World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:17, No:03, 2023

Flood Early Warning and Management System

Authors : Yogesh Kumar Singh, T. S. Murugesh Prabhu, Upasana Dutta, Girishchandra Yendargaye, Rahul Yadav, Rohini Gopinath Kale, Binay Kumar, Manoj Khare

Abstract : The Indian subcontinent is severely affected by floods that cause intense irreversible devastation to crops and livelihoods. With increased incidences of floods and their related catastrophes, an Early Warning System for Flood Prediction and an efficient Flood Management System for the river basins of India is a must. Accurately modeled hydrological conditions and a web-based early warning system may significantly reduce economic losses incurred due to floods and enable end users to issue advisories with better lead time. This study describes the design and development of an EWS-FP using advanced computational tools/methods, viz. High-Performance Computing (HPC), Remote Sensing, GIS technologies, and open-source tools for the Mahanadi River Basin of India. The flood prediction is based on a robust 2D hydrodynamic model, which solves shallow water equations using the finite volume method. Considering the complexity of the hydrological modeling and the size of the basins in India, it is always a tug of war between better forecast lead time and optimal resolution at which the simulations are to be run. High-performance computing technology provides a good computational means to overcome this issue for the construction of national-level or basin-level flash flood warning systems having a high resolution at local-level warning analysis with a better lead time. High-performance computers with capacities at the order of teraflops and petaflops prove useful while running simulations on such big areas at optimum resolutions. In this study, a free and open-source, HPC-based 2-D hydrodynamic model, with the capability to simulate rainfall run-off, river routing, and tidal forcing, is used. The model was tested for a part of the Mahanadi River Basin (Mahanadi Delta) with actual and predicted discharge, rainfall, and tide data. The simulation time was reduced from 8 hrs to 3 hrs by increasing CPU nodes from 45 to 135, which shows good scalability and performance enhancement. The simulated flood inundation spread and stage were compared with SAR data and CWC Observed Gauge data, respectively. The system shows good accuracy and better lead time suitable for flood forecasting in near-real-time. To disseminate warning to the end user, a network-enabled solution is developed using open-source software. The system has query-based flood damage assessment modules with outputs in the form of spatial maps and statistical databases. System effectively facilitates the management of post-disaster activities caused due to floods, like displaying spatial maps of the area affected, inundated roads, etc., and maintains a steady flow of information at all levels with different access rights depending upon the criticality of the information. It is designed to facilitate users in managing information related to flooding during critical flood seasons and analyzing the extent of the damage.

Keywords : flood, modeling, HPC, FOSS
Conference Title : ICHPECA 2023 : International Conference on High Performance Extreme Computing and Applications
Conference Location : Miami, United States
Conference Dates : March 16-17, 2023