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Interactive web mapping for urban climate monitoring and research based on reference and crowdsourced observations

Timofey Samsonov [a,c] *, Anastasia Shurygina [a], Mikhail Varentsov [b,c], Pavel Kargashin [a], Yulia Yarynich [a], Pavel Konstantinov [a]

[a] *Lomonosov Moscow State University, Faculty of Geography, Moscow, Russia*
[b] *Lomonosov Moscow State University, Research Computing Center, Moscow, Russia*
[c] *Hydrometeorological Research Center of Russian Federation, Moscow, Russia*

* Corresponding author: tsamsonov@geogr.msu.ru

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Abstract:

Climate change and high-impact weather phenomena receive growing attention from scientific community and general public. Urban areas affect atmospheric processes to a high degree (Varentsov et al., 2021) and are highly vulnerable to weather extremes at the same time (Ebi et al., 2021). Recent progress in web technologies facilitated the development of weather-focused web services (Middel et al., 2022). However, web mapping applications providing the visual and computational analytics in urban climate research remain quite rare and have limited functionality. Our study is dedicated to the development of such application and the underlying data processing workflow for a large metropolitan area on the example of Moscow city.

Mosclim application (Figure 1) collects, processes and maps observations from official weather stations of Roshydroment and crowdsourced observations of Netatmo citizen weather stations.

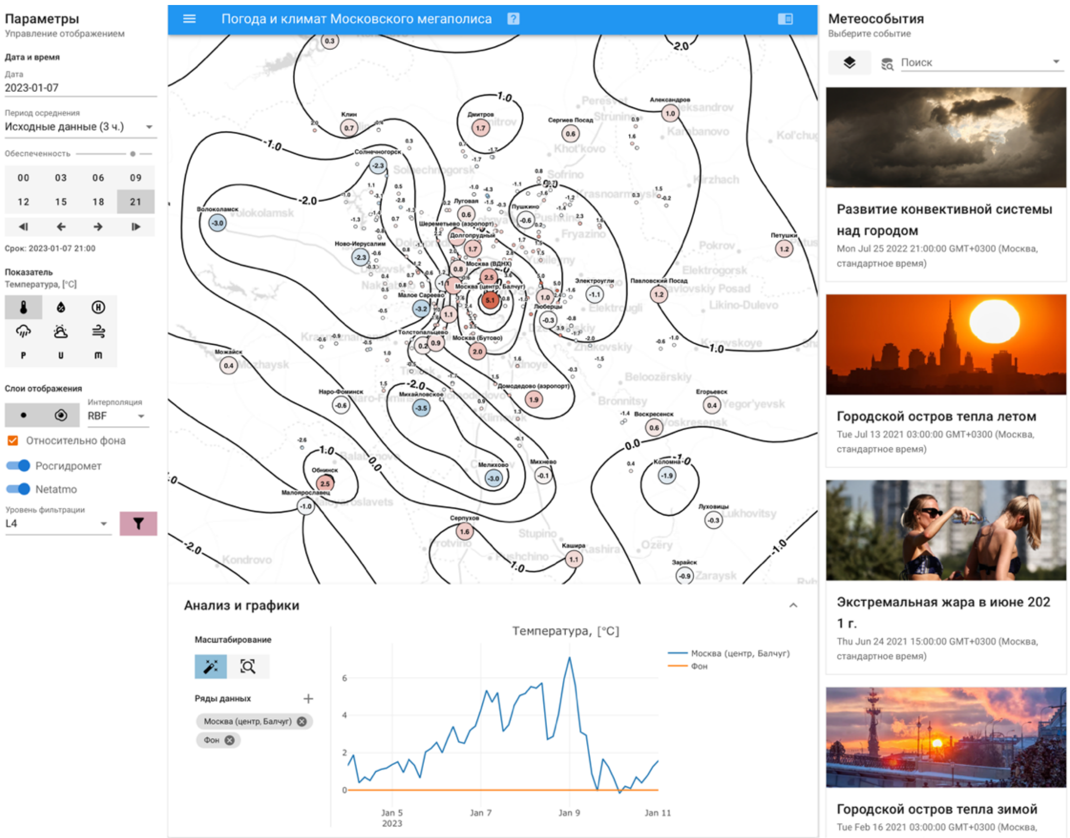

Figure 1. Mosclim web mapping application for urban climate monitoring and research

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Displayed raw meteorological variables include temperature, humidity, pressure, precipitation, wind speed, and cloudiness. In addition to the raw variables Mosclim backend calculates advanced human thermal comfort indices: UTCI (Universal Thermal Comfort Index), PET (Physiological Equivalent Temperature) and MRT (Median Radiant Temperature). Netatmo data is processed through a complex filtering procedure which allows detection of unreliable observations. Analytical part of the application allows statistical on-the-fly data aggregation of the variables within selected time periods (days, weeks, months and years) and interactive time series plots, which can combine data from multiple weather stations. Aggregation is currently implemented via calculation of the mean value, and is planned to be extended with a variety of summary statistics.

Cartographic visualization is implemented via point symbols (weather stations) and isolines. The novelty of the visualization technology is that interpolation of isolines is performed on the fly in the browser and can be applied to any variable at any aggregation time period. Two methods are implemented for interpolation: inverse distance weighted (IDW) and radial basis functions (RBF). Since both methods have their own strengths and shortcomings, the user can select the best approach in each case. Spatial interpolation expands significantly the possibilities of visual analytics of urban meteorological data. To demonstrate the capabilities of the web application, we implemented a catalogue of illustrative meteorological events, including temperature and thermal stress extremes, cases of pronounced urban heat island, intense precipitation etc. For each selected case the map of the event is opened and can be analysed alongside its description, which can also be used in educational purposes.

The web application is published at **http://carto.geogr.msu.ru/mosclim/** address.

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