AOSS 102/GeoSci 122/Environ102
eXtreme Weather

Winter Semester, 2010
[Pre-semester draft version]

INSTRUCTION TEAM

Web Site:	http://ctools.umich.edu	
Instructor:	Professor Perry Samson	
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Office:	1539 Space Research Building (North Campus)	
Office Hours:	The best time is in the classroom directly after lecture, or by appointment. Call 763-6234 to make an appointment.	
Phone:	734-763-6234	
Teaching Assistants	David Wright	
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RESOURCES

Required Resource:	***XamPREP*** [http://aoss102.xamprep.com/] Purchase from http//store.xamprep.com
Optional Traditional Text:	***Essentials of Meteorology*** *(selected chapters)* by C. Donald Ahrens ***Earth's Climate: Past and Future*** *(selected chapters)* by William Ruddiman
In-Class Tool:	***LectureTools*** Free from http://www.lecturetools.org [also available through "LectureTools" button in left column]

GRADING

ITEM	DATE	WEIGHT
Hour Exam #1	Friday, February 5, 2010	20% *
Hour Exam #1 (*optional repeat*)	Friday, February 12, 2010 (during class time)	
Hour Exam #2	Friday, March 12, 2010	20% *
Hour Exam #2 (*optional repeat*)	Friday, March 19, 2010 (prior to class time)	
Hour Exam #3	Friday, April 16, 2010	20%**

Final Exam (*optional*)	Wednesday, April 28, 2010 (10:30 am, Room TBD)	60% ***
XamPREP Assignments	Next class unless otherwise announced	15%
In-Class Activities	Throughout semester	15%
Common Good	Throughout semester	10%
Expectations	A- to A+: 90-100 B- to B+: 80-89 C- to C+: 70-79 D: 60-69 E: Everything Else	

*This exam can be retaken (won't be the same exam, of course) and the grade assigned will be the average of the two grades.

**This exam cannot be retaken.

***Two-hour comprehensive final is optional. Grade on final will replace average of thee hourly exams if higher.

Hourly Exams

A sizable portion of students enrolled in this class will proclaim that "science doesn't come easy to me." Experience suggests that this is a self-fulfilling prophesy and many don't do as well as they want on the hourly exams. To deal with this you will be offered 'retake' opportunities on the first two hourly exams. For example, after you take the first exam they will be graded and returned. We will then schedule a retake day. Your grade for the first exam will be the average of the two exams.

Final Exam is Optional!

If after the three exams you have received a grade that satisfies you you can elect to skip the final exam. The final exam will be a two-hour comprehensive exam offered at the scheduled final exam time for this course. If the numerical score you receive on this exam exceeds the average for the three hourly exams you will be awarded the higher grade for all three hourly exams. Example: you get grades of 78, 68 and 85 (average = 77) on the three exams. If on the final you get an 80 you will be awarded an 80, 80 and 80 for the three exams.

Common Good

"Common good" points are awarded for your contributions to the running of the course. These points will be earned by:

1. Participation in class surveys that help guide the class experience and the tools we use to facilitate the course.
2. Posting of your lecture notes for specific days.
3. Attending lectures germane to the content of this course outside of class as specified by the instructors.

MISSION

This course provides an introduction to the physics of extreme weather events. We examine solar eruptions, ice ages, climate change, monsoons, El Niño, hurricanes, floods, droughts, heat waves, thunderstorms, lightning, hail, tornados, and other extreme atmospheric events to illustrate the basic physical laws that produce these events. Participants are expected to apply these principles to a series of homework assignments including hands-on weather forecasting and analysis of storm events.

SELF-HELP PROBLEMS

Generally, relevant problems from the Questions for Review, Questions for Thought, and Problems at the end of the textbook chapters will be identified when pertinent. These assignments represent the material (but not necessarily the specific questions) to be covered on the exams. These questions are for review only and you are not required to hand them in for grading. You are, however, encouraged to review the questions and follow the reading assignments in a timely manner. Your answers can be checked either during weekly office hours or at pre-exam review sessions. The time and location of these sessions will be announced in class.

WHAT'S EXTREME ?

Global Scale

Solar Storms — Without the sun this class would be pretty boring. It is the source of virtually all energy on the Earth so we must understand the source of that energy. But what happens when the Sun has storms?

Ice Ages — We're marching toward a warmer climate. …Right? Silly Hollywood movies aside (not to name names or point fingers), what do we know about what caused previous ice ages and what are the chances they could come again?

Global Warming — OK, so maybe we blew a sizable fraction of the global fossil fuel reservoir on silly do-da's like leaf blowers. Will that extra CO_2sub> really cause the oceans to rise to Ypsilanti?

Synoptic Scale

Ozone Hole — The ozone hole was ignored for a number of years because scientists couldn't understand it. Now that we're out of denial what else don't we know about the chemistry of our stratosphere?

El Niño/La Niña — How is it that the water temperature off the coast of Peru is related to the rainfall amount in California and Australia? How well can we predict these features?

Monsoons — The rains come to parts of the world with regularity. Unfortunately the intensity of that rain varies and we have little understanding why. More unfortunately these rains affect a majority of the world's population.

Extratropical Storms — Nor-easter's and blizzards in the Great Plains are dramatic examples of extratropical storms. How well can we (you) predict these storms?

Mesoscale

Hurricanes — The weather of the tropics can be a beauty or a beast. How do tropical storms form? Why do some become hurricanes? How well can we predict their movement? How is tropical weather interconnected with weather in the mid-latitudes?

Floods — While some flooding is widespread due to monsoons others occur on a smaller scale and affect specific watersheds. What conditions lead to these events and how can a community prepare?

Drought — The lack of precipitation can have as devastating results as the over-abundance. Droughts are somewhat self-propagating but less is known abut how they start. These can lead to dust storms such as blanketed the Great Plains last century.

Heat Waves — Hand in hand with droughts, heat waves are one of the deadliest weather phenomena in existence. These events affect those without adequate climate control, the elderly and poor, hardest and may become more common in the future.

Deep Freeze — Economically speaking, a freeze in a normally temperate region link Florida can be devastating to crops. What can be done to protect crops from these events?

Ice Storm — Under the right conditions falling rain will freeze on contact and coat the surface with ice. These events can cause power outages and slow or stop transportation.

Lake Effect Storms — Anyone from western Michigan knows the intensity of snowfall associated with

lake-effects storms. Why do they form and why are they so intense?

Mountain Storms — Ever hike a 14er in Colorado? Then you know you need to be off the top by noon. How does topography affect storm formation?

Killer Fog — OK, so you're skeptical about this one. Suffice to say that about 10 years ago planes collided at the Detroit Metro Airport because a pilot got so disoriented in the fog he taxied up an active runway and was struck by a departing plane.

Microscale

Clear Air Turbulence — Weather affects the aviation industry in many ways. What is the clear-air turbulence that causes your coffee to wind up in your lap?

Downbursts — Every year or two a plane crashes because unseen currents beneath a thunderstorm carry cold air straight toward the ground and force planes to the surface. What conditions cause this and what can be done to avoid it in the future?

Hail — Inside clouds the cloud droplets can be supercooled (liquid but below freezing). In that state they can accrete onto ice crystals and grow to very large sizes. We'll look at how this happens and what has been tried in the past to interrupt this process.

Lightning — About the width of your wrist, they heat the air to 10,000°C in a millisecond and pack a charge that could light a house for hours. What causes them is, believe it or not, still a mystery.

Tornadoes — Probably the most dramatic atmospheric phenomenon is the tornado. Why do they form? Where are they most apt to form? Where should you go if one is sighted to either (1) seek shelter or (2) get the best possible photograph of the inside of the funnel cloud.