Long-term Ozone exposure calculations with an episodic method

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Outline:

- Objectives and background
- Episode selection
- application to Paris urban zone
- comparison with other episode selection methods

Objectives and background

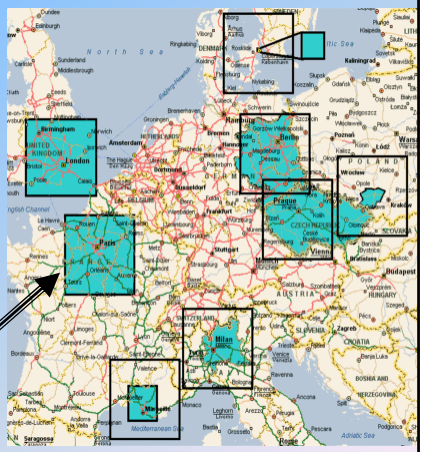
- Long term exposure: an important issue
- For ozone, two indexes: average and AOT
- The present study performed in the framework

of City-Delta project
(*http://rea.ei.jrc/netshare/thunis/citydelta)*

model intercomparisons and

scenario reduction analyses

- O3 exposure calculations for Paris
- method: ***episodic scenarios***



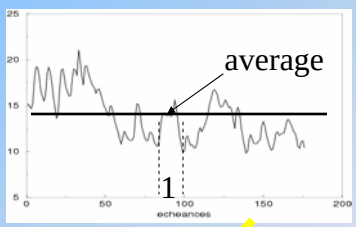
Objectives and background continued

Episodic scenario method:

1-With several meteorological parameters: definition of a distance between events

2- definition of a selection criteria

3- Calculation of a few selected periods which must be representative as much as possible of the long term application



Advantages : less time consuming

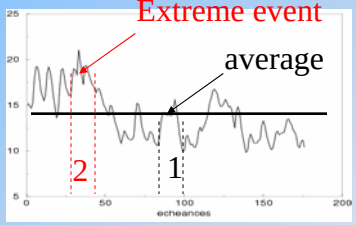
===> refinement in space and time are possible

Objectives and background continued

drawback: loss of information,
the problem of peak episode

- For the average exposure: few episodes are needed

- For exposure determined above threshold (AOT, percentile, …): Not the same episode



Main question: how to select the episode ?

Episode selection: Hypothesis and method

Definition of a selective criteria (on meteorological data)

➔ for each day d: distance to the mean day

$$dist_d = \sum_i \frac{\left|\overline{x}_d^i - \overline{x}^i\right|}{\overline{x}^i}$$

$\overline{x}_d^i$ met. param. i averaged over the day d

i = pression, temperature, …

- **selection of the closest real day**

  the smallest distance to the mean day

- **period used to calculate the mean day**

  One month===> selection of day/month

Episode selection: Hypothesis and method

The present study is based on two assumptions

- **mean day**

The meteorological conditions of the ***mean day*** (over a given period) can be used to determine the exposure value

- **Closest real day**

The calculation performed with the ***closest real day***

give also a good estimate of the exposure value

Episode selection: Hypothesis and method

- advantages of the selection of the closest real day
  - **simple and physical method of selection**
  - **simulation of a *real day*:**
    direct comparisons with observations
    (not a 'built' day with averaged parameters)
- 5 meteorological parameters are used:
  - T, P, RH, u, v, average values over the domain

$$dist_d = \sum_i \frac{\left|\overline{x}_d^i - \overline{x}^i\right|}{\overline{x}^i}$$

$\overline{x}_d^i$ met. param. i averaged over the day d

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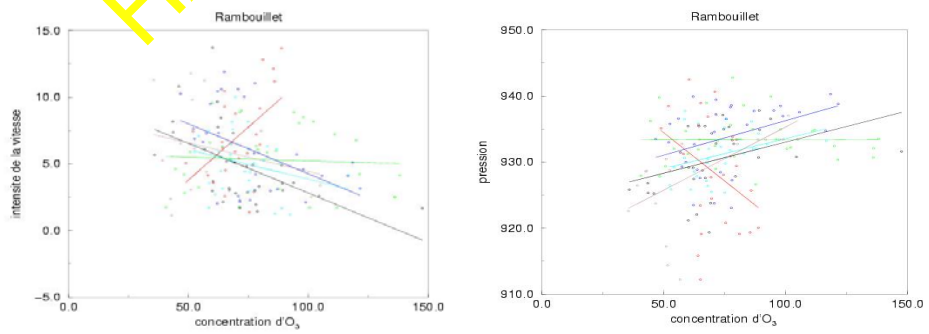
Episode selection: Hypothesis and method

Influence of the meteorological parameters

(With observed O3 data)

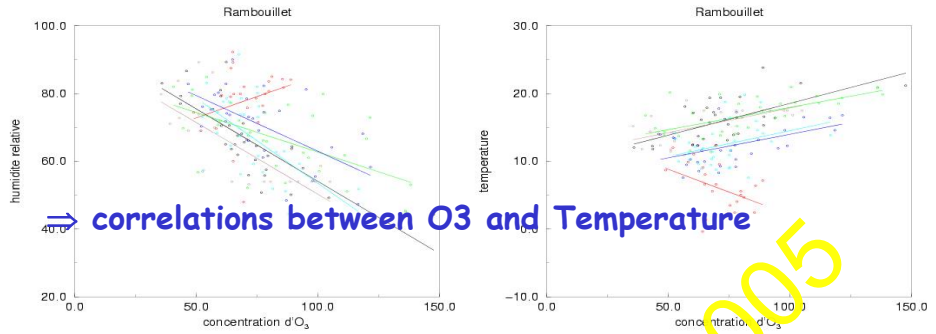


⇒ No obvious correlations with wind speed and pressure

Episode selection: Hypothesis and method

Influence of the meteorological parameters

(With observed O3 data)



⇒ correlations between O3 and Temperature

===>Selection of one day/month with the Tp only

The UAQ model: TRANSCHIM

- 3D transport + chemistry model

  chemical mechanism : Melchior (44 species-116 reactions)

- 10 levels in the vertical direction

  → the first one at 25m height

- Diffusivity coefficients: Louis parameterisation

- Meteorological parameters : ALADIN data

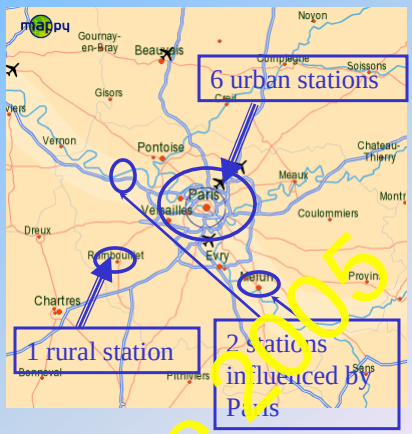
- Boundary condition : EMEP data

Application to Paris

For 6 months (April to September 1999):

- calculations of mean ozone concentration and AOT40

-comparisons between observations, sequential calculation episodic method

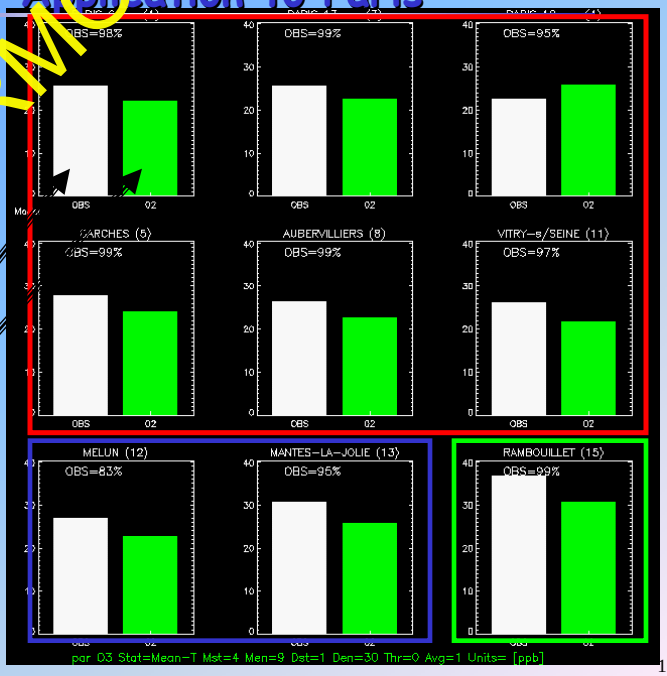


Application to Paris

6 month average

OBS : observations

green: station values for the selected day



Application to Paris

AOT40

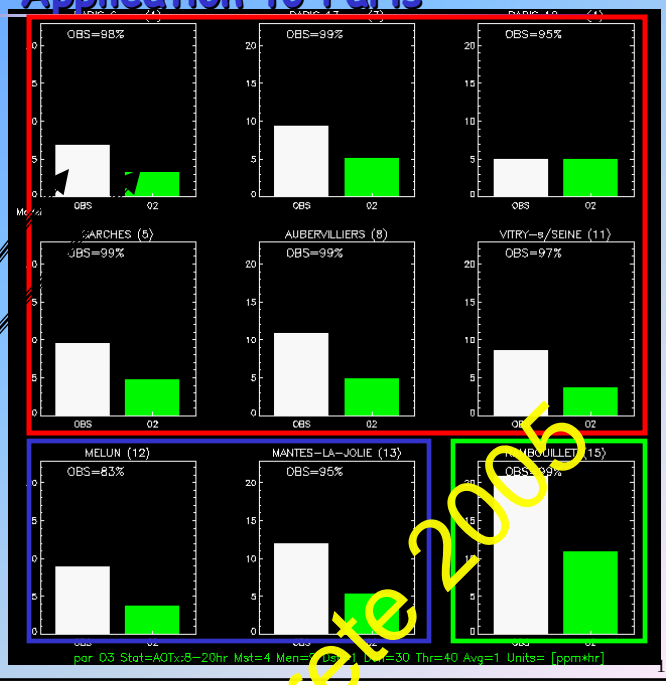
(6month)

OBS : observations

green:

station values for

the selected day



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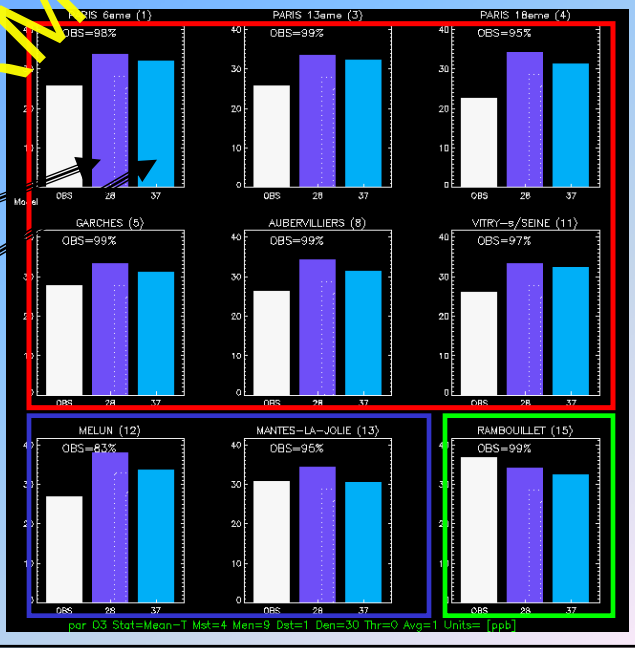
Application to Paris

6 month average

28 : episodic

37 : sequential



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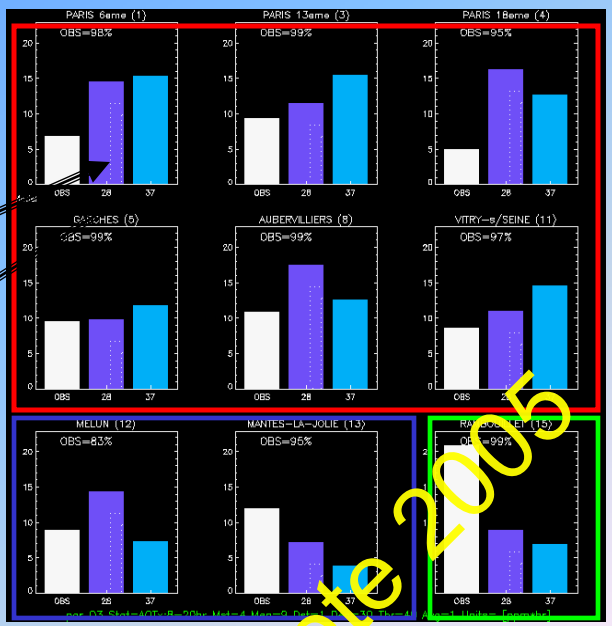
Application to Paris

AOT40

(6month)

28 : episodic

37 : sequential



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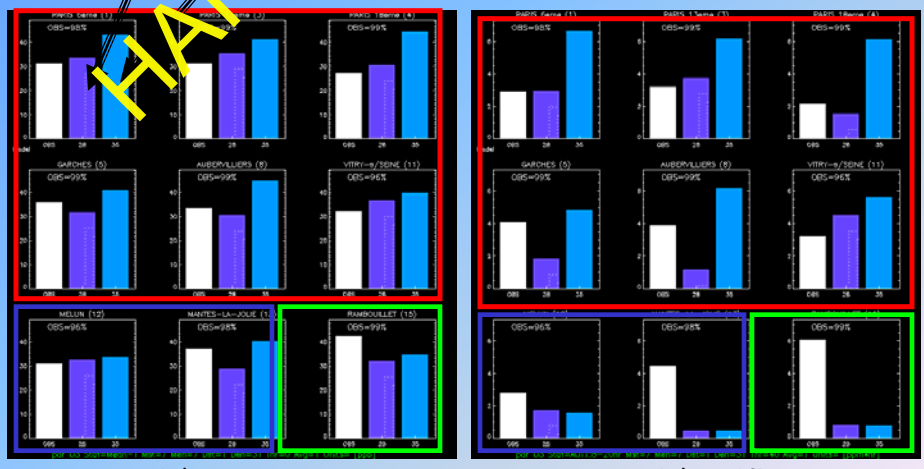
Application to Paris

episodes selected on 5 meteorological parameters

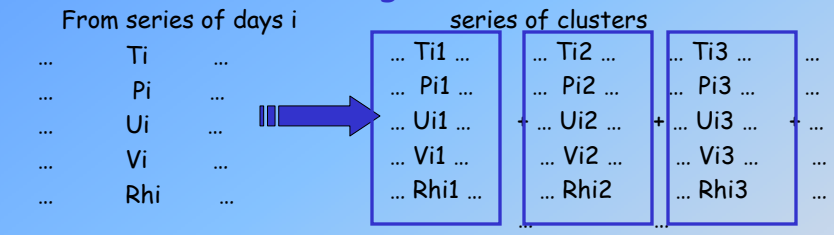
episodes selected only with the temperature



July average | July AOT

Comparisons with other episode selection methods

- cluster selections: general method



Two particular cluster analyses

- k-means: the closest neighbours , partition
  - Eder et al. (1994-1998)
- hierarchical method (Ward's method)

Fernau et al. 1990, Cohn et al. 1999, Brook et al. 1995

Comparisons with other episode selection methods

k-means: the closest neighbours ,

The number of clusters is fixed

1-for each element:attribution to the closer cluster

2-calculation of the new gravity centre of the cluster

Repeat 1 and 2 ….

With our method of selection: two particular days the closest and farest day to the mean

Month	Minimum number of clusters to have the two days in two different cluster
Avril	2
Mai	3
Juin	3
Juillet	3
Août	2
Septembre	2

Comparisons with other episode selection methods

Hierarchical method (Ward): bottom up clustering

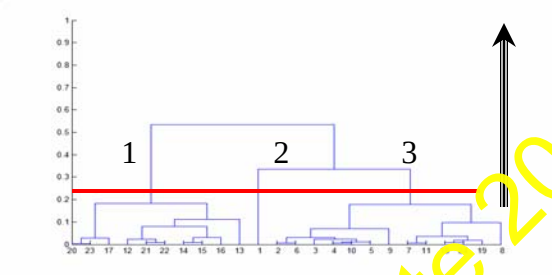
Each element is a cluster

clustering between two clusters if

the within-cluster variance is minimum

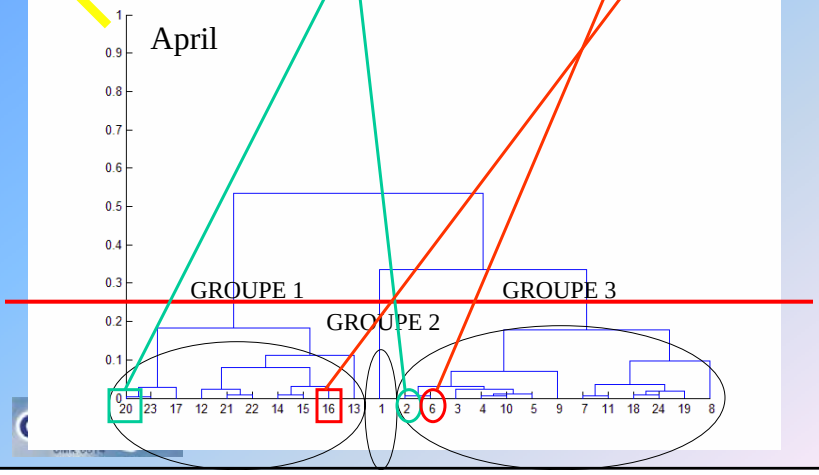
And the distances between cluster is maximum

repeat until one cluster



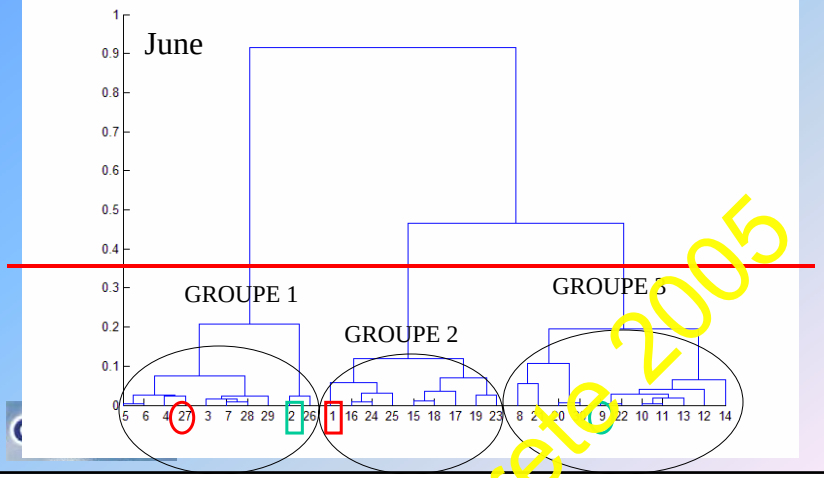
Comparisons with other episode selection methods

	T, [illegible]H, u,v selection	T selection
Day closest to the mean day	2	6
Day far[illegible] from the mean day	20	16



Comparisons with other episode selection methods

	T, P, RH, u,v selection	T selection
Day closest the mean day	9	27
Day far from the mean day	2	1



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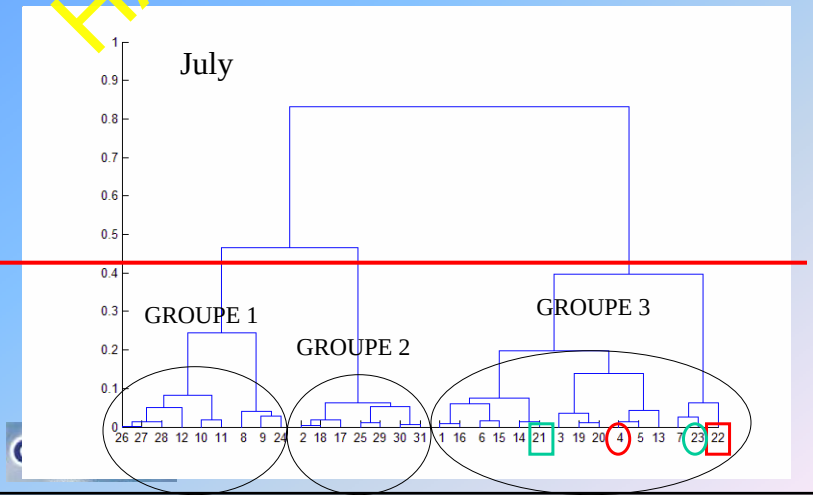
Comparisons with other episode selection methods

	T, P, RH, u,v selection	T selection
Day closest the mean day	23	4
Day far from the mean day	21	22



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Conclusions 1

1- main advantage of the episodic scenario methods:

reduction of the calculation task for simulating long term series: possible to increase time and spatial resolutions

2- Disadvantage (of all episodic scenario method)

No error compensations due to the small number of calculation periods: Short term assessments (ex: daily O3 max) cannot be performed

3- main advantage of the present method:

The choice of real days as scenarios makes it possible direct comparisons to observations

Conclusions 2

4- *With our simple and physical scenario approach,* **average values are in agreement** *with observations*

5- *With our simple and physical scenario approach,* **AOT are not in agreement** *with values determined from observations*

6- our physical approach is consistent to more statistical clustering methods as Kmean or Ward's method

7- 6 *months is a short period for the application of episodic scenario method*