UNIVERSITÀ DEGLI STUDI DI BERGAMO

justWATER
Water Decision Making tools for informed hydropolitics in Italy

European Commission
Marie Skłodowska-Curie Actions

JustWATER

Water Decision Making tools for informed hydropolitics in Italy

SUMMARY

1. JustWATER : project overview / how food production affects fragile water bodies in Italy through the analysis of virtual water and water footprint analysis
2. Gender component : Women in Water in Italy project component
3. Methodological challenges
4. Challenges: how co – creating viable solutions and not imposing prescriptions (like export substitution or crop substitution)
5. the GEOSPATIAL outputs of JustWATER
6. Providing informed decision making for policy makers:

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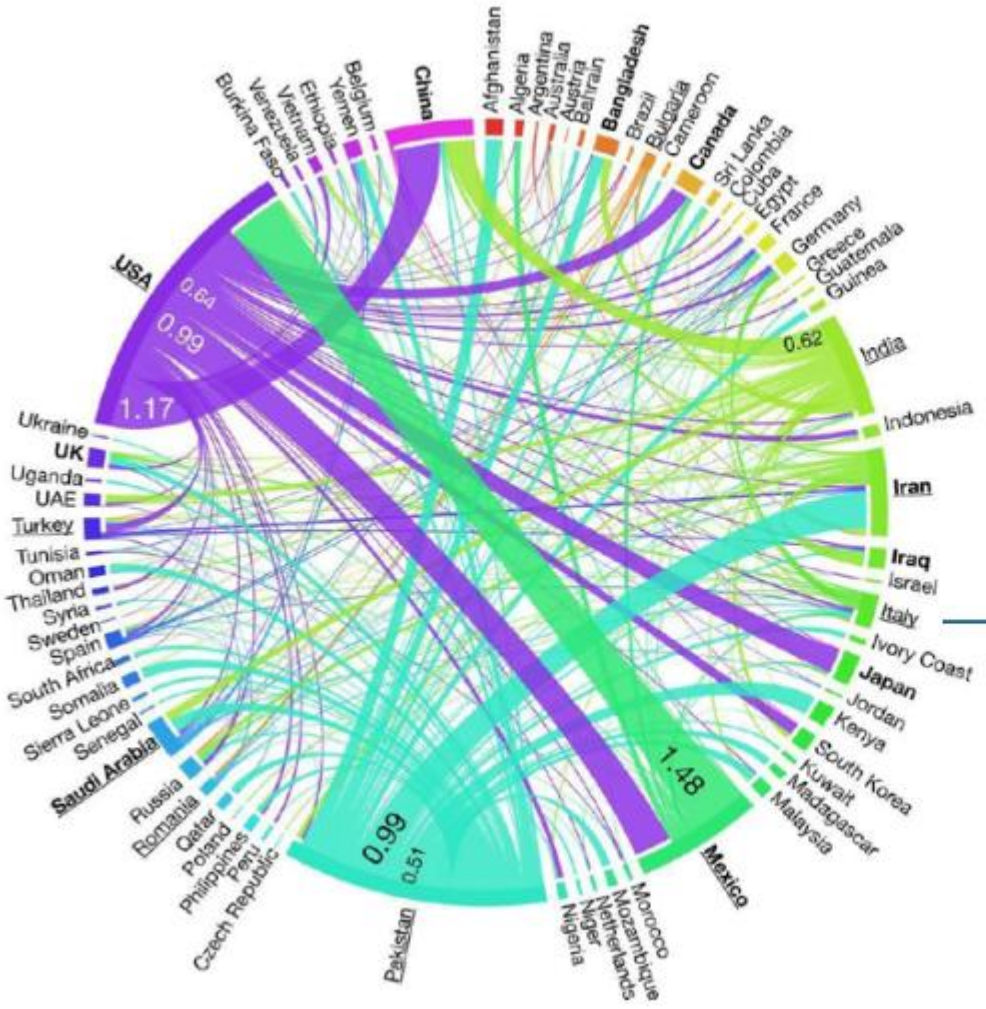
OUTPUTS (as per Marie Skłodowska Curie requirement)

OPEN ACCESS & INTEROPERABILITY OF DATA REGARDING ITALY WITH HIGH GEOSPATIAL RESOLUTION

1. Using GIS mapping and geo Python large dataset processing
2. Creating open access maps of virtual water and water footprint from selected Italian water bodies with the highest amount of withdrawals

PROJECT OVERVEW

THE PROBLEM



Esaurimento delle acque sotterranee nelle esportazioni agricole internazionali nel 2010

Groundwater depletion due to agricultural exports in 2010 (Nature, 2017)

L'Italia si colloca tra i 10 esportatori più grandi

Italy is among the 10° largest exporters of vulnerable groundwater

Source:Dalin et al. 2017

SOME TERMINOLOGY / VIRTUAL WATER GREEN WATER, BLUE WATER, WATER FOOTPRINT

Virtual water

is the total volume of water consumed to produce crops, or a product, service, or commodity. This "hidden" or "embedded" water is not the water that is directly visible in the final item, but rather the water consumed during its entire value chain, from production to distribution.

Green water

is freshwater from rain which does not contribute to surface water but stays in the body of plants, constitute soil moisture and allows transpiration of plants.

Blue water

is freshwater from lakes, rivers and groundwater.

It is what we use for irrigation of crops and what arrives to us from the tap of our home. It is what we

know as “freshwater”

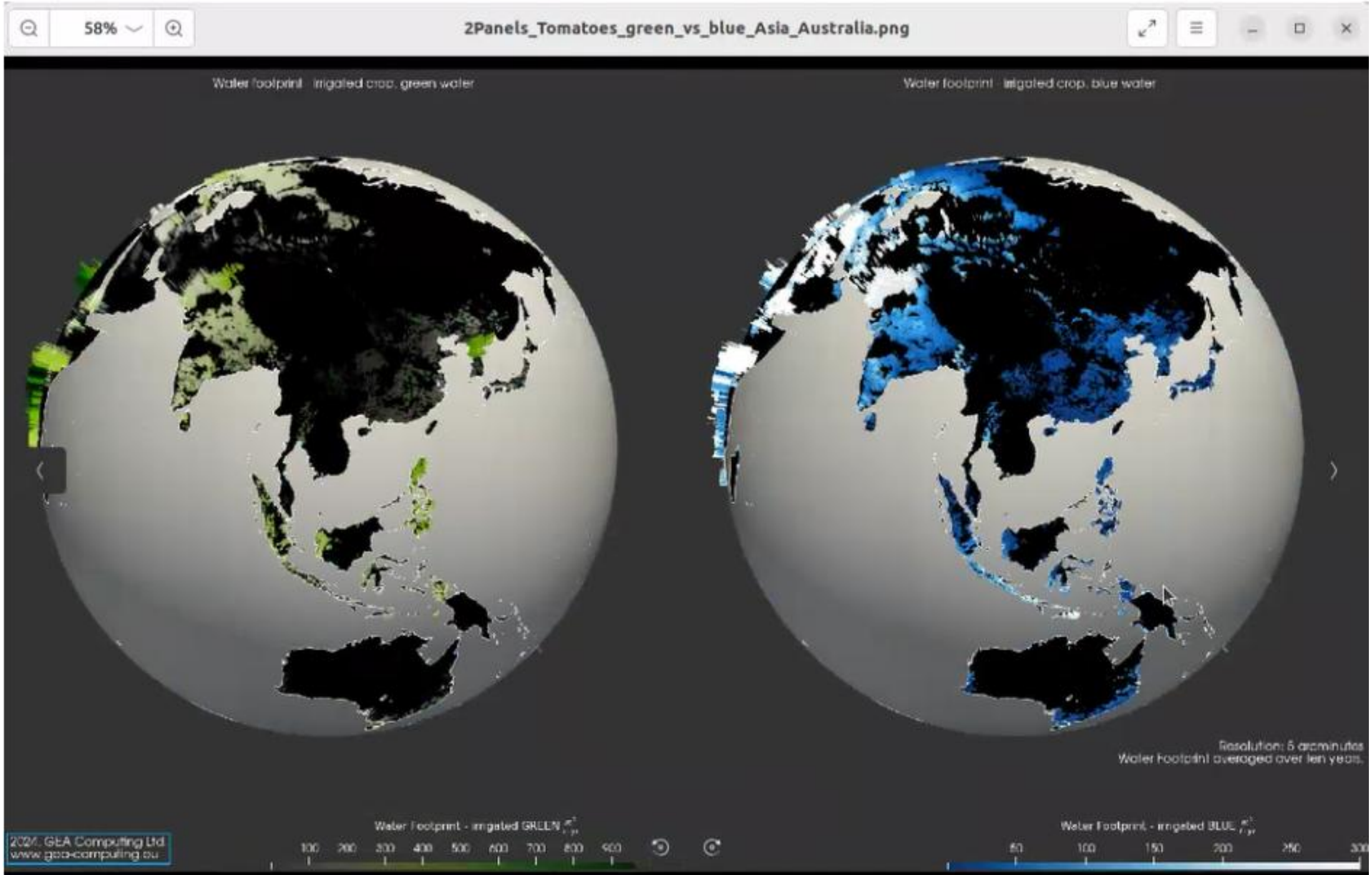
SOME TERMINOLOGY / VIRTUAL WATER GREEN WATER, BLUE WATER, WATER FOOTPRINT

THE WATER FOOTPRINT

Is an indicator of water consumption , which includes

- Green water
- Blue Water
- Grey Water (representing pollution dilution)

In order to understand withdrawals from water bodies of Italy, we will focus more on Irrigated BLUE WATER component of water footprint of crop production.


58%
2Panels_Tomatoes_green_vs_blue_Asia_Australia.png
Water footprint - irrigated crop, green water
Water footprint - irrigated crop, blue water
Resolution: 5 arcminutes
Water footprint averaged over ten years.
Water Footprint - irrigated GRLLN
100 200 300 400 500 600 700 800 900
Water Footprint - irrigated BLUE
50 100 150 200 250 300
2024, GEA Computing Ltd
www.gea-computing.eu

1. Providing informed decision making for policy makers: the GEOSPATIAL output of JustWATER

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MAIN GOAL: GEO LOCATING VULNERABLE WATER BODIES WITH THE HIGHEST WATER FOOTPRINT DUE TO IRRIGATION IN ITALY

Getting a baseline water dataset for the geo localization of vulnerable water bodies, using Aqueduct 4.0 dataset

Mapping intersections , relevant and non – relevant data

Connecting the dots: overlapping the baseline dataset with water data from Water Footprint Dataset (last update: May 2025 Source: Myalik et al 2024/ May 2025 update).

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USE OF AQUEDUCT 4.0 DATASET ON ITALY

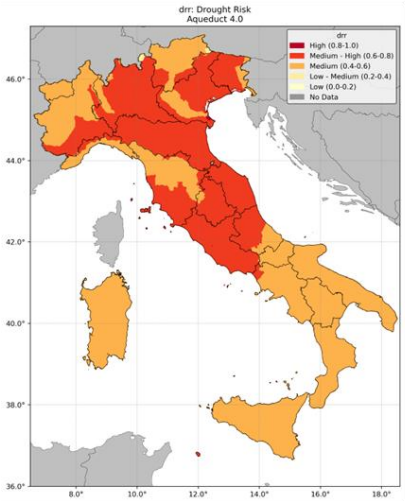
The 5 maps illustrate:

- top left : Italy under drought risk. Not surprisingly the North is on medium-high risk for drought and this map represents 2019, anticipating the 2022-2023 drought

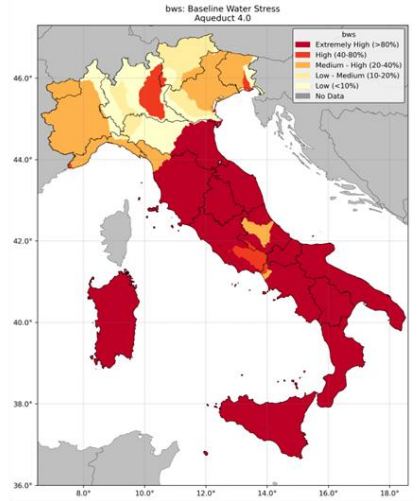
-top right: Italy is under water stress in almost its totality

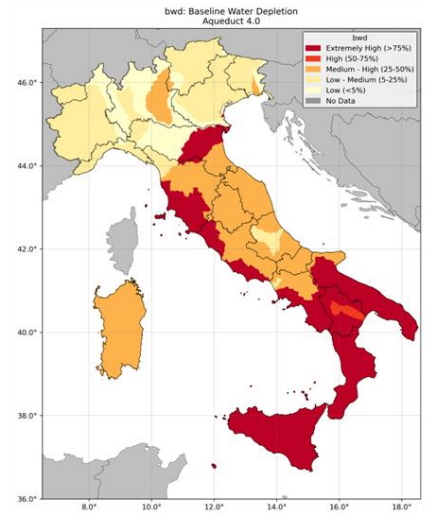
- bottom right: Water depletion (when natural recharge is lower than withdrawals) is higher in the South
- bottom central map: Groundwater Table Decline is of interest only in Liguria and Sicily
- Bottom right: intersection map between extremely high values for water stress, water depletion and drought risk

DROUGHT RISK

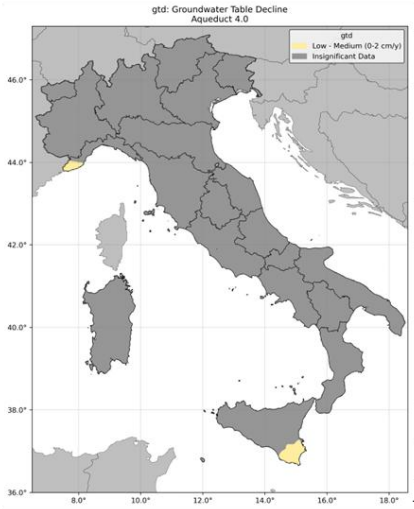


WATER STRESS





WATER DEPLETION



GW TABLE DECLINE

INTERSECTIONS

baseline water dataset for the geo localization of water bodies of interest, using Aqueduct 4.0 dataset

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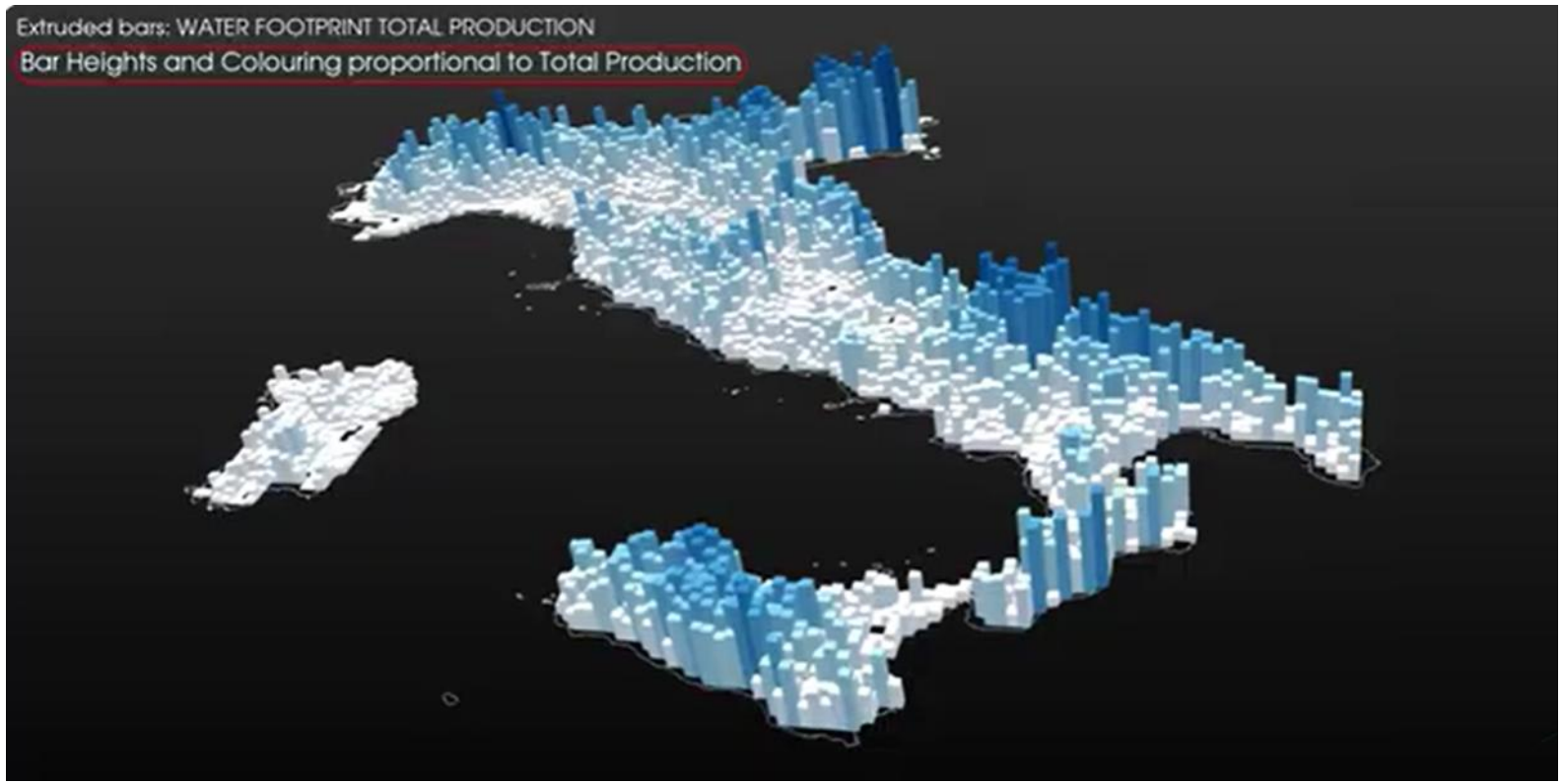
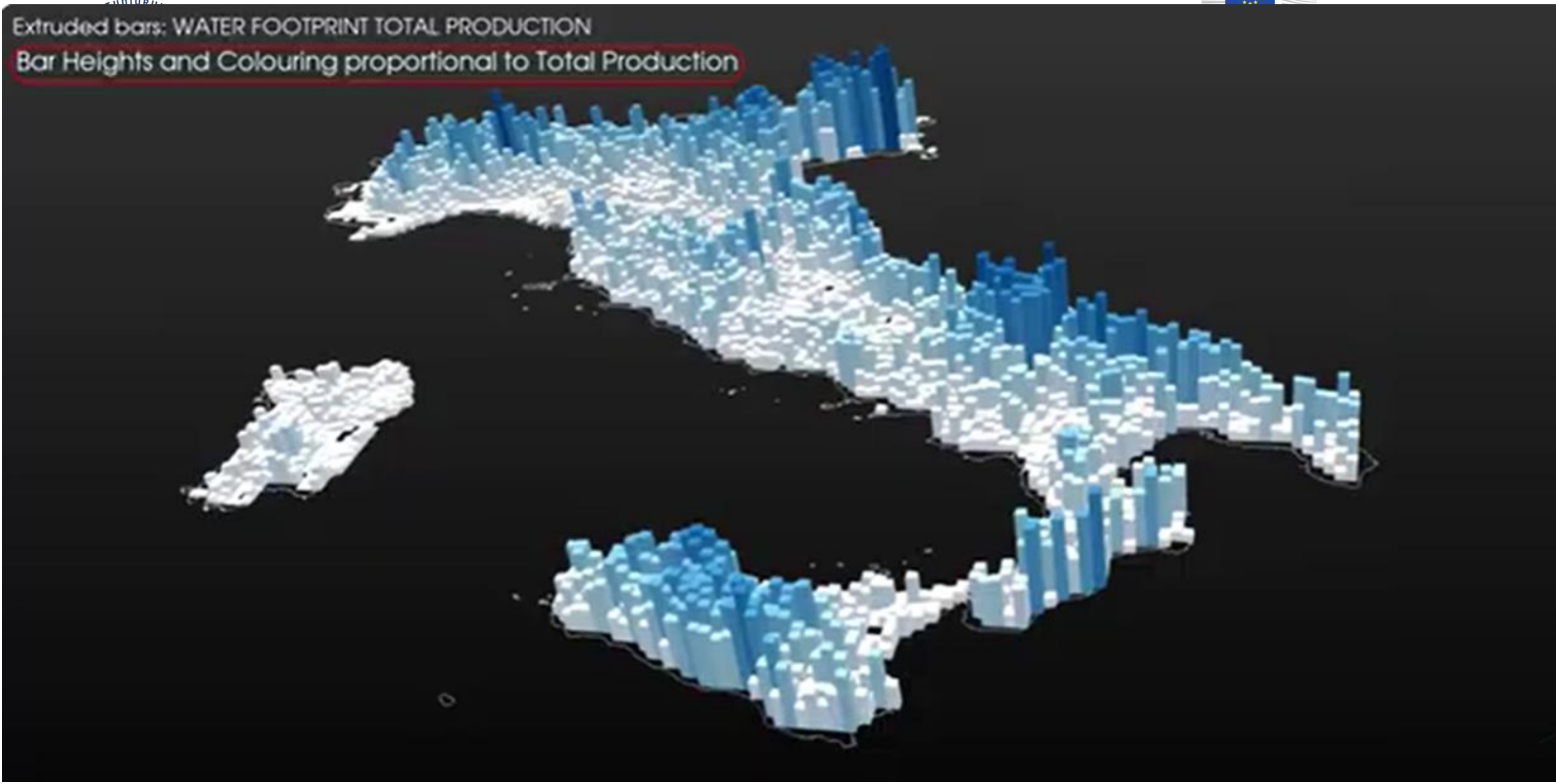
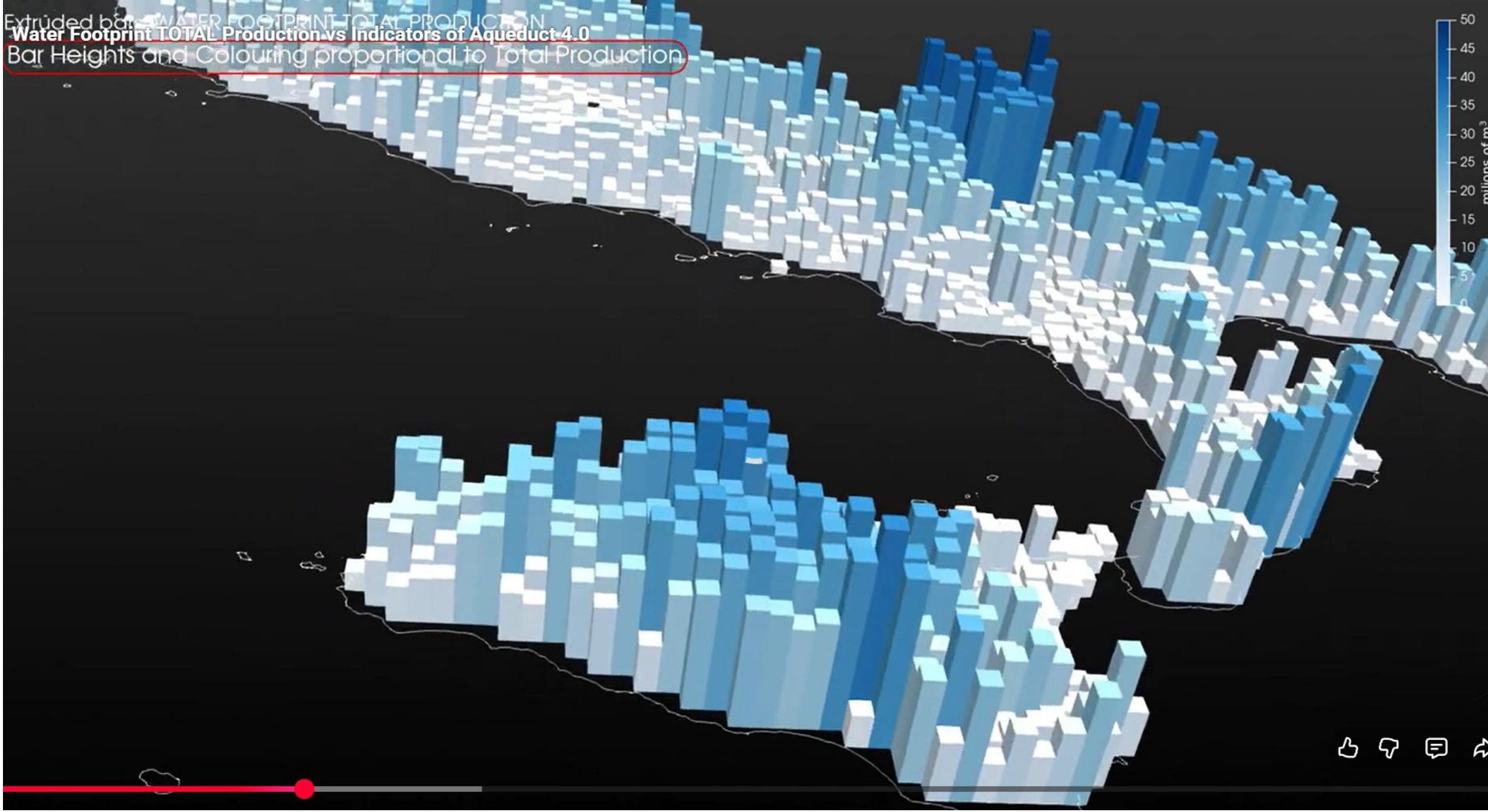
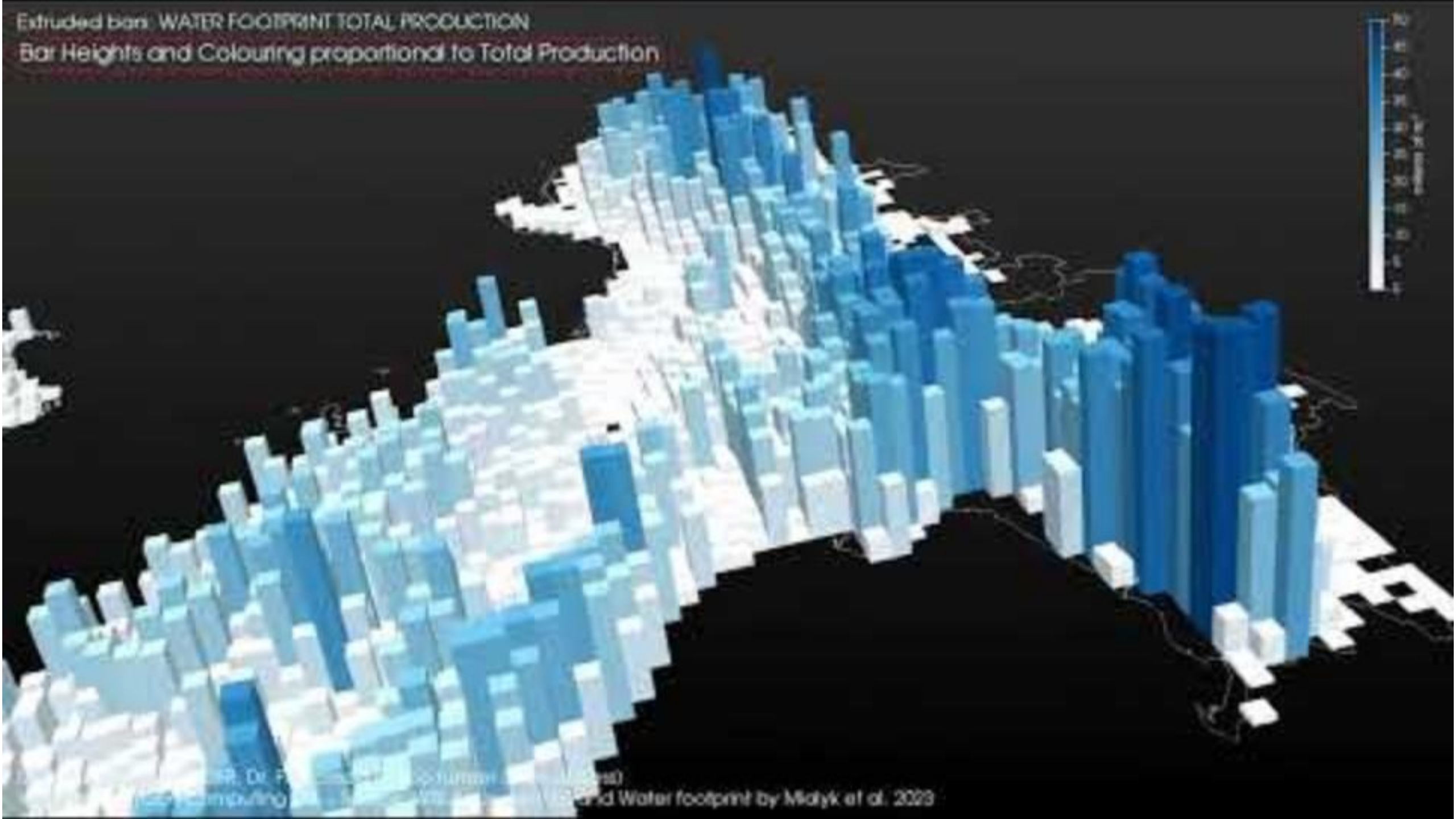
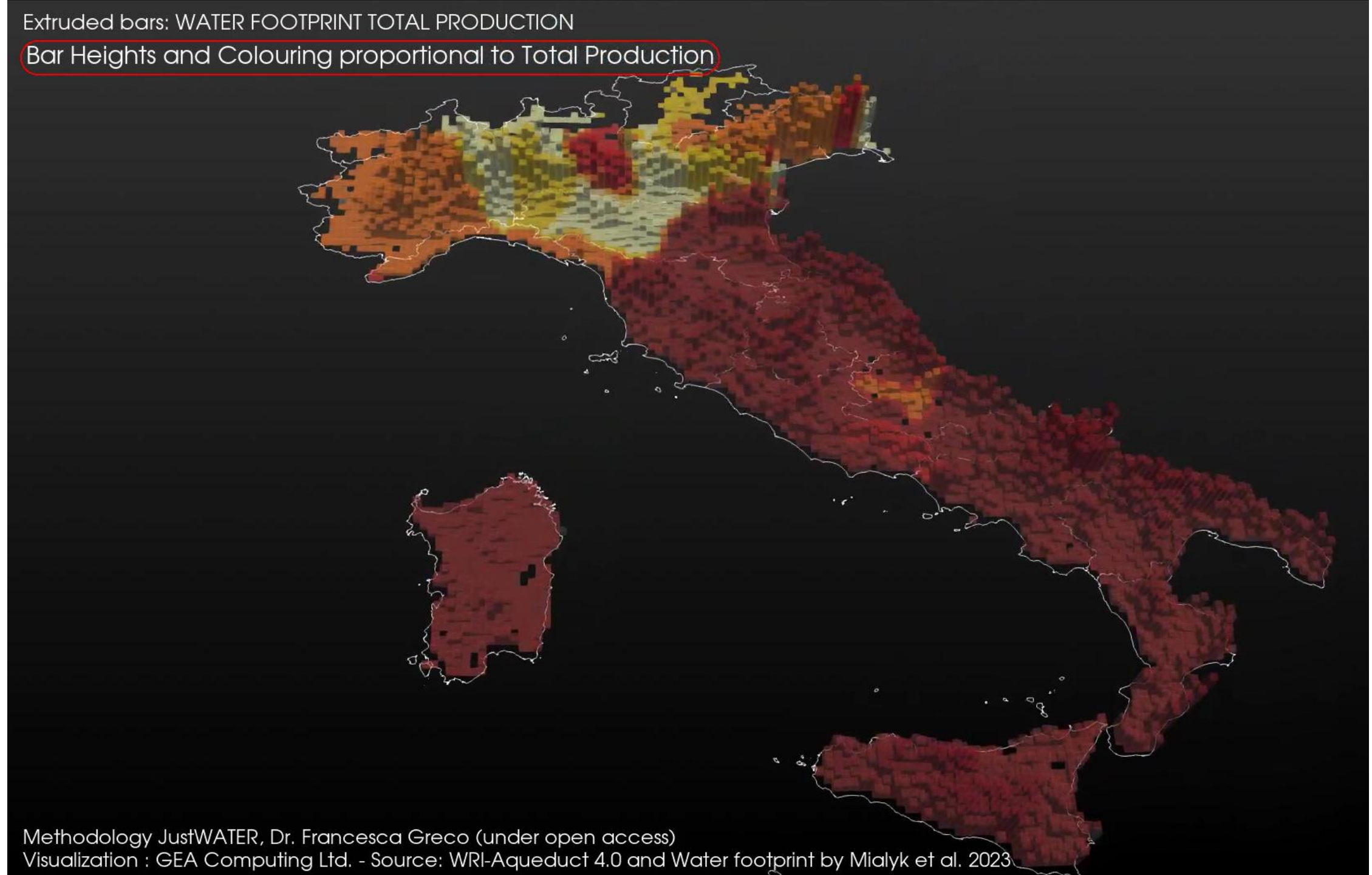
Water Footprint Data for Italy from Water Footprint Dataset
2025 update (Source: Myalik et al 2024) and its application to AQUEDUCT 4.0 Drought Risk, Water Depletion, Groundwater Table Decline and Water Stress.

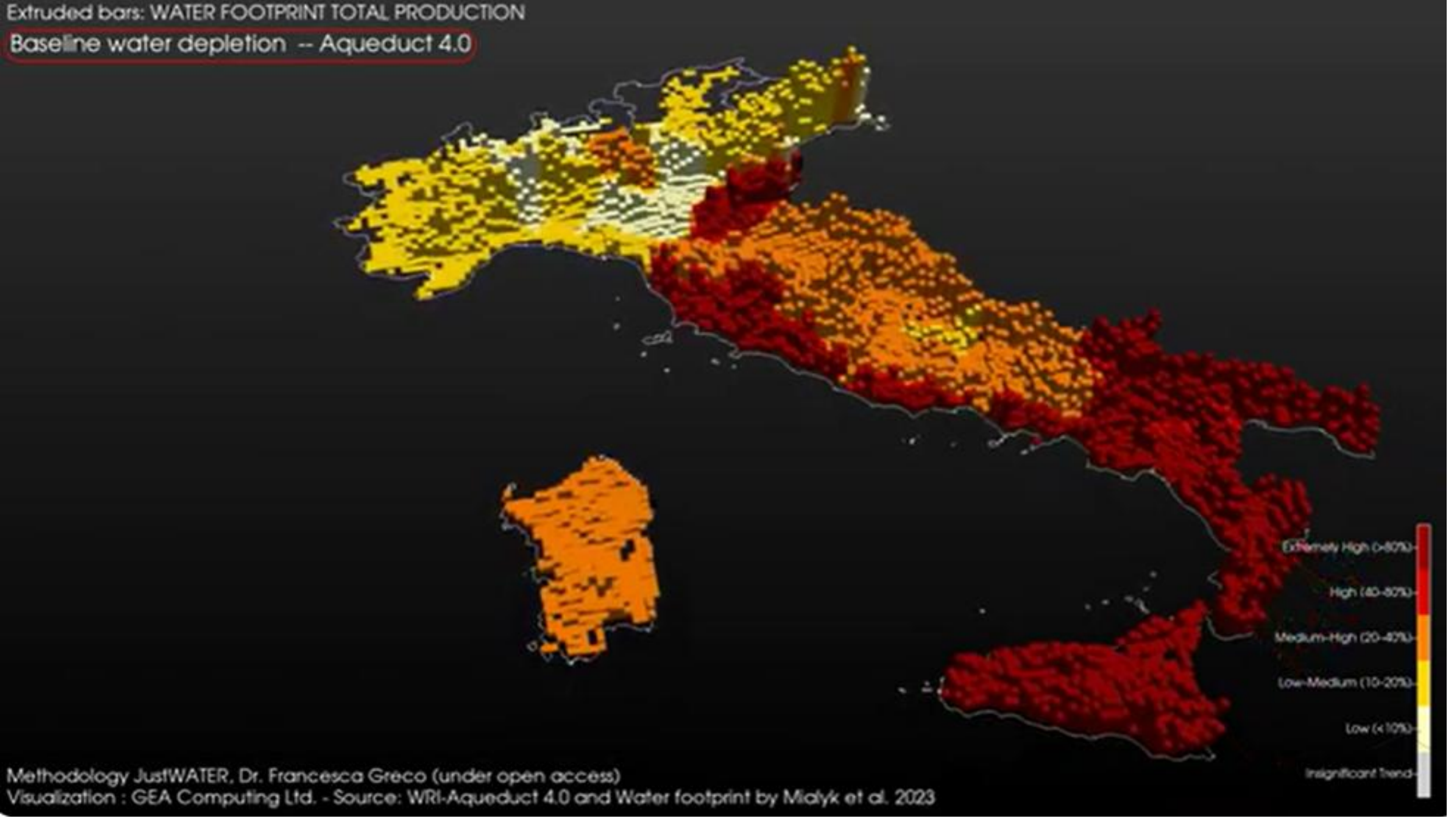


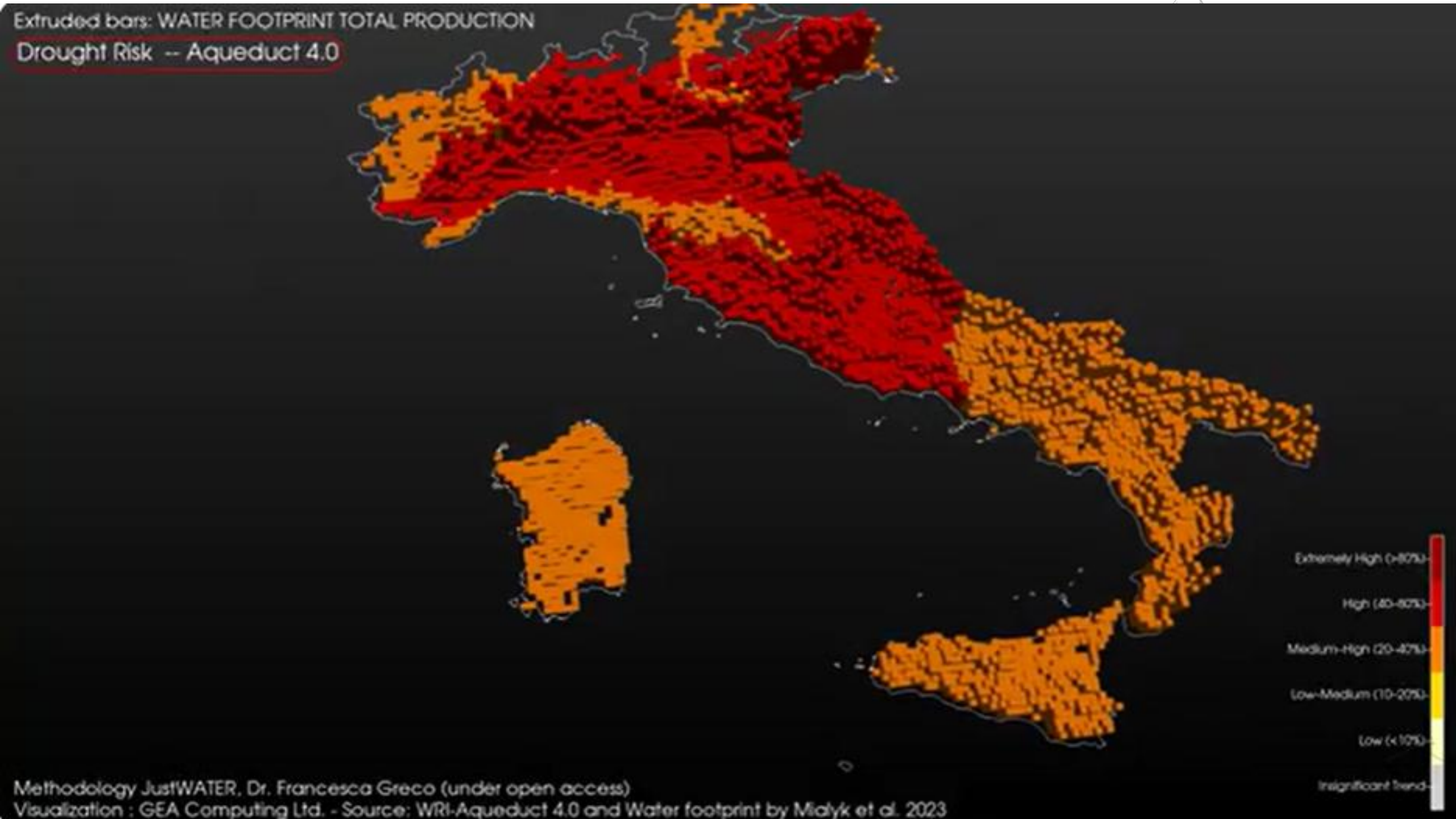

Extruded bars: WATER FOOTPRINT TOTAL PRODUCTION
Bar Heights and Colouring proportional to Total Production


Extruded bar: WATER FOOTPRINT TOTAL PRODUCTION
Water Footprint TOTAL Production vs Indicators of Aqueduct 4.0
Bar Heights and Colouring proportional to Total Production
50
45
40
35
30
25
20
15
10
5
0
millions of m3


Extruded bars: WATER FOOTPRINT TOTAL PRODUCTION
Bar Heights and Colouring proportional to Total Production
nd Water footprint by Mialyk et al. 2023


Extruded bars: WATER FOOTPRINT TOTAL PRODUCTION
Bar Heights and Colouring proportional to Total Production
Methodology JustWATER, Dr. Francesca Greco (under open access)
Visualization : GEA Computing Ltd. - Source: WRI-Aqueduct 4.0 and Water footprint by Mialyk et al. 2023


Extruded bars: WATER FOOTPRINT TOTAL PRODUCTION
Baseline water depletion -- Aqueduct 4.0
Extremely High (>80%)
High (40-80%)
Medium-High (20-40%)
Low-Medium (10-20%)
Low (<10%)
Insignificant Trend
Methodology JustWATER, Dr. Francesca Greco (under open access)
Visualization : GEA Computing Ltd. - Source: WRI-Aqueduct 4.0 and Water footprint by Mialyk et al. 2023


Extruded bars: WATER FOOTPRINT TOTAL PRODUCTION
Drought Risk -- Aqueduct 4.0
Extremely High (>80%)
High (40-80%)
Medium-High (20-40%)
Low-Medium (10-20%)
Low (<10%)
Insignificant trend
Methodology JustWATER, Dr. Francesca Greco (under open access)
Visualization : GEA Computing Ltd. - Source: WRI-Aqueduct 4.0 and Water footprint by Mialyk et al. 2023


Extruded bars: WATER FOOTPRINT TOTAL PRODUCTION
Water Table Decline -- Aqueduct 4.0
Extremely
Medium-Hi
Low-Medi

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Water Footprint Data for Italy from Water Footprint Dataset

2025 update (Source: Myalik et al 2024) and its application to AQUEDUCT 4.0 Drought Risk, Water Depletion, Groundwater Table Decline and Water Stress.

Methodologial justification

1. Global methodological consistency
AQUEDUCT 4.0 applies a unified and peer-reviewed framework for assessing physical water risks, regulatory risks, and reputational risks. This allows Italy to be compared reliably with other countries and regions, which is essential for studies involving EU, Mediterranean, or global benchmarks. (more on the methodological choices is available in the poster roll up).

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SCAN & WATCH FULL VIDEO

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MAIN GOAL: GEO LOCATING VULNERABLE WATER BODIES WITH THE HIGHEST WATER FOOTPRINT DUE TO IRRIGATION IN ITALY

Identifying the water bodies where water withdrawals are putting more pressure to the water body

Mapping intersections of surface water bodies with groundwater bodies

Connecting the dots: vulnerable water bodies where most irrigation withdrawals happen in Italy. Data from Water Footprint Dataset (last update: May 2025. Source: Myalik et al 2024/ May 2025 update).

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GENDER COMPONENT: LITERATURE REVIEW & SEX DISAGGREGATED INDICATORS for the topic “WATER AND GENDER IN ITALY”

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Water Decision Making tools for informed hydropolitics in Italy

Method: UNESCO WWAP

TOPIC COVERED BY THE SURVEY :

- Agriculture / agricultural extension services for women and men
- Women in water policy and politics in Italy
- Women in water related STEM / education
- female immigrant work in the agricultural sector

JANUARY 2025:
PRESENTED at PISA UNIVERSITY AT THE INTERNATIONAL WORKSHOP ON WATER AND GENDER / WWAP UNESCO

- member of the Scientific Committee of the conference
- Paper published by UNESCO for WWDAY26

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WOMEN IN WATER ITALY

- HOMEPAGE
- PRACTICAL INFORMATION
- SPEAKER LIST

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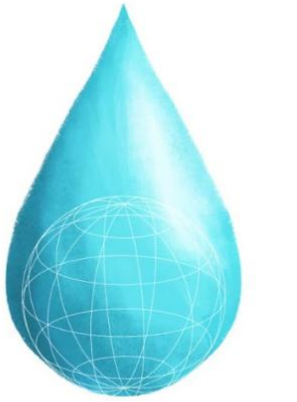
WOMEN IN WATER ITALY is part of the project



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https://sites.google.com/unibg.it/WOMENINWATERITALY

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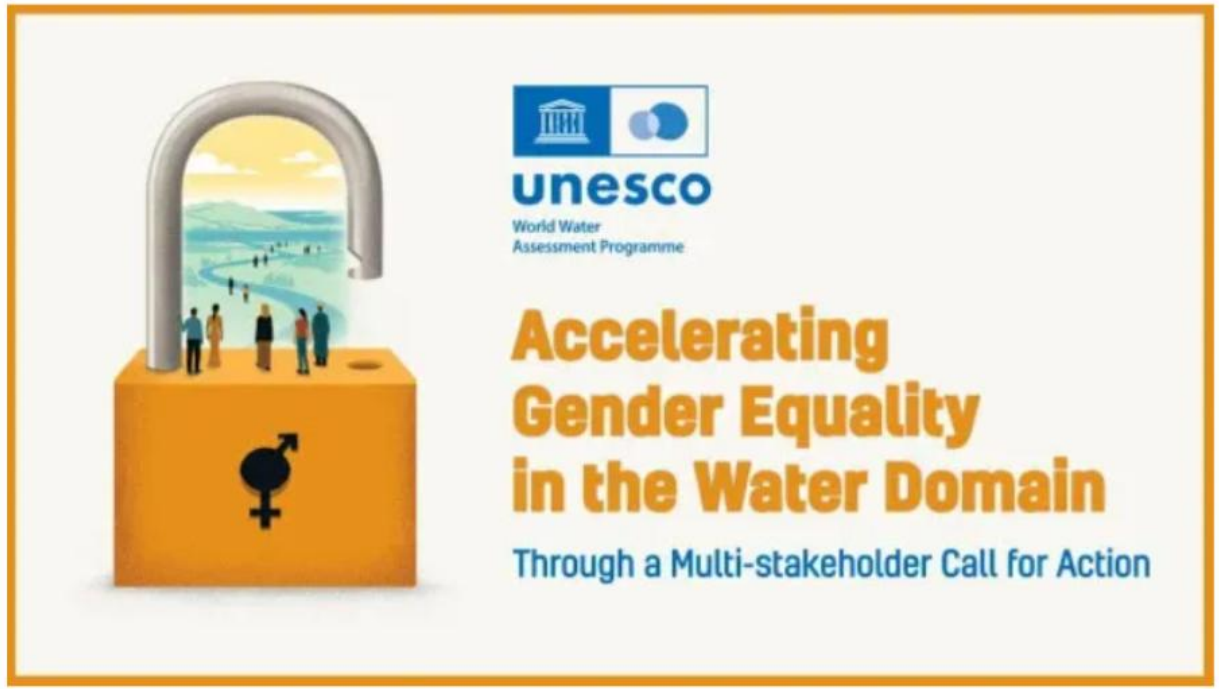
The University of Bergamo joined the UNESCO Coalition for the Acceleration of Gender Equality in the Water Domain (April 2024)



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OUTPUT 1 / GENDER / UNESCO PUBLICATION

unesco

Women and water in Italy: gender roles in the water sector, a preliminary review, methodological framework and indicators

currently under publication in OPEN ACCESS through UNESCO

Francesca Greco, Marie Skłodowska-Curie Researcher, Bergamo University, Italy; Visiting Research Fellow, King's College London, UK

Abstract

This study explores women's participation in Italy's water sector – science, agriculture, policy, and governance – addressing a critical gap in national research on gender and water governance. Anchored in feminist Political Ecology, intersectionality issues, and gendered institutions theory, it applies the UNESCO World Water Assessment Programme (WWAP) gender-responsive sex-disaggregated indicators to the Italian context for the first time. The preliminary literature reveals persistent gender disparities in the realm of technical professions, decision-making, and policy influence, compounded and exacerbated by regional inequalities and entrenched gender norms of the country. By operationalizing UNESCO WWAP indicators, the study not only contributes to the creation of a methodology but also to the provision of a first questionnaire in order to allow the production of empirical insights into Italy's gender–water nexus. The paper also offers methodological guidance for integrating gender perspectives into national water policy. This preliminary study provides a foundation for evidence-based interventions that address structural barriers, promote capacity-building, and strengthen institutional accountability in line with European Union (EU) directives and stemming from the UNESCO-led international "Call for Action for the Advancement of Gender Studies and Promotion of Women in the Water Sector". This research builds on the University of Bergamo participation in the WWAP Coalition for "Accelerating Gender Equality in the Water Domain" and it is funded by the EU-Marie Skłodowska Curie Action "JustWATER".

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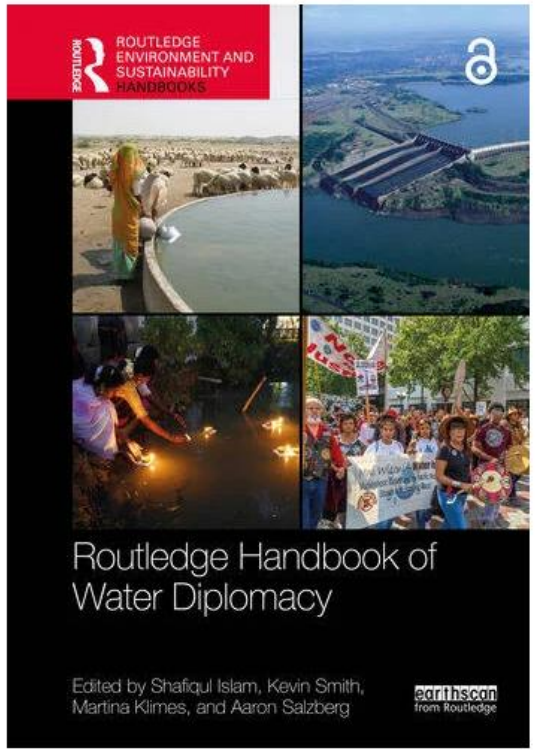
OUTPUT 2 / GENDER :CHAPTER ROUTLEDGE HANDBOOK OF WATER DIPLOMACY

25

GENDER MAINSTREAMING AND GENDER TRANSFORMATIVE APPROACHES

Assessing Progress and Potential in Water Diplomacy

Francesca Greco



OPEN ACCESS
FREE TO
DOWNLOAD

WORLD WATER DAY 2026

WATER AND GENDER EQUALITY

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Methodological challenges

EXTERNAL DATASET

PCR-GLOBWB 2.0

PCRaster GLOBal Water Balance model: version 2.0

Data from the database Aqueduct WRI (**4.0**) (original data from the dataset GLOBWB 2.0 Water Balance Dataset) , Water Footprint Network Dataset, FAO Cropwat dataset
VARIABLES:

- WATER STRESS
- GROUNDWATER TABLE DECLINE
- DROUGHT RISK
- BASELINE WATER DEPLETION (4.0)
- BASELINE WATER STRESS (4.0)

- **OLD DATA**
  - MISSING DATA
  - ITALIAN DROUGHT 2022 2023 NOT COVERED
  - GROUNDWATER NOT ENOUGH EXPLORED

regional export and Trade data (UN TradeMap). Copernicus (European Dataset)

- **ISTAT data not available**

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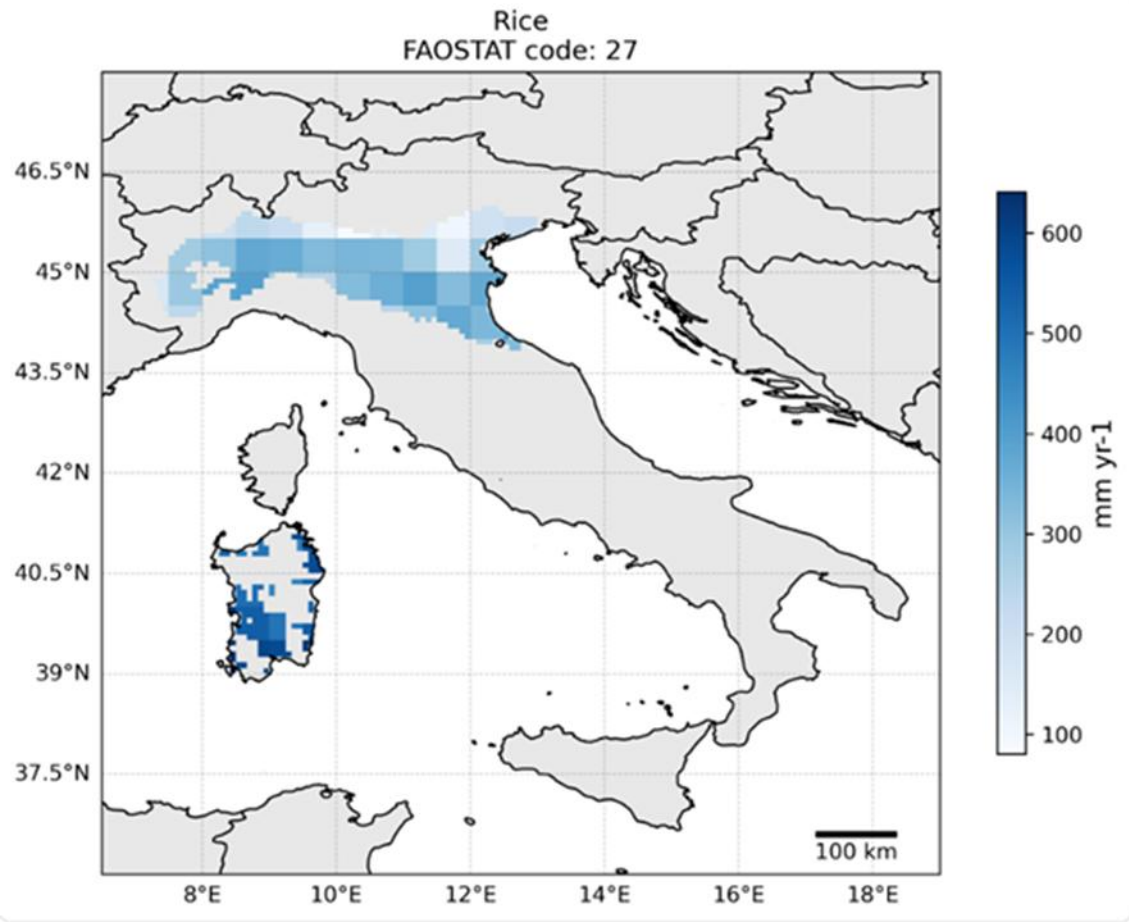
USE OF WATER FOOTPRINT DATA ON ITALY: EXAMPLE OF NATIONAL USE OF THE DATASET: BY CROPS: RICE

Water Footprint Data for Italy from Water Footprint Dataset (Source: Myalik et al 2024/May 2025 update): out of the National Water Footprint of Production, JustWATER has extrapolated the irrigated blue component, which is representing irrigation and excluding rainwater (green water) component

Crop production (irrigated blue water footprint) has been performed for Italy for 175 crops and is available under image file and Georeferred file in GitHub and ZENODO id:francescagreco78 from 31° dec 2025.

Challenges: how co – creating viable solutions and not imposing prescriptions (like export substitution or crop substitution)



IRRIGATED RICE PRODUCTION IN ITALY / water footprint of irrigation; illustrated value is «blue irrigated water footprint of production».

This maps shows how **rice production in Sardinia requires more blue water irrigation compared to the Po Valley**, which receives more precipitation, compared to Sardinia.
The Po Vally therefore benefits from more greenwater coming from rain and soil moisture.

Crop production (irrigated blue water footprint) has been performed for Italy for 175 crops and is available under image file and Georeferred file in GitHub and ZENODO id:francescagreco78 from 31° dec 2025.

Data plotted for Italy from Water Footprint Dataset (Mialyk et al. 2024 / May 2025 update) Data source: Water Footprint Dataset (Myalic et al 2024/ May 2025 Update)

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Challenges: how co – creating viable solutions and not imposing prescriptions (like export substitution or crop substitution)

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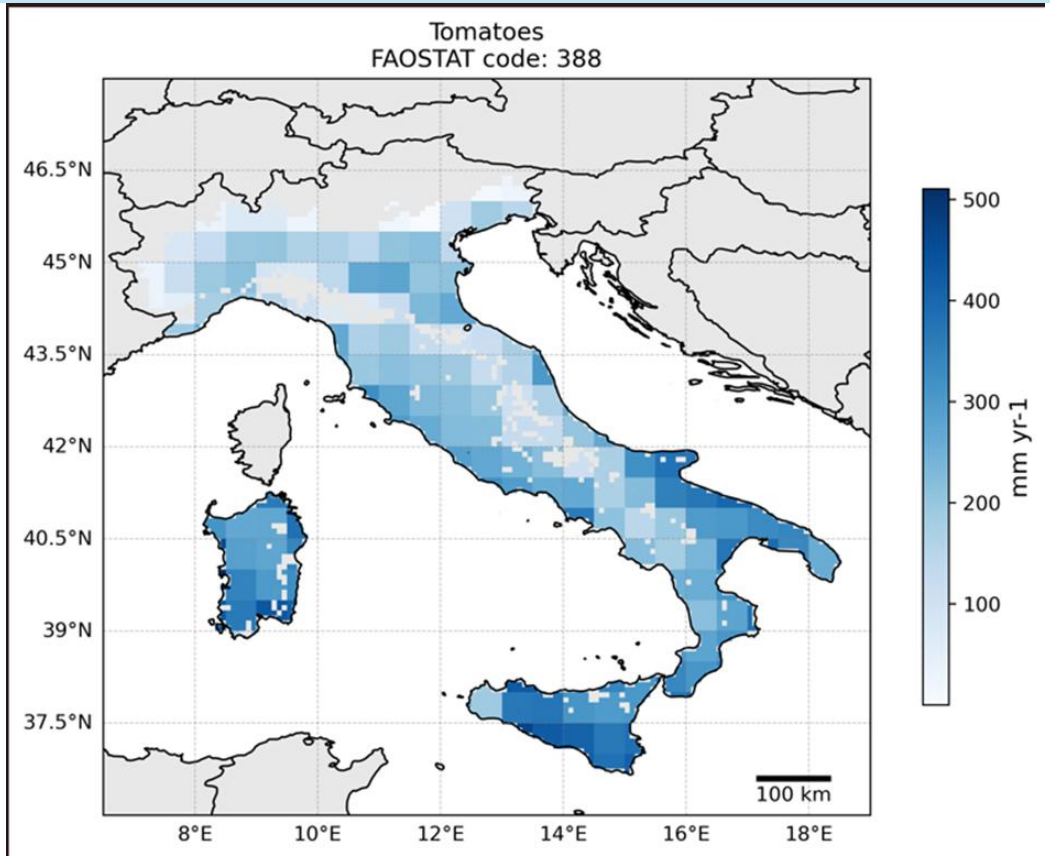
USE OF WATER FOOTPRINT DATA ON ITALY: EXAMPLE OF NATIONAL USE OF THE DATASET: BY CROPS: TOMATO



IRRIGATED TOMATOES IN ITALY: «blue irrigated water footprint of production».

This maps shows how tomato production in Sicily and Puglia requires much more blue water irrigation compared to the Po Valley.

Crop production (irrigated blue water footprint) has been performed for Italy for 175 crops and is available under image file and Georeferred file in GitHub and ZENODO id:francescagreco78 from 31° dec 2025.

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the GEOSPATIAL outputs of JustWATER

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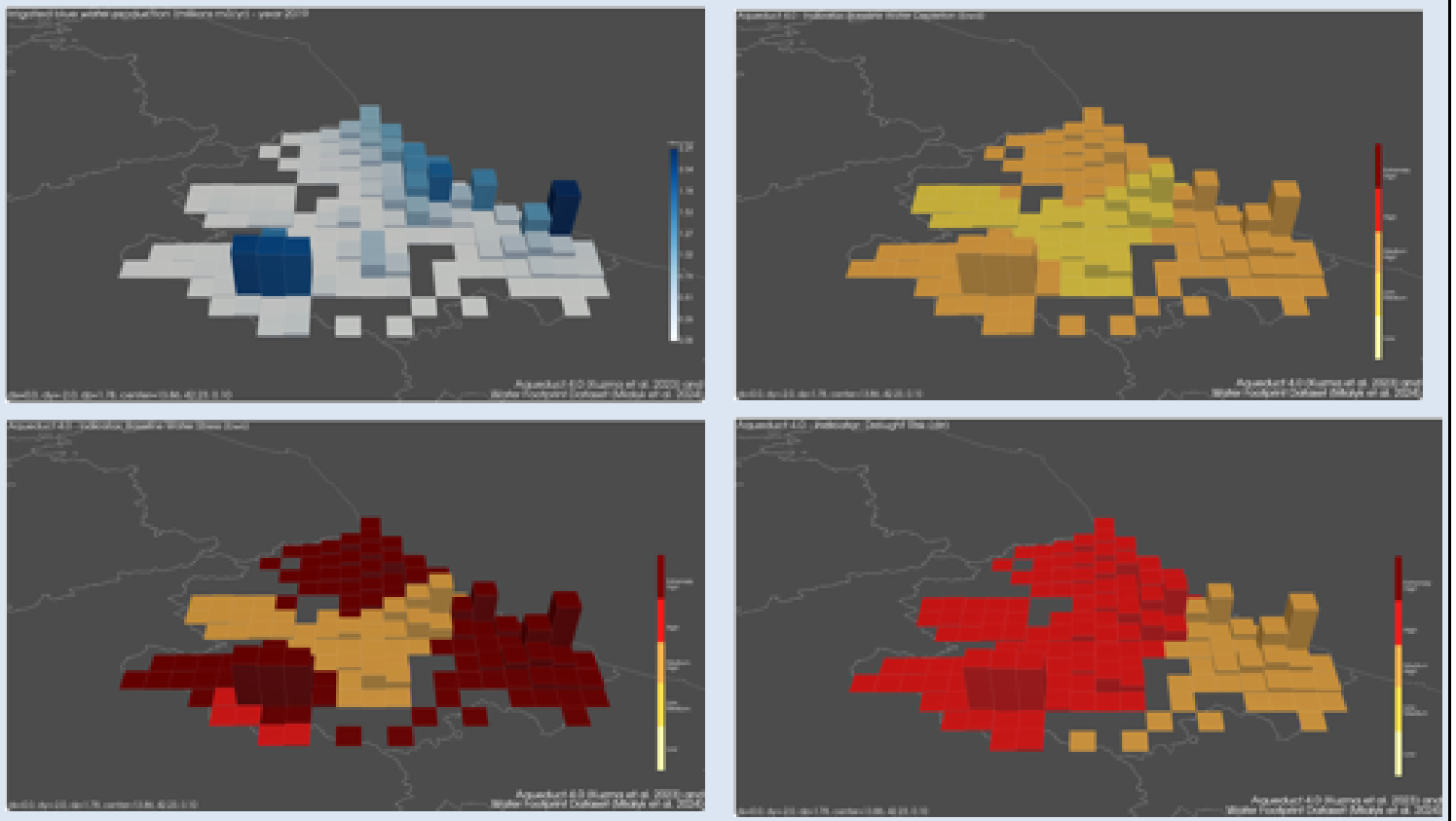
USE OF WATER FOOTPRINT DATA ON ITALY: EXAMPLE OF NATIONAL USE OF THE DATASET: BY REGION



EXAMPLE FOR THE ABRUZZO REGION

Analysis of highest volumes of water footprint of irrigated blue water by region can be indicative of «hot spots» . This visualization has been performed for the South, East , West and North angle of each of the 20 regions of Italy, to avoid blind spots. For each region it is possible to obtain a simple water footprint of irrigated blue of agricultural production (top left) and have different values when coming to water depletion (top right) , drought risk (down right) and water stress (down left). Source: Aqueduct 4.0 dataset.

Irrigated blue water footprint) has been performed for Italy all of the 20 regions and plotted with the WATER SCARCITY, WATER DROUGHT RISK, WATER DEPLETION and WATER TALE DECLINE and it is available under image file and Georeferred file in GitHub and ZENODO id:francescagreco78 from 31° dec 2025.

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the GEOSPATIAL outputs of JustWATER

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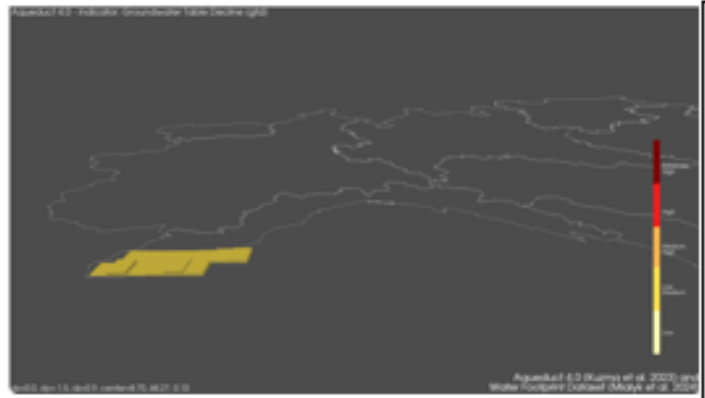
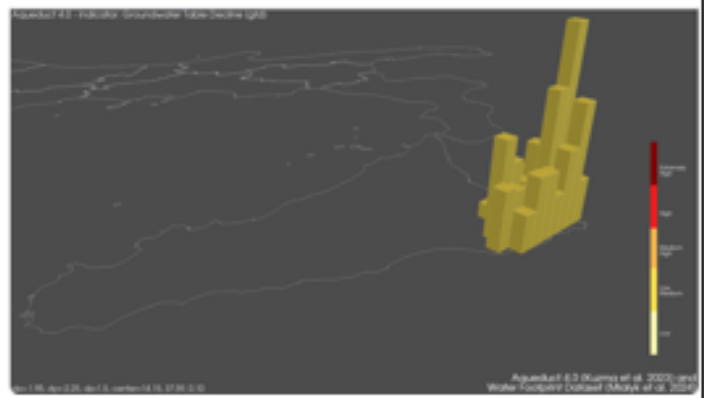
EXAMPLE OF NATIONAL USE OF THE DATASET: GROUNDWATER TABLE DECLINE IN SICILY AND LIGURIA REGION : TOMATOES AND FLOWER PRODUCTION RELYING ON VULNERABLE AQUIFERS





FOCUS ON GROUNDWATER TABLE DECLINE

Analysis of groundwater table decline have highlighted how the production of tomatoes and cherry tomatoes in Sicily rely on a decline from 0 to 2 cm per year of their aquifers.

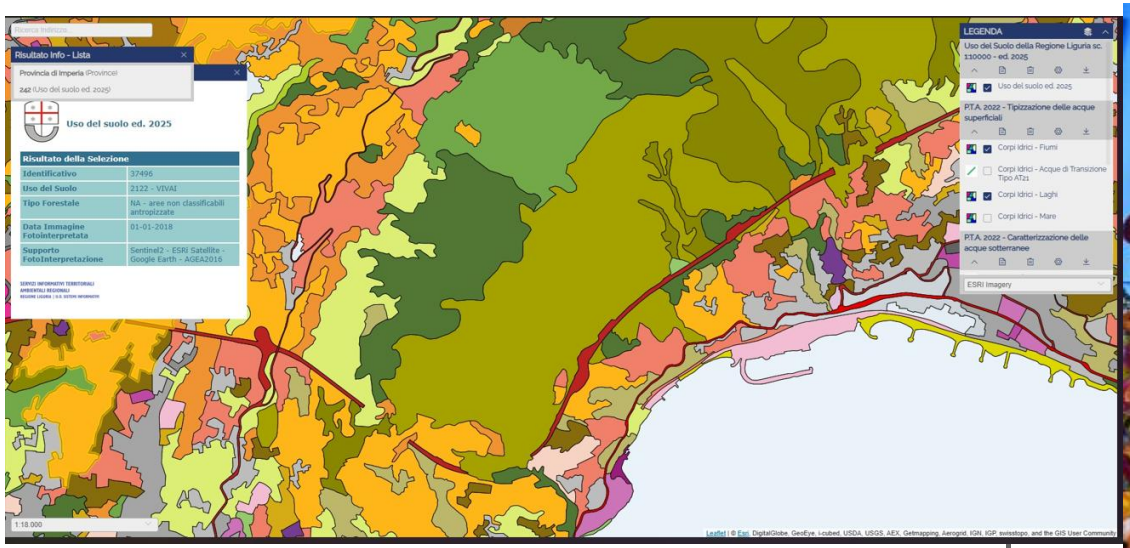
Same aquifer vulnerability is recorded foragriculture in Liguria, in particular, what CORINE LAND COVER marks as «VIVAI», corresponding to the production of flowers in the Liguria region, but the volumes of water abstraction are lower compared to those of Sicily. Source: Aqueduct 4.0 dataset, Water Footprint Dataset (Mialyk 2024/ 2025 update)

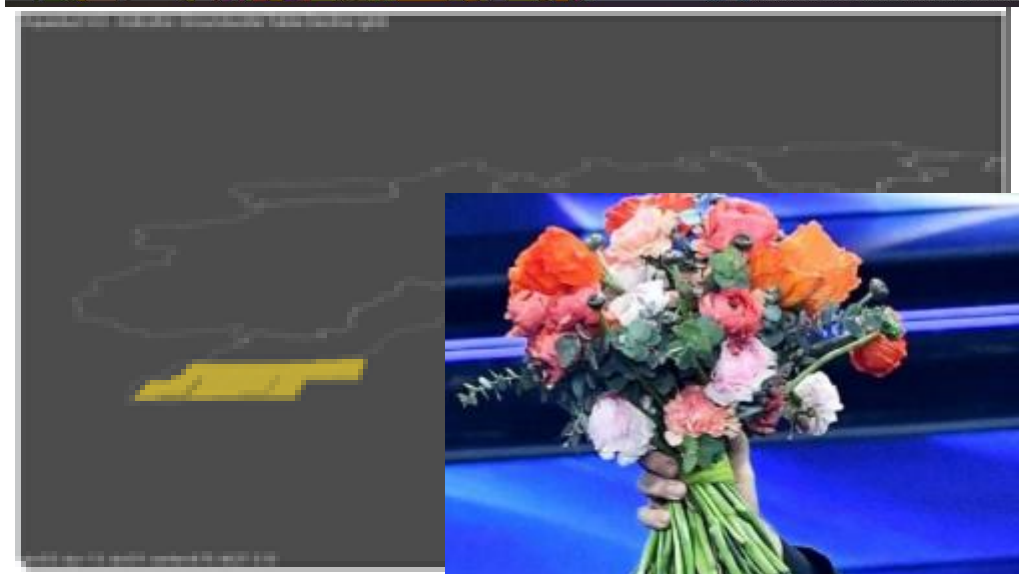
Irrigated blue water footprint) has been performed for Italy all of the 20 regions and plotted with the WATER SCARCITY, WATER DROUGHT RISK, WATER DEPLETION and WATER TALE DECLINE and it is available under image file and Georeferred file in GitHub and ZENODO id:francescagreco78 from 31° dec 2025. Each region has been visualized using PARAVIEW software from North, South, East and West to avoid blind spots

References

WATER FOOTPRINT DATASET: Mialyk, O., Schyns, J. F., Booij, M. J., Su, H., Hogeboom, R. J., & Berger, M. (2024). Water footprints and crop water use of 175 individual crops for 1990–2019 simulated with a global crop model. Scientific data, 11(1), 206;

AQUEDUCT 4.0: Kuzma, S., M.F.P. Bierkens, S. Lakshman, T. Luo, L. Saccoccia, E. H. Sutanudjaja, and R. Van Beek. 2023. "Aqueduct 4.0: Updated decision-relevant global water risk indicators." Technical Note. Washington, DC: World Resources Institute. Available online at: doi.org/10.46830/writn.23.00061.


Risultato Info - Lista
Provincia di Imperia (Province)
242 (Uso del suolo ed. 2025)
Uso del suolo ed. 2025
Risultato della Selezione
Identificativo 37496
Uso del Suolo 2122 - VIVAI
Tipo Forestale NA - aree non classificabili antropizzate
Data Immagine Fotointerpretata 01-01-2018
Supporto FotoInterpretazione Sentinel2 - ESRI Satellite - Google Earth - AGEA2016
LEGENDA
Uso del Suolo della Regione Liguria sc. 1:10000 - ed. 2025
Uso del suolo ed. 2025
P.T.A. 2022 - Tipizzazione delle acque superficiali
Corpi idrici - Fiumi
Corpi idrici - Acque di Transizione Tipo AT21
Corpi idrici - Laghi
Corpi idrici - Mare
P.T.A. 2022 - Caratterizzazione delle acque sotterranee
ESRI Imagery
1:18.000
Leaflet | © Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community




grid
Low - Medium (0-2 cm/y)
Insignificant Data
42.0°
40.0°
38.0°
36.0°
8.0°
10.0°
12.0°
14.0°
16.0°
18.0°

justWATER

Water Decision Making tools for informed hydropolities in Italy

GEOSPATIAL TURN OF VIRTUAL WATER ENQUIRY

-- from HYDRO HEGEMONY THEORIES (Zeitoun & Warner 2006)

--TO VIRTUAL WATER HEGEMONY (Sojamo et al 2012)

-- RECONNECTING THE DOTS OF LOCAL SUPPLY CHAINS : GEOSPATIALITY OF WATER & FOOD PRODUCTION / WATER & FOOD TRADE

GEOSPATIAL TURN OF VIRTUAL WATER ENQUIRY

NEW THEORETICAL FRAMEWORK: WATER HEGEMONS AND WATER OPPRESSED INVESTIGATION (WATER SUBALTERNS / OPPRESSED)

- HYDRO SOCIAL CYCLE OF VIRTUAL WATER PARADOX happens when overabstraction is caused by an export-led agricultural production from vulnerable water bodies

JUST WATER GEOSPATIAL TOOLS DO HELP THE INVESTIGATION OF HYDRO SOCIAL TERRITORIES OF ITALIAN WATER ABSTRACTION,

exploring

POWER , WATER JUSTICE AND WATER EXTRACTIVISM ENQUIRY PROVIDING A GEOSPATIAL SUPPORT

-- BUILDING NARRATIVES FOR THE WATER-SUBALTERNS AND THE WATER OPPRESSED for a MORE JUST WATER CONSUMPTION

GEOSPATIAL TURN OF VIRTUAL WATER ENQUIRY

justWATER

Water Decision Making tools for informed hydropolitics in Italy

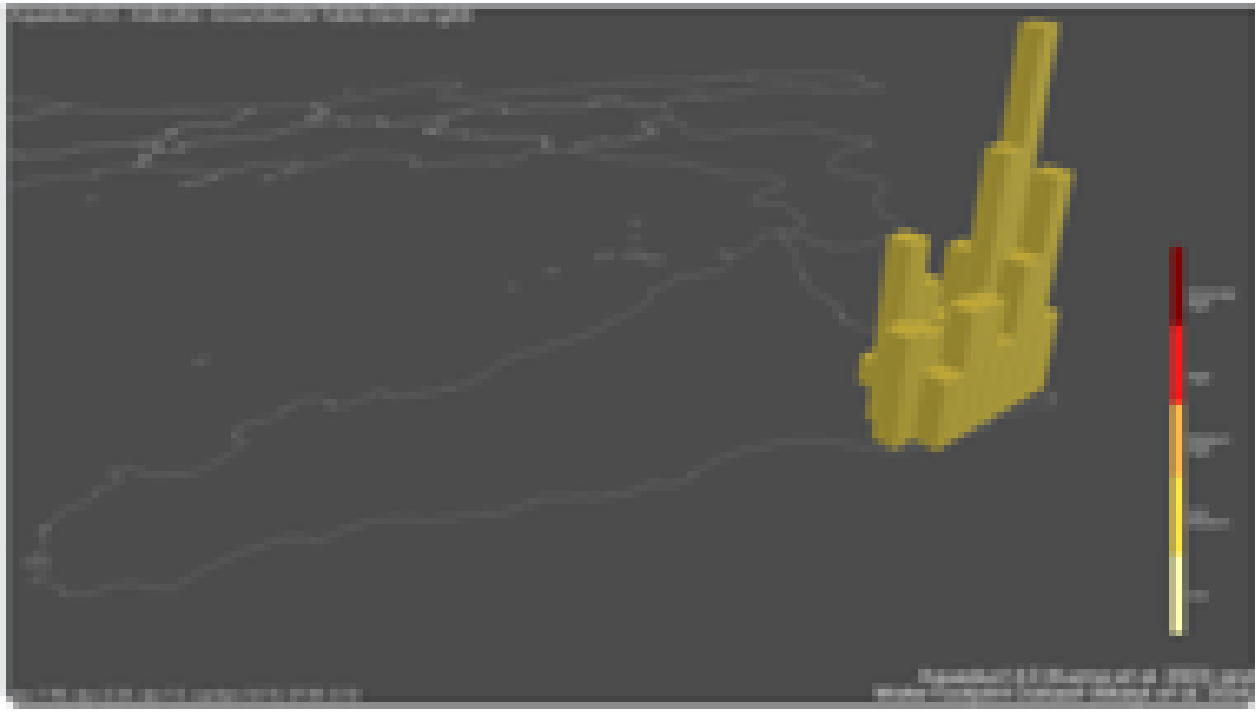
THEORETICAL OUTPUT OF JUSTWATER

PUBLICATION FOR «WORLD DEVELOPMENT»

(reviews being finalized in December 2025)

SUMMARY

1. JustWATER : project overview / how food production affects the vulnerability of water bodies in Italy through virtual water use (blue water only)
2. Gender component : Women in Water in Italy project component
3. Methodological challenges
4. Challenges: how co – creating viable solutions and not imposing prescriptions (like export substitution or crop substitution)
5. the GEOSPATIAL outputs of JustWATER
6. Providing informed decision making for policy makers:




Low - Medium (0-2 cm/y)
Insignificant Data
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44.0°
42.0°
40.0°
38.0°
36.0°
8.0°
10.0°
12.0°
14.0°
16.0°
18.0°

UNIVERSITÀ DEGLI STUDI DI BERGAMO

justWATER
Water Decision Making tools for informed hydropolities in Italy

European Commission
Marie Skłodowska-Curie Actions

JustWATER as a tool to HELP BUILDING NARRATIVES OF WATER AND AGRIULTURAL PRODUCTION

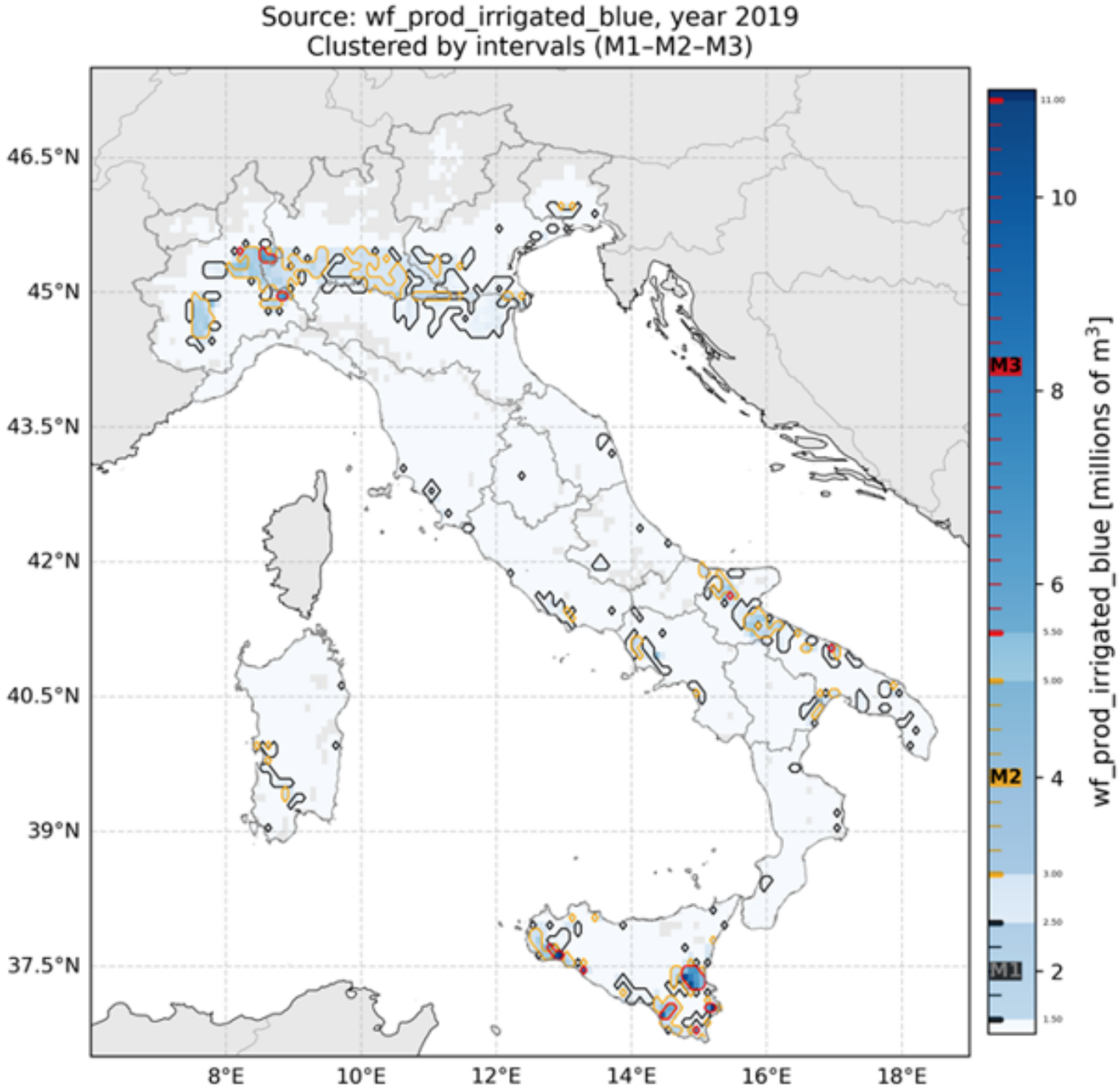
SILENT NARRATIVES

HYDRO SOCIAL NARRATIVES OF VIRTUAL WATER AND WATER CONSUMPTION

OUTPUT : PRODUCTION OF A GEO LOCATION MAP FOR ITALY REGARDING ALL VULNERABLE WATER BODIES UNDER HIGH IRRIGATION USE IN VOLUMES (blue water footprint of irrigation) . This is irrigatino water, not considering rain)

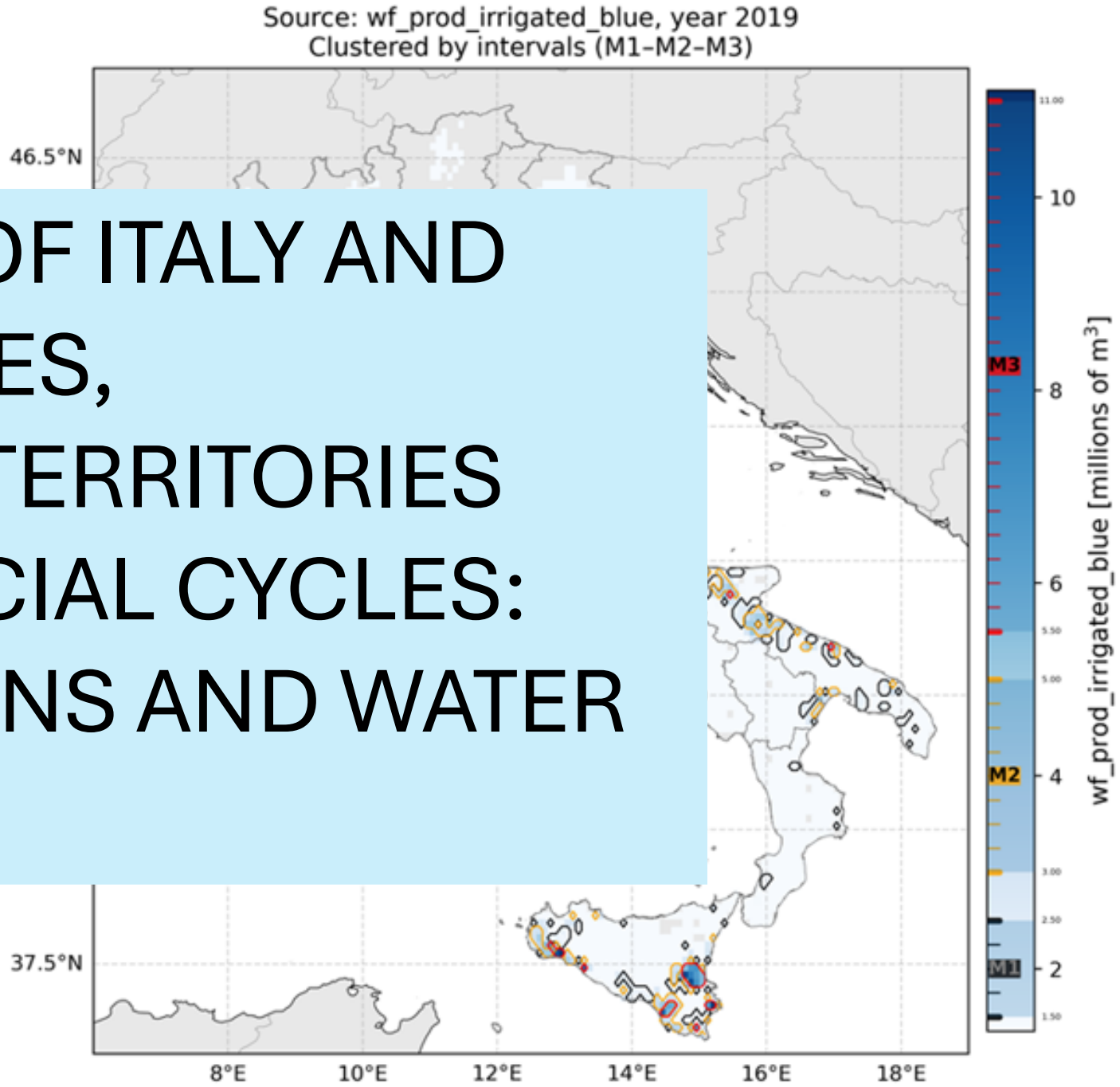
Mapping intersections:
Medium high levels of Blue irrigated water, high levels and extremely high levels: SEE MAP

Connecting the dots:
overlapping vulnerable water bodies with crop production and creating local water cyle narratives.
Power dynamics of food, irrigation and food trade.

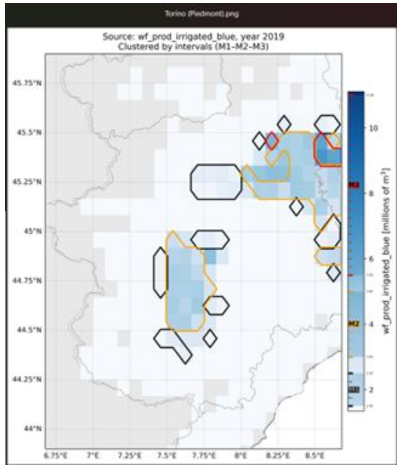


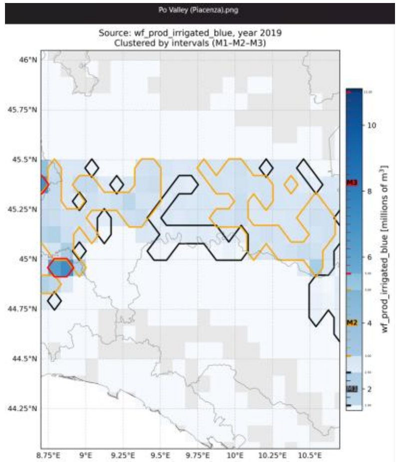
OUTPUT : PRODUCTION OF A GEO LOCATION MAP FOR ITALY REGARDING ALL VULNERABLE WATER BODIES UNDER HIGH

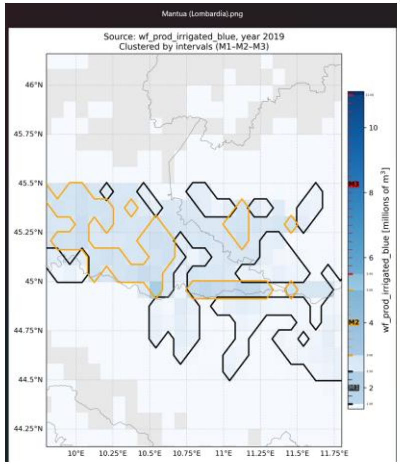
WATER BODIES OF ITALY AND THEIR NARRATIVES, GEOGRAPHIES, TERRITORIES AND HYDRO SOCIAL CYCLES: WATER HEGEMONS AND WATER SUBALTERNS

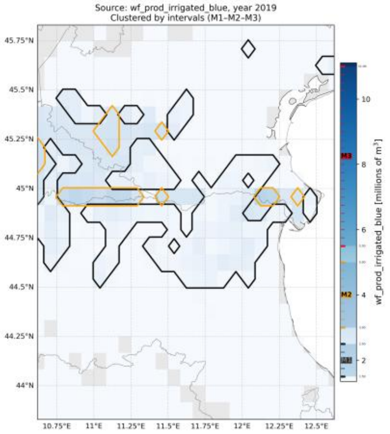


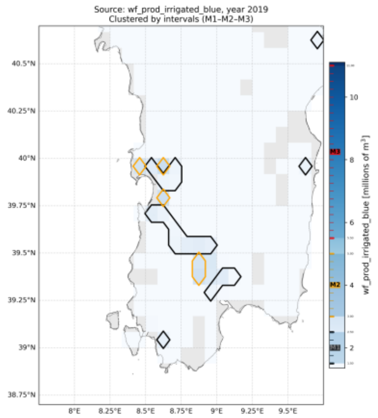
MORE THAN 600 GEO LOCALIZED POINTS HAVE BEEN CREATED AND ARE AVAILABLE OPEN ACCESS FOR PUBLIC SEARCH. FOR EACH OF THEM, THE RESOLUTION IS 8 KM X 8 KM ; THIS ALLOWS PRECISE TERRITORIAL CONFIGURATION OF WATER IRRIGATION AND USE, WITH INFORMATION ON CROPS AND THE POSSIBIILTY TO LINK IT TO THE CORRESPONDING WATER BODY OR TO OVERLAP IT WITH CORINE LAND COVER (available from 31st of December 2025, ZENODO and GITHUB repository called : JustWATER . ID: francescagreco78

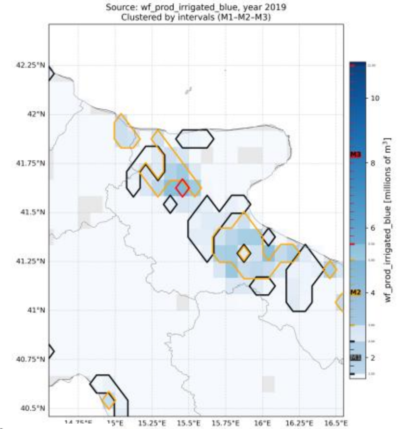


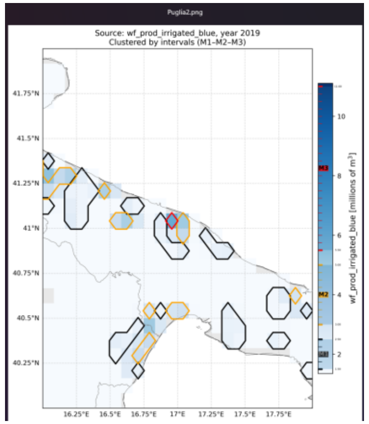


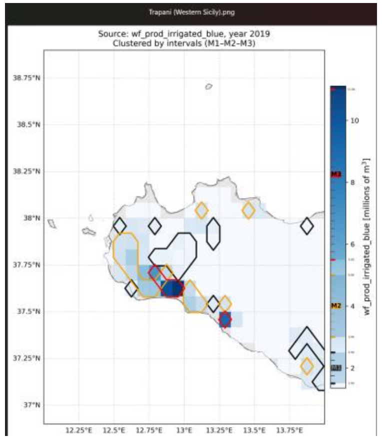


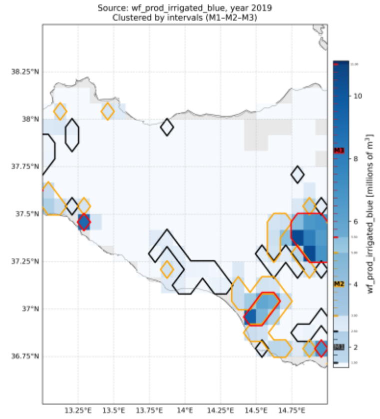


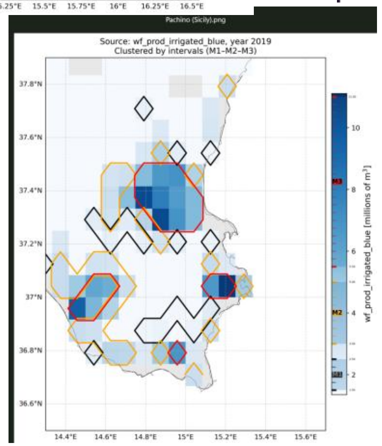


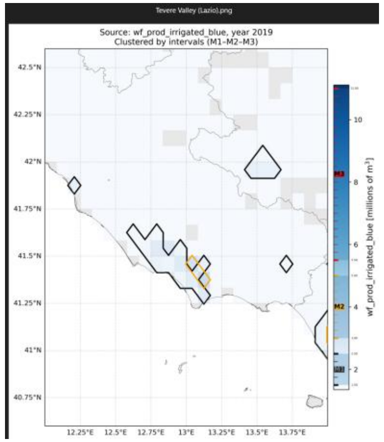












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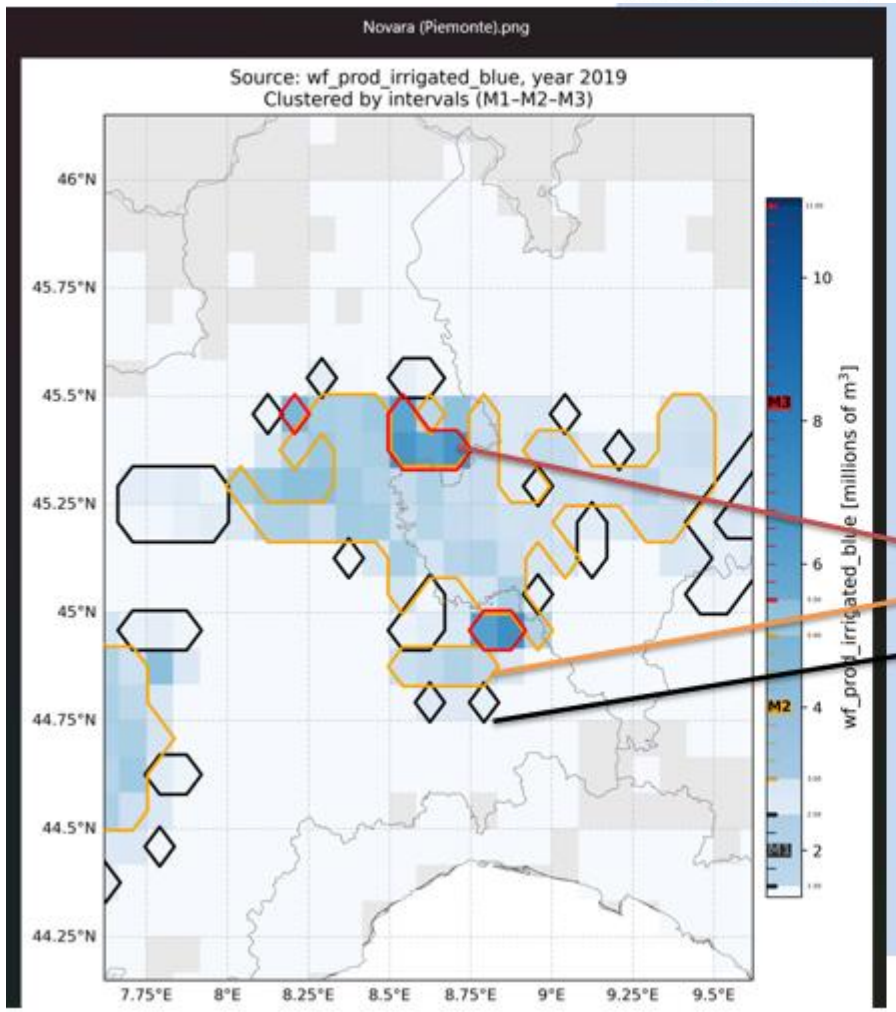


How to read the map of water bodies location and irrigation intensity

RED CLUSTER: from 5.50 to 11 Million Cubic Meter per year

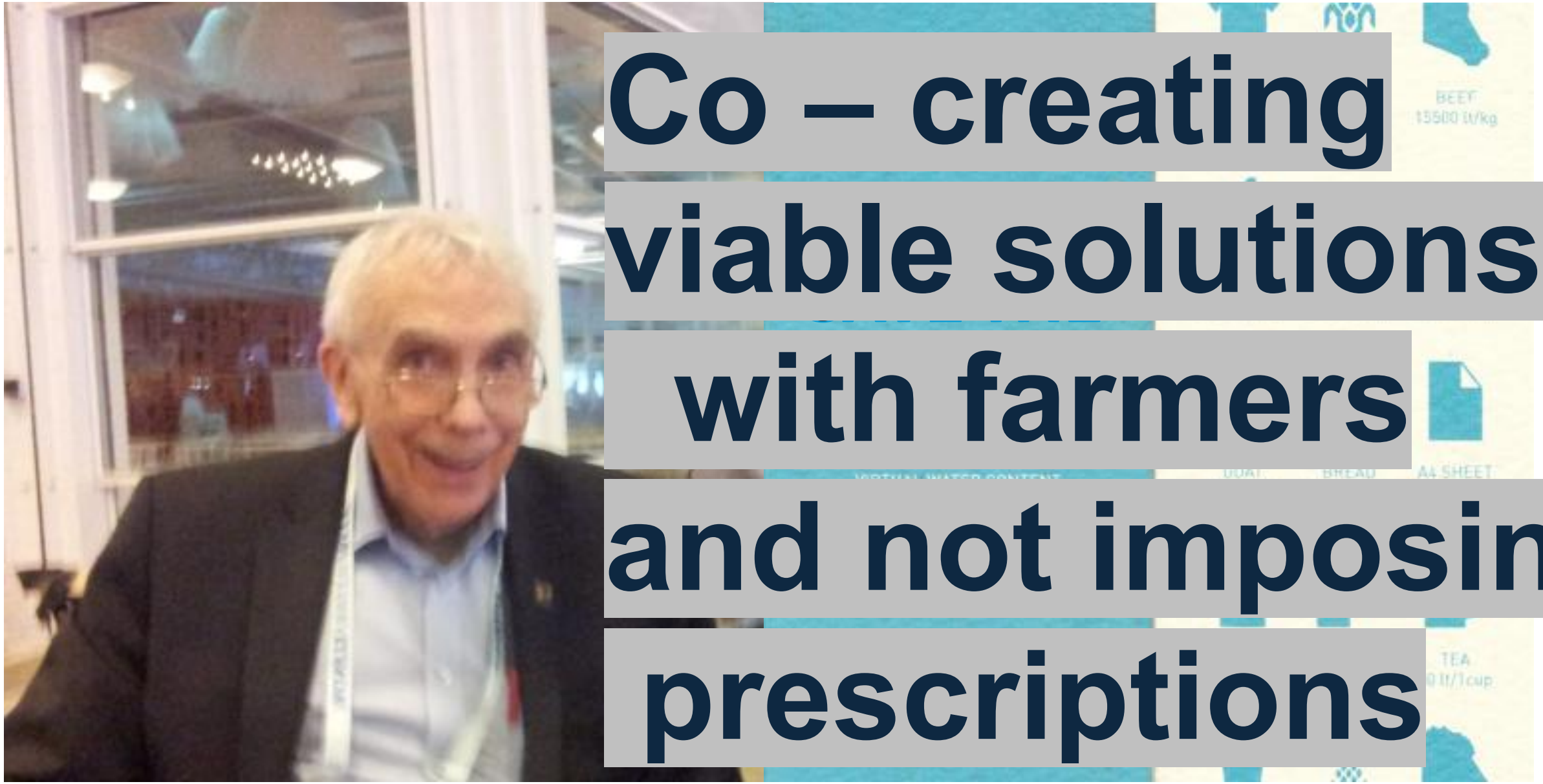
ORANGE CLUSTER: from 4 to 5.50 Million Cubic Meter per year

BLACK CLUSTER: 1.5 to 4 Million Cubic Meter per year

The referral year is 2019 (latest available year for Water Footprint dataset) . Cluster shape may vary according to the extension of the area.

WATER IS NOT JUST WATER:
WATER IS FOOD, IDENTITIES, LANDSCAPES, …

GROUNDWATER TABLE DECLINE


Co – creating
viable solutions
with farmers
and not imposing
prescriptions

FARMERS WILL SAVE THE WORLD !

VIRTUAL WATER CONTENT

JUST WATER PROJECT IS FUNDED BY THE EU UNDER THE MARIE SKLODOWSKA CURIE FELLOWSHIP ACTION

Call: HORIZON-MSCA-2022-PF-01 (MSCA Postdoctoral Fellowships 2022)
Topic: HORIZON-MSCA-2022-PF-01-01 Type of Action: HORIZON-TMA-MSCA-PF-EF (HORIZON TMA MSCA Postdoctoral Fellowships - European Fellowships) **Project number: SEP-210874497 Project acronym: JustWATER**

https://justwater-0cb8db74bf24.herokuapp.com/

Marie SKŁODOWSKA-CURIE ACTIONS

Research Fellowship Programme