Modeling Triton's Seasonal Atmospheric Change: Applications of the VT3D Model to Triton

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The seasonal cycling of volatile nitrogen, methane, and carbon monoxide ices from pole to pole causes significant changes in Triton's atmospheric pressure. The ability to model these changes is crucial for planning missions to Triton and understanding more about planetary bodies with volatile cycles. For my research, I adapted a simple analytic energy balance model called VT3D that was originally developed for Pluto and used it to investigate how Triton's atmospheric pressure evolves over time. I then compared my results to those of Bertrand et al. (2021), who used a general circulation model, or GCM. Using different models to investigate Triton's atmospheric change is critical in verifying that the results do not depend on the type of model used. I performed two experiments with the VT3D model: one where I investigated the effects of varying volatile ice distribution, and another where I conducted a parameter space search to determine which geophysical parameter values were needed to best match a range of telescopic observations of Triton's atmosphere. In both experiments, I analyzed the similarities and differences between the predictions of VT3D and the GCM. I found many similarities between the results of the two models, including similar minimum and maximum pressures and responses to varying the northern volatile cap extent. The shared predictions are now supported by more than one model, which is evidence that they are not model-dependent. Overall, my research gives us more confidence in our predictions of the atmospheric dynamics of Triton and other planetary bodies with volatile cycles.

Awards Won:

Arizona State University: Arizona State University ISEF Scholarship (valued at up to $52,000 each)