

The background of the slide is a composite image of Earth from space. The top half shows a dark starry sky with a thin, glowing green aurora borealis arc. The bottom half shows the Earth's horizon with a dense layer of yellow and orange city lights at night.

Nightglow Brightens Horizons for Nighttime Imagery

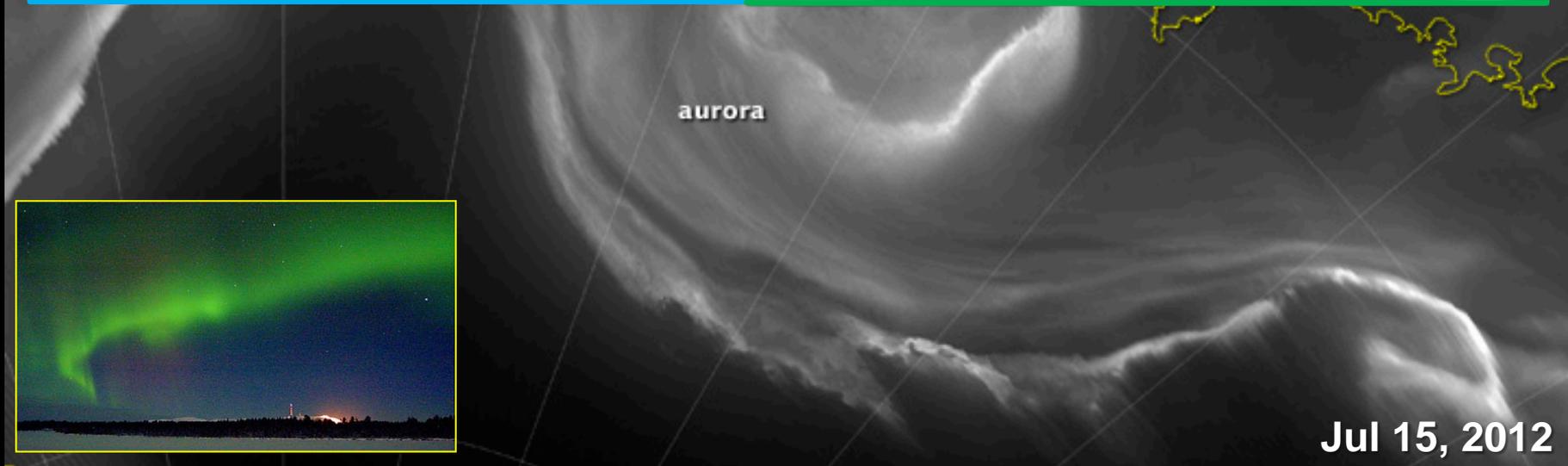
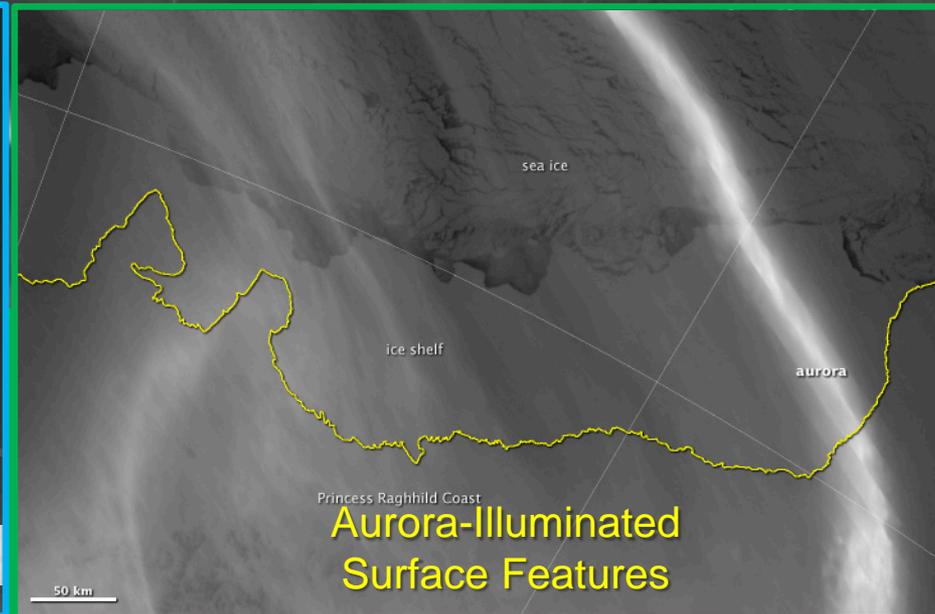
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**93rd Annual Meeting
American Meteorological Society
Austin, TX**

8 January 2013

Aurora: Moonless Night



Jul 15, 2012

The International Space Station's View of Nocturnal Light Sources



Courtesy: NASA Johnson Space Center

A So-Called 'Dark' Night...

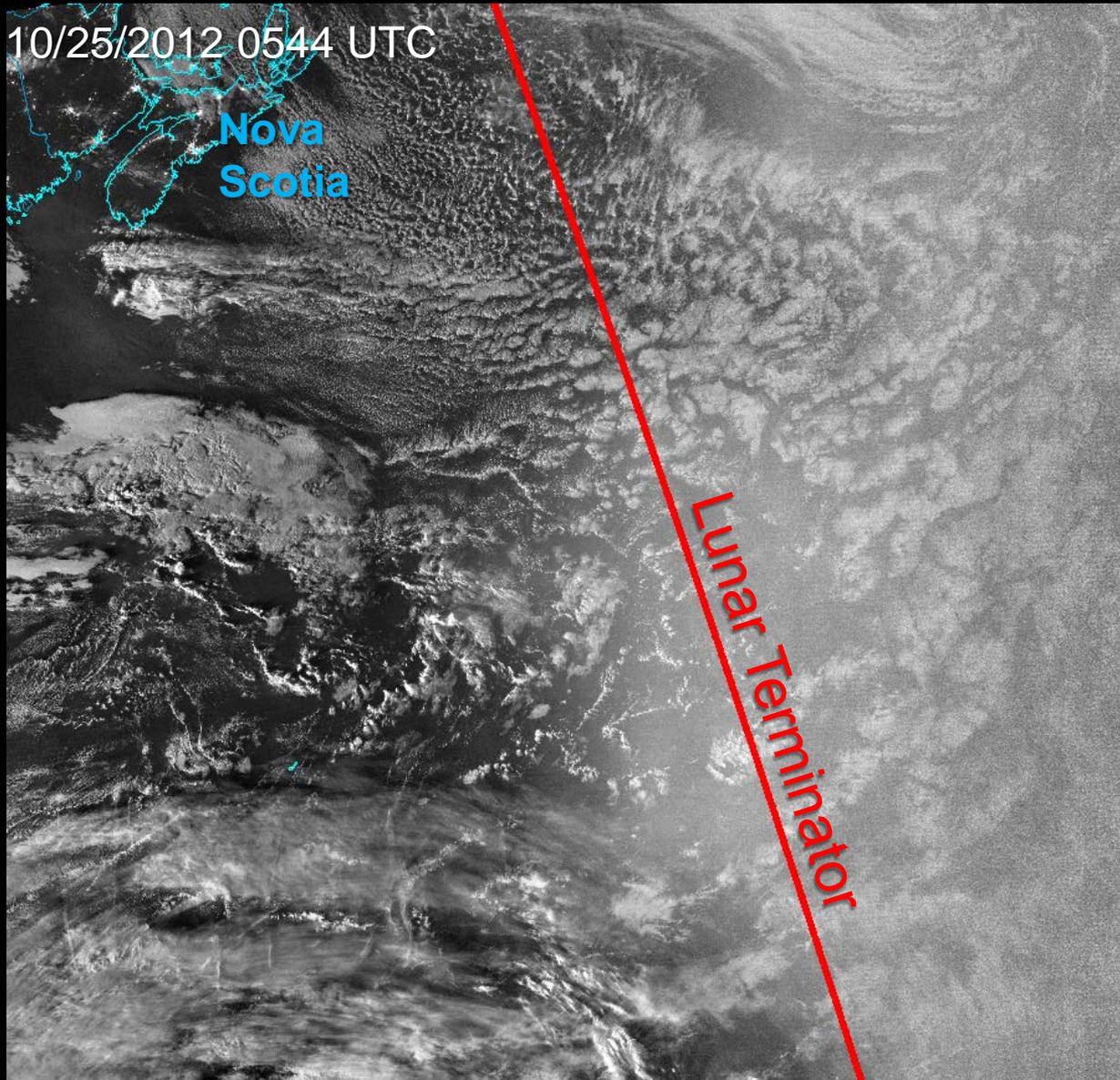


Starlight

Nightglow

Discovery: The Day/Night Band is sensitive enough to detect and use these light sources for visible imagery *on completely moonless nights!*

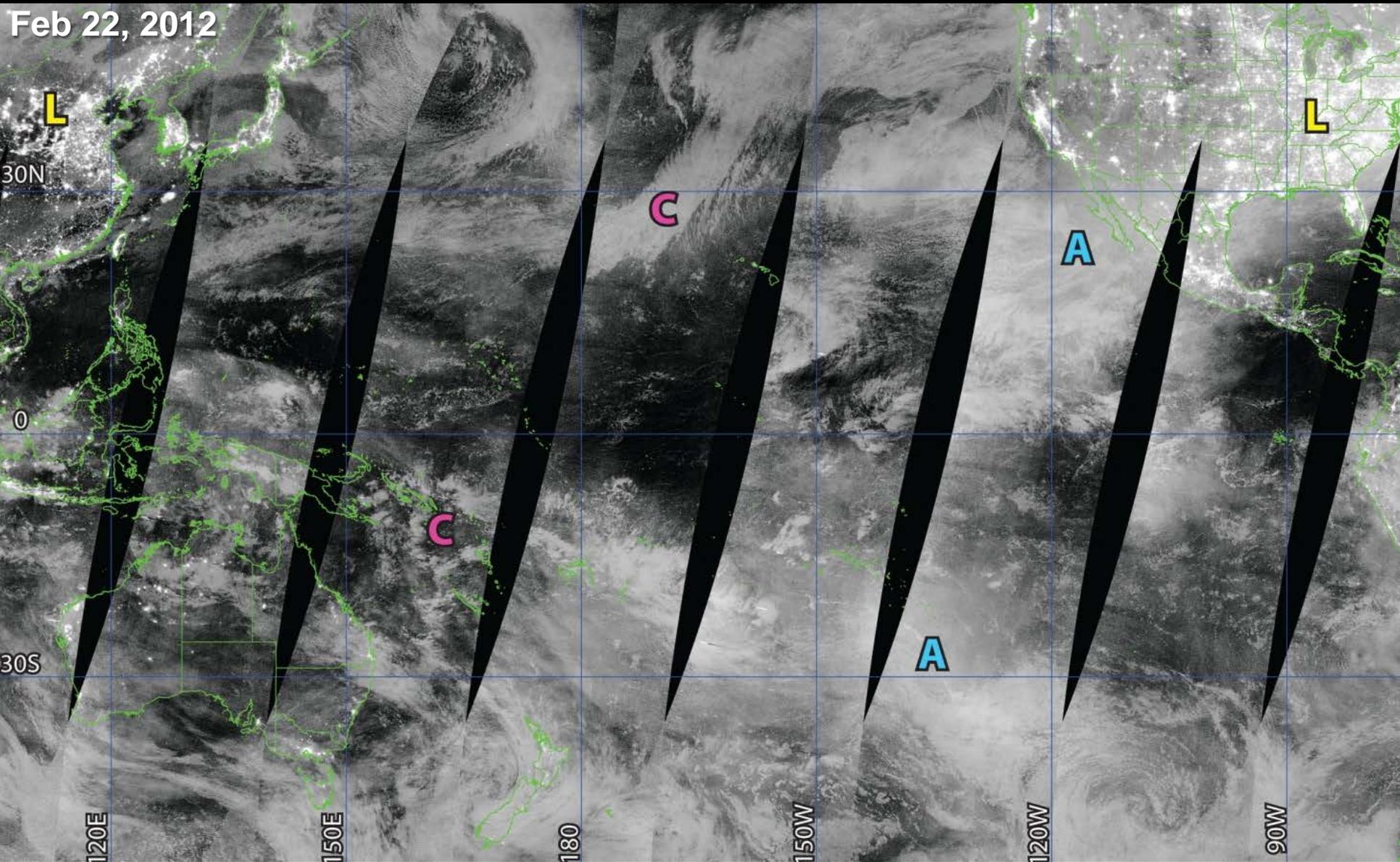
Clouds Beyond 'Moonset'



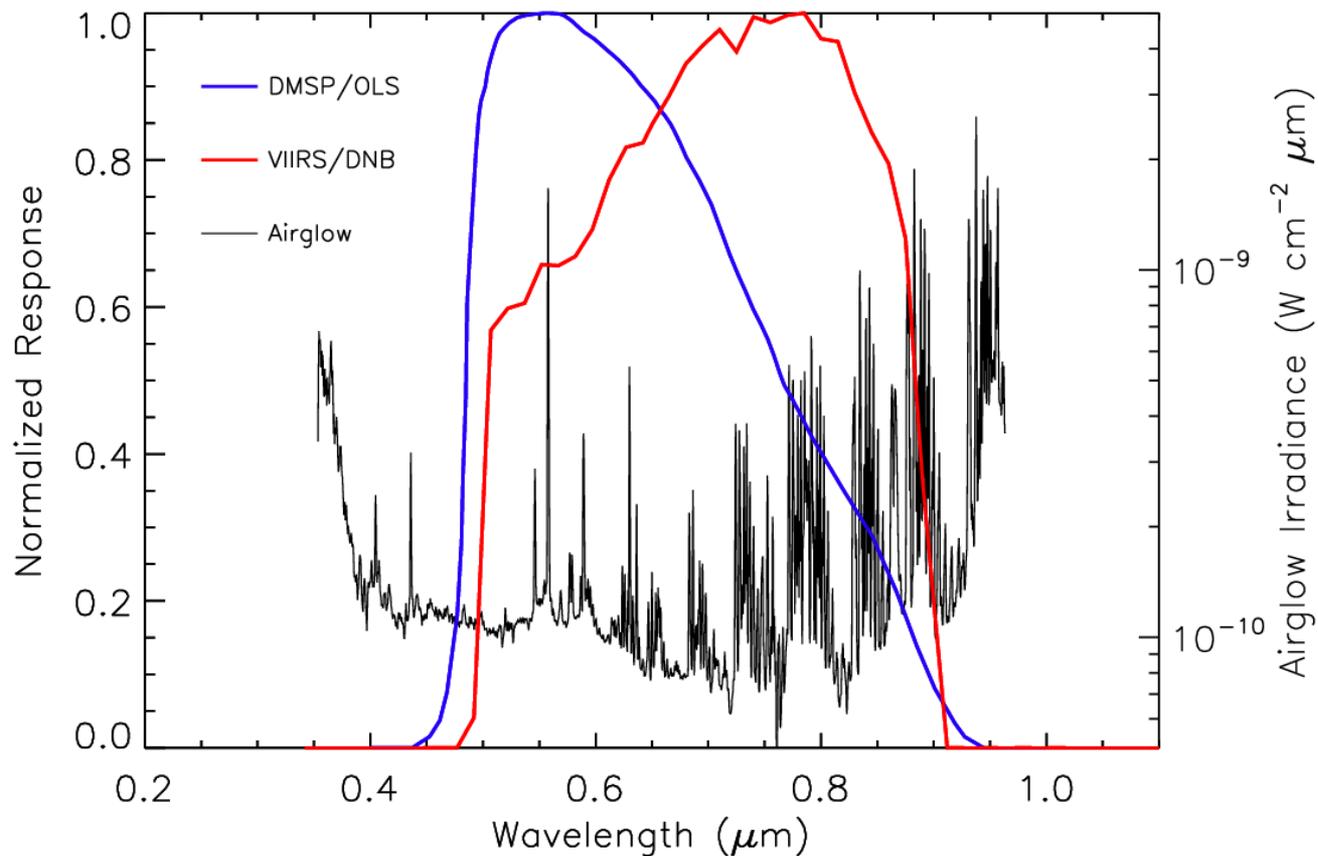
Courtesy: W. Straka and K. Strabala, SSEC/CIMSS

~1:30 AM Over the Pacific: *New Moon*

Feb 22, 2012



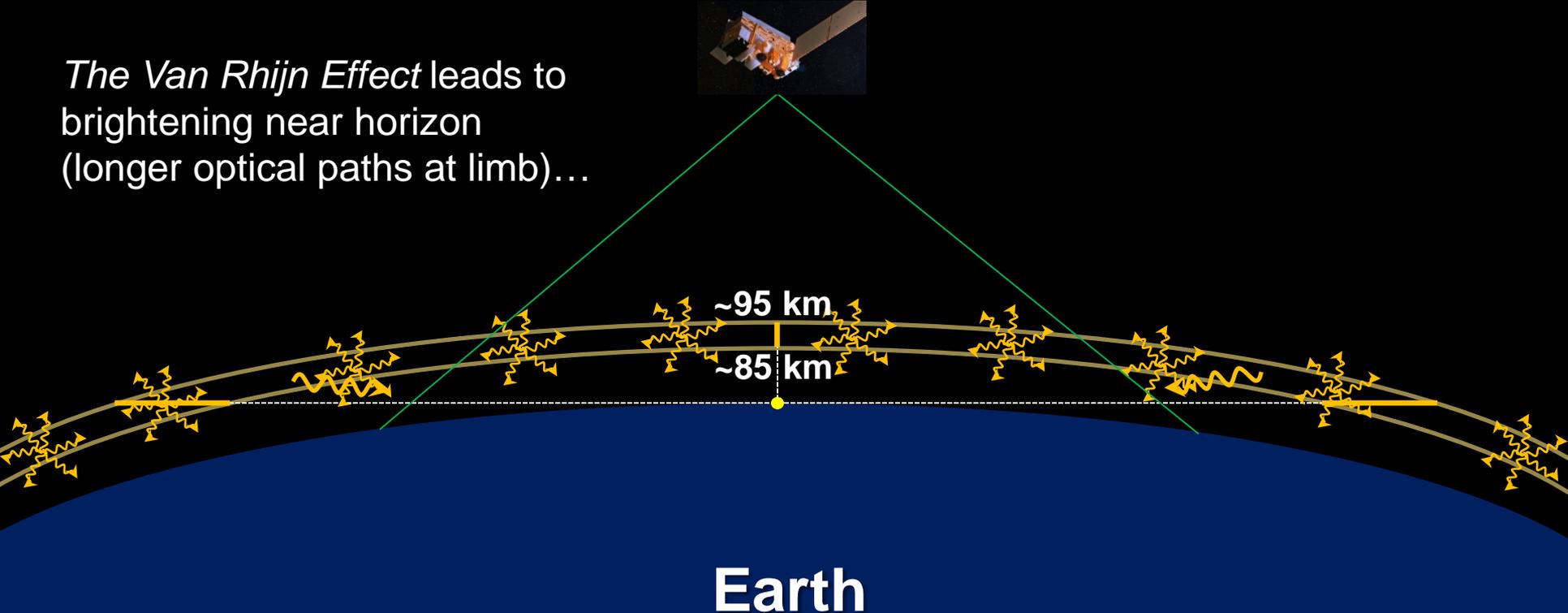
Illumination Sources & Sensor Response



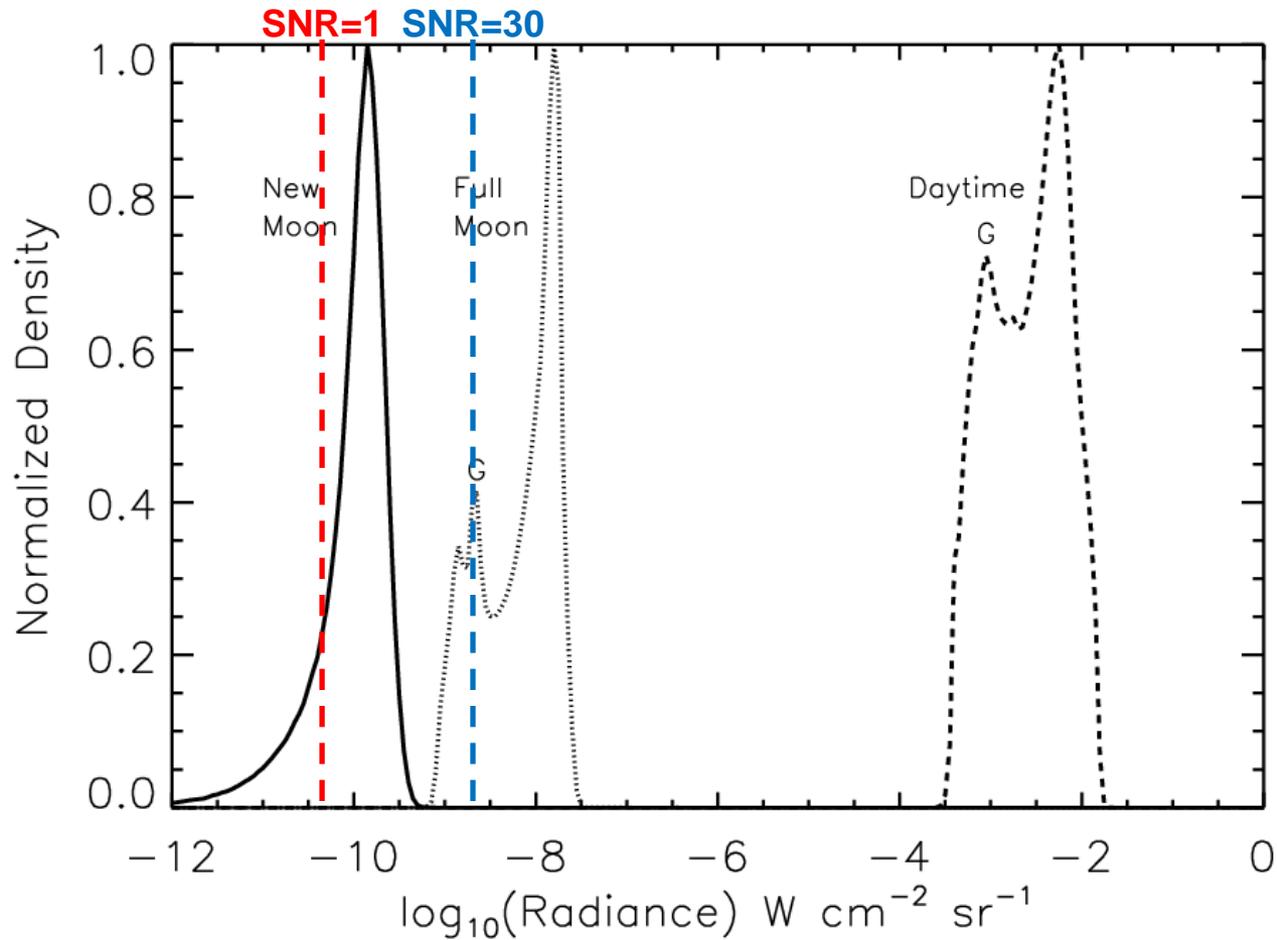
The Nightglow Emission Source

- Nightglow → chemiluminescence in upper-atmospheric gases
 - Vibrationally excited Hydroxyl (OH^* ; reactions between O_3 and atomic Hydrogen), atomic & molecular Oxygen, Sodium and Nitrogen, among others
 - Brightest emissions in ~10 km thick layer near the mesopause (85-95 km)
 - Strong correlation with temperature and atomic Oxygen mixing ratio
 - Highly variable emissions across space & time

The Van Rhijn Effect leads to brightening near horizon (longer optical paths at limb)...

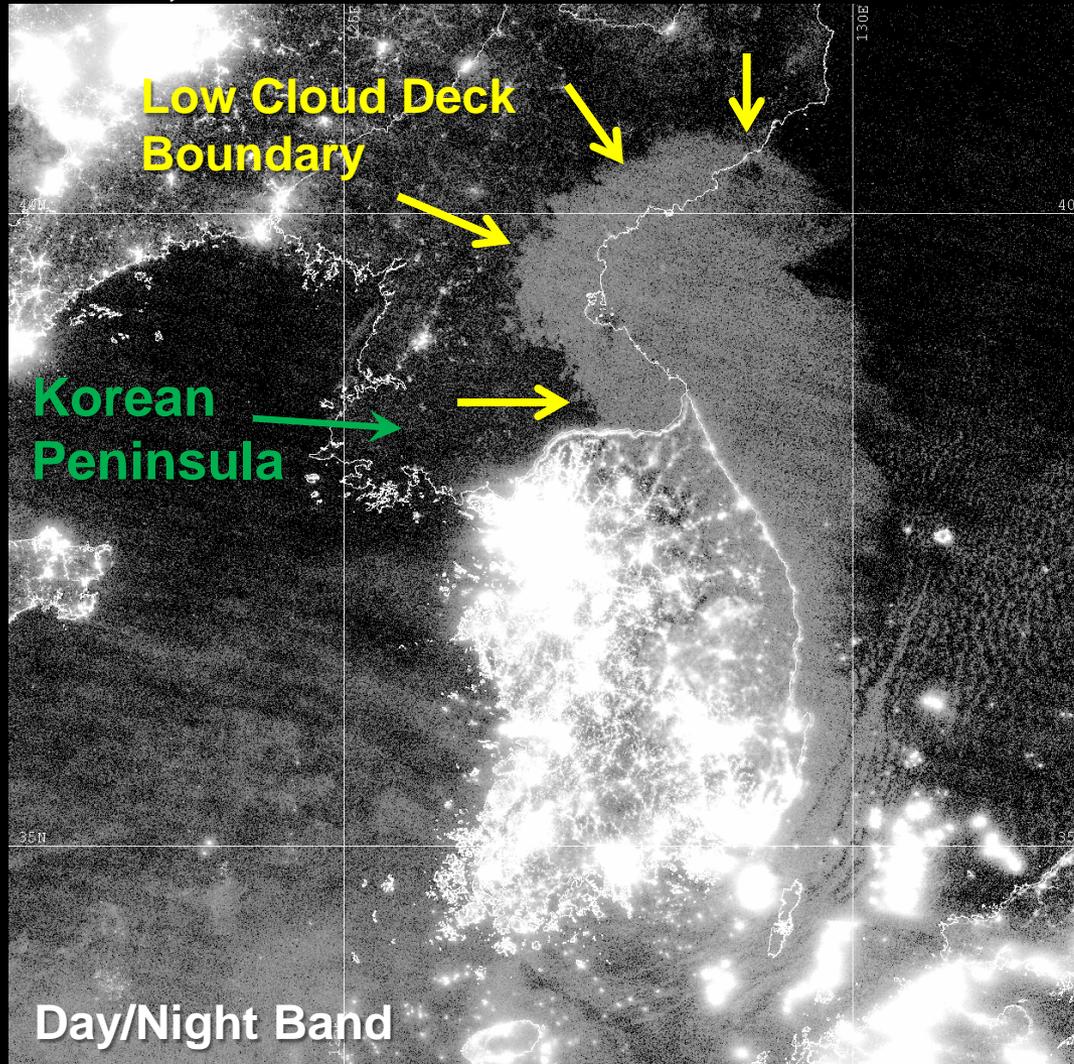


Radiance Distribution

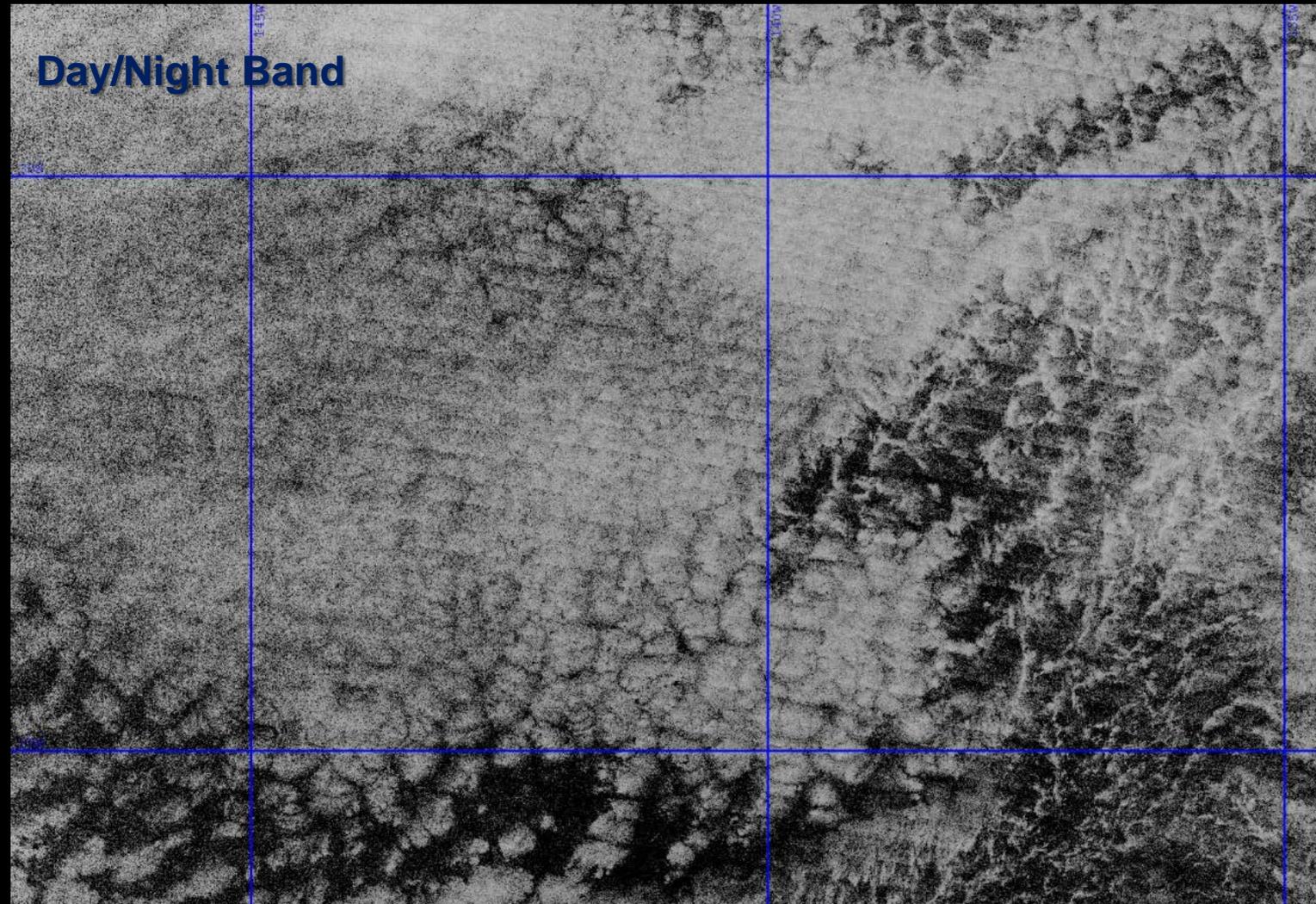


Low Clouds & Fog Sensitivity

Feb 23, 2012

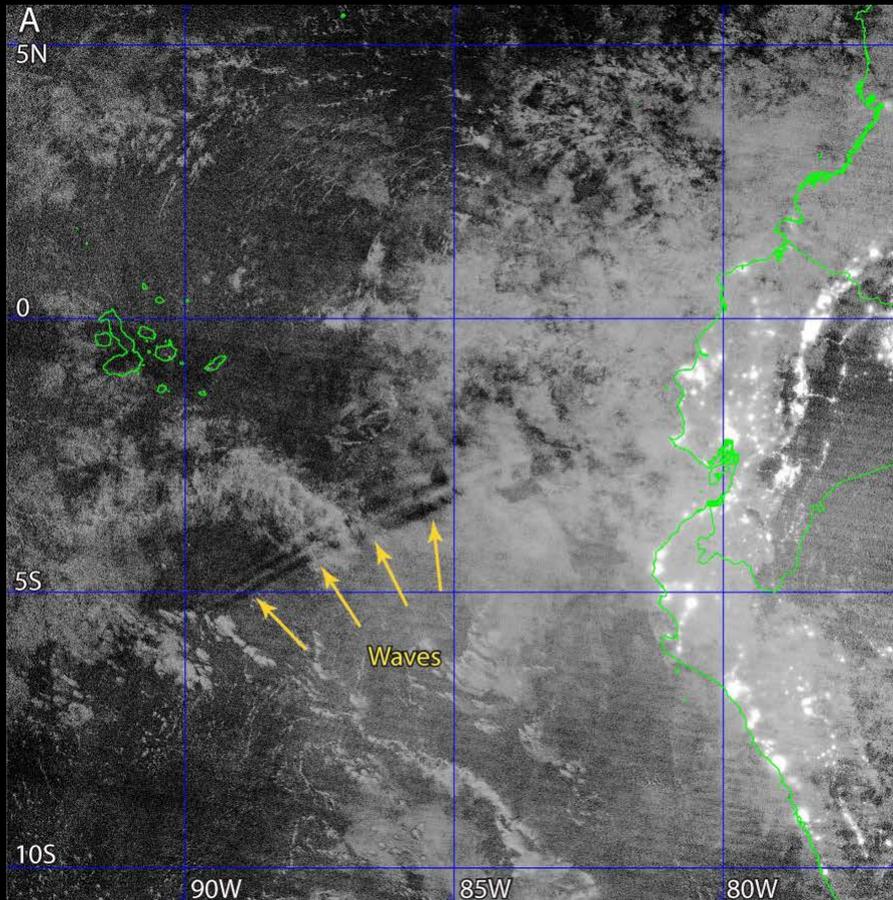


Improved Low Cloud Structure

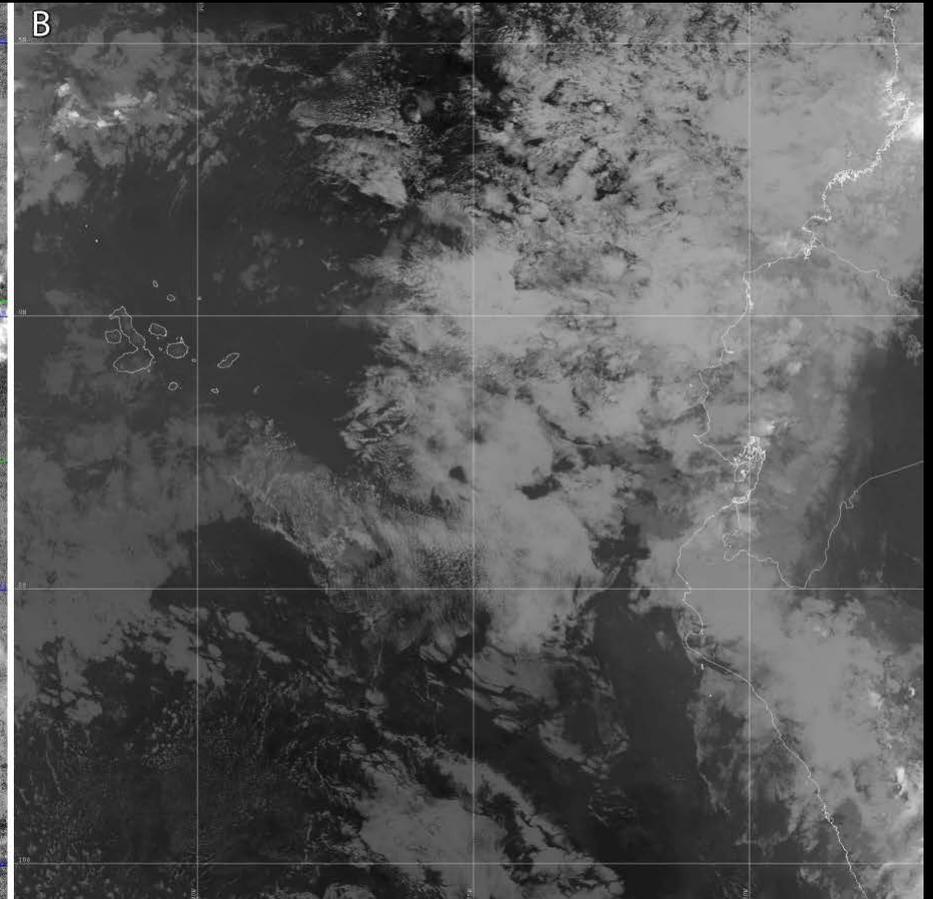


Nightglow Waves

Day/Night Band



Thermal Infrared



→ Provides a top-down, synoptic scale perspective on coupling between lower & upper atmosphere...

Thunderstorm Forcing



Implications of the Discovery...

- A form of visible sensing exists on *all* nights.
- Reflectance and emission from diffuse light sources.
- Still exploring the information content; challenges and opportunities...a new research frontier!
- Improved sensitivity to lower atmosphere and surface environmental parameters.
- Direct observation of lower/upper atmospheric coupling (nightglow waves).

Open Access Article:

Miller, S. D., *et al.*, 2012, *Proc. Nat. Acad. Sci.*, 109(39), 15706-15711.