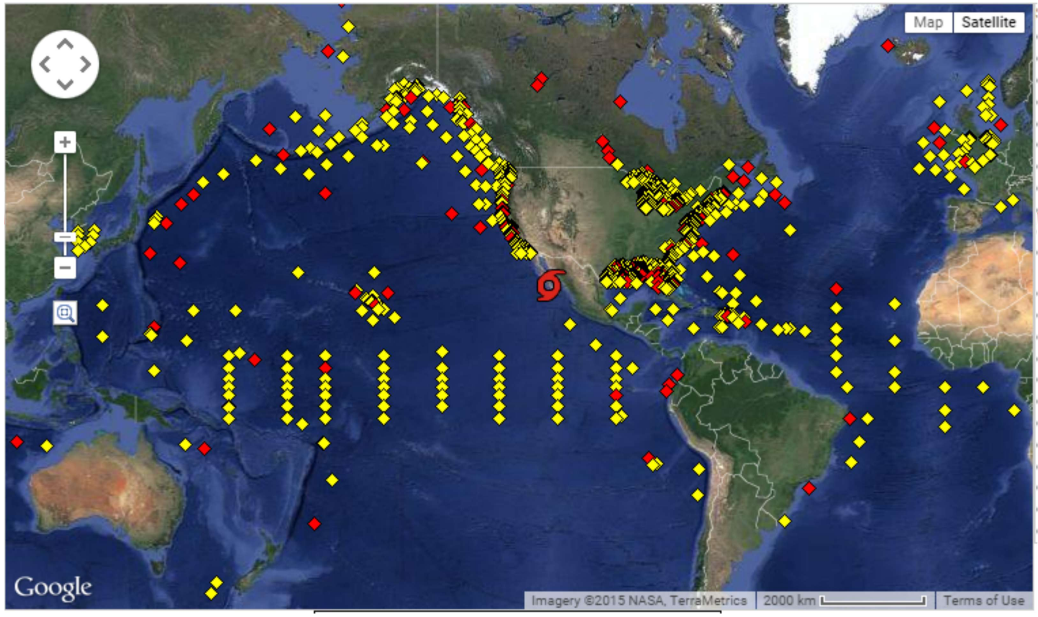
Motivation

Data Buoys around the world



Beaufort Scale from NOAA

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects: On the Water	Appearance of Wind Effects: On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-19 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (18-25 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	High waves (23-32 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (29-41 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (37-52 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

Motivation

Pelamis wave energy converters

Research Questions

Can we use other metrics to accurately characterize these tropical storms?

Will other metrics be consistent?

If so, help characterize wave energy projects. Possibly warrant putting buoys or other sensors further out to sea.

#YY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	TIDE
#yr	mo	dy	hr	mn	degT	m/s	m/s	m	sec	sec	degT	hPa	degC	degC	degC	mi	ft
2010	12	31	23	50	120	9.2	11.4	2.10	7.14	5.09	999	1017.3	21.5	21.1	19.6	99.0	99.00
2011	01	01	00	50	124	10.1	12.2	1.89	7.14	4.74	999	1017.6	21.5	21.1	19.4	99.0	99.00
2011	01	01	01	50	123	10.4	12.3	1.90	7.69	4.88	999	1018.1	21.5	21.1	19.2	99.0	99.00
2011	01	01	02	50	129	10.2	12.2	1.90	7.14	4.80	999	1018.3	21.6	21.2	19.0	99.0	99.00
2011	01	01	03	50	131	10.0	11.7	2.25	7.14	5.00	999	1018.4	21.6	21.2	18.8	99.0	99.00
2011	01	01	04	50	130	10.7	12.9	2.17	6.67	4.91	999	1017.7	21.5	21.2	18.9	99.0	99.00
2011	01	01	05	50	133	10.0	12.0	2.18	7.14	5.01	999	1017.4	21.5	21.2	18.9	99.0	99.00
2011	01	01	06	50	131	10.0	12.4	2.00	6.25	4.65	999	1016.8	21.6	21.3	18.9	99.0	99.00
2011	01	01	07	50	132	9.6	11.2	2.21	7.14	4.95	999	1016.6	21.6	21.3	19.0	99.0	99.00
2011	01	01	08	50	127	9.7	12.2	2.14	6.25	4.91	999	1015.9	21.6	21.4	19.0	99.0	99.00
2011	01	01	09	50	131	9.3	11.7	2.16	6.25	4.94	999	1015.8	21.6	21.4	19.1	99.0	99.00
2011	01	01	10	50	132	9.1	11.3	2.26	7.14	5.04	999	1015.9	21.7	21.5	19.3	99.0	99.00
2011	01	01	11	50	132	9.7	11.7	2.32	6.67	5.38	999	1016.1	21.8	21.5	19.5	99.0	99.00
2011	01	01	12	50	132	7.8	9.6	2.08	7.69	5.09	999	1016.9	21.9	21.5	19.8	99.0	99.00
2011	01	01	13	50	128	6.2	7.3	2.04	7.14	5.28	999	1017.9	22.2	21.5	20.1	99.0	99.00
2011	01	01	14	50	127	5.7	6.9	1.94	7.14	5.24	999	1018.6	22.3	21.5	20.2	99.0	99.00
2011	01	01	15	50	130	5.8	7.0	1.85	7.14	5.13	999	1018.5	22.3	21.5	20.2	99.0	99.00
2011	01	01	16	50	142	4.2	4.9	99.00	99.00	99.00	999	1018.2	22.3	21.6	20.5	99.0	99.00
2011	01	01	17	50	136	6.1	7.2	1.81	6.67	5.22	999	1016.5	22.2	21.6	20.0	99.0	99.00
2011	01	01	18	50	139	7.7	9.5	1.73	5.88	5.07	999	1014.7	22.5	21.6	20.0	99.0	99.00
2011	01	01	19	50	144	8.0	9.8	1.65	6.25	4.91	999	1014.1	22.6	21.6	20.0	99.0	99.00
2011	01	01	20	50	196	3.5	4.3	1.79	7.14	5.10	999	1015.9	22.8	21.6	20.0	99.0	99.00
2011	01	01	21	50	57	0.2	0.8	1.78	7.14	5.33	999	1016.8	22.3	21.6	20.2	99.0	99.00
2011	01	01	22	50	74	0.3	0.9	1.76	7.14	5.29	999	1017.0	22.3	21.6	20.3	99.0	99.00
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2011	01	02	00	50	133	4.5	5.2	1.57	6.67	5.24	999	1017.7	22.1	21.6	20.4	99.0	99.00
2011	01	02	01	50	120	3.2	4.0	1.48	6.67	5.15	999	1018.6	22.1	21.6	20.3	99.0	99.00
2011	01	02	02	50	133	4.3	5.3	1.58	7.69	5.45	999	1018.7	22.0	21.5	20.3	99.0	99.00
2011	01	02	03	50	125	4.9	5.7	1.53	7.69	5.29	999	1019.1	22.0	21.5	20.4	99.0	99.00
2011	01	02	04	50	126	5.4	6.7	1.49	7.14	5.19	999	1019.4	21.8	21.5	20.5	99.0	99.00
2011	01	02	05	50	128	6.4	7.4	1.44	6.25	4.97	999	1019.0	21.8	21.5	20.5	99.0	99.00
2011	01	02	06	50	132	6.8	8.1	1.49	5.26	4.81	999	1018.5	21.7	21.5	20.3	99.0	99.00
2011	01	02	07	50	134	6.7	7.9	1.52	7.14	4.92	999	1018.0	21.7	21.5	20.3	99.0	99.00
2011	01	02	08	50	132	6.5	8.0	1.37	5.00	4.52	999	1017.8	21.6	21.5	20.3	99.0	99.00
2011	01	02	09	50	135	6.6	7.8	1.29	7.14	4.58	999	1017.7	21.6	21.5	20.3	99.0	99.00
2011	01	02	10	50	135	6.4	7.7	1.44	7.14	4.69	999	1018.1	21.6	21.5	20.2	99.0	99.00
2011	01	02	11	50	138	6.1	7.4	1.30	6.67	4.49	999	1018.5	21.7	21.4	20.3	99.0	99.00

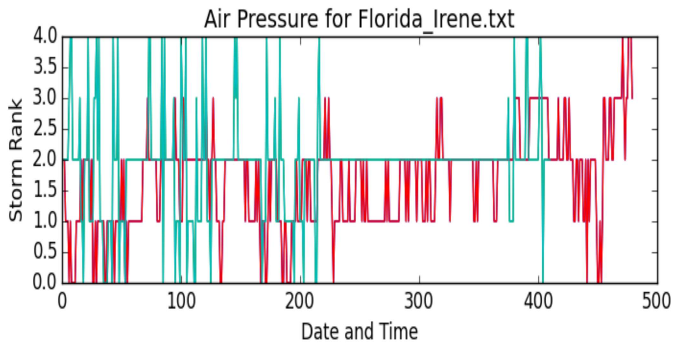
Methodology

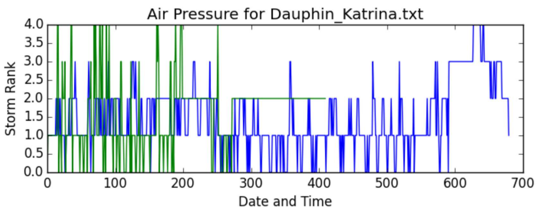
a. Create a datum by scanning the most recent and highest quality data. Use the Florida Buoy and find data from 2011.
b. Classify each wind speed using the Beaufort scale, and match the data's corresponding wave height data to also have this classification.
c. Classify wave height and air pressure, taking average of corresponding metric values to wind speed ranks.
    i. We want a definite set of ranges, and there will be an imperfect correlation between wind and wave height in the data. To create a definite scale, be sure to take each unique wind speed, rounded to an integer, find all of the corresponding wave heights, and take the mean of those wave heights. The mean of the wave height will be the corresponding wave height metric for classifying the storm.
d. Now we have a metric! Apply this metric to another data set (the Louisiana buoy).
e. Now we need to know if our metric worked. Compare wind speed classification for the Louisiana Buoy to the classifications found using the wave height metric we made.
f. Accurate? Use the MSE to determine whether or not there is a correlation
g. Consistent? Does accuracy hold across different data sets?

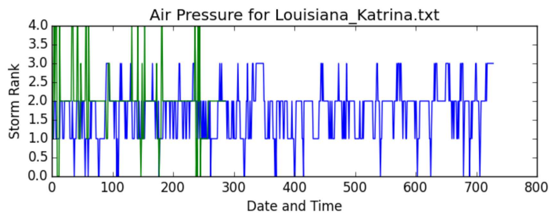
Results

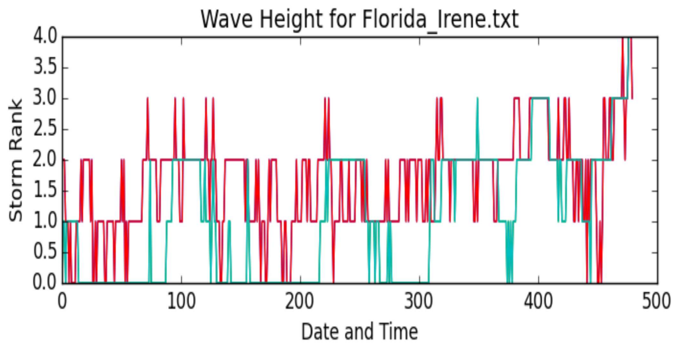
Report MSE against Beaufort Datum

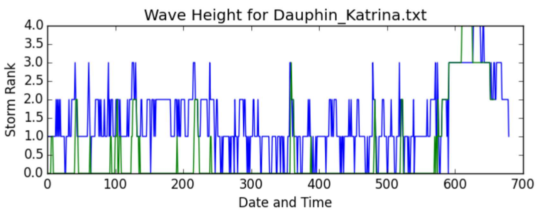
MSE for Wave Height for Florida_Irene.txt... 1.2630480167
MSE for Air Pressure for Florida_Irene.txt... 1.11435523114
MSE for Wave Height for Dauphin_Katrina.txt... 1.52807283763
MSE for Air Pressure for Dauphin_Katrina.txt... 1.4
MSE for Wave Height for Louisiana_Katrina.txt... 1.34156378601
MSE for Air Pressure for Louisiana_Katrina.txt... 1.08710801394

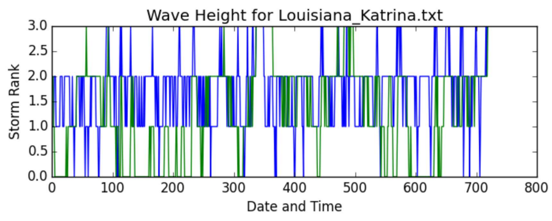












Results

In essence, the results drawn here can imply that our buoys weather stations could indicate storm encroachments. To answer the research questions.

Can we use other metrics to accurately characterize these tropical storms? **No**

Will other metrics be consistent? **Yes**

This analysis is not detailed enough yet to warrant putting buoys further out to see (where storms brew, giving weaker signs but also more consistent). The next step would be to fine tune analysis, and if achieved, use ARGOs float data.