QuikSCAT Follow-On Efforts at NOAA

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Outline

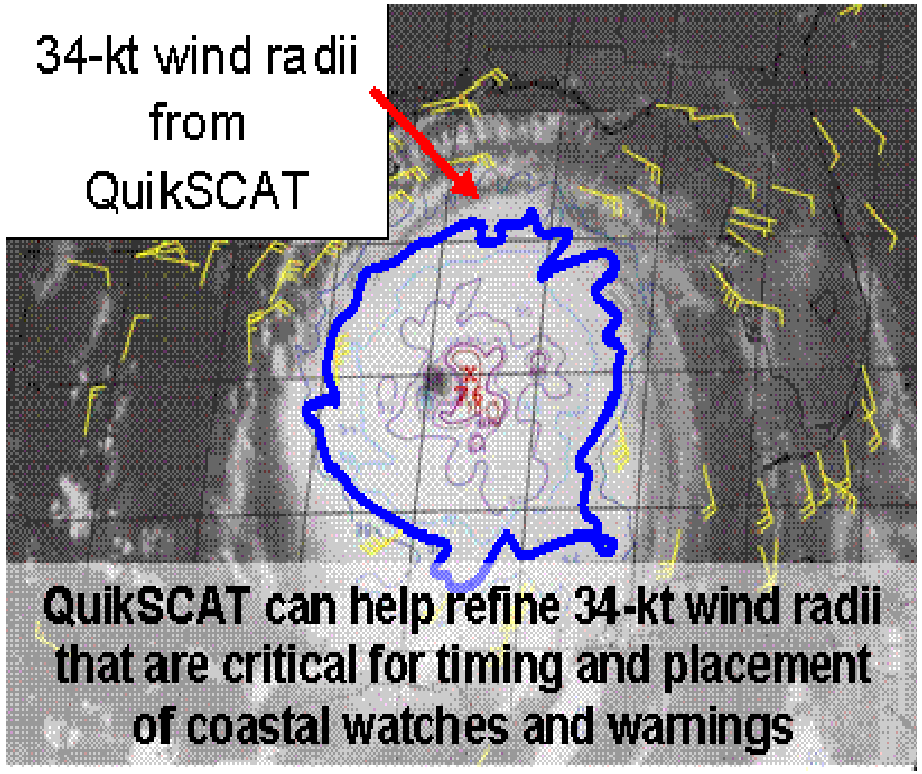
- The Importance
- The Goal
- The Requirements
- The Status
- The Next Steps
- The Outlook

QuikSCAT OSVW data has significant positive impacts on marine warning and forecasting capabilities

Impact of QuikSCAT on Tropical Cyclone Forecasts and Warnings

Tropical Prediction Center/National Hurricane Center (TPC/NHC), Central Pacific Hurricane Center (CPHC), and Joint Typhoon Warning Center (JTWC) provide analyses, forecasts and warnings of tropical cyclones. QuikSCAT winds are used to:

- **Estimate intensity (maximum wind)**
  - Especially for tropical storms, but not for most hurricanes (typhoons)
- **Improved analysis of 34 kt and 50 kt wind radii**
  - Critical for ship avoidance
  - Refine coastal warning areas
- **Detect and locate surface circulation centers**
  - Incipient cyclones (especially critical for Pacific Ocean where operations are not supported by aircraft)

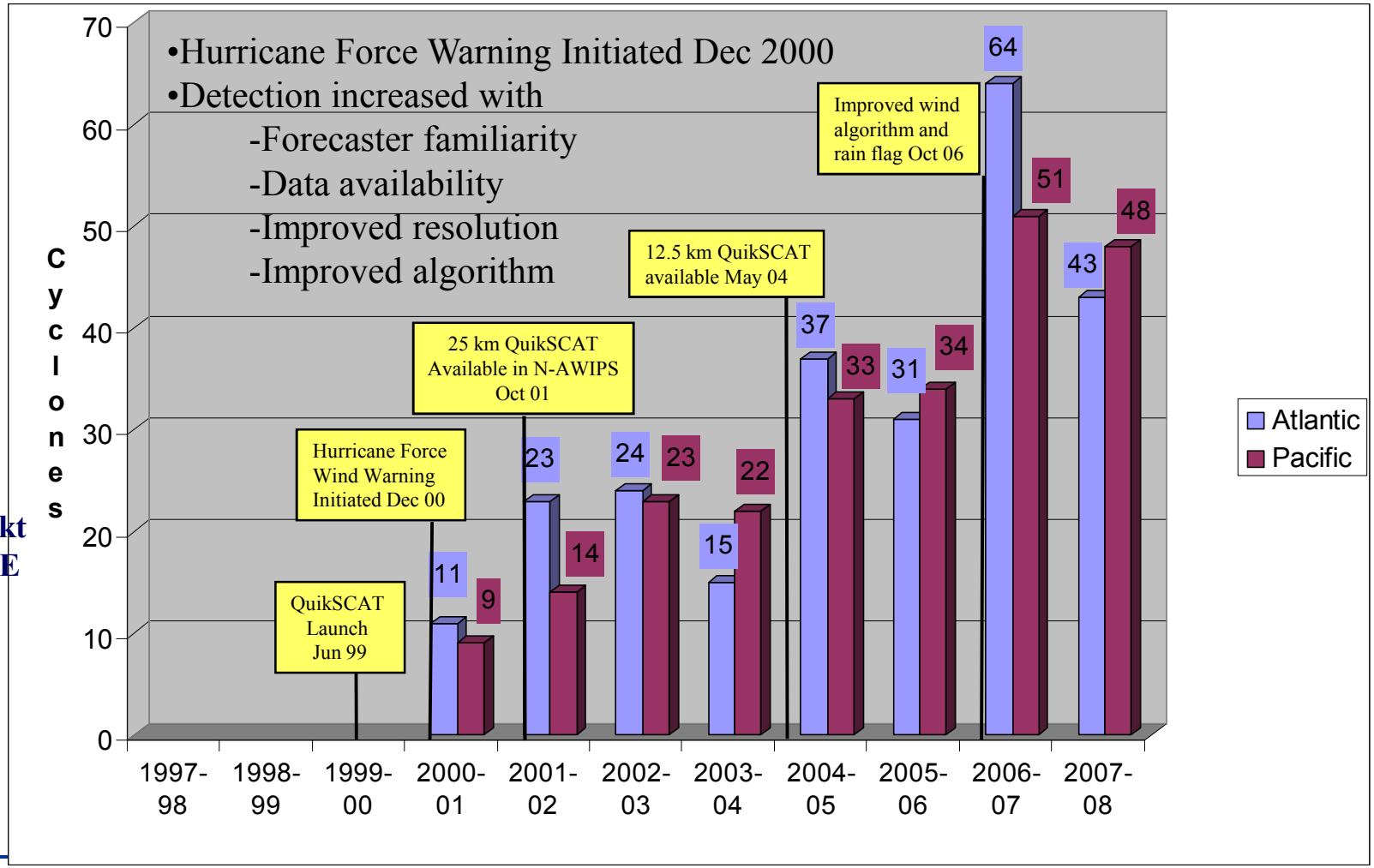


Extratropical Cyclones with Hurricane Force Winds Detected using QuikSCAT

WARNING CATEGORIES

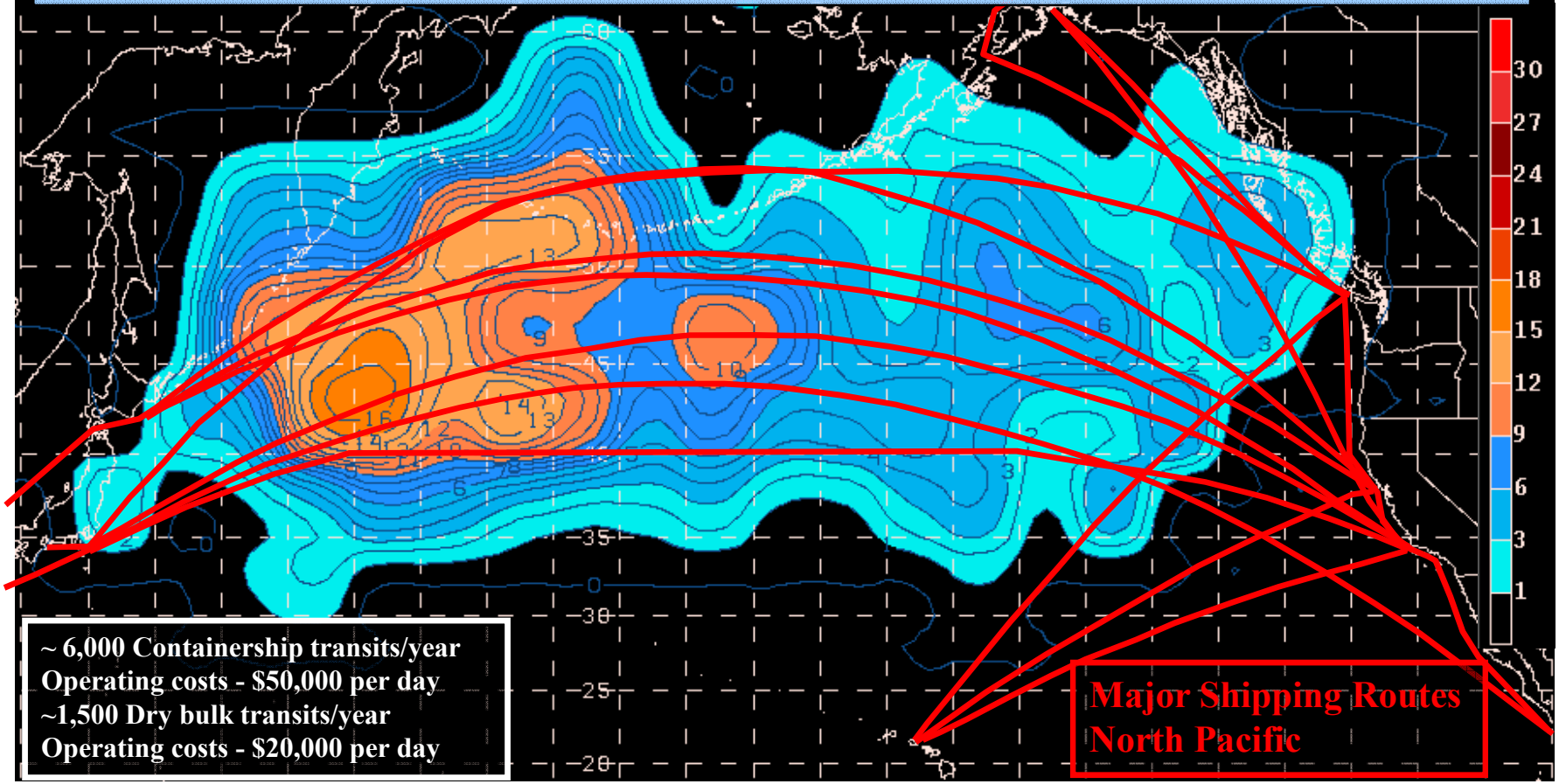
Pre- QSCAT
1. GALE 34-47 kt
2. STORM ≥48

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



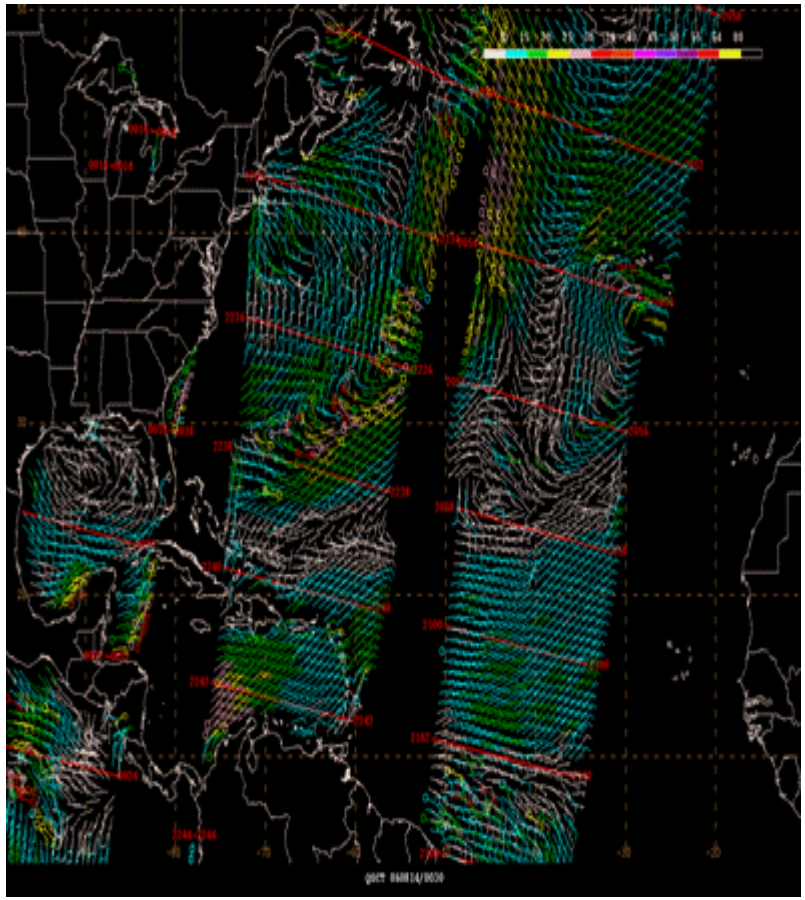
Cumulative number of extratropical cyclones observed (contoured) with hurricane force winds for the years 2000 - 2007Hurricane Force Winds Occur Across the Sea Lanes

Today's marine warning and forecast services out to 48 hours (for hurricane force cyclones) has an estimated **savings of $140 million** annually to North Pacific dry bulk and container shipping by minimizing storm exposure Preliminary results - Hauke Kite-Powell - Woods Hole Oceanographic Institute



QuikSCAT Limitations

- Long intervals between repeat passes - at most two passes per day at low and mid-latitudes
- Gaps between swaths approach 1000 km in deep Tropics
- Sensitive to rain → potential contamination in tropical cyclones and elsewhere
- Cannot measure maximum wind in most hurricanes (typhoons)
  - Resolution, instrument design, rain effects
- Directional uncertainty limits ability to identify or locate tropical cyclone center
  - Subjective analysis by forecaster required
- No data available within 30 km of coastlines and islands



A Sustained OSVW Capability

- **Recent Events**
  - NOAA OSVW workshop (June 2006)
  - NRC Decadal Survey (January 2007)
  - The lack of a QuikSCAT Follow-On (QFO) hurricane controversy (Summer 2007)
  - QFO Mission studies Initiated (June 2007)

The Requirements

- **All-weather retrievals (i.e. accurate retrievals in rain)**
- Accurately measure 10-m 1-min sustained wind in 0–165 kt range (up to category 5 hurricane)
- Reduce time between passes over a particular point to every 6 h (1–3 h goal)
- Reduce time from measurement to availability to 45–60 min (15 min goal)
- **2.5-km grid spacing** between wind vector retrievals

(1 km goal)

- Measurements **within 2.5 km of the coast** (1 km goal)
- Data must be delivered into the operational environment

(N-AWIPS, AWIPS, etc.)

- Product documentation / tutorial / training

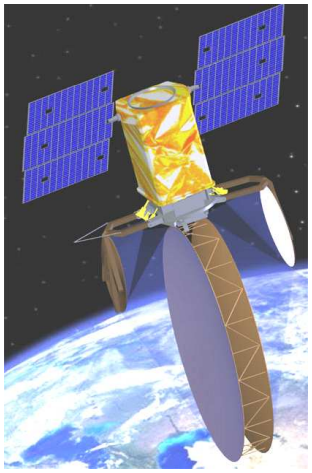
http://manati.orbit.nesdis.noaa.gov/SVW_nextgen/SVW_workshop_report_final.pdf

QFO Mission Options

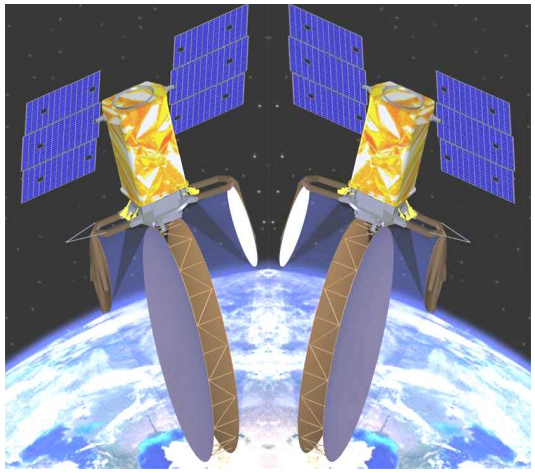
In June 2007, NOAA asked JPL to conduct a study to provide the technical readiness, cost, and impact to NOAA of:

1. A QuikSCAT equivalent re-flight
2. An Extended Ocean Vector Winds Mission (XOVWM)
3. A constellation (2) of XOVWM instruments

1.QuikSCAT Replacement



2. XOVWM

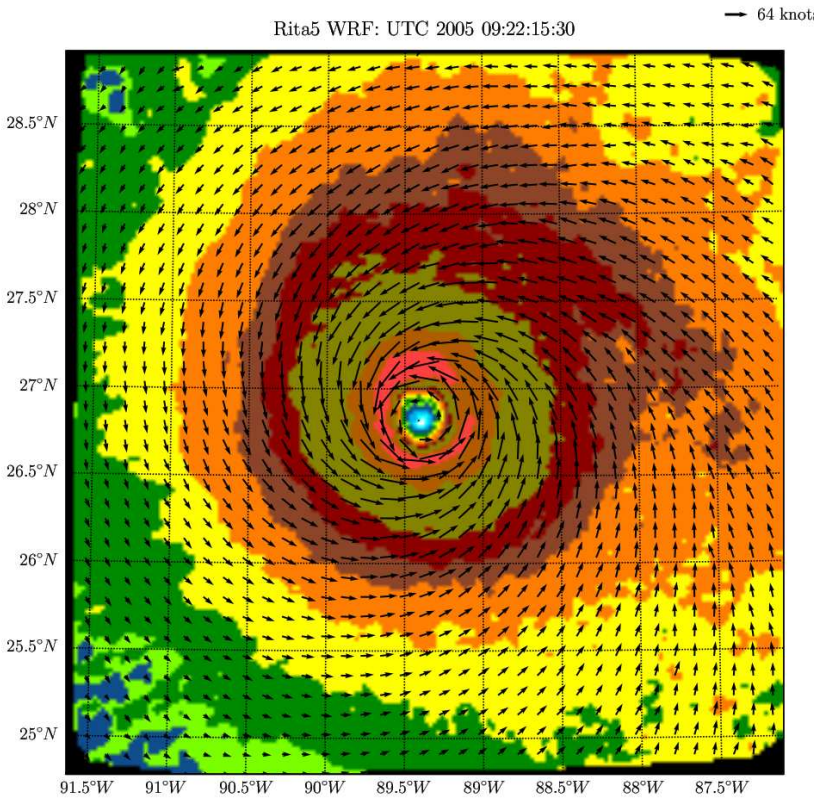


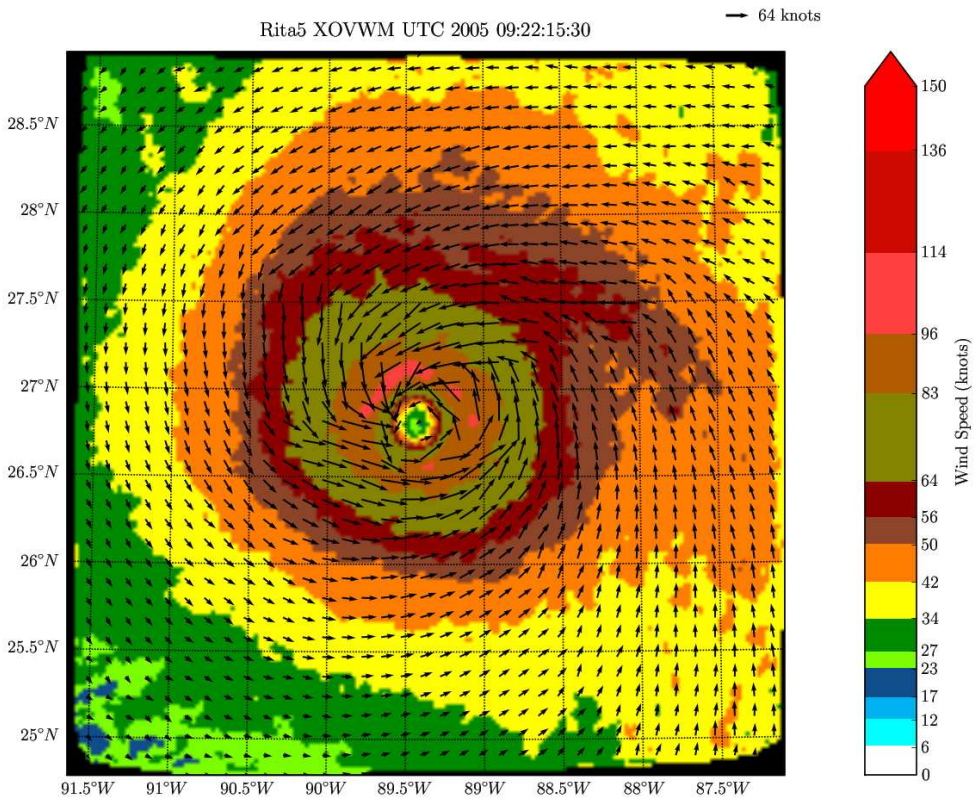
3. XOVWM Constellation

QFO User Impact Study

- **Areas of Emphasis:**
  - Tropical cyclones (Katrina and Rita)
  - Extra-tropical cyclones (Helene)
  - Coastal winds (dual low level jets off of Cape Blanco and Cape Mendocino, high wind events along the Alaska coast)
- **Study Participants:**
  - JPL: measurement simulations, algorithm development
  - NOAA (NHC, OPC, CPHC, WFO – Alaska, Pacific, Western, Southern and Central Regions, AOML, NESDIS): provide impact assessments based on data simulations

Rita – 5th Example 9/22/05 15:30





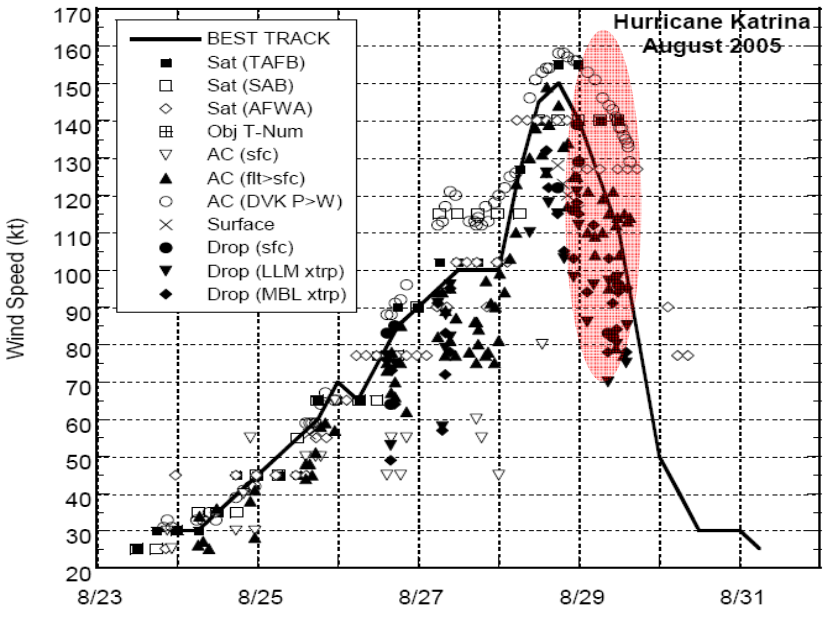
QuikSCAT – 12.5km, 20km of the coast

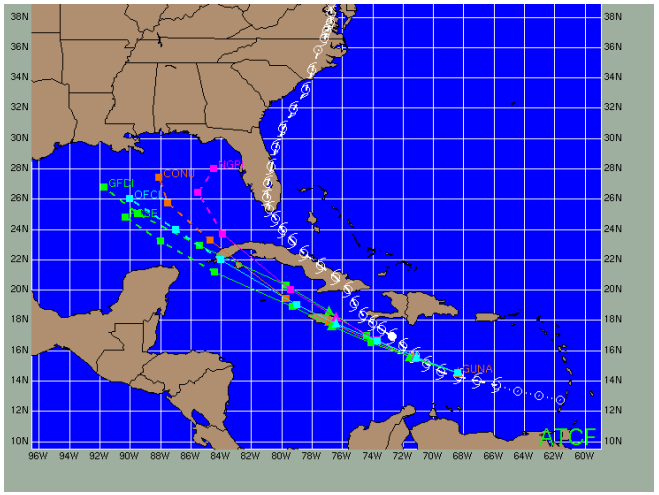
XOVWM – 5km, 5km of the coast

XOVWM Benefits

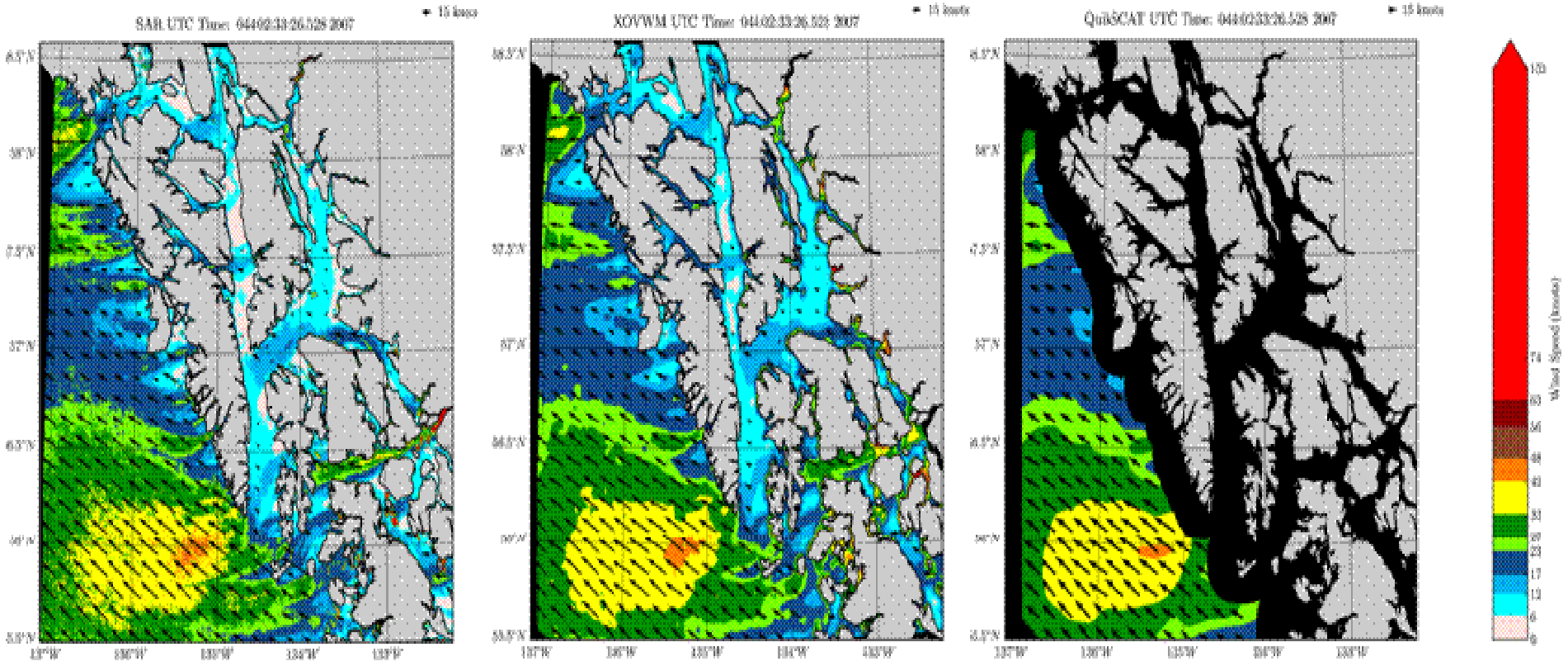
Increased resolution and decreased sensitivity to rain will allow for:

- More reliable **estimates of tropical cyclone intensity through all stages of development** → tropical depressions, tropical storms, hurricanes and potentially major hurricanes
- Improved analysis of tropical cyclone wind field structure (**34, 50, and 64 kt radii**) → more refined watch/warning areas for the coast
- More accurate **tracking of tropical cyclone centers and earlier identification of developing TCs** → more accurate initial motion estimates as input into model guidance
- More accurate **maximum wind estimates of extratropical cyclones** and distribution of all warning categories





Coastal Benefits of an Enhanced XOVWM Capability

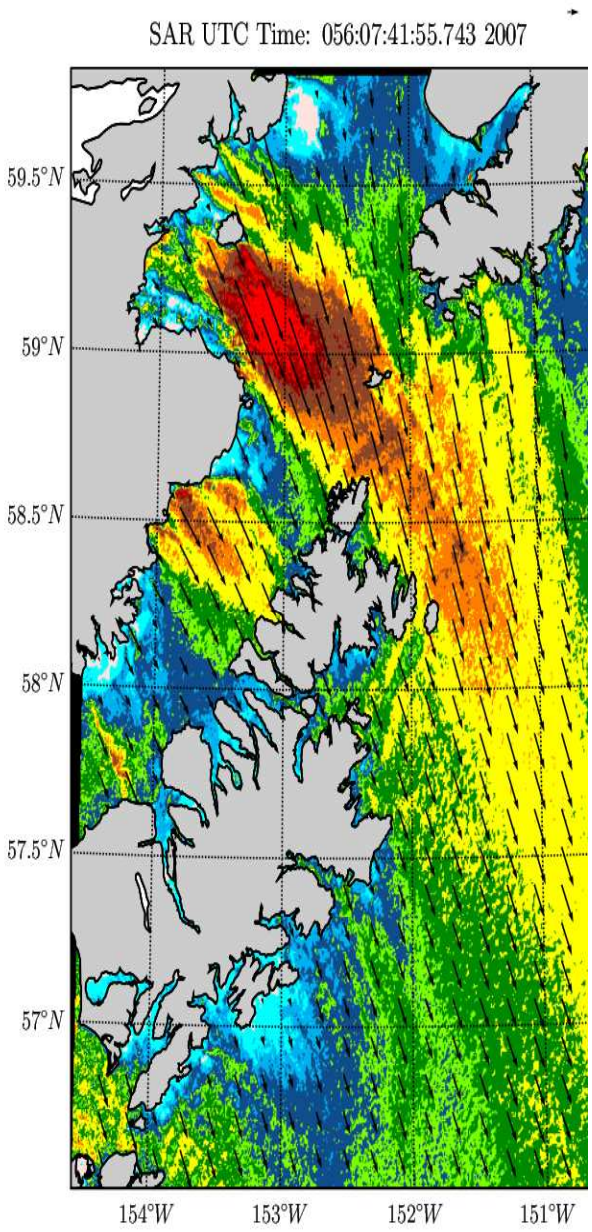


Simulated "ground truth" wind field | Simulated XOVWM | Simulated QuikSCAT

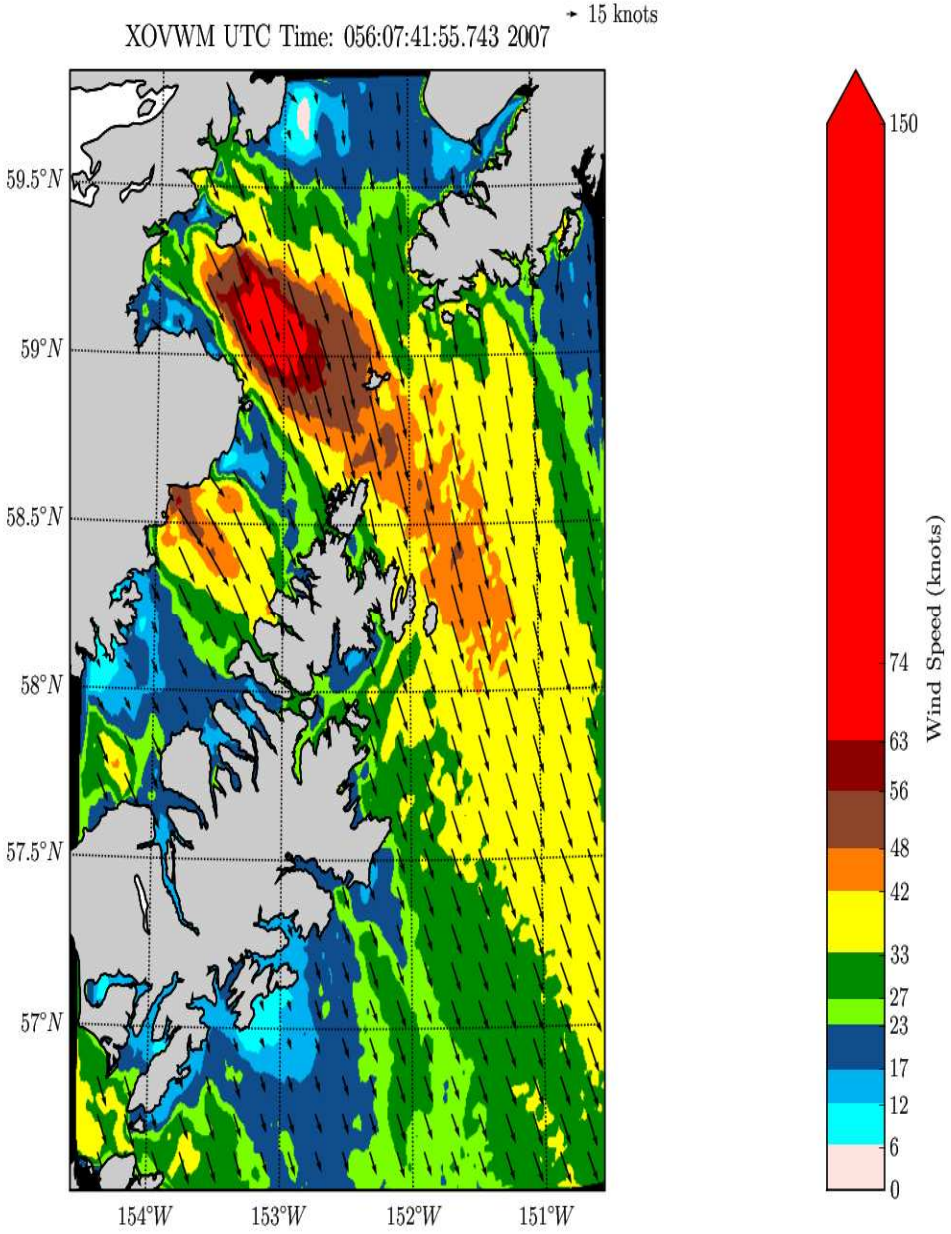
Coastal winds from XOVWM will allow for:

- Accurate OSVW data much closer to the coast (2.5–5 km) than is currently available from QuikSCAT (30 km)
- More accurate and meaningful coastal forecasts, warnings and advisories
- Significantly better definition of coastal wind features such as low-level jets
- Significantly better definition of ocean forcing for areas affected by phenomena such as upwelling

SE Alaska Coast SAR Winds and Simulations

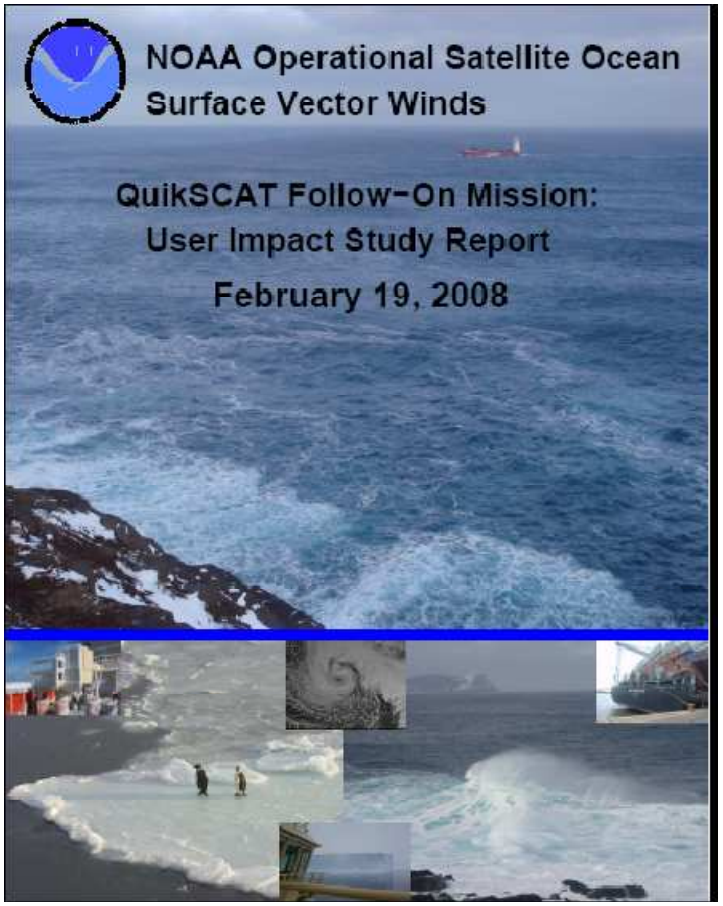


SAR Winds + NOGAPS Directions



QuikSCAT Retrievals

User Impact Study -Summary



- OSVW data are identified as critical data needed for weather forecast and warning products for Local Forecasts and Warnings and Marine Weather Programs
- To maintain improvements in operational weather forecasting and warning applications resulting from QuikSCAT OSVW, **continuity of OSVW data at a level equivalent to or better than QuikSCAT is required**
- XOVWM would greatly enhance the detection and warning capability across a wide range of weather phenomena for nearly all of the coastal, offshore, high seas, and Great Lakes areas of responsibilities. **Even a single XOVWM would be a major step toward meeting critical aspects of OSVW operational requirements** compared to a QuikSCAT-equivalent solution

http://manati.orbit.nesdis.noaa.gov/SVW_nextgen/QFO_user_impact_study_final.pdf

The Status

- NOAA conducted Analysis of Alternatives Study Dec ’07- Jan ’08. AoA working group recommendations:
  - Recommend establishing a sustained operational satellite OSVW capability mission
  - XOVWM satellite capability is preferred solution with structured fall-back plan to QuikSCAT capability if technical or cost issues arise

- QFO and AoA studies presented to NOSC in Feb ’08
  - QuikSCAT data have had a significant impact on NOAA operational analyses and forecasts
    - There is broad NOSC support for an improved all-weather capability
  - However, the NOSC believes that the cost as presently formulated is beyond NOAA's means at this time
  - NOSC recommended modest level of funding in FY10 to further pursue OSVW program with specific guidance to **NESDIS to seek partnership arrangements** that would have the potential to significantly reduce the cost and risk to NOAA of implementing such an improved capability

The Next Steps

- **JAXA GCOM collaboration opportunity**
  - Promising potential to realize a QFO mission
  - Two meetings have been held between NOAA, JAXA and JPL
    - GCOM-W2 can accommodate a system with OSVW capabilities between XOVWM and QuikSCAT
    - NOAA and JAXA have drafted a letter of intent

- **NESDIS will be conducting user impact assessments of the GCOM-W2 scatterometer capability**

- **NOAA and JAXA are pursuing this collaboration in their respective budget processes**

The QFO Outlook

- **Significant progress has been made toward justifying a sustained satellite OSVW capability, but the road ahead is still not certain**

- **The QuikSCAT Conundrum**

  - QuikSCAT OSVW data are used operationally and have yielded significant positive impacts in NOAA's mission, but QuikSCAT is viewed as a research mission when it comes to continuity of operations.
  - Satellite OSVW measurement capability was given to NOAA in the NRC Decadal Survey and is now considered an operational mission by NASA HQ.
  - NOAA OSVW requirements actually point toward a more advanced capability than QuikSCAT.
  - Continuity of satellite OSVW data is desired by both the operational and research communities.

- **Bottom line: A QuikSCAT follow-on capability needs to be supported by both the operational and science communities to succeed.**