Patterns of Multidecadal Atlantic Hurricane Variability

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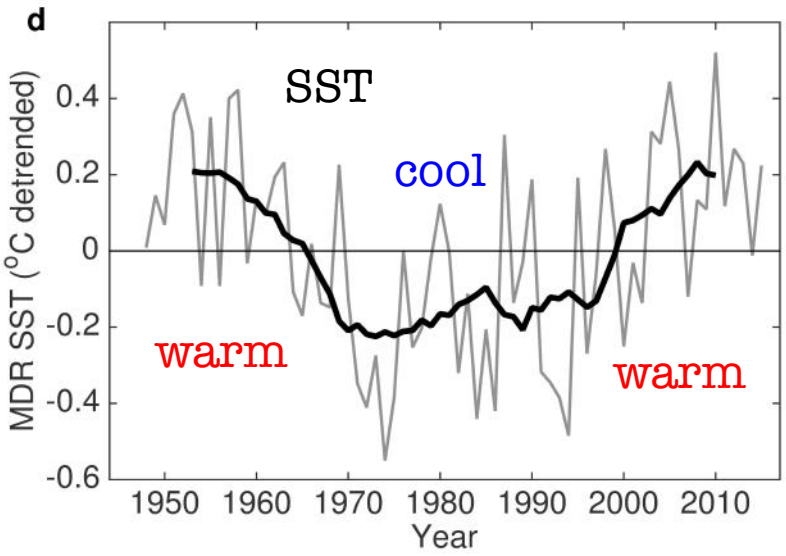
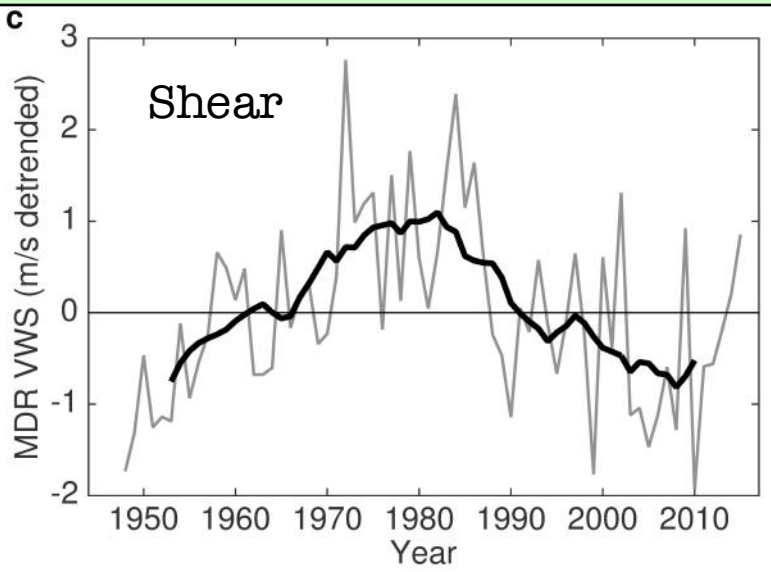
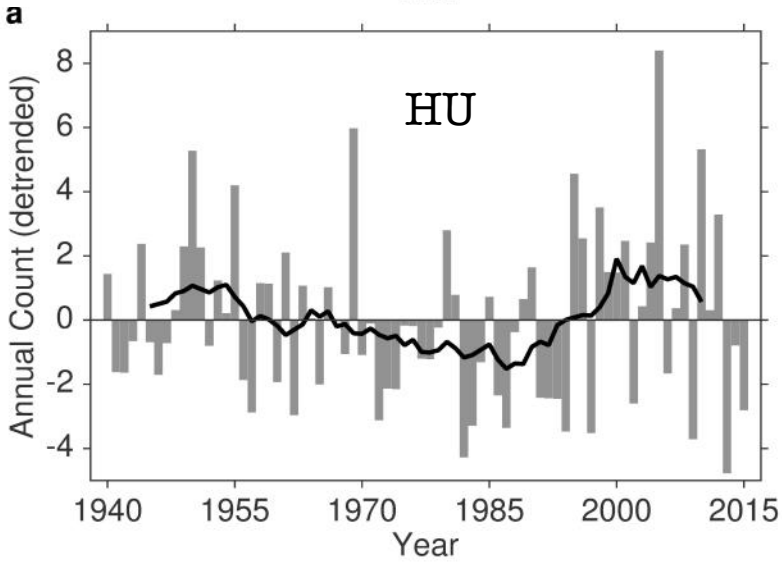
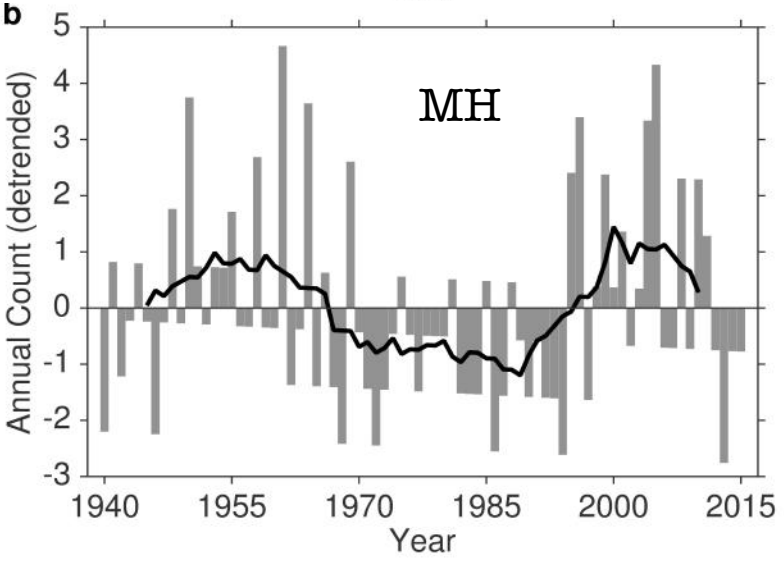
The multidecadal variability of the tropical N. Atlantic ocean and atmosphere, particularly sea surface temperature and vertical wind shear, strongly modulates basin-wide Atlantic hurricane activity.









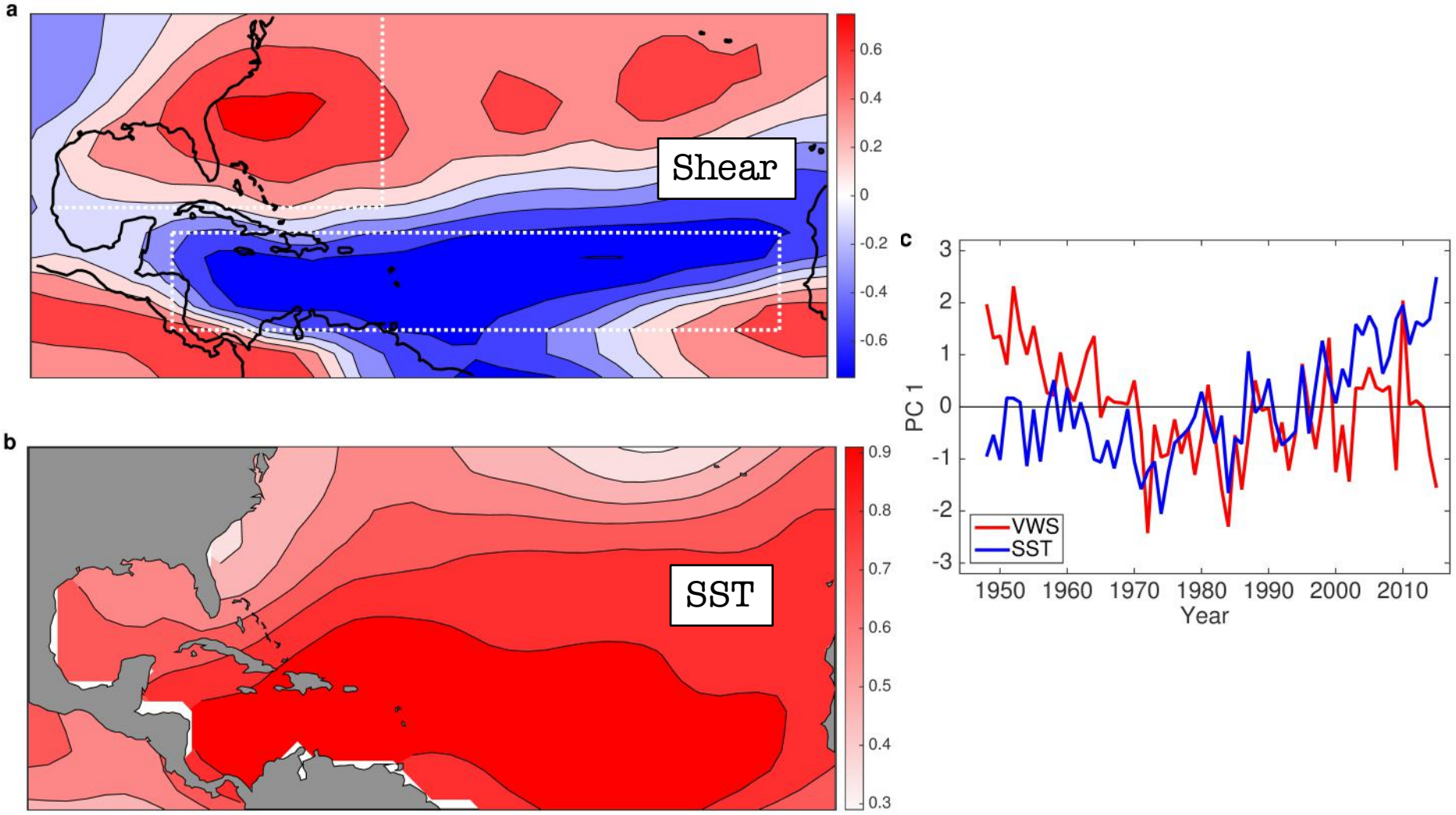
There have been more than twice as many major hurricanes per year during the contemporary warm period compared to the last cool period

	All	Tropical Storms	Category 1–2	Category 3–5
1970–1994	**9.3**	**4.3**	3.5	**1.5**
1995–2015	**14.7**	**7.2**	4.1	**3.4**

These statistics reflect basin-wide activity and the environmental parameters are typically measured in the Main Development Region.

Are there any regional patterns of variability that may be relevant but missing from these types of analyses?

Leading EOFs of SST and shear (VWS)



Kossin, J. P., 2017: Hurricane intensification along United States coast suppressed during active hurricane periods. *Nature*, **541**, 390–393, doi:10.1038/nature20783.

What effect do these regional patterns of multidecadal variability have on hurricanes?

6-hourly intensification rates near/along the U.S. coast

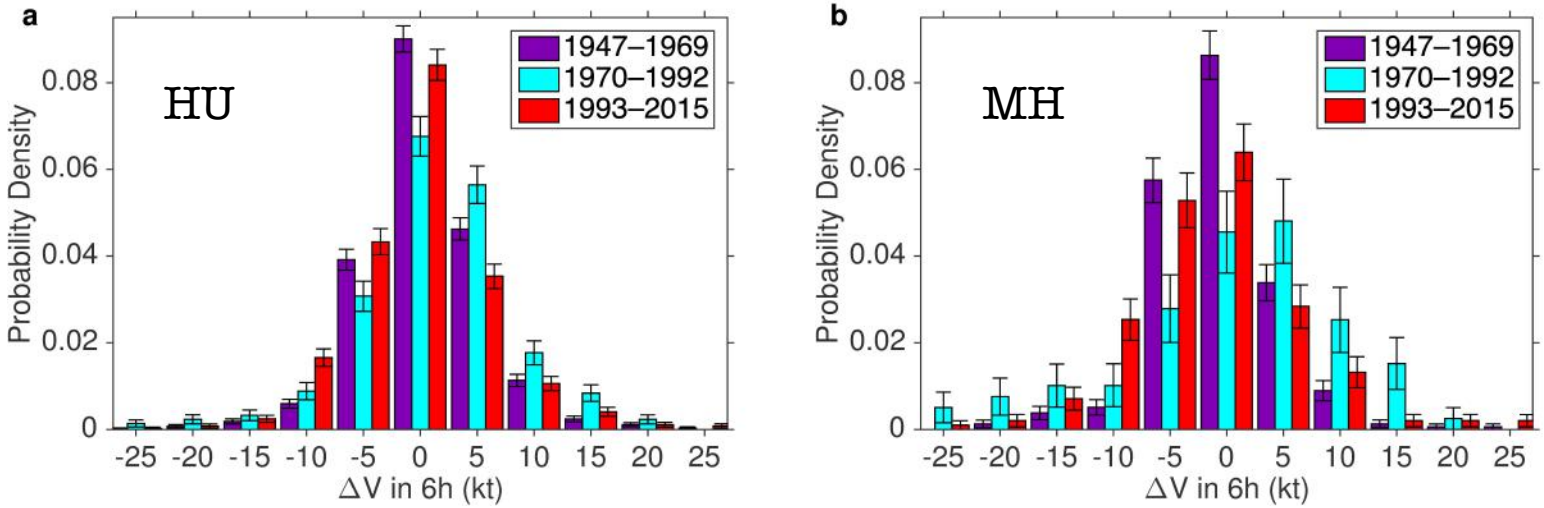
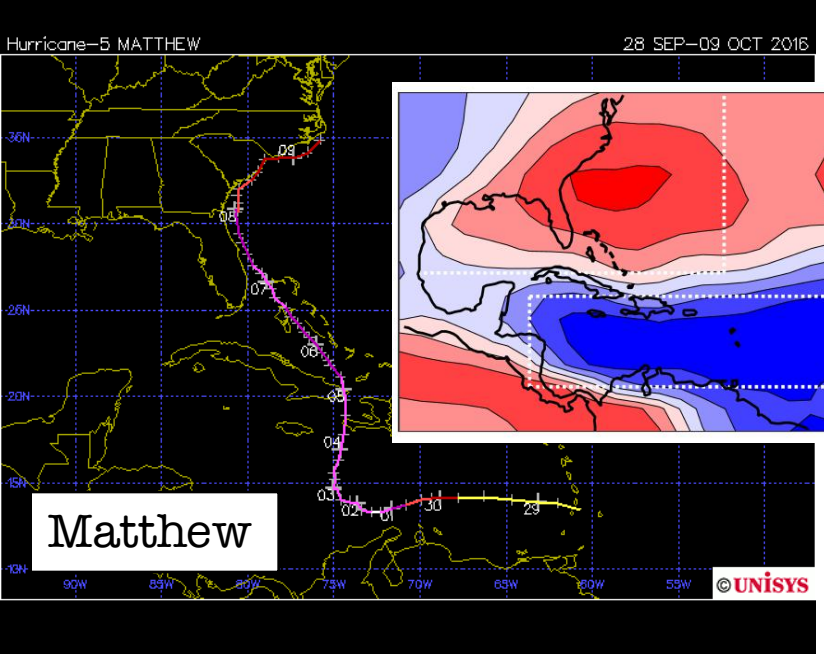


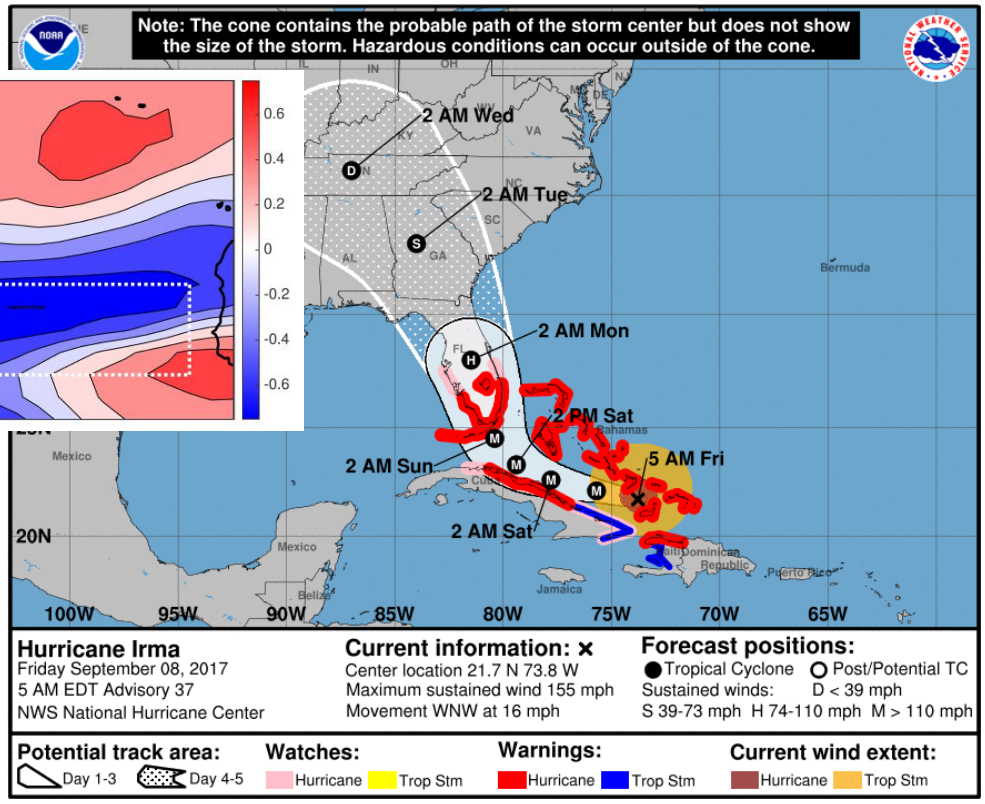
Table 2 | Probabilities of exceedance of 6-hour intensification rates near the US coast

	$P(\Delta V \geq 5\,kt)$		$P(\Delta V \geq 10\,kt)$		$P(\Delta V \geq 15\,kt)$	
	HU	MH	HU	MH	HU	MH
1947–1969	0.310±0.028	0.230±0.047	0.079±0.016	0.061±0.027	0.022±0.009	0.016±0.014
1970–1992	0.429±0.047	0.468±0.110	0.147±0.034	0.228±0.093	0.058±0.022	0.101±0.067
1993–2015	0.263±0.032	0.239±0.060	0.086±0.020	0.096±0.041	0.033±0.013	0.031±0.024

Values are the probabilities (and their 95% confidence intervals) that the 6-hour intensity change was equal to or exceeded 5 kt, 10 kt or 15 kt for hurricanes (HU) and major hurricanes (MH) near the US coast in each of the three 23-year periods.

Major hurricanes that approach or move along the U.S. coast are *3 to 6 times less likely* to rapidly intensify during warm periods

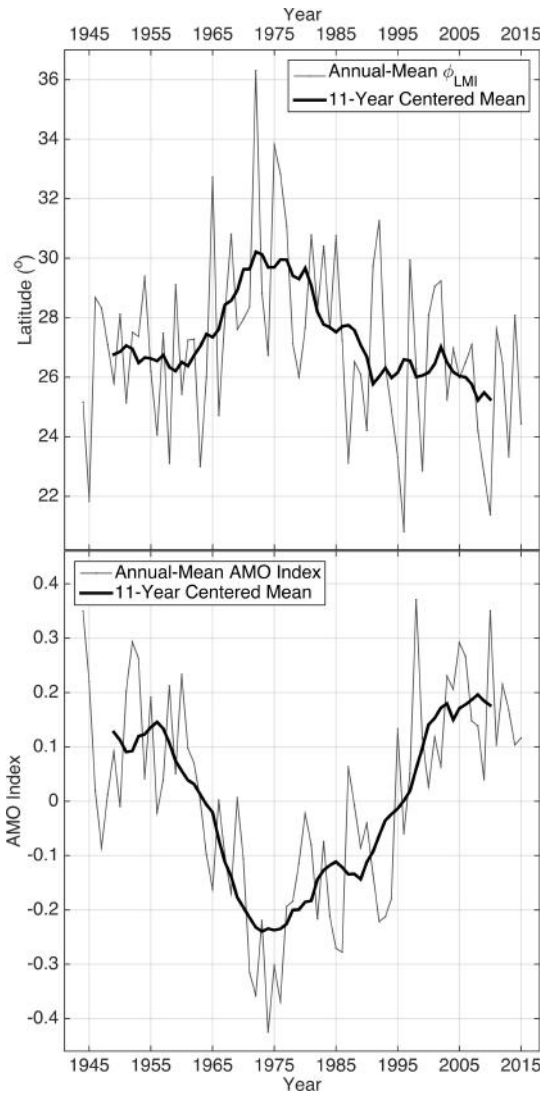


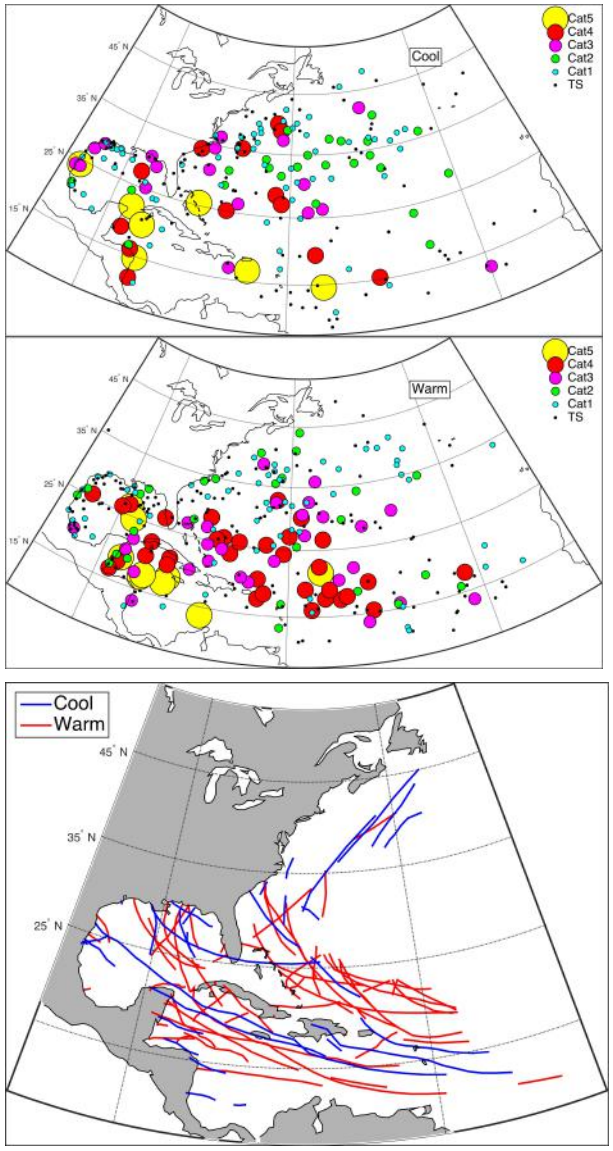


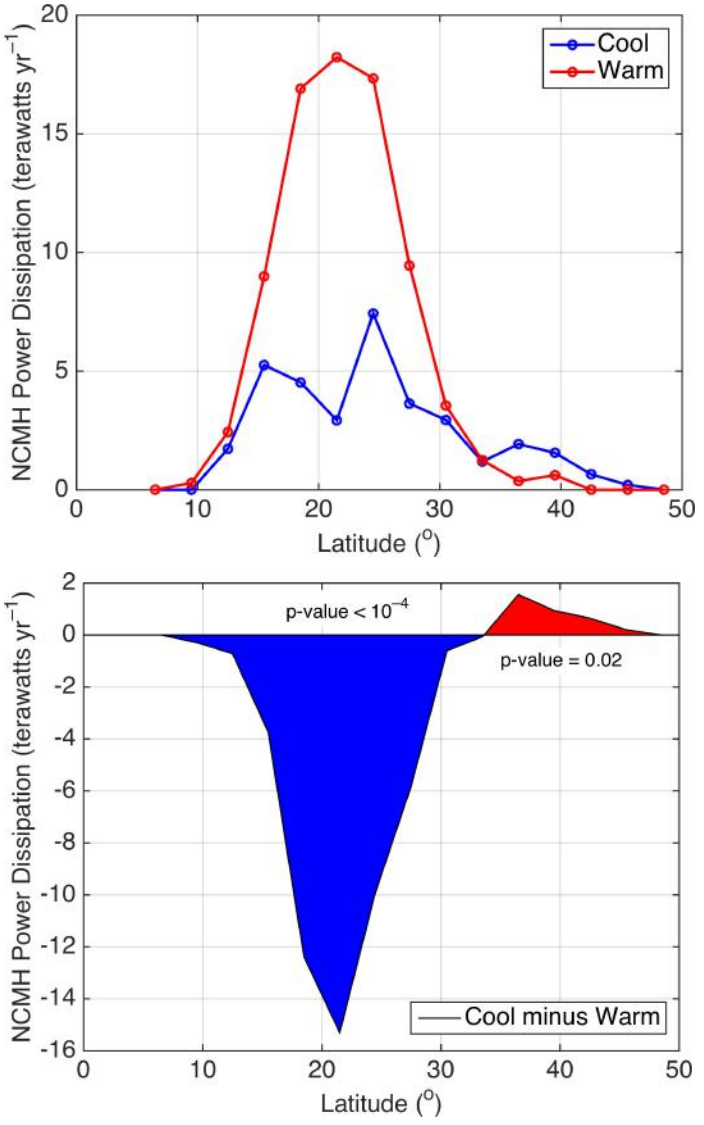
* ATLANTIC SHIPS INTENSITY FORECAST *
* IR SAT DATA AVAILABLE, OHC AVAILABLE *
* IRMA AL112017 09/08/17 06 UTC *

TIME (HR)	0	6	12	18	24	36	48	60	72	84	96	108	120
V (KT) NO LAND	140	139	142	146	147	146	142	135	124	110	86	66	55
V (KT) LAND	140	139	142	146	147	146	142	99	52	35	29	28	27
V (KT) LGEM	140	136	135	134	134	134	131	97	50	34	29	27	27
Storm Type	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP
SHEAR (KT)	4	4	4	4	6	9	14	20	31	42	47	46	42
SHEAR ADJ (KT)	4	2	1	-1	-1	1	2	0	7	3	-7	-1	1
SHEAR DIR	249	295	319	300	283	303	268	245	224	204	214	210	217
SST (C)	29.5	29.7	29.7	29.8	29.9	30.0	29.9	29.9	29.4	28.7	27.8	26.5	25.2
POT. INT. (KT)	162	165	164	166	167	168	167	168	160	148	135	119	106

Regionally reduced shear during the last cool period allowed major hurricanes to survive at higher latitudes







Summary

Atlantic multidecadal variability is best considered in terms of its pattern rather than via MDR averages.

Important regional differences (sign changes) exist in the SST and shear co-variability, which causes large regional differences in how hurricanes are modulated by the multidecadal variability in the basin.

An important unanswered question then is whether we can expect another cool phase, and if one emerges, how well will the previous cool period serve as an analog?