CLIM 751: PREDICTABILITY AND PREDICTION OF WEATHER AND CLIMATE – CONCEPTS AND PHENOMENOLOGY

Fall 2017 - Syllabus

Instructors: J. Shukla (office: 105, Research Hall, email: jshukla@gmu.edu)
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Guest Lecturers: See list.

Class Schedule: Wednesday 10:30 am – 1:10 pm (Room: Innovation 139)*

Course Homepage: http://cola.gmu.edu/kinter/CLIM751/
http://mymasonportal.gmu.edu (Blackboard)
All reading materials will be posted on Blackboard.

Textbooks, Recommended and Supplementary Reading Materials:
Required Reading: See list.

Course Description:
This course covers fundamental aspects of weather and climate predictability. Using simple dynamical models, illustrates basic theorems on divergence of trajectories in phase space and fundamental periodicity properties of flow. Explores paradigms of turbulence, barotropic and baroclinic instability, and optimal linear growth to describe fundamental error growth mechanisms. Examines examples from real weather forecasting systems. Studies predictability of time averages with simple dynamical models and experiments using complex general circulation models and historical data analysis. Emphasizes roles of boundary conditions of sea surface temperature and soil moisture.

Course Requirements:
1. Presentation of Selected Papers from the Literature: 70%
2. Data analysis project: 30%

Each week, selected students will be assigned to present papers from the scholarly literature. All students are expected to read all the papers each week. One student will be asked to present the paper, and one student will be asked to summarize the impact of the paper, e.g., with a summary of the papers that have cited it since publication. All students are expected to conduct a data analysis exercise, using data sets provided for the course including long time series of re-forecasts and verifying observations. A separate assignment sheet describes the data analysis project.

* Will be shifted to Wednesday 2:45 – 5:25 pm (Room: Research 121)
### Detailed Course Schedule (subject to minor adjustment)

<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Lecture</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Aug</td>
<td>1</td>
<td>Kinter/Shukla</td>
<td>Logistics; Introduction to Predictability &amp; Prediction</td>
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<tr>
<td>06 Sep</td>
<td>2</td>
<td>Shukla/Adams</td>
<td>Predictability of Weather / CLIM 751 Data Analysis Project</td>
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<tr>
<td>13 Sep</td>
<td>3</td>
<td>Shukla</td>
<td>Dynamical Seasonal Prediction</td>
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<tr>
<td>20 Sep</td>
<td>4</td>
<td>DelSole</td>
<td>Unified Framework for Predictability / Predictability Measures</td>
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<tr>
<td>27 Sep</td>
<td>5</td>
<td>Krishnamurthy</td>
<td>Predictability of the South Asian Monsoon</td>
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<tr>
<td>04 Oct</td>
<td>6</td>
<td>Straus</td>
<td>Intraseasonal Predictability</td>
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<tr>
<td>11 Oct</td>
<td>7</td>
<td>Dirmeyer</td>
<td>Land Surface Predictability</td>
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<tr>
<td>18 Oct</td>
<td>8</td>
<td>Kinter</td>
<td>Predictability of Extreme Events</td>
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<tr>
<td>25 Oct</td>
<td>9</td>
<td>Kinter</td>
<td>Ensembles and Predictability</td>
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<tr>
<td>01 Nov</td>
<td>10</td>
<td>Huang</td>
<td>Seasonal Prediction of ENSO and Indo-Pacific Variability</td>
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<tr>
<td>08 Nov</td>
<td>11</td>
<td>Burls</td>
<td>The Ocean’s Role in Tropical Climate Prediction</td>
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<td>15 Nov</td>
<td>12</td>
<td>Buckley</td>
<td>Role of Ocean Dynamics in North Atlantic SST Anomalies</td>
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<tr>
<td>22 Nov</td>
<td>13</td>
<td>Thanksgiving break</td>
<td>NO CLASS</td>
</tr>
<tr>
<td>29 Nov</td>
<td>14</td>
<td>DelSole</td>
<td>Predictability of Decadal Variations and Climate Change</td>
</tr>
<tr>
<td>06 Dec</td>
<td>15</td>
<td>Students</td>
<td>Data Project Presentations</td>
</tr>
</tbody>
</table>

### PAPERS

The papers listed below (subject to revision) are readings for each week of the course. The references below are labeled as follows:

- **A**: required (should be read by all students)
- **B**: recommended (optional reading)
- **P**: to be presented by students

1 – INTRODUCTION (no student presentations this week)


2 – WEATHER (no student presentations this week)


3 – DYNAMICAL SEASONAL PREDICTION


4 – UNIFIED FRAMEWORK (no student presentations this week)
5 – SOUTH ASIAN MONSOON


6 – INTRASEASONAL


7 – LAND SURFACE


8 – EXTREME EVENTS


9 – ENSEMBLES


10 – SEASONAL PREDICTION

• ENSO prediction


• Indian Ocean SST mechanism and prediction

  o B: Zhu, J., B. Huang, J.L. Kinter, and A. Kumar, 2015: Seasonality in predictive skill and predictable pattern of the tropical Indian Ocean SST. *J. Climate*, 28, 7962-7984.


11 – OCEAN’S ROLE (no student presentations this week)

12 – OCEAN DYNAMICS AND NORTH ATLANTIC SST
(Note: The student presentation includes one paper, a comment on that paper and a reply to the comment.)

THANKSGIVING

14 – DECA DAL & CLIMATE CHANGE


**Goals and Learning Outcomes:**

The course will:

1. *Provide a background in the scientific problem of weather and climate predictability.* Students will gain an in-depth understanding of how and why weather and climate may be predictable. Students will have the opportunity to critically review the scholarly literature on the predictability of variations of the Earth system at time scales of days to decades. The emphasis on both the nature of scientific findings and the impact that individual papers have had on subsequent scholarship ensure that students will gain an appreciation for the practice of professional scientific inquiry.

2. *Provide knowledge and skills necessary to conduct original quantitative research in predictability.* By have access to a current research-quality data set for analysis and manipulation, the students will develop the ability to work with high-volume geophysical data from a variety of sources.

3. *Reinforce oral and written communication skills.* Students will present papers from the literature, evaluate the impact these papers have had on the scientific body of knowledge, and critically examine the results reported in the literature. Students will write reports on the findings of their calculations with research-quality data sets, with the potential to submit truly new findings for peer-reviewed publication.

**Academic Integrity:**

Mason is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, *you* will perform that task. When you rely on someone else’s work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind), please ask for guidance and clarification. As in many classes, there will be a project in this class designed to be completed within small study groups. With collaborative work, the names of all the participants should appear on the work. Collaborative projects may be divided up so that individual group members complete portions of the whole, provided that group members take sufficient steps to ensure that the pieces conceptually fit together in the end product.

*Please note:* The homework for this course should be your own work, not done in collaboration with
Diversity

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

The reflection of Mason’s commitment to diversity and inclusion goes beyond policies and procedures to focus on behavior at the individual, group and organizational level. The implementation of this commitment to diversity and inclusion is found in all settings, including individual work units and groups, student organizations and groups, and classroom settings; it is also found with the delivery of services and activities, including, but not limited to, curriculum, teaching, events, advising, research, service, and community outreach.

Acknowledging that the attainment of diversity and inclusion are dynamic and continuous processes, and that the larger societal setting has an evolving socio-cultural understanding of diversity and inclusion, Mason seeks to continuously improve its environment. To this end, the University promotes continuous monitoring and self-assessment regarding diversity. The aim is to incorporate diversity and inclusion within the philosophies and actions of the individual, group and organization, and to make improvements as needed.

GMU Email Accounts:
Students must use their Mason email accounts to receive important University information, including messages related to this class. See http://masonlive.gmu.edu for more information.

Disability Accommodations:
If you are a student with a disability and you need academic accommodations, please see me and also contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. http://ods.gmu.edu

Other Useful Campus Resources:
Mason has several support services for students. Please go to http://ctfe.gmu.edu/teaching/student-support-resources-on-campus/ for a directory of services.

University Policies:
The University Catalog, http://catalog.gmu.edu, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at http://universitypolicy.gmu.edu/. All members of the university community are responsible for knowing and following established policies.