



Regional geoinformation modelling of ground access to the forest fires in Russia

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Introduction

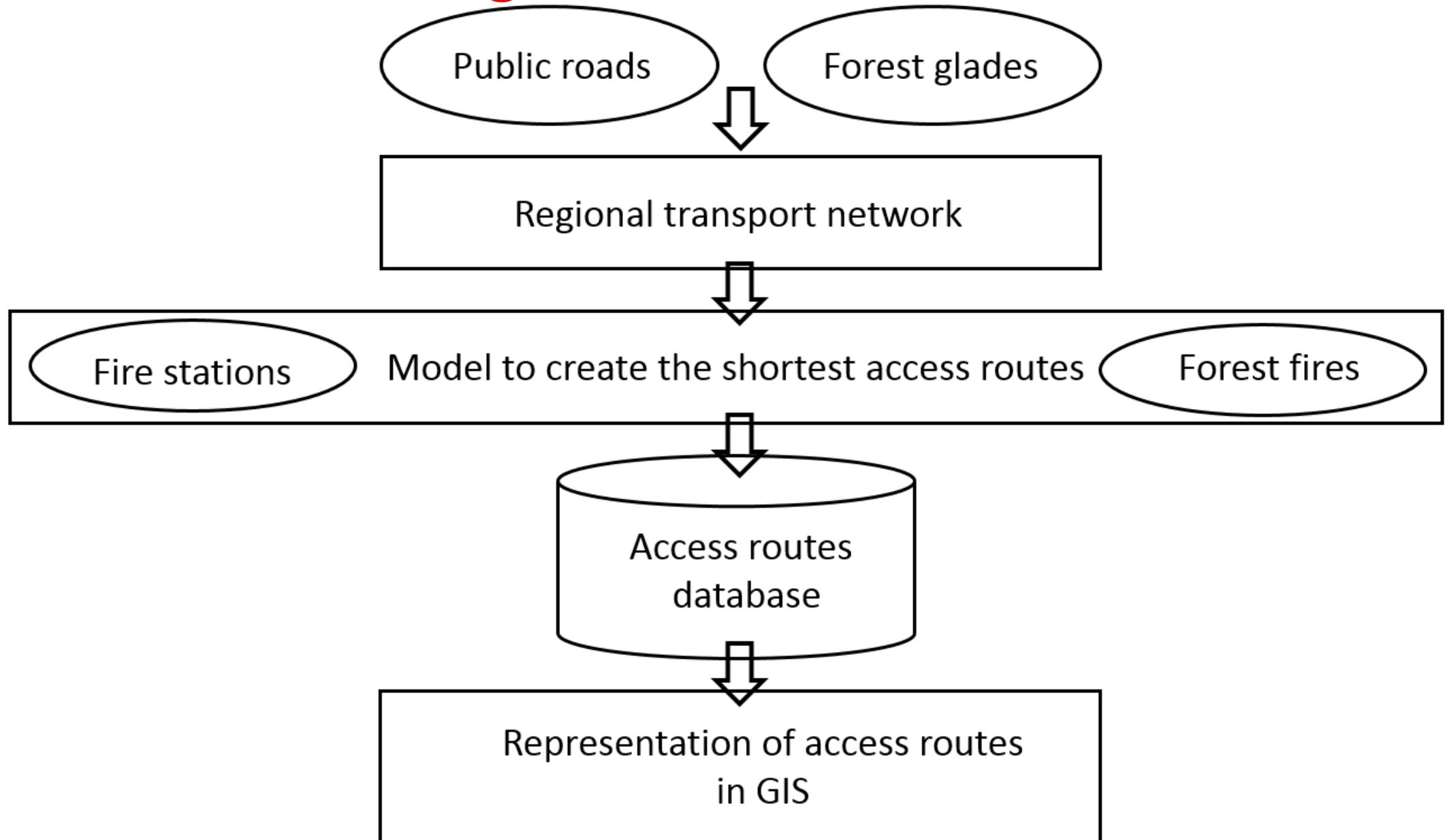
Our goal is to propose a GIS-workflow to create the shortest access routes

There are two tasks to complete it:

- (1) to create and to test transport model to assess the forest fires from the fire stations (stage of geoinformation modelling),
- (2) to propose a GIS-service for the fire hazardous season's daily monitoring (stage of development). Practical implementation of the transportation task in GIS environment is the subject of our study.

A forest fire is a temperature anomaly detected by satellite Terra/Aqua on the platform MODIS and localized in points. *An access route* is a created polyline of shortest (according to the Dijkstra algorithm) distance. *A forest hazardous season* is a time period when a forest fire can occur

Implementation design



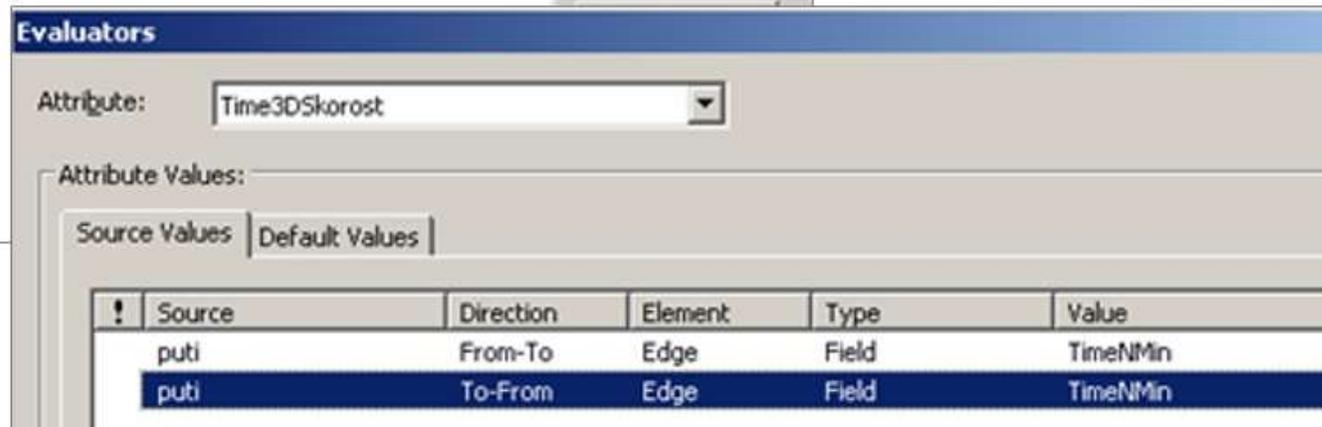
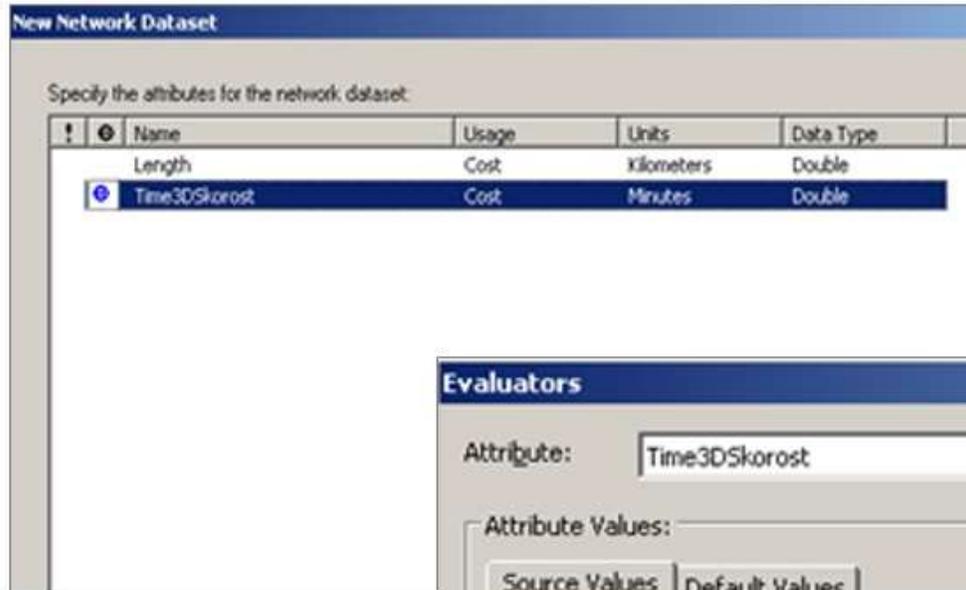
Network Analysis

Parameters of network dataset

Table. Technical description of Irkutsk regional transport network

| Properties | Attributes |
|---|---|
| Name: Transport Routes Type: Geodatabase-Based Network Dataset Edge Sources: Transport Routes Connectivity: Edge Connectivity: Transport Routes (Any Vertex) Elevation Model: Z Values | <i>Length:</i> Usage Type: Cost Data Type: Double Units Type: Kilometers <i>Time3D Speed:</i> Usage Type: Cost Data Type: Double Units Type: Minutes |

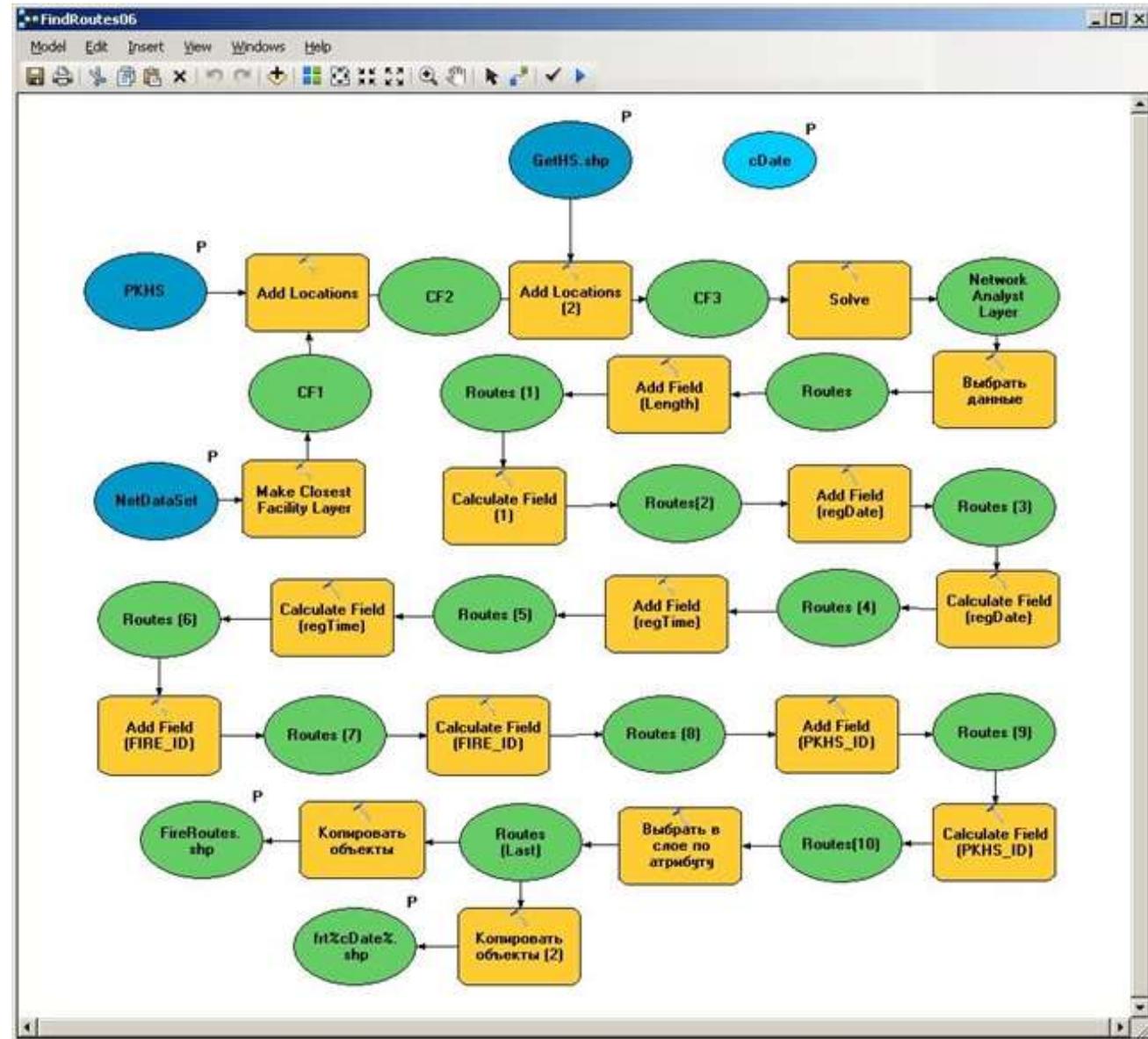
Interface



Developed model to create the access routes

Proposed open-source Python workflow is characterized the following way:

- A basis model using the ArcToolBox ArcGIS Desktop toolkit, implemented in Model Builder
- A server with RDBMS with the data structure developed for annual statistical databases of forest fires and routes
- An algorithm which processes the data at the certain intervals according to the predetermine schedule, scripts retrieve information from the forest fire databases for the new occurred forest fires. If there are any of them, workflow creates the access routes



Input data and resulting access routes

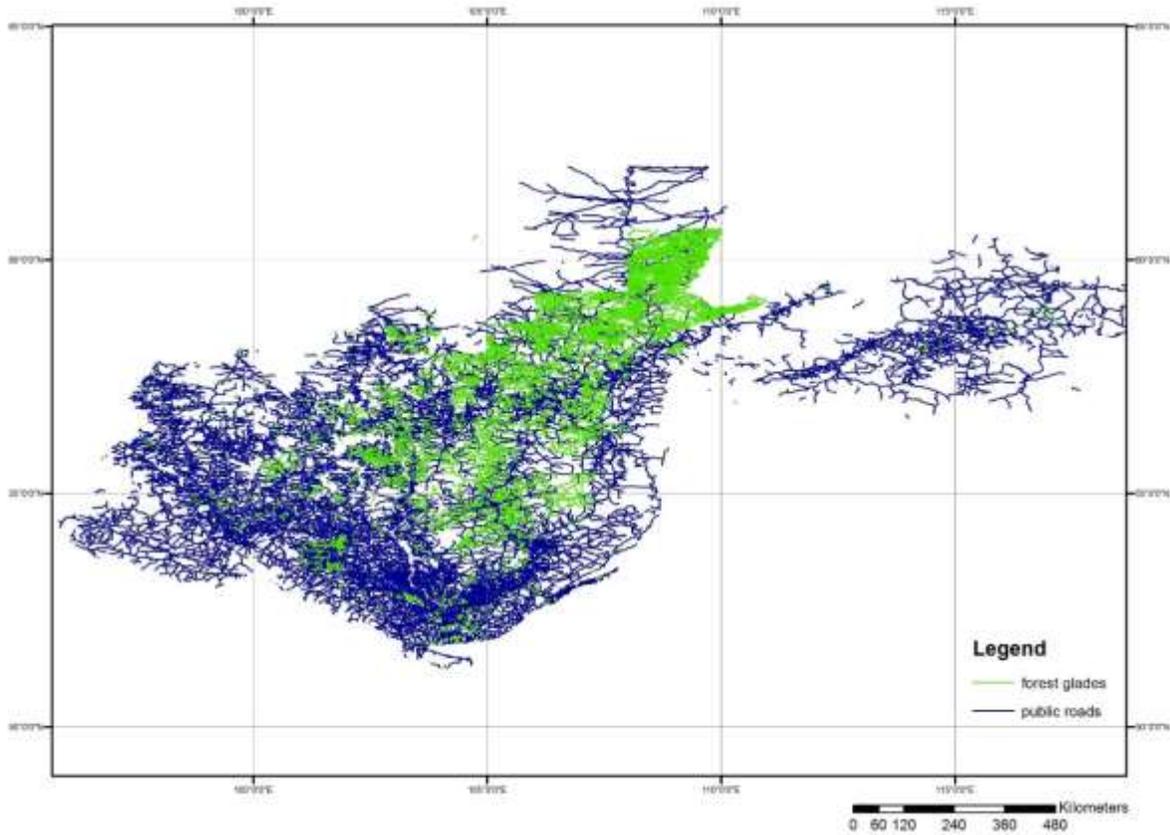
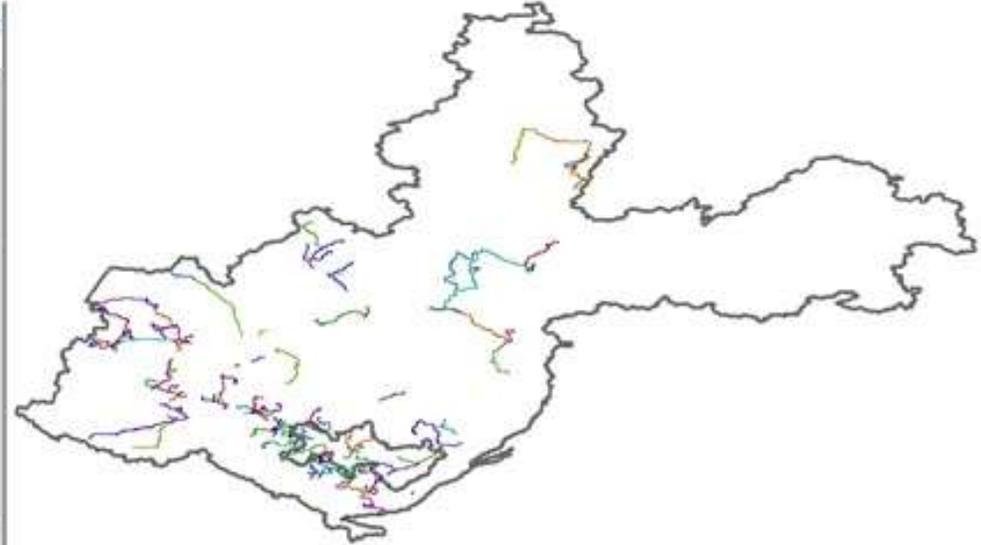


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 - fr20180418
 - fr20180419
 - fr20180420
 - fr20180421
 - fr20180422
 - fr20180423
 - fr20180424



Table

fr20180403

| FacilityID | FacilityRa | Name | IncidentCu | FacilityCu | IncidentID | Total Time | Length | reqDate | reqTime | FIRE_ID | PKMS_ID |
|------------|------------|------------|------------|------------|------------|------------|------------|------------|----------------|---------|---------|
| 42 | 1 | 32941 - 42 | 2 | 1 | 1 | 34,517,657 | 16,621,528 | 03.04.2018 | 20180424180326 | 32941 | 42 |

(0 out of 1 Selected)

fr20180403

Table

fr20180404

| FID | Shape * | FacilityID | FacilityRa | Name | IncidentCu | FacilityCu | IncidentID | Total Time | Length | reqDate | reqTime |
|-----|-------------|------------|------------|------------|------------|------------|------------|-------------|------------|------------|----------------|
| 0 | Polyline ZM | 42 | 1 | 34197 - 42 | 1 | 1 | 1 | 1665,411325 | 360,789590 | 04.04.2018 | 20180424180345 |
| 1 | Polyline ZM | 16 | 1 | 35306 - 16 | 2 | 2 | 2 | 89,483541 | 96,421437 | 04.04.2018 | 20180424180345 |

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fr20180404

GIS-service “Access routes”

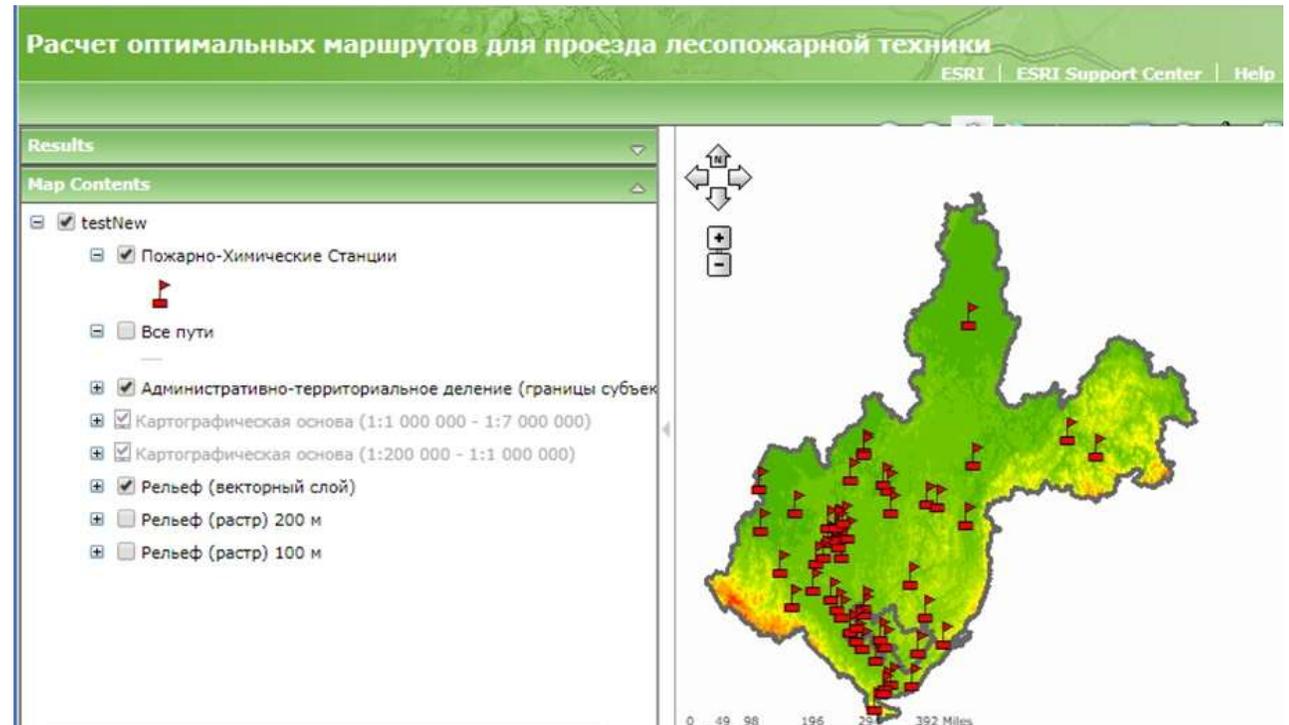
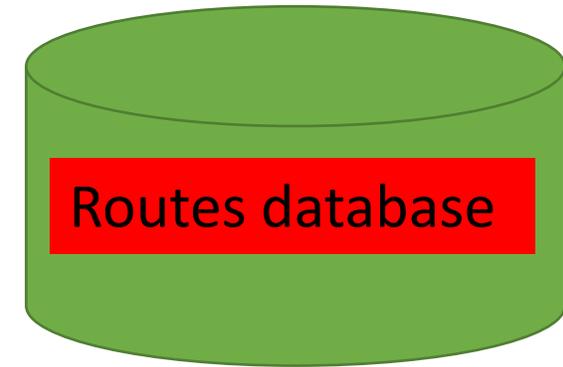
consists of the following elements:

a) Spatial information on the access routes loads into the database and becomes available for the clients, for example, regional web services

b) System produces the shapefiles of forest fires and access routes to them; these shapefiles are loaded into existing template documents and can be used for viewing both in ArcGIS and other Desktop GIS-applications

c) There is a periodic generation (depending on the forest fire occurrence during the fire hazardous season) of raster image, which is a referenced, a ready-made solution for the users on the web pages

Map Image Picture
Shape file
Client Web-service
Client Desktop Application
User Custom Solution



Output files



Conclusions

- a) We have presented an example of geoinformation solution to solve the transportation task at the regional scale taking into account the forest fire network's parameters (travelled time and length, both with elevation values)
- b) Technical value of the described approach for the consumers is in a combination of developed workflow on how to create the shortest routes (taking into account speed and elevation) with multiple data sources (forest firefighting infrastructure and geographical data) into one GIS-service available for the regional needs in Russia
- c) Developed GIS-service will help to prepare to cooperate and to optimize the efforts between ground and aviation forest fire fighting teams. By creating and analyzing the access routes every single new forest fire hazardous season we will have more information about the spatial distribution and length of the routes
- d) Daily monitoring for the ongoing fire hazardous season and for the years to come has been established in the GIS form. Important result in our workflow is that by analyzing the archive of created access routes we can indirectly estimate spatial correctness of actual protection zones
- e) We have processed geospatial data and produced the archive of access routes for the forest fires detected in 2002-2017. Analysis of access routes data allowed us to give the recommendations on how to distinguish the technical means of access to the forest fires: by forest fire trucks (ground access within three hours which is required by Russian forest legislation), and then by firefighting airplanes

Acknowledgments. This work was supported by the state contract “Development of methodological approaches to remote monitoring of resource potential and ecological state of forest ecosystems” (topic No. 0110-2017-0001)