

# Using VIIRS DNB to Detect Natural (and other) Disasters

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# Overview

- Day Night Band Overview
- Why is DNB is useful for disaster detection
- Examples of interest
  - Hurricanes/Typhoons
  - Fires
  - Volcanos
  - Other natural and human disasters
- Conclusions

# Day/Night Band (DNB) overview

- The DNB measures visible radiances from both the Earth and atmosphere
- Wavelength of 0.7  $\mu\text{m}$ , 742m x 742m pixel size
- Receives visible data from via reflection and emission sources (natural and anthropogenic )
- Sufficiently sensitivity to observe the reflected emissions of nocturnal airglow (nightglow); which are emissions originating primarily from ~85-95 km and starlight (Miller et al 2012), which is within upper boundary of the mesosphere (~50-85km)



# Why is DNB useful for disaster detection

- Can provide visible imagery at night
- Can be combined with other channels to produce unique nighttime products
- Publicity
  - Noted on national and international news, social media
- Being used by National Weather Service
  - Public Awareness
  - Improved forecasting

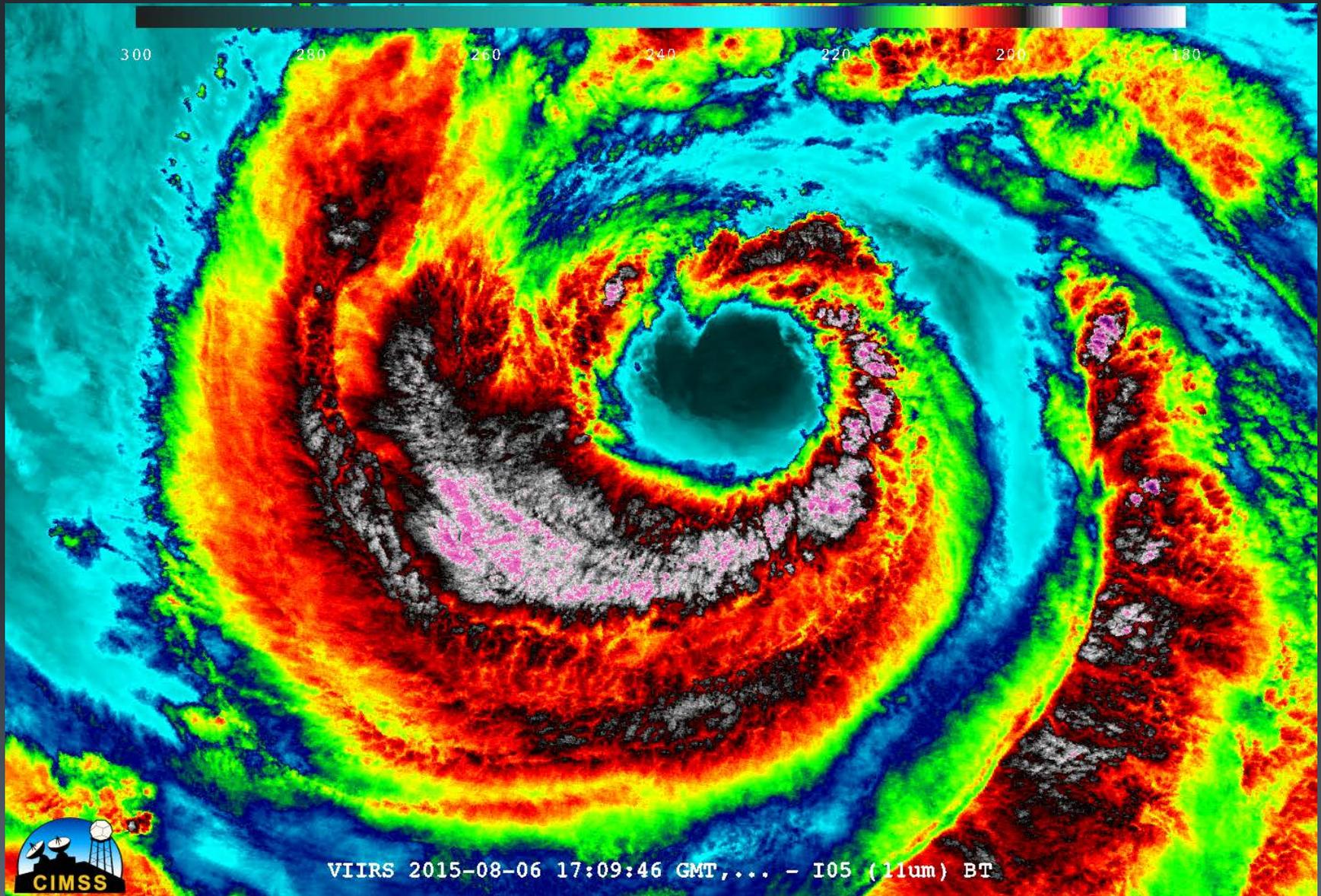
Examples of interest

Hurricanes, Typhoons

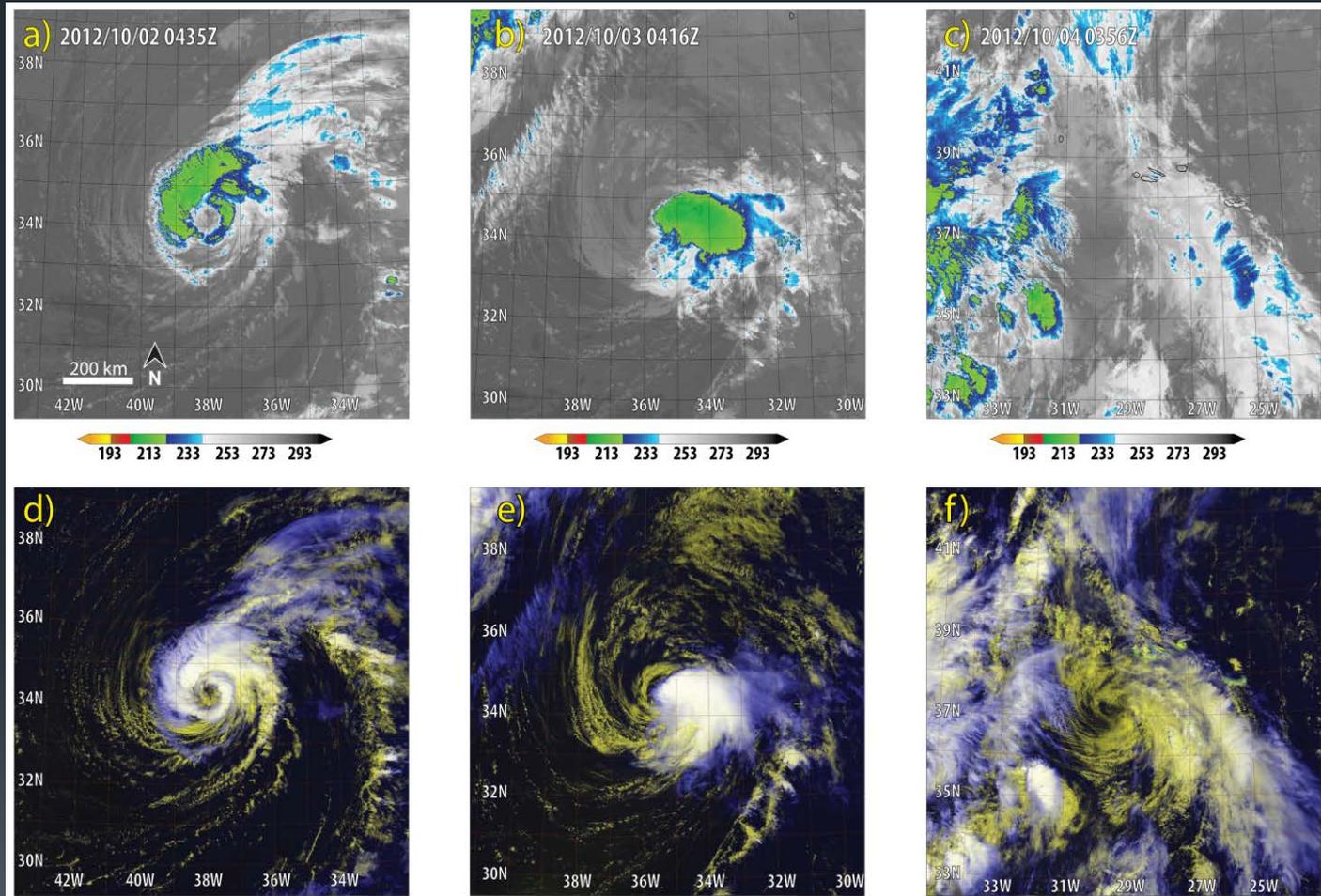
# Tropical Cyclones

- Tropical cyclones occur in the major ocean basins of the world and pose a significant threat to coastal communities
- Numerous aspects of low light imagery from the DNB which can be useful to forecasters
  - Inner-eye-wall low cloud mesovortices, sometimes not seen from thermal infrared observations
  - Detection of eye-wall lightning for remote storms
  - Lunar reflection-based observations of low-level circulation
    - Already used by the NWS in at least two cases in Hawaii (Flossie, Ela) to re-center storm center
  - Post-storm analysis

# Typhoon Soudelor



# Tropical Cyclones: Exposed Low-Level Circulation (Nadine, 2012)



Miller, S.D.; Straka, W., III; Mills, S.P.; Elvidge, C.D.; Lee, T.F.; Solbrig, J.; Walther, A.; Heidinger, A.K.; Weiss, S.C. Illuminating the Capabilities of the Suomi National Polar-Orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band. *Remote Sens.* **2013**, *5*, 6717-6766.

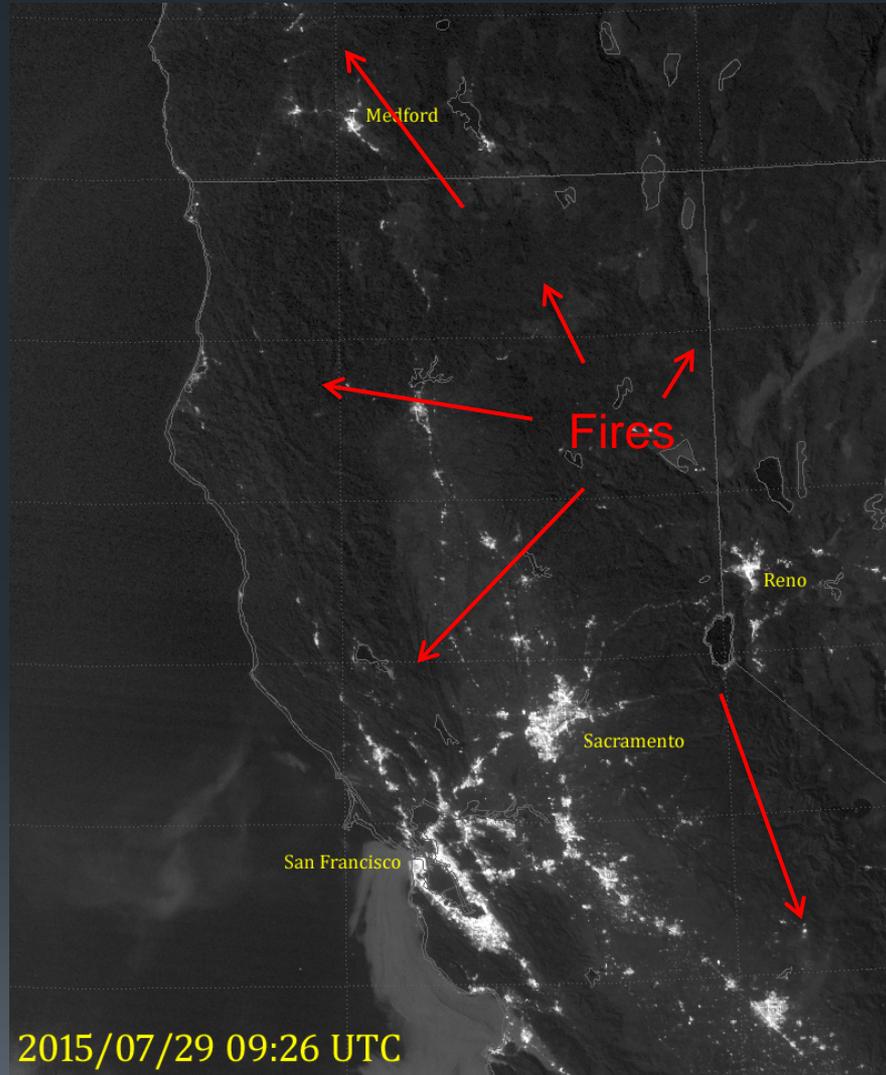
Examples of interest

Fires

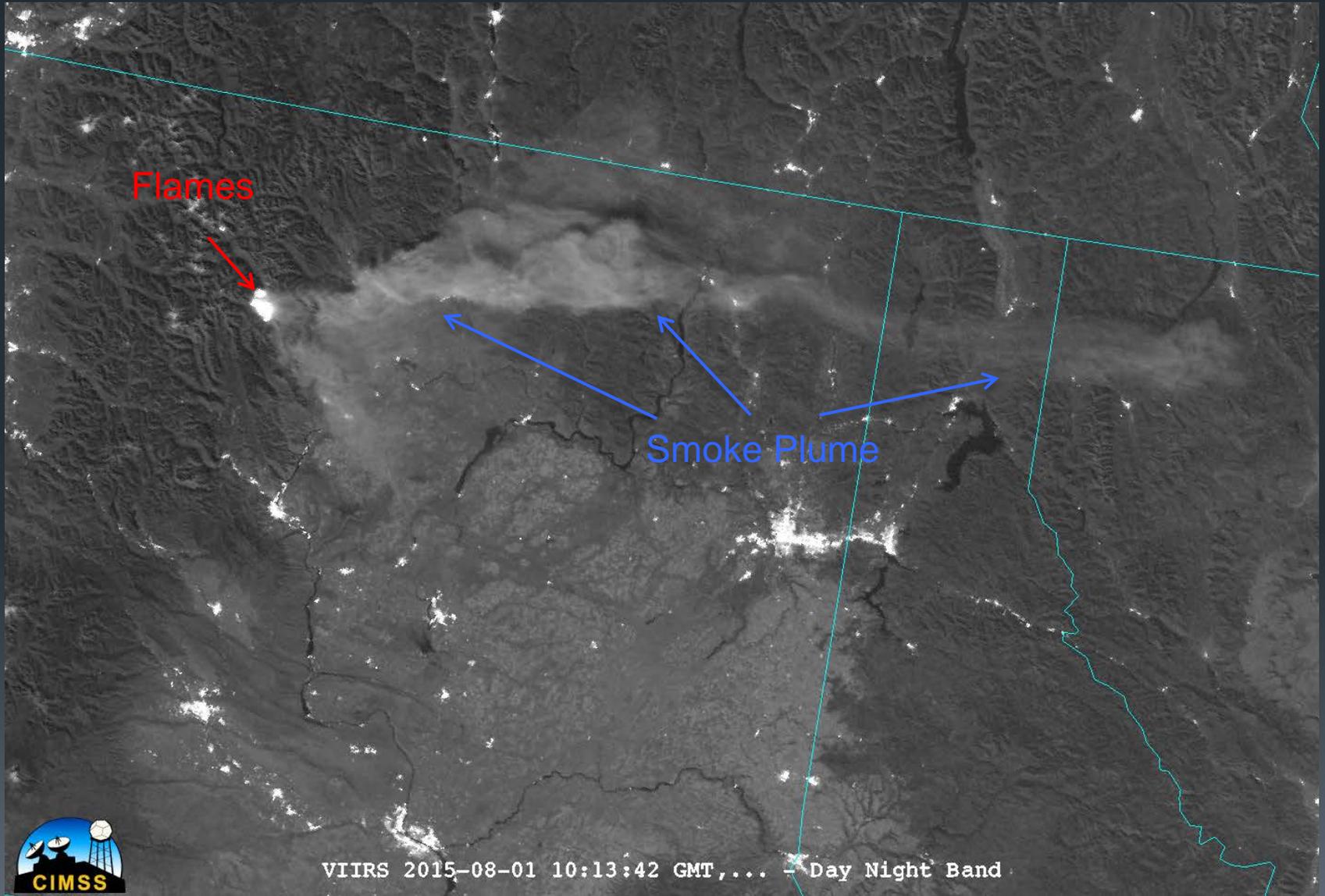
# DNB for fire detection

- Traditionally the 3.9 $\mu$ m (M13) channel was used for nighttime fire detection
  - Requires multiple thresholds over various surface type
- The DNB can be used directly to visually see smoke and fire locations
  - Useful public informational tool (Facebook, Twitter)
- The DNB along with other channels can be combined to develop improved night time fire detection algorithm
  - Example: VIIRS Nightfire product - Elvidge, C.D.; Zhizhin, M.; Hsu, F.-C.; Baugh, K.E. VIIRS Nightfire: Satellite Pyrometry at Night. *Remote Sens.* **2013**, 5, 4423-4449.

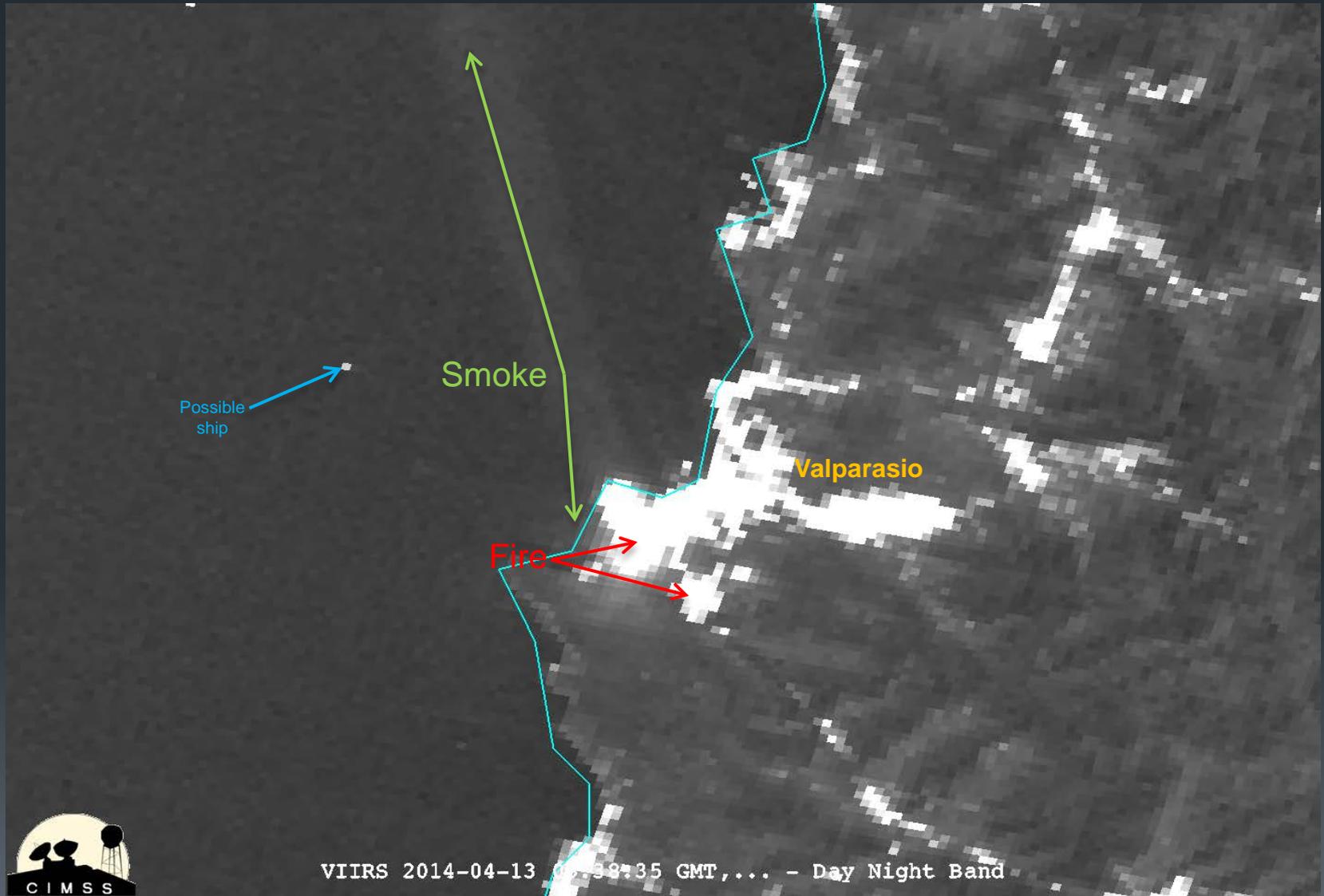
# California Multi-Night Loop



# Wolverine Fire



# Valparaiso, Chile Fire



Examples of interest

**Volcanos**

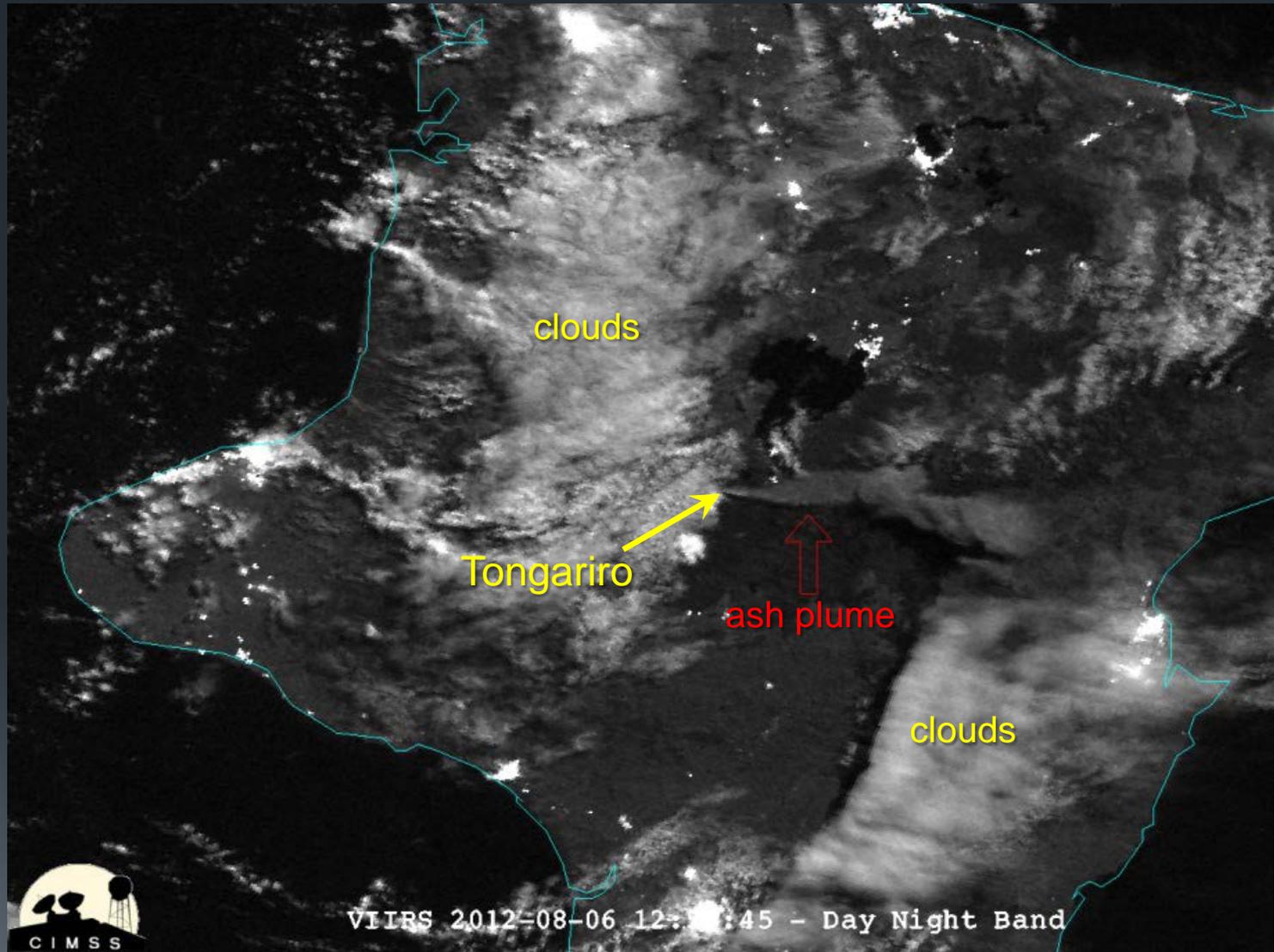
# DNB uses with Volcanos

While not a substitute for multi-spectral ash detection algorithms, the DNB can still provide useful insights during and after volcanic eruptions, both during moonlit and moonless nights

Examples:

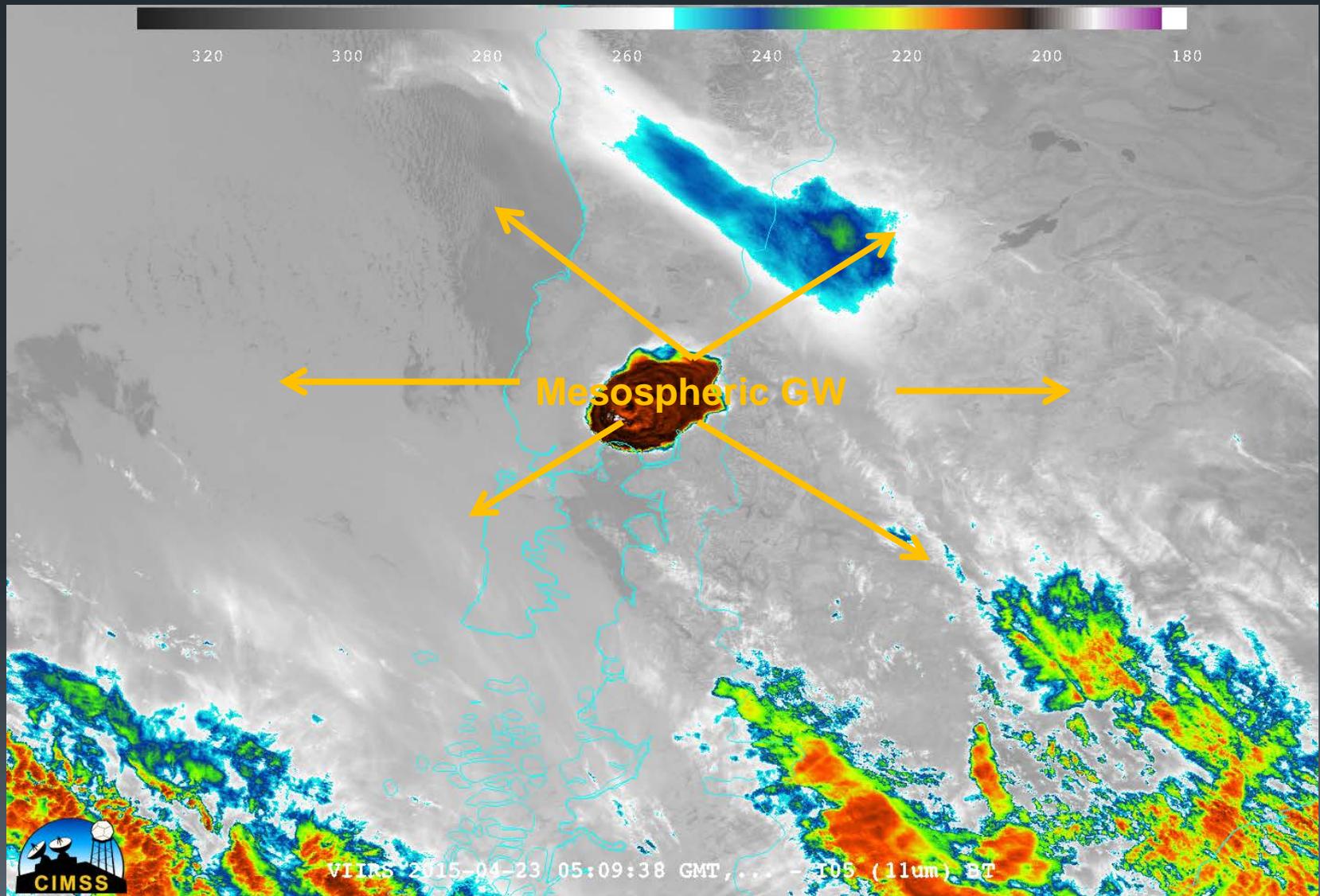
- Secondary, visible source for ash detection
- Monitoring of growth of lava field
- Shockwave detection

# Volcanic Ash

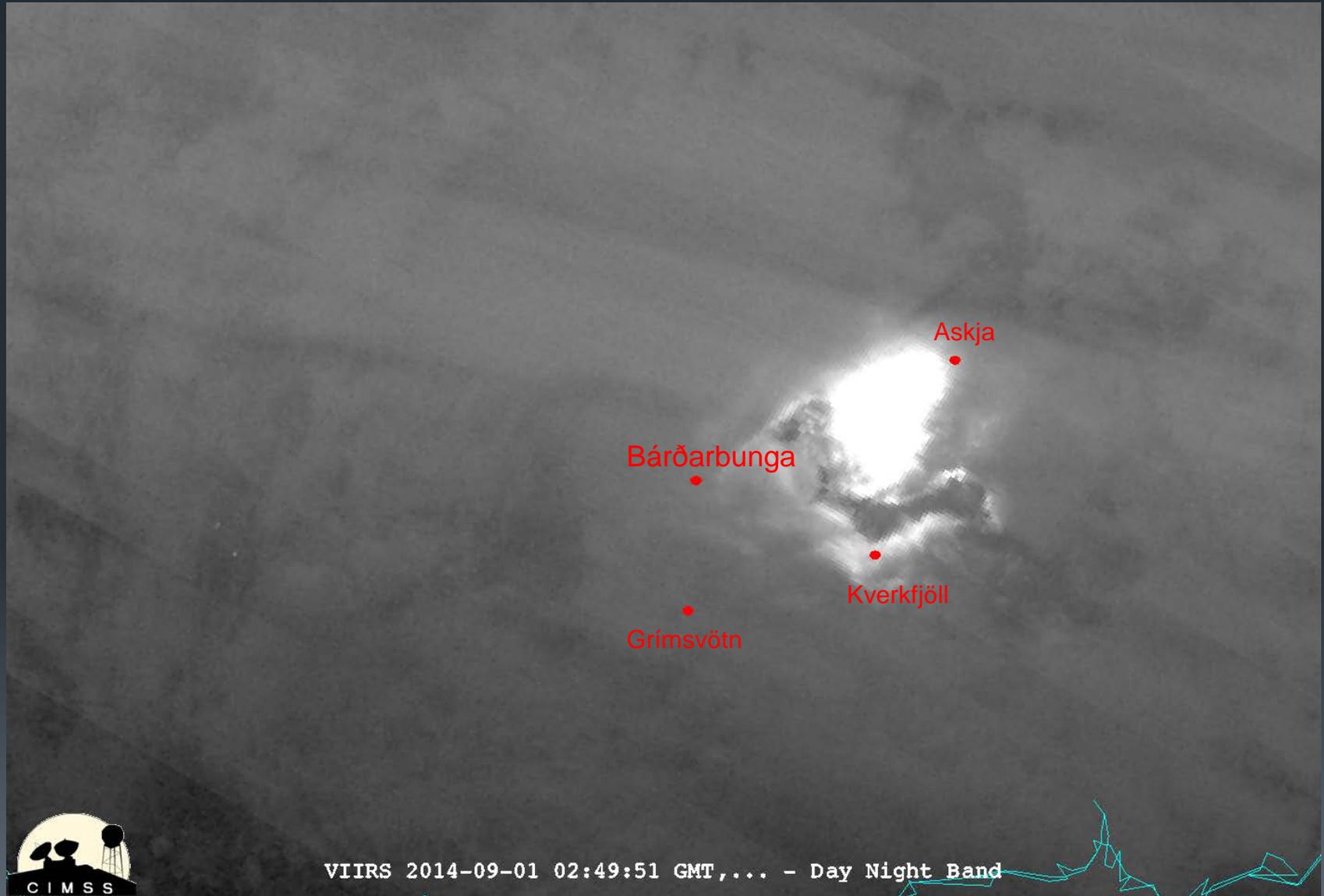


# Volcanic shockwave

Calbuco volcanic eruption, March 2015



# Iceland volcanos



Examples of interest

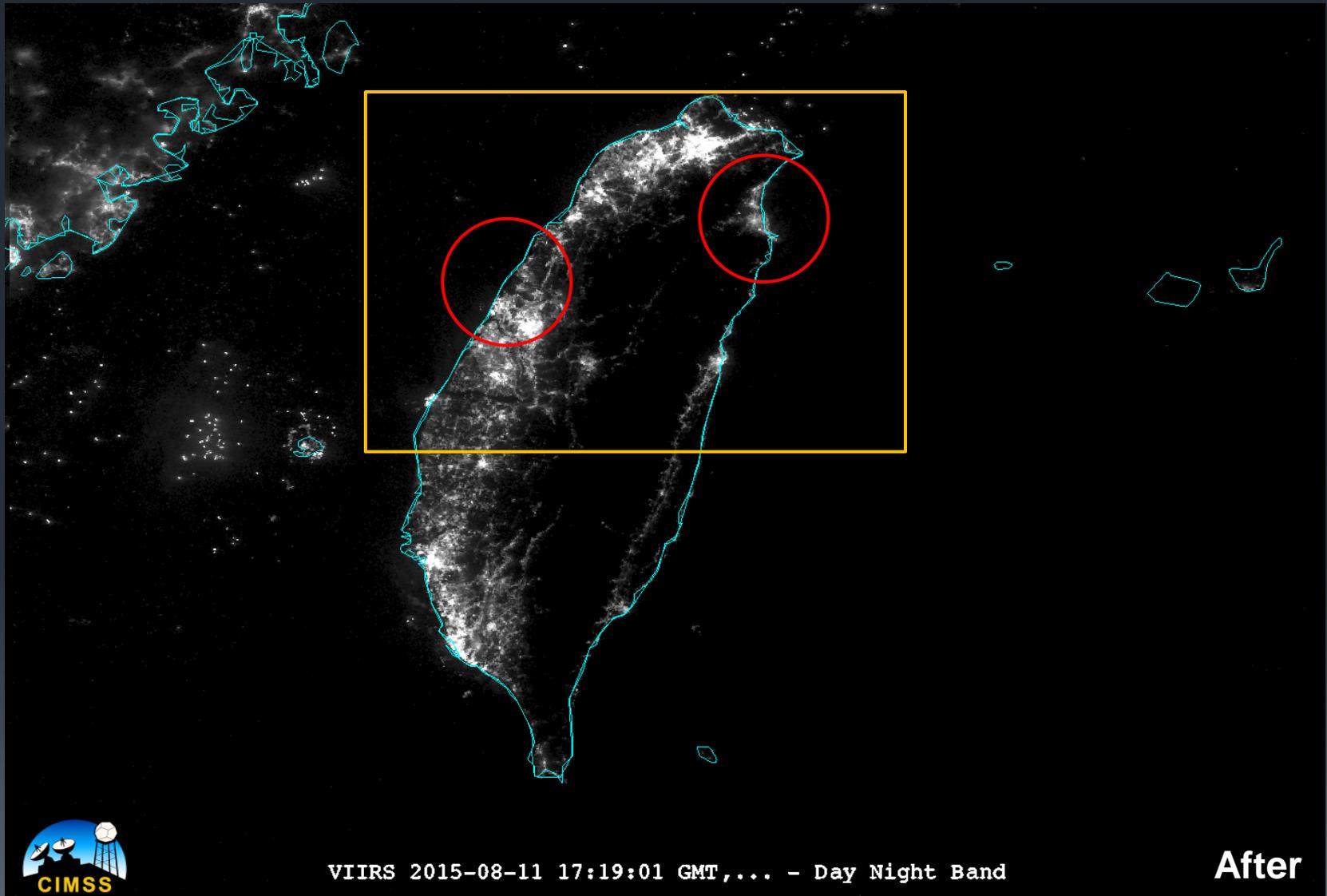
Other natural/human disasters

# Other natural/human cause events (disasters) detected by DNB

- Post-case power outage analysis
- Severe Weather
  - Visible overshooting top detection
  - Lightning detection
- Monitoring of accidental and purposeful human caused incidents

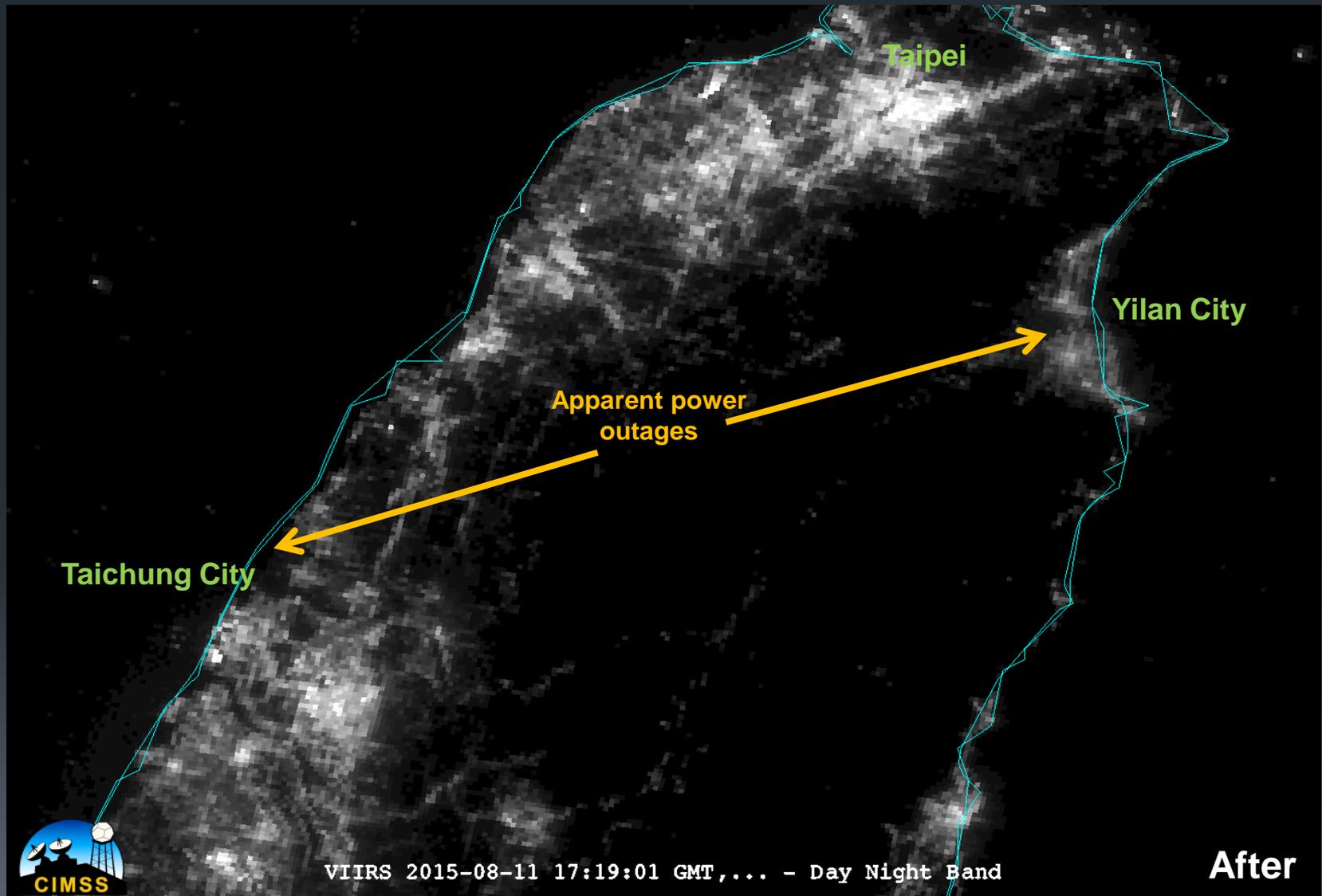
# Post Case power outage analysis

## Taiwan - Typhoon Soudelor

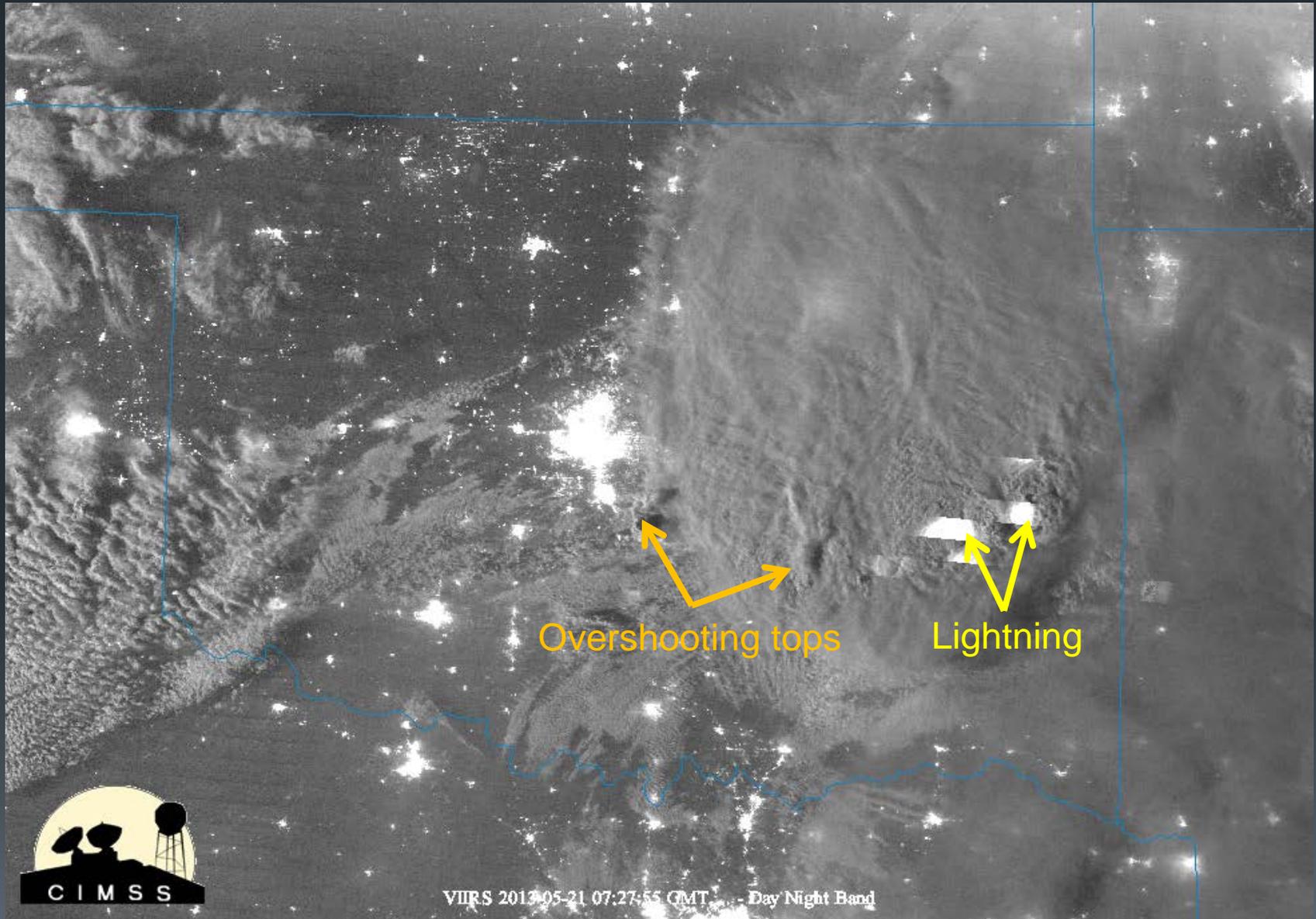


# Post Case power outage analysis

## Taiwan - Typhoon Soudelor

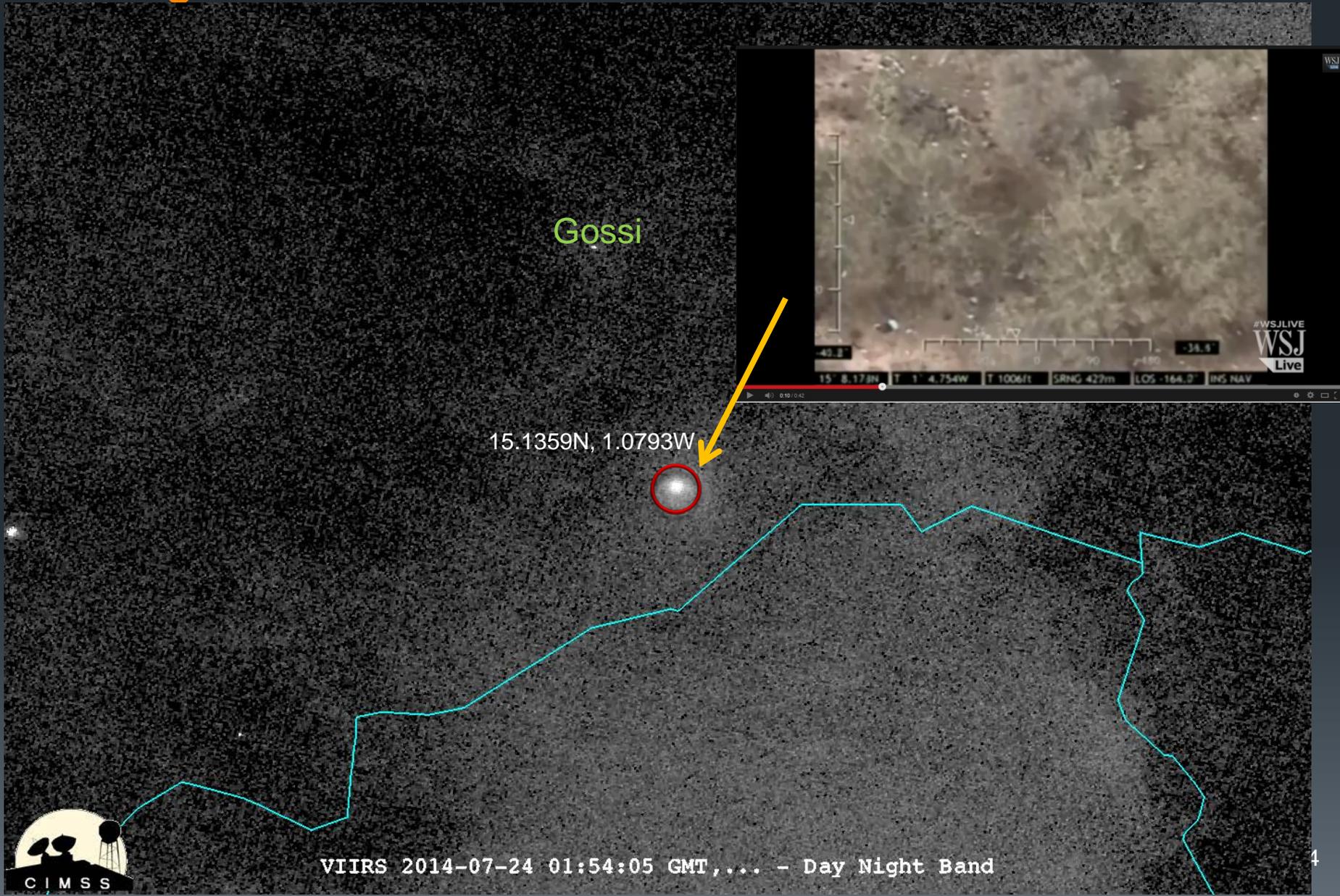


# Severe Weather



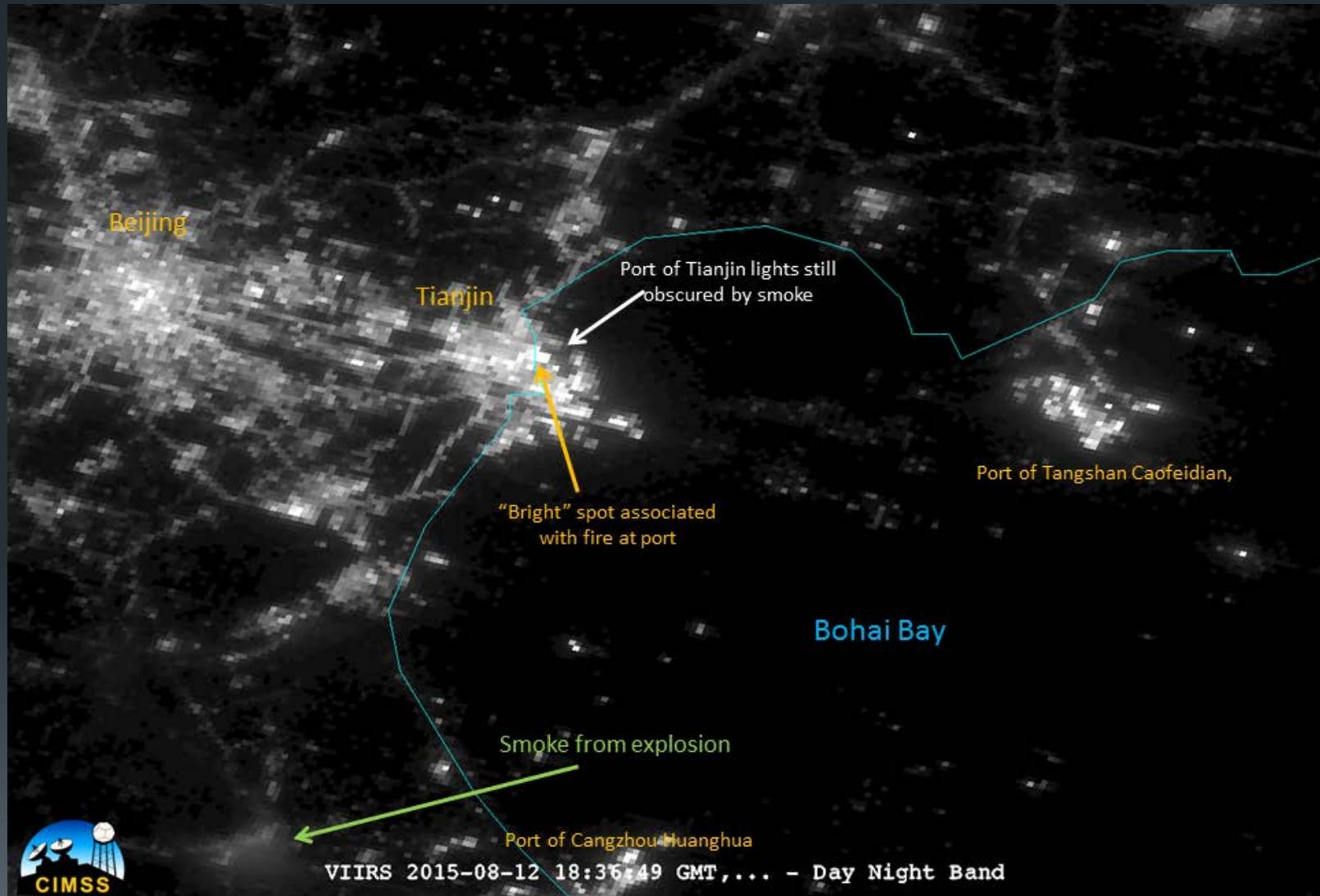
# Severe Weather related

## Air Algérie 5017



# Human made disasters

## Tianjin Port Explosion



# Other natural/human cause events (disasters) detected by DNB

- Monitoring of Sea Ice changes
  - Kiska Sea rescue
- Fog
- Monitoring of large scale dust storm events in the Middle East
- Monitoring of accidental and purposeful human caused incidents
  - Examples:
    - Monitoring of smoke plumes/fires from Tikrit/Baiji, Iraq refineries
    - Erie, IL pipeblast
    - Hercules 265 blowout
    - Lac-Mégantic rail disaster

# Summary

- The DNB provides the unique capability to provide visual imagery both during the day and at night
- Visible imagery can be used for public awareness via social and traditional media
- The DNB can provide qualitative and quantitative information of various disasters
- DNB imagery has been used in a number of *operational* cases during various natural disasters
- DNB imagery can be used for near-realtime analysis and monitoring of human-made disasters