

Artificial intelligence to predict wildfire ignition and support response

An ignition probability map is used by decision makers to optimise the allocation of fire suppression resources across a vast territory of Mediterranean Turkey.

/// Context ///

In Turkey, about 230,000 km² of its 783,562 km² of land are covered by forests, mainly publicly owned. A significant portion of them burnt in the Mediterranean region in 2021 in the worst-ever wildfire season in the country's history. Around 80% of the fires are caused by humans due to urban expansion, infrastructures, and recreational activities. As early detection and initial attack are crucial, it is important that the suppression resources are located as close as possible to the potential fire outbreaks. As a result, firefighting services are under great strain and require a high level of mobility. During the fire season, firefighters are stationed at fire stations near or within forest areas to extinguish fires as quickly as possible.

The Turkish Ministry of Agriculture and Forestry (TMAF) has been using a forest fire risk prediction tool based on meteorological parameters. However, meteorological data is not sufficient to assess fire risk if human activities are the main driver of ignitions, as they are unpredictable. Thus, there was an urgent and fundamental need for an ignition probability map that could take into account statistical as



Forest firefighting workers extinguish and control a fire in Bodrum, Turkey, in August 2021.
 Author: idiltoffolo | © Shutterstock

well as dynamic parameters, including human-made ignitions. Koç Digital created FireAld, an interactive fire risk map developed using artificial intelligence and machine learning that predicts the probability of ignition in each area. It optimises the distribution of fire suppression resources across the territory.

/// Solution for a Resilient Future ///

The World Economic Forum's Center for the Fourth Industrial Revolution, Koç Digital, TMAF and Deloitte launched the FireAld initiative in January 2022. The goal of FireAld is to facilitate the use of artificial intelligence (AI), machine learning (ML) and other cutting-edge technological advances in predicting fire outbreaks and optimising the distribution of suppression resources in different territorial compartments for early detection and initial response. This effort is motivated by the need to increase the efficiency and affordability of forest fire fighting operations at country scale.

The output of this effort is FireAld, an interactive fire risk map developed using AI algorithms and ML, backed by a global community of experts. It provides crucial information for authorities to prepare and respond to fires, with simulation tools processing fire size, predicting progress, and evaluating firefighting tactics. FireAld has two phases:

- An interactive map where predictive data (dynamic and static wildfire related datasets) are input to generate an ignition probability map.

- The ignition probability map is used to create an optimal post-ignition resource allocation model to help decision makers direct resources to predicted wildfires and identify potential threats.

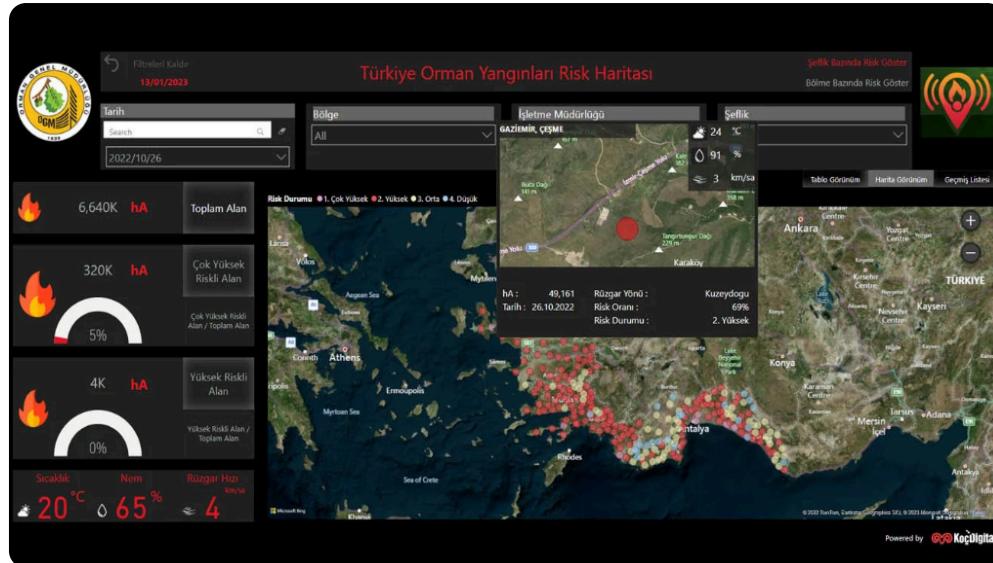
FireAld pilot project has been developed for South Aegean and West Mediterranean areas of Turkey, which account for 44,000 km² of land. For the model, the area was divided into 66,394 territorial compartments. Historical data is used to train the models included the location, date, duration and size of any fire in the area since 2010, the means used to extinguish them in relation to different forest and land characteristics (vegetation and land features, land use types, and terrain) and the meteorological conditions before and during the fire (including the daily five-day weather forecast).

The output of the model is the probability of fire occurrence, with four classes of risk per territorial compartment: extremely high, high, medium and low. The model is run twice a day: once in the afternoon using current weather data, and once in the evening using the forecast for the next five days.

This pilot project in Turkey resulted in an 80% accuracy rate in predicting the ignition of forest fires. In 2023, FireAld is collecting users' feedback via a network of users: TMAF government structures. Afterwards, the model refinement phase will begin. New data on fire statistics, forest stand maps and meteorological data that can be integrated into FireAld system. By continuously improving the FireAld technology's learning techniques, researchers aim to improve its adaptability to the unpredictable nature of wildfires.

ForestAld required a highly specialised team of project managers, business advisors, business intelligence

consultants, ML engineers, data engineers, data scientists and software engineers to ensure that every aspect of the project is covered. And for FireAld to be successfully implemented, there must be constant cooperation with fire experts. The entire budget of the project was covered by Koç Digital as a social responsibility project. General Directorate of Forestry (OGM) conducts benefit-cost analysis for all projects it carries out and implements. This analysis was also made for this project. Prioritising AI in wildfire prediction and prevention will improve the cost efficiency, effectiveness, and capacity of wildfire mitigation efforts at large scale.



/// Always Moving Forward ///

Koç Digital developed FireAld for TMAF, which was launched at the World Economic Forum 2023 meeting. The initiative aims to help countries and organisations to model fire behaviour (including ignitions) under different conditions by integrating their fire, land and weather data into the FireAld system. The source codes and algorithms will be made publicly available, increasing the capabilities and impact of the FireAld initiative. The next phase of Koç Digital's FireAld initiative is to expand its solutions to entirely cover Turkey, and Koç Digital's risk maps, resource allocation models and fire statistics will help the TMAF with its annual resource allocation planning.

Forest fire fighting services are not an area that is the focus

of high-technology companies, as is the case all over the world. High-energy forest fires that may occur in the future due to climate change will cause great damage to both forests and wildlife. The costs of extinguishing forest fires will increase dramatically. Identifying these negative impacts in advance could create new opportunities for high-technology companies in this area. To effectively manage the risk of forest fires and to avoid disasters, it is necessary to empower ministries, strengthen cooperation, incentivise contribution, prepare for long-term efforts. For Koç Digital to ensure the continuity of AI capabilities and to expand its capacities, the goal is to collect and enter as much data as possible into the FireAld system.

Further information

- World Economic Forum. 2023. The Next Frontier in Fighting Wildfires: FireAld Pilot and Scaling – Insight report January 2023. URL: https://www3.weforum.org/docs/WEF_The_Next_Frontier_Wildfire_Fighting_2023.pdf
- The power of AI in wildfire prediction and prevention. <https://www.weforum.org/impact/artificial-intelligence-wildfire-prediction-and-prevention/> (Accessed 21 August 2024)

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