Debates in Geomorphology

Part 2: How do our landscapes change?

In Part 1 we asked the geomorphology community what they felt were the big debates still raging in our discipline. If you haven't read that part yet, I'd encourage you to do so before reading this one.

For Part 2, we asked about how our landscapes changed. Do they change gradually, through collecting up lots and lots of small changes that given enough time are enough to make big changes to planetary surfaces? Or, do we have long periods where literally nothing happens, and then in a short space of time a rare yet catastrophic event results in a lot of change in a small time?

We put it to the geomorphology community on Twitter to see what they thought -

Team catastrophe were the first off the blocks, getting in a series of heavy punches. Possibly, with the heaviest punch of all in geomorphology - the impact crater.

Whether formed by the collision of an icy comet or a rocky asteroid, and more frequently smaller fragments of these, meteoroids, the process could never be said to be slow and steady. These are rare, big, and dramatic, and most likely what polished off the dinosaurs.

Team catastrophe quickly followed up this first blow with another - these rare events have shaped landscapes on all planetary surfaces throughout our solar system, and are the dominant features on many.

And bang, an uppercut - it's a process that can create mountains in seconds!

They take seconds to form but they last for millenia - some craters on Mars for example were formed billions of years ago and can still be seen on the surface.

Finally, the opening salvo from team catastrophe concluded with the ongoing imprint of these events on geomorphology and how they can feedback onto other processes.

Finally, we saw team slow and steady deliver a counter-punch. If these rare catastrophic events dominate the development of our landscapes, why do we see so few of them on Earth? With our planet's active plate tectonics and atmosphere, these features are eroded on Earth's surface.

Contrast the surface of the Moon to the Earth. Both bodies will have had a similar level of impacts in the past, yet without an atmosphere, the slow and steady processes of weathering just do not take place. On Earth, they do in abundance and surficial evidence of these events is eroded away over time.

More members of team slow and steady piled in. What about the development of rivers, the evolution of meander bends? Surely, this is driven by the gradual build up of movements by individual sediment grains?

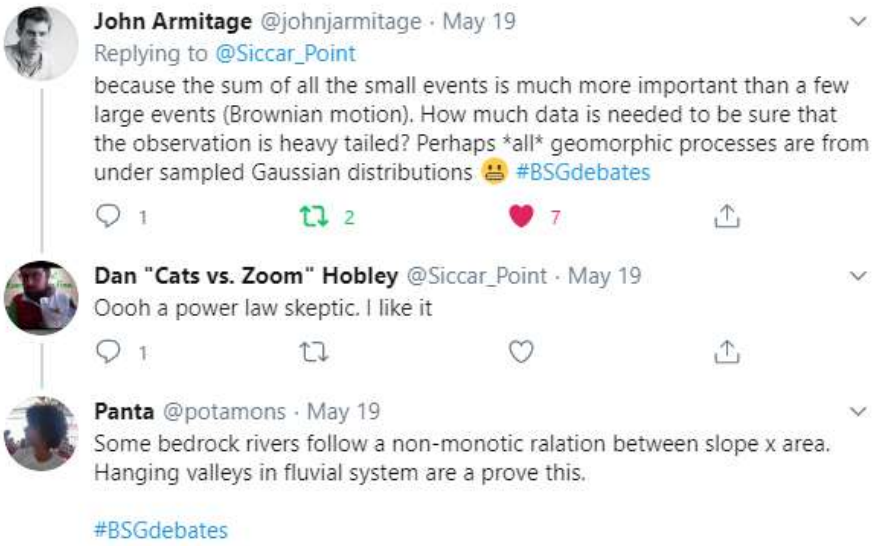
But then we began to get different view points. What about features on the landscape that seemingly come and go - they form slowly, but seem to disappear rapidly, only to form slowly once more.

https://www.youtube.com/watch?v=8anSoi2eI1U

The debate became less combative and more nuanced. Geomorphic processes seem to be quite random. The evidence of what we observe in nature suggests that large, rare, catastrophic events have a disproportionate impact on the formation of landscapes. YET, when we build models to understand or explain how these processes work - assuming changes are small and gradual works really well.

https://www.earth-surf-dynam.net/7/17/2019/

Even simplifying processes down massively, using a small number of equations, and computer models with a small amount of complexity, we can recreate landscapes as they appear now and this seems counter-intuitive to what we see happening around us.



Finally, it was suggested that this was because over the passage of time the sum of all the gradual changes over-rides what we would perceive as catastrophic changes. Maybe these large and rare events are not disproportionate at all, but instead we haven't been around and observing the world for long enough to understand it fully yet.

So, at the end of Part 2, I don't think we have a clear winner. Large, rare catastrophic events clearly do have a big imprint on our landscapes, yet the forces of slow and steady wear these down over time. The balance between these clearly changes between different environments and settings and also the time scales that we are looking at.

I think this debate is going to go on for many decades yet and continue to drive new research in geomorphology.

Thank you for reading.

www.geomorphology.org.uk - @BSG_geomorph - search British Society for Geomorphology on YouTube

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