PhD position: Emulator for large-scale models

Location: Lahti University Campus, Niemenkatu 73, Lahti, Finland

Start: 1st of August 2024 or on an agreement

Duration: 3 years

Supervisors: Michael Boy, Zhi-Song Liu, Heikki Haario, Andrea Rupp

Background

Join us in revolutionizing Earth System Models (ESM) and regional air quality models through cutting-edge emulator development! Traditional models employ simplified parameterization due to computational constraints, leading to significant biases in results. Our recent study (Boy et al., npj Climate and Atmospheric Science, 5:72, 2022) identified discrepancies of up to 50%, emphasizing the urgent need for advanced modeling techniques. This discrepancy occurred between the global chemistry transport model TM5 and the 1-dimensional chemistry transport model SOSAA at SMEAR II, Finland. The primary reason for this difference lies in the impact of the two distinct chemistry schemes. SOSAA incorporates nearly explicit chemistry from the Master Chemical Mechanism (MCM), while TM5 employs a more simplified chemistry scheme for computational efficiency.

The political plans in large-scale modelling include pushing to higher resolution (both spatial and temporal domain), providing less computational time for individual processes. Artificial intelligence has emerged as a valuable tool for addressing model limitations from extended computation times and multimodal learning, like utilising pre-trained large language, graph and image models to assist detailed modelling processes.

Objectives of the project

In this project, we will use data from our FLEXPART/SOSAA modelling system, which is actively applied at several locations around the globe, to create an emulator (neural network) representing the first layer (0 to about 100 m) in large-scale models. By integrating state-of-the-art AI algorithms and expanding the Master Chemical Mechanism (MCM) chemistry with novel auto-oxidation modules, we aim to overcome current limitations and enhance model accuracy. The developed emulator will undergo rigorous evaluation within regional and global frameworks, including Enviro-HIRLAM and EC-Earth, ushering in a new era of precise atmospheric modelling.

Work environment

As a PhD candidate, you will have the privilege of working in the dynamic Atmospheric Modeling Centre Lahti, affiliated with the esteemed Lappeenranta-Lahti University of Technology and the University of Helsinki's Institute for Atmospheric and Earth System Research. With access to cutting-edge computing resources, including the state-of-the-art supercomputer at CSC Finland (over 100 V100 and A100 GPUs) and dedicated laboratory servers, you will be empowered to push the boundaries of scientific discovery.

What We're Looking For

While not all requirements are mandatory, we seek candidates who possess:

Research experience coupled with proficiency in deep learning programming (e.g., Fortran, Python, PyTorch).

A Master's degree with outstanding academic performance.

Demonstrated passion and commitment to scientific pursuits.

Excellent communication skills and the ability to articulate your motivations effectively.

A track record of tackling significant challenges, whether through failure or success.

A clear understanding of why pursuing a PhD is essential and why our program aligns with your aspirations.

Why Choose Us?

At our institutions, you will be part of a vibrant community of scholars dedicated to advancing atmospheric science. Our collaborative environment fosters innovation and encourages interdisciplinary exchange, providing unparalleled opportunities for personal and professional growth. By joining our team, you will play a pivotal role in shaping the future of AI driven atmospheric modeling while making a meaningful impact on global environmental research.