Title: Mapping the capacity of watersheds to regulate floods

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Abstract

Scientific knowledge about ecosystem services (ES) – the benefits people derive from nature – is increasingly being used to inform how we manage land and water. A globally important ES, especially in the context of rapid urban development, is the ability of landscapes to regulate floods. Flood regulation capacity is determined not only by biophysical features such as soils and land cover that facilitate water infiltration, but also by technological features such as reservoirs and farm ponds that retain surface water. These technological features may replace and/or enhance an ecosystem's natural flood regulation capacity but their distribution are rarely represented in maps of ES. In this study we quantify and map the biophysical and technological features that contribute to flood regulation, then compare their distributions across urban watersheds.

We selected eight urban, small watersheds (≤ 31 mi^2) in North Carolina and mapped the biophysical (i.e. water infiltration, retention and storage potential) and technological features (i.e. flood-control structures and artificial waterbodies). We derived indicator importance factors for biophysical and technological indicators using long-term flood records. Based on the indicator importance factors, we mapped the biophysical and technological components and standardized each from 0 to 1 (one representing the greatest flood regulation capacity).

We found that our overall measure of biophysical and technological capacity responded observed flooding records (greater capacities were associated to lower flood magnitude and longer flood duration). This study presents an improvement on previous efforts to map flood regulation by: (1) including technological features in ES mapping efforts, (2) use long-term hydrologic records to derive indicator importance factors, and (3) map technological and biophysical flood regulation capacity. Our study presents an innovative effort to spatially represent both the natural and technological features contributing to flood regulation.