CLOUD TRACKING AND STORM IDENTIFICATION: A PREDICTIVE PERSPECTIVE

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The use of remote sensing techniques in the field of flood hazard forecasting received in the last years a noticeable impulse due to the spreading availability of satellite data, especially in the form of digital images coming from the infrared band of radiometers flying on board of geosynchronous orbiting platforms. The use of infrared information remotely sensed from satellite sensors is by no means reliable, at present, for quantitative precipitation forecasting when the scales of interest for flash floods are concerned. Nevertheless the predictive content of satellite imagery in the face of the overall cloud dynamics is quite high. In this view the use of cloud tracking techniques and storm identification procedures has been recently proposed with the aim of predicting the evolution of cloud entities associated with the highest heavy rainfall probability. Algorithms for this kind of analysis are based on the processing of geosynchronous satellite imagery in the infrared band and implemented in the limits of a real time monitoring framework. Cluster analysis is used for storm identification and the dynamics of the storming system is tracked along the whole series of half-hourly incoming images. A method for developing a fully automated predictive procedure is proposed in this paper together with a critical discussion about its suitability for predicting the probability of heavy rainfall events when associated with a specific modeling of small scale rainfall distribution which is actually responsible for the occurrence of flash floods in small size catchments.

ON THE USE OF RADAR DATA AND STOCHASTIC SPACE-TIME RAINFALL MODELS FOR PREDICTING THE DISTRIBUTION OF SHOWERS WITHIN A DEVELOPING STORM

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The high predictive content of satellite imagery was enthusiastically proposed as a powerful tool in flash flood forecasting, leading to the development of empirical algorithms for deriving ground rainfall rates. Two major constraints were later recognized to hold: the reliability of rainfall estimates is low except for large areas and the resolution of the satellite data itself is quite coarse. On the contrary, flash floods are usually driven by the small scale distribution of rainfall intensities at the scale of the showers. Radar data are thus addressed with the aim of exploiting the high resolution scanning of the atmosphere. Again two major constraints arise when a single radar is used: (a) the spatial coverage is quite limited with respect to the scale of storms evolution and (b) the predictive content of the information is very low. This paper investigates the potential of using radar data as an input to the space-time modeling of rainfall fields, orientated to flash flood forecasting. To this end, a preliminary analysis is performed to examine the capabilities of a stochastic space-time rainfall model in the face of reproducing the small scale features of the rainfall field. The model performance is examined on the basis of high resolution data from the Chilbolton radar (UK), for different kinds of storm events.

PREDICTIVE POTENTIAL OF JOINT CLOUD TRACKING TECHNIQUES AND METEOROLOGICAL ANALYSIS ORIENTED TO FLASH FLOOD FORECASTING

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Meteorological analysis of heavy rainfall events which cause flash floods in highly developed countries is being significantly assisted by the use of information received from satellite sensors. One of the most promising approaches to the satellite imagery relies on cluster analysis aimed at cloud tracking and storm identification. In order to assist scientists in identifying areas with the highest probability of strong convective development, the present paper investigates the potential of combining the above automated techniques with recent advances in meteorological theory on synoptic systems. From this last point of view those areas become defined by the intersection of three synoptic mechanisms: upward quasi-geostrophic forcing, convergence of water vapor at low levels and convective instability in the lower troposphere.

INTENSE RAINFALL AND FLOOD EVENT CLASSIFICATION BY WEATHER TYPE

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The influence of different weather types on intense rainfall and flood discharge is studied. Data from Western Greece are analysed, through a weather type classification that has been widely used in Greece. The probability of occurrence of intense rainfall events and flood events, conditional on the prevailing weather type, are calculated. Also, the statistics of the event characteristics are extracted and analysed through statistical tests and analysis of variance. The analyses show that there exist statistically significant differences in the probability of occurrence of an intense rainfall and flood event. However, the weather type concept does not explain significant portion of the variance of the event characteristics, such as rainfall duration, total depth, intensity, and discharge volume.

USE OF MULTIPLE TIME STEPS IN RAINFALL-RUNOFF MODELLING: EVALUATION ON SYNTHETIC DATA

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We propose a methodology for initialisation of rainfall-runoff models applied in event-based flood forecasting. It involves the calibration of a continuous-time daily model used to initialise a finer time-step model applied during flood periods. The methodology is tested and compared to other initialisation techniques. For a reliable evaluation, we use synthetic data to avoid the uncontrolled error effects of real-world situations; also, we have added some error to the input data. A simplified version of TOPMODEL was selected for the tests. The results show that the proposed methodology can be a very effective alternative in tackling the problem of model initialisation.

USING A LIMITED AREA PRECIPITATION MODEL FOR FLASH FLOOD REAL TIME FORECASTING

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Within the frame of the EC funded project AFORISM, a study is being conducted on the possibility of operationally using the rainfall forecasts generated by a Limited Area Model (LAM) of the atmospheric dynamics in order to improve flash floods forecasts.
This paper refers to an experiment under progress on the Reno river catchment, by trying to reproduce the events of November 1990 when a large flood occurred and a flood plain was inundated.
Precipitation forecasts are generated using the LAM and coupled with the rain-gauge precipitation measurements of the last few hours in order to improve the extrapolation.
The resulting precipitation field is then used within the frame of a real time rainfall-runoff model to produce flood forecasts.