NOAA: Current and Future Satellite Systems

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NOAA’s National Environmental Satellite Data and Information Service (NESDIS) -- at a Glance

- NESDIS operates the Nation’s weather satellites, 24/7
- Acquires next-generation Earth observation satellites
- Provides data and imagery for predictive environmental and atmospheric modeling
- Provides definitive assessments of the U.S. and global climate
- Maintains one of the most significant archives of environmental data on Earth
... With a Global Perspective

**NESDIS Mission**

Provide a truly integrated digital understanding of our earth environment that can evolve quickly to meet changing user expectations by leveraging our own capabilities and partnerships.
# NOAA’s Next-Gen Earth Observation Strategy

## Integrated, Adaptable, and Affordable: Orbits, Instruments & Systems

<table>
<thead>
<tr>
<th>LEO</th>
<th>GEO</th>
<th>Space Weather</th>
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<td>Miniaturized instruments on small, lower cost, and proliferated satellites and partner data improving forecasts through better and additional data. Better precipitation forecasts, wave height predictions, ocean currents, and more.</td>
<td>Continuous real-time observations supporting warnings and watches of severe weather and hour-by-hour changes. High-inclination orbits to observe northern latitude &amp; polar regions.</td>
<td>Reliably monitoring coronal mass ejections from L1, GEO, and LEO can protect the nation’s valuable, vulnerable infrastructure. New capabilities at L5 and high earth orbit can provide additional insight and improve forecasts.</td>
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### Common Ground Services

Secure ingest of data in different formats from different partners requires a flexible, scalable platform. Common Services approach integrates cloud, AI, and machine-learning capabilities to verify, calibrate, and fuse data into new and better products and services.
Geostationary Satellites
Launched November 2016 (Series will extend through ~2036)

COUNTDOWN TO GOES-T LAUNCH
106 days
GOES-T is scheduled to launch no earlier than February 16, 2022.
NOAA Geostationary Satellite Programs
Continuity of Weather Observations
Commercial Weather Data Pilot

- Publish standards for space-based commercial weather data
- Contract with one or more private sector entities capable of providing data that meet published standards
- Assess data’s ability to meet standards and its impact to weather models
Application: Fire Weather Forecast Exchange with Australia’s Bureau of Meteorology

Mutually benefit from

- Developing a unified approach to fire forecasting
- Using best practices for estimation of fuel loads and fire direction to keep fire fighting teams safe

Australia’s 2019-2020 Fire season

- From October 2019 – March 2020
- NOAA NWS Incident Meteorologists traveled to Australia on 6-week rotations
- Assisted with fire weather forecasting for 135 individual fires

Images from NOAA-20 VIIRS. November 2019
Application: Partnership between NESDIS & Indonesia’s LAPAN

Main Goals:

• Advance satellite-based fire monitoring capabilities using NOAA (S-NPP and NOAA-20) and non-NOAA (e.g., Landsat-8, Himawari-8) assets, and specialized software (e.g., NOAA’s Hazard Mapping System)

• Promote capacity building through online training, collaborative R&D activities, visiting scientist programs
Application: NOAA Water Clarity-Turbidity Index (CTI) off the coast of Vietnam

- This CTI product (G. Zheng and P. DiGiacomo, 2021), a simple indicator of water quality, was generated from NOAA VIIRS ocean color data.
- It depicts the south coast of Vietnam near the mouth of Mekong River for the end of the rainy season (July–December; left panel) and during the dry season (May; right panel).
- Much higher and extended zones of turbid water are observed along the coast following the rainy season.
Application: Dynamic seascapes support monitoring and management of pelagic ecosystems

- Seascape pelagic habitats are classified in space and time from NASA and NOAA satellite data.
- Habitat occupancy and diversity patterns are validated by MBON nodes and community partners.
- Seascapes are distributed through NOAA CoastWatch, R package, R-shiny
Alone: NOAA Operates 15 Satellites
Together: We Form an International Community
Thank you!

谢谢你!

9 Feb 2020: Himawari-8, GOES-17, GOES-16, Meteosat-11
(image credit: CIMSS/SSEC)
Additional Informational Slides
NOAA Mission

As an Agency within NOAA, NESDIS works to support NOAA’s mission of:

• NOAA climate **Science** is the foundation for smart policy, and decision-making in a changing world.

• NOAA delivers climate **Services** to federal agencies, states, tribes, communities, and businesses across America, helping people protect themselves and their livelihoods in a changing world.

• NOAA’s climate **Stewardship** protects our lands, waters, resources, and people.
Evolution from GOES-R to GeoXO

Growing needs require new observations

GOES-R provides Visible/Infrared Imagery and Lightning data:
- Essential for short-range forecasting, issuing severe weather watches and warnings, and monitoring hazardous environmental conditions including tropical storms, severe storms, damaging winds, snow, ice, flooding, fog, fires, smoke, and volcanic ash

GeoXO will continue and improve Imagery and Lightning data and add new observations:
- Hyperspectral IR Sounder for numerical weather prediction and local nowcasting
- Ocean Color Instrument for monitoring dynamic coast/ocean features, ecosystem change, water quality, and hazards
- Atmospheric Composition Instrument for monitoring air quality and the linkage between air quality, weather, and climate
Highly Diverse LEO Observations

**Foundational Products:** Satellite Radiances and Satellite Imagery

**NESDIS Level Requirements – Geophysical Products**

- Atmosphere
- Cryosphere
- Land
- Ocean, Fresh Water & Coasts

**Analytical**

- Climate & Weather
- Ocean, Fresh Water & Coasts

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**Multipurpose VIS/NIR/IR Imagery**

- UV Imagery
- Soundings from IR/MW/RO

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**RADAR Imagery**

**LIDAR**

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**Scatterometry**

**MW Imagery**

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NOAA National Environmental Satellite, Data, and Information Service
The Space Weather Program will need a comprehensive observational capability for several orbital regimes.

Thermospheric and ionospheric objectives will require in situ measurements from LEO as well as imaging capabilities from GEO.

For the magnetosphere, in situ measurements from GEO and HEO can combined with auroral imaging.

Coronal and photospheric imagery from L1 and L5 can be used for stereoscopic analysis. In situ plasma/field data will drive heliospheric models.
Application: VIIRS Suspended Particulate Matter in coastal waters of Vietnam

- Suspended Particulate Matter (SPM) is an indicator of water clarity (~turbidity); higher SPM means lower water clarity

- Source: NOAA/NESDIS/STAR Ocean Color Team (J. Wei, M. Wang et al., 2021 – JGR-Oceans)

Daily SPM Product (27 Feb 2021) from merge of data from 3 ocean color sensors: VIIRS-SNPP, VIIRS-NOAA-20, OLCI-Sentinel-3A

Monthly SPM Product (Feb 2021) from VIIRS-SNPP ocean color data. Note higher SPM levels off Mekong River Outfall (lower left corner)
**Application: NOAA Satellites Monitoring Fires**

**JPSS Program – Polar orbiting**

NOAA-20 captures plumes of smoke from the Camp Fire in Northern California.

**GOES-R Series - Geostationary**

GOES-R provides nearly continuous observations of fires.
Application: NOAA Satellites & Drought

VIIRS Green Vegetation Fraction Product

VIIRS Vegetation Health Product (VVHP)

U.S. Seasonal Drought Outlook
Drought Tendency During the Valid Period

Valid for September 19 - December 31, 2019
Released September 19

Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (remained from 01 to 14). 

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity level by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).
Application: Climate Response and Economic Recovery

Top Left: Coral Reef Watch bleaching alert, December 2020 - January 2021
Bottom left: Oregon and California Fires, Sept. 7-9, 2020
Top right: Harmful Algal Bloom products, Aug 18, 2021