VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Estifanos Addisu Yimer**

The public defense will take place on **Thursday 11th September 2025 at 5.30 pm** in room **I.2.01** (Building I, VUB Main Campus)

To join the digital defense, please click here

FROM DROUGHT DEFICITS TO CLIMATE RESILIENCE: COUPLED SURFACE-GROUNDWATER MODELLING AND NATURE-BASED SOLUTIONS FOR DROUGHT MITIGATION

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Abstract of the PhD research

Geohydrological models usually treat rivers and aquifers separately, which hides how tightly they interact in real life. This PhD brings them back together by advancing the fully distributed SWAT+gwflow model, adding a missing link (groundwater–soil exchange), and building open tools that make setup, calibration, and analysis easier. The approach is tested across the Scheldt basin's seven watersheds and benchmarked in other representative catchments to show where a coupled model really pays off.

With extremes becoming more frequent, we ask a simple question with big consequences: how much have recent climate changes intensified drought in our rivers and aquifers? Using calibrated models and "what happened" versus "what if there had been no warming" climate datasets, we find clear signals. Low river flows drop by about 3.5–14%, and drought-period streamflow deficits rise by roughly 10 m^3/s in the Upper Scheldt and Leie. In the Kleine Nete, groundwater levels trend down after 2010—on average ~10 cm, with some places seeing 0.1–1.5 m declines. Short droughts (1–3 months) hit hardest, while longer timescales show partial recovery—typical of shallow, fast-responding aquifers.

Diagnosis isn't enough—we also explore solutions. This work develops a practical mapping framework to place nature-based solutions (NbS) where they can recharge aquifers and cushion drought: managed aquifer recharge zones and detention basins at regional scale in Flanders. The maps highlight large, promising areas for both options and provide ready-to-use evidence for planners and water managers deciding where to act first.

At the defense, you'll see how coupling physics, data, and design turns drought "deficits" into concrete choices on the map—so communities can build resilience before the next dry spell. If you work with water, land, climate policy, or simply care about reliable rivers and groundwater, this session will give you clear takeaways you can use the very next day.