

Preliminary VIIRS calibration for estimating flared gas volumes

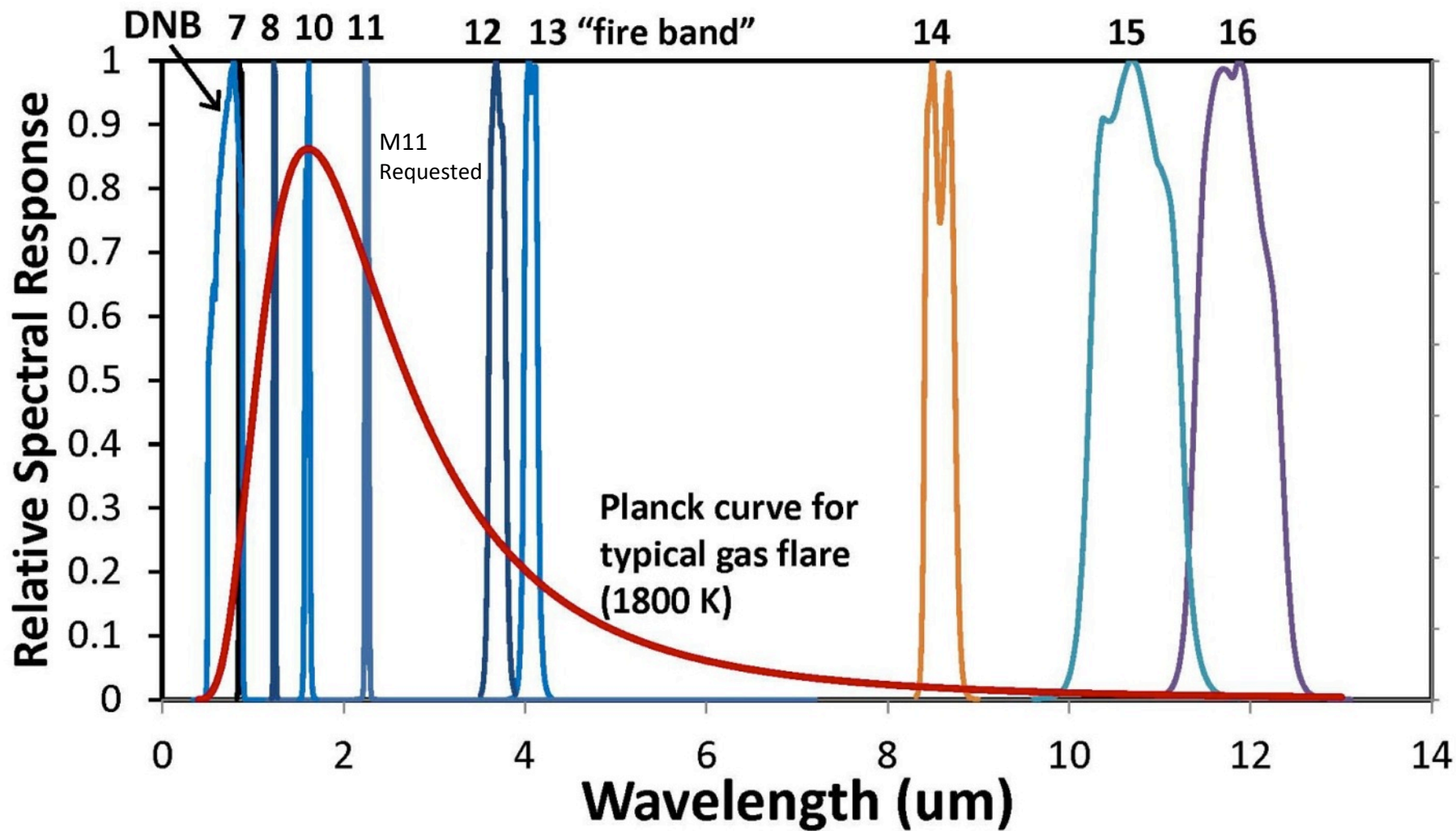
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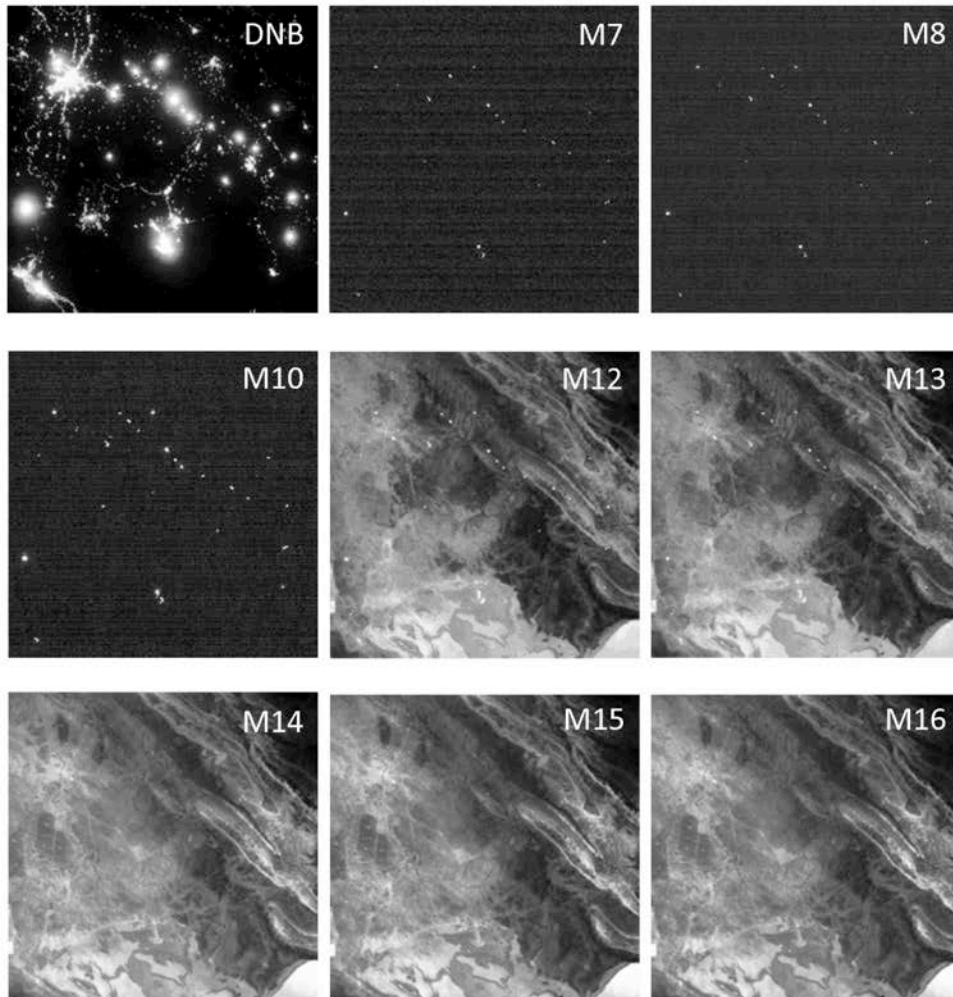
May 21, 2014

VIIRS

- The Visible Infrared Imaging Radiometer Suite (VIIRS) is the primary imaging sensor flown on the NASA/NOAA Suomi National Polar Partnership satellite.
- Launched on October 28, 2011, VIIRS began to collect usable data in late-February 2012.
- 22 spectral channels, most with 750 meter pixels at nadir.
- 3000 km swath. Overpasses at ~01:30 and 13:30 daily.
- VIIRS is unique for collecting near and short-wave infrared data at night.



Basra Gas Flares, Iraq - July 17, 2012



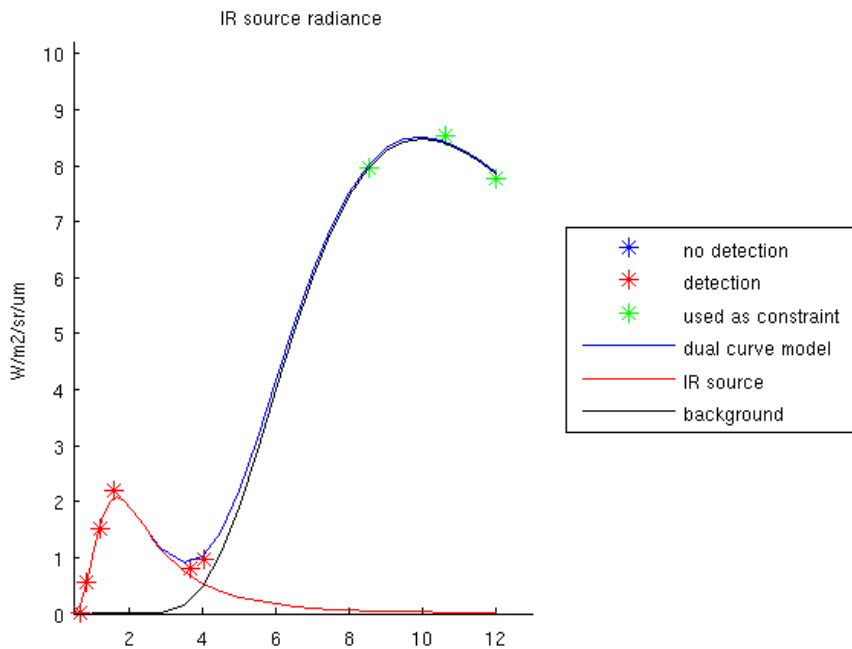
Gas flares are readily detected in the VIIRS M10 spectral band

Nighttime data processed on 24 hour increments

Typical gas flare detection

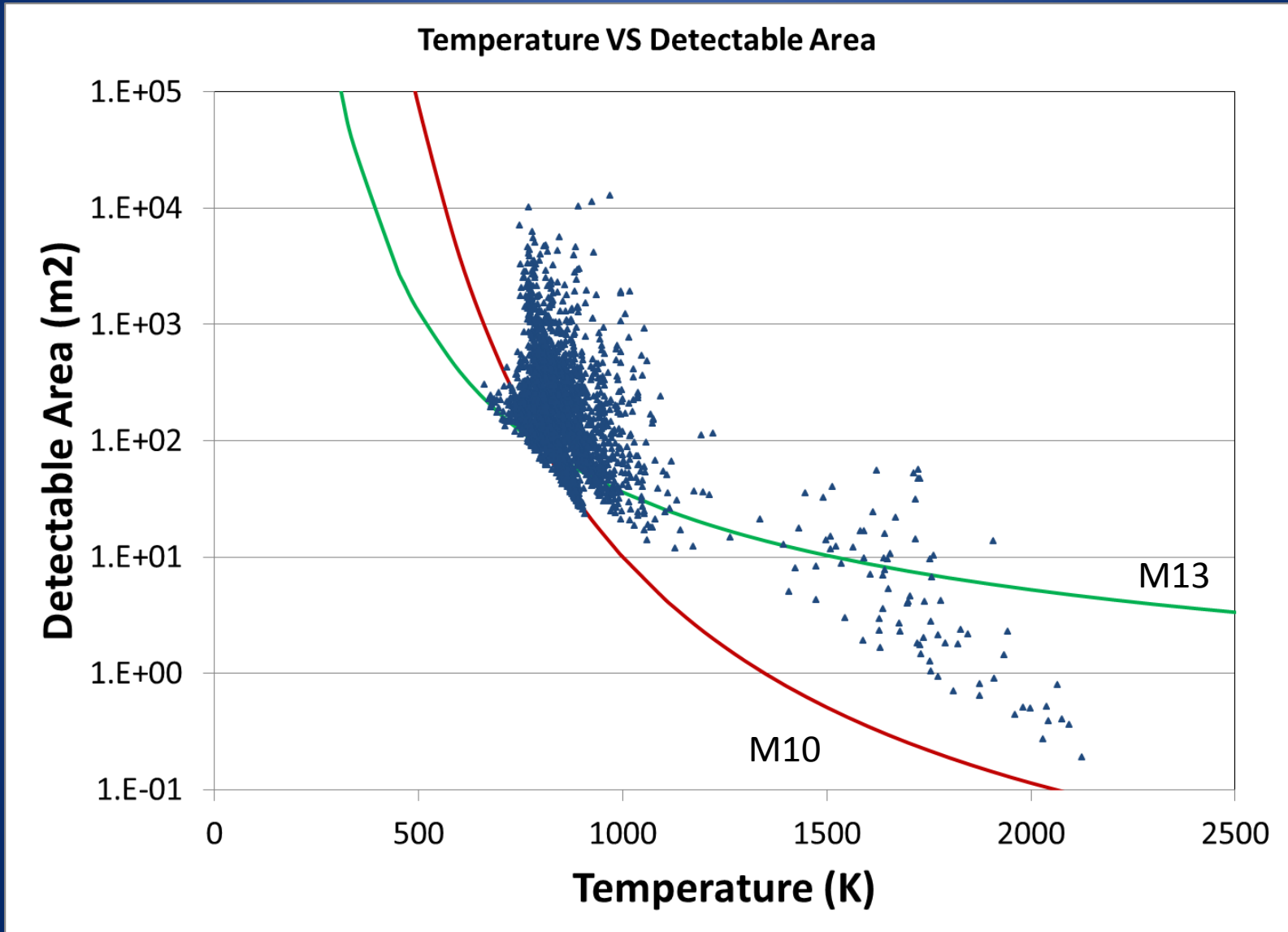
Combustion parameters:

ID=VNF_npp_d20140426_t0800568_e0806372_b12924_x0922946W_y196042N_l2716_s2045_v21
Lat=19.604204 Lon=-92.294624 deg. Time=2014/04/26 08:06:32
Temperature source=1730 deg. K Temperature background=291 deg. K
Radiant heat intensity=16.63 W/m² Radiant heat=13.18 MW
Source footprint=25.96 m²
Methane equivalent=0.356 m³/s CO₂ equivalent=651.983 g/s
Cloud state=clear Atmosphere corrected=no



Daily files are in csv and kmz formats

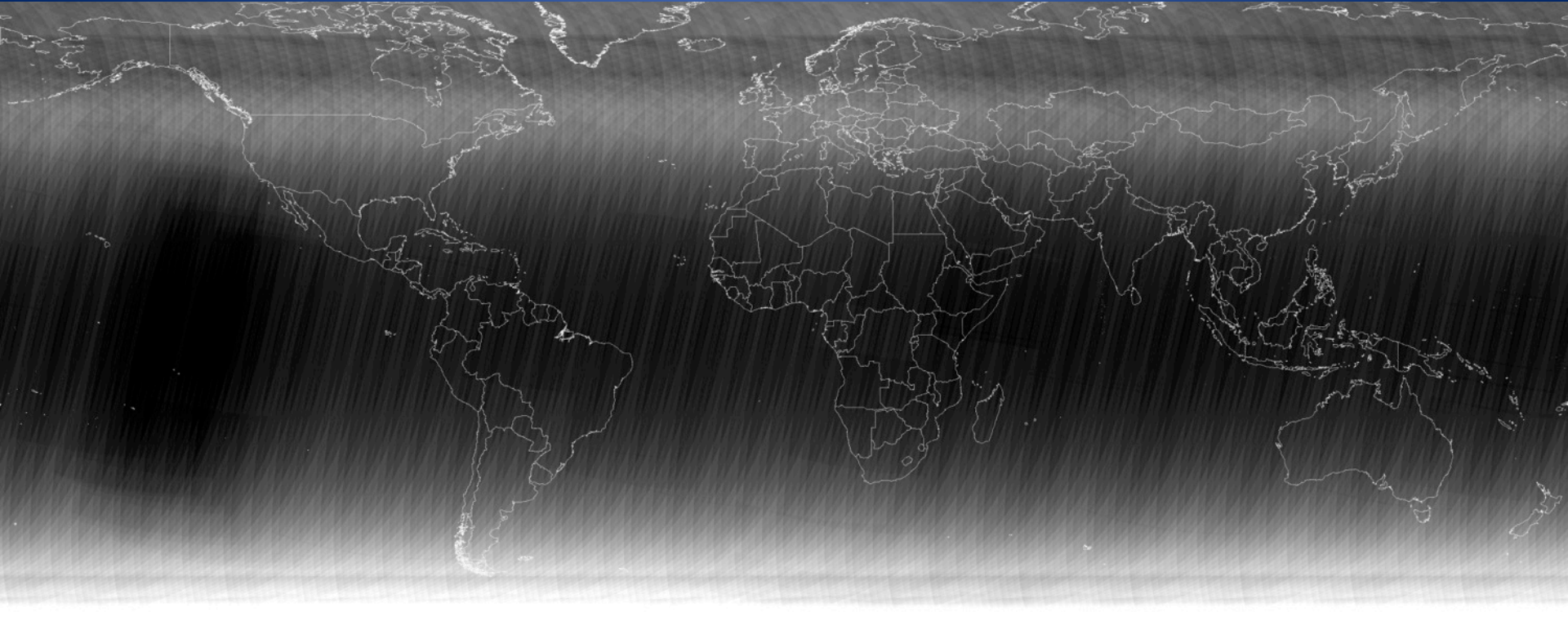
Detection Limits



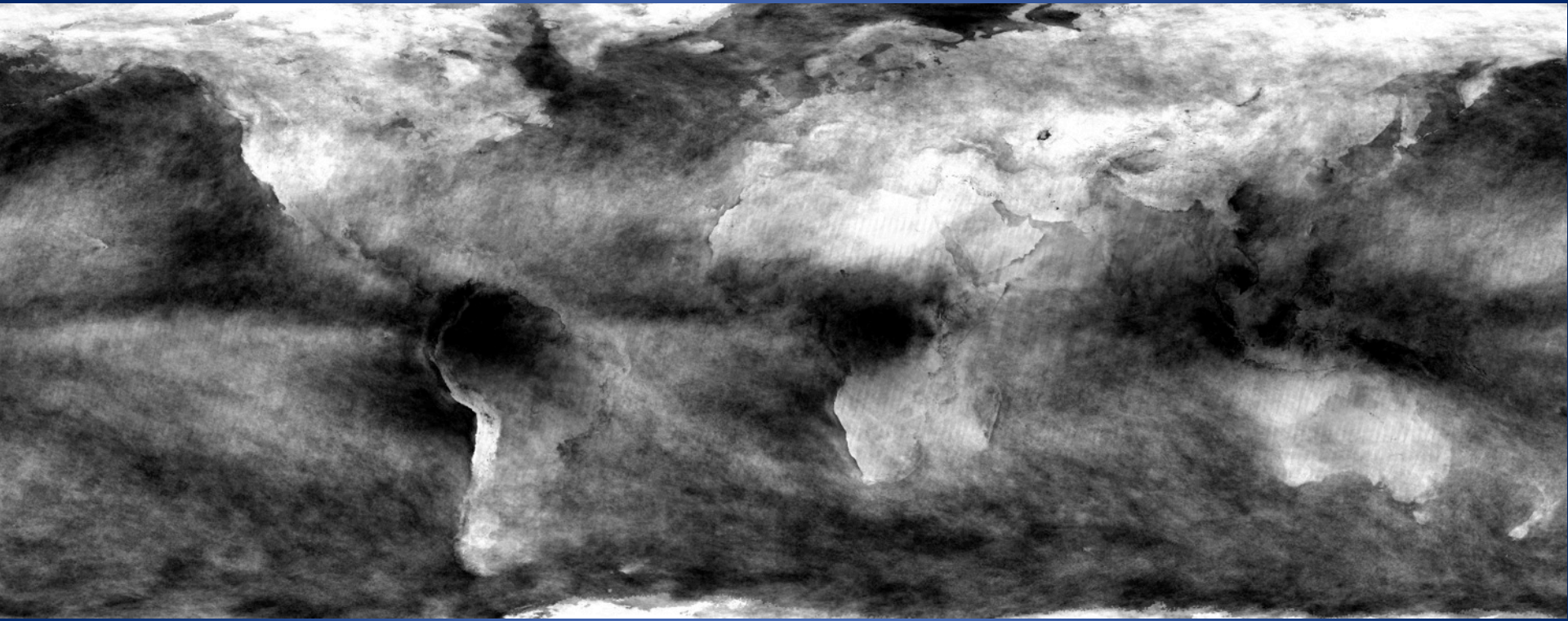
How to assemble a preliminary estimate for 2012?

- Five nights per month.
- Account for cloud obscuration using the VIIRS cloud product.
- Account for intermittent flaring by checking all cloud-free observations for detection.
- Filter to remove biomass burning and non-flare sources. Retain features 1400 K and hotter on land, 1000 K on water.
- Normalize for latitudinal variation in pixel area.
- Estimate flared gas volume for individual flares and countries.
- Generate ranked lists for flares and countries.

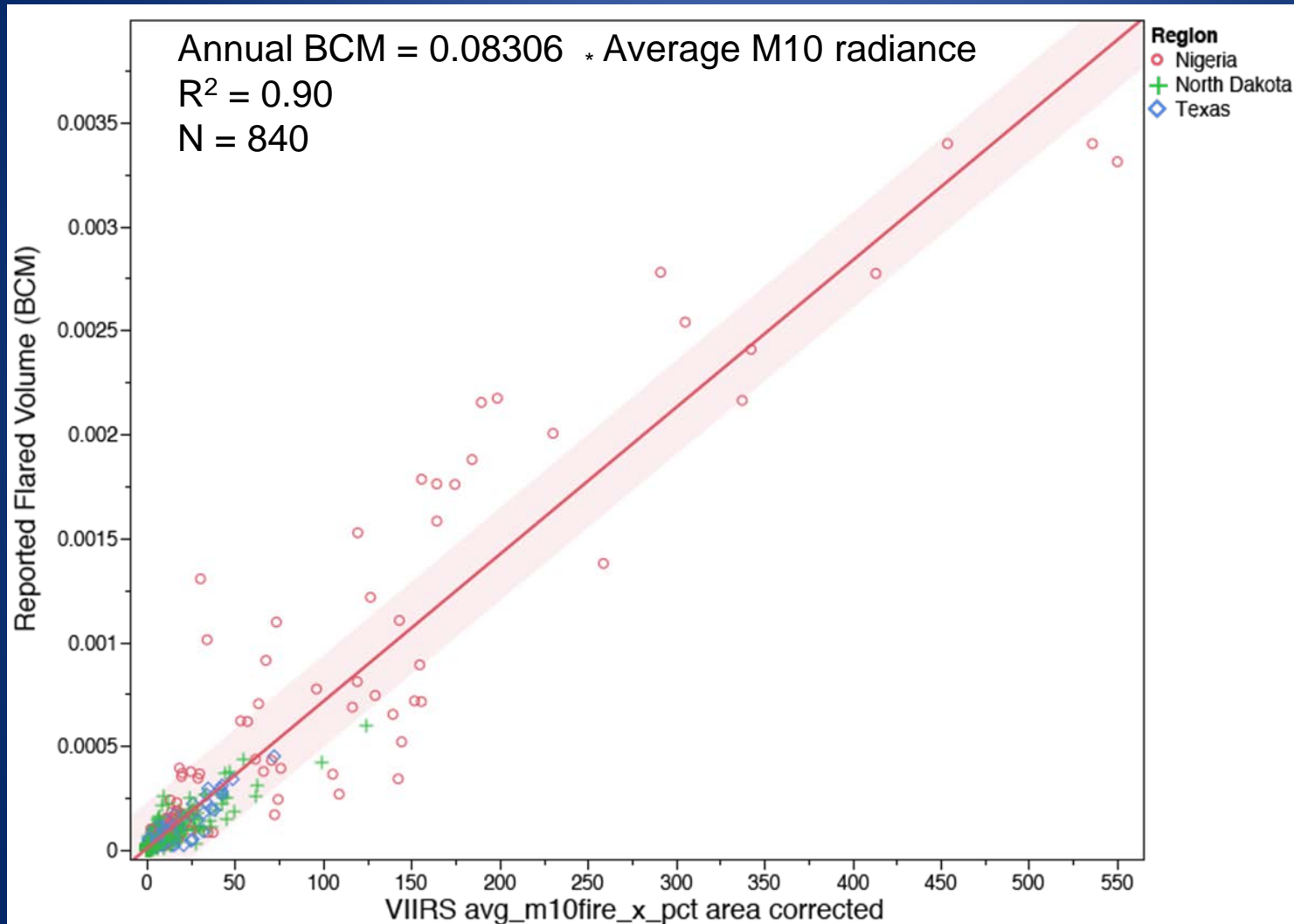
Total number of coverages



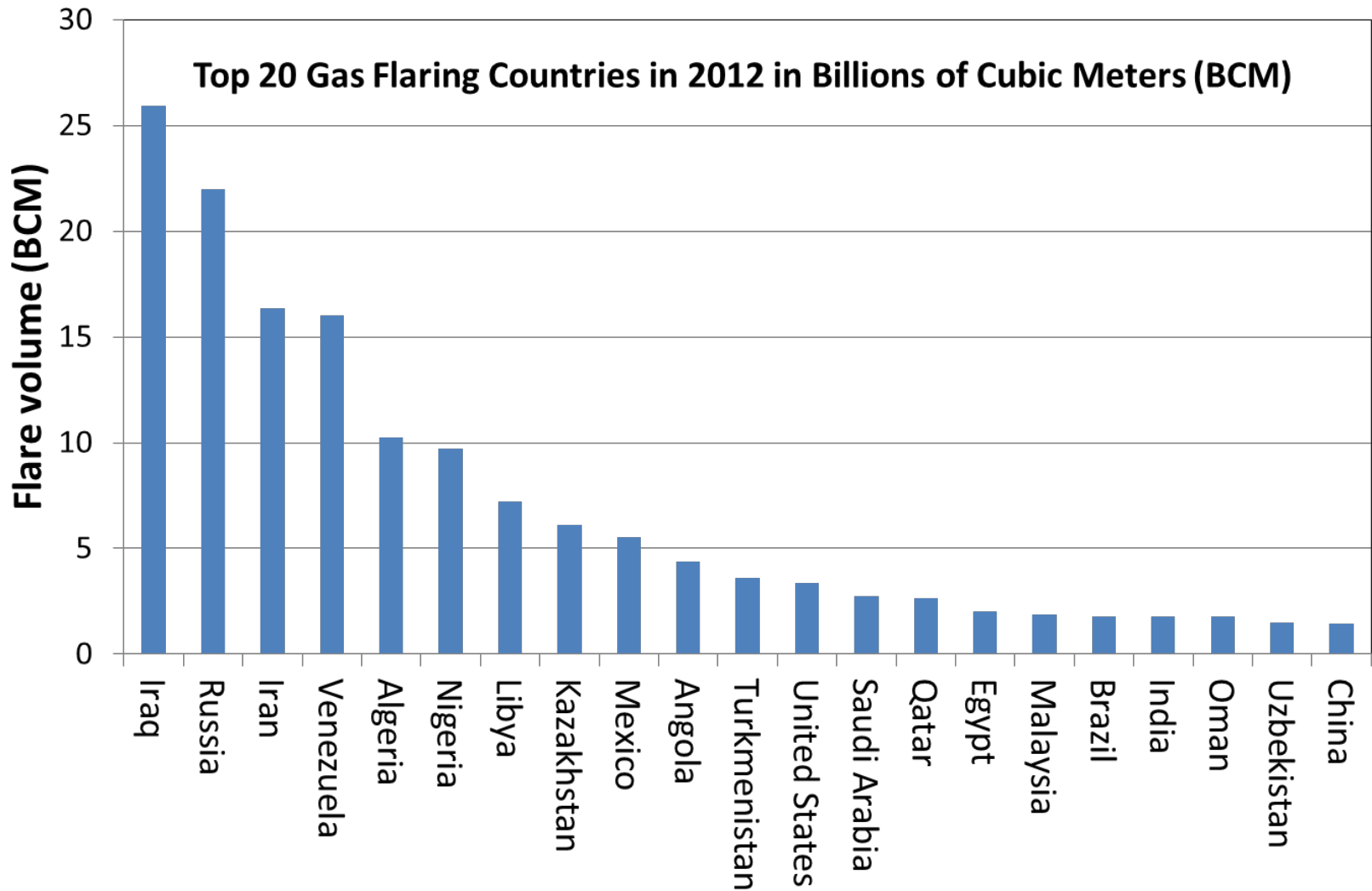
Cloud-free coverages



Calibration based on monthly reported data



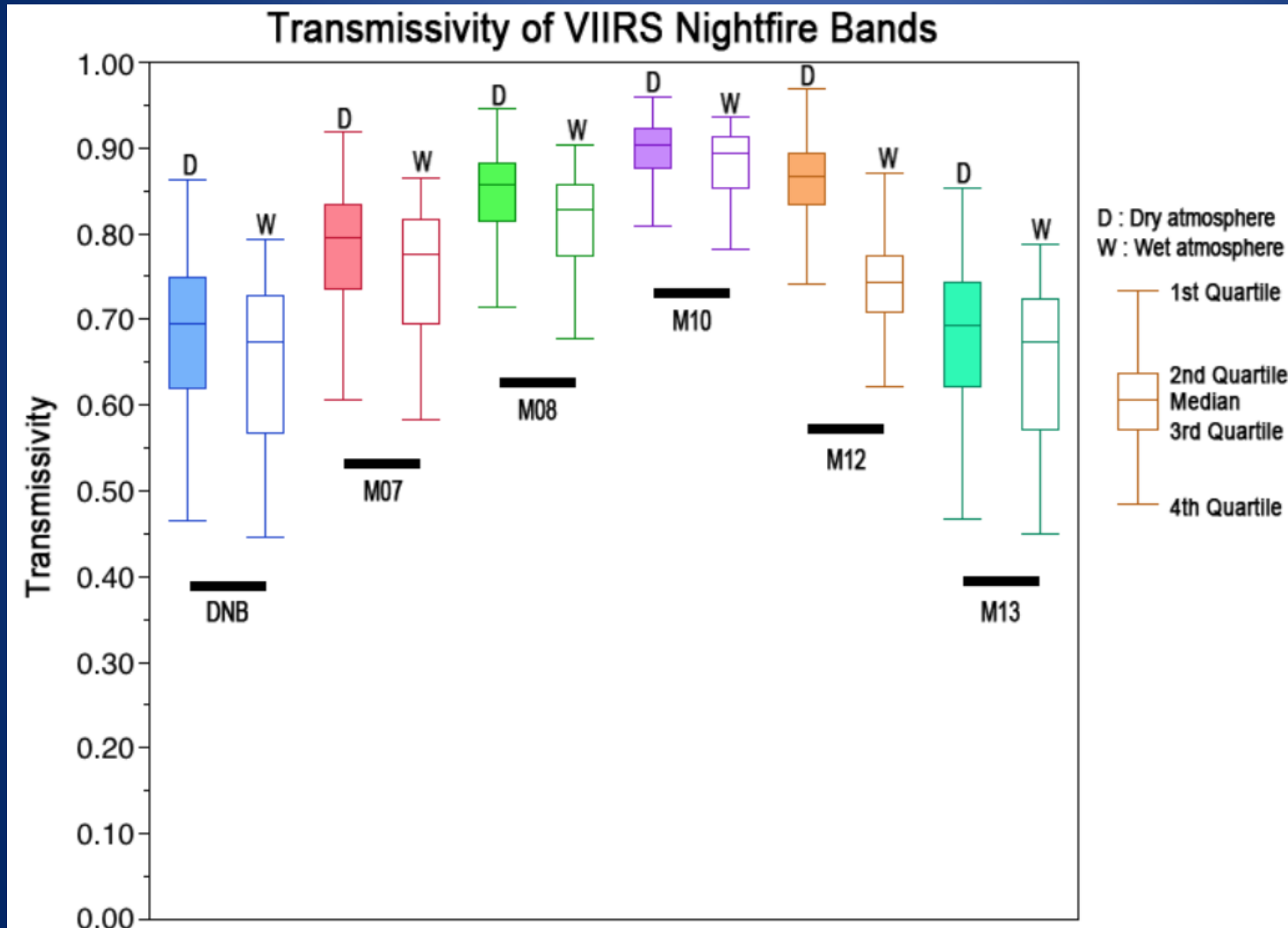
Total 2012 flared gas volume estimated at 165 BCM (preliminary)



The largest single gas flare is in Venezuela



Are the results affected by atmospheric differences?



Not much!
M10 is in a very clear atmospheric window, with near 90% transmissivity worldwide.

Summary

- VIIRS is well suited for global monitoring of gas flares.
 - Global data collected every day
 - Spectral band centered on peak radiant emission from flares is collected at night
 - That band is in one of the clearest atmospheric windows
 - Suite of spectral bands provides for cloud product and measurement of cloud optical thickness
- The preliminary estimates for 2012 find:
 - 165 BCM total
 - Iraq is the country with the most flaring, followed by Russia, Iran, Venezuela, Algeria and Nigeria.
- Why are VIIRS estimates different from DMSP?
 - No signal saturation on VIIRS
 - DMSP could not distinguish light from flare and facility
- Next steps:
 - Add larger flares to calibration
 - Develop automated approach to discriminate clear versus cloud impacted flares based on the width of spikes
 - Fill out the processing for all dates in 2012, 2013, 2014
 - Improve the separation of flares and fires using temporal leverage
 - Other next steps.....

Data Access

- Daily data (all detections):
http://ngdc.noaa.gov/eog/viirs/download_viirs_fire.html
- Daily data (flares only):
http://ngdc.noaa.gov/eog/viirs/download_viirs_flares_only.html
- Results on gas flaring (annual composite, spreadsheets, flare rankings):
http://ngdc.noaa.gov/eog/viirs/vnf_flaring_cal_n_est.html

Reference

Elvidge, C.D.; Zhizhin, M.; Hsu, F.-C.; Baugh, K.E.
VIIRS Nightfire: Satellite Pyrometry at Night.
Remote Sens. 2013, 5, 4423-4449.
doi:10.3390/rs5094423