EAS 8803-AVN: Modern Geodetic Methods

The Georgia Institute of Technology

January 11 - May 5, 2016
Tues., Thurs. 1:35 - 2:55 pm in ES&T L1116

Instructor: Andrew Newman (anewman@gatech.edu)

http://geophysics.eas.gatech.edu/classes/MGM

General

This course is a combination of lecture, discussion, and computer-based usage of many of the modern tools applied to determining and understanding the earth's surface deformation. Through this course we will be using existing tools developed by myself, collaborators, and ex-students. As well, I hope we can develop some new ones through the semester. *The focus in MGM-2016 will be primarily on interpretation of data, analytic and numerical modeling of faulting, magmatism and possibly mantle relaxation.*

The course will cover:

- Tools of the trade: detailed discussions of the modern instrumentation and methods (GPS, InSAR, tilt, strain)
  - Different methods and uses for GPS (kinematic, rapid-static, static, differential, seismo-geodesy)
  - Spatial imaging methods, satellite, airborne and terrestrial tools for Synthetic Aperture Radar interferometry (InSAR) and Laser/light detection and ranging (LIDAR) including time series analysis
  - Pros and cons of current tools: discussions of instrument fidelity including noise sources (orbits, atmospheric, instrument, local) and absolute vs. relative measurements.
  - Hands-on tutorials for some of the most advanced tools
    - Sub-cm GPS processing using double-difference or globally-referenced precise point positioning
    - Spatial imaging of sub-cm deformation using InSAR
- Putting it into perspective: Evaluation of the kinematics of signals.
  - Coordinate transformations
  - Reference frames
  - Strain determinations
  - Time-dependent signals
- What does it mean?: Modeling the sources responsible
  - Analytic models for planer dislocations and volumetric sources (fluid reservoirs, including magmatic)

  - Region-wide block modeling
  - Introduction to time-dependent modeling due to changes in rheologic and source conditions
  - Introduction to Finite-Element Method for a geometrically and rheologically more complex earth
  - Hands-on exercises using each to to predict deformation from a range of sources
- Taking a step backwards: An introduction to inverse problems in geodesy. Again, we'll go through some hands-on exercises using real-world data

Office Hours: Tuesdays from 3 pm - 4 pm, and by appointment.

Text: No text is required for this course, however a few books would be helpful for understanding and further reading. We will be covering components from each of these books, and most are recommended for geodetic professionals.

- Segall, P., *Earthquake and Volcano Deformation*, Princeton University Press, 432 pp., 2010.
- Dzurisin, D., *Volcano Deformation*, Springer, 476 pp., 2006. (in repository)
- Wahr, J., *Geodesy and Gravity*, Samizdat Press, 294 pp., 1996. (in repository)
- Rees, W. G., *Physical Principles of Remote Sensing*, Cambridge University Press, 343 pp., 2001.
- Hofmann-Wellenhof, B., H. Lichtenegger, and J. Collins, *GPS: Theory and Pracice 5th edition*, Springer-Verlag Wien, New York, 382 pp., 2001.

Class Communication: You will occasionally receive class information via email to your prism account. Because this information may not be communicated in class, you should be sure to read messages identified as [EAS: MGM]. In emailing me for class, please add [EAS: MGM] to the subject line and identify yourself by name in the message since not all email accounts clearly identify the email's author.

Evaluation

As the goal of this course is to train upper level graduate students for research, students are expected to come to learn in order to help better their research. Thus, there will not be rigorous evaluation of individual homework, laboratory exercises, nor exams, but on overall participation (30%), completion of laboratory exercises (40%), and a final research project (20%) and presentation (10%).

Academic Honesty

General: It is expected that all students are aware of their individual responsibilities under the Georgia Tech Academic Honor Code (`http://www.deanofstudents.gatech.edu/Honor/`), which will be strictly adhered to in this class.