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Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

Are forecasts of weather regimes better than temperature and precipitation in predicting cold spells, heat waves and droughts?

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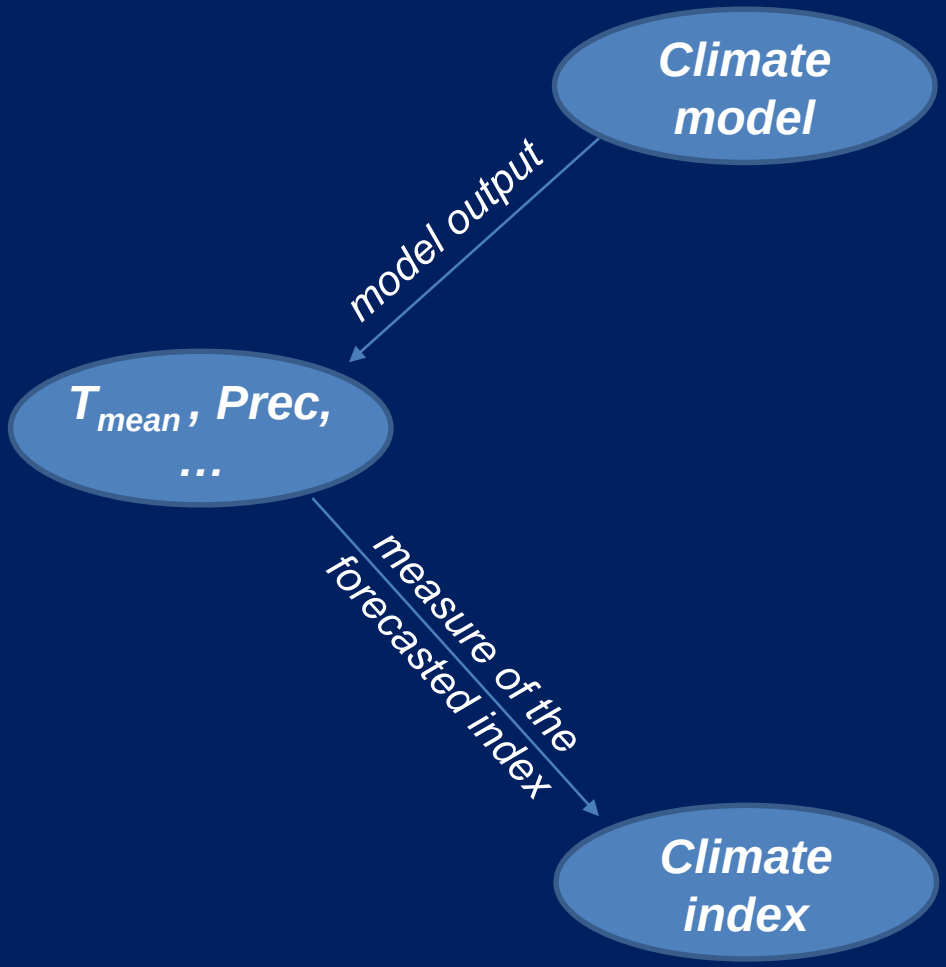
Earth System Services (ESS)

BSC-ES Internal Seminar

12 November 2019

Forecast types



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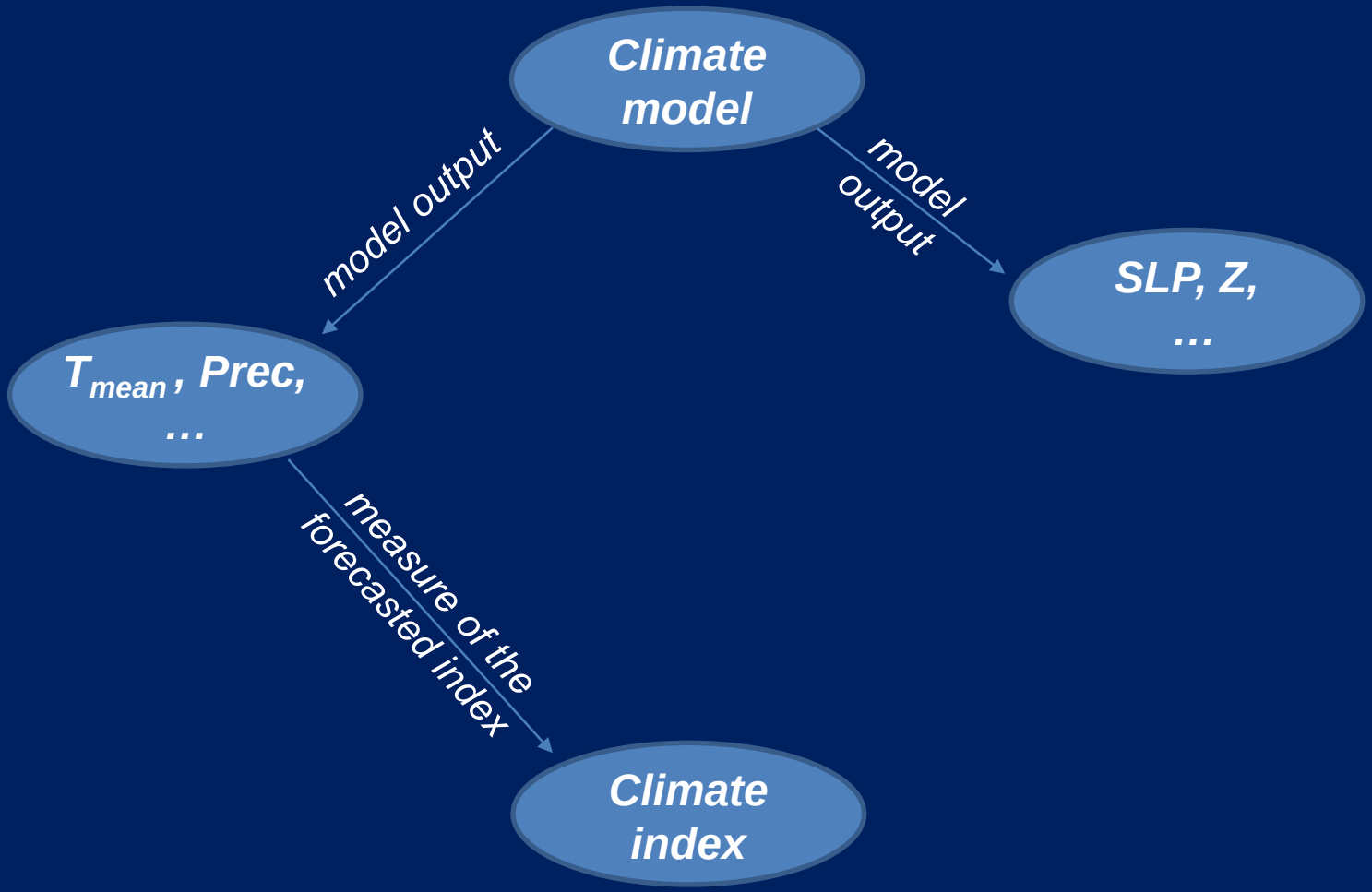

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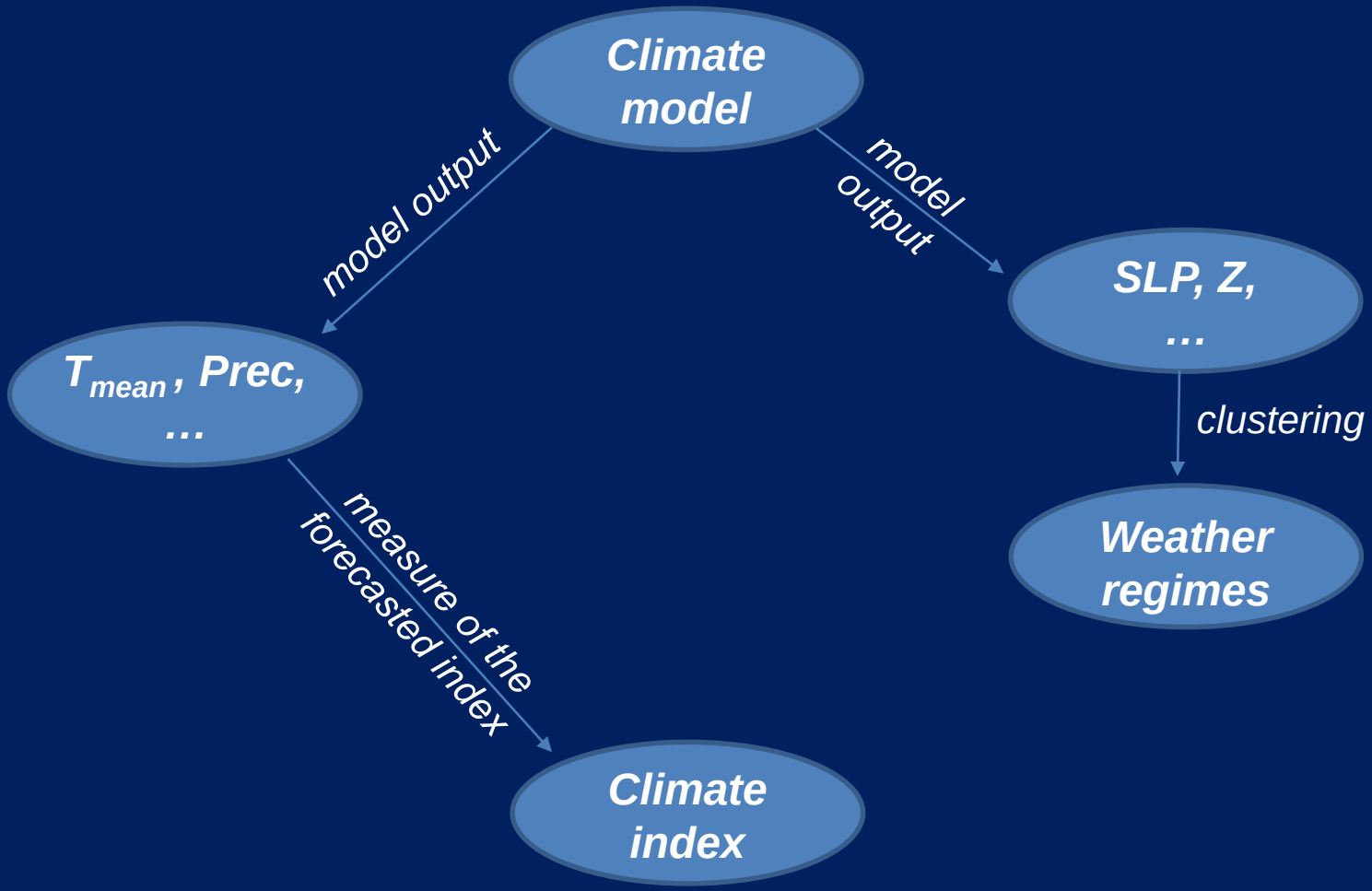

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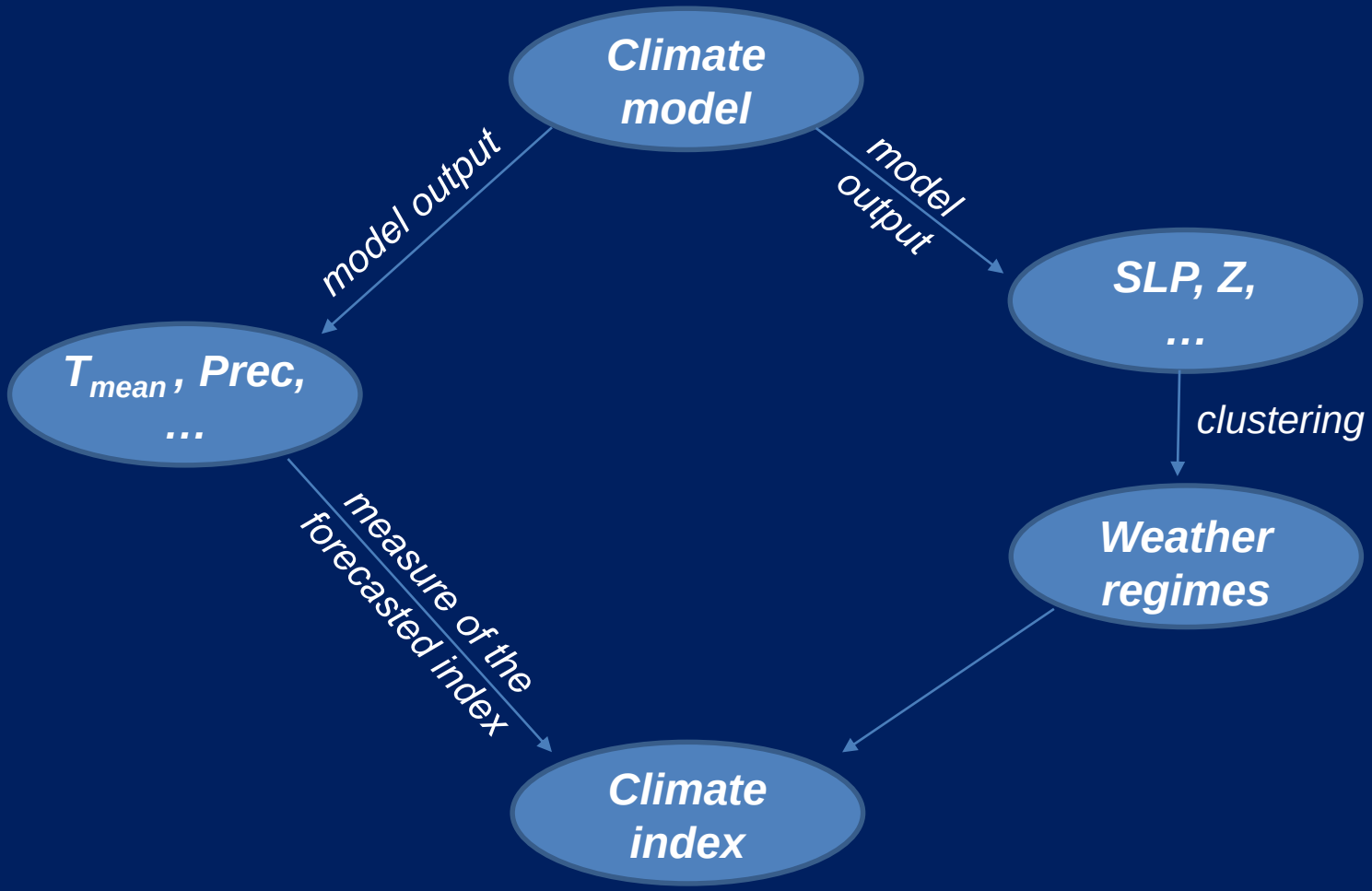

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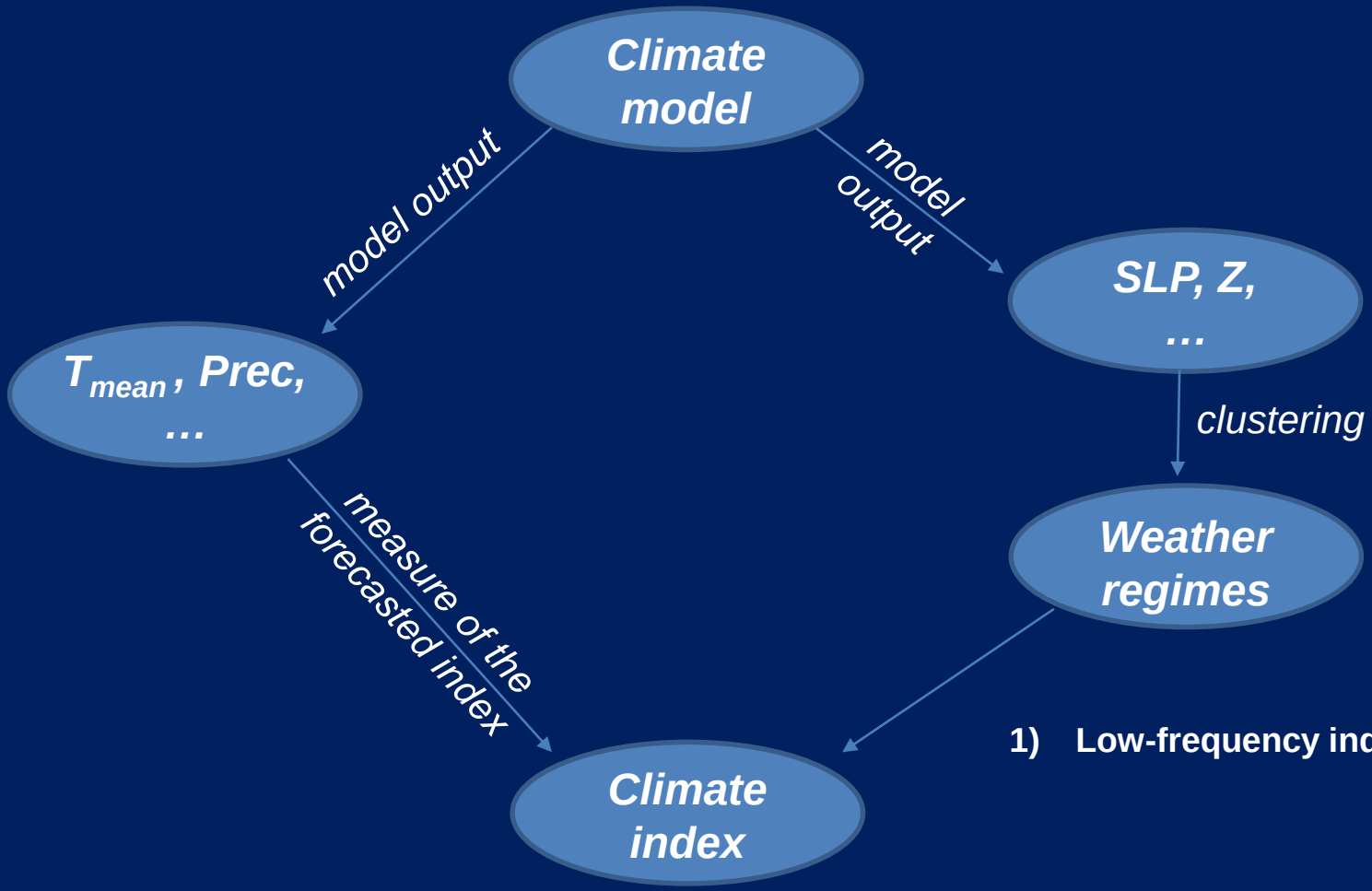
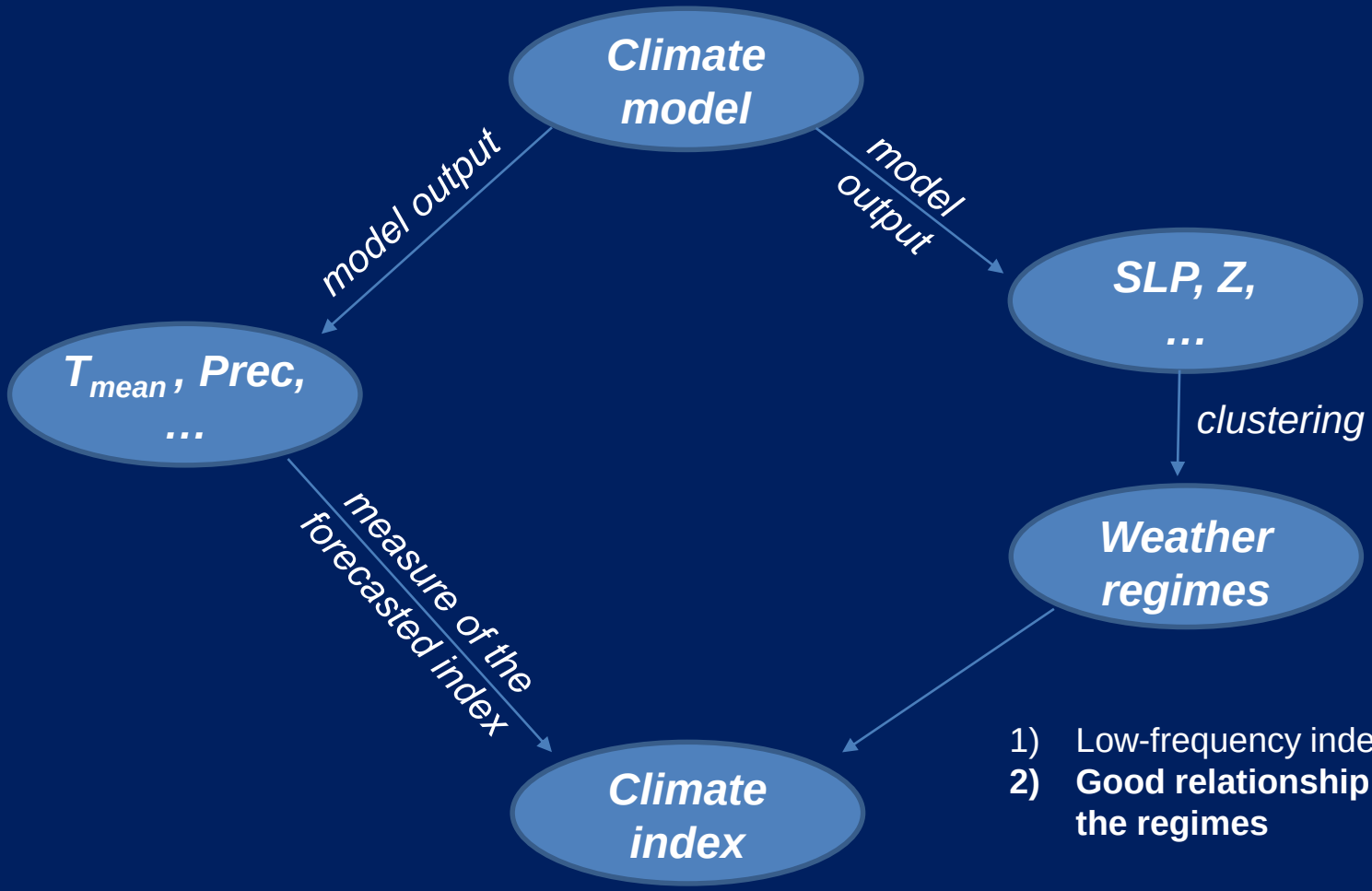


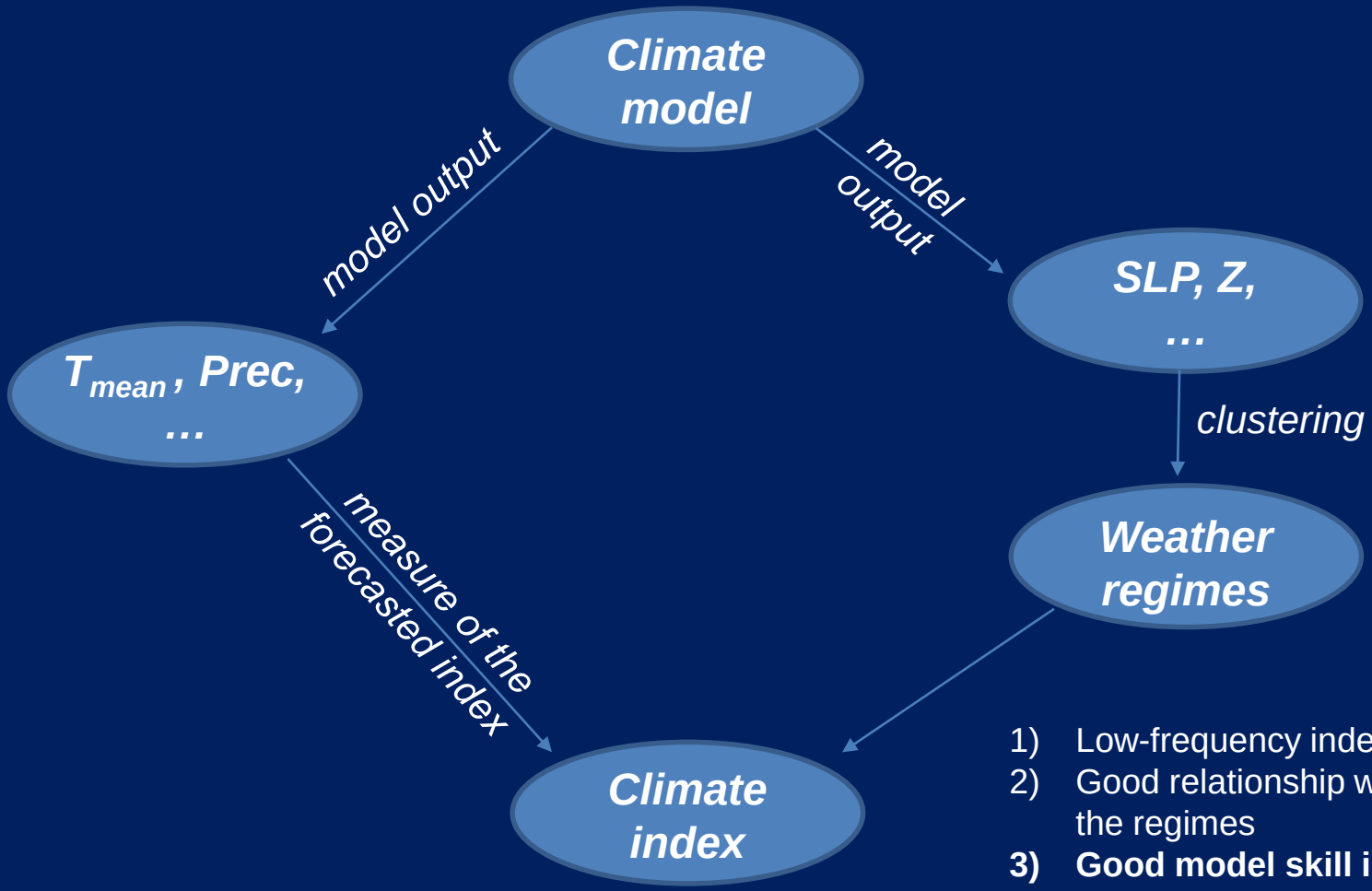
1) **Low-frequency index**

Forecast types



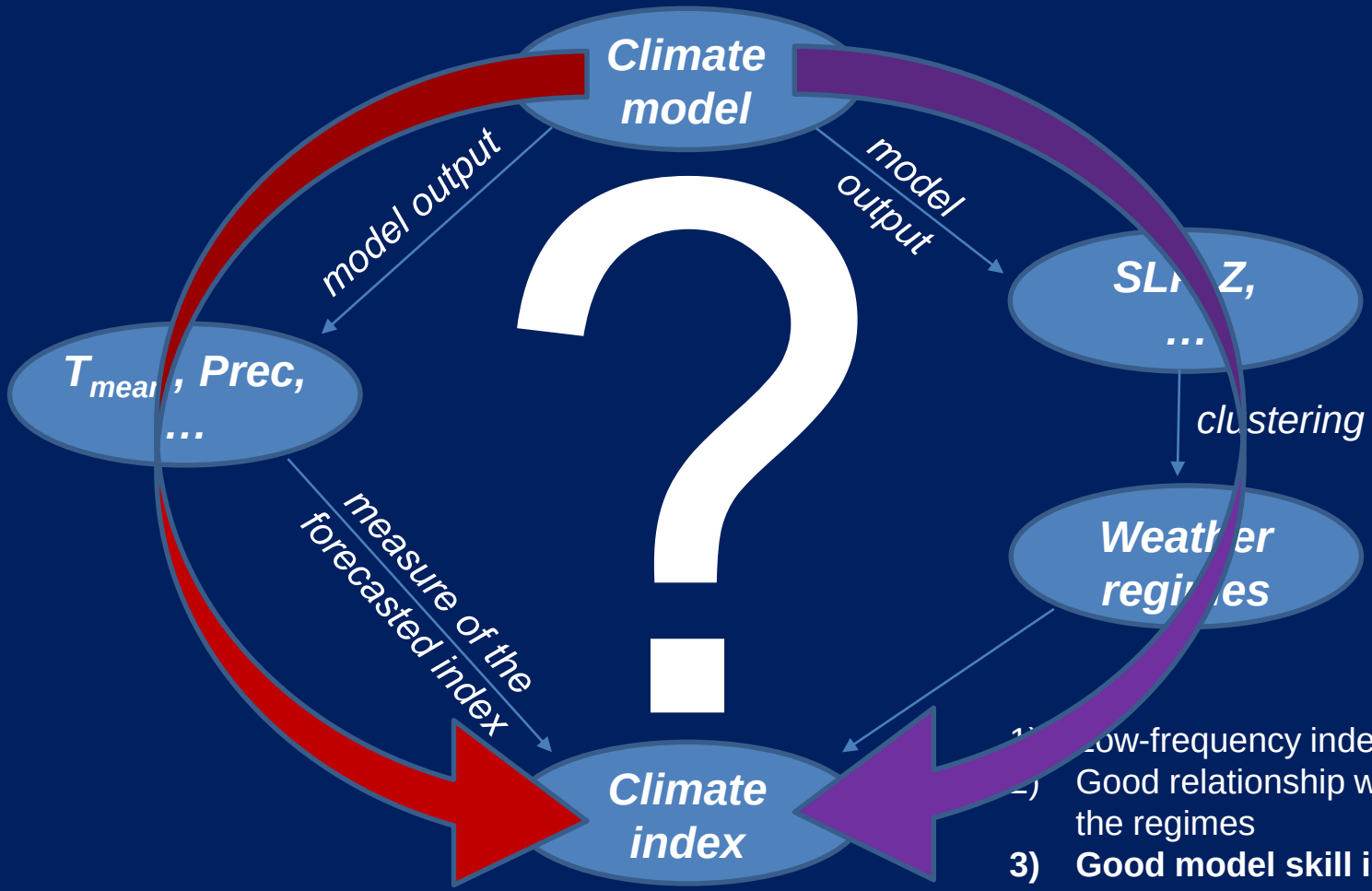
1) Low-frequency index
2) **Good relationship with the regimes**

Forecast types



1) Low-frequency index
2) Good relationship with the regimes
3) **Good model skill in reproducing regimes**

Forecast types



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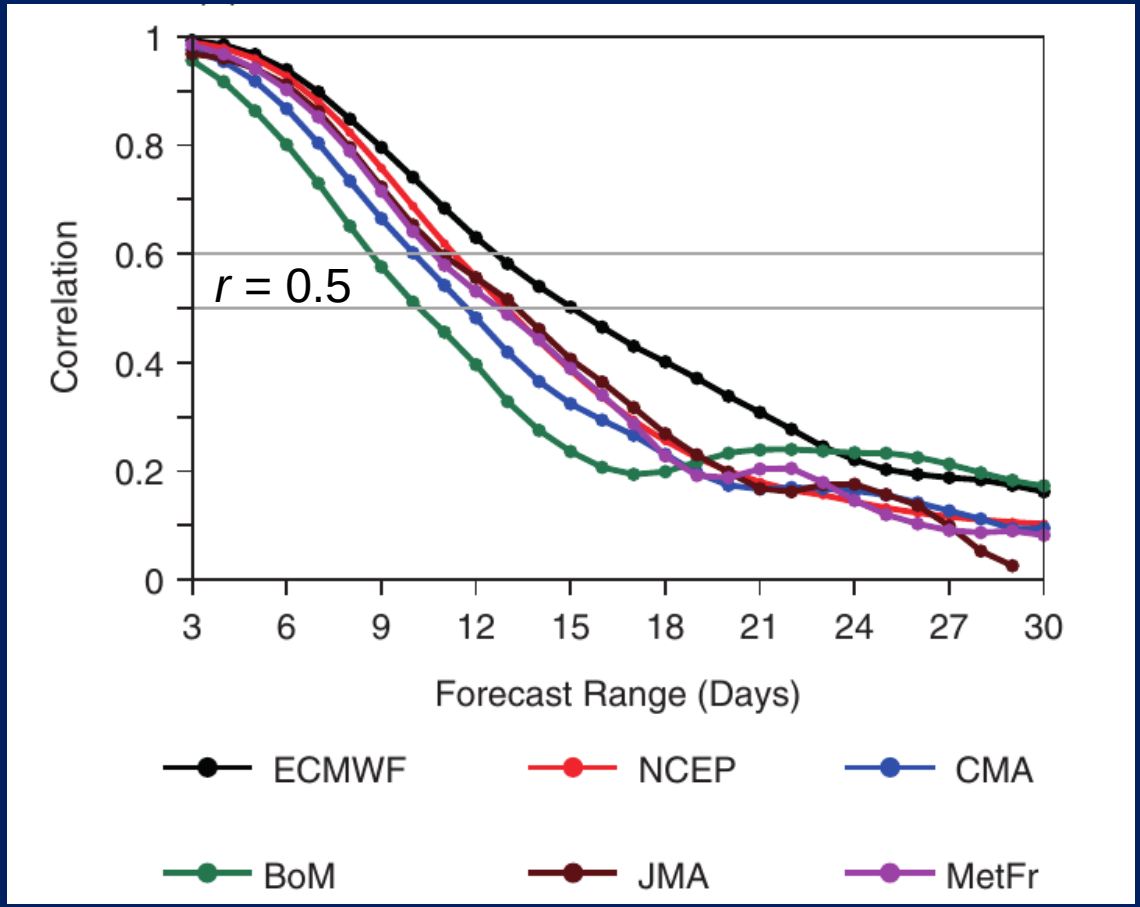
2) Good relationship with the regimes
3) **Good model skill in reproducing regimes**

Forecasts of cold spells

(4+ days below 10th percentile)

NAO- and blocking winter forecasts



source: Ferranti et al 2018 "How far in advance can we predict changes in large-scale flow leading to severe cold conditions over Europe?"

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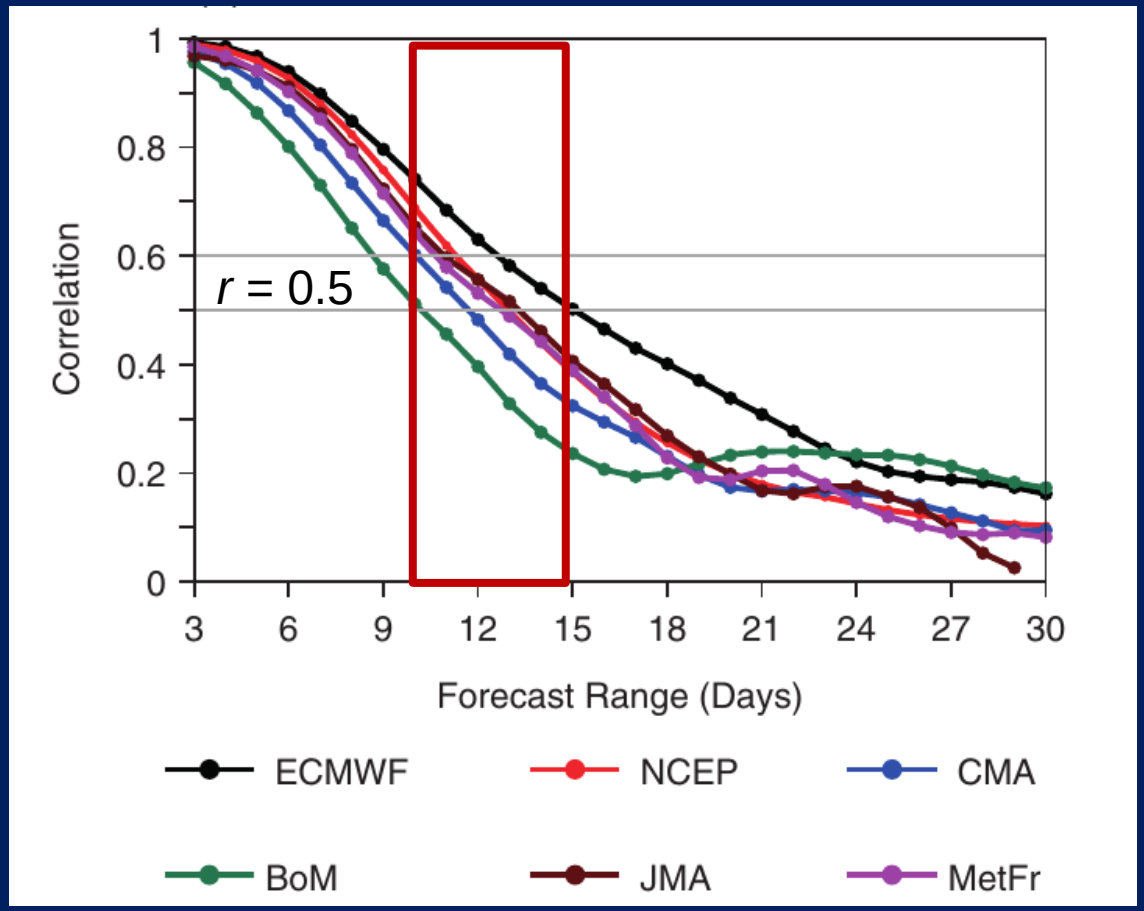
NAO- and blocking winter forecasts



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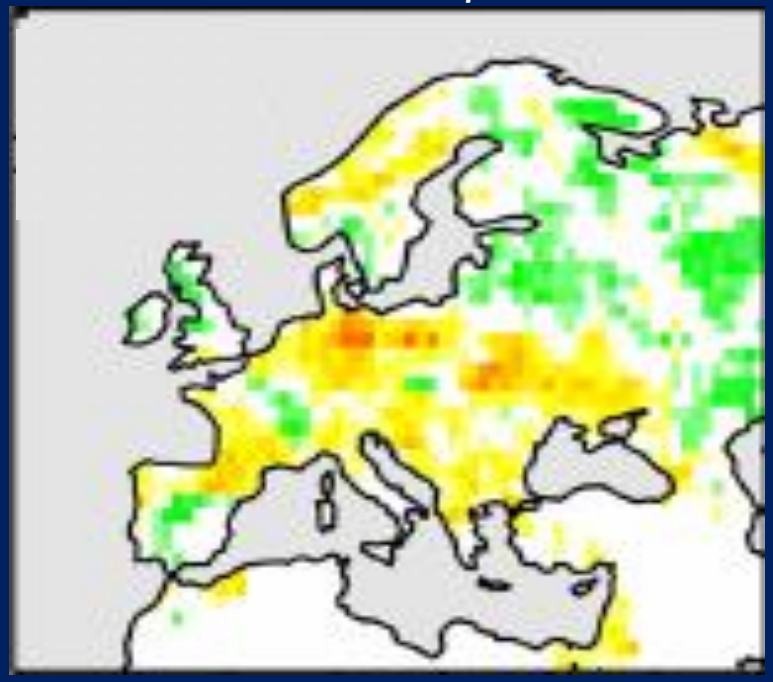
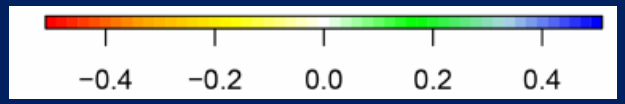
Forecasts of droughts

(SPI-1 index)

Winter skill comparison



Precipitation forecasts better



Regime forecasts better

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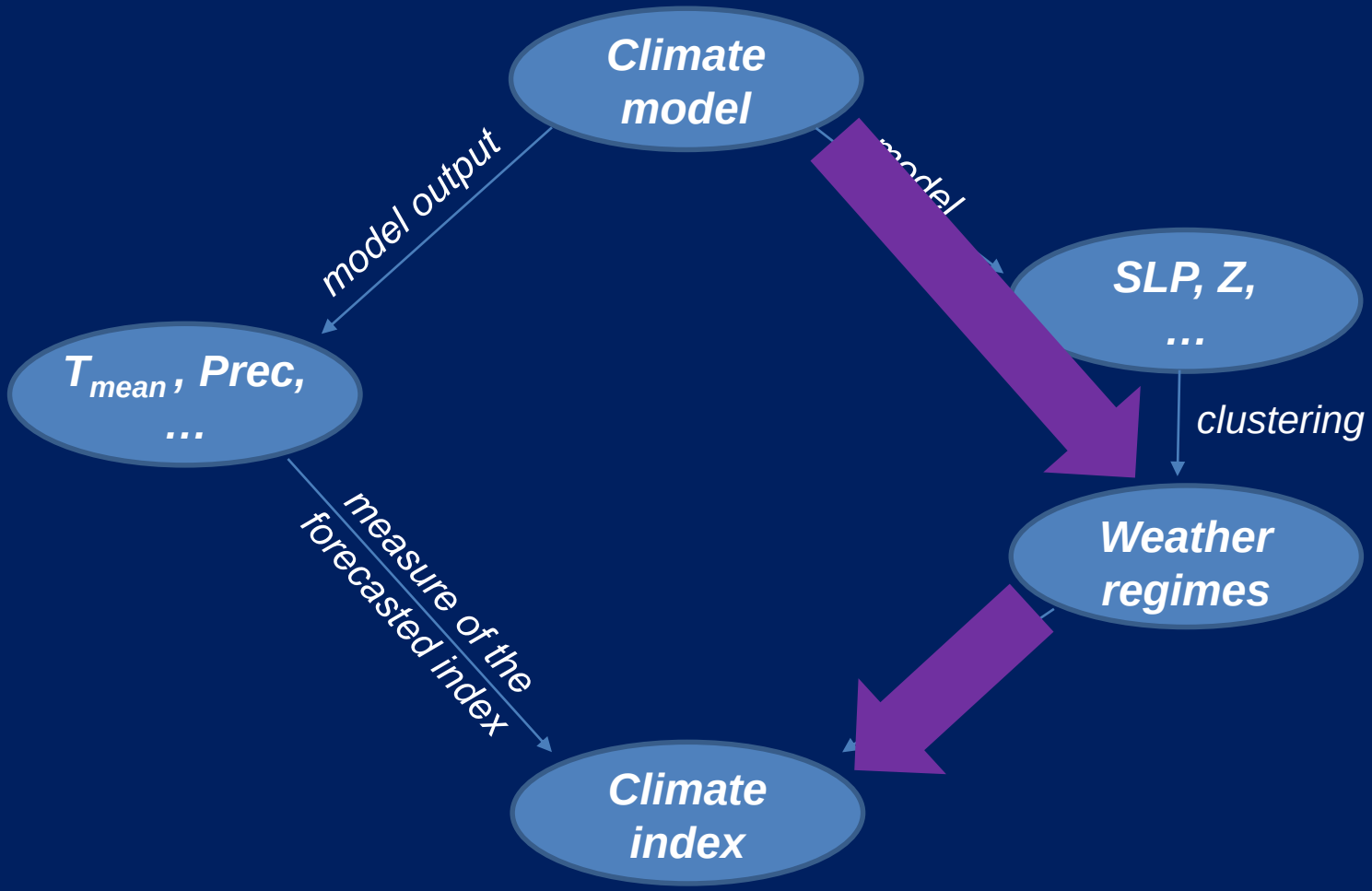
source: Lavaysse et al 2018 "On the use of weather regimes to forecast meteorological drought over Europe"

Forecast types, revisited



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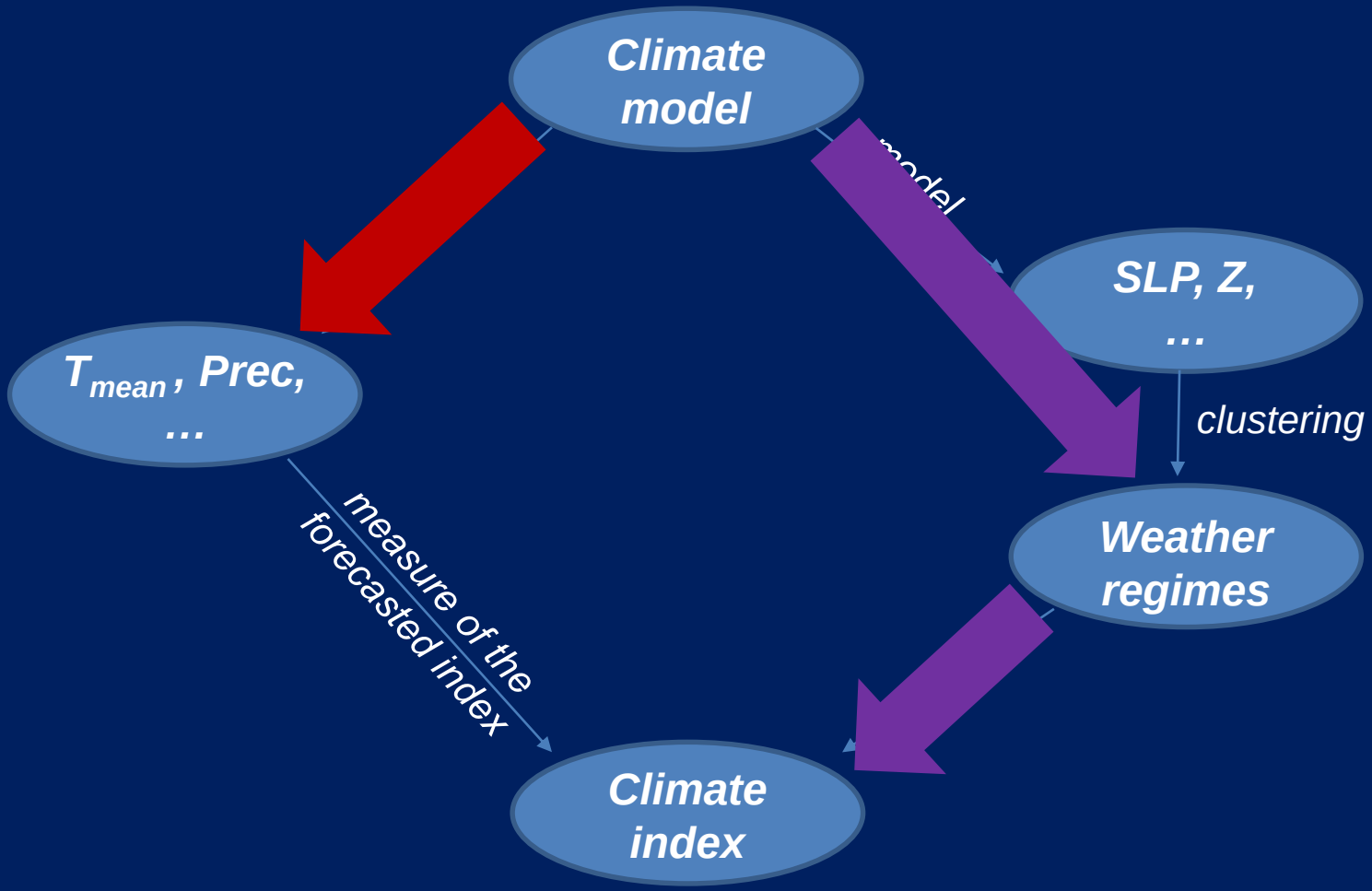
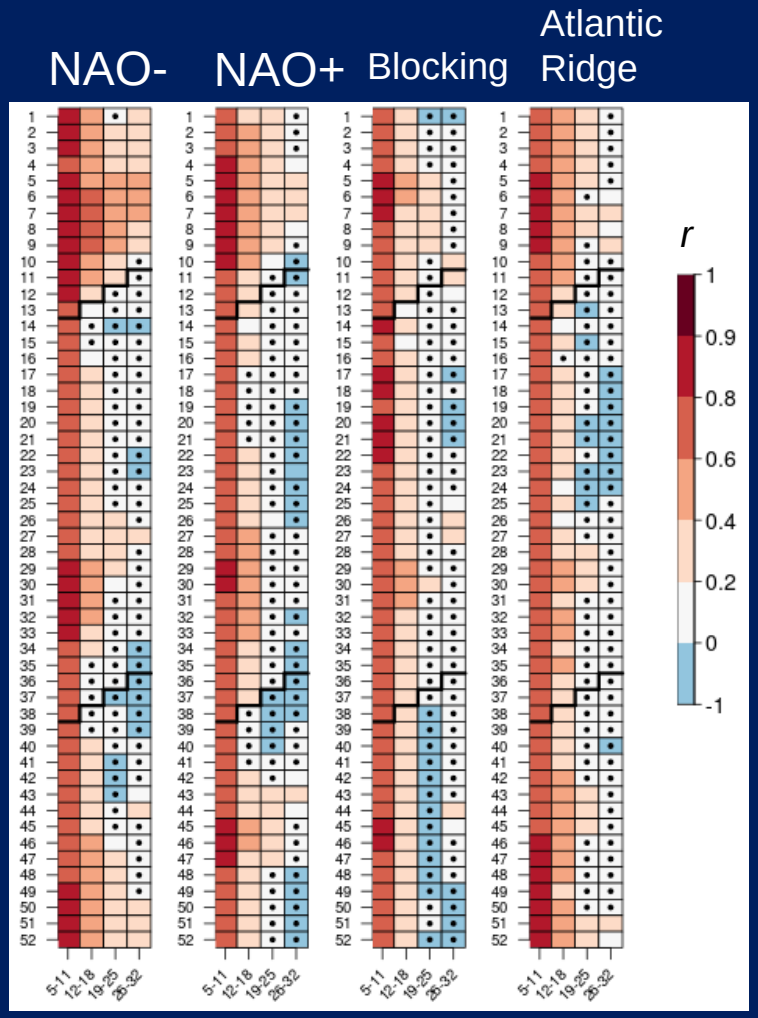
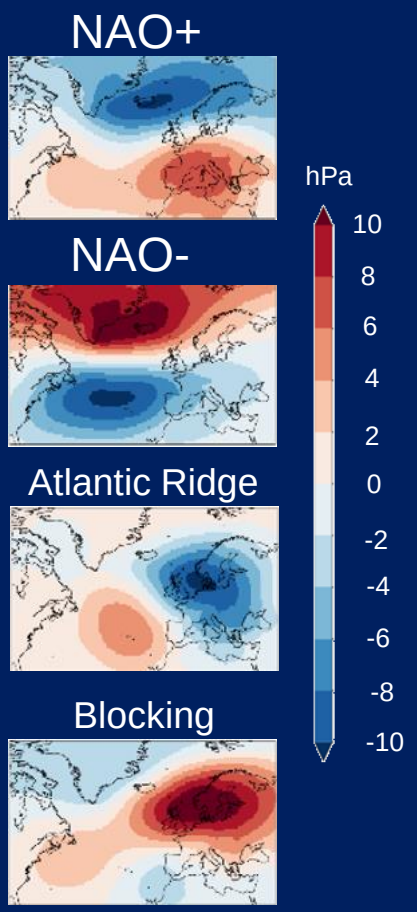


Model skill in forecasting weather regimes





Reference reanalysis: ERA-Interim
Hindcast period: 1998-2017
source: ECMWF-MFS (11 members, 30 km resolution)
Black points show non-significant correlations (for a t-test at the confidence level of 99%)

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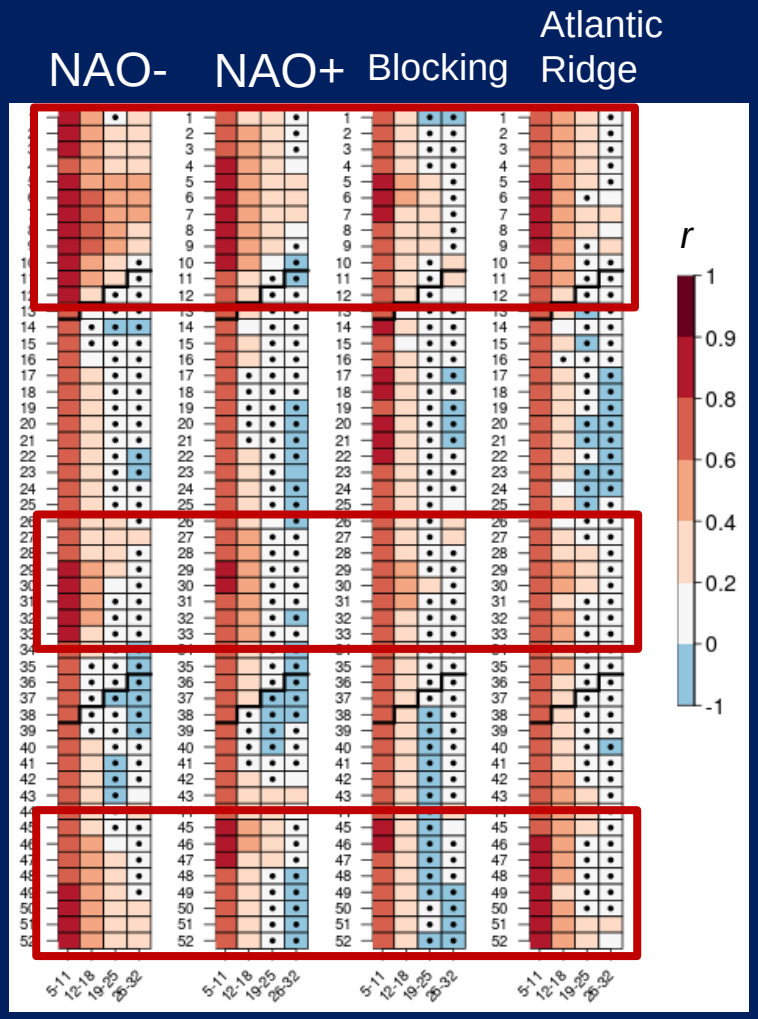

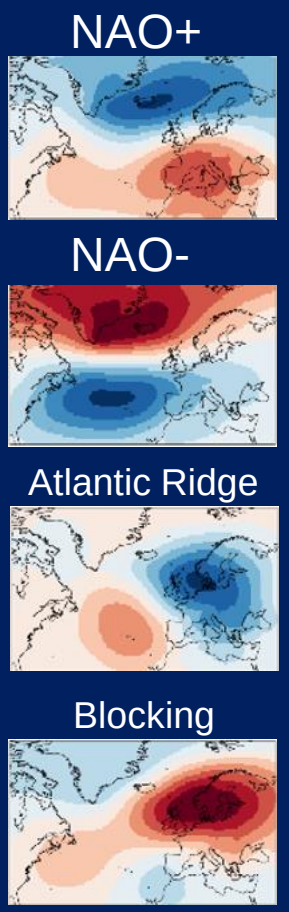

Forecast week (in days: 5-11, 12-18, 19-25 and 26-32)

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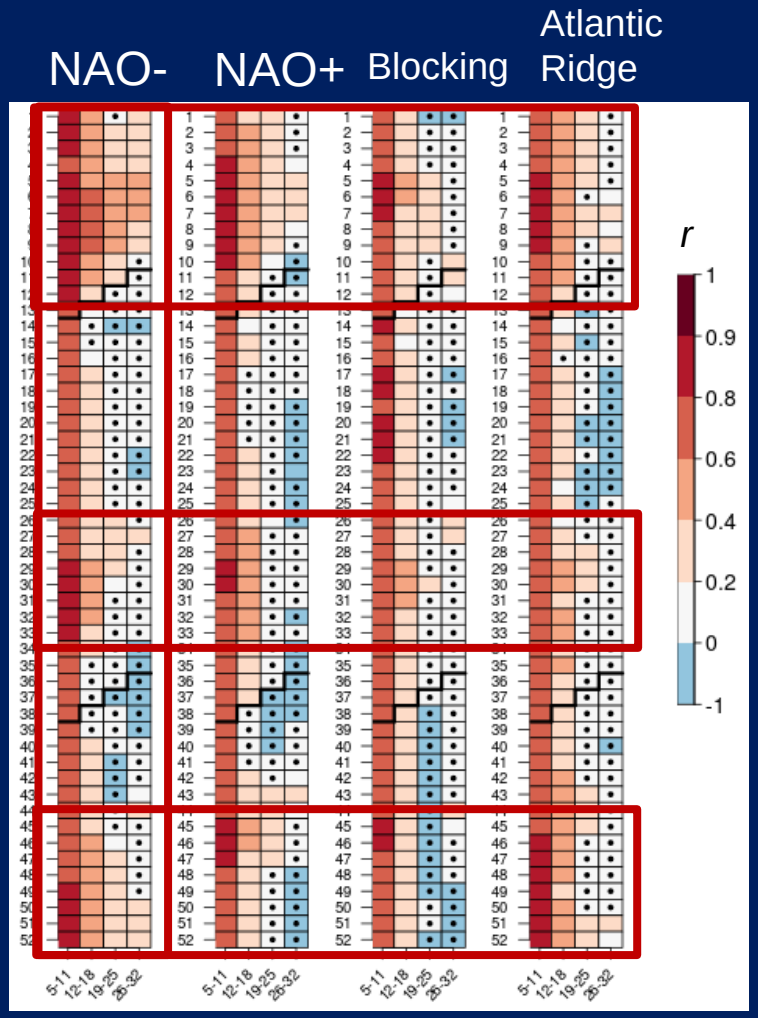

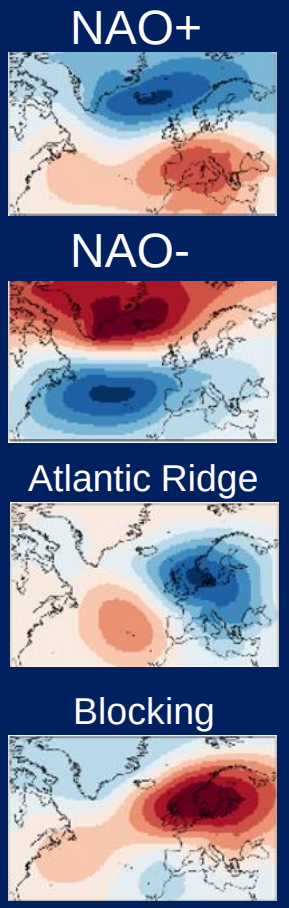

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Concusions

- At forecast week 1 (days 5-11), sub-seasonal correlation skill in Europe is quite high (always $r > 0.6$, even in summer weeks), so regime forecasts might be able to beat direct forecasts.

- At forecast week 2 (days 12-18) and beyond, model correlation skill is still to low (< 0.6), so the overall skill of WR in forecasting any climate index is expected to be low too and not to beat direct model forecasts.

- Start weeks of December, January, February and August are the only ones with correlation skill $r > 0.6$ also at forecast week 2, so they are the most likely start weeks when regimes might beat direct forecasts.

- Globally, NAO- is the regime with the highest skill, so indexes related to it are easier to forecasts with weather regimes.

References

- Ferranti L, Magnusson L, Vitart F, Richardson DS (2018) *How far in advance can we predict changes in large-scale flow leading to severe cold conditions over Europe?* Quarterly Journal of the Royal Meteorological Society 144(715):1788–1802, DOI doi:10.1002/qj.3341

- Lavaysse C, Vogt J, Toreti A, Carrera ML, Pappenberger F (2018) *On the use of weather regimes to forecast meteorological drought over Europe.* Natural Hazards and Earth System Sciences 18(12):3297–3309, DOI https://doi.org/10.5194/nhess-18-3297-2018

- Vigaud N, Robertson AW, Tippett MK (2018) *Predictability of recurrent weather regimes over north america dur ing winter from submonthly reforecasts.* Mon Wea Rev 146(8):2559–2577, DOI https://doi.org/10.1175/MWR-D-18-0058.1

- Matsueda M, Palmer T (2018) *Estimates of flow-dependent predictability of wintertime euro-atlantic weather regimes in medium-range forecasts.* Quarterly Journal of the Royal Meteorological Society 144(713):1012–1027, DOI https://doi.org/10.1002/qj.3265

- Neal R, Fereday D, Crocker R, Comer RE (2016) *A flexible approach to defining weather patterns and their application in weather forecasting over Europe.* Meteorol Apps 23(3):389–400, DOI https://doi.org/10.1002/met.1563

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Thank you!

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