IUSS
Scuola Universitaria Superiore Pavia

Course: **Data Assimilation**
Lecturer: Prof. A. Veneziani
Date: May 22 – June 1
Classroom: 1-17; 1-16 @IUSS

Course schedule

Week	Date	Lecture hours From___To___	Tutorial hours From__To__	Subject	Tot h
1	22/5 Classroom-1-17		14:00- - 18:00	Introduction to data assimilation, uncertainty quantification and inverse problems.	4
	23/5 Classroom-1-17	10:00-12:00	14:00- - 16:00	The calculus of variations, Lagrange multipliers and and adjoint methods	4
	24/5 Classroom-1-17	9:00-12:00	14:00 – 15:00	Variational Methods of DA	4
	29/5 Classroom-1-16		14:00 – 18:00	Statistical DA: the Bayesian approach. Kalman filtering techniques.	4
	30/5 Classroom-1-16	10:00-12:00	14:00 – 16:00	Implementation of the Kalman filter and extensions to nonlinear problems	4
2	31/5 Classroom-1-16	10:00-12:00	14:00- - 16:00	Advanced methods: nudging and reduced methods	4
	1/6 Classroom-1-17	10:00-12:00	14:00- - 18:00	The ensemble Kalman filtering and ensemble variational techniques	6

Brief Contents Description and Course Syllabus:

The use of quantitative methods in traditional and new fields of engineering and science urges the introduction of specific techniques for merging the background knowledge of mathematical and physical models with the foreground knowledge of data, measures and images. This is a critical step for moving from "simulation" to "assimilation", i.e. from a segregated quantitative use of different information to an integrated one. This is expected to reduce the impact of modeling error as well as measurement noise, and to quantify the reliability of the numerical results. Diverse methods are available for this aim, ranging from variational deterministic techniques to stochastic approaches. The course will cover the most popular techniques and some of their recent customizations. In the second part of the course, a showcase of different applications ranging from the geophysical and environmental fields to human sciences will be presented. The course will be completed by Lab sessions with Matlab and FreeFem++.

Grading
Students will be asked to choose a field of interest, to read one or more papers on the subject and to present it in an oral presentation. The connection with the individual topic of research is strongly encouraged.

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