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 **Ioan Sabin Taranu**

The public defense will take place on **Tuesday 20th May 2025 at 10am** in room **D.2.01** (Building D, VUB Main Campus)

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ADVANCING GLOBAL WATER USE RESEARCH

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Abstract of the PhD research

Water is fundamental to human life and societal development, used for drinking, farming, industry, and power generation. Global water consumption has surged over the past century due to population growth and industrialization and is projected to continue rising. This increasing demand, coupled with challenges like climate change altering water availability, groundwater depletion, and pollution, necessitates improved water management strategies guided by advanced modeling.

This thesis enhances our understanding and modeling of global water use. Firstly, it introduces a comprehensive water use module into a leading climate model, the Community Earth System Model (CESM2). This module incorporates diverse human water uses such as domestic, livestock, power generation, manufacturing, mining, and irrigation along with how these sectors might compete for limited water. This innovation allows for better assessments of global water scarcity.

Secondly, the research addresses significant inconsistencies often found in water use datasets where historical data meets future projections. A novel algorithm was developed to smooth these transitions and correct spatial errors, creating more reliable data for research. This is important, as using uncorrected data can lead to flawed conclusions about water stress, sometimes even misrepresenting whether a region's water problems will worsen or improve in the future.

Finally, the thesis proposes a new conceptual framework for how water models might simulate the sharing of water during shortages. It suggests dividing water demand into "essential" (basic needs) and "prosperity" (discretionary uses) categories, combined with a "traffic light" system to guide allocation based on water availability. This aims to make models more realistic in portraying how water competition and management decisions play out in the real world.

By improving modeling tools, data quality, and conceptual approaches to water allocation, this research contributes to the active field of sustainable water resource management in an increasingly water-stressed world.