

DEMETER: United We Stand

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Outline

- Simple multi-model
- Improvement in reliability and resolution
- Impact of the ensemble size
- Impact of number of models

Brier score and its decomposition

- Measures the quadratic distance between forecast and verification probabilities for binary events (negatively oriented)

$$BS = \frac{1}{N} \sum_{n=1}^N (p_n - o_n)^2$$

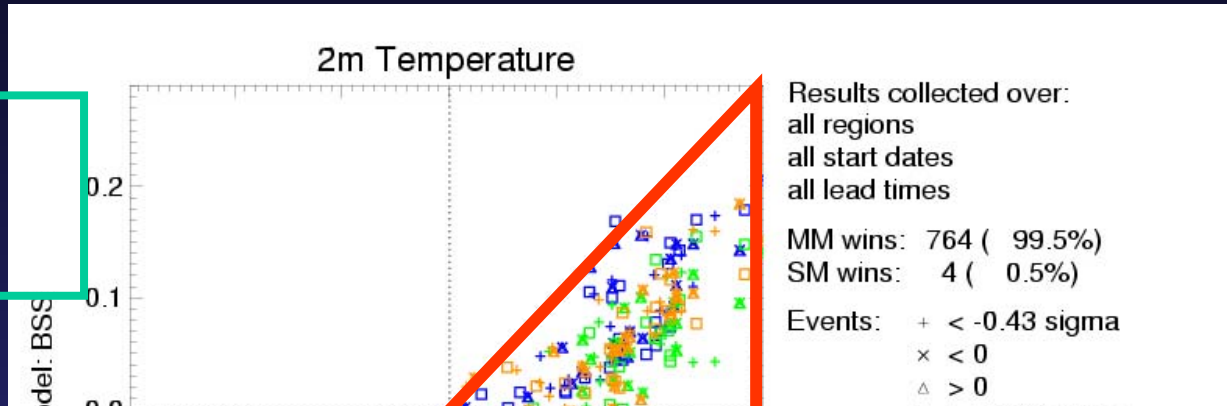
- The Brier score can be split into three terms that measure different aspects of the forecast quality

Brier Score = Reliability – Resolution + Uncertainty

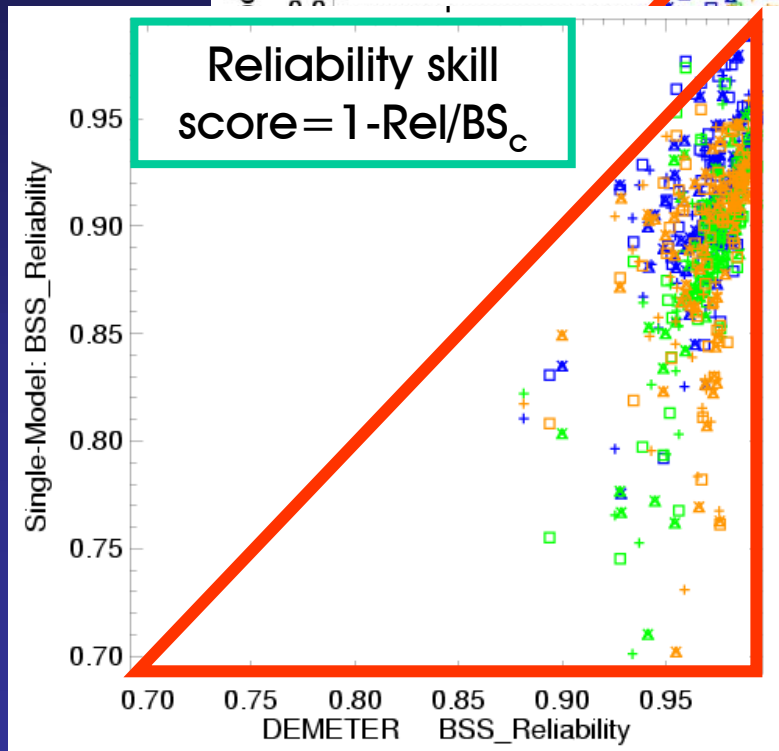
- ▶ Reliability: forecast prob. vs. observed relative
- ▶ Resolution: ability to issue reliable forecasts close to 0% or 100%
- ▶ Uncertainty: variance of observations frequency in sample

Single vs. multi-model: Brier score

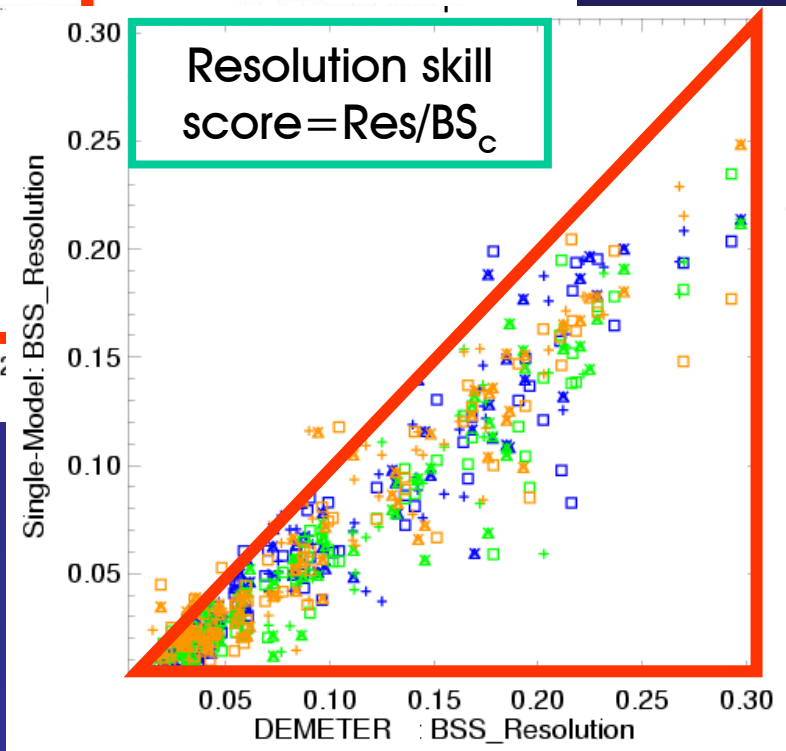
Brier skill score = $1 - BS / BS_c$



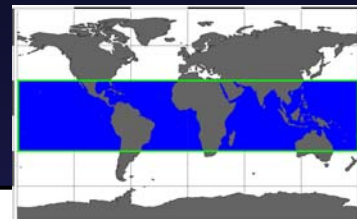
Reliability skill score = $1 - Rel / BS_c$



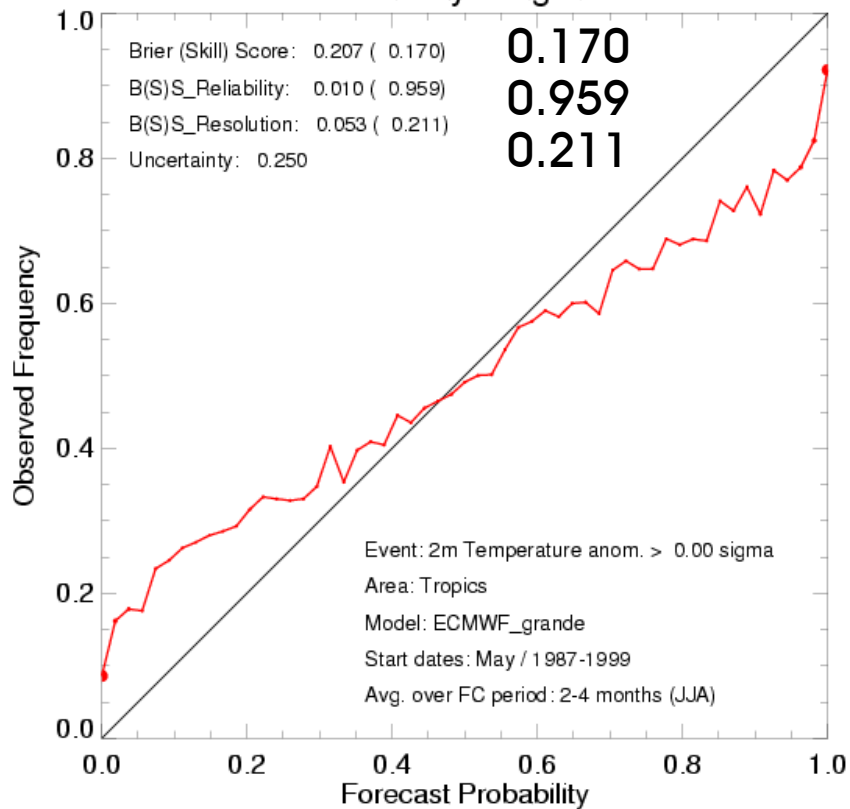
Resolution skill score = Res / BS_c



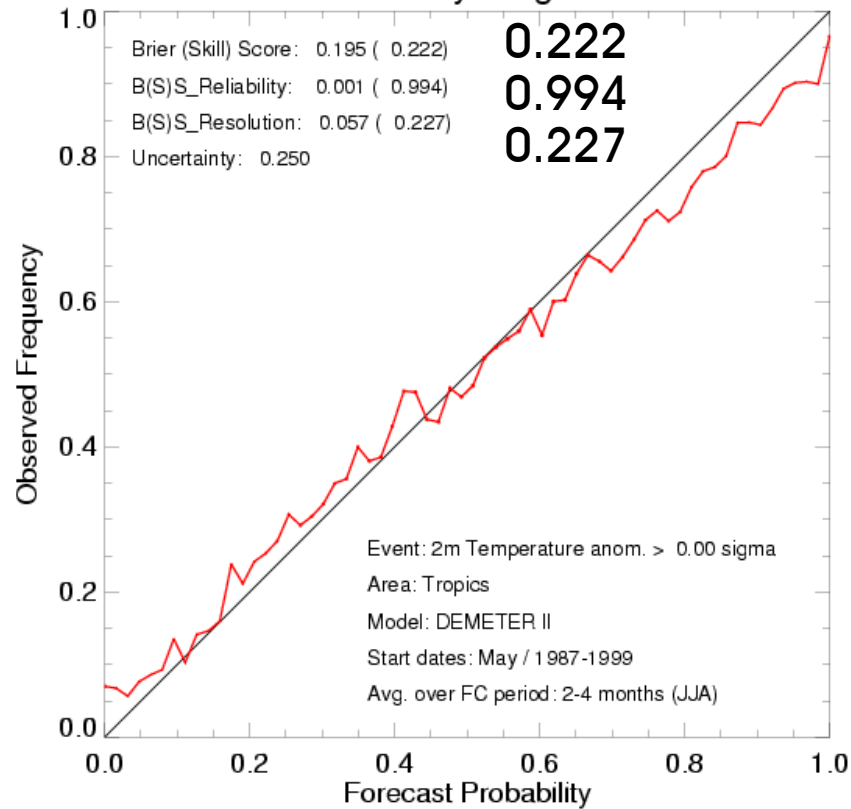
Reliability diagram: 2m-Temp. > 0



Reliability Diagram



Reliability Diagram

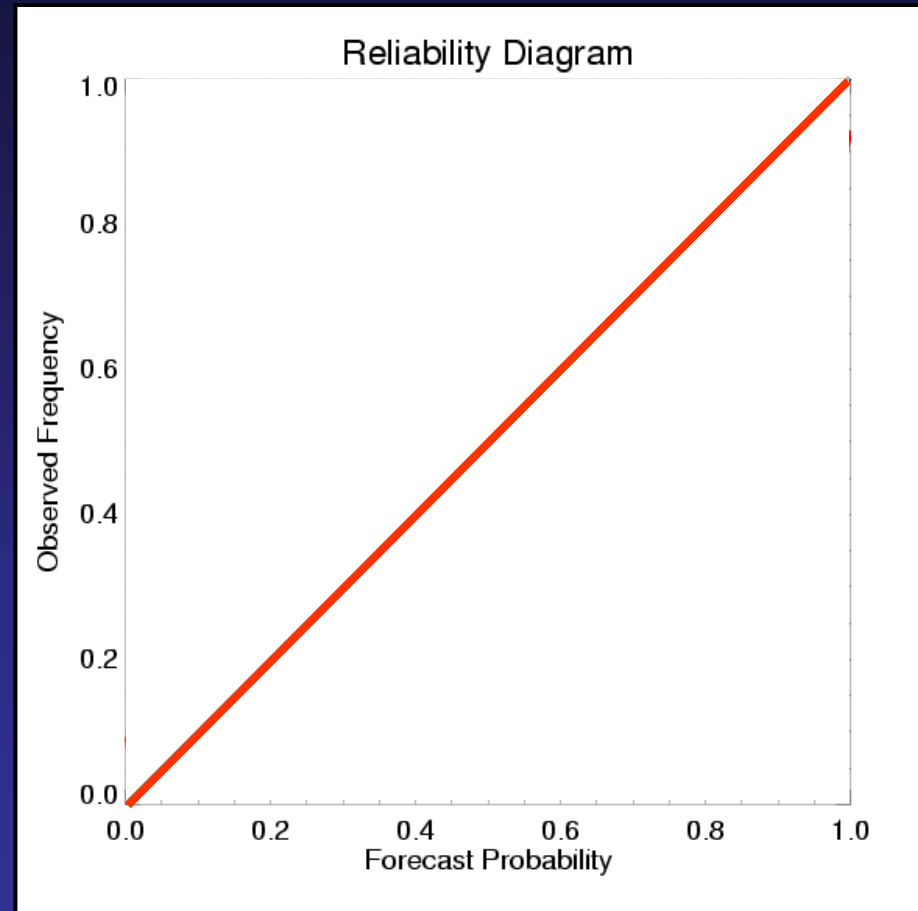
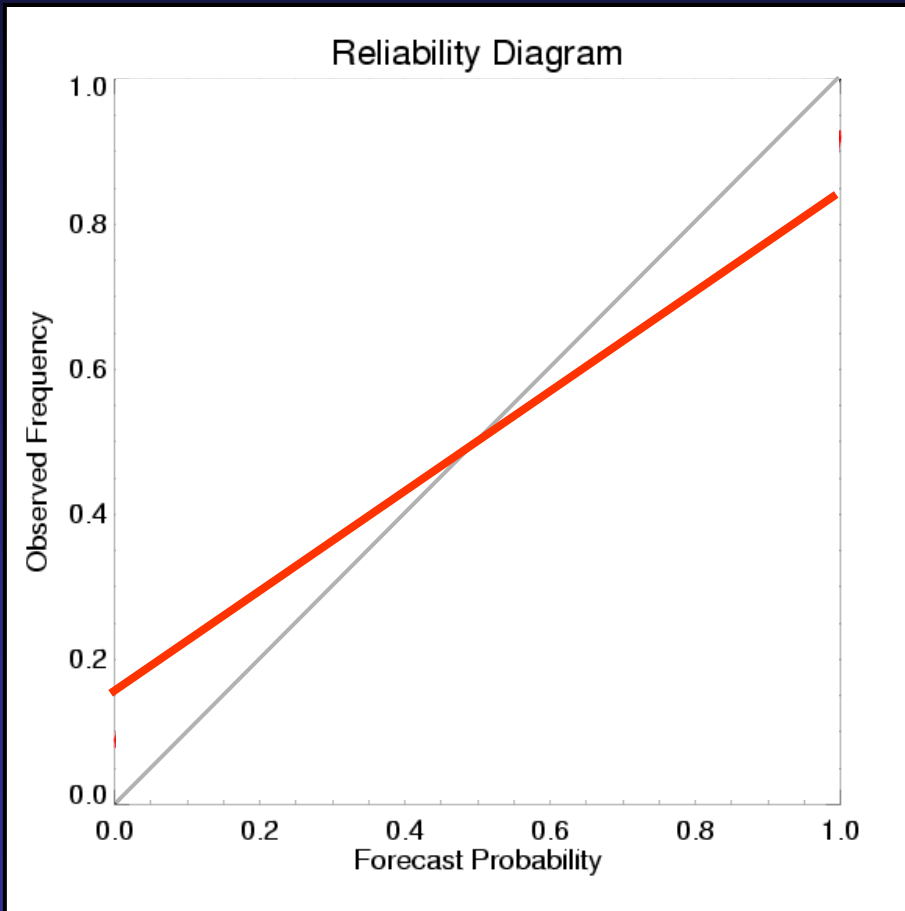


single-model (54 members)

multi-model



Reliability diagram



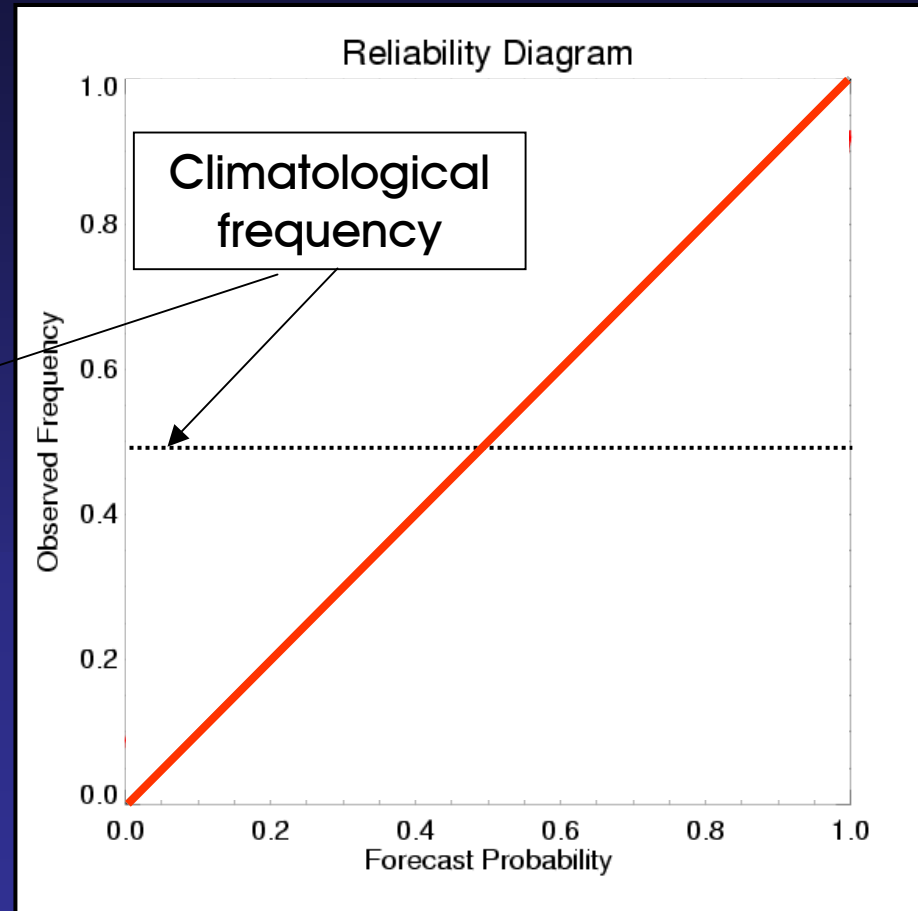
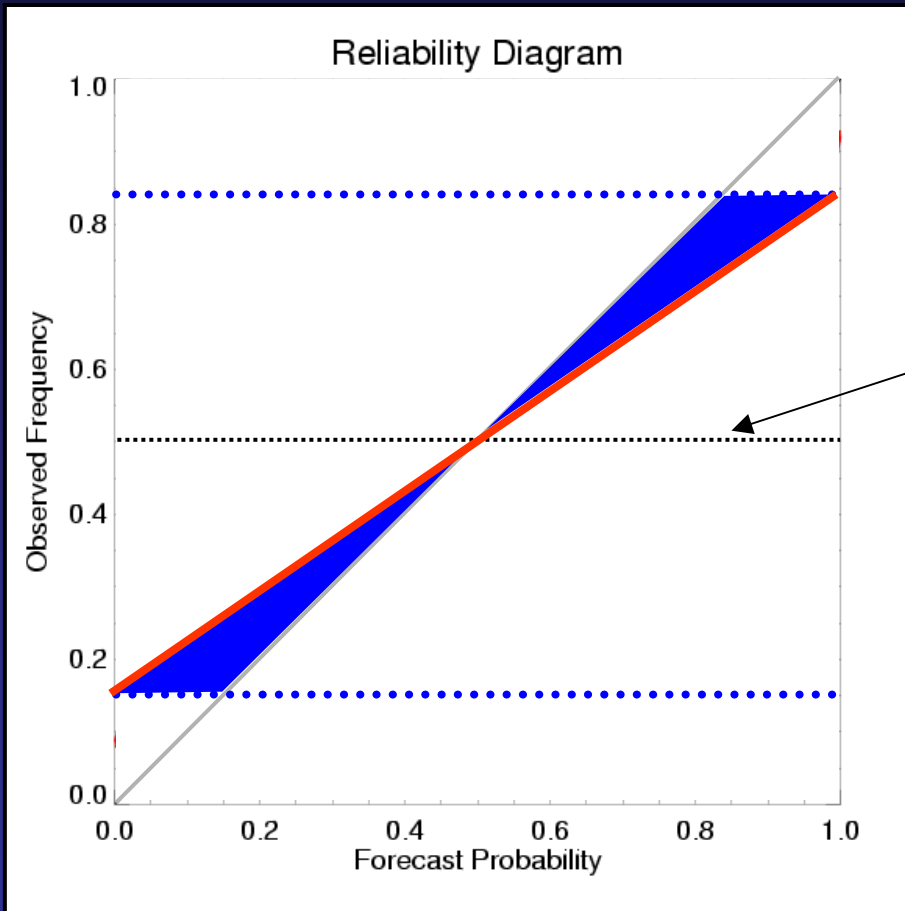
single-model (54 members)

multi-model



Reliability diagram

■ Reliability score (the smaller, the better)



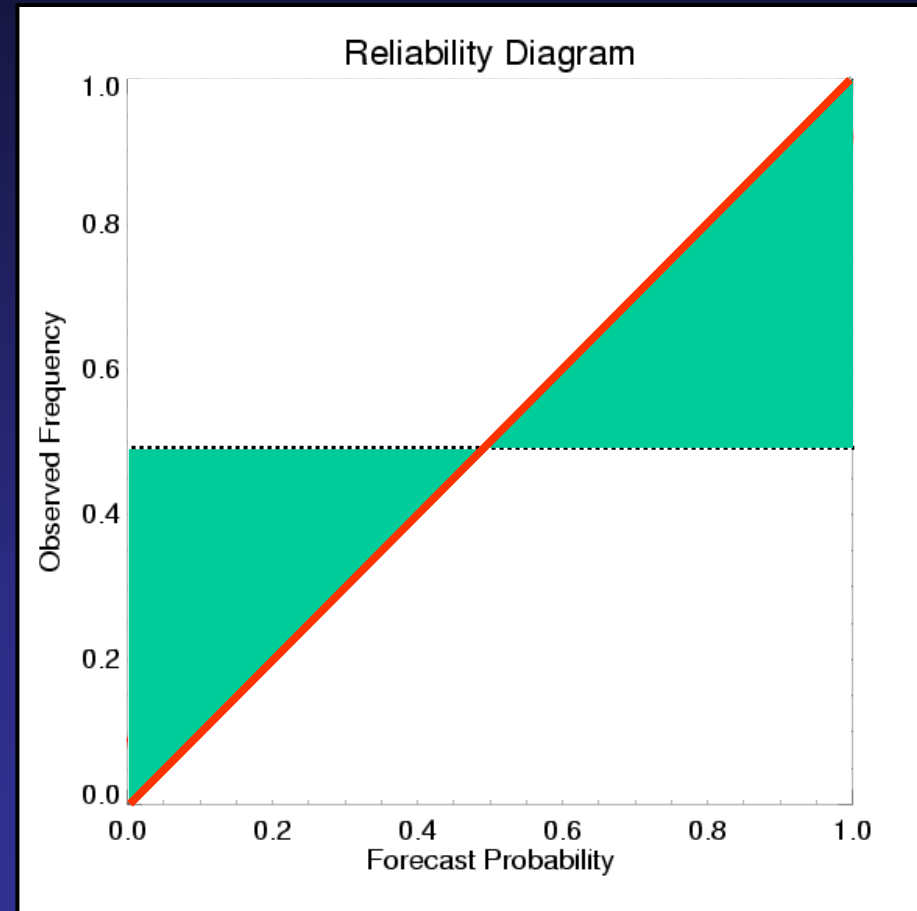
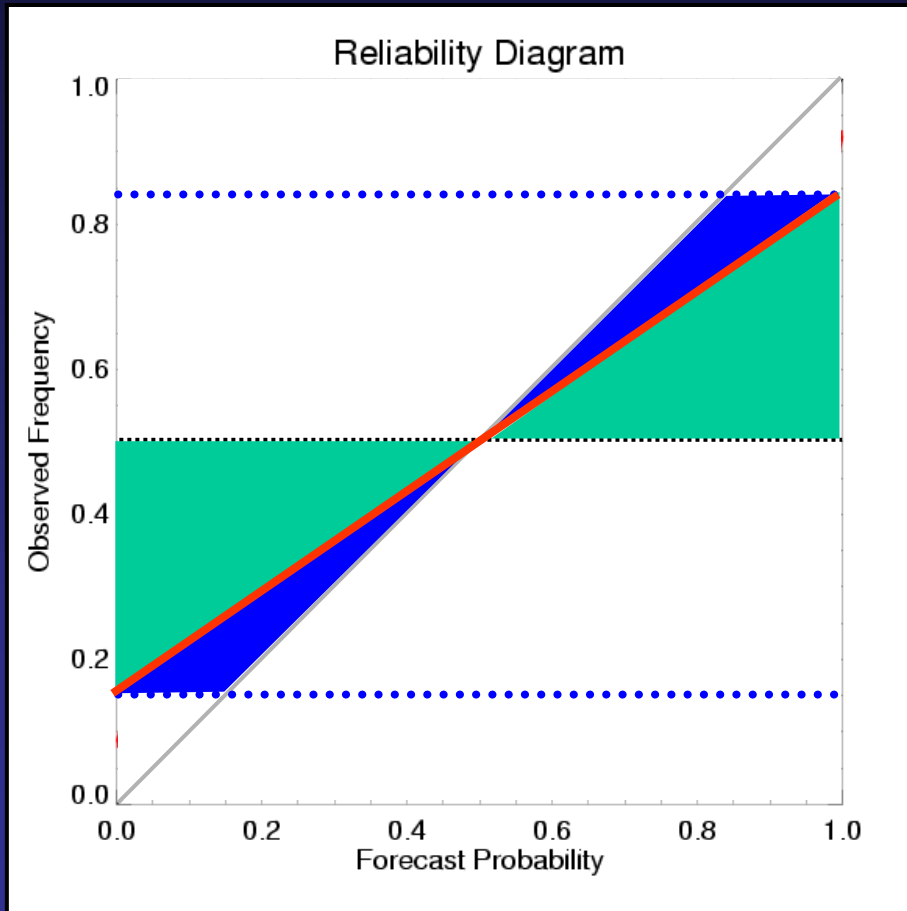
single-model (54 members)

multi-model

Reliability diagram

■ Reliability score (the smaller, the better)

■ Resolution score (the bigger, the better)



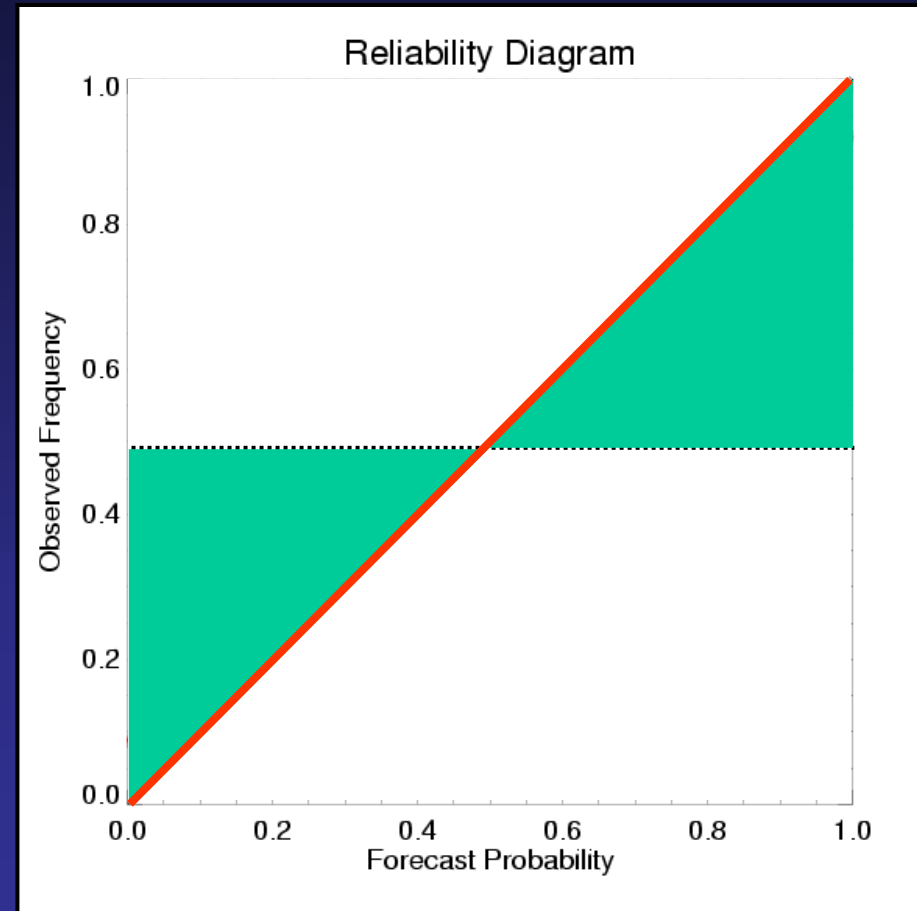
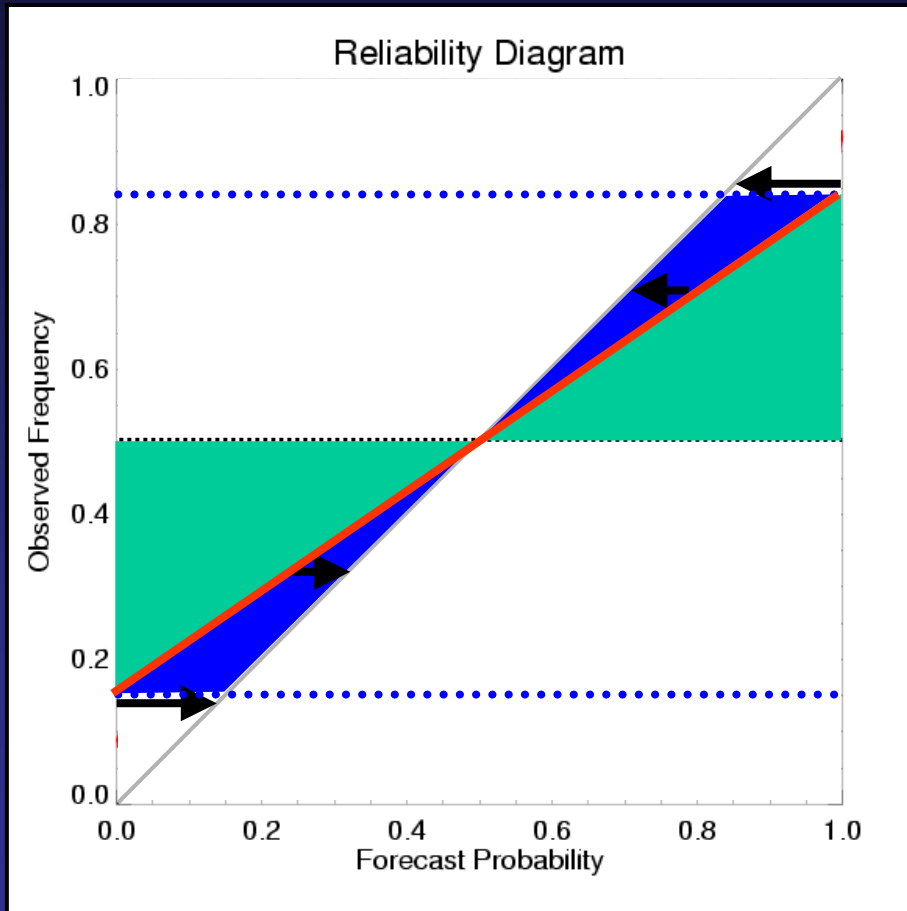
single-model (54 members)

multi-model

Reliability diagram

■ Reliability score (the smaller, the better)

■ Resolution score (the bigger, the better)



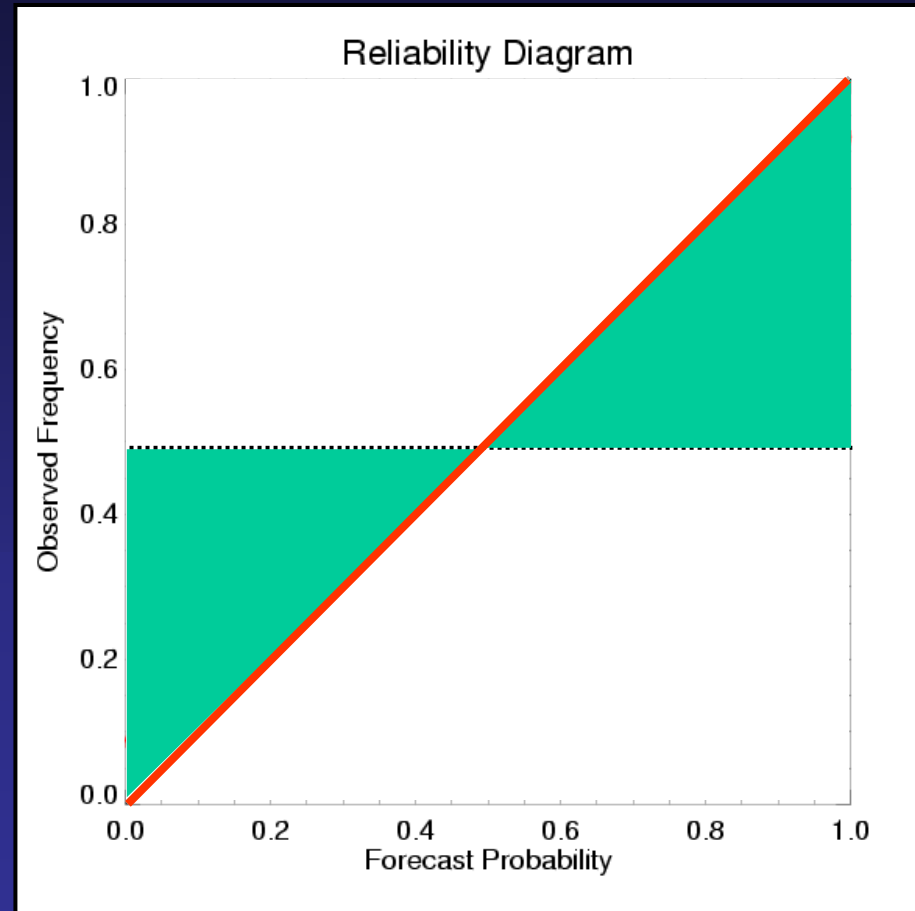
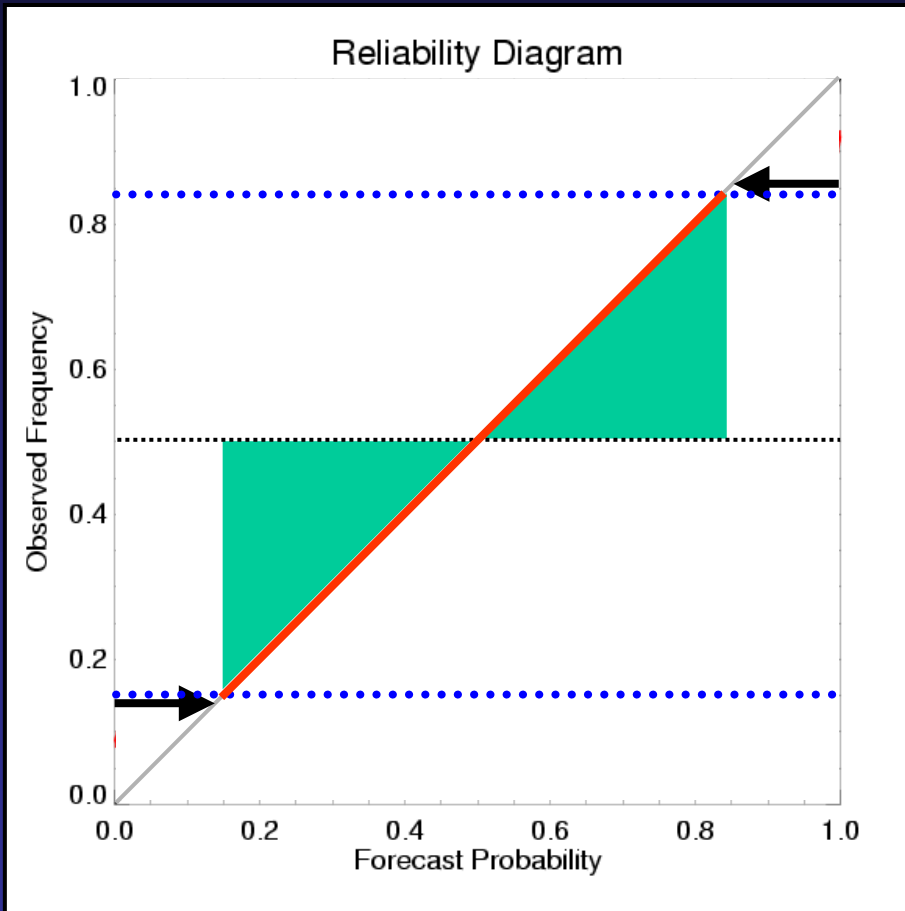
single-model (54 members)

multi-model

Reliability diagram

 Reliability score (the smaller, the better)

 Resolution score (the bigger, the better)



single-model (54 members)

multi-model

Ranked probability score

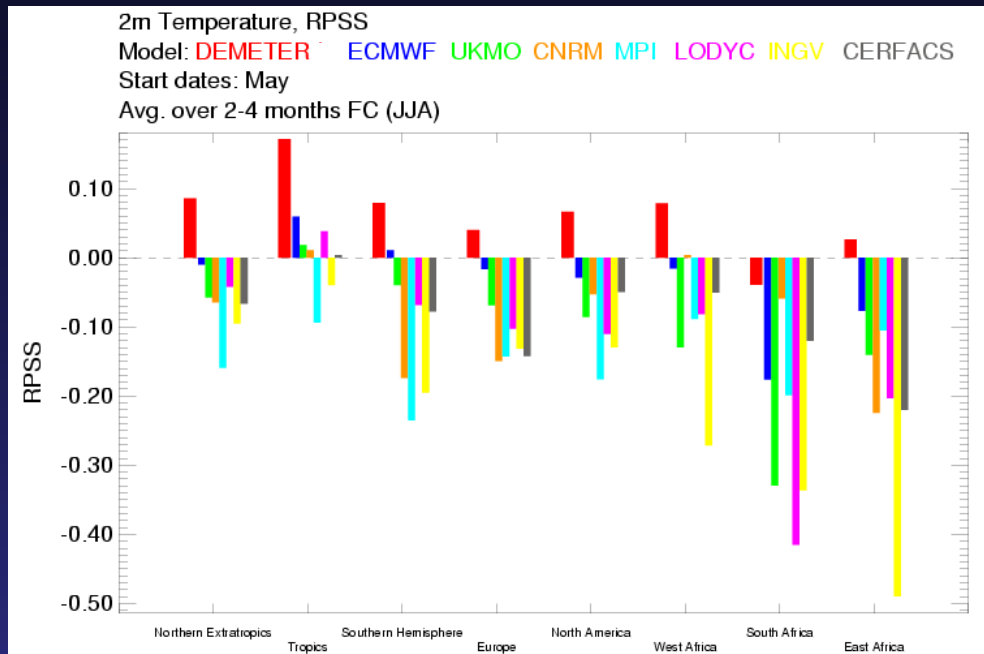
- Measures the quadratic distance between forecast and verification probabilities for several categories
- It is the average Brier score across the range of the variable

$$RPS = \frac{1}{K-1} \sum_{k=1}^K BS_k$$

- As for the Brier score, it can be split into three terms

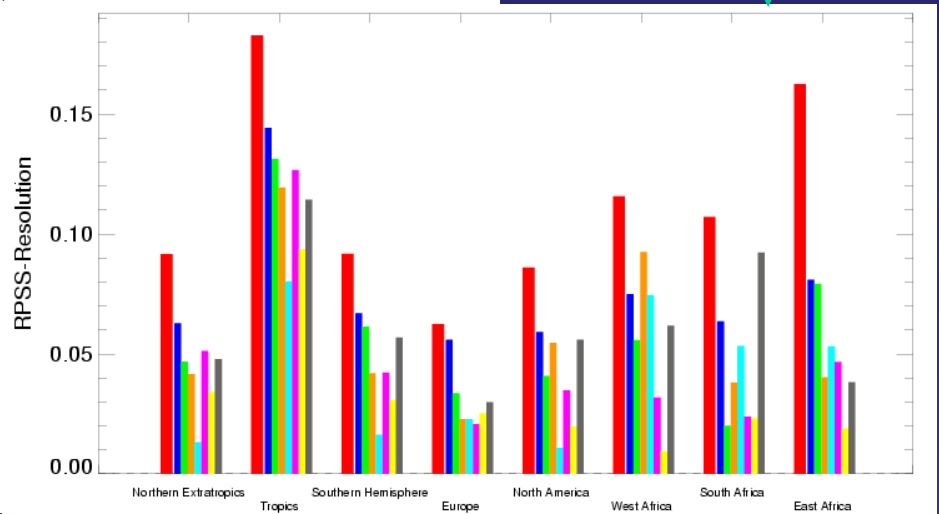
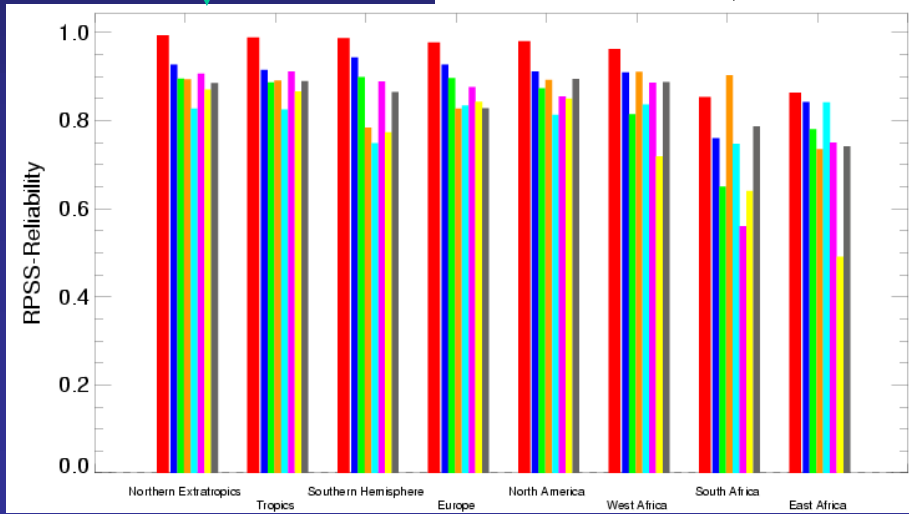
$$RPS = \text{Reliability} - \text{Resolution} + \text{Uncertainty}$$

RPSS decomposition: T2m (JJA)



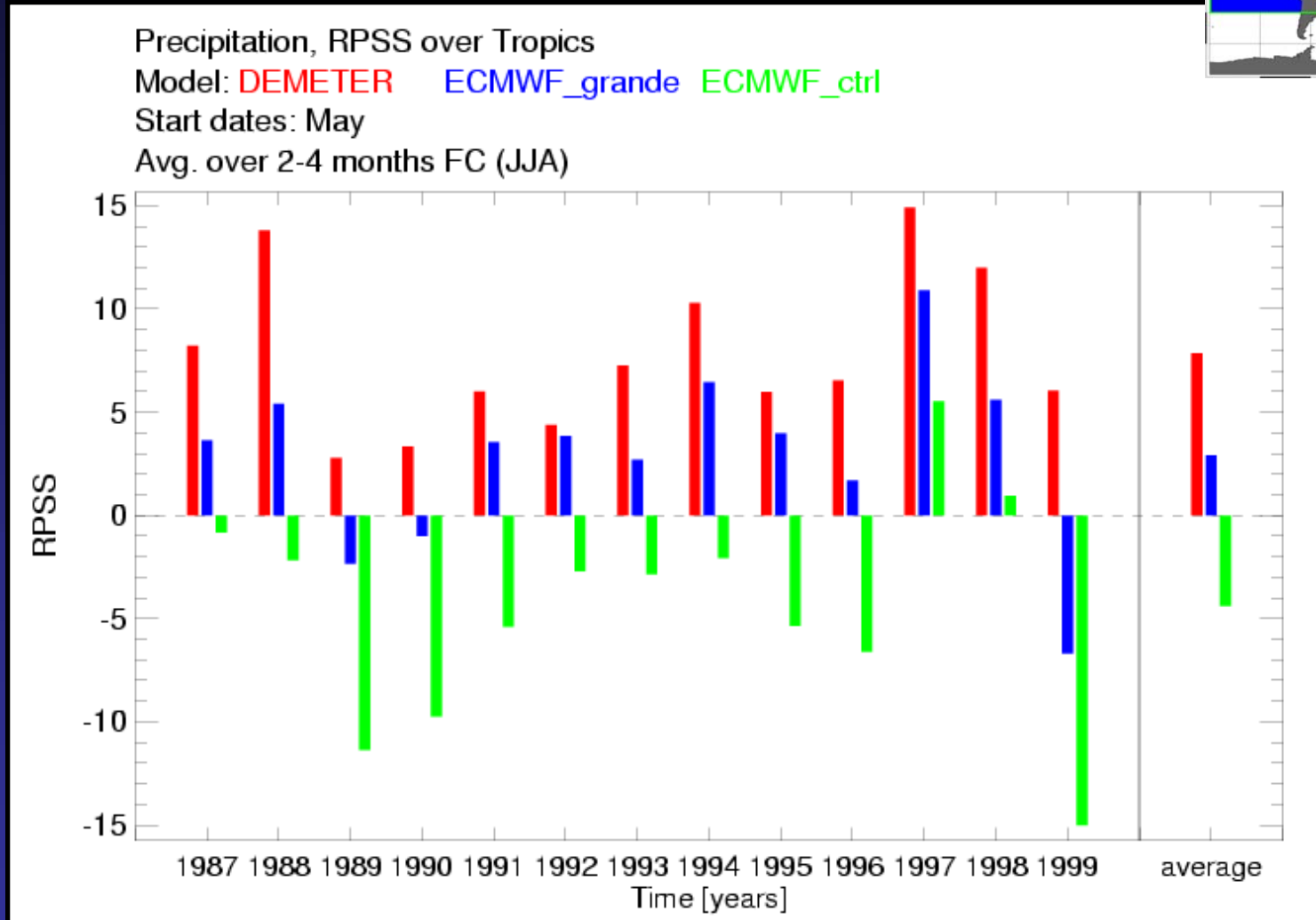
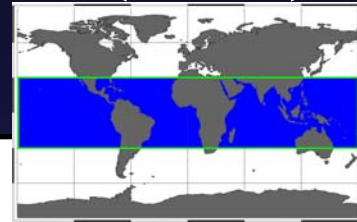
Reliability skill score

Resolution skill score

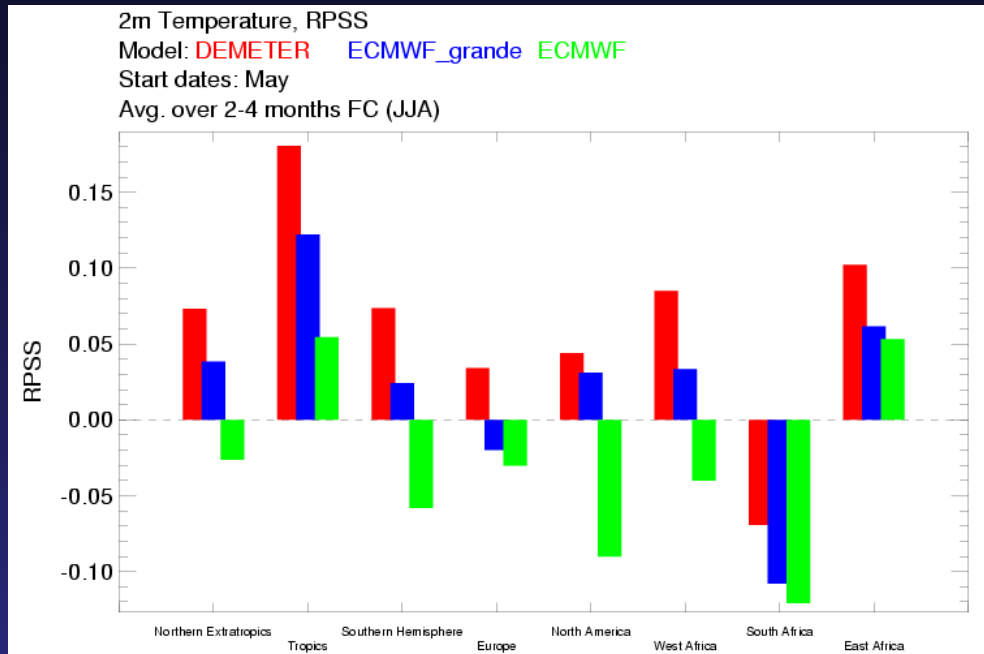


Impact of ensemble size: Precip (JJA)

Multi-model (54 members) single model (54) single model (9)

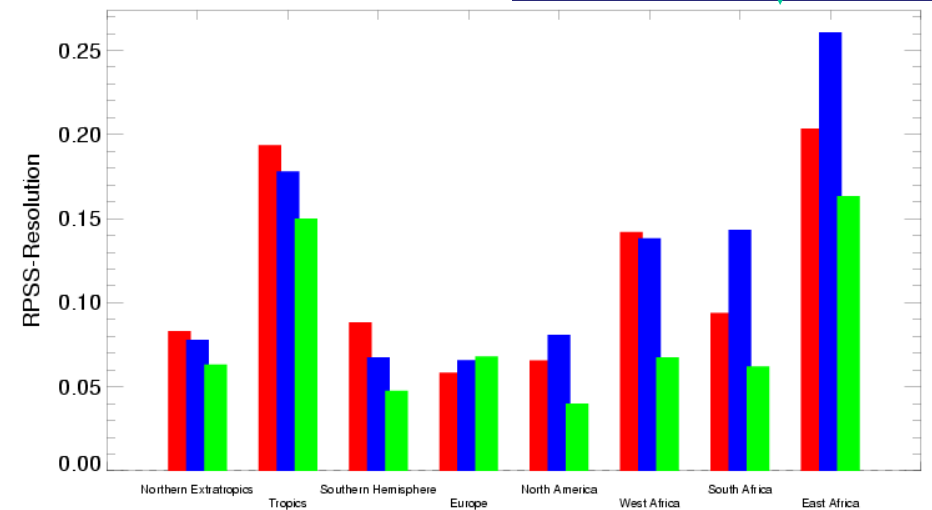
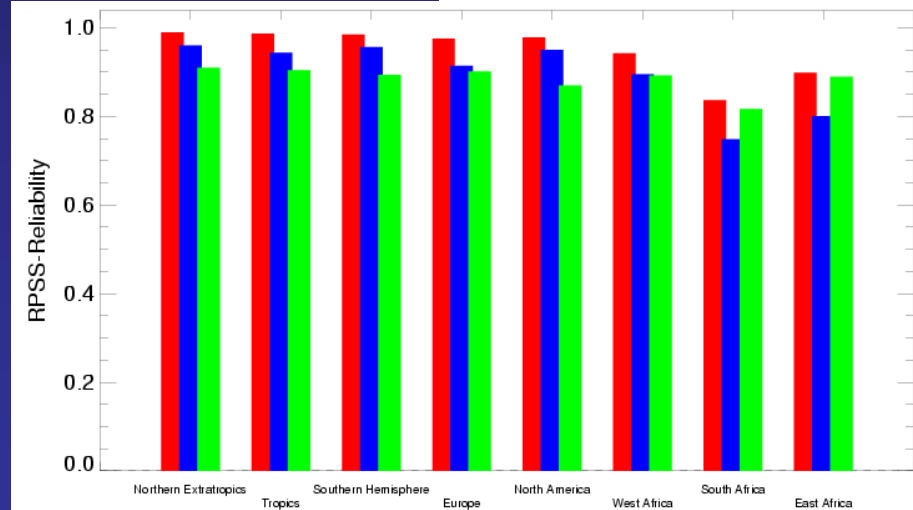


RPSS decomposition: T2m (JJA)

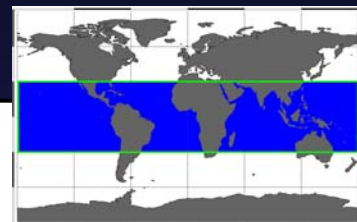


Reliability skill score

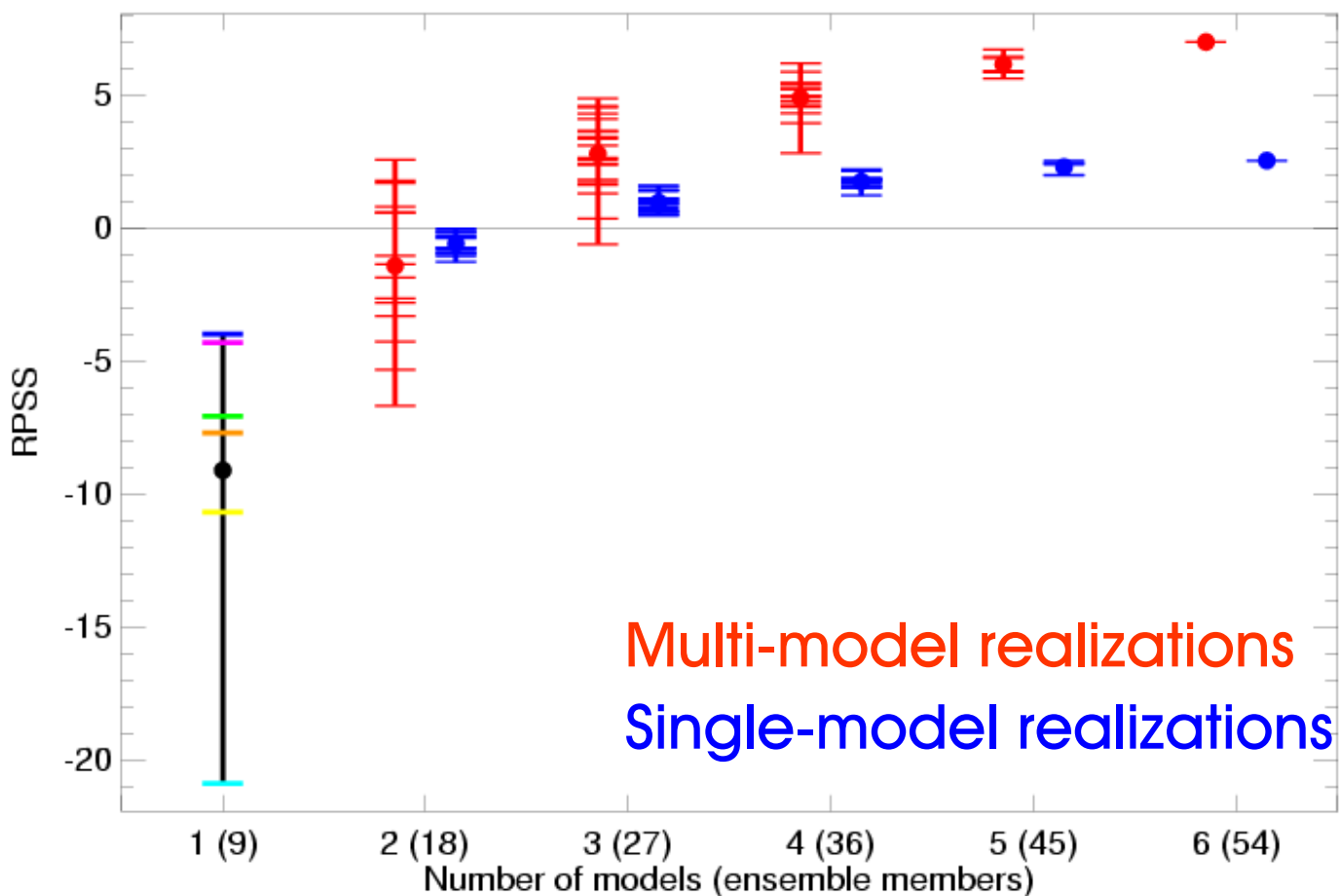
Resolution skill score



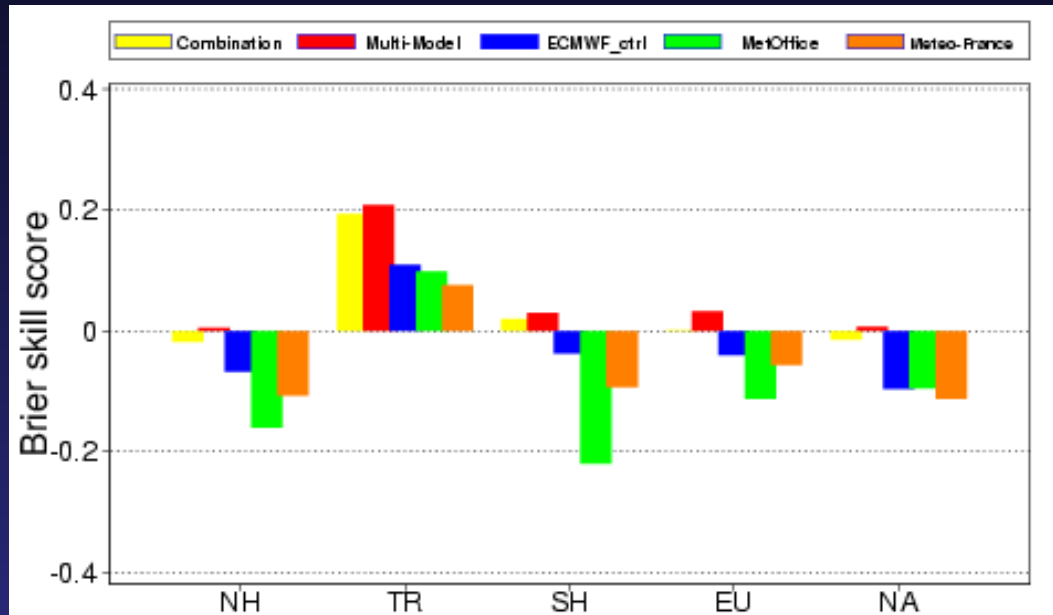
Impact of number of models: Precipitation (JJA)



Precipitation, RPSS over Tropics
Forecast start month and years: May / 1987-1999
FC period: months 2-4 (JJA),

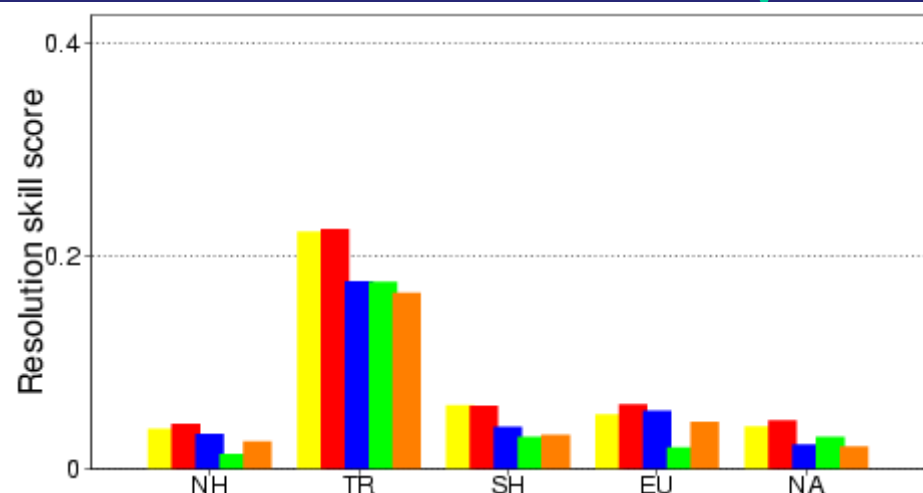
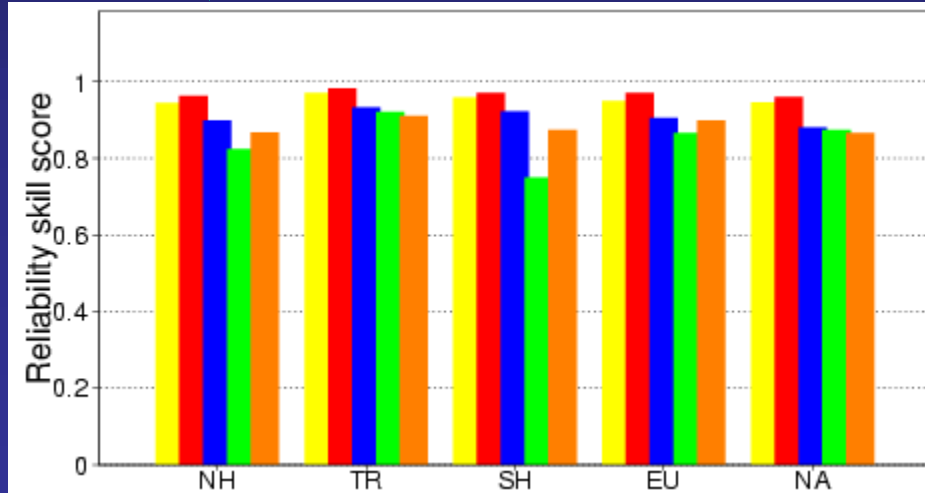


Optimal combination: T2m > 0 (JJA)



Reliability skill score

Resolution skill score



Summary

- DEMETER simple multi-model hindcasts show better resolution and reliability than single models
- The improvement in the simple multi-model is not just the result of increasing the ensemble size
- Increasing the number of single-model ensembles improves the simple multi-model