DECIPHERING HOT EXOATMOSPHERES WITH THE ATMOS PHOTOCHEMICAL MODELING TOOL FOR FUTURE MISSIONS. Mahmuda Afrin Badhan[2,1], Ravi Kumar Kopparapu[2,1], Shawn Domagal-Goldman[1], Eric Hébrard[3], Drake Deming[2], [1]NASA Goddard Space Flight Center, Greenbelt MD, MD, USA, [2]University of Maryland College Park, College Park, MD, USA, [3]University of Exeter, Exeter, UK.

Abstract: Unique and exotic planets give us an opportunity to understand how planetary systems form and evolve over their lifetime, by placing our own planetary system in the context of vastly different extrasolar systems. In particular, close-in planets such as Hot Jupiters provide us with valuable insights about the host stellar atmosphere and planetary atmospheres subjected to such high levels of stellar insolation. Observed spectroscopic signatures from a planet reveal all spectrally active species in its atmosphere, along with information about its thermal structure and dynamics, allowing us to characterize the planet's atmosphere. NASA's upcoming missions will give us the high-resolution spectra necessary to constrain such atmospheric properties with unprecedented accuracy. However, to interpret the observed signals from exoplanetary transit events with any certainty, we need reliable atmospheric modeling tools that map both the physical and chemical processes affecting the particular type of planet under investigation. My work seeks to expand on past efforts in these two categories for irradiated giant exoplanets, and extend the capability of latest tools probing rocky planet atmospheres to bigger and hotter planets [1]. My atmospheric models can be combined with future mission simulations to build tools that allow us to self-consistently "retrieve" the signatures we can expect to observe with the instruments. In my work thus far, I have built the robust Markov Chain Monte Carlo convergence scheme [2], with an analytical radiative equilibrium formulation to represent the thermal structures [3, 4], within the NEMESIS atmospheric radiative transfer modeling and retrieval tool [5, 6, 7]. I have combined this physics-based thermal structure with photochemical abundance profiles for the major gas atmospheric constituents, using the NASA Astrobiology Institute's VPL/Atmos photochemical model, which I recently extended to giant planet regimes. Here I will present my new Hot Jupiter models and retrievals results constructed from these latest enhancements, and use them to discuss what we can reliably expect to extract from the upcoming JWST mission. I will discuss how my work applies to model development efforts for future mission observations of potentially habitable rocky worlds, such as LUVOIR and HabEX, by enabling robust studies that will leverage the use of a suite of models of different types of planets.

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