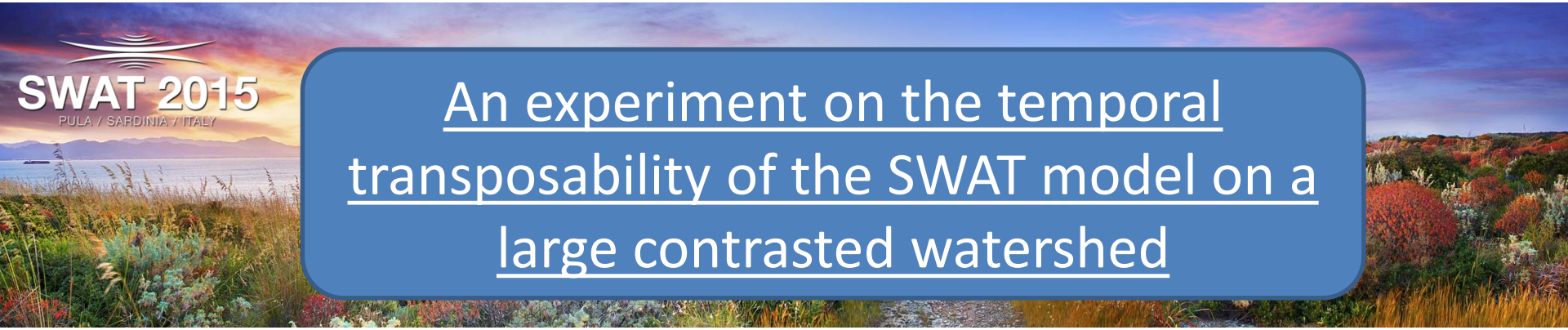
2015 INTERNATIONAL SWAT CONFERENCE

Pula - Italie



An experiment on the temporal transposability of the SWAT model on a large contrasted watershed

Youen GRUSSON,
José-Miguel SANCHEZ-PEREZ, Sabine SAUVAGE, François ANCTIL

EcoLab
Laboratoire écologie fonctionnelle et environnement

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INP ENSAT

UNIVERSITÉ LAVAL

G-MOD

The project

Assess the evolution of green and blue water stocks and fluxes in a climate change context, over the Garonne river watershed

Blue Water

Stock

- Snow
- Shallow aquifer
- Deep aquifer
- Stream

Flux

- Run off
- Infiltration
- Percolation
- Subsurface flow
- Groundwater flow

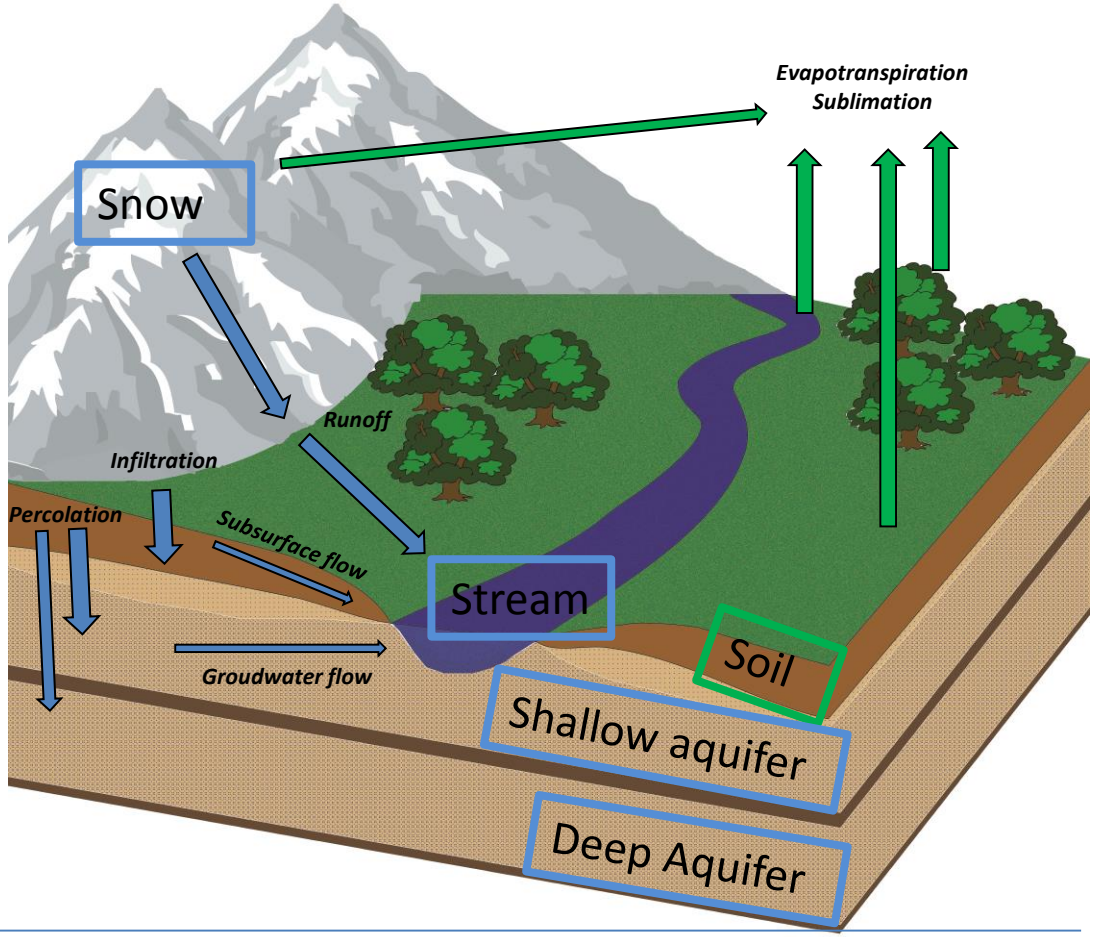
Green Water

Stock

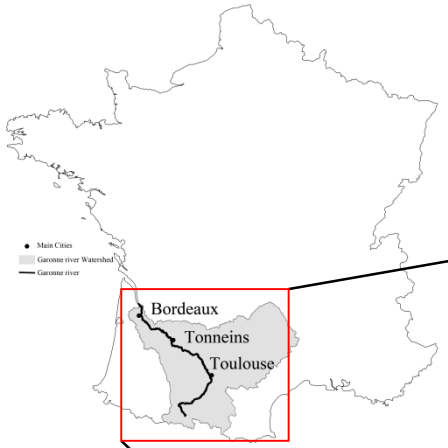
- Soil water

Flux

- Evaporation
- Transpiration
- Sublimation



Garonne river subwatershed and model setup



Tonneins

Toulouse

Legend

Streams

Elevation (m)

2 500 - 3 250
2 250 - 2 500
2 000 - 2 250
1 750 - 2 000
1 500 - 1 750
1 250 - 1 500
1 000 - 1 250
750 - 1 000
500 - 750
250 - 500
0 -250

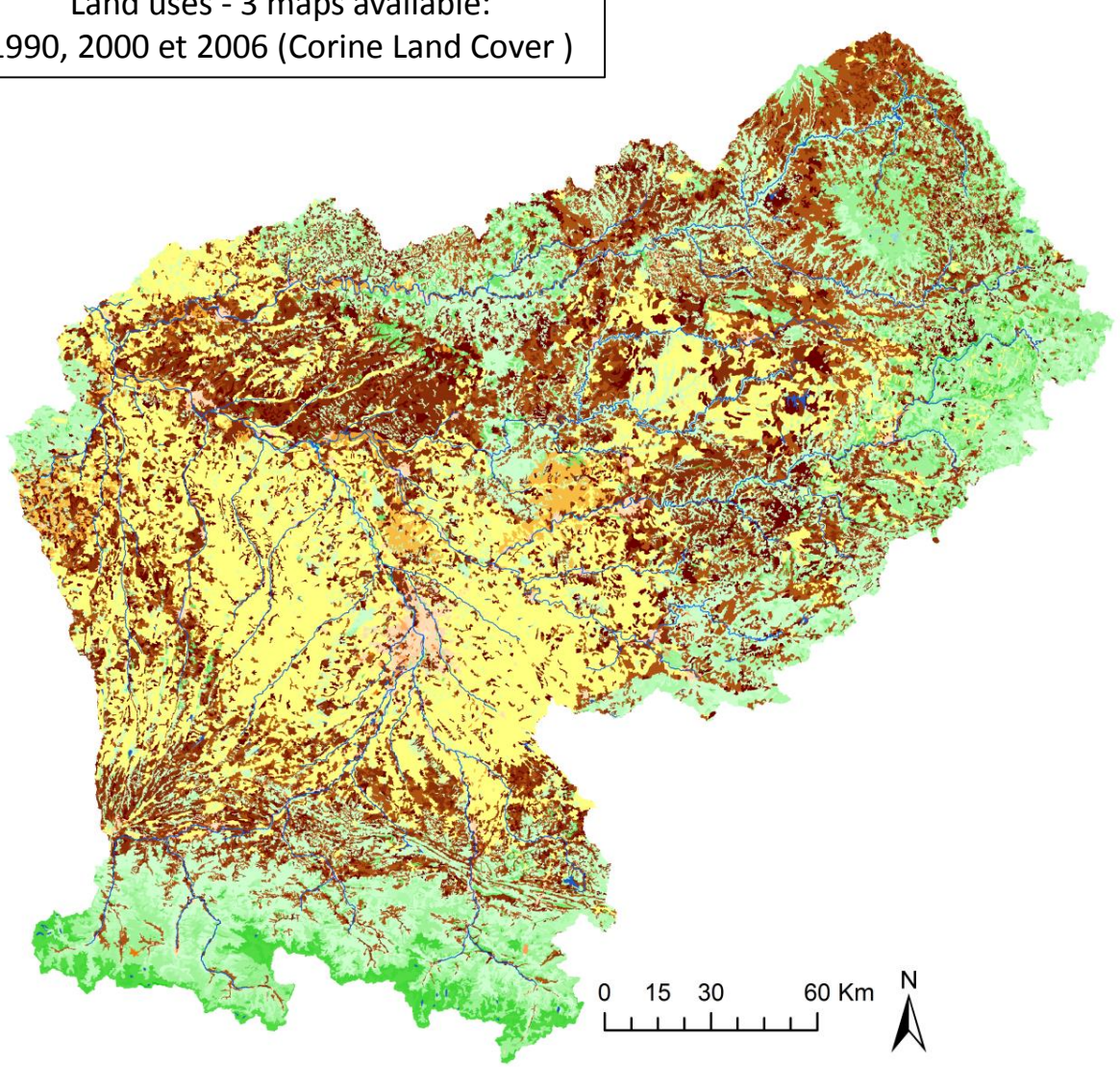
0 15 30 60 Km

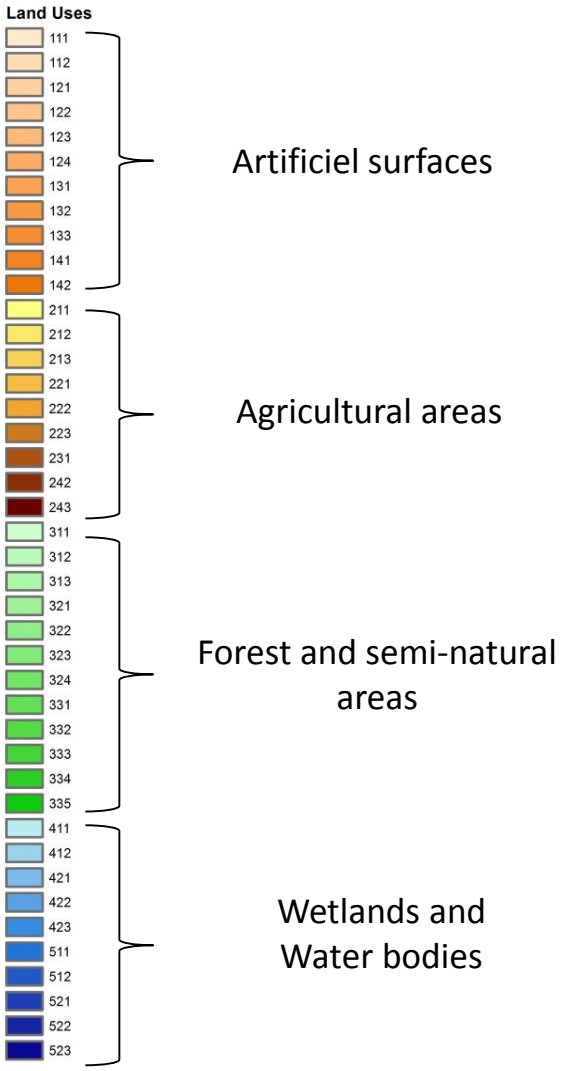
N

Garonne watershed at Tonneins :
45 000 km²

Garonne river subwatershed and model setup

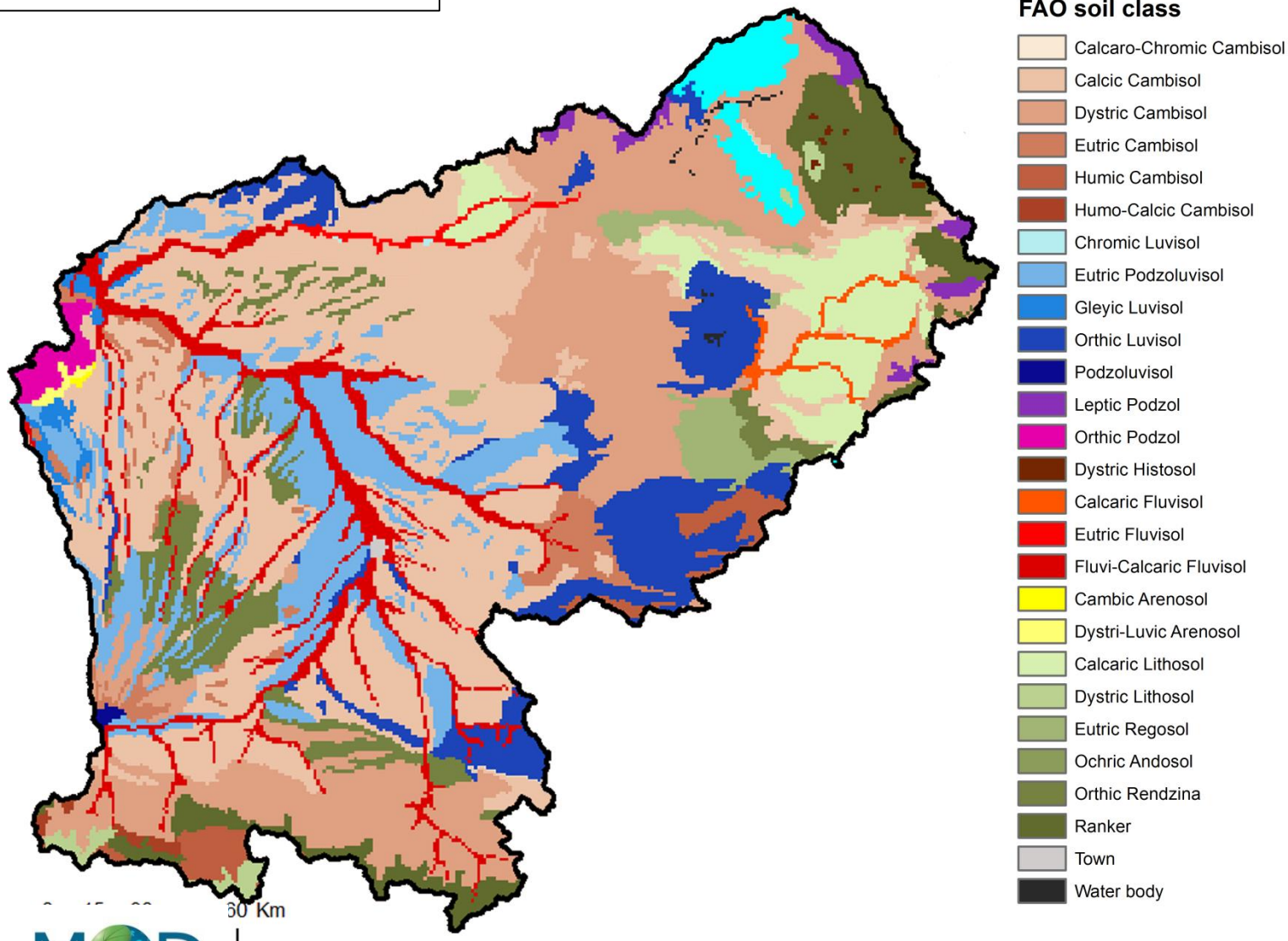
Land uses - 3 maps available:
1990, 2000 et 2006 (Corine Land Cover)





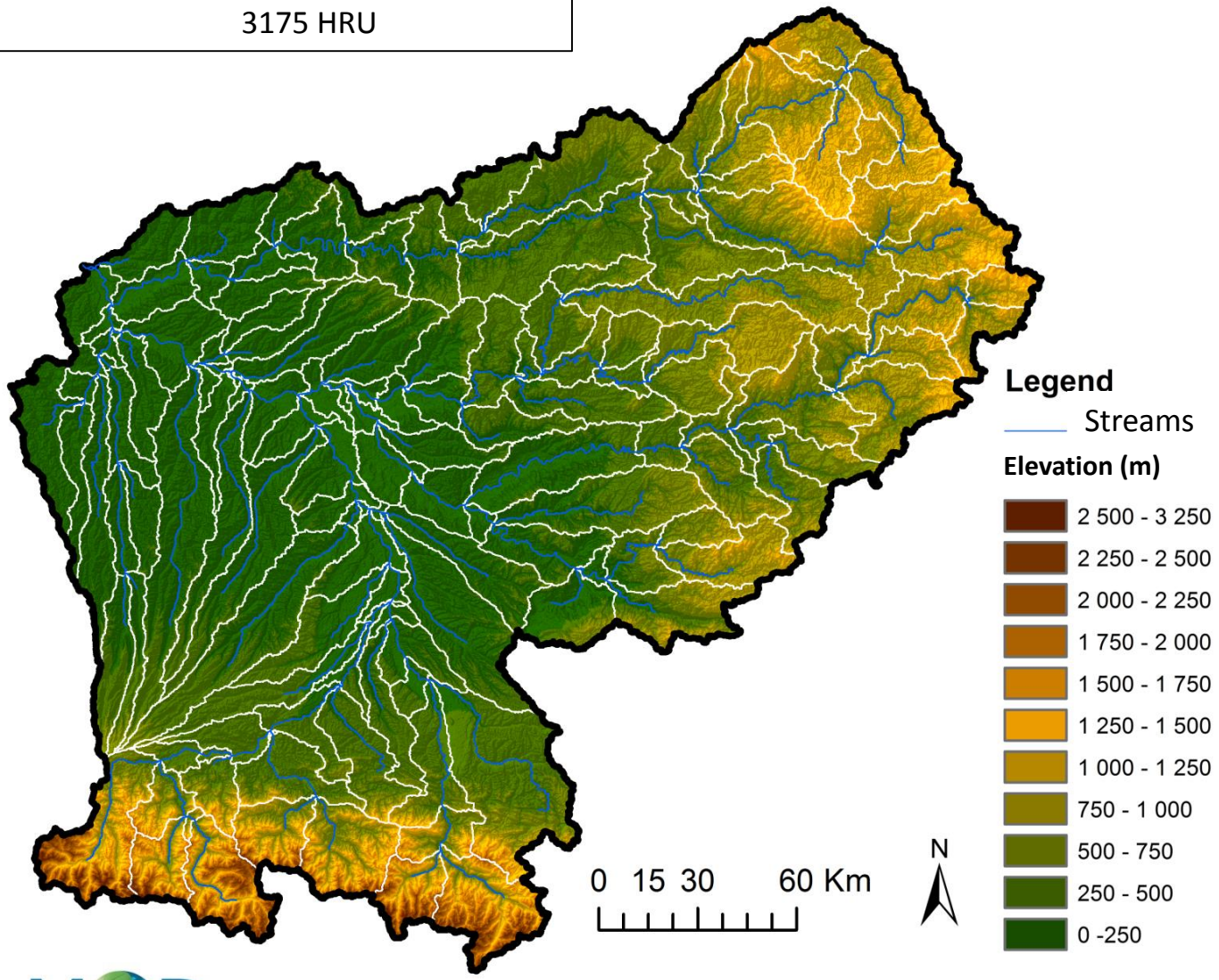
Garonne river subwatershed and model setup

Soil : FAO map 1/1 000 000



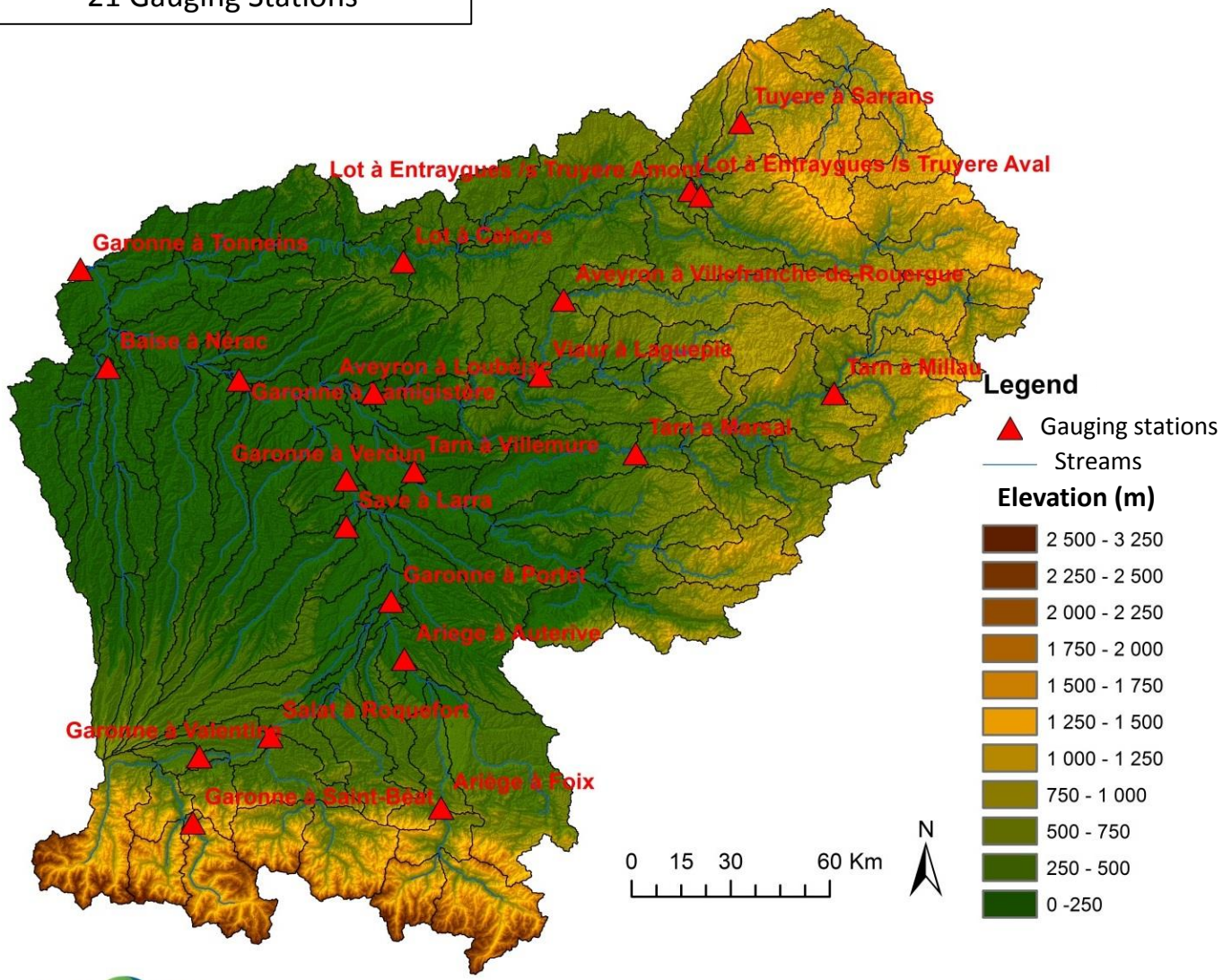
Garonne river subwatershed and model setup

Set-up: 150 Subbasins
3175 HRU



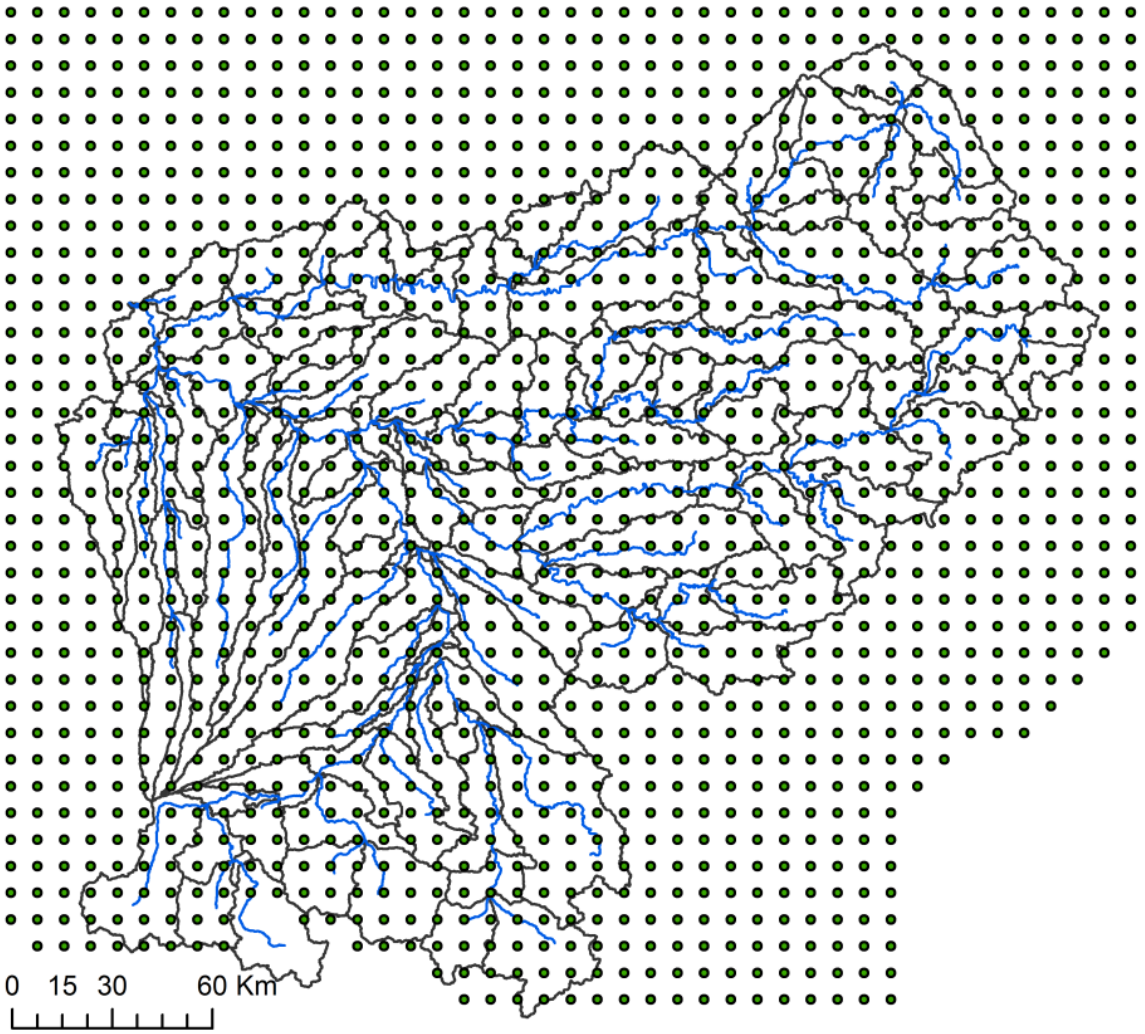
Garonne river subwatershed and model setup

21 Gauging Stations



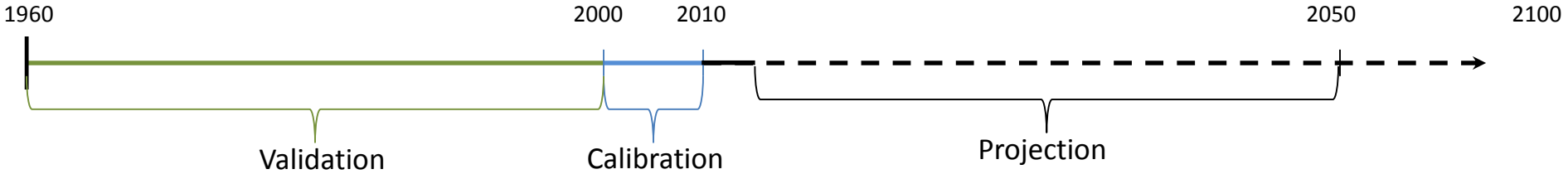
Garonne river subwatershed and model setup

Météo : SAFRAN GRID
8 x 8km,
Daily time step from 1958

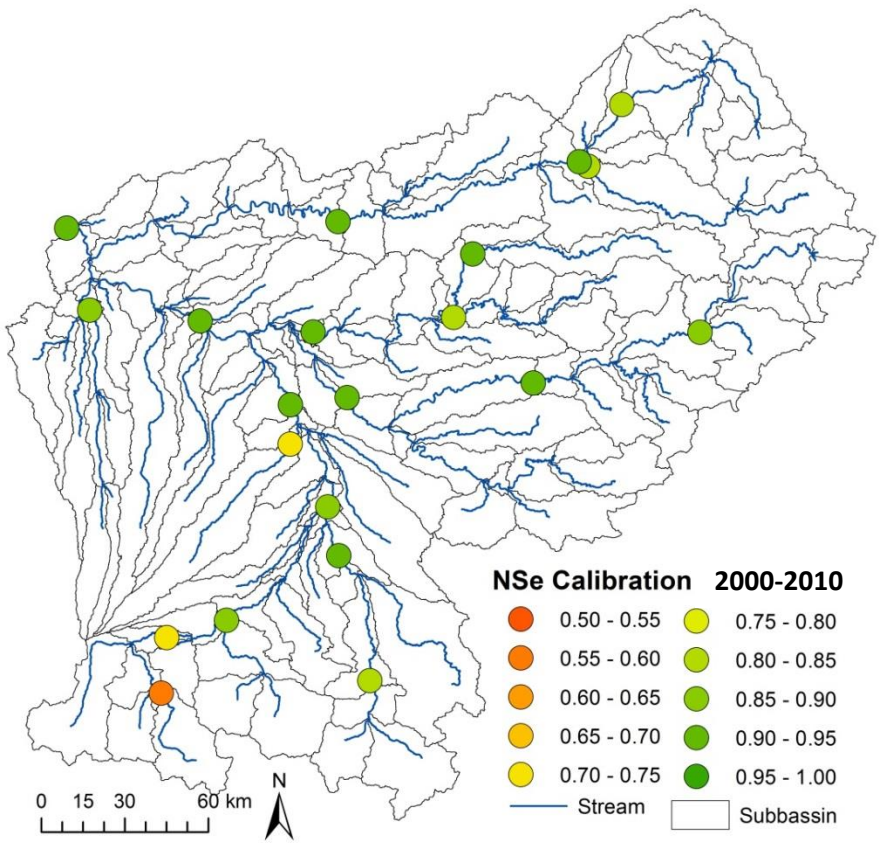


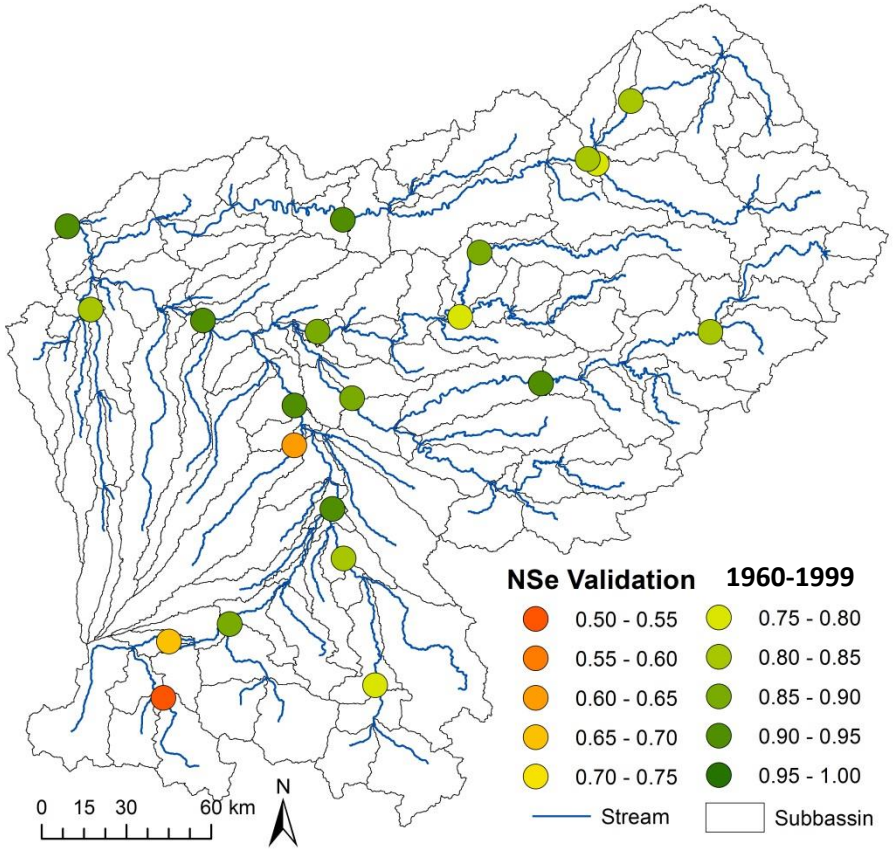
First results : 1960 - 2010

Standard Calibration/Validation process:

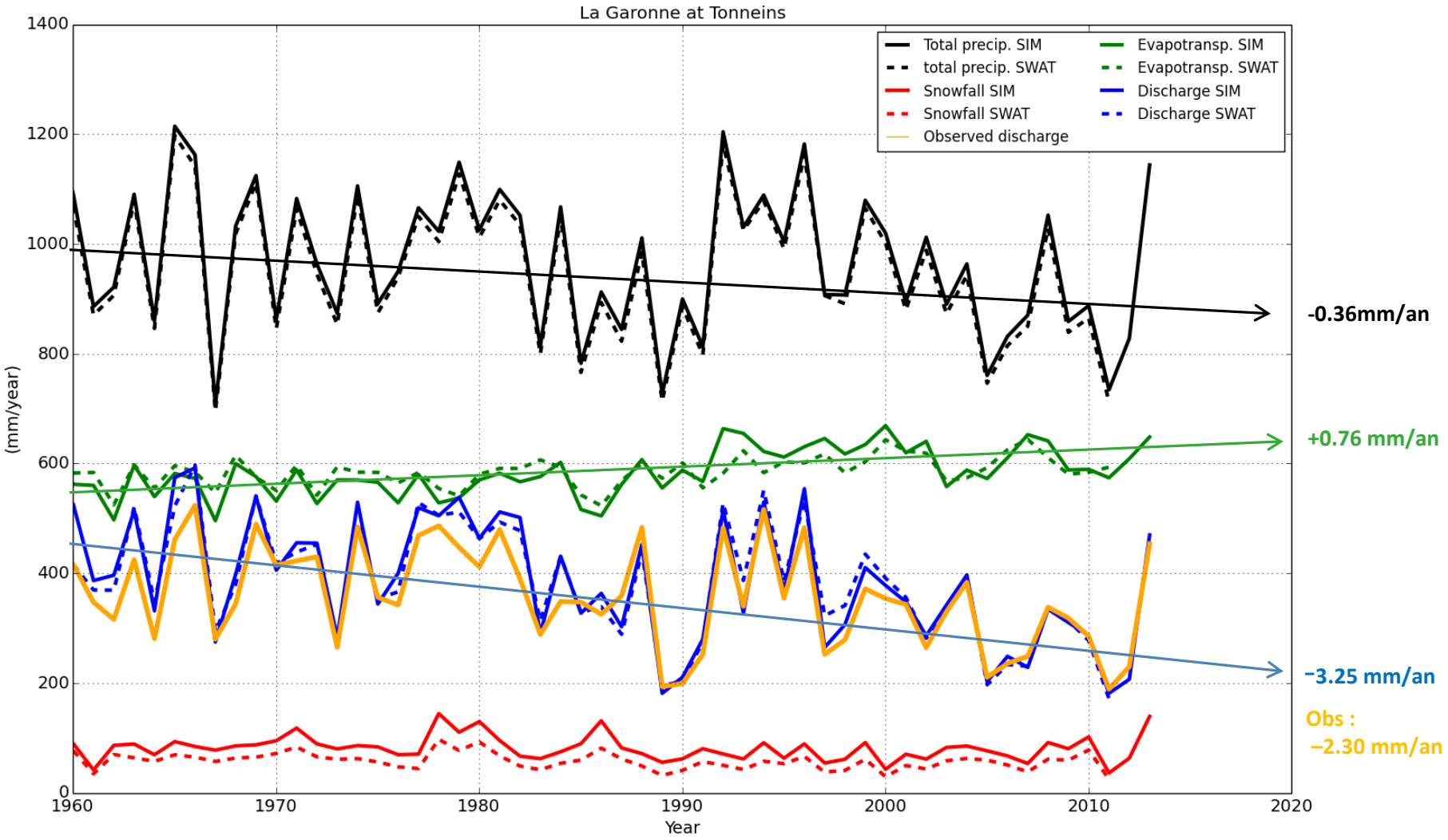


First results : 1960 - 2010





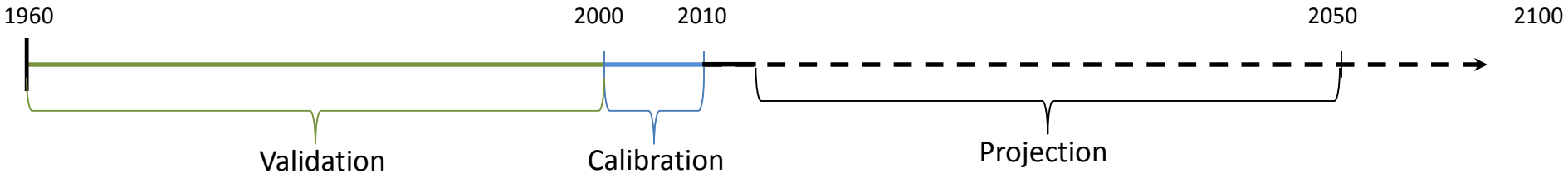
First results : 1960 - 2010



Martin E. et al. *Hydrological modelling in highly anthropized basins: examples from the Garonne basin* Geophysics Surveys-Submitted

Why test the temporal transposability?

- Sensibility to climate evolution?
- Sensibility to land uses evolution?

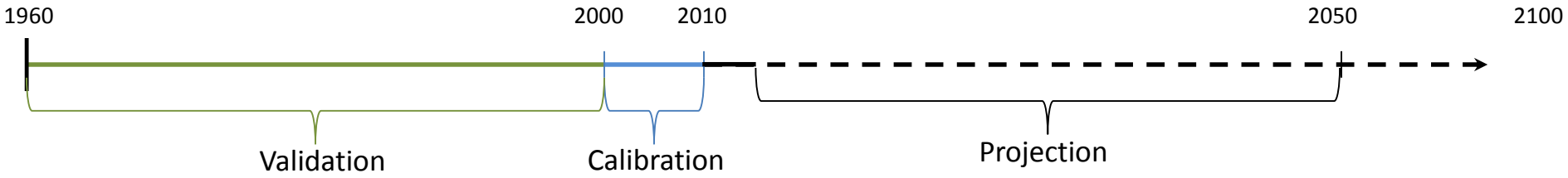


Temporal transposability

→ Sensibility to climate evolution?

Differential Split Sampling Test (DSST)

Klemeš, V. (1986) : Operational Testing of Hydrological Simulation-Models



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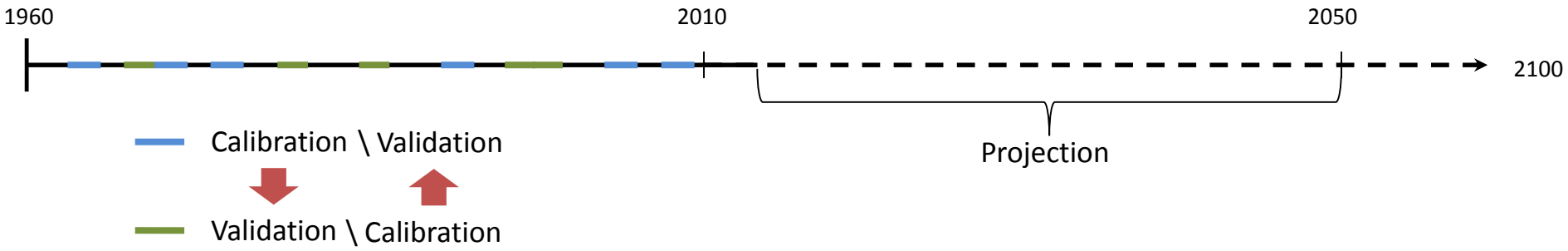


→ Test the robustness of the model under changing conditions

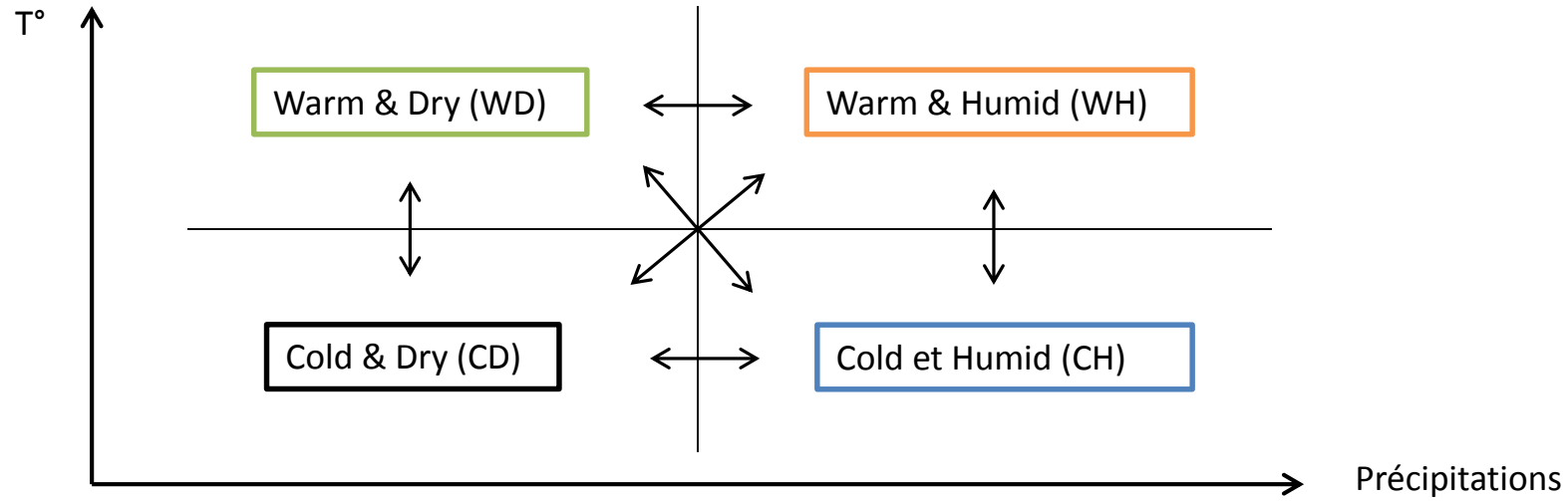
Temporal transposability

→ Sensibility to climate evolution?

Differential Split Sampling Test (DSST)

Klemeš, V. (1986) : Operational Testing of Hydrological Simulation-Models

Seiller, G.(2012) : Multimodel evaluation of twenty lumped hydrological models under contrasted climate conditions



→ Good knowledge of the catchment from historical data and consensus on future trends

Temporal transposability

→ Sensibility to climate evolution?

Differential Split Sampling Test (DSST)

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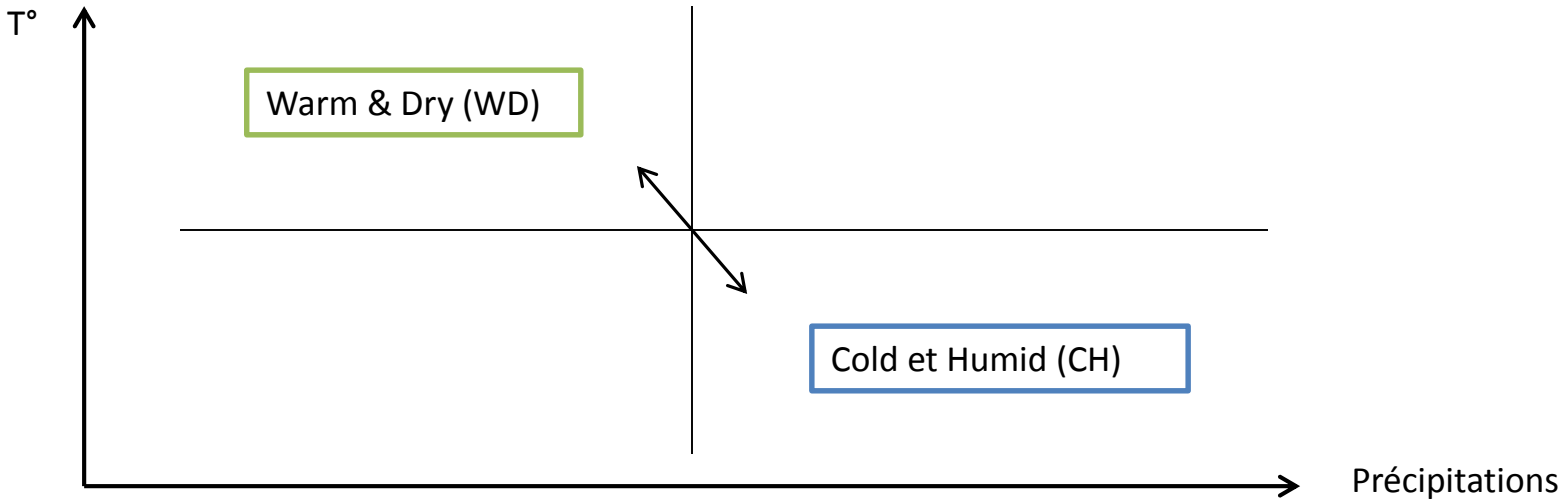
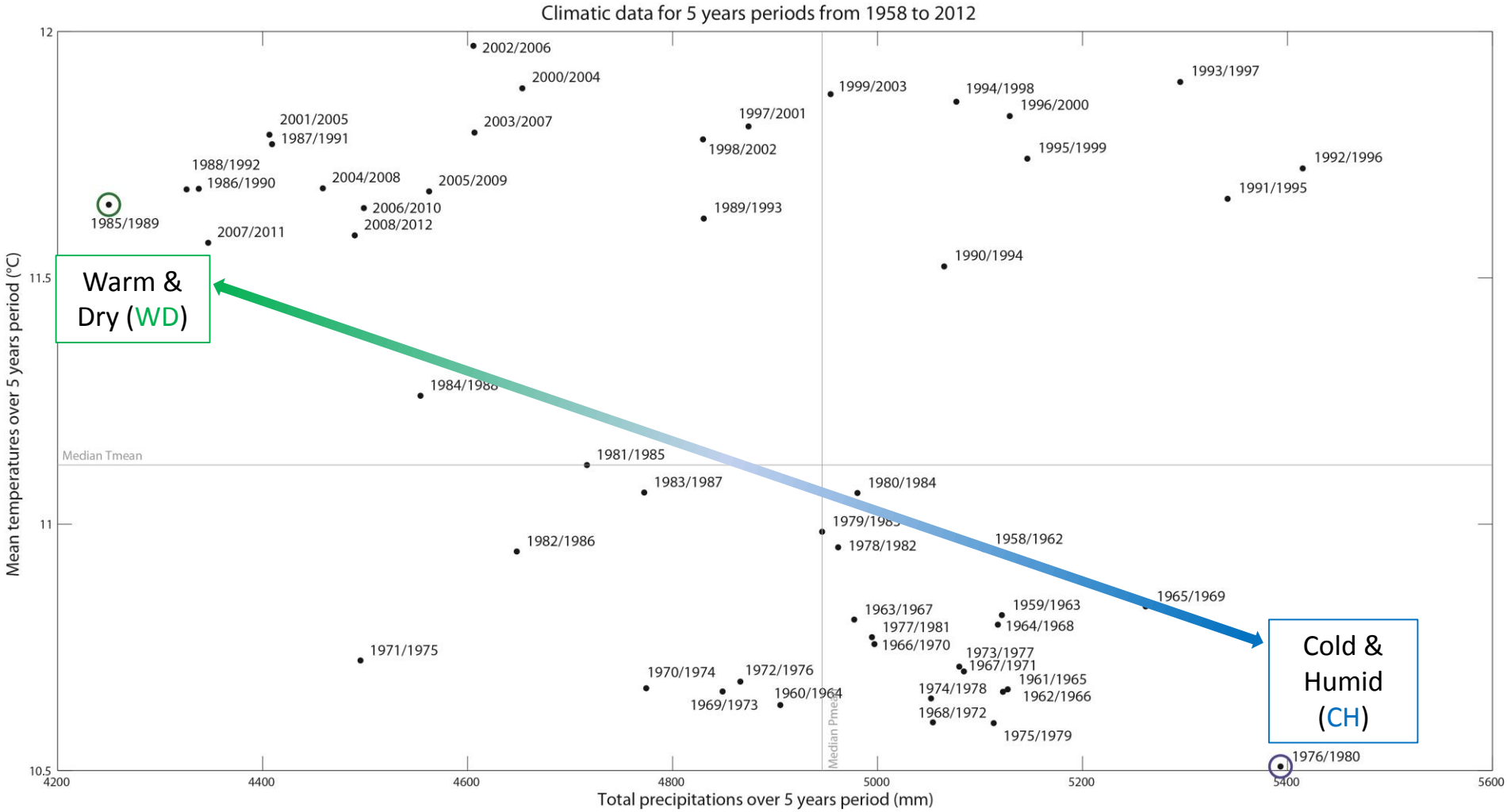


→ Good knowledge of the catchment from historical data and consensus on future trends

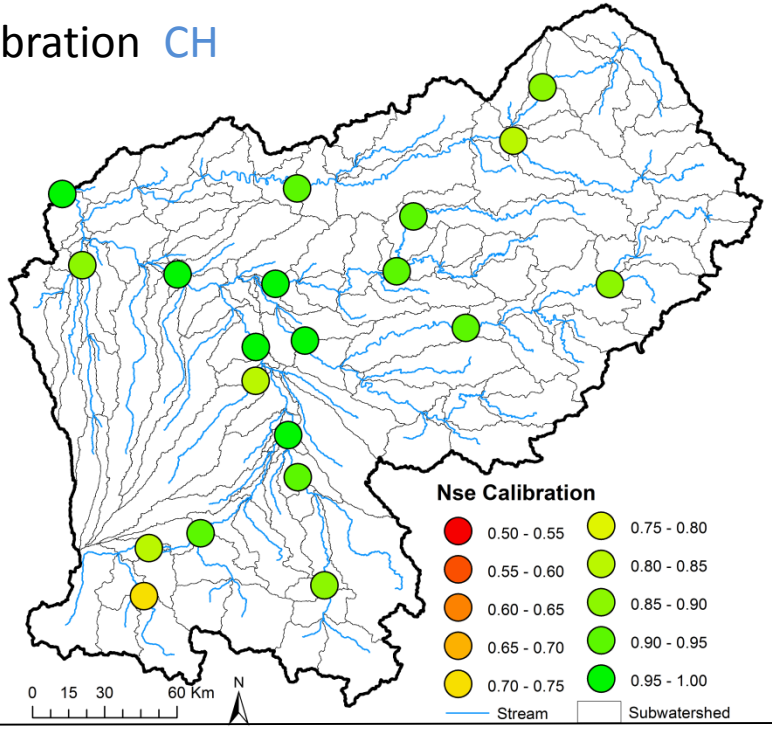
→ Calibration is time consuming over 60 years period

Temporal transposability

Sensibility to climate evolution?

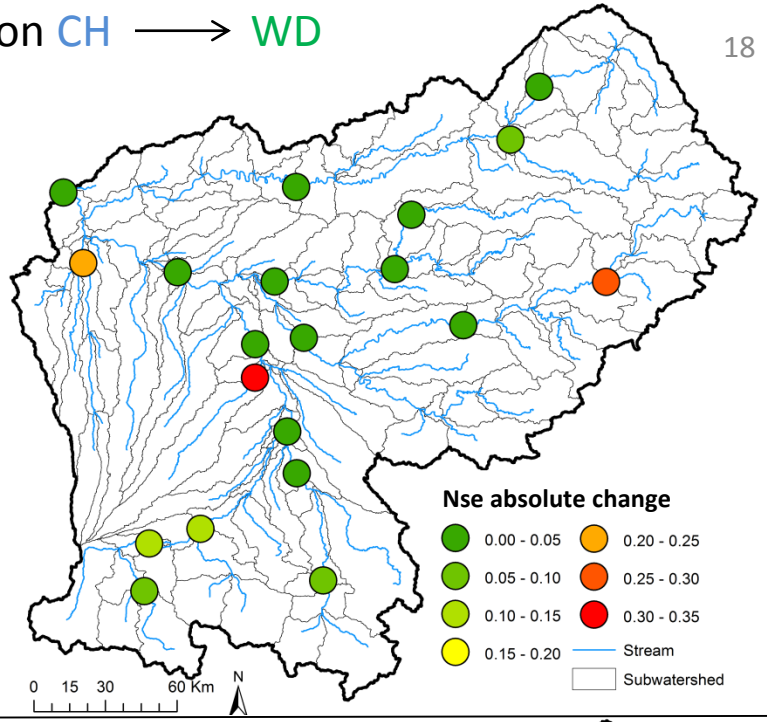


Calibration CH

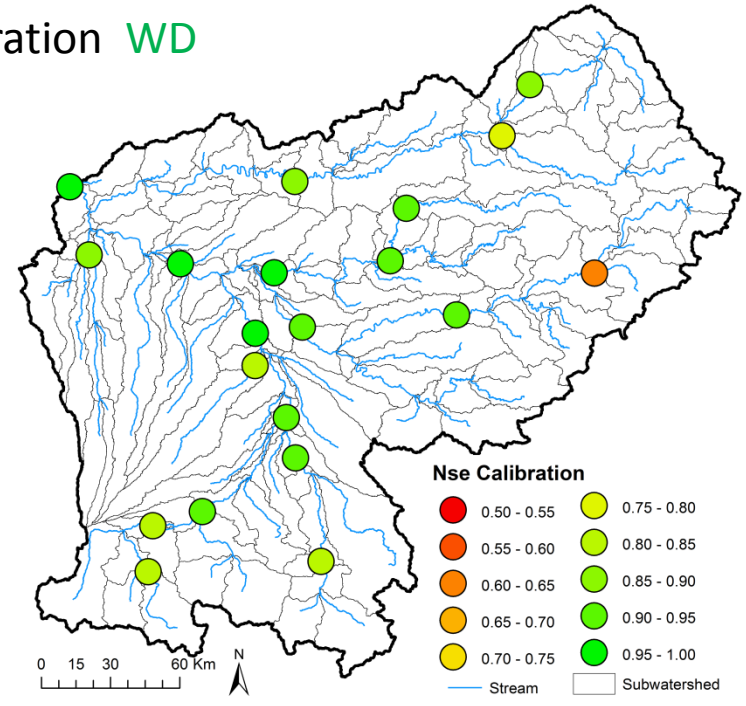


Validation CH ⟶ WD

ΔNse



Calibration WD



Validation WD ⟶ CH

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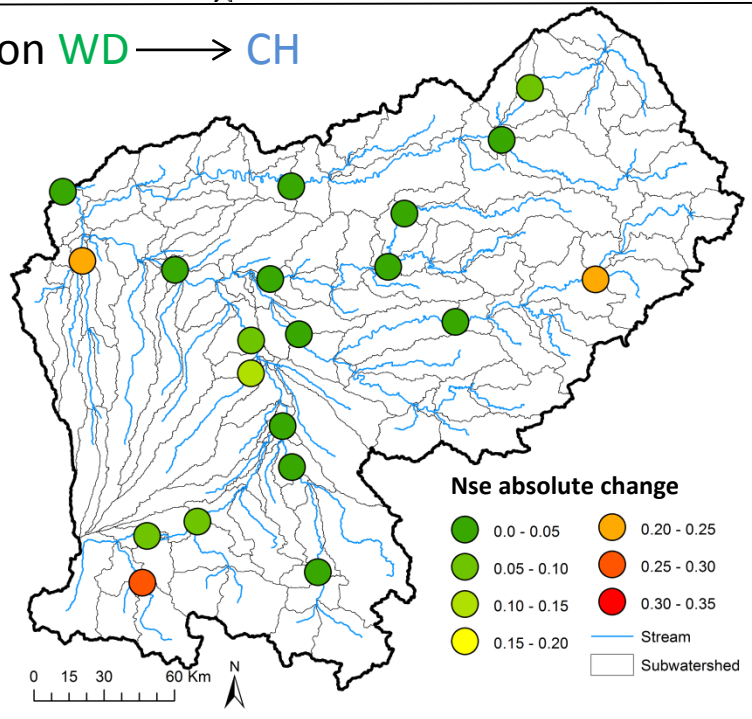
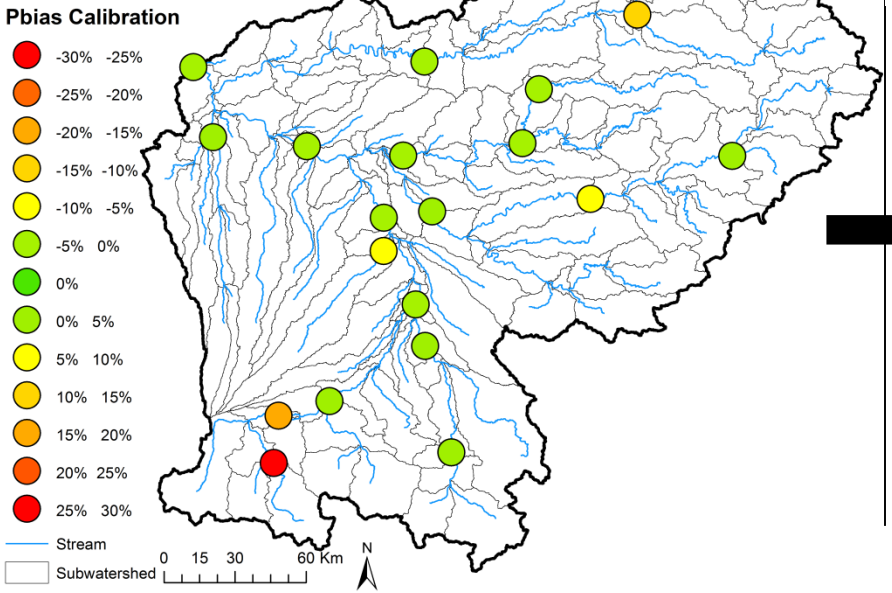
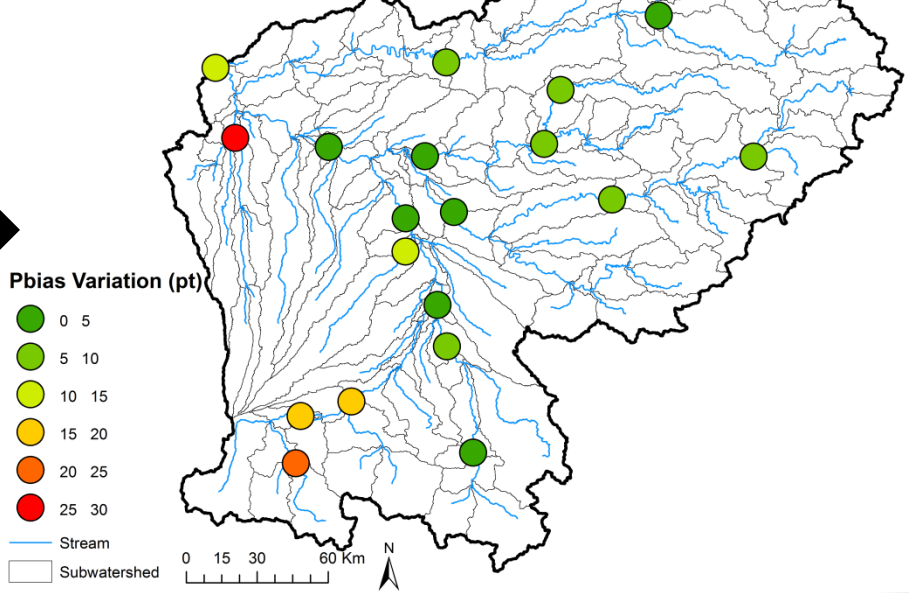


Calibration CH

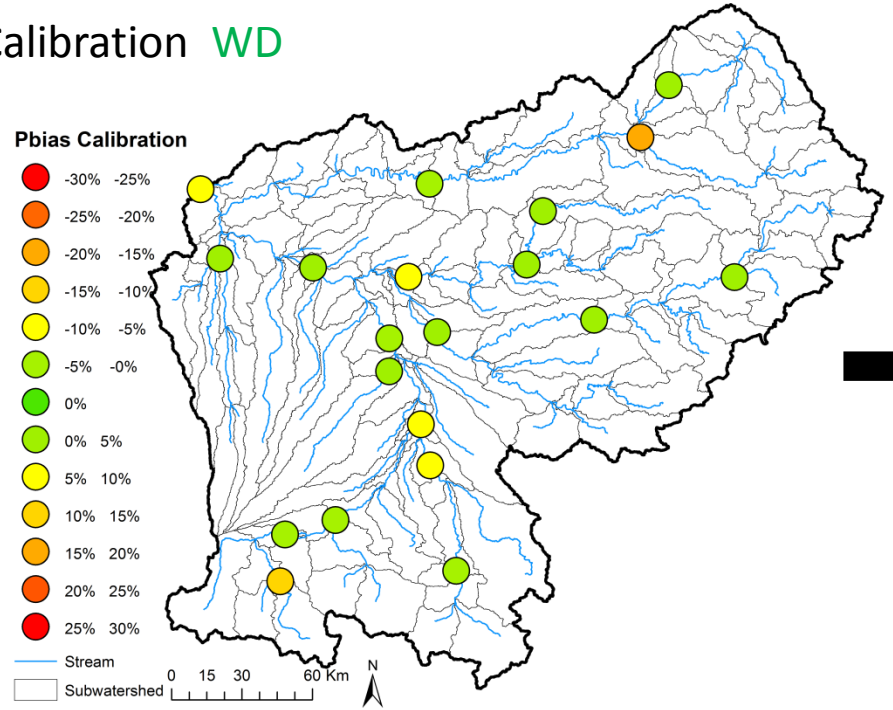


Validation CH ⟶ WD

ΔPbias

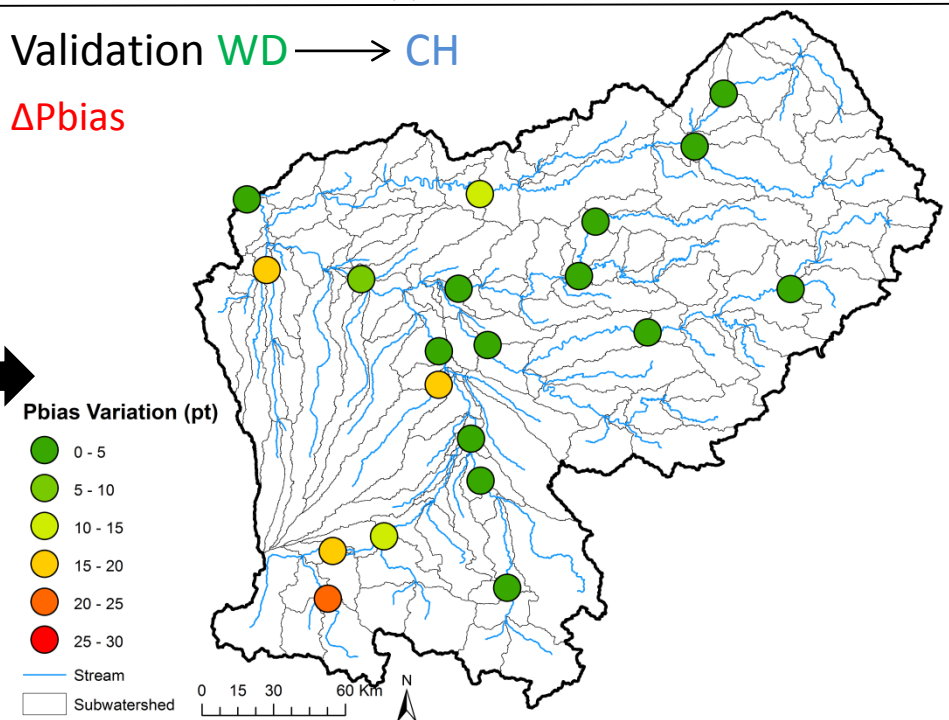


Calibration WD



Validation WD ⟶ CH

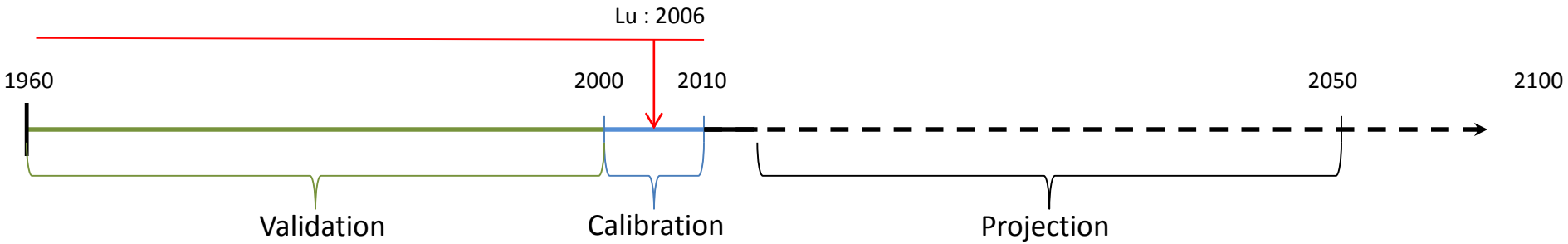
ΔPbias



Temporal transposability

→ Sensibility to land uses evolution?

↳ *Differential Split Sampling Test* apply to Land use evolution.



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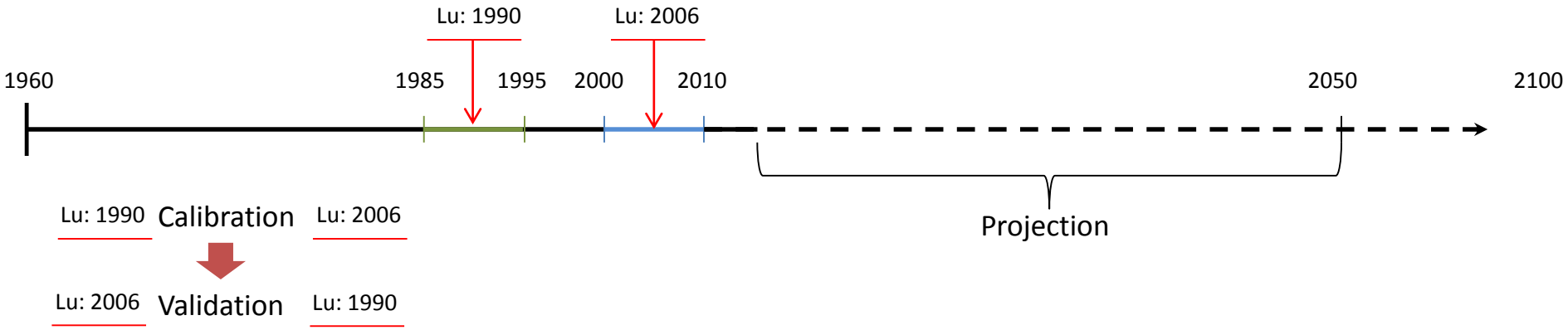
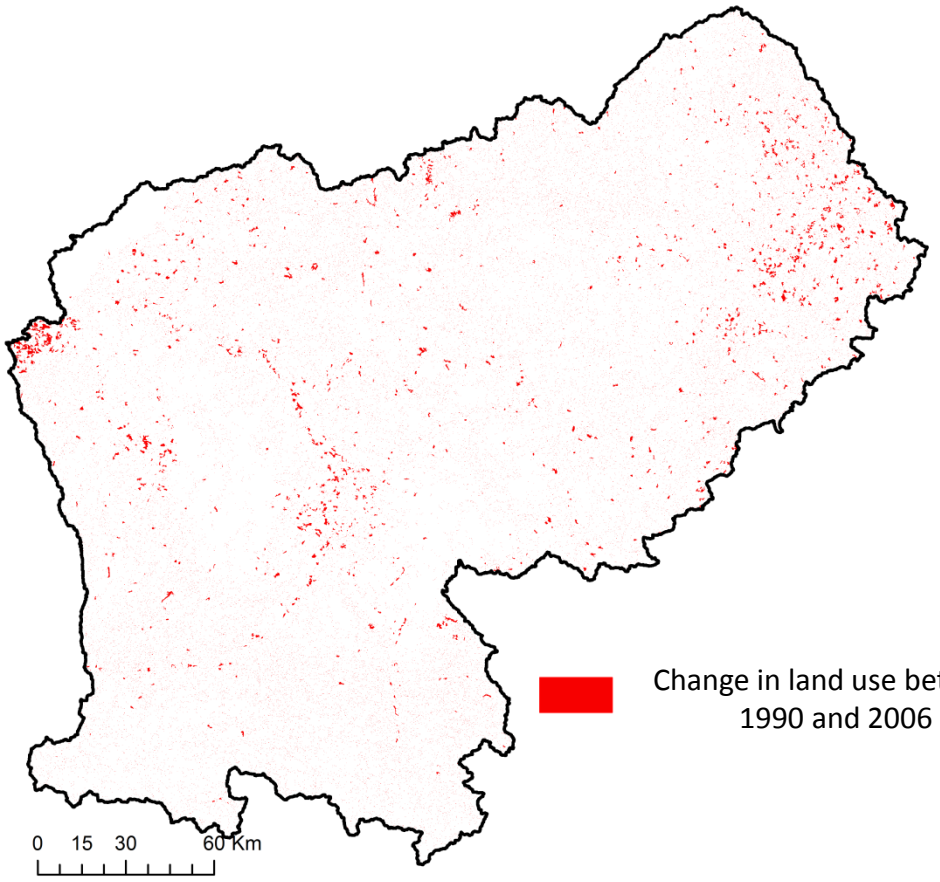


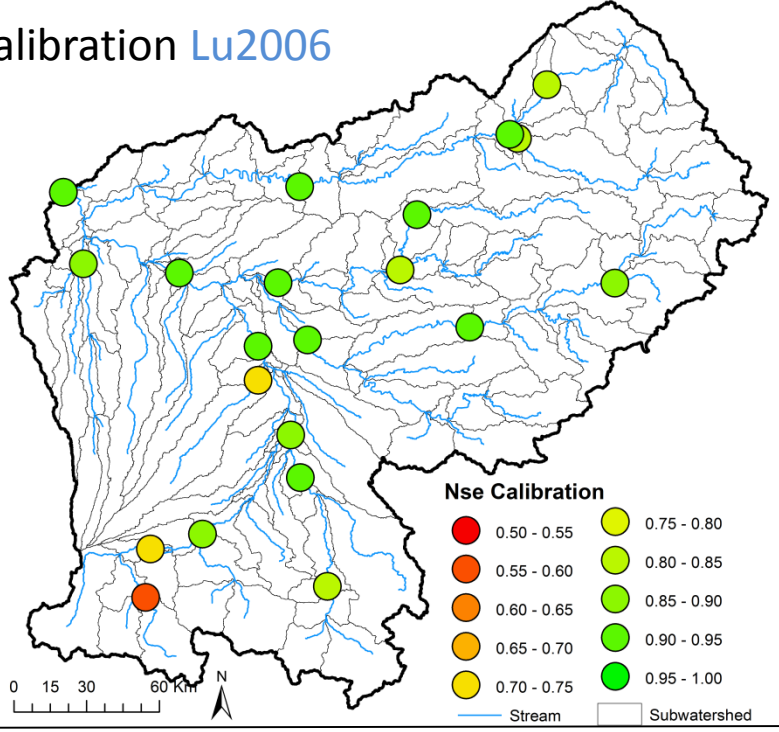
Temporal transposability



- Land use map from 1990 and 2006
- Changes : 1% of surface
- Homogeneous geographical distribution

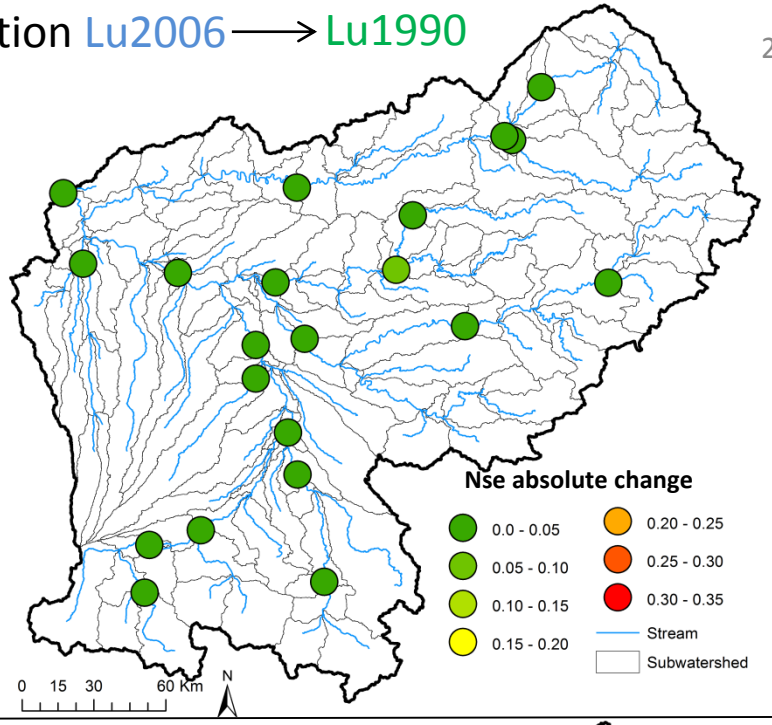
+9381 ha	Artificiel surfaces
-6822 ha	Agricultural areas
-3656 ha	Forest and semi-natural areas
+ 1096 ha	Wetlands and Water bodies

Calibration Lu2006

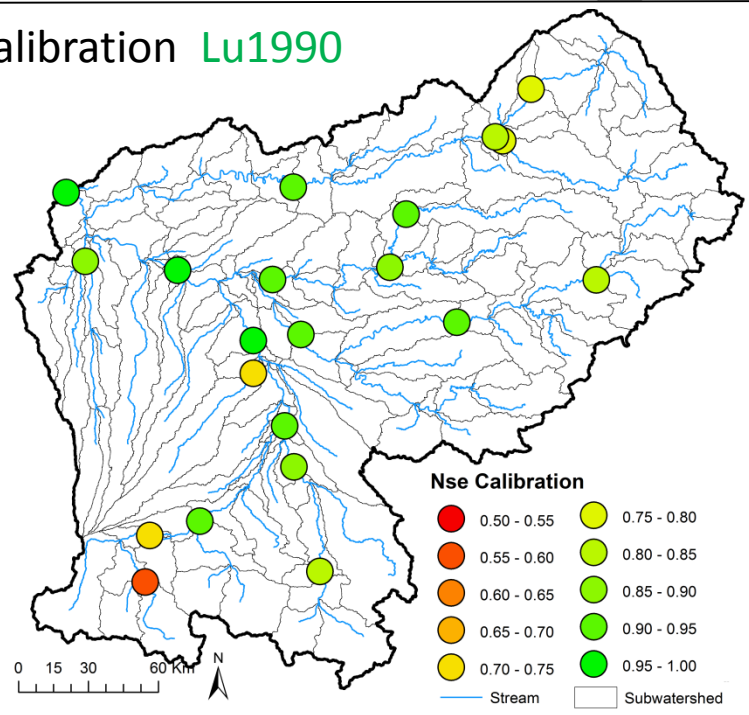


Validation Lu2006 → Lu1990

ΔNse

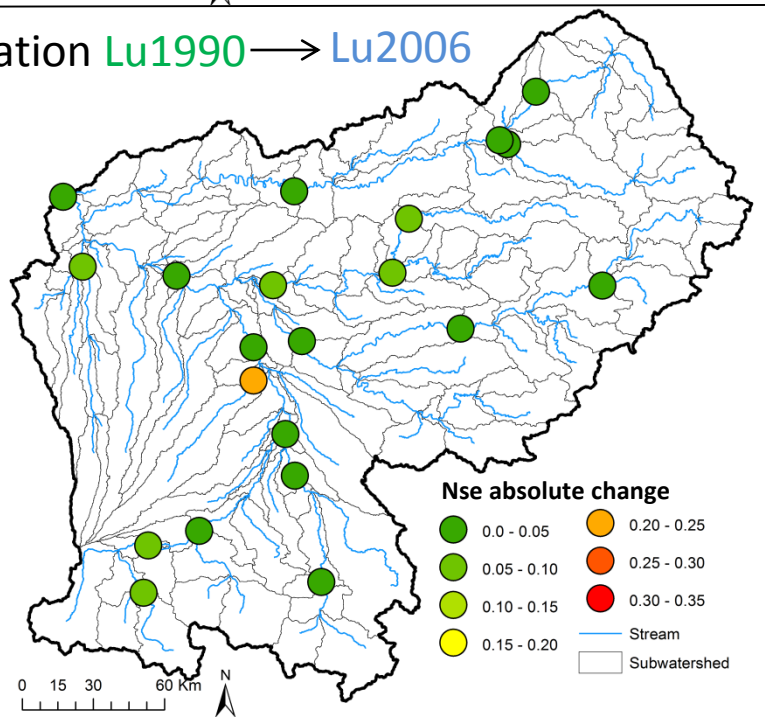


Calibration Lu1990

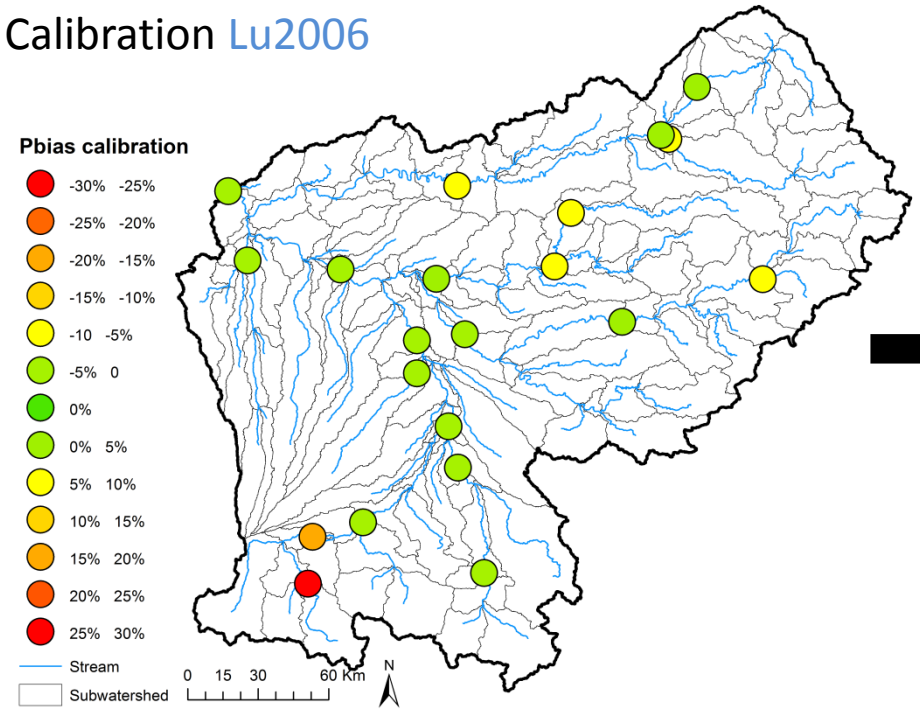


Validation Lu1990 → Lu2006

ΔNse

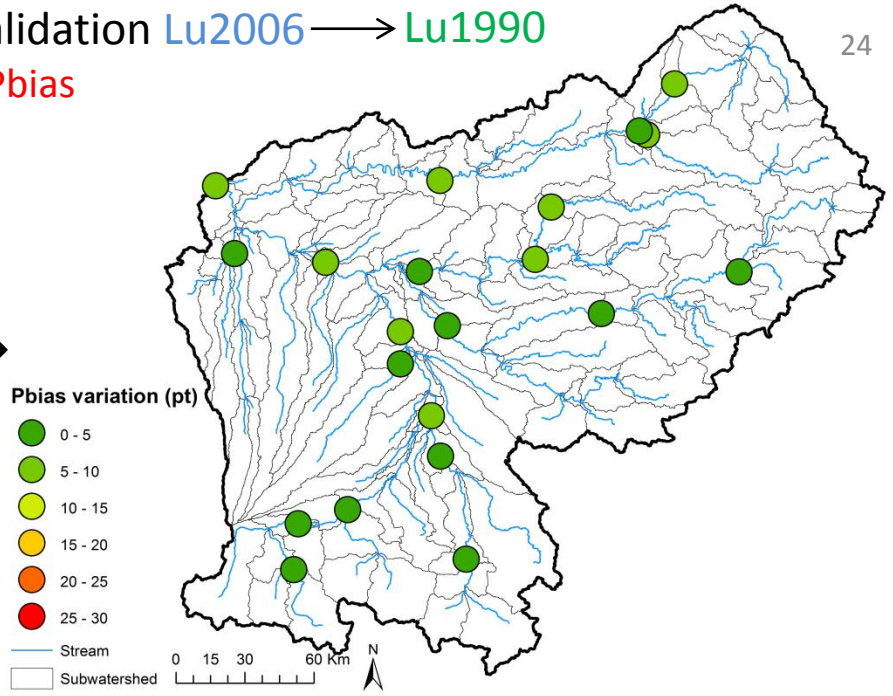


Calibration Lu2006

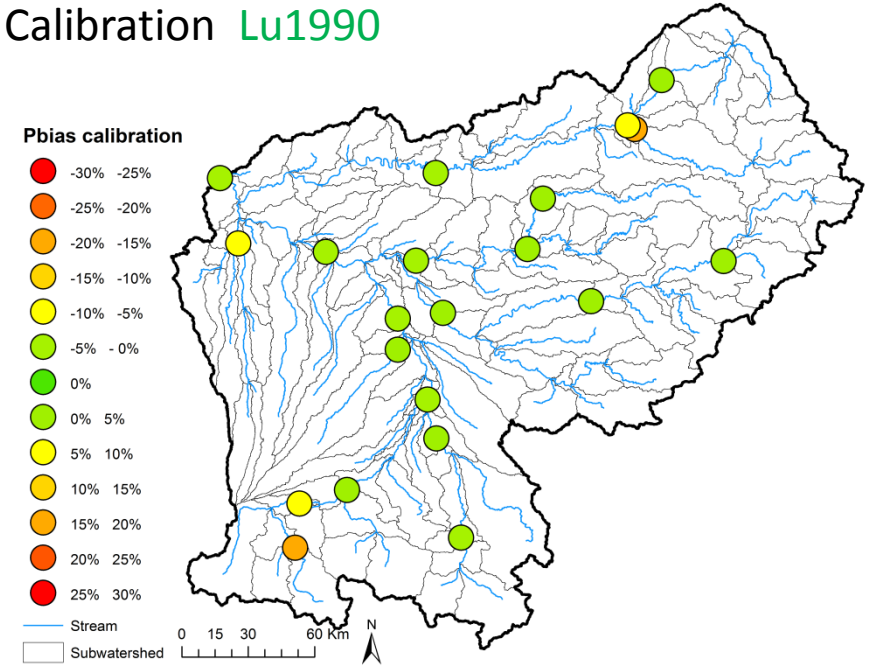


Validation Lu2006 → Lu1990

ΔPbias

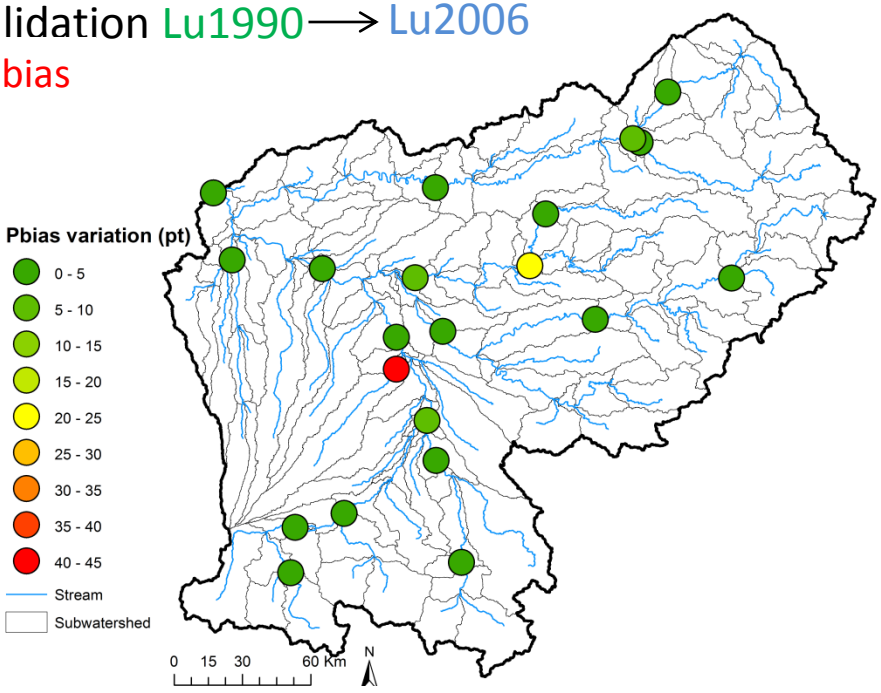


Calibration Lu1990



Validation Lu1990 → Lu2006

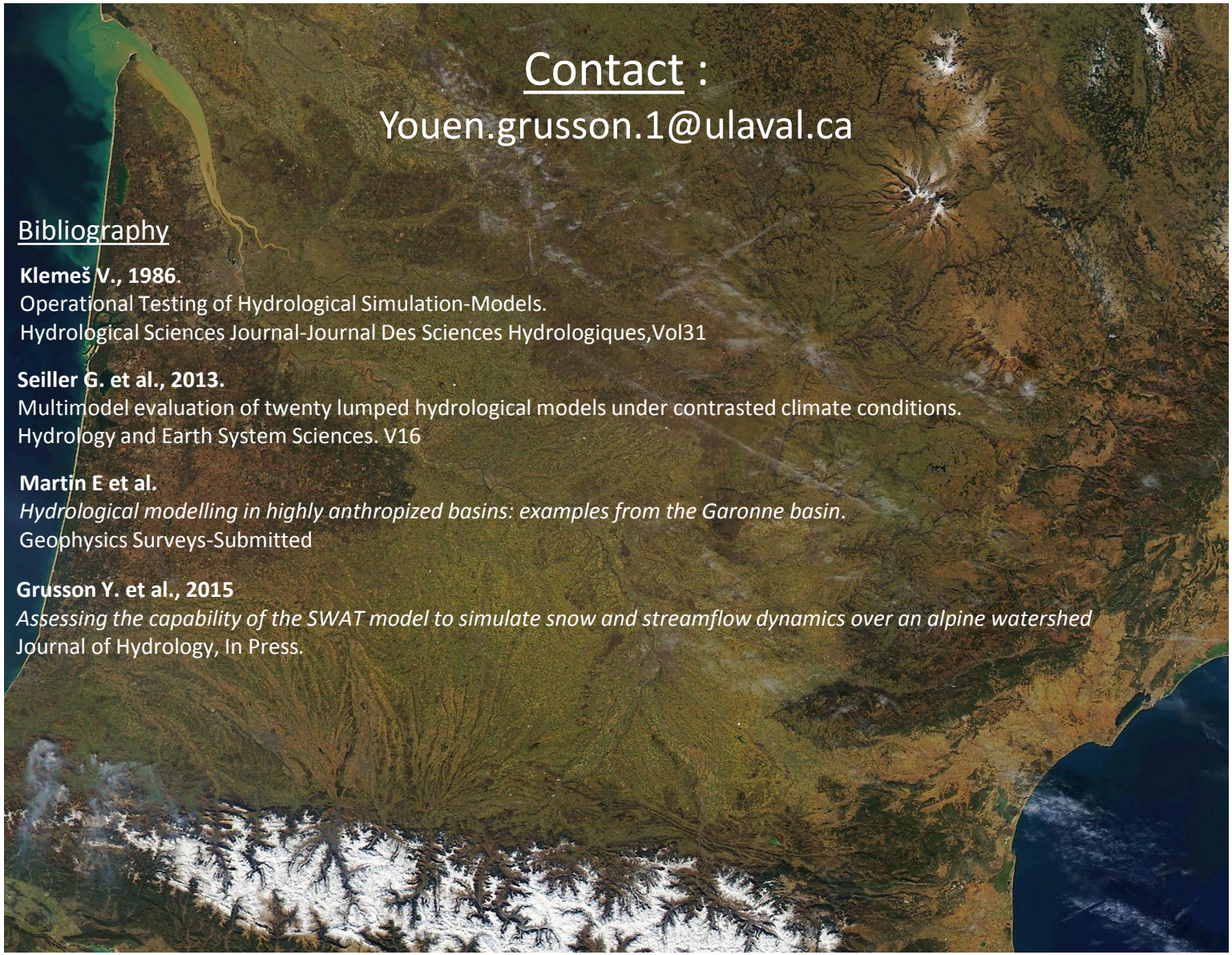
ΔPbias



Conclusions

- Relatively good stability of the model facing changes in climate conditions over the watershed.
- Good stability of the model facing land uses changes over a 16 years period.
- Good alternative to Land uses scenarios for studies in CC context, over watersheds where land uses changes are not very important.
- Main observed instabilities are caused by the anthropogenic activities and in snow dominated subbasins.
- Comparison of first results over a 50 years periods with the SAFRAN-ISBA-MODCOU model are promising for future climate changes projection analysis.

Thank You



Contact :

Youen.grusson.1@ulaval.ca

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Geophysics Surveys-Submitted

Grusson Y. et al., 2015
Assessing the capability of the SWAT model to simulate snow and streamflow dynamics over an alpine watershed
Journal of Hydrology, In Press.

ANNEX

	Periode de calibration	Periode de validation	Nse calibration	Nse validation	R^2 calibration	R^2 validation	Pbias calibration	Pbias validation
Saint Béat	2000-2010	1971-1999	0.60	0.53	0.89	0.69	-29.20	-24.05
Valentine	2000-2010	1960-1999	0.74	0.69	0.90	0.87	-16.68	-12.69
Roquefort	2000-2010	1960-1999	0.87	0.88	0.94	0.94	-4.81	0.82
Foix	2000-2010	1960-1999	0.80	0.79	0.90	0.90	-2.26	4.88
Auterive	2000-2010	1966-1999	0.90	0.82	0.95	0.87	-1.59	9.83
Portet	2000-2010	1960-1999	0.90	0.91	0.95	0.95	-1.98	-4.13
Larra	2000-2010	1965-1999	0.74	0.64	0.87	0.78	-1.04	-17.50
Verdun	2000-2010	1972-1999	0.92	0.92	0.96	0.81	-3.94	-3.96
Millau	2000-2010	1969-1999	0.89	0.84	0.95	0.85	6.76	-5.44
Marsal	2000-2010	1960-1999	0.95	0.92	0.97	0.96	4.24	2.08
Villemure	2000-2010	1970-1999	0.93	0.88	0.97	0.77	-4.83	10.13
Villefranche	2000-2010	1961-1999	0.90	0.87	0.97	0.94	5.68	4.74
Laguepie	2000-2010	1960-1999	0.83	0.79	0.92	0.90	-7.12	-9.98
Loubejac	2000-2010	1960-1999	0.93	0.85	0.97	0.92	4.27	0.25
Lamagistère	2000-2010	1967-1999	0.95	0.93	0.98	0.88	-2.92	-1.41
Sarran	2000-2010	1960-1999	0.83	0.84	0.91	0.92	1.61	8.13
Truyère amont	2000-2010	1972-1999	0.81	0.79	0.91	0.75	-6.41	-14.49
Truyère Aval	2000-2010	1979-1999	0.91	0.81	0.95	0.64	3.51	9.61
Cahors	2000-2010	1960-1999	0.93	0.91	0.97	0.95	7.33	-2.44
Nerac	2000-2010	1965-1999	0.87	0.81	0.94	0.84	-0.43	-4.52
Tonneins	2000-2010	1960-1999	0.95	0.93	0.97	0.97	-0.96	-4.07

ANNEX

	Variation de surface en Ha
Tissu urbain continu	+8.91
Tissu urbain discontinu	+3881.52
Zones industrielles et commerciales	+2033.1
Réseaux routier et ferroviaire et espaces associés	+477.9
Aéroports	+12.15
Extraction de matériaux	+1282.23
Décharges	0
Chantiers	+1118.61
Espaces verts urbains	-8.1
Équipements sportifs et de loisirs	+575.1

+9381 ha
Artificiel surfaces

Terres arables hors périmètres d'irrigation	-518.4
Vignobles	-9.72
Vergers et petits fruits	-428.49
Prairies	-4774.95
Systèmes culturaux et parcellaires complexes	-3581.01
Surfaces agricole	+2490.75

-6822 ha
Agricultural areas

Forêts de feuillus	+3449.79
Forêts de conifères	-3345.3
Forêts mélangées	+530.55
Pelouses et pâturages naturels	-1935.9
Landes et broussailles	-473.04
Forêt et végétation arbustive en mutation	-1881.63

-3656 ha
Forest and semi-natural areas

Plages, dunes et sable	+0.81
Roches nues	-47.79
Végétation clairsemée	-40.5
Glaciers et neiges éternelles	-3.24
Marais intérieurs	-0.81
Tourbières	-16.2
Cours d'eau et voies d'eau	-6.48
Plans d'eau	+1210.14

+ 1096 ha
Wetlands and Water bodies