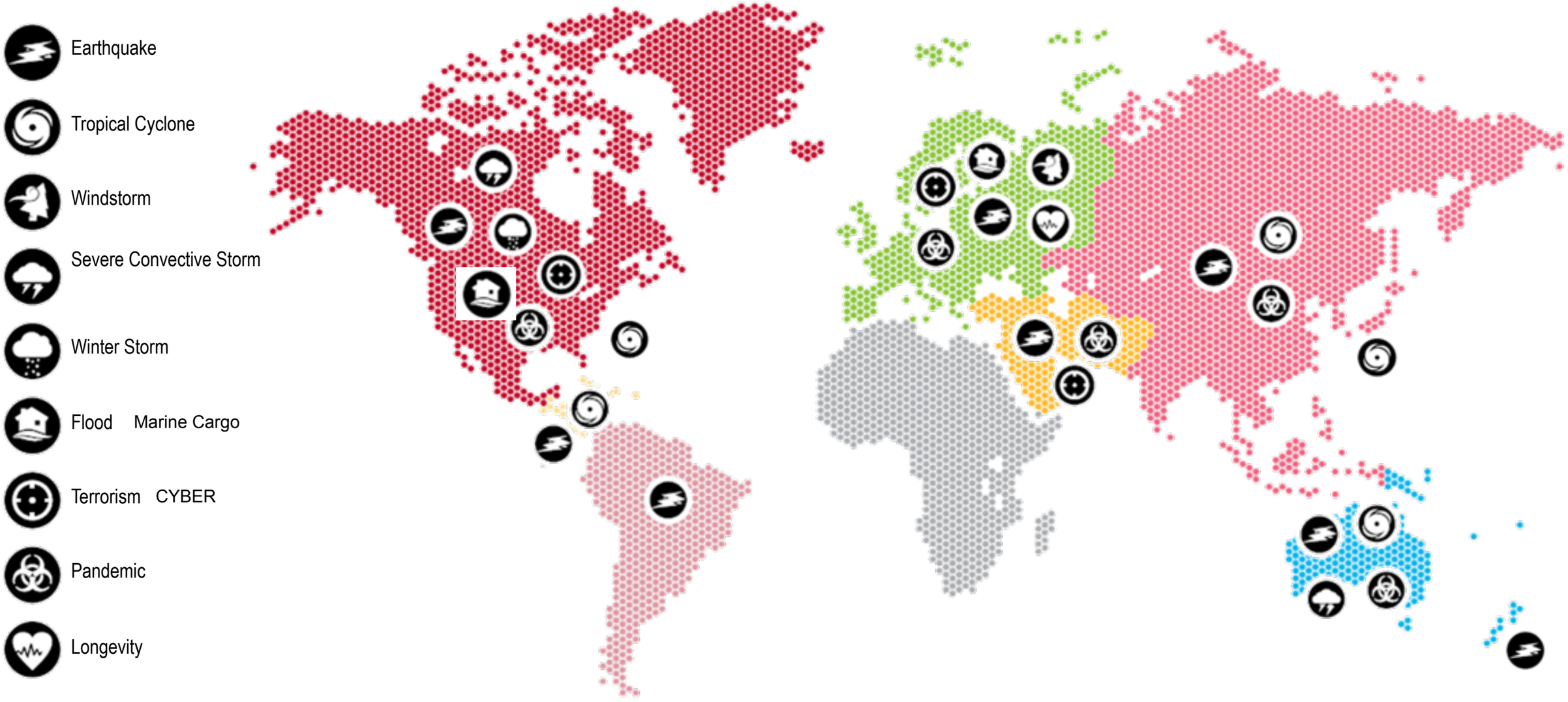
HWIND FIELDS IN SUPPORT OF HIGH WIND REMOTE SENSING IN TROPICAL CYCLONES

November 15, 2016

Mark Powell

http://www.rms.com/perils/hwind/

CATASTROPHE SCIENCE – MODEL AND PERIL COVERAGE

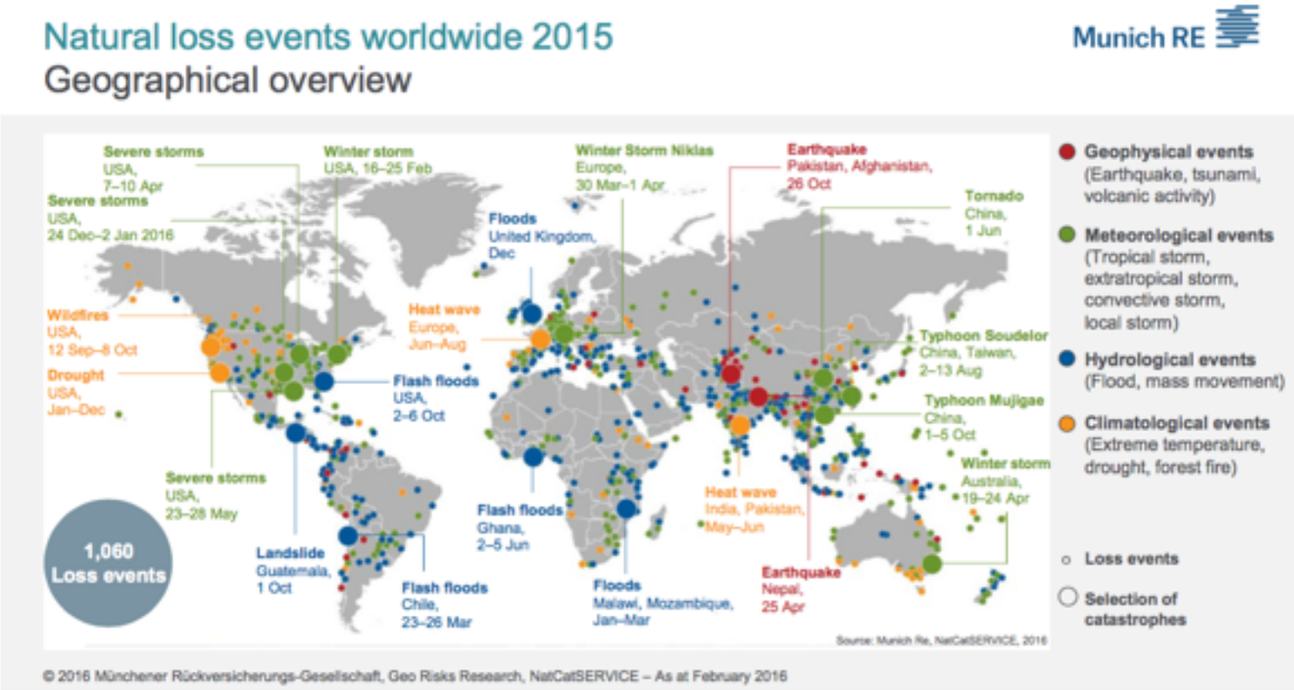


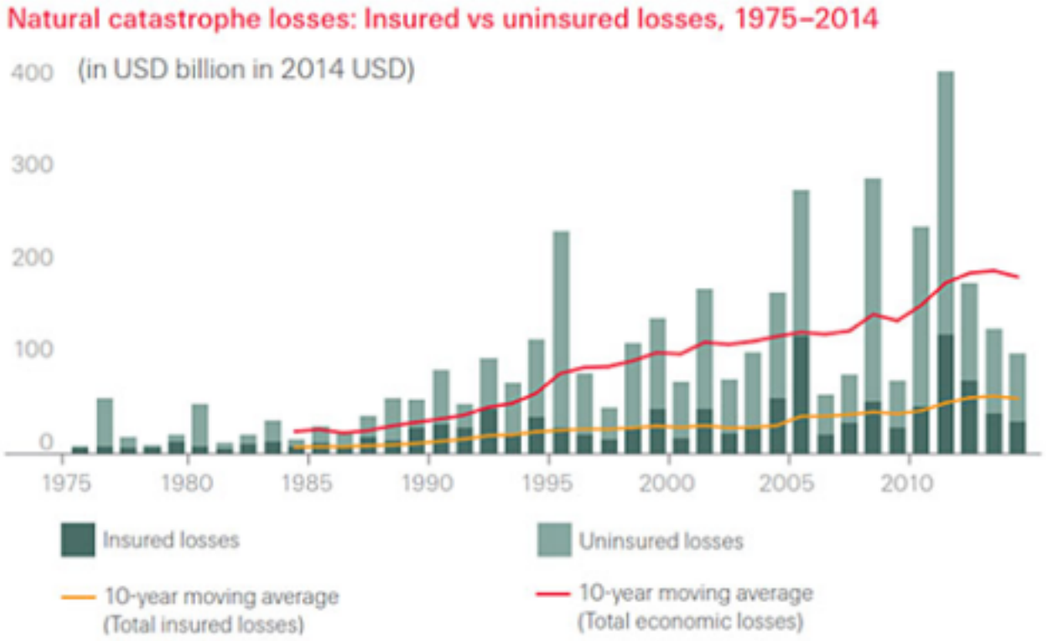
WHO WE SERVE

- Insurers
- Reinsurers
- Capital Markets
- Brokers and Reinsurance Intermediaries
- Corporations
- Government and NGOs

More than 400 institutions trust RMS models, technology, and services to better understand and manage catastrophe risks throughout the world.

AN INSURANCE INDUSTRY PERSPECTIVE: THE PROTECTION GAP





Source: Swiss Re Economic Research & Consulting and Cat Perils

THE DISASTER GAP

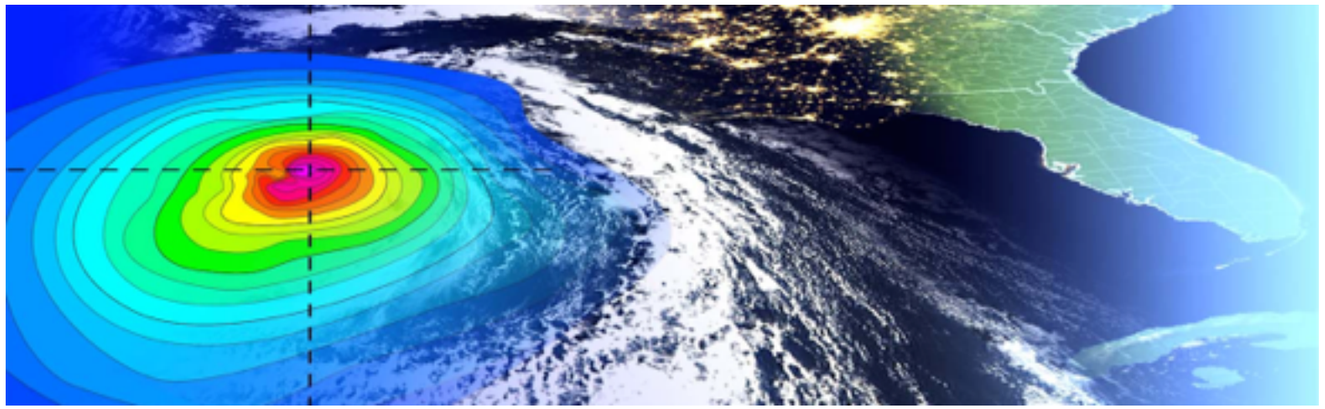
New financial instruments “insurance linked securities” are designed to use capital markets to address the gap

Risk modeling needed to price them, Hurricane data needed to model, actively trade, and sometimes even trigger payouts

HWIND METHODOLOGY

HWIND: WHAT IS IT?

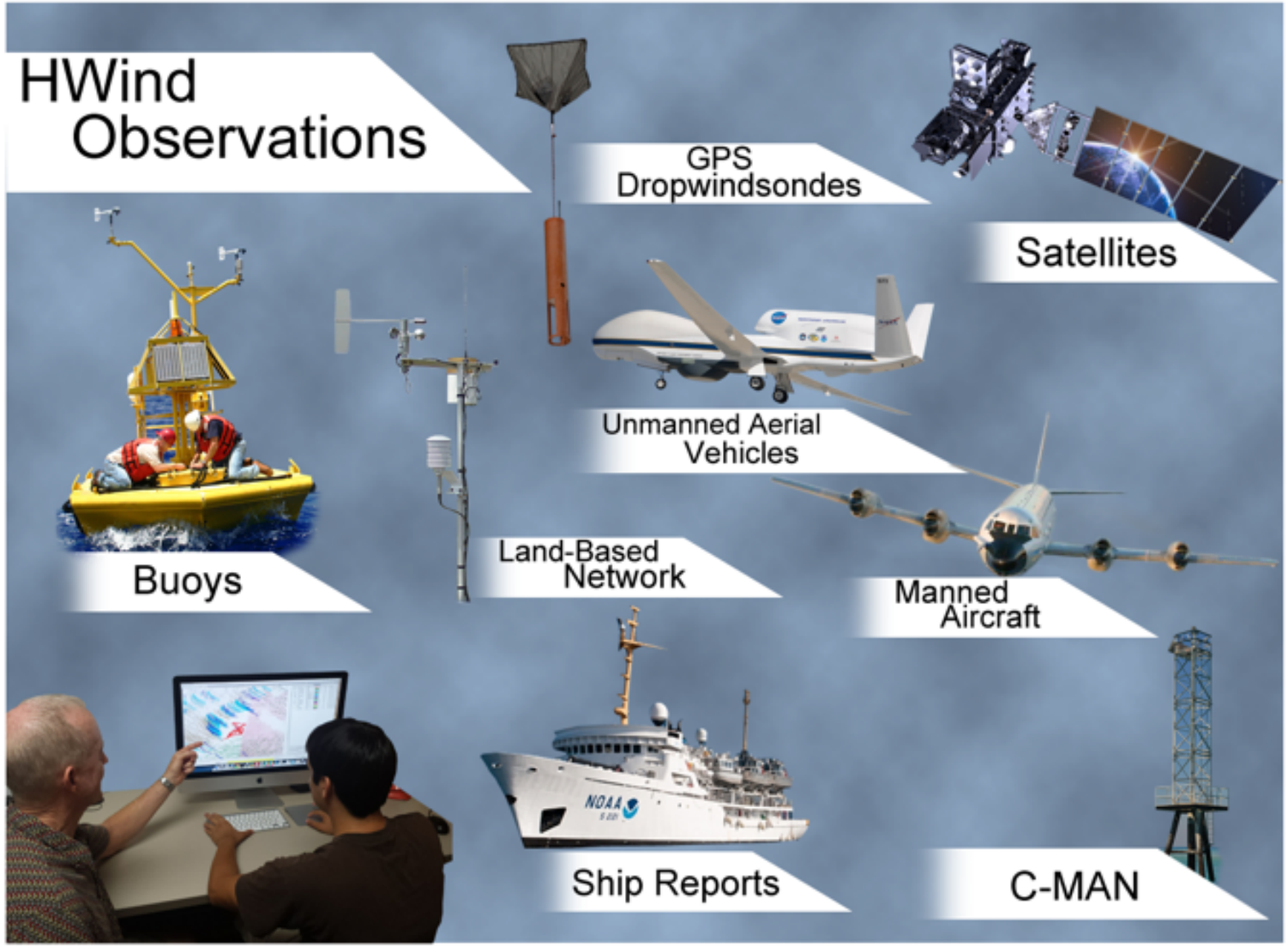
A system for real-time tropical cyclone analysis



Gather Observations → Standardize → Database → QC → Analyze → Products

OBSERVATIONAL DATA SOURCES

- ~40 different observational data sources included in the HWind database
- On average, tens of thousands of observations for each event, depending on availability of satellites, airborne instruments, and the storm's proximity to land
- Subject to stringent independence and quality control testing



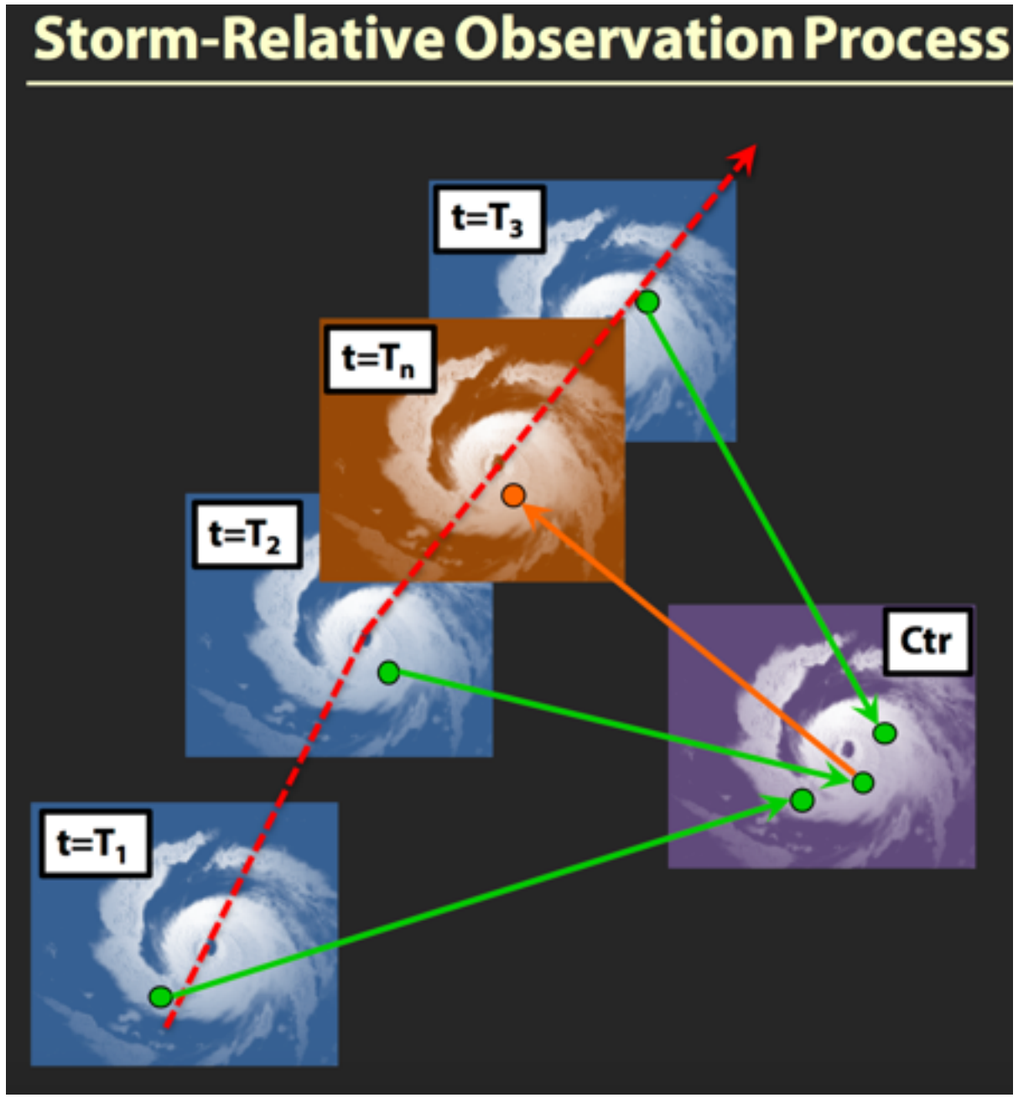
NOISE REDUCTION

- Storm relative framework
  - Helps fill data voids
  - More spatial information than synoptic (all at one time)

- All wind measurements standardized
  - Common height (10 m)
  - Common averaging time (max 1 min, peak 3s gust)
  - Standard upstream fetch roughness regimes
    - Open terrain
    - Marine
- Subject to stationarity assumption

At any time an observation has a unique range and bearing from storm center

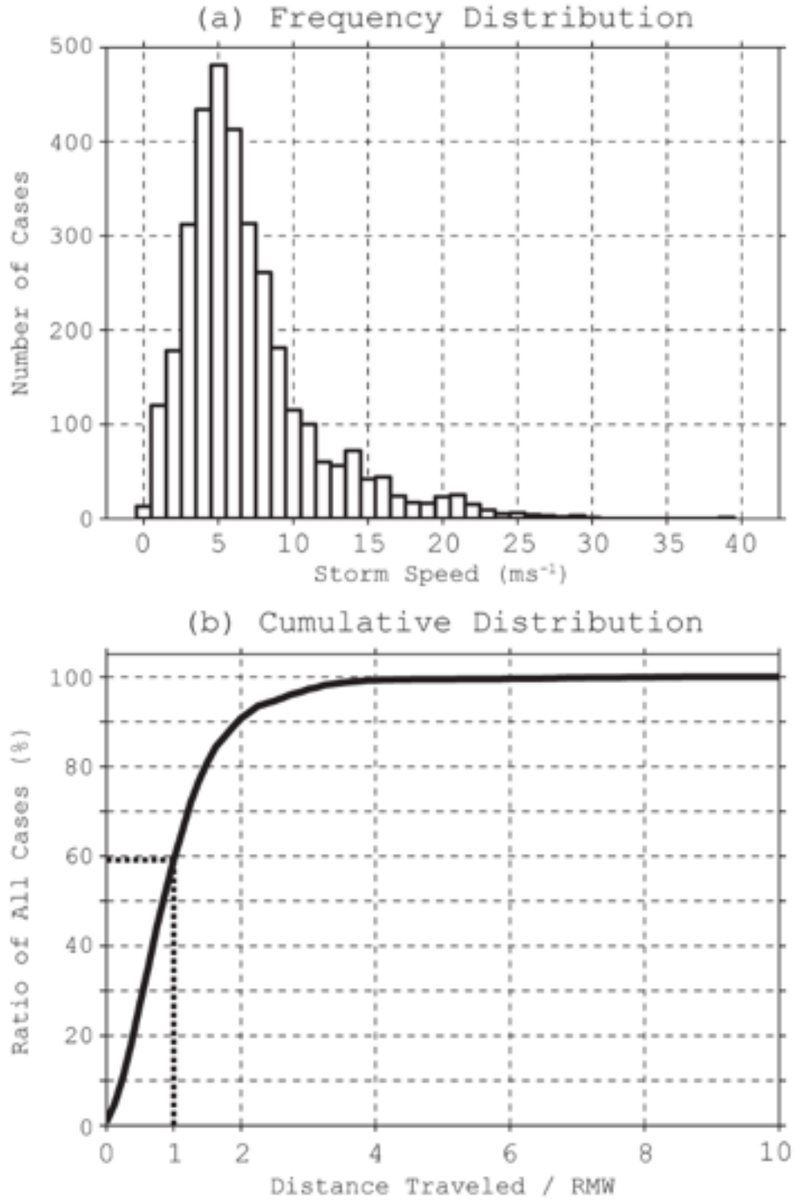
Over a time window one location can provide spatial information



From Altug Aksoy, HRD-AOML

Over a half of a typical 4h time window for data assimilation systems ~40% of storms move > 1 RMW —> additional variance

Storm relative frameworks reduce variance

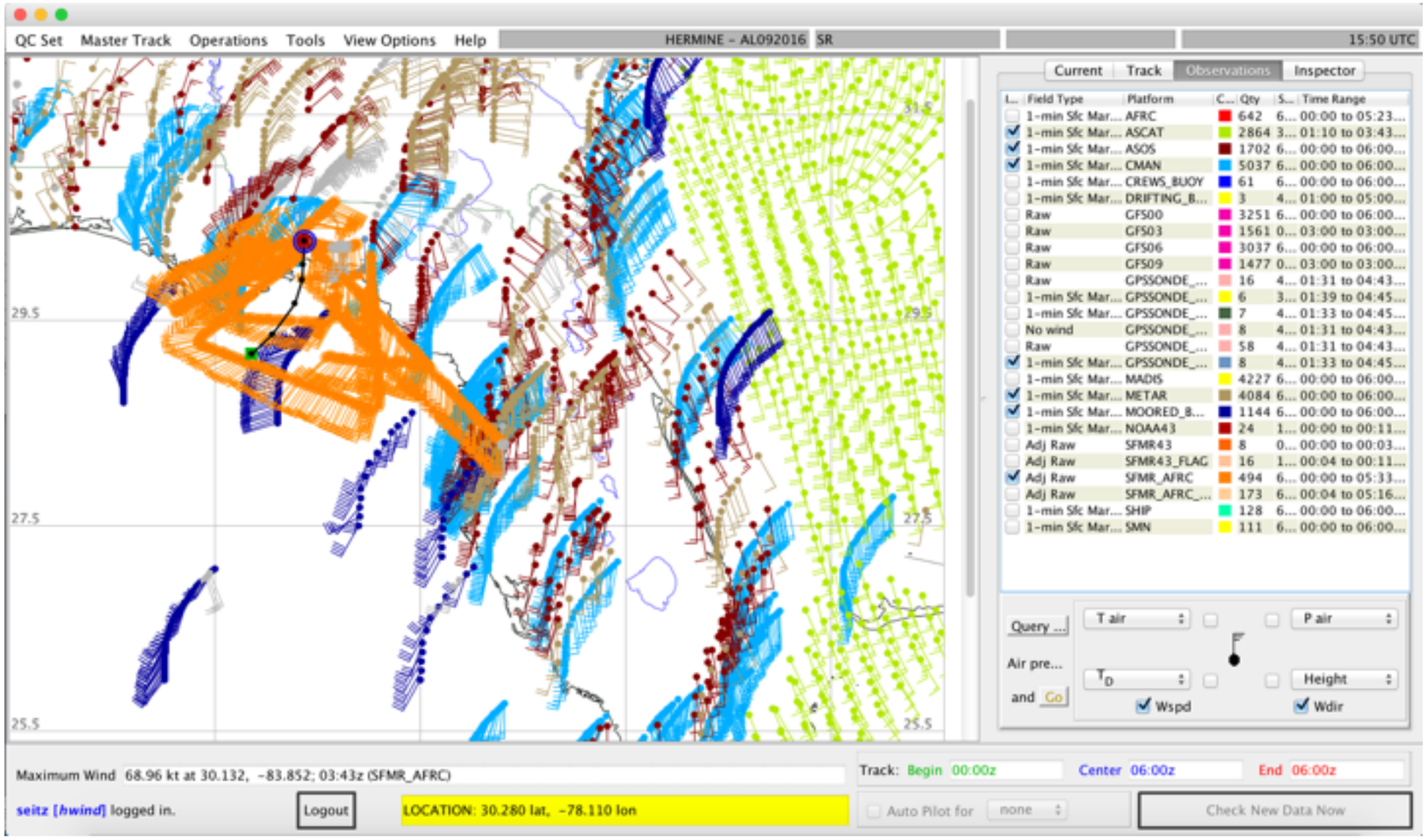


From Altug Aksoy, HRD-AOML MWR 2013

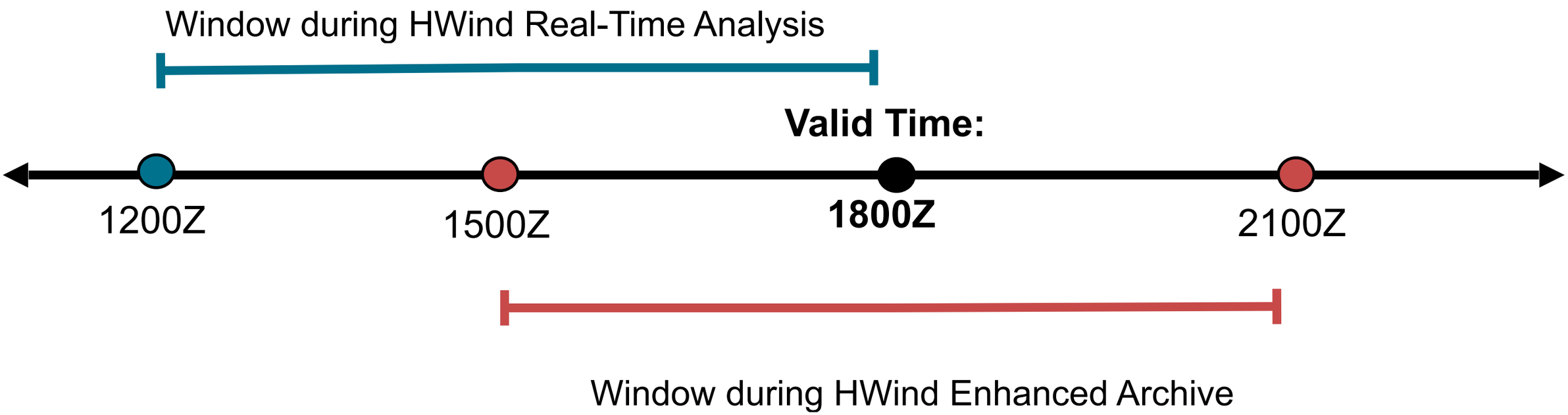
HWIND METHODOLOGY – APPROACH AND OBJECTIVES

- Goal is to estimate wind field as accurately as possible based on observations

Screenshot of HWind platform used to import and QA observational data



REAL-TIME VS. ENHANCED ARCHIVE METHODS - SNAPSHOTS

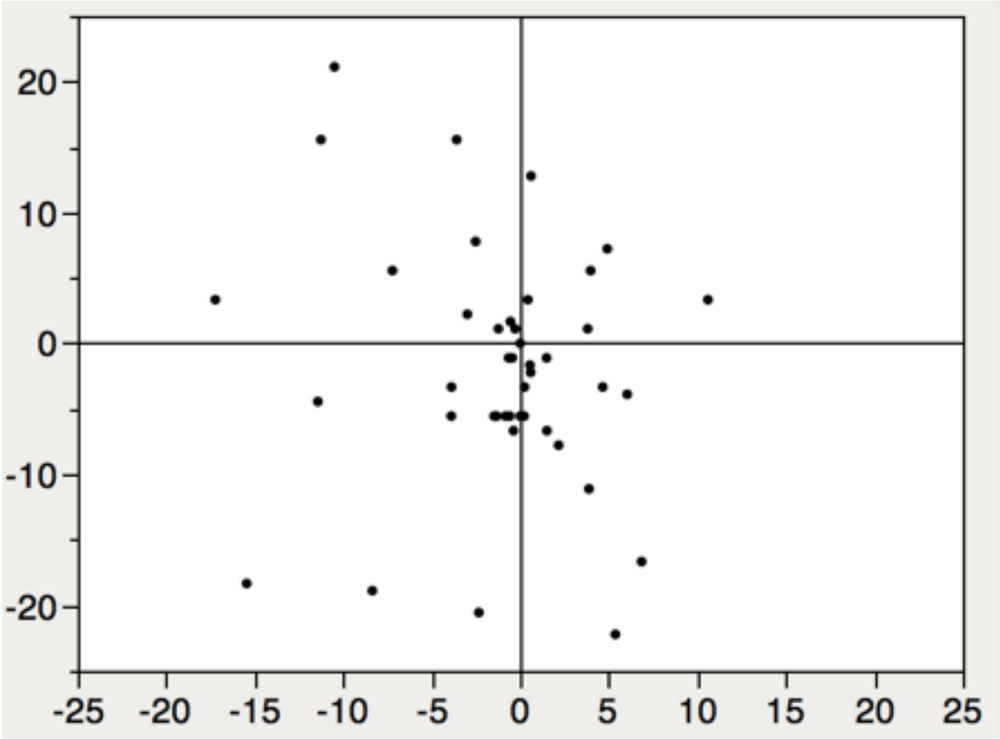


Using data on either side of the time step informs a more accurate representation of storm structure

REAL-TIME VS POSTANALYSIS POSITIONS

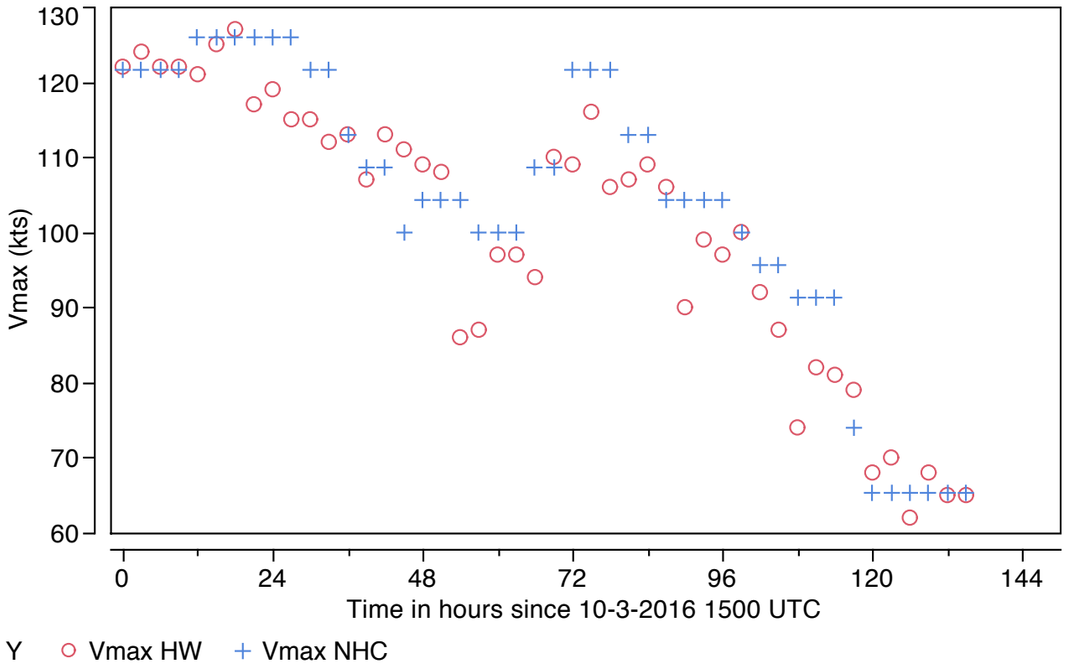
Differences between real-time and post storm positions

8 km mean difference
47 Matthew snapshots

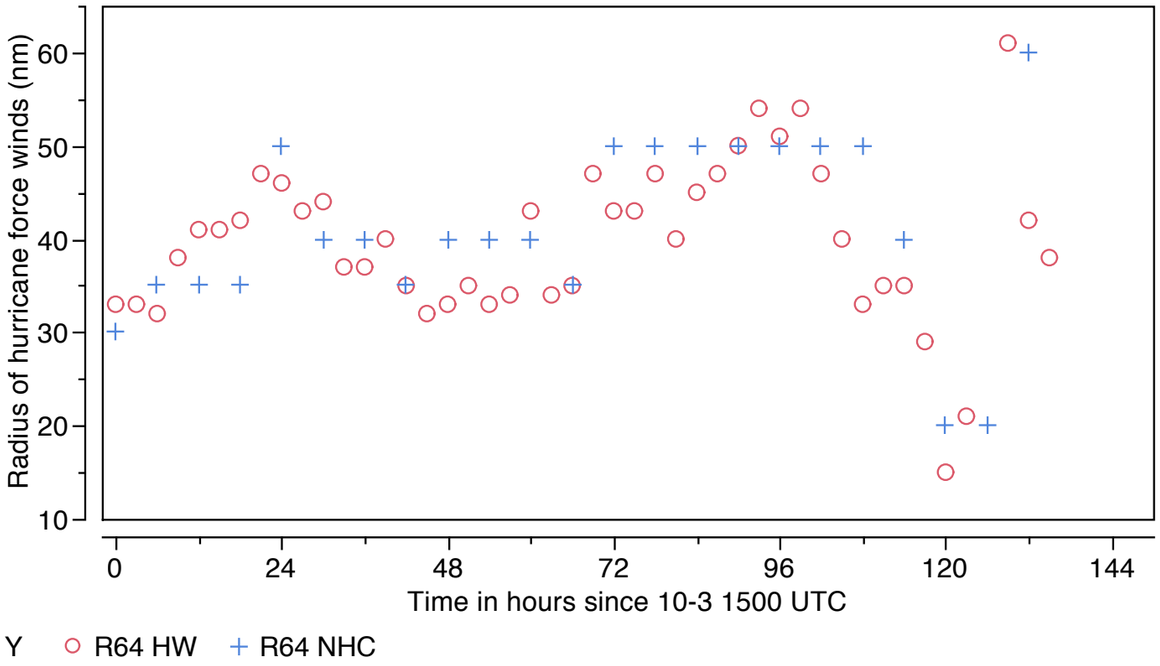


COMPARISON TO NHC PRODUCTS

Vmax



R64

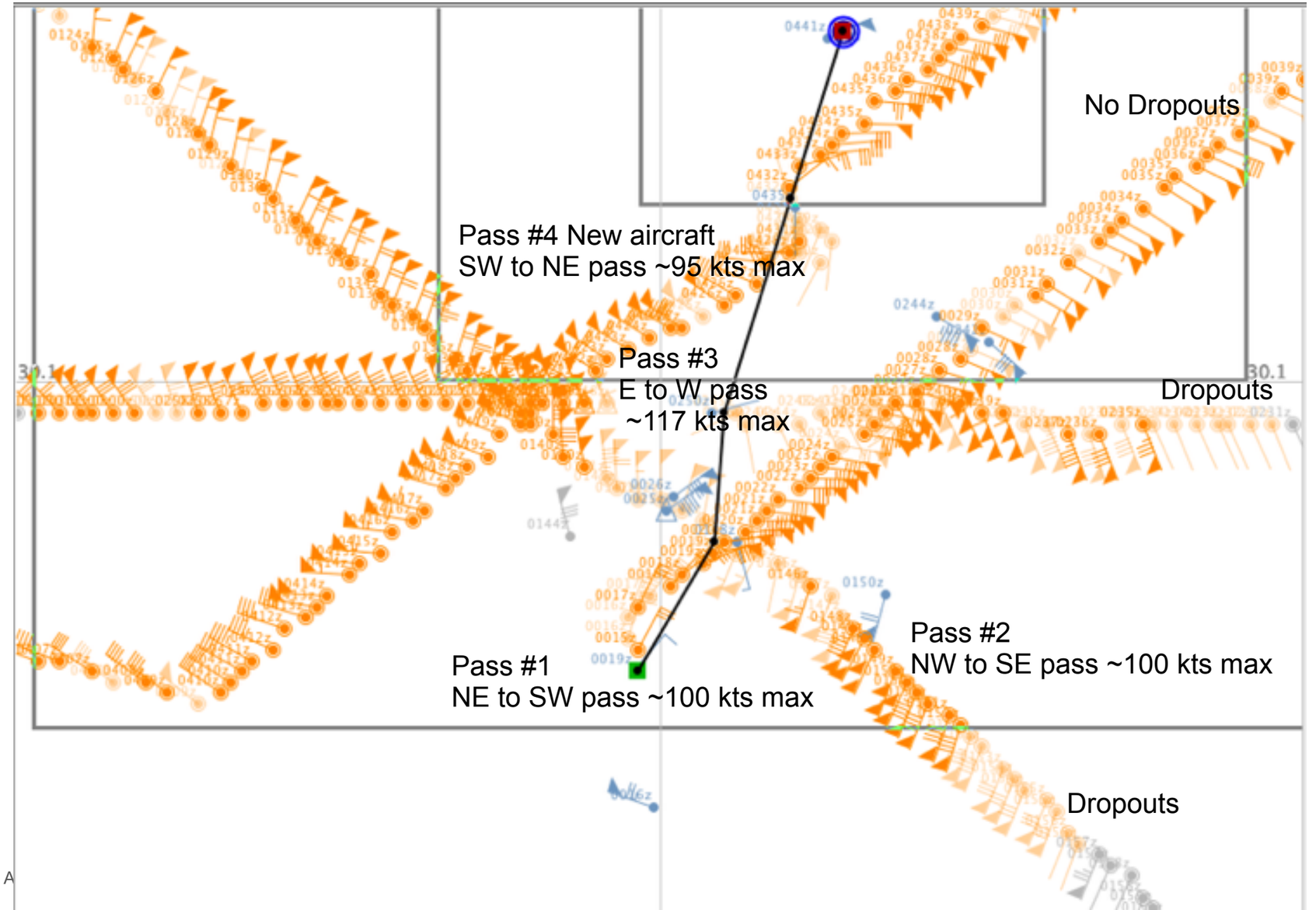


HWind depicts variability, trends, and changes

REAL-TIME MONITORING: HURRICANE NICOLE 10-13

Nicole was not a Cat 4!

Once intermittent data appeared SFMR peaks were higher than FL peaks and compared poorly to sondes and to ASCAT winds outside the core area



APPLICATIONS

- Observation-based analysis of record
- Objective input to extreme wind climate
- Evaluation of model performance
- Loss model development and calibration
- Real-time impact assessment
- Response and recovery application
- Claims and Exposure applications

Utility and Insurance loss relationships

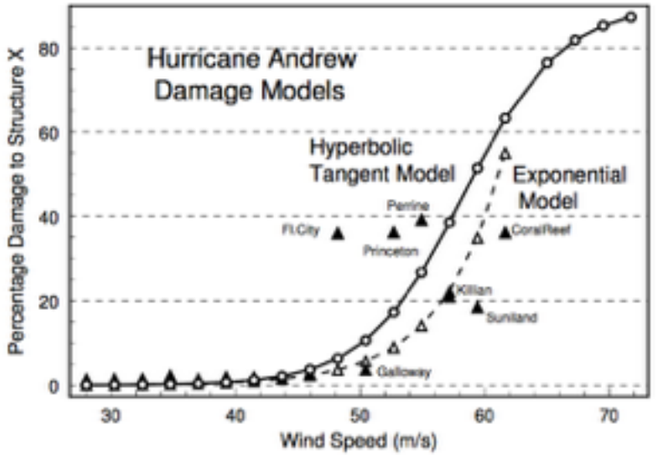


Figure 3. Prototype curve fit models for damage estimation as a function of wind speed.

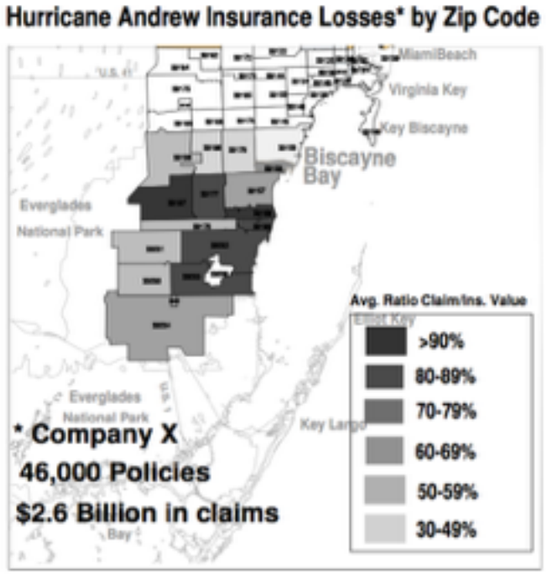


Figure 4. Dade insurance ratio of loss claim to insured value from Hurricane Andrew.

HWind at the National Hurricane Center

R2O didn't happen

With help from

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION OCEANIC AND ATMOSPHERIC RESEARCH

TECHNOLOGY PARTNERSHIPS OFFICE

Promoting Partnership & Commercialization of NOAA Technology and Innovations

R2B in 2014

Acquired by RMS
Oct. 2015

OVERVIEW OF RMS HWIND

RMS HWIND: PRODUCT OVERVIEW

RMS HWind Products

Real-Time Solution

Snapshot

Real-Time Views of Wind field Size and Intensity

Post-Event Footprint

High Resolution Wind Hazard Footprints Post-landfall

Enhanced Archive

Enhanced Archive

Archive Library of Data from Historical Events

Old HWind Products that RMS Supports

Legacy Archive

Archive Library of Data from Historical Events. Created when HWind was still affiliated with NOAA

HWIND REAL-TIME ANALYSIS

2016 HWIND ANALYSES

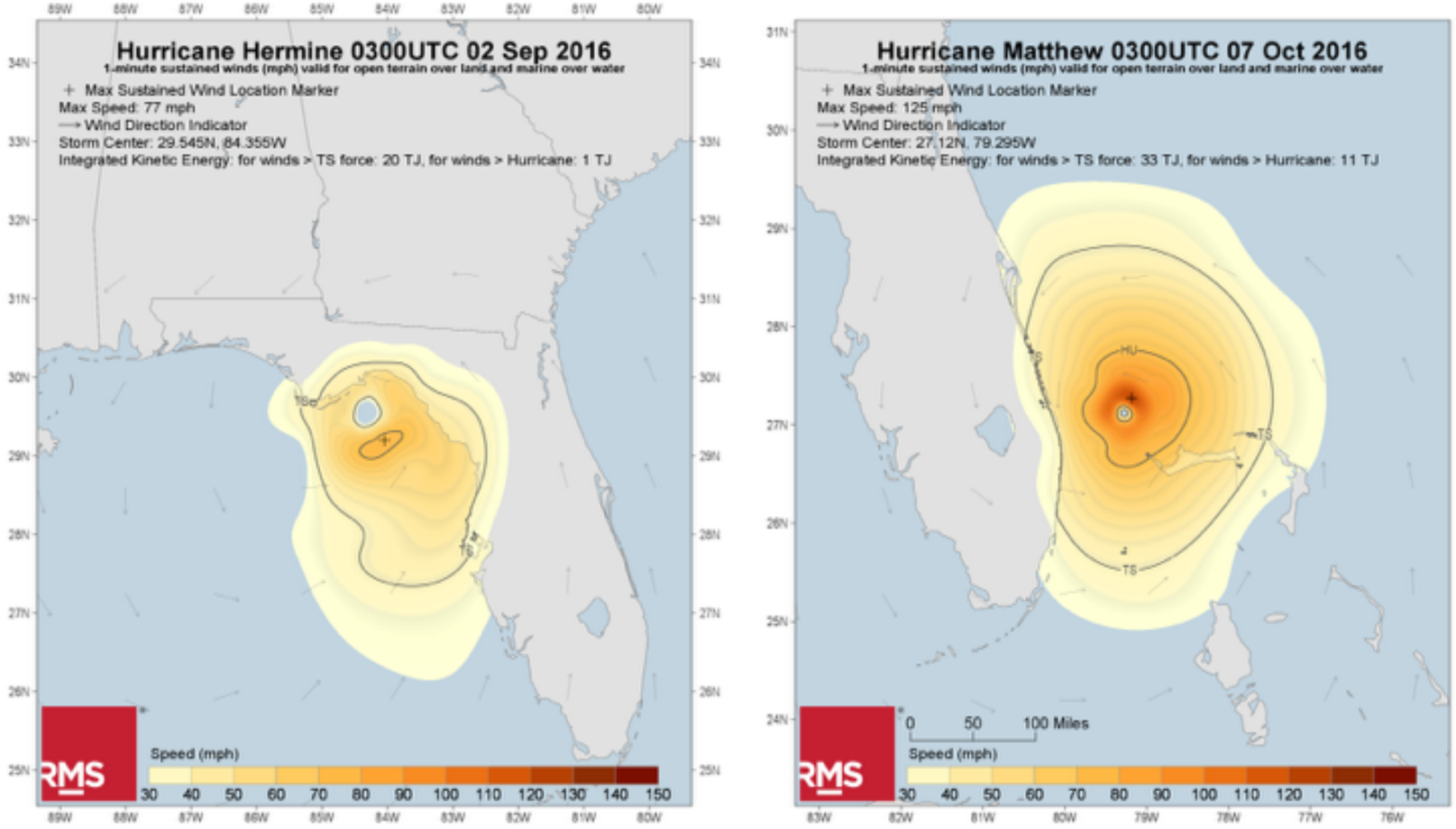
- 10 Atlantic basin
- 5 East Pacific
- 3 Central Pacific

Storm Name	Basin	# Snapshots
Bonnie	AL	3
Colin	AL	14
Danielle	AL	2
Earl	AL	9
TD8	AL	9
Hermine	AL	67
Julia	AL	14
Karl	AL	11
Matthew	AL	83
Nicole	AL	12
Darby	EP/CP	13
Javier	EP	2
Lester	EP/CP	8
Madeline	EP/CP	5
Newton	EP	2

REAL-TIME SOLUTION – SNAPSHOTS

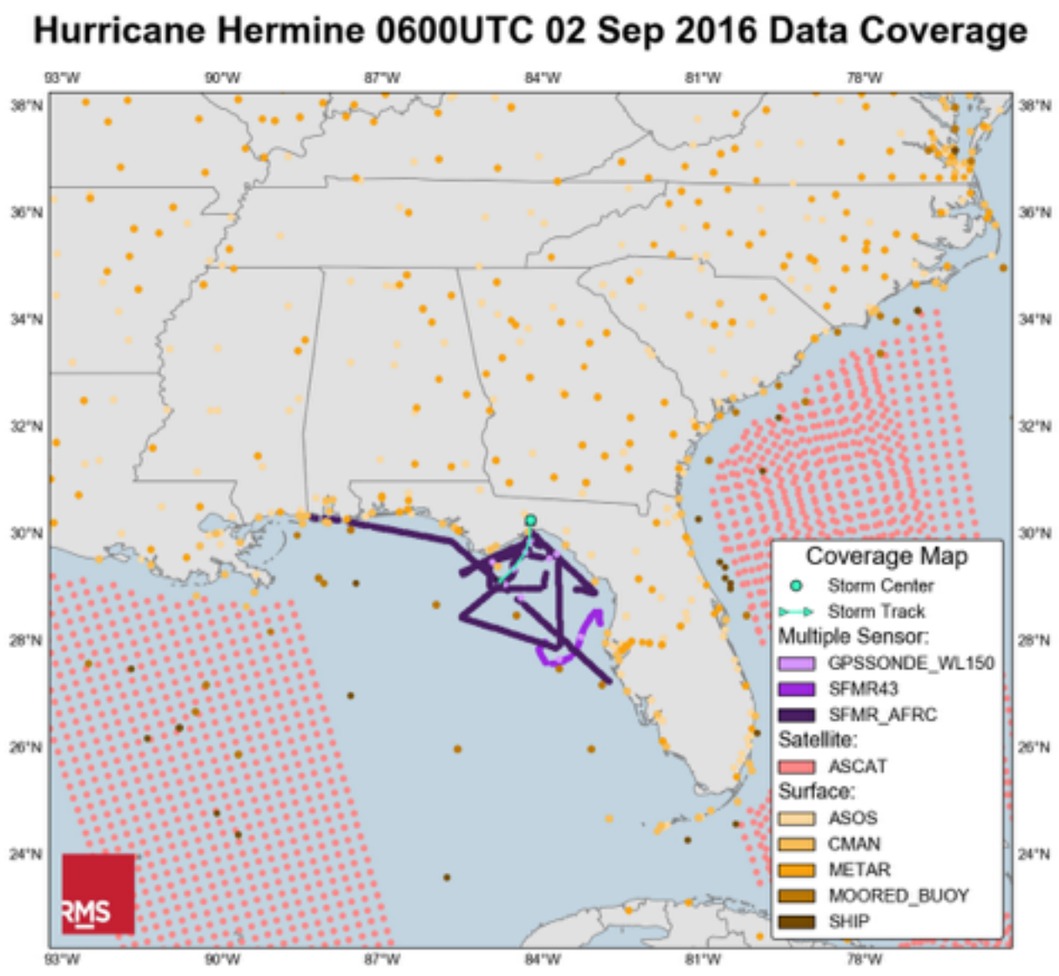
Hurricane Hermine
September 2016

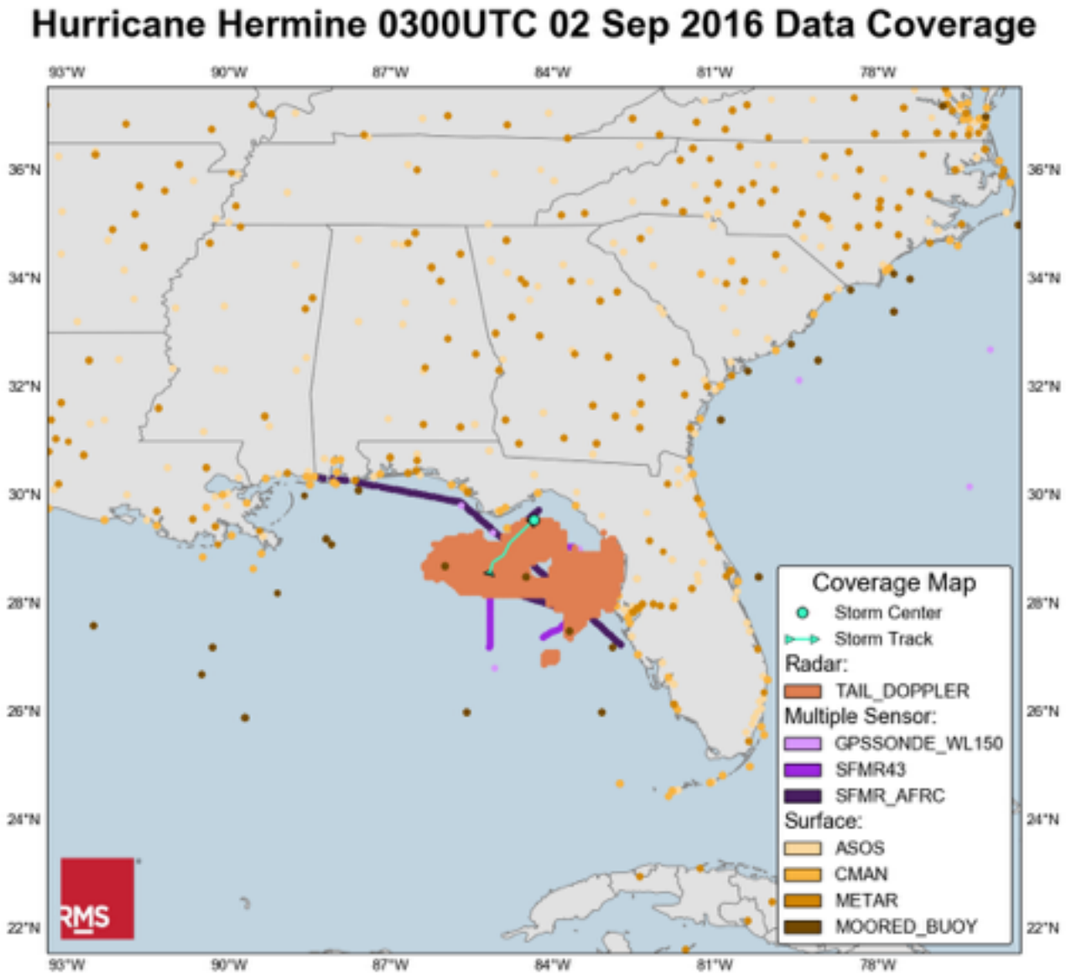
- 3-6 h frequency (when in aircraft recon range)
- 67 snapshots for Hermine
- 83 snapshots for Matthew
- 12 for Nicole
- 8-16 degree domain
- Continuous field
- 1 km grid
- Grid, GIS, image files
- Data coverage



Maximum 1-minute sustained surface windspeeds (kts). Valid for marine exposures over water, and open terrain exposure over land

SAMPLE DATA COVERAGE IMAGES – HURRICANE HERMINE (2016)

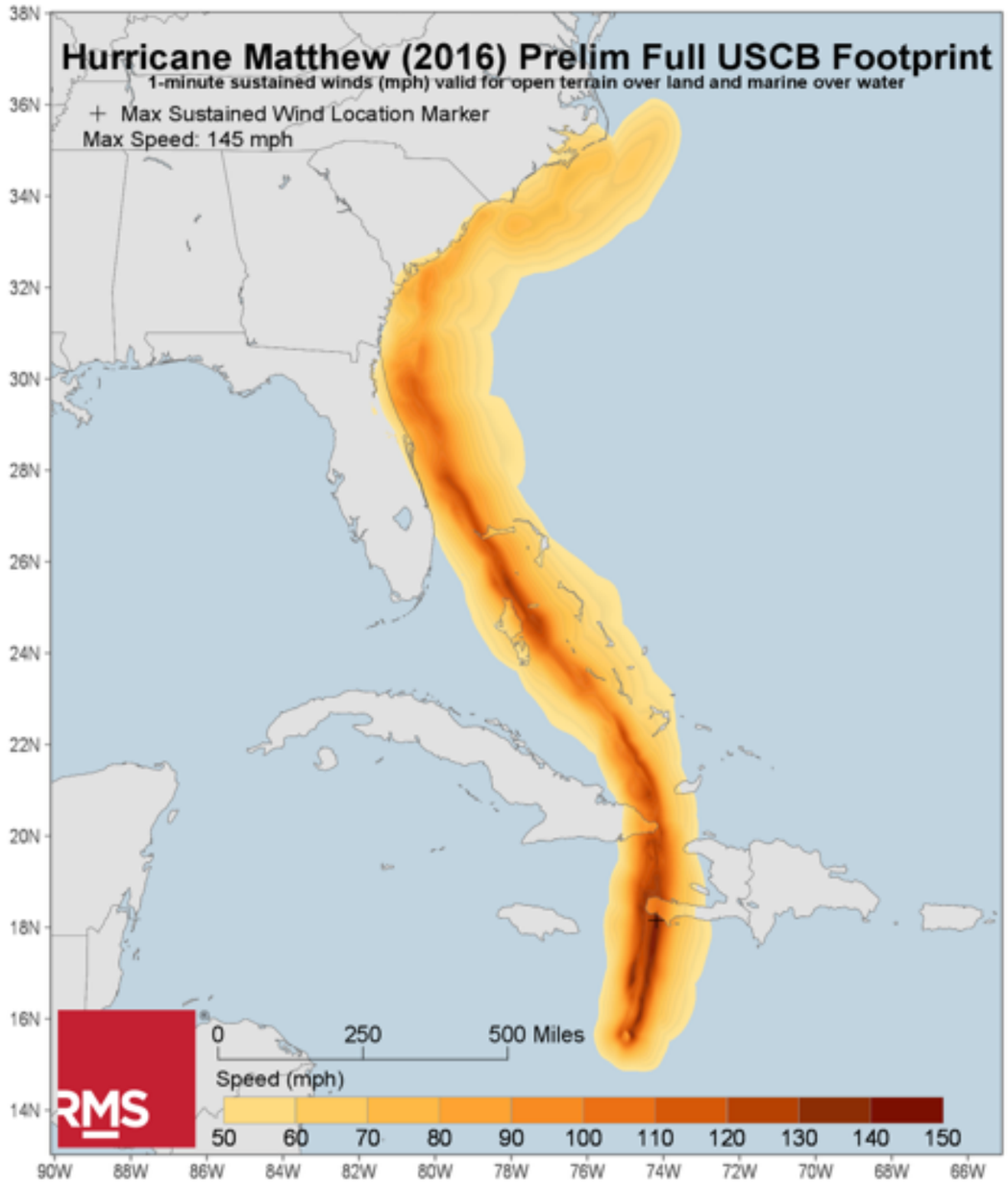




REAL-TIME SOLUTION – FOOTPRINTS

78 snapshots for Matthew

- Detailed storm track
- Snapshots repositioned to revised track
- wind hazard footprint constructed 1-3 days after landfall
- 1 km grid

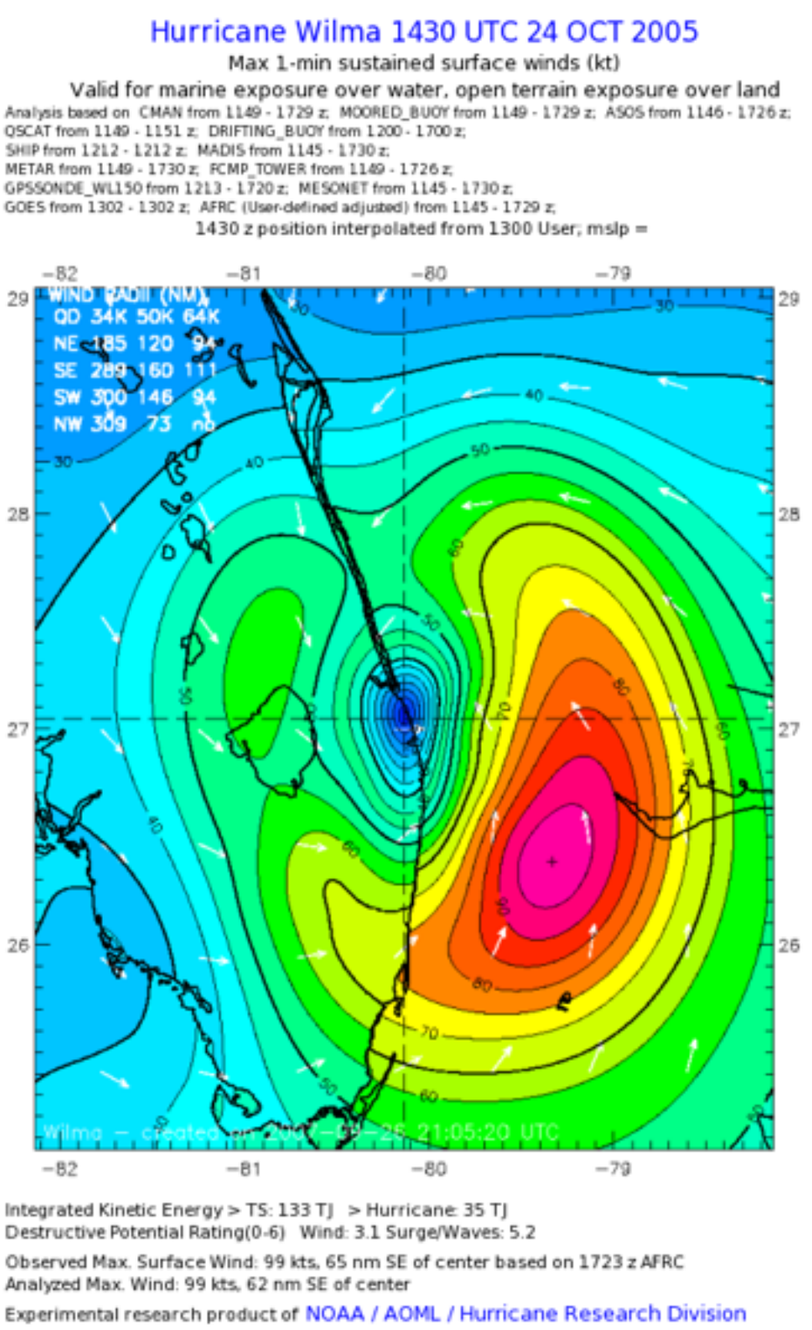


HWIND LEGACY ARCHIVE

http://www.rms.com/perils/hwind/legacy-archive/

LEGACY ARCHIVE

- Created when program was in public domain (NOAA)
- Nearly 250 storms, but stops at the conclusion of the 2013 season
- Inconsistent file formats and subject to different research assumptions/methodologies
- RMS is hosting HWind legacy archive data as a public service to the research and business community
  - http://www.rms.com/perils/hwind/legacy-archive/
  - Available to public
  - “as is” from NOAA-HRD



HWIND ENHANCED ARCHIVE

- Post season all analyses and footprints are redone with centered time windows and updated data sources
- e.g. reprocessed SFMR data from HRD using Klotz and Uhlhorn (2014) based on 4200 sonde / sfmr pairs

Enhanced Archive Data

Academic researchers interested in accessing HWIND enhanced archive data, please send an email to Support@rms.com.

19 STORMS IN VERSION 1 OF HWIND ENHANCED ARCHIVE

Year	Storm Name	Landfall Location(s)
1992	Andrew	Homestead, FL
2004	Charley	Cayo Costa, FL
		North Myrtle Beach, SC
	Frances	Hutchinson Island, FL
		St. Marks, FL
	Ivan	Gulf Shores, AL
	Jeanne	Hutchinson Island, FL
2005	Cindy	Grand Isle, LA and Waveland, Mississippi
	Dennis	Santa Rosa Island, FL
	Katrina	Hallandale Beach, FL
		LA/MS Border
	Rita	Johnson Bayou, LA
	Wilma	Cape Romano, FL
2008	Gustav	Cocodrie, LA
	Ike	Galveston Island, TX
2011	Irene	Cape Lookout, NC
		NJ/NY Border
2012	Isaac	Port Fourchon, LA
	Sandy	Brigantine, NJ
2014	Arthur	Shackleford Banks, NC
	Fay	Bermuda
	Gonzalo	Bermuda
2015	Joaquin	Bahamas

- Snapshots and footprints for 19 hurricanes, 16 of which made landfall in the U.S.
- Additional data from 2014-2016 seasons

Questions?