

The National Hurricane Center GOES-R Proving Ground

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September 20, 2012



Outline

- Overview of NHC Proving Ground
- Lightning and tropical cyclone rapid intensity change (RIC)
- Preliminary Plans for 2013



Goals of NHC PG Experiment

- Demonstrate identified GOES-R surrogate products in real-time at NHC during the 2012 hurricane season
- Ensure that NHC forecasters can use and get familiar with GOES-R surrogate products
- Evaluate products and provide valuable feedback to GOES-R Program Office and developers

Project Schedule

- Jul 31, 2012 – Project Briefing to NHC
- Aug 1, 2012 - NHC PG begins
- Sep 11, 2012 – Mid-project review at NHC
- Oct 31, 2012 - Mid-project report completed
- Nov 30, 2012 – NHC PG ends
- Jan 2013 - Project debriefing
- Feb 28, 2013 - Final report completed
- Mar 2013 - IHC Presentation and planning for 2013 experiment

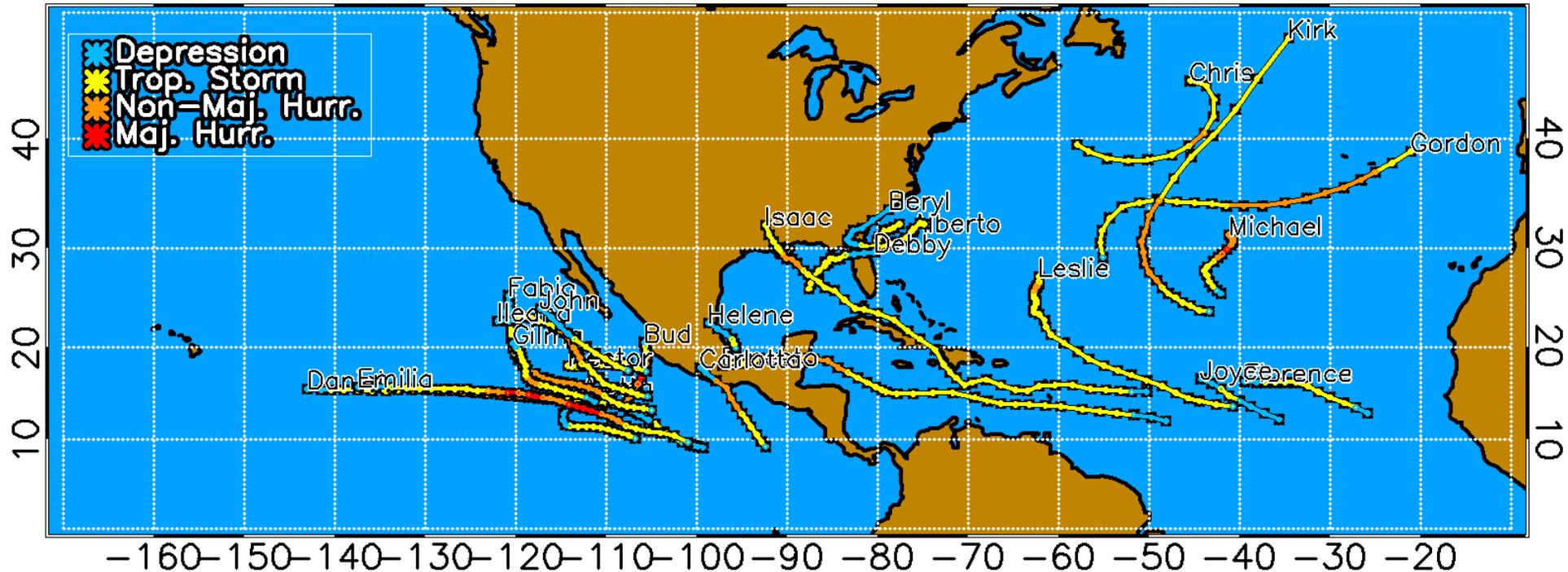


2012 NHC Proving Ground Products

- 1. Hurricane Intensity Estimate (HIE)**
- 2. Super Rapid Scan Imagery**
- 3. Objective Tropical Overshooting Tops (TOT)**
- 4. Saharan Air Layer (SAL) Product**
- 5. Pseudo Natural Color Imagery**
- 6. GOES-R Natural Color Imagery**
- 7. Red-Green-Blue (RGB) Air Mass Product**
- 8. RGB Dust Product**
- 9. Rapid Intensification Index (RII)**

The 2012 Hurricane Season as of Sept 7th

-160 -150 -140 -130 -120 -110 -100 -90 -80 -70 -60 -50 -40 -30 -20



Atlantic 13 TS, 7 hurricanes, 1 major hurricane

E. Pacific 10 TS, 7 hurricanes, 3 major hurricanes

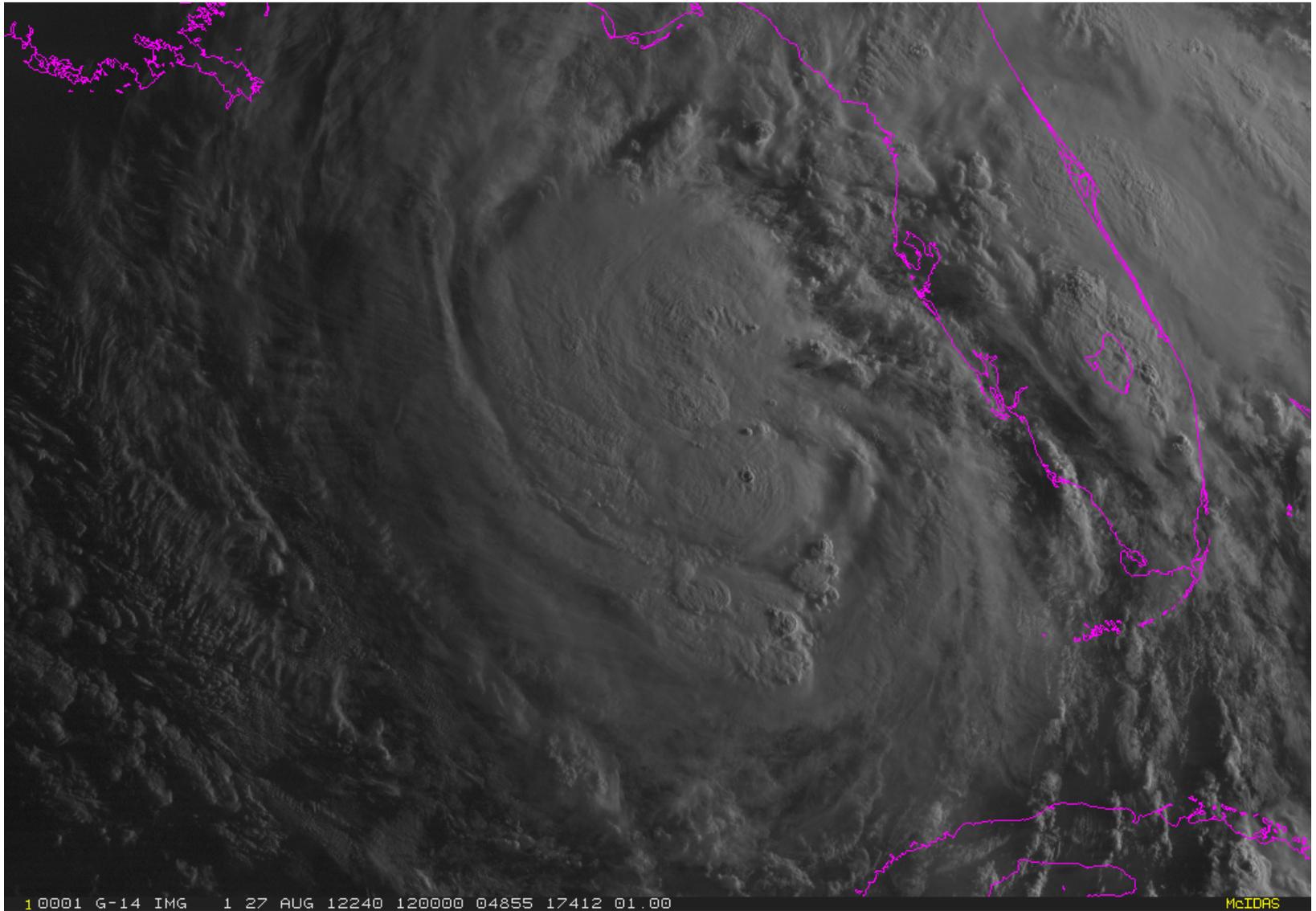
2012 Season similar to 2011 so far

- Fewer but more intense East Pacific storms
- Most Atlantic hurricane activity north of 25 N

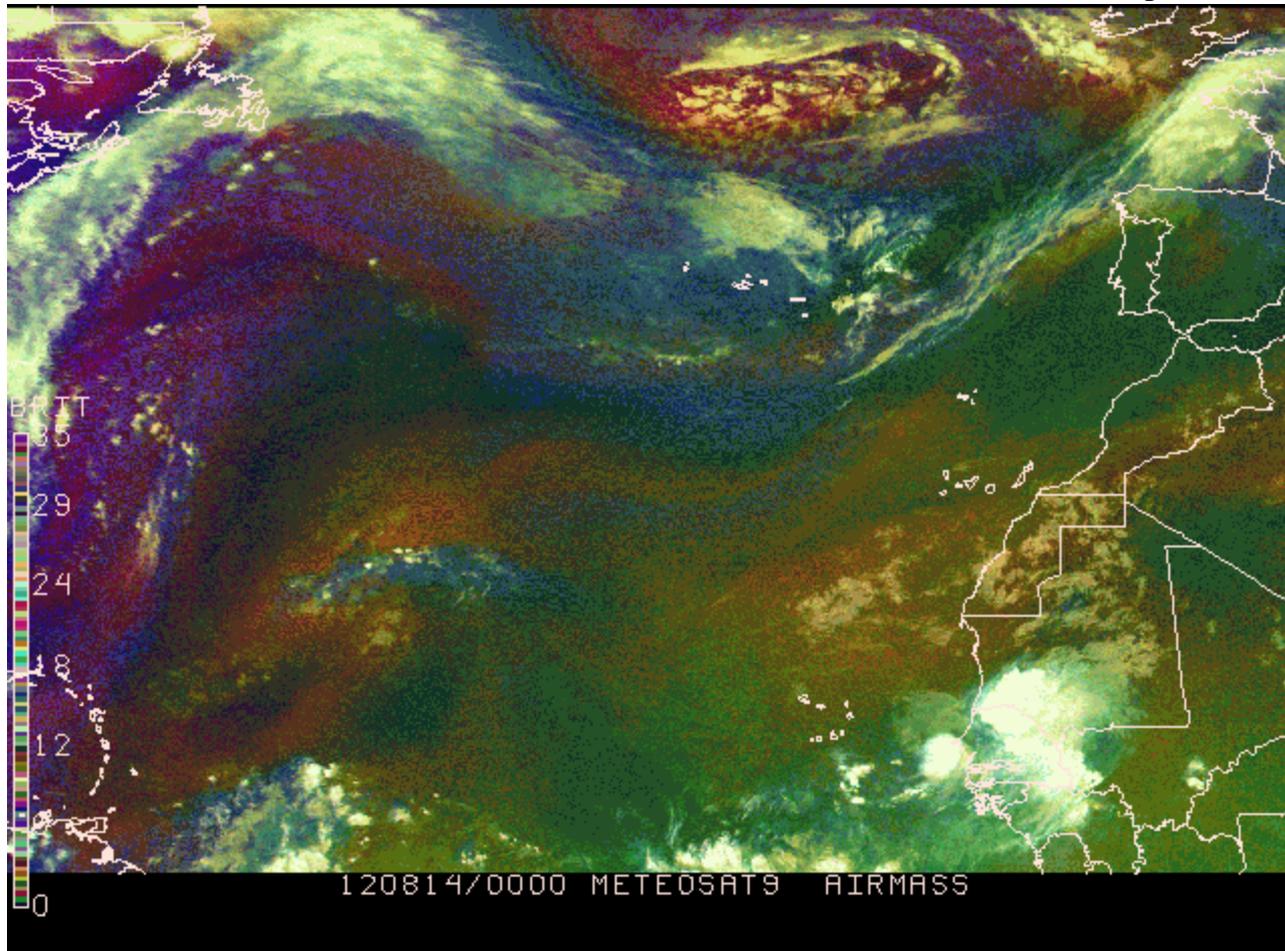
First Half Highlights

- Many SRSO cases obtained from GOES-14
 - ASPB and CIMSS lead
- Most RGB and related products in N-AWIPS
 - Air Mass (SEVIRI and GOES sounder), Dust, Pseudo-Natural Color, SAL
- More involvement from TAFB
 - Thanks to Michael Folmer
- New forecaster feedback form working well
- Most feedback on RGB Air Mass Product
- NHC leveraging data distribution from SPoRT to get routine microwave imagery
 - *Maybe most useful NHC PG contribution so far*

GOES-14 SRSO for Isaac 8/27



Hurricane Gordon Life Cycle





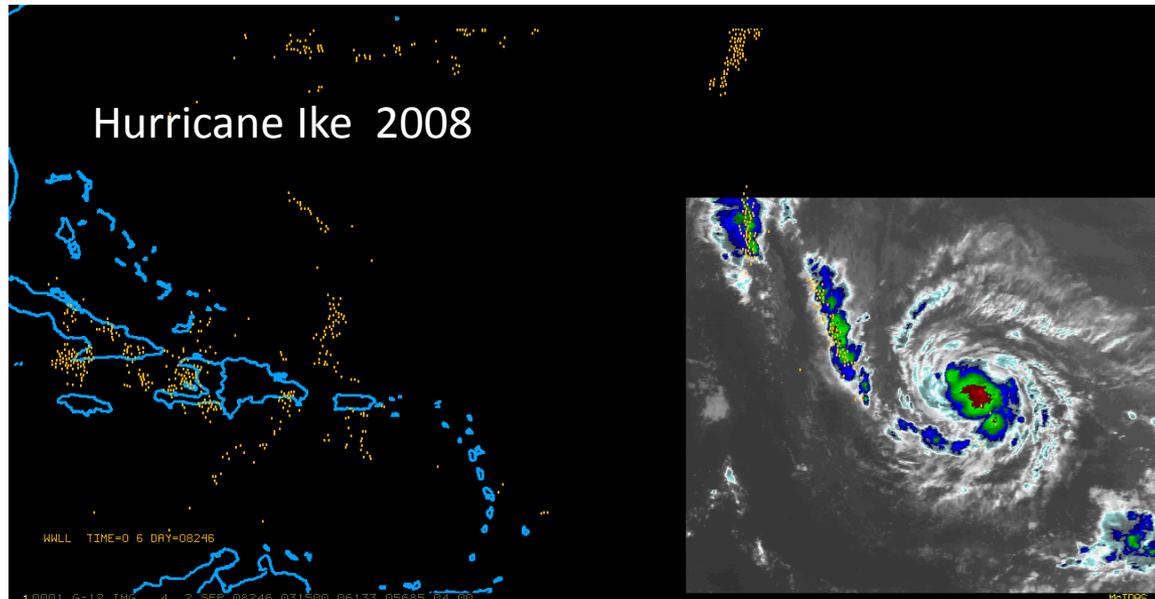
NHC Forecaster Lixion Avila
Demonstrating Microwave
Imagery in N-AWIPS

Forecasting Rapid Intensity Changes with Lightning Data

- Use large sample of cases to develop statistical relationships with intensity change
- Combine with SHIPS model database
 - SST, shear, etc
- Full life cycle of Atlantic and east/central Pacific tropical cyclones 2005-2011
- WWLLN data proxy for GLM
- Annual basin wide correction for detection efficiency, conversion to total lightning
 - Normalize to OTD/LIS climatology

Lightning Analysis

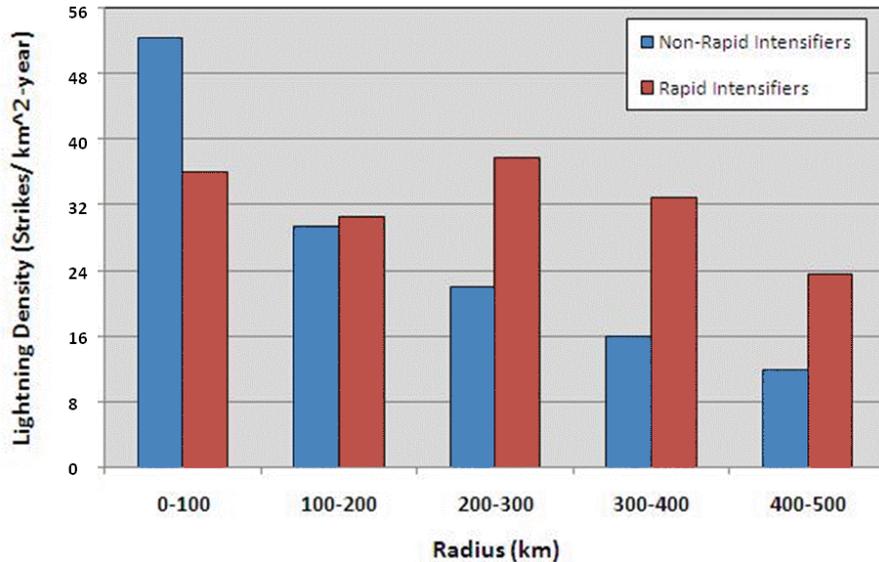
- Transform strike locations to storm-centered cylindrical grid
- Composite data over 6 hour intervals
- Compute lightning density in radial intervals
 - 0-50, 50-100, 100-200 km, ...
- Adjust density using annual conversion factors



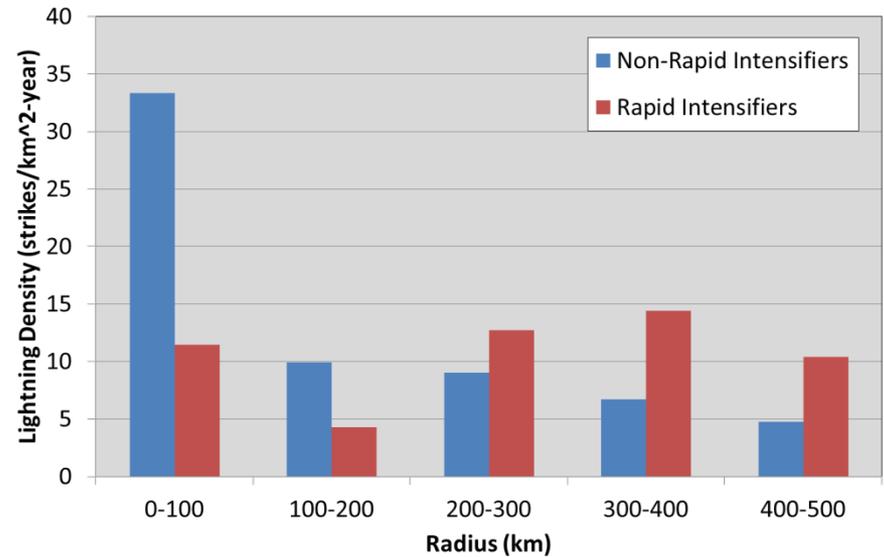
Rapid Intensity Change

- Rapid Intensification (RI)
 - Increase in maximum wind of 30 kt or more in 24 hr
 - ~95th percentile of Atlantic sample
- Rapid Weakening (RW)
 - Decrease of maximum wind of 20 kt or more in 24hr
 - ~5th percentile of Atlantic sample (over water)
- Stratify lightning density by intensity change, RW and RI

Lightning Density vs. Radius for RI and non-RI Cases



Atlantic



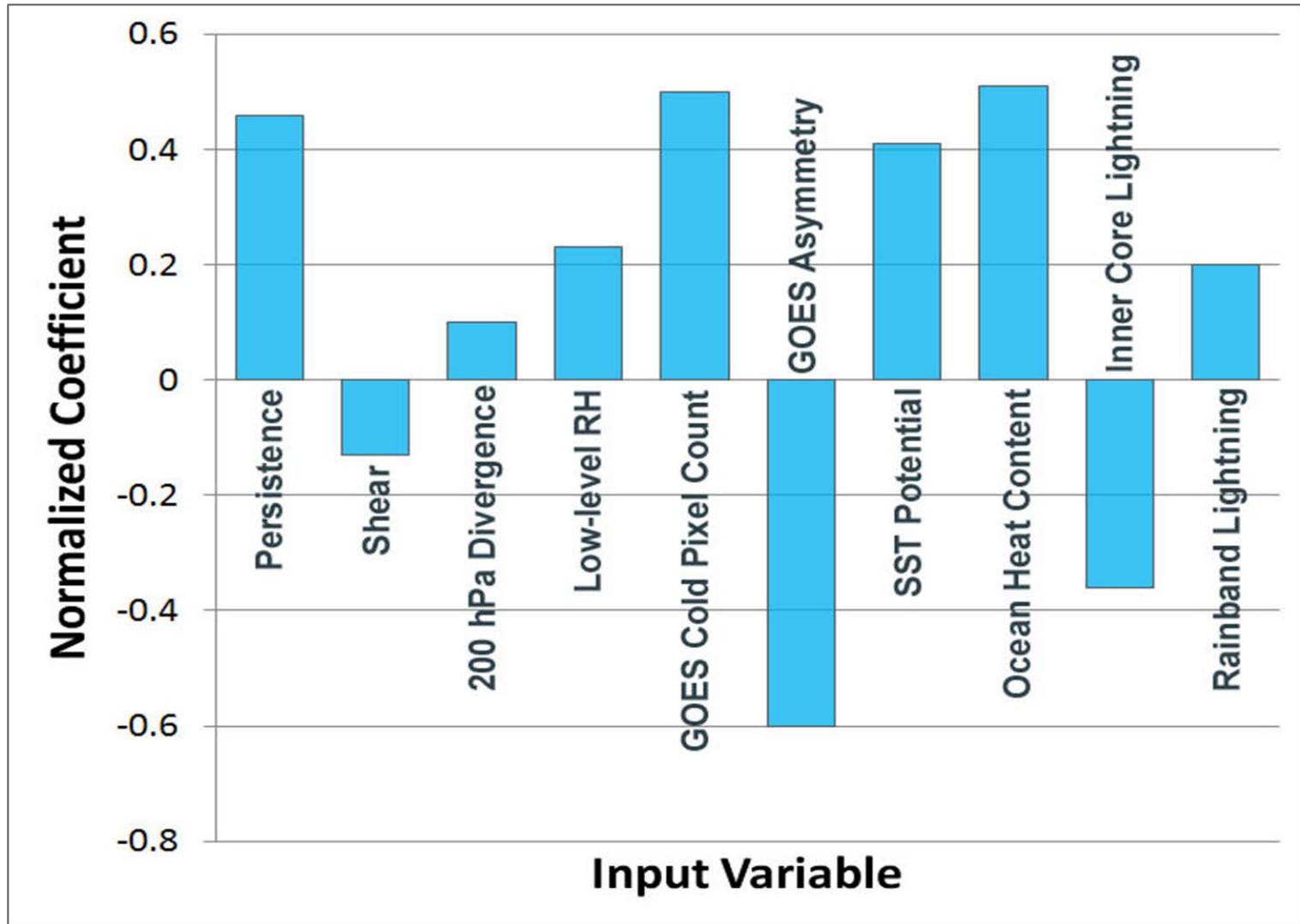
East Pacific

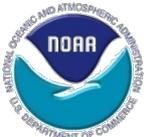
Lightning density also function of vertical shear, SST, initial intensity, etc.

Experimental Algorithm in 2012 NHC Proving Ground

- Three class Linear Discriminant Analysis
 - Rapid weakening, average intensification, rapid intensification
- WWLLN predictors added to other discriminators
 - Inner core and rainband lightning density
- Run in real time, product available via web page
 - Probability of RI and RW
 - Lightning density time series

Normalized Discriminant Weights (Atlantic RII Algorithm)





* EAST PACIFIC RII PARALLEL RUNS FOR JHT/PG *
 * GOES AVAILABLE OHC AVAILABLE *
 * EP05 EP052012 07/13/12 12 UTC *

CURRENT MAX WIND (KT): 55. LAT, LON: 15.5 -125.4

+++++++ SECTION 1. 2012 OPERATIONAL RII WITH ++++++
 TPW, IRPC, CFLUX ENHANCEMENTS

** 2012 E. PACIFIC RI INDEX EP052012 EP05 07/13/12 12 UTC **
 (30 KT OR MORE MAX WIND INCREASE IN NEXT 24 HR)

12 HR PERSISTENCE (KT): -20.0 Range: -22.0 to 38.5 Scaled/Wgtd Val: 0.0/ 0.1
 POT = MPI-VMAX (KT) : 55.2 Range: 40.3 to 144.5 Scaled/Wgtd Val: 0.1/ 0.2
 850-200 MB SHEAR (KT) : 2.7 Range: 18.7 to 1.4 Scaled/Wgtd Val: 0.9/ 1.5
 HEAT CONTENT (KJ/cm2) : 0.0 Range: 0.0 to 73.7 Scaled/Wgtd Val: 0.0/ 0.0
 STD DEV OF IR BR TEMP : 11.1 Range: 38.9 to 2.4 Scaled/Wgtd Val: 0.8/ 1.1
 MAXIMUM WIND (KT) : 55.0 Range: 22.5 to 132.0 Scaled/Wgtd Val: 0.9/ 1.2
 D200 (10**7s-1) : -13.4 Range: -11.0 to 135.3 Scaled/Wgtd Val: 0.0/ 0.0
 BL DRY-AIR FLUX (w/m2): 423.8 Range: 638.0 to -19.8 Scaled/Wgtd Val: 0.3/ 0.0
 % AREA WITH TPW <45 mm: 0.0 Range: 82.1 to 0.0 Scaled/Wgtd Val: 1.0/ -0.4
 2nd PC OF IR BR TEMP : -0.7 Range: 2.1 to -1.7 Scaled/Wgtd Val: 0.7/ -0.1

Prob of RI for 25 kt RI threshold= 4% is 0.3 times the sample mean(12.5%)
 Prob of RI for 30 kt RI threshold= 2% is 0.3 times the sample mean(8.3%)
 Prob of RI for 35 kt RI threshold= 2% is 0.3 times the sample mean(5.7%)
 Prob of RI for 40 kt RI threshold= 1% is 0.3 times the sample mean(4.0%)

+++++++ SECTION 2. RII WITH LIGHTNING DATA ++++++
 FOR GOES-R PROVING GROUND

Prob of RW, Avg IC, RI= 61% 39% 0% no lightning, experimental algorithm
 Prob of RW, Avg IC, RI= 64% 36% 0% with lightning, experimental algorithm

Rapid Weakening (RW) = -20 kt or less max wind change in 24 hr
 Rapid Intensification (RI) = +30 kt or more max wind change in 24 hr

Recent Lightning Density History (Strikes/km2-year)

Date/Time	vmax(kt)	Inner core (0-100 km)	Rainband (200-300 km)
12 0713 12	55	0.0	0.0
12 0713 06	60	0.0	0.0
12 0713 00	80	0.0	0.0
12 0712 18	90	0.0	0.0
12 0712 12	100	0.0	0.0
12 0712 06	95	0.0	0.0
12 0712 00	100	0.0	0.0
12 0711 18	100	1.0	0.0
12 0711 12	90	0.0	0.0
12 0711 06	90	0.0	0.0
12 0711 00	95	0.0	0.0
12 0710 18	110	0.0	3.0
12 0710 12	115	3.0	2.0
12 0710 06	115	26.0	0.0
12 0710 00	105	2.0	7.0
12 0709 18	95	16.0	8.0
12 0709 12	85	23.0	1.0
12 0709 06	65	8.0	2.0
12 0709 00	60	0.0	45.0
12 0708 18	55	0.0	41.0
12 0708 12	45	0.0	39.0
12 0708 06	40	0.0	8.0
12 0708 00	35	0.0	12.0
12 0707 18	30	0.0	61.0

Sample mean: 33.0 9.0

Note: Inner core lightning < sample mean favors RI
 Rainband lightning > sample mean favors RI
 Converse for RW

+++++++ SECTION 3. RII WITH MULTIPLE TIMES ++++++
 AND CONSENSUS FOR JHT

** 2012 E. Pacific EXPERIMENTAL RI INDEX EP052012 EP05 07/13/12 12 UTC **

Prob RI for 20kt/ 12hr RI threshold= 2% is 0.3 times sample mean (6.2%)
 Prob RI for 25kt/ 24hr RI threshold= 4% is 0.3 times sample mean (12.5%)
 Prob RI for 30kt/ 24hr RI threshold= 2% is 0.3 times sample mean (8.3%)
 Prob RI for 35kt/ 24hr RI threshold= 2% is 0.3 times sample mean (5.7%)
 Prob RI for 40kt/ 24hr RI threshold= 1% is 0.3 times sample mean (4.0%)
 Prob RI for 45kt/ 36hr RI threshold= 2% is 0.3 times sample mean (5.9%)
 Prob RI for 55kt/ 48hr RI threshold= 2% is 0.3 times sample mean (5.5%)

Matrix of RI probabilities

RI (kt / h)	20/12	25/24	30/24	35/24	40/24	45/36	55/48
SHIPS-RII:	1.8%	4.0%	2.5%	1.6%	1.1%	1.6%	1.5%
Logistic:	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Bayesian:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Consensus:	0.6%	1.4%	0.8%	0.5%	0.4%	0.6%	0.5%

Sample Text Output from 2012 RII products

Hurricane Emilia
13 July 2012 12 UTC

1. Operational RII, but with TPW, IRPC and J. Cione dry air flux predictors
2. Proving Ground Lightning based RII
3. JHT extended range and consensus RII

RII Verification Metrics

- Bias = $(\sum P_f / N_{obs}) - 1$
- Brier Score = $(1/N_f) \sum [P_f - P_{obs}]^2$
- Threat Score = $a / (a+b+c)$ from 2 by 2 contingency table
 - Area of overlap between forecast and observations
 - Find max TS for range of probability thresholds
- Verification to be performed at the end of the 2012 season
 - Compare to no-lightning version

Preliminary Plans for 2013

- Add new RGB products for storm inner core
 - Most RGB products for storm environment
- Work towards direct generation of RGB products on NHC AWIPS-2 systems
- Add lightning RII to Pacific proving ground for JTWC
- Add NPP Products
 - High resolution Vis, IR, Day-Night Band
 - Direct readout from CIMSS for CONUS
 - Larger domain from NESDIS + other sources
- ATMS/CrIS
 - Temperature/moisture soundings
 - Intensity/size retrievals
 - Maximum potential intensity estimates

Day-Night Band for Isaac

