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# The Role of Amateur Observations in Characterizing the Current Equatorial Zone Disturbance in Jupiter

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## Abstract

Observations from both the amateur and professional communities report the emergence of a disturbance in Jupiter's Equatorial Zone, which is being observed for the first time with a wide range of wavelengths. The continuous monitoring of the event by the amateur community is an invaluable resource for documenting the behavior of this phenomenon.

## 1. Introduction

Jupiter's Equatorial Zone (EZ) is normally bright and white colored at visible wavelengths, but it is subject to periods of remarkable darkening and coloration in records that date back to 1890. Recent work by Antuñano et al. [1] has shown that these episodes of EZ darkening are accompanied by brighter thermal emission at a wavelength of 5 µm, which is sensitive to thermal emission attenuated by absorption by clouds. Images and spectra at this wavelength are therefore very useful to diagnose the depth of clouds. The brightest, therefore deepest, regions detected at 5 µm are generally associated with the darkest visible features, with the most extreme brightness associated with the visibly darkest blue-gray regions, such as those located at the southern edge of the North Equatorial Belt (NEB), known as 5-µm "hot spots".

## 2. Historical behavior

During an EZ disturbance event, much of the EZ becomes generally a darker and usually redder color, sometimes evolving from yellow to browner shades and followed by an overall dark gray hue [2]. Meanwhile, there is often an intensification of the filaments of dark blue-gray material extending southward from the NEB hot spots far into the EZ. High 5-µm radiances continue to be associated with the darkest features during these events and, at their peak, a large portion of the EZ has become bright at 5 µm, quite the opposite of its normally dark/cold appearance that is consistent with high cloud tops reaching into the upper, colder parts of Jupiter's troposphere. One of the conclusions reached by Antuñano et al. [1] is that these events are quasi-periodic: the visible darkening seems to take place every 6-7 (Earth) years, although in some cycles, the bright 5-µm appearance of the EZ is much less than in other cycles (or even absent, which was the case in the mid-1980s and in 2012-2013). When a 5-µm-bright appearance takes place, it is generally limited to a lifetime on the order of 1-1.5 years.

## 3. The current event

Antuñano et al. [1] predicted a repeat of this EZ disturbance in 2019. A first harbinger of this event was the progressive visual darkening of the EZ in mid 2018, starting with a light orange-brown color, as documented by a suite of amateur astronomers (Figure 1). True to the progression of previous EZ disturbances, strips of bright 5-µm emission began appearing in 2018 August in the mid/southern part of the EZ. In 2019 January, 5-µm brightening was increased in longitudinal strips and also detected in some oblique streaks, but it retreated soon afterward (see the abstract by Orton et al. in session OPS4).

## 4. What's next?

It is difficult to forecast weather, particularly on a planet with no routine multispectral monitoring and only primitive versions of global climate models (CGMs). What we are left with are simple analogies to previous observations, with only the last two events (1999-2000 and 2006-2007) having routine 5-µm monitoring involving several observations taken throughout the course of a year. The lifetimes of the EZ disturbances at 5 µm have been on the order of 1-1.5 years, much shorter than historical coloration events, which can be 3 years or longer [2]. However, this comparison is provisional because only the most recent events in 1999-2000 and 2006-07 were well documented at 5 µm, and they had little visible color; 5-µm observations were sparse for the prolonged

coloration events in previous decades, which were more similar to the present event. Observations by the amateur community have and will continue to help document the evolution of this disturbance, including the relationship between the darker blue-gray regions and the regions of enhanced 5-µm brightness over the next few months.

We will report on what will clearly be a definitive set of observations relating the evolution of this disturbance between the writing of this abstract and its presentation some 5 months from now. The need for continued support from the amateur community has seldom been more important, with the potential involvement of the Juno mission – particularly including the potential for observations by Juno's Microwave Radiometer of the ammonia distribution deep in the EZ during this period. It is also important because these disturbances are sometimes associated with other planetary-scale phenomena, such as South Equatorial Belt "fade and revival" sequences in what have been called "global upheavals" [2].

## 5. Summary and Conclusions

It has been and will continue to be important for the involvement of the amateur community to determine the evolution of EZ disturbances, particularly short time scales, as might be involved in the appearance of regions that are detected as bright at 5 µm. This will impact the evaluation of the forces responsible for the evolution of the phenomenon, e.g. whether this is a disturbance propagating upwards from below or downwards from above [1], and the interpretation of professional observations, including those from the Juno mission.

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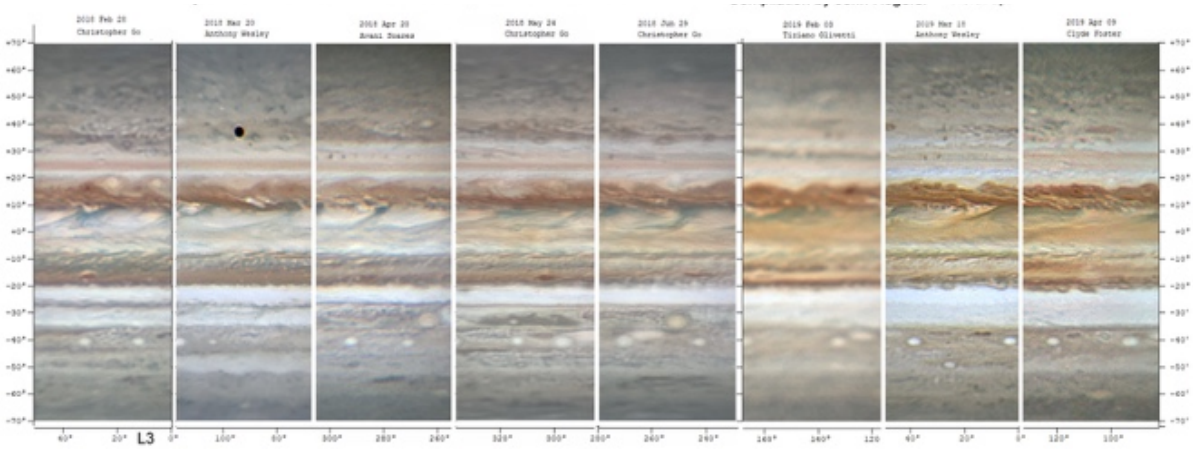


Figure 1: Series of Jupiter's belts and zones from 2018 February through 2019 April, from maps created by Marco Vedovato (JUPOS team). North is up.