Improving sponge functioning at the landscape scale

Welcome to the webinar!

We will start shortly

Funded by the European Union

UK Research and Innovation

OiEau International Office for Water

Deltares

House Rules

- This webinar will be **recorded**, and the recordings will be shared
- **Mute yourself**: Keep your microphone muted when you are not speaking
- If you want to **ask a question**…

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Agenda

11.00 **Welcome** and entrance of participants, introduction to the speakers (UL)

11.05 **Sponge functioning at landscape scale : general concepts**
Ellis Penning (Deltares)

11.15 **Sponge measures**
Benoit Fribourg-Blanc (OiEAU)

11.35 **Sponge measures at landscape scale**
Ellis Penning (Deltares)

11.45 **Q&A**
(UL)

11.55 **Closing remarks**
(UL)

First in a series (and which ones are following afterwards, every 3 months)

Improving sponge functioning at the landscape scale: general concepts

Ellis Penning

Coordinator SpongeScapes, Co-coordinator SpongeWorks

Benoit Fribourg-Blanc

SpongeScapes WP1 lead, SpongeWorks WP2 lead

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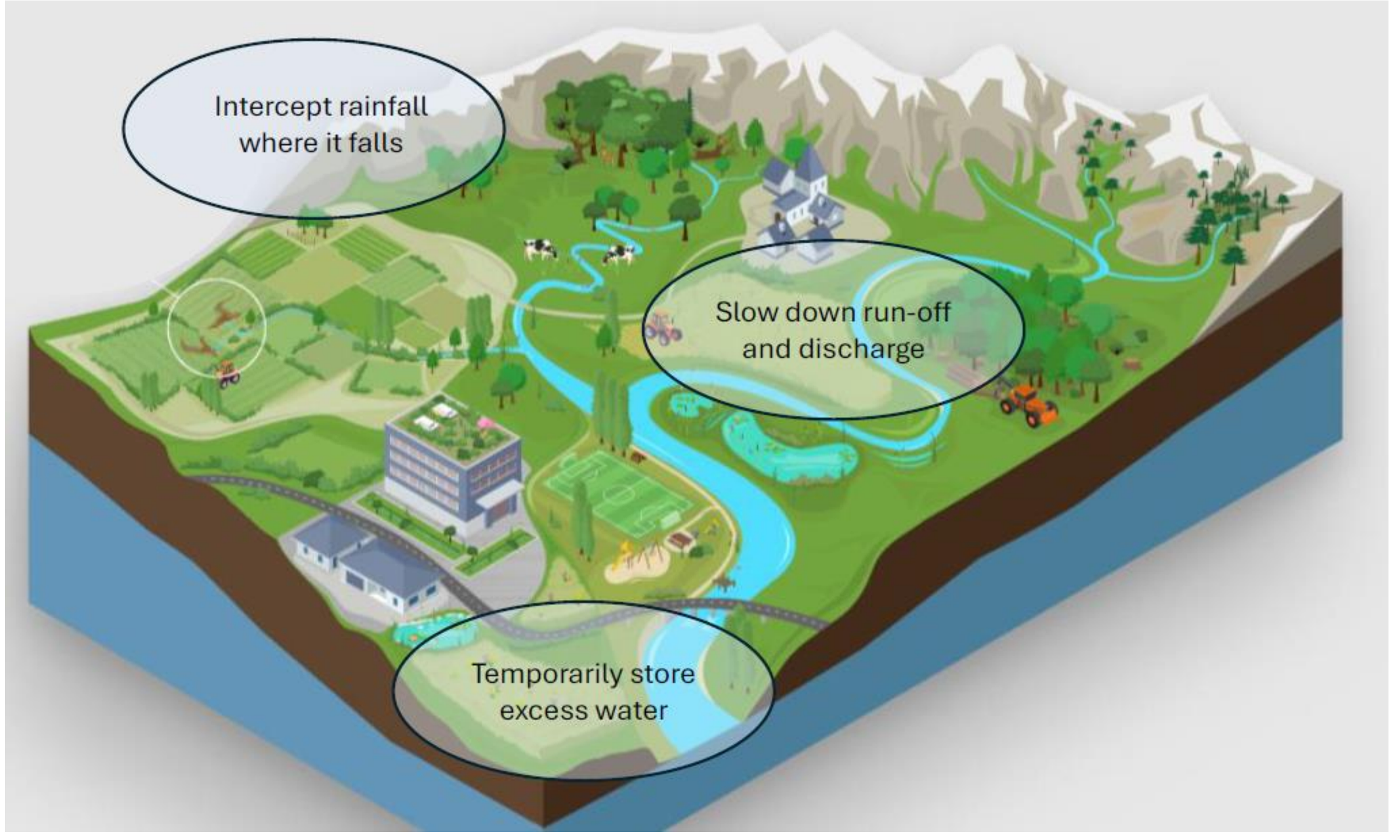
3 key principles, 1 motto

current

Droughts

Floods

Biodiversity



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future

Droughts

Floods

Biodiversity

‘Green where you can, Grey where you must’

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ukri.org/who-we-are/how-we-are-doing/research-outcomes-and-impact/nerc/driving-policy-innovation-over-decades-natural-flood-management/

5 - WP5... Dropbox - REXUS -... World Water Week:... projecten somtoday Adobe Acrobat Adobe Acrobat SpongeScapes | Zot... USACE

Driving policy innovation over decades: natural flood management

28 November 2024

NERC and partners identified and de-risked a new approach that is now key to UK flood strategy, delivering economic, environmental and wellbeing benefits.

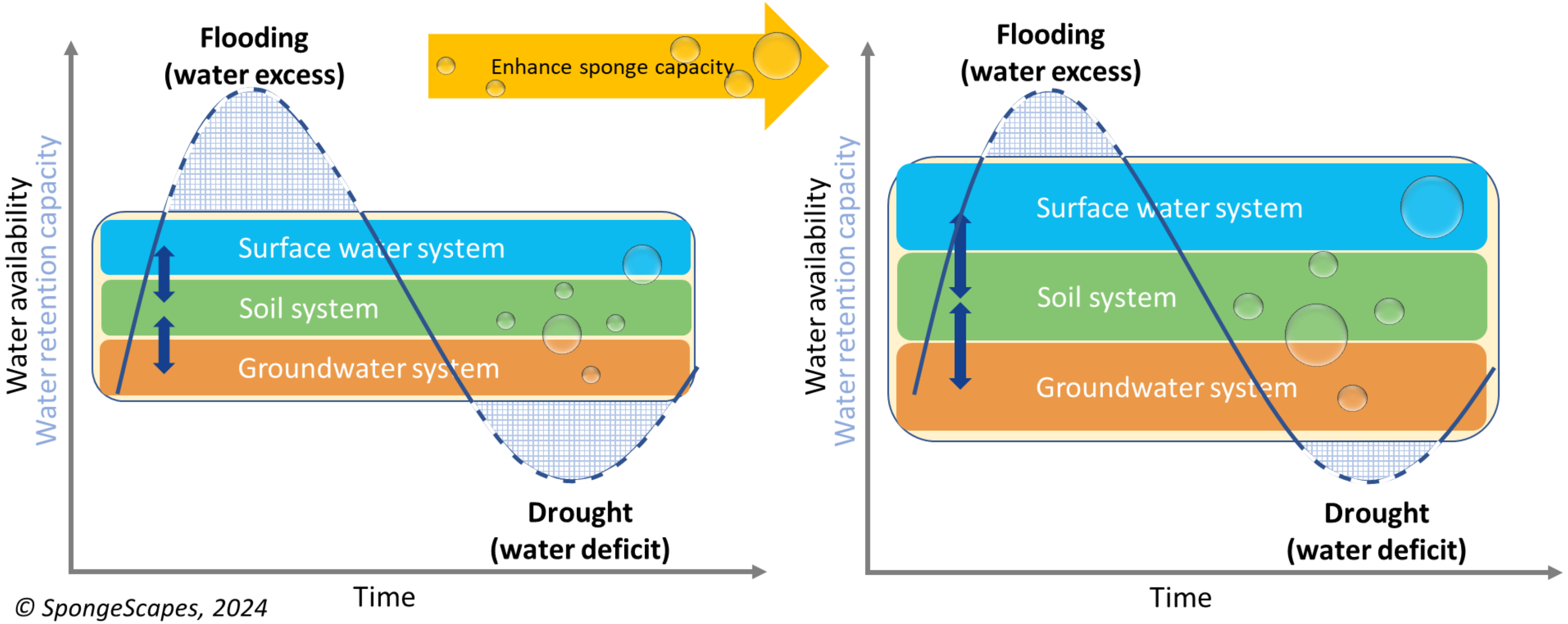
Flooding costs the UK economy £2.2 billion a year, with projections indicating a 27% increase by 2050. The Natural Environment Research Council (NERC), the Department for Environment Food and Rural Affairs (Defra), the Environment Agency and partners have collaborated to identify and de-risk a more sustainable way to deliver flood and coastal resilience.

Up until the early 2000s, the UK's flood and coastal erosion strategy was heavily focused on defence and hard engineering solutions, primarily involving the construction of physical barriers to prevent flooding. However, this approach has evolved significantly over the past two decades.

Today, the strategy emphasises resilience and adaptation through a basket of measures, including natural flood management (NFM).

NFM approaches deliver multiple benefits, such as sustainable flood resilience, biodiversity gains, improvements in water quality, carbon capture, and enhanced health and wellbeing for communities.

Sponge functioning - hypothesis



www.nwrm.eu

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SpongeScapes, SpongeBoost, SpongeWorks

- HORIZON-MISS-2022-CLIMA-01-05 - Boost the sponge function of landscape as a way to improve climate-resilience to water management challenges
  - SpongeScapes & SpongeBoost (each ~ 3MEuro RIA, since October 2023 & February 2024)

- HORIZON-MISS-2023-CLIMA-OCEAN-SOIL-01-01 – Mission Climate adaptation, Mission Ocean & waters and Mission Soil Deal for Europe – Joint demonstration of an integrated approach to increasing landscape water retention capacity at regional scale (15 Meuro IA, since Sept 2024)

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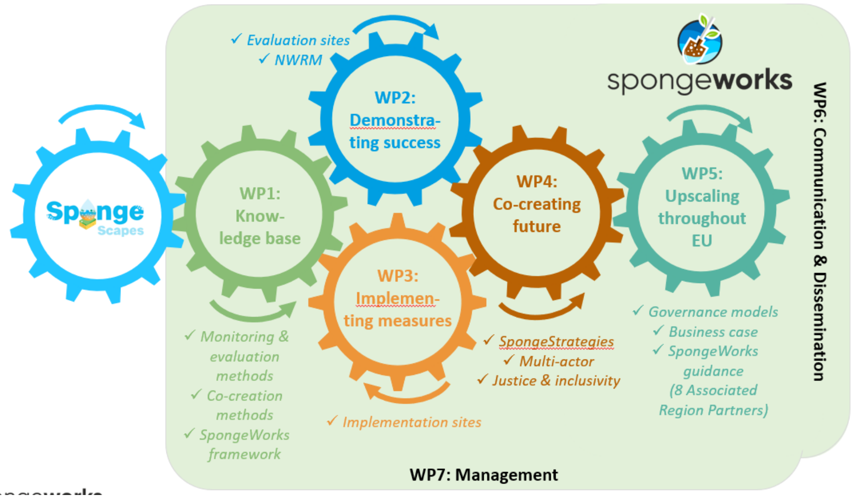

23 in-depth cases in different climate zones + 8 (?) to come

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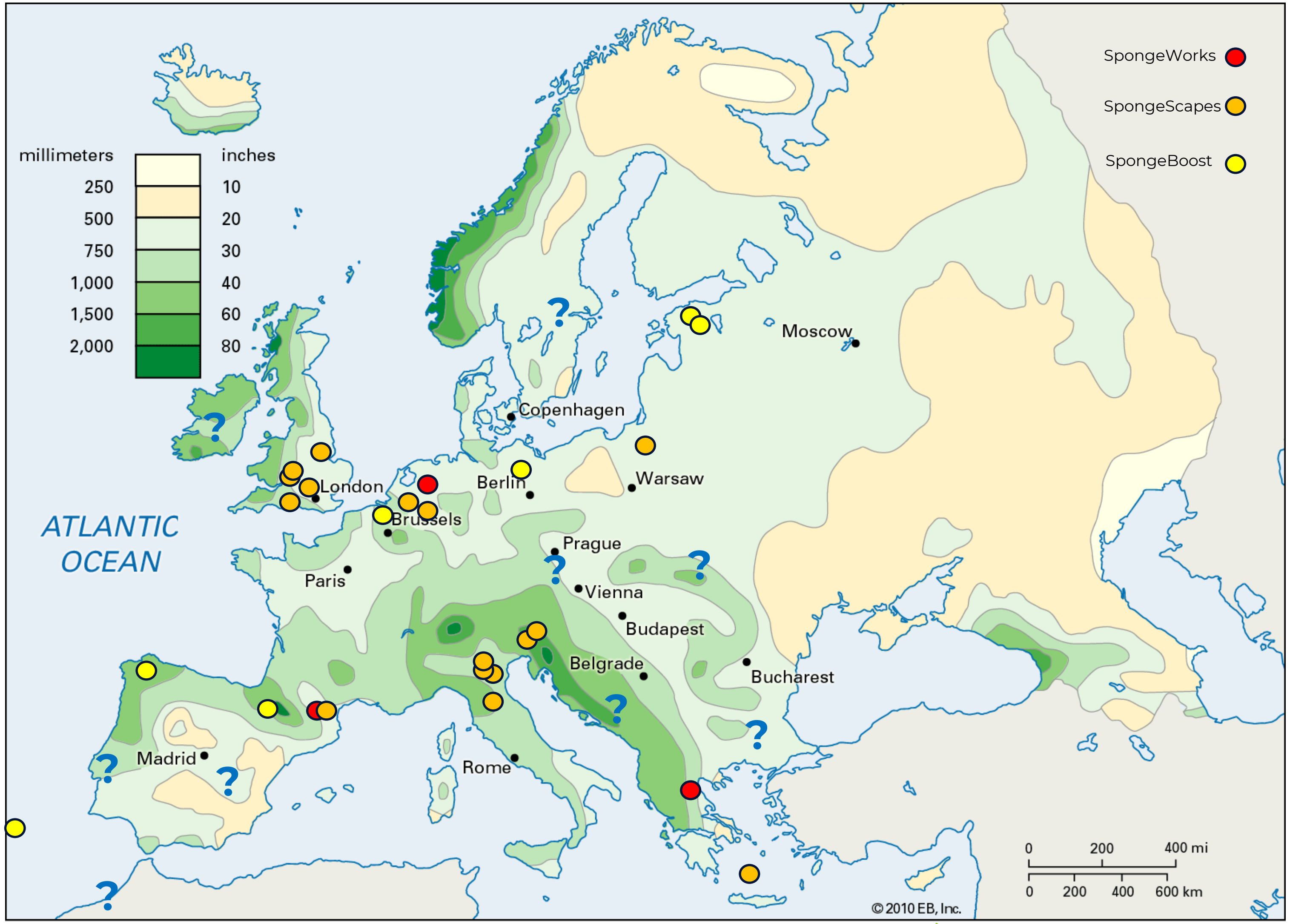
on-the-ground implementation:
- 19 types of sponge measures
- 4,000 hectares of land
- 47 kilometres of rivers
- 800+ individual farms
- 300+ stakeholders

?



Research & Practice partners

Knowledge partners

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Let’s watch a movie!

https://www.youtube.com/watch?v=1-l5y2N0hX0

Over to Benoit

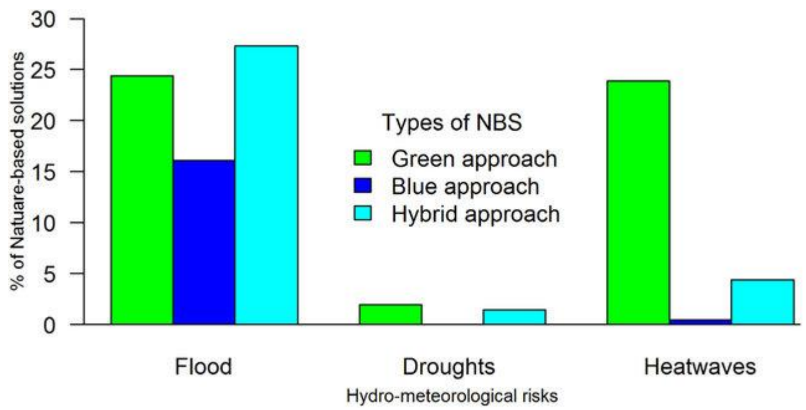
How about the evidence?

*While there is **substantial scientific evidence supporting the sponge functioning concept**, the effectiveness of landscape-based flood and drought mitigation may vary depending on the specific local conditions, climate, and land use practices. **It's essential to consider the local context and consult with experts** when implementing landscape management strategies for water regulation and risk reduction.*

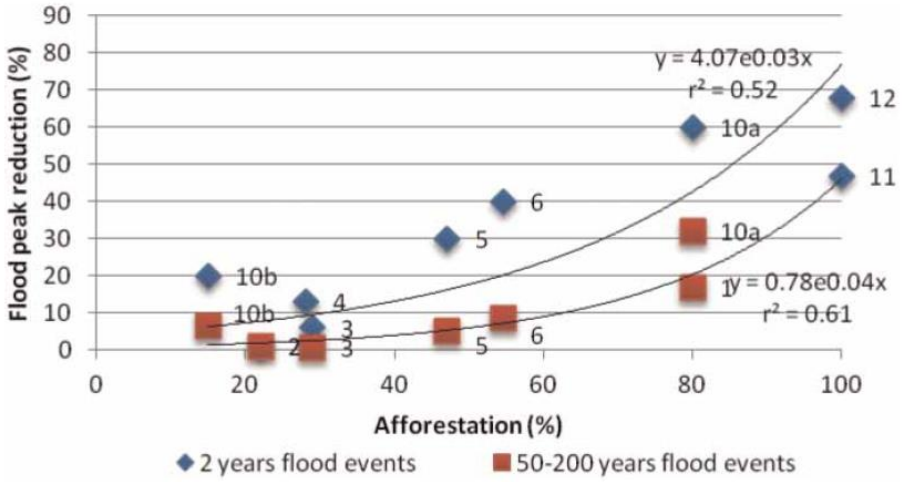
database	#cases	F&D	F&D&B	F&B	D&B
Nwrm.eu	140	8	5	18	7
World Bank	72	12	7	23	9

http://www.nwrm.eu/
https://naturebasedsolutions.org/projects

(Penning et al, 2023 –doi:10.1017/wat.2023.12)



(Sahani et al 2019 https://doi.org/10.1016/j.scitotenv.2019.133936)



Iacop et al 2014 doi: 10.2166/nh.2014.184

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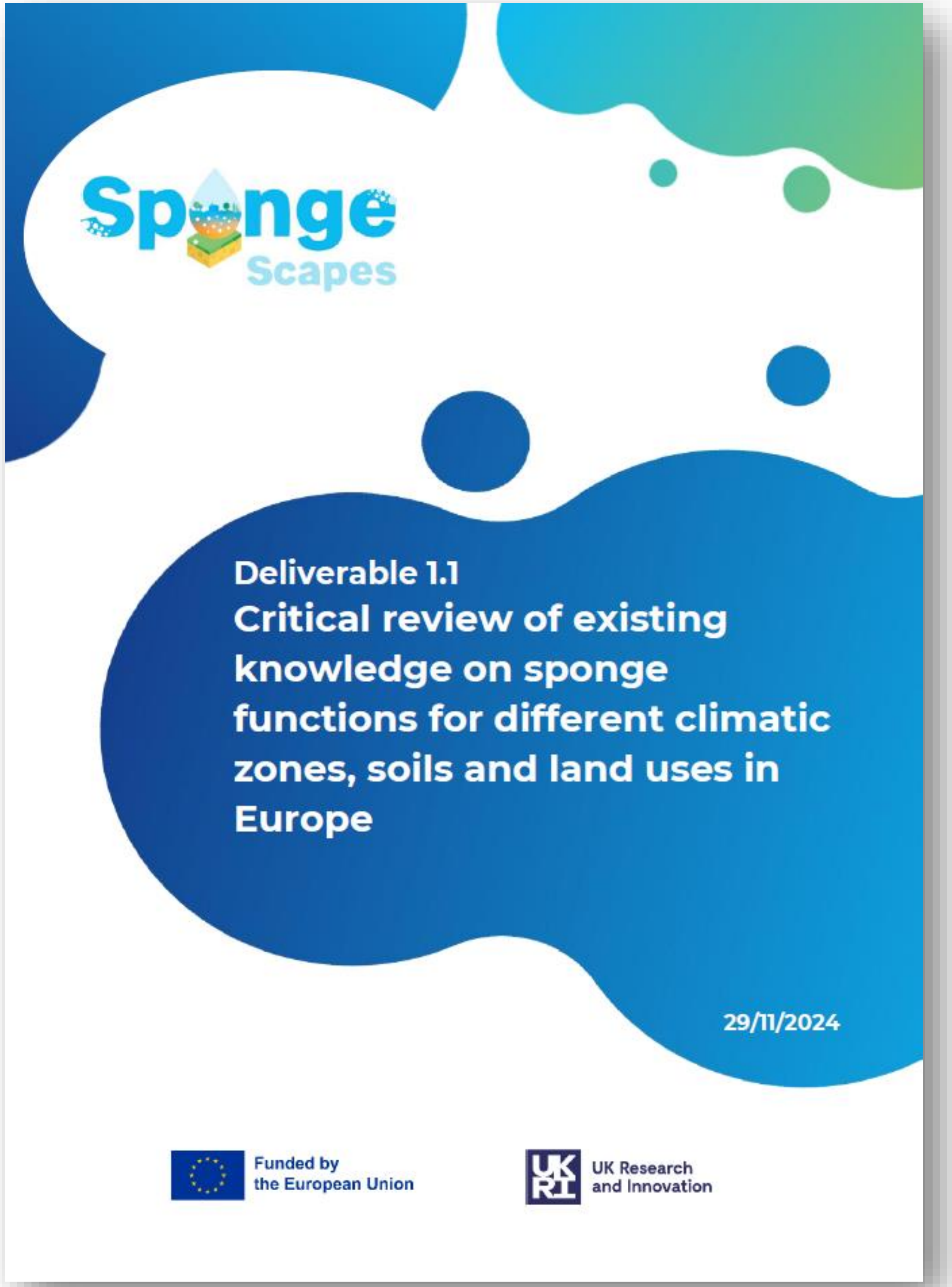

Study	Sponge Measure	Location/ Region	Observed (O) or Modelled (M) Effect	Flood & Drought Management Benefit
Majidi et al. (2019); Ruangpan et al. (2020)	Water retention ponds, vegetated buffer strips	General (Urban, Agricultural)	Reduced flood volume, peak, and delay; increased infiltration and soil water retention.	Flood reduction, increased water retention and infiltration.
Lockwood et al. (2022)	Offline ponds	Tone & Parrett catchments, SW England	Attenuation of peak flows from 3% when ponds are filled by rain/runoff to 7% when filled from channel [O]	Flood reduction
Nauta et al. (2024), Waterloo et al. (2019)	Wetland restoration	Kylldal catchment, Germany	12-24% reduction in annual maximum peak flows; increased low flows by up to 21% in summer/fall, suggesting drought risk reduction. []M	Flood reduction, drought risk reduction.
Kurki-Fox et al. (2022)	Wetlands, river basin afforestation	Neuse River Basin, North Carolina, USA	6-9% reduction in runoff, 5% reduction in peak flow at sub-watershed level.	Flood and drought risk reduction.
Frédéric Paran (2024)	Wetland restoration	General	Limited effect on summer low flows but effective in retaining high flows after dry periods.	Drought and flood flow regulation, seasonal flow retention.
Ottermann et al. (2017)	restored floodplains, wetlands, peatlands	Rhine basin	Reduced peak flows 5-8%	Flood reduction
Shuttleworth et a. (2019)	Peat restoration	N England	27% reduction in peak flows, longer lag times >100% increase [O, M]	Flood reduction
URBAN				
Baggio et al. (2023)	Rain gardens, bio-retention areas	Veneto Region, Italy	>98% runoff retention in two years of data, even for extreme rainfall events (up to 15-year return periods).	Pluvial flood mitigation, stormwater retention.
Cerema (2020)	Schoolyard greening, de-impermeabilizatio n	France	Reduces stormwater runoff and provides co-benefits like heat reduction and improved health for children.	Flood reduction, heat island mitigation, health benefits.
Kõiv-Vainik et al. (2022)	Bioretention systems (ponds, rain gardens, swales)	General	40% reduction in peak discharge (though data on real-world runoff retention often missing, especially in cold climates).	Flood reduction, stormwater management.
Kõiv-Vainik et al. (2022)	Permeable pavements	Warm and wet climate conditions	75-80% reduction in stormwater runoff.	Flood reduction, stormwater management.
Quagliolo et al. (2021)	Green parking, rain gardens	Rapallo, Italy	69-71% average water retention capacity in urban scenarios.	Urban flood vulnerability reduction.

In the field you hear things you don't see in literature

Some nice numbers:

- Infiltration rate from 4,5 min to 23 seconds
- Bird diversity from 44 to 89
- 17KEuro woody dam or 4Meuro dredging project
- From 16,5 days in 1850 to 9 hours now (lowland stream of sandy soil and 50km)

- 'the only grazing place left'
- 'peace of mind'
- 'i've not been flooded this year'

Photo: David Gasca – Blenheim Estate

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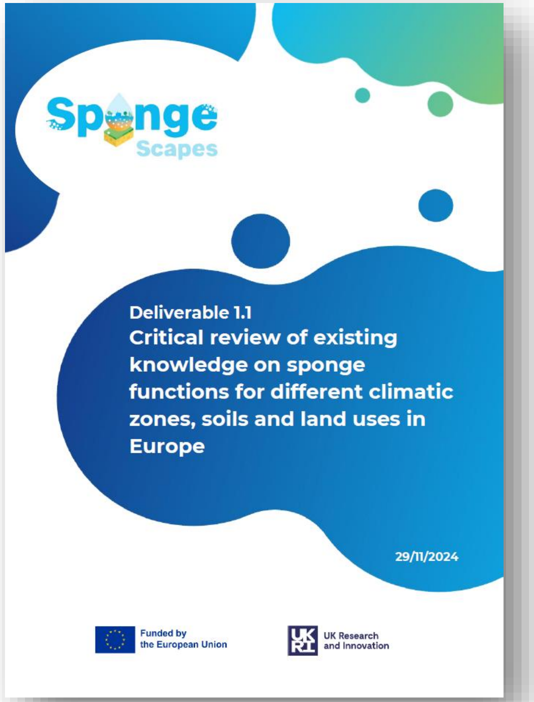
Gaps in evidence

1. Reported sponge measures are often not evaluated for a range of hydro-meteorological events under current and future conditions;
2. Surface water, groundwater, and soil hydrology are often analysed separately;
3. Analyses of the combined effects of sponge measures on hydrology, co-benefits, dis-benefits, and trade-offs are often lacking or incomplete;
4. The evidence base for a good understanding of the combined effects of multiple measures at landscape scale is lacking;
5. The role of maintenance over time and longevity of measures is hardly known;
6. The replicability of measures depends on local contexts that are poorly reported on;
7. The integration of quantification of system understanding with stakeholder engagement on a catchment scale is lacking;
8. Local knowledge, success stories and lessons learned are poorly communicated outside of the local context.



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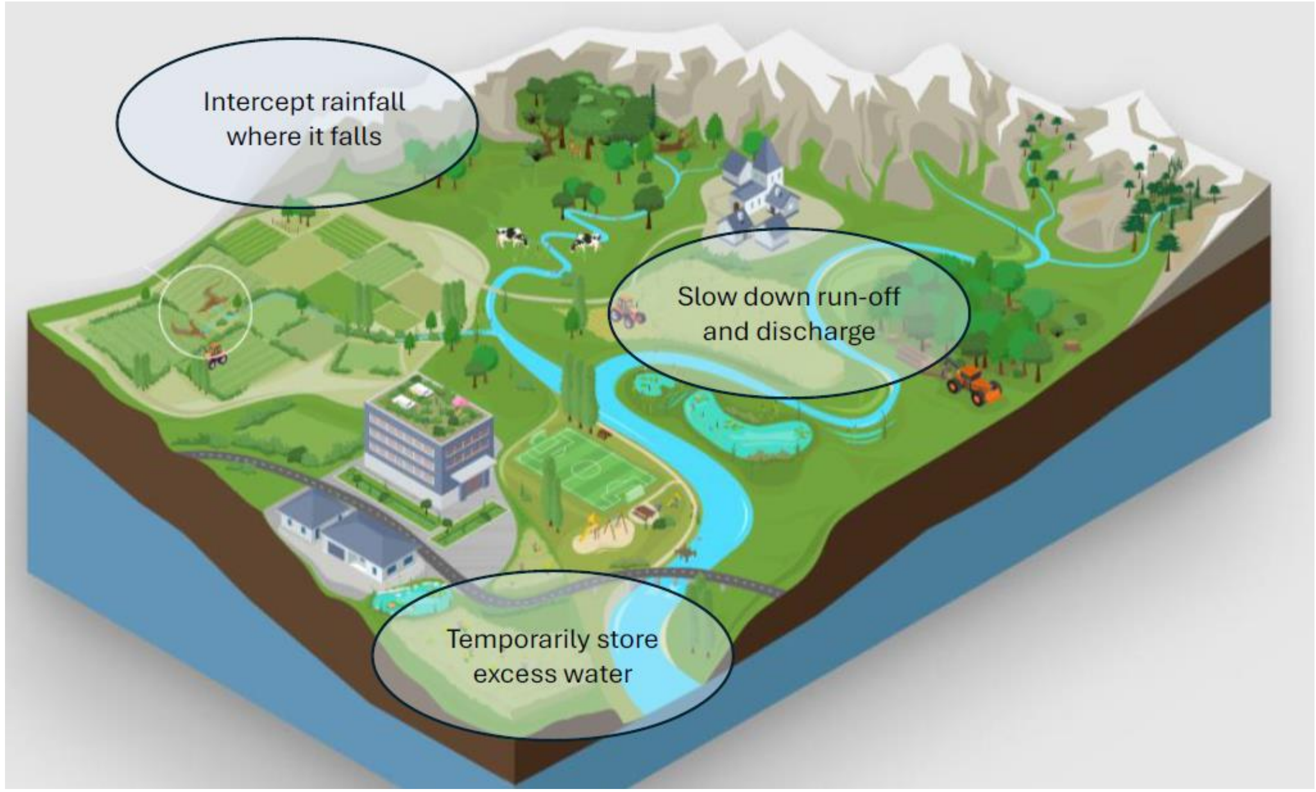
Sponge principles

There are three main sponge principles:

1. Reduce the formation of runoff by intercepting rainfall where it falls and stimulating infiltration into the soil,

2. Slow down the runoff that has formed on the surface, is drained from groundwater, or is channelised in streams, and

3. Temporarily store excess water in the soil, groundwater or surface water bodies.



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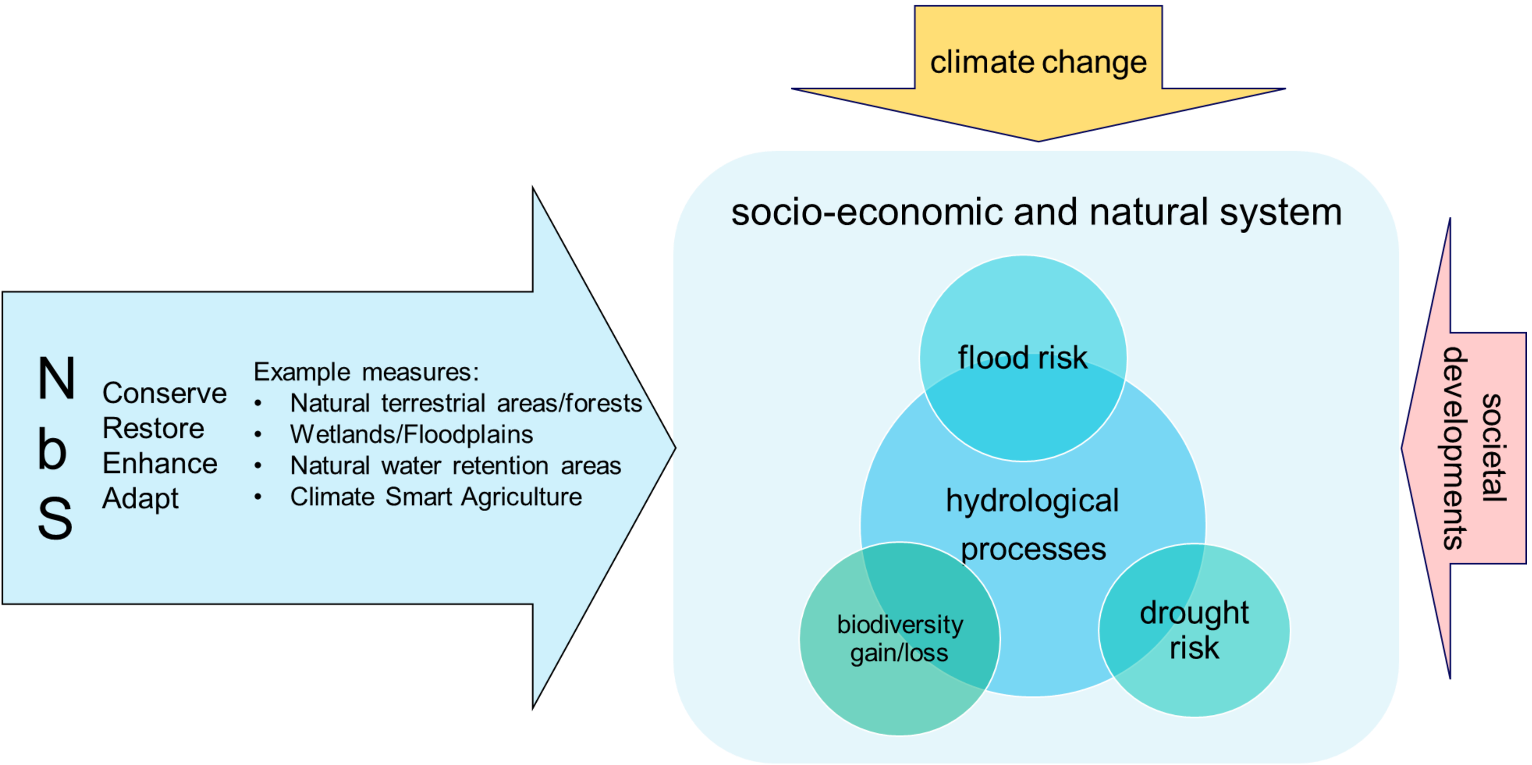
Hydrological processes & NbS at the core



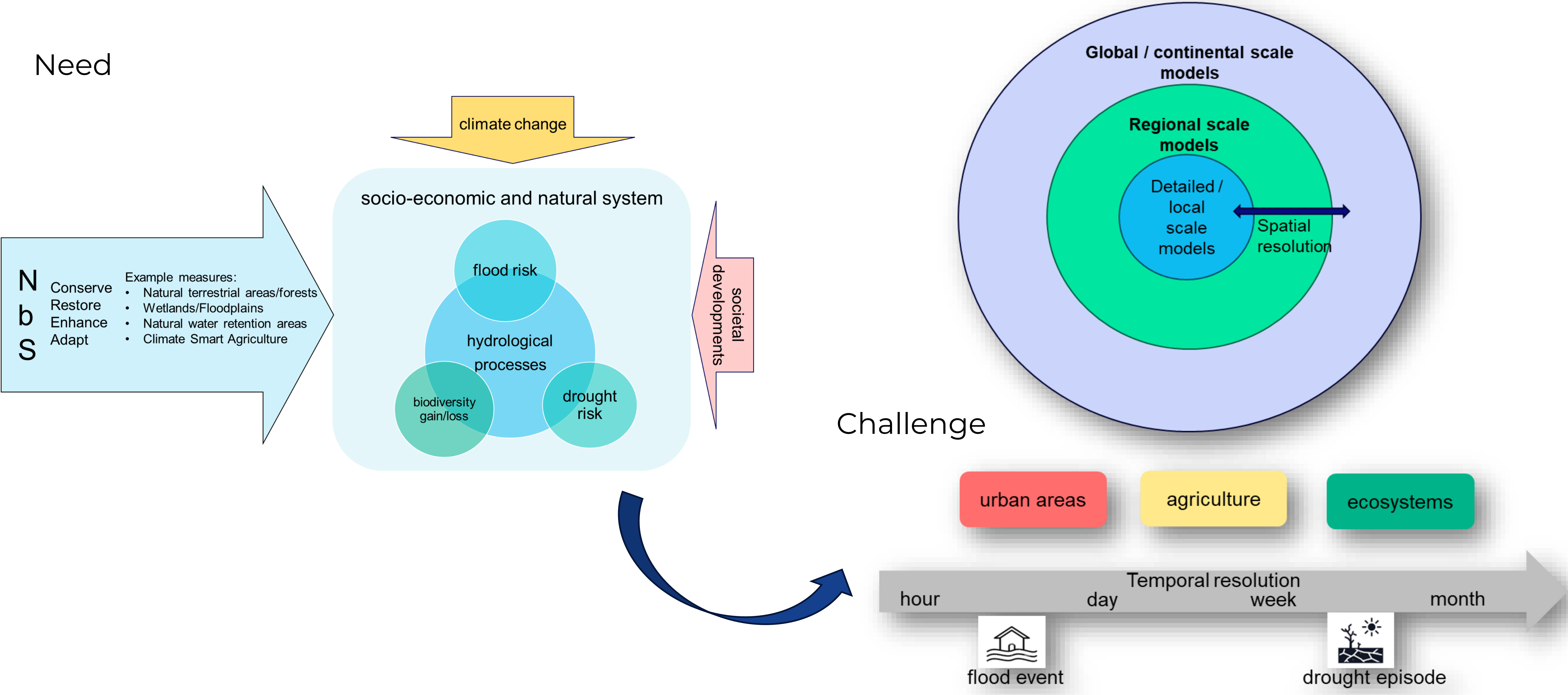
Way forward:

1. Improve process understanding
2. Work at landscape scale
3. Improve integrated modelling and upscaling
4. Use a consistent set of indicators for evaluation

Penning et al, 2023
https://doi.org/10.1017/wat.2023.12

Quantifying Sponge Measures for Floods AND Droughts AND Biodiversity

Need



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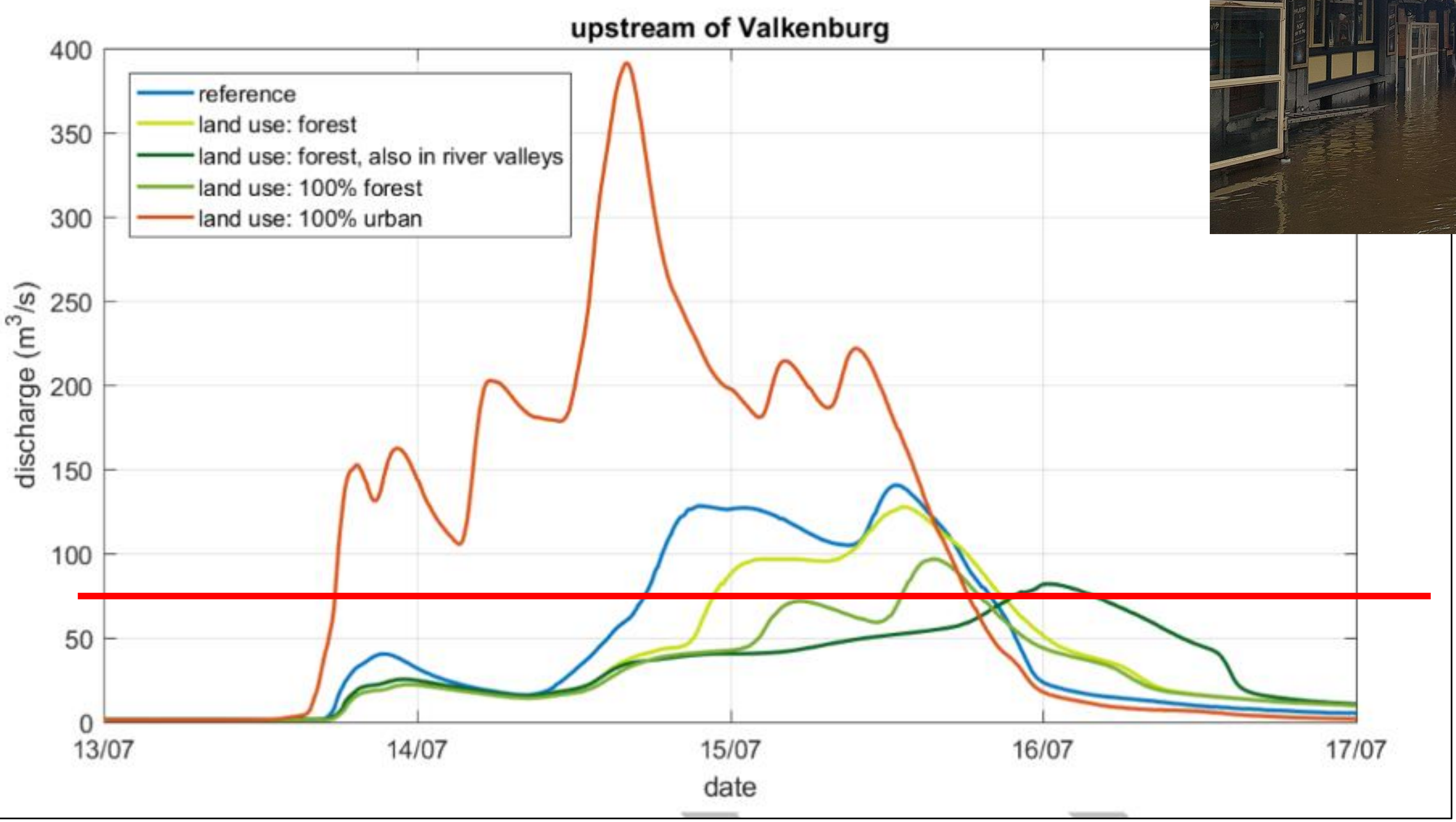
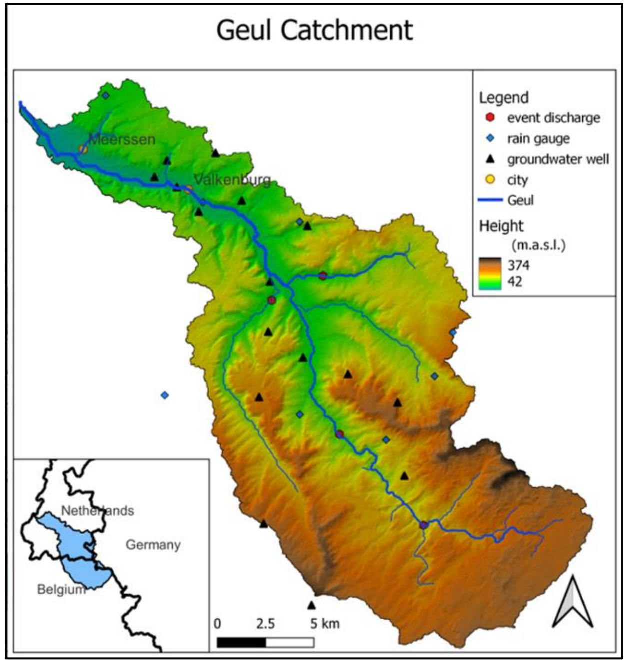
Modelling tools for system understanding:
Limburg july 2021 event (ca. 130mm/48 hr)





WFLOW_SBM + SOBEK (RAT Study Geul, 2022)

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What is the role of history + type of event (Geul Case Study)

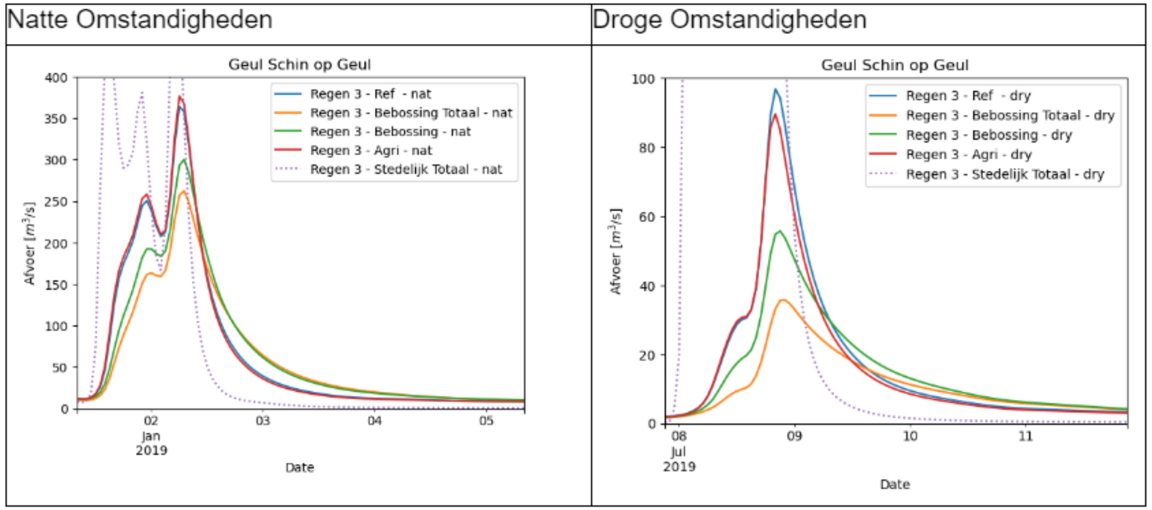
Sponge functioning is highly dependent on the

1. pre-event history
   - wet
     --> little additional sponge action possible
   - dry
     --> large sponge effect possible
2. type of rain event
   - In very extreme rain events, the sponge always becomes full and the effect of land use etc. decreases

Up to factor 10 difference between discharge depending on dry or wet history

wet

dry



Figuur 4.14 Met Wflow-sbm Gesimuleerde afvoeren met Wflow van een neerslag gebeurtenis (98.4 mm/24 uur) voor droge en natte omstandigheden voor de verschillende scenario's.

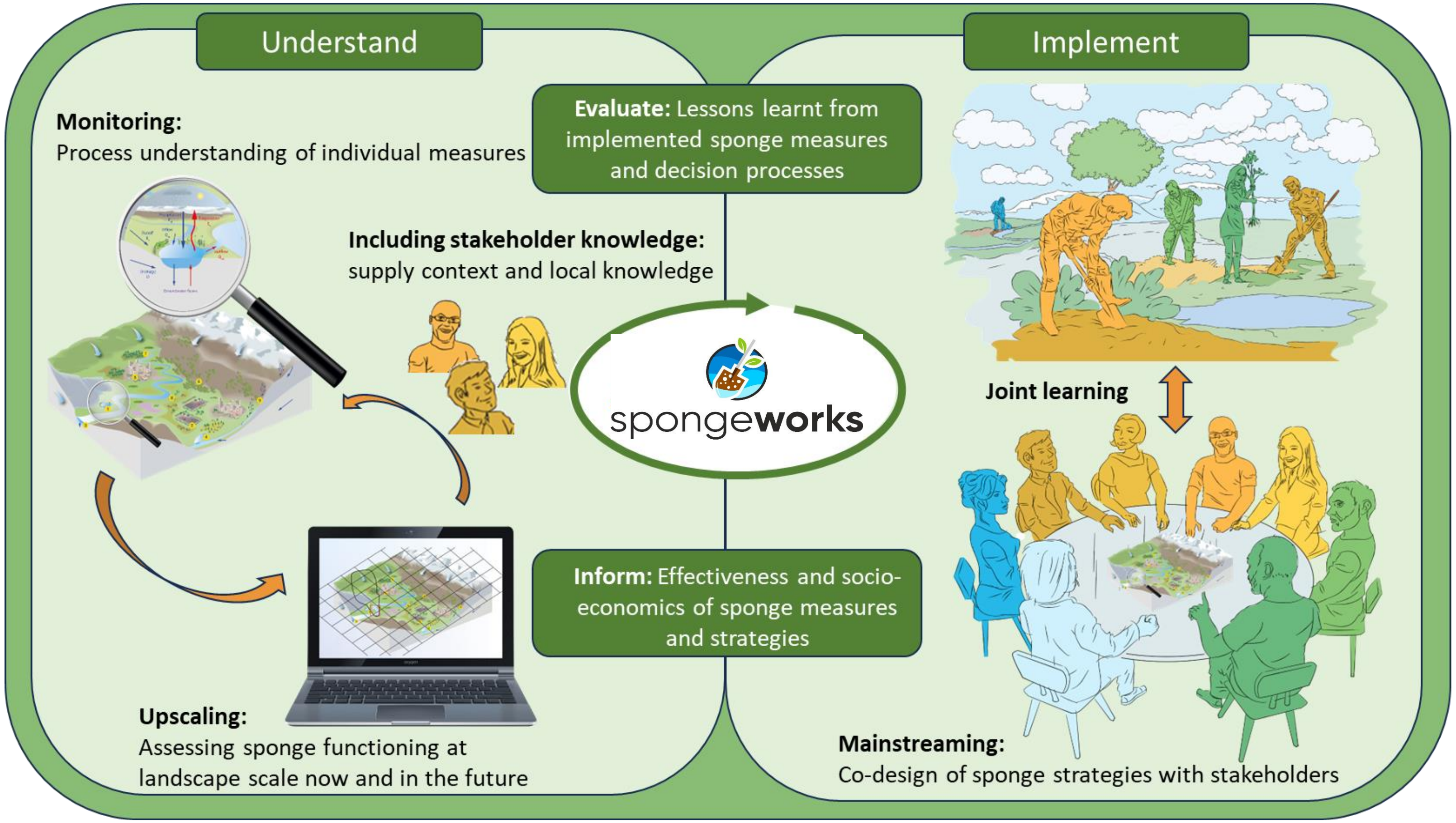
Approach towards upscaling sponge landscapes

Good system understanding:

- Evaluate for different hydrometeorological events
- Evaluate for more than water quantity
- Use both technical indicators and demand indicators
- Evaluate success stories

Implement together

- Apply in new cases and learn with stakeholders
- Co-design with stakeholders at landscape scale



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Knowledge brings nuance and realism

Evaluate for:
- Different types of events
- Primary benefits, co-benefits and trade-offs
- Combinations of measures in overarching strategies

Evaluate with stakeholders:
- what is feasible and acceptable?
- what is useful for you and what creates significant effects on larger scales?
- what is the relation between upstream and downstream neighbours?

Use both technical and demand indicators

Tell succes stories and lessons learnt

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Upcoming Webinars

Date	Topic
May 2025	Monitoring sponge measures: indicators and approaches
September 2025	Modelling sponge measures at landscape scale
November 2025	Co-benefits and trade-offs of sponge measures and strategies
February 2026	Integrating sponge thinking into planning: co-designing sponge strategies

Thank you!

Ellis Penning ellis.penning@deltares.nl

Benoît FRIBOURG-BLANC b.fribourg-blanc@oieau.fr

@spongescapes;
@spongeworks

www.spongescapes.eu
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