NEXOGENESIS
STREAMLINING WATER RELATED POLICIES

Nexus data vector of biophysical data for each case study

Lead : Euro-Mediterranean Centre on Climate Change (CMCC)

Date: 29/08/2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003881

Project

Project Number	Project Acronym	Project Title
101003881	NEXOGENESIS	Facilitating the next generation of effective and intelligent water-related policies, utilizing artificial intelligence and reinforcement learning to assess the water-energy-food-ecosystem (WEFE) nexus

Instrument:	Thematic Priority
H2020RIA	LC-CLA-14-2020

Title
Nexus data vector of biophysical data for each case study

Contractual Delivery Date	Actual Delivery Date
31.08.2023	29.08.2023

Start Date of the project	Duration
01 September 2021	48 months

Organisation name of lead contractor for this deliverable	Document version
CMCC	1

Dissemination level		Deliverable Type	
PUBLIC		ORDP: Open Research Data Pilot	

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Reviewers (organisations)
Blaine Haupt (JAWS)

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Abstract

Deliverable 2.2 (D2.2) includes a publication of Nexus data vectors of biophysical projections for each case study as Open Research Data Pilot (ORDP), with delivery of biophysical modeling data in NEXOGENESIS (NXG) to all case studies and to wider scientific community. The present document reports background information and technical description regarding the biophysical modeling data made available to NXG case studies and uploaded on the ORDP through the project Zenodo public repository. The biophysical data made available are used to populate the System Dynamic Models (SDM, WP3) that forms the base for the development of the NExus Policy Assessment Tool (NEPAT, WP4). NEPAT supports the development of the most suitable set of policies for sustainable management of water, energy, food and ecosystem resources in each case study. The current set of shared biophysical data might be modified and likely improved, if needed, to accommodate eventual further case study's needs.

Keywords

RCP, WEF nexus, Modelling, Biophysical, Climate, Hydrology, Water, Ecosystem, Crop, Hydrology, Policy, System Dynamic Model, Zenodo

Disclaimer:

This report is prepared solely for the purpose of fulfilling the deliverables of this project and is based on the information and datasets available at the time of preparation. The data used reflects the most recent updates to the relevant databases and models at the time of release. The authors are not responsible for any changes or updates to the data or information that may occur after the report's completion.

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Abbreviation/Acronyms

AGMIP	Agricultural Model Intercomparision and Improvement Project
AI	Artificial Intelligence
CMIP	Coupled Model Intercomparison Project
CS	Case Study
EC	European Commission
GHGs	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
ISIMIP	Inter-Sectoral Impact Model Intercomparison Project
NXG	NEXOGENESIS
RCP	Representative Concentration Pathway
SDM	System Dynamic Model
NEPAT	NExus Policy Assessment Tool
ORDP	Open Research data Pilot
WEFE	Water-Energy-Food-Ecosystem

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Deliverable 2.2

The deliverable is submitted on time. Nevertheless, a number of shortcomings is present, which
requires revision. Recommendations related to this deliverable:
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[1]The deliverable provides information that is too general and lacks sufficient detail to enable the
reader to gain an accurate understanding of the specific actions undertaken by the team. The deliverable is entitled "Nexus data vector of biophysical data for each case study." It would be
beneficial to establish a correlation between the data availability and the case studies. This would
entail indicating which data set is accessible for each case study and subsequently evaluating the
adequacy of the data sets and resolutions at the case study level.

Response:
The deliverable 2.2 itself is a public ORDP: Open Research Data Pilot, which was first loaded and shared on project surfdrive for internal use, and then upon finalization on the project Zenodo for wider and public dissemination. This document reports background information and technical description regarding the biophysical modeling data, like climate drivers / impact model, thematic variables, scenarios. We have modified the abstract in the document (highlighted in red) with the aim to make this more clear.
The dataset was used intensively and tested in WP3 for System Dynamic Modelling. In particular, in task 3.2 (Biophysical and socio-economic models: Implementation for all case studies under selected scenarios) the specific use of these biophysical and socio-economic data have been elaborated, with clear links to those specific variables for the different case studies. Furthermore, the data need for WP3 activities, and thereafter WP4 activities, have been discussed and validated through multiple discussion with modellers and stakeholders at case study level, and integrated in the D3.3.

Thanks to reviewer observations, we realize that interactions between these different project activities are not clearly defined in this Deliverable, and we have added specific section (section 2.3: Interaction with NXG project Activities and contribution to project Objectives) to clarify this together with some conclusions, and a brief summary of how this deliverable contributes to project objectives.

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[2]It is expected that biophysical data that are relevant to the CS will be duly collected and utilised. For example, for CS1, a cursory online search reveals that approximately 50% of the water used is for the purpose of supplying water to the region, while only about 20% is used for industrial purposes and a further 20% for agricultural activities. It is unclear how this water use distribution was considered in the work performed. In particular, it is not evident how the

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water-energy-food interrelationship will be modelled in the absence of a basic analysis of this kind.

Response:
The data has been processed and arranged as data sheets on the project Zenodo, a data sheet for each case study, where all time series for each variable according to different /climate drivers/impact model/scenarios are presented as separate rows among different thematic tabs. These can be plotted on desktop by users though excel or other analytical softwares (e.g. R, matlab, Python), and streamlined to System Dynamic Modelling in WP3 that has elaborated on the use of these data through D3.2. and D3.3.

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[3] In accordance with the description of the deliverable provided in the DoA, the metadata information should be presented as supplementary material, offering further insight into the characteristics of the data in question. This information is not provided.

Response:
Thanks for the useful feedback. We have associated a metadata description file with the Biophysical Nexus data vectors for NEXOGENESIS case studies present on Zenodo. Furthermore the following data Description (Metadata) was included at the end of the deliverable (section 3.2 Climatic and Biophysical Data Description)

The set of data delivered for each case study involved in the NXG project and currently uploaded on the open repository Zenodo include the following information:

The data is provided as monthly/annual trends from historical over future projections (i.e. 1971-2070) under different radiative forcing (i.e. Representative Concentration Pathways or RCPs) to cover different thematic variables related to four main sectors, i.e., climate, water, agriculture, and ecosystem.

RCP 2.6, RCP 6.0 and RCP 8.5 RCP 2.6, RCP 6.0 and RCP 8.5 have been chosen as plausible future GHG emission scenarios to test effects of mitigation policies and as probabilistic distribution function for uncertainty analyses.

Data is forced with the latest CMIP6 climate projections,

The biophysical and climate data are provided as separate file for the five NXG case studies located in Europe and Africa: 1) Nestos river basin (BG-EL); 2) Lower Danube Basin (RO); 3) Lielupe River basin (LT-LV); 4) Adige River Basin (IT); 5) Inkomati-Usuthu River Basin (ZA). Among these CSs, two are transboundary: Nestos (Greece- Bulgaria) and Lielupe (Latvia-Lituania).

- T2.2 - Adige 3b.2.1.xlsx

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- T2.2 - Inkomati 3b.2.2.xlsx

- T2.2 - Jiu 3b.2.1.xlsx

- T2.2 - Lielupe 3b.2.1.xlsx

- T2.2 - Nestos 3b.2.1.xlsx

Spatial resolution: Average values over the basin

Keywords: Climate, Hydrology, Ecosystems, Agriculture, Water, Food

Source of data → repositories sites, climate data services, model data; *e.g., ISIMIP3b/CMIP6, ISIMIP2b/CMIP5, Copernicus Climate Change Data Service, GLOBIO, SIMETAW-GIS*

Sector → Nexus Sectors; *e.g., Agriculture, Climate, Water, Ecosystem*

Short name –> short suffix used in coding and file naming; *e.g., a) tas, b) Qs, c) evap*

Long name → *e.g., a) 2m Temperature, b) Surface RunOff, c) Total Evapotranspiration*

Description → Description of the variables; *e.g., a) Near-Surface Air Temperature. Data are available at monthly resolution; b) Surface runoff. The surface runoff is expressed in kg m-2 s-1 and it is the water that leaves top soil layer (the surface layer). Data are available at monthly scale. C) Crop Yield. The crop yield is expressed in dry matter as tons ha-1 per growing season. The crop model simulations have a global spatial coverage under the assumption that the crops are cultivated everywhere.*

Unit → unit for which variables are expressed; *e.g., a) K; b) kg m-2 s-1; c) tons ha-1*

Available Spatial resolution/s → *e.g., average over basin, 0.5 degrees*

Impact model → model used to define sectorial impact following climate drivers and scenarios; *e.g., CLM 45, ORCHIDEE, GEPIC, WaterGAP*

Climate forcing → Atmospheric climate input (data projections) used for impact modeling; *e.g., HadGEM, MIROC, GFDL-ESM2M, EC-EARTH*

Climate scenario → emission and/or socioeconomic scenarios; *e.g., RCP2.6, RCP 6.0, RCP 8.5*

Time period → Historical and future time frame of data projections; *e.g., 1971-2070*

Available temporal resolution → data temporal frequency or time steps; *e.g., monthly, yearly, 30-yr mean*

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Available rainfed crop → crops modelled for agricultural sector; *e.g., maize, rice, wheat, soy, millet, sugar beet, cassava, rapeseed*

Available Irrigated crops → crops modelled for agricultural sector; *e.g., maize, rice, wheat, soy, millet, sugar beet, cassava, rapeseed*

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[4] The conclusions are not clearly provided, and a brief summary of how this deliverable contributes to Objectives 2 and 3 of the project is required.

Response:
We have added relevant text of contribution towards project objectives 2, 3 and 5, in a specific section (section 2.3: Interaction with NXG project Activities and contribution to project Objectives).

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[5] Disclaimer is missing, please, add.

Response:
A Disclaimer was added at bottom of page 3

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[3] Please, indicate all changes in a clear manner, preferably by using a different colour for the text.
It will help to reassess your work accordingly

Response:
All the additions to the text in the deliverable to address reviewer observations are highlighted in red
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Recommendations related to next project stages:
[1] It is recommended that the biophysical data for each case study be subjected to verification by local experts in order to ensure the credibility of the modelling results.

Response:
Indeed we appreciate and highly agree with such recommendation. In fact, the data need for WP3 activities, and thereafter WP4 activities, have been discussed and validated through multiple discussion with modellers and stakeholders at case study level, and integrated in the D3.3. We also have added relevant text to clarify this in a specific section (section 2.3: Interaction with NXG project Activities and contribution to project Objectives).

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1 Introduction

1.1 Project summary

NXG aims to enhance sustainable socio-economic development in CSs characterized by different pedo-climatic, hydrological, social, and economical factors. Four NXG CSs are located in Europe and one in Africa. The NXG project contributes to the development of the most suitable combination of policy instruments, referred to as policy packages, for the sustainable management of Water, Energy, Food, and Ecosystem (WEFE) in each CS. The set of policies that contribute to optimizing the WEFE performance in the CSs is identified by the Artificial intelligence (AI) used by the NExus Policy Assessment Tool (NEPAT) developed within the NXG project.

1.2 Case studies

The Nexogenesis project applies a consistent and coherent methodology in five case studies (Figure 1). The biophysical and climate data are used in the five NXG case studies located in Europe and Africa: 1) Nestos river basin (BG-EL); 2) Lower Danube Basin (RO); 3) Lielupe River basin (LT-LV); 4) Adige River Basin (IT); 5) Inkomati-Usuthu River Basin (ZA). Among these CSs, two are transboundary: Nestos (Greece- Bulgaria) and Lielupe (Latvia- Lituania).

Fig.1 Geographical location of the five case studies in the NXG project.

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2 Climate and Biophysical data

2.1 Characteristics of the climate and biophysical data used in NXG

In addition to the socio-economic data trends, WP2 provides consolidated and harmonized monthly time-series of data trends of biophysical processes spanning from historical to future (1971-2070) projections under a range of climate emission scenarios. The present report indicates the status of information about climatic, hydrological and other biophysical variables consolidated to CSs and available on public repository (Zenodo OpenAire), as for aim and dissemination level (ORDP: Open Research Data Pilot) foreseen for D2.2. The climatic, hydrological, and environmental variables that characterize relevant biophysical processes for each CS are in line with a set of selected Intergovernmental Panel on Climate Change (IPCC) representative concentration pathway (RCP) scenarios spanning from low (RCP2.6) to high (RCP6.0/8.5) emission scenarios. The data used within the NXG project are generated under a structured, coherent, and uniform methodology consolidated from intercomparison projects, repository sites and climate data services. The climatic and biophysical data are used to populate the System Dynamic Models developed for the five CSs involved in the project. The climatic and biophysical data generated and made available for the NXG case studies to assess the Water-Energy-Food-Ecosystem (WEFE) nexus have multiple sources to account for modeling uncertainties according to different impact models and driving climate projections.

Data sources for most of the biophysical and climate data are based on the **Inter-Sectoral Impact Model Intercomparison Project (ISIMIP),** which considers modeling impact and the interaction of several sectors from regional to global scale. ISIMIP modeling outcomes, at 0.5 degrees spatial resolution, are based on climate drivers based on the Coupled Model Intercomparison Project (CMIP) projections. The set of data covers relevant sectors such as water, biomes (ecosystem), agriculture (food), forest, terrestrial biodiversity, lake, and climate. Data have been selected, collected, and elaborated from the ISIMIP simulation rounds “ISIMIP 2b (following CMIP5 simulation runs in support to the V IPCC report) and ISIMP 3b (following CMIP6 simulation runs in support to the VI IPCC report). The ISIMIP data used within the NXG project are made available from an historical to future time frame (1971-2070) period under three Representative Concentration Pathways (RCPs) scenarios, i.e., RCP 2.6, RCP 6.0, and RCP 8.5.

In addition to ISIMIP model outcomes data, further biodiversity data have been consolidated from the **Global Biodiversity (GLOBIO)** model for policy support to provide information about biodiversity in terms of Mean Species Abundance (MSA) in the NXG case studies. The

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data are available at a 300x300 m resolution from 2015 to 2050 under RCP2.6, RCP 6.0, and RCP 8.5. MSA ranges from 0 to 1 and indicates the biodiversity intactness relative to a pristine reference situation.

For specific needs of some CSs (e.g. to enrich the list of considered crops), the atmosphere-soil-water-crop **SIMETAW_GIS (**Simulation of Evapotranspiration of Applied Water**)** model is used within the project to simulate the water requirements, crop yield losses due to water stress, and irrigation scheduling for 69 crops (e.g., vegetables, cereals, legumes, orchards, etc). The model uses input data (e.g., precipitation, wind speed, humidity, etc) coming from the above-mentioned sources and this ensures coherence in data use and methodology that allows for comparison of outcomes and replicability of method. Being able to accommodate input data from the selected NXG data sources, this model delivers outputs at the same spatial and temporal resolution of downscaled climate projections used as initial input to the model.

The NXG data sources and the variables included in each sector and made available to the case study leaders up to now are extensively reported in D2.1 (Trabucco et al., 2022).

2.2 NEXUS Sectors (Models and Variables)

In the NXG project, the climatic and biophysical data cover four main sectors, i.e., climate, agriculture, water, and ecosystem. Intercomparison project sources (details in section 2.1) have been screened to make possible the selection and elaboration of the climatic and biophysical variables needed to accommodate the case study's needs for SDMs development (Table 1). The data generated for each case study are available for the past and the future (1971-2070) period under RCP 2.6., RCP 6.0, and RCP 8.5.

The current variables uploaded to Zenodo and made available for the case studies are listed in Table 1. The details of each variable (e.g., unit, name abbreviation, spatial and temporal resolution, etc) can be found in Deliverable 2.1 (Trabucco et al., 2022).

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Table 1 shows the current variables available for each sector.

Sector	Models	Variable
Climate	HADGEM2-ES, IPSL-CM5A-LR, GFDL-ESM2M, MIROC5	Near-Surface Air Temperature; Near-Surface Relative Humidity; Precipitation; Surface Downwelling Shortwave Radiation; Near-Surface Wind Speed; Daily Maximum Near-Surface Air Temperature; Daily Minimum Near-Surface Air Temperature; Total Evapotranspiration; Snow fall
Water	CWATM, H08, LPJML, MATSIRO, PCR-GLOBWB, WATERGAP, MPI-HM	Potential Evapotranspiration; Surface runoff; Subsurface runoff; Soil moisture (= soil water storage); Groundwater recharge; Groundwater storage; Irrigation water demand (=potential irrigation water Withdrawal); Total (all sectors) water demand (=potential water withdrawal); Actual domestic water consumption; Actual manufacturing water withdrawal; Actual industrial water consumption; Actual livestock water consumption; Lake & Wetland storage; Reservoir storage;
Agriculture	GEPIC, PEPIC, LPJML, CLM45	Irrigated crop yields; rainfed crop yields; Irrigated crops biomass yields; Rainfed crop biomass yields; Irrigation water withdrawal (assuming unlimited water supply); Irrigated crop Nitrogen application rate; Rainfed crops Nitrogen application rate
Ecosystem	CARAIB, LPJML, LPJ-GUESS, ORCHIDEE, VISIT	Net Primary Production on Land; Gross Primary Production on Land; Leaf Area Index; Carbon Mass in Soil Pool; Carbon Mass in Vegetation Biomass; Burnt Area Fraction;

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The following plots indicated some instances of data trends according to different CSs, climate drivers, model impact and/or emission scenarios.

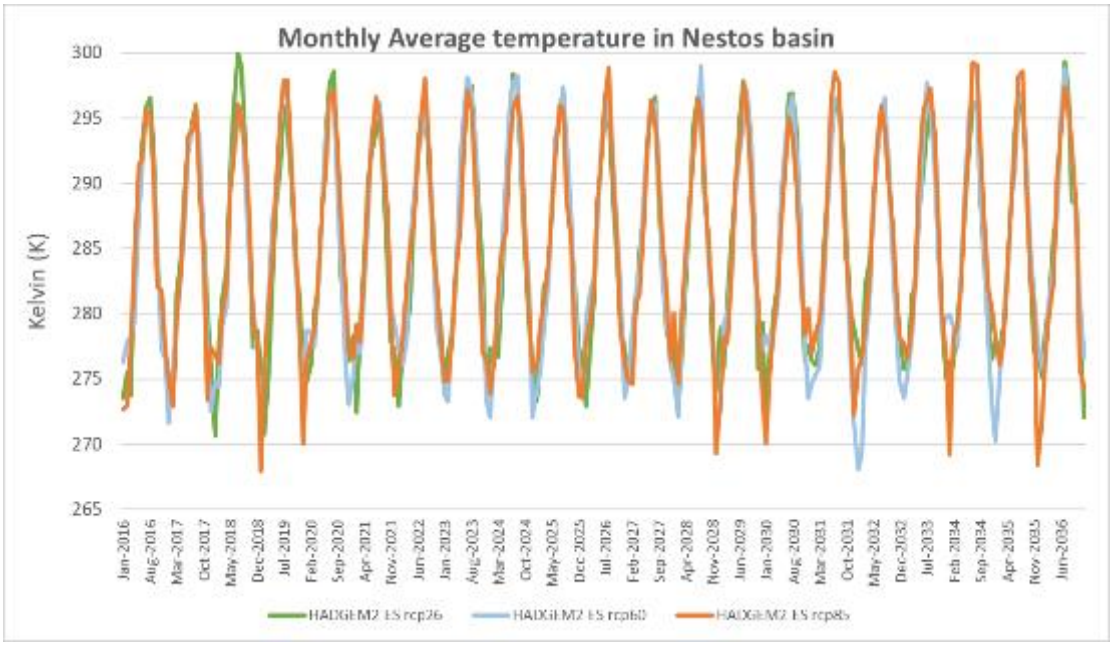

Figure 2. Trends of monthly average mean temperature according to three rcp scenarios (rcp2.6, rcp6.0 and rcp8.5) for Nestos case Study according to HADGEM-ES GCM.

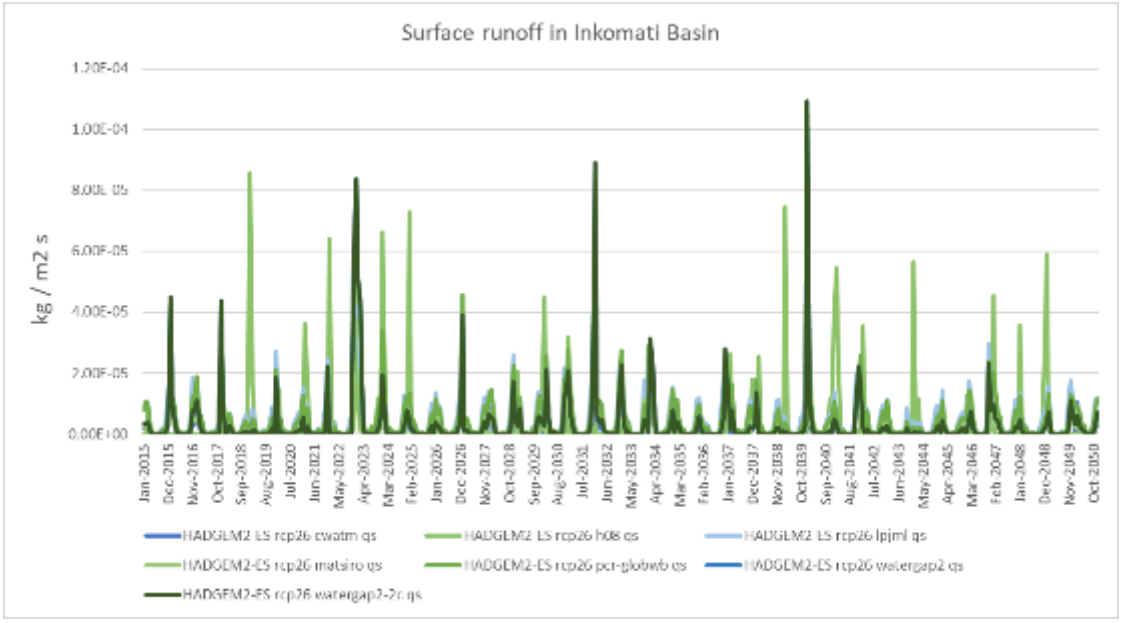

Figure 3. Trends of monthly average mean surface runoff according to different hydrological models for Inkomati case Study according to HADGEM-ES climate projections and RCP2.6.

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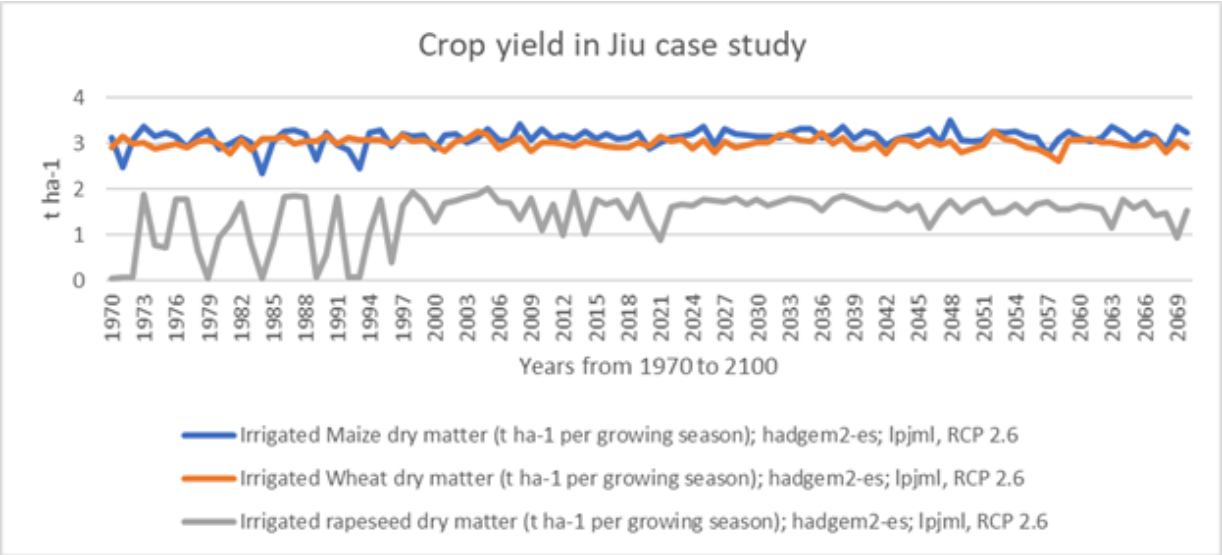

Figure 4 Trends of yearly crop yield for Jiu case Study according to Lpjml, HADGEM-ES GCM climate projections and RCP2.6 scenario.

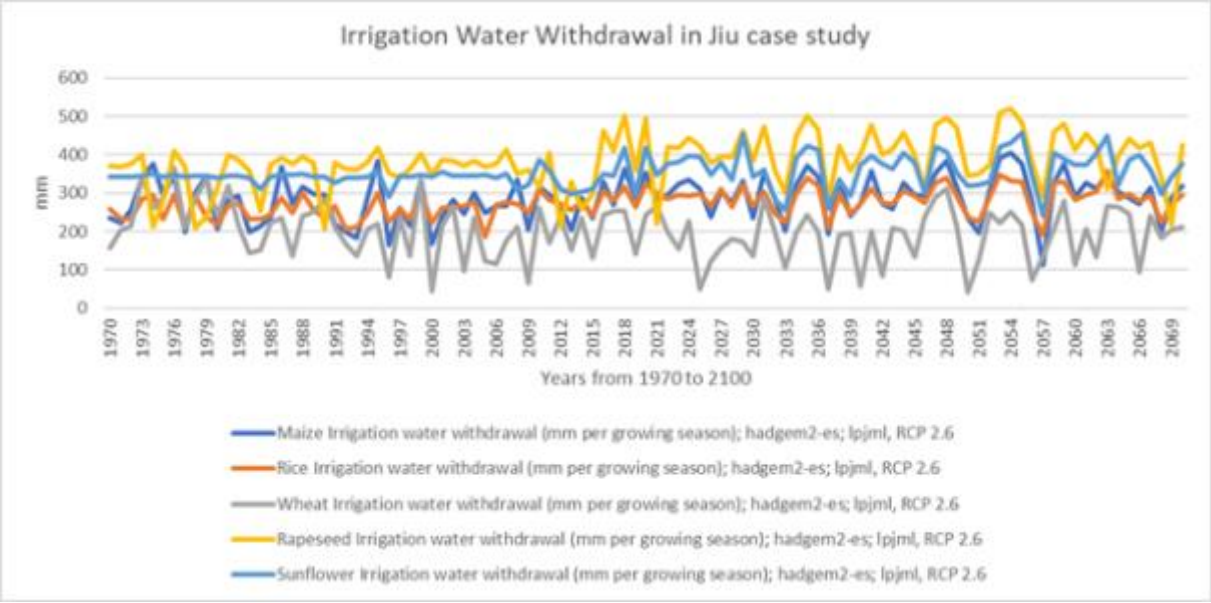

Figure 5. Trends of yearly crop irrigation requirements for Jiu case Study according to Lpjml, HADGEM-ES GCM climate projections and RCP2.6 scenario

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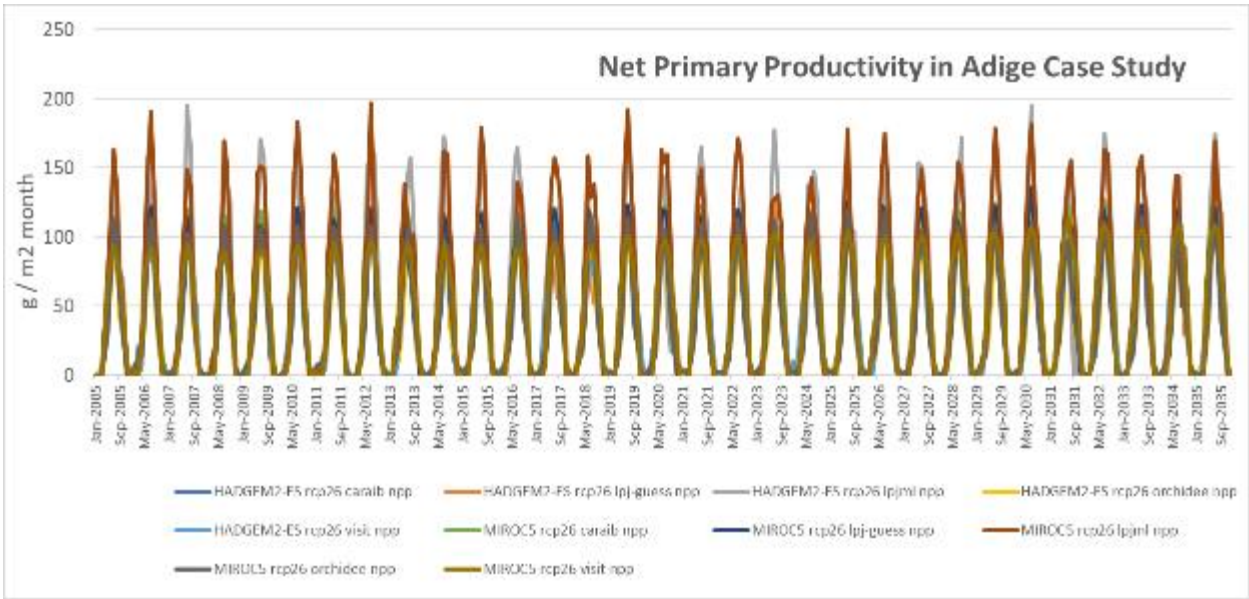

Figure 6. Trends of monthly Net Primary Productivity for Adige case Study according to different ecosystem models (Caraib, Visit, LPJ-Guess, LPJML, Orchidee), HADGEM-ES and MIROC5 climate projections, and RCP2.6 scenario

2.3 Interaction with NXG project Activities and contribution to project Objectives

The deliverable 2.2 consolidates a public Open Research Data Pilot (ORDP), which was first loaded and shared to project partners on NXG surfdrive for internal use, and then upon finalization of the data pilot was also shared on the NXG project Zenodo for wider and public dissemination. This document reports background information and technical description regarding the biophysical modeling data, like climate drivers / impact model, thematic variables, scenarios.

The data has been processed and arranged as data sheets on the project Zenodo, a data sheet for each case study, where all time series values for each variable according to different /climate drivers/impact model/scenarios are available as separate rows among different thematic tabs. These can be plotted on desktop by users though excel or other analytical softwares (e.g. R, matlab, Python), and have been streamlined to System Dynamic Modelling in WP3 that has aggregated multi projections ensembles elaborated on these data and described their use through D3.2. and D3.3.

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WP2 has implemented and advanced the state-of-the-art for biophysical data trends across WEFE NEXUS dimensions. The latest CMIP6 driven biophysical data are used as input to nexus models, then in line with the latest climate modelling simulation run and IPCC VI Assessment Report (2021) climate forcing. In some cases, climate data have been downscaled and gridded as necessary to provide necessary spatial detail for specific case study implementation of hydrological and crop modelling.

Projections and biophysical data modelling are elaborated and consolidated to force and operate SDM first, and NEPAT Machine Learning after, to characterize interlinkages of the WEFE nexus and its response to different policy options. The Biophysical Nexus data projection framework for NEXOGENESIS establishes a common knowledge basis including mapping and creation of harmonized geospatial datasets and indicators of biophysical variables, expanded across a wide range of WEFE aspects. This framework can be can be easily expanded from the used modelling data sources to characterize and feed different implementations of WEFE analyses and extrapolation at EU level. Such framework implementation can support assessment of interlinkages and interdependencies of water, food and energy sectors and ecosystems in different water bodies, and trade-offs available on the long term. In addition, the implementation across a combination of scenarios (i.e. RCPs, SSPs) allows assessing the impact of mitigation efforts against the residual climate change challenge These points are essential to grant and contribute to Objectives 2, 3 and 5 of the NEXOGENESIS project:

Obj1: Accounting for climate change dynamics and socio-economic development with extensive structured and harmonized data projection across CS and mutually consistent mix of RCPs/SSPs scenarios.

Obj2: Assessing uncertainty through multi model/drivers/scenarios for probability distributions of NEXUS variables for WP3, reflecting and risk in quantitative analysis and robust decision-support to policy-makers.

Obj5: Data framework harmonized to facilitate comparable implementation across CS of NXG solution. Expandable to different implementations and extrapolation across EU.

The dataset was used intensively and tested in WP3 for System Dynamic Modelling (SDM). In particular, in task 3.2 (“Biophysical and socio-economic models: Implementation for all case studies under selected scenarios”) the specific use and implementation in SDM of these biophysical data (together with the socio-economic data projections developed in task 2.3) have been elaborated and described, with clear links and definition to the specific variables for any of the different case studies. Furthermore, the data need for WP3 activities, and thereafter WP4 activities, have been discussed and validated through multiple discussion with modellers and stakeholders at case study level, and integrated in the D3.3

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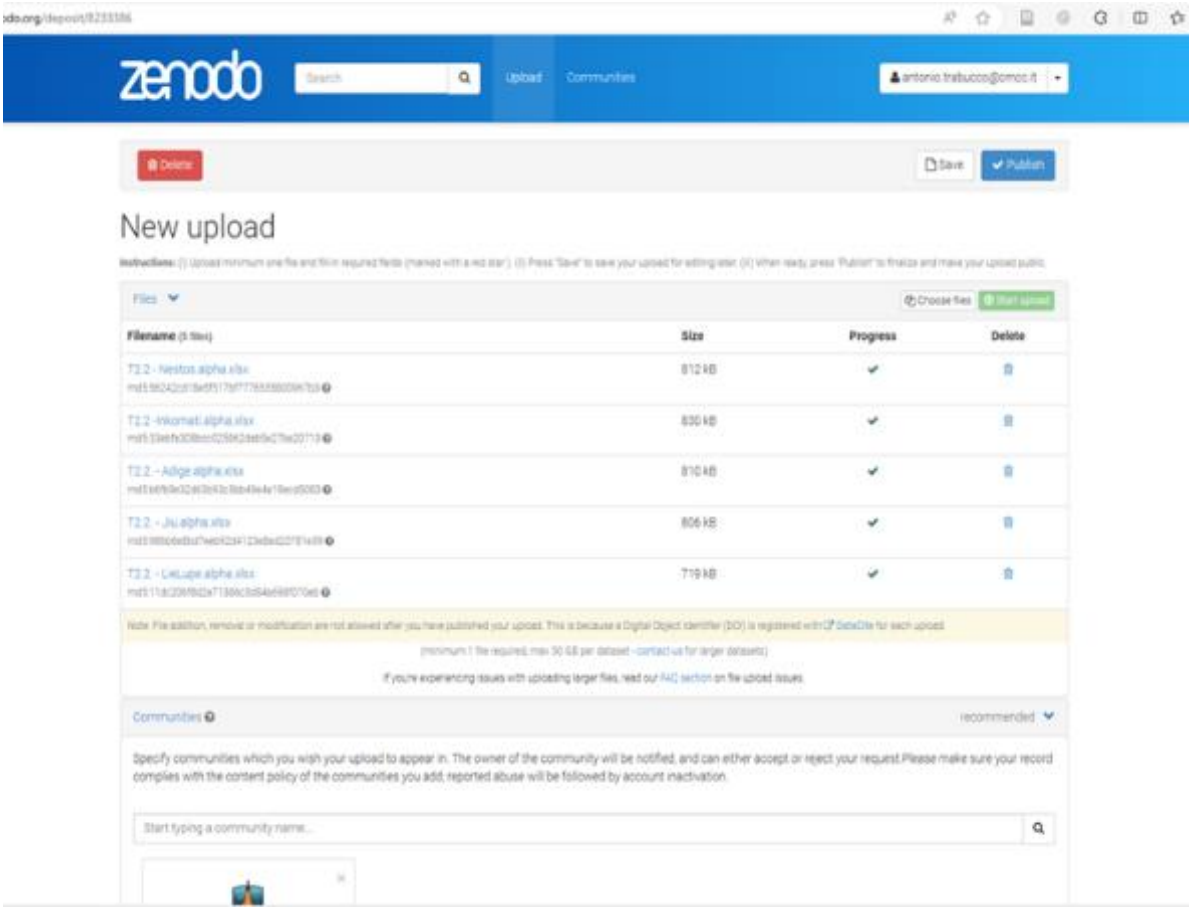
3 ORDP: Open Research Data Pilot

3.1 Open AIRE

OpenAIRE has been consolidated since 2013 as Open Research data Pilot (ORDP) to publish project data and disseminate research outputs in compliance with European Commission (EC) and national funders'. OpenAIRE is a tool that grants Open Access policies for publications and data, but also links published data to specific EC funded projects, via the EC Participant Portal and the network of repositories. Specifically OpenAIRE created the repository Zenodo (https://zenodo.org and https://openscience.eu/zenodo/), enabling researchers and project partners to share and document their research outputs, regardless of size or format. Zenodo makes such scientific outputs citable, shareable and discoverable over the long term. To the end of publishing and making available Open Research Data produced from NXG projects, Nexus data vector of biophysical data for each case study has been uploaded on Zenodo Nexogenesis community (https://zenodo.org/communities/nexognesis/) via OpenAIRE, with a structure of compiled data vectors in separate files for each of NXG Case Study. Each data vector reports average value (over unit surface area) for the whole basin.



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3.2 Climatic and Biophysical Data Description

The set of data delivered for each case study involved in the NXG project and currently uploaded on the open repository Zenodo include the following information:

The data is provided as monthly/annual trends from historical over future projections (i.e. 1971-2070) under different radiative forcing (i.e. Representative Concentration Pathways or RCPs) to cover different thematic variables related to four main sectors, i.e., climate, water, agriculture, and ecosystem.

RCP 2.6, RCP 6.0 and RCP 8.5 RCP 2.6, RCP 6.0 and RCP 8.5 have been chosen as plausible future GHG emission scenarios to test effects of mitigation policies and as probabilistic distribution function for uncertainty analyses.

Data is forced with the latest CMIP6 climate projections,

The biophysical and climate data are provided as separate file for the five NXG case studies located in Europe and Africa: 1) Nestos river basin (BG-EL); 2) Lower Danube Basin (RO); 3) Lielupe River basin (LT-LV); 4) Adige River Basin (IT); 5) Inkomati-Usuthu River Basin (ZA). Among these CSs, two are transboundary: Nestos (Greece- Bulgaria) and Lielupe (Latvia-Lituania).

- T2.2 - Adige 3b.2.1.xlsx

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- T2.2 - Jiu 3b.2.1.xlsx

- T2.2 - Lielupe 3b.2.1.xlsx

- T2.2 - Nestos 3b.2.1.xlsx

Spatial resolution: Average values over the basin

Keywords: Climate, Hydrology, Ecosystems, Agriculture, Water, Food

Source of data → repositories sites, climate data services, model data; *e.g., ISIMIP3b/CMIP6, ISIMIP2b/CMIP5, Copernicus Climate Change Data Service, GLOBIO, SIMETAW-GIS*

Sector → Nexus Sectors; *e.g., Agriculture, Climate, Water, Ecosystem*

Short name –> short suffix used in coding and file naming; *e.g., a) tas, b) Qs, c) evap*

Long name → *e.g., a) 2m Temperature, b) Surface RunOff, c) Total Evapotranspiration*

NEXOGENESIS STREAMLINING WATER RELATED POLICIES

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Description → Description of the variables; *e.g., a) Near-Surface Air Temperature. Data are available at monthly resolution; b) Surface runoff. The surface runoff is expressed in kg m-2 s-1 and it is the water that leaves top soil layer (the surface layer). Data are available at monthly scale. C) Crop Yield. The crop yield is expressed in dry matter as tons ha-1 per growing season. The crop model simulations have a global spatial coverage under the assumption that the crops are cultivated everywhere.*

Unit → unit for which variables are expressed; *e.g., a) K; b) kg m-2 s-1; c) tons ha-1*

Available Spatial resolution/s → *e.g., average over basin, 0.5 degrees*

Impact model → model used to define sectorial impact following climate drivers and scenarios; *e.g., CLM 45, ORCHIDEE, GEPIC, WaterGAP*

Climate forcing → Atmospheric climate input (data projections) used for impact modeling; *e.g., HadGEM, MIROC, GFDL-ESM2M, EC-EARTH*

Climate scenario → emission and/or socioeconomic scenarios; *e.g., RCP2.6, RCP 6.0, RCP 8.5*

Time period → Historical and future time frame of data projections; *e.g., 1971-2070*

Available temporal resolution → data temporal frequency or time steps; *e.g., monthly, yearly, 30-yr mean*

Available rainfed crop → crops modelled for agricultural sector; *e.g., maize, rice, wheat, soy, millet, sugar beet, cassava, rapeseed*

Available Irrigated crops → crops modelled for agricultural sector; *e.g., maize, rice, wheat, soy, millet, sugar beet, cassava, rapeseed*

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