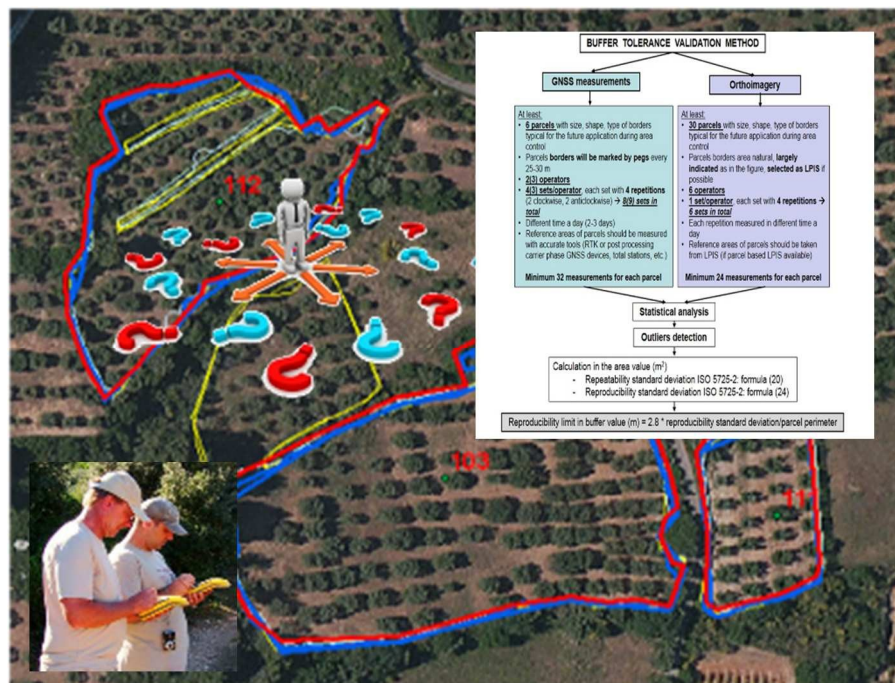


AREA MEASUREMENT AND TOOL VALIDATION PROCESS

Varese, March 5-6 2014

www.jrc.ec.europa.eu



Serving society
Stimulating innovation
Supporting legislation

Why measuring ?

CAP: 58 000 000 000 € / year
40 Billions Direct aids
14 Billions Rural development

0,3 € / EU citizen / day

Average 250 € direct aids / ha



Check the conditions under which aid is granted on a sample of applications.

Elements to be checked:

The declared area of the agricultural parcel;

The area which is eligible for payment;

The compliance with the minimum area of the agricultural parcel where necessary.

Area to measure ?

The total area of the agricultural parcel, in accordance with Art.34(2) and 34(3) of R.1122/2009, should be measured. Areas not taken up by agricultural activities such as buildings, woods, ponds and paths are to be excluded from this area (Art.34 of R.73/2009).



Art. 34 (2)(3)

House, rocks 

Trees (density)  

Trees, ponds, hedges  

Target is a relative
notion not absolute



Measurement framework

Areas expressed in ha with 2 decimals

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”.

.... with a homogenous standard guaranteeing accuracy at least equivalent to cartography at a scale of 1:10 000 (IACS management system)

Requirement of a spatial accuracy:

Maps shall have a horizontal standard deviation of approximately 0.25mm in the representation scale

For 1:10 000 scale a horizontal accuracy of 2.5m ($10\,000 \times 0.25\text{mm} = 2.5\text{m}$) is required

tools proven to assure measurement of quality at least equivalent to that requirement



General concept of error

The statistical meaning of « errors » is « the discrepancy between an observed value of a feature and its unknown true value »

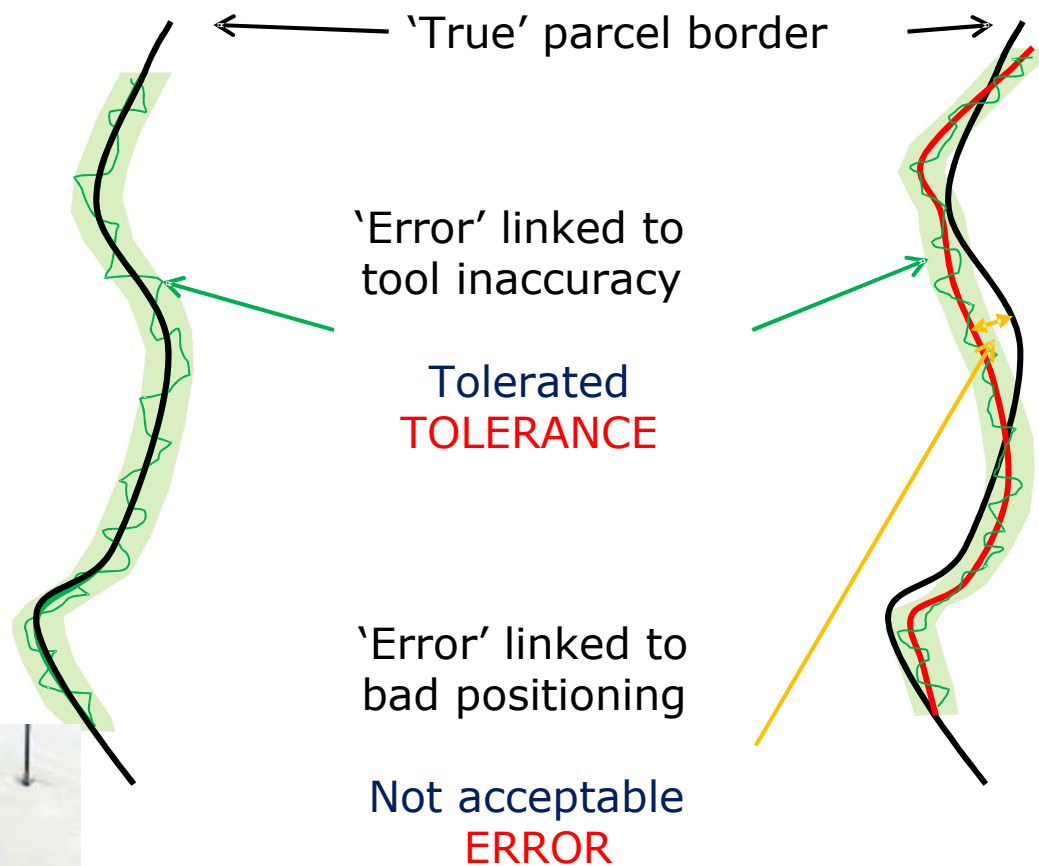
It can be caused by many different sources:

- Inherent tool error
- Inappropriate tool
- Inappropriate tool use
- Interpretation of the definition of the feature
 - From the farmer
 - From the controller
- ...

Accurate tool

Training
Guidance

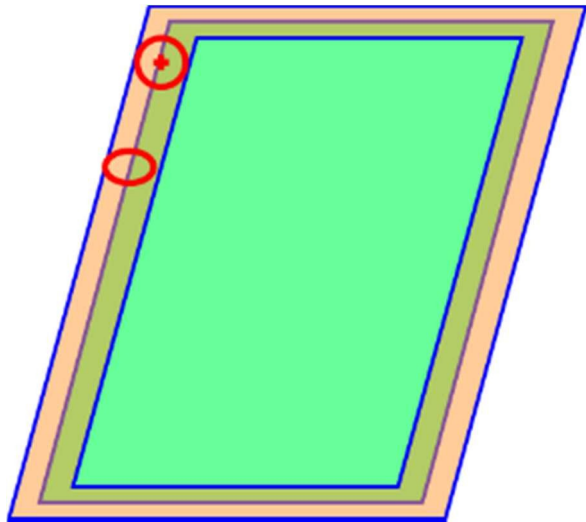
'Errors' are not equal



Accuracy - technical tolerance

Measurement devices provided with **point accuracy**
But **nothing for area measurement accuracy**

Need to **define a validation method**



Measurements made on points on parcel perimeter, with **uncertainty on each point**

the longer the perimeter, the higher the error on area for a given tool

Dividing the error on area (m²) by the perimeter (m) gives the “error on perimeter” = **mean margin of error (m)** around the parcel perimeter.

This “error on perimeter” is expected not to depend on the parcel (area or perimeter) but on the tool



Buffer tolerance determination method

Initiated in 2007

VALIDATION based on ISO 5752

$\text{Tolerance} = 2,8 * \text{reproducibility} = 1,96 * \sqrt{2} * \text{reproducibility}$

Different controllers making measurements using the same equipment and the same method



Legally today:

The quality of a given tool is defined by the tolerance (i.e. buffer width) applicable to this tool as determined through an area measurement validation test .

Only tools (e.g. GNSS equipment, remote sensing ortho-images - cf. Art.20 of R.73/2009) with a buffer width not exceeding 1.5m should be used (Art.34(1) of R.1122/2009).

Validation of tools

Aim:

Determine the **Inherent tool error** (accuracy)

Limit as much as possible **other errors**

Use a set of parcels representative of parcels to measure

Nota bene: **Not in real** On-The-Spot checks **conditions**



Validation test is different than proficiency test

Validation method tests and components



BUFFER TOLERANCE VALIDATION METHOD

GNSS measurements

At least:

- **6 parcels** with size, shape, type of borders typical for the future application during area control
- Parcels borders will be marked by pegs every 25-30 m
- **2(3) operators**
- **4(3) sets/operator**, each set with 4 repetitions (2 clockwise, 2 anticlockwise) → **8(9) sets in total**
- Different time a day (2-3 days)
- Reference areas of parcels should be measured with accurate tools (RTK or post processing carrier phase GNSS devices, total stations, etc.)

Minimum 32 measurements for each parcel

Orthoimagery

At least:

- **30 parcels** with size, shape, type of borders typical for the future application during area control
- Parcels borders area natural, **largely indicated** as in the figure, **selected as LPIS** if possible
- **6 operators**
- **1 set/operator**, each set with 4 repetitions → **6 sets in total**
- Each repetition measured in different time a day
- Reference areas of parcels should be taken from LPIS (if parcel based LPIS available)

Minimum 24 measurements for each parcel

Statistical analysis

Outliers detection

Calculation in the area value (m²)

- Repeatability standard deviation ISO 5725-2: formula (20)
- Reproducibility standard deviation ISO 5725-2: formula (24)

Reproducibility limit in buffer value (m) = 2.8 * reproducibility standard deviation/parcel perimeter

Validation method components

Borders

Parcels should have unambiguous borders to ensure that all measurements will be of the same object

If GNSS (borders marked with sticks, 1 peg / 25m)

If ortho image (shape around the parcel)

Number of parcels

More parcels, more reliable assessment (but more workload)

If GNSS at least 6 parcels

If ortho image at least 30 parcels

Need to compare measurements with a reference area ('true area') and perimeter

The reference area can (should) be taken from the **LPIS**

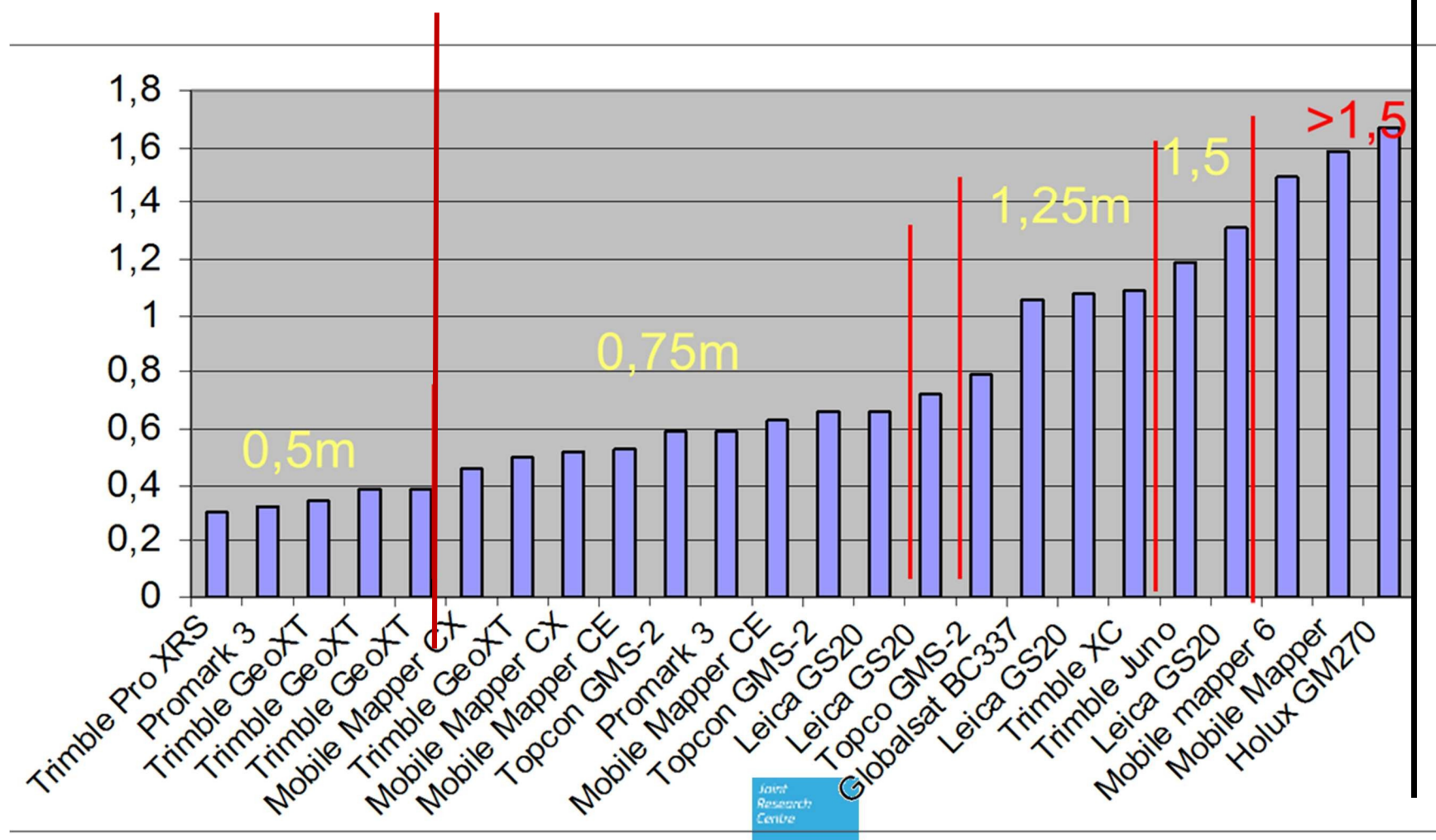
If no corresponding LPIS parcel, the reference area should be established with a surveying tools or **GPS RTK measurements**



Validated tools by class

1:10 000 scale
Legal limit (1.5 m)

Real practical limit (50 cm)





Why validating tools ?

To prove that the instrument is compliant with requested accuracy

If not validated, MS have to provide other evidence

Currently, the class of measurement accuracy (e.g. "better than 1.0m") determined for this type of GNSS should be used.

Each MS is strongly encouraged to perform its own validation test

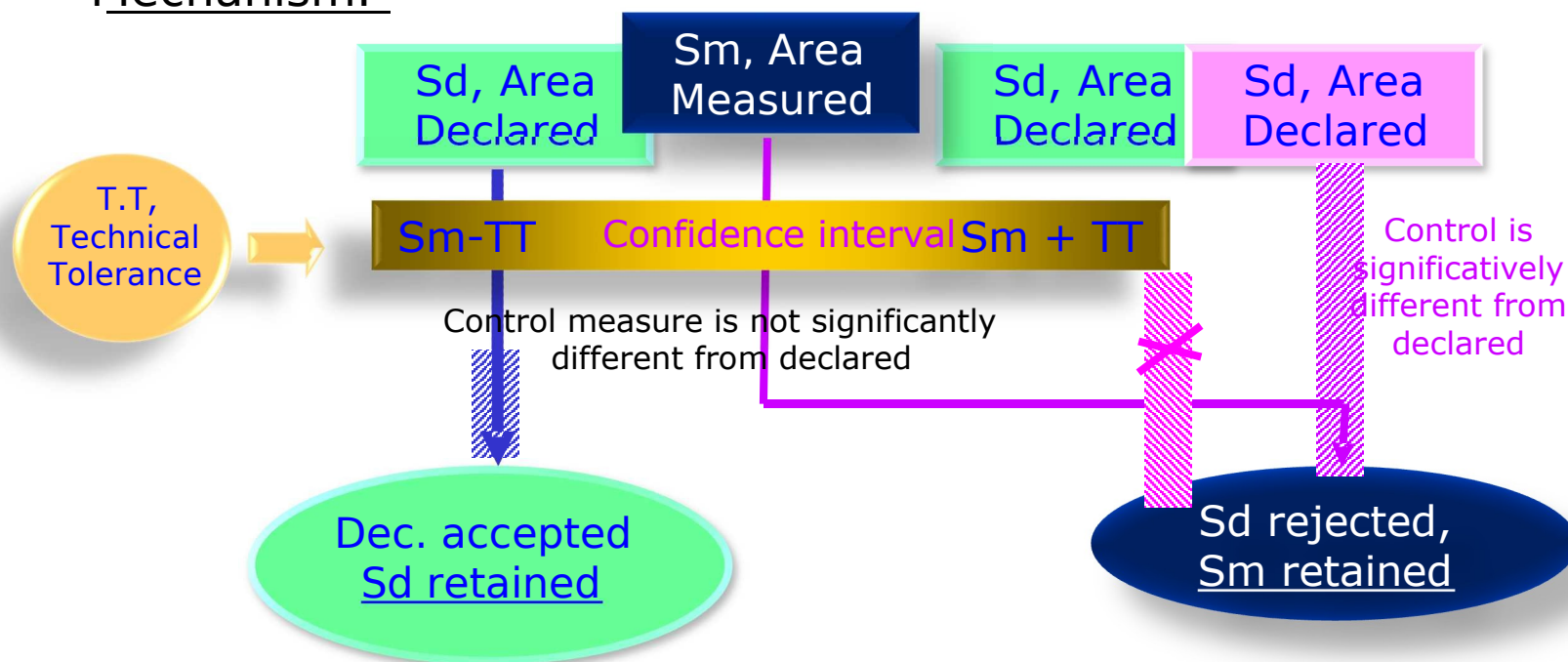
Specificity of the GNSS receivers (local differential corrections or EGNOS, different version of the hardware/software, etc ..) and of the parcels to be measured (size, shape, type, etc ..)

If not validated, it is recommended to use a 0.5 m buffer tolerance default value

To be on the safe side on tolerance

Use of Technical tolerance

- Applied to area measured
- Mechanism:



Reminder

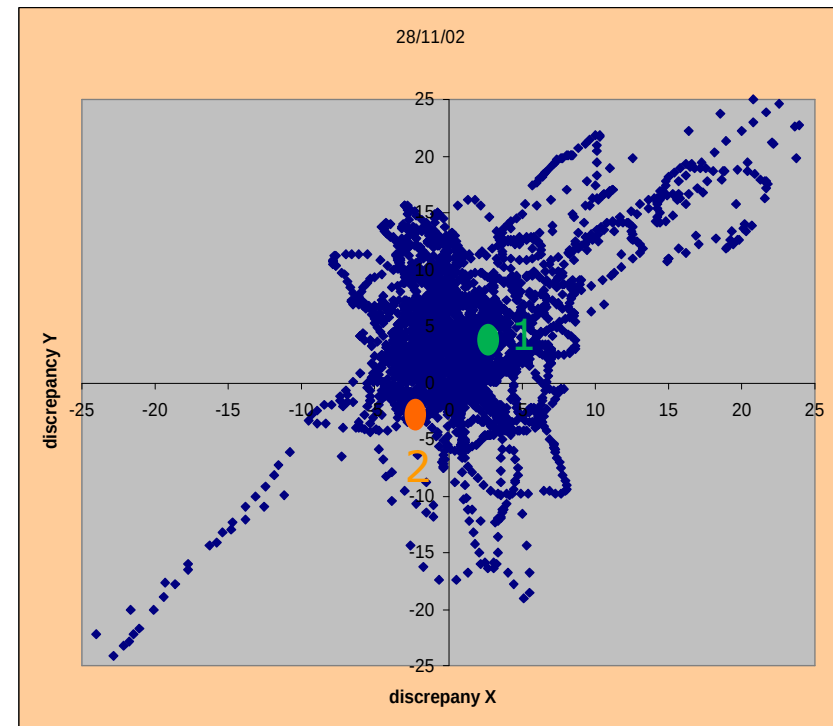
Using stand-alone without any correction
Typically the rmse would be 10 m
(statement manufacturers- safe estimate)

measurements

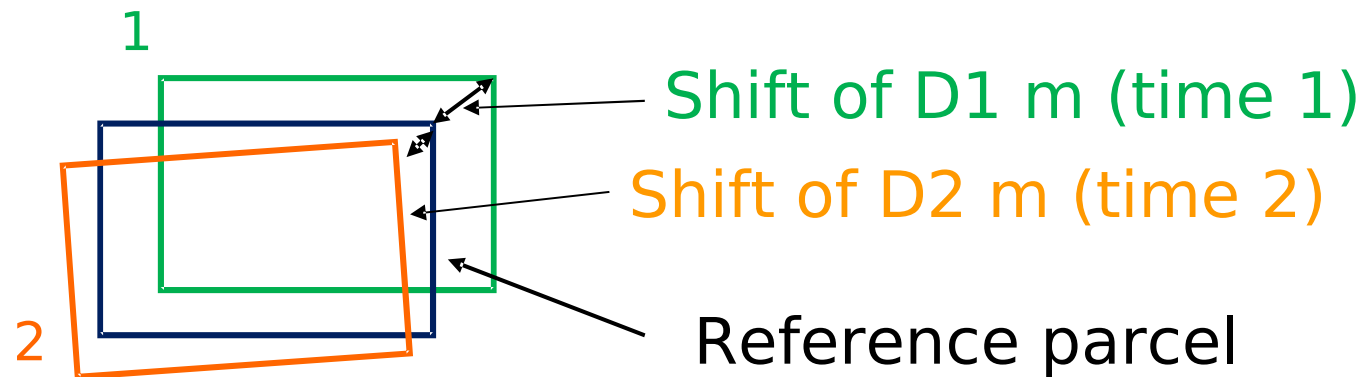
RMSX = 6.12 m

RMSY = 8.04 m

Peaks: 30m (1D)



Reminder



Area measurement 1 = Area measurement 2

But measurement D1 shifted north east
measurement D2 shifted south west

‘ GNSS stand alone ’ not accurate enough in positioning
for LPIS update

Only a warning maybe triggering LPIS up date

When to measure ?

Where the LPIS , together or not with ancillary data such as ortho-photos, permits the confirmation the whole "correctness" of the declared agricultural area (boundaries, ineligible areas)

NO measurement and the declared area must be confirmed



In all other circumstances a measurement of the parcel area is required

How to measure ?



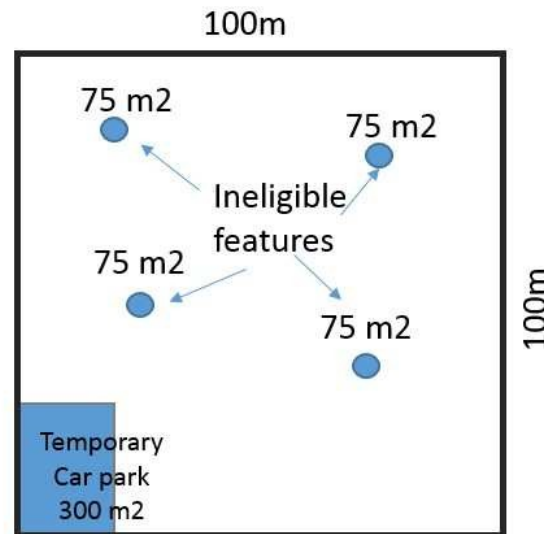
Measuring the whole parcel

Measurement by deduction

Where the LPIS , together or not with ancillary data such as ortho-photos, permits the confirmation the "correctness" of the boundaries of the declared agricultural area

measurement on the determination of ineligible areas and deductions .

What if deduction ?



Car park temporarily ineligible + 4 ineligible features $< 100 \text{ m}^2$.

1. Area declared = 1.0 ha, tolerance = $400\text{m} \times 0.75\text{m} = 0.03 \text{ ha}$;
2. One temporary ineligible feature of 300m^2 . This area alone does not exceed the tolerance;
3. Four scattered features of 75m^2 each, give a total ineligible area of 300m^2 which does not exceed the tolerance;
4. However, the combined area of the ineligible features in points 2) and 3) must be considered: $0.03 + 0.03 = 0.06 \text{ ha}$, which is above the tolerance. The determined area is therefore $1.0 - 0.06 = 0.94 \text{ ha}$.

INELIGIBLE FEATURES

Elements that cannot be declared for CAP subsidies
depends on agriculture activity, GAEC, greening, RD ...

Elements with area > 0.1 ha must be mapped in LPIS

Elements with 1000 m^2 (0.1 ha) $< \text{area} < 100 \text{ m}^2$ must be counted
but not mapped
but excluded if on parcel border



The total area of the ineligible features is the ineligible area

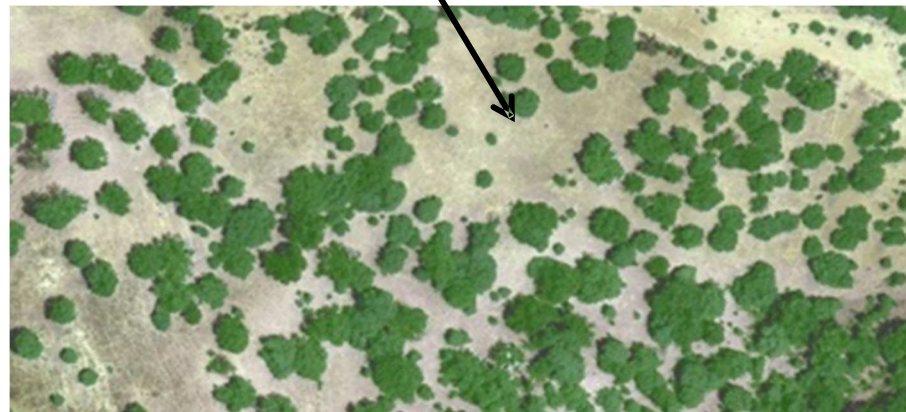
do not forget to report alert message for possible LPIS up date

Specific cases

Pasture, grassland

If ineligible features are uncertain **Pro rata system**

- area classes linked to eligibility value
- 0 - 10% ineligible cover 100 % eligible area
- 10 - 30 % ineligible cover 90% eligible area
- 30 - 50% ineligible cover 70 % eligible area
- > 50% 0% eligible



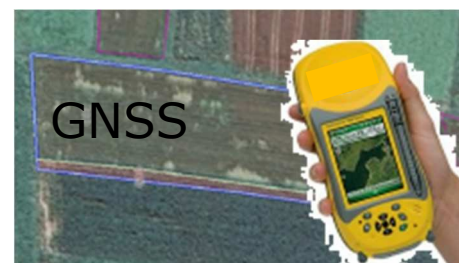
Material to be used

Tools proven to assure measurement of quality at least equivalent to that requirement

Validated tool

but also appropriate tool and appropriate use !!!!!

Office



Field

Ortho image
+ GNSS

Office + field



Joint
Research
Centre

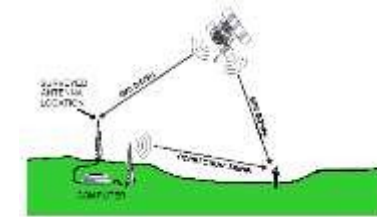


Field

Material to be used

dGPS

Accurate measurements (appropriate for LPIS, small parcels vineyards ...)



Laser range-finder

A solution for measurements in forest, woody areas

Measurement of length



Wheel, topefil, tape (back up tool)

Mainly for **length measurements (2% tolerance)**



Use appropriate tool



Huge parcels, perimeter > 3 km



No GNSS if too many obstacles
(trees, mountains)

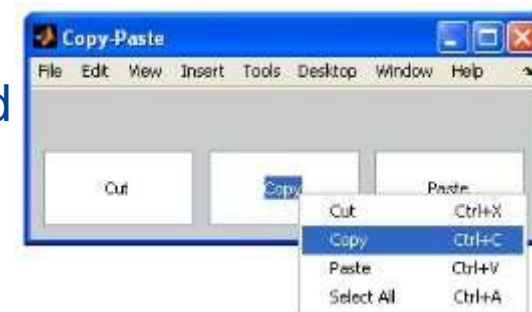
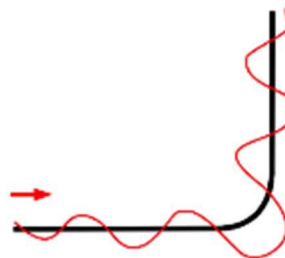


Use tool appropriately

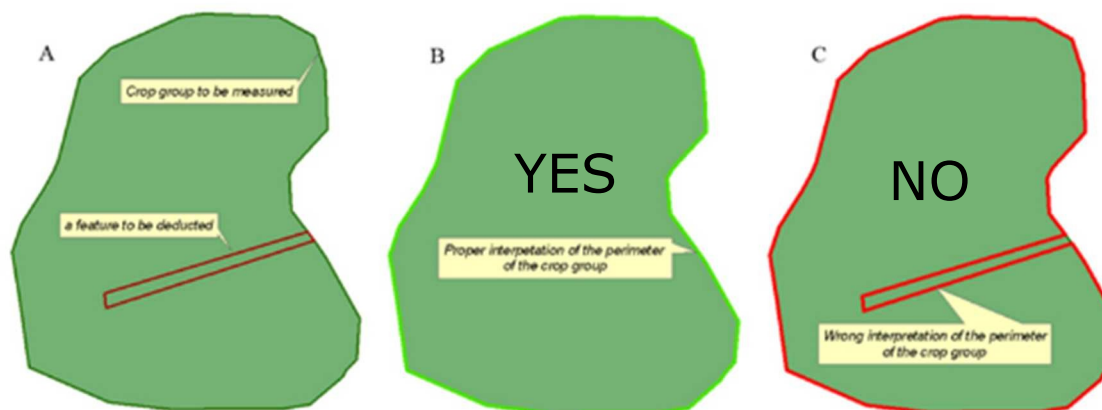
Same conditions, settings as validated

“Stay on the line”

But define your line ...



Not adding perimeter (not adding tolerance...)



Define clearly the limits ...



... as function of your conditions

GAEC, greening ...

You Choose

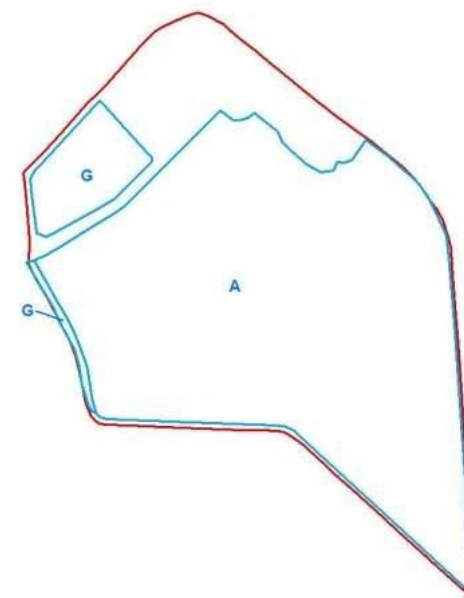
LPIS QA Executable Test Suite ETS



Original reference parcel



A - Agricultural land
G - Grassland



Area Observed = 94513 sq.m
Area Recorded = 120198sq.m.
 $\text{Area Observed} / \text{Area Recorded} = 0.79$
21% of ineligible land found

Reference Parcel is non-conformant,
as it contains more than 3% ineligible
land

LPIS Features catalogue



Permanent crop, LCCS code: 10566-1891-S0610
"Permanent crops (vineyards)"



Single Trees, LCCS code:
20274-T1(1)[Z11] "Single tree"



Trees in line, LCCS code:
20282-T2(3)[Z4] "Row of trees"



Hedges, LCCS code:
10176(3)[Z1] //
1021110285 "Hedgerows"

CONCLUSIONS

Choose and use the appropriate tool

Use the tool appropriately

Define your limits

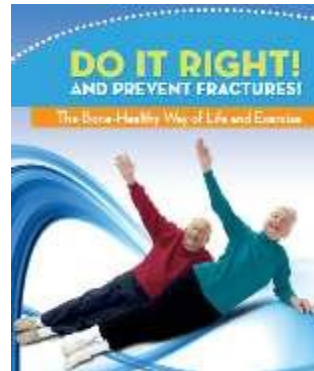
Share your limits

Good tool well used will prevent complaints and measurement repetitions

And a good reference (LPIS) will prevent from measuring



It takes less time
to do things right
than to explain why
you did it wrong.



Why Who
Disagree Constraint
Clarification Advantage
Opinion
Question
Agree



Thank you