AI-Readiness of the Tropical Cyclone Precipitation, Infrared, Microwave, and Environmental Dataset (TC PRIMED)

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TC PRIMED

Has over 176,000 multi-sensor overpasses of 2,101 tropical cyclones from 1998 through 2019 with

1) inter-calibrated passive microwave brightness temperatures
2) retrieved precipitation from NASA's Goddard Profiling Algorithm (GPROF)
3) coincident infrared brightness temperatures and derived products
4) tropical cyclone position and intensity information
5) ECMWF ERA-5 fields and derived environmental diagnostics
6) precipitation radar observations from TRMM and GPM Core Observatory satellites.

https://rammb-data.cira.colostate.edu/tcprimed/

Goals

- Assess and improve TC PRIMED's AI-readiness
- Provide feedback to NOAA/NCAI to improve draft AI-readiness standard
- Generate easy and accessible training materials for new forecast product development and as reference for future dataset generators and curators.

Work Towards a More AI-Ready Dataset

- ❑ Develop example notebooks on how users can use the data
- ❑ Develop a consistent, gridded version of TC PRIMED
- ❑ Develop a real-time version of TC PRIMED for real-time applications
- ❑ Provide feedback on the ESIP Data Readiness Cluster AI-readiness checklist

TC PRIMED Example

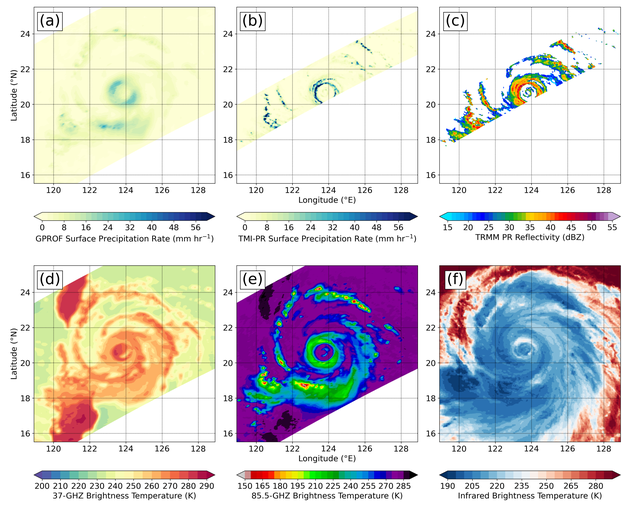

Figure 1. TRMM observation of Typhoon Sepat (2007):

(a) GPROF surface rain rates

(b) PR surface rain rates

(c) PR reflectivity at 3 km altitude

(d) 37.0 GHz brightness temperatures

(e) 85.5 GHz brightness temperatures

(f) Coincident infrared brightness temperatures

AI Application: Precipitation Type Classification

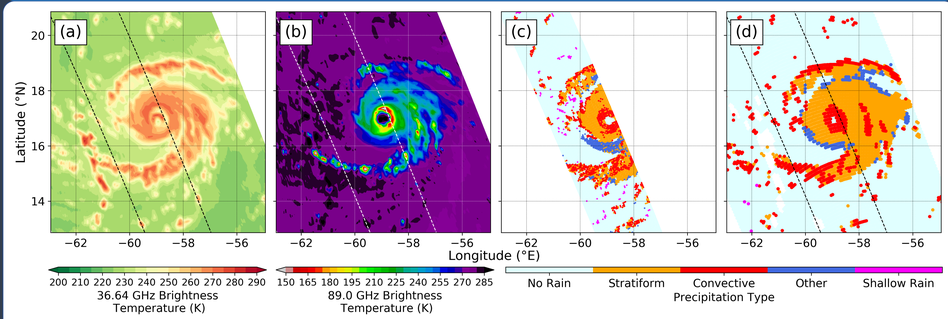

Figure 2. GPM observation of Hurricane Irma (2017) showing (a) 36.64 GHz brightness temperatures, (b) 89.0 GHz brightness temperatures, (c) precipitation type from the GPM DPR, and (d) precipitation type from the random forest model.

Current AI-Readiness Level

Based on the ESIP Data Readiness Cluster AI-Readiness Checklist

- ✓ Missing or bad data are removed or assigned fill values
- ✓ Multiple AI targets
- ✓ Data compiled from public datasets that have been peer-reviewed and are properly cited
- ✓ Currently being reviewed for archival and DOI issuance
- ✓ Passive microwave brightness temperatures are inter-calibrated such that differences are mainly due to sensor differences
- ✓ Precipitation retrieval comes from a single algorithm (NASA's GPROF)
- ✓ Data consistency is sensor-specific
- ✓ Files in NetCDF format and are compliant with the CF-1.7 and ACDD-1.3 metadata convention

AI Application: Synthetic Passive Microwave

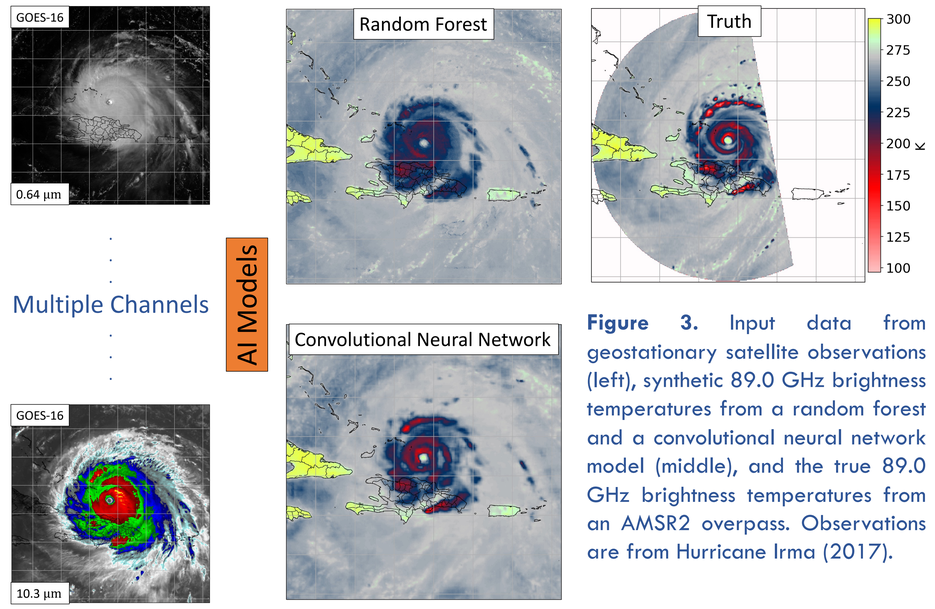

Figure 3. Input data from geostationary satellite observations (left), synthetic 89.0 GHz brightness temperatures from a random forest and a convolutional neural network model (middle), and the true 89.0 GHz brightness temperatures from an AMSR2 overpass. Observations are from Hurricane Irma (2017).

AI Application: Secondary Eyewall Detection

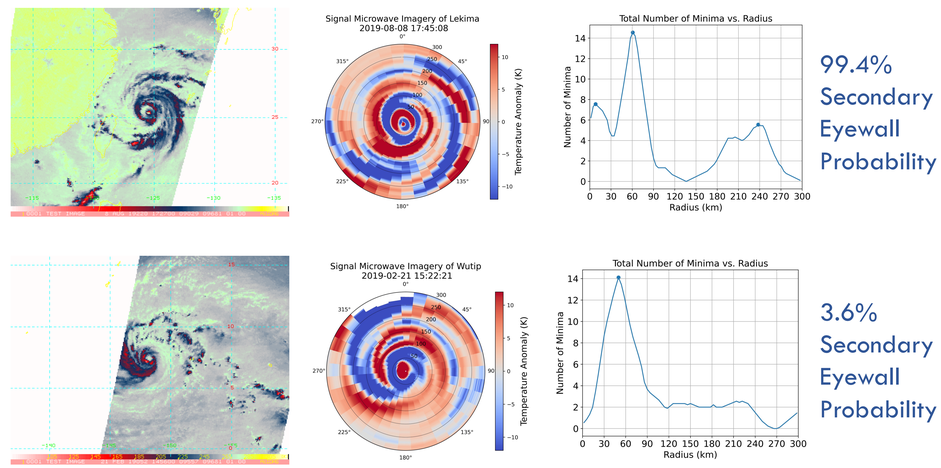

Figure 4. 89.0 GHz brightness temperatures (left), brightness temperature anomaly (middle), and radial profile of brightness temperature anomaly minima (right) for Typhoon Lekima (top) and Typhoon Wutip (bottom) in 2019.

Credits: Alvin Cheung

Acknowledgments

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