**AOSC-630 STATISTICAL METHODS IN METEOROLOGY AND OCEANOGRAPHY** Updated January 2018 (Eugenia Kalnay/Huug vanden Dool)

*Prerequisite:* STAT 400 or equivalent, or approval by instructor. *Grading:* Homeworks, 30%; Mid-term take home exam, 30%; Final take home exam: 40%.

*Syllabus:* Review of the most widely used statistical methods currently used in meteorology and oceanography including tests of significance; time series analysis; linear multiple regression; neural networks; wavelets; Model Output Statistics. Notes discussing the syllabus subjects are available at [http://www.aosc.umd.edu/~ekalnay/#AOSC630](http://www.aosc.umd.edu/~ekalnay/#AOSC630).

*Note:* Some of these lectures are presented by world leaders in the field. The class notes prepared for this course by Dr. Huug van den Dool became the basis for the textbook “Empirical Methods in Short Term Climate Prediction” (Oxford University Press, 2007).


*Approximate schedule:*

1. Introduction, probability distributions, tests of significance (3 weeks)

   - (1) Introduction - concepts of probability, random variables and probability distributions. Wilks: Chapters 2, 3, 5.1

2. Tests of hypothesis - Type I error, Type II error, level of significance, one tailed tests and two tailed tests. Parametric tests of significance against non-parametric tests and Monte Carlo methods. Bootstrapping. Wilcoxon-Mann-Whitney non-parametric test. Wilks: 5.1-5.4

II. Regression, Statistical Weather forecasting, MOS, Neural Networks, Ensemble forecasting (3.0 weeks) Wilks: Chapter 6; other refs.


3. Screening regression - explained variance and incrementally explained variance, all possible regression, forward selection, stepwise regression, and stagewise regression.


5. Nonlinear regression, neural networks (**Guest lecturer: Vladimir Krasnopolsky**).

6. Probabilistic forecasting and verification from ensembles (Guest lecturer: **Malaquías Peña-Méndez/Emily Becker**).

III. Time series (2.0 weeks) Wilks: Chapter 8, plus additional refs.


(5) Wavelets (Guest lecturer: Andy Tangborn)

IV. Statistical methods for climate prediction (5.0 weeks, lecturer: Huug van den Dool)

(1) Introduction: Empirical orthogonal functions (principal components) - rotated and complex empirical orthogonal functions. Coupled fields: Singular Value Decomposition, Canonical Correlation Analysis. Clustering (Wilks, Chapter 9)

(2) Applications developed at CPC: Empirical Wave Propagation; Natural analogues; Constructed analogues; Empirical Basis Functions; Teleconnections; Empirical Orthogonal Teleconnections: examples from reanalysis; Empirical Orthogonal Functions; Compact representation of data sets

V. Forecast verification (0.5 week):

(6) Currently used operational forecast scores