ASPECT
FACILITATING SEAMLESS CLIMATE ADAPTATION

What can novel approaches towards seamless climate information further add to climate services?

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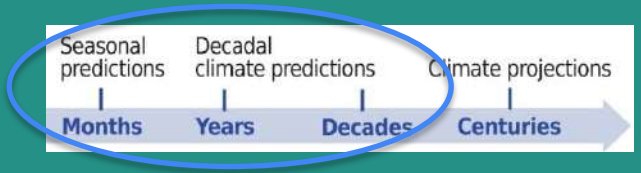


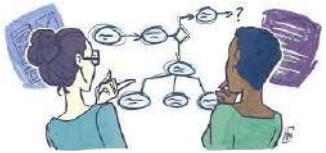
- **Seamless Climate Information**
- **Novel approaches: User-driven Downscaling and Temporal Merging**
- **Next steps**

Seamless Climate Information

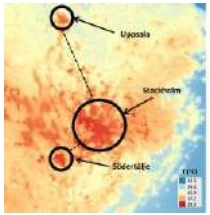
To create and evaluate

- actionable **climate information**, including extremes, **at high spatial resolution** using downscaling
- seamless climate information for adaptation using **temporal merging** techniques
- crucial for
  – assessing impacts
  – guiding adaptation at the regional and local level

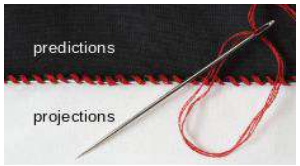
3 key components



- Integration of user needs and knowledge exchange : Codesign and Coproduction



- Downscaling : Event-based Dynamical and Statistical



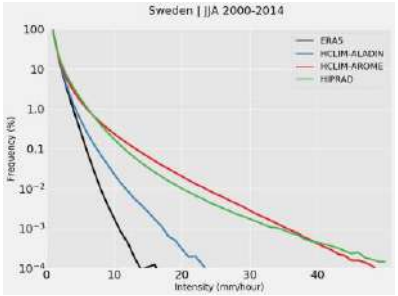
- Temporal merging : Stitching and Shadowing

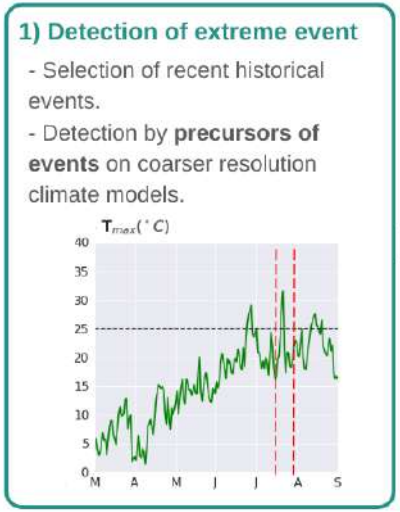
Event-based dynamical downscaling

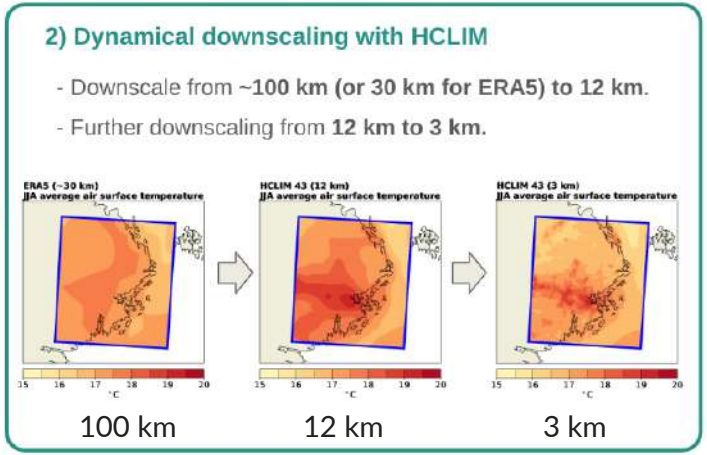
Key results

- The concept of EBD
  - Detection of an extreme event
  - Inexpensive model spin up
  - Dynamic downscaling of a short period, by a Convection Permitting Model

- First test case in the Stockholm region





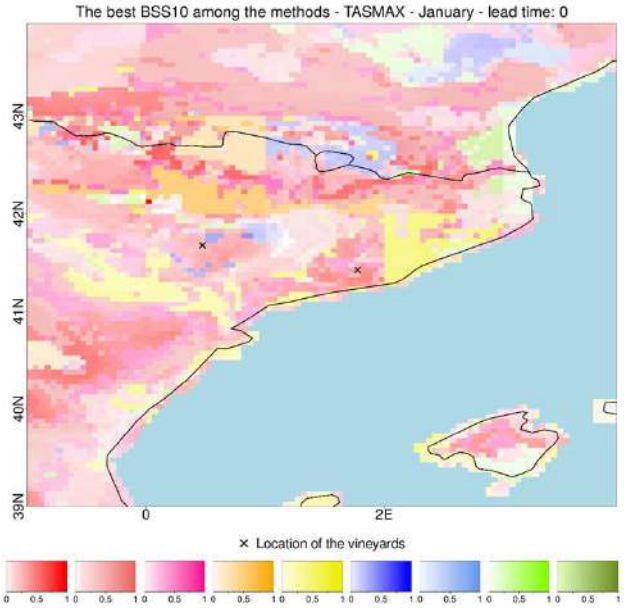


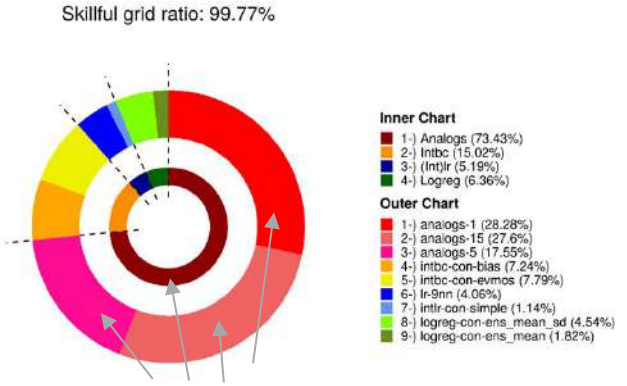
Wang et al., submitted

Statistical Downscaling

Key Results

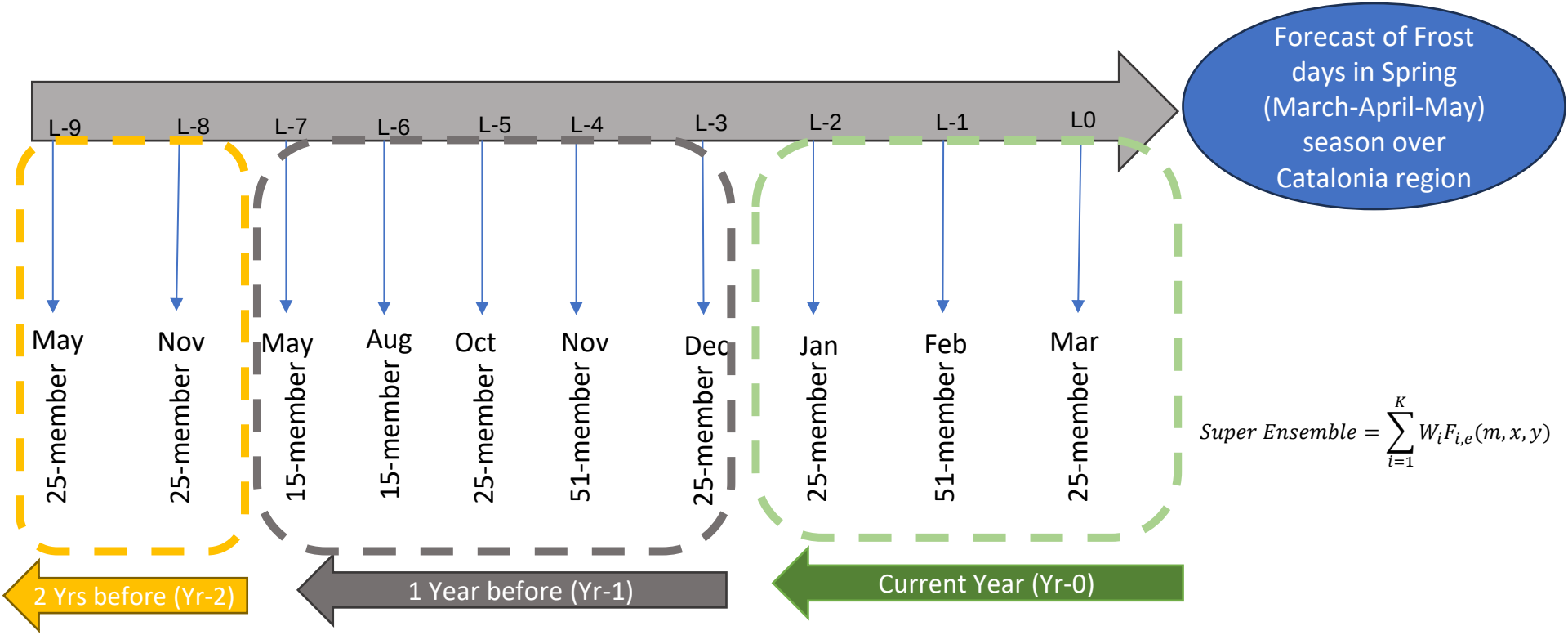
- **Seasonal**: **A robust statistical link** has been **found** between **March frost occurrence in Catalunya and atmospheric** drivers in the Euro-Atlantic region (*Sebastiano Roncoroni, Panos Athanasiadis, CMCC*)
- **Seasonal:** Performance of different methods suggests that **analogue methods perform by far best** (*BSC*)
- **Decadal**: Systematic analysis being completed for temperature and precipitation for Europe (*BSC*)





Eren Duzenli, Sara Moreno, Veronica Torralba, Carlos Delgado Torres (BSC)

Conceptual model of Temporal Merging



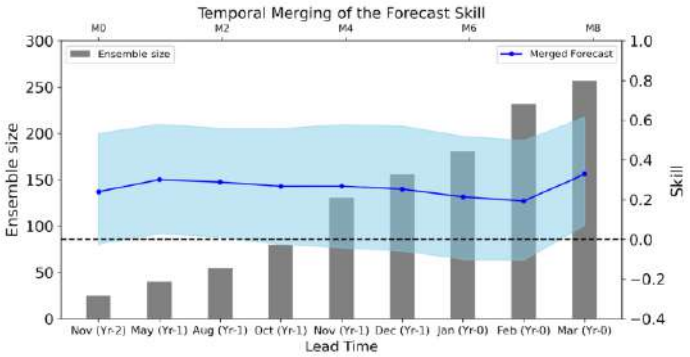
$$Super\ Ensemble = \sum_{i=1}^{K} W_i F_{i,e}(m,x,y)$$

This framework demonstrates the ECMWF-SEAS5 seamless system from seasonal to multi-annual timescales.

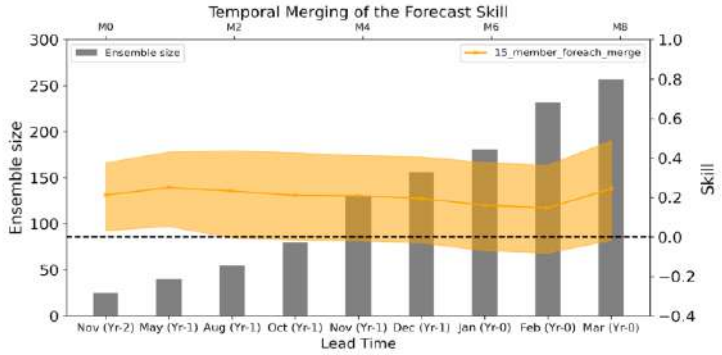
M. Adnan Abid, Beena Balan Sarojini, Antje Weisheimer (Univ of Oxford) (manuscript in prep)

Temporal Merging: Seasonal to multi-annual

- Temporally merged forecasts of Catalonian Frost Frequency Days with uncertainty (blue shading) at each merged step.

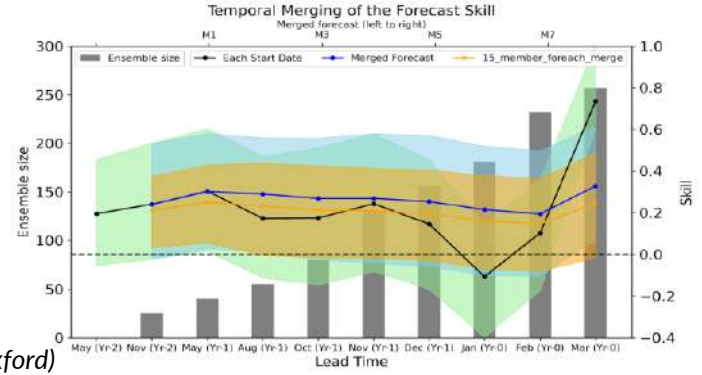


- Impact of Ensemble size on the forecast skill



- Comparing the skill of Merged forecasts to that of individual forecasts, a persistent skill is noted from previous May (Yr-1) in the merged forecasts.

- Also increasing ensemble size minimises internal variance, which has a positive feedback onto the forecast skill.

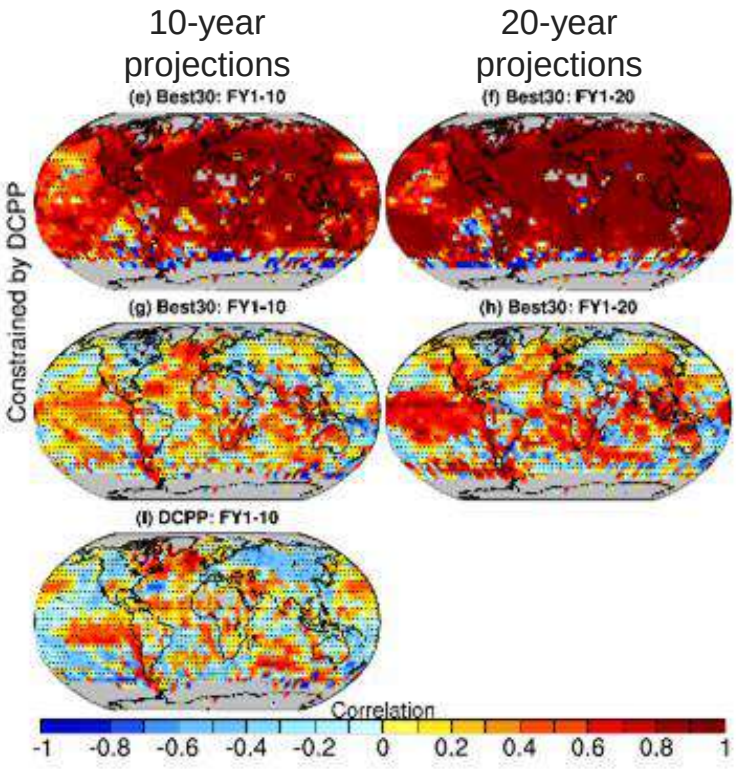


M. Adnan Abid, Beena Balan Sarojini, Antje Weisheimer (Univ of Oxford)
(manuscript in prep)

Temporal merging: Decadal to multi-decadal

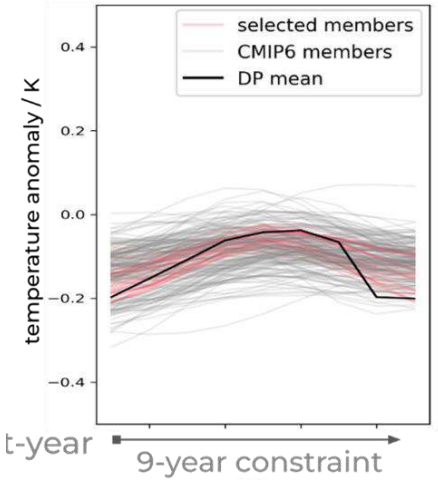
Anomaly correlation

Residual correlation *(measuring added value over the unconstrained CMIP6 projections)*



Donat et al. 2024 (BSC)

Applying the constraint to select the 30 (out of 311) CMIP6 ensemble members that are in closest agreement with the DCPP ensemble mean for the 5 years after initialisation.



From decadal to multi-decadal timescales

Pep Cos (BSC)

Temporal merging

Key Results

- Development of a **seamless climate prediction system prototype** to predict a regional extreme **spring frost frequency** for **Catalonian wine industry**, from **seasonal to multi-annual timescales** using a novel temporal merging technique (UOXF)

- **Publication** of three studies that develop and **evaluate the different constraining methods** (Cos et al 2024: Donat et al 2024 for large CMIP6 multi-model ensembles (>200 members), and apply the constraints to **improve near-term projections** of climate extremes (De Luca et al 2023) (BSC)

- Development of **user-friendly visualisation** of seasonal and decadal forecasts using **shiny apps** (BSC)

Next Steps

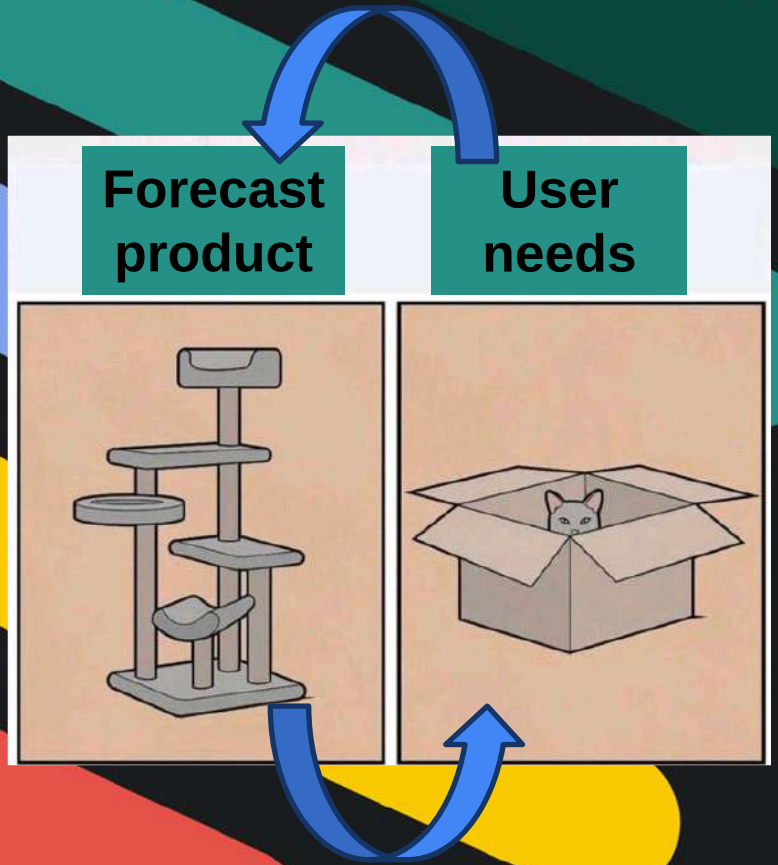
Temporal Merging

- To test the methods on very large single-model ensembles (~100 members) to a**void artificial effects** in merged/shadowing results
- Towards the **development of a multi-model merged product** in the seasonal to multi-annual time scale for Catalonian spring frost user need
- To explore the feasibility of **extending** the product **to multi-decadal time scales**
- To co-design and codevelop **temporally merged products for the Red Cross heat wave and Pension Fund case studies**

Next Steps

Downscaling

- To produce **prototype events of** heat waves and extreme precipitation for the **Emilia Romagna** region and develop km scale information for the governance case study
- To apply machine learning methods **to detect precursors of extreme events**
- To utilize the best methods for both decadal and seasonal forecasts to extract further information from the statistically downscaled data tailored to ASPECT case studies.
- To develop **multi-model products** for downscaled frost information for Catalonia



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