Great Papers in the Earth Sciences

Great Papers, EPS 281r

(Spring 2011)

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Day & time: Wednesday 3-5

Location: Geological Museum room 413

1st meeting: Wednesday Jan 26, 3pm

Bibliography: Papers are linked from this document.

this document: EPS281 syllabus2011.pdf

Announcements. Feel free to write, call, or visit us with any questions.

1 Administrative

Prerequisites: This is a basic introductory breadth course and should be accessible to all Earth and Planetary Science graduate students.

Requirements: Apart from reading all assigned papers, students will be asked to prepare presentations on one or more of the topics to be covered during the course and based on the appropriate papers posted on the course web page, and lead a discussion during class. In addition, each student not part of the presenting group turns in a one page (12pt, single spacing) discussion of the paper briefly discussing: the objective of the paper, the approach/ methods used, the main results, and what does (or does not) make the paper great.

Guidelines for student presentations

Each subject will require two presentations by the students leading the corresponding discussion. You are welcome to organize in groups of 2-3 for this purpose.

The first presentation is about 5-slides, 10 minute long, and has a minimum font size of 24. It is given the week before the subject is discussed in class. The purpose of this brief presentation is to motivate the subject, explain its importance, and help the other students understand the reading material.

The second presentation is about 30-slides long, has a minimum font size of 24, and is to be used during the discussion. Please provide some background for the other students, but then get to the actual paper within 5 to 6 slides. Please show the figures and equations from the paper, explain them, and provide guiding questions. In particular, make an effort to excite a discussion about the reading material. That is, the purpose of this presentation is to guide discussion, as opposed to supporting a lecture. Note that we may not cover all $\sim$30 slides if the discussion uses all the class time, and that this would be a good indication of a successful presentation.

Grading: Based on presentations, discussion, participation, one page summaries, and (mandatory) attendance.

2 Overview and goals

A survey of historic breakthrough papers in all of the earth sciences, as well as modern papers that put the classics in perspective. Students engage in the material through reading, presentation, and discussion. The course has several goals. (1.) To engender an understanding and appreciation of major breakthroughs in our field. (2.) To develop skills in presenting and discussing scientific results. And (3.) to refine students' understanding of what constitutes great science.

3 Syllabus

The blue links below lead to the reading material for each lecture.

Jan 26th Introductory lecture and discussion

Feb 2nd **Zach and Erik** Thermal history of the earth (geophysics): read the wikipedia entry about the age of the earth, and then the England et al (2007) historical review and the short address by Kelvin 1869 ("On geological dynamics"). Finally, read our classic paper for this time: Davies (1980). Optional: read the beginning of the two Lord Kelvin piece from 1868 to learn more about Kelvin's opinion of geologists. For many more Kelvin papers, see here.

Feb 9th **Claire and Archana** Stable isotopes and paleoclimate (geochemistry) Read the two wikipedia entries on $\delta^{13}C$ and $\delta^{18}O$, and then the Urey (1948) and Epstein et al (1953) classic papers. For essentially the current interpretation of marine $\delta^{18}O$ records, see Chappell and Shackleton (1986).

Feb 16rd **Chris and Wenchen** Greenhouse effect (climate). Read (A) from IPCC chapter 2: executive summary, sections 2.1, 2.2 (including FAQ 2.1), 2.3.1, 2.3.2; (B) Arrhenius (1896).

Feb 23rd **Patrick and Yingjun** Snowball, Budyko-Sellers (geology, climate). Read the two page Kirschvink (1992) paper (that's our classic this time) and then Hoffman et al (1998). Finally, read the 1 page notes file energy_balance_0d for the Budyko-Sellers model which predicted the existence of a snowball earth in 1969.

Mar 2nd **Claire and Steven** Silicate weathering and CO2 (geochemistry) Read the papers by James et al (1981) and Berner et al (1983).

Mar 9th **Lee and Archana** Hadley cell (atmospheric dynamics). Read (A) wikipedia entry, (B) Hadley (1735), (C) Schneider (2006) until the end of section 2.1 (pp 655-663). (Possibly replace this with a discussion of the Walker circulation.)

Mar 23rd **Lee and Wenchen** Glacial cycles (geology, climate) Read the Wikipedia entry about Milankovitch cycles (changes in the orbital parameters of the earth around the sun which affect climate). Next, read our classic paper by Hays, Imbrie and Shackleton (1976). For the personality perspective in this case read the wikipedia entry about Louis Agassiz and the article by E.P. Evans in the file "did-agassiz-discover-glacial-cycles.pdf". Note the contrast between (1) his objection to Darwin's ideas, his "work" on "Racial classification", and the suspicion that he may have stolen

the glacial cycle idea from someone else, and (2) the fact that he was such a beloved, admired and influential scientist (especially wikipedia entry about him).

Mar 30th **Steven and Yingjun** Extinctions and the KT impact hypothesis (geology). Read (A) wikipedia entry on Chicxulub crater, (B) wikipedia entry on KT boundary, (C) Alvarez et al (1980), (D) Raup and Sepkoski (1982).

Apr 6th **Patrick and Natasha** The Gulf Stream (physical oceanography) Read Stommel (1948).

Apr 13th **Zach and Erik** Continental drift and Plate tectonics (geology, geophysics). Read first the two wikipedia entries, then the few pages from the book by Wegener. All this reading so far is quite simple. Finally, for the geophysical treatment of plate tectonics on a sphere, please read the Morgan 1968 paper. This subject has a very interesting history, see the fascinating LePichon notes which tell the story of why the McKenzie-Parker paper came out first although Morgan came up with the idea (and submitted the paper) before them. [Optional: McKenzie-Parker 1967 and the original 1967 Morgan notes in the file MorganTectonoph91.pdf; also Hess 1962 early on hypothesized the modern tectonic cycle and supported it with a series of astute qualitative arguments.]

Apr 20th **Chris and Natasha** Chaos and weather prediction (atmospheric dynamics). Read the brief introduction to chaos and then the wikipedia entry about fractals (better read this one on-line, for the nice animations in wikipedia), and then Lorenz 1963 paper itself. Note that Lorenz does not use the terms "chaos" or "fractals" which were only coined later, yet but he clearly understands both. For a nice on-line fractals demo, see here.

Apr 27th Student selected topics. Each group selects a great paper not discussed earlier and presents its significance to the class. These presentations should be $\sim$10 slides long, take about 30 minutes, and survey the findings in the paper and discuss what makes it great.