

Summary and main outcomes of the

EURO-CORDEX Distillation Workshop

Thursday 25 January 2024, 2 - 6 pm, Chilehaus Hamburg

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Scope and Objectives of the Workshop

The workshop took place as a side event of the EURO-CORDEX General Assembly 2024 in Hamburg, taking advantage of the presence of numerous climate services providers involved in the EURO-CORDEX modeling community. The workshop's main objective was to bring together European (and beyond) climate service providers to review and discuss distillation issues when producing national climate scenarios and further scenario products.

In general, climate information distillation is not limited to data generation and data products. It also includes user aspects, user values and user interaction that need to be taken into account when translating information to users. These issues were addressed in parts of the workshop. Still, the focus was very much placed on the climate data aspect and followed these guiding questions:

What can we learn from contrasting evidence when designing climate scenario products and how can we best deal with it?

- Which are the most important challenges arising from multiple and partly contrasting data sources for establishing national/regional climate scenario products?
- How do different climate service providers approach these challenges?
- Is it possible to establish a 'best practices' guideline on how to handle multiple datasets and multiple lines of evidence in developing climate service products (one example being the design of global warming level based products)?

This workshop was above all an opportunity to get to know each other, build up connections between climate service providers and link with WCRP RIFS (Regional Information for Society).

Speakers and participants

A number of institutions/persons provided input in terms of a brief presentation on their particular distillation approaches or in terms of their overarching view on the distillation issue, guided by the following set of questions:

1. Which climate model ensembles do you include to provide your climate scenario products?
2. Do you also employ ESD approaches? If yes, how exactly do you combine GCM/RCM and ESD ensembles?
3. How do you take into account observed evidence / observations when designing your products?

4. How do you deal with potential inconsistencies between multiple data sources?

Speaker	Institution
Sven Kotlarski	MeteoSwiss
Karin van der Wiel (talk given by Sven Kotlarski)	KNMI
Rasmus Benestad	met.no / NORCE
Gustav Strandberg	SMHI
Claas Teichmann	GERICS
Nicolas Ghilain	RMI
Lola Corre	Météo France
Petr Skalak	CzechGlobe
Alfonso Hernanz, Esteban Rodriguez Guisado	AEMET
Nora Leps	DWD
Louis-Philippe Caron	Ouranos
Douglas Maraun	Wegener Center/Univ. Graz, IPCC
Bruce Hewitson	RIFS

About 20 further participants attended the workshop either in person or virtually.

Synthesis of Presentations

- **Overlaps and common approaches:** Considerable overlaps exist in the approaches of different climate service providers to tackle the distillation issue. Most providers use EURO-CORDEX regional climate simulations, along with some model selection process and statistical downscaling/bias adjustment. But also GCM-only approaches are represented (e.g., CzechGlobe).
- **Use of different data sources:** In most cases, only one ensemble of simulations is considered (mostly EURO-CORDEX). Several recent applications try to merge different ensembles, partly along the global or regional warming level dimension (KNMI, MeteoSwiss, Météo France). Observations are partly taken into account indirectly but not upfront. New convection-permitting ensembles are considered by some providers, either as a centerpiece or more or less only loosely connected to products derived from standard model ensembles.
- **Handling of contrasting/conflicting evidence:** This is a tricky issue for which no common strategy exists so far. Some groups employ model scaling methods to merge different climate model ensembles, putting a particular emphasis on one data source depending on the

application (and scaling other sources to the selected one).

- **Merging models and observations:** Observations are taken into account in different manners. Often, they are used as a reference for bias adjustment. Constrained AR6 estimates of future warming, which indirectly include observations, are used by several providers. For overlapping historical periods, observations and (bias-adjusted) model results are merged in single figures in order to provide long-term and “seamless” evidence of climatic changes. Some providers have noticed inconsistencies between EURO-CORDEX and observations or CMIP projections. CzechGlobe has chosen not to use EURO-CORDEX because of inconsistencies with observed trends. Meteo-France and MeteoSwiss use Regional Warming Levels (RWL) to “rescale” EURO-CORDEX projections.
- **Empirical-statistical downscaling:** Only few services actually run ESD schemes. DWD, for instance, complements the EURO-CORDEX ensemble by the EPISODES SD method. AEMET provides both gridded EURO-CORDEX data and station data based on ESD. The use of AI-based emulators is considered for future application by some providers.
- **Stakeholder integration:** Stakeholder integration and product co-design are considered by most providers, but no common strategy exists. Several providers already include storyline approaches or are planning to do so in the near future.

Summary of Discussion

The discussion block after the presentations highlighted a number of issues and challenges which are briefly summarized in the following:

1. **Types of data use:** In processing chain for climate service products, four different types of data usage can be distinguished:
 - a. Climate services based on a single ensemble of climate projections (CORDEX or CMIP).
 - b. Climate services based on different climate projection ensembles, used separately for different applications.
 - c. Climate services based on a combination of several datasets, including ensembles of climate projections but explicitly also observations.
 - d. Climate services based on a small number of high-resolution simulations, including information on how these ensembles compare with reference multi-model ensembles (CMIP and CORDEX).
2. **Sources of information:** A decent consideration of different sources of information is key. These can include observational evidence (e.g., observed historical trends), climate model simulations (eventually downscaled), process understanding, existing literature, local knowledge etc. In the distillation process, differences (or conflicting evidence) in these data sources need to be explained as far as possible! Based on such an assessment, it is often possible to select some data sources for a given user application and to downweight others (fit-for-purpose discussion). Conflicting/contrasting evidence might hence be explainable and arguments might be available for excluding certain data sources for a given application and to thereby reduce uncertainties. Different ensembles can (and should?) serve different purposes. A remaining challenge is to ensure maximum consistency between different user

products at the same time. Note: Sometimes, observations alone can be used to communicate climate change and to raise awareness.

3. **Stakeholder involvement:** Involving relevant stakeholders in the design of scenario products and in the distillation process is highly valuable and highly recommended.
4. **Commonalities in climate services processing chains:** An attempt to synthesize the approaches followed by different climate service providers resulted in the following schematic figure which includes many of the presented approaches:

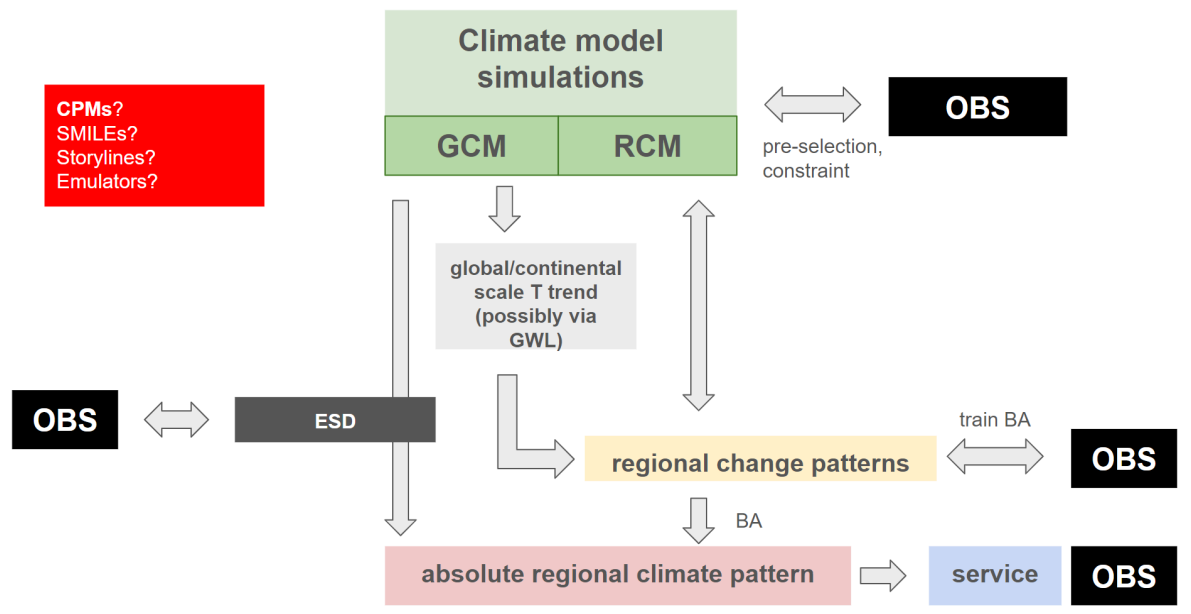


Figure 1: Processing chain of climate information as employed by a number of climate service providers. OBS: observations. CPMs: convection permitting ensembles. ESD: empirical-statistical downscaling. BA: bias adjustment. GWL: global warming level.

Next Steps

The final discussion block was centered around the question of how to move on with the distillation topic after the workshop. The following possibilities were suggested:

Shared tools

- Establish a [main landing page](#) to collect references to resources (existing data, portals, guidelines, papers, ...), also naming specific contact persons both at (EURO-CORDEX) level at the level of individual climate service providers/institutions.
- Establish a [distillation mailing list](#) to distribute relevant information → should be open to all interested colleagues whether active in (EURO-) CORDEX or not

Future meetings of the Distillation group

- Regular (3 mo) [online meetings](#) focused on particular topics (ESD, conflicts,...).

- EMS 2024 (Barcelona): Climate services session and/or a specific (but very informal) side event, eventually in hybrid mode.

Links with other initiatives

- WCRP/RfS Expert Meeting on the Robustness of Climate Change Information for Decisions: April 22-24, Brussels, on invitation, ~70 participants → on-site participation of Lola Corre, online participation of Sven Kotlarski. Objectives (among others)
 - Review the **current status** of assessing climate information robustness
 - Establish a sustained cross-cutting dialogue for the purposes of **developing a (white) paper** that articulates the cross-community perspectives, the ethical and epistemic issues, and the research challenges proportional to the participating communities¹
 - Identify and outline potential **new research actions** required to move the community forward in managing the non-congruence of data streams and associated uncertainty
 - Establish a **writing team** to scope and develop an evolving “distillation guidance” on how to best use the diversity of data streams based on current knowledge.
 - Propose a **framework** to facilitate the coordinated response across the WCRP with relevant external partners and foster a community of practice for collaboration
- EGU 2024 Townhall Meeting “Information for society: from CMIP to decision makers” (April 14-29, Vienna): Online participation of Sven Kotlarski. <https://cordex.org/wp-content/uploads/2024/03/EGU-flyer-information-for-society-pdf.jpg>

WCRP programs tasked with supporting the production and use of climate data are interested in understanding the range of practices employed by the EGU community to produce information for society based on climate science.
- Coordination with ECRA (European Climate Research Alliance, <https://ecra-climate.eu/>): ECRA aims to strengthen, expand and optimise EU climate research capabilities through the sharing of world-class national facilities in Europe and the collaborative realisation of pan-EU programmes (see ecra-climate.eu). Experts from ECRA could also provide guidance on what knowledge and climate information should be used and how?
- White paper on the distillation aspect as a long-term perspective.