



Global Climate Change and Variability

Instructor: Dr. Jiquan Chen

Guest Lectures: Prof. Atul Jain (UIUC), Prof. Geoff Henebry, Prof. Nathan Moore, Dr. Cheyenne Lei, Mr. Moriz Steiner, and Mrs. Carrie Wicker

Office: 213 Geography Building

Contact: jqchen@msu.edu; 517-884-1884 (office); 419-932-1517 (emergency)

Webpage: <https://lees.geo.msu.edu/course-geo409.html>

Time: 3:00-4:20 pm, Monday & Wednesday

Location: 126 Geography Building

Office Hours: Wednesday, 12:00 – 14:00 h, or by appointment

Textbook: None

Reading: Available on the course webpage & distributed via email prior to each lecture

Jiquan Chen

Landscape Ecology & Ecosystem Science (LEES) Lab

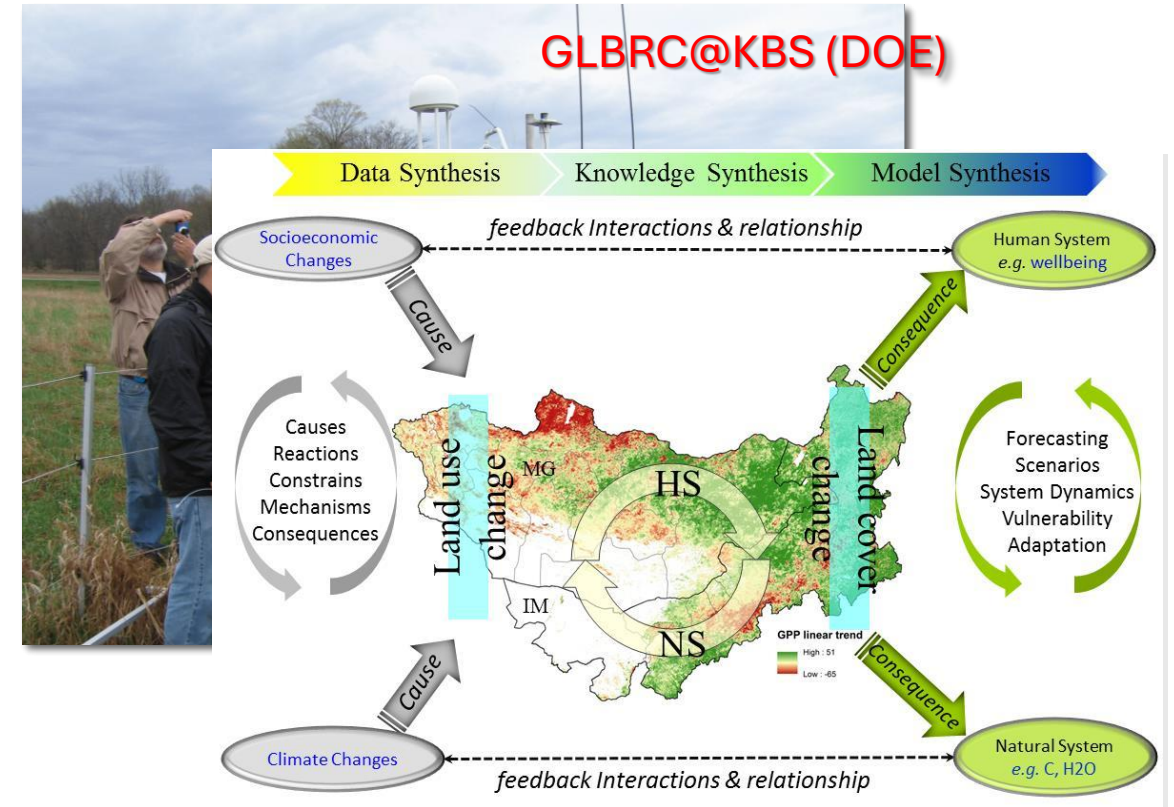
(<https://lees.geo.msu.edu/>)

- (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

Plant Ecology (grasslands)



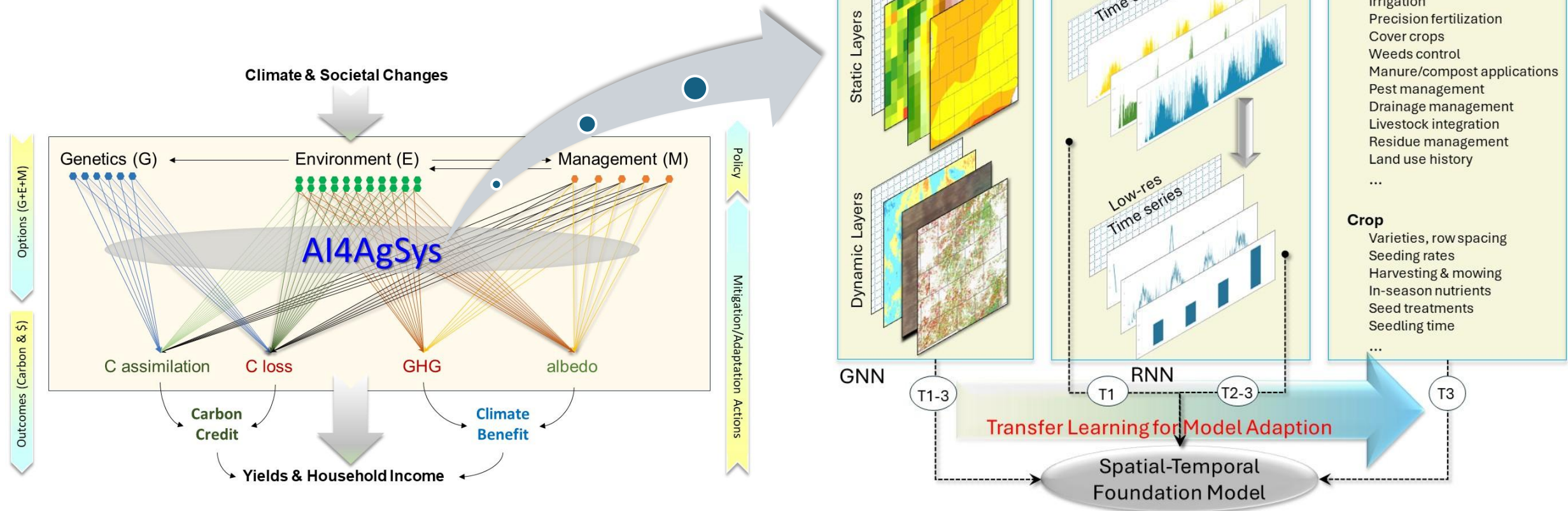
Forest Ecology



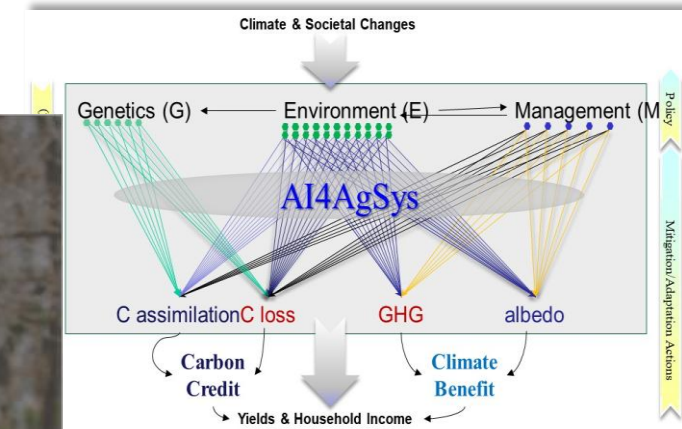


Current Focus: AI Applications in Natural Science

Empowering Michigan Farmers: An AI-Based Forecasting and Management System for Building Resilient Agriculture (AI4AgSys)



Research @ the LEES Lab



Plant
Community

Edges &
Fragmentation

Micro-
Meteorology

Renewable
Energy

Forest
Canopies

GIS &
Spatial Analysis

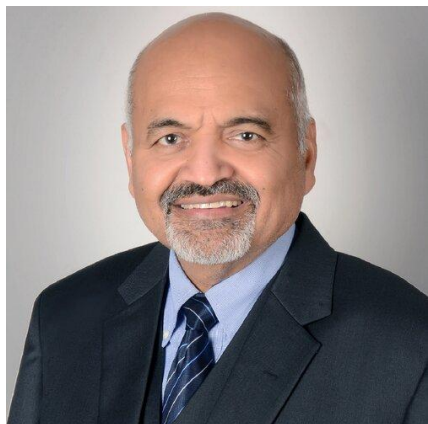
Global Change
and LCC

CHN
Systems



Guest Lectures and Students

Dr. Atul Jain, UIUC



Dr. Geoffrey M. Henebry



Professor

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

Geography Building, 673 Auditorium
or
Manly Miles Building 1405 S. Harrison
517-355-3899
henebryg@msu.edu

Dr. Nathan Moore



Associate Professor

Geography, Environment, and Spatial

Geography Building
673 Auditorium Road, Room 200
East Lansing, MI 48824
517-884-0546
moorena@msu.edu

Dr. Cheyenne Lei



Mr. Moriz Steiner



Mrs. Carie Wicker



GEO409-FS2026 Students (images are not allowed to share!)

- Name (preference)
- Major
- Academic/Education
- Hobby?
- GEO103?
- Anything else to share?



What are expected from this class?

What? → Why? → So What?

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

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
 ...

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



Housekeeping Before We Begin

<https://lees.geo.msu.edu/course-geo409.html>

- **The Syllabus:** Expectations, Grading, Term Papers, and Schedule
 - **Virtual Lectures:** Nov. 11 (Dr. Jain), Nov. 25 (Thanksgiving Week), and Dec. 9 (Course Recap)
 - **Lecture at the MSU Museum:** Dec. 2
 - **Group Presentations:** Consider moving the Dec. 7 presentations to Dec. 2 at the MSU Museum
 - **Course Coverage:** Most course materials will be covered before Thanksgiving
 - **Term Paper:** Two components
 - (1) Group Presentation, and
 - (2) Individual Paper.
- Detailed instructions will be provided before the Midterm Exam on Oct. 21
- **Other Questions or Suggestions?**



Housekeeping Before We Begin

<https://lees.geo.msu.edu/course-geo409.html>

Class Attendance

- Each unexcused absence will result in a **2-point deduction**, except for **Aug 31 and Nov 23**.
- Please **check in for attendance at each class**.
- Requests for an excused absence must be **reasonable and supported by appropriate documentation** (e.g., an email from your academic advisor).

Student Name	2-Sep
Banek, Gabriel Joseph	
Bean, Emma	
Bradke, Elliot	
Haddix, Morgan	
Hernandez, Lilah	
Ismail, Hassan	
Kensler, Aliya Renee	
Lee, Danah	
Mathews, Zach H	
McLuckie, Meghan	
Middleton, Danielle Rae	
Morales, Noah	
Ochoa Peterson, Tj Clingfelt	
Panis, Daniel J	
Phillips, Chloe	
Redfield, Dawson	
Richard, Emerson Reeh	
Saunders, Allison Nicole	
Singh, Aastha	
Verburg, Ava	
Wax, Stephen Michael	



Housekeeping Before We Begin

<https://lees.geo.msu.edu/course-geo409.html>

GRADING

Points earned for each assessment will be posted on D2L in a timely manner. Final grades will be based on the total points earned out of a possible **350 points**, according to the breakdown and grading scale provided below. **Grades will not be rounded or curved.**

Requests for an **Incomplete (I) grade** will be considered in accordance with the guidelines provided in MSU's *Academic Programs*. **Extra credit is not offered in GEO 409.**

Except under extreme circumstances, students must earn a minimum of **60% of the total available points (210 out of 350 points)** to pass the course.

- Midterm Exam: 100 points
- Term Paper: 100 points
- Quizzes: 60 points
- Presentation: 40 points
- Attendance: 50 points
- **Total: 350 points**



Housekeeping Before We Begin

<https://lees.geo.msu.edu/course-geo409.html>

Potential Term Paper Topics by Group

- 1) Spatiotemporal Changes in Global and Regional Climate
- 2) Climatic Extremes and Their Impacts
- 3) Carbon Science and Global Climate Change
- 4) Greenhouse Gases (GHGs) and Emissions
- 5) Near-Future Climate Change and Its Consequences
- 6) Climate Data Analysis and Synthesis
- 7) Climate Change Impacts on Ecosystems (e.g., Coral Reefs)
- 8) Biodiversity Conservation under the Changing Climate
- 9) Sea-Level Rise and Its Impacts
- 10) Urbanization, Land-Use Change, and Climate
- 11) Impacts of Climate Change on People and Society
- 12) Nature-Based Solutions (NBS) for Climate Change
- 13) Climate Policies and Public Debates
- 14) Others from the Students

Group Formation

- Three students per group
- Establish a communication channel (e.g., email, WhatsApp, Cell, etc.)
- Select a group coordinator
- Select a presenter
- Assign a PowerPoint coordinator
- Select a term paper topic

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
- IPCC

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

Reading Materials

Reading materials will be shared one week before each class. They will be selected from government and organizational reports, peer-reviewed journal articles, book chapters, and relevant webpages.



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.



Sep 2: Global Climate and Changes

Synoptic Review of Global Climate, Variability, and Change

Five focal questions

- 1) What is climate change?
- 2) How do we know climate change is real (Evidence)?
- 3) What is causing climate change (Causes)?
- 4) What are the effects of climate change (Effects)?
- 5) What are the effects of climate change on extreme weather?

Reading:

NASA: <https://science.nasa.gov/climate-change/>