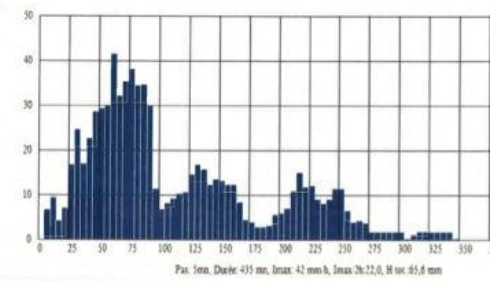# Surface water flood risk management in parisian agglomeration : Cases of Seine-Saint-Denis and Val-de-Marne
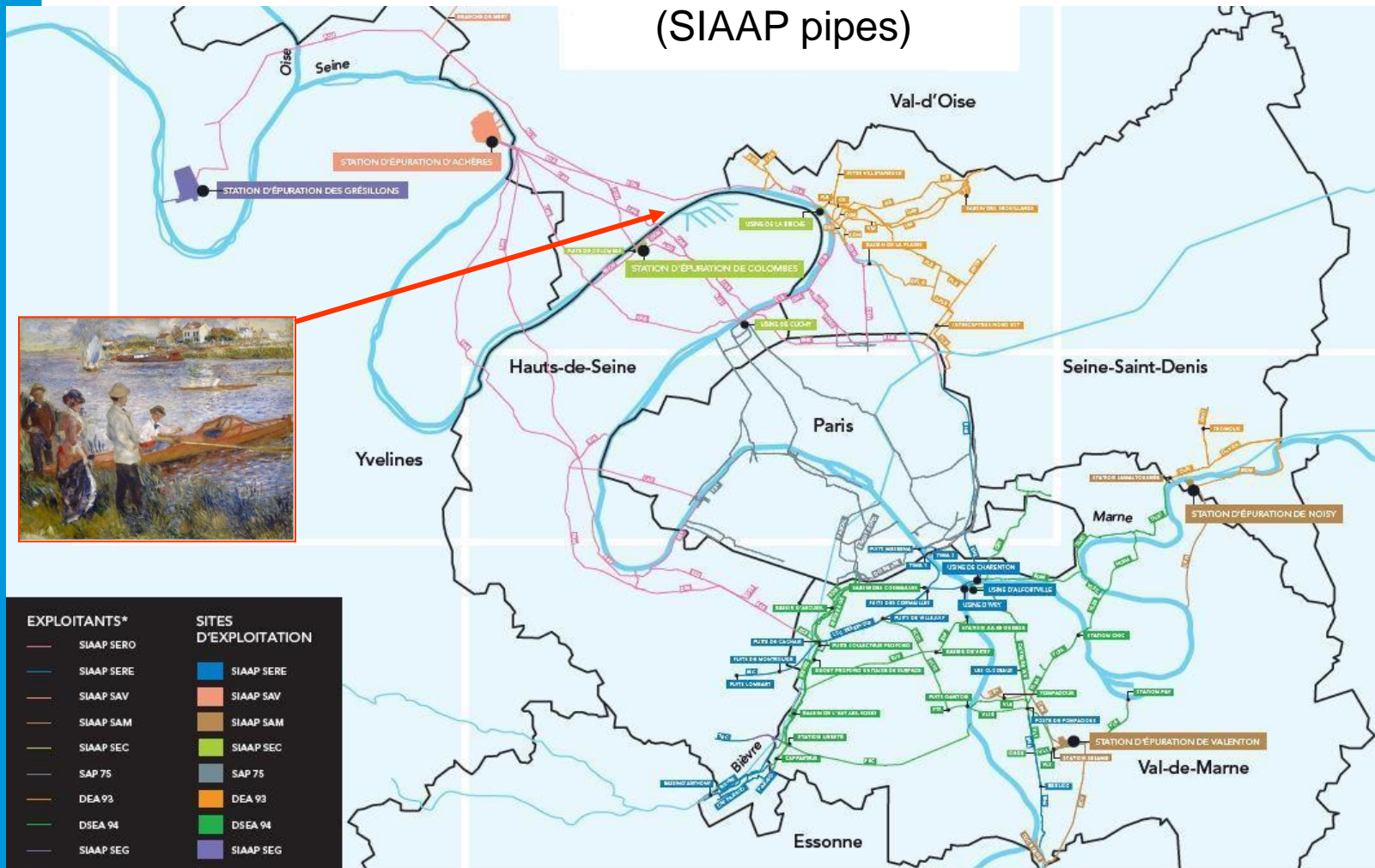

Natalija Stancic & Philippe Bompard

UK NATIONAL OBSERVERS GROUP
City Hall - LONDON
Tuesday 16TH APRIL 2013

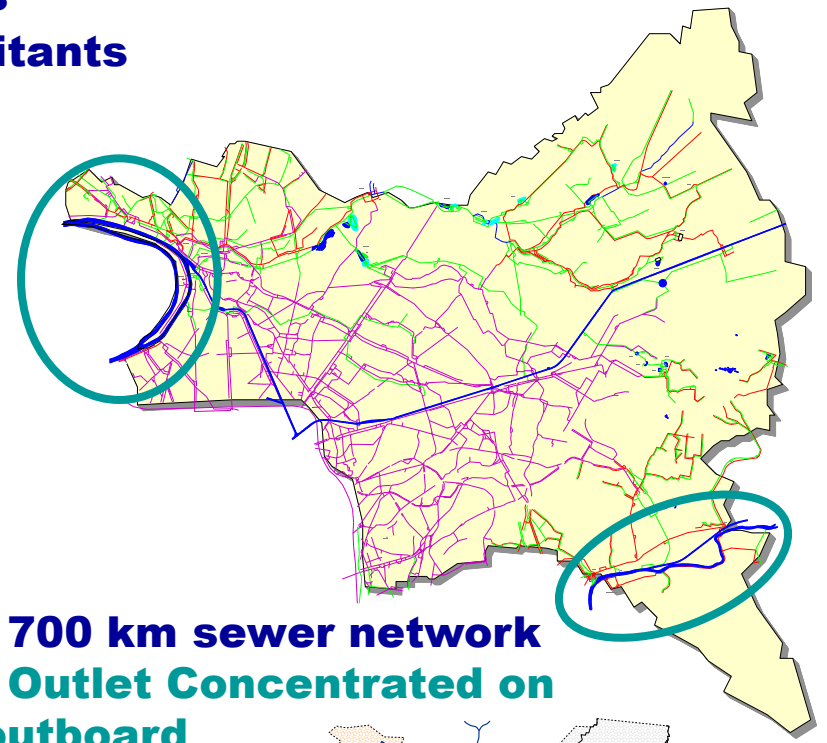# Sewage system of the Parisian agglomeration

(SIAAP pipes)

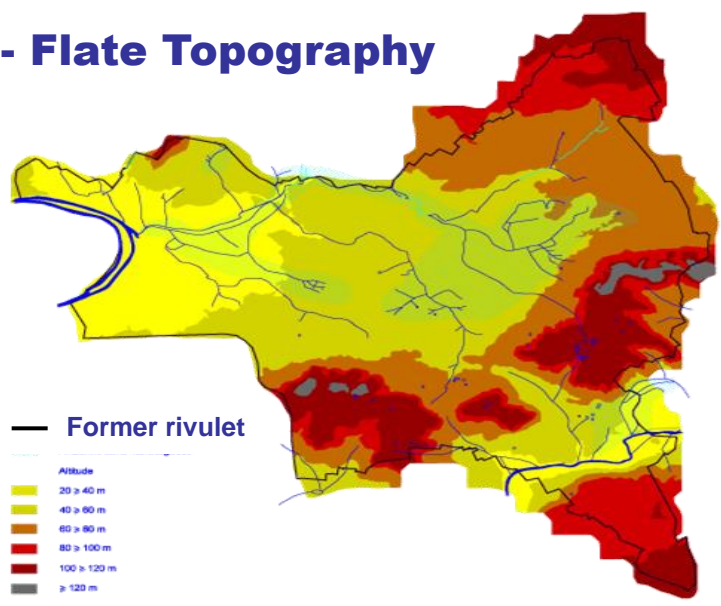# Seine-Saint-Denis County

- ❑ 236 km^2
- ❑ 40 municipalities
- ❑ 1,5 million inhabitants

- Flate Topography

Former rivulet

Altitude
- 20 ≥ 40 m
- 40 ≥ 60 m
- 60 ≥ 80 m
- 80 ≥ 100 m
- 100 ≥ 120 m
- ≥ 120 m

- 700 km sewer network
- Outlet Concentrated on outboard

1900

2000

Le Croult
Canal de l'Ourcq
La Seine
Canal Saint-Denis
Sens des écoulements
La Marne

Urbanized area

Marshland area
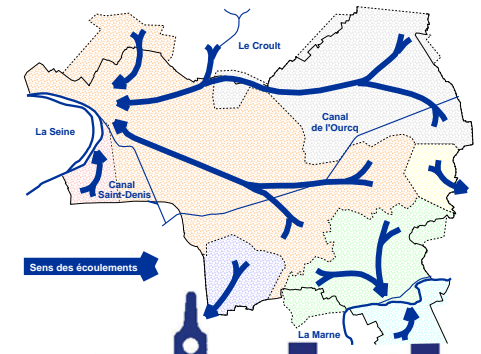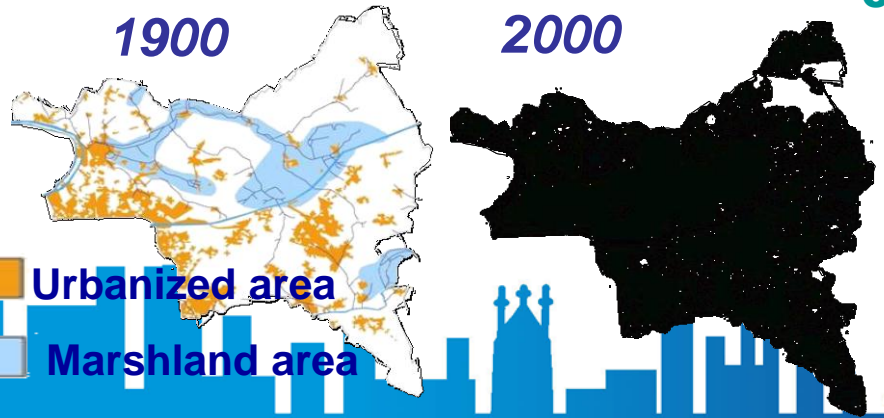
Generalized and regular flooding

LEGENDE

▬ Sensitive areas for flooding

▬ Sensitive areas for flooding because of county sewer system

Real-time operation system : 142 remote local control sites on the « primary » sewer network
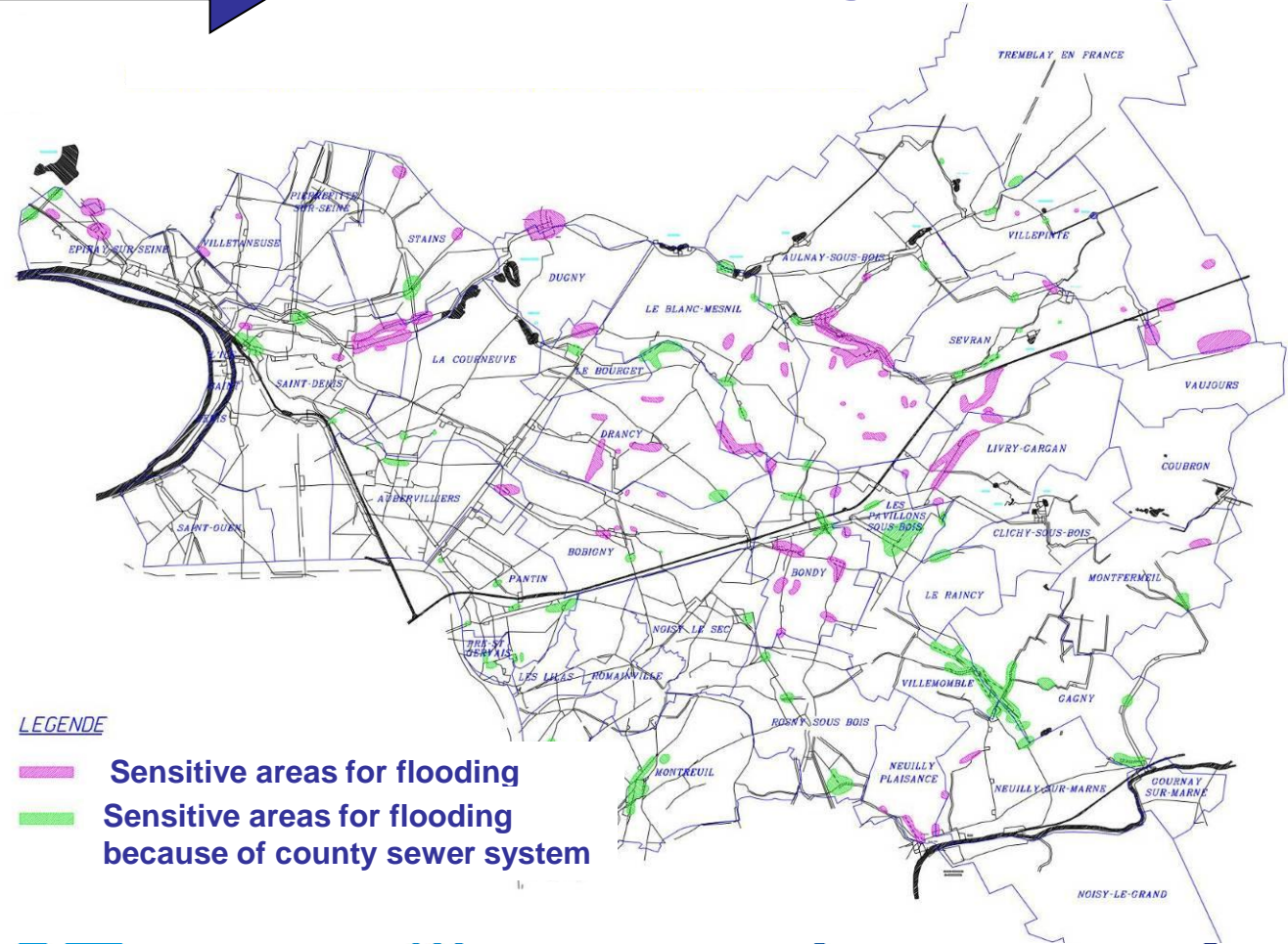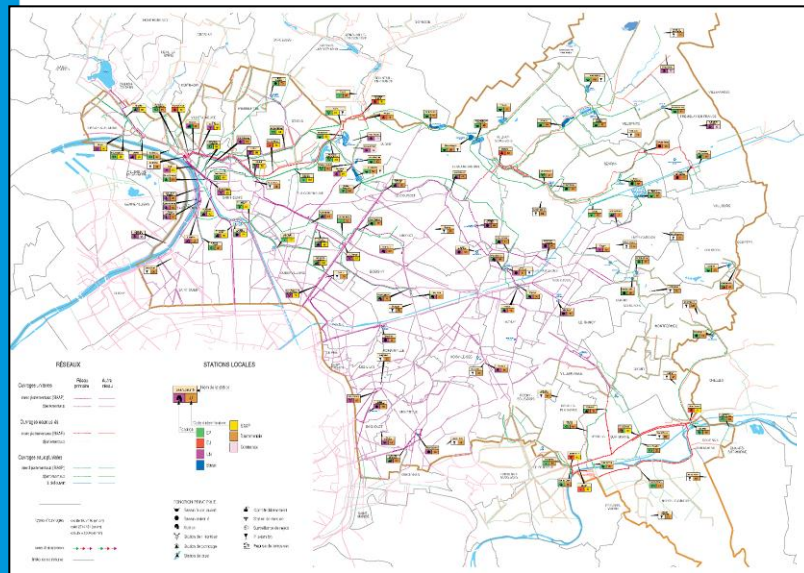
For raining time :

➤ **34 storm water basins**
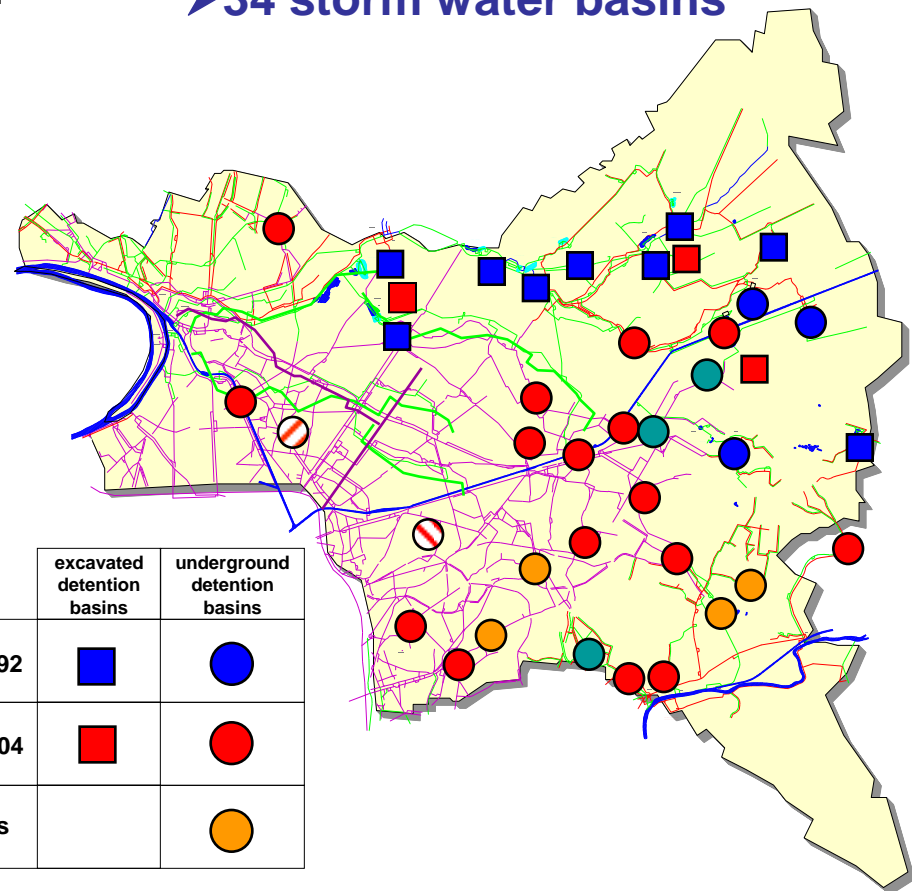
➤ **12 pumping stations**

➤ **27 rain gauges**

➤ **26 measurements sites**

➤ **8 siphons**

➤ **7 regulating gates**

	excavated detention basins	underground detention basins
Up to 1992	🟦 (blue square)	🔵 (blue circle)
1993 / 2004	🟥 (red square)	🔴 (red circle)
projects		🟠 (orange circle)

Real-time operations during raining time

Local management for each remote site = reference setting made for protection for 10 year return period rain

Machine commands equipments to respect water level or flow regulation

+

Actions by the operator during raining time : Remote control and flow regulation remote control

GAP from reference setting

Adaptation of the strategy to the rain

A designed decision making Support System, made during the 90's, assist the operator ("the pilot") to chose the remote control to apply.

The support system is based on a
        « Rain-type catalogue »
and
        « scenarios of control strategy »

previously established, with hydraulic simulations and operator experience.

Rain of 5mm/1hour on 2 rain gauges of 1 sub catchment

The control system call the « pilot » →

The rain-type is estimated by the pilot, with rainfall picture observed on radar images (calibrated with local rain gauges), rain gauges and rainfall forecast, and input into the real-time control system
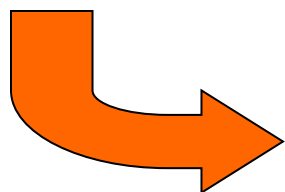
Proposition of a scenario of control strategy for each one of the 4 catchment area. Global or individual activation of the remote control compared to local condition.

Viewing on a map of the network per catchment area of water levels reached and maximal water level expected.

The result are analyzed by the pilot and can be changed during all the rain event

Rain-type Catalogue

- ➢ 2 PARAMETERS:

⊙RAINFALL INTENSITY (5MM/HOUR INTERVAL STEPS),
⊙RAIN DURATION (15 MN INTERVAL STEPS)

- ➢ RAINFALL RANGE: 5 – 40 MM

- ➢27 SYNTHETIC RAINFALLS, DERIVED FROM A STATISTICAL ANALYSIS

- ⟹ ANY SELECTED SYNTETIC RAINFALL SHOULD BE CLOSE TO THE REAL (OBSERVED + PREDICTED) RAINFALL

H=5mm

20mm/h	10mm/h	5mm/h
15min	30min	1h
05_01	05_02	05_04
T1<1an T2<1an	T1<1an T2<1an	T1<1an T2<1an

H=10mm

40mm/h	20mm/h	10 mm/h	7,5mm/h	5mm/h
15min	30min	1h	1h20	2h
10_01	10_02	10_04	10_05	10_08
T1=5ans T2=2ans	T1=2ans T2=1an	T1=1an T2<1an	T1=1an T2<1an	T1<1an T2<1an

H=15mm

30mm/h	15mm/h	10mm/h	7,5mm/h	5mm/h
30min	1h	1h30	2h	3h
15_02	15_04	15_06	15_08	15_12
5<T1<10ans 2<T2<5ans	2<T1<5ans 1<T2<2ans	T1=2ans T2=1an	1<T1<2ans T2<1an	T1=2ans T2=1an

H=20mm

40mm/h	20mm/h	10mm/h	5mm/h	
30min	1h	2h	4h	
20_02	20_04	20_08	20_16	
T1>10ans 5<T2<10ans	5<T1<10ans 2<T2<5ans	2<T1<5ans 1<T2<2ans	2<T1<5ans 1<T2<2ans	

H=25mm

50mm/h	25mm/h	12,5mm/h
30min	1h	2h
25_02	25_04	25_08
T1>10ans T2=10ans	T1>10ans T2=5ans	5<T1<10ans 2<T2<5ans

H=30mm

30mm/h	15mm/h	10mm/h	7,5mm/h
1h	2h	3h	4h
30_04	30_08	30_12	30_16
T1>10ans T2=10ans	T1=10ans 2<T2<5ans	T1>10ans T2=10ans	T1>10ans 2<T2<5ans

H=40mm

40mm/h	20mm/h	10mm/h
1h	2h	4h
40_04	40_08	40_16
T1>10ans T2>10ans	T1>10ans T2=10ans	T1>10ans T2=10ans

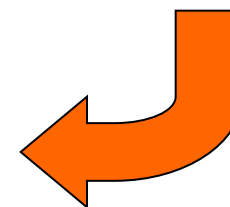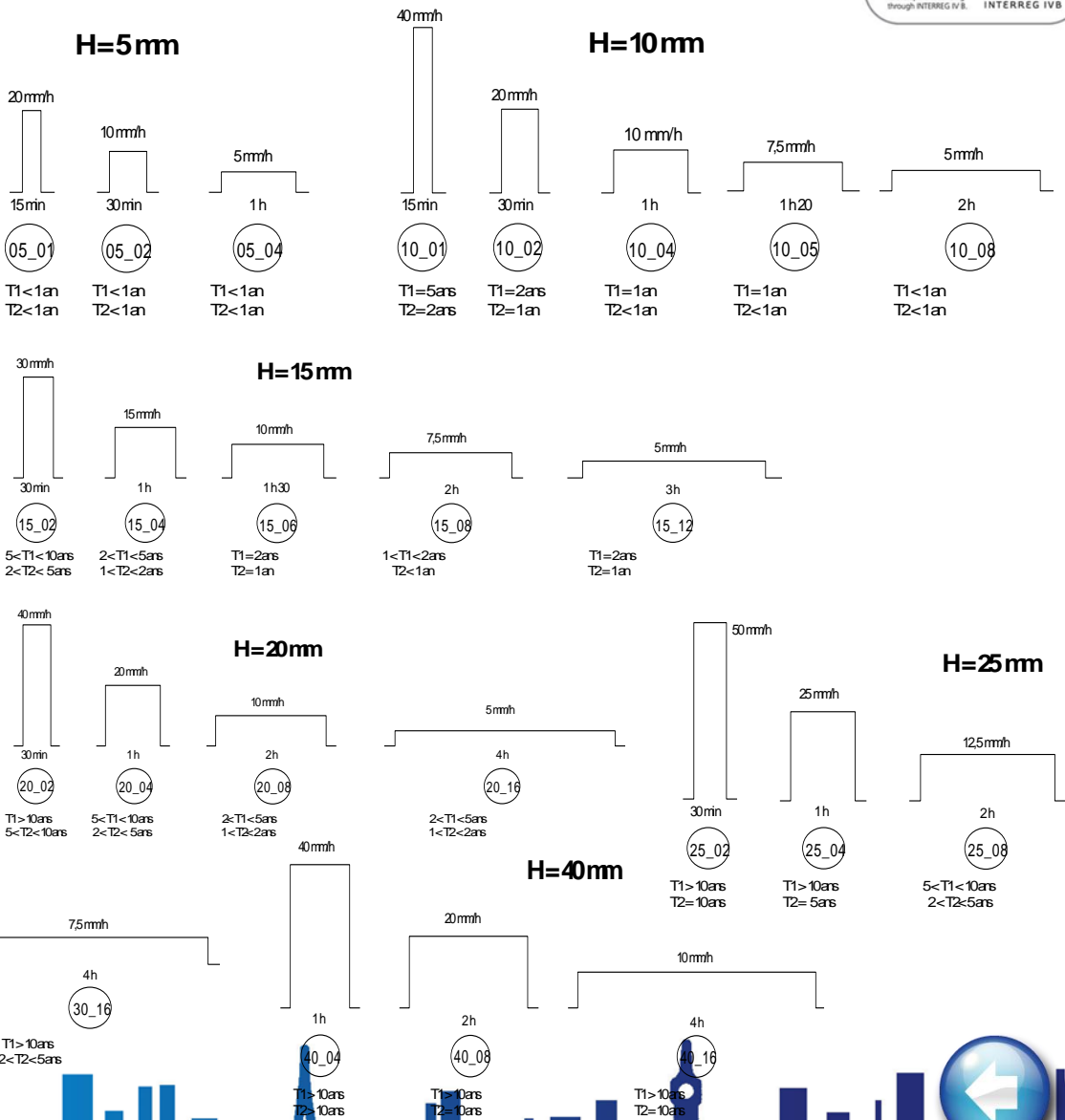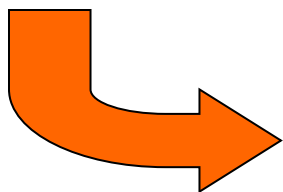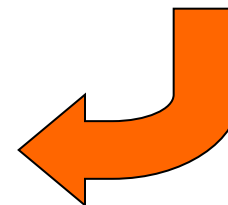**Rain of 5mm/1hour on 2 rain gauges of 1 sub catchment**

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Synoptique | planning pluie MVM | *Moree-Vieille Mer* | Courbe intensite | Courbe cumul horaire | Courbe evenement | Journal zone

Imprimer

TABLEAU : planning pluie MVM à 12/04/2013 16:07:54

12/04/2013 16:07:54

Selection de la pluie zone Moree-V.Mer

Duree_pluie_ecoulee		Pluie_observee_terrain		Pluie_prevue_Calamar		Pluie_proposee_IPSP	Pluie_choisie_Pilote	Heure_prevue_debut_pluie_IPSP		Validation_scenario_Pilote		Bulletin	
Nom	Valeur	Nom	Valeur	Nom	Valeur	Valeur	Valeur	Nom	Valeur	Nom	Etat	Nom	Etat
DUR_PLU_MOREE	20.00	CUM_EVT_MOREE	1.84	PREVISION_MVM	0.12	temps sec	temps sec	DEB_PLU_MVM	12/04/13 16:00	Validation scenario	OFF	Bulletin_ZV	OFF

12/04/2013 16:07:54

Planning de conduite Zone Moree Vieille Mer

TC scenario	Activation TC	TC envoyee		TR scenario		Activation TR		TR envoye				Decantation
		Date_Activation	Nom	Nom	Valeur	Nom	Valeur	Date_Activation	Nom	Consigne	Val Regul.	
	ACT_INH_VIDB_AB	12/04/13 15:43	INH_VIDB1B2_AB									DECANT_AB
				TRQ~B_BM	7.00	ACT_TRQ_B_BM	7.00	NORMAL	TRQ_B_BM	7.00	0.00	
	ACT_CDF_V3_BT	12/04/13 15:50	CDF_V3_BT	TRQ~VS_BT	1.00	ACT_TRQ_VS_BT	1.00	NORMAL	TRQ_VS_BT	1.00	0.00	
	ACT_INH_VIDB1B2_BT	12/04/13 15:40	INH_VIDB1B2_BT									DECANT_BT
	ACT_CDF_V_CI	12/04/13 15:50	CDF_V_CI									DECANT_CI
	ACT_CDI_2V_CI	NORMAL	CDI_2V_CI									
CDE~DECB1_DU	ACT_CDE_DECB1_DU	NORMAL	CDE_DECB1_DU	TRQ~B1B2_D2	0.00	ACT_TRQ_B1B2_D2	0.00	NORMAL	TRQ_B1B2_D2	0.00	0.00	DECANT_DU
	ACT_INH_VIDB_GP	12/04/13 15:40	INH_VIDB_GP									DECANT_GP
	ACT_CDF_V_LP	12/04/13 15:50	CDF_V_LP									DECANT_LP
CDF~V1_MP	ACT_CDF_V1_MP	NORMAL	CDF_V1_MP									
	ACT_INH_VIDB1B2_MP	12/04/13 15:40	INH_VIDB1B2_MP									DECANT_MP
CDF~V1_PM	ACT_CDF_V1_PM	NORMAL	CDF_V1_PM									DECANT_PM
	ACT_INH_VIDB1_PY	12/04/13 15:40	INH_VIDB1_PY	TRQ~V1_PY								
	ACT_CDF_V_VG	12/04/13 15:40	CDF_V_VG									

12/04/2013 16:07:54

Maxi

Maximum mesure		Maximum mesure		Maximum mesure		M
Nom	Valeur	Nom	Valeur	Nom	Valeur	
m_YAM_B1_PM	62.34	m_YAM_D_BA	39.42	m_YAM_D_KK	50.70	m_
m_YAM_S2_PY	36.89	m_YAM_V_CI	50.07	m_YAM_V_JP	42.63	m_
m_YAM_V1_PD	32.55	m_YAM_V1_PM	62.09	m_YAM_V1_SA	48.04	m_
m_YCO_EP_GE	26.84	m_YCO_MOREE_AB	38.25	m_YCO_MOREE_PY	36.79	m_Y
m_YEP_VMER_JM	25.69	m_YEP_VMER_PO	26.66	m_YUN_PLB_PO	25.05	m_Y

State of activation of the remote control after having validation of a scenario
Dark Green field: **automatic** mode, local condition of passing the remote control are reached: the remote control is send by the control system to the local control site
Purple field : **automatic** mode, the remote control has been correctly established at the local control site
Light green field : **automatic** mode, we have reached the local condition to cancel the remote control the control system send a remote control to cancel it locally
Dark blue field: **manual** mode, the pilot is sending the remote control without the local condition
Light blue field: **manual** mode, the pilot cancel manually the remote control because the local condition have been reached to cancel it
Orange field: NO authorisation to pass the remote control
Yellow field: the activation « line » has been forced to 0 or 1
Dark pink field: remote control disabled when it was sending to the local control site
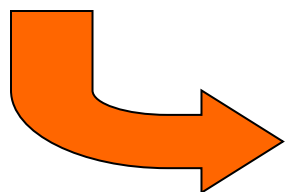*Light pink field*: remote control disabled when it get back in normal

Rain of 5mm/1hour on 2 rain gauges of 1 sub catchment
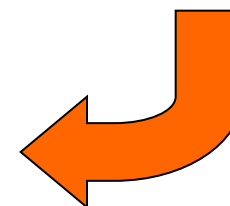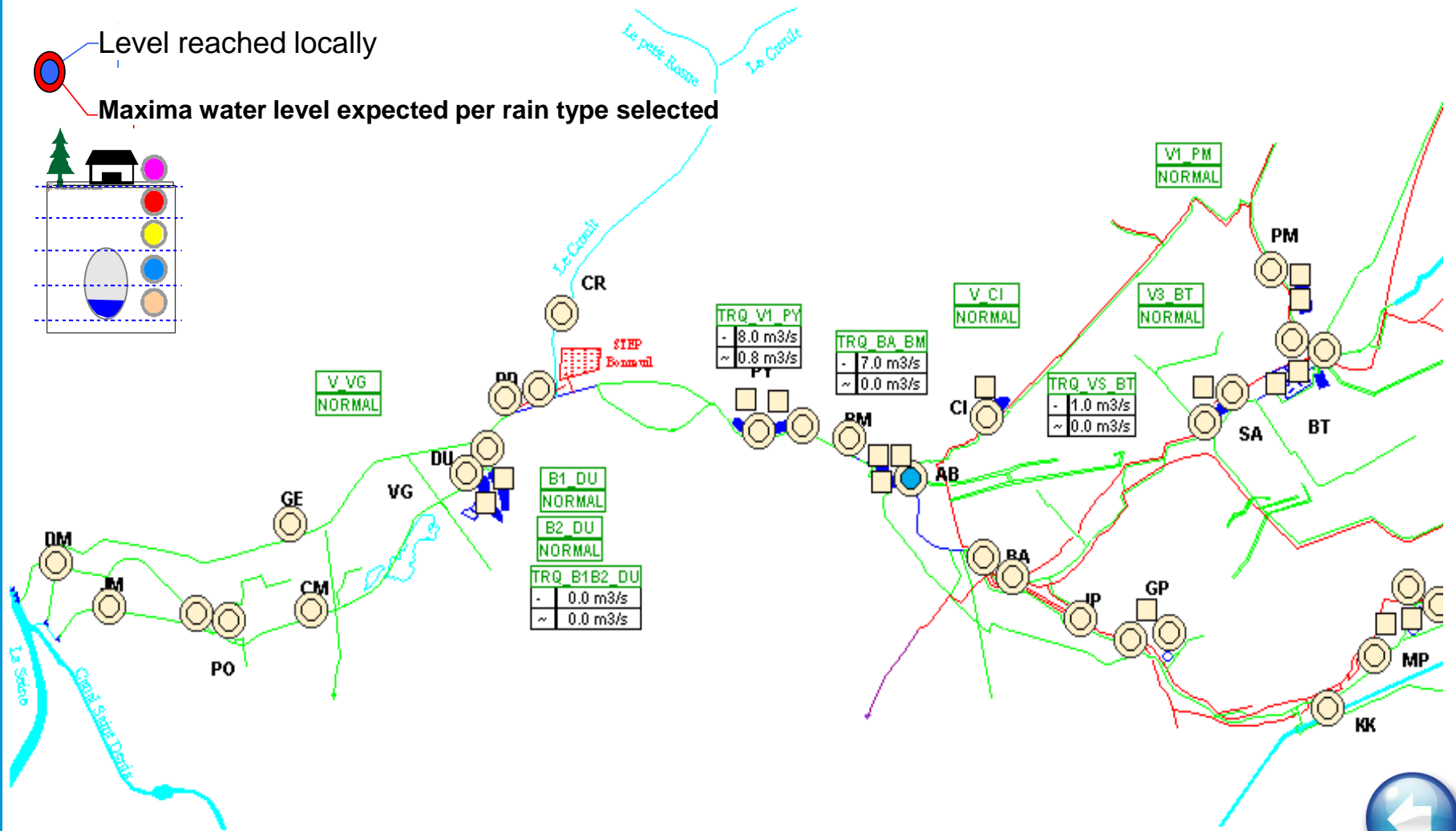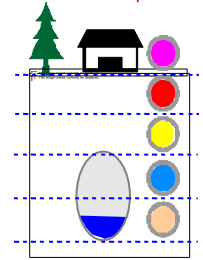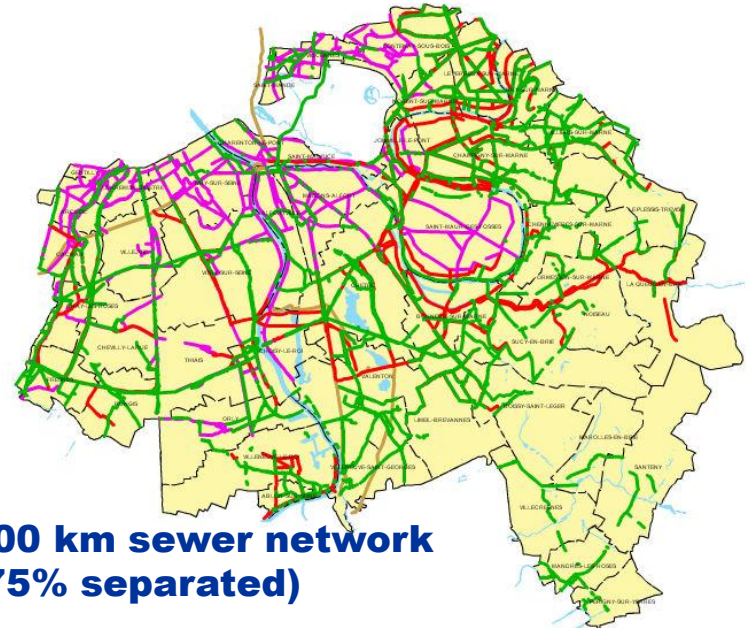
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Map of the network of a catchment area

Val-de-Marne County

- ❑ **245 km²**
- ❑ **47 municipalities**
- ❑ **1,35 million inhabitants**

- Flate Topography

Altitudes (en m)

- 140 à 110
- 110 à 80
- 80 à 50
- 50 à 20

car_0201_01. Carto SIGEC 2006. Sources CG94.

0   2 km
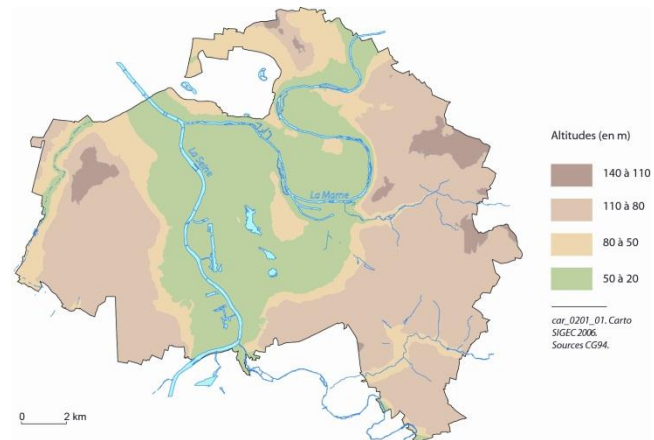
900 km sewer network (75% separated)

| 1865 | 1900 | 1945 | 1965 | 1982 | 1999 |
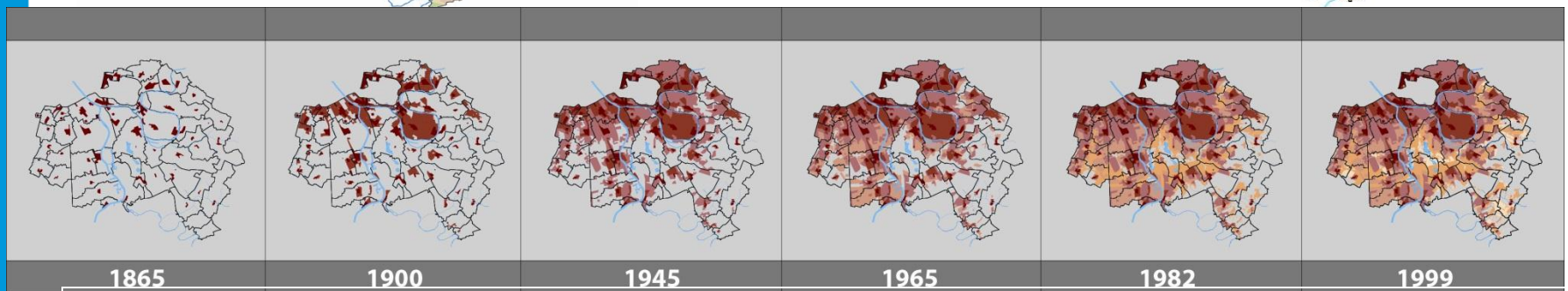
Evolution of urbanisation : A new colour represents areas urbanised since the previous step
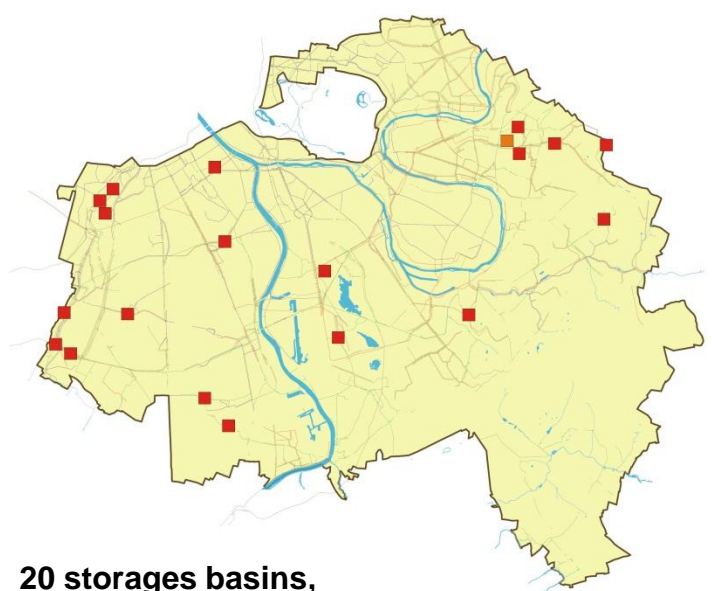
20 storages basins, from 200 to 75000 m3
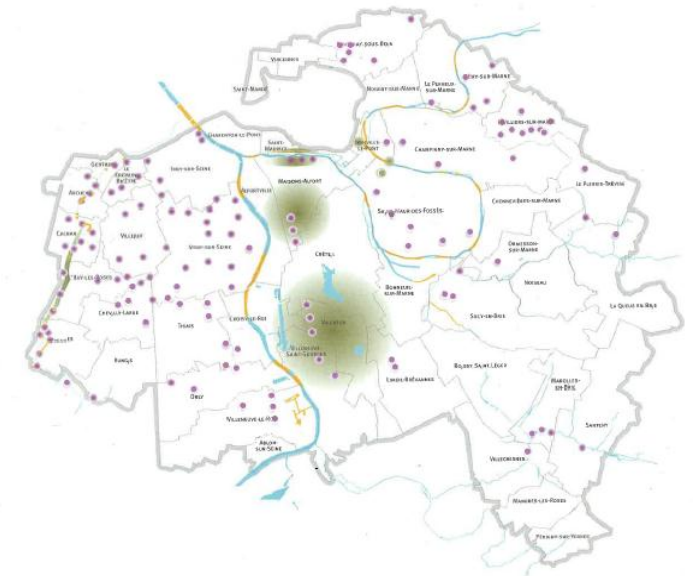
On this map, points represent an area with flood risk, clouds the odour problems, and yellow river streches those which receive combined discharges

The system also includes 24 pumping stations, 222 measurements points into pipes (Flow and level) storage, more than 200 electromechanical equipments

An attempt of forecasting management on storage basins (with Calamar system)
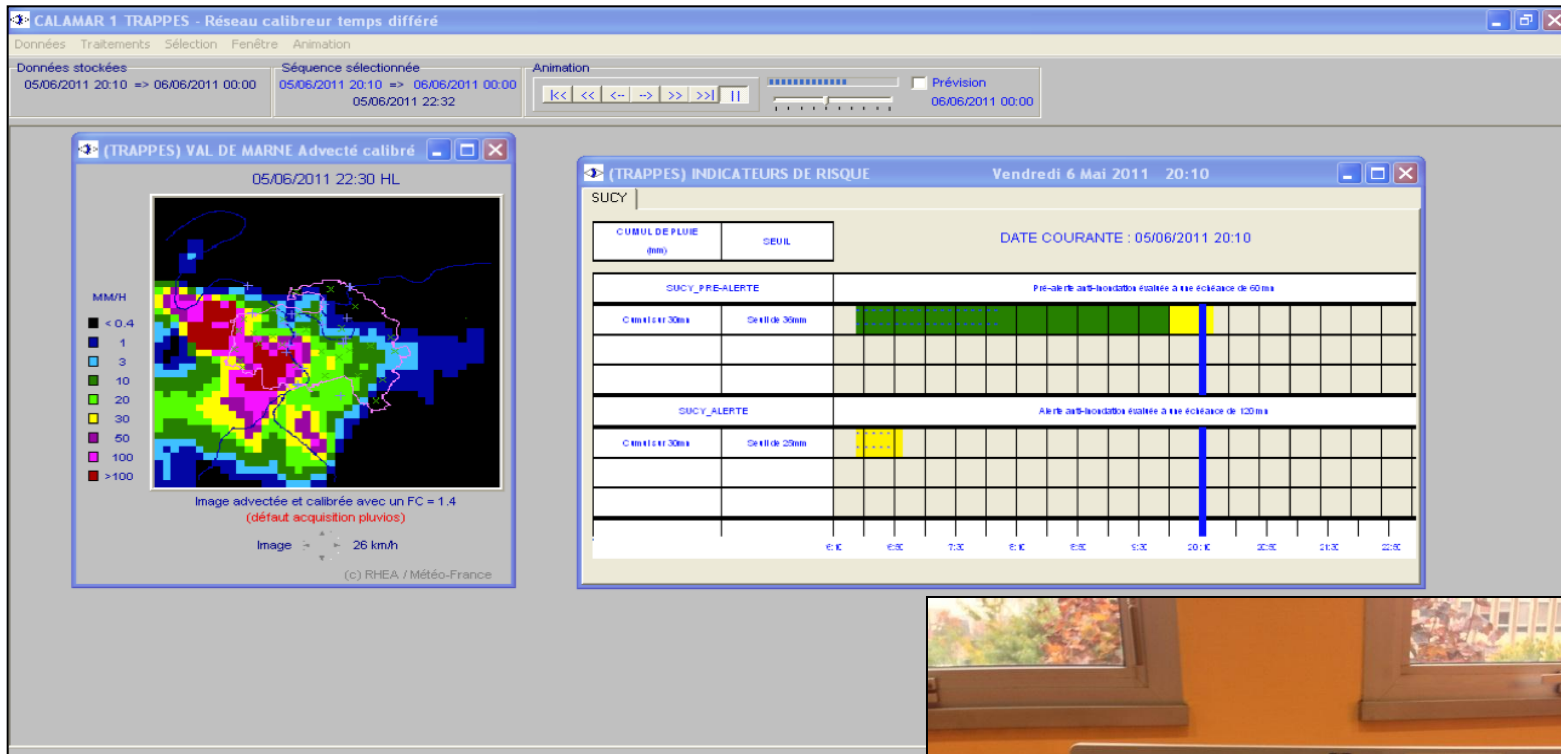
- A forecasting system (during the next hour) with 2 levels of alarm (1st : 36mm on a 4km2 area at less than 20 km; 2nd: 25 mm on the catchment)
- Real time calibration
- A lot of false alarm exists on the first level, not on the second