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UAV Photogrammetry to monitor dykes

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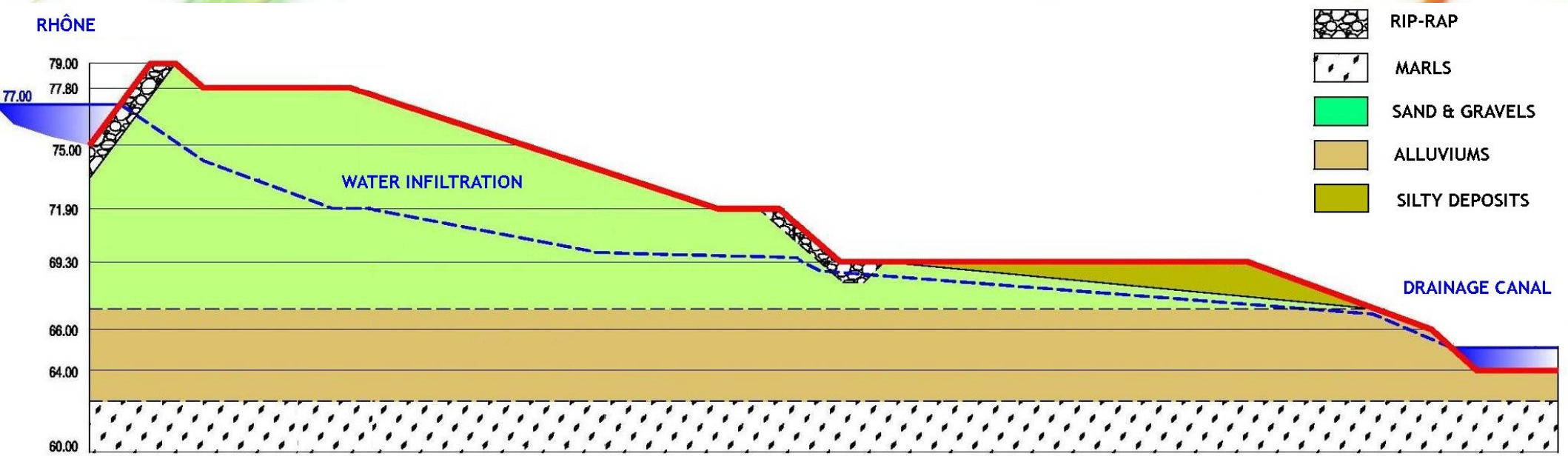
What is a dyke ?

Why monitoring dykes is important ?



Why monitoring dykes is important ?

- 8 000 kilometers of dykes in France
- Building 1 kilometer costs over 1 million €
- 75 000 people in Toulouse, 55 000 people in Orléans,... are protected dykes
- French regulation makes monitoring necessary

What are the industrial's needs ?

- ***Regular monitoring :***
  - Frequency : once a year on sensitive sites
  - Dimensions : up to 1000m long on 100m wide
  - Accuracy needed : 2,5cm
  - Accuracy wished : 1cm
- ***Exceptionnal monitoring :***
  - Frequency : crisis situation
  - Dimensions : up to a few kilometers long
  - Accuracy needed : 5cm
  - Accuracy wished : 3cm
- ***Objective :*** Faster, cheaper, more

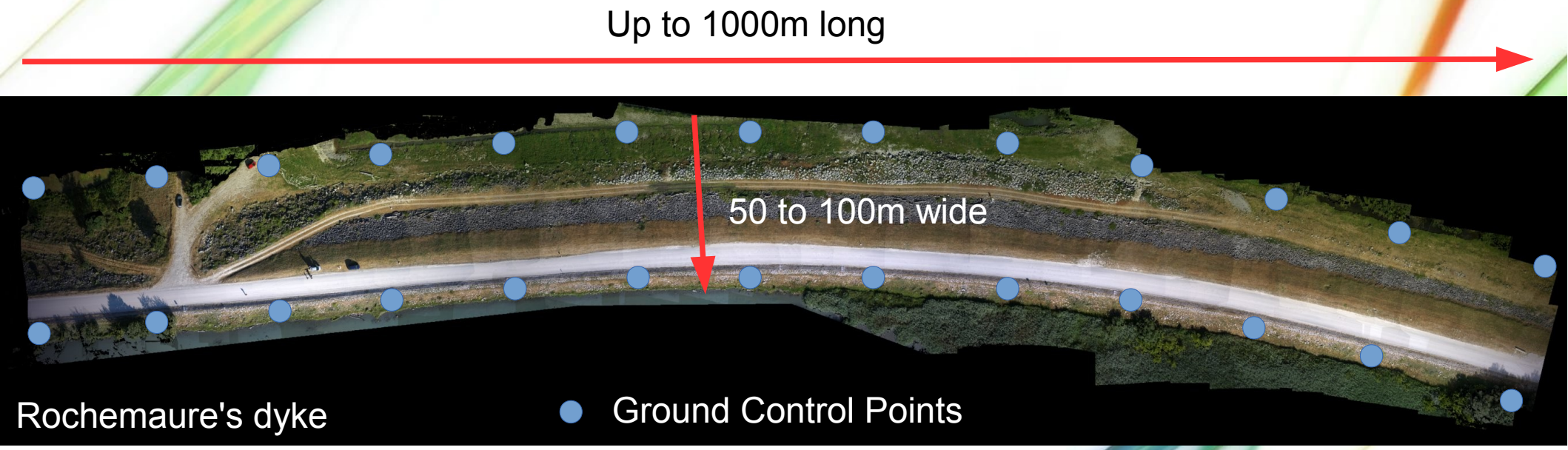
Why using UAVs is interesting ?

- Much more affordable than aircrafts/helicopters
- Easy to deploy on the field (in most cases)
- Flight plan easy to adapt on the field
- Low altitudes → Bigger GSD → New applications

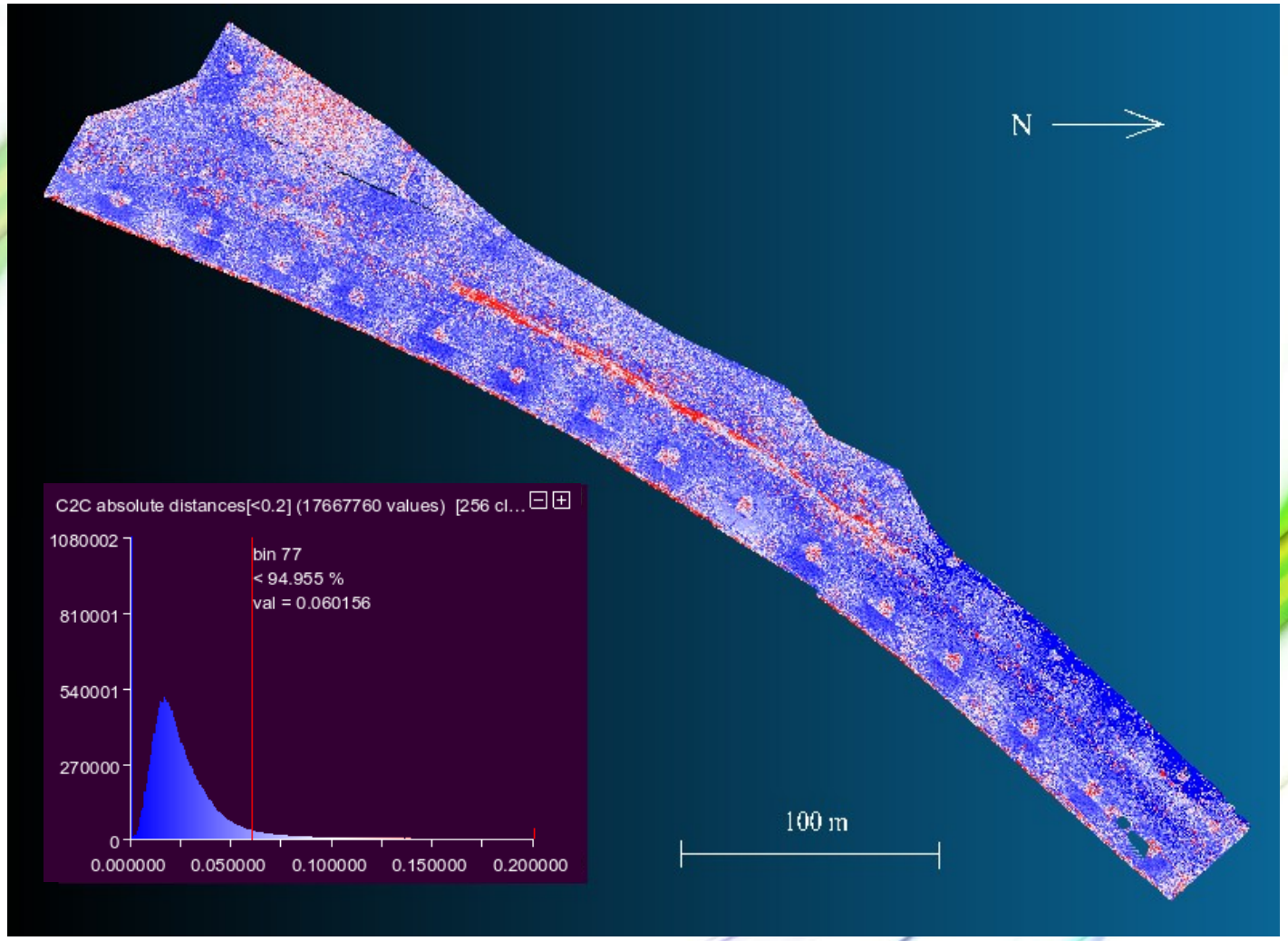
UAV Legislation in France

UAV Legislation in France

Typical test site



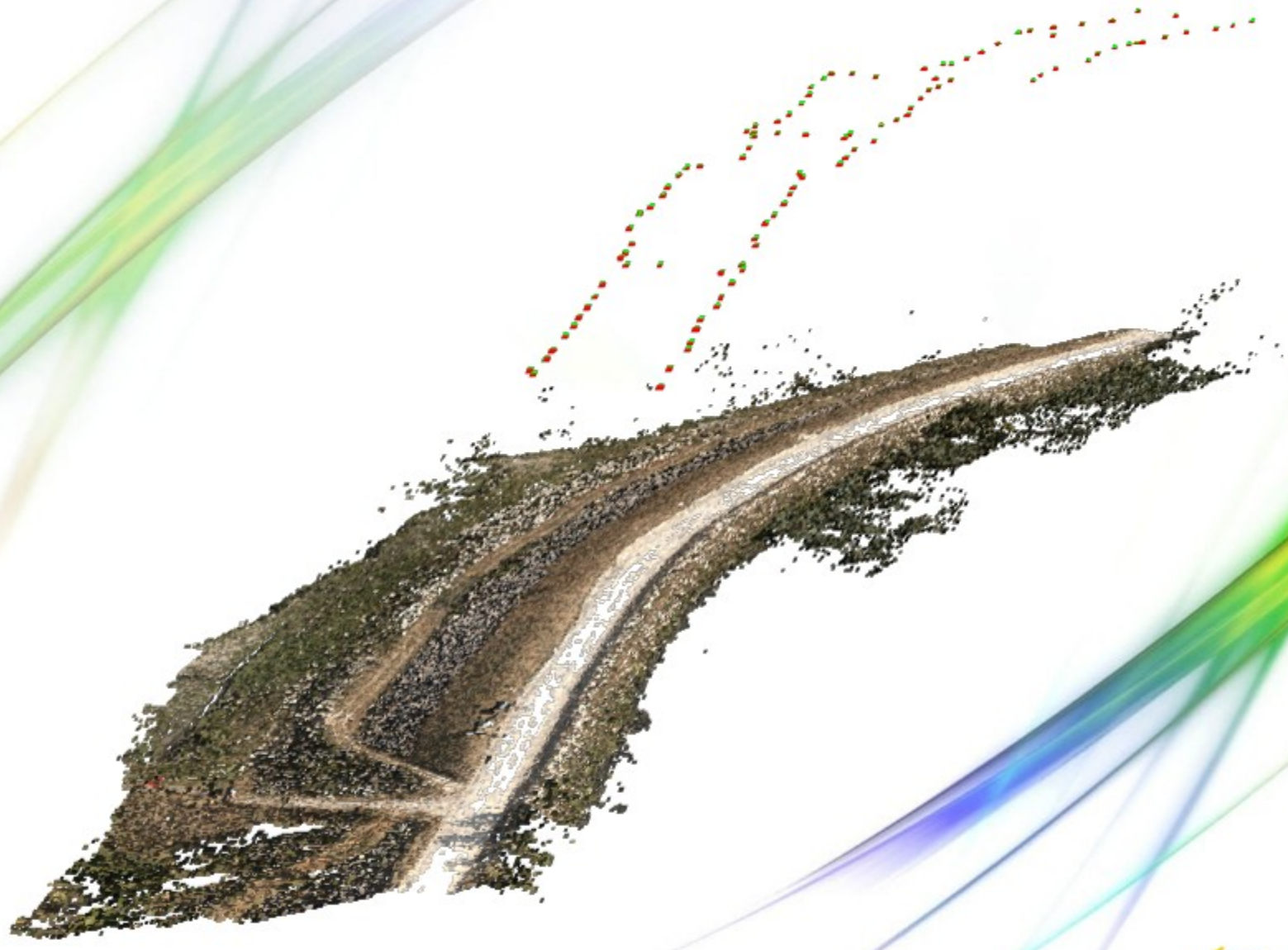
Comparison between Lidar Surveys



Two terrestrial Lidar survey compared using CloudCompare

Photogrammetric survey

First results

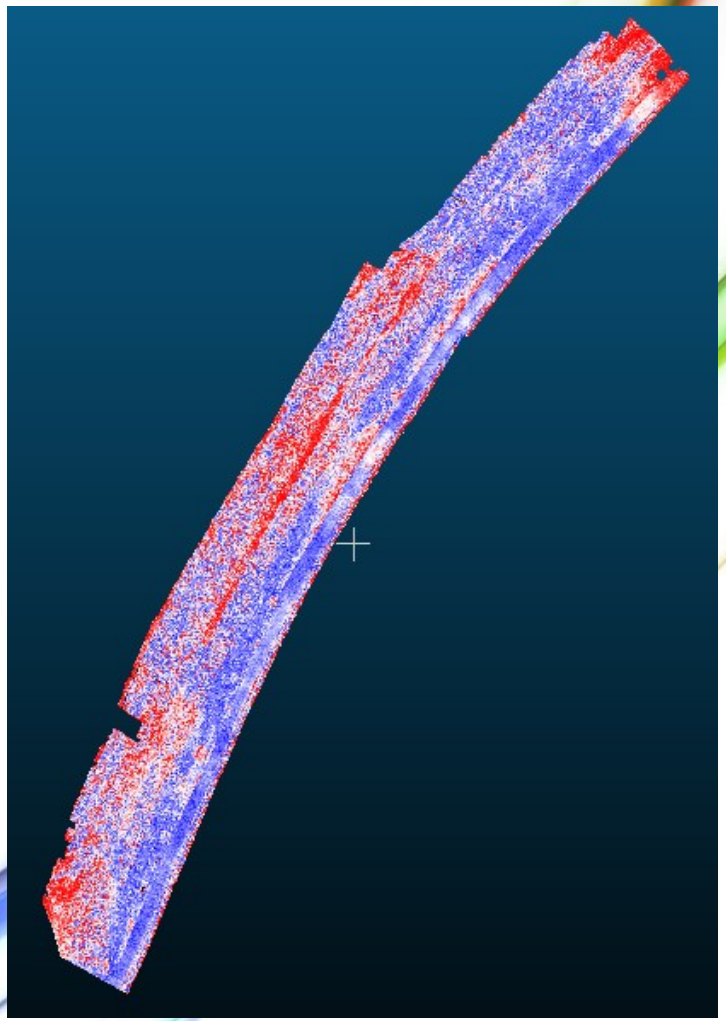


Different calibration models

	Focale	PPA	PPS	r^3	r^5	r^7	r^9	r^{11}	Affine	Decentric	TOTAL
RadialBasic	x	xx		x	x	x					**6**
RadialStd	x	xx	xx	x	x	x					**8**
RadialExtended	x	xx	xx	x	x	x	x	x			**10**
FraserBasic	x	xx		x	x	x			xx	xx	**10**
Fraser	x	xx	xx	x	x	x			xx	xx	**12**

Residuals during the calibration

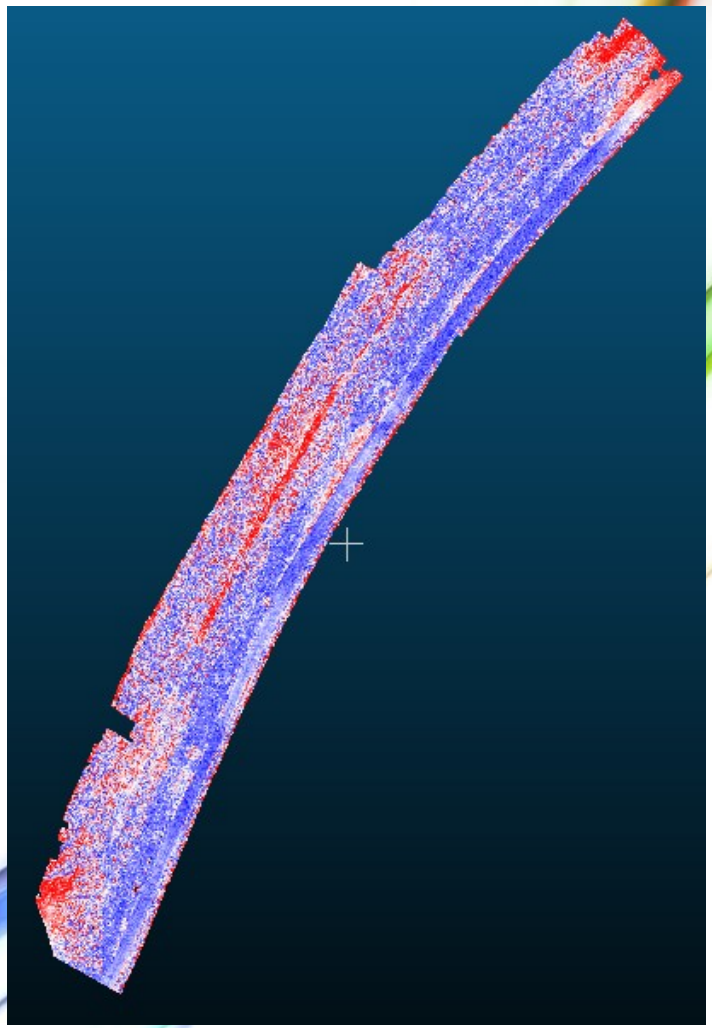
	X (mm)	*Y (mm)*	*Z (mm)*	*Image (pixel)*
RadialBasic	12	5	3	0,64
RadialStd	4	1	1	0,38
RadialExtended	10	3	2	0,51
FraserBasic	9	3	2	0,50
Fraser	9	3	2	0,50



RadialStd : Mean = 3,7cm ; Std Dev = 1,9cm

Bundle adjustment residuals

	Figee	*AutoCal*	*Evolution*
RadialBasic	0,951	0,939	+ 1,26 %
RadialStd	0,990	0,936	+ 5,45 %
RadialExtended	0,778	0,769	+ 1,16%
FraserBasic	0,935	0,938	- 0,32 %
Fraser	0,998	0,935	+ 6,01%

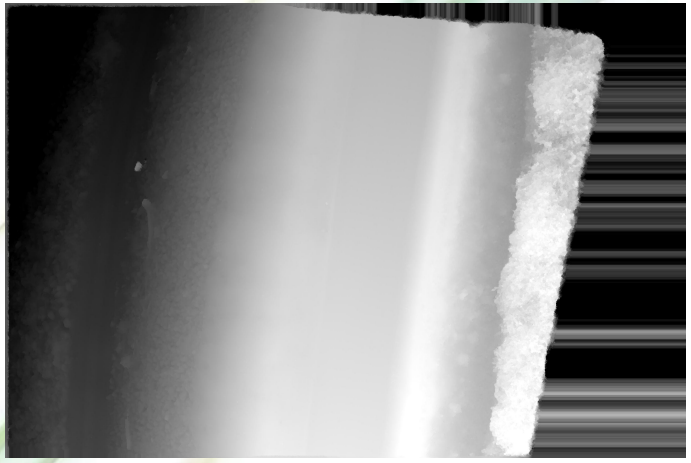


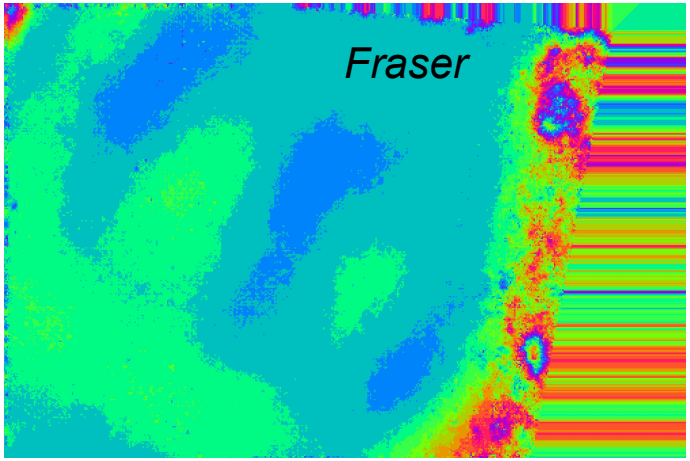
RadialStd : Mean = 3,5cm ; Std Dev = 1,8cm

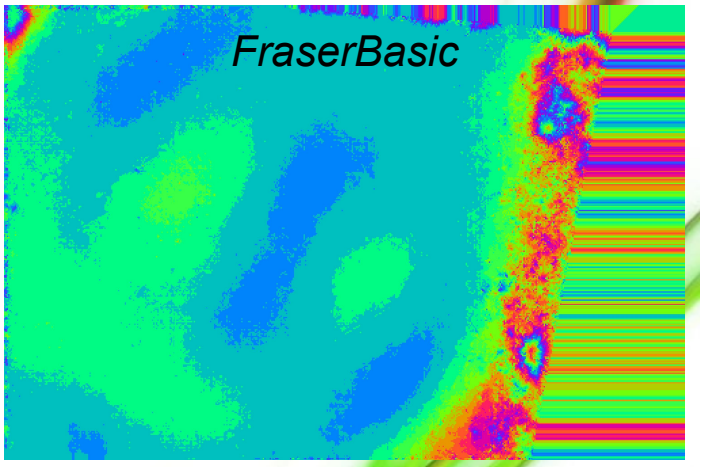
Residuals on the check points

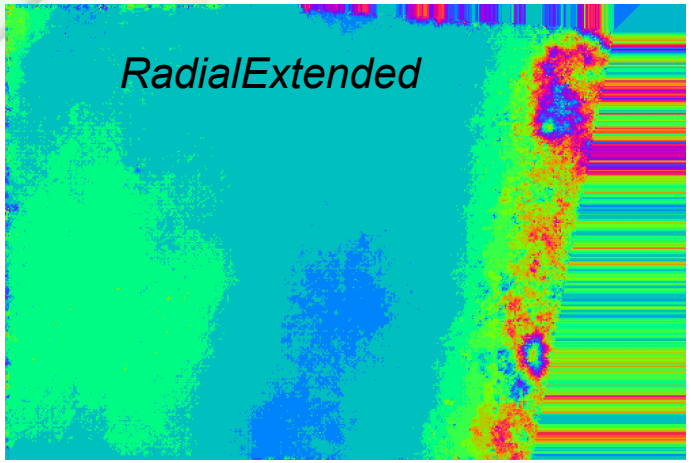
	Mean Absolute Error		Root Mean Square Error	
	Z (mm)	XYZ (mm)	Z (mm)	XYZ (mm)
RadialBasic	20	26	27	31
RadialStd	23	35	30	38
RadialExtended	18	23	23	26
FraserBasic	31	35	39	44
Fraser	35	41	44	48
CPI	19	24	23	26

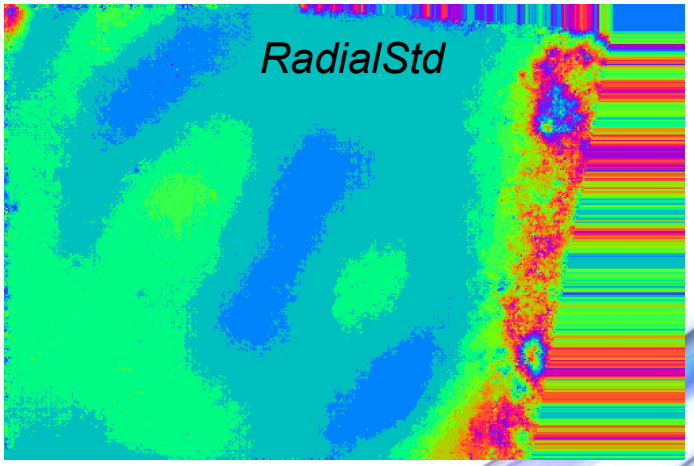
Paralaxe

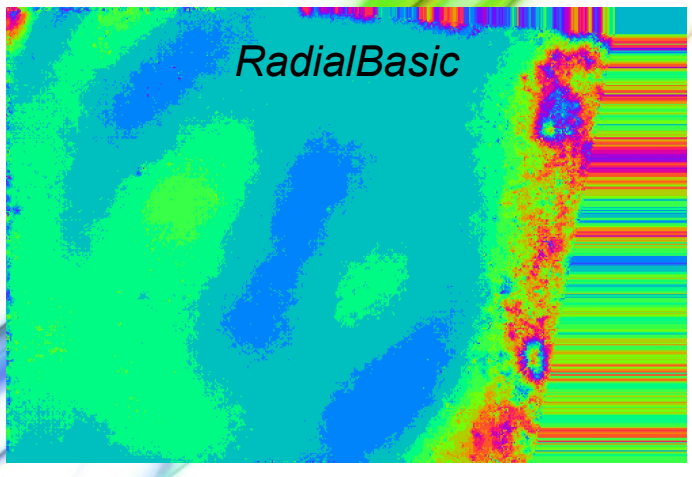



Fraser

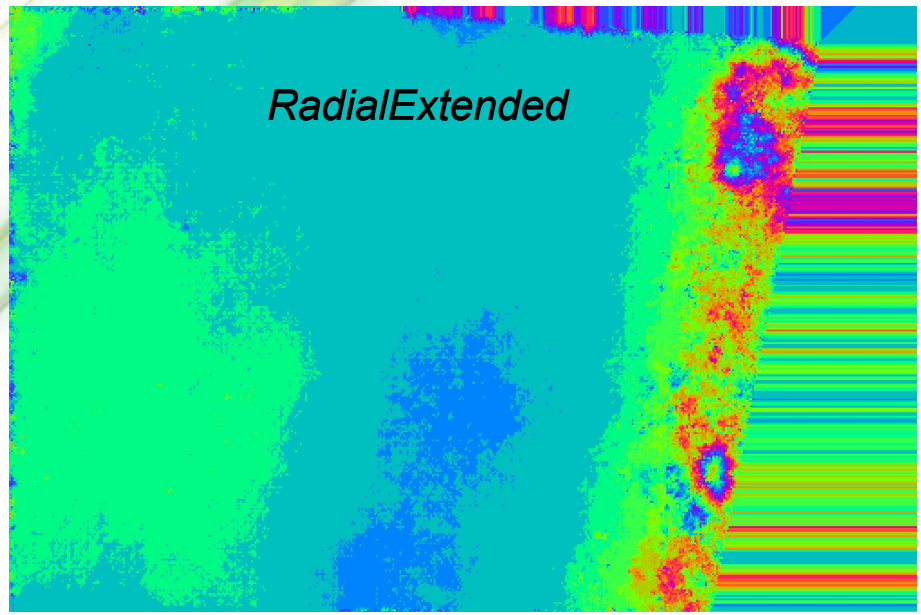

FraserBasic

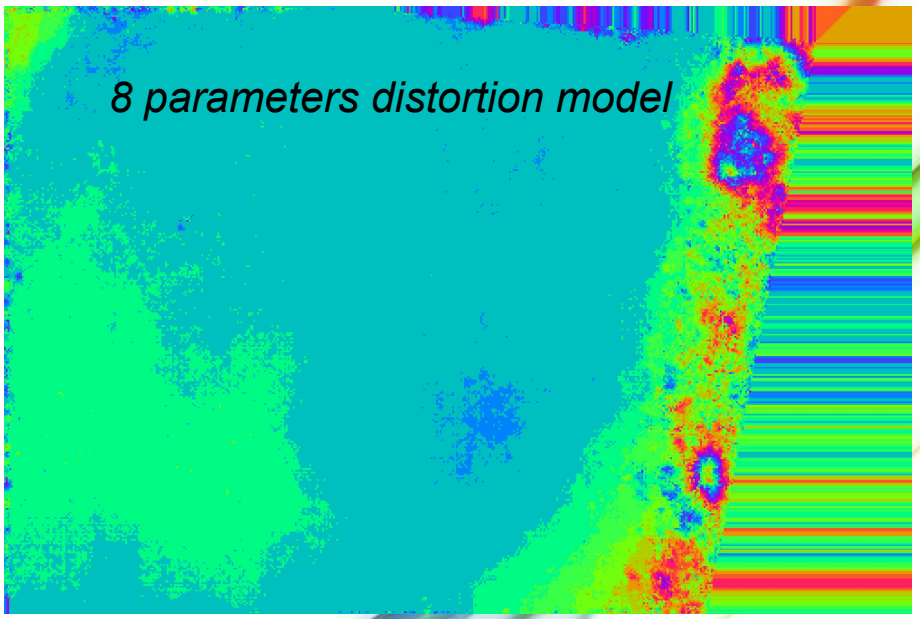

RadialExtended


RadialStd


RadialBasic

Paralaxe





Simulation of a UAV flight at 1/20