Spaceborne Scatterometer and Oceanographic Applications in the Nineties

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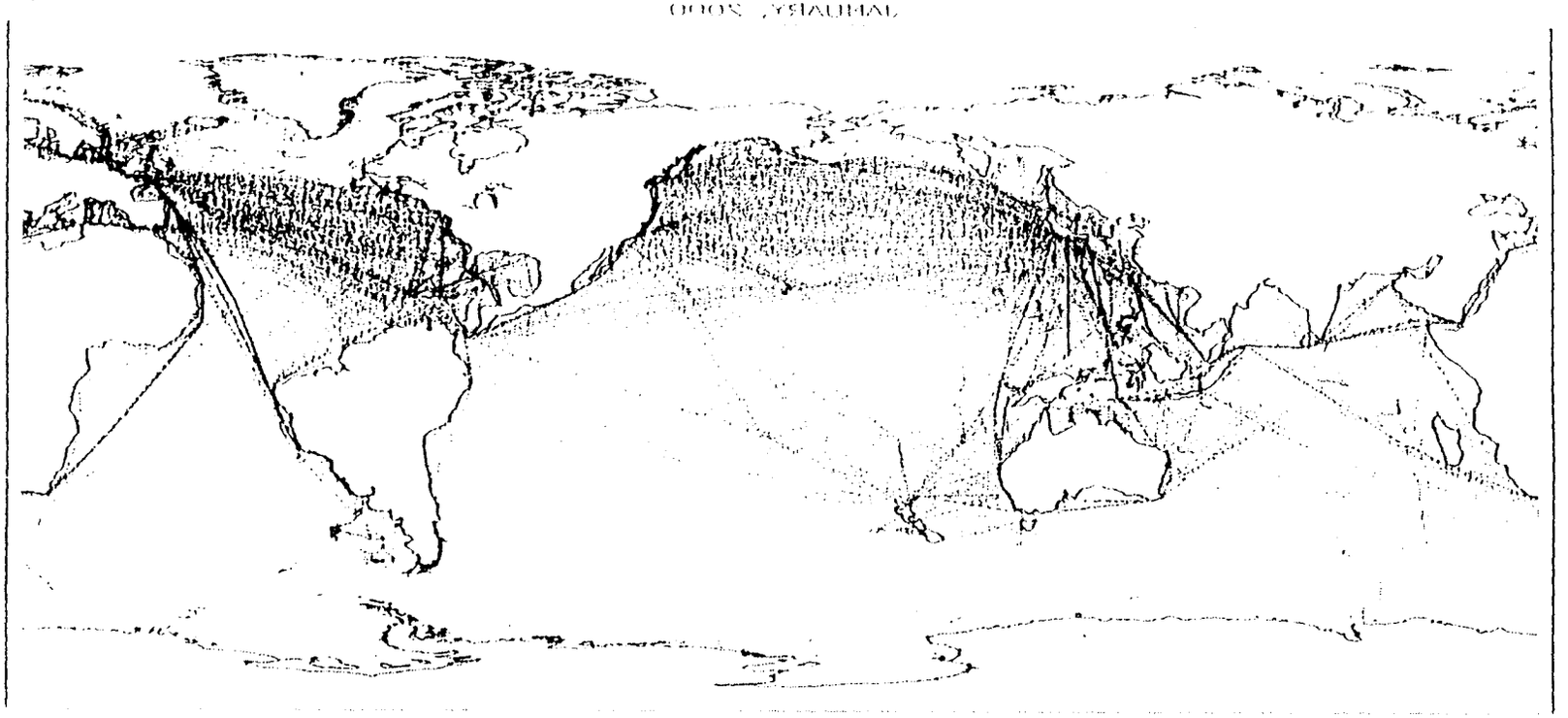
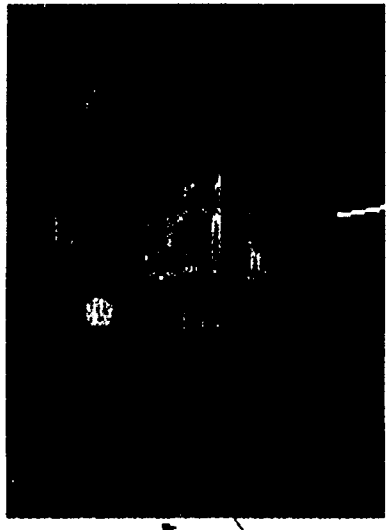
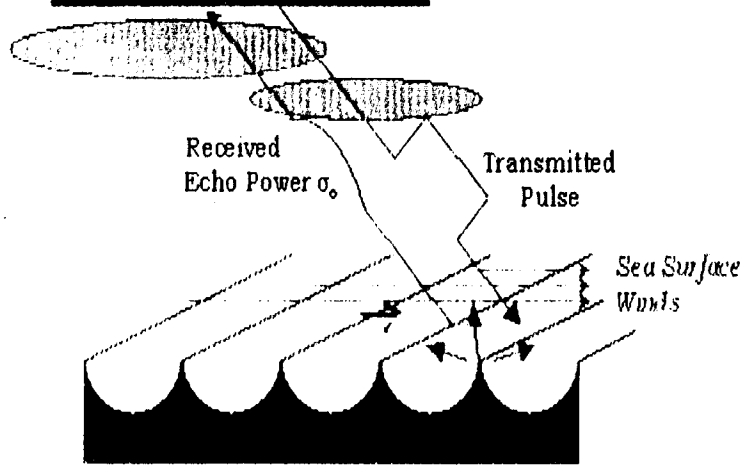


Principles of Scatterometry



- Scatterometer sends microwave pulses to Earth's surface and measures the power scattered back.
- Backscattered power depends on surface roughness.
- Roughness may describe characteristics of polar ice or land vegetation.

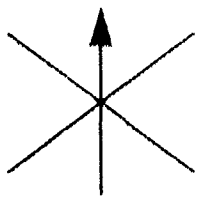
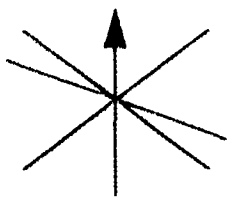
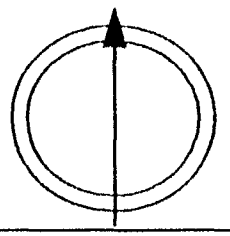
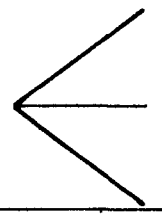
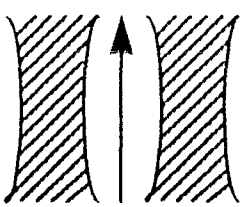
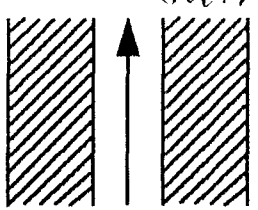
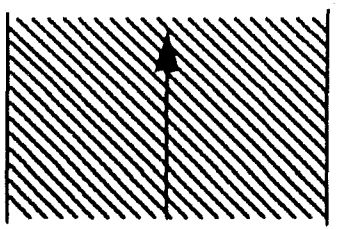
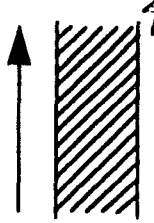


Surface waves in local equilibrium with wind produce Bragg scattering

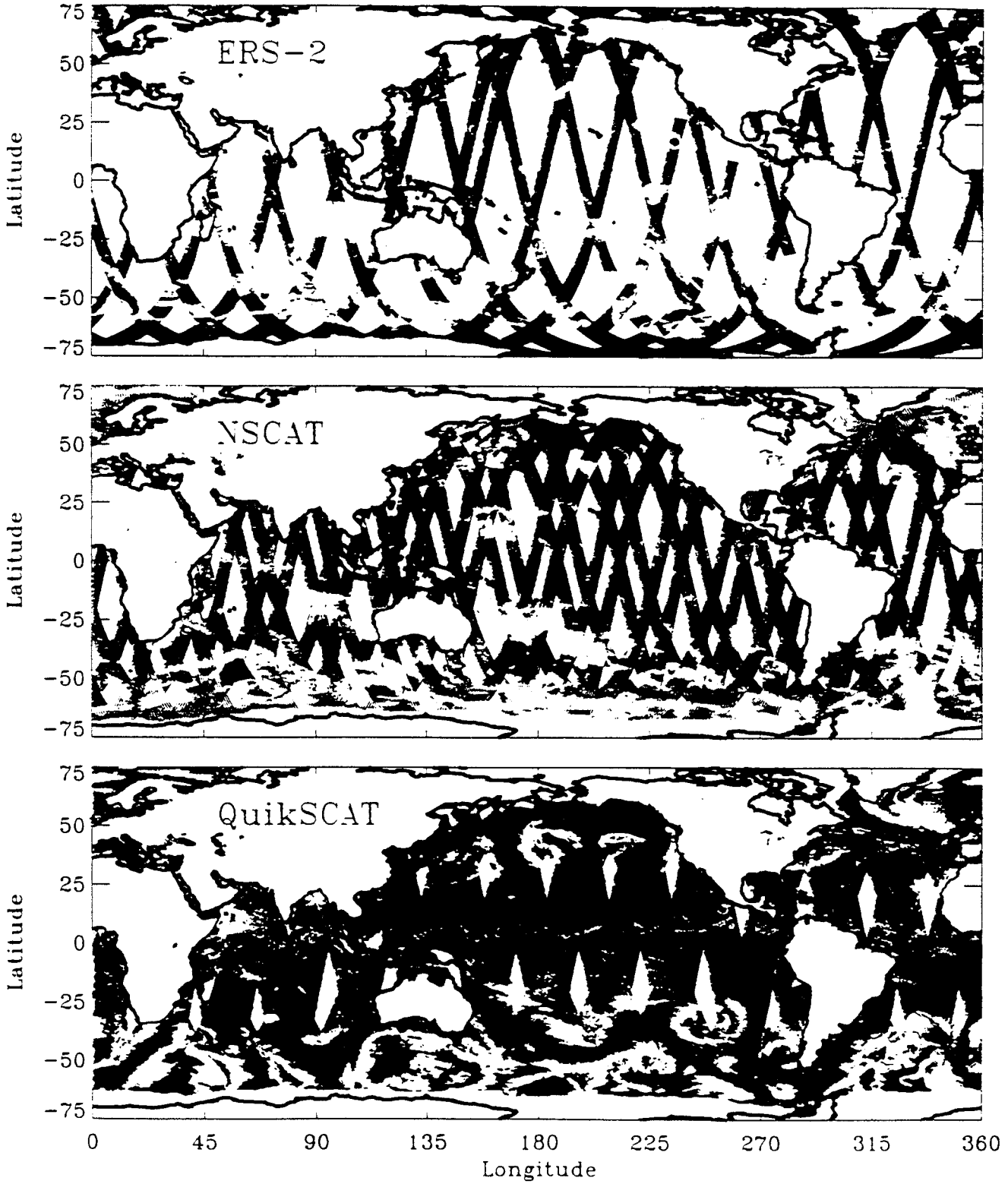
- Over ocean, roughness is caused by small waves in equilibrium with wind stress.
- Measuring both wind speed and direction is a unique capability of the scatterometer

Spaceborne Scatterometers

Past, Present, and Future

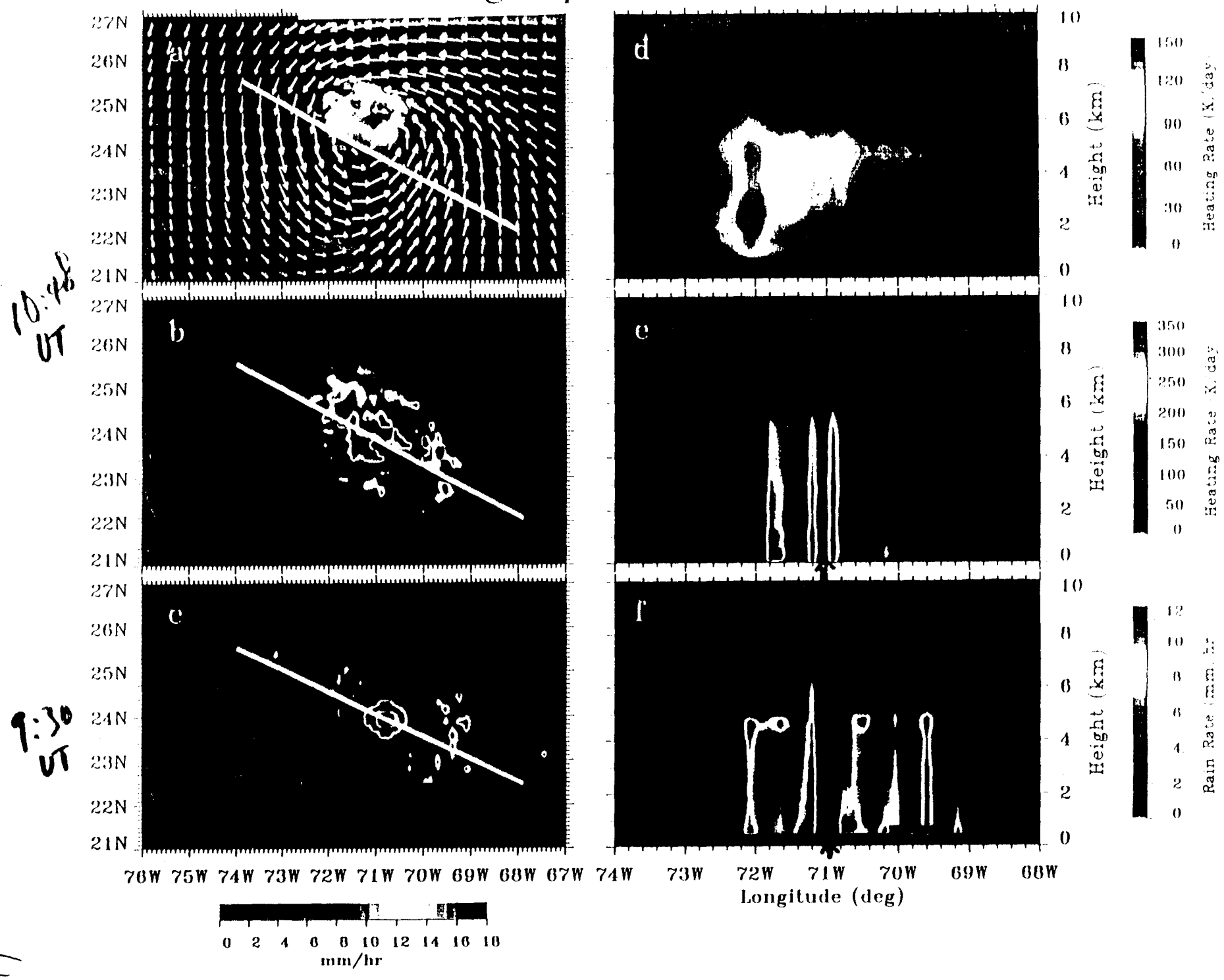
	SASS	NSCAT	SeaWinds	**ERS-1/2**
Frequency	14.6 GHz	13.995 GHz	13.402 GHz	**5.3 GHz**
Scan Pattern				
Polarization	V-H, V-H	V, V-H, V	V, H	**V ONLY**
Beam Resolution	Fixed Doppler	Variable Doppler	Spot	**RANGE GATE**
Resolution	50/[redacted] km	25/[redacted] km	25 ~~25/50~~ km	**[redacted]50 km**
Swath		600 km 		476 km 
Daily / 2-day Coverage	Variable	77/97%	93/100%	**41%**
Dates	6/78 - 10/78	8/96 - 8/99	2/99 - 2/02	**91 +**

Daily Coverage of Three Scatterometers



Speed U (m/s): $0 \leq U < 5$ ... $U \geq 15$

Need High Spatial Resolution



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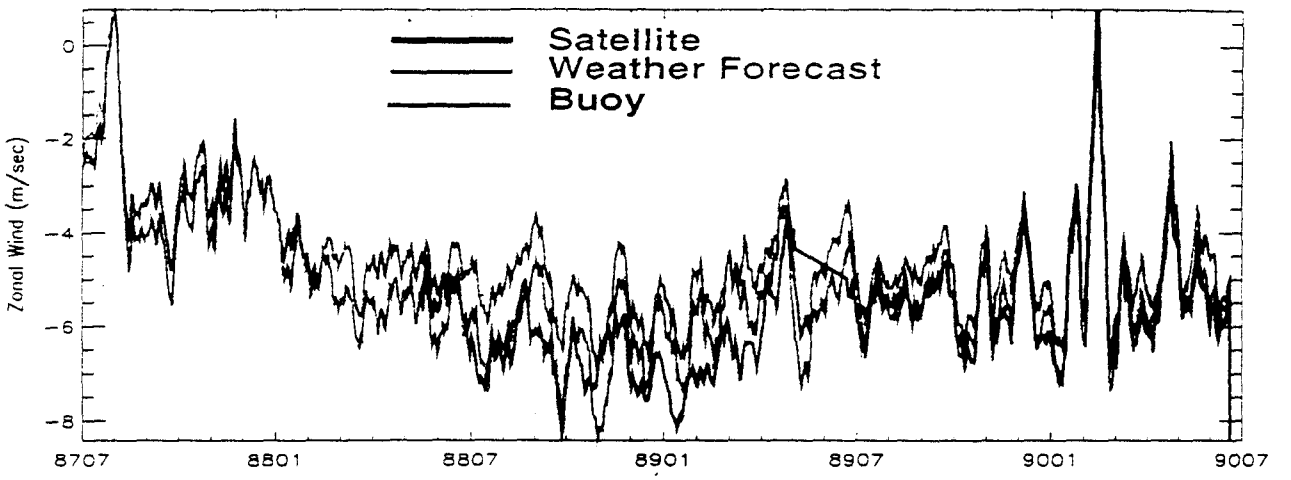
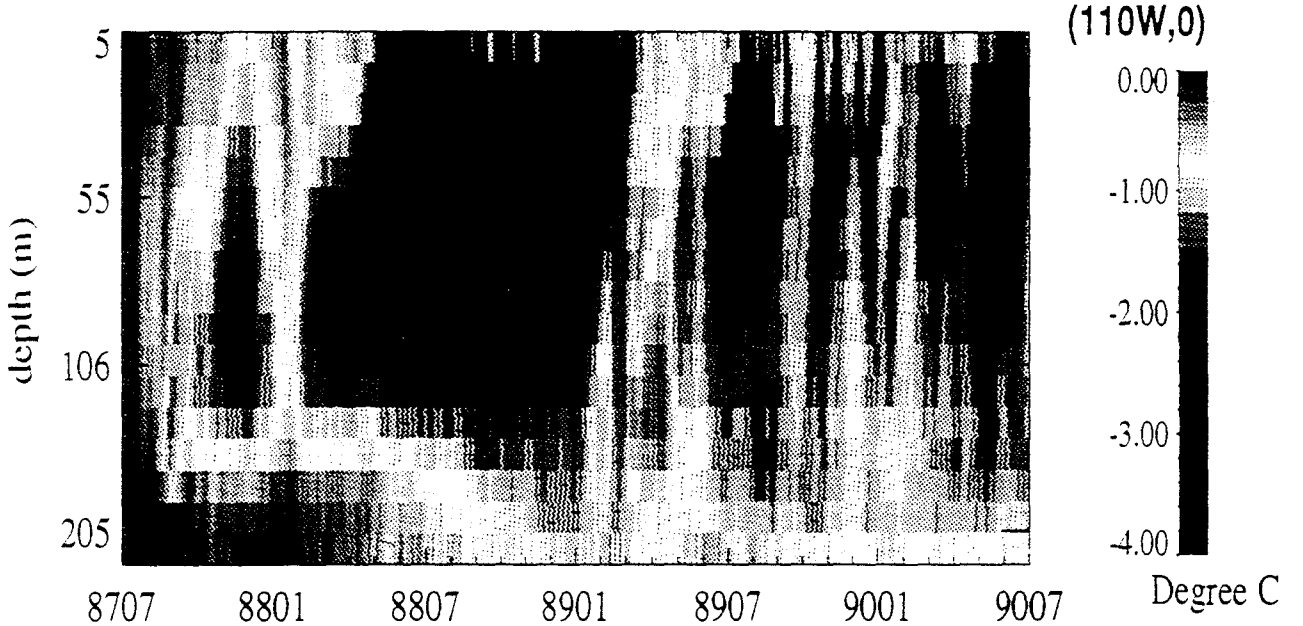
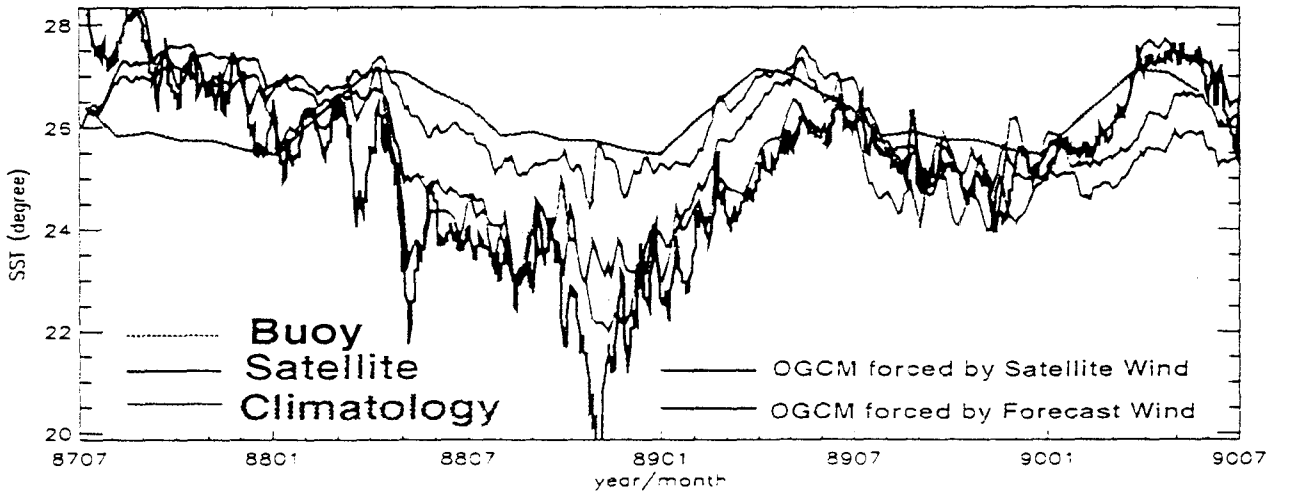
Zonal Wind Speed at (170W,0)



Difference in OGCM Temperature Response to Wind (Satellite - Forecast) (110W,0)



Sea Surface Temperature at (140W,0)



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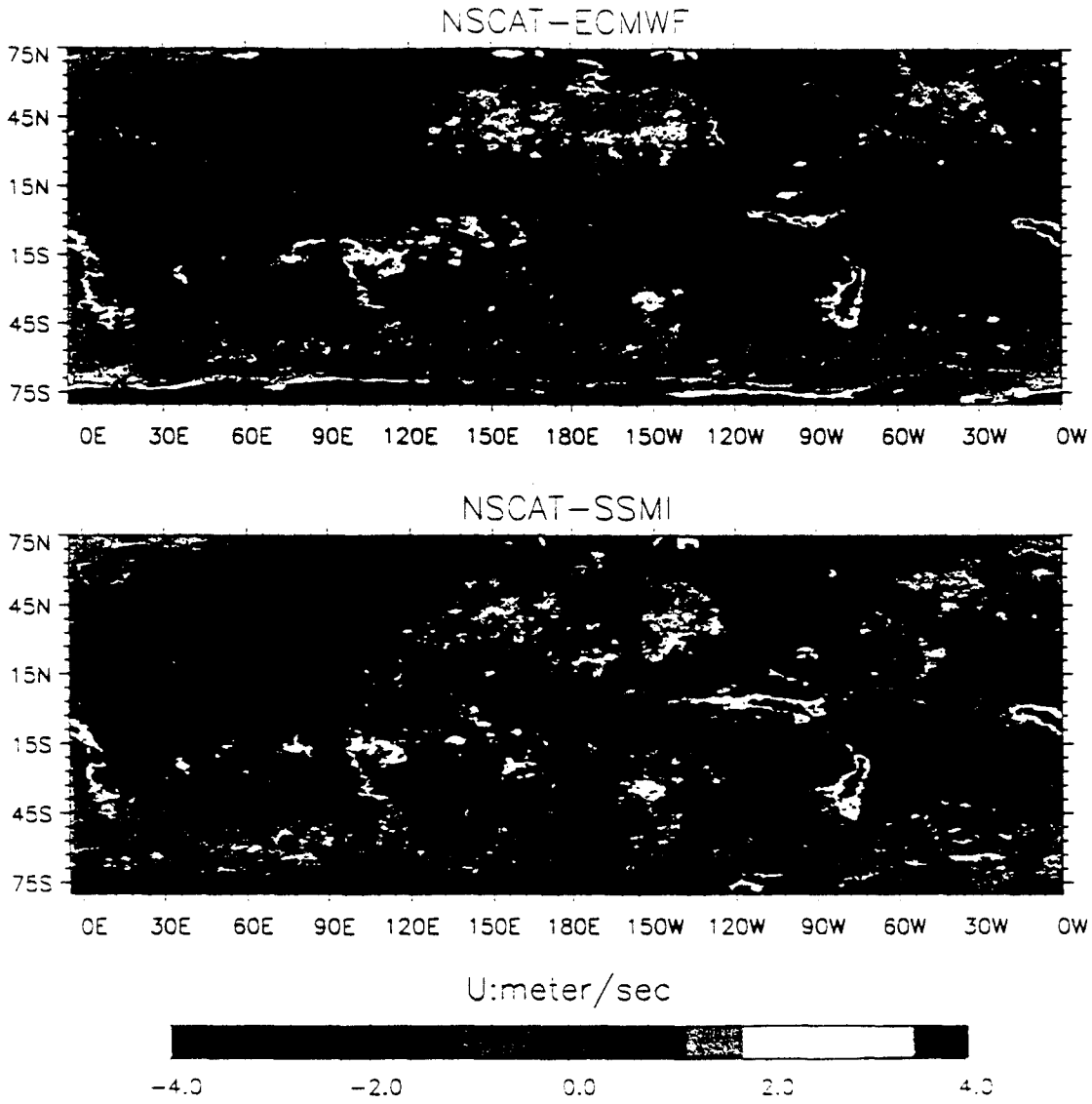
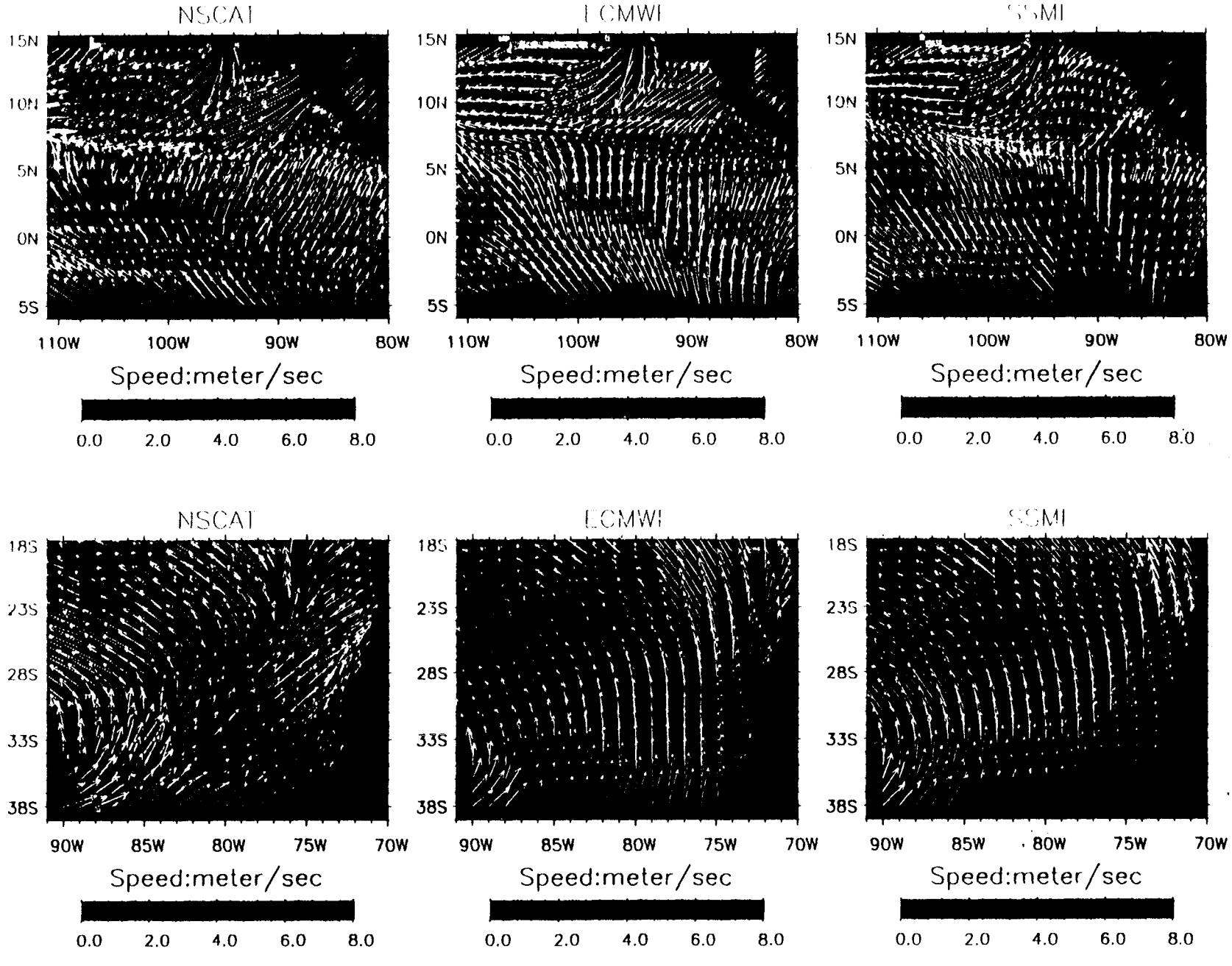
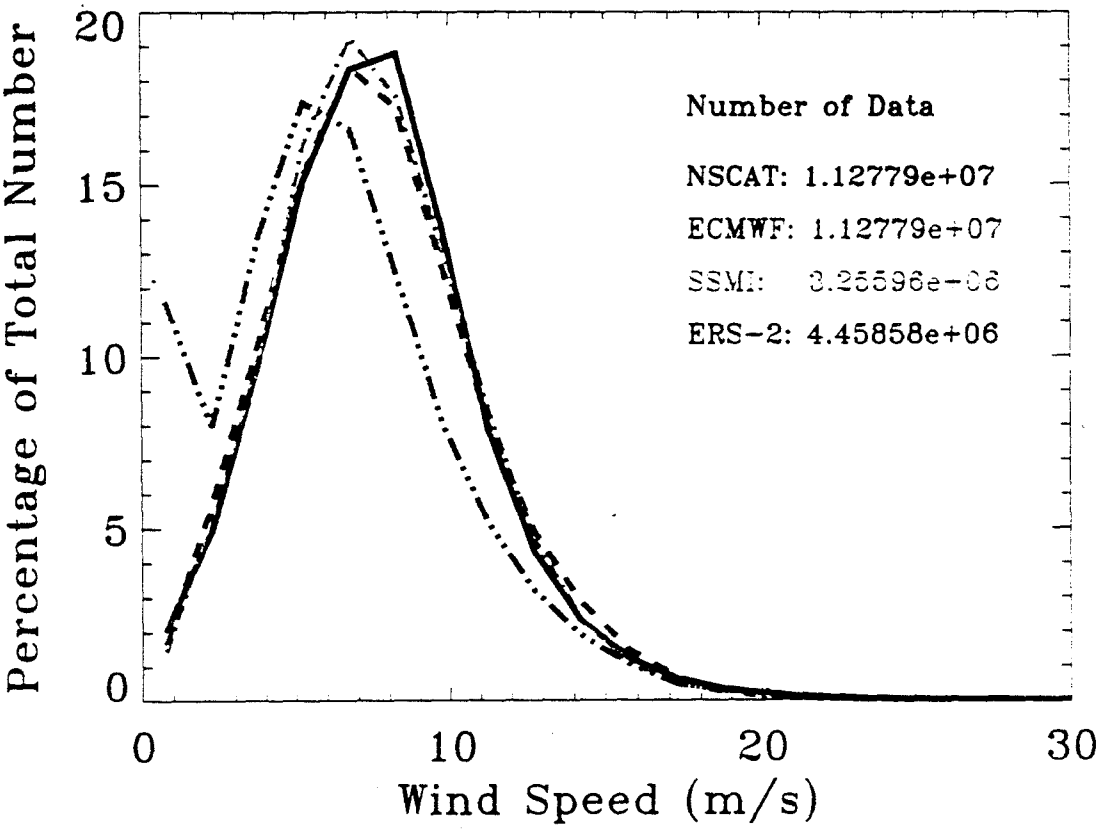
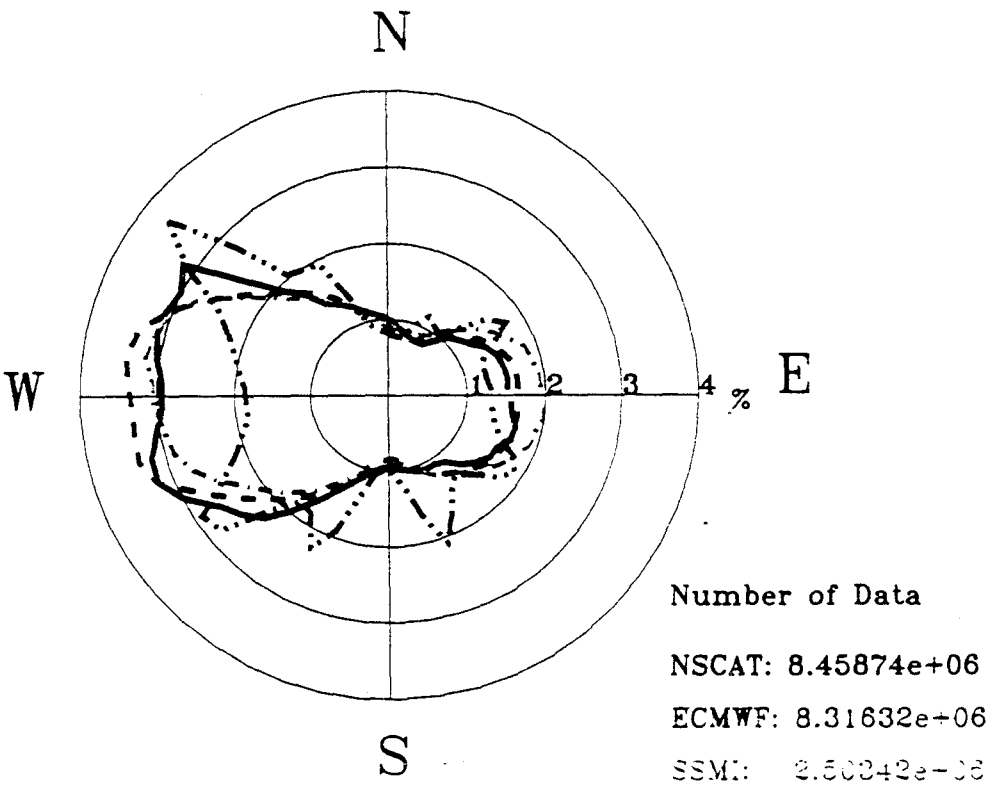


SSMI Wind Fields Inherit Similar Directional Deficiencies as NWP Winds

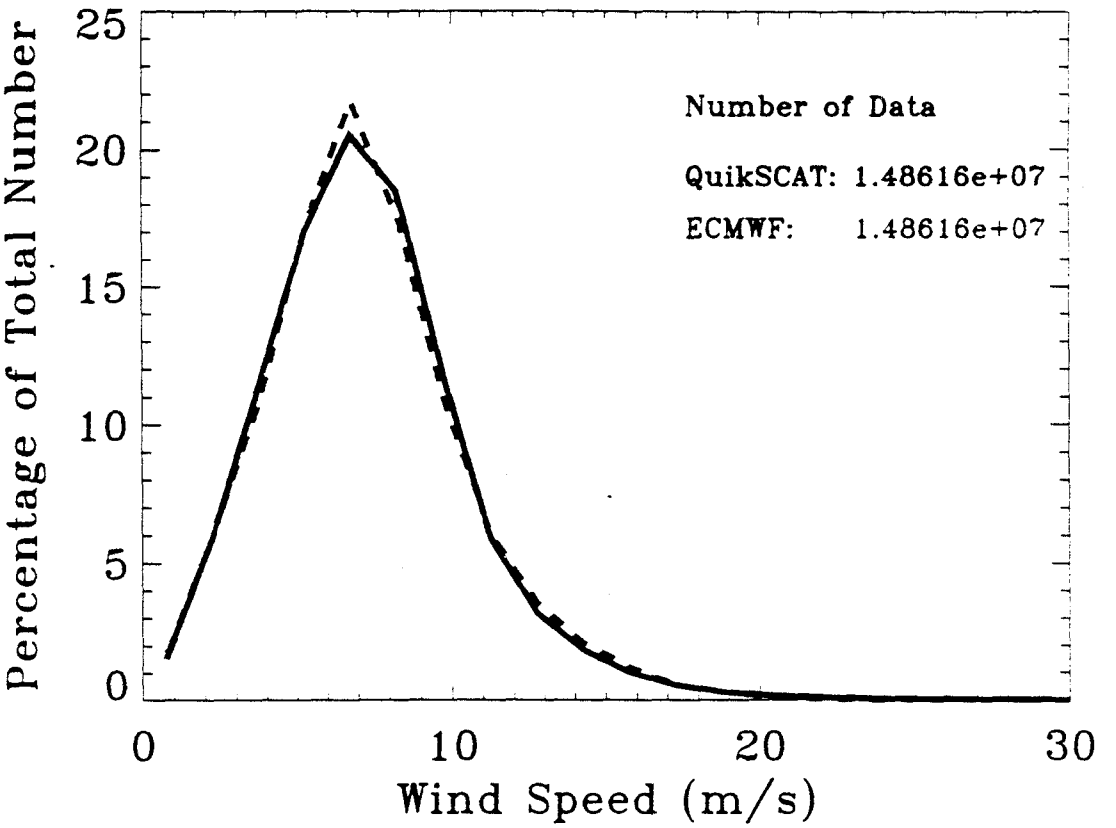

NSCAT
ECMWF
SSMI
15N
10N
5N
0N
5S
110W
100W
90W
80W
Speed:meter/sec
0.0
2.0
4.0
6.0
8.0
NSCAT
ECMWF
SSMI
18S
23S
28S
33S
38S
90W
85W
80W
75W
70W
Speed:meter/sec
0.0
2.0
4.0
6.0
8.0

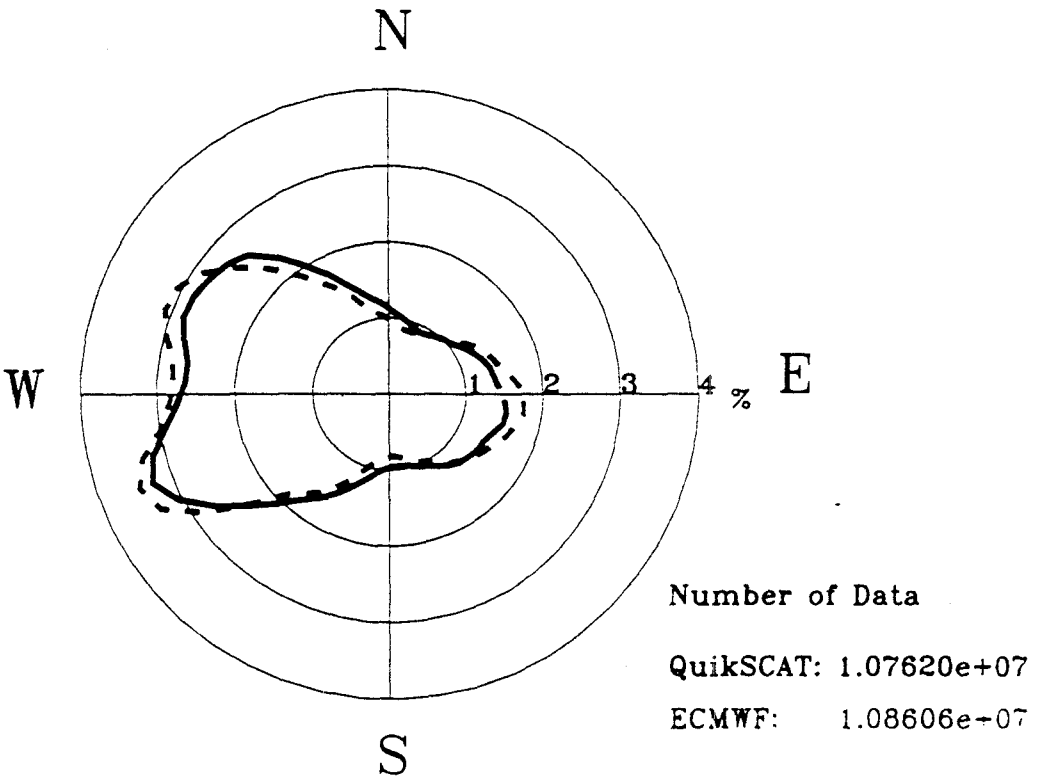
52°S ≦ Latitude ≦ 52°N, December 1996





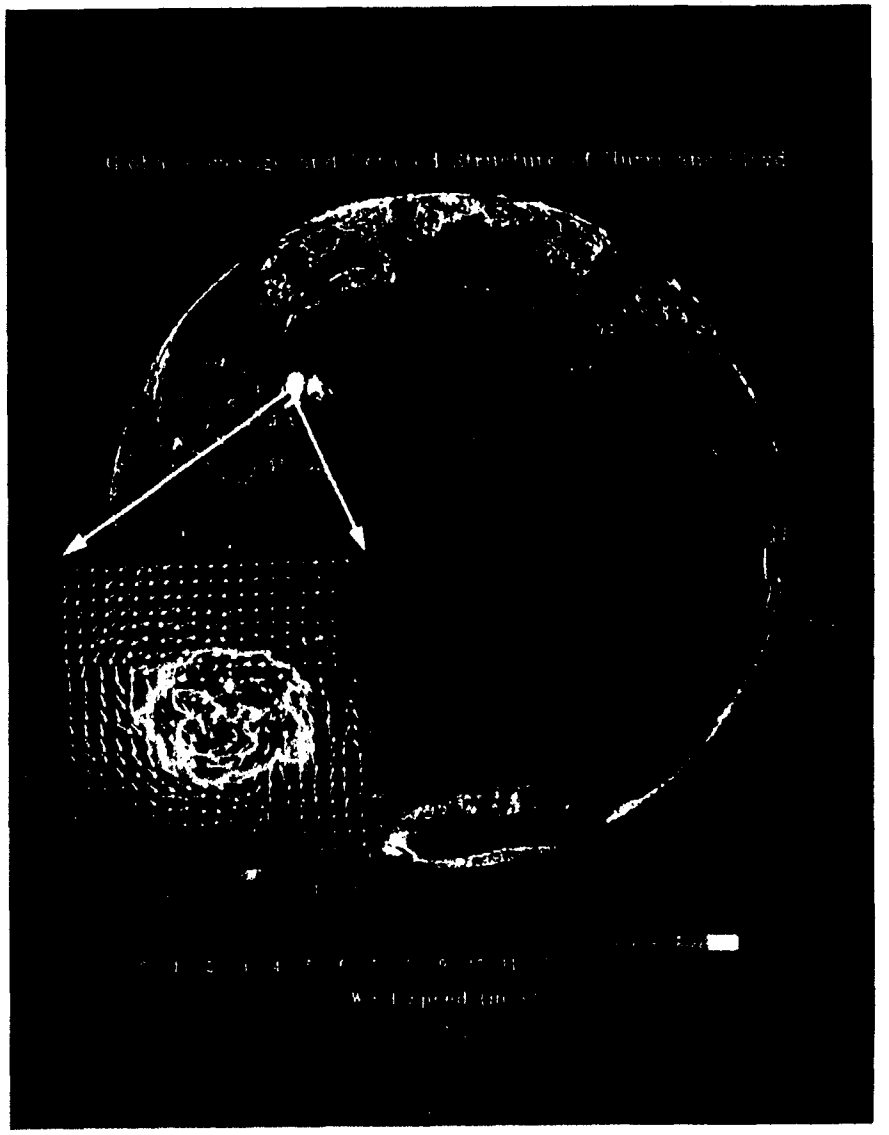
52°S ≦ Latitude ≦ 52°N, December 1999





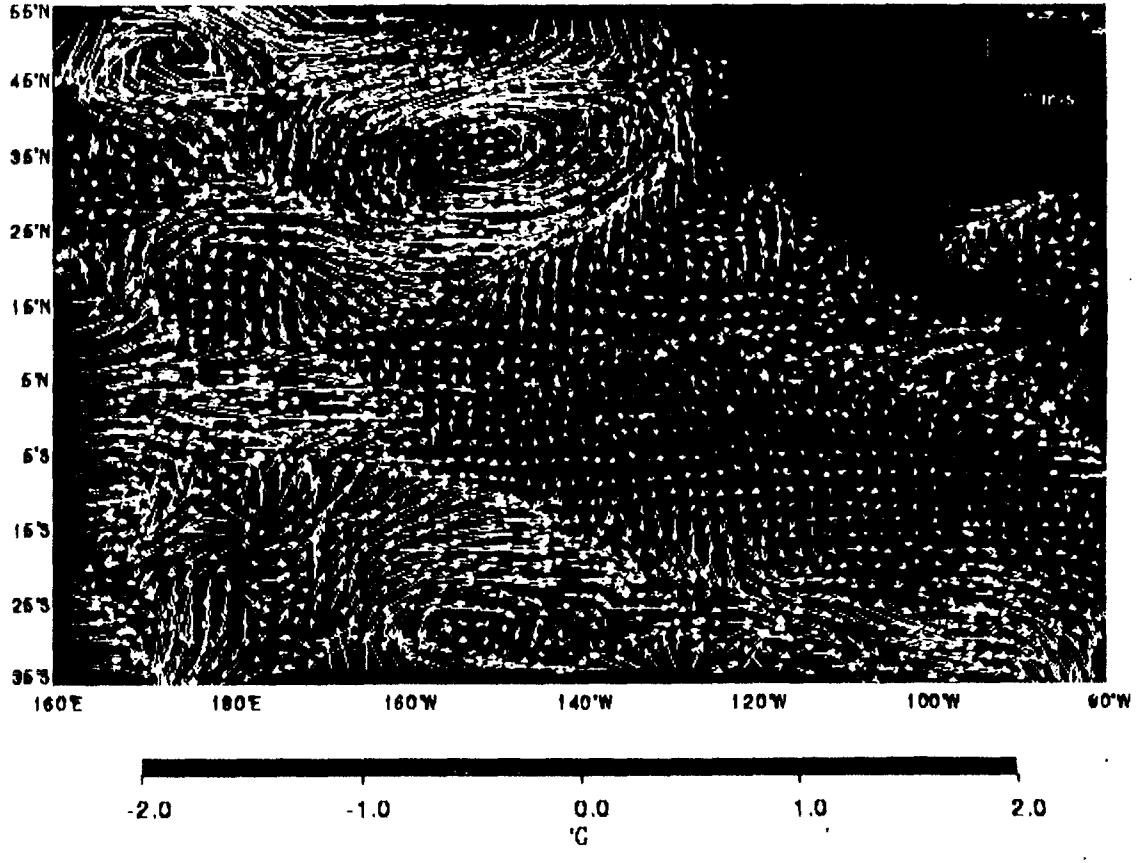
Global Weather and Marine Storms

- Synoptic view of wind over global ocean
- Improve weather forecast
- Detail structure of marine storms
- Wind-driven ocean circulation & ecological change



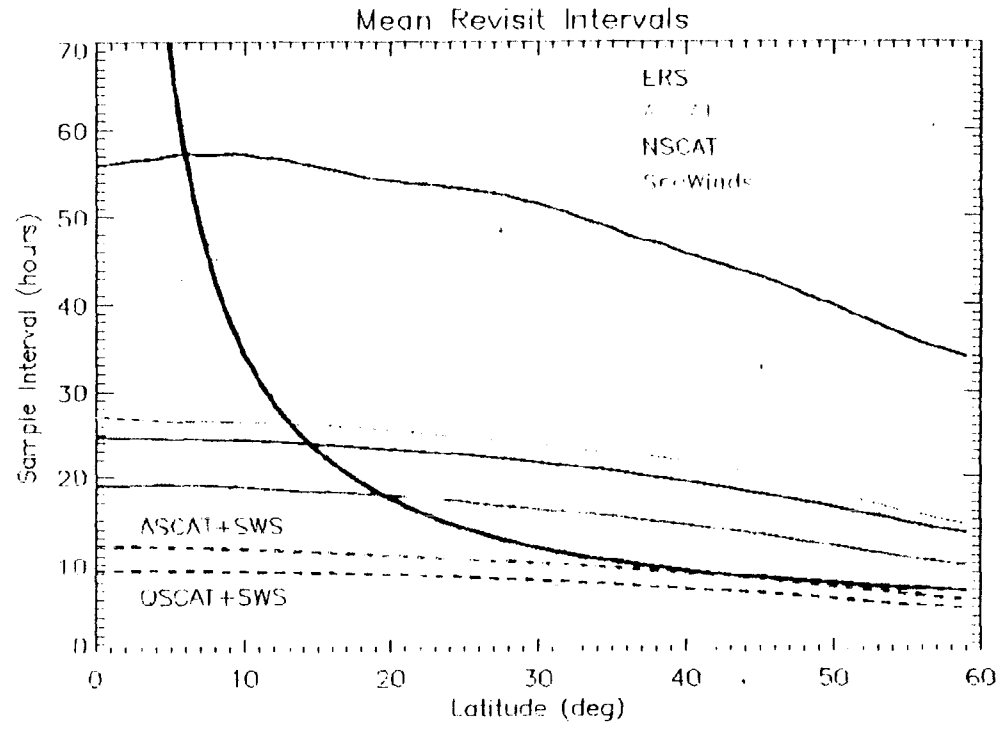
Climate Changes

- El Nino & La Nina
- "Pineapple Express"
- Coastal Ecology
- Decadal Anomalies



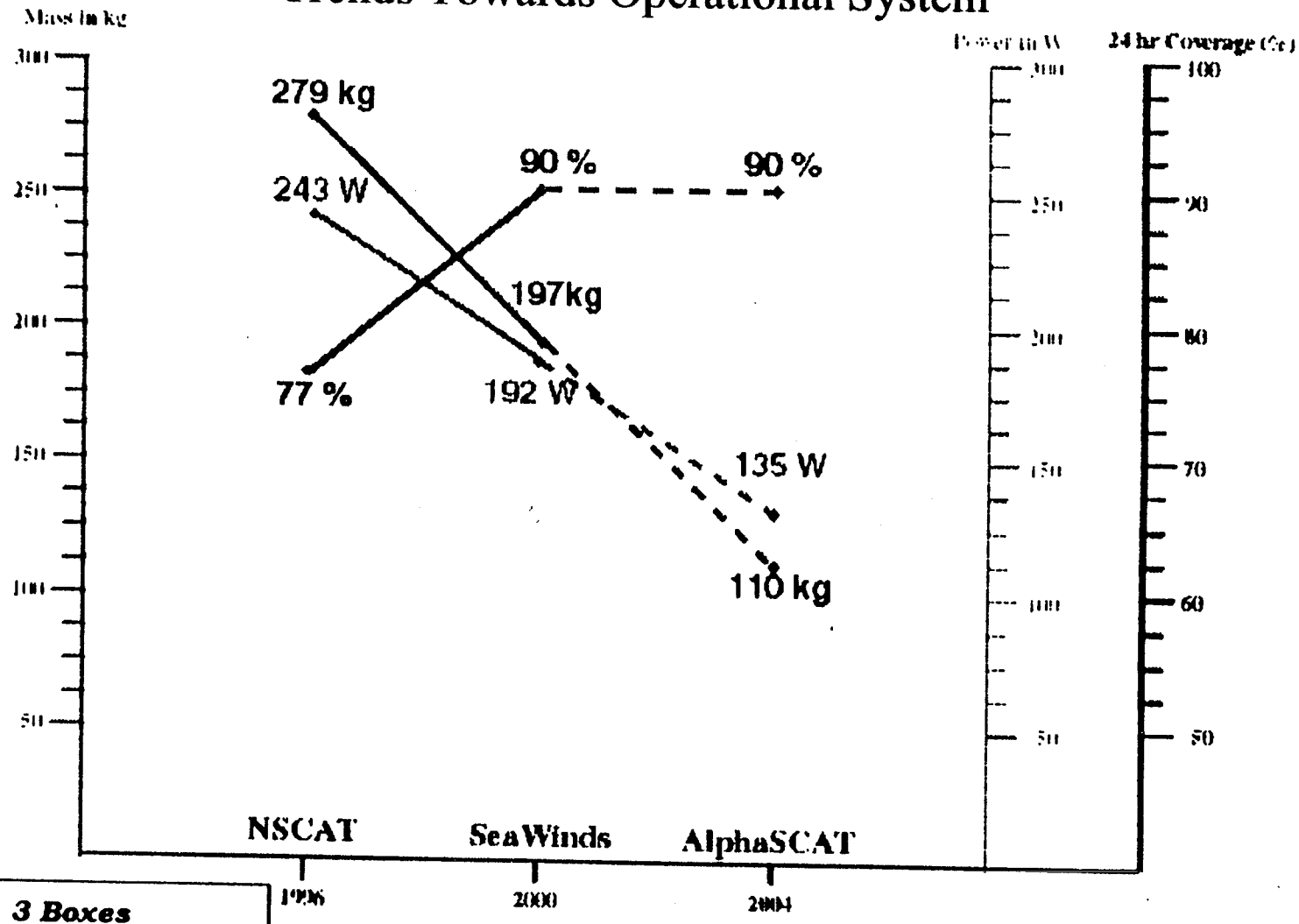
Global coverage several times a day are required to satisfy scientific requirements

- **Multiple scatterometer flying in tandem**
- **International partnership**



JPL

Mass, Power and Coverage Trends Towards Operational System



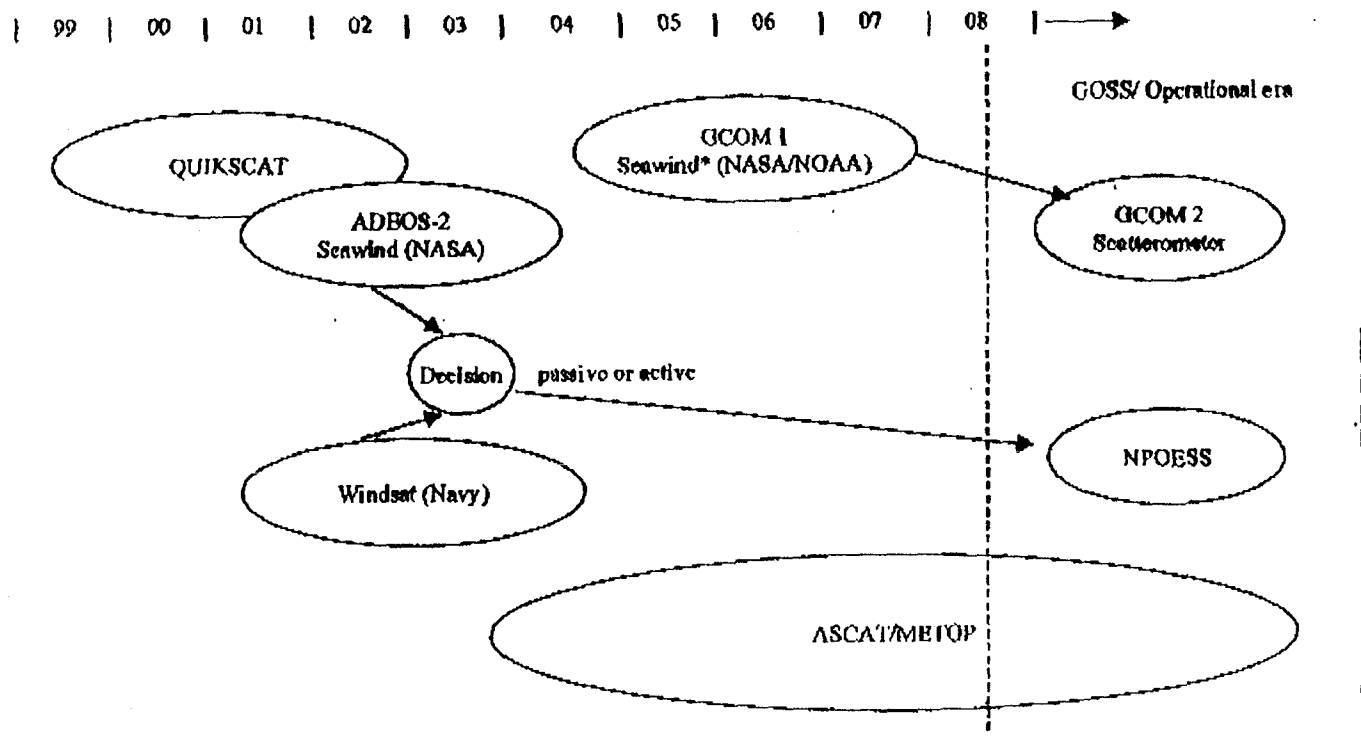
3 Boxes
6 Deployable Antennas
Cabling
Waveguide
1 Tower

→

3 Boxes
Cabling
Waveguide

→

1 Box

- Long records required to understand and predict climate change
- Transfer from research to operational missions to preserve continuous vector wind measurements, with infusion of new technology

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