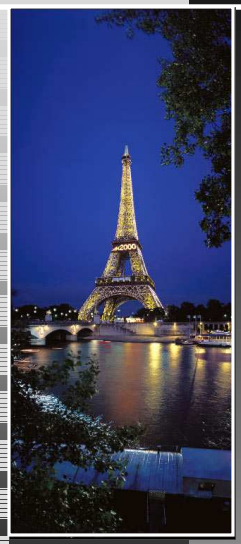


FUTURE HEAT WAVES IN PARIS METROPOLITAN AREA

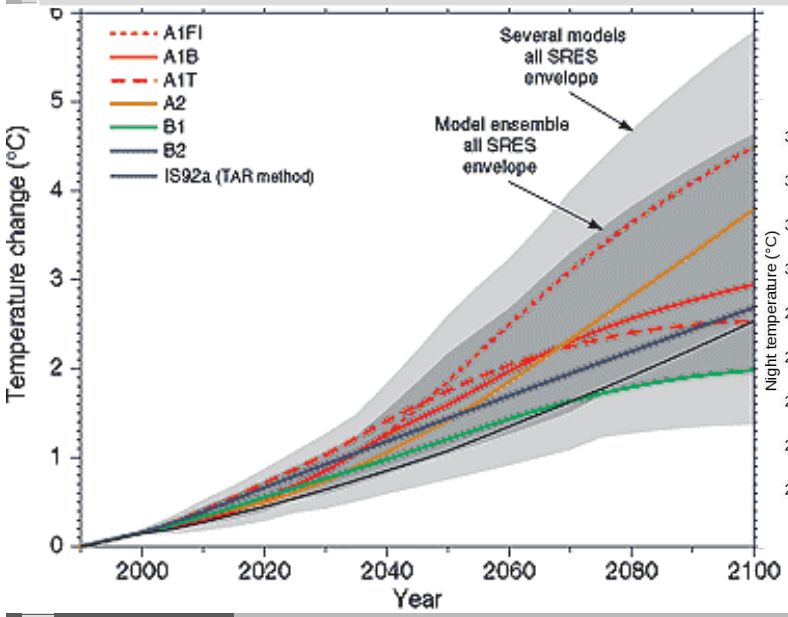
A.L. Beaulant, A. Lemonsu, S. Somot, V. Masson

Meteo-France, CNRS, Toulouse (France)

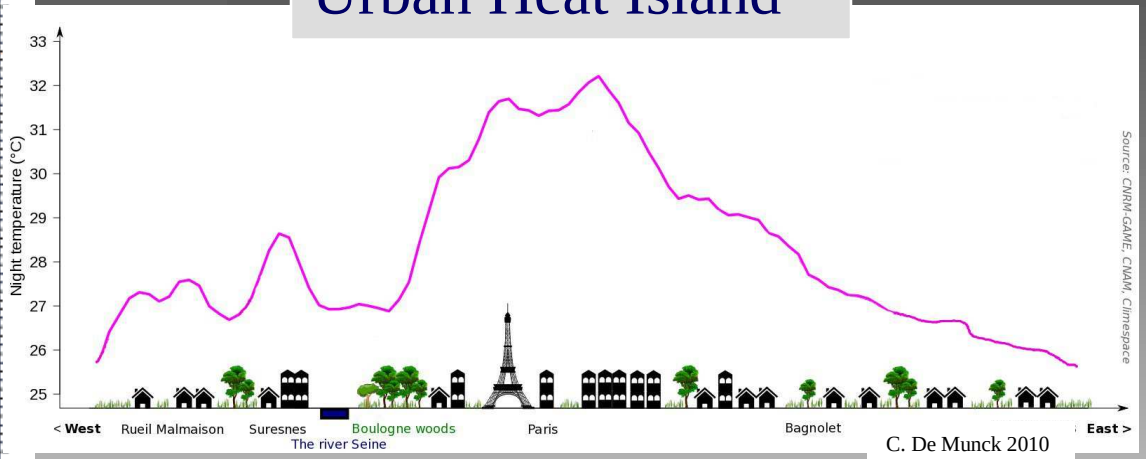
AGU Fall meeting 12-17 december 2010, San Francisco

Context

IPCC Scenarios Global warming



Urban Heat Island



C. De Munck 2010

- UHI is exacerbated by anticyclonic conditions in summer especially during Heat Wave events
- HWs in cities have consequences :
  - Health (extra or premature deaths)
    - e.g. 2003 HW in Paris or 2010 HW in Moscow (700 deaths a day)
  - Energy demand
- In this context, our study focuses on cities vulnerability to HW events

Objectives

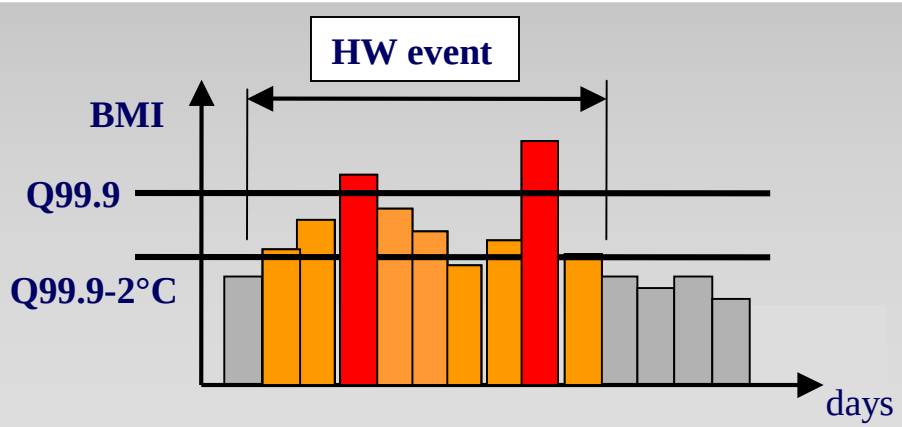
- Main purpose : establishing a range of possible future HWs over Paris region by analyzing their evolution within climate model projections
  - HW definition
  - Definition validation by extracting historical HW events over the study area
  - Extraction of future HW events within climatic projections (RCMs + IPCC-scenarios)
  - Analysis of future HW characteristics

HW definition

- Definition based on the Meteo-France operational warning system for HWs
  - BMI : Bio-Meteorological Indicator
    - Tnight ⇔ BMIn and Tday ⇔ BMIx
- 2 stages :
  - Detection of HW peak by applying thresholds on BMIs :

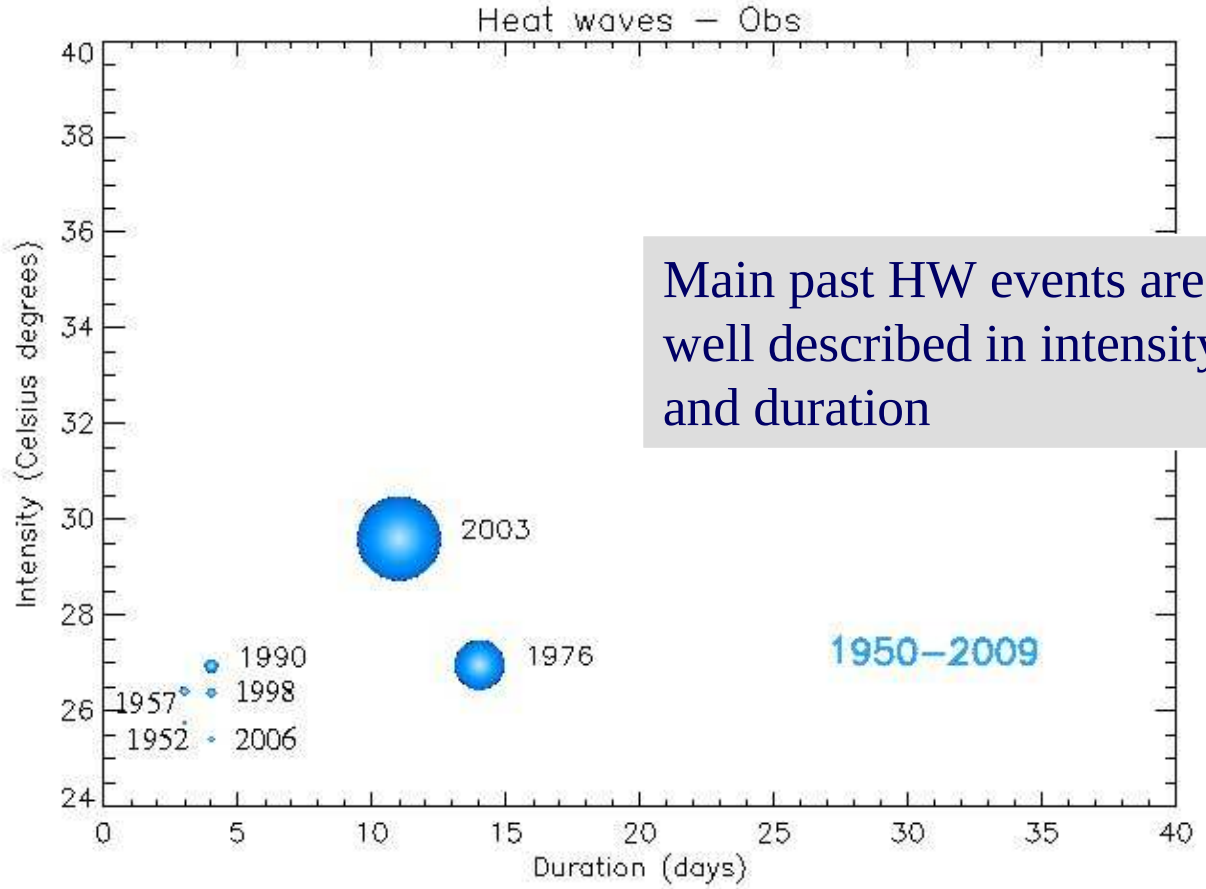
    BMIx or (BMIn+BMIx)/2 > Q99.9 (provided by the warning system)
  - HW duration : all adjacent days for which

    BMIx or (BMIn+BMIx)/2 > Q99.9 - 2°C



Definition validation

Historical HWs extracted within a reference observation time-serie (1950-2009)



Main past HW events are well described in intensity and duration

Extraction of future HWs within 12 climatic projections

RCM	GCM	IPCC-SCN
ARPEGE CLIMATE Variable Resolution		A2
		B1
		A1B
CNRM RM 5.1	ARPEGE	A1B
DMI HIRHAM5	ARPEGE	A1B
DMI HIRHAM5	ECHAM	A1B
KNMI RACMO2	ECHAM	A1B
ICTP REGCM3	ECHAM	A1B
SMHI RCA	ECHAM	A1B
MPI REMO	ECHAM	A1B
ETHZ CLM	HadCM3Q0	A1B
METO-HC HadRM3Q0	HadCM3Q0	A1B

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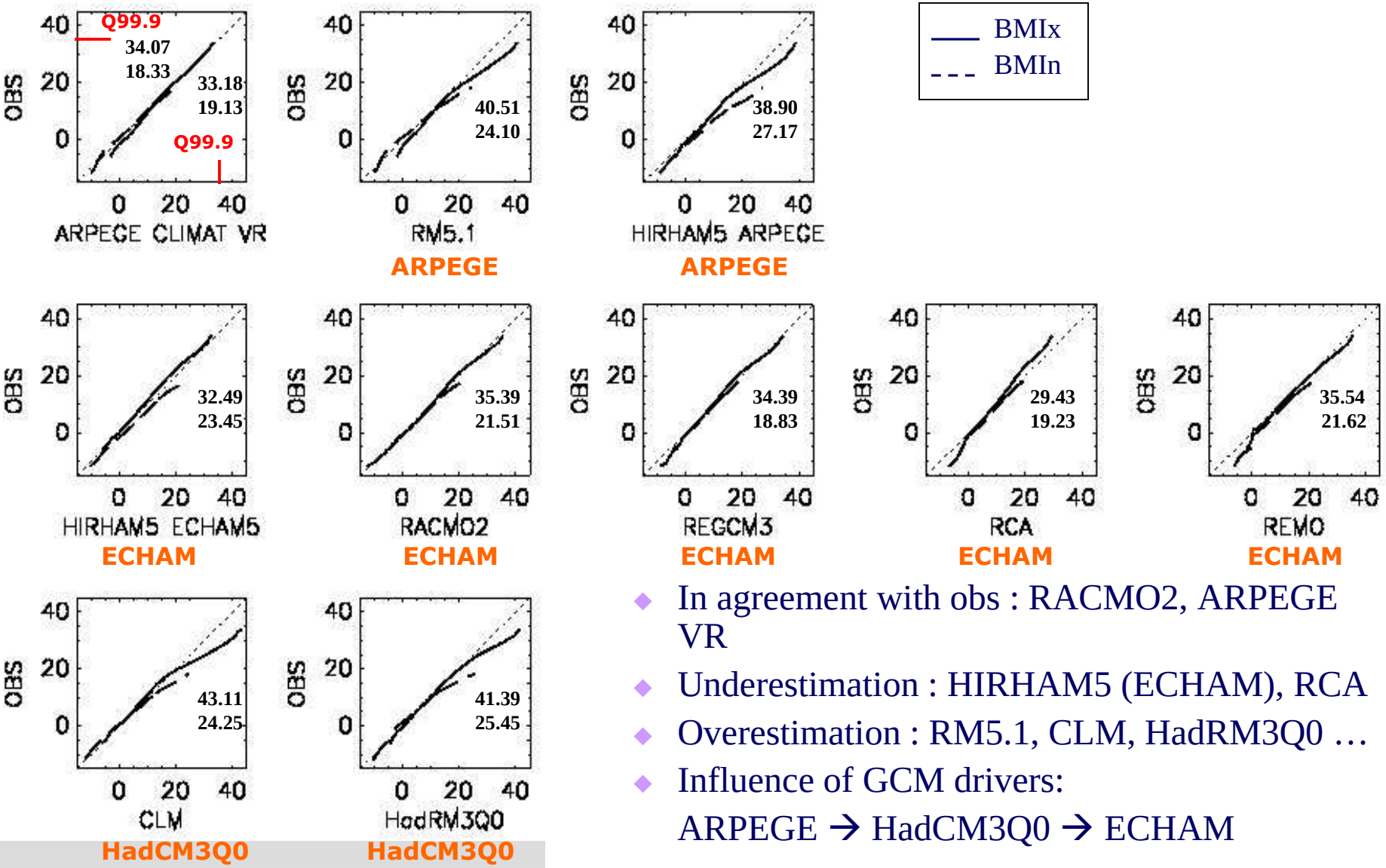
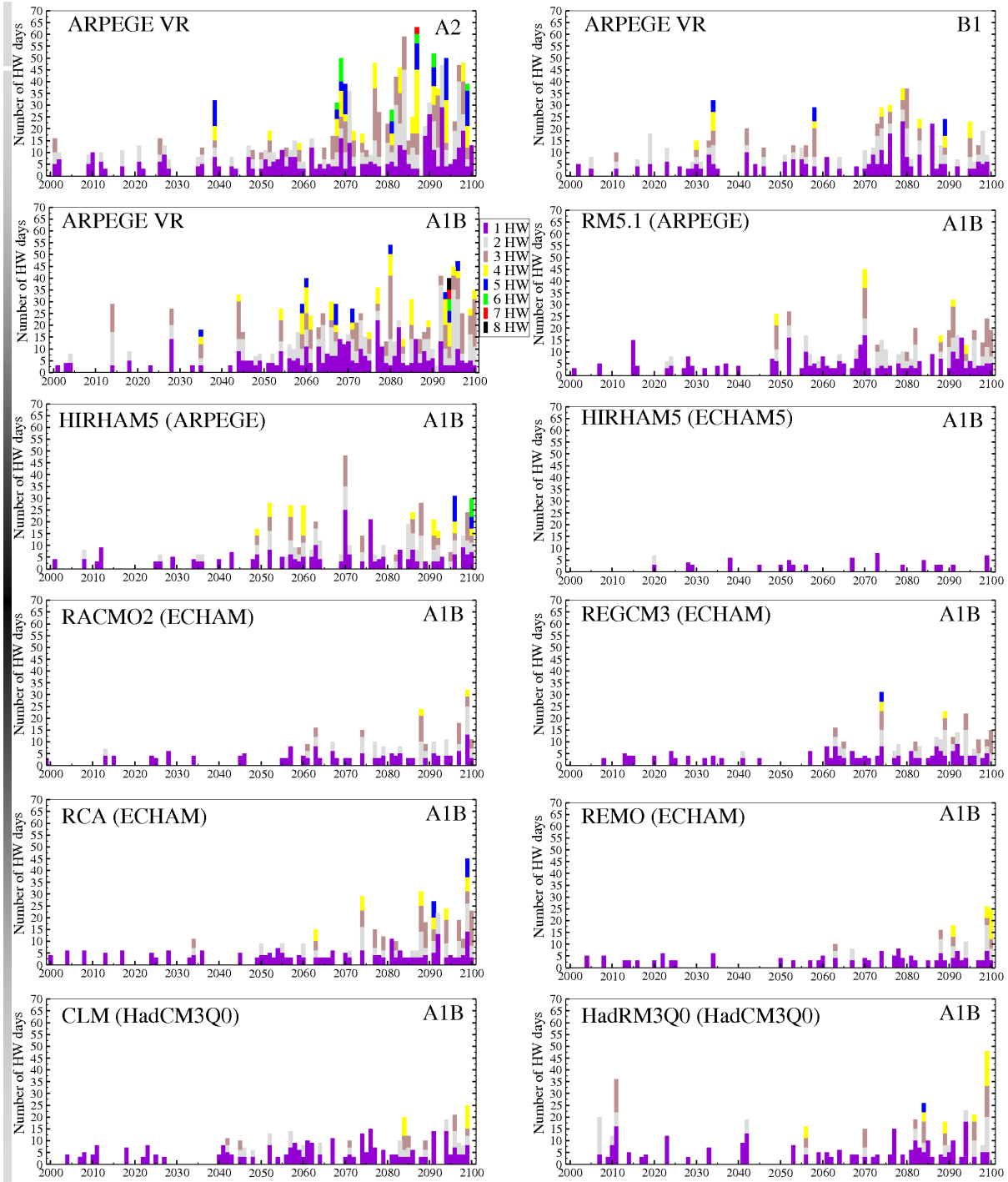
Extraction of simulated HWs

Quantile-quantile plots for BMIs



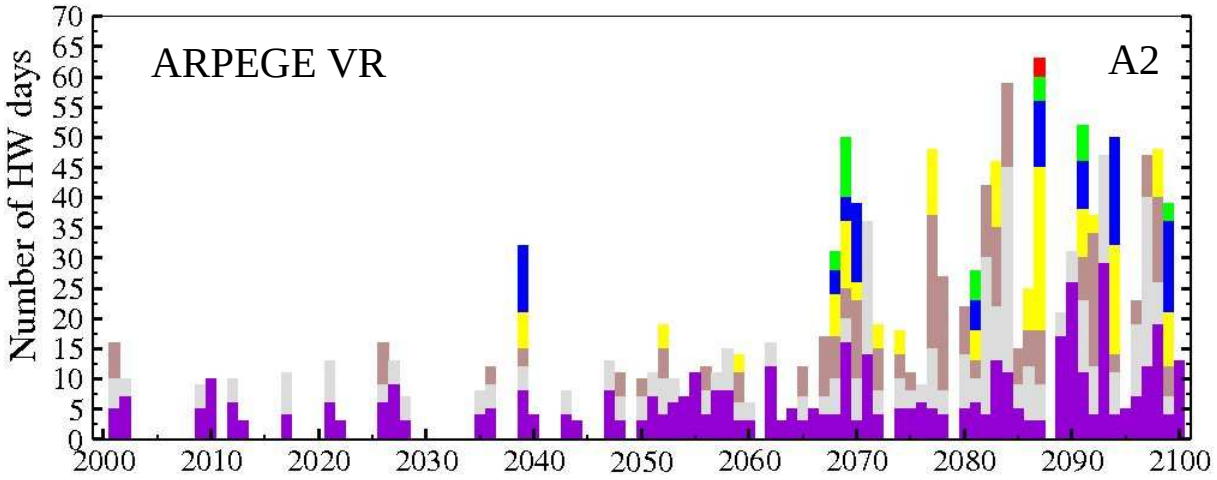
- In agreement with obs : RACMO2, ARPEGE VR
- Underestimation : HIRHAM5 (ECHAM), RCA
- Overestimation : RM5.1, CLM, HadRM3Q0 …
- Influence of GCM drivers:
  ARPEGE → HadCM3Q0 → ECHAM

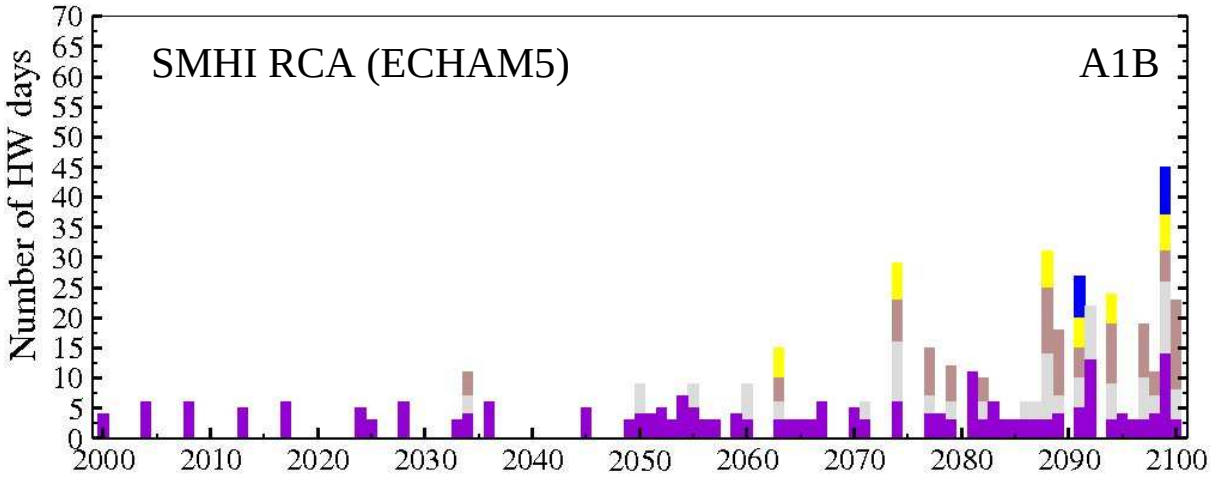


Future HWs : occurrence and duration

A2	3 HWs per year in average
A1B (or B1)	2 HWs per year in average
Obs	1 HW every 4 years

1 HW
2 HW
3 HW
4 HW
5 HW
6 HW
7 HW
8 HW





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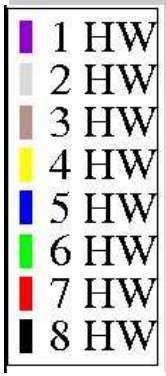
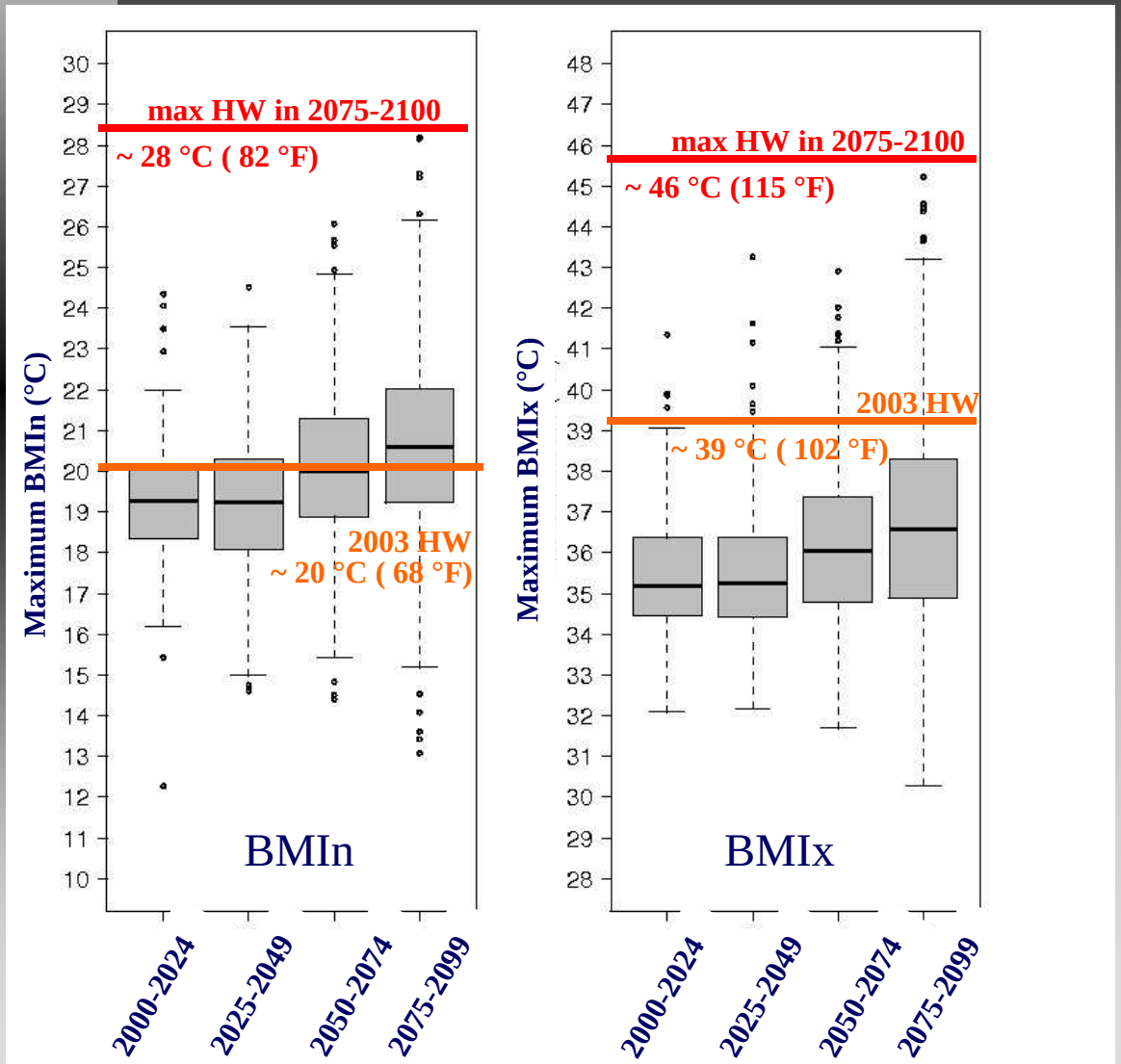
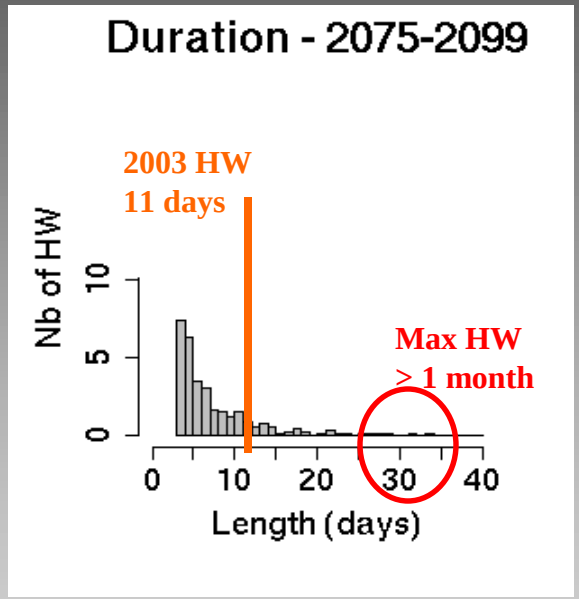
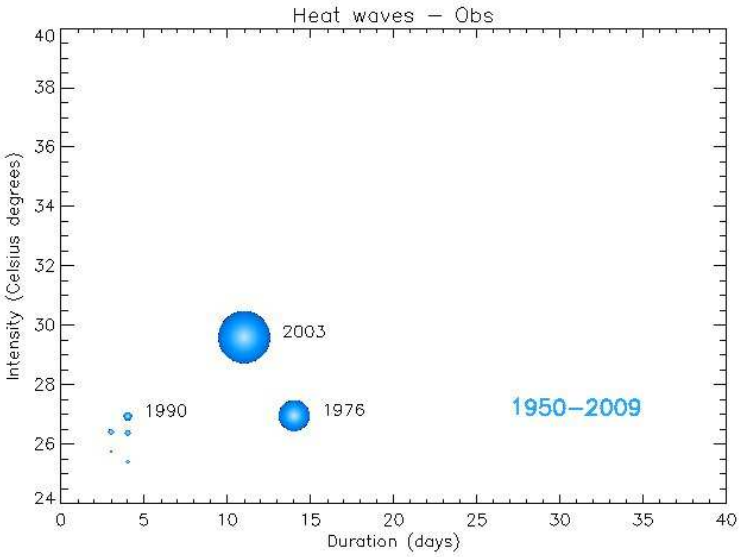


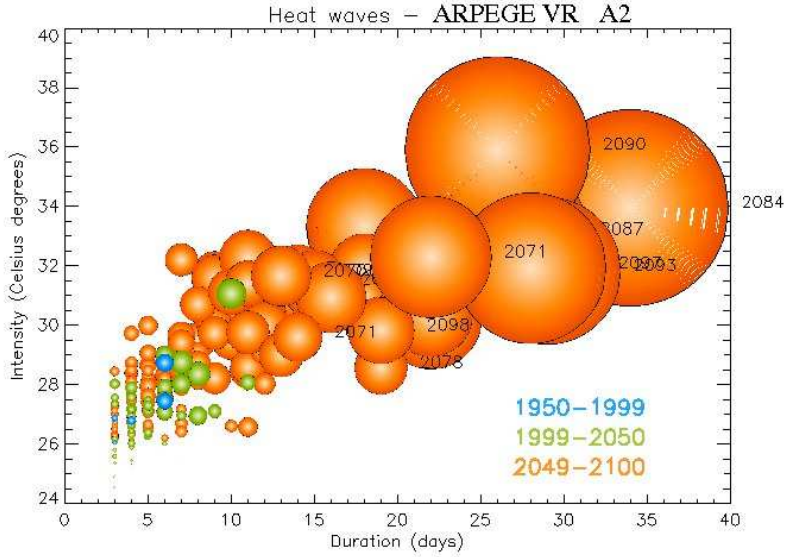
Future HW characteristics : intensity and duration

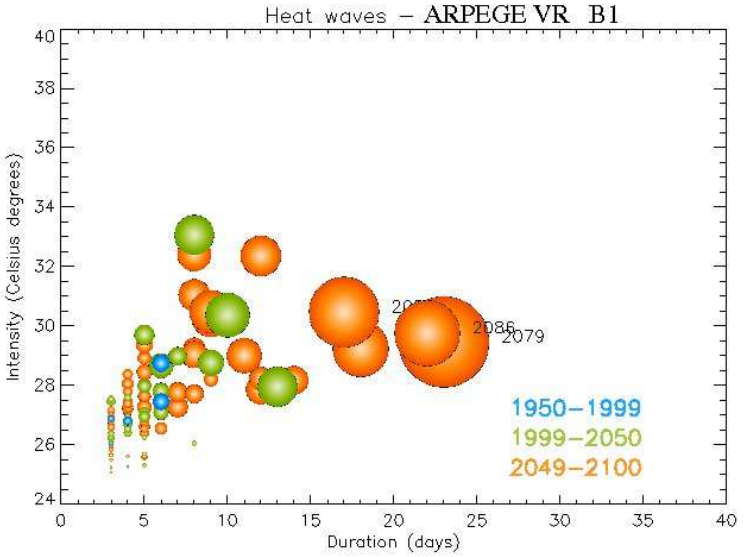


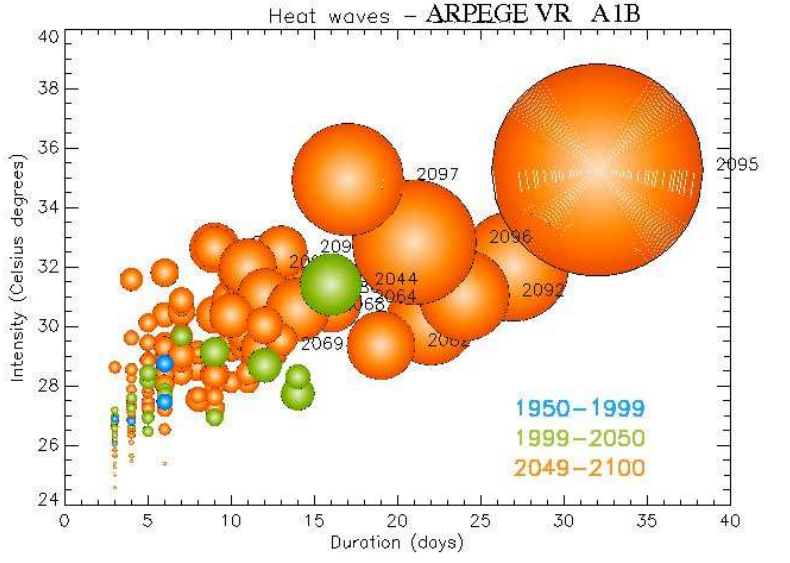


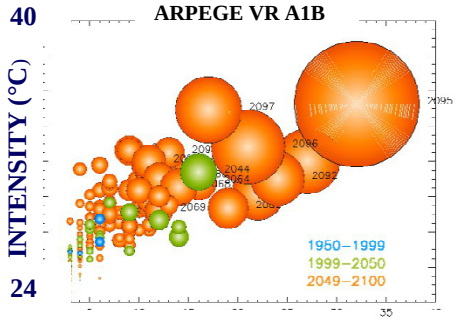
Future HW seriousness (3 IPCC-scenarios)

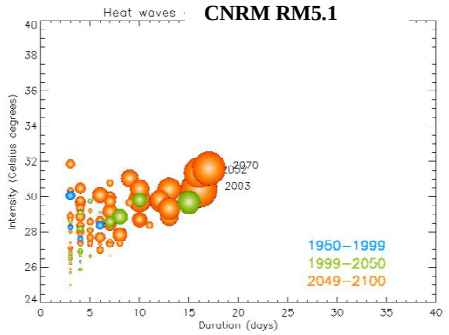


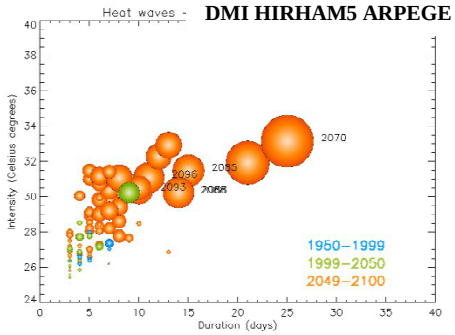


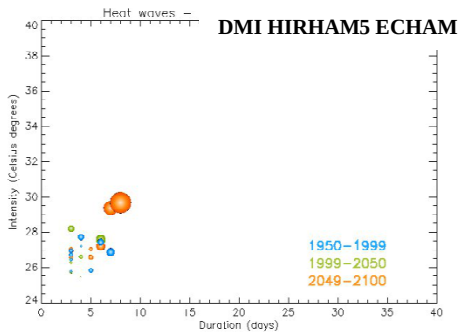


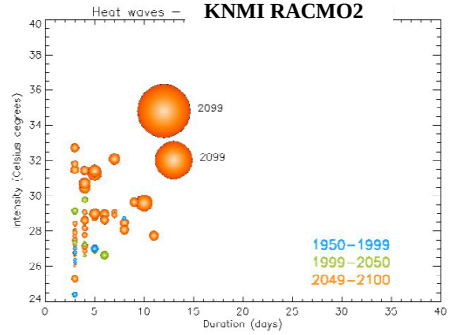


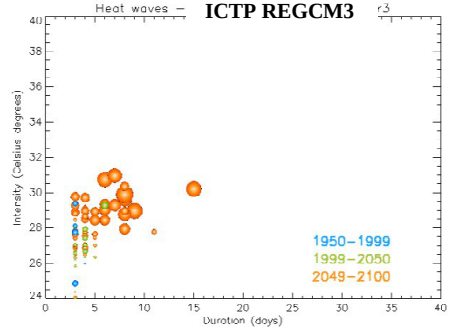


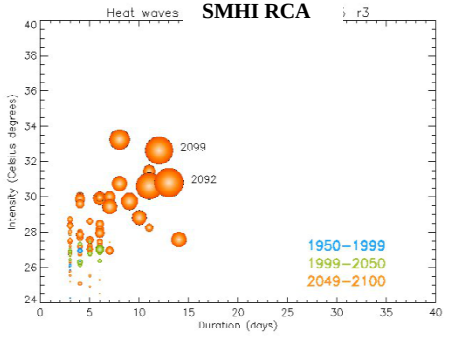


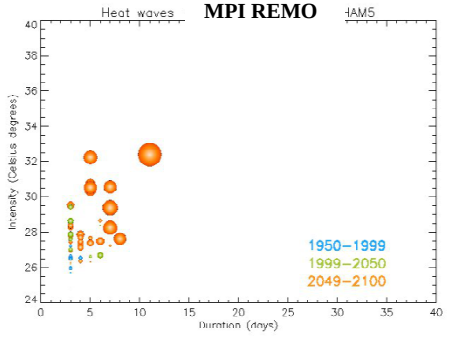


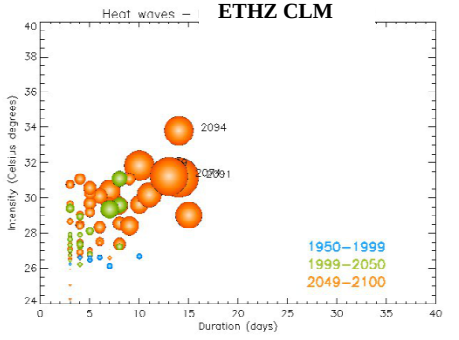


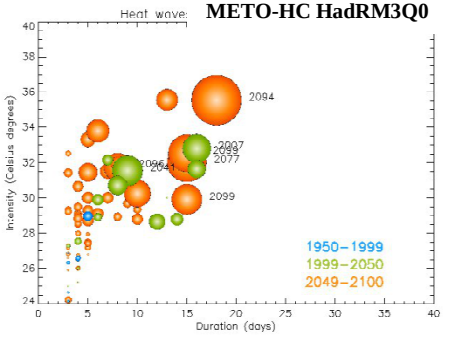












Future HW seriousness

(10 simulations, 1 scenario: A1B)

Conclusion and further work

- Conclusion of the analysis
  - For extreme HWs in 2075-2100 :
    - Increase in intensity: 22 °C (72 °F) < Mean Intensity < 36 °C (97 °F)
    - Increase in duration : up to one month
    - Increase in frequency: 2-3 HWs per year
- Modeling of the impact of these future HWs on urban climate
  - Using a specific urban climate model TEB in order to simulate air temperature at street level, evaluate energy consumption …
  - Using several projections of Paris 2100 (expansion, intensive use of air conditioning systems, adaptation strategies such as greening strategies …)

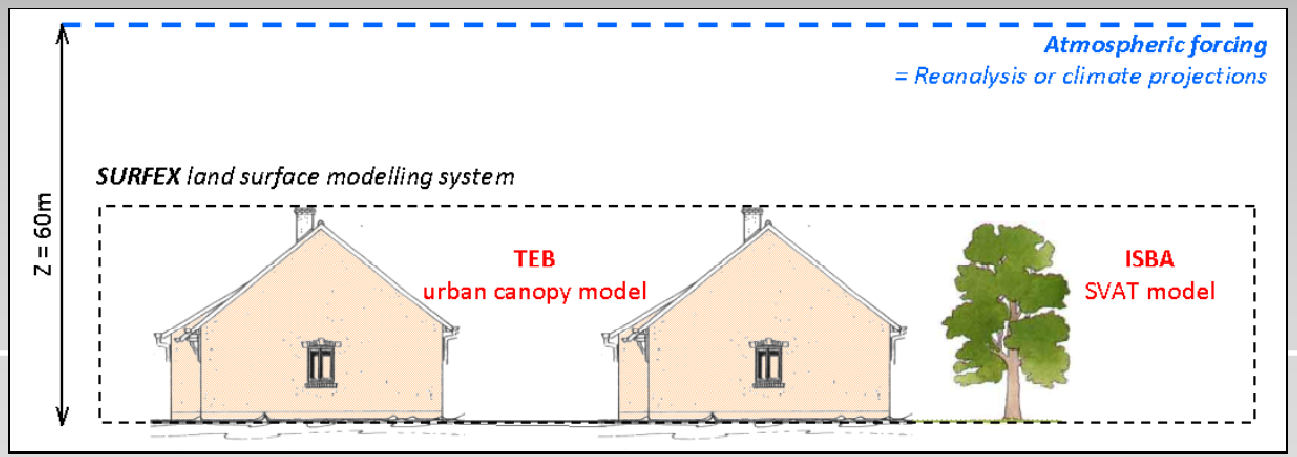


Fig1. Schematic of the SURFEX system including TEB and ISBA, running in offline mode. A. Lemonsu 2010

Adaptation strategy

Paris 2100
imagined by two
Parisian architects

Questions ?

SOURCE : Yannick Gourvil and Cecile Leroux, collectif ET ALORS