Catastrophic Fires in Russian Forests

Natural Resources Canada / Ressources naturelles Canada
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Introduction

Impacts of climate change on the areas burned by wildfires and its implications on carbon emissions in the boreal zone are globally significant. Wildfires in Russia burn from 4 to 18 million ha annually depending on burning conditions. Russia contains two-thirds of the world's boreal forest and peat lands, yet quantification of these fires is hampered by the lack of accurate historical fire data. Official Russian wildfire records greatly under estimate burned areas. However, satellite data have become available for assessing area burned since 1994 when the NASA first established satellite downlinks in Siberia. Changing weather conditions have greatly increased the burned area, fire severity, and emissions in this region in the last 15-20 years. We will present evidence of frequent catastrophic fires during this time period.

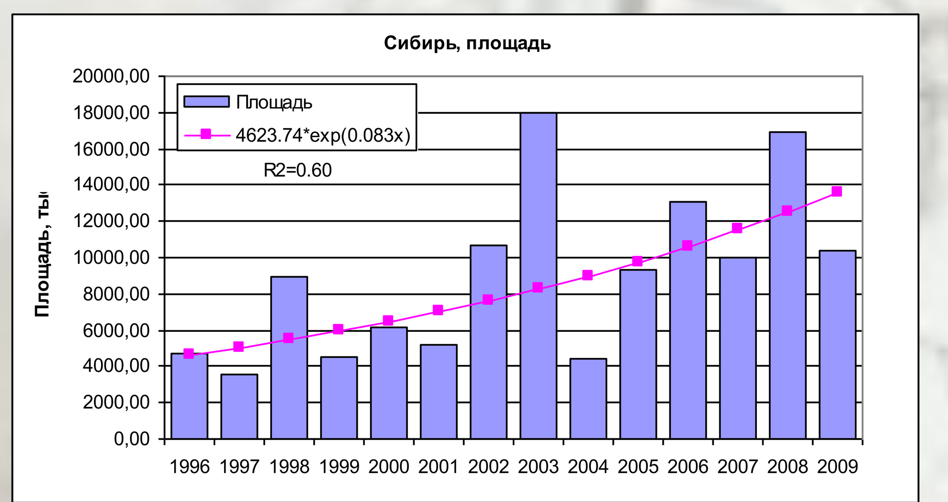


Figure 1. Annual burn area for the 1996-2009 fire seasons.
http://www.ruf.uni-freiburg.de/fireglobe/current/globalfire.htm.

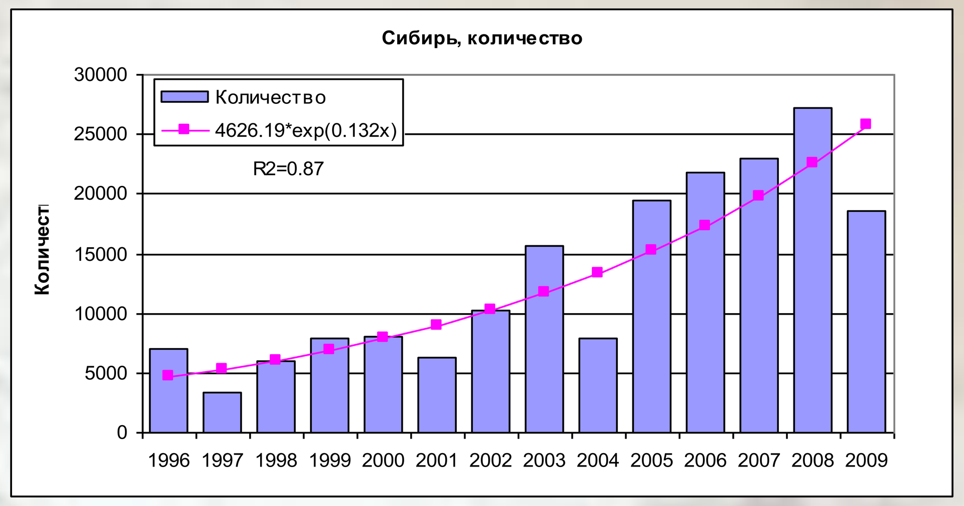


Figure 2. Annual number of fires for the 1996-2009 fire seasons.

Catastrophic fires in Russia are responsible for large burned areas and are the main reasons for major changes in Russian forest (Figs. 1 and 2). The 2002 wildfire situation in the Yakutia Region was an example of a catastrophic regional-scale ecological disaster (Figs. 3 and 4). As a result of high-intensity surface fires, high tree (primarily *Larix* sp.) mortality (up to 40%) occurred in an area >50,000 km² (Fig. 3). This area between the Lena and Viliuy River did not have any precipitation during the entire 2002 fire season. Mass wildfires occupied a total area of >700,000 km². Cloud cover observed from a satellite image (Fig. 4) taken during the fire season was a classical example of the development of stable high-pressure ridges associated with no-precipitation conditions.

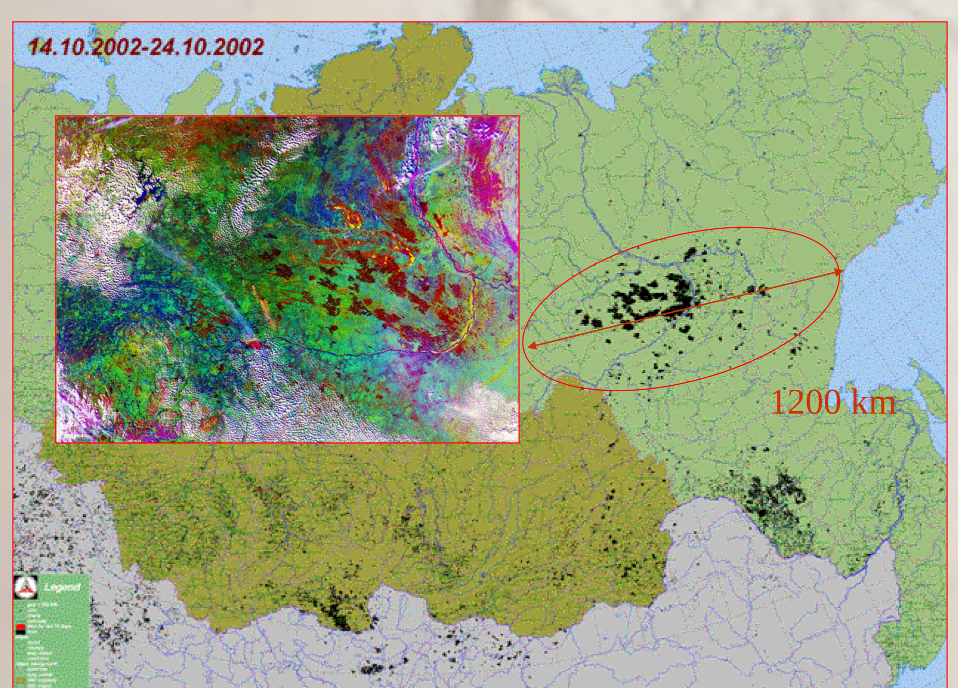


Figure 3. Fire polygons showing the burned areas across Siberia and the Russian Far East. Note a large area burned in Yakutia (red circle) over 1,000 km wide. The insert shows a satellite images (NOAA-16) taken a year after the fires, showing the severity of the 2002 fires.

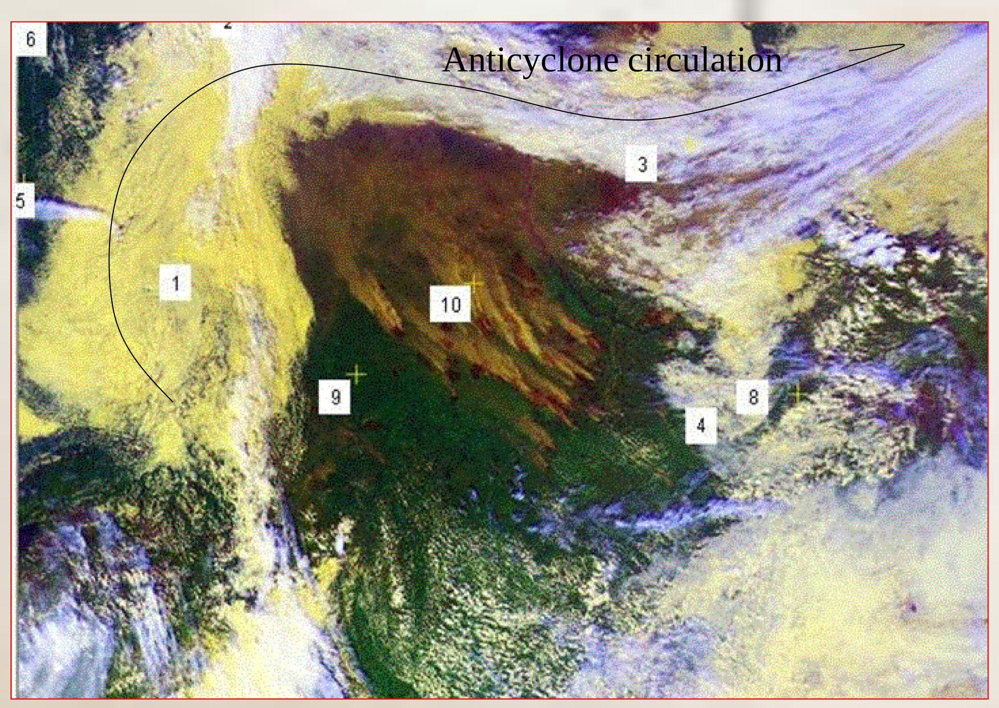


Figure 4. Cloud fronts cannot cross mass fire areas in the Yakutia Region in 2002. Circulation in smoke column (right vortex-current) counters the circulation of cloud mass.

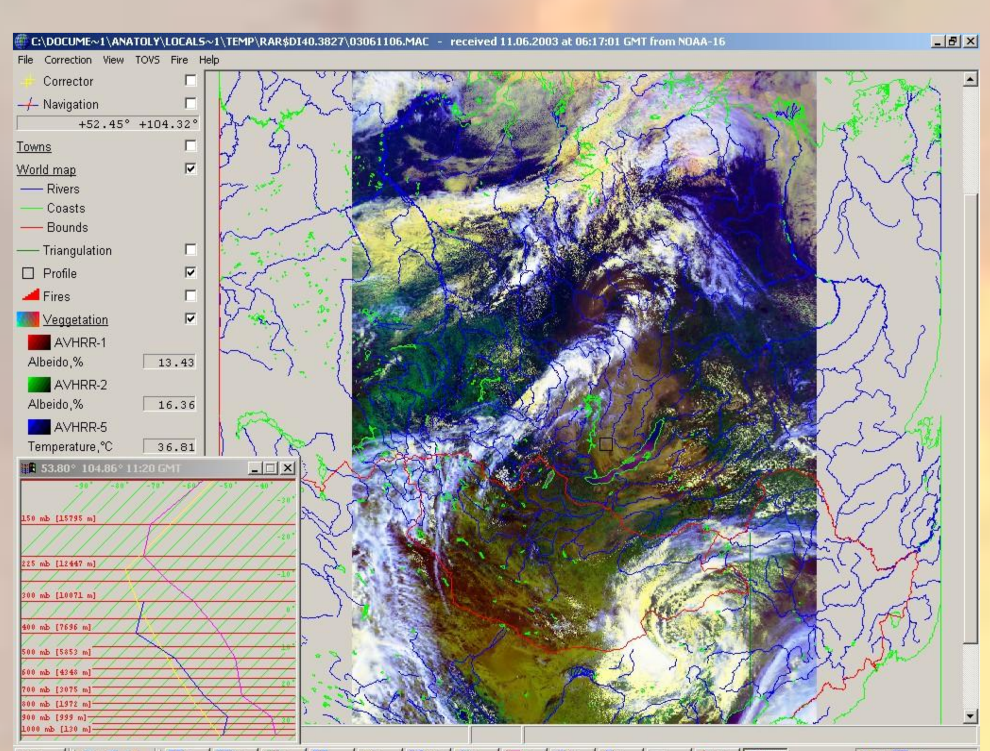


Figure 5. Vertical profiles of air temperature and dew point obtained using ATOVS data showed that air over mass fires in2003 in the Baikal Lake territory is very dry (humidity less than 20%). There was no precipitation from April to July 2003. Daily humidity in Chita region was down to 10% in July .

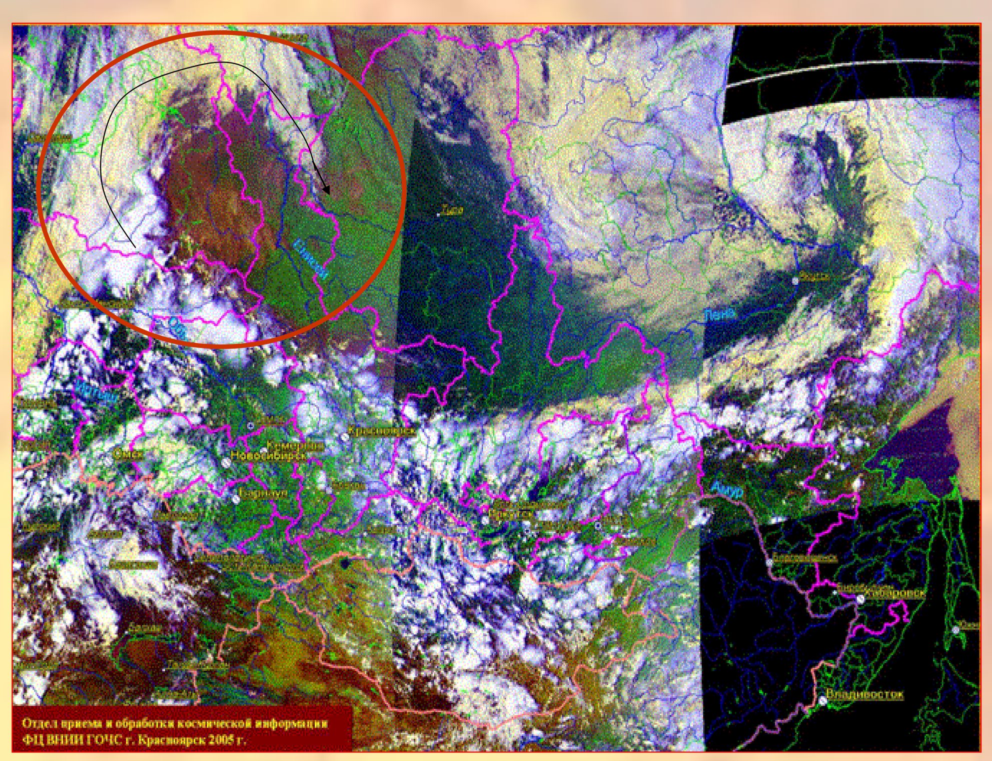


Figure 6. Blocking anticyclone over mass fires in Khanty -Mansy oblast in August 07, 2005.

Cluster character of spatial mass fires distribution

The method for estimating catastrophic wildfire situation is being developed in our investigations. The catastrophic wildfire situation includes grouping spatial distributions of large and extra large fires produced by the spatial clusters integrated by the common zone of aerodynamic interaction of convective columns and atmospheric pressure formations. Such situation can be characterized by the grouping of catastrophic fires over an area of more than 400,000 km² under a long duration of anticyclone with the drought class more than 5 (extreme) preventing the atmospheric front passage, while the burn area portion exceeds 10%. Smoke cover decreases the visibility to be less than 200 m, which prevents the aviation forest protection services from operation.

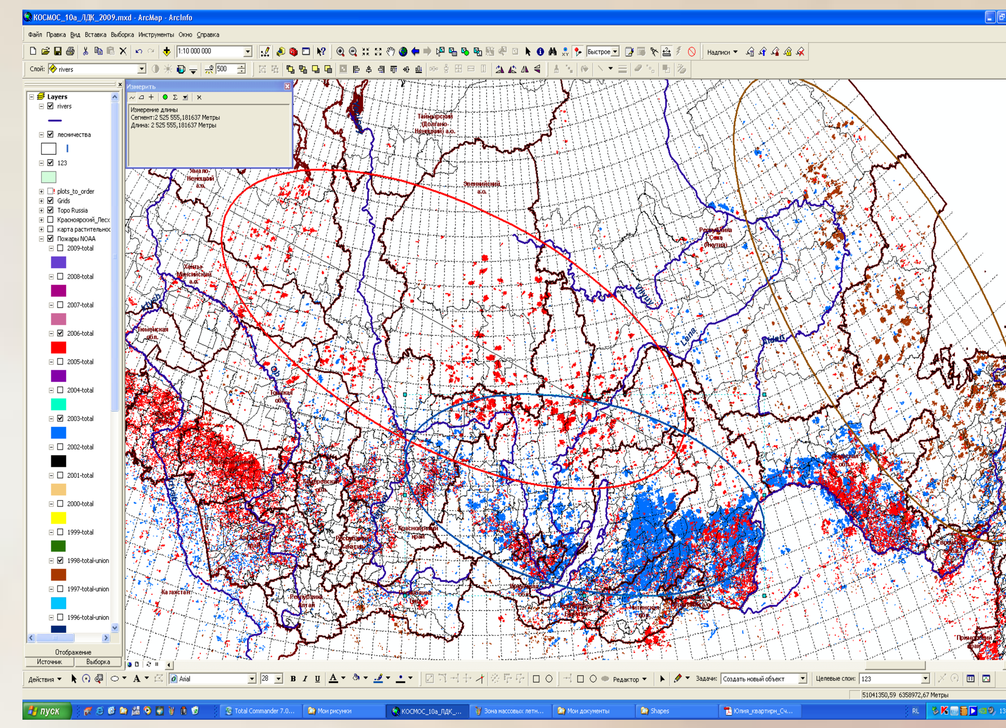


Figure 7. Catastrophic fire polygon clusters for 1998 (brown), 2003 (blue) and 2006 (red) .

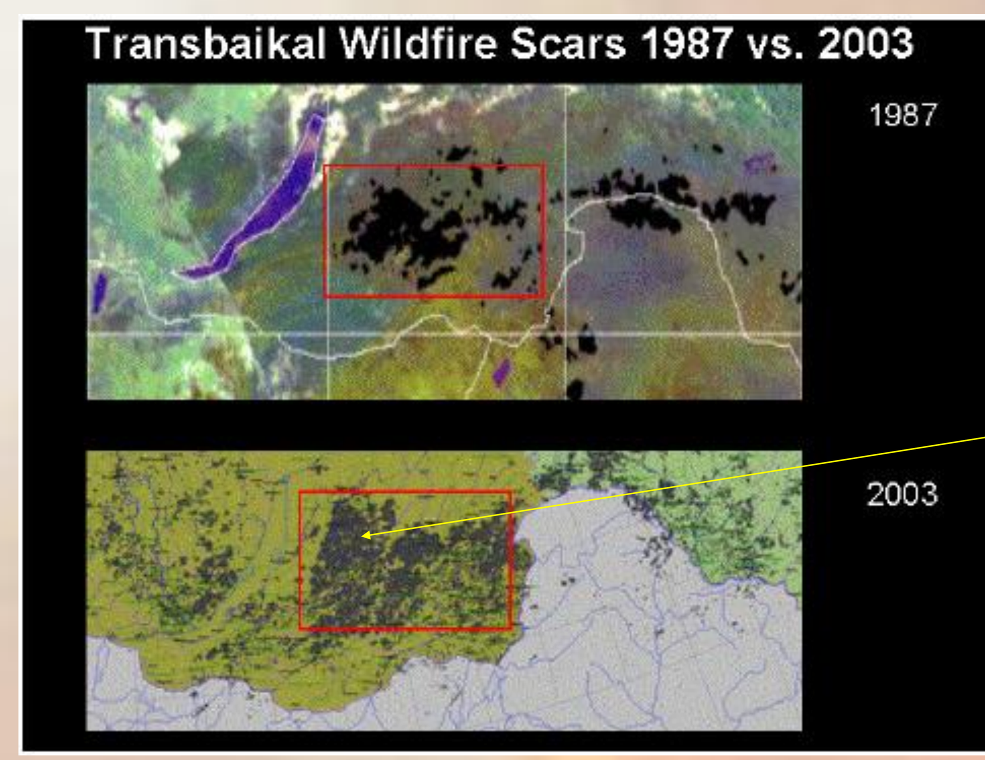


Figure 8. Fire scars on the Transbaikal area in 1987 and 2003. Massive fires occurred practically on the same region mainly in spring and summer seasons.

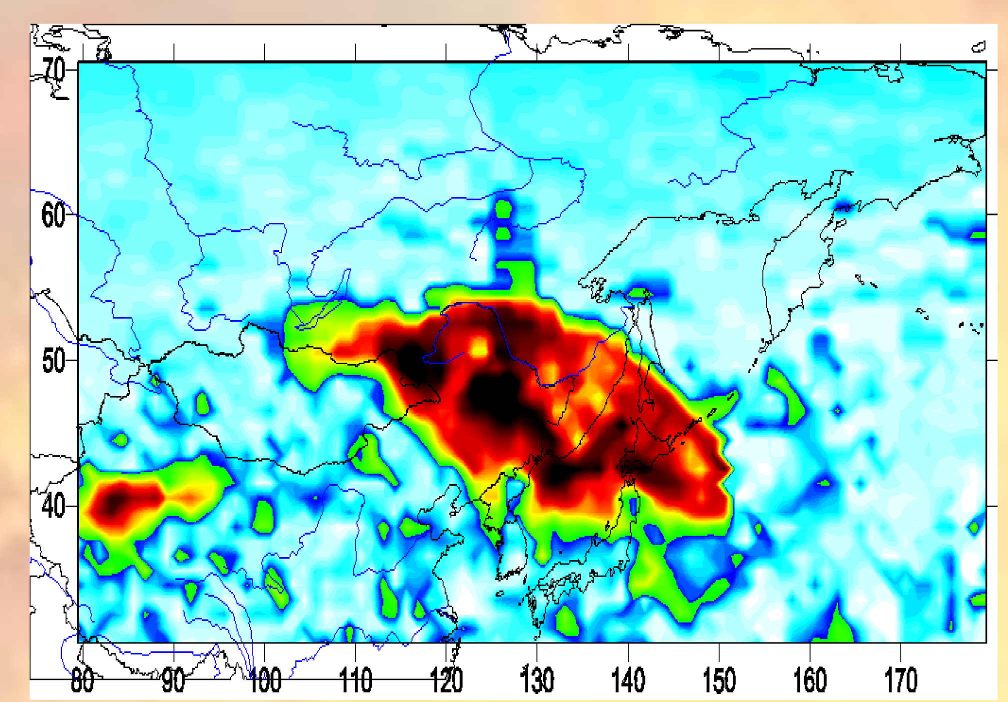
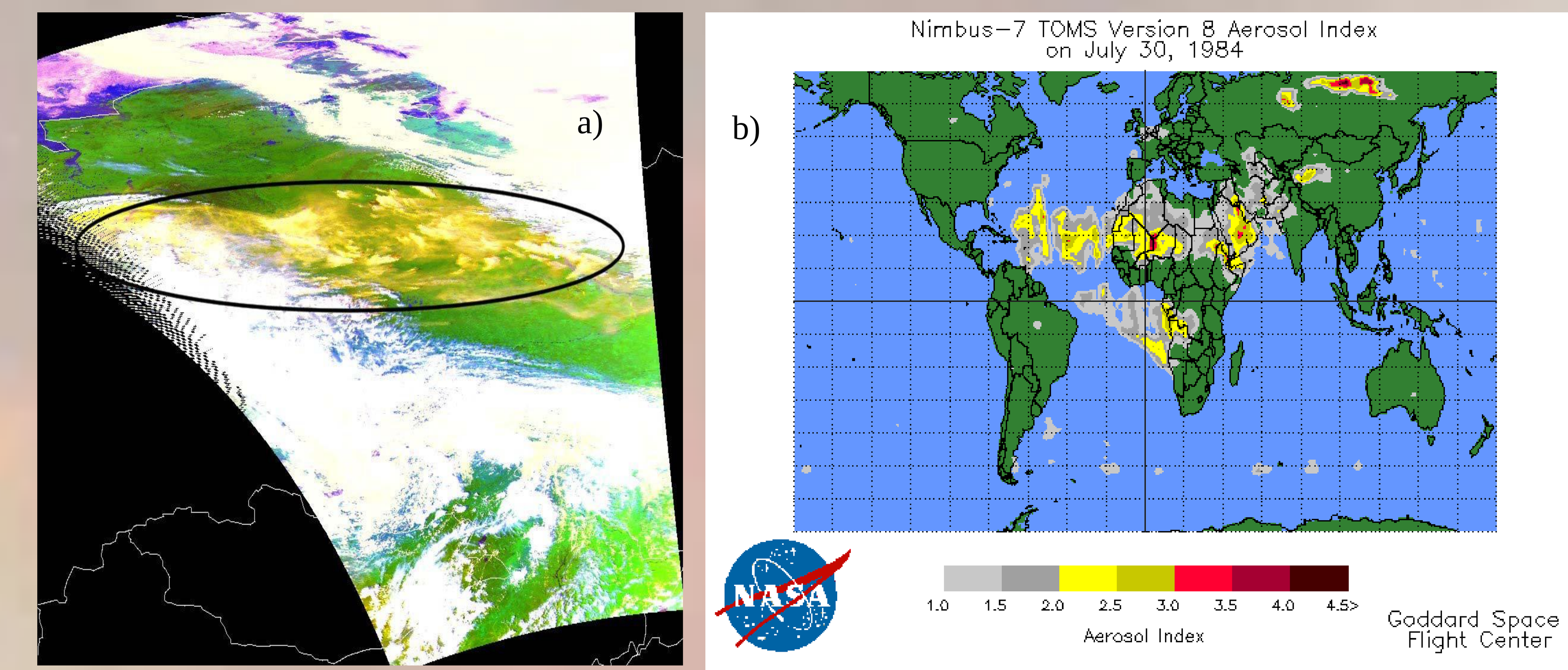
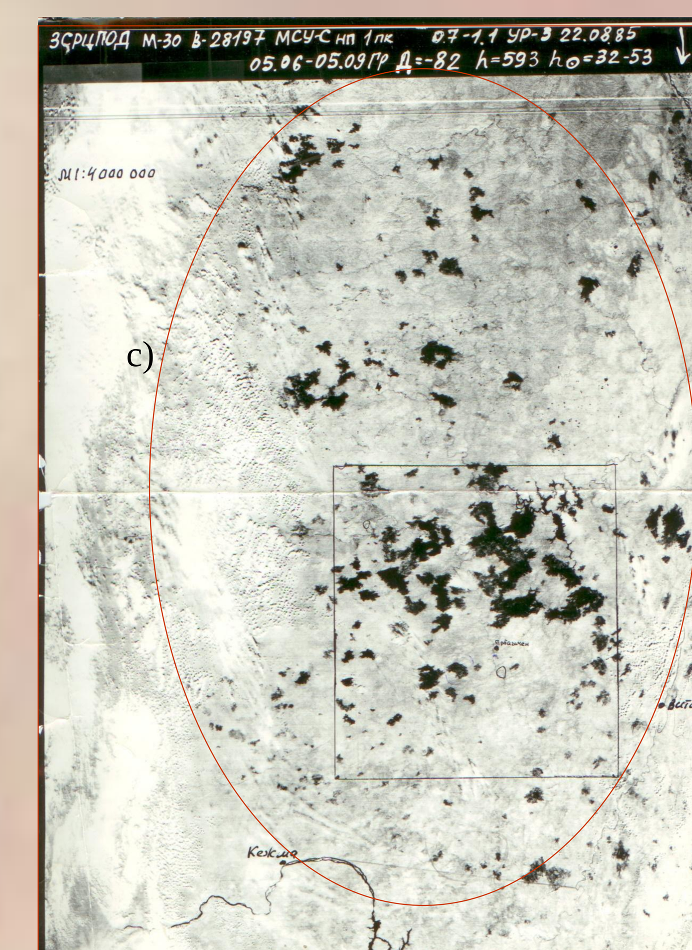


Figure 9. Smoke aerosol depth propagated from Baikal Lake to Japan on 15 May, 2003, .





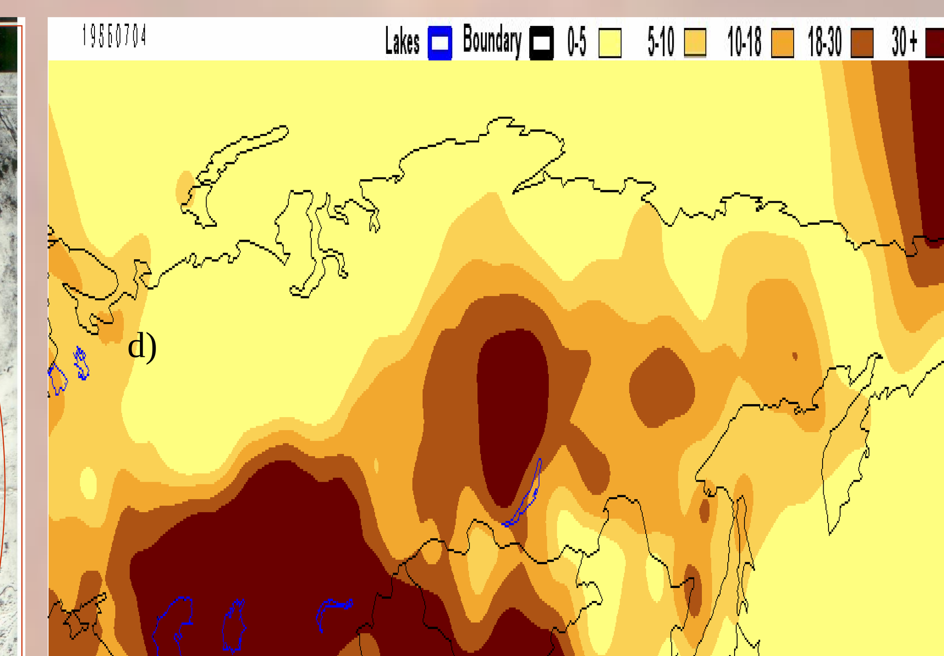


Figure 10. (a) smoke plumes near the Viluy River taken from NOAA-7 on 30 July, 1984; (b) aerosol index distribution taken from Nimbus – 7 satellite; (c) satellite image taken from Russian satellite "Resours-O" 22.08.1985 showing the burned areas after catastrophic fires; and (d) Canadian Fire Weather Index of the same date.

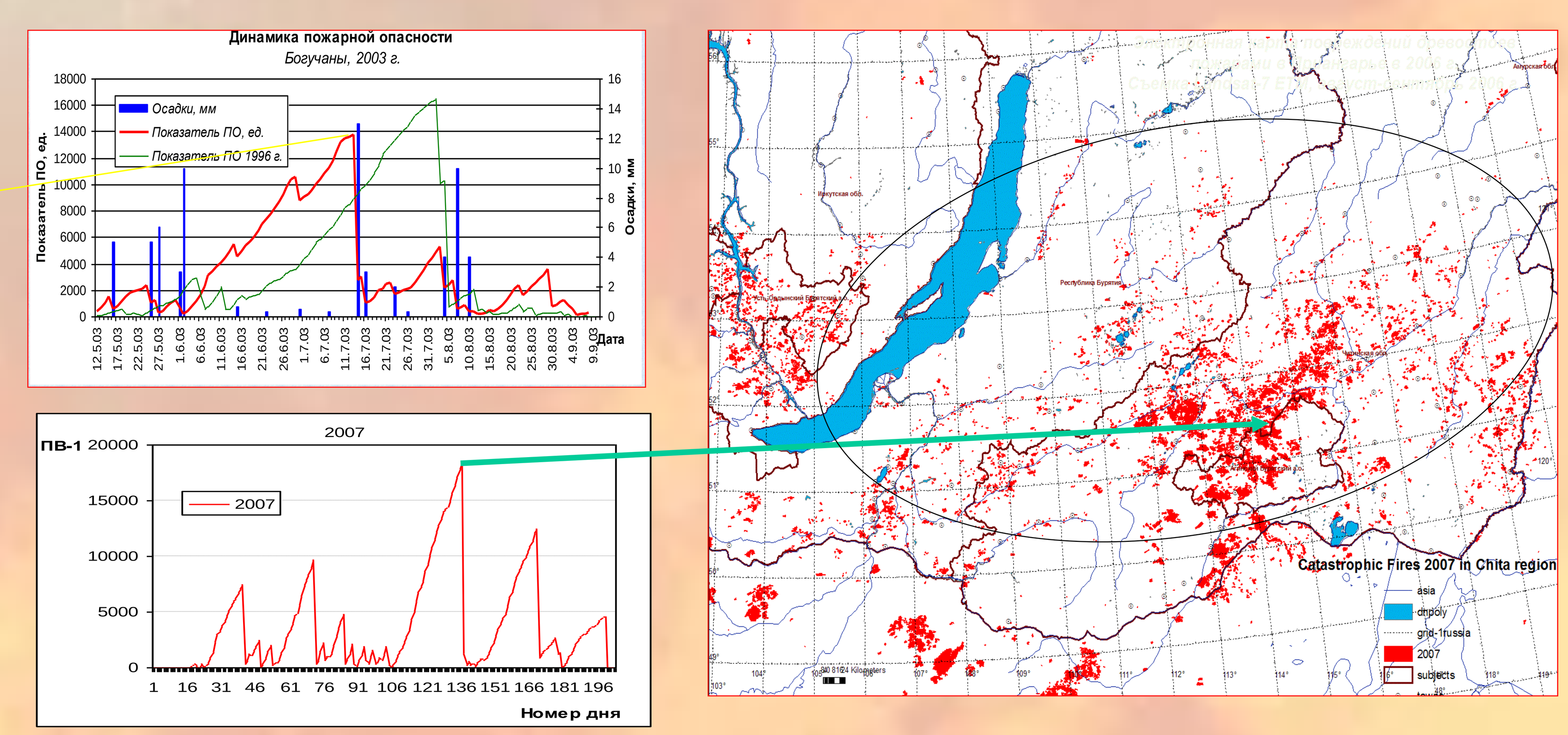


Figure 11. Catastrophic fires occur red over the Transbaikal region in 2007, when the fire weather danger index (PV-1, Nesterov or BUI) were 4 times higher than the average fire season index in the same region.

Conclusion

The Asian part of Russia is experiencing an increasing number of catastrophic fires. This fires affect huge areas, and their increase is likely related in part to global climate change. The problems of prevention and suppression of large and catastrophic fires in Russia are often more organizational in terms of the fire management agency (e.g., financial), rather than technical knowledge. It will be necessary to strengthen early fire detection and to increase suppression efforts to extinguish fires while they are still small. Tactics for the use of burn-out operations should be considered. It is also important to develop a national fire danger system for estimating fire danger based on the application of remote-sensing weather. A procedure for estimating fire impact (i.e., economic, social and ecological) caused by a wildfire is needed which would allow for better fire and forest management decisions.