

Hurricane Force Extratropical Cyclones as Observed by QuikSCAT

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Outline

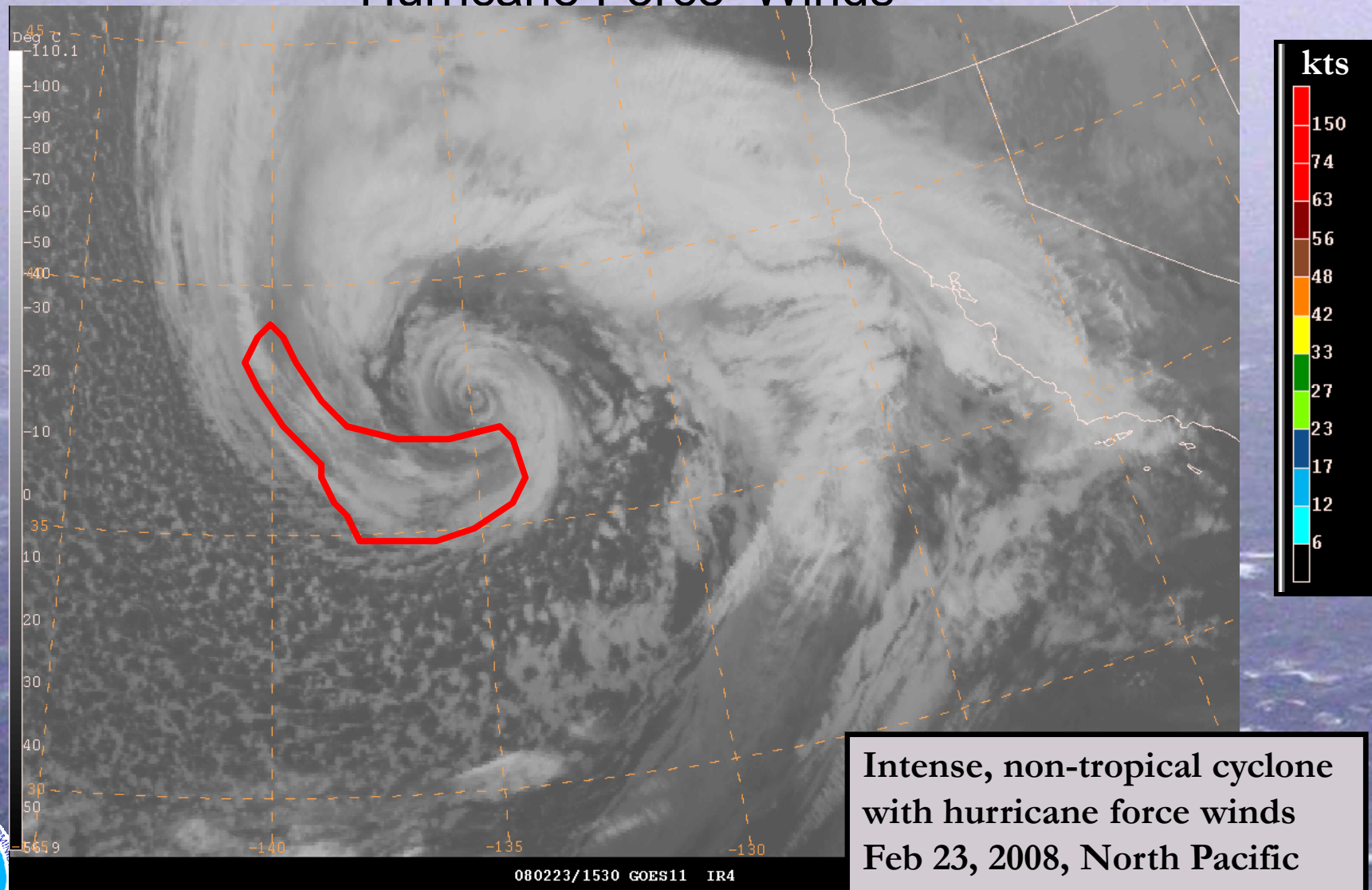
1. 7 yr. QuikSCAT climatology
2. Impact / forecast skill
3. 12 km WRF results
4. Summary



Ocean Vector Wind Science Team Meeting, Seattle, WA, Nov 19-21, 2008

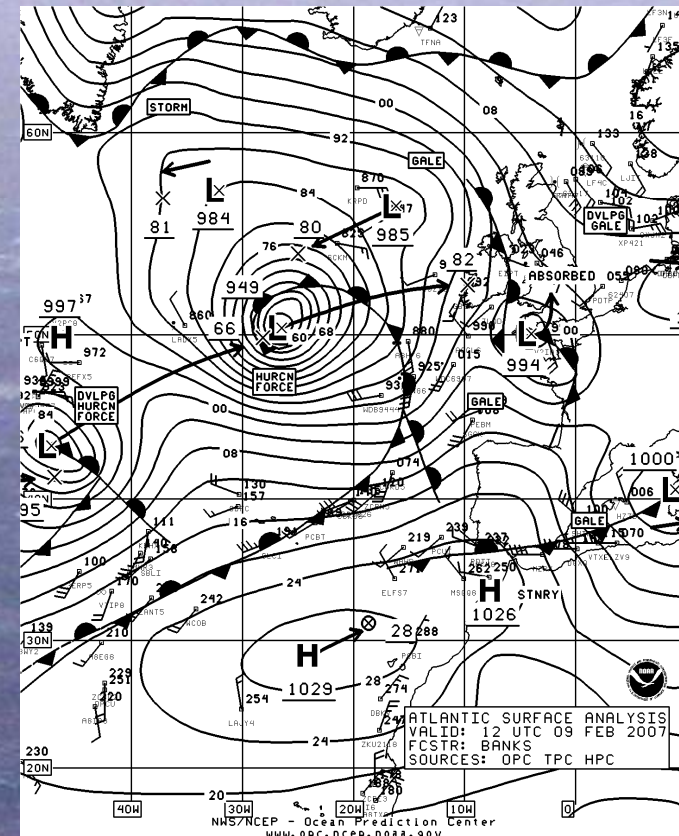
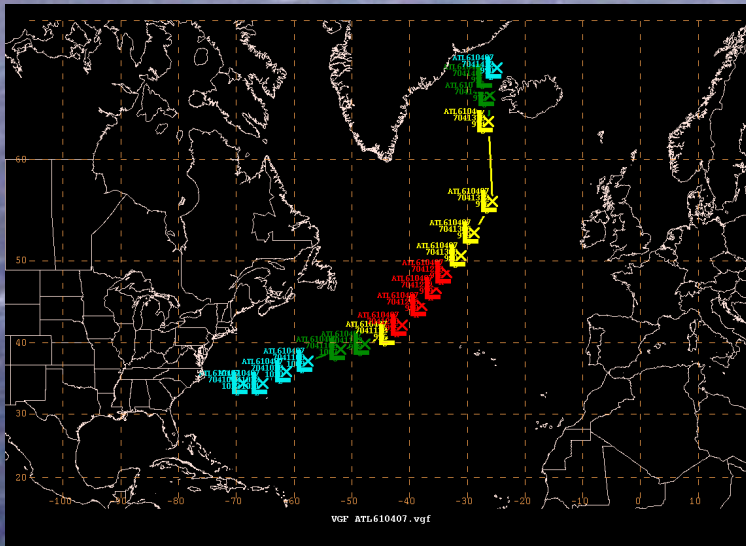
QuikSCAT

Increased awareness of the *pervasiveness* of
Hurricane Force Winds



Methodology

- 6 hourly oceanic surface analyses
- Forecaster decision (based on all data - primarily QuikSCAT)
- Catalog events
- Similar to NHC “best track”
 - some post analysis



Hurricane Force Extratropical Cyclones - Detection and Warning Trend using QuikSCAT

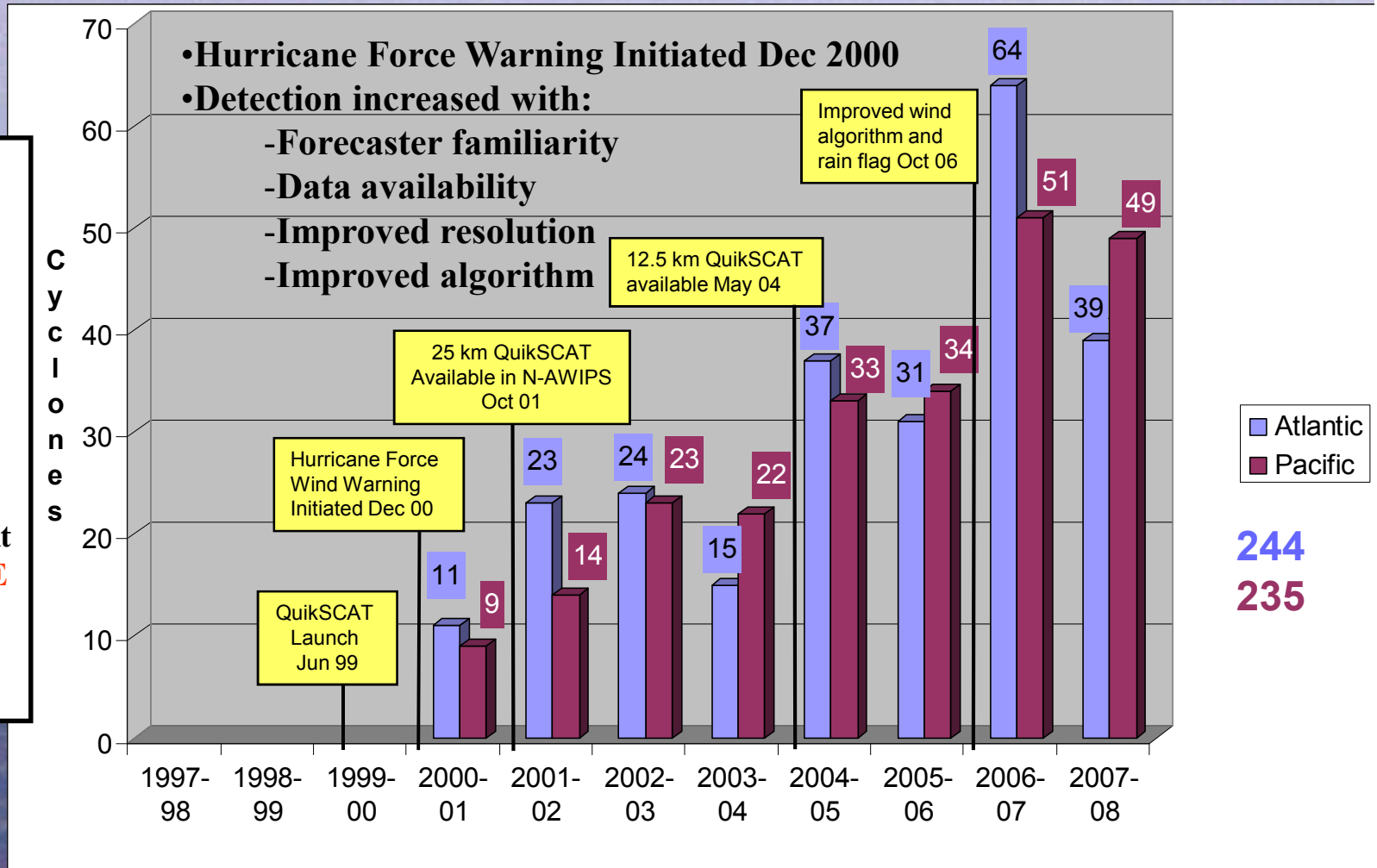
WARNING CATEGORIES

Pre- QSCAT

1. GALE 34-47 kt
2. STORM ≥ 48

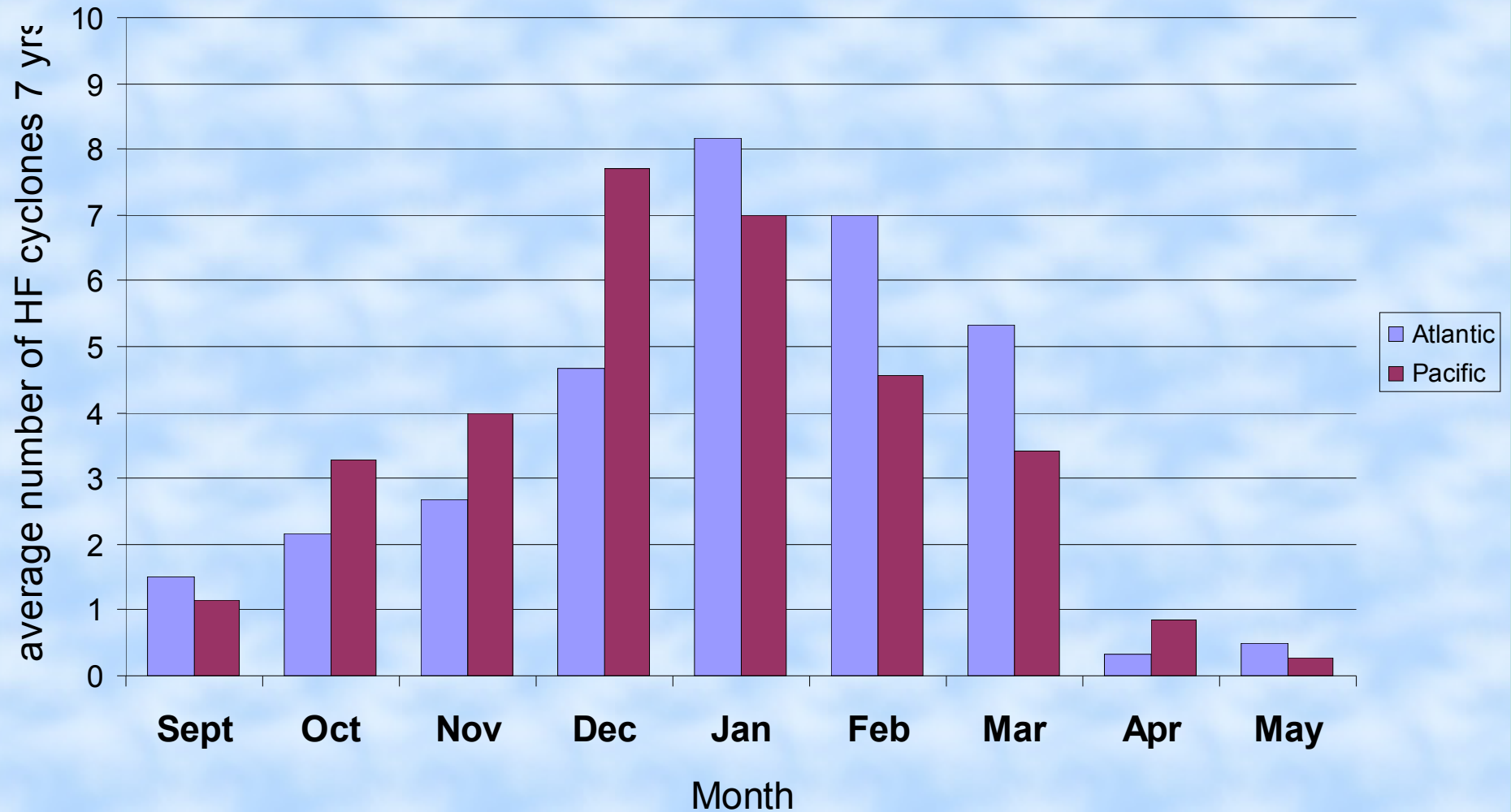
QSCAT ERA

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



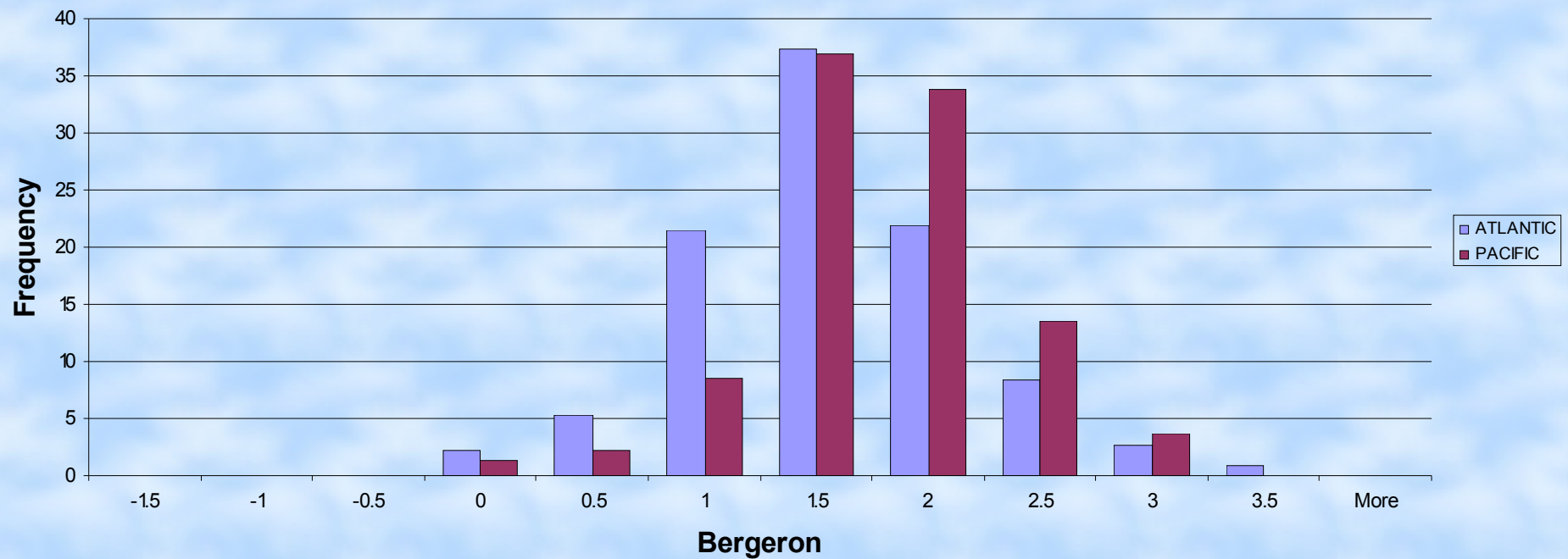
2001-2008 Climatology

7yr Average Monthly Distribution



2001-2008 Climatology

Distribution of Maximum 24 Hour Deepening Rate



1 Bergeron = 1 mb / hour @60 deg latitude

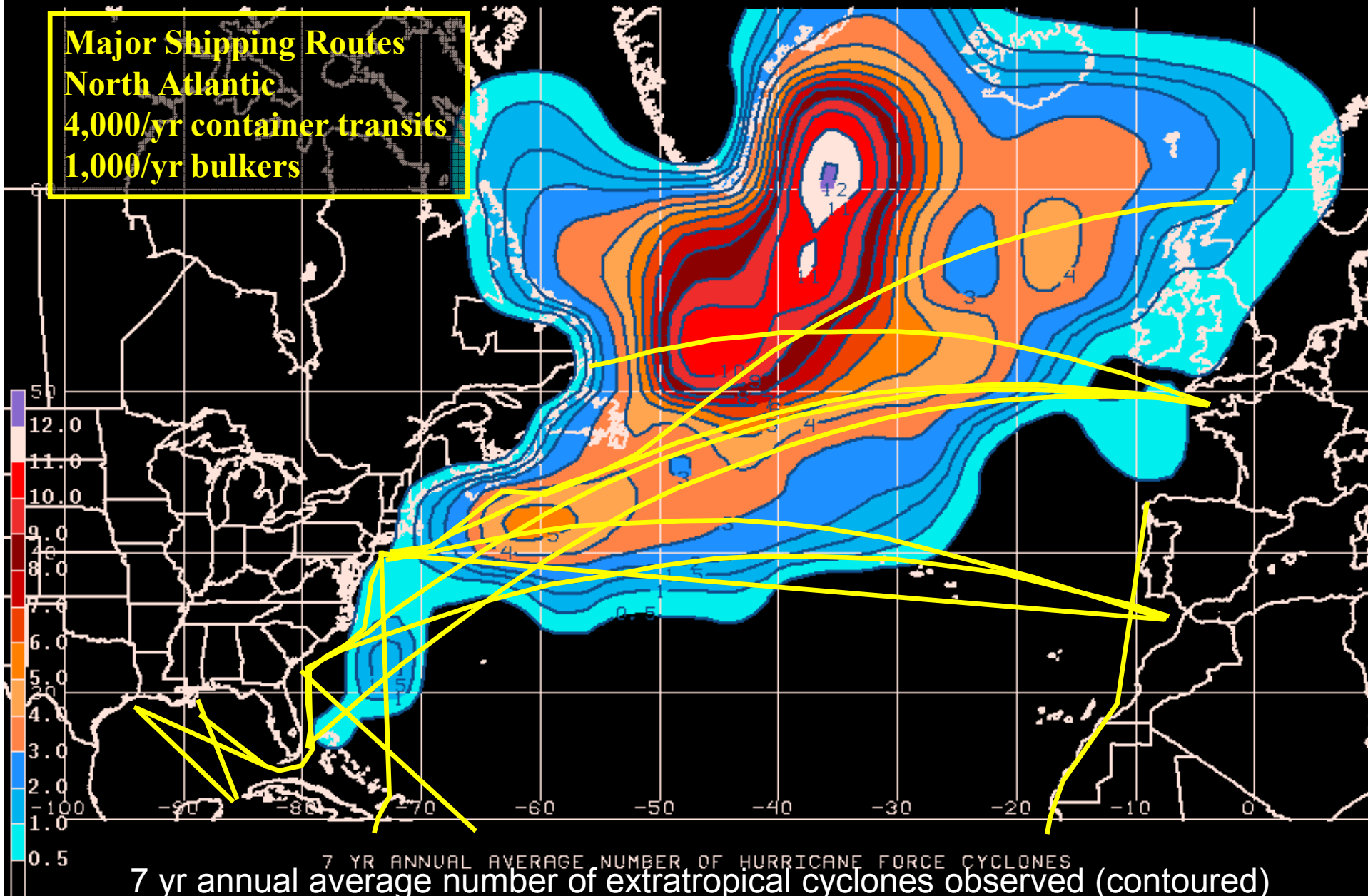
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2001-2008 Climatology

- Hurricane Force winds in extratropical storms
 - **much** more frequent than thought
 - Detection linked to algorithm and resolution improvements
 - Onset within 24 hours of cyclone reaching maturity (minimal central pressure)
 - Conditions short lived, average 24 hrs or less
 - Occur on meso to small synoptic scale in limited precipitation and little turning of wind!!! (over unparalleled fetch lengths)
 - Scale appropriate for remote sensing
 - Primarily ocean phenomena...landfall possible (West Coast, AK, Maritimes, Europe, New England)
 - waves do impact shoreline
 - Do not know maximum strength of winds!
 - Category 2, 3, or 4?

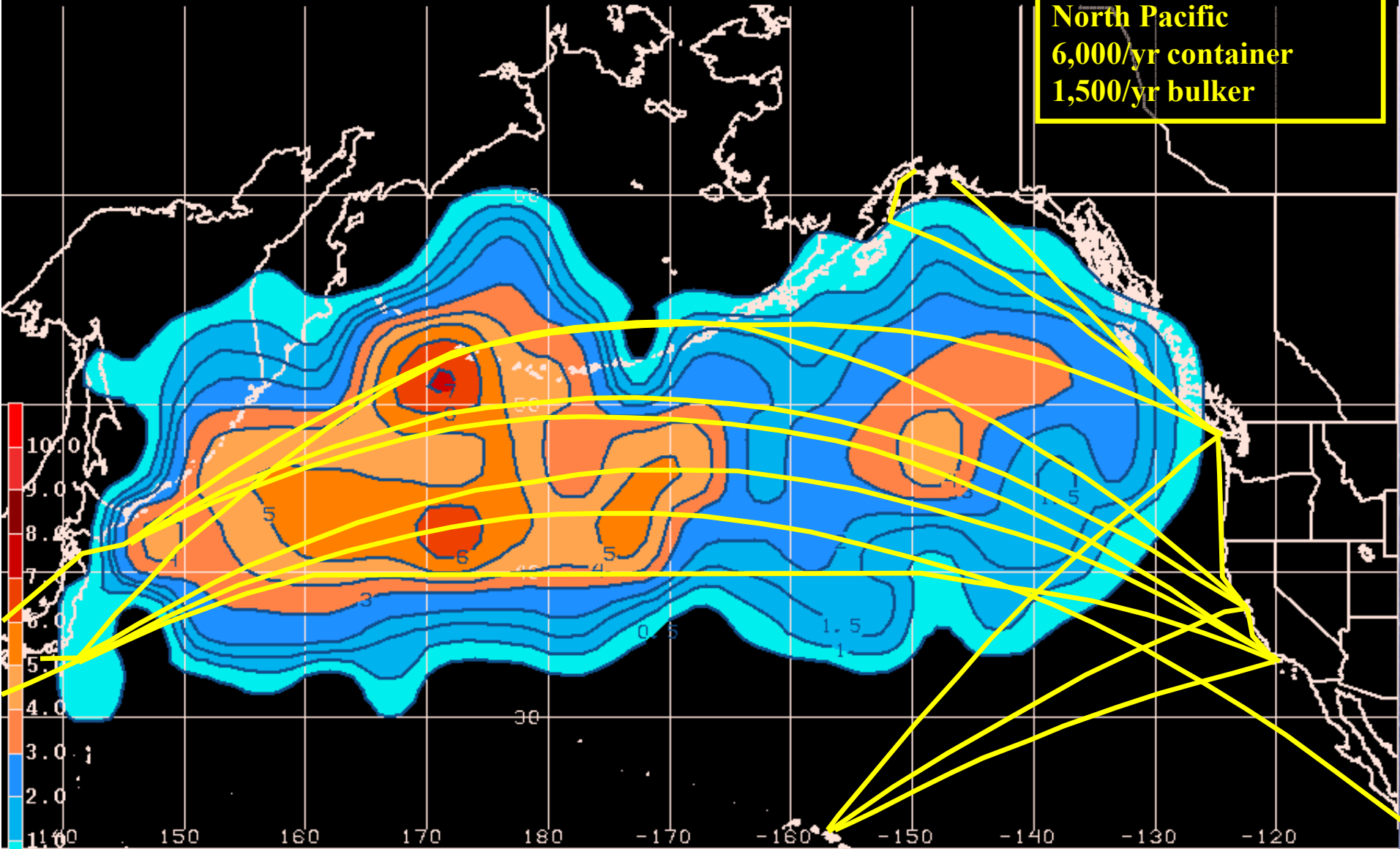


**Major Shipping Routes
North Atlantic
4,000/yr container transits
1,000/yr bulkers**



7 yr annual average number of extratropical cyclones observed (contoured)
with hurricane force winds for the years 2001 - 2008

**Major Shipping Routes
North Pacific
6,000/yr container
1,500/yr bulker**



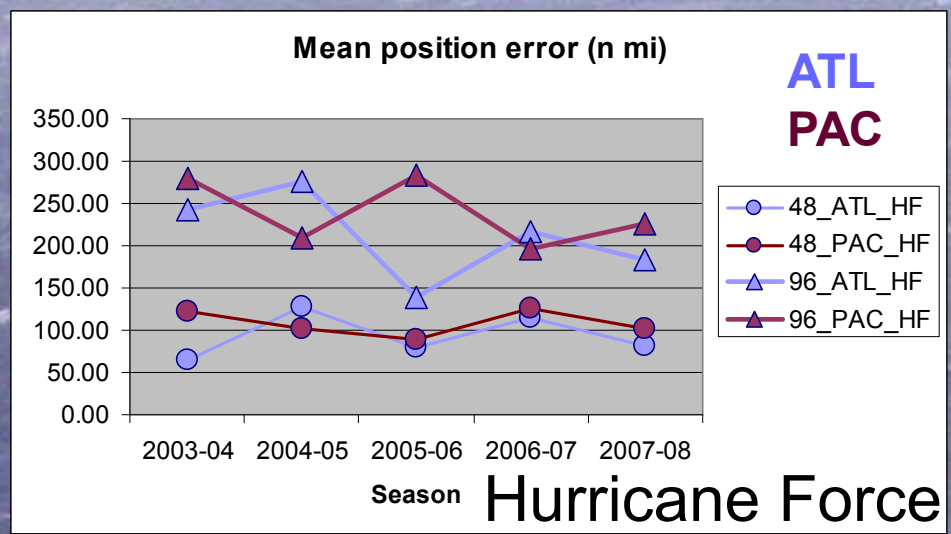
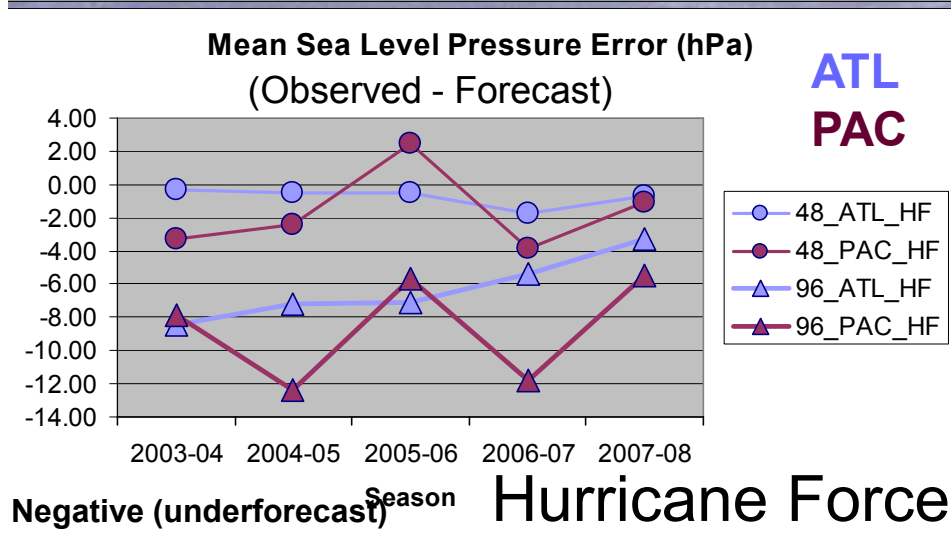
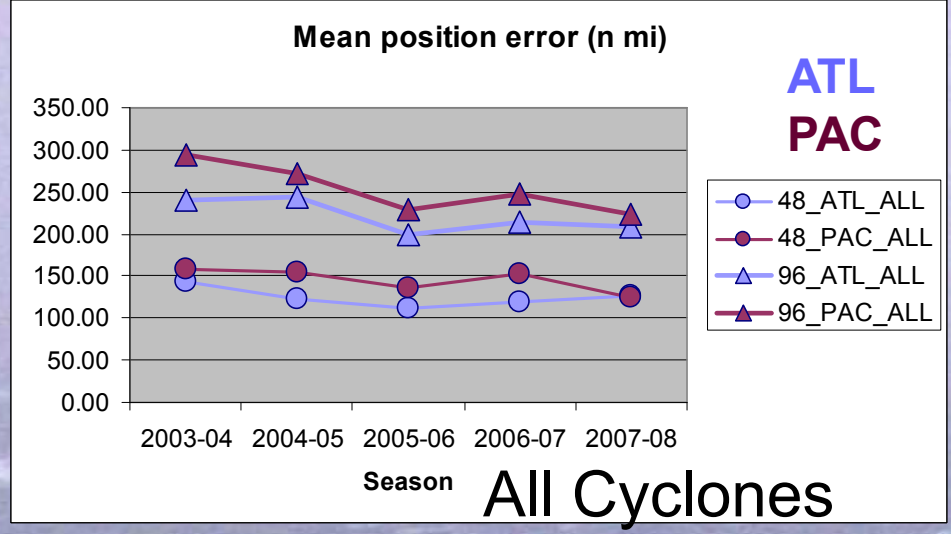
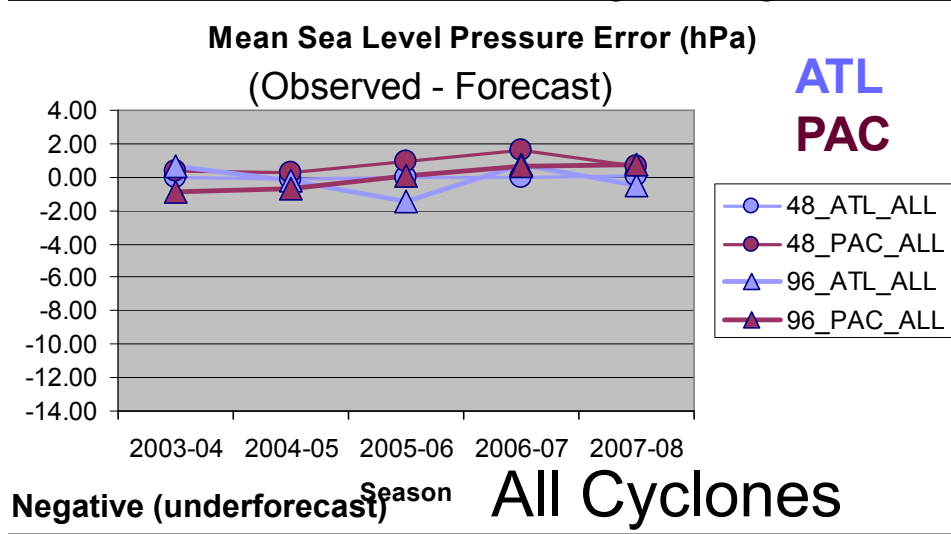
7 yr annual average number of extratropical cyclones observed (contoured) with hurricane force winds for the years 2001 - 2008

Impact on Maritime Commerce

- Present level of warning/forecast services to 48 hours w/QuikSCAT
 - **\$135 million** per year savings in reduced damage / cargo loss for **container** and **bulk** commerce (Kite-Powell, 2008)
 - Potential impact of other instruments (XOVWM and ASCAT) also defined
 - Second study near shore/coastal impacts underway - QuikSCAT vs XOVWM



2 & 4 day cyclone forecast skill



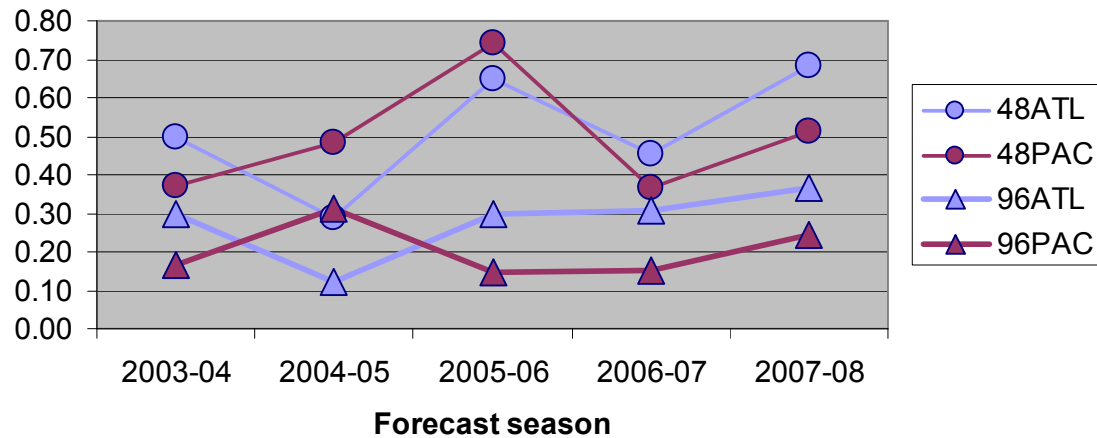
Intensity (hPa)

Track (n mi)

2 & 4 day warning skill

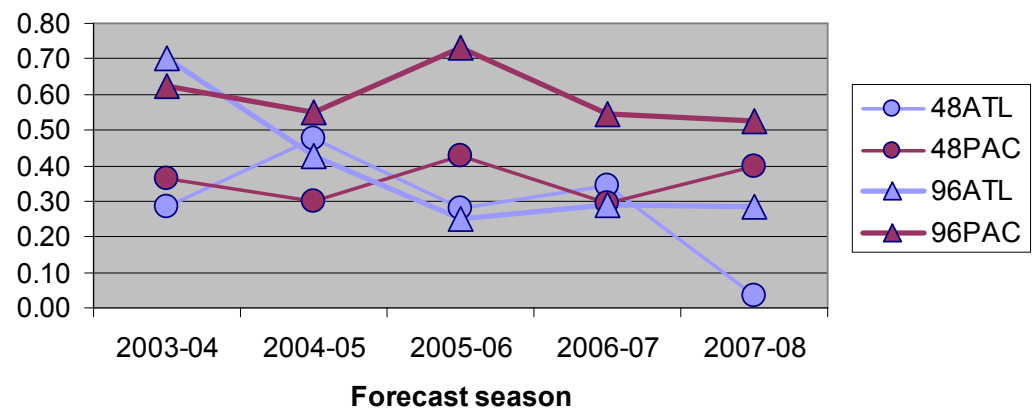
Hurricane Force Warning Skill
Probability of Detection

POD



Hurricane Force Warning Skill
False Alarm Ratio

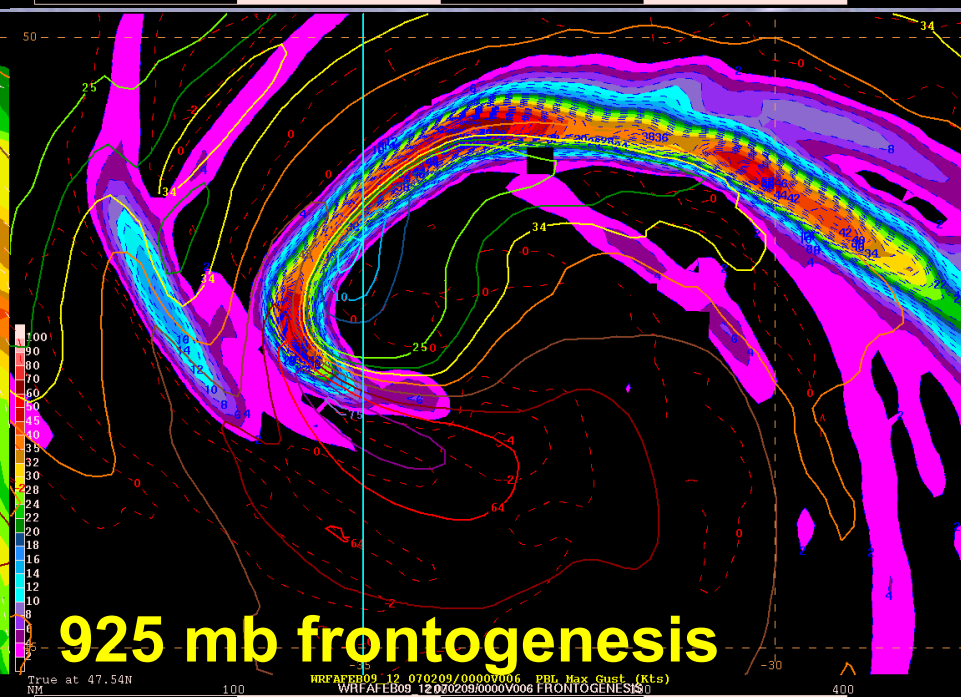
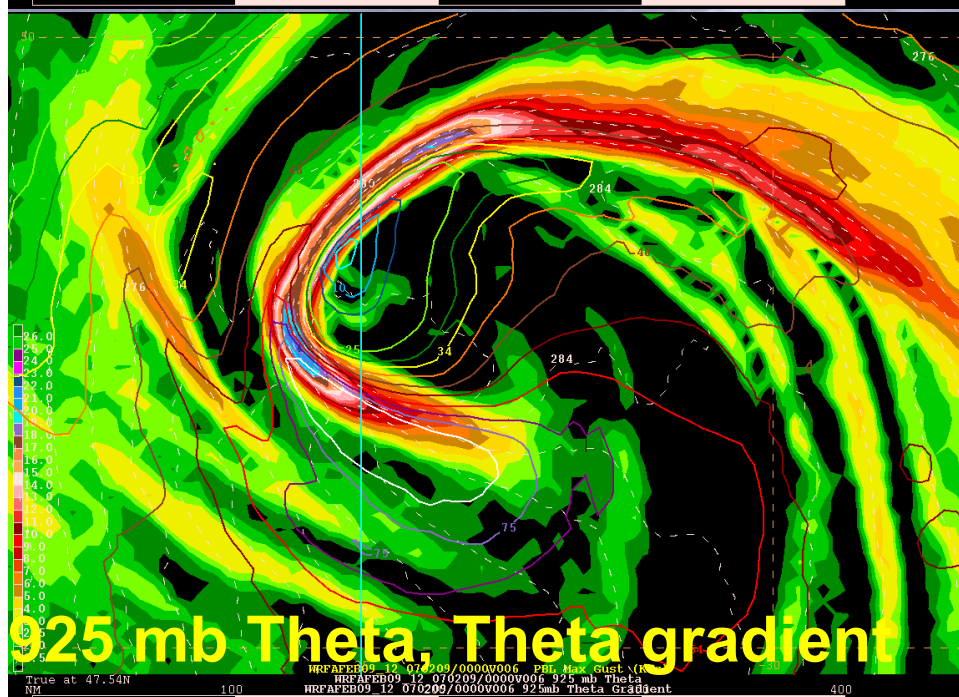
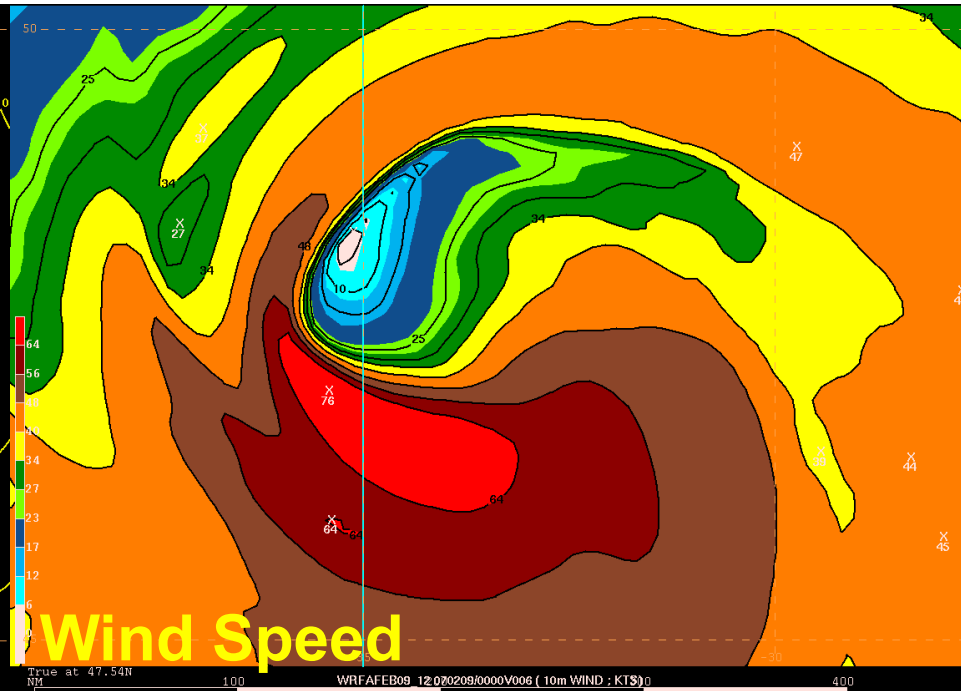
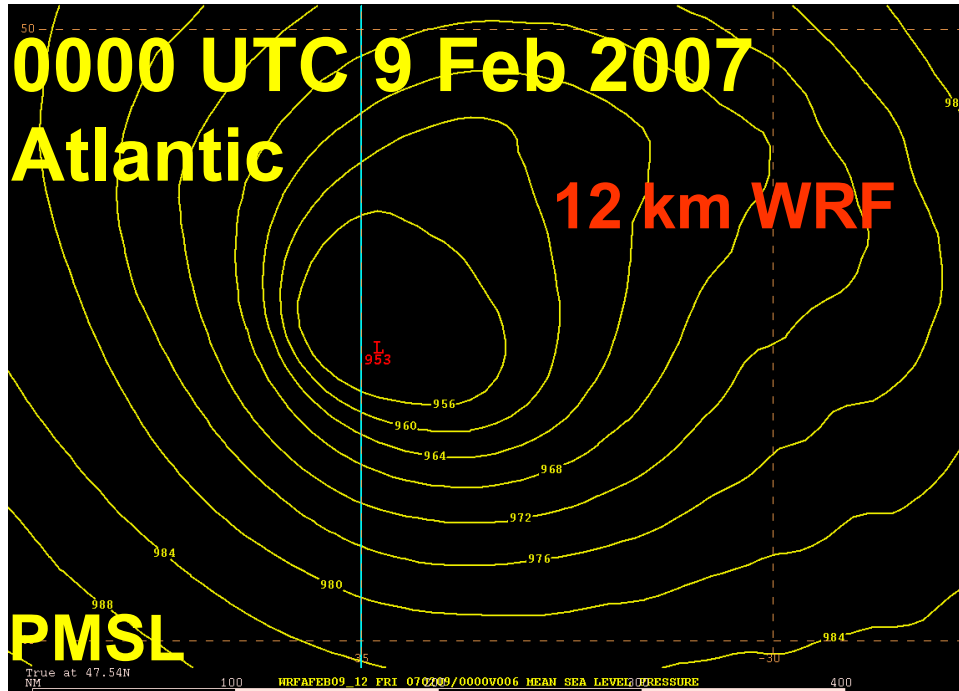
FAR



2 & 4 day forecast skill

- More skill in Atlantic than Pacific (intensity, track, warning)
- Skill improvement from 92/93 review (Uccellini et al 1999) has been slow
- Intensity forecast skill still underestimates development rates for most intense storms
- Underestimate of intensity translates to warning skill
 - Appreciable skill at 48 hrs
 - Limited at 96 hrs (suggests probabilistic approach)
- In essence for HF cyclones:
 - Can predict cyclone will exist and where under predict intensity and associated winds





WRF results

- **Hurricane Force Winds**
 - **Successfully modeled (7 cases)**
 - **Onset, rapidly deepening phase**
 - **Bent-back front, key ingredient to formation of low-level jet, HF winds**
 - **Onset of winds occurs in area of maxima of frontolysis downstream of area of frontogenesis**
 - **Scale varies, meso to small synoptic scale**
- **Science issues**
 - **Mechanism for development of structure and for momentum transfer**
 - **Predictability; maximum winds**

Using results to tailor ensemble based forecast guidance



Summary

- Hurricane Force conditions exist in non-tropical cyclones (much more frequent than thought)
 - Validation of high winds NEEDED
- Loss of QuikSCAT
 - Significant reduction in detection, warning & verification capabilities (lose consistency!!!)
 - Rely on ASCAT, conventional obs, satellite interpretation, NWP analyses
 - ASCAT – (Poster – Khalil Ahmad)
- Effort initiated by NOPP and then R20
- HF Cyclone database available at:
ftp://ftp.mpc.ncep.noaa.gov/misc/hfcyclone_study/
 - Hurcn_Force_Pac_Atl_01_08.xls

