# NOAA ROSES Semi-Annual Report

**Reporting Period: March 2021 – August 2021 (2nd report)**

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**Project Title**: GeoRing-ProxyVisible Satellite Imagery: Turning Night into Day with Machine Learning

## Executive Summary

Visible satellite imagery is routinely and widely used by operational forecast centers for marine, tropical and extratropical cyclone analysis and forecasting [e.g., at National Hurricane Center (NHC), Central Pacific Hurricane Center (CPHC), Ocean Prediction Center (OPC), Weather Prediction Center (WPC), Joint Typhoon Warning Center (JTWC)]. This project's goal is to develop the new geostationary satellite product Geo-Ring ProxyVisible Imagery (GRPV) to address the lack of nighttime visible imagery by replicating visible imagery at night-time using advanced machine learning techniques. GRPV will work with multiple next generation geostationary satellites including GOES-16, GOES-17, Himawari, and Geo-KOMPSAT-2A. The project team will work closely with NHC forecasters and use feedback for product development. GRPV will be made available in real-time for NHC's Advanced Weather Interactive Processing System (AWIPS2), and online for operational forecaster's evaluation and feedback.

## Progress toward FY20 Milestones and Relevant Findings (with any Figs)

In this reporting period the focus was on continuing development of the databases of training cases, development of the baseline models, and the development of the mutli-sateliite composite imagery.

1) VIIRS data in GOES-16 projection, originally developed for JPSS-PGRR project, is now being extensively used by this project for finding and collecting VIIRS/TC overpasses in various conditions. VIIRS is GOES-16 projection is available on the experimental version of SLIDER, https://rammb-slider2.cira.colostate.edu. Work is in progress on moving the application to the main version of SLIDER.
2) The NASA Earthdata API has been used to develop automated data selection, visualization, and download tool. An automated search tool for finding VIIRS/GOES overpasses using NASA API available at the NASA Earthdata database, https://cmr.earthdata.nasa.gov/search/ has point, region, and line search capabilities. For the data available locally, we can use CIRA's pass prediction software and the CIRA Polar-Orbiting Database (CPOD) software that allows for quick and efficient indexing and querying of satellite data, and is tuned for performance with SNPP and NOAA-20 ATMS-MiRS and VIIRS data. The NASA Earthdata search tools, however, allow for performing searches without downloading data, and can be used to reduce the amount of data that needs to be archived locally. The NASA search API returns the list of intersecting granules where each granule has data on the start and end time, four geolocation corners of the granules, day/night flag, and download link for the data file.

An automated script was developed for searching and displaying VIIRS overpasses over a user-requested region, which could be a TC or any other region for a case study. The search can be performed only for the data stored at NASA DAACs, and we tested searching VIIRS SDR data from SNPP and NOAA-20. Quick preliminary comparison of NASA and NOAA-processed VIIRS data suggest that the processing of VIIRS data by NOAA and NASA is different enough so that, unfortunately, these data cannot be used interchangeably. However, since the search is performed for the same satellites, SNPP and NOAA-20, we can use the overpass times returned by the NASA search tools to obtain selected data using NOAA archives available at NCEI and CLASS. We will further investigate the possibility of doing some of the development using VIIRS data processed by NASA.

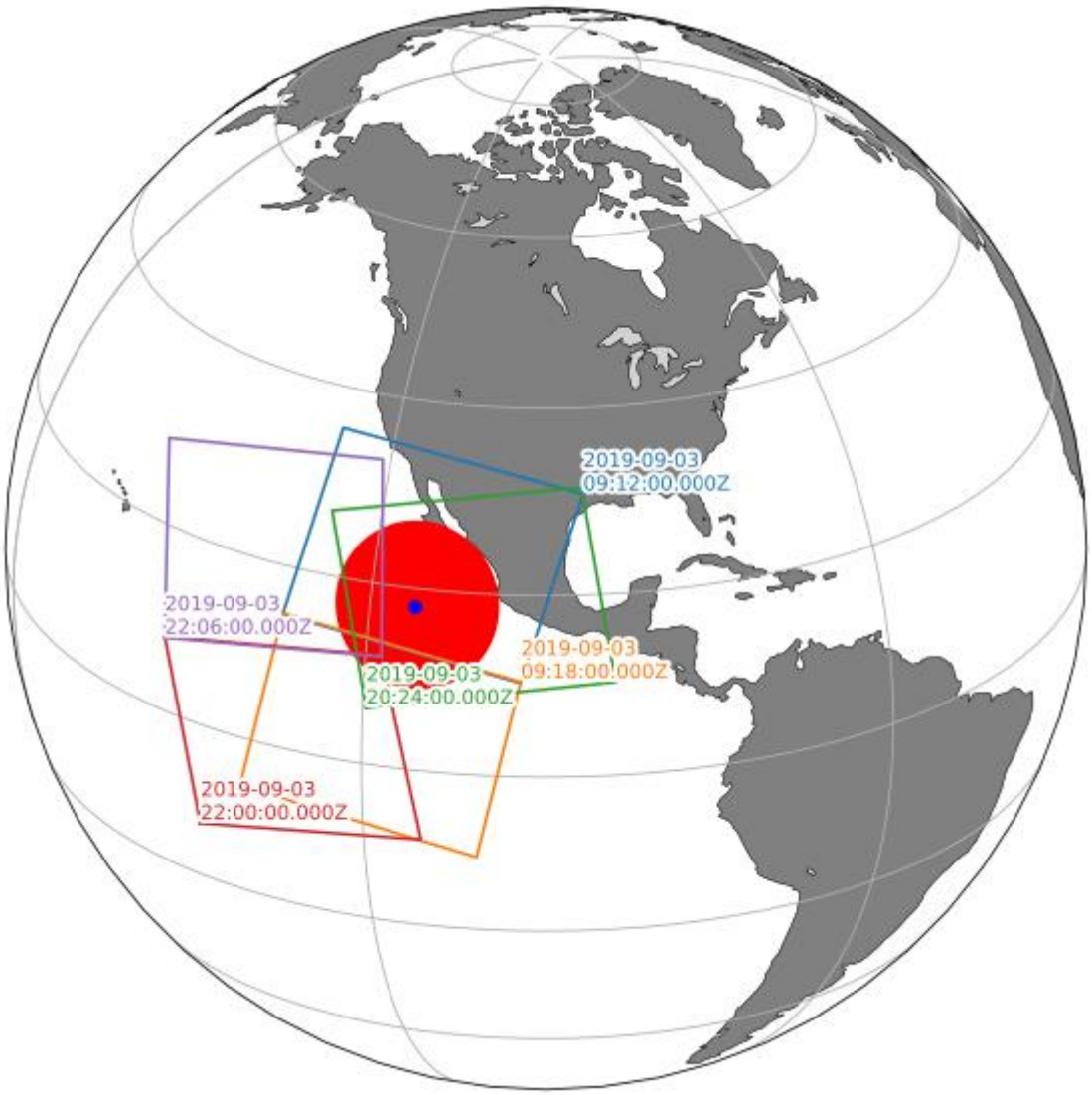


Figure 1. JPSS1 VIIRS 6-minute granules within 1000km of east Pacific Hurricane Juliette (2019), centered at 18.2°N, 114.7°W between 2019-09-03 00Z and 2019-09-04 00Z. Shown are both Day and Night Passes

3) The pre-processing code for GOES-16/-17 has been completely rewritten. The possibility of saving the resulting proxy image as a netcdf file has been added. The updated processing also includes a more flexible way for reading and transforming VIIRS data.

4) The updated processing software has been used to develop composite imagery for GOES-16/-17. As a first step, we reproduced in Python composite algorithms described in literature, for visible and short-wave IR channels. This compositing technique will be further adapted to be used with multispectral imagery.

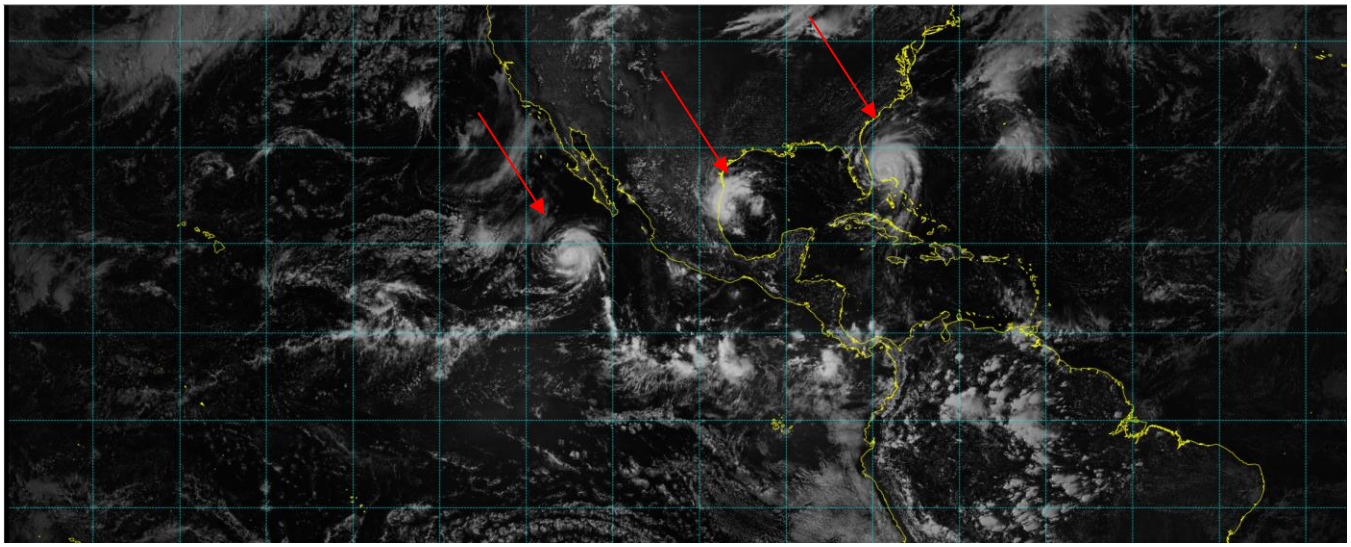

*Figure 2. Zoomed in GOES-16/-17 composite for Visible Channel 2, using CIMSS satellite subpoint algorithm, on 2019-09-03 at 18:50 UTC. Systems (from left to right) are Juliette, Fernand, and Dorian*

**Plans for Next Reporting Period**

During the next report period work will continue on developing a baseline GRPV algorithm and on setting up a framework for testing hierarchy of machine learning methods.