Climate change impact on the water resources of the Garonne River watershed

Youen GRUSSON, José-Miguel SANCHEZ-PEREZ, Sabine SAUVAGE, Chea RATHA, Raghavan SRINIVASAN, François ANCTIL

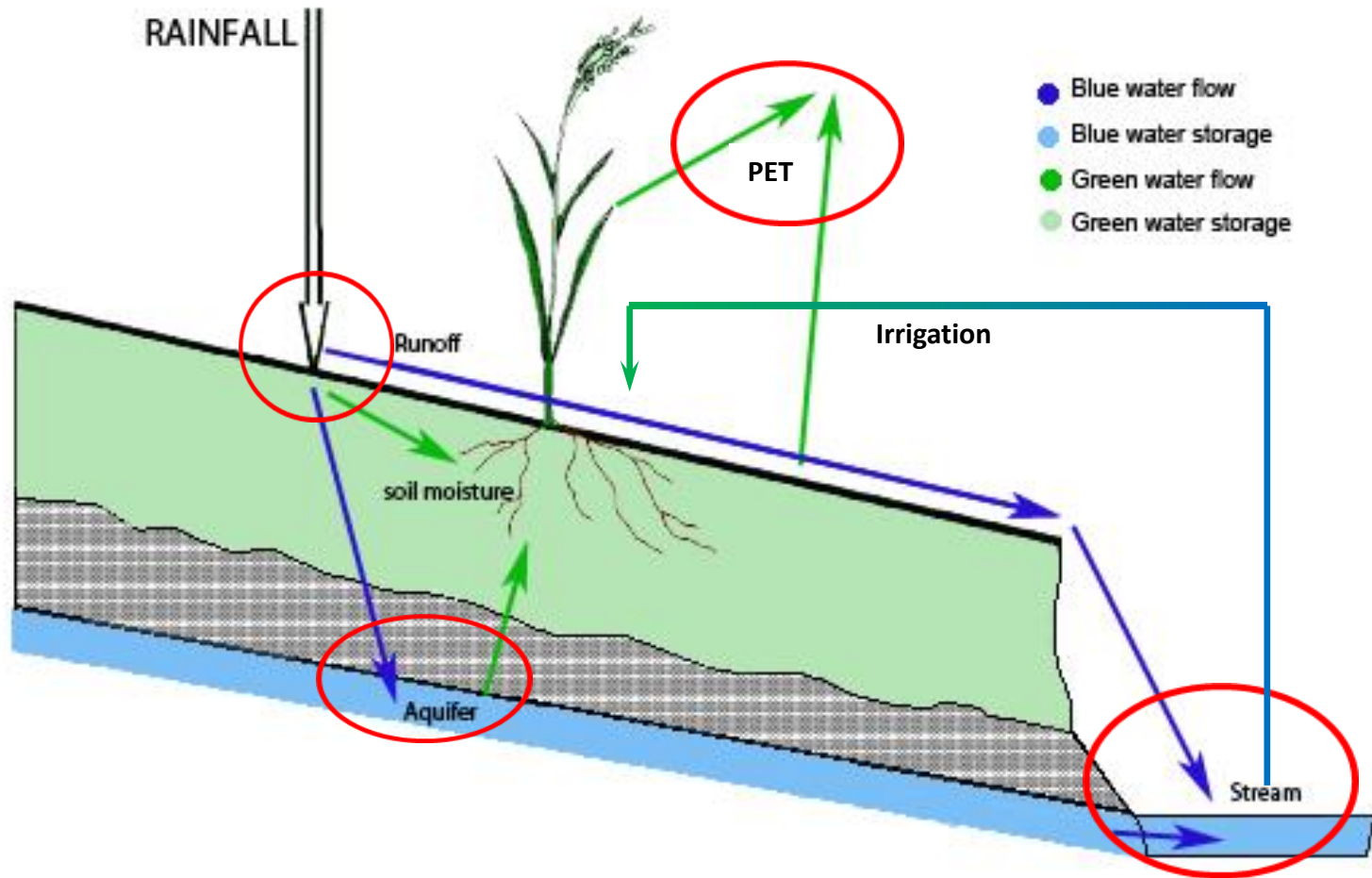EcoLab — Laboratoire écologie fonctionnelle et environnement

cnrs — www.cnrs.fr

INP TOULOUSE ENSAT

UNIVERSITÉ TOULOUSE III PAUL SABATIER — Université de Toulouse

UNIVERSITÉ LAVAL

G-MOD

GREEN AND BLUE WATER

Blue Water: **Run Off**, **Aquifers** and **Streams**, «available» water, the most studied.

Green Water: **PET** and **Soil moisture,** «Invisible» water, hard to manage.

RAINFALL

- Blue water flow
- Blue water storage
- Green water flow
- Green water storage

PET

Irrigation

Runoff

soil moisture

Aquifer

Stream

(AFTER ROCKSTRÖM 1997)

G-MOD

Swat Model and Blue/Green water

▪ Very large Scale: Continental : Africa (Schuol & al. 2006)

Sub Continental : West africa (Schuol & al. 2008)

Country : Iran (Abbaspour & al. 2009 Faramarzi & al. 2008)

Large Watershed : Heihe river (Zang & al. 2012)
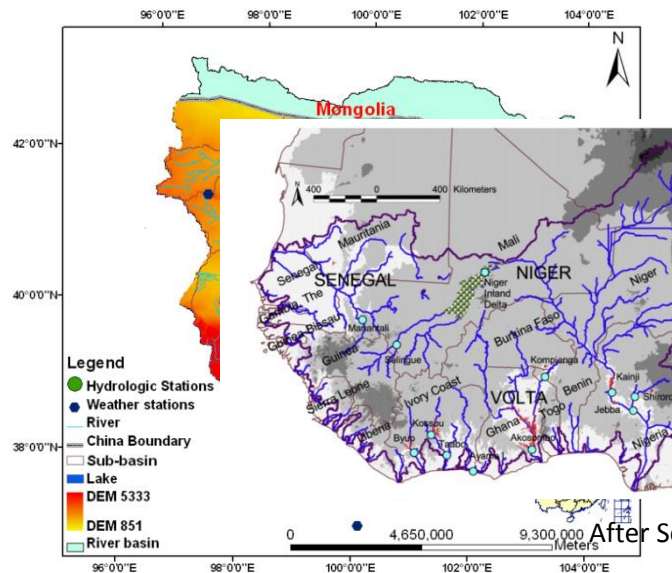
After Zang & al 2012
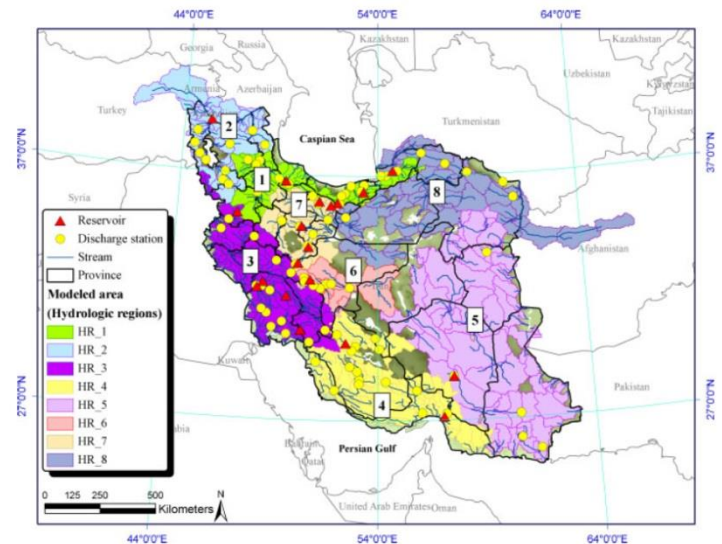
After Schuol & al 2006
After Faramazi & al 2008

Swat Model and Blue/Green water

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▪ Monthly time Step

▪ Climate change impact
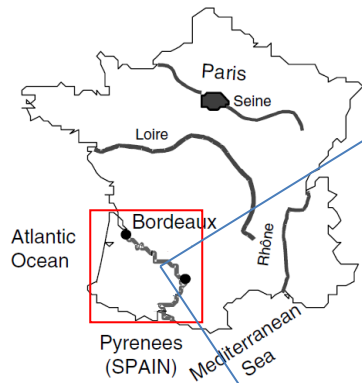
▪ Our project:

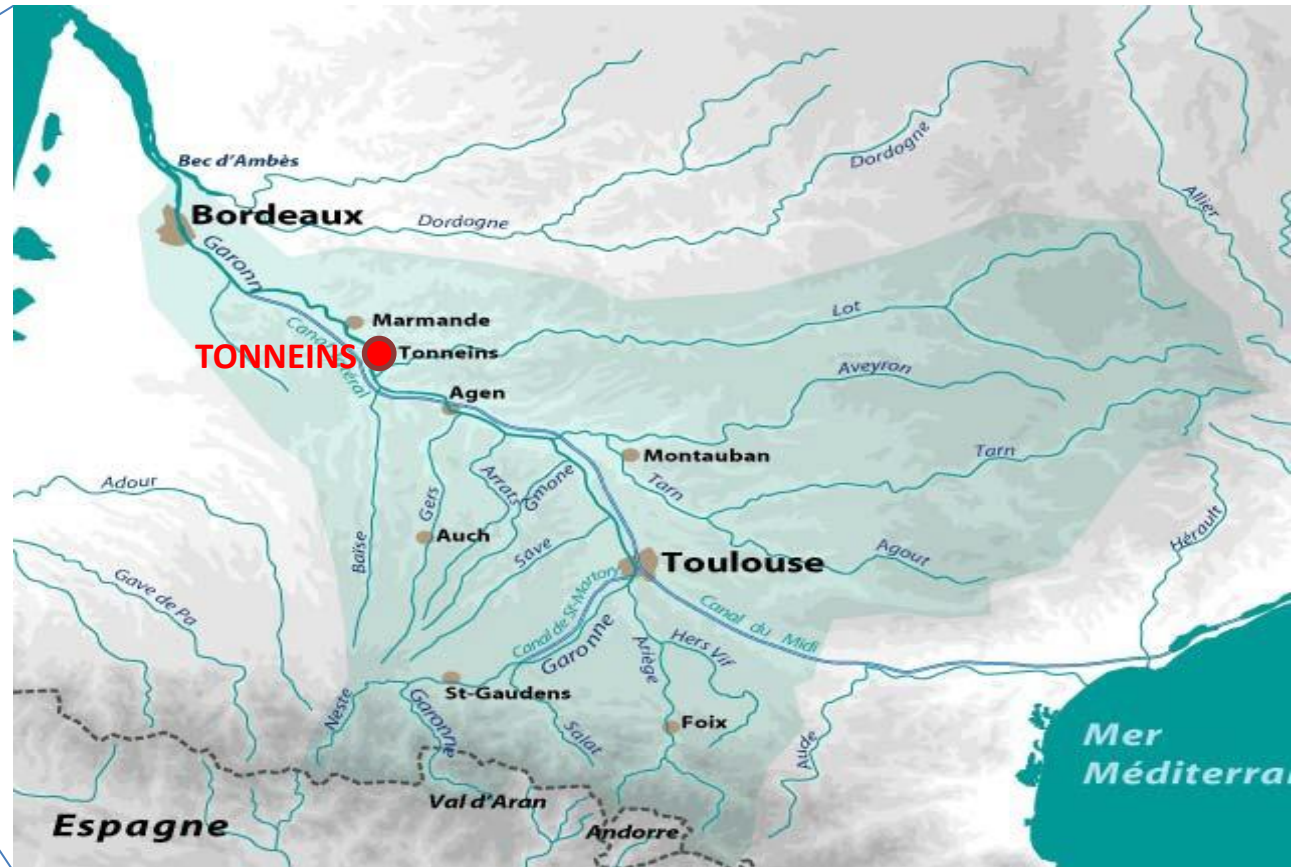**Meso-scale Sub-watershed** **+** **Daily time Step** **+** **Climate change impact**

GARONNE RIVER PROJECT

GARONNE RIVER :
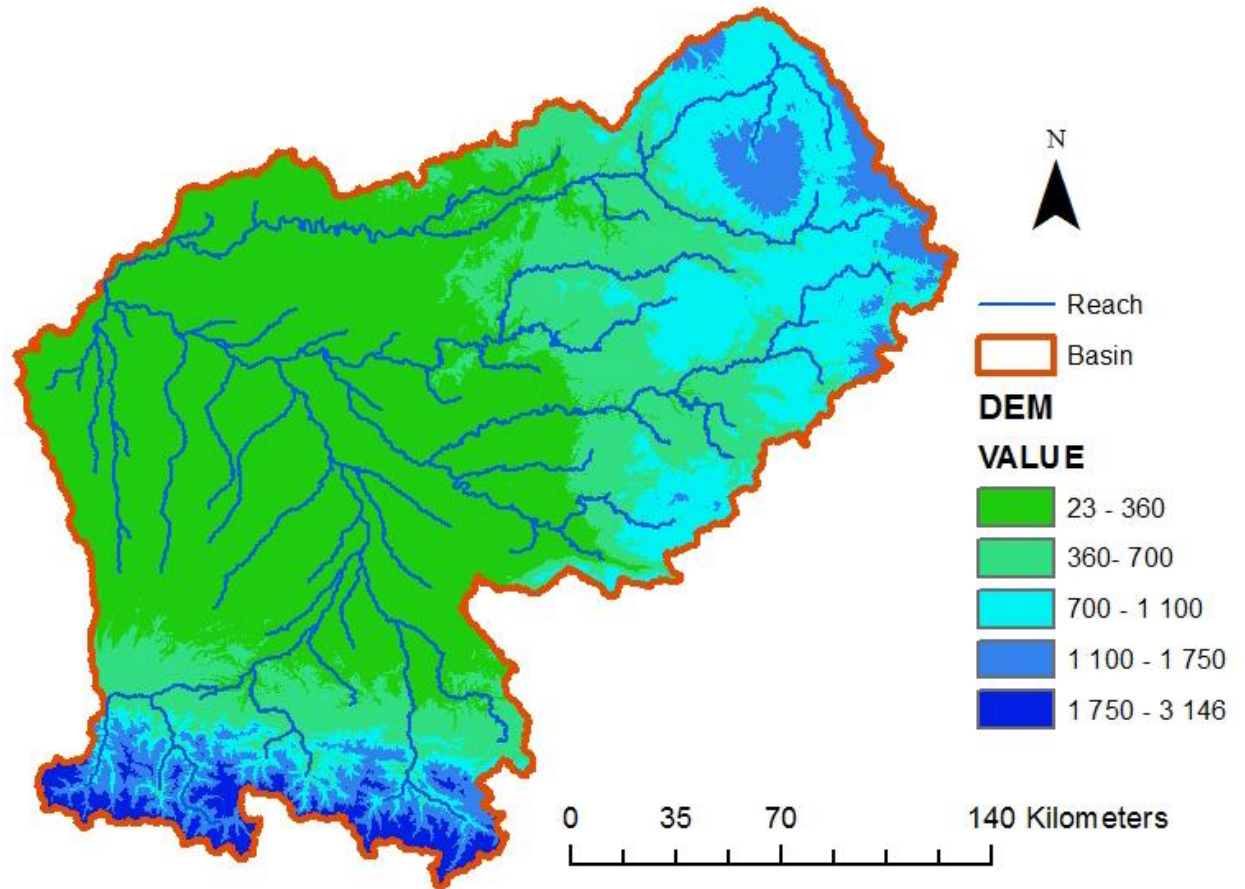## AN HETEREGENOUS, WELL KNOWN WATERSHED

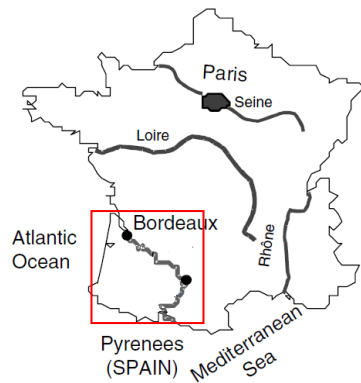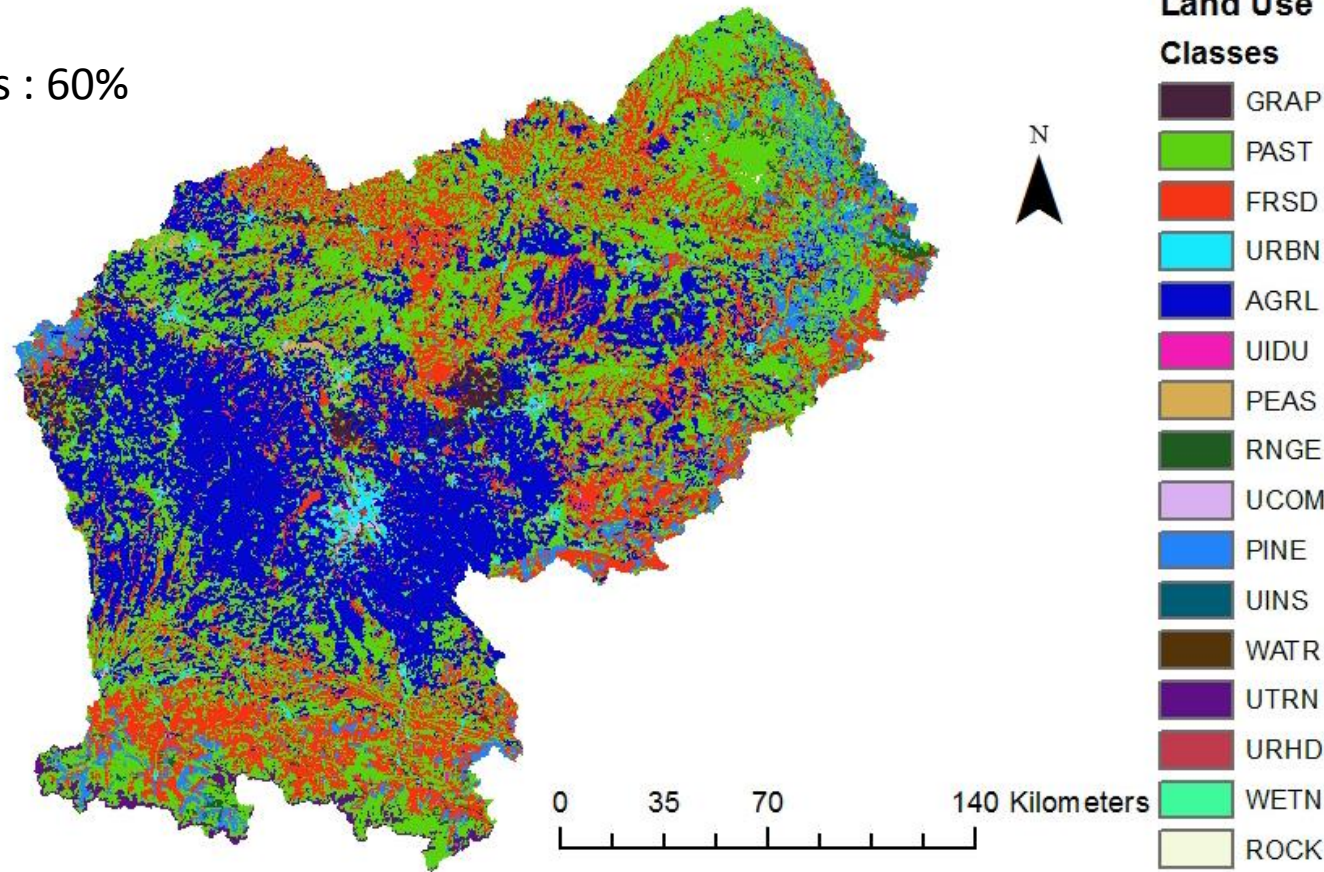▪ 51 000 km²

An heterogenous catchment…

- 51 000 km²

- From 25m to 3146m

GARONNE RIVER PROJECT : Data

…and a well known and monitored catchment

▪ **LAND USES:**
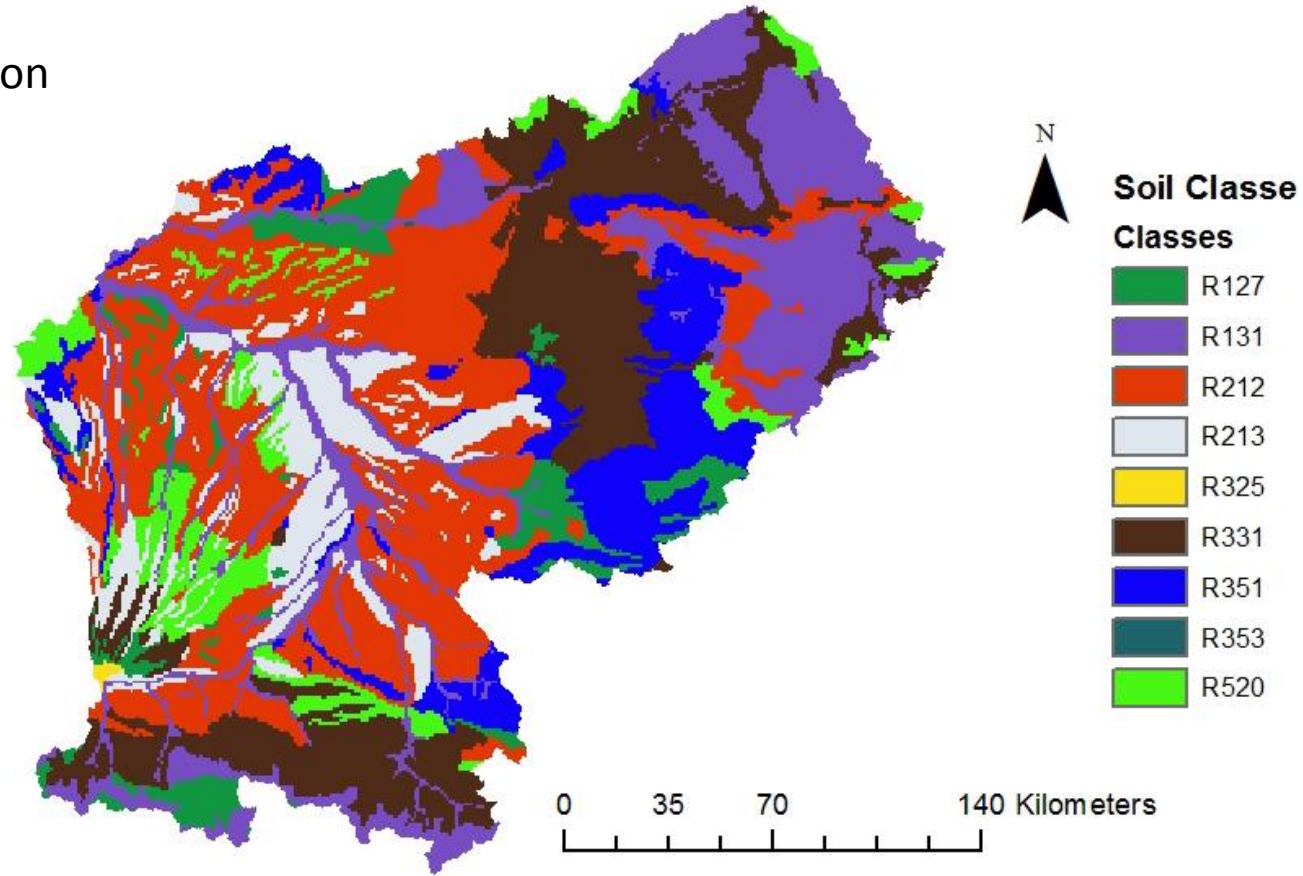
- Agricultural and Pastural uses : 60%

- Forest : 30%

Land Use Classes
- GRAP
- PAST
- FRSD
- URBN
- AGRL
- UIDU
- PEAS
- RNGE
- UCOM
- PINE
- UINS
- WATR
- UTRN
- URHD
- WETN
- ROCK

0   35   70   140 Kilometers

CORINE Land Cover (CLC) , 2006 , (1 : 1 000 000)

G-M●D

…and a well known and monitored catchment

▪ **SOIL:**

168 differents soil simplified on
  9 types of dominant soil

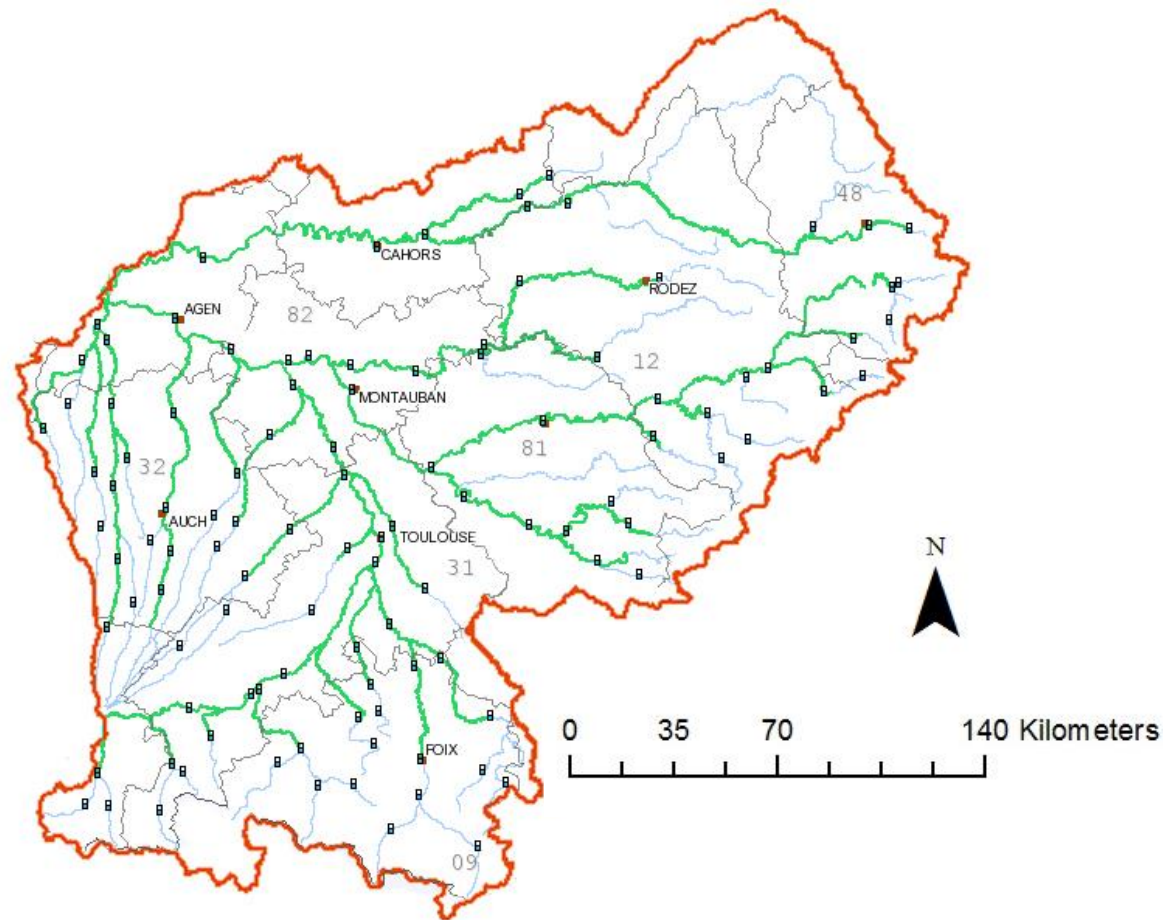FAO map1985, simplified, scale (1 : 1 000 000)

GARONNE RIVER PROJECT : Data

…and a well known and monitored catchment

▪ **HYDROLOGY:**
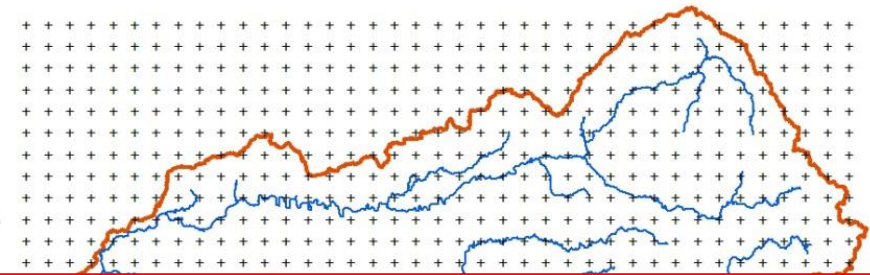
Banque Hydro:
280 gauging stations on the
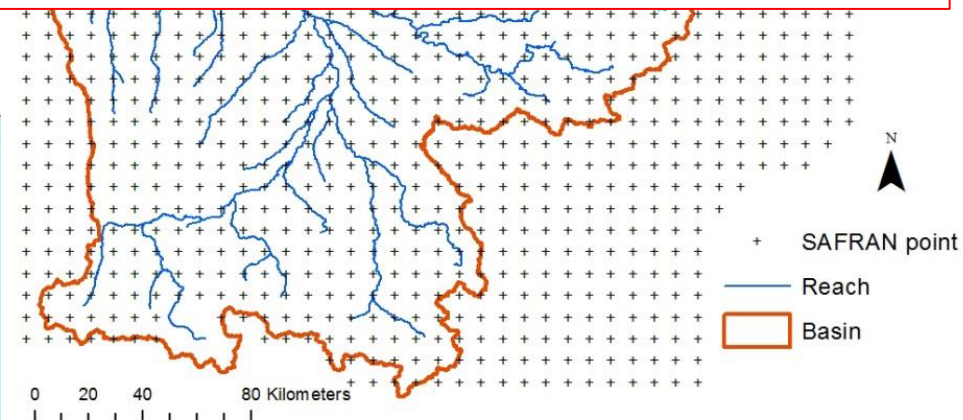Watershed

...and a well known and monitored catchment

▪ **WEATHER:**

Adaptability : Regional Climatic Model output on the SAFRAN grid

Météo France: 39 Weather Stations

Météo France SAFRAN grid:
Meso scale atmospheric analysis system for surface variables

G-M☺D

...and a well known and monitored catchment
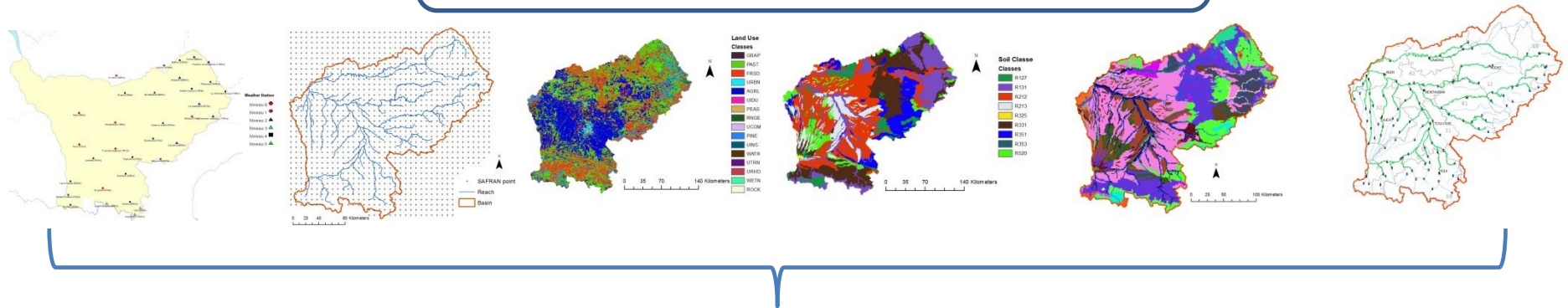
Which data? Which accuracy?
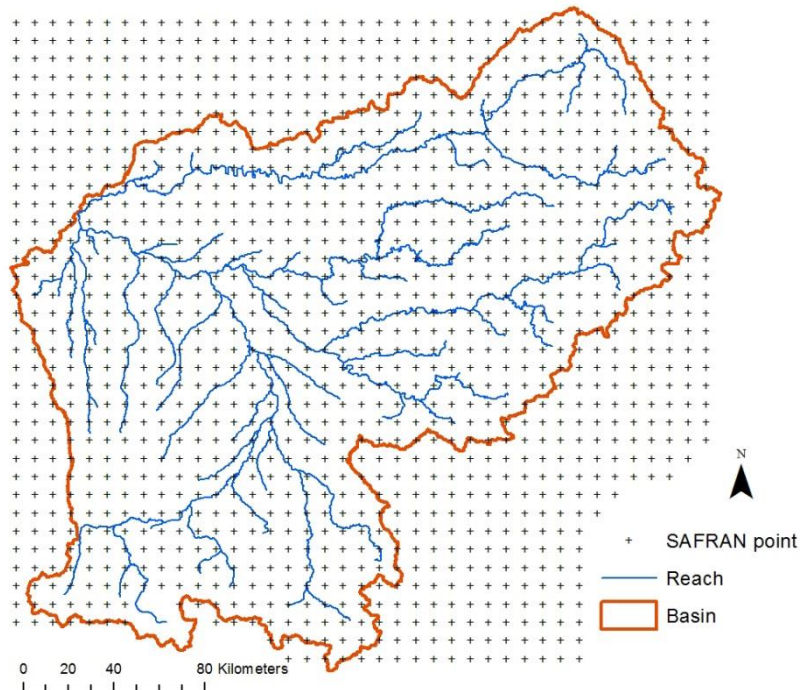
Preliminery test :

Impact of spatial accuracy on the performance

CLIMATE CHANGE : Suitable Weather Data

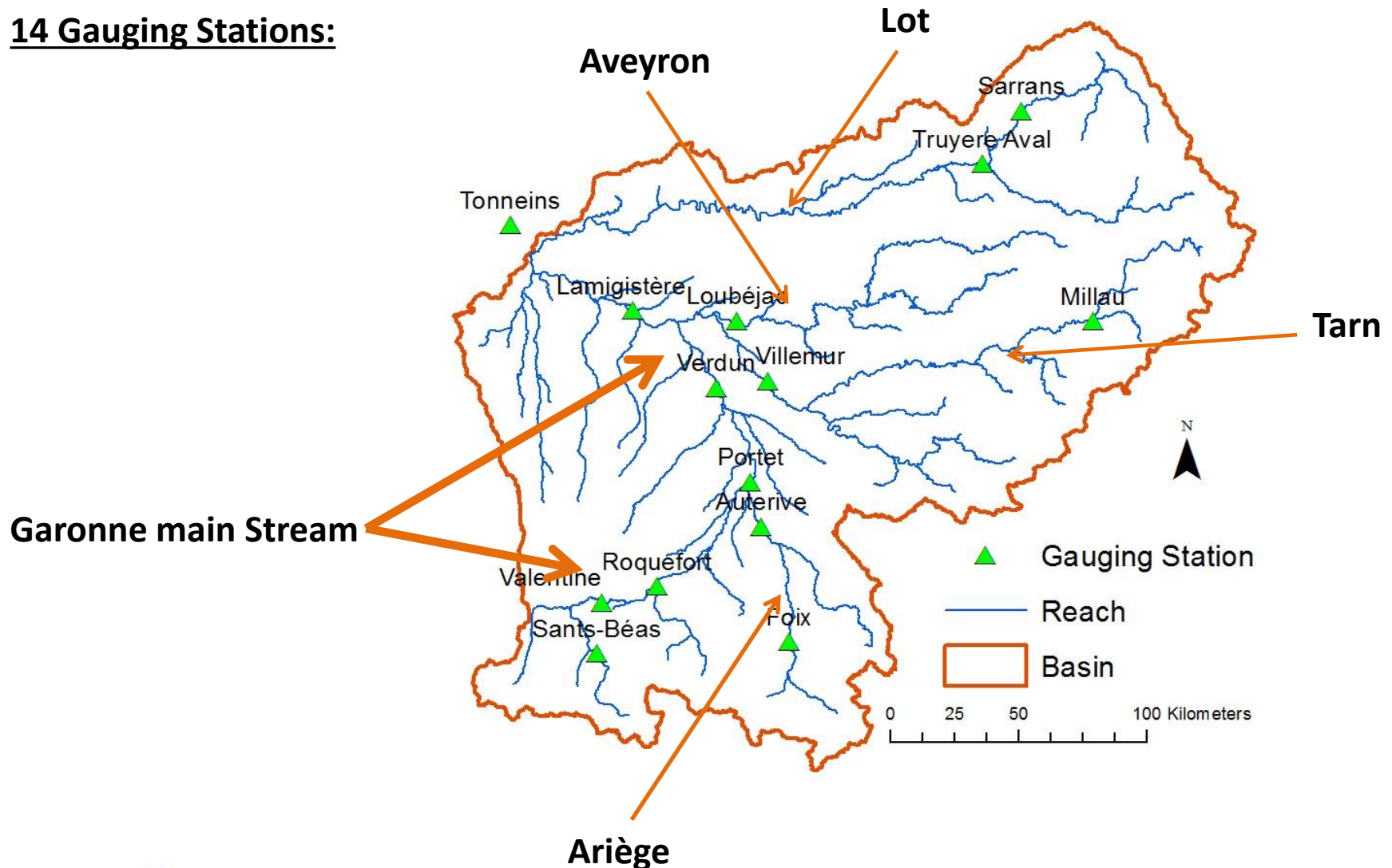1st test: Impact of Sub Watershed number

- Sub watershed definition: 44 to 2552 sub watershed
- SAFRAN data : 43 to 780 SAFRAN input point
- With default parameters / Monthly time step
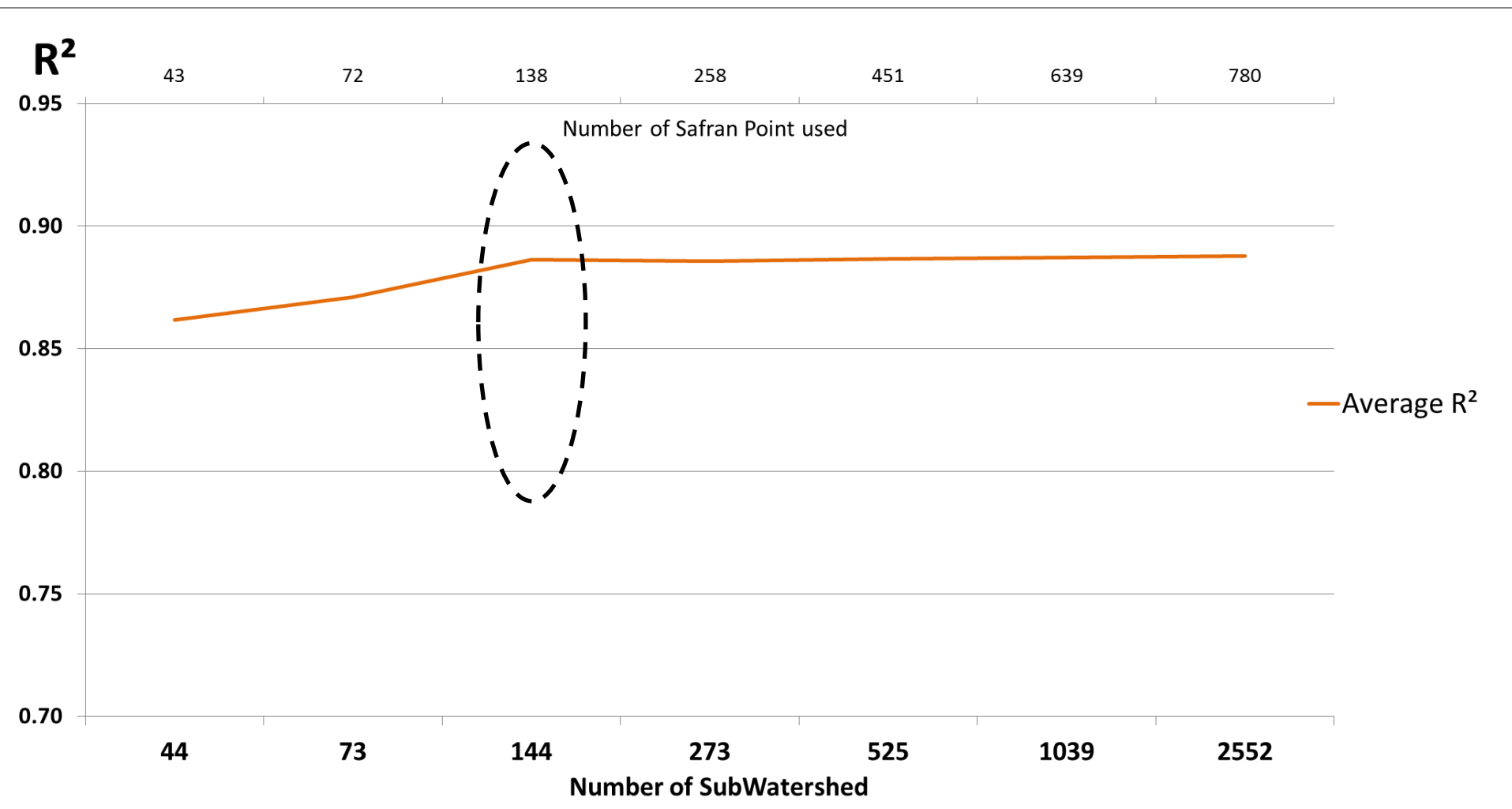- Comparision with 14 gauging stations on 1990-2000 period
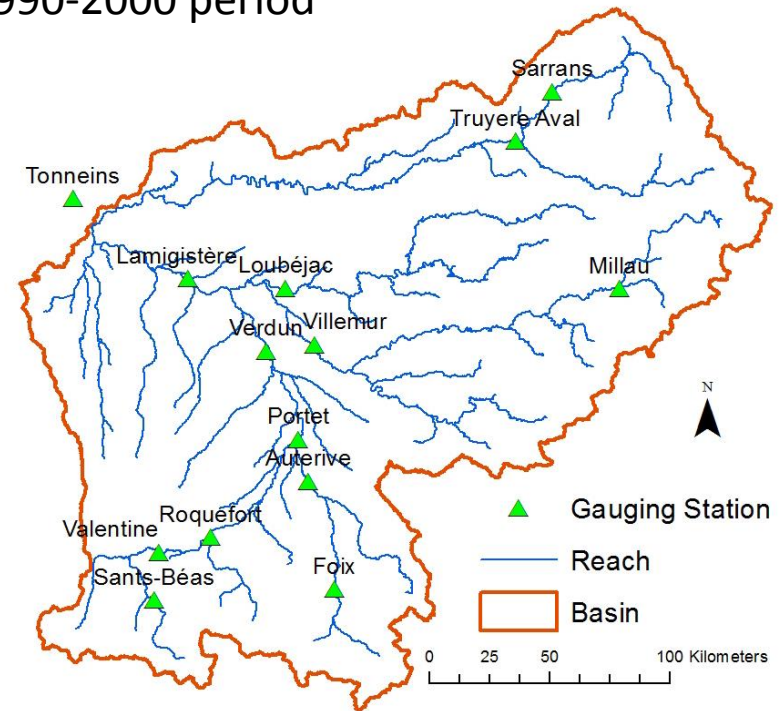
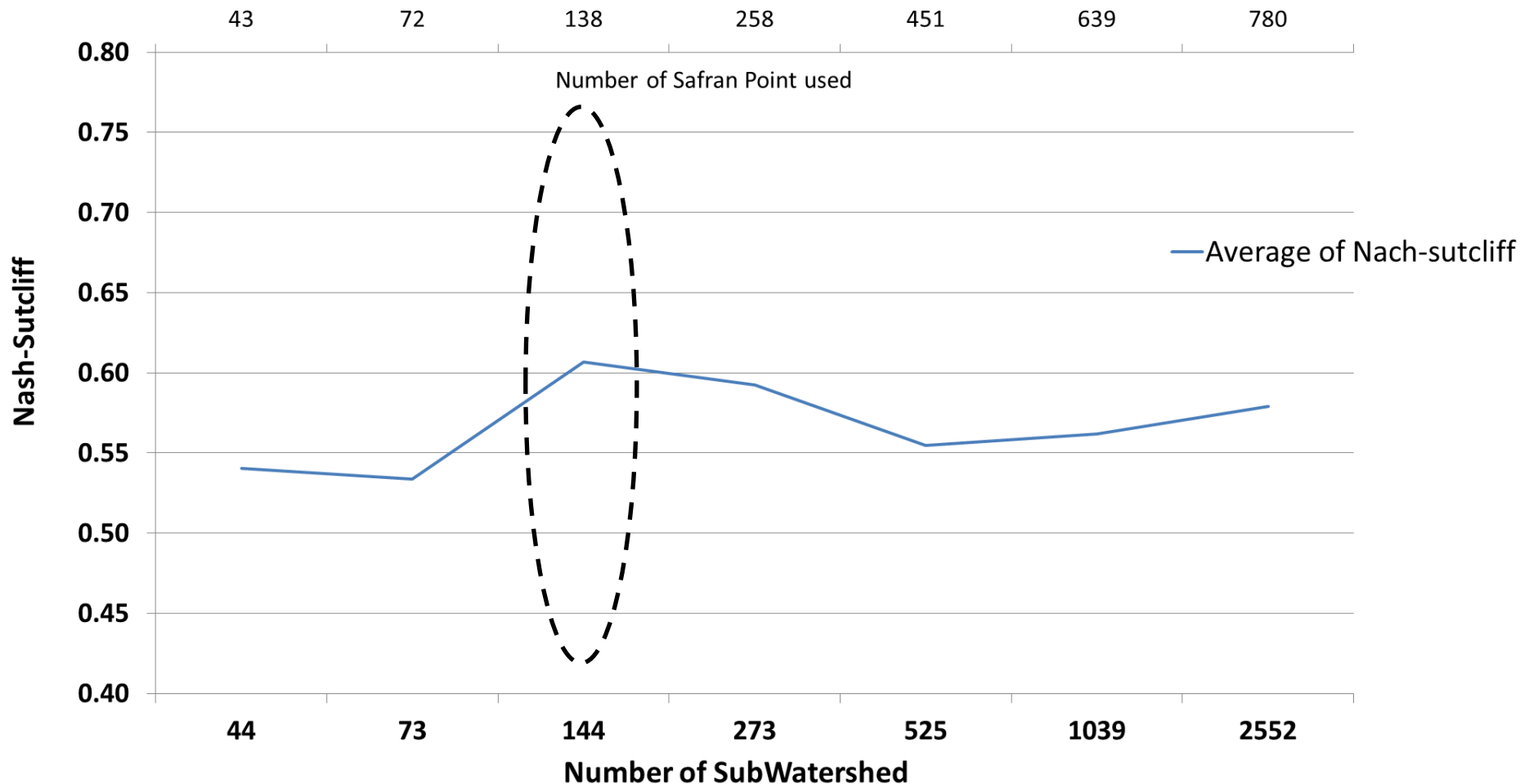# CLIMATE CHANGE : Suitable Weather Data

14 Gauging Stations:

CLIMATE CHANGE : Suitable Weather Data

R² evolution as a function of Subwatershed number

CLIMATE CHANGE : Suitable Weather Data

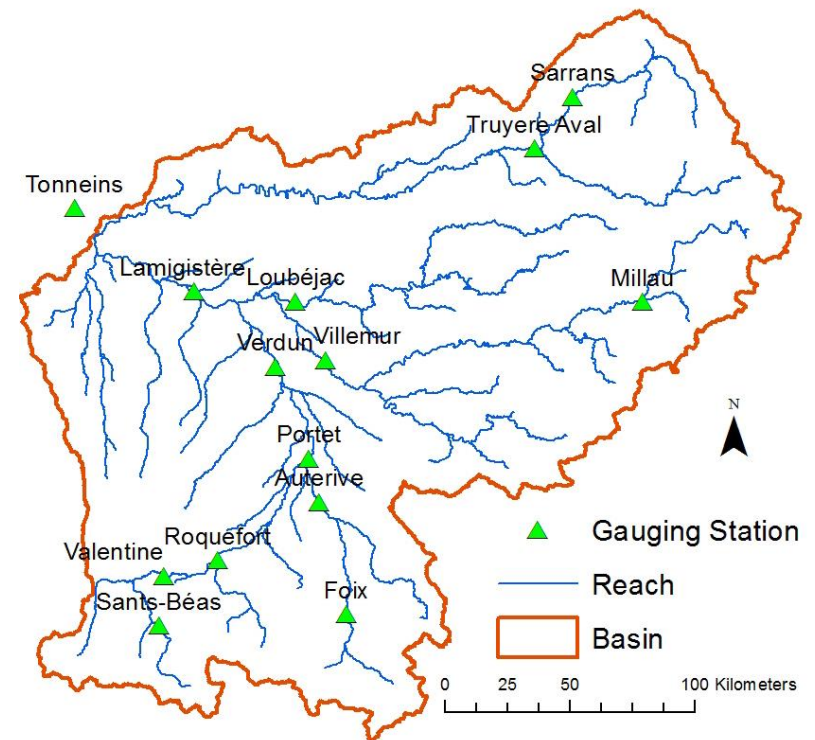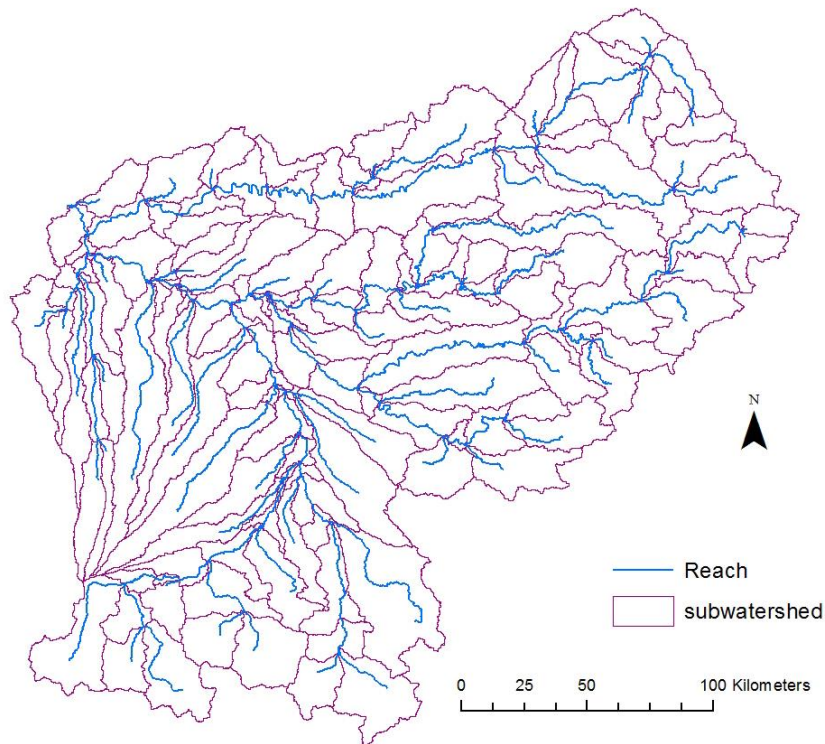## Nash-Sutcliff evolution as a function of Subwatershed number

Maximum on 144 Sub-Watershed = 138 SAFRAN points

CLIMATE CHANGE : Suitable Weather Data

2nd test: Influence of weather data spatial density

- With same stream definition : 144 sub-watershed (20 000ha)

- With default parameters / Monthly time Step

- Comparision with 14 gauging stations on 1990-2000 period

2de test: Influence of weather data spatial density

- With same stream definition : 144 sub-watershed (20 000ha)
- With default parameters / Monthly time Step
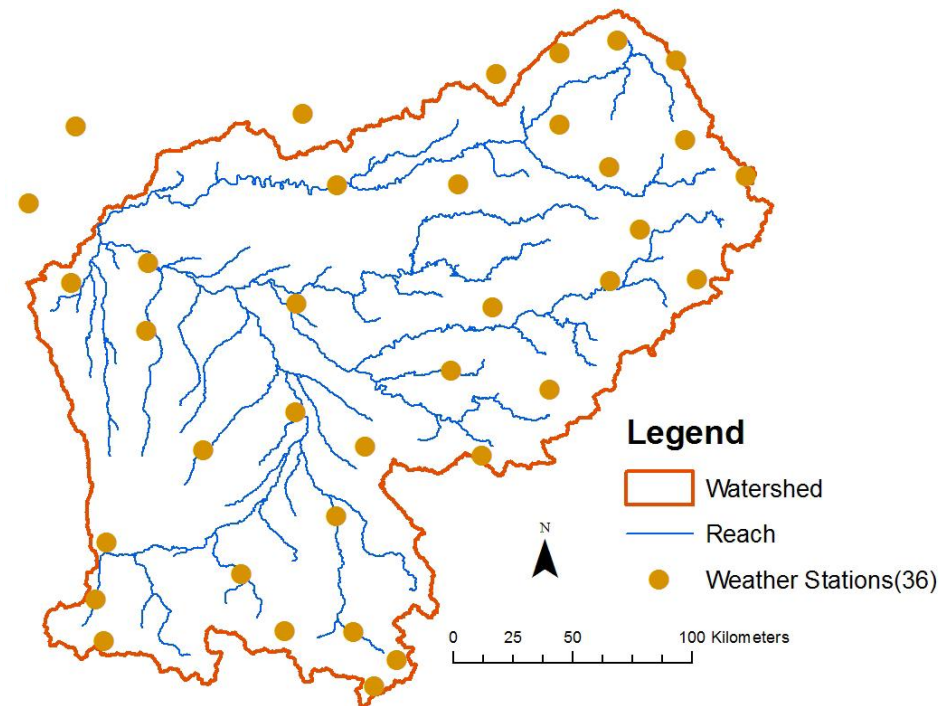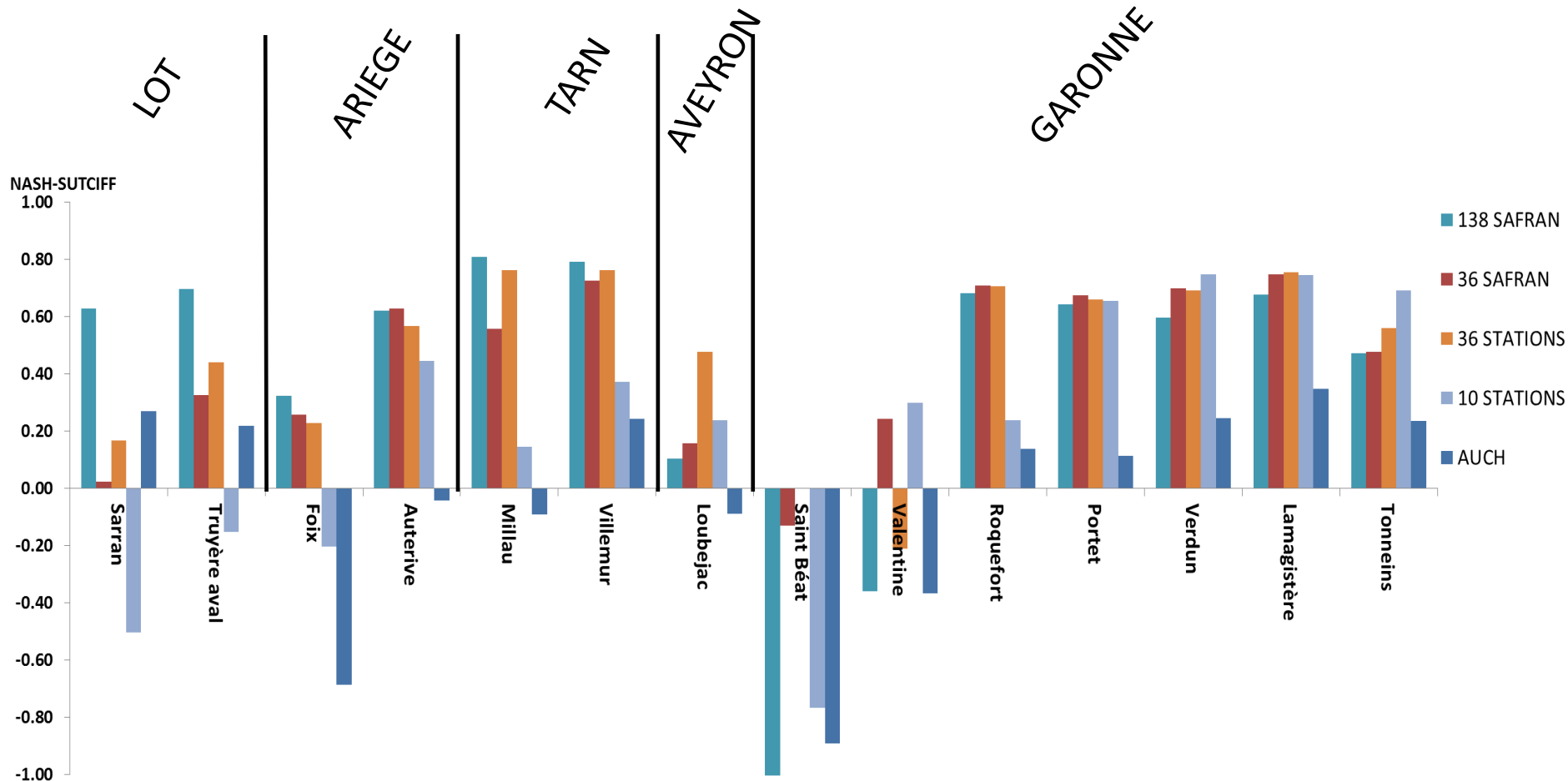- Comparision with 14 gauging stations on 1990-2000 period

5 differents configurations:

▪ SAFRAN data (138 points)

▪ 36 weather stations

▪ 36 SAFRAN points corresponding

▪ 10 weather Stations

▪ 1 weather station : Blagnac (Toulouse)

Legend

- ▭ Watershed
- — Reach
- ● Weather Stations(36)
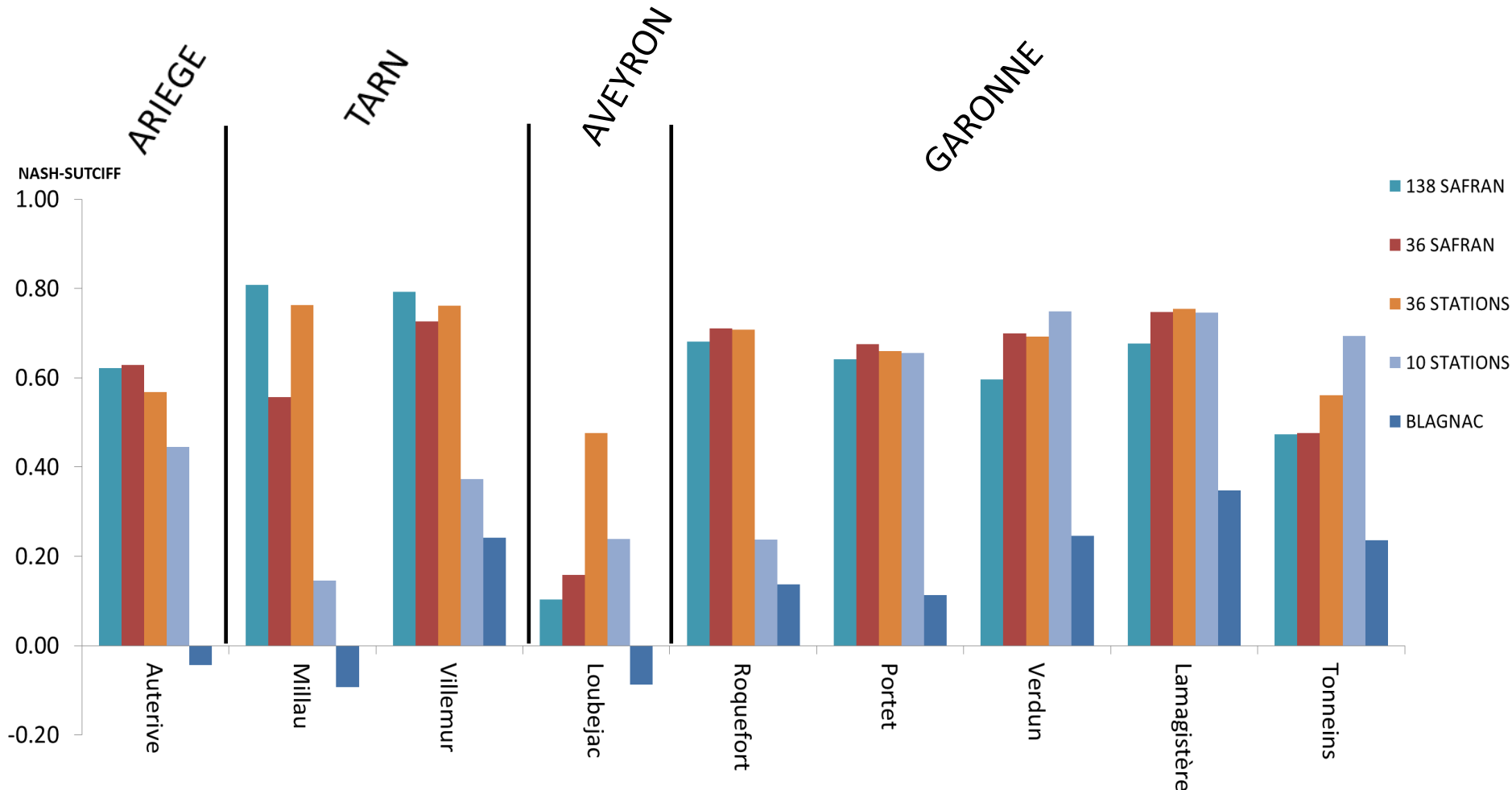
0   25   50   100 Kilometers

# CLIMATE CHANGE : Suitable Weather Data

Nach-Sutcliff Evolution as a function of weather data spatial density

CLIMATE CHANGE : Suitable Weather Data

Nach-Sutcliff Evolution as a function of weather data spatial density

CLIMATE CHANGE : Suitable Weather Data

R² Evolution as a function of weather data spatial density

2013 International SWAT Conference, Toulouse, France
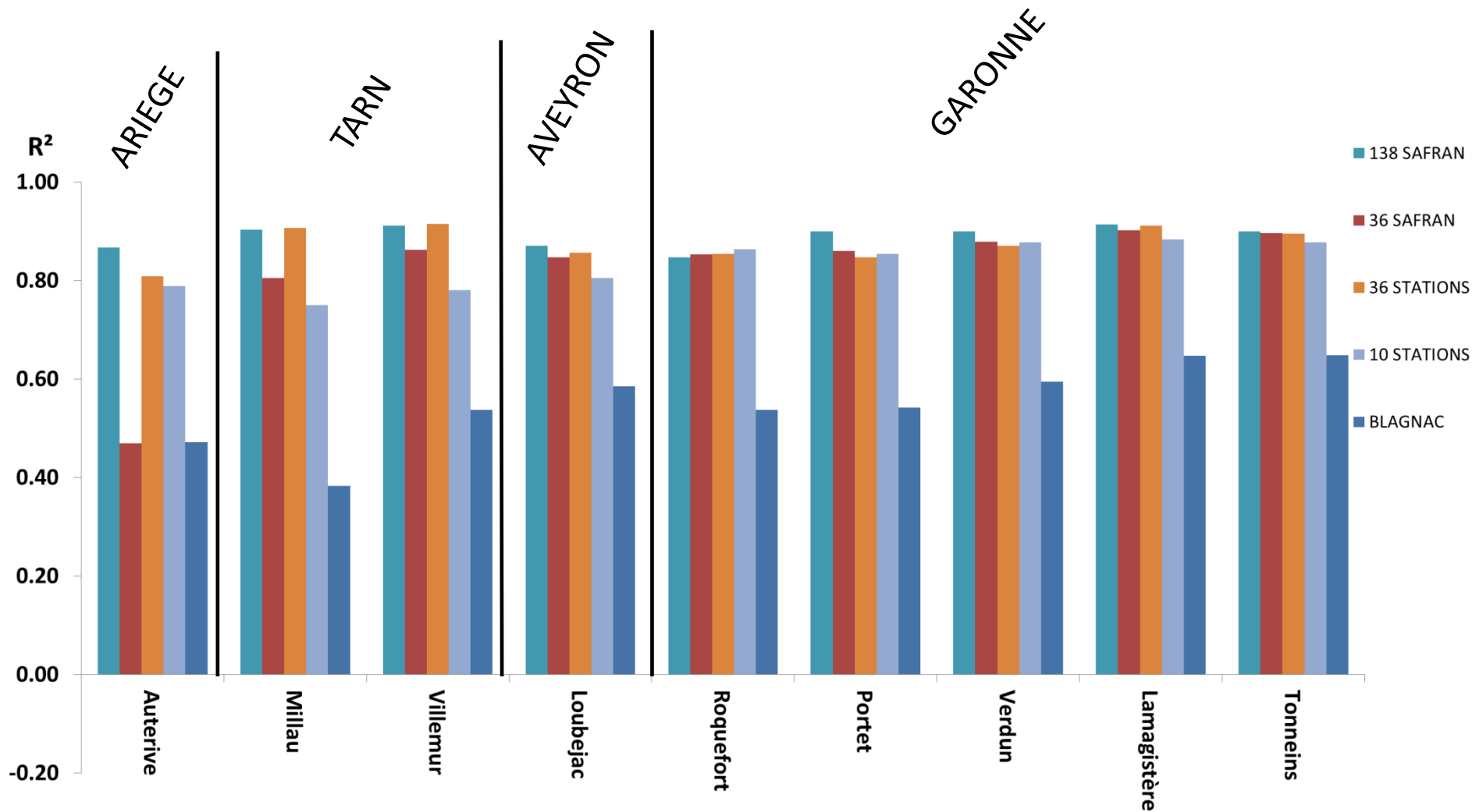
Perspectives & Conclusions

Conclusions

Weather data : Higher resolution ≠ better result

⟶ Treshold of data resolution

⟶ Find the good balance:
Result / complexification

Ongoing studies

▪ Impact of different soil data resolution on the hydrological output
(SGDBE soil map on SWAT - 70 soil classes)

▪ Impact of Soil and Weather data resolution on other output
(PET, groundwater, runoff)

▪ Maranda Benoit, LAVAL university: sensibility of PET formula
for past and futur climate: 24 formula added on SWAT code

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THANK YOU

2013 International SWAT Conference, Toulouse, France