

The National Hurricane Center GOES-R Proving Ground

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Outline

- Overview of the NHC Proving Ground
- Preliminary results from 2013
- Changes to the lightning-based rapid intensification index for 2013

Goals of NHC PG Experiment

- Demonstrate identified GOES-R surrogate products in real-time at NHC during the 2013 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
- Begin evaluation of NPP products

Project Schedule

- Apr 24-25, 2013 – New product presentations to NHC
- Aug 1, 2013 – NHC PG begins
- Sep 17, 2013 – Mid-project review at NHC

- *Oct 31, 2013 – Mid-project report completed*
- *Nov 30, 2013 – NHC PG ends*
- *Jan 2014 – Project debriefing*
- *Feb 28, 2014 – Final report completed*
- *Mar 2014 – IHC Presentation and 2014 planning*

2013 NHC Proving Ground Products (Continued from 2012)

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) with Lightning Data

Local Data Manager (LDM) Feed from SPoRT

- Most PG products obtained via SPoRT
- wget script at NHC could not be modified due to lack of technical support staff experience
- M. DeMaria was acting TSB chief Aug 14-Sep 25
- Permission obtained from NCEP/NCO to open LDM feed to SPoRT
- NHC/SPoRT coordination allowed replacement of wget script
- New products for NHC now available
- Bandwidth analysis showed 30% reduction due to LDM efficiency

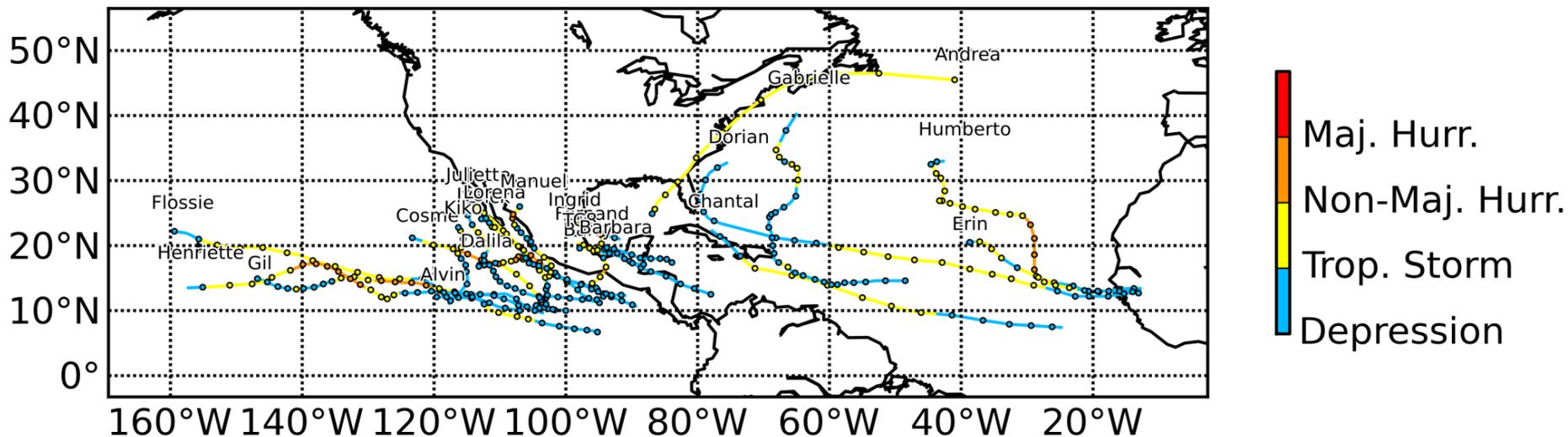
2013 NHC Proving Ground Products (New for 2012)

10. EUMETSAT RGB Day Time Microphysics
11. EUMETSAT RGB Convective Storms
12. NPP Day-Night Band

GLD360 Lightning Density Product also being added

- **Now part of N-AWIPS Baseline**

The 2013 Hurricane Season as of Sept 23rd



Atlantic: 9 TS, 2 hurricanes, 0 major hurricanes

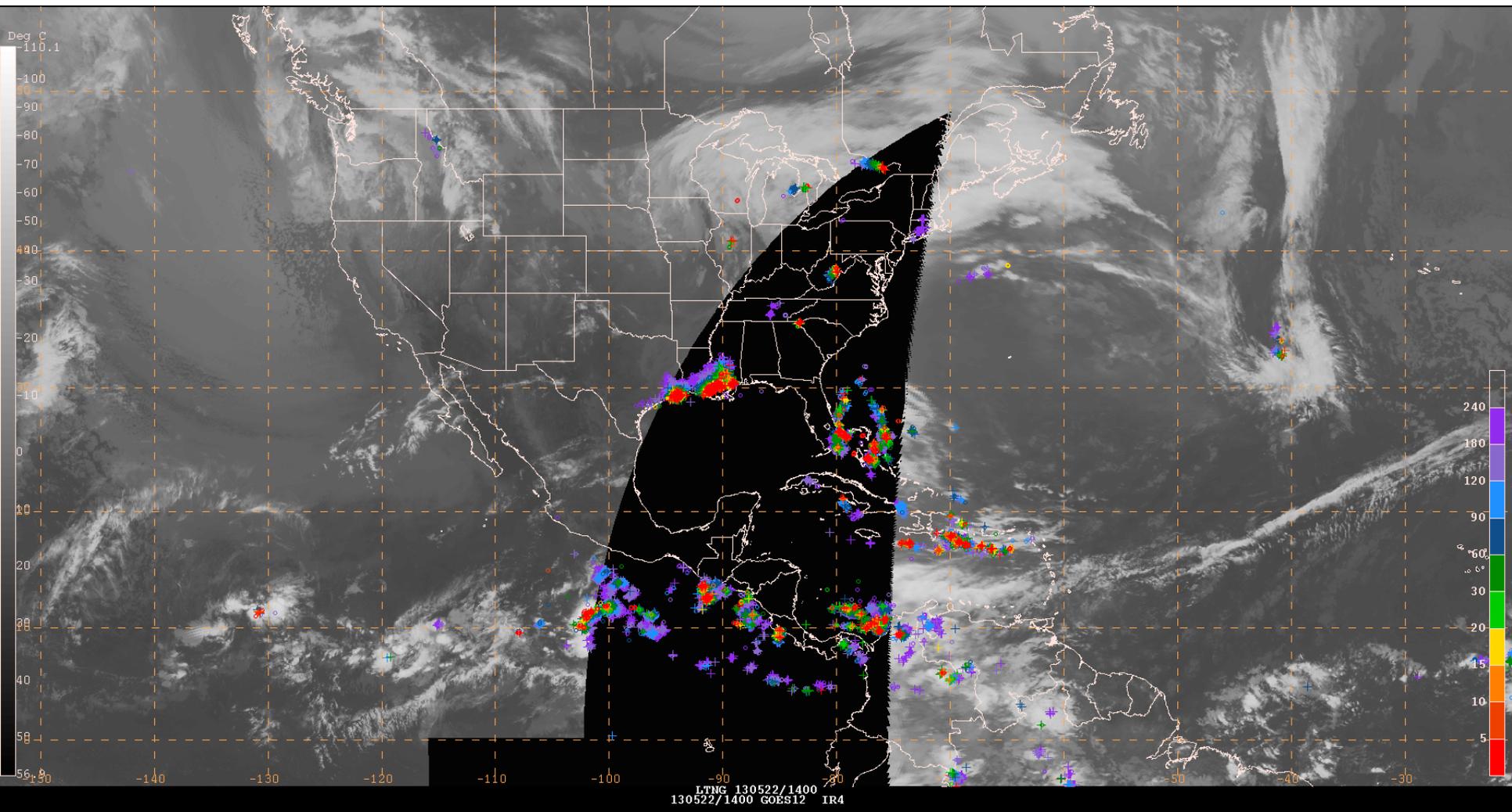
East Pacific: 13 TS, 7 hurricanes, 0 major hurricanes

Combined Atlantic and East Pacific: Only one cat 2 hurricane
5 RI cases (43 in typical year)

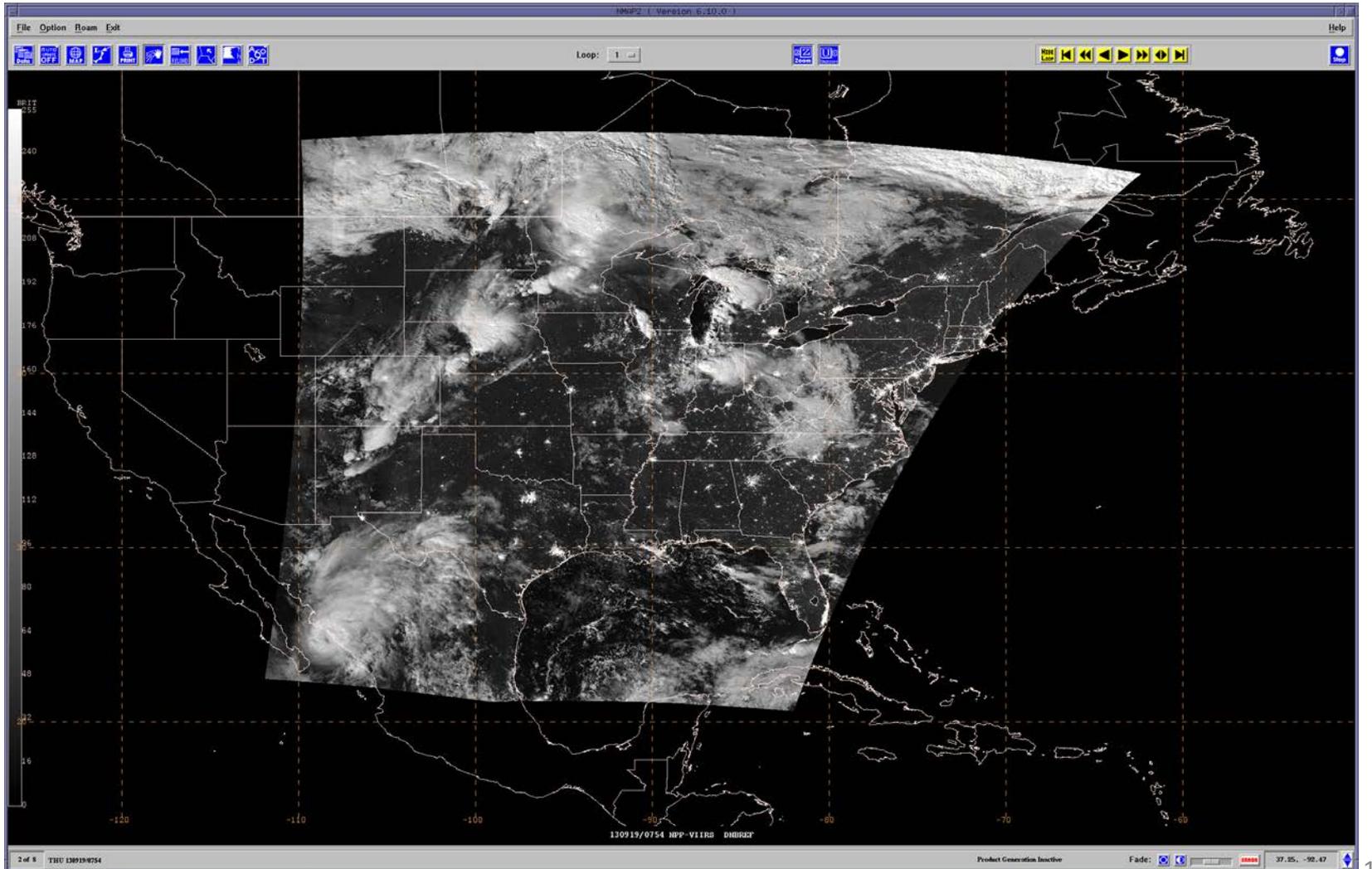
First Half Summary

- Very quiet season in both basins
- No SRSO cases from GOES-14
- 05/22 12Z GLD360 lightning data used for continuity during GOES-east outage
- 06/13 18Z: Dust product used in easterly wave analysis
- 07/13 12Z: Lightning flare up during Chantal lowers probability of intensification
- 08/16 18Z: Air Mass product suggests dry air will slow the development of TS Erin
- 08/29 00Z: TOT product highlights convective bursting in TS Juliette
- 09/05 06Z: Lightning burst near center of TS Gabrielle lowers probability of intensification
- 09/13 10Z: Higher refresh of HIE provides better scene type estimate for Hurricane Humberto
- 09/19 12Z: Suggestion to smooth lightning density product
- 09/21 18Z: First Day/Night band image available in N-AWIPS

Lightning Data Fills the Missing GOES Data Gap



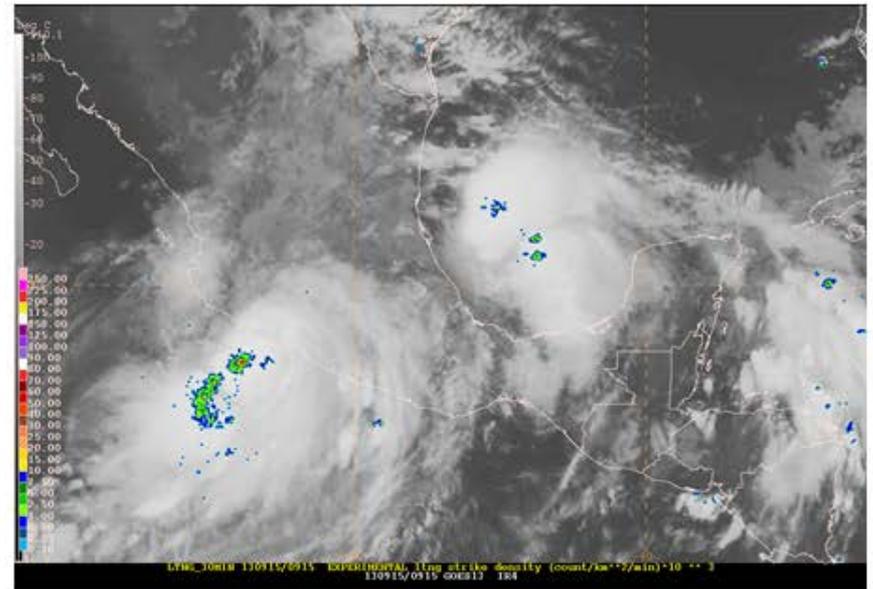
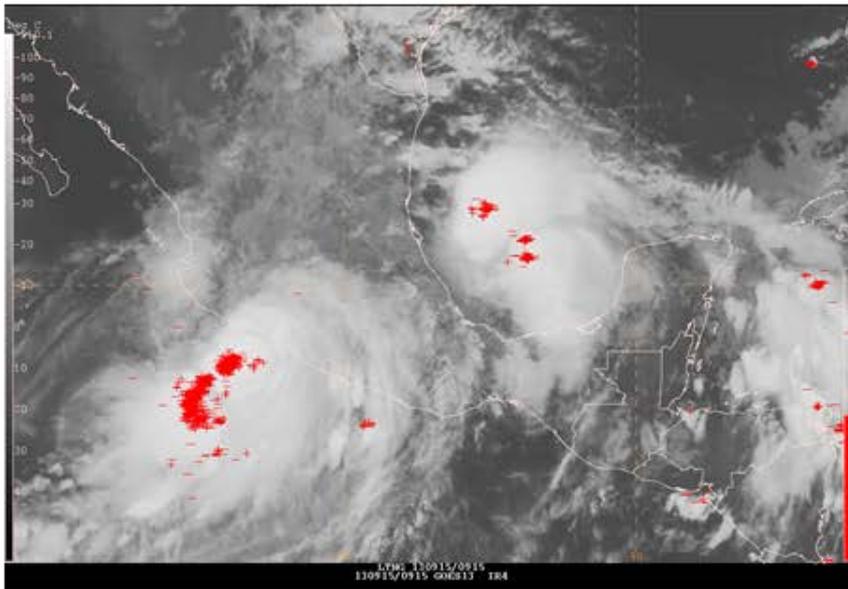
VIIRS Day-Night Band for Hurricane Manuel (East Pacific) in N-AWIPS



Hurricanes Ingrid and Manuel 2013

Vaisala GLD-360

GLD-360 Lightning Density



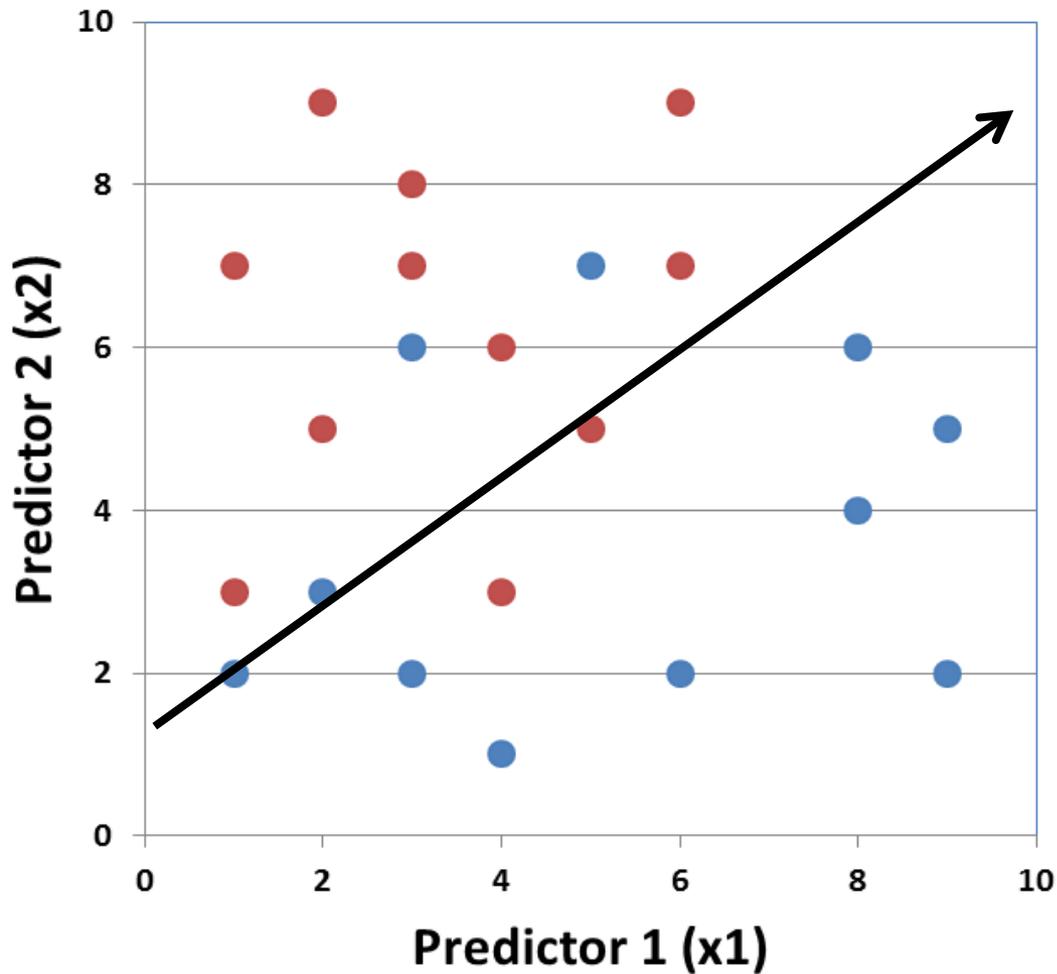
The Rapid Intensification Index

- Define RI as 30 kt or greater intensity increase in 24 hr
- Find predictors that separate RI and non-RI cases
- Linear Discriminant Analysis technique
- Use training sample to convert discriminant function value to a probability of RI

Linear Discriminant Analysis

- 2 class example
 - Objectively determine which of two classes a data sample belongs to
 - Rapid intensifier or non-rapid intensifier
 - Predictors for each data sample provide input to the classification
- Discriminant function (DF) linearly weights the inputs
$$DF = a_0 + a_1x_1 + a_2x_2$$
- Weights chosen to maximize separation of the classes

Graphical Interpretation of the Discriminant Function



DF chosen to best separate red and blue points

- Class 1
- Class 2

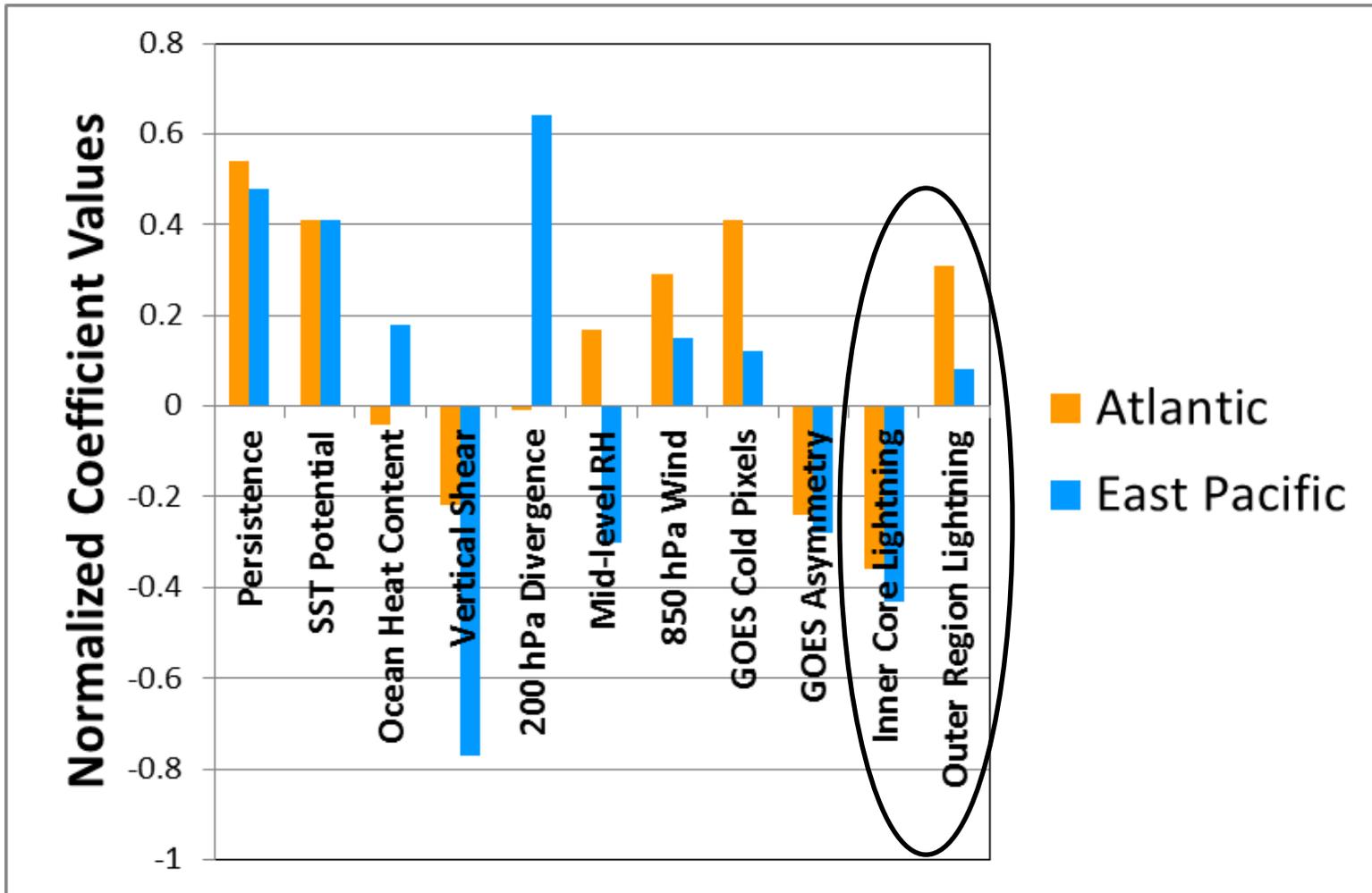
2013 RII Modifications

- Previous PG versions included 3 classes
 - Rapid weakening, typical IC, Rapid Intensification
- Two class version used in 2013
 - Much higher max probabilities
 - 95% compared with 60%
- Inner and outer lightning regions modified
 - Old: Inner=0-100 km, Outer=200-300 km
 - New: Inner=0-200 km, Outer=200-400 km
- Inner → weakening, Outer → intensification
- New predictor (GFS Vortex)
- New probability table

RII Predictors

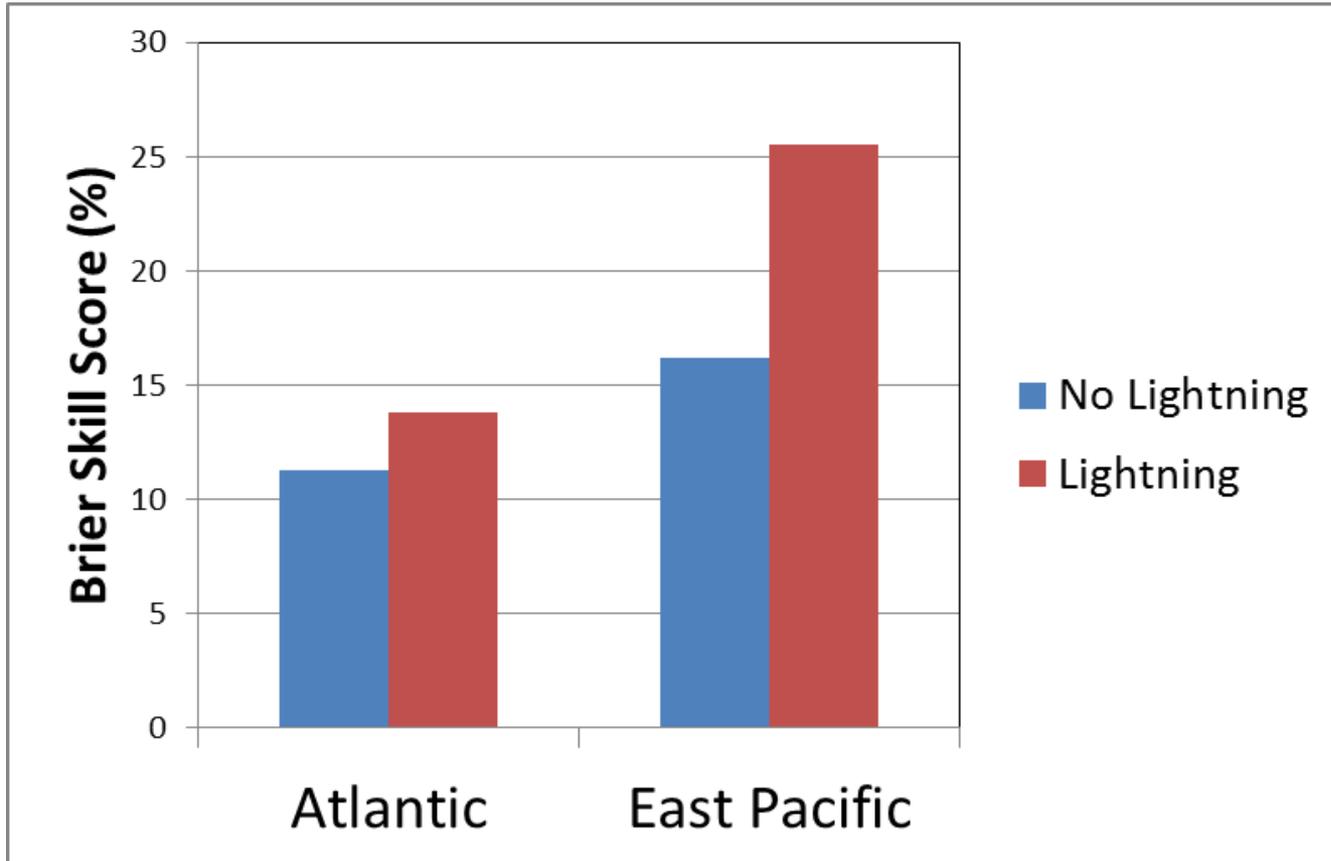
1. Previous 12 h max wind change (persistence)
2. Maximum Potential Intensity – Current intensity
3. Oceanic Heat Content
4. 200-850 hPa shear magnitude (0-500 km)
5. 200 hPa divergence (0-1000 km)
6. 850-700 hPa relative humidity (200-800 km)
7. 850 hPa tangential wind (0-500 km)
8. IR pixels colder than -30°C
9. Azimuthal standard deviation of IR brightness temperature
10. Inner region lightning density (0-200 km)
11. Outer region lightning density (200-400 km)

RII Predictor Weights

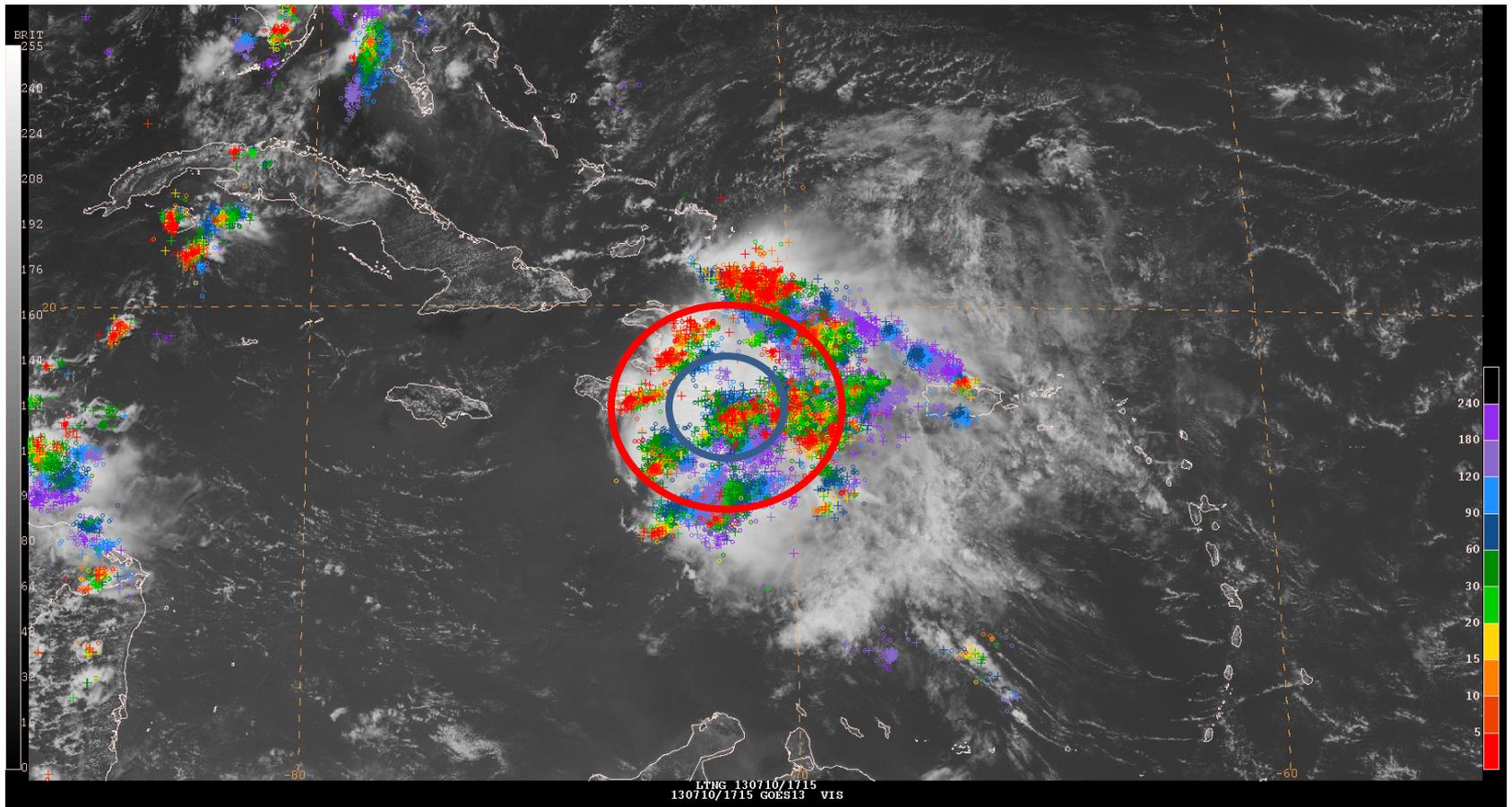


Brier Skill Score

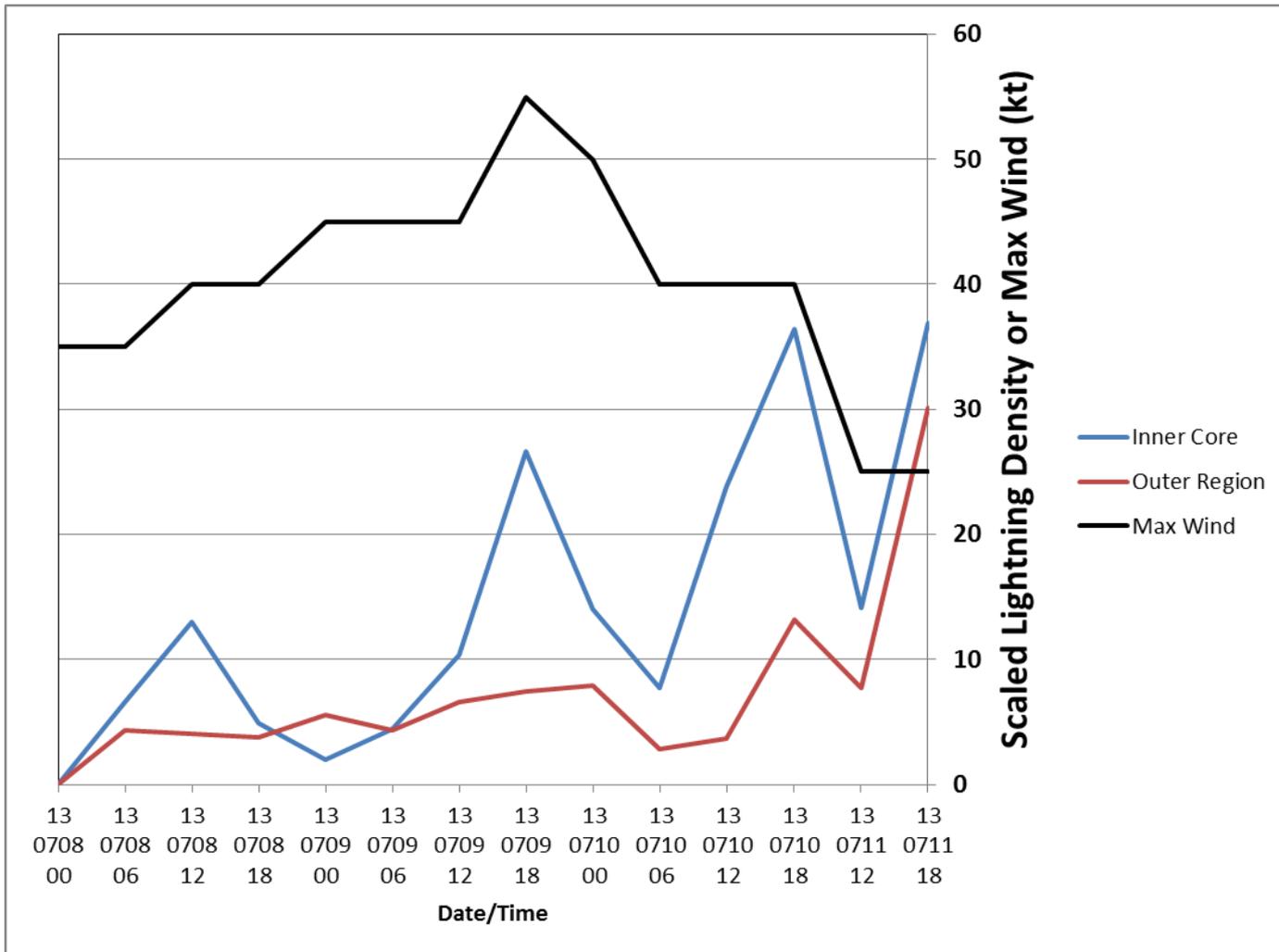
2005-2012 Dependent Sample



GLD360 Lightning Locations for Tropical Storm Chantal



Lightning Density Evolution for TS Chantal



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

AL03 Initial vmax, lat, lon: 55, 14.8 -62.7

Probability Rapid Intensification= 7% no lightning, experimental algorithm
Probability Rapid Intensification= 3% with lightning, experimental algorithm

Rapid Intensification (RI) = +30 kt or more max wind change in 24 hr

Predictor Name	Normalized Value	Prob Contribution
Climatology	0.0	5.5
SST Potential	0.0	0.9
850-200 hPa Shear	0.8	-0.7
200 hPa Divergence	0.3	0.0
Persistence	0.9	2.2
GOES IR Cold Pixels	0.7	1.2
GOES IR asymmetry	1.0	-1.1
Ocean Heat Content	-0.7	0.1
850-700 hPa RH	-0.9	-0.7
GFS Vortex Tendency	-0.8	-1.1
Near Core Lightning	2.2	-3.6
Outer Lightning	0.3	0.4

Recent Lightning Density History (Strikes/km²-year)

Date/Time	vmax(kt)	Near Core (0-200 km)	Outer Region (200-400 km)
13 0709 18	55	259.0	19.0
13 0709 12	45	27.0	10.8
13 0709 06	45	5.0	4.8
13 0709 00	45	1.0	7.7
13 0708 18	40	6.0	3.6
13 0708 12	40	42.0	4.1
13 0708 06	35	11.0	4.8
13 0708 00	35	0.0	0.0
Weighted sample mean:		15.1	8.3

Note: Near core lightning < sample mean favors RI
Outer lightning > sample mean favors RI

**Lightning RII Text
Product
Chantal
09 Jul 2013 18 UTC**

Summary

- 2013 NHC Satellite Proving Ground underway
 - Very inactive season in both basins
 - Main accomplishment so far is new LDM feed
- Rapid Intensification Index reformulated
 - Larger averaging areas
 - Increases sensitivity to lightning input
- Dependent results show significant improvement in skill with lightning data
- 2013 RII cases will be verified after the season