Debates in Geomorphology

Part 1 : What are the main debates in geomorphology

Welcome to Part 1 of *Debates in Geomorphology* by the British Society for Geomorphology and The SeriousGeoGames Lab. My name is Chris Skinner and I am the current vice-chair of the Society's Outreach and Education sub-committee. Over this short series I will be taken you through some of the most highly discussed issues in the science of geomorphology - each debate has been proposed and contributed to by the membership of the society and active researchers in the field.

First off, what is geomorphology for those who have never heard it before. In school, you are most likely to encounter geomorphology through geography lessons and, in particular, physical geography. It is the science of how landscapes and landforms develop and change. It tells the story of how the Earth's surface got to look like how it does today and helps us understand how it will continue to evolve in the future.

Where geology tells us how tectonic plates collide and thrust up new mountain ranges, it is here where geomorphology begins its long journey of weathering those mountains down. It is the processes of water, wind, and ice that erode the mountains. The glaciers that slowly grind away at the rock to form huge u-shaped valleys, carrying the boulders it has plucked out of the ground and those that have fallen onto it by rockfalls and landslides. At its end of the glacier, and as it retreats, it drops its cargo leaving behind piles of rocks.

Here, the rivers take over. Rain and melting ice and snow, swell into strong flows able to pick up or roll the rocks in its path. As they tumble, they are ground down into smaller and smaller fragments, stones, to pebbles, to individual grains of sand. The river is constantly changing, shaping and reshaping its valley. As it flows it forms winding paths as it meanders over the floodplain that contains the memories of itself from years gone by, ever seeking a straighter path and leaving behind lonely and forgotten Oxbow lakes.

Our rock from the mountains is now sand as it enters the tempestuous estuary where river and tide duel over sand and mud, constantly reforming the underwater bed. Eventually, our sand grain will make it to the sea, but its story doesn't quite end yet as below the sea is another world of geomorphology mirroring that on land, with its own channels, landslides, and fields of dunes. One day that sand grain may settle and become buried. Crushed under the weight of a millennia of deposits, it will on day leave the world of geomorphology and rejoin the world of geology.

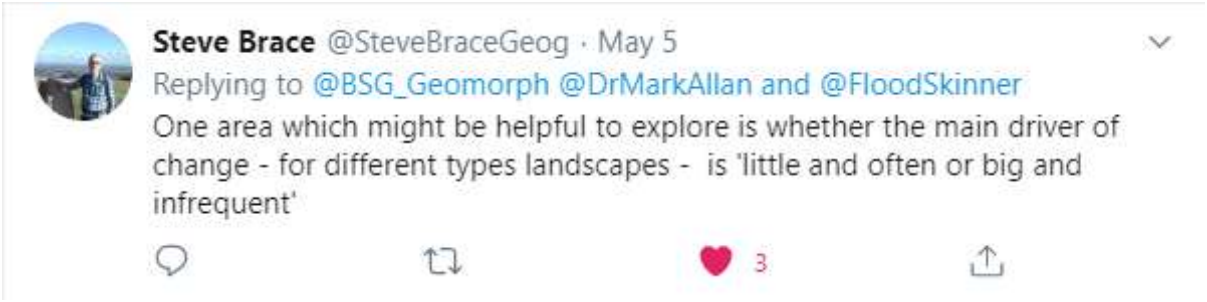
Around the world's coasts, the waves of our stormy seas are shaping the boundary between the land and water, forming beaches and eroding cliffs. In the deserts, it is the wind that shifts the landscape, whipping up fine sands into migrating fields of dunes. Geomorphology is now taking us to different worlds as space craft provide us eyes on other planetary surfaces and we try to understand what forms the rocky and icy landscapes of the Moon, Mars, or Pluto.

Geomorphology is the science of the big, of mountains, and rivers, and ocean floors. It is also the science of the small, of sand grains and how they are picked up by water and wind. It is a science of the ages, of landscapes forced upwards and then pulled back down over millions of years of erosion, and it is a science of now, of hillsides suddenly collapsing and rivers bursting their banks. It is a science of the past, of how landscapes got to be how they are, and a science of the future, predicting how they will continue to change.

As the morphology in the name suggests, geomorphology is a science about change. It is dynamic, and just as our Earth keeps changing, so does our understanding of it. There are still many things we just don't know or understand fully enough. It is likely that there are things we think we understand but somewhere down the line something will surprise us and make us think differently. There are things that as a group or scientists, researchers, practitioners, and enthusiasts, we are still very much divided on.

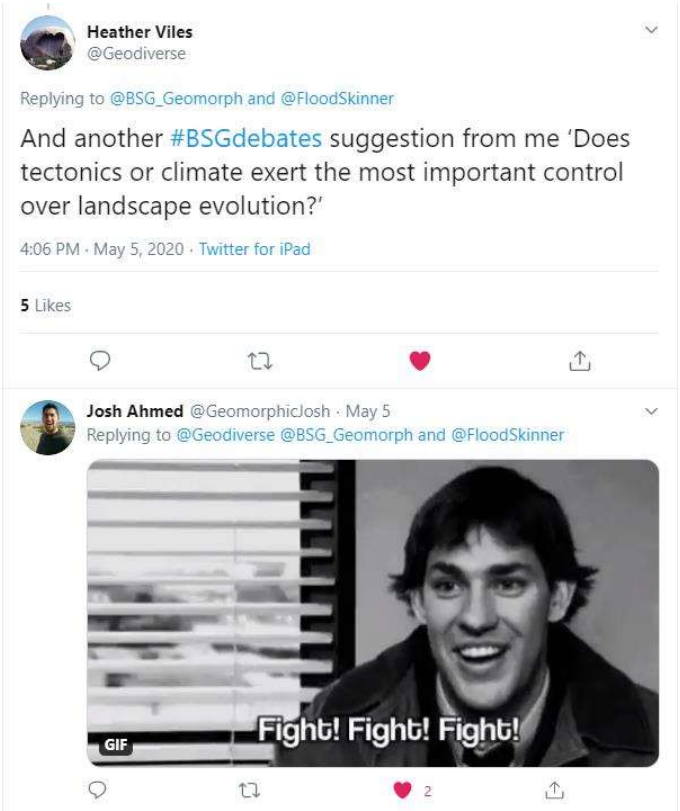
I opened this up to the geomorphology community on Twitter, asking them for their thoughts on what these big debates are.

Many of the suggestions were based around processes -

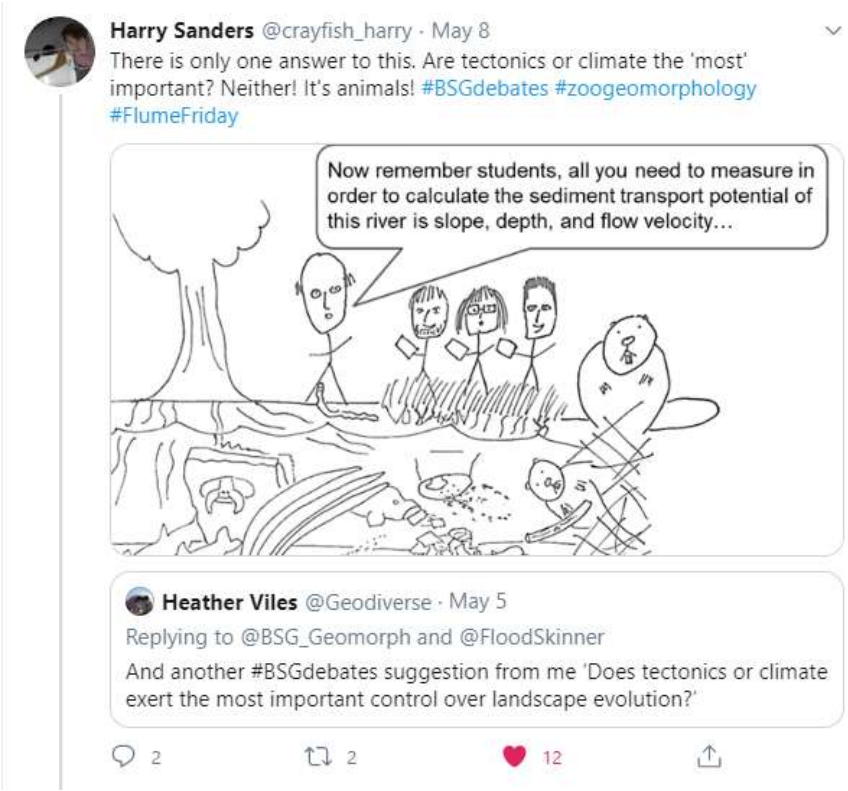


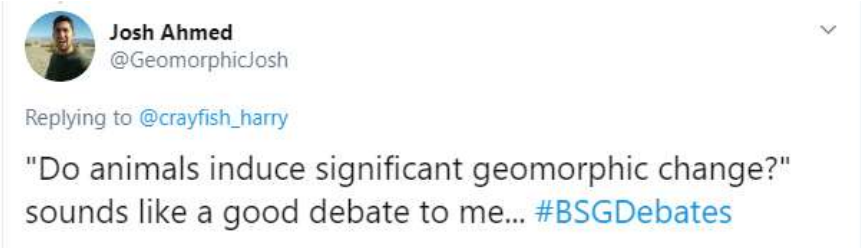
This suggestion by Steve Brace strikes at the heart of our understanding of how landscapes are formed. It takes an exceptionally long time for something like a river valley to develop and often we think that this happens because of lots of small changes that happen often and gradually build up over time. However, we know there are some landscapes where actually almost nothing changes in a long time, and then suddenly one big event, like a storm, causes a large amount of change very quickly.

Continuing the landscape evolution theme, other suggested the debate about what are the most important things for developing landscapes, such as tectonics or climate.

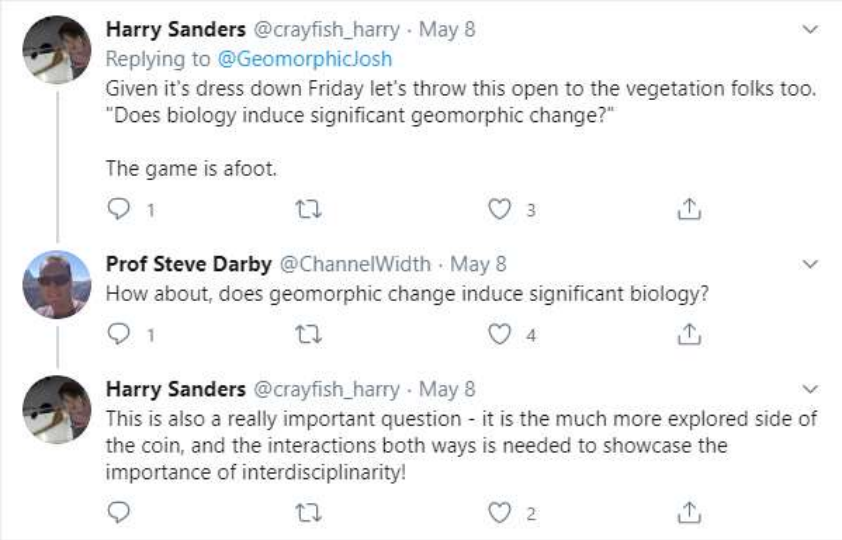


This is a contentious issue and others weighed in with suggestions for other factors that might be involved.

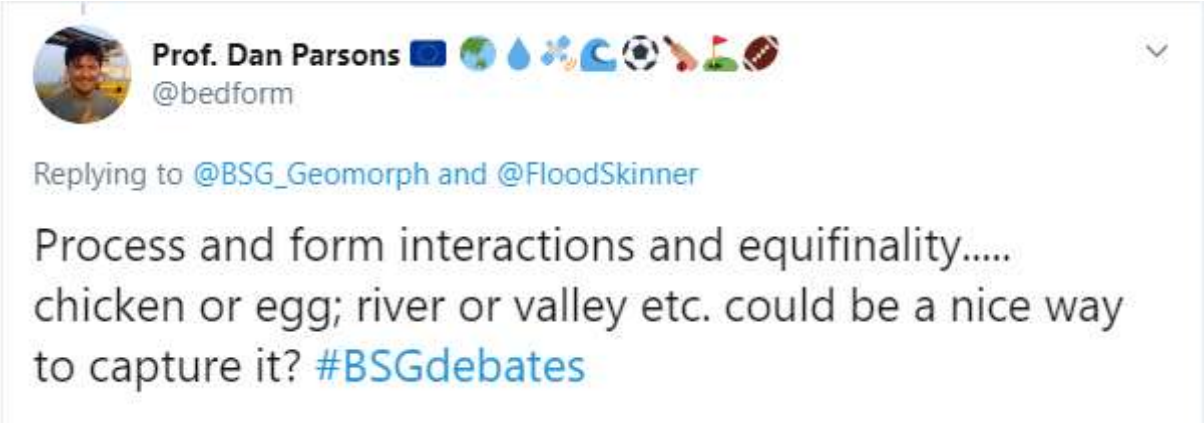




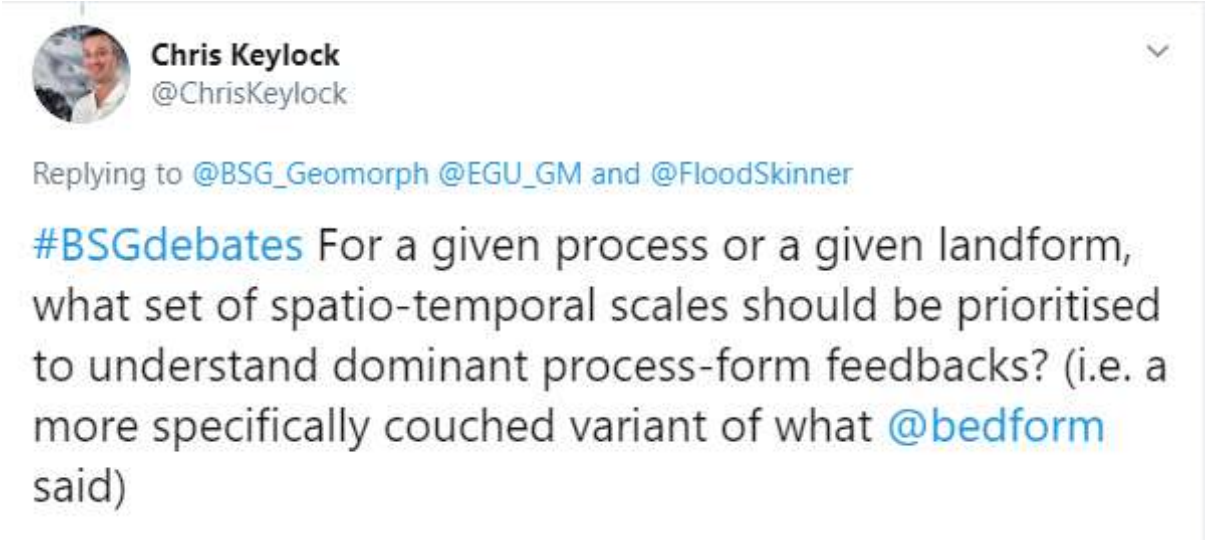
Animals were thrown into the mix as potential contributors - but can they really exert the same level of impact as large scale processes like tectonics or climate?



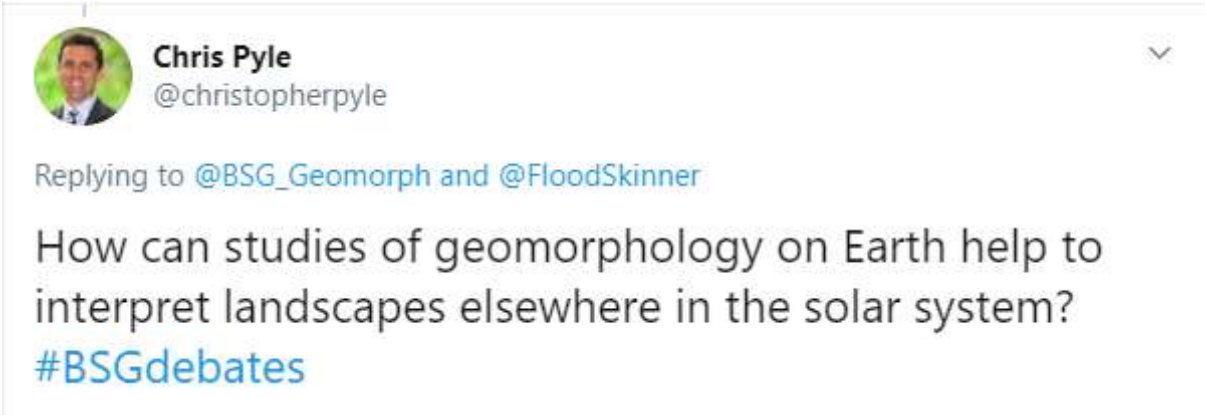
As the discussion developed - as well as animals, do plants also help to form our landscapes - it was suggested that there is a feedback and our landscapes and their shapes also influence the biology and the plants and animals that live in them.



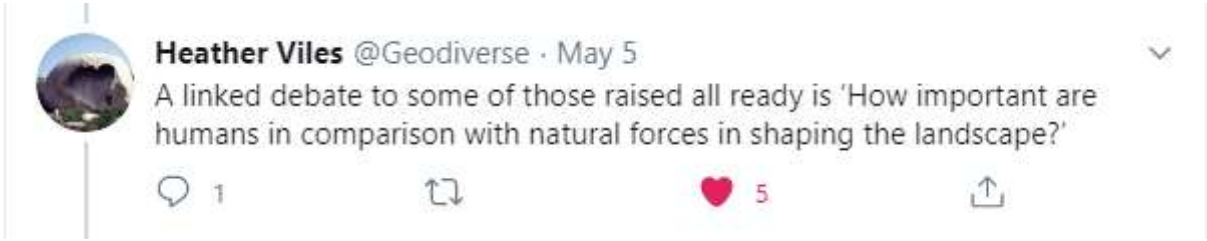
If we take it back to the beginning - how do landscapes start developing? For example, does the water flow natural form a river that develops into a valley, or does some kind of proto-valley have to exist in the first place for the river to form? This is a real geomorphology chicken and egg situation!



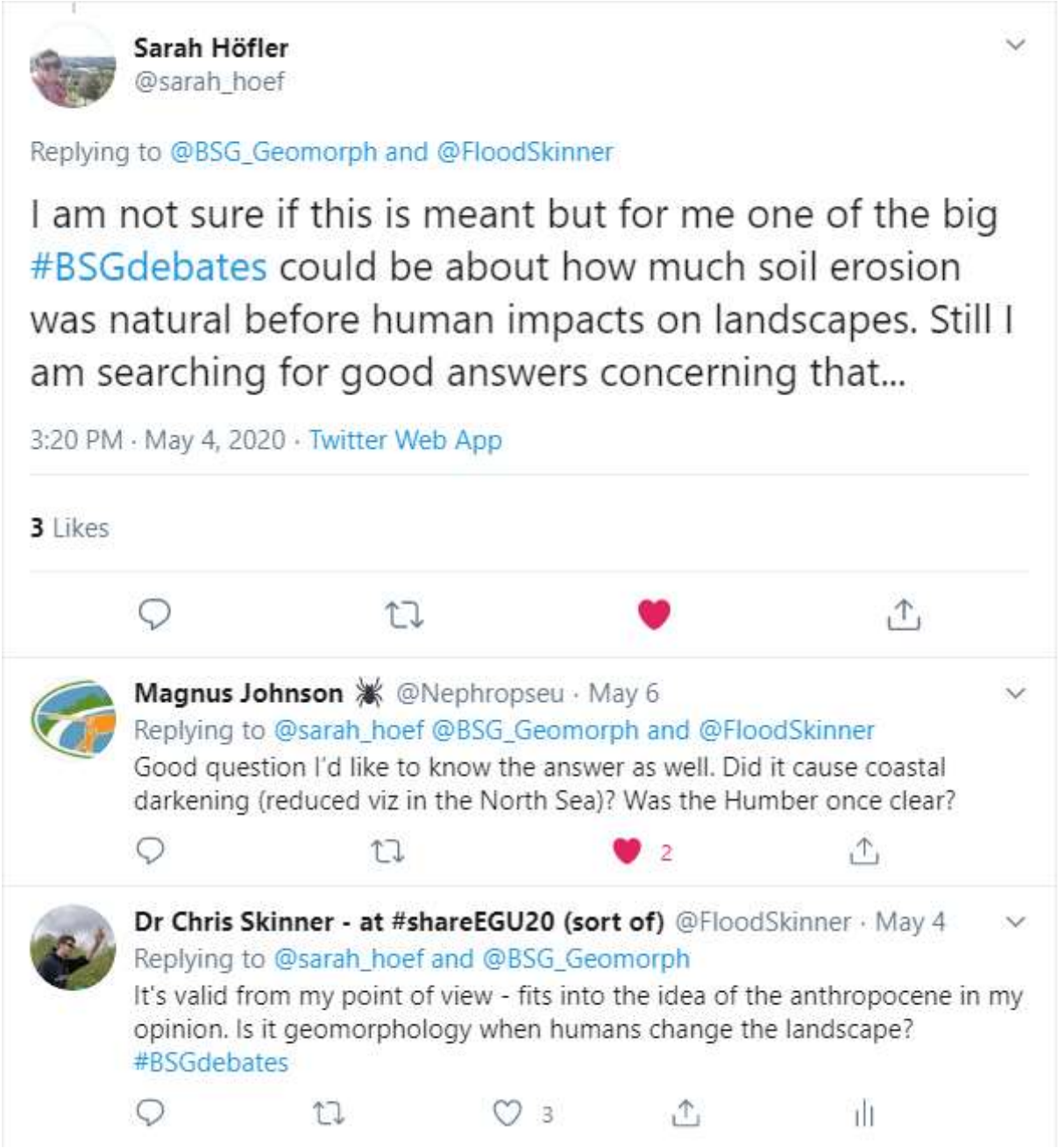
And following on from this it was asked at what scales we needed to look at to understand how landscapes form, considering that these changes occur over large areas and very long times, yet they are driven by processes and events that are much smaller and quicker.



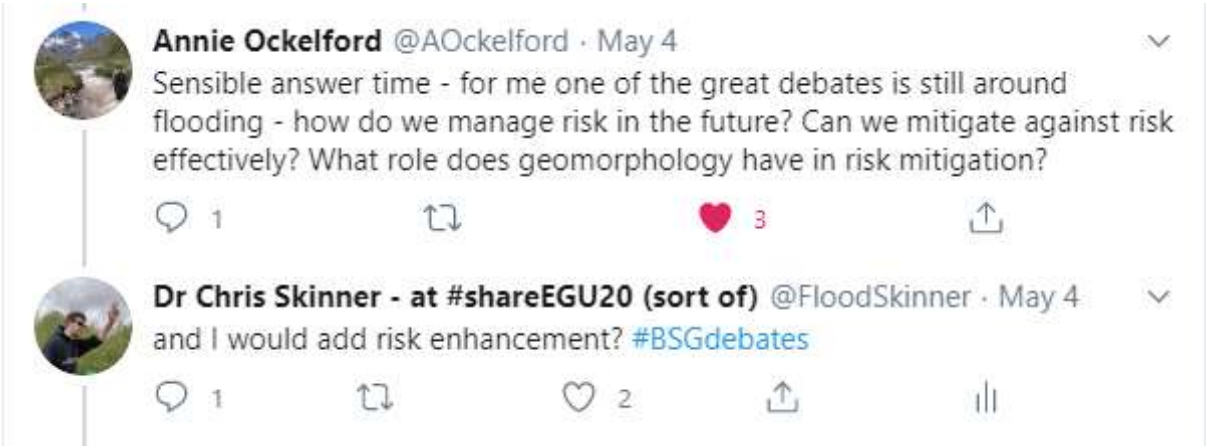
Even if we answered these questions for landscapes on Earth, how can we use this knowledge to better understand landscapes on other planetary bodies - are the processes and physical laws as we know them for Earth applicable when trying to understand how channels form on Mars - would a Martian river behave the same of a terrestrial one?



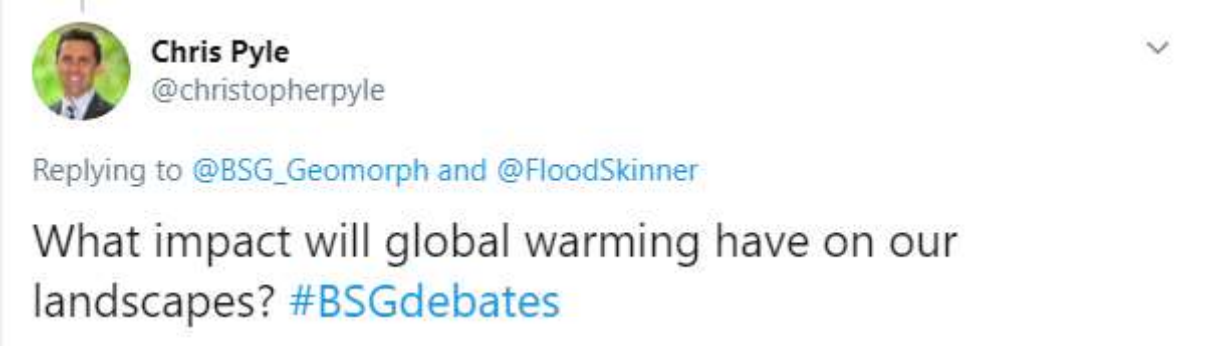
Others looked closer to home and questioned to what extent our actions as society are affecting geomorphology. With us moving into the geological era of the Anthropocene, humans are the dominant influence on the environment - are we a geomorphological agent?



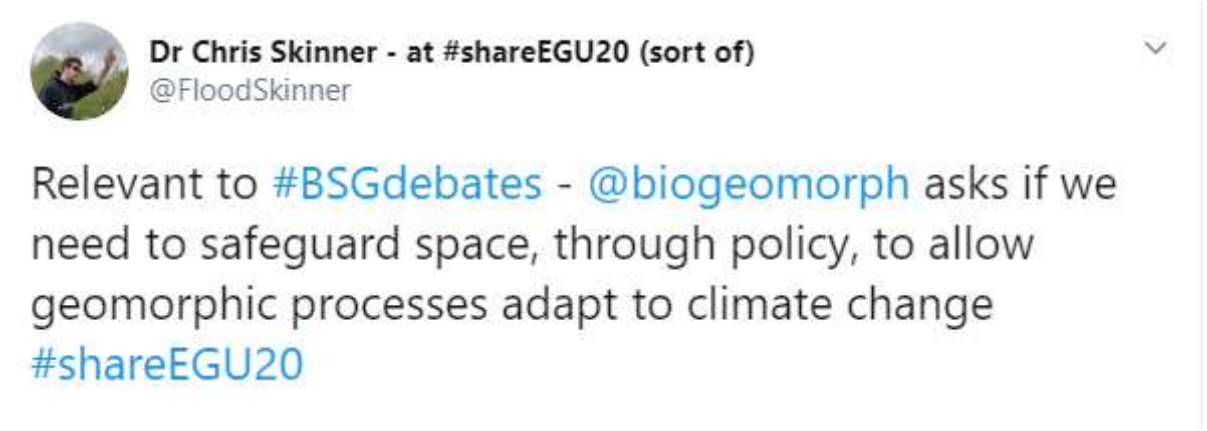
For example, how much of the sediment in our rivers today is there naturally and how much is there because the way we farm is causing erosion of soil. At a continental scale, is it possible for our actions to change the visibility of an entire sea?



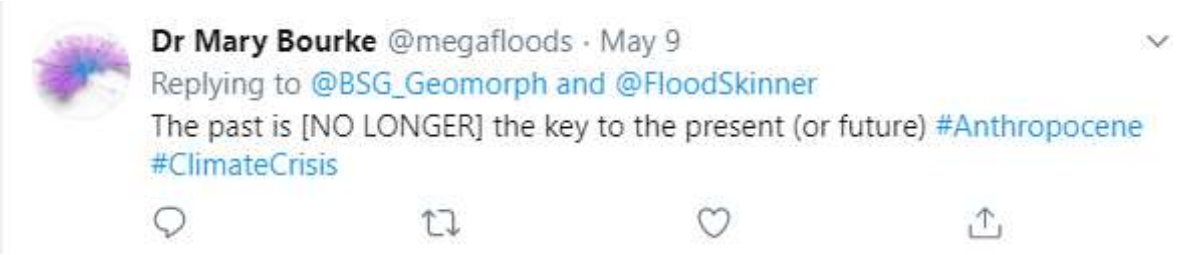
Relating to my own research, as rivers change so does the likelihood of them flooding and also the severity of flooding when it does happen. Can we use geomorphology to our advantage to help reduce the chances and damages of flooding?



At a global level, our actions are changing the climate and this will inevitably have an impact on our landscapes, both in the short and the long term. But what exactly will that impact be.



How do we adapt to it - do we have to start thinking now about how we are going to manage future changes to keep people and properties safe? For example, if increasing rainfall causes rivers to change more frequently and dramatically, do we need to start moving towns and cities away from the edges of rivers to give them space to move?



Finally, are the changes we have wrought, and will continue to make, meaning that the way landscapes change is so fundamentally different that looking to the past, and how they have changed previously, is no longer useful for understanding how they will change in the future?

So, having watched the discussion evolve over the last week, I think we have four themes we can turn into debates -

1. How do our landscapes change?

How does the process of landscape formation get started? Do they change through small and often processes or large and rare ones? Is it the same everywhere? How does it vary around the world?

2. What are main drivers for landscape change?

What processes dictate how our landscapes look? Is it tectonics or climate? What role do plants and animals have on shaping landscapes? How does this change when we look at different scales?

3. How does our understanding of landscapes on Earth help us understand landscapes on other planetary surfaces?

Did Mars once have water? Would glaciers and rivers behave in a similar way on Mars as they do on Earth? What formed the landscape of the Moon? Is the surface of Pluto too different to anything on Earth to make analogies?

4. What is the impact of geomorphology on society and what is the impact of society on geomorphology?

What are the feedbacks? Where is geomorphology one of the driving issues facing society today? And how can we use geomorphology to address some of those?

Over the next four parts we will be conducting these debates on Twitter and putting them together in short videos to share online. Check the BSG Twitter, YouTube, and Website for more news and updates.

Thank you for reading.

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

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