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From disk midplanes to exoplanet atmospheres. The volatile chemical link.

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Exoplanetary science is now pushing to constrain the atmospheric compositions of exoplanets. This quest will be further aided by the next generation of facilities, such as the JWST and ground-based ELTs. Linking the observed composition of exoplanet atmospheres to where and how these atmospheres formed in their natal protoplanetary disks often involves comparing the observed exoplanetary atmospheric carbon-to-oxygen (C/O) ratio to a model of a disk midplane with a fixed chemical composition. In this scenario, chemical evolution in the midplane prior to and during the planet formation era is not considered. The C/O ratios of gas and ice in the disk midplane are simply defined by icelines of volatile molecules such as water and CO in the midplane. However, kinetic chemical evolution during the lifetime of the gaseous disk can change the relative abundances of volatile molecules, thus altering the C/O ratios of the planet-forming material. In my chemical evolution models, I utilize a large network of gas-phase, grain-surface and gas-grain interaction reactions, thus providing a comprehensive treatment of chemistry. In my talk, I will outline how such chemical reactions can cause the chemical composition in the disk midplane to evolve, how this affects the C/O ratios of the gas and solid material that form planets, and how such changes to the midplane chemical composition can lead to differences in exoplanet atmospheric compositions. These differences in exoplanet atmospheric compositions may be discernible with JWST observations.