

CLIM763: Advanced Statistical Methods in Climate Research

Instructor: Timothy DelSole

Semester: Fall 2019

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Office Locations and Phone Number: Room 112, Research Hall (703-993-5715)

Office Hours: By appointment (request made by email).

Catalogue Description: Introduction to multivariate statistical techniques commonly used in climate science, with special emphasis on estimation in large dimensional spaces. Topics include: multivariate regression, canonical correlation analysis, predictable component analysis, field significance tests, data assimilation (especially the ensemble Kalman Filter), discriminant analysis, and detection and attribution of climate change.

Course Objectives: Techniques covered in this course focus on multivariate techniques for quantifying dependencies between climate variables, differences in variability between two data sets, predictability of ensemble forecasts, and changes in extremes. The course also introduces ensemble data assimilation methods. Emphasis will be placed on practical issues that arise in climate science, especially the problem of estimating more unknown parameters than samples. After taking this course, the student should be able to address related problems with appropriate statistical methods while recognizing the major limitations and pitfalls of the methods. The course provides students with practical experience through near-weekly problem sets based on climate-related data provided by the instructor.

Prerequisites: CLIM762, or permission of instructor.

Class Meeting: Thursdays, 9am-11:45am, Research Hall 121 (Climate Lab)

Grading: Comments on Reading Material: 15% (must be submitted by the midnight before each class)
Homework: 60%, Project: 25%

Policy: Homework assignments will be distributed on Thursday and are due in class the following Thursday. Late assignments will be penalized one letter grade per day late (exceptions for medical reasons).

Class Web Site: GMU Blackboard

Course Text There is no official text book for this course. Lecture notes will be made available electronically before each lecture. The following texts may prove useful:

Statistical Analysis in Climate Research, by von Storch and Zwiers, Cambridge Univ Press.

Applied Multivariate Statistical Analysis, by Johnson and Wichern.

Software Homework computations are expected to be done using the package **R**.

Class Schedule

08/29	field significance
09/05	NO CLASS: attend GMU seminar on August 28
09/12	multivariate linear regression
09/19	canonical correlation analysis: part 1
09/26	canonical correlation analysis: part 2
10/03	covariance discriminant analysis: part 1
10/10	covariance discriminant analysis: part 2
10/17	Analysis of Variance (ANOVA)
10/24	Predictable Component Analysis (PrCA)
10/31	extremes
11/07	data assimilation, Bayes theorem
11/14	ensemble square root filter
11/21	filter divergence and adaptive inflation
11/28	NO CLASS: Thanksgiving
12/05	detection and attribution of climate change
12/16	class presentations (1:30-3:30)