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Uncertainties propagation in planetary atmospheres modeling: consequences for Titan

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Uncertainties carried by the different kinetic parameters included in photochemical models of planetary atmospheres have rarely been considered even if they are supposed to be contributing mostly to the inconsistencies between observations and computed predictions. We report here the first review of the uncertainties carried by the different photochemical rates coefficients included in an up-to-date photochemical model of Titan's atmosphere. Monte-Carlo calculations performed on these coefficients were used to introduce their uncertainties in order to investigate their significance on the photochemical modeling of Titan's atmosphere. We conclude that overall modeling uncertainties related to photochemical rates coefficients are important enough to question any comparisons with observations and any conclusions subsequently inferred, especially in the frame of the latest missions, such as Cassini-Huygens. Promoting low-temperature kinetic studies of hydrocarbon reactions coupled to low-temperature spectroscopic investigations would greatly assist in developing planetary atmospheric models that more accurately -and usefully- reproduce observations. Whatever the stakes are, our conclusions show that it is crucial to reform the way we think of, and use, current photochemical models to understand the processes occurring in the atmospheres of the outer solar system.