

2016 Hurricane Season Preview

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Agenda

- Recap of last season
- Current climate conditions
- Organization forecasts
- ALERTTM

Recap of 2015 Hurricane Season

- El Niño played a significant role in activity
- Atlantic activity was slightly below normal
 - 11 named storms, 4 hurricanes, 2 major hurricanes
 - Average (1981-2010): 12/6/3
 - Overall, predictions of suppressed activity verified
 - Hurricane Joaquin was responsible for the sinking of the cargo ship *El Faro*, resulting in 33 deaths



Hurricane Joaquin

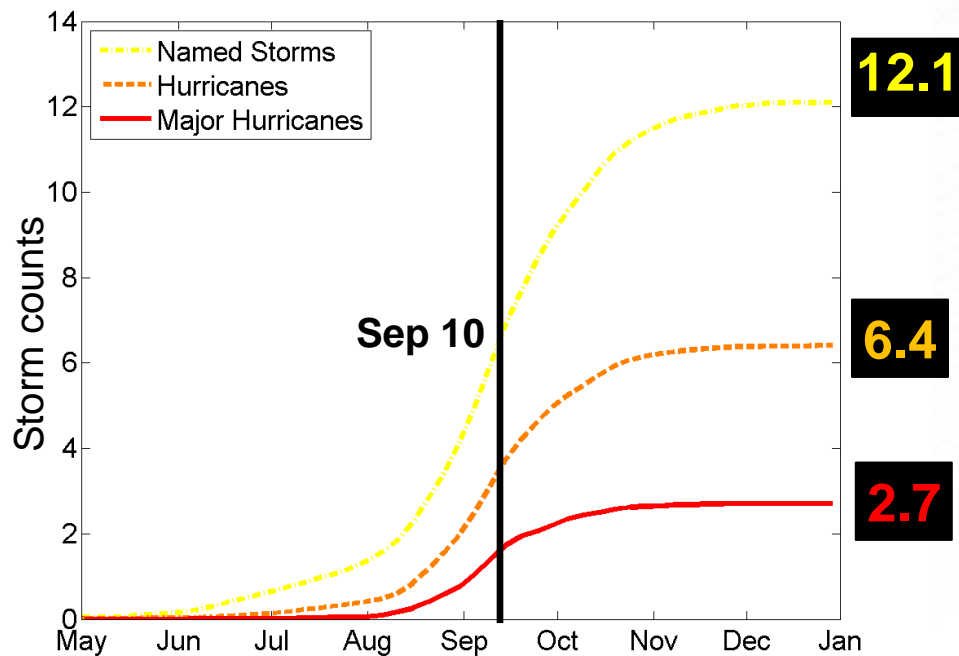
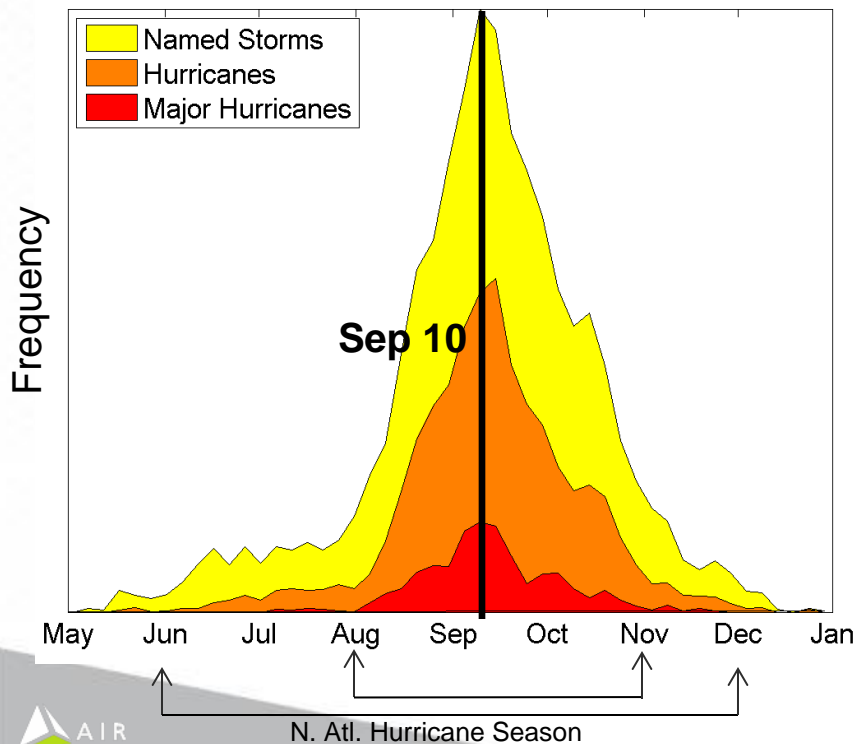


Hurricane Patricia

- Eastern and Central Pacific activity was far greater than normal
 - 26 named storms, 16 hurricanes, 11 major hurricanes
 - Average (1981-2010): 15/8/3
 - Activity far exceeded predictions
 - Hurricane Patricia became the western hemisphere's most intense cyclone on record (872 mb)

Typical Atlantic Hurricane Season Activity

Average Counts From 1981-2010



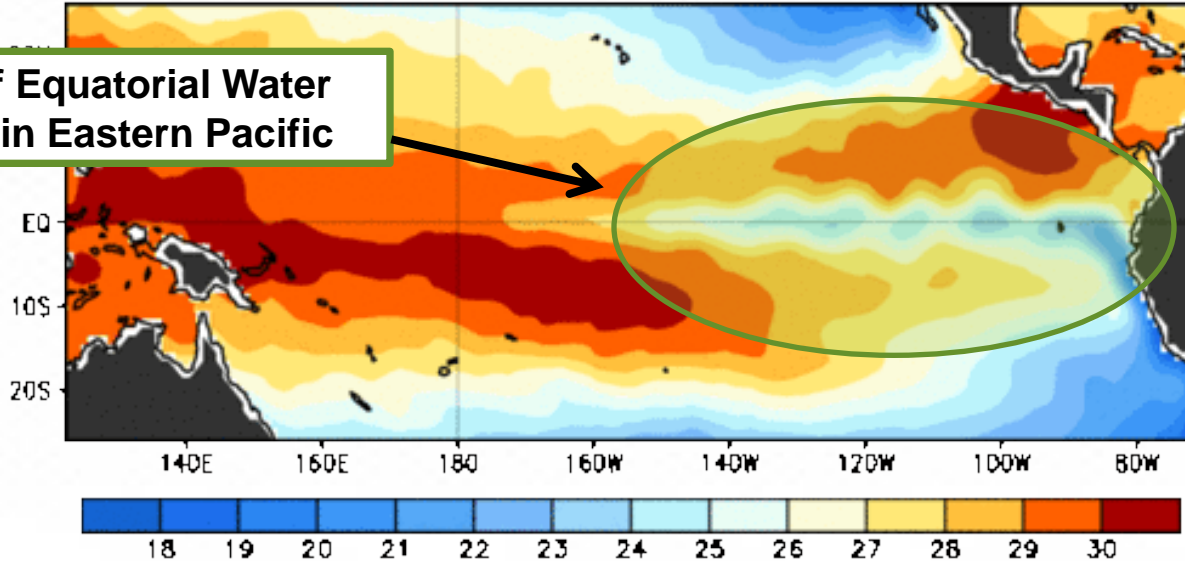
Factors Influencing Hurricane Activity



Current State of El Niño-Southern Oscillation (ENSO)

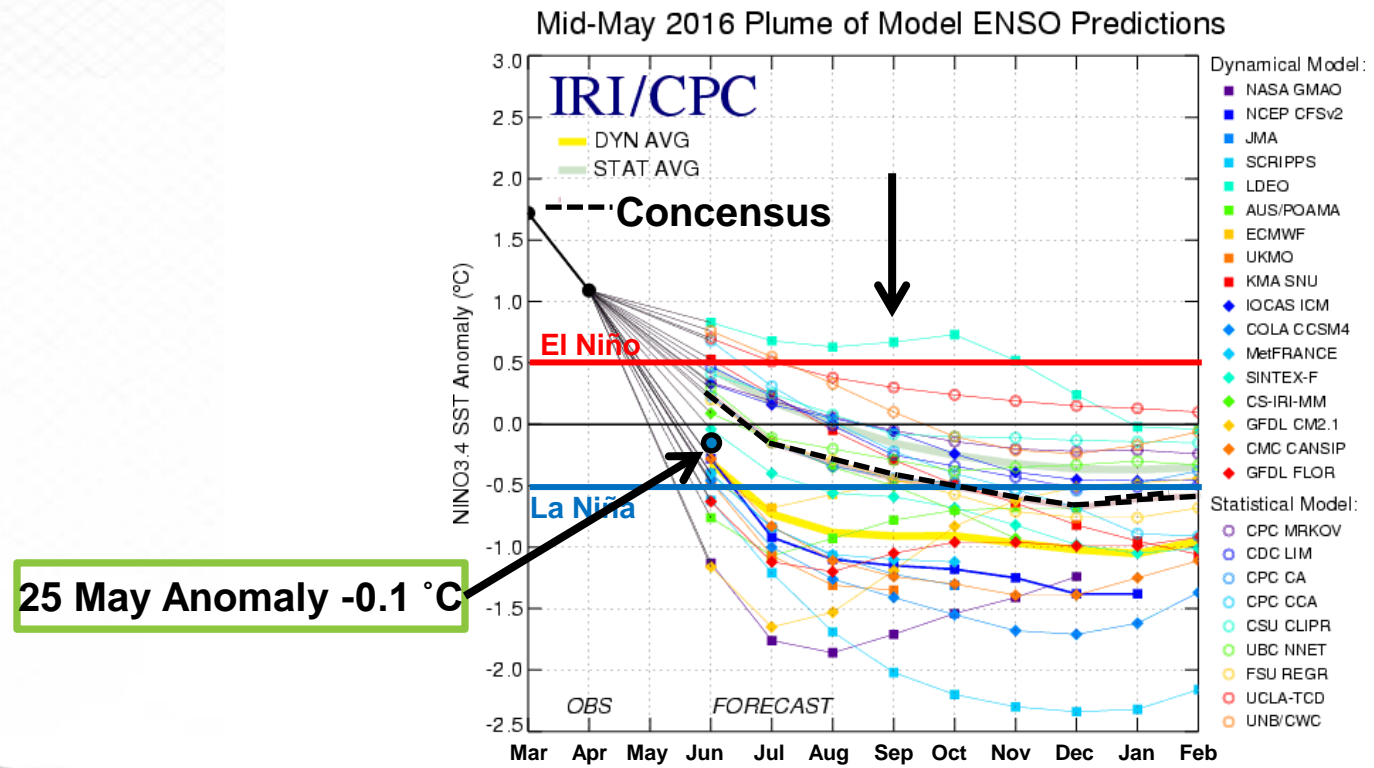
Observed Sea Surface Temperature (°C)

Cooling of Equatorial Water
Observed in Eastern Pacific



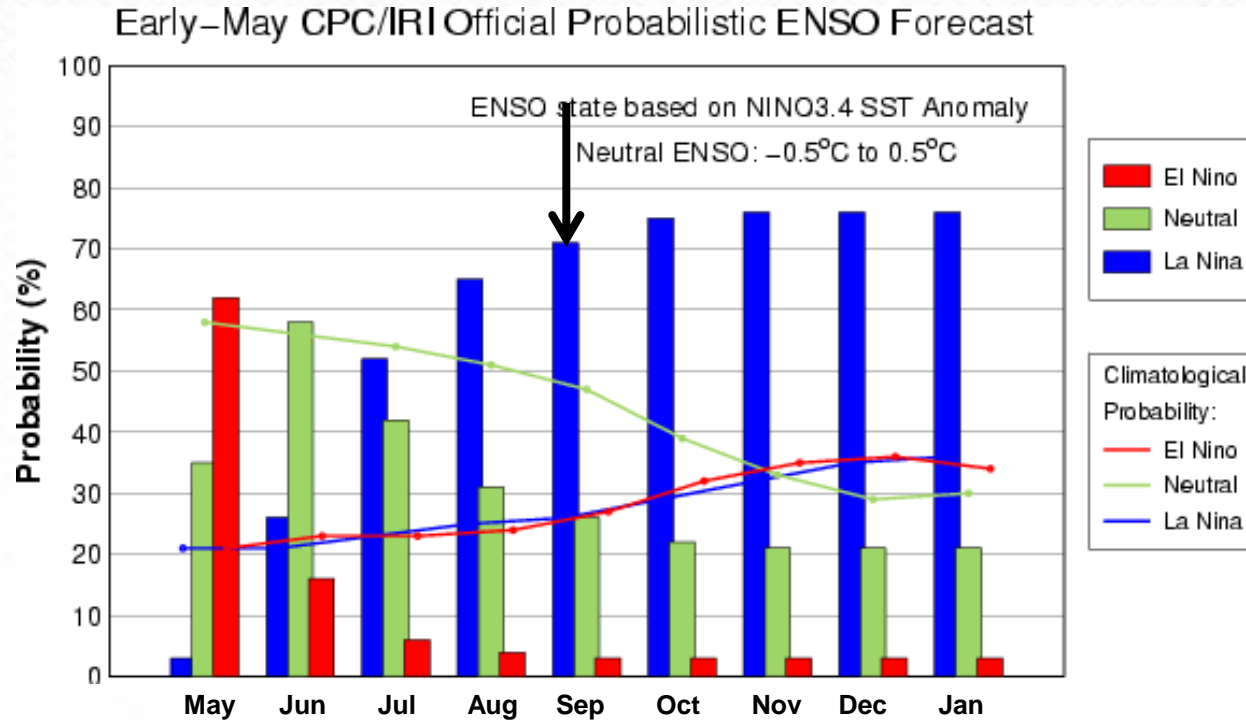
**7-day Average;
Centered on 25 May, 2016**

ENSO Forecasts



Source: International Research Institute (IRI) for Climate and Society (May 2016)

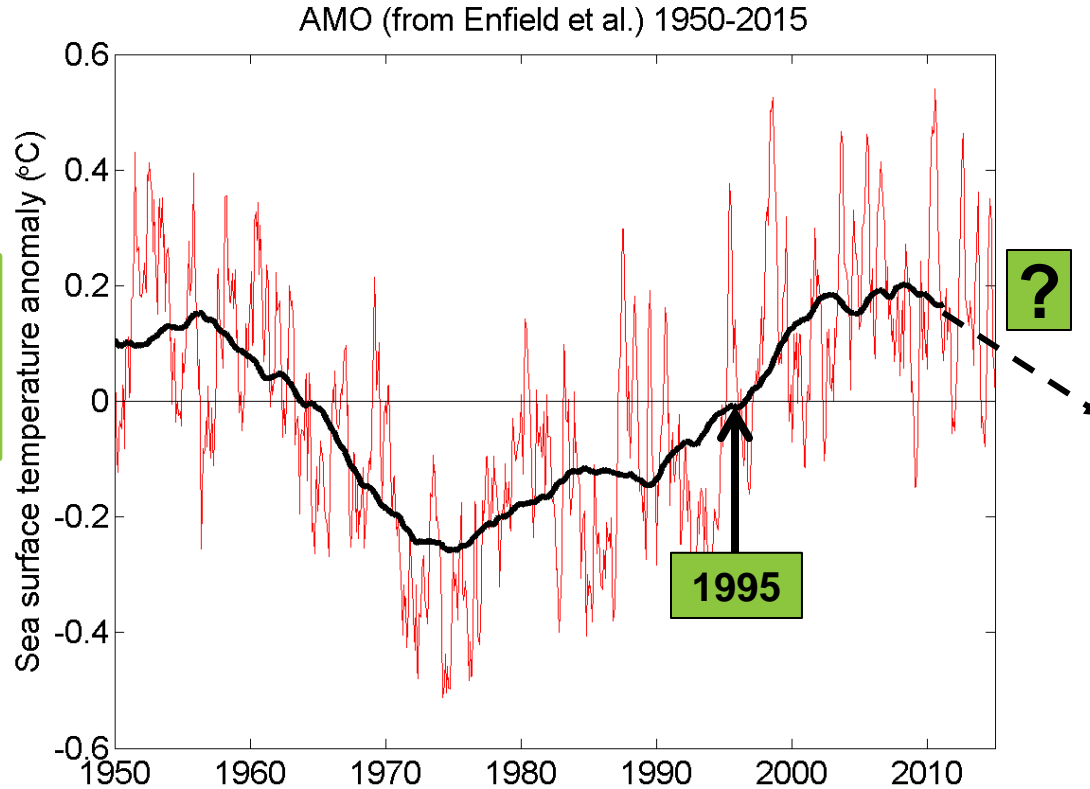
CPC/IRI Probabilistic ENSO Outlook



Source: International Research Institute (IRI) for Climate and Society (May 2016)

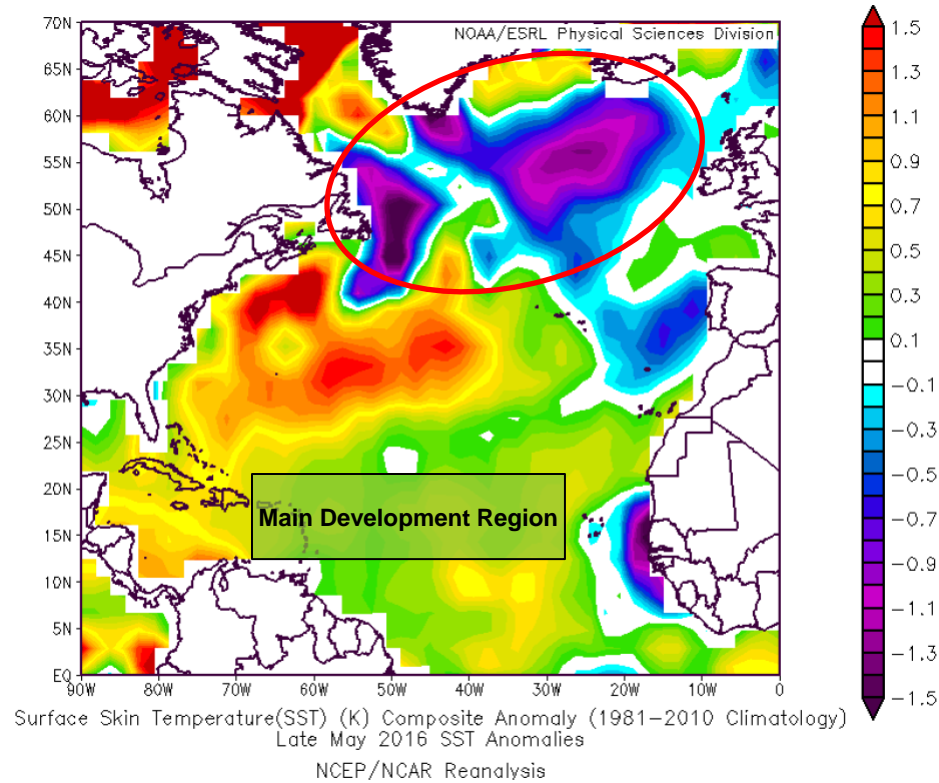
The Atlantic Multi-decadal Oscillation (AMO)

Averaged over
the Atlantic from
the equator to
70°N latitude



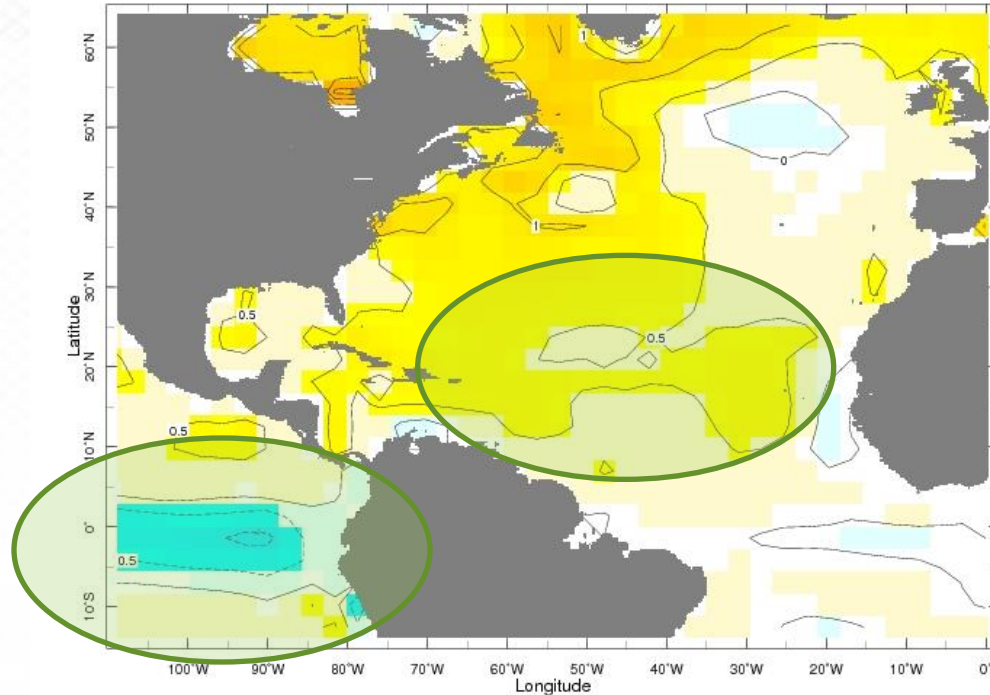
Source: NOAA Earth System Research Laboratory; <http://www.esrl.noaa.gov/psd/data/climateindices/>

Current State of the AMO



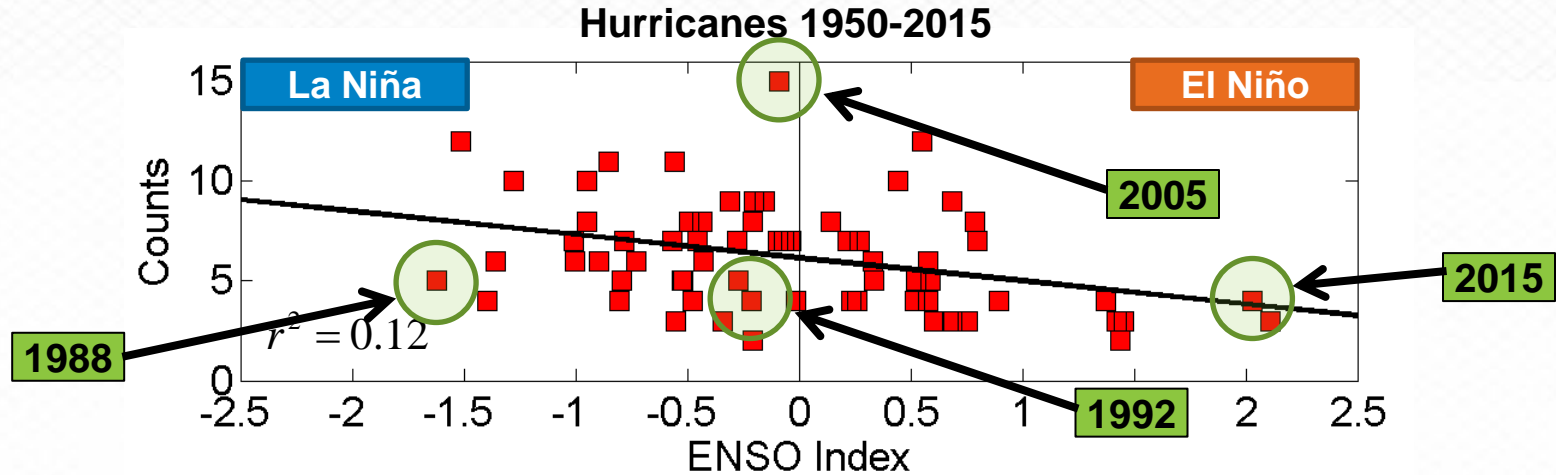
Atlantic and Pacific Sea Surface Temperature Forecast

Aug-Oct 2016 IRI seasonal Forecast SSTA issued 0000 1 May 2016



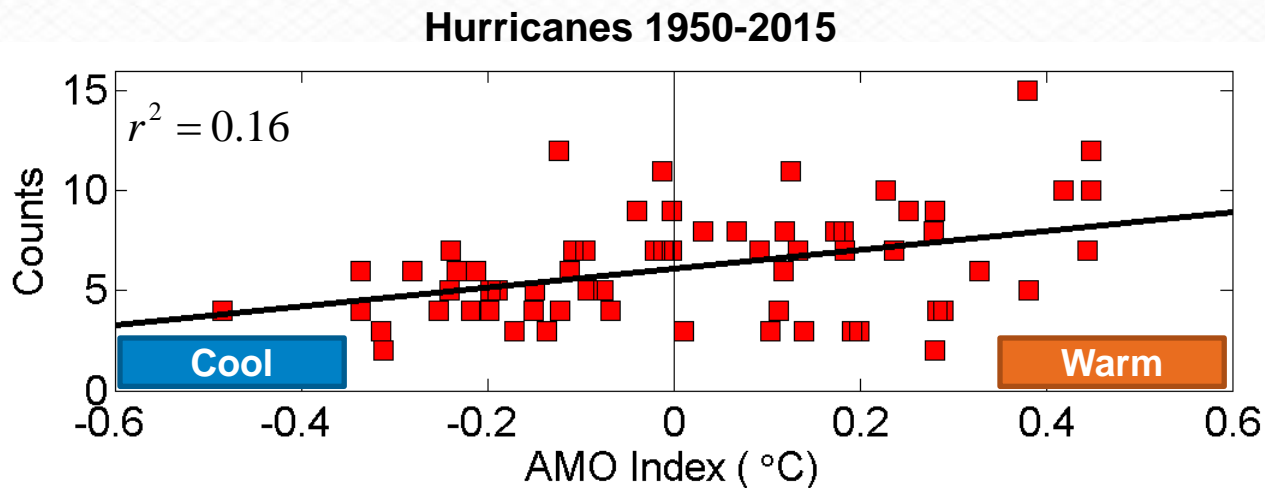
Source: International Research Institute for Climate and Society (IRI)

How are ENSO and TC Activity Related?



	Named Storms	Hurricanes	Major Hurricanes
El Niño	8.7	4.8	1.8
La Niña	12.5	6.9	3.1
Neutral	11.5	6.7	2.7

What about the AMO?

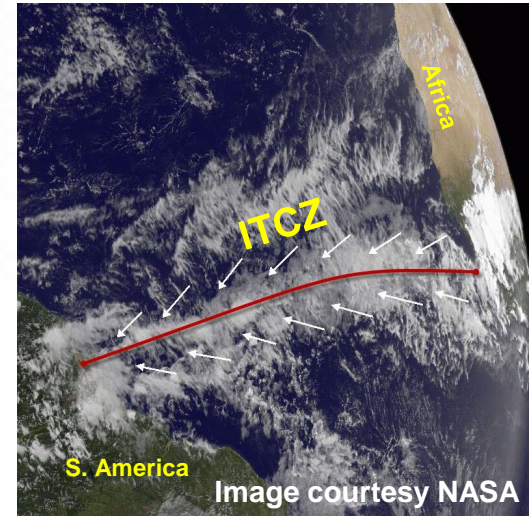
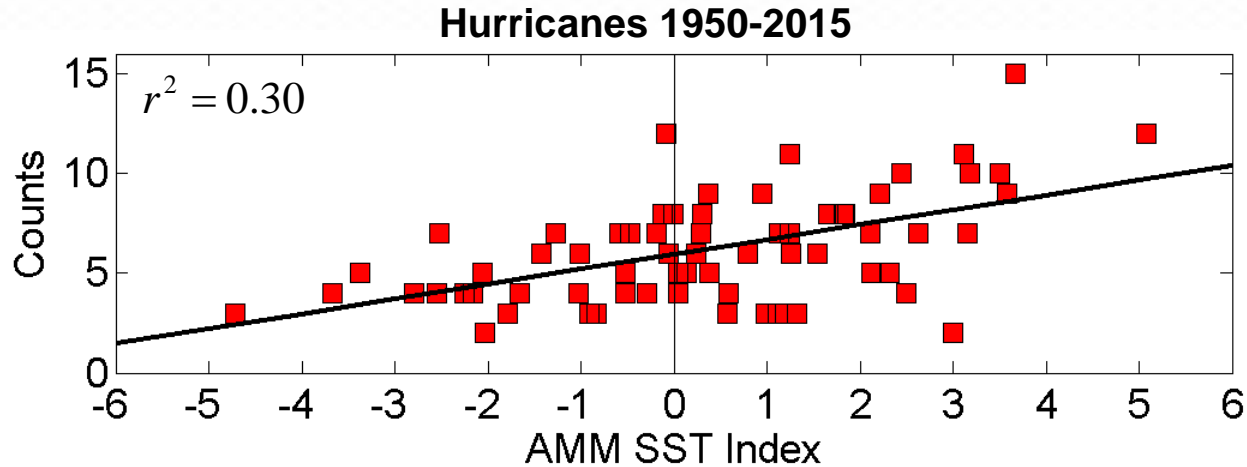


	Named Storms	Hurricanes	Major Hurricanes
Warm	14.1	7.6	3.1
Cool	8.2	4.8	1.8
Neutral	10.6	6.1	2.6

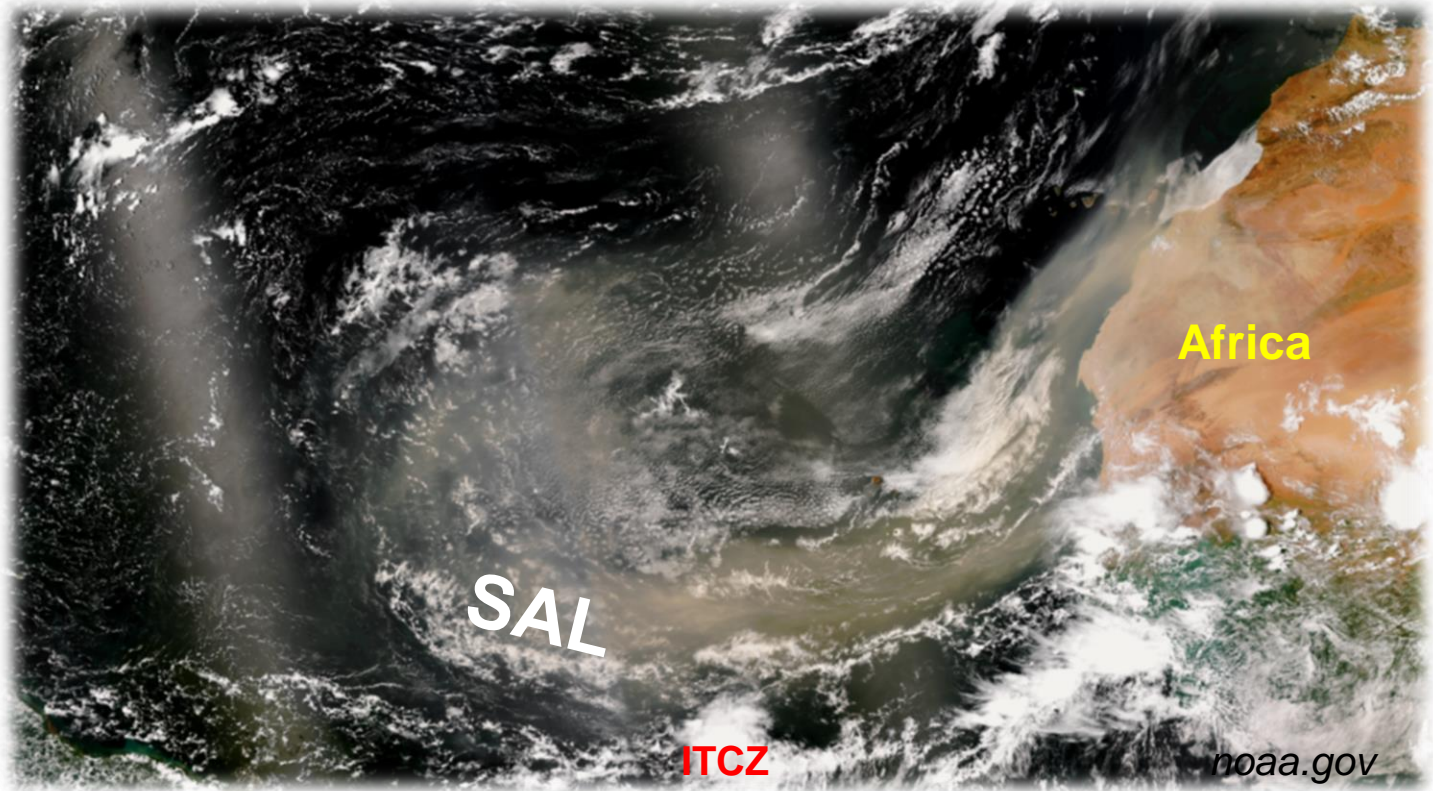
The Atlantic Meridional Mode (AMM)

(Kossin and Vimont 2007)

- Contains both multi-decadal as well as inter-annual variability
- Influences activity by altering the Intertropical Convergence Zone (ITCZ) location which impacts shear and SST across tropical Atlantic

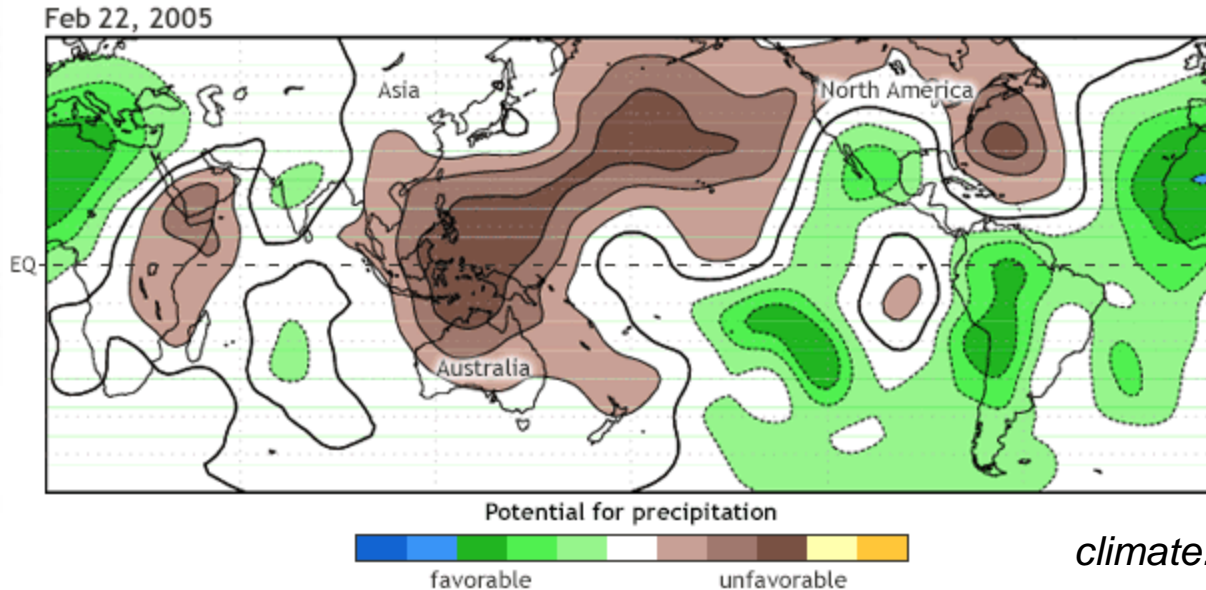


Short-term Factors: Saharan Air Layer (SAL)



Short-term Factors: Madden-Julian Oscillation (MJO)

- Wave travels eastward around the globe
- Period 30-60 days
- Tends to cause 1-2 week periods of increased tropical activity basin-wide



climate.gov

Seasonal Forecasts



Seasonal Forecasts



- The late Dr. William Gray, a member of the Colorado State University (CSU) faculty, issued the first “seasonal hurricane forecast” in 1984
- His former student, Dr. Phil Klotzbach has assumed the CSU forecast team leadership
- Since then, numerous other agencies have been predicting seasonal activity, including academic, private, and government



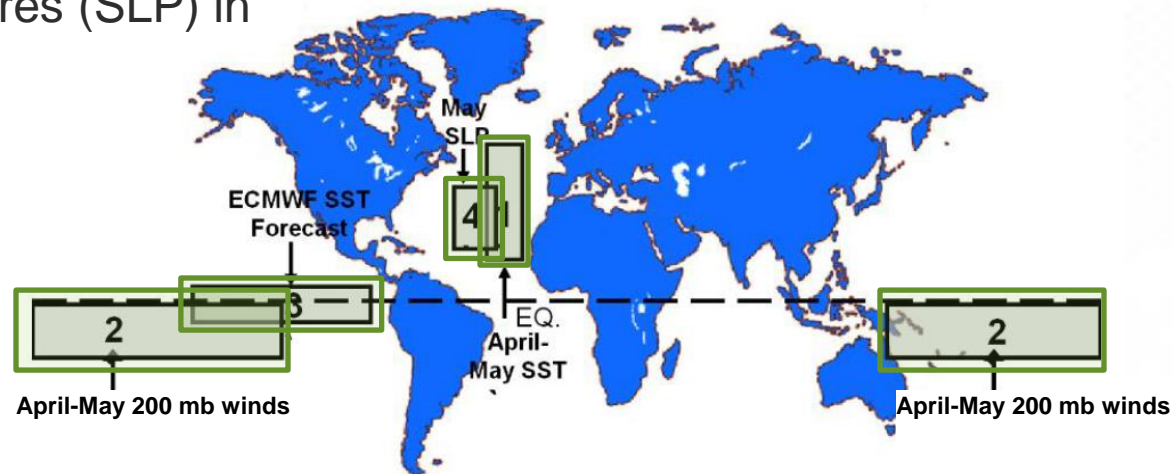
NOAA



Summary of June Predictors of Seasonal Activity

1. Observed SSTs in E. Atlantic (+)
2. Observed upper-level winds in S. Pacific (+)
3. European Centre for Medium Range Weather Forecasts (ECMWF) SST forecast in E. Pacific (-)
4. Observed sea-level pressures (SLP) in Atlantic (-)

Colorado State University



2016 Forecast from Colorado State University

14

NAMED STORMS

(average 12 per year)

6

HURRICANES

(average 6 per year)

2

**MAJOR
HURRICANES**

(average 3 per year)

PREVIOUS APRIL FORECAST

13

NAMED STORMS

6

HURRICANES

2

**MAJOR
HURRICANES**

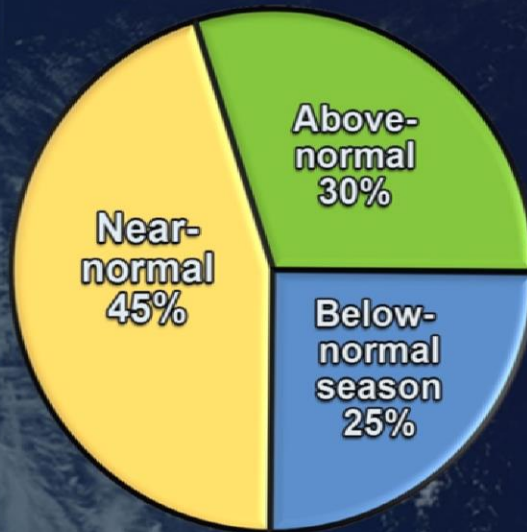
2016 Atlantic Hurricane Season Outlook

Named storms: 10 - 16

Hurricanes: 4 - 8

Major hurricanes: 1 - 4

Outlook
probability



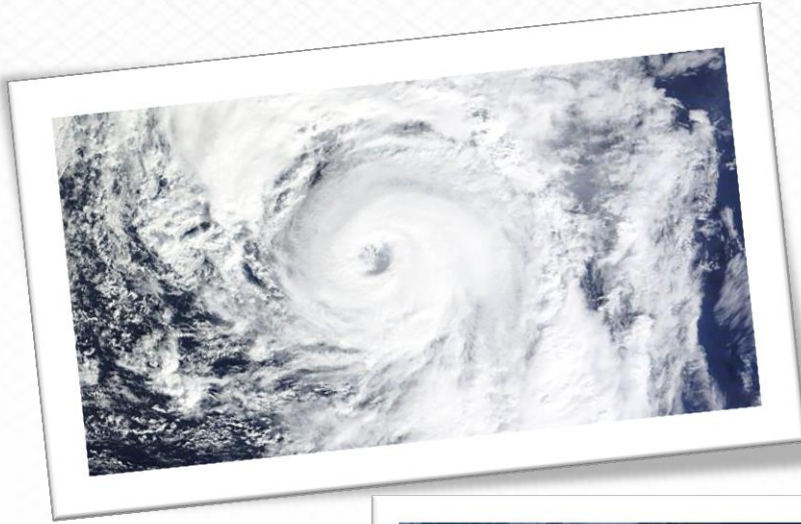
Be prepared: Visit hurricanes.gov
and follow @NWS and @NHC_Atlantic on Twitter

Forecasts for 2016 Atlantic Basin Activity

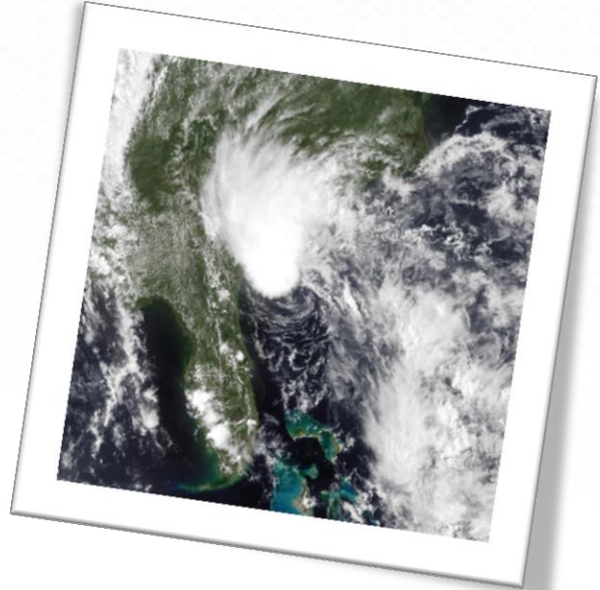
Agency	Forecast Date	Named Storms	Hurricanes	Major Hurricanes
CSU	June 1	14	6	2
WeatherTiger	June 1	14	9	3
NOAA	May 27	10-16	4-8	1-4
Tropical Storm Risk	May 27	17 (± 4)	9 (± 3)	4 (± 2)
UK Met Office*	May 12	14	8	--
CCU	April 28	13	7	3
Weather Channel	April 22	14	8	3
NCSU	April 15	15-18	8-11	3-5
AccuWeather	April 9	14	8	4
Consensus		14	8	3
Climatological Avg.		12	6	3

*Jun-Nov only

A Very Early Start: Hurricane Alex and TS Bonnie



Most predictions include **Hurricane Alex**, which formed in the Eastern Atlantic in January, and **TS Bonnie** which traveled inland in South Carolina at the end of May



2016 Atlantic Tropical Cyclone Names

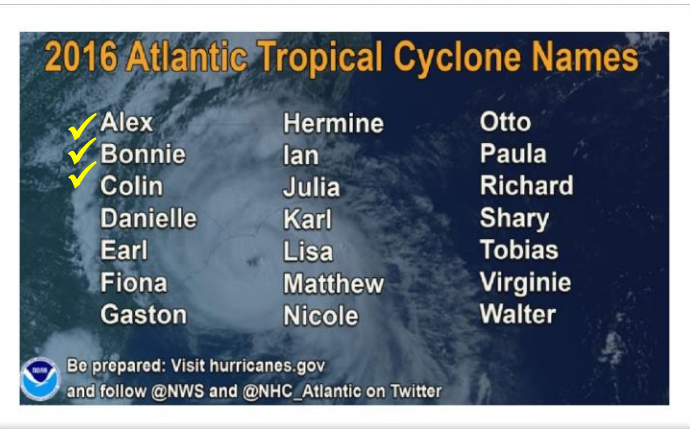
✓ Alex	Hermine	Otto
✓ Bonnie	Ian	Paula
Colin	Julia	Richard
Danielle	Karl	Shary
Earl	Lisa	Tobias
Fiona	Matthew	Virginie
Gaston	Nicole	Walter



Be prepared: Visit hurricanes.gov
and follow @NWS and @NHC_Atlantic on Twitter

Tropical Storm Colin

- The earliest 3rd Named Storm in the Atlantic
- Does *not* necessarily portend an active season*
 - Seasons with <2 named storms by June 30 have averaged **6.3 hurricanes** at the end of the season
 - Seasons with ≥ 2 named storms by June 30 have averaged **6.1 hurricanes** at the end of the season



* From P. Klotzbach

Eastern and Central Pacific Forecasts

- Pacific hurricane season runs from May 15 to November 30
- La Niña conditions tend to suppress activity

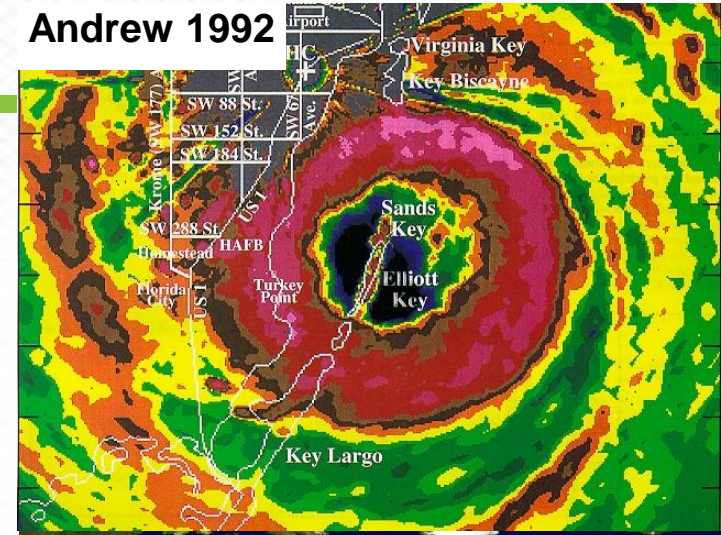
Agency	Forecast Date	Named Storms	Hurricanes	Major Hurricanes
NOAA	May 27	13-20	6-11	3-6
AccuWeather	May 23	14	7	3
SMN	May 6	17	9	4
Climatological Avg.		15	8	3

Landfall Forecasts

- Little correlation between seasonal activity and hurricane landfalls
- Storm tracks depend on highly-variable steering currents which cannot be accurately predicted more than a week in advance
- Contrasting examples
 - 1992: Six named storms with Hurricane Andrew
 - 2010: Nineteen named storms with no landfalls
- Historical average of 1-2 U.S. hurricane landfalls per year
 - Ten-year (2006-2015) running total of seven landfalls
 - Well-below ten-year average of 17 landfalls.

Will this year be the end of the drought?

Andrew 1992



2010 Season



Takeaways from Seasonal Hurricane Forecasts

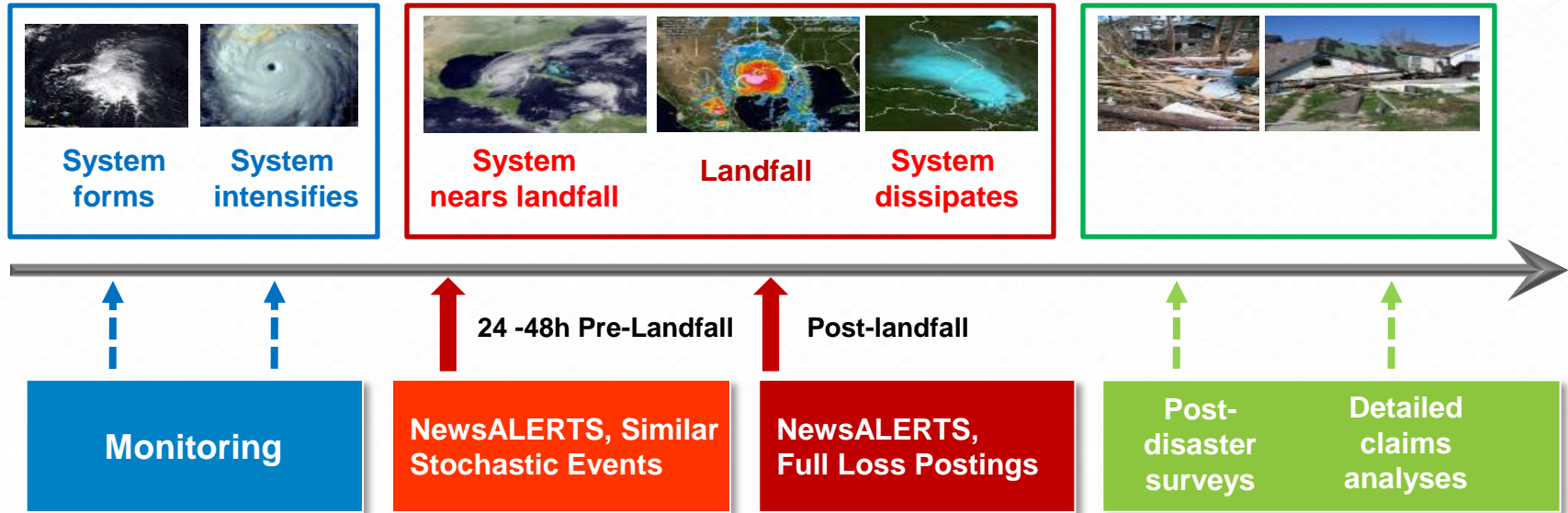
Meant to provide an indication of basin-wide activity in the upcoming season as compared to the climatological average

Seasonal forecasts are unable to capture the year-to-year volatility in land-falling hurricane counts and, more importantly, in the resulting losses

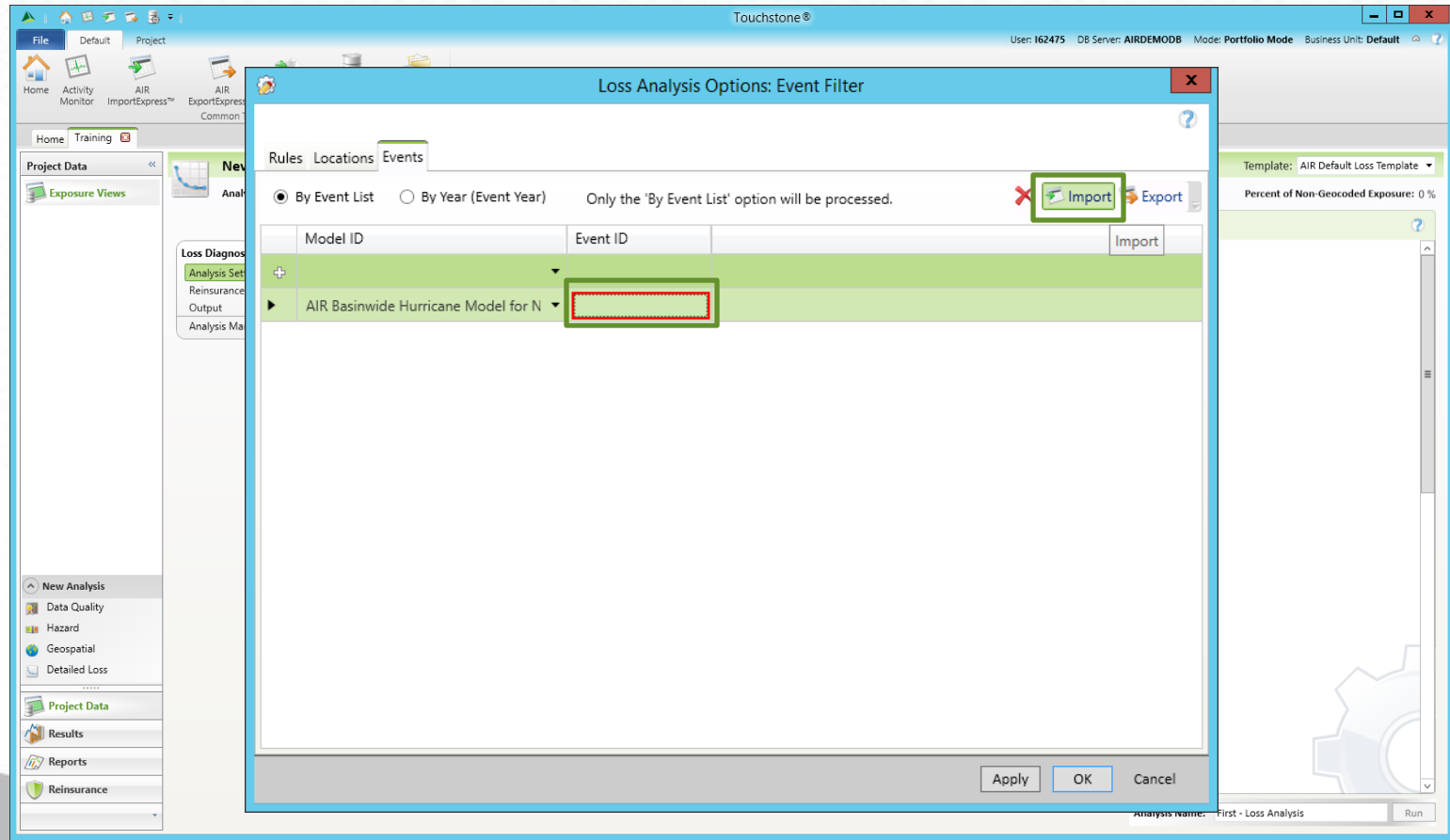
Preparing for the Upcoming Season



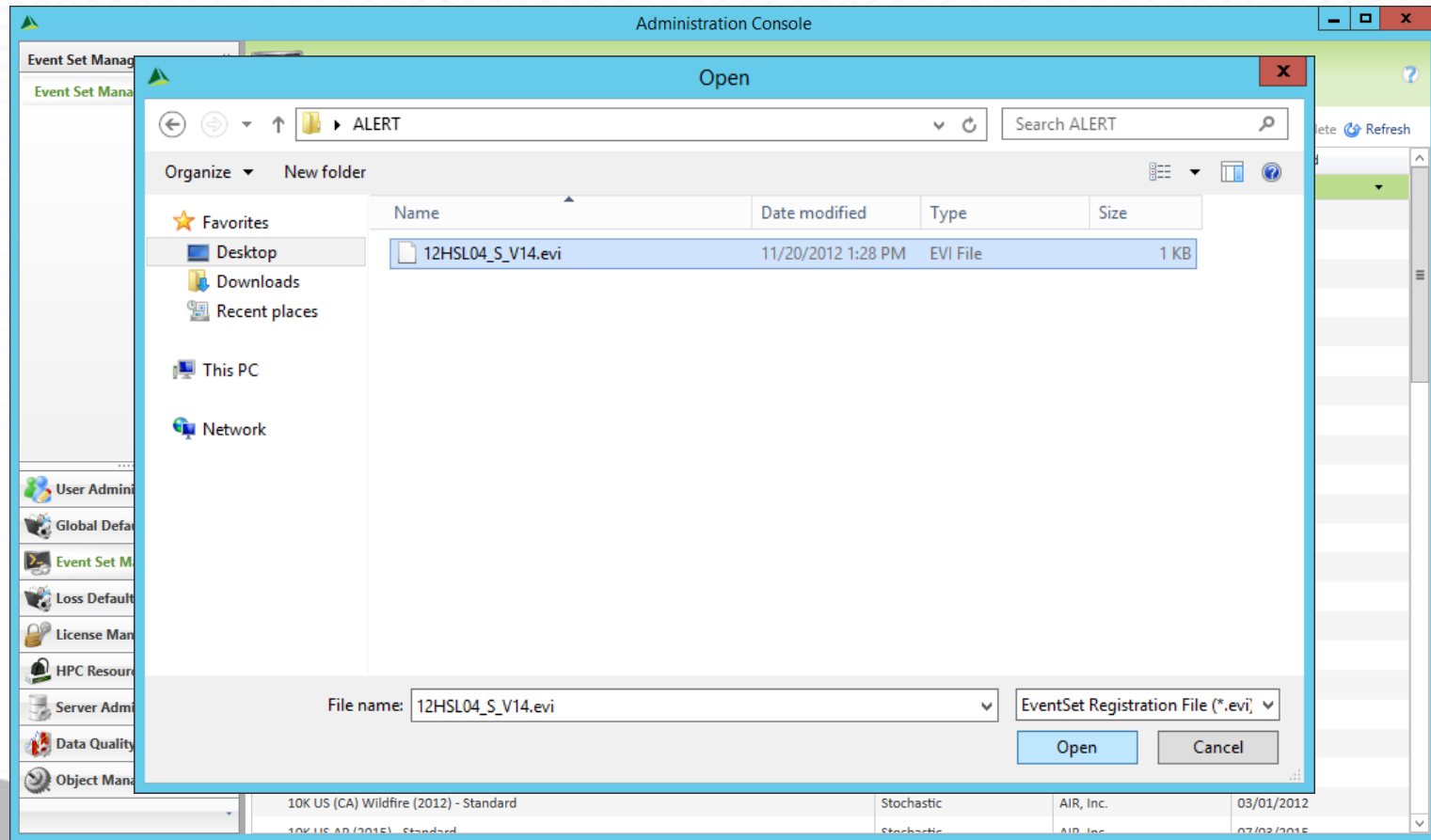
Overview of the **AIR** Loss Estimation in Real-Time (ALERT) Process for U.S. Hurricanes



Similar Stochastic Events Can Be Used in Touchstone and CATRADER



ALERT Event Sets Work Seamlessly in Touchstone and CATRADER



NewsALERT Subscribers Receive Email Notification of Significant Events



- NewsALERT emails begin several days prior to landfall
- Provide summary information about event
- Updates are sent when new information becomes available
- Sign up today at www.air-worldwide.com by clicking “Sign In” at the top of the page

Links to External Sources of Data

- Climate conditions

- <http://www.cpc.ncep.noaa.gov/products/CFSv2/CFSv2seasonal.shtml>
- <http://www.esrl.noaa.gov/psd/data/timeseries/AMO/>
- <http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/>

- Seasonal Forecasts

- <http://hurricane.atmos.colostate.edu/Forecasts/>
- <https://weather.com/storms/hurricane/video/hurricane-outlook-for-2016>
- <https://news.ncsu.edu/2016/04/hurricane-2016/>
- <https://scmss.coastal.edu/news/hugo-team-ccu-releases-hurricane-outlook-2016>
- <http://www.tropicalstormrisk.com/>
- <https://enterprisesolutions.accuweather.com/news/accuweather-2016-atlantic-hurricane-season-forecast>
- <http://weathertiger.com/samples/2016-hurricane-outlook/>
- <https://blog.metoffice.gov.uk/2016/05/12/met-office-predicts-slightly-above-average-atlantic-hurricane-season/>

- Landfall Forecasts

- <http://www.e-transit.org/hurricane/welcome.html>
- <http://weathertiger.com/samples/2016-hurricane-outlook/>

- HURDAT

- <http://www.nhc.noaa.gov/data/#hurdat>



Thank you!

*Eye of Cat-5 Hurricane Isabel, Sept. 13, 2003
Photo courtesy NOAA/HRD*