

PAG 454/654 – APPLICATIONS OF PRECISION AGRICULTURE

BASIC INFORMATION

Course prefix, catalog number, and title: PAG, 454/654, Applications of Precision Agriculture

Number of credits: 3

Term and year: Spring/2020

Time and place: Monday & Wednesday 8:30 am – 9:20 am – Lecture / Location TBD

Lab: Thursday 2:00 pm – 4:30 pm/Location TBD

Instructor's name: Dr. Paulo Flores

Office location: ABEN 106

Office hours: Monday and Wednesday, 10:00 am – 11:00 am. Students can also meet instructor by appointment. Drop-ins are acceptable at other times but instructor availability cannot always be guaranteed. Students are also welcome to call or send questions via e-mail.

Phone Number: 701.231.5348

Email Address: paulo.flores@ndsu.edu

BULLETIN DESCRIPTION

This course is designed to introduce the student to the different layers of information collected by agricultural machinery during crops growing season (from planting to harvest), to the use of online resources to retrieve farm level soil information, to create field level soil fertility maps, to the use of drones at different crop stages, to basic drone imagery analysis, to the integration of machinery and drone data to aid management decisions, and to the creation of field management zones and prescription maps using AgSMS software. The course is offered as two 50-minute lectures (two meetings) and three 50-minute lab (one meeting) per week.

PREREQUISITES

PAG 215 for undergraduate students.

Introductory GIS course for graduate students.

RECOMMENDED STUDENT RESOURCES

- D. Kent Shannon, David E. Clay, Newell R. Kitchen. *Precision Agriculture Basics*. American Society of Agronomy, Incorporated, 2018. ISBN: 978-1-4200-9270-7. (Recommended)
- David E. Clay and John F. Shanahan (Editors). *GIS applications in precision agriculture - Volume Two*. CRC Press, 2011. ISBN: 978-1-4200-9270-7. (Recommended)
- K. Green, R.G. Congalton, M. Tukman. *Imagery and GIS – Best practices for extracting information from imagery*. ESRI Press, 2017. ISBN 9781589484542 (Recommended).
- Paul A. Zandbergen. *Python Scripting for ArcGIS*. ESRI Press, 2015. ISBN-10: 1589483715, ISBN-13: 978-1589483712. (Recommended for graduate students)

COURSE OBJECTIVES

Objectives

The course objective is to introduce students to tools/software, hardware, and techniques that will allow them to integrate different sources of information collected during planting activities, crop growing season, and harvest to make more informed crop management decisions using precision agriculture principles.

In addition to the objectives listed above, graduate students will be introduced to the use of GIS software and basics of Python to automate, to some degree, the tasks listed above.

Outcomes

Students will learn how to integrate machinery data and remote sensing data to make crop management decisions that can be applied to crops during the growing season and/or applied to the field in consideration for the next growing season.

Graduate students will learn how to use GIS software and basics of Python programming language to integrate data from different sources and how to automatize some steps on that process, increasing efficiency during both data analysis and data extraction from raster datasets.

MODES OF PRESENTATION

Lecture with Power Point
Guest Speakers (possible)
Problem solving/demonstrations

BLACKBOARD

Blackboard will be used for announcements, class presentations, and for posting temporary grades.

EVALUATION PROCEDURES AND GRADING CRITERIA

Students will have 6 categories in which they will be evaluated in the course. Those categories are as follows.

Category	Undergraduate, 454	Graduate, 654
	----- % of the final grade* -----	
1. Homework (up to 12)	15	10
2. Quizzes (unannounced, up to 6 quizzes)	5	-
3. Labs (projects)	20	30
4. Exam 1	15	15

5. Exam 2	15	15
6. Final exam (comprehensive)	30	30
Total	100	100

*Letter grades will be assigned using the following scale: A= 90-100%; B= 80-89%, C= 70-79%; D= 60-69%, and F= less than 60%.

Homework, quizzes, and test scores will be posted on Blackboard for informational purposes only.

Quizzes will be unannounced. No make-up quizzes will be allowed, except circumstances when an excusable justification has been provided to the instructor at least 24 hours prior to the class. As for scheduled midterm and final exams, students that provide an excusable justification at least 48 hours ahead of the exam's date will be allowed to take a make-up exam. Excusable justifications are describe in policy 333 (<https://www.ndsu.edu/fileadmin/policy/333.pdf>).

Due dates for homework and projects will be provided with the assignments, and they will be due at 4:30 pm on the day of submission. Late assignments will be accepted with a 10% penalty per NDSU class day, but they will not be accepted after solutions are posted/handed out/discussed or 2 NDSU class days after the original due date.

Students are encouraged to work in groups to complete their homework and lab assignments, which allow for students to learn from each other. Although working groups are encouraged, students are required to turn in individual versions of their assignments. In the case where assignments seem to be a "copy" from other individual's assignment, all students involved will receive 0 points for that assignment.

Graduate students will be held to a higher standard than undergraduate students when it comes to writing reports regarding lab assignments. In addition, graduate students will be expected to write Python scripts to automatize some of the steps thought in the classroom regarding to imagery and data analysis.

ATTENDANCE STATEMENT

According to [NDSU Policy 333 \(www.ndsu.edu/fileadmin/policy/333.pdf\)](https://www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected.

Attendance in classes is expected and important. (The term "class" includes class, online class, laboratory, field trips, group exercises, or other activities.) However, there are instances in which students are unable to attend class, and if those are described in policy 333 (<https://www.ndsu.edu/fileadmin/policy/333.pdf>), then those absences will be excused. Absences not covered under policy 333 are excusable at the discretion of the instructor. However, class policies regarding class absence are provided below. (Note: NDSU Student Health

Service does not provide students with excuses for class absences or tardiness due to illness or injury.)

If a student will be missing class for an event related to university clubs or teams, or other excusable reason to be determined by the instructor, the student must let the instructor know **before** he/she misses the class. Consideration will be given to those students who have a **valid excusable reason** when making a determination regarding making up assignments or tests.

VETERANS AND MILITARY PERSONNEL

Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

AMERICANS WITH DISABILITIES ACT FOR STUDENTS WITH SPECIAL NEEDS STATEMENT

Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the [Disability Services Office \(www.ndsu.edu/disabilityservices\)](http://www.ndsu.edu/disabilityservices) as soon as possible.

APPROVED ACADEMIC HONESTY STATEMENT

The academic community is operated on the basis of honesty, integrity, and fair play. [NDSU Policy 335: Code of Academic Responsibility and Conduct](#) applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the [Office of Registration and Records](#). Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

IMPORTANT DATES – SPRING 2020 - [HTTPS://WWW.NDSU.EDU/REGISTRAR/DATES/](https://www.ndsu.edu/registrar/dates/)

January	20	HOLIDAY — Martin Luther King, Jr. Day (<i>no classes, offices closed</i>)
January	22	Last day for Campus Connection Wait Lists to run
January	23	Last day for no-record Drop of classes and Withdraw to Zero Credits @ 100% refund (<i>full semester classes only</i>)
January	23	Attempted credits calculated for financial aid SAP (11:59 p.m.)
January	28	Financial aid applied to NDSU account balances
January	29	Payments due for NDSU account balances

February 3		Last day to submit requests to Audit, Pass/Fail
February 7		Undergraduate/Professional Spring and Summer Degree Applications due
February 7		Graduate student Spring/Summer Intent to Graduate forms due
February 10		Last day to Add full semester classes (<i>appeal needed after this date, contact Registration & Records</i>)
February 17		HOLIDAY — Presidents' Day (<i>no classes, offices closed</i>)
March 6		Grades of 'Incomplete' convert to 'F'
March	First Week	Summer/Fall schedule available
March	16-20	Spring Break Week (<i>no classes, offices open</i>)
April	9	Last day to Drop classes with 'W' record and Withdraw to Zero credits for Spring
April	10-13	HOLIDAY -- Spring Recess (<i>no classes, offices closed Friday, offices open Monday</i>)
April	24	Student Spring Commencement Participation deadline
May	4-8	Dead Week
May	11-15	Final Examinations
May	16	Commencement ceremonies (10:00 a.m. & 2:00 p.m. in FargoDome)
May	19	Spring grade access begins online (late evening)

Use of Cell Phones, iPods, MP3 Players, and Other Electronic Devices:

All participants in this class are subject to NDSU University Senate Policy 158: Acceptable use of Electronic Communications Devices (<http://www.ndsu.edu/fileadmin/policy/158.pdf>).

As a courtesy to other students and the instructor, all cell phones, iPods, MP3 players, and other electronic devices, except handheld calculators, should be turned off or placed in a vibrate-only mode during class time. Initiating phone calls, text message, or other types of messages during class time -including those to friends, family, classmates, coworkers, or supervisors—is unacceptable unless there is a genuine emergency. Examples of emergencies include weather-related school closing announcements; fire, bomb, or other threats to public safety and well-being; and other incidents in which the NDSU system is or could be activated to provide broadcast messages to the NDSU community.

Use of cell phones or other portable electronic devices for communication, transmission, retrieval, or storage of information during the administration of a test or quiz may be considered an incident of **academic dishonesty**. One exception to this policy is the use of handheld calculators for computational purposes. Use of cell phones or similar devices as a calculator during tests and quizzes will not be allowed because it is difficult to distinguish such activity from sending and receiving text messages, which could obviously be interpreted as a form of academic dishonesty.

Dead Week Policy: The NDSU Dead Week policy is available at <http://www.ndsu.edu/registrar/dates/deadweek/>.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Tentative lectures schedule

Week	Date	Topics
1	Jan 15	Class introduction
2	Jan 20	Holiday – no class
2	Jan 22	GIS Review, NRCS Web Soil Survey Introduction
3	Jan 27	Mapping soil fertility data
3	Jan 29	Planting equipment and data collected during planting
4	Feb 3	Planters/seeder technology (Guest lecture)
4	Feb 5	Planting equipment data visualization and interpretation
5	Feb 10	Remote Sensing and precision ag
5	Feb 12	Imagery applications early in the growing season
6	Feb 17	Holiday – no class
6	Feb 19	Imagery applications early in the growing season
7	Feb 24	Weed control technologies
7	Feb 26	Exam 1
8	Mar 2	Imagery applications during the growing season
8	Mar 4	Imagery applications during the growing season
9	Mar 9	Uses of remote sensing and proximal sensors for irrigation management
9	Mar 11	Irrigation – management zones and variable rate application (Guest lecture)
10	Mar 16	Spring break – no class

10	Mar 18	Spring break – no class
11	Mar 23	Basics of UAS imagery analysis
11	Mar 25	Basics of UAS imagery analysis
12	Mar 30	Exam 2
12	Apr 1	Combine yield monitor - calibration and data cleaning (Guest lecture)
13	Apr 6	Integrating field data from different sources
13	Apr 8	Integrating field data from different sources
14	Apr 13	Spring recess - no class
14	Apr 15	Technologies for grain storage and moisture management (Guest lecture)
15	Apr 22	Creating management zones in a field
15	Apr 27	Creating prescription maps – fertilizers and chemicals
16	May 4	Final week: Class review
16	May 11	Final Exam

Tentative labs schedule

Week	Date	Topics
1	Jan 16	GIS Overview – Introduction of GIS software to be used during the course
2	Jan 23	Integration Web Soil Survey into GIS software and soil fertility mapping (Guest)
3	Jan 30	Tour/Demo of technologies present in modern planters/seeders
4	Feb 6	Planting/Seeding maps – visualization and interpretation
5	Feb 13	Working with raster data in ArcGIS – vegetative indices (VI) calculation
6	Feb 20	Working with raster data in ArcGIS – VIs threshold and UAS imagery analysis
7	Feb 27	Tour/Demo of technologies present in modern sprayers
8	Mar 5	Working with raster data in ArcGIS – UAS imagery analysis geared towards weed control
9	Mar 12	UAS – UAV components, sensors, and UAS mission planning
10	Mar 19	Spring break – no lab
11	Mar 26	Field tour: UAS mission flights

12	Apr 2	Visualization, cleaning, and interpretation of yield monitor data
13	Apr 9	Integrating yield and other machinery data with raster (UAS imagery) data to aid decision making process
14	Apr 16	Creating management zones in AgSMS
15	Apr 23	Creating prescription maps – fertilizer and chemical applications
16	Apr 30	Uploading prescription maps to fertilizer and sprayers