

Lecture 1—Introduction to fluvial sediment transport

Fluvial sediment transport is the study of the interaction between channelized, unidirectional flows of relatively clear water and natural, generally non-cohesive, sediment. Sediment transport is an important branch of both applied and pure geology (and engineering) because it helps answer questions like “how can we keep sediment out of these turbines?” and “how fast was water flowing in this Devonian river system?” Like many applied geology classes, sediment transport is often taught in the Engineering school of universities that have one, and therefore often results in simplification for the sake of getting an answer. *THIS IS NOT BAD.*

At a recent talk on the philosophy of science, I heard it said that all sciences pass through three main stages: empirical, theoretical, and computational. Some sciences (like nuclear physics) are relatively well behaved, so computation comes relatively easily. Other branches of science (most definitely including sediment transport) are not so well behaved, and many parts of sediment transport remain in the empirical stage. This is actually great, because so many fundamental questions about how sediment moves remain to be answered. Just a warning that you won't get The Answer from this class, because we don't *know* The Answer yet. We'll talk, instead, about what approaches people have taken, and what we don't yet know.

So, how are we going to simplify in this class? Our simplifications will include:

- Simplified channel geometries (trapezoids are a big favorite)
- Clear water
- Often, bulk-averaged velocity (both time and depth)
- Idealized sediment (spheric, single bulk density, one-parameter size distributions)
- Non-cohesive sediment (no clays)

Now, what's going to be covered in this class? Take a look at the syllabus to see the approach. Up front, we're going to take several weeks to study how sediment transport is measured directly, and

hopefully to gain some insight into the precision of those measurements. Next, we'll return to the classroom and start with a review (for some) of how water flows. This is hydraulics, and it will take up about two weeks. Next we'll describe the physical properties of sediment, which will take about a week. Then on to the rules governing how sediment falls through water, which will include a little bit of dimensional analysis and sensitivity analysis. This will finally get us to how sediment moves, followed by equations that attempt to quantify how much sediment is moving in a river. We'll end by talking about sediment routing, which is a computer technique to evaluate sediment motion in rivers. IF there's time, I'll try to include some material on hyperconcentrated flows, too.

What is *not* covered in this class? This class is called *fluvial* sediment transport for a reason. Unidirectional, channelized flows (*e.g.* rivers) are relatively easy to explain, but there are lots of things we're not going to cover, including:

- Oscillatory flows (*e.g.* waves) (see Coastal Processes)
- Overland flows (see Hydrology)
- Hyperconcentrated flows (*e.g.* debris flows)
- Cohesive sediments
- Channel geometry (see Geomorphology)
- Subterranean flows (see Hydrogeology)