

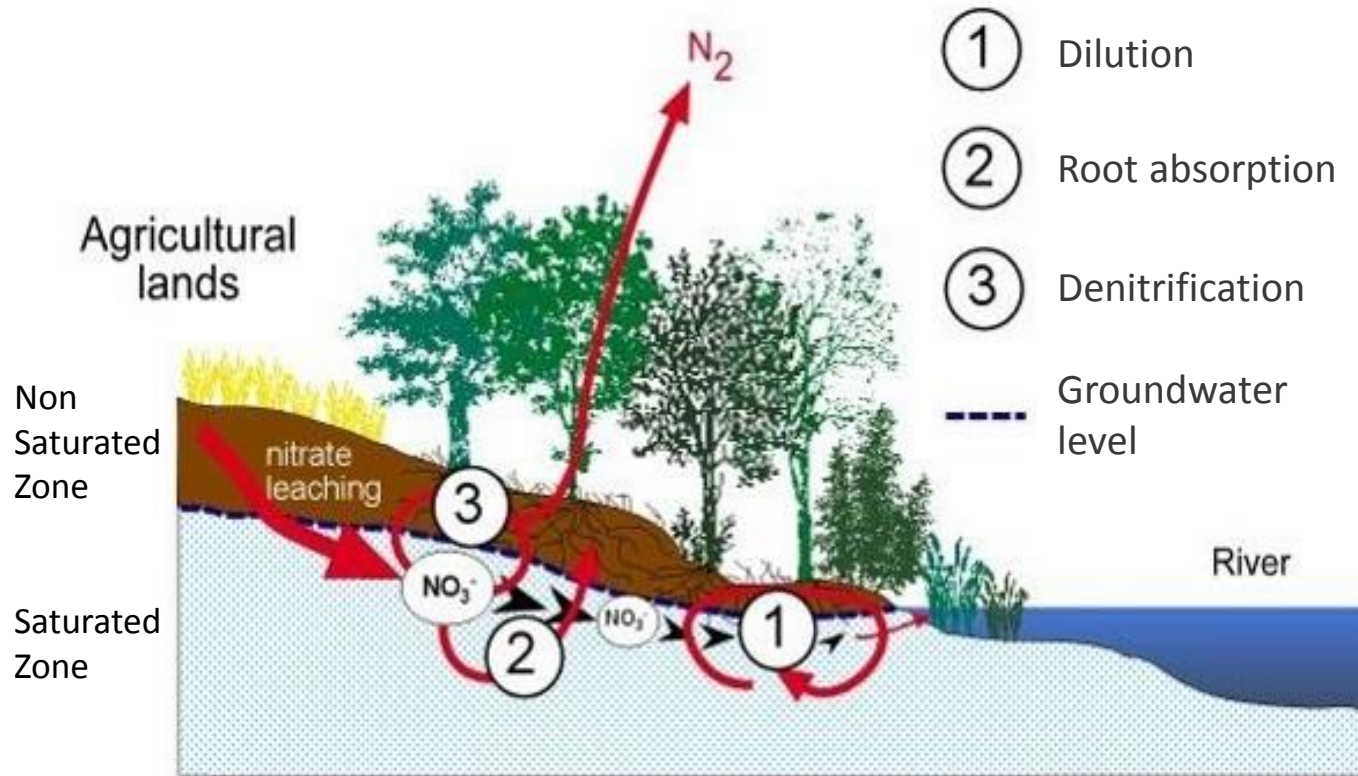
Organic carbon and nitrate transfers at a watershed scale with the SWAT+ model using landscape units: application to a large watershed in France

Clément Fabre, Sabine Sauvage, Raghavan Srinivasan, José Miguel Sánchez Pérez

Presented by Clément Fabre



Riparian zones : Powerful water cleaners



- ① Dilution
- ② Root absorption
- ③ Denitrification

--- Groundwater level

Riparian zones :

40% of nitrates consumed by denitrification at a watershed scale

(Seine : Pacsy et al., Garonne : Sun et al., 2015)



Riparian zones impacts on the nitrogen cycle

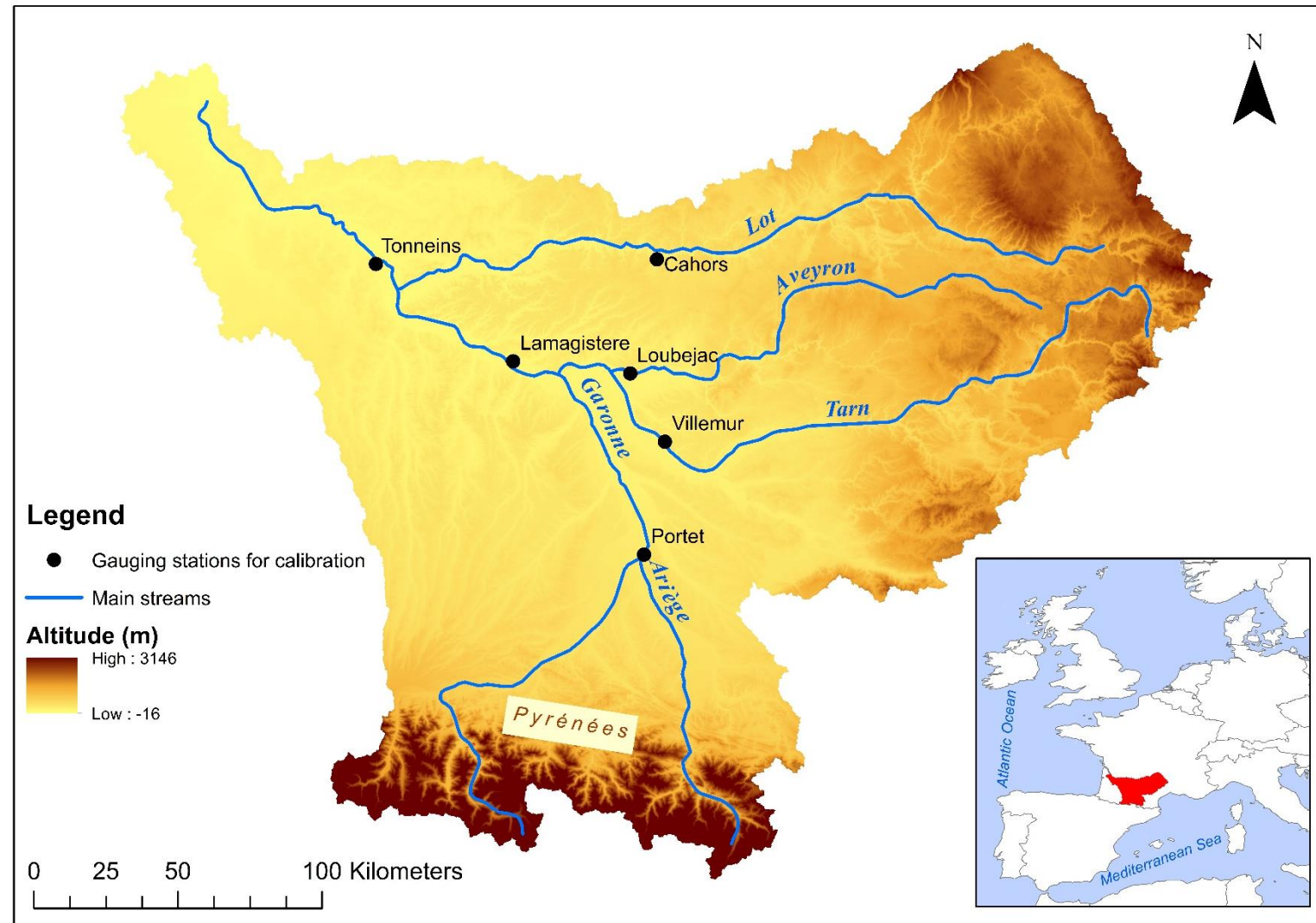
(Pinay et al., 1998 ; Sánchez-Pérez et al., 2003 ; Sun et al., 2015)

Objectives

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

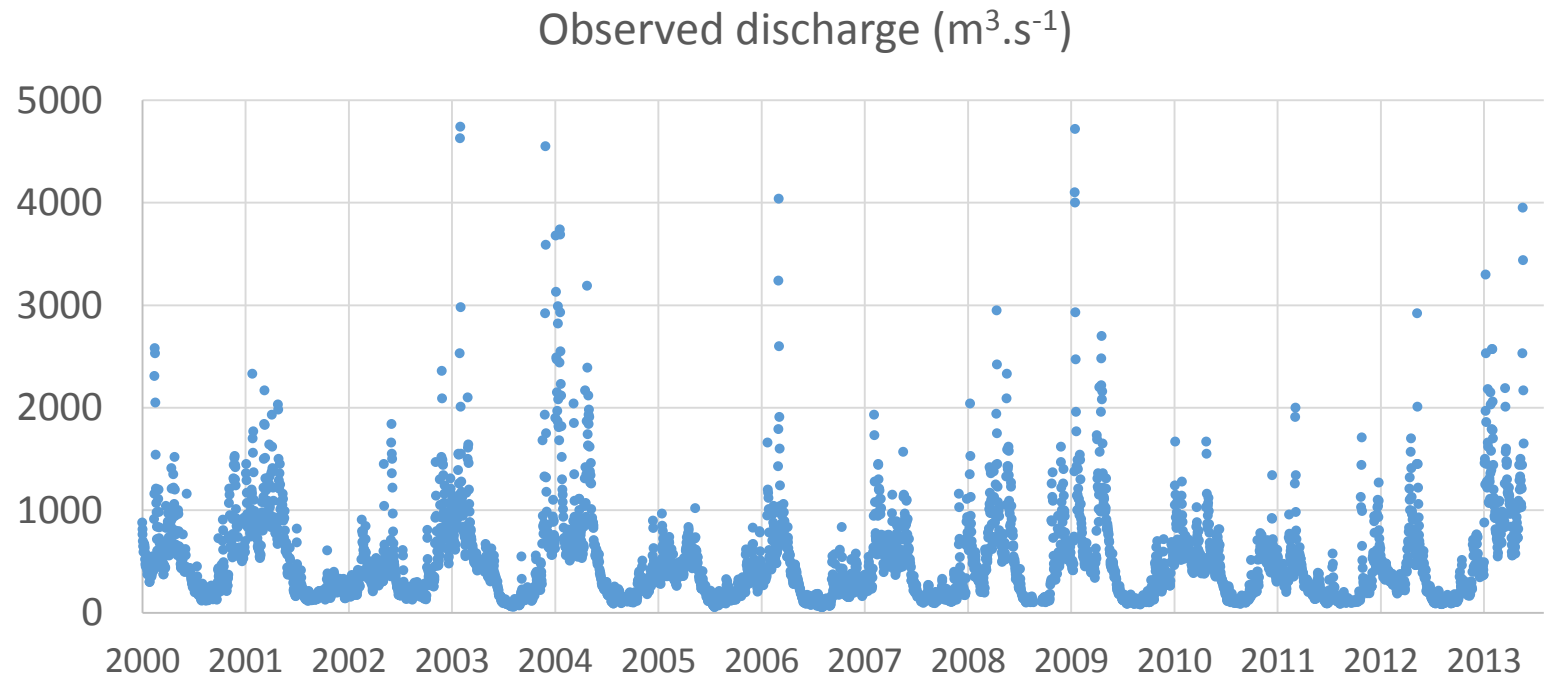
The Garonne River

- Area : $\approx 55\,000\text{ km}^2$

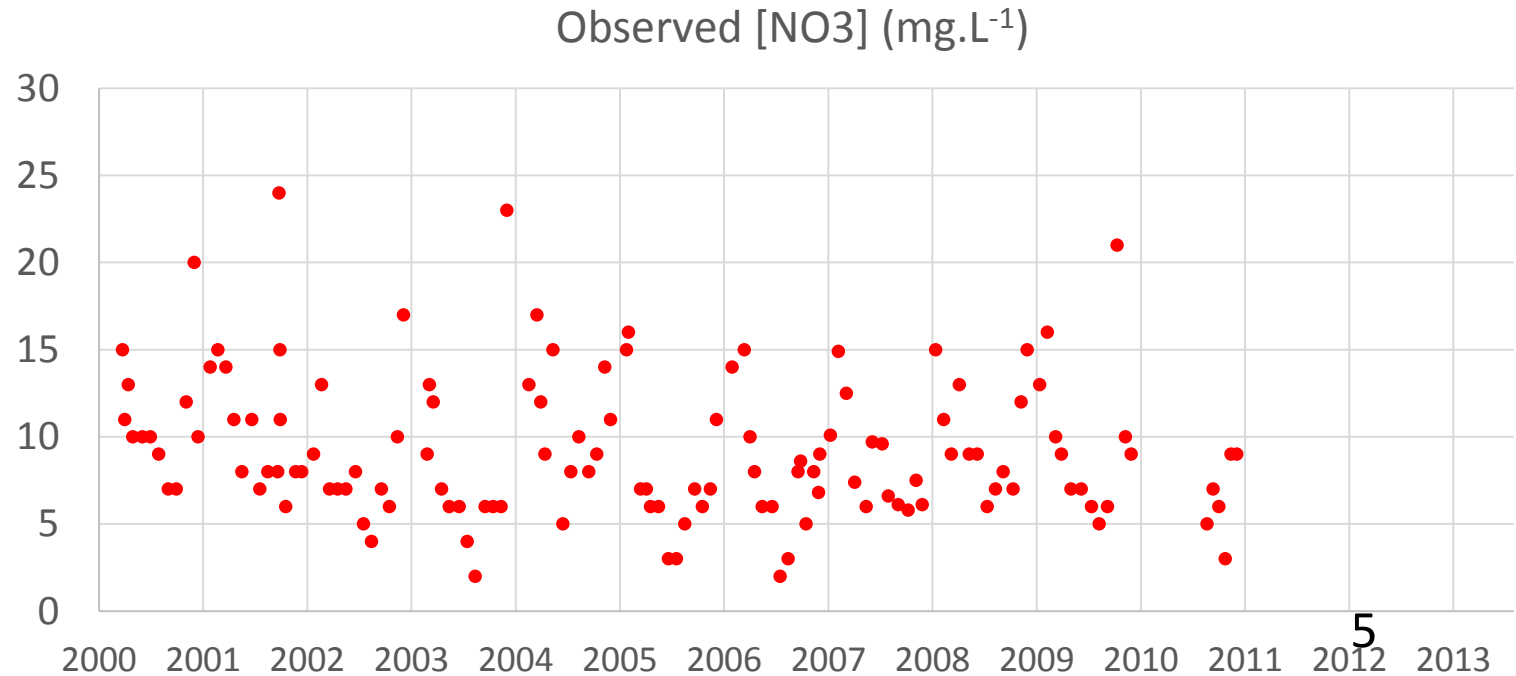


The Garonne River

- Average discharge : $\approx 650 \text{ m}^3.\text{s}^{-1}$



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



Portail Adour-Garonne










The Garonne River : An agricultural catchment

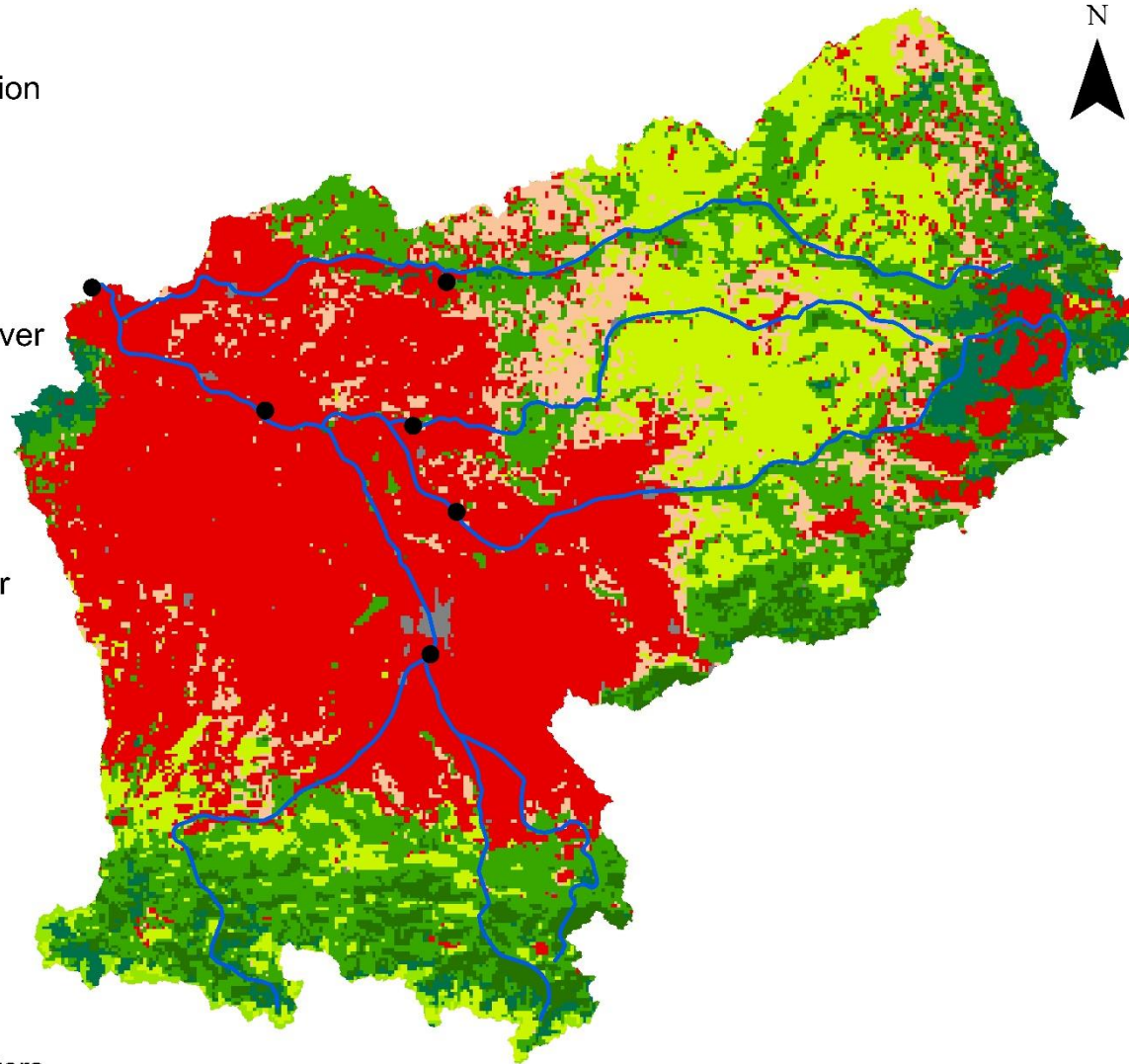
Legend

● Gauging stations for calibration

— Main streams

Landuse classes

-  Agricultural lands
-  Mosaic: crop/shrub/grass cover
-  Forest - deciduous
-  Forest - evergreen
-  Forest - mixed
-  Herbaceous and shrub cover
-  Herbaceous cover
-  Urban areas
-  Water bodies



0 25 50 100 Kilometers

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

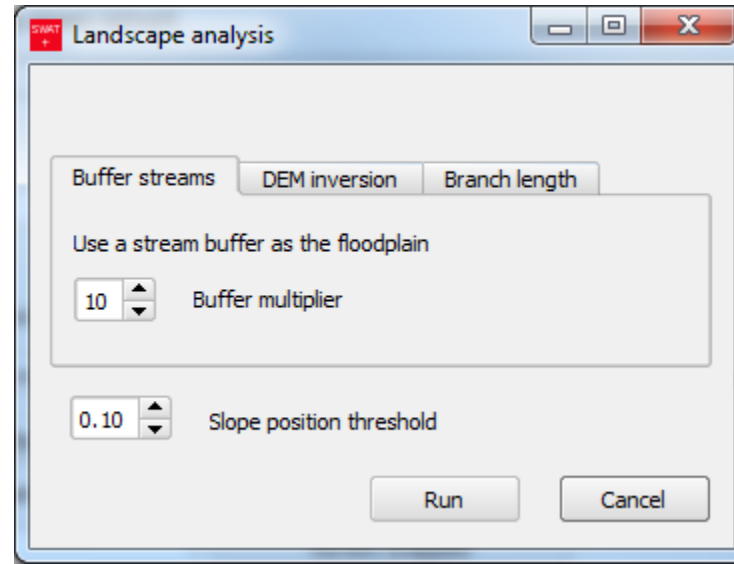
SWAT+ advantages for this study

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

The screenshot shows the 'Delineate Watershed' dialog box in the SWAT+ software. The 'Select DEM' field is set to 'C:\Users\cfabre\Desktop\Projects SWAT +\LUR - Garonne SWAT Plus\Garonne_SWAT_Plus\Source\dem90m_proj.tif'. The 'Delineate watershed' tab is active, showing options for 'Burn in existing stream network' (unchecked), 'Define threshold' (9997, 80.98 cells, sq. km), and 'Use an inlets/outlets shapefile' (checked, pointing to 're\Desktop\Projects SWAT +\LUR - Garonne SWAT Plus\Garonne_SWAT_Plus\Watershed\Shapes\drawoutlets.shp'). The 'Snap threshold (metres)' is set to 300, and 'Grid size' is 1. The 'Create landscape' button is highlighted with a red box. Other buttons include 'Create streams', 'Draw inlets/outlets', 'Select inlets/outlets', 'Review snapped', 'Merge', 'Add', 'Number of processes' (0), and 'Show Taudem output' (unchecked). 'OK' and 'Cancel' buttons are at the bottom right.

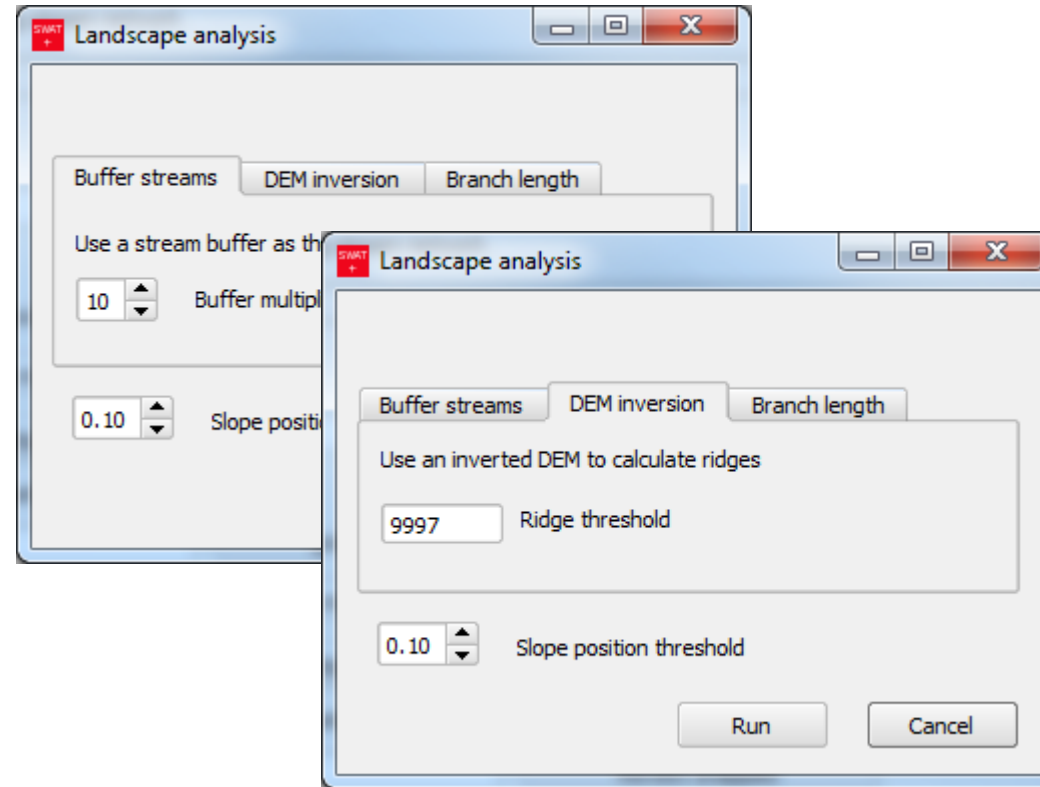
SWAT + advantages for this study

- 3 methods



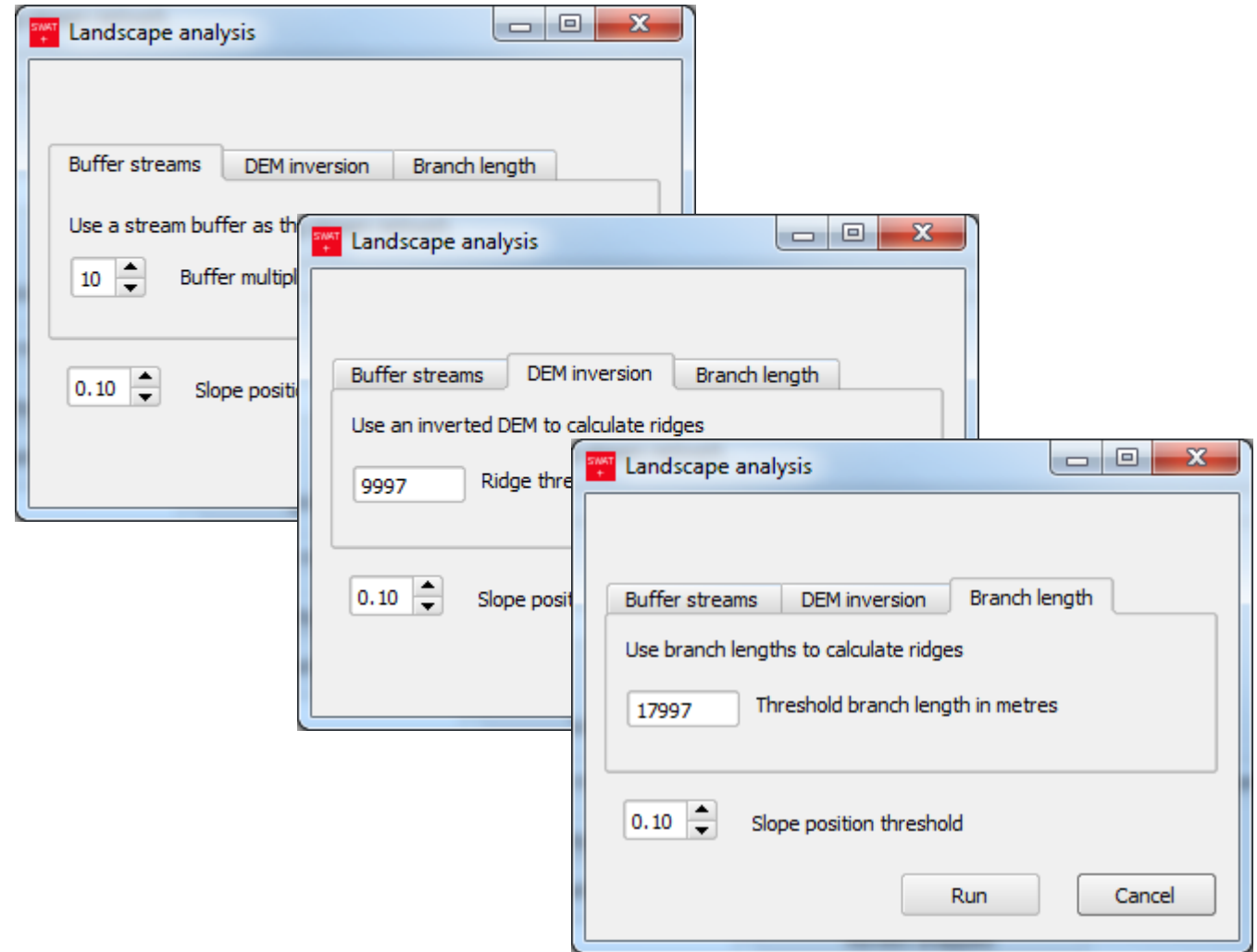
SWAT + advantages for this study

- 3 methods



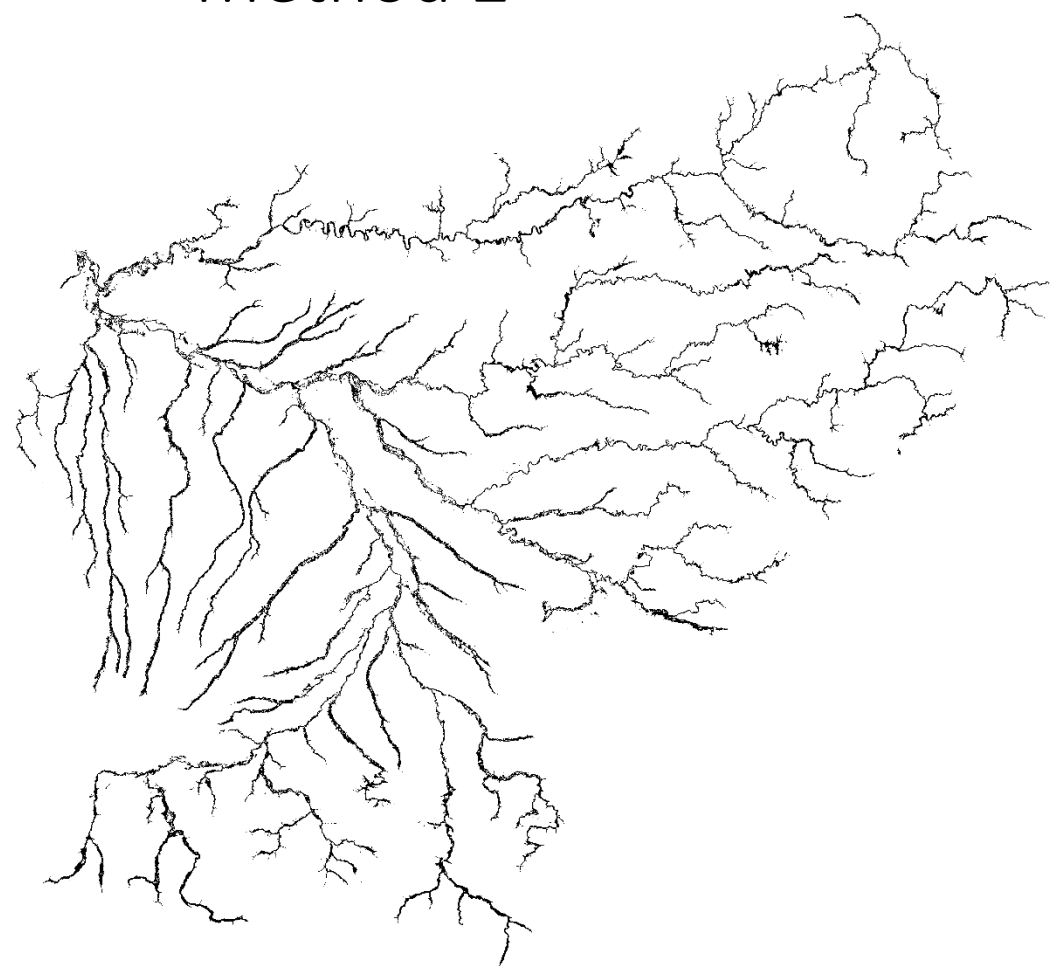
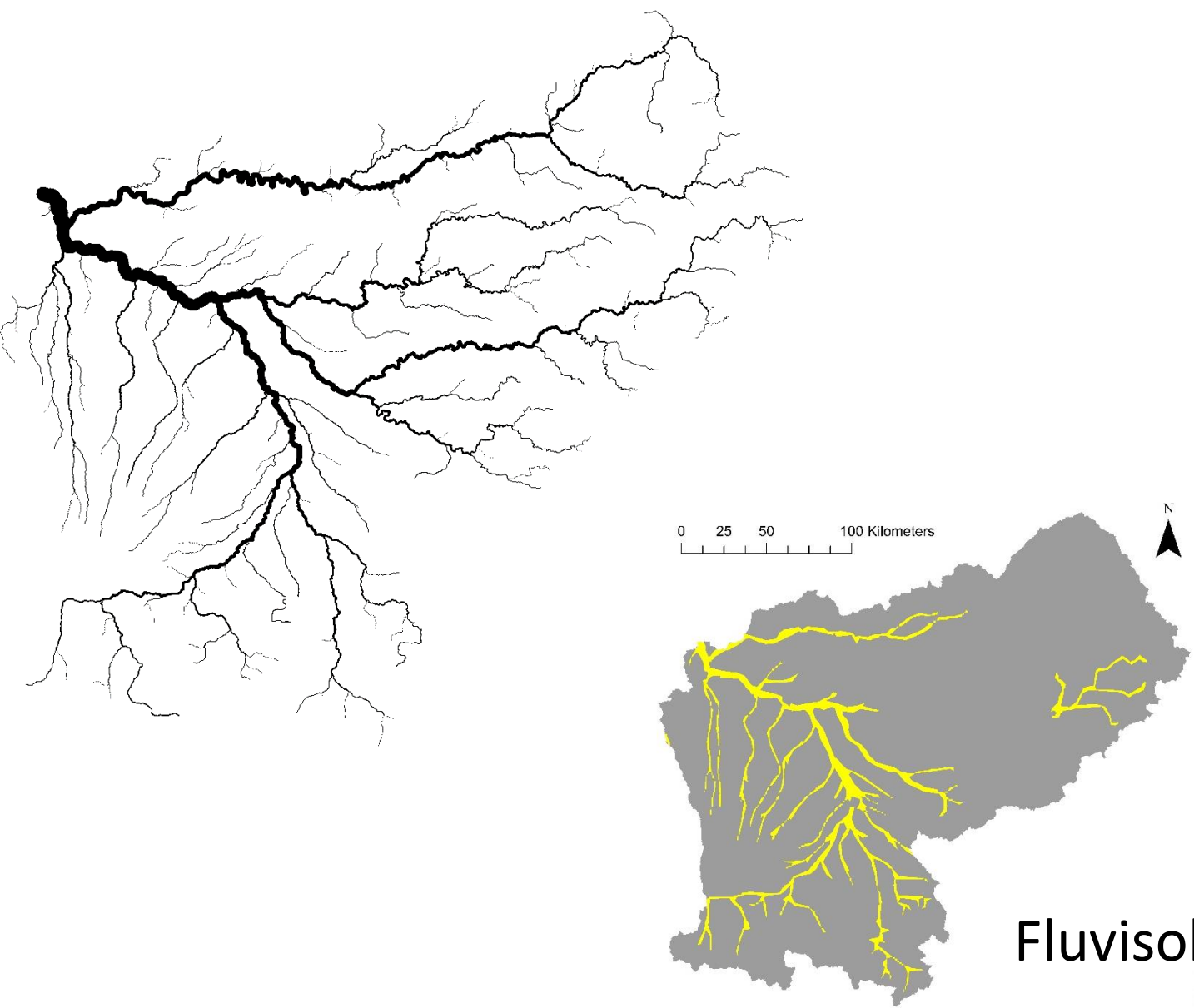
SWAT + advantages for this study

- 3 methods



Method 1

Method 2

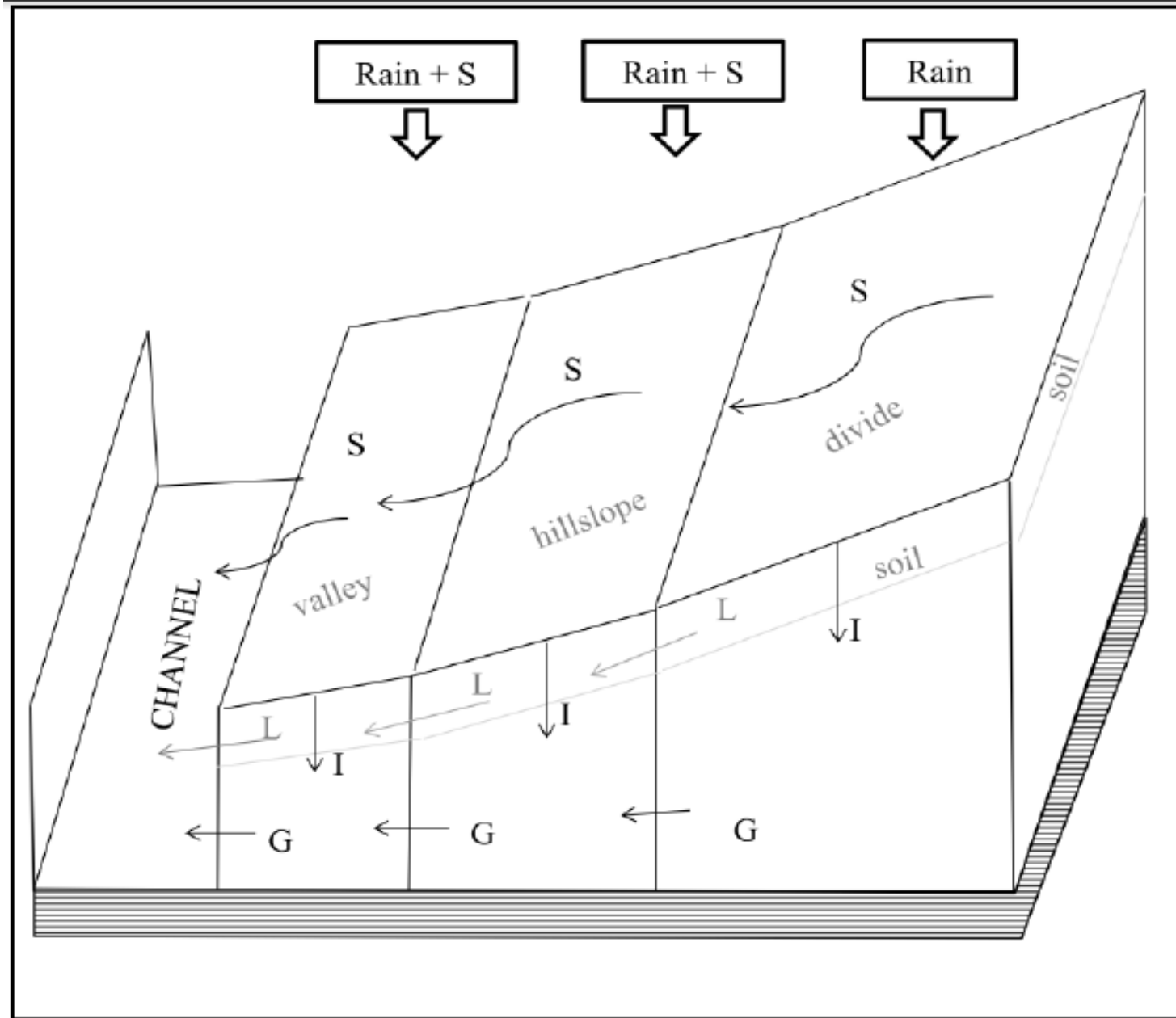


Fluvisols

Alternative : SWAT - LUD

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

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



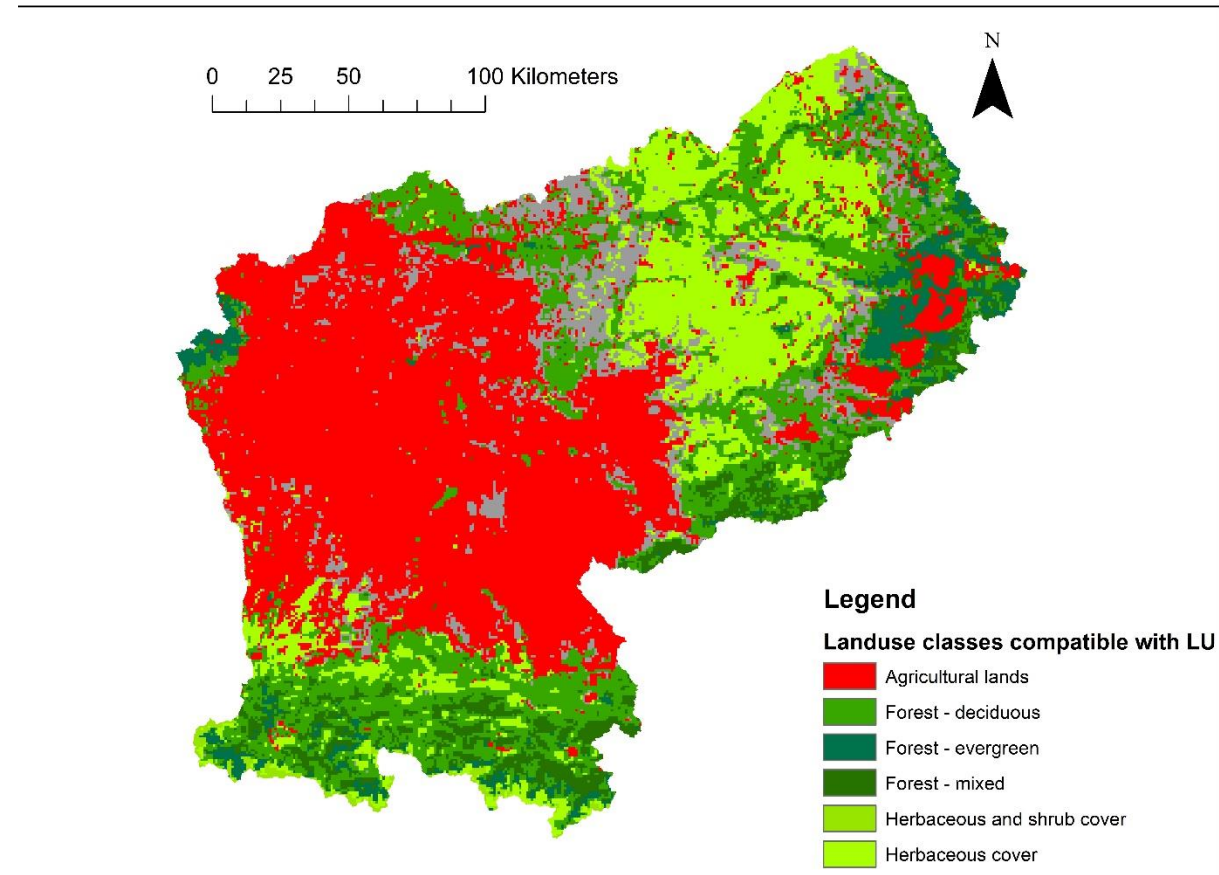
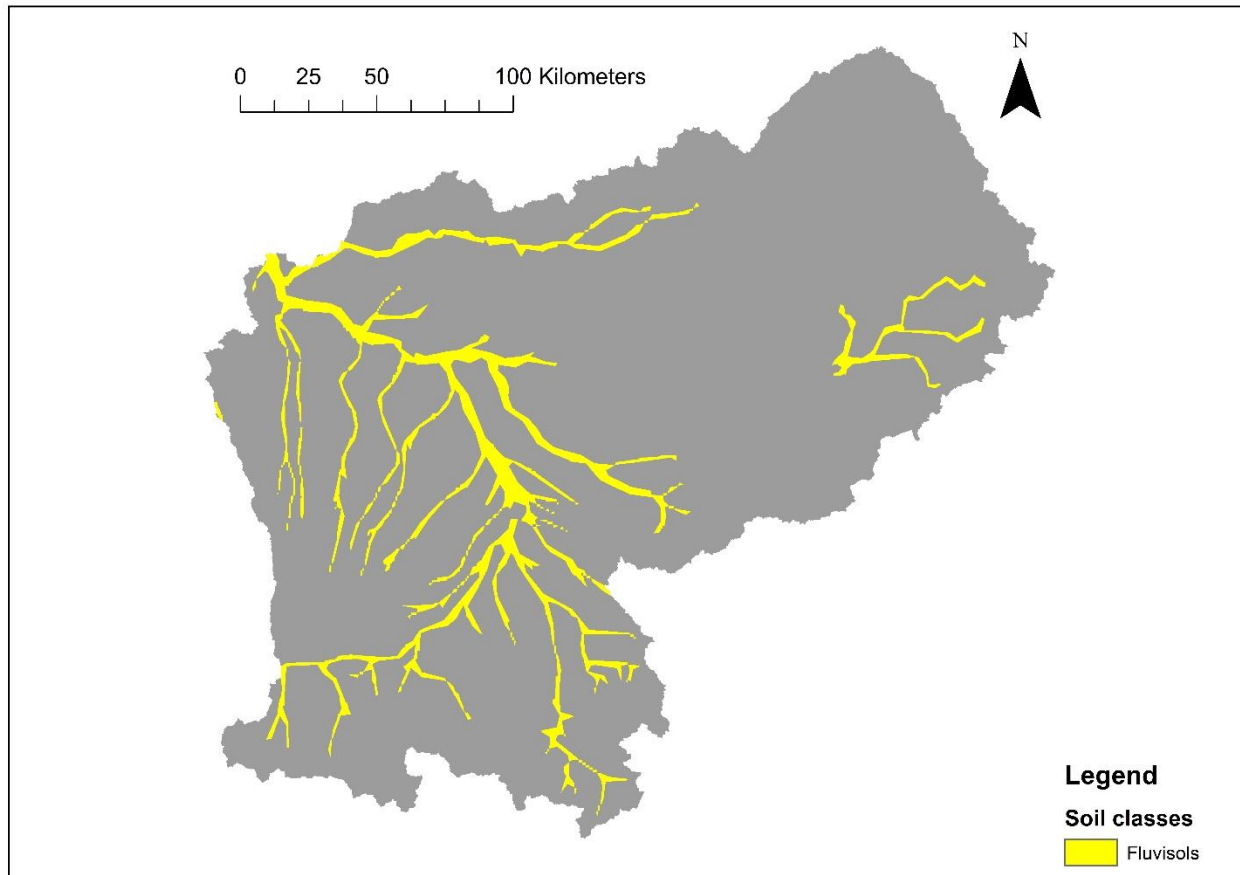
LU 1

LU 2

LU 3

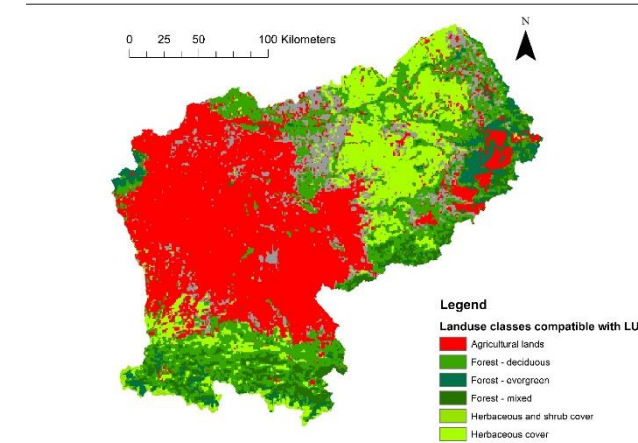
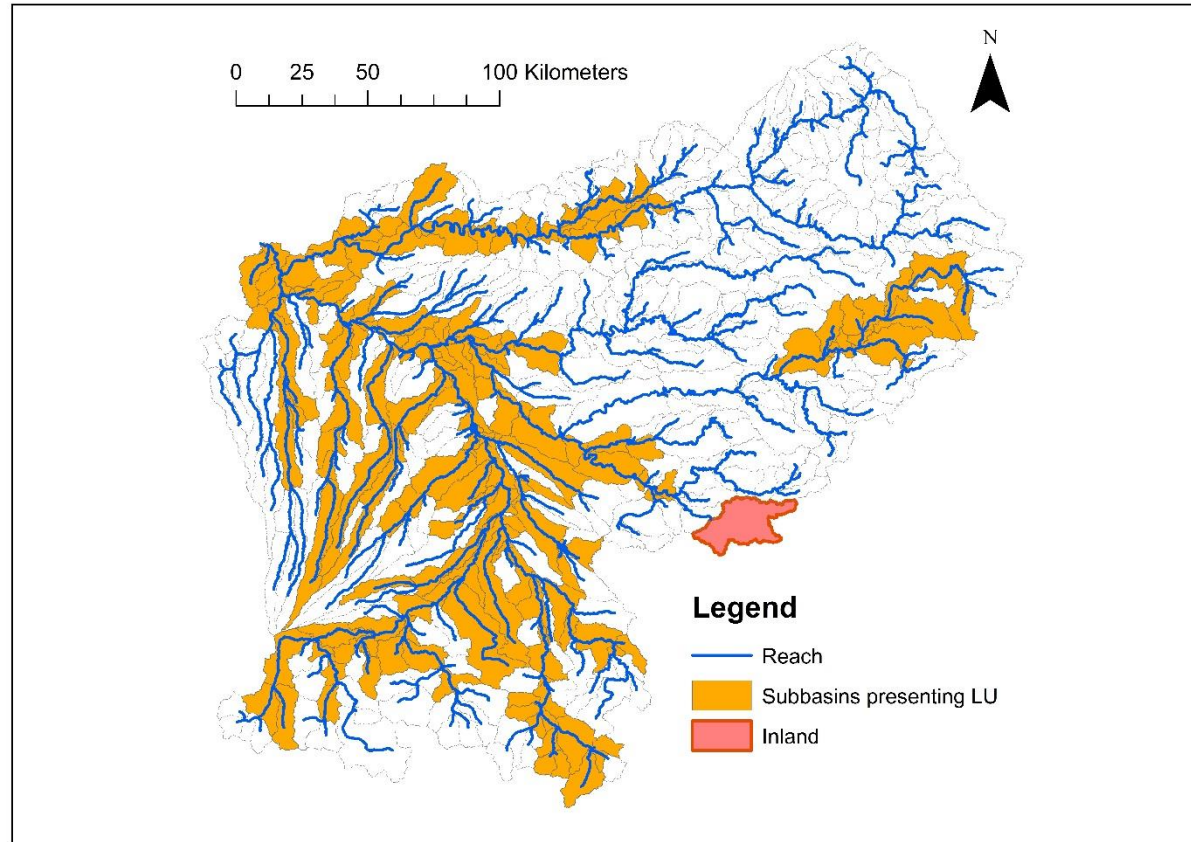
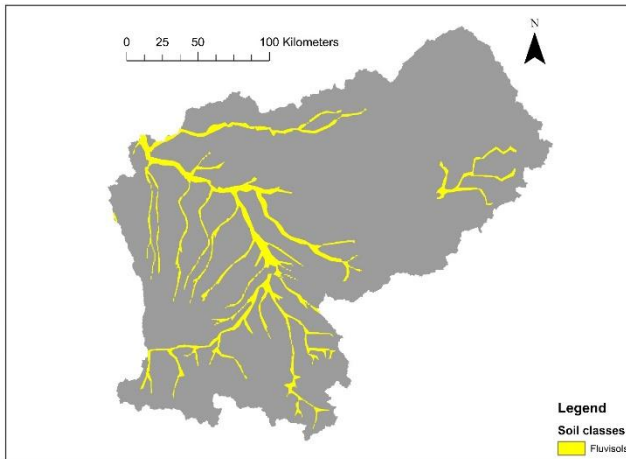
Alternative : SWAT - LUD

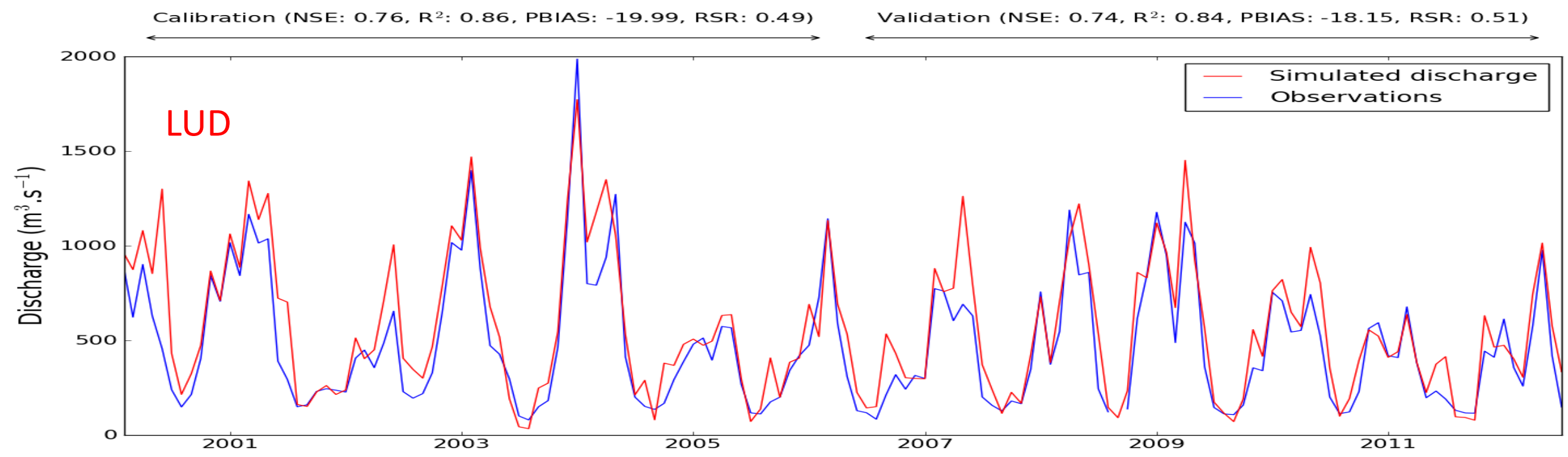
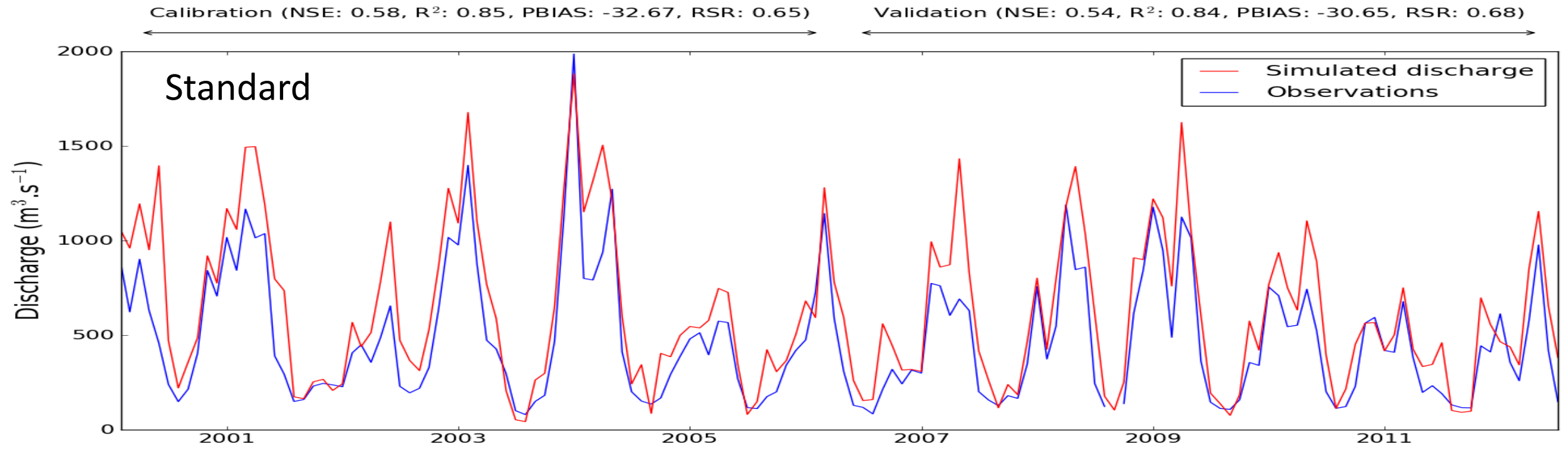
- Landuse and soil dependant

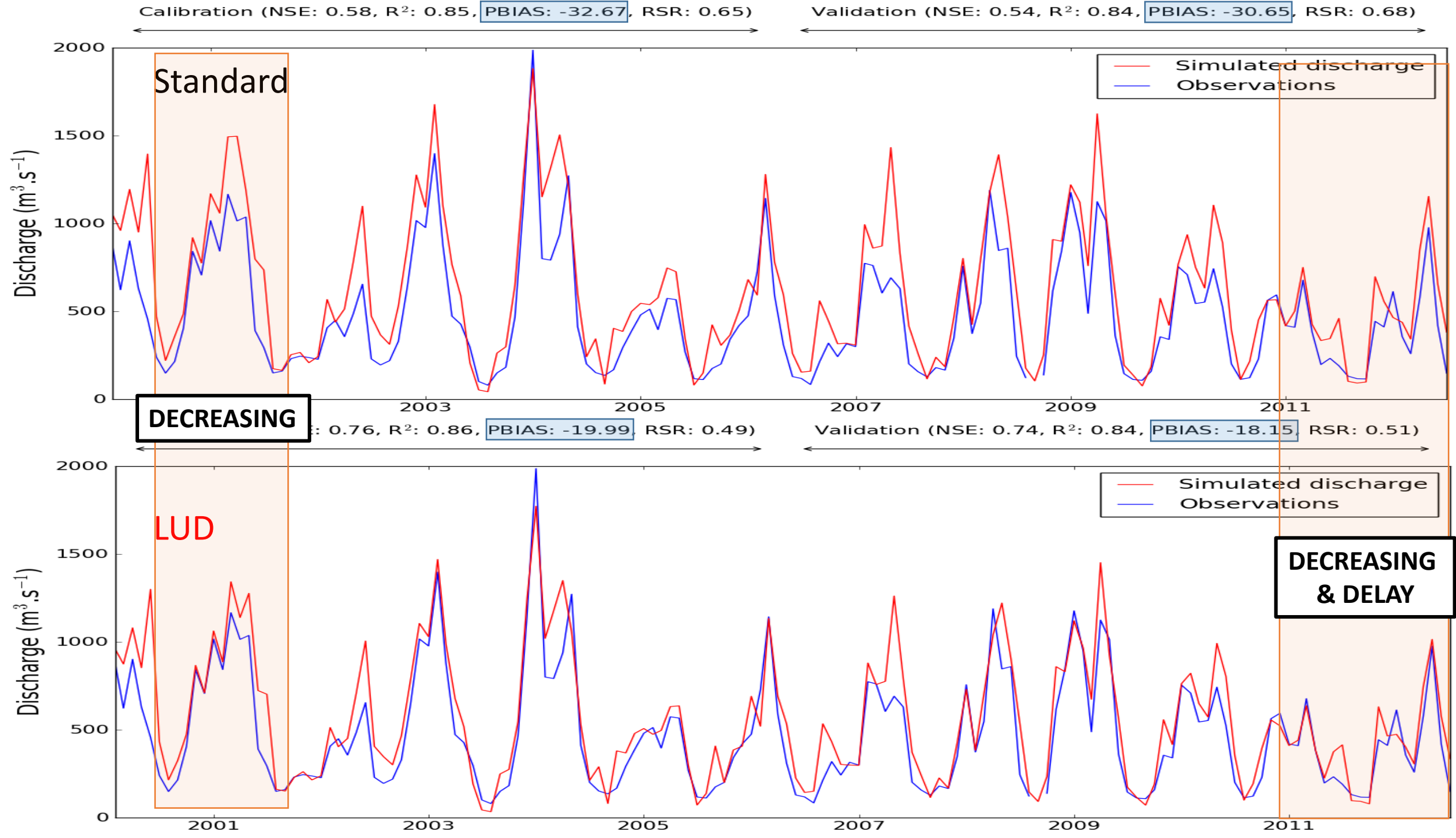


Alternative : SWAT - LUD

- Landuse and soil dependant



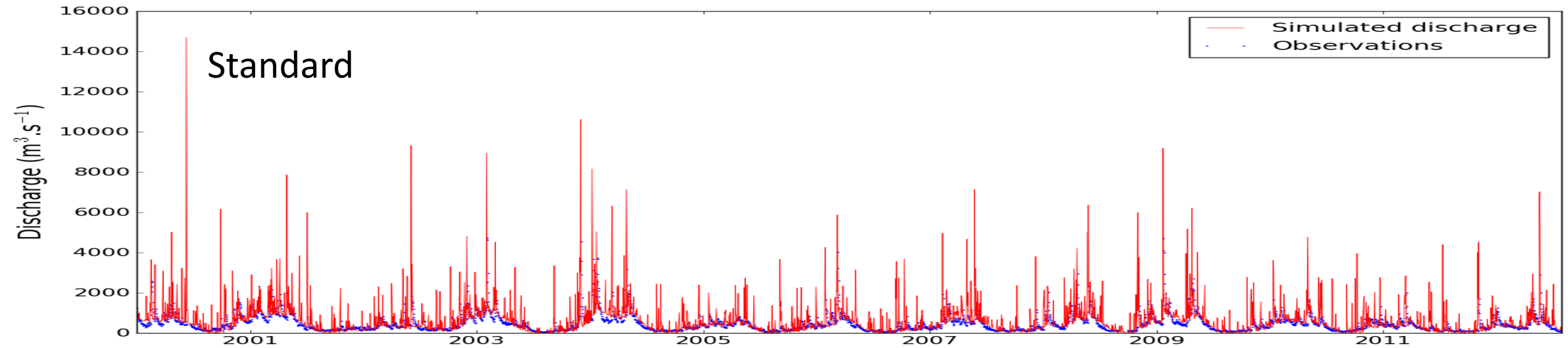




Daily time step

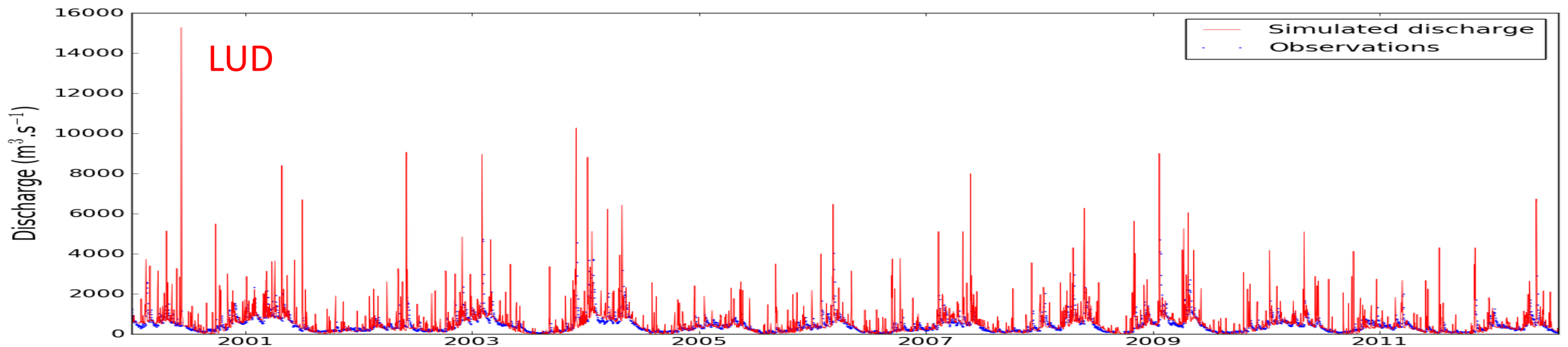
Calibration (NSE: -1.99, R^2 : 0.18, PBIAS: -31.85, RSR: 1.73)

Validation (NSE: -1.77, R^2 : 0.19, PBIAS: -30.37, RSR: 1.66)



Calibration (NSE: -1.98, R^2 : 0.14, PBIAS: -19.51, RSR: 1.73)

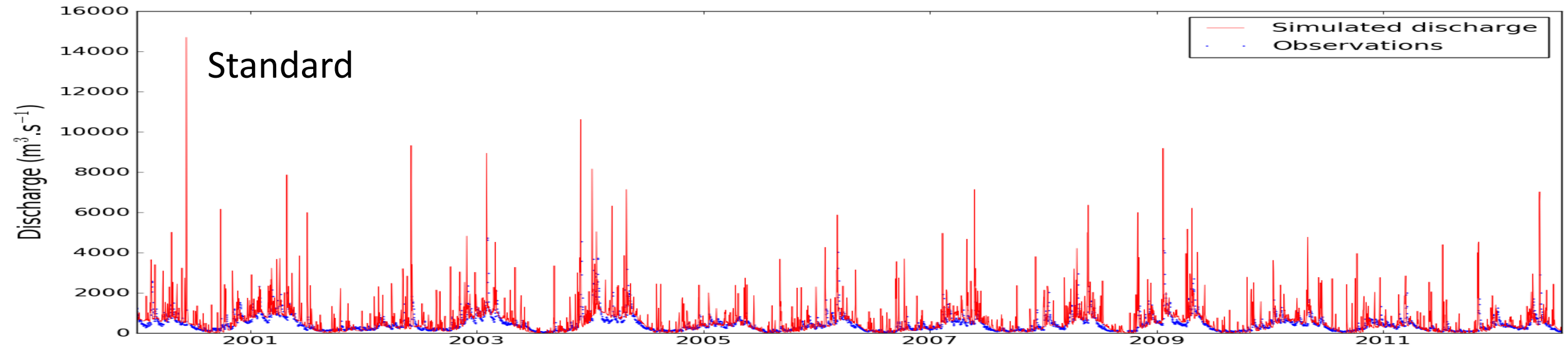
Validation (NSE: -1.70, R^2 : 0.15, PBIAS: -17.66, RSR: 1.64)



Daily time step

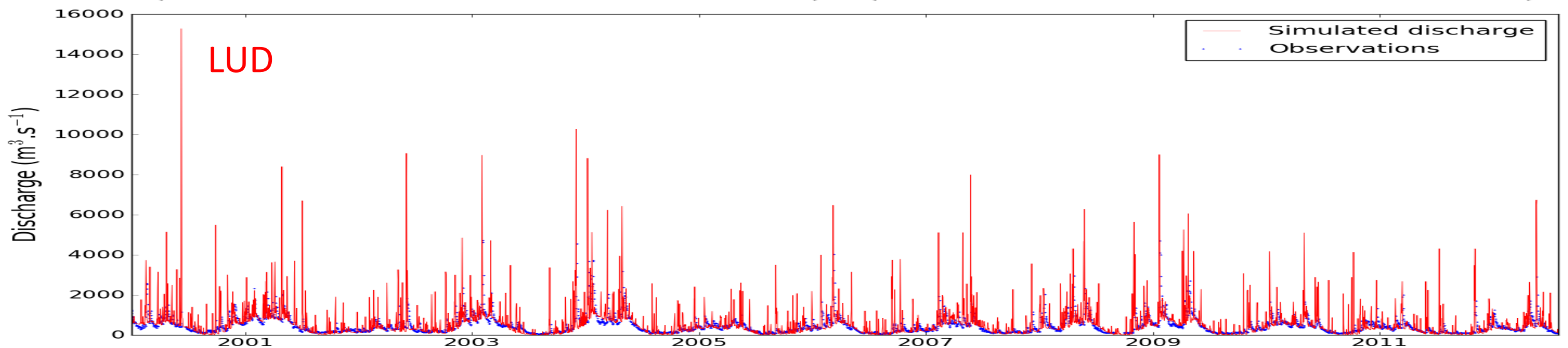
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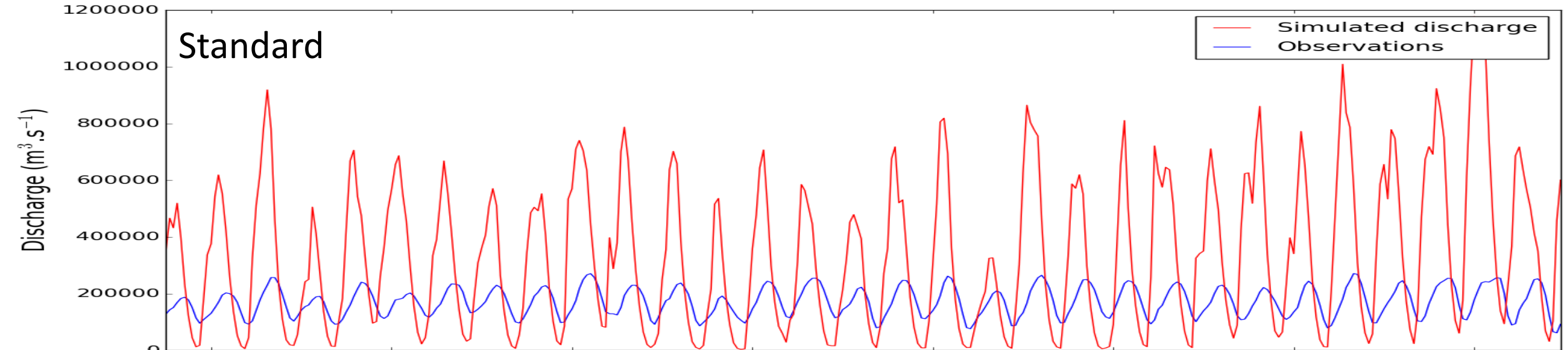
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Perspectives : Amazon River

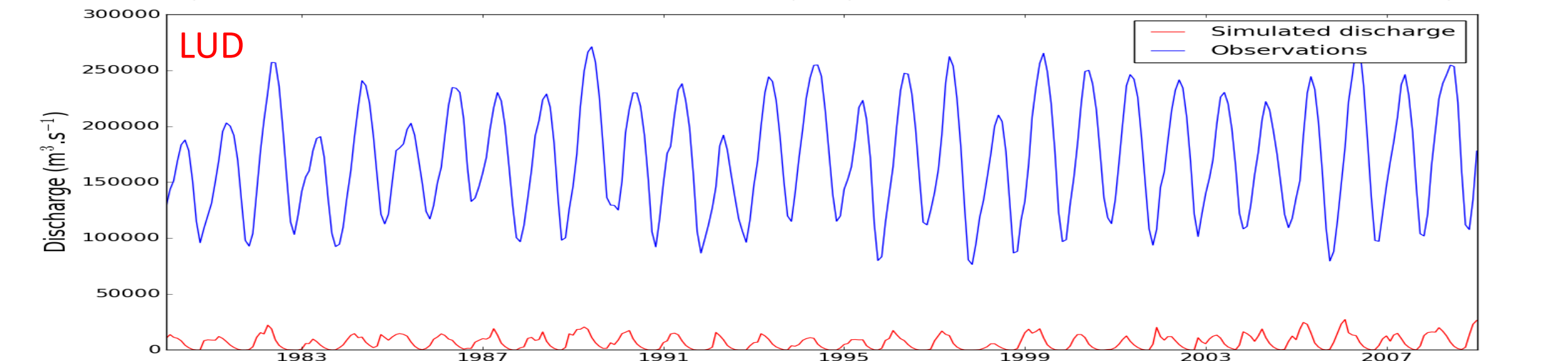
Calibration (NSE: -27.18, R^2 : 0.26, PBIAS: -75.62, RSR: 5.31)

Validation (NSE: -38.00, R^2 : 0.10, PBIAS: -112.78, RSR: 6.25)



Calibration (NSE: -12.00, R^2 : 0.20, PBIAS: 96.18, RSR: 3.60)

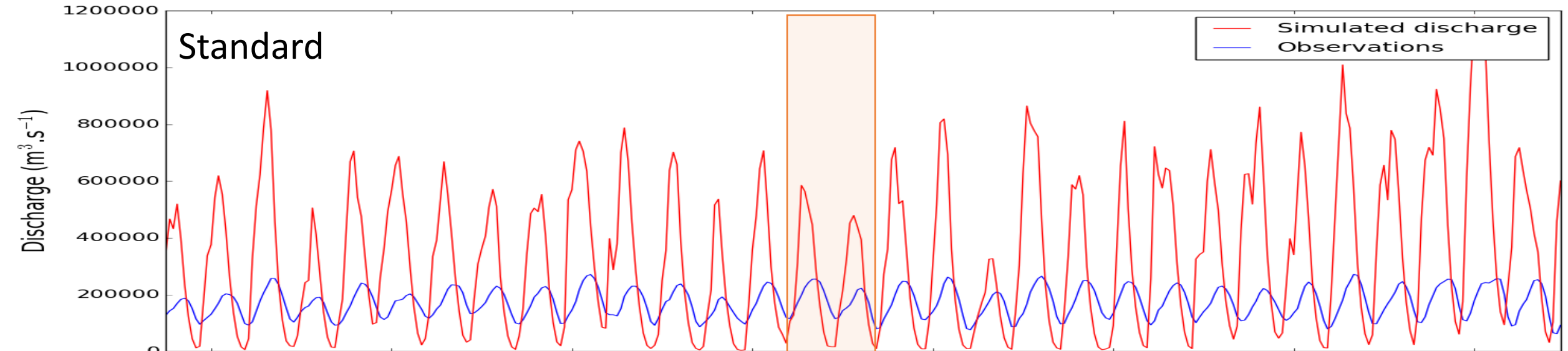
Validation (NSE: -9.92, R^2 : 0.05, PBIAS: 95.82, RSR: 3.30)



Perspectives : Amazon River

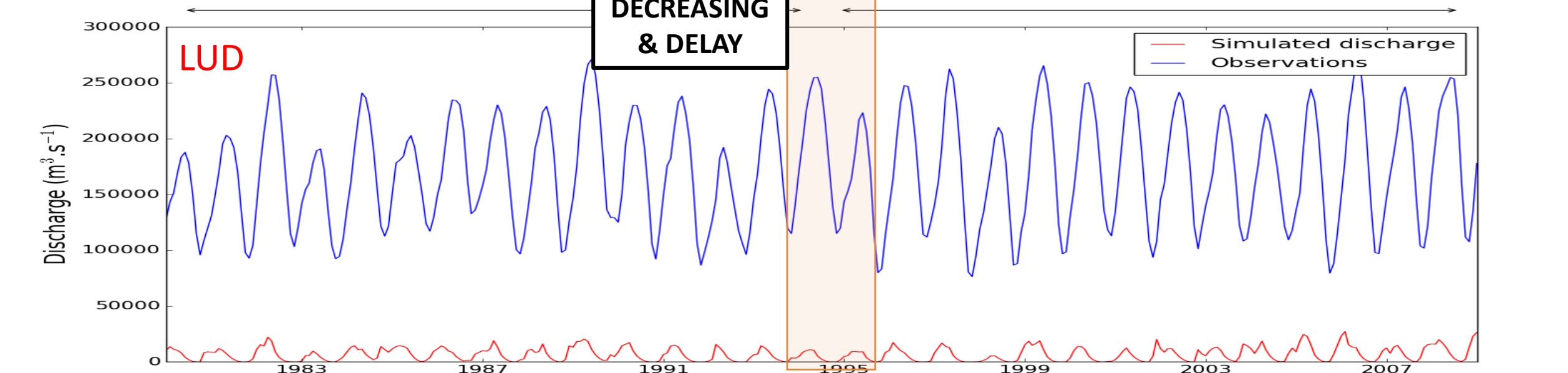
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Conclusion

- 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

