Syllabus	
Course Information	GGS379: Remote Sensing Location: Distance Education/Blackboard
Instructor	Dr. Konrad Wessels About Konrad Wessels COS (https://science.gmu.edu/directory/konrad-wessels) Please refer to your online course: https://mymasonportal.gmu.edu/ Office Hours by appointment.
Course Description	The world is currently experiencing a proliferation in image data from satellites, aircraft and UAV's. These images have to be processed to produce geospatial information to inform natural resource management, urban planning and business decisions. This course will introduce the foundations of remote sensing, as well as the processing and analyses of imagery for diverse applications using ENVI. The course will introduce key concepts in electromagnetic radiation, passive (multi-spectral) and active (Lidar) sensor systems, and methods for image processing, classification and geospatial information extraction.
Course Objectives	Upon completion of the course, students will be able to: 1. Understand and explain the key theories of remote sensing and image analysis. 2. Use image processing tools to process imagery to geospatial products. 3. Gain fundamental insight into the use of remote sensing for multiple, real-world applications.
Course Methodology	The class format will combine reading, lectures, presentations, and hands-on processing of satellite imagery. The class will be interactive and require every student to be engaged in the material and assignments. In addition to the lectures, screencasts and timely completion of assignments, every student will be expected to be an active participant and a dedicated individual applying what you learn to every element of the course work.
Required textbook(s) and/or materials	Required Textbook: (Relevant chapters are available as pdf under "e-Reserve Textbook" in menu of this course's Blackboard page) "Remote Sensing and Image Interpretation" by Lillesand, Kiefer and Chipman (7th edition, John Wiley & Sons). https://www.wiley.com/en-us/Remote+Sensing+and+Image+Interpretation%2C+7th+Edition-p-9781118919477.

	Additional Textbook: In the lecture presentations I also use figures and Examples from "Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition" by J.R. Jensen. (4th edition, Pearson). https://www.pearson.com/us/higher-education/program/Jensen-Introductory-Digital-Image-Processing-A-Remote-Sensing-Perspective-4th-Edition/PGM30020.html
Computer Requirements	**Hardware:** You will need access to a Windows or Macintosh computer with at least 2 GB of RAM and access to a fast and reliable broadband internet connection (e.g., cable, DSL). A larger screen is recommended for better visibility of course material. You will need speakers or headphones to hear recorded content and a headset with a microphone is recommended for the best experience. For the amount of Hard Disk Space required taking a distance education course, consider and allow for: 1. the storage amount needed to install any additional software and 2. space to store work that you will do for the course. If you consider the purchase of a new computer, please go to Patriot Tech to see recommendations. **Software:** Many courses use Blackboard as the learning management system. You will need a browser and operating system that are listed compatible or certified with the Blackboard version available on the myMason Portal. See supported browsers and operating systems. Log in to myMason to access your registered courses. Some courses may use other learning management systems. Check the syllabus or contact the instructor for details. Online courses typically use Acrobat Reader, Flash, Java, and Windows Media Player, QuickTime and/or Real Media Player. Your computer should be capable of running current versions of those applications. Also, make sure your computer is protected from viruses by downloading the latest version of Symantec Endpoint Protection/Anti-Virus software for free here. Students owning Macs or Linux should be aware that some courses may use software that only runs on Windows. You can set up a Mac computer with Boot Camp or virtualization software so Windows will also run on it. Watch this video about using Windows on a Mac. Computers running Linux can also be configured with virtualization software or configured to dual boot with Windows. Note: If you are using an employer-provided computer or corporate office for class attendance, please verify with your systems administrators that you will be able to install the necessary applications and that system or corporate firewalls do not block access to any sites or media types. **Course-specific Hardware/Software** You will have to install **ENVI** on your own computer. You can purchase a student license, or a temporary student license may be provided by Harris Geospatial under a special arrangement during COVID. Pls wait for instructions before purchasing any software:

	https://www.harrisgeospatial.com/Industry-Solutions/Academic. Home installation instructions will be provided.
Course Website	Blackboard 9.1 will be used for this course. You can access the site at http://mymasonportal.gmu.edu. Login and click on the "Courses" tab. You will see MGMT 461 course NOTE: Username and passwords are the same as your Mason email account. You must have consistent access to an internet connection in order to complete the assignments in this course through Blackboard (http://mymason.gmu.edu). Note the technology requirements for School of Business in your Blackboard course menu—it contains details of minimum technology requirements.
Participation	Learning can only happen when you are playing an active role. It is important to place more emphasis on developing your insights and skills, rather than transmitting information. Knowledge is more important than facts and definitions. It is a way of looking at the world, an ability to interpret and organize future information. An active learning approach will more likely result in long-term retention and better understanding because you make the content of what you are learning concrete and real in your mind.

Although an active role can look differently for various individuals, it is expected in this class that you will work to explore issues and ideas under the guidance of the professor and your peers. You can do this by reflecting on the content and activities of this course, asking questions, striving for answers, interpreting observations, and discussing issues with your peers. |
| Rules and Expectations | In correspondence/communication students will be expected to:
a) Be professional and respectful in correspondence
b) Make reasonable requests of the instructor. We will be happy to clarify course material and answer legitimate questions; however, please exhaust other information sources (e.g., syllabus, Blackboard) for answering your question before contacting me and remember, "Poor planning on your part does not constitute an emergency on my part"
In regard to honesty in work students will be expected to:
a) Review the University integrity and honesty policies in the student handbook for guidelines regarding plagiarism and cheating (summarized below). I will gladly clarify my stance on any questionable or "grey area" issues you may have.
b) Refrain from dishonest work as it will receive a minimum penalty of zero on the assignment and a maximum penalty of a zero for the course with a report to the Honor committee. The GMU Honor Code requires that faculty submit any suspected Honor Code violations to the Honor Committee. Therefore, any suspected offense will be submitted for adjudication. |
| Mason Honor Code | **The complete Honor Code is as follows:**
To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this honor code:
Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work. |

	(From the Catalog – catalog.gmu.edu)
Cheating Policy	Any form of cheating on an activity, project, or exam will result in zero points earned. "Cheating" includes, but is not limited to, the following: reviewing others' exam papers, having ANY resources utilized when not allowed, collaborating with another student during an individual assignment. If you have questions about when the contributions of others to your work must be acknowledged and appropriate ways to cite those contributions, please talk with the professor or utilize the GMU writing center.
Plagiarism and the Internet	Copyright rules also apply to users of the Internet who cite from Internet sources. Information and graphics accessed electronically must also be cited, giving credit to the sources. This material includes but is not limited to e-mail (don't cite or forward someone else's e-mail without permission), newsgroup material, information from Web sites, including graphics. Even if you give credit, you must get permission from the original source to put any graphic that you did not create on your web page. Shareware graphics are not free. Freeware clipart is available for you to freely use. If the material does not say "free," assume it is not. Putting someone else's Internet material on your web page is stealing intellectual property. Making links to a site is, at this time, okay, but getting permission is strongly advised, since many Web sites have their own requirements for linking to their material. Review the Honor Code here.
Individuals with Disabilities	Students with documented disabilities should contact the Office of Disability Services (703) 993-2474) to learn more about accommodations that may be available to them. *(From the 2019-2020 Catalog – catalog.gmu.edu)*
Academic Integrity and Inclusivity	This course embodies the perspective that we all have differing perspectives and ideas and we each deserve the opportunity to share our thoughts. Therefore, we will conduct our discussions with respect for those differences. That means, we each have the freedom to express our ideas, but we should also do so keeping in mind that our colleagues deserve to hear differing thoughts in a respectful manner, i.e. we may disagree without being disagreeable. http://oai.gmu.edu/
Student Privacy Policy	George Mason University strives to fully comply with FERPA by protecting the privacy of student records and judiciously evaluating requests for release of information from those records. Please see George Mason University's student privacy policy https://registrar.gmu.edu/students/privacy/
E-Mail Policy	Web: masonlive.gmu.edu Mason uses electronic mail to provide official information to students. Examples include notices from the library, notices about academic standing, financial aid information, class materials, assignments, questions, and instructor feedback. Students are responsible for the content of university communication sent to their Mason e-mail account and are required to activate that account and check it regularly.

	Students are also expected to maintain an active and accurate mailing address in order to receive communications sent through the United States Postal Service. *(From the 2017-18 Catalog – catalog.gmu.edu)*
Course Grading & Evaluation	<table><tr><td>Assignments</td><td>45%</td></tr><tr><td>Midterm exam</td><td>20%</td></tr><tr><td>Quizzes and participation</td><td>15%</td></tr><tr><td>Final exam</td><td>20%</td></tr><tr><td>Total:</td><td>100%</td></tr></table> Grades will be assigned as follows: <table><tr><td>Weighted average range</td><td>Letter grade</td></tr><tr><td>≥ 98.0</td><td>A+</td></tr><tr><td>97.9 – 93.0</td><td>A</td></tr><tr><td>92.9 – 90.0</td><td>A</td></tr><tr><td>89.9 – 87.0</td><td>A-</td></tr><tr><td>86.9 – 83.0</td><td>B+</td></tr><tr><td>82.9 – 80.0</td><td>B+</td></tr><tr><td>79.9 – 77.0</td><td>B</td></tr><tr><td>76.9 – 73.0</td><td>B-</td></tr><tr><td>72.9 – 70.0</td><td>C</td></tr><tr><td>69.9 – 60.0</td><td>D</td></tr><tr><td>≤ 59.9</td><td>F</td></tr></table>
Discussion board	We will use Discussion board mainly for trouble shooting during Assignments and for listing common theoretical questions.
Assignments – 45%	Each week assignment reports are required to be uploaded to Blackboard. Assignments are due by Sunday, 11:59 PM, ET unless otherwise stated. Refer to the course schedule and weekly overviews for details. Each Assignment will have a demo video which explains all the steps you need to follow in ENVI - be sure the watch the video. ENVI's website also has outstanding instructions and additional information for each function in the software. If you have a specific question, email the TA for help. If the question and answer is potentially useful to other students, the TA will post it on Discussion Board.
Exams – 40%	Mid-term Exam 20% Final Exam 20%
Need Help? Utilize the "Course Q&A" discussion forum or email your instructor directly.	

Expect to work 3-6 hours per week on assignments for this course.

Submission of assignment report should be done only **through the Blackboard course website**. Reports should be neat and clearly indicate question number and answer. Insert cropped screen shots of

processed satellite imagery at appropriate zoom level to respond to the question. Submit **pdf files** of assignment to Blackboard, not Word documents.

Unless otherwise stated, all assignments are due by the end of the week in which they are assigned. For the purposes of this course, a week is defined as **beginning at 12:01 am each Monday EST**, and **ending at 11:59 pm on the following Sunday EST.**

To help you manage your schedule and time to complete the assignments in this course, please follow the recommended timeline below. If you have a question or concern or encounter a problem about an assignment, please contact me immediately so we can discuss and work out a resolution.

Course Calendar

Weeks	Lessons	Assignments
Week 1 **25 Jan**	**Lesson 1:** Introduction. Overview of Remote Sensing applications, Remote Sensing process, History, Electromagnetic Waves and Spectrum, Spectral signature, Energy Sources and Radiation	- Watch all videos - Start Reading textbook Chapter 1: **Concepts and foundations of Remote Sensing** - Review lecture notes - Set up ENVI license - Do ENVI tutorials: https://www.harrisgeospatial.com/docs/DisplayTools.html - https://www.harrisgeospatial.com/docs/OpeningLocalFiles.html
Week 2 **1 Feb**	**Lesson 2:** Energy Sources and Radiation, Energy Interactions, Atmospheric Scattering and Absorption, Interaction with earth surface (vegetation and water)	- Watch videos - Read textbook Chapter 1: **Concepts and foundations of Remote Sensing** (Page 1-30, 45-59) - Do Practical Exercise ENVI: Getting started - Start Assignment 1 in ENVI: Interpretation of WorldView image of GMU campus (due next Sunday 11:59pm)
Week 3 **8 Feb**	**Lesson 3:** Geometric influence on spectral response, Digital image acquisition, Four digital image resolutions: Radiometric resolution	- Watch videos - Take Quiz 1 (Lesson 2&3) - Read Textbook 25-35 - Complete Assignment 1 in ENVi. (Due Sunday 11:59pm)
Week 4 **15 Feb**	**Lesson 4:** Spatial resolution, Types of multispectral sensors, Spectral resolution, Satellite orbits, Temporal resolution	- Watch lecture videos - Watch External videos (they are awesome!!) - Class exercise / Discussion: Fill in Google Sheets on 4 resolutions of selected satellite sensors - Textbook: 72-75, 290-293, 218-229, 219-224, 140-143, 286-290, 309-318, 359-367, 290-321 - Download Data for Assignment 2 - Complete Assignment 2: WorldView image interpretation of Washington DC. Due Sunday 11:59pm

Week 5 22 Feb	**Lesson 5:** Processing digital numbers to surface reflectance	• Watch lecture videos • Watch External videos • Read textbook: p 491-495 • Take Quiz 2 (Lesson 5)
Week 6 1 Mar	**Lesson 6:** Geometric correction, Image enhancement, spatial filters	• Watch lecture videos • Watch ENVI Demo video on Image enhancement: Contrast stretch • Watch External video • Read text book: 495-499, 500-06, 507-512, 147-148 • Complete and submit Assignment 3 on Sunday 11:59pm
Week 7 8 Mar	**Lesson 7:** Spectral Indices, Vegetation indices time series	• View lecture videos • View external videos • Read text book: 517-522 • Contribute 2 anticipated Midterm exam questions to Discussion Board • Complete Lesson 7, Assignment 4 by Sunday 11:59pm
Week 8 15 Mar	**Lesson 8:** Midterm Exam	• Contribute 2 anticipated Midterm exam questions to Discussion Board by 15 Oct • Take Midterm exam on Bb at 1:30pm • There are two parts to this exam. Complete both. • Instructions: • Use symbols and formatting in answer text box where required. Enable the full toolbar by clicking on ^^ on top right of answer text box. • Be comprehensive in your answers - explain yourself well.
Week 9 22 Mar	**Lesson 9:** Data transforms, Image Classification - Supervised and Unsupervised	• View lecture videos • View external videos • Read text book: p529-530, 537-556 • Complete Lesson 9, Assignment 5 by Sunday 11:59pm
Week 10 29 Mar	**Lesson 10:** Land Cover classification, Accuracy Assessment	• Review lecture video • View external videos • Complete and submit lesson 10 Assignment 6 by Sunday 11:59pm • Read textbook: 575-580, 611-618
Week 11 5 Apr	**Lesson 11:** Sub-pixel classification, Object-based Classification,	• Review lecture video • Read Textbook: 562-567, 568-570, 570-573. • Take Quiz 3 (Lesson 11).
Week 12 12 Apr	**Lesson 12:** Change Detection	• Watch lecture videos • Complete and submit Assignment 7 by Sunday 11:59pm • Read textbook: 582-587

Week 13 19 Apr	**Lesson 13:** LiDAR remote sensing	• View lecture videos and external video • Read textbook sections: 471-482 • View demo video on LiDAR processing • Complete Assignment 8 by Sunday 11:59pm • Review lecture presentation
Week 14 26 Apr	**Lesson 14:** Hyperspectral and Thermal remote sensing and applications	• View lecture videos and external video • Read textbook sections: 271-281, 598-602, 245 – 269, • Complete all late Assignments • Review lecture presentation • In preparation for Final Exam, post 2 example questions and on discussion board. • Review questions on discussion board
Week 15 3-10 May	**Lesson 15:** Final exam period	• Instructions for Final 379 Exam date TBD • Go to BlackBoard / Assessments / Final Exam Part1 and 2 • Part 1 and Part 1 of the final exam is in 2 separate Assessments / tests. Complete both. • Time available? Part 1 120 min; Part 2 90 min • This is an "open-book" and "open-notes" exam. • You may NOT Google information from other websites. • You may NOT communicate with other students or anybody during the exam. • Do NOT Copy/Paste from notes • Email me if you have any problems with the on-line test or questions. kwessels4@gmu.edu. • **Read questions carefully and answer all parts of the questions.**