Flood control structures, such as levees, often reduce the perception of risk, encouraging human settlements in floodplain areas. This circumstance, often denoted as levee effect, exposes the population to a residual risk, for instance when a breach occurs in the levee during a significant flood. Hence, we developed a risk-based framework in order to define the above residual risk based on Varnes formula. We analyzed the risk in two scenarios: (i) before, and (ii) after the building of control structures; it is made up of three main components: (i) a structural term, linked to the probabilistic nature of the phenomenon, (ii) a dynamic term, which expresses the hydraulic component of risk, and (iii) an anthropic term, that represents human dynamics in the floodplain. We applied the framework to a synthetic model of the Arrone river near Rome (Italy) for the analysis of the residual risk after the formation of a breach for piping in the levee. We performed extensive numerical simulations of flood propagation due to random breaches, along a Monte Carlo approach. The application example shows that the proposed risk analysis can be a relatively simple and valuable tool for analyzing the residual risk, along a rational and sound framework.

Membrane Protein Nanosheet-Based Biomimetic Membranes
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Biological membranes incorporating membrane protein (MP) channels exhibit high permeability and selectivity because they possess channels with well-defined pore geometry and functionality designed to exclude or pass specific components. Nevertheless, these membranes studied thus far have been limited to small improvements due to the use of vesicular morphologies, low protein insertion, and unstable structures in synthesizing such membranes. In this presentation, we will demonstrate the development of high-performance biomimetic membranes based on robust and flat nanosheets with densely packed MPs in block copolymers. These well-ordered crystalline structures and nanosheets were constructed by a novel 2-hours solvent evaporation method and further supported on a porous substrate as selective layers by a modified layer-by-layer technique. Three passive MP channels with inherently narrow and uniform pore sizes of ~ 0.8, 1.3 and 1.5 nm were tested in this work. These biomimetic membranes demonstrate 20-1,000 times greater water permeability than commercial membranes with comparable molecular exclusion ratings, thus providing a superior alternative to the energy reduction in chemical and biological separations in the challenging nanometer size range.