GEO4D

Digital mapping using LiDAR data

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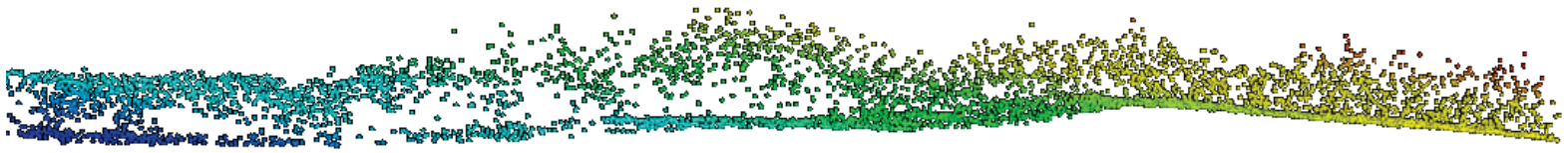
10th- 21st September 2018
Ponferrada, León



P4 Model validation

STEPS

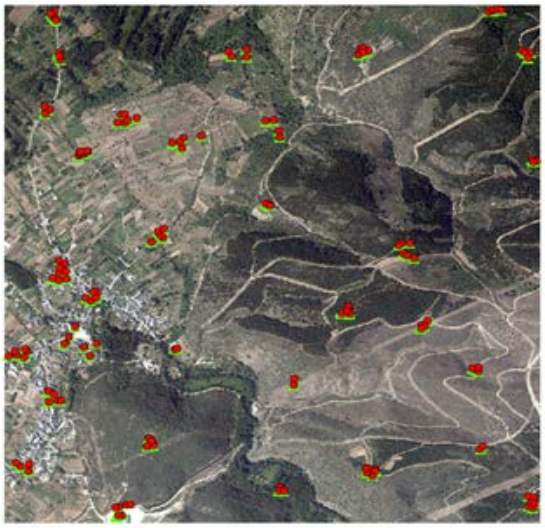
FROM THE METHOD POINT OF VIEW (FILTERING)

FROM THE MODEL POINT OF VIEW

SUMMARY OF PRACTICAL #4 (I)

FROM THE METHOD POINT OF VIEW (FILTERING)

RANDOM SAMPLES IN THE STUDY AREA ? GROUND POINTS (BareEarth.las)



0% **OMISSION ERROR**:
ALL THE GROUND SAMPLES ARE IN THE BareEarth.las FILE

0% **COMMISSION ERROR**:
NONE OF THE OBJECT SAMPLES ARE IN THE BareEarth.las FILE

FILES WITH THE SAMPLES (points):

GROUND SAMPLES: C:\...\ GEO4D\Data\CP\Method\Method_gp.txt
OBJECT SAMPLES: C:\...\ GEO4D\Data\CP\Method\Method_ngp.txt

FILE TO VALIDATE (checking area) (created by using *polyclipdata.exe* in order to reduce the processing time)**:**

BARE EARTH: C:\...\GEO4D\Results\ 06_CheckingArea\BE_subset.txt

COMPARISON

LET'S COMPARE

BE_subset.txt

METHOD_gp.txt

METHOD_ngp.txt

Type I Error (OMISSION ERROR)

Type II ERROR (COMMISSION ERROR)

$$Type\ I = \frac{a}{a+b}$$

$$Type\ II = \frac{c}{c+d}$$

a – # ground points well classified (filtered) as ground points (they are in the BE_subset.txt)

b – # ground points filtered out as objects (they are not in BE_subset.txt)

c – # object points misclassified as ground (they are in the BE_subset.txt)

d – # object points well classified (they are not in the BE_subset.txt)

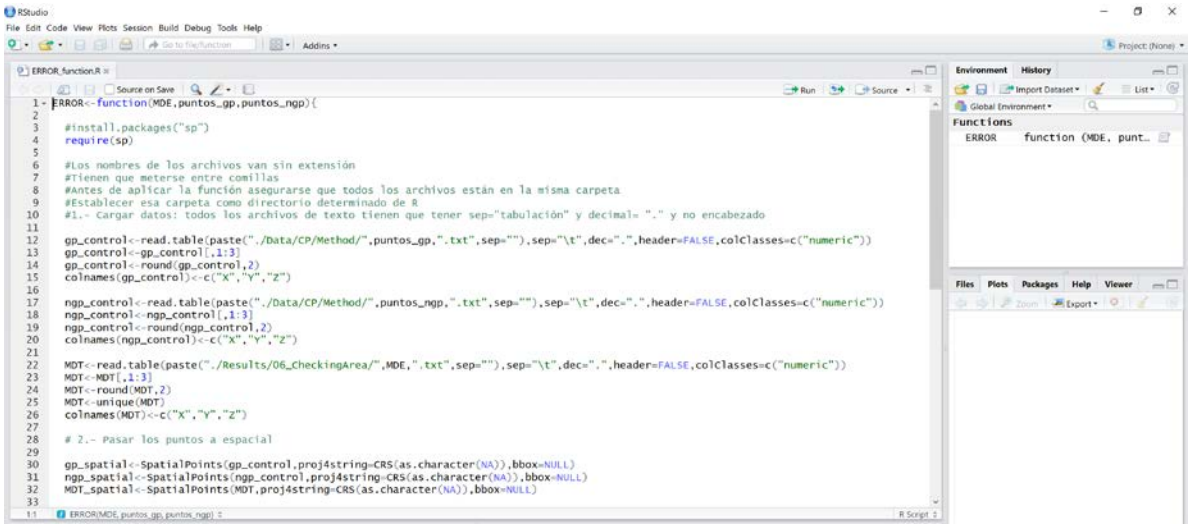
IMPORTANT:

1. The three *.txt files that we are going to use have to: use the TAB as separator, use the point (.) to separate the decimals, NOT have a header for the fields. Tip: use Notepad++ to check it.

STEPS TO FOLLOW:

1. Open C:\...\GEO4D\Tools
2. Double click in “method_validation_V5.R”
3. Set the working directory: "C:/…/GEO4D/"
4. Select all the lines in the script and run them

5. The script “method_validation_V5.R” has called the ERROR function. You can check the function in C:\...\GEO4D\Tools\



6. You will get the results of the validation on the console and in a file (Resultados.txt): GEO4D\Results\06_Validation\01_Method\results.txt

WHAT IS THE MAGNITUDE OF THE ERRORS?

OMISSION

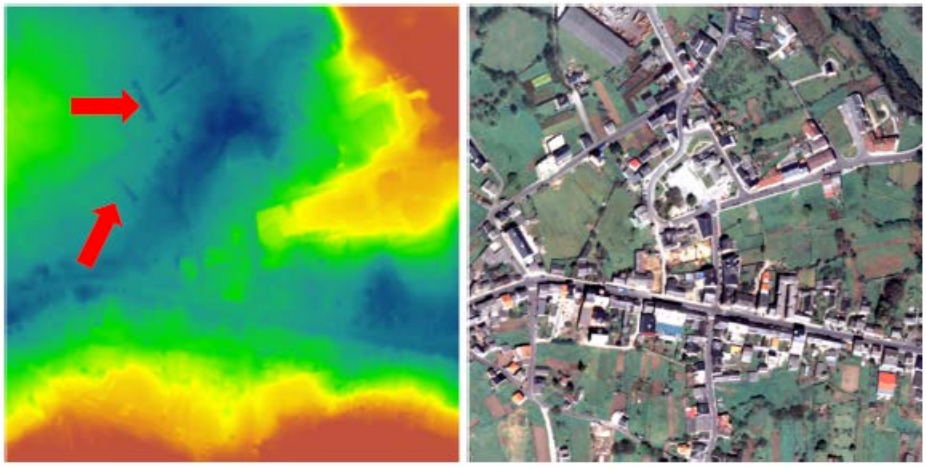
COMMISSION

IS THE FILTERING ALGORITHM WORKING PROPERLY?

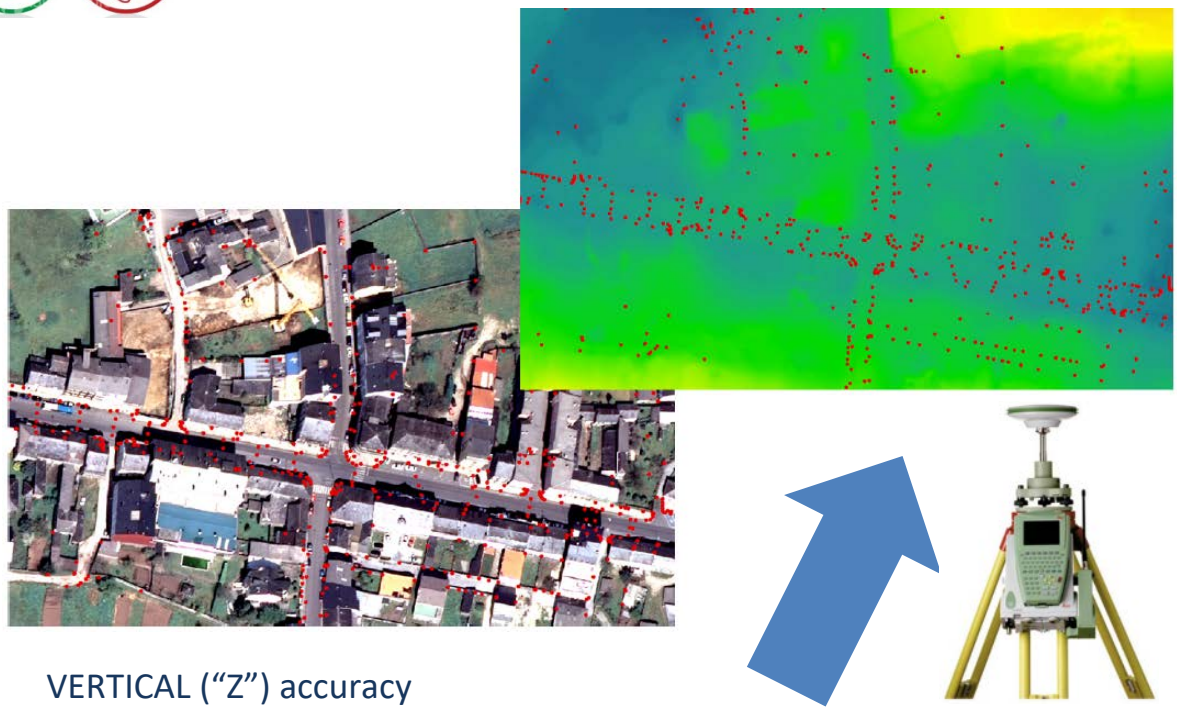
FROM THE MODEL POINT OF VIEW

HOW GOOD (ACCURATE) IS OUR DEM?

OPTION 1: VISUAL INSPECTION



OPTION 2: EXTERNAL SAMPLE



VERTICAL (“Z”) accuracy
X,Y,Z data measured with TOTAL STATION, GPS
Precision of the sample: at least 3 times > LiDAR data precision
NEVER use LiDAR data to validate

FROM THE MODEL POINT OF VIEW

HOW GOOD (ACCURATE) IS OUR DEM?

ROBUST ESTIMATORS
(the errors do not have to follow a normal distribution)

Accuracy measure	Error type	Notational expression
Median (50% quantile)	Δh	$\hat{Q}_{\Delta h}(0.5) = m_{\Delta h}$
Normalized median absolute deviation	Δh	$\mathrm{NMAD} = 1.4826 \cdot \mathrm{median}_j\,(\lvert \Delta h_j - m_{\Delta h} \rvert)$
68.3% quantile	$\lvert \Delta h \rvert$	$\hat{Q}_{\lvert \Delta h \rvert}(0.683)$
95% quantile	$\lvert \Delta h \rvert$	$\hat{Q}_{\lvert \Delta h \rvert}(0.95)$

Höle, J. & Höle, M. (2009). Accuracy assessment of digital elevation models by means of robust statistical methods. *ISPRS Journal of Photogrammetry and Remote Sensing*, 64, pp. 394-406.

OTHER INTERNATIONAL STANDARDS
(not robust):

Root mean square error	$\hat{\mathrm{RMSE}} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} \Delta h_i^2}$
Mean error	$\hat{\mu} = \frac{1}{n}\sum_{i=1}^{n} \Delta h_i$
Standard deviation	$\hat{\sigma} = \sqrt{\frac{1}{(n-1)}\sum_{i=1}^{n} (\Delta h_i - \hat{\mu})^2}$

$\mathrm{Precision}_z = 1.96 \cdot \mathrm{RMSE}_z$

HOW DOES **LAND COVER** AFFECT THE QUALITY OF THE DEM?

HOW DOES **SLOPE** AFFECT THE QUALITY OF THE DEM?

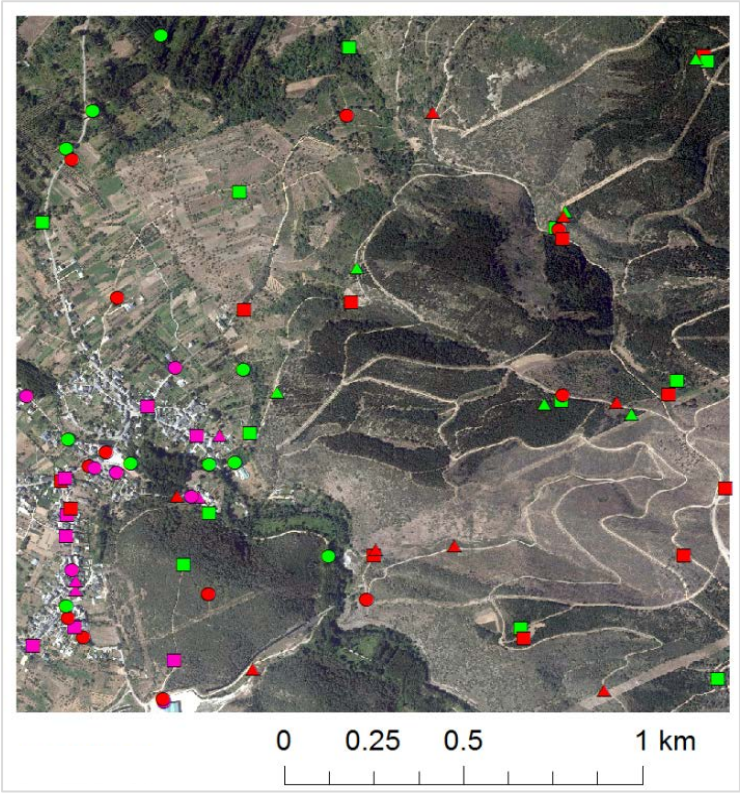
HOW DOES THE **INTERPOLATION ALGORITHM** AFFECT THE QUALITY OF THE DEM?

HOW DOES THE **FILTERING METHOD** AFFECT THE QUALITY OF THE DEM?

HOW DOES THE **OUTLIER REMOVAL** AFFECT THE QUALITY OF THE DEM?

FROM THE MODEL POINT OF VIEW

SAMPLES



SLOPE: HIGH/MEDIUM/LOW

FILES WITH THE SAMPLES (points):

D:\...\GEO4D\Data\CP\Model

ONE FILE WITH ALL THE SAMPLES: CP_MODEL.txt

3 FILES WITH THE POINTS CLASSIFIED BY SLOPE

FILES TO VALIDATE (DEM) (*.TIF) .asc .tif

MDE from GroundFilter: C:\...\GEO4D\Results\06_CheckingArea\DEM_GS.tif

MDE from TinSurface: C:\...\GEO4D\Results\06_CheckingArea\DEM_TS.tif

MDE from IDW (GIS): C:\...\GEO4D\Results\06_CheckingArea\DEM_IDW.tif

R SCRIPT TO USE: C:\...\GEO4D\Tools\model_validation_V5

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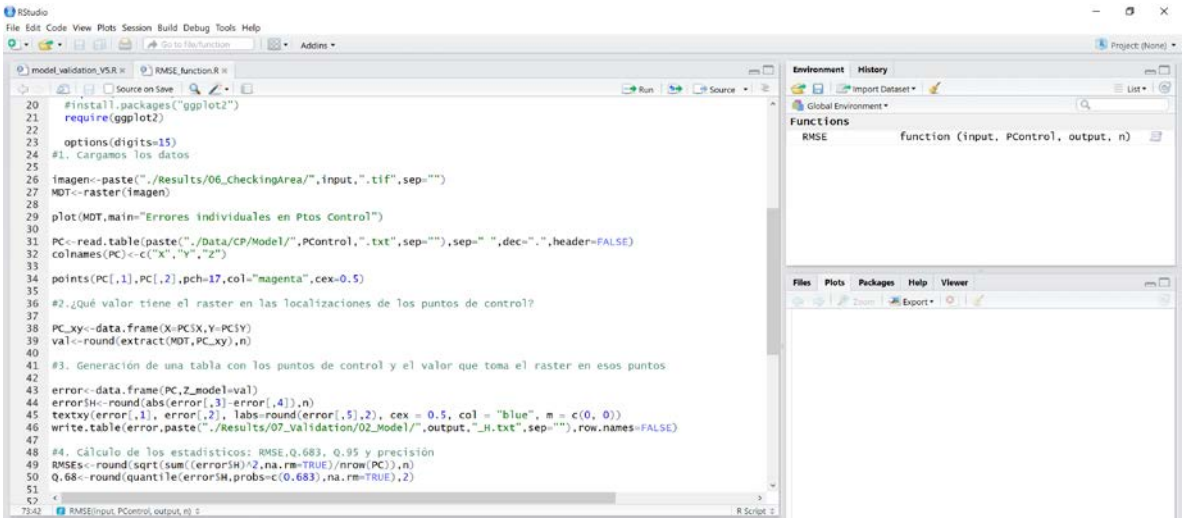
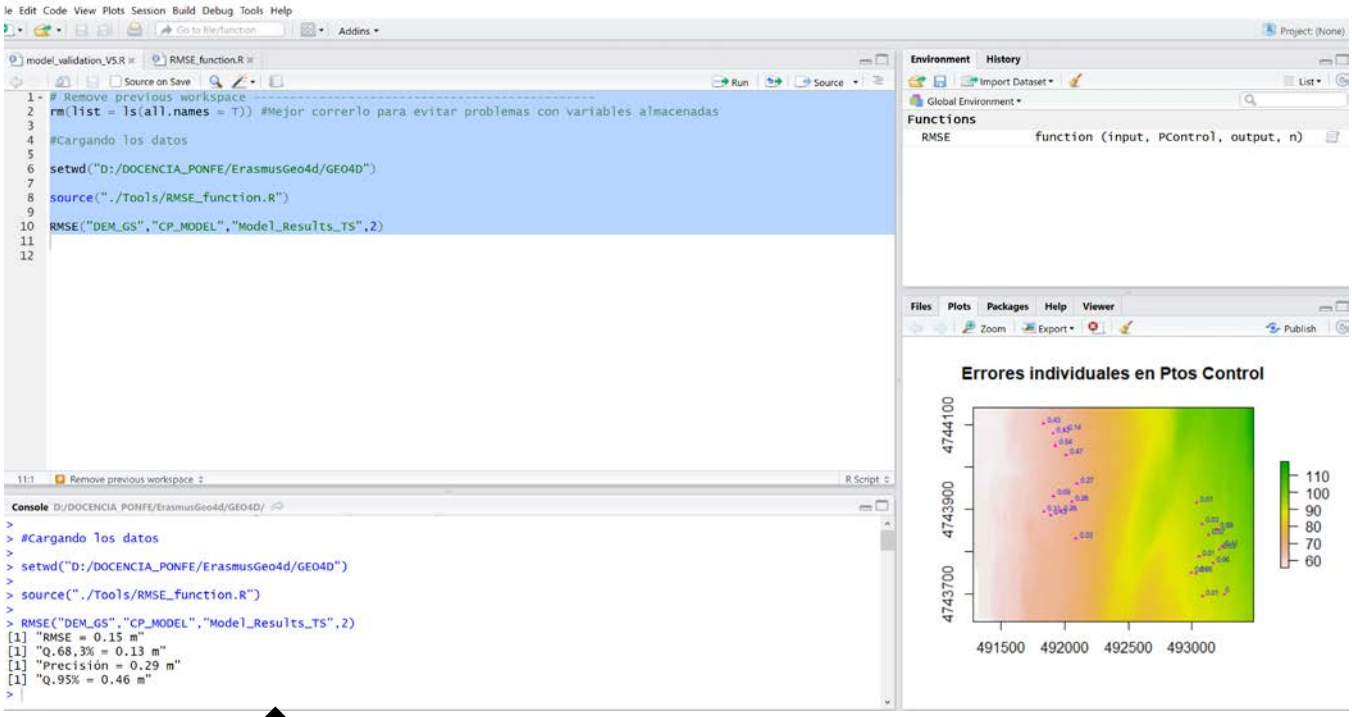


6. You will get the results of the validation on the console and in the following directory: GEO4D\Results\06_Validation\02_Model*.txt



HOW DOES THE INTERPOLATION ALGORITHM AFFECT THE QUALITY OF THE DEM?

	GridSurfaceCreate	TIN	IDW
Precision			
Q95%			

AND THE SLOPE?

	GridSurfaceCreate			TIN			IDW		
	H	M	L	H	M	L	H	M	L
Precision				??	??	??	??	??	??
Q95%				??	??	??	??	??	??

TO KNOW MORE…

Barreiro-Fernández, L., Sandra Buján, David Miranda, Ulises Diéguez-Aranda , Eduardo González-Ferreiro (2016). Accuracy assessment of LiDAR-derived digital elevation models in a rural landscape with complex terrain. *J. Appl. Remote Sens.* 10(1), 016014 (Feb 18, 2016). doi:10.1117/1.JRS.10.016014