Coastal Hazards as Pollution Drivers: From Extreme Events to Environmental Risks

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Coastal regions concentrate populations, critical infrastructure and environmental contamination, while being highly exposed to natural hazards. By 2030, roughly half of the world's population is projected to live in coastal areas, and sea-level rise and climate change will further increase exposure to storm surges and flooding. Yet extreme events are still assessed primarily in terms of physical damage, even though they can also act as powerful drivers of pollution.

Floods, storm surges and tsunamis differ in their triggers but share a common mechanism, they mobilize water, sediment, debris, sewage, persistent organic pollutants and legacy contamination, rapidly connecting environmental compartments across the land-to-sea interface. The result is a cascade extending from contaminant mobilization and direct exposure to redistribution and long-term environmental risk.

Evidence from coastal hazards-affected regions illustrates these processes. On land, contaminants such as DDT metabolites, PCBs, PAHs and linear alkylbenzenes reveal distinct pollution sources, damage patterns and transport pathways, while topography and backwash control the spatial redistribution of contaminants. Offshore, sediment records show that gravity flows can remobilize contaminated shelf and slope sediments and transport pollutants to water depths of 8 km.

Linking coastal hazards with contaminant fate and transport highlights the need to recognize extreme events as pollution events in environmental risk assessment, monitoring, preparedness and coastal management. Addressing this challenge requires close collaboration across geoscience, environmental chemistry and ecotoxicology.