XXV CONGRESO DE ECUACIONES DIFERENCIALES Y APLICACIONES
XV CONGRESO DE MATEMÁTICA APLICADA
DEL 26 AL 30 DE JUNIO DE 2017
CEDYA+CMA
XXV CONGRESO DE ECUACIONES DIFERENCIALES Y APLICACIONES
XV CONGRESO DE MATEMÁTICA APLICADA
CARTAGENA - 2017

GIS-integrated environmental models

M.I. Asensio*, D. Prieto*, D. Álvarez*, L. Ferragut* and J.M. Cascón†

Mathematical models can be useful in decision-making processes, particularly in complex environmental decision problems. Moreover, these models provide truly interesting mathematical and computational problems. But the final goal is to supply to the end-user a functional and efficient tool. This implies the need for interdisciplinary collaboration, and the use of spatial data management tools as Geographic Information Systems (GIS).

Several models for different environmental problems have been developed by the authors: a Physical Forest Fire Spread model (PhFFS) and a High Definition Wind field Model (HDWF). The PhFFS model is a simplified 2D semi-physical wildland fire spread model based on conservation equations, with convection and radiation as main heat transfer mechanisms, that includes some 3D effects and takes into account topography, wind, fuel moisture content and fuel type. The numerical solution of the model equations involves efficient numerical and computational tools for simulating real fire events in less than real time [1, 2, 3]. The HDWF lies in an asymptotic approximation of the primitive Navier-Stokes equations, with the aim to provide a 3D velocity wind field, solving only 2D linear equations [4]. Solving an optimal control problem in which the wind flow on the surface boundary is the control, the model provides a 3D wind field adjusted to several meteorological wind data at some points of the domain [5].

In order to bring these models to the end-user through a readily accessible, intuitive and easy-to-use tool, a GIS-based interface has been developed integrating both models [7]. The development of this tool is based on the extent of the functionality of the commercial software ArcGIS, through the Python scripting language and Esri's ArcPy library. This tool also facilitates the testing and validation process of the models, by automating and simplifying the spatial data acquisition procedure and the display of the solution.

Acknowledgements

This work has been partially supported by the Department of Education of the regional government, Junta of Castilla y León, Grant contract: SA020U16.

References

[1] L. Ferragut, M.I. Asensio, S. Monedero *Modelling radiation and moisture content in fire spread.* Communications in Numerical Methods in Engineering **23** (2007), 819–833.

[2] L. Ferragut, M.I. Asensio, J.M. Cascón, D. Prieto *A simplified wildland fire model applied to a real case.* Advances in Differential Equations and Applications, SEMA SIMAI Springer Series **4** (2015), 155–167.

[3] L. Ferragut, M.I. Asensio, J.M. Cascón, D. Prieto *A wildland fire physical model well suited to data assimilation.* Pure and Applied Geophysics **172** (2015), 121–139.

[4] M.I. Asensio, L. Ferragut, J. Simon *A convection model for fire spread simulation.* Applied Mathematical Letters **18** (2005), 673–677.

[5] L. Ferragut, M.I. Asensio, J. Simon *High definition local adjustment model for 3D wind fields performing only 2D computations.* International Journal for Numerical Methods in Biomedical Engineering **27** (2011), 510–523.

[6] A. Skidmore *Environmental Modelling with GIS and Remote Sensing* Taylor & Francis, Londond, 2002.

[7] D. Prieto, M.I. Asensio, L. Ferragut, J.M. Cascón, A. Morillo *A GIS-based fire spread simulator integrating a simplified physical wildland fire model and a wind field model.* Submitted.

*Departamento de Matemática Aplicada, Universidad de Salamanca, Casas del Parque 2, 37008–Salamanca(SPAIN). Email: mas@usal.es, dprieto@usal.es, dalle@usal.es, ferragut@usal.es

†Departamento de Economía e Historia Económica, Universidad de Salamanca, Edificio FES, Campus Miguel de Unamuno, 37007–Salamanca(SPAIN). Email: casbar@usal.es