# Meteorological data analysis capabilities in the "VEGA constellation" information systems family

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**Abstract.** Satellite monitoring information systems require joint analysis of heterogeneous data, including meteorological data. To solve these problems, IKI RAS developed a technology for automatic acquisition, storage, presentation and analysis of meteorological data. The archive of meteorological data in IKI RAS is maintained within the Center for Collective Use "IKI-Monitoring". The data is being continuously updated from a number of sources, primarily with the data obtained by the NCEP model. The data is available for visualization on the map in various ways. Plotting provides time series analysis in comparison to other variables such as vegetation indices. The developed technologies have been applied in development of a number of specialized information systems of satellite monitoring of natural and anthropogenic objects.

The development of specialized thematic information systems for satellite monitoring involves the possibility of joint analysis of remote sensing data with other types of data, one of which is meteorological data. [1,2] the range of applications of meteorological data is quite wide: assessment of the risks of natural fires, the impact of drought on plant development, monitoring the spread of ash plumes during volcanic eruptions, the study of processes on the ocean surface, and much more.

To solve these problems, RAS IKI has developed the technology for automatic acquisition, storage, visualization and analysis of weather data. [3]

The data used in the information systems include forecast and historical data obtained from various sources, which differ significantly in the set of available variables, time resolution and spatial localization.

The source data is usually localized either at the points of weather stations (including the measured data), or in the nodes of the regular grid. Data that has been statistically processed can also be presented in terms of units of spatial division, for example, regions or districts.

The data archives obtained using the Climate Forecast System Version 2 (CFSv2) NCEP model are constantly updated (https://www.ncep.noaa.gov/). the Spatial resolution of the data is 0.25° and the temporal resolution is 3 hours. The archives of the RAS IKI contain more than two dozen indicators of the state of the atmosphere at the Earth's surface, as well as vertical temperature profiles on various Isobaric surfaces.

Various methods can be used to display weather data in the map interface. Depending on the nature of the data, isolines, cartograms, and icons are used. Isolines can be used for data of any spatial localization, but are best suited for data based on a regular grid. When

analyzing data localized at weather stations, it is reasonable to use icons. In this case, the location of the weather station shows rectangular icons, characterized by the color and numerical value of the displayed value. Simultaneous analysis of several values is possible by applying complex icons at the location of the weather station, where the numerical values, provided with color, are arranged in a column. Data can be visualized in the context of territorial divisions. In this case, the mapping method is used. Indicators can be presented in both absolute and relative terms.

Analysis of the temporal dynamics of meteorological variables is possible for objects of different types: individual points, objects of observation, weather stations, areas. A special user interface presents data in the form of graphs. This makes it possible to jointly analyze the dynamics of various meteorological indicators and the dynamics of other variables, such as vegetation indices obtained from a time series of satellite observations. A comparative analysis of the intra-seasonal dynamics of different years is available, as well as a comparison of the climatic characteristics of different objects.

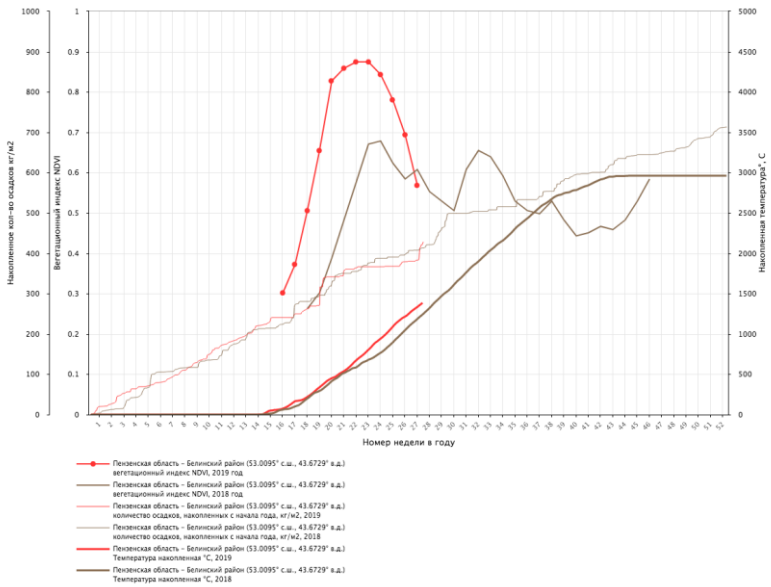


**Fig. 1.** Time series analysis in the VEGA-Science system. Time series of accumulated temperature and precipitation in comparison with the NDVI index.

Derived indicators are the result of statistical processing of climate data and are designed to detect weather anomalies on certain natural or man-made objects. In particular, any of the key indicators, such as temperature or precipitation, apply transformations, such as the calculation of the multi-year average for specific day of the year, calculation of the multi-year monthly average, calculation of current deviations from the multiyear average, calculation of accumulated value since the beginning of the year, determination of regional norm, windowing etc. It is possible to calculate temperature indices, the hydrothermal coefficient. The combination of such transformations is intended to help identify the most significant factors in the analysis of the temporal dynamics of climate data.

Conclusion. The proposed technologies and approaches allow us to develop tools for analyzing meteorological data. This has been used in a number of information systems for

monitoring natural and man-made objects. The operation of subsystems for archiving and access to weather data is provided by the facilities of the "IKI-Monitoring" Center for Collective Use. [4]

## References

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