

Andhra Pradesh Cyclone Hazard Mitigation Project; real time early warning modelling system

assignment

Following the destruction caused by two cyclones and repeated floods during June to November in 1996, the Government of Andhra Pradesh (GoAP), India, started the 'Cyclone Hazard Mitigation Project'. The overall objective of the project was to provide a system that minimises impacts due to cyclone natural disasters, as well as enhances sustainable development of the coastal zone. To meet this objective, the project consisted of two major components: 1) the set-up of a real time early warning system and 2) the formulation of an Integrated Coastal Zone Management (ICZM) Programme. The early warning system focuses on the short-term and operational measures to be taken, while the ICZM programme deals with the long-term reduction of coastal vulnerability to cyclonic disasters.

The aim of the early warning component was to develop and implement an integrated set of state-of-the-art models to predict storm surge inundation areas, heavy rainfall areas and wind hazard areas, based on the latest cyclone track and landfall point information. Extensive training was given to the local staff responsible for the operational use of the early warning system in the Andhra Pradesh Disaster Management Society (APSDMS)

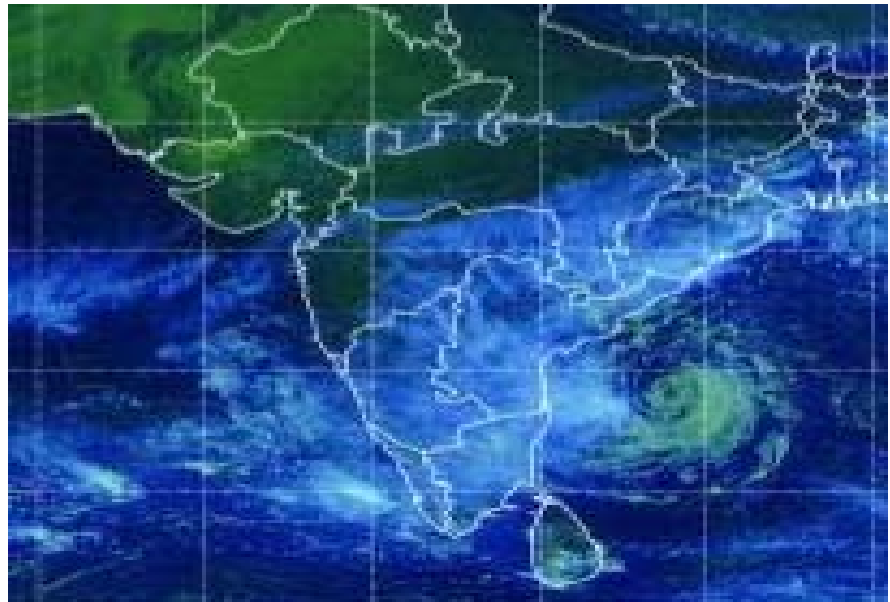
The project was jointly funded by a World Bank loan to the Government of Andhra Pradesh and GoAP itself.

client

Government of Andhra Pradesh, Department of Planning, Hyderabad, India

period

June 1999 - November 2003



Satellite image of a cyclone approaching the coastline of Andhra Pradesh, India (Indian Meteorological Department)

keywords:
storm surge modelling
coastal zone management
technology transfer
early warning systems



background

Andhra Pradesh is the fifth largest state in India. It is situated along the eastern coast of India, bordering the Bay of Bengal, and has a coastline of 1030 km extending from Srikakulam in the North to Nellore in the South. The nine coastal districts are highly vulnerable to natural hazards like cyclones originating from the Bay of Bengal, floods due to river waters, heavy rains and winds associated with cyclones. Nearly one-third of the cyclones originating in the Bay of Bengal cross the Andhra Pradesh coast. These occur primarily during pre-monsoon (April-May) and post-monsoon seasons (November - December), the cyclones in the latter season being more severe.

what is a tropical cyclone?

A tropical cyclone (also known as a typhoon or hurricane) is an intense low pressure area that is associated with strong winds, heavy rains and storm surges (in coastal areas). In India, cyclones develop over the generally warm waters of the Bay of Bengal and Arabian Sea. The storm surge is the most dangerous phenomenon associated with any cyclone and it is usually responsible for large-scale loss of life. Wind speeds of up to 200 km/hr, rainfall of 50 cm/day for several consecutive days and storm surges of up to 5-6 meters are not uncommon.

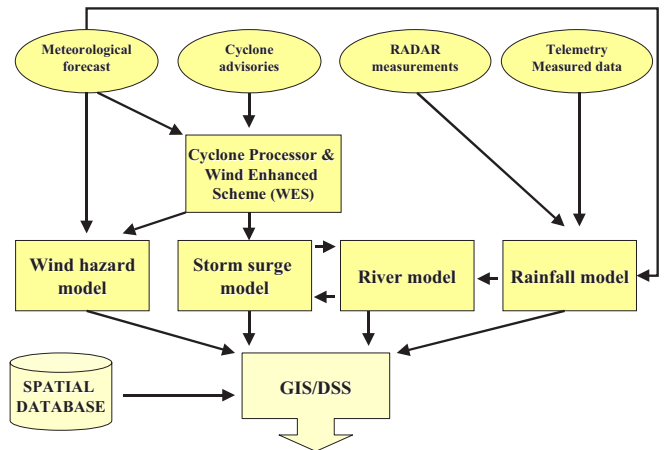


Effect of a storm surge along the coast (courtesy NCstormsurge.com)

the real time early warning system

The ‘Real Time System’ is a modelling framework consisting of a group of models, modules and data input/output and analysis procedures to predict rain, wind and flood hazards along the coast. Specific components of the system are:

- a Rainfall Model, which reads telemetered rainfall measurements and rainfall forecasts and generates rainfall estimates for the next 24 hours;



Hazard Maps & Bulletins

Components of the real time early warning system

- a Cyclone Processor, which reads the cyclone advisories for cyclone intensity and for track predictions, then produces the required cyclone parameters;
- a Wind Enhancement Scheme (WES), which takes the cyclone parameters generated by the cyclone processor and the latest meteorological forecast and prepares wind and pressure data at a high spatial resolution. It also generates and incorporates predicted wind and pressure due to the cyclone ;
- a Wind Hazard & Damage Model, which reads the wind data generated by WES and produces hazard warnings to the coastal districts of Andhra Pradesh; it estimates damages;
- a Storm Surge Model, which reads the wind and pressure data generated by WES, the telemetered sea levels and the river flow data and produces coastal surge levels for the next 36 hours;
- an Inundation Model, which reads the surge levels produced by the storm surge model and produces inundation level data along the coast of Andhra Pradesh.

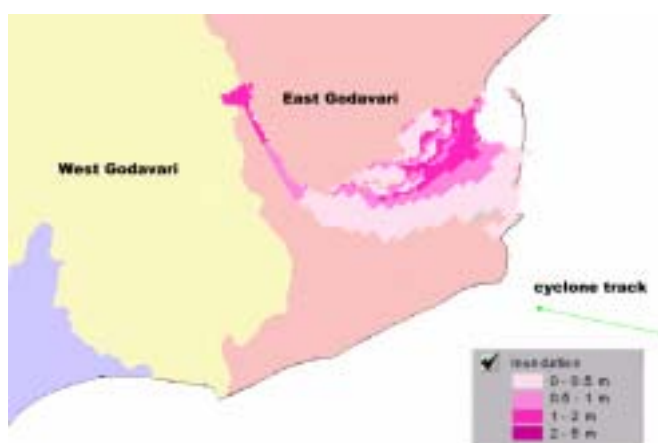


Storm surge model region

decision support system and data base

In addition to models, the real time system contains a GIS-based Decision Support System (DSS-RTS) to integrate model outputs with spatial information (for example the location of cyclone shelters) and to enable communication of relevant system outputs to decision-makers.

A spatial database contains data on population, infrastructure, communication lines and socio-economic status of the coastal population, per mandal (administrative district). The database also includes historical data of all cyclone tracks in the Bay of Bengal. Relevant data about the cyclones which crossed the Andhra Pradesh coast and the damage caused are also archived. The database together with the DSS-RTS can be of direct use to support evacuation and relief operations.

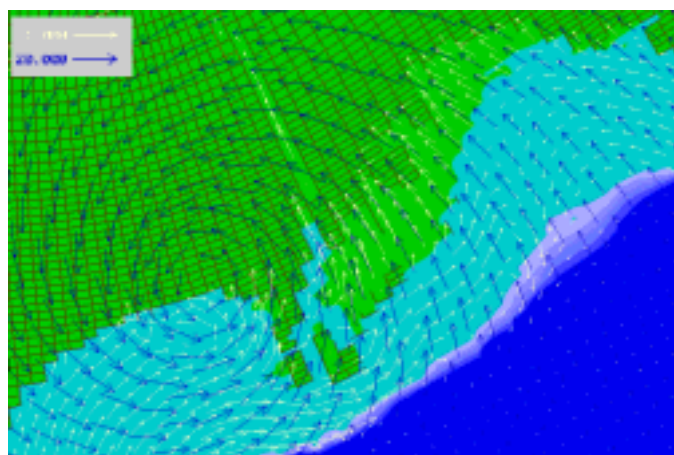


Cyclone track and inundation map issued by the real time system

benefits of the project

The implementation and use of the real time modelling system provides many important benefits to Andhra Pradesh:

- Increased potential for saving human life and protecting coastal area investments;
- Increased cyclone hazard management potential;
- Increased level and intensity of predictions from the integrated system;
- Increased level of understanding cyclone weather systems in government ranks;
- Trained staff to carry on the work after the completion of project;
- Policy advice for the short term cyclone relief; and
- Recognition for the measures put in place.

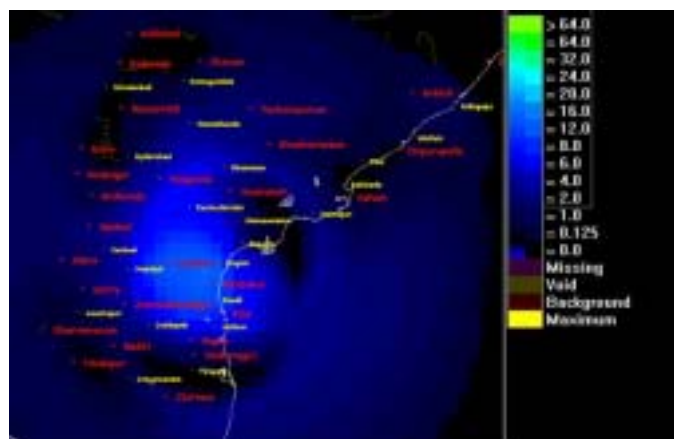


Cyclone wind forcing (dark coloured vectors) at landfall and the resulting flow (light coloured vectors) during 1990 Kakinada Cyclone (09-05-1990). Wet/inundated area on land in the picture is shown without grid lines

training of local staff

During the project, extensive formalised and on-the-job training was provided to Government of Andhra Pradesh staff, who are responsible for the operational use of the developed early warning system after the completion of the project:

- Basic meteorological training;
- Workshops and training courses on storm surge modelling, cyclone track forecasting, rainfall forecasting models and the Wind Enhancement Scheme;
- Foreign training for selected officers of counterpart staff.



Rainfall forecast results for coastal Andhra Pradesh

the consortium

The project was conducted by a consortium of international and national companies, headed by WL | Delft Hydraulics. The GoAP contributed 5 project engineers and scientists to the project on a full-time basis.

International:

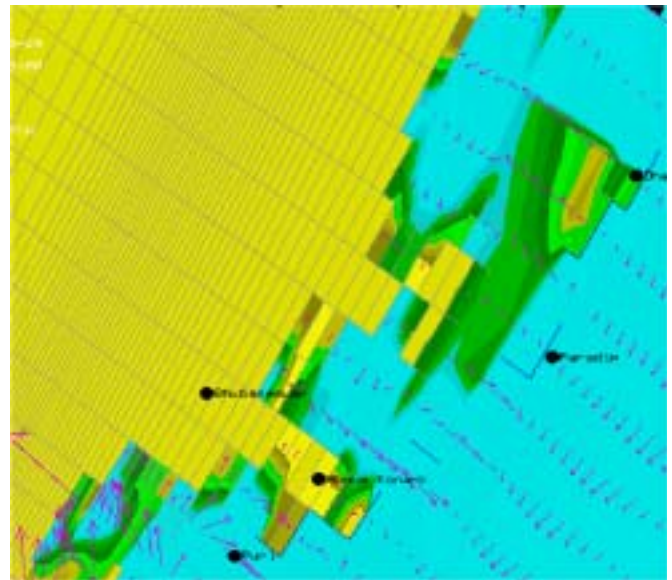
- WL | Delft Hydraulics (consortium leader)
- DHV Consultants BV, The Netherlands
- ARGOS, The Netherlands
- Flood Hazard Research Center, UK
- HR Wallingford/Centre for Hydrology and Ecology, UK
- UK Meteorological Office, UK
- Coastal Zone Management Center, The Netherlands

Indian Agencies/Departments co-operating with the study:

- Andhra Pradesh Remote Sensing Applications Center (APSRAC, GoAP)
- Shore Area Development Agency, (SADA, GoAP)
- Relief Commissioner's Office (GoAP)
- Irrigation & Command Area Development Department (GoAP).
- India Meteorological Department (IMD)
- Central Water Commission (CWC)



A cyclone shelter



Predicted inundation of the coastal areas due to a cyclone storm surge

National:

- Consulting Engineering Services (India) Ltd, New Delhi
- INDPROTECH, Hyderabad
- JPS Associates, New Delhi
- MDP Consultants Pvt. Ltd, New Delhi
- IIT-Madras, Chennai
- National Institute of Ocean Technology, Chennai



Low-lying coastal village vulnerable to storm surges

WL | Delft Hydraulics

Decisive advice: from multidisciplinary policy studies to design and technical assistance on all water-related issues.

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