2.3. METHODOLOGY: METEO & IRRIGATION

FROGS (French Refinement Of Groundwater Scenarios)
UIPP Training

Paris, 16 November 2011

UIPP Environmental Methodology Working Group

I: METEOROLOGICAL DATA

Selection of meteorological data

- Use of the MARS European database
  - Commonly used in the EU for environmental modeling
  - Consists of tiles of 50 x 50 km and covers most of Europe
  - For each AU, one MARS tile was selected as most representative of the meteorological conditions within the AU
- Methodology
  - Start with the MARS tile corresponding to the largest agricultural occupation within the AU
  - Implementation of a checking process to evaluate representativity in terms of temperature and rainfall and make sure there were no obvious reasons to chose another tile

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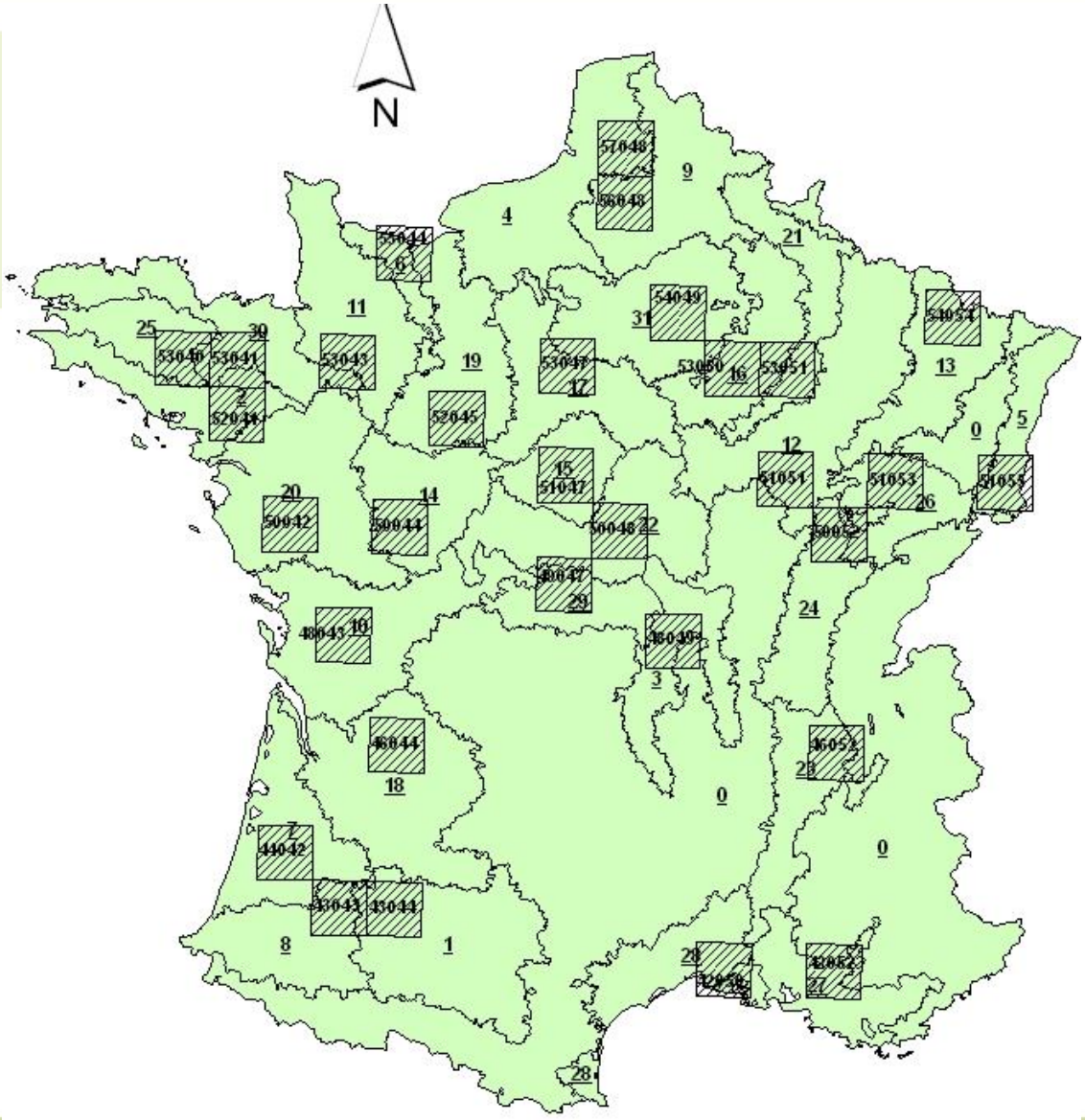
Selection of most representative tile for each AU



Selection of the MARS tile representing the highest target area (surface of arable land) in each AU

Implementation of weather data in PEARL

- MARS database downloaded in 2008
  - Parameters available for the period 1975-2006
  - For the FROGS scenarios: use of the years 1981-2006 (26 years)

Value	Description
MAXIMUM_TEMPERATURE	maximum temperature (°C)
MINIMUM_TEMPERATURE	minimum temperature (°C)
VAPOUR_PRESSURE	mean daily vapour pressure (hPa)
WINDSPEED	mean daily windspeed at 10m (m/s)
RAINFALL	mean daily rainfall (mm)
E0	Penman potential evaporation from a free water surface (mm/d)
ES0	Penman potential evaporation from a moist bare soil surface (mm/d)
ET0	Penman potential transpiration from a crop canopy (mm/d)
CALCULATED_RADIATION	daily global radiation (kJ/m^2/d)

Implementation of weather data in PEARL

- Correspondance between MARS available data and PEARL needed input
  - ETP calculated in PEARL from other available MARS data (MARS ETP data not used)

PEARL Input	MARS Parameter
Daily global radiation (kJ/m^2/d), between 0 and 5 E6	CALCULATED_RADIATION
Minimum daily temperature (°C), between -50 and 35	MINIMUM_TEMPERATURE
Maximum daily temperature (°C), between -30 and 60	MAXIMUM_TEMPERATURE
Average vapor pressure (kPa), between 0 and 10	VAPOUR_PRESSURE / 10
Average windspeed (m/s), between 0 and 50	WINDSPEED
Daily precipitation (mm/d), between 0 and 1000	RAINFALL
Reference evapotranspiration (mm/d), between 0 and 100	ES0

Adjustments of MARS data for SWAP

- SWAP (hydrology module in PEARL) collapsed for 58 scenarios out of 1481:
  - Large rainfall event
  - Low hydraulic conductivity soil
  - In the real world, such situation would normally result in a runoff event
  - SWAP is not able to simulate such significant runoff and crashed

→ adjustments where needed to « force » SWAP for these 58 scenarios

Adjustments of MARS data for SWAP

- Implemented solution:
  - Splitting of the specific rainfall events causing the problem over 2-4 days → allows the water to percolate into the soil
  - Total amount of rain is not modified, only intensity, to force the water through the soil profile
  - Modified weather files specifically prepared only for scenarios that would fail otherwise
- Problem still not solved for 9 scenarios
  - All in the same AU (n°23), with numerous rainfall combined with cambisol
  - Very small percentage of the total area (0.11%) is finaly failing

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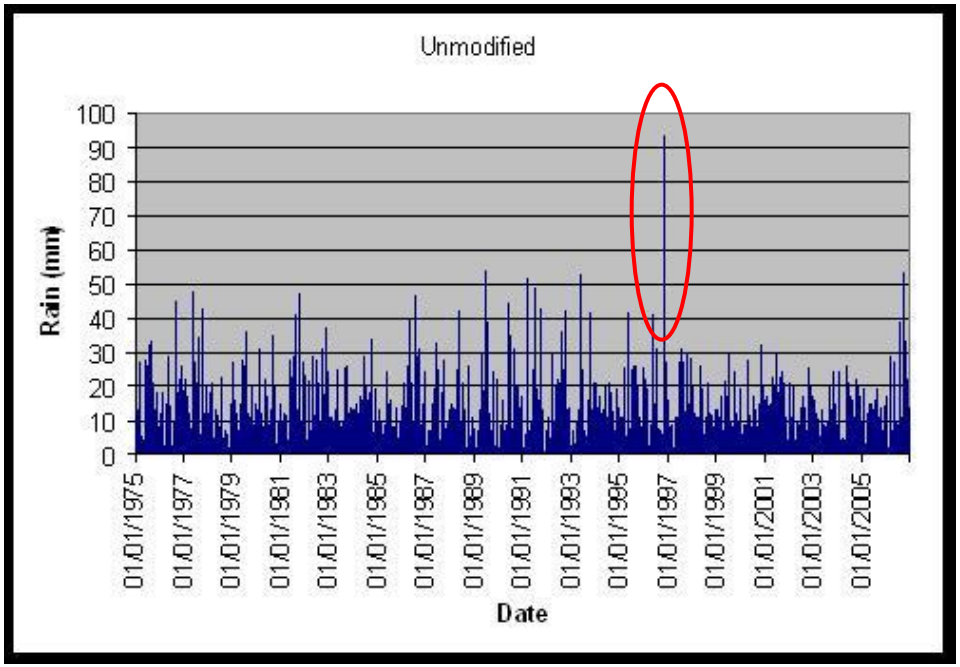
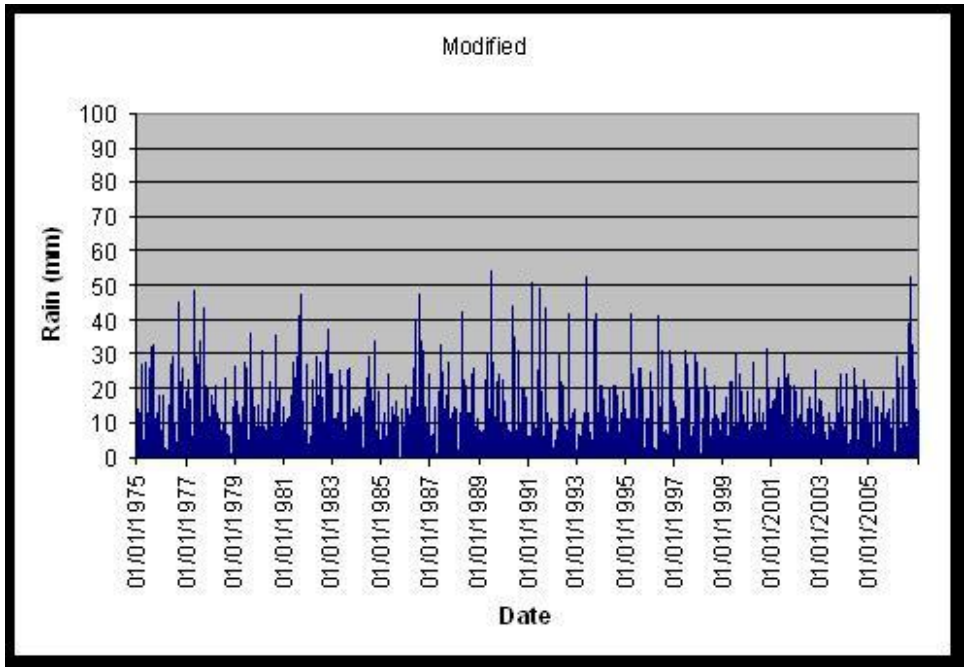
Adjustments of MARS data for SWAP

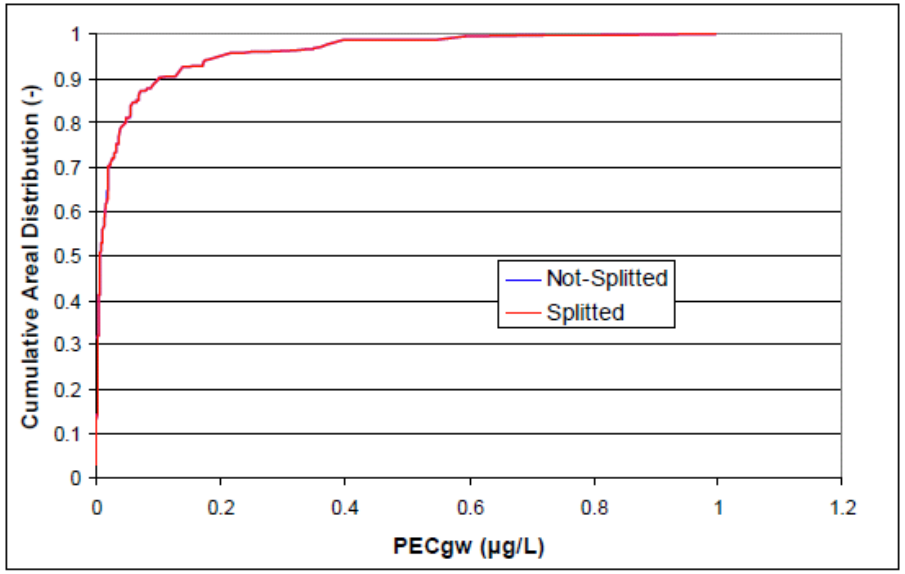




Splitting of the rainfall event (93mm) over 3 days (3x31mm) → modification of the intensity → more water is able to infiltrate and percolate through the soil

Impact of rainfall adjustments on the PECgw

Effect of rainfall splitting evaluated on a dummy substance



- No significant change in PECgw values
  - Cumulative areal distribution almost identical
  - Individual temporal 80th percentile increased by 0.12%
- Only slight effect of splitting the rainfall event, which can be considered as a conservative approach

II: IRRIGATION

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stepwise approach for implementation of irrigation

1 – Collection of irrigated surface for each crop included in FROGS from the “Recensement Agricole” (Agreste, 2001)

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2- Selection of the main irrigated crops

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3- For each selected crop, determination of the Agronomic Unit where irrigation is significant (irrigation > x% of the total crop in the AU and > y ha)

↓

4- Collection of irrigation practices for the selected crops and AU

1 – Collection of irrigation data from Agreste

- Total irrigated acreage for the crops included in FROGS

Table 24 Irrigation acreage from Agreste (2001)

	Acreage (ha)	Acreage (% of FROGS crops irrigated)	Cumulative acreage (% of FROGS crops irrigated)
Total FROGS crop irrigated	1151375	-	
Irrigated Grain maize	780952	67.8	67.8
Irrigated Fodder maize	105085	9.1	77.0
Sum of oilseed crops irrigated (a)	66774	5.8	82.8
Sum of other irrigated cereals (b)	63831	5.5	88.3
Irrigated potato	56424	4.9	93.2
Irrigated sugarbeet	34257	3.0	96.2
Irrigated Hard wheat	17378	1.5	97.7
Irrigated wheat	15182	1.3	99.0
Irrigated Sunflower	11492	1.0	100.0

(a) including oilseed rape
(b) including barley

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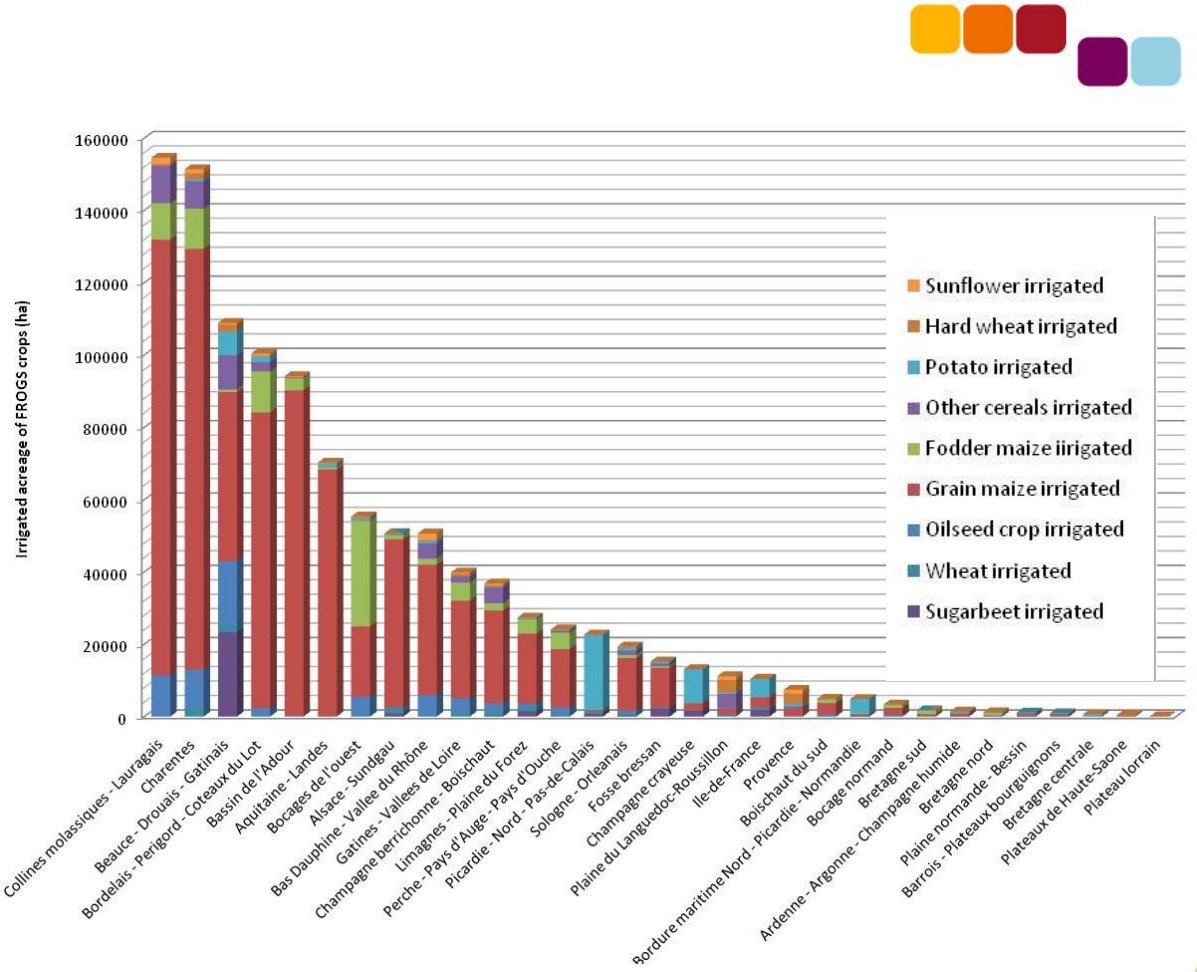
2 – Selection of the main irrigated crops

- Maize is clearly the main irrigated crop for most of the AU
- Potatoes and Sugar Beet can also be important in some AU
- Grain maize + Fodder Maize + Sugar beet + Potatoes = 84.8% of irrigated crops included in FROGS

Implementation of irrigation on these crops only



3 – Relevant AUs for implementing irrigation

- Irrigation varies among the AUs
  - Pedo-climatic differences
  - Local water policies
- Implementation of irrigation in FROGS
  - Represents these differences
  - Avoid including irrigation where it is not a standard practice
- Selection of the most relevant Aus for irrigation
  - Ratio of irrigated crop surface to the total acreage of the crops > 20%
  - Total irrigated crops cover more than 1000 ha within the AU
  - Presence of the crop in the crop rotation of the AU

4 – Irrigation practices

- Number of irrigation events and amount of water applied available in Agreste (2006) and Golaz (2006)
- First irrigation date set for each crop based on expert judgment and external documents (Arvalis and Chambre d'Agriculture de la Somme)
- Interval between 2 irrigations calculated considering 8 weeks of irrigation for maize and 6 weeks for potatoes, divided by the number of irrigation events
- Amount of water per event calculated based on total amount from Agreste divided by number of events

Implementation of irrigation in FROGS

- The irrigation schedules for the relevant crop/AU combinations were included in the FROGS database
- In FROGS, irrigation water is applied directly to the soil surface (as in standard FOCUS simulations)
- The relevant irrigation schemes were already considered in the generation of pre-run SWAP sol hydrology (*.pfo files)

Thank you very much for your kind attention