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## Glacio-hydrological behaviour of the Gasbreen, a debris-covered glacier from high Arctic

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### **Presentation outline**

- RAW project
- Background
- Debris-Covered glacier

**Global distribution (extent and thickness)** 

**Debris-cover processes and control** 

Gasbreen Glacier: Hornsund Svalbard

Characteristics

**Melting pattern** 

**DEM Differencing** 

**Debris-cover control** 

**Glacio-hydrological modelling** 

- Conclusions
- Questions

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Project funded by the Norwegian Financial Mechanism 2014-2021 Grant agreement no. UMO-2019/34/H/ST10/00504

#### Head of the Project: Mateusz Moskalik



\* purchased within the project \*\* more information about methods in text



### orway ants Background



Projected changes in glacier area and mass balance on **Svalbard** (Marzeion et al, 2020)



Schuler et al 2020

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## **Debris-covered glaciers: Global distribution**



Scherler et al 2018

#### Debris-covered glaciers: Global distribution and Svalbard Norway Arctic Canada Souti

1008 km² (2.47%)







0.2 10' 10' 10' 10' 10' 10' 10'









#### Scherler et al 2018; Rounce et al 2021



## Norway grants Debris-covered glaciers: Debris-cover processes and control

VILL

Group	Thickness (cm)	No. of stakes	Observed average ablation in case of debris cover (cm. w.e.d <sup>-1</sup> )	Calculated average ablation in case of debris free (cm. w.e.d <sup>-1</sup> )	Control (multiple)
A	<2	4	-1.7	-4.6	2
B	2 to 5	2	-1.4	-5.0	3
С	5 to 25	2	-1.0	-6.5	6
D	25-50	3	-1.0	-6.3	6
E	>50	3	-0.7	-7.1	10









Catchment area: 27.93 km<sup>2</sup>

Glacier area: 10.93 km<sup>2</sup>

Debris cover area: 1.93 km<sup>2</sup>



76°57'0"N



#### Norway Upper **Gasbreen: Debris-cover thickness** grants DEBRIS THICKNESS (cm) Middle ... Lower ALTITUDE (masl)

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## Norway Gasbreen Glacier: Glacier Ice-thickness



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## Gasbreen: Glacier retreat (Vertical thinning)



Glacier area loss:  $0.52 \pm 0.05 \text{ km}^2$  (0.03 km<sup>2 a-1</sup>)

Terminal retreat: approx. 406  $\pm$  15 (21 m<sup>a-1</sup>)

Average Glacier retreat in Hornsund region (Blaszczyk et al 2015)

Glacier area loss: 1.6 km<sup>2 a-1</sup>)

Terminal retreat: approx. 45 - 70 m<sup>a-1</sup>)

Project funded by the Norwegian Financial Mechanism 2014-2021 Grant agreement no. UMO-2019/34/H/ST10/00504 Gasbreen: Glacier retreat (Vertical thinning) Norway grants 15°50'0"E 15°55'0"E 16°0'0"E 16°5'0"E Gasbreen dh/dt - 2003 - 2022 76°55'0"N 76°55'0"N 76°54'0"N 76°54'0"N **Profile Graph Title** 41 30 dh/dt 20 10 76°53'0"N High : 79 76°53'0"N -10 -20 -30 -40Low : -58 5,000 10,000 15,000 20,000 25,000 30,000 Profile Graph Subtitle 0 0.751.5 4.5 Miles 15°50'0"E 15°55'0"E 16°5'0"E 16°0'0"E

## Norway grants Gasbreen: Debris-cover control





## **Norway** MATILDA - Modeling Water Resources in grants Glacierized Catchments



Seguinot, J. (2019); Ayzel, G. (2016); Bergström, S. (1992); Seibert et.al. (2018).

## Norway grants ERA5 Reanalysis data: Temperature/Precipitation





### Norway grants Glacier-discharge





## B Norway grants Conclusions:

- The glacier has lost significant glacial mass (vertically and horizontally) during the period 2003-2020.
- The observations showed that the debris thickness over the glacier ablation zone varied between 3 and 20 cm and debris cover over Gasbreen Glacier has been increasing annually.
- The increasing debris-cover over the glacier have affected the glacier ablation.
- The glacier melt has majorly contribution in the melt-runoff.
- It has been observed that the glacio-hydrological properties of debris-covered glaciers differ between clean ice from land/marine terminal glaciers, although they are within the same climatological, geological, and geomorphological setting.
- Incorporation of detailed in-situ measurements for River discharge, Mass-balance and energy balance models.

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Thanks

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## **Questions ?**









