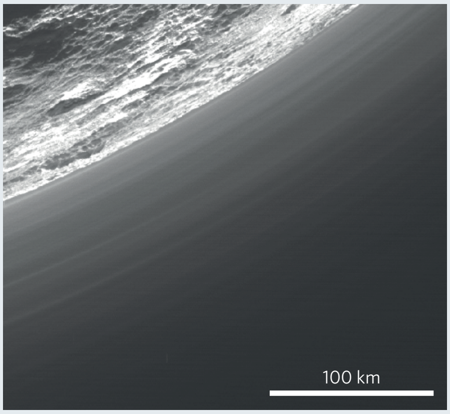
PLANETARY ATMOSPHERES

Layers of complexity

When the New Horizons spacecraft looked back at Pluto a short time after the closest encounter, it obtained one of its most iconic images of the dwarf planet. It observed a bright bluish ring, which indicated the presence of an extensive haze composed by particles effectively forward-scattering the weak sunlight arriving at Pluto's distance. This finding was one of many surprises from New Horizons, because pre-flyby photochemical models had not anticipated an extended haze system. The first close-ups also showed that Pluto's haze is structured in several fine layers. Planetary scientists immediately remarked on the similarity with hazy Titan, as well as the contrast with Neptune's captured moon Triton, which had been considered up to then the closest Pluto analogue in the Solar System. The full dataset of images from the Long-Range Reconnaissance Imager (LORRI) finally acquired, Andrew Cheng and collaborators now present a detailed study of the behaviour and properties of Pluto's haze (*Icarus* **290,** 112–133; 2017).

The image shows the haze in all its beauty and complexity. About 20 layers were detected within the ~200-km-thick haze, exhibiting varying thickness with latitude, merging, splitting, appearing and disappearing. A dynamic system is thus in place, whose layered appearance is controlled by atmospheric dynamics such as gravity waves generated by surface reliefs. Of course, Cheng *et al.* do not stop at beautiful images, and use the LORRI dataset to constrain the optical properties of the haze and to infer the processes driving its formation and evolution. The resemblance with Titan emerges clearly. The creation of haze particles follows a similar path: high-altitude photochemistry breaks nitrogen and methane into ions that subsequently interact and aggregate into increasingly complex fractal hydrocarbon molecules. Interestingly, this mechanism supports the existence of an ionosphere around Pluto, of which we have only indirect measurements for now. The particles then precipitate onto the surface on timescales of the order of days to weeks.



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Pluto, however, differs from Titan in one key aspect: it undergoes huge seasonal changes during its year because of its eccentric orbit. When Pluto is further from the Sun, the low solar irradiation could induce a collapse of its atmosphere and of haze production with it. This could explain why Pluto's surface is not uniformly coated with sedimented aerosols and instead maintains significant regional differences in albedo. However, we do not yet have a full picture of the mechanisms that can affect Pluto's current appearance, and Pluto's atmospheric collapse is still a debated issue in itself. Nevertheless, New Horizons' observations of Pluto's haze bring an important contribution to comparative planetology of atmospheres, particularly the nitrogen/methane-dominated atmospheres that exist in our outer Solar System.

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