GGS 754: Earth Science Data and Advanced Data Analysis

Time & Place: Wednesdays, 7:20-10:00pm, Exploratory Hall 2102

Instructor: Donglian Sun

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Office Hours: Wednesdays, 2:00 pm-4:00pm or by appointments.

Text Books:


GMU Catalog Entry:

GGS 754 - Earth Science Data and Advanced Data Analysis (Credits: 3)

Covers accessing and applying Earth observations and remote-sensing data for Earth system science research and applications. Major topics are data formats, analysis and visualization tools, advanced data analysis methods, and data applications. Also covers combining innovative information technology techniques and Earth science data to set up online data centers for accessing data through the web. Prerequisites GGS 753 (Converted to GGS 579: Remote Sensing) or permission of instructor

Computing Requirements: Programming is an essential part for homework assignments and possibly for the final project. If you do not have any programming experience, you may encounter difficulty to meet the course requirements. It is your choice to use specific programming environment, tools or languages to perform the tasks. Nevertheless, for certain problems such as working with data in special formats, the choice of programming
languages and environment may be limited. That means if you are not familiar with the right programming language such as Matlab, you may need to learn it or search for a substitute. Either approach may need substantially extra time. As a result, Matlab and/or IDL/ENVI are highly recommended for this course.

**Goals and Objectives:**

To introduce data, data formats and data analysis methods for earth sciences. Emphasis is on advanced data analysis for time series and spatio-temporal data sets, which are widely used in publications and recently emerged.

**Learning Outcomes:**

After successful completion of this course,

1. Students will become familiar with earth science data in various formats.
2. Students will understand and utilize data analysis methods for Earth science data analysis.
3. Students will be knowledgeable on certain modern data analysis methods which are potentially useful for earth science data analysis
4. Students will be able to analyze earth science data sets and to write a technical report based on the analysis results.

**Course Web Site:** Mason Blackboard System

**Grading Policy:**

Homework Assignments: 50%

Final Project (style undetermined) 50%

Total 100% *(Letter grades based on relative numbers)*

**General Course Policies**

Attendance will not be considered in the final grade.
Late assignments will be accepted in the following two days with no penalty. Late assignments beyond 2 days will be accepted and considered for the final grade. However, the late submissions will not be graded as regular submissions.

Extra credit points may be granted to extra efforts, especially those including creative thinking.

The followings are university wide required information from Office of the Provost:

ACADEMIC INTEGRITY

GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else’s work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

GMU EMAIL ACCOUNTS

Students must use their Mason email accounts—either the existing “MEMO” system or a new “MASONLIVE” account to receive important University information, including messages related to this class. See http://masonlive.gmu.edu for more information.

OFFICE OF DISABILITY SERVICES

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. http://ods.gmu.edu

OTHER USEFUL CAMPUS RESOURCES:

WRITING CENTER: A114 Robinson Hall; (703) 993-1200; http://writingcenter.gmu.edu

UNIVERSITY LIBRARIES “Ask a Librarian”
http://library.gmu.edu/mudge/IM/IMRef.html

COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS): (703) 993-2380;
http://caps.gmu.edu
UNIVERSITY POLICIES

The University Catalog, http://catalog.gmu.edu, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at http://universitypolicy.gmu.edu/. All members of the university community are responsible for knowing and following established policies.

Tentative Course Content (will be changed during the semester):

Week 1: Introduction

Course Requirements

NASA's Earth Observing Systems (EOS)

Related URL's

Week 2: Theoretical Background

- Satellite Orbit Theory
- Basics: Newton’s laws and Kepler’s laws
- Circular orbits and geostationary orbits
- Concepts of orbit elements, inclinations
- Orbit perturbation and Sun-synchronous orbits
- Space-time samplings
- Radiation Transfer Theory

Week 3: Map Projections

Basic concepts on distortions, projection planes and projection points

Classifications

Earth model and mathematical theory

Mathematics of specific mappings

Links

- USGS Map Projections
- ARL Conformal Map Functions
- An example
- JazPanel
Week 4: Data Formats

ASCII

Binary

GRIB;

HDF and HDF-EOS;

Assignment #1 given

Week 5: Data Processing Procedures

Measurements, Nyquist Frequency

Data Representation

Multi-variant data presentation

o Parallel Coordinate

o Grand Tour

Tools: GrADS; WebWinds; IDV; CrystalVision

Week 6: Time Series

Basic Concepts

TS Components

General Decompositions

STL Decomposition

Assignment #1 due

Assignment #2 given

Week 7: Time Series (Cont.)

Autocorrelation

Correlations

Assignment #2 due

Assignment #3 given
Week 8: Time Series (Cont.)

Regression
Granger Causality
Assignment #3 due
Assignment #4 given

Week 9: Time Series (Cont.)-Integral Transforms

Fourier Analysis
Wavelet Analysis

Week 10: Time Series (Cont.)-Integral Transforms

Wavelet Analysis (Cont.)
The 2nd Generation Wavelets
Assignment #4 due
Project outline due
Assignment #5 given

Week 11: Time Series (Cont.)

HOC
Hilbert-Huang Transformations
Compressive Sensing

Week 12: Principal Component Analysis
Assignment #5 due

Week 13: Nonlinear Principal Component Analysis

Week 14: Introductions on Data Systems

OPeNDAPS
SIESIP and GDS
LAS
Week 15: (May 7, 2014) Exam Day

Project Report due

All late HW assignments for consideration due