



# GCP and WUDAPT on the global scale

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Geography



# Compatibility of WUDAPT and GCP

- GCP has a global perspective and part of GCP is to measure Carbon fluxes at global scales; hence a global scale modeling perspective is needed
- Any global scale C mitigation program will need to know Carbon fluxes is from urban systems at sufficiently fine scale to identify possible mitigation strategies
- There needs to be the ability to distinguish emissions from a wide range of socially and physically different urban environments
- This requires a standardized methodology that applies at the global scale – Basic urban form can be retrieved from WUDAPT
- An effective global program needs a methodology for knowledge transfer and local actionable information



# The global perspective

- Many developed nations have local data on urban system, and these systems are rapidly increasing in complexity and quality; however for most of the world this is not the case.
- Urbanization is advancing most rapidly in places that are not well documented
- Most global products are satellite derived – with inherent bias and shortcomings (i.e. the inability to measure things other than land cover, atmospheric components etc. such as building materials and building use information)
- Many models are to the stage where they need information that cannot be easily derived from remotely sensed data
- Much of the data derived presently is for climate/meteorology purposes, to assess sustainability we need a different approach
- The need to involve more scientists from under represented regions that provide new perspectives



# Carbon Modeling at the global scale

## Two major approaches

1. Model individual cities and locations (e.g. in regional climate and air quality models) and aggregate results from local studies to generalize globally

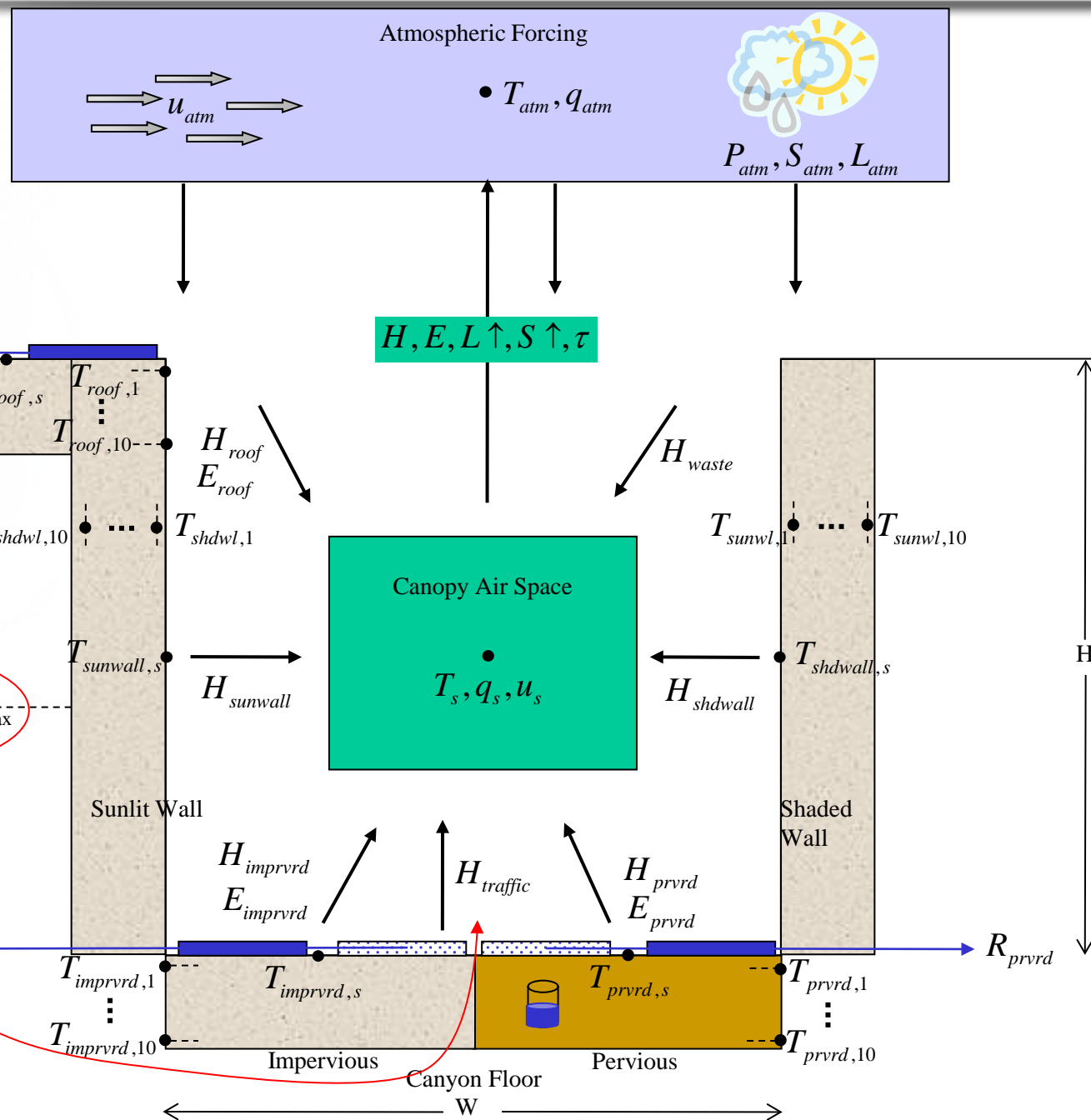
*This process is ongoing in many developed communities using regional scale climate and emissions models but is grossly underrepresented in tropical and under developed communities*

2. Modeling in the Earth System Framework and involving the IPCC (like) process

*This is starting with a number of groups but needs a much better model globally applicable model parameterization process*

# Representing urban areas in an ESMs

## e.g. CLMU



$Q_F$  removed as  $Q_H$  from canyon floor



## What is needed for this type of project?

1. Spatial information on global urban extent
2. Information on urban characteristics at a resolution that can be used for both simulation and mitigation/adaptation strategy levels
3. Comparable information on human use of urban systems that can inform carbon metabolism studies

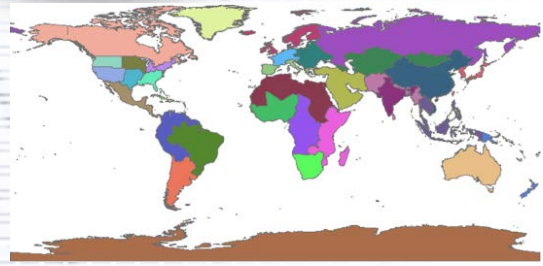


# Current global parameterization process for CLMU

## Spatial data

## Urban property data

33 Regions



### Urban morphology

> 10 cities used to define urban properties by region

### Building types

3 most common wall and 3 most common roof types

### Class delineation

LandScan population data to discriminate urban class

### Building use properties

AC/heating usage  
Interior temperature ranges

### Building material properties

Virtual wall reconstructions including window types  
Materials look-up table

## Final Product\*

Tall building district  
High Density  
Medium Density

### Scenario generator

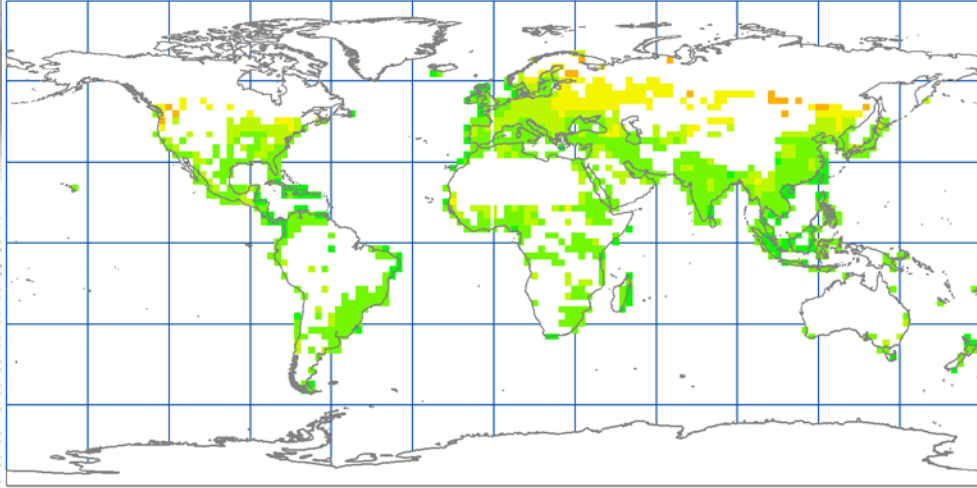
Change wall types, urban morphology and building material properties (IPCC scenarios etc.)

GCM data by Region with 4 Urban types, 3 Building types and typical road type

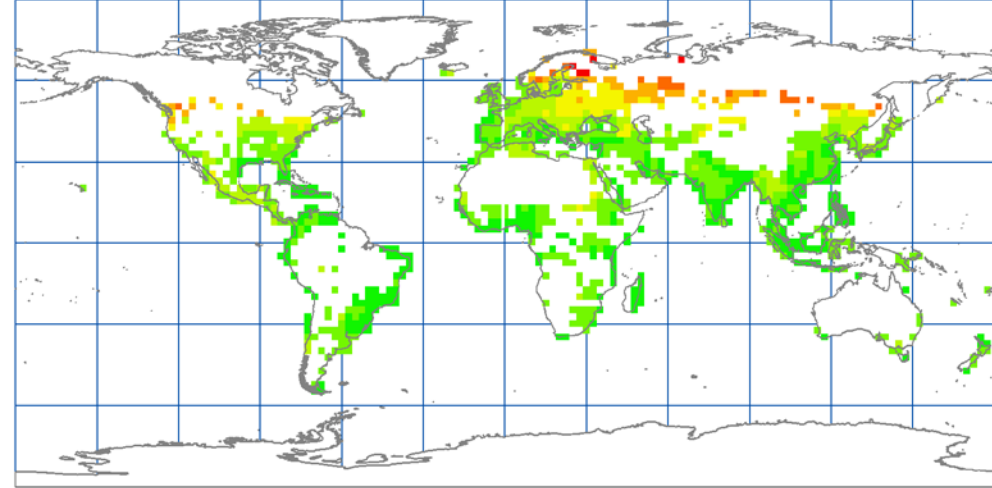
\*Low density created but not used

# Urban Heat Island Comparison: Parameterization Sensitivity

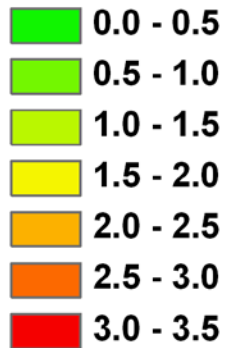
## Vancouver Parameters Applied Globally



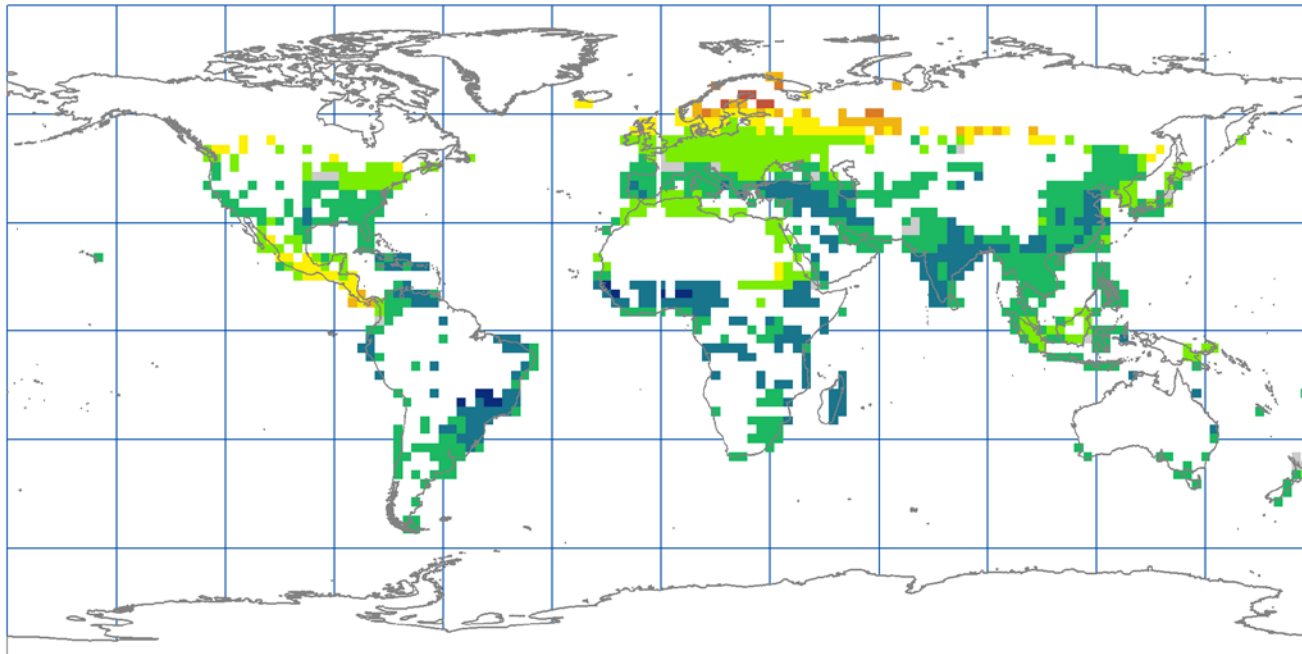
## Global Parameter Set



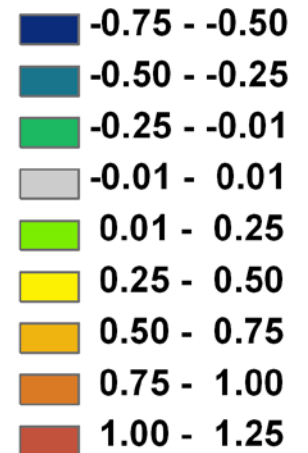
### Urban - Rural Temperature Difference (K)



## Difference: Global - Vancouver



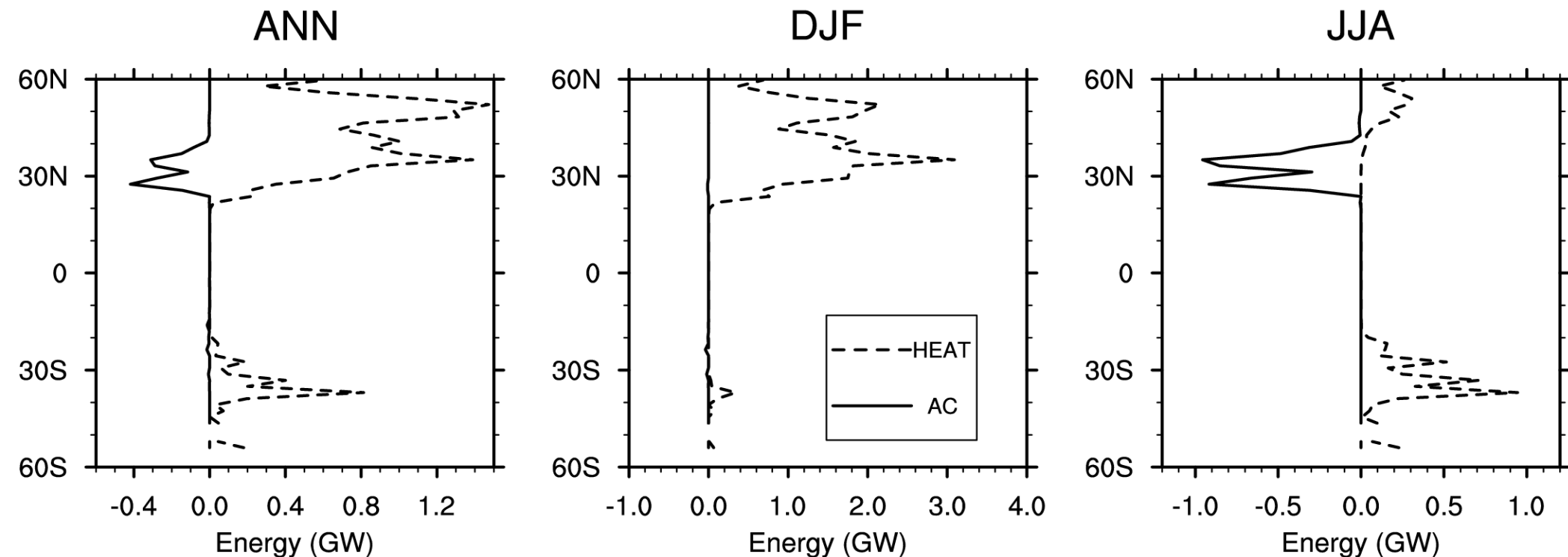
### Global - Vancouver UHI Temperature Difference (K)







# White Roof Experiment: Change in Global Energy Demand



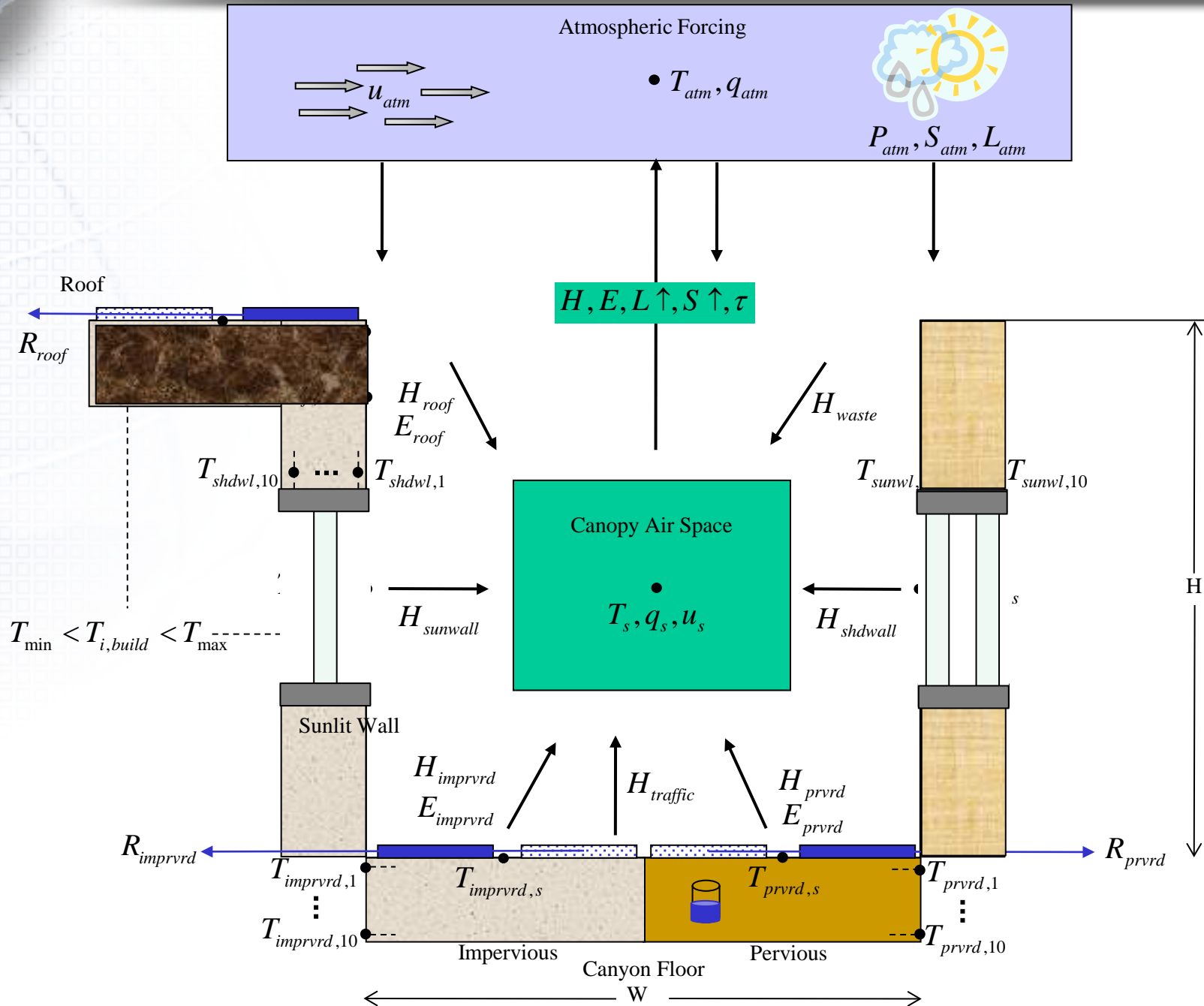
**Figure 4.** Zonal means of ALB minus CON simulations of urban space heating (HEAT) and air conditioning (AC) energy for 1980-1999 annual, DJF, and JJA climatology (gigawatts).

## Conclusion:

The globally averaged annual air conditioning demand decreases from 0.09 TW in the CON simulation to 0.02 TW in the ALB simulation, while space heating demand increases from 5.61 TW to 6.30 TW. Thus, the total **global energy demand increases by 0.62 TW** from 5.70 TW to 6.32 TW.



# Example experiments compatible with GCP





# How can WUDAPT help?

## Spatial data

## Urban property data

33 Regions

Redefine regions possibly to city level

Urban morphology

LCZ

properties by region

Building types

GeoWiki photo/  
crowd source App  
roof types

Class delineation

GeoWiki  
LCZ delineation

Building use properties

GeoWiki quiz/  
Crowd source App

Building material properties

Link wall types and  
building use to LCZ  
delineations

Final Product\*

Tall building district  
High Density  
Medium Density

Scenario generator

Change wall types,  
urban morphology  
and building  
material properties  
(IPCC scenarios etc.)

GCM data by region  
with 4 Urban types, 3  
Building types and  
wall types

Fine  
grained  
dataset

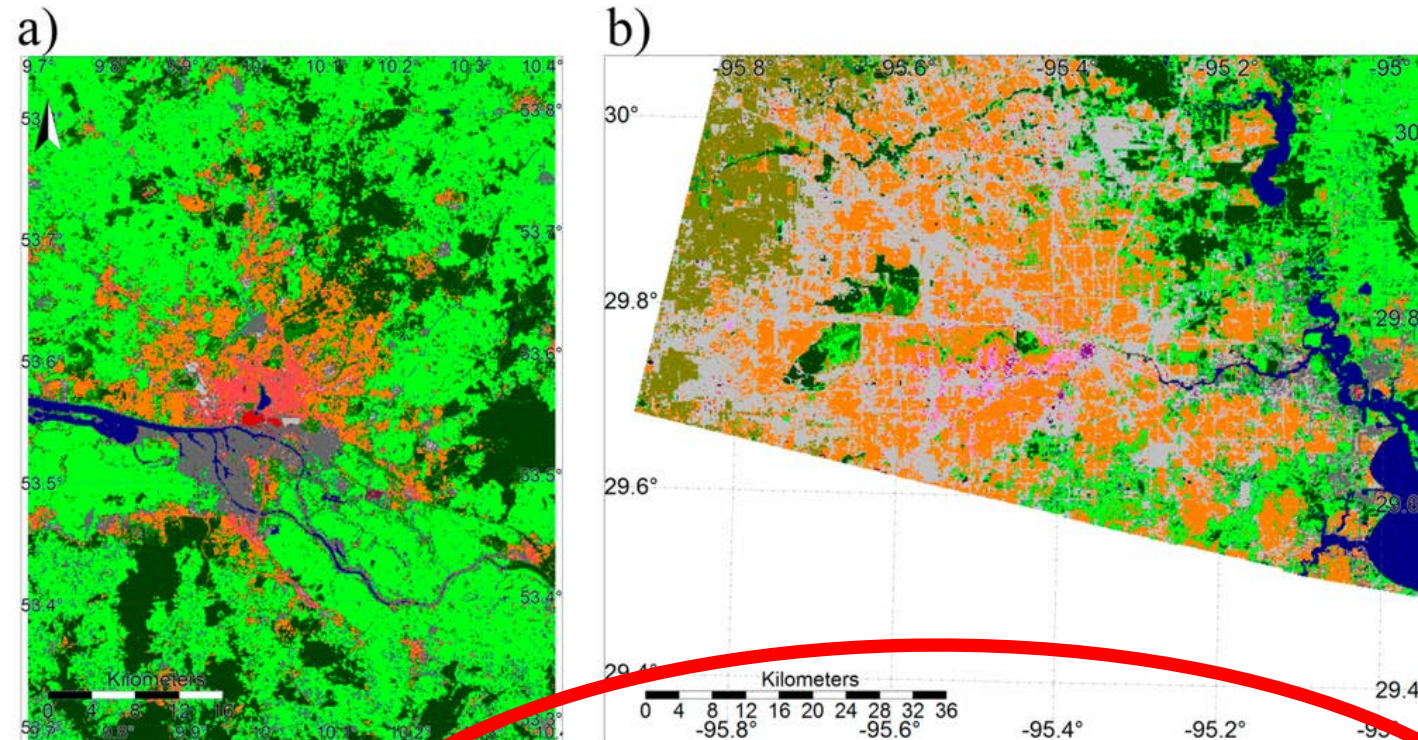
\*Low density created but not used



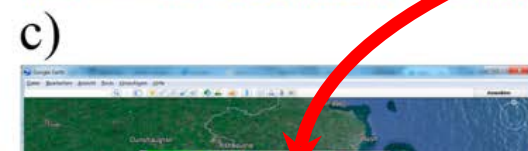
## Expanding WUDAPT

- WUDAPT was initiated for a specific purpose to inform climate and air quality models.
- However it can be easily adapted to add information about building types and building uses
- To assess sustainability of cities we need additional information (e.g):
  - Who lives in an area; socioeconomic status, political status
  - How they use the area; building use, transportation infrastructure
  - People's ability and willingness to adapt sustainable ideas

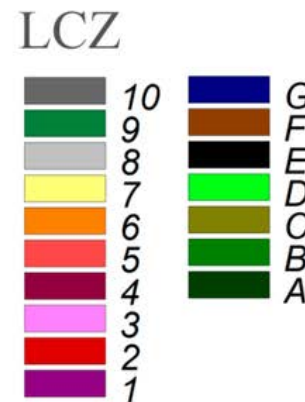
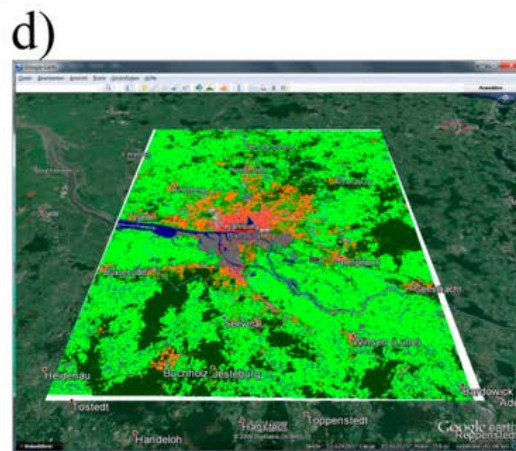
# WUDAPT as a tool for enabling local action



Local Climate Zones (LCZ) classification results for (a) Hamburg, Germany; (b) Houston, USA; (c) Dublin, Ireland in Google Earth; (d) Hamburg in Google Earth.



**YOUR CITY!!**



**Your Relevant Information**

# **GCP/WUDAPT as a platform for knowledge dissemination and C/climate mitigation/adaptation**

Expand WUDAPT dissemination platform to:

- Create city web resources (template with)
  - WUDAPT map
  - additional crowd sourcing or municipal/national level socioeconomic information about cities
  - links to upload climate and C action plans for a city
- Resource to connect experts (locally) to communities
  - Much like the AGU system linking climate experts to local communities use IAUP and planning organization memberships as a resource
  - General Section with information on planning
  - General Section with information about mitigation/adaptation



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**Questions?  
Discussion!**