GLOBAL REFERENCE 2.0: THE NEW BENCHMARK FOR POSITIONAL ACCURACY WORLDWIDE

- Massimiliano Vitale

BlackBridge
Delivering the World

A long journey …

2009: 1.0
Landsat GCPs

2010: 1.1
GLS2000

Global Reference
2.0

Global Reference 2.0 - Best-in-class

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Best accuracy (80% under 5m)

- 500,000+ GCPs (86% satellite, 14% aerial) from VHR sources (mostly DG WV-1/2 GE-1)
- 160,000 reference images

Best locations

- Good features, minimal slopes

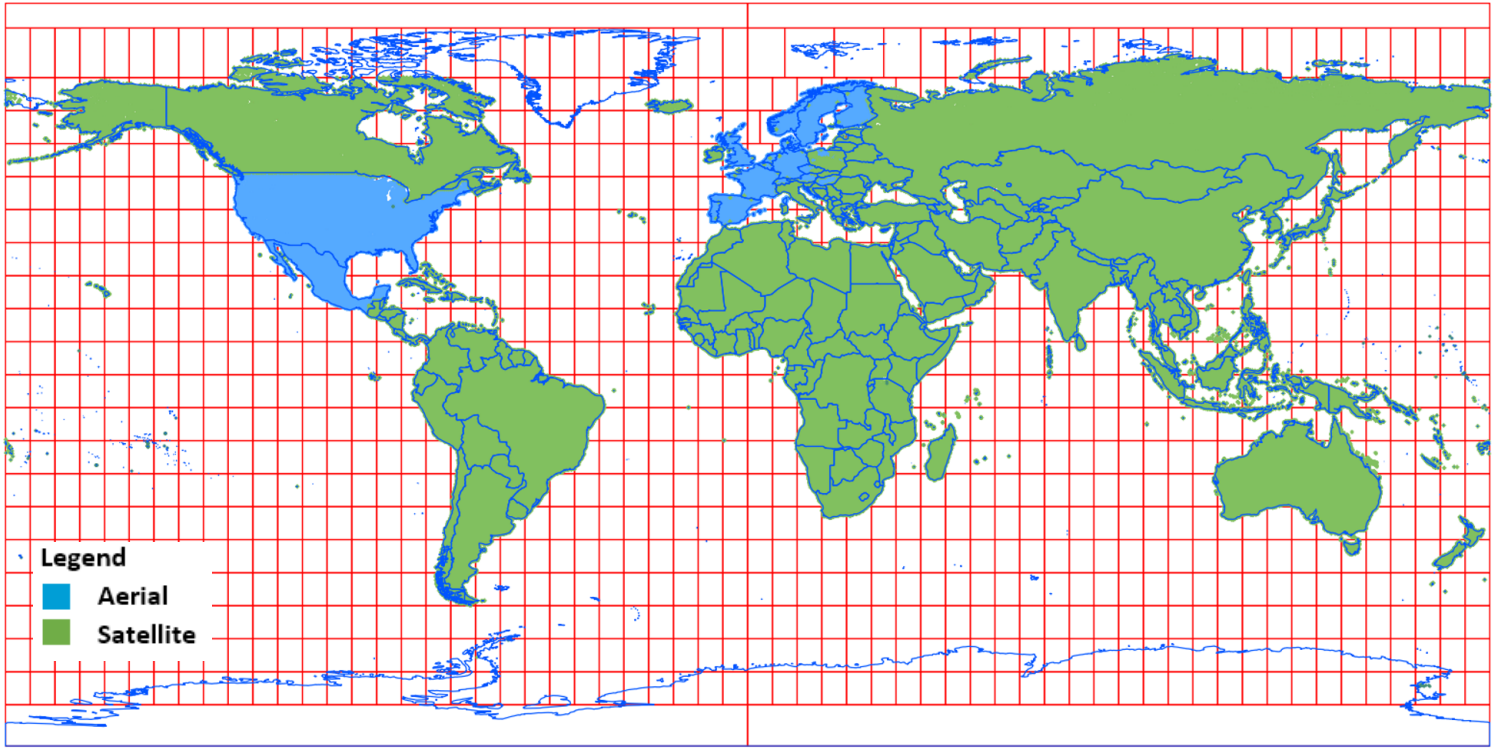
Best imagery

- Lowest view angle, most current image

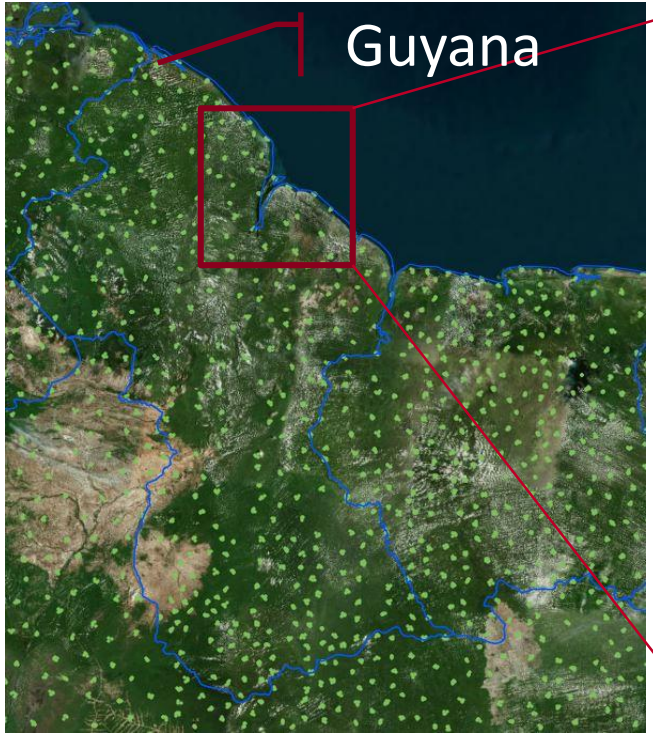
Uniform spatial distribution

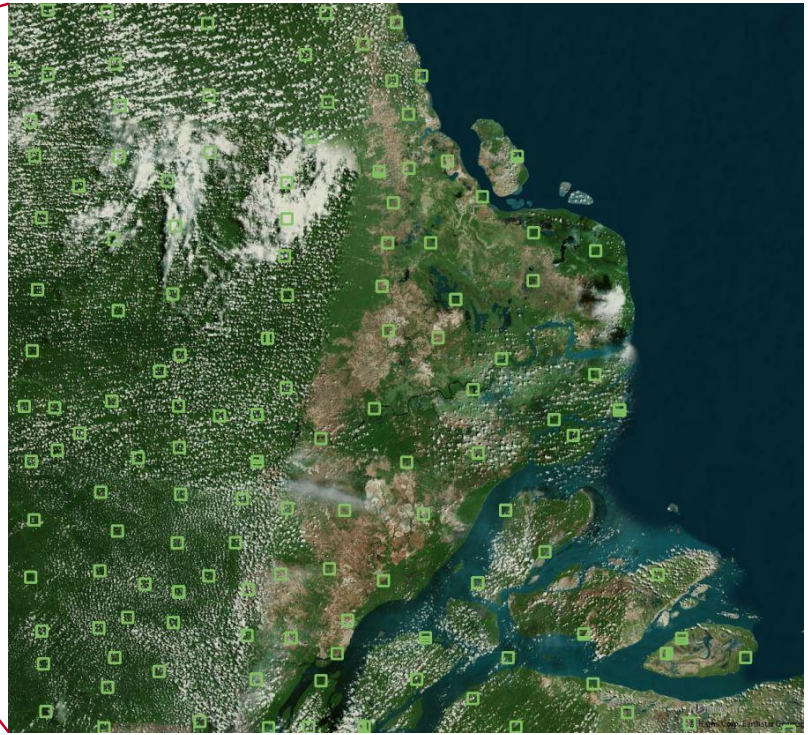
- Regular grid, optimized for RapidEye orbits and swath

Global Coverage - 130Mkm^2

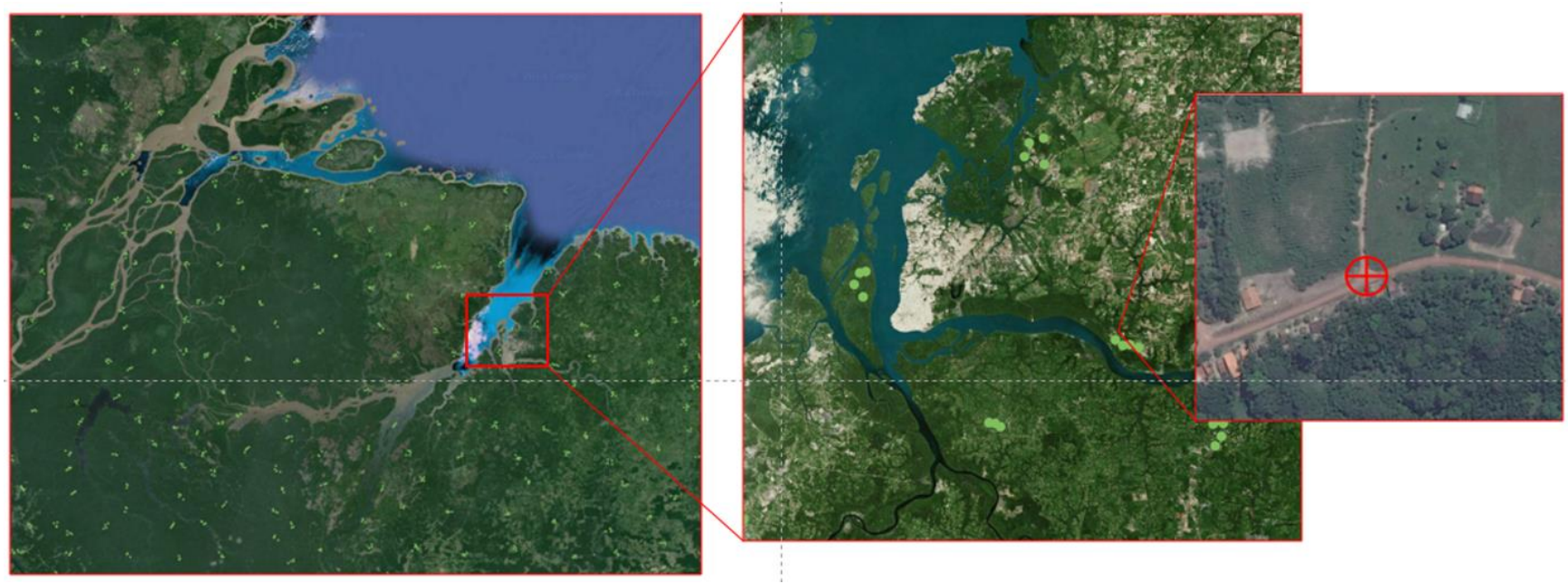


Everywhere on Earth …





… you name it, we have it!



L3A ACCURACY EVALUATION

Objective of the Study

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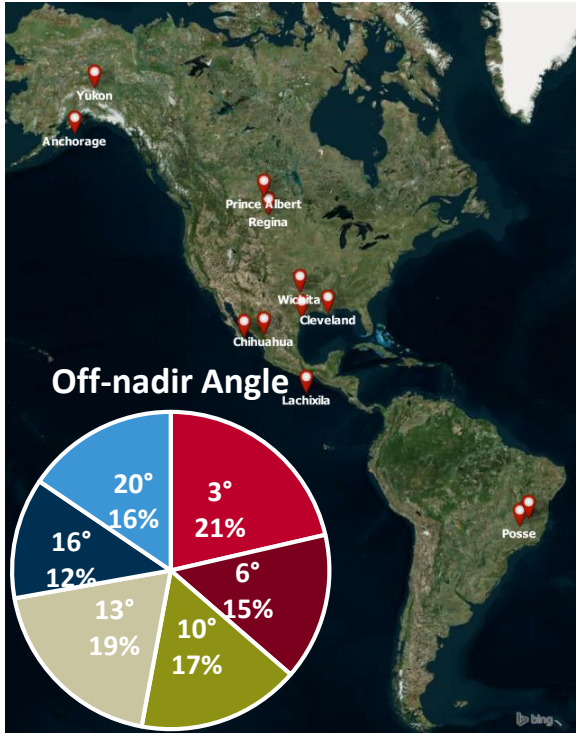
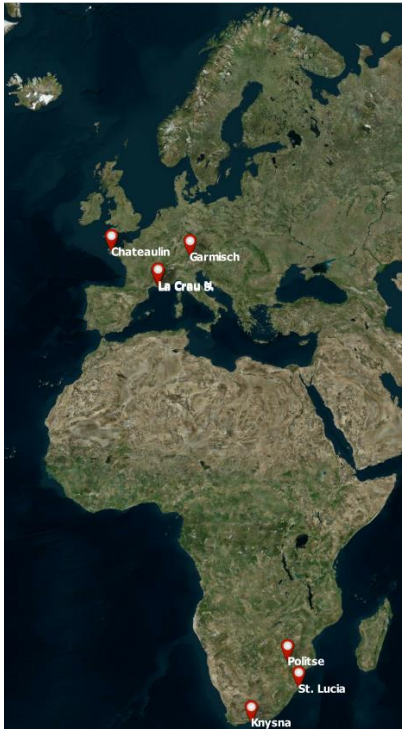
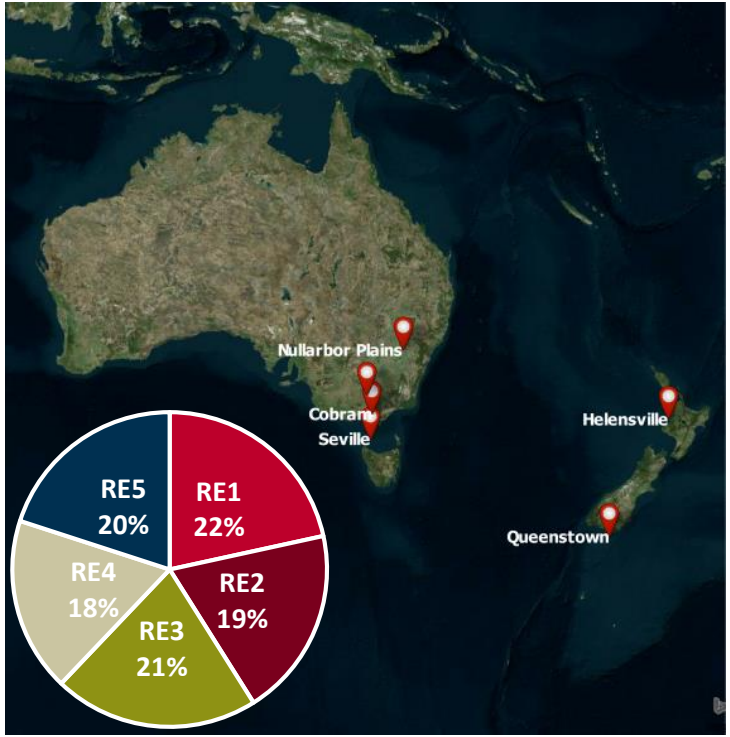
- Evaluate the positional accuracy of RapidEye L3A products generated with Global Reference 2.0
  - DEM: Intermap World30 (30m post) or better
  - All five satellites
  - Full off-nadir angle range (-20° to +20°)

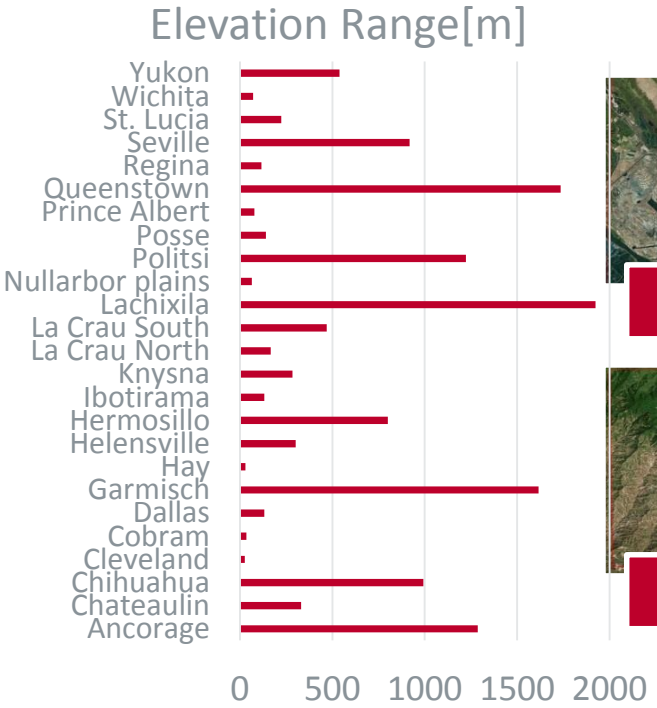
25 Test Sites worldwide, 177 products



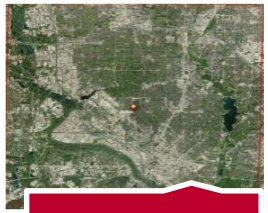




25 Test Sites worldwide, 177 products

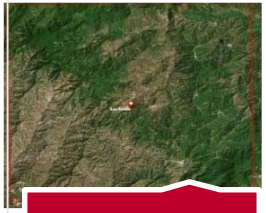


La Crau, FR


Dallas, TX

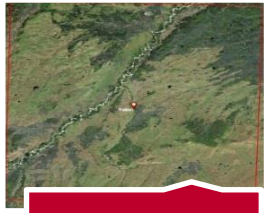
Garmisch, DE

Ibotirama, MX


Lachixila, MX

Queenstown, NZ

Regina, CA


Yukon, AK

Methodology

- Use VHR imagery (0.5 to 2.5m) as “reference”
  - „Independent“ dataset i.e. not same used for GCP extraction
- Use automatic image correlation algorithm to extract check-points from “reference” image
- Verify results visually with GIS SW

Methodology – cont‘d

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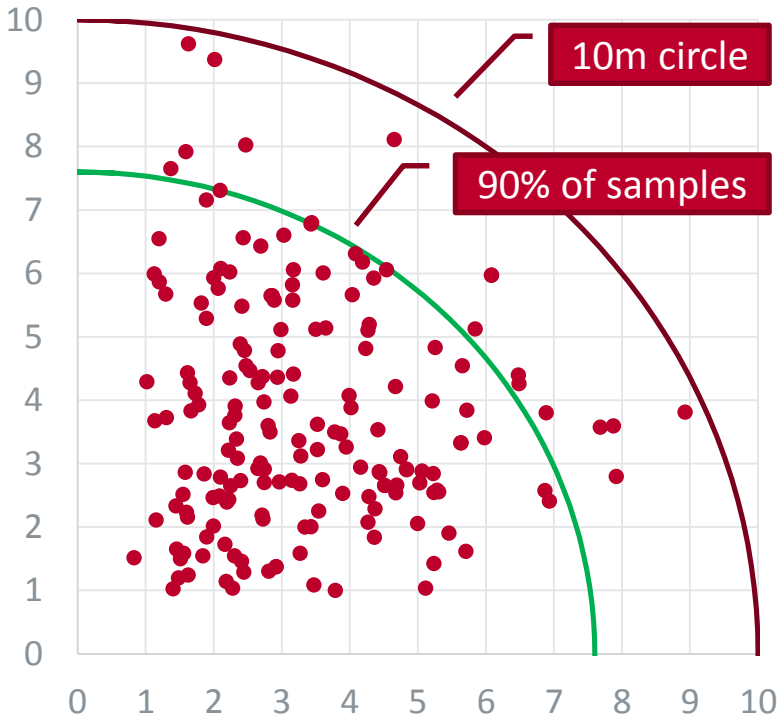
- Compute radial RMSE (RMSEr) for each image
- Compute additional statistics
  - Mean, standard deviation, etc.
- Estimate CE90 for the population of images
  - One data point (RMSE) for each image
  - „percentile method“ (same approach as CCAP)

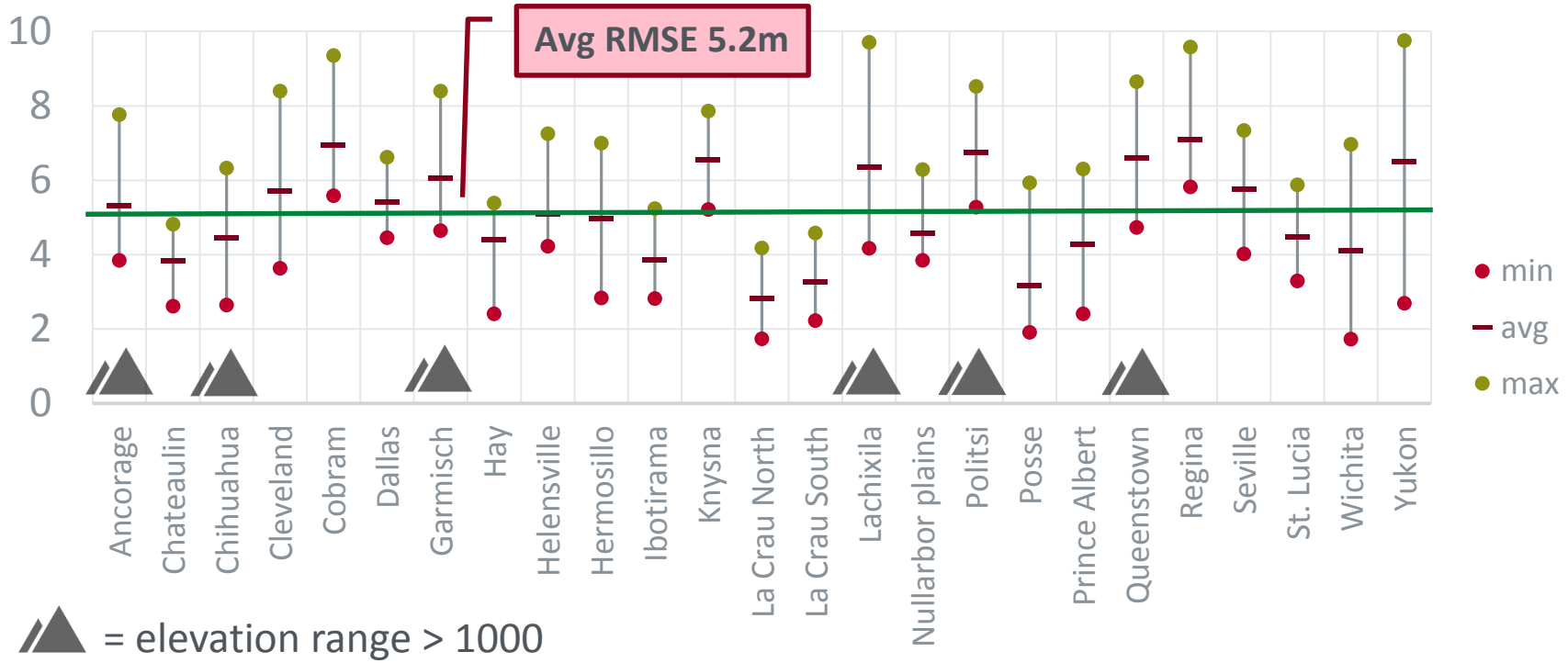
Evaluation results – RMSEr [meters]

- One dot for each L3A image
- **Always under 10m**

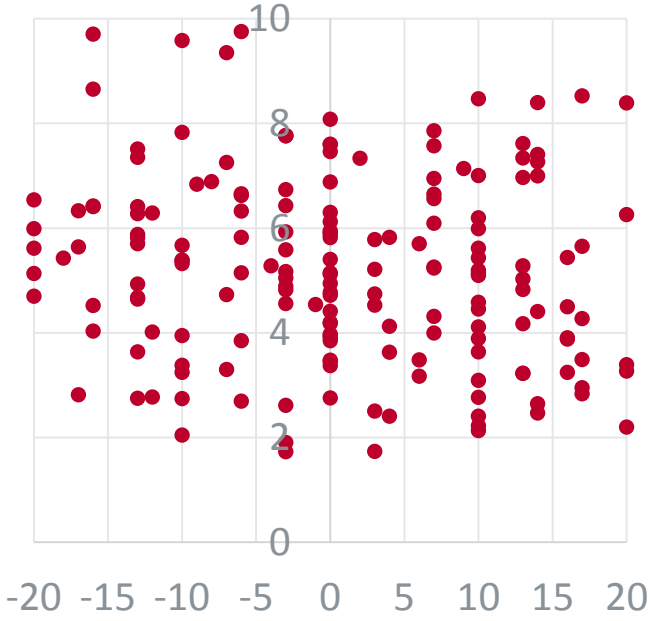
# images	177
Avg RMSEr	5.2m
CE90 est.	7.6m
CMAS 90 (1.5175 x RMSE)	8.2m
CE95 (NSSDA) (1.7308 x RMSE)	9.4m

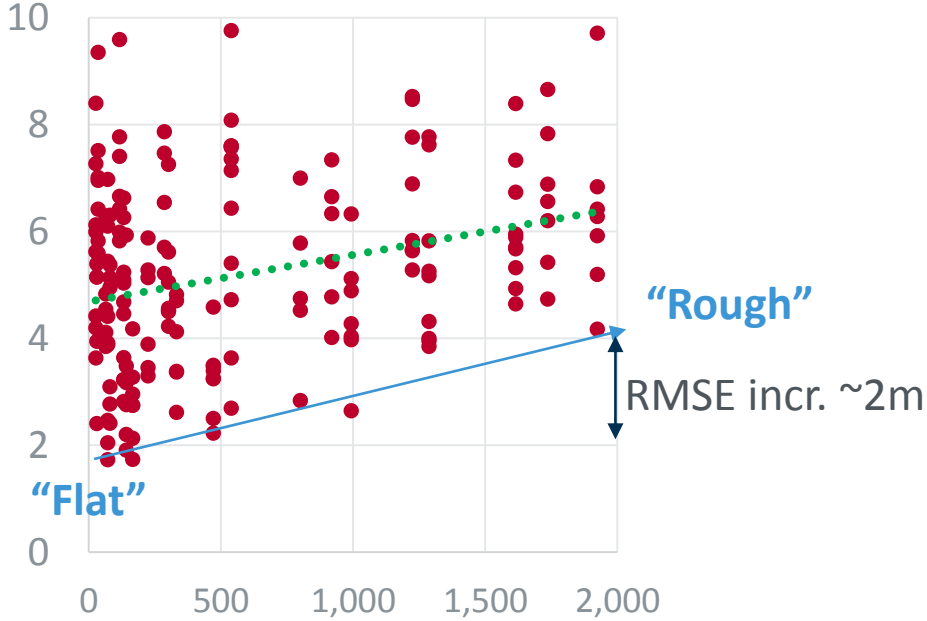


Evaluation results per site – RMSEr [m]

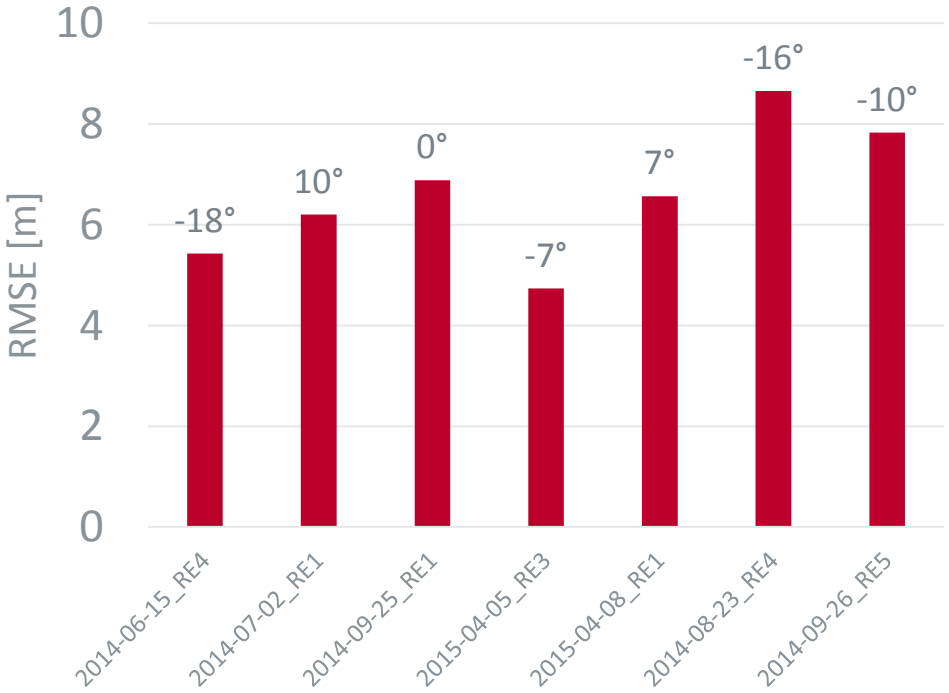


RMSEr vs off-nadir angle and Elevation

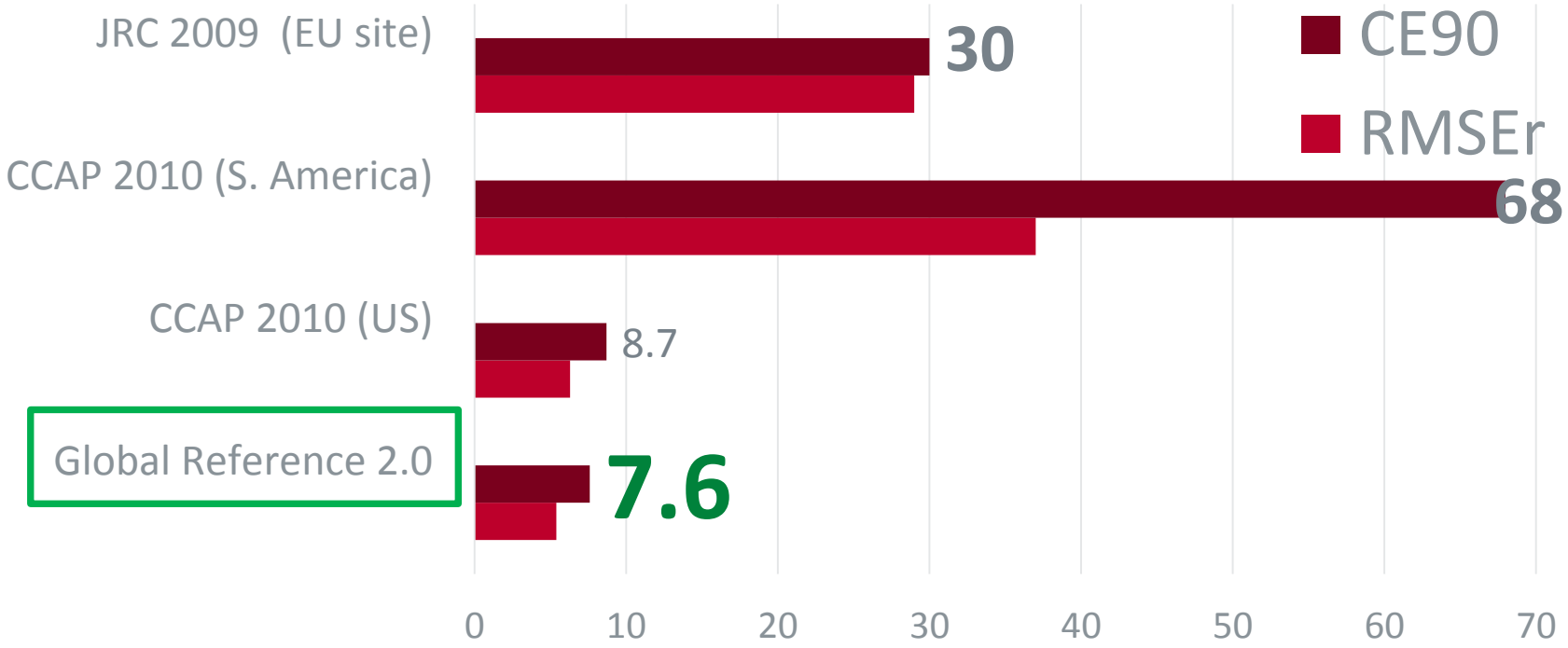




Queenstown, NZ (elevation 300 - 1,700m)



Comparison with past evaluations



The bottom line is …

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Your standard **RapidEye** ortho product

Global Reference 2.0

30m DEM

10m accuracy worldwide

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BACKUP SLIDES

Reference images for this study

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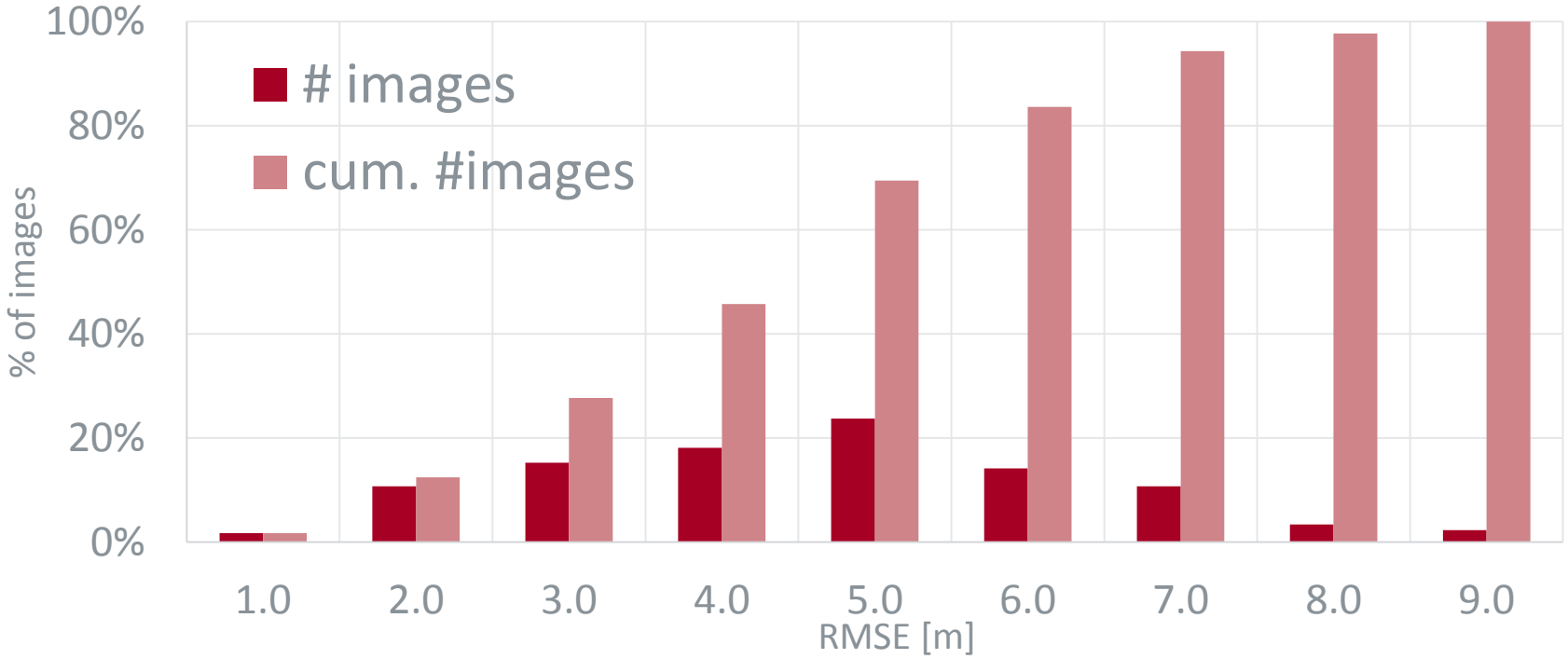
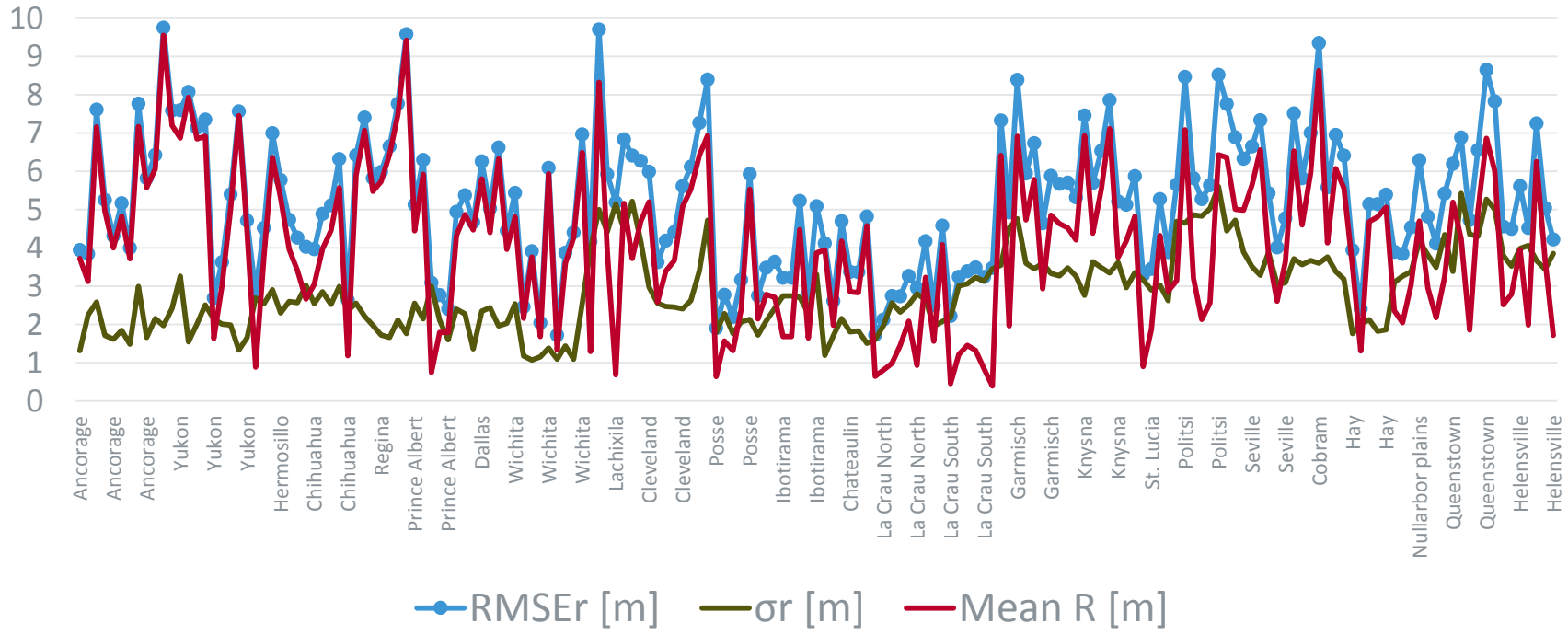
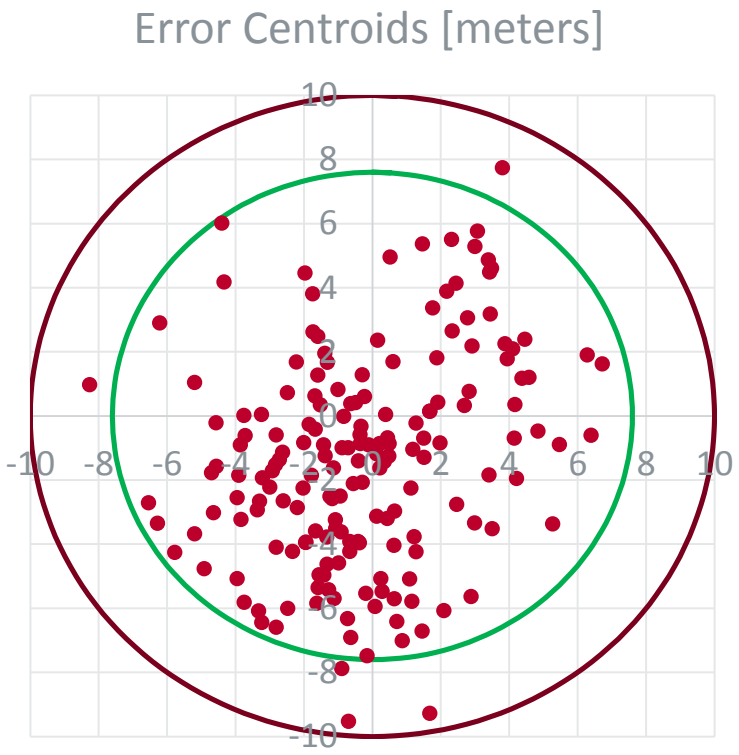
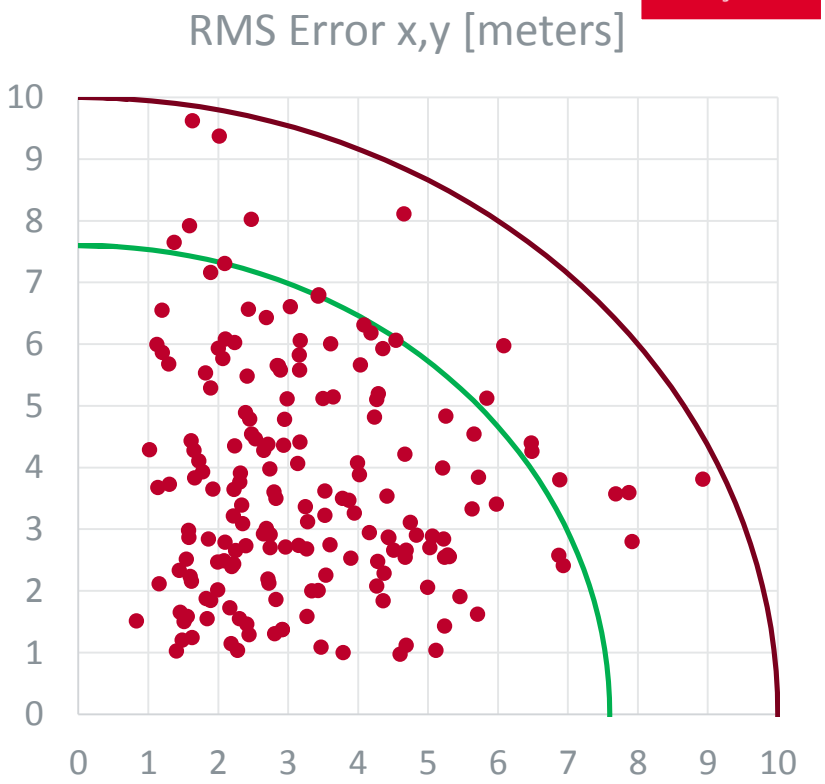
Country	Reference images description	Published Accuracy
Australia	Geoscience Australia AGRI 2.5m	3-7m RMSE
Brazil	Orthophotos, 0.8 m resolution	< 5 m CE90
Canada	SPOT mosaic from Geobase, 10m resolution	< 10 m CE90
France	Aerial imagery 50cm	< 2.5 RMSE
Germany	Orthophotos, 2 m resolution	< 10 m CE90
Mexico	Orthophotos, 2 m resolution	CE90 = 5 m (< 30° off-Nadir)
New Zealand	Orthophotos 1995-1996 and 2000-2001, 2.5 m resolution	< 12.5 m CE90
South Africa	Orthophotos from NGI, S. Africa, 0.5 m resolution	< 10 m CE90
United States	USGS digital orthoimagery, 0.3 - 1 m resolution	< 10 m CE90

RMSE distribution – 1 meter bins



Mean Error, RMSE and variance



Error Centroids vs RMSE