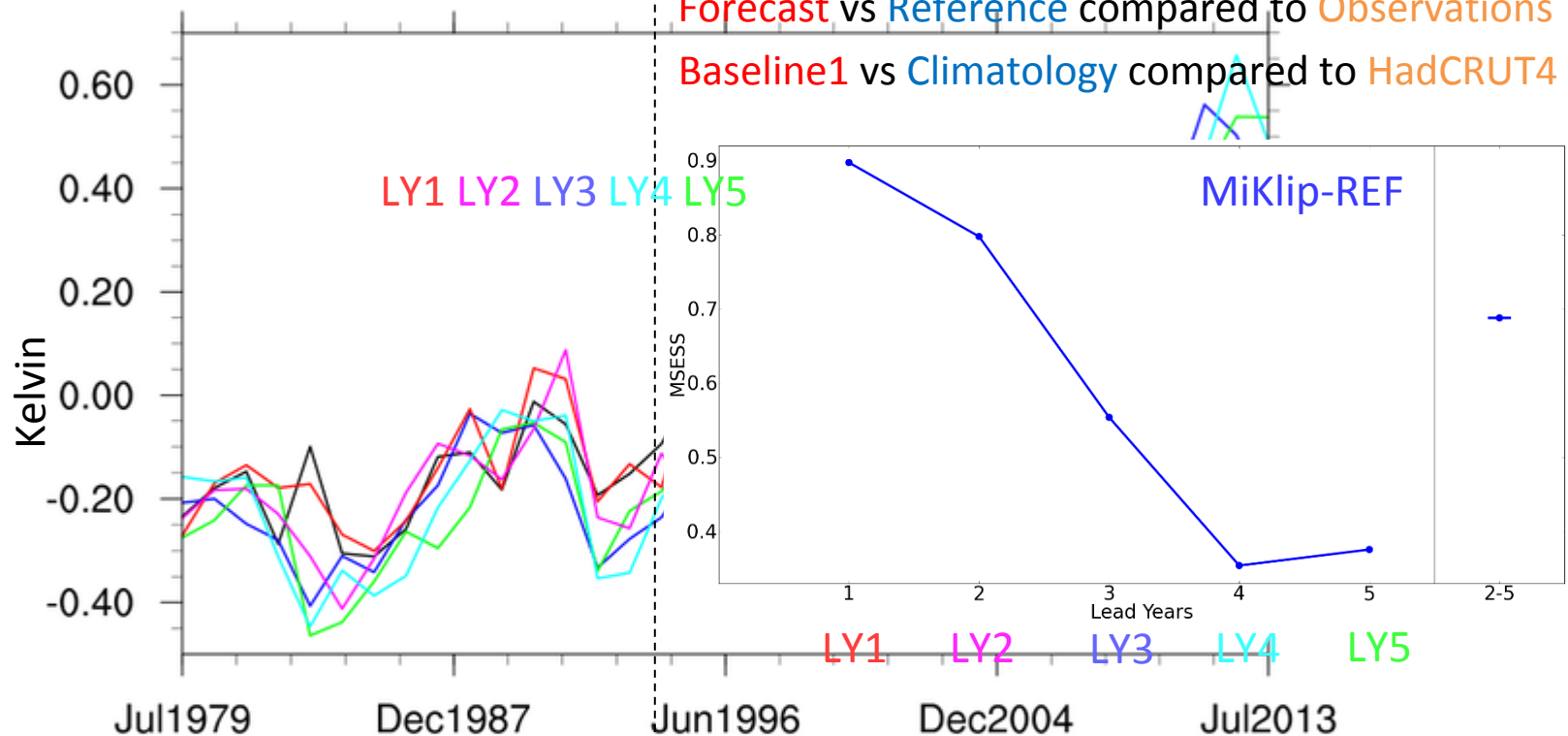
MSESS

**Black:** HadCRUT4 Observation

**Colors:** MiKlip-REF (Lead Years) or Skill Score

**Forecast** vs **Reference** compared to **Observations**

**Baseline1** vs **Climatology** compared to **HadCRUT4**



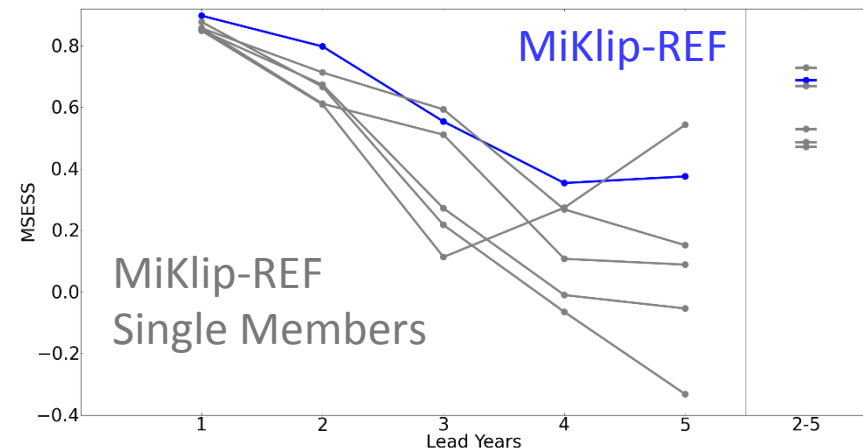
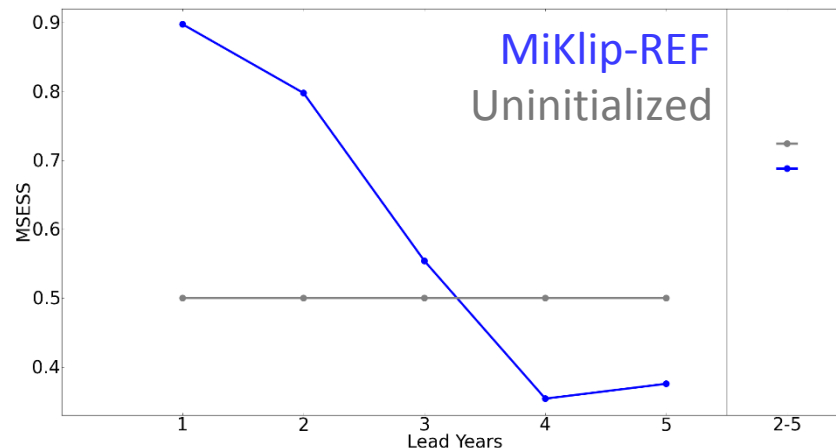
Question: What are we trying to do? Answer: Improve the forecast! <sup>4/9</sup> MiKlip

# The Ocean 2 The Ensemble

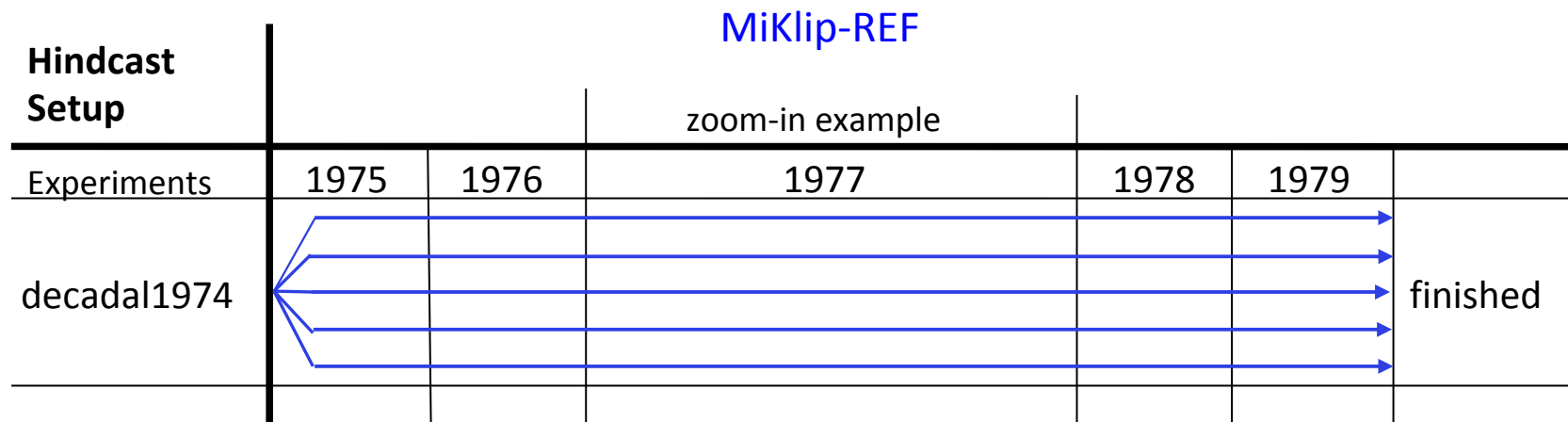
## Climate Science Facts

- large-scale mixing occurs on time scales from years to decades
- The ocean has a much larger heat capacity than the atmosphere  
*Vuille and Garreaud*
- the ocean provides the important memory for climate variations  
*Trenberth*

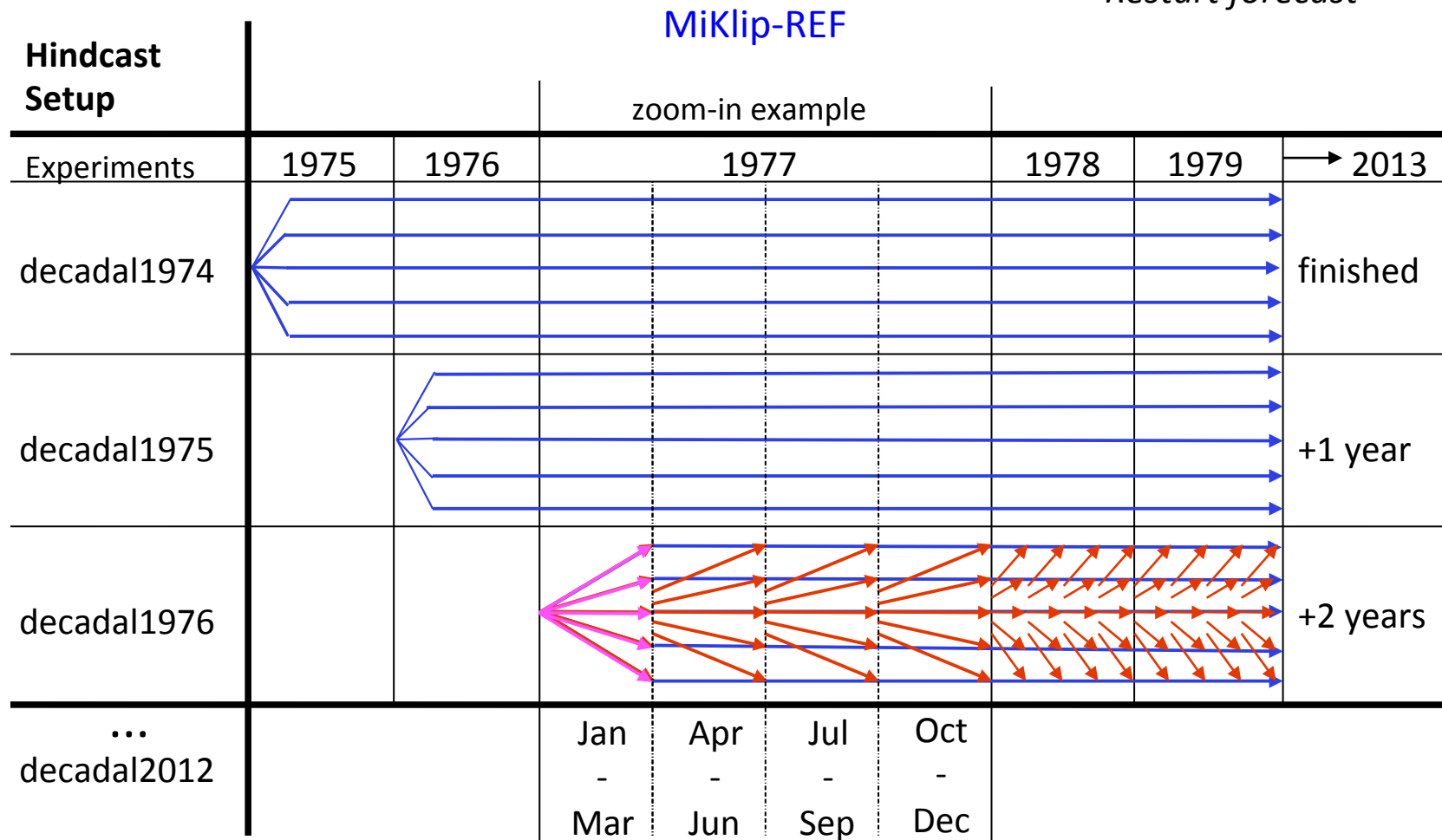
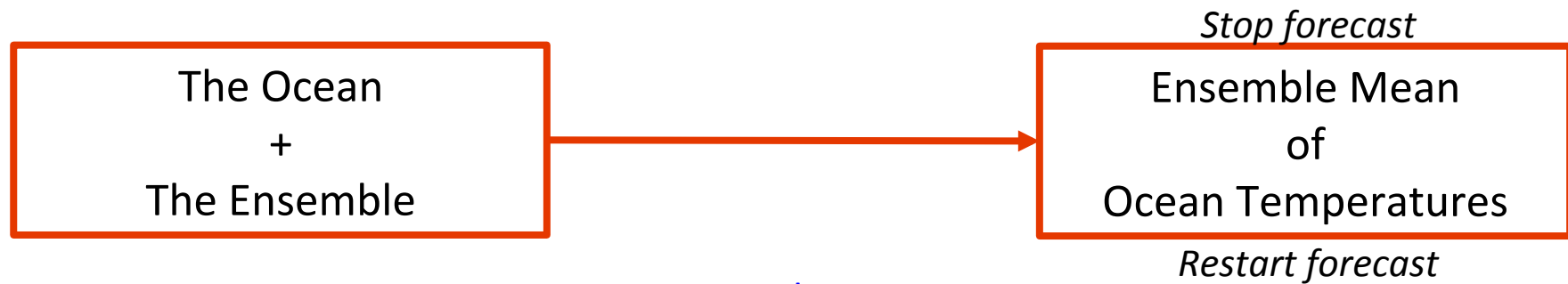
- ... the ensemble average is closer to the truth [...] due to non-linear filtering of errors ...  
*Kalnay, Hunt, Ott, Szunyogh*
- ... skill of a [...] prediction based on the ensemble mean is shown to be always greater than that based on a single realization  
*Kumar and Hoerling*



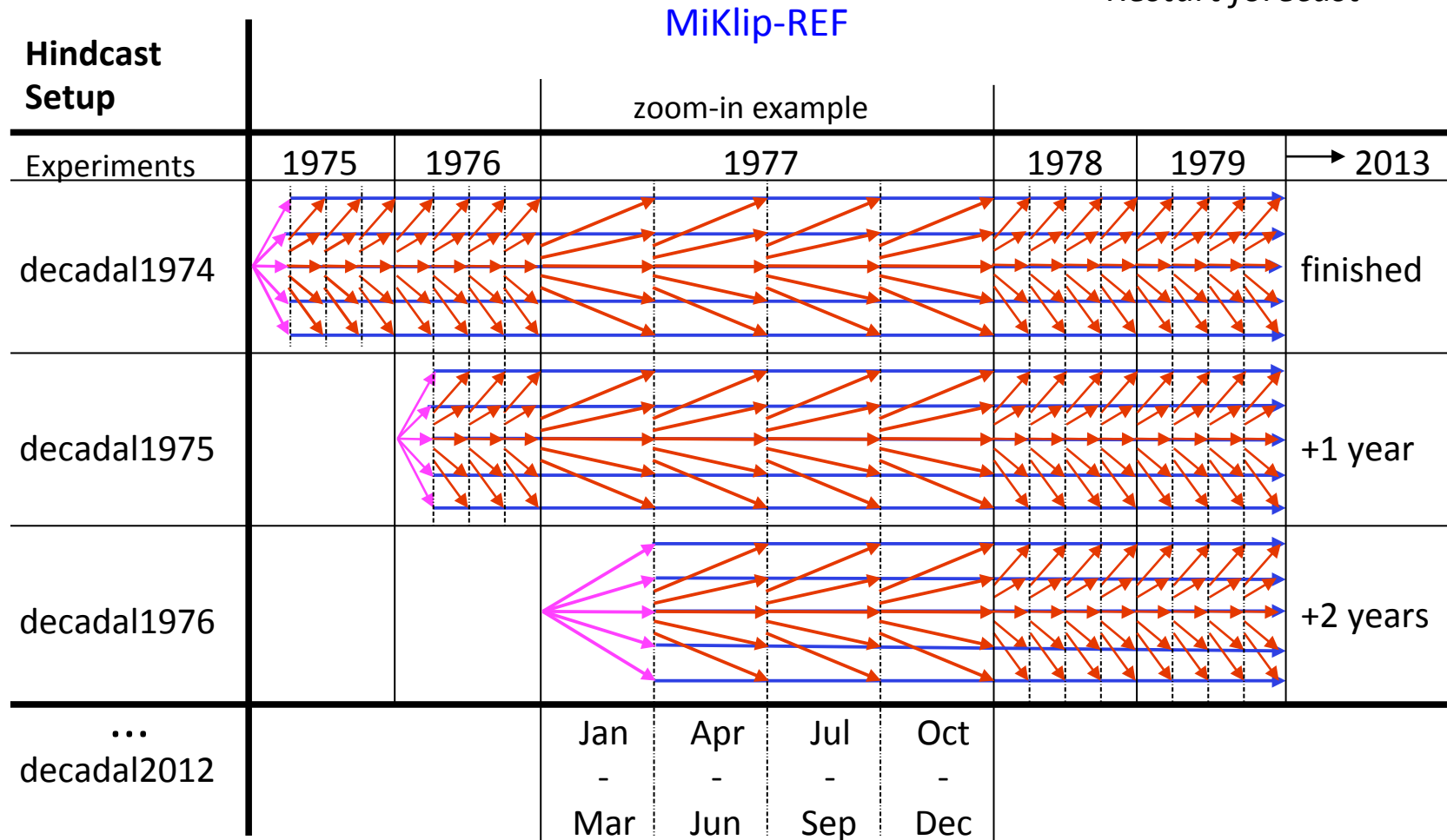
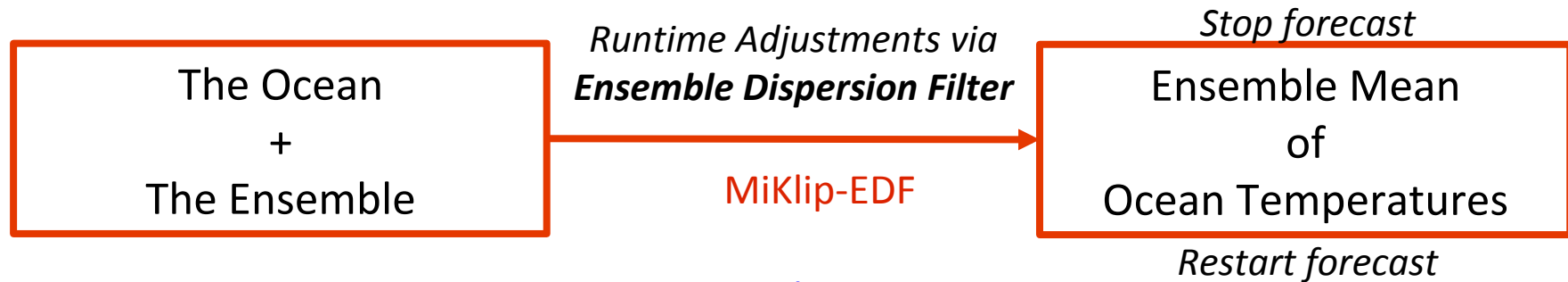
**Question:** What are we trying to do? **Answer:** Improve the forecast! <sup>5/9</sup> **MiKlip**



**Question:** What are we trying to do? **Answer:** Improve the forecast! 5/9  
MiKlip



**Question:** What are we trying to do? **Answer:** Improve the forecast!



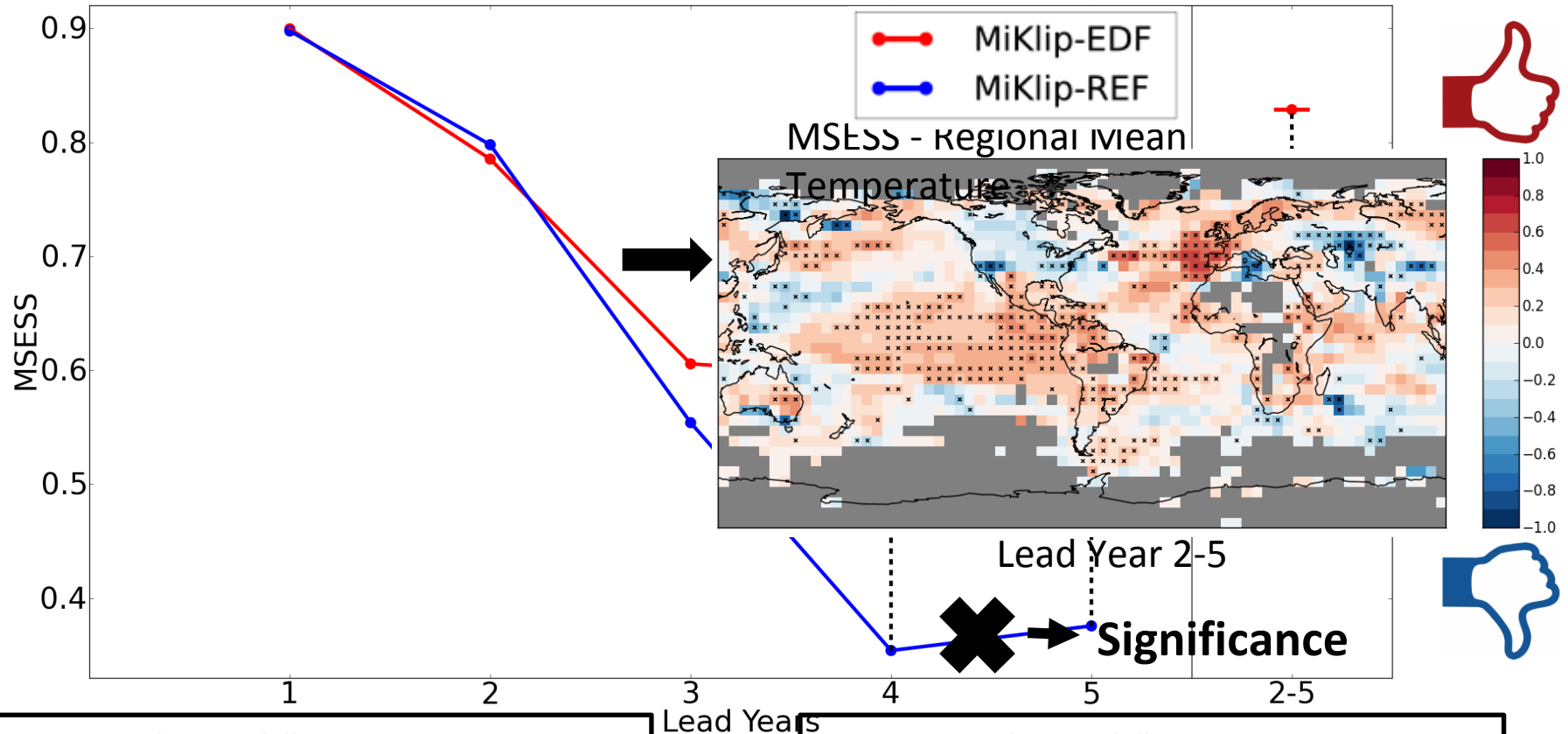
**Question:** Is the EDF system better? **Answer:** Compare evaluations!

**MiKlip**

### Temporal Evolution of Temperature

- + Deceleration of the loss of skill over lead years
- + Significant skill improvement in LY2-5

- + Strongest effect in the North Atlantic
- + Global Mean Temperature Impact over Central Pacific



Mean Squared Error Skill Score

Forecast vs Reference compared to Observations

— MiKlip-REF vs Climatology compared to HadCRUT4

— MiKlip-EDF vs Climatology compared to HadCRUT4

.... MiKlip-EDF vs MiKlip-REF compared to HadCRUT4

Mean Squared Error Skill Score

Forecast vs Reference compared to Observations

— MiKlip-EDF vs MiKlip-REF compared to HadCRUT4



**Question:** Is the EDF system better? **Answer:** Compare evaluations! **MiKlip**

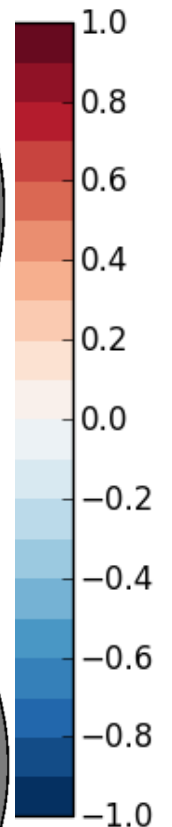
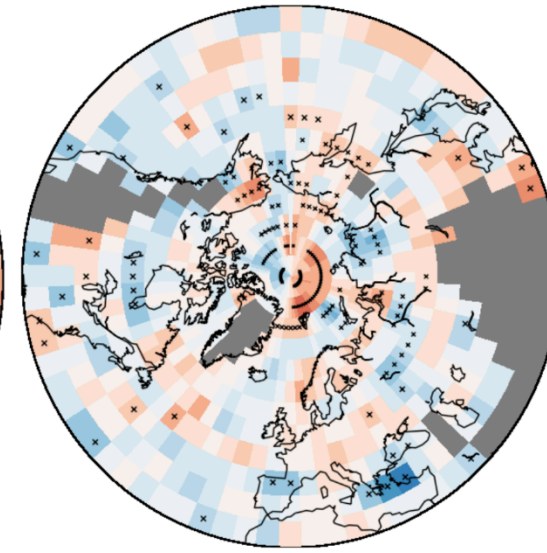
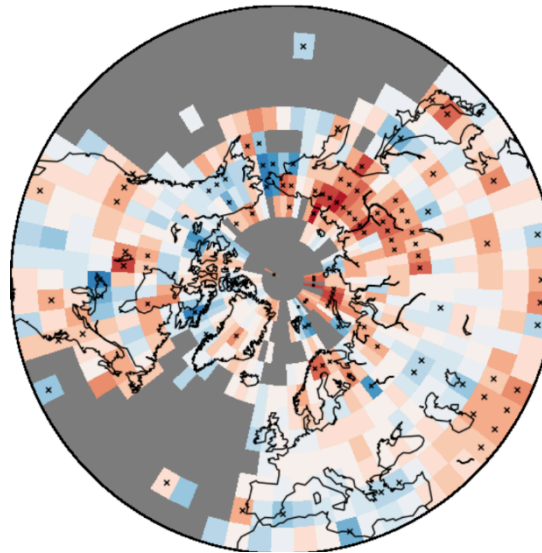
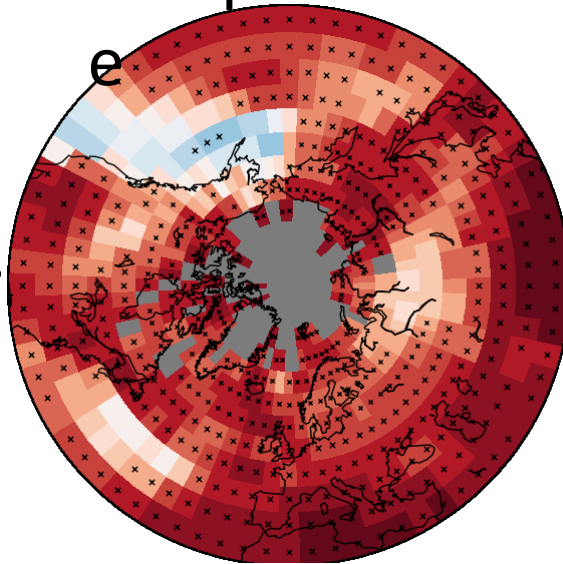
Correlation Coefficient LY2-5 - 1979 to 2013

Temperatur

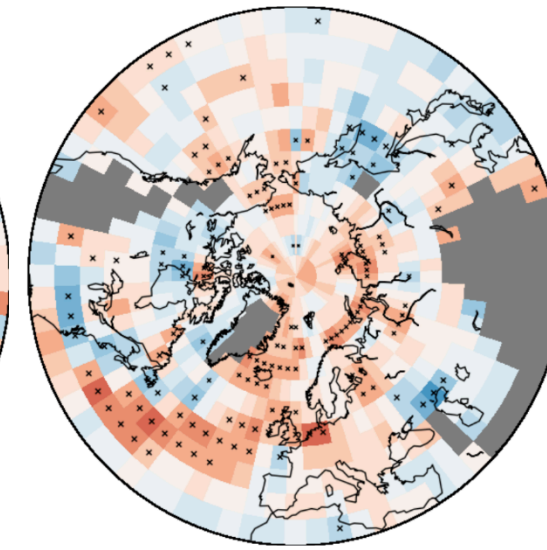
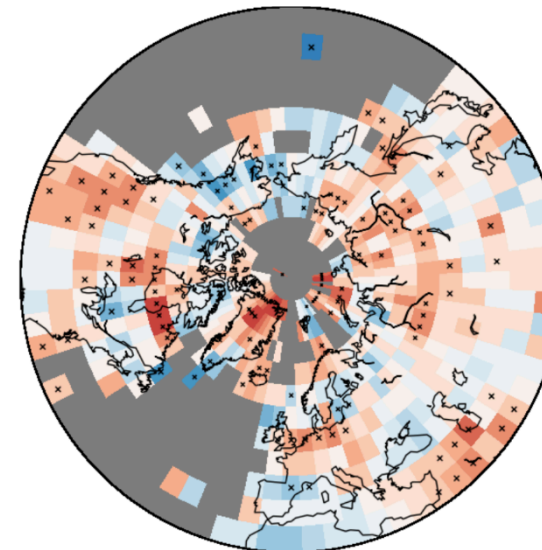
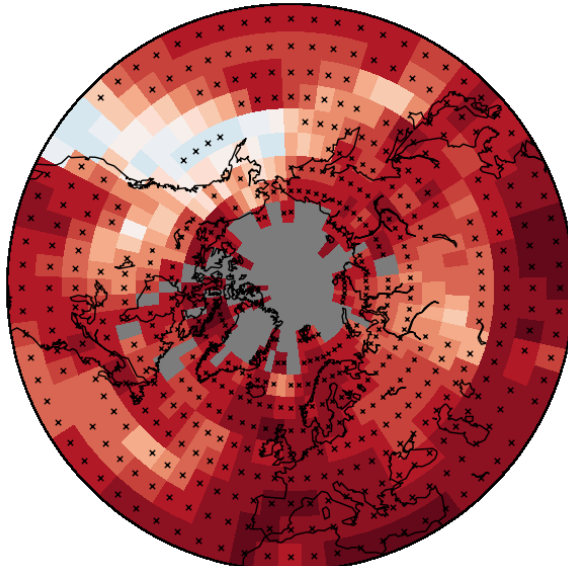
Precipitation

Cyclones (DJF)

MiKlip-REF



MiKlip-EDF



compared to **HadCRUT4**

compared to **GPCC**

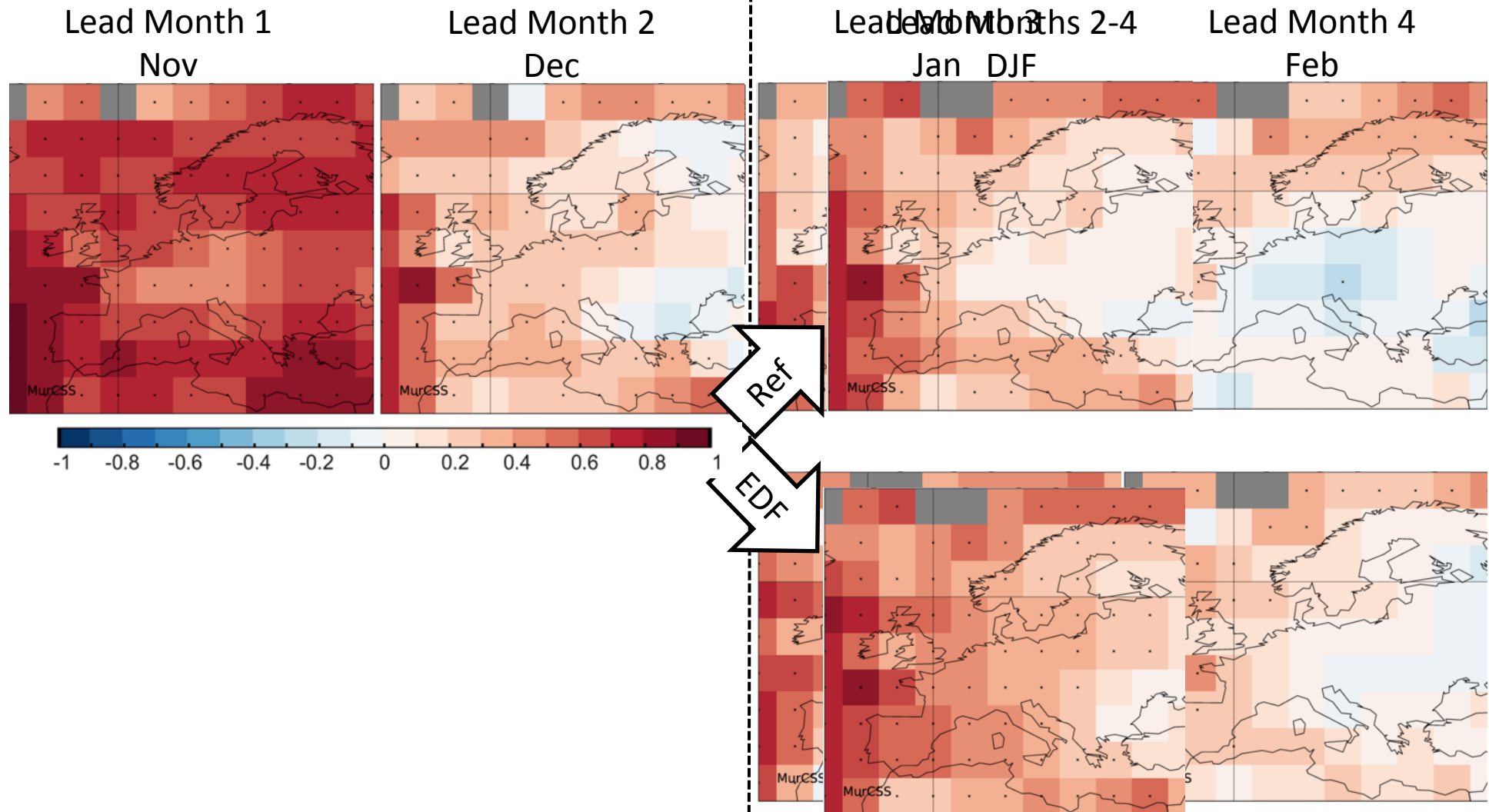
compared to **ERA-Interim**

**Question:** Seasonal effect of the EDF? **Answer:** Check first months!

Decadal system starts in November to be synchronized with the Seasonal system

- New MiKlip Prediction system -

**Check first Winter - Correlation**

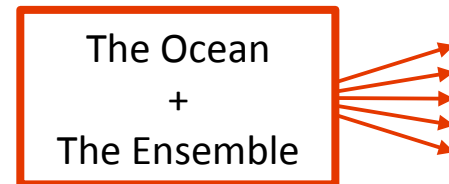


# Summary

## Question:

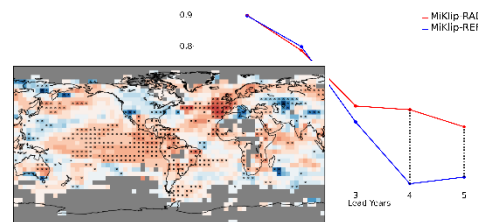
What is the main idea behind this novel approach?

## Answer:



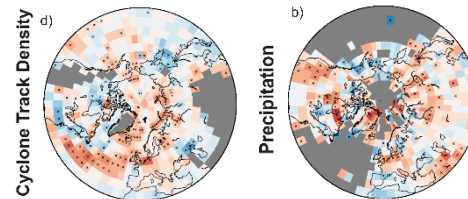
Using the ensemble mean (non-linear error filter) of the ocean temperatures (decadal memory) within a forecast, keeps the forecast on track

Is the temperature forecast closer to the observations?



Yes, the prediction is better, due to deceleration of the loss of skill over lead years and a significant skill improvement in LY2-5 (global and regional)

What about other important variables than temperature?



MiKlip-EDF shows large areas of significant positive correlation coefficients from precipitation and winter cyclone track density

Kadow, C., S. Illing, I. Kröner, U. Ulbrich, and U. Cubasch (2017), Decadal climate predictions improved by ocean ensemble dispersion filtering, J. Adv. Model. Earth Syst., 9, 1138–1149, doi:

[10.1002/2016MS000787](https://doi.org/10.1002/2016MS000787)

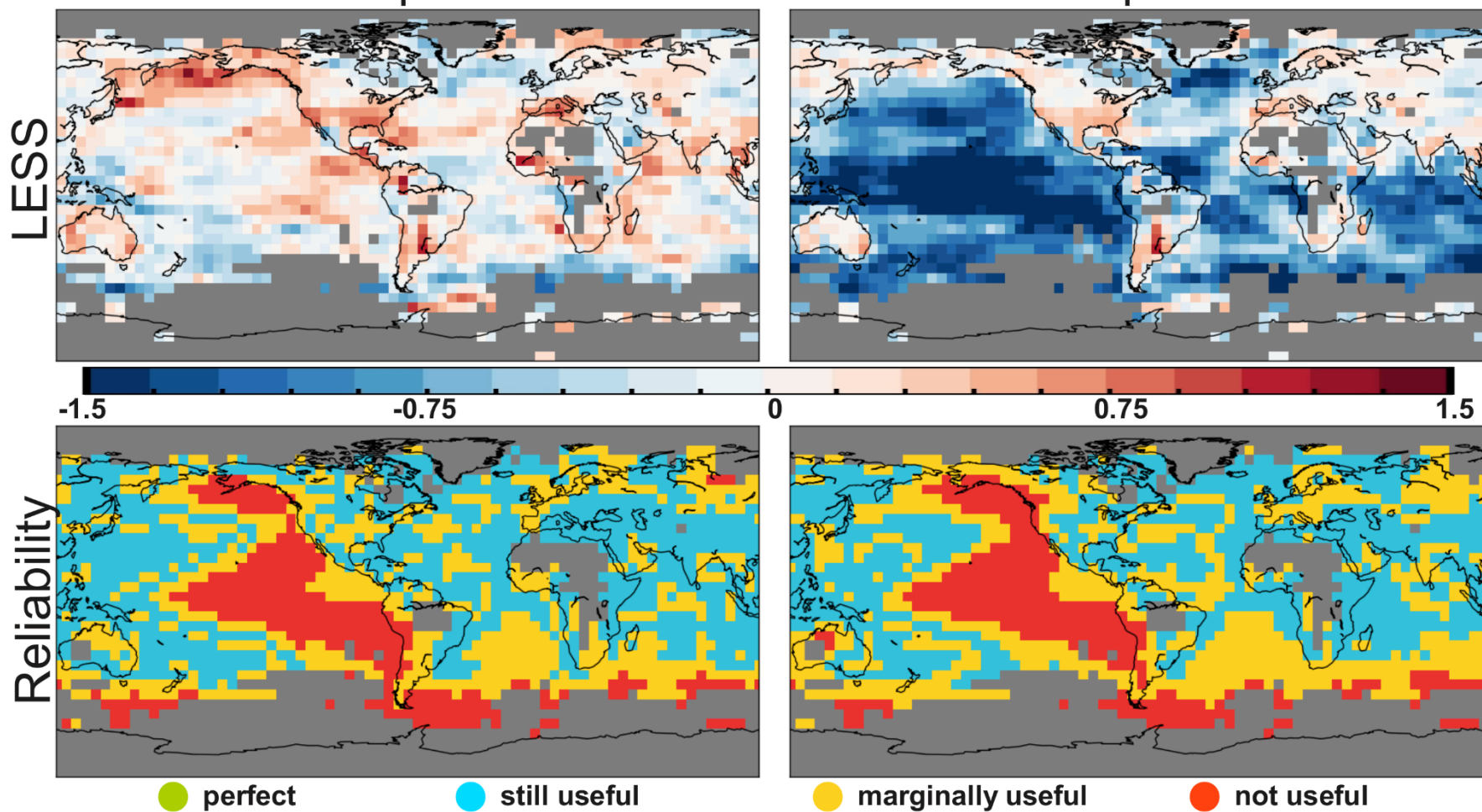
### **TAKE HOME MESSAGE:**

***The ensemble dispersion filter via the ensemble mean of ocean temperatures improves the accuracy of the decadal prediction system of MiKlip on the important time-scale LY2-5.***

## Ensemble Spread and Reliability – Near-Surface Air Temperature

MiKlip-REF

MiKlip-EDF

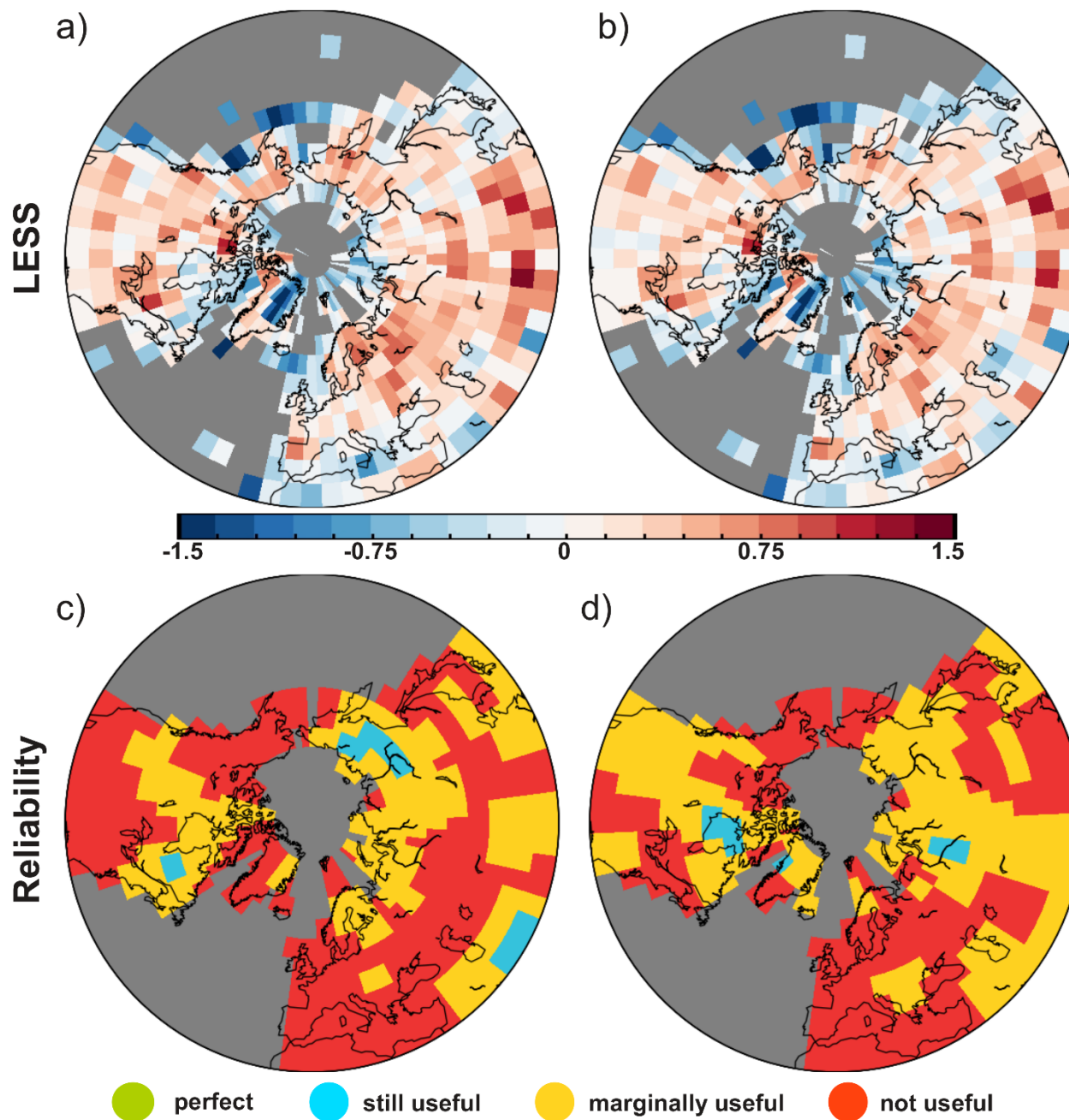




# Ensemble Spread and Reliability – Precipitation

MiKlip-REF

MiKlip-EDF



# Ensemble Spread and Reliability – Cyclone Track Density

MiKlip-REF

MiKlip-EDF

