

# PHY2509S Course Outline - Jan 2004

## Atmospheric Data assimilation

**Time:** Fridays 10:00-12:00 starting Jan. 9, 2002

**Place:** Room 606, MacLennan Physics Bldg., Univ. of Toronto

**Lecturer:** Saroja Polavarapu, Room 611, MacLennan Physics Bldg.  
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**Course Website:**

<http://www.physics.utoronto.ca/graduate/courses/2003-2004/PHY2509S.html>

**Scope:** Data assimilation involves combining observations with model output to obtain a consistent, evolving 3-dimensional picture of the atmosphere. This process is used to generate an initial state for producing forecasts at operational weather forecast centers. Data assimilation can also provide added value to observations by filling in data gaps and inferring information about unobserved variables. In this course, common methods of data assimilation (optimal interpolation, Kalman filtering, variational methods) are introduced and derived in the context of estimation theory. A hands-on approach will be taken so that methods introduced in the lectures will be implemented in computer assignments using toy models and MATLAB. The main applications of data assimilation that will be discussed are weather and environmental prediction.

**Texts:** There will be no textbook to purchase. Notes on my lectures will be distributed during class. Additional references include the course notes by Ricardo Todling (see Course website for relevant chapters) and Daley (1991).

**Assessment:** 5 problems sets (50%), project (50%)

Problem sets are due Fridays at the beginning of class, 14 days after being assigned.

**Topics:** Numbers in brackets indicate the expected length in weeks. Actual time spent per topic may vary from these estimates. Also, the order of presentation of topics may vary slightly from that suggested below.

- motivation, simple examples (0.5)
- review of probability and statistics (1.5)
- optimal interpolation (2)
- stochastic processes (1)
- intro to estimation theory (1)
- 3D-variational methods (1)
- the linear Kalman filter (3)
- 4D-variational methods (2)

**References:**

Daley, R., 1991: Atmospheric Data Analysis. Cambridge University Press.

Todling, R., 1999: Estimation Theory and Foundations of Atmospheric Data Assimilation, DAO Office Note 1999-01. (Copies available as needed)