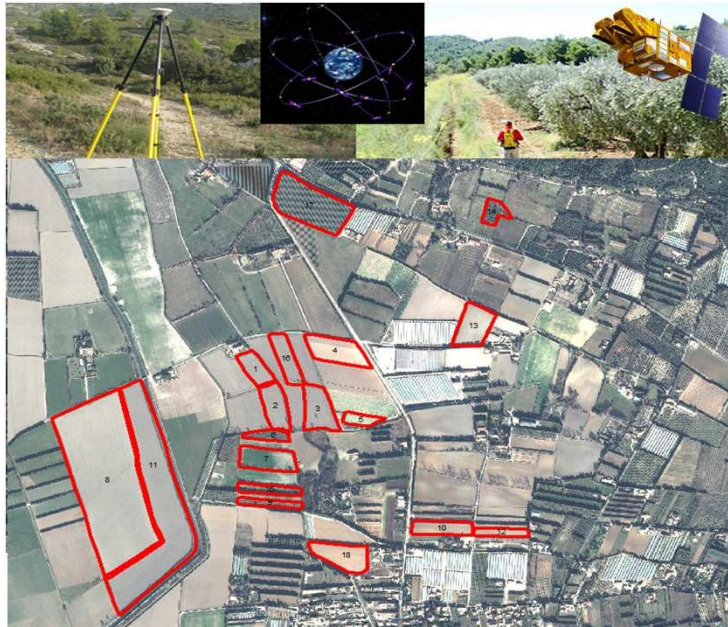


GNSS and orthoimagery for area measurement: validations state of play

www.jrc.ec.europa.eu



Serving society
Stimulating innovation
Supporting legislation

Outline

1. Validation/certification overview
2. 2013 survey results
3. Specific cases
 - Long fields
 - Measurements in difficult conditions (forest)
4. Conclusions and perspectives

Outline

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1. Validation/certification overview

In the frame of CAP direct payments and associated On-The-Spot checks, agricultural parcel areas shall be determined as laid down in Art.34 of R.1122/2009.

According to this article, MS shall use measurement tools that are “proven to assure measurement of quality” at least equivalent to that required by applicable technical standard as drawn up at Community level”. The quality of a measurement tool (e.g. GNSS equipment, remote sensing ortho-images - cf. Art.20 of R.73/2009) can be characterized by a number of parameters such as its bias, precision and accuracy.

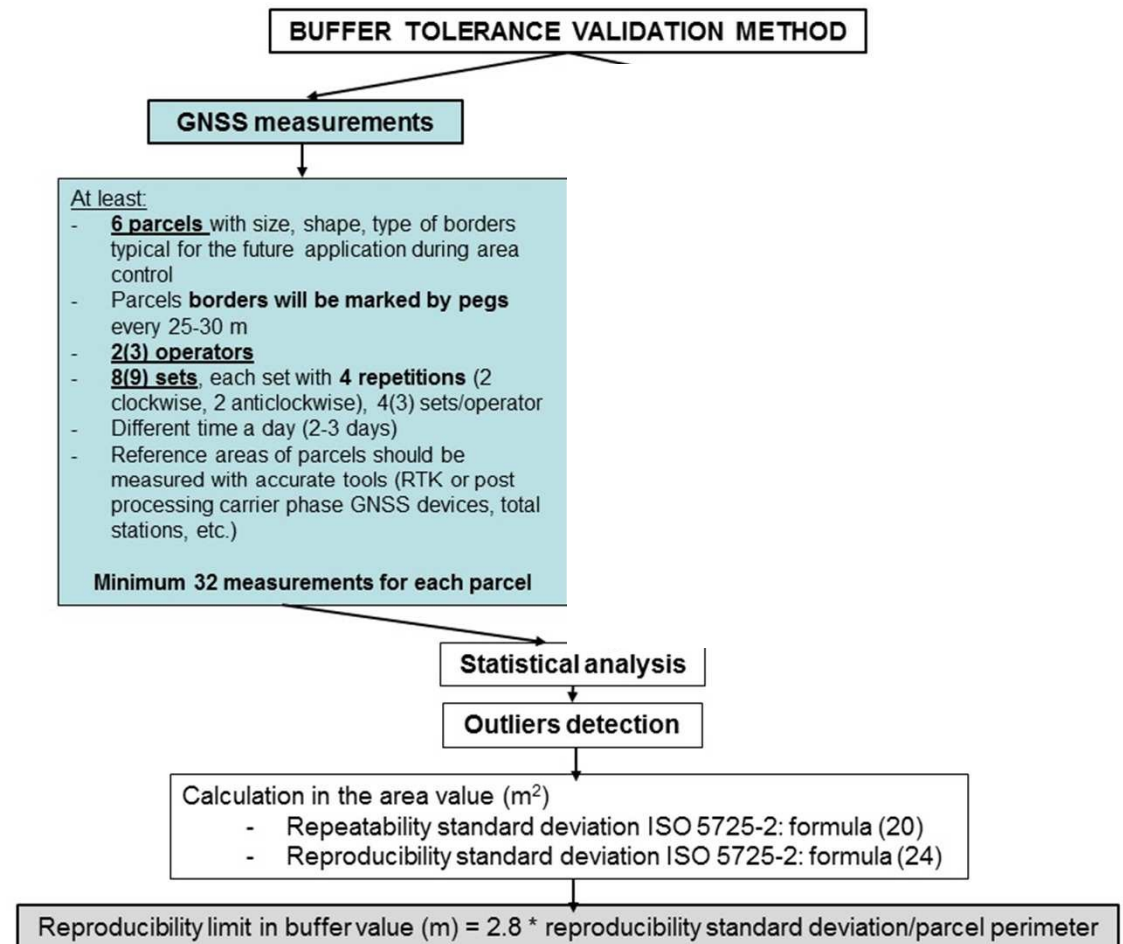
In order to evaluate the reliability and accuracy of area measurement with GNSS receivers and orthoimagery (because the assessment of GNSS point accuracy is not sufficient), the JRC elaborated a **validation protocol** for the area measurements based on the ISO 5275 norm.

1. Validation/certification overview

Since 2009 (2007) main tools used for area measurements are:

GNSS receivers

- Validated (MS or RL*)



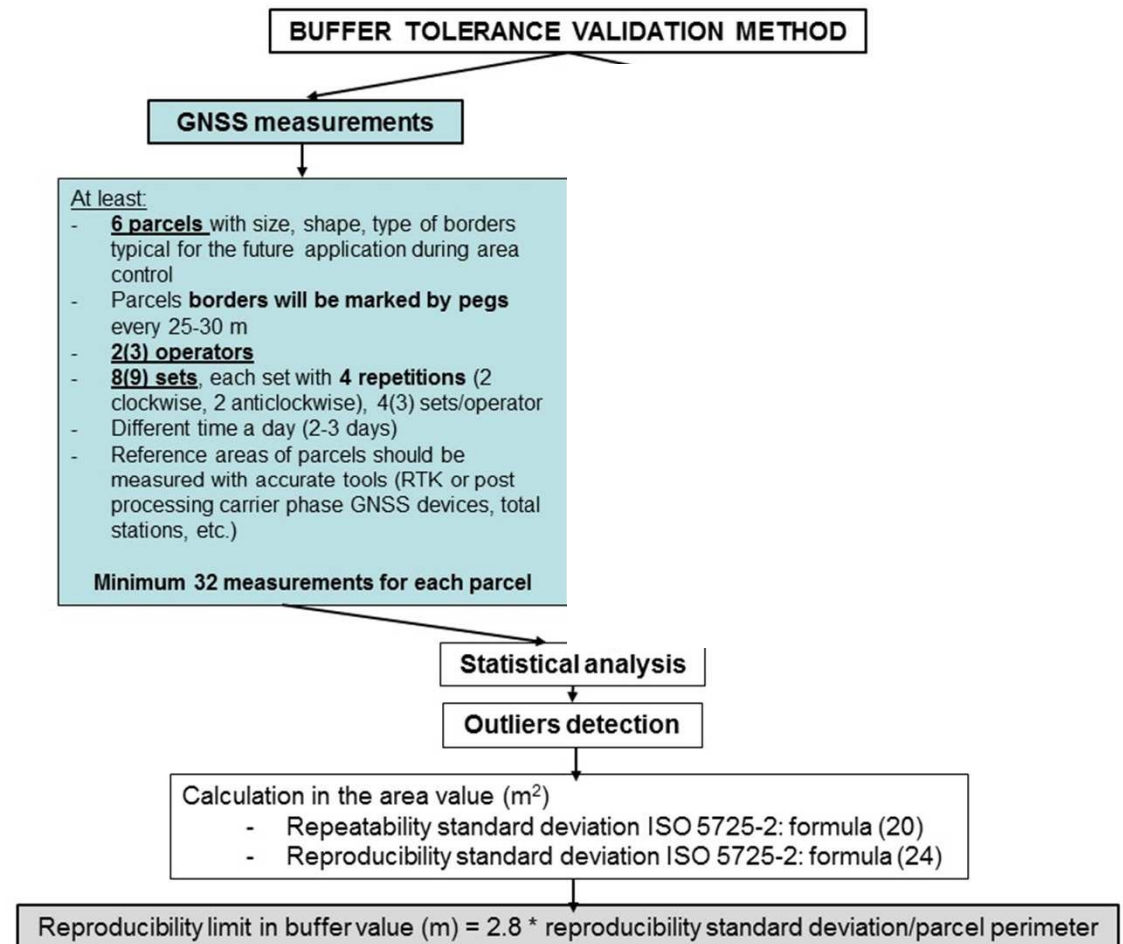
* Reference laboratories
9 April 2013

1. Validation/certification overview

Since 2009 (2008) main tools used for area measurements are:

GNSS receivers

- Validated (MS or RL*)
- **Certified (Navcert)**



* Reference laboratories
9 April 2013

1. Validation/certification overview

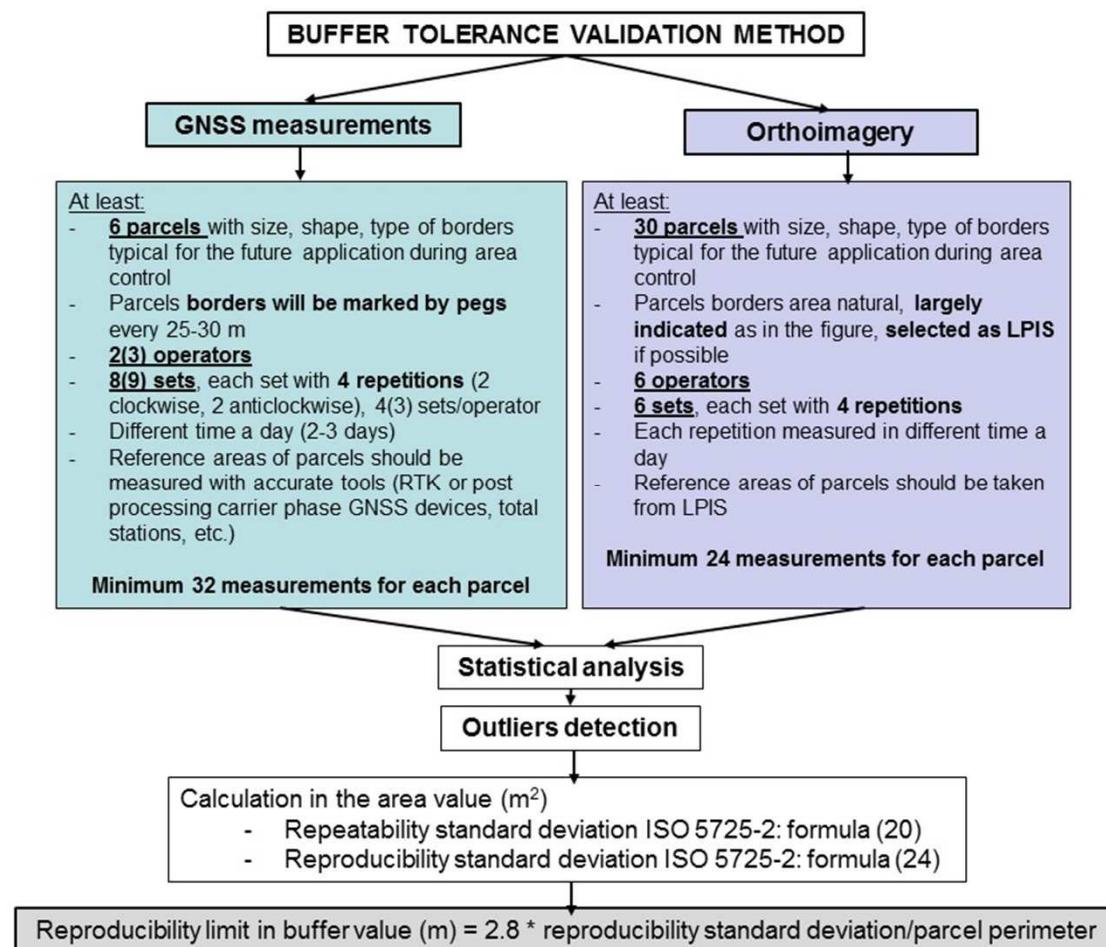
Since 2009 (2008) main tools used for area measurements are:

GNSS receivers

- Validated (MS or RL*)
- Certified (Navcert)

Orthoimagery

- Validated according to the proposed protocol



* Reference laboratories
9 April 2013

1. Validation/certification overview

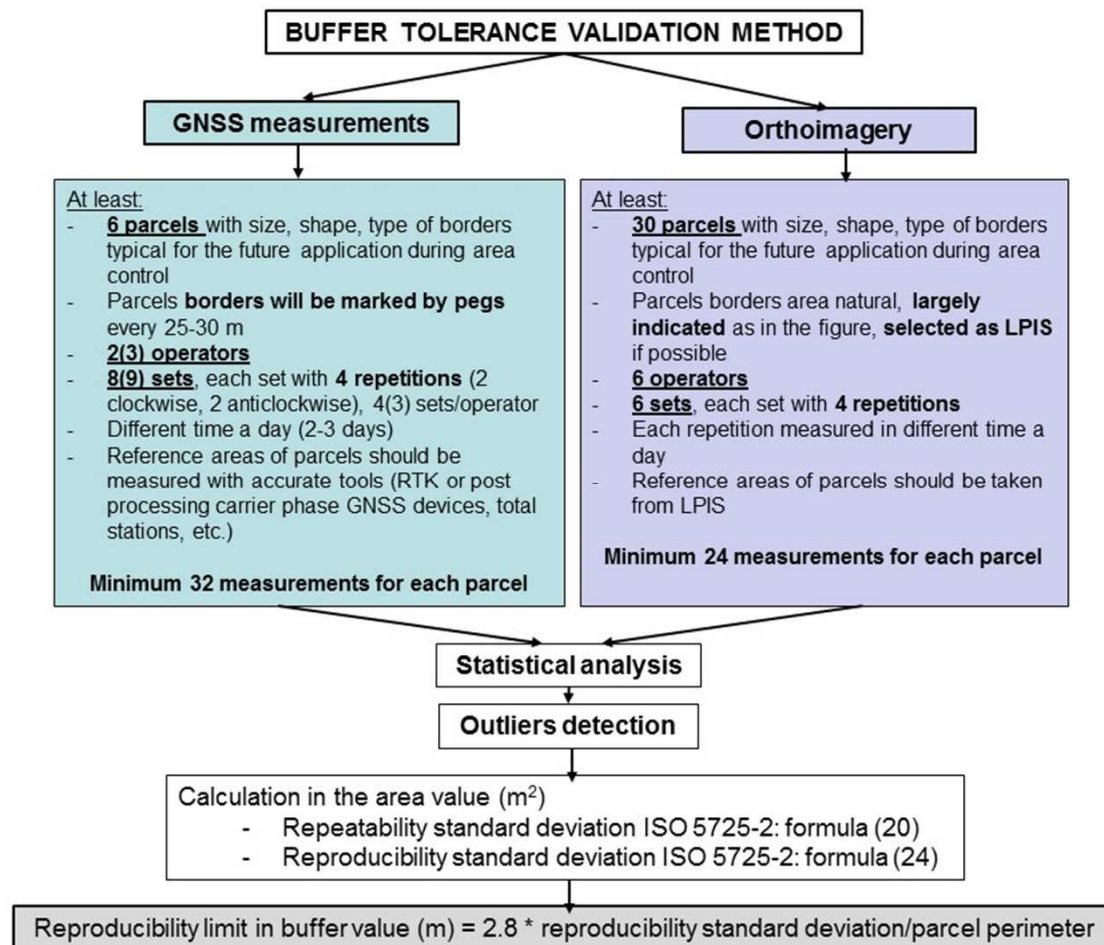
Since 2009 (2008) main tools used for area measurements are:

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Orthoimagery

- Validated according to the proposed protocol
- "Rule of thumb" ($R = 1.5 * \text{pixel size}$) !!!



* Reference laboratories
9 April 2013

1. Validation/certification overview

Since 2009 (2008) main tools used for area measurements are:

GNSS receivers

- Validated (MS or RL*)
- Certified (Navcert)

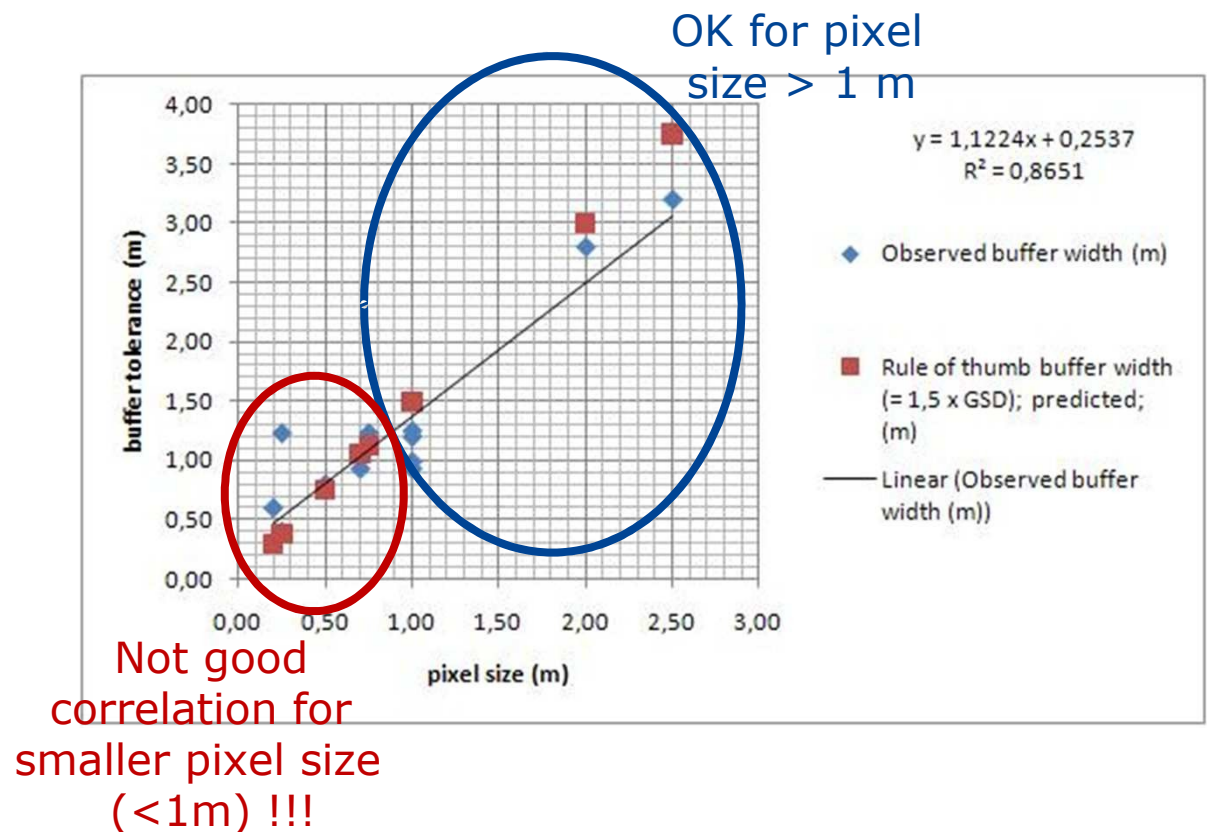
Orthoimagery

- Validated according to the proposed protocol
- "Rule of thumb" ($R=1.5 \times \text{pixel size}$) !!!

Laser, etc ...

* Reference laboratories

9 April 2013



1. Validation/certification overview

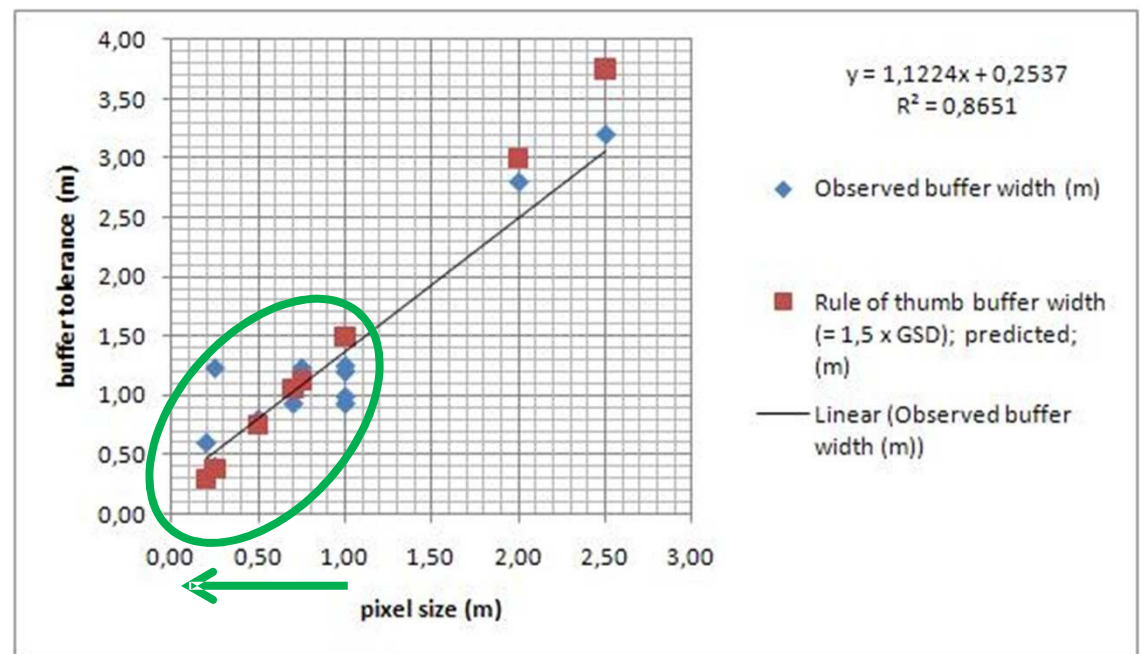
Since 2009 (2008) main tools used for area measurements are:

GNSS receivers

- Validated (MS or RL*)
- Certified (Navcert)

Orthoimagery

- Validated according to the proposed protocol
- "Rule of thumb" ($R=1.5 \times \text{pixel size}$) !!!



Laser, etc ...

We strongly recommend to validate the orthoimagery according to the proposed validation protocol !!!

* Reference laboratories

9 April 2013

1. Validation/certification overview

Reproducibility limit calculated in validation process allows to classify the area measurement method to the one of the following classes:

- (1) "1.50 m" for RL* inside (1.25m, 1.5m];
- (2) "1.25 m" for RL inside (1.0, 1.25m];
- (3) "1.00 m" for RL inside (0.75m, 1.0m];
- (4) "0.75 m" for RL inside (0.50m, 0.75m];
- (5) "0.50 m" for RL below 0.50m.

*RL = Reproducibility limit

Buffer tolerance = 0

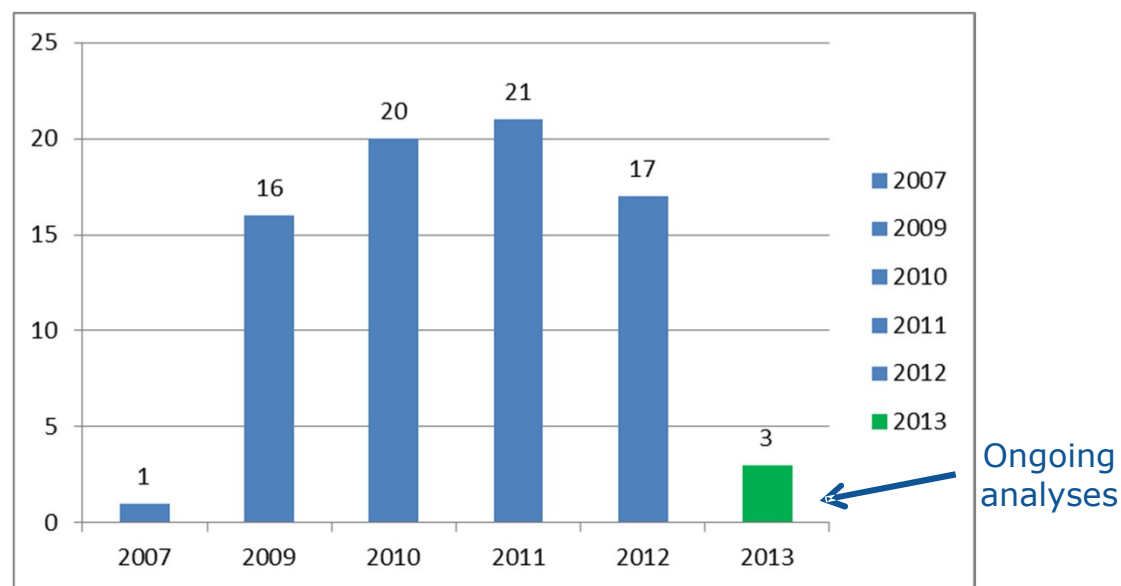
can be used with GNSS devices !!!

must be used with reference parcels !!!

http://marswiki.jrc.ec.europa.eu/wikicap/index.php/Buffer_tolerance_validation_method

1. Validation/certification overview

78 GNSS devices/modes/methods validates since 2007 by MS !!!

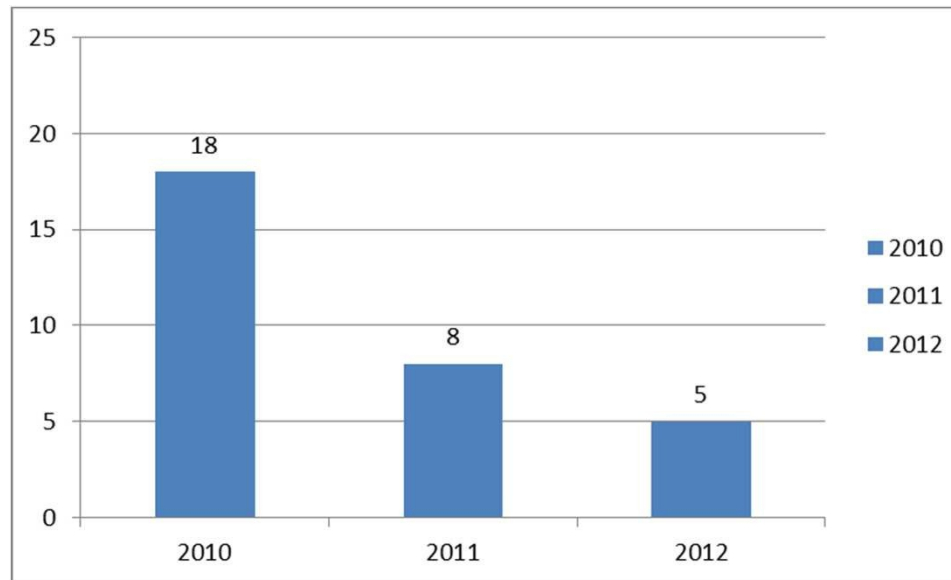


Number of validated GNSS devices per year

http://marswiki.jrc.ec.europa.eu/wikicap/index.php/GNSS_receivers_validated#GNSS_devices_validated_by_Member_States

1. Validation/certification overview

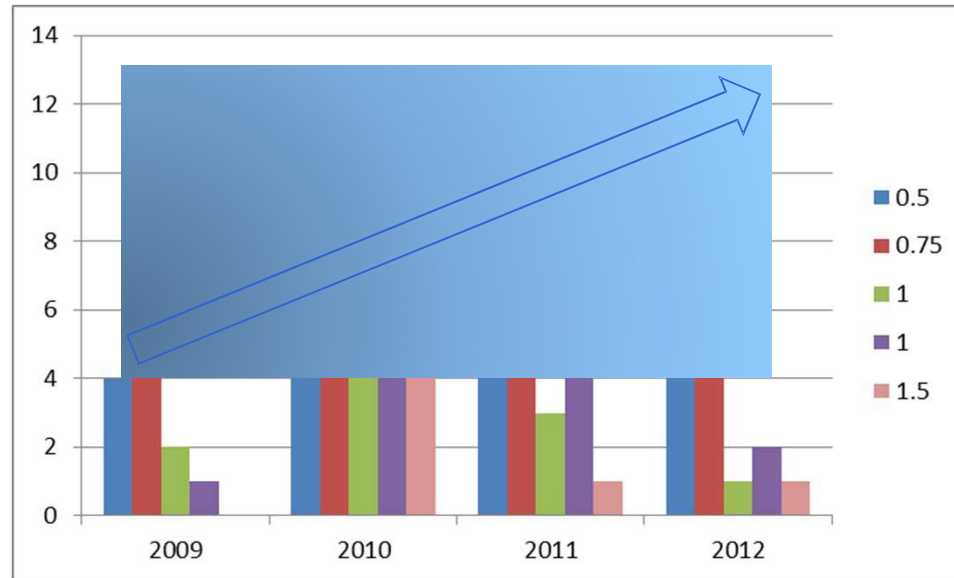
31 GNSS devices/modes/methods validates since 2007 by Reference Laboratories !!!



Number of validated GNSS devices per year

1. Validation/certification overview

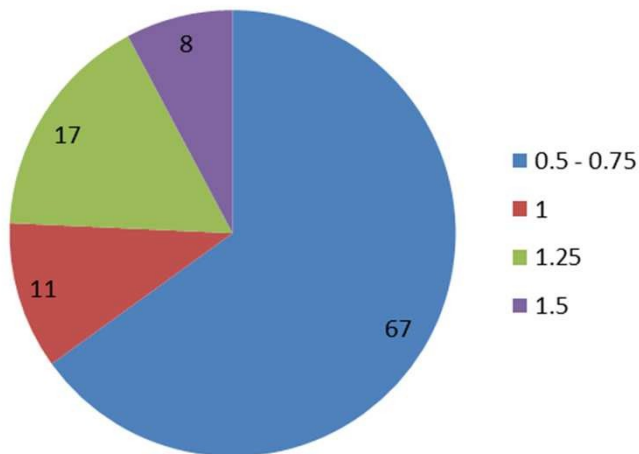
The number of validated GNSS devices with an accurate buffer tolerance value increase each year !



Number of validated GNSS devices per year (MS + RL
with calculated buffer below 1.50 m)

1. Validation/certification overview

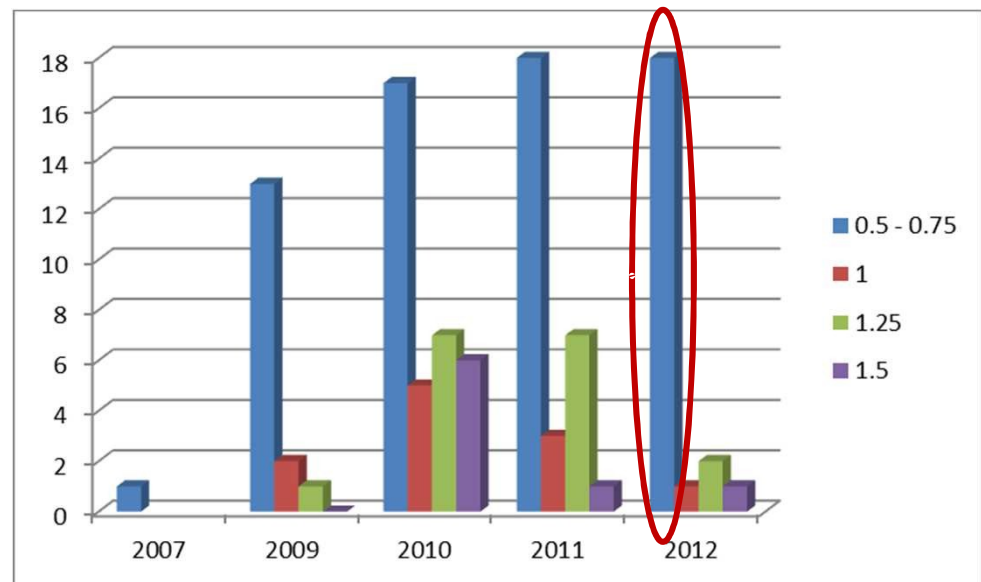
65 % of total validated GNSS devices are better than 75 cm of buffer tolerance !!



Number of validated GNSS devices per tolerance class

9 April 2013

82 % of validated GNSS devices during 2012 year are better than 75 cm of buffer tolerance !!



Number of validated GNSS devices per year (MS + RL with calculated buffer below 1.50 m)



1. Validation/certification overview

More requests concerning orthoimagery validation
during last year !

Czech Republic, France, Germany, ...

Outline

1. Validation/certification overview
2. 2013 survey results
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4. Conclusions and perspectives

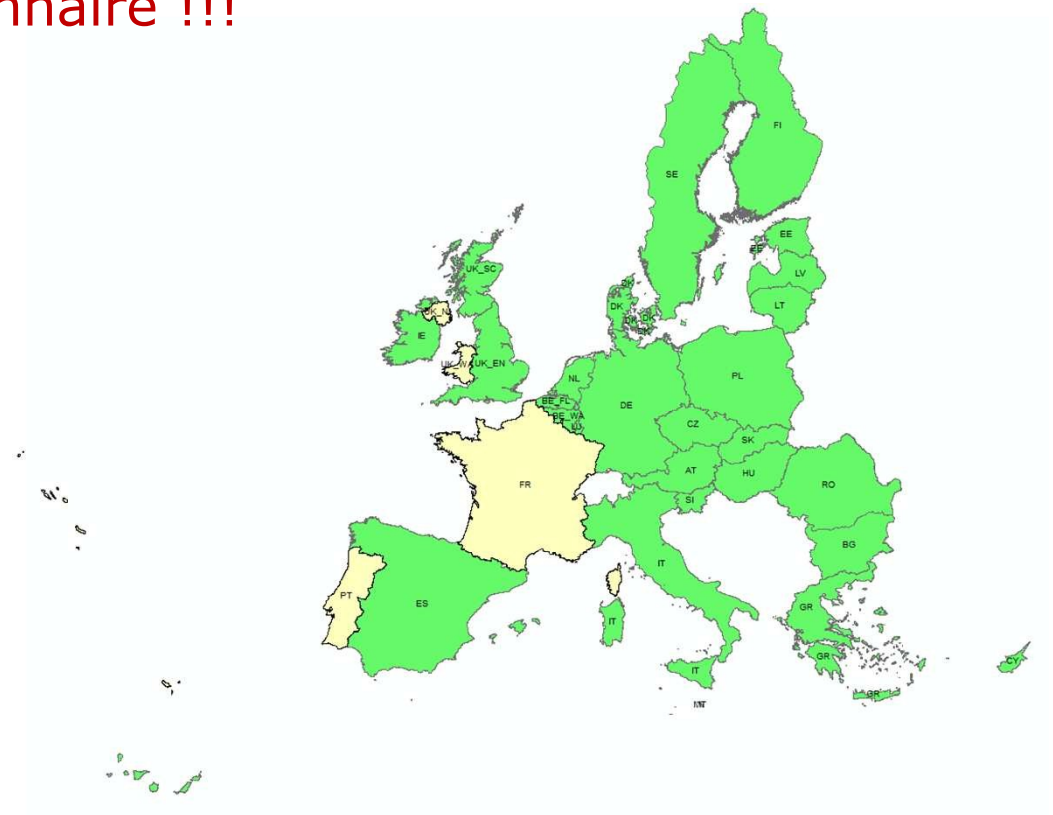
2. 2013 survey results

Thank you for the questionnaire !!!

Your answers allow us to have an overall view about the:

- number of used **GNSS device**,
- the **orthoimages** used for area measurement and the corresponding buffer tolerance...

.....
and to try to clarify some points....



2. 2013 survey results

GNSS devices

> 6400 receivers !!!!
(78 different devices/mode/method)

(> 6200 in 2012)

The statistics calculated in the next slides of this presentation are preliminaries and take in account only partially data due to:

- For the 1500 receivers used in Poland there are not yet complete information
- Some data were filled Friday impossible to update all graphics

General trends are presented !!!

2. 2013 survey results

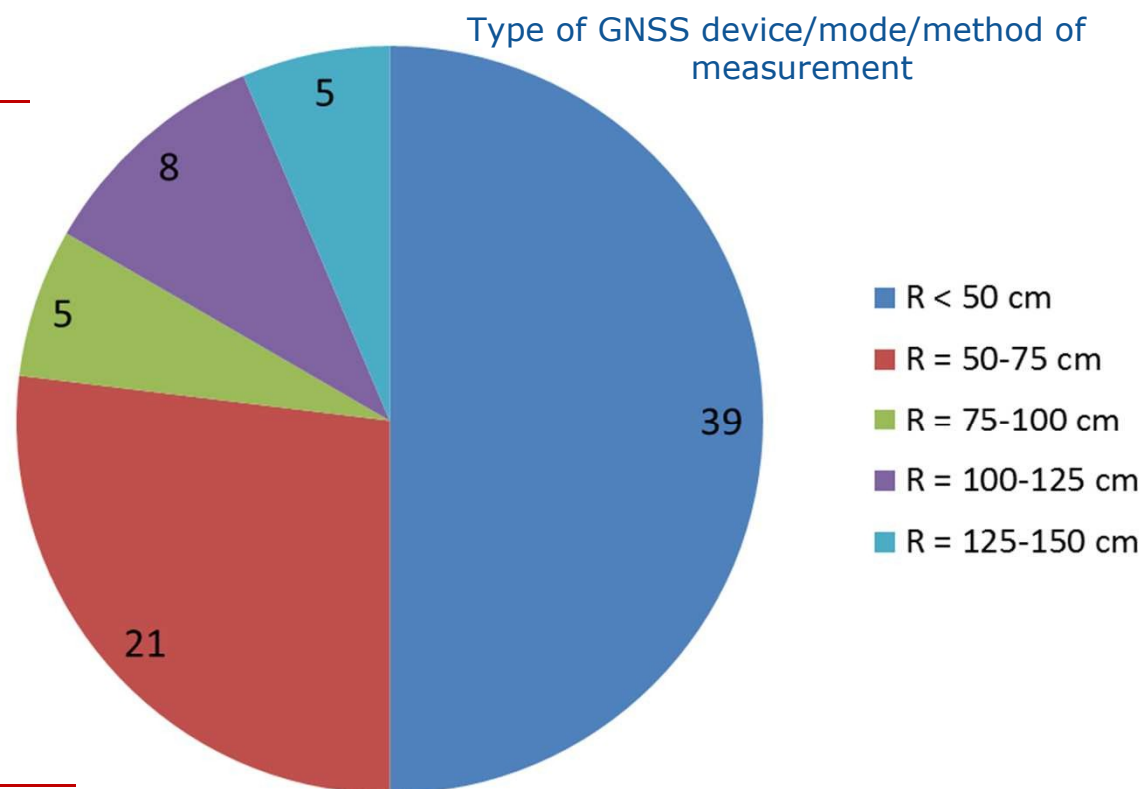
GNSS devices

78 different GNSS
devices/mode/method of
measurement are used

The statistics calculated in the next slides of this presentation are preliminaries and take in account only partially data due to:

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General trends are presented !!!

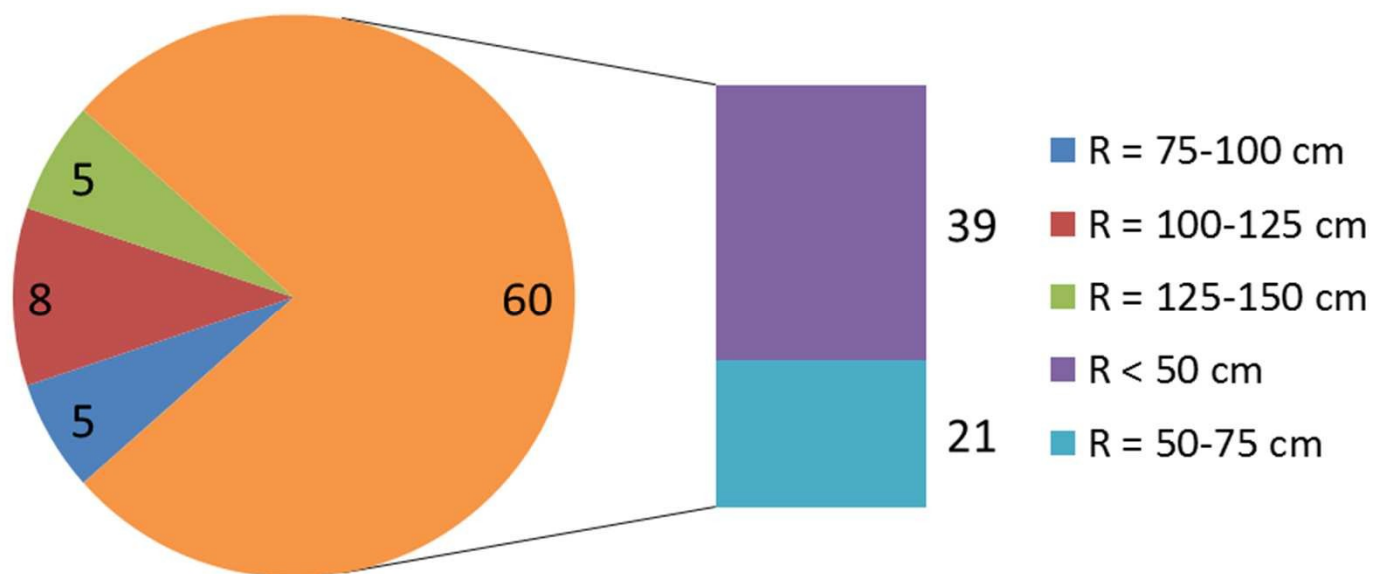


Number of validated GNSS devices per tolerance class

2. 2013 survey results

GNSS devices

For **60 devices** /modes/methods out of 78 (67 % from validated devices in use) the tolerance is **below 0.75 m !!**

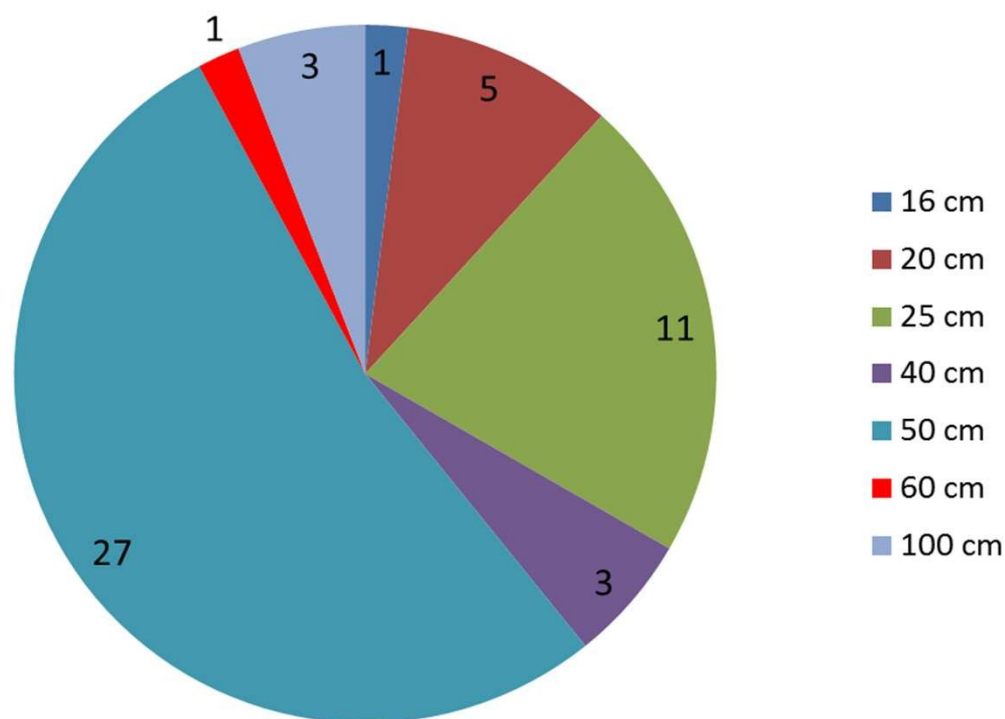


Number of validated GNSS devices per tolerance class

2. 2013 survey results

Orthoimagery

The majority (92%) of ortho images (aerial + satellite) have a spatial resolution below 50 cm

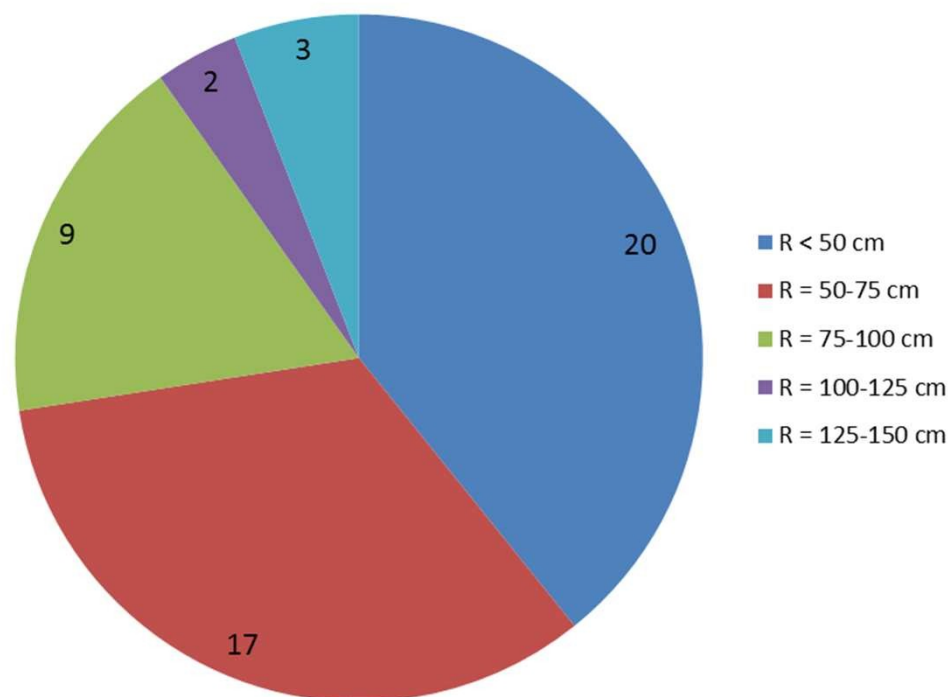


Number of ortho images per pixel size

2. 2013 survey results

Orthoimagery

For **37 ortho images** out of 51 (72 % from total of orthoimages) the used tolerance is below 0.75 m !!

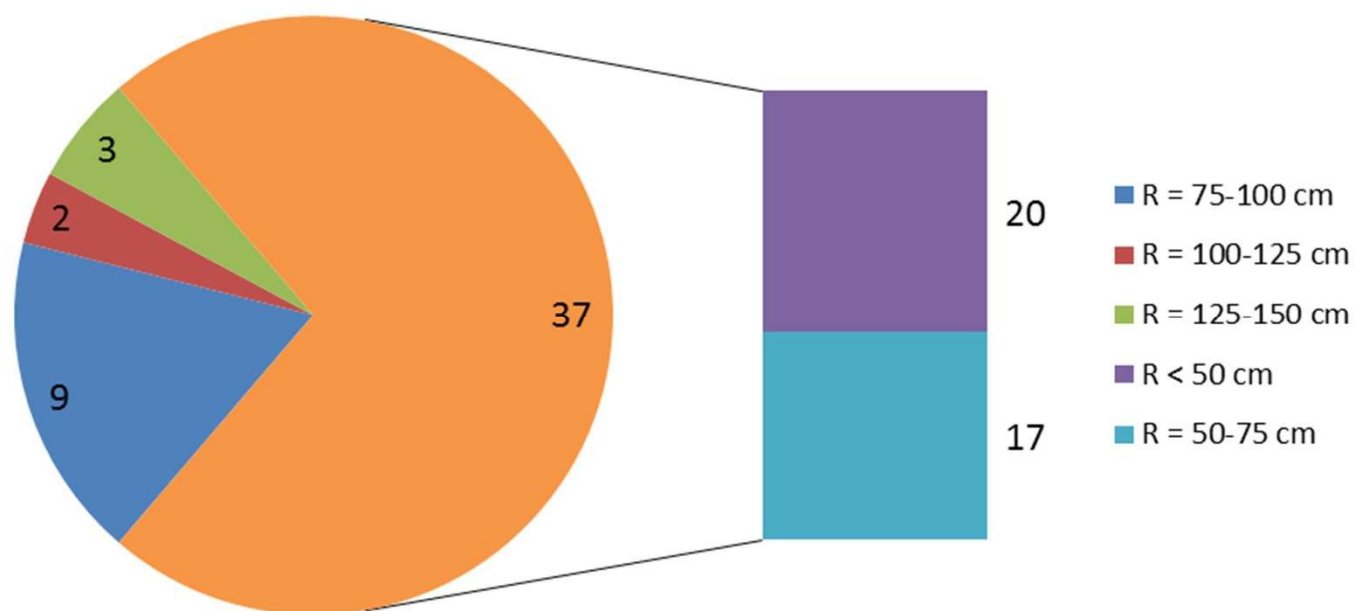


Number of ortho images per tolerance class

2. 2013 survey results

Orthoimagery

For **37 ortho images** out of 51 (72 % from total of orthoimages) the used tolerance is below 0.75 m !!

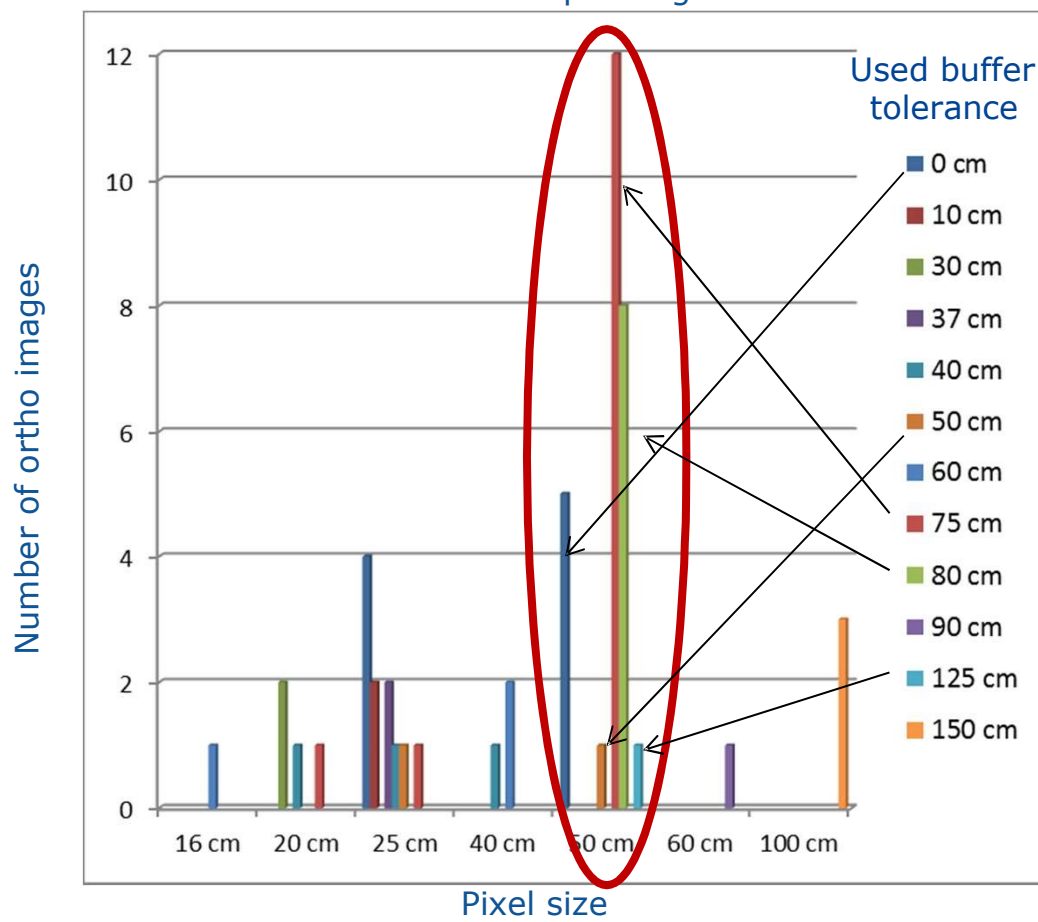


Number of ortho images per tolerance class

2. 2013 survey results

Orthoimagery

Number of ortho images per pixel size and the corresponding buffer tolerance used



For the same spatial resolution, several buffer values are used !

For 50 cm pixel size 5 different values of buffer (0 cm, 50 cm, 75 cm, 80 cm, 125 cm)

2. 2013 survey results

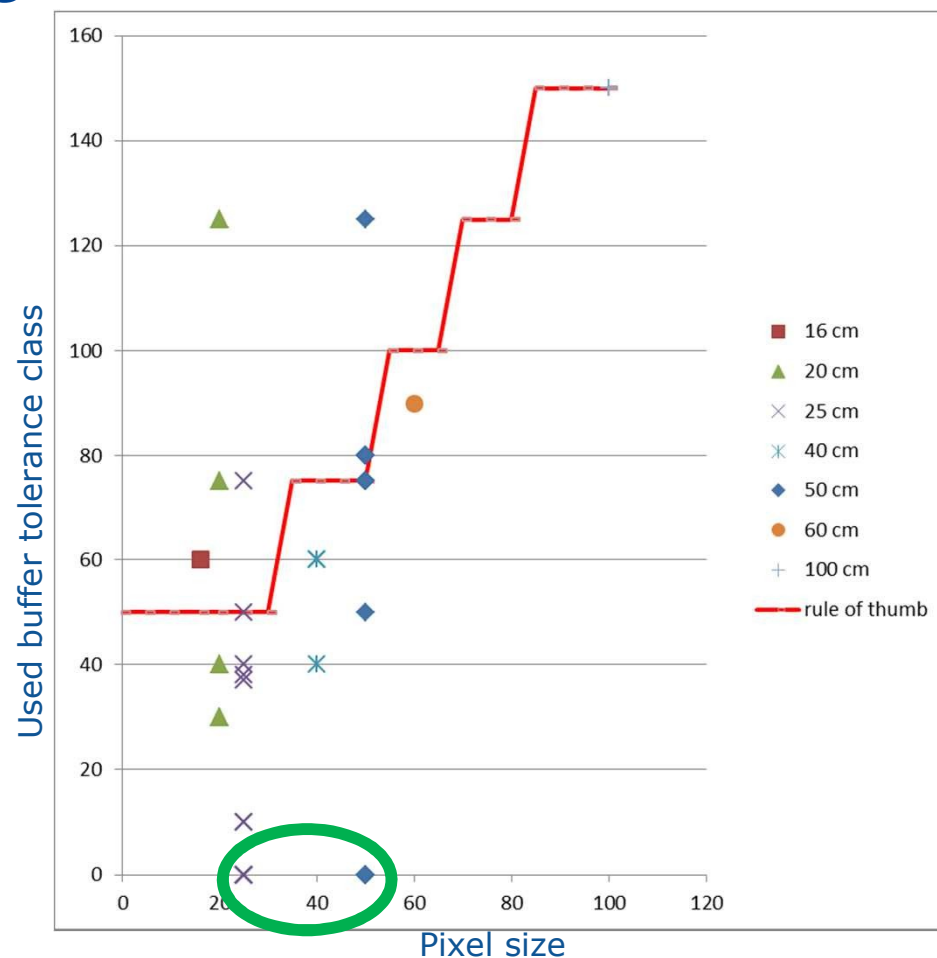
Orthoimagery

Four situations can be stressed :

- "0 tolerance"

Tolerance 0 can be used with each tool (GNSS, orthoimagery, etc ...). For orthoimagery tolerance 0 is used by LU, IT, BE FL, SE.

9 images out of 51.



The pixel size versus buffer tolerance class used

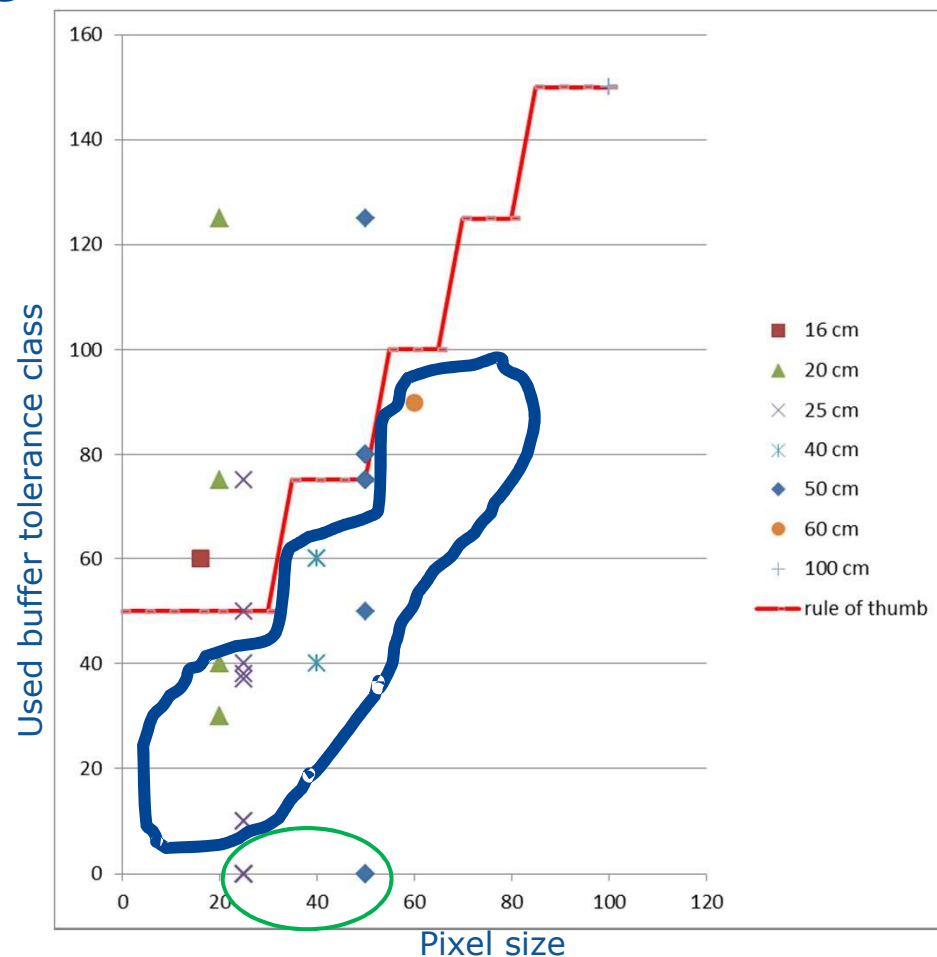
2. 2013 survey results

Orthoimagery

Four situations can be stressed :

- "0 tolerance"
- used tolerance below the estimation from "rule of thumb"

13 images out of 51



The pixel size versus buffer tolerance class used

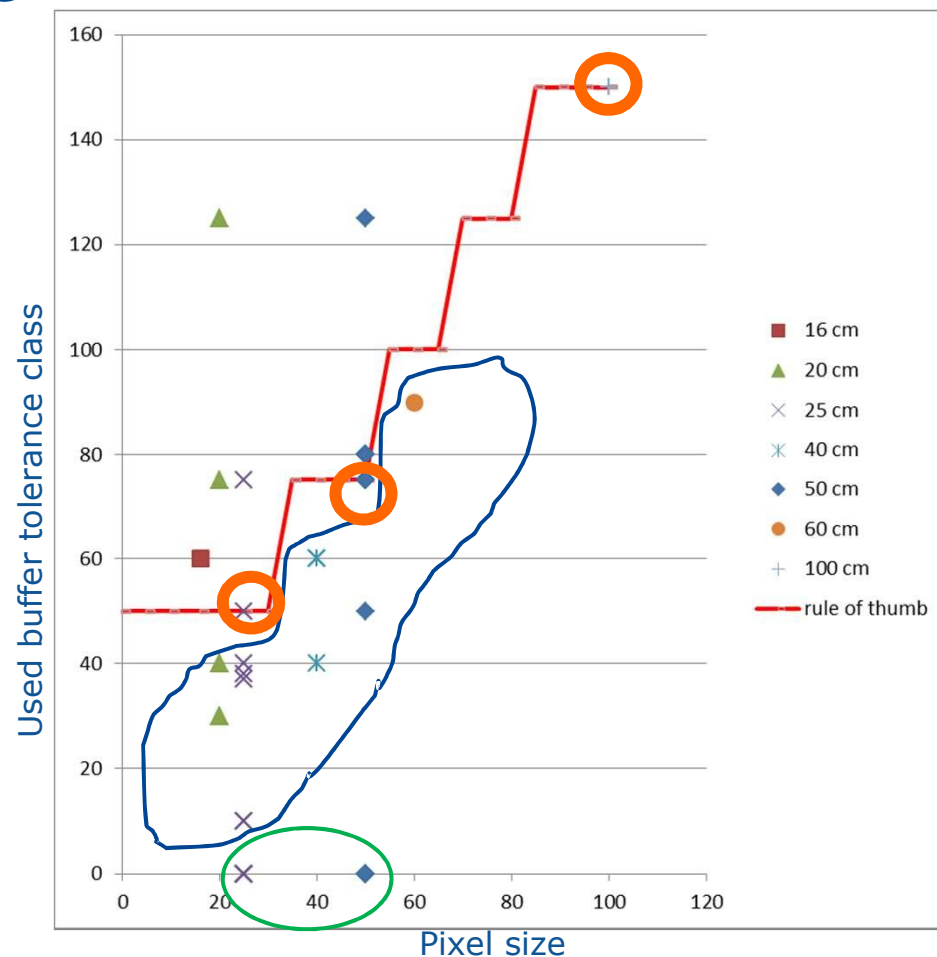
2. 2013 survey results

Orthoimagery

Four situations can be stressed :

- "0 tolerance"
- used tolerance below the estimation from "rule of thumb"
- used tolerance from "rule of thumb"

16 images out of 51



The pixel size versus buffer tolerance class used

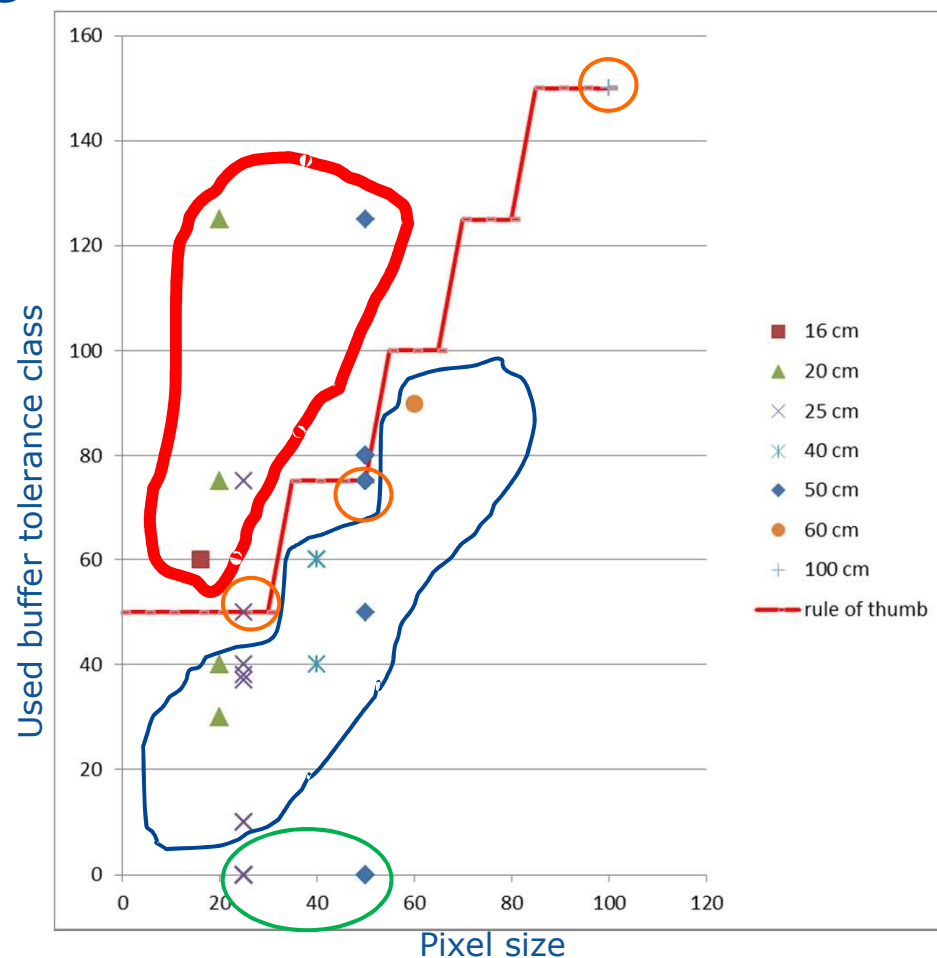
2. 2013 survey results

Orthoimagery

Four situations can be stressed :

- "0 tolerance"
- used tolerance below the estimation from "rule of thumb"
- used tolerance from "rule of thumb"
- used tolerance is higher than estimation from "rule of thumb"

13 images out of 51. Some of them were validated (CZ)

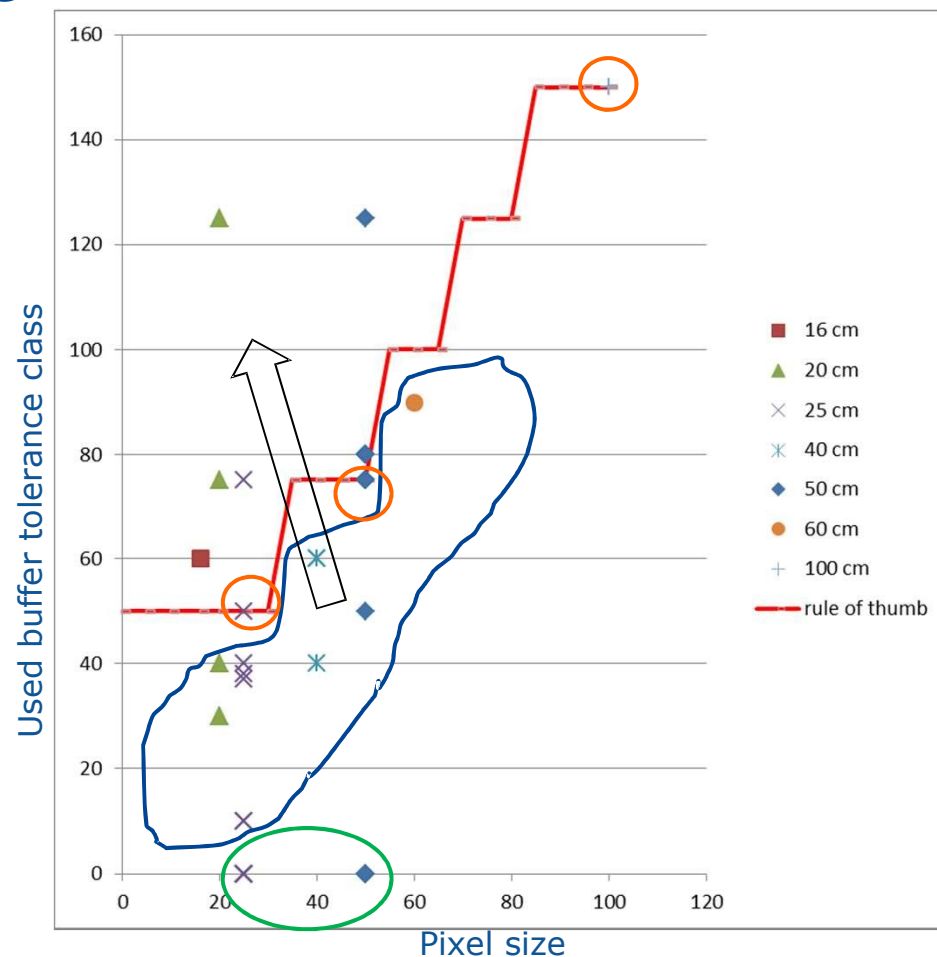


The pixel size versus buffer tolerance class used

2. 2013 survey results Orthoimagery

We strongly recommend to
validate the orthoimagery
according to the proposed
validation protocol !!!

Similarity with GNSS
measurements !



The pixel size versus buffer tolerance class used

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 - Measurements in difficult conditions (forest)
4. Conclusions and perspectives

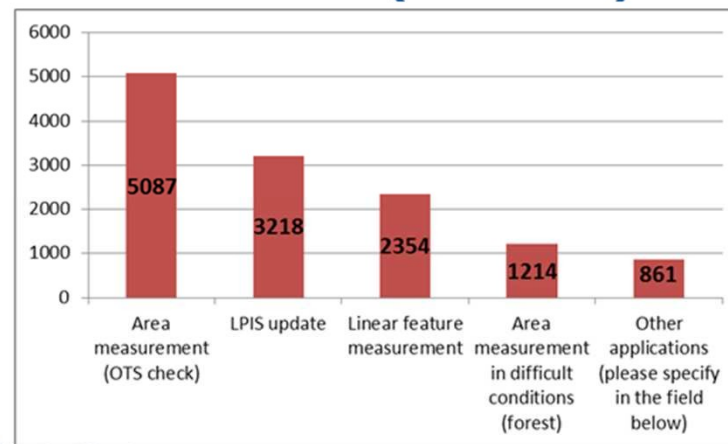
3. Specific cases

2012 presentation ; output of the 2012 survey

2. GNSS devices available for 2012 control campaign

The majority of existing receivers are used for area measurements (**n=5087***)

Number of
available
GNSS
receivers
per
application
type



* the same receiver can be used for different applications

Other applications

- During the Audit C.E.
- Used for RD controls (2nd pillar)
- Some Cross - compliance feature capture
- Verification of good orthorectification for current year imagery used for RS
- Other uses different measurements (location, orientation, ...etc)
- LPIS QA rapid field visits. Point capture for photographs

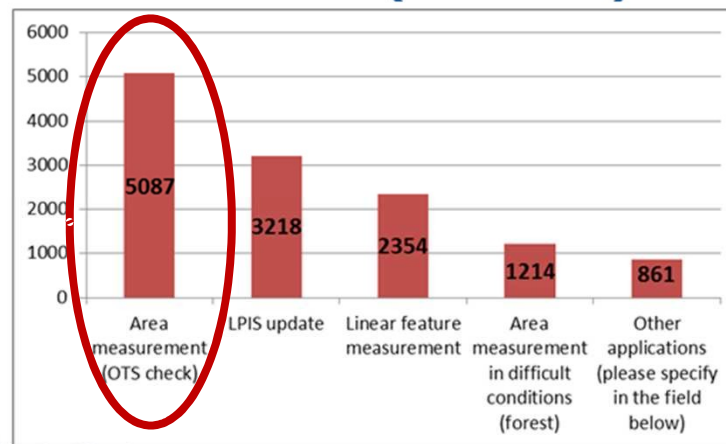
3. Specific cases

2012 presentation ; output of the 2012 survey

2. GNSS devices available for 2012 control campaign

The majority of existing receivers are used for area measurements (**n=5087***)

- Validation for continuous AND vertex measurement method
- Unique tolerance
-



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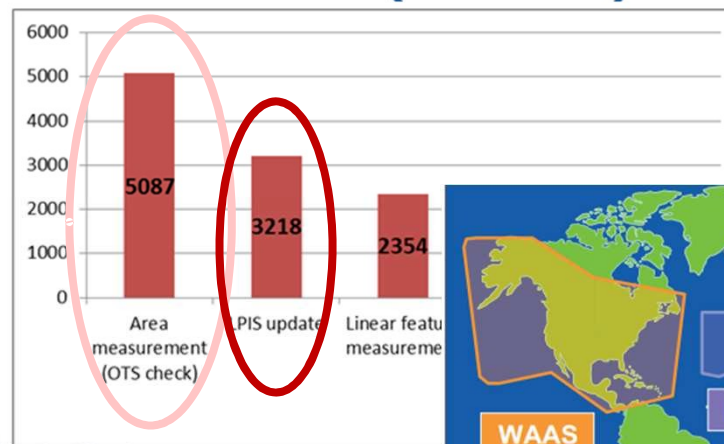
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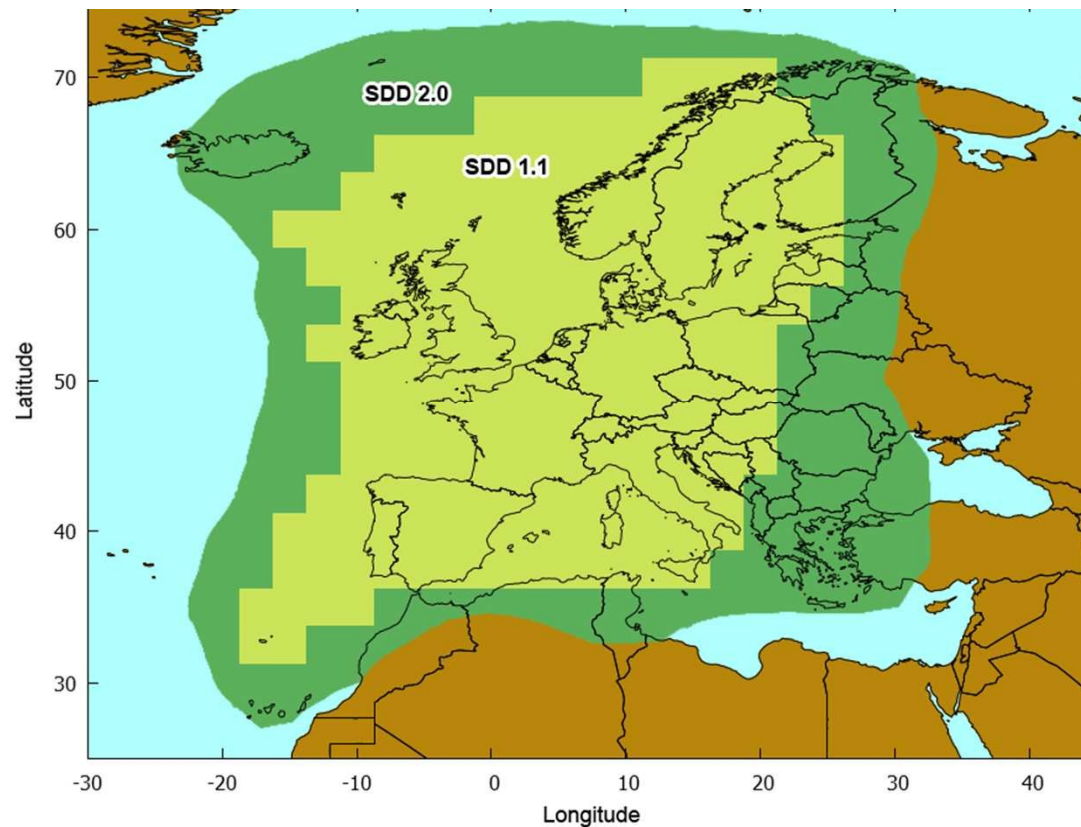
Other applications

- During the Audit C.E.
- Used for RD co
- Some Cross -
- Verification of
- Other uses diff
- LPIS QA rapid

- Absolute accuracy:
EGNOS (GNSS WS 2012),
DGPS, GALILEO

3. Specific cases

Improvements on the geographic coverage of the EGNOS Open Service - 2013



http://ec.europa.eu/enterprise/newsroom/cf/itemdetail.cfm?item_id=6508&lang=en

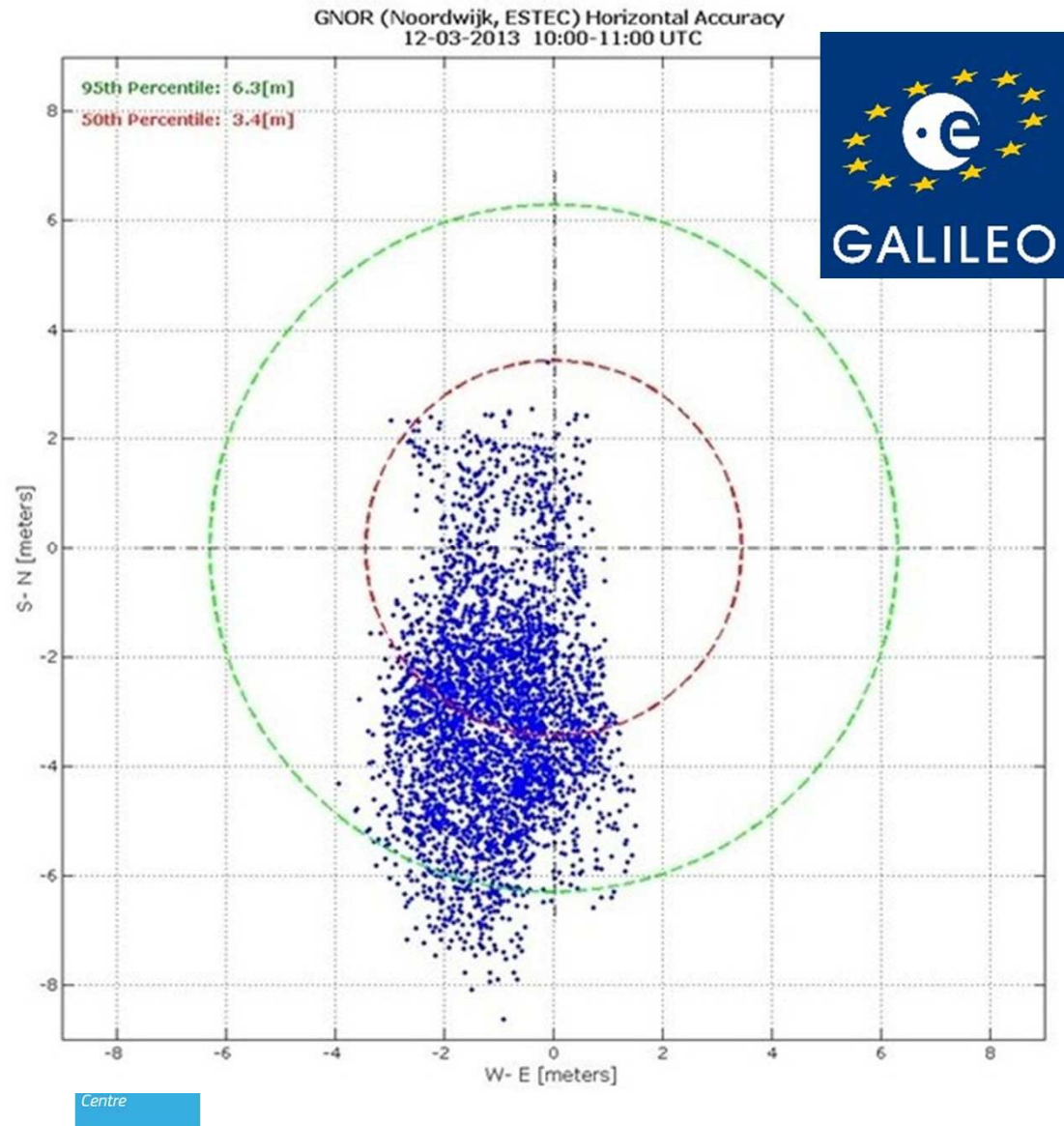
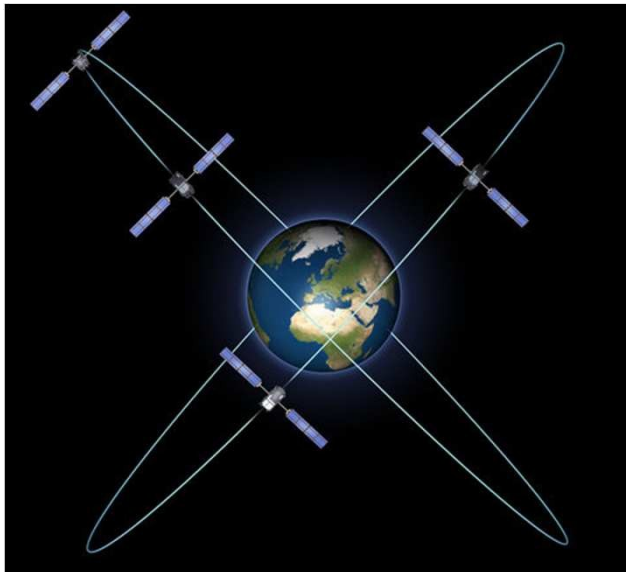
9 April 2013

3. Specific cases GALILEO first position

12/03/2013 - first Galileo-only
position fix received

12/10/2012 - Second launch of
Galileo satellites

21/10/2011 - Launch of the first
two Galileo satellites



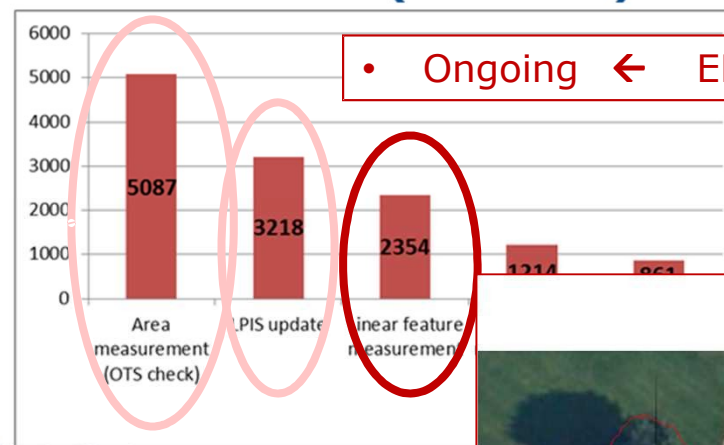
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2012 presentation ; output of the 2012 survey

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- Ongoing ← EFA

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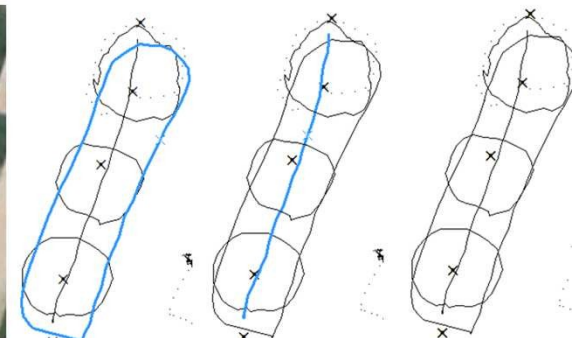
Other applications

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- EGNOS (GNSS WS 2012), DGPS

ent year in
orientati
photographs

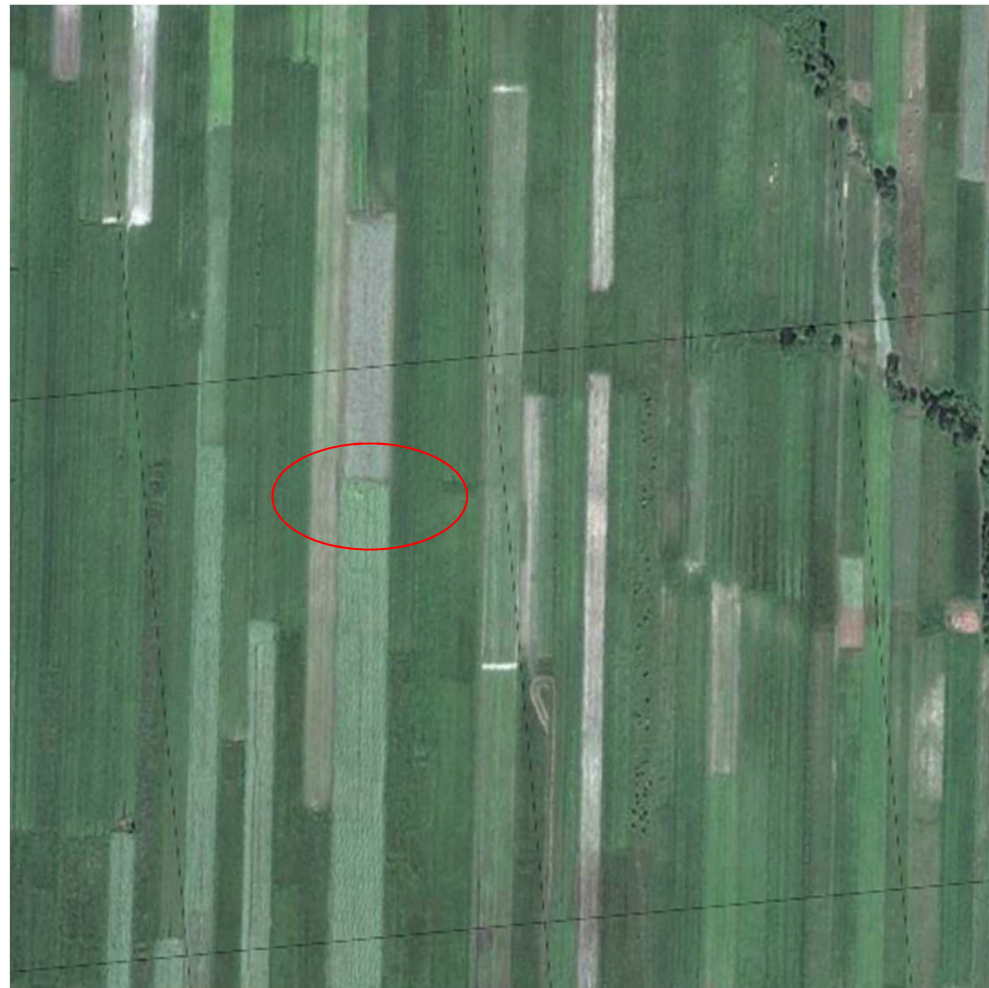
"Linear" features



3. Specific cases

Linear measurements

Linear/point
measurement ?



3. Specific cases

Linear measurements

Linear/point
measurement ?

“correct” length but
5-15 m accuracy !!
DGNSS !!



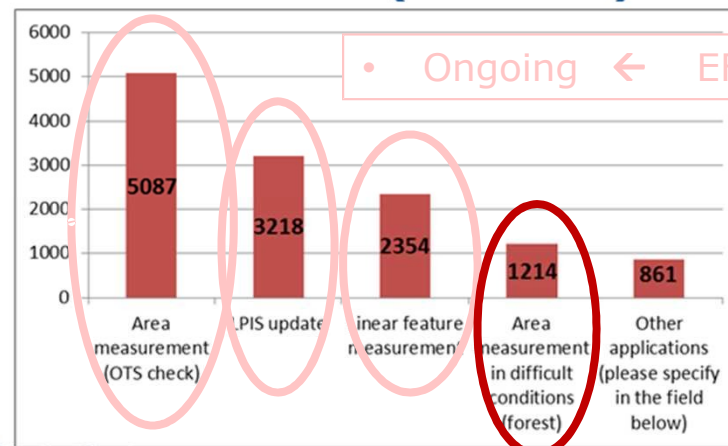
3. Specific cases

2012 presentation ; output of the 2012 survey

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- Validation for continuous AND vertex measurement method
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-



• Ongoing ← EFA

* the same receiver can be used for different applications

Other applications

- During the Audit C.E.
- Used for RD co
- Some Cross -
- Verification of
- Other uses diff
- LPIS QA rapid

• EGNOS (GNSS WS 2012), DGPS

- GNSS WS 2012
- Ongoing JRC tests
- CZ validation of GNSS device in forest for area measurement

3. Specific cases

Validation of GNSS device in forest CZ 2012

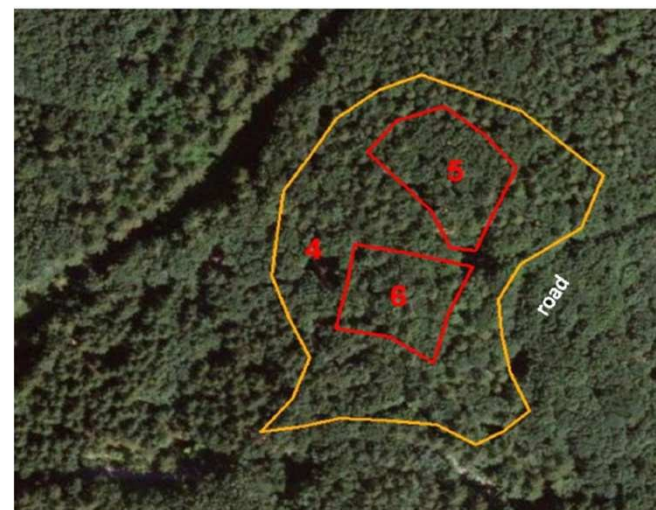
Polygon no.	Type	Area [ha]	Shape
1	Coniferous	0,28	Irregular
Polygon no.	Type	Area [ha]	Shape
2	Deciduous, coniferous	0,22	Regular, elongated

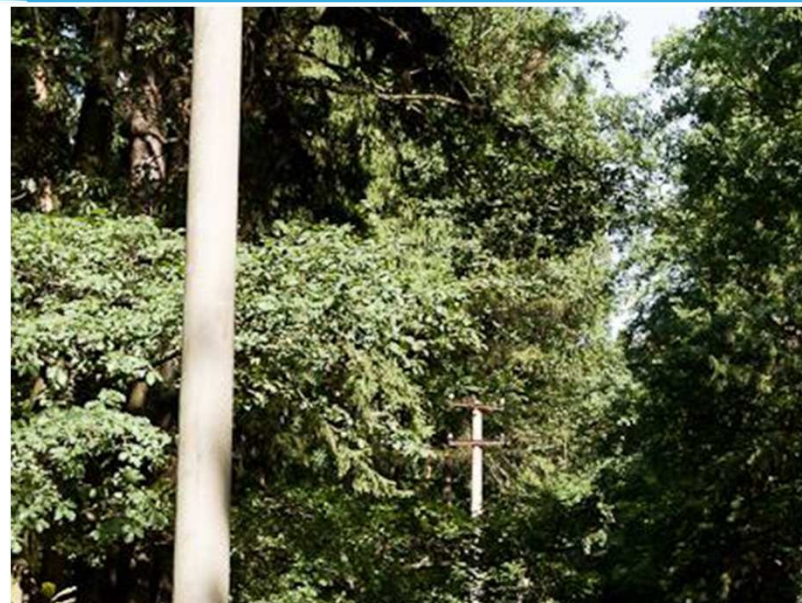
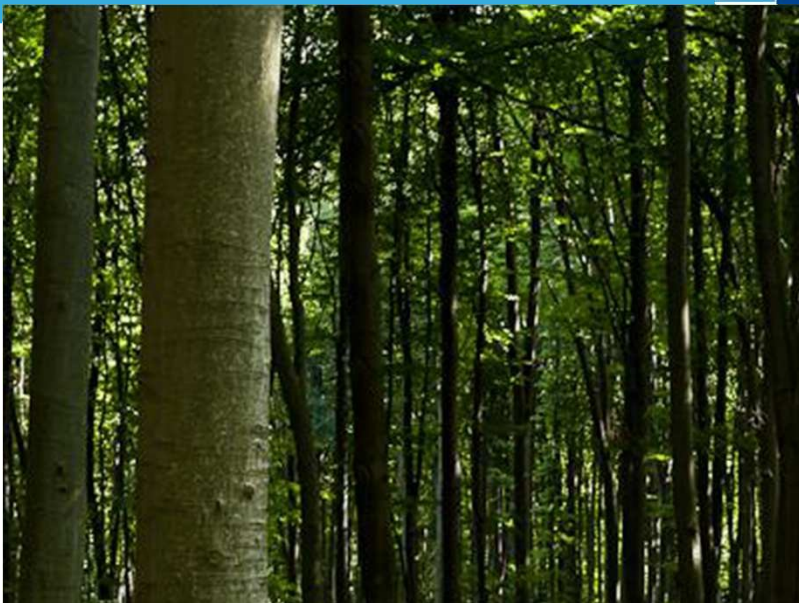


Polygon no.	Type	Area [ha]	Shape
3	Coniferous - young trees	0,24	Regular



Polygon no.	Type	Area [ha]	Shape
4	Deciduous	1,42	Irregular
Polygon no.	Type	Area [ha]	Shape
5	Deciduous	0,2	Regular
Polygon no.	Type	Area [ha]	Shape
6	Deciduous	0,17	Regular





3. Specific cases

Validation of GNSS device in forest CZ 2012

Measurement method:

Method: vertex

Number of log per vertex: 20 in 5 second interval

External antenna was attached to 2 m height pole

Differential correction: CZEPOS correction applied during post

– processing

Coordinate system: Czech national coordinates system (S-JTSK) – ESRI definition: Krovak East-North, GCS_S_JTSK.

RESULT:

1.25 m buffer tolerance to be applied to GPS single frequency code differential corrected measurements made with Trimble GeoXT model 2008 GNSS device using vertex (20 records at 5 sec interval/point) measurement method and CZEPOS data for post processing of field measurements.

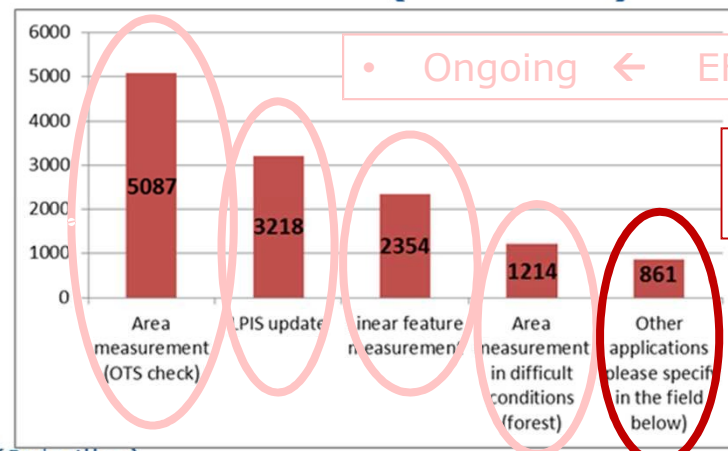
3. Specific cases

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The majority of existing receivers are used for area measurements (**n=5087***)

- Validation for continuous AND vertex measurement method
- Unique tolerance
-



• Ongoing ← EFA

- Very long fields
-

Other applications

- During the Audit C.E.
- Used for RD co
- Some Cross -
- Verification of
- Other uses diff
- LPIS QA rapid

• EGNOS (GNSS WS 2012), DGPS

- GNSS WS 2012
- Ongoing tests
- CZ validation of GNSS device in forest for area measurement

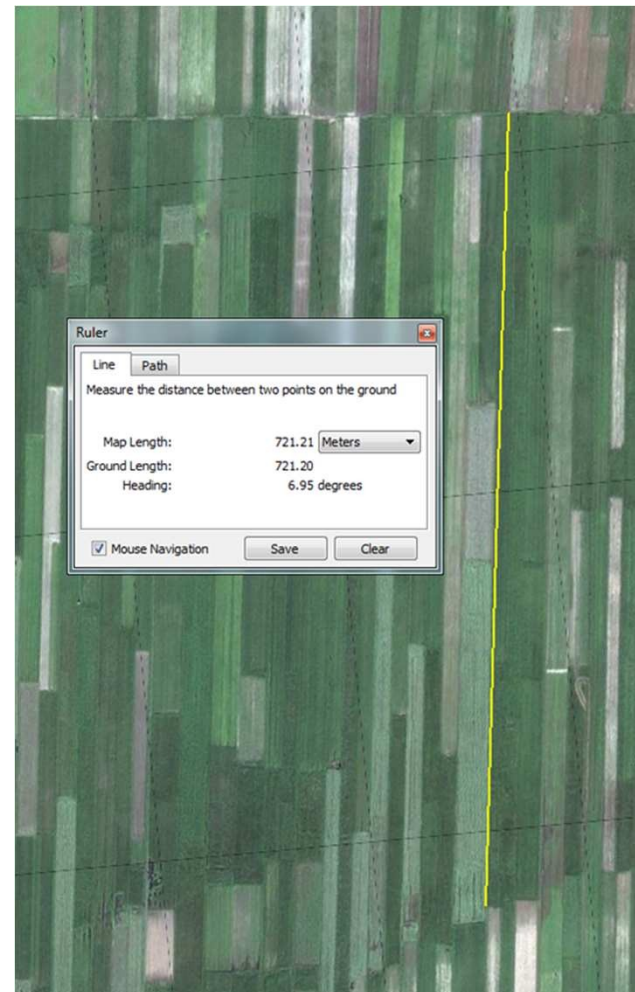
3. Specific cases

Vertex measurement method using GNSS devices for very long fields

PL (but also in RO)
Elongated shape for parcels
 $L < 1000$ m
W 10 – 20 (50) m

Vertices every 25-30 m time
consuming

? - Increase the distance
between vertices up to ??? m??

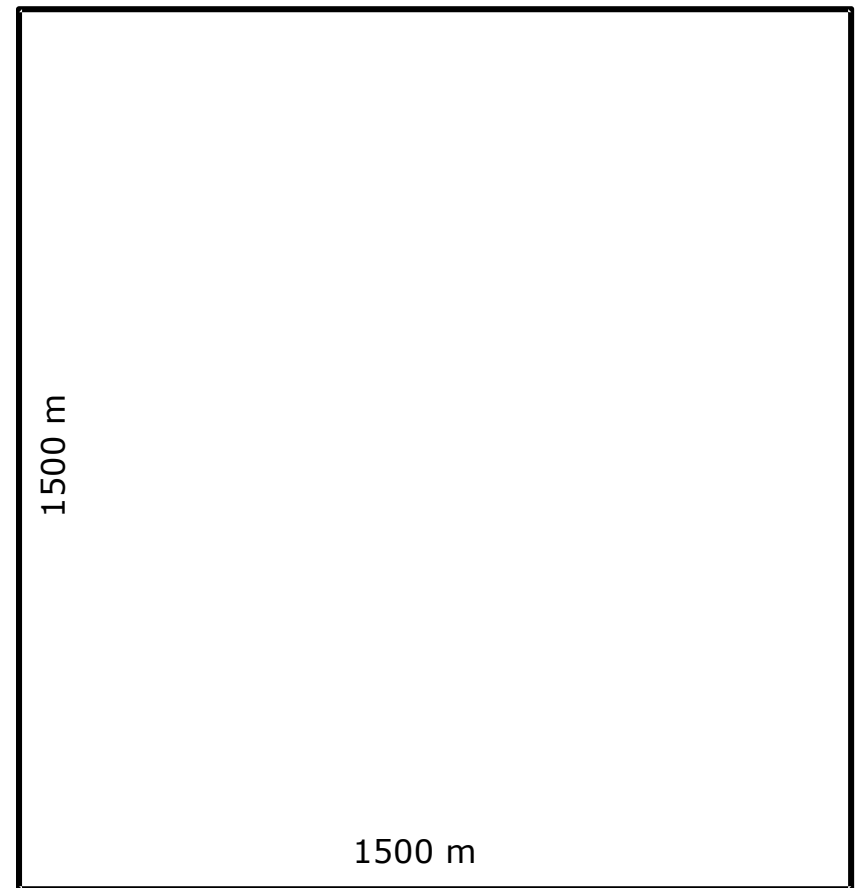
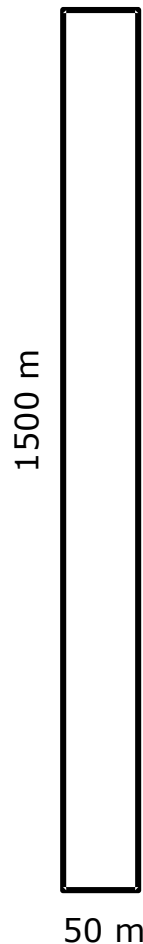


3. Specific cases

Vertex measurement method using GNSS devices for very long fields

Theoretical JRC model
(D. Fasbender)

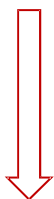
- Two regular shapes
 - Rectangle (1500/50m)
 - Square (1500/1500 m)
- Different GNSS parameters (Point Positioning Accuracy, Temporal dependency, etc ...)
- 5 recorded positions per vertex
-



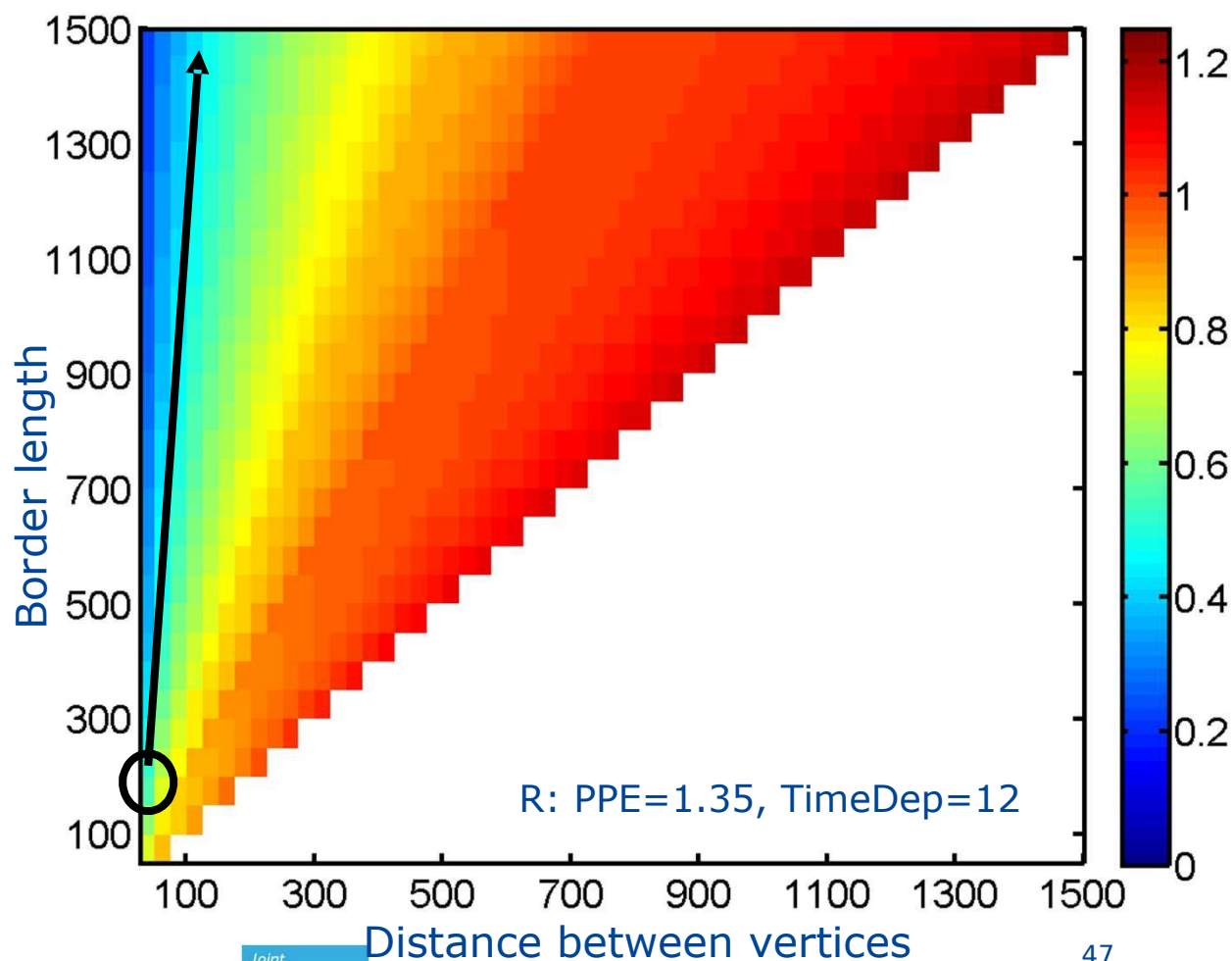
3. Specific cases

Vertex measurement method using GNSS devices for very long fields

A GNSS device validated with 0.5 m RL



Depending of the parcel length, the distance between vertices can be increased up to 150 – 200 m



Outline

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4. Conclusions and perspectives

1. Increase of quality of GNSS devices used for area measurement during the last four years (2012 – 67 % of used devices with a RL < 0.75 m)
2. The majority of ortho images (72 %) were used for area measurement in 2012 with a buffer class < 0.75 m
3. The validation of GNSS devices and ortho-imagery is ongoing process (new GNSS receivers and orthoimages, specific measurement methods, etc.)
4. The validation of ortho imagery is strongly recommended (for pixel size below 1m, the “rule of thumb” is not adapted !!!)
5. Due to the high quality of new GNSS receivers and high resolution of orthoimages, the independent errors (use of device, border interpretation) are higher
detailed and complete instructions
for trained inspectors

4. Conclusions and perspectives

1. Support for validation
2. Support for specific cases of area measurement (long fields, forest, combined measurements GNSS + orthoimages, laser, linear measurements, etc ...)
3. Unique tolerance

Thank you for your attention!