# Syllabus: SIOC 221A, Analysis of Physical Oceanographic Data

Sarah Gille
*Class Meetings:* Monday and Wednesday, 9:30-10:50, Spiess 330
*Discussion:* Friday, 9:30-10:30(ish), Spiess 330

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*Course website:* http://www-pord.ucsd.edu/∼sgille/sioc221a
*Grading:* letter or S/U

*Course Description:* Fundamental elements of analysis of geophysical and oceanographic time series, including sampling problems, least-squares techniques, spectral analysis, interpretation of series, design of experiments.

*Course Objectives:* During this class you will learn (or refresh your knowledge of) basic statistics, Fourier transforms, time-series analysis methods including least-squares fitting and spectral analysis. Along the way, you should develop your programming skills so that you are able to put the methods that we discuss in class into practice.

*Course requirements:* Complete weekly problem sets (by due dates). You may work on most of the problem sets collaboratively, but you need to work through the problems yourself and write up your own work. If you work in a group, please identify your collaborators. (Science is collaborative, and we always acknowledge our sources and our collaborators.) A mid-term problem set will have about the same scope as the regular problem sets, but you will complete it independently, and you will be asked to sign a statement indicating that the work you submit is your own. The final problem set will be a project based on data that you choose and will also be completed independently. Each problem set will contribute approximately equally to your final grade. Bonus points may be awarded for exemplary class participation.

In lieu of a final exam, you will prepare and present a final project based on a data set of your choosing. This will take place, either during discussion section in the last two weeks of the quarter, or during the final exam time slot (Wednesday 12 December, 8:00-11:00). The decision about when to do this will depend on scheduling for the American Geophysical Union fall meeting, which is taking place during final exam week.

Perhaps needless to say, you are expected to come to class, to participate in class discussions, and to ask questions (e.g. for clarification, because you don't understand a point, or to seek further perspective.) I will assign some small segments of reading, which will be available in electronic form, and you are expected to complete the reading.

*Topics:*
— Introduction: statistics, probability density functions, mean, standard deviation, skewness, kurtosis
— Error propagation
— Least-squares fitting

— The Fourier transform

— Spectra, spectral uncertainties, using Monte Carlo methods (and fake data) to evaluate formal uncertainties

— Windowing and filtering

— Cross-spectra, coherence, uncertainties of coherence

— Multi-dimensional spectral analysis

*Time permitting, we might get to:*

— Rotary spectra

— Alternative approaches for computing spectra: multitaper and maximum entropy methods

— Filter design

— Introduction to linear systems

— Spectral modeling; spectral physics

**Texts on reserve for SIOC 221A**

*Electronic resources (available on line and in hard copy):*

Bendat, J. S. and A. G. Piersol, 2010: *Random Data: Analysis and Measurement Procedures*. John Wiley & Sons, 4th edition.

Thomson, R. E. and W. J. Emery, 2014: *Data Analysis Methods in Physical Oceanography*, 3rd edition, Elsevier.

von Storch, H. and F. W. Zwiers, 1984: *Statistical Analysis in Climate Research*, Cambridge University Press.

*Hard-copy resources (available for consulation in the Eckart Building):*

Helstrom, C. W., 1991: *Probability and stochastic processes for engineers*. Macmillan.

Koopmans, L. H., 1974: The spectral analysis of time series, Academic Press.

Papoulis, A. and S. U. Pillai, 2002: *Probability, random variables, and stochastic processes*. McGraw-Hill.

Percival, D. B. and A. T. Walden, 1993: Spectral analysis for physical applications : multitaper and conventional univariate techniques, Cambridge.