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Uncertainty of large-basin hydrological response to climate change: scenario and model variability effect

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Outline

ECOMAG validation experiments: results for the Lena and Mackenzie river basins

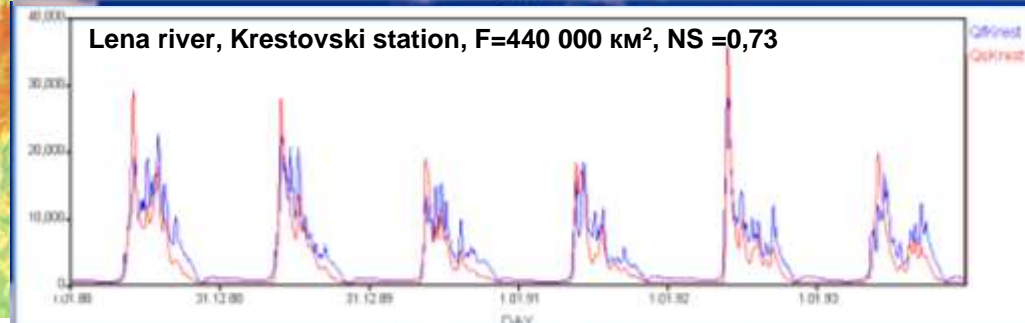
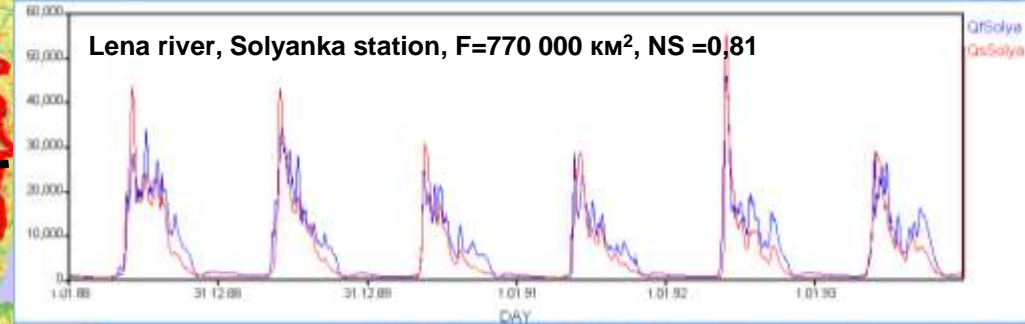
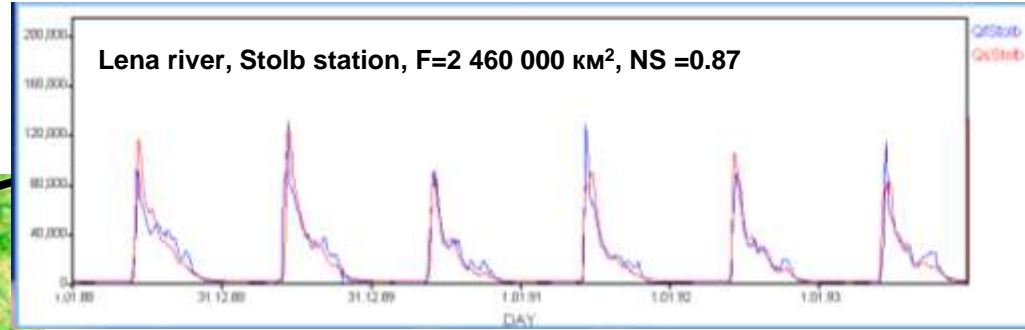
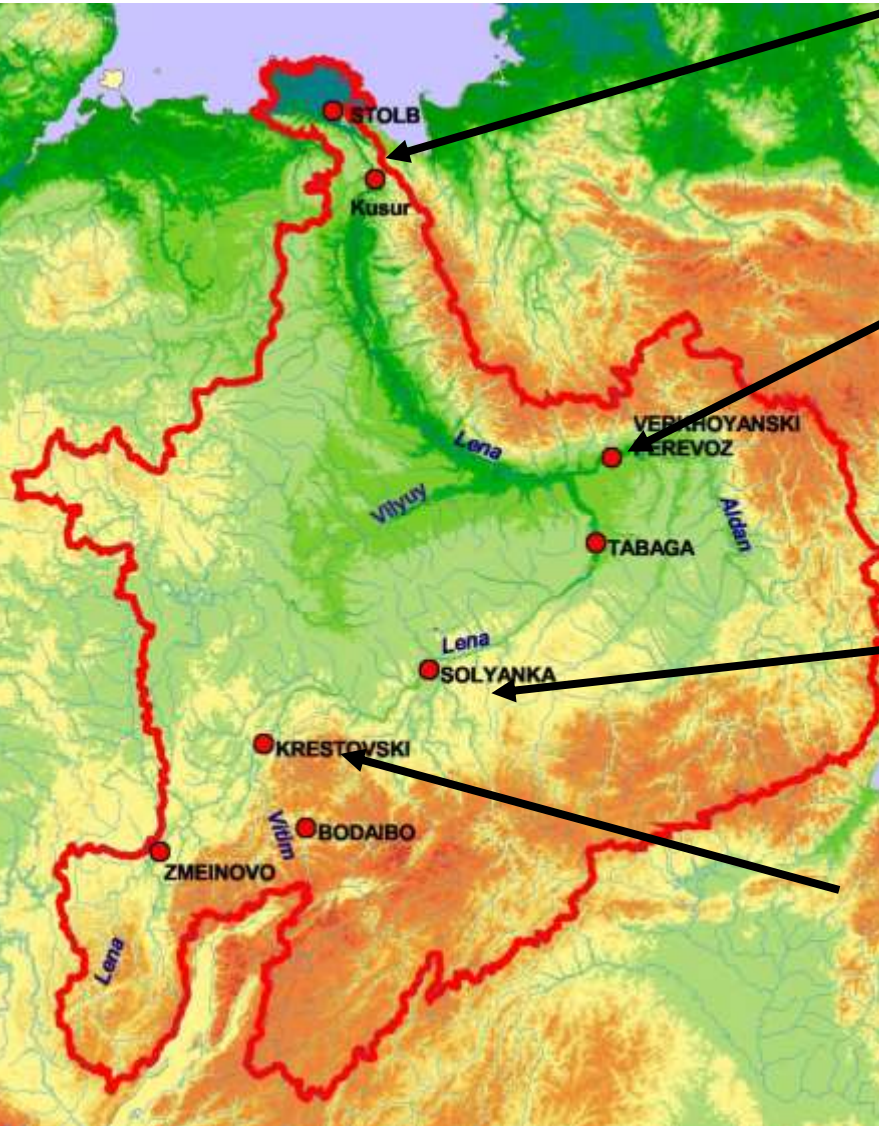
- **historical runs driven by WATCH data**
- **historical runs driven by GCM data**
- **future runs driven by the scenario GCM experiments**

Sources of the hydrological uncertainty: Forcing, Response, Climate Noise

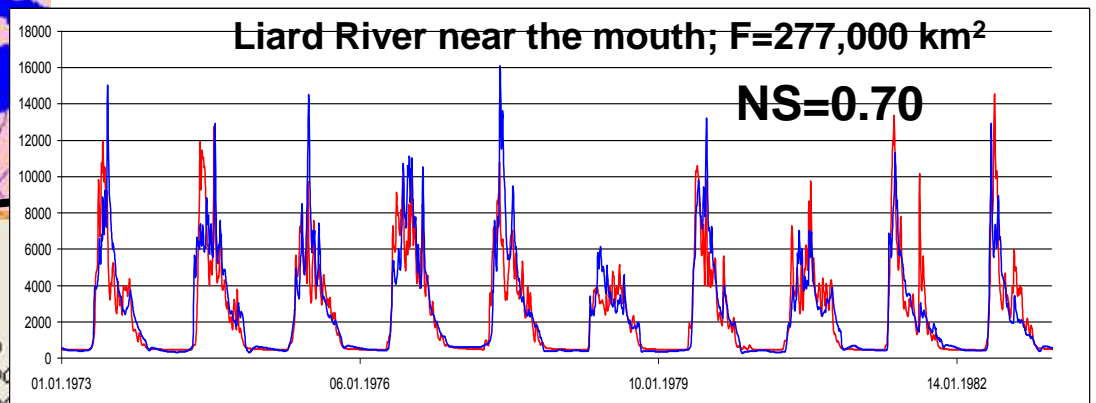
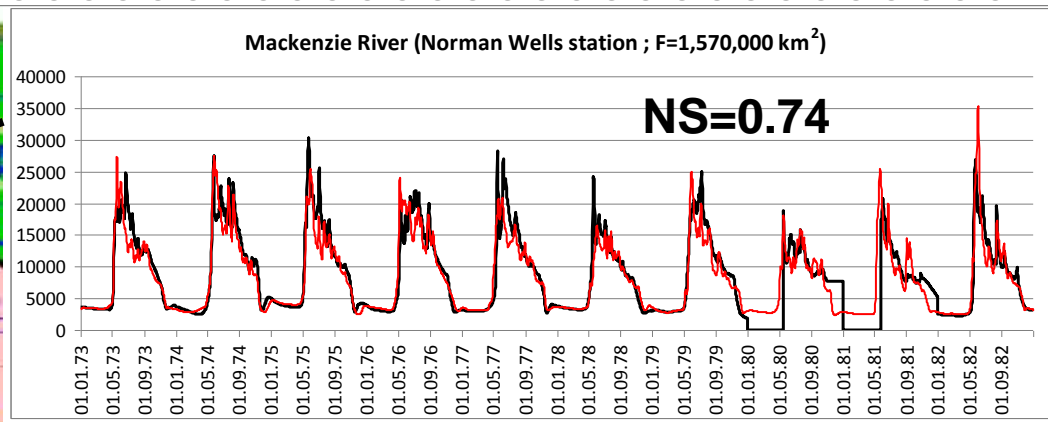
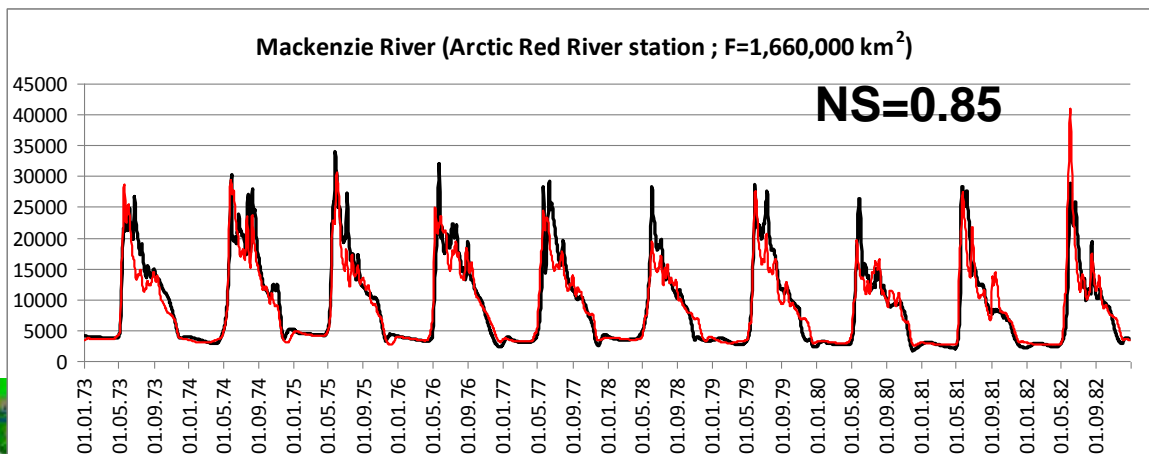
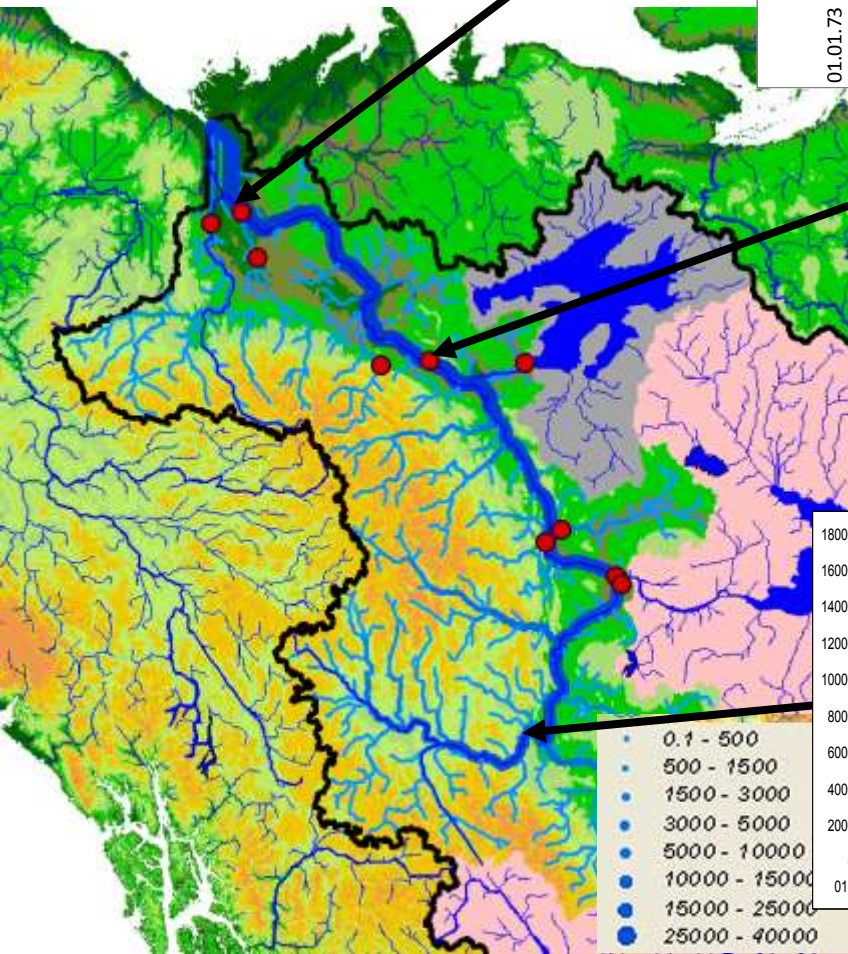
Concluding remarks



Case Study 1: Lena River basin: Historical runs driven by the WATCH reanalysis dataset



Case Study 2: MacKenzie River basin: Historical runs driven by the WATCH reanalysis dataset



Historical (1971-2001) runs driven by GCM data

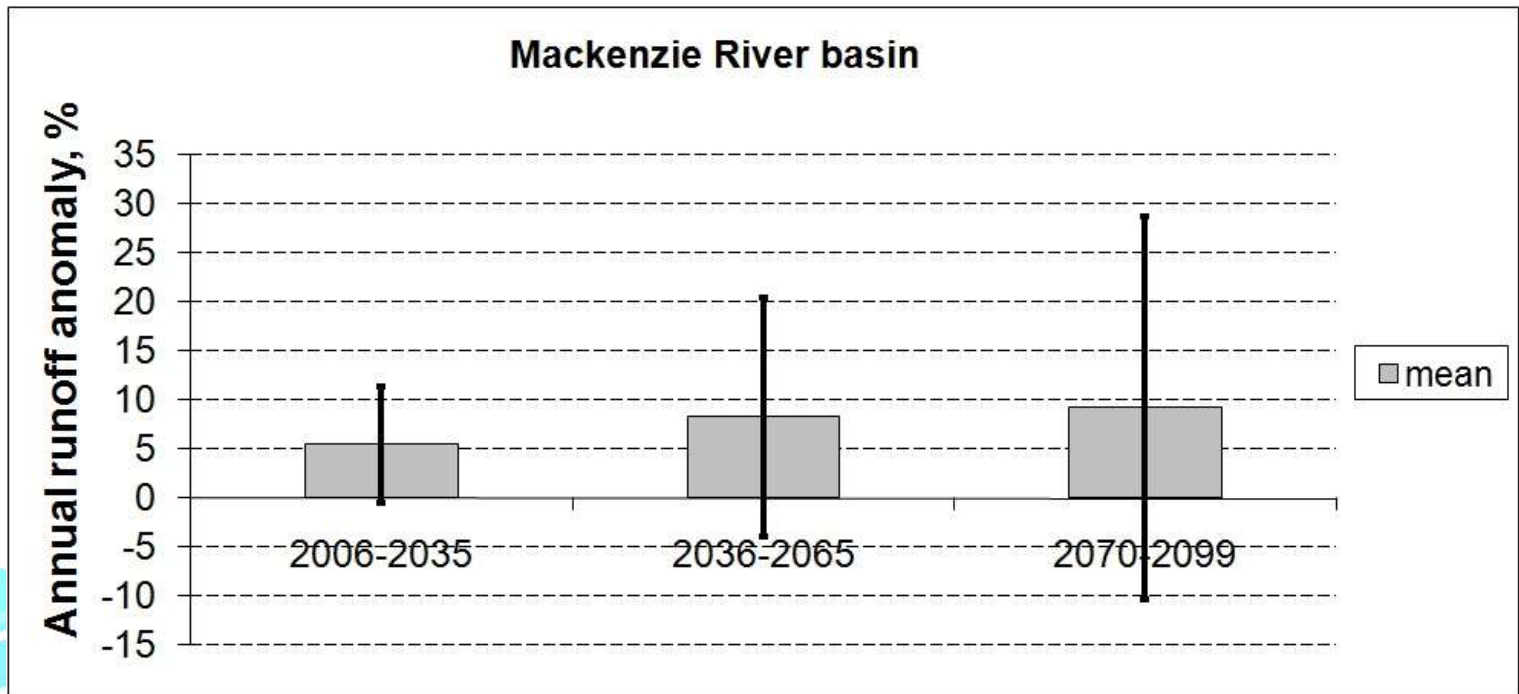
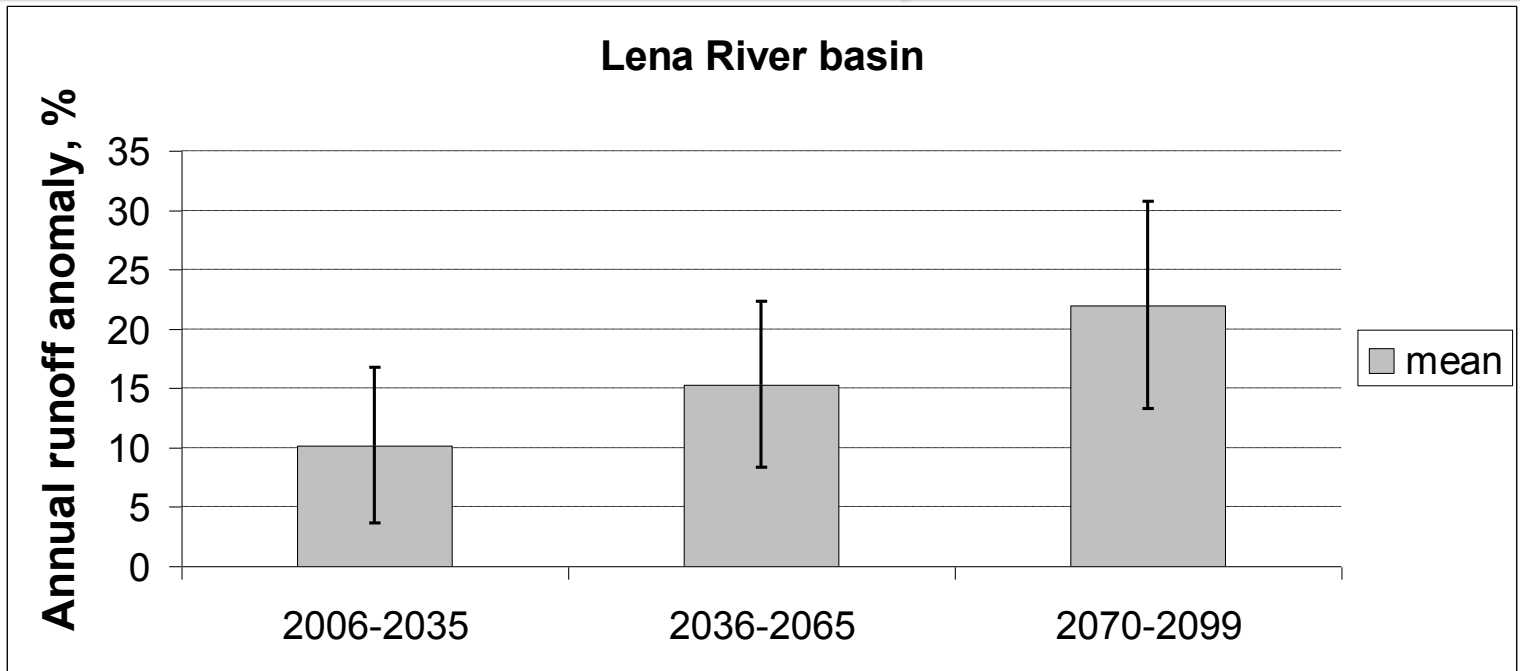
MODEL	Bias Lena, %	Bias, McKenzie %	NS Lena,	NS, McKenzie
GFDL-ESM2M	12	0	0.64	0.63
HadGEM2-ES	9	-6	0.51	0.73
IPSL-CM5A-LR	7	-16	0.52	0.62
MIROC-ESM- CHEM	15	-3	0.51	0.60
NorESM1-M	13	-14	0.55	0.71
WATCH	7	-1	0.83	0.87

Annual runoff changes (%) depending on the used GCM and forcing scenario (Lena River basin)

Scenario/ Model	rcp2p6			rcp4p5			rcp6p0			rcp8p5		
	2006 - 2035	2036 - 2065	2070 - 2099	2006 - 2035	2036 - 2065	2070 - 2099	2006 - 2035	2036 - 2065	2070 - 2099	2006 - 2035	2036 - 2065	2070 - 2099
GFDL- ESM2M	12.8	12.3	21.9	10.4	16.6	21.4	10.7	12.3	19.2	9.4	15.6	23.5
HadGEM2- ES	10.4	17.6	17.2	10.4	19.6	26.2	9.4	17.8	22.7	15.3	17.6	17.3
IPSL-CM5A- LR	14.6	16.6	24.0	15.8	18.2	21.2	13.8	14.0	22.0	13.1	18.7	28.5
MIROC-ESM- CHEM	9.2	15.7	14.0	6.1	14.8	21.7	5.7	17.4	24.7	10.5	20.6	29.7
NorESM1-M	5.7	10.4	17.8	9.7	9.7	22.3	5.3	7.2	13.9	5.2	13.0	18.8
Mean	10.5	14.5	19.0	10.4	15.7	22.6	9.0	13.7	20.5	10.7	17.1	23.6



95% c.i. of annual runoff anomalies caused by scenario and model variability



Concluding remarks

- 1. On the basis of both Lena and Mackenzie simulations, we found that ECOMAG demonstrates satisfactory performance of historical simulations independently on the reanalysis and GCM-simulated data. These data should be bias-corrected before using them as input into hydrological model.**
- 2. By the end of XXI century, the GCM-averaged scenario experiments demonstrated 19-23% increase of annual runoff for Lena river and 8-12% increase for MacKenzie river.**
- 3. Uncertainty in estimates of hydrological response to climate change is, primarily, caused by the future climate projection uncertainty, which, in turn, is related to three independent factors: scenario, model, and internal variability. Ensemble experiments demonstrate that runoff anomaly estimate uncertainty caused by scenario and model variability can exceed the anomaly per se**





LHG ECOMAG Team

Thank you for attention!

