REQUEST FOR ADDITIONAL RESOURCES IN THE CURRENT YEAR FOR AN EXISTING SPECIAL PROJECT

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MEMBER STATE: Italy

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Address: Via Rubattino 54, 20134 Milano, IT

Project title: WRF-based high resolution numerical weather simulations to complete the extension of the new Italian Wind Atlas

Project account: **spitsper**

Additional computing resources requested for year		**2025**
High Performance Computing Facility	[SBU]	11,000,000
Total DHS Data storage capacity	[GB]	11,000
EWC resources		
Number of vCPUs	[#]	
Total memory	[GB]	
Storage	[GB]	
Number of vGPUs[3]	[#]	

Continue overleaf

[1] The Principal Investigator is the contact person for this Special Project

Technical reasons and scientific justifications why additional resources are needed

The new Italian Wind Atlas - Atlante EOLico ItaliANo (AEOLIAN) [1] is a tool aimed at determining the best locations for wind energy turbines. It has been developed to support institutional authorities in planning the use of local resources, to assist regulatory authorities in the proper development of the electricity grid, to support producers in wind energy turbine siting and to evaluate cases of lost wind power production due to curtailments. AEOLIAN has been carried out as a collaboration effort between RSE and the National Center of Atmospheric Research (NCAR), which provided additional scientific support and computational resources.

AEOLIAN provides 30 years (1990-2019) of wind speed data across Italy, including marine areas. It features a horizontal grid spacing of 1.33 km and provides hourly data outputs. The Atlas integrates a 2-grid dynamical downscaling of the ERA5 global reanalysis fields using the WRF model [2] with a statistical approach based on the Analog Ensemble (AnEn) [3] technique. These two methods have been used together to temporally extend high-resolution weather model data only available for the most recent 5 years (2015-2019) to an additional 25 years further in the past (1990-2014) using coarser mesoscale model runs [1]. Observational nudging on both domains has been activated using surface synoptic observations (SYNOP) of 2-m temperature, which are available for the entire 30-year period of this study. Also, observations of 10-m wind collected by the Regional environmental agencies (ARPAs) that include about 300 stations across Italy and a set of selected surrounding marine locations have been used for observational nudging on the fine- resolution grid because of their limited availability with time, becoming more abundantly available only after 2010.

The resources granted for the “spitsper” late request projects 2024 and 2025 allowed extending AEOLIAN for the years 2020-2023 and half of 2024. Due to some technical issues which made necessary to re-run the WRF-model for a few months, more resources than expected were consumed. Hence, the aim of this request is to complete the extension of AEOLIAN for 2024, to have the most recent 10 years (i.e., 2015-2024) of numerical-based simulations, allowing more robust considerations for planning and supporting decision-makers with an updated tool that considers the most recent wind conditions affecting the Italian territory.

Also, considering validating the performance of AEOLIAN not only on wind speed, additional focus is set on comparing surface weather variables different than wind (i.e., 2-m temperature and precipitation) with another high-resolution dataset developed in RSE, MERIDA-HRES [4], aiming to highlight the improvement given by the higher resolution of AEOLIAN. To this aim, MERIDA-HRES needs to be extended to the end of 2024, being currently available up to March 2023.

This request for additional resources aims then to complete the extension of both AEOLIAN and MERIDA-HRES, thus allowing to perform robust comparison statistics on additional surface weather variables, other than wind, between the two datasets over the whole 10-years period of 2015-2024.

The 11M SBU required to conclude the project are calculated as follows:

- A single, 2-day AEOLIAN run submitted as a parallel job requires about 100’000 SBU, while a single, 2-day MERIDA HRES run requires 10’000 SBU
- 75 runs are required to complete the year 2024 of AEOLIAN and 317 runs for the years 2023/2024 of MERIDA HRES.
- Each AEOLIAN run requires a disk storage of about 100 GB after cleaning of unnecessary files, which become about 10 GB for each MERIDA HRES run.

1. Sperati S, Alessandrini S, D'Amico F, et al. A new Wind Atlas to support the expansion of the Italian wind power fleet. Wind Energy. 2024; 27(3): 298-316. doi:10.1002/we.2890.
2. Skamarock, W., Klemp, J., Dudhia, J. A description of the Advanced Research WRF Version 3. Tech. Note NCAR/;475;2008.

3. Delle Monache, L., Eckel, F.A., Rife, D.L., Nagarajan, B., Searight, K. Probabilistic weather prediction with an analog ensemble. Mon Weather Rev. 2013;141(10):3498-3516. doi:10.1175/mwr-d-12-00281.1
4. Viterbo F, Sperati S, Vitali B, D'Amico F, Cavalleri F, Bonanno R, & Lacavalla M. MERIDA HRES: A new high-resolution reanalysis dataset for Italy. Meteorological Applications. 2024; 31(6), e70011. https://doi.org/10.1002/met.70011