New England's Changing Climate

Instructors: Prentice and others **Timing:** AY 2001/2 Spring
Credits: 4 (Lecture and Lab)

Course Description

This course examines the current state of New England meteorology and atmospheric chemistry, how the atmospheric environment has changed over the last century, and possible future changes. The rationale is that meso- to micro-scale processes and their integration with hemispheric-scale processes are critical to improved prediction of global climate change as well as to assessment of regional-local impacts. The seasonal cycle in New England's physical and chemical weather is explored in the context of global-to-local forcing. Simple models of key synoptic- to micro-scale processes are developed. Century-long instrumental records of New England and hemispheric-global climate change are explored. Statistical and GIS tools are used to quantify the influence of global-to-local forcings and processes, both natural and anthropogenic, on New England's climate over this time period. Strategies for predicting change in New England's atmospheric environment are examined with emphasis on uncertainties and research needed to reduce these uncertainties.

Syllabus

Introduction

Rationale for course: elucidate New England meso- to micro-scale atmospheric pr
and chemical, in context of larger-scale hemispheric influences. Importa
scale (sub-grid) processes in assessing impact of global climate change.
Conventional space-scales of weather analysis with inherent renderings of globa
Strategies for dealing with meso-micro scale in a global context: types of mode
deductive versus inductive approaches, model-data convergence, uncertaint
Methods for analysis of regional climate-change record to refine understanding
attribution of climate change.

New England Physical Weather: Annual Cycle

Meteorology primer: radiation, thermodynamics, moisture, horizontal and vertical motion, the general circulation.
Analysis of recent seasonal cycles in New England weather (tropospheric tempera
precipitation, etc.) in context of hemispheric-scale atmosphere-ocean cha
Interpolation of nested 3-D arrays of key atmospheric properties from irregular
integrating local weather records with global-scale model reanalyses (NCE
Parsing the influence of hemispheric to-micro scale processes on New England we
Modeling of micro-atmospheric processes: radiation budgets (radiative-convectiv
pressure and circulation patterns.
Synoptic circulation patterns and their hemispheric controls, statistical analy
influence on local weather.

New England Chemical Weather: Annual Cycle

Atmospheric chemistry primer: sources, pathways, and sinks for chemical components including O_3, NO_x, fine aerosols, CO, CO_2.
Narrative of seasonal (and higher frequency) variations in gas-phase and aerosol chemistry of New England atmosphere.
Air-transport, advection and diffusion, back-trajectory models.
Regional and local, anthropogenic and natural sources of important chemical species.

Statistical-GIS-based analysis of seasonal variation in local air chemistry in context of physical weather change to understand controls on New England air chemistry.

New England Climate Variability On Decadal Timescale

Analysis of instrumental record of New England climate (primarily physical, som of hemispheric climate record: major trends and events.

Survey of global- to micro-scale forcing functions from New England perspective

Hypotheses based on GCM experiments for influence of selected forcing functions

Statistical analyses (principal components, regression, spectral) at scales up causal mechanisms of New England climate variability. Relations between and notable climate-change phenomena including El Niño-Southern Oscillati Oscillation, Pacific-North American Oscillation.

Detection and possible attribution of New England climate change: synoptic to m anthropogenic.

Detailed analysis of selected New England climate events using nested 3-D array understanding/modeling of meso- to micro-scale processes.

Predicting Physical and Chemical Weather in New England

Predictions for forcing functions

Downscaling of GCM-based predictions

Uncertainties