

Meeting di coordinamento
Bologna, 19 Febbraio 2024



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Spoke 4 Sustainable Finance

Contributions to Amelia



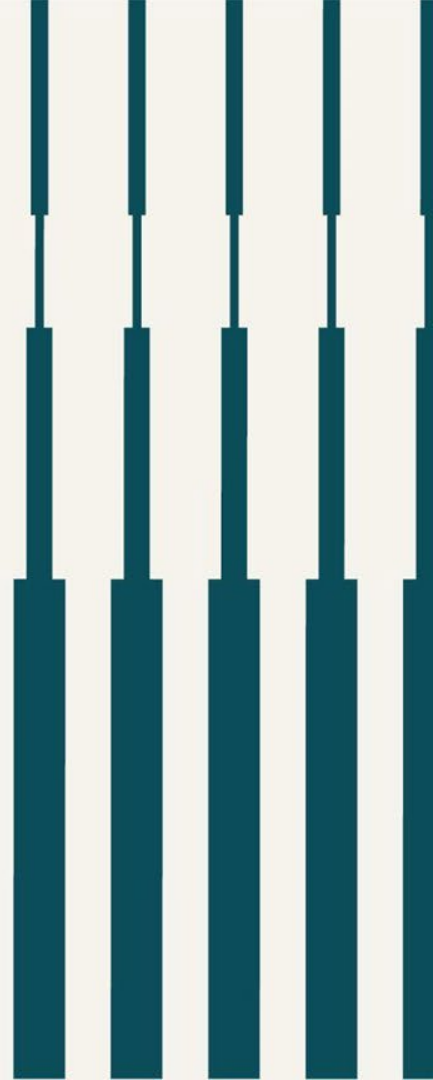
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DIPARTIMENTO



Spoke 4, WP 1 – ESG risk dimensions and their
impact on investors and SMEs



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WP 1 – Contributions to Amelia

M. Billio

Università Ca' Foscari Ve

M. Caporin

Università di Padova





Economic, financial and business data within Amelia

GRINS data vs. external data

Distinguish between data produced within the GRINS network and data recovered from external sources (public data and private data)

We refer here to external data which are not public, that is, data that originate from providers (Bloomberg, Refinitiv/Eikon/LSEG, MSCI, Bureau Van Dijk, FactSet...)

Two possible cases:

- There exist an agreement between the GRINS foundation and the provider
- There is no agreement between the GRINS foundation and the provider but there exist an agreement between a University/a research group and the provider



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Economic, financial and business data within Amelia

Agreement between the foundation and the provider

In this case, the access to the provider can be integrated within the Amelia platform

Update of the data will be, ideally, automatic and integrated within the production of indicators proposed in the deliverables of the GRINS project

In general, raw data collected from the provider cannot be made available, but indicators produced with the raw data can be made available for research purposes

Commercial activities based on the indicators produced is, in general, conditional to the signing of a commercial agreement with the provider (more expensive than standard academic agreements)



Economic, financial and business data within Amelia

Agreement between one University and the provider

In this case, the access to the provider **CAN'T** be integrated within the Amelia platform

The research group **MUST** upload the data into Amelia and will be responsible of their update (the update of indicators can be done conditional to the update of the raw data)

Raw data collected from the provider **can't** be made available, but indicators produced with the raw data can be made available for research purposes

Free diffusion of the indicators is also possible, but commercial activity based on the indicators produced is **NOT POSSIBLE**

ESG investor appetite

Survey

Ugo Rigoni
Caterina Cruciani



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Assessing ESGness regarding retail investors and their perceptions of sustainable investments

Sample representation consists of:

- 800 Italian investors with portfolios valued below €200,000
- 200 investors with portfolios exceeding €200,000
- 200 private investor category (very significant portfolios)

Three waves

Managing by Doxa

Construction of ESG scores through dedicated surveys and public information SMEs

Survey – Data collection

CRIF

Construction of ESG ratings for SMEs

Online tool

Contract - Modefinance

Spoke 4, WP 3 - Assessment of climate change
impact, physical and transition risks



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WP 3 - Contributions to Amelia

M. Billio S. Battiston
Università Ca' Foscari Venezia



Spatial smoothing tool

Luigi Salvati

An example of available data to measure exposure to climate risk

Data on insurance against natural disasters

Data

- Granularity. Italian municipalities (“comuni”)
- ISTAT code of the municipality
- Number of firms insured with the data provider
- Number of firms insured, in particular, against natural disasters

Consolidation with the ISTAT shapefile for municipalities

Spatial smoothing: in progress

- Problem: in some municipalities the share of insured against natural disasters over total insured is 0 or 1
- This creates a privacy issue
- Need for spatial smoothing

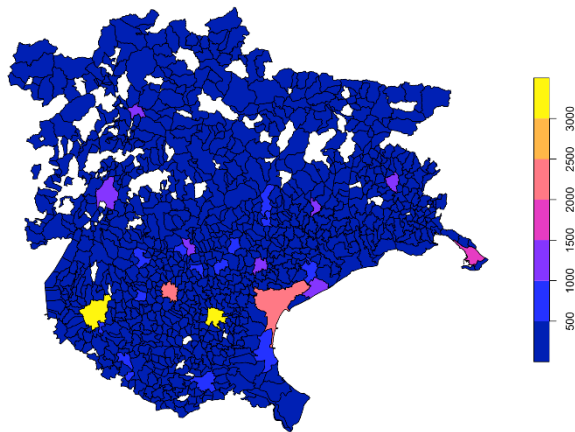
Next steps

- Acquiring the full dataset
- Application of different spatial smoothing techniques in order to achieve a reasonable equilibrium between data protection and reliability

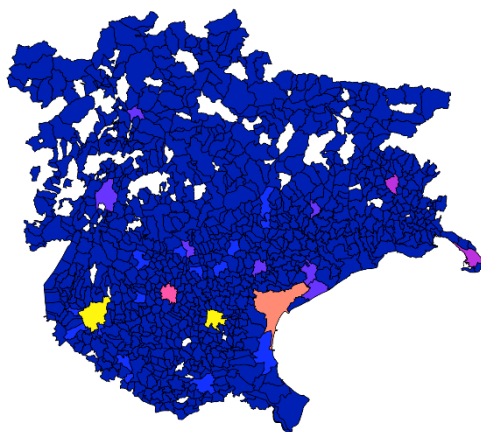
A subsample of the full dataset Raw data

- 914 municipalities

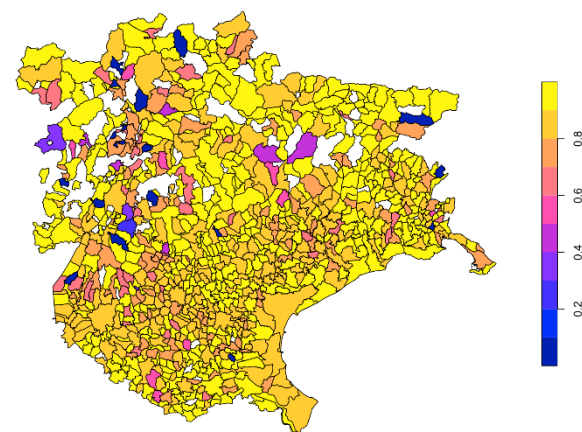
Insured firms



Firms insured against natural disasters



Insured against NDs/Total insured



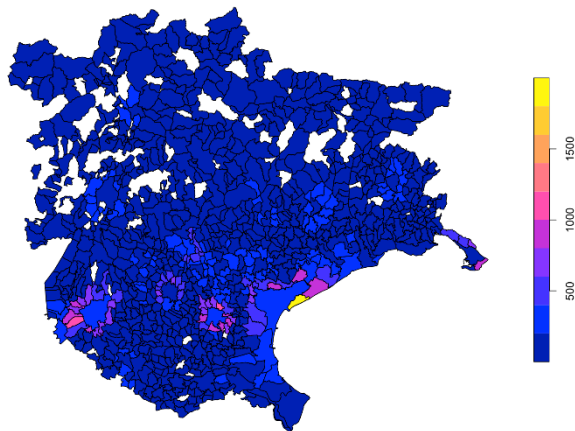
Data source Unipol

A subsample of the full dataset

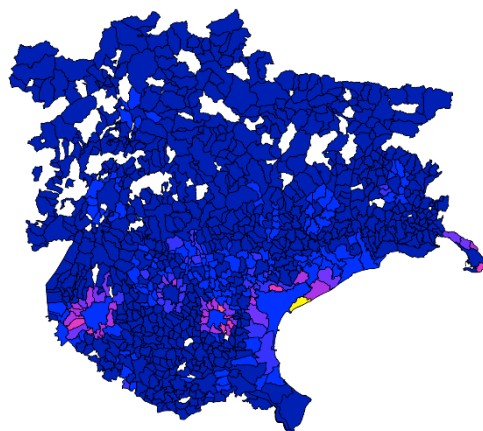
- 914 municipalities

After a first attempt to smoothen data (spatial moving average)

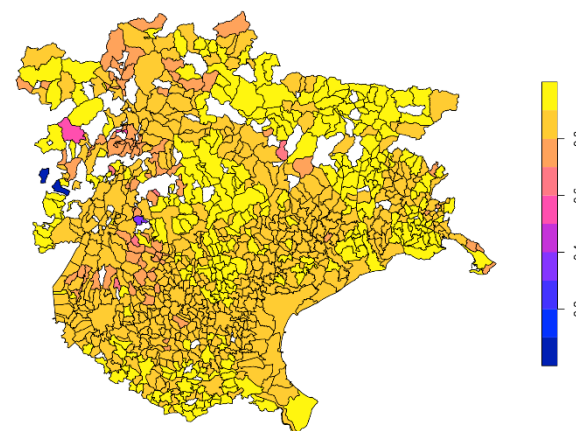
Insured firms - Spatial moving average



Firms insured against natural disasters - Spatial moving average



Insured against NDs/Total insured - Spatial moving average



Simulation results for macro-financial variables by climate scenarios

Online platform

Stefano Battiston

EIRIN: a macro-financial model to study climate risks and the low-carbon transition

Model overview

- open economy model with agents and sectors of the real economy and financial system (Monasterolo & Raberto 2018)
- Well-established model used by central banks and financial institutions (e.g. ECB, World Bank) to complement standard approaches for climate analyses

Model improvements during the project:

- Development of a SFC default mechanism: partial defaults within a sector of the model, which permits a better integration of financial stability considerations
- Interaction of the policy rate with consumption: building on the buffer-stock theory so that consumption and saving behaviours react better to interest rates and unemployment levels
- Improvement in the channel from policy rate to investment decisions, i.e. on the investment from firms' own equity and the volume of credit granted by the bank

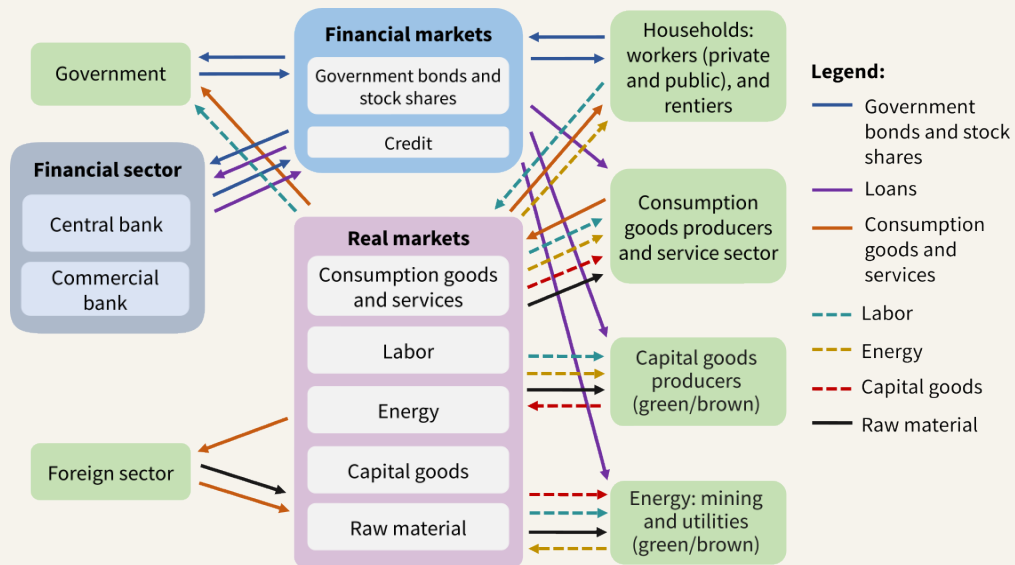


Figure 1: Interactions of agents and sectors in EIRIN through real and financial markets.

Towards an interactive model website

- We develop an online platform that includes simulation results of the EIRIN model: macro-financial variables by climate scenarios (including NGFS), country, time, etc.
- Website development has started (currently offline), with the following sections:
 - *Home*: landing page,
 - *Publications*: summary of papers based on EIRIN,
 - *Projects*: description of projects that funded/used the model,
 - *Applications*: results for different countries/regions,
 - *Technical documentation*: sections of the documentation
- The model documentation is also available in PDF format



Figure 2: illustration of the work stream for the EIRIN website development

A comprehensive analysis of land use and climate change impacts on water quality in Italian river basins

Hung Vuong PHAM
Olinda RUFO
Andrea CRITTO

+ BAC



Recaps

- Selection of the land use classes relevant to water quality
- Spatio-temporal land use change analysis
- Data collection on water quality with specific focus on nutrient
- Data collection on riverbasin/watersheds associated to the river network reported water quality according to the WFD.
- Climate change analysis

Update on data collection

New data on land use – VP

Land cover legend
view global (level 1)

- Cropland, rainfed
- Herbaceous cover
- Tree or shrub cover
- Cropland irrigated or post-flooding
- Mosaic cropland (>50%) / natural vegetation (Tree, shrub, herbaceous cover) (<50%)
- Mosaic natural vegetation (Tree, shrub, herbaceous cover) (>50%) / cropland (<50%)
- Tree cover, broadleaved, evergreen, closed to open (>15%)
- Tree cover, broadleaved, deciduous, closed to open (>15%)
- Tree cover, broadleaved, deciduous, closed (>40%)
- Tree cover, broadleaved, deciduous, open (15-40%)
- Tree cover, needleleaved, evergreen, closed to open (>15%)
- Tree cover, needleleaved, evergreen, closed (>40%)
- Tree cover, needleleaved, evergreen, open (15-40%)
- Tree cover, needleleaved, deciduous, closed to open (>15%)
- Tree cover, needleleaved, deciduous, closed (>40%)
- Tree cover, needleleaved, deciduous, open (15-40%)

Documentation

- Product User Guide v2
- Quick User Guide for maps v2.0.7
- Quick user guide Land Surface Remotely Sensed
- Legend for LC Map v2.0.7
- Preview LC Map v2.0.7 for Year 2015

1992	1998	2004	2010	2016
1993	1999	2005	2011	2017
1994	2000	2006	2012	2018
1995	2001	2007	2013	2019
1996	2002	2008	2014	2020
1997	2003	2009	2015	

The 300 m CCI-LC Maps (22 LCCS classes) were obtained from the processing of the full archives of 300 m MERIS, 1 km SPOT VEGETATION, 1 km PROBA-V and 1 km AVHRR. 28 yearly classifications from 1992 to 2019 are provided.

CCI land cover data

Resolution: 300m

Coverage: Global

Time frame: 1992 till 2020

Accessibility: free – downloaded

Link:

<https://maps.elie.ucl.ac.be/CCI/viewer/index.php>



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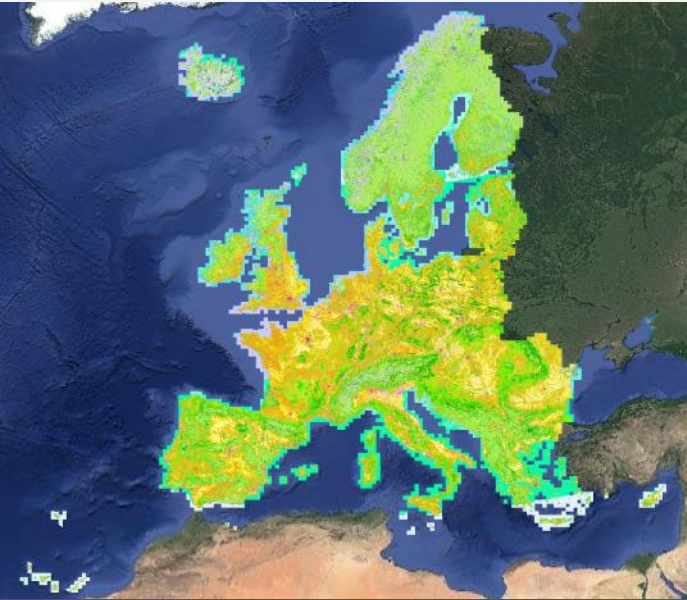
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Update on data collection

New data on land use – VP



Europe land cover mapping at 30m

Resolution: **30m**

Coverage: EU

Time frame: 2000 till 2019

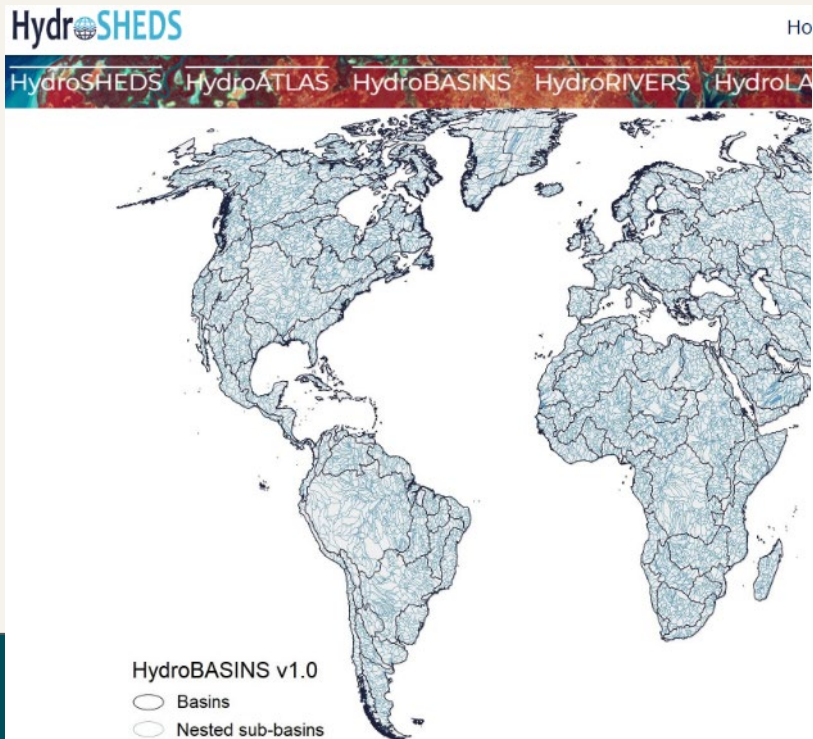
Accessibility: free – downloaded

Compactability: compactible with CORINE
land cover

Link: <https://zenodo.org/records/4725429>

Update on data collection

New data on sub-river basins – VP



Coverage: Global and regional
Resolution: vector file with 12 levels of details.

Europe and Middle East

- Europe and Middle East Level 00 - Standard (75MB)
- Europe and Middle East Level 01-06 - Standard (39MB)
- Europe and Middle East Level 01-12 - Standard (361MB)
- Europe and Middle East Level 01 - Standard (3MB)
- Europe and Middle East Level 02 - Standard (4MB)
- Europe and Middle East Level 03 - Standard (4MB)
- Europe and Middle East Level 04 - Standard (7MB)
- Europe and Middle East Level 05 - Standard (9MB)
- Europe and Middle East Level 06 - Standard (13MB)
- Europe and Middle East Level 07 - Standard (21MB)
- Europe and Middle East Level 08 - Standard (33MB)
- Europe and Middle East Level 09 - Standard (51MB)
- Europe and Middle East Level 10 - Standard (70MB)
- Europe and Middle East Level 11 - Standard (74MB)
- Europe and Middle East Level 12 - Standard (74MB)

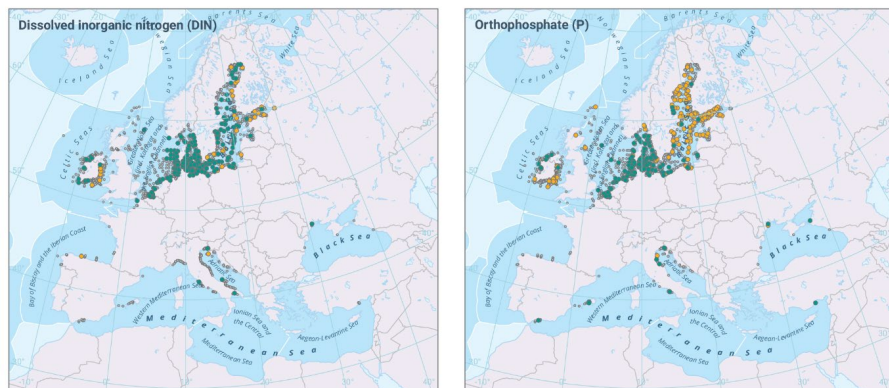


Update on data collection

New data on nutrients- OR



European Environment Agency



Reference data: © EuroGeographics, © FAO (UN), © TurkStat Source: European Commission – Eurostat/GISCO



Time frame: 2000 – 2021, annual mean concentrations

Indicators: **Total Nitrogen and phosphorous**

Coverage: EU

Accessibility: free – downloaded, NetCDF-4

Link: [Waterbase - River monitoring stations — European Environment Agency \(europa.eu\)](https://waterbase.eea.europa.eu/river-monitoring-stations)

Update on data collection

New data on nutrients- OR



European Environment Agency



Water quality monitoring stations
Year 2006
• River stations

Time frame: 2000 – 2021, annual mean concentrations

Indicators: **Phosphate and nitrate in lakes and rivers**

Coverage: EU

Accessibility: free – downloaded,

Link: [Nutrients in European water bodies – European Environment Agency \(europa.eu\)](https://europea.eu/en/european-environment-agency)

Number of river monitoring sites:

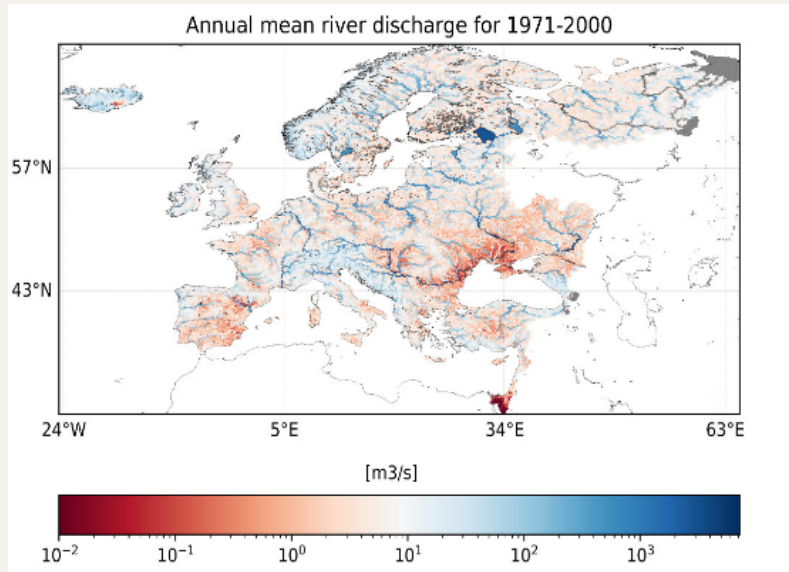
Nitrate in rivers: Italy (25), (all data total oxidised nitrogen, some data total oxidised nitrogen)

Phosphate in rivers: (1992–2021, Italy (18)). No data on lakes.



Update on data collection

New data on nutrients- OR



Resolution: **5km x 5km and catchments**

Time frame: **1970 to 2100**

Indicators: **Total Nitrogen and phosphorous**

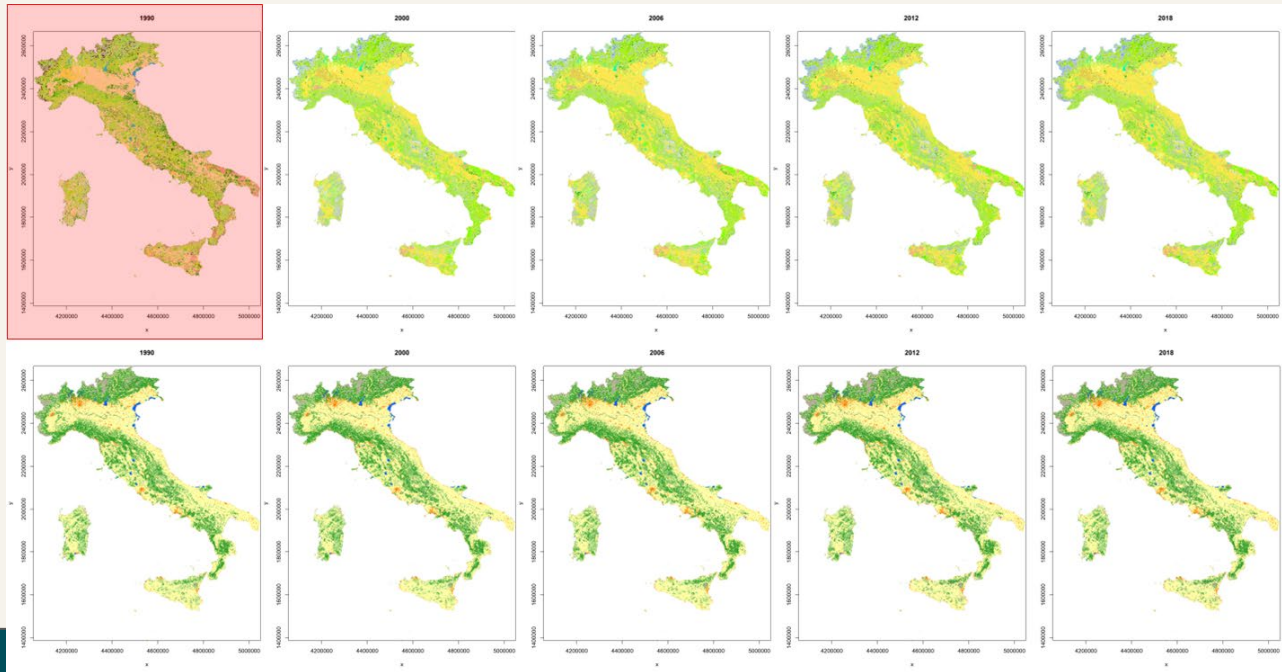
Coverage: EU

Accessibility: free – downloaded, NetCDF-4

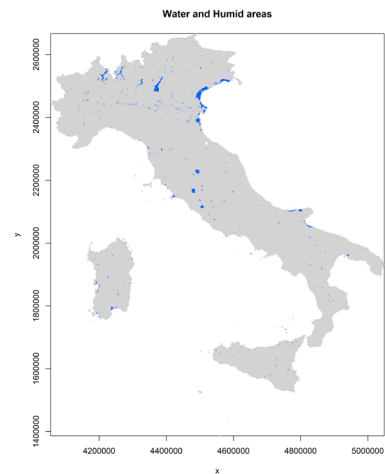
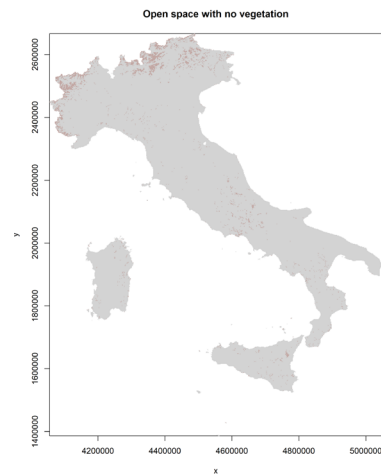
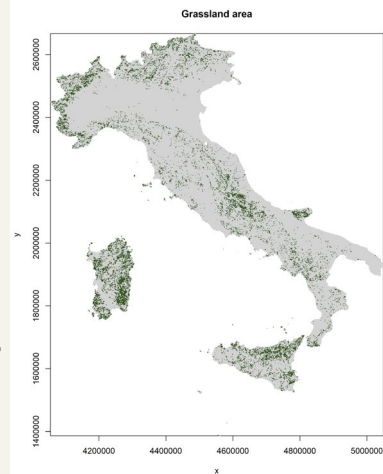
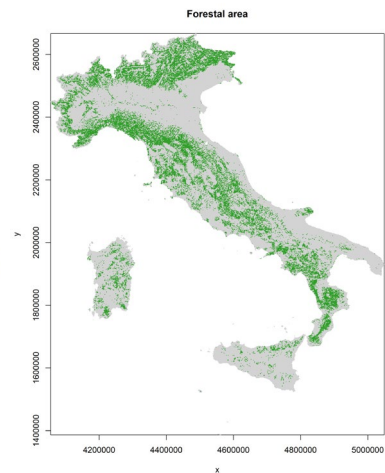
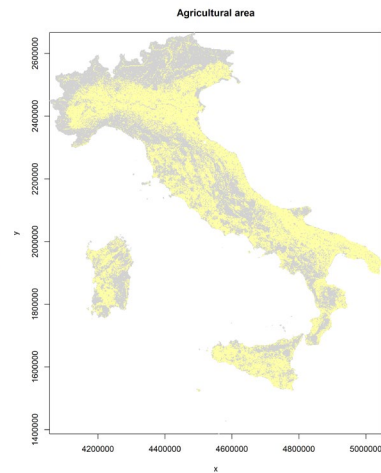
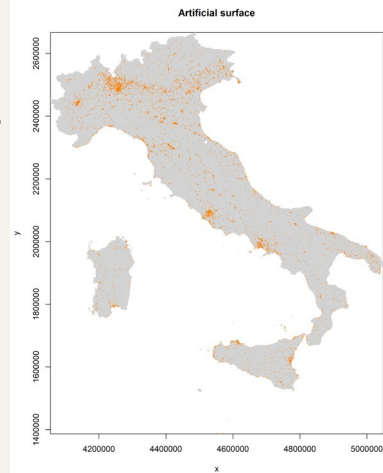
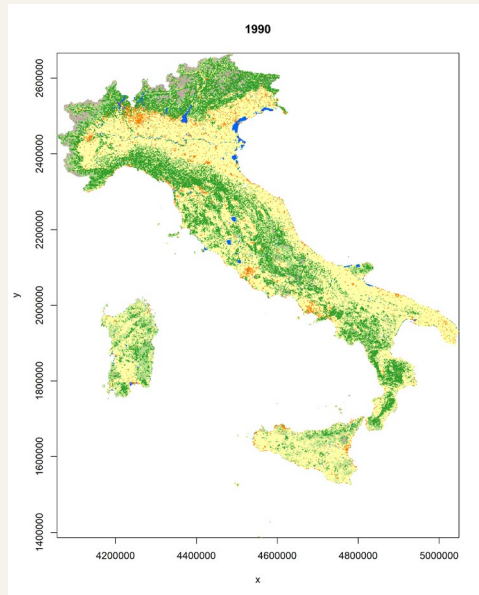
Link: [Hydrology-related climate impact indicators from 1970 to 2100 derived from bias adjusted European climate projections \(coperNICUS.eu\)](https://coperNICUS.eu)

Update on land use change analysis

LULCC indicator and land use change analysis – SC



Land Use Classes – CORINE 1990

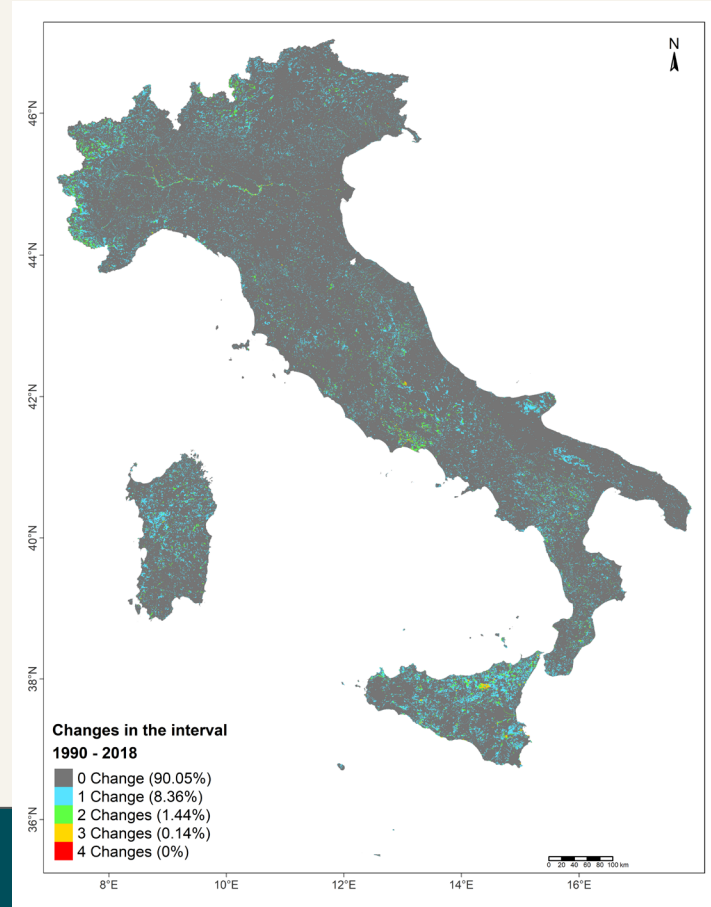




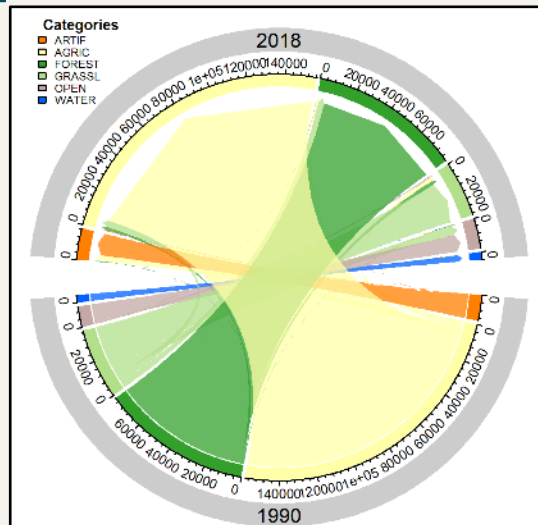
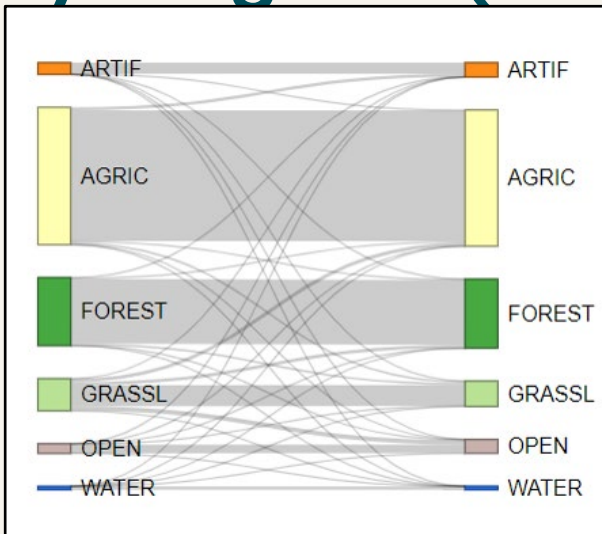
Accumulated Changes 1990-2018

This function calculates the number of times a pixel has changed during the analysed period. It returns a raster with the number of changes as pixel value and a table containing the areal percentage of every pixel value (number of changes).

	PxValue	Qt	Percent
	<int>	<int>	<dbl>
1	0	27139881	90.0
2	1	2520848	8.36
3	2	434624	1.44
4	3	42745	0.142
5	4	1118	0.00371



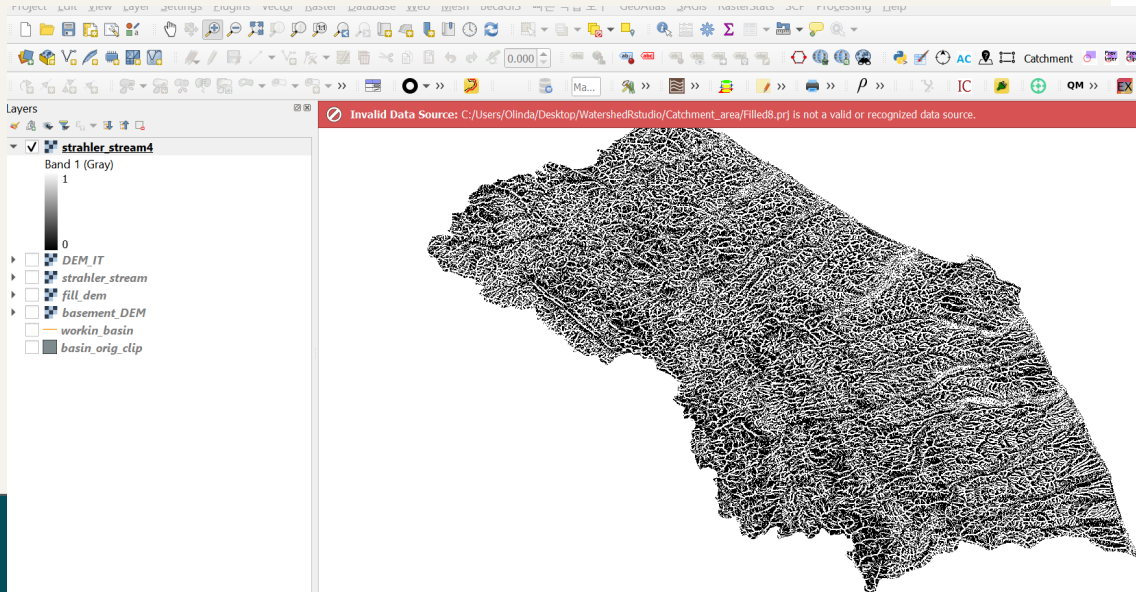
Sankey diagram (one step) + Chord diagram



source	target	value	source	target	value	source	target	value
ARTIF	ARTIF	12738.25	FOREST	ARTIF	137.49	OPEN	ARTIF	18.94
ARTIF	AGRIC	569.79	FOREST	AGRIC	1425.28	OPEN	AGRIC	181.44
ARTIF	FOREST	35.05	FOREST	FOREST	74074.41	OPEN	FOREST	107.64
ARTIF	GRASSL	53.35	FOREST	GRASSL	2231.20	OPEN	GRASSL	796.30
ARTIF	OPEN	27.27	FOREST	OPEN	288.32	OPEN	OPEN	9907.39
ARTIF	WATER	27.77	FOREST	WATER	23.91	OPEN	WATER	38.35
AGRIC	ARTIF	3467.22	GRASSL	ARTIF	137.14	WATER	ARTIF	27.60
AGRIC	AGRIC	150229.59	GRASSL	AGRIC	3993.97	WATER	AGRIC	60.38
AGRIC	FOREST	1316.34	GRASSL	FOREST	3687.99	WATER	FOREST	14.37

Update on river basin delineation

- Workflow:
- DEM projected-Fill DEM-Stream order-Channel
- Analysis- target stream- watershed delineation



Spoke 4, WP 2 - Digital finance, inclusion and
green/young entrepreneurship



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WP 2 – Contributions to Amelia

S. Vismara
Università di Bergamo

M. Colombo
Politecnico Milano



Activities

- (i) Define measures to foster the inclusiveness of capital markets on both the supply and the demand sides
- (ii) Favor the access to capital markets and sustainable finance by companies (with particular attention to SME and new green/young enterprises)
- (iii) Develop the inclusiveness of digital finance, by providing financing opportunities to small investors
- (iv) Measure and control of the risks of digital finance also by using artificial intelligence
 - **Cascade call: University of Pavia**

Definition of risk measures of digital finance and credit ratings of SMEs and new green/young enterprises based on artificial intelligence



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Two-sided approach

Demand side of digital financial markets: entrepreneurs and SMEs

Activities i/a & ii

Supply side of digital financial markets: investors

Activities i/b & iii

Teams are working jointly to favor the comparison and integration of different research lines (matching demand and supply of capital)

- i/a. Define measures to foster the inclusiveness of capital markets on the **demand** side*
- ii. Favor the access to capital markets and sustainable finance by companies (with particular attention to SME and new green/young enterprises)*

Contributions to AMELIA

Demand of capital (Identification: investee company) to Venture Capitalists and Equity Crowdfunding by region (NUTS3), industry (NACE REV 2 digits) and year:

- Number of investments and amount of capital invested
- Number of invested companies and amount of capital invested
- Assets, sales and employees of invested companies
- Density indicators, ratios (e.g., employee ratio)

- i/b. Define measures to foster the inclusiveness of capital markets on the **supply** side*
- iii. Develop the inclusiveness of digital finance, by providing financing opportunities to small investors*

Contributions to AMELIA

Supply of capital (Identification: investor) by Venture Capitalists by region (NUTS3), industry (NACE REV 2 digits) and year:

- Number of investments and amount of capital invested
- Number of invested companies and amount of capital invested
- Assets, sales and employees of invested companies
- Density indicators, ratios (e.g., employee ratio)

Spoke 4, WP 4 – Public debt and the financial system under compounding risks



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WP 4 – Contributions to Amelia

M. Marcellino
Università Bocconi

A. Consiglio
Università di Palermo



Contributions to Amelia

- 1. Real time monitoring and forecasting of key macroeconomic and financial indicators** (Massimiliano Marcellino, Università Bocconi):
 - Real time monthly and quarterly macro and financial datasets;
 - Periodic reports on real time monitoring and forecasting of key indicators;
 - Replication codes in R.
- 2. Stochastic debt sustainability and financial stability** (Andrea Consiglio, Università di Palermo):
 - A dashboard in Python and core numerical models in Gams;
 - Efficient frontiers and fan charts of the main debt and macroeconomic aggregates.



Contributions to Amelia

3. **Sovereign debt risk management** (Carlo Favero, Università Bocconi):

- Codes for pricing and simulation in R.

4. **Fiscal Policy and the Italian economy** (Efrem Castelnuovo, Università di Padova):

- Quarterly country-level database of macroeconomic variables;
- Estimates of country-specific multipliers;
- Technical working papers;
- Replication codes in MATLAB.



Contributions to Amelia

5. **Regional Fiscal Multipliers** (Luca Fanelli, Università di Bologna):

- Annual regional database of macroeconomic variables;
- Estimates of fiscal regional multipliers;
- Technical working papers;
- Replication codes in MATLAB.

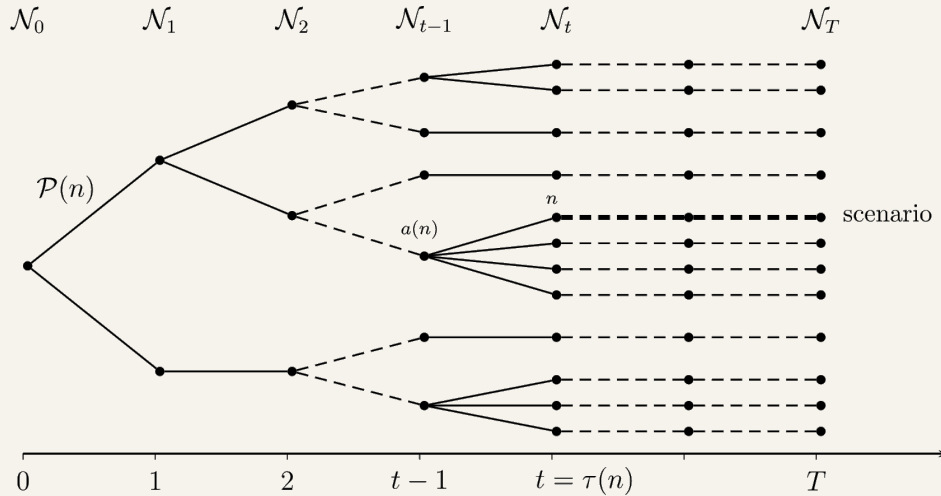
6. **International trade and public debt** (Roberto Casarin, Università Ca' Foscari, Venezia):

- Quarterly database on international trade and similarity in debt dynamics networks;
- Estimates on the group of countries with similar trade-debt characteristics;
- Technical working paper;
- Replication codes in MATLAB.

Stochastic debt sustainability and financial stability

Dashboard

Andrea Consiglio



Scenario Trees

Consiglio, Carollo and Zenios,
Quantitative Finance, 16, 2016



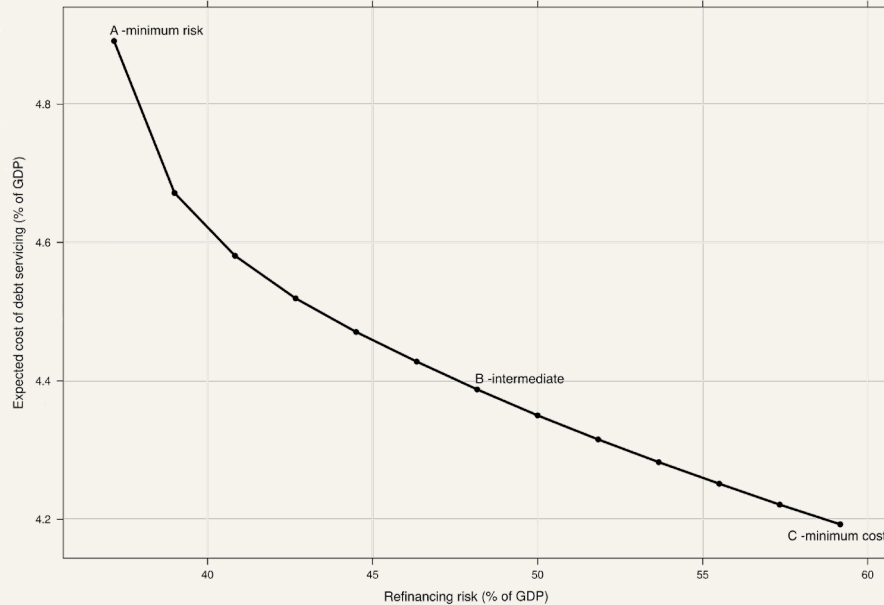
Model uncertainty around **baseline projections**



Moment matching – Expected values, Standard deviations and Correlations



Exogenous risk factors: GDP growth, Primary Balance, Yield Curve



Efficient Frontiers

Zenios, Consiglio, et al.

Operations Research, 69(3), 2021

📈 Minimize cost of servicing debt while bounding refinancing

📊 Endogenous debt and credit risk spread

📈 Fan charts of stock of debt and gross financing need

DSA

Input

Output

Drag and Drop or Click to Upload a file

Legacy Debt

YEAR	AMORTIZATION	INTEREST	EXISTING_DEBT_STOCK
2023	366.120140527282	47.8478410872384	2332.568459874963
2024	270.135776267948	43.626495423692	1966.448319347681
2025	218.682314	39.1762503221867	1696.3125430797331
2026	211.096011592688	35.0132164773981	1477.630229079733
2027	144.062649	31.127657087827	1266.5342174870452
2028	140.988494443593	27.4329766091738	1122.4715684870453
2029	107.9564272	24.5536114124112	981.4830740434522
2030	142.11560447276	21.5560049356224	873.5266468434522
2031	96.877823	19.4198792717573	731.4110423706923
2032	82.2590456702966	17.0341498534114	634.5332193706922
2033	59.4600744484376	15.7634486678096	552.2741737003955
2034	28.9916504	13.8935408063786	492.81409925195794
2035	44.2426336215919	12.530688423009	463.8224488519579
2036	36.983912	11.2950576896752	419.57981523036597
2037	51.214753	10.6865062211481	382.59590323036605
2038	23.760662	9.30758265316947	331.3811502303661
2039	27.5870700745761	8.62704039495706	307.62048823036616

Dashboard Output



User friendly input (Excel) output (any graphic format) interactive dashboard



Written in Python, using Dash library (open source)



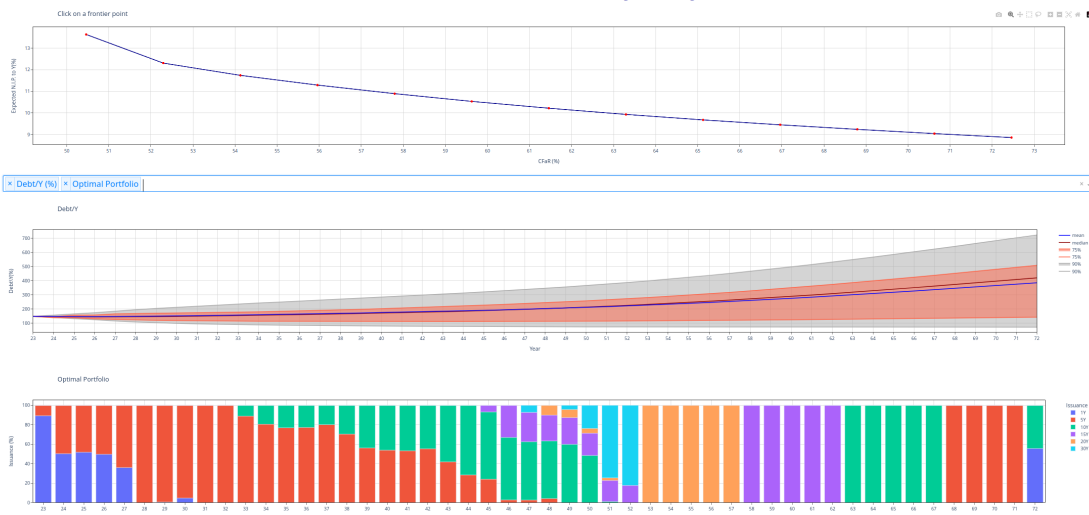
Numerical optimization powered by Gams®

DSA




Input

Output

DSA - Debt Sustainability Analysis



Dashboard Output

-  Interactive plots and fancarts
-  Advanced data visualization charts, using Plotly (open source)
-  Universal dashboard adaptable across any device

Grazie per l'attenzione

