# Modeling the Climate System: Mathematical Issues and Potential Collaborations in the Atmospheric Sciences

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## Abstract

This talk will give some information on the weather and climate research at the VNU University of Science (HUS) and the Mathematical Issues that could bring opportunities of collaborations between mathematical and atmospheric scientists in the field of weather and climate modelling.

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# Mathematical model for simulating flow processes and tracer transport in the Vietnamese Mekong Delta

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## Abstract

The Mekong River is known as the largest river system in Southeast Asia. The river consists of various interconnected regions such as a river and its tributaries, lakes, a delta, and adjacent coastal ocean, with high stresses and strong alternations especially in the Vietnamese Mekong Delta (VMD). A wide range of temporal and spatial scales of flow, salinity and sediment transport processes can be observed in the VMD due to the combined effects of human activities and various natural factors, e.g. hydropowers, climatic variability, droughts, floods, river discharge, tides. For instance, the average annual cost of the repercussions of flood in the VMD ranges from 60 to 70$ million while the average annual value of flood benefits is approximately from 8 to 10$ million, representing that reduction of the costs and impacts of flooding while preserving the benefits are still challenge. Thus, besides field measurements that are generally time-consuming and rarely obtained over long time intervals and at different locations due to the highly spatial and temporal variability of the phenomena, a multi-scale model that allows for reproducing the flow, salinity and sediment transport in the VMD is necessary, to (i) qualitatively simulate the flow processes, salinity as well as sediment fluxes and (ii) study related issues, e.g. inundation, salt intrusion, suspended sediment, ecological status, morphology. In this context, a finite-element, multi-scale model, which consists of hydrodynamic and tracer modules, is developed and applied to reproduce the flow and tracer transport in the VMD. The depth shallow-water equations and the depth-averaged advection-diffusion equations including the influence of source/sink terms are solved in the hydrodynamic and tracer transport module, respectively. The model is then applied to simulate the flow processes, suspendede sediment and salinity transport at different flow conditions.

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# Mathematical Modeling for some complex systems

# in Biology, Ecology and Epidemiology.

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**Abstract**

In this talk, we will summarize some results and present perspectives in term of mathematical modeling of complex systems. We focus on behavior dynamics of some systems such as a bacteria system in soil where we are interested in interaction between bacteria and organic matter in a 3D-structured soil sample, a fishery system where we take into account of marine protected areas (MPA) as well as artifical fish device (AFD), and a SIR-network system where we consider an urban disease spreading.

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# Critical transitions in complex systems and their early warning signalsJereon Lamb 1,[[1]](https://mail.google.com/mail/u/0/#m_-6512684124000790943__ftn1)

 **Abstract**

In this talk, I will give a broad introduction into the problem of finding early warning signals for abrupt changes in complex systems. While there is some experimental evidence of such early warning signals, a solid  mathematical foundation is still elusive.

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