

National Environmental  
Satellite, Data, and  
Information Service

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# LEO Program

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# Why Observations from LEO?

- LEO observations feed the global numerical weather prediction (NWP) models for critical applications, including hurricane forecasting, weather forecasts, and boundary conditions for regional models
- LEO data plays a major role in meeting a variety of user applications beyond NWP (land, ocean, meteorology, climate, etc.)
- Future NWP systems will require a variety of LEO global measurements at higher accuracy, refresh rate and spatial resolutions.



# What is 'LEO' from NESDIS's perspective?

- Global measurements (vs. GEO's persistent regional measurements)
- Not bound by a specific orbit geometry or altitude
- LEO Program Requirements
  - Provide measurements to support NOAA line office needs
  - Continuity of the product baseline, generated from:
    - Measurements currently provided by JPSS
    - Current non-JPSS partner measurements from LEO
  - Evolving to support changing needs:
    - New products
    - Enhanced performance measurements

# LEO Observations Cover the Entire Electromagnetic Spectrum and Support NESDIS Products and Services Portfolio

## NESDIS Level Requirements – Geophysical Products

Atmosphere

Cryosphere

Land

Ocean, Fresh Water & Coasts

Analytical

Climate

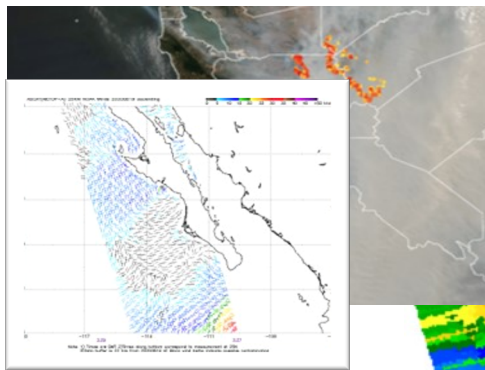
Weather

Ocean, Fresh Water & Coasts



## Foundational Products: Satellite Radiances and Satellite Imagery

Multipurpose VIS/NIR/IR Imagery



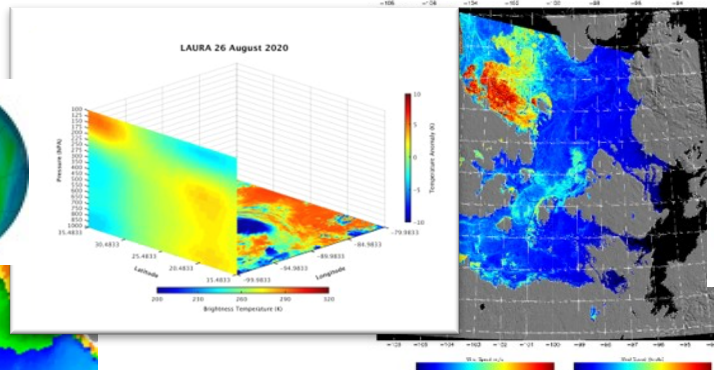
Scatterometry

UV Imagery



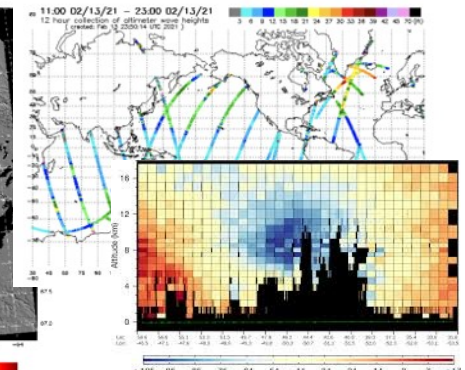
MW Imagery

Soundings from IR/MW/RO



RADAR Imagery

Altimetry



LIDAR

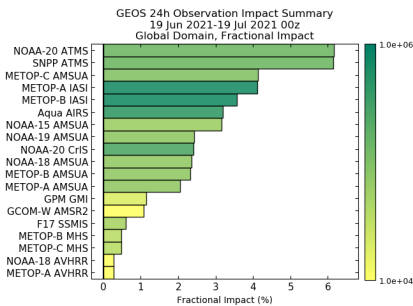
Nearly every product category and subcategory across the thematic areas described in the NESDIS Level Requirements relies on observational measurements from LEO.



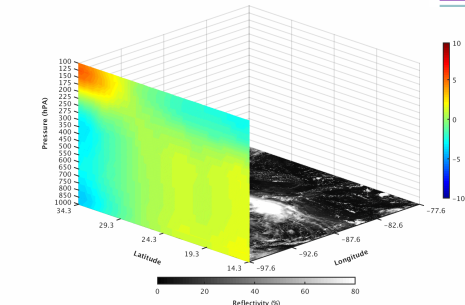
# LEO Measurements Contribute to All NOAA Mission Service Areas

*Several products that support NOAA Mission Support Areas are collected by LEO satellites only*

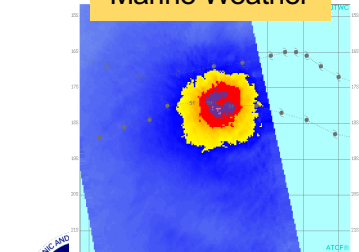
## Severe weather



LAURA 25 August 2020



## Marine Weather



## WEATHER READY NATION (WRN)

### National Weather Service

1. Aviation Weather & Volcanic Ash (WRN-AWX)
2. Fire Weather (WRN-FWX)
3. Hydrology & Water Resources (WRN-IWF)
4. Marine Weather & Coastal Events (WRN-MWX)
5. Hurricane/Tropical Storms (WRN-HUR)
6. Routine Weather (WRN-RWX)
7. Severe Weather (WRN-SEV)
8. Space Weather (WRN-SWX)
9. Tsunami (WRN-TSU)
10. Winter Weather (WRN-WWX)

Observation Count Per Analysis

11. Science, Services and Stewardship

## HEALTHY OCEANS (HO)

### National Marine Fisheries Service

1. Ecosystem Monitoring, Assessment & Forecast (HO-ECO)
2. Fisheries Monitoring, Assessment & Forecast (HO-FMA)
3. Habitat Monitoring & Assessment (HO-HAB)
4. Protected Species Monitoring (HO-PSM)

5. Science, Services and Stewardship

## RESILIENT COASTS (RC)

### National Ocean Service

1. Coastal Water Quality (RC-CWQ)
2. Marine Transportation (RC-MTS)
3. Planning & Management (RC-PAM)
4. Resilience to Coastal Hazards & Climate Change (RC-RCC)

5. Science, Services and Stewardship

## CLIMATE (CLI)

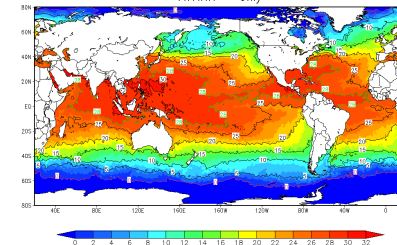
### Office of Oceanic and Atmospheric Research

1. Assessments of Climate Changes & Its Impacts (CLI-ACC)
2. Climate Mitigation & Adaptation Strategies (CLI-CMA)
3. Climate Science & Improved Understanding (CLI-SIU)

4. Climate Prediction and Projections (CLI\_CPP)

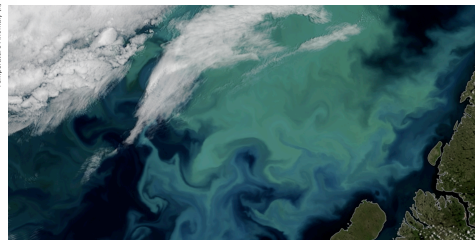
## Climate Data Records

Daily OISST intv2: 19JUL2021  
AVHRR - only

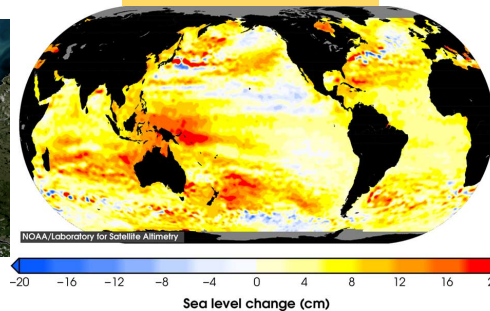


## Ozone Mapping

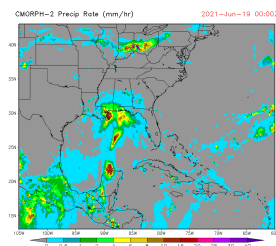
## Ocean biology



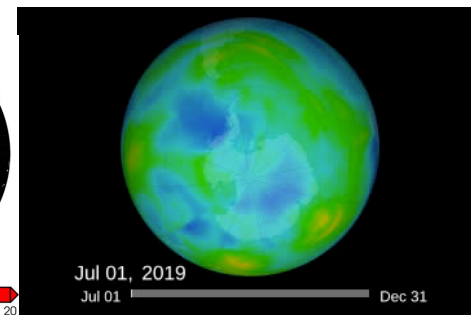
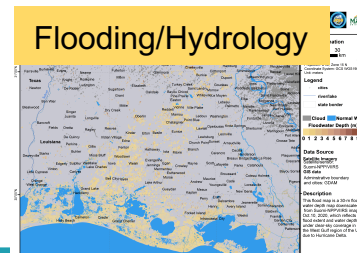
## Sea level change



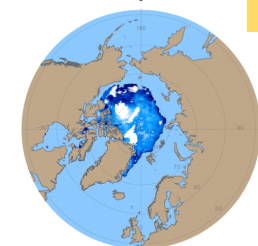
## Precipitation/Hydrology



## Flooding/Hydrology

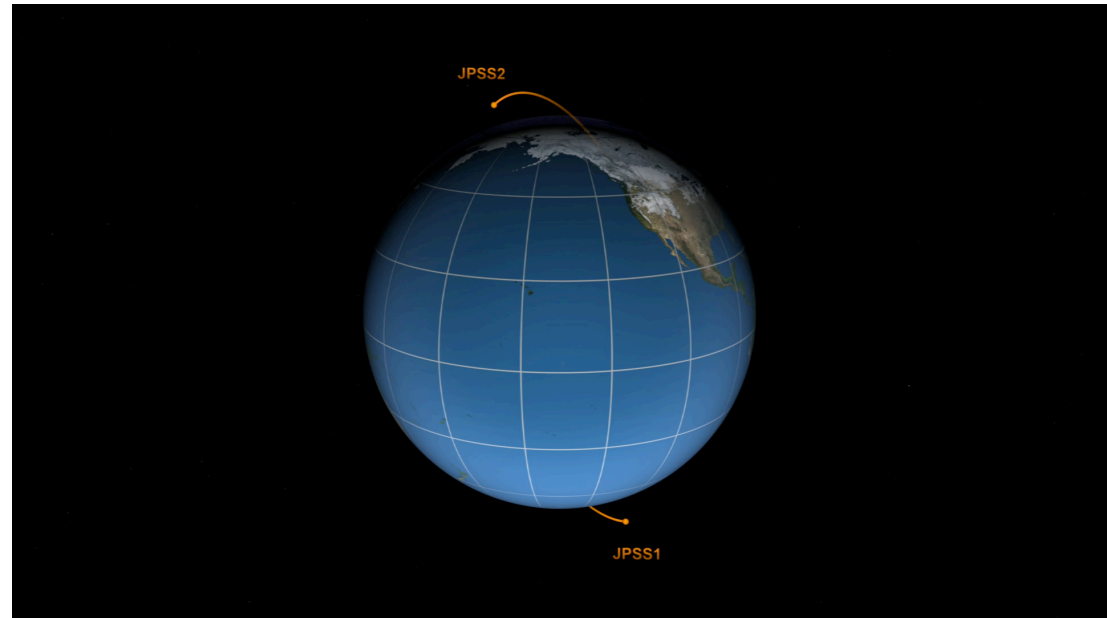


## Arctic ice



# Current LEO Satellites: The Backbone of NOAA's Numerical Weather Prediction

- NOAA's Joint Polar Satellite System (JPSS)
- EUMETSAT's Metop satellites
- NOAA's legacy POES
- DMSP



JPSS and EUMETSAT's EPS-SG satellites are expected to provide LEO observations for operational meteorology till the end of the next decade.



# LEO Initiative

NESDIS initiative to develop LEO missions outside the current Programs of Record for operation in 2025-2050 timeframe

- LEO Initiative will study and develop plans to implement:
  - All NOAA space assets within LEO scope, including:
    - Commercial, partner, and hosted options
    - Partnerships necessary to meet observational needs
  - Ground services to support the NOAA space assets and to acquire, ingest, distribute and process mission-supporting partner and commercial data



# LEO Architecture

Congressionally mandated NSOSA recommended a partially disaggregated LEO implementation to:

- Allow for separation of essential missions from those less critical
- Exploit efficient and quick access to space
- Use new technology and commercial capability
- Become more agile (adapt to changing needs)
- Take advantage of new business models



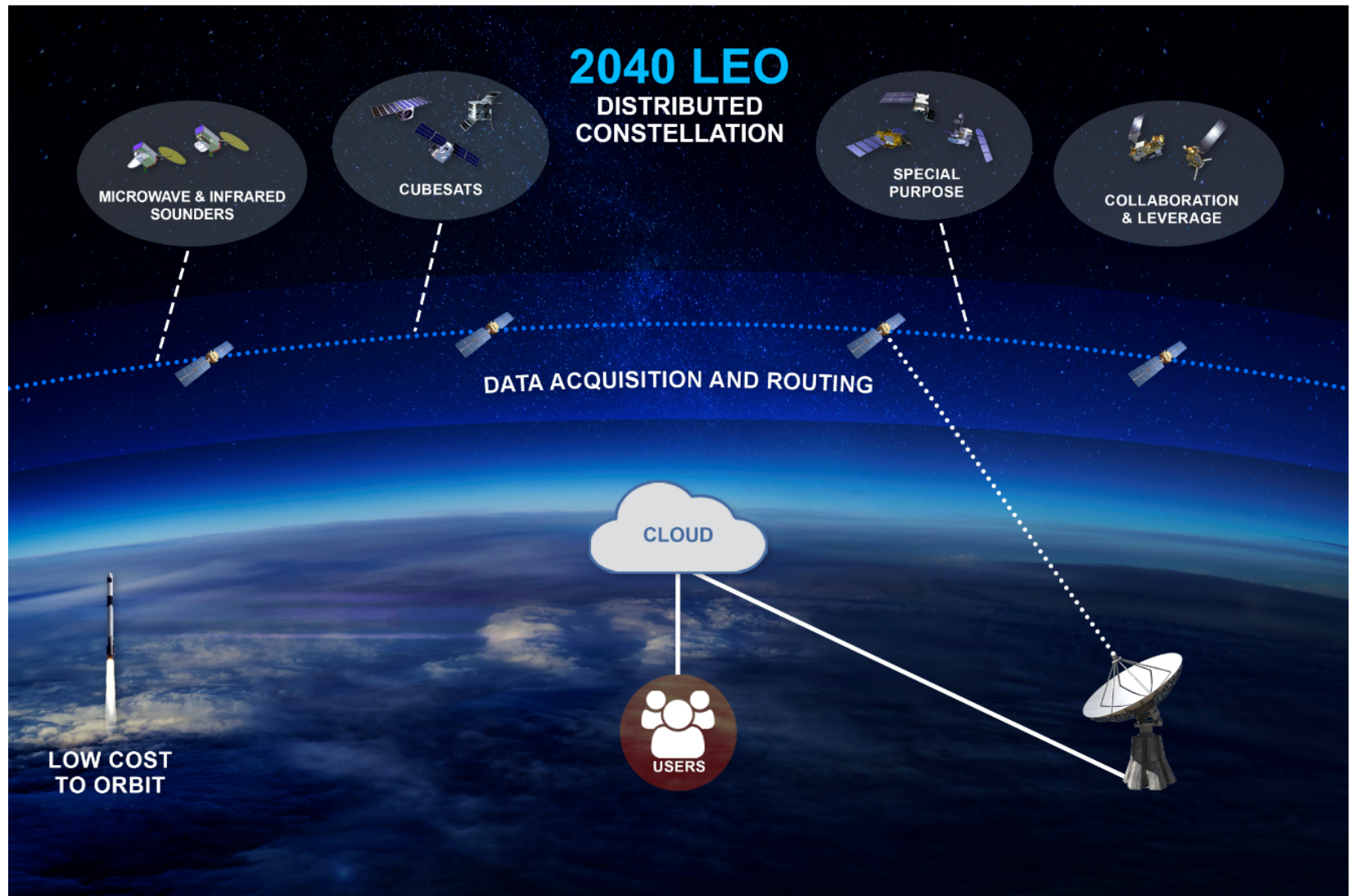
# How does this translate to the LEO Program?

Exploit the trends, leverage advancements

- Utilize industry's expertise and innovation
- Shorter development timelines, more frequent launches
- Better prices, leveraging smaller instruments and satellites
- Incorporate continuous advancement, using new business models and partners
- Take advantage of larger selection of less expensive launch vehicles



# 2040 LEO Vision



# LEO Mission Types

- Interagency, international, industry and academic collaboration is critical to meeting program requirements with limited resources.
- Projects within the LEO Program may use one or more mission types to meet objectives/requirements:
  - NOAA managed: Owned and operated by NOAA
  - NOAA collaborated: Missions NOAA has invested in, alongside partners
  - NOAA leveraged: NOAA obtains data access through agreements or purchase



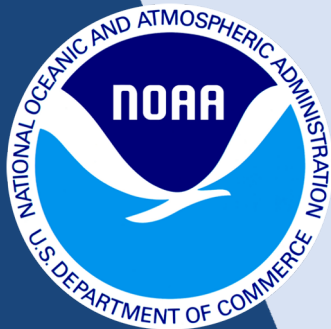
# Key Partnerships

- Assisted Acquisition – NASA
- Interagency collaboration – NASA, USSF, SDA, US Navy
- International collaboration – EUMETSAT, JAXA, JMA, KMA, ISRO
- Data purchase – Industry



# User Engagement

- Purpose
  - Enable better understanding of user needs, and determine LEO measurements and missions to meet those needs
  - Inform users of the status of the LEO missions
  - Optimize the operational exploitation of LEO data and products
- Includes user outreach to all NOAA line offices in addition to non-NOAA users via a variety of workshops, conference sessions, and targeted meetings. Coordinating with NESDIS User Engagement team members.



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# A Microwave Sounder Mission—QuickSounder



# Microwave Sounding Mission: First Objective of the LEO Program

## Increase in Program Capability

- The first of a new generation aimed at extending LEO observations
- Spearhead the formulation of disaggregation concepts to determine the viability of meeting observational requirements while improving agility and infusion of new technology
- Smaller satellites to place/replace specific observational capabilities in the desired locations when needed

## Increase in Program Capacity

- Supplements the critical sounding observations and improve density in 2026 with the launch of the first satellite in the early morning orbit
- Increases atmospheric observational density commensurate with the success in capitalizing new architectural concepts to improve effectiveness
- Extension to other LEO observations will enter pre-formulation on a priority basis

A MW sounder mission provides early demonstration of disaggregation and preserves current observational density



# Questions? Comments?

