Mode of Delivery: Lecture
Prerequisites: MET 4301 or MET 5311, MET 4302 or MET 5312, MET 4420 or MET 5425, or instructor permission
Credit Hours: 3

Course Description:
This course covers the physical processes leading to extreme weather phenomena and how they are expected to change in a warming climate, approaches of characterizing extreme events, and detection and attribution of long-term changes. Topics include extreme rain, floods, droughts, tropical cyclones, severe convective storms, extreme cold, and heat waves.

Learning Objectives: At the completion of this course, students will be able to:

1. Assess the current state of knowledge about how each extreme weather phenomenon is expected to change in a warming climate and where uncertainties remain.
2. Understand the physical mechanisms behind the sensitivity of the occurrence, intensity, and impact of extreme weather phenomena to climate.
3. Develop critical reading skills and review scientific papers.

Course Structure and Student Responsibilities: Since extreme weather in a warming climate is an active area of research, the course is structured around close reading and detailed discussion of contemporary papers in the peer-reviewed literature. The exact balance between instructor-led or student-led paper discussions and lectures may vary by instructor, but a general guideline is that approximately one-half to two-thirds of the class sessions will be paper discussions and the remainder will be lectures. Final grades will be determined from the following required course activities:

1. Written assignments for all papers discussed: 15%
2. Presentation of paper(s) about specific topic: 25%
3. Written review of paper(s) about specific topic: 25%
4. Participation: 10%
5. Final paper: 25%

For the paper discussions (marked "required" readings), the class will read a scientific paper from the peer-reviewed literature about a particular topic and during class time will review and discuss the paper. For each required reading, all students must read the paper and identify the three key points of the paper and three questions they had about the paper (this will be turned in as a written assignment - item 1 above).

The leader of the discussion will create a presentation summarizing the findings of the paper, the main tools used, and any problems or issues with the results (item 2 above). Each student must present once during the semester. The student must also turn in a written review of the paper they present (item 3 above).

All students must participate by asking at least one question during each discussion. If a student completes this baseline level of participation, as well as attends every class, the student will receive a 95% for their overall participation grade (item 3 above). Students

may receive above a 95% by participating more (i.e., asking more questions, responding to questions, etc...). An estimated participation grade will be posted on Canvas halfway through the semester.

All students must submit a final paper that will discuss the relationship between a specific extreme weather phenomena and climate change, written for a general audience (item 4 above).

Grading Scale:
Specific points-based schemes used to mark individual assignments will be discussed as appropriate at the time of assignment. Grading standards may vary by instructor; a sample standard is provided.

Grade	Range	Grade	Range	Grade	Range
–	–	A	94.00% to 100%	A-	90.00% to 93.99%
B+	87.00% to 89.99%	B	84.00% to 86.99%	B-	80.00% to 83.99%
C+	77.00% to 79.99%	C	74.00% to 76.99%	C-	70.00% to 73.99%
D+	67.00% to 69.99%	D	64.00% to 66.99%	D-	60.00% to 63.99%
–	–	F	59.99% and below	–	–

- A- to A: Demonstrates a deep understanding of material. Exhibits a high level of insight and originality.
- B- to B+: Demonstrates a sound understanding of material and some level of insight and originality. Few errors.
- C- to C+: Demonstrates a sufficient understanding of material. Moderate errors. Little insight or originality.
- D- to D+: Demonstrates little understanding of material. Many errors. No insight or originality.
- F: Makes an insufficient attempt to complete required work. Demonstrates a serious lack of understanding of material.

Course Content:

- Week 1: Course Logistics, Overview
- Week 2: Basics of Climate Modeling and CMIP
- Week 3: Climate Attribution of Extreme Weather Events
- Week 4: Heat Waves
- Week 5: Precipitation Extremes
- Week 6: Extreme Snowfall
- Week 7: Tropical Cyclones
- Week 8: Tropical Cyclones
- Week 9: Drought
- Week 10: Wildfires
- Week 11: Floods
- Week 12: Extreme Cold Events
- Week 13: Severe Convective Storms

- Week 14: Extratropical Cyclones
- Week 15: Arctic Amplification and Mid-Latitude Weather

Sample Readings: Readings will be available on the course website, on Canvas. Exact choice of readings will vary by instructor and by year; this is a representative sample.

- Detection and Attribution of Extreme Events
  - IPCC 2012 Special Report on Extremes
  - National Academies 2016 Report: *Attribution of Extreme Weather Events in the Context of Climate Change*
- Heat Waves
  - Stott, P. A., D. A. Stone, and M. R. Allen (2004): Human contribution to the European heatwave of 2003 , Nature, 432, 610-614.
- Extreme Precipitation
  - O'Gorman, P.A. and Schneider, T., (2009): The physical basis for increases in precipitation extremes in simulations of 21st-century climate change Proceedings of the National Academy of Sciences 106, 14773-14777
  - Fischer, E.M. and R. Knutti (2016): Observed heavy precipitation increase confirms theory and early models, Nature Climate Change, 6, 986-991, doi: 10.1038/NCLIMATE3110.
- Extreme Snowfall
  - O'Gorman, P. A. (2014): Contrasting responses of mean and extreme snowfall to climate change . Nature 512, 416-418.
- Tropical Cyclones
  - Kossin, J.P., K.R. Knapp, T.L. Olander, and C.S. Velden (2020): Global increase in major tropical cyclone exceedance probability over the past four decades. Proc. Nat. Acad. Sci., 117, 11975-11980, doi: 10.1073/pnas.1920849117.
  - Kossin, J.P. K.A. Emanuel, and G.A. Vecchi (2014): The poleward migration of the location of tropical cyclone maximum intensity, Nature, 509, 349-352.
  - Knutson, T., S.J. Camargo, J.C. Chan, K. Emanuel, C. Ho, J. Kossin, M. Mohapatra, M. Satoh, M. Sugi, K. Walsh, and L. Wu, (2019): Tropical Cyclones and Climate Change Assessment: Part I: Detection and Attribution. Bull. Amer. Meteor. Soc., 100, 1987-2007, doi: 10.1175/BAMS-D-18-0189.1
  - Knutson et al (2020): Tropical Cyclones and Climate Change Assessment: Part II. Projected Response to Anthropogenic Warming, Bull. Amer. Meteor. Soc., 101, E303-E322, doi: 10.1175/BAMS-D-18-0194.1.
- Drought
  - Diffenbaugh, N. S., D. L. Swain, and D. Touma. 2015. Anthropogenic warming has increased drought risk in California Proc. Nat. Acad. of Sci., 112(13):3931-3936.
    doi: 10.1073/pnas.1422385112.
  - Trenberth, K.E., A. Dai, G. van der Schrier, P. D. Jones, J. Barichivich, K. R. Briffa, J. Sheffield. (2014): Global warming and changes in drought. Nature Climate Change, 4, 17-22.
- Wildfires

  - Abatzoglou, J.T. and A.P. Williams, (2016): Impact of anthropogenic climate change on wildfire across western US forests. Proc. Nat. Acad. of Sci., 113, 11770-11775, doi: 10.1073/pnas.1607171113.
- Floods
  - Milly, P.C.D., R.T. Wetherald, K.A. Dunne, and T.L. Delworth, (2002): Increasing risk of great floods in a changing climate . Nature, 415(6871), 514-517.
- Extreme Cold Events
  - Gao, Y., L. R. Leung, J. Lu, and G. Masato (2015): Persistent cold air outbreaks over North America in a warming climate. Environmental Research Letters 10(4). doi: 10.1088/1748-9326/10/4/044001.
- Severe Convective Storms
  - Diffenbaugh, N. S., M. Scherer, and R. J. Trapp (2013): Robust increases in severe thunderstorm environments in response to greenhouse forcing. Proc. Nat. Acad. of Sci. 110(41):16361-16366. doi: 10.1073/pnas.1307758110.
  - Allen, J.T. (2018): Climate change and severe thunderstorms. Oxford Research Encyclopedia of Climate Science (Future Climate Change Scenarios, Climate Impact: Extreme events). doi: 10.1093/acrefore/9780190228620.013.62.
- Extratropical Cyclones
  - Catto, J.L., Ackerley, D., Booth, J.F. et al. (2019): The Future of Midlatitude Cyclones. Curr Clim Change Rep, 5, 407-420, doi: 10.1007/s40641-019-00149-4.
- Arctic Amplification and Mid-Latitude Weather
  - Francis, J. A., and S. J. Vavrus (2012): Evidence linking Arctic amplification to extreme weather in mid-latitudes . Geophysical Research Letters, 39, doi: 10.1029/2012gl051000.
  - Barnes, E.A. and J. Screen (2015): The impact of Arctic warming on the midlatitude jet stream: Can it? Has it? Will it? WIREs Climate Change, 6, doi: 10.1002/wcc.337.

University Attendance Policy:
Excused absences include documented illness, deaths in the family, and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid written excuse. Consideration will also be given to students whose dependent children experience serious illness.

Academic Honor Policy:
The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of student's academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to ". . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at `http://fda.fsu.edu/academic-resources/academic-integrity-and-grievances/academic-honor-policy`)

Academic Success:

Your academic success is a top priority for Florida State University. University resources to help you succeed include tutoring centers, computer labs, counseling and health services, and services for designated groups, such as veterans and students with disabilities. The following information is not exhaustive, so please check with your advisor or the Department of Student Support and Transitions to learn more.

Americans with Disabilities Act:
Florida State University (FSU) values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive, and welcoming. FSU is committed to providing reasonable accommodations for all persons with disabilities in a manner that is consistent with academic standards of the course while empowering the student to meet integral requirements of the course. Students with disabilities needing academic accommodation should:
(1) register with and provide documentation to the Office of Accessibility Services; and
(2) request a letter from the Office of Accessibility Services to be sent to the instructor indicating the need for accommodation and what type; and,
(3) meet (in person, via phone, email, skype, zoom, etc...) with each instructor to whom a letter of accommodation was sent to review approved accommodations.

Please note that instructors are not allowed to provide classroom accommodations to a student until appropriate verification from the Office of Accessibility Services has been provided. This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact:

Office of Accessibility Services
874 Traditions Way
108 Student Services Building
Florida State University
Tallahassee, FL 32306-4167
(850) 644-9566 (voice)
(850) 644-8504 (TDD)
oas@fsu.edu
`https://dsst.fsu.edu/oas`

Confidential Campus Resources:
Various centers and programs are available to assist students with navigating stressors that might impact academic success. These include the following:

- **Victim Advocate Program**, University Center A. Rm. 4100. (850) 644-7161. Available 24/7/365. Office Hours: M-F 8-5. `https://dsst.fsu.edu/vap`
- **Counseling and Psychological Services**: Florida State University's Counseling and Psychological Services (CAPS) primary mission is to address psychological needs and personal concerns, which may interfere with students' academic progress, social development, and emotional well-being. The following in-person and virtual (telemental health) services are available to all enrolled students residing in the state of Florida:
    1. Individual therapy

2. Group therapy
3. Crisis intervention
4. Psychoeducational and outreach programming
5. After hours crisis-hotline
6. Access to community providers for specialized treatment

Call 850-644-TALK (8255) for more information about how to initiate services.
Counseling and Psychological Services, 250 Askew Student Life Center. 942 Learning Way. (850) 644-TALK (8255). Walk-in and Appointment Hours: M-F 8 am - 4 pm. `https://counseling.fsu.edu`

- **University Health Services:** Services at UHS are available to all enrolled students residing in Florida. The mission of University Health Services (UHS) is to promote and improve the overall health and well-being of FSU students. UHS provides a coordinated continuum of care through prevention, intervention, and treatment. Services include general medical care, priority care, gynecological services, physicals, allergy injection clinic, immunizations, diagnostic imaging, physical therapy, and a medical response unit. The Center for Health Advocacy and Wellness (CHAW) assists students in their academic success through individual, group, and population-based health and wellness initiatives. Topics include wellness, alcohol and other drugs, hazing prevention, nutrition and body image, sexual health, and power based personal violence prevention. For more information, go to `https://uhs.fsu.edu`.
  University Health Services, Health and Wellness Center. 960 Learning Way. Tallahassee, FL 32306. Hours: M-f, 8am - 4 pm. (850) 644-6230. `https://uhs.fsu.edu`

Free Tutoring from FSU:
On-campus tutoring and writing assistance is available for many courses at Florida State University. For more information, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of on-campus tutoring options - see `http://ace.fsu.edu/tutoring` or contact tutor@fsu.edu. High-quality tutoring is available by appointment and on a walk-in basis. These services are offered by tutors trained to encourage the highest level of individual academic success while upholding personal academic integrity.

Syllabus Change Policy:
Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.

Statement on HB233 Recording:
In this class, consistent with state law and university policy, students are permitted to make recordings of class lectures for personal use only. As noted, sharing, posting, or publishing classroom recordings may subject you to honor code violations and legal penalties associated with theft of intellectual property and violations of other state laws. Moreover, students and educators have expressed concern that recording classroom activities may negatively impact the learning experience for others, especially in classes that involve questions, discussion, or participation. To protect a learning environment in which everyone feels free to experiment with ideas, we ask you to refrain from recording in ways that could make others feel reluctant to ask questions, explore new ideas, or otherwise participate in class. Students must monitor their recordings so that they do not include participation by other students without

permission. Students with disabilities will continue to have appropriate accommodations for recordings as established by the Office of Accessibility Services.