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Earth's surface topography: erosion, climate and teconics

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The Earth's topography is the product of vertical movements resulting from plate interactions and the associated flow in the Earth's mantle, and strong interactions with the overlying hydrosphere. Work accomplished over the past 10 years demonstrates that there exists a subtle balance between these processes resulting from a strong coupling between the solid-earth and the hydrosphere. This coupling takes place at the interface between the two systems by fluvial, glacial and hillslope processes. The rise of mountain belts and continental plateaux is known to perturb atmospheric patterns at the local and global scales leading to changes in precipitation and thus erosion rate. In turn, erosion can be regarded as a process by which surface topography gradients are lowered resulting in a redistribution of stresses within the underlying lithosphere and a perturbation of flow/deformation in the solid Earth. Therefore erosion affects tectonics.

In this presentation, I will show how the results of numerical simulations of the complete hydrosphere-lithosphere system have demonstrated the efficiency of the coupling between erosion and tectonics. I will then proceed to illustrate through a series of examples chosen in a variety of tectonic and climatic environments, how we can estimate the rate at which topography is created by tectonic processes and destroyed by erosional processes, in part through the use of rock dating techniques and their interpretation by sophisticated numerical models. From these estimates, one can determine the nature and strength of the coupling between solid Earth and hydrosphere in a variety of tectonic and climatic environments.