ISDM-Rosleskhoz operation and evolution experience

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Abstract. The paper marks the 15-th anniversary of the Wildfires Monitoring Information System of the Federal Forestry Agency (ISDM-Rosleskhoz). Creation and development of the system was partaken by many organizations, including the Aerial Forest Protection Central Base (Avialesookhrana), Space Research Institute of the Russian Academy of Sciences (IKI), Center for Forest Ecology and Productivity of the Russian Academy of Sciences (CEPF RAS), State Research Center “Planeta”, OOO Inkom, Institute of Solar-Terrestrial Physics of the Siberian Branch of the Russian Academy of Sciences (ISTP SB RAS), Saint Petersburg Forestry Research Institute (SPbNIIILH). The system provides uniform near real-time information necessary for forest fires and their impact monitoring all over the Russia territory and border areas. The paper highlights main trends and key stages of ISDM-Rosleskhoz development and evolution during the entire operation time span. This constant evolution has made and is keeping the system as the largest fires monitoring industrial system operated by Forest Protection Services both in Russia and in the world. The paper also briefly provides major development directions of the system for the nearest years.

1. Introduction
2020 marked the 15th anniversary of the commissioning of the Information System for Monitoring Forest Fires of the Federal Forestry Agency [1]. A large number of different organizations took part in the creation and development of the system, including FBU "Central Base of Aviation Forest Protection"), Space Research Institute of the Russian Academy of Sciences, Center for Ecology and Forest Productivity of the Russian Academy of Sciences), FGBU "Research Center" Planeta " , LLC "Inkom", Institute of Solar-Terrestrial Physics of the Siberian Branch of the Russian Academy of Sciences, St. Petersburg Scientific Research Institute of Forestry (SPbNIIILH) This system allows you to receive on the entire territory of the Russian Federation and border areas operational and homogeneous information necessary for maintaining monitoring of forest fires and their consequences. Different elements and methods that made it possible in 2003-2004 to create, and in 2005 to put ISDM-Rosleskhoz into commercial operation were carried out in fact from the beginning of the nineties of the last century remains the largest industrial system for monitoring wildfires and their consequences, which are used by forest protection services. The history of its creation, implementation and evolution is described in sufficient detail (see, in particular, [2]). The main tasks, capabilities and features of the system at various stages of its development, operation and modernization are described in sufficient details in various papers (including, [3-15]).
2. Results and Discussion

One of the main features of ISDM-Rosleskhoz is that the system is constantly evolving over the years of its operation. In it, in particular, new opportunities constantly appeared associated with the use of data from the most modern satellite systems as shown on figure 1. Point to note that nowadays mostly all of the satellite data is provided as service from TsKP “IKI-Monitoring, see [16, 17] for details.

A new functionality was constantly adding to ISDM-Rosleskhoz, in the creation of which both new technical capabilities that constantly appeared over 15 years of its operation and new ones were used approaches and methods of processing and analysis of remote sensing data, which have been developed to evaluate various characteristics of forest fires and their consequences. Some possibilities of these approaches and methods are presented in the papers [18-23]. Major improvements of ISDM-Rosleskhoz are shown in table 1.

![Figure 1. The number of different satellite systems used in ISDM-Rosleskhoz in different years.](image)

**Table 1.** Major improvements of ISDM-Rosleskhoz that were performed in the period from 2005 to 2020.

| Year | Improvement of the ISDM | Comments |
|------|-------------------------|----------|
| 2008 | Created a dynamic cartographic web-interface | Cartographic interfaces ISDM-Rosleskhoz for remote access has the functionality for data analysis almost like in traditional desktop GIS systems |
| 2009 | Daily automatic integration of ground and satellite information has been started (and the integration with services of «Yasem» system) | The level of automated control of reporting of regional services has been increased |
| 2009 | Started the annual calculation of forest damage areas for entire Russian coverage from the MODIS data | Objective express assessments of forest damage areas by fires appeared |
2010 The creation of unified layers of the quarter network and forest fund has begun (creation of a specialized database) Completed in 2014. Now it is possible to automatically annotate all remotely detected fires to the forest fund, forestries and districts.

2010 A for refining the contours of burned-out areas based on the results of flyovers / bypasses / and tracing using high-resolution satellite data software has been created Now it is possible to carry out a selective refining of the areas burned by fire.

2011 A block for modelling the of a fire expansion has been created Now it is possible to calculate threats from fires to infrastructure facilities.

2012 Created a block for calculating various statistics on fires data Numerical spatial data have appeared, which is necessary, among other things, for assessing the expected losses from fires in various territories and zoning areas by levels of protection.

2013 A reporting system based on BI technology was created This way, among other things, the possibility of comparing the current forest fire situation with the situation observed in other years and analysis of data at various levels of integration became possible.

2014 The transfer of the central site of ISDM-Rosleskhoz to the "cloud" of FBI "Avialesokhrana" started The stability of the central site ISDM-Rosleskhoz has increased

2014 A block for automated mass refinement of areas covered by fire was created based on high-resolution data. Now it is possible to carry out a mass clarification of the forest fires burned areas.

2015 A new design of ISDM-Rosleskhoz web services has been introduced. The convenience of working with information provided by ISDM-Rosleskhoz has been improved, as well as the flexibility and controllability of the information provision subsystem.

2015 Hotspots from Himawari-8, Sentinel 2, Meteor satellites are integrated The frequency of observation has increased, and the amount of available information required to clarify the first burned areas increased more than twice.

2016 Transition to a service model in satellite data integration Service model allows to reduce an amount of maintenance efforts of regional nodes ISDM-Rosleskhoz at the centers for receiving and processing satellite data.

2016 New platform of the burned areas clarification system The level of automation has been fundamentally increased during the clarification of burned areas.

2017 VIIRS hotspots data (NPP satellite) included in the fire processing system The ability to detect small fires has increased.

2018 Commissioning of the ALO public data interfaces The possibilities of public data provisioning by ISDM-Rosleskhoz have increased.

2019 VIIRS hotspots data (NOAA 20 satellite) included in the fire accounting system The ability to detect small fires has increased. The number of detected fires compared to the situation before the use of VIIRS data has increased by more than 2.5 times.
2020 A system for the primary assessment of forest cover damage based on operative fire radiation power (FRP) information has been created and prepared for operation. The commissioning of the subsystem will make it possible to obtain the first estimates of the expected damage to the forest cover immediately after the completion of a particular fire.

The constant development of the system allows it to remain, all the years of operation, one of the most advanced specialized remote monitoring systems not only in our country, but also in the world. The system is constantly in demand. This, in particular, confirms the constant growth in the number of its active users, the graph of which is shown in figure 2.

![Figure 2. The number of active users in ISDM-Rosleskhoz in different years.](image)

3. Conclusion
Nowadays forest protection services face new challenges, including those related to a general increase in the activity of forest fires in recent years (see, for example, [24]), which, among other things, may be caused by processes associated with global climate change. Therefore, ISDM-Rosleskhoz also faces new development priorities, which, in our opinion, include the following:

- Development of objective methods for zoning areas by forest protection levels;
- Development of objective methods of deciding on extinguishing;
- Rapid estimation of the aftereffects from fires, both in terms of forest resource losses and in terms of assessing potential carbon emissions.

It should be noted that there is already a sufficiently large scientific and technological basis for solving these problems, developed within the framework of various scientific projects and programs carried out in organizations that have been providing support and development of ISDM-Rosleskhoz all these years.

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