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LIFE Observatoire Libano-Français de l'Environnement



Snow Research Activities

Charbel Abou Chakra, Janine Somma

Workshop Snow and Flow Webinar, 3 November 2020

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Geomorphology

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High lands of Mount Lebanon

Altitudes: between 1700 and 3000m;
Geology: Cénomannien (C4);
Characterized by karstic shapes like dolines (sinkholes) and undulations



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Snow = water
Snow Volume is very important to have an accurate estimation for SWE



These depressions trap the snow and its meltwater.
General orientation of undulations favors cornices formation due to prevailing winds from south-west

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Geomorphology

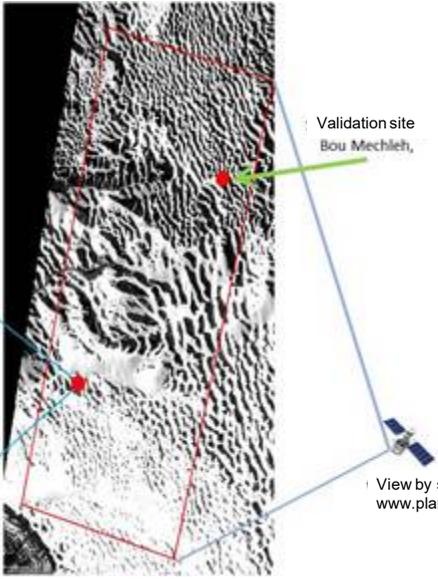
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11 avril 2017

View by terrestrial steady camera



Experimental site
Jabal El Dib Sinkhole



Validation site
Bou Mechleh,

View by satellite
www.planet.com

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Geomorphology
Infiltration Process

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https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-irish-karst/karst-landforms/Pages/Enclosed-depressions.aspx

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Bare land DEM from PLEIADE images

Enhancement of the DEM shows a multitude of dolines that act as containers and also as strainers since the meltwater that cannot flow out of the depressions is forced to infiltrate.

The very large number of dolines make from the summits of Lebanon a huge water tower. For that reason those areas have to be protected from all kind of degradations.

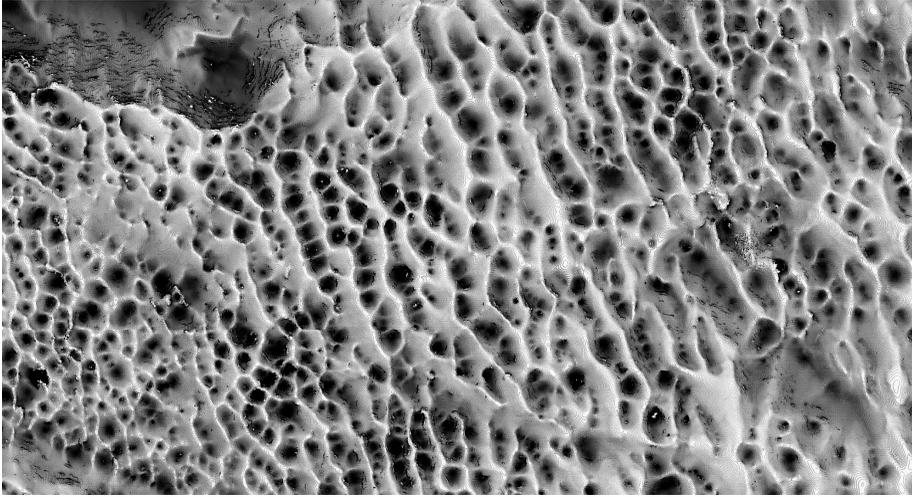
Other interests:

- Help to find dolines alignements;
- and to map faults and fractures.

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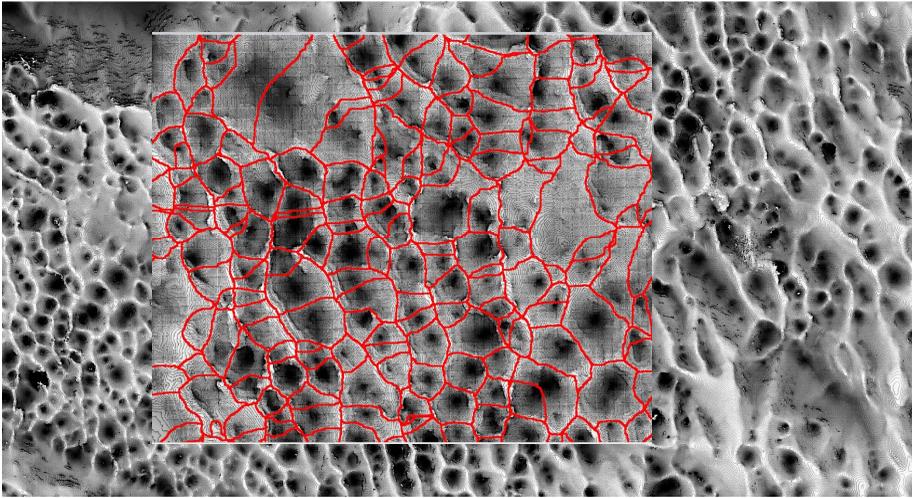
Map big and micro watersheds;
Find the lowest points of each doline which could be the most important infiltration point;
Use those points to map the dip of the floor

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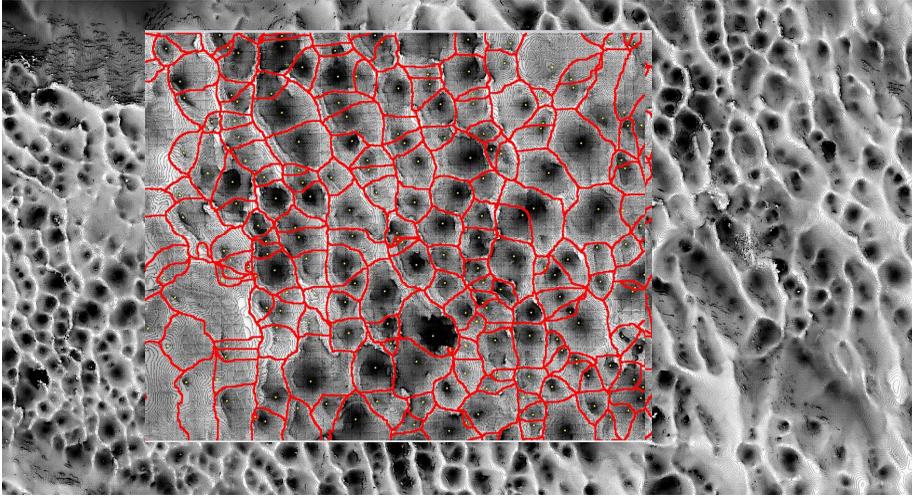
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Map big and micro watersheds;
Find the lowest points of each doline which could be the most important infiltration point;
Use those points to map the dip of the floor

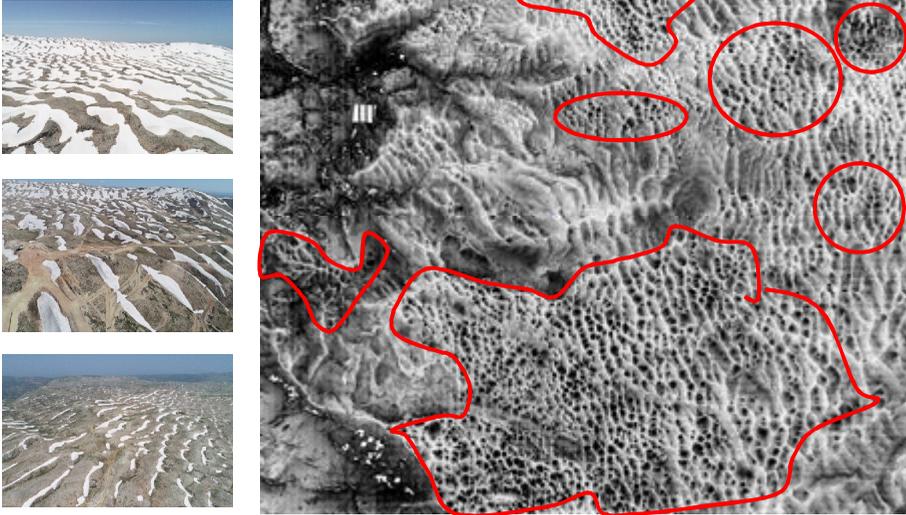
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Dolines Concentration



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Weakness of AWS for snow height mapping in high plateau

The image shows an aerial view of a snow-covered plateau. An Automatic Weather Station (AWS) is located in the lower center, with a red label 'Automatic Weather Station (AWS)' and a '0.5m' measurement. To the left, there are three red labels: '1.5m', '6m', and '12m', indicating snow height variations. An inset image on the right shows a ground-level view of the AWS with a red label 'Snow height' and a '0.5m' measurement. Arrows connect the ground-level view to the corresponding area in the aerial view.

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Study area and multi-scale monitorings

The diagram illustrates multi-scale monitoring of a study area. On the left, four monitoring methods are shown: 'Planet' (satellite), 'Drone', 'Total Station', and 'Steady Cameras'. On the right, an aerial view of the study area is shown, with a blue outline representing the overall area and a red outline representing a smaller sub-area. The sub-area is labeled 'Warde' and contains a 'Pilot Doline at Jabal el Dib'. The main area is labeled 'Chabrouh' at the top and 'Mzaar' at the bottom. Arrows indicate the scale of monitoring: Planet (satellite) covers the entire area, Drone covers the sub-area, Total Station covers the Pilot Doline, and Steady Cameras cover the sub-area.

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Instrumentation of the observatory at the pilot doline

3D Model obtained by Photogrammetry on 3 March 2019

Geodetic Point

Stereoscopic overlap

Steady camera

AWS

GCP drone

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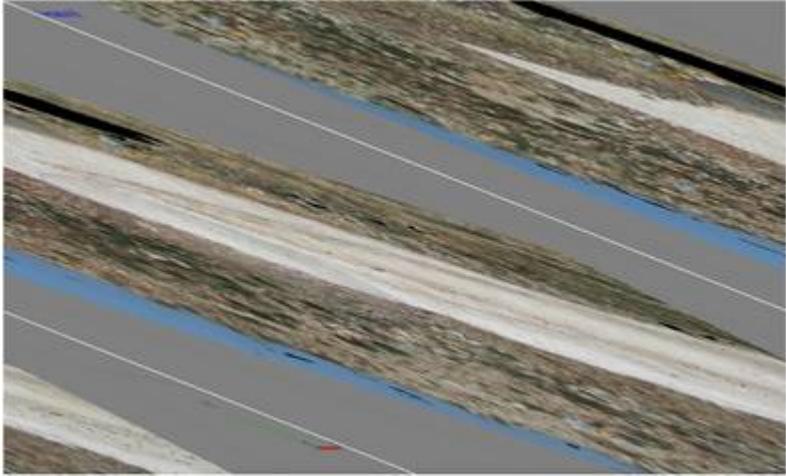
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Automatic daily snowmelt monitoring using steady cameras

04/20/2015

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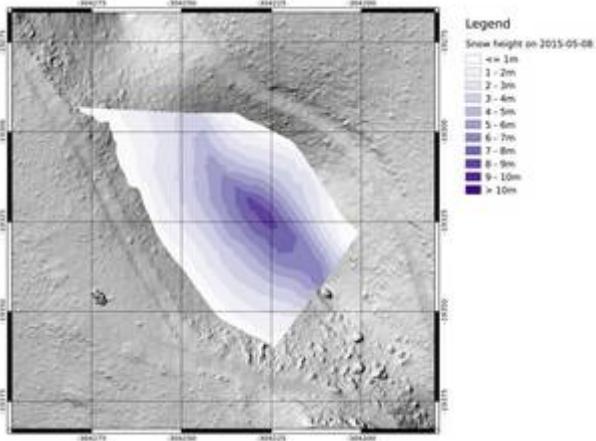
Obtained 3d Volume for the automatic daily observation



Ref: Abou Chakra, C, Gascoïn S., Somma, J., Drapeau L. & Fanise Pascal (2019). "Monitoring the snowpack volume in a sinkhole on Mount Lebanon using time lapse photogrammetry". Sensors 19(18):3890. DOI: 10.3390/s19183890

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Time-lapse photogrammetry toward automatic snow daily snow volume estimation on the pilot doline at Jabal El Dib.



Legend
Snow heights on 2015-05-08

- <= 1m
- 1 - 2m
- 2 - 3m
- 3 - 4m
- 4 - 5m
- 5 - 6m
- 6 - 7m
- 7 - 8m
- 8 - 9m
- 9 - 10m
- > 10m

Ref: Abou Chakra, C, Gascoïn S., Somma, J., Drapeau L. & Fanise Pascal (2019). "Monitoring the snowpack volume in a sinkhole on Mount Lebanon using time lapse photogrammetry". Sensors 19(18):3890. DOI: 10.3390/s19183890

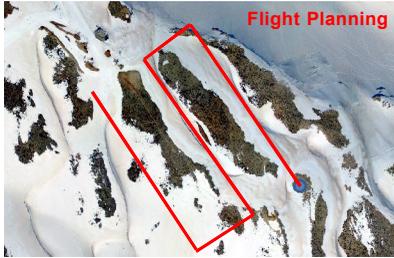
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Snowmelt monitoring using Drone

28 March 2017
to
11 July 2017



Ref: Abou Chakra, C., Somma, J., Gascoin S., Somma, J., Drapeau L. & Fanise Pascal (2020). "Impact of flight altitude on unmanned aerial photogrammetric survey of the snow height on mount Lebanon". ISPRS, . <https://doi.org/10.5194/isprs-archives-XLIII-B2-2020-119-2020>.

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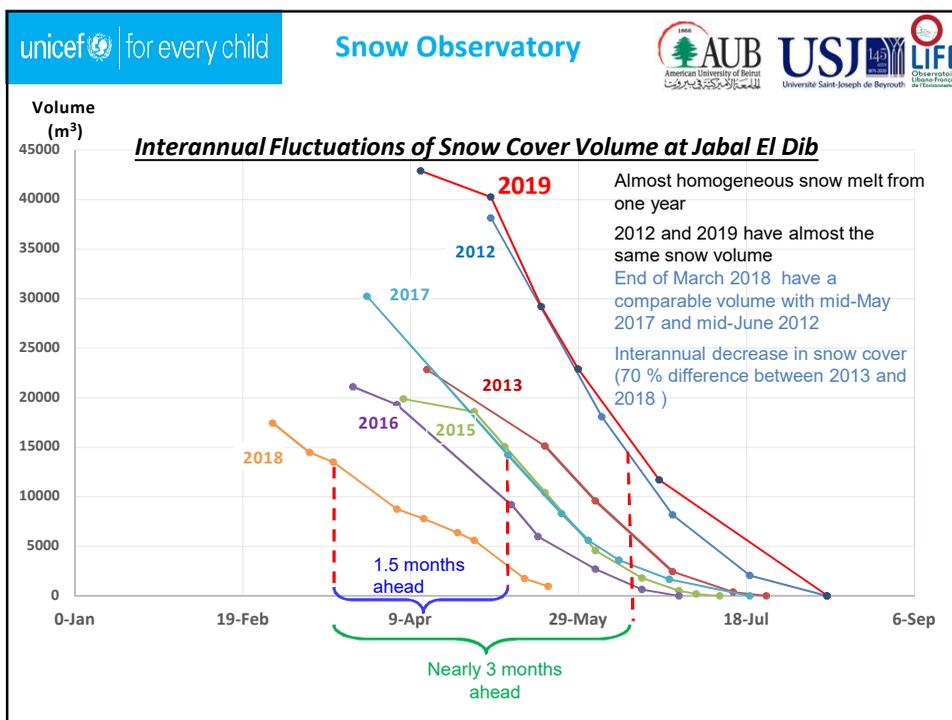
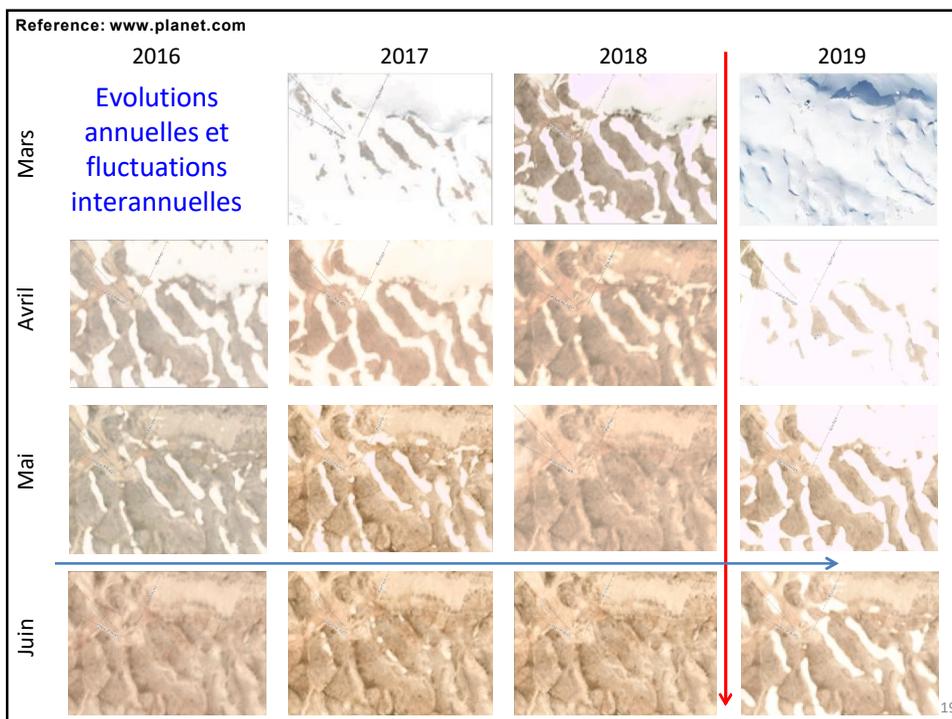
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Obtained 3d Volume using drone observation



Ref: Abou Chakra, C., Somma, J., Gascoin S., Somma, J., Drapeau L. & Fanise Pascal (2020). "Impact of flight altitude on unmanned aerial photogrammetric survey of the snow height on mount Lebanon". ISPRS, . <https://doi.org/10.5194/isprs-archives-XLIII-B2-2020-119-2020>.



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Prediction of total snowmelt date



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Prediction of total snowmelt date

(Jabal El Dib in 2018)

 28 Feb 2018	 18 March 2018	 06 April 2018	 18 April 2018	 24 April 2018
 29 April 2018	 14 May 2018	 20 May 2018	<p>Date of prediction →</p> <p>Uncertainty of prediction = ± 1 week</p>	
				 15 June 2018

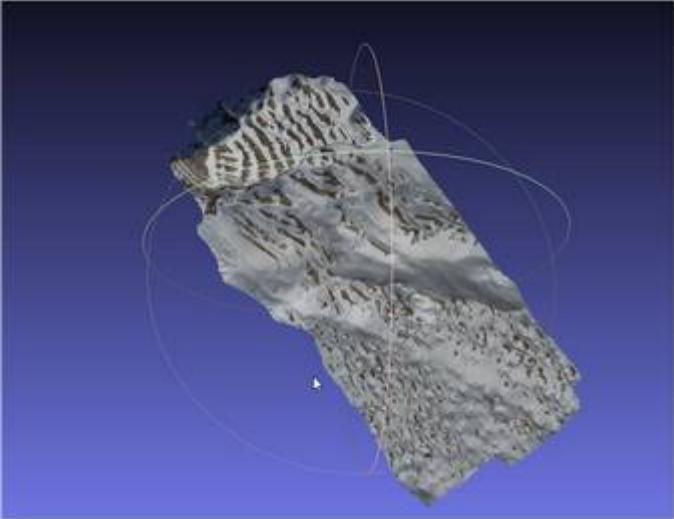
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Future Expectations

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3D Animation of the observed area on 3 March 2020
Observed area: 3 km * 1 km



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This slide features a 3D topographic map of a mountainous region. The terrain is rendered in shades of gray and white, showing significant elevation changes. A blue rectangular bounding box is overlaid on the map, indicating the observed area of 3 km by 1 km. The map is set against a dark blue background. The slide includes logos for UNICEF, Future Expectations, AUB, USJ, and LIFE.

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Future Expectations

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Time-lapse of the observed area during 2020 snow season
Observed area: 3 km * 1 km



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This slide displays a satellite time-lapse image of the same 3 km by 1 km area shown in the previous slide. The terrain is now covered in snow, appearing in shades of white and light gray. The same bounding box is visible. The slide includes logos for UNICEF, Future Expectations, AUB, USJ, and LIFE.

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 Expected Challenges





To confirm that the evaluated snow volume on a large surface area have the same melting tendency as the pilot observation site;

Verify if it is possible to estimate the snow volume through the 2D satellite images having a free access and high temporal and spatial resolutions;

To have a reliable predictive approach on the date of the total melting of large snowy area;

In our case, the snow being up-stream on the hydrological cycle, it seems important to monitor as part of an observatory due to the impact that the monitoring can have on the understanding of the hydrology of the area.

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Thank You



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