

FIG

FIG WORKING WEEK 2017

Helsinki Finland

29 May - 2 June 2017

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# Examining Service Area of Fire Stations in Forest Fire with Network Analysis

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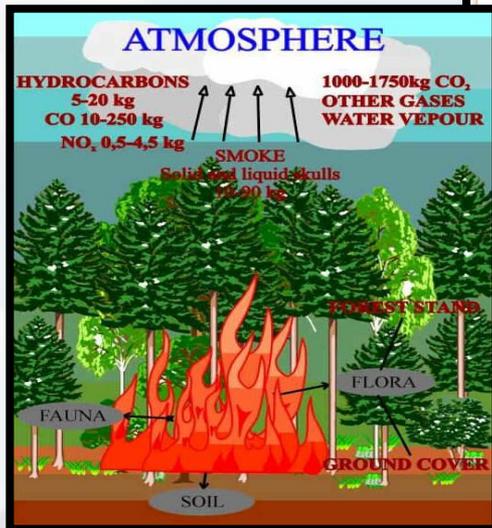
## INTRODUCTION

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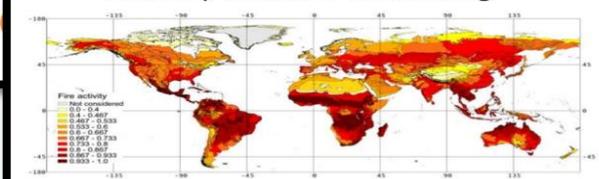
Forests which are our primary recyclable sources must effectively be protected so as to meet the needs of current and next generations. As in the whole world, in Turkey, the main factor endangering the continuity of forests is forest fires. Forest fires are not only ecologically but also economically dangerous and environmental problems mostly threatening human life.

### EFFECT OF FOREST FIRE

- loss of valuable timber resources
- degradation of catchment areas
- loss of biodiversity and extinction of plants and animals
- loss of wildlife habitat and depletion of wildlife
- loss of natural regeneration and reduction in forest cover
- global warming
- loss of carbon sink resource and increase in percentage of CO<sub>2</sub> in atmosphere
- change in the microclimate of the area with unhealthy living conditions



### Globally fires are increasing



Fire weather seasons are extending  
"If these fire weather changes are coupled with ignition sources and available fuel, they could markedly impact global ecosystems, societies, economies and climate"



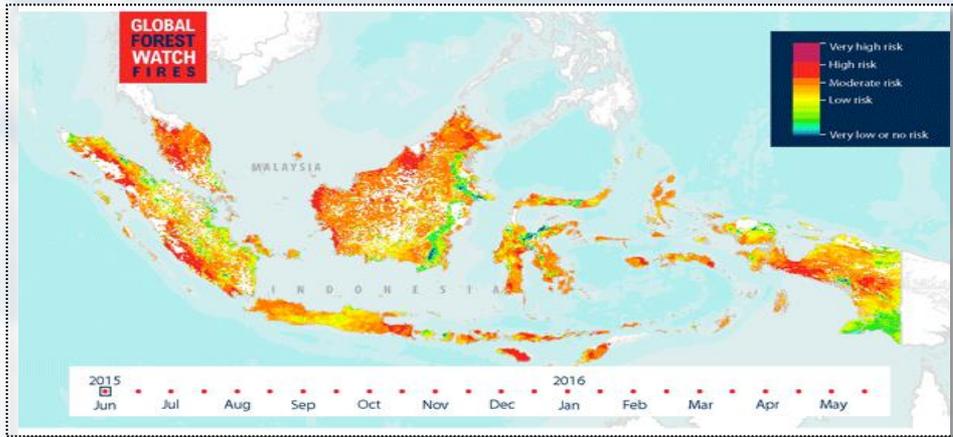


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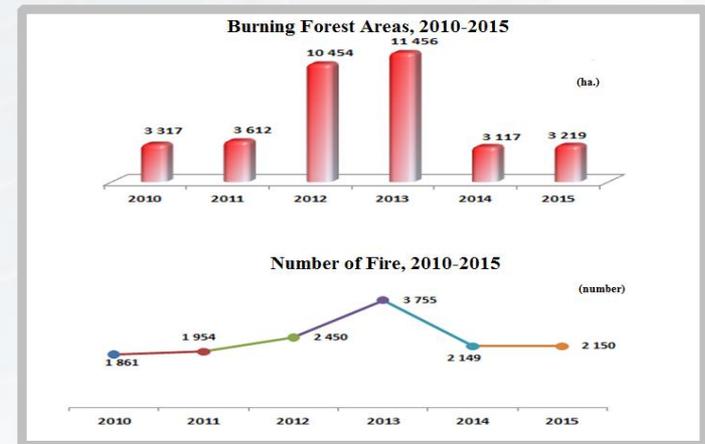
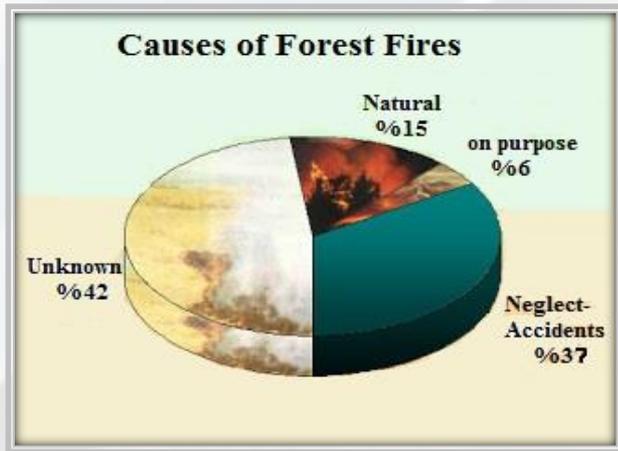
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- \* 500 million hectares of woodland, open forests, tropical and sub-tropical savannahs,
  - \* 10-15 million hectares of boreal and temperate forest,
  - \* 20-40 million hectares of tropical forests.
- (Rowell and Moore, 2004)



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## Fire Management

To be able to respond to forest fires effectively and early, fire-fighters must reach to area in critical time. Critical time might become the most ideal one through taking and processing urgent call, moving to the scene and successful fire management. However, the most crucial period here is the reaching time and this time period is influenced by several factors which cannot be controlled. These factors is;

- \* The location of station,
- \* Potential fire area,
- \* Traffic density,
- \* Average velocity,
- \* Habits of drivers,
- \* Situation of road network and
- \* Intra-day time period and season

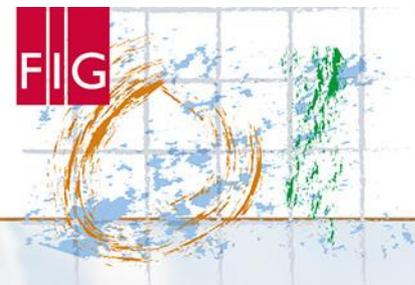


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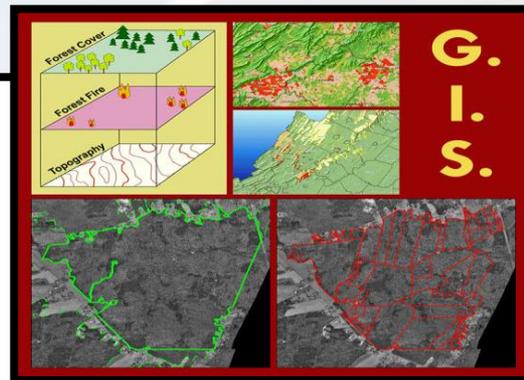
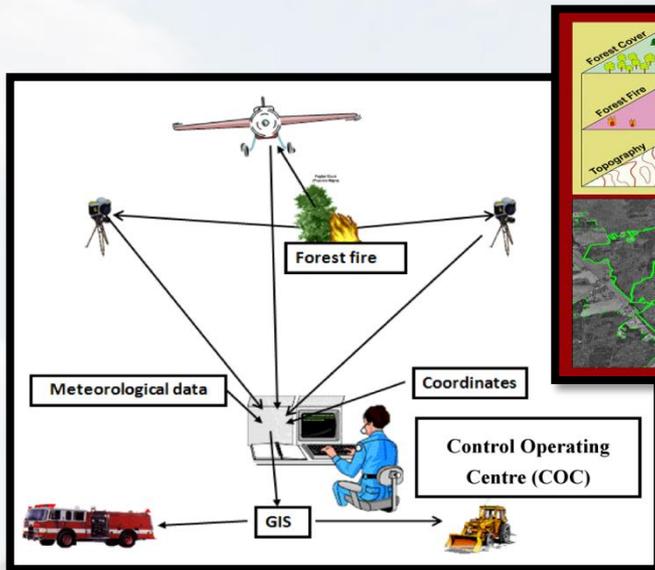
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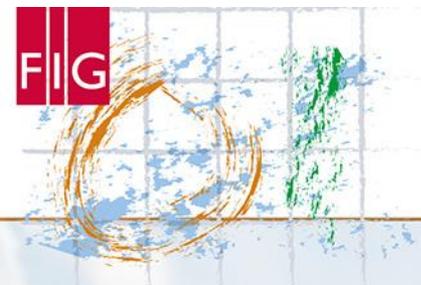
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So as to become successful in fight against forest fires, necessary precautions need to be taken at right place and time and resources should be used effectively and economically. High technology should also be used at every stage of fire process. In this context, very well-disciplined studies are needed and Geographical Information Systems (GIS) which is the most significant part of decision support systems has been used. New service areas and their numbers and possible fire areas might be determined via the functions of locational searching and analysis of GIS. Therefore, the use of resource in fires and late responses to fires may be minimized.



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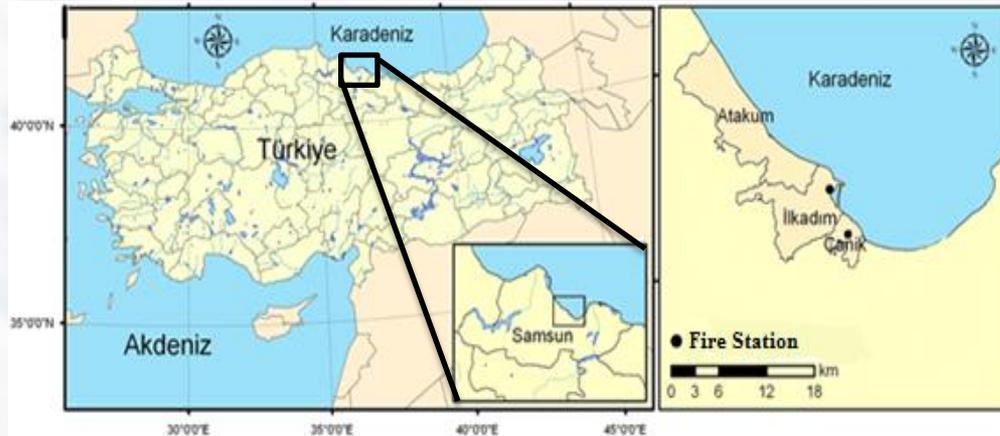


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- Atakum Forest Sub-district Directorate is **28.689.60 ha** in total,
- **11.871.00 ha** of it is forestland
- **16.818.60 ha** of it is non-forested land.

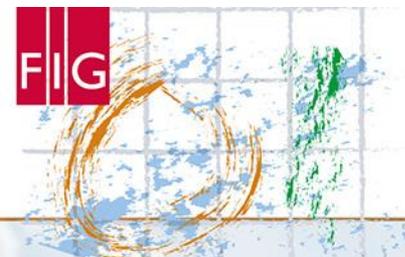
This study was conducted for Atakum Forest Sub-district Directorate located in the borders of Samsun Forestry Operation Directorate which is bound to Amasya Regional Directorate of Forestry. In case of fire within the borders of Sub-district Directorate, accessible areas in critical time period were found by service analysis based on the locations of the existing fire stations. Fire station points' capability to respond to the events in the determined time period was examined by conducted service area analysis.

There are 2 intervention teams in study field: one of them is the main fire station within the borders of İlkadım town and the other one is first intervention unit belonging to Forestry Operation Directorate in Canik town.



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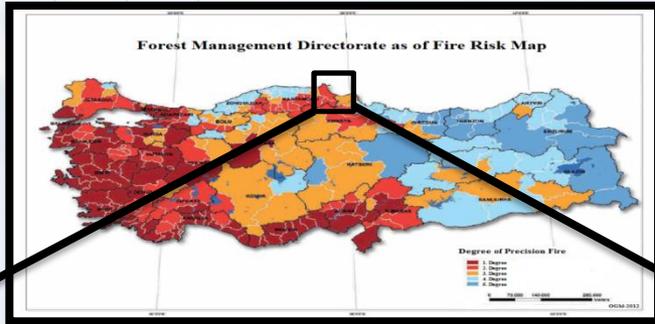


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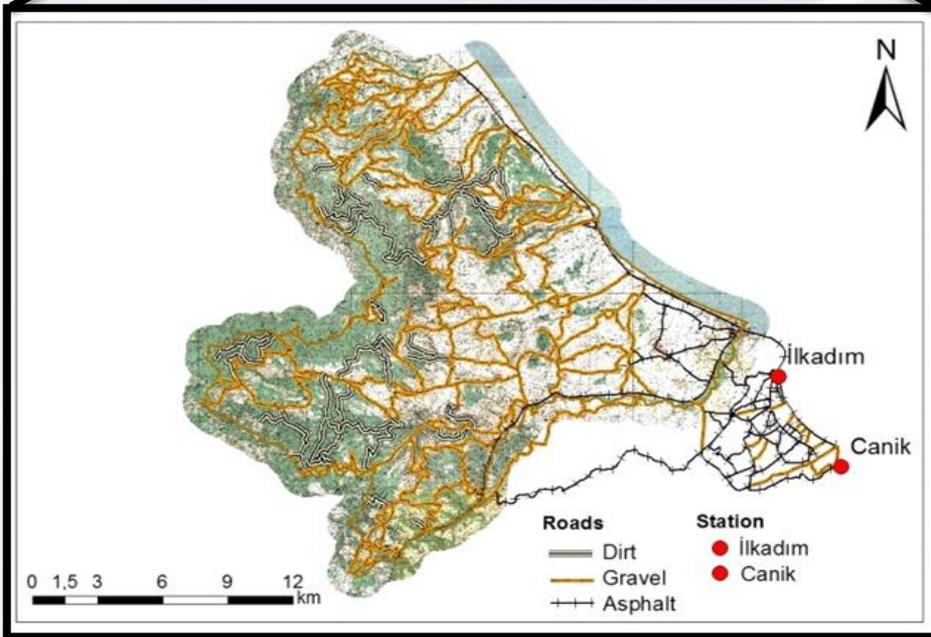
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Sensitivity Degrees Fire					
	I	II	III	IV	V
Critical Time (minutes)	20	30	40	50	50

- In terms of fire sensitivity, the area is sensitive to fire in **3rd degree**.

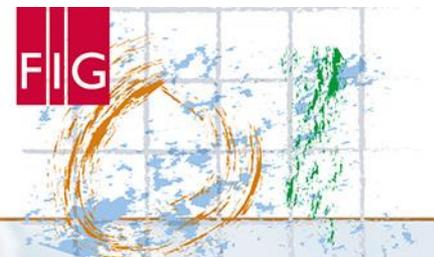


Road standards	Velocity of vehicle (km/h)	The distribution of road (%)
Earth	30	%17,2
Stabilized	50	%60,2
Asphalt	60	%22,6



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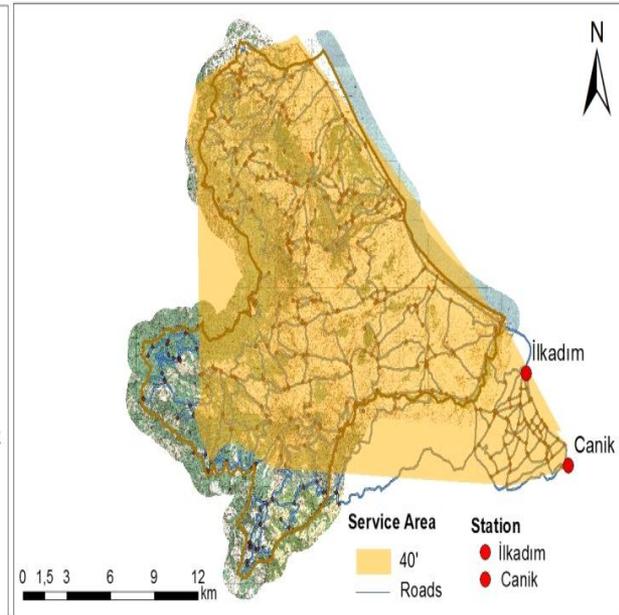
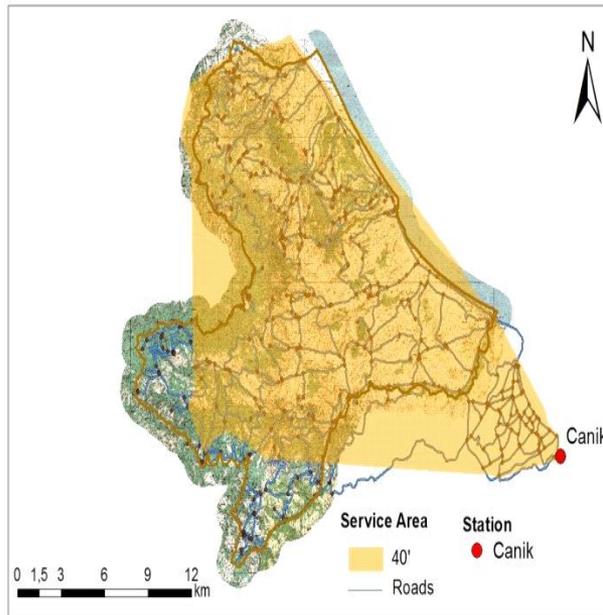
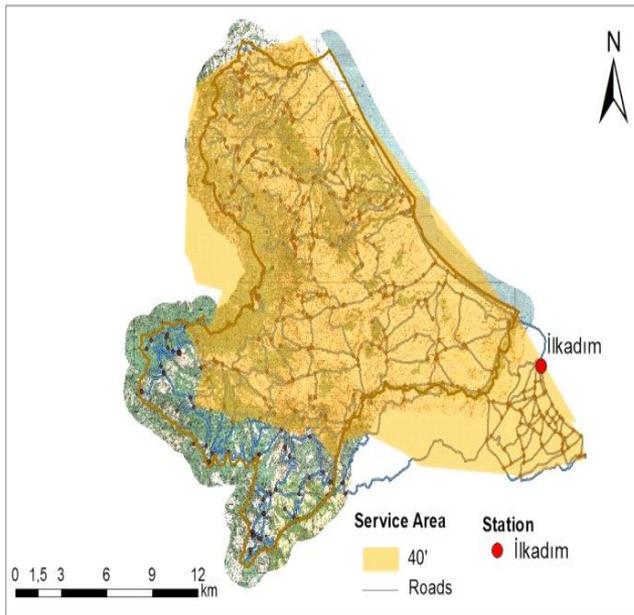
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## - Network Analysis



Name of Station	Responded Area (%)
İlkadım-Canik	%85,3
İlkadım	%81,3
Canik	%84,1



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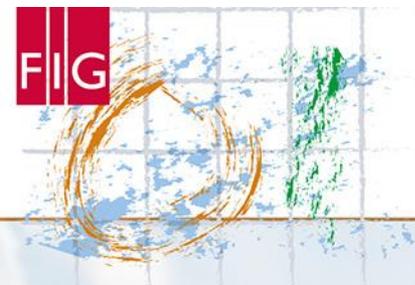
## CONCLUSION

- In this study, decision-support system based on GIS, network analysis was used. In case of fire, the suitability of numbers and locations of fire operation centers within the borders of Atakum Forest Sub-district Directorate was analyzed.
- The areas that first intervention teams might reach were determined.
- The location of intervention teams were established in an appropriate place for the study field.
- It was found that intervention teams are capable of arriving in critical time period.
- It was observed that, intervention teams can't access to almost %15 of study area in 40 minutes.
- These unacceptable areas located in high level region of the study areas and these areas covered densely forest and also has weak road network such as earth road. Therefore, it is predicted that the risk of fire for these region is likely to increase, considering the road condition and population needs of these inaccessible regions.
- It is estimated that a fire taking place in these regions may not responded in 40 minutes called as critical time. It can be beneficial to a solution of this problem that intervention teams are located in particularly Atakum town or through improve the standards of earth roads, arriving speed is increased.



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