GEO409-FS2025 (3 credits)

Global Climate Change and Variability

Instructor:	Dr. Jiquan Chen
Guest Lectures:	Dr. Nathan Moore; Dr. Geoffrey Henebry; Dr. Tom Dietz
Office:	213 Geography Building
Contact:	jqchen@msu.edu; 517-884-1884 (office); 419-932-1517 (emergency)
Webpage:	http://lees.geo.msu.edu/courses/geo409
Time:	3:00-4:20 pm, Monday & Wednesday
Location:	126 Geography Building
Office Hours:	Tuesdays, 10:30 am – 12:00 am, or by appointment
Textbook:	None
Reading:	Available on the course webpage & distributed via email prior to each class

Jiquan Chen

MICHIGAN STATE UNIVERSITY

Landscape Ecology & Ecosystem Science (LEES) Lab

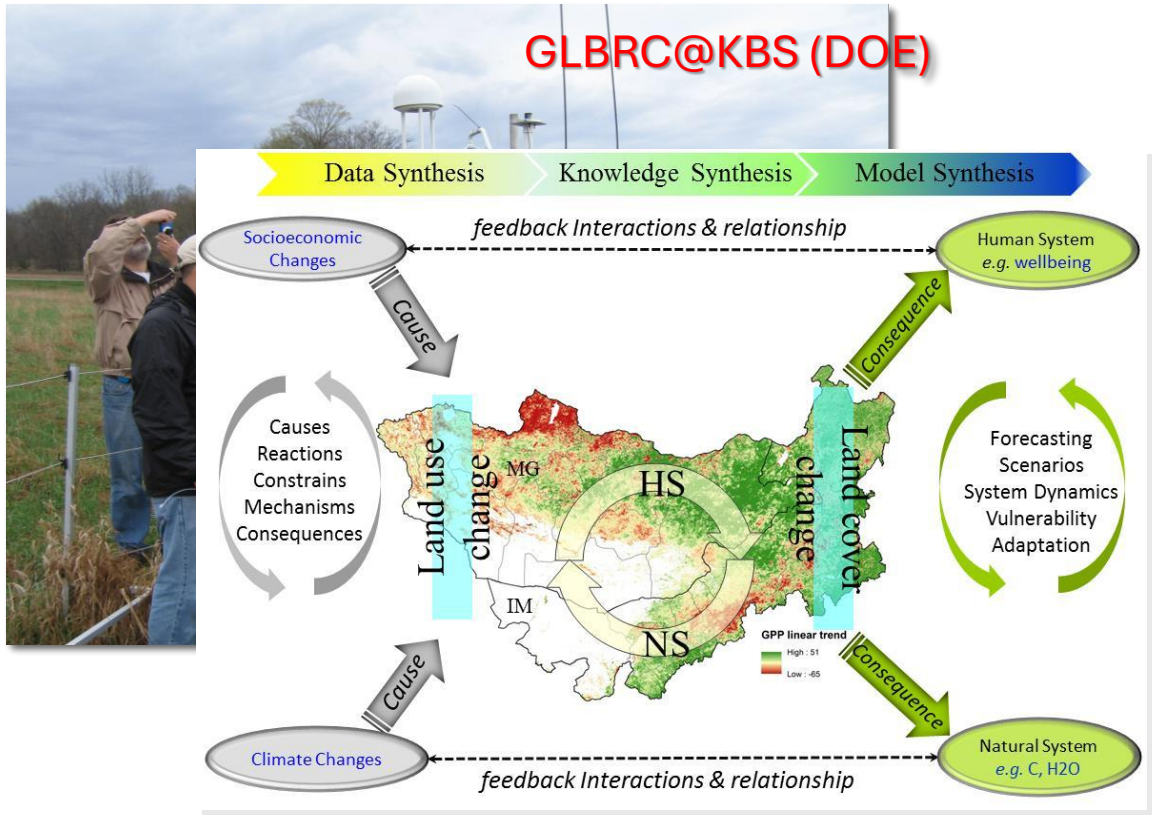
(http://lees.geo.msu.edu/index.html)

(1) Department of Geography, Environment, & Spatial Sciences (GUESS)

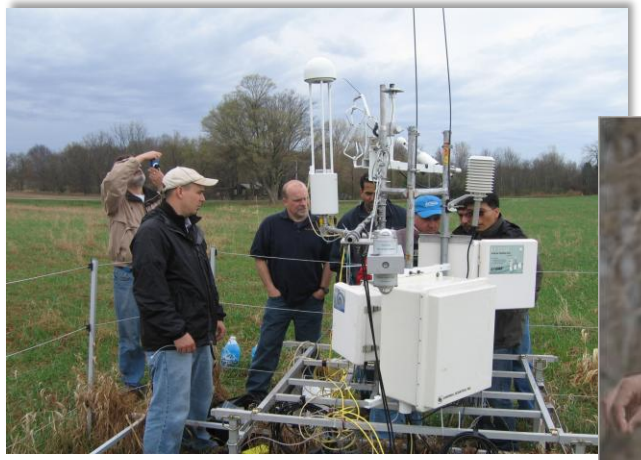
(2) Department of Plant, Soil and Microbial Sciences (DPSMS)

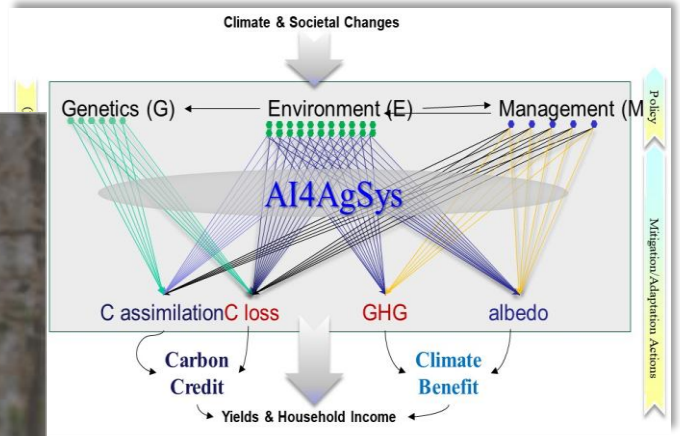
(3) Center for Global Change and Earth Observations (CGCEO)

(4) AgBioResearch



Research @ the LEES Lab





Plant Community

Edges & Fragmentation

Micro-Meteorology

Renewable Energy

Forest Canopies

GIS & Spatial Analysis

Global Change and LCC

CHN Systems

MICHIGAN STATE UNIVERSITY

Landscape Ecology & Ecosystem Science Lab

Center for Global Change and Earth Observations | Department of Geography

LATEST NEWS

Dr. Jiquan Chen is selected as a "University Distinguished Professor (UDP)" at MSU on June 13, 2025

Dr. Ranjeet John, a

Welcome to the LEES Lab

The LEES Lab at Michigan State Unisversity, led by Dr. Jiquan Chen at Michigan State University, is dedicated to advancing scientific research and education on fundamental ecosystem and landscape processes.

Our goal is to deepen our understanding of ecosystem functions and

Guest Lectures and Students

Dr. Geoffrey M. Henebry

Professor

Geography, Environment, and Spatial Sciences
Center for Global Change and Earth Observations

Geography Building, 673 Auditorium, Room 216, East Lansing, MI 48824
or
Manly Miles Building 1405 S. Harrison Rd, Room 206b, East Lansing, MI 48
517-355-3899
henebryg@msu.edu

Dr. Nathan Moore

Associate Professor

Geography, Environment, and Spatial Sciences

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673 Auditorium Road, Room 206
East Lansing, MI 48824
517-884-0546
moorena@msu.edu

Thomas Dietz, PhD

Thomas Dietz is a professor of Sociology and Environmental Science and Policy (ESPP). He holds a Ph.D. in ecology from the University of California, Davis, and a bachelor of general studies from Kent State University. At MSU he was founding director of the Environmental Science and Policy Program and associate dean in the colleges of Social Science, Agriculture and Natural Resources and Natural Science,

At the National Research Council he has served on many panels including as chair of the U.S. National Research Council Committee on Human Dimensions of Global Change, the Panel on Public Participation in Environmental Assessment and Decision Making, and as vice chair of the Panel on Advancing the Science of Climate Change of the America's Climate Choices study.

GEO409-FS2025 Students
(images are not allowed to share!)

- Name (preference)
- Major
- Academic/Education
- Hobby?
- Driver's license
- Anything else to share?

Information and Materials via Class Webpage

http://lees.geo.msu.edu/courses/geo409

Notes

- Password protected
- Schedule to be updated
- Virtual lecture by Dr. Tom Dietz (maybe others)
- Drivers are needed for Oct. 22 (~7 miles)
- Most materials will be covered before Thanksgiving
- Students ruminate term paper before Sept. 8, 2025
- Student presentations on Dec. 1 and Dec 3 (random numbers). Instructions will be provided on Sept 8
- Others?

What are expected from this class?

What?

Temperature
Precipitation
Soil moisture
Snow cover & depth
Surface albedo (reflectivity)
Sea level
Ocean salinity
Extremes
Heatwaves & Droughts
Urban Heat Islands
…

Why?

Natural forcings
Greenhouse effects
Greenhouse gases(GHG)
Ice–albedo effect
El Niño & La Niña (ENSO)
Atmospheric circulation changes
Aerosols & particulates
Land use & urbanization
Industrial activities
…

So What?

Sea Level Rising
Ecosystems
(wildfires, hurricanes, etc.)
Conservation
People & Society
(e.g., Migration & displacement)
Economy
Feedback Loops
(i.e., Worsening Effects)
IPCC & Policy
…

Climatic Variables

- Temperature
- Precipitation
- Humidity
- Air pressure & VPD
- Radiation
- Wind (speed & direction)
- PAR
- Visibility & Turbidity
- Cloud (cover, type)
- Soil moisture
- Snow cover & depth
- Surface albedo (reflectivity)
- Sea level
- Ocean salinity
- …

Terminology

- Climate
- Weather
- Microclimate
- Polar Jet Stream
- Subtropical Jet Stream
- Climate anomalies
- Permafrost
- El Niño & La Niña
- *Energy balance*
- …

Information

- WMO
- NOAA
- NASA
- USGS
- Networks

Key Issues

- QA/QC
- Units & Conversions
- Interpretation (LST)
- Mean vs range
- Sensors (type, accuracy, Hight, *etc*.)
- Location & Time
- Sampling frequency
- Interpolations
- Trending
- Networks
- Modeled values
- Scale & resolution
- ?

Major Webpages for information, data, and tools

- WMO: https://wmo.int/topics/climate-change
- IPCC: https://www.ipcc.ch/
- NOAA: https://www.noaa.gov/climate; https://www.ncei.noaa.gov/access/monitoring/ghcn-gridded-products/
- NASA: https://science.nasa.gov/climate-change/
- USGS: https://www.usgs.gov/centers/western-geographic-science-center/science/climate-change
- FLUXNET: https://fluxnet.org/
- More to be added

Terminology (will continue on a weekly basis)

WMO: World Meteorological Organization is a United Nations specialized agency. It oversees a global network of observation systems—including weather stations, balloons, satellites, buoys, and aircraft—and coordinates the exchange of this data internationally to support weather prediction, climate monitoring, and early warning systems for extreme weather (https://wmo.int/)

Weather is the state of the atmosphere at a particular time, as defined by the various meteorological elements, including temperature, precipitation, atmospheric pressure, wind and humidity.

Climate is the average weather conditions for a particular location over a long period of time, ranging from months to thousands or millions of years. WMO uses a 30-year period to determine the average climate.

Variables and Units (will continue as needed)

Climatic Variables

- Temperature
- Precipitation
- Humidity
- Pressure & VPD
- Radiation (PAR)
- Wind (speed & direction)
- Visibility & Turbidity
- Cloud (cover, type)
- Soil moisture
- Snow cover & depth
- Surface albedo (reflectivity)
- Sea level
- Ocean salinity
- …

English Unit vs International System of Units (SI)

1. Temperature

Fahrenheit (°F): not an SI unit, but used in the U.S., UK, and other countries

Kelvin (K): the SI base unit for thermodynamic temperature.

Celsius (°C): commonly used in daily life and science; related to kelvin by

$$T(°C) = T(K) - 273.15$$

$$°C = (°F - 32) \times 5/9$$

$$°F = (°C \times 9/5) + 32$$

Quick calculations

What is the temperature of an object in English Unit and SI?

Object	English (°F)	SI (°C)	SI (K)
Earth surface	?	?	~288 K
Sun's surface	?	?	~5,500 K
Normal human body	?	37	X
Water boiling temperature	?	100	X
Ice temperature	?	0	X
Temp in E Lansing	75	?	X
			X
			X

Next lecture

Aug 27: An introduction to land surface phenology
(Guest Lecture by Dr. Geoff Henebry)

What is it and why is it critical for understanding terrestrial ecosystem dynamics?

Reading:

De Beurs, K.M., Wright, C.K. and Henebry, G.M., 2009. Dual scale trend analysis for evaluating climatic and anthropogenic effects on the vegetated land surface in Russia and Kazakhstan. *Environmental Research Letters*, *4*(4), p.045012.

Morisette, J.T., Richardson, A.D., Knapp, A.K., Fisher, J.I., Graham, E.A., Abatzoglou, J., Wilson, B.E., Breshears, D.D., Henebry, G.M., Hanes, J.M. and Liang, L., 2009. Tracking the rhythm of the seasons in the face of global change: phenological research in the 21st century. *Frontiers in Ecology and the Environment*, *7*(5), pp.253-260.