

REQUEST FOR A SPECIAL PROJECT 2026–2028

MEMBER STATE: Austria

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Project Title: High resolution regional reanalysis ensemble for Austria

To make changes to an existing project please submit an amended version of the original form.)

If this is a continuation of an existing project, please state the computer project account assigned previously.	SP	
Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.)	2026	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for project year:	2026	2027	2028
High Performance Computing Facility [SBU]	80 M	20 M	20 M
Accumulated data storage (total archive volume) ² [GB]	50.000	80.000	110.000

EWC resources required for project year:	2026	2027	2028
Number of vCPUs [#]	70	70	70
Total memory [GB]	350	350	350
Storage [GB]	25000	25000	25000
Number of vGPUs ³ [#]	0	0	0

Continue overleaf.

¹ The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide annual progress reports of the project's activities, etc.

² These figures refer to data archived in ECFS and MARS. If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year etc.

³ The number of vGPU is referred to the equivalent number of virtualized vGPUs with 8GB memory.

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Extended abstract

All Special Project requests should provide an abstract/project description including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used. The completed form should be submitted/uploaded at <https://www.ecmwf.int/en/research/special-projects/special-project-application/special-project-request-submission>.

Following submission by the relevant Member State the Special Project requests will be published on the ECMWF website and evaluated by ECMWF and its Scientific Advisory Committee. The requests are evaluated based on their scientific and technical quality, and the justification of the resources requested. Previous Special Project reports and the use of ECMWF software and data infrastructure will also be considered in the evaluation process.

Requests exceeding 5,000,000 SBU should be more detailed (3-5 pages).

Reanalysis products are a cornerstone of modern climate science, enabling a physically consistent reconstruction of past atmospheric states by assimilating diverse observational datasets with the numerical weather prediction model output. This special project proposal is requested to extend the ARA dataset created within the framework of High-resolution Austrian Re-analysis ensemble with AROME (ARA) project that was funded by Austrian research promotion agency (FFG) under the Austrian Space Application Programme (ASAP). The work done within the framework of ARA project has successfully delivered Austria's first high-resolution (2.5 km) reanalysis ensemble dataset, covering the period 2012–2022, using the AROME (Seity et. al. 2011) model and a 3DVAR assimilation system within the C-LAEF (Wastl et. al. 2021) framework.

This proposal seeks to continue and expand ARA's scope, by extending the dataset temporal coverage from 2022 – 2028. Thereby, bridging a critical gap in Austria's climatological record and supporting other national research initiatives like the TEAMx (Transport and Exchange processes in the Atmosphere over Mountains - programme and experiment; Rotach et al. 2022) Observational Campaign (TOC) as well as impact modelling activities focusing on recent historical flooding events e.g. September 2024. The proposed extension maintains the project's foundational principles— i.e. paving way to higher spatial resolution, providing ensemble uncertainty quantification, and assimilation of diverse observational sources, and proposes technical refinements and enhanced stakeholder engagement for more targeted impact.

The updated dataset will be crucial for validating new generations of regional climate projections (e.g., CMIP6 downscaling), supporting high-resolution impact modelling (e.g., hydrology, energy systems), and contributing to the next release of Austria's national climate dataset (OKS2025). In addition to supporting scientific excellence, the extended ARA dataset will ensure sustained benefits for stakeholders in weather risk management, agriculture, insurance, and renewable energy sectors.

1. Scientific and Technical Background

The original ARA project laid the groundwork for high-resolution reanalysis by successfully deploying a 11-member ensemble based on the AROME model at 2.5 km spatial resolution. This approach incorporated 3DVAR assimilation using diverse observation types, including GNSS, satellite, aircraft, and radiosonde data. Verification against WegenerNet and INCA demonstrated the system's high fidelity.

The engagement with the stakeholder's and end user's within the project has been very fruitful. There is a growing demand from TEAMx and impact modelling community for ARA data for understanding and analysing the ARA data. Since within the framework we have only simulated 10 years (2012-2022), and the stakeholder's have highlighted the need for extending regional

reanalysis as 10 years is considered as a short period in typical climate sense. Moreover, the era post-2022 has already featured a series of climate anomalies (e.g., extreme rainfall events in 2024, heatwaves in 2022–2024), highlighting the critical importance of up-to-date high-resolution datasets for understanding the underlying physical processes, impact modelling and climate adaptation strategies.

Internationally, regional reanalysis initiatives like COSMO-REA6, UERRA, and SPHERA are also extending temporal coverage to capture recent years. ARA must follow suit to remain aligned with these benchmarks and support Austria's commitments to European climate services (e.g., Copernicus C3S, EUMETNET).

2. Objectives, milestones and deliverables

2.1 Main Objective

To extend the Austrian high-resolution reanalysis dataset (ARA) up to 31 December 2028, ensuring physical, spatial, and temporal consistency with the existing ensemble and providing additional uncertainty quantification for the extended period.

2.2 Specific Milestones

- Create boundary forcing from ERA5 to include 2022–2028.
- Collecting and quality control observations from all sources used for the assimilation process.
- Reconstruct high-resolution essential climate variables (ECVs) for 2022-2028 for the complete 11-member ensemble.
- Archiving the ECVs on MARS and make it publicly available via C3S, and Geosphere Datahub.
- Evaluate model skill against observations (e.g., INCA, SPARTACUS, WegenerNet).
- Contribute to operational applications including EFI generation and OKS2025 updates.
- Early and continuous engagement of stakeholders.

2.3 Deliverables

- 11-member regional reanalysis ensemble dataset for Austria.

3. Innovation and Added Value

The extension introduces several innovations:

- By extending the reanalysis to 2028, the project ensures relevance for the upcoming CMIP6 regional climate evaluation cycle, the 6th Austrian Assessment Report (Österreichischer Klimabericht), and post-COVID climate baselining.
- This proposal will not only help GSA to extend this high value dataset, it will also make it possible to collaborate with the TeamX TOC initiative.
- We are planning user centric validations together with national universities and research institutes. This will help us to exploit the potential of this high-value dataset and improve GSA contribution in understanding of physical processes relevant for the European Alpine region.

4. Impact and Exploitation

The extended dataset will significantly enhance Austria's capacity for:

- Climate Monitoring: Enable statistics for 2012–2028 with sub-daily resolution, supporting OKS2025.
- Early warning for Extreme Events: Creation of Extreme Forecast Index (EFI) will help the forecaster to improve Austrian early warning system.
- Operational Forecast Evaluation: Validate new versions of AROME and C-LAEF in real-time NWP.
- Sectoral Uptake: Used in renewable energy (wind, solar forecasts), agricultural planning, and insurance risk modelling.
- Data products will be made available via GSA Data Hub, and promoted in collaboration with ECMWF, and Copernicus C3S for international exposure.

5. Feasibility and Risk Mitigation

With well-defined milestones and extensive prior experience, the ARA extension is both scientifically sound and operationally feasible. The project benefits from a matured and tested technical infrastructure. GSA have prior experience in long-term simulations, ensemble processing, and stakeholder collaboration. The two risks are delays in ERA5 update or computational breakdowns causing delays in production of reanalysis.

Table 1. Expected computational resources usage

Computational resources / day	Expected usage
Total SBUs / day	85000 SBUs
LBC DATA produced / day	1.4 TB
Model data produced / day	5.5 TB
Data archived at MARS / day	240 GB

References

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