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Local to global data gaps for assessment of water and substance fluxes to oceans and the atmosphere

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About two thirds of the water precipitated over land returns to the atmosphere via evapotranspiration. Most of the remaining water, flows eventually from land to sea, transporting with it various dissolved substances and pollutants. Human induced effects, such as land cover and use changes, water withdrawal and infrastructure developments may all have considerable global effects on such water, vapour and substance fluxes from land to sea and the atmosphere. For understanding these effects and fluxes an extensive, relevant and up-to-date set of base data is required. Going from the local to the region scale in a well monitored part of the world to the global scale we identify critical data gaps for monitoring water, vapour and substance fluxes. We study in particular detail catchment areas for which core observation data are unavailable (unmonitored areas) or inaccessible. Unmonitored catchment areas in Sweden and the Baltic Sea Drainage Basin (BSDB) were found to have quite different land cover and population characteristics compared to monitored catchment areas, indicating possible misleading and uncertain coastal runoff and pollutant load estimates. Specifically results show that areas with high population densities are systematically left unmonitored. 24 % of the total BSDB population, living in 13% of the total area are found in catchment areas unmonitored by national environmental monitoring program. For Sweden the unmonitored population is as high as 55%, even though 80% of the Swedish land area is covered by relevant monitoring. On the global scale we analyze if high population pressure, land cover variability and general uncertainty in quantification of water, vapour and substance fluxes in unmonitored coastal catchment areas reflect only particular conditions or are indicative of more general global conditions. Results show that the accessibility of necessary data for realistically understanding and quantifying such fluxes has been decreasing dramatically all over the world. Most of the decrease

is in population-rich and thus particularly water-demanding and pollution-producing coastal catchment areas. Necessary land cover data for independent calculation of vapor fluxes to the atmosphere and related freshwater runoff to oceans is further found to largely differ between available remotely sensed land cover databases. The results indicate potentially high and increasing uncertainties for continental to global scale assessments.