

ARQULUK: A FEW NUMBERS

- 12 research projects
- 22 HQP (Highly Qualified Personnel)

3 PhD. thesis

1 BSc. dissertation

7 MSc. thesis

9 research assistants

2 internships



ARQULUK : A FEW NUMBERS

- **1 canadien patent** for the core-barrel prototype
- **Many collaborations** internally at Laval University and with several national and international institutions
- **7 project committees**
- **7 annual meetings**
- **Partners implication** (meetings, project committees, products, expertise, assistance on field work, ...)



PUBLICATIONS

55 publications:

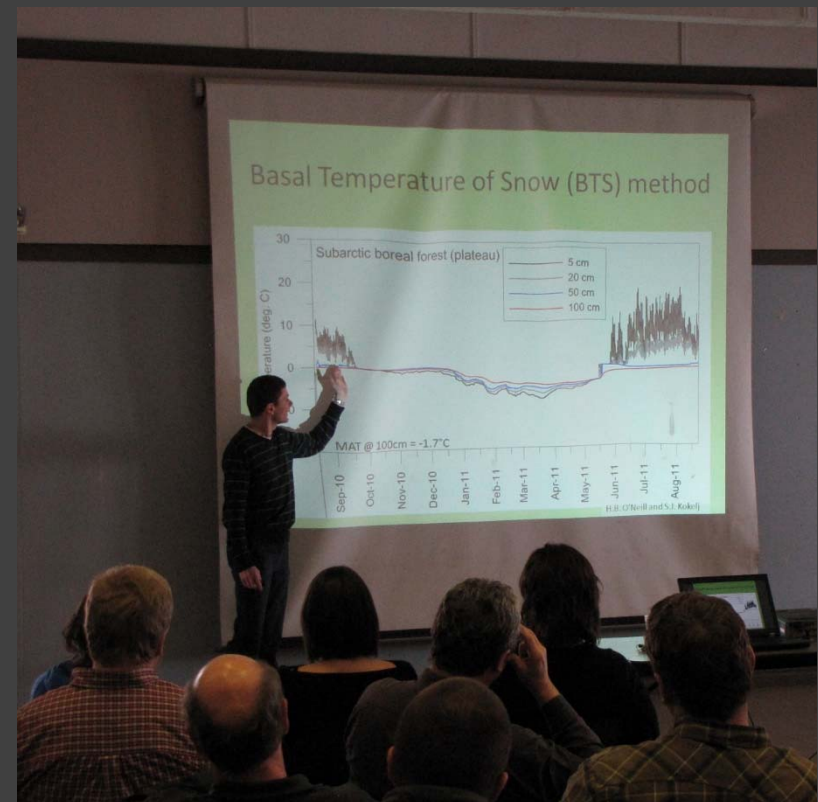
5 master thesis

2 papers in Cold Regions Science and Technology journal

7 conference paper

41 presentations oral / poster

... and more to come!



SCHOLARSHIPS



12 important scholarship

- Laurie-Anne Grégoire : BMP Innovation, **CRSNG-FRQNT**
- Simon Dumais : **FRQNT**
- Julie Malenfant-Lepage : **W. Garfield Weston Award**, AUCEN
Fonds Marthe et Robert Ménard, ULaval-FSG

- **EnviroNord-CRSNG** : J. M-Lepage and F. Lanouette
- **AQTr** : L-A. Grégoire
- **ATC** : S. Dumais, L-A. Grégoire, B. Loranger and C. Richard
- **Congrès Infra Québec – CERIU** : L-A. Grégoire

- Plusieurs autres bourses :**
- mobility
 - internship (FQRNT)
 - Northern Scientific Training Program
 - ...

DISTINCTIONS



10 Excellence Awards

Simon Dumais :

- Pierre-La-Rochelle, SCG Québec
- Faculté Sciences et Génie - ULaval
- EnviroNord-CRSNG

End of study award

- EnviroNord-CRSNG : S. Dumais

Thesis competition

- AQTr : S. Dumais and L-A. Grégoire

Communication oral / poster




- ICOP - Inter. Conf. On Permafrost : H. Brooks (2016) and Julie Malenfant-Lepage (2012)
- ATC : S. Dumais
- Center for Northern Studies : several students
- EnviroNord-CRSNG : several students

arquluk.gci.ulaval.ca

All documents will be available on the website in a few weeks:
symposium presentation, thesis, publications,
tools, chart, product sheet, ...

PRUDUCT SHEET - EXAMPLE




THERMAL STABILIZATION OF TRANSPORT INFRASTRUCTURE BUILT ON THAW-SENSITIVE PERMAFROST USING HIGH ALBEDO SURFACE

Simon Dumais, Caroline Richard, Guy Doré (Director)
Theme 3 - 2 MSc. projects

OBJECTIVES

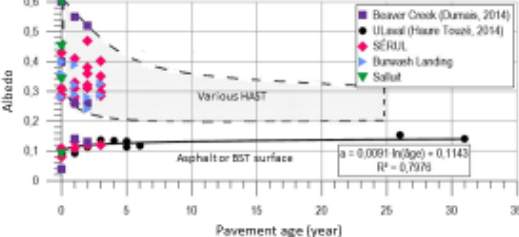
Develop a method for thermal stabilization of transportation infrastructures built on thaw-sensitive permafrost, using High Albedo Surface Treatment (HAST) to limit heat absorption.

- Quantify the effect of a pavement's albedo on its surface temperature
- Develop an approach to assess the technical properties of HAST
- Document the evolution of albedo with time for various pavement surfaces
- Develop a thermal stabilization method using modeling



Salluit, Nunavut

Study sites: Alaska Highway (Yukon), Salluit and Forêt Montmorency (Québec)

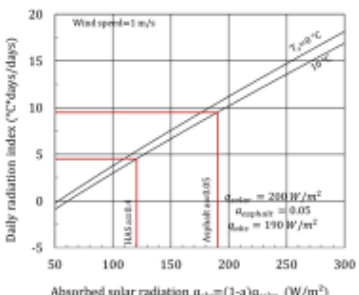


Evolution of albedo for protected and unprotected surfaces

While aging, the albedo of HAST tends to decrease due to the fatigue of the coating, while asphalt albedo tends to increase due to bitumen oxidation. The shaded area represents the estimated relation between albedo and time.

RESULTS

- A calculation tool, using a simplified energy balance, and abacus was developed to assess pavement surface temperature and thaw penetration based on the surface albedo; allowing to quickly determine the need to use HAST on a specific site.
- A relation between the albedo and pavement age was made.
- Technical specifications of HAST was identified to assure efficient, sustainable and safe use of these products in permafrost regions, and were considered by the two private collaborators (Colas Canada and Nippo Corporation) manufacturing the products.
- Thermal stabilization approach was provided and includes: 1) A model (using TEMP/W) to determine thaw depth depending on site characteristics and albedo; 2) A chart to assess the difference of temperature required (T_{interface} - T_{permafrost}) to limit heat input and stabilize the infrastructure.

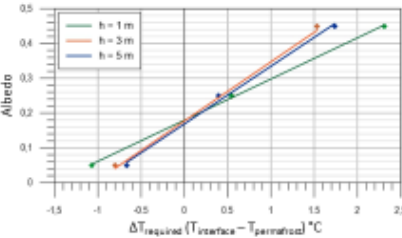


CHART

Calculation of daily radiation index for pavement surface.

- Calculate solar radiation absorbed by pavement surface $q_{obs} = (1 - \alpha)q_{solar}$
- Obtain radiation index uncorrected (RI) using the chart
- Other charts were developed to obtain correction factor for wind speed and convection, respectively ΔRI_w and ΔRI_c
- Calculate total radiation index of pavement surface RI_T or $RI_T = (RI + \Delta RI_w) + \Delta RI_c$
- Calculate the thawing index of pavement surface $TI_T = TI_p + RI_T$

Detailed calculation method available in S. Dumais, G. Doré, Cold Regions Science and Technology 125 (2016) 44-52













Surface albedo required to thermally stabilize the paved infrastructure according to $\Delta T_{required}$ for various embankment thicknesses. Based on Beaver Creek site, Yukon, for a permafrost temperature of -0,6 °C and a MAAT of -4,9 °C.

$$\Delta T_{required} = T_{interface} - T_{permafrost} = -0,3 - -0,6 = 0,3 \text{ °C}$$

BENEFITS

- The **thermal stabilization approach** will allow managers to use the embankment thickness (reload) and HAST to thermally stabilize paved sections of roads or airstrips built on thaw-sensitive permafrost.
- The **technology** has been **transferred** to our industrial partners: Colas Canada via Skookum based in Whitehorse and Nippo Corporation based in Japan. This should make them key players in the implementation of high albedo surface treatment in Yukon, Alaska and perhaps other countries.
- The next step will be to perform a **large scale pilot application** (around 1 km of road) to document the cost-benefit of the technique.

CONCLUSION

Perspectives ?

- Many projects in progress or starting up
 - ✓ Retrogressive thaw-slumps (TC)
 - ✓ Drainage (TC/Sentinelle Nord)
 - ✓ Infrastructure monitoring (Sentinelle Nord)
 - ✓ CRSNG-RDC « Glass foam »
 - ✓ Nunavik synthesis (MTMDET)
- We are interested in any new partnerships



THANK YOU
to our partners and collaborators
and to all those who contributed to the success
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