Study of Wind Field within Extra-Tropical Cyclones during Hurricane Force Events in the North Pacific from 7 years of QuikSCAT Data

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Motivation

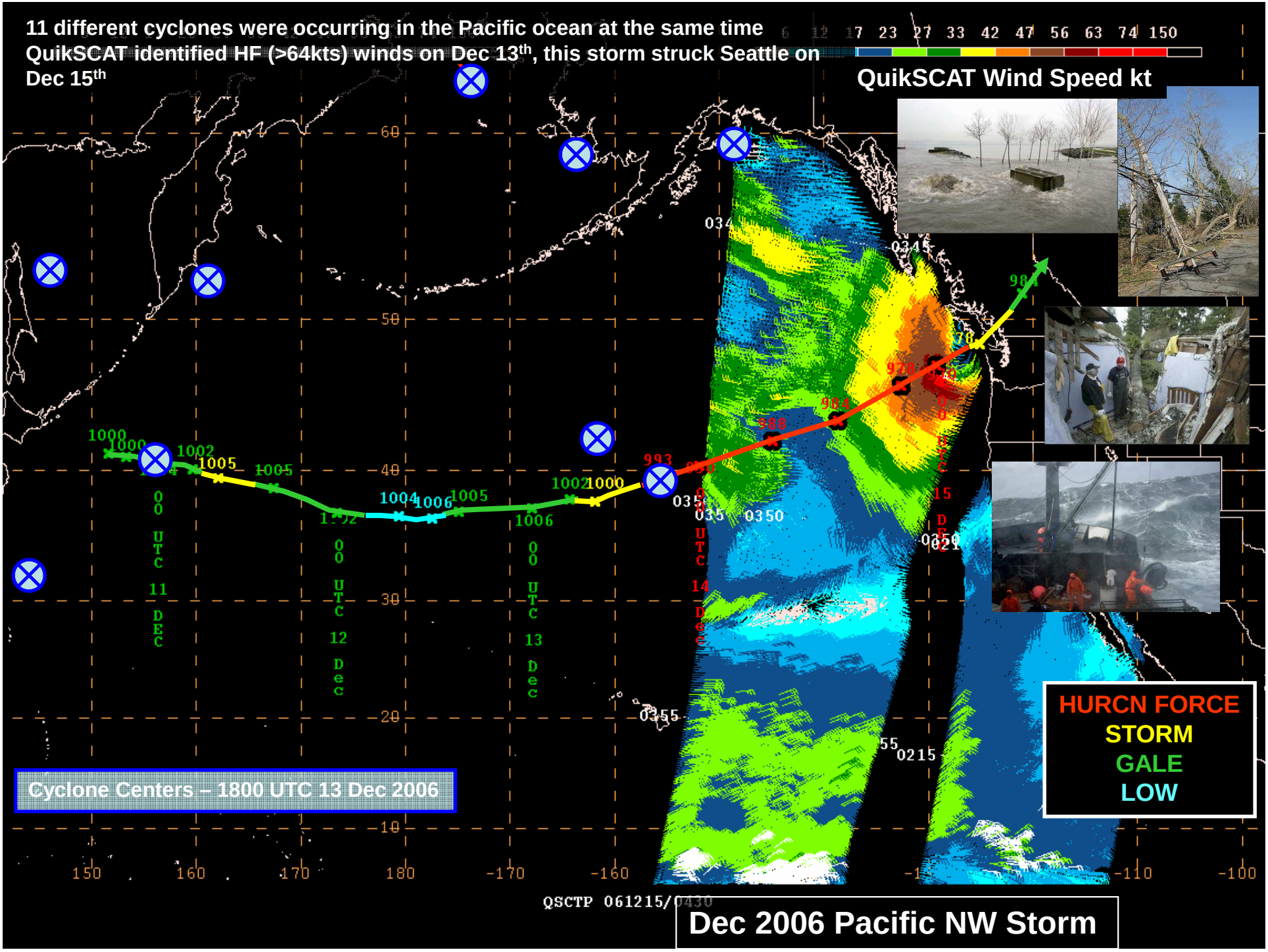
WARNING CATEGORIES

Pre- QuikSCAT ERA

1. GALE 34-47 kt
2. STORM ≥48

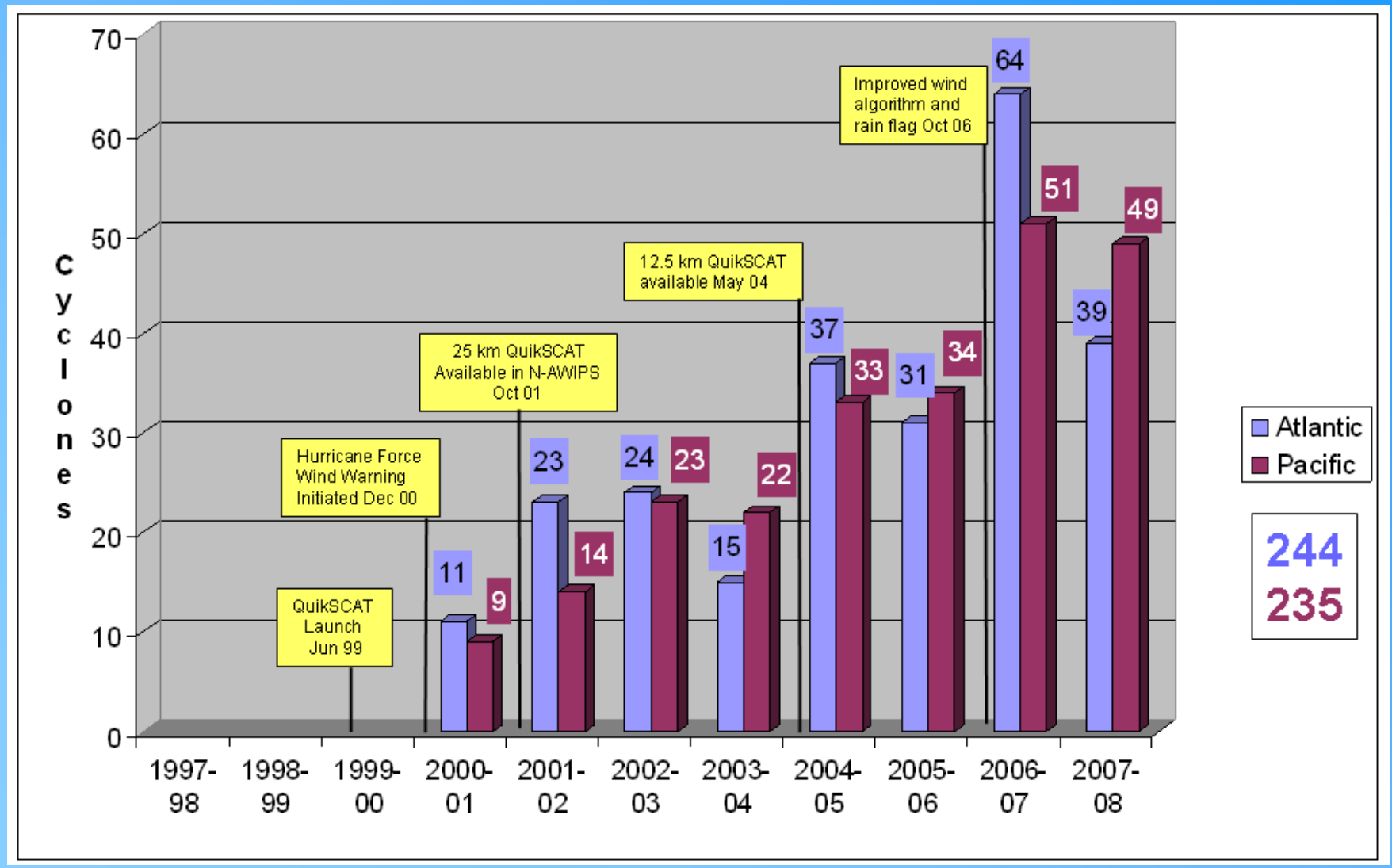
QuikSCAT ERA

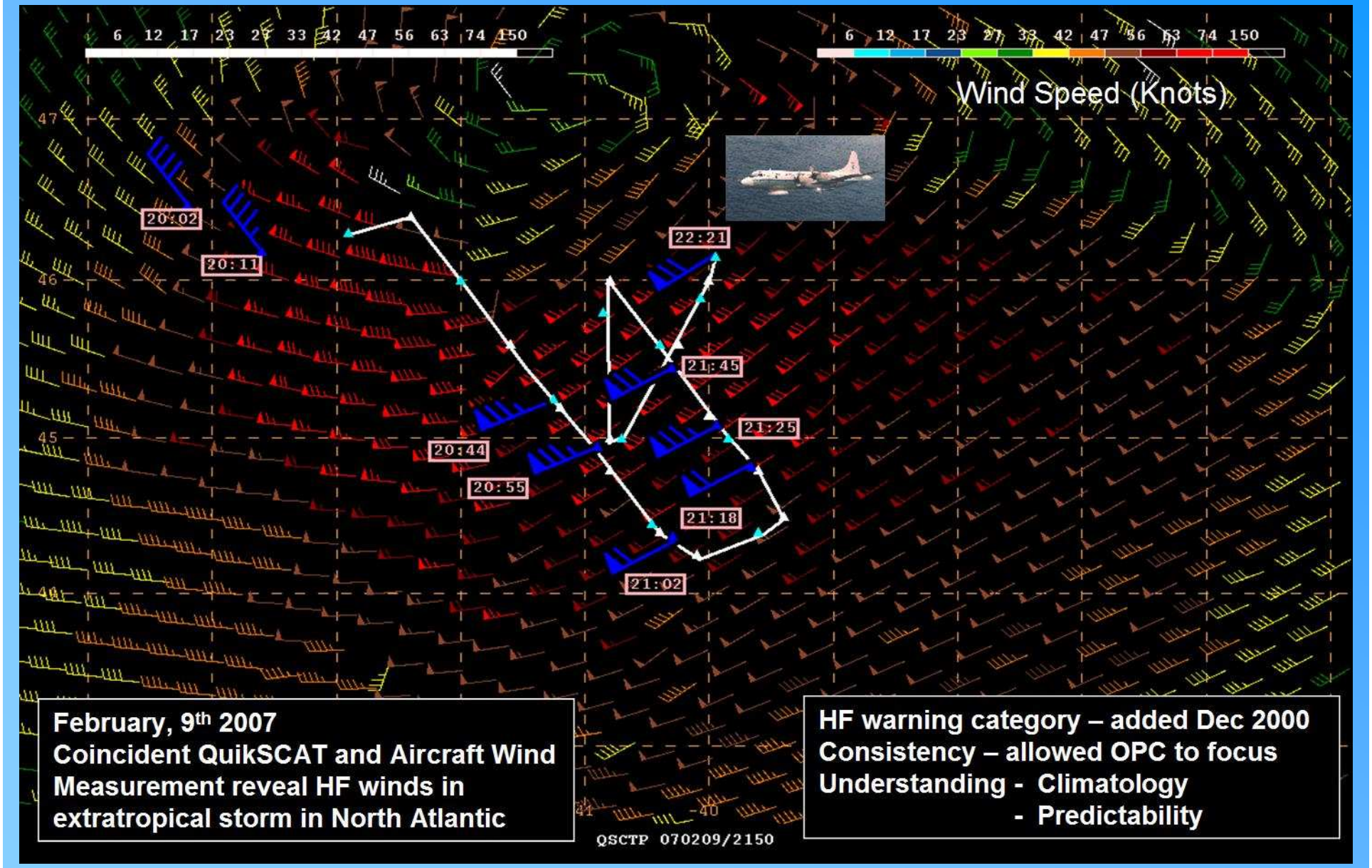
1. GALE 34-47 kt
2. STORM 48 -63 kt
3. HURCN FORCE ≥ 64 kt


11 different cyclones were occurring in the Pacific ocean at the same time
QuikSCAT identified HF (>64kts) winds on Dec 13th, this storm struck Seattle on Dec 15th
7 23 27 33 42 47 56 63 74 150
QuikSCAT Wind Speed kt
HURCN FORCE
STORM
GALE
LOW
Cyclone Centers – 1800 UTC 13 Dec 2006
QSCTP 061215/0430
Dec 2006 Pacific NW Storm

Number of Extratropical cyclones that Reached Hurricane Force (HF) Intensity for Eight Cold Seasons

Dec 2001 – May 2008



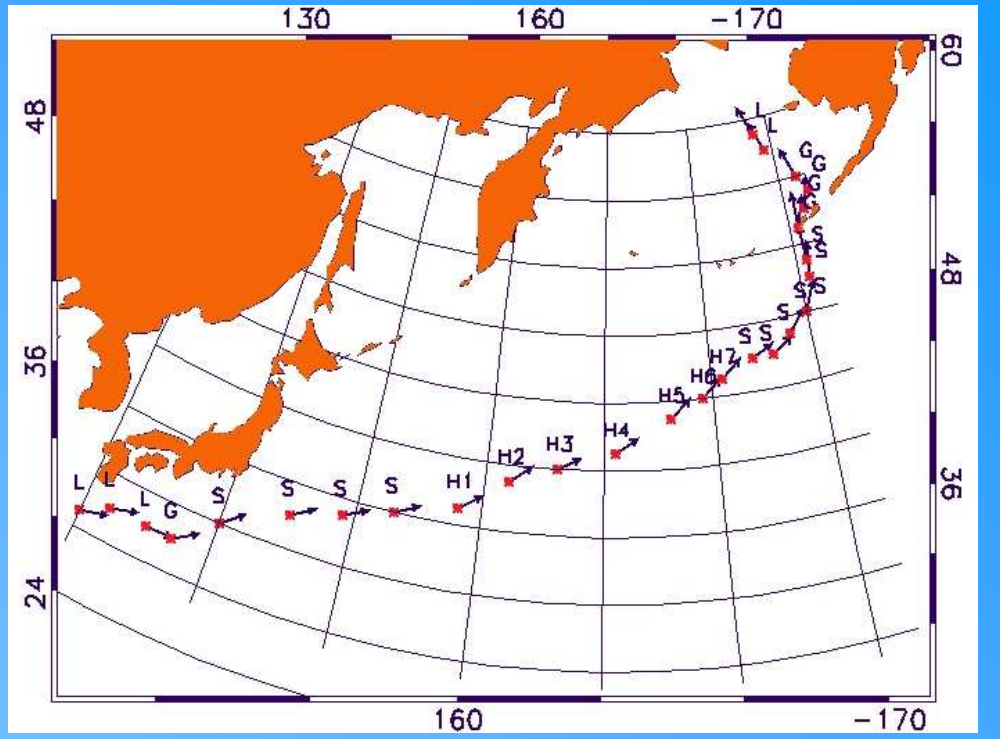


February, 9th 2007
Coincident QuikSCAT and Aircraft Wind Measurement reveal HF winds in extratropical storm in North Atlantic

HF warning category – added Dec 2000
Consistency – allowed OPC to focus
Understanding - Climatology
- Predictability

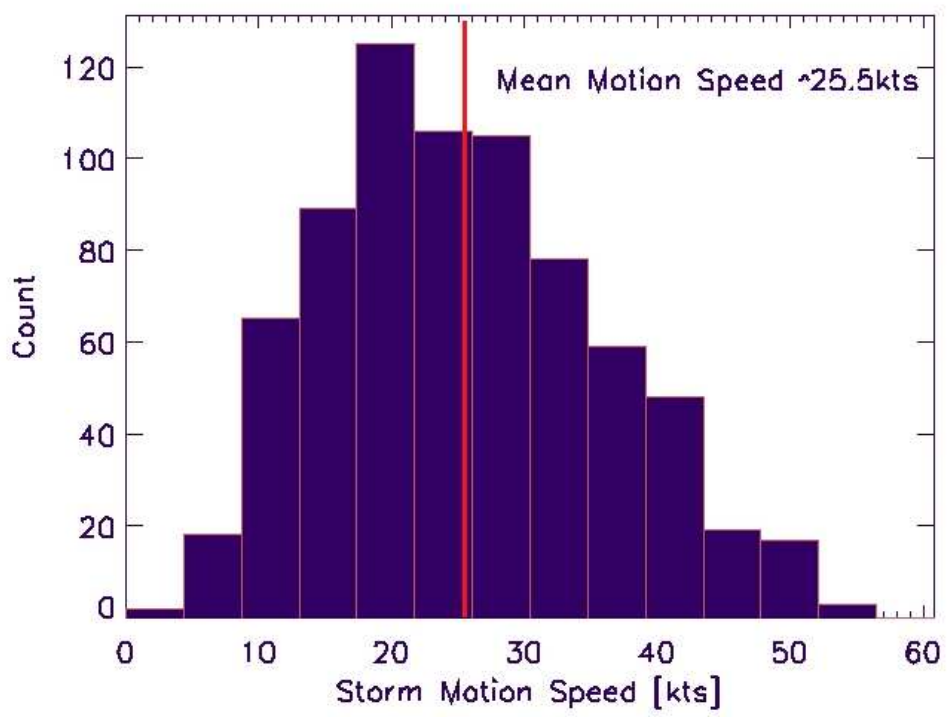
HF Cyclone Database

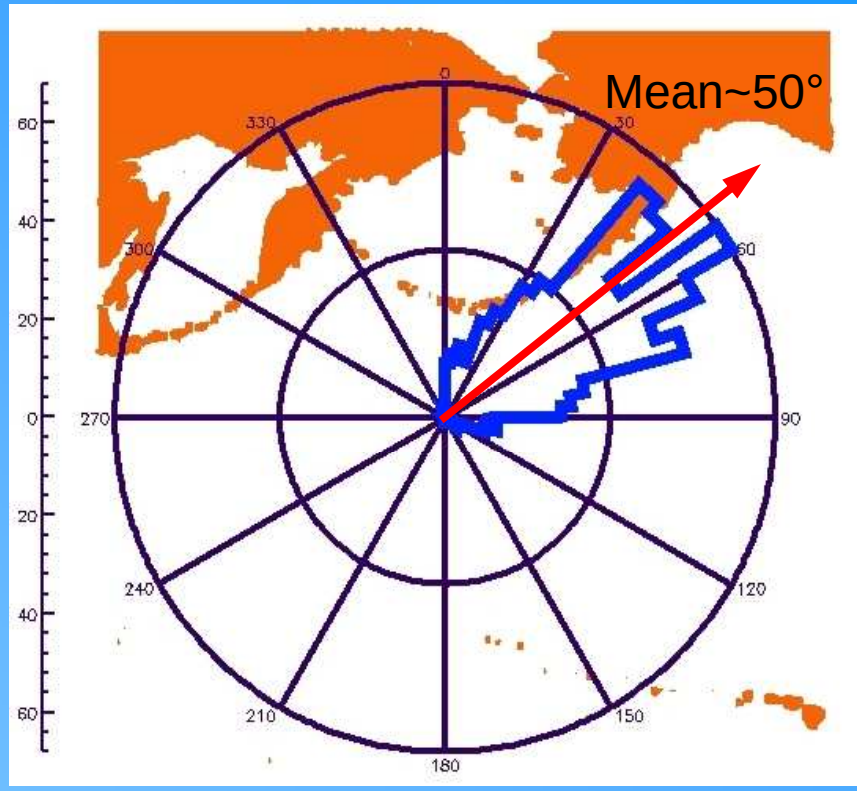
Storm ID	Date	Lat	Lon	Press.	Type
PAC011007	2007100712	43.93	-169.72	1013	L
PAC011007	2007100718	43.23	-164.06	1010	G
PAC011008	2007100800	42.37	-158.38	1010	G
PAC011008	2007100806	41.33	-152.07	1007	G
PAC011008	2007100812	39.87	-143.82	998	S
PAC011008	2007100818	40.76	-137.83	974	S
PAC011009	2007100900	43.15	-134.94	970	H
PAC011009	2007100906	44.46	-134.08	964	H
PAC011009	2007100912	46.45	-132.94	966	H
PAC011009	2007100918	47.51	-132.81	968	H
PAC011010	2007101000	48.90	-132.36	967	S
PAC011010	2007101006	50.65	-132.3	964	S
PAC011010	2007101012	52.17	-132.36	975	G
PAC011010	2007101018	53.67	-131.68	977	G



- Estimate cyclone motion speed and direction
- Extract all hurricane force 6-h cycles per month
- Extract hurricane force events during 6h, 12h 18h, 24h and >24h
- Perform statistical analysis of these events
- Select QuikSCAT files that correspond to each chosen event

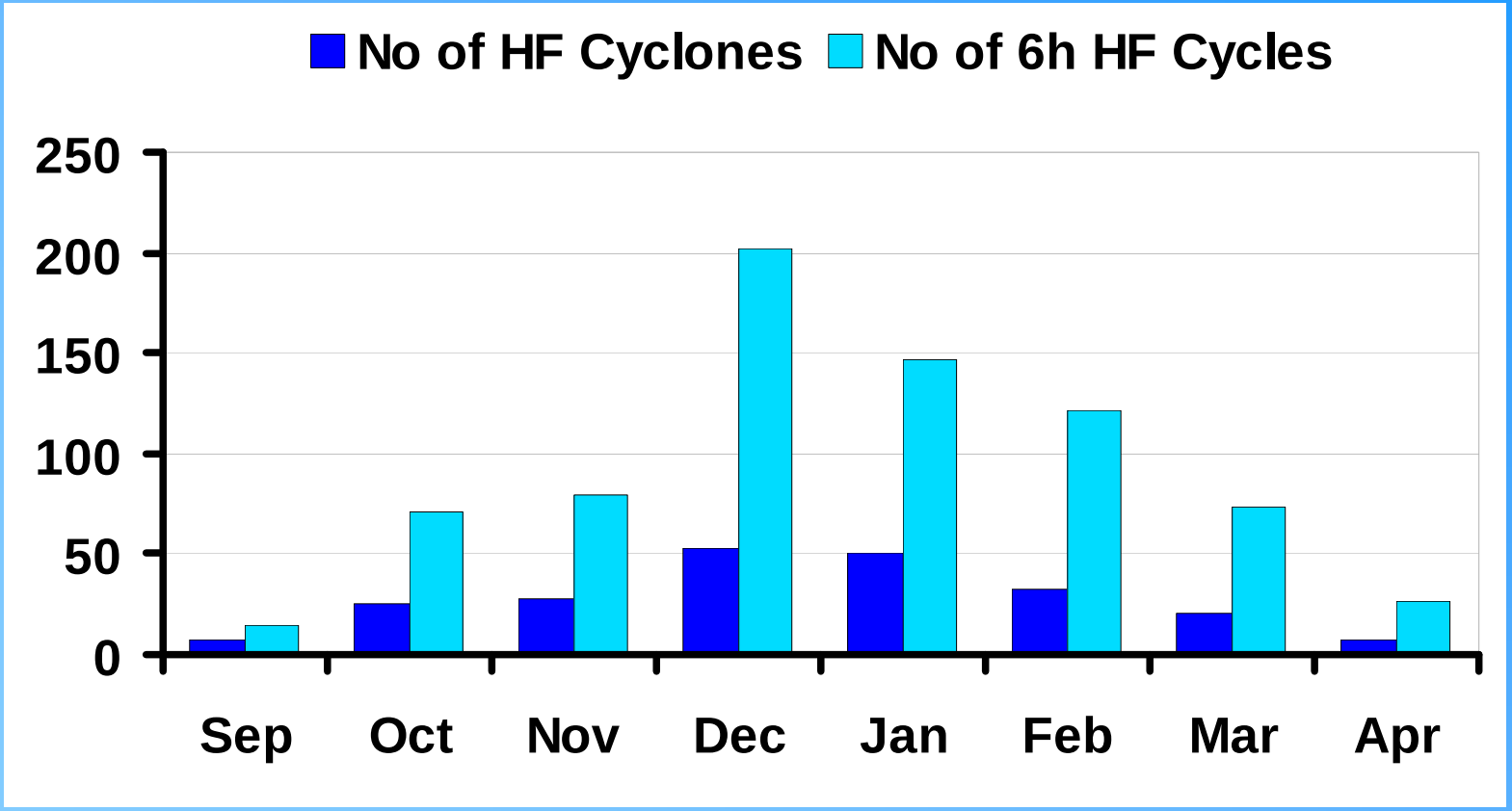
Cyclone Motion Speed and Direction during HF cycles





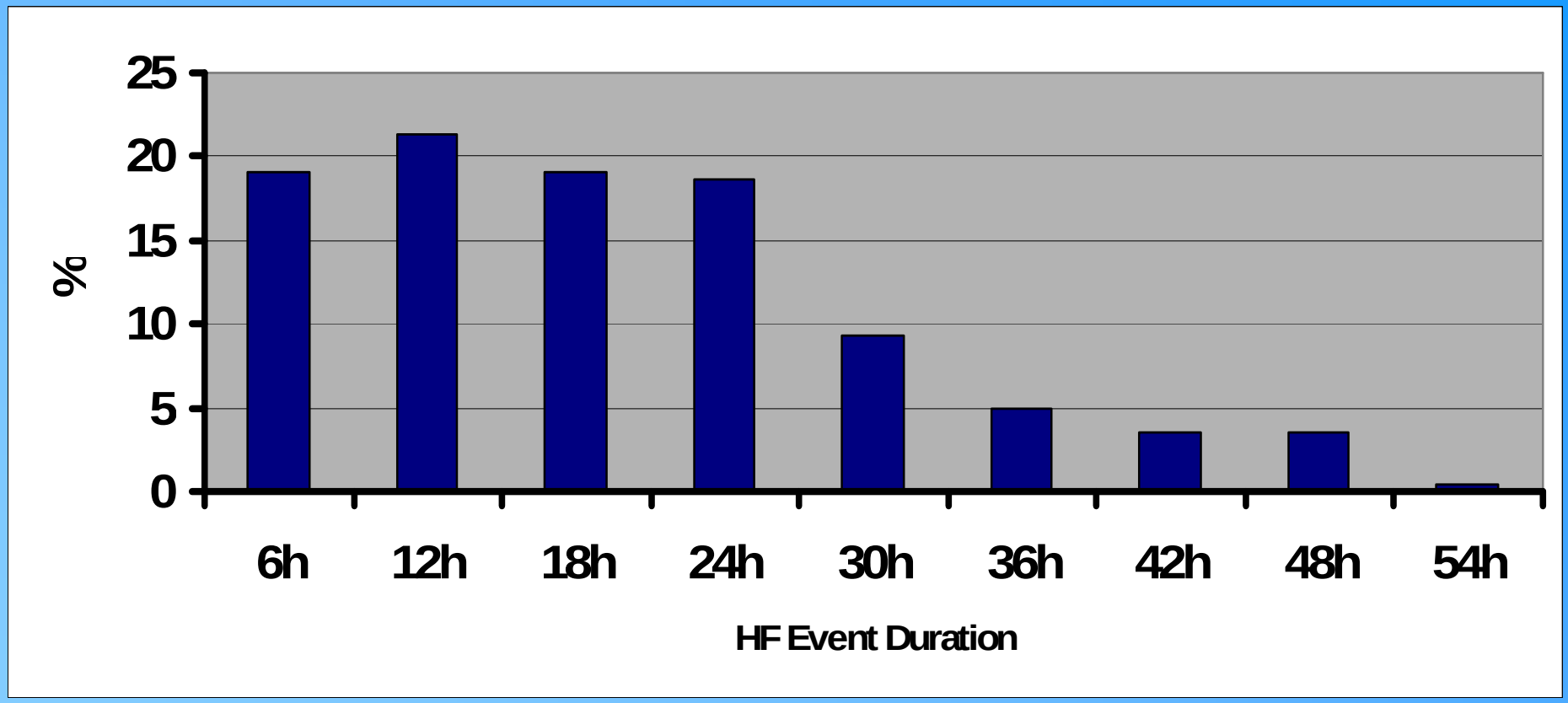
- Fast moving cyclones with average storm speed ~25kts
- Storm moving in NE direction (average heading 50°) during hurricane force wind phases

Number of HF Cyclones per Month 2001-2008 North Pacific



- Extratropical cyclone season from September to April
- Peak activity during December and January
- September and April have same number of cyclones, but April storms last longer

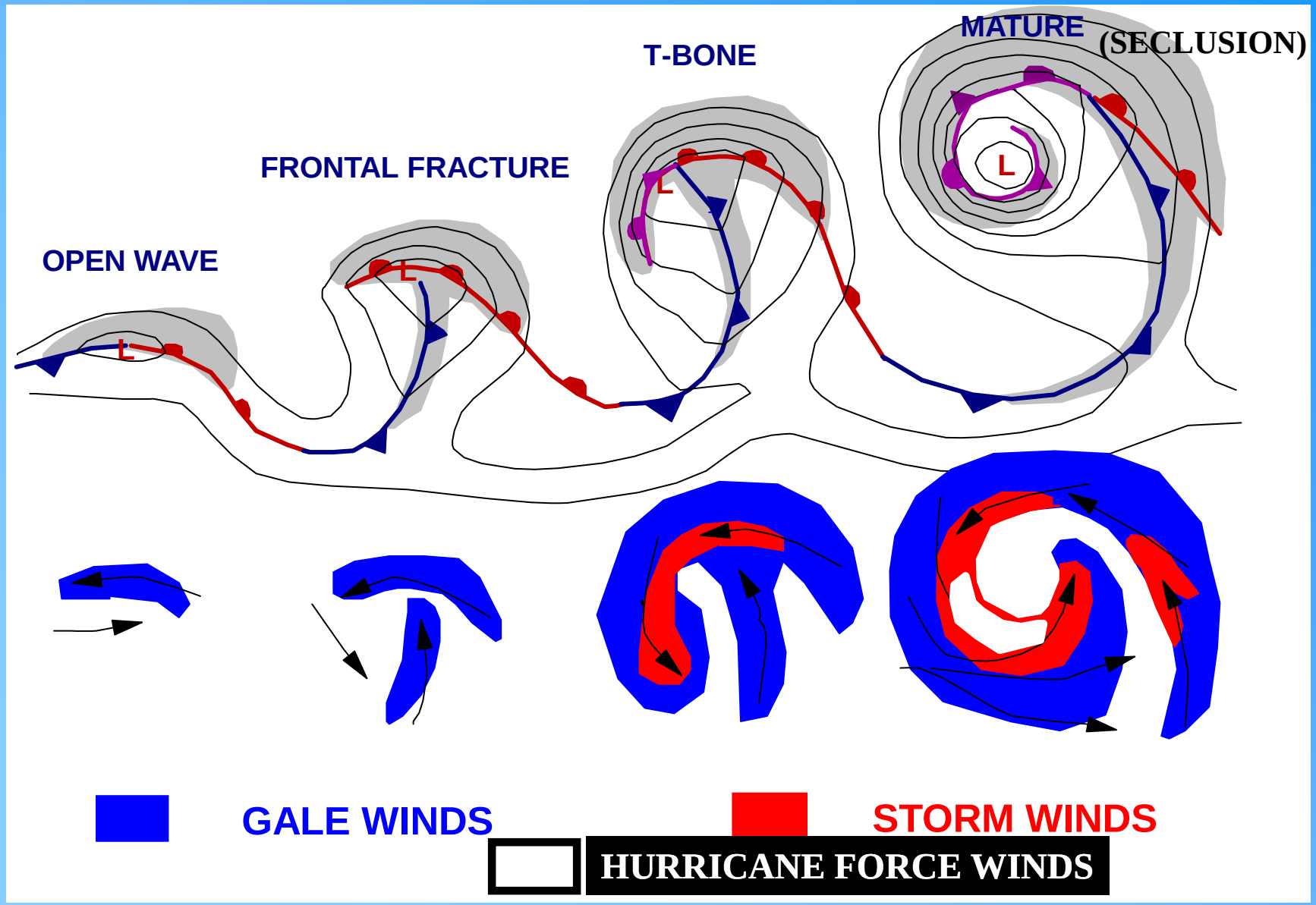
Duration of HF Events



- Most HF events last between 6-24h
- 50% of 12-h events occurred during December
- 75% of 30-h events occurred during November and December
- In February most events last between 18-24h

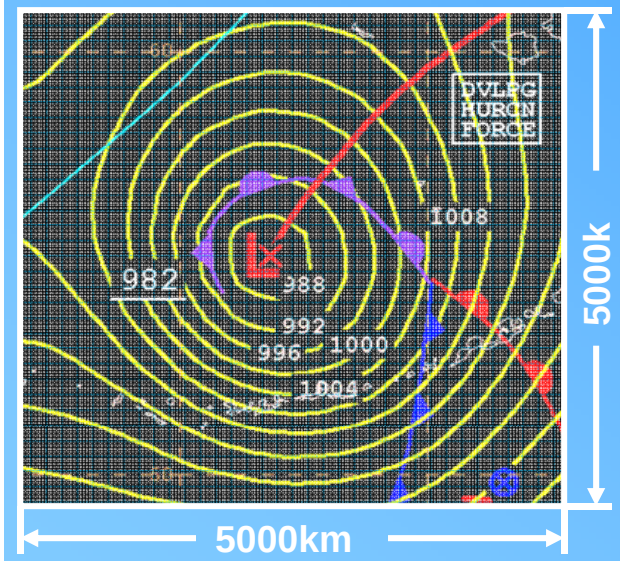
Extratropical Storm Life Cycles

(adapted from Shapiro – Keyser Cyclone Model)

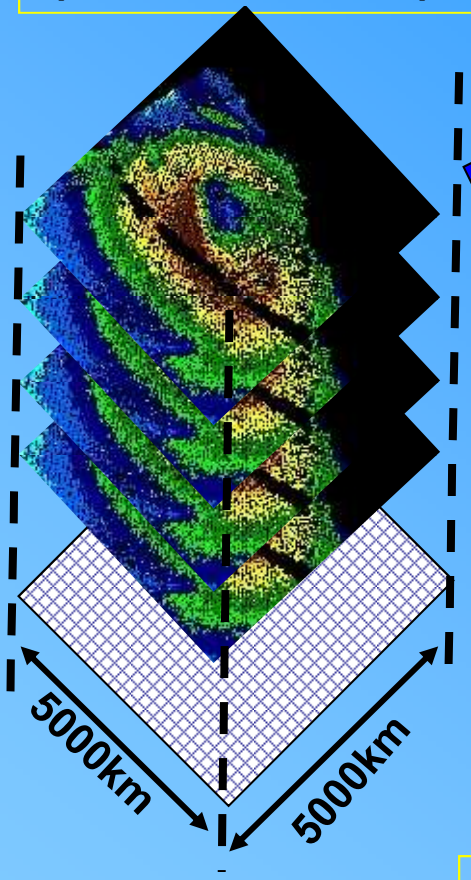


Storm track file

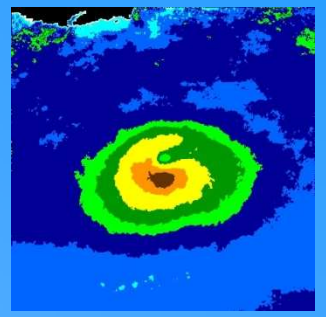
Read HF Cyclone Info.

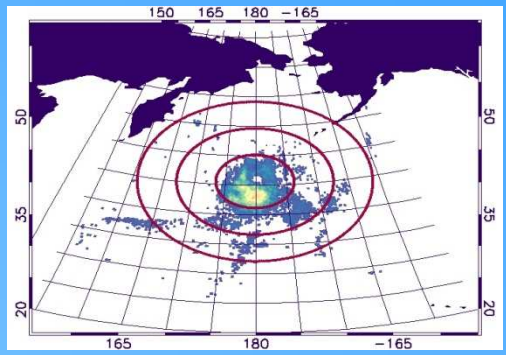


Extract Science QS 12.5km Data
&
Perform QC
(land, ice, coast, rain) flags

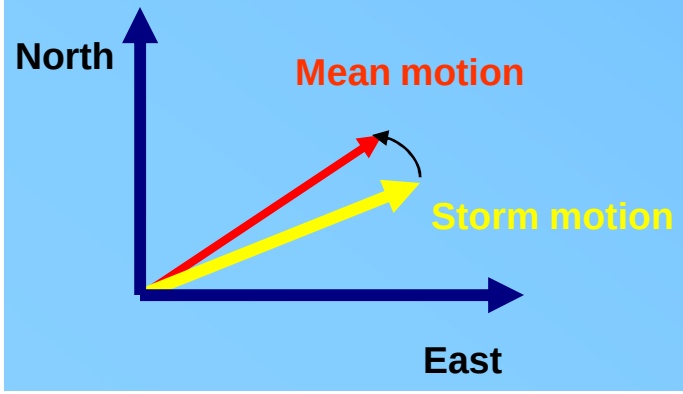


Generate Mean Wind Fields



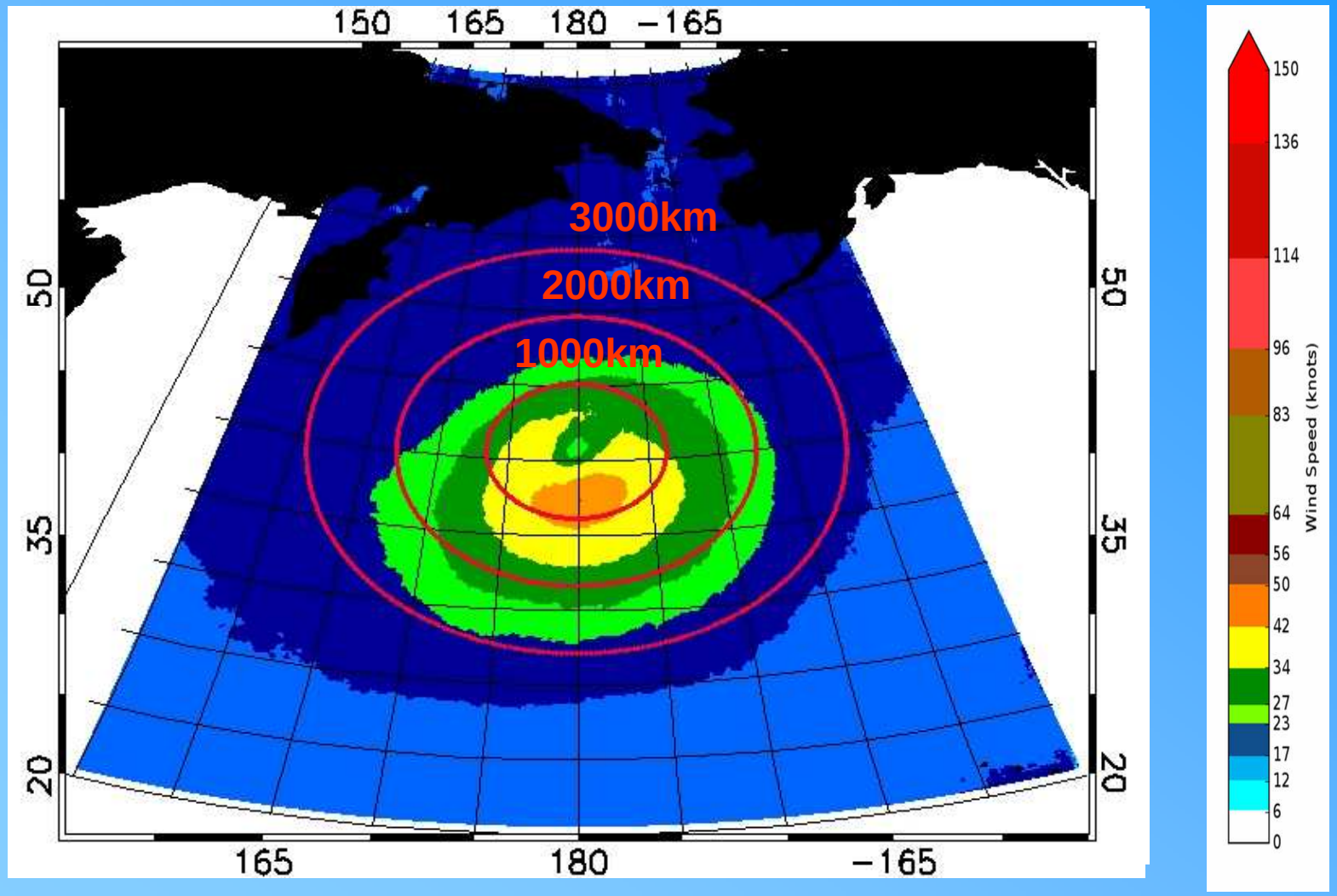


Estimate speed & Angle
(Heading Vector)



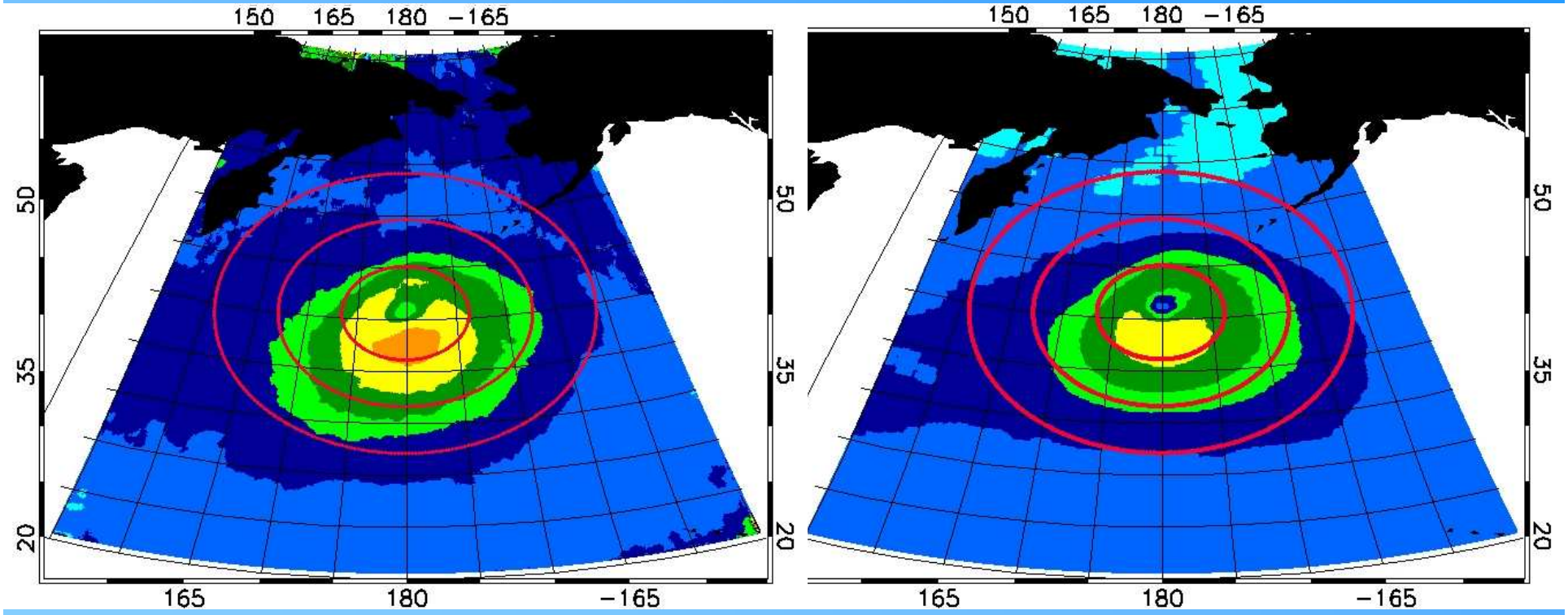
Generate Frequency of HF Occurrence per grid fields

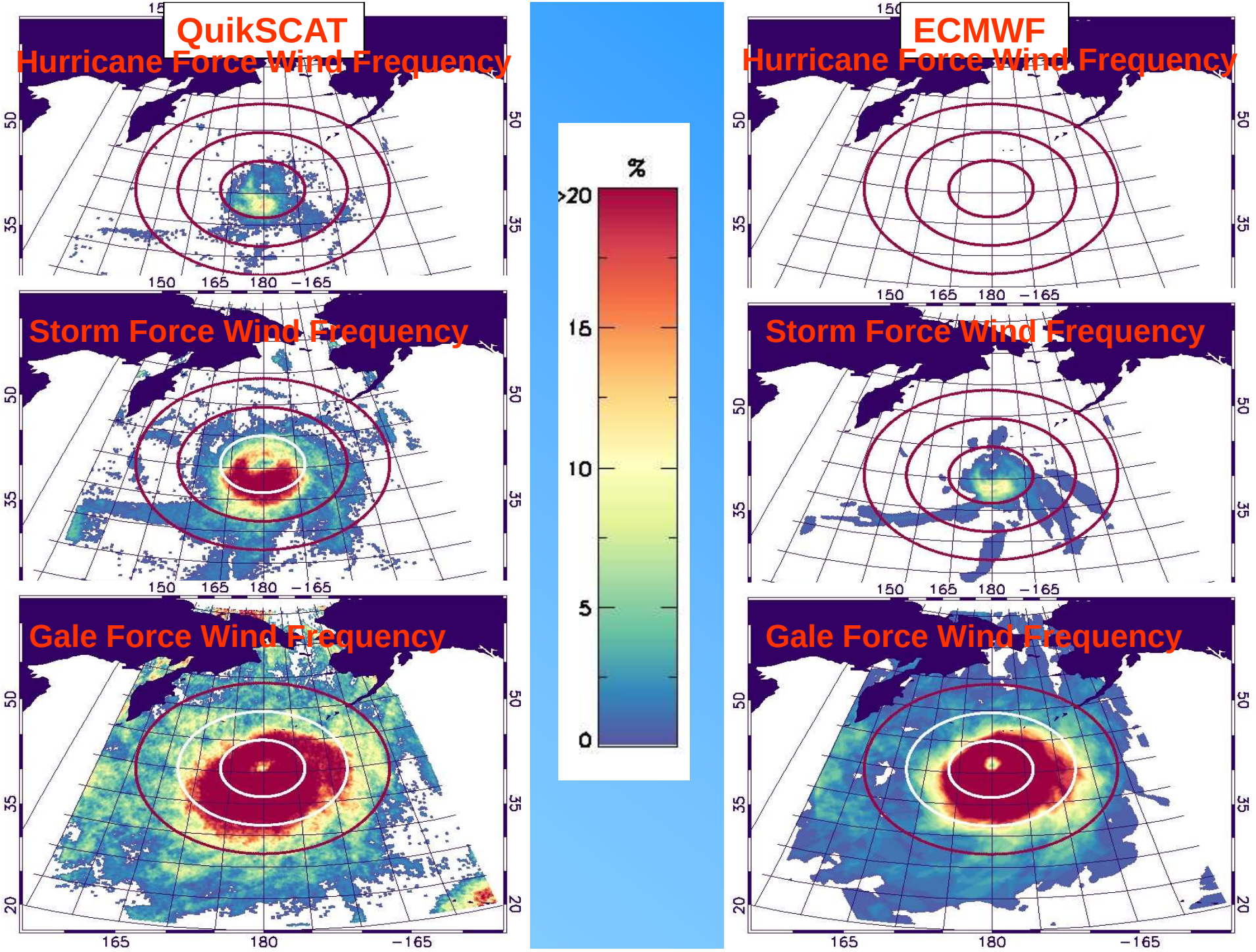
Mean Cyclone Wind Speed 2001-2008 North Pacific

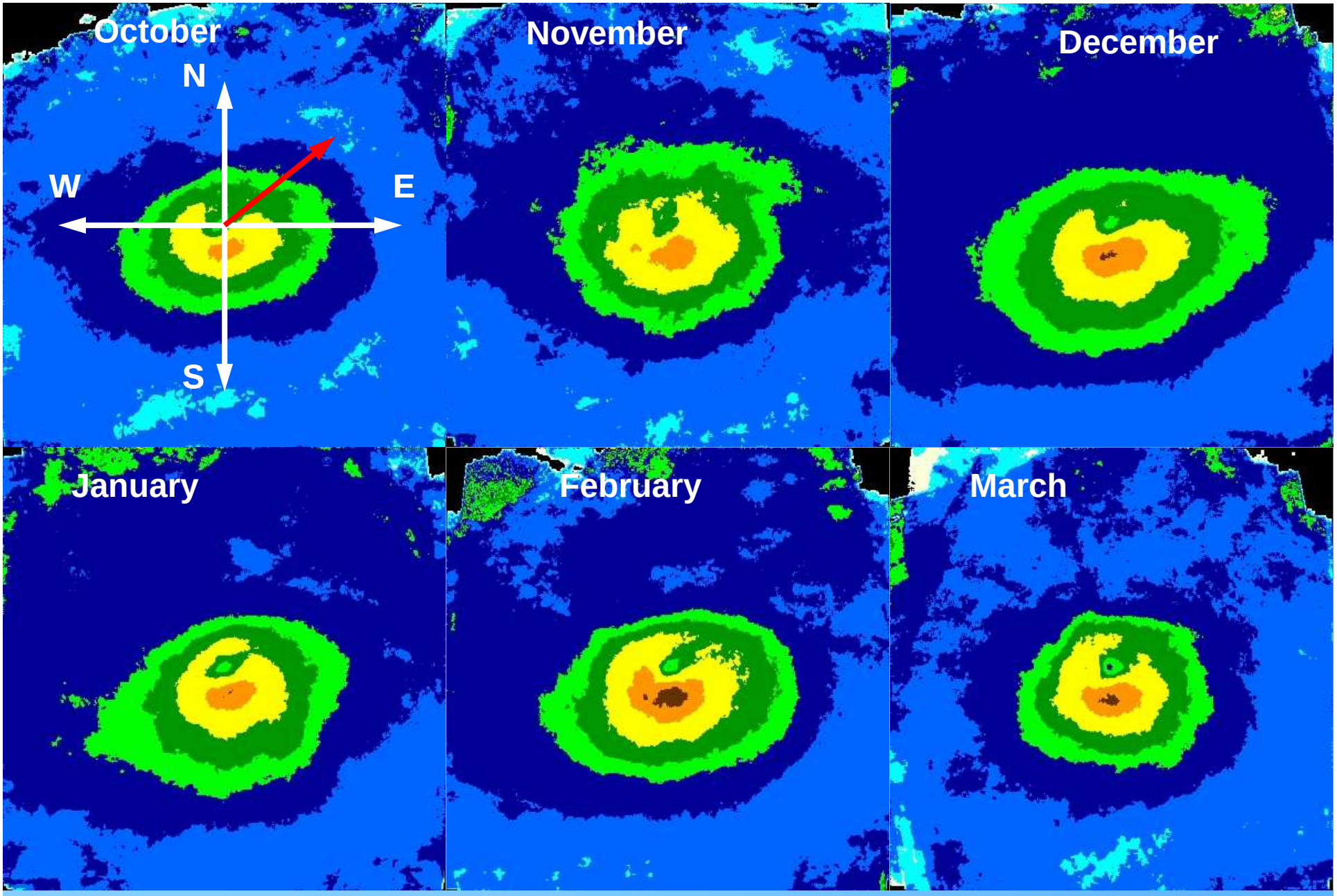


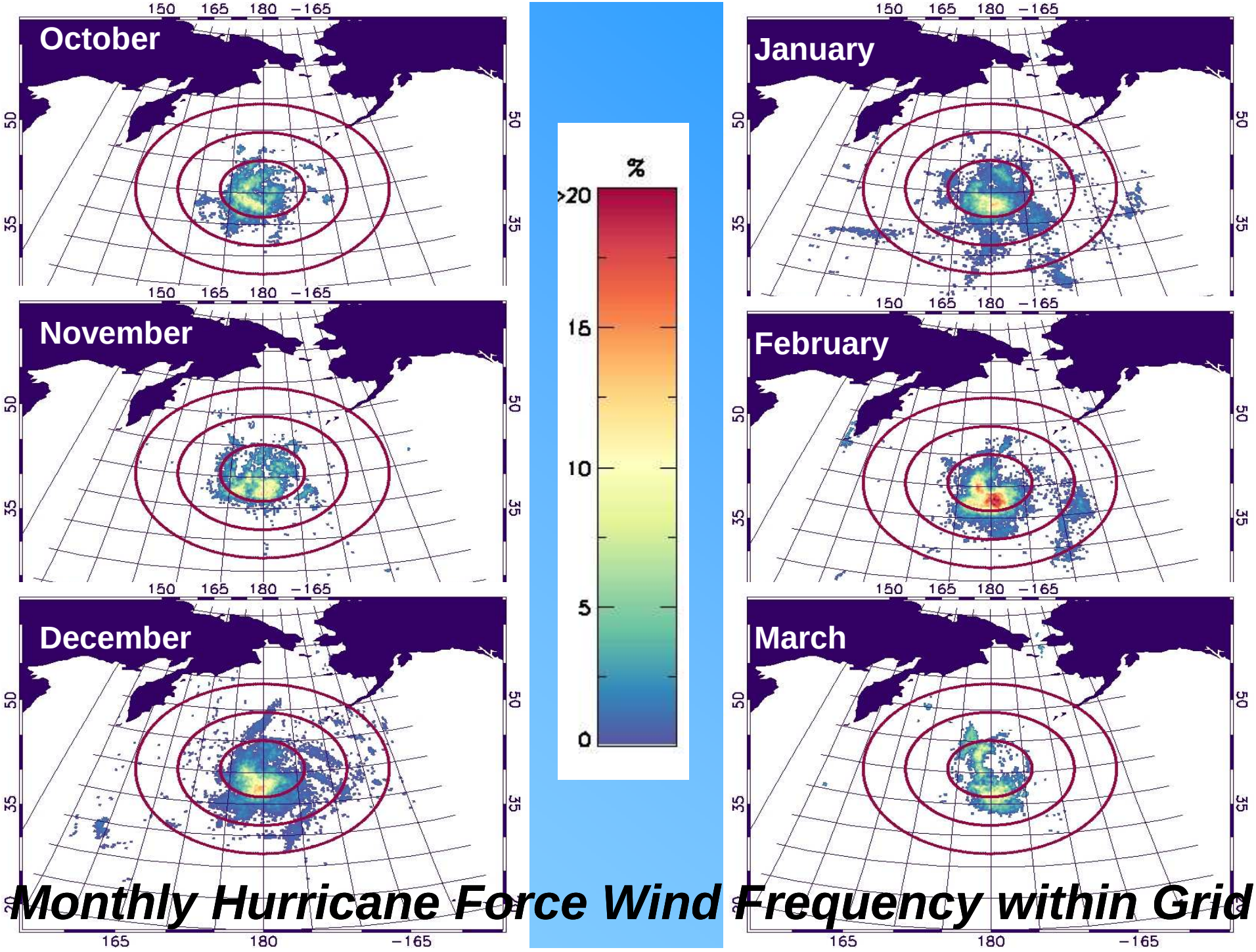
Mean Wind Speed Field 2007-2008 North Pacific

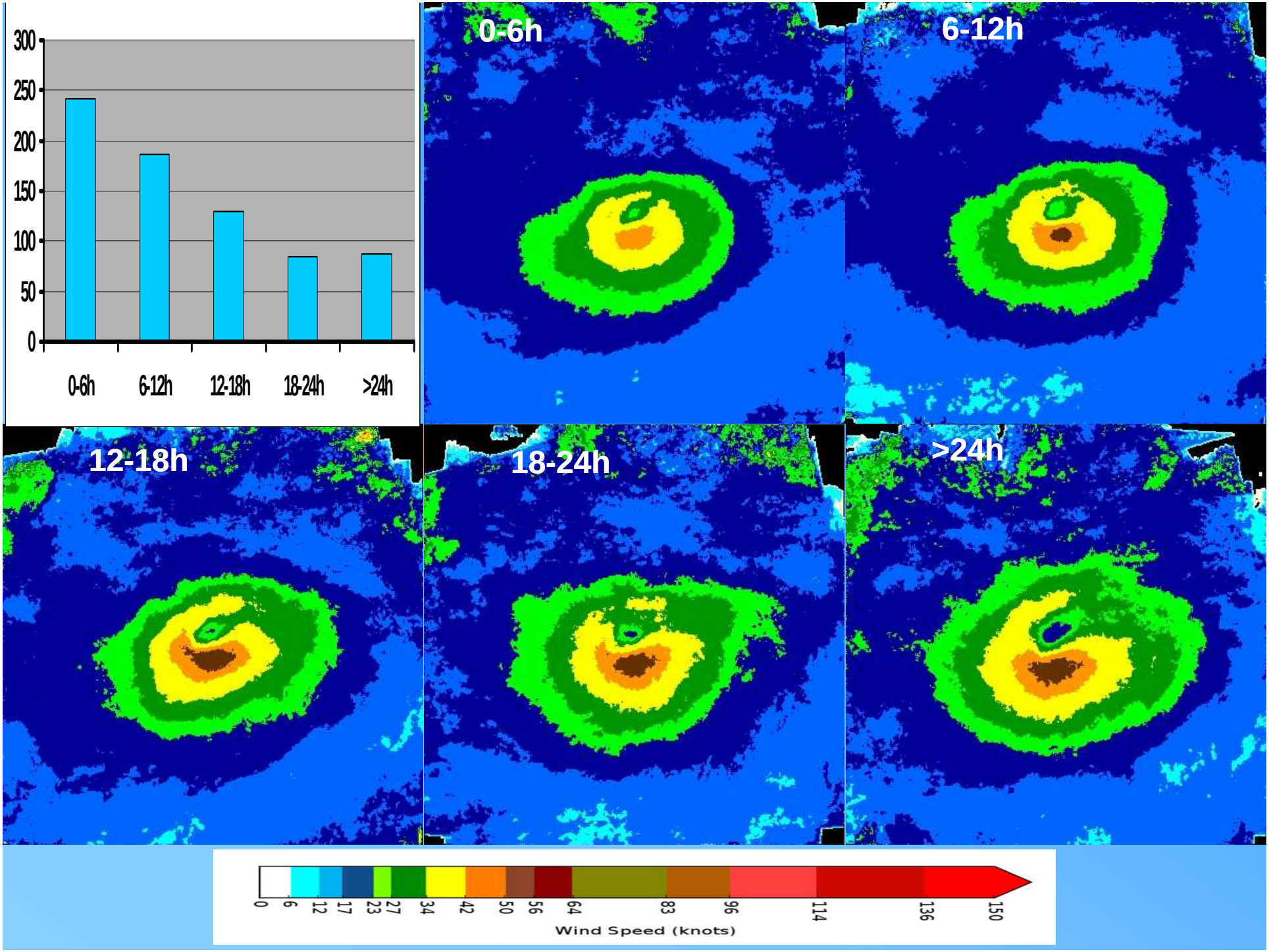
QuikSCAT **ECMWF analysis**

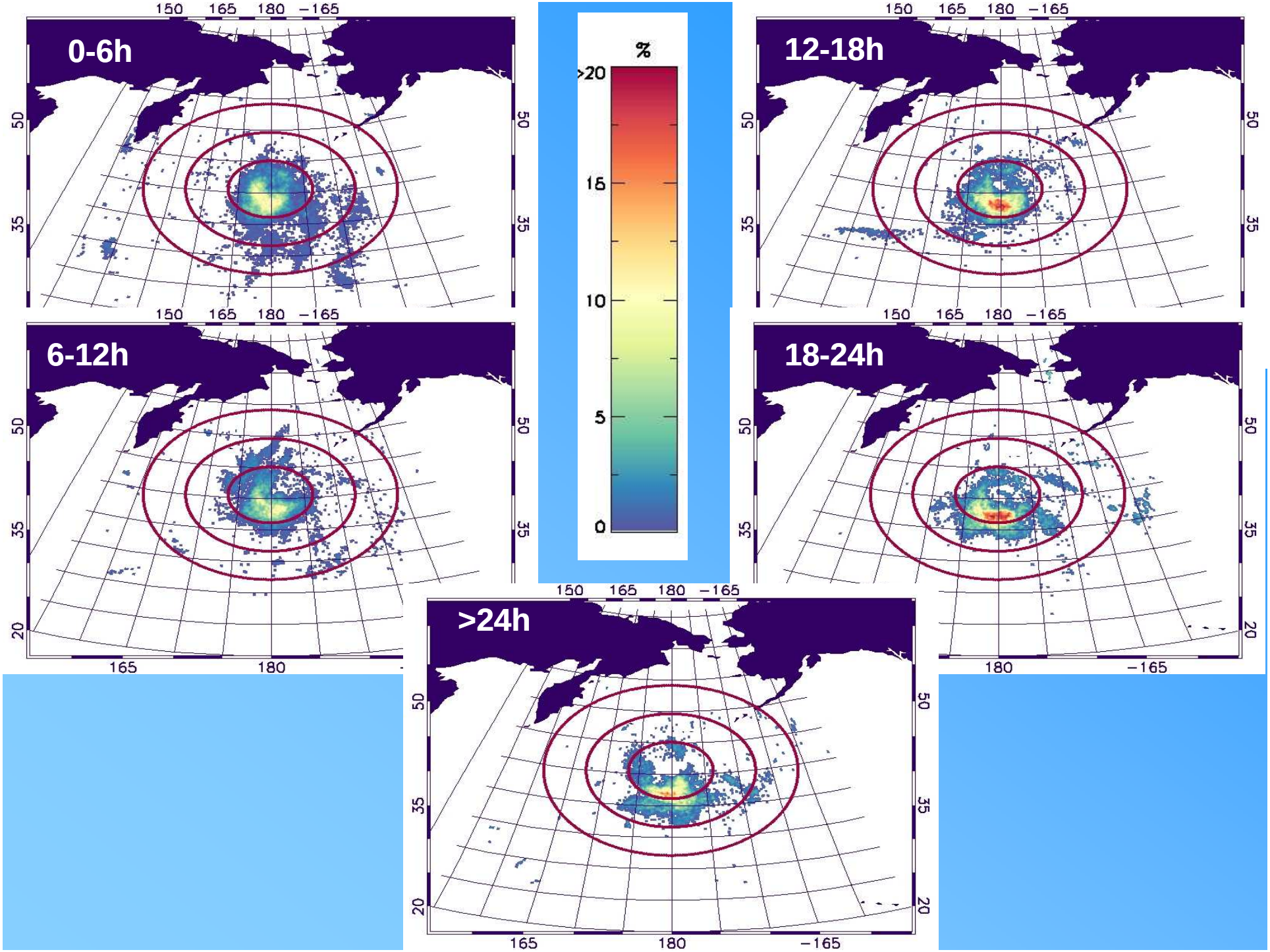



QuikSCAT
Hurricane Force Wind Frequency
Storm Force Wind Frequency
Gale Force Wind Frequency
ECMWF
Hurricane Force Wind Frequency
Storm Force Wind Frequency
Gale Force Wind Frequency
%
>20
15
10
5
0
150
165
180
−165
50
35
20


October
N
W
E
S
November
December
January
February
March
0
6
12
17
23
27
34
42
50
56
64
83
96
114
136
150
Wind Speed (knots)


October
November
December
January
February
March
150 165 180 −165
50
35
%
>20
15
10
5
0
165 180 −165
Monthly Hurricane Force Wind Frequency within Grid


300
250
200
150
100
50
0
0-6h
6-12h
12-18h
18-24h
>24h
0-6h
6-12h
12-18h
18-24h
>24h
0
6
12
17
23
27
34
42
50
56
64
83
96
114
136
150
Wind Speed (knots)


0-6h
12-18h
6-12h
18-24h
>24h
%
>20
15
10
5
0
150
165
180
−165
50
35
20

Conclusions and Future Work

- Gale force wind radii reaches beyond 3000km
- Hurricane force wind can spread 1000km from cyclone low on south, south-east side relative to cyclone motion
- Longer-lived cyclones show higher probability of hurricane-force winds farther from the center
  - Also reflected in larger composite wind field
- Strongest hurricane force signal seen in February (in terms of frequency)
- ECMWF composites show similar structure, but wind field systematically weaker
- Re-examine science-level data for duration of mission to identify all HF cyclones and create climatology of HF extratropical cyclones
- Extend compositing to North Atlantic cyclones
- Extend analysis to Southern Ocean cyclones