PLUTO DATA BEFORE AND AFTER NEW HORIZONS: THE TAKEAWAY FOR FUTURE OBSERVATIONS. C. M. Dalle Ore[1,2], M.A. Barucci[3], and S. Fornasier[3], D. P. Cruikshank[2], W. M. Grundy[4], and S. Protopapa[5] ,[1]SETI Institute, Mountain View, CA (cmdalleore@gmail.com); [2]NASA Ames, Moffett Field, CA; [3]LESIA, Observatoire de Paris, 92195 Meudon Principal Cedex, France; [4]Lowell Observatory, Flagstaff, AZ; [5]Southwest Research Inst., Boulder, CO.

Introduction: Pluto is the largest of the transneptunian objects (TNOs), a group consisting of thousands of objects that populate the 'third zone' of the Solar System, after the terrestrial and giant planet zones. Because of its location and size Pluto offers the unique advantage of having been investigated both as an unresolved point of light, i.e., as a TNO, and recently, as the target of the New Horizons flyby, close up with high spatial resolution and spectral mapping.

Pluto has been observed over time with ground-based instruments that have yielded an overall preview of a varied world with intriguing variations in albedo and subtle but important spectral changes. The ground-based observations have given us tools to gauge the importance of the observed changes by providing temporal and therefore contextual information to the *in situ* data that New Horizons provided during the 2015 flyby.

The Pluto flyby has confirmed the previously predicted variations in albedo, so far paralleled in the Solar System only by Iapetus, and has also linked them to impressive geological and compositional features that herald processes that could not have been foreseen with only remotely sensed data.

Spectral Data Before and After New Horizons: When comparing spectral data obtained before and after the New Horizons flyby it is evident that only high spatial resolution can yield the information needed to constrain the physical and geological properties of the surface. This is demonstrated clearly in Figure 1 where ground-based spectra taken over the time span 2001-2012 with IRTF/SpeX [1] are compared to those obtained *in situ* during the flyby [2]. For instance, the spectrum taken by [1] (Fig. 1, green spectrum on the left bottom panel) provided a good view of Cthulhu, corresponding to the New Horizons spectrum marked by the letter 'c' (Fig 1, right side). However, because ground-based spectra represent an entire hemisphere of Pluto, this spectrum includes a wide variety of terrains. Further, much of Pluto's surface is rich in CH_4, whose spectral signature is dominant over that of the almost featureless dark material, and even that of the icy regions where the much weaker N_2 and CO absorption bands occur. It is partly for this reason that data taken with only hemispheric resolution before the flyby show relatively little spectral variation, hinting at a degree of homogeneity that is not representative of the great variety seen with the spatial resolution achieved in the New Horizons data.

Conclusions: From the comparison of data taken before and after New Horizons one of the takeaways is that subtle longitudinal variations in ground-based data can correspond to dramatic variations at regional scales. While the amount of information provided by New Horizons on Pluto is immense its impact on the rest of the TNOs future data gathering is also very important. We present what we have learned in the comparison of before and after New Horizons observations and we draw conclusions on how we should proceed with future observation planning of TNOs.

References:

[1] Grundy, W.M., Olkin, C.B., Young, L.A., Buie, M.W., and Young, E.F. 2013. Icarus, 223, 710-721. [2] Protopapa, S., Grundy, W.M., Reuter, D.C., et al. 2017. Icarus, 287, 218-228.

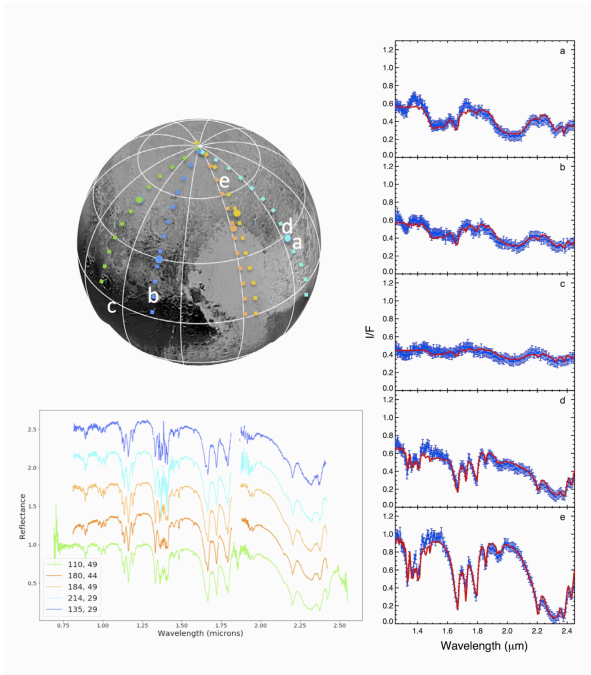

Figure 1. Left top panel: Geographical location of the spectra considered in this work. Left bottom panel: Ground based observations of Pluto taken in the time period of 2001-2012 [1]. Right panel: spectral averages of pixels sampled in the regions marked on the map with corresponding letters [2].

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