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Chapter XXII

Development of a Decision Support Tool for Technological Risk Management with Remote Sensing and GIS

Nektarios Chrysoulakis,
Foundation for Research & Technology - Hellas, Greece

Poulicos Prastacos,
Foundation for Research & Technology - Hellas, Greece

Constantinos Cartalis, University of Athens, Greece

Abstract

In this study, a GIS based decision support tool is proposed for the support of technological risk management by integrating moderate and high spatial resolution satellite imagery with in-situ vector data. The Advanced Very High Resolution Radiometer (AVHRR) on board the NOAA satellites has been used for the detection of fire as well as for the detection and

monitoring of plumes caused by major technological accidents. The Thematic Mapper (TM) on board the Landsat satellite has been used for the depiction of the urban areas and the main road network as well as for the estimation of the spatial distribution of vegetation in the study area. A major technological accident scenario was developed for the broader area of Athens (Greece) in order to present the functionality of the GIS tool for the support of decision making during the crisis, as well as for the assessment of the accident's impact on the natural and human environment.

Introduction

Major technological accidents comprise great danger to the environment and public health. A number of accidents have taken place in recent years with serious costs in terms of human life as well as with considerable – and in many cases irreversible – damage to the natural environment. In many cases toxic substances or released airborne material develop into plumes which may reach high concentrations at ground level and pose dangers to the human and natural environment. Damages may thus occur both as an immediate and direct consequence of the accident, and subsequently during propagation and dispersion of the resulting plume. Exhaustive consideration is usually given to the immediate ground-level effects in close vicinity to the installation; however, it should be mentioned that in several cases, only limited effort was given to examining the impacts of the plume in the wider geographic area during the course of the hours or days following the accident. Technological accidents can be characterized by a number of different events and processes, including spillage or sudden release of materials, fire, or explosion. Airborne releases usually develop in plumes, which can thereafter be monitored either due to their optical depth or their temperature difference from the ambient air. The emission of toxic gases and formation of carbon particles which can carry toxic material absorbed onto their surface as well as obscuring vision both present hazards in a fire situation.

A number of experiments (Atkinson et al., 1994; Bartelds et al., 1993; Cozzani et al., 1996; Davie & Nolan, 1993; Grant & Drysdale, 1994; Lang, 1993; Marliere, 1996; Martins & Borrego, 1994; Martins et al., 1996; Miles & Cox 1994; Porter et al., 1996) involving fires in warehouses and awareness of the hazards of plumes in a fire situation have been oriented towards the definition of the properties and of the amount of the plume particulates generated by different materials, including pesticides, under varying fire conditions. Various numerical models and software packages have been developed for the simulation of the