

LAAS 5416 Precision Agriculture and Nutrient Management**INSTRUCTOR**

Yuxin Miao
Precision Agriculture Center
Department of Soil, Water and Climate
Office: S505 Soils Building
Office hours: Thursday 2:00-3:00 PM or by appointment
Phone: (612)625-4731
Email: ymiao@umn.edu (Preferred contact method)

BACIS INFORMATION AND LOGISTICS

<i>Term</i>	Fall Semester
<i>Credits</i>	3
<i>Lecture</i>	Soil 415, Thursday, 3:05 PM -4:35PM
<i>Discussion and Lab</i>	Soil 415, Thursday, 4:45 PM -5:45 PM

In general, basic knowledge of precision agriculture and nutrient management will be covered in lecture and practical applications of this knowledge will be covered in discussion and lab sessions.

COURSE DESCRIPTION

The focus of this course is on the concept, principles and technologies of precision agriculture and their applications in nutrient resource management. The specific topics include concept and development of precision agriculture and nutrient management, key supporting technologies, soil spatial variability and analysis, yield data analysis, remote sensing-based precision nutrient management, management zone delineation and application, crop growth modeling, combining crop growth modeling and remote sensing for precision nutrient management, and the challenges and future directions of precision agriculture and nutrient management.

Precision agriculture and nutrient management is data intensive and you will also learn basic agro-informatics through hands-on experiences and computer exercises. This course will involve background knowledge and technologies from multi-disciplines, which will facilitate multi-disciplinary integration and innovation. The class will include both lectures and activities such as case studies, group discussion and presentation, problem solving, and hands-on exercises.

This course is intended for graduate students and upper-level undergraduate students whose major is related to agriculture, environmental science and sustainability.

GOALS

Upon completion of this course, you will be able to:

1. Understand the basic concept, principles, major technologies and advances of precision agriculture and nutrient management;
2. Use basic sensors and software to analyze spatial and temporal data related to precision agriculture and nutrient management;
3. Develop critical thinking and ability to solve real world practical precision agriculture and nutrient management problems;
4. Improve communication skills and multi-disciplinary integration and innovation.

STUDENT LEARNING OUTCOMES

1. Master the knowledge and skills of precision nutrient management: Understand the principles, key technologies and major advances of precision nutrient management, understand the strengths and weaknesses of different precision nutrient management strategies, and be aware of potential future directions and knowledge gaps in precision nutrient management;

2. Solve practical precision nutrient management problems: You will build on course materials and strengthen their research and professional development by writing learning journals based on each major topics of this course to reflect their potential applications. The discussion and lab session will give you hands-on experiences and help you to apply the concepts, principles and technologies to solve real world problems.

3. Think critically and systematically: The course will discuss the limitations of different precision nutrient management strategies and practices. You will review and discuss some research papers to help you gain critical thinking skills. Course materials and exercises will strengthen your understanding of precision nutrient and crop management systems and help you develop a systems perspective for solving complex nutrient management problems.

4. Communicate effectively: You will write a learning journal for each class period (lecture and discussion & lab) reflecting the important and new concepts, ideas or applications you learn that can be helpful in your research or professional development. You will write a report for each class discussion and participate in the discussions. All these activities will help you learn to communicate more effectively in writing and oral conversation.

5. Become more interested in precision nutrient management and have the ability to learn by themselves: Your interest in precision agriculture and nutrient management will be kindled and you will have the desire and ability to continue to learn about such topics by yourself after this course.

PREREQUISITES

- Soil 3416 (Plant Nutrients in the Environment) or other soil, agronomy and environmental science courses or Instructor consent;

Recommended courses:

- Soil 4111 (Introduction to Precision Agriculture) or other GIS and remote sensing related courses.

RESOURCES**Textbook**

No textbook is required. Related reading materials will be provided on the class website.

Reference:

Shannon, D.K., D. E. Clay, and N. R. Kitchen. 2018. Precision Agriculture Basics. ASA, CSSA and SSSA, Madison, WI, USA. (PDF version available from:

<https://dl.sciencesocieties.org/publications/books/tocs/acesspublicati/precisionagbasics>)

Clay, D.E., S. A. Clay, and S. A. Bruggeman. 2017. Practical Mathematics for Precision Farming. ASA, CSSA and SSSA, Madison, WI, USA. (PDF version available from:

<https://dl.sciencesocieties.org/publications/books/tocs/acesspublicati/precisionagbasics>)

Krishna, K. R. 2013. Precision Farming: Soil Fertility and Productivity Aspects. Apple Academic Press, Oakville, ON, Canada. (PDF version available from internet:

<https://eshraghtranslators.com/education/storage/book/aDxRGNctfJErf3Xgbe4YLPZYcOC9FpppUCmEJG1o.pdf>)

Class Website and Web Resources

Most of the course material and information you need will be available on the class website, so it will be essential to use it. The website is organized in weekly blocks that include the presentation slides used in lectures, discussion problem sets, reading assignments, and class schedules. Many of the practical applications of precision agriculture and nutrient management that you learn in the course will be from reading assignments on related publications and links to these will be on the website. The website will also host the course syllabus. The website format is called “Canvas.” If you are registered for the class, you will automatically be given access privileges to the LAAS 5416 website on Canvas.

Software

QGIS is an open source GIS software that you can download freely at <https://qgis.org/en/site/>

DSSAT Crop Modeling software can be requested at <https://dssat.net/>

APSIM Crop Modeling software can be downloaded at <http://www.apsim.info/>

Management Zone Analysis (MAZ) can be downloaded at

<https://www.ars.usda.gov/research/software/download/?softwareid=24&modecode=50-70-10-00>

VESPER Geostatistical software can be downloaded at

<https://sydney.edu.au/agriculture/pal/software/vesper.shtml>

Demo GS+ software can be downloaded at https://download.cnet.com/GS-Geostatistics-for-the-Environmental-Science/3000-2054_4-10957867.html

STUDENTWRITING SUPPORT

Student Writing Support (SWS) helps student writers develop confidence and effective writing strategies through collaborative one-to-one writing consultations. Consultants work with writers at any stage of the writer's process, such as brainstorming and organizing ideas, developing a thesis statement or line of argument, creating cohesive paragraphs, revising sentences, and documenting sources. A consultation is often focused on a specific assignment or writing task, with the goal of supporting writers as they develop more effective and productive writing strategies to apply to future writing projects.

Consulting is available by appointment online and in Nicholson Hall, and on a walk-in basis in Appleby Hall. For more information, go to writing.umn.edu/sws or call 612.625.1893.

In addition, SWS offers a number of web-based resources on topics such as avoiding plagiarism, documenting sources, and planning and completing a writing project.

You can learn more about writing support for graduate students offered by the center at: <http://writing.umn.edu/sws/assets/pdf/gtmfsws-grad.pdf> or special support for multilingual students at:

<http://writing.umn.edu/sws/multilingual/index.html#mlvideo>

EXPECTATIONS FOR STUDENTS

To read and note the information contained in this syllabus.

To attend lecture and discussion sessions. Both the lecture and discussion sessions will include active learning exercises along with traditional lectures. Active learning activities include small and large group discussions based on specific questions or case studies, problem solving, and small group work on projects. These exercises will require that you work with your classmates to solve or discuss specific problems. Precision agriculture and nutrient management professionals frequently work in group settings. These projects will give you an opportunity to develop skills that you will need to work in this type of setting. Please let your instructor know ahead of time if you will not be able to attend a session.

To provide feedback. Given the interdisciplinary nature of the course, please give your feedback regularly to allow the instructor to assess course effectiveness and make adjustments accordingly.

To come prepared for class. If a reading or case-study assignment is listed for a class, please read it before that class. We will be discussing the reading assignments during the lecture and discussion sessions in small groups and with the class as a whole.

To ask questions. We encourage you to critically evaluate what you read and what is discussed in class. Also, if you don't understand something, please ask. Chances are that you are not the only person with that question. If at any time during the course you have concerns about how you are doing in the class, need more information about something covered in lecture or discussion, please come see me.

To hand in assignments on time. Assignments will not be accepted after the due date unless you have

received permission from the instructor before the due date.

To prepare assignments in a professional manner. Correct spelling and grammar are expected. Some assignments can be turned in by email.

To actively participate in small group discussions.

STUDENTS EVALUATION AND COMPONENTS OF GRADE

Learning Journal (50 points)

Students are expected to write 1 learning journal after each class (lecture + discussion) to digest the key concepts, ideas, principles, strategies, technologies and methods, etc. and reflect how they can be applied to the student's major area of study, research projects or professional development. These should be turned in before or at the next class. A total of 10 learning journals are required.

Grading:

Each learning journal (worth 5 points) should be 1 page, typed, single-spaced. It should reflect your thinking about how the key concepts, principles or technologies discussed in class can be helpful to your research, your major area of study or your future career development. You can also include questions you have related to the class materials. The use of complete sentences is needed to meet this requirement.

Discussion and Assignments (100 points)

Reading assignments and discussion questions for next class will be given to the students after each class. Students are expected to write a report in response to these questions and turn in the report before next class.

Grading:

Each discussion assignment has 10 points. Some discussion questions are short answer questions based on the reading materials. These questions have definite answers and if you don't answer correctly, you will receive no points. Some questions will require you to share your opinions and explain why you think this way by showing your reasoning. These questions may not have definite answers and you will get points based on your efforts to read and synthesize the materials, and express your opinions clearly with justification. Some questions will require analyses and calculations using certain software programs. Grading will be based on the final product or results, which are more objective. Partial points will be given if you complete the assignment, but make small mistakes.

Exams (200 points)

There will be one mid-term exam and one final exam (100 points each), covering all topics discussed up until the time of each exam. The final exam covers all the materials of the course. All exams are closed book.

Final Course Grade

Total points for this course will be 350. Final course grades use the +/- system of grading. Course grades will be broken down by the following percentage scale:

A	≥ 325.5	(≥93%)
A-	315 to <325.5	(90% to <93%)
B+	304.5 to < 315	(87% to < 90%)
B	290.5 to < 304.5	(83% to < 87%)
B-	280 to < 290.5	(80% to < 83%)
C+	269.5 to <290	(77% to < 80%)
C	255.5 to <269.5	(73% to < 77%)
C-	245 to <255.5	(70% to < 73%)
D+	234.5 to <245	(67% to < 70%)
D	210 to <234.5	(60% to < 67%)
F	< 210	(< 60%)

The above scale may be lowered if the average grade for the course is < 75%. The scale will *not* be raised. A grade of C- is needed to pass this class if you elected to take it under the Pass/Fail grading system.

CLASS SCHEDULE

Date	Lecture Topic	Discussion and Lab
9/5	Class Overview, Overview of Precision Agriculture	Applications of GIS in Precision Agriculture and Nutrient Management (1)
9/12	Overview of Precision Nutrient Management	Applications of GIS in Precision Agriculture and Nutrient Management (2)
9/19	Soil and Crop Spatial Variability and Analysis	Geostatistical analysis
9/26	Soil Sensing for Precision Nutrient Management	GPS and EC Mapping
10/3	Site-specific Management Zones	Management Zone Delineation Practice
10/10	Remote and Proximal Sensing for Crop Growth Monitoring	Crop Sensing Practice and applications
10/17	Mid-term Exam	
10/24	Strategies for in-season Non-destructive N status diagnosis	Crop Sensing-based Crop N Status Diagnosis

10/31	Sensing-based Precision Nitrogen Management Algorithms and Strategies	Sensing-based N recommendations
11/7	Crop Growth Modeling for Precision Nutrient and Crop Management	Crop Growth Model Simulation Analysis
11/14	Integrated Strategies for Precision Nutrient and Crop Management	System Integration and Innovation
11/21	Challenges and Future Directions of Precision Agriculture and Nutrient Management	Future Directions of Precision Agriculture and Nutrient Management
11/28	Thanksgiving	
12/5	Summary and Review	Summary and Review
12/12		
12/13-14, or 16-19	Final Exam (dates to be assigned by the university)	

POLICIES

Use of Personal Electronic Devices in the Classroom:

Students are encouraged to use their personal laptop computers during the computer exercises and for their proposal presentations. Use of other personal electronic devices such as cell phones is not allowed during the class.

Student Conduct Code:

Students are expected adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see:

http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

Scholastic Dishonesty:

Students are expected to do their own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test

materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf). If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: <http://policy.umn.edu/education/instructorresp>.

Sexual Harassment, Sexual Assault, Stalking and Relationship Violence:

Sexual harassment, assault, stalking and relationship violence are prohibited by the University policy. https://regents.umn.edu/sites/regents.umn.edu/files/policies/Sexual_Harassment_Sexual_Assault_Stalking_Relationship_Violence.pdf

Equity, Diversity, Equal Opportunity, and Affirmative Action:

The University provides equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy:

http://regents.umn.edu/sites/regents.umn.edu/files/policies/Equity_Diversity_EO_AA.pdf.

Disability Accommodations:

If you have a disability, please contact the instructor as early in the semester as possible to discuss how the accommodations will be applied in the course.

Student Mental Health and Stress Management:

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. University of Minnesota services are available to assist you with addressing these and other concerns you may be experiencing. You can learn more about the broad range of confidential mental health services available on campus via <http://www.mentalhealth.umn.edu/>.

Late work and Makeup Work for Legitimate Absence:

Unless arrangements are made in advance (due to verified illness, etc.), 1 point per day will be deducted for assignments submitted late. Please plan ahead! Complete your work in a timely fashion. Makeup work for legitimate absence will follow the university's policy:

<https://policy.umn.edu/education/makeupwork>

Incomplete Work:

A grade of Incomplete (I) will be awarded only in extraordinary circumstances, where prolonged illness or events beyond the control of the student prevent completion of course assignments and/or exams. According to University Senate policy, an Incomplete is to be given only when the student and the instructor have reached a mutual agreement about the specific nature of the incomplete work, the specific action to be taken to complete the work, and the amount of time to be allowed for work to be completed. An agreement form must be completed. The student must be doing passing work in the course. An Incomplete not made up by the end of the next semester (excluding summer session) will lapse to an F. A student who doesn't register the semester after receiving an Incomplete will have one semester after returning in which to make up the incomplete work. An instructor may at any time after evaluating completed coursework submit a grade for an Incomplete that has lapsed to an F.

Appropriate Student Use of Class Notes and Course Materials

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: <http://policy.umn.edu/education/studentresp>.

Academic Freedom and Responsibility

We support academic freedom and responsibility following the university's policy:
https://regents.umn.edu/sites/regents.umn.edu/files/policies/Academic_Freedom.pdf