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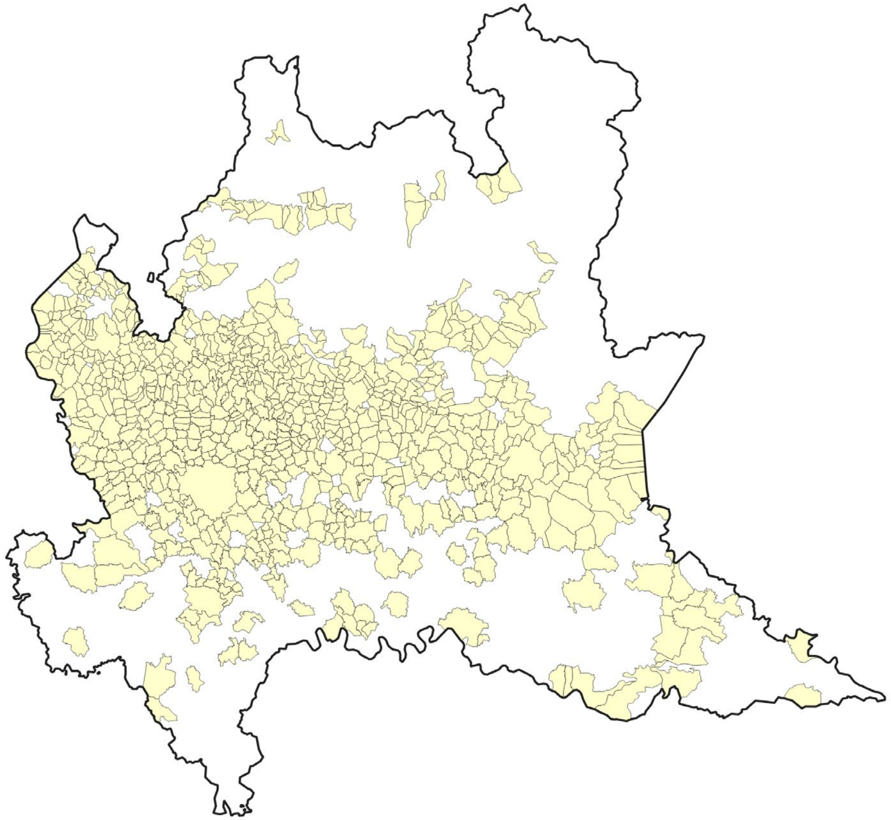
Linkages Between Condition Indicators and the Flood Control Ecosystem Service in the Urban Ecosystem

Mayra Zurbaran
Sara Vallecillo
Ioanna Grammatikopoulou

Joint Research Centre of the European Commission
Unit D3 - Land Resources and Supply Chain Assessments

Objective

The **urban ecosystem** is defined as the Local Administrative Units (LAUs) that are either cities or towns and suburbs.

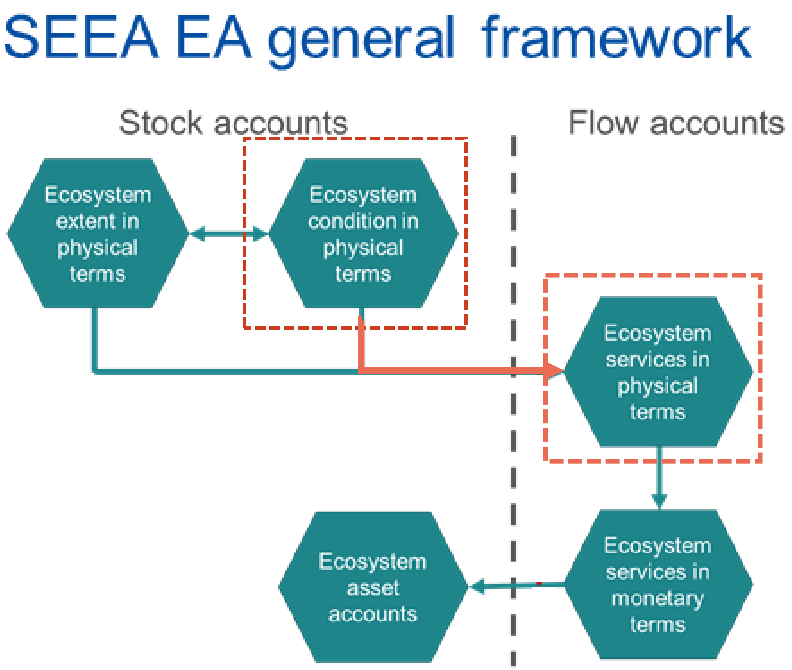


To investigate the **relationship between urban green spaces, tree cover density, and imperviousness on the flood control potential in the urban ecosystem in the EU** as defined in the Nature Restoration Regulation, with the aim of quantifying the individual and combined effects of these variables on flood control.

‘local administrative unit’ or ‘LAU’ means a low-level administrative division of a Member State, below that of a province, region or state, established in accordance with Article 4 of Regulation (EC) No 1059/2003 of the European Parliament and of the Council

Ecosystem condition

- According to the global statistical standard "System of Environmental Economic Accounting - Ecosystem Accounting":
    - Ecosystem condition is the quality of an ecosystem measured in terms of its abiotic and biotic characteristics
    - Ecosystem condition refers **to the state of an ecosystem's physical and biological components**, including its structure, function, and composition
    - The SEEA EA suggests that ecosystem condition can be assessed using a range of **indicators**
- Changes in ecosystem condition can have significant implications for the provision of ecosystem services:
    - Degradation is associated with a decline in the condition of an ecosystem asset during an accounting period
    - Changes in the quality and quantity of ecosystem services provided
    - impacts on human well-being and the economy due to changes in ecosystem services
- *"The decrease in the ES potential is translated in a decrease of the ecosystem service flow"* (La Notte, et al., 2022)



La Notte, A., Czucz, B., Vallecillo, S., Polce, C., & Maes, J. (2022). Ecosystem condition underpins the generation of ecosystem services: an accounting perspective. *One Ecosystem 7: E81487*, 7, e81487-. https://doi.org/10.3897/ONEECO.7.E81487

Flood control ecosystem service

- The regulation of water flow by ecosystems that mitigates or prevents potential damage to economic assets (i.e., infrastructure, agriculture) and human lives.

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Accounting for changes in flood control delivered by ecosystems at the EU level

Sara Vallecillo, Georgia Kakoulaki, Alessandra La Notte, Luc Feyen, Francesco Dottori, Joachim Maes

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Ecosystem service potential (Flood control)

Ecosystem contribution irrespective whether there is an ES demand or not (Burkhard and Maes, 2017). It measures and map the supply from the ecosystem side that eventually becomes actual flow/use once it interacts with the ES demand.

Curve number scoring for land cover classes

USDA Soil Conservation Service

Adjustments to the Curve Number

CN Score: capacity to produce runoff

Land cover classes + Soil Type

- Sandy soil: - runoff
- Clay soil: + runoff

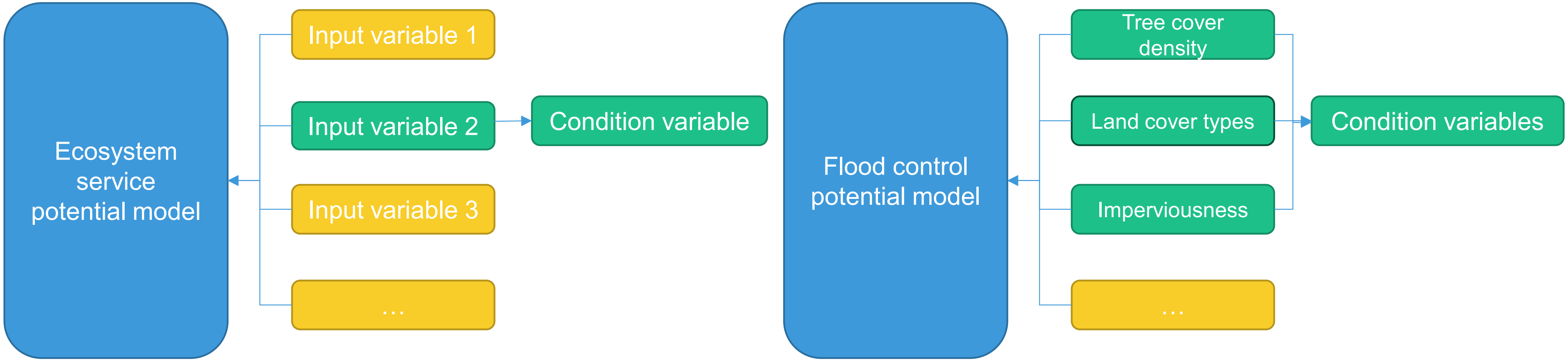
+ runoff

- runoff

Burkhard, B., & J. Maes, Mapping Ecosystem Services. Pensoft Publishers, ISBN: 978-95-46-42852-3 (2017)

European Commission

Identifying condition variables in the flood control potential model



Indicators and flood control potential

Flood control potential (runoff retention): dimensionless and is the mean of the output of the model by urban LAUs.

EU mean: 58.5

There was no data for 306 LAUs, these were removed from the analysis.
Total obs: 16,731

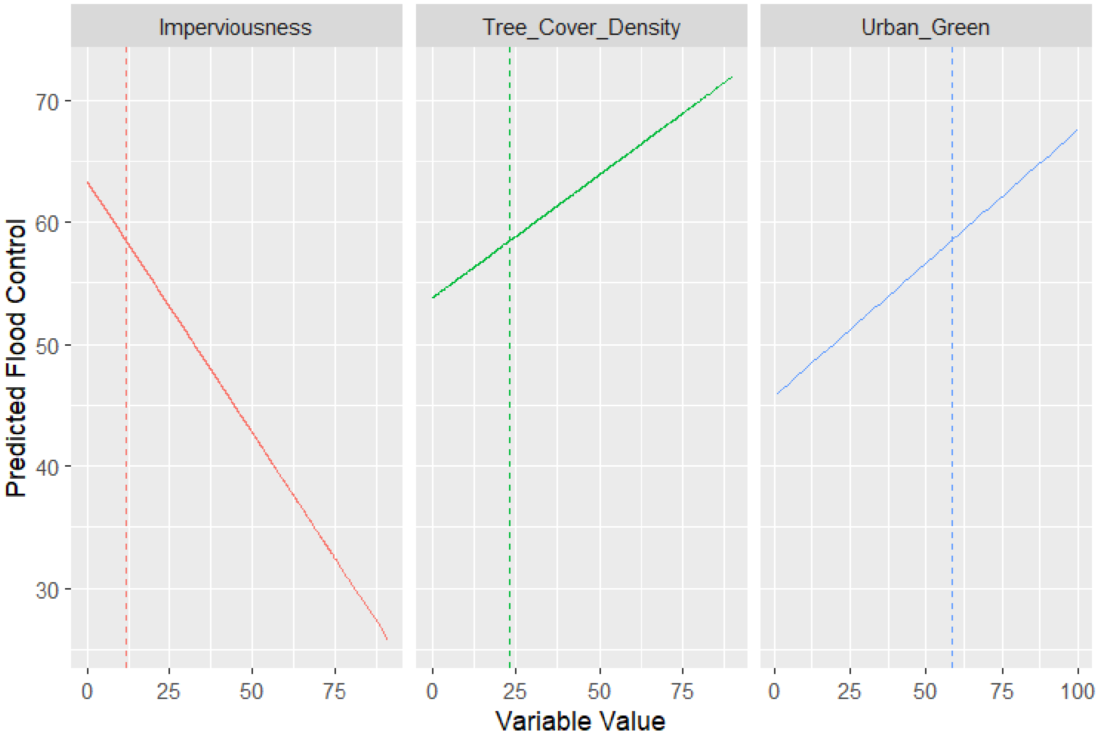
Indicator	Definition	Part of Nature Restoration Regulation	EU mean (%)	SD
Urban Green Spaces	Share (%) of the following classes in CLC+ backbone 2021: 2: Woody – Needle leaved trees 3: Woody – Broadleaved deciduous trees 4: Woody – Broadleaved evergreen trees 5: Low-growing woody plants (bushes, shrubs) 6: Permanent herbaceous 8: Lichens and mosses	Included in NRR	58.4	22.4
Tree Cover Density	Share (%) of tree cover using Copernicus HRL tree cover density for 2021.	Included in NRR	23.4	17.6
Imperviousness	Share (%) of imperviousness using Copernicus HRL imperviousness for 2018.		11.7	11.9

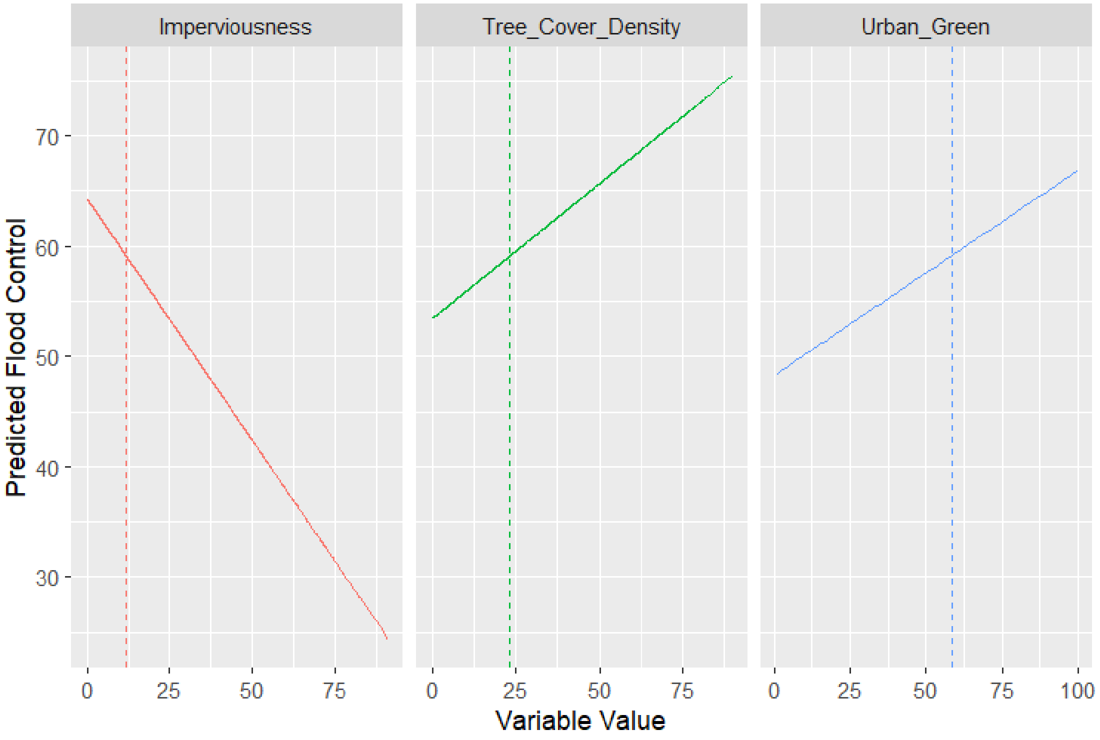
linear regression model and interactions

	Linear regression	Linear regression with interactions
Predictor	**Coef. (std.error)**	**Coef. (std.error)**
Urban_Green	0.219*** (0.001)	0.243*** (0.003)
Tree_Cover_Density	0.203*** (0.002)	**0.429***** (0.001)
Imperviousness	**-0.413***** (0.002)	-0.398*** (0.005)
Urban_Green:Tree_Cover_Density		-0.003*** (0.00009)
Urban_Green:Imperviousness		0.0004 (0.0002)
Tree_Cover_Density:Imperviousness		-0.003*** (0.0003)
$\overline{R^2}$	0.911	0.915
Marginal effects	**Estimate (std.error)**	**Estimate (std.error)**
Urban_Green	0.219 (0.001) C.I: 0.215-0.222	0.186 (0.002) C.I: 0.182-0.190
Tree_Cover_Density	0.203 (0.002) C.I: 0.198-0.207	0.245 (0.003) C.I:0.239-0.251
Imperviousness	**-0.413** (0.002) C.I: -0.417 to -0.408	**-0.438** (0.004) C.I:-0.446 to -0.430

Simulation of Flood Control Potential

	Scenario	Linear model	Linear model with interactions
Predictor	+1 SD	Flood control % change from EU avg.	Flood control % change from EU avg.
Urban_Green	38.40%	8.38%	8.22%
Tree_Cover_Density	75.30%	6.09%	8.46%
Imperviousness	101.38%	-8.39%	-7.83%





Conclusions and further work

- Preliminary results of an approach to explore the relationship between condition indicators and the flood control service through ES potential
  - From the 3 variables, at the marginal effect, imperviousness has the greatest impact on flood control potential decreasing it by 0.4 units
  - Tree cover density increases flood control by 0.2 units followed by urban green which increases by 0.19
  - <u>To counterfact the effect of imperviousess it is needed to double the efforts of increasing either tree cover density or urban green</u>
- Further exploration of the prediction model is required. e.g. different scenarios, spatially explicit and model specifications to account for decreasing effects
- **Recommendations:**
  - HRL are needed with regular updates to do ecosystem accounting especially in the urban ecosystem which requires more detail
  - EO derived products that ensure comparability across years are essential for Ecosystem Accounting and to support policies

Thank you

mayra.zurbaran-nucci@ec.europa.eu

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