Contemporary changes in continental runoff: evidence for increased sediment and freshwater fluxes into the Great Barrier Reef

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Contemporary environmental change is having a profound effect on river catchments and the resultant chemical and physical fluxes that are entering the oceans. Large-scale landuse changes, such as more intensive cultivation, pastoral grazing, mining, urbinisation and land clearing, have resulted in increased erosion and globally higher sediment and associated nutrient fluxes entering the oceans. On geological timescales higher sediment fluxes may provide a feedback to CO_2 draw-down, through increased carbon burial on the continental shelves together with higher rates of Ca-Mg mineral-solution silicate weathering reactions. Although there is also persausive evidence for greater freshwater discharges to the oceans, the likely causes are more complex, being attributed to landuse changes, reduced evaporation due to 'solar diming' from aerosols or increased water-use efficiency in plants by the reduction of stomatal aperatures in response to higher atmospheric pCO_2.

In the Great Barrier Reef (GBR) of Australia, contemporary changes in suspended sediment loads delivered to the reef, have been reconstructed using Ba/Ca ratios preserved in long-lived (300-400 year old) *Porites* coral. The onset and magnitude of Ba/Ca peaks measured in corals by laser ablation ICPMS, coincides with the timing of river flood plumes entering the reef, with the area of the peaks being approximately proportional to the total sediment discharge. The coral Ba/Ca records show a five- to tenfold increase in the sediment load delivered to the GBR following European settlement, with the situation being further exacerbated during drought-breaking floods. There is also a close correpondence between high cattle numbers, especially during the mid-late 1970's, and increased sediment fluxes.

Long-term variations in water discharge volumes into the inshore GBR have been quantified using a combination of oxygen isotope and Sr/Ca tracers in corals, reflecting changes in near-shore salinity. This indicates that since European settlement, freshwater runoff into the inner GBR has increased twofold. The correlation between increased freshwater runoff and sediments loads shows that both are primarily a consequence of landuse changes such as reduced vegetation cover and compacted soils, hence reduced rates of water infiltration and greater erosion.

These results are in contrast to global-scale models of terrestrial runoff that suggest increased water-use efficiency by plants is the major cause of enhanced freshwater inputs to the oceans. Furthermore these changes are having major deleterious impacts on coral reef ecology which more than outweigh any potential longer-term benefits, such as draw-down of atmospheric CO_2.