

Are Cloud Bands on Mars Rare?

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Introduction

The atmosphere of Mars is ever changing. White water ice clouds, yellowish dust clouds, bluish limb hazes, and bright surface frosts have been studied with increasing interest in the past decades. We are beginning to think these clouds are related to the seasonal sublimation and condensation of polar caps.

Statistical analysis indicates that water ice-crystal cloud activity and near-surface "fog" occurrence is significantly higher in the Martian Northern spring and summer than the same seasons for the Southern Hemisphere. This period also coincides with periods when the northern polar cap is in rapid retreat. To a lesser extent, clouds increase in frequency during southern summer polar cap rapid retreat as well.

Until recently little attention has been paid to another phenomena seen on Mars during both of the polar cap's respective yearly retreat. This being an atmospheric cloud referred to as *cloud bands*.

Planetary System Cloud Banding

A faint veil of wispy white clouds with variable shapes and levels of opacity, known as the **Planetary System Cloud Banding, or Equatorial Cloud Band (ECB)** as it is sometimes called, are rarely observed from Earth. The ECB is a faint violet or blue-white band of high-altitude ice crystals that appears as a broad and diffused hazy streak crossing within ± 20 degrees of the Martian equatorial zone. Cloud bands are probably composed of thin CO₂ ice crystals carried aloft by high altitude winds.

Also, cloud bands are seen to streak across many degrees in longitude in far northern or southern latitudes. These streaks resemble polar fronts similar to those seen from earth orbiting weather satellites. From visual observations these particular streaks tend to be brighter than those seen in the equatorial zone are. Could this be due to increased dust loading within the other aerosols in these higher latitudes?

Until recently, ECBs were observed most often during the Martian Northern Summer, however, systematic tricolor CCD imaging has uncovered evidence that these cloud bands may be more frequent and that they may occur in all Martian seasons -- especially were appearing with the rapid sublimation of each cap. With the limited data available the behavior of these clouds remains speculative.

Before space telescopes began to send us high definition images of Mars our ground-based astrophotographers would capture images that would occasionally reveal a band of dim haze traversing across the planet. Also, because visual observation of ECBs is difficult it probably led observers to overlook many of them in the past.

One of the surprises we encountered while viewing images of Mars from the Hubble Space Telescope (HST) was they revealed more bright ECBs. ECBs were seen on many of the recent HST images and even

more prominent than we saw on CCD images taken with ground-based telescopes -- large or small. More so than was expected and it was becoming blatantly obvious we had either missed them in the past or they were on the increase. Are these clouds common place in the atmosphere of Mars or not?

As modern CCD technology caught on in the amateur world we struggled along making images with film and producing less than satisfactory results. Then several experienced astrophotographers turned from film to the "chip." CCDs capture images much faster than film; so, the problems with "astronomical seeing" and transparency while long exposures using film virtually disappeared.

Modern techniques for imaging planets also led astronomers to begin experimenting with more sophisticated filters. Filters will increase exposure times; so, atmospheric turbulence smears filmed images and reduces images of many band clouds that may be present in Mars's atmosphere at the time.

Faster imaging with CCD cameras enabled us to use dense filters and also to increase the number of useable images of the Red Planet. We began to see more and more of this elusive cloud bands on tricolor images of Mars. By using a special Infrared blocking filter in conjunction with high quality glass Wratten red, green, and blue filters these ECBs are readily detected that may be unseen by visual observers.

Discussion

The International Mars Patrol (I.M.P.) has initiated an observing program for intensive investigation into this phenomena and will appeal to all planetary observers using CCD technology to assist us in this important study.

HST has revealed that these clouds may be more common than we have suspected in the past. Their prevalence during the 1997 apparition led some conferees at the Mars Telescopic Observations Workshop-II (MTO-II) to postulate that many limb clouds are simply the limb portions of ECB's. ALPO astronomers are encouraged to watch for these elusive features during the 1999 apparition. Are they really more common, or are our improved technologies merely allowing us to detect them more easily?

ECB's are best detected visually through a deep blue (W47 and W47B) Wratten filters and may be photographed or imaged in blue or ultraviolet light.

New technologies, such as CCD cameras, sophisticated computer hardware and software, and large-aperture planetary telescopes have given rise to a virtual explosion in advanced techniques of studying our Solar System. Never before have we been able to readily detect the delicate wispy Martian Equatorial Cloud Bands so well as we do now with CCD imaging.

While it is not the purpose to discuss the physics of these cloud bands we never the less draw certain conclusions from observational evidence. Questions remain that may be answered with high-tech observing techniques by amateur astronomers. There is not reason we can not at least serve as long termed clouds reporters between scant times of HST observing periods.