## Freeze/ Thaw mapping using SMAP data over the Canadian Tundra: Sheldrake and Nastapoka (Turjusuk park) INRS

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## 1. INTRODUCTION

The seasonal Freeze/Thaw (F/T) cycle is a major phenomenon

in the climate system and plays an important role in ecosystem

functioning. Boreal and Arctic regions form a land cover mosaic where vegetation structure, conditions and distribution are strongly regulated by the environmental factors such as soil



Soil moisture and temperature sensors;

Landscape Photographs;

Vegetation species and structure.



4.1 TB Correction for Water Bodies coverage  $TB = \alpha TB_{water} + (1 - \alpha)TB_{Land}$ 

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**5. RESULTS** 

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moisture, permafrost status, growing season length and disturbance. The frozen soil mapping can be improved by using the NASA **SMAP** instrument launched in January 2015 which is a passive microwave Radiometer operating at L-band (1.20-1.41 GHz).

2. OBJECTIVE

To validate L1C\_TB SMAP product to monitor F/T state at low

resolution (36 km) over the **Tundra and the Boreal Forest**.

## **3. STUDY SITE**

The experimental site is the Sheldrake catchment in the

National Tursujuq, Park on the East coast of Hudson Bay.



③ Soil moisture sensor 25 cm Temperature sensor 5cm Soil moisture sensor 10 cm Osil moisture sensor 50 cm

Fig.3. Localisation of the probes near or in the Tursujuq park



Fig 6. TB correction for Water Bodies Coverage (%) effects within a given pixel

4.2 Freeze/thaw reference and threshold T(x)





Fig.1. Study site, Turjusuk Park, Nunavik, Quebec

## 4. Data base

- **Passive data :** SMAP Brightness Temperatures (TB) in
- processing Level-1C (L1C) at L-band, spatial resolution 36 km.
- Active data : PALSAR-2 (fine resolution: 7-80 m).



Fig.4. Example of soil temperature and soil moisture **2016-2017 profiles near the Turjusuk park.** 

4. METHODOLOGY





Optical data : MODIS (250 m), Landsat (30 m).



**Fig.2.** L1C TB data characteristics

Fig.5. Freeze/Thaw mapping algorithm adapted from (Rautiainen et al., 2016)

-150	$\Delta T(x,t) < T(x,t).$	→Freeze state	$\Delta T(x,t) > T(x,t)$	$(x, t) \longrightarrow$ Thaw state
-200	delta_N	PR	_200	delta_NPR
Fig 8. Delta_NPR for (a) 29 December and (b) 26 April 4.4 Validation (Umiujaq pixel, Hum-4)				
St	First F day	First T day	First F day	First T day
	sensor	sensor	SMAP	SMAP
lum-4	23-10-15	11-05-16	22-10-15	10-05-16

6. CONCLUSION

The threshold is calculated for each pixel using freeze and thaw

NPR distribution (Fig.7 and Fig.8). Freeze and Thaw state are

validated using soil temperature measured by in-situ sensors.