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I will discuss some recent results on the interplay between geometry and topology, and between Morse theory and persistent homology, in the setting of geometric complexes. This concerns constructions like Rips, Čech, Delaunay, and Wrap complexes, which are fundamental construction in topological data analysis. The tandem of Morse theory and homology shows the topological equivalence of several of these constructions, helps in speeding up their computation by a huge factor (in the software Ripser), reveals thresholds at which homology necessarily vanishes (with links to a classical result by Rips and Gromov), and relates optimal representative cycles for persistent homology to the industry-tested Wrap reconstruction algorithm.

Joint work with Fabian Roll (Technical University of Munich).