Nat. Hazards Earth Syst. Sci. Discuss., 3, C2508–C2515, 2015
www.nat-hazards-earth-syst-sci-discuss.net/3/C2508/2015/

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "AEGIS: a wildfire prevention and management information system" *by* K. Kalabokidis et al.

K. Kalabokidis et al.

athanasis@geo.aegean.gr

Received and published: 7 December 2015

The authors sincerely thank the anonymous referee #1 for the peer-review of the manuscript and the suggestions offered for improvements. Answers to each comment are given below.

Comment #1: In the Introduction section, there is need to further justify the selection of the MTT algorithm as fire spread model for AEGIS. What are advantages and disadvantages of this choice? Why not other fire spread models?

The MTT fire spread algorithm (Finney 2002) and associated crown fire models, as implemented in the FlamMap code libraries (Finney 2006), is by far the most widely used and tested fire simulation in the world. The MTT is incorporated into FAR-

SITE (Finney 1998) FlamMap5 (Finney 2006), FSIM (Finney et al. 2011), Envision (http://envision.bioe.orst.edu/) , FSPro (Noonan-Wright et al. 2011), Randig (Ager et al. 2007, Ager et al. 2014), and other models in the research domain. MTT has been applied in numerous studies (over 30 papers). The MTT code is used at a range of spatial scales in the US for active incident response (Noonan-Wright et al. 2011), continental scale risk analysis (Finney et al. 2011), watershed scale planning (Ager et al. 2012). Extensive documentation on the functionality is contained within the FlamMap5 help system and the functionality can be downloaded and run within the FalmMap5 program at www.fire.org. This level of availability of support information and example data sets does not exist with other fire simulations systems, nor does the code modularity. The MTT algorithm models two-dimensional fire growth under constant weather by Huygens' principle where the growth and behavior of the fire edge is modeled as a vector or wave front (Knight and Coleman 1993). This method results in less distortion of fire shape and response to temporally varying conditions than techniques that model fire growth cell-to-cell on a gridded landscape (Finney 2002). Perimeter validation has been performed in many studies including Ager et al. 2012, Salis et al. 2013. A number of support papers have been published on the application of MTT and related models that detail sources of input data, parameters and model limitations (McHugh 2006, Stratton 2006, Ager et al. 2011).

Comment #2: -The authors did not point out if the MTT algorithm was already successfully applied in Europe or if the present study is the first attempt of replicating fire spread and behavior and assessing fire damages and "danger" outside US and Canada.

Application and testing includes fire systems outside of the US, including France, Spain, Italy (Salis et al. 2013, Alcasena et al. 2015, Salis et al. 2015), and Portugal (Oliveira et al. In review) where the MTT algorithm encapsulated as a Dynamic Link Library (DLL) in Randig and FconstMTT (contains all the input and output functionality of the FlamMap5 program), and used to model fire exposure to highly valued resources and the effect of fuel breaks.

Comment #3: In the Introduction, as well as in the other parts of the manuscript, the references to Greek authors manuscripts and studies is very high, while references to papers of other European authors is quite limited. Is there evidence that the Greek research is the most advanced at European level for wildfire simulation purposes and prevention platforms? Or is there another justification? I recommend to enlarge the references to other studies performed in other European areas.

In the revised manuscript, more references to European wildfire simulation and prevention platforms were added (i.e. Salis et al. 2013, Alcasena et al. 2015, Salis et al. 2015, Oliveira et al. In review).

Comment #4: The authors stated that "A prototype spatial fire danger estimation system was developed and incorporated into AEGIS that uses both ignition probability and expected burn area, thus providing an integrated fire danger metric." I wonder if this definition of fire danger is correct. I suggest to make reference to previous studies or scientific papers that proposed definitions and state-of-the-art about wildfire glossary and terminology, and to use a terminology consistent to such works. See for instance http://gacc.nifc.gov/nrcc/dc/idgvc/dispatchforms/glossary.pdf, http://nrfirescience.org/sites/default/files/documents/ScottGlossaryWildlandFireTerms.pdf or http://www.fire.uni-freiburg.de/literature/EUFOFINET-Fire-Glossary.pdf

We agree and we changed "danger" to fire hazard system according to the reviewer's suggestion.

Comment #5: -I recommend to use comma as separator of thousands in the text We agree to use comma as separator of thousands in the text.

Comment #6: The authors presented a number of case studies that were used to test the effectiveness of AEGIS in simulating actual events. I do suggest to apply some statistical indicators (e.g.: Sorensen index, Dice index, etc., see for instance Filippi, J.-B., V. Mallet, and B. Nader. 2014. Representation and evaluation of wildfire propagation simulations. International Journal of Wildland Fire, v. 23, no. 1, p. 46-57.

10.1071/WF12202) to quantify the agreement between simulations and actual fires. An evaluation based on the general shape of the perimeter as derived from visual analysis is scientifically weak and can lead to misinterpretations.

Testing of the fire perimeters is the subject of future work. Given the spatiotemporal uncertainty in weather and fuels before and during a fire, precise comparisons are exceedingly difficult, and it is possible that comparisons are correct for the wrong reason.

Comment #7: The readers could benefit from a table that summarizes the most relevant information (e.g.: size, date, duration, etc.) of the fire events selected, as well as of the main outputs (e.g.: simulated size). The same suggestion is valid for the description of the study areas, which will also benefit of the addition of the main fire regime information

The MTT algorithm is used to compute potential short-term fire behavior characteristics, as stated in the manuscript. Thus, in the results section we preferred to focus on the comparison between the actually burned areas and the simulated burned areas conducted at the beginning of each event by trained civil protection personnel. In the revised manuscript, we added that the duration of each MTT simulation was 3 hours, i.e. at the early stage of the suppression efforts. Details about the main fire regime information can be found in Kalabokidis et al. 2014.

Comment #8: It is not clear what are the fuel models used for the fire spread simulations. Custom or standard? How many fuel models were identified on the whole? This needs to be addressed and presented with more detail. Moreover, the selection of standard or customized fuel models should be justified since fuel models greatly affect the fire model performances. Finally, do the authors previously tested the fuel models for other case studies?

We used standard fuel models for 4 out of 7 study areas, while the other 3 study areas have a set of custom fuel models to describe the different fuel conditions of Pinus brutia, a common pine species of eastern Greece. Four fuel models were used to describe these pine forests, detailed in Palaiologou et al. 2013. Tests on more than 10 wildfire events occurred in this vegetation type revealed that standard fuel models presented overestimations of both final fire size and wildfire progression through time (please see Kalabokidis et al. 2014). Several other available custom fuel models designed for Greece and other Mediterranean countries are under evaluation for future use.

Comment #9: The authors stated that “The spatial data of the SKIRON model for wind speed and direction are provided as FlamMap input, while relative humidity and air temperature values are used to estimate fuel moisture values”. The fuel moisture is a key element for fire simulations, and the authors should provide more details and information for the readers. Also, the fuel moisture description should be presented in the paragraph 2.5 instead of 2.6

According to the reviewer’s comment, we now present the fuel moisture description in paragraph 2.5 instead of paragraph 2.6. Furthermore, the Fine Moisture Content (10-h) is computed based on relative humidity (ÎŮ) and air temperature (Îď) by using the following method, as proposed by Viney 1991:

The 1-h and the 100-h fuel moisture values are calculated by subtracting and adding 1% to the 10-h fuel moisture, respectively, while the values of Live Herbaceous and Live Woody moisture are predefined based on the actual date of each fire event, linked to the standard fuel moisture scenarios of the BehavePlus software according to the table below:

Comment #10: It is not clear what is the meaning of the numbers (1-1.5-2, etc.) in Table 2. The table caption should be improved.

It was a quantitative index of each pair comparison. In order to avoid any misinterpretations, we did remove it from the next version of the ms.

Comment #11: In Figure 9, it is recommended to indicate the spatial scale of reference of the maps. The same should be addressed for the other maps, when needed.

These images are not maps in the classical sense but screenshots of the platforms outputs. Therefore, it is difficult to add a posteriori the spatial scale since this is dependent on the zoom scale specified by the user’s navigation.

Comment #12: It is not clear what is the objective of Figure 10. The caption states “Spatial fire danger results (left column panels) of the six actual wildfires (right column panels with zoom-in of the starting points in red dots) that occurred during the summer of 2015 in four of our study areas (a: West Attica, 13 June 2015; b: Chalkidiki, 16 June 2015; c: Rhodes Island, 23 July 2015; d: Rhodes Island, 31 July 2015; e: Rhodes Island, 23 August 2015; and f: Lesvos Island, 30 August 2015)”. Since the “fire danger” metric is the result of simulated burn probability and fire size, what is the rationale of showing these maps with the actual fire ignition points? If the goal is to show the spatial fire danger maps, then the ignition point can be removed. Furthermore, in the figure caption, the authors should replace the fire dates by the actual fire size.

The "fire danger" metric (defined as hazard in the new ms.) is not the result of burn probability and fire size but a result based on the ignition probability and fire size as described in paragraph 2.6. The maps shown in Figure 10 is the results of merging 2 maps; i.e. the probability of ignition classified into 5 classes and the predicted burned area also classified into 5 classes. This merging is based on Table 2; i.e. the red area is the area that was identified for the specific day (specific weather conditions) as Extreme danger etc. Therefore we believe that overlaying the ignition points to this danger maps is quite relevant because we want to see (validate) what was the danger characterization of the areas that fires occurred and the overall spatial distribution of the danger to each study area. We also believe that fire dates should remain because the maps are valid only for these dates. Fire sizes are already mentioned in page 6202, lines 5-17 of the manuscript (http://www.nat-hazards-earth-syst-sci-discuss.net/3/6185/2015/nhessd-3-6185-2015.pdf). In the revised manuscript the fire sizes were added in the caption of Figure 10.

References

Ager, A. A., A. Barros, M. A. Day, H. K. Preisler, C. Evers, R. Pabst, T. Spies, J. Bailey, J. Bolte, and E. Platt. This issue. Developing and testing of a fire simulation system for the agent-based Envision modeling platform. Ecology and Society. Ager, A. A., M. A. Day, M. A. Finney, K. Vance-Borland, and N. M. Vaillant. 2014. Analyzing the transmission of wildfire exposure on a fire-prone landscape in Oregon, USA. Forest Ecology and Management 334:337-390. Ager, A. A., M. A. Finney, B. K. Kerns, and H. Maffei. 2007. Modeling wildfire risk to northern spotted owl (Strix occidentalis caurina) habitat in Central Oregon, USA. Forest Ecology and Management 246:45-56. Ager, A. A., N. M. Vaillant, and M. A. Finney. 2011. Integrating fire behavior models and geospatial analysis for wildland fire risk assessment and fuel management planning. Journal of Combustion 572452: 19. doi: 10.1155/2011/572452 Ager, A. A., N. M. Vaillant, M. A. Finney, and H. K. Preisler. 2012. Analyzing wildfire exposure and source–sink relationships on a fire prone forest landscape. Forest Ecology and Management 267:271-283. Alcasena, F. J., M. Salis, A. A. Ager, B. Arca, D. Molina, and D. Spano. 2015. Assessing landscape scale wildfire exposure for highly valued resources in a Mediterranean area. Environmental Management 55:1200-1216. Finney, M. A. 1998. FARSITE: fire area simulator-model development and evaluation. Res. Pap. RMRS-RP-4, USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. Finney, M. A. 2002. Fire growth using minimum travel time methods. Canadian Journal of Forest Research 32:1420-1424. Finney, M. A. 2006. An overview of FlamMap fire modeling capabilities. Pages 213-220 in P. L. Andrews and B. W. Butler, editors. Fuels Management-How to Measure Success. Proceedings RMRS-P-41. USDA Forest Service, Rocky Mountain Research Station, Portland, OR. Finney, M. A., C. W. McHugh, I. C. Grenfell, K. L. Riley, and K. C. Short. 2011. A simulation of probabilistic wildfire risk components for the continental United States. Stochastic Environmental Research and Risk Assessment 25:973–1000. Kalabokidis ., Palaiologou P., Finney M. 2014. Fire Behavior Simulation in Mediterranean Forests Using the Minimum Travel Time Algorithm. In Wade DD & Fox RL (Eds), Robinson ML (Comp): Proceedings of 4th Fire Behavior and Fuels Conference, 18-22 February 2013, Raleigh, NC, USA and 1-4 July 2013,

St. Petersburg, Russia. Published by the International Association of Wildland Fire, Missoula, MT, USA. pp. 468-492. Knight, I. and J. Coleman. 1993. A fire perimeter expansion algorithm based on Huygens' wavelet propagation. International Journal of Wildland Fire 3:73-84. McHugh, C. W. 2006. Considerations in the use of models available for fuel treatment analysis. Pages 81-105 in P. L. Andrews and B. W. Butler, editors. Fuels Management-How to Measure Success. Proceedings RMRS-P-41. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. Noonan-Wright, E. K., T. S. Opperman, M. A. Finney, G. T. Zimmerman, R. C. Seli, L. M. Elenz, D. E. Calkin, and J. R. Fiedler. 2011. Developing the US Wildland Fire Decision Support System. Journal of Combustion 168473: 14. doi: 10.1155/2011/168473 http://dx.doi.org/10.1155/2011/168473. Oliveira, T. M., A. M. G. Barros, A. A. Ager, and P. M. Fernandes. In review. Assessing the effect of fuel break networks to mitigate wildfire risk transmission in Portugal. Journal of Environmental Management. Palaiologou, P., K. Kalabokidis, and P. Kyriakidis. 2013. Forest mapping by geoinformatics for landscape fire behaviour modelling in coastal forests, Greece. International Journal of Remote Sensing 34(12):4466-4490. Salis, M., A. Ager, B. Arca, M. A. Finney, V. Bacciu, P. Duce, and D. Spano. 2013. Assessing exposure of human and ecological values to wildfire in Sardinia, Italy. International Journal of Wildland Fire 22:549-565. Salis, M., A. A. Ager, F. J. Alcasena, B. Arca, M. A. Finney, G. Pellizzaro, and D. Spano. 2015. Analyzing seasonal patterns of wildfire exposure factors in Sardinia, Italy. Environmental Monitoring and Assessment 187:1-20. Stratton, R. D. 2006. Guidance on spatial wildland fire analysis: models, tools, and techniques. Gen. Tech. Rep. RMRS-GTR-183, USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. Viney, N. R. 1991. A review of fine fuel moisture modelling. International Journal of Wildland Fire 1(4), 215–234.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 6185, 2015.