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 µm, 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)

Examples of interest

Fires
DNB for fire detection

- Traditionally the 3.9 µm (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
California Multi-Night Loop

2015/07/29 09:26 UTC
Wolverine Fire

Flames

Smoke Plume
Valparasio, 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

Tongariro

ash plume

clouds

clouds
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

Before

Taichung City

After

Yilan City

Taipei

Apparent power outages

Taichung City

VIIRS 2015-08-11 17:19:01 GMT,... - Day Night Band
Severe Weather

Overshooting tops

Lightning

VIIRS 2013-05-21 07:27:55 GMT  Day Night Band
Severe Weather related
Air Algérie 5017

Gossi

15.1359N, 1.0793W
Human made disasters

Tianjin Port Explosion

VIIRS 2015-08-12 18:37:49 GMT, Day Night Band
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