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Land cover impact on bicarbonate fluxes in North American rivers

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Chemical rock weathering is an important sink for atmospheric CO_2, which is transported in river water generally as bicarbonate (HCO_3^-). An empirical forward model is presented that estimates HCO_3^- fluxes using the predictors runoff, lithology and land cover. The model was calibrated on 338 catchments in North America with an average size of 5600 km^2. The applied land cover data are classified in ten classes of which five cover 98 % of the calibration area. Three of those (managed lands, grasslands and shrubs) are included in the model equation. Despite of holding only a very small proportion of the calibration area, urban areas are included as fourth land cover class.

The correlation coefficient between observed and predicted HCO_3^- fluxes is r=0.84. The model confirms runoff and lithology as major predictors for HCO_3^- fluxes. Forested as well as minor land cover classes act as reference value for land cover impact. Compared to these reference classes, the model suggests HCO_3^- fluxes from managed lands, grasslands and shrubs to be increased by a factor of 1.77, 2.08 and 5.91, respectively. According to the model, the largest increase of HCO_3^- flux results from urban areas, with a HCO_3^- flux 36.6 times as high as the reference land cover classes, for comparable lithology and runoff conditions.

However, correlations between land cover and other spatial parameters (e.g. climate or topography) may cause the observed differences between land cover classes. The reasons leading to the results shown are still subject of further investigation. In conclusion, land cover should be considered to improve continental or global scale models of HCO_3^- fluxes induced by chemical weathering.