deep INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

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REVISITING CONCEPTUAL STORMWATER QUALITY MODELS BY RECONSTRUCTING VIRTUAL STATE-VARIABLES

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When it rains ?!?....

urban catchments....

To the outlet...

Retention basins, WWTP, urban rivers (CSO)....

Flow rate Q [m³/s]

Sewer system

Total Suspended Solids TSS load [Kg]

load[kg], t

Can we know load(t) from rainfall?
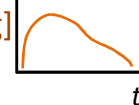
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Accumulation/wash-off model

load[kg]

t

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Storage
mass M

Rain   Interevent dry   Rain
period

Washoff   Accumulation L_0

load[kg]   time

$$load(t) \quad = M(t) \cdot W(t)$$

Rating Curve (RC) model: $load(t) = a^t \cdot Q(t)^r$
Storage mass $M(t)$ [kg]   removal factor $W(t)$ [-]

$$load(t) = M_0 \cdot e^{-a \cdot Q(t)^r \cdot t} \qquad \boxed{a \cdot Q(t)^r}$$

1) If no $M(t)$ is considered-> Better descriptions than RC?

Simplified Parameters: traditional Accum/wash-off

2) Is a wash-off alike process missed by RC?

Vezzaro, L., Sandoval, S., Bertrand-Krajewski, J.-L., (2017). Training the urban water engineers of the future – the challenge of stormwater TSS model. Proceedings of the 14th International Conference on Urban Drainage, Prague, Czech Republic, 10-15 September, 6 p.

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Chassieu catchment

Bassin versant
Espace vert aménagé
Espace naturel
Espace agricole
Domaine artificialisé
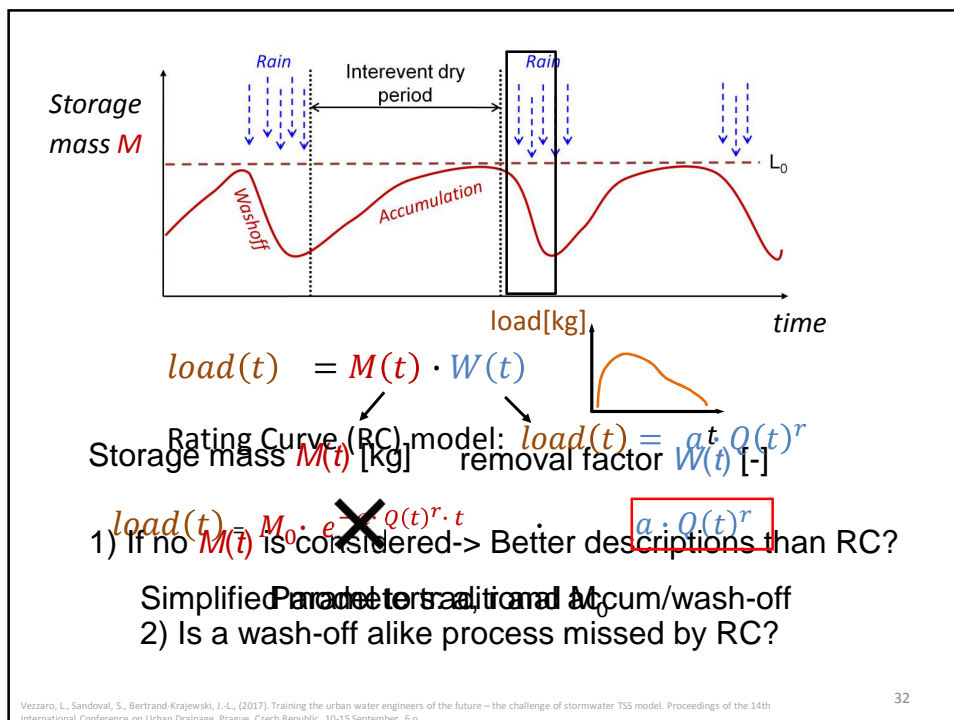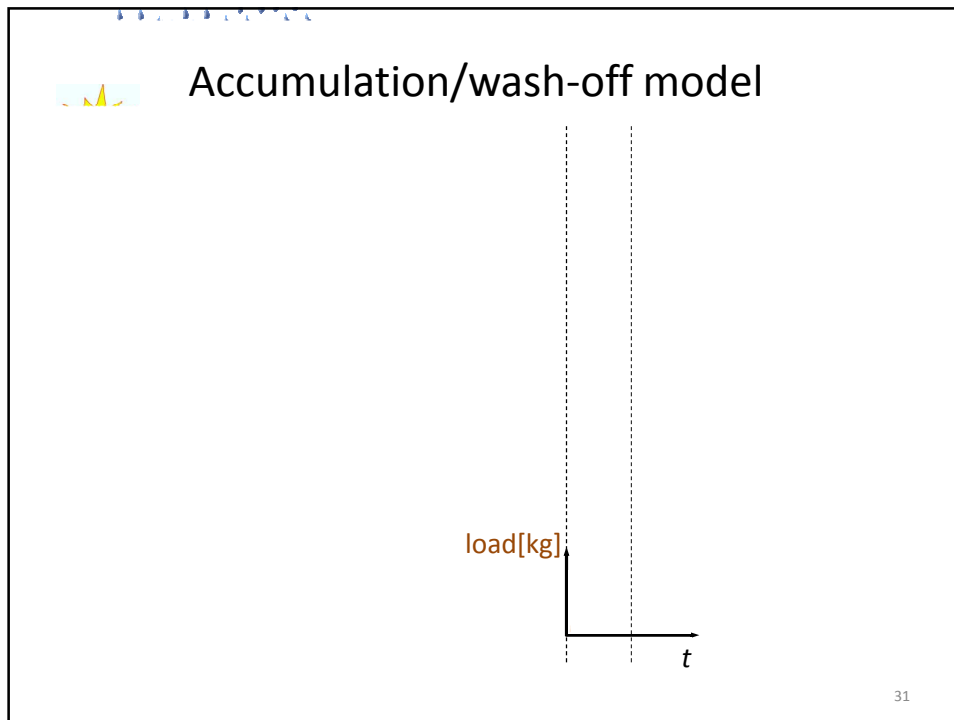
- Surface: 185 ha
- Separate system
- 365 rainfall events
  (from 2004 to 2011)
- Flow-rate (Δt = 2 min)
- TSS (Δt = 2 min)
- 255 cal./110 val. events

N

0   500   1 000   Mètres

10/07/2015   Santiago Sandoval   5

models without *M(t)*

RC: load(t) = $a \cdot Q(t)^r$

TFs: load(t) = f(Q(t), Q(t-1), Q(t-2), load(t-1), ...)

Accuracy   Calibration with 255 events   Precision

TFs   TFs
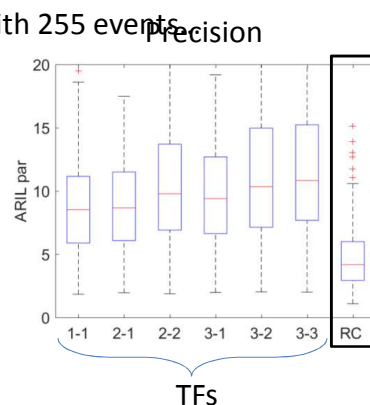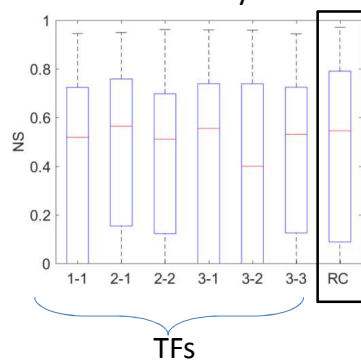
Better Nash and ARIL with RC compared to 10 different TFs
For which events the load is non-reprod. by RC(Q)?
Non-reproducible events by RC are Non-reproducible by TFs

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Non-reproducible events by RC model

load(t) ≈ f(Q(t), Q(t+1), Q(t+2), ...)

Additional process ?

f(ADWP) ?

Can we reconstruct **M(t)** ?
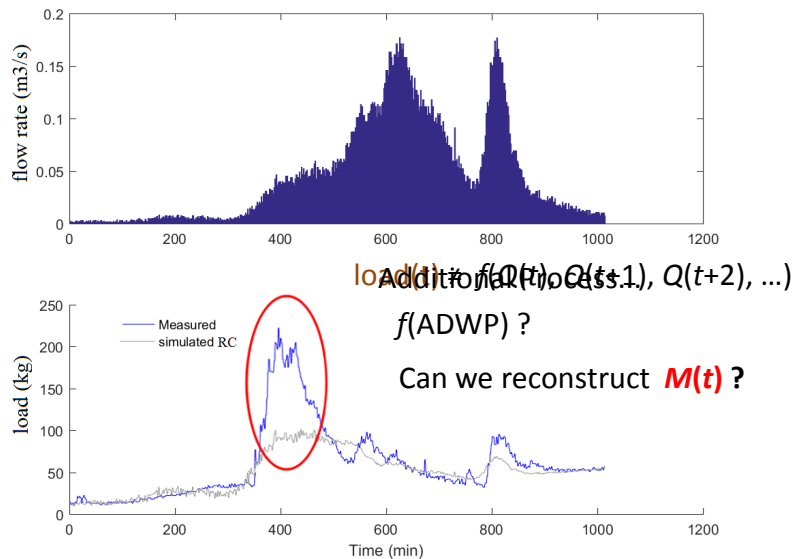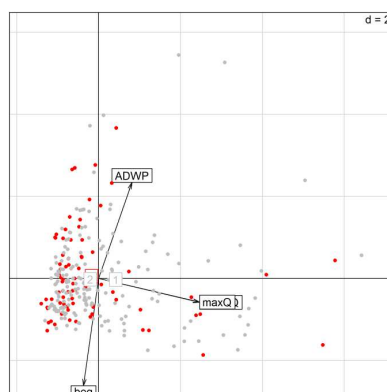
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Non-reproducible events by RC model

Relation between events Nash RC(**Q**) < 0.8 with ADWP, input char.

PCA with event char.
Division by:

RC: non-repr. in red
RC: repr. in grey

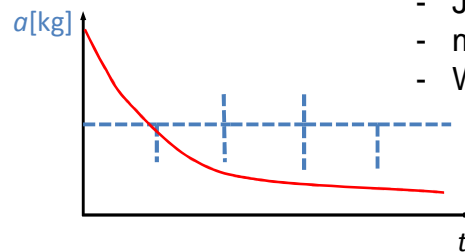No relation with ADWP or further char. (max Q, mean Q)

non-repr. events are randomly distributed in time

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Bayesian reconstruction of *M*

RC model: $load(t) = a \cdot Q(t)^r$

By making *a* time variable parameter in a cal. event:

a[kg]

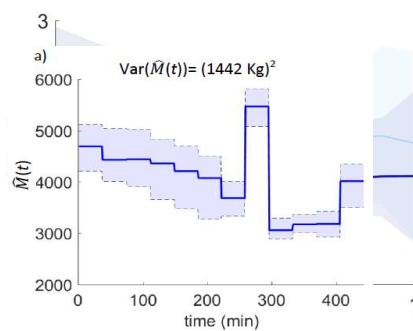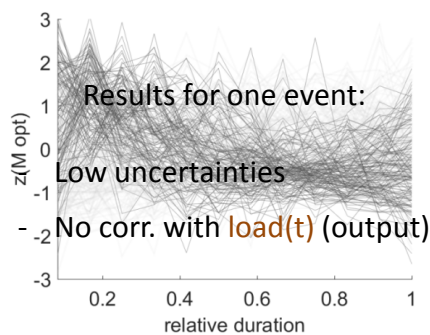- Jointly with *r*
- minimize $\sigma(a(t))$
- What RC is missing..

t

Traditional wash-off model of *M*(t) interpretable as *M*?
Are the reconstructions of $a(t)$ interpretable as M? $load = a_0 Q(t)^r \cdot t$

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Results

The *a* curves -> suitable intra-event identifiability for 255 events... is time-dependent variability for all the

z(M opt)

relative duration

Results for one event:

Low uncertainties

- No corr. with load(t) (output)

$Var(\hat{M}(t))= (1442\ Kg)^2$

$\hat{M}(t)$

time (min)

Grouping similar "shapes" into groups
light and dark blue groups of curves, 57 % and 43 % of the events

No trend, no "mean shape" interpretable as an *M* process

Low transferability curves between rainfall events

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Conclusions

Evidence of the missing representation of an essential process if only the removal factor is considered (RC model)

- Low prediction capacity of RC (Nash < 0.6 in val.)

- Identifiability at an intra-event scale of this potential process

high unrepeatability/non-transferability of reconstructions ->

hardly interpretable as a virtual unique state of available mass decreasing over time

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Thank you

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