Biologically Relevant Chemical Space:

From Characterization to Predictive Modeling

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The concept of chemical space provides a multidimensional framework to organize molecules according to their structural and functional properties. Within this universe, the Biologically Relevant Chemical Space (BioReCS) encompasses compounds with measurable biological effects, beneficial or detrimental, across domains such as drug discovery, agrochemistry, food chemistry, and toxicology. In this lecture, I will present an integrative view of BioReCS, highlighting its heavily explored regions (e.g., drug-like molecules and peptides) as well as underexplored subspaces, including metallodrugs, macrocycles, and beyond-Rule-of-5 compounds. Particular attention will be given to key methodological challenges, such as descriptor selection, pH-dependent properties, integration of inactive (“dark”) chemical matter, and the expansion of BioReCS through generative models. Building on this conceptual framework, the talk will present case studies illustrating how navigation of BioReCS enables the development of predictive models across diverse datasets, including small molecules, peptides, and metal-containing compounds. These examples will demonstrate how hybrid computational workflows and machine learning approaches can enhance biological interpretation, improve coverage of underrepresented subspaces, and support rational exploration of biologically meaningful regions of chemical space.