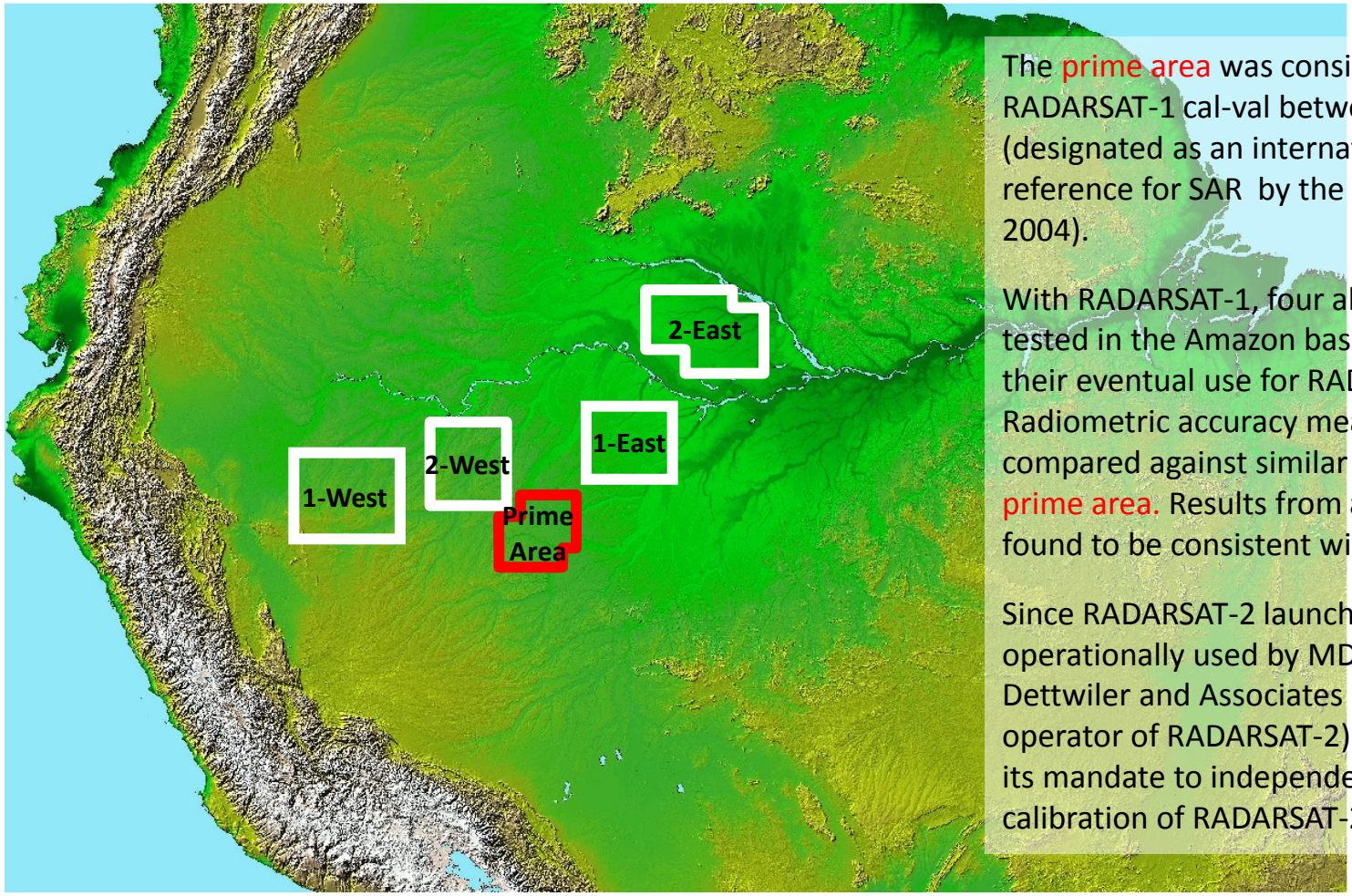
Update on CSA Calibration Sites

Distributed Areas and Point Targets

for the RADARSAT Program

CEOS SAR WGCV 2013

Natural Cal-Val Sites: Amazon



The prime area was consistently used for RADARSAT-1 cal-val between 1996 and 2008 (designated as an international calibration reference for SAR by the CEOS SAR WGCV, 2004).

With RADARSAT-1, four alternate areas were tested in the Amazon basin in 2006-07 for their eventual use for RADARSAT-2. Radiometric accuracy measurements were compared against similar datasets from the prime area. Results from all 4 areas were found to be consistent with the prime area

Since RADARSAT-2 launch, all five areas are operationally used by MDA (MacDonald Dettwiler and Associates Ltd, owner and operator of RADARSAT-2) and by the CSA (for its mandate to independently monitor the calibration of RADARSAT-2).

Natural Cal-Val Sites: Amazon

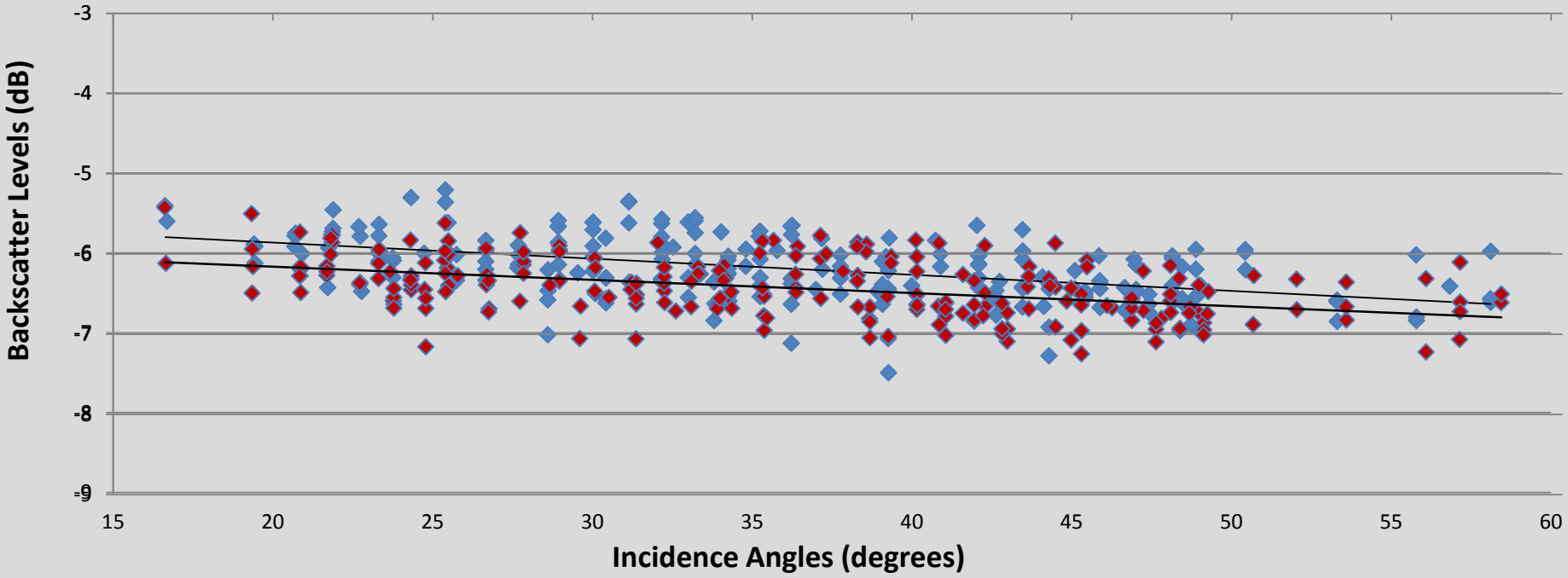
Amazon Basin coordinates

Site	Coordinates (counterclockwise)	
Prime	6.6171S	68.4715W
	7.8935S	68.4463W
	7.8840S	66.8862W
	7.4076S	66.8873W
	7.3978S	66.5630W
	6.1034S	66.5574W
	6.0961S	67.9229W
	6.6085S	67.9230W
1-East	5.6333S	64.1111W
	3.8353S	64.1111W
	3.8353S	66.2611W
	5.6333S	66.2611W
1-West	4.9764S	71.1900W
	4.9764S	74.0000W
	7.2469S	74.0000W
	7.2469S	71.1900W
2-East	1.1097S	62.8050W
	1.1097S	64.9167W
	2.5511S	64.9167W
	2.5511S	63.9667W
	3.2053S	63.9667W
	3.2053S	62.0092W
	1.5500S	62.0092W
	1.5500S	62.8050W
2-West	4.3625S	70.2089W
	6.3778S	70.2044W
	6.3844S	68.2783W
	4.3625S	68.2783W

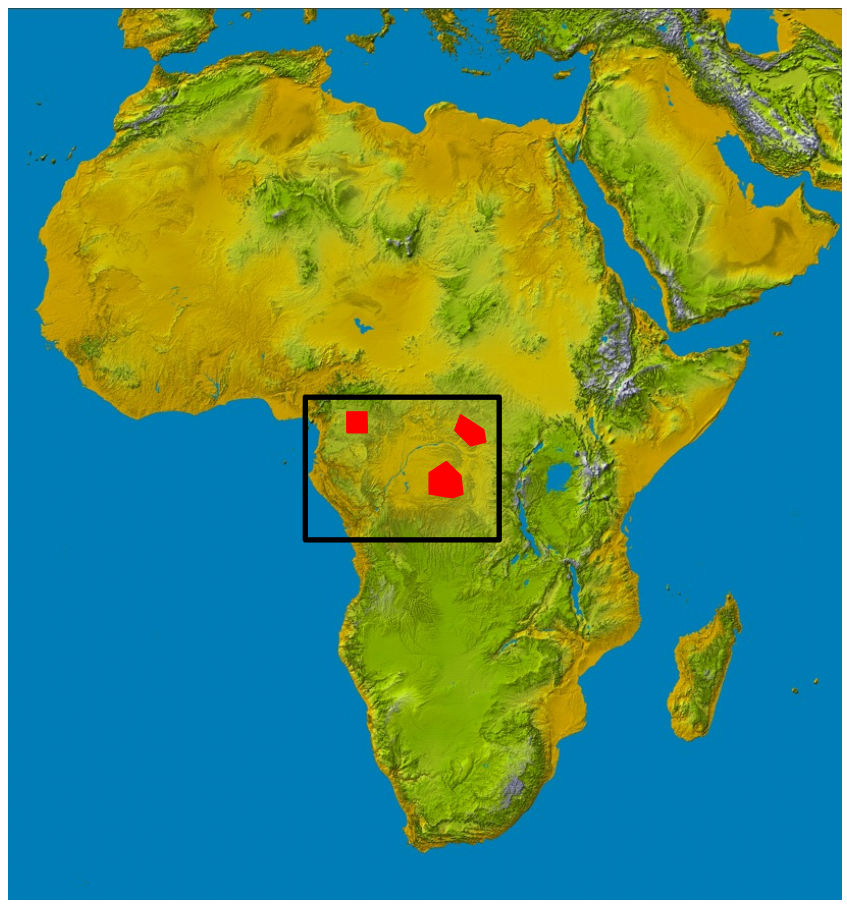
Natural Cal-Val Sites: Amazon

- Gamma extracted from co-pol images acquired from January 2009 to October 2013
- ~0.23 dB difference between ascending and descending passes
- A point represent the average gamma level of a beam pattern placed in the middle of its incidence angle range

Ascending in **blue**
Descending in **red**



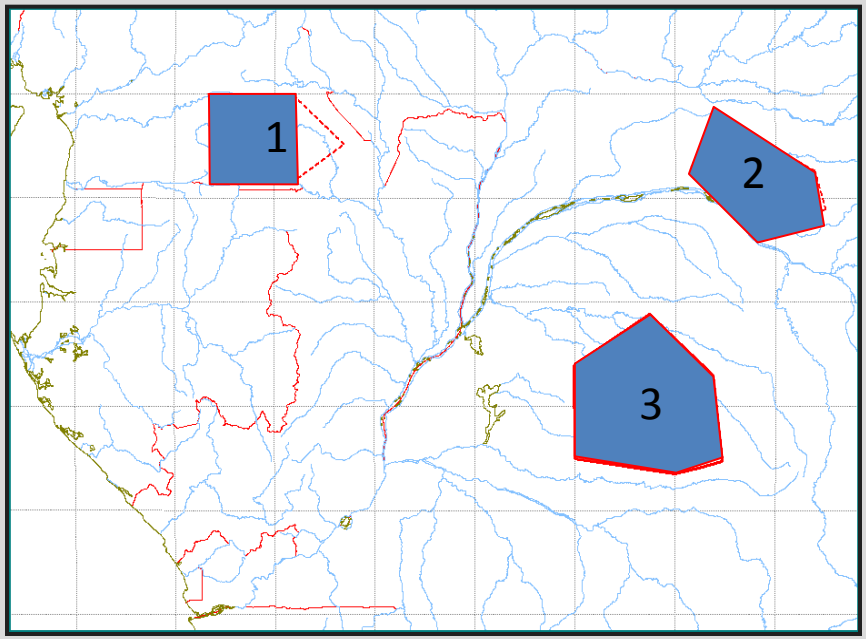
Natural Cal-Val Sites: Congo River Basin



1- Cameroon: Boumba Bek National Park

2- Congo: unprotected area

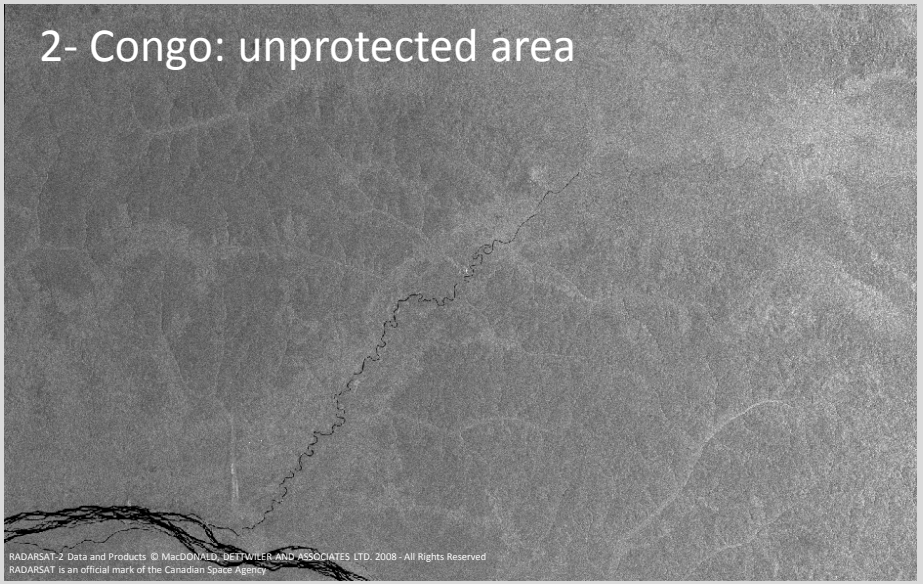
3- Congo: La Salonga National Park



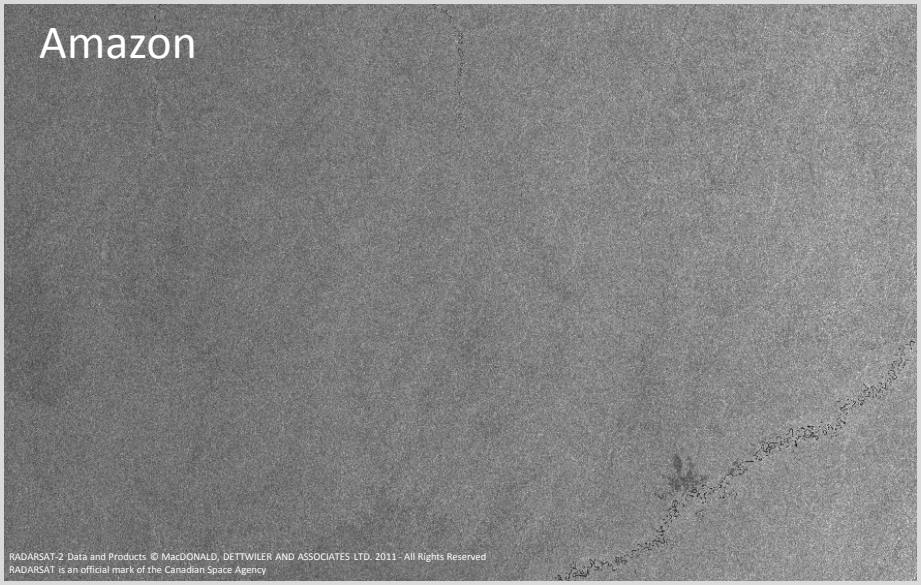
Natural Cal-Val Sites: Congo River Basin

1- Cameroon: Boumba Bek National Park

2- Congo: unprotected area



Amazon



3- Congo: La Salonga National Park

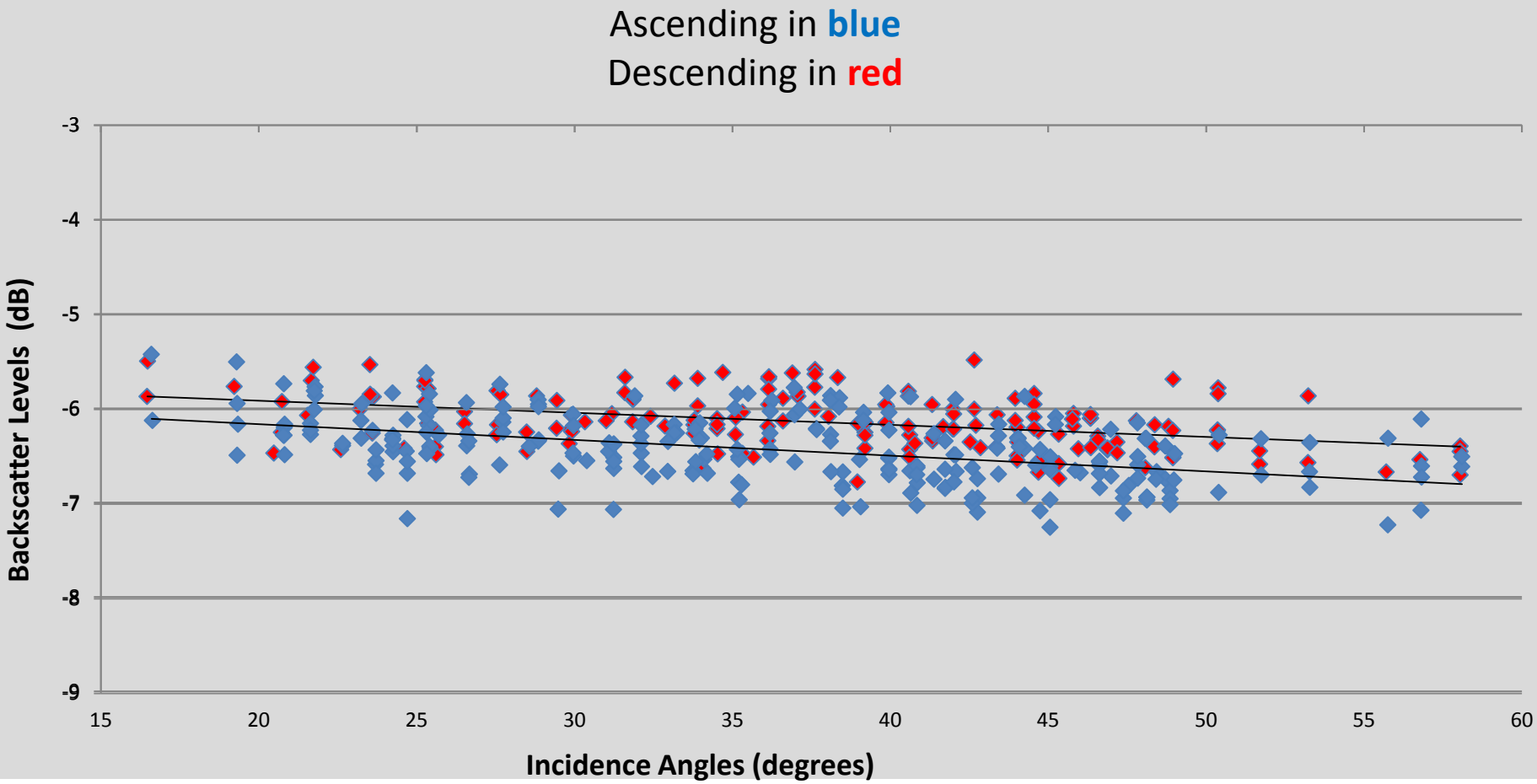
Natural Cal-Val Sites: Boumba Bek National Park (Cameroon)

Most reliable Congo site so far: Boumba Bek National Park (Cameroon)

Site	Coordinates (counterclockwise)	
Boumba Bek National Park	4.1413N	13.4880E
	4.1357N	13.4880E
	4.1512N	12.1974E
	2.5991N	12.2664E
	2.6113N	13.5383E
Congo Unprotected Area	2.5296N	24.7849E
	3.5265N	22.7873E
	2.5396N	22.2941E
	1.4605N	23.6619E
	1.7674N	25.0028E
La Salonga National Park	1.2194S	19.9758E
	3.0038S	20.0035E
	3.2986S	21.9975E
	3.0544S	22.9445E
	1.3909S	22.7519E
	0.2325S	21.4800E

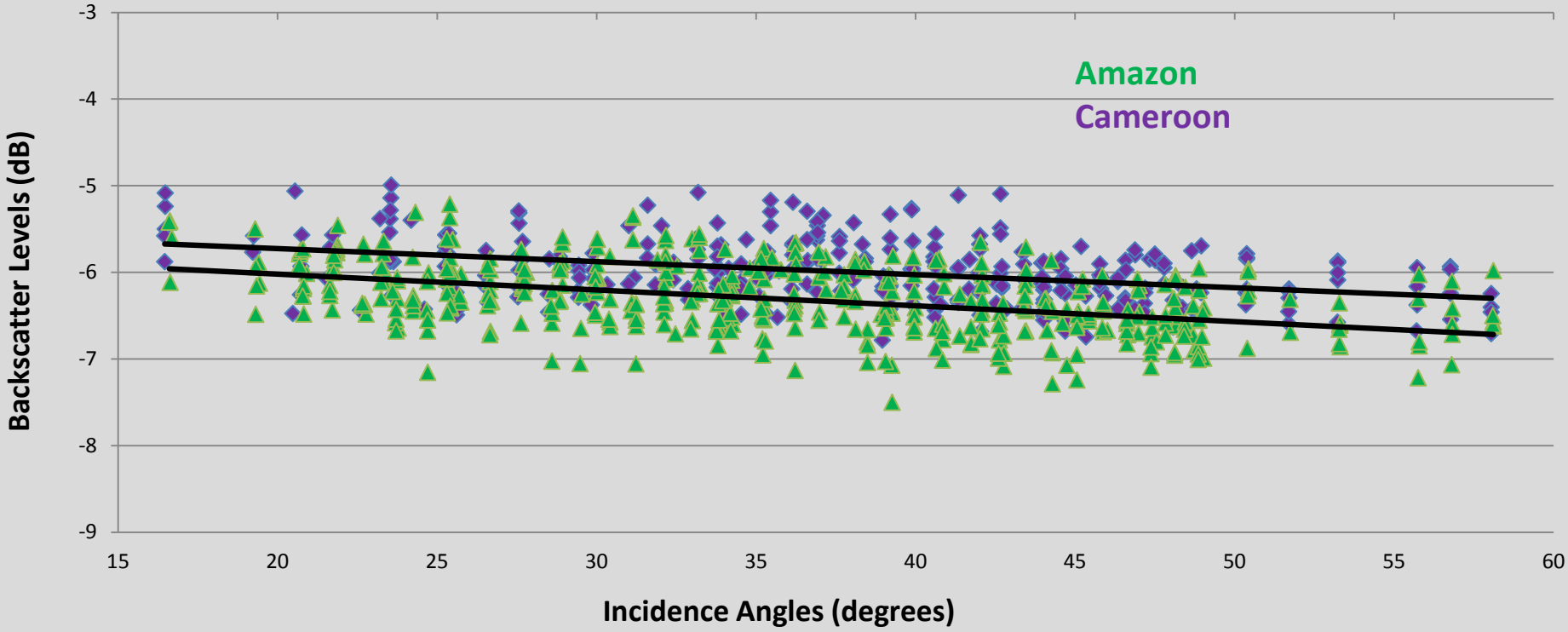
Natural Cal-Val Sites: Boumba Bek National Park (Cameroon)

- Gamma extracted from co-pol images acquired from January 2009 to October 2013
- ~0.34 dB difference between ascending and descending passes
- A point represent the average gamma level of a beam pattern placed in the middle of its incidence angle range

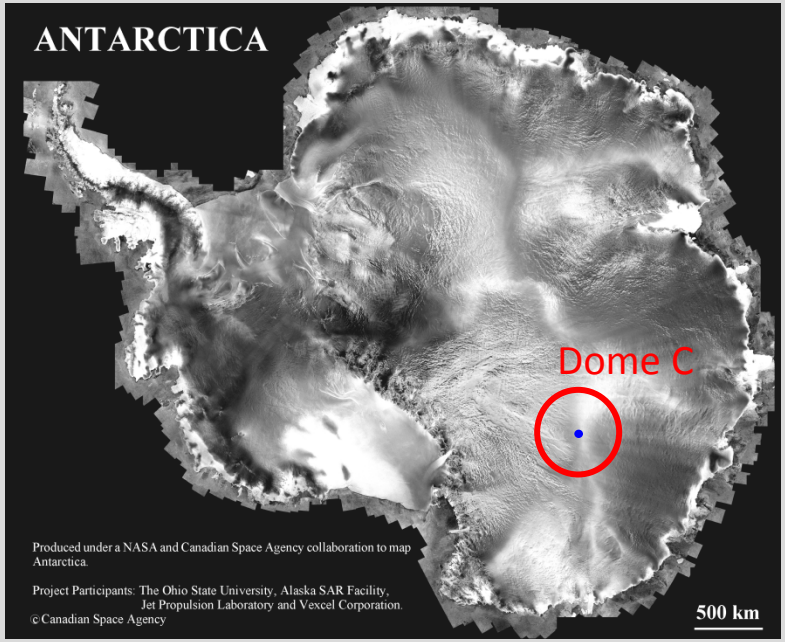


Cameroon – Amazon Comparison

- Gamma extracted from like-pol images acquired from January 2009 to October 2013
- ~0.32 dB difference between Cameroon and Amazon backscatter levels
- A point represent the average gamma level of a beam pattern placed in the middle of its incidence angle range

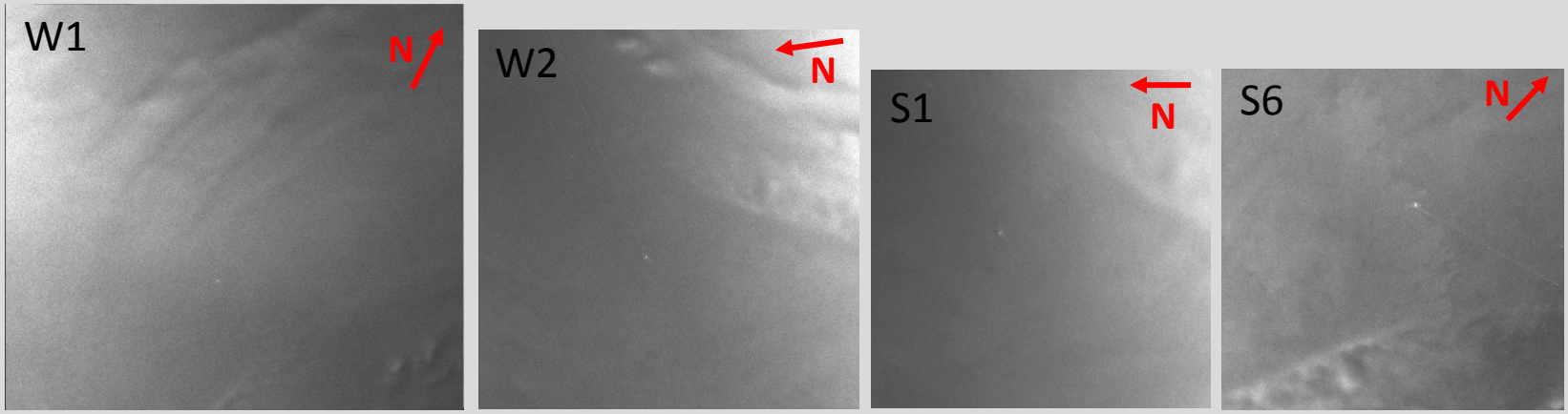


Natural Cal-Val Sites: Dome-C, Antarctica



Potential calibration site for microwave sensors: CEOS WGCV Microwave Sensor Subgroup 2008, Mark Drinkwater, ESA, *DOME-C: Radiometer Calibration/Validation & Spectral Emission*

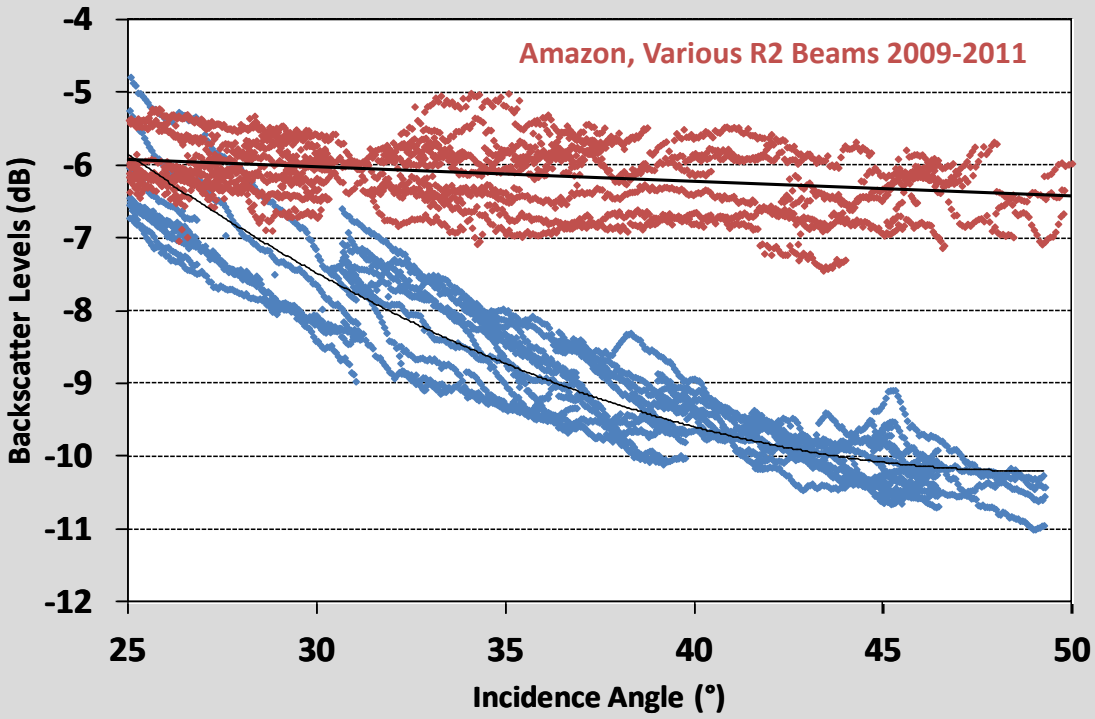
- High-latitude provides frequent revisits;
- Light wind: temporal stability of surface patterns, smoothness, low anisotropy in C and Ku bands;
- Proposed as a multi-sensor calibration site.
- Acquisition campaigns were undertaken by the CSA to examine the site at C-band and report to the CEOS.



Natural Cal-Val Sites: Dome-C, Antarctica

Natural Cal-Val Sites: Dome-C, Antarctica

Excluding larger scenes with spatial non-uniformities (2008-2009, winter 2011):



- Despite anisotropy and lower backscatter level, consistency of measurements appears commensurate with, if not better than, Amazon data for incidence > 30 ° around Concordia station;
- At these incidence values, backscatter level so far seems independent of scene orientation;
- Repeat pass acquisitions will consolidate year-long stability of backscatter levels.

Natural Cal-Val Sites: Dome-C, Antarctica

Site	Coordinates (counterclockwise)	
Dome-C	73.75806S	123.35000E
	73.83250S	121.70222E
	74.04917S	120.21111E
	74.38667S	119.03028E
	74.81083S	118.30222E
	75.27500S	118.14667E
	75.72472S	118.63444E
	76.10167S	119.75889E
	76.35333S	121.40556E
	76.44167S	123.35000E
	76.35333S	125.29444E
	76.10167S	126.94111E
	75.72472S	128.06556E
	75.27500S	128.55333E
	74.81083S	128.39778E
	74.38667S	127.66972E
	74.04917S	126.48889E
	73.83250S	124.99778E

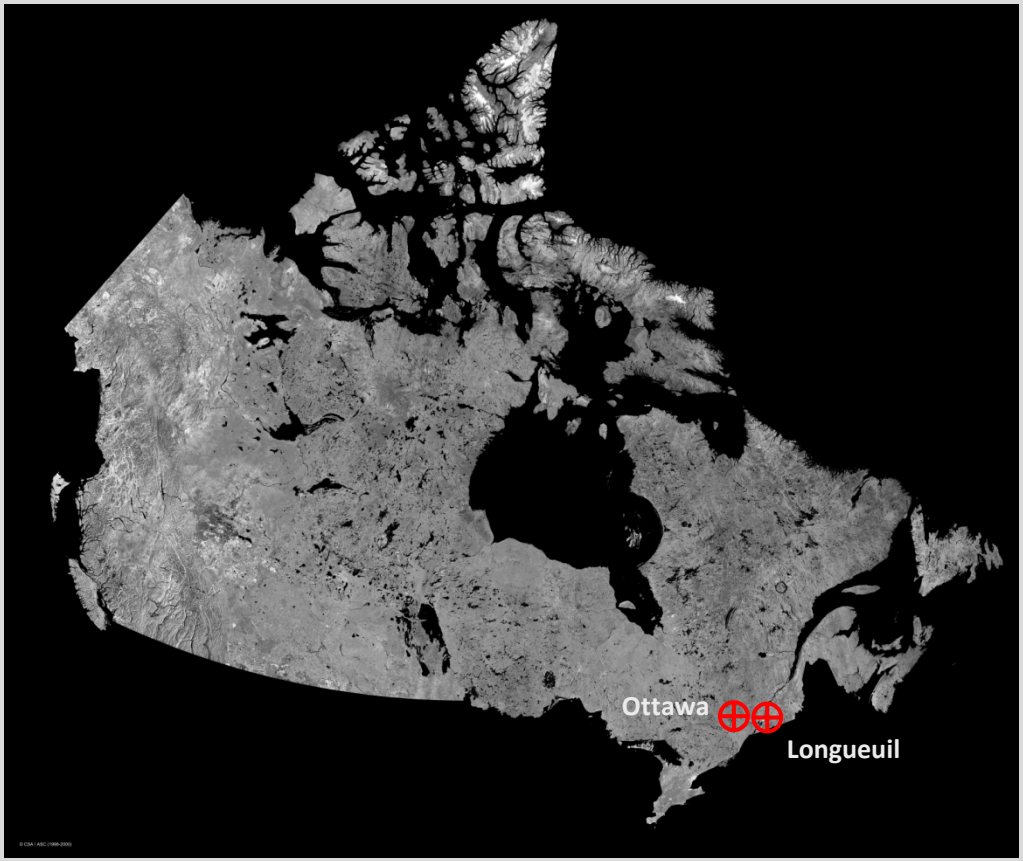
Artificial Cal-Val Sites (transponders point targets)

In the mid 2000s, Commercial Off-The-Shelf components were utilized for a low-cost upgrade of the Ottawa unit into a manually-operated instrument, with settable polarizations at receive and transmit (H, V and 45°) achieved through a flexible cable (right) now replacing fixed waveguides (left).

To increase imaging possibilities, another RADARSAT-1 instrument, in Fredericton, was similarly upgraded on a part-time basis, between 2008 and 2011. In an effort to minimize offsite operations and maintenance costs, this upgraded unit was moved to the CSA Headquarters in Longueuil (Quebec) in 2011. A dome facility was designed, and then built in an area of the CSA property where radar reflections of the surrounding structures cause minimum interference with the transponder response.

Artificial Cal-Val Sites (transponders point targets)

With the end of RADARSAT-1 operations, the RADARSAT-1 instruments at Prince Albert and Resolute were decommissioned. Calibration monitoring activities (for RADARSAT-2) are now exploiting the upgraded units in Ottawa and Longueuil.

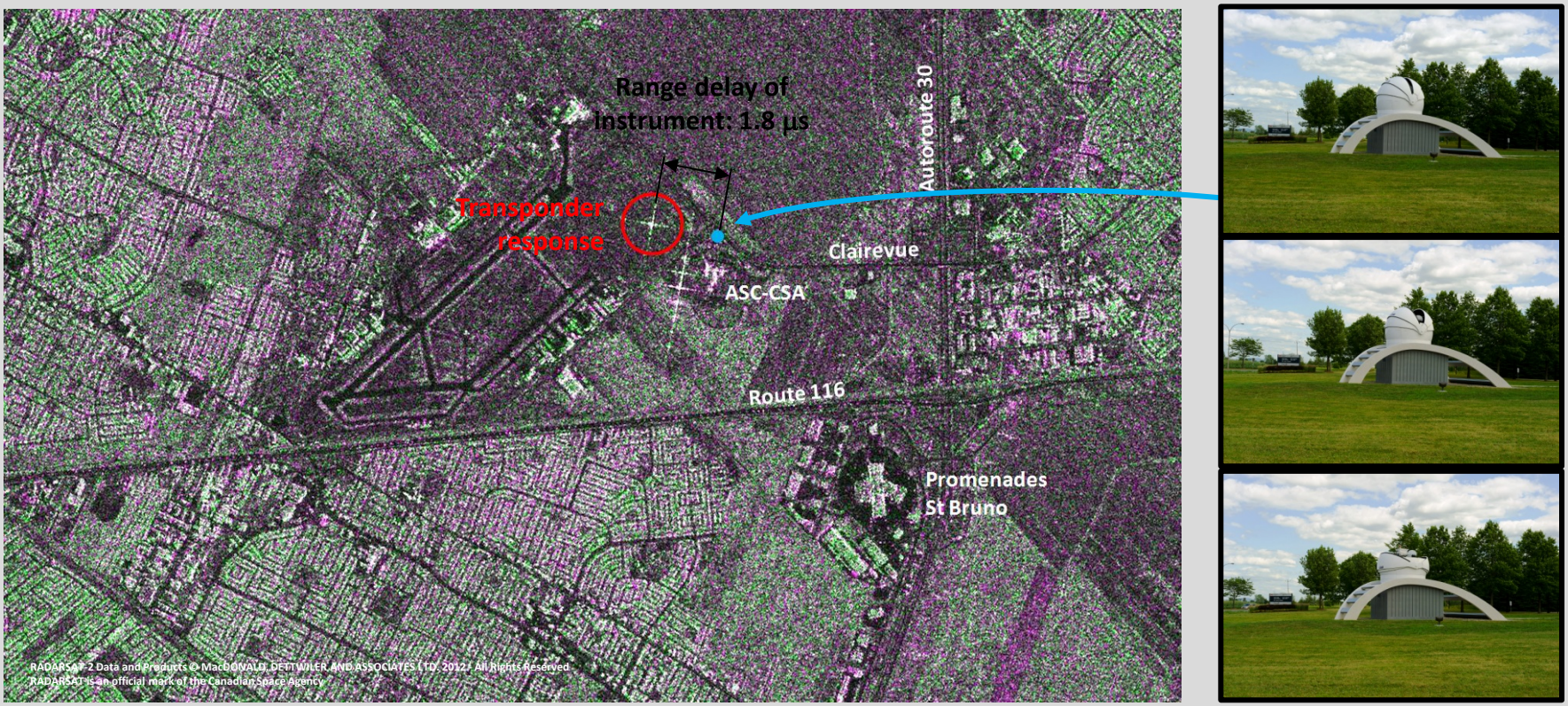


Ottawa: conventional deployment

Longueuil (CSA HQ): instrument is hosted in a retractable dome facility built for long-term use (future equipment and missions).

Artificial Cal-Val Sites (transponders point targets)

RADARSAT-2, Fine 1 Near, HH+HV, Descending orbit – March 5 2012, Longueuil site



Artificial Cal-Val Sites (transponders point targets)

Transponder site locations

Site	Coordinates (above ellipsoid)
Ottawa	45.294665N 75.808111W 62.09m
Longueuil	45.52235544N 73.39362747W 0.0028m

Transponder main specifications

Frequency	GHz	5.3 to 5.405
Bandwidth	MHz	170, from 5285 to 5455 MHz
Antenna Gain	dBi	27
Tx polarizations	-	H, 45°, V
Rx Polarizations	-	H, 45°, V
RCS	dBm^2	Ottawa unit: 55 @5.3 GHz (RADARSAT-1), 56 @5.405 GHz (RADARSAT-2) Longueuil unit: 57 @ both 5.3 and 5.405 GHz
Pulse Width	µs	21-42
PRF range	Hz	1000-3000
Delay	µs	1.85 (the purpose of the hardware delay is to offset the transponder response in an area clear from the apparatus and from nearby buildings)