

New RADARSAT Capabilities Improve Maritime Surveillance

Paris W. Vachon
DRDC Ottawa / RAST / RDE

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Menu

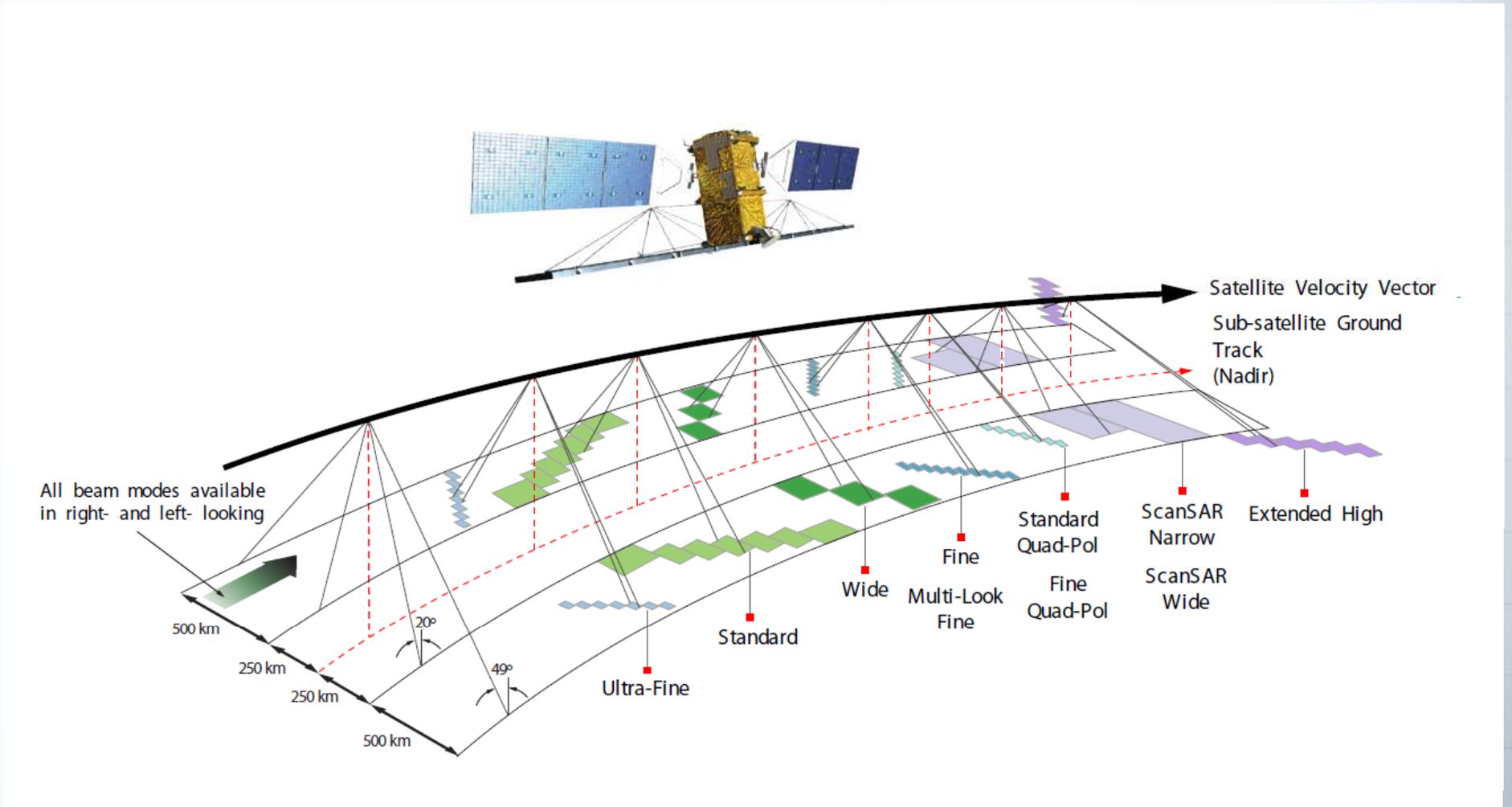
- RADARSAT-2:
 - Polar Epsilon;
 - Maritime Satellite Surveillance Radar;
 - Cross-polarization wind speed retrieval;
- RADARSAT Constellation Mission:
 - Polar Epsilon 2.

RADARSAT-2

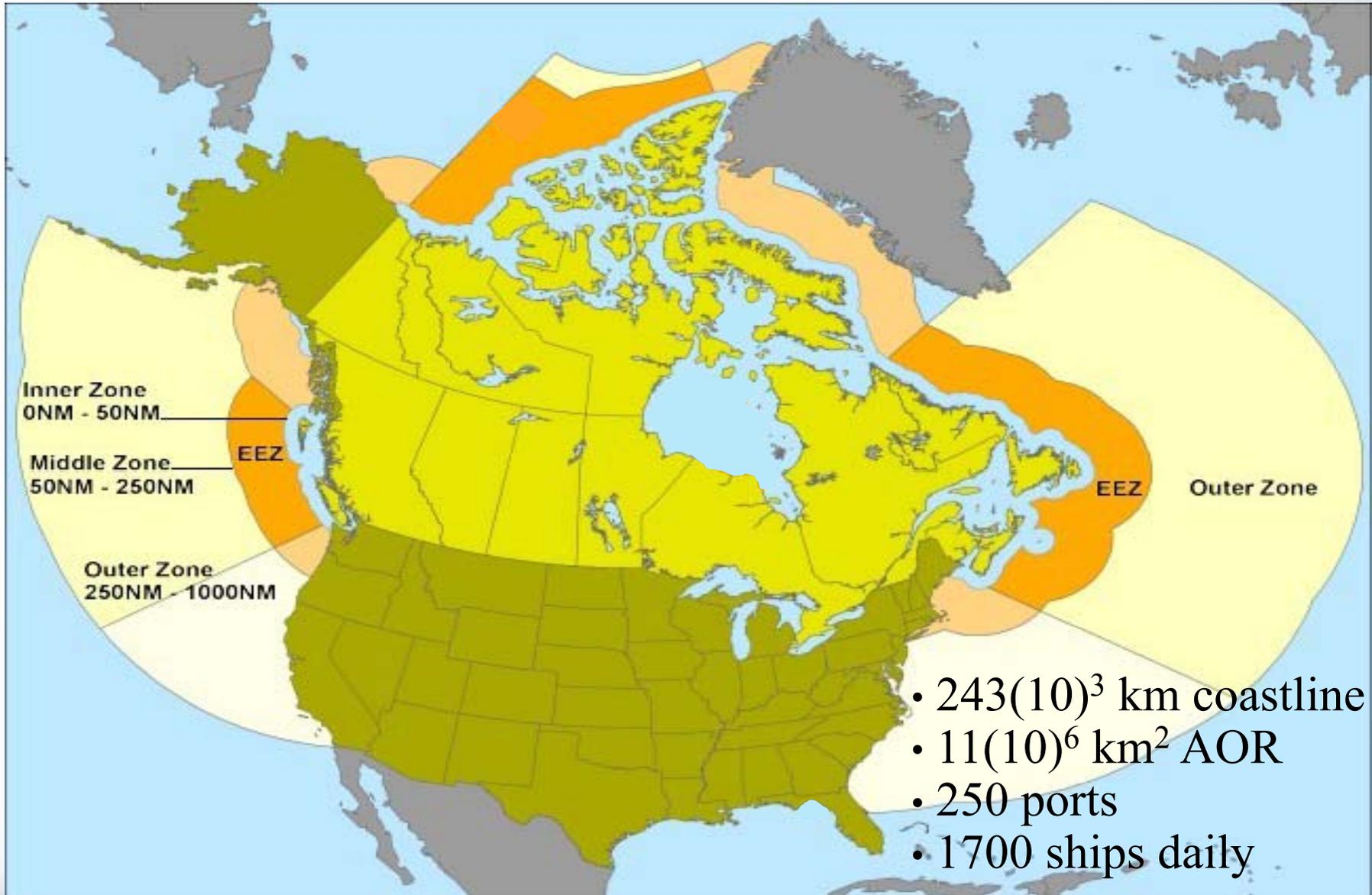


- Follow-on to RADARSAT-1;
- Built, owned and operated by MDA;
- GoC \$445 M investment being returned as imagery to GoC users;
- Launched 14 Dec 2007;
- C-band SAR;
- Trade spatial resolution for swath coverage;
- Up to 1 metre resolution;
- Selective Single, Dual, and Quad Polarization
- Polar Orbit, 780 km;
- 24-day repeat.

RADARSAT-2 Modes



Canada's Areas of Responsibility and Surveillance Zones



Project Polar Epsilon: Joint Space-Based Wide Area Surveillance and Support Capability

Overview

Aim: (1) Support to CF operations;
 (2) Arctic, maritime domain awareness.

Description: Exploit RADARSAT-2 for DND/CF operational stakeholders.

Funding: \$64.5 M, DND.

Project Phase: Implementation.

Capabilities

Arctic Surveillance (Land) (R-2):

- Surveillance of Canada's Arctic Region;

Environmental Sensing (MODIS):

- Support to CF operations;

Near-Real Time Ship Detection (R-2):

- Surveillance of Maritime approaches;
- Global surveillance (CDI);

Maritime Satellite Surveillance Radar (R-2):

- New beam modes for ship detection and maritime surveillance.

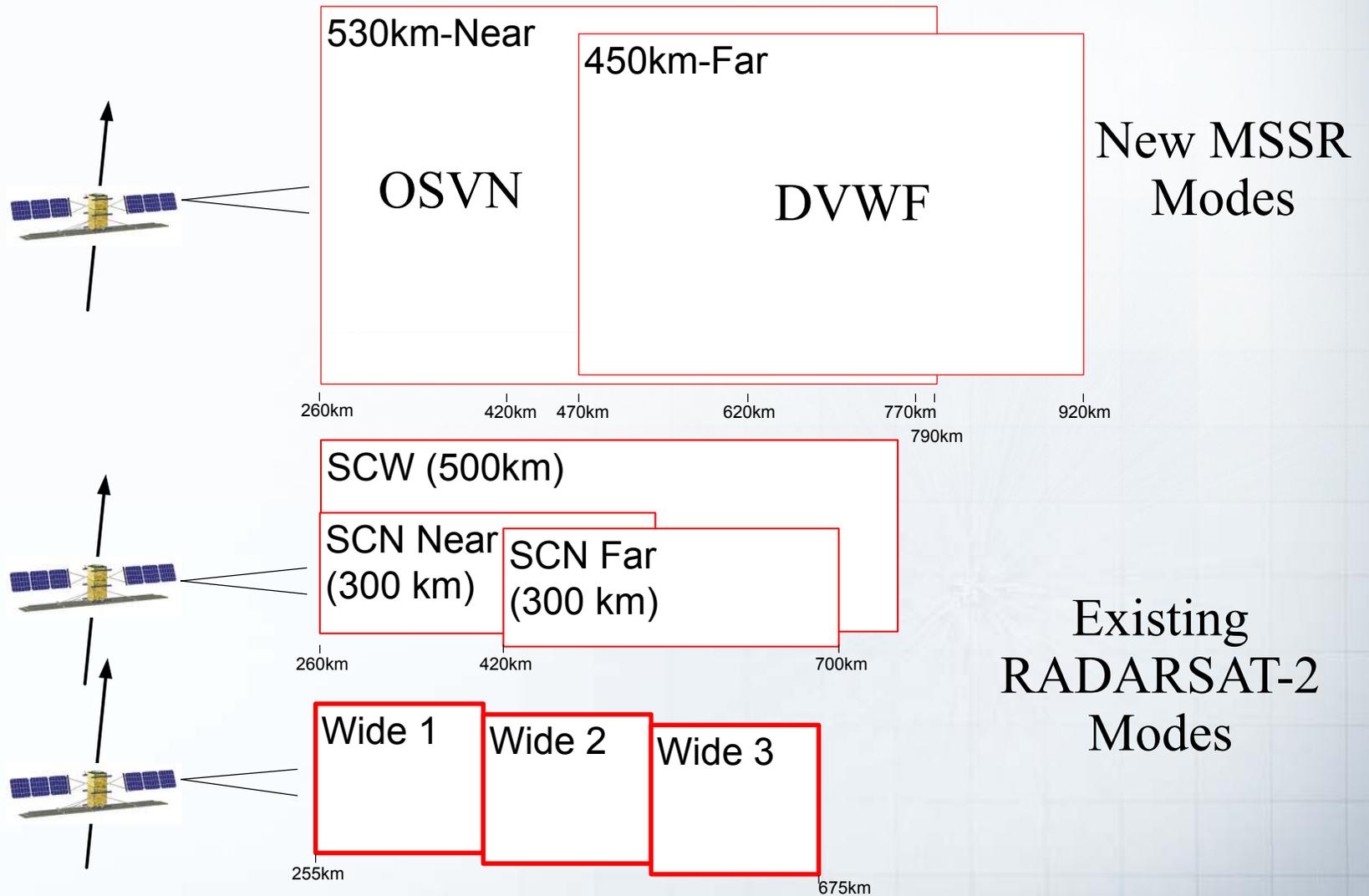


| Schedule | IOC | FOC |
|---------------------------------------|--------|--------|
| Arctic Surveillance (Land) | Oct-09 | Jun-10 |
| Environmental Sensing | Oct-10 | Nov-10 |
| Near-Real Time Ship Detection | Apr-11 | Jul-11 |
| Maritime Satellite Surveillance Radar | | Jul-11 |

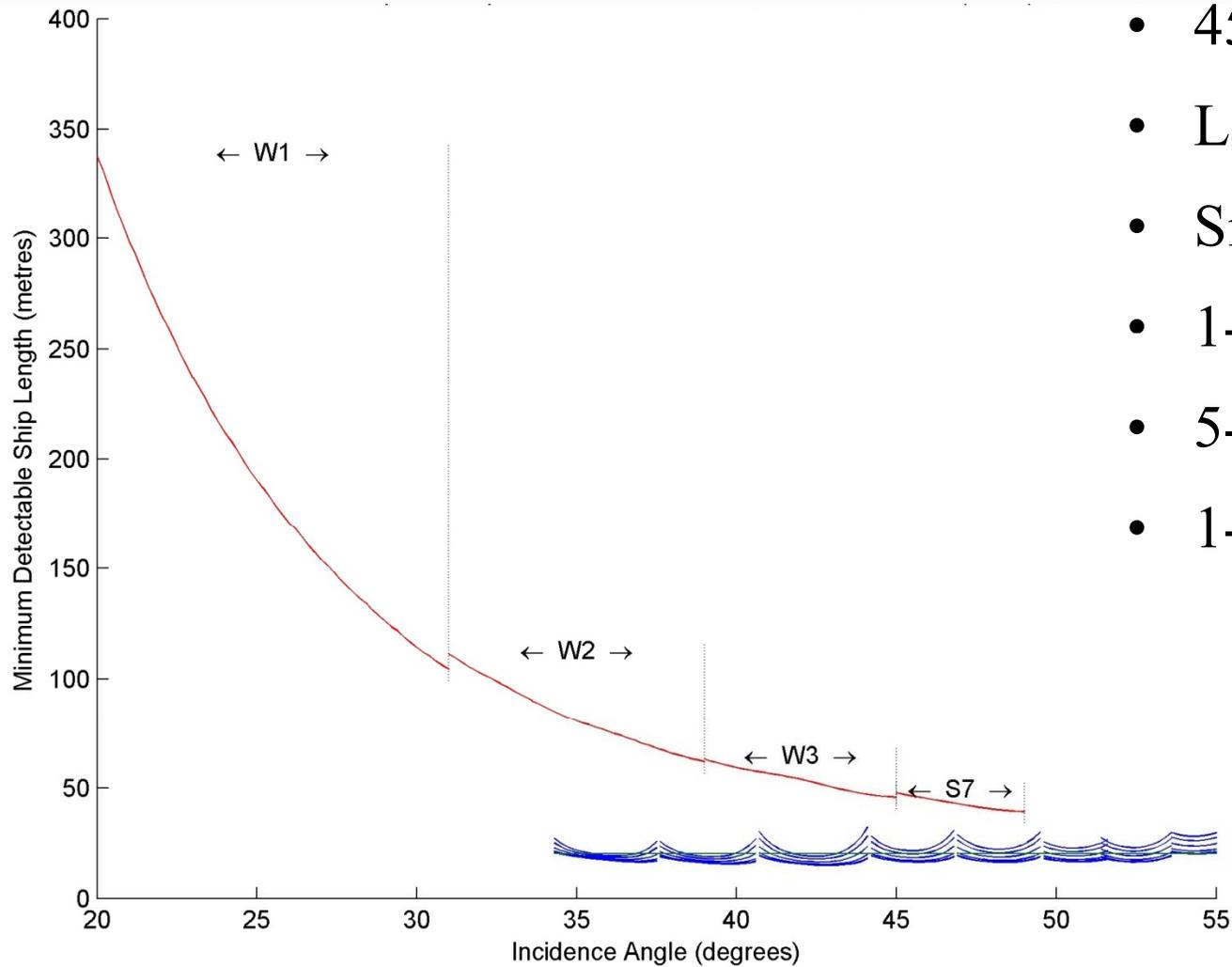
- Reception at Masstown and Aldergrove;
- Processing at Aldergrove;
- OTHGold in 15-30 min;
- Automated ingest into RMP.



Maritime Satellite Surveillance Radar (MSSR)

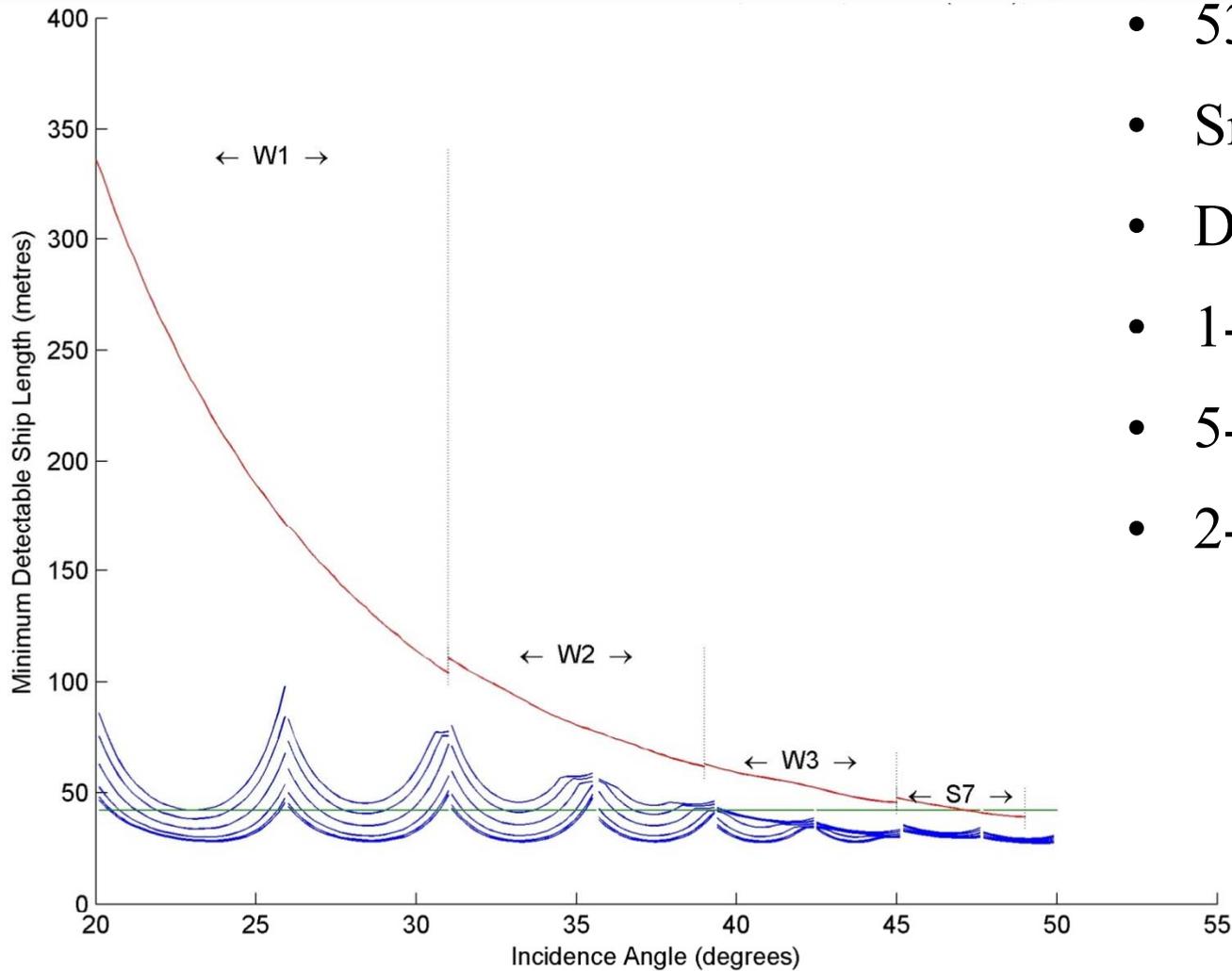


DVWF – Detection of Vessels



- 450 km swath;
- Large incidence;
- Single polarization;
- 1-look azimuth;
- 5-looks range;
- 1-bit BAQ.

OSVN – Ocean Surveillance



- 530 km swath;
- Small incidence;
- Dual polarization;
- 1-look azimuth;
- 5-looks range;
- 2-bits BAQ.

Cross-polarization Wind Speed Retrieval

- Cross-pol ocean backscatter needed for ship detectability modelling;
- RADARSAT-2 Fine Quad (FQ) Mode data of operational buoys;
 - Extremely low noise floor (~ -35 dB);
 - All linear polarization combinations available simultaneously;
 - Channel cross-talk corrected.



West Coast Buoy Locations

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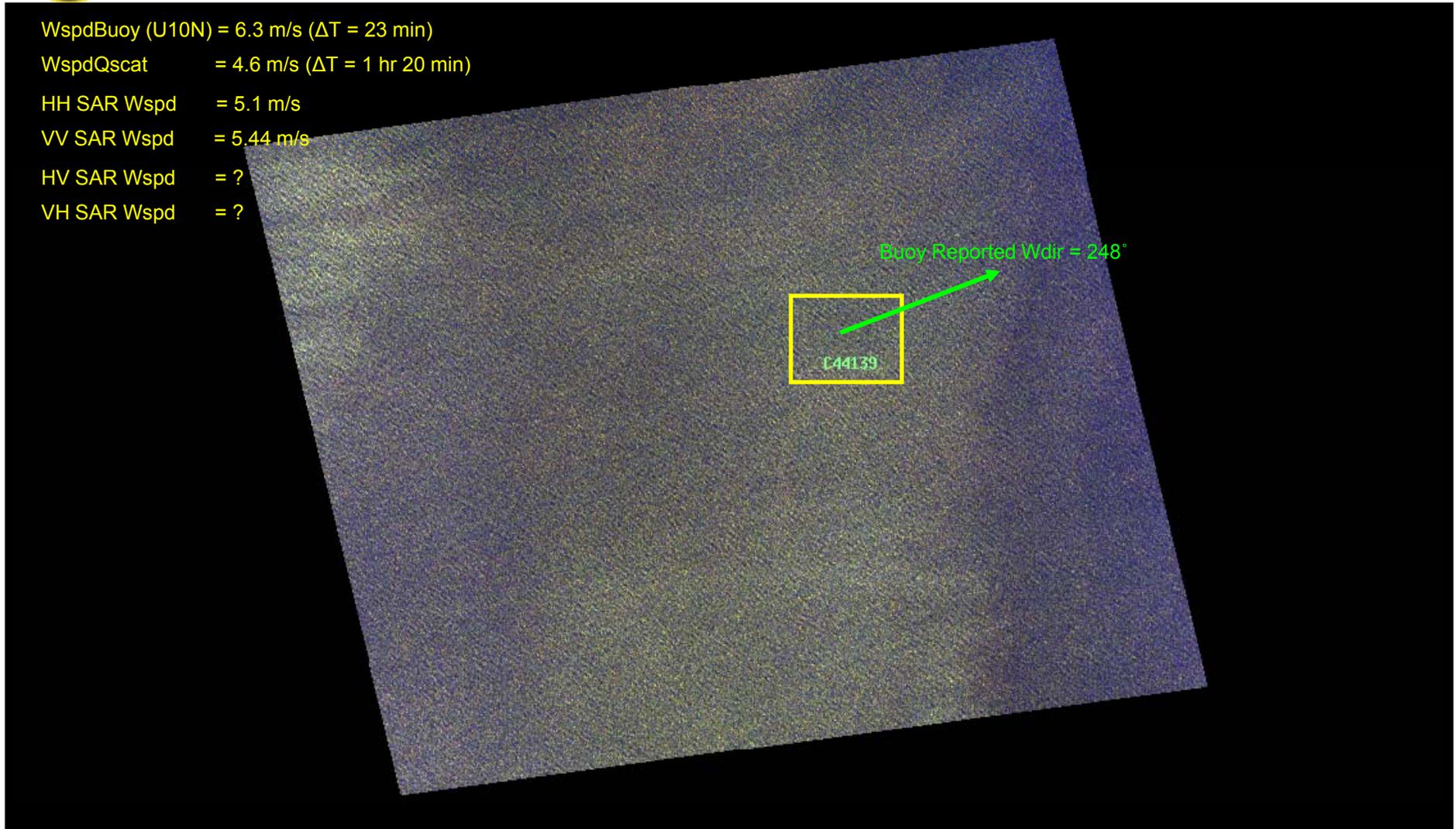
Canada 



R-2, 05-Apr-2009 21:43, FQ18

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WspdBuoy (U10N) = 6.3 m/s ($\Delta T = 23$ min)
WspdQscat = 4.6 m/s ($\Delta T = 1$ hr 20 min)
HH SAR Wspd = 5.1 m/s
VV SAR Wspd = 5.44 m/s
HV SAR Wspd = ?
VH SAR Wspd = ?

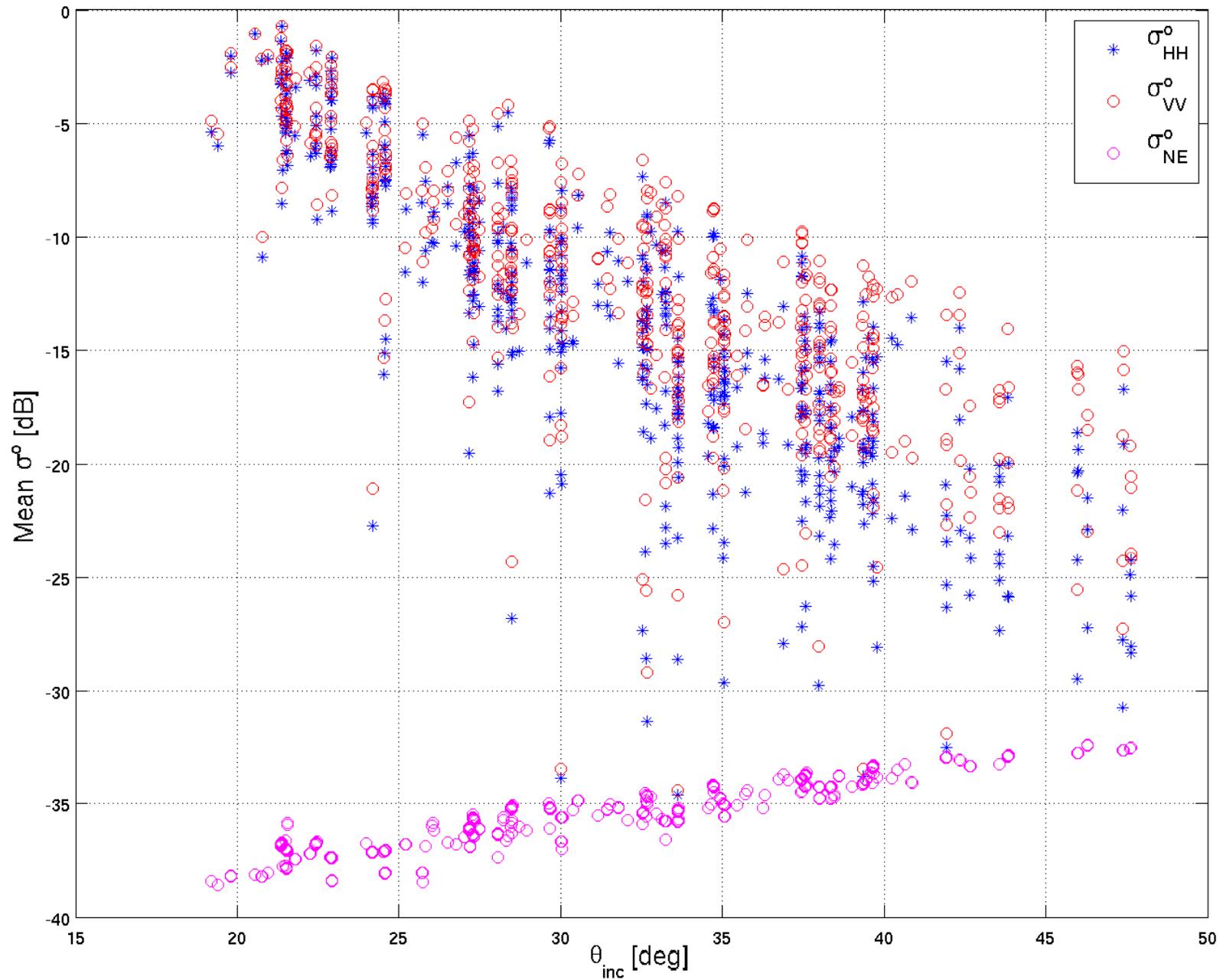


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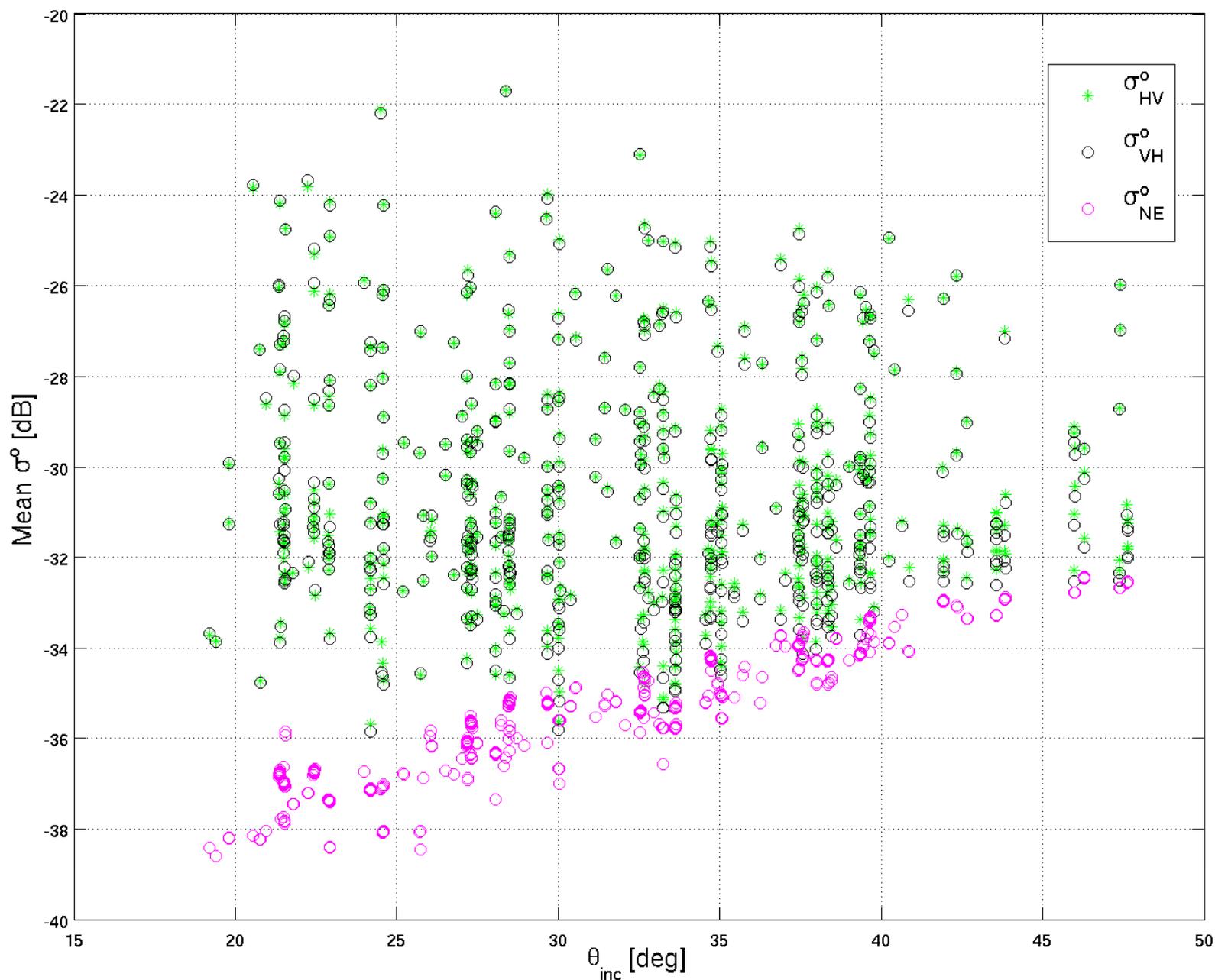
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Canada 

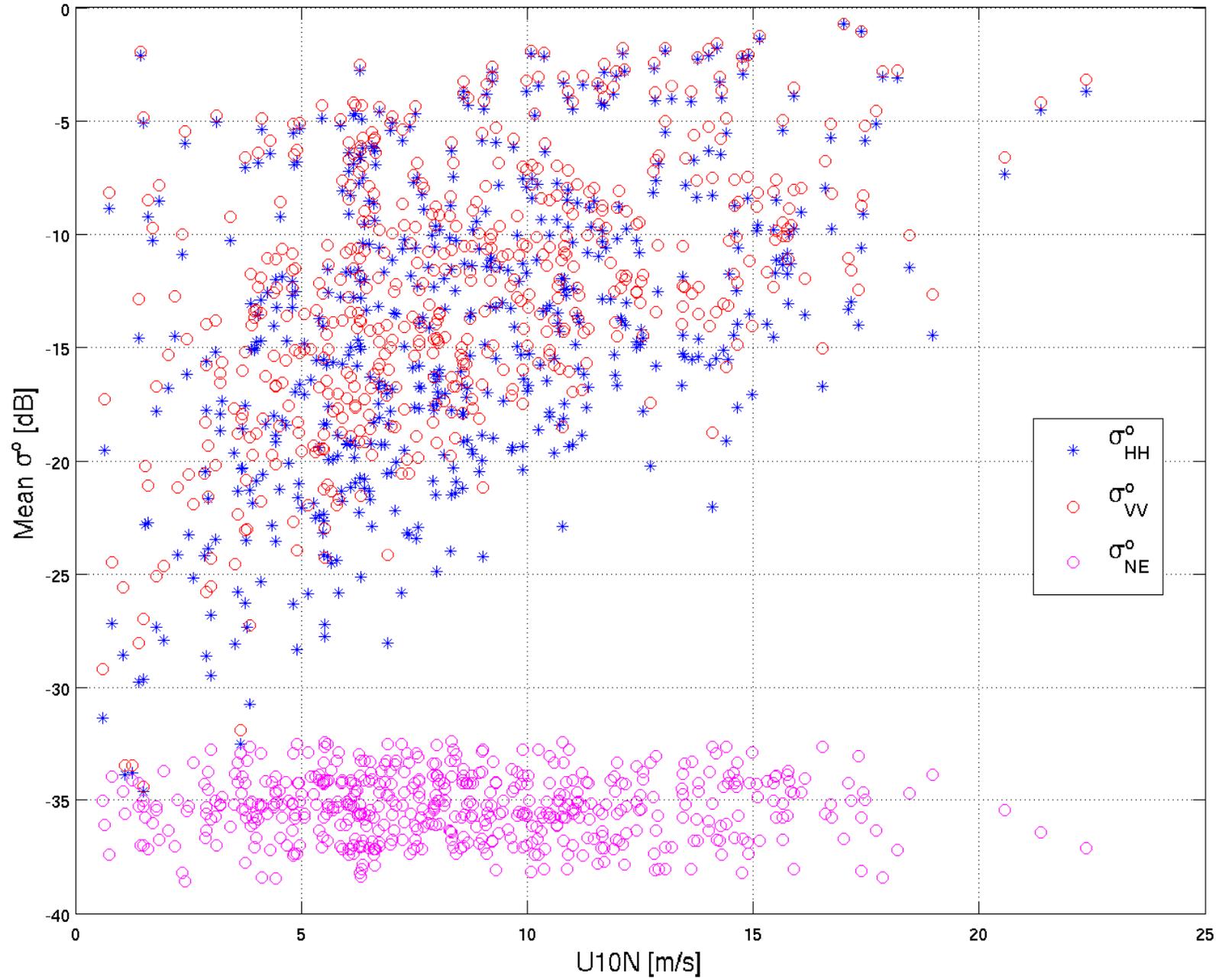
RADARSAT-2, Buoy Analysis, Co-pol σ° vs θ_{inc} , N=546



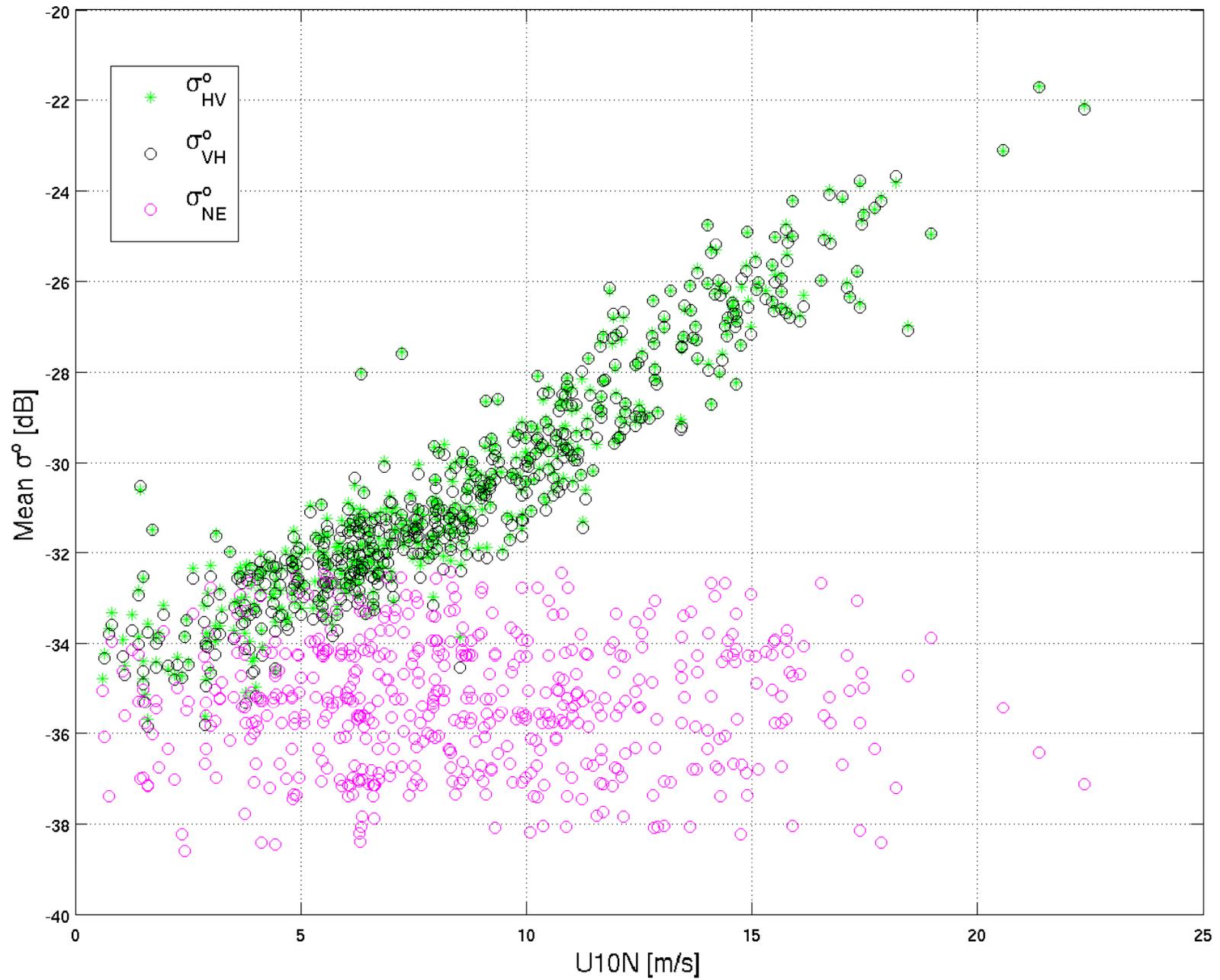
RADARSAT-2, Buoy Analysis, Cross-Pol σ° vs θ_{inc} , N=546



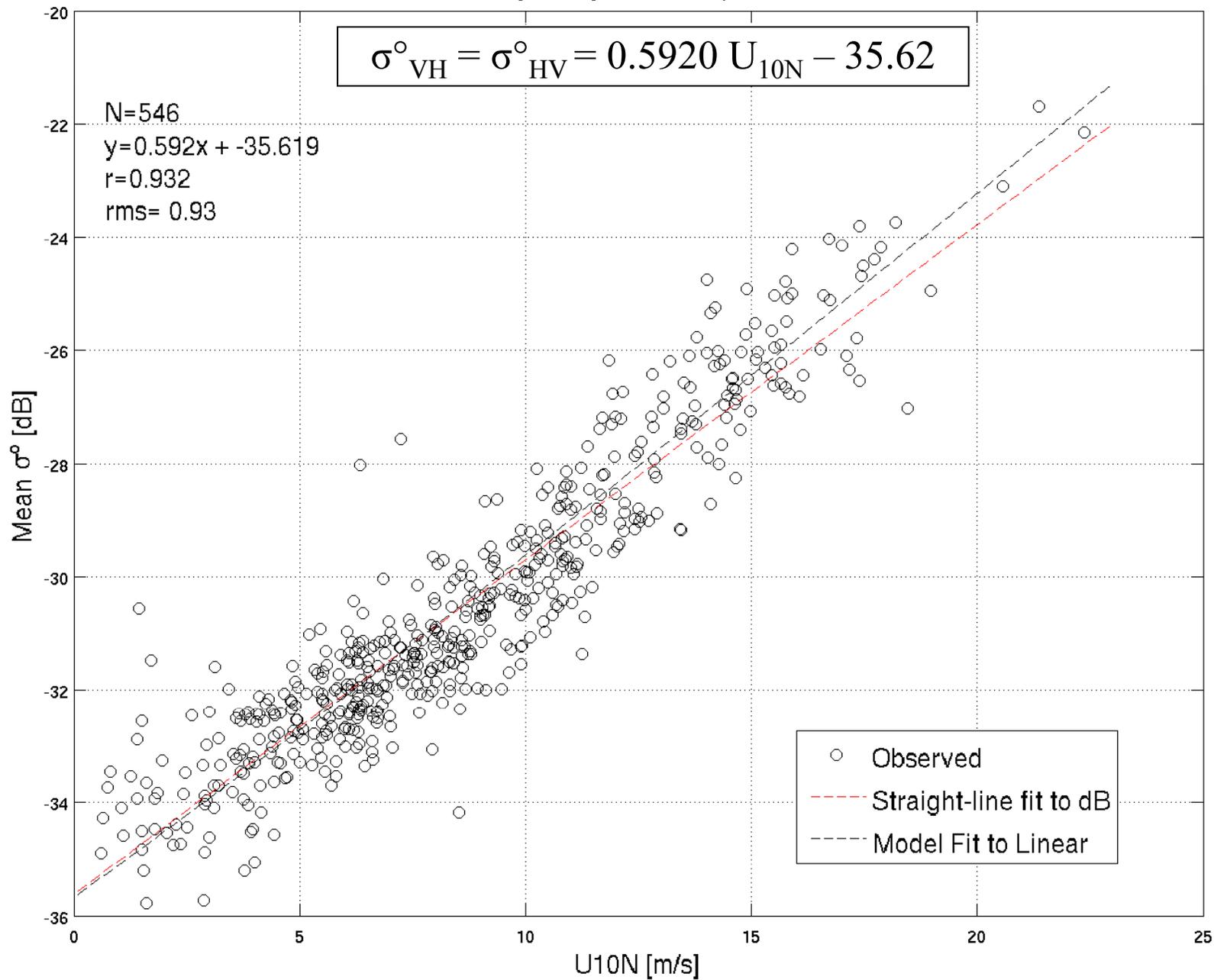
RADARSAT-2, Buoy Analysis, Co-pol σ° vs U10N, N=546



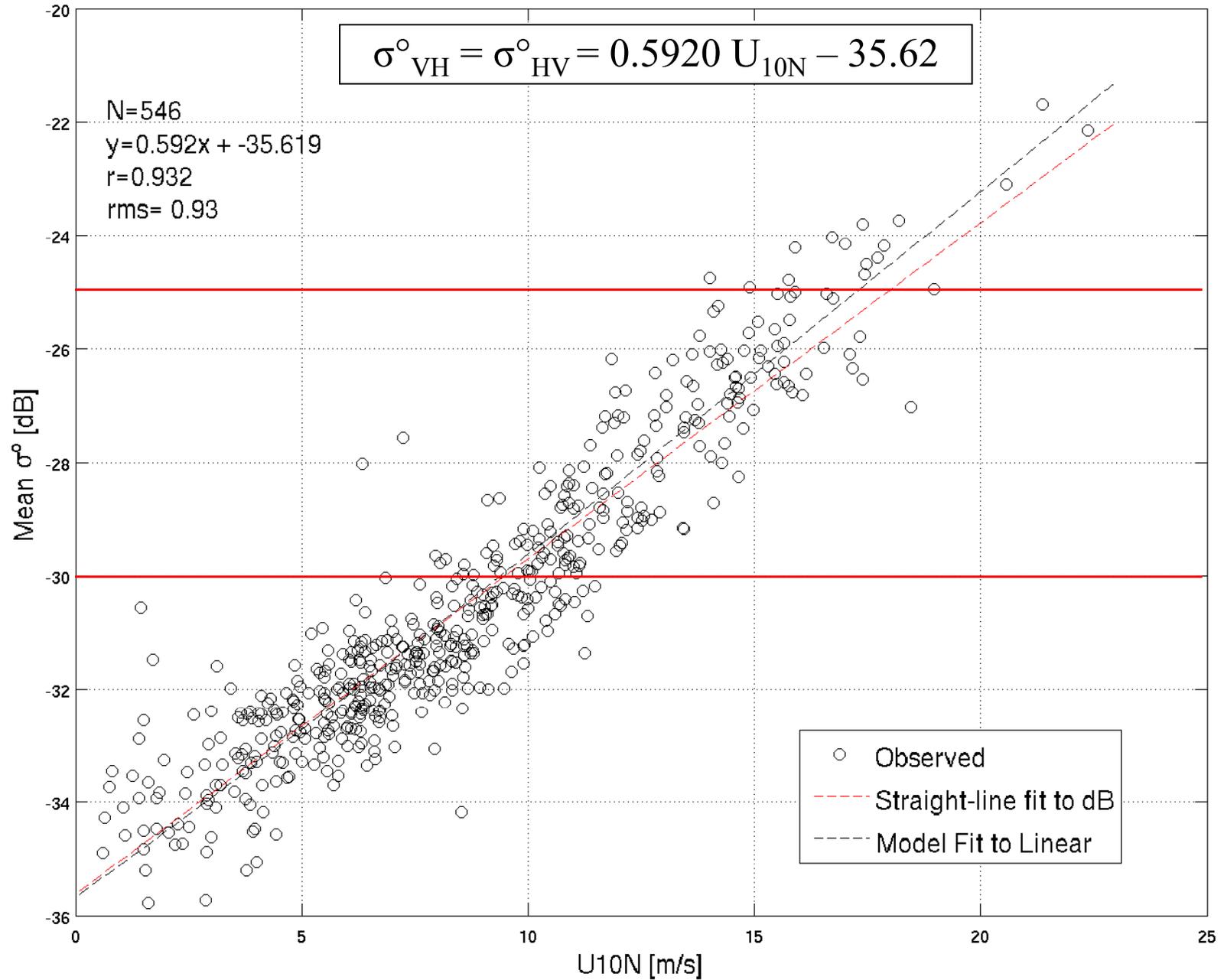
RADARSAT-2, Buoy Analysis, Cross-pol σ° vs U10N, N=546



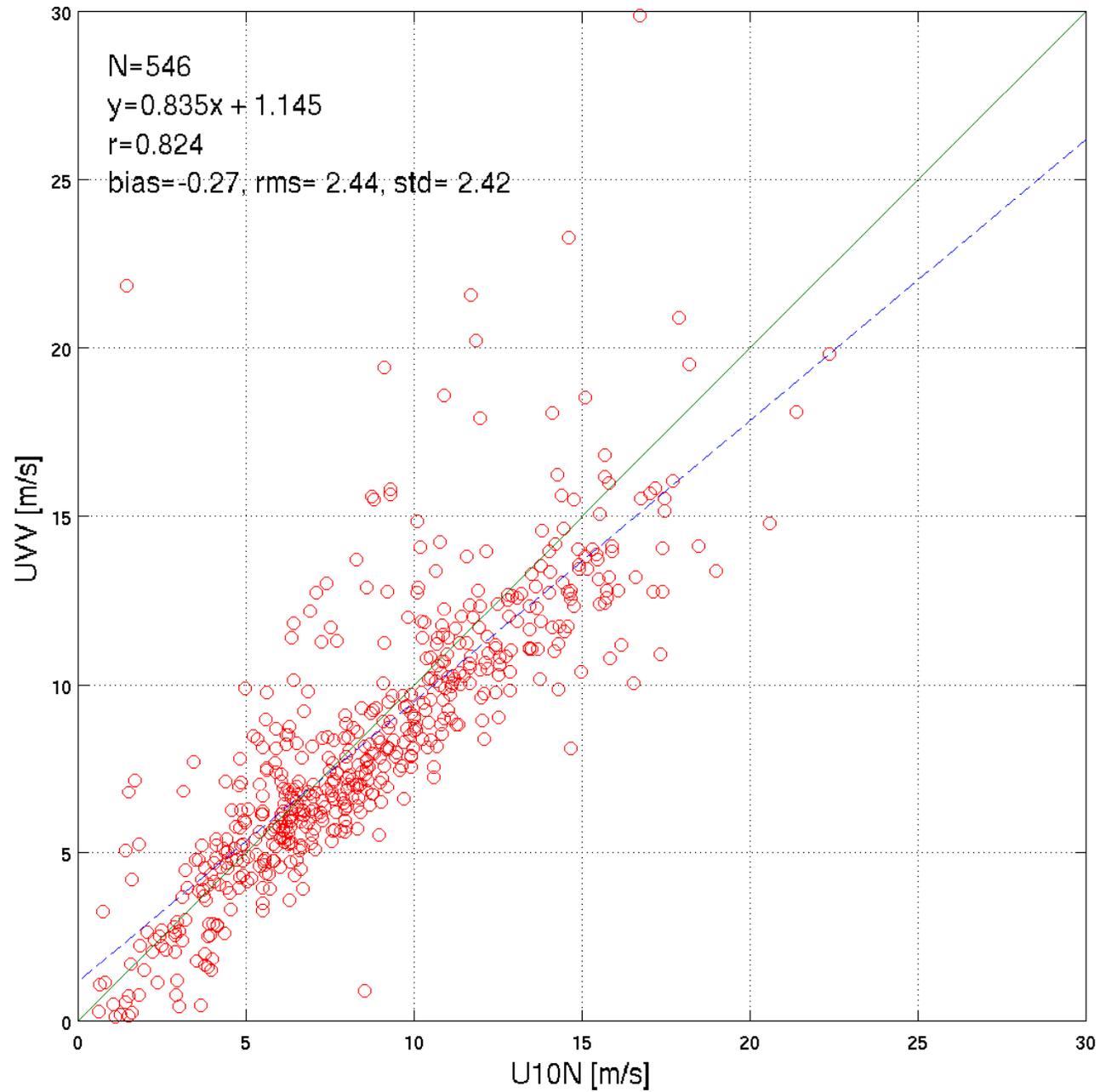
RADARSAT-2, Buoy Analysis, Cross-pol σ° vs U10N, N=546



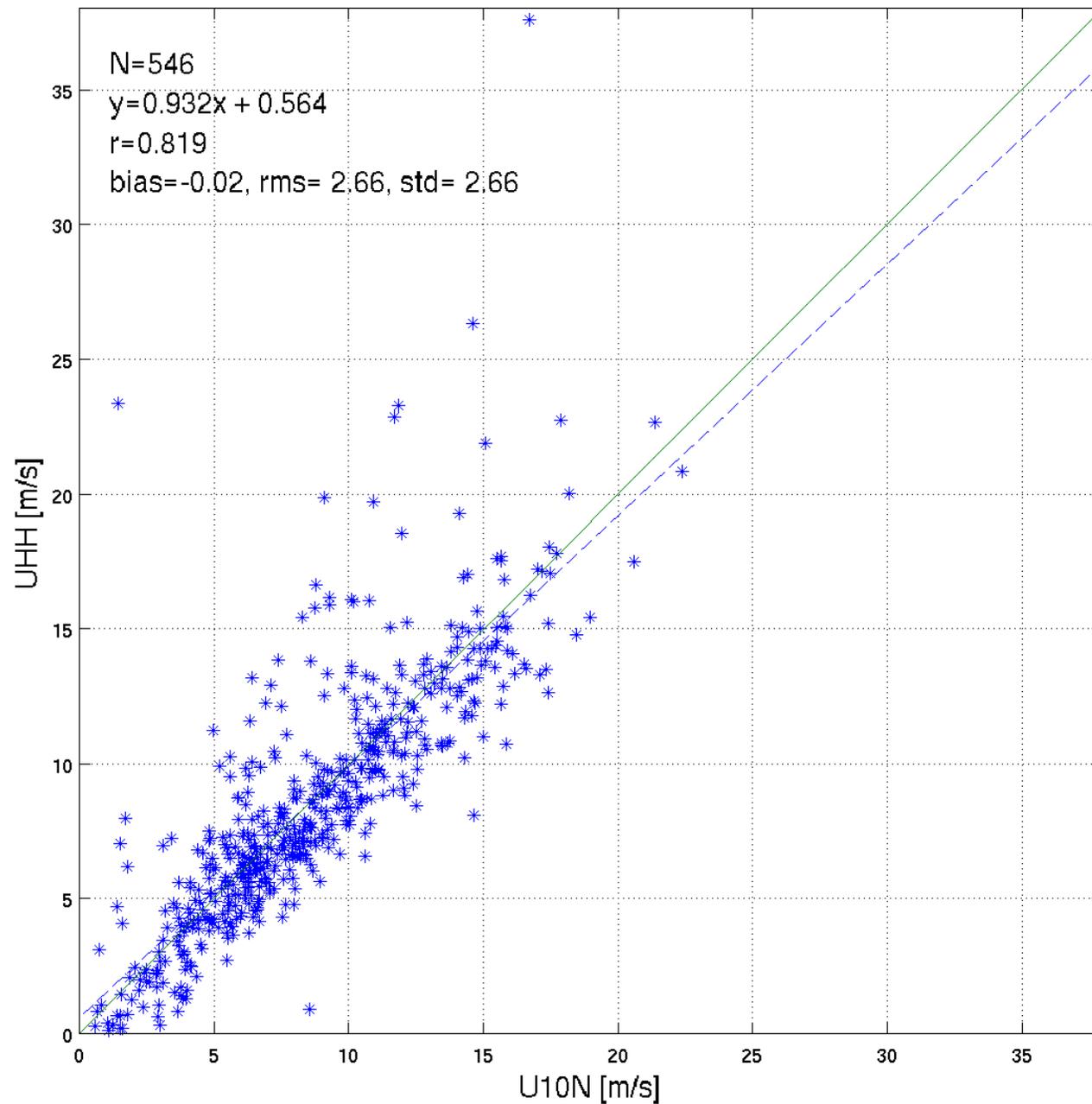
RADARSAT-2, Buoy Analysis, Cross-pol σ° vs U10N, N=546



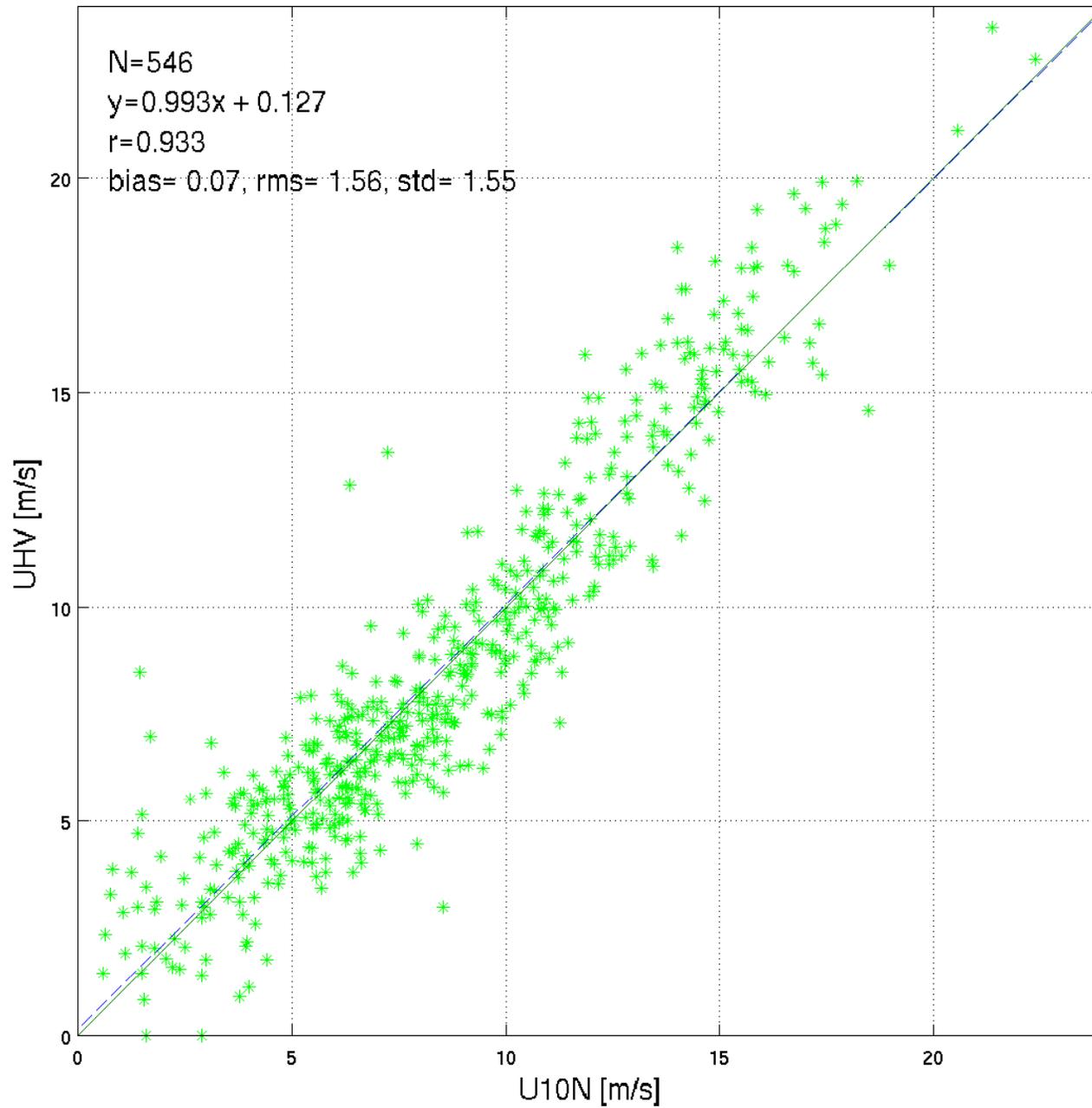
RADARSAT-2, Buoy Analysis, CMOD5, UVV vs U10N, N=546



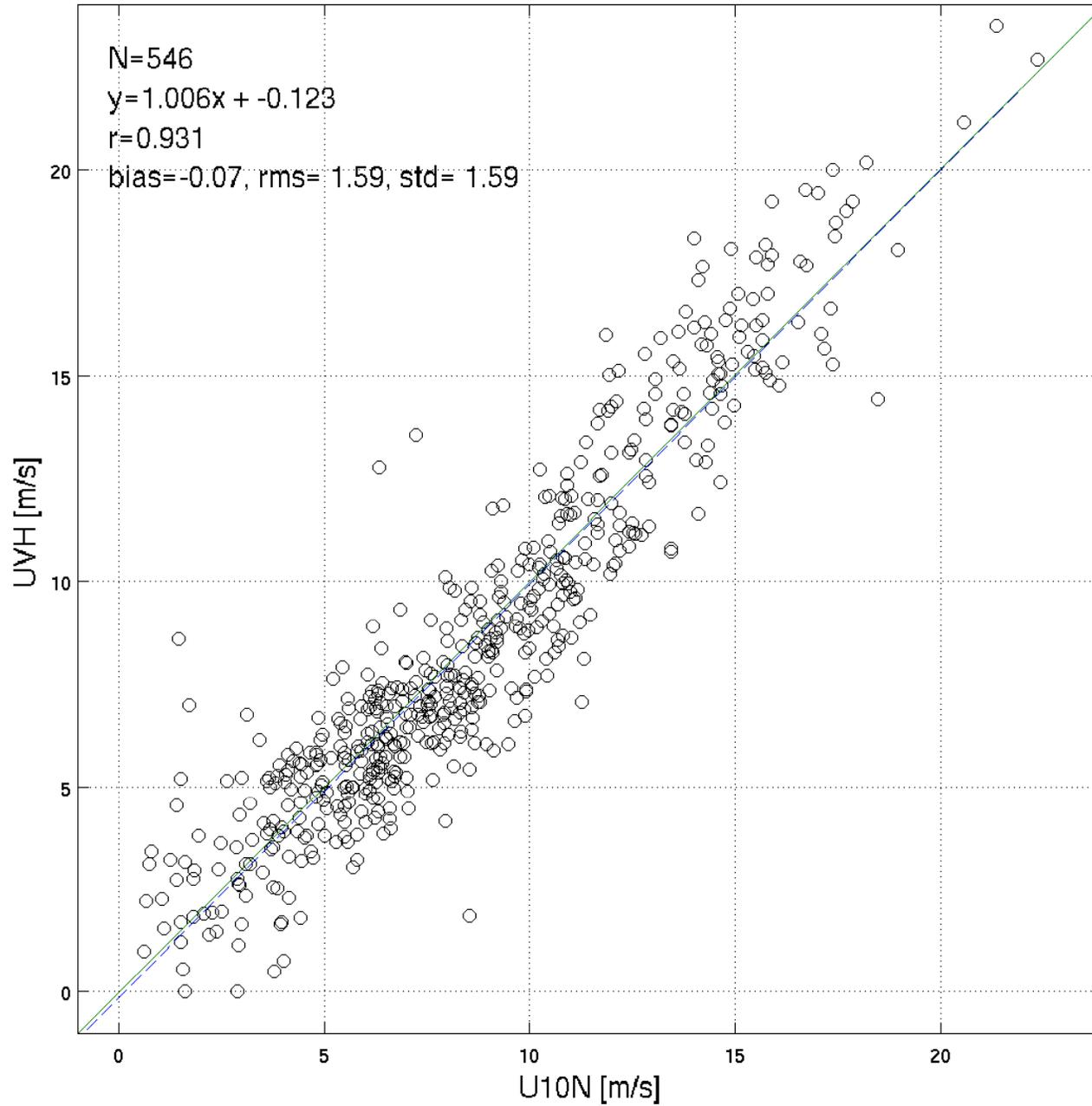
RADARSAT-2, Buoy Analysis, CMOD5 & RSAT2 Polratio, UHH vs U10N, N=546



RADARSAT-2, Buoy Analysis, UHV vs U10N, N=546

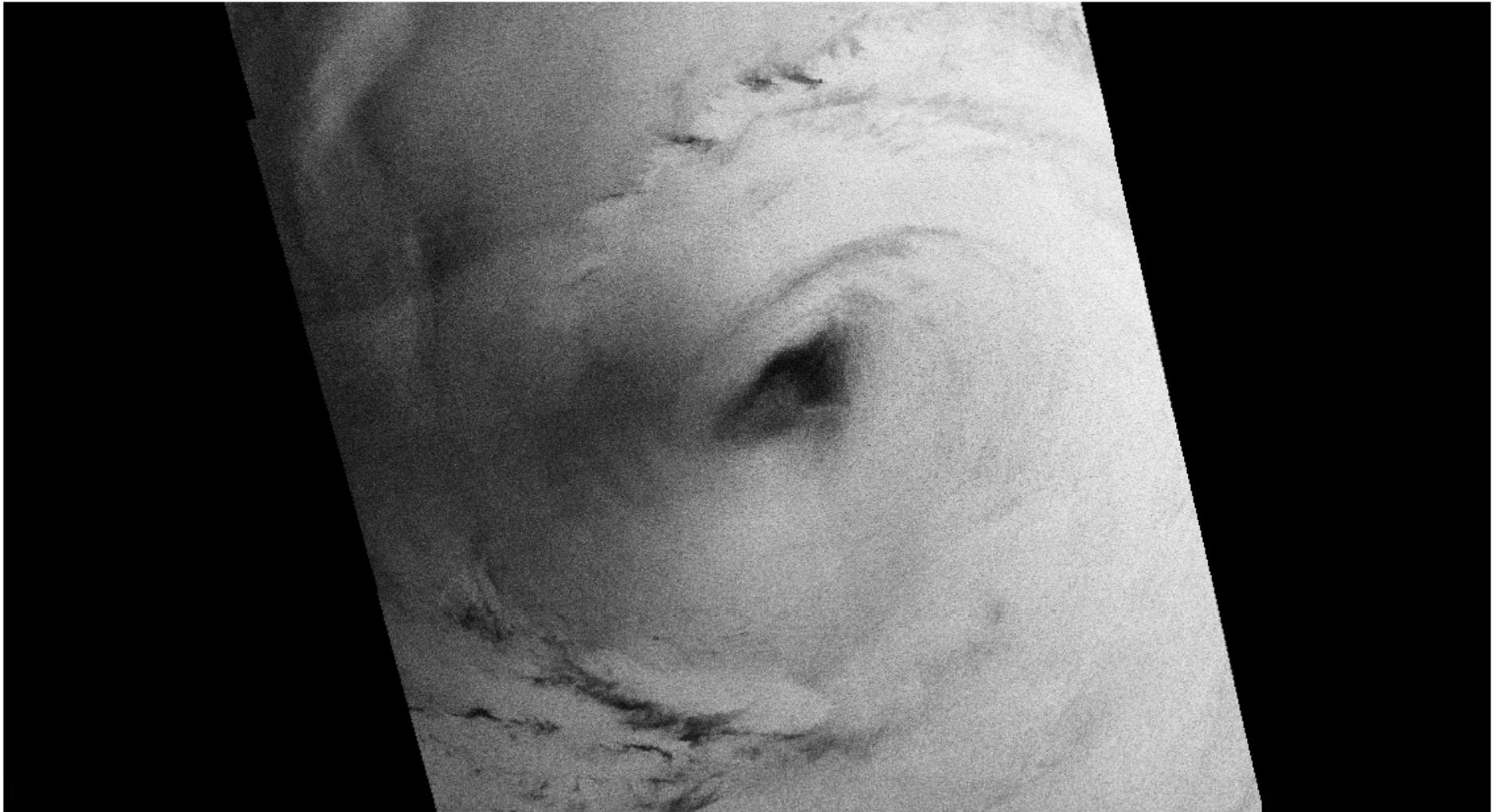


RADARSAT-2, Buoy Analysis, UVH vs U10N, N=546

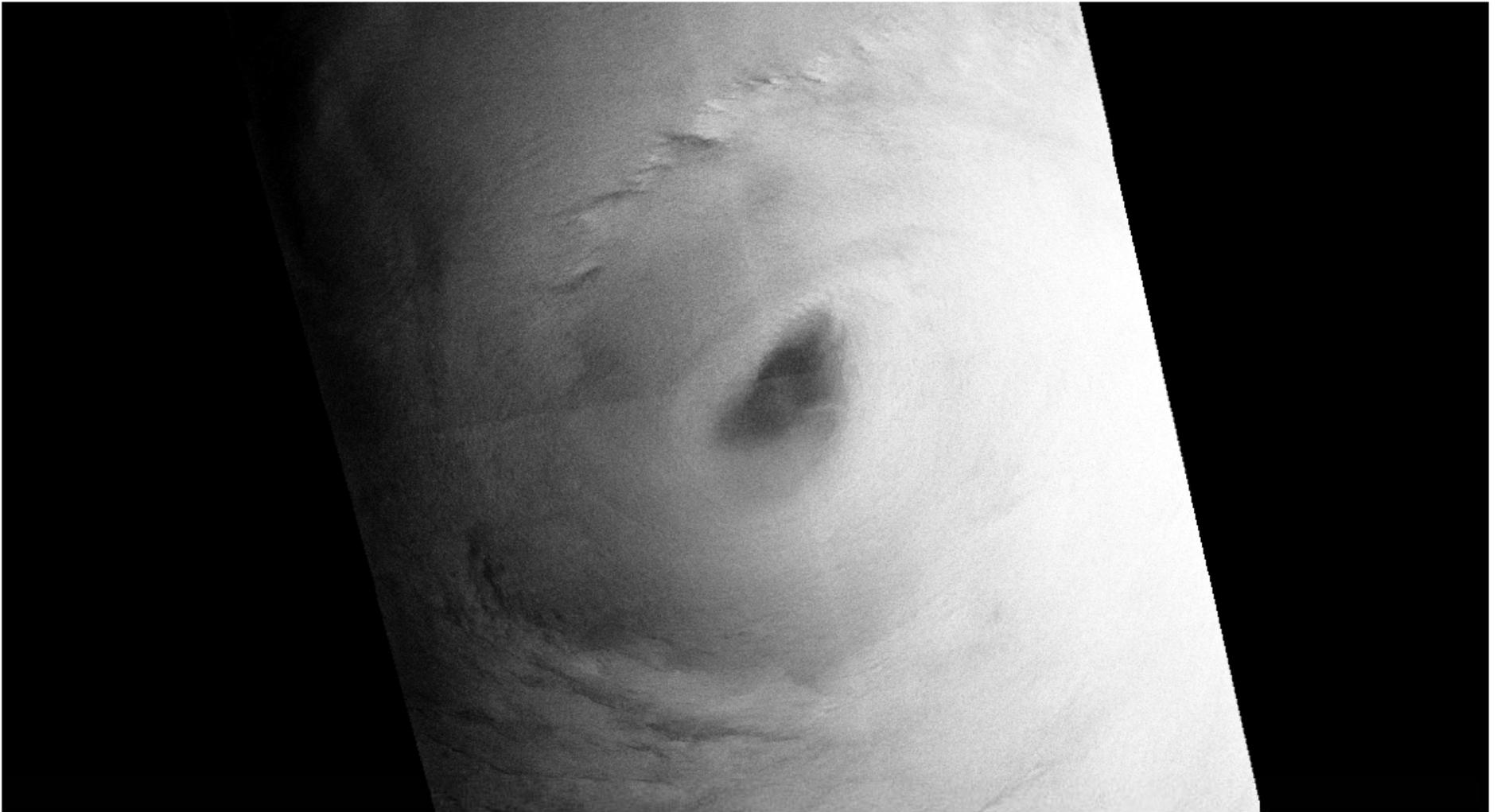


Hurricane Bill – 22 Aug 2009, off Nova Scotia

- R-2 SCNA, VV+VH;
- VV wind retrieval:
 - Geometry, QuikScat wind direction, SAR backscatter;
- VH wind retrieval:
 - SAR backscatter only.

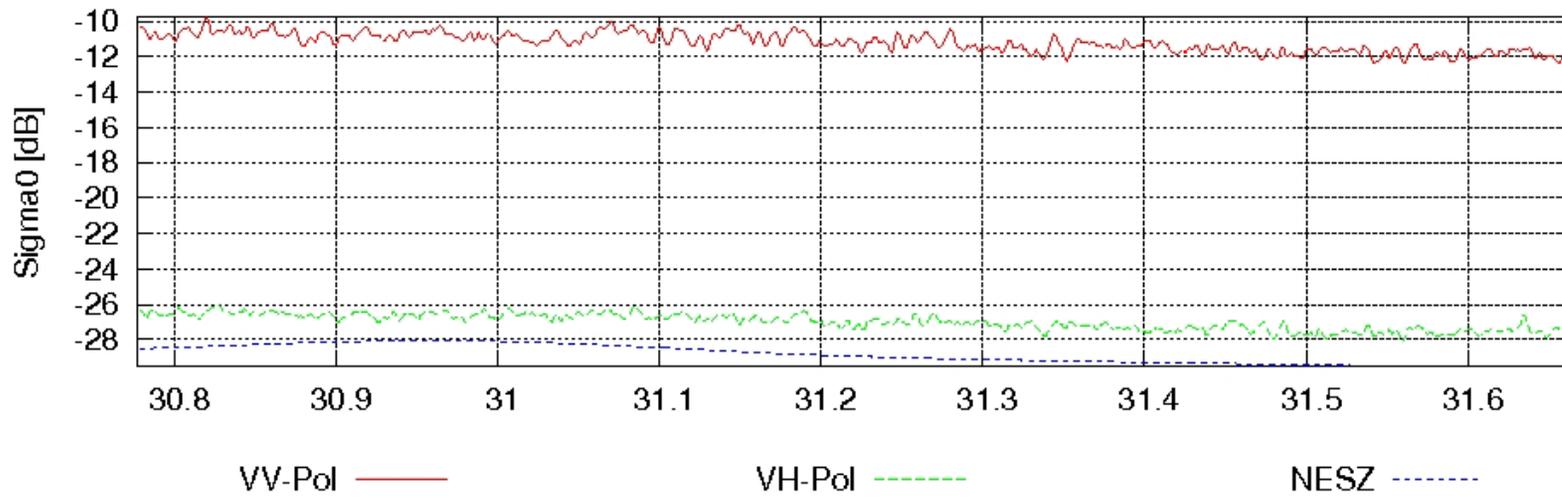


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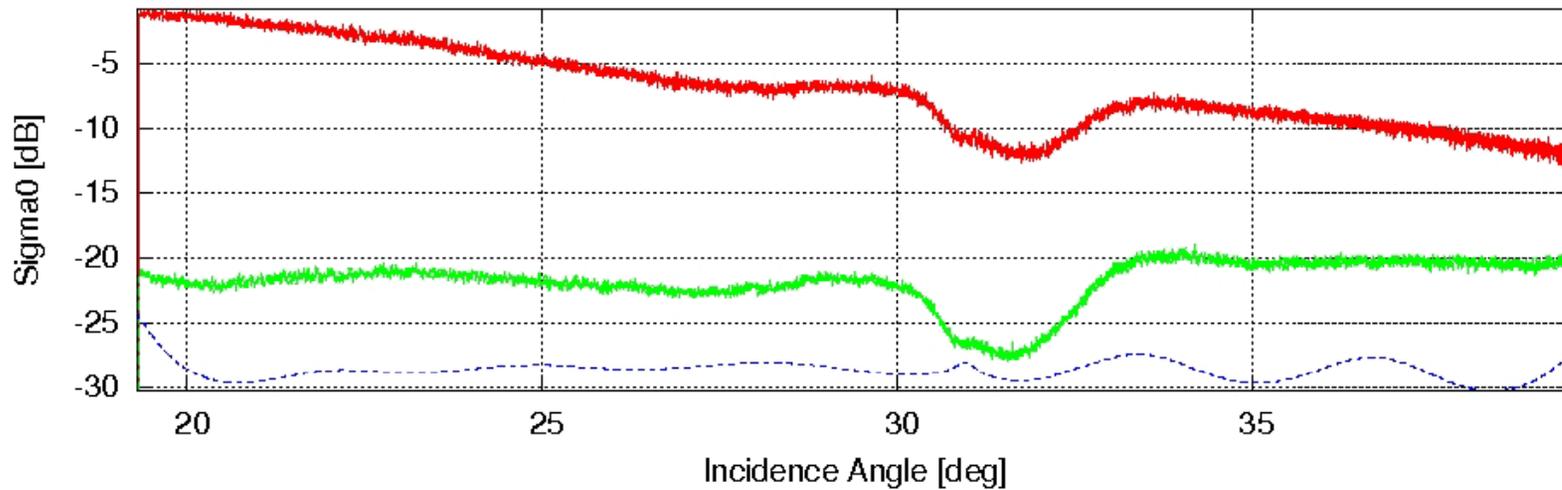


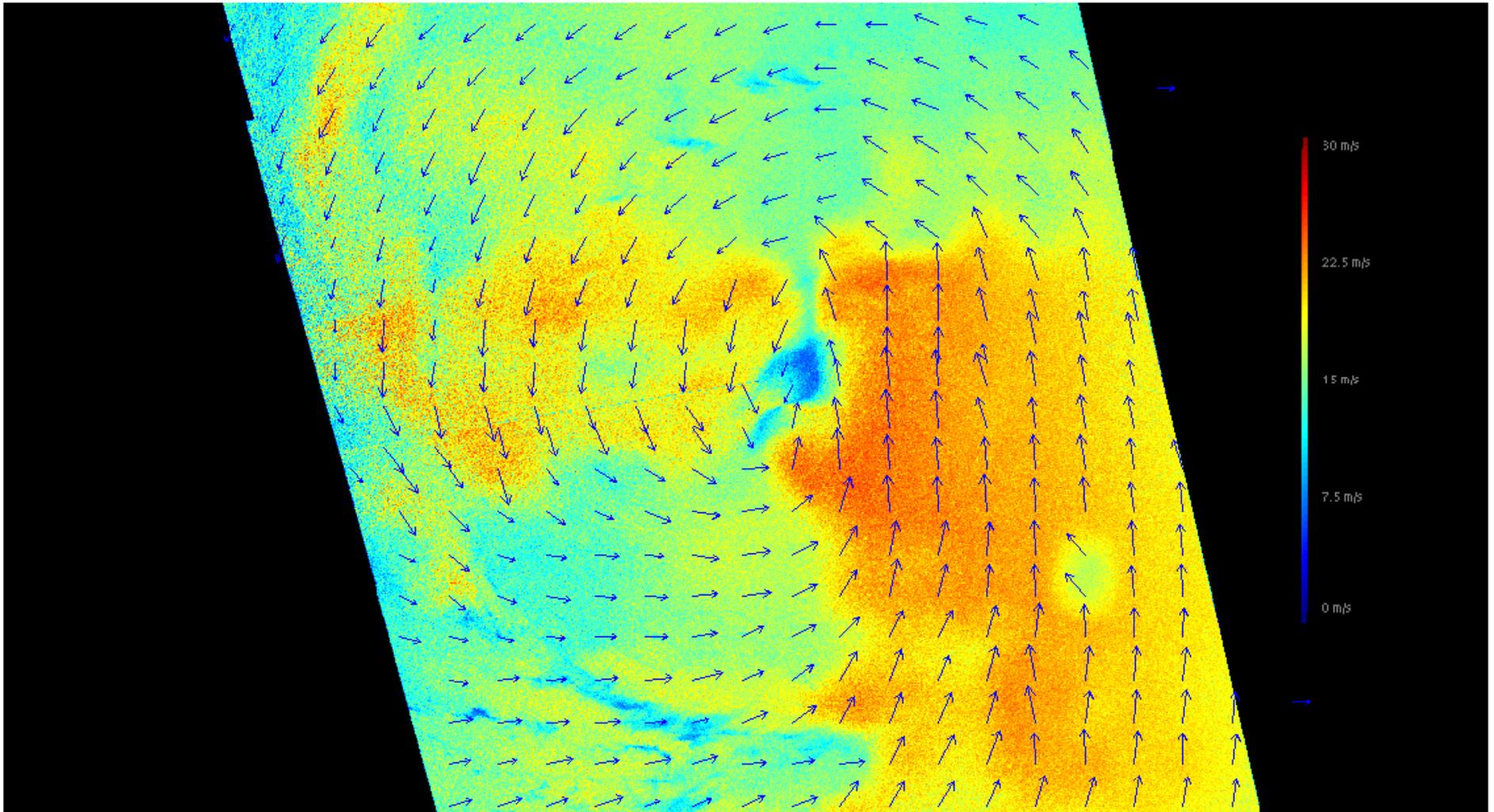
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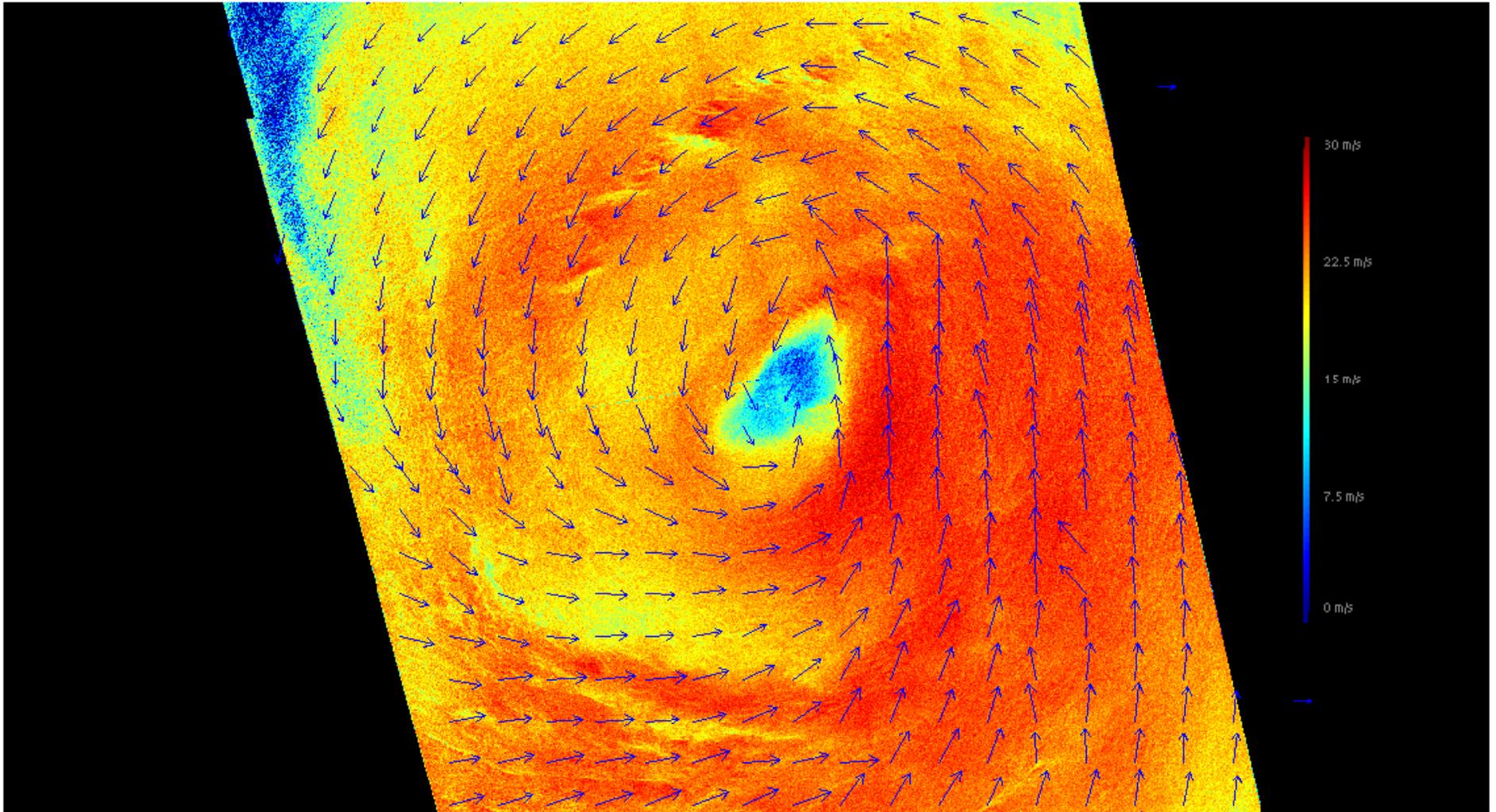
RSAT2,2009-08-22,VV VH,W1 W2,Asc,Lstart : 11702,Lstop : 12144,Pstart : 6713,Pstop : 7280



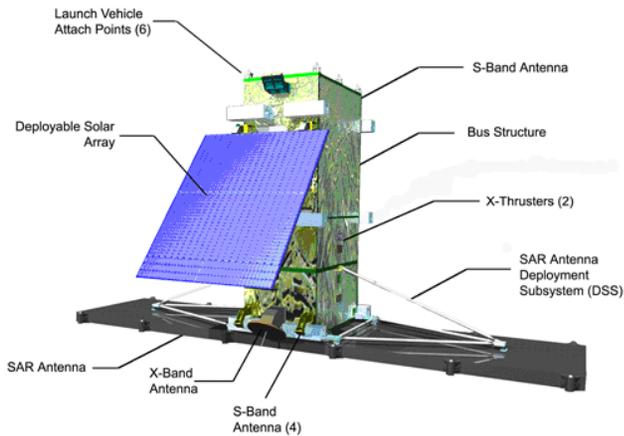
RSAT2,2009-08-22,VV VH,W1 W2,Asc,Lstart : 11702,Lstop : 12144,Full Swath



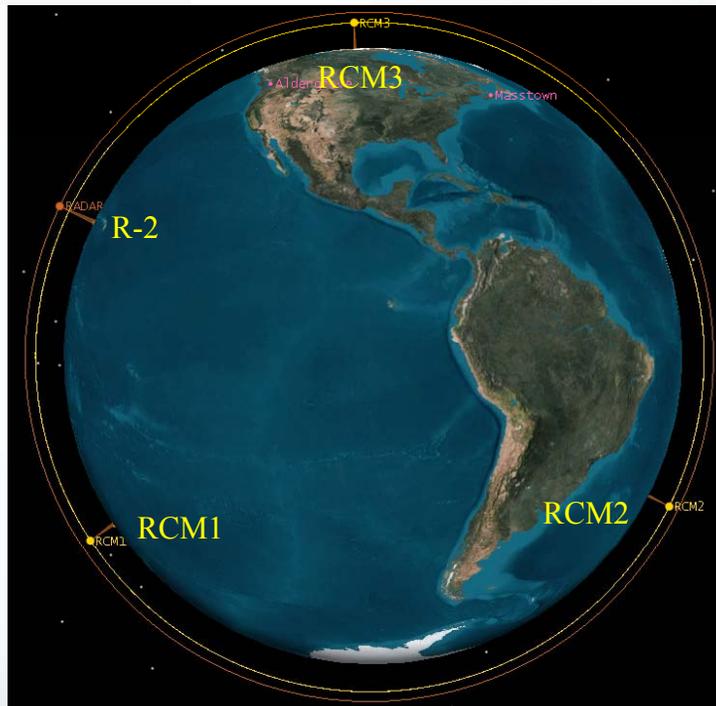




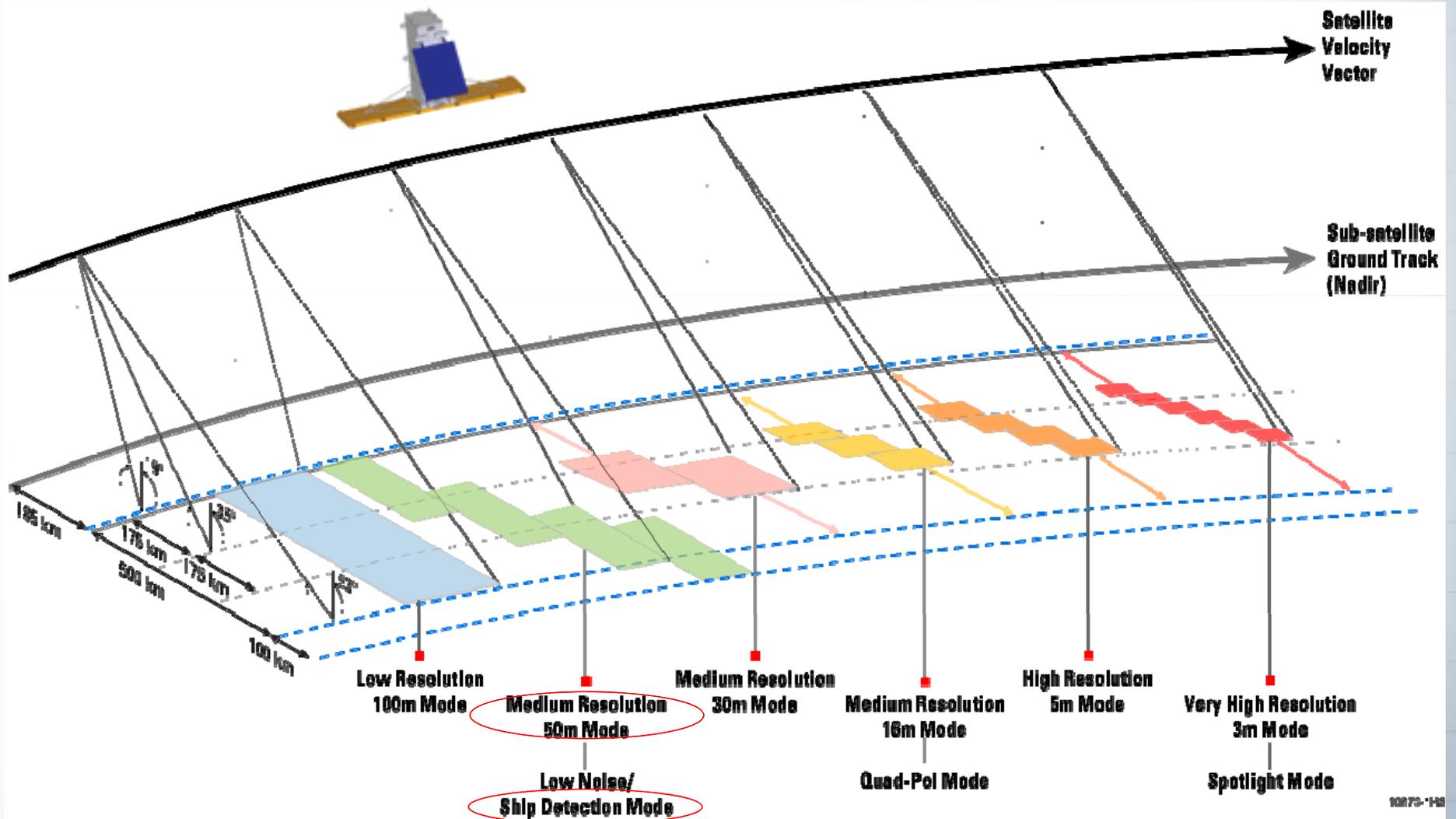
RADARSAT Constellation Mission (RCM)



- Follow-on to RADARSAT-2;
- C-band SARs ;
- GoC owned and operated;
- Operational end-to-end system;
- Three small satellites (scalable);
- Polar orbit, 600 km;
- Average daily coverage of Canada and adjacent waters;
- Medium resolution, wide swath;
- 12 day repeat, 4-day CCD;
- Dual polarization, Compact Polarimetry, and Experimental Polarimetric;
- Launches in 2014 and 2015 (×2).



RCM Modes



10073-140

Project Polar Epsilon 2: Space-Based Surveillance and Reconnaissance Capability

Overview:

Aim: Whole of Gov't approach to delivering more persistent and responsive Arctic, maritime, and deployed operations surveillance & reconnaissance using RADARSAT.

Funding: \$95 M, DND.

Project Phase: Options Analysis (Oct-09)

IOC: 2014 (tbd)

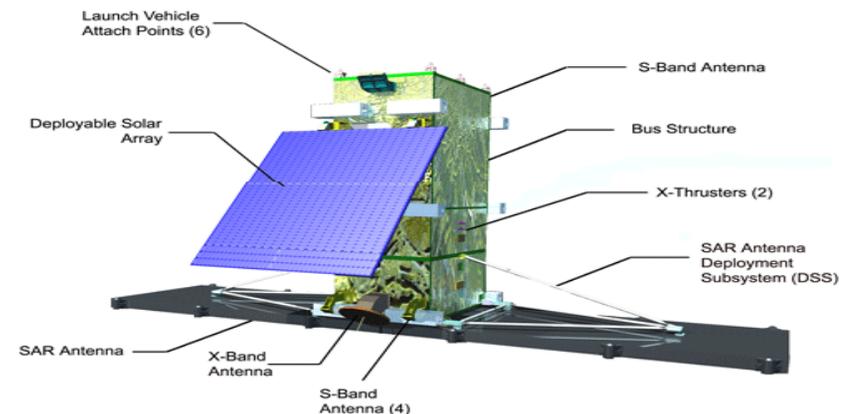
Scope:

Exploit RCM and R-2:

- Upgrade Polar Epsilon's ground infrastructure, including exploitation tools, for RCM compatibility;
- Transfer funds to CSA to support increase in military utility (i.e., AIS payload);
- Build Northern Ground Station for Command and Control & data reception.

Military Utility:

- Better than daily coverage of the Arctic AOI and Maritime approaches;
- Increased revisit frequency for change detection;
- Near-real time ship detection using radar;
- Ship identification with AIS payload;
- Contribution to Alliance/Coalition JTF.



Summary

- MSSR will improve maritime surveillance;
- New cross-pol ocean backscatter model:
 - Independent of wind direction and incidence angle;
 - VV: 2.4 m/s;
 - HH: 2.7 m/s;
 - Cross-pol: 1.6 m/s.