Triton and Pluto: A comparison of changes in ground-based photometry

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Voyager II observations of Triton revealed it to be a geologically active satellite with at least two erupting plumes, numerous plume deposits, and a polar cap that is predicted to wax and wane in a seasonal cycle. A long term record of seasonal change, and possibly geologic activity, on Triton is provided by telescopic observations of Triton's albedo, rotational lightcurve, and color through time (Buratti et al., 1994). Changes in the amplitude of Triton's lightcurve since the Voyager encounter in 1989 suggest sustained activity on it within the past decade (Cobb et al., 2001).

Triton is often considered an analogue to Pluto, even though important differences between the two bodies exist. For example, Triton has a much higher geometric albedo, an attribute of freshly deposited volatiles, and it lies close to a giant planet that acts to induce tidal bulges and internal heating. In any case, might a study of spectrophotometric changes on Pluto, similar to that done for Triton, be undertaken to uncover signs of geologic activity or volatile transport on its surface? One difficulty for both objects is that substantial changes in their albedos, lightcurve amplitudes, and possibly color, are expected as the subsolar and sub-Earth points on their surface constantly vary. We have developed a model that fully accounts for this effect. In the case of Triton, Voyager images have been used to map the albedo variegations, while for Pluto, an HST map has been employed (Stern et al., 1997). When these corrections are taken into account, Triton still shows substantial changes in its color and the amplitude of its lightcurve during the past 25 years. However, the significant changes in the amplitude of Pluto's lightcurve can be explained by the effects of viewing geometry alone. For both objects, albedo is the most difficult parameter to measure, because absolute errors are typically 10% (for current measurements) to 15-20% (for historical measurements).

Even though there is no photometric evidence for either volatile transport or geologic activity on Pluto (at least in the past 50 years!), it is important to fully document its spectrophotometric characteristics in the next several decades. The critical time for possible changes on Pluto is now, as it moves away from perihelion.

Funded by NASA at Jet Propulsion Laboratory, California Institute of Technology.

References

Buratti, B. J., J. D. Goguen, J. Gibson, and J. Mosher 1994. Historical evidence for volatile migration on Triton. Icarus 110, 303-314.

Cobb, B. E. et al. 2001. The BVRI lightcurve and opposition phase curve of Triton in 2000. DPS 2001 talk.

Stern, S.A., M.W. Buie, L.M. Trafton 1997. HST High-Resolution Images and Maps of Pluto. AJ, 113, 827-843.