Course Change Request

New Course Proposal

Date Submitted: 09/20/19 9:33 am

Viewing: CLIM 631 : Urban Climate

Last edit: 09/20/19 12:20 pm

Changes proposed by: bklinger

Are you completing this form on someone else's behalf?

No

In Workflow

1. **AOES Chair**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Graduate
5. Registrar-Courses
6. Banner

Approval Path

1. 09/20/19 9:50 am Jim Kinter (ikinter): Approved for AOES Chair
2. 09/20/19 12:20 pm Jennifer Bazaz Gettys (jbazaz): Rollback to AOES Chair for SC Curriculum Committee
3. 10/03/19 3:52 pm Jim Kinter (ikinter): Approved for AOES Chair

Effective Term: Fall 2020

Subject Code: CLIM - Climate Dynamics

Course Number: 631

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Urban Climate

Banner Title: Urban Climate

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable: May only be taken once for credit, limited to 2 attempts (N2)

Max Allowable Credits: 3

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):
none

Recommended Corequisite(s):
none

Required Prerequisite(s) / Corequisite(s) (Updates only):
none

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):
none

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:

Provides a coherent system to describe, study, and understand the essentials of urban (micro) climates. Explores the physical principals governing the creation of distinct urban climates. Explains ways the built environment interacts with the atmosphere over scales that extend from walls and roofs up to whole cities. Also considers the effects of weather and climate on the city.

Justification:

Urban areas are an important part of our environment. At present, there is no George Mason course that provides knowledge of the urban climate and its impact on global climate change. The course will provide sufficient interdisciplinary knowledge to students to enable them to understand urban climates.

Does this course cover material which crosses into another department? No

Learning Outcomes:

Attach Syllabus

clim631syllabus.pdf

Additional Attachments

Staffing:

Zafer Boybeyi

Relationship to Existing Programs:

Will be elective in MS Climate Science and MS Earth System Sciences. This course will provide useful background for students in the Atmospheric, Oceanic, and Earth Sciences (AOES), Physics, Geography and Geoinformation Science (GGS), and Environmental Science and Policy (ESP) departments.

Relationship to Existing Courses:

There is no significant overlap between this course and other courses.

Additional Comments:

Reviewer Comments

Jennifer Bazaz Gettys (jbazaz) (09/20/19 12:20 pm): Rollback: Rolling back per email request.

Key: 16492

SYLLABUS

CLIM-631: Urban Climates

Instructor:

Associate Prof. Zafer Boybeyi
Research Hall, room 217
(703) 993 1560
zboybeyi@gmu.edu

Course Website:

http://camp.cos.gmu.edu/CLIM-631.html

Office Hours:

9 :00-10 :30am Tuesday/Thursday

Catalog Description:

Provides a coherent system to describe, study, and understand the essentials of urban climates. Explores the physical principals governing the creation of distinct urban climates. Explains the ways cities interact with their atmospheres over scales that extend from walls and roofs up to whole cities. Also considers the effects of weather and climate on the city.

Course Prerequisites:

None

Summary:

Cities affect climate at both local and global scales. Cities are typically warmer, more prone to flooding, and have poorer air quality than their rural surroundings. They are also particularly exposed to the potential hazards of future global climate change, such as increasing temperatures, increasing in severity and frequency of extreme events, and sea-level rise.

For most people on the planet, an urban climate is the norm. Over the past 200 years, the global population has increased sevenfold, from 1 billion in 1800 to more than 7 billion by 2015; during the same period the fraction of people living in urban areas increased from 3% to more than 50%. By 2050, the proportion of the world's population living in urban areas is expected to approach 65-70%. The intensity of landscape change and its impact on environmental systems, including the atmosphere (i.e., weather and climate), are profound and this influence is transmitted to regional and global systems far downwind.

The primary focus in CLIM-631 is the interactions between a city and the overlying atmosphere. While interactions are two-way, the prime focus of this course is the impact of the city on the atmosphere. Urban development so fundamentally transforms the pre-existing biophysical landscape that a city creates its own climate. To a lesser extent, the course also considers the effects of weather and climate on the city.

At present, there is no George Mason course that provides knowledge of the urban climate and its impact on global climate change. This course will provide sufficient interdisciplinary knowledge to students to enable them to understand urban climates and will draw on resources within the AOES and other departments.

Required Text:

Urban Climates, T. R. Oke, G. Mills, A. Christen & J. A. Voogt
ISBN 978-0-521-84950-0, 2017, 525p.

Useful Readings:

- OECD (2010), Cities and Climate Change, OECD Publishing (http://dx.doi.org/10.1787/9789264091375-en)
- Technical Report (2008), Development and Climate Change: A Strategic Framework for the World Bank Group (http://siteresources.worldbank.org/DEVCOMMINT/Documentation/21928837/DC2008-0009(E)ClimateChange.pdf)

Evaluation Criteria:

The assessment of student performance will be based on;

- 5-6 homework assignments (20%)
- class participation & surprise quizzes (10%)
- midterm exam (25%)
- comprehensive final exam (45%)

Academic Integrity:

All students are expected to abide by the honor code of George Mason University, which can be viewed at https://oai.gmu.edu/mason-honor-code/.

Student Learning Outcomes:

- Acquire knowledge of the basic components of urban climates
- Understand the relationships among these components
- Understand the role of urban areas in climate change
- Integrate and use microclimate knowledge in real-world applications.

Format:

The course will meet once per week for lecture (total 3-credits).

Course Outline:

1) ***Introduction & Concepts***
   An outline of the idea of urban ecosystems and ways to approach the study of urban climates; Sets out a central theme to understand and efficiently communicate about urban climate systems, a set of common terms, symbols, units, descriptions of the urban surface, roughness

elements, scales of atmospheric motion, and vertical stratification; The urban surface; The urban atmosphere; Defining an urban climate.

2) Methods

An overview of techniques used to obtain valid field observations and model results; Field experiments (urban & regional scales), Physical modeling, Numerical modeling.

Micro & Local Effects on Urban Climate

The main exchange processes governing the budgets of momentum and radiation and the balances of heat, water, and carbon in cities are outlined in ***Outlines 3 through 9*** (see below). This permits description and analysis of the spatial distribution and dynamics of airflow, temperature, humidity, greenhouse gases, and air pollutants in urban areas. These and other cloud processes are relevant to the potential effects of cities on cloud development, precipitation, and severe weather. Urban air pollution has been a bane of urban living for centuries, but the mix of emissions keeps changing over history, as does the urban atmosphere into which it must be dispersed. It is, then, useful to view things through the prism of scale.

3) Airflow

Basics of urban boundary layer; Basics of wind and turbulence; Flow in the roughness sublayer; Flow in the inertial sublayer; Flow in the mixed layer.

4) Radiation

Basics of radiation exchanges and budgets; Radiation in the urban canopy layer; Radiation in the urban boundary layer; Surface net allwave radiation budget.

5) Energy Balance

Basics of energy transfer and balance; Anthropogenic heat flux; Heat storage change; Turbulent heat flux; Example energy balances in cities.

6) Urban Heat Island

Urban temperatures and heat island types; Surface heat island; Canopy layer heat island; Boundary layer heat island; Subsurface heat island.

7) Water

Basics of surface hydrology and water balances; Water balance of urban hydrologic units; Urban effects on water balance components.

8) Atmospheric Moisture, Cloud & Precipitation

Basics of atmospheric moisture; Urban effect on humidity; Urban effect on condensation. Basics of cloud and precipitation formation; Urban observations; Hypotheses of urban effects.

9) Air Pollution

Basics of air pollution; Micro- and local-scale air pollution in cities; Indoor air pollution; Urban-scale air pollution; Regional and global effects of urban air pollution.

10) Geographical Controls

The role of orographic and coastal controls on urban climate, and the significance of the synoptic and macroclimatic context of a city.

11) Cities & Global Climate Change

The scales expand further to consider the increasing impacts of cities on global climate and how the altered state of that system in turn imposes impacts on city life; Urban impacts on the global climate system; Greenhouse gas emissions from cities; Global climate change in Urban environments.

12) Climates of Humans & Climate-Sensitive Design

Introduces the fundamental climatic requirements of humans, our need for shelter and a comfortable environment to live and work, and how they set the concept for the construction of appropriate buildings and urban infrastructure.

The principles are outlined to discuss ideas about intelligent and effective use of design elements such as construction materials, shade, shelter, water, and vegetation to create or modify urban climates at all scales; Basics of climate-sensitive planning and design; Design interventions at different scales.

13) Urban Modeling

Basics of urban modeling. Urban parameterization in weather and climate scale models.