

Hubble Space Telescope and Ground-Based Observations of Bright Storms on Uranus during 2014-2015



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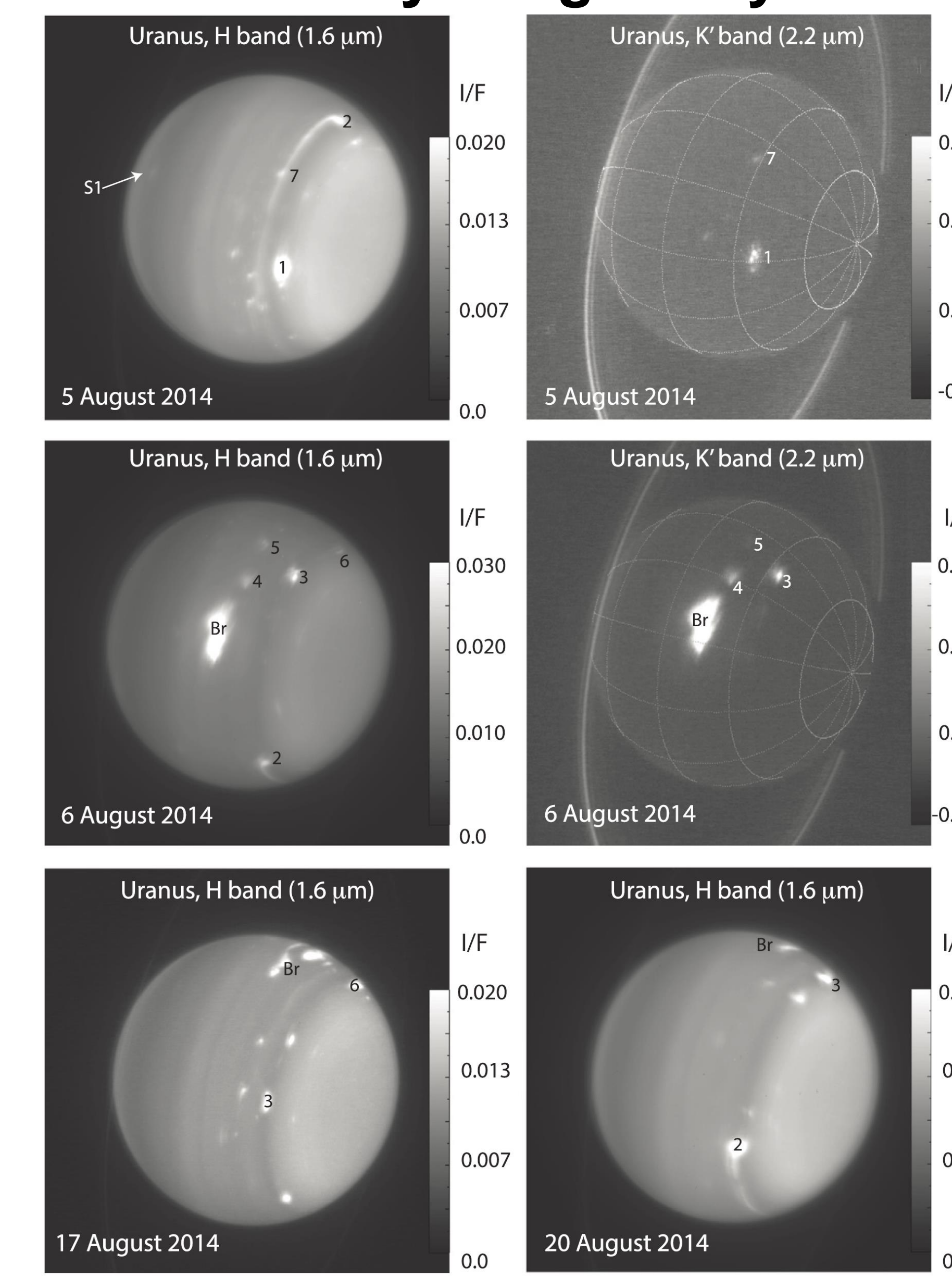
1. Abstract:

We report the temporal evolution of bright, long-lived cloud features on Uranus. We observed and tracked the features between August 2014 and January 2015 with the Hubble Space Telescope, the Keck 2 10-m telescope, VLT, Gran Telescopio Canarias, Gemini, William Herschel Telescope, Robo-AO, Pic du Midi 1-m telescope, and multiple smaller telescopes operated by amateur astronomers. Surprisingly bright features were first revealed in the Keck adaptive-optics images in August; this initial set of observations motivated follow-up observations around the world. One of the storms (identified as "Feature F" in Sromovsky et al. 2015, and Feature 2 in de Pater et al. 2015), which was the deepest in that dataset, was bright enough that it was detected by multiple amateur observers, permitting us to trigger a Hubble Target of Opportunity (ToO) observation on October 14th, 2014. A complex of features at this latitude was also observed by Hubble as part of the Outer Planet Atmospheres Legacy (OPAL) program on November 8-9, 2014. We will present the temporal evolution of the cloud activities from August 2014 through January 2015, and analyze the vertical structure of the cloud features in the Hubble datasets. The Hubble images used in our study were collected with support of HST grants GO13712 to KMS and GO13937 to AAS.

2. Observation List

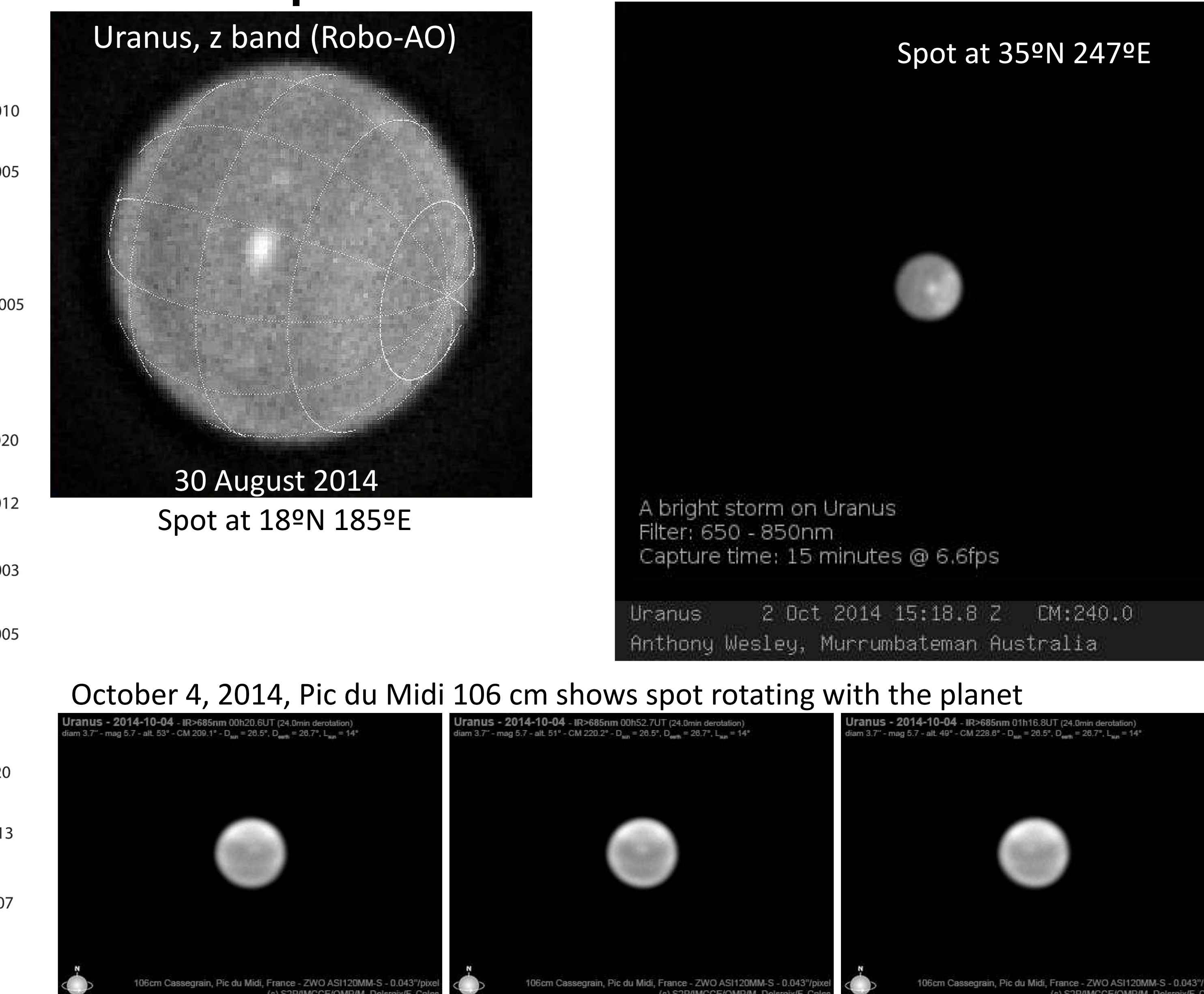
Date (UT)	Time (UTC)	Filter	Telescope/Observatory	Observer/P.I.
2014-08-05		H	Keck 2	de Pater
2014-08-06		H	Keck 2	de Pater
2014-08-17		H	Keck 2	Beranec
2014-08-20		H	Keck 2	de Pater
2014-08-30	11:45	z	Palomar 60"	Beranec
2014-09-11	02:51	> 685 nm	14" S-C	de-Benedictis
2014-09-18	15:24	> 650 nm		Wesley
2014-09-19	15:24	> 650 nm		Wesley
2014-09-27	01:58	> 685 nm		La Gall
2014-10-02	14:57	650-850 nm		Wesley
2014-10-04	00:53	> 685 nm	Pic du Midi 106 cm	Delcroix
2014-10-14			HST	Sayanagi
2014-10-15			GTC	Hueso
2014-10-15			WHT	Hueso
2014-10-30			Gemini	Sromovsky
2014-11-08			HST	Simon
2014-11-09			HST	Simon
2014-11-09			VLT	Irwin
2014-11-11?			VLT	Irwin
2014-11-19			Gemini	Sromovsky
2014-11-26		H,Hcont,Kp	Gemini	Sromovsky

3. "Discovery Images" by Keck



de Pater et al. (2015)

4. Follow-up Observations



5. HST Observations (Target of Opportunity by Sayanagi et al.; DDT by Simon et al.) Show Temporal Evolution of Storm Systems

