Satellite Data Applications for Offshore Aviation Weather

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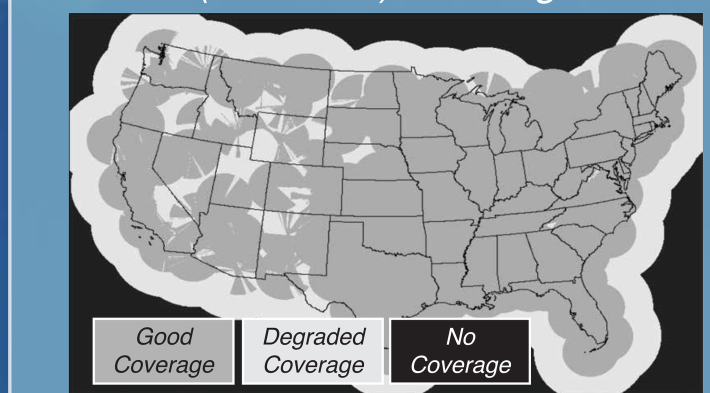
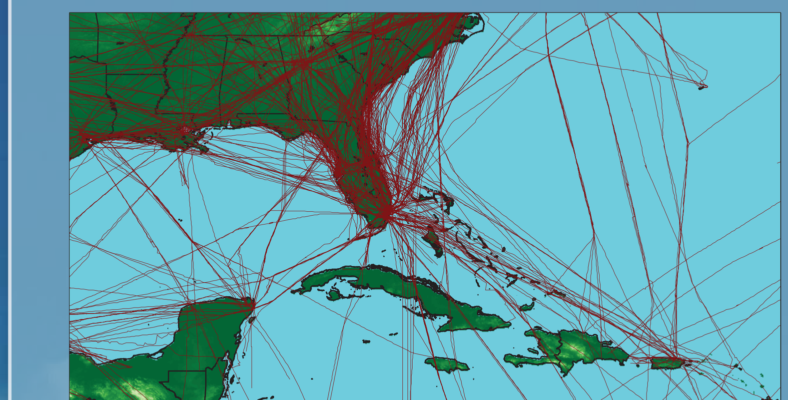
Aviation Weather Information Shortfall

Limited Radar Observations Offshore

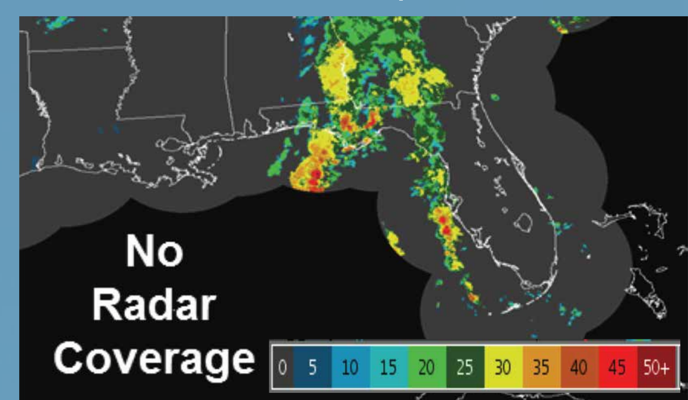
Next-Generation Radar (NEXRAD) Coverage



Impacts of inadequate radar coverage
- Unanticipated aircraft course deviations
- Extended aircraft spacing
- Elevated workload for air traffic controllers
- Ineffective determination of safe and efficient weather avoidance routes
- System-wide flight delay



EchoTops

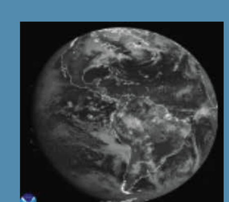


Approximately 22 million square miles of the Air Traffic Organization's offshore airspace has limited or no weather radar coverage

Overview

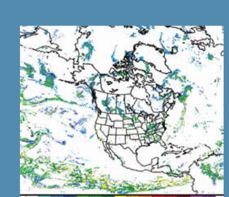
- The Offshore Precipitation Capability (OPC) is a system that creates radar-like mosaics of precipitation intensity and echo tops beyond the range of current weather radar
- OPC fuses together five Geostationary Operational Environmental Satellite (GOES) channels, global lightning data, and several fields from the National Oceanic and Atmospheric Administration's (NOAA) Rapid Refresh (RAP) 13 km numerical weather prediction model
- OPC output is merged with radar mosaics over land
- These capabilities will directly benefit the Federal Aviation Administration (FAA) by providing improved situational awareness for offshore air traffic control and management

OPC Multisensor Data Fusion



Satellite
- GOES Imager
- Visible and 4 Infrared Channels

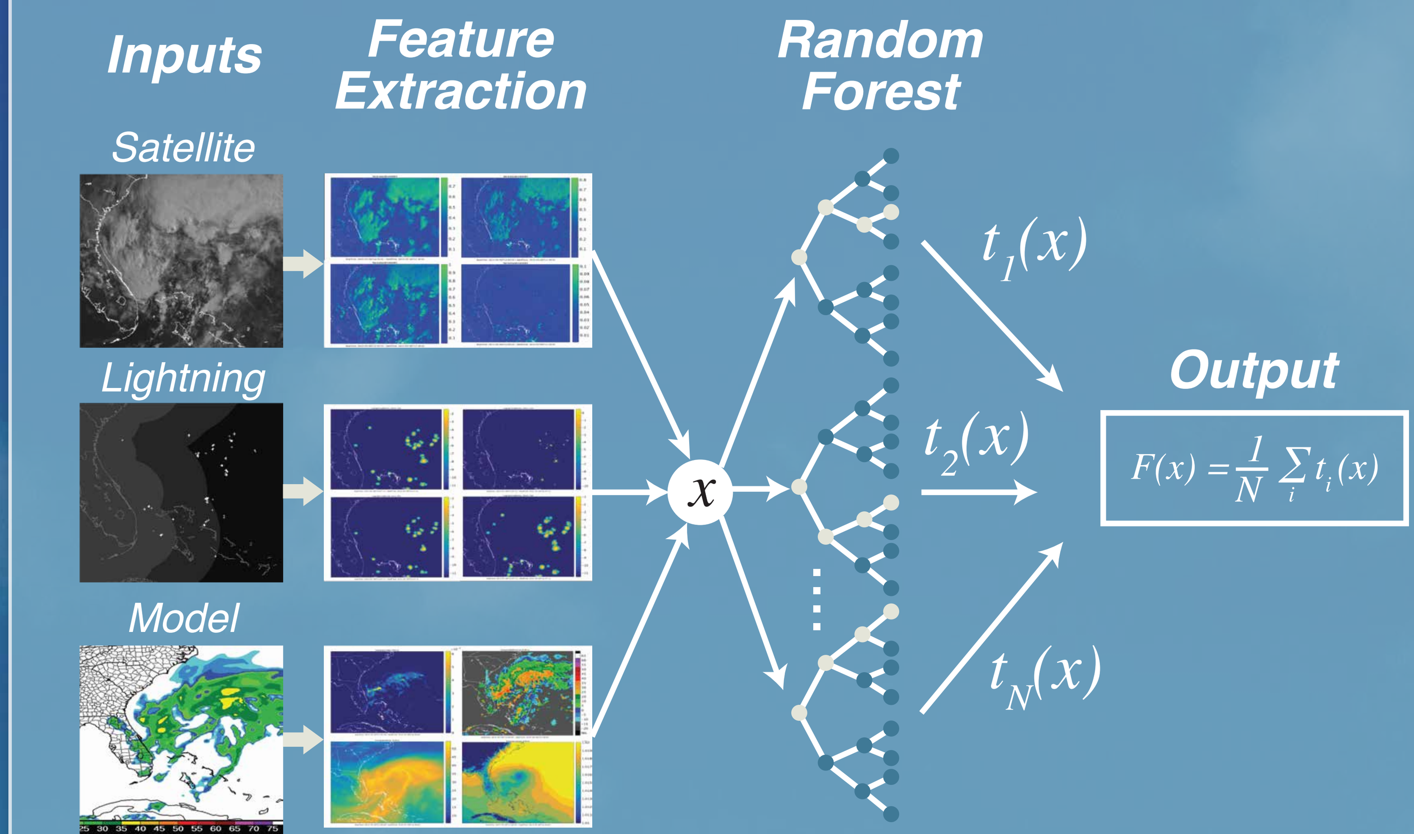
Lightning
- Earth Networks Total Lightning Network
- Cloud-to-Ground lightning strikes used in OPC



Numerical Model
- Rapid Refresh (RAP) 13 km

Weather Radar
- NEXRAD
- Terminal Doppler Weather Radar

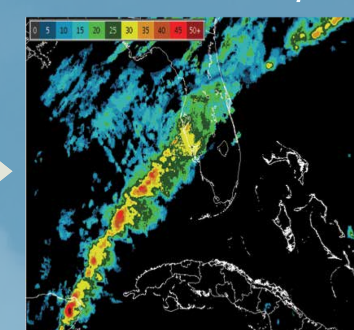
Offshore Precipitation Capability



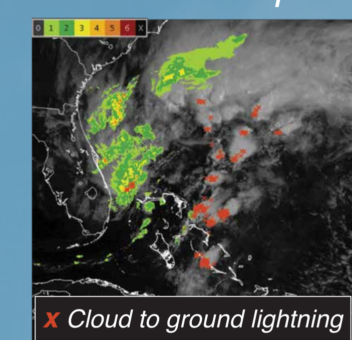
- The OPC uses machine learning to combine multiple non-radar data sources to create radar-like precipitation and storm height analyses
- OPC analyses are combined with radar to create seamless mosaics that extend offshore

NEXRAD Echo Tops

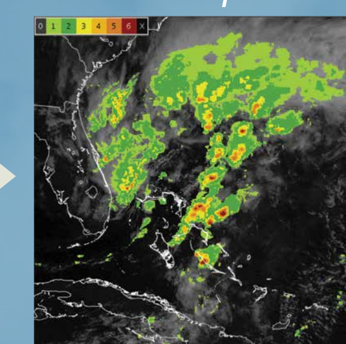
OPC Echo Tops



NEXRAD Precipitation

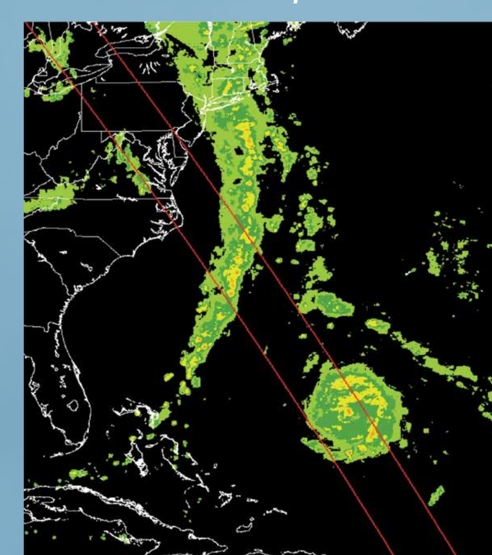


OPC Precipitation

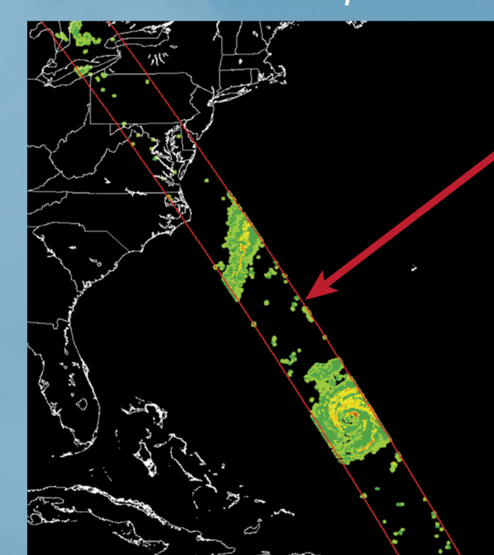


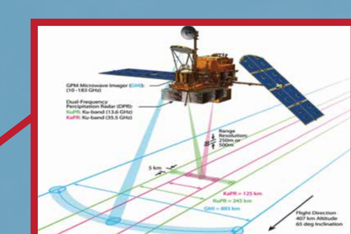
Satellite Validation

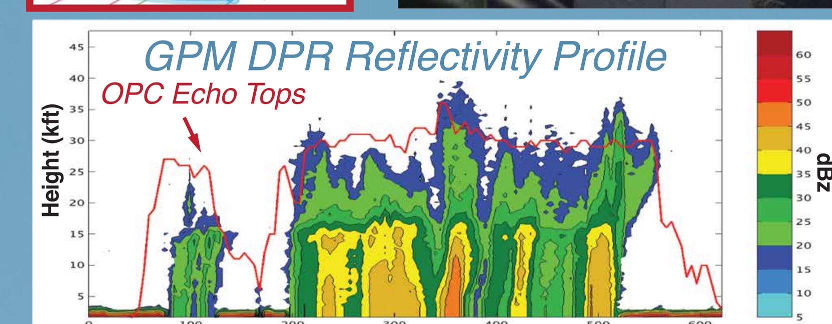
OPC Precipitation



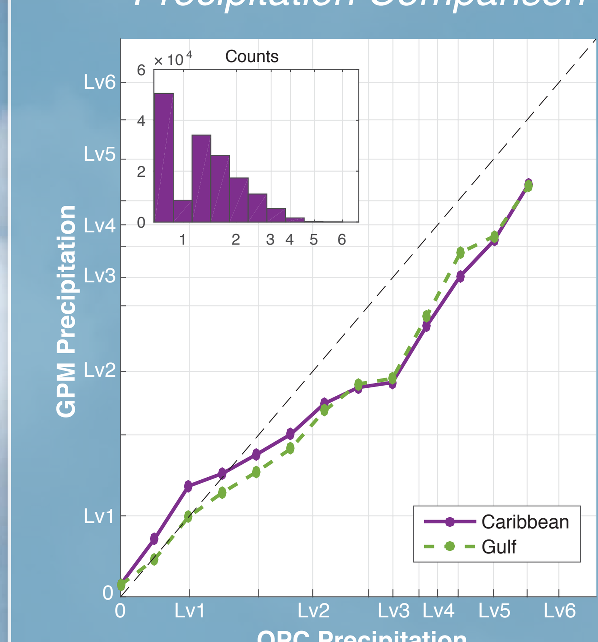
GPM DPR Precipitation



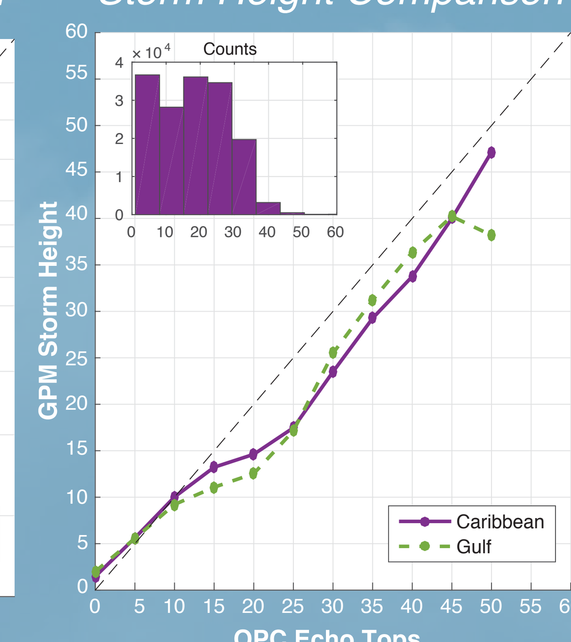




Precipitation Comparison



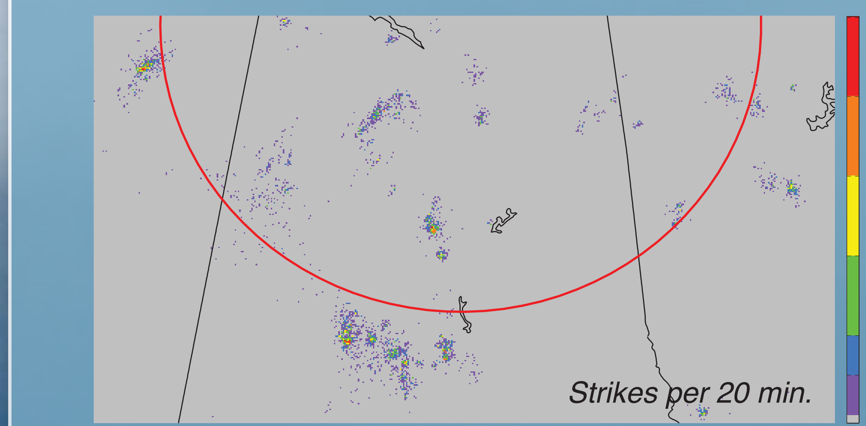
Storm Height Comparison



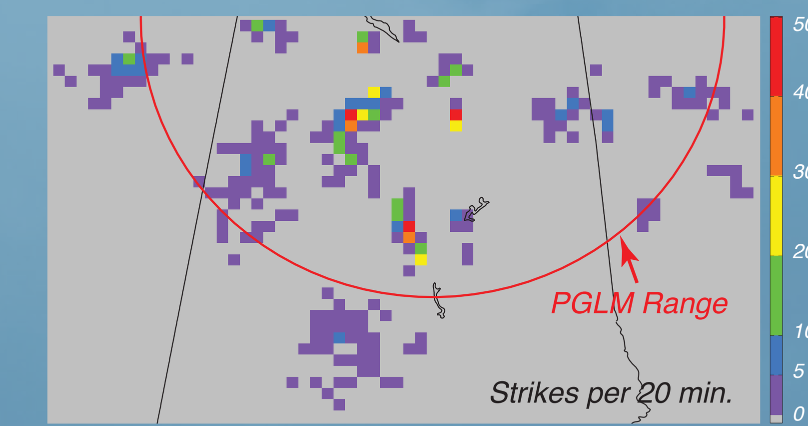
- Validation data over ocean provided by NASA Global Precipitation Measurement (GPM) Mission Core Observatory Dual-frequency Precipitation Radar (DPR)
- OPC compared with GPM in Caribbean and Gulf of Mexico for summer 2015
- OPC Precipitation and Storm Heights generally higher than GPM measurements

OPC in the GOES-R Era

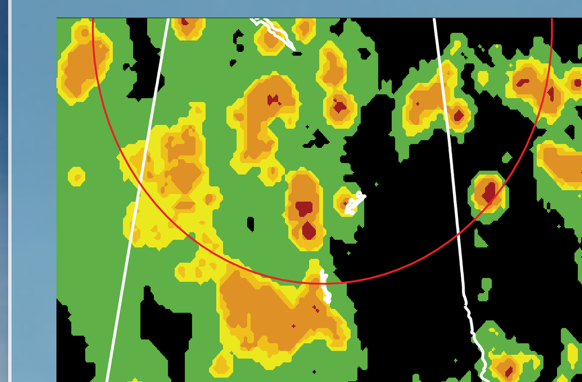
Earth Networks Cloud-to-Ground Lightning Density (1km)



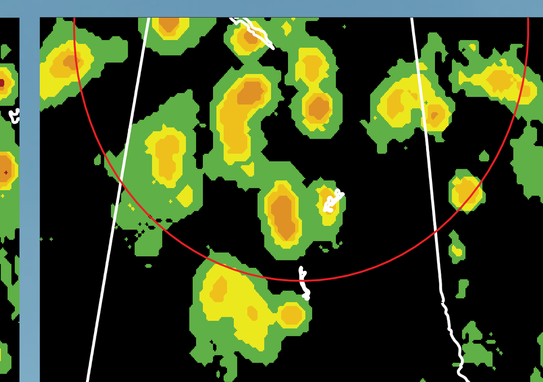
Pseudo Geostationary Lightning Mapper (PGLM) Lightning Density (8 km)



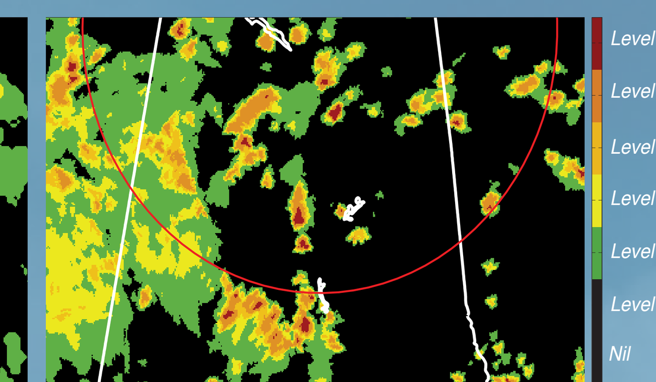
OPC with EN Lightning



OPC with PGLM Lightning

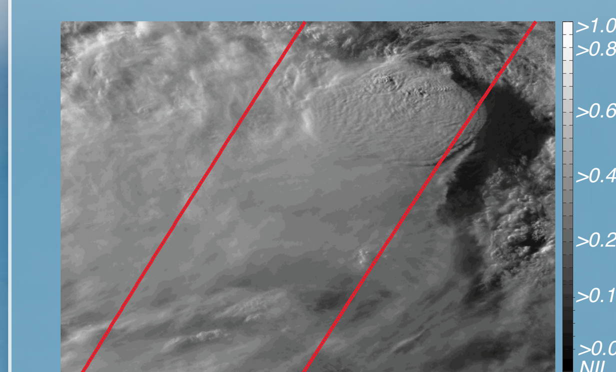


Radar Precipitation

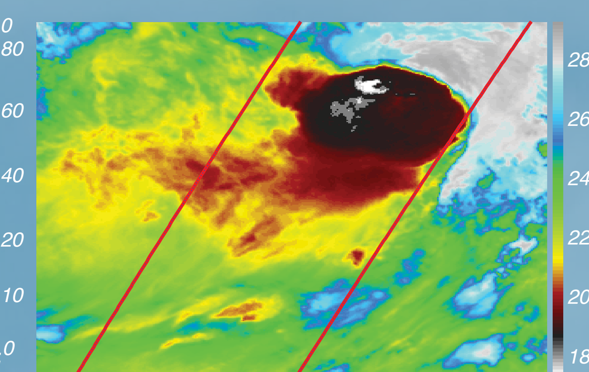


- Training OPC with PGLM data to simulate GOES-R GLM
- PGLM uses Lightning Mapping Array total lightning to create a proxy for GLM
- PGLM leads to less intense features in OPC

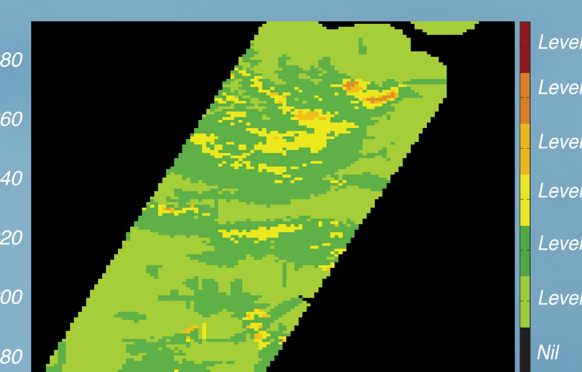
Himawari-8 Visible (0.5 km)



Himawari-8 10.4 μm (2 km)



GPM Precipitation (5 km)



- Training OPC with Himawari-8 Advanced Himawari Imager (AHI) data to explore impact of increased spatial resolution, number of channels, and image frequency in preparation for GOES Advanced Baseline Imager (ABI)

Summary and Future Work

- The OPC creates radar-like mosaics beyond the range of radar
- Global Precipitation Measurement Dual-frequency Precipitation Radar precipitation and storm heights used to validate OPC over the water
- Activities to prepare OPC for the GOES-R era include
  - Using Pseudo Geostationary Lightning Mapper (PGLM) data to anticipate OPC performance with GOES-R GLM
  - Training OPC with Himawari-8 AHI data to simulate GOES-R ABI
  - Investigating GOES-R ABI Cloud Height Algorithm (ACHA) and Joint Polar Satellite System Visible Infrared Imaging Radiometer Suite (JPSS VIIRS) products for improving OPC

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