

A satellite image of a hurricane, showing a well-defined eye and spiral cloud bands, occupies the left half of the slide. A solid blue vertical bar is positioned between the image and the text on the right.

Applying Artificial Intelligence and Machine Learning for Hurricane Research and Development

Xuejin Zhang (HRD)

Hua Leighton (HRD/CIMAS) and Xin Yang (HRD/CIMAS)

Collaborators: UM, GFDL, EMC, OU, and CSU



Atlantic Oceanographic & Meteorological Laboratory
National Oceanic and Atmospheric Administration
U.S. Department of Commerce



AI/ML Frontier Applications

Completed

- Observations
 - TDR data quality control
 - Processing cloud physics data

Ongoing

- Modeling
 - Physics parameterization
 - AI forecasts for hurricanes

Planned

- Advanced applications
 - Data assimilation
 - Physics emulator

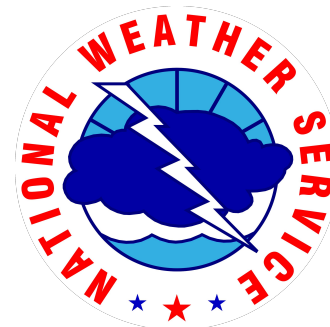


Colorado State University



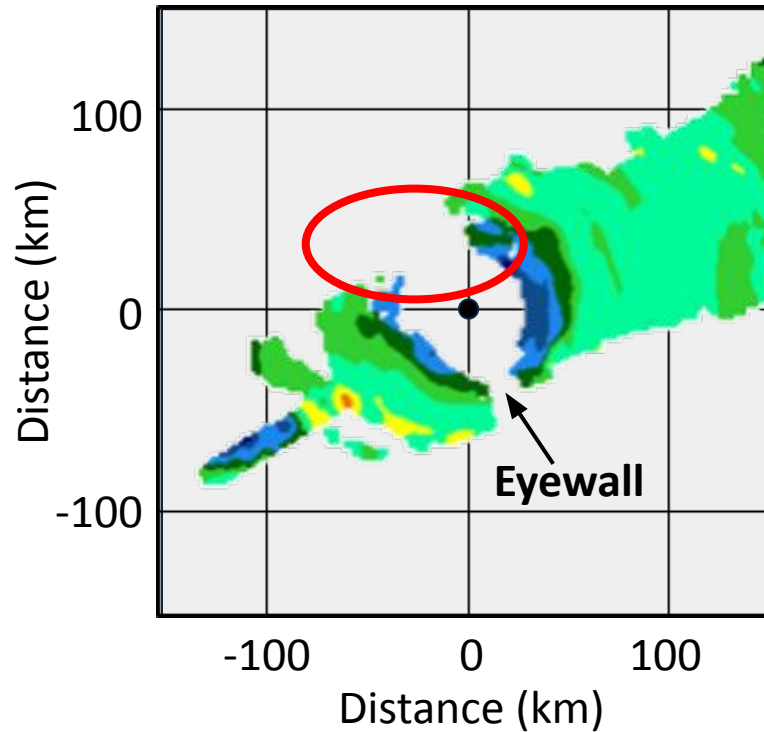
UNIVERSITY OF MIAMI

ROSENSTIEL SCHOOL of
MARINE, ATMOSPHERIC
& EARTH SCIENCE



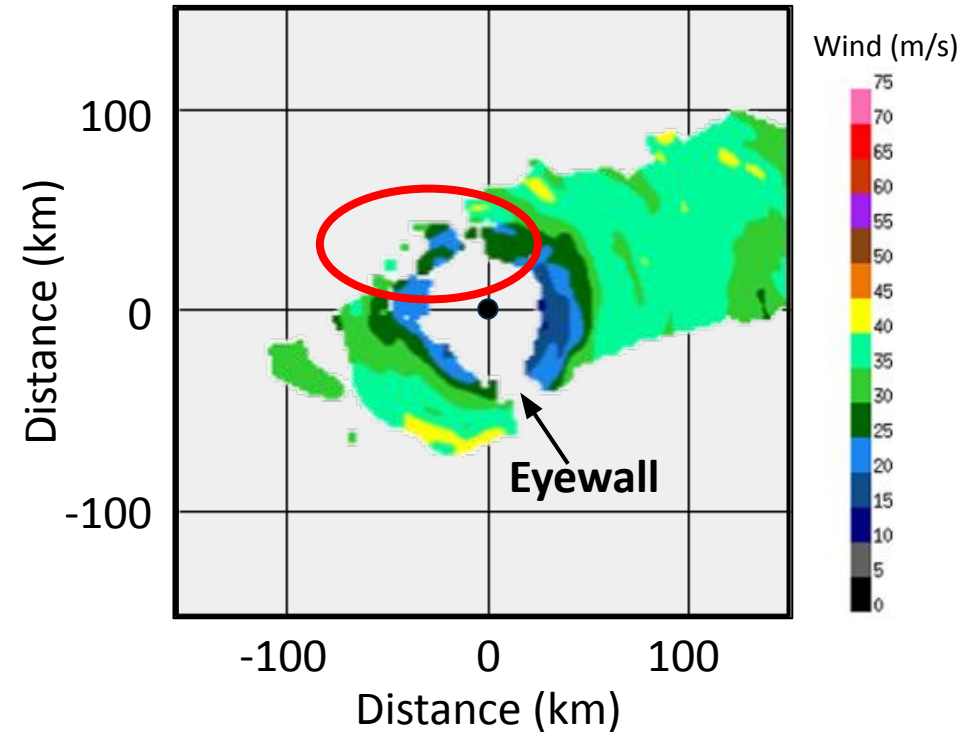
AI/ML Retains More TDR Data for Model Input

Current, Operational Method



Meteorological Data Retained: **71%**
Non-Meteorological Data Removed: **99%**

New, AI/ML Method



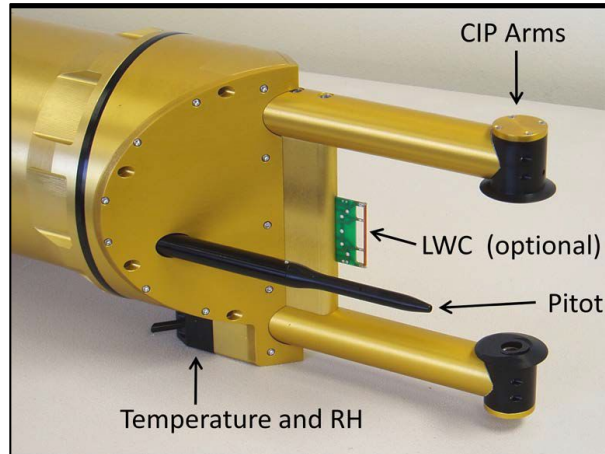
Meteorological Data Retained: **91%**
Non-Meteorological Data Removed: **99%**

Credit: Paul Reasor & Michael Bell

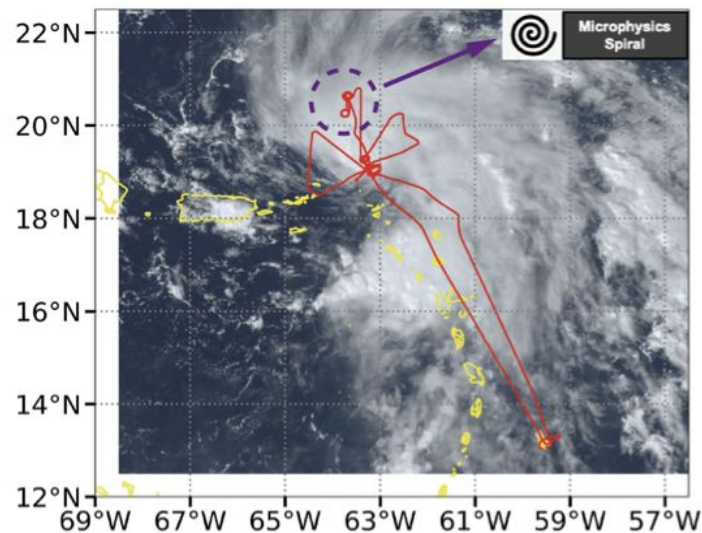


Collecting Cloud Physics Data

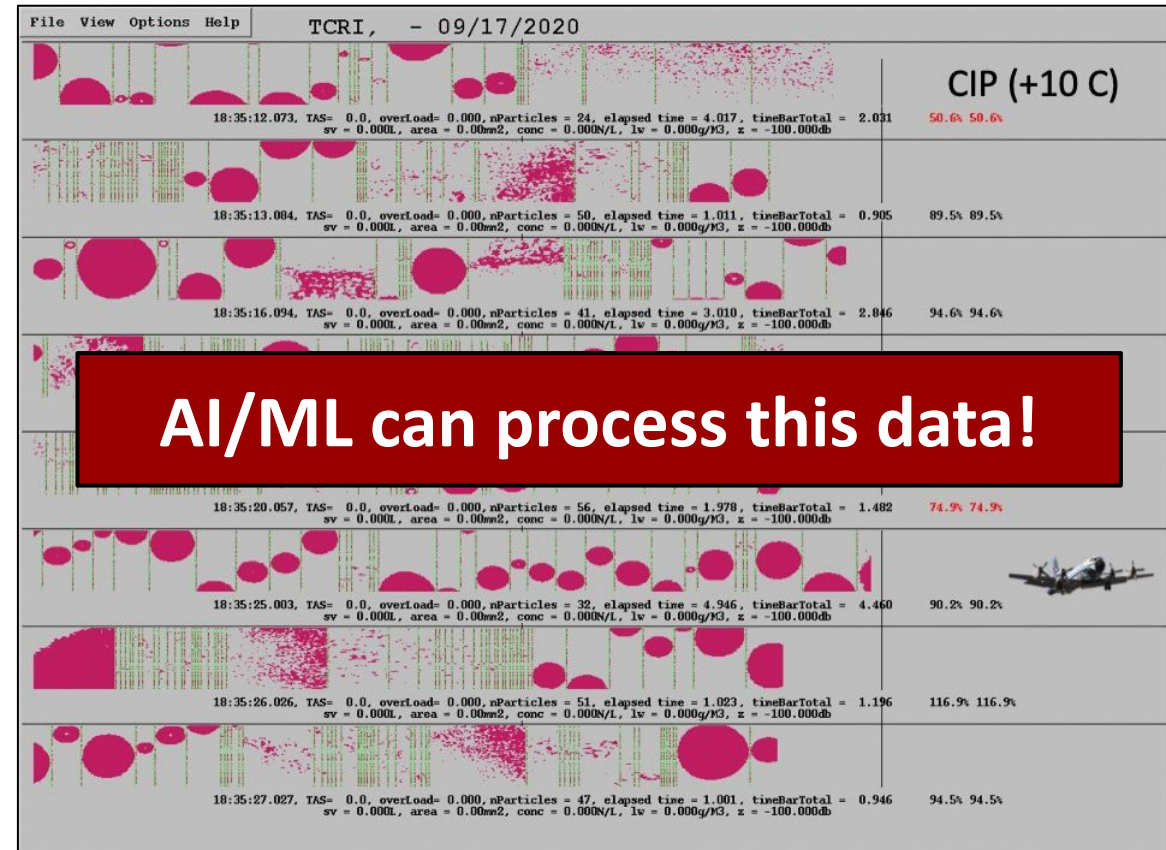
Instrument: Cloud Imaging Probe (CIP)



Collecting Cloud Data



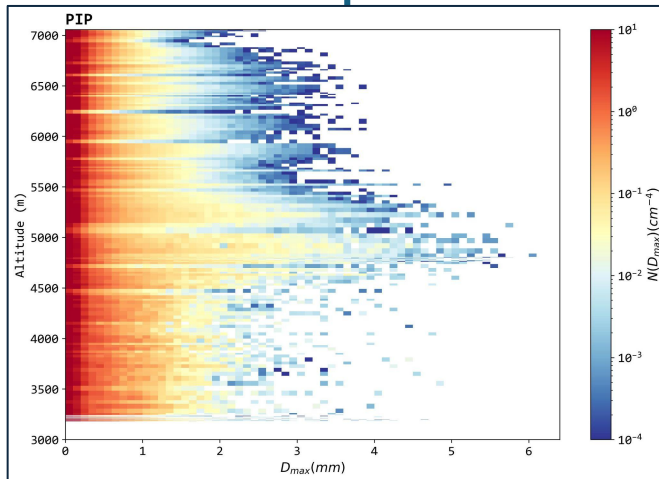
Microphysics Observations at Different Altitudes



Credit: Jason Dunion & Robert Rogers

Improving Microphysics Parameterizations



Particle Size Distributions (AI-Processed Observations)

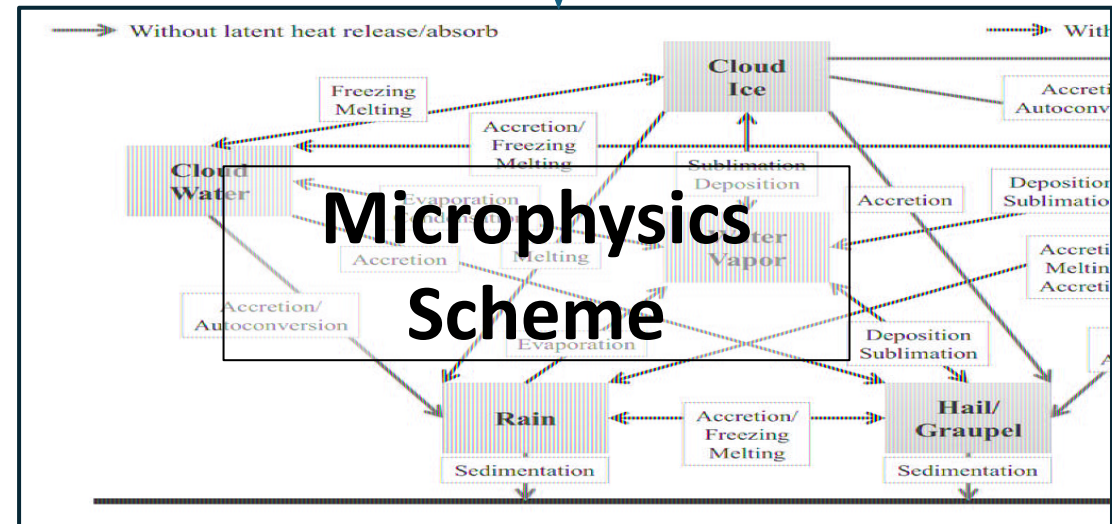


Atmospheric Environment and Precipitation (Model Analysis)

Bin/Bulk Microphysics Simulations

Diagnosed Particle Size (AI Deep Learning)

 AI processing
 Non-AI inputs



Future Directions

- **Expanding** AI/ML fundamental capabilities
- **Increasing** reliable observational datasets
- **Building** Large Eddy Simulation modeling capabilities
- **Applying** AI/ML techniques for observations, modeling, and data assimilation
- **Generating** better initial vortex for model initialization
- **Providing** new AI-driven forecast products