Automated Detection of Extratropical Storms from SMAP Winds

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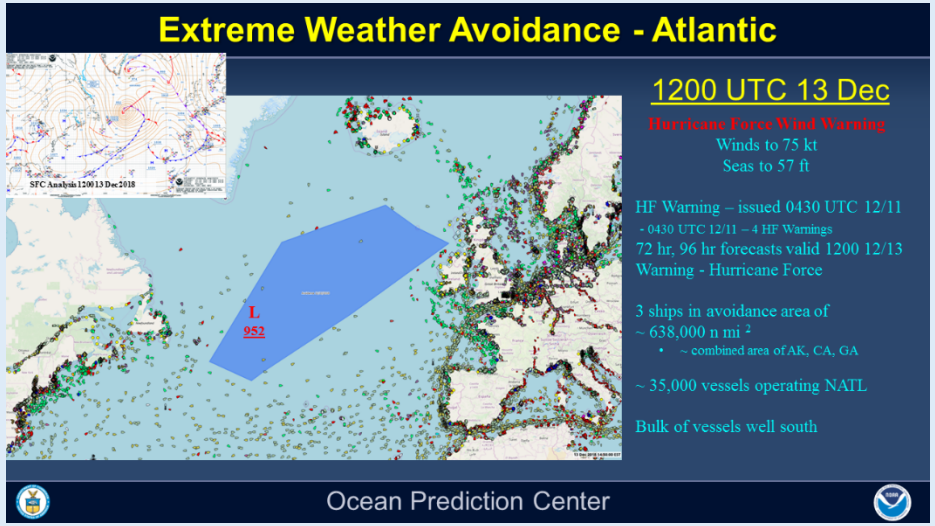
Portland, Maine, US

MARINE ADVISORIES FOR EXTRATROPICAL STORMS

This work was motivated by presentations/conversations with Joe Sienkiewicz (NOAA/OPC) →→→



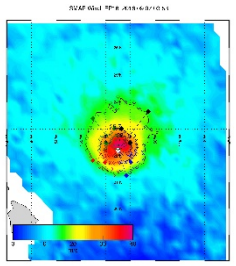
- Marine advisories for avoiding extreme weather are issued by NOAA/OCP based on surface analysis of model forecasts; at this time, these rely on forecaster's experience. They are not automated
- ISSUE: Can Near-Real-Time (NRT) satellite wind observations help in automating the process for the Extratropical Storms?

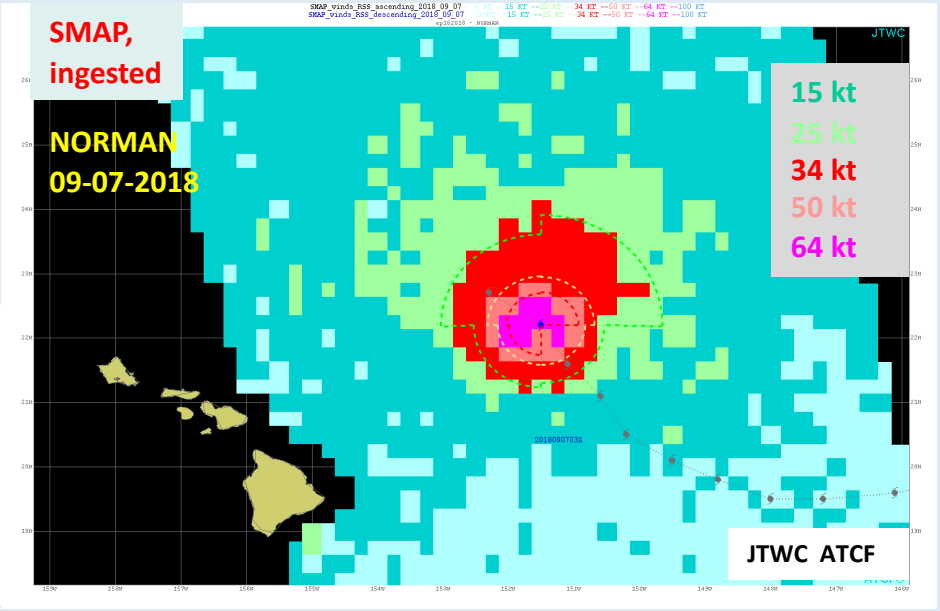
A little background about Tropical Storms

In the past year, using SMAP NRT winds we automated production/distribution of wind analyses for Tropical Cyclones forecasting

- Input: Tropical storm location coming from Best Track data
- Output: jpeg and small text file with SMAP wind intensity and radii for gale/storm/hurricane-force winds
- These "Fixes" are currently ingested in the NAVY/NRL Automated Tropical Cyclone Forecasting (ATCF) system and at the Joint Typhoon Warning Center

Automated SMAP fix





CAN WE DO SOMETHING SIMILAR FOR EXTRATROPICAL STORMS?

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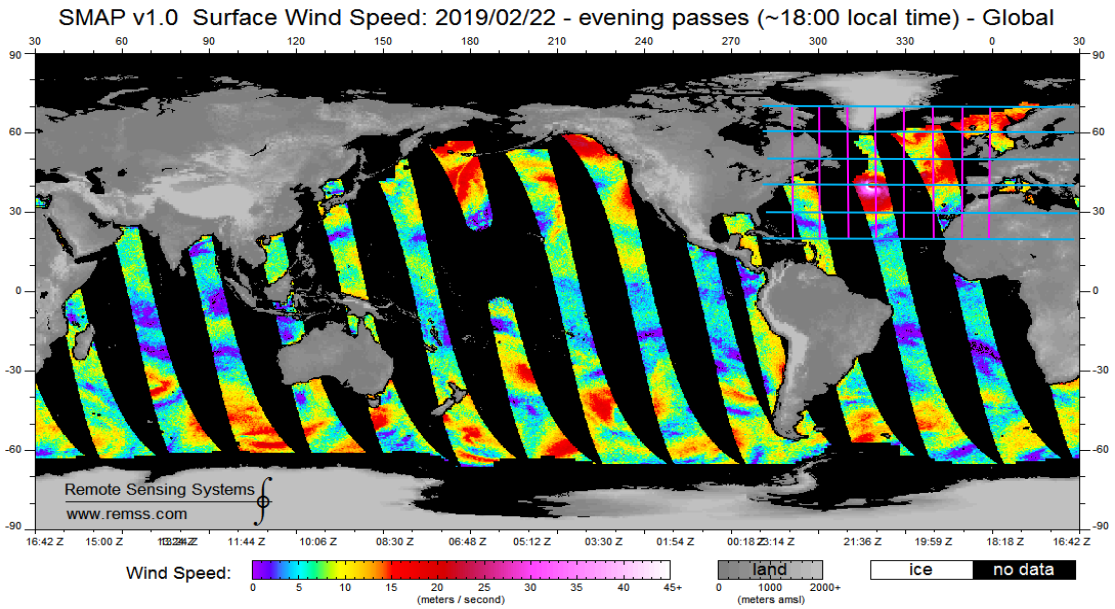
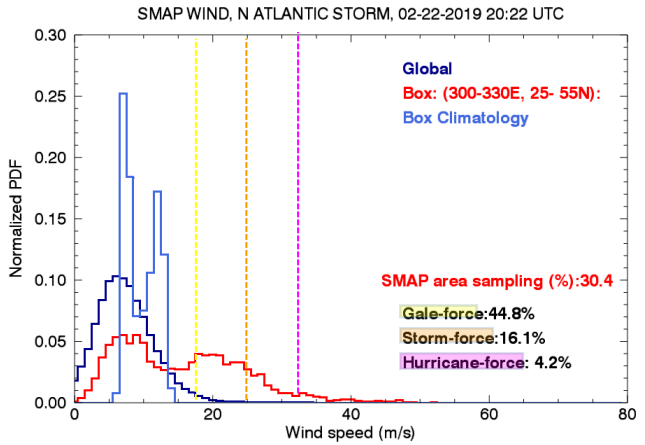
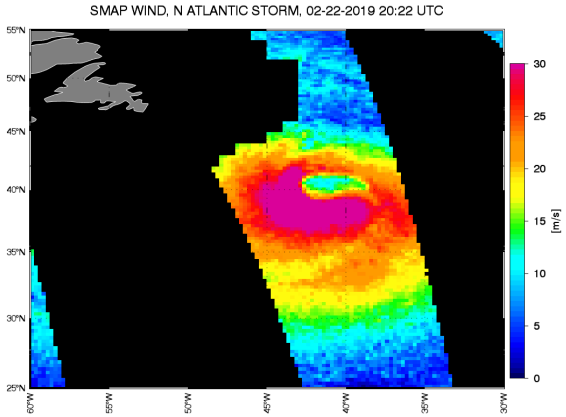
1. NO INPUT NEEDED: No a-priori knowledge on where the storm is
2. Scan each ocean basin in 10x10 deg boxes from gridded satellite data (ASC/DESC)
3. Check wind probability distribution function (PDF) for each box
4. If high occurrence of storm-force winds , then select box
5. Chosen threshold: PDF storm winds >1%
6. Among all 10x10 deg boxes, select the one with highest percentage of hurricane or storm force winds
7. Use selected box as center, and repeat PDF analysis over larger area, 30x30 deg to include full storm
8. OUTPUT: Determine areas affected by gale, storm, hurricane-force winds (jpeg and text file)
9. Tested method with SMAP, ASCAT, WINDSAT, in North Atlantic and North Pacific Ocean (2017-2019)







SAMPLE OUTPUT: SMAP AND ASCAT, Feb 22 2019

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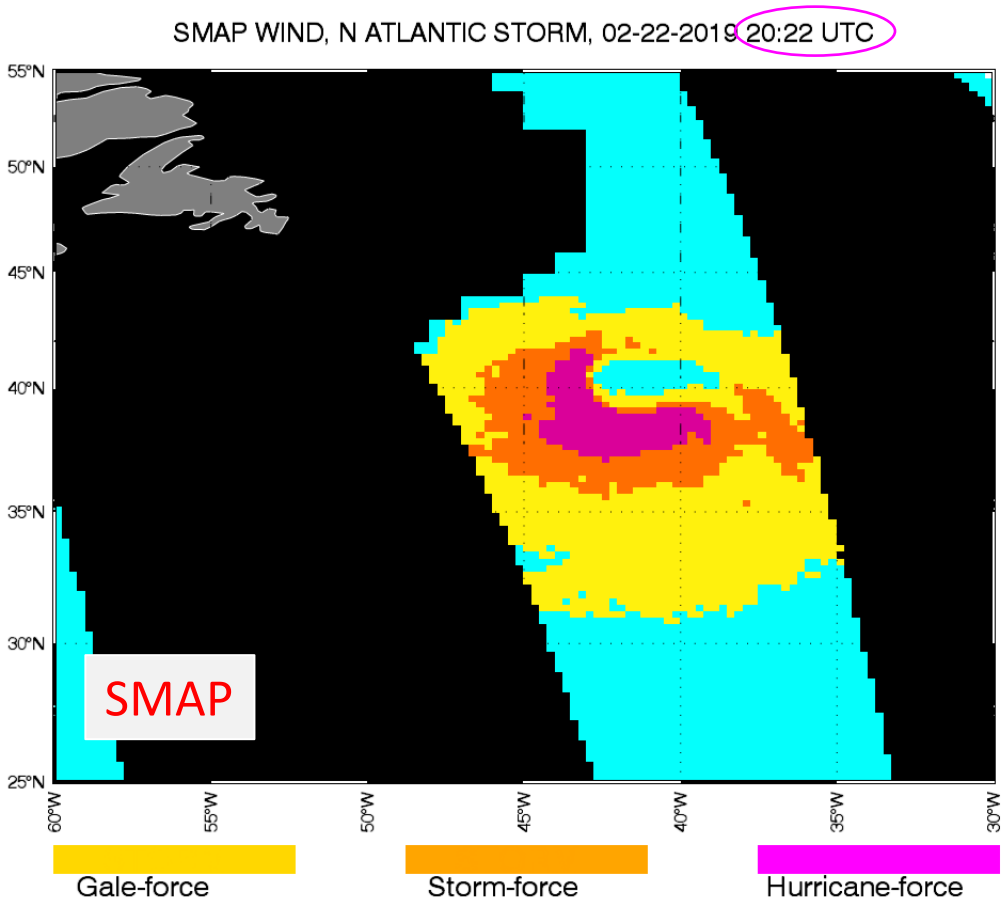

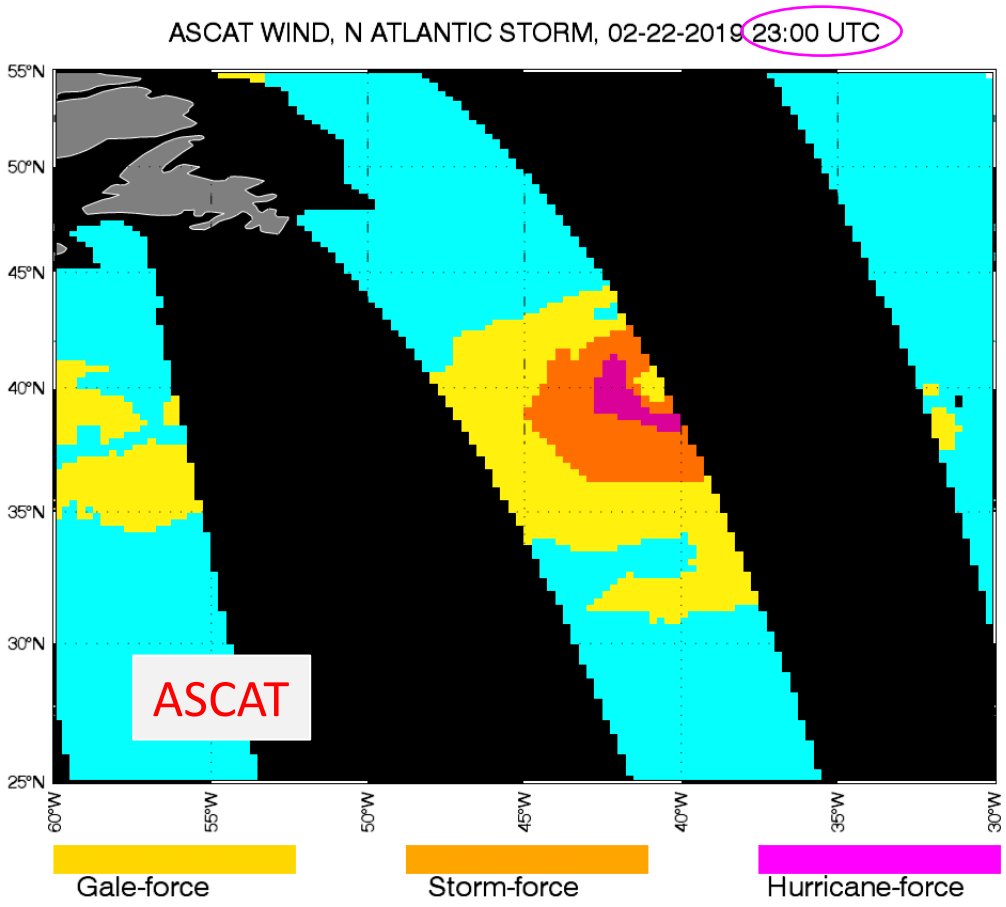

Basin	Sensor	Year	mm	dd	Asc/Dsc	Utime	W_{max}	Lon_{max}	Lat_{max}	G(nm^2)	S(nm^2)	H(nm^2)
NA	SMAP	2019	02	22	A	20 22	>40	317.38	38.88	G 551395	S 184921	H 78770

MONSTER N ATLANTIC STORMS: Dec 11, 2018

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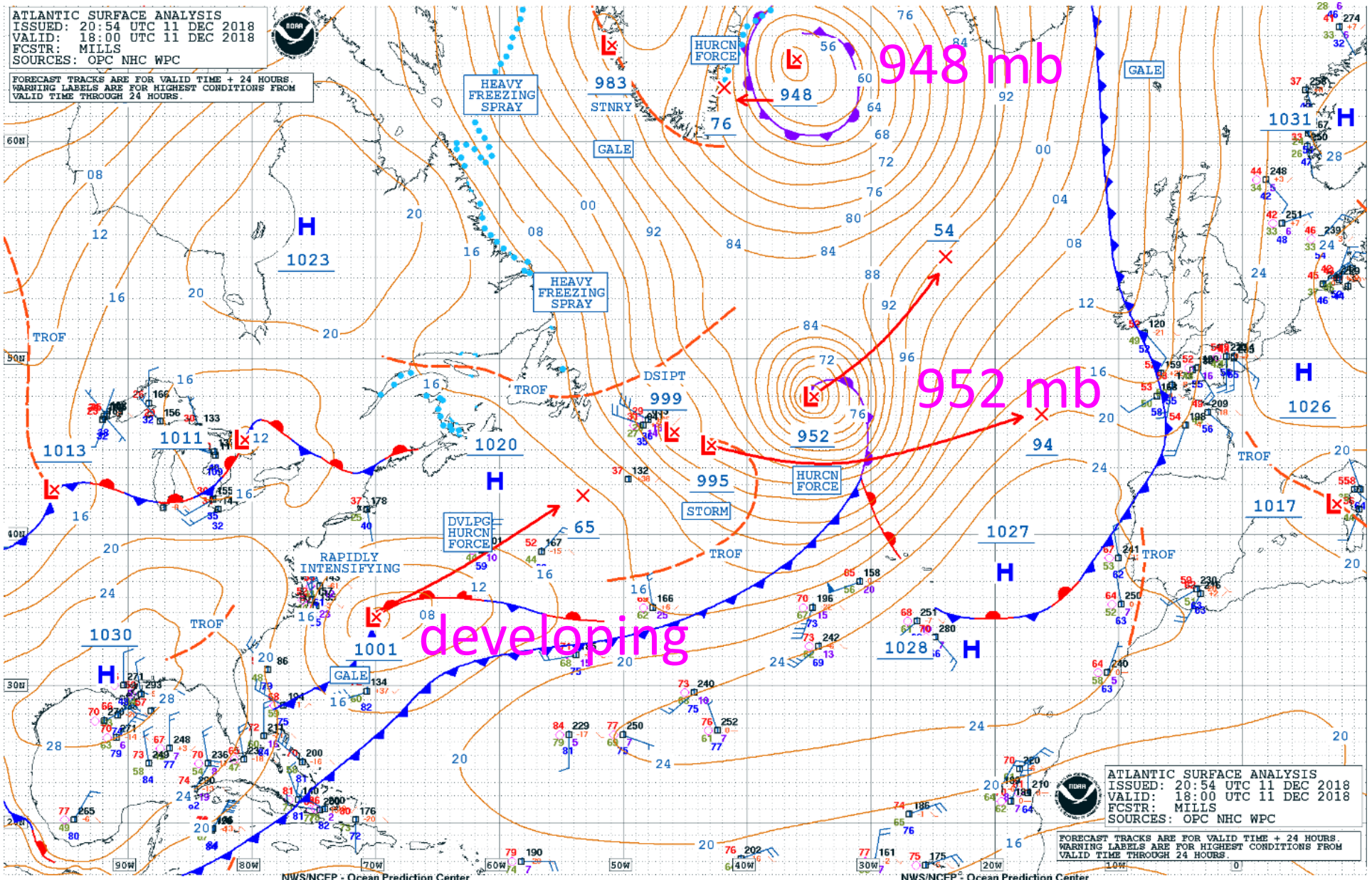

NOAA
Atlantic Surface Analysis
From J. Sienkiewicz

MONSTER STORM 1: Dec 11, 2018: SATELLITE VIEW

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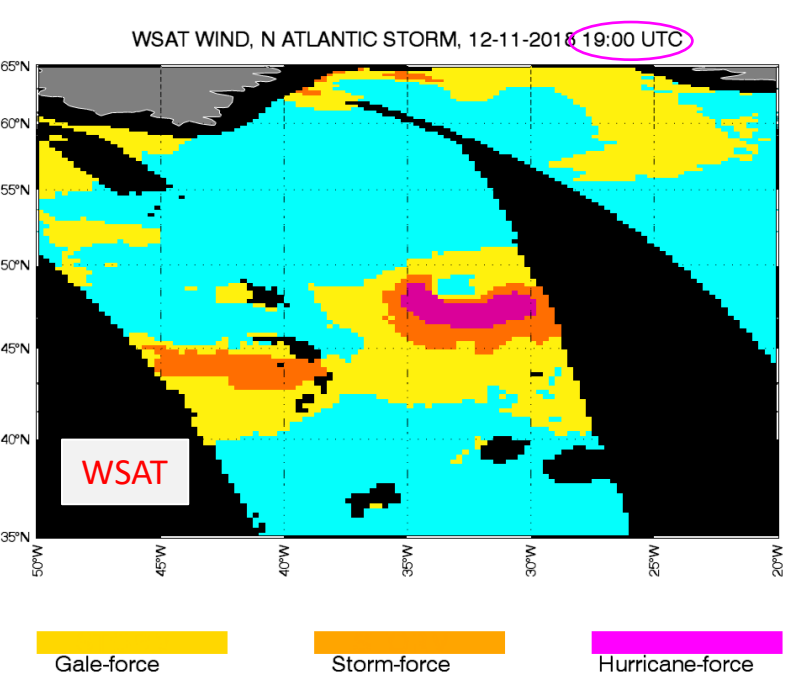

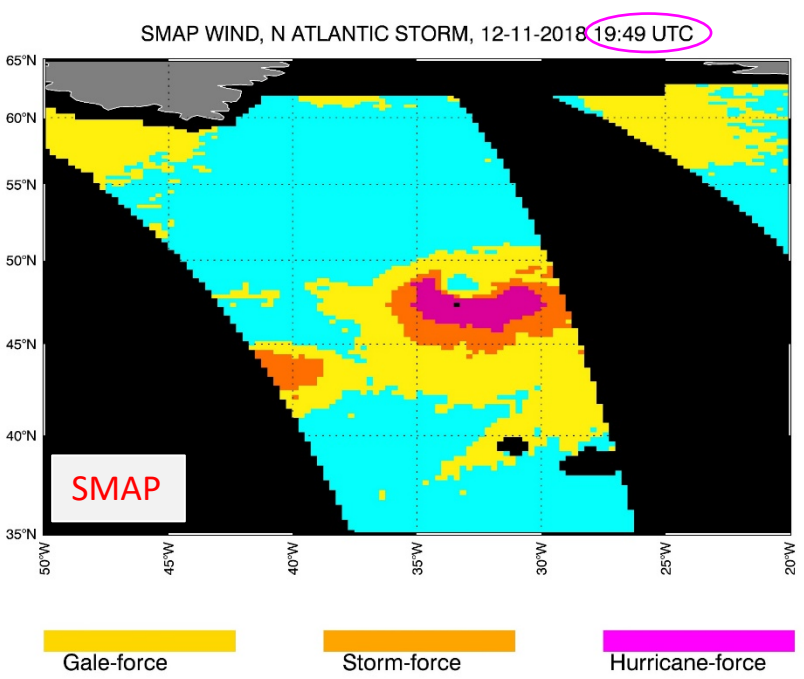

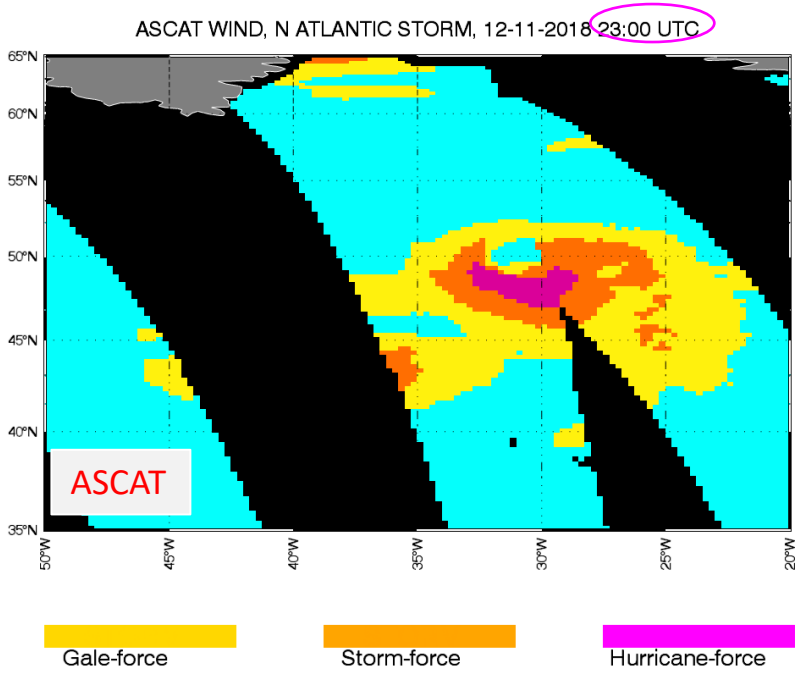

Basin	Sensor	Year	mm	dd	Asc/Dsc	Utime	W_{max}	Lon_{max}	Lat_{max}	$G(nm^2)$	$S(nm^2)$	$H(nm^2)$
NA	WSAT	2018	12	11	D	19 00	>40	326.63	47.13	G 1067386	S 171870	H 56071
NA	SMAP	2018	12	11	A	19 49	>40	326.38	47.38	G 865855	S 123113	H 60540
NA	ASCAT	2018	12	11	D	23 00	>40	329.88	48.38	G 665948	S 186498	H 42662

MONSTER STORM 2: Dec 13, 2018: SATELLITE VIEW

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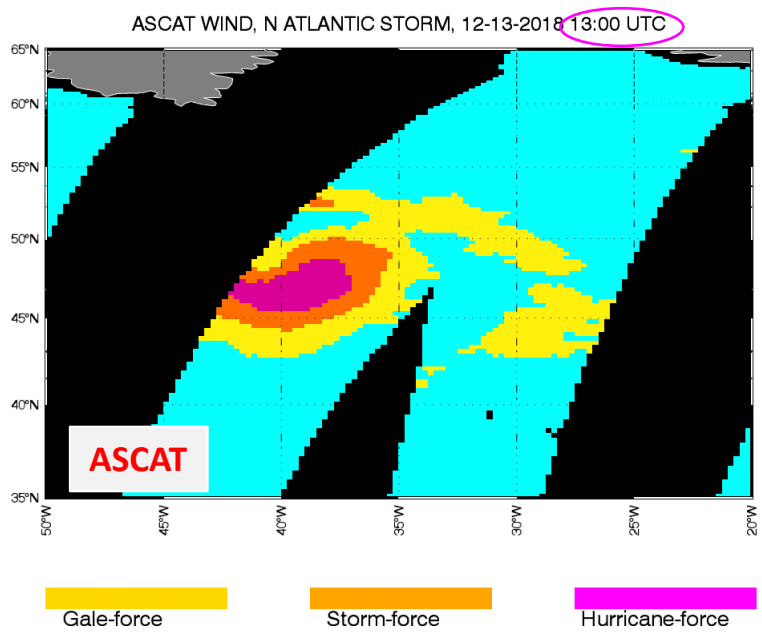
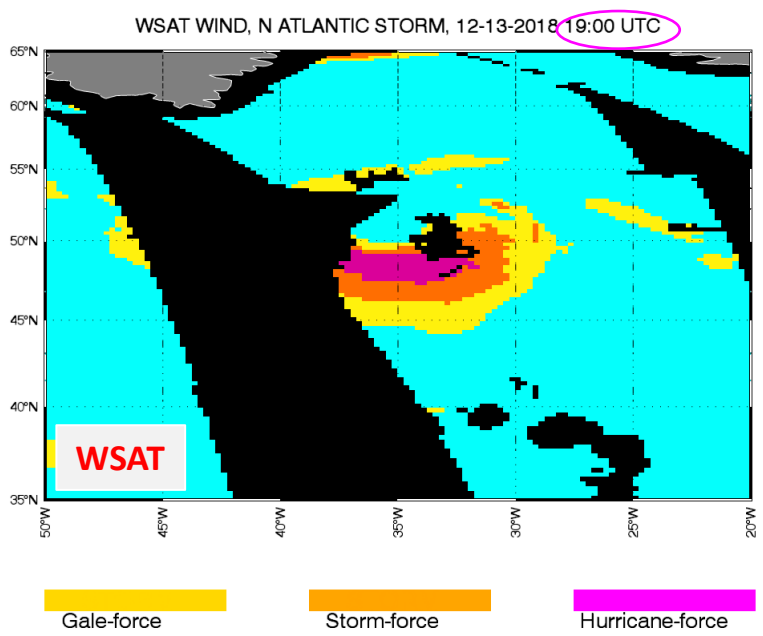
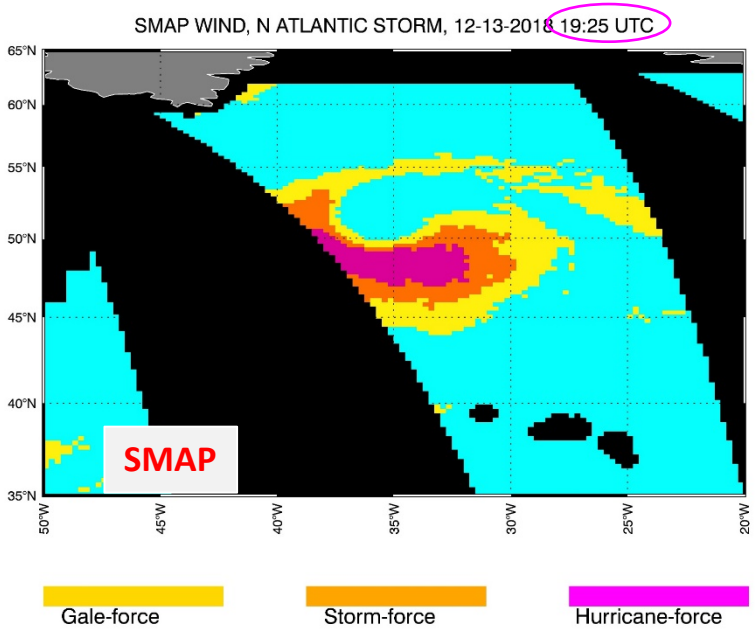
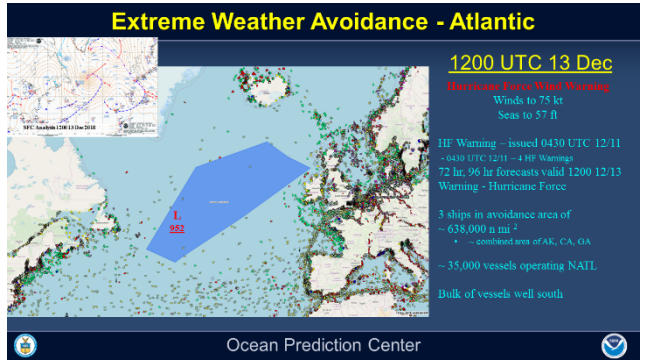






Sensor	Year	mm	dd	Utime	W_{max}		G(nm^2)		S		H
ASCAT	2018	12	13	13 00	>40	G	432318	S	112142	H	70698
WSAT	2018	12	13	19 00	38	G	295796	S	107673	H	51195
SMAP	2018	12	13	19 25	>40	G	358775	S	125957	H	84106
NOAA	2018	12	13	12 00	38 (75 kt)	638000 → ship avoidance area					



STORM OFF MAINE: Dec 6, 2018

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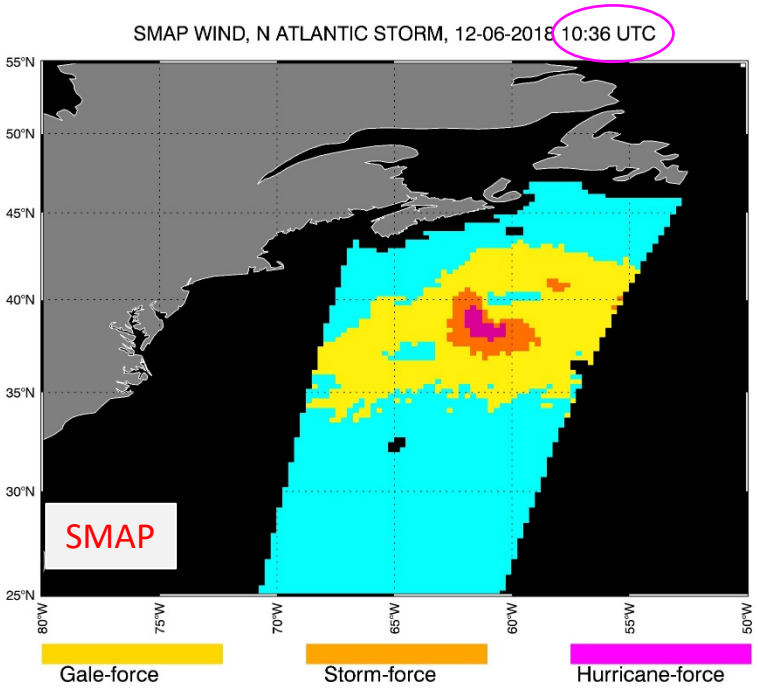

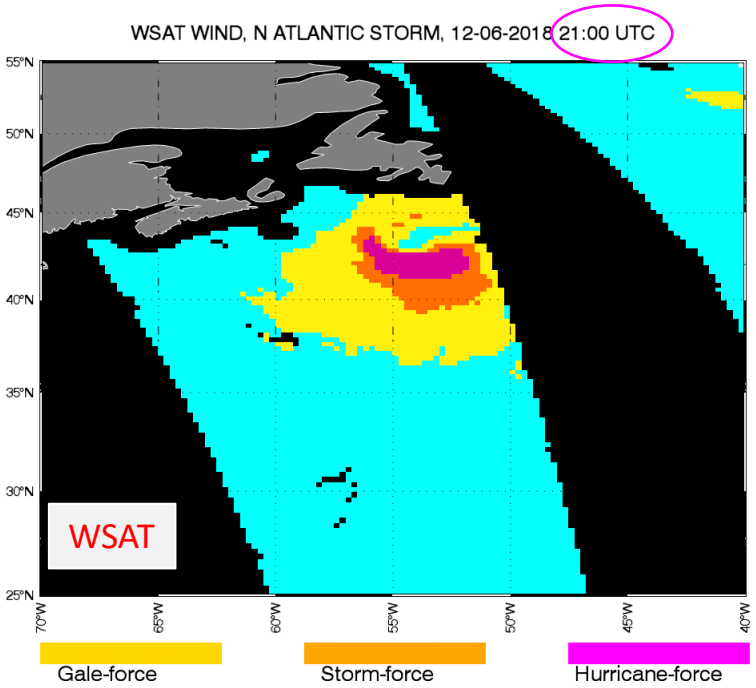

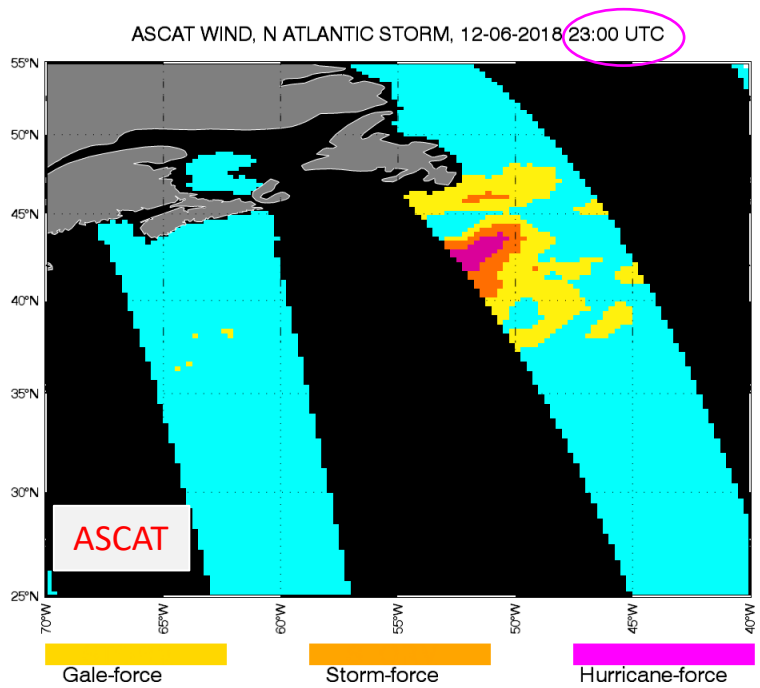

CONCLUSIONS

- Developed a simple algorithm to automatically detect storms in the extra tropics (ET) from satellite observations
- No input needed about storm location
- Only input is the most recent gridded global daily map for each satellite (continuously updated swaths)
- Tested it on SMAP (NRT), WSAT (almost NRT) and ASCAT (manually): Consistent results
- Produces ET storm fixes (images and text files) with storm location and extent of gale/storm/hurricane-force winds.
- Beta-version, not public yet.
- Feedback and suggestions are welcome