



**HAL**  
open science

## Looking at catchments in colors: why not? But what if we can not even look at them?

C. Fouchier, P. Javelle, P. Arnaud, Dimitri Defrance

### ► To cite this version:

C. Fouchier, P. Javelle, P. Arnaud, Dimitri Defrance. Looking at catchments in colors: why not? But what if we can not even look at them?. EGU Leonardo Topical Conference on the hydrological cycle “Looking at Catchments in Colors, Nov 2010, Luxembourg, Luxembourg. pp.1, 2010. hal-02605900

**HAL Id: hal-02605900**

**<https://hal.inrae.fr/hal-02605900>**

Submitted on 16 May 2020

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Looking at catchments in colors: why not? But what if we can not even look at them?

Catherine Fouchier, Pierre Javelle, Patrick Arnaud, Dimitri Defrance

Cemagref Aix-en-Provence, hydrology research team – [catherine.fouchier@cemagref.fr](mailto:catherine.fouchier@cemagref.fr)

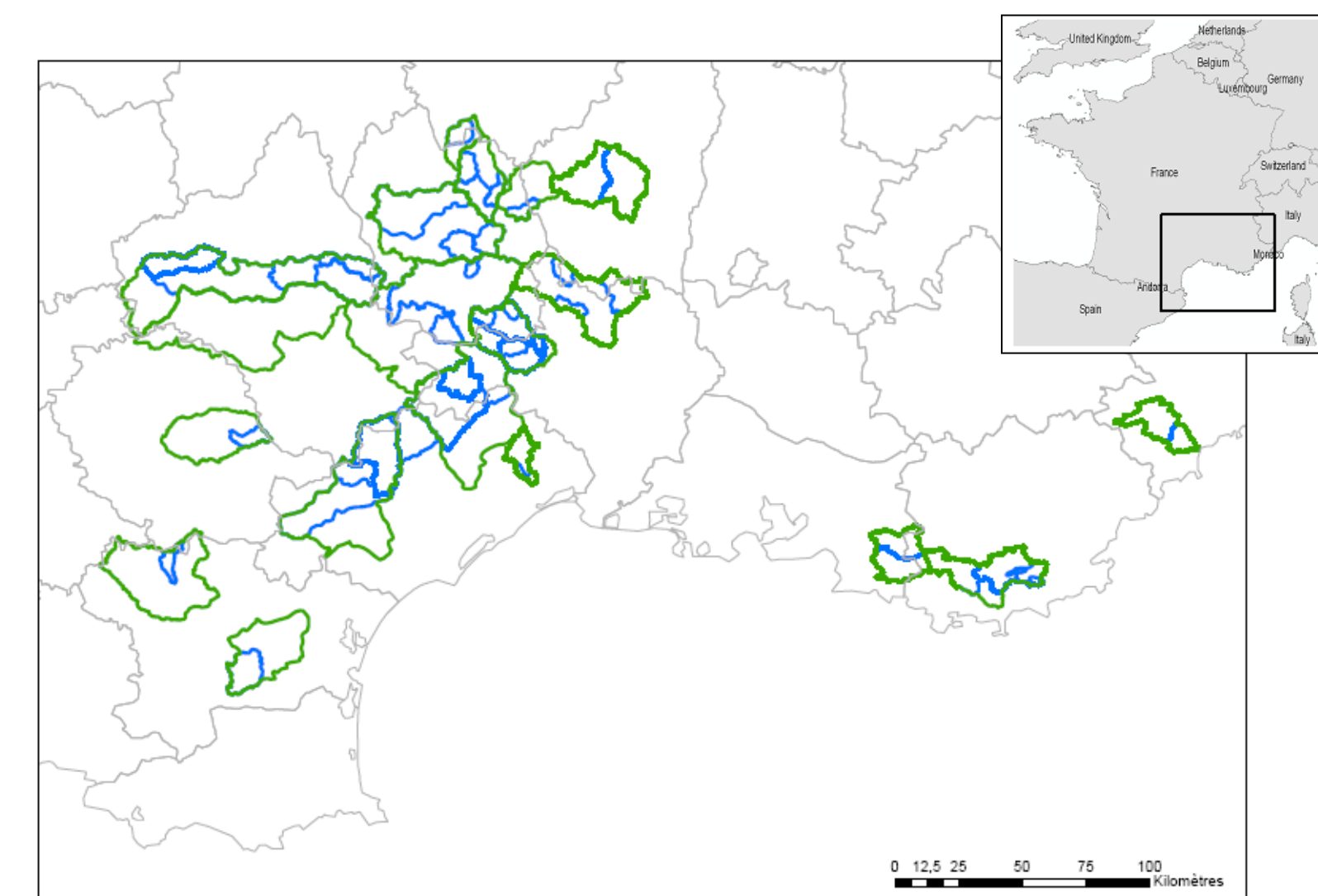
The flood of the Nartuby and Argens rivers claimed the lives of 25 people in June 2010. These two French rivers were not monitored at that time. This dramatic event highlights the need for an operational flood alert system dedicated to  **ungauged watersheds**.

## Objectives

- We want to assess the ability of a simple conceptual and parsimonious rainfall-runoff model to deliver flood alerts on ungauged catchments. To do so, we applied a proxy-basin scheme using several sets of nested catchments.
- We want to know if allowing spatial variability in our model improves its performances. To answer this question, we tested different levels of spatial variability into our model.

## Data

- Runoff data from 67 watersheds in southern France:
  - 20 “downstream” catchments ranging from 150 to 2170 km<sup>2</sup>
  - 47 “upstream” catchments, considered as ungauged, nested within the “downstream” ones
- Rainfall radar data (provided by a radar network) for 15 events between 2005 and 2008
- Time step: 1h; spatial resolution: 1 km<sup>2</sup>

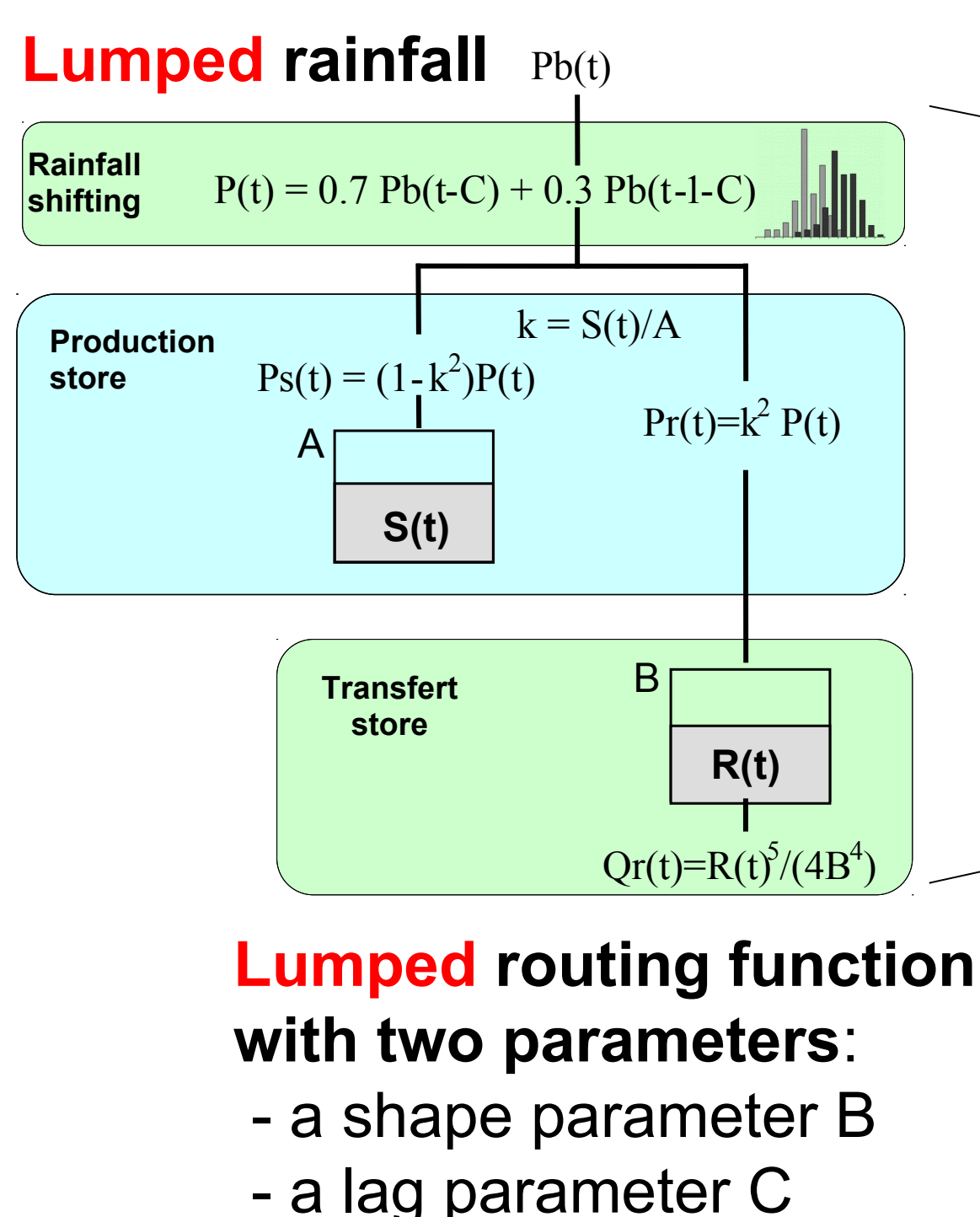


Studied catchments in southern France. The downstream catchment are drawn with a green border, the upstream ones are drawn with a blue border.

## Three cases of spatial variability

### Case A: lumped

**Lumped production function with one parameter:** initial soil moisture condition  $S_0/A$ , to be initialised at the beginning of each event



### Case B: semi-distributed

**Constant routing function**  
B and C identical for each cell within a given catchment

### Case C: distributed

**Distributed routing function**  
 $B_i$  and  $C_i$  parameters values in pixel  $i$  are functions of the  $d_i$  distance to the outlet:  
 $B_i = B_0 (pB \cdot d_i + 1)$     $C_i = C_0 + pC \cdot d_i$

For each B and C cases

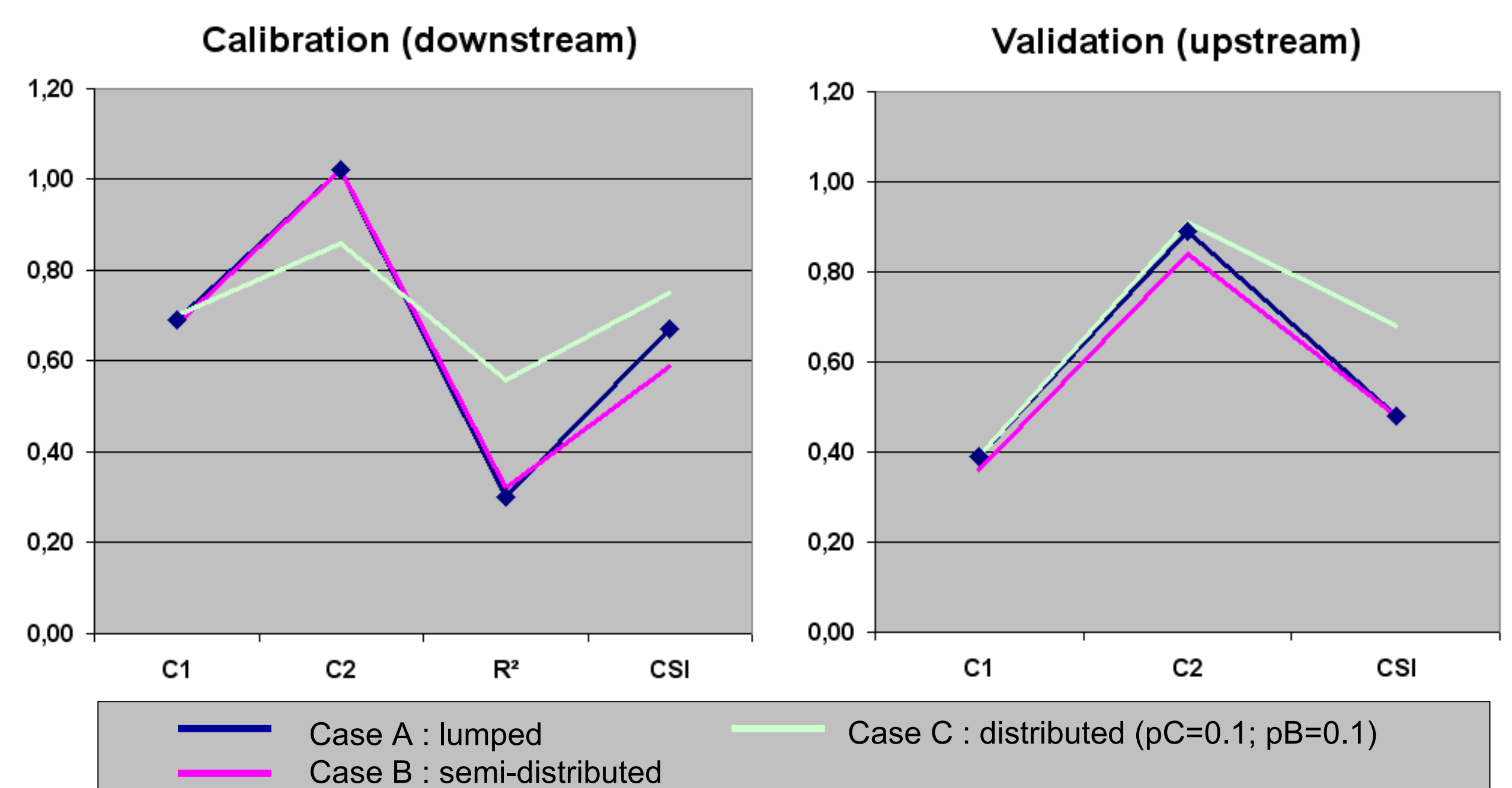
- distributed rainfall
- distributed production function
- $Q_{outlet} = \sum Q_i$

## Calibration and validation

- **Calibration** at the 20 downstream outlets:
  - calibration of the initial level of the production store ( $S_0/A$ ) for each flood
  - calibration of the routing parameters for each watershed
  - optimisation of the bounded Nash and Sutcliff criteria ( $C_{2M}$ , see Mathevet *et al.*, 2006) with optimal lag
- **Validation** at inner points transferring parameters and initial production condition calibrated downstream
- **Multi-criteria** evaluation in order to assess:
  - how well the upstream calculated floods fit the observed ones (C1 to C2 criteria);
  - how well the calibrated production parameters correlate to the moisture index of a continuous daily soil moisture accounting model ( $R^2$  criteria, for the downstream catchments only);
  - if the model delivers correct alerts (CSI index).

## Results

- The distributed version performs slightly better than the lumped version.
- Fully distributing the routing parameters results in better alerts than using uniform routing parameters in the distributed version.
- To fully assess the performance of the model, further evaluation should be carried out in an operational mode, i.e. using an initialisation procedure to determine the value of the production parameter at the beginning of each event instead of using a calibrated value (see Javelle *et al.*, 2010). However, the  $R^2$  coefficients calculated between the calibrated initial level of the production store ( $S_0/A$ ) and a daily moisture index gives an indication about the “ability” to initialise the model in a operational use. The  $R^2$  values obtained at the downstream calibration indicate that the distributed version of the model seems the most promising for an operational use.



Performance criteria: (BNS: Bounded Nash and Sutcliff criteria)

C1: median flood BNS      R<sup>2</sup>: correlation with continuous init. index  
C2: mean flood relative peak error      CSI: critical success index  
for all criteria: the closer to 1, the better

## EGU Leonardo Topical Conference on the hydrological cycle “Looking at Catchments in Colors”, 10-12 November 2010, Luxembourg

Javelle, P., Fouchier, C., Arnaud, P., Lavabre, J., Flash flood warning at ungauged locations using radar rainfall and antecedent soil moisture estimations, Journal of Hydrology (2010), doi: 10.1016/j.jhydrol.2010.03.032

Mathevet T., Michel C., Andréassian V. et Perrin C. (2006). A bounded version of the Nash-Sutcliffe criterion for better model assessment on large sets of basins. IAHS-AISH Publication, n° 307, 211-219.

This work was supported by the Ecology, Energy, Sustainable Development and Sea French Ministry, Service Central d'Hydrométéorologie et d'Appui à la prévision des inondations (SCHAPI). Météo-France is also acknowledged for having provided the rainfall data used in this study.