ENANDES and ENANDES+ Projects

Enhancing Adaptive Capacity of Andean Communities through Climate Services in Chile, Colombia, Peru (ENANDES), and Argentina, Bolivia, Ecuador (ENANDES+)

Activity: Co-development of National Renewable Energy Atlases in South America

Deliverable N°1: Methodology update report and updated codes, factsheet and HTML templates, country needs assessment, and workplan

History of draft preparation and review

V1.0- Initial draft by Sara Dal Gesso and Alessandro Moser	01/04/2026
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Deliverable 1: Methodology update report and updated codes, factsheet and HTML templates, country needs assessment, and workplan

WMO ENANDES Project Consultancy: Co-development of National Renewable Energy Atlases in South America – ENANDES and ENANDES+ countries

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Introduction

The High-Resolution National Renewable Energy Atlas for wind, solar, and hydropower initiative (NRA) is a pioneering initiative launched by the World Meteorological Organization (WMO) in response to the Members 'need for high-quality, high-resolution data on renewable energy resources in a changing climate. The initiative aims to support countries in advancing towards climate-resilient energy transitions by providing robust, decision-ready information. It addresses the gaps identified in the WMO Energy Survey of 2022, which revealed that many National Meteorological and Hydrological Services (NMHSs) either have outdated national atlases or lack essential climate projection data in their existing atlases.

During its first phase (2024), the initiative was implemented in Chile, Iran, Malawi and Costa Rica, resulting in a comprehensive implementation guideline and open-source codes[1]. During its second phase (2025), the methodology was refined to integrate satellite data, in collaboration with the German Weather Service (DWD), and extended to support Tanzania, Cuba, and Croatia received in co-developing their atlases.

Building on the successful outcomes of the first two phases of the WMO Renewables Atlas initiative, the WMO ENANDES+ Project[2] decided to take this unique opportunity to address similar existing gaps across the participating countries in South America. This new phase will draw on the technical expertise and data resources of the WMO Regional Climate Prediction Centres where applicable, namely the RCC–Western South America (RCC–WSA) hosted by CIIFEN in Ecuador, and the RCC–Network for Southern South America (RCC–Network–SSA).

The primary goal of the current phase of the initiative under the ENANDES project (phase 3 of the WMO NRA initiative) is to build on previous phases to co-develop national atlases for wind, solar, and hydropower resources in South America. With the goal of empowering NMHSs with the necessary resources to develop and maintain high-resolution national atlases that incorporate current data and future climate projections, the present phase will expand the portfolio of tools developed in the previous ones. Specifically, the general methodology will be adapted to the data availability of the pilot countries, and operational optimisations will be implemented to ensure a continuous refinement and advancement. Furthermore, the accessibility of the information will be enhanced through the development of dedicated factsheet and an interactive webpage.

Developed methodology under the previous phases and identified areas for improvement

The methodology employed in the WMO NRAs has been extensively described in "National Renewable Energy Atlases for Wind, Solar and Hydropower – WMO Implementation Guidelines" (2026)[3] and in the following scientific article published in Climate Services: From global data to

[1] https://energymeteorology.info/reatlas/
[2] https://wmo.int/activities/projects/project-portfolio/enandes-building-regional-adaptive-capacity-and-resilience-climate-variability-and-change-vulnerable
[3] https://library.wmo.int/idurl/4/69779

local action: *A participatory framework for national wind, solar, and hydropower atlases based on observations, climate projections and artificial intelligence, Petitta et al*. (2026)[4].

In the following two infographics that summarise the developed methodology for wind, solar and hydropower atlases are provided.

Fig. 1_a)

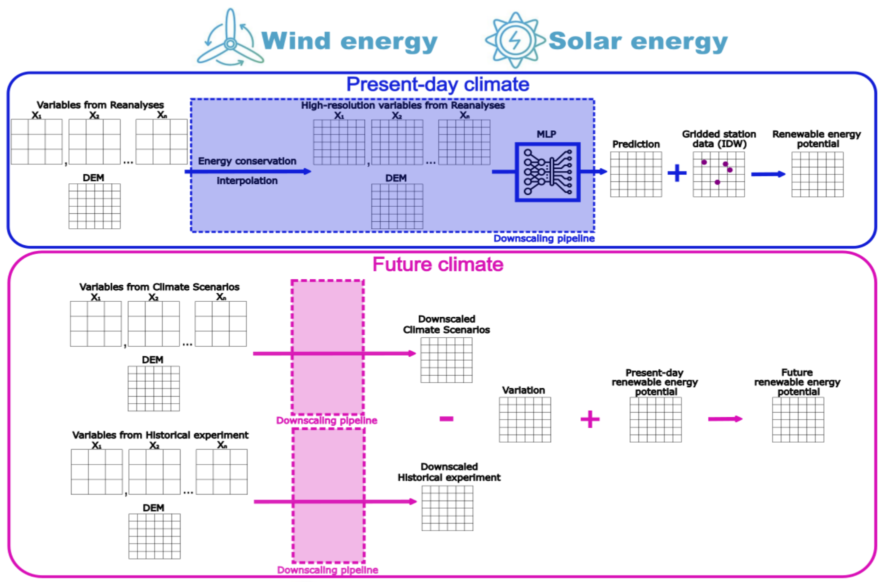
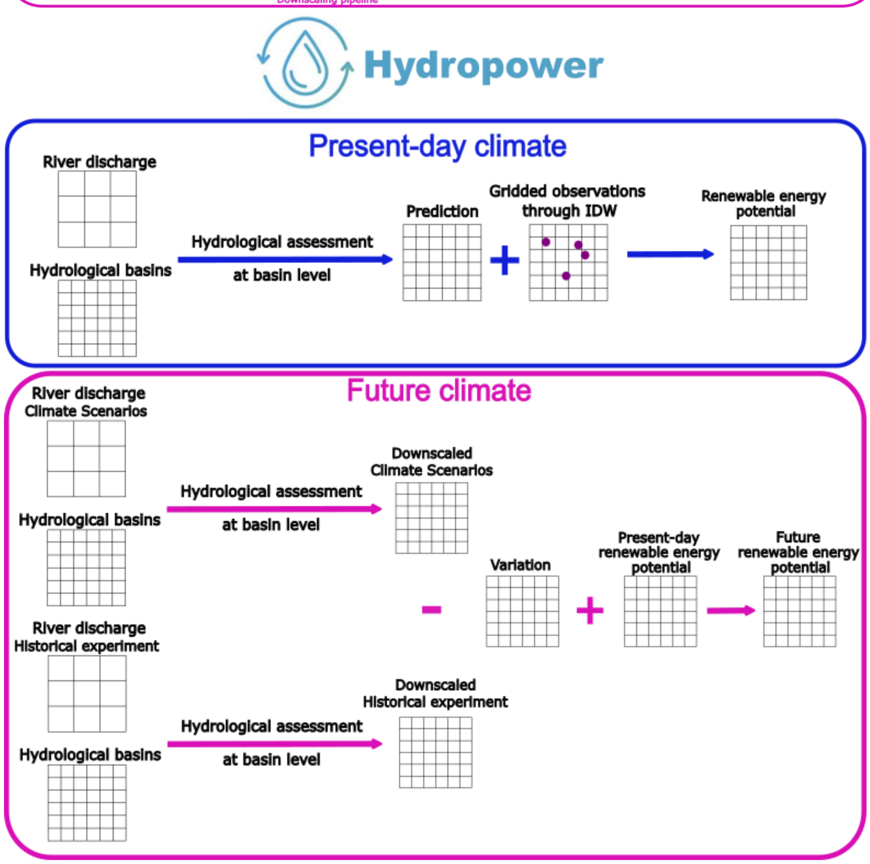


Fig. 1_b)



[4] https://doi.org/10.1016/j.cliser.2026.100663

As it can be seen in the figures (1_a) wind and solar, and 1_b) hydropower), the foundation of the NRA methodology is built on reliable and accessible data sources. Such datasets might differ greatly in nature and characteristics. In particular, the hydropower atlas (1_b) incorporates GloFAS data[5], that are at river-level with a horizontal resolution of 5.5 km, and CMIP6 river discharge variable, which is a gridded dataset with 100 km resolution. The delta between future climate projections and present-day values are downscaled using a Multi-Layer Perceptron (MLP) Neural Network (NN) model, clipped over the river basins, and finally aggregated over the considered basins and sub-basins. The great differences in the dataset characteristics might result in unnaturally high values of the variation between present-day and future climate.

With the objective of obtaining high-resolution NRAs, datasets with the highest resolution of the original grids have been selected, i.e. ERA5Land was selected over ERA5. Based on the collected feedback from the participating countries during the previous phase of the NRA project, it has been highlighted that locations along the coasts, that are favourable for wind energy production, might be not covered by ERA5Land data, hence limiting the application of wind NRAs. Similarly, the satellite data used in previous phases of the initiative are not applicable to South America to calculate solar energy atlases. In fact, the current phase exploits regional satellite observations, i.e. CERES dataset, and the integration of available data from the WMO RCC–WSA and RCC–Network–SSA, is under evaluation through direct communication with the responsible staff. Furthermore, the method for wind atlases is limited to the two meteorological standard heights for wind speed, i.e. 10m and 100m. However, wind turbines could reach different heights, and detailed information could be a significant added value.

The developed methodology under the previous phases is flexible enough to be fed with more datasets. Some datasets have already been identified for potential consideration. CORDEX regional climate projection offers high-resolution maps of the key variable to be downscaled. Specific satellite radar data could be considered for integration in the wind-energy atlases. Finally, decadal predictions are an emerging tool for continuous strategic management to be integrated with climate scenarios.

A key challenge of climate scenarios is the evaluation of uncertainties and variability, which is not well addressed under the current methodology. A preliminary assessment has been carried out in a scientific publication resulting from the first and second phases of the WMO NRA initiative, i.e. Petitta et al. 2026 (Footnote No. 4), but such an assessment has not been systematically integrated in the methodology. On the other hand, the variability of climate projections is currently limited by the fact that river discharge is only available for one specific model.

Analysis of potential improvements

In light of the above, a list of suggested improvements is provided below under three main directions: operational optimization, methodology enrichment, and long-term advancements. Further elaboration on each item is provided in the respective tables below.

It is important to clarify that the proposed improvements under operational optimization will be implemented in the current phase of the project, while the other two groups are intended for consideration in future phases of the WMO NRA initiative.

[5] https://ewds.climate.copernicus.eu/datasets/cems-glofas-historical?tab=overview

- *Operational optimisations* (applied under the current phase of the project):

    1. *Hydropower atlas*: Modification of river discharge clipping by interpolation of CMIP6 projections onto the GloFAS grid dataset.

    2. *Hydropower atlas:* Modification of delta calculation (anomalies) based on historical and future SSP scenarios.

    3. *Wind and solar atlas*: Applying data blending of ERA5 and ERA5Land for coastal grid cells.

    4. All atlases: Integration of a simple and straightforward data-cleaning step across the three atlases.

- *Methodology enrichment* (mid-term advancements):

    1. *Wind atlas:* Integration of wind speed from satellite data;

    2. *All atlases:* Utilisation of CORDEX datasets for climate scenarios.

    3. *All atlases*: Integrating an assessment of the efficacy of blending observational data into the downscaled NRAs.

    4. *All atlases*: Evaluation of variability of climate scenarios through a multi-model analysis.

    5. *All atlases*: Integration of advanced data cleaning for station data.

- *Long-term advancements* (significant modifications of the methodology that need considerable effort to be designed and integrated)

    1. *Wind atlas*: Adjustable wind turbine height

    2. *All atlases*: Integration of decadal predictions

    3. *Hydropower atlas*: Extension of hydropower atlases with precipitation integrating ground-based radar data

    4. *Hydropower atlas*: Extension of hydropower atlases with precipitation integrating ground-based radar data

More detailed information for each category and item is provided in the tables below.

Operational optimisations (applied under the current phase of the project)

Optimisation of river discharge clipping	
Methodological modification:	Interpolation of CMIP6 projections onto the GloFAS grid and application of the river mask prior to the delta computation. Extension of the clipping procedure to improve dataset extraction within national boundary geometries and reduce missing values at borders.
Jupyter notebook upgrades:	*ATLAS_hydro_scenarios.ipynb:* Modify *clip()* function with additional parameters for more accurate extraction of datasets within national boundaries. Addition of interpolation function with nearest neighbour method to bring CMIP6 data onto the GloFAS grid, followed by a clipping function applied to both datasets using the river shapefile.
Modification of delta calculation for hydropower atlases	
Methodological modification:	Anomalies between SSP scenarios and the historical experiment are computed as monthly percentages differences relative to the historical baseline. Future river discharge is then aggregated by averaging over sub-basins at different spatial resolution levels.
Jupyter notebook upgrades:	*ATLAS_hydro_scenarios.ipynb:* Application of the percentage in the delta function. Conversion of the percentage when future river discharge is calculated from the reanalysis data set. Subbasin statistics also for the future climate and saving the results as GeoJSON files. *ATLAS_hydro_plots_scenarios.ipynb:* Maps of the discharge delta and projected future river discharge following the catchment geometries at the two spatial resolutions considered.
Data blending of ERA5 and ERA5Land datasets	
Methodological modification:	Combination of ERA5-Land over terrestrial areas with ERA5 data along coastal grid cells. ERA5 is first interpolated onto the ERA5-Land grid, and then used to replace missing coastal values.
Jupyter notebook upgrades:	*ATLAS_preprocessing.ipynb:* Interpolation of ERA5 to the ERA5-Land spatial grid using bilinear interpolation. ERA5-Land values are retained over land areas, while ERA5 data are used for coastal grid cells to fill missing values. The merged dataset is then clipped to the national boundary geometry using parameters that improve accuracy near borders.
Integration of a simplified data cleaning	

Methodological modification:	Integration of a simplified version of data cleaning for a first evaluation of station data. The data cleaning includes harmonization of station metadata and variable names, standardization of date and time formats, handling of missing and duplicated records, filtering of invalid or inconsistent values, detection of basic outliers and quality issues, and restructuring of datasets into a common format.
Jupyter notebook upgrades:	*ATLAS_stations_data_{country}_preprocessing.ipynb:* dedicated notebook developed for country specific station preprocessing. It deals with heterogeneous data structures, object types, storage formats, and sharing mechanisms across countries, ensuring harmonized input datasets for subsequent analysis.

Methodological enrichments (Proposed for future phases)

Integration of wind speed from satellite radar data	
Methodological modification:	In the case of wind energy atlas, wind velocity from scatterometer observations are available at 0.125° horizontal spatial resolution over the oceans. The dataset might be integrated for coastal wind adjustments.
Jupyter notebook upgrades:	*ATLAS_wind_downscaling.ipynb:* Addition of the high-resolution satellite-derived variable, resampled to daily mean resolution, to the feature set used for statistical downscaling. *ATLAS_wind_downscaling_scenarios.ipynb:* Addition of satellite wind measurements as a feature after computing the day of year mean from the available satellite time series.
Difficulties and limitations:	The dataset has some limitations, as it includes only 10 m wind velocities. Moreover, it is available exclusively over the ocean, hence significant only for coastal regions. Although technically feasible, the present modification is of uncertain efficacy.
Utilisation of CORDEX datasets	
Methodological modification:	The CORDEX dataset would substitute CMIP6 climate scenarios in the method to downscale relatively high-resolution climate model outputs.
Jupyter notebook upgrades:	*ATLAS_*_download_scenarios.ipynb*: Modification of the retrieve function to ensure that the appropriate dataset is selected depending on the data origin (CORDEX or CMIP6).
Difficulties and limitations:	To mitigate the effect of driven Global Climate Models (GCMs) on Regional Climate Model (RCM) outputs, it is essential to thoroughly identify a set of GCM-RCM combinations. This task is relatively complex, and needs specific

	competences. Furthermore, river discharge is not a variable currently available in the dataset, hence limiting the application to hydropower NRAs.
Estimate of efficacy of observational data integration	
Methodological modification:	Integration in the method of an assessment of the efficacy of blending observational data into the downscaled NRAs. Such an assessment could result in a comparison via selected performance metrics (e.g. bias, mean absolute error) between a reference dataset and the downscaled data with and without observational data.
Jupyter notebook upgrades:	*ATLAS_*_scaling.ipynb:* Calculation of NRA with and without integration of observational data. Computation of selected metrics for specific locations and calendar months, followed by averaging of the metrics across locations to derive monthly country-level performance indicators.
Difficulties and limitations:	The main difficulty relies on the identification of a reference dataset to assess the selected metrics. Such a reference dataset should be independent from the data used to calculate the NRAs, but, at the same time, trustworthy to make the assessment meaningful.
Evaluation of variability of climate scenarios	
Methodological modification:	Application of the method to a set of CMIP6 climate models to estimate the multi-model variability, and hence assess the uncertainty in future climate projections.
Jupyter notebook upgrades:	*ATLAS_*_download_scenarios.ipynb*: Addition of a parameter allowing the selection and download of specific CMIP6 models. *ATLAS_*_delta_scenarios.ipynb*: Application of the whole downscaling pipeline to each model separately, and calculation of multi-model mean and variability, possibly defined either as standard deviation or difference between max and min values.
Difficulties and limitations:	The application of the method would become more time and IT resource consuming (proportionally to the number of CMIP6 models considered). The uncertainty estimate might be not straightforward to interpret. River discharge values are available for one model alone. Therefore, at the time being, this modification can be applied only to wind and solar NRAs.
Integration of structured data cleaning	
Methodological modification:	Integration of a comprehensive data cleaning module for the preprocessing of observations that (i) identifies and eliminates outliers; (ii) considers temporal and spatial patterns; (iii) manages measurement gaps.

Jupyter notebook upgrades:	Creation of a dedicated notebook to process heterogeneous station data, harmonizing formats and generating one CSV file per country, to be used as input for the inverse distance weighting interpolation.
Difficulties and limitations:	Data cleaning approaches are not that easy to standardise. Considering the variety of observation types, and climatological and orographic conditions of the participating countries, special attention need to be put to filter data effectively.

Long-term advancements (Proposed for future phases)

Adjustable wind turbine height	
Methodological modification:	Integration of a dedicated function to estimate the wind speed at a height specified by the user following, for instance, a logarithmic function.
Jupyter notebook upgrades:	*ATLAS_wind_plotting*.ipynb*: Implementation of a function that derives wind speed at a target height from reference levels (10 m and 100 m), by applying a logarithmic wind profile formulation based on surface roughness length to generate wind maps at the desired elevation.
Difficulties and limitations:	Thorough consideration should be given to formulation of the function to be used for interpolation between heights. It should also be analysed whether the algorithm would perform best when applied to the raw data, at the beginning of the pipeline, or at its end, to downscaled data.
Integration of decadal predictions	
Methodological modification:	To leverage the effort of WMO RCCs, decadal predictions are harmonised into the current method. They should be combined rather than substitute climate scenarios to support different decisions over a timeframe of several years rather than decades.
Jupyter notebook upgrades:	Creation of a new notebook completely dedicated to the management of this data flow.
Difficulties and limitations:	Decadal predictions are mainly used in research. Considerable technical and operational limitations exist. First of all, the data is not available on the Copernicus infrastructure and is not of easy access. Secondly, the decadal prediction applicability is still unclear. Examples of climate services utilising this data source exist as a result of R&D projects, no commercial or operational use is demonstrated yet. Finally, the integration of decadal predictions with climate scenarios, and, in particular, the interpretation of discrepancies is an open scientific question.
Extension of hydropower atlases with precipitation integrating ground-based radar data	

Methodological modification:	The hydropower REA is expanded with a specific section on precipitation regimes. This modification will support the integration of a variety of data sources, especially ground-based radar data. Moreover, it facilitates the selection of climate models of CMIP6, as the majority of them includes precipitation while only an extremely limited number of them present river discharge data.
Jupyter notebook upgrades:	Creation of a new notebook completely dedicated to the management of this data flow.
Difficulties and limitations:	The relationship between precipitation and river discharge is highly complex. Information of changes in precipitation regimes cannot be directly used for decision-making concerning hydropower. The combination of river discharge with precipitation is surely powerful and has a great potential especially for the possibility to assess multi-model variability (as discussed before). However, the provision of the information needs to be designed in a thorough manner to ensure correct utilisation.

Pilot countries

During the current phase, the following participating countries of the WMO ENANDES and ENANDES+ projects are eligible to receive support for creating NRAs based on their national needs: Argentina, Bolivia, Chile, Colombia, Ecuador, and Peru. The priorities, needs and available data for each country have been clarified through a survey (Appendix A) and a follow-up bilateral meeting. The results of this first stakeholders' engagement activity are reported hereafter in a dedicated table per country. All countries, except Colombia (IDEAM), which is still pending a response, have confirmed their participation in this activity.

Argentina	
Atlas priorities	Solar Atlas
Identified needs	• Update the current atlas finalised in 2007; • Integration of climate scenarios to assess climate change impact on renewable resources.
Available datasets	The Argentinian NHMS manages 110 stations throughout the Country. However, only 10 of those include observation of GHI. Considering the crucial role of this variable for generating the solar NRA, these 10 stations will be the focus of the following activities.

Bolivia	
Atlas priorities	Hydropower Atlas
Identified needs	• Assessing the renewable energy potential to accelerate transition; • Integration of climate scenarios to assess climate change impact on renewable resources.
Available datasets	The Bolivian NHMS manages 20 meteorological stations provinding key variables such as precipitation, temperature, wind speed and GHI. Moreover, its network includes 40 stations measuring water level and 5 for river discharge.

Chile	
Atlas priorities	Wind Atlas
Identified needs	• Definition of a wind-energy atlas which is currently not available for strategic decisions; • High spatial resolution and long-term data for wind speed and direction should be included; • Future climate projections are a key element.
Available datasets	The Chilean NHMS operates a national network of 100 meteorological stations equipped with anemometers that measure wind speed and direction at 10 m.

Ecuador	
Atlas priorities	Hydropower Atlas, Solar Atlas
Identified needs	• Updating the Solar NRA, which has been created in 2008; • Expanding the Hydropower NRA, which mainly focused on the infrastructure, with climate information; • Incorporating climate projections for long-term planning
Available datasets	The Ecuadorian Meteorological Institute has a set of 10 stations monitoring GHI, cloud cover and temperature in the period 2018-2023, and 20 stations measuring Precipitation, Surface Water Runoff, and River discharge from 1985 to 2015.

Peru	
Atlas priorities	Solar Atlas
Identified needs	• Updating the current Solar NRA, which has been created in 2003; • Expanding the utilised data with open source data such as reanalyses; • Integrating climate scenarios for long-term planning.
Available datasets	The Peruvian NHMS manages a network of 197 stations. Among these stations, 15 stations include GHI, which is a key variable for solar atlas generation. The available dataset covers the period 1975-1990. More recent data exists but did not undergo quality control.

Visualization of the results

The third phase of the NRA initiative includes specific effort for the creation of a visualisation toolkit. Indeed, the visualisation of the results is essential for the correct communication of the information, and ensure the accessibility of atlases to diverse stakeholders, hence enhancing climate-informed decision making. Such a visualisation tolkit included:

- A set of **factsheets**, one for each pilot Country, that collect all the key results in a concise and standardised manner;

- An interactive **HTML webpage** design that demonstrates all the atlases of the current phase in a ready-to-use graphic user interphase to facilitate visualisation and exploration;

Factsheet templates for maps

The factsheet will be structured according to the following proposed template (with in grey the sections that need adjustments at country level). Please note that the present design is intended as a general structure to highlight the considered information, rather than the final version which will incorporate a more refined graphic. A draft version of the factsheet will be validated during the co-production phase with the counties to ensure alignment with the users expectations. The final product will be shared with the pilot Countries and accessible through the HTML webpage.

Country name

Atlas type

Flag

The project “Enhancing Adaptive Capacity of Andean Communities through Climate Services” – hereafter “ENANDES” – seeks to enhance the capacity of society and communities to adapt to a varying and changing climate by producing, communicating and assessing the use of credible, authoritative, and useful information as the scientific evidence for decision- and policy-making on preparedness for, and reduction of damages from climatic hazards in Chile, Colombia and Peru. ENANDES+ scales up the ENANDES project, currently being implemented by WMO through the Adaptation Fund. With The Swiss Agency for Development and Cooperation (SDC)contribution adding Argentina, Bolivia and Ecuador. Within this context, the National Renewable Energy Atlas (NRA) initiative integrates high-quality, high-resolution data on renewable energy resources in a changing climate in support of National Meteorological and Hydrological Services (NMHSs) and relevant stakeholders in the renewable energy sector to enhance climate-smart decision making.

Objectives:
Specific objectives of the NRA co-production process in relation to the currently available products.

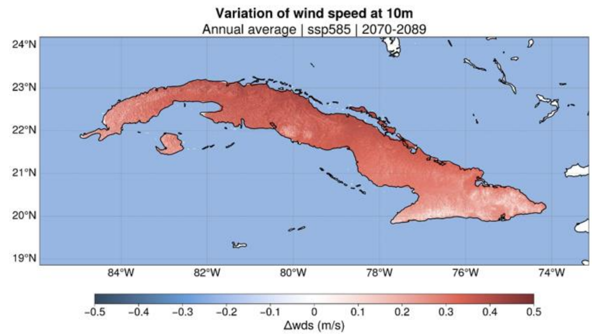
Overview of the method:
The technical framework consists of a Machine-Learning based method of downscaling and data blending, based on reliable and accessible data sources. The results compare historical data – combining reanalyses, earth observations and station data – with climate projections of two shared socioeconomic pathways (SSPs), specifically SSP3-7.0 and SSP5-8.5, from a single CMIP6 model.

Data used:
Brief description of the categories of data integrated in the NRAs, with particular emphasis on the station data.

Present-day climate (2025):

Future climate (2050):

Variation:

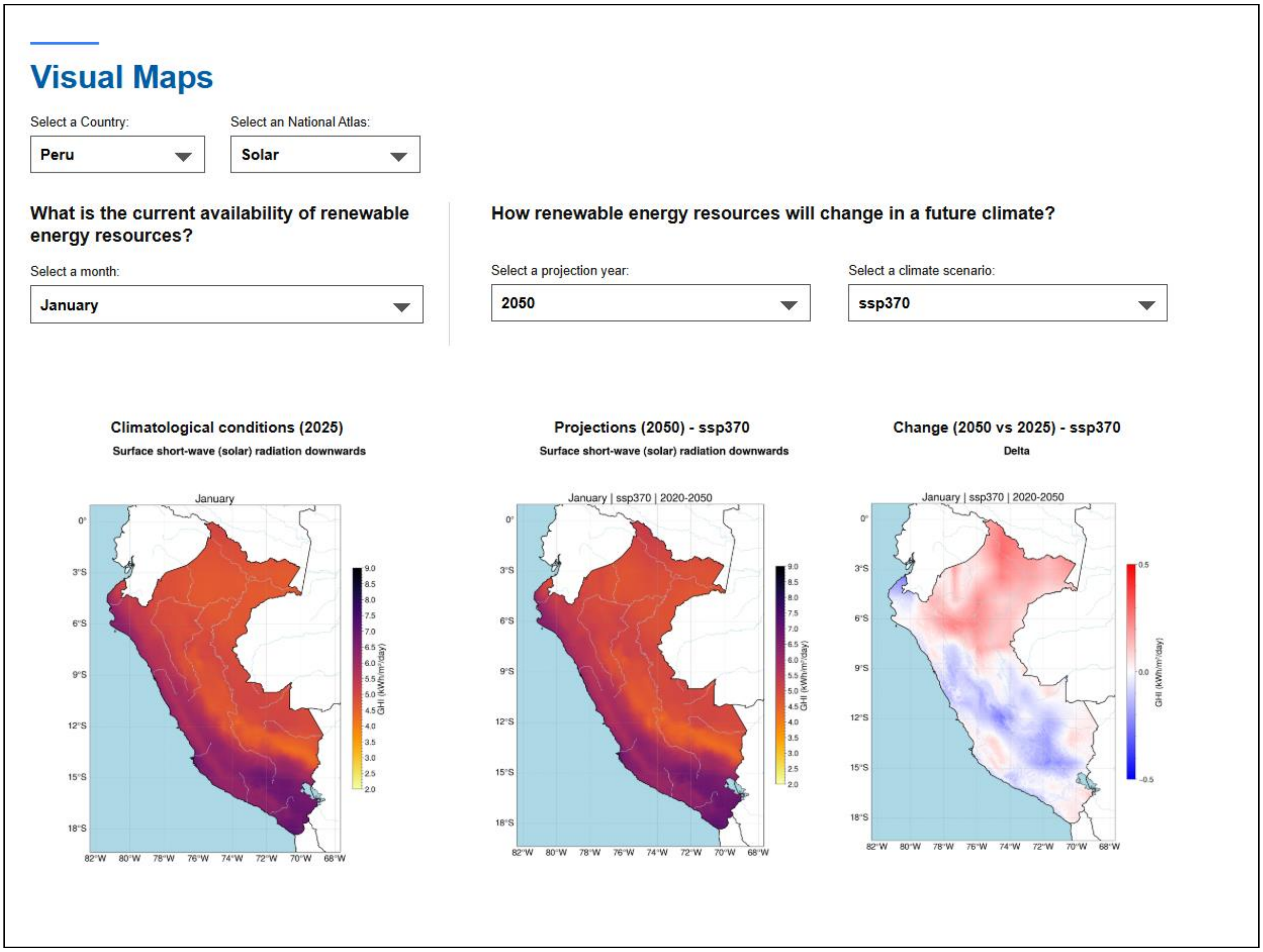


HTML webpage design

The NRAs can be integrated into the CIIFEN ENANDES CST[6], as well as WMO energy and meteorology portal[7] via the developed HTML webpage.

The entry page of the service will include a brief description of the objective of the current phase of the WMO NRA initiative under the WMO ENANDES project. The user will be able to select the country and the NRA of interest through two independent drop-down menus. This first combination of choices will visualise the corresponding atlases. At this point, the user can select the 20-year time interval in the future that wants to analyse and a socio-economic pathway (SSP) as defined by the IPCC. It will then be possible to visualise the corresponding map for future-day climate and compare the two NRAs. A graphic representation of the HTML webpage is reported hereafter.

[6] https://crc-osa.ciifen.org/en/cst-enandes/
[7] https://energymeteorology.info/reatlas/



Workplan of the activities

The activities are organised as follows.

Months	Activities	Outputs
Feb 2026	• Identification and first contact with pilot countries; • Work planning; • Identification of potential methodological improvements	
March 2026	• Organization of KOM with pilot counties; • Desing of HTML webpage; • Desing of factsheets; • Selection of methodological improvements to be implemented; • Upgrade of the survey;	Updated survey

April-May 20206	• Bilaterial meetings with pilot counties; • Collection of station data; • Preparatory work for co-production sessions.	D1
May-June 2026	• Organization of co-production sessions; • Organization of training sessions and material including factsheets; • Development of HTML webpage. •	HTML webpage Country factsheet Notebooks and datasets
June-July 2026	• Organization of capacity building online sessions; • Preparation of a conference paper; • Drafting a policy brief; • Participation in a technical webinar organized by WMO ENANDES project	D2 and D3 Policy brief Conference Paper

Appendix

The present appendix presents the survey shared with the participants to the WMO NRA project. The survey is an excel file with the following sheets.

1) **Sheet 1: Instructions**

WMO National Renewable Energy Atlas
Overview: The National Renewable Energy Atlas (NRA) initiative is a pioneering project launched by the World Meteorological Organization (WMO) in response to the urgent need of National Meteorological and Hydrological Services (NMHSs) for high-quality, high-resolution data on renewable energy resources in a changing climate.
Scope of the survey: The present survey aims at lay the foundation for co-production of NRAs. The goal is to identify all the key stakeholders to be involved in the process to ensure access to data and information, and maximise impact of the project. Furthermore, the survey support a correct evaluation of what is currently available in terms of NRA in the Country, and how this existing knowledge can be leverage at best.
Instructions:
1) Please feel in the sheet "**Stakeholders**" with contact information of organitians you currently collaborate with in the context of renewable energies;
2) **Select the NRA(s) of interest** for you Country and fill in only the sheets that correspond to those ones among "Hydropower", "Wind-power" and "Solar-power"
3) For each NRA of interest, please **answer in a concise manner to the questions** on the current approaches to support decisions related to renewable energy resources, and the available data that can be used in the project.

2) **Sheet 2: Stakeholders**

Focal point of contact	
Full Name	
Organisation	
E-mail address	
Active collaborations with other national public institutions in the context of NREA	
Organisation	
Full Name of contact	

person	
E-mail address	
Type of collaboration	
Organisation	
Full Name of contact person	
E-mail address	
Type of collaboration	
Organisation	
Full Name of contact person	
E-mail address	
Type of collaboration	
Organisation	
Full Name of contact person	
E-mail address	
Type of collaboration	

3) **Sheet 3: Hydropower**

Hydropower: status quo				
1)	Do you already have NREAs?	*y/n*		
2)	What is the current temporal resolution of the NREA?			
3)	What is the current spatial resolution of the NREA?			
4)	What is the time span covered by the NREA?			
5)	What are the included variables?			
6)	Which re-analysis products were used, if any?			
7)	Which in-situ observations were used, if any?			
8)	Which satellite data were used, if any?			
9)	Are climate scenarios			

	included in the atlases?			
10)	What is the main weakness of the available NREA?			
Available observational datasets for Hydropower NREA				
		Precipitation	**Surface Water Runoff**	**River discharge**
Number of stations				
Span of the time series				
Quality check implemented		*y/n*	*y/n*	*y/n*

4) **Sheet 4: Wind-power**

		Wind energy	
1)	Do you already have NREAs?	*y/n*	
2)	What is the current temporal resolution of the NREA?		
3)	What is the current spatial resolution of the NREA?		
4)	What is the time span covered by the NREA?		
5)	What are the included variables?		
6)	Which re-analysis products were used, if any?		
7)	Which in-situ observations were used, if any?		
8)	Which satellite data were used, if any?		
9)	Are climate scenarios included in the atlases?		
10)	What is the main weakness of the available NREA?		
Available observational datasets for Windpower NREA			
		Wind speed at 10 m	**Wind speed at 100 m**
Number of stations			
Span of the time series			
Quality check implemented		*y/n*	*y/n*

5) **Sheet 5: Solar power**

		Solar energy		
1)	Do you already have NREAs?	*y/n*		
2)	What is the current temporal resolution of the NREA?			
3)	What is the current spatial resolution of the NREA?			
4)	What is the time span covered by the NREA?			
5)	What are the included variables?			
6)	Which re-analysis products were used, if any?			
7)	Which in-situ observations were used, if any?			
8)	Which satellite data were used, if any?			
9)	Are climate scenarios included in the atlases?			
10)	What is the main weakness of the available NREA?			
Available observational datasets for Solar NREA				
		Global Horizontal Irradiance (GHI)	**Cloud cover**	**Temperature at 2 m**
Number of stations				
Span of the time series				
Quality check implemented		*y/n*	*y/n*	*y/n*