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Monitoring Neptune's atmosphere with small and large telescopes: results for 2019

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Neptune’s atmosphere is highly dynamic with atmospheric systems observable as bands and discrete cloud systems that evolve in time scales of days, weeks and years. Most of them are observed as tropospheric clouds and elevated hazes that appear highly contrasted in observations obtained in hydrogen and methane absorption bands in the red and near-infrared spectrum of the planet. Given the small size of Neptune as observed from Earth (2.3 arcsec), it is difficult to characterize most of these clouds. Basic questions such as if they are convective storms, vortices or clouds detached from atmospheric waves or bands can be difficult for an specific feature in a given observation. Only Adaptive Optics or lucky-imaging instruments in 8-m telescopes or larger, and HST, can provide suitable data, but the difficulty to access enough observational time in these facilities suggests that a combination of data from several observing programs can help. Smaller telescopes can also play an important role since they can be used to follow the main cloud systems and cover the gaps between observations obtained by the larger telescopes. This can provide the life-time or drift rates of the largest meteorological systems allowing to compare observations of the same features observed months apart in the largest telescopes.

During the last few years we have combined observations obtained from a variety of telescopes to study the major cloud systems and understand their life-time and evolution [1, 2], including those of “companion” clouds linked to rare dark vortices that are only observable in blue wavelengths from space [1, 3, 4]. In this work we present our data for 2019 which consists of the following observations:

- HST observations from the Outer Planets Atmospheres Legacy program (OPAL).
- Several sets from Keck and Lick telescopes from different programs including some relatively frequent observations from the TWILIGHT program.
- GTC observations with the HiperCam instrument doing lucky-imaging.
- Calar Alto 2.2m telescope with the PlanetCam lucky-imaging instrument.

- One single observation from Gemini while testing an AO system.
- Additional observations from the Pic du Midi 1.05 m telescope.
- Images provided by amateur astronomers and available through the PVOL [5] database.

The combination of these data suggests more variability and less cloud activity in 2019 than in previous years with a lower number of features in the data sets obtained with smaller telescopes. We provide the identifications of particular meteorological systems over late summer 2019 and present drift rates of different mid-latitude features in the south hemisphere that are close but separated enough to the Voyager zonal winds to deserve attention. Other cloud systems in the south polar region and north tropics seem to follow the Voyager wind profile.

Future punctual observations achievable with new observational facilities such as the JWST will benefit from the evolutionary time-lines of the major cloud systems of Neptune and their drift rates in the atmosphere provided by similar future campaigns.

References

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