Riverine Inputs of Inorganic Carbon to Coastal Waters of High Tropical Islands: The Example of Hawaii

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The CO_2–carbonic acid system dynamics of tropical coastal regions are complex, particularly in estuaries and lagoonal settings of high islands with coral reefs. The role of freshwater dissolved inorganic carbon (DIC) fluxes from such high islands in carbon cycling and exchange with the atmosphere in the nearshore zone remains especially poorly constrained. In this presentation, we review studies conducted in Hawaii of freshwater DIC inputs to coastal areas from streams and wetlands during low flow and high runoff conditions. This work shows that coastal inputs of DIC reflect a complex interplay between the intensity of weathering of inorganic and organic materials in the soil/rock source of DIC, river and groundwater discharges, in-stream biological processes, land use change in adjoining watersheds and gas-exchange with the atmosphere. We examine the connections between the freshwater systems and receiving waters and how the freshwater DIC inputs impact fluxes of CO_2 between the waters and the atmosphere. One important conclusion is that, during mixing of freshwater with seawater, the "salting out effect" generally causes degassing of CO_2 to the atmosphere in the coastal proximal zone. However, the remaining freshwater DIC plume, depending on various factors such as the intensity of runoff, physical mixing, and biogeochemical reactions, may be transported into and through the distal coastal zone. Finally we extrapolate the results from Hawaii to other tropical and subtropical high islands of the Pacific and estimate their contribution to the flux of DIC to the tropical coastal zone.