

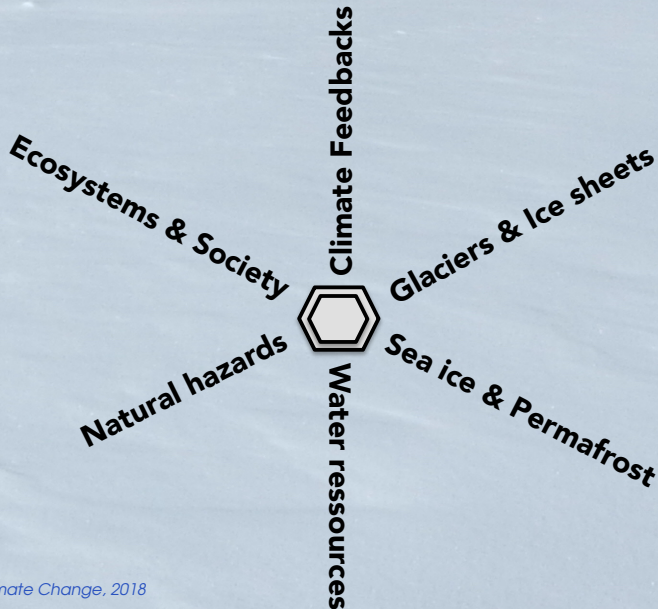
DUST AND SNOW

Marie Dumont

Météo-France - CNRS, CNRM/CEN, UMR 3589, Grenoble, France

inDust, November 2021





e.g. Let it snow, Nature Climate Change, 2018

SNOW WHITE

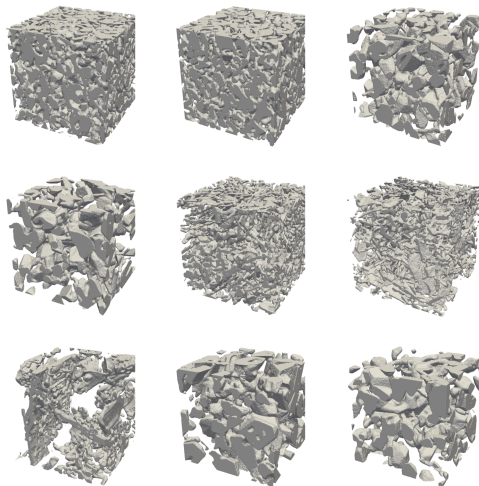


Picard et al., 2019

SNOW WHITE



Picard et al., 2019



Lombardo, Schneebeli and Löwe, 2021



A THOUSAND SHADES OF WHITE

Snow reflectance and snow microstructure

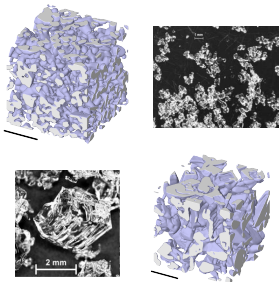
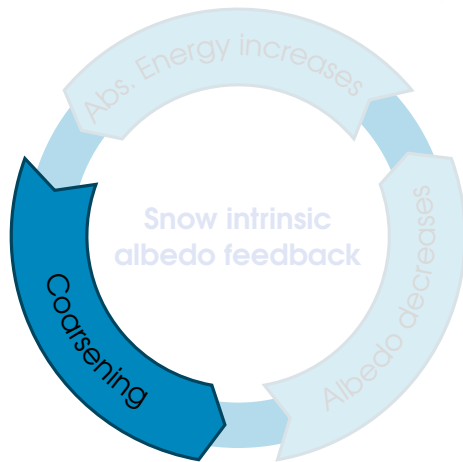


Photo : Fierz et al., 2009

Tomography : Flin F. and Calonne N., 2011

Optics and microstructure

$$\frac{S}{\rho_{ice} V} \approx \frac{\text{scattering}}{\text{absorption}}$$



e.g., Flanner & Zender, 2006



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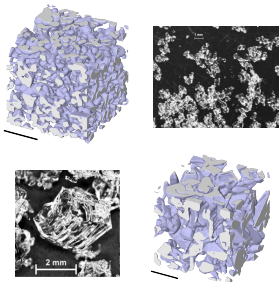
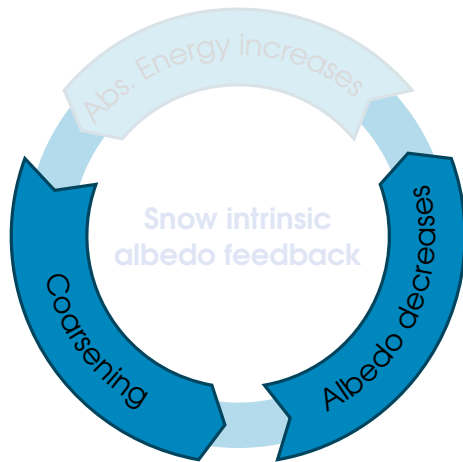


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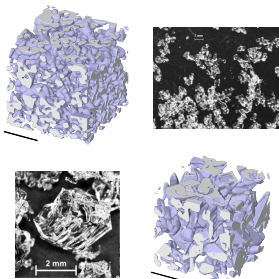
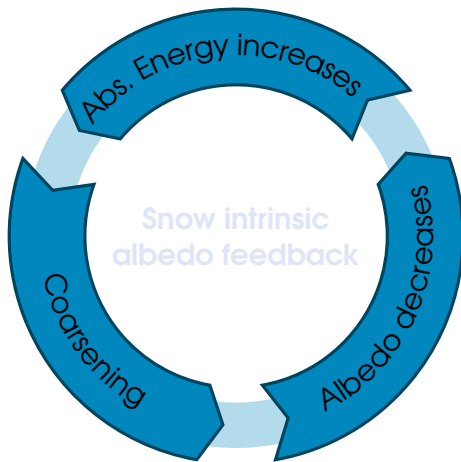


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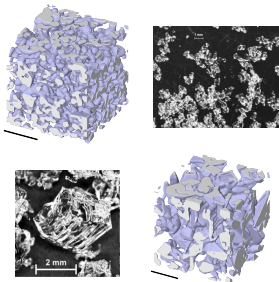
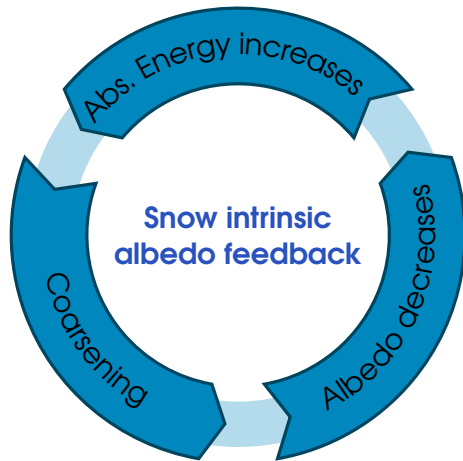


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Optics and microstructure

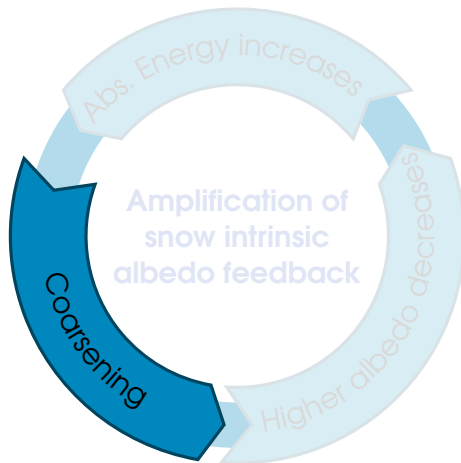
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DIRTY SNOW

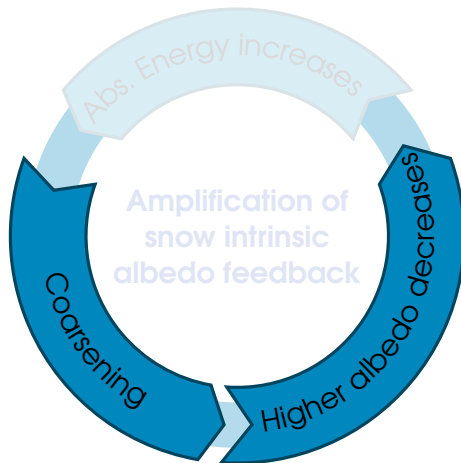
Snow reflectance and light absorbing particles (LAPs)



e.g., Doherty et al., 2010, Dumont et al., 2014, Skiles et al., 2018

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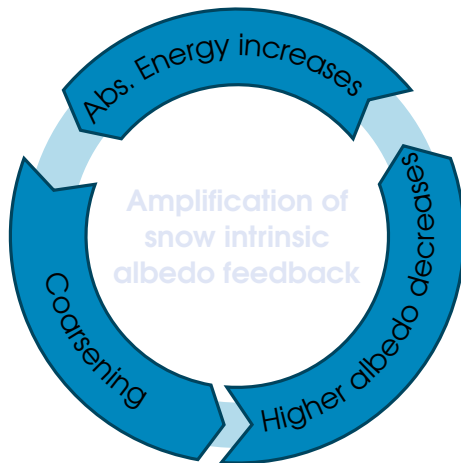
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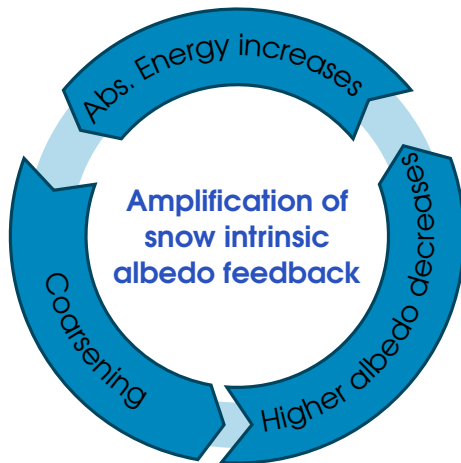
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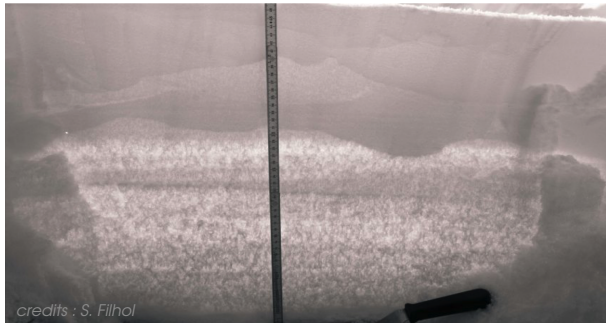
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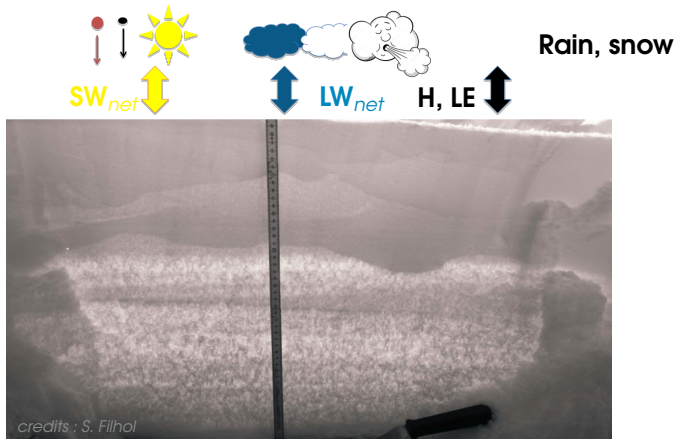
SNOWPACK EVOLUTION



SNOWPACK EVOLUTION

Atmosphere

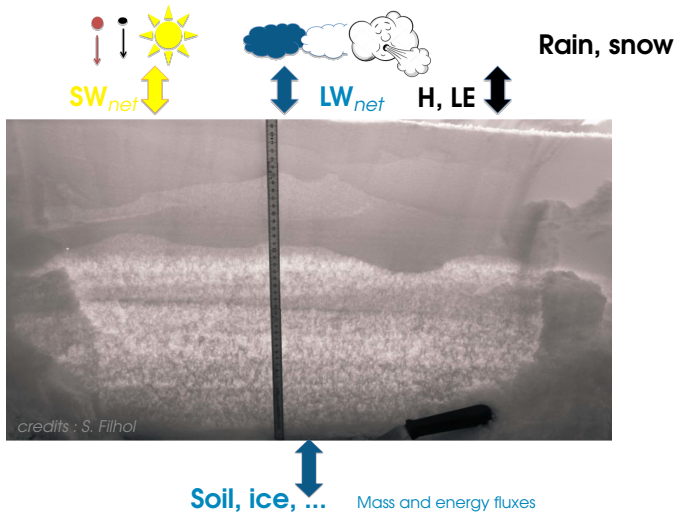
Mass and energy fluxes



SNOWPACK EVOLUTION

Atmosphere

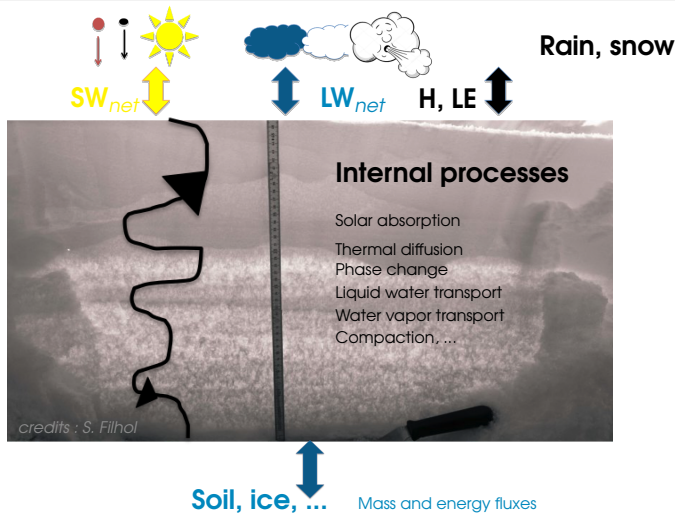
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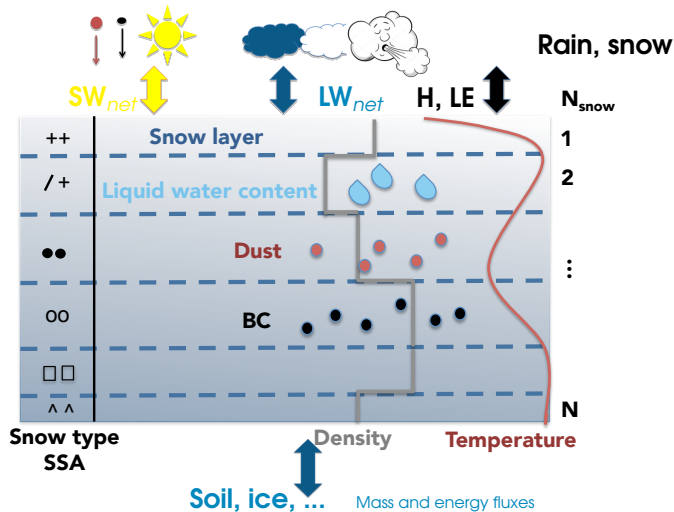
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SNOWPACK EVOLUTION

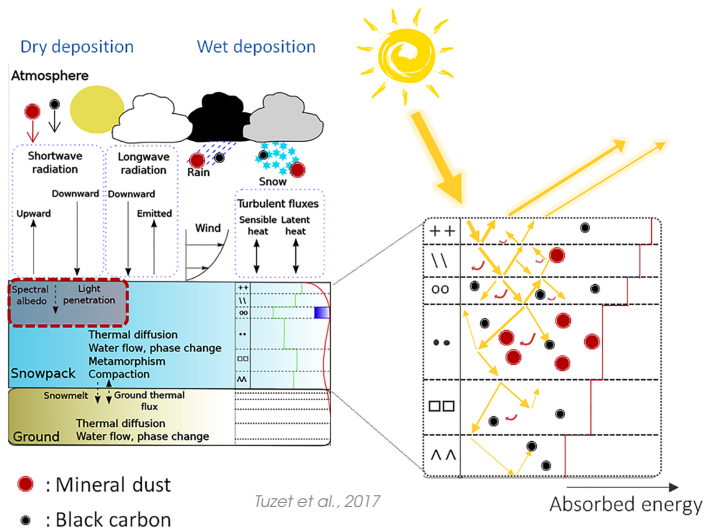
Atmosphere

Mass and energy fluxes

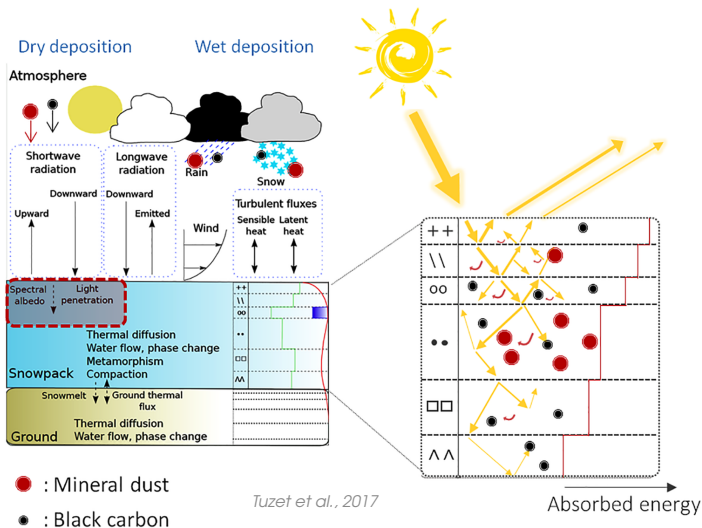


e.g. Crocus : Brun et al., 1992; Vionnet et al., 2012, SNOWPACK : Bartelt and Lehning, 2002; Lehning et al., 2002

MODELLING LIGHT ABSORBING PARTICLES IN SNOW

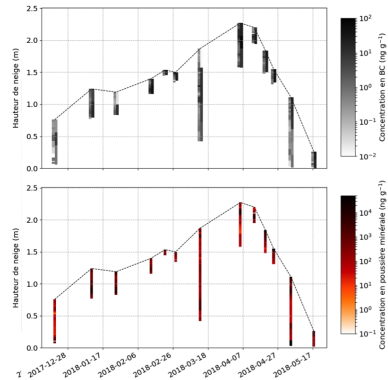
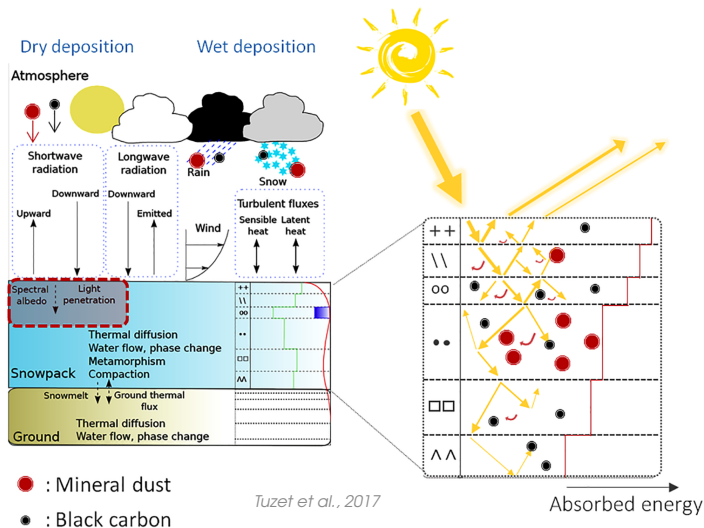


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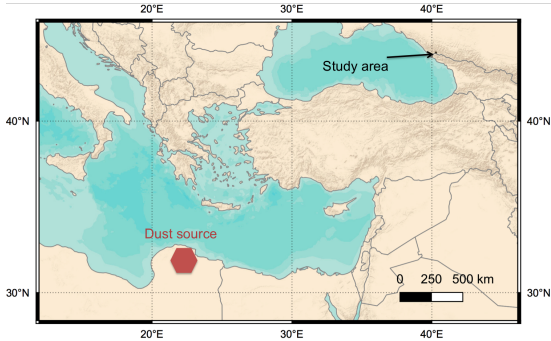
Tuzet et al., 2020

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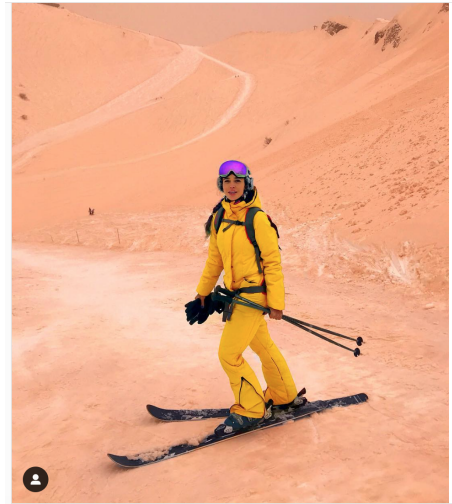


Tuzet et al., 2020

ORANGE IS THE NEW WHITE

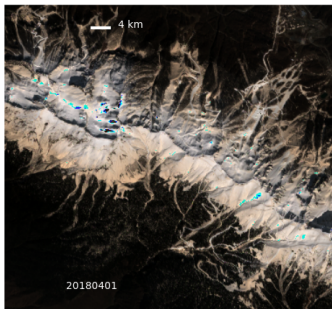


Instagram, March 2018; Gascoin, Dumont and Picard, 2018, EGU news

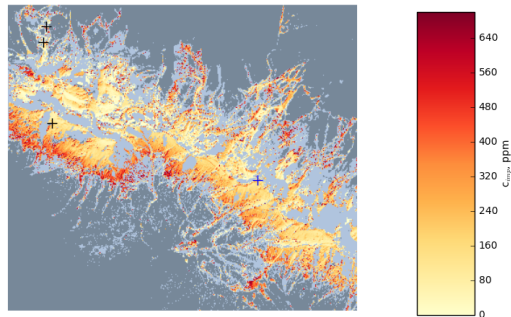


DUST CONTENT EVOLUTION FROM SENTINEL-2

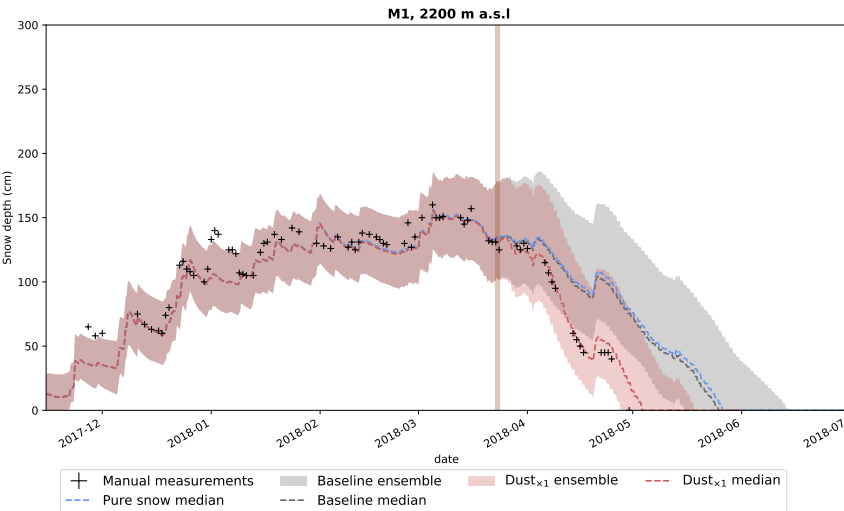
RGB composite



Surface dust content

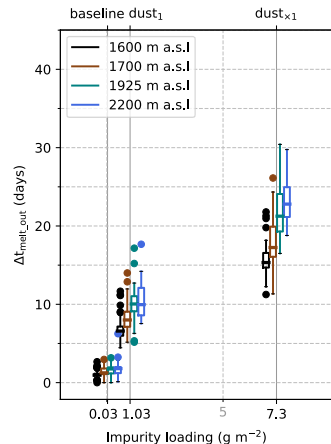
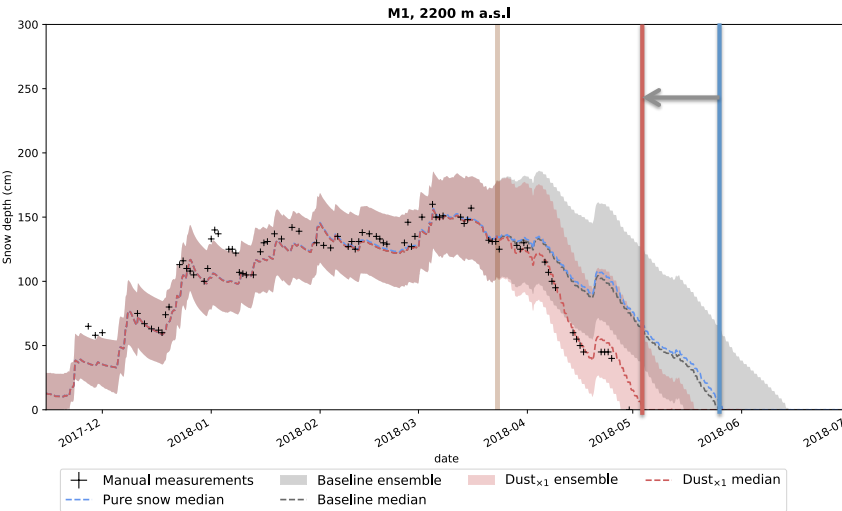


ORANGE SNOW MELTS FASTER



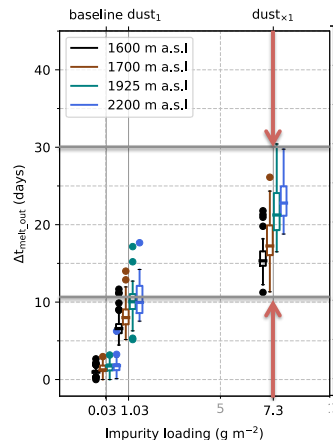
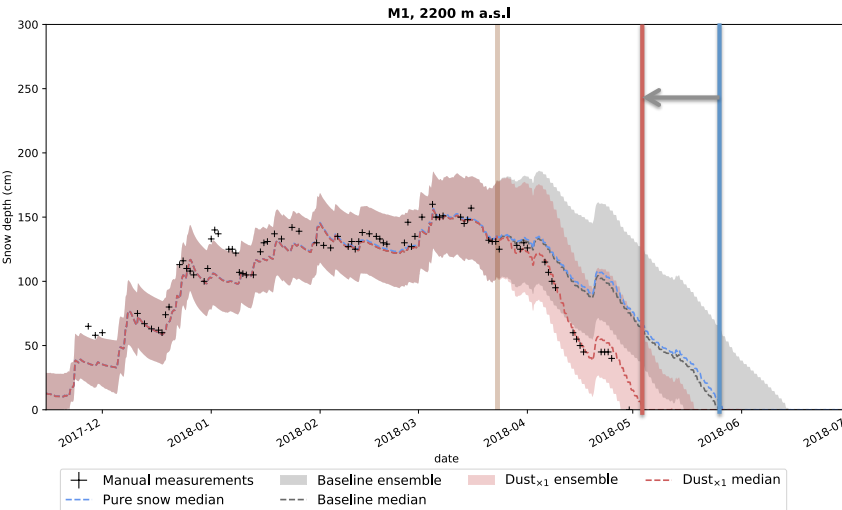
Dumont, et al., 2020; also see Di Mauro et al., 2019

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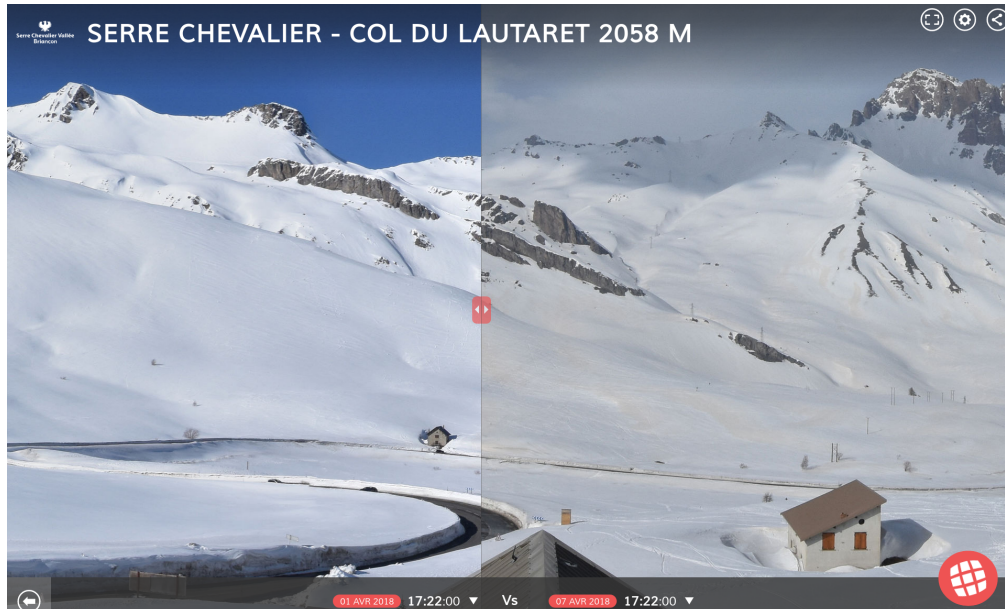


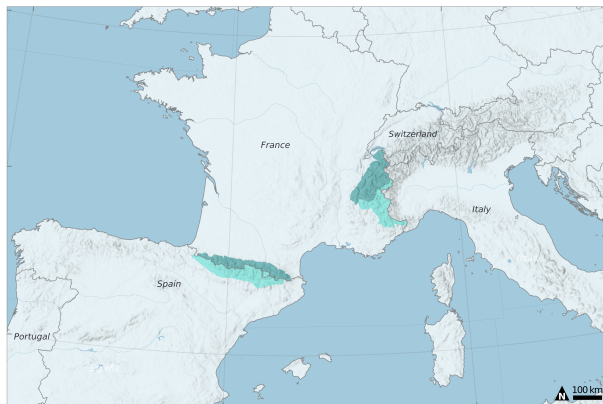
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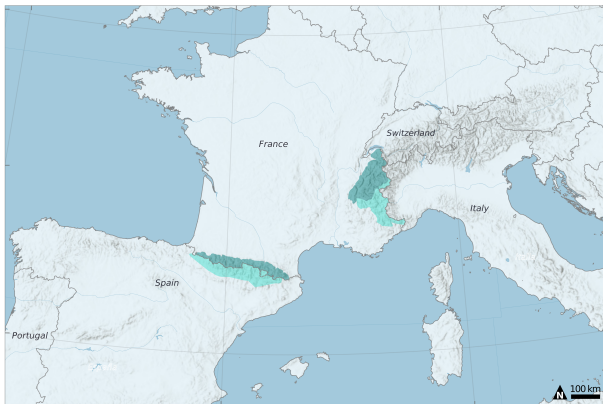
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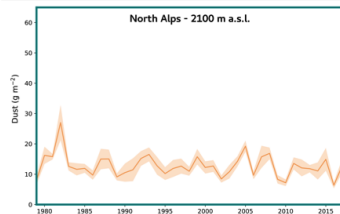
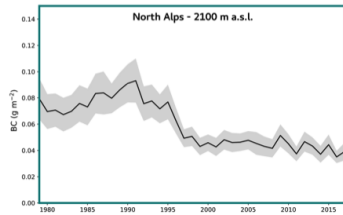
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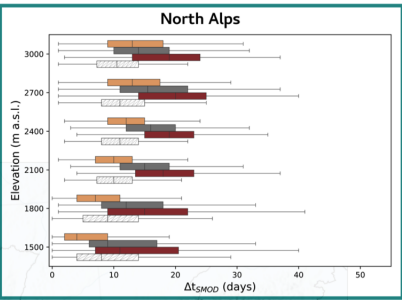




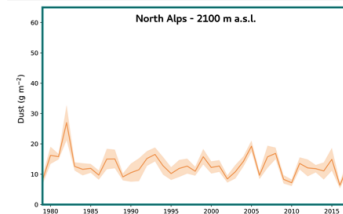
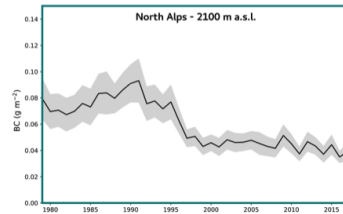
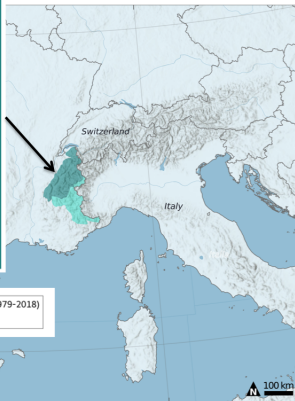
Reveillet et al., in review



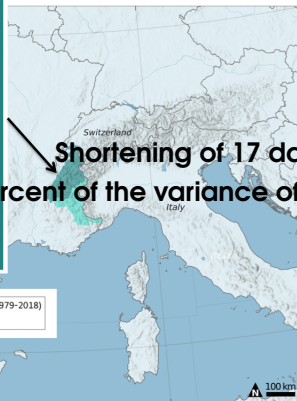
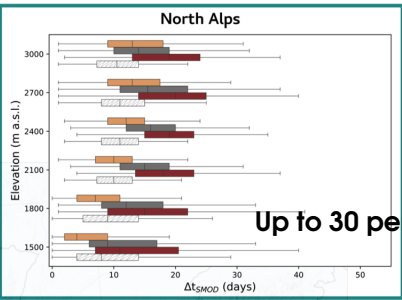
ALADIN-Climat Nabat et al., 2015



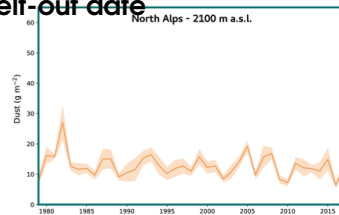
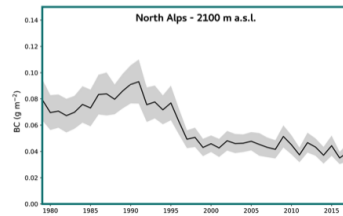
SMOD difference between pure (i.e. LAPs = 0) and impure simulations (1979-2018)
 Impure simulations: Baseline BC+Dust BC only Dust only



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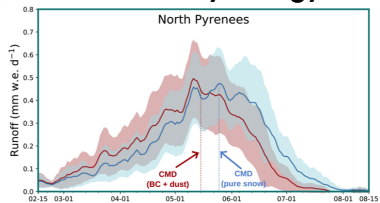
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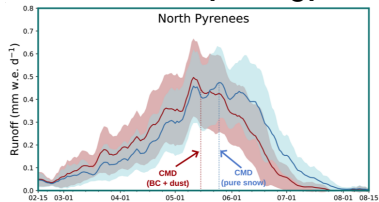
IMPACTS

Mountain hydrology



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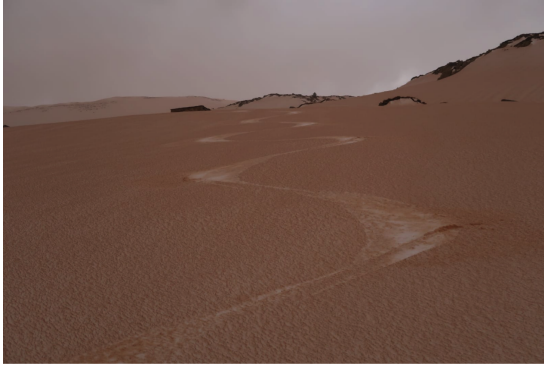


Reveillet et al., in review

Mountain ecosystems



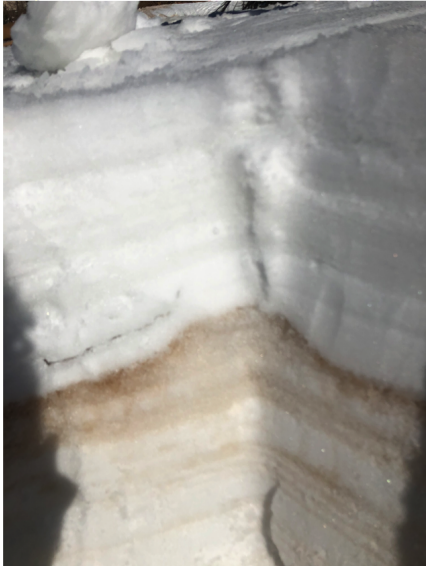
e.g. Niittynen et al., 2020

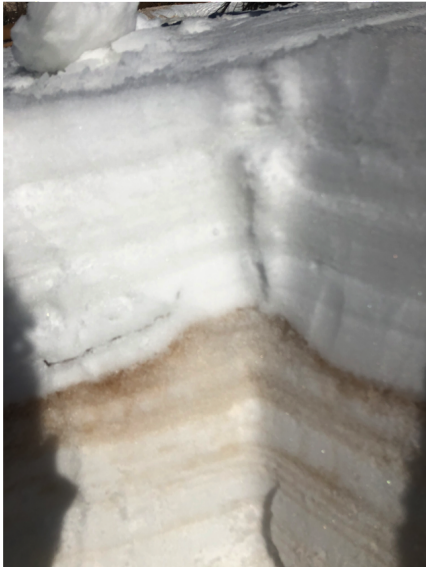


Q. Libois, Pyrennees

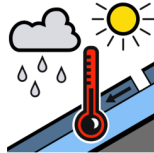


D. Goetz, French Alps





Impact on the snow temperature profile



Earlier wet snow



Less or more stable
No effect

Dick et al., 2021



← Tweeter



Simon Gascoin
@sgascoin

📌 Si vous allez en montagne ce weekend : aidez-nous à mesurer la neige orange ! ❄️❄️

Les données seront utilisées par les scientifiques

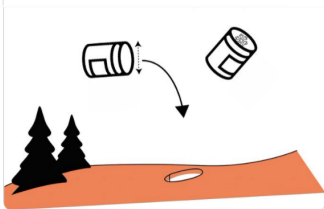
@CNRS_Toulouse @meteofrance @ObsMip

@OSUG_fr @IGE_Grenoble @CesbioLab

Merci de retweeter

Plus d'infos : labo.obs-mip.fr/multitemp/aide...

- 1) Prélevez l'intégralité de la couche de neige orange
- 2) Prendre une photo avec un smartphone (géolocalisé)
- 3) Stockez chez vous (pas besoin de garder au frais)
- 4) Notez le diamètre de votre récipient de prélèvement



8:43 PM · 6 févr. 2021 · Twitter Web App

217 Retweets 14 Tweets cités 187 J'aime



← Tweeter



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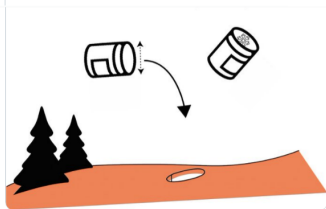
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Prélèvement « neige orange » - Savoie – LA FECLAZ

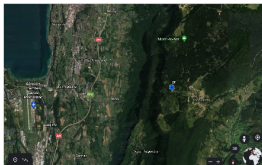
Préleveur : GILLET Frédéric (AQUALTI)

Date : 12 février 2021 (15h)

Lieu : sommet du télésiège Orionde, station de LA FECLAZ (73)

Points GPS : 45°38'45"N 5°58'13"E

Altitude : 1523 m



Profondeur : sous 25 cm de neige fraîche

Largeur du prélèvement : 20 cm x 20 cm

Epaisseur du prélèvement : 5 cm

Dispositif de prélèvement : 2 bocaux en verre (diamètre 9 cm)



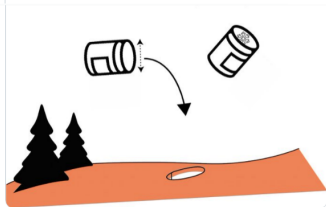
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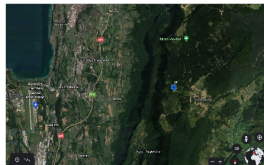
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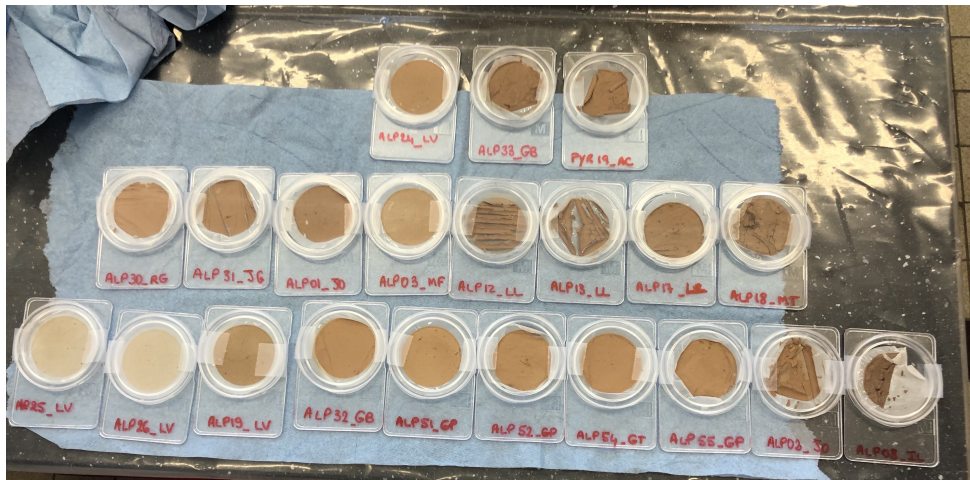
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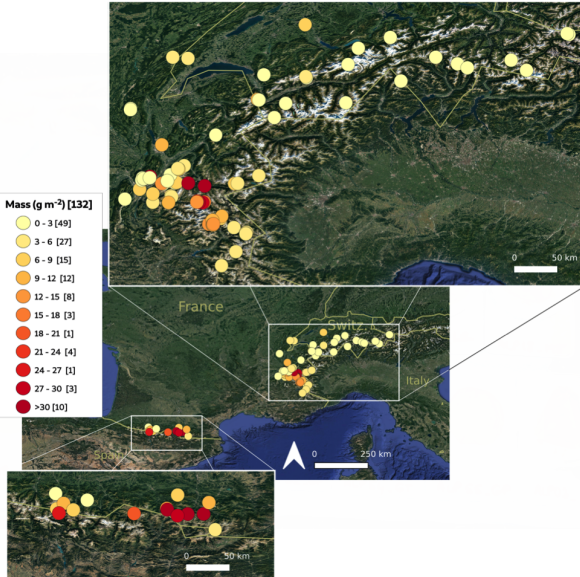
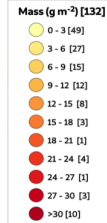
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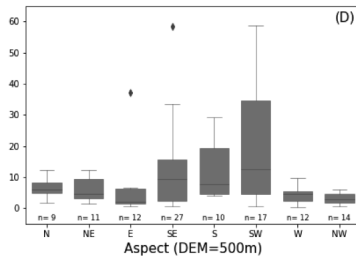
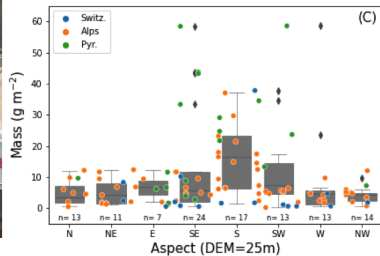
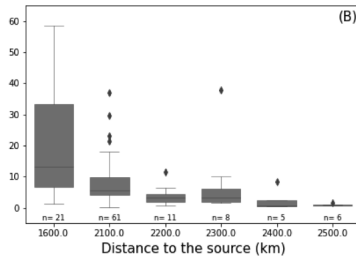
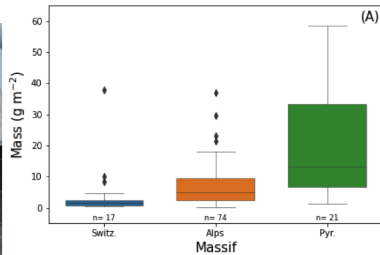
Épaisseur du prélèvement : 5 cm

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KEY MESSAGES

- Dust on snow enhances the absorption of solar energy by the snowpack and modify snowpack evolution.
- The main impact of dust deposition is the accelerated snow melt that shortens the snow cover duration. In cascade, it impacts the hydrological cycle and the soil temperature.
- Dust deposition can change snowpack mechanical stability and may have other impacts not directly related to radiative effects.

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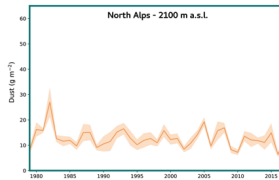
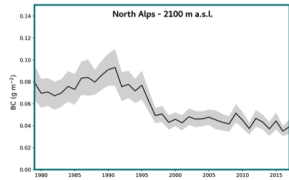
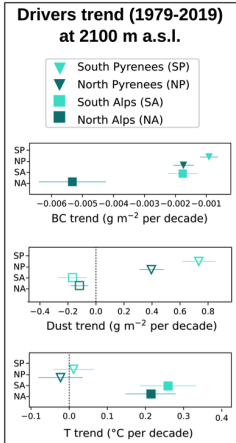
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- Dust on snow enhances the absorption of solar energy by the snowpack and modify snowpack evolution.
- The main impact of dust deposition is the accelerated snow melt that shortens the snow cover duration. In cascade, it impacts the hydrological cycle and the soil temperature.
- Dust deposition can change snowpack mechanical stability and may have other impacts not directly related to radiative effects.



TRENDS IN SNOW COVER AND IMPURITIES DEPOSITION



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