Applications of Calculus in the Earth and Environmental Sciences (EES 4891)

> "Calculus required continuity, and continuity was supposed to require the infinitely little; but nobody could discover what the infinitely little might be."
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> — Bertrand Russell

Credit: 1 hr, if you want credit for your efforts, but audits are welcome

Prerequisite: an interest in gaining a clearer understanding of how the calculus you are learning (or have learned) is used in the Earth and Environmental Sciences

Class time: MW 2:30–3:20, 5722 Stevenson Center; note that we might not use the full time each week

Instructor: David Furbish

Text: This course will focus on the textbook currently required for the calculus course you are enrolled in, or plan to enroll in. I also will refer to the the delightful, classic text by S. P. Thompson,[1] and I will provide notes on certain topics in calculus.

Description: Courses in calculus typically are aimed at developing an understanding of the mathematical elements of this topic, but not necessarily the physical interpretation of these elements as applied to science problems. This is understandable. Namely, given that the calculus is relevant to virtually all fields of science, it would be impossibly difficult to tailor these courses to the specifics of the great breadth of problems that are of interest across science fields. As a consequence it can be difficult to readily imagine how what one is learning in calculus is likely to be relevant to problems in EES, or how it is actually put into practice. The purpose of this course therefore is aimed at the prerequisite above: to provide the context and interpretation of the elements of calculus in order to gain a clearer understanding of how the calculus you are learning (or have learned) is actually used in the Earth and Environmental Sciences. You may think of this as a "shadow" course — to fill in the pieces that are not covered in your calculus course in order to gain a physical (not just mathematical) understanding of what you are learning. For example, we will consider physical interpretations of the various calculus operations you are learning. We will examine the idea of dimensions — a particularly important topic in all science — which typically is not addressed in calculus courses yet which is foundational for understanding how calculus works. We will consider the idea that much of calculus is actually just geometry. For fun we also will consider historical and philosophical elements of the calculus and its use, for example, how we must wrap our brains around the necessary ideas of infinitesimals, infinities and limits.

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[1] Thompson, S. P. 1910. *Calculus Made Easy: Being a Very-Simplest Introduction to Those Beautiful Methods of Reckoning which are Generally Called by the Terrifying Names of the Differential Calculus and the Integral Calculus*, Macmillan Company, New York. This text is freely available here: https://calculusmadeeasy.org/