

课程大纲

COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	数据同化前沿 Advanced topics in data assimilation
2.	课程性质 Compulsory/Elective	选修 Elective
3.	课程学分/学时 Course Credit/Hours	2 学分/32 学时 1 credit/32 hours
4.	授课语言 Teaching Language	中文 Chinese
5.	授课教师 Instructor(s)	展鹏 Peng Zhan
6.	先修要求 Pre-requisites	无 NA.
7.	教学目标 Course Objectives	
	<ul style="list-style-type: none"> ● 掌握数据同化（数据融合）的思路 ● 了解顺序数据同化算法和连续数据同化的逻辑与算法 ● 明确不同数据同化的异同与优缺点 ● 数据同化方法在非线性模型的应用 ● To understand the philosophy of data assimilation (data fusion) ● To learn the logic and algorithm of sequential and continuous data assimilation ● To learn key data assimilation methods with their advantages and disadvantages ● To apply the data assimilation algorithm into basic non-linear models 	
8.	教学方法 Teaching Methods	
	理论 Theory	
9.	教学内容 Course Contents	
	Section 1	课程简介、数值预报的历史回顾、资料同化的发展 Course Introduction, Review of the numerical prediction and data assimilation In this section, the information about the course will be introduced and the background and key components of a numerical model for simulation and prediction will be addressed. In addition, the history and logic of numerical simulation and data assimilation will be introduced, with the implementation of a tutorial on the shallow water equation model.
	Section 2	基于最优插值的同化方法 Optimal Interpolation (OI) In this section, OI will be introduced and its relevance to best linear unbiased estimation will be derived.
	Section 3	基于卡尔曼滤波的同化方法 Kalman Filter

	<p>In this section, Kalman Filter will be introduced from an optimization approach, as well as its equivalency to OI algorithm that is derived as a BLUE.</p>
Section 4	<p>基于集合卡尔曼滤波及其主要变种的数据同化方法 Ensemble Kalman Filter (EnKF)</p> <p>In this part, EnKF and a few important variants will be introduced based on the Gaussian and Bayes' theorem, and some useful techniques will be explained, including inflation, localization, ensemble perturbation, and so forth.</p>
Section 5	<p>伴随模型 Adjoint modelling</p> <p>In this part, adjoint model and its use for sensitivity analysis will be introduced, as well as its use in back propagation for deep learning.</p>
Section 6	<p>基于四维变分的数据同化方法 4-Dimensional variational method</p> <p>In this section, the 4-Dimensional variational method will be introduced based on a perfect forward model, and the associated adjoint model for computing the sensitivity or gradient of the objective function.</p>
Section 7	<p>数据同化与反问题 Data assimilation as an inverse problem</p> <p>In this section, relationship of data assimilation and an inverse problem will be introduced as a strong prior.</p>
Section 8	<p>数据同化方法在非线性模型的应用 Application to non-linear model</p> <p>In this part, data assimilation methods will be applied with basic non-linear models, based on which factors that affect data assimilation performances will be discussed.</p>
10.	<p>课程考核 Course Assessment</p> <p>请再此注明：①考查/考试；②分数构成。 Assignment & Final presentation, Attendance 10%; Assignment 40%; Final presentation 50%</p>
11.	<p>教材及其它参考资料 Textbook and Supplementary Readings</p> <p>Park, Seon Ki, and Liang Xu, eds. Data Assimilation for Atmospheric, Oceanic and Hydrologic Applications (Vol. II). Berlin, Heidelberg: Springer Berlin Heidelberg, 2013.</p>