Project Management of Transboundary Rivers between Ukraine, Russia and the EU (MANTRA-Rivers)

SWAT Model Application for Simulating Nutrient Emission from Small Agricultural Catchment in the Desna River Basin (Ukraine)

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Management of Transboundary Rivers between Ukraine, Russia and the EU (MANTRA-Rivers)

The Desna river (Russia and Ukraine)

The Western Bug (Ukraine and EU)

A. Assessment of the status quo

B. Comparison of data and methods

C. Definition of a future strategy

D. Promote trilateral dialogue and cooperation

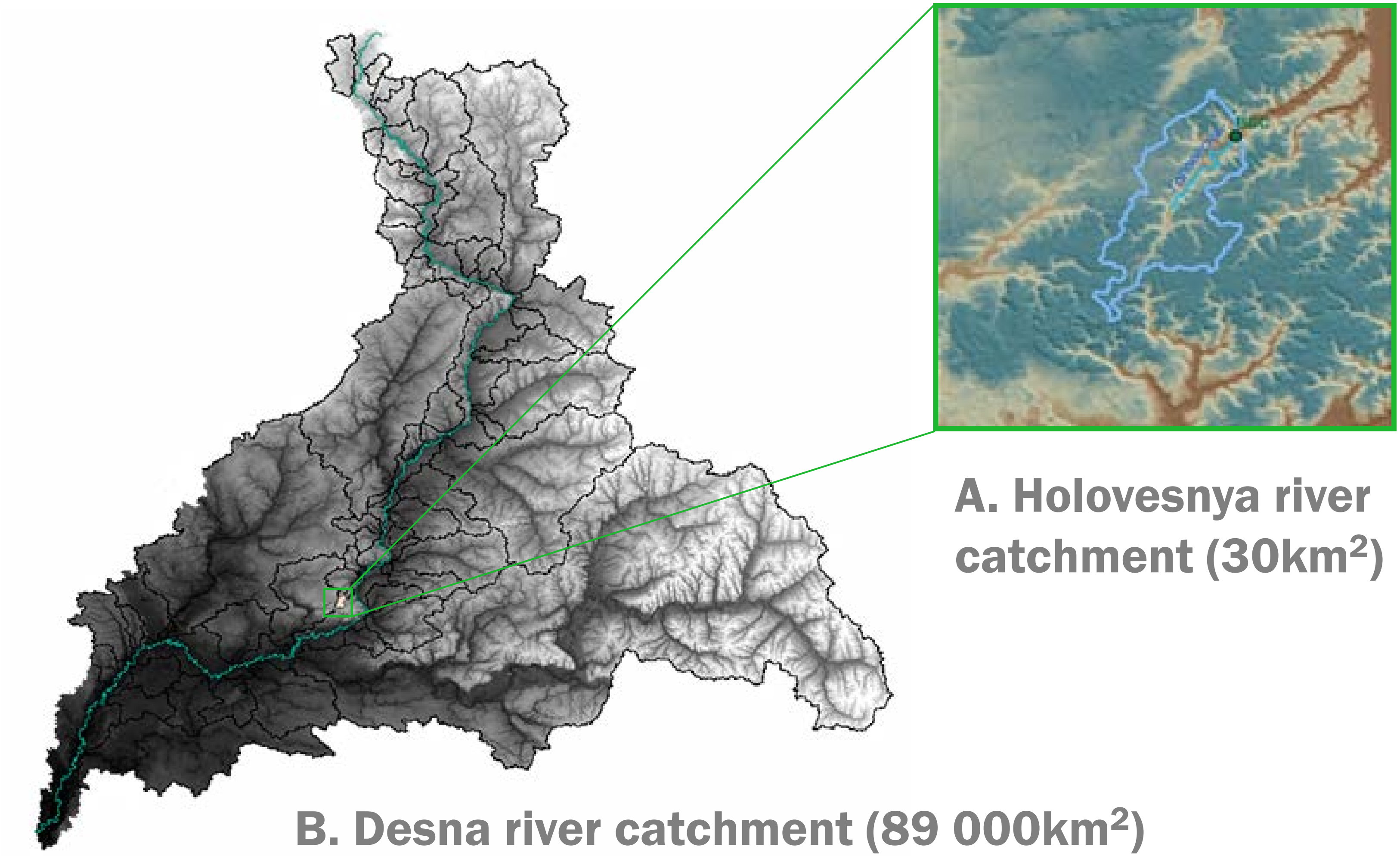
The Western Dvina (Russia, Belarus, EU)

What is the work related to?

2014 Implementation 2024

- ❑ Eutrophication
- ❑ Vulnerable zones
- ❑ Monitoring

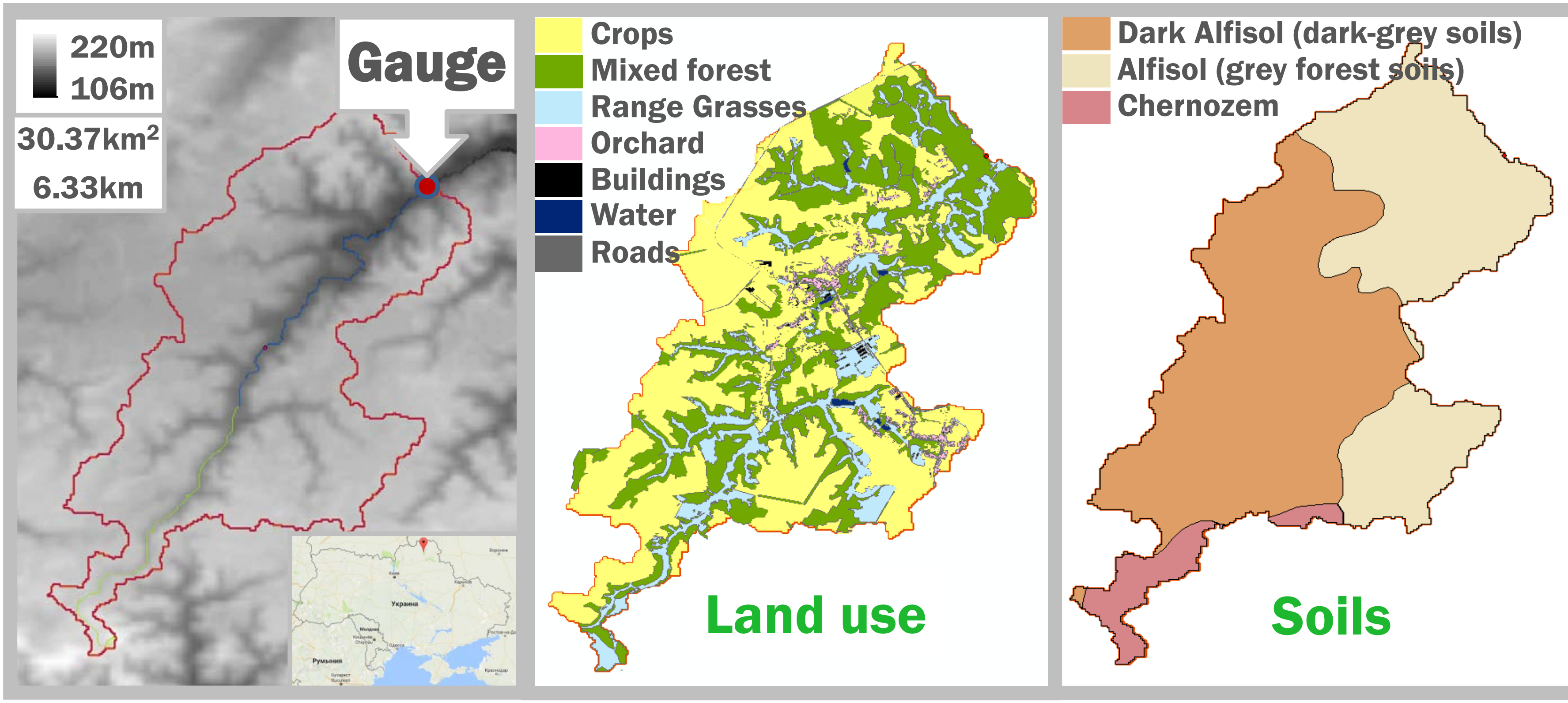
From small scale to large scale



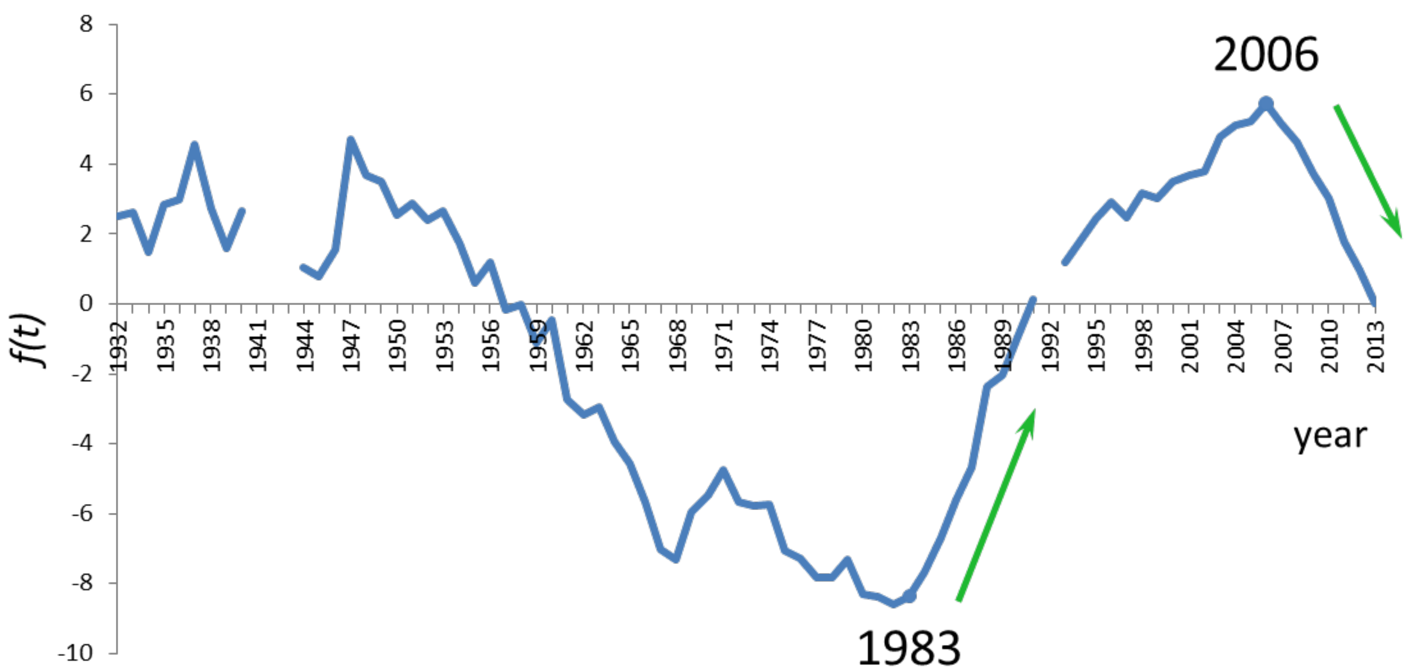
A. Holovesnya river catchment (30km^2)

B. Desna river catchment (89 000km^2)

Study area: the Holovesnya river catchment



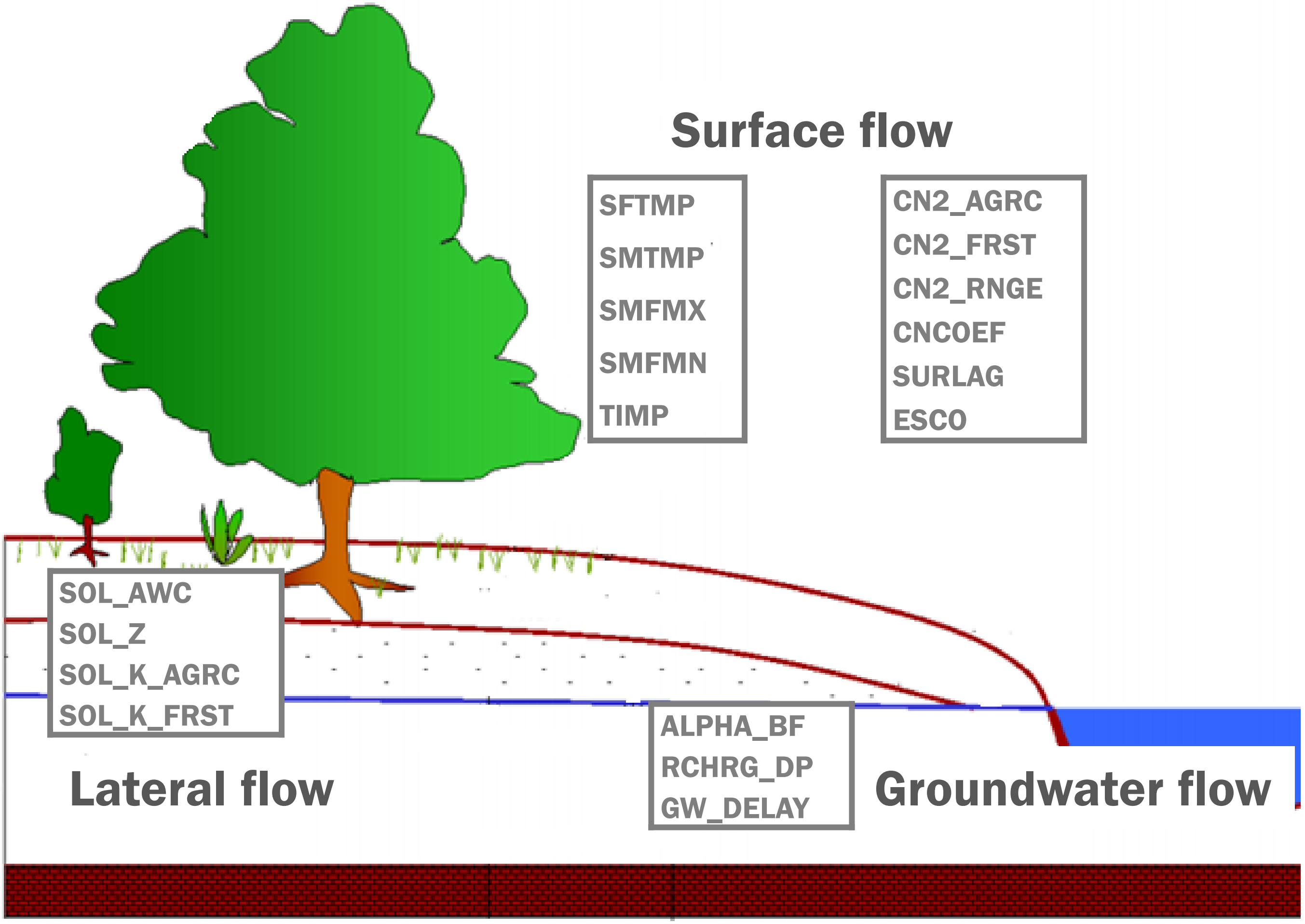
Is the discharge changing?



Residual mass curve of discharges

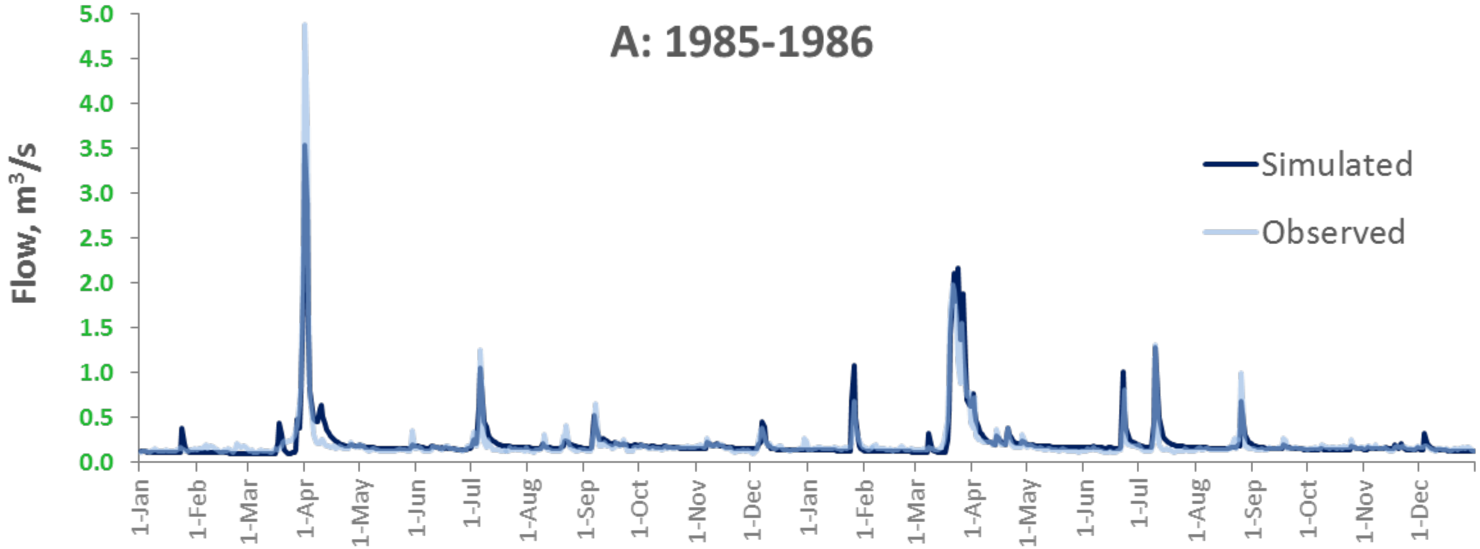
$$f(t) = \sum_{1}^{t} \left(\frac{Q_i}{\overline{Q}} - 1\right) \qquad Q - discharge$$

To what **parameters** is the model **sensitive?**

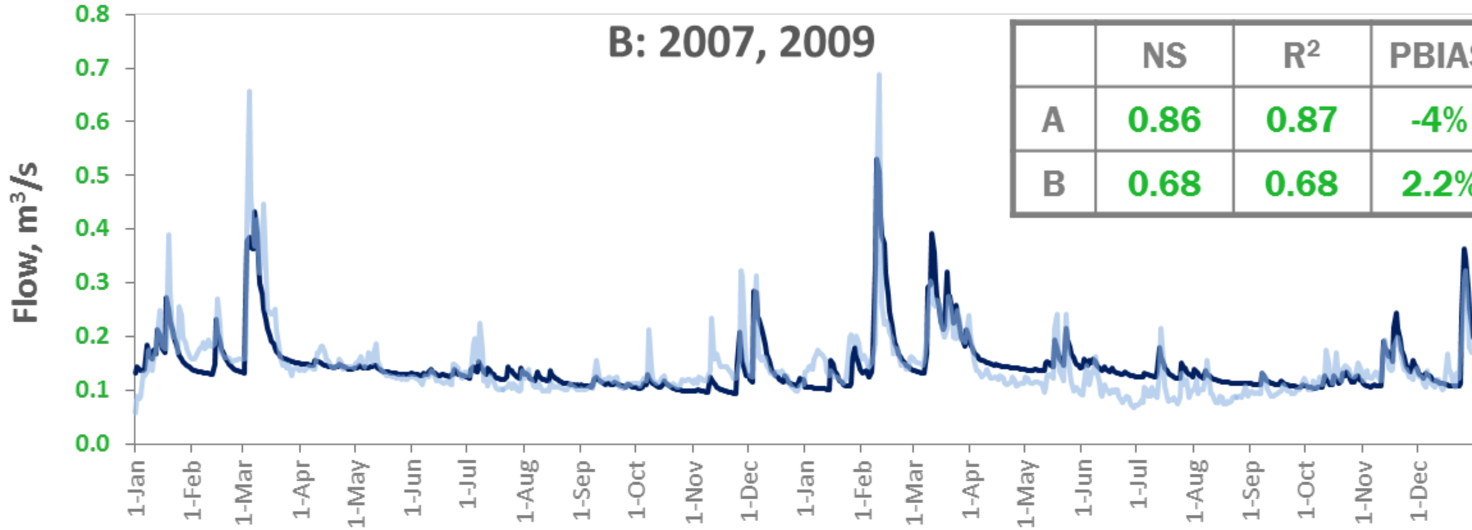


Flow calibration

Full-flow period

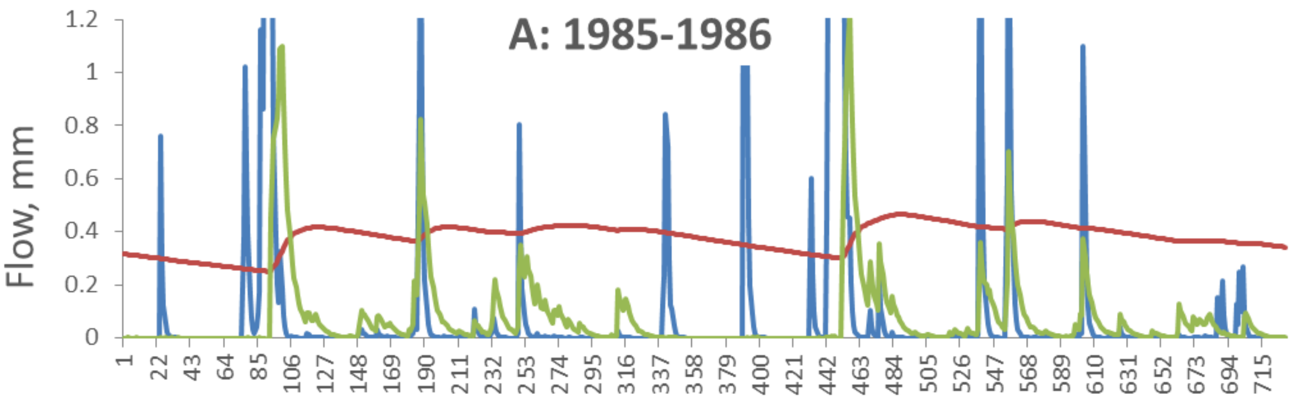


Low-flow period

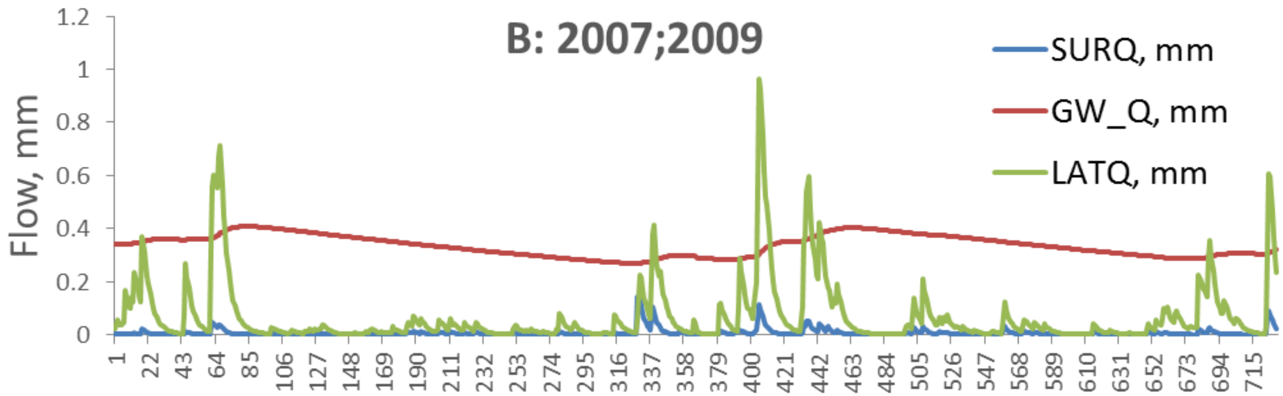


	NS	R^2	PBIAS
A	0.86	0.87	-4%
B	0.68	0.68	2.2%

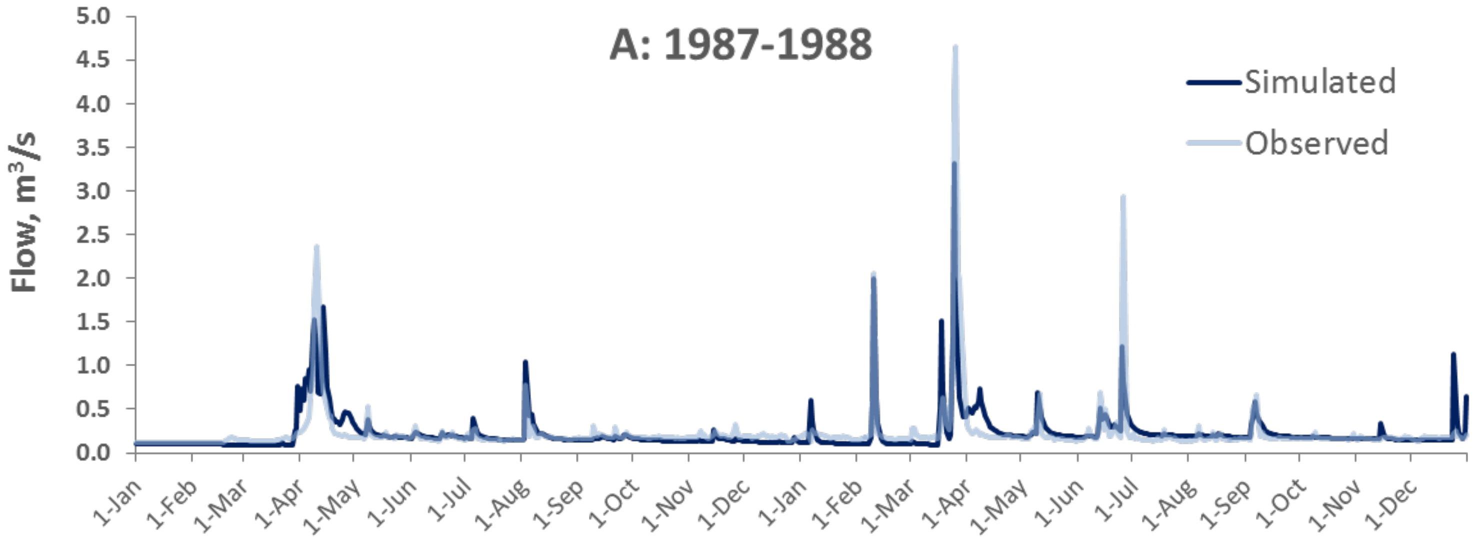
What is the **difference?**

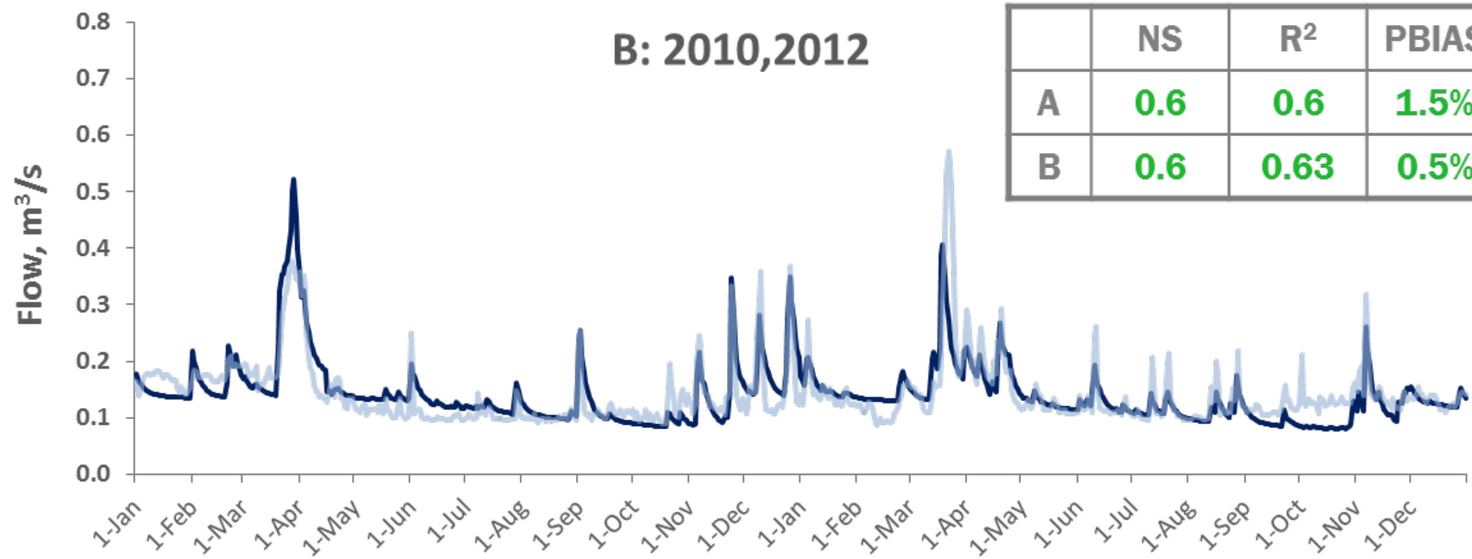


Parameter	A	B
CN2_FRST	59	56
CN2_AGRC	76	63
SOL_AWC	0.13	0.106
SOL_K_AGRC	139	107
RCHRG_DP	0.4	0.52



Flow validation





	NS	R^2	PBIAS
A	0.6	0.6	1.5%
B	0.6	0.63	0.5%

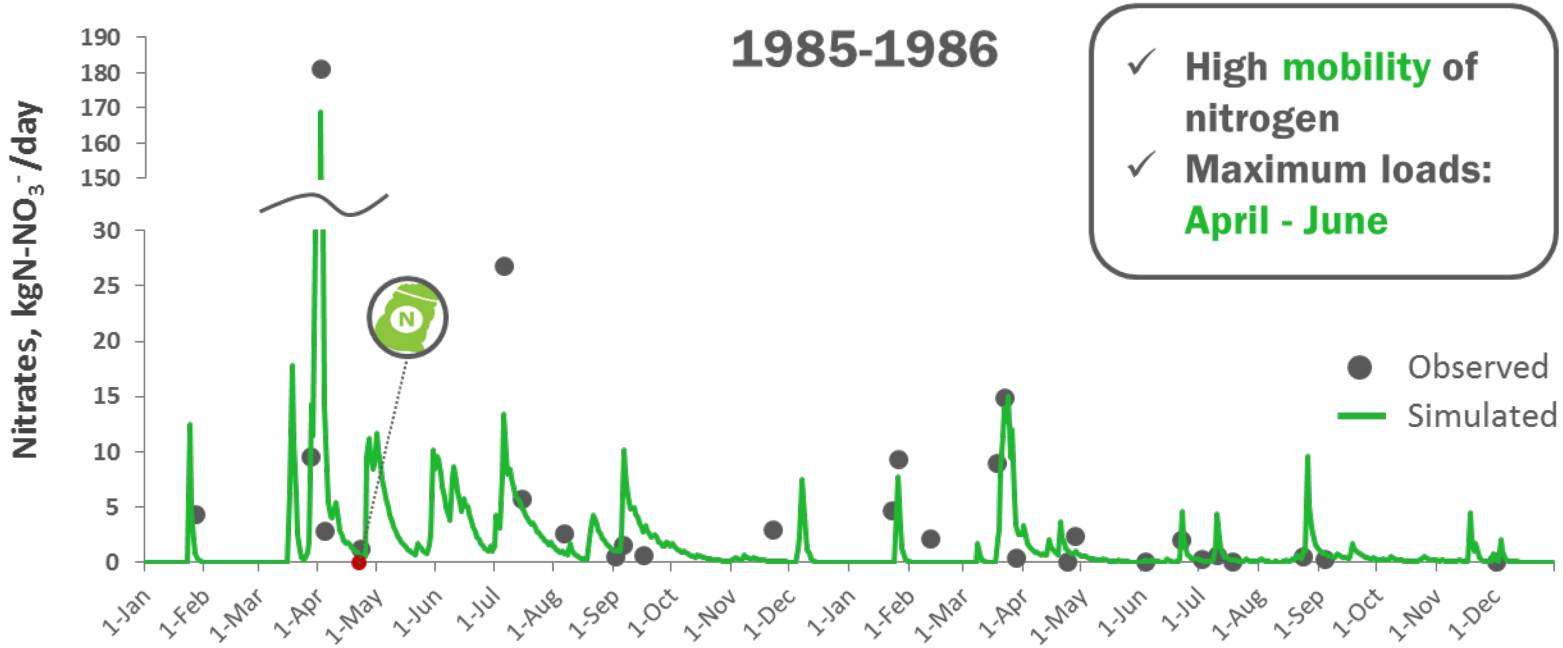
What parameters were chosen for Nitrogen calibration?

RCN.bsn (Concentration of nitrogen in rainfall)
NPERCO.bsn (Nitrate percolation coefficient)
CDN.bsn (Denitrification exponential rate coefficient)
RSDCO.bsn (Residue decomposition coefficient)
SDNCO.bsn (Denitrification threshold water content)
N_UPDIS.bsn (Uptake distribution parameter)
CMN.bsn (Rate factor for humus mineralization of active organic nutrients)
BIOMIX.mgt (Biological mixing efficiency)
ANION_EXCL.sol (Fraction of porosity from which anions are excluded)
HLIFE_NGW.gw (Half-life of nitrogen in groundwater)

Sensitivity analysis →

	Past	Present
RCN	0.7	0.2
CDN	2.61	
SDNCO	0.995	
NPERCO	0.3	
ANION_EXCL	0.144	
CMN	0.1	
N_UPDIS	81	
HLIFE_NGW	1.5	

Nitrogen calibration



- ✓ High **mobility** of nitrogen
- ✓ Maximum loads: **April - June**

	Calibration	Validation	
	1985-1986	1987;1989	2007;2009
NS	0.97	0.69	0.71
RSR	0.15	0.56	0.54
PBIAS	10.2%	-29.3%	10.4%

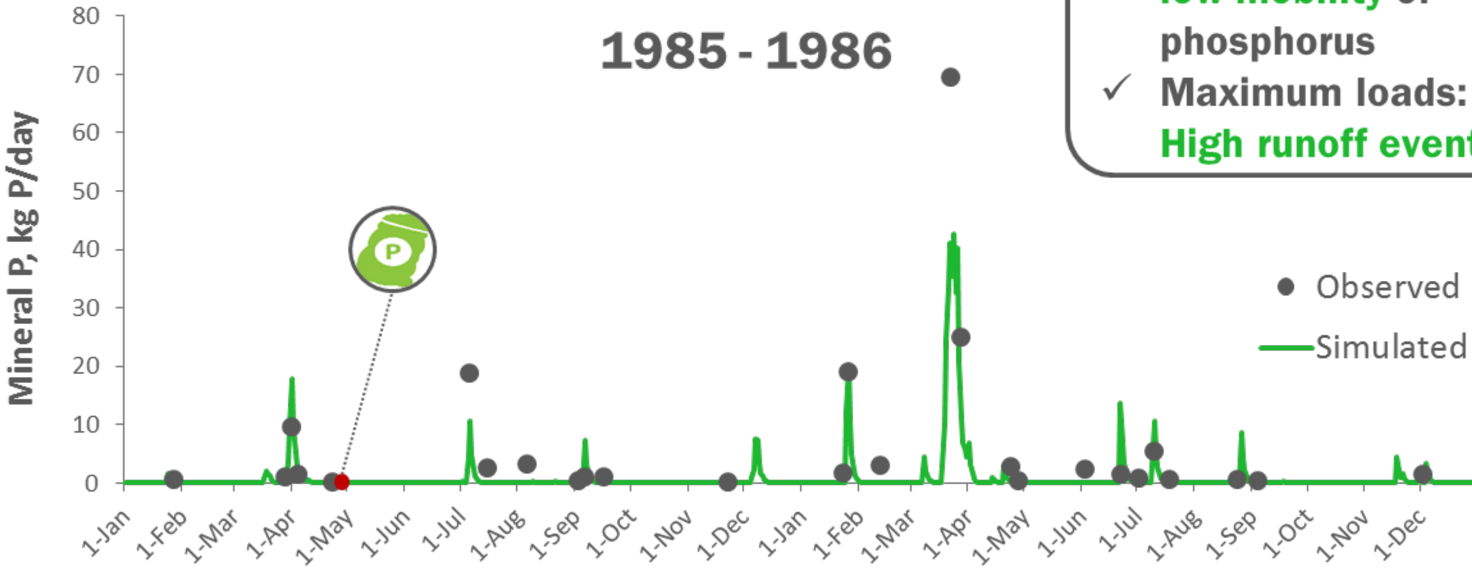
What **parameters** are important for **Phosphorus calibration?**

PSP.bsn (P availability index)
P_UPDIS.bsn (Uptake distribution parameter)
PPERCO.bsn (P percolation coefficient)
PHOSKD.bsn (P soil partitioning coefficient)
SOL_SOLP_AGRC(1).chm (Initial soluble P concentration in first soil layer for crop lands)
SOL_SOLP_FRST(1).chm (Initial soluble P concentration in first soil layer for forest)
ERORGP.hru (P enrichment ratio for loading with sediment)

Sensitivity analysis →

PHOSKD	128
ERORGP	4.24
SOL_SOLP_AGRC	8.5
SOL_SOLP_FRST	1.1
P_UPDIS	72

Phosphorus calibration

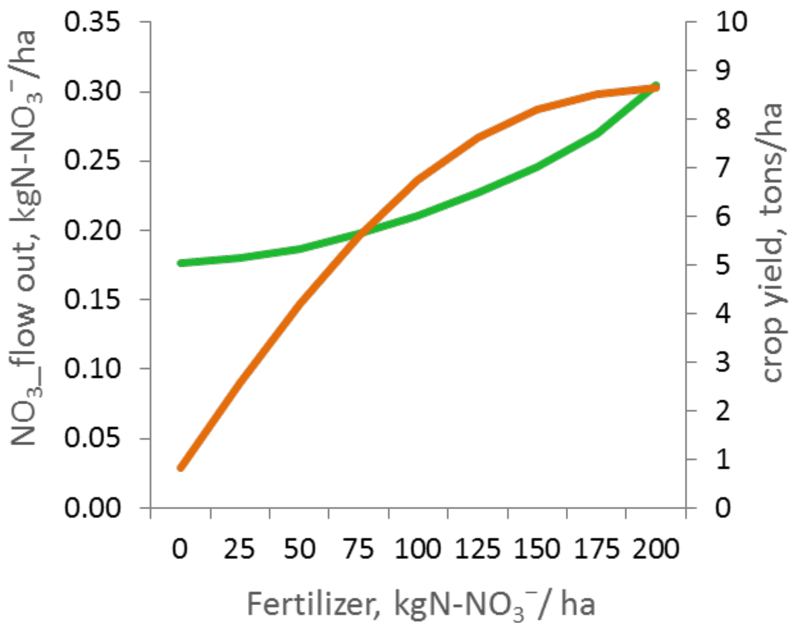


- ✓ High adsorption – low mobility of phosphorus
- ✓ Maximum loads: High runoff events

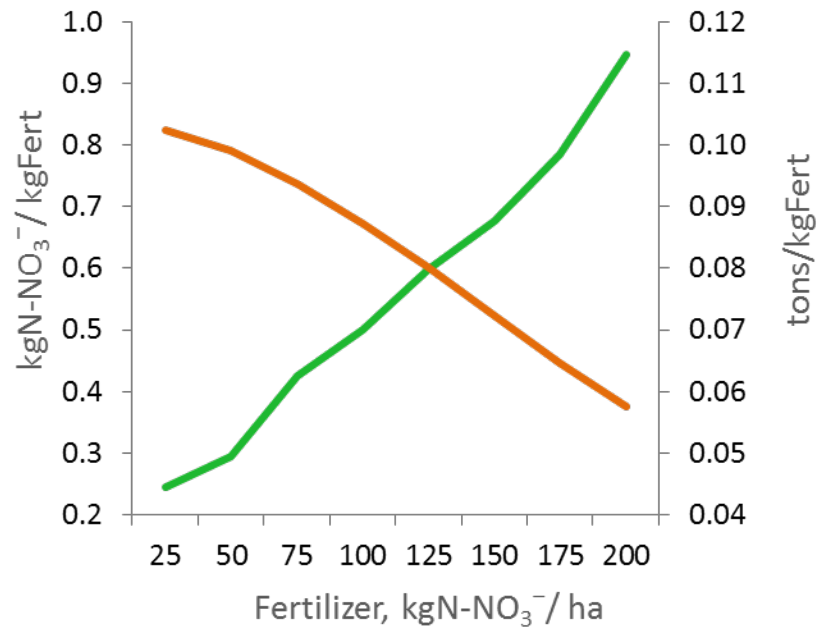
	Calibration	Validation
	1985-1986	1987-1988
NS	0.73	0.6
RSR	0.52	0.63
PBIAS	21%	42.5%

Crop yield – Nitrate load relationship

Increase of crop yield* and NO_3 loads

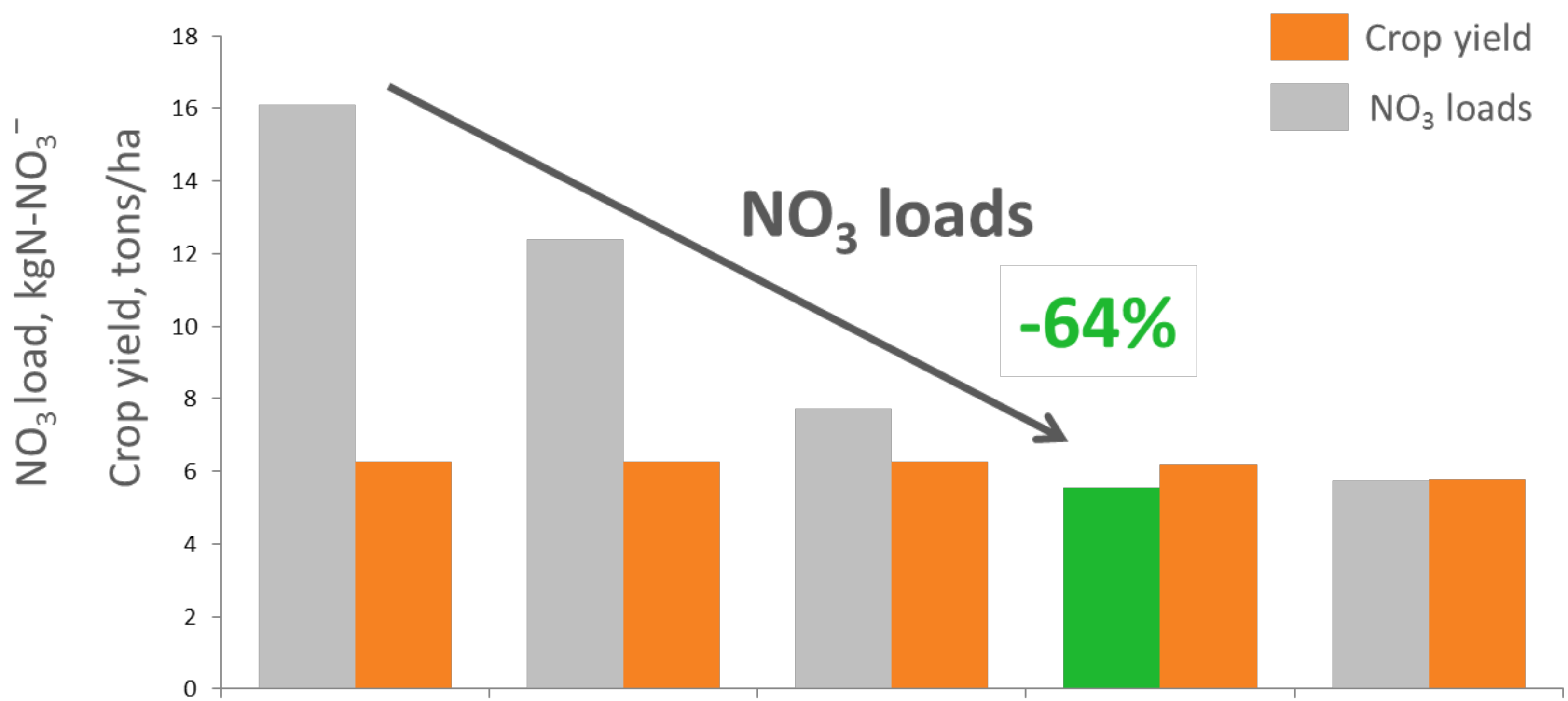


Rate of increase



*Agricultural land close-grown crops (AGRC)

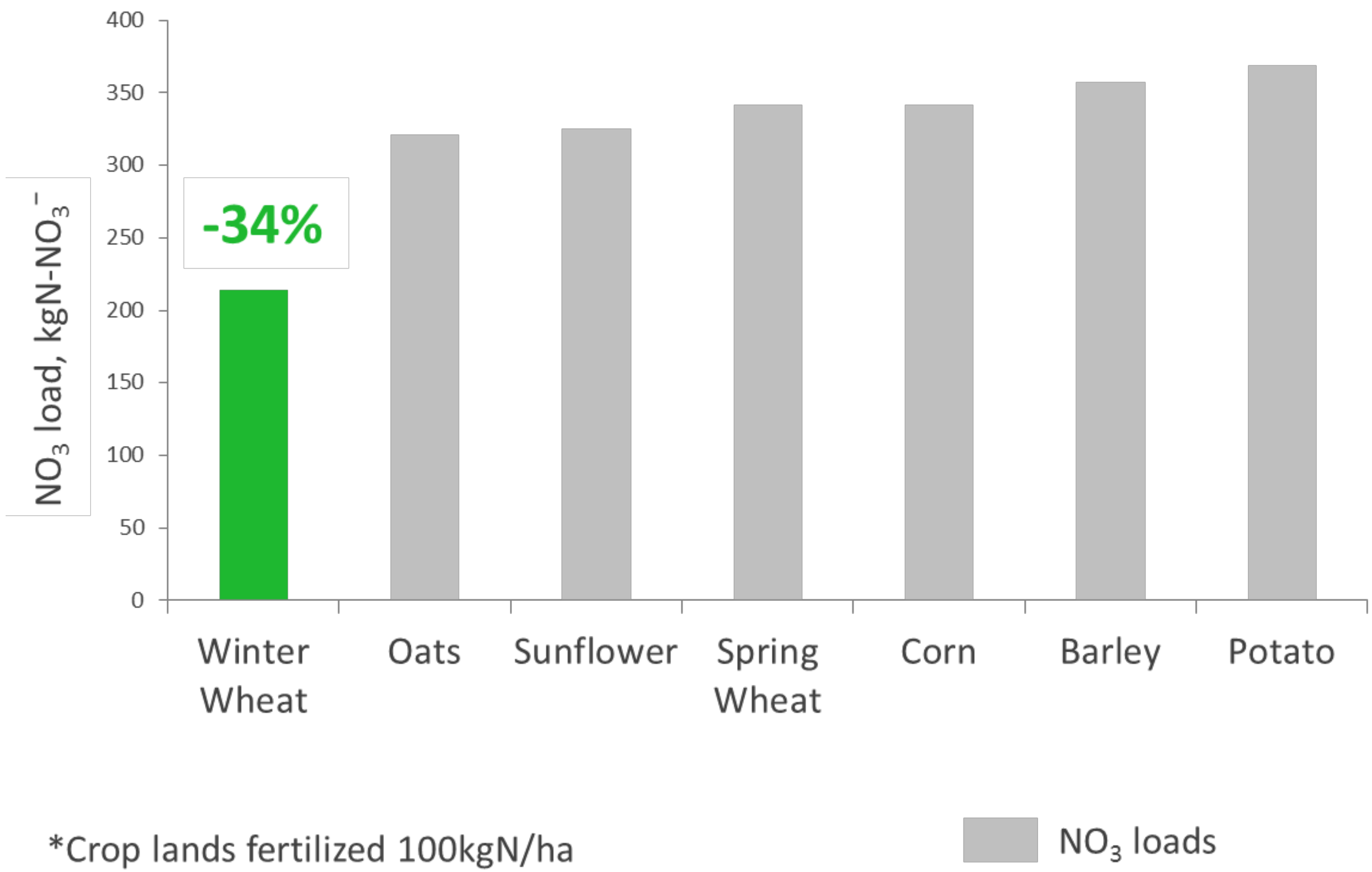
Split of fertilizer application



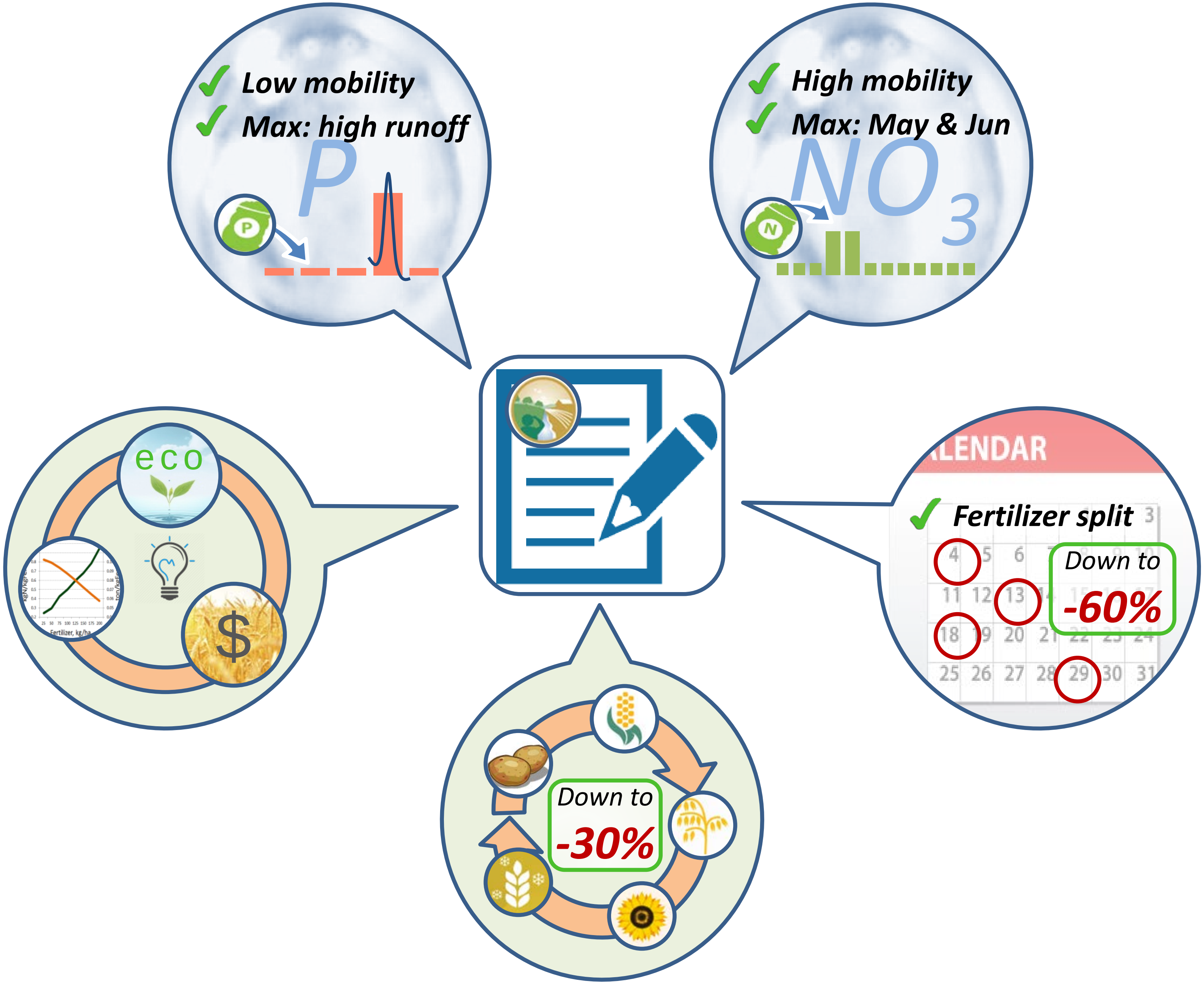
Day	25	25 5	25 5 15	25 5 15 25	25 5 15 2
Month	04	04 05	04 05 05	04 05 05 05	04 05 05 06
Fertilizer*	1	2x1/2	3x1/3	4x1/4	4x1/4

*Crop lands fertilized 100kgN/ha

Nitrates loads for various crops



*Crop lands fertilized 100kgN/ha



Low mobility
Max: high runoff
P
High mobility
Max: May & Jun
NO_3
eco
$
LENDAR
Fertilizer split
Down to
-60%
Down to
-30%

Thank you!

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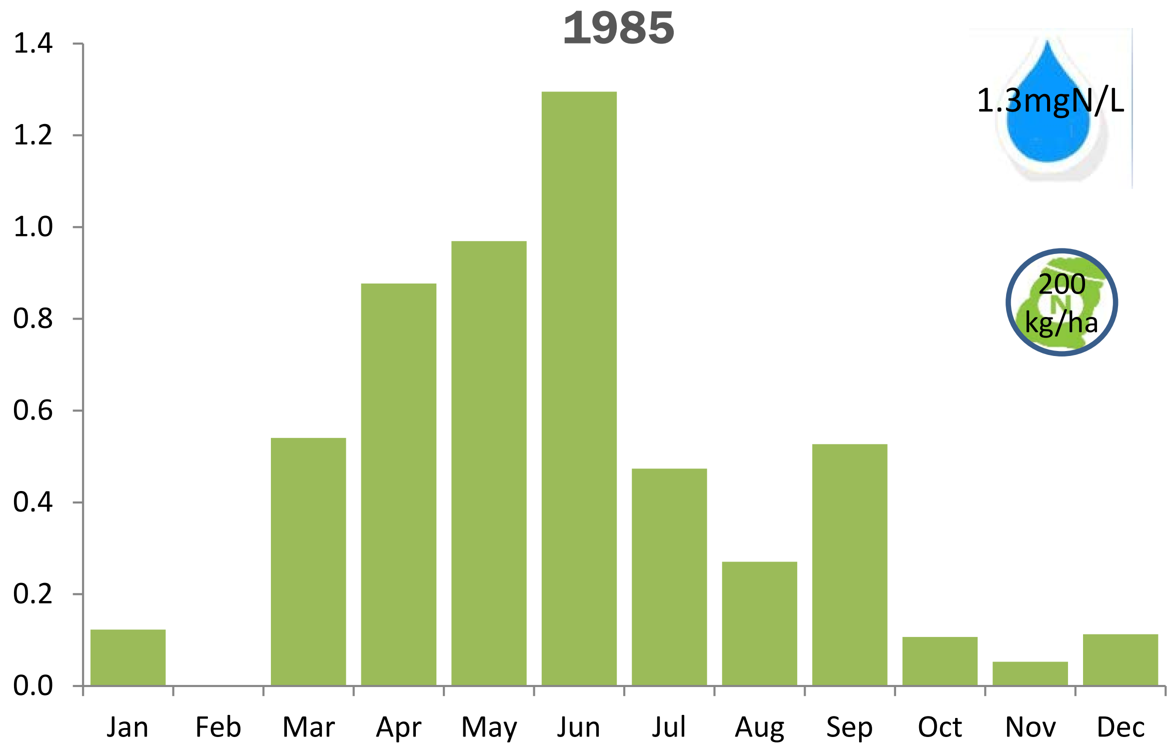
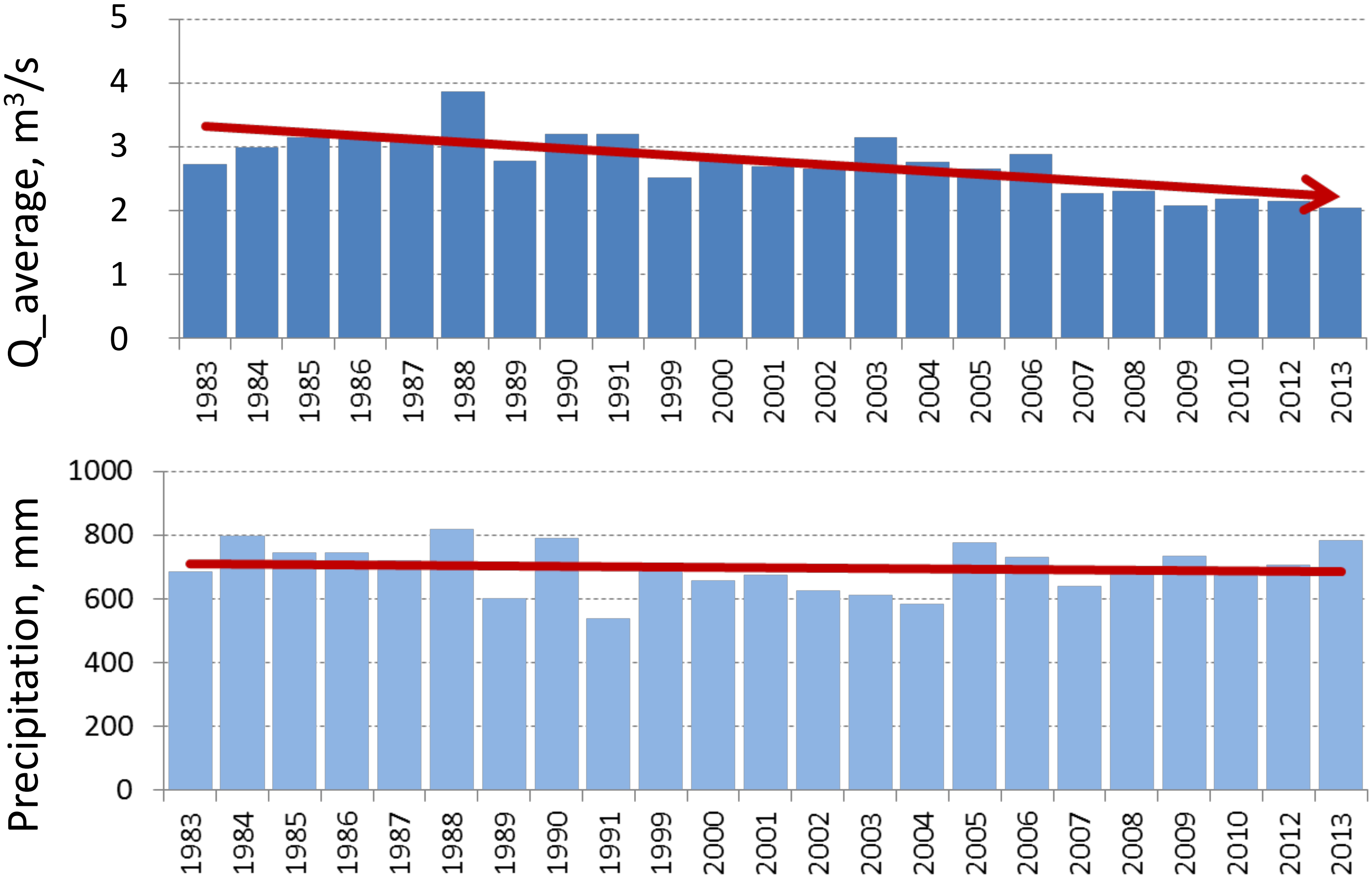
Nitrate concentration in flow



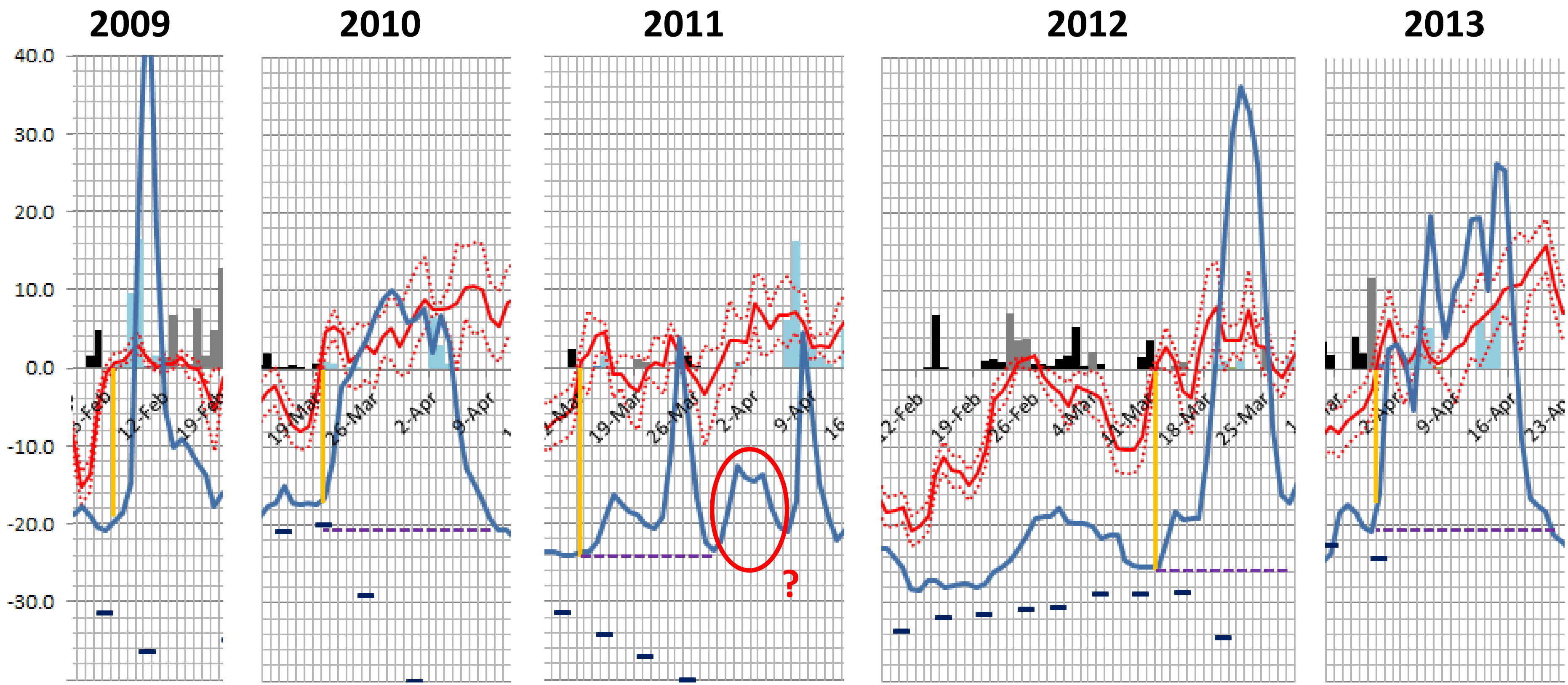
Snowmelt period runoff

	Snow cover	Rain	Runoff, m3	(Snow+Rain)/ Runnoff
1985	134	8	15997	0.32
1986	41	20	14488	0.68
1987	162	8	11768	0.20
1988	71	45	17303	0.42
2007	35	32	3242	0.14
2009	38	34	1527	0.06
2010	150	12	2537	0.04
2012	85	7	2586	0.08

Flow evaluation



Периоды весеннего половодья 2009-2013гг



Осадки
Тср
Tmin
Tmax
Расход
В снеге

2010:
$150_{снег}+14_{ос.}=164$мм
Сток = 277тис.м^3
1мм→1,69тис. м^3

2011:
$65_{снег}+7_{ос.}=72$мм
Сток = 70тис.м^3
1мм→0,97тис. м^3
? сток = 30тис. м^3
1мм →1,39тис. м^3

2012:
$85_{снег}+8_{ос.}=93$мм
Сток = 264тис.м^3
1мм→2,84тис. м^3

2013:
$118_{снег}+39_{ос.}=157$мм
Сток = 360тис.м^3
1мм→2,29тис. м^3