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ČESKÝ HYDROMETEOROLOGICKÝ ÚSTAV**

<http://www.chmi.cz>

<http://www.setvak.cz>



## ***Use of the VIIRS Day-Night Band for nocturnal storm-top studies and for night-time sandwich products***

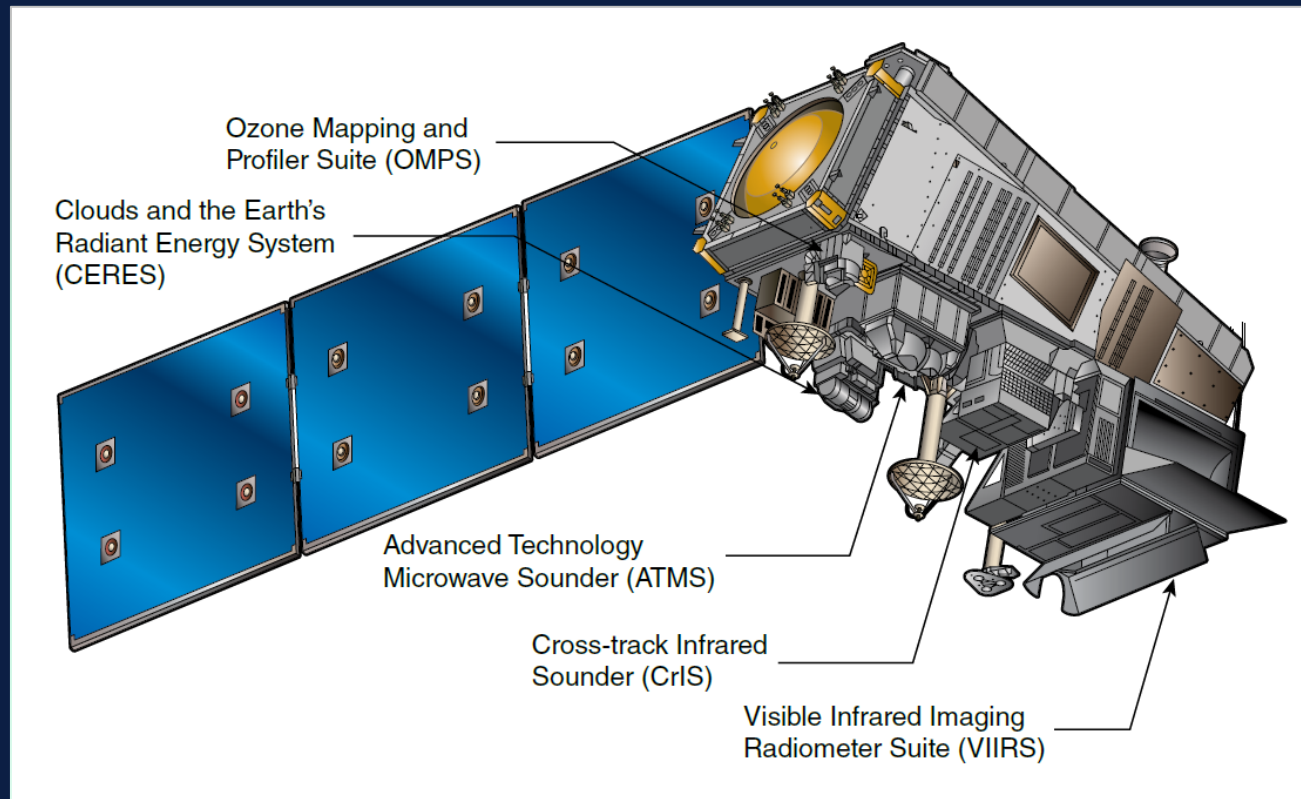
Convection Working Group workshop Zagreb

07 – 11 April 2014

# VIIRS (Suomi NPP satellite)

launched 2011-10-28

## Visible Infrared Imaging Radiometer Suite



- [Visible Infrared Imaging Radiometer Suite \(VIIRS\)](#)
- [Advanced Technology Microwave Sounder \(ATMS\)](#)
- [Cross-track Infrared Sounder \(CrIS\)](#)
- [Ozone Mapping and Profiler Suite \(OMPS\)](#)
- [Clouds and the Earth's Radiant Energy System \(CERES\)](#)

# VIIRS (Visible Infrared Imaging Radiometer Suite)

		Band No.	Wave-length (μm)	Horiz Sample Interval (km Downtrack x Crosstrack)		Driving EDRs	Radiance Range	Ltyp or Ttyp	Signal to Noise Ratio (dimensionless) or NEΔT (Kelvins)		
				Nadir	End of Scan				Required	Predicted	Margin
VIS/NIR FPA	Silicon PIN Diodes	M1	0.412	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	44.9 155	352 316	483 827	37% 162%
		M2	0.445	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	40 146	380 409	501 774	32% 89%
		M3	0.488	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	32 123	416 414	573 747	38% 80%
		M4	0.555	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	21 90	362 315	482 586	33% 86%
		I1	0.640	0.371 x 0.387	0.80 x 0.789	Imagery	Single	22	119	135	13%
		M5	0.672	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	10 68	242 360	306 450	26% 25%
		M6	0.746	0.742 x 0.776	1.60 x 1.58	Atmospheric Corr'n	Single	9.6	199	279	40%
		I2	0.865	0.371 x 0.387	0.80 x 0.789	NDVI	Single	25	150	212	41%
		M7	0.865	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	6.4 33.4	215 340	467 467	117% 37%
CCD	DNB	0.7	0.742 x 0.742	0.742 x 0.742	Imagery	Var.	6.70E-05	6	6.2	3%	
S/MWIR	PV HgCdTe (HCT)	M8	1.24	0.742 x 0.776	1.60 x 1.58	Cloud Particle Size	Single	5.4	74	109	47%
		M9	1.378	0.742 x 0.776	1.60 x 1.58	Cirrus/Cloud Cover	Single	6	83	156	88%
		I3	1.61	0.371 x 0.387	0.80 x 0.789	Binary Snow Map	Single	7.3	6.0	71	1084%
		M10	1.61	0.742 x 0.776	1.60 x 1.58	Snow Fraction	Single	7.3	342	461	35%
		M11	2.25	0.742 x 0.776	1.60 x 1.58	Clouds	Single	0.12	10	14	44%
		I4	3.74	0.371 x 0.387	0.80 x 0.789	Imagery Clouds	Single	270 K	2.500	0.236	68%
		M12	3.70	0.742 x 0.776	1.60 x 1.58	SST	Single	270 K	0.396	1.039	141%
		M13	4.05	0.742 x 0.259	1.60 x 1.58	SST Fires	Low High	300 K 380 K	0.107 0.423	0.051 0.353	111% 20%
LWIR	PV HCT	M14	8.55	0.742 x 0.776	1.60 x 1.58	Cloud Top Properties	Single	270 K	0.091	0.057	60%
		M15	10.763	0.742 x 0.776	1.60 x 1.58	SST	Single	300 K	0.070	0.034	105%
		I5	11.450	0.371 x 0.387	0.80 x 0.789	Cloud Imagery	Single	210 K	1.500	1.004	49%
		M16	12.013	0.742 x 0.776	1.60 x 1.58	SST	Single	300 K	0.072	0.059	23%

Swath width: 3000 km (± 56° from nadir)

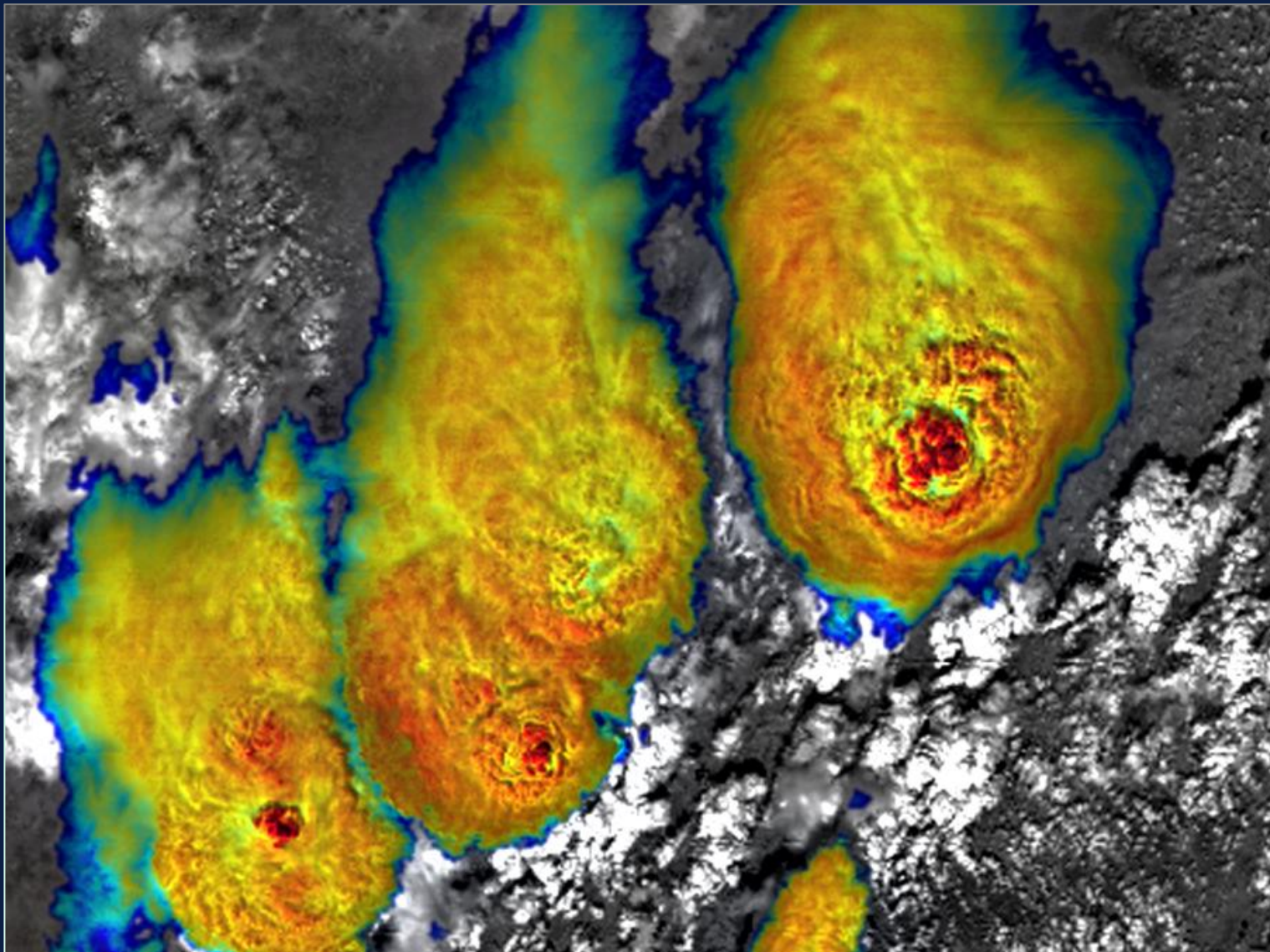
# VIIRS – daytime 375 m image bands

		Band No.	Wave-length (μm)	Horiz Sample Interval (km Downtrack x Crosstrack)		Driving EDRs	Radiance Range	Ltyp or Ttyp	Signal to Noise Ratio (dimensionless) or NEΔT (Kelvins)		
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CCD	DNB	0.7	0.742 x 0.742	0.742 x 0.742	Imagery	Var.	6.70E-05	6	6.2	3%	
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Swath width: 3000 km (± 56° from nadir)



## **VIIRS – daytime sandwich (375 m)**



2012-07-05 12:06 UTC Suomi NPP, VIIRS – sandwich bands I1 & I5 (BT 208-240K), Germany

***VIIRS DNB (Day-Night Band) nocturnal  
observations of storm-top details***

# VIIRS – Day-Night Band (DNB, 750 m)

		Band No.	Wave-length (μm)	Horiz Sample Interval (km Downtrack x Crosstrack)		Driving EDRs	Radiance Range	Ltyp or Ttyp	Signal to Noise Ratio (dimensionless) or NEΔT (Kelvins)		
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Swath width: 3000 km (± 56° from nadir)

## **VIIRS – Day-Night Band (DNB, 750 m)**

Detailed information about the VIIRS Day-Night Band:

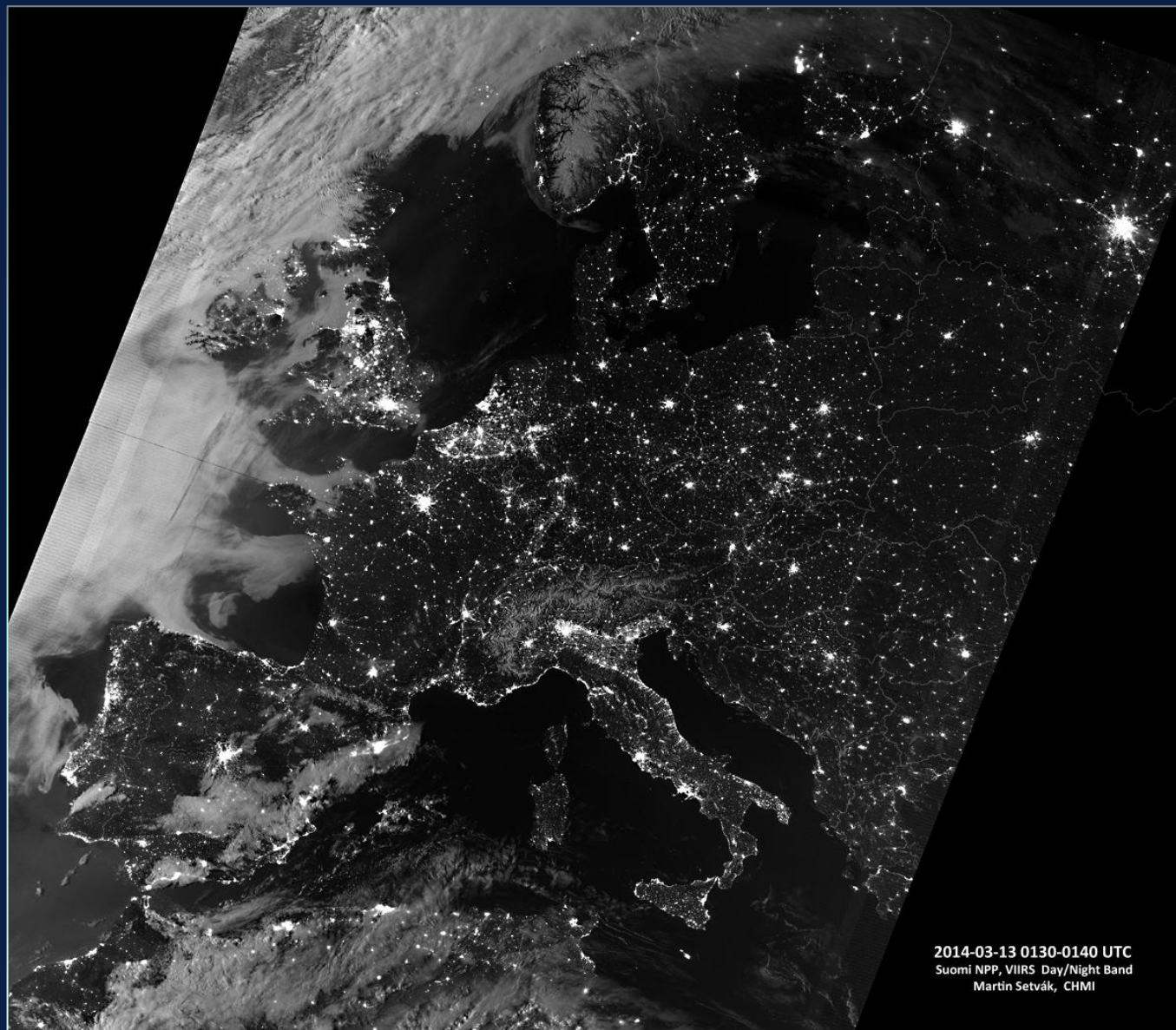
Miller, Steven D., Cynthia L. Combs, Stanley Q. Kidder, Thomas F. Lee, 2012: Assessing Moonlight Availability for Nighttime Environmental Applications by Low-Light Visible Polar-Orbiting Satellite Sensors. *J. Atmos. Oceanic Technol.*, **29**, 538–557.  
DOI: <http://dx.doi.org/10.1175/JTECH-D-11-00192.1>

Miller, S.D., Mills, S.P., Elvidge, C.D., Lindsey, D.T., Lee, T.F., Hawkins, J.D., 2012: Suomi satellite brings to light a unique frontier of nighttime environmental sensing capabilities. *PNAS*, vol. 109 no. 39, 15706–15711, DOI: [10.1073/pnas.1207034109](https://doi.org/10.1073/pnas.1207034109)

(see also the [supporting information](#) of this paper)



# VIIRS – Day-Night Band (DNB, 750 m)



**2014-03-13 01:40 UTC**

VIIRS Day-Night Band (DNB)

- City lights
- Land and clouds illuminated by full moon

2014-03-13 0130-0140 UTC  
Suomi NPP, VIIRS Day/Night Band  
Martin Setvák, CHMI

## VIIRS - Day-Night Band (DNB, 750 m)



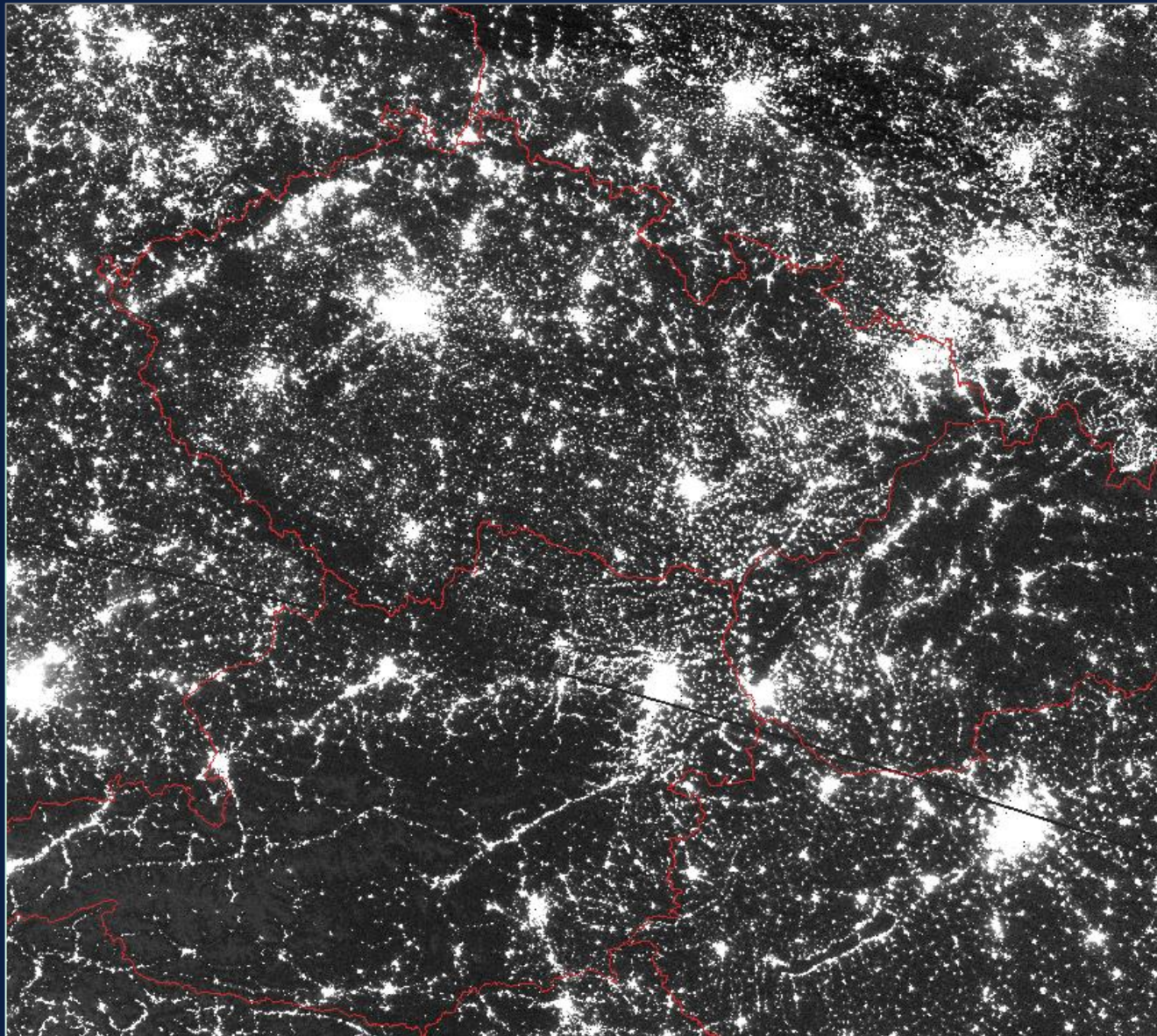
2014-03-13 01:40 UTC

VIIRS Day-Night Band (DNB)

- City lights - DETAIL
- Land illuminated by full moon



# VIIRS - Day-Night Band (DNB, 750 m)



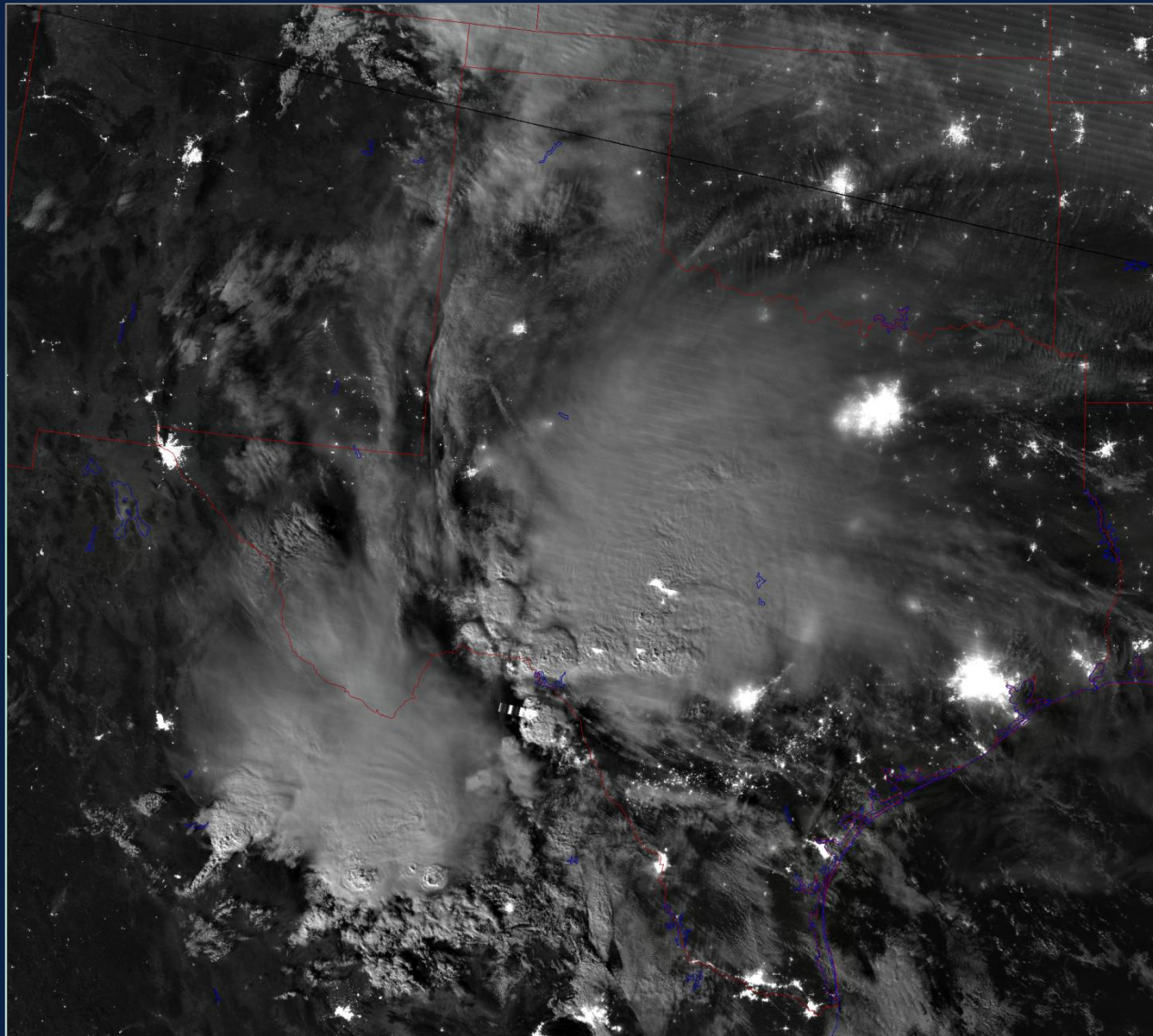
2014-03-30 01:17 UTC

VIIRS Day-Night Band (DNB)

- City lights - DETAIL
- Land (snow-covered Alps) illuminated by moonless sky



# VIIRS – Day-Night Band (DNB, 750 m)



**2013-05-24 08:17 UTC**

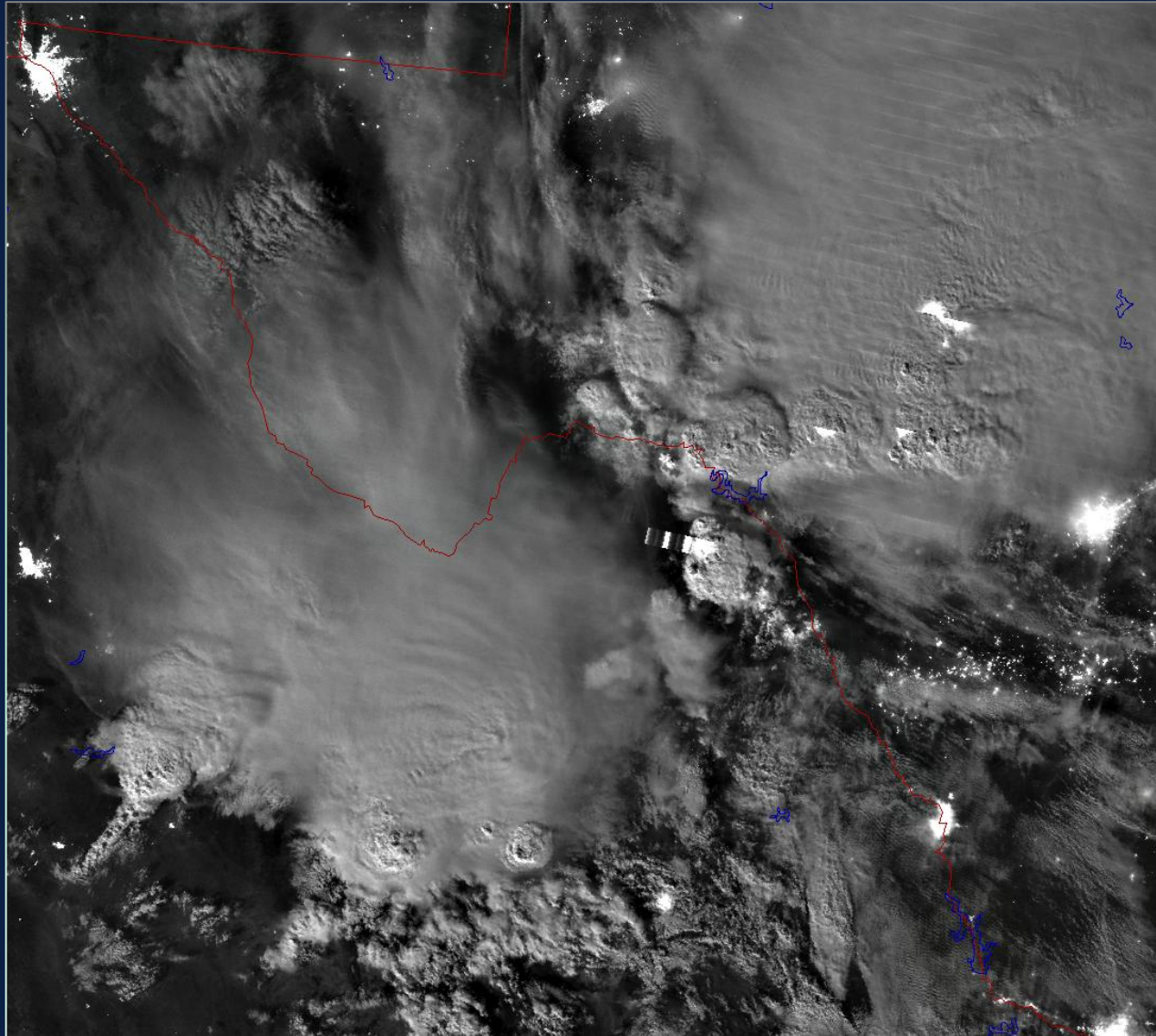
VIIRS Day-Night Band (DNB)

Texas, north-east Mexico

- City lights
- Land and storms illuminated by full moon
- Lightning



# VIIRS – Day-Night Band (DNB, 750 m)



**2013-05-24 08:17 UTC**

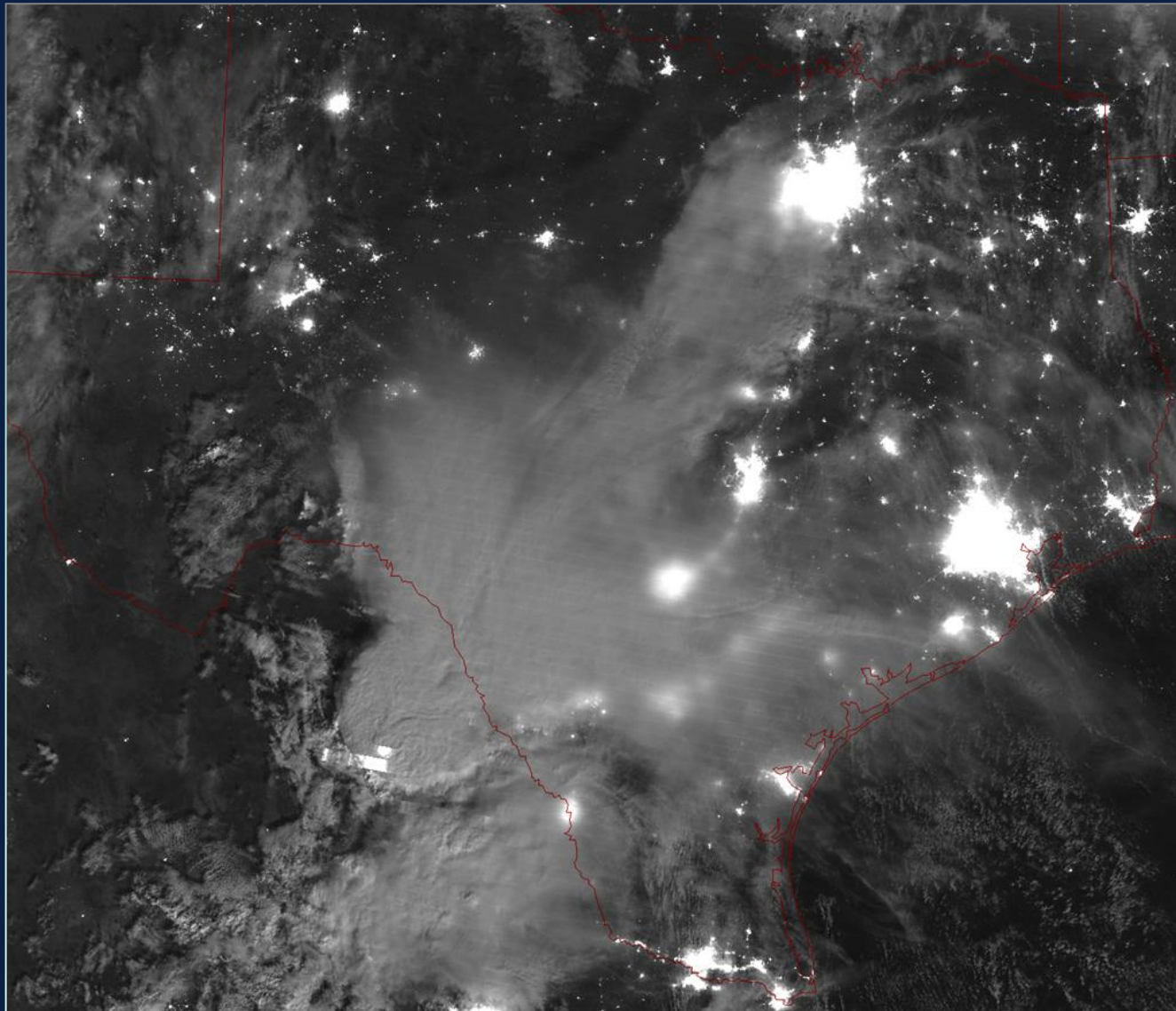
VIIRS Day-Night Band (DNB)

Texas, north-east Mexico (detail)

- City lights
- Land and storms illuminated by full moon
- Lightning

**Overshooting tops**

# VIIRS – Day-Night Band (DNB, 750 m)



**2013-05-29 08:23 UTC**

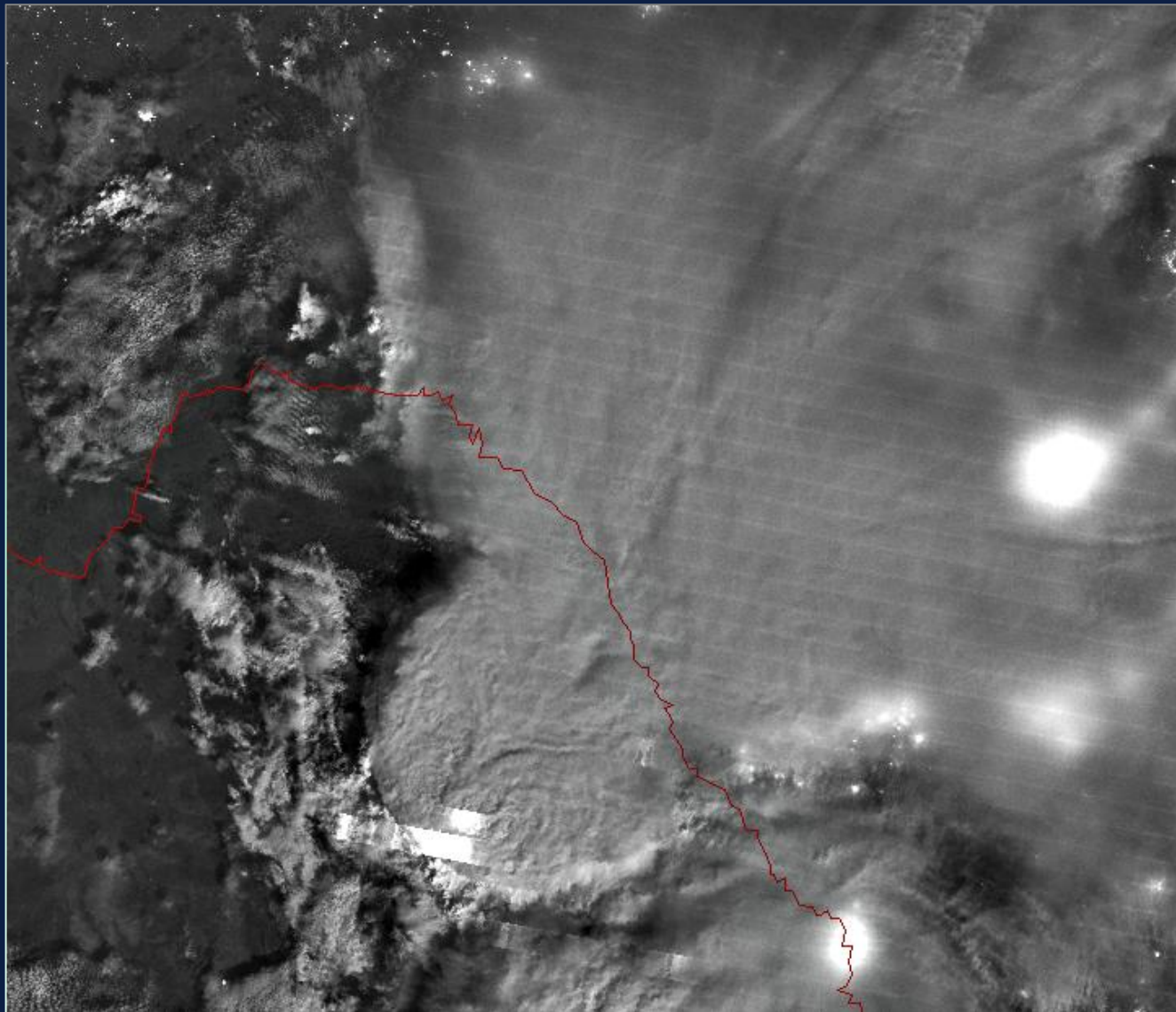
VIIRS Day-Night Band (DNB)

Texas, north-east Mexico

- City lights
- Land and storms illuminated by Moon – 5 days after full moon and 2 days before third quarter
- Lightning



# VIIRS – Day-Night Band (DNB, 750 m)



2013-05-29 08:23 UTC

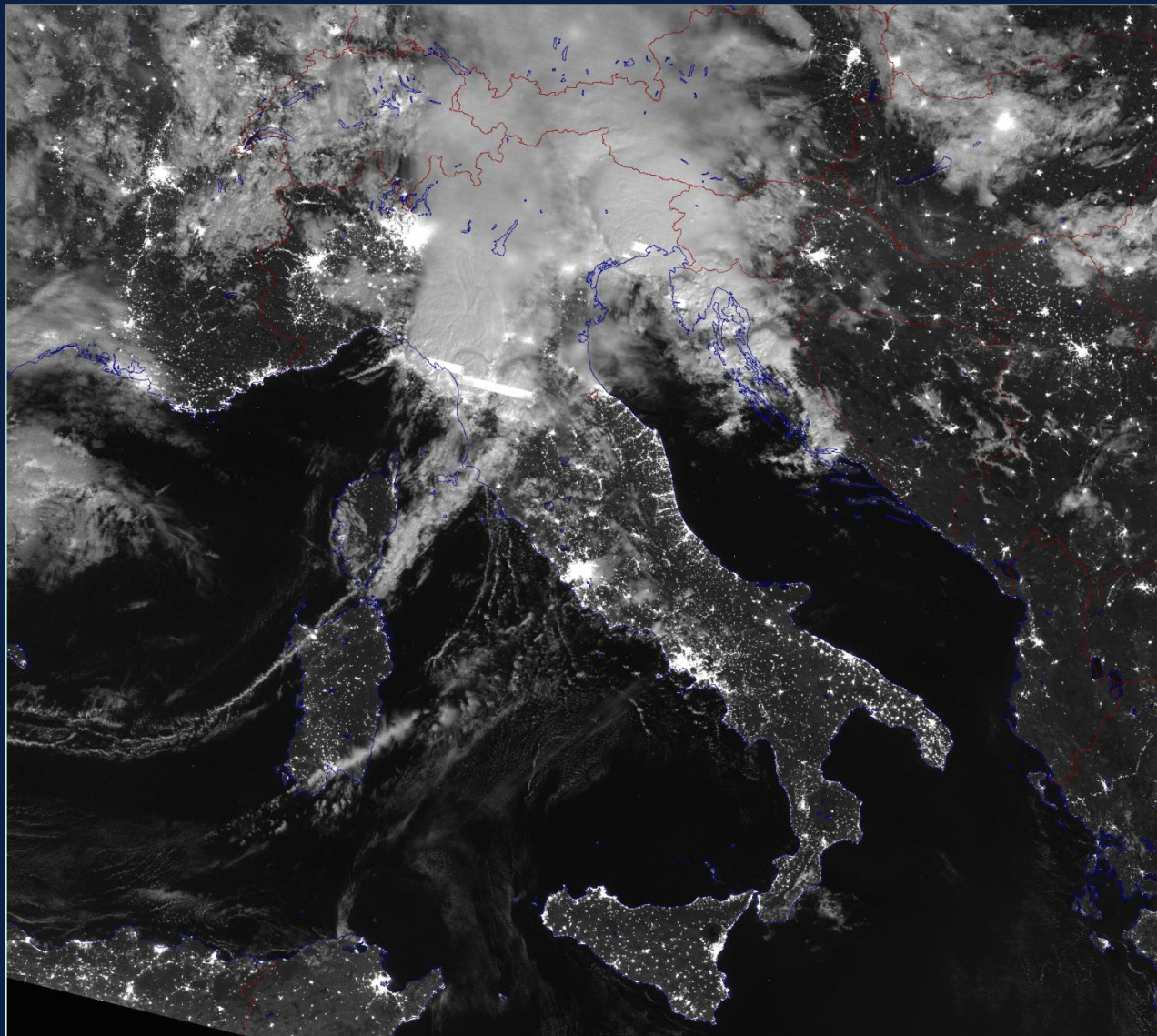
VIIRS Day-Night Band (DNB)

Texas, north-east Mexico (detail)

- City lights
- Land and storms illuminated by Moon – 5 days after full moon and 2 days before third quarter
- Lightning

**Plume above SW part of the storm**

# VIIRS – Day-Night Band (DNB, 750 m)



**2013-08-25 00:43 UTC**

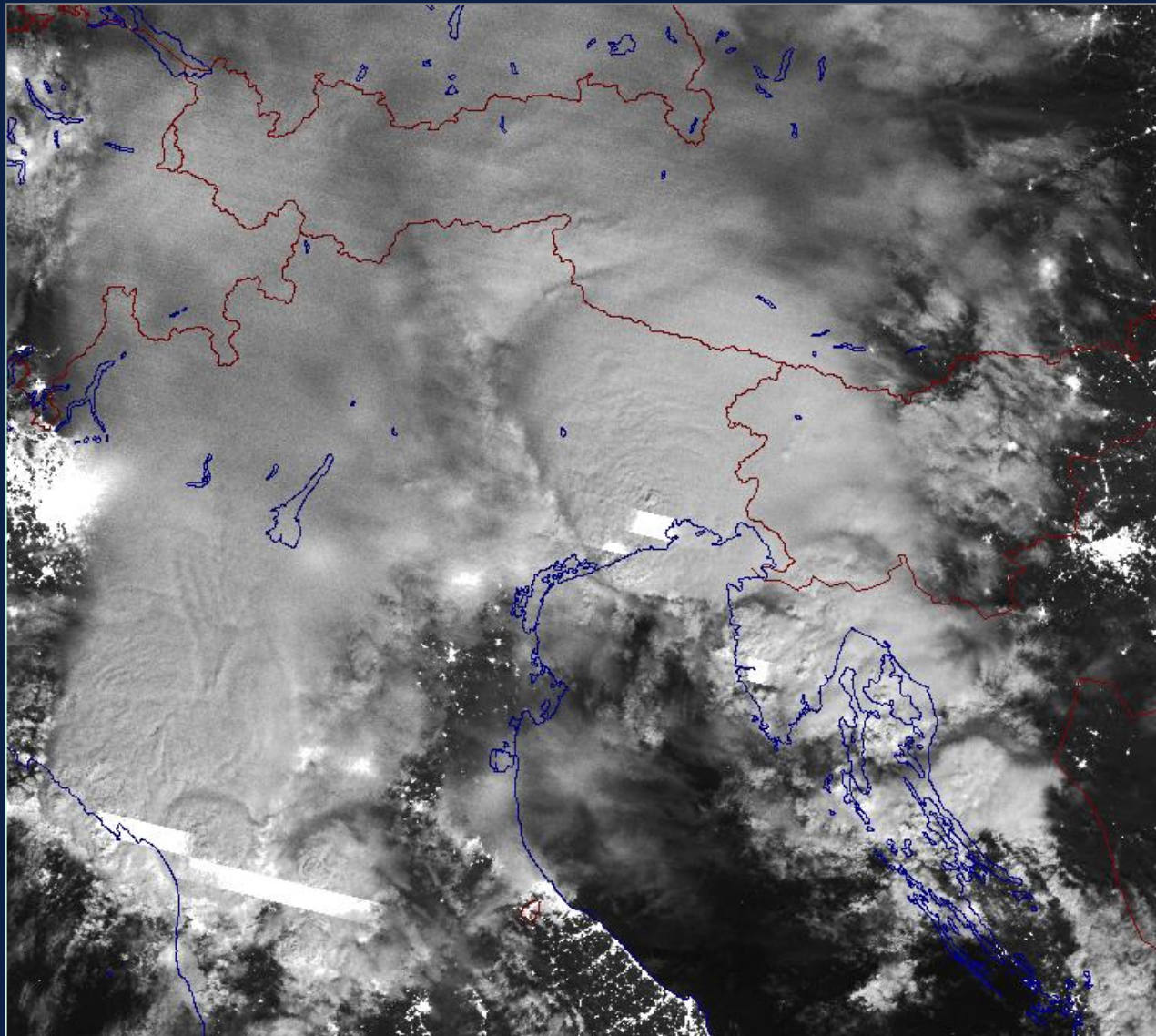
VIIRS Day-Night Band (DNB)

Italy, Croatia, Slovenia

- City lights
- Land and storms illuminated by Moon – 4 days after full Moon and 3 days before third quarter
- Lightning



# VIIRS – Day-Night Band (DNB, 750 m)



**2013-08-25 00:43 UTC**

VIIRS Day-Night Band (DNB)

Italy, Croatia, Slovenia (detail)

- City lights
- Land and storms illuminated by Moon – 4 days after full Moon and 3 days before third quarter
- Lightning

## **VIIRS – Day-Night Band (DNB, 750 m)**

### ***When available for storm-top studies (to resolve details of the cloud-tops)?***

- Sufficient illumination of the storm tops by moonlight:
  - best around the full moon
  - still sufficient between the first and third quarter
- the Moon has to be above the local horizon at the time of the NPP overpass (about 02:00 – 02:30 AM local time for mid-latitudes of the northern hemisphere),
- taking into account typical moonrise/moonset times for spring – summer:
  - ⇒ from about two-three days before the full moon, till about one or two days after the third quarter ... total of ~ 10 days only for each lunar cycle, depending on the local latitude and (astronomical) declination of the Moon
- Moonrise/moonset calculator:
  - <http://www.timeanddate.com/worldclock/moonrise.html>
  - time data given in local civic (zone) time, including daylight saving time (when applicable)!

# ***VIIRS DNB airglow detection***



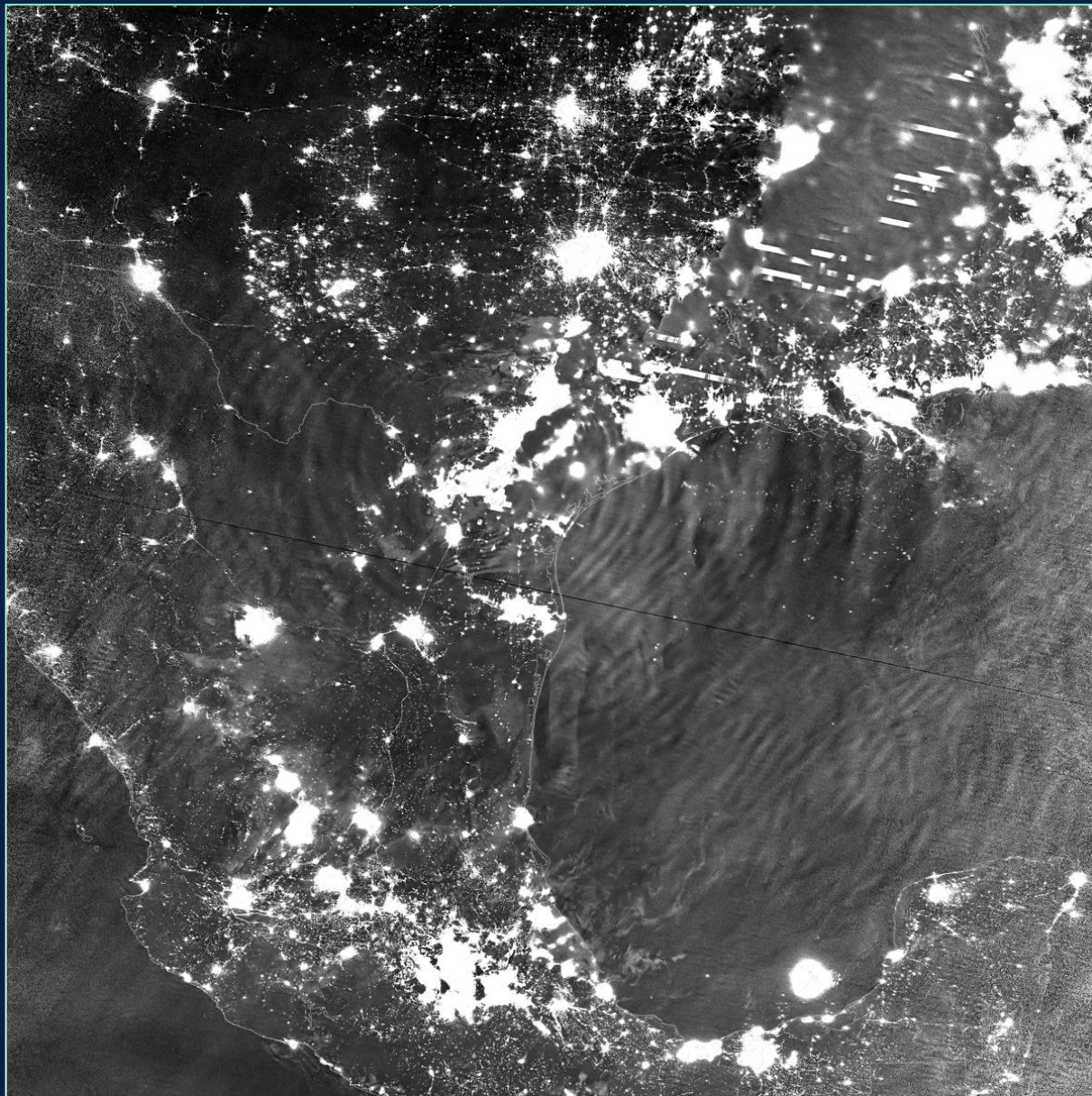
01 Jan 2014, Slovakia. Source: Petr Horálek, <http://www.astronom.cz/horalek/?p=477>

About airglow:

<http://www.atoptics.co.uk/highsky/airglow1.htm>  
<http://www.atoptics.co.uk/highsky/airglow2.htm>



# VIIRS – Day-Night Band (DNB, 750 m) – AIRGLOW detection



2014-04-04 08:15 UTC

VIIRS Day-Night Band (DNB)

generated by storms above Texas

- City lights, lightning
- moonless sky

# VIIRS – Day-Night Band (DNB, 750 m) – AIRGLOW detection



2014-04-04 08:15 UTC

VIIRS Day-Night Band (DNB)

generated by storms above Texas

- City lights, lightning
- moonless sky

[Convectively-generated mesospheric airglow waves over Texas](#) (CIMSS Satellite Blog)  
[Severe Weather in the Mesosphere](#) (VIIRS Imagery and Visualization Team Blog)

# ***VIIRS DNB nocturnal sandwich product***



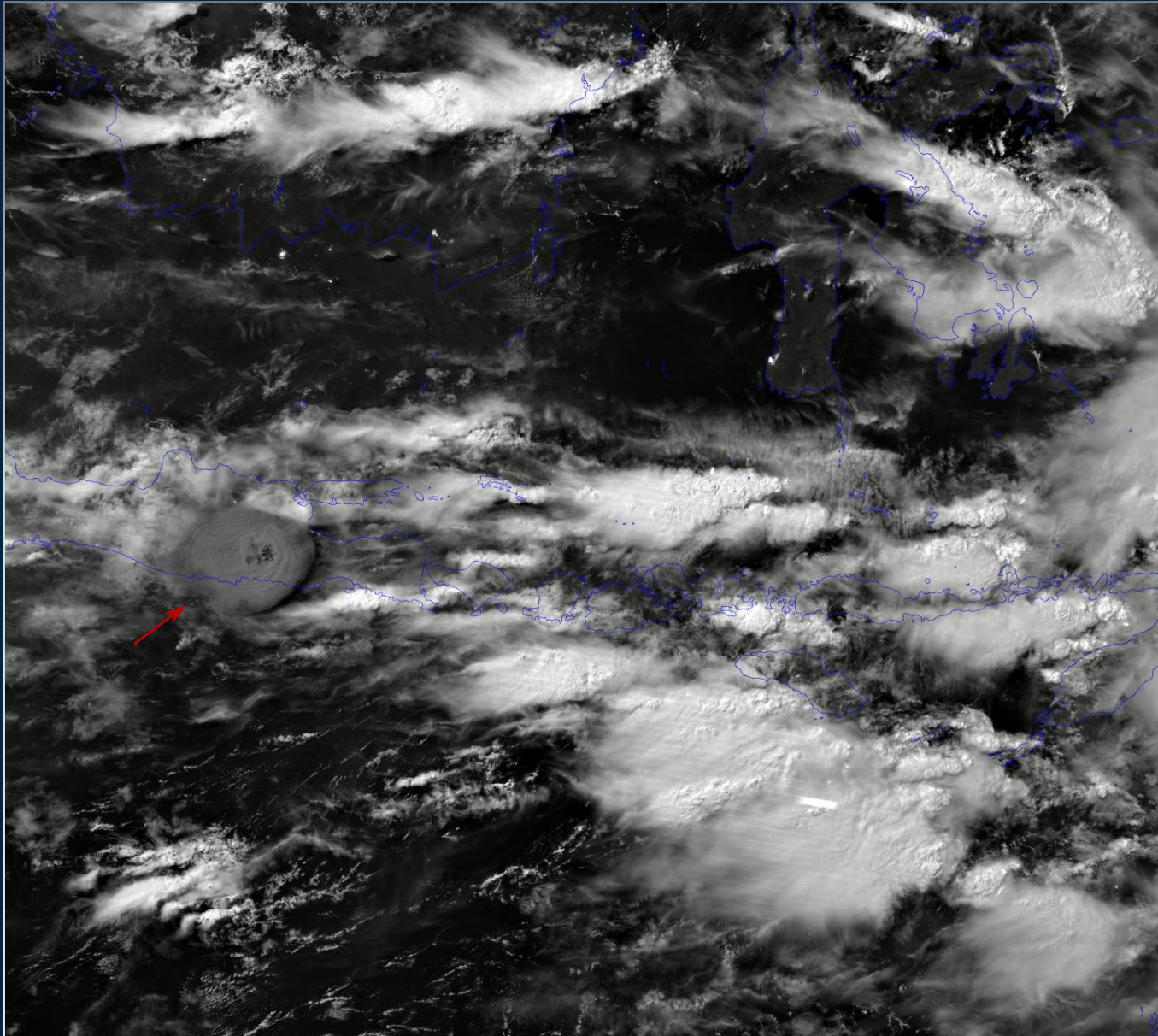
# VIIRS – nocturnal bands for the sandwich product

		Band No.	Wave-length (μm)	Horiz Sample Interval (km Downtrack x Crosstrack)		Driving EDRs	Radiance Range	Ltyp or Ttyp	Signal to Noise Ratio (dimensionless) or NEΔT (Kelvins)		
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# VIIRS – Kelut volcano eruption cloud



**2014-02-13 17:30 UTC**

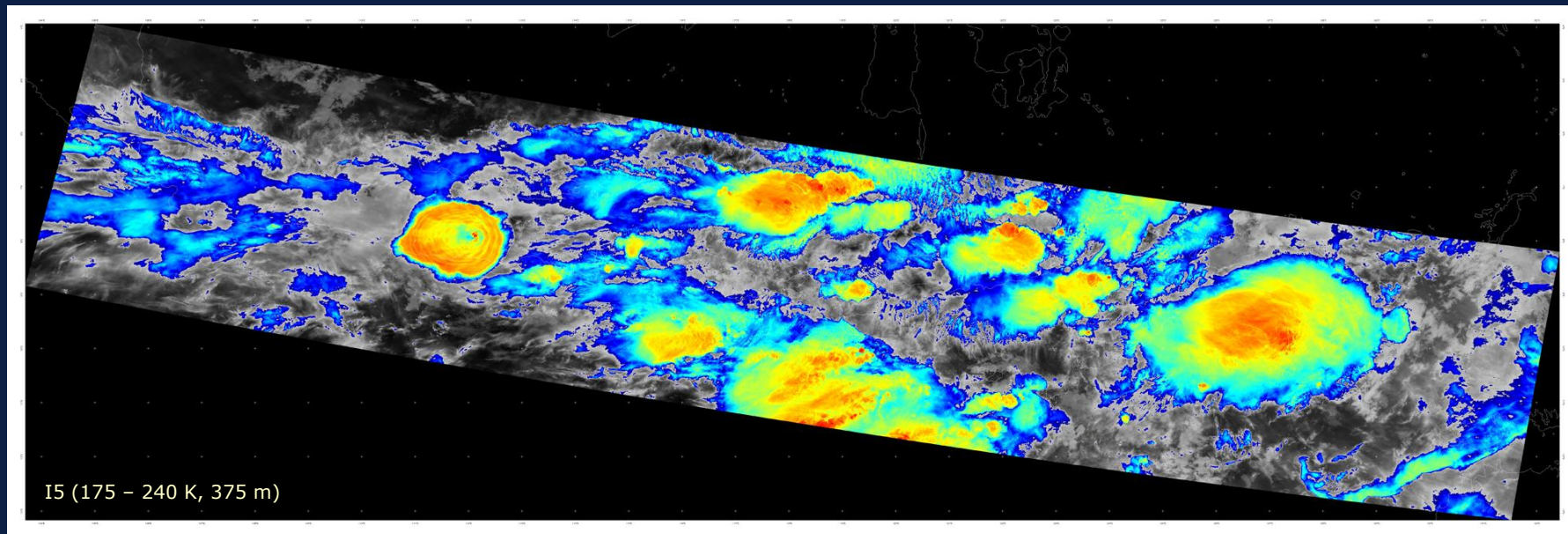
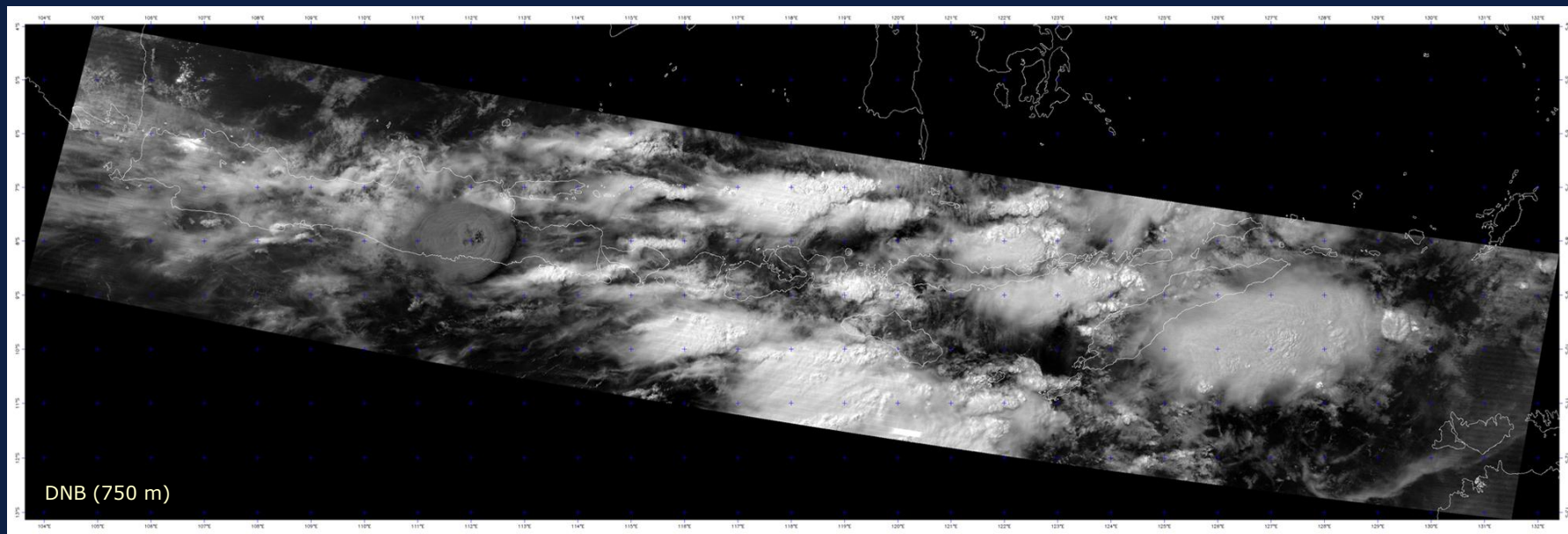
VIIRS Day-Night Band (DNB)

Kelut Volcano eruption,  
Java, Indonesia

- Clouds and land illuminated by full moon

# VIIRS - Kelut volcano eruption cloud

2014-02-13 17:30 UTC Java, Indonesia



## ***VIIRS – Kelut volcano eruption cloud***

Detailed information for this case:

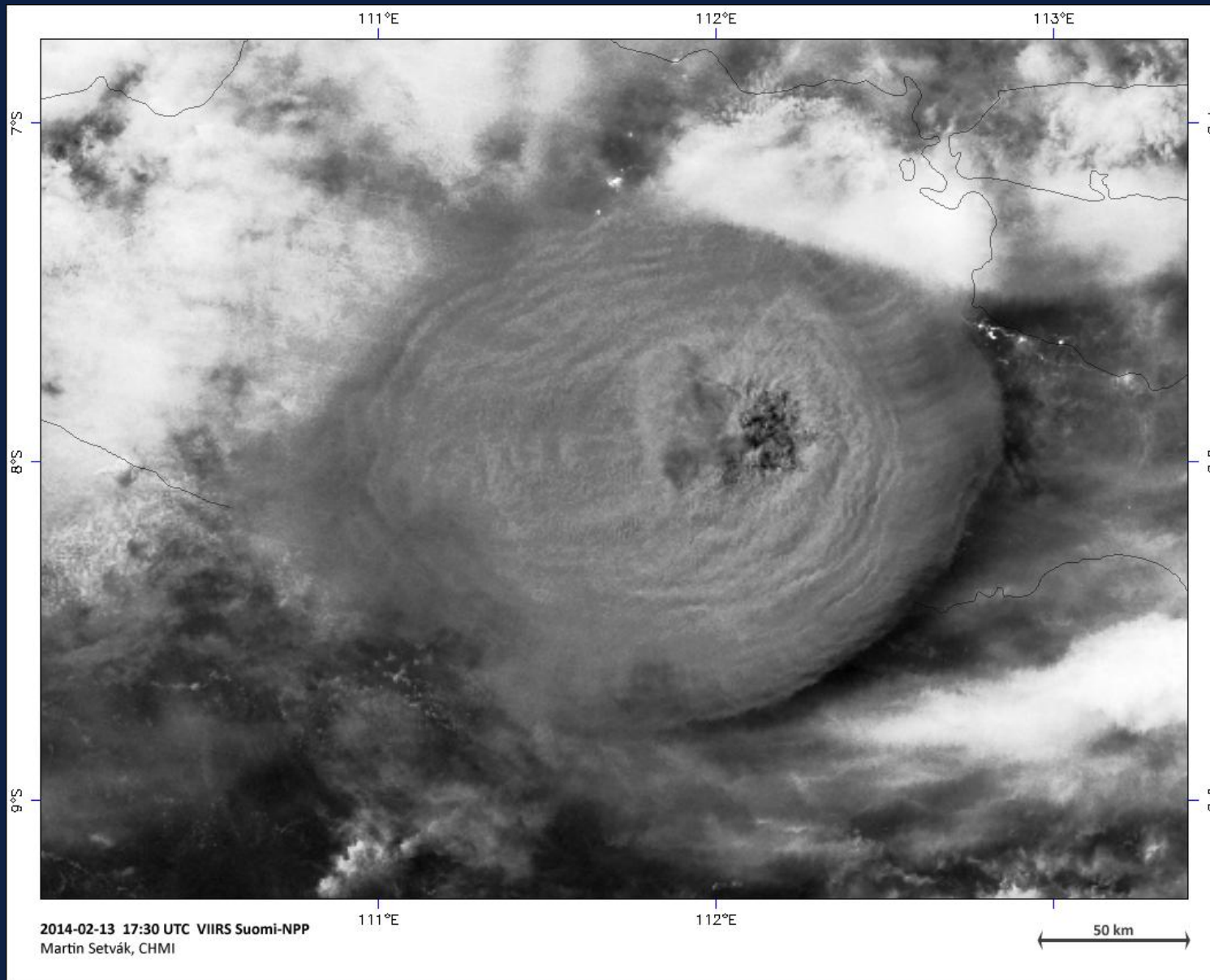
<http://cimss.ssec.wisc.edu/goes/blog/archives/14910>

[http://www.eumetsat.int/website/home/Images/ImageLibrary/DAT\\_2169181.html](http://www.eumetsat.int/website/home/Images/ImageLibrary/DAT_2169181.html)

<http://www.volcanodiscovery.com/kelut/eruptions/13feb2014plinian-explosion.html>



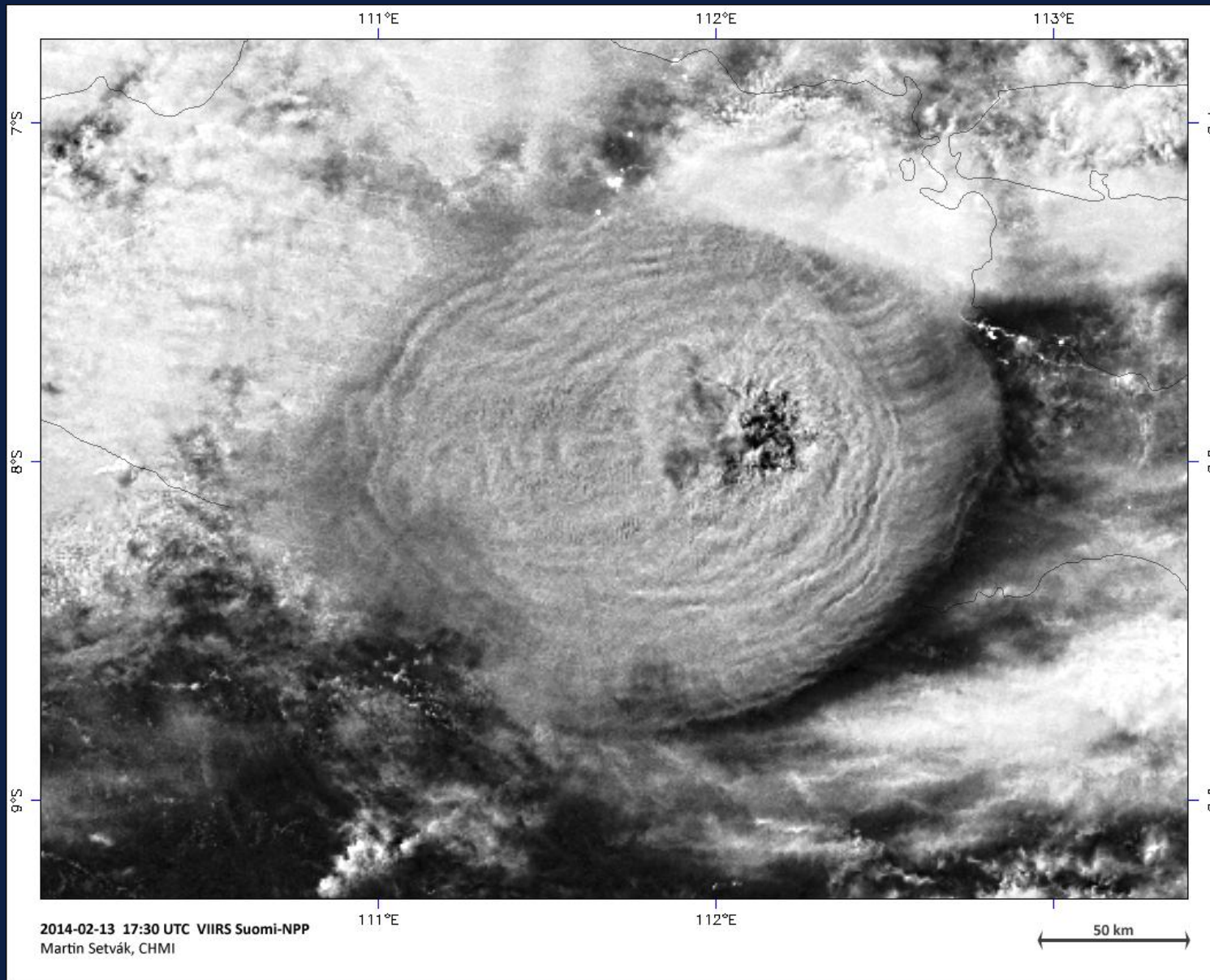
## VIIRS – Kelut volcano eruption cloud



**DNB**

regular image

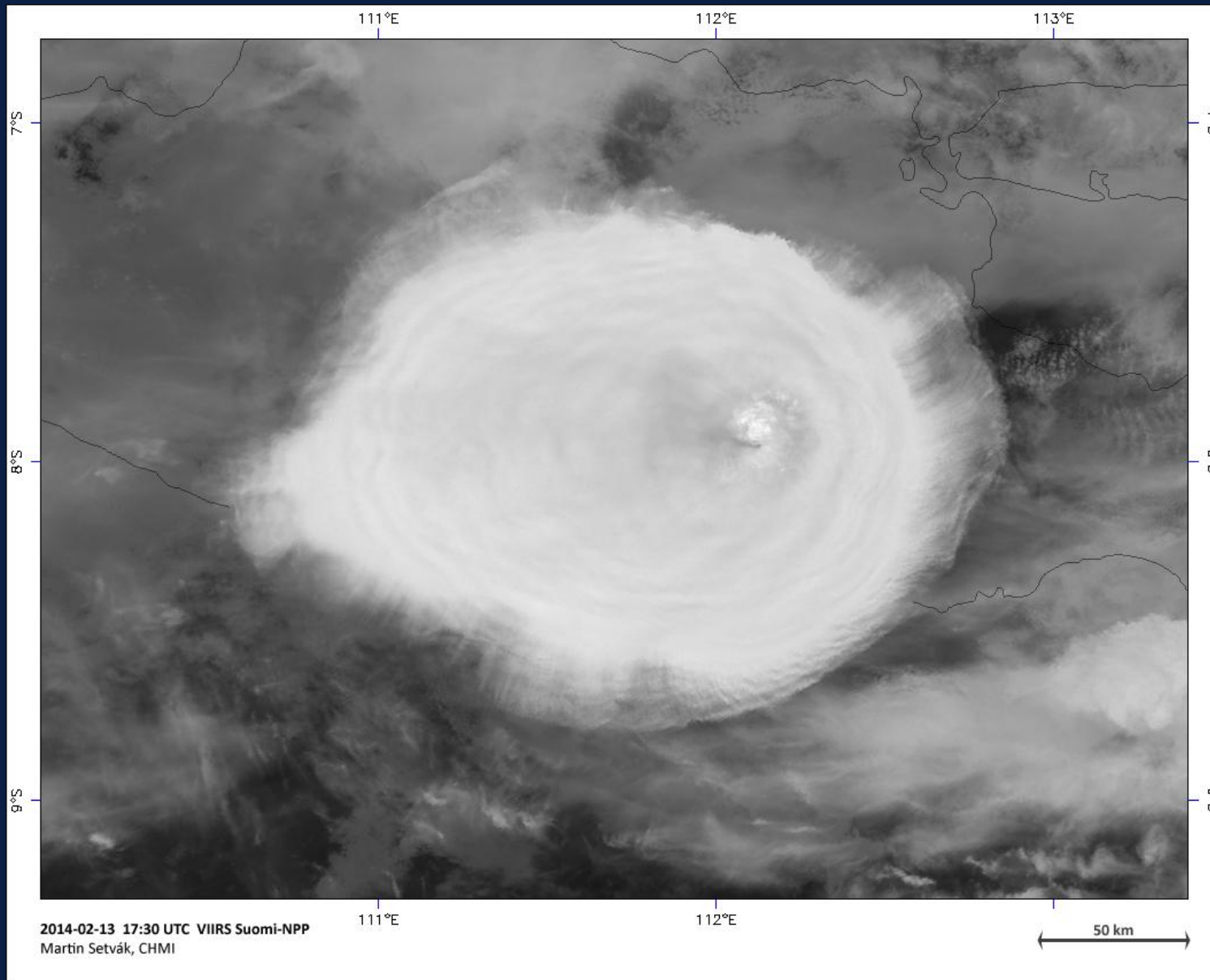
## VIIRS – Kelut volcano eruption cloud



**DNB**

processed by  
HDR method

## VIIRS – Kelut volcano eruption cloud

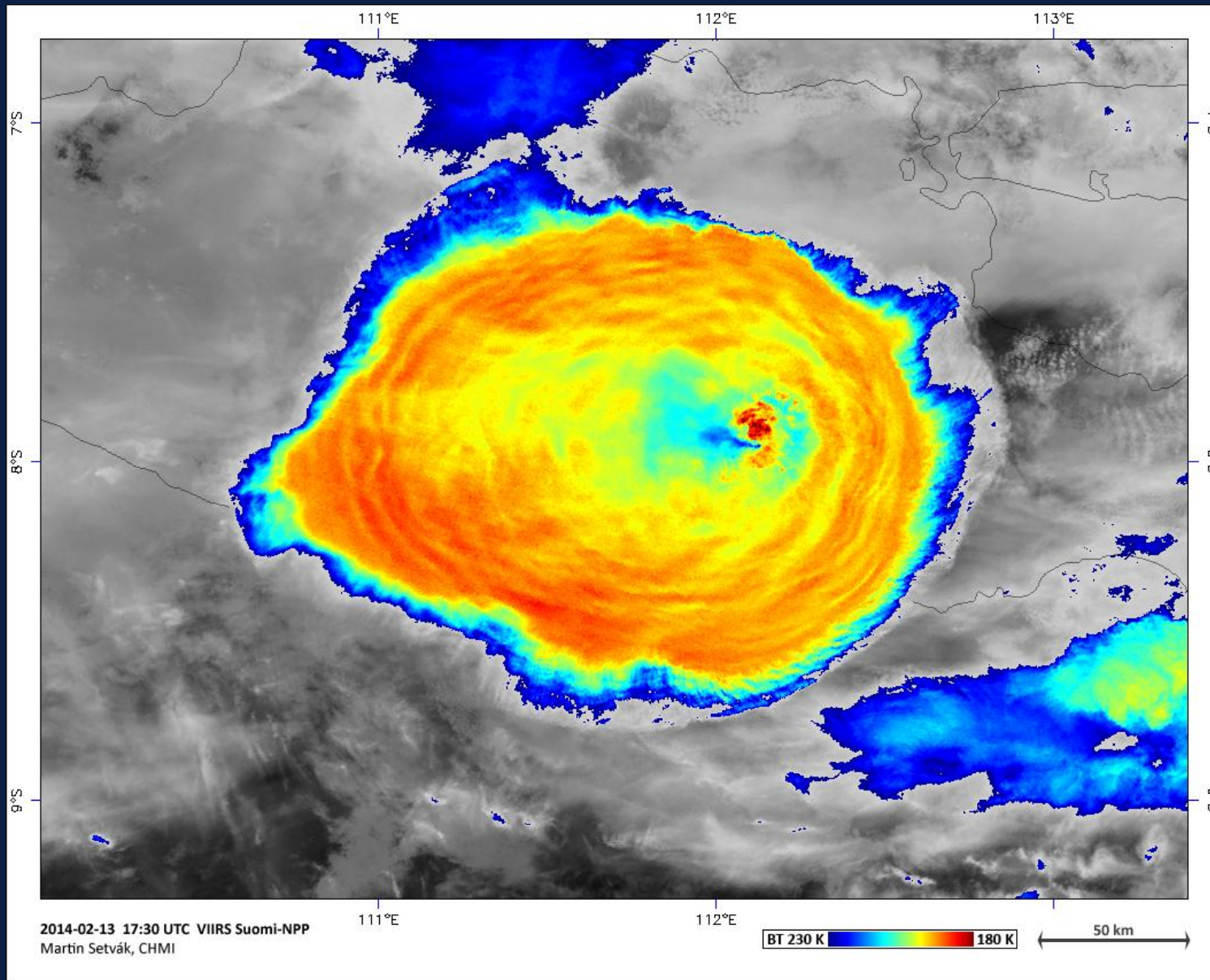


**I5** band

175 – 300 K



## VIIRS – Kelut volcano eruption cloud



**I5** band

180 – 230 K

# ***VIIRS – Kelut volcano eruption cloud – sandwich product***

**Sandwich  
image**

DNB (HDR) and  
I5 (180–230 K)

