Development of Fires Space Monitoring System in Kazakhstan

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Abstract – Structure and functions of fire space monitoring system in Kazakhstan are described. The results of its exploitation and planned directions of further development are shown.

Keywords: Fire space monitoring, fires sources, burnt areas, areas of high fire risk, potential danger of fire.

1. INTRODUCTION

Annually forest and steppe fires bring a great damage for Kazakhstan economy. Fires begin in May and finish in the middle of October. Characteristic property of steppe fires is high mobility of fiery front. They enveloped large areas and create real menace for people safety, electricity transmission lines, oil and gas pipelines, other important objects. Fires have a serious danger for agriculture areas, especially in ripening and harvesting period (July-September). Therefore very important to detect fires sources as soon as possible and estimate their danger. For these purposes Space Research Institute of Kazakhstan developed Fire Space Monitoring System (FSMS).

2. STRUCTURE AND FUNCTIONS of FSMS

FSMS structure is represented on Fig. 1. System is a complex of technologies, implementing following functions:

- operative detection of fires sources;
- fast estimation of potential danger of fire;
- forecast of development and estimation of menace for very important objects;
- mapping of burnt areas;
- estimation of natural and economy damage;
- localization of areas of high fire risk.

2.1 Operative detecting of fire sources

Technology of early detection fire sources is based on using night AVHRR NOAA and daily MODIS Aqua & Terra space images in infrared diapason (Spivak L.F. et al, 2003). During night from 4 till 6 receiving data are processing.

Fast identification procedure has two steps. Firstly are allocated all high temperature sources (it is important: not miss). On the next step are realized dividing of sources to stationary identified as industrial objects and mobile identified as fires. Using the "mask" of stationary objects allows as much as possible reduce the number of false fires sources. The maps with coordinates of detected fire sources

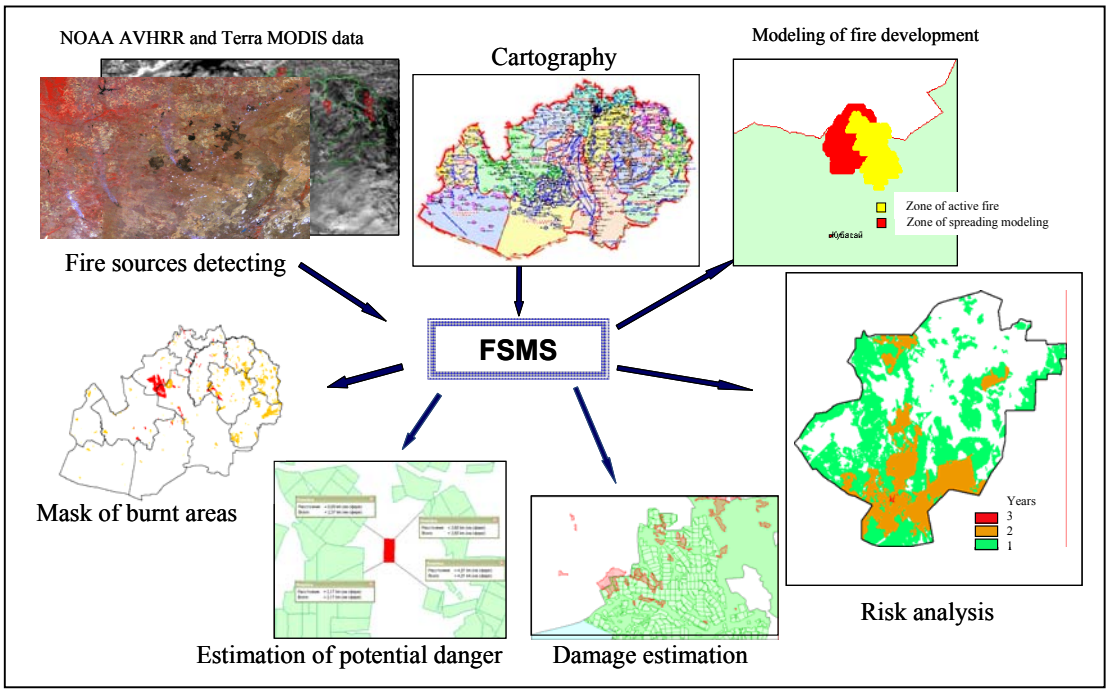

Figure 1. Technological scheme of Fire Space Monitoring System.

(Fig. 2) are sent to users in near real time mode.

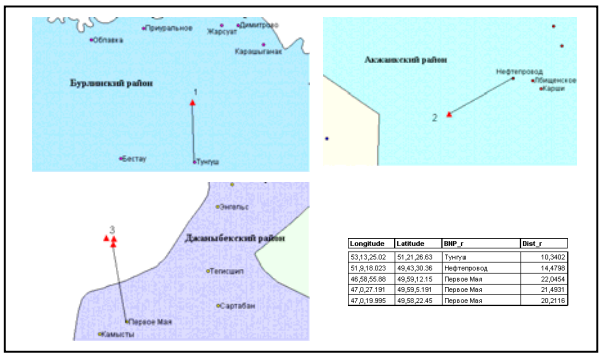

Figure 2. The maps with coordinates of detected fire sources.

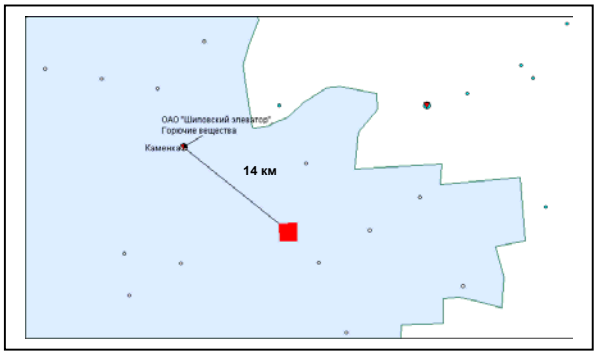

Figure 3. Distance from sources of active fire till most important objects.

2.2 Fast estimation of potential danger of fire

For operative analysis of situation and estimation of potential danger coordinates of fire centers notes down into GIS which includes layers of most important objects (railroads, oil and gas pipelines, high-volt lines, agriculture fields, forests, etc). Distances from sources of active fire till corresponding objects (Fig. 3) are calculated.

2.3 Forecast of development and estimation of menace for very important objects

Forecast of fire development are based on modeling of fire front dynamics with considering meteorological data, first of all speed and direction of wind. Unfortunately, the net of meteorological stations in Kazakhstan is not regular and receiving data in real time often impossible. At present are carried out researches on calculation speed and direction of wind by using smoke-screen which precisely fixed in RGB - synthesis (213) of first three MODIS channels.

2.4 Mapping and analysis of burnt areas dynamic.

Main signs of fire are burnt areas. For calculation of burnt areas are used daily MODIS data. Fresh burning areas overlap on topographical basis (Fig. 4).

2.5 Estimation of damage

The masks of burnt areas can be used for different applications, in particular for estimation of agriculture damage and calculation of fire risk in different areas. Quantity of damage can be determined as natural as economic scale. For determination of natural damage it is enough to spatial overlap mask of burnt areas and mask of agriculture areas. For calculating of economic damage it is necessary to take into account condition of damaged crops (potential productivity), market price, etc.

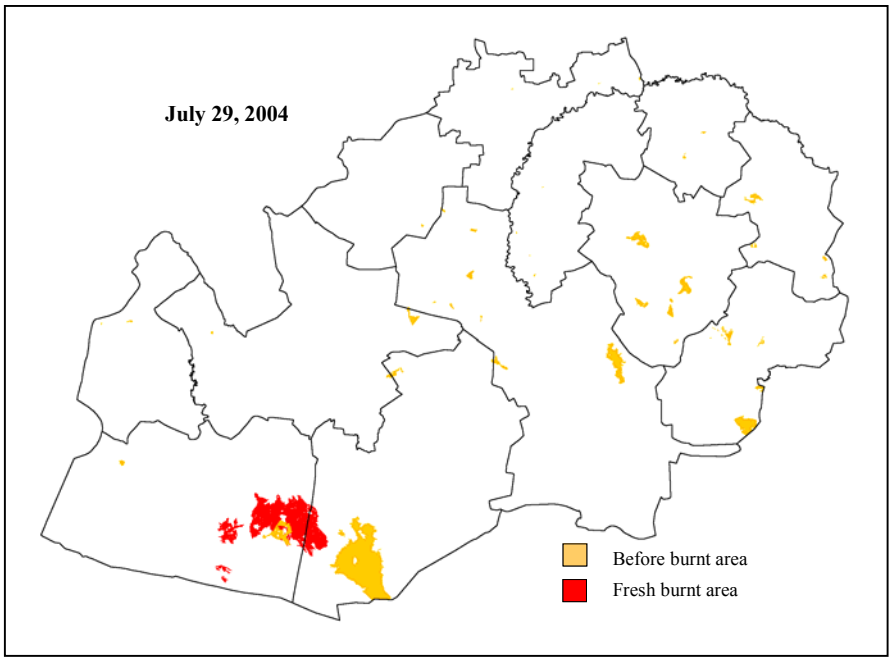

Figure 4. Map of burnt areas.

2.6 Localization of areas of high fire risk

Roughly to estimate fire risk it is possible spatially overlapping burning areas data for different years. Map of Taskalinskiy district of West-Kazakhstan oblast built by overlapping burnt areas for last four years are represented on Fig. 5. Analysis of map allows determining distritct which are burnt more often then others.

To note that by accumulating more data objectivity of estimation will increase.

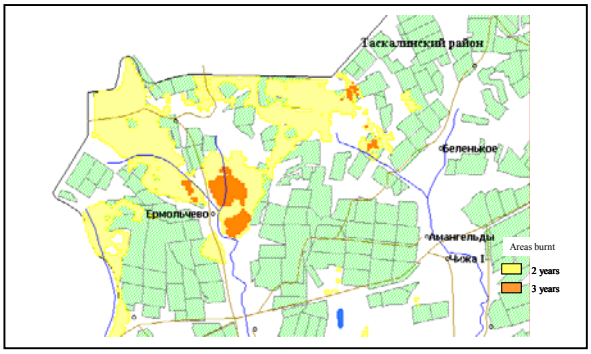

Figure 5. Localization of areas of high fire risk in Taskalinskiy district of West-Kazakhstan oblast for 2001-2004.

3. VERIFICATION

FSMS is exploited in West-Kazakhstan, Actubinsk and Karaganda oblasts. Should note that technology influenced positively and assisted to reduction of total burnt areas. It clearly shown on diagrams of dynamic of summary burnt areas in West-Kazakhstan oblast for 2001-2004 (Fig. 6).

On the meeting of Emergency Situation Ministry of Kazakhstan Republic in February 2004 technology of fire space monitoring was recommended for distribution on all Kazakhstan area.

Figure 6. Dynamic of summary burnt areas in West-Kazakhstan oblast for 2001-2004.

4. CONCLUSIONS AND RECOMMENDATIONS

1. FSMS allows fast localize centers of active fire, exactly determine geographical coordinates and location concerning to very important objects. FSMS allows fast inform local fire services, timely estimate potential menace of fire and speed up time of liquidation.

2. In order to increase efficiency of making decisions it is expediently to design GIS in local emergency situations agency. It will allow speeding up the process of analysis of operative situation.

5. REFERENCES

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