Variations of hydrological characteristics at the rivers of different size in the Lena river basin

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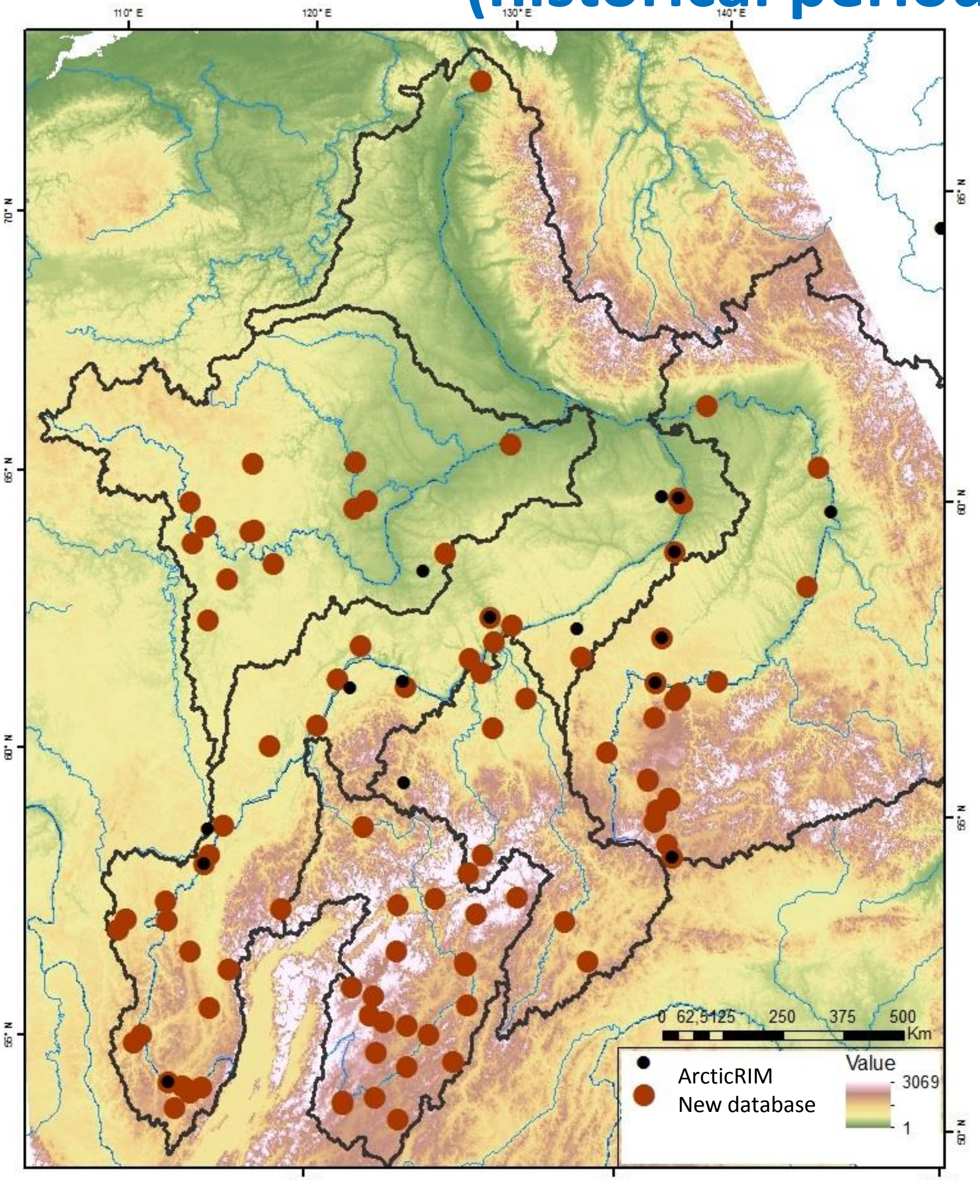
New database of daily runoff for the Lena River basin (historical period up to 2013)



Area, km^2	Number of gauges (including Olenek, Yana and Indigirka)
<100	15
100-200	7
200-1000	14
1000-10000	49
10000-50000	42
50000-150000	18
>150000	13
Σ	**158**
ArcticRIMS	**21**

	Average	Maximum
New database	54	89
ArcticRIMS	56	75

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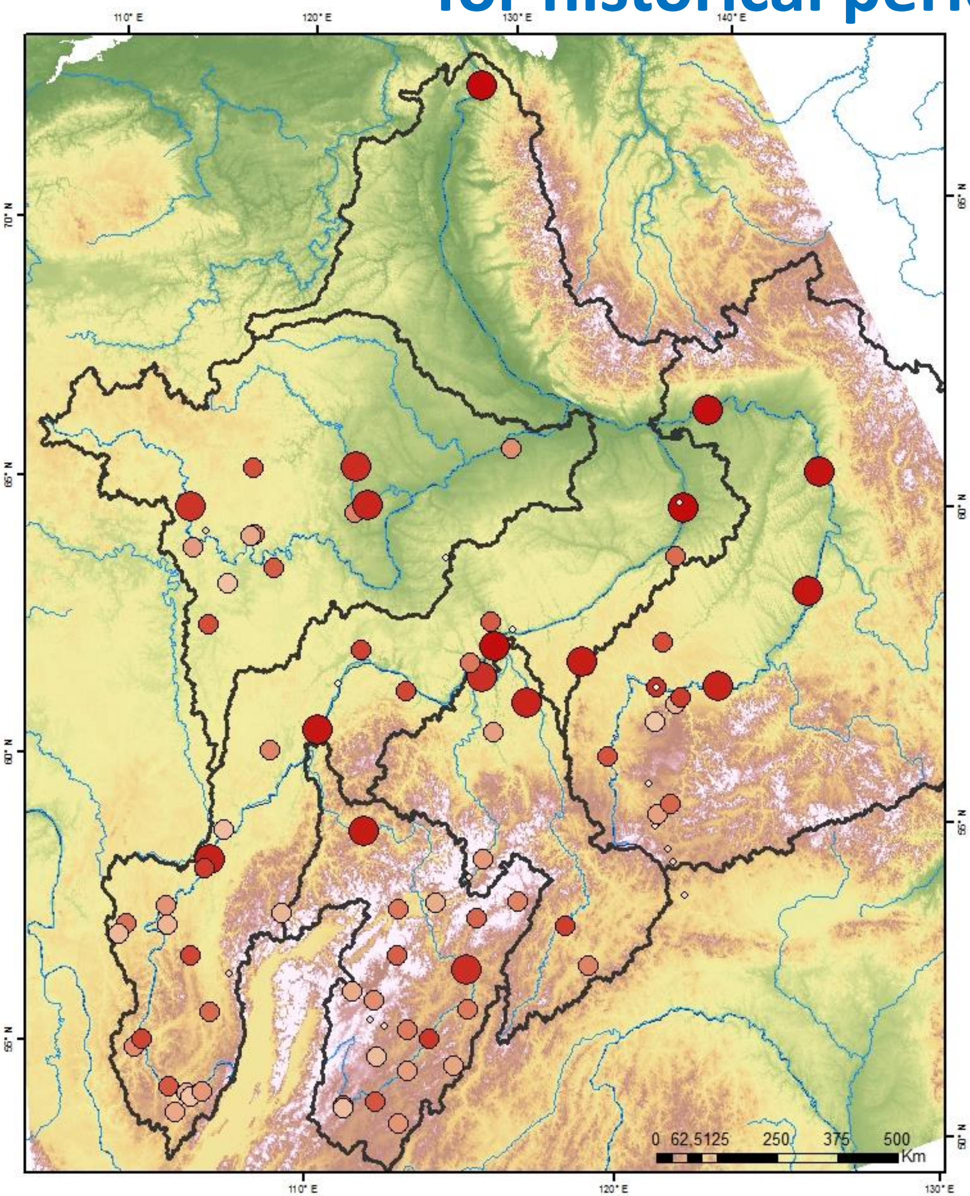

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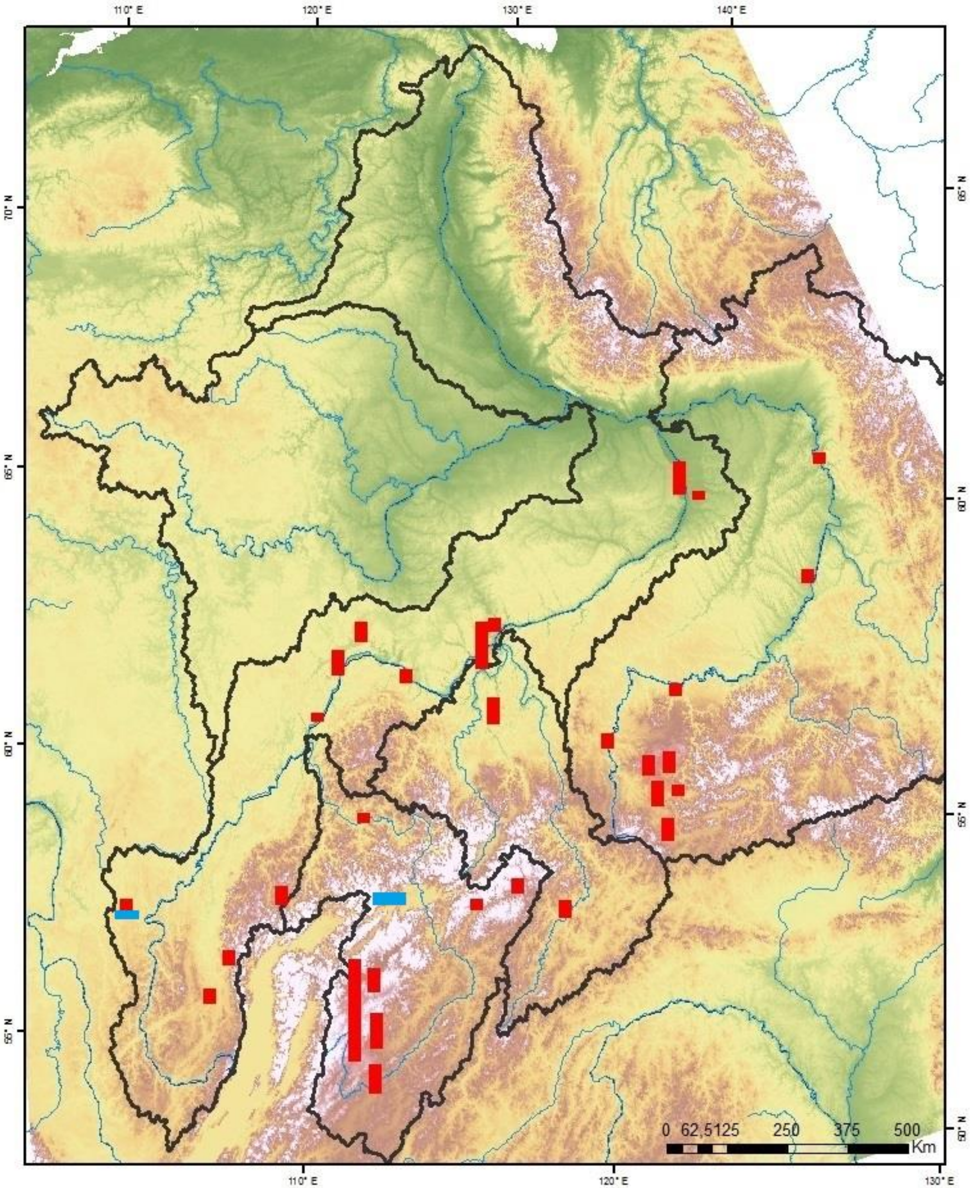
Nonparametric methods

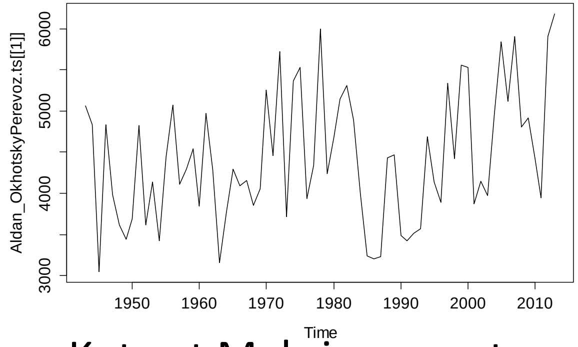
- Trend detection was performed using the **Mann–Kendall trend test and the Spearman's rank correlation test**
- Whence both tests detected trend in the time–series with *p* ≤ 0.05, serial correlation coefficient at lag 1 *r(1)* was calculated. **'Trend–free pre–whitening' (TFPW)** was performed for the series with significant *r(1)* values, and those with *p* ≤ 0.05 for MK *tau* after TFPW procedure were deemed showing persistent trend pattern.
- **The nonparametric Pettitt's test** was employed in preliminary analysis of the dataset to detect the presence of at least one 'breakdown–type' discontinuity in the time–series. Whence the Pettitt's test marked a significant change–point, the series were admitted as nonstationary, and **the Buishand range test** was used to search for numerous discontinuities. Significantly nonstationary time–series were subsetted using a detected change point as a divide, and ***t*–test** applied to the subsets to confirm the difference in location parameter.
- **Trend magnitude for stationary time–series was assessed as the Theil–Sen slope per unit time multiplied by period length and related to long–term average flow (discharge).** In nonstationary series, Hodges–Lehmann estimator was calculated for each subset, and difference between the estimator values was divided by its first (earliest) value to derive a relative magnitude.

Detected trends in mean annual daily flow (MADF)

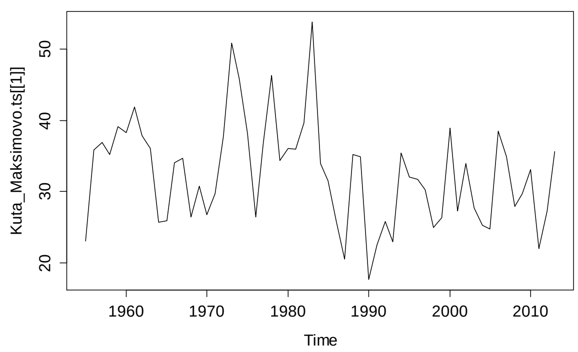


Negative Positive

Aldan at Okhotsky Perevoz, + trend

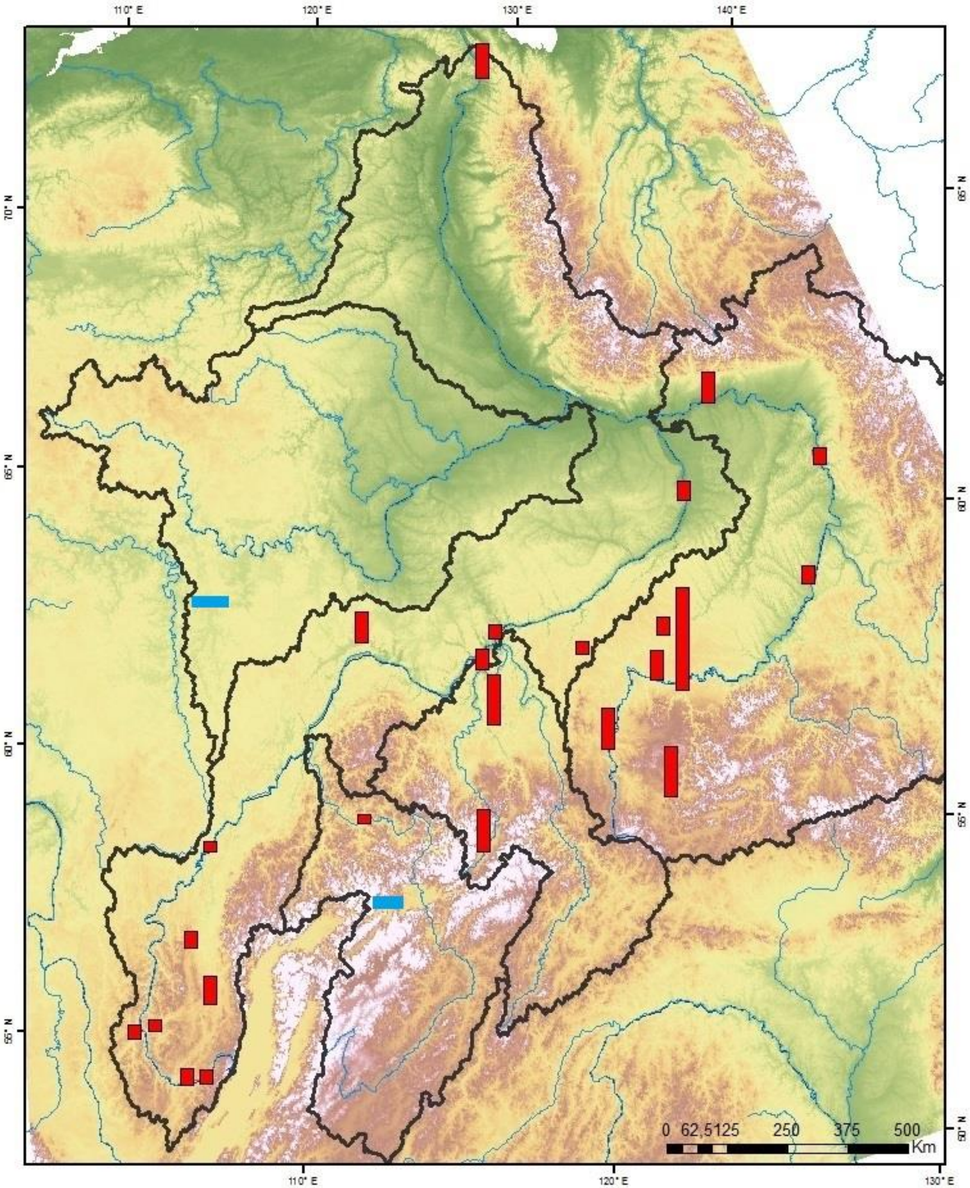


Kuta at Maksimovo, - trend



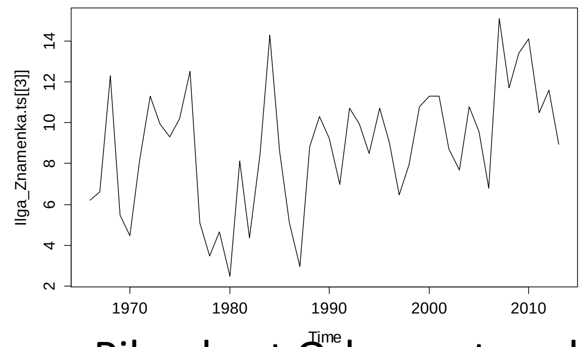
32 of the 96 studied time-series showed significant trends in MADF (2 negative, 30 positive). Positive trend magnitude varies from 14.3% to 184.2%, and all-records average is 40%. Negative are -14,7 and -17,8%.

Detected trends in minimum flow (Qmin)

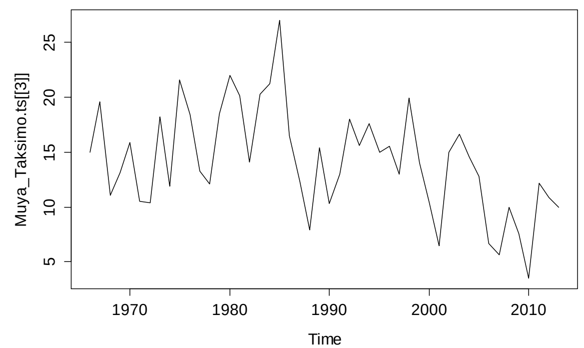


Negative Positive

Kempendiay at Chaingda, + trend

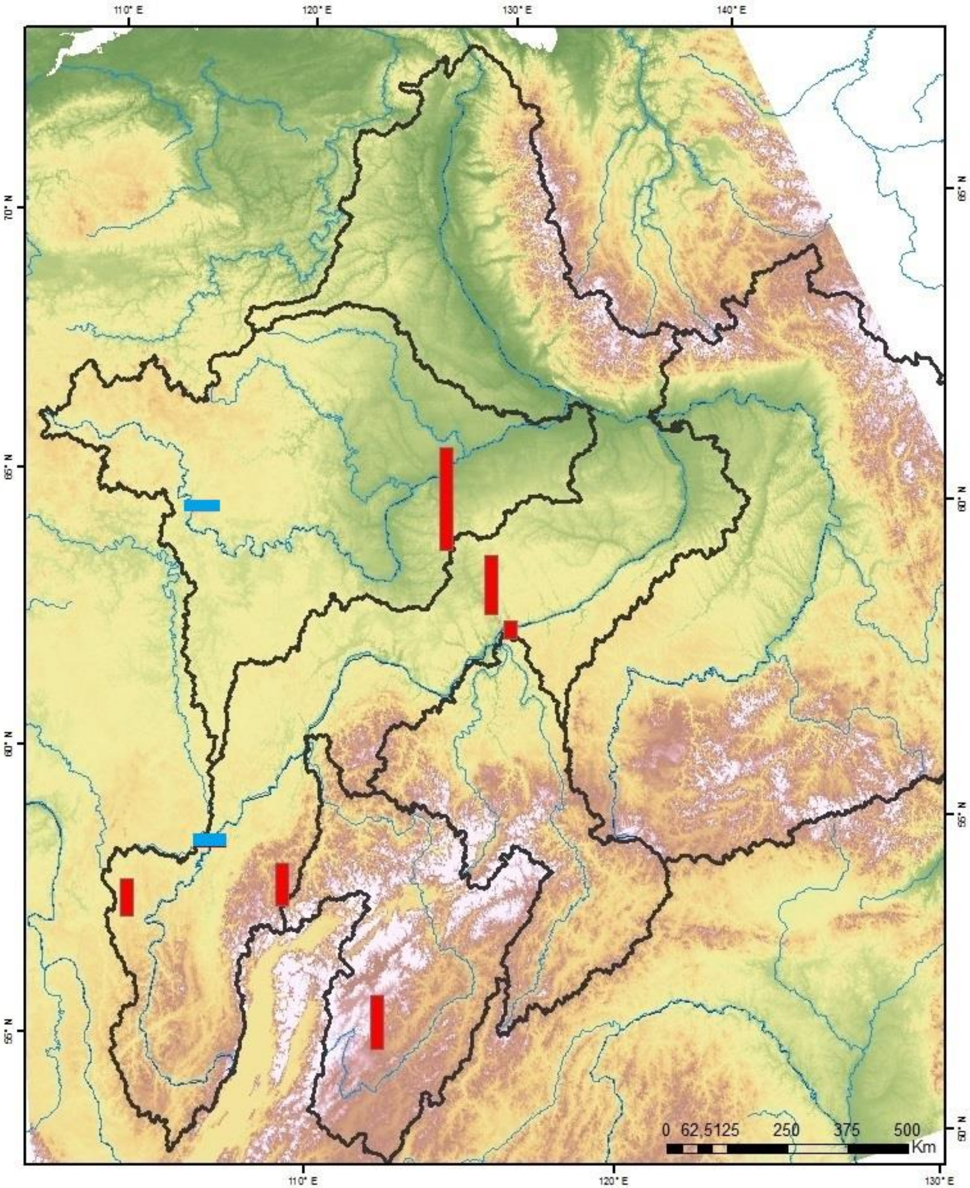


Pilyuda at Orlova, - trend



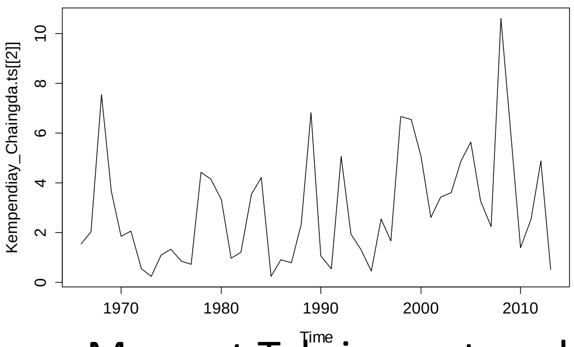
31 of the 48 records showed trends in Q_{min}, 2 negative and 29 positive.

Detected trends in maximum flow (Qmax)

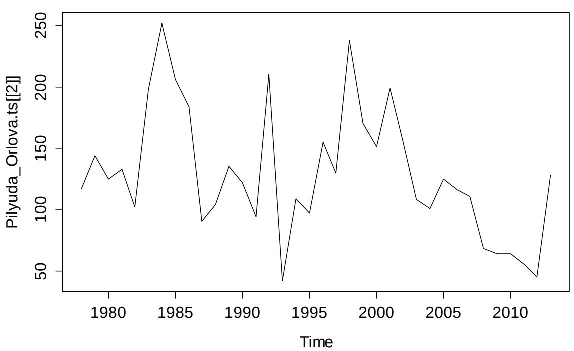


Negative Positive

Ilga at Znamenka, + trend

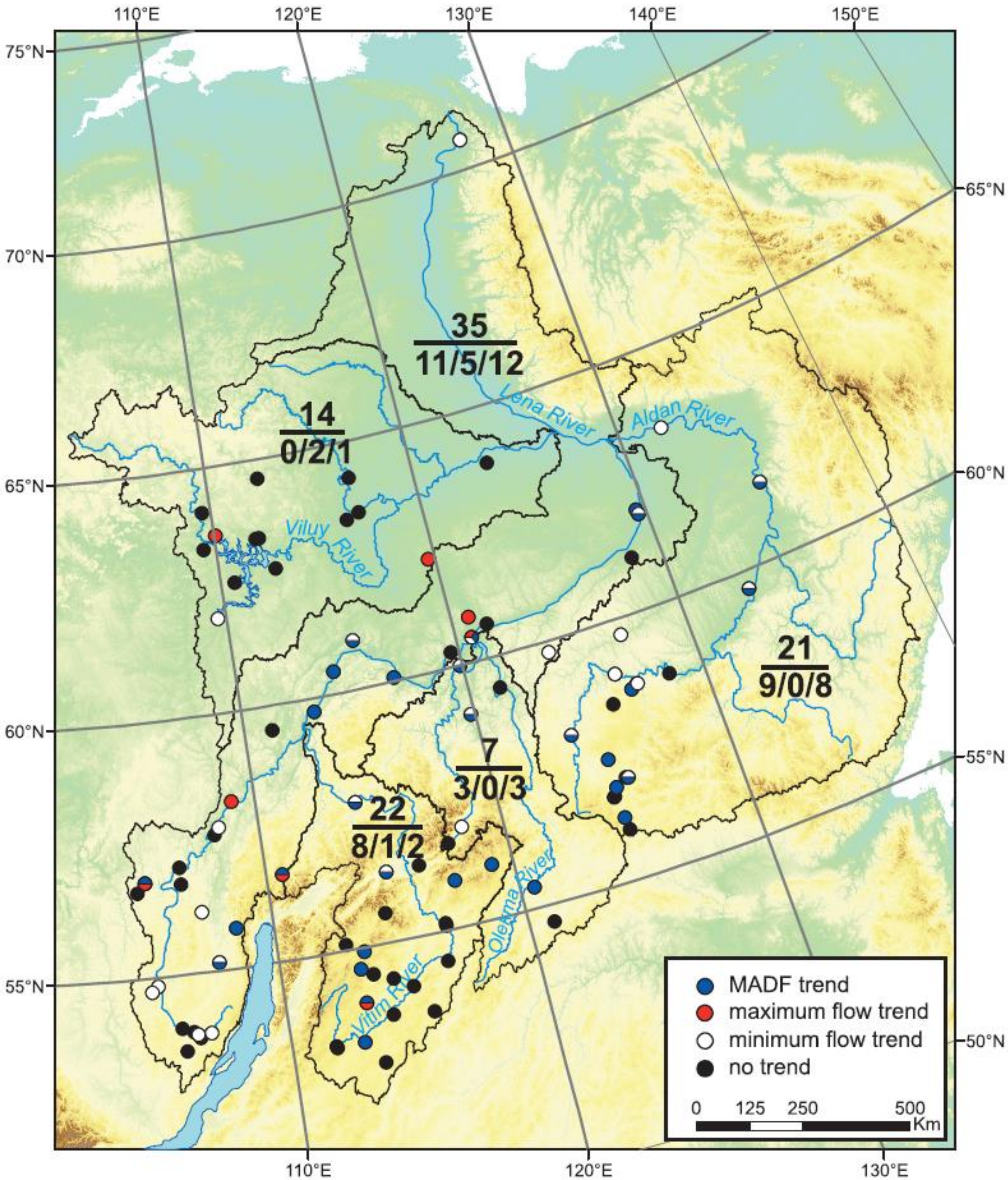


Muya at Taksimo, - trend



Trends in Q_{max} were found in 8 time-series, negative at 2 and positive at 6 gauges. Trend magnitude varies from -30.8% to -38.6% (-34.7% on average) for negative, and from 18% to 108.7% (54.9%) for positive trends.

SUMMARY



A relatively small number of significant trends found in our study may be attributed to a more thorough investigation of the significance of trends, compared to recent paper of *Dzhamalov et al.*, [2012], which lacks the description of employed trend detection techniques.

Non-significant trends yield an average magnitude +5.3% (positive) and –2.7% (negative), hence at or below the instrumental accuracy of discharge measurements.