# Future Satellite Capabilities for Air Quality Applications

Pawan Gupta
EPA Training
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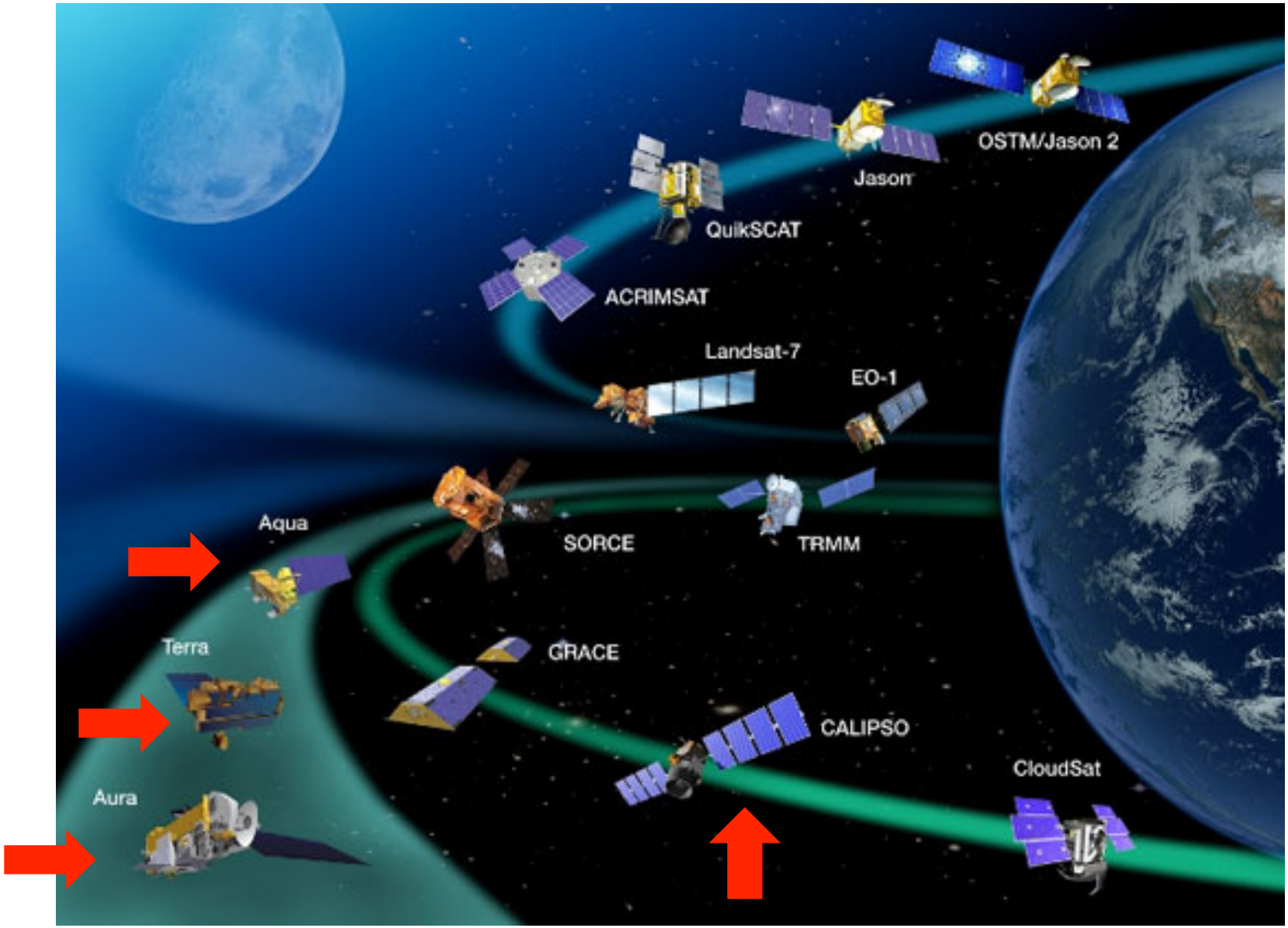
**ARSET - AQ**

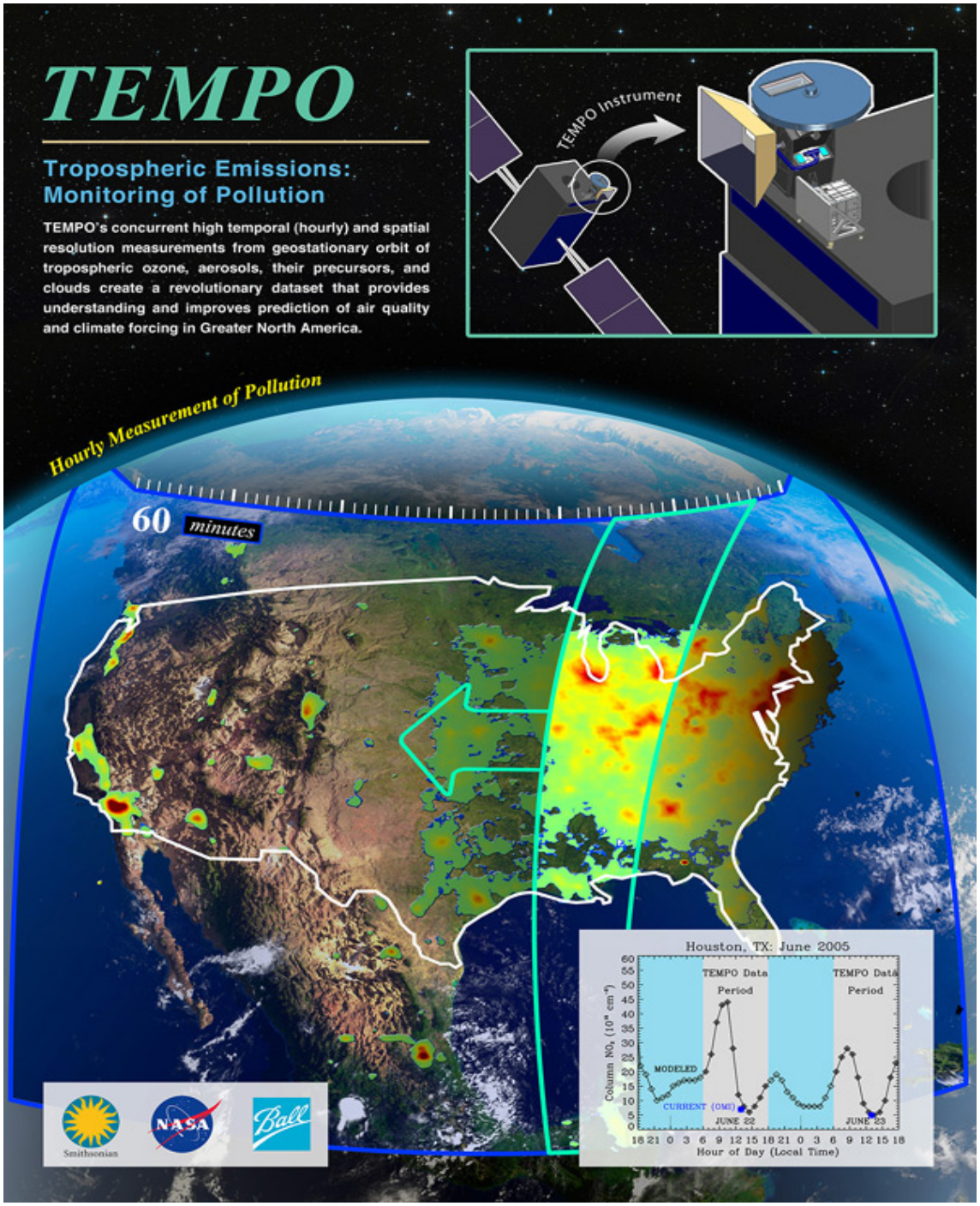
**Applied Remote SEnsing Training – Air Quality**

A project of NASA Applied Sciences

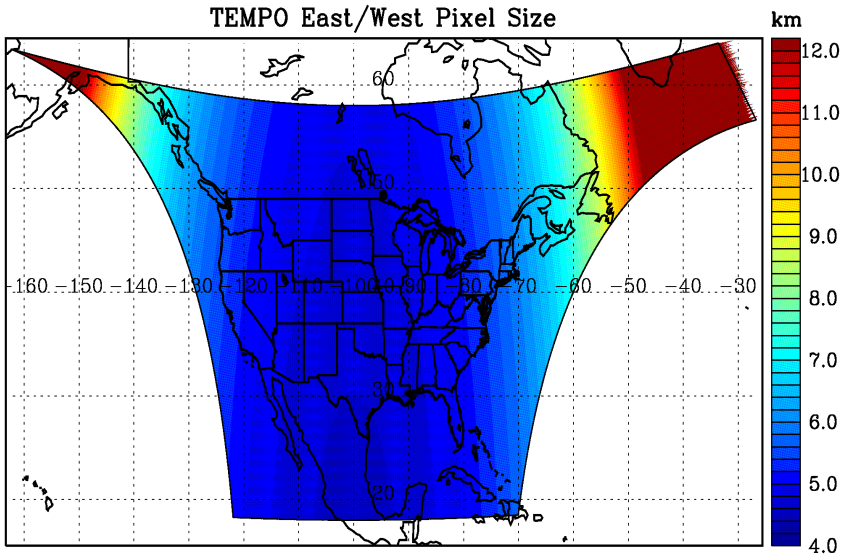
# Current Sensors & Air Quality Capabilities

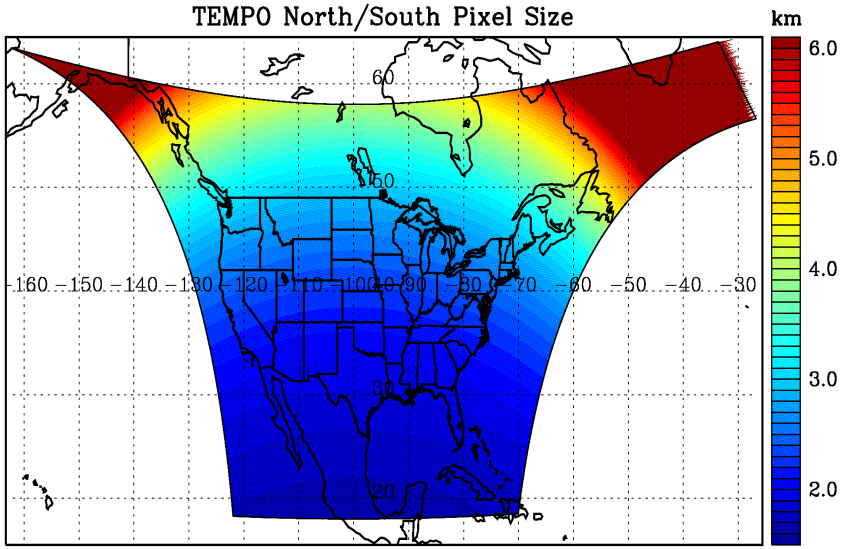


- Geostationary over Northern America
- High Temporal Resolution - 1 hour
- High Spatial Resolution – 2.2x4.7 km
- Spectral Range 290-740 nm
- Data Products:O3, NO2, SO2, H2CO, C2H2O2, aerosols, cloud parameters, and UVB radiation.
- Expected Launch 11/2018



# TEMPO footprint (GEO at 100° W)




| Location | N/S (km) | E/W (km) | GSA ($km^2$) |
|---|---|---|---|
| 36.5°N, 100°W | 2.11 | 4.65 | 9.8 |
| Washington, DC | 2.37 | 5.36 | 11.9 |
| Seattle | 2.99 | 5.46 | 14.9 |
| Los Angeles | 2.09 | 5.04 | 10.2 |
| Boston | 2.71 | 5.90 | 14.1 |
| Miami | 1.83 | 5.04 | 9.0 |
| Mexico City | 1.65 | 4.54 | 7.5 |
| Canadian tar sands | 3.94 | 5.05 | 19.2 |

**Assumes 2000 N/S pixels**

**For GEO at 80°W, pixel size at 36.5°N, 100°W is 2.2 km × 5.2 km.**

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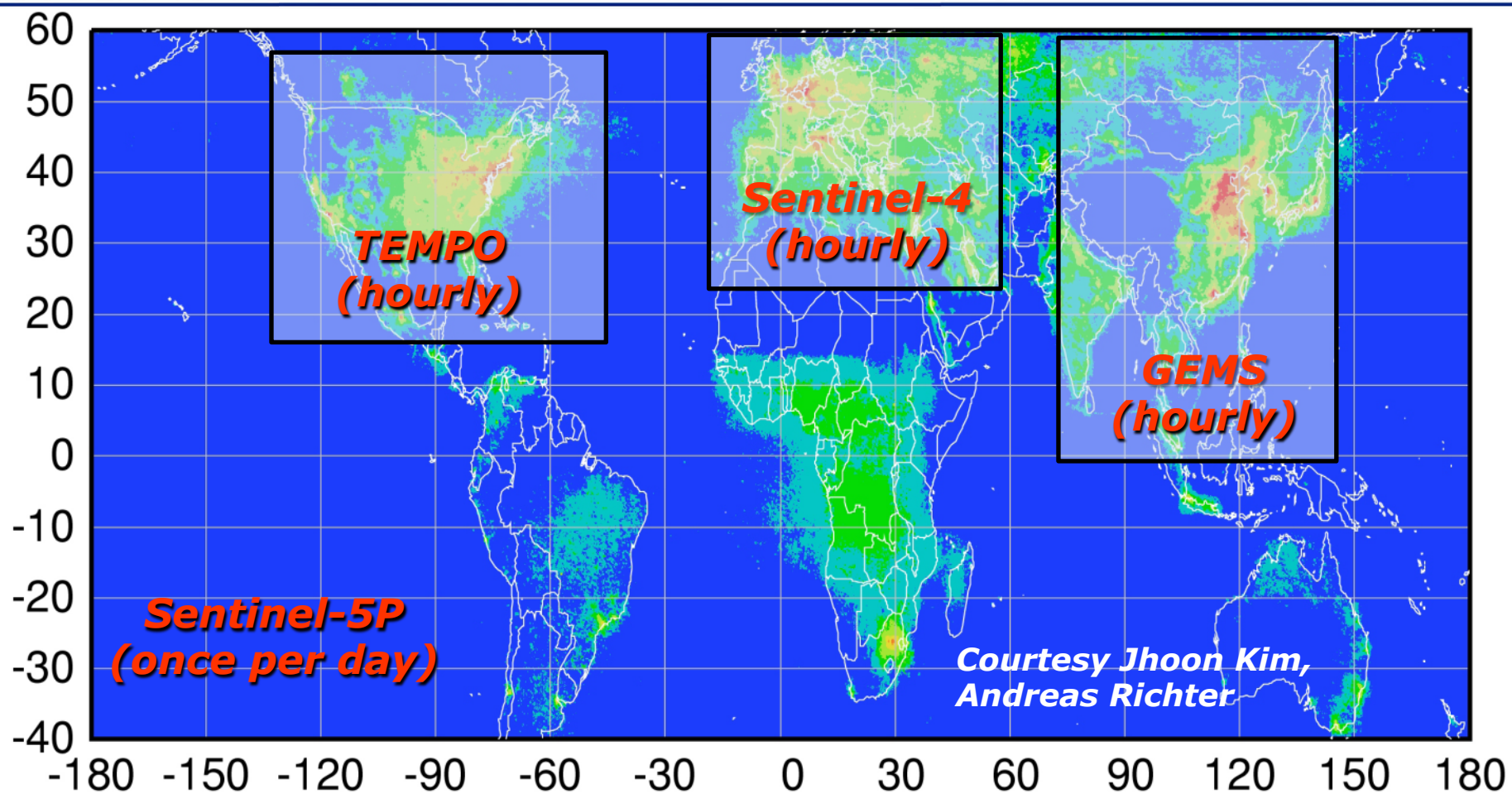
# Global pollution monitoring constellation (2018-2020)




**Policy-relevant science and environmental services enabled by common observations**

- Improved emissions, at common confidence levels, over industrialized Northern Hemisphere
- Improved air quality forecasts and assimilation systems
- Improved assessment, e.g., observations to support United Nations Convention on Long Range Transboundary Air Pollution

Slide from KChance

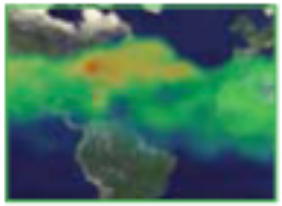
# The GEOstationary Coastal and Air Pollution Events (GEO-CAPE)

## NASA Earth Science Decadal Survey Mission

## Expected Launch - 2020

# GEOSTATIONARY COASTAL AND AIR POLLUTION EVENTS (GEO-CAPE)

**Launch: 2013-2016** **Mission Size: Medium**



Identification of human versus natural sources of aerosols and ozone precursors

Dynamics of coastal ecosystems, river plumes, and tidal fronts

Observation of air pollution transport in North, Central, and South America

Prediction of track of oil spills, fires, and releases from natural disasters

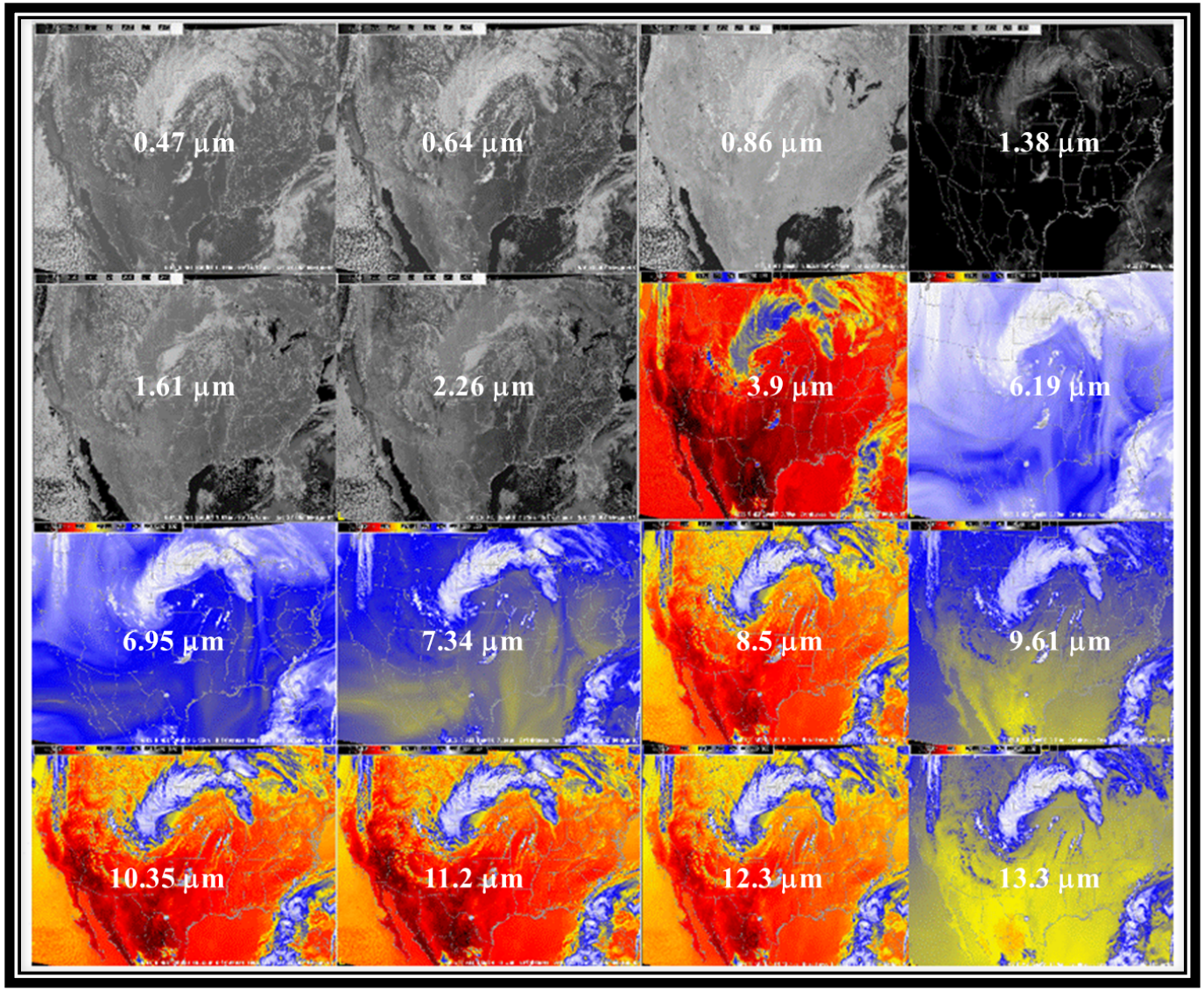
Detection and tracking of waterborne hazardous materials

Coastal health

Forecasts of air quality

| | |
|---|---|
| **Expected Launch:** | **2016** |
| **Advance Baseline Imager (ABI):** | **16 Spectral bands** |
| **Very High Temporal Resolution:** | **15 min to 30 seconds** |

# GOES-R Spectral Coverage



| | ABI | Current GOES Imager |
|---|---|---|
| **Spectral Coverage** | 16 bands | 5 bands |
| **Spatial Resolution** | | |
| 0.64 µm Visible | 0.5 km | ~ 1 km |
| Other visible/near-IR | 1.0 km | n/a |
| Bands (>2 µm) | 2 km | ~ 4 km |
| **Spatial Coverage** | | |
| Full Disk | 4 per hour | Scheduled (3 hrly) |
| CONUS | 12 per hour | ~4 per hour |
| Mesoscale | Every 30 sec | n/a |
| **Visible (reflective bands)** | | |
| **On-orbit calibration** | Yes | No |

# Remote Sensing Capabilities - Current Missions

| Sensor | Launch Date | Design Length | Resolution | End Date/Problems |
|---|---|---|---|---|
| Terra - MODIS | 1999 | 5 Years | 10/3/(1) KM | 2015 -2016 |
| Terra – MISR | 1999 | 5 Years | 17.6 KM | 2015 -2016 |
| Aqua - MODIS | 2001 | 5 Years | 10/3/(1) KM | 2018 |
| Aura – OMI | 2004 | 6 Years | 13 x 27 KM | Loss of data |
| Parasol - POLDER | 2004 | 2 Years | 18 KM | Out of A-Train |
| Calipso - CALIOP | 2006 | 3 Years | 5 Km x .2 KM | |
| NPP - VIIRS | 2011 | 5 Years | 6 KM | |
| NPP - OMPS | 2011 | 5 Years | 6 KM | |
| TES | | | | |
| MOPITT | | | | |
| Geostationary | | | | |
| MSG - SEVIRI | 2005 | | 10 KM | |
| GOES - GASP | 2006 | 5 Years | 4 KM/30 Min | |

# Remote Sensing of Aerosol Capabilities - Upcoming Missions

| Sensor | Launch Date | Measurements | Notes |
|---|---|---|---|
| EarthCARE | 2015 | Aerosols/Clouds | LIDAR Narrow swath |
| OCO-2 | 2014 | CO2/Aerosols | 7 KM Resolution/7 Yr. |
| TROPOMI | 2014 | Aerosols/Gases | Few bands |
| Sentinel-3 | 2014 - 2020 | Aerosols | Improve A-Train Capabilities |
| | | | |
| Geostationary | | | |
| GOES-R | 2015 | Aerosols | North America |
| TEMPO | 2018-2019 | Aerosol & Trace Gases | Cluster |
| Sentinel-4 | 2019 | Aerosol & Trace Gases | Cluster |
| MP-GEOSat | 2018 | Aerosol & Trace Gases | Cluster |
| GEO-CAPE | 2020 | Aerosols | North America<br>May be preempted by TEMPO |