GEOL/PHYS 6650 Geophysics Seminar: Geomagnetism
Spring 2016 University of Colorado Boulder
Wednesday 11-11:50, Benson Rm 355

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Course Objectives: This course introduces students to the field of geomagnetism, including theory, research, and applications. Topics will include global magnetism, geomagnetic field modeling, mapping of magnetic anomalies using satellite, ship, and airborne platforms, and electromagnetic induction.

Course Format: This weekly seminar course will consist of readings from the literature, discussions, and guest lectures. Weekly readings will be posted on the class D2L page.

Grading: Attendance and class participation 80%, class presentations 20%. No exams. Students are expected to attend all lectures and arrive on time, read assigned papers ahead of class, participate in questions and discussion, make one or two short presentations in class on related research or a paper from the literature, and introduce and host one visiting speaker (work with speaker to find an appropriate paper to assign to class, handle logistics of speaker visit to campus).

Tentative schedule, Geomagnetism seminar, CU, Spring 2016
Week, topic, lecturer, date

1. Introduction. Maxwell's equations, electromagnetic induction [Justin Ball, CU GEOL and CIRES] [Jan 13]

2. Geomagnetism basics (involving the geomagnetic elements, magnetic dipole, its historical use for navigation, geomagnetic measurements with observatory satellite, ships and aircraft, major geomagnetic events, uses of geomagnetic field exploration, navigation). [Manoj Nair, CIRES] [January 20, 2016].
Reading assignment. Hulot, G., Finlay, C. C., Constable, C. G., Olsen, N., & Mandea, M. (2010). The magnetic field of planet Earth. Space science reviews, 152(1-4), 159-222.
ftp://ftp.space.dtu.dk/pub/cfinl/publications/2010_Hulot_etal.pdf

3. Applications of electromagnetic induction methods to shallow subsurface imaging (magnetotellurics, time domain EM, controlled source MT) [Danny Feucht, CU GEOL and CIRES] [January 27, 2016]
Reading assignment: Pellerin, L., 2002, Applications Of Electrical And Electromagnetic Methods For Environmental And Geotechnical Investigations, Surveys in Geophysics, v 23, n 2, p 101-132, http://dx.doi.org/10.1023/A%3A1015044200567

4. Geomagnetic field modeling. The inclined dipole and geomagnetic coordinates, main field models, magnetic spectrum, standard geomagnetic models by NGDC [Patrick Alken, CIRES] [Feb 3, 2016]
Reading assignment: World Magnetic Model Technical Report (http://www.ngdc.noaa.gov/geomag/WMM/data/WMM2015/WMM2015_Report.pdf), sections 1 and 2

5. Time changes in the geomagnetic field I: core field, secular variation and the geodynamo, [Arnaud Chulliat, CIRES] [Feb 10]

6. Time changes in the geomagnetic field II: Time changes generated by currents in the ionosphere. Modeling of ionospheric sources. [Patrick Alken and Arnaud Chulliat , CIRES][Feb17]
Reading assignment: R.A. Heelis, Electrodynamics in the low and middle latitude ionosphere: a tutorial, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 66, Issue 10, July 2004, Pages 825-838, ISSN 1364-6826, http://dx.doi.org/10.1016/j.jastp.2004.01.034.
(http://www.sciencedirect.com/science/article/pii/S1364682604000525)

7. Time changes in the geomagnetic field III: Time changes generated by the coupling of Earth's magnetosphere with solar wind. [TzuWei Fang, NOAA and Space Weather Prediction Center]. [Feb 24]

8. Crustal magnetic field anomalies: Magnetic properties of rocks. Mapping of magnetic anomalies using satellite, ship and airborne platforms. Use of crustal magnetic maps inresource exploration and in tectonics. [Rick Saltus, USGS] [March 2]
a. Reading assignment: Saltus and Blakely, 2011, Unique Geologic Insights from "NonUnique" Gravity and Magnetic Interpretation: GSA Today, v. 21, n. 12.
http://geology.gsapubs.org/cgi/doi/10.1130/G23470A.1

9. Electromagnetic induction in the earth's crust and mantle. Principles of EM induction. Sources for EM induction. Global and regional EM induction studies. [Alexey Kuvshinov, ETH Zurich, Switzerland] [March 9]

10. Electromagnetic Induction applied to crustal geological studies. [Paul Bedrosian /USGS Denver] [March 16]

11. SPRING BREAK, no class [March 23]

12. Planetary applications of EM induction methods, review the work on Galilean satellites. [Bob Grimm, SwRI] [March 30]
Reading assignment:
a. Banerdt, W. B., V. Dehant, R. Grimm, M. Grott, P. Lognonné, and S. Smrekar, Probing the Interiors of Planets with Geophysical Tools, in Encyclopedia of the Solar System, 3rd ed., T. Spohn editor, Elsevier, 2014. http://www.sciencedirect.com/science/article/pii/B9780124158450000554
b. Grimm, R. E., Low-frequency electromagnetic exploration for groundwater on Mars, J. Geophys. Res., 107(E2), doi:10.1029/2001JE001504, 2002.
http://onlinelibrary.wiley.com/doi/10.1029/2001JE001504/full

c. K. K. Khurana, M.G. Kivelson, K.P. Hand, C.T. Russell, Electromagnetic induction from Europa's ocean and the deep interior, Europa, ed. R.T. Pappalardo, W.B. McKinnon, K.Khurana, The University of Arizona Press, Tucson, 2010.
http://www-ssc.igpp.ucla.edu/personnel/russell/papers/electromagnetic_induction.pdf

13. Magnetic field generated by moving ocean water circulation, tides and tsunamis. Modeling and detection in observatory and satellite data. [Manoj Nair, CIRES] [April 6]

14. Geomagnetic Induction Hazards. Geological Sciences colloquium talk on Wednesday, April 13, [Jeff Love, USGS] [April 13, 4 pm, Benson Rm 180]

15. EGU, no class [April 20]

16. Last class [April 27]

* note different time and location

Recommended Syllabus Statements from CU Office of Academic Affairs. Please see me if you have any questions about the topics below.

THE BOULDER PROVOSTS DISABILITY TASK FORCE RECOMMENDED SYLLABUS STATEMENT:
If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see Temporary Injuries guidelines (www.colorado.edu/disabilityservices/students/temporary-medical-conditions) under the Quick Links at the Disability Services website (www.colorado.edu/disabilityservices/) and discuss your needs with your professor.

RECOMMENDED RELIGIOUS OBSERVANCES SYLLABUS STATEMENT:
Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. See the campus policy regarding religious observances (http://www.alumniconnections.com/links/link.cgi?l=6835138&h=133868&e=UCBI-20151203180101 for full details.

RECOMMENDED CLASSROOM BEHAVIOR SYLLABUS STATEMENT:
Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veterans status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior (http://www.alumniconnections.com/links/link.cgi?l=6835141&h=133868&e=UCBI-20151203180101 and the student code (http://www.alumniconnections.com/links/link.cgi?l=6835142&h=133868&e=UCBI-20151203180101.

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All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy of the institution (http://www.alumniconnections.com/links/link.cgi?l=6835145&h=133868&e=UCBI-20151203180101. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible of violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at http://www.alumniconnections.com/links/link.cgi?l=6835146&h=133868&e=UCBI-20151203180101.