Environmental Prediction in Canadian Cities

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EPiCC

Environmental Prediction in Canadian Cities

Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)

Fondation canadienne pour les sciences du climat et de l’atmosphère (FCSCA)
What is EPiCC?

- EPiCC is a research network: includes observations, remote sensing and numerical modeling components
  - Two cities: Montreal & Vancouver, 6 main observation sites, a focus on residential vegetated areas
  - Mandate: to complete research objectives (not necessarily HQP or outreach centred)
What is the overall objective of EPiCC?

- To provide Canadian urban residents with better weather and air quality forecasts through development of an urban-atmosphere modeling system evaluated for Canadian urban climates.

Statistics Canada 2006 Census Data
Funding Agency Requirements

- Network must include a minimum number of partners
- International & Government partners are permitted
- Collaboration and outreach supported by budget
- Annual workshops
- All data must become public after a certain time period.
EPiCC Observations

- Time series of atmospheric conditions.
  - Temperatures, heat, water vapour and carbon fluxes, solar and atmospheric radiation, winds, humidity
  - Sampling rates of up to 20Hz
  - Averages 5 – 30 min
EPiCC Observations: Profiles

- How do cities impact the boundary layer above them?
- Assess UBL height, structure and circulations through observations and modelling.

Boundary layer height from ceilometer observations;
Vancouver Sunset residential area

Images courtesy D. van der Kamp
EPiCC Observations: Other data types

Feb. 13, 2008; 0545-0600 EST
Clear skies, $T_{air} = -11^\circ C$

Christensen et al. (2009)
EPiCC Observations: Surface Characteristics

- Airborne LiDAR transect
- Point density 1 per 0.7 m²
- Surface structure: built and vegetated

Images courtesy N. Goodwin
MSC Forecasting: Global Model (33km)

Urban Scale Forecasting

Global Environmental Multiscale Model (GEM; 33 km)
MSC Forecasting: Regional Model

Regional 15-km model grid setup

Regional operational grid core:
432x565 points

Grid projection: Polar stereographic

Image courtesy J. Mailhot / Environment Canada
MSC Forecasting: Local Area Model

GEM LAM (Local Area Model) 2.5 km windows

Surface Representation: mosaic-type approach

4 surface types
• soil with vegetation and snow
• open water
• sea ice
• glaciers

(no urban)

Image courtesy J. Mailhot / Environment Canada
Adding the Urban Component

“Urbanized” LAM at 250m
- Vancouver CRTI prototype

GEM/LAM 2.5km : 200 x 200
GEM/LAM 1km : 200 x 200
GEM/LAM 250m : 300 x 300

Can extend this domain for better cover of Whistler area

Belair & Mailhot (2007)
EPiCC: Developing and Testing the Urban Model

**Vegetated part:** ISBA
Noilhan & Planton [1989]

**Built part:** TEB
Masson [2000]

Each urban zone

Tile scheme

EPiCC: Integrate the vegetated and built components of the city.

A. Lemonsu, S. Leroyer;
Urban Modeling Example

Radiative surface Temperature simulated on 5 July 2008, 10:00 LST

Screen Level Temperature simulated on 6 July 2008, 01:00 LST

Application to Montreal Urban Heat Island studies for health and air quality
Intended Outcomes

- Primary aim: to develop a version of urban surface model optimized and verified for conditions in Canadian cities and implemented in Environment Canada’s modeling suite for operational forecasting

- An urban forecast tool for use in:
  - air quality/emergency response
  - weather warning systems (ice, snow, wind, flood, heat, wind chill, fog)
  - scheduling water and energy resources
  - urban design
  - assessment of climate impact and adaptation
  - heat stress and wind chill, and dispersion of air pollutants in urban environments
EPiCC’s use of technologies for communication

- Project website
  - Public
  - Research Community
  - Participants
EPiCC On-line Database

- Registered Users
- Select by Station
- Select by Parameter
Benefits of Free Information Exchange

- In urban climate research there are:
  - Many modelling groups
  - Few observation groups (and good field campaigns are increasingly multi-institutional due to logistics and costs involved)
  - Good observations are therefore in demand e.g. for evaluation of model developments – multiplies use of original data – sometimes by many times.
  - Good observations may have a legacy lasting decades
Participation in Research Community

International Association for Urban Climate: *Urban Climate News*

Reaches over 1500 online readers (digital only)

IAUC a *free* association
Participation in Research Community

International Association for Urban Climate: Urban Flux Network

Site Index
Information for research community users
Impact of Technologies on Research

- Web-interface to data plots for quick view and assessment
- Potential users can quickly assess availability of data for their needs.
Impact of Technologies on Research Practice

- Technology allows for (near) real time data to be displayed and saved. Time to availability (sec) but no QC/QA
- Requires additional infrastructure
- Potential new users/applications
- Normal practice: off-line collection and processing Time to availability – months.
Impacts of Technologies on Research Practice

- Use of remote facilities – e.g. Env Canada modeling system. Firewalls, data storage etc.
- Access to the model for users?
- Future forecasts – links to customized cell phone delivery

UWO Green Roof Test Site

Urban Scale Modeling of Green Roof Deployments
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Visit us online at www.epiccc.ca