SIAM MPE Community Meetings: Colloquium

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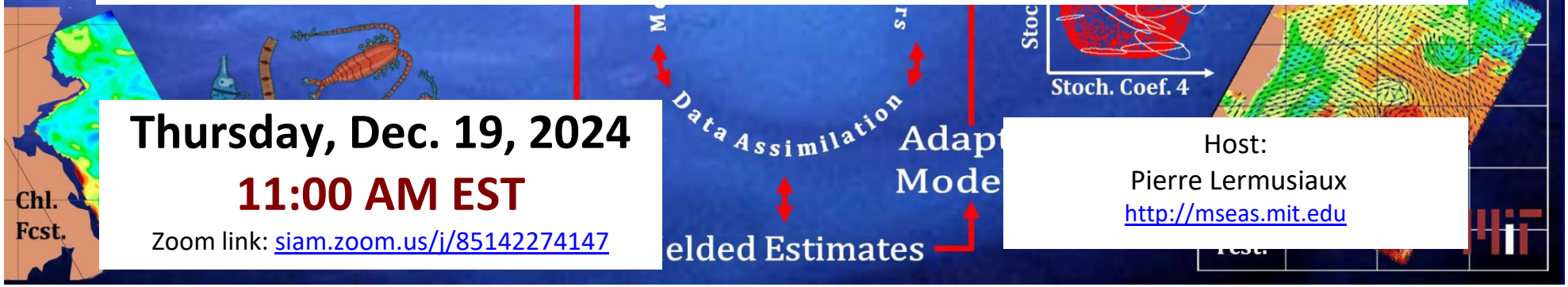
Predictability and Early Warning of Climate Tipping Points

Abstract: Rising global temperatures lead to mounting stress on societies due to an increased frequency of extreme weather events. This will worsen as the climate continues on its currently projected path, which is a linear function of the greenhouse gas emissions. But there is further concern from paleoclimate data and theoretical considerations that the climate's response will eventually become non-linear and may feature discontinuous jumps, the so-called tipping points. These are a result of co-existing stable steady states in parts of the Earth system, such as the ice sheets, rainforests and ocean circulation, and they can make climate change partially irreversible even under drastic reduction of the atmospheric CO2 concentrations. State-of-the-art Earth system models show too little agreement to give quantitative estimates on the critical levels of global warming that trigger tipping points. As alternative line of evidence, data-driven methods have been proposed that harness general features of dynamical systems undergoing critical transitions, requiring only little detailed knowledge of the system. Such early-warning signals have been identified in various parts of the climate system, but they are not without caveats. In this talk I will present some recent and ongoing work on the predictability of climate tipping points, focusing on a potential collapse of the Atlantic Ocean circulation. The work shows limitations of commonly used early-warning signals, and proposes improvements using tools from statistical physics to construct optimal observables. I will further briefly discuss work on more fundamental challenges to climate predictability due to high multistability, non-autonomous instabilities, chaos, and fractal basin boundaries.

Biography: Dr. Johannes J. Lohmann received his MSc in physics from TU Berlin and Duke University, and his PhD in climate physics at Copenhagen University (2018). He has been an Assistant professor at NBI since 2021, working in the group for Physics of Ice, Climate and Earth (PICE). He was a Visiting assistant professor at the University of Tokyo in 2023, returning to NBI in 2024. He is currently PI for two projects on climate tipping points funded by DFF and Villum.



Thursday, Dec. 19, 2024

11:00 AM EST

Zoom link: siam.zoom.us/j/85142274147

Host:
Pierre Lermusiaux
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