Drought Risk Assessments for the Danube Region and Romania

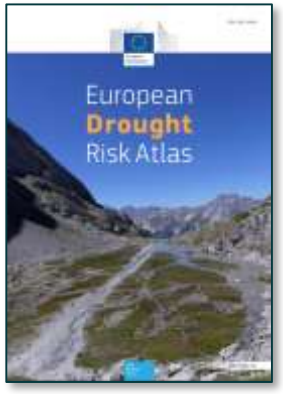
International Conference
Drought Risk & Drought Risk Management in Romania & Europe
Bucharest, October 30-31, 2023

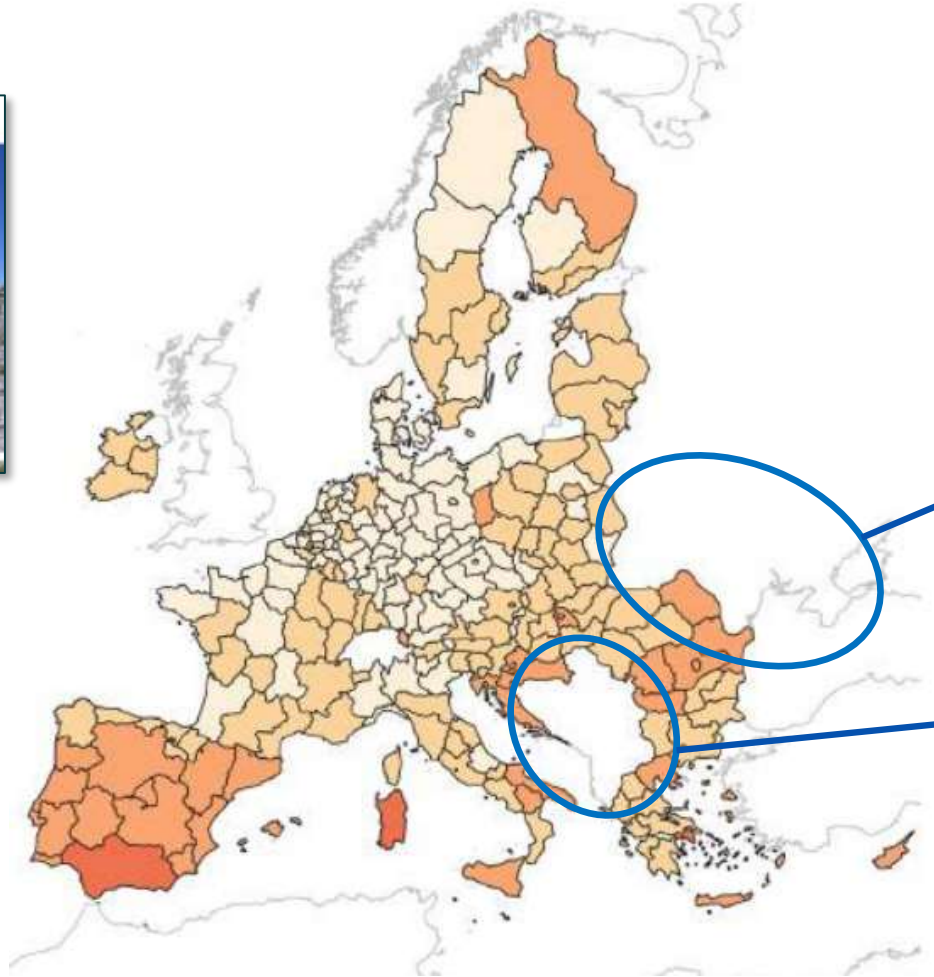
WORLD BANK GROUP
Water

Raimund Mair
Senior Water Resources Management Specialist
World Bank

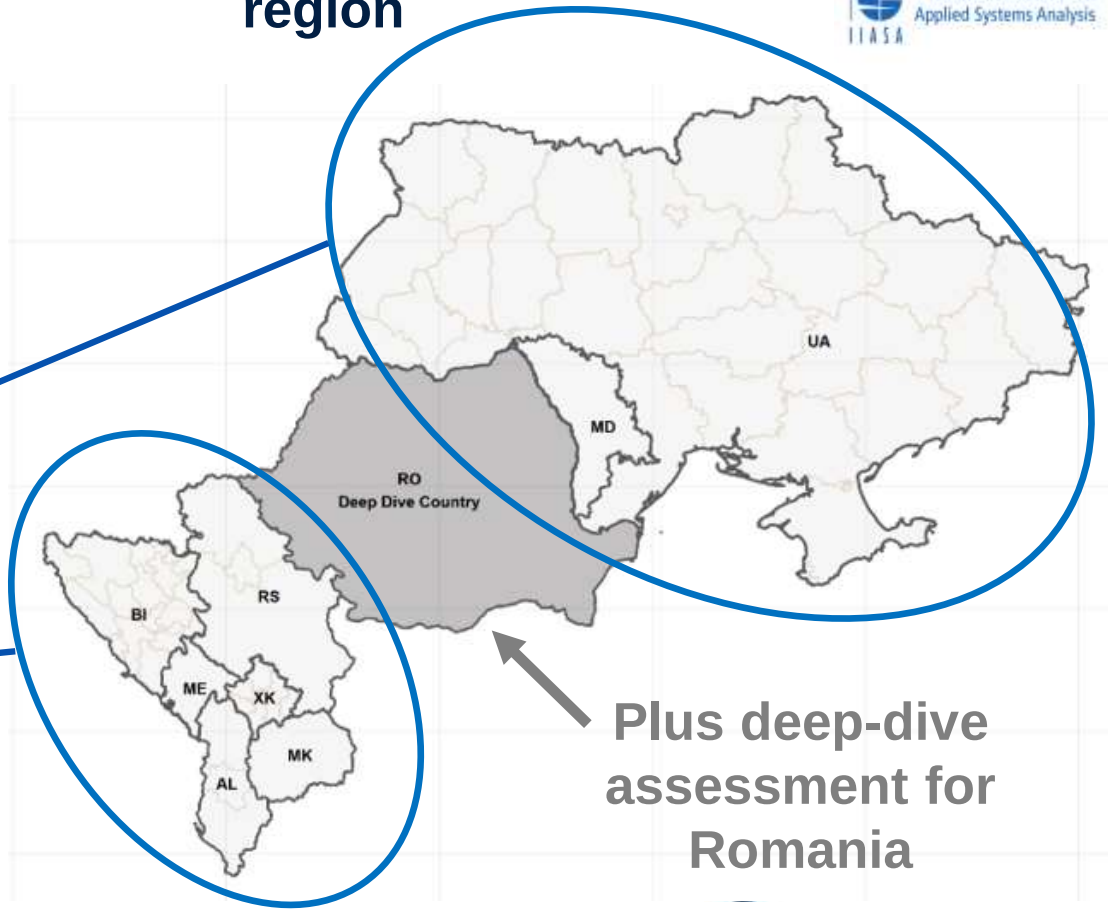
Drought risk management activities

Activities EU Member States





World Bank complementing EU assessments for non-EU countries in Danube region



Plus deep-dive assessment for Romania

Why complementing drought risk assessments?

1. **Droughts increasingly an issue** in the context of climate change and socio-economic development patterns
2. Input for development of **Western Balkans Country Climate and Development Report** (CCDR)
   - Core diagnostic tool by the World Bank
   - Integrate climate change and development considerations to help prioritize impactful actions for resilience, adaptation, and reducing greenhouse gas emissions
   - Under development for the Western Balkans, including assessments on drought risk
3. **Uniform analytical basis covering all Danube region countries** based on common pan-European methodology developed by JRC
   - Additional assessments for non-EU countries which were not assessed in the frame of EU activities
   - Input for drought-related discussions in the frame of transboundary River Basin Commissions, i.e. ICPDR and ISRBC

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Drought risk assessment for the Danube Region and Romania

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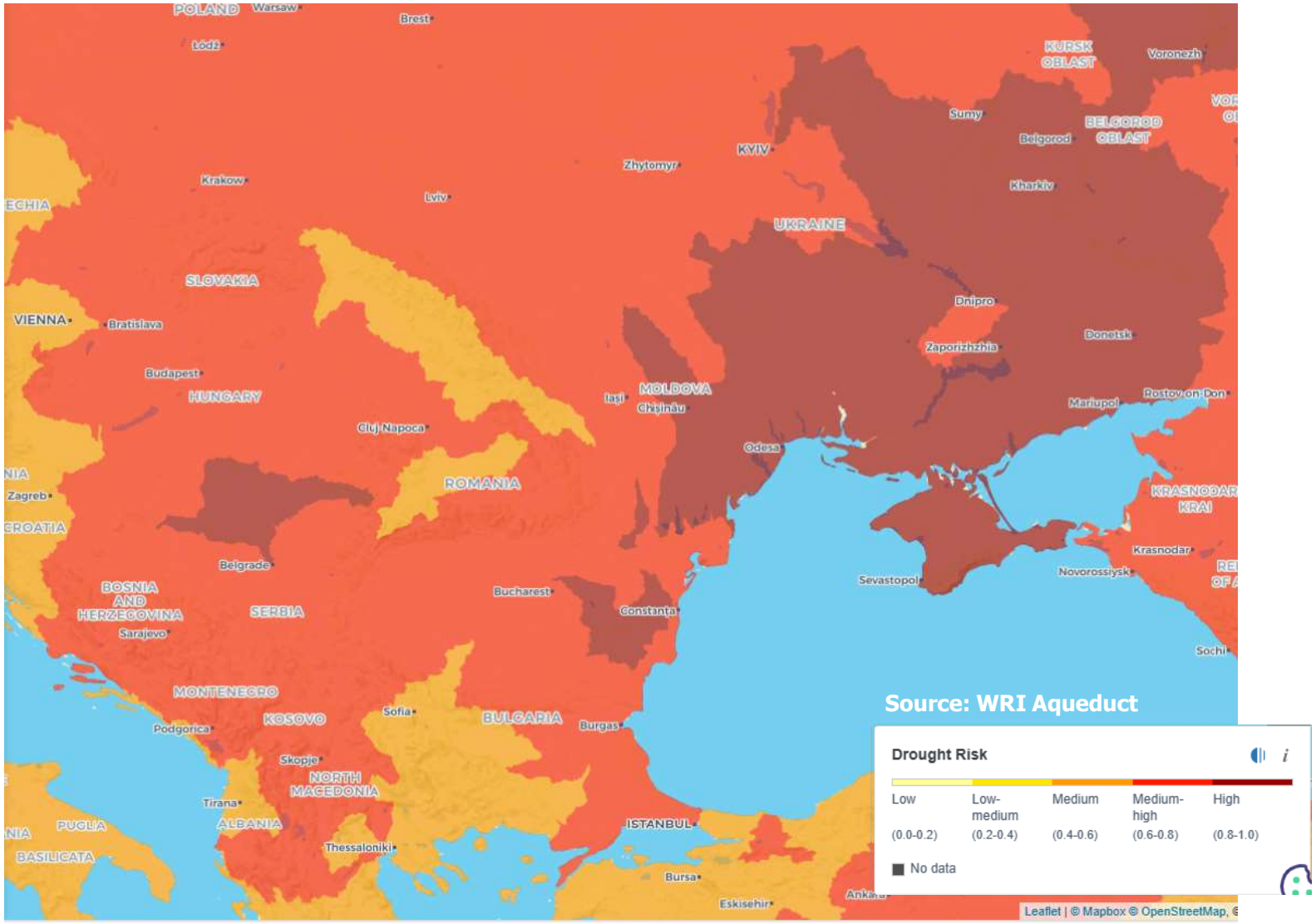
Drought Risk and Drought Risk Management in Romania and in Europe
October 30 and October 31 in Bucharest, Romania

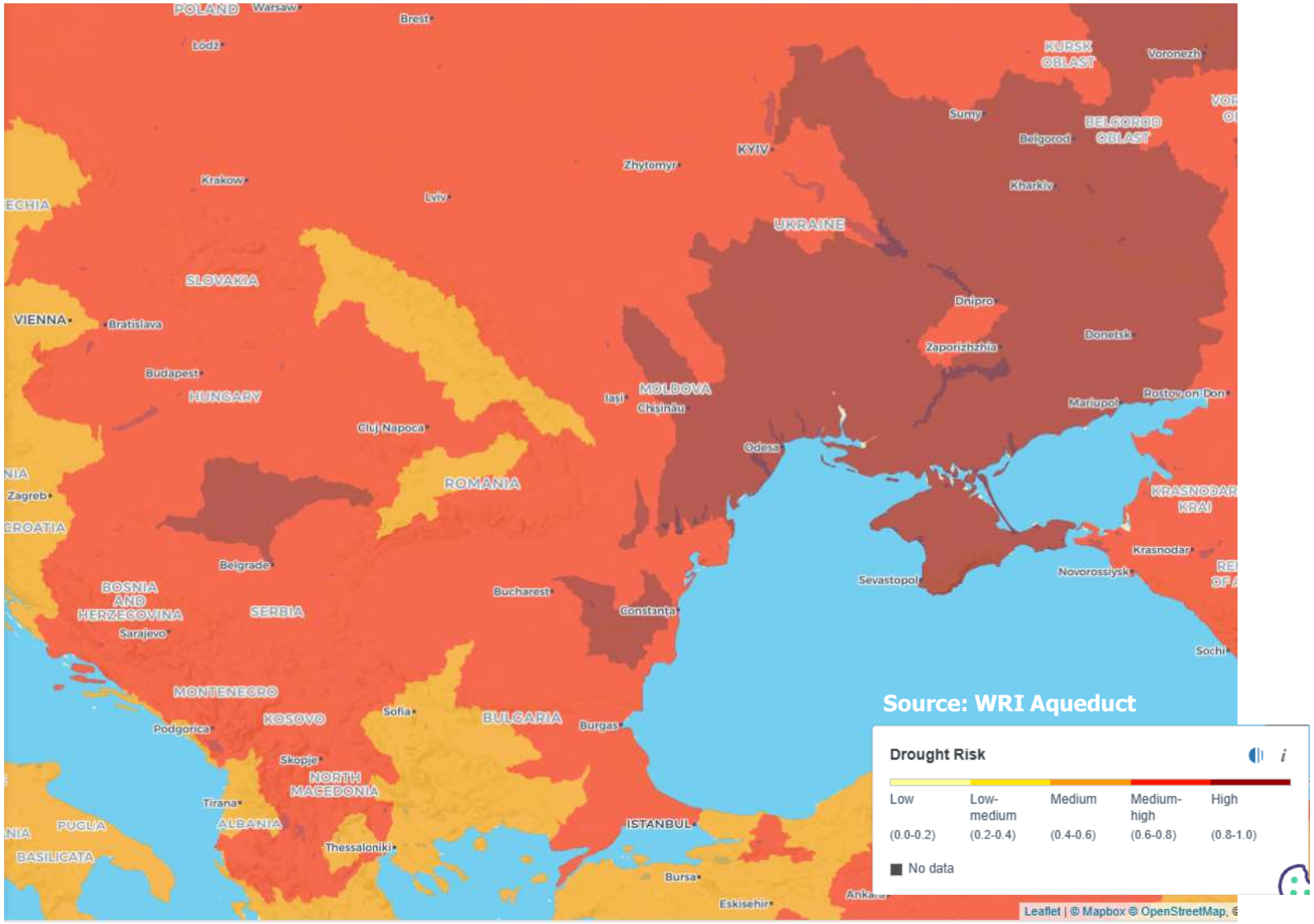
Funded by and in collaboration of the world bank group

Why is drought risk assessment important in this region?



- Medium to High drought risk is evident at a regional scale.
- Putting population at risk, and may negatively affect water supply, navigation and commerce, agriculture, and energy generation.
- Putting ecosystem at risk.

Why is drought risk assessment important?



- Medium to High drought risk is evident at a regional scale.
- Putting population at risk, and may negatively affect water supply, navigation and commerce, agriculture, and energy generation.
- Putting ecosystem at risk.

- But what are the sectoral impacts?

The factors approach for drought risk assessment

Risk = Hazard X Exposure X Vulnerability

The EDORA approach for drought risk assessment

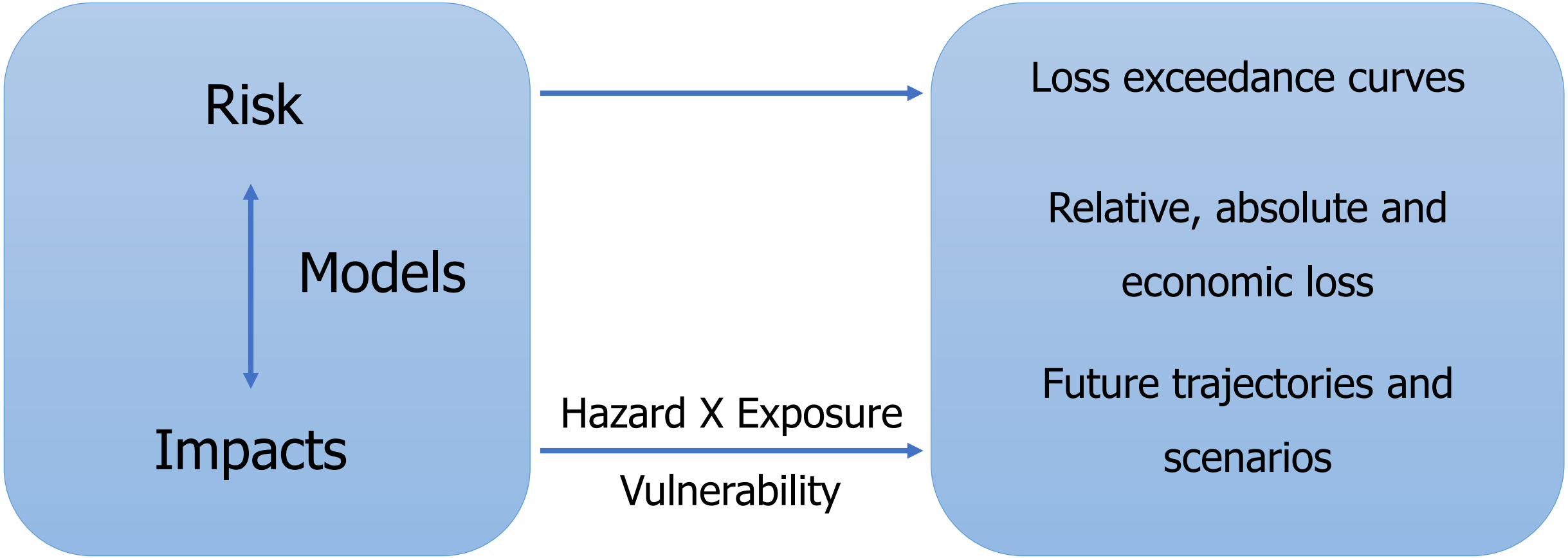
Risk = Hazard X Exposure X Vulnerability

Models (Random forest)

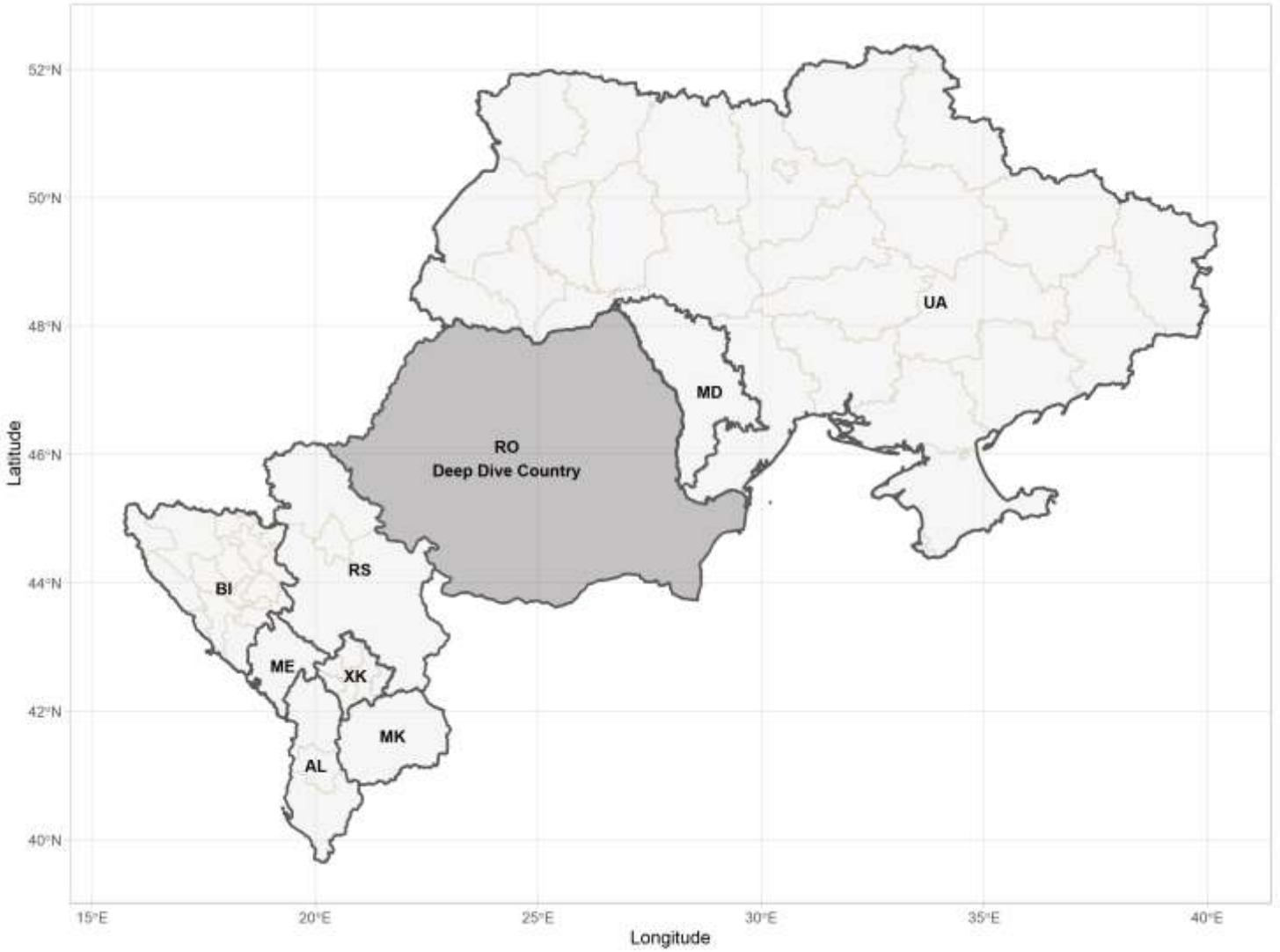
Impacts

Theoretical impact chains

The EDORA approach for drought risk assessment



Assessment’s goals and scope

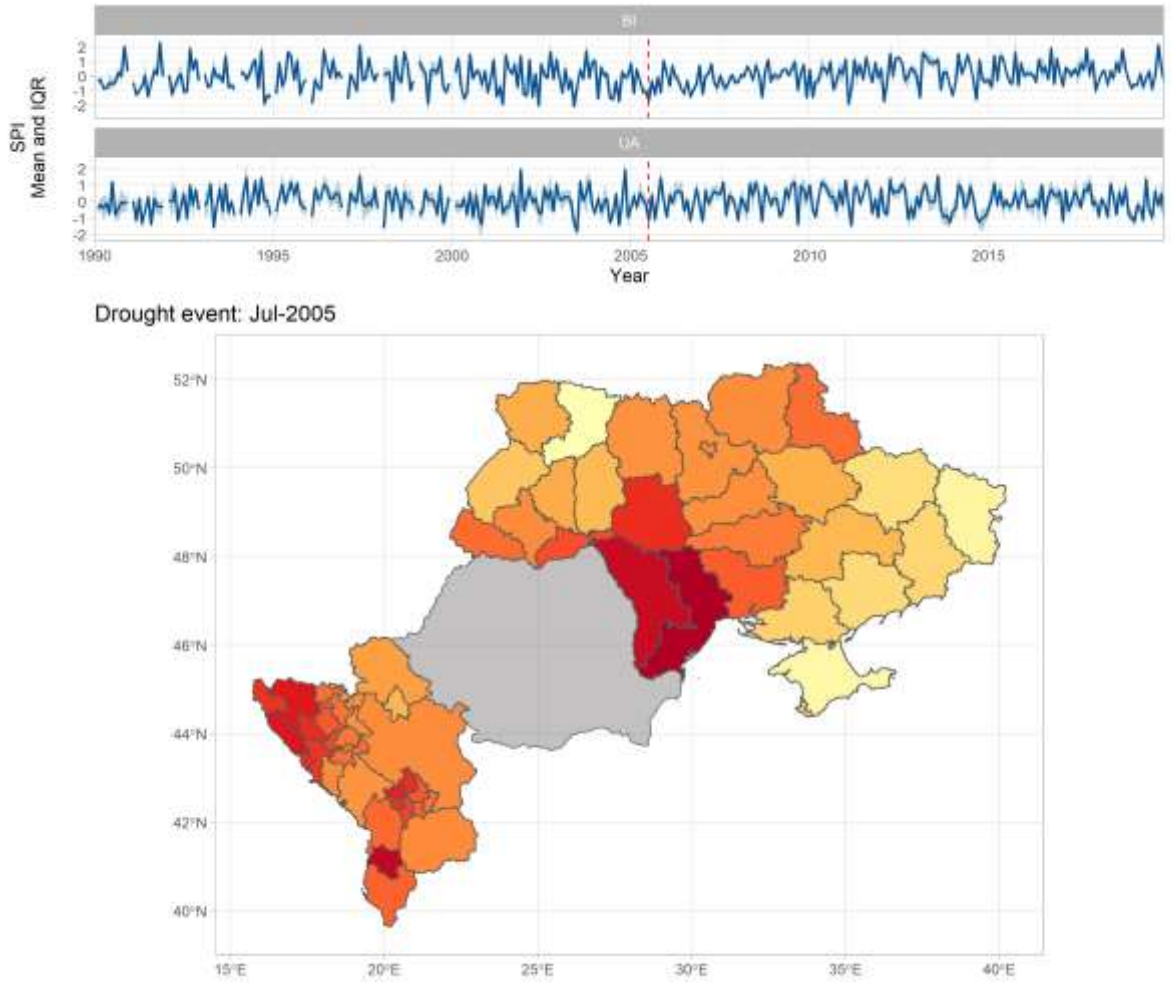


- Extending the EDORA-EU assessment to include the Western Balkan, and Ukraine and Moldova (Eight countries).
- The assessment focuses on 61 NUTS 2 (or parallel) administrative units.
- A separate assessment for Romania includes data from national sources and focuses on eleven river basins.

Systems-at-risk & data

System-at-risk	Impact proxy	Data source & coverage
Agriculture – crops	Yield of wheat and maize	Lizumi and Sakai, 2020 0.5°, 1982 -2016
Water Supply	Water withdrawal	Global CWatM 0.5°, 1990 -2019
Energy supply – hydroelectricity	Hydroelectricity generation	Country Statistics, IEA National, 1990 -2020
Inland water transport	Goods transported	UNECE Statistical database National, 1980 -2021
Ecosystem – terrestrial	Forest Net Primary Productivity (NPP)	MODIS Net Primary Productivity & MODIS landcover type (annual) 500 meter, 2001 -2022
Ecosystem – freshwater	Wetland Net Primary Productivity (NPP)	

Hazard factor

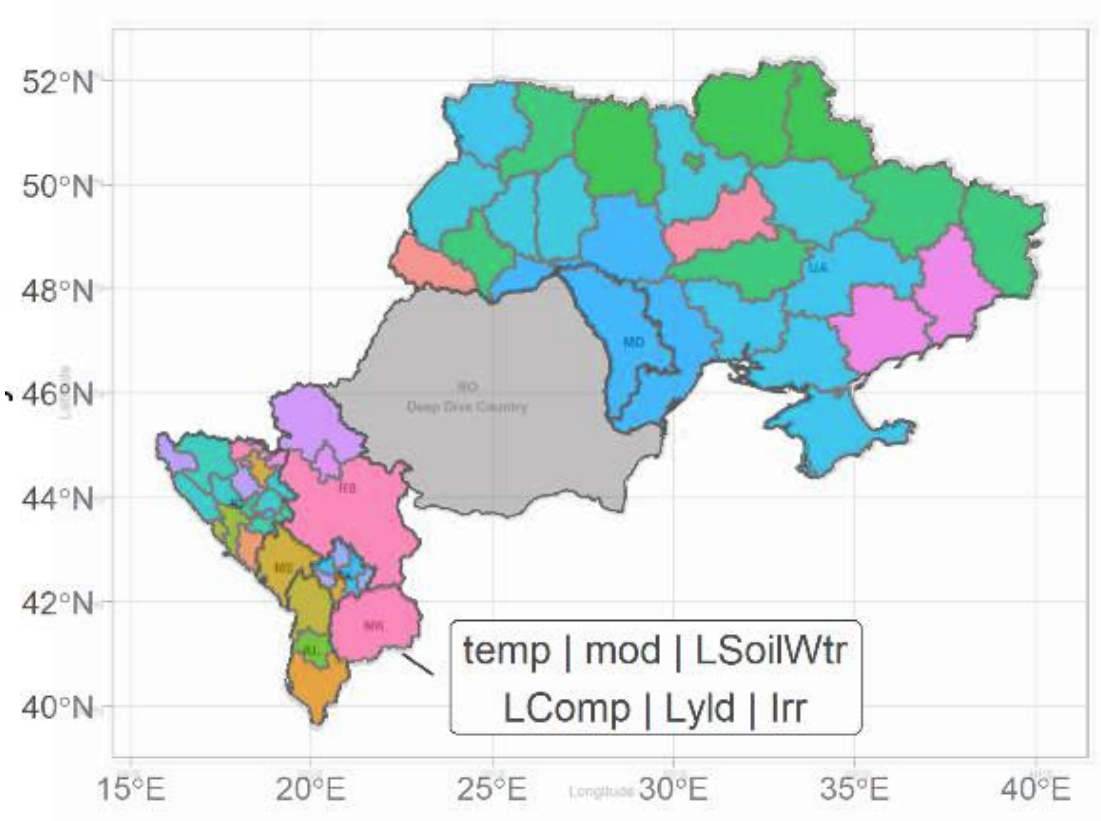


Standardized precipitation index (1990 -2019) for three months accumulation period; Source: Global CWatM. Top: Monthly average and IQR; bottom: spatial distribution during July 2005.

- Hazard indices (standardized and normalized) are calculated from data on precipitation, effective precipitation, river discharge, evaporation, soil moisture.
- Accumulation periods: 1, 3, 6, and 12 months.

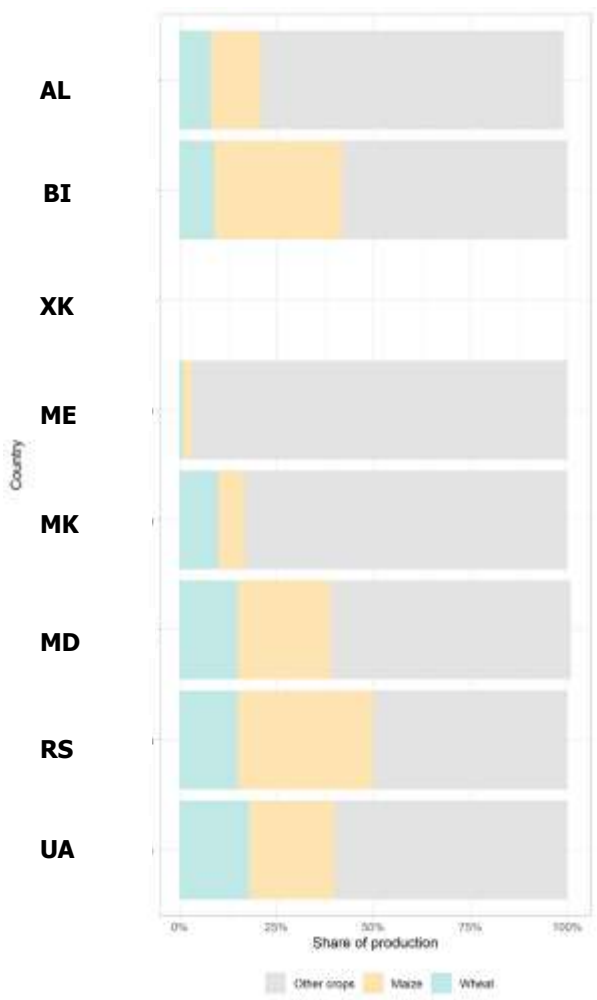
- Baseline hazard (1990 -2019). Future hazard (2021 -2060, 2061 -2100)
- Four RCPs: 2.6, 4.5, 7.0, 8.5
- Five GCMs: GFDL-ESM4, IPSL-CM6A-LR, MPI-ESM1-2-HR, MRI-ESM2-0, UKESM1-0-LL

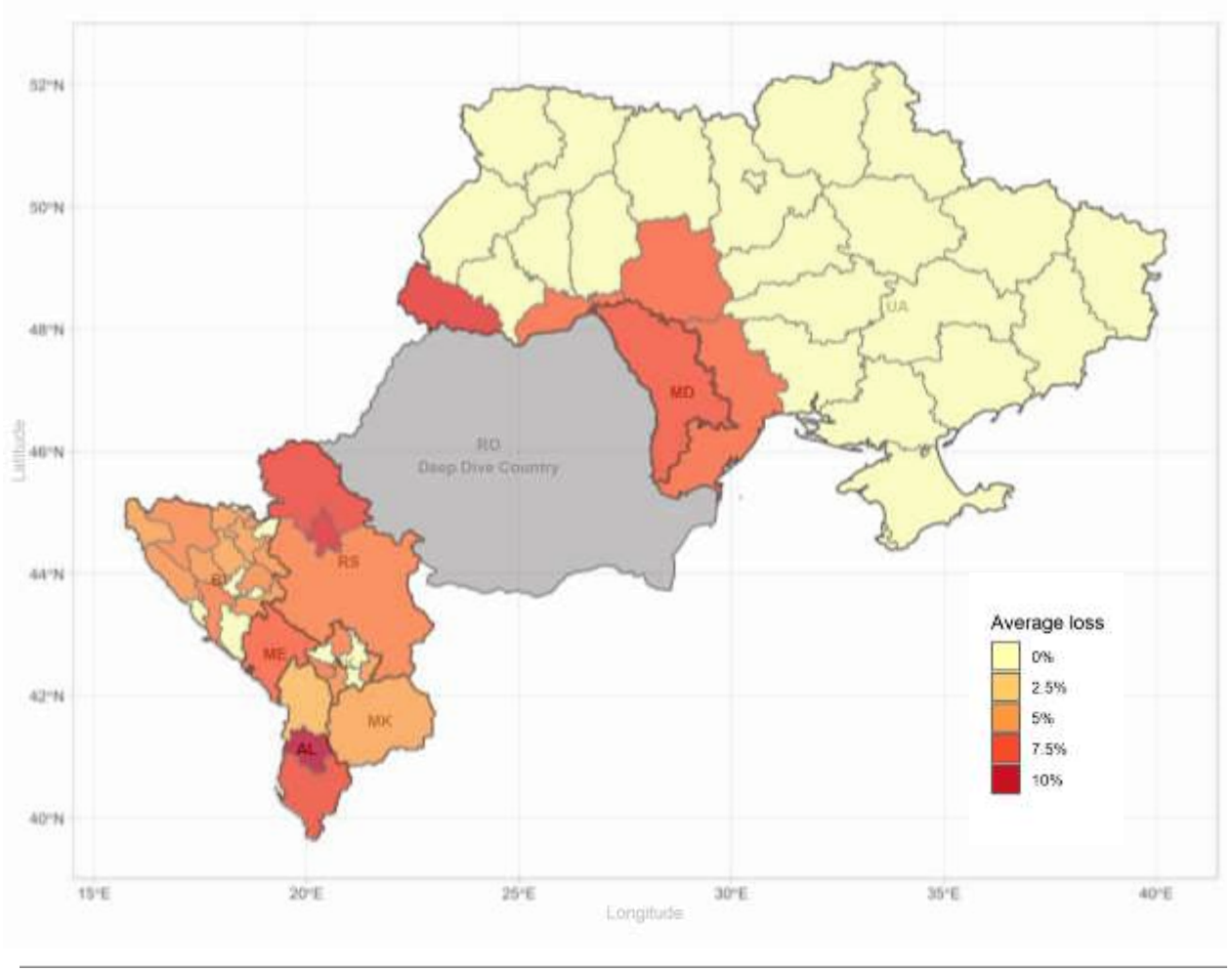
Understanding vulnerability classes



- Combination of categorized indicators, that control the risk-impact relationship, based on the theoretical impact chains.
- Facilitate the link between drought risks and impacts, i.e., for a single model is trained for each class.
- Each model can use different sets of weighted hazard indices.

Average annual yield losses for maize



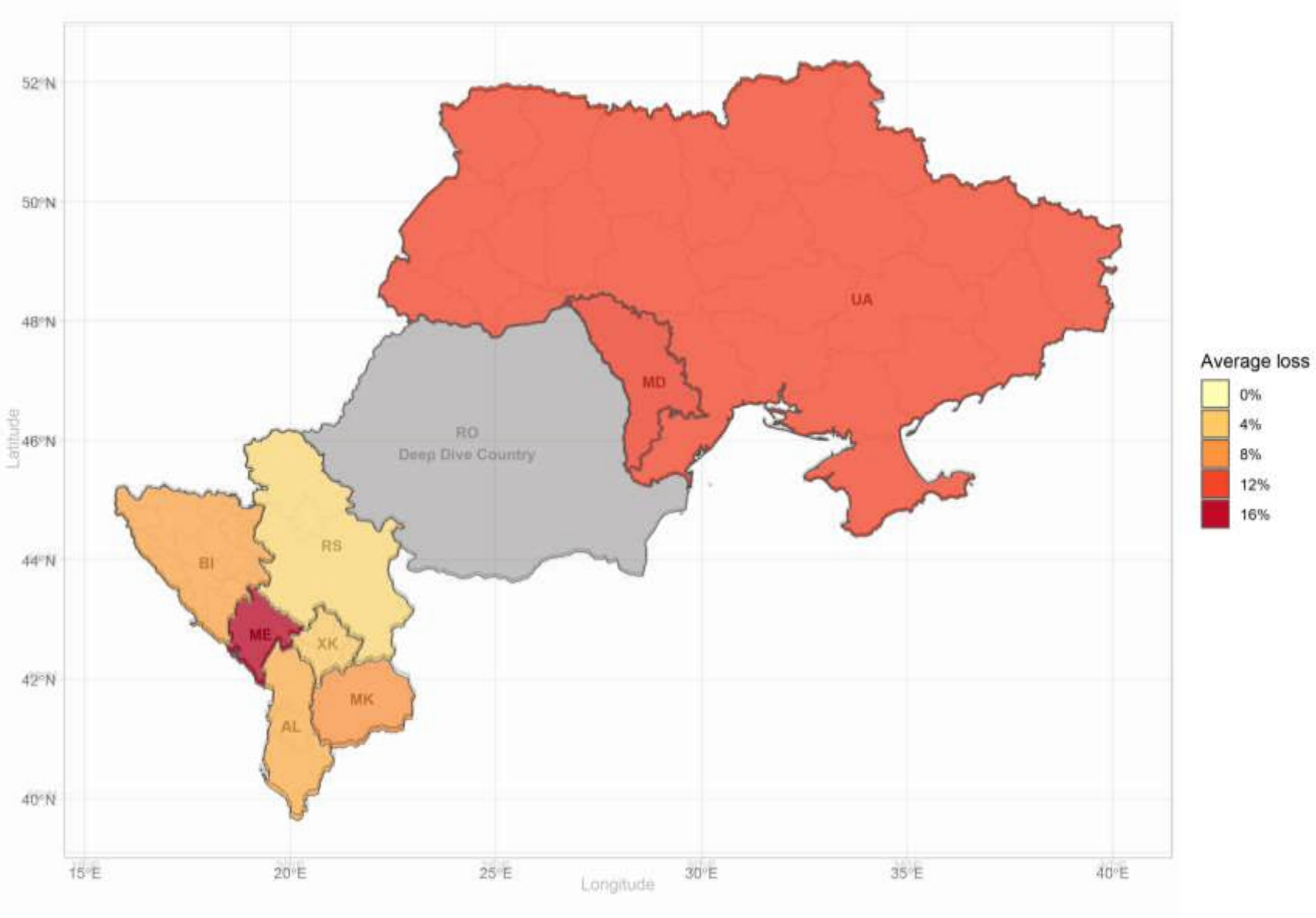


- Maize and wheat make significant share agricultural production in most countries.
- Maize and wheat losses are high in the countries with higher production shares.

Energy

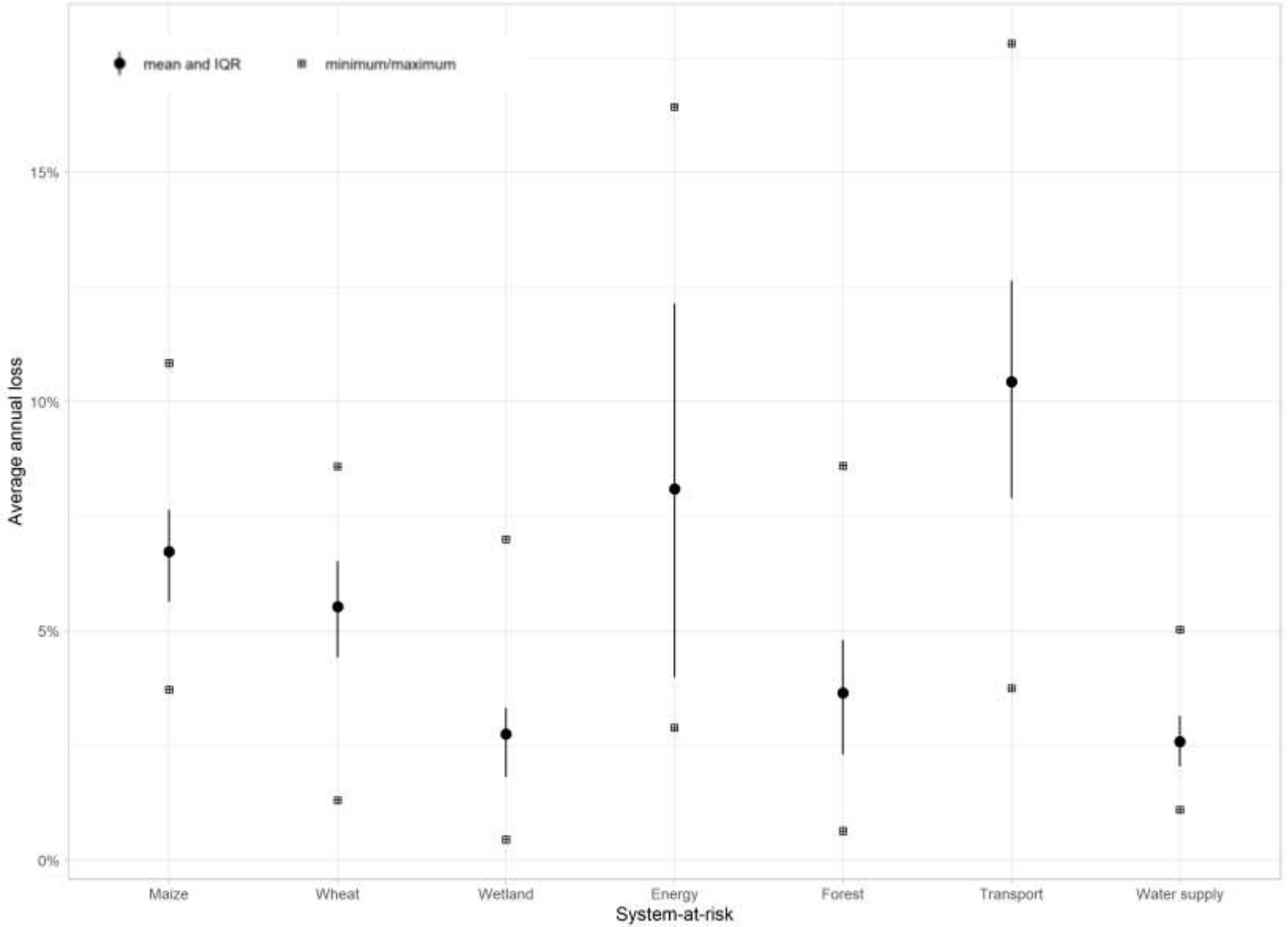
- Significant losses in Western Balkan electricity production due to droughts.
- These losses may result in up to 9% decrease of electricity generation/increased costs.

Country	AL	ME	BI	MK
Hydropower share of total	99%	56%	41%	26%
AAL	8%	16%	8%	8%
Impact on electricity production	8%	9%	3%	2%



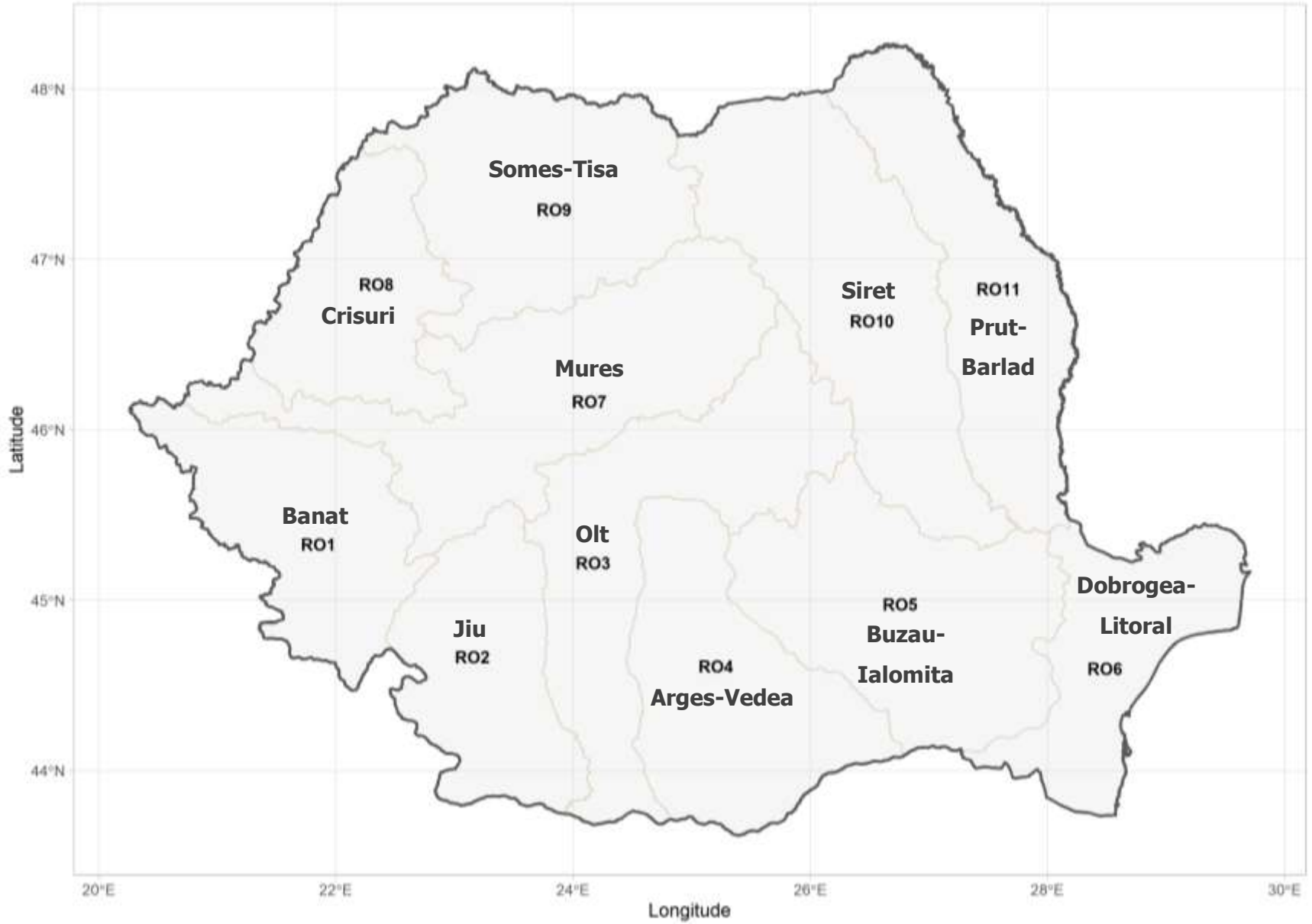
Overall assessment

- Average AAL range between 5% -10%, except from forest, wetland and water supply.
- The transport and energy sectoral AALs are larger but show larger variability.

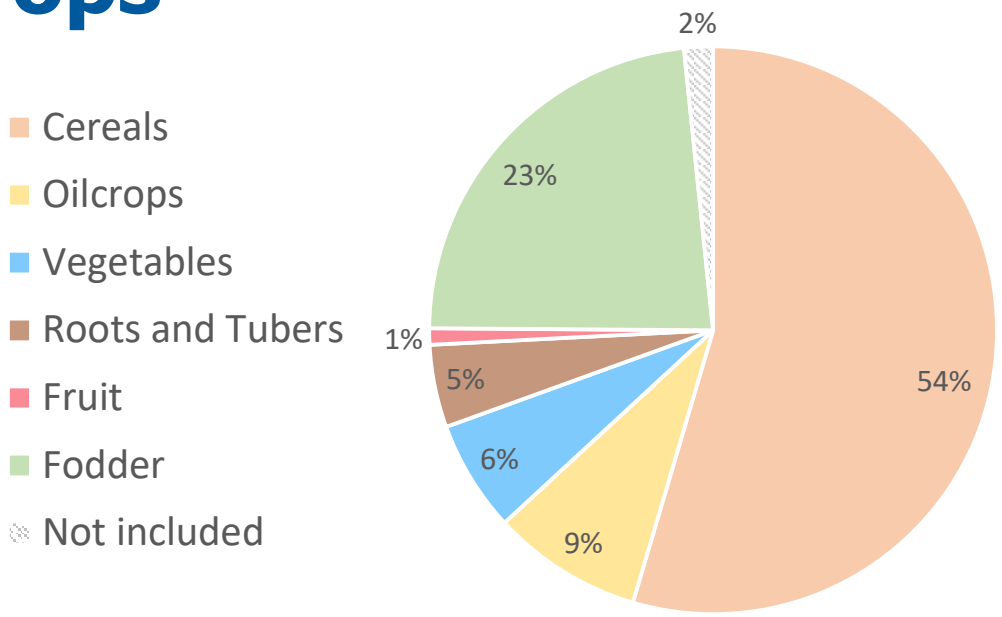


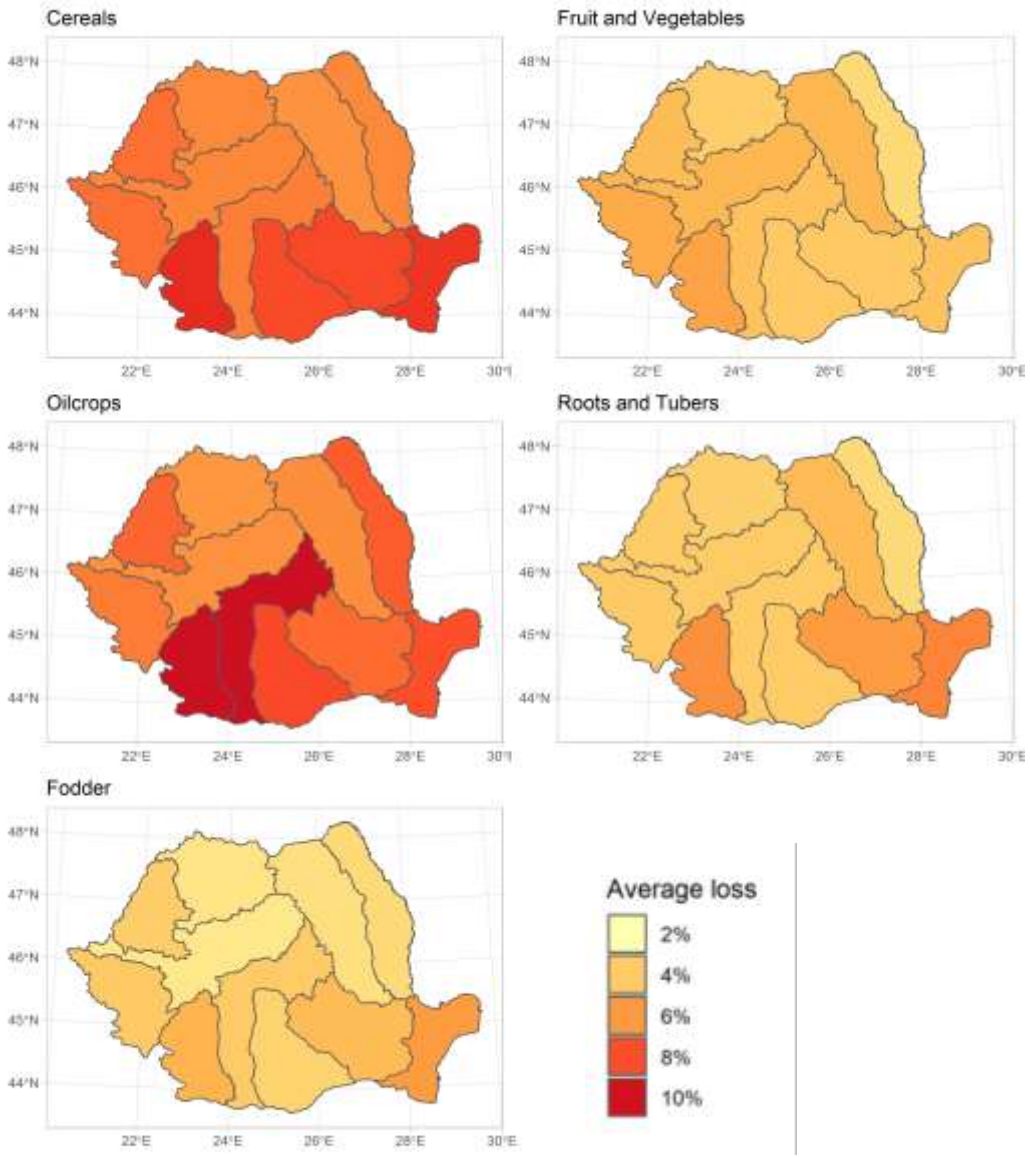
The Romania Deep dive assessment

- Eleven River basins/watershed areas.
- Datasets from national sources: hydroelectricity water use, 18 crop's yields, inland water transportation.
- Datasets from European sources: Water abstraction for public supply.



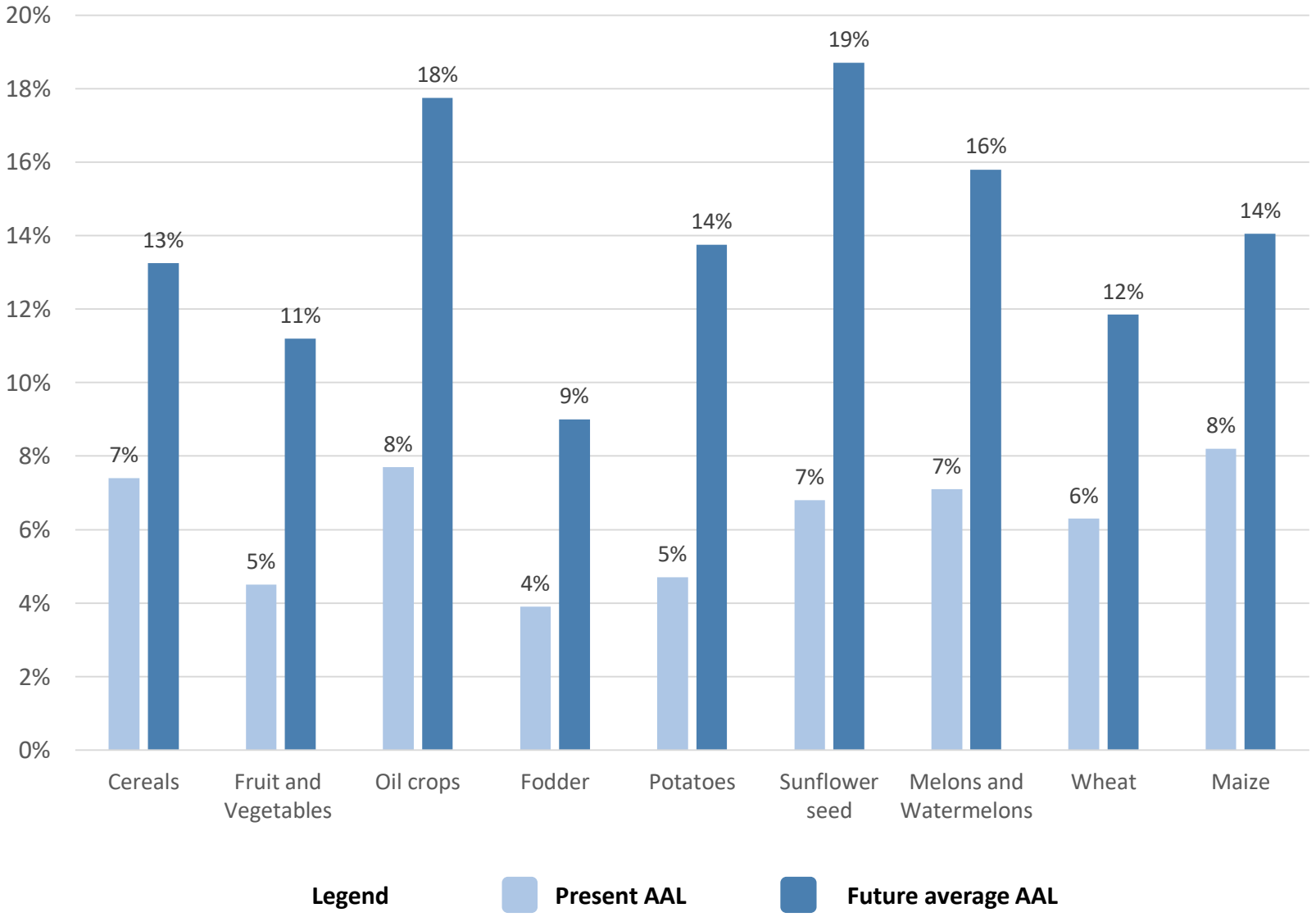
Crops





- The included crops cover 98% of the total production in Romania.
- Average annual yield losses range between 2.8% - 15.4%
- The most common crops show the highest yield losses.

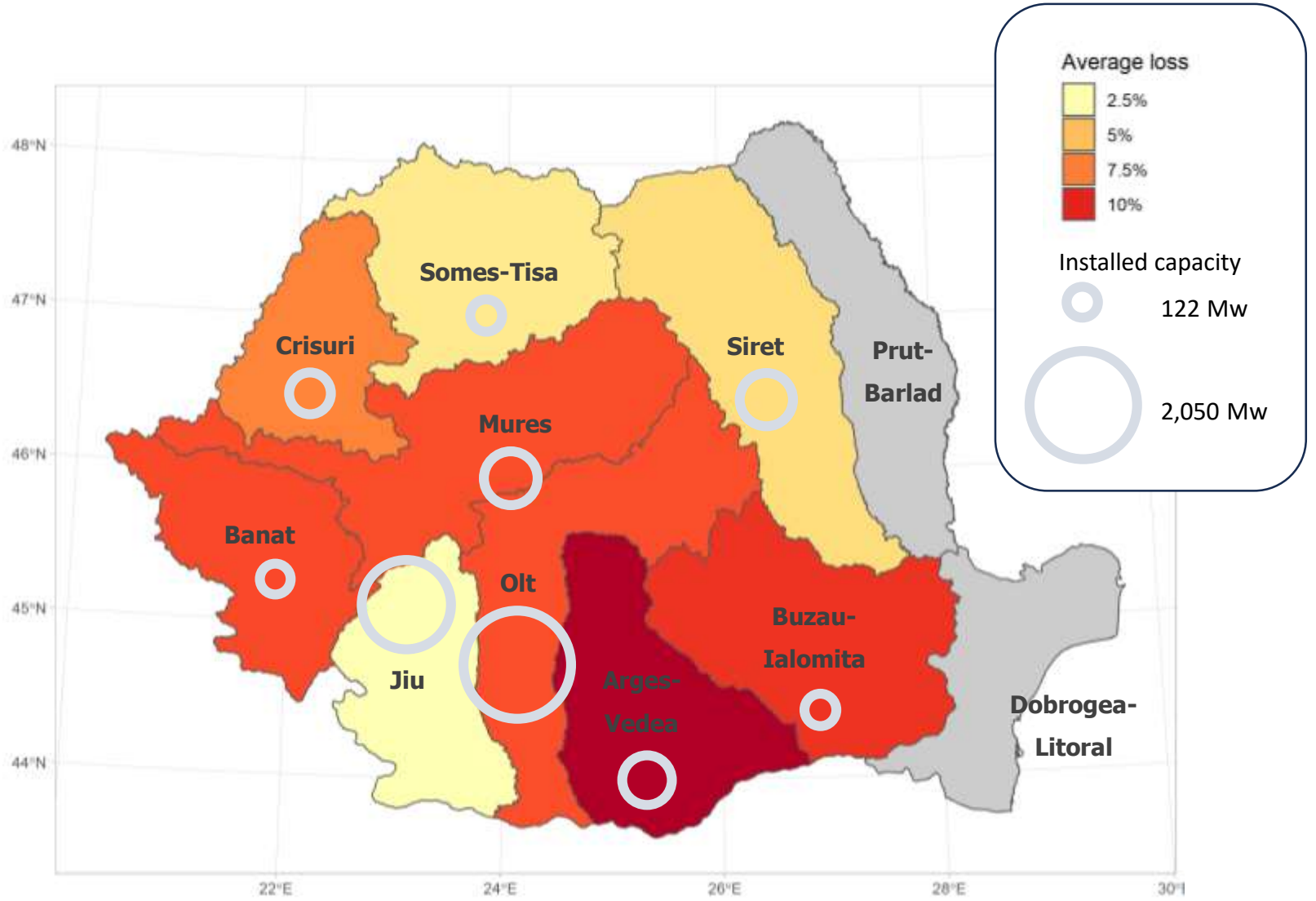
Crops - Future



- Most crop groups/crops AALs increase by more than 100%.
- Future crop groups' losses range, on average, between 9% - 18%.
- Individual crops can reach, on average, an annual loss of 20%.

Water allocation for hydroelectricity generation

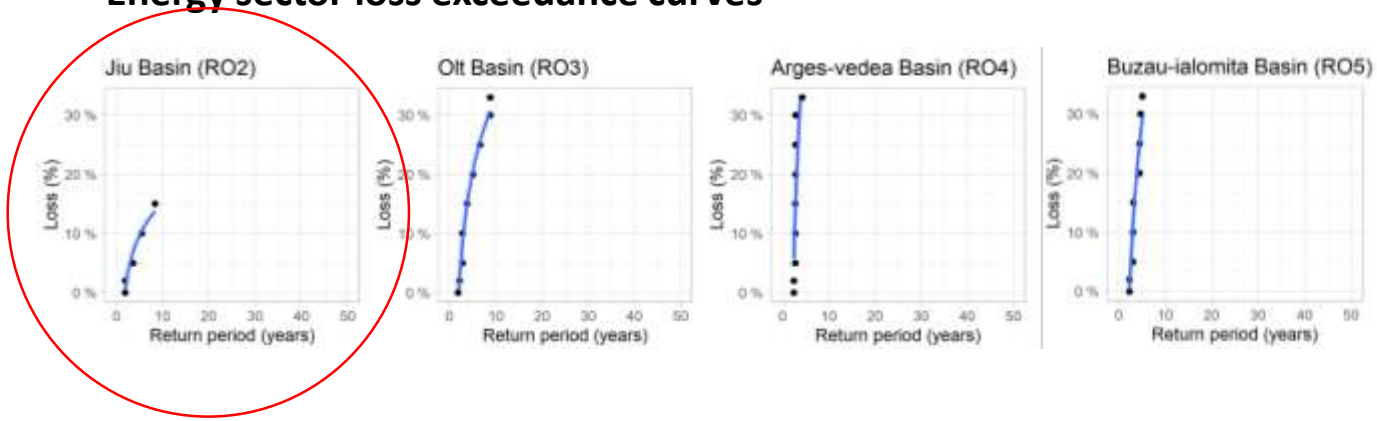
- The river basin with the highest installed capacity (Olt) has AAL of ~7.5%.
- Most river basins have AALs > 4%.
- The Jiu River basin (Iron gates located on the Danube) has a lower AAL (2.5%), yet the overall impact may be relatively high since it accounts for 25% of the installed capacity.

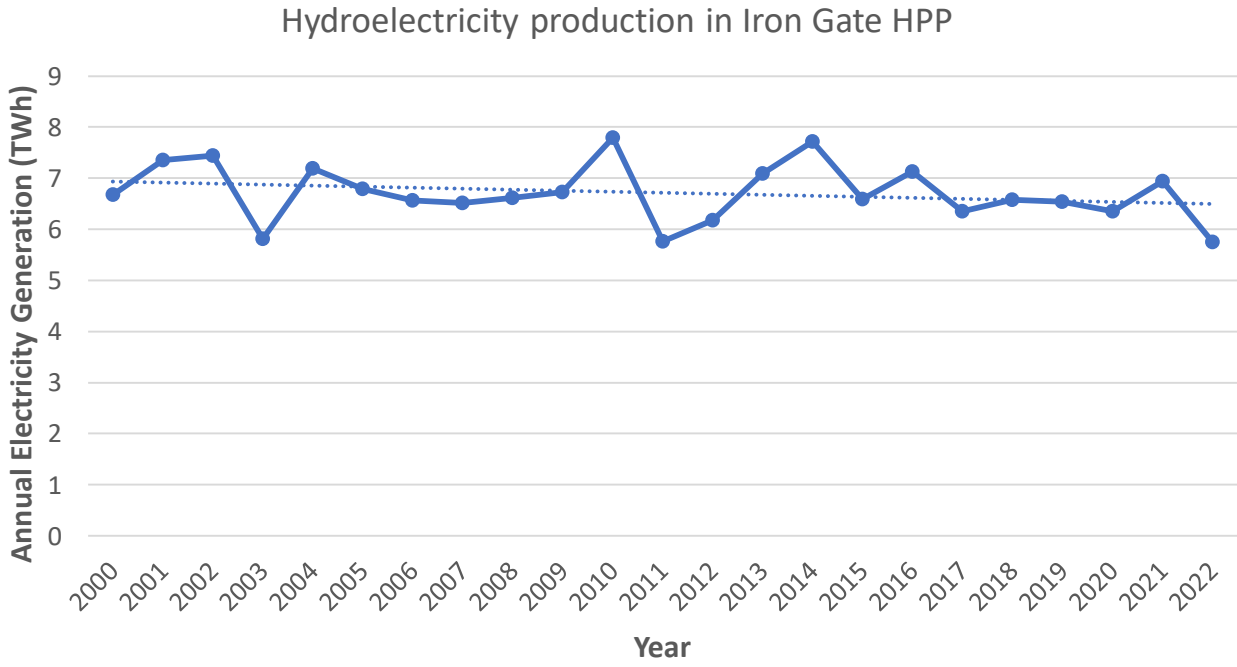


Iron Gates

- The Iron Gates HPP in the Jiu basin uses Danube water and is assumed to be more drought-resilient.
- Local hazard indices (except discharge) are less suitable to model these impacts.
- Impact categories in observed data and electricity generation do not cross 15% loss.
- Other river basins are more likely to reach higher losses (>15%), which increases their AALs.

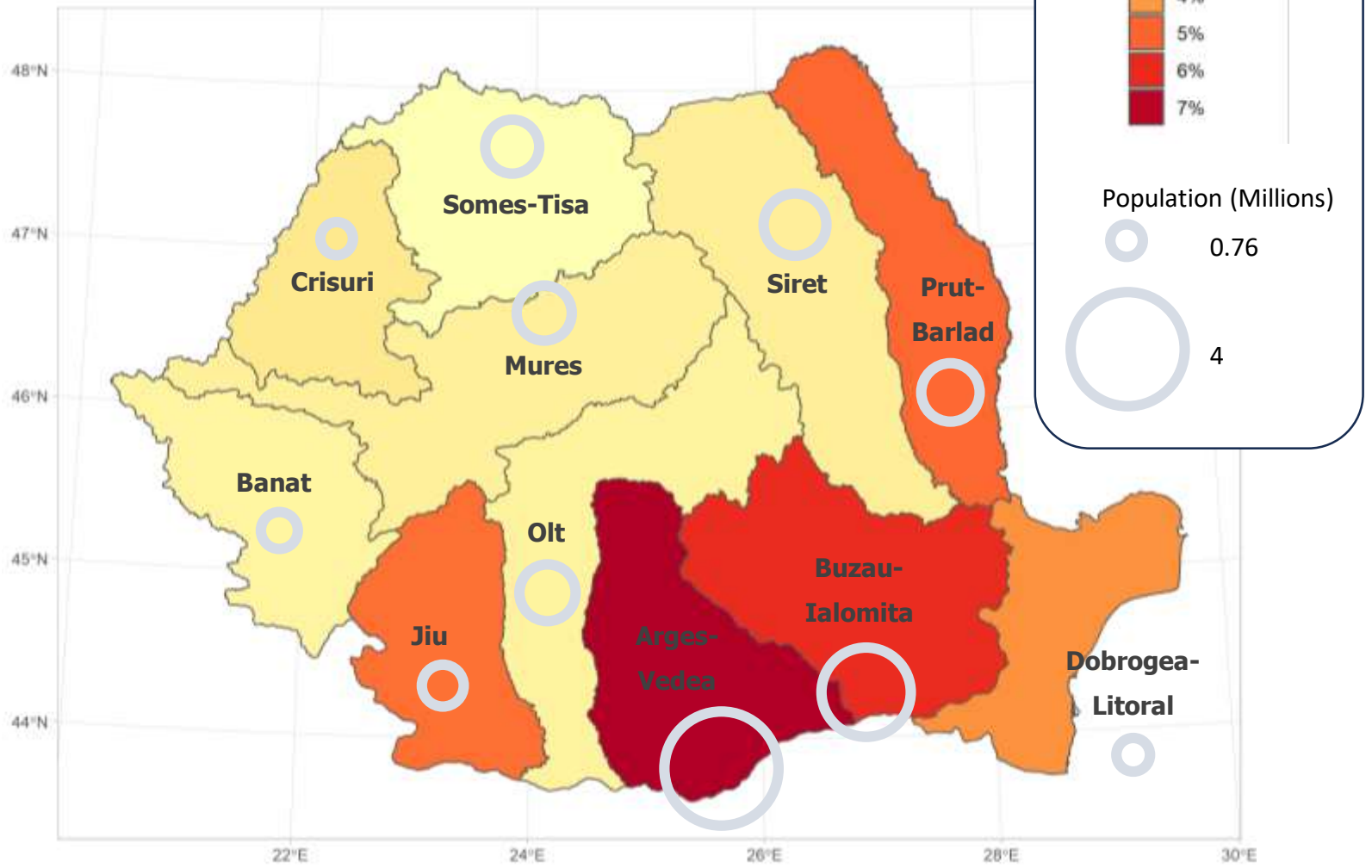
Energy sector loss exceedance curves





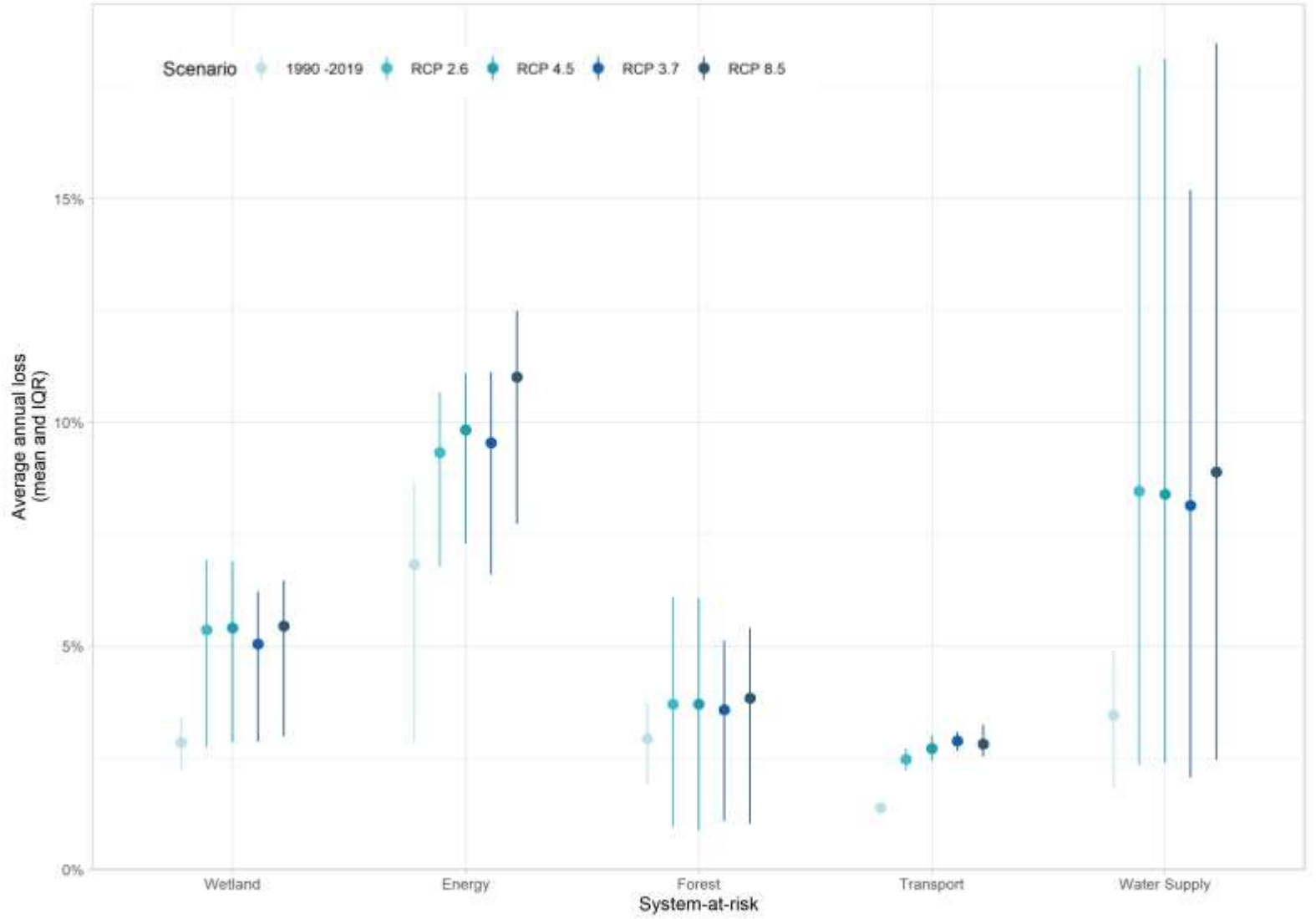
Water abstraction by public water supply

- Half of the population of Romania inhabits river basins with AAL > 5%.
- Most impacts occur in Southern and Eastern Romania.
- Loss of surface water may incur additional water abstraction costs.



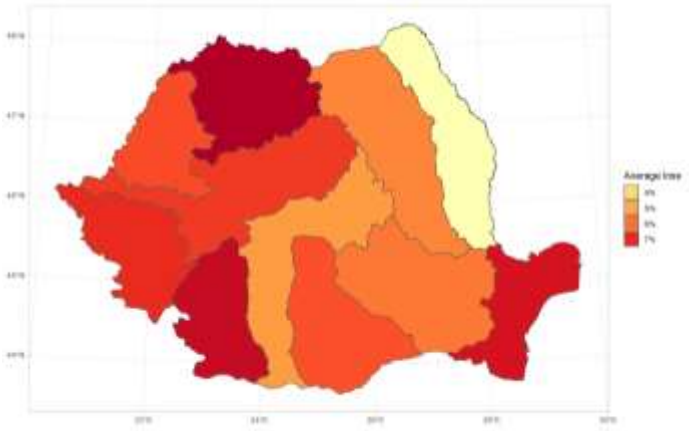
Summary and Future

- As in the agricultural sector, all systems show increased impacts in the future under all scenarios.
- Future AALs have higher ranges, due to different GCMs and different effects of climate change across river basins.
- Human managed systems seem to be more sensitive to RCPs.



Potential directions? Beyond relative impacts

Wheat
(27% from exported tons;
5% from value)



Absolute crop loss

Economic loss

Potential directions? Beyond relative impacts

Wheat
(27% from exported tons;
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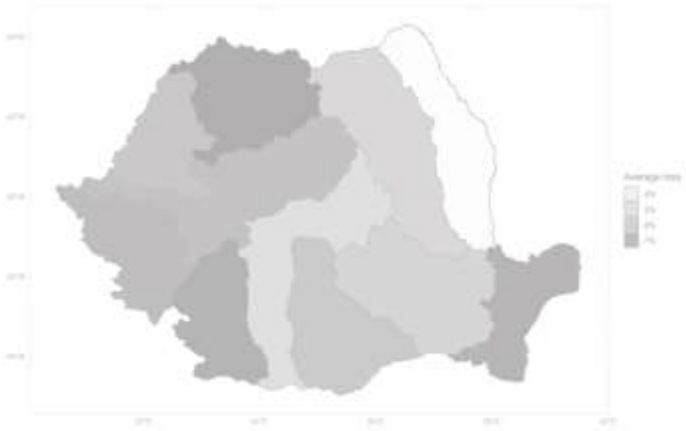
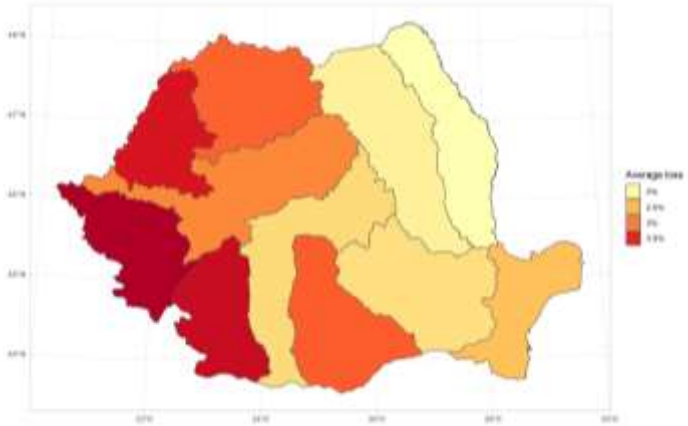


Absolute crop loss

Economic loss

Wetland



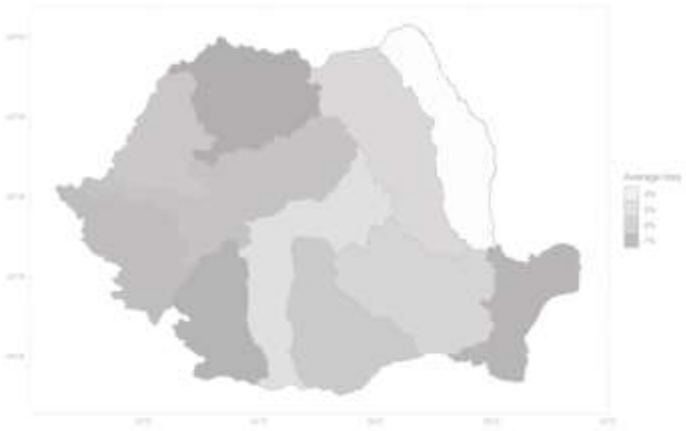
Absolute NPP loss

Ecosystem services/habitat/
biodiversity loss

Potential directions? Beyond relative impacts

Wheat

(27% from exported tons; 5% from value)



Absolute crop loss

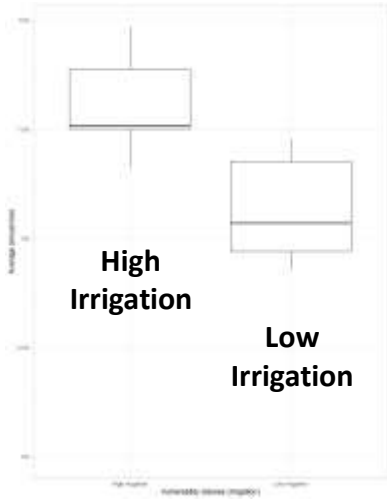
Economic loss

Wetland

Absolute NPP loss

Ecosystem services/habitat/ biodiversity loss

Yield loss



Observed AAL – Predicted AAL*

*** Based on model trained prior to infrastructure development.**

Main gaps and limitations

- Model usability and relevancy is grounded in theoretical development of impact chains, and strongly depend on high quality, detailed data (e.g., hydroelectricity production)
- Background data is very important for model interpretation (e.g., time series of irrigated areas, population structure, water abstraction costs, agricultural production costs and crop prices).
- The model advantages are not expressed when cross scale/inter-regional links are relevant – e.g., the case of Iron Gates.

Key take-aways

- This drought risk assessment extends other available estimates, by quantifying sector-specific losses.
- Both Danube region and Romania demonstrate significant current losses in multiple sectors, and particularly in agriculture and energy.
- Climate change (if no adaptation occurs) would increase the AALs significantly under all scenarios, for most regions.
- The national dataset from Romania has improved the analysis, increased its granularity (e.g., for energy), and extended its coverage (e.g., crops).
- Additional data would allow better interpretation of the results, and exploring innovation and useful application (e.g., the effect of technological improvement/adaptation) of the model.

Any questions?

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