What will be the summer of Brussel under future climate conditions?

CORDEX.be Stakeholders meeting

Duchêne François, Gwenn Cugnon
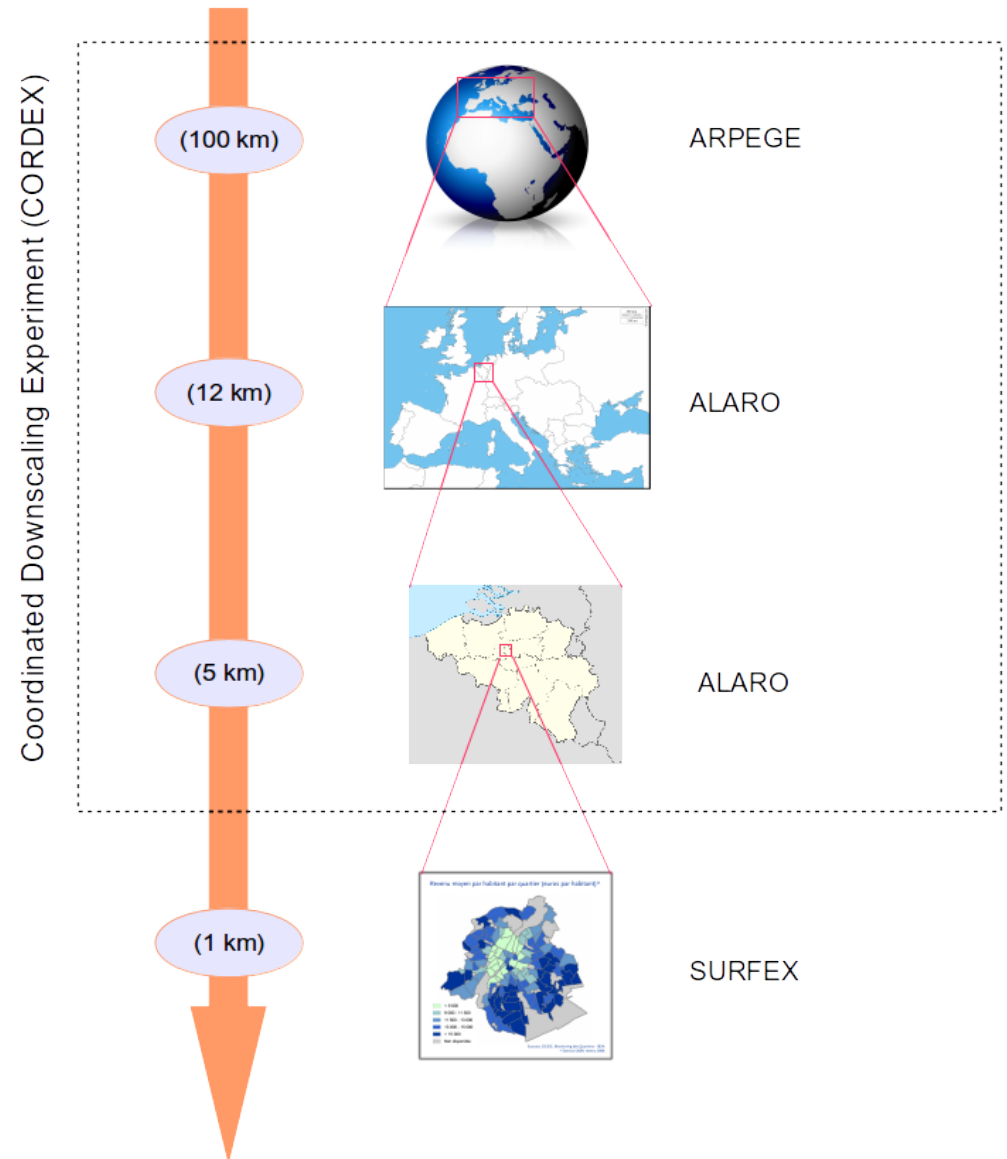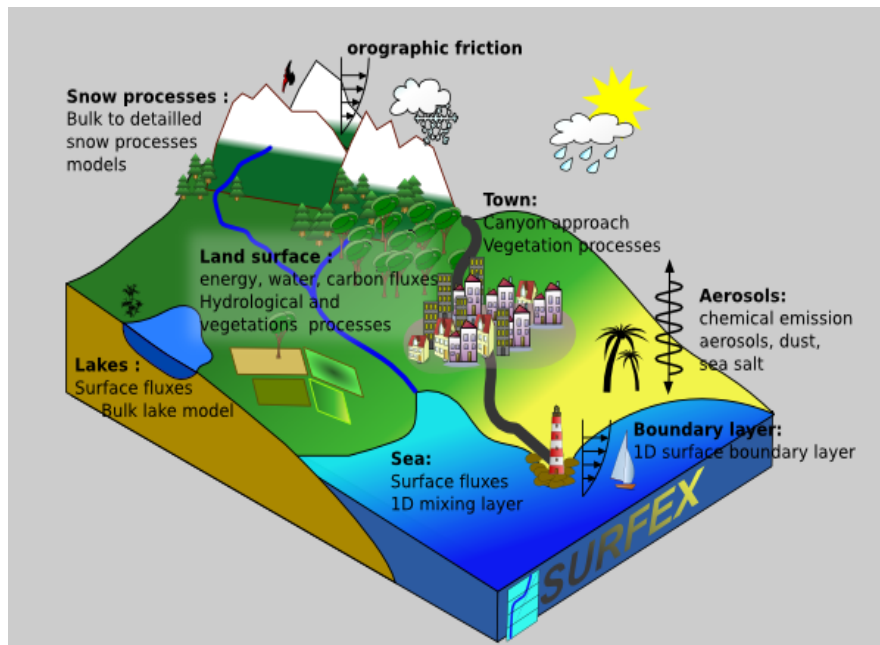
25 september 2017

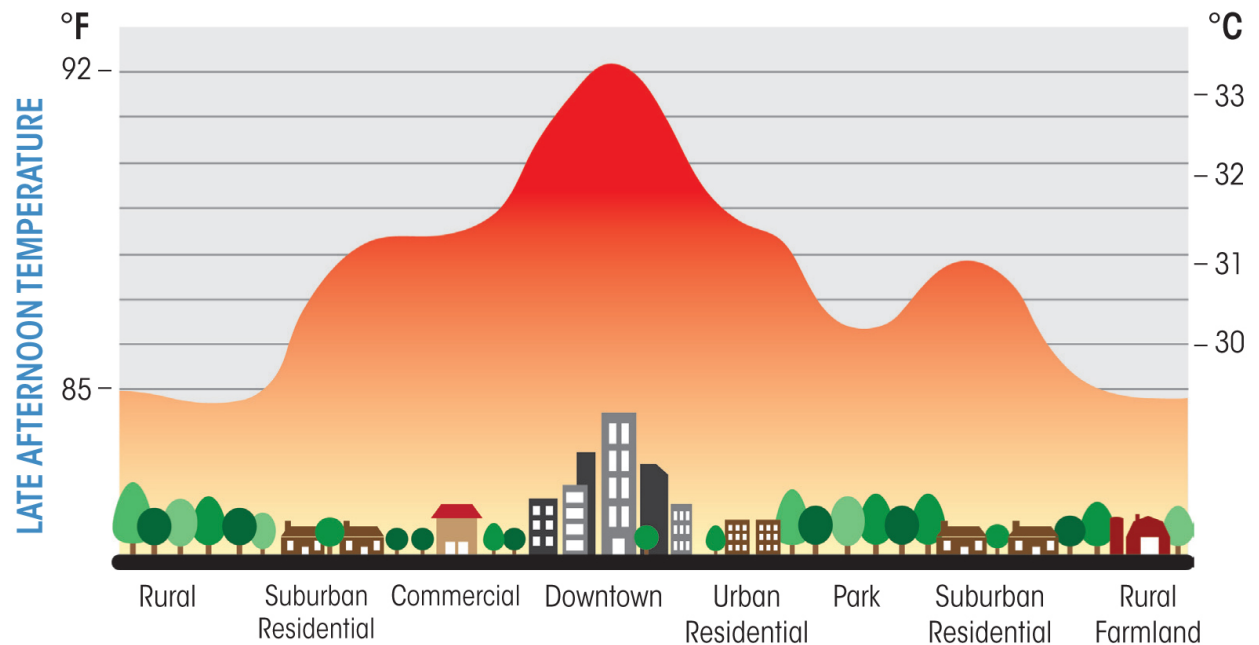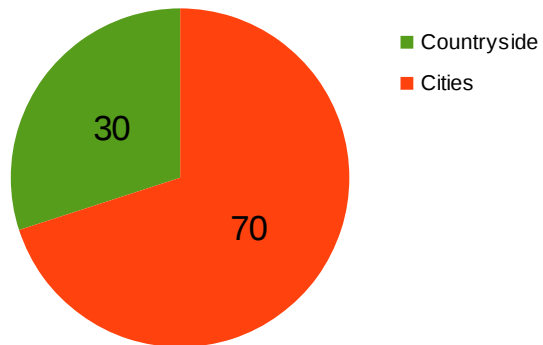CORDEX.be

IRM

Tools

- Dynamical Downcalling

SURFEX : Land Surface model

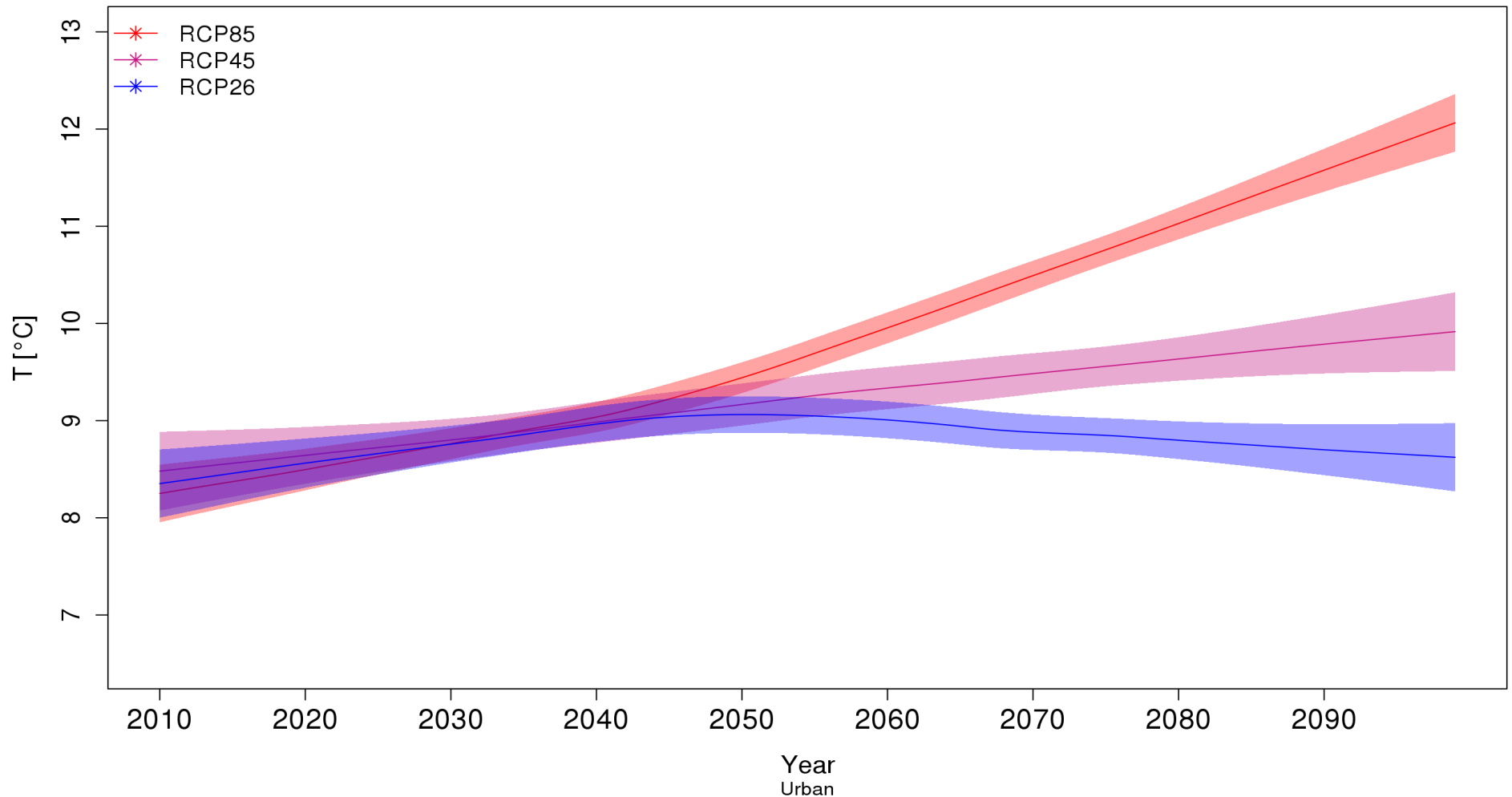Coordinated Downscaling Experiment (CORDEX)

(100 km) — ARPEGE

(12 km) — ALARO

(5 km) — ALARO

(1 km) — SURFEX

Cities more vulnerable

Population by 2050 (UN-Habitat, 2010)

- Countryside
- Cities

30

70

Temperature in Brussel Center

Average T per year

Heatwaves ?

How many?

(a) RCP26

Legend:
- Brussegem (green)
- Uccle (blue)
- Molenbeek (red)

Total (Brussegem) : 71
Total (Uccle) : 91
Total (Molenbeek) : 138

Y-axis: Number HWs

How many?

(b) RCP45

Total (Brussegem) : 74
Total (Uccle) : 87
Total (Molenbeek) : 142
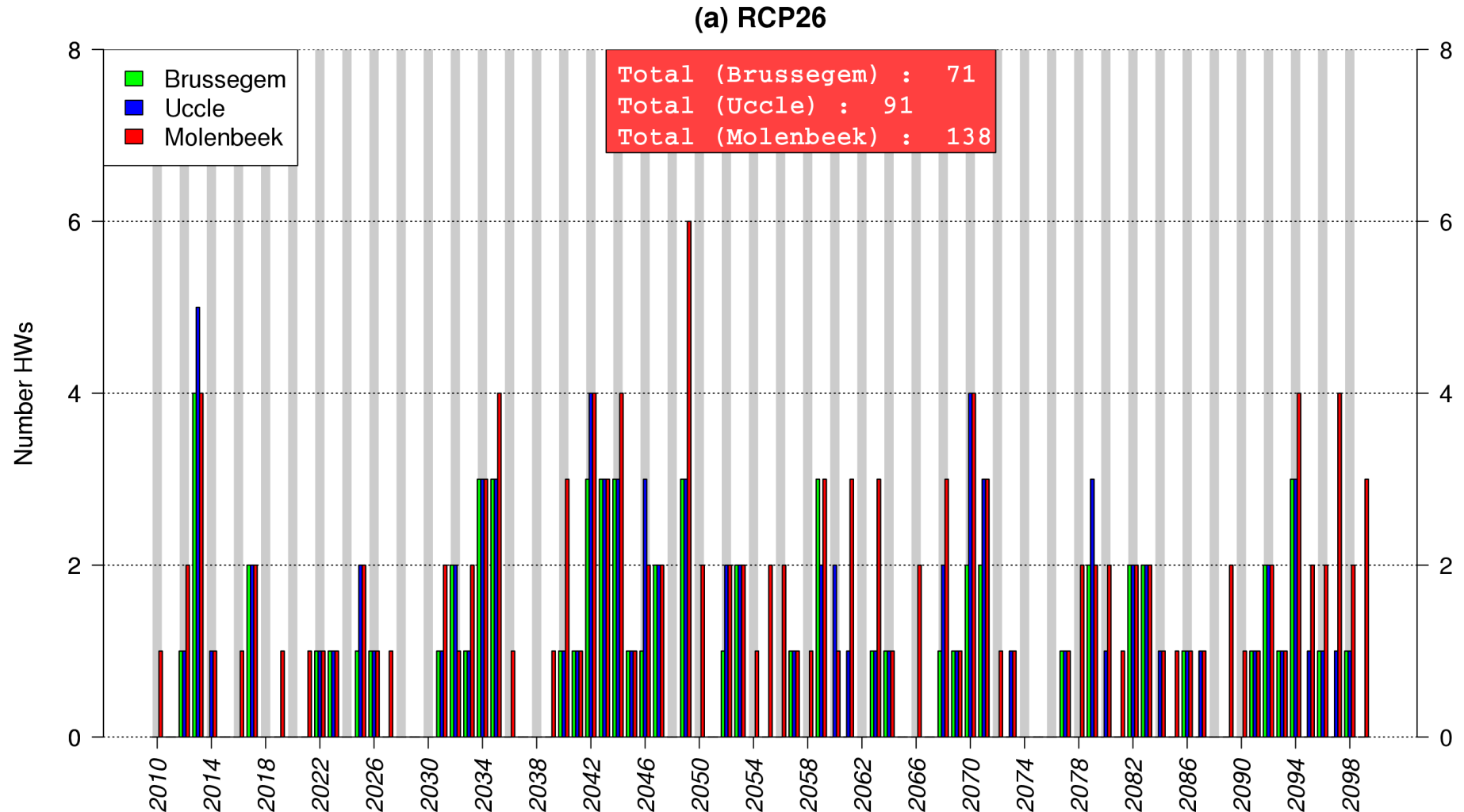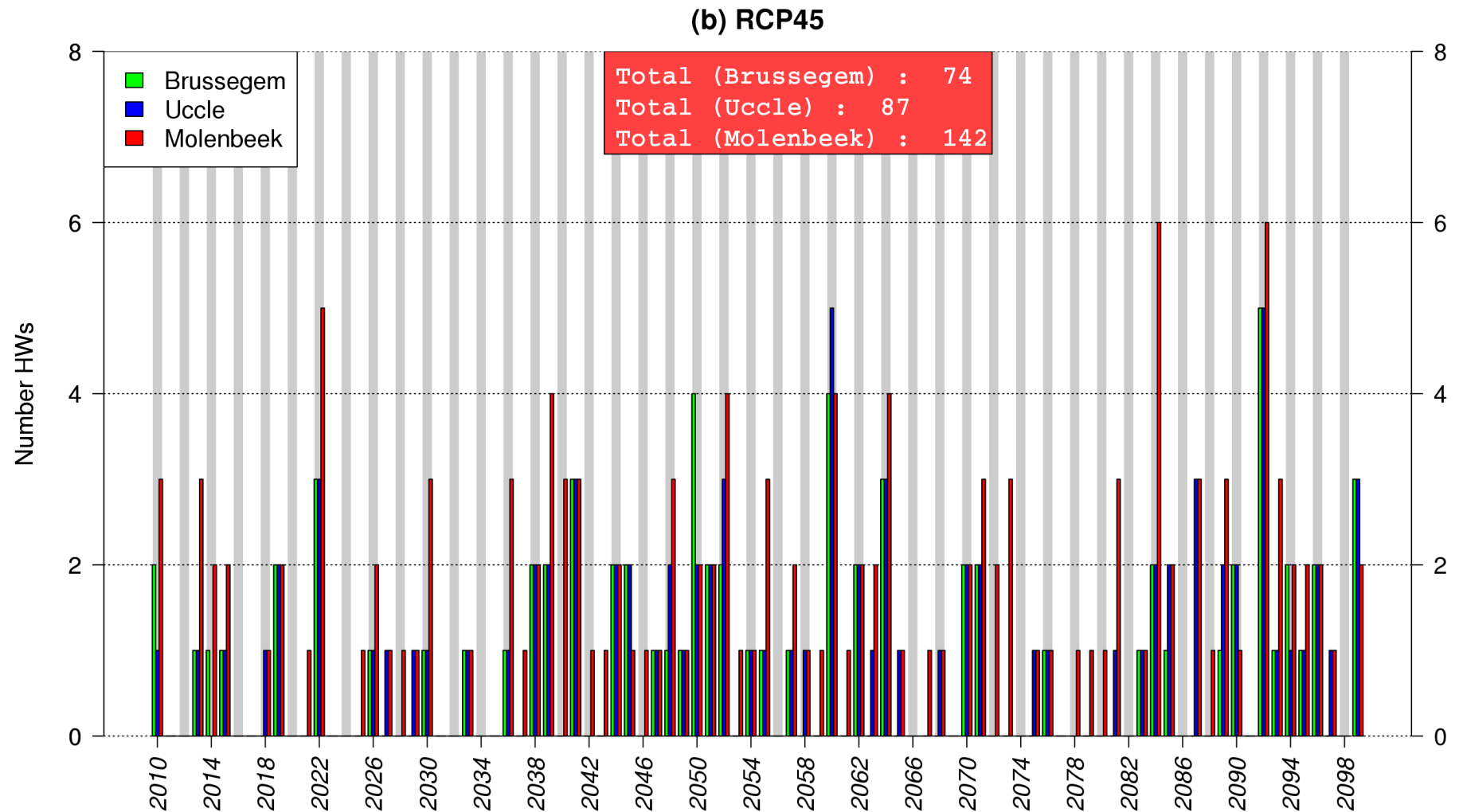
How many?
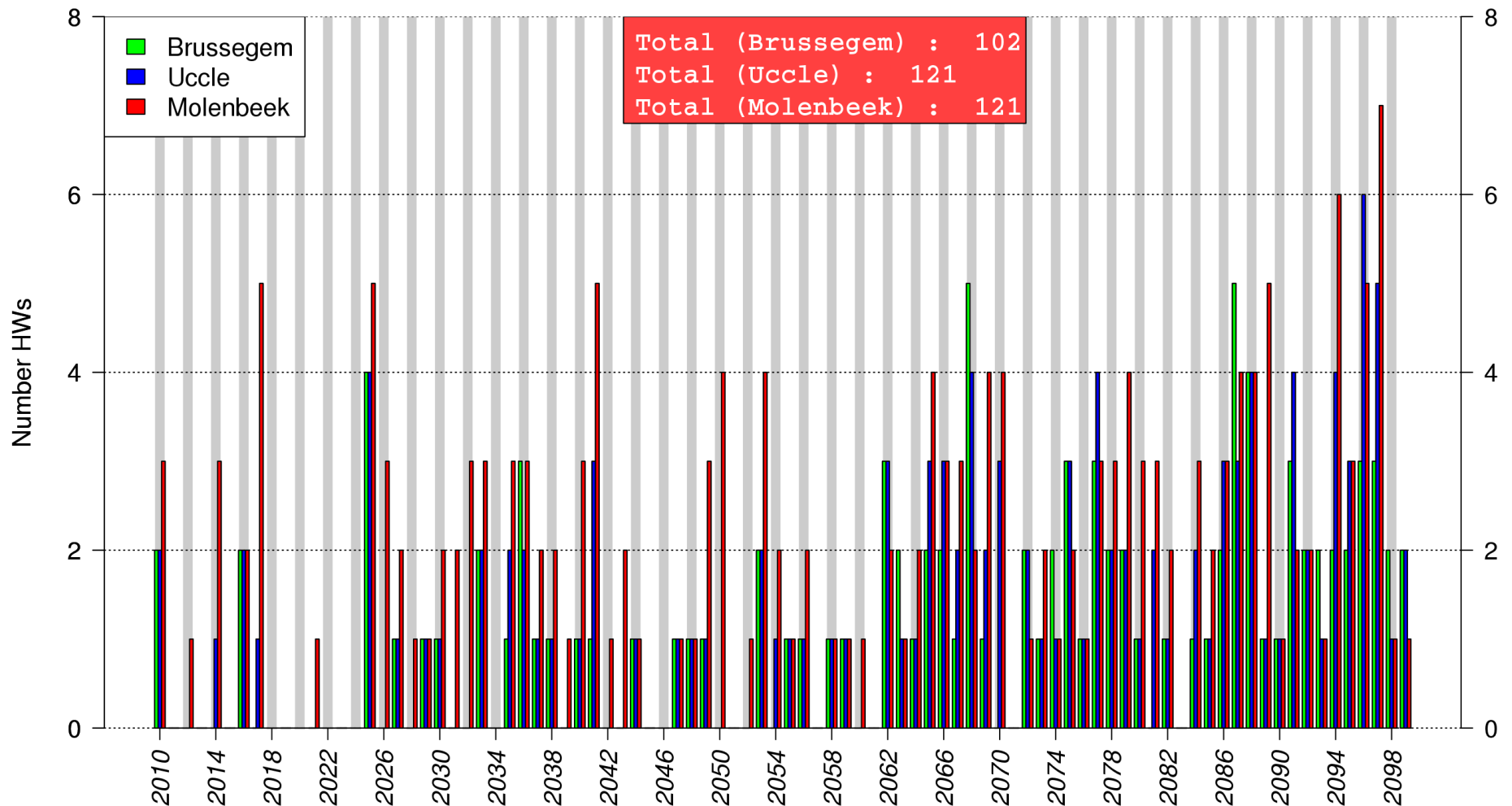
(c) RCP85
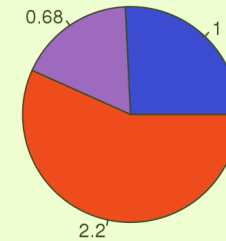
How strong?

(a) RCP85 Urban : Number HW / year
- HIST
- Near Future
- Far Future

1.64 · 1 · 3
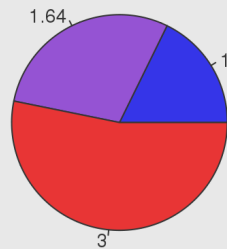
(b) RCP85 Rural : Number HW / year
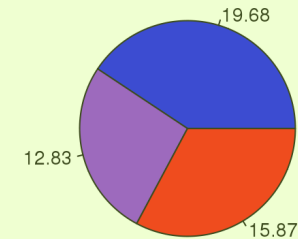- HIST
- Near Future
- Far Future

0.68 · 1 · 2.2

Frequency

(c) RCP85 Urban : Average Intensity [°C]/ HW
- HIST
- Near Future
- Far Future

19.68 · 18.75 · 34.52
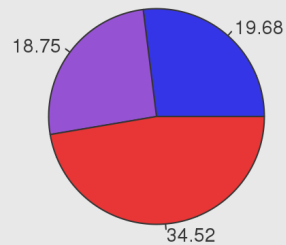
(d) RCP85 Rural : Average Intensity [°C]/ HW
- HIST
- Near Future
- Far Future

19.68 · 12.83 · 15.87

Intensity

(e) RCP85 Urban : Average Duration [days]/ HW
- HIST
- Near Future
- Far Future

8.76 · 8.59 · 12.99
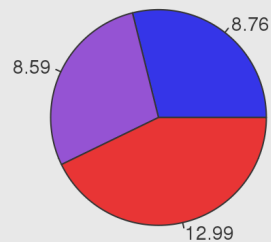
(f) RCP85 Rural : Average Duration [days]/ HW
- HIST
- Near Future
- Far Future

8.76 · 8.47 · 10.02

Duration
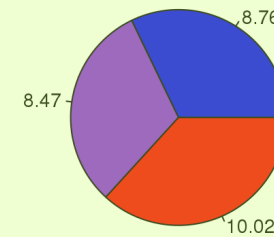
What about human comfort?

Heat stress

Rural

55% (T_min) / 45% (T_max)
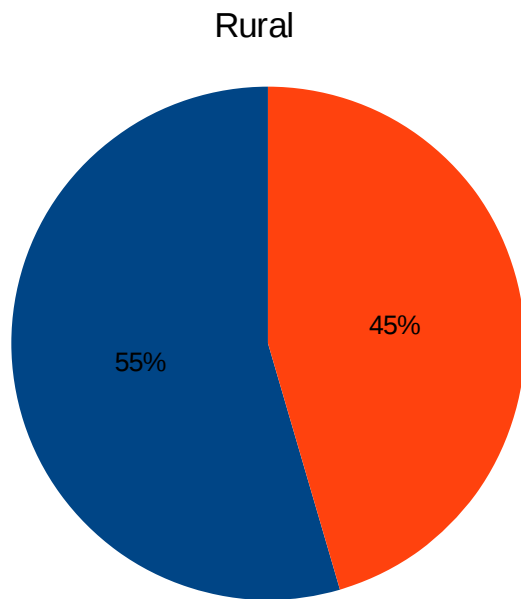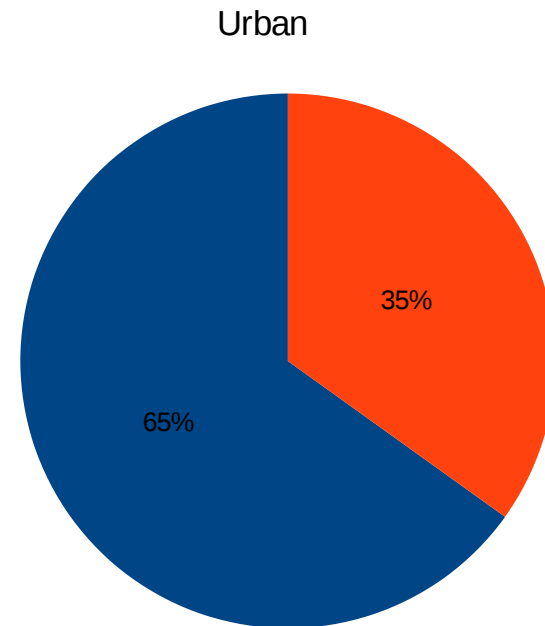
Urban

65% (T_min) / 35% (T_max)
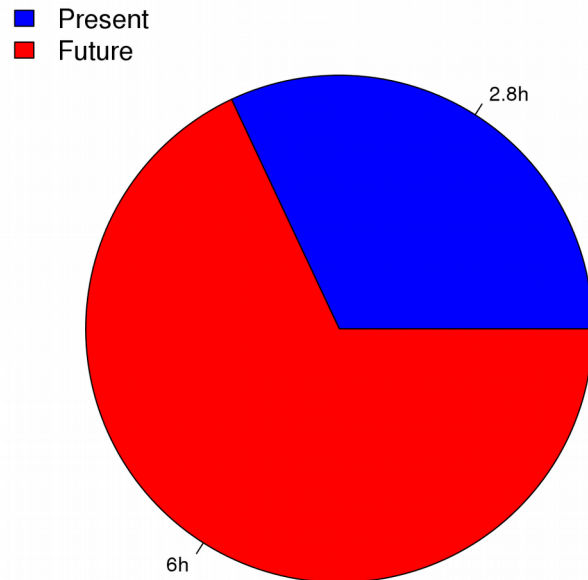
Twice as large !

$$\sum_i [(T_{min,i} - 18\,°C) + (T_{max,i} - 30\,°C)] h_i$$

HUMIDEX

(a) Rural : Number [h] / Number [days]

(b) Urban : Number [h] / Number [days]

Present
Future

2.8h

6h

RCP85 Far Future (2075-2099)

Present
Future

3h

5.5h
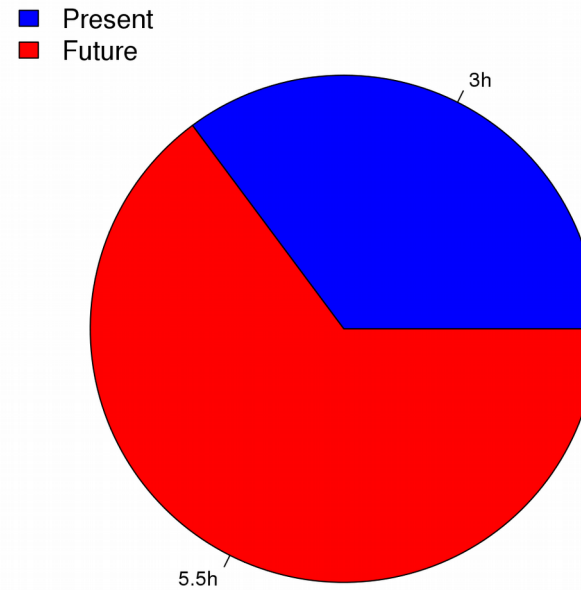
RCP85 Far Future (2075-2099)

$$HUMIDEX = T + \frac{5}{9(e-10)}$$

$$e = RH \times 6.11\, e^{(17.67*T/(243.5+T))}$$
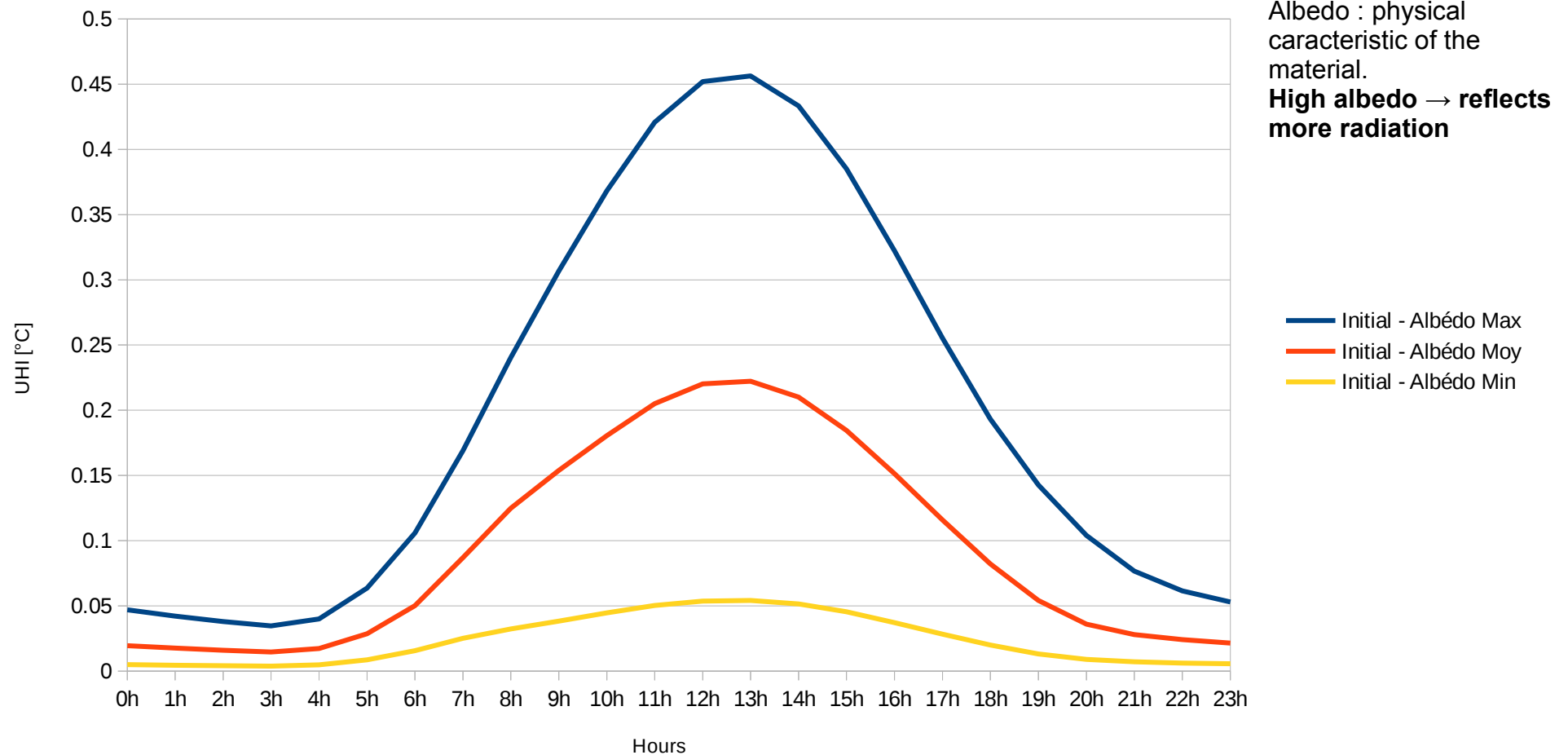
Mitigation :
- change albedo : new materials, white painting,…
- green area : more trees, parks,...

Albedo

Average summer UHI reduced

Albedo : physical caracteristic of the material.
High albedo → reflects more radiation

Legend:
- Initial - Albédo Max
- Initial - Albédo Moy
- Initial - Albédo Min

Y-axis: UHI [°C]
X-axis: Hours
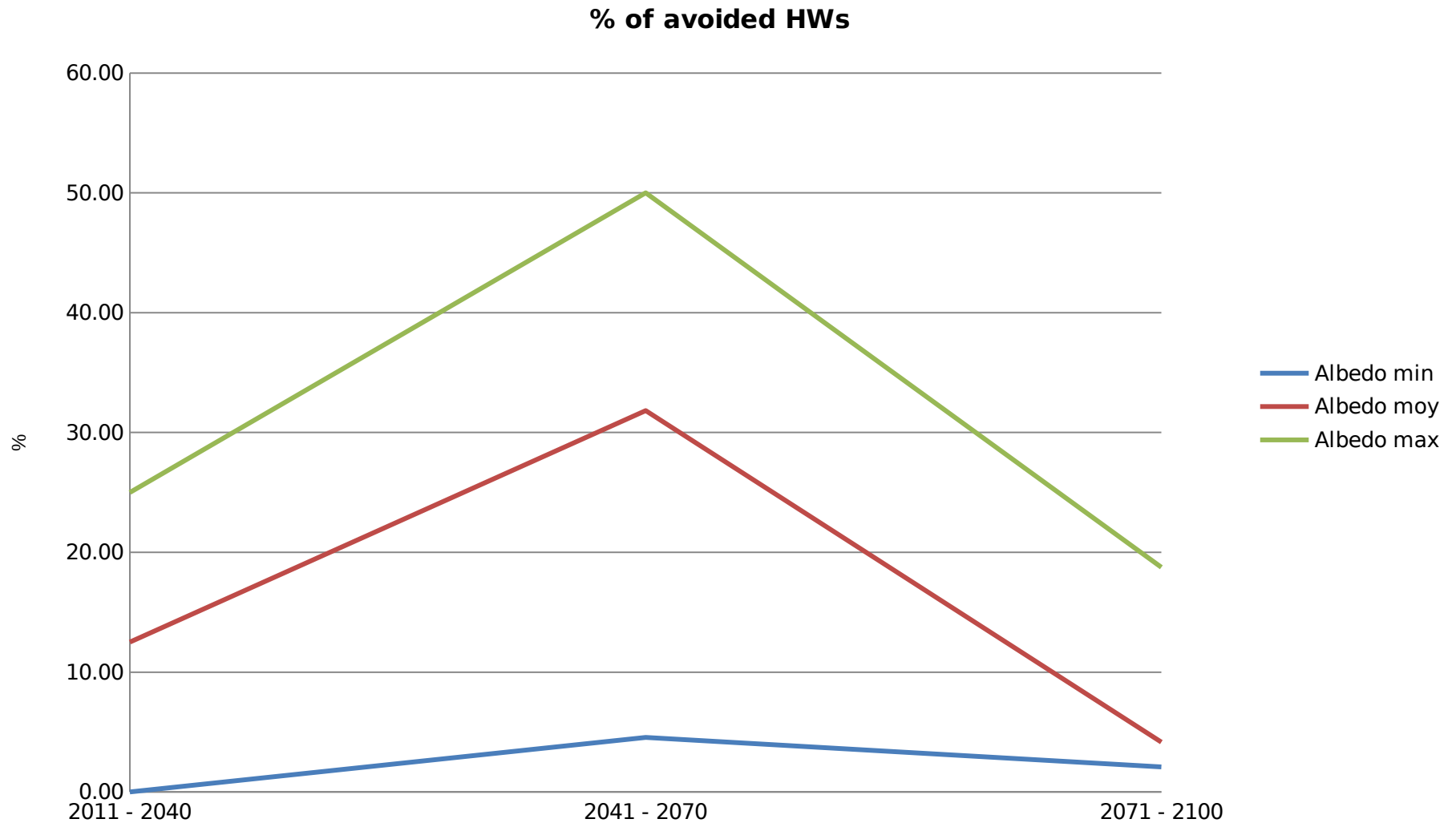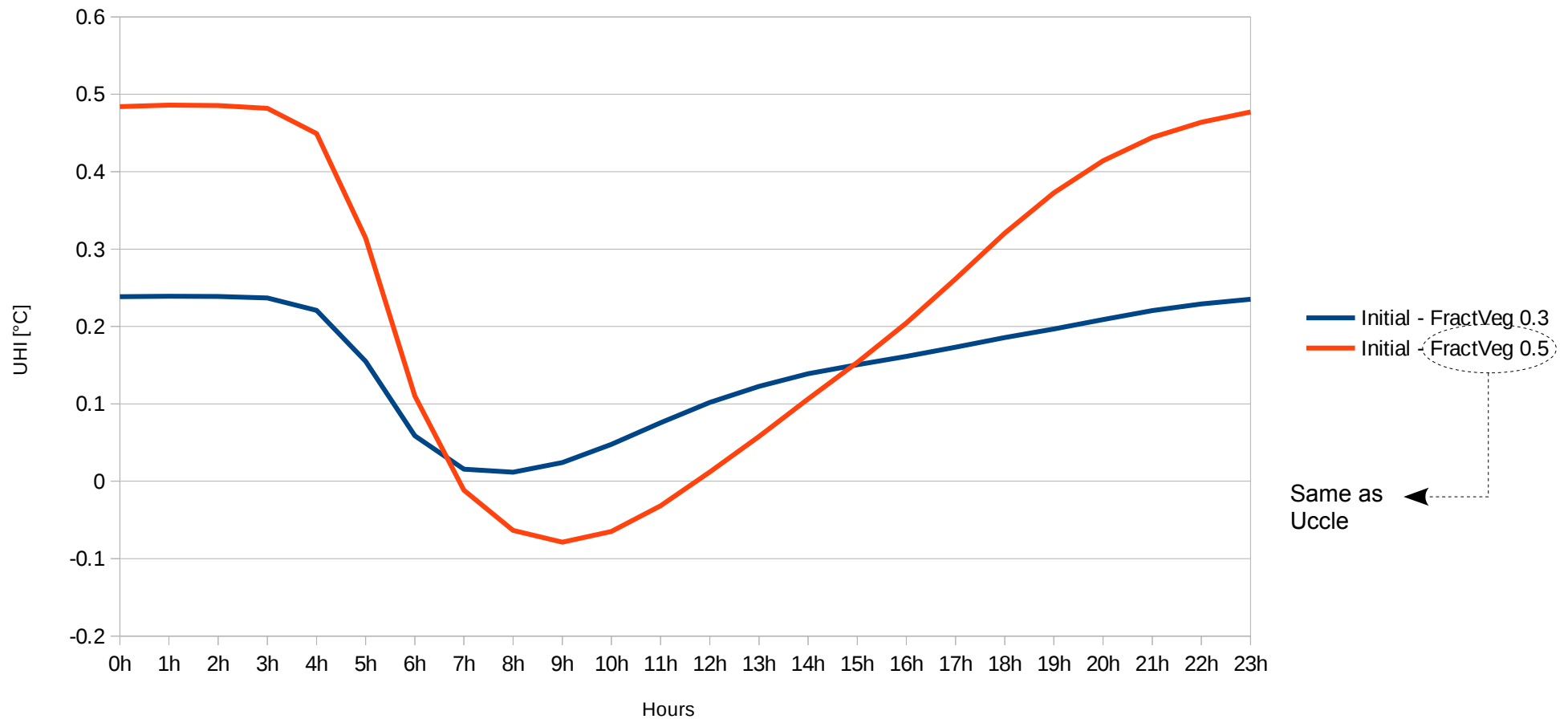
Source albedo : Global Cool Cities Alliance, A practical guide to cool roofs and cool pavements, 2012, pages 24-29, 30

Effect

% of avoided HWs
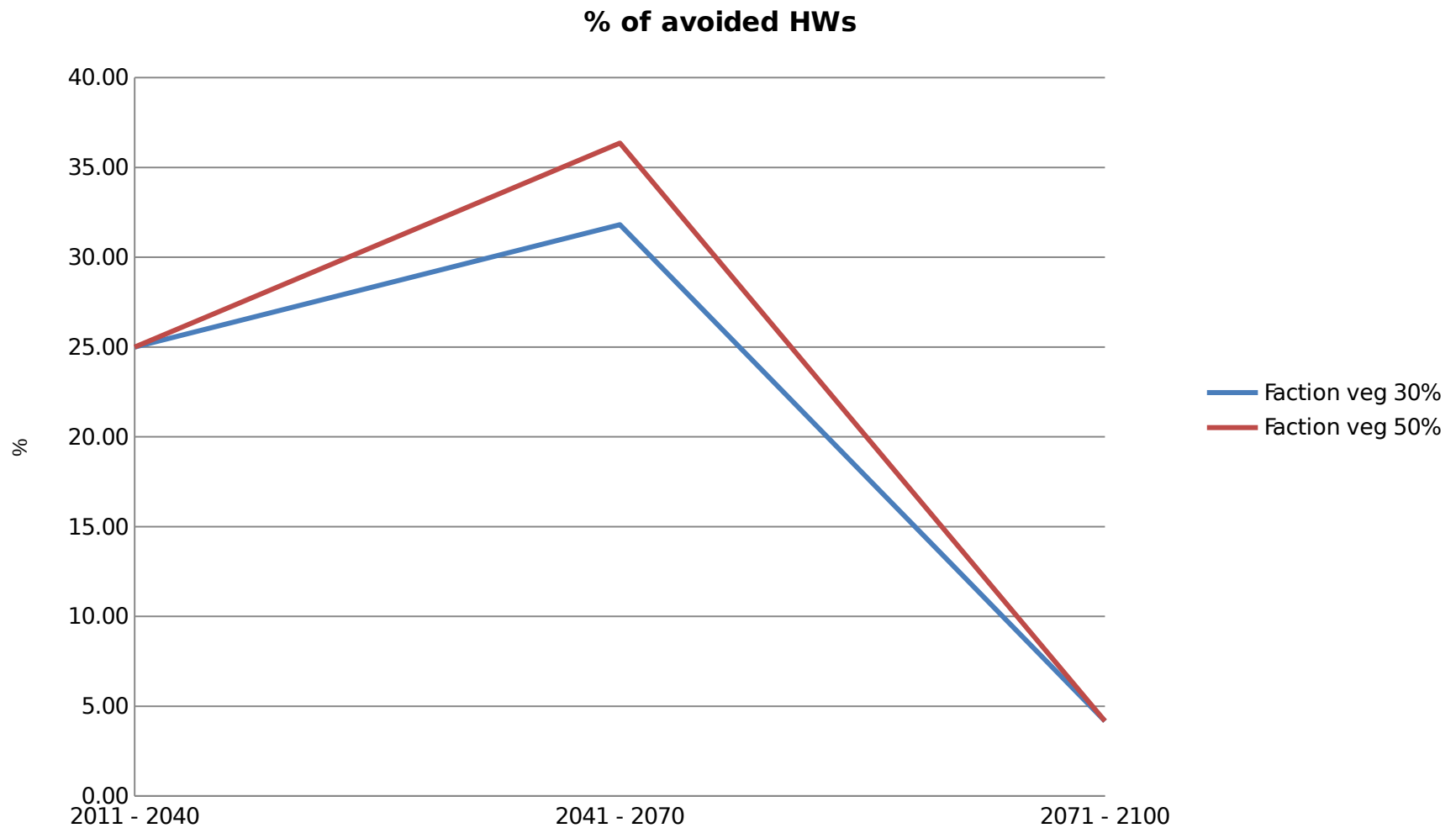
And for green area

Average summer UHI reduced

Effect

% of avoided HWs

Discussion

- Limits :
  - Results depends on the scenario (rcp85 /= cop21)
  - No city expansion
- Future work :
  - URCLIM project :
    - Same downscaling methodology & urban footprint
    - Several case studies : Toulouse, Gent, Helsinki,...
    - UHI, precipitations extremes, snow & ice for road, air quality, economic impacts

Thank you!

"I know nothing about the subject,
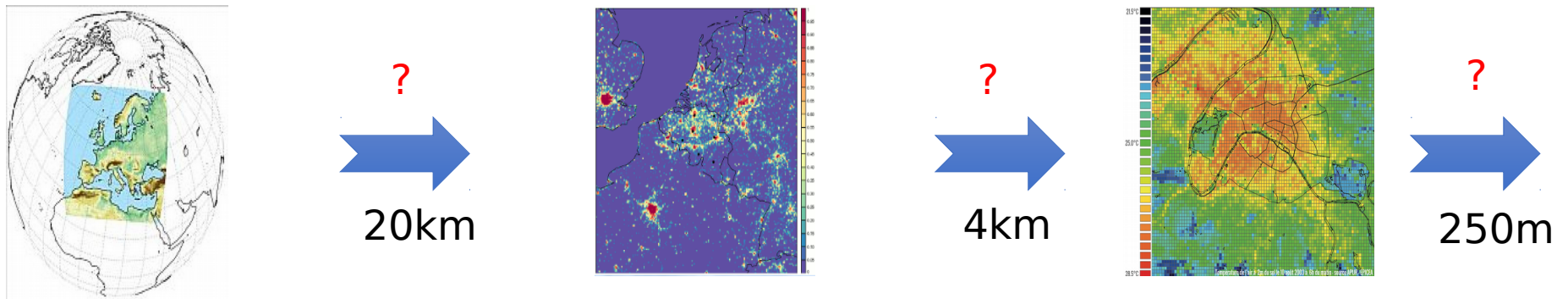but I'm happy to give you my expert opinion."

francois.duchene@meteo.be

Annexes

URCLIM
Urban CLIMate services

2) Downscalling methods from regional climate models to urban scales & uncertainties

20km

?

4km

?

250m

?

- Urban Heat Island
- Precipitations extremes
- Snow and ice for road
- Air Quality
- Economic impacts

WP4: Case studies

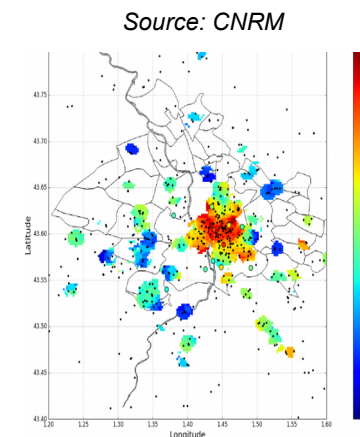Toulouse

Gent & Brussels

The Randstad

Helsinki

Bucarest

5 case studies:

- Involvement of urban users
- Case study selection
- Repository
- Collection of high resolution datasets
- Data fusion

Source: CNRM

Example of data:

https://weathermap.netatmo.com/

	routes	murs	toits
Initial	0,08	0,25	0,15
Albedo min	0,20	0,40	0,25
Albedo moy	0,50	0,62	0,55
Albedo max	0,80	0,85	0,85

	Proportion de végétation en milieu urbain dense
Etat inital	10%
FractVeg 0.3	30%
FractVeg 0.5	50%