

SPN7 – Sheffield, UK – 28-30 August 2013



The  
University  
Of  
Sheffield.



International  
Water Association

# *Dynamics of pollutant discharge in combined sewer systems during rain events: chance or determinism?*

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IFSTTAR

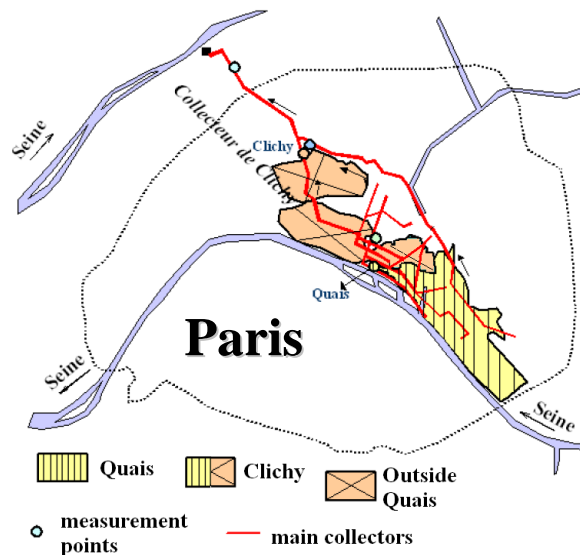


# Context

- Importance of urban wet weather pollution;
- Negative impact of TSS (main vector of certain contaminants);
- High temporal variability of TSS concentrations and fluxes not only during event but also between events;
- Some studies have observed some spatial homogeneity between sites, as regards fluxes and concentrations (Kafi Benyahia *et al.* 2008: Spatial variability of the characteristics of combined wet weather pollutant loads in Paris. *Water Research* 42, 539-549)
- Conventional sampling methods on samples collected during rain events:
  - limited number of samples per event
  - some events can be sampled
- Continuous turbidity measurement in sewer systems:
  - indirect access to the dynamics of particulate pollution

# SOERE URBIS databases (A long-term Observation System for research and Experimentation on urban environment)

- Statistically representative databases for continuous water flow and turbidity measurements at the outlet of:
  - two embedded catchments in Paris (Quais and Clichy)
  - one in Lyon (Ecully)
  - hundreds of rainfall events and dry weather days



## • Aim of this study

- Assessment of the variability of TSS fluxes and concentrations observed at the outlet of these catchments during both wet and dry weather periods

# Description of the sites

| Catchments             | Quais       | Clichy      | Outside Quais | Ecully      |
|------------------------|-------------|-------------|---------------|-------------|
| Land uses              | Dense urban | Dense urban | Dense urban   | residential |
| Surface area (ha)      | 402         | 942         | 540           | 245         |
| Runoff coefficient (-) | 0.64        | 0.68        | 0.71          | 0.15        |
| Active surface (ha)    | 257         | 641         | 383           | 37          |
| Median slope (%)       | 0.14        | 0.10        | 0.10          | 2.7         |

- Quais catchment is totally embedded in the Clichy catchment  
 ➡ complementary fraction of the “Quais” catchment denoted “Outside Quais”
- Ecully’s characteristics are quite different vs. Parisian sites: low population density, residential area with steep slopes, and no street cleaning
- Paris sewer network is known for its high deposit level but this is not the case for Ecully

# Equipments and available data set

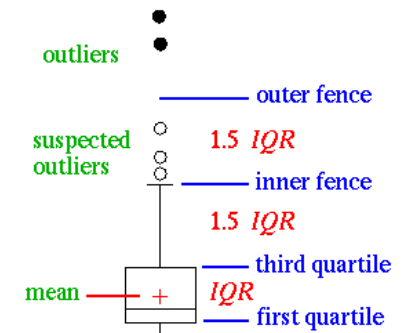
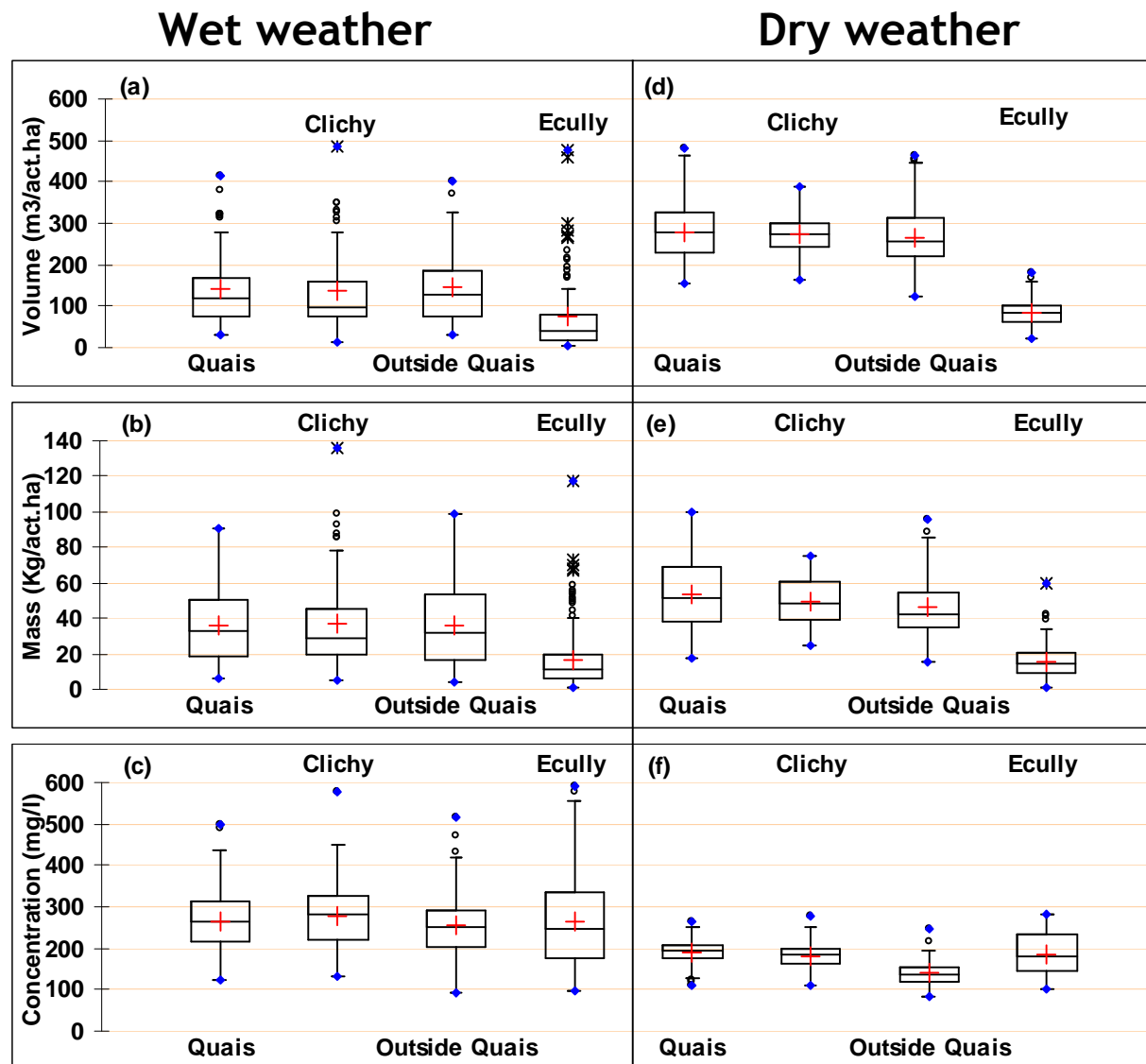
- @ each site: 2 redundant turbidity sensors, 1 flow-rate sensor & 1 conductivity sensor
- Flow-rate, turbidity and conductivity measurements: time step: 1 minute @ Quais & Clichy (2006), 2 minutes @ Ecully (2004→2008))
- Turbidity-TSS average relationship was applied
- Available data set

|             | Quais | Clichy | Common events | Ecully |
|-------------|-------|--------|---------------|--------|
| Dry weather | 221   | 215    | 209           | 180    |
| Wet weather | 74    | 88     | 70            | 239    |

# RESULTS AND DISCUSSION

- Volumes, masses and concentrations at the level of rainfall events and dry days

Distributions  
“Tukey box plots”

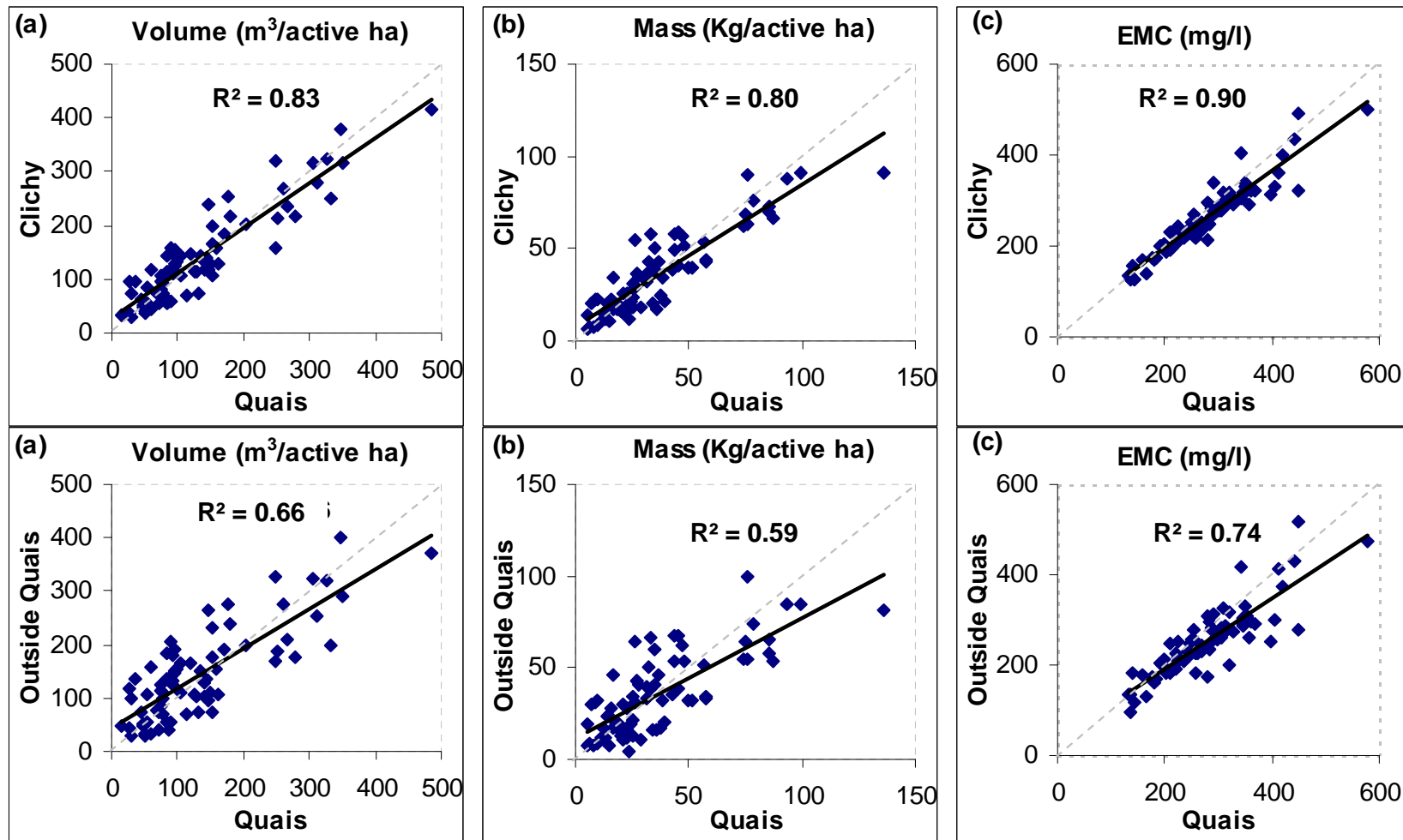


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# RESULTS AND DISCUSSION

- Volumes, masses and concentrations at the level of rainfall events

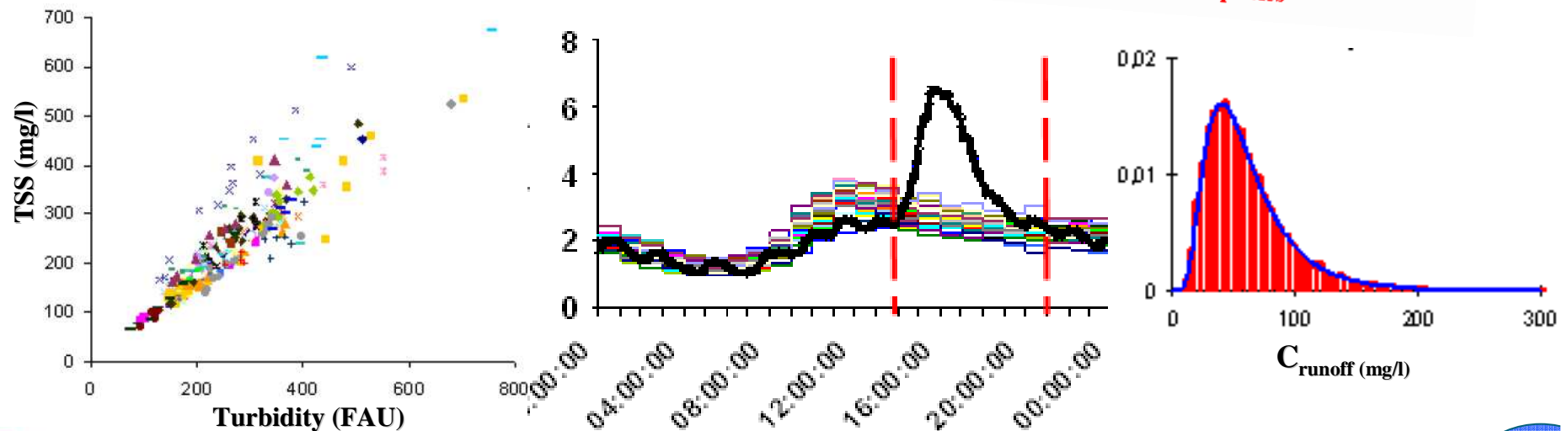
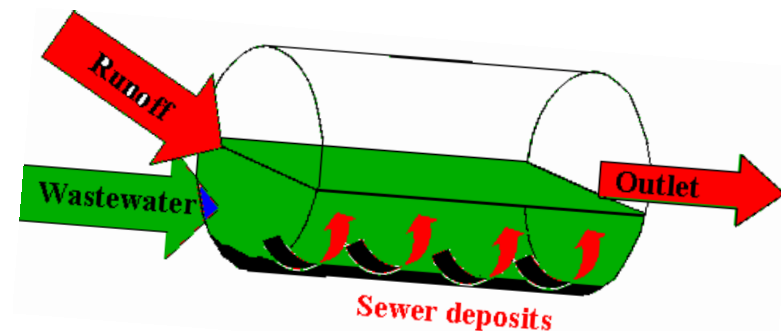
Correlations between sites for common rainfall events





# CONTRIBUTION OF SOURCES

- Contribution of different sources to mass results for each rain event
- 3 distinct origins of event load during a rain event ( $M_{\text{Outlet}}$ ) :
  - Wastewater ( $M_{\text{WW}}$ ),
  - Surface runoff ( $M_{\text{SR}}$ )
  - Sewer deposits ( $M_{\text{SD}}$ )
  - $M_{\text{SD}} = M_{\text{Outlet}} - M_{\text{WW}} - M_{\text{SR}}$



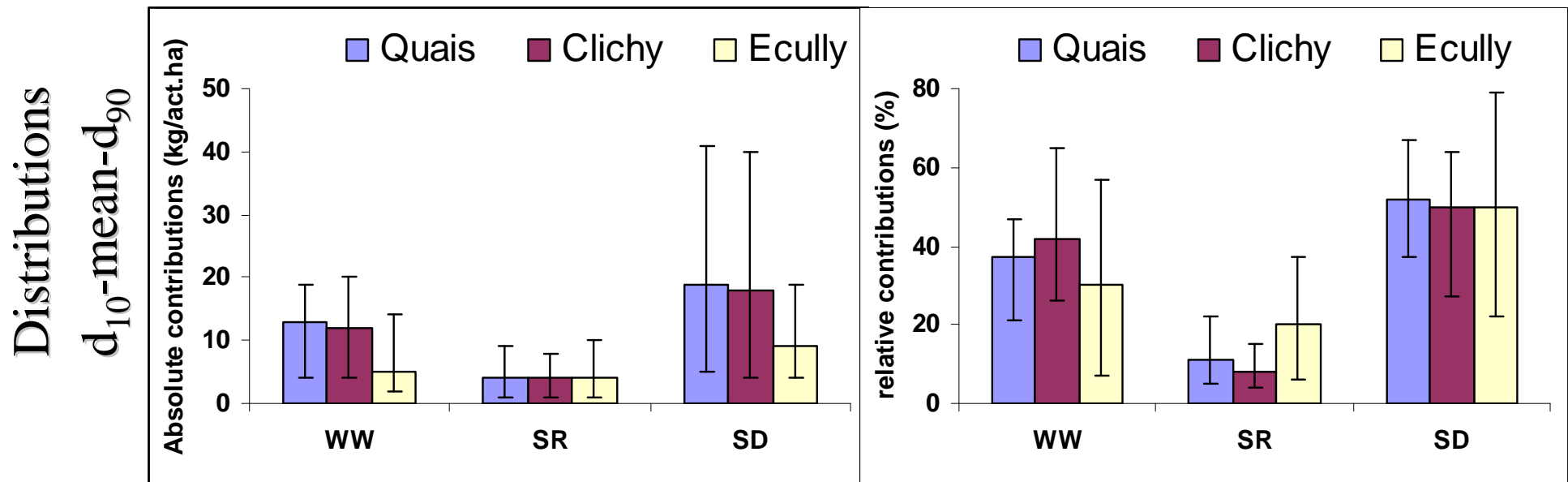


# RESULTS AND DISCUSSION

- Contribution of different sources to mass results for all rainfall events

Absolute contribution

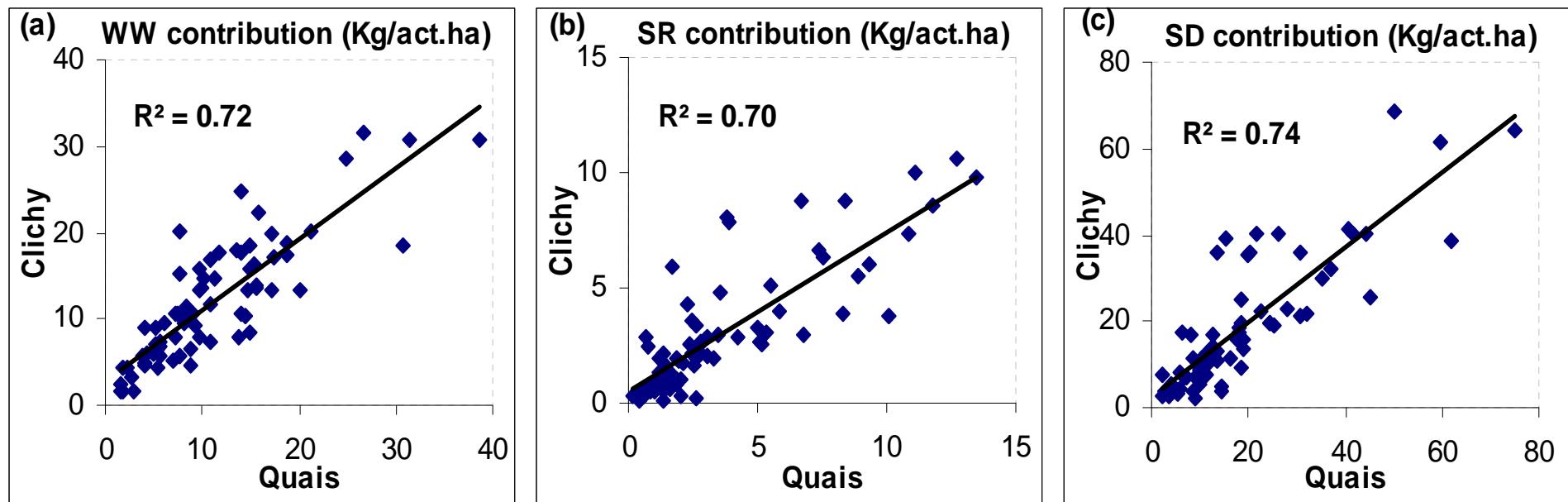
Relative contribution



# RESULTS AND DISCUSSION

- Contribution of different sources to mass results for common rainfall events

Correlations between sites (Quais & Clichy)



# Conclusions

- The results confirmed obtained for other Paris sites with similar land uses;
- Masses and concentrations for different rain events are correlated between sites with similar land uses
- The correlation between the concentrations is unexpected and may be a clue for some deterministic processes
- Regarding urban water discharges, wastewater is a decisive factor for two reasons:
  - Wastewater generates straightforwardly a significant part of the total event load
  - deposits contribution is also comparatively substantial;
- substantial contribution of sewer deposits is not specific to sewer systems like the Paris sewer network (low slope, coarse sewer deposits)

An aerial photograph of Paris, France, featuring the Eiffel Tower prominently in the center-left. The city's dense urban landscape is visible below, with a large green park area in the foreground. The sky is filled with dark, heavy clouds, creating a dramatic and somewhat somber atmosphere.

THANK YOU FOR  
YOUR ATTENTION

Questions?