Radiance Calibrated Night Lights
Products that Reveal Urban Cores and Gas Flares

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The Observations

• The Defense Meteorological Satellite Program (DMSP) has flown a long series of satellites.
• These satellites have an instrument called the Operational Linescan System (OLS), which was designed to detect moonlit clouds.
• Anthropogenic lighting is also detectable.
• Digital OLS data have been archived at the National Geophysical Data Center (NGDC) from 1992.
Saturation

- Observations of bright targets such as cities tend to saturate, so resolving spatial details and estimating the actual radiance of cities is impossible.
Variable Gain

• Gain is adjusted continuously both along the satellite track and along the scan line.

• The goal was to create a large area image of uniform brightness.

• Gains are not recorded in the data stream.
Fixed Gain Observations

- Upon request the USAF will allow us to specify the gain of the OLS instrument.
- A series of days with gains “fixed” at 15, 35, and 55 are acquired.
  - Non-saturated
  - Low coverage (high noise and anomalous events get large statistical weight)
  - Low gain reduces sensitivity

![Graph showing AVG VIS for Denver Stable Lights and Fixed Gain 15]
Merging Fixed Gain Data

- Weighted Mean
  - Number of observations
  - Proximity to saturation
- Smooth data may include saturated pixels

<table>
<thead>
<tr>
<th>FIXED GAIN</th>
<th>MULTIPLIER</th>
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<tr>
<td>15</td>
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<td>35</td>
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Blending with Operational Data

• Fixed Gain products tend to have three flaws:
  – Insufficient coverage in some places
  – Anomalous events, such as fires, are included
  – Noise

• Blending with Operational data improves each of these issues.
Match to the Nile Delta

Fixed Gain 55

Stable Lights
Benefits of Blending

• Red water? Noise, boats, low coverage...
• Blue-Green land – low coverage due to clouds. Ops data fills in.
• Fires present

RED – FG MERGED
GREEN – OPERATIONAL
BLUE – BLENDED
Gas Flares
Products

<table>
<thead>
<tr>
<th>SATELLITE</th>
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Next Steps

- Complete all years for which we have observations
- Intercalibrate to make a uniform time series
- Request more fixed gain data from satellite F16 (superseded by F18)
- Perform research utilizing the new information from unsaturated urban cores and gas flares.