Session No.

Study of relationships between cardiovascular disease peaks and weather: application in Quebec and Montreal, Canada

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1.Background

- **Cardiovascular diseases** (CVD) affect the heart and the blood vessels, heavy socioeconomic burden in the Quebec province
- **Health peaks**: extreme values of the sanitary variable
- Difficult to predict → management issues for health network

- Large literature about relationships between CVD and meteorological conditions based on **mean events**, not peaks
- **Climate change** context (CC)
- CC might modify directly or indirectly CVD peaks distribution

2.Objectives

Main objective: **health system support**
- Study of health peaks **relationships with meteorological conditions**
- Development of a general methodology

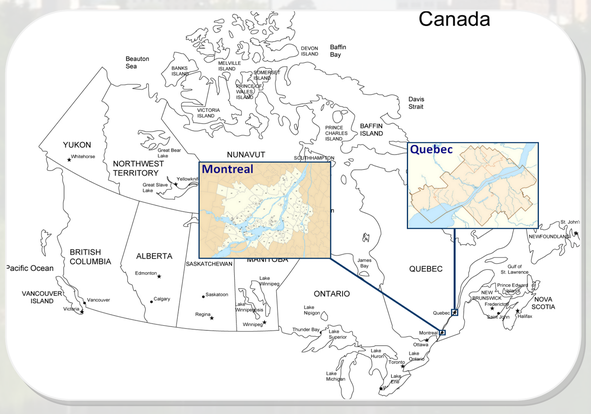
3.Data

Health variables
- Daily CVD **hospitalisations** (1996 to 2006, n = 4077)
- Daily CVD **deaths** (1981 to 2011, n = 11322)

Y

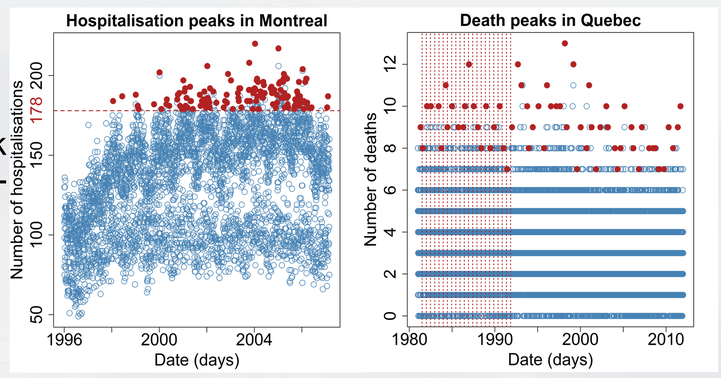
Meteorological variables
- Atmospheric pressure (kPa)
- Relative humidity (%)
- Total precipitations (mm)
- Temperature (°C)
- Snow (cm)

X

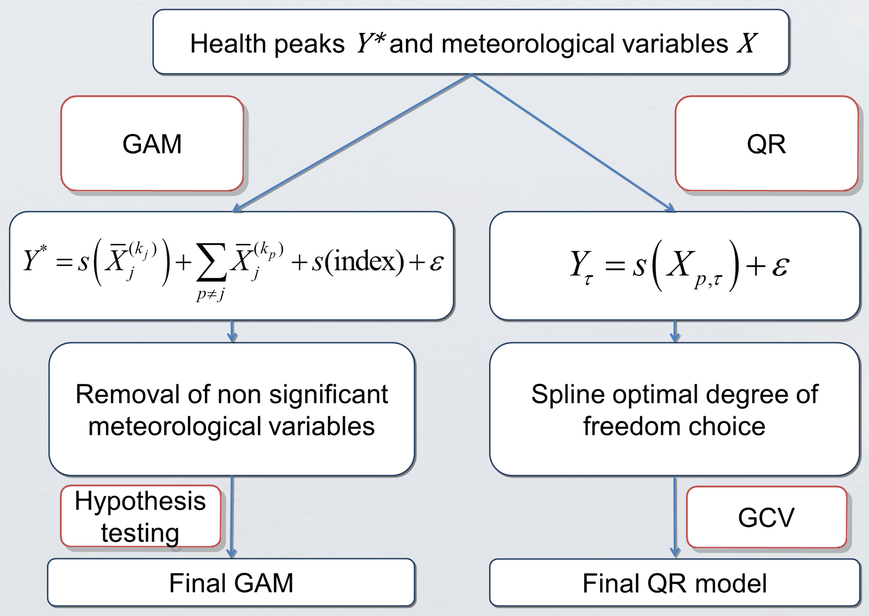


4.Methods

Extreme value theory
- Extraction with block and peaks-over-threshold methods
- Health variable Y
  → Y^* peaks



Generalized Additive Models (GAM) and Quantile Regression (QR)
- Once peaks are extracted, study of relationships with weather
- GAM and QR with **non parametric methods**
- Meteorological variables may have a lagged effect on CVD peaks
  → use of **lags**
- **Explained deviance** (EXD) used to assess the fit

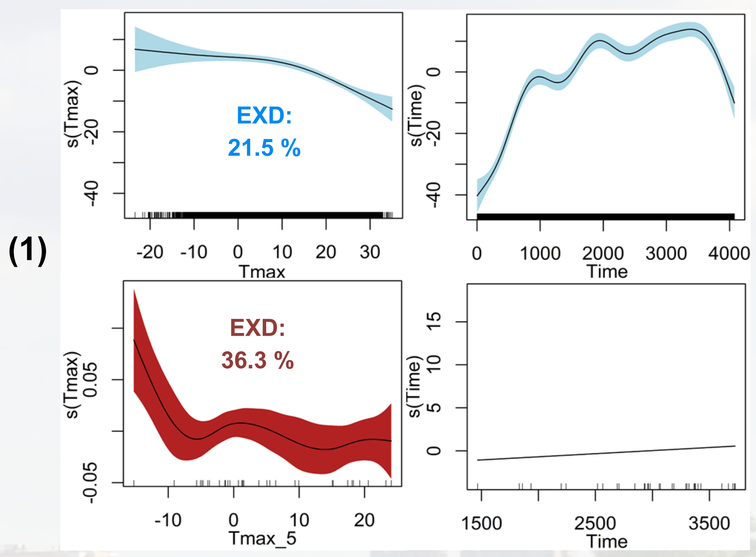


Y_τ: variable in the τ quantile, s: cubic spline, $\bar{X}^{(k)}$: lagged mean over k days

5.Results

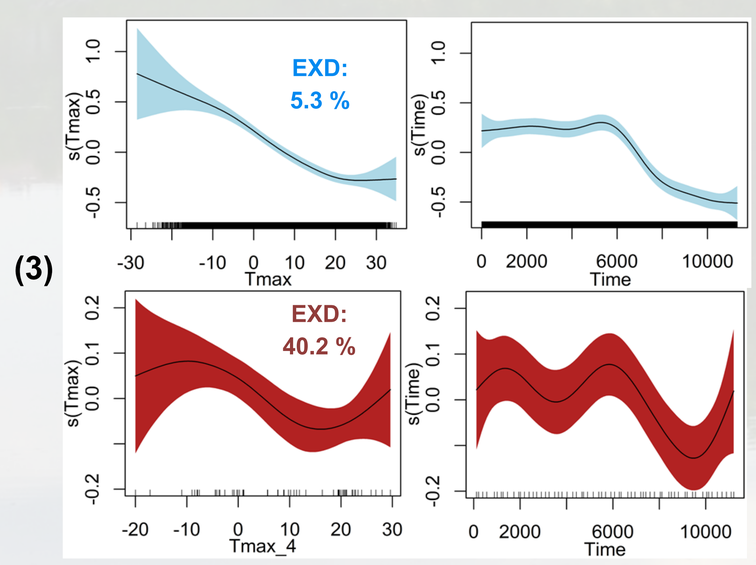
Selected results
- Hospitalisations in Montreal (POT 95 %), n = 33
- Deaths in Quebec (blocks 180 days), n = 63
- Models with only temperature and date as significant variables

Hospitalisations in Montreal



(1) GAM: **influence functions** in classical case and peaks case (temperature lagged by 5 days)
→ ~10 °C: temperature of lesser effect (function is low)
(2) Comparison with QR
→ similar function

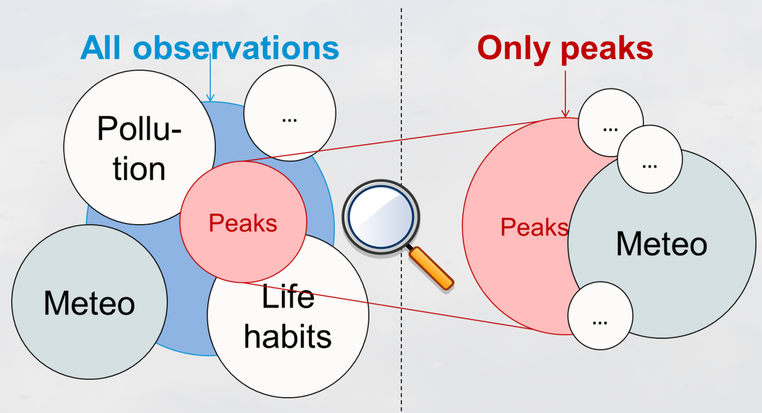
Deaths in Quebec



(3) GAM: **influence functions** in classical case and peaks case (temperature lagged by 4 days)
→ hot and cold: higher effect
→ ~10 °C: temperature of lesser effect (function is low)
(4) Comparison with QR
→ small differences with GAM

6.Conclusions

- **Explained deviances** in the peaks case much larger than in the classical case



- As in the classical case, **temperature** has an important influence on peaks occurrence
- **Non-linear relationships** between CVD peaks and weather
- Methodology can help refine **meteorological and sanitary alerts**
- Main limitations
  → **small samples**
  → no **individual** or **pollution** variables

References

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- Koenker, R. (2005). *Quantile regression* (No. 38). Cambridge university press.
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