DAY 2

Special Course on Point-clouds at UMS University (November 2023)

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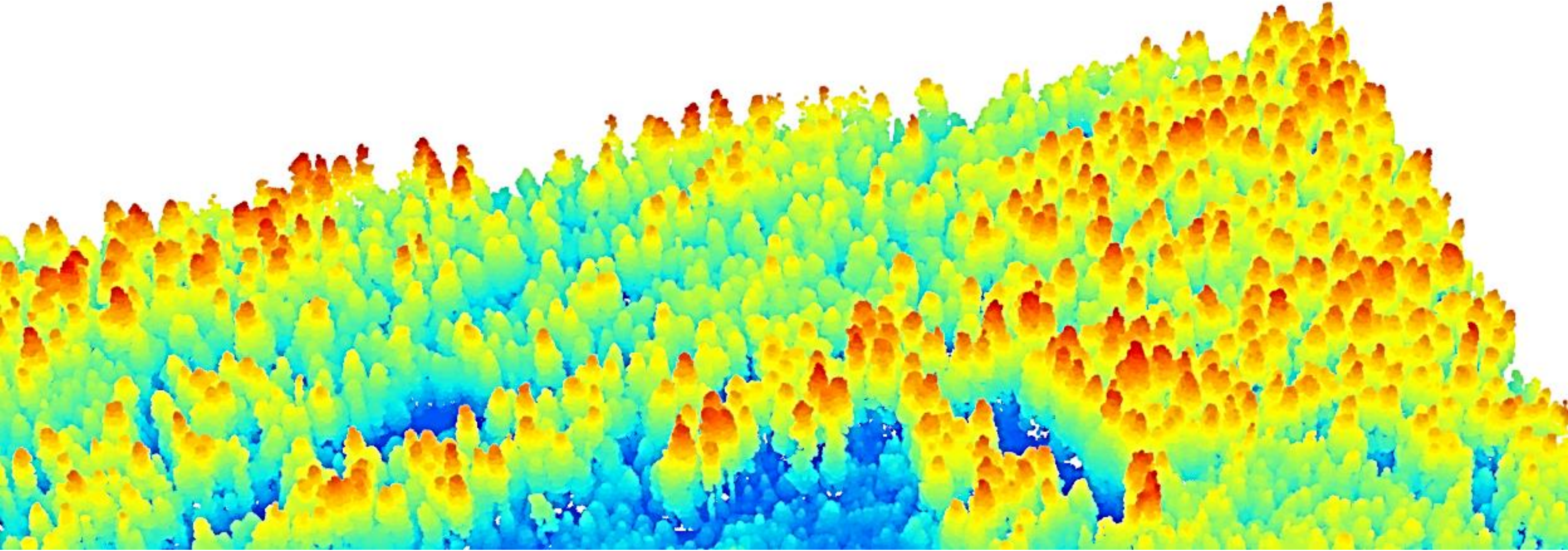
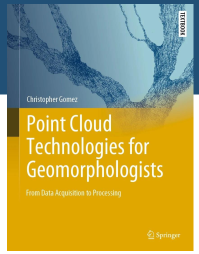


Program of the week for the general lectures

Monday 13th	10:00 – 11:15	General Lecture 1: Introduction to pointclouds
	11:15 – 11:30	Q&A
Wednesday 15th	8:00 – 9:30	General Lecture 2: Applications of PCLs
	9:30 – 10:00	Q&A
	10:30 – 11:30	General Lecture 3: SfM-MVS: coba aja
	11:30 – 12:00	Q&A
Thursday 16th	8:00 – 9:30	General Lecture 4: Combining PCL with other technologies, working outside the box.
	9:30 – 10:00	Q&A
Friday 17th	8:00 – 9:30	Workshop on LiDAR data processing
	9:30 – 10:00	Q&A
	10:15 – 11:45	Workshop on SfM for Density Analysis (Daikai)
	11:45 – 12:00	Q&A



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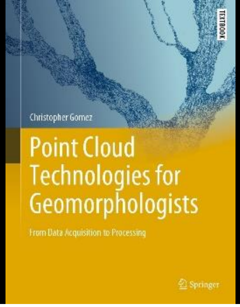

Preparation

Please download and use the 30 days free version of METASHAPE PRO!

Agisoft Metashape 2.0.3

This is the latest released version.
Check Metashape Tutorials and User Manual to get started.

Professional Edition

Windows
macOS
Linux

Standard Edition

Windows
macOS
Linux

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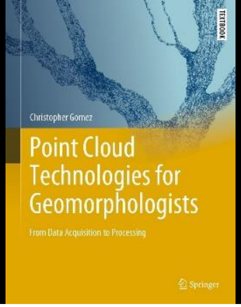

What did we learn in lecture 1

From lecture 1, you should know:

(a) What is a pointcloud, what data are stored with it and the different structures
(b) The different types of sensors used to generate 3D from laser data
(c) The SfM-MVS photogrammetric method to generate 3D
(d) Be able to choose one method or another, based on your objectives.
(e) Understand the potential of the SfM-MVS method beyond traditional remote sensing (historical data…)

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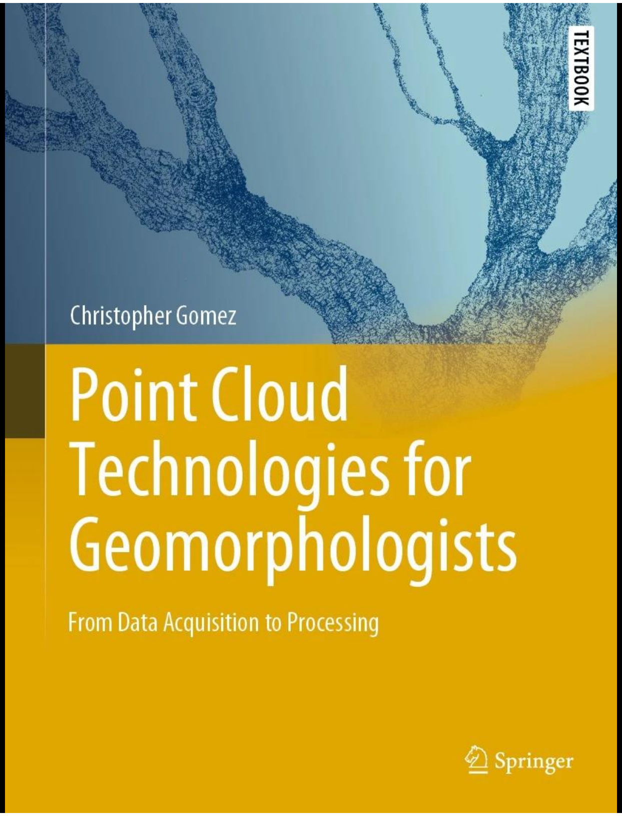

砂防2
点群データ:入門
Applications of Pointclouds to Different Environment

Christopher Gomez

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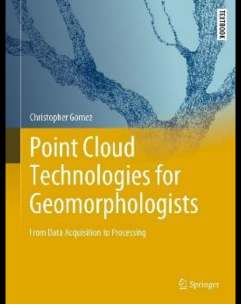

Lecture's objectives and plan

Lecture's objectives:

(a) Know the possibilities of PCL in geomorphology for different environments;

(b) Understand what tool will provide the best results;

(c) … also know the limitations of each tool.

Lecture's plan:

1. Pointcloud technology for floodplain environments
(5' break)
2. Pointcloud technology for coastal environments
(5' break)
3. Pointcloud technology for hillslope geomorphology
4. Pointcloud technology for volcanic geomorphology

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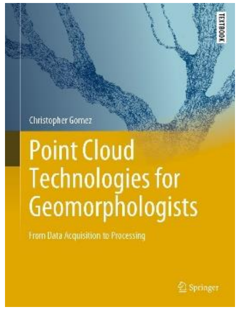

1. PCL for floodplain environments

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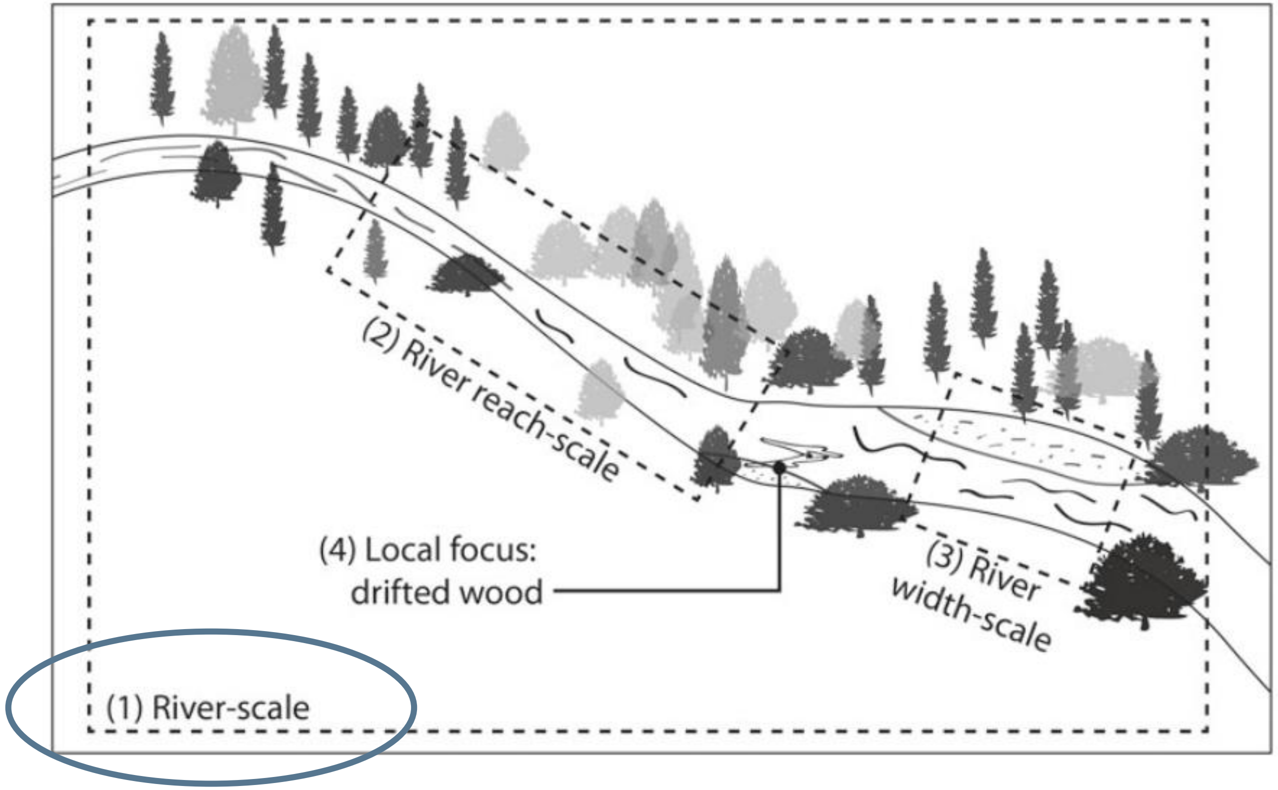
Working at the river-scale

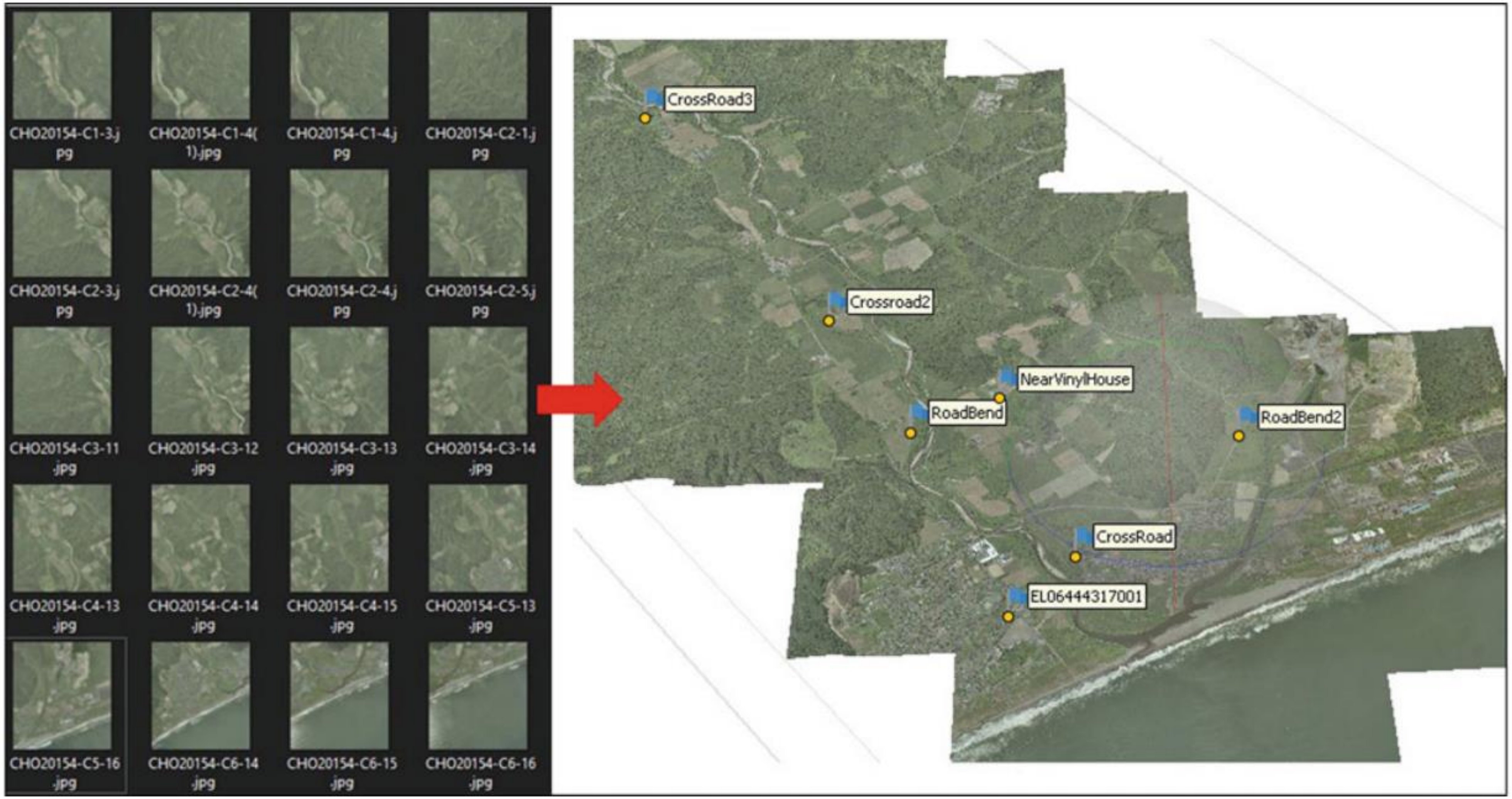
Difficulties	– Elongated thin strip with often limited vertical variation – Often associated with forested vegetation hiding the river and elements of the fluvial corridor – Seasonal water-level change modifies the geometry that can be captured with inundated zones being difficult to capture
Recommended tools (not exhaustive)	– Airborne LiDAR from traditional airplane – Fix-wing UAV LiDAR – In vegetation-deprived environments airborne platforms for photogrammetry work as well – Aerial photographs stitching (understanding the limitations)



If the water is clear enough, you can also "see through" in the water itself, and make a bathymetry.

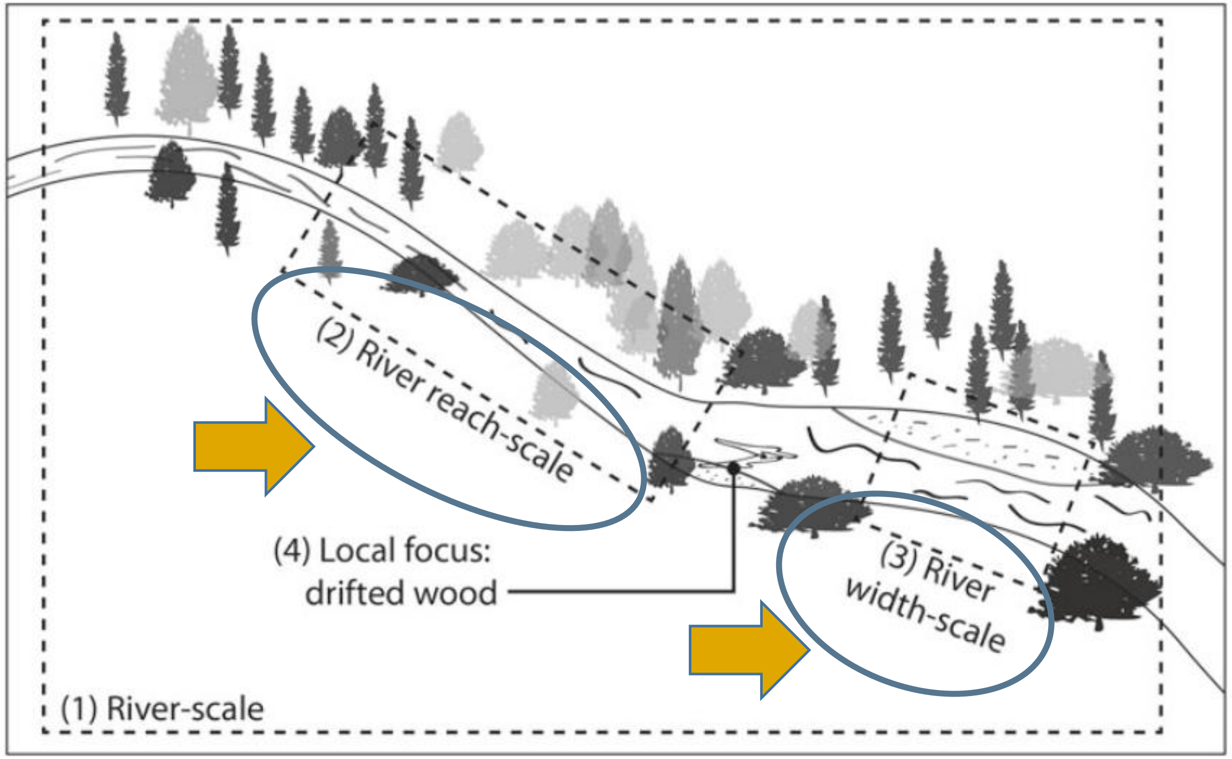
Working at the river-scale

From aerial photographs to 3D model using the Agisoft Metashape-Pro software using the aerial photographs from the Geospatial Authority of Japan (www.gsi.go.jp). The photographs were acquired in July 2015 at an altitude of 3230 m with a digital colour DMC2-230 camera of 92.041 mm focal. The blue flags are the ground control points (GCPs) with known coordinates (X, Y, Z). Please note that you will also need another set of points with known values to check for the error in the model



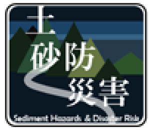
Working at the reach scale

Difficulties	– Water-level change over time and water surface reflection – Vegetation hiding point-bars and details of the topography – Small-scale variations in the topography
Recommended tools (not exhaustive)	– Vehicle-mounted TLS – UAV SfM-MVS or LiDAR – Helicopter-based LiDAR



Working at the valley-width scale

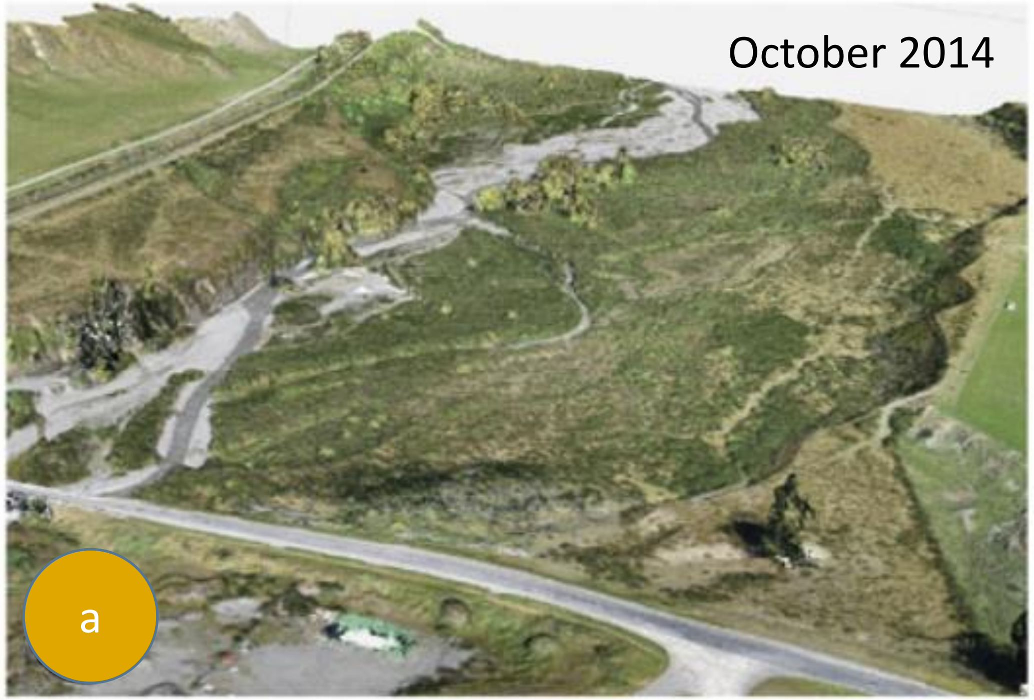
Difficulties	– Water surface reflection – Vegetation and wind in vegetation moving trees and elements measured
Recommended tools (not exhaustive)	– TLS – UAV-based SfM-MVS – UAV-based LiDAR – Vehicle-mounted LiDAR




Example: The Kowhai River in New Zealand

Canon Powershot SX260	Focal length (mm)	Pixel size (mm)	Number of photographs	Mean flight altitude (m)	MAE (m)	$RMSE_Z$ (m)	$RMSE_{XY}$ (m)
	4.5	0.0015494	508	550	0.059	0.031	0.057

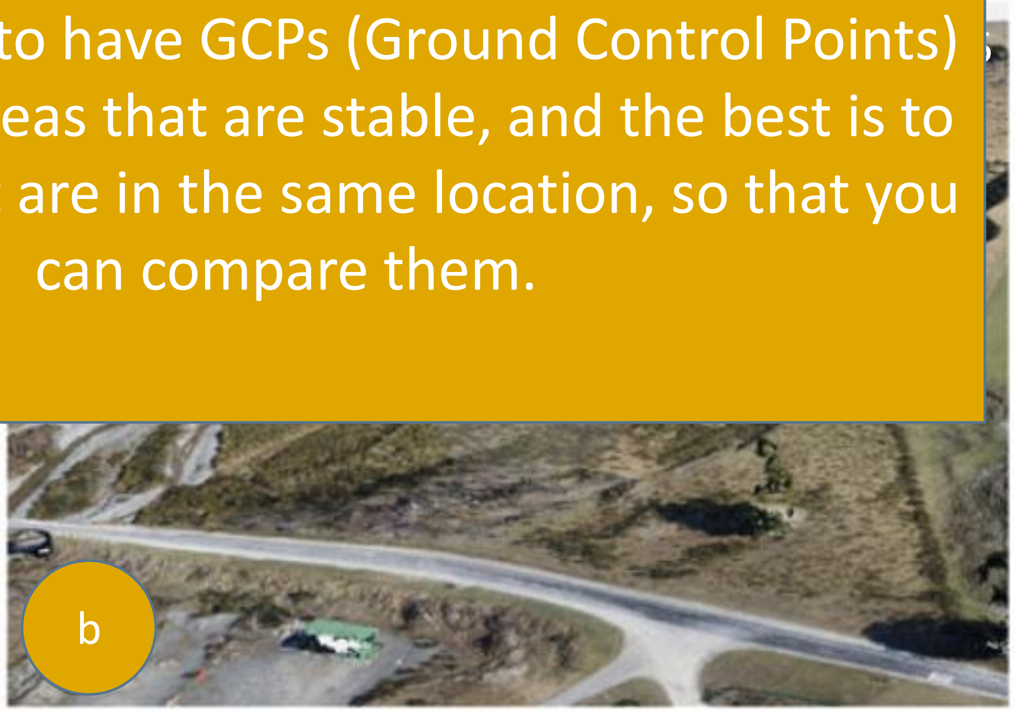
Camera, image capture specification and error metrics for ten ground control points used for the creation of one of the pointcloud of the Kowhai River at * 920 pts/m2 presented in this subsection



Example: The Kowhai River in New Zealand

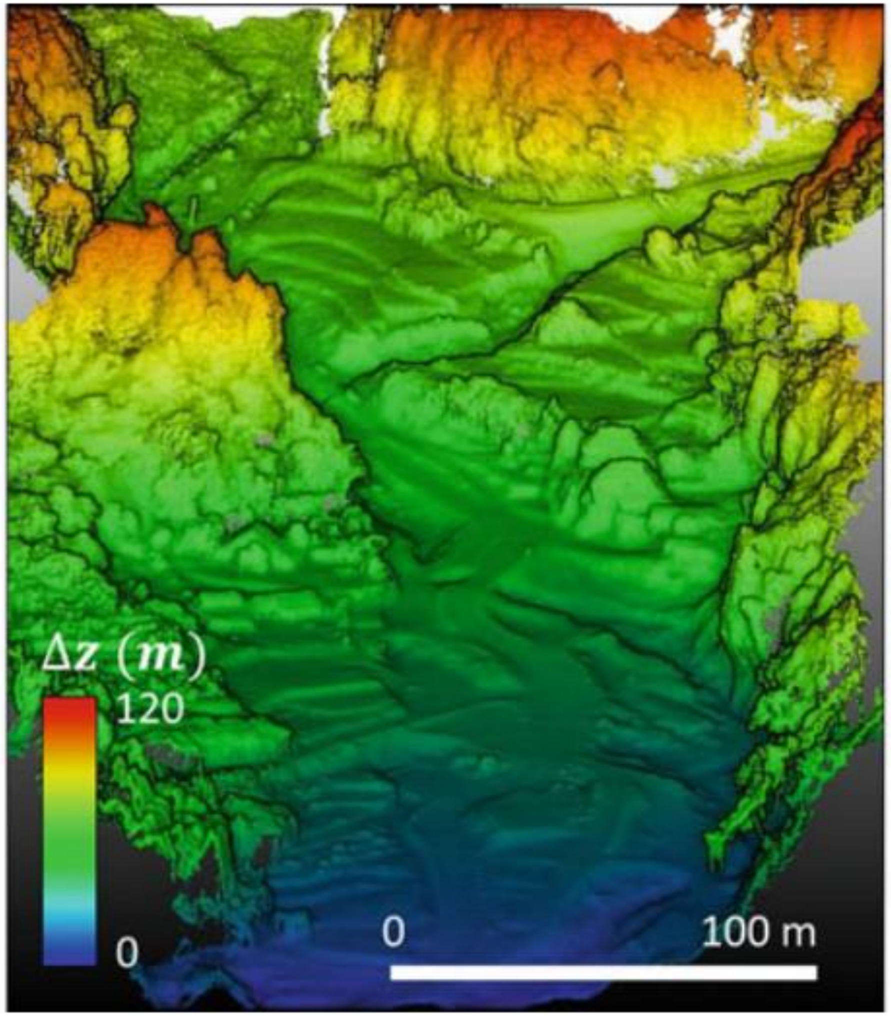
Canon SX260	Pixel size (mm)	Number of photographs	Mean flight altitude	MAE (m)	$RMSE_Z$ (m)	$RMSE_{XY}$ (m)
	0.00154					057

Camer… and erro… of the pointc… 0 pts/m2…

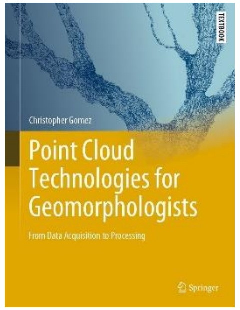


We will talk about it during the workshop, but to compare two surfaces taken at two different times, it is important to have GCPs (Ground Control Points) which are in areas that are stable, and the best is to have GCPs that are in the same location, so that you can compare them.

You can also use PCL to monitor the evolution of work (like the sand mining at Merappi Volcano in Kaliurang for instance)



This is the reconstruction after the 2017 disaster in South Japan in Asakura. You can then use it to monitor the impact of the sediment hazards, against the impact of reconstruction and how it changes the geomorphology.



2. PCL for coastal environments

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Coasts can be very different. What do you think are the challenges of gathering data at the coast?

Menurut Anda apa tantangan ambil data titik di pesisir dan di dekat laut?

2. PCL for coastal environments

2. PCL for coastal environments

Coastal dunes

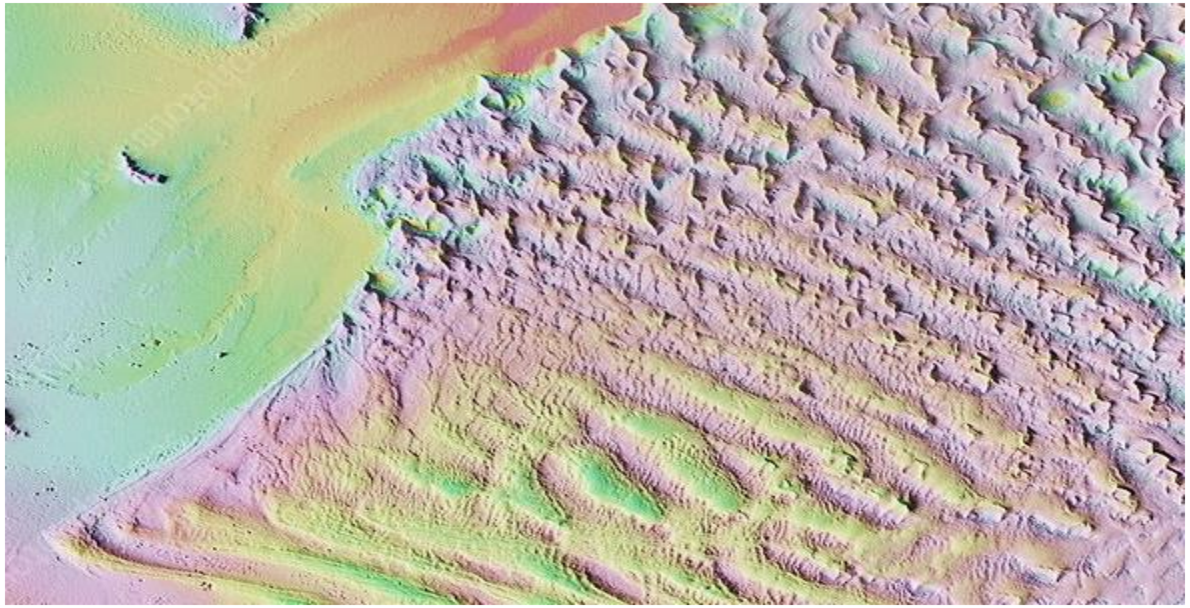
Difficulties	– Large-scale features but needing high-resolution data – Constantly in movement, even in "seemingly" stable zones – Survey in windy areas transporting winds at the surface can lead to extensive error in the laser signal
Recommended tools (not exhaustive)	– ALS – UAV-borne SfM

beach

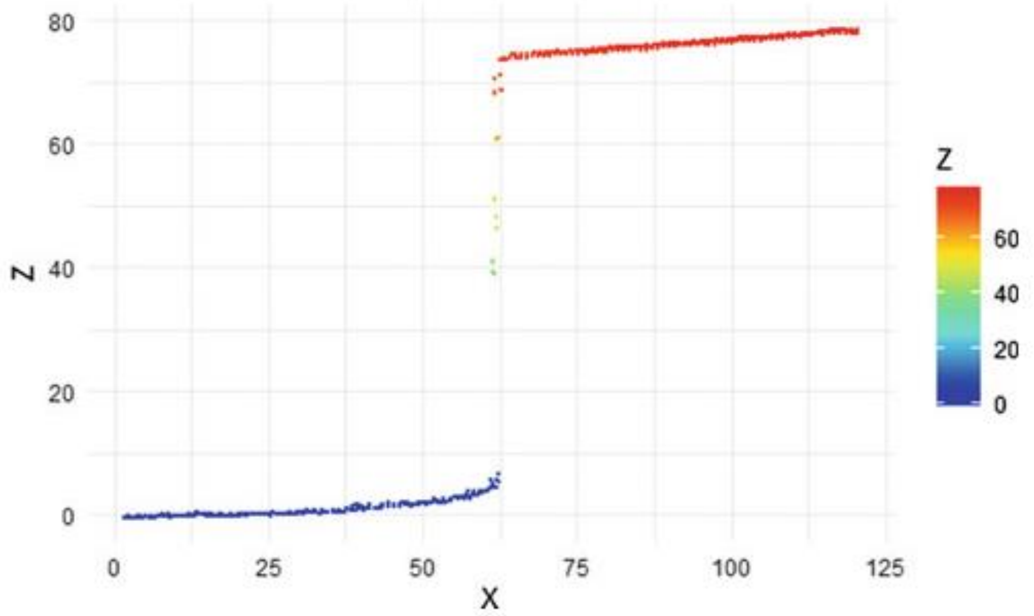
Difficulties	– Long strips with limited topographic variation – One constantly moving limit (where to put it anyway) – For photography matching, the constant change in wetting pattern or wave rolling in and out makes SfM-MVS difficult;
Recommended tools (not exhaustive)	– ALS – TLS

Coastal barriers

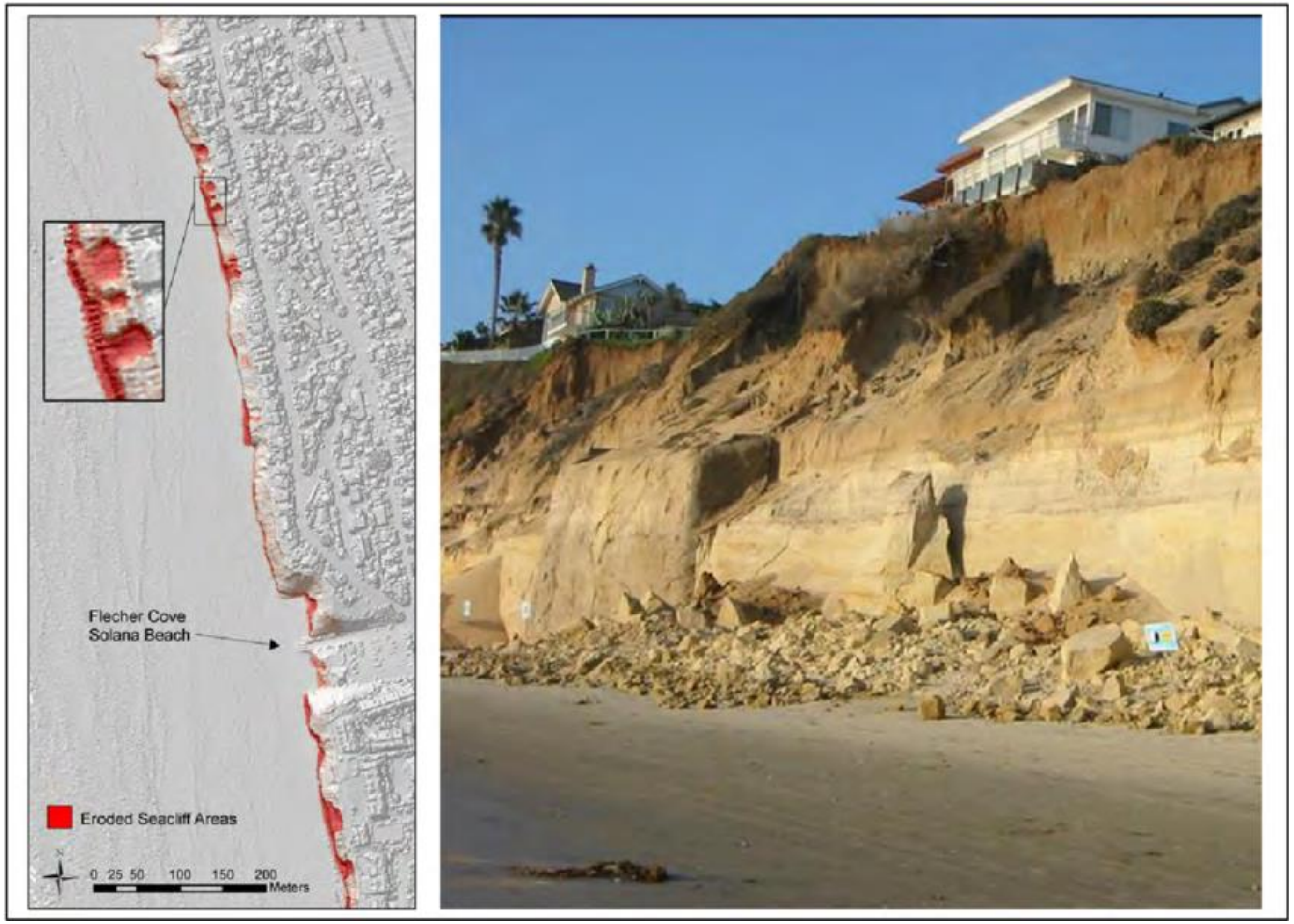
Difficulties	– Long strips with limited topographic variation – One to two constantly moving limits (where to put it anyway) – For photography matching, the constant change in wetting pattern or wave rolling in and out makes SfM-MVS difficult
Recommended tools (not exhaustive)	– ALS – TLS



The specific challenges of working with cliffs

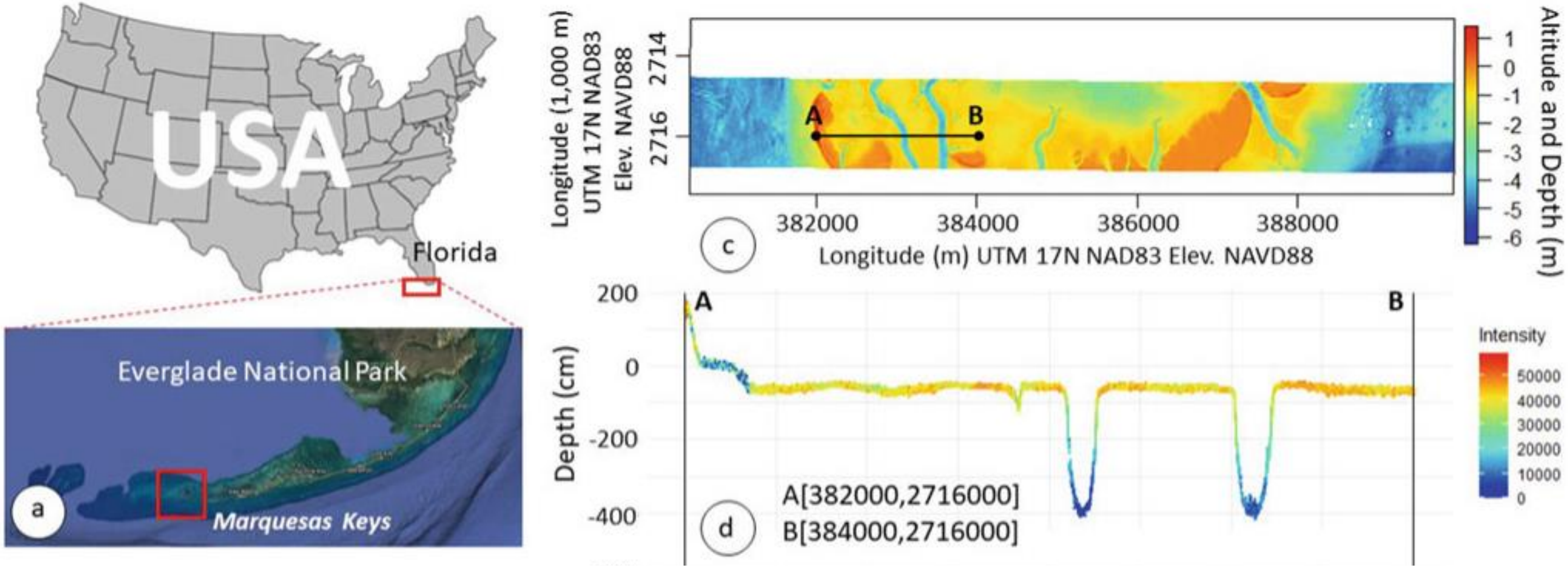


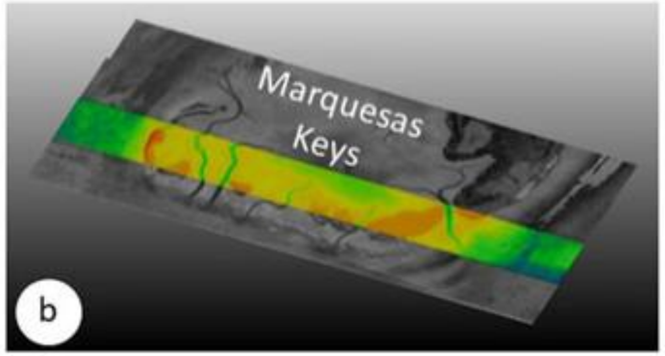
Transect of the 2007 LiDAR from a cliff of the southern coast of the UK, illustrating the problems encountered when imaging sub-vertical surfaces from LiDAR data. The strip extracted is 5 m wide and extends between the two points X0 [552413, 97286] and Xend [552471, 97384]



Grubbs, M. 2017. Beach Morphodynamic Change Detection using LiDAR during El Niño Periods in Southern California. Master thesis.

Submerged and Semi-submerged Landforms: Shore Platforms, Estuaries, Deltas, Coastal Marsh and Wetlands

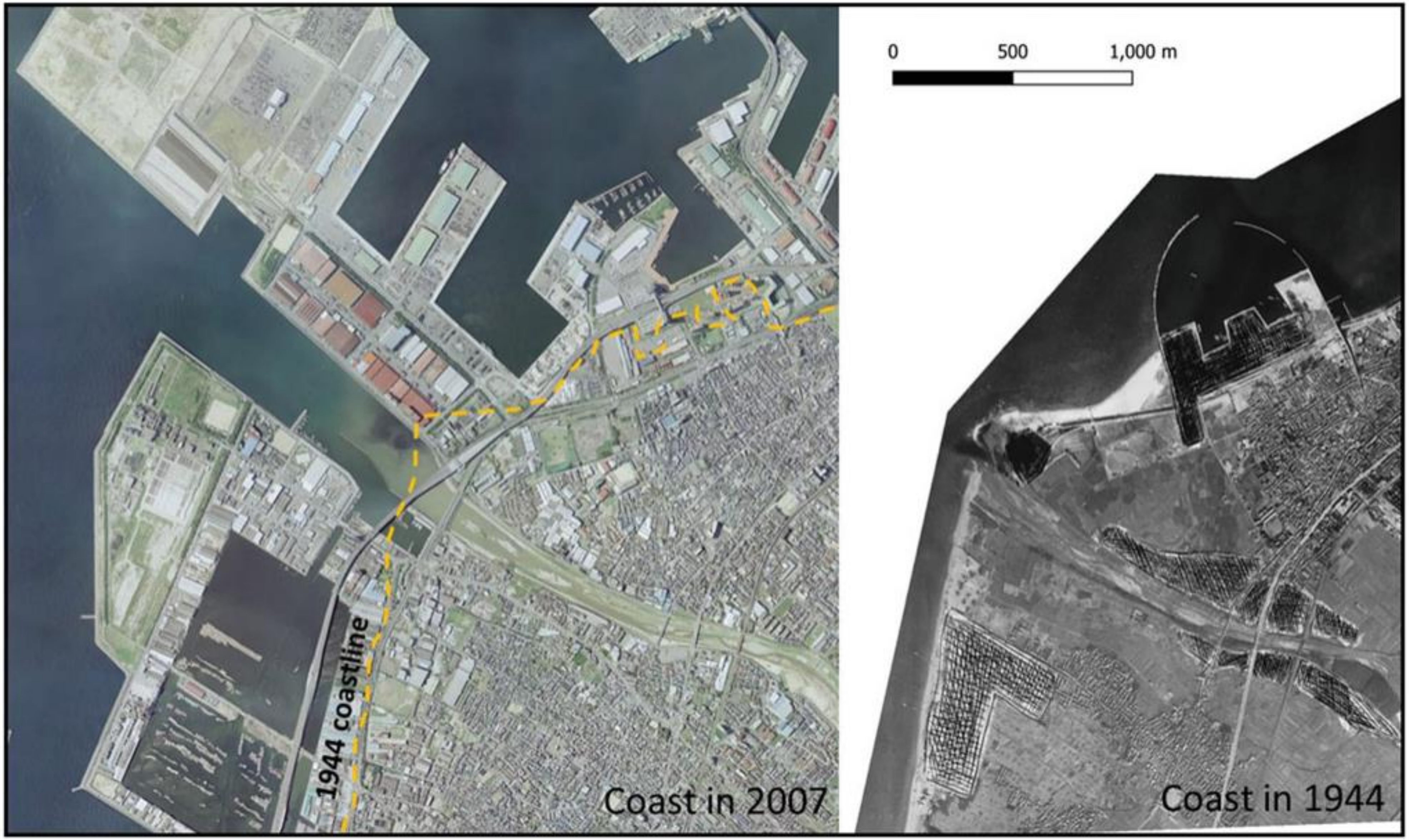




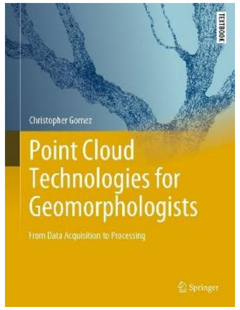
Difficulties	– Several kilometres' horizontal scale for small vertical variation – Partly or fully underwater
Recommended tools (not exhaustive)	– Bathymetric Lidar – Multiband TLS (local scale) – Underwater camera for SfM-MVS (local scale)

2. PCL for coastal environments

You can also use PCL technology to reconstruct high-resolution imagery from past-data and follow the coastal evolution, like for the river, and see how it progresses or get eroded over time.



2. PCL for coastal environments



3. PCL for hillslope geomorphology

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Hillslope drainage

Difficulties	– The walls of the drainages can be steep and difficult to capture – Water-level change can have important impacts on – The low position of the drainage can be blocked by a dense vegetation cover
Recommended tools (not exhaustive)	– Helicopter-based LiDAR for slow movement – UAV-based LiDAR – Ground-based slam and hand-held scanners

Knickpoint

Difficulties	– In bedrock, the knickpoint can move very slowly – Knickpoints associated with cascades experience constant geometric change with the water – Cascade water can hide and hamper measurements
Recommended tools (not exhaustive)	– TLS – SfM-MVS combined with TLS – UAV LiDAR

Glacial and periglacial

Difficulties	– An ever-moving landscape – Debris-covered slopes are all unstable – Often narrow and deep valley offer limited sky-view – Steep topographies are hard to address from the sky
Recommended tools (not exhaustive)	– TLS – UAV LiDAR

Hillslopes interfluves

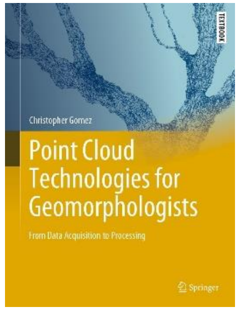
Difficulties	– Large spatial extent with often relative limited local variability – Potential dense vegetation – Potentially hard to access and ground control points can be difficult to place on the slope
Recommended tools (not exhaustive)	– TLS if the slope is small enough of steep enough to be seen from sets of vantage points – UAV LiDAR – ALS

Tectonic deformation and rupture

Difficulties	– Deformation with a wall can be difficult to measure from aerial position in NADIR – Ruptures tend to be smoothed out rapidly and rapid assessment can be essential in specific environments – Large-scale deformations, like undulation call for wide-scale measures
Recommended tools (not exhaustive)	– ALS – Airplane and UAV photographs for photogrammetry – TLS for local rupture walls

Mass movements and slope collapses

Difficulties	– Large-scale events can move slowly – Mass movements often occur under vegetation cover – Heavy rainfall events and earthquake can trigger thousands of events – Topographic variations on large fans can be minute to measure
Recommended tools (not exhaustive)	– UAV LiDAR – TLS – UAV SfM



4. PCL for volcanic geomorphology

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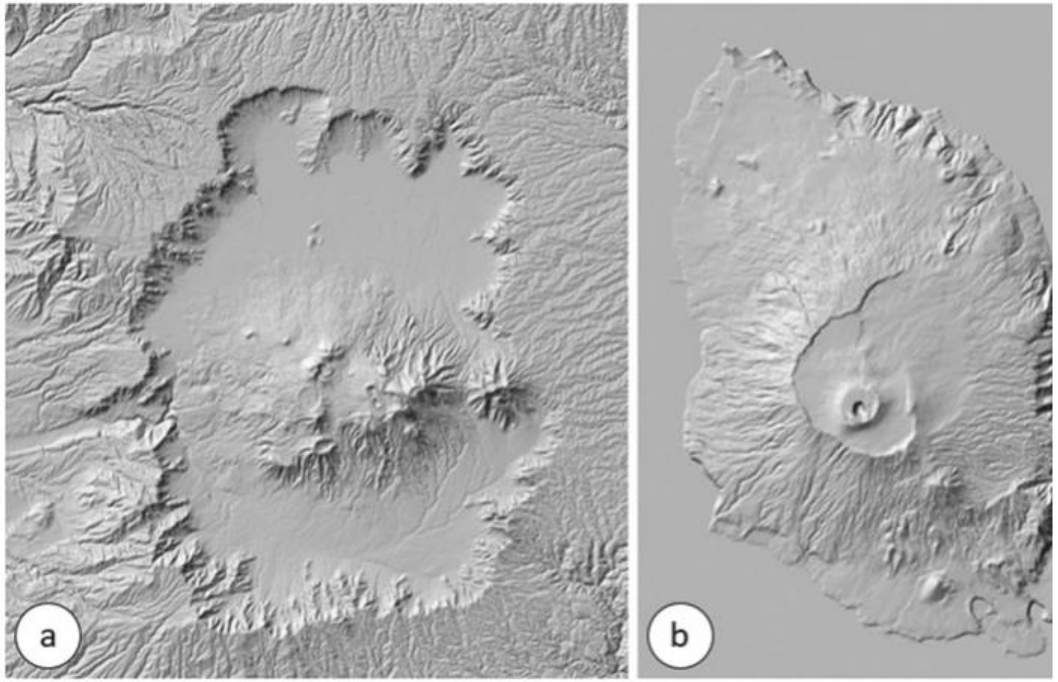
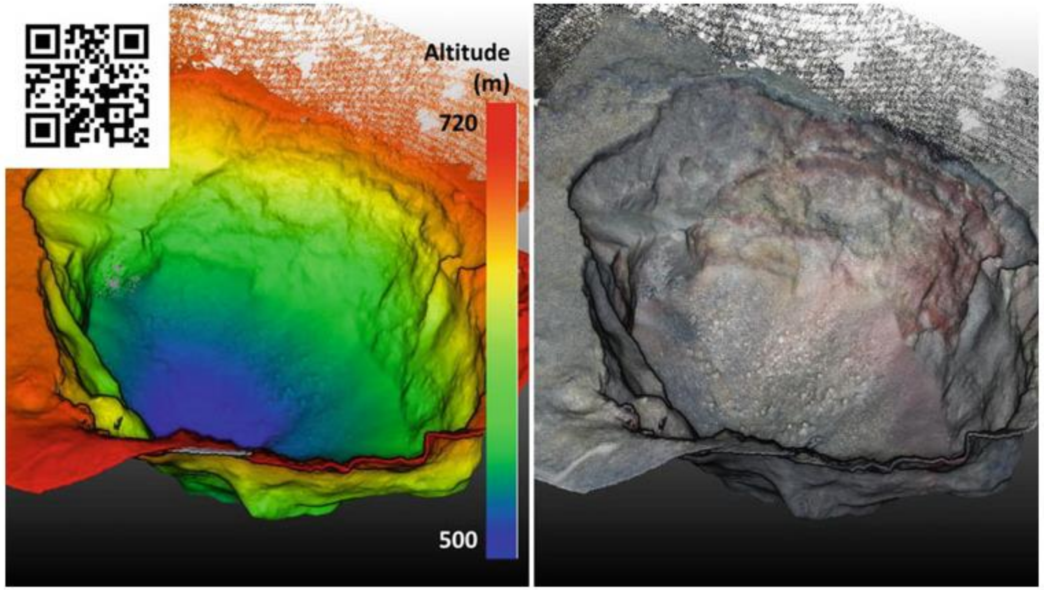
At the volcano scale



Difficulties	– Large-scale features spanning for several tens to hundred square kilometres – Potential cover of vegetation and smoke/dust during and just after eruptions
Recommended tools (not exhaustive)	– ALS from aeroplane or from satellite station – Aircraft-based aerial photographs

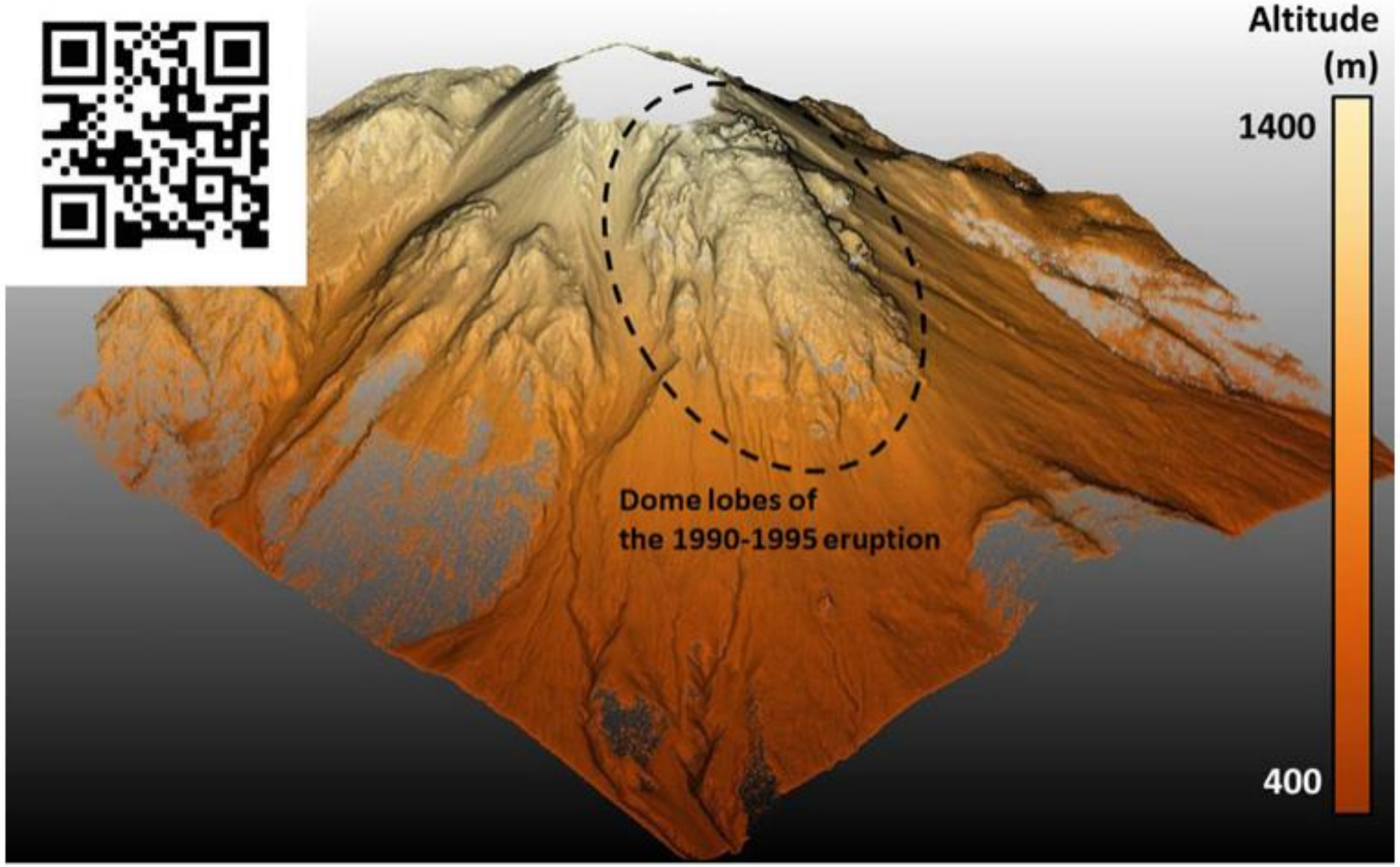
At the slope scale

Difficulties	– Sub-vertical features difficult to capture from NADIR sensors – Sometimes, local features like craters only a few tens to hundred metres in diameter – Stratovolcanoes' valleys are often deeply incised but narrow, limiting the field of view on the walls
Recommended tools (not exhaustive)	– TLS – Hand-held cameras photography for photogrammetry – Small UAV photography with tilted camera



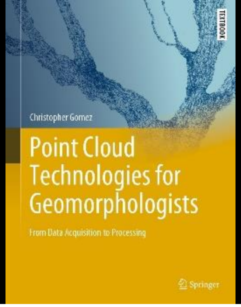
Lava-dome scale

Difficulties	– Highly reflective surfaces (andesites) or very homogenous black surfaces not conductive to automation in photogrammetry – Features active and rapidly eroded, requiring acquisition when the volcano is often still at risk to erupt further – The need to collect GCPs in hazardous areas
Recommended tools (not exhaustive)	– TLS – UAV and helicopter-based LiDAR – Small UAV photography for photogrammetry with extensive markers



Volcanic micromorphology

Difficulties	– Small-scale vertical variations – In a climate with important moisture, the return of vegetation can be very quick
Recommended tools (not exhaustive)	– TLS – Hand-held cameras photography for photogrammetry – Small UAV photography operated over a very short range



Conclusion of Lecture 02

What you should know:

(a) What can be done in Geomorphology in different environments
(b) Know the different techniques and limitations

Lecture's plan for next time:

This second lecture closes the more “theoretical” aspect of pointcloud technology. For the next lecture, we will do a more hands’ on lecture, which will look more like a workshop.

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