Considering adaptation to climate change as a timescale problem: examples from the tourism industry.

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Simulations et analyses climatiques
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Motivation

Climate change and its effects are / will be felt in many areas.

What areas will be most affected? Where will it be felt first? How to decide if climate change is an "urgent" or long-term problem? With limited resources, which sectors should be prioritized?

We propose to start the prioritization process by combining two timescales: climatic change signal emergence and planning horizon.
Step 0: scientific point of view
2071-2100: RCP 8.5

Δ Temperature 2m (°C) : DJF

2071-2100 - 1971-2000 CMIP5

Acting on climate change. Solutions from Canadian Scholars, 2015
Step 1: use time instead of °C
Vulnerability timescale computed from NARCCAP regional models for seasonal (DJF—left and JJA—right) surface temperature expressed in number of years, assuming a threshold of one standard deviation over the natural climate variability calculated from the recent past with UDEL observations for the period 1971-2000.

de Elia et al. (2014)
Step 2 : simplify the message
Climate vulnerability timescale (climatic change signal emergence)

Vulnerability threshold

Change rate

\[ T_{CC\_emer} = \frac{s}{\beta} \]

with

\[ s = 3 \, ^\circ C \]

\[ \beta = 6 \, ^\circ C/\text{century} \]

\[ \Rightarrow \quad T_{CC\_wmer} = 50 \, \text{years} \]

Variable : x
sensitivity parameter : median
vulnerability threshold : s
Two timescales on one graph

Slow CC vs planning horizon

T-CC-Emergence (years)

T-Planning (years)

No action needed

Long-term adaptation or redesign

Pressing redesign

Pressing adaptation

Quick CC vs planning horizon
Step 3 : hypothetical examples
Example 1: Outdoor festival

- Sensitive to summer 10-day weather
- No significant changes expected in precipitation regime
- Planning: 5 years

Hypothetical example

![Graph showing T-CC-Emergence (years) vs. T-Planning (years)]
Example 2: National park (conservation issue)

- Sensitive to seasonal means: (temperature, precipitation, snowpack)
- Changes already observed
- Planning: for the next century
Step 4 : a real example
Bromont ski station

Indices from literature

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>INDICES</th>
<th>PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily mean surface temp</td>
<td>T &gt; -4°C</td>
<td>November / December</td>
</tr>
<tr>
<td>Daily max surface temp</td>
<td>2 consecutive days with T &gt; 10°C</td>
<td>March</td>
</tr>
</tbody>
</table>

Configuration

- CRCM5@0.22° driven by CanESM2#1, RCP8.5, 1950-2100
- Observations
  - Stations Environment & Climate Change Canada
  - Gridded data U. of Princeton

Threshold from our mind!

- 85 and 95 percentiles of observed distribution from 1951-2005
Bromont

Distribution U. of Princeton

Données MRCC5

# days, Tmoy > -4°C Nov/Dec

**# days > -4°C (-0.6°C)**
Bromont ski station

T-CC- Emergence (years)

T-Planning (years)

No action needed

Long-term adaptation or redesign

Pressing redesign

Pressing adaptation
Step 5: assess (some) uncertainty factors
Uncertainties

- Only one simulation from one model, one driving GCM, one RCP, ....
  - Does not cover uncertainty at all
- Indices should be better defined to reflect reality
  - May differ from one ski station to another
- Thresholds need to be discussed
  - Maybe 85% and 95% are inappropriate

- Paquin, de Elia, Charron, Logan, Bleau and Biner. *A multiple timescales approach to assess urgency in adaptation to climate change with an application to the tourism industry*. Submitted to *Environmental Science and Policy*
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*Merci!*