ADVANCED TOPICS IN APPLIED MATH:
Filtering Turbulent Signals in Complex Systems

Thursday 9:00–10:50, room 905, WWH
MATH-GA

Instructor: Prof. Andrew J. Majda

An important emerging scientific issue in many practical problems ranging from climate and weather prediction to neural and material sciences involves the real time filtering through observations of noisy turbulent signals for complex dynamical systems with many degrees of freedom, as well as the statistical accuracy of various strategies in this context. This is a research expository course on modern applied mathematics involving the blending of rigorous mathematical theories, qualitative and quantitative modeling, and novel numerical procedures driven by the goal of understanding physical phenomena which are of central importance. These ideas include classical stability analysis for PDE’s and their finite difference approximations, suitable versions of Kalman filtering, ensemble Kalman filters, and instructive stochastic qualitative models from turbulence theory and concrete models from climate atmosphere ocean science. The course will begin with an elementary introduction to these topics filling in the necessary background with elementary scalar and low dimensional models with eventual applications to fully turbulent and chaotic, linear and nonlinear, large dimensional systems. New development in mathematical theories and algorithms currently developed at CIMS will also be discussed at the end of this course.

Audience: The course should be interesting for graduate students, and postdocs in pure and applied mathematics, physics, engineering, and climate, atmosphere, ocean science interested in filtering and data assimilation for complex turbulent dynamical systems.

Course Organization:

- **Main reference:**

- **Course style:** A lecture reading course with active participation of registered students and active discussion led by Prof. Andrew Majda and his postdocs.

- **Prerequisite:** Elementary background in ODEs and PDEs.

- **Grading:** All active registered participants will pass the course, no exams or problem set homework.

(see also [http://cims.nyu.edu/~qidi/courseinfo18.html](http://cims.nyu.edu/~qidi/courseinfo18.html) for supplementary course materials)