

Building a Hydrological Model of Europe

Karim C. Abbaspour, Elham Rouholahnejad

SWAT International Conference, Toulouse

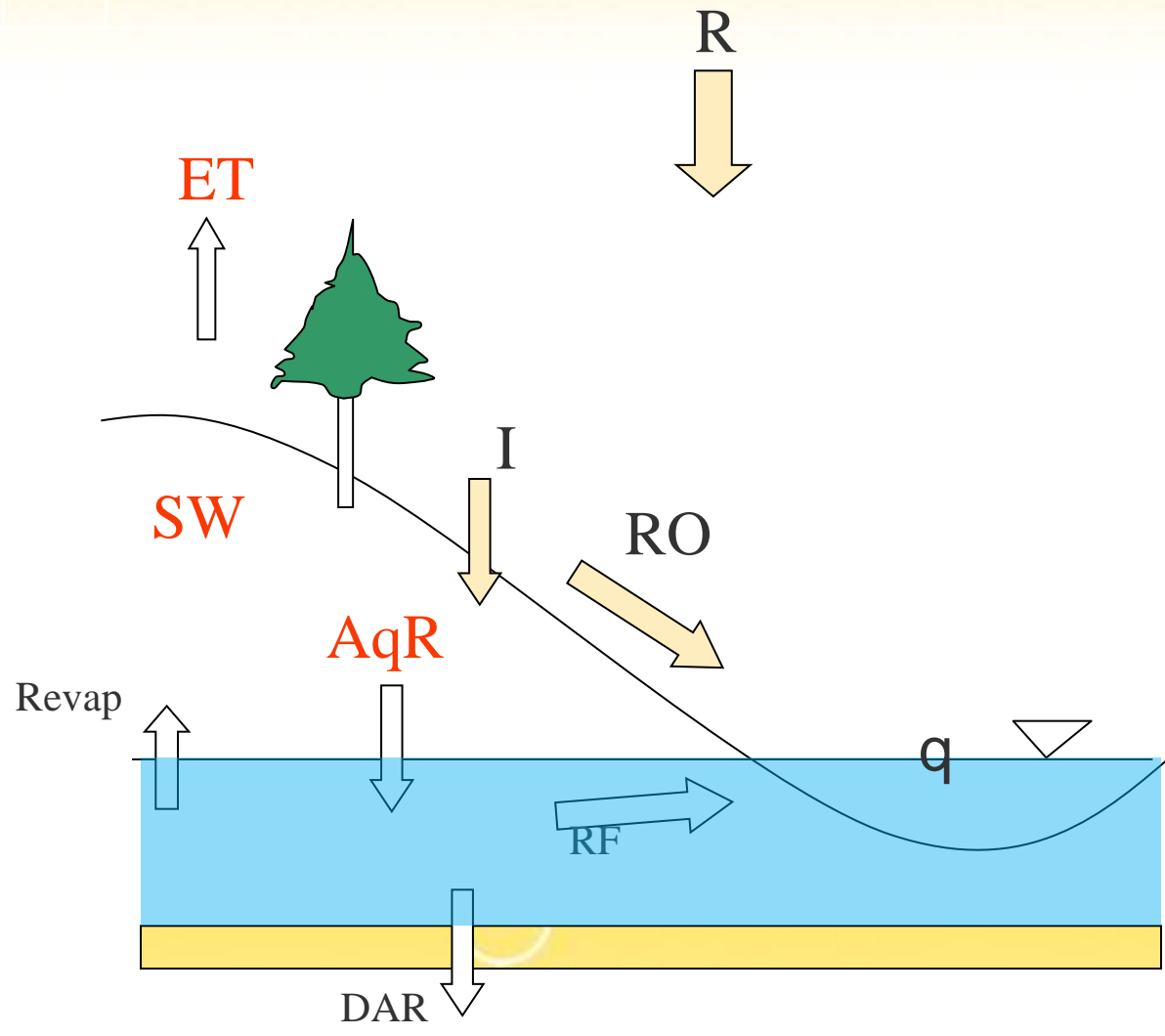
European Framework 7 Projects:

EnviroGRIDS—Building Capacity for a Black Sea Basin
Observation and Assessment System supporting
Sustainable Development

GENESIS- Groundwater and Dependent Ecosystems:
NEw Scientific and Technical BasIS for Assessing Climate
Change and Land-use Impacts on Groundwater Systems

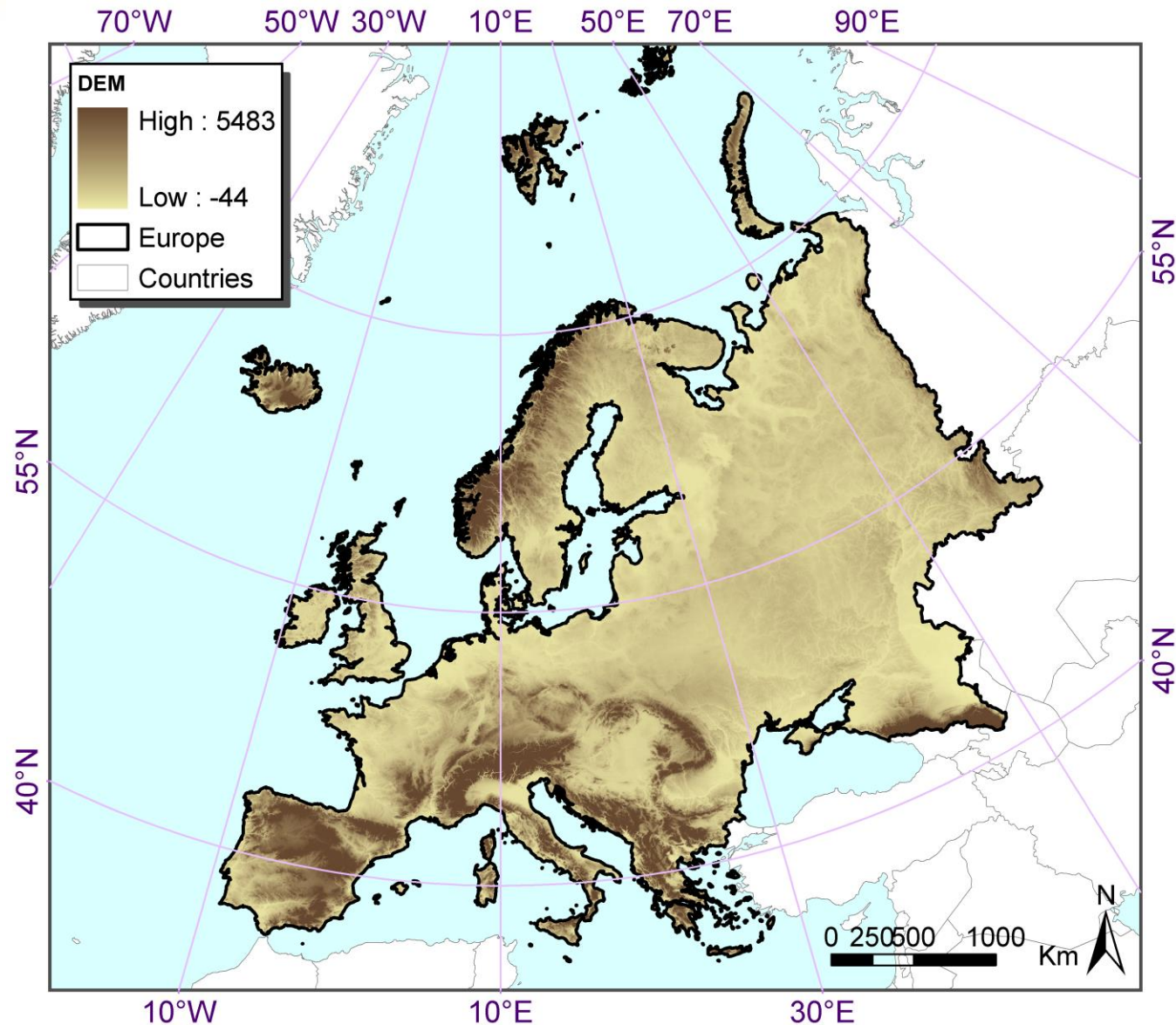
Objectives

- Build a hydrological model of Europe including water quality
 - Water resources (blue and green)
 - Groundwater recharge
 - Nitrate in groundwater recharge
- To see the limits of building a high-resolution large-scale model, and the possibility to calibrate such a model



DEM

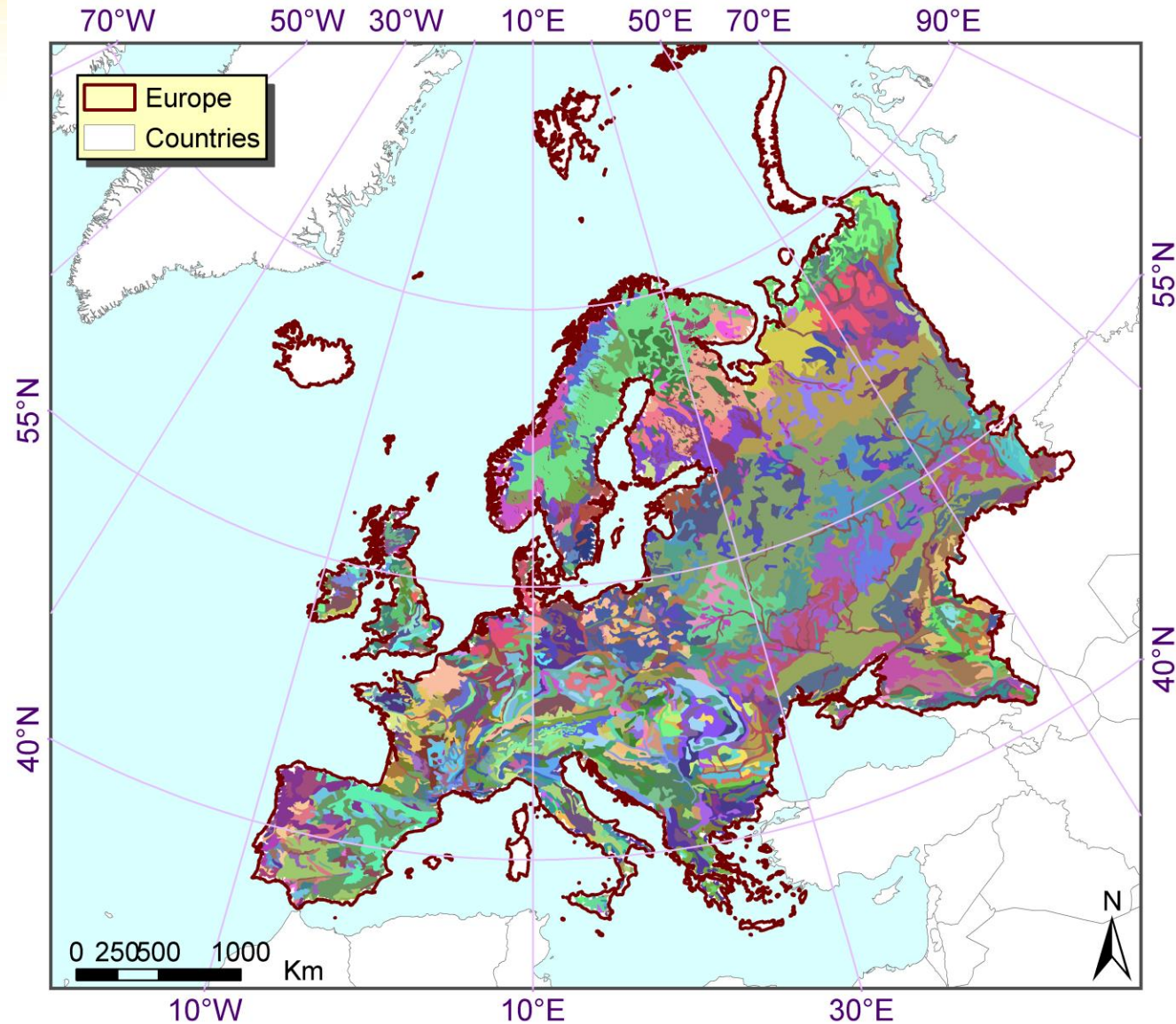
SRTM 90 m
aggregated
to 700 m



Soil Map

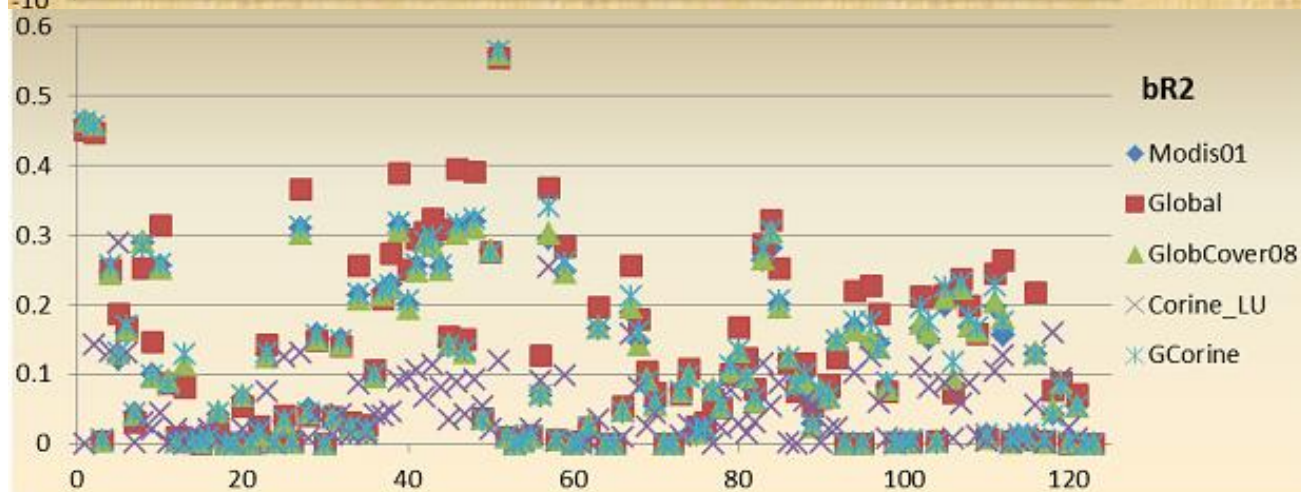
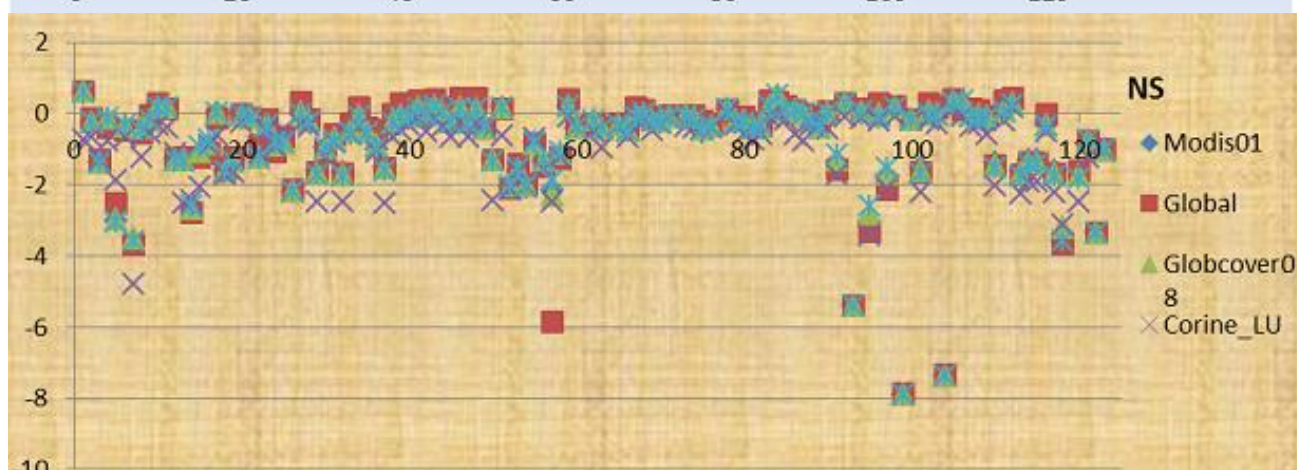
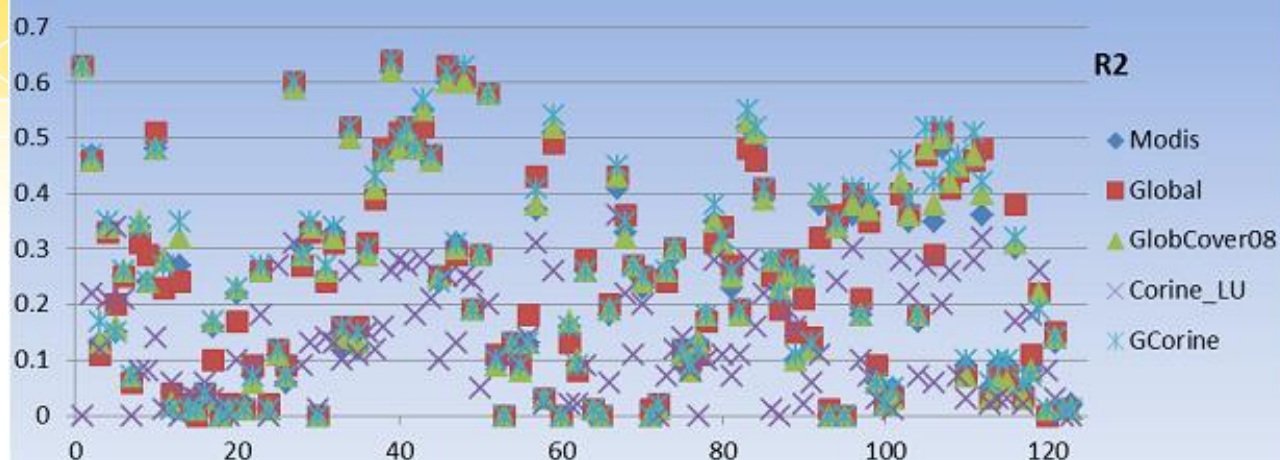
Soil

FAO global soil map (FAO, 1995)



Landuse

- (i) Global Landuse/Land Cover Characterization (GLCC) at 1 km spatial resolution from USGS
- (ii) MODIS land cover with spatial resolution of 500 m
- (iii) GlobCover with spatial resolution of 300 m by European Space Agency (ESA_a)
- (iv) Global Corine at 300 m spatial resolution provided by European Space Agency (ESA_b)



Climate data

- ECAD: 0.25° grid
- **CRU: 0.5° grid**
- NCAR: 1° grid
- Observed station data

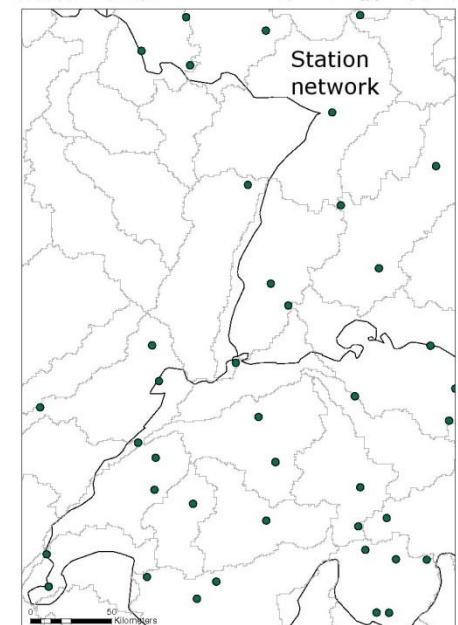
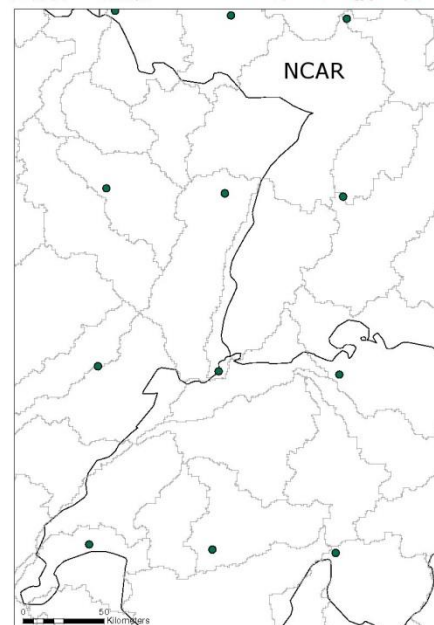
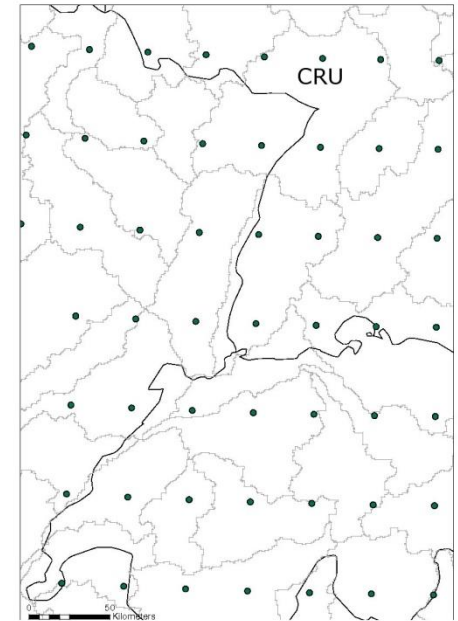
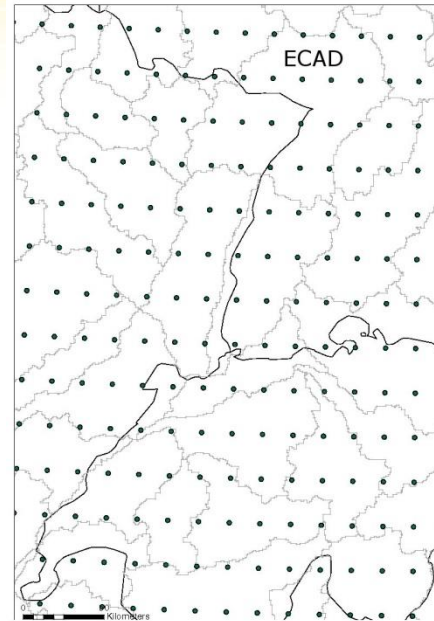


Table 3. Mean annual river discharges for a selection of European rivers based on four different climate datasets. The GRDC values are the observed annual average river discharges, all in $m^3 s^{-1}$

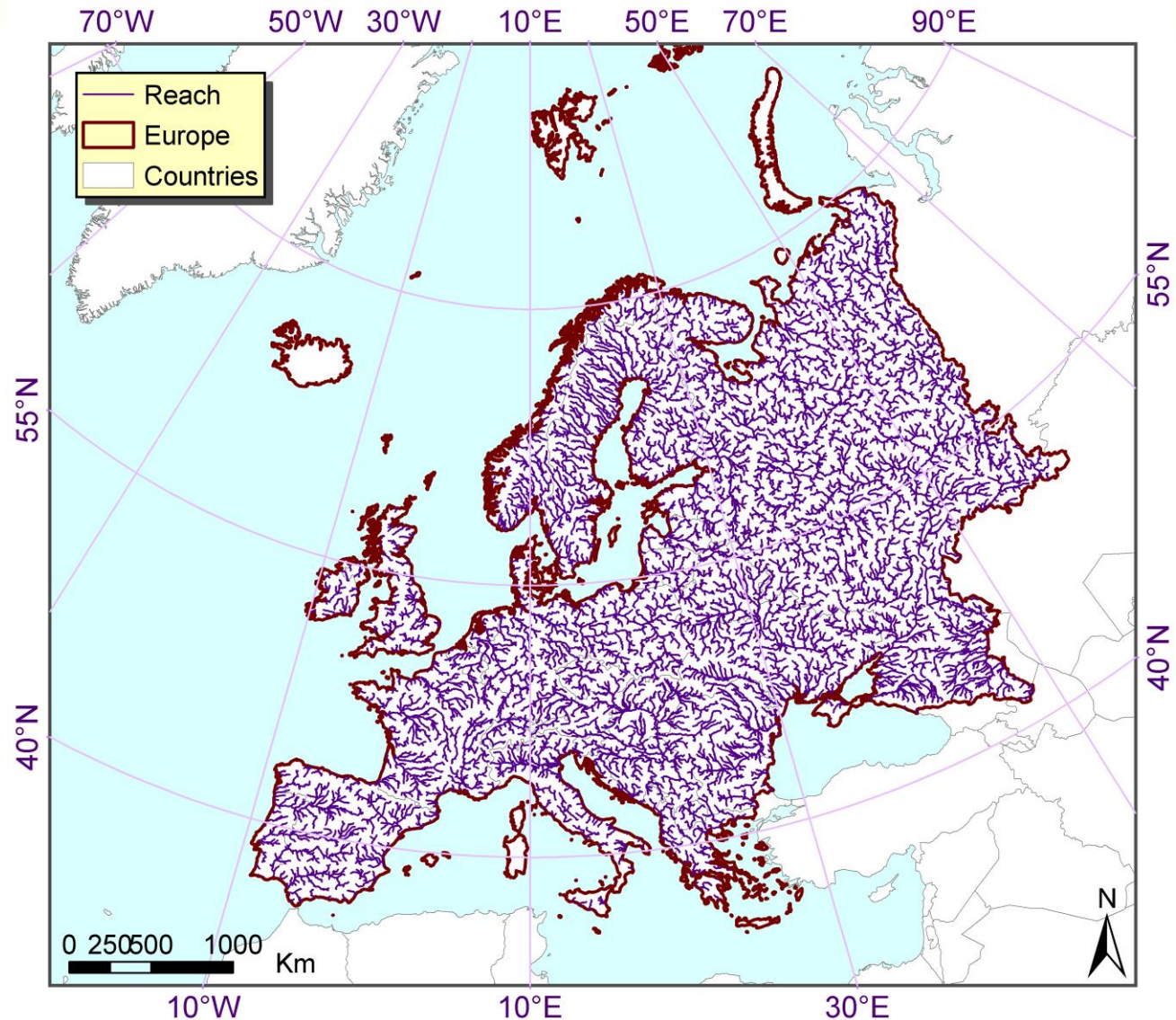
			Climate database			
River	Station Name	GRDC	ECAD	CRU	NCAR	Observed
Volga	Volgograd	8141	5570	6924	5951	7465
Danube	Ceatal Izmail	6415	3243	5244	4724	4204
Pechora	Oksino	4444	1849	2396	2330	2277
North. Dvina	Ust-Pinega	3331	1419	1597	1470	1705
Rhine	Lobith	2229	1725	2065	2110	1589
.....	:	:	:	:	:	:
.....	:	:	:	:	:	:
Maros	Mako	173	9	95	86	85
Olt	Stoenesti	161	21	62	67	47
Szamos	Satu Mare	126	41	63	81	54
Trent	Colwick	85	67	65	59	61
Thames	Teddington	82	37	47	72	36
Root Mean Square Error			5500	3360	4100	3900

□

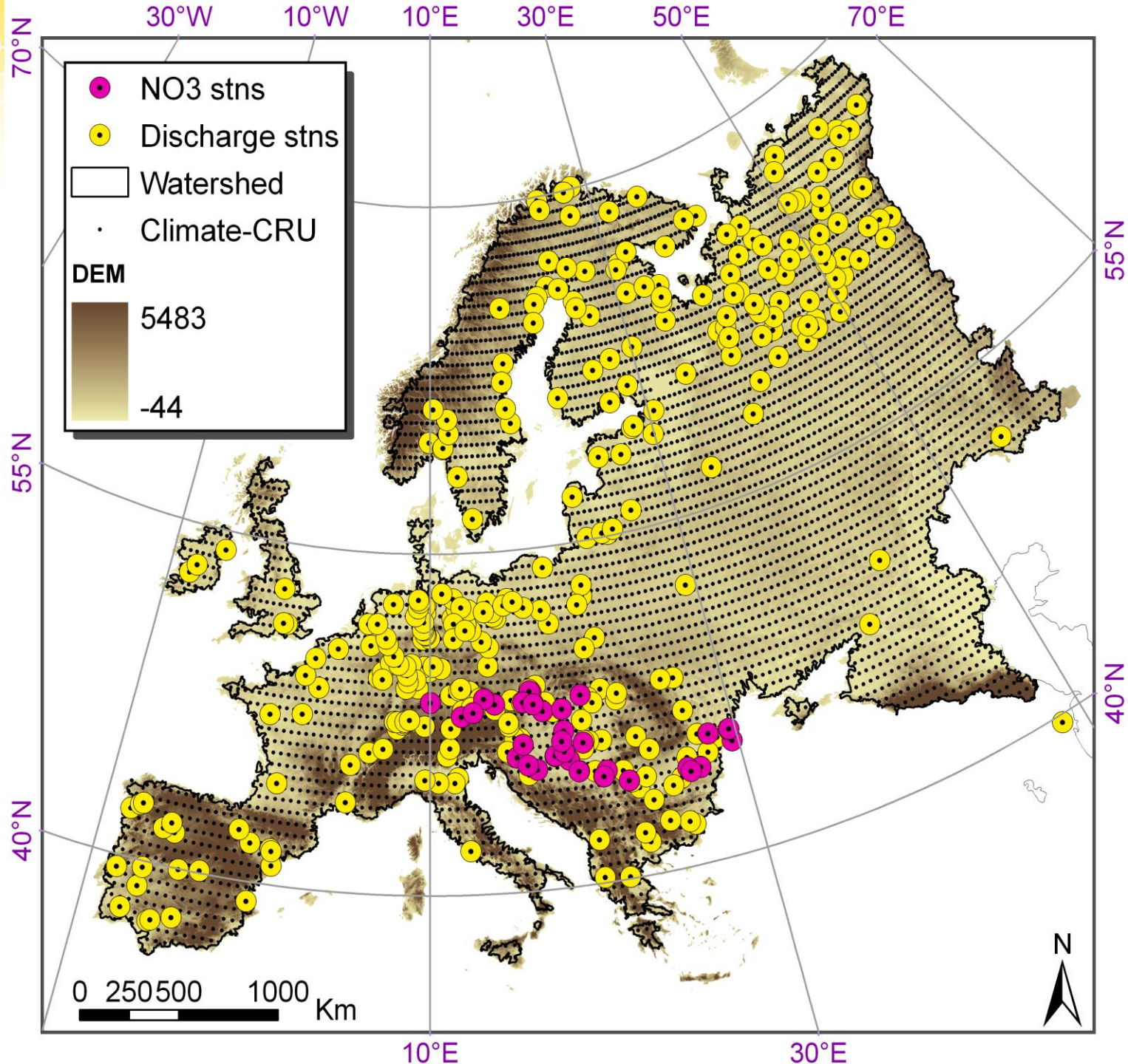
River Network

The river
dataset from
European
Catchments
and Rivers
Network
System
(Ecrins)

100 m

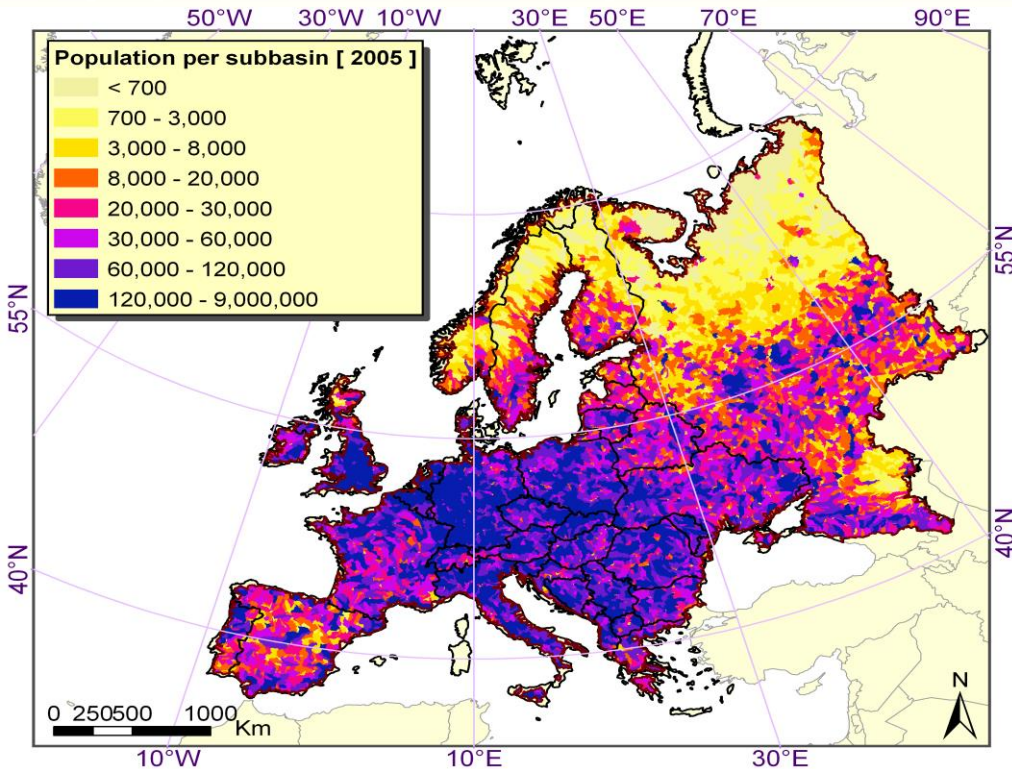


Discharge And Nitrate stations



Point Sources

$$Load_{NO3} = POP_i * \left[\left(1 - S_{rate} * N / PE \right) + \left((1 - T_{Eff}) * S_{rate} * N / PE \right) \right]$$



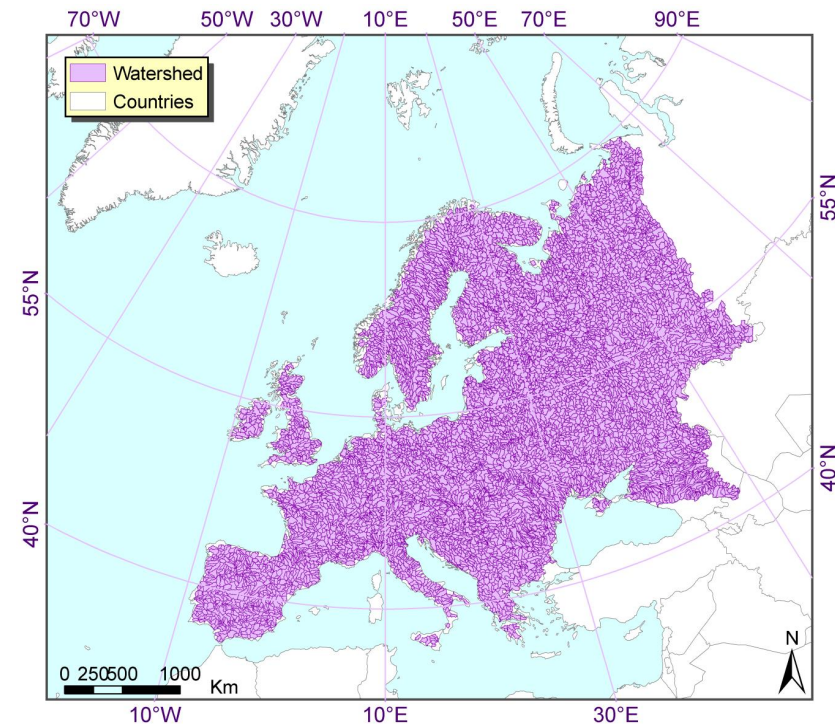
Load NO3 g/day

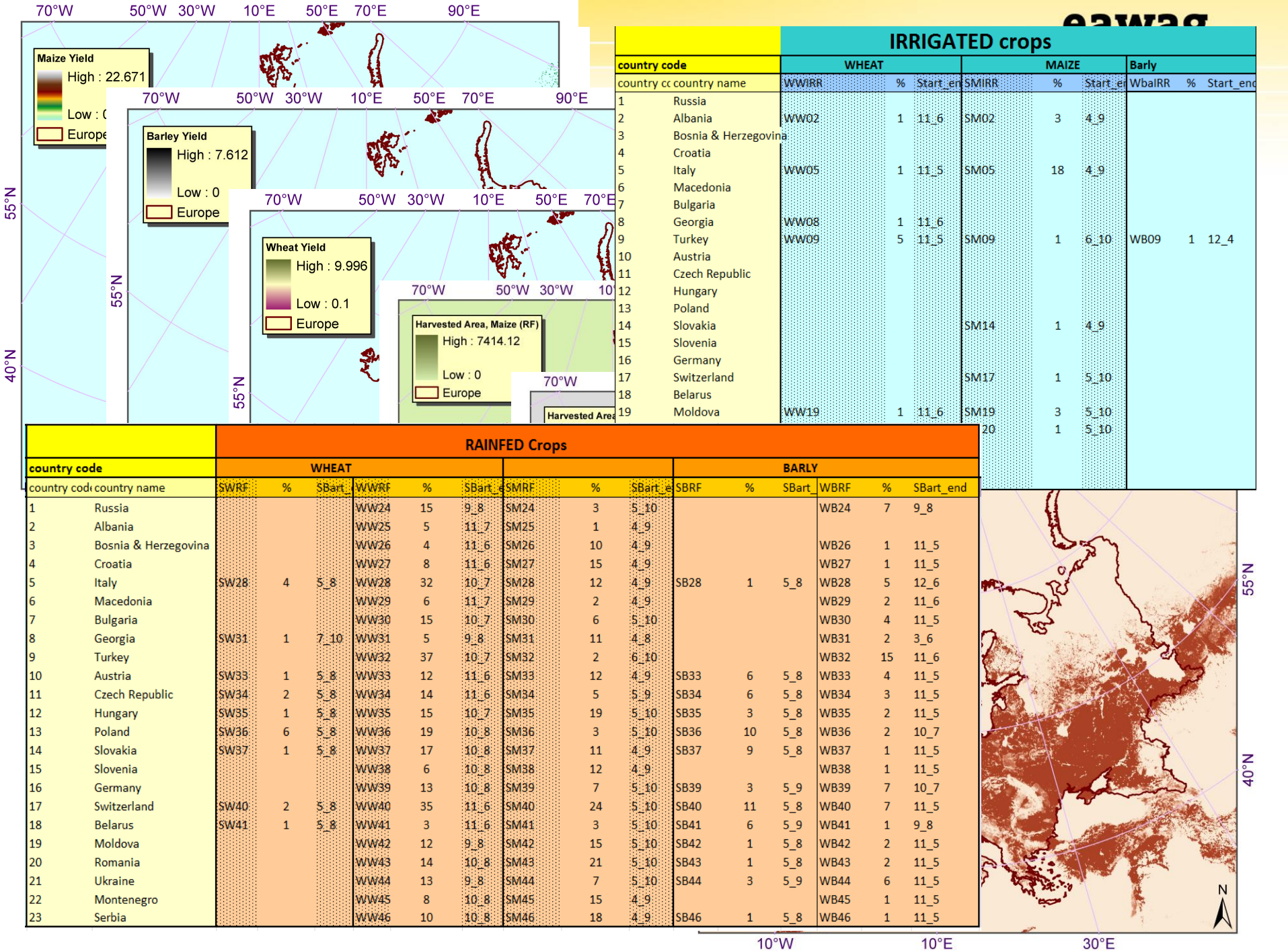
$T_{eff} = 0.8$ treatment efficiency

$N = 8.8$ g

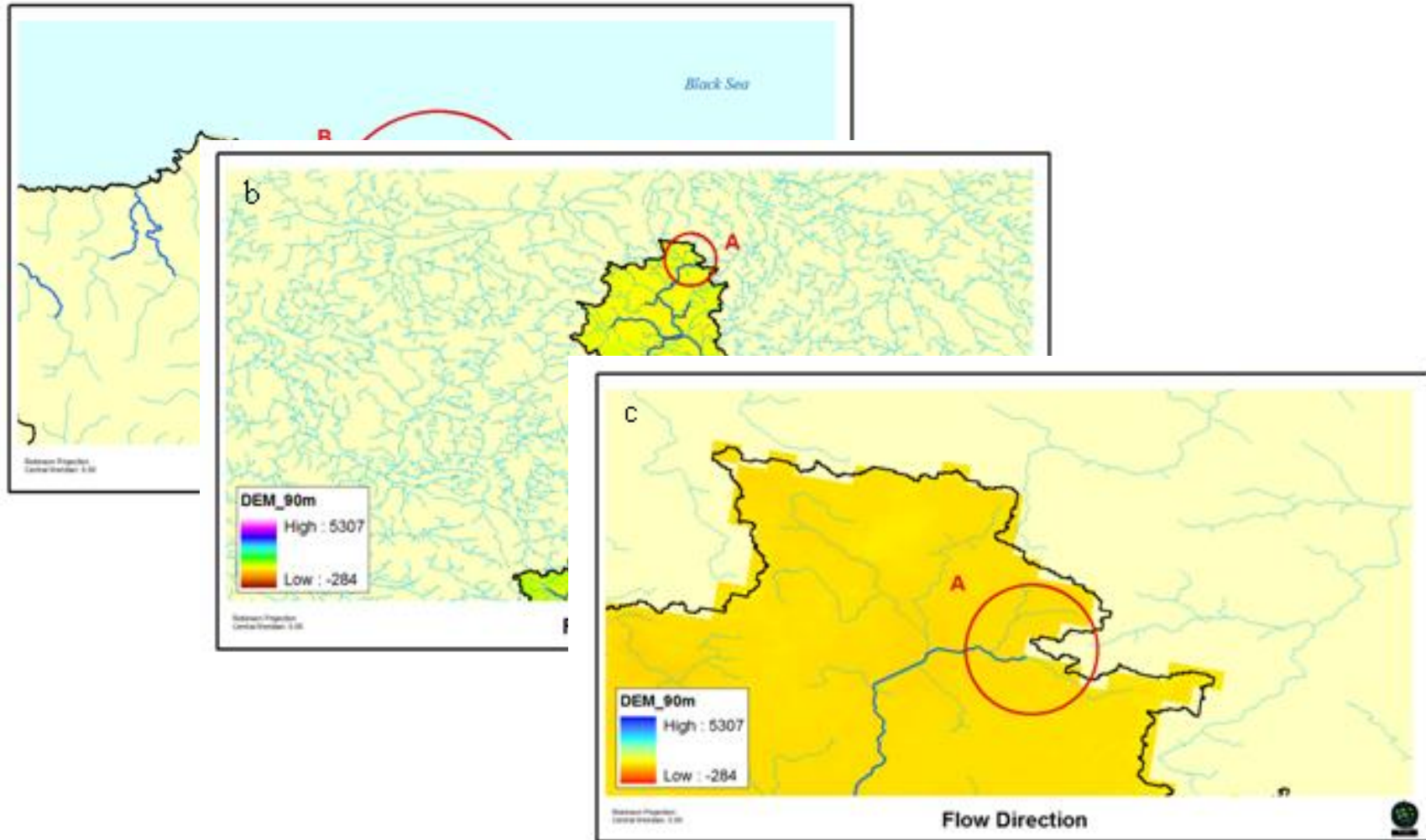
$S_{rate} =$ As presented in table 2..

$PE = 0.63$

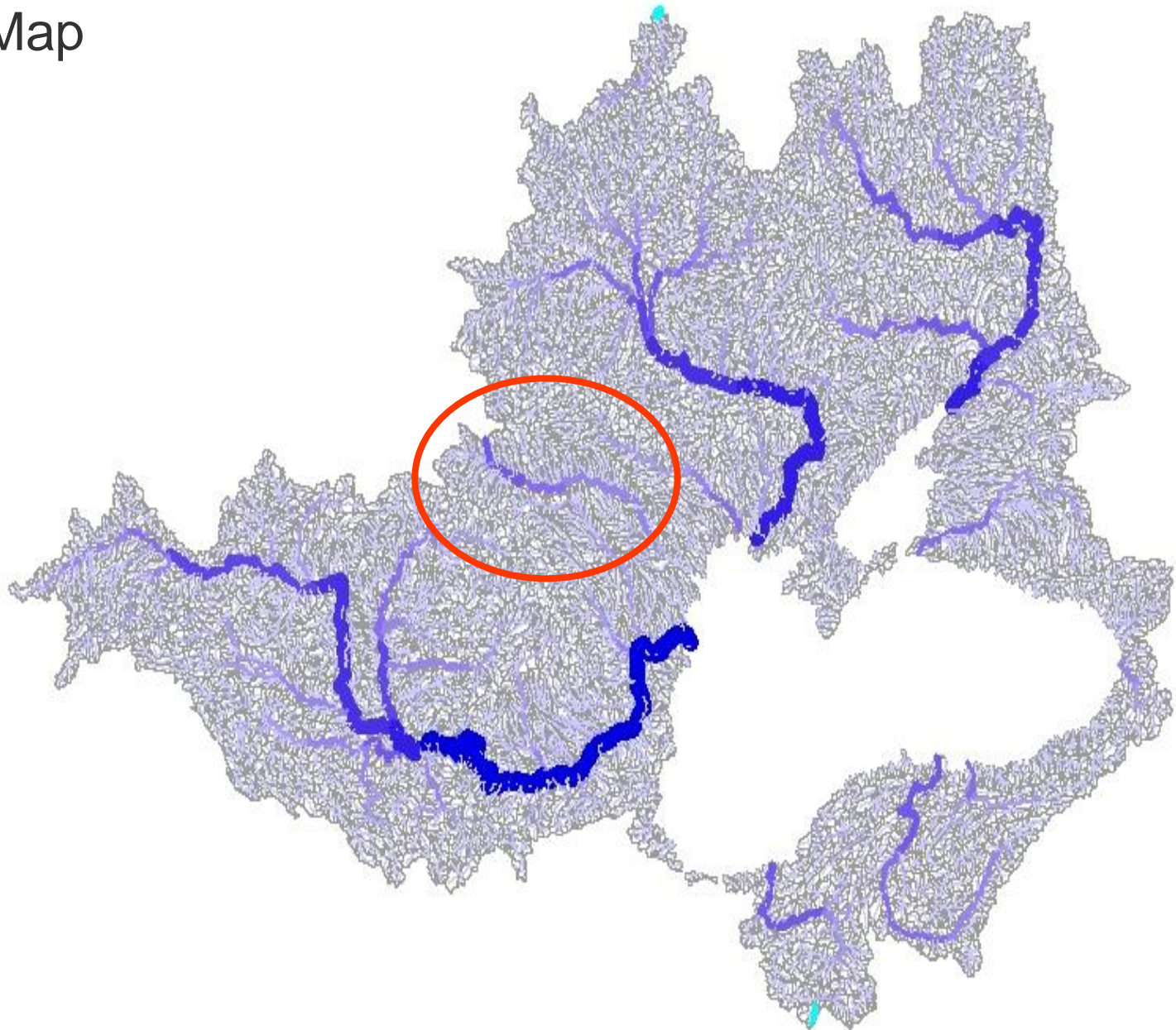




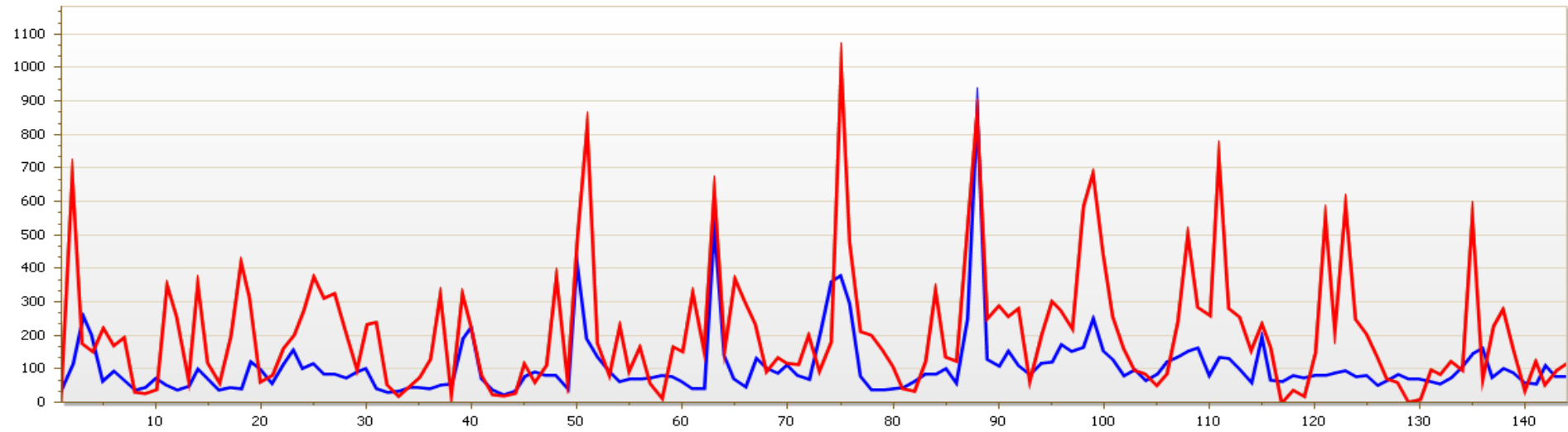
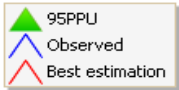
Difficulties with database



Flow Map



q_5842

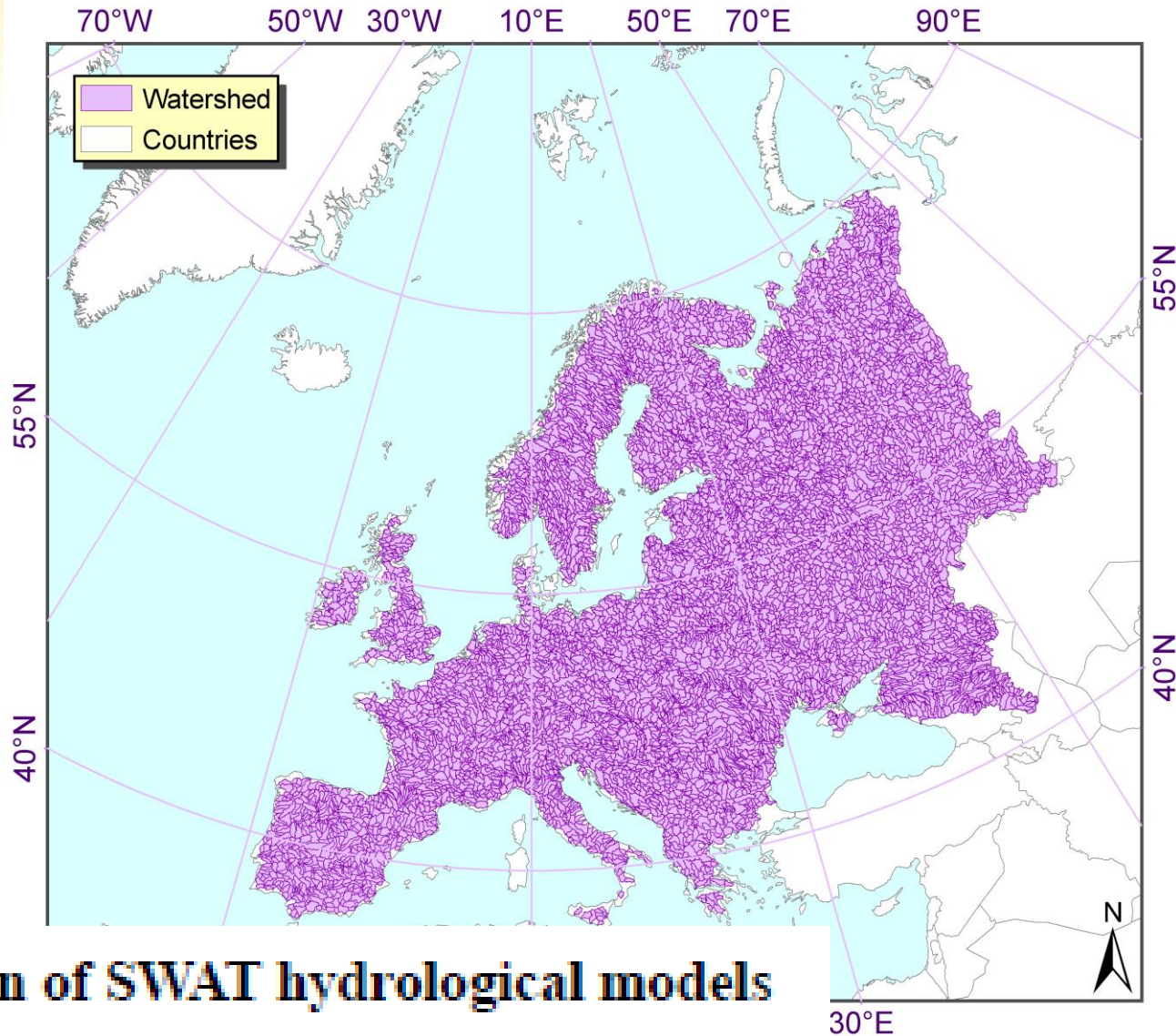


8592 subbasins

60,012 HRUs

23 hrs run

Run on a network
of 50 Linux
computers



Grid based calibration of SWAT hydrological models

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¹Computer Science Department, Technical University of Cluj-Napoca, Romania

²EAWAG, Swiss Federal Institute for Aquatic Science and Technology, Switzerland

CUPL

EU5.Sufi2 - SWAT-CUP

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Edit Calibration - Validation Print Tools Window Help

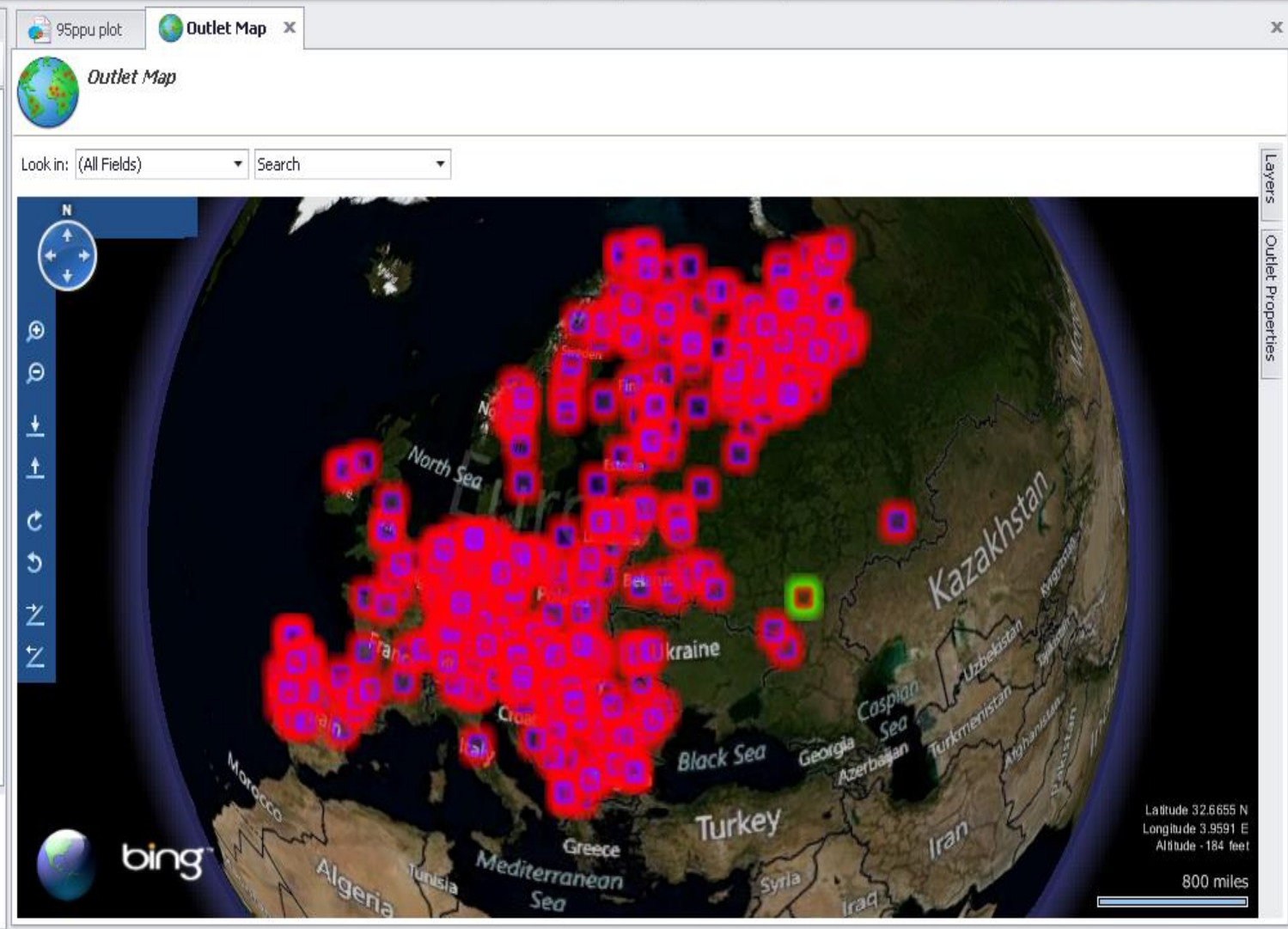
Project Explorer

95ppu plot Outlet Map

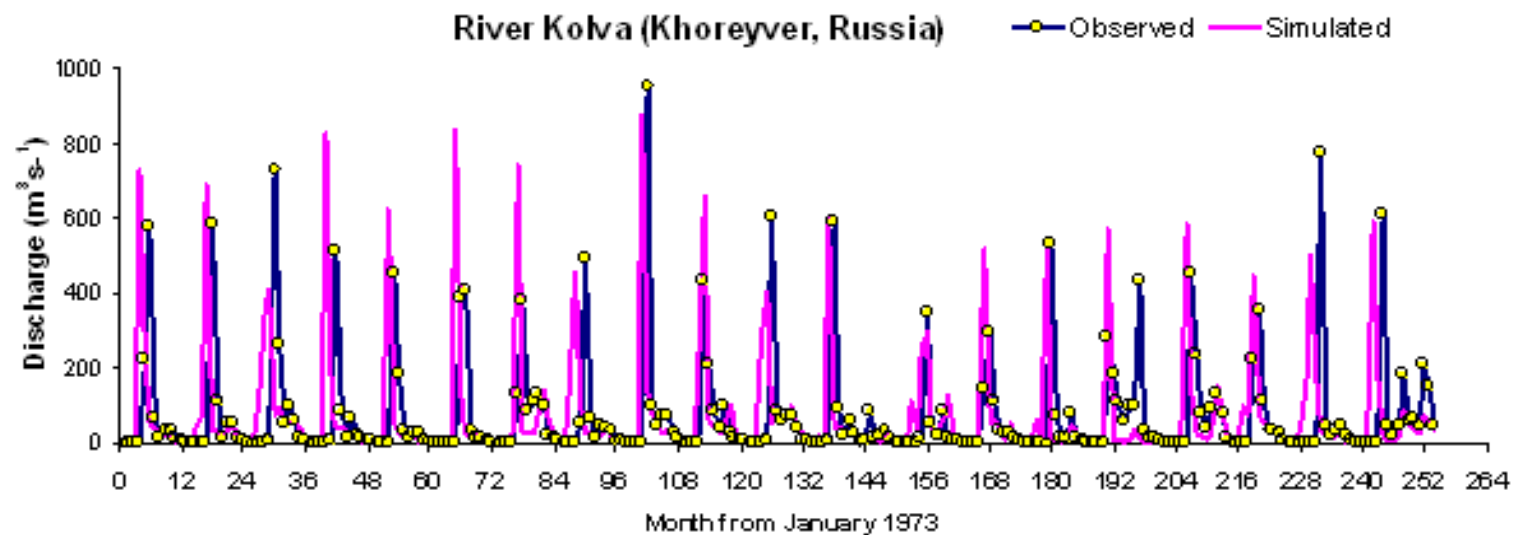
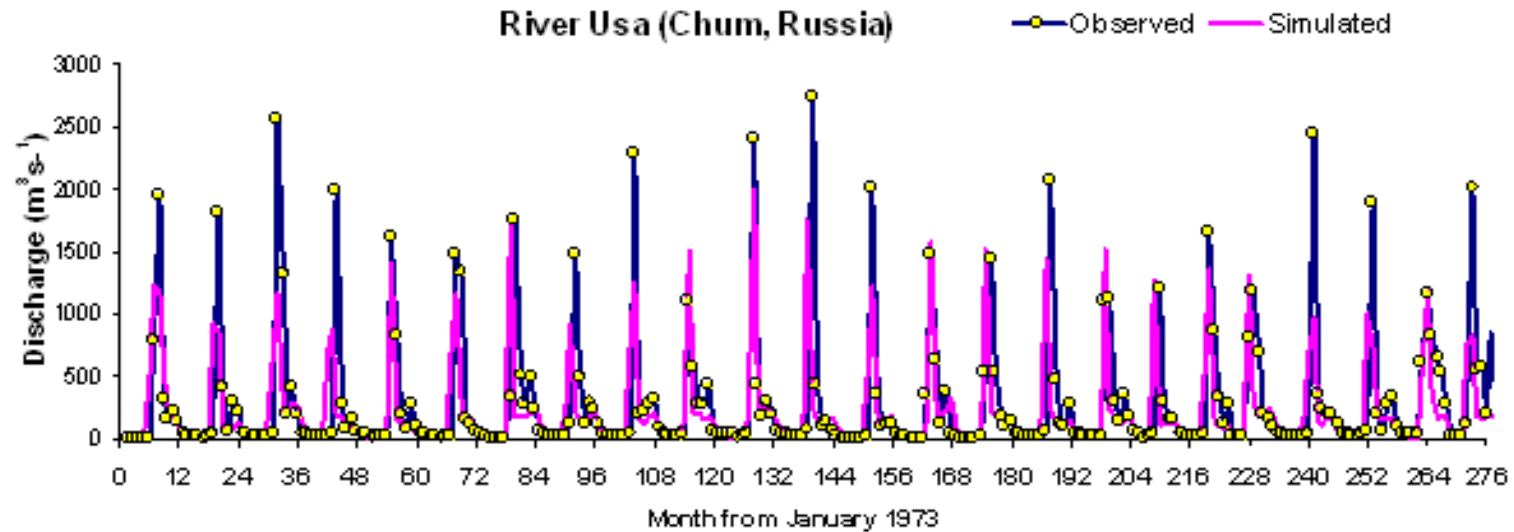
EU5

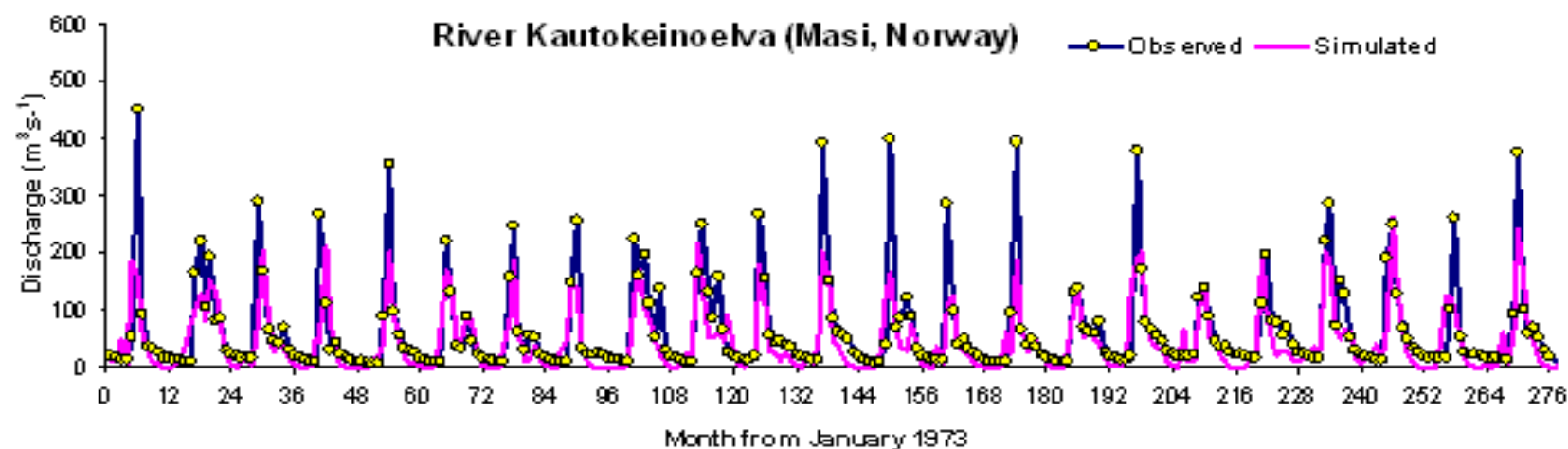
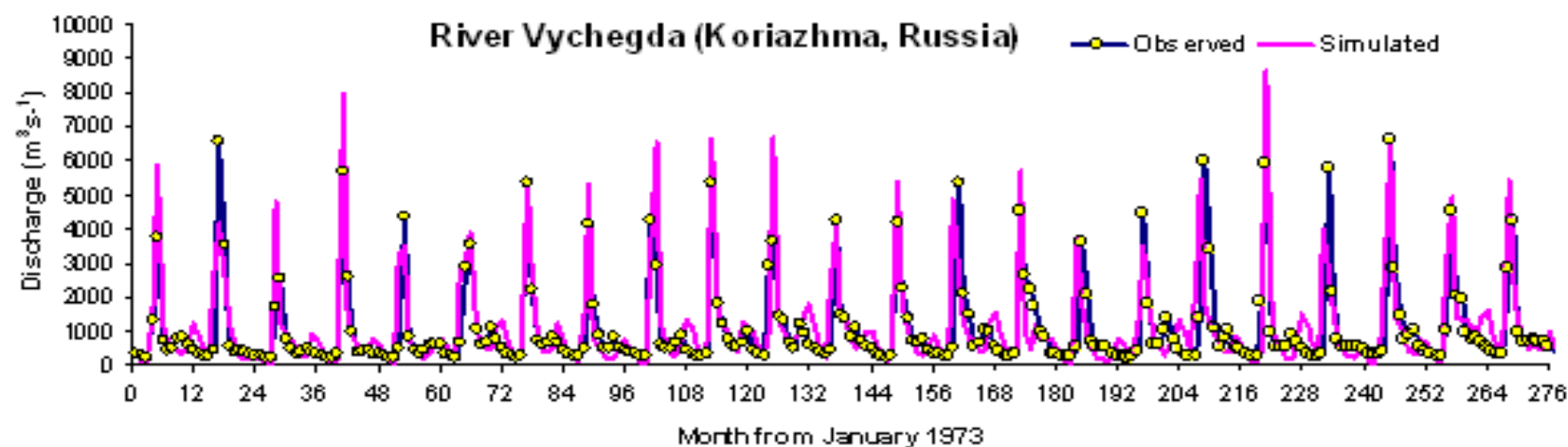
- Calibration Inputs
- Executable Files
- Calibration Outputs
- Sensitivity analysis
- Maps
 - Outlet Map
- Utility Programs
- Iteration History

Outlet Map

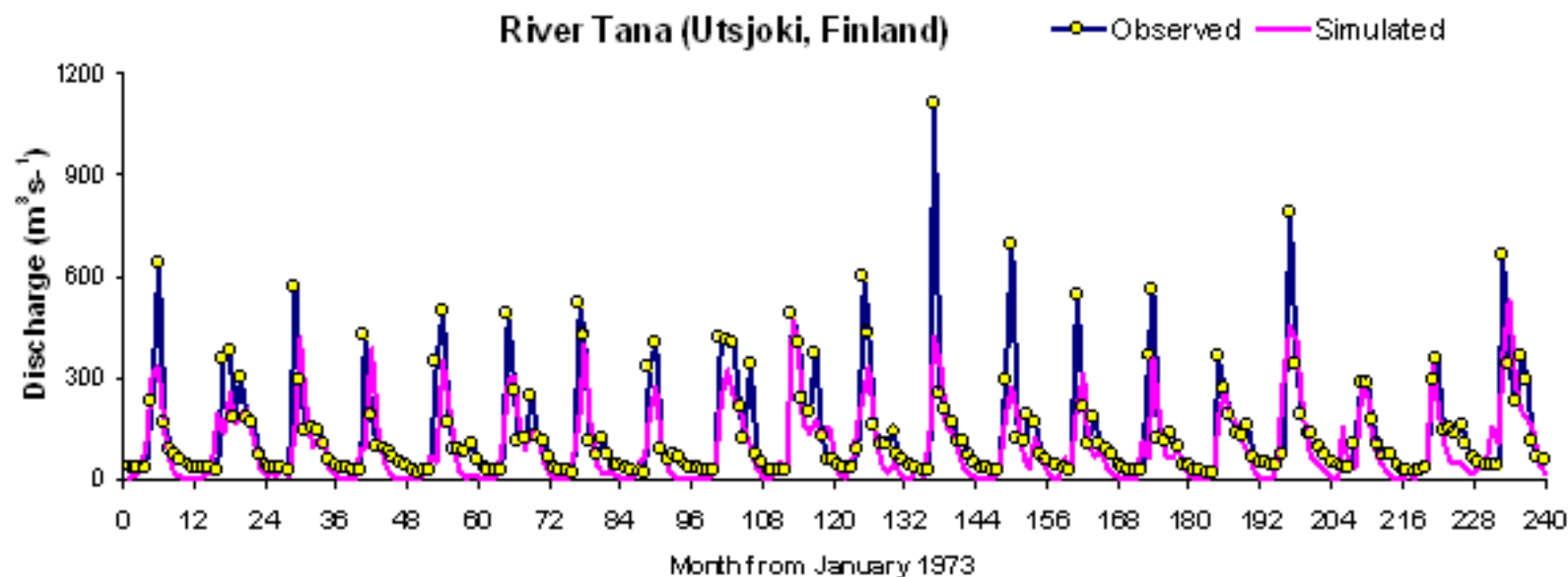


Outputs

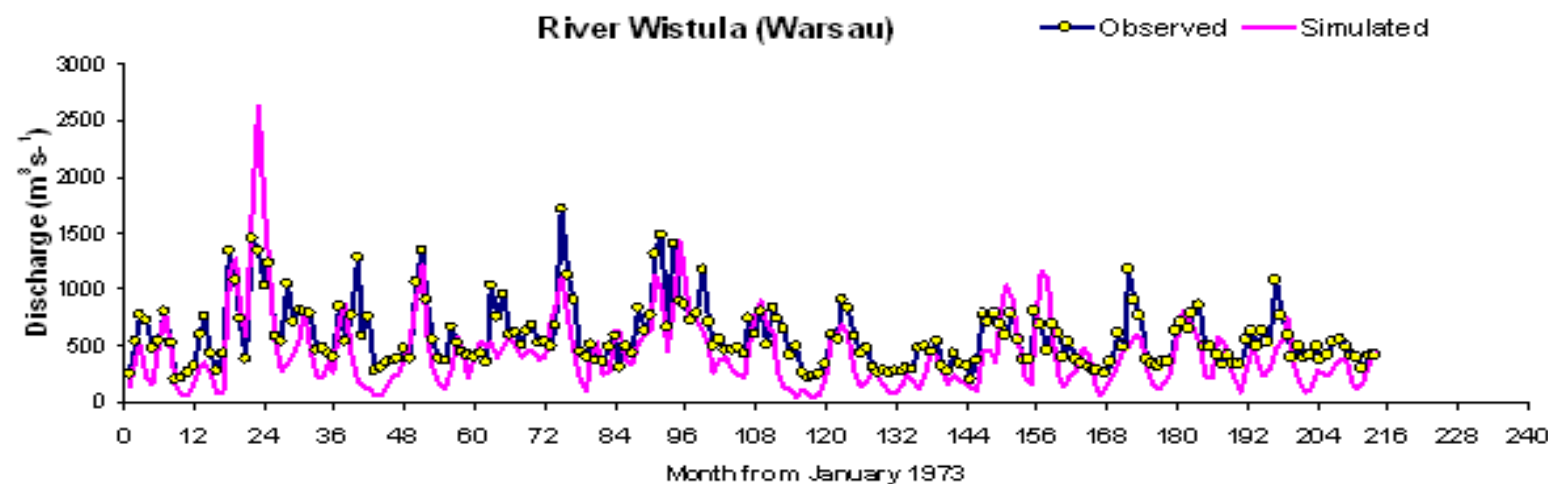




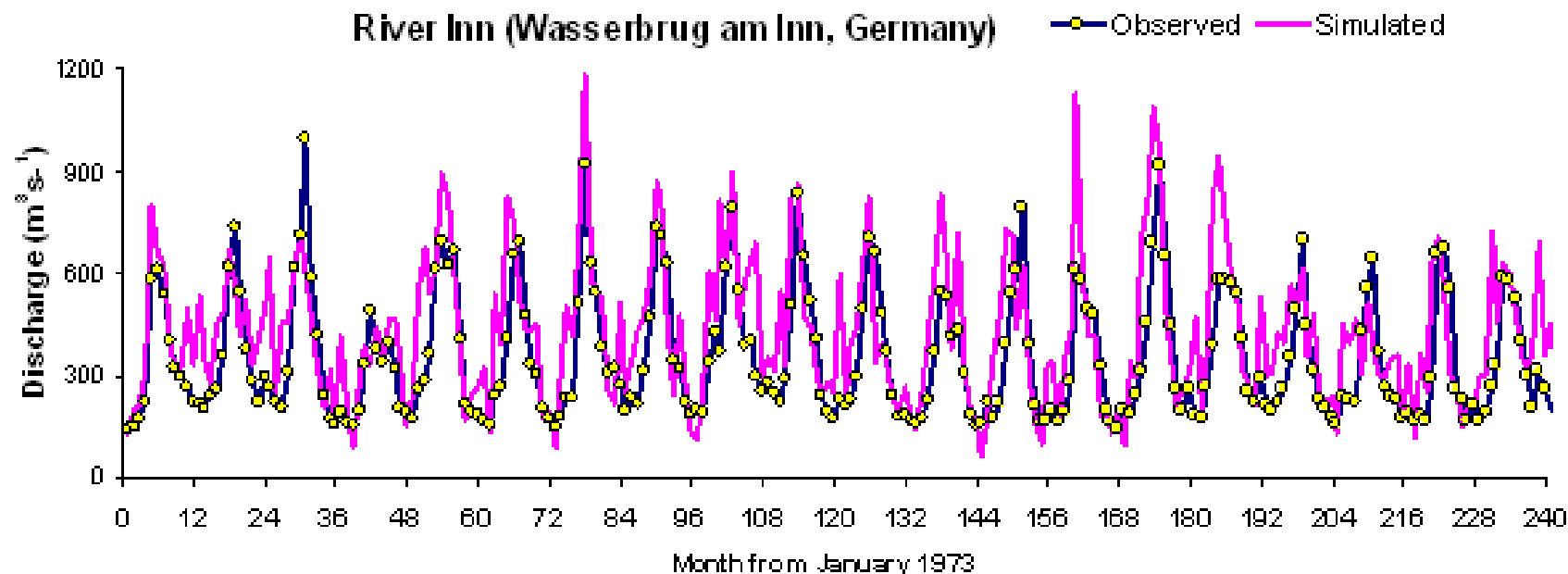
River Tana (Utsjoki, Finland)



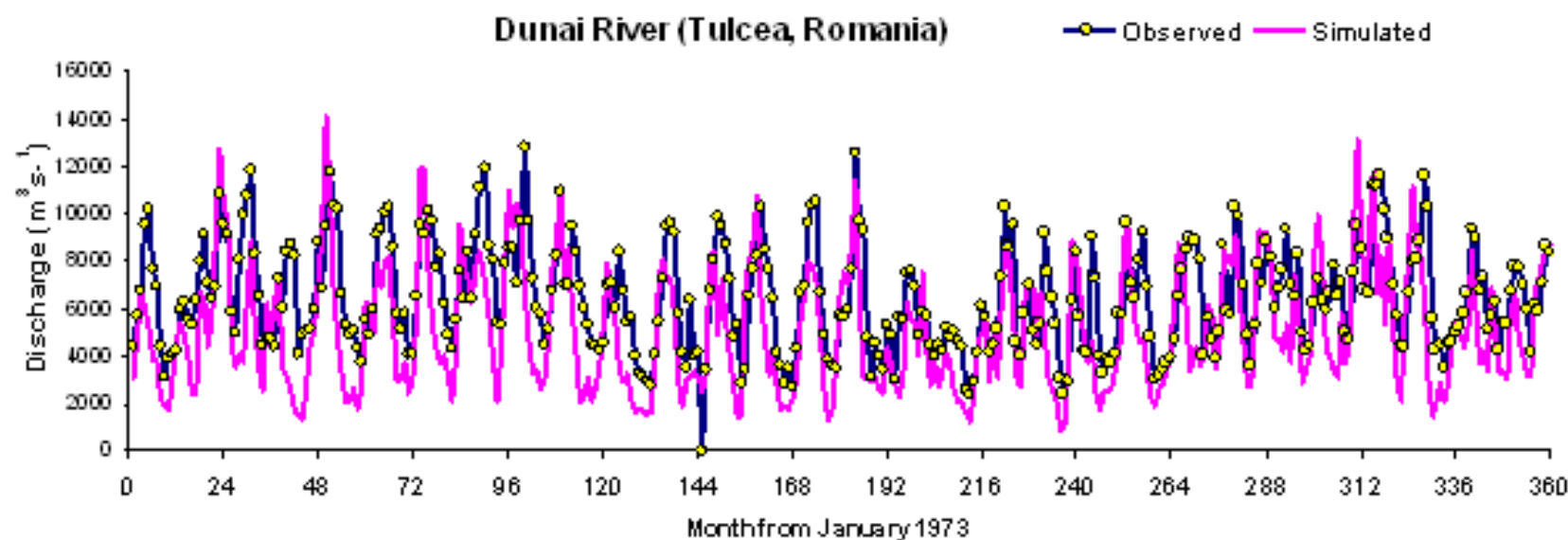
River Wistula (Warsau)

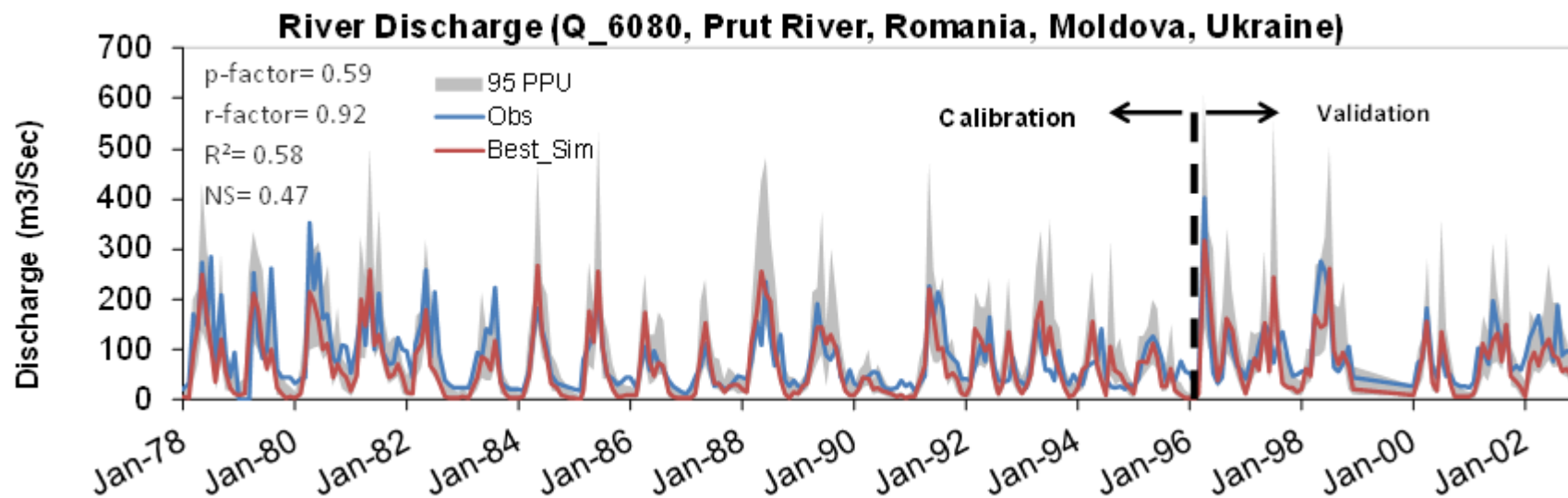
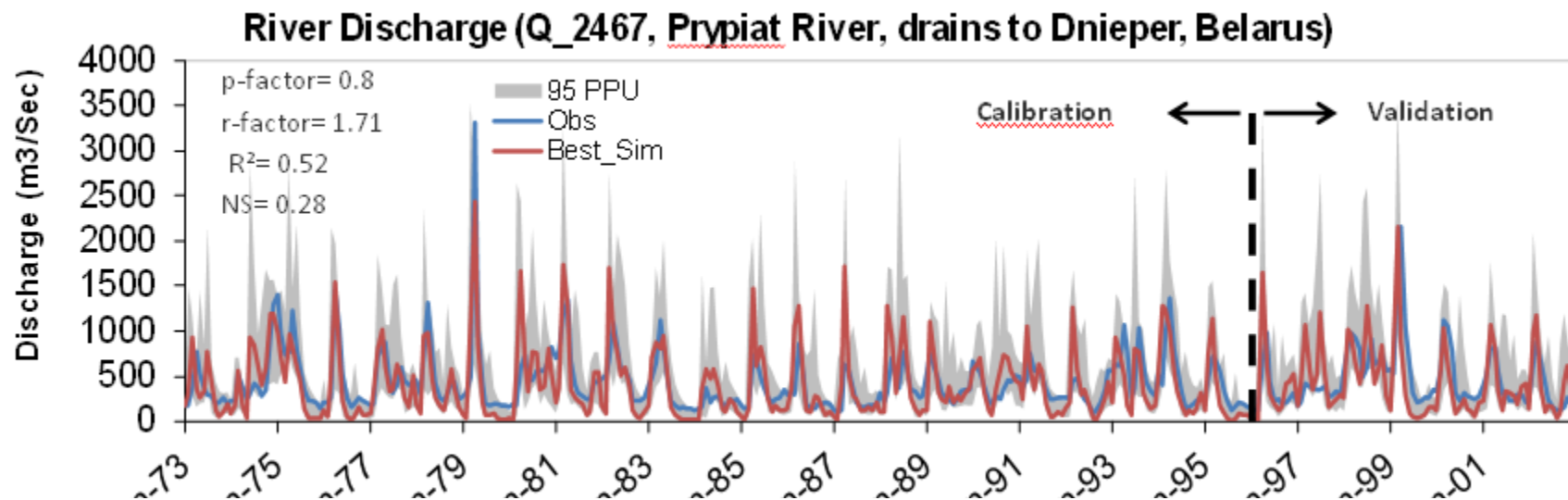


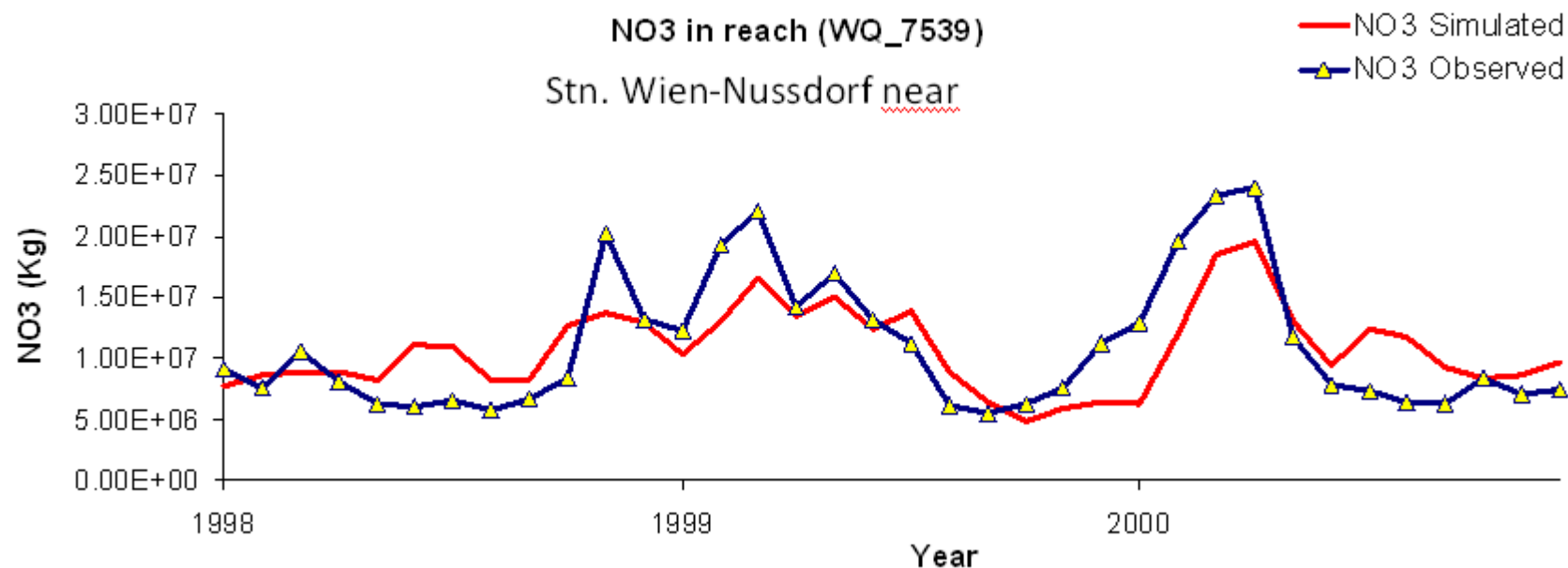
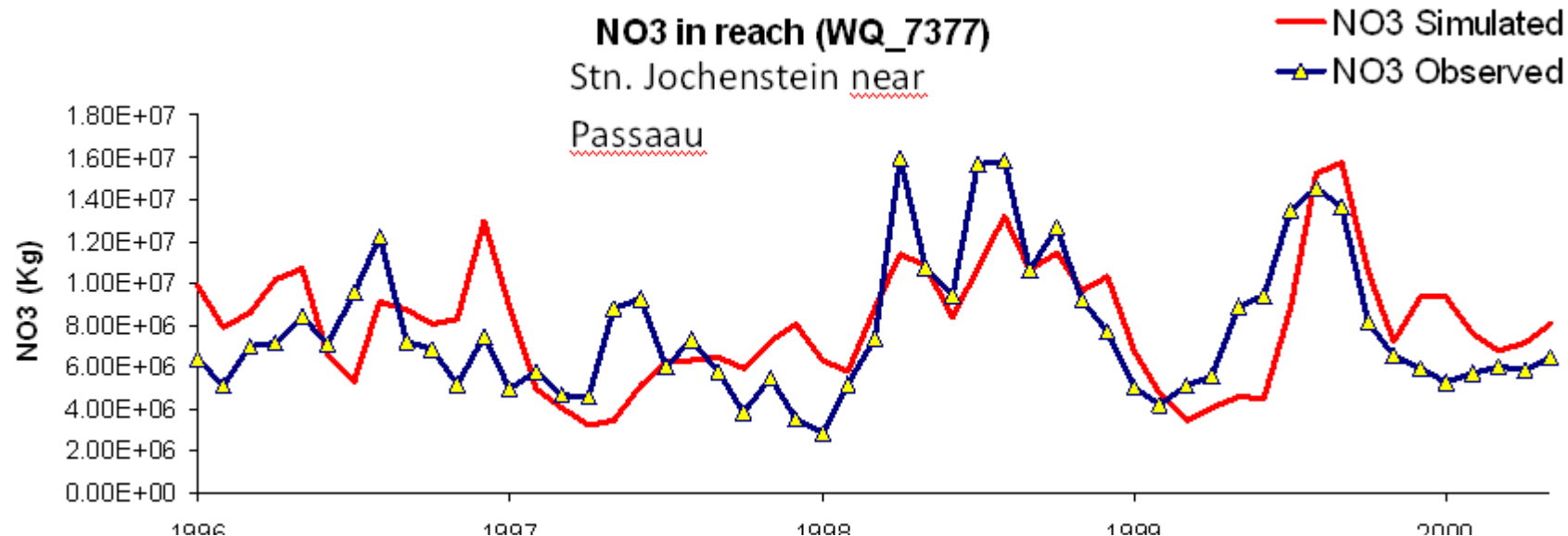
River Inn (Wasserbrugg am Inn, Germany)

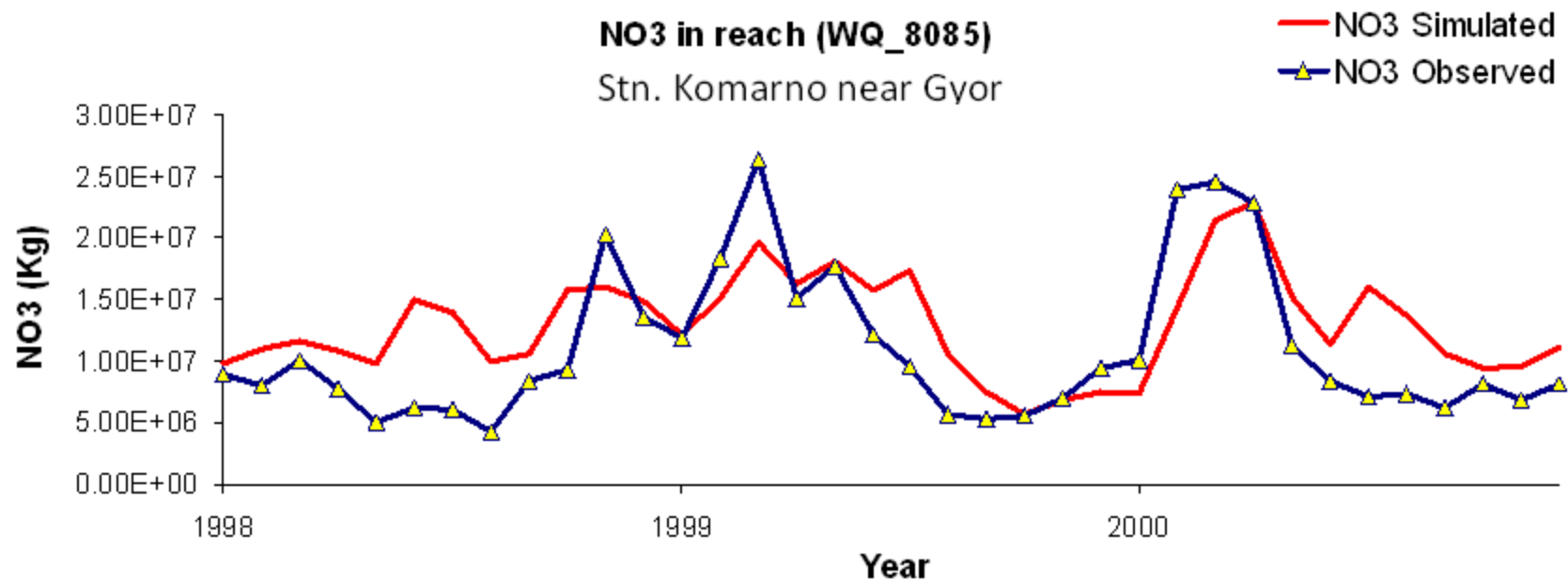
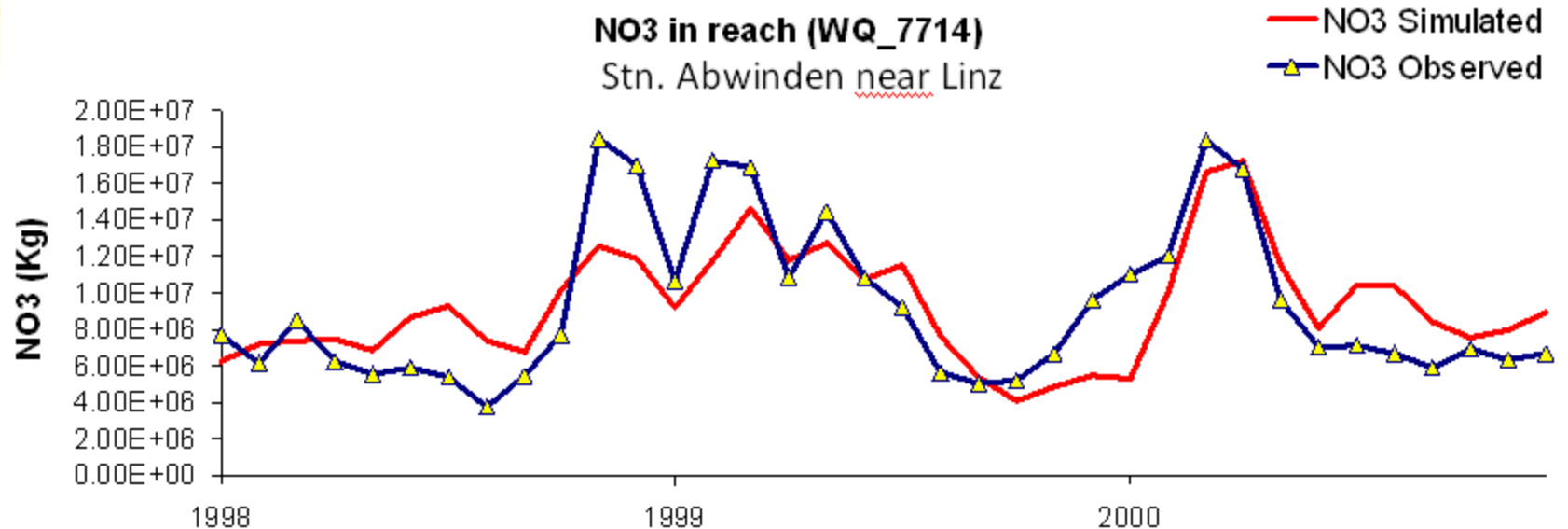


Dunai River (Tulcea, Romania)



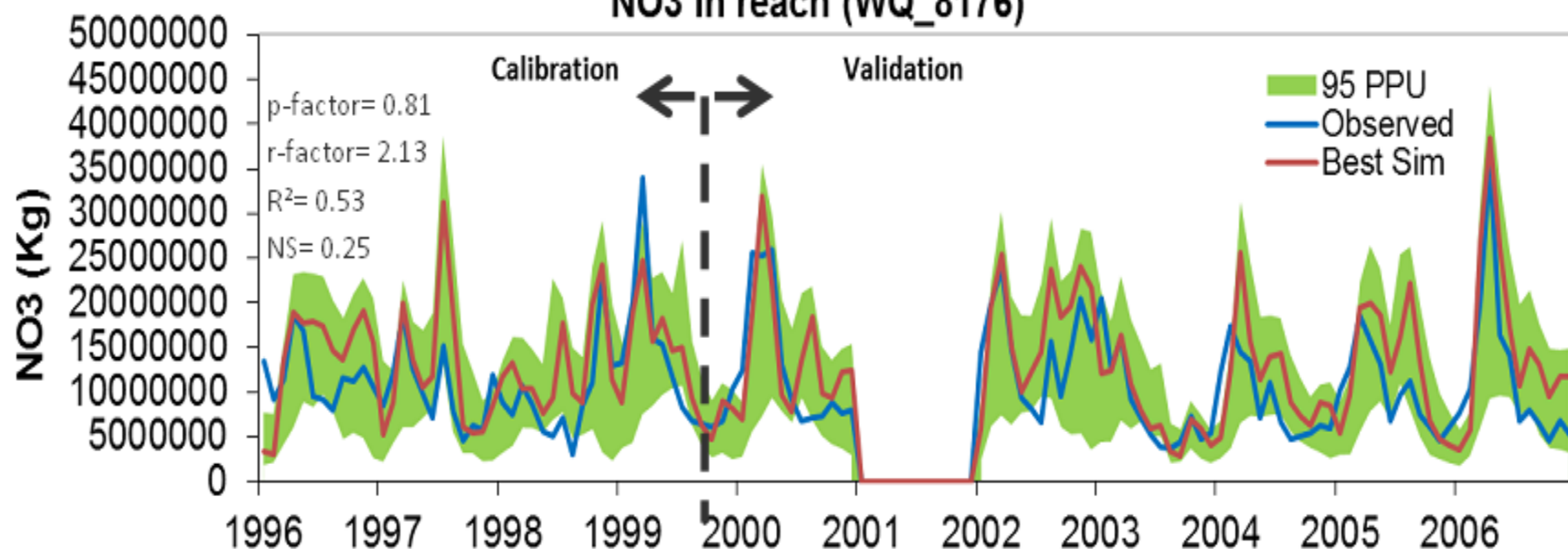






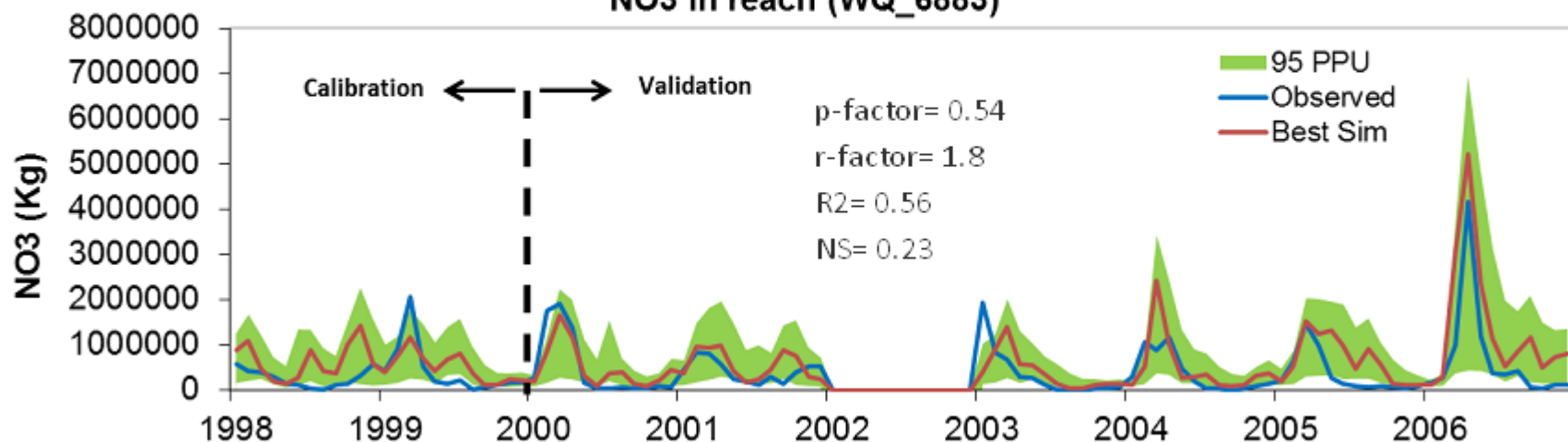
Stn Medvedof near Medvedof in

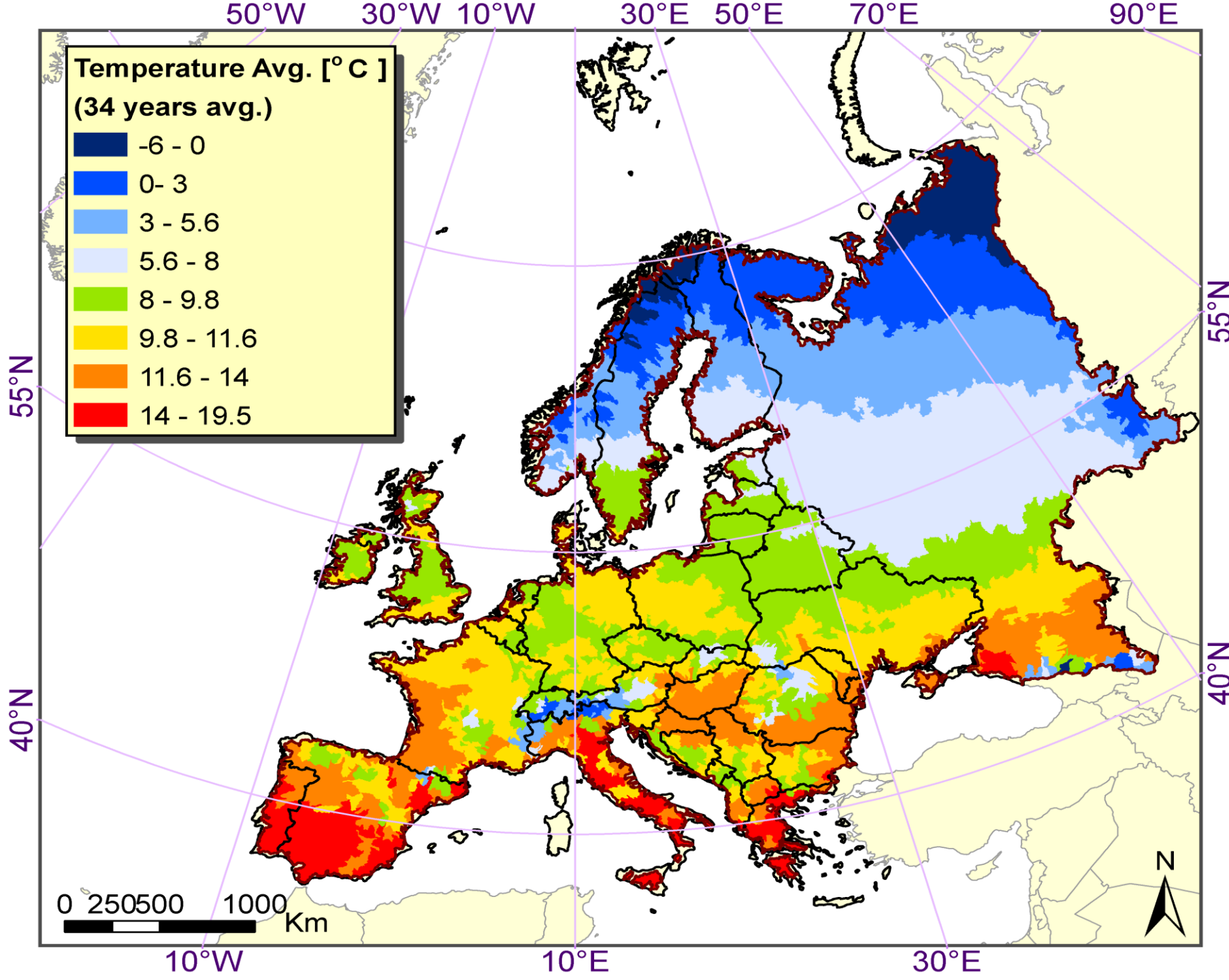
NO3 in reach (WQ_8176)

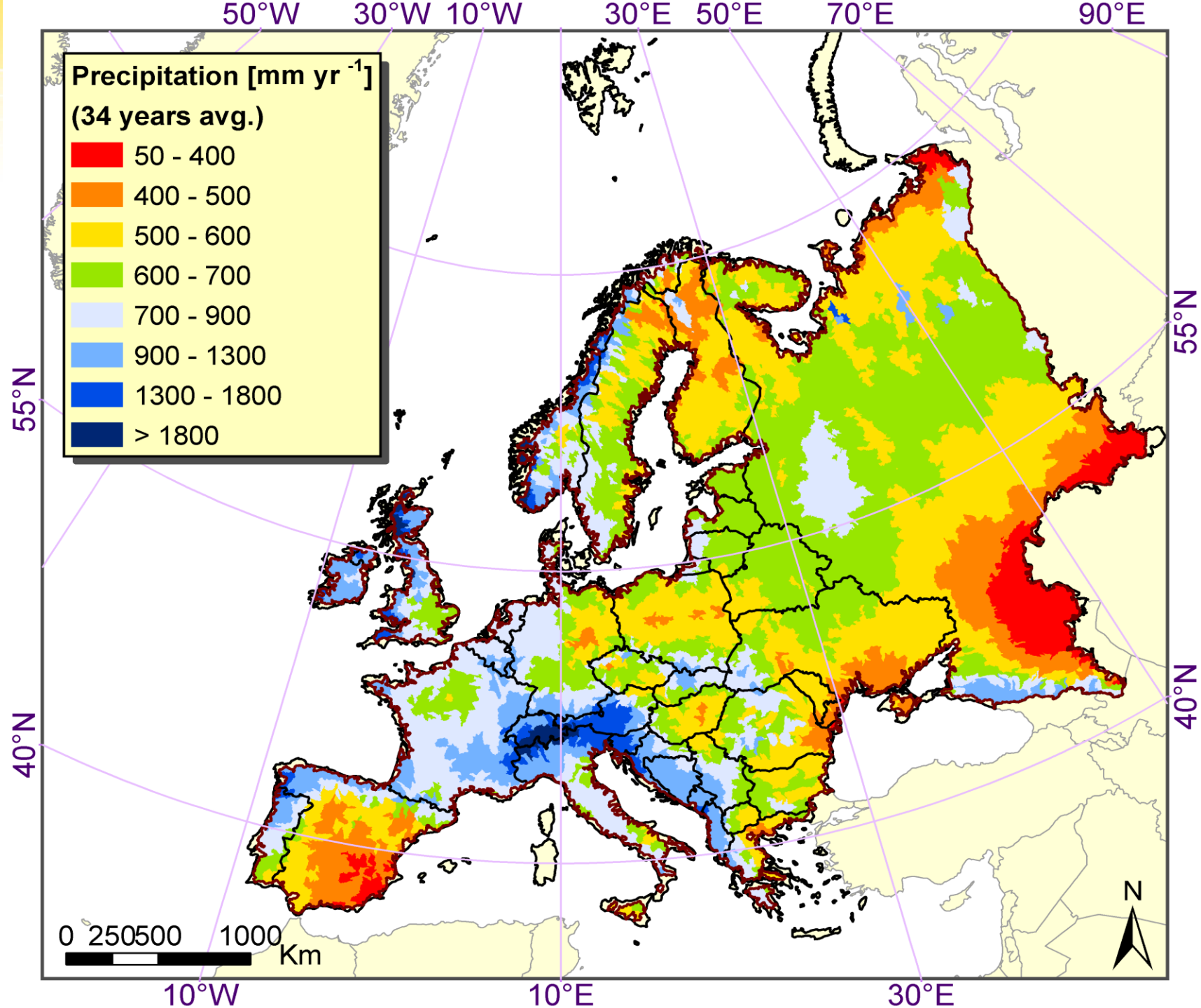


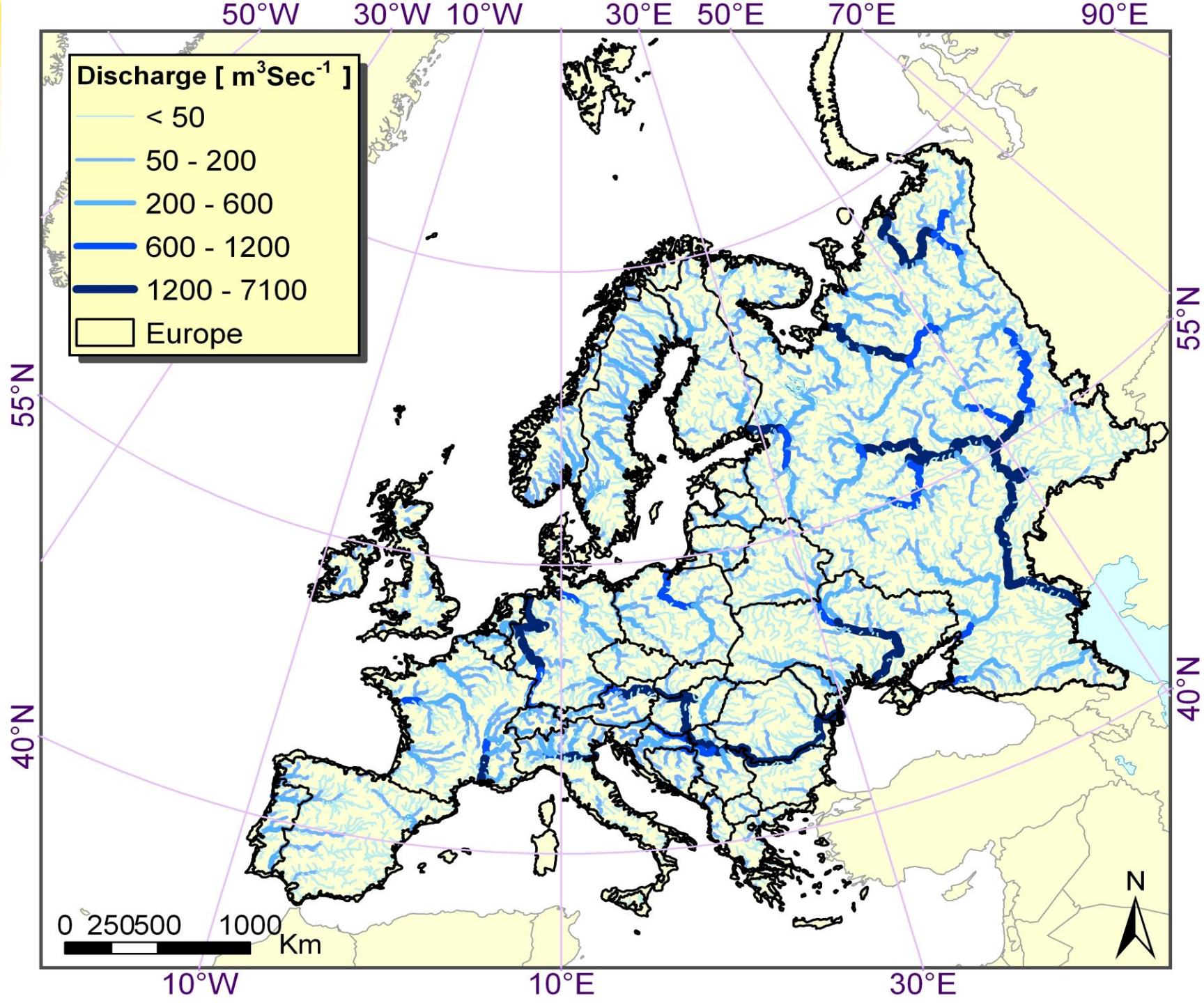
Stn Pohanskp near Breclav in Czech

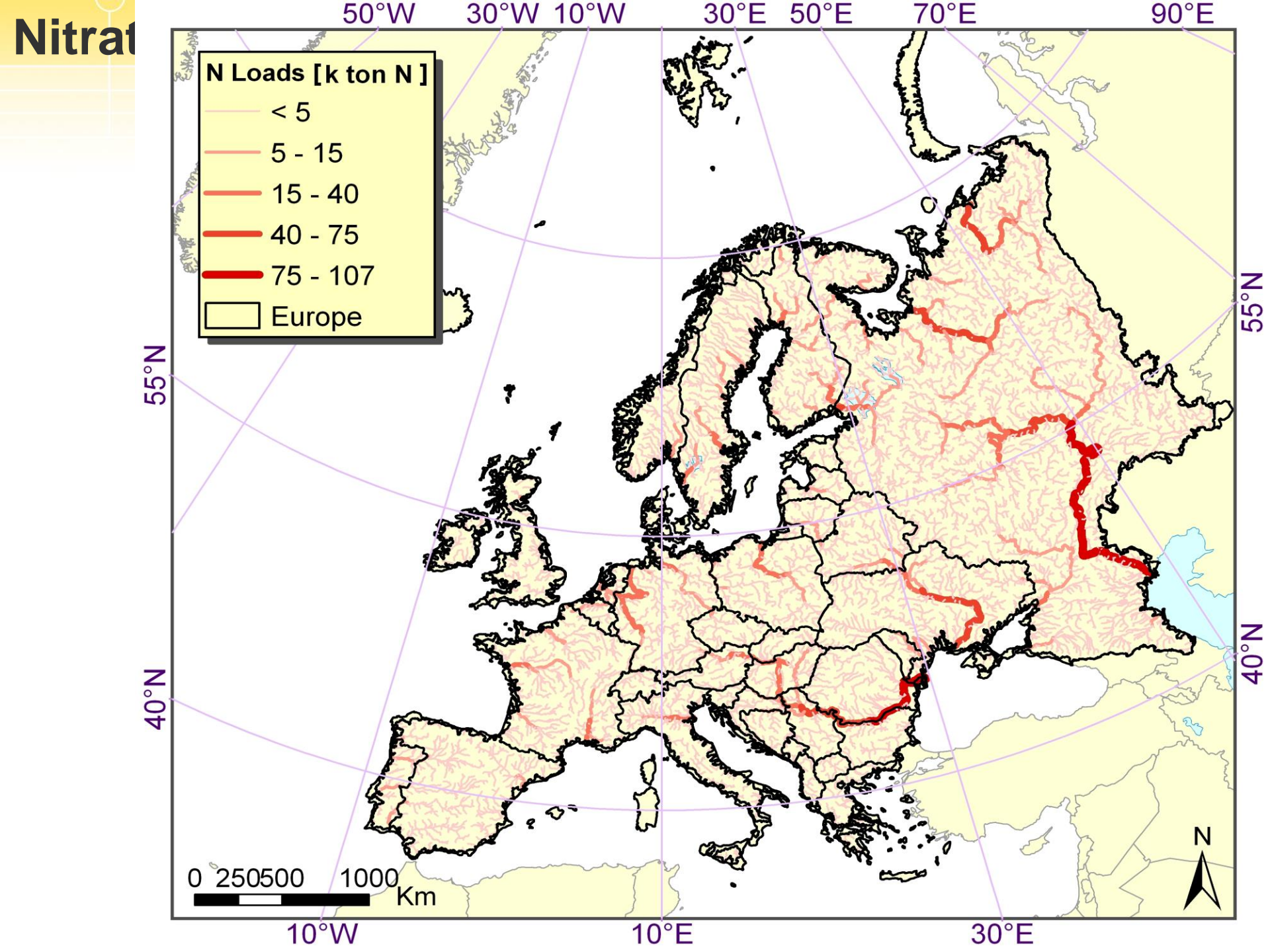
NO3 in reach (WQ_6883)

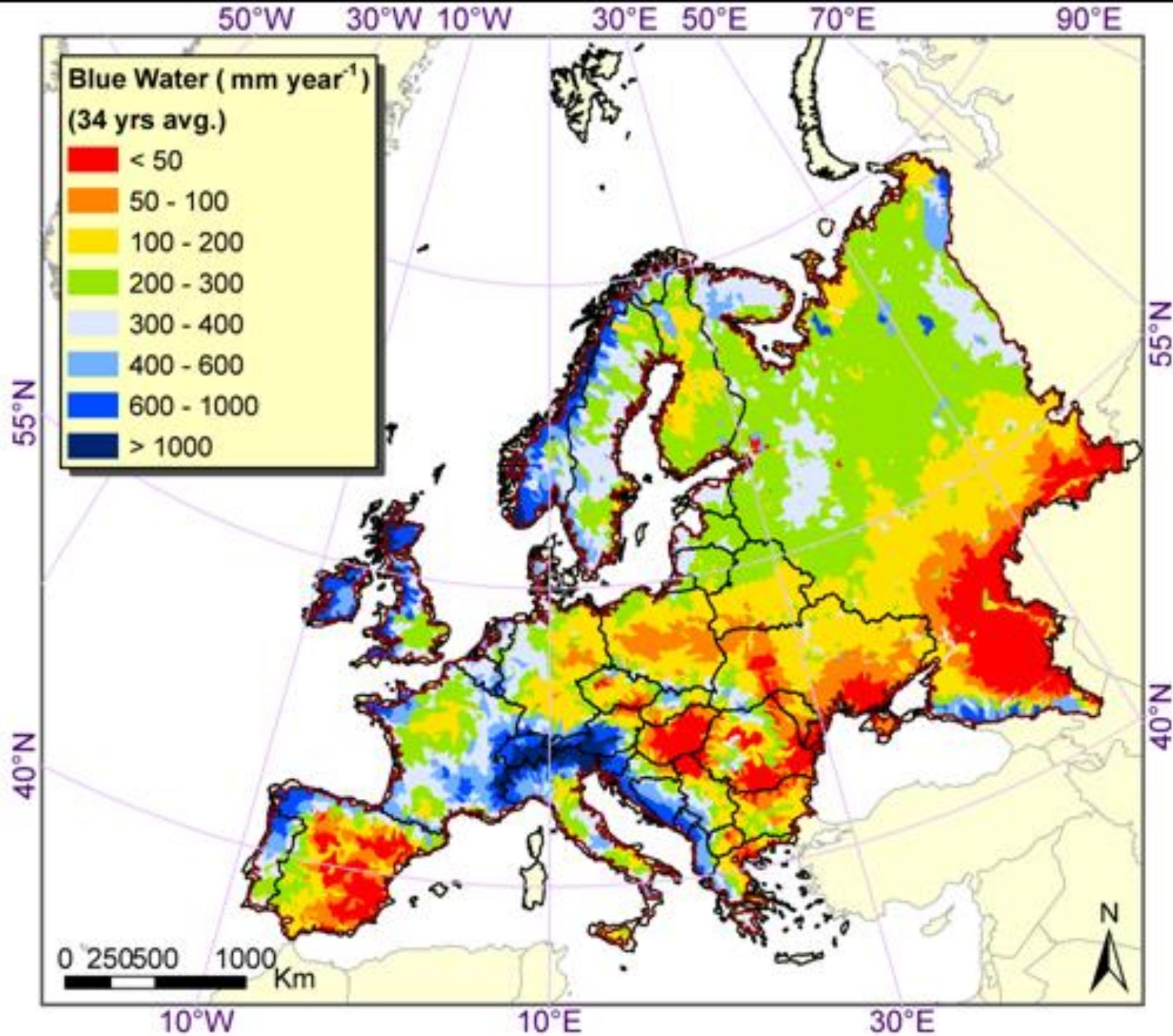


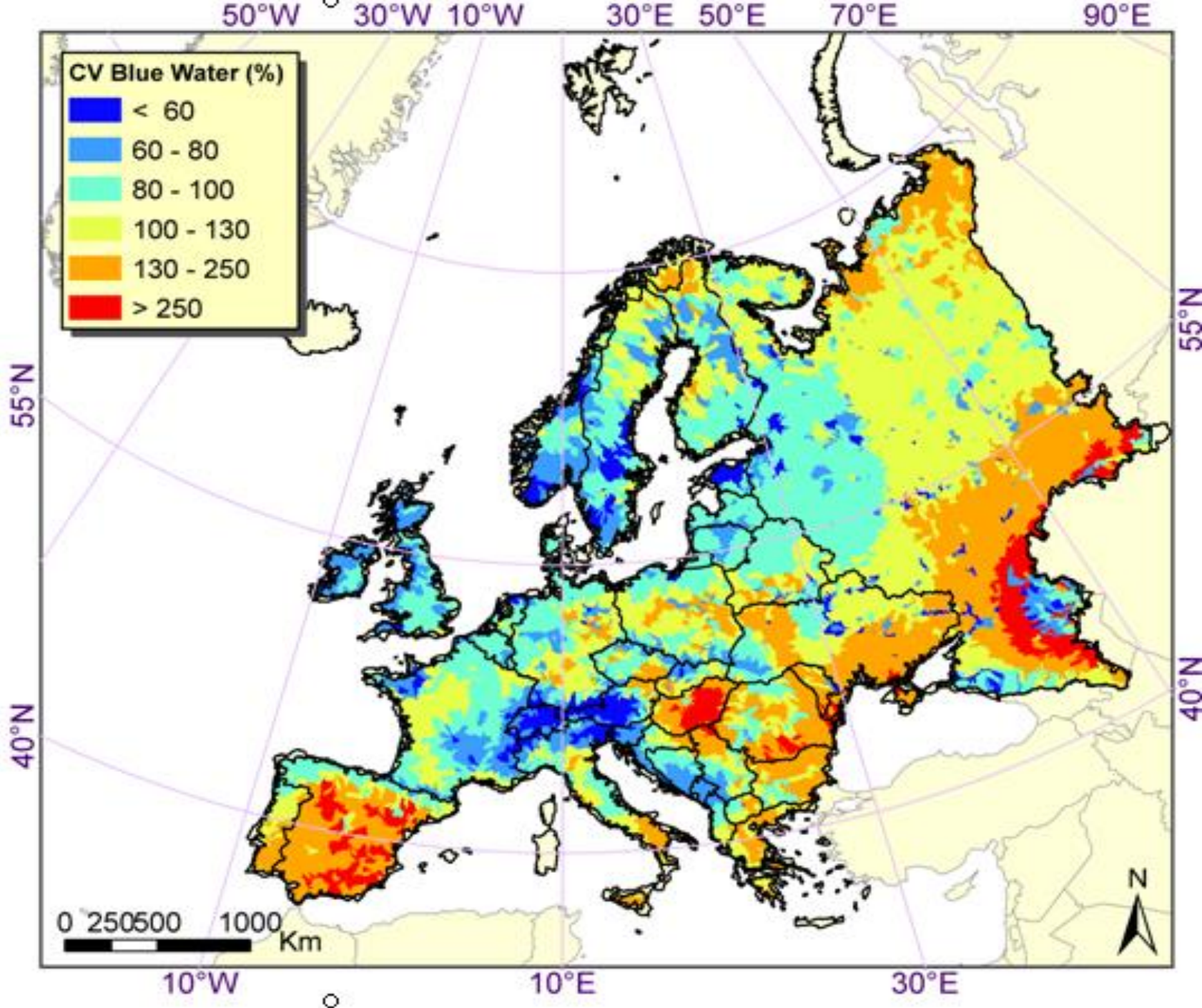


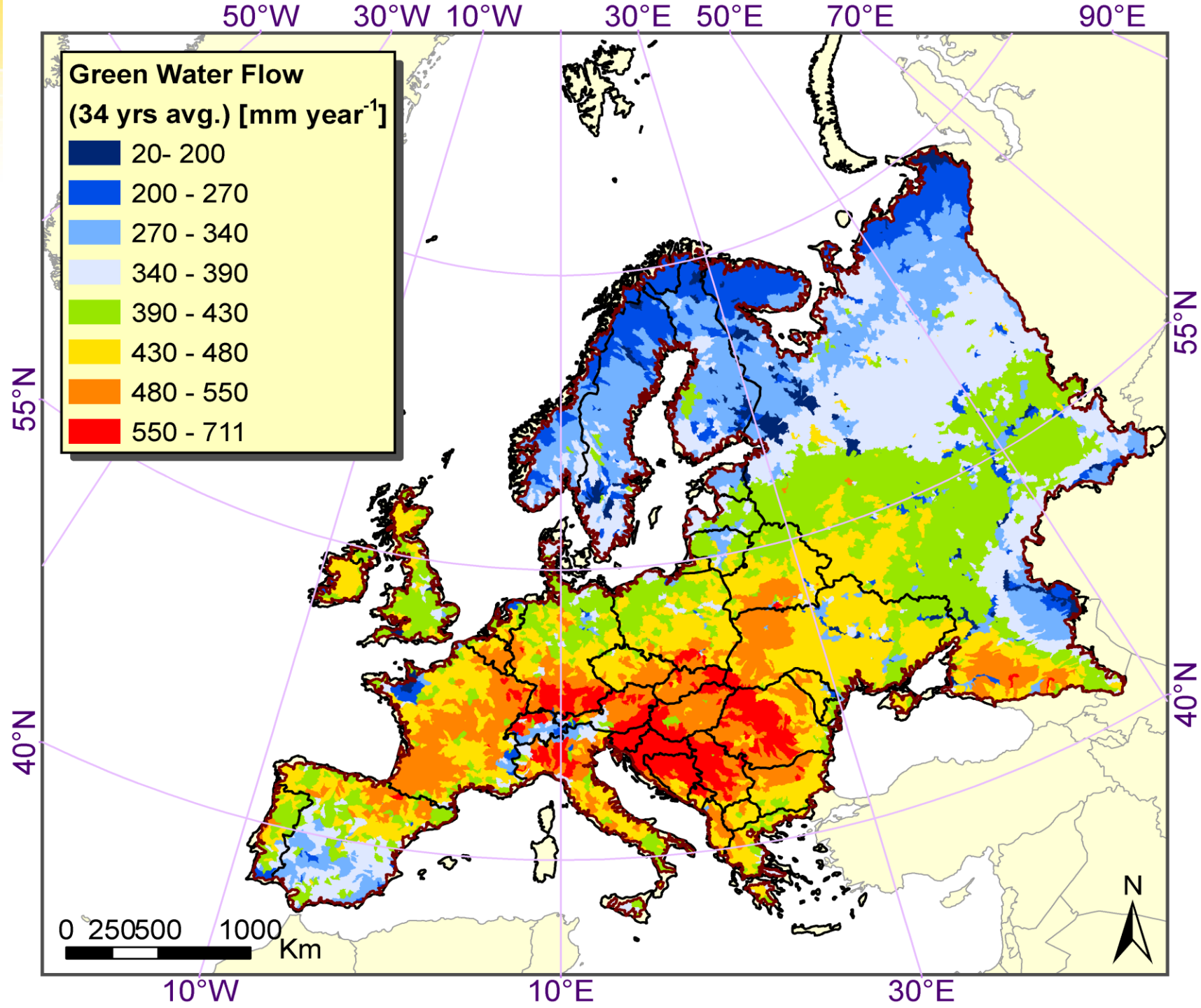


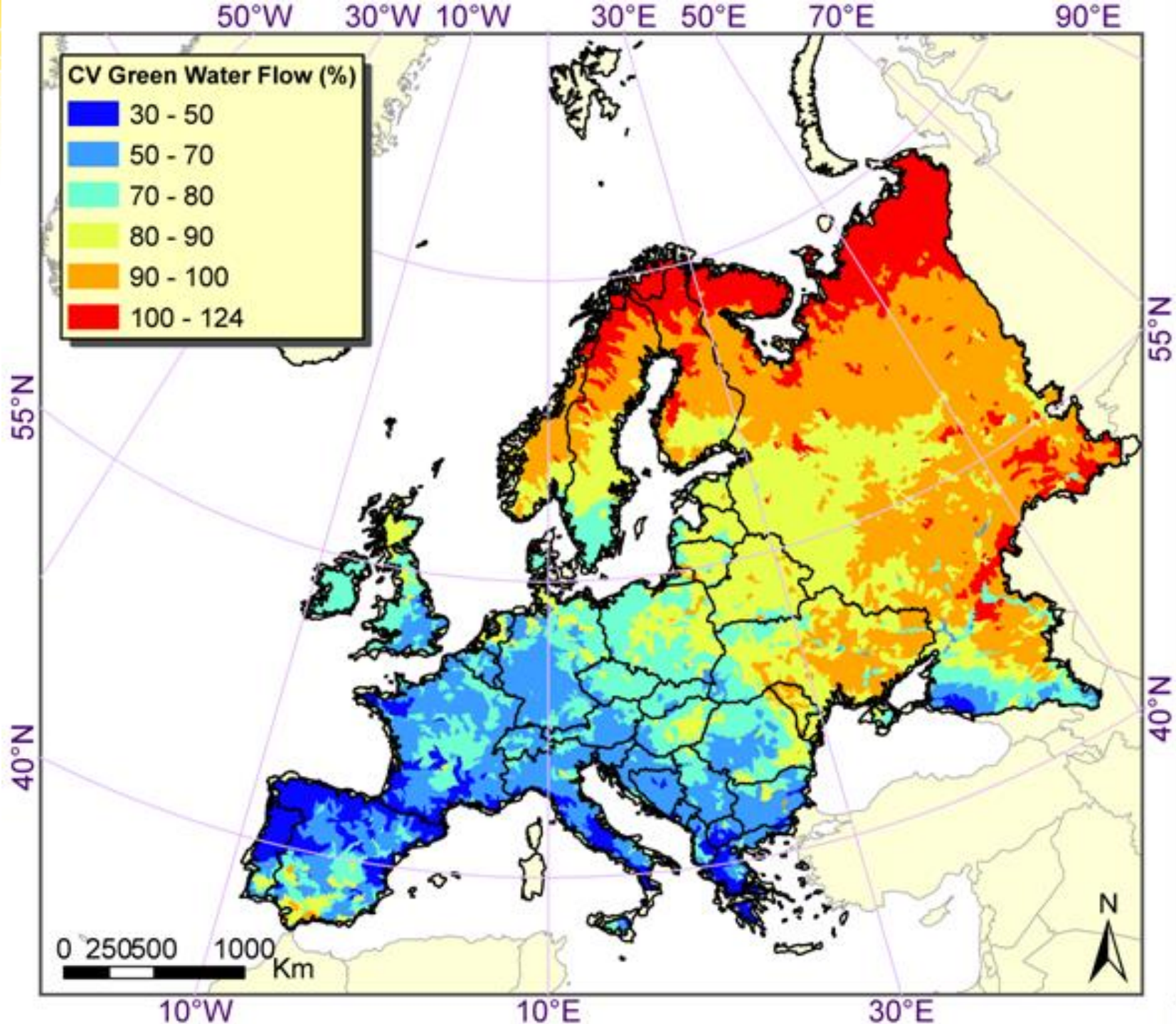


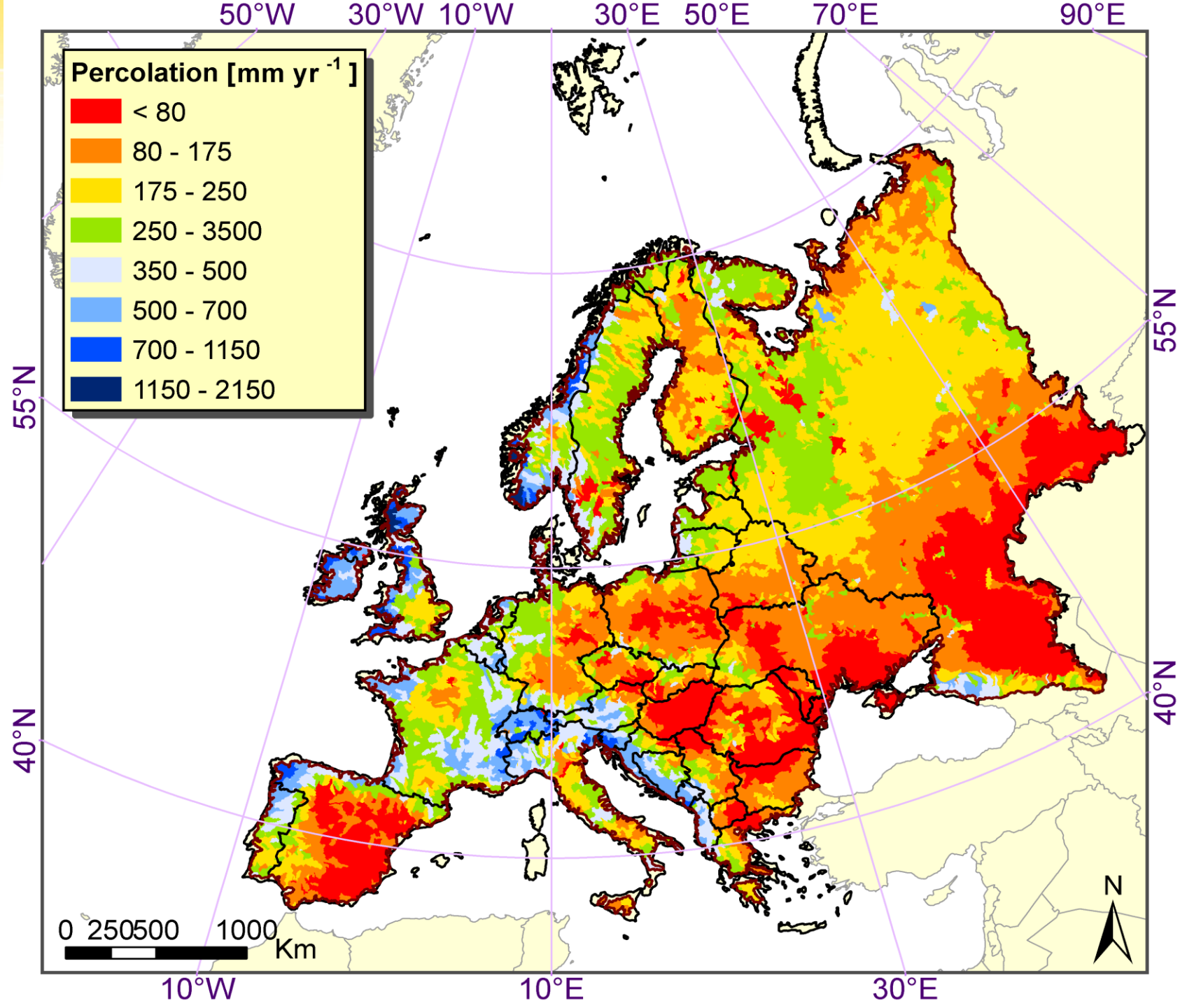


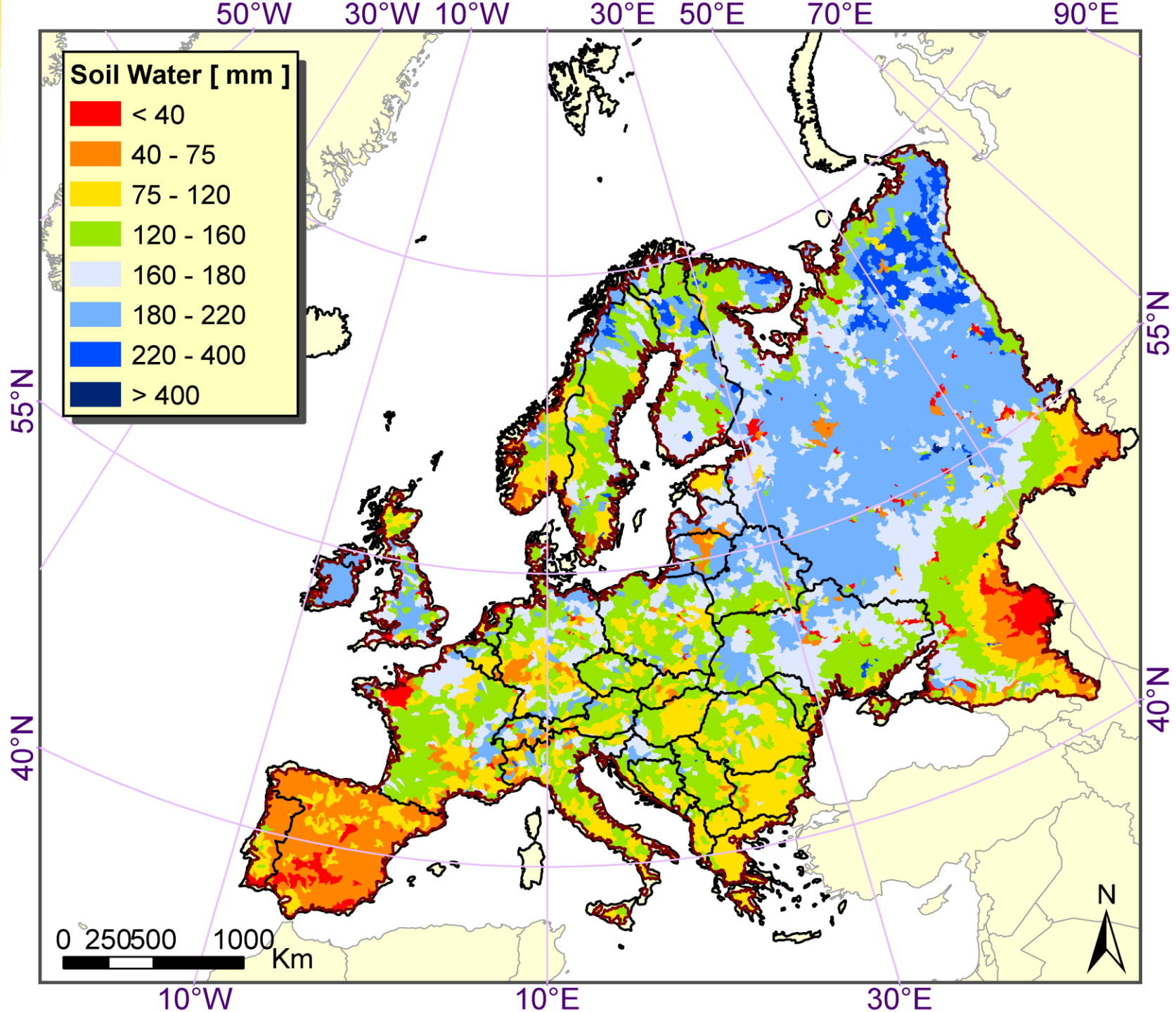


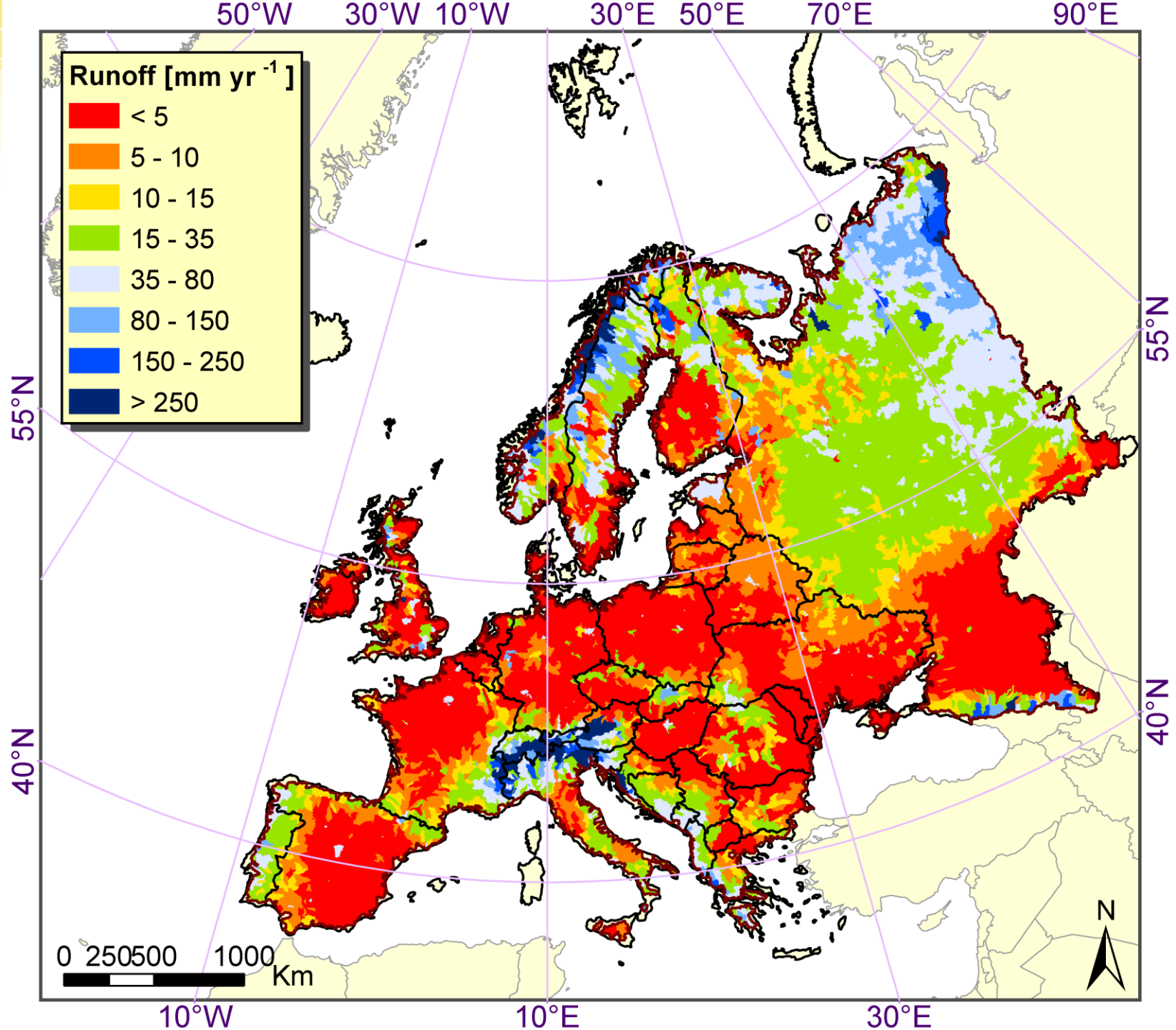


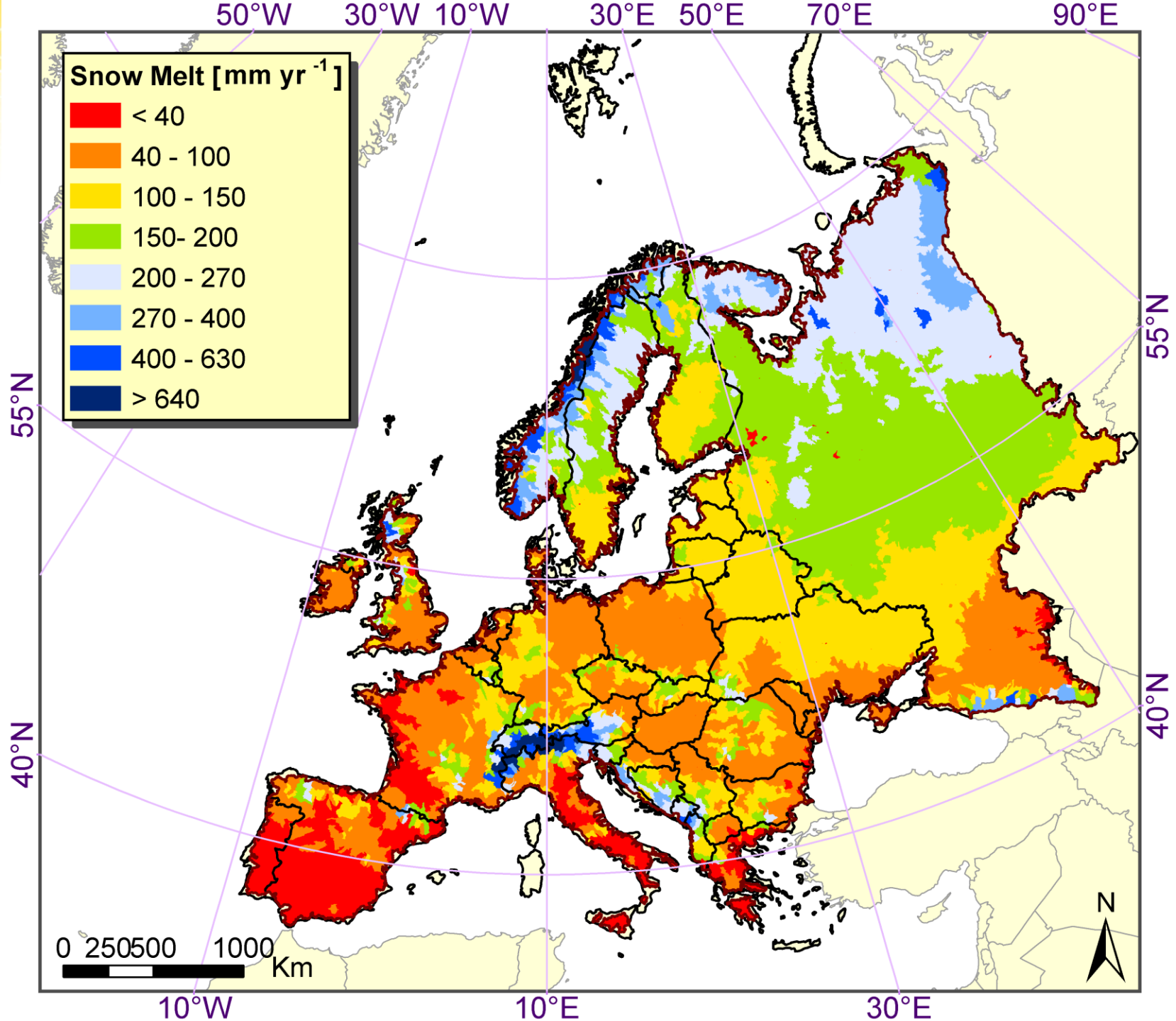


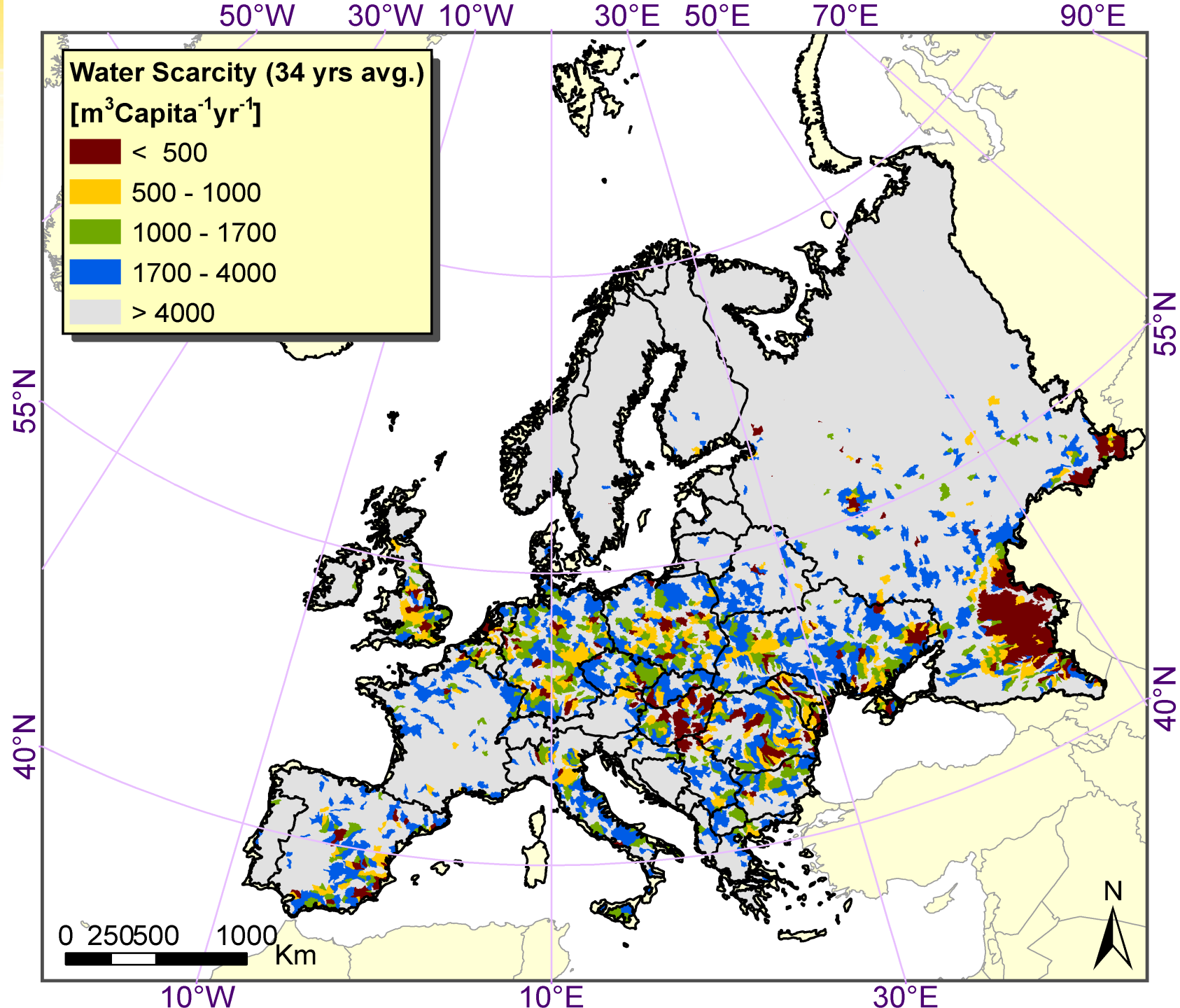


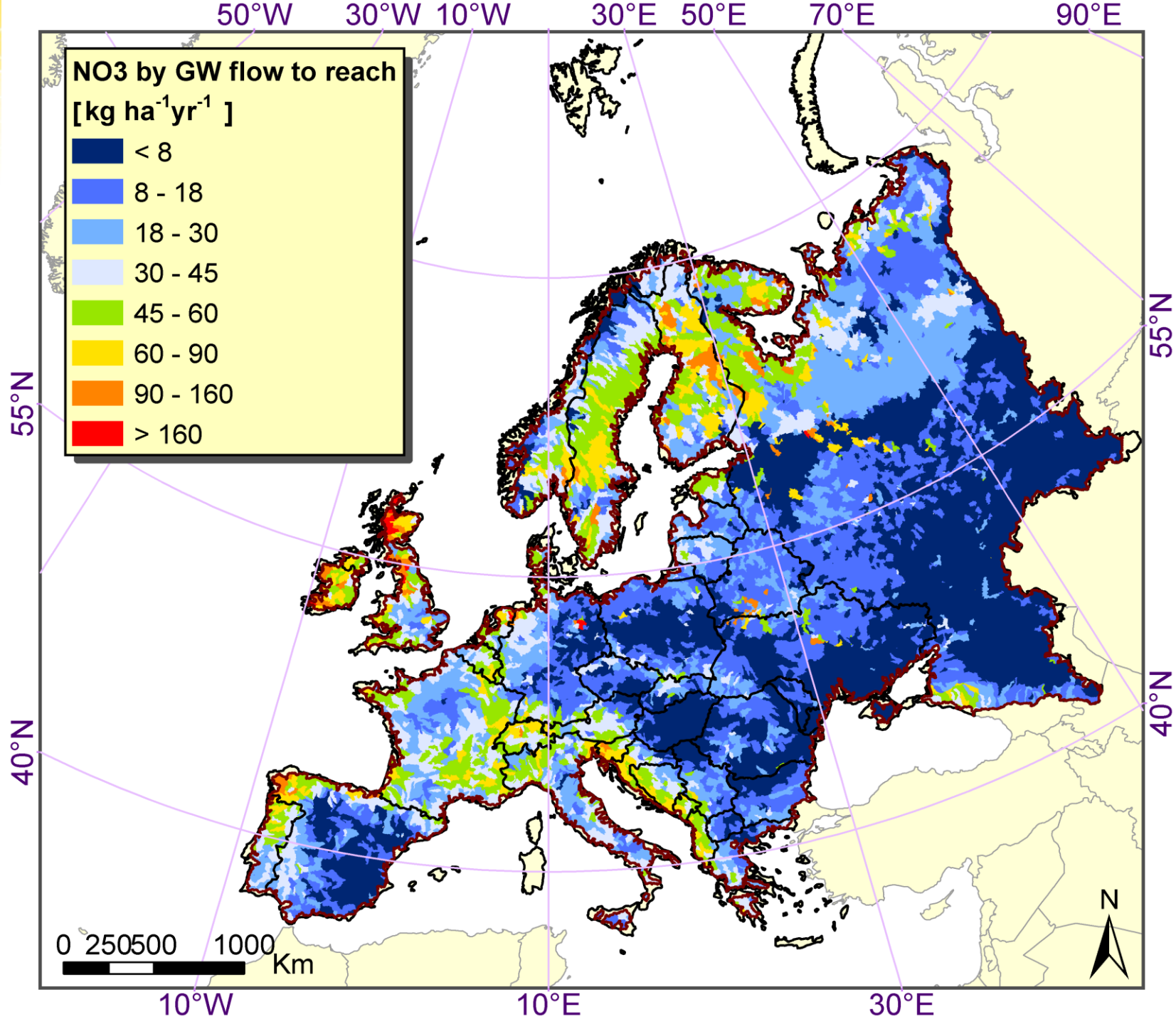


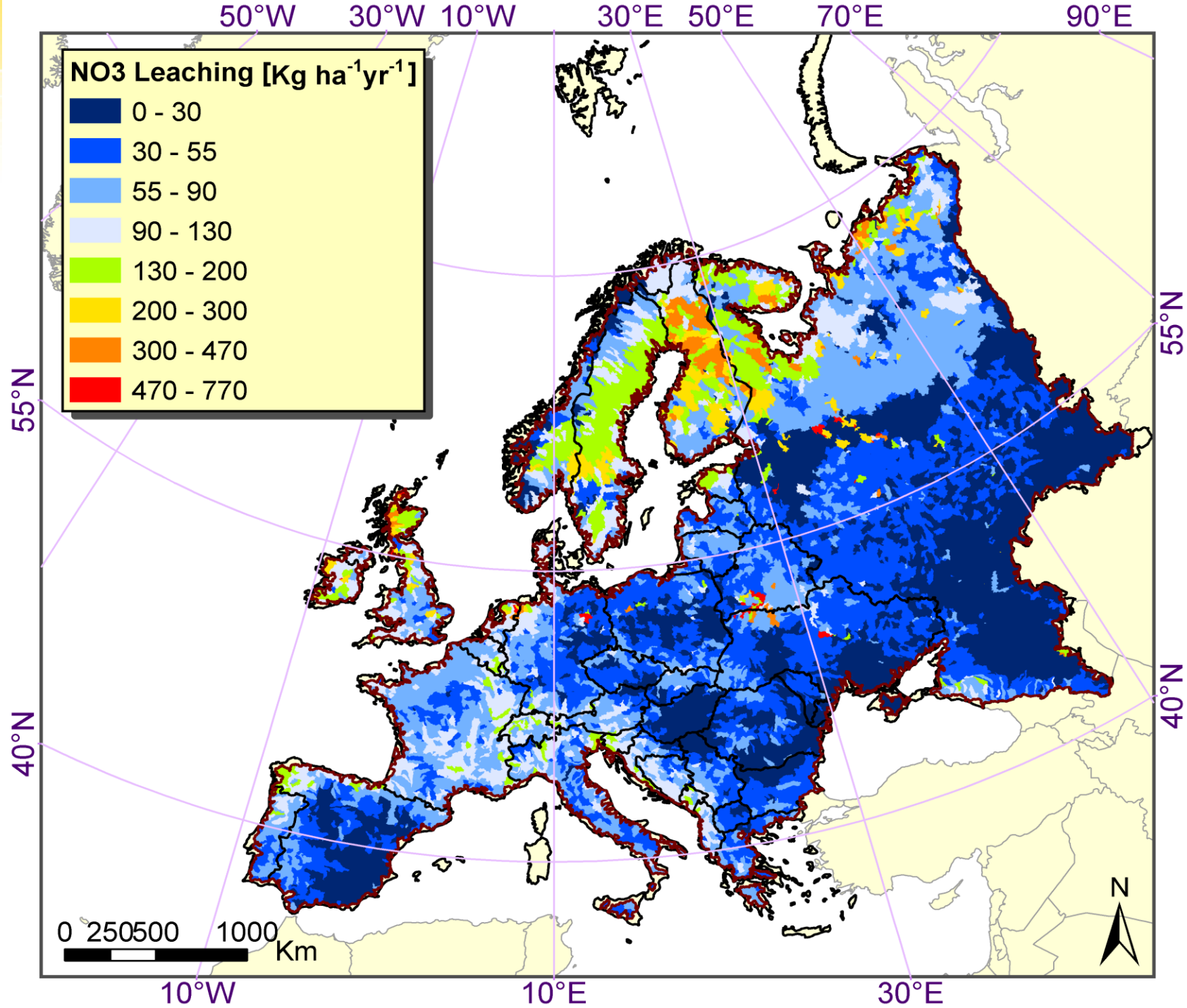


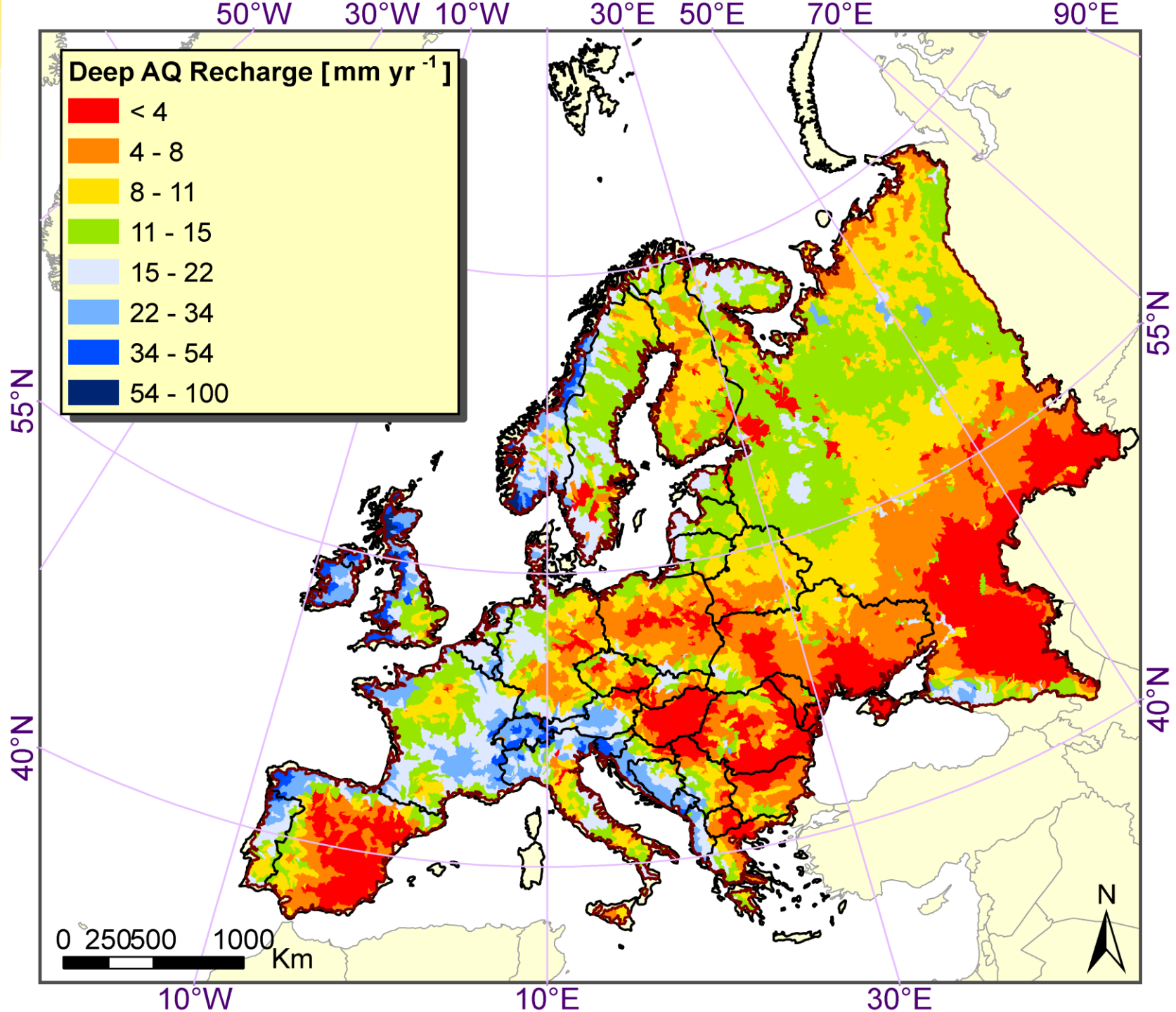


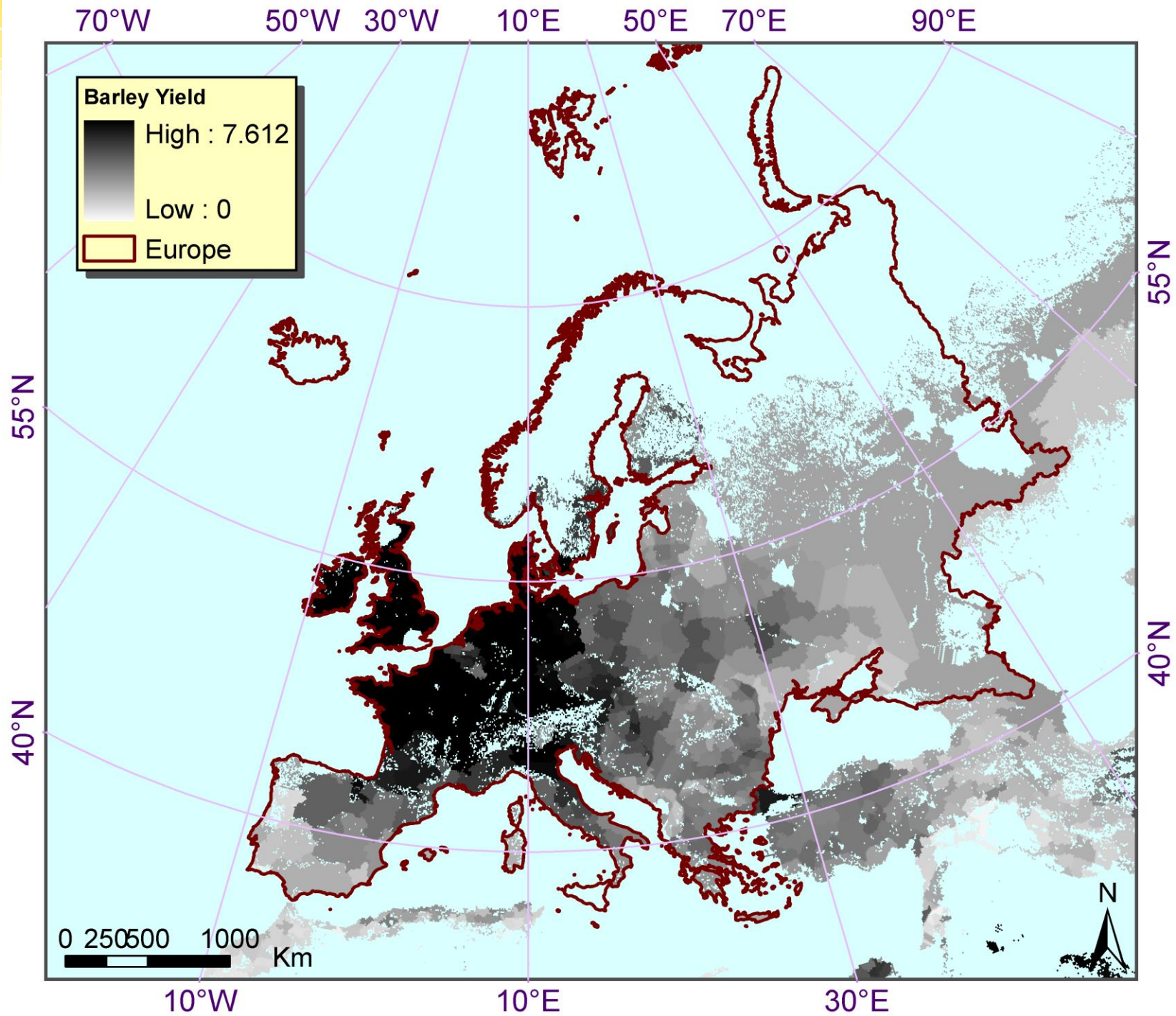


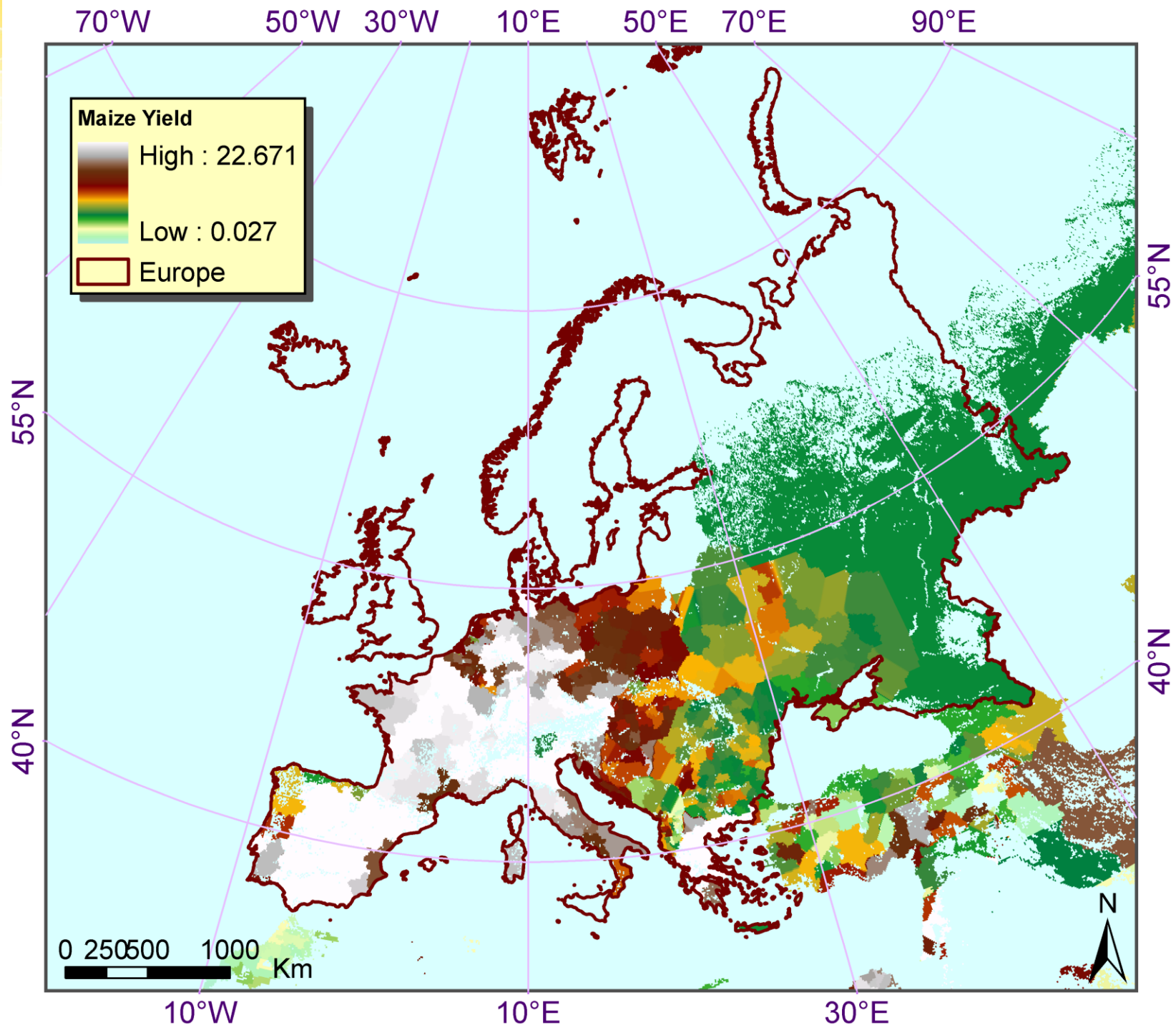


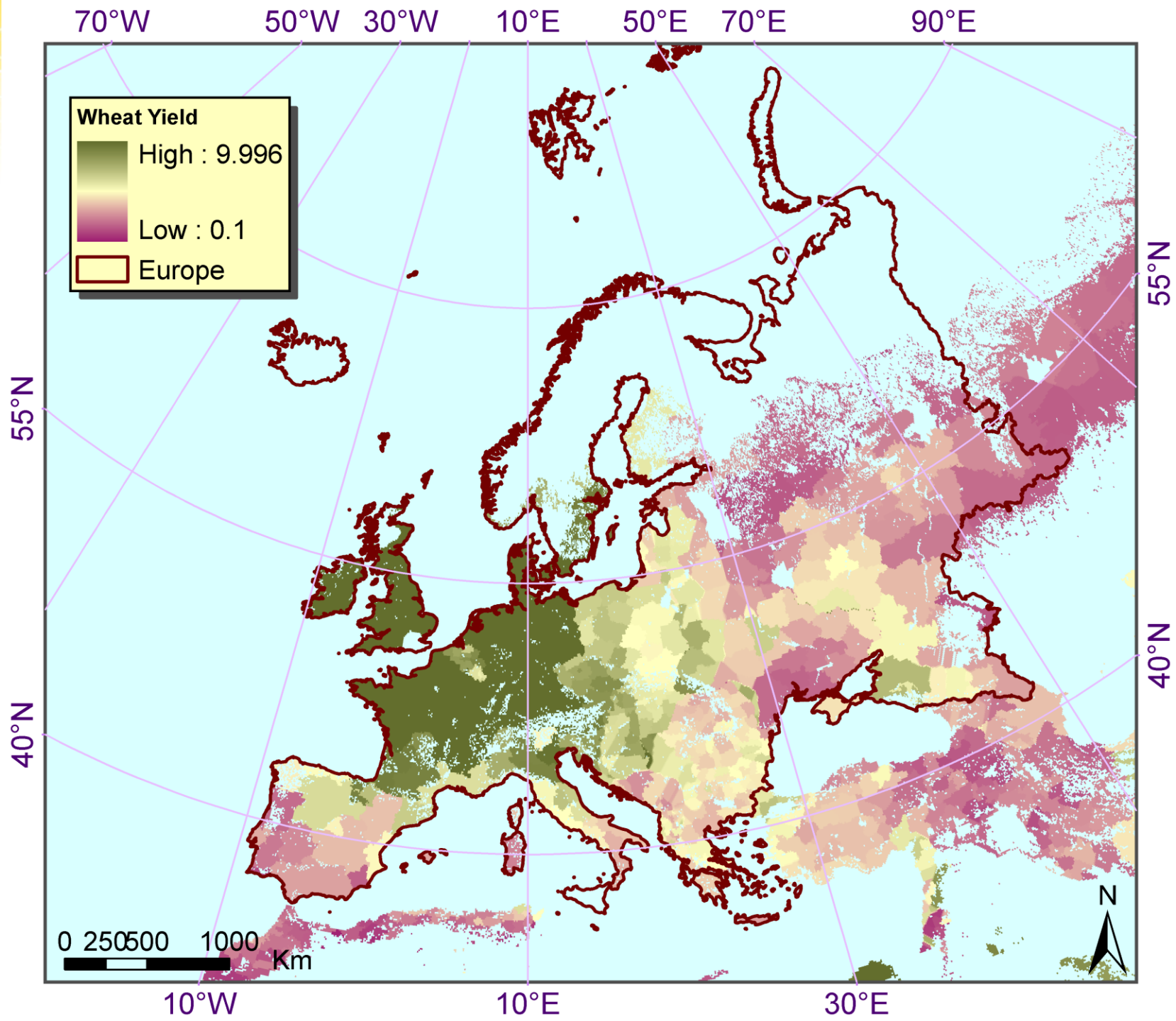






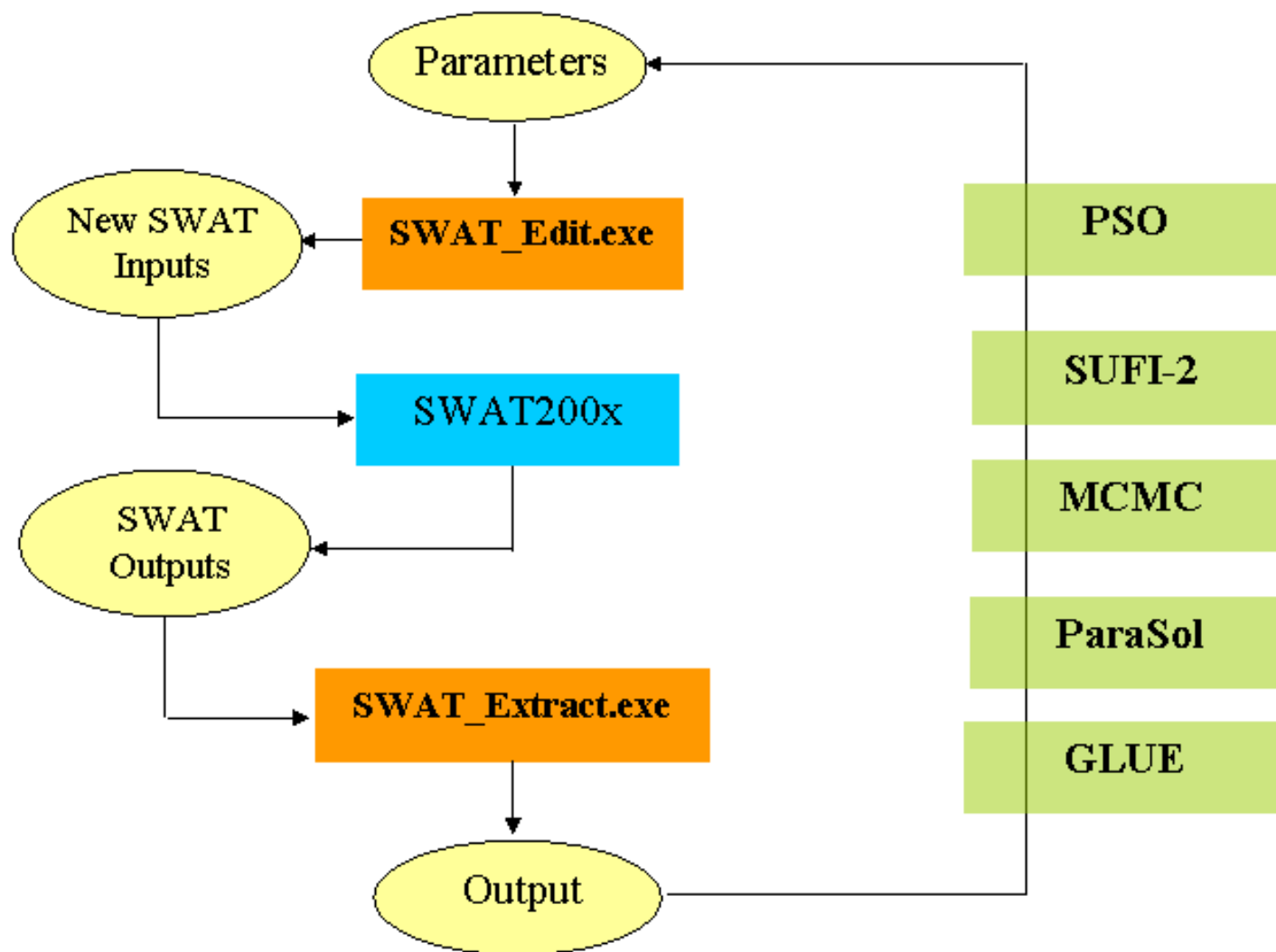






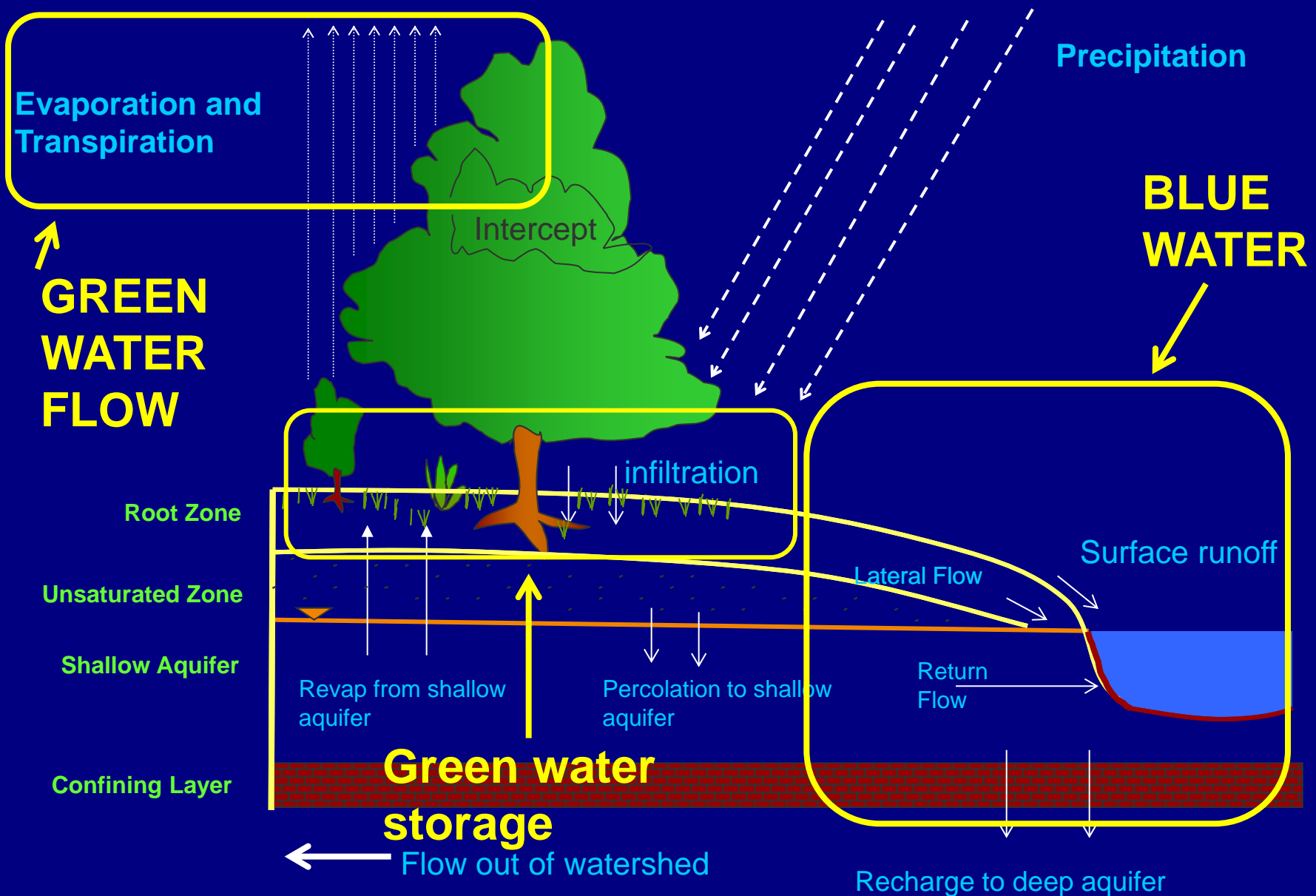
Next, assess the impact of climate change on water quality and quantity....

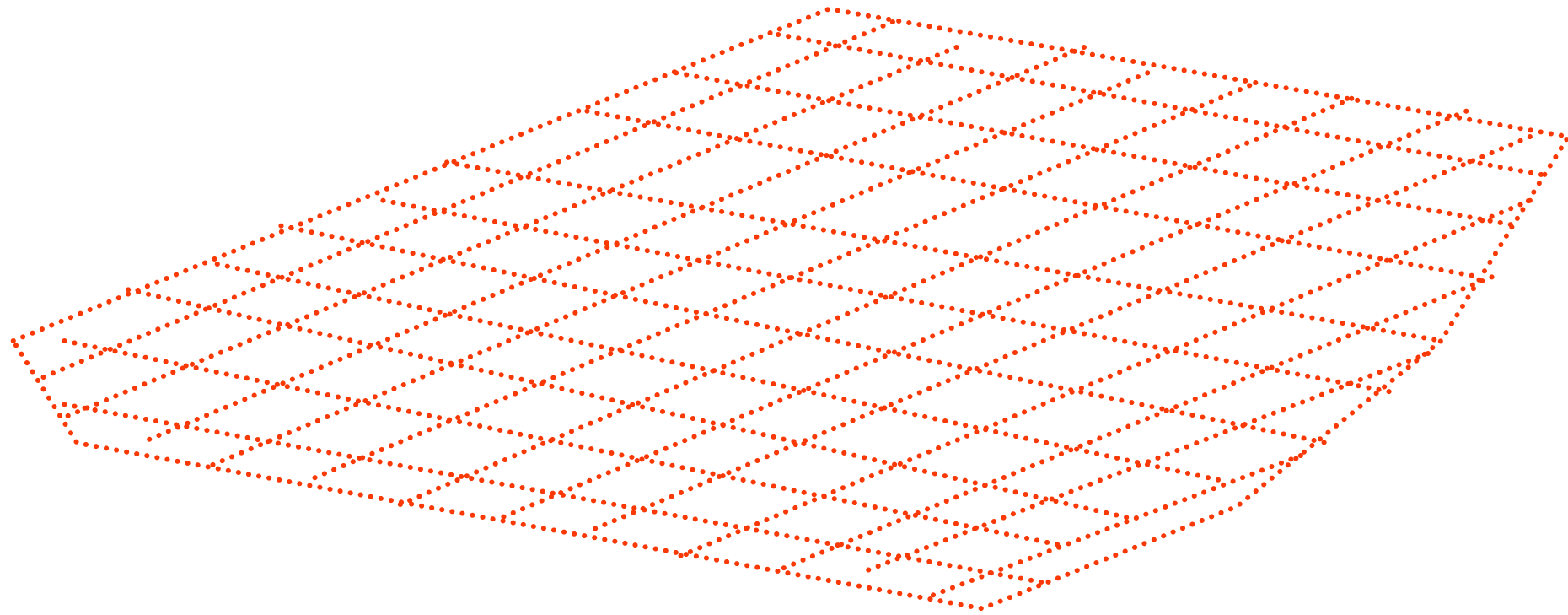
SWAT-CUP (calibration uncertainty procedures)



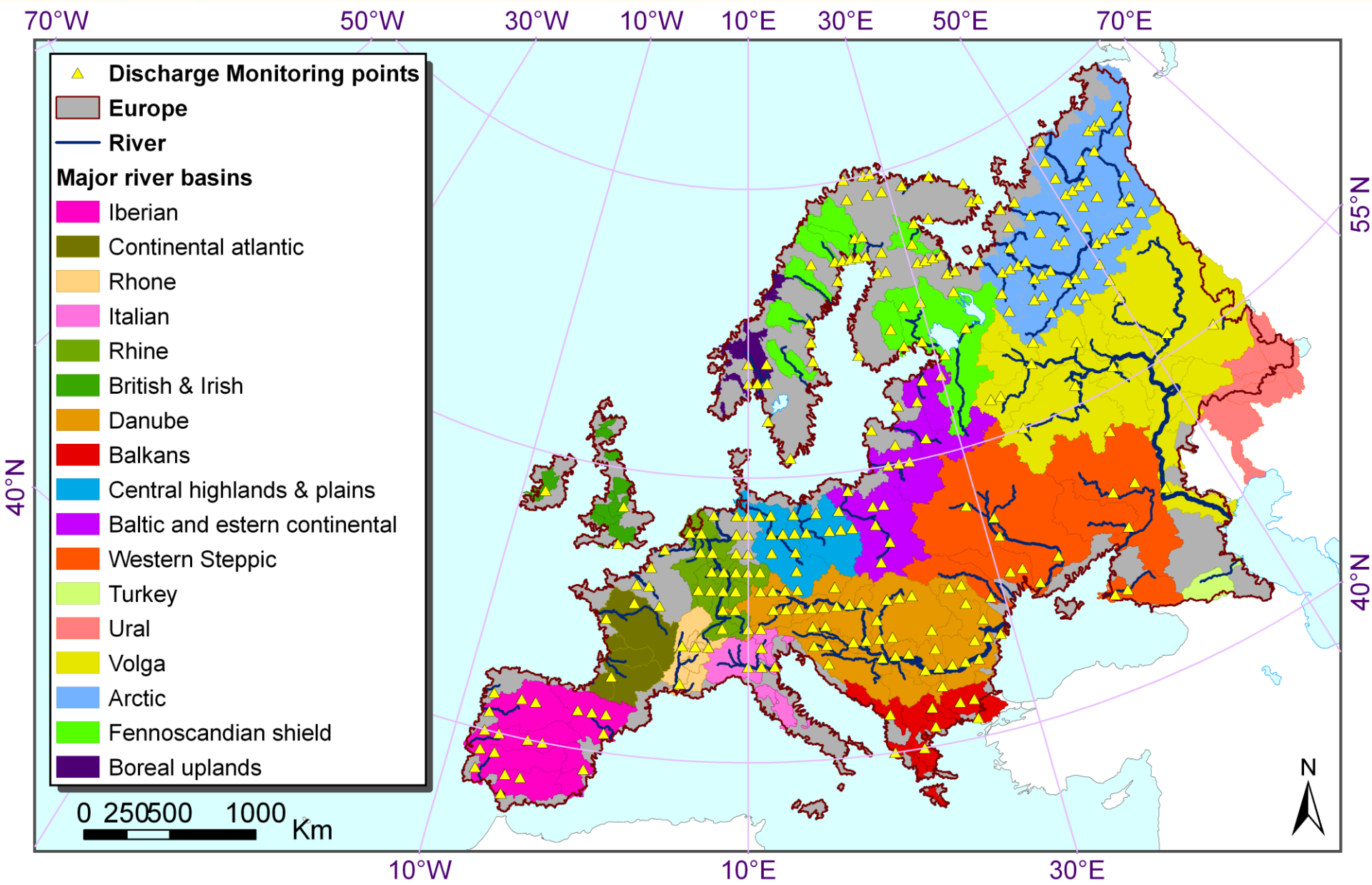
Land Phase

Conceptual model of Hydrology in SWAT





Discharge and nitrate stations



CUPL

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Project Explorer

95ppu plot Outlet Map

EU5

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- Executable Files
- Calibration Outputs
- Sensitivity analysis
- Maps
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Outlet Map

