



# T-MOSAiC and RATiC

## Connections and Opportunities



**Warwick Vincent ([warwick.vincent@bio.ulaval.ca](mailto:warwick.vincent@bio.ulaval.ca)), João Canário, Skip Walker, Jana Peirce, Vladimir Romanovsky RATiC-ASSW, 26 May 2019, Arkhangelsk, Russia**

AREAS TO WATCH

## What's coming up in 2019



## WINTER DRIFT ACROSS THE ARCTIC OCEAN



The RV *Polarstern*, shown here on a 2013 polar research cruise, will spend a winter frozen in Arctic sea ice. ALFRED WEGENER INSTITUTE/STEFAN HENDRICKS

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## The science stories likely to make headlines in 2019

By Science News Staff | Jan. 3, 2019, 8:00 AM

### CLIMATE SCIENCE

## All eyes on polar ice

If you want to understand Earth's warming future, look to the poles. This year, scientists in two international projects will heed that call. In September, researchers will position a German icebreaker, the *RV Polarstern*, to freeze in Arctic sea ice for a year's stay. The ship will serve as the central hub for the €120 million Multidisciplinary drifting Observatory for the Study of Arctic Climate, hosting researchers from 17 countries. They'll study how polar clouds, ocean dynamics,

IASC **MOSAiC** expedition  
600 participants from 17  
countries; five icebreakers,  
aircraft and other support



# MOSAiC: Multidisciplinary drifting Observatory for the Study of Arctic Climate

“What are the causes and consequences of an evolving and diminished Arctic sea ice cover?”







## T-MOSAiC: Terrestrial Multidisciplinary distributed Observatories for the Study of Arctic Connections

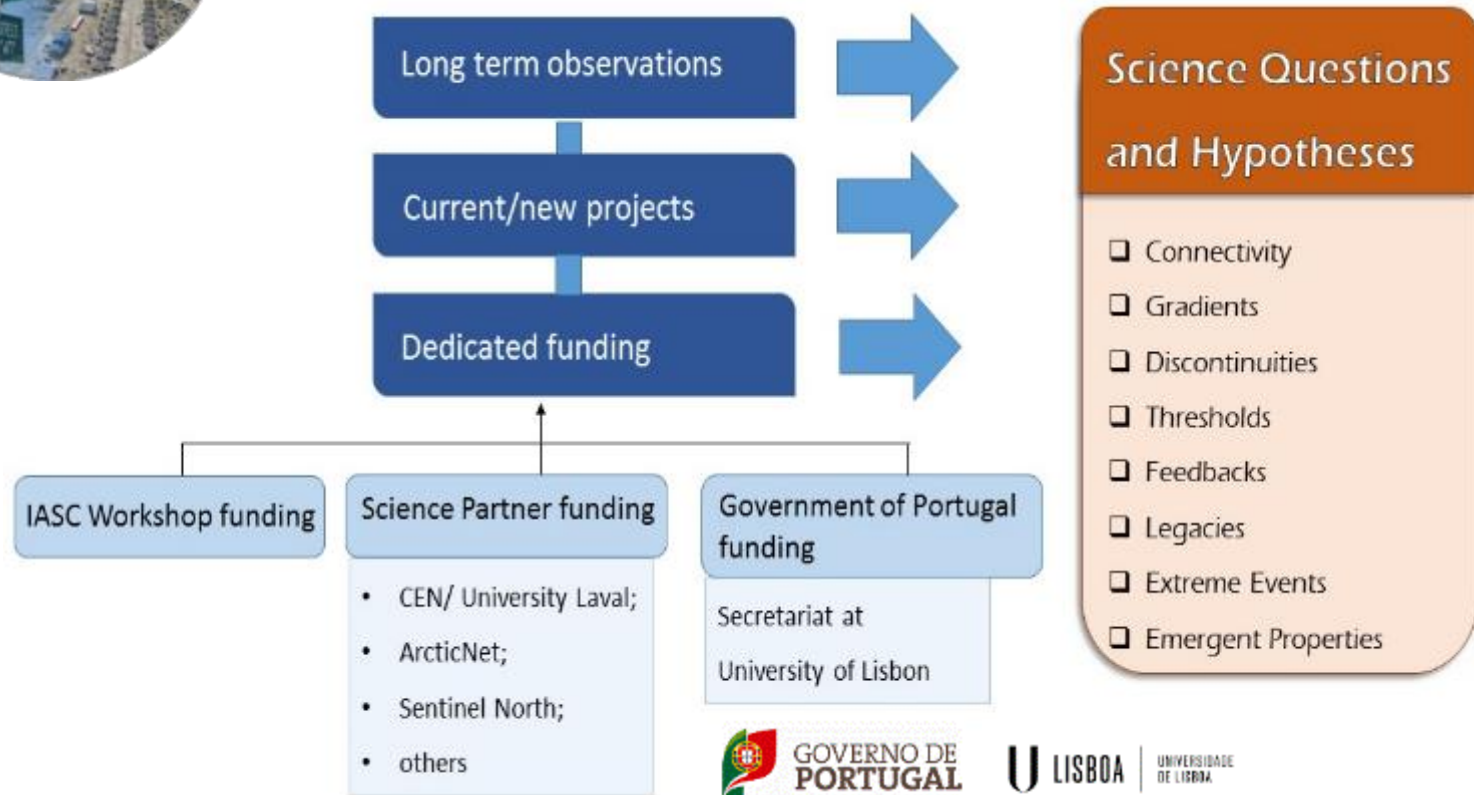
“What are the consequences of diminished Arctic sea ice cover and changes in Arctic Ocean climate for terrestrial geosystems, ecosystems and human systems ?”

## Terrestrial

- Geosystems
- Ecosystems
- Human systems



# T-MOSAiC - Implementation



ArcticNet



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# T-MOSAiC - Implementation

## Action Groups

These aim to bring together researchers to collaborate on common themes within T-MOSAiC and define **specific questions, activities & outputs**



# T-MOSAiC Science Plan

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## Example topics & questions

- Can land-based stations be used to improve radiation models and remote sensing products for Arctic seas and the surrounding lands?
- How does the connectivity between sea, atmosphere & land affect terrestrial components such as water, permafrost, ice, biota (including microbiota), northern communities and infrastructure?
- What are the coastal and inland gradients in these components of the Arctic system; how do the gradients differ among Arctic sectors?



# T-MOSAiC - Implementation

## Action Groups

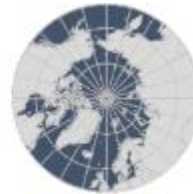
### Examples of T-MOSAiC Action Groups



Arctic Gas Fluxes



Arctic Radiation  
Balance



Arctic Transects



Coastal Processes



Northern  
Community Issues



Northern  
Infrastructure



Remote Sensing



Paleoclimatology/  
Paleoecology



# T-MOSAiC Remote Sensing Action Group



Remote Sensing

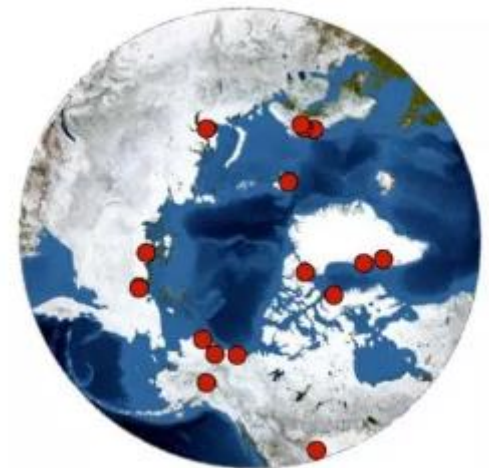


## Drone Ecology Network

Using drones to study high-latitude ecology

[Main](#) [Blog](#) [Media](#) [HiLDEN Protocols](#) [People](#) [Publications](#) [More ▾](#)

Welcome to the High-Latitude  
Drone Ecology Network (HILDEN)



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## Intranet



## Permafrost thaw and the changing Arctic coast, science for socioeconomic adaptation



# T-MOSAiC Arctic Infrastructure Action Group



## Rapid Arctic Transitions due to Infrastructure and Climate (RATIC): A contribution to ICARP III



# Rapid Arctic Transitions due to Infrastructure and Climate (RATIC): A contribution to ICARP III

**Walker, D. A., & J. L Peirce (editors)** 2015. Rapid Arctic Transitions due to Infrastructure and (RATIC). A contribution to ICARP III. University of Alaska Fairbanks, Fairbanks, Alaska.

## Recommendations

- **Develop an IASC interdisciplinary Infrastructure Action Group that includes participation by members of all IASC working groups and APECS;**
- Incorporate infrastructure-related issues more explicitly in the IASC working groups' research priorities;
- Promote regular infrastructure workshops at international scientific meetings;
- Emphasize the need for social-ecological-system studies in relationship to infrastructure;
- Promote infrastructure-related themes in future international research initiatives.



### Conceptual models, hypotheses, protocols, sites & data

*Eos*, Vol. 94, No. 42, 15 October 2013

## Adapting to Permafrost Change: A Science Framework

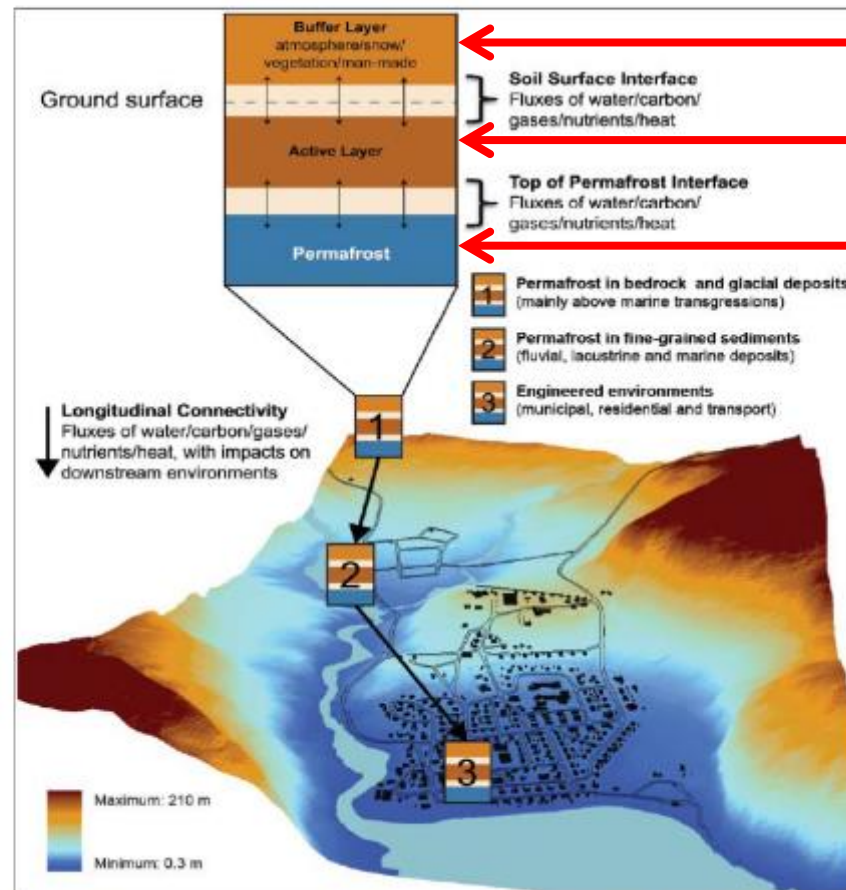
PAGES 373–375

Permafrost is a defining feature of the circumpolar north, and with climate change already affecting its range and behavior, understanding the fate of northern environments is a pressing concern. The Canadian Arctic Development and Adaptation to Permafrost in Transition (ADAPT) project is bringing together researchers from within and outside Canada to study the mechanisms and consequences of permafrost degradation and to place this information within an interdisciplinary systems framework.

Permafrost lands are home to many northern communities, including aboriginal peoples such as the Inuit, who have lived in the Arctic for millennia, and increasingly are the adopted home of many people who have moved from the south. The infrastructure and resources for all of these settlements, from drinking water and exploited wildlife to industry, runways, roads, and housing, critically depend on the state of the permafrost.

At a broad level, changes in the temperature of permafrost over time and depth define the physical and biogeochemical stability of the landscape. Small climate- or human-induced changes in temperature can weaken the ability of permafrost to serve its various functions, such as being a stable foundation for transportation infrastructure, sequestering carbon, or retaining freshwater in permafrost-bound lakes. Globally significant quantities of organic carbon are stored in permafrost soils. If the permafrost thawed fully, this would substantially raise atmospheric carbon dioxide levels.

## 3-Layer Model



**3. Buffer Layer**

**2. Active Layer**

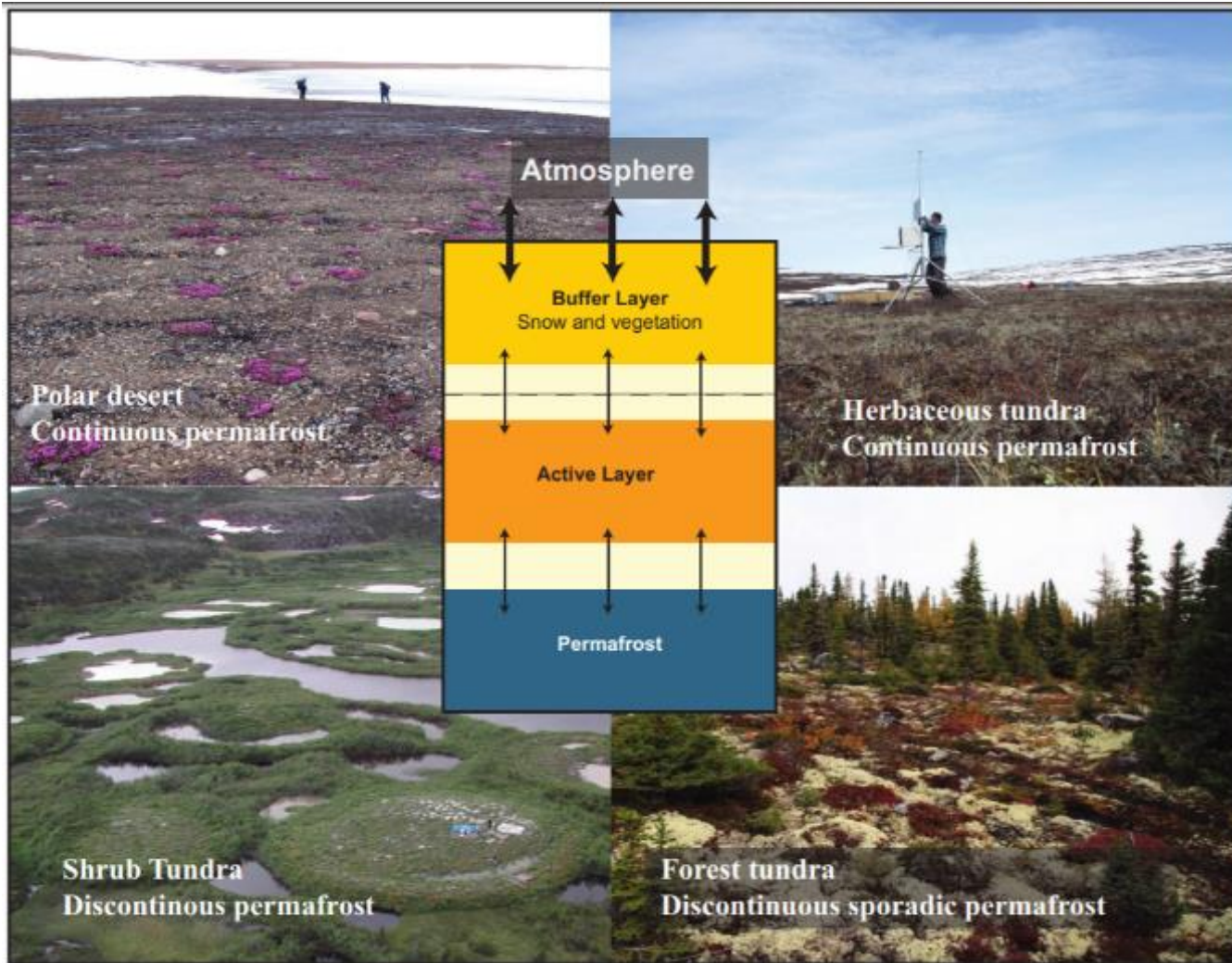
**1. Permafrost**

**ADAPT 2011-16:**  
Special issue of  
*Arctic Science* on  
permafrost systems  
[https://www.nrcresearchpress.com/to  
c/as/3/2](https://www.nrcresearchpress.com/to/c/as/3/2)

# ADAPT

Arctique en Développement et Adaptation au Pergélisol en Transition

Arctic Development and Adaptation to Permafrost in Transition

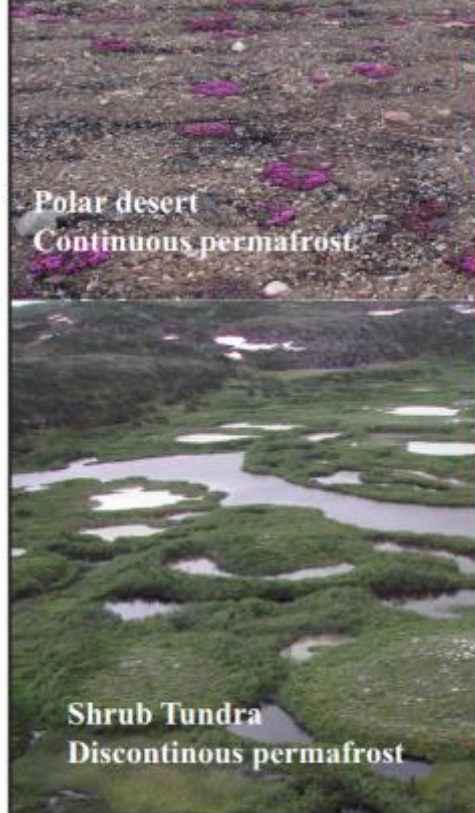


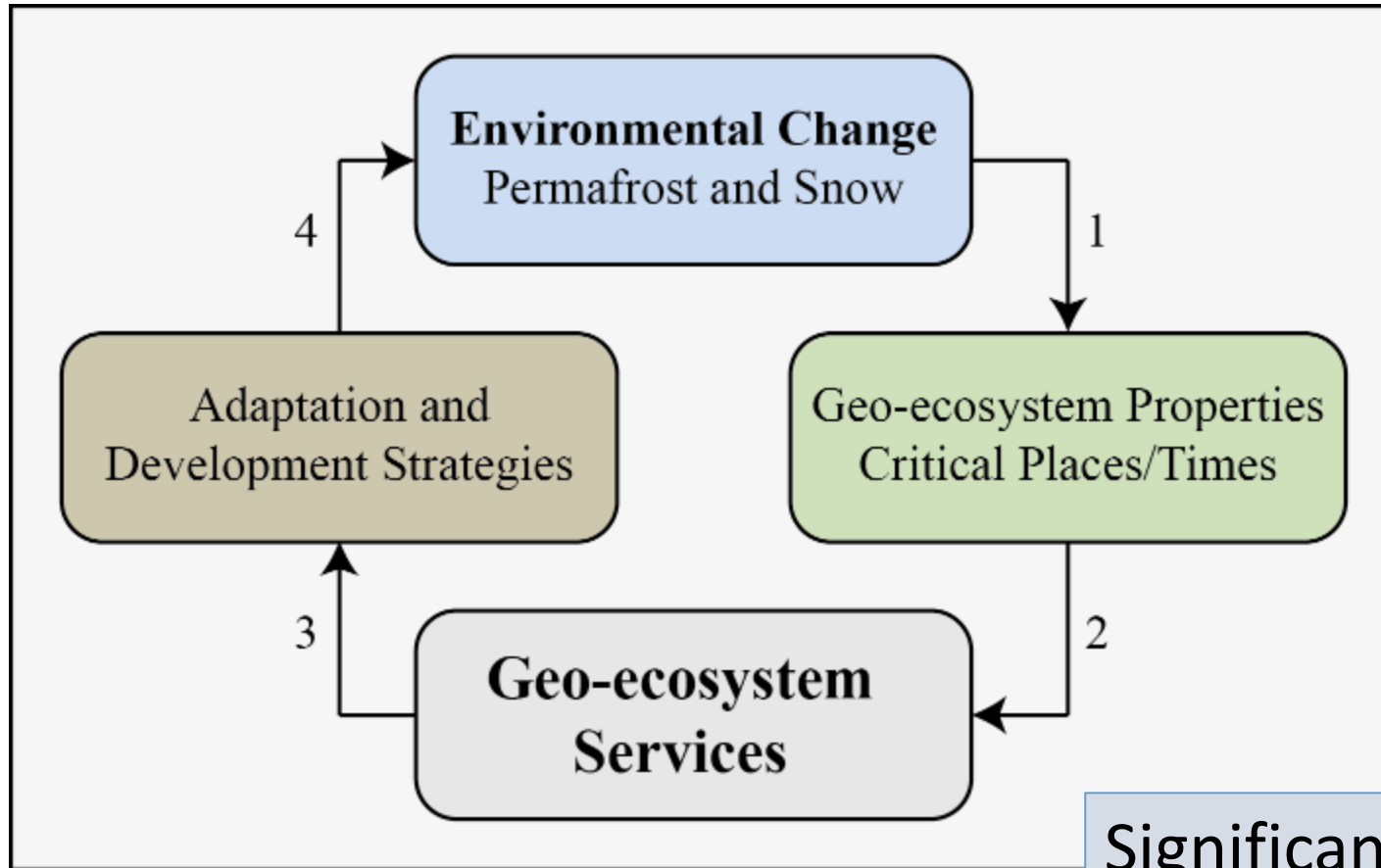


# ADAPT

Arctique en Développement et Adaptation au Pergélisol en Transition

Arctic Development and Adaptation to Permafrost in Transition





Significance of  
liquid water and  
snow for permafrost  
systems








# T-MOSAiC - Implementation

## Action Groups

Chairs will build on existing+new projects and networks to link with similar activities elsewhere in the circumpolar North, to address one or more elements of the T-MOSAiC Science Objectives:

-  **Winter-spring set-up**
-  **Gradient hypotheses**
-  **System-level concepts \***

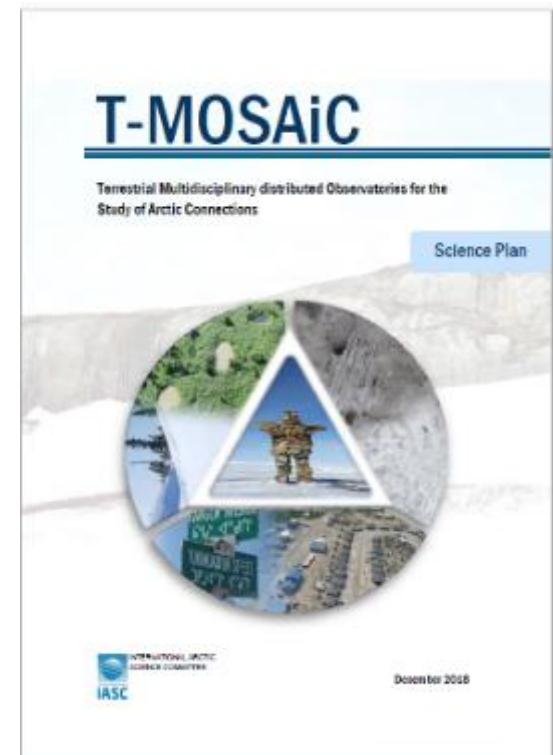


# T-MOSAiC Science Plan

**\*System-level concepts**

## Geo-Eco-Human Systems

-  **Connectivity**
-  **Gradients**
-  **Discontinuities & Thresholds**
-  **Extreme events**
-  **Legacy effects**
-  **Emergent properties**



<https://www.t-mosaic.com/science-plan.html>

# Consequences of discontinuities for sustainable infrastructure



ice-rich permafrost

Canada North Photo Galleries

## Thawing permafrost a growing problem for Iqaluit airport

Manager wants more information on ground below runway as renovations are slated to start soon



# Consequences of extreme events for sustainable infrastructure



Joseph Culp, Environment Canada and  
Canadian Rivers Institute (CRI@UNB)



# Threshold effects of infrastructure on Arctic terrestrial systems



**Canada's first permanent road to the Arctic Ocean (2017)**

(CBC North)

**Developing Arctic port facilities**



<https://www.newsdeeply.com/arctic/community/>









# T-MOSAiC - Implementation

## Action Groups

(2019-2020-2021)

These are bringing together researchers to collaborate on common themes within T-MOSAiC and address **specific questions, activities & outputs:**

-  **Curated / merged data sets**
-  **Observations and sampling**
-  **Analysis and modeling**
-  **Review / synthesis articles**
-  **Strategic plans and protocols**
-  **Involvement of APECS/ECR**

Action Groups: chairs, co-chairs members and plans by 31 December 2019



# T-MOSAIc and RATIC

## Connections and Opportunities

One day T-MOSAIc Cross-cutting Science Session  
at ASSW-2021 in Lisbon







# T-MOSAiC and RATiC

## Connections and Opportunities

### Conclusions

- T-MOSAiC is an IASC cross-cutting project focused on terrestrial social-ecological-systems
- Provides a circumpolar, multidisciplinary platform to leverage resources and networking for RATiC
- The system-level themes of T-MOSAiC are relevant to northern infrastructure and sustainable development

Website: <https://www.t-mosaic.com/>