THE INFLUENCE OF THERMOCHROMIC GLAZING PARAMETERS ON ENERGY SAVING AND COMFORT CRITERIA USING MOMENT-INDEPENDENT MEASURE

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AIM OF THE STUDY

Identify the influence of thermochromic glazing parameters for office buildings in hot climates using dynamic building simulations and sensitivity analysis techniques

BACKGROUND

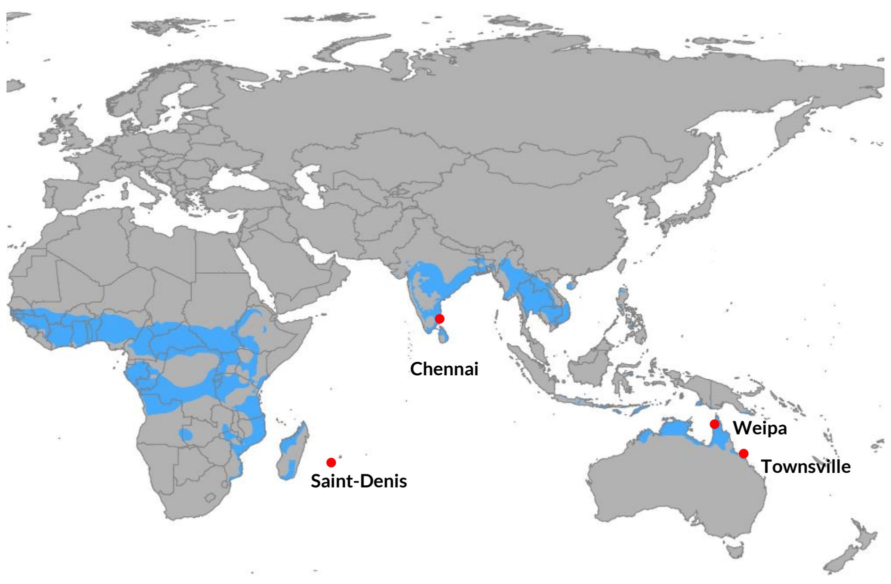
Thermochromic glazing (TC) :
Has the capability to modulate its thermo-optical properties dynamically and reversibly when a change in its temperature occurs

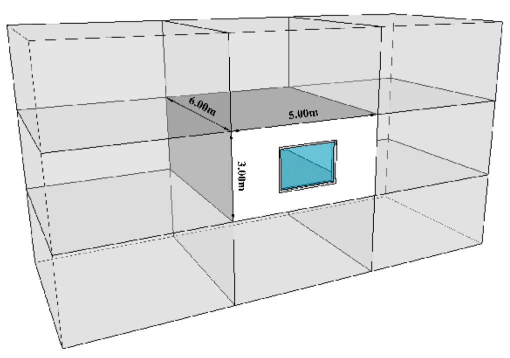
TC glazing

TC glazing for building application

- Has to be doped with other metals to improve its properties: (Li and al., 2012)
  - Transition temperature
  - Visible Transmittance
  - Solar modulation
- Has a potential to:
  - Reduce energy consumption (Hoffmann et al., 2014)
  - Improve thermal and visual comfort (Costanzo and al., 2016)
- Has a greater efficiency for hot climates (Saeli and al., 2010)

METHODOLOGY





Office building configuration

- Thermal and daylighting simulations with EnergyPlus
- Sensitivity analysis method with a Python code with the SAlib
- Analysis on several indexes and on 4 locations (hot tropical climates)

SENSITIVITY ANALYSIS

Moment-Independent Measure (Borgonovo, 2007):

The assessment of "the influence of the entire input distribution on the entire output distribution without reference to a particular moment of the output"

INPUT VARIABLES	SYMBOL	RANGE	UNIT	PROBABILITY
Building Orientation	BO	0-360	°	Continuous; Uniform
Window to Wall Ratio	WWR	5-99	%	Continuous; Uniform
Insulation Thickness	θ_{ins}	0.01-0.7	m	Continuous; Uniform
Weather File	wea	1-4	-	Discrete; Uniform
Switching Temperature	T_s	5-70	°C	Continuous; Uniform
Switching Temperature range	ΔT_s	1-50	°C	Continuous; Uniform
Solar Transmittance Max	$\tau_{sol,max}$	0.3-0.9	-	Continuous; Uniform
Solar Transmittance range	$\Delta\tau_{sol}$	0.01-0.5	-	Continuous; Uniform
Visible Transmittance Max	$\tau_{vis,max}$	0.3-0.9	-	Continuous; Uniform
Visible Transmittance range	$\Delta\tau_{vis}$	0.01-0.5	-	Continuous; Uniform
Number of states	state	2-20	-	Discrete; Uniform

4096 simulations were performed

MODEL OUTPUTS

Normalized output indexes

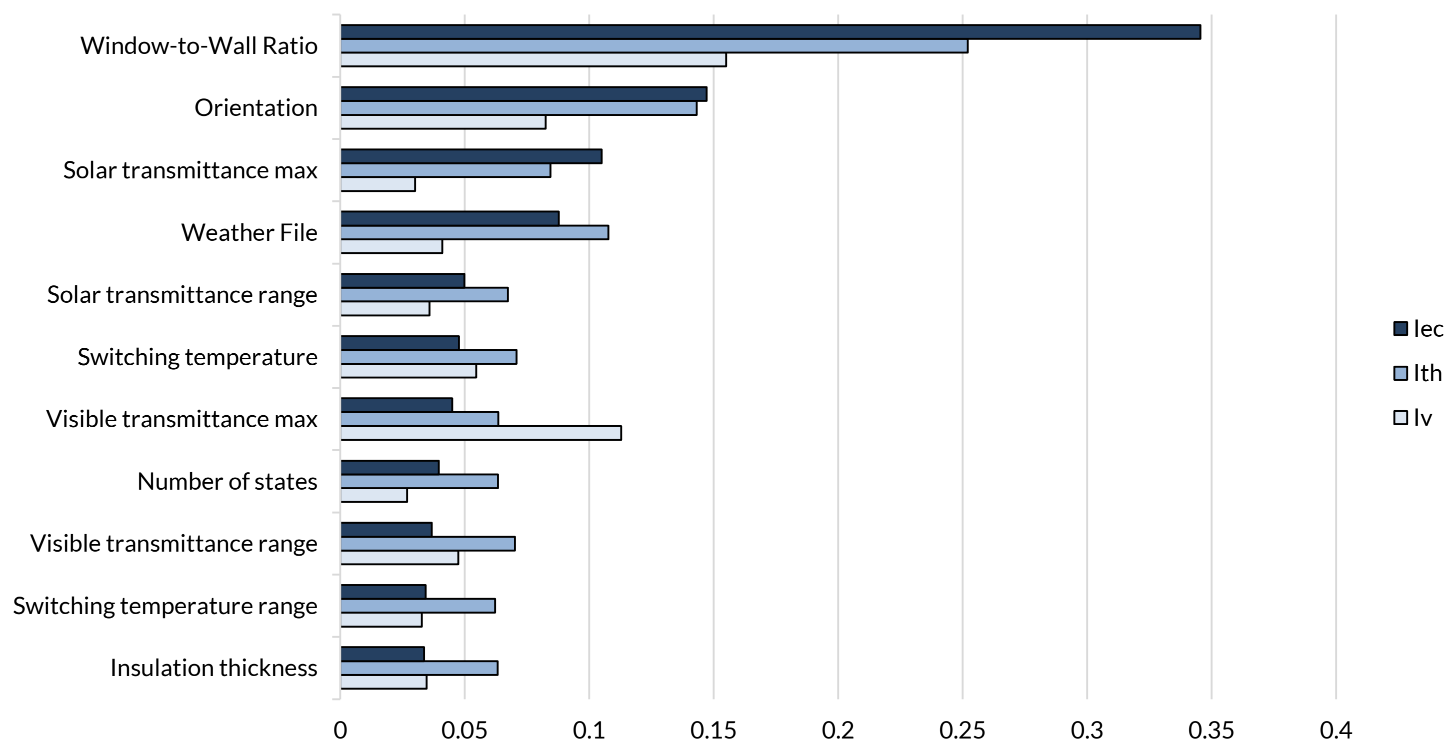
Energy consumption index (I_{ec}):
- Sum of the final energy consumed in one year
- Cooling and artificial lighting

Thermal comfort index (I_{th}):
- % of time when the operative temperature is below $26°C$

Visual comfort index (I_v):
- % of time when the illuminance reference points are between 300 and 2000 lux

RESULTS

Delta

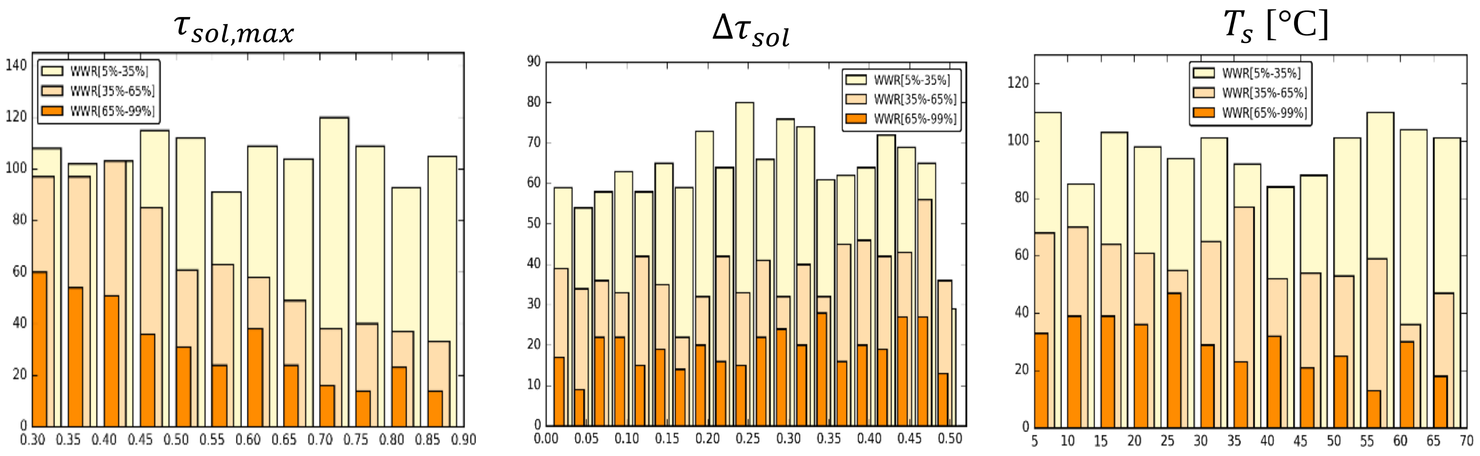


Distribution of input parameters

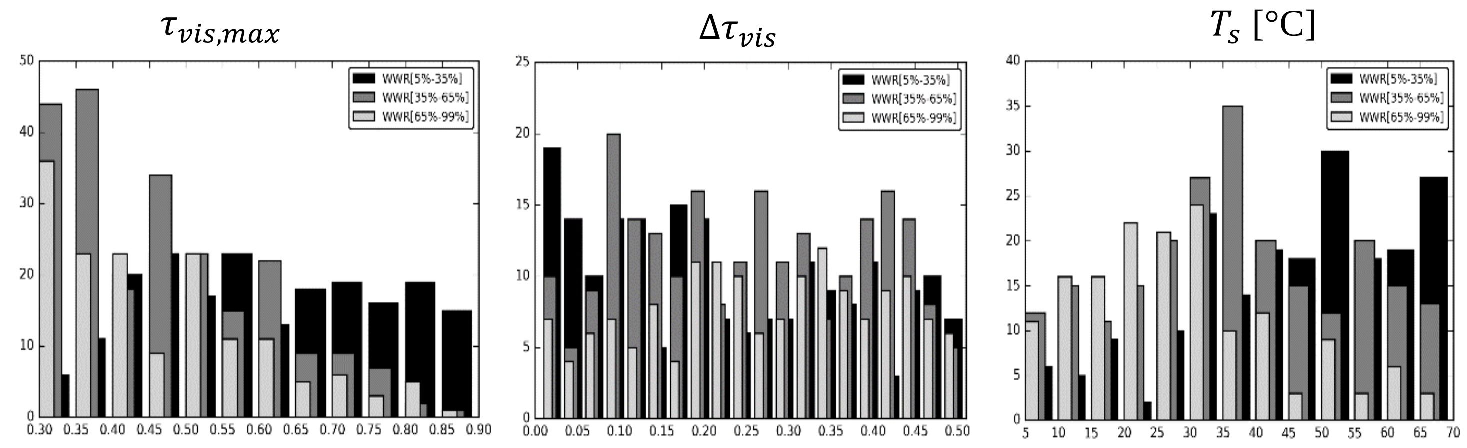
- Filtering model outputs according to a criteria
- Sorting given inputs by glazing size (small, medium, large)

WWR[5% - 35%[
WWR[35% - 65%[
WWR[65% - 99%]

Energy consumption: [0; 0.40]



Visible comfort: [0.70; 1]



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