The Portal Component, Strategic Perspectives and Review of Tactical plans to implement the IAUC Initiative, WUDAPT; a worldwide urban database for climate and environmental modeling

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WUDAPT’s critical elements

Prototype Census of Cities and Collaborative Partnerships

Prototype Census of Cities: Remote sensing automation methodology generates Level”0” LCZs

Expert system incorporates urban- GeoWIKI to produce Level “1 & 2” UCPs and MMDs

Full implementation by collaborative partnerships between IAUC and engaged technical and geopolitical communities

Create and establish customized Portals
Progressive Staging of WUDAPT Level “0”

WUDAPT Level “0”
LCZ Classification

Methodology development, 2014
Dublin Workshop

ICUC9 Workshop

Improved methodology & protocol

Full implementation
Rich diversity and complex distributions of climate zones observed within each city

LCZ signature palate different and unique to each city

Distributions of “Form and Function” modeling parameters produce unique climate and meteorological responses to each urban area
Comprehensive Implementation Stages

Level “0”, Data Portal, Website, Initial model testing

Level “1” (Geowiki, Crowd Sourcing, Geopedia Portal)

Level “2” (Geowiki, Crowd Sourcing, Geopedia Portal)

Processing Tools, MRA, Growth models

Portal Developments, Applications, Refinements
World Urban Database

- Level “0”
  - Census of Cities as Local Climate Zone LCZ atlases
  - All world’s major urban areas
- Level “1” Form and function data “FIT FOR PURPOSE” Multi-scale “fine to meso”
- Community-based and accessible
- Evolutionary and dynamic

Access Portal Tools

- Database Functionalities:
  - Collection,
  - Processing,
  - Validation,
  - Storage and Retrievals
- APPS Functionalities
  - Generic and rudimentary
  - WPS/WRF Interface
  - Scale dependent analyses
  - Modeling apps
  - Base and projections
Conceptual Design Functionalities of WUDAPT

- **Open source** community framework
- **Worldwide coverage** of urban areas, all climate zones

- **Function 1**: User friendly portal to support user’s inquiries and search inclusive of structured and unstructured information and supporting metadata- Ingestible to variety of user communities
- **Function 2**: Custom applications keyed to addressing variety of community needs
WUDAPT Public Portal: Geopedia functions: database generation methodology, storage & access

GIS layers

Governmental data

GMES (sentinel etc.)

Crowd-sourcing data

Local Experts
Open Street Maps
LCZs

Environmental models

WUDAPT

GEOPEDIA
Current modeling progress using WUDAPT. Processing WUDAPT Level “0” data to run WRF – Urban: the case for Madrid, Spain, Bousse & Martilli 2015

- LCZ maps obtained by WUDAPT
  - 120m Resolution
  - LCZs Values are 31-40 (31=LCZ1) Other classes 1-30 are from MODIS

- Using Stewart ID & Oke TR, 2012 supplement for Urban Fraction, Building & Roads Width and Heights

- New Land Use Index in WPS
  - Using Stewart ID, Oke TR & Scott E, 2014 for Building & Roads Heat Capacity and Thermal Conductivity

- URBPRAM.TBL

- Running the WRF model

- Statistical verification

- LCZs dependent results

- Needing supplementary datas for BEP-BEM (Roughness length, Capita/floor, Surface emissivity, Windows coverage ratio, AC system datas)
  - Assuming Martilli A & Salamanca F, 2002/2010 values for now

Land Use of Madrid in WPS (Brousse O., 2015)
1. What is the macroscopic feedback of urban canopies into larger scale models and what is the sub-grid scale Information for parameterization?

2. How do representation of urban canopies (resolved and sub-grid information) change with scale/model resolution?

Adding Multi-Resolution Analysis (MRA) into WUDAPT
Consideration for Portal: Urban Planning-Growth Model APPS

• **SLEUTH** urban growth and land use change model, simulates four types of urban land use change:
  – spontaneous growth,
  – new spreading center growth,
  – edge growth, and
  – road-influenced growth.

• **SynCity** (Synthetic City) – Sub-models (Layout, Agent Activity & Resource Technology Network (RTN))

• **MARS** (Metropolitan Activity Relocation Simulator)
  Strategic, dynamic, integrated urban land use and transport model
Conceptual hierarchical urban modeling systems incorporating WUDAPT

Model systems
As Portlets

- Population
- Traffic
- WUDAPT
- Chemical emissions
- Energy, Activity

Portal System
Data handling, Query-Based Toolkits
- Urban Growth models
- Scale dependent analyses tools

Level One
Application
Current Climate Conditions

Level Two
Applications
Climate Change Scenarios

Broaden capabilities to performing integrated modeling applications
Two Examples of emerging Portal Apps using WUDAPT

- Risk Assessments (Heat stress) current and climate projection modeling

- Systemic modeling approach
Example 1: APP/Portal for heat stress advisories for extreme heat wave situations in urban areas under current and future climates

(Hanna, Pinto and Ching, ICUC9 (2015)

Goals: Heat stress indices (WBGT, Tmrt, PETs) for:

- Enhanced mortality, morbidity risks
- Safe activity levels, comfort/discomfort advisories

Method: Customized APPS (using portlets?) for:

- **Operational O(10km)** weather and climate model now and futurecasts outputs *with Intra-urban variation using Sky View Factor as weights based on Level “0” table lookups*
- **Fine grid customized and urbanized** Wx model outputs [O (1km)] utilizing **MRA portlet generates appropriate UCPs to mesoscale models**
Summer Heat Stress (WBGT) Index for Atlanta and Chicago 2003, 2050

Overall increase across the Distribution for both cities from 2003 to 2050

WBGT Chicago 2003 vs 2050

WBGT Atlanta 2003 vs 2050
Sensitivity of WBGT to Sky View Factor (SVF)

Differences of more than 3.0 are seen particularly during June and July.

1/3 the range of concern of heat stress risk levels.

Significant diurnal variability in WBGT.
Portal APPS options

Context: Urban adaptation planning for Baseline and Climate Change impacts projections (Masson et al., 2014)

**Impact (risks) and direct outcome modeling**
- Climate projection model tools
- Scale dependent weather prediction model tools
- Air quality and exposure modeling tools
- City long term planning modeling tools
- Off line Vulnerabilities, Adaptation and Risk assessment modeling tools

**Systemic modeling (interdisciplinary)**
- Baseline and climate change projections
- City models for adaptation strategies
- Physical modeling for impacts
- Indicators and outcomes
Example 2: Systemic-type modeling that incorporates WUDAPT into environmental models (e.g., WRF, TEB by Strasburg Research Group)
Countries with active WUDAPT collaborators: Produced 16 Level “0” (LCZ) cities @ 2014 Dublin workshop
Urban communities
Creativity in Resource plans

Continue to fulfill goals of Level “0” implementation

Enhancing Geopedia Portal; Incorporate tools for information processing

Testing methodologies at Levels “1&2”, Initial deployments and assessments

Urban Planners

Research, Modeling and tool developers

Stakeholders Engagements
Public/Private Resource Partnerships
Crowdsourcing Activities

Data Management

Stakeholder applications
Villagers, Thanks & please join, support WUDAPT
Exciting times are ahead!