LECCIONES APRENDIDAS DEL CO-DISEÑO Y CO-DESARROLLO DE SERVICIOS CLIMÁTICOS SECTORIALES BASADOS EN PREDICCIONES ESTACIONALES

LESSONS LEARNED FROM THE CO-DESIGN AND CO-DEVELOPMENT OF SECTORAL CLIMATE SERVICES BASED ON SEASONAL PREDICTIONS

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SUMMARY

Many applications of climate information, and in particular of seasonal predictions, are nowadays provided as climate services mainly designed to assist decision-making. These climate services frequently have in common the following features: i) support of decision-making process through customized products based, e.g., on mobile phone apps, websites, and other easily accessible platforms; ii) based on sound scientifically information and expertise; iii) appropriate engagement between the users and providers. The transformation of seasonal predictions into actionable information that can help in the decision-making process for those sectors affected by climate conditions frequently consist of a suite of steps starting from global model outputs and ending up with probabilistic forecasts for indicators defined by users. Figure 1 depicts schematically the main steps in a typical prediction-based suite (Máñez Costa et al. 2021).

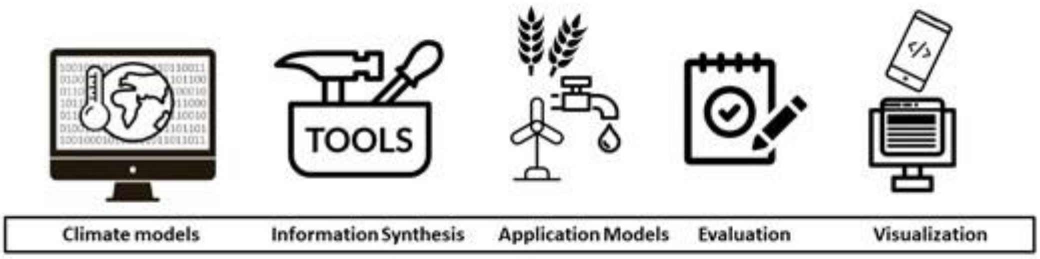

Figure 1- Diagram with a simplified climate services chain based on climate forecasts.

Once selected adequate climate model outputs, then a set of post-processing tools for synthetizing and correcting climate forecasts is applied such as bias adjustment (to correct systematic model errors), probability calibration (to make the forecasts reliable, i.e. match the issued probabilities with the observed frequencies), downscaling (to better represent unresolved spatial scales), combination and/or weighting of ensemble members (to deal with the different quality of systems and/or ensemble members) and mixed statistical-dynamical post-processing methods (to address problems of particular sectoral applications unmanageable by standard prediction approaches). Such tools are frequently collected in general purpose software packages. The next step is the use of application models driven by post-processed climate model outputs for converting climate data (e.g., precipitation, temperature, wind) into users' defined indicators (e.g., crop yield, dam inflow, wind energy capacity factor, etc.). Then probabilistic or deterministic relevant products (e.g., probability of exceeding a given threshold) are generated and displayed in a visual way. Specific packages are also developed for computation of sectoral indicators. Evaluation is conducted by computing objective verification skill scores for seasonal re-forecasts (usually covering between 20-30 years). This evaluation is typically carried out for user indices computed from re-forecasts. Finally, a friendly visualization of the selected indicators, jointly with their uncertainty and skill is crucial for an effective support in the decision-making process. As both skill and predictability vary considerably depending on the geographical area, the time of the year and the climate variable, "windows of opportunity" may enhance the usability of seasonal predictions for some users depending on the phenomenon, thresholds, and decisions involved. These “windows of opportunity” are related to the fact that at times certain influences/factors -if they are stronger and/or act in concert- may enhance predictability and skill. In such situations, signals in the forecast are likely to be stronger and the confidence in climate predictions may be greater than the average skill information would indicate. Consequently, additionally to using models with higher levels of skill many services should also focus on exploring how existing ‘windows of opportunity’ can be used to satisfy current users’ needs and inform their decision-making.

The role and contribution of users to each step is highly dependent on the nature of each step and on the service. Furthermore, the role of users can vary widely among different services during the cooperation process, ranging from a general collection of points of view to a more specific and structured co-design and co-development. All services should ideally be evaluated in a sufficiently long reforecast period computing deterministic and probabilistic skill scores to check the quality and usefulness of the service. Series of experiments leading to co-evaluate and unveil the origin of predictability and skill of different steps during the development of each service should be conducted. Ideally each step should enhance the generally limited skill of direct seasonal model outputs for midlatitudes.

A close relationship between developers and users of climate services along the life of the projects contributes to overcome some barriers in the development and implementation of climate services. Such barriers were in part related with the insufficient knowledge from users of the state-of-the-art seasonal forecasting capabilities/limitations and from the developers’ side of the specific user needs for addressing decision-making. Discussion sessions, workshops, and questionnaires involving developers and users’ communities facilitate a better knowledge of the essence of climate services development which should mainly rely on an optimal exploitation of scientific knowledge addressing specific decision-making problems. The core arguments of all discussions between developers and users were mainly the following: usage of user-relevant indicators instead of climatic variables to help in decision-making, probabilistic instead of deterministic forecasts to express and accommodate uncertainty, and identification of objective scores to determine the skill of the forecasts (Sanchez-Garcia et al. 2002).

It is important to underline that the co-design process is far from linear evolution. In fact, the main feature of this process is mainly iteration. Most prototypes only reach a mature state after several iterations involving different starting data, use of different tools to combine/correct/transform model outputs and different ways to display results in a satisfactory and understandable format, adequate for final users. Finally, it should be mentioned that the collaboration between developers and users established for the purpose of the project has in many cases resulted in a long-term collaboration beyond the project lifetime, including some form of institutional partnership or agreement. These long-term collaboration cases have been very fruitful and included frequent dialogue, capacity building, and a good understanding of user needs by developers as well as current limitations of climate science by users.

REFERENCES

Máñez Costa, M. et al. (2022): *Co-production of Climate Services*. CSPR Report No 2021:2, Centre for Climate Science and Policy Research, Norrköping, Sweden. https://doi.org/10.3384/9789179291990

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