Organic carbon and nitrate transfers at a watershed scale with the SWAT+ model using landscape units: application to a large watershed in France

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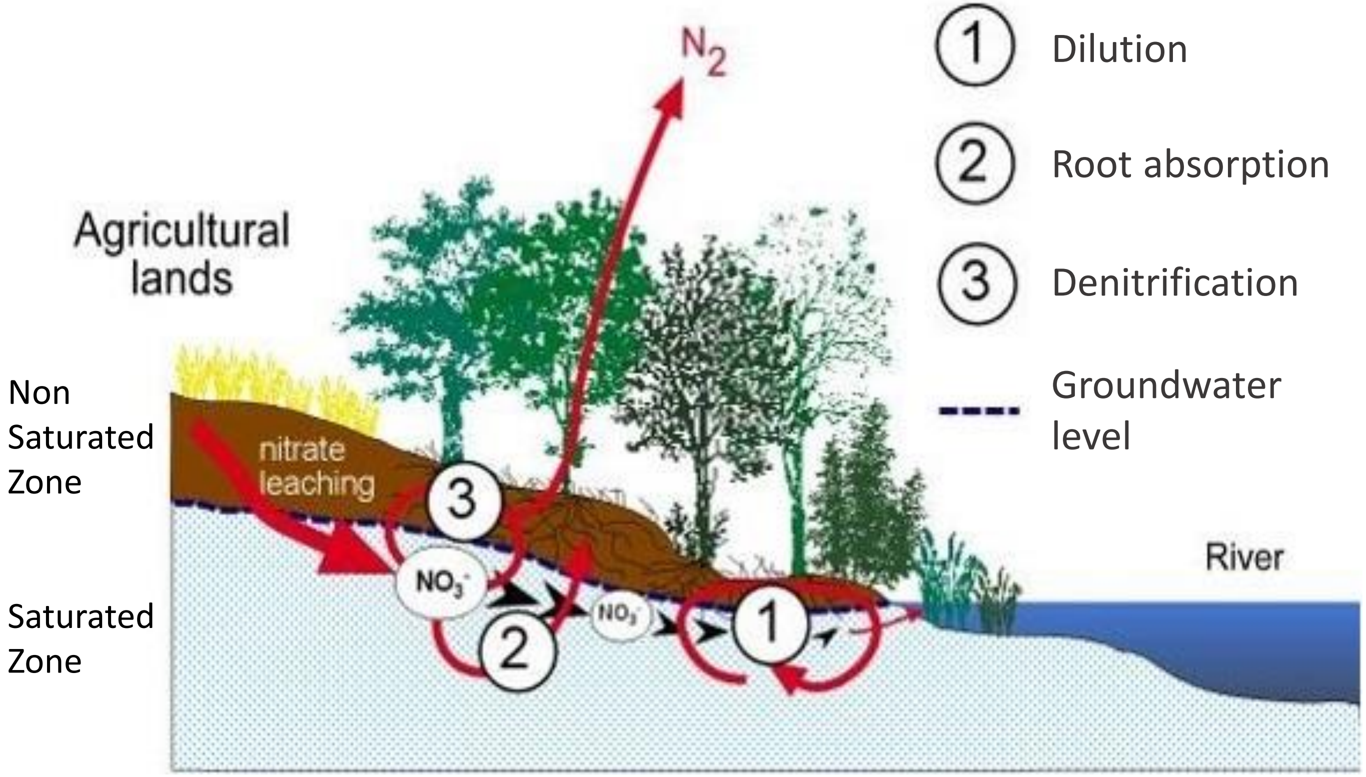
Presented by Clément Fabre

Riparian zones : Powerful water cleaners



$$5(CH_2O) + 4NO_3^- + 4H^+ \rightarrow 5CO_2 + 2N_2 + 7H_2O$$

Riparian zones impacts on the nitrogen cycle
(Pinay et al., 1998 ; Sánchez-Pérez et al., 2003 ; Sun et al., 2015)

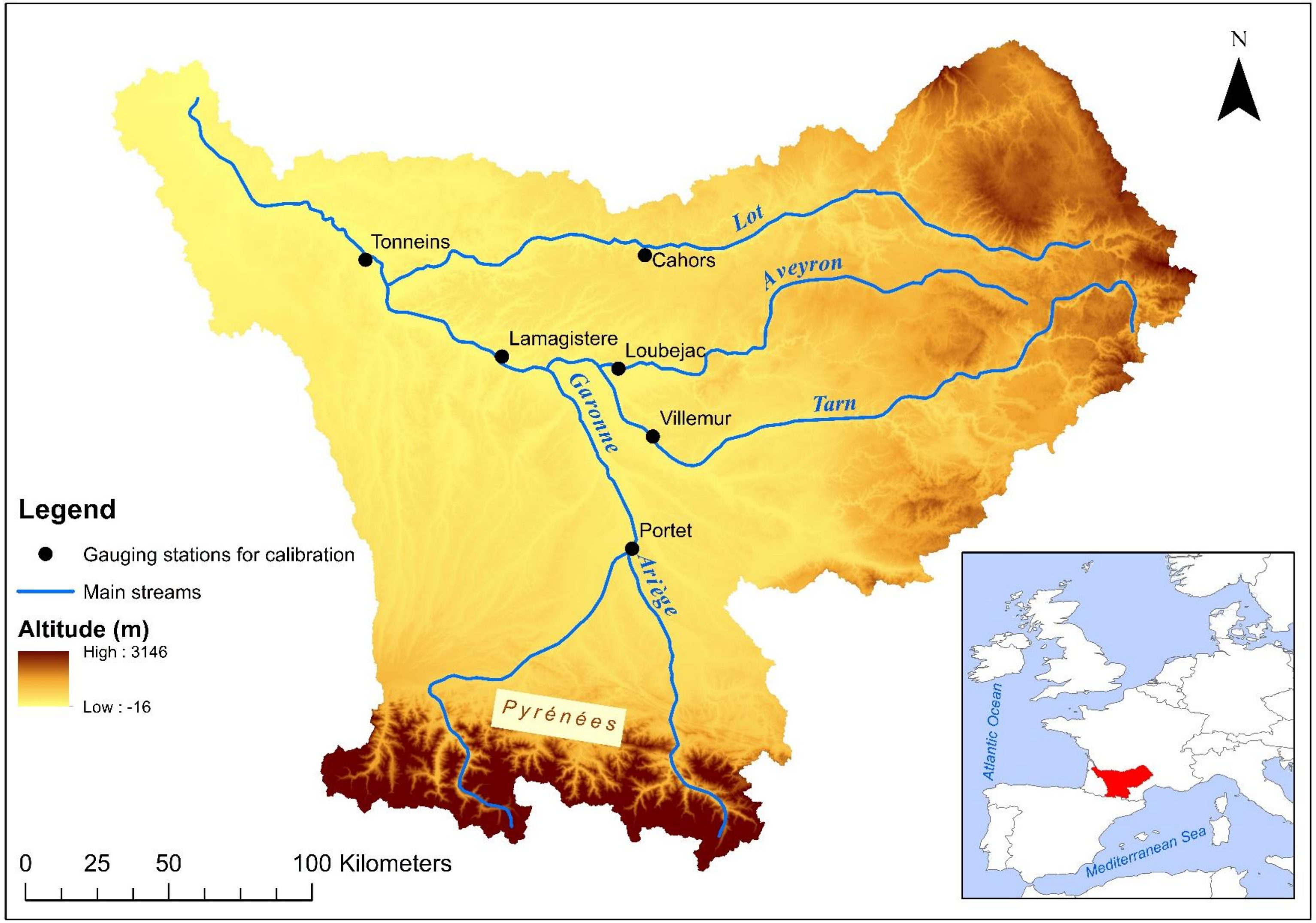
Riparian zones :
40% of nitrates consumed by denitrification at a watershed scale
(Seine : Pacsy et al., Garonne : Sun et al., 2015)

Objectives

- Characterize hotspots of denitrification in the alluvial plain of an agricultural catchment
- Quantify the effect of riparian zones on the nitrogen cycle

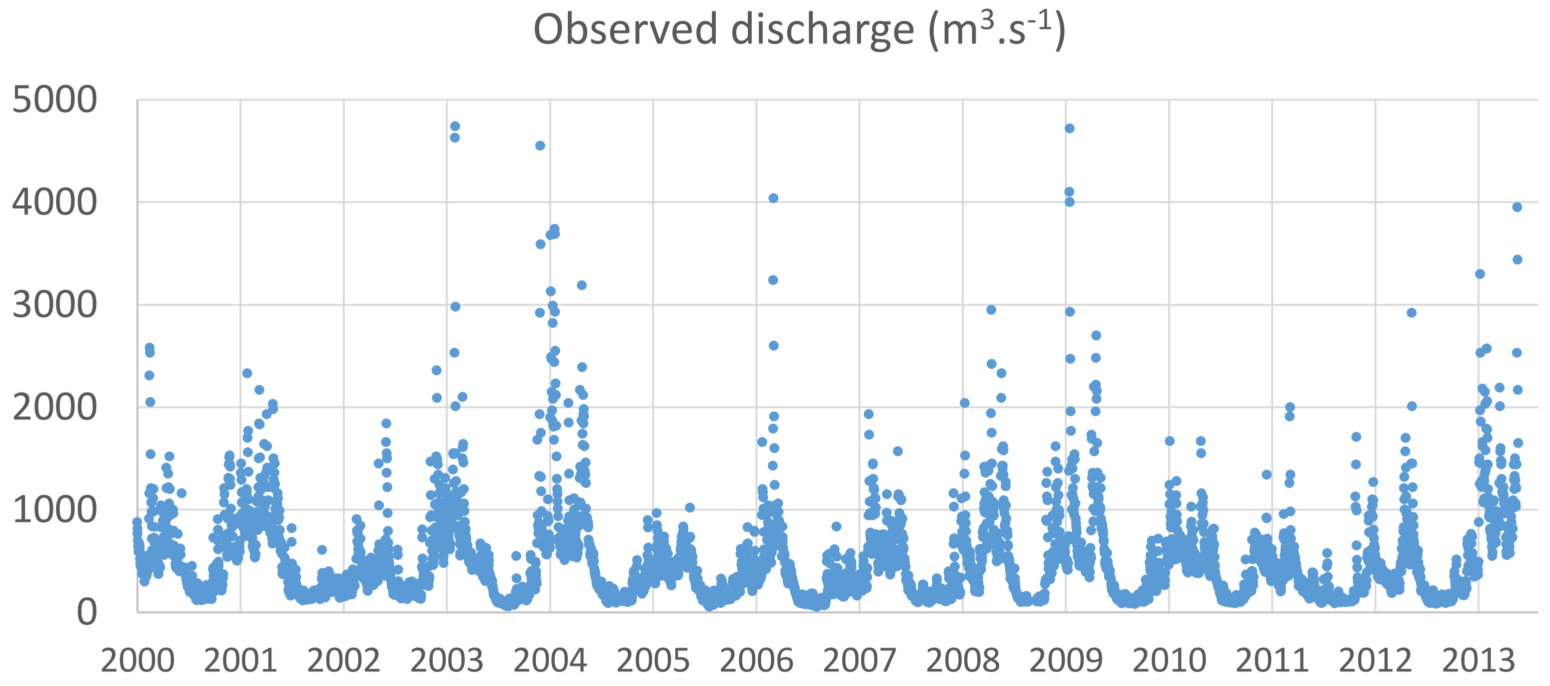
The Garonne River

- Area : ≈ 55 000 km²

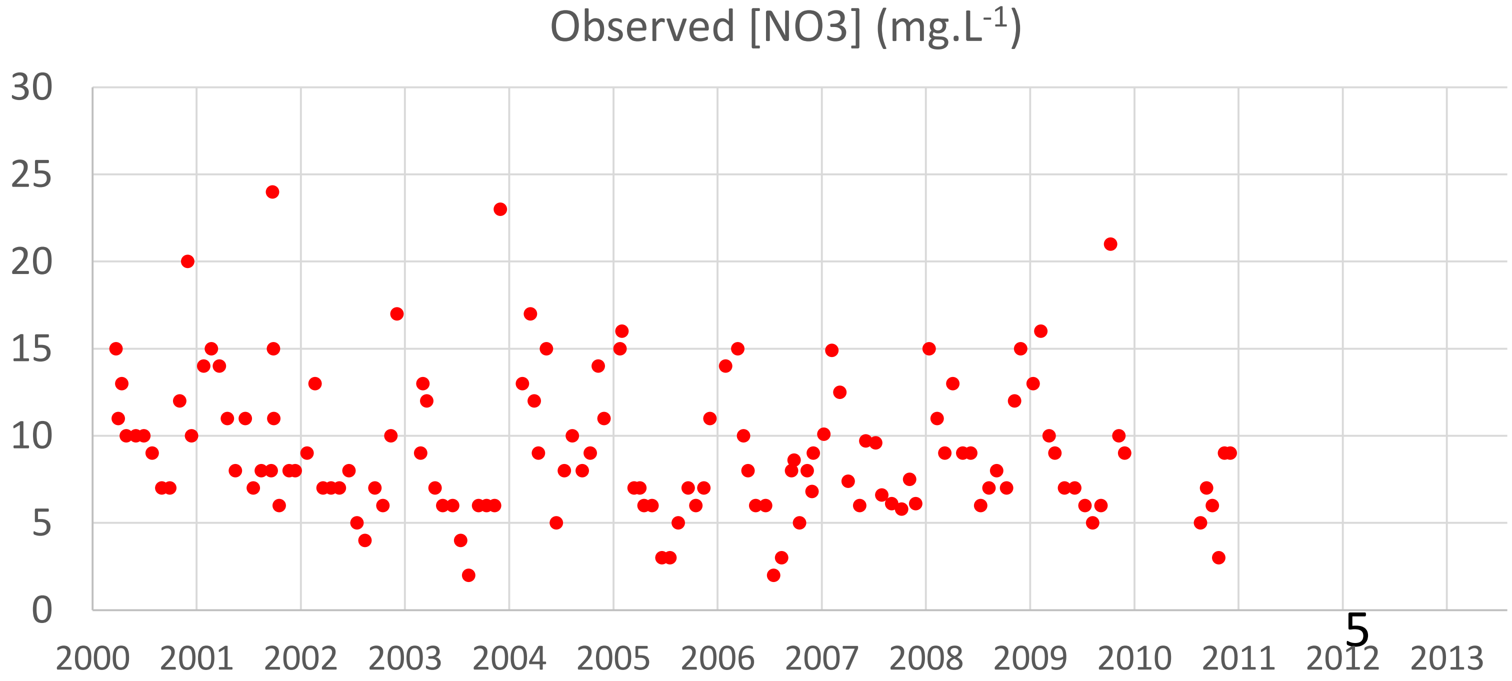


The Garonne River

- Average discharge : ≈ 650 $m^3.s^{-1}$

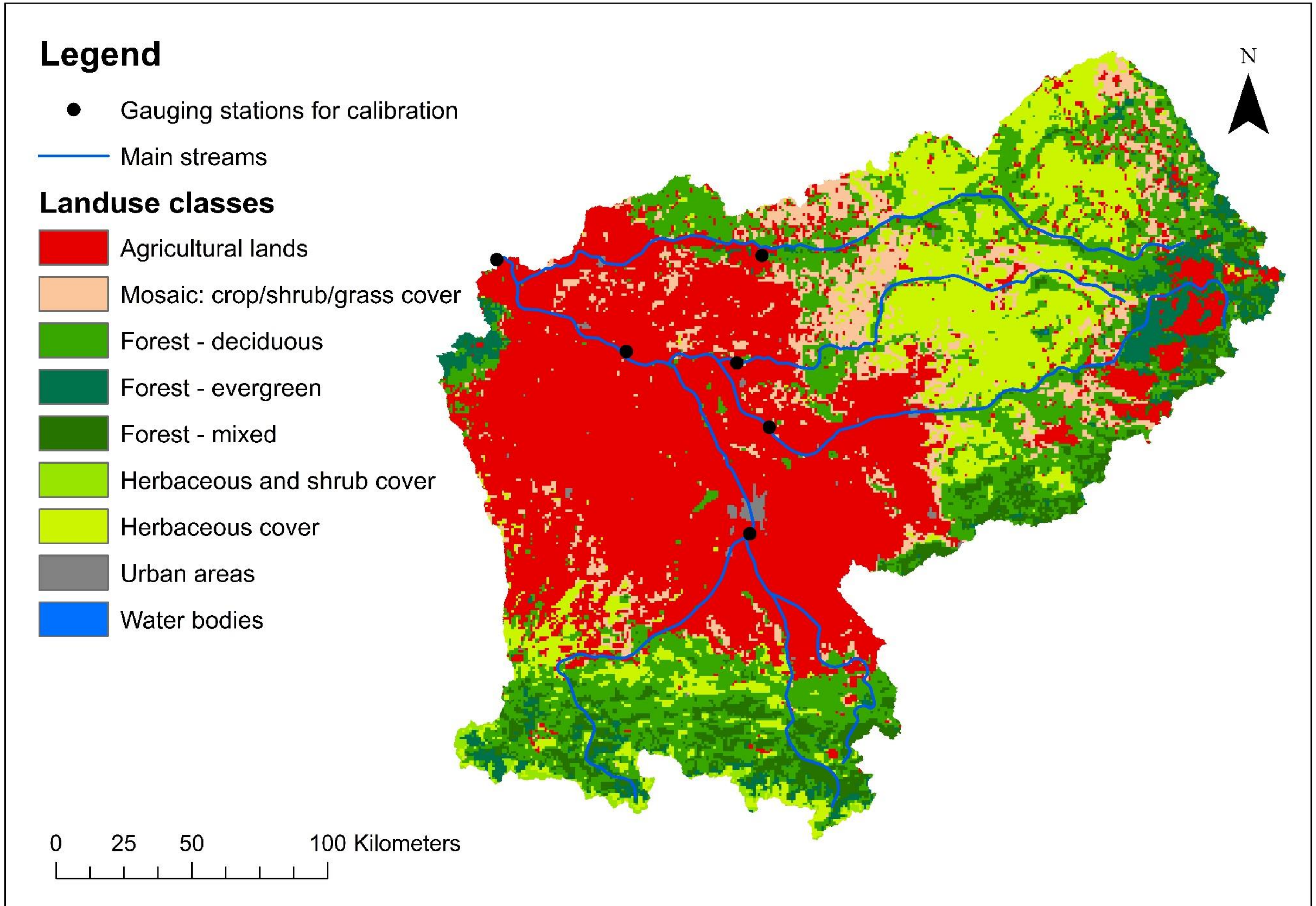


- Nitrate concentration : 9.3 $mg.L^{-1}$



Portail Adour-Garonne

The Garonne River : An agricultural catchment

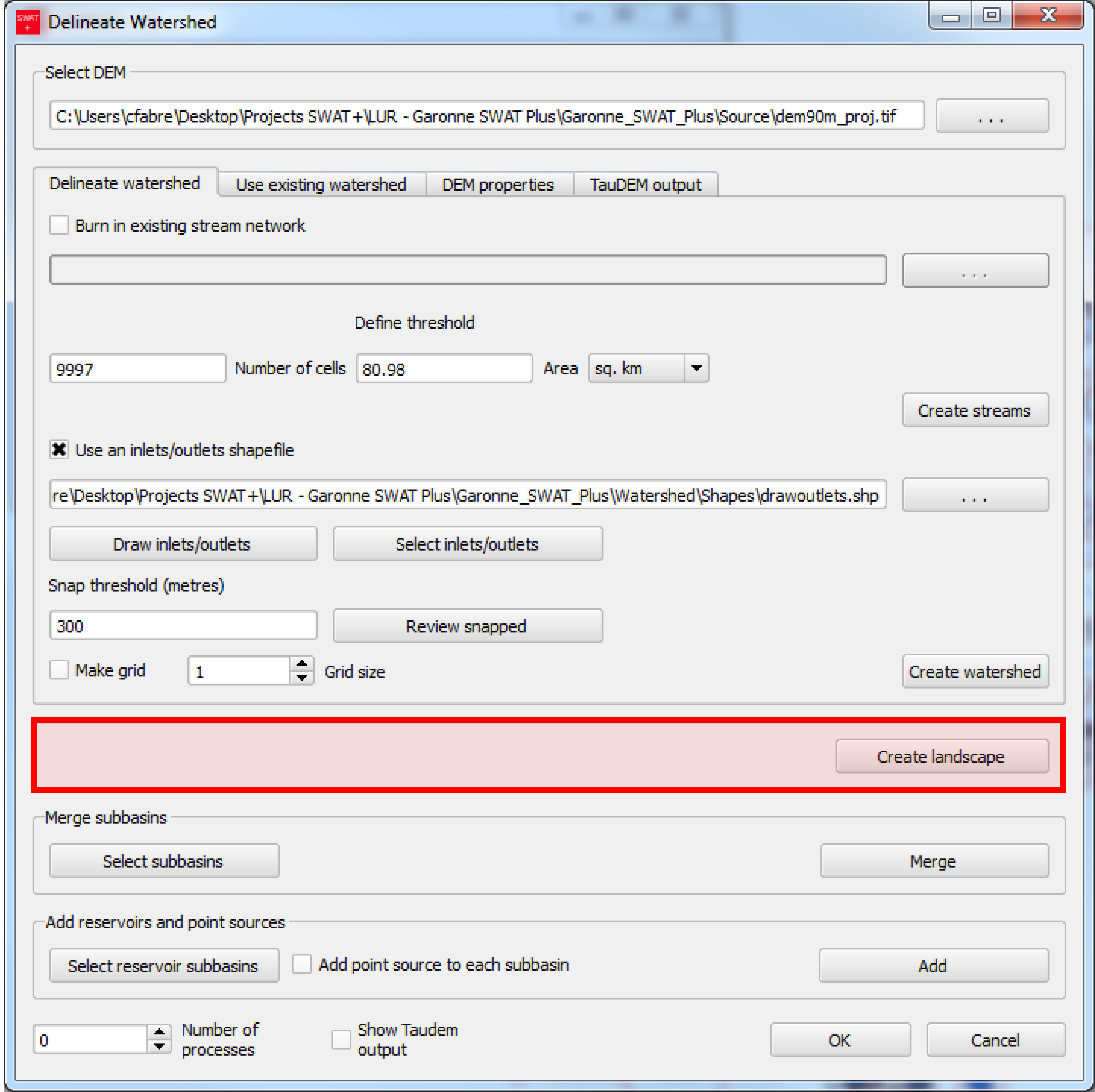


Land use type	Coverage
Agriculture	43 %
Forest	32 %
Pasture	16 %

FAO

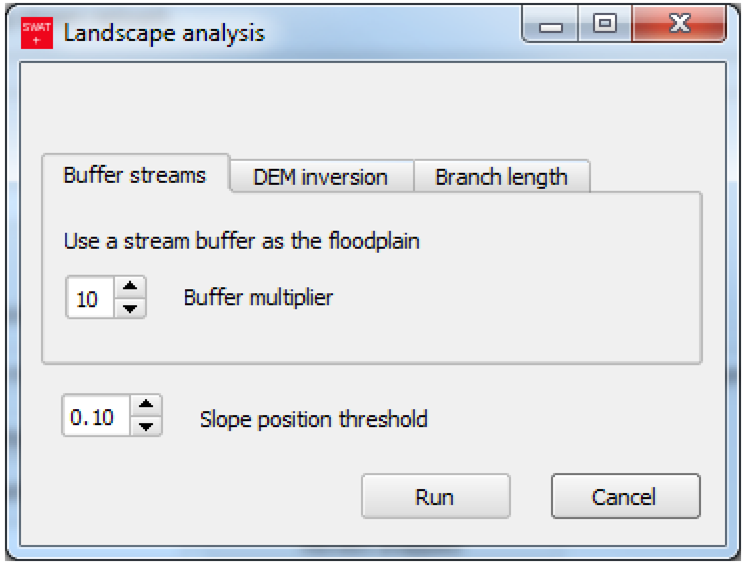
SWAT+ advantages for this study

- Delineation of the floodplain directly in the setup of the project



SWAT + advantages for this study

- 3 methods



SWAT + advantages for this study

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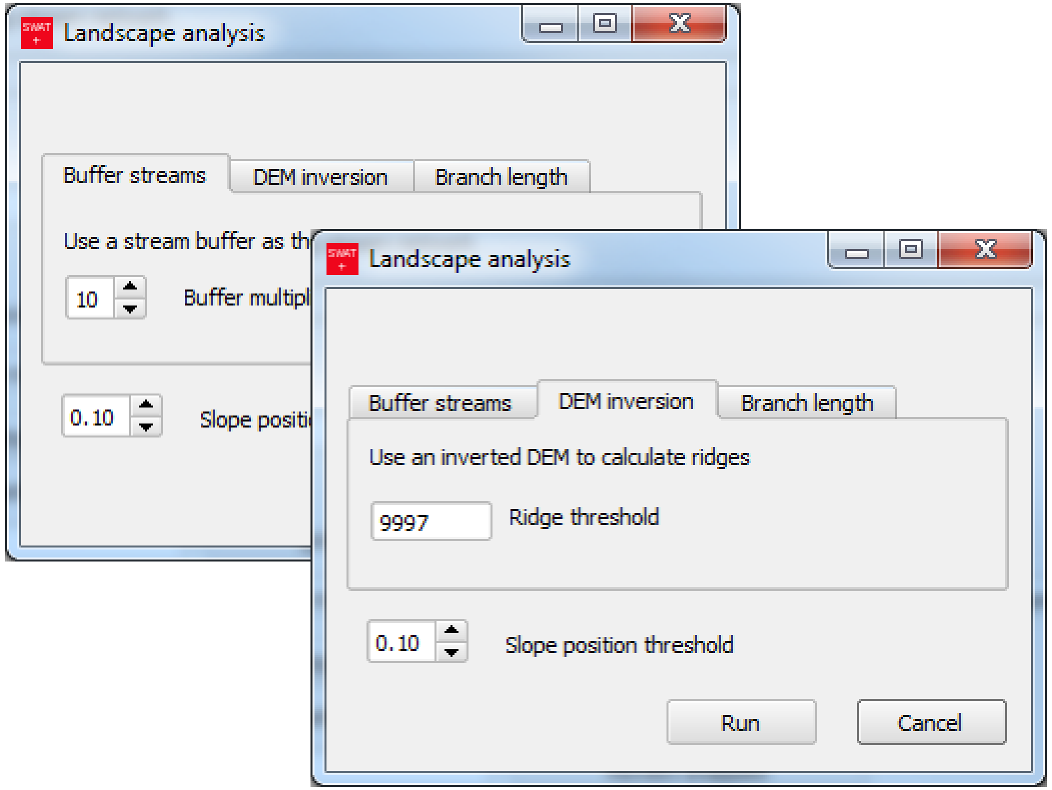

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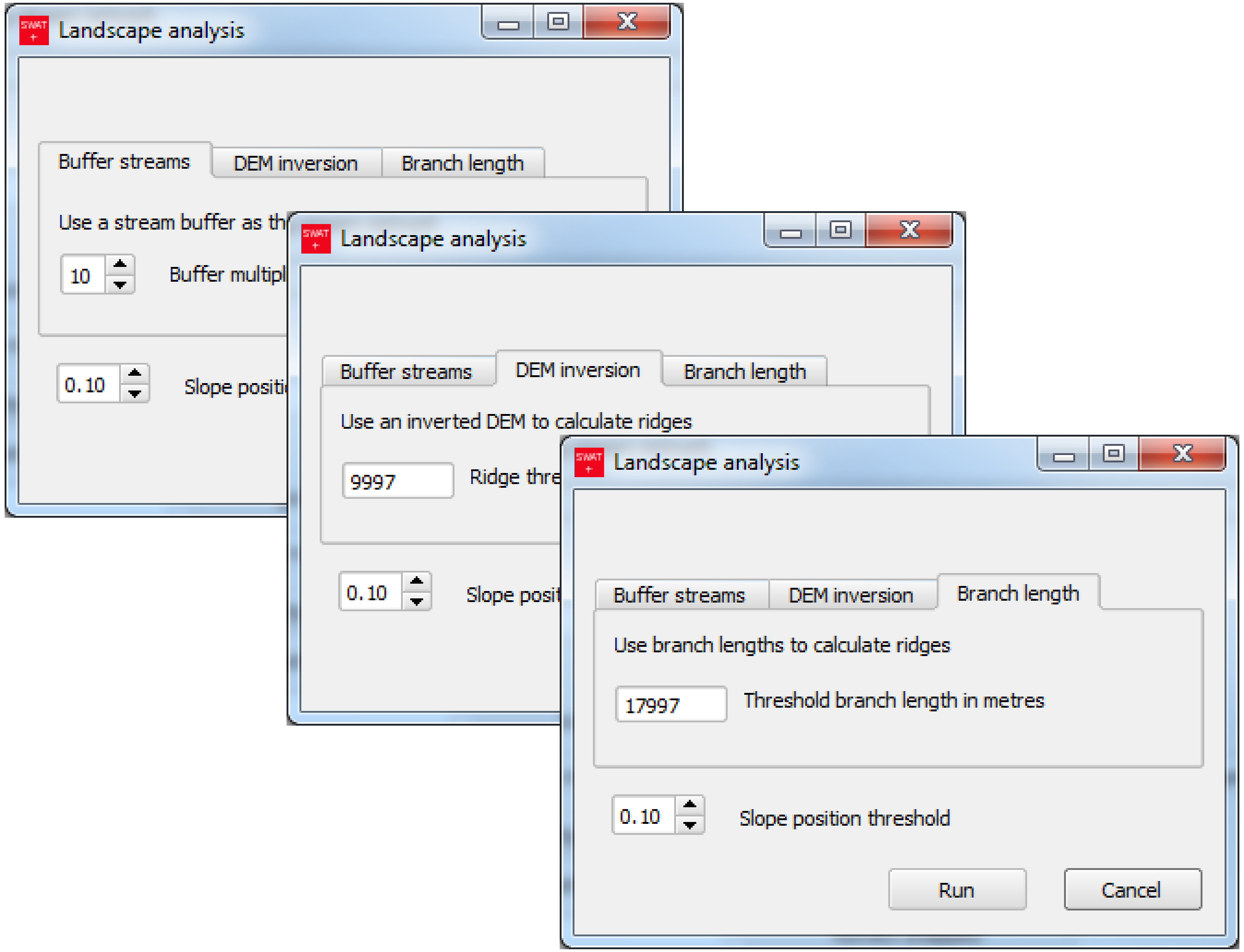
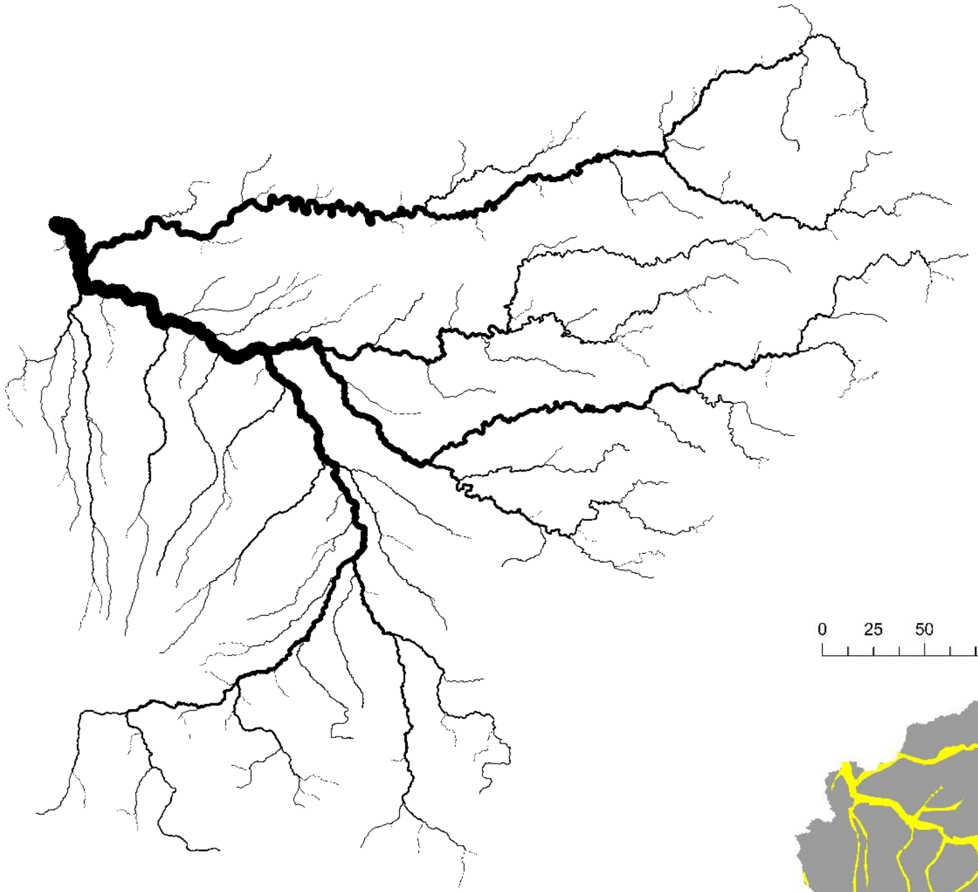
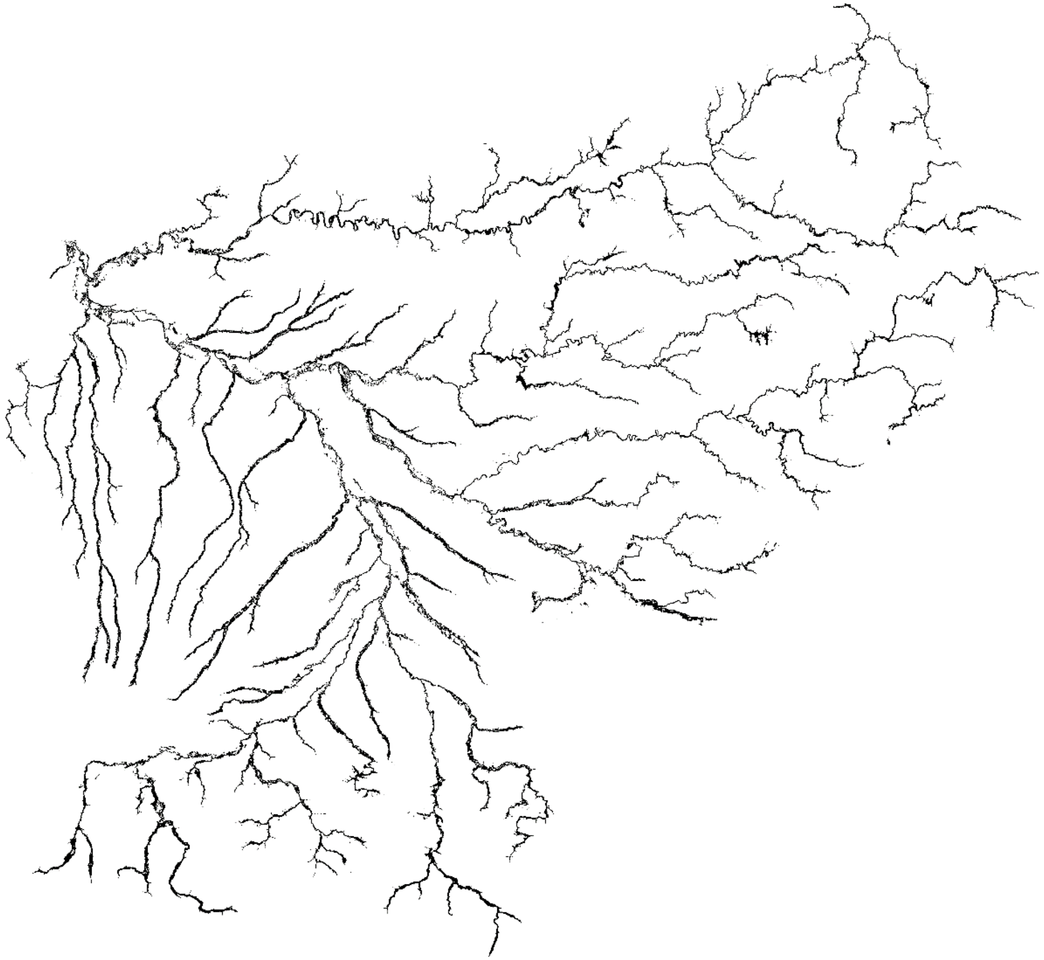
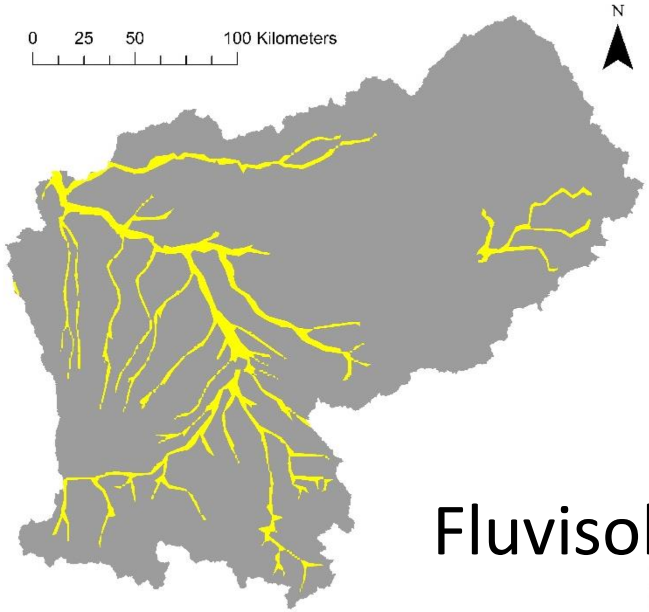


Method 1



Method 2



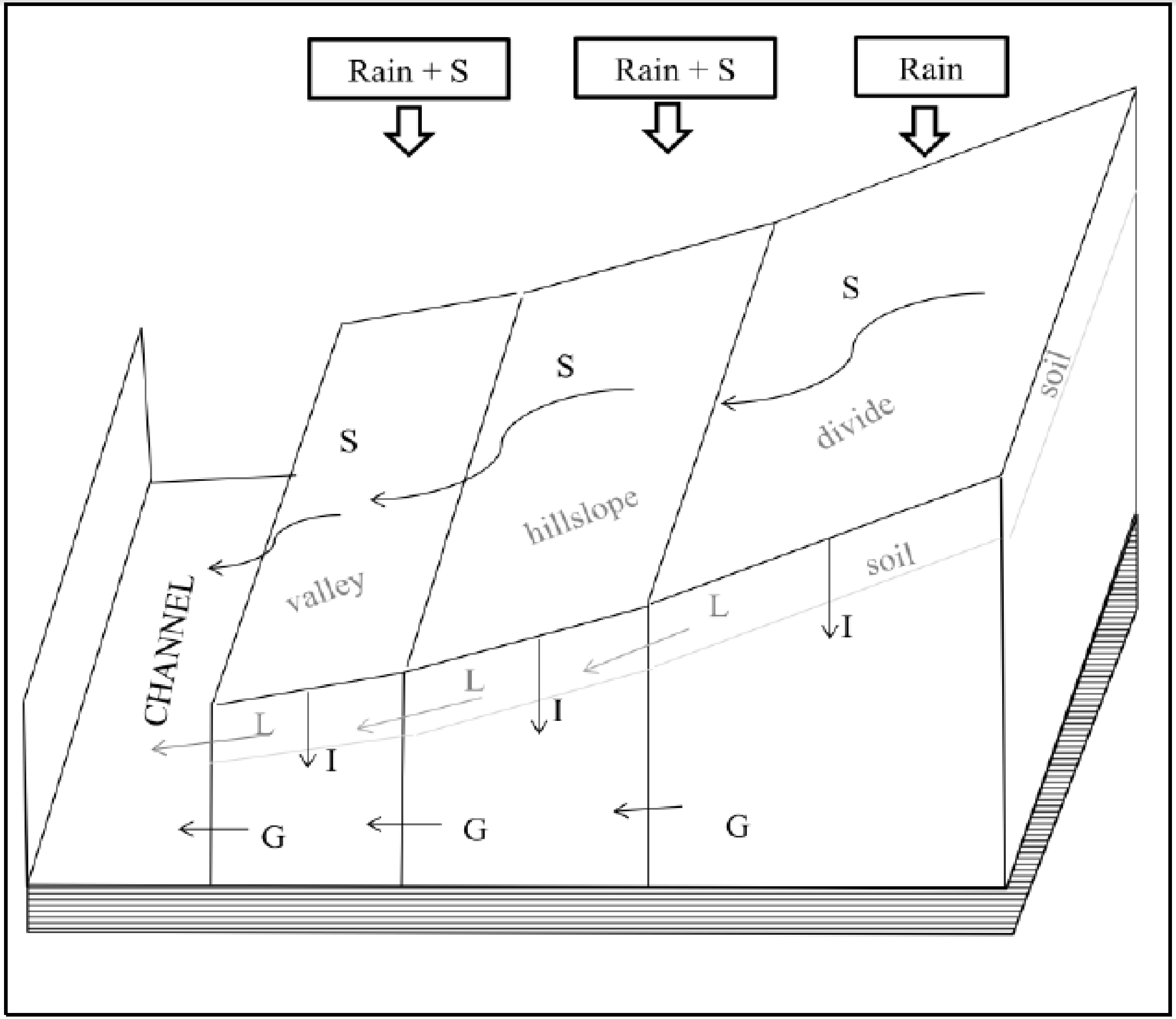


Fluvisols

Alternative : SWAT - LUD

- Landscape Units as in SWAT + with Darcy's law

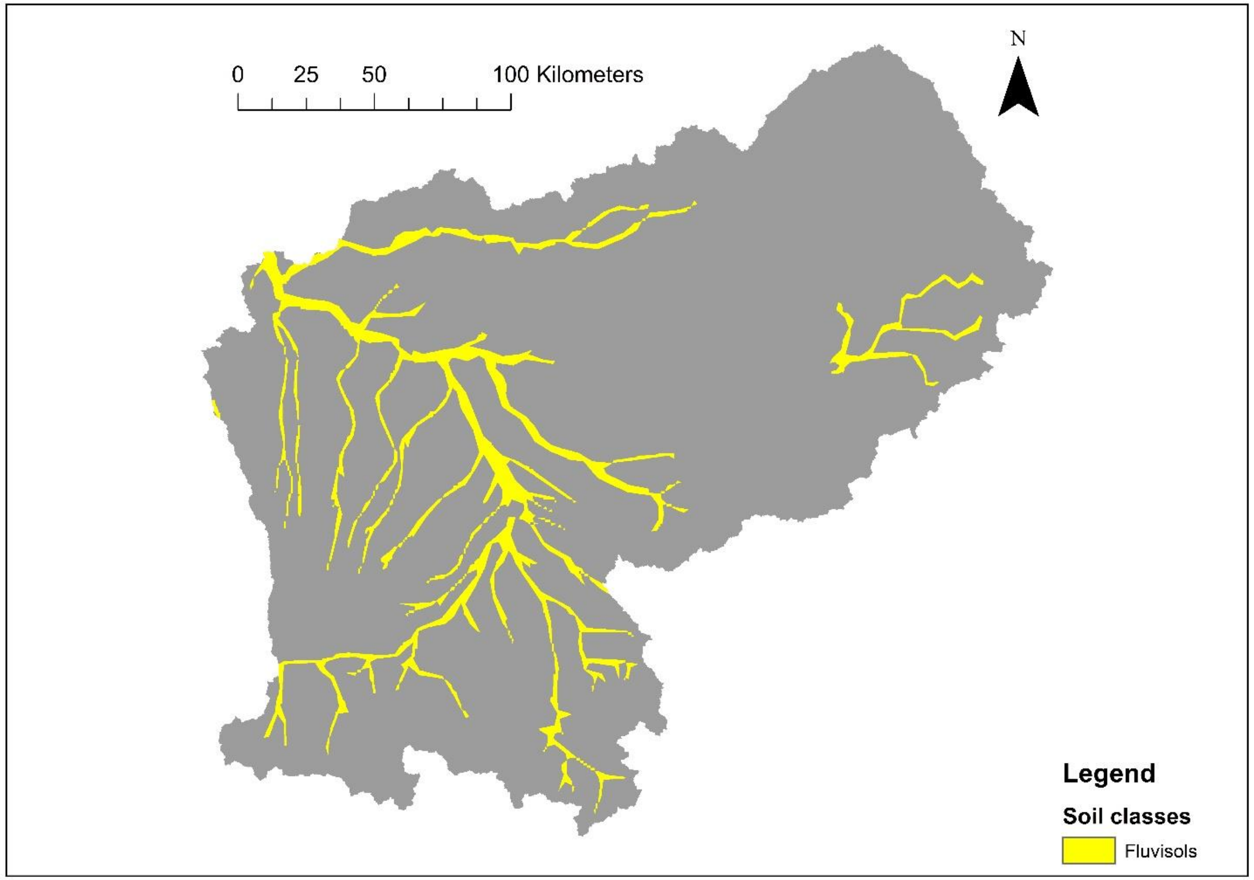
$$Q = KA\frac{\Delta H}{L}$$

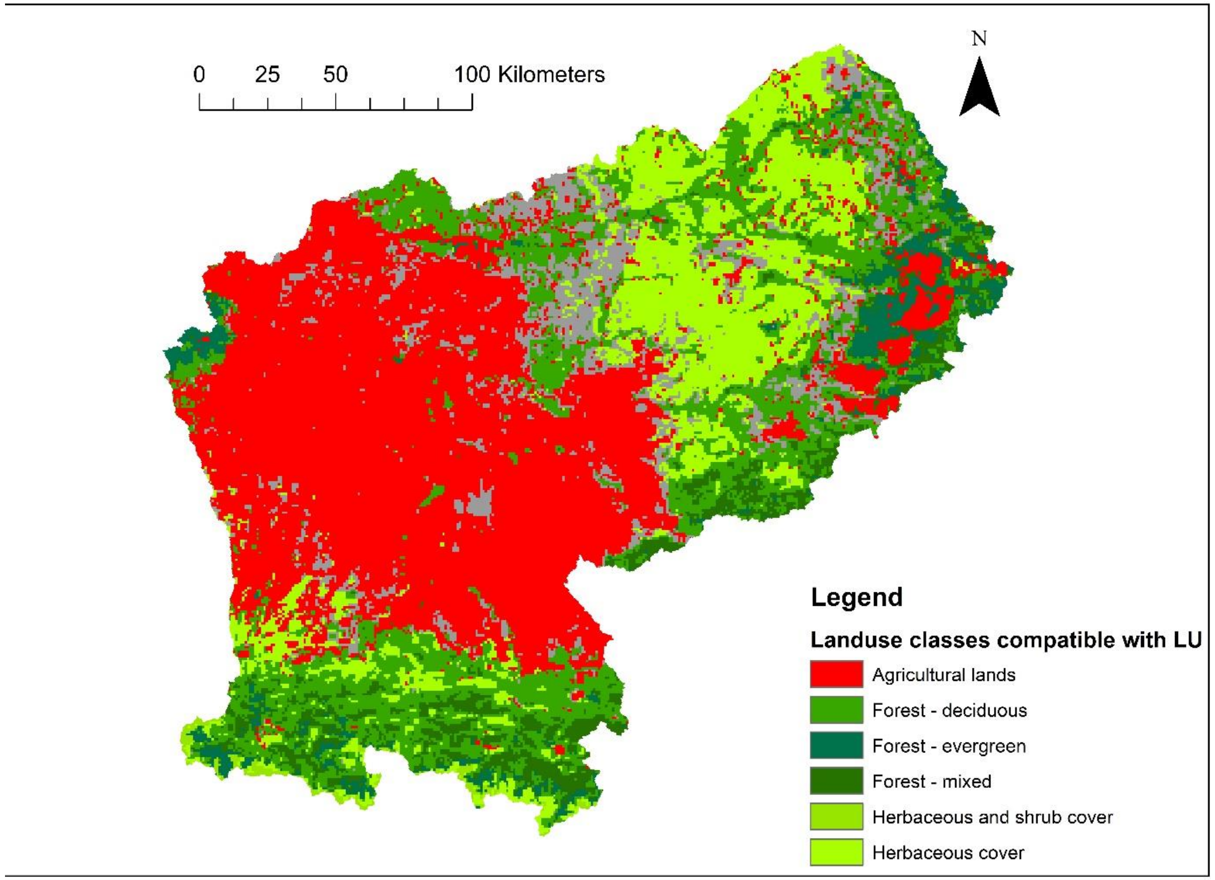


LU 1 LU 2 LU 3

Alternative : SWAT - LUD

- Landuse and soil dependant





Alternative : SWAT - LUD

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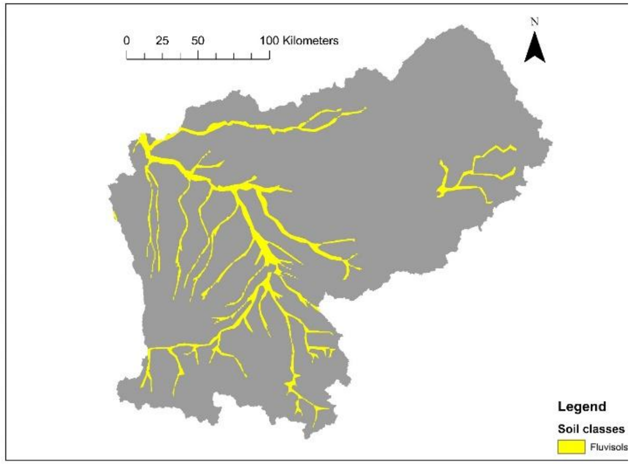
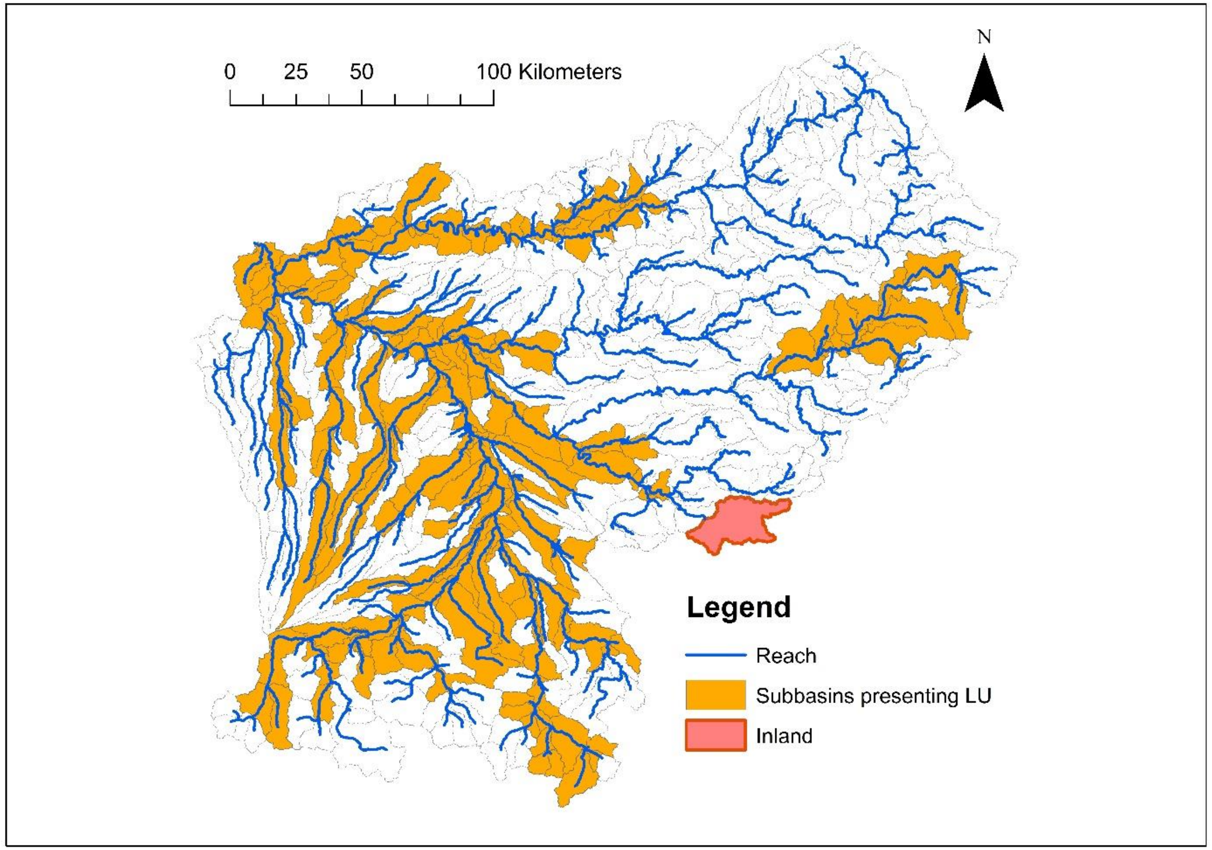
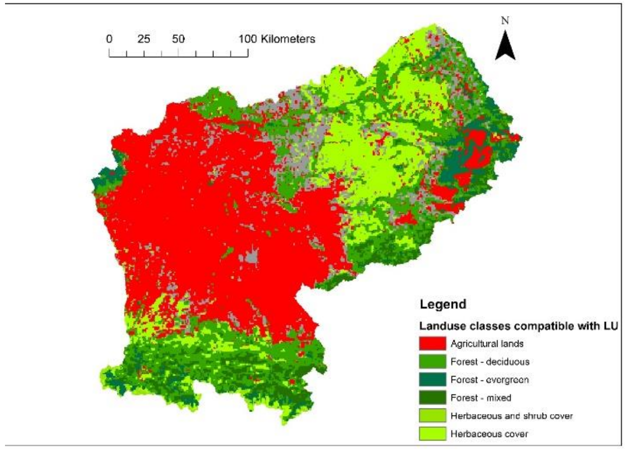
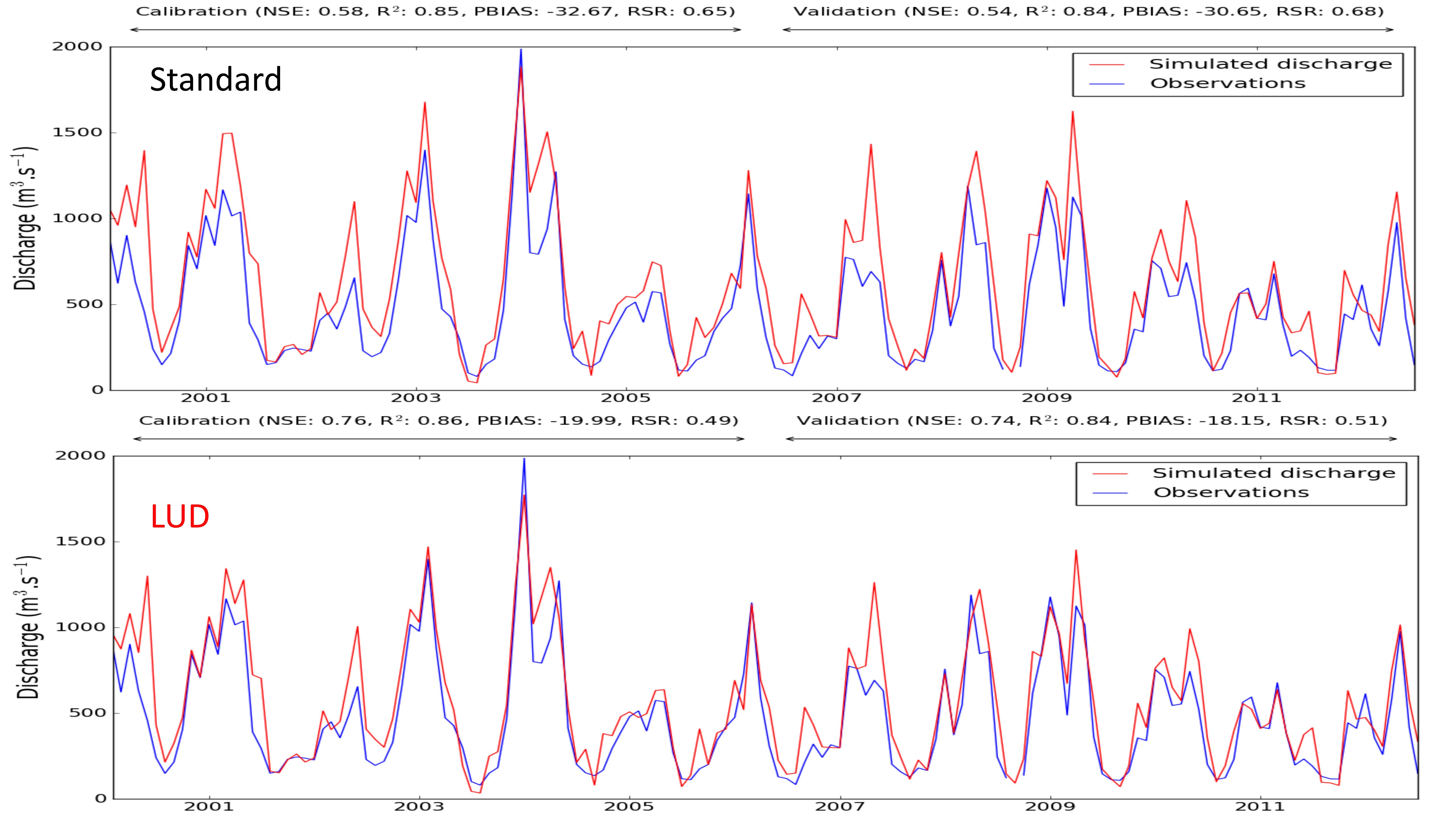
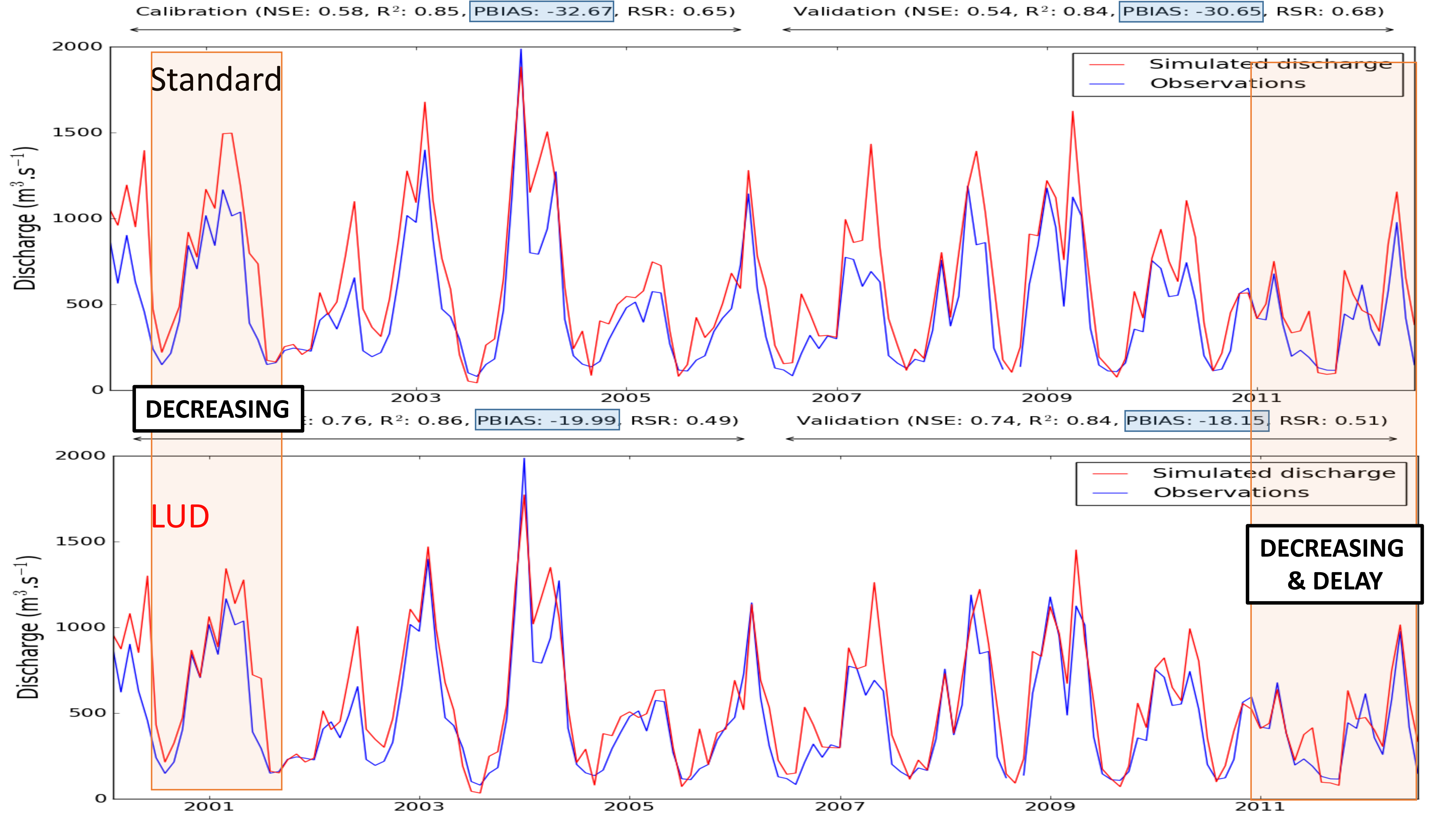








Calibration (NSE: 0.58, R²: 0.85, PBIAS: -32.67, RSR: 0.65)
Validation (NSE: 0.54, R²: 0.84, PBIAS: -30.65, RSR: 0.68)
Standard
Simulated discharge
Observations
Discharge (m³.s⁻¹)
2000
1500
1000
500
0
2001
2003
2005
2007
2009
2011
Calibration (NSE: 0.76, R²: 0.86, PBIAS: -19.99, RSR: 0.49)
Validation (NSE: 0.74, R²: 0.84, PBIAS: -18.15, RSR: 0.51)
LUD
Simulated discharge
Observations
Discharge (m³.s⁻¹)
2000
1500
1000
500
0
2001
2003
2005
2007
2009
2011



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LUD
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Observations
DECREASING
& DELAY
Discharge (m³.s⁻¹)
2001
2003
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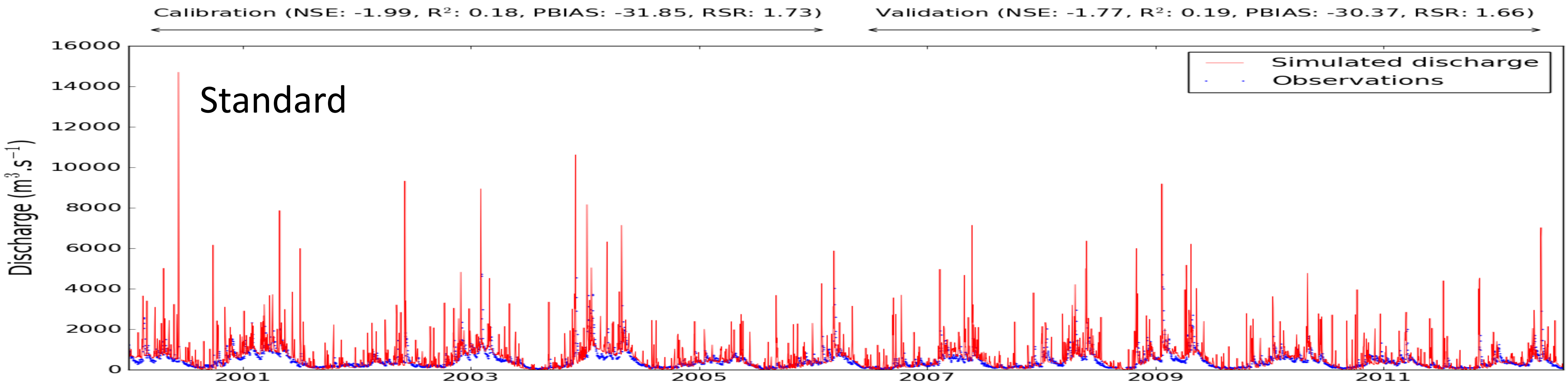
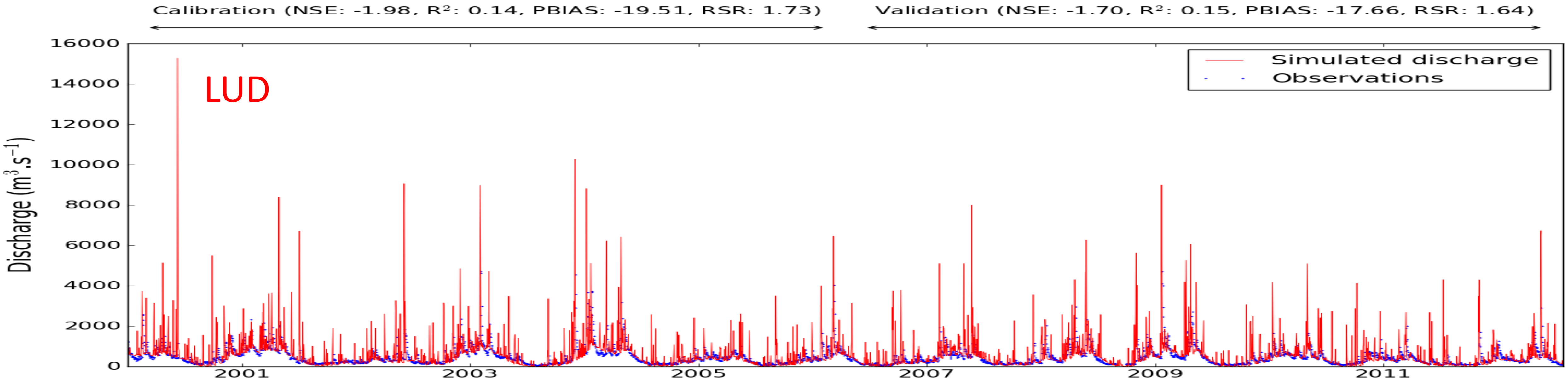
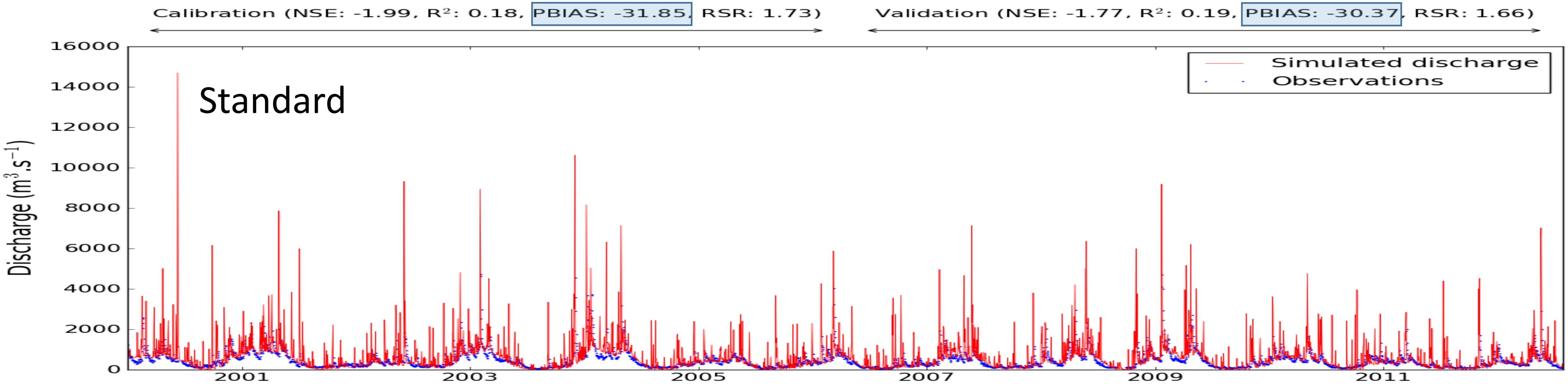
2011

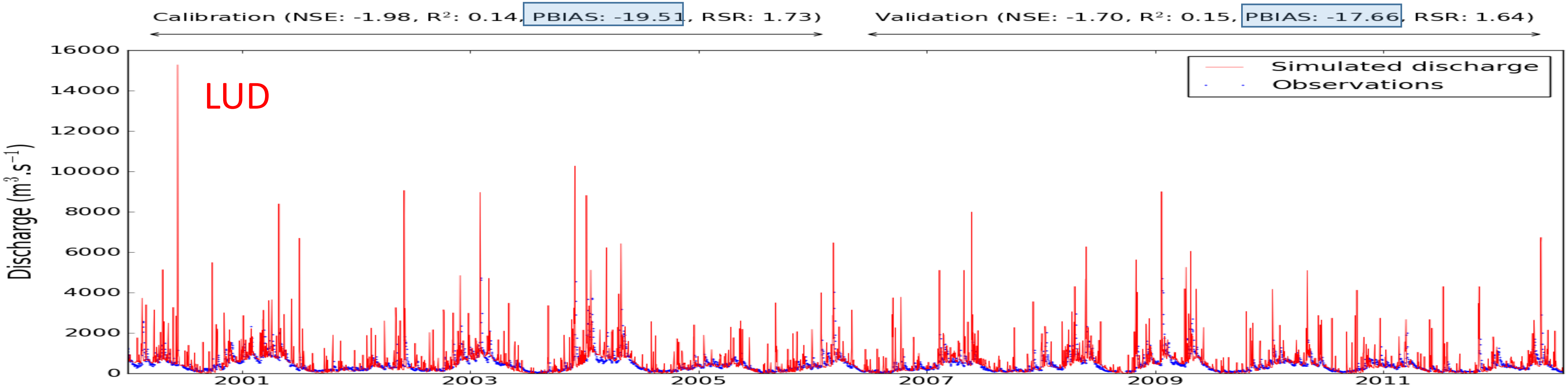
Daily time step



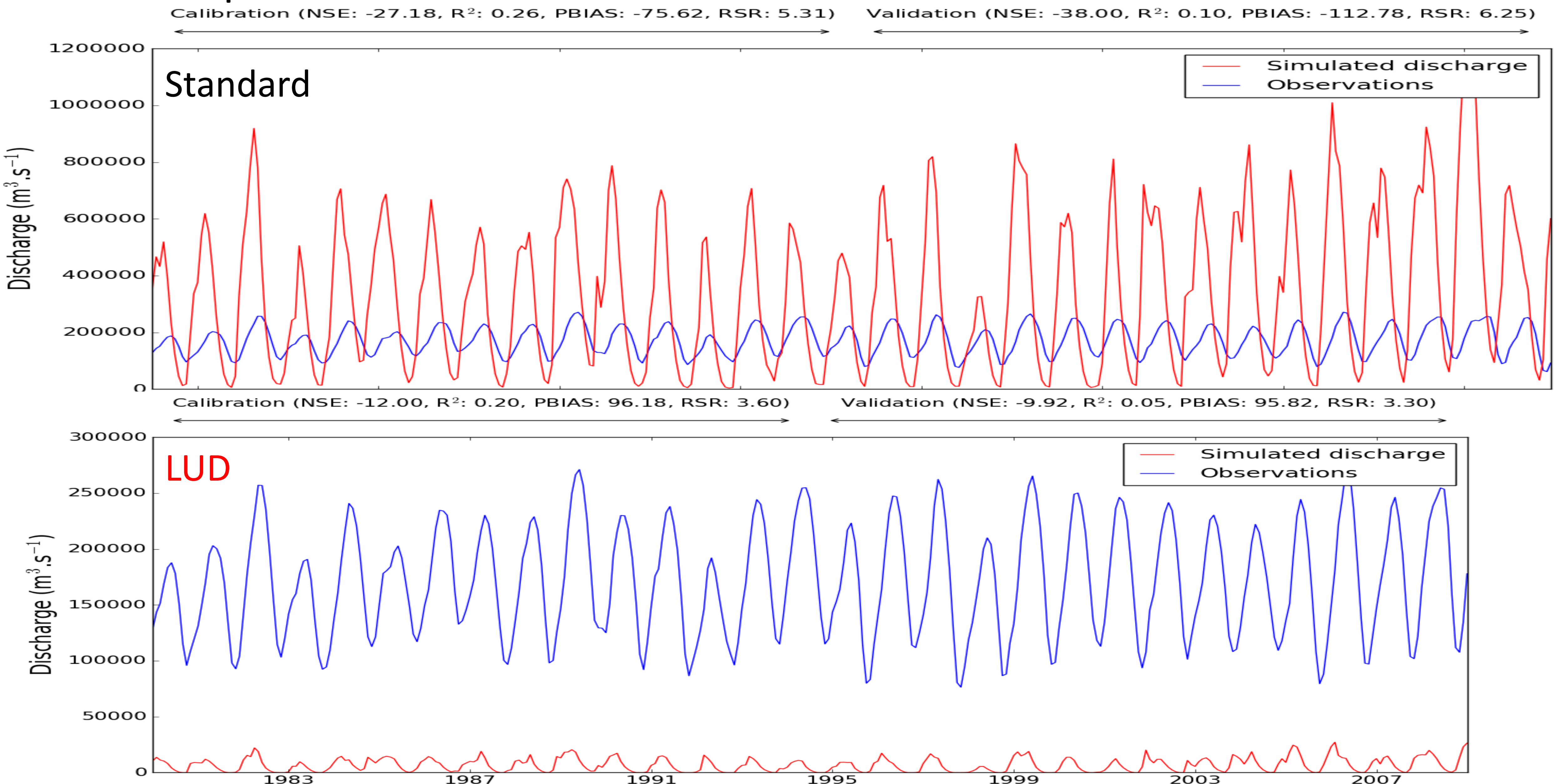


Daily time step





Perspectives : Amazon River



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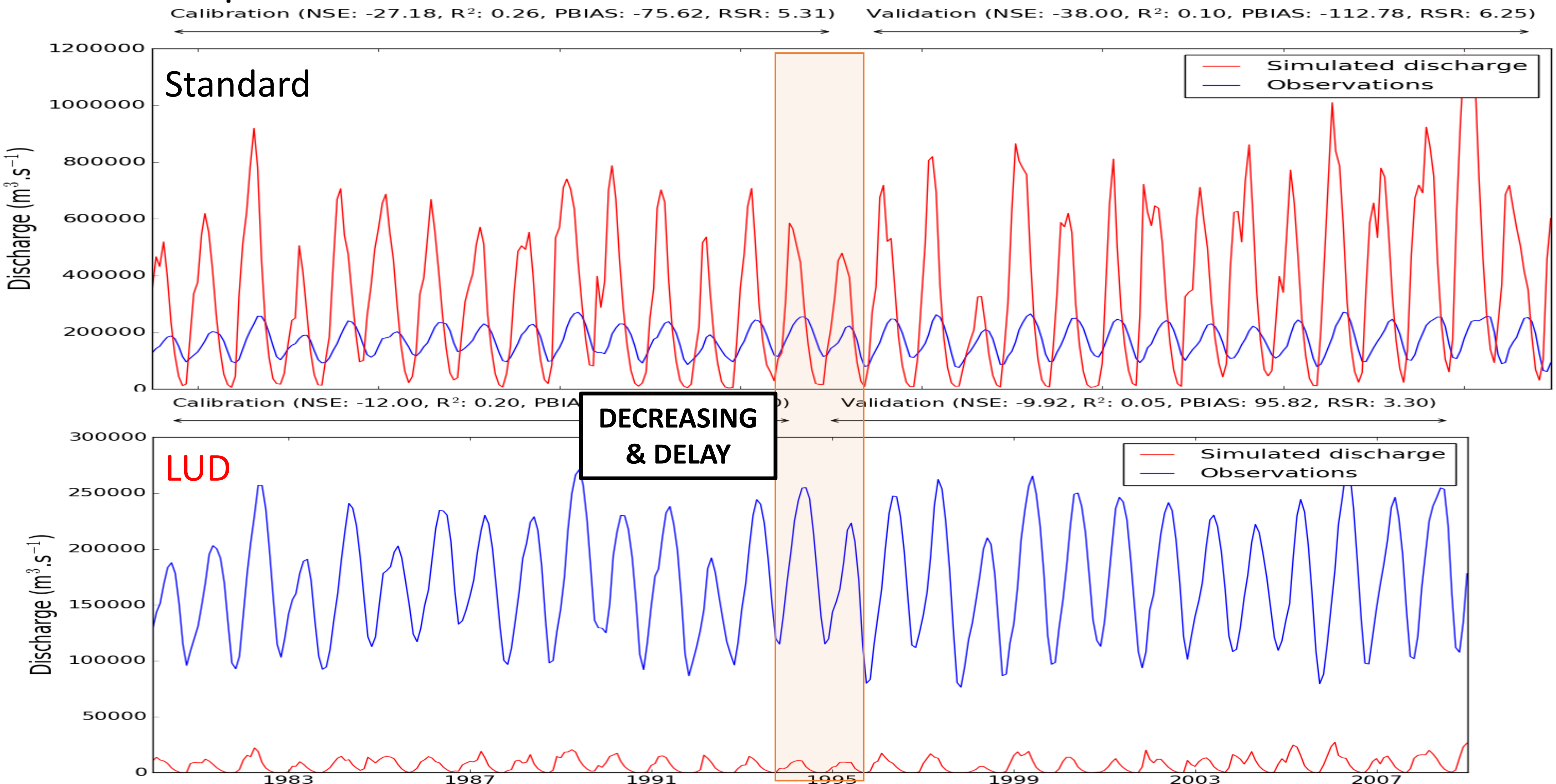

Conclusion

- Each model(SWAT, SWAT_LUD, SWAT+) → different responses

- Spatially → different hotspots
- Different methodologies → A whole spectre of the effective alluvial zones

Thank you for your attention