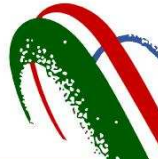


**Development of GIS based Flood Hazard Models – Effective use of Information & Communication Technology**

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Edida Rajesh

RMSI Private Ltd.,  
Noida

November, 2006



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**Background**

- Stochastic Module
- Hazard Module
- Vulnerability Module
- Financial Module



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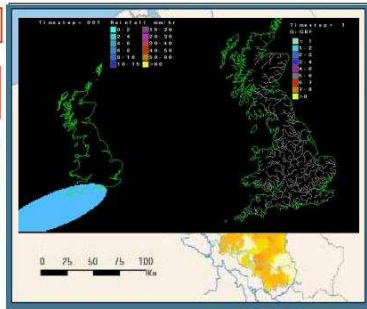
Presentation Outline

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**Introduction**

Flood Hazard Modeling Started in Year 2000

- Covered 110 River Basins of Japan
- Major River Basins of United Kingdom
- Major River Basins of Belgium
- Major River Basins of Germany
- Working on rest of European countries



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Background

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## Background

- Indian context
  - Developed flood risk profiles for the states of Andhra, Orissa and Gujarat for World Bank.
  - Worked out quick analysis on "What if Pareechu Lake Bursts?" in 2003



Pareechu Lake



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Background

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## Technology

- GIS Technology for spatial modeling and visualization
- Specialized software for Hydraulic Analysis
- Applications for data formatting & analysis
- Internet for public access



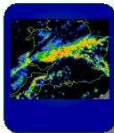
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Model Structure

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## Flood Risk Model Components



Define Event

Stochastic  
Module



Calculate Flood  
Depths

Hazard  
Module



Calculate  
Damage

Vulnerability  
Module



Quantify Financial  
Loss

Financial  
Module



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Model Structure

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- Background
- **Stochastic Module**
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- Financial Module



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Presentation Outline

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### Flood Risk Model : Stochastic Module

- River Flows
  - Spatial correlation
  - Peak flows
  - Winter & Summer
- Off flood plain
- Rainfall Intensity



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Stochastic Module

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- Background
- Stochastic Module
- **Hazard Module**
- Vulnerability Module
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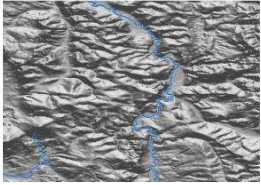
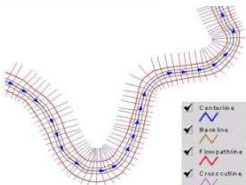
## Flood Risk Model : Hazard Module


**Basic Data**

- River Network (High & Low Resolution)
- Digital Elevation Model
- Satellite Images
- Rainfall/Discharge Data

- Stream Centerline
- Bank Lines
- Flow Path Lines
- Cross-Cut Lines
- Catchments
- TIN
- Processed Flow Data





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Hazard Module

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## DEM - Pre Processing

**Process Flow**

**DEM Tiles**

**Data Tiles**

Checked against river network

Correction for the shift (if required)

Visual check for:


- No data along river
- Tiles within tile
- Artifacts
- Bad pattern

Inter tile shift check

Merging all DEM tiles

**No Data Tiles**

No corrections



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DEM

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## DEM - Pre Processing

File Edit View Theme Analysis Surface Graphics Window Help

Scale 1:1 6/26/2008 11:28 AM

**L** For loading the Grid

**S** Shift distance marker

**A** Applying the shift and save. As many trials for best match

**F** Freeze the grid after satisfactory match



Before correction



Corrected grid

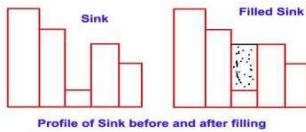
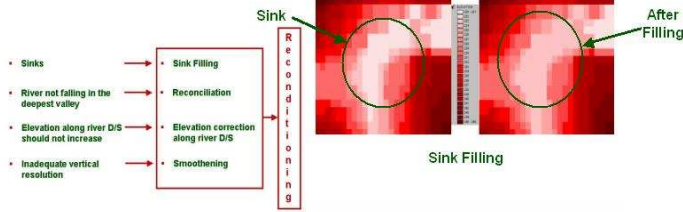


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DEM

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## Dem- Reconditioning



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DEM

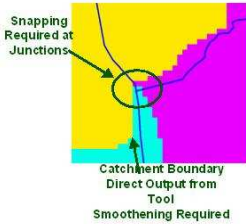
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## Catchments Derivation

- Catchment is a geographical area drained by a river
- Derivation using tool
- Snapping with network junctions
- Smoothering
- Catchment attributes



- Catchments were
  - QAed Against
    - Contour lines
    - DEM
    - High Resolution river network
    - Reference Catchments
  - Compared Against
    - Published data
    - Area compared with gauge data



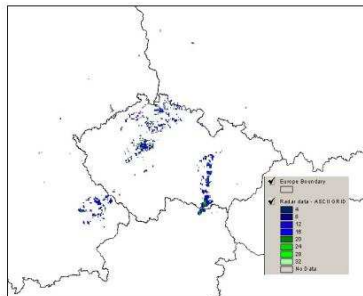
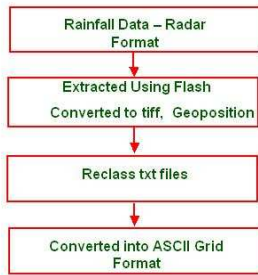
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DEM

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## Rainfall Data Processing

- Rainfall Data is in the form of Radar Images from different sources



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Rainfall Data Processing

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## Hydraulic Modeling - HEC-RAS

- U.S. Army Corps of Engineers  
- Hydrologic Engineering Center (HEC)
- HEC-RAS Version 3.1.1 (May 2003)
- HEC-GeoRAS Version 3.1 (October 2003)

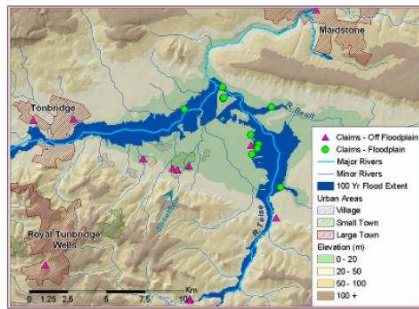


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Hazard Module

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## Floodplain Mapping



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Derived Flood Map

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- Background
- Stochastic Module
- Hazard Module
- **Vulnerability Module**
- Financial Module



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Presentation Outline

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## Flood Risk Model : Vulnerability module

- Flood depth modeled for each event at each postcode unit
- Vulnerabilities modeled as % loss based on flood depth for range of building types
  - Building height
  - Occupancy
  - Basements
- Vulnerabilities modeled for extreme rainfall and overland flow



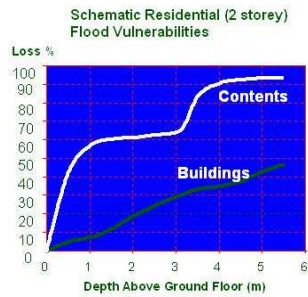
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Vulnerability Module

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## Vulnerability module: Residential Flood Vulnerabilities

- Cost modelling method
- Data sources:
  - FLAIR reports (Middlesex University)
  - EUROflood
  - US Corps of Engineers
  - FEMA, USA
  - CRES, Australia
  - Dundee Studies
  - NOAA data



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Vulnerability Module

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- Background
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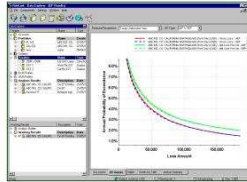
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## Flood Risk Model: Financial Module

- Full average annual losses
  - unit resolution flood risk pricing
  - portfolio aggregation of loss
- Insured loss return periods
- Specific insurance and reinsurance structures
- Different financial perspectives



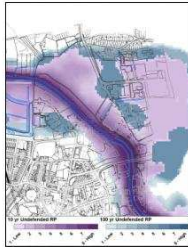
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Financial Module

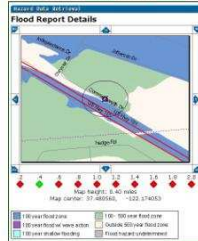
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## Communication Channels

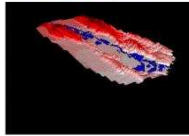
Flood Risk Maps in the form of digital data



Internet based flood lookups



Animations for public



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