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Continental hydrology and its linkages to the marine realm and organic rich sediments – from the Late Cretaceous greenhouse to the Future

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Comparison of numerical model simulations for the Late Cretaceous, present day, and the future suggest both an enhanced hydrological cycle and a fundamental change in the relation between surface and subsurface runoff during past and future greenhouse times.

Nine climate simulations have been run for the Late Cretaceous (5 models using 6 times modern atmospheric CO_2 and four different orbital configurations representing one full precessional cycle), the present (1 model), and the future (3 models using modern geography; (1) 6 times modern atmospheric CO_2 (2) plus Cretaceous soil composition, and (3) plus Cretaceous vegetation.

The paleoclimate simulations of the Cretaceous suggest that on a global scale total river discharge was increased by $\sim$34%, surface runoff was reduced by $\sim$33%, and subsurface runoff was enhanced by $\sim$60% compared to today. Similar proportions have been simulated for the future if CO_2 continues to rise to Late Cretaceous values (i.e. 6 times modern values) using soil composition and vegetation as for the Late

Cretaceous.

To validate these past and future models we compare the results from the present day model run with instrumental data from hydrographic measurements. We observe strinking similarities between modelled and measured data both on a global and regional scale supporting the conclusion that current GCM do well represent natural conditions.

As suggested by the geological record, these findings emphazise the importance of changes in the hydrological cycle at different scales as they enhance deep chemical weathering, in particular under tropical conditions. As a result these processes are expected to result in enhanced continental nutrient export to the coastal ocean, strongly affecting ocean chemistry (O_2 CO_2, C, and nutrient cycling) and impacting on future climate change. This study highlights the crucial role of terrestrial-marine interactions both for past and future climate change.