# Downscaling and biascorrection of seasonal climate forecasts

EURAC and ENEA



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#### The Added Value of Seasonal Climate Forecasting for Integrated Risk Management

Clear, operative and close to the users' needs climate information represents relevant a support tool for a wide range of decisionmaking policies, including risk management and energy production.



Local **General processes**  Tailored Information Replicable Users What do the users want? Tailored New products solutions Validation and **Building trust** assessment Tested by the users Tuning Do you like these services?

Seasonal forecasts (SF) provide predictions of the climate up to several months ahead and could support a wide range of activities, such as the optimization of renewable energy sector





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The spatial resolution of SF needs to be adapted to the local scales of specific applications. Especially over complex orographically areas, original predicted values could have relevant biases.



https://doi.org/10.1007/s00382-019-04640-4



A downscaling scheme was set-up to provide tailored seasonal forecasts of monthly temperature and precipitation to be applied for runoff prediction for hydropower production in case study 2



## 

#### The Added Value of Seasonal Climate Forecasting for Integrated Risk Management

### Downscaling workflow for seasonal forecasts







#1) Downscaling/Regridding: Bilinear interpolation





#### #2) Bias correction: Quantile mapping



https://www.meteoschweiz.admin.ch/home/service-undpublikationen/publikationen.subpage.html/de/data/publications/2018/11/exploringquantile-mapping-as-a-tool-to-produce-user-tailored-climate-scenarios-forswitzerland.html





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Evaluation of the mean monthly bias over all 25 members with respect to ERA-5 of monthly mean temperature and total precipitation SF over the period 1985-2014

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Results for lead times 1 (top) and 6 (bottom) are reported



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Could a different downscaling approach reduce the final seasonal forecast errors?

#### Anomaly-based scheme with linear interpolation

 $\bar{t}_m(x,y) = \alpha_m(x,y) + \beta_m(x,y) \cdot h(x,y)$ 

Interpolated long-term means using elevation as predictor and weights depending on geographical features

 $a_m(x,y) = \frac{\sum_j w_j(x,y) \cdot a_{m,j}}{\sum_j w_j(x,y)}$ 

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*Interpolated monthly anomalies* by weighted average approach depending on distance and elevation

 $t_m(x,y) = a_m(x,y) + \bar{t}_m(x,y)$ 

*Final fields* as superimposition of interpolated anomalies and long-term means



The mean bias of downscaled fields with respect to ERA-5 is lower by applying the anomaly-based (top) rather than the bilinear interpolation (bottom)







Could a different downscaling approach reduce the final seasonal forecast errors?

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# Case study 2

#### Mild/dry winter 2015-16 over Northern Italy.

The prolonged and strong drought caused a reduction of hydroelectric power production with an associated reduction of volume of sold energy





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Grant Agreement



# Statistical models may represent a valuable solution with respect to hydrological model:



Some proxy variables which are representative of all the variables can be selected. No need to estimate exactly each variable (i.e. catchment state, contribution in the forecast period variables)



Generally, the prediction function found using a statistical model cannot be extended to other catchments without re-fitting the statistical model









## Conclusions

- Seasonal forecast downscaled on ERA5 allow to train the runoff prediction model on ERA5 inputs
- For the selected case study the proposed method outperforms the runoff climatology:
  - for the **1-month lead time**, when the catchment state variables play a more relevant role
  - with a long enough training dataset (> ~15 years) for all the lead times (from 1 to 7 months)
- The use of the **seasonal forecast of the runoff** obtained with the proposed method can be employed to **improve the management of the basins**. This may lead to an **optimization of energy production** and an **increase of the overall profit**. An evaluation of the gains in these terms for the specific case study in Ulten Valley is currently under investigation in WP3

