Waterlogging Effects on Soil and Vegetation in Mediterranean Forests Used for Runoff Attenuation

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The Problem

Climate change in the Eastern Mediterranean:

↓ Annual rainfall

↑ Intensity of individual rain events

→ Higher flood risk

Runoff attenuation facilities are planned upstream, but their effects on soils and trees are poorly known.

Case-Study Site

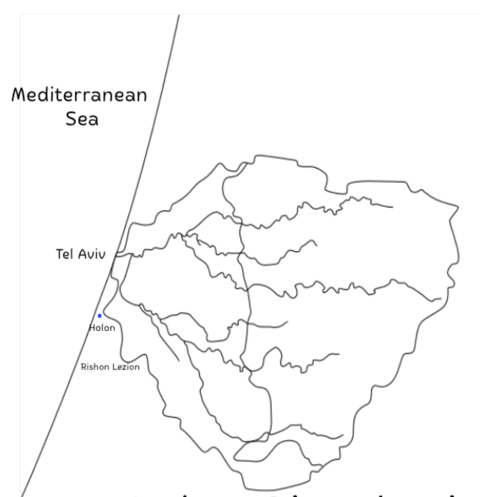
Wadi Qana, a main tributary of the Yarkon River, Horshim Forest, Israel.

Planned attenuation facility: 2.4 million m³.

Site includes agricultural land and planted *Aleppo pine*.

Methods

Design	Flooded vs. control plot
Flooding	48-72 h winter events
Trees	*Aleppo pine*, 35 yr
Soil	Terra Rossa



Yarkon River basin

Soil sensors: water content, O_2, redox (continuously)

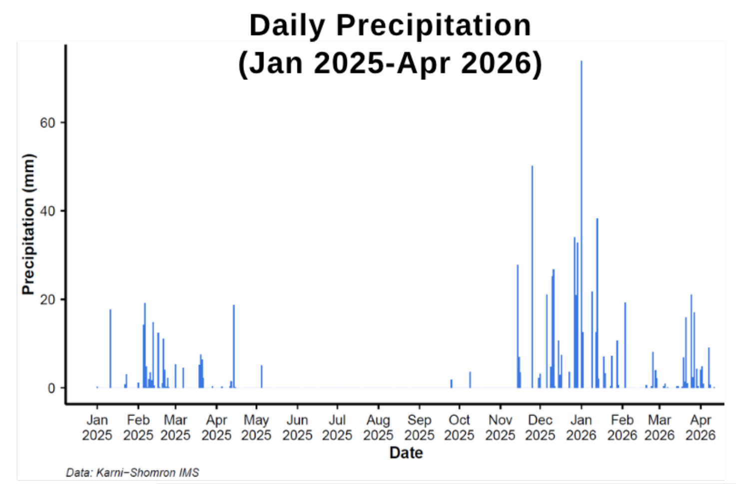
Tree sensors: Dendrometers (continuously),

Stem girth, needle length (monthly).


Flooding experiment plot at Horshim Forest


Runoff attenuation upstream

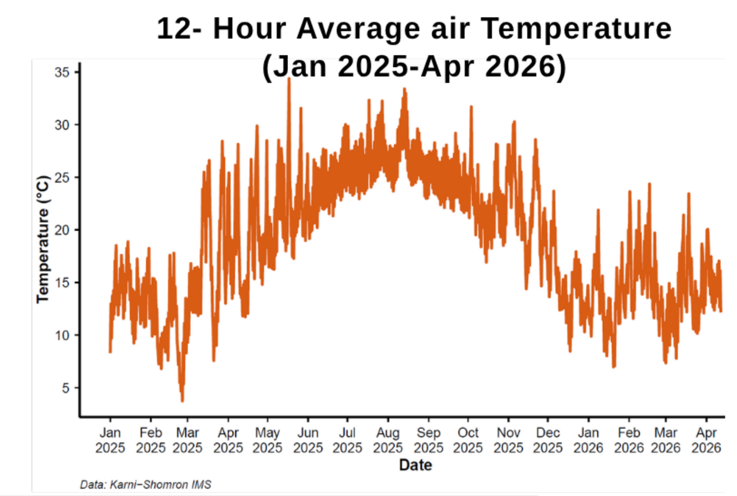
RESULTS



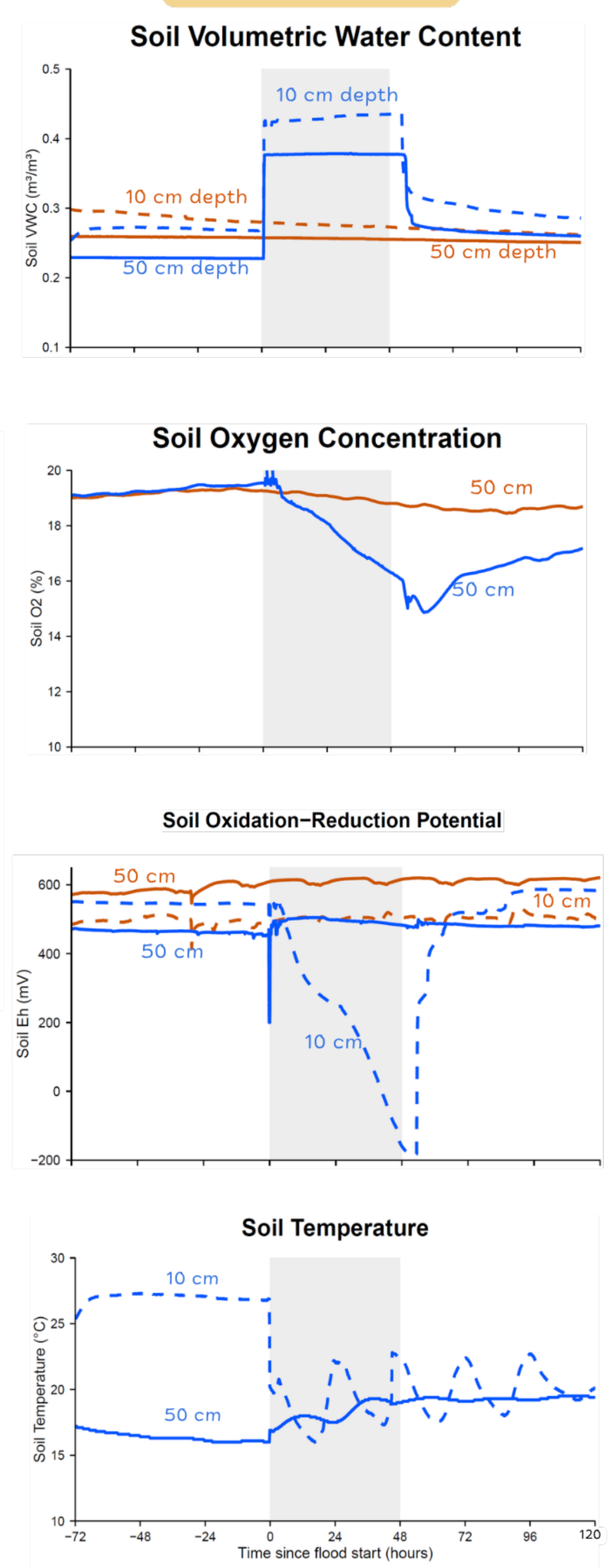
Annual Precipitation

2023/24	855.5mm
2024/25*	345.8 mm
mean	620.7 mm

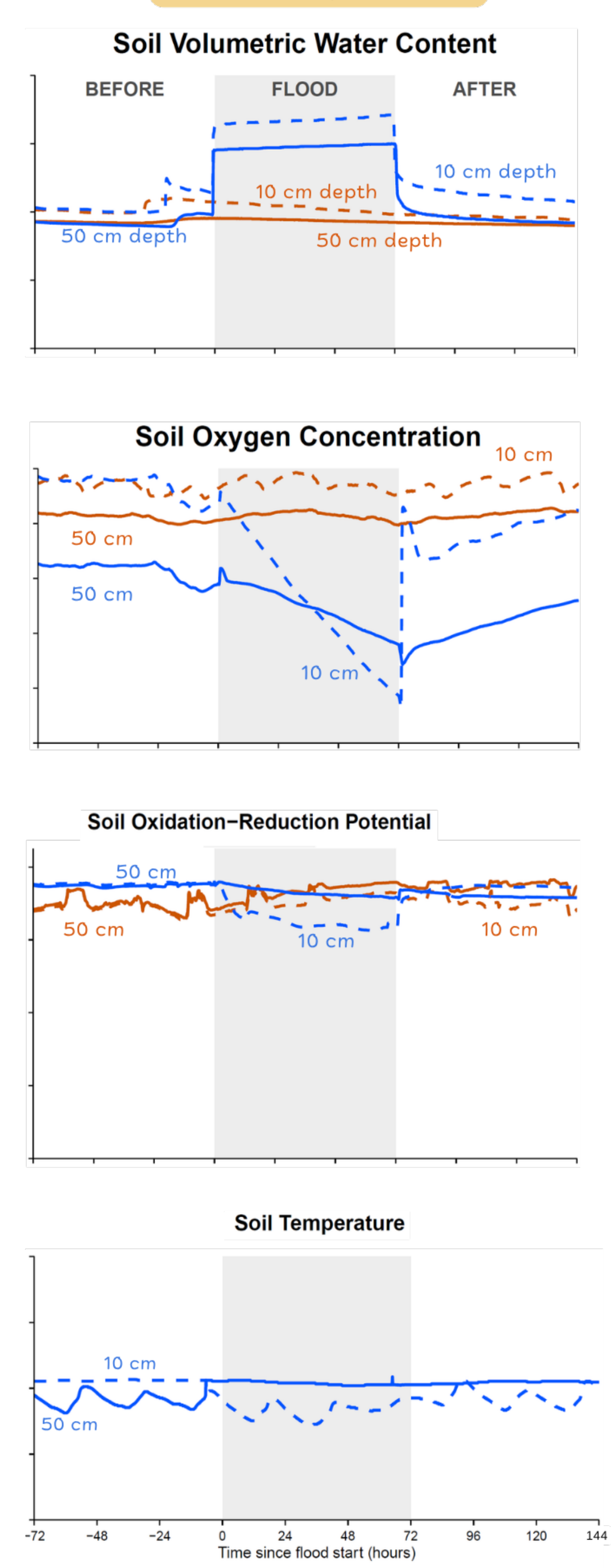
Data: Horashim IMS



First Flood Experiment - March 2025



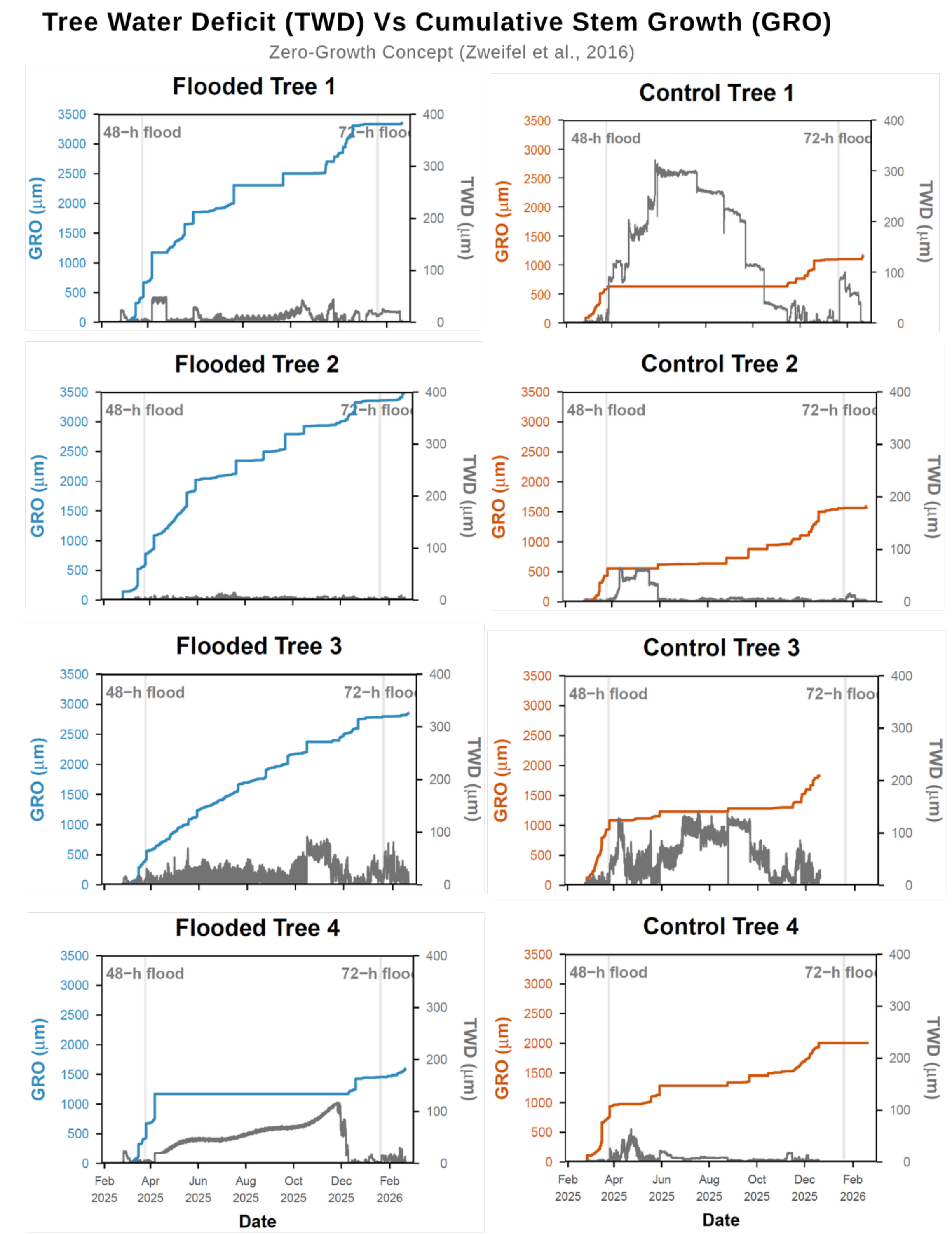
Second Flood Experiment - January 2026

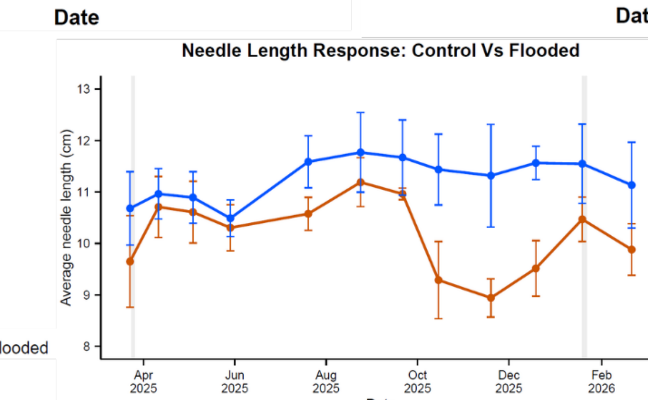


Control Flooded

2024/25* was an exceptionally dry year; the first flood experiments were during this period.

Tree Response





What We Found

During a **dry year** (2024/25, 345 mm rainfall vs. 620 mm mean):

- the **soil responded rapidly** – VWC rose, O_2 dropped, and redox became near-anaerobic (especially at higher temperatures).
- The **first flood experiment increased water storage** in the flood treatment during the growth season (March–May), resulting in higher cumulative GRO in flooded trees. In addition, the growth period was extended into summer in flooded trees, whereas growth ceased in control trees.
- **Flooded trees grew more**: Average of cumulative stem growth (GRO) was 3.1 mm vs. 1.5 mm in controls, and needles were 10.5% longer (11.26 vs. 10.19 cm, $p < 0.001$). However, there are individual characteristics for each tree.
- This response probably depends on **pre-flood soil moisture and flood timing.**

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