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A Realtime Coupled Physical-Numerical Geophysical Fluids Laboratory

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Motivated by the mid-latitude atmospheric circulation, we develop a system that uses observations from a differentially heated rotating annulus experiment to constrain a numerical simulation in real-time.

The coupled physical-numerical system provides a tool to rapidly prototype new methods for state and parameter estimation, and facilitates the study of prediction, predictability, and transport of geophysical fluids where observations or numerical simulations would not independently suffice.

A computer vision system is used to extract measurements from the physical simulation, which constrain the model-state of the MIT general circulation model in a hybrid data assimilation approach. Using a combination of parallelism, domain decomposition and snapshots of model-states, we show that estimates that effectively track the fluid-state can be produced in an ensemble framework. To the best of our knowledge, this is the first realtime coupled system for this laboratory analog of planetary circulation. The system is robust and is targeted both towards research and education. In this talk, we describe some typical experiments conducted with it. Please visit http://ravela.net/pinbot.htm