Turbulent forces within river plumes affect spread

August 8 2012

When rivers drain into oceans through narrow mouths, hydraulic forces squeeze the river water into buoyant plumes that are clearly visible in satellite images. Worldwide, river plumes not only disperse freshwater, sediments, and nutrients but also spread pollutants and organisms from estuaries into the open ocean. In the United States the Columbia River, the largest river by volume draining into the Pacific Ocean from North America, generates a plume at its mouth that transports juvenile salmon and other fish into the ocean. Clearly, the behavior and spread of river plumes, such as the Columbia River plume, affect the nation's fishing industry as well as the global economy.

A delicate balance between density and velocity controls turbulent mixing within the plume and how far river plumes extend into the deep ocean. On the other hand, coastal winds and currents affect the shape and orientation of the plumes. However, current understanding of momentum changes along a river plume is limited by poorly constrained numerical models and sparse remote sensing data.

In a new study, Kilcher et al. document velocity, density, and turbulence along the centerline of the Columbia River plume at a high resolution for 10 tidal cycles. The authors find that turbulence varied by 2 to 3 orders of magnitude within a single tidal cycle as well as between cycles. The authors also show that turbulence, which is most vigorous at the beginning of the strongest ebbs, dramatically reduces the velocity of water at the river mouth. The quickly decelerating plumes tend to spread less into the deep ocean. Their observations supplement satellite data and

could help to fine-tune numerical models that predict the behavior and spread of river plumes as they drain into coastal waters.

More information: "The role of turbulence stress divergence in decelerating a river plume" *Journal of Geophysical Research-Oceans*, doi:10.1029/2011JC007398 , 2012

Provided by American Geophysical Union