Post Tsunami Survey for Hazard Map Development in Sri Lanka

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Outline of Talk

- Tsunami disaster in Sri Lanka
- Survey for Hazard Map preparation
- A Multi-hazard perspective
- Challenges


10 9:30


10 9:32


10 9:33

2004 December Tsunami Impacts

- Accounted for 94% of all deaths related to natural disasters in 2004 world wide
- In Sri Lanka current estimates stand at more than 35000 lives lost, 8000 missing and 1 million affected. Almost half of the affected lost their livelihoods
- Sri Lanka: 1,809 persons killed per 1 million inhabitants; Next was Indonesia with 759 persons killed per million
- The direct estimated economic losses at 1 bn $, stands around 4.5% of the national GDP. Indirect damage from output losses are estimated at 330 m $and 1.5% of GDP. Economic growth will drop by 1% (6 -> 5%)

Building Damage

- 5900 non residential buildings were completely or severely damaged and 5125 partially damaged.
- Recently released survey data show that about 50,000 residential houses completely destroyed or heavily damaged and another 38,500 partially damaged.
- Considering the number of families affected and the existing quality of housing, the government has decided to build 100,000 new housing units

Requirements in Reconstruction

- **Minimize Risk by**
  - **Reducing Hazard [For Tsunami?]**
  - **Reducing vulnerability**
    - **Strong construction to withstand hazard**
    - **Reduce Exposure (Moving away)**
    - **Early warning, Safe evacuation**
- **A Hazard map is an important requirement for reducing vulnerability**

Survey Organization

- ***Objectives:***

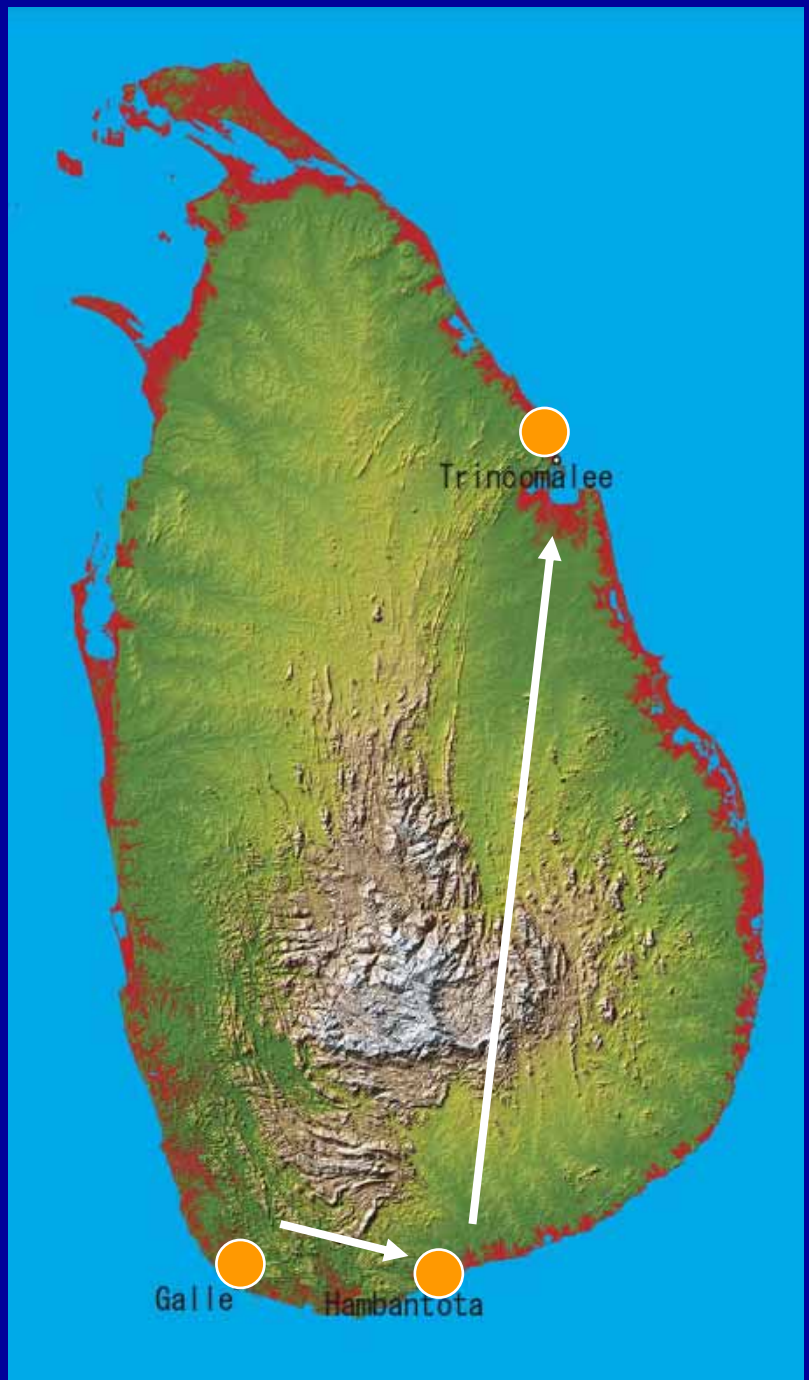
1. **To carry out a rapid reconnaissance survey to prepare a basic hazard map to assist the medium and long term reconstruction process**
2. **Understand the Tsunami mechanism and impacts**

- **Benefits**
  - **Build partnership and cooperation among professional institutes**
  - **Make basic data available for Hazard and Risk assessment**
  - **Knowledge/Technology transfer through cooperative research**

Activities

Activities

- **High resolution mapping of affected area (with RS, GPS and GIS)**
  - **Areas to be covered are Galle, Hanbantota and Trincomalee for this initial exercise.**
- **Detailed survey of localized wave impacts, in conjunction with satellite images.**
- **Assessment of Wave Strength from Building failure characteristics**
- **Interviewing stakeholders in Tourism industry, Fishing industry**



Cities Covered

Galle

Hambantota

Trincomalee

Sri Lankan organizations

Central Engineering Consultancy Bureau
Central Environment Authority
Dept. of Coast Conservation
Dept. of Survey
Geological Survey and Mapping Bureau
Irrigation Department
Meteorological Department
National Building Research Organization
State Development and Construction Corporation
University of Moratuwa
University of Peradeniya
University of Ruhuna

Teams

International Organizations

Asian Institute of Technology, Geoinformatics Center (Remote Sensing and GIS)

The University of Tokyo, Tsukuba University (Hazard map, Tsunami strength)

United Nations University, Environment and Sustainable Development (Hazard Map, Survey coordination)

United Nations University, Institute for Environment and Human Security (Social Vulnerability survey)

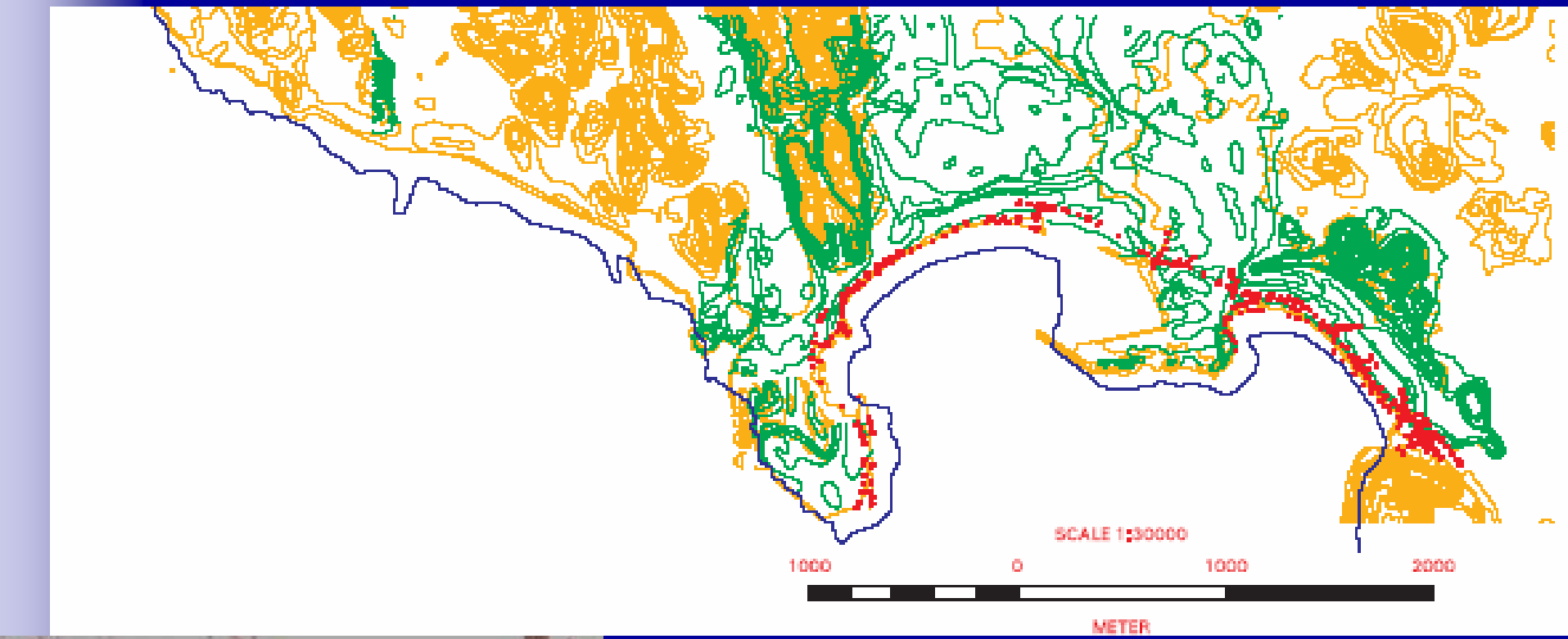
Topographic Mapping

- The GPS mapping team of the Survey Department assisted in the improvement of existing topographic data using Kinematic GPS units.

Building Damage

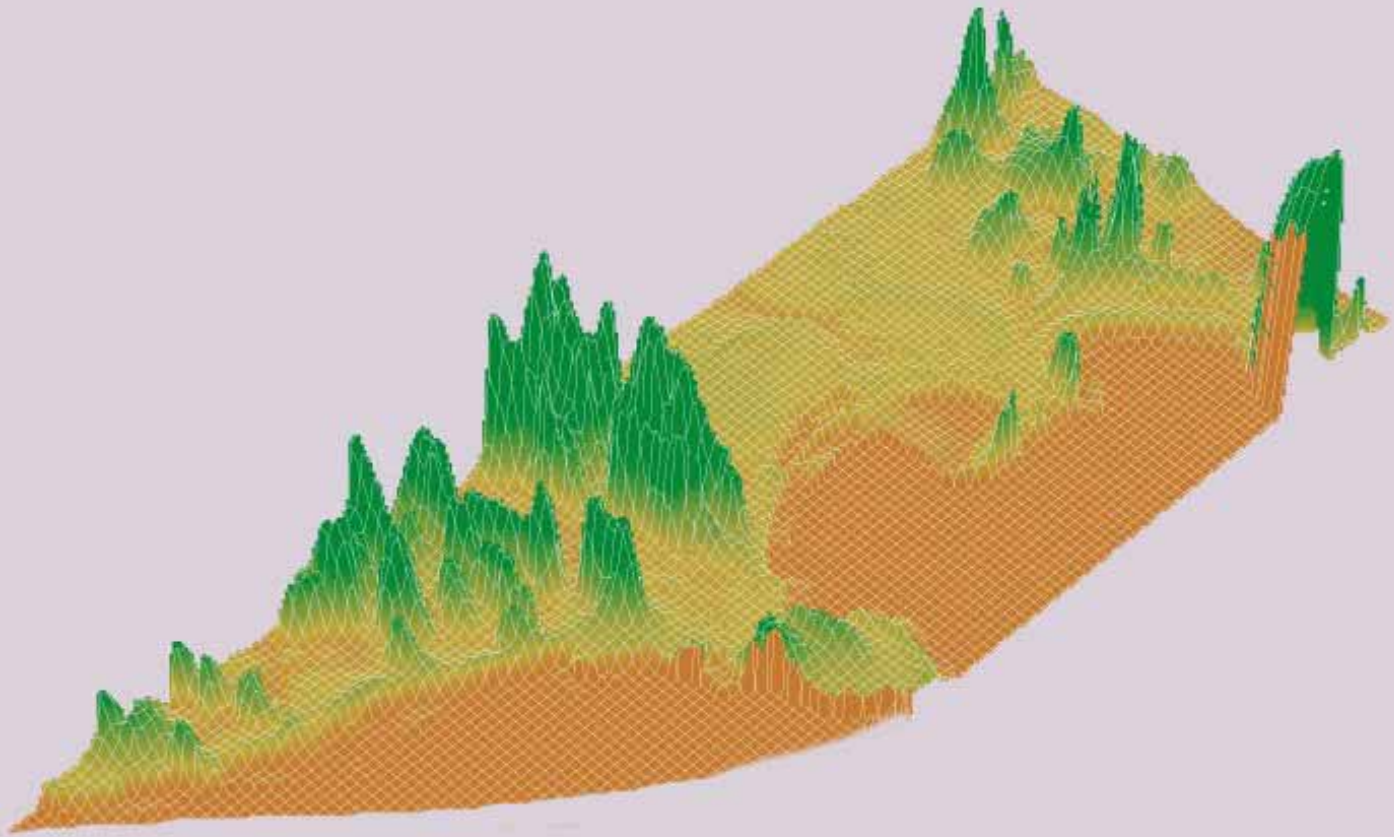
- Building damage was categorized with respect to degree of damage, type of construction, alignment, etc.
- GPS pictures are also made for future reference

Galle DEM



- 1:5000 existing digital data
- 2 ft contour map
- Total station survey along coast

Galle



DEM for Galle incorporating different dat

Inundation and Run-up

- Inundation measurements to improve existing observations

- Building damage was categorized with respect to degree of damage, type of construction, alignment, etc.
- GPS pictures are also made for future reference

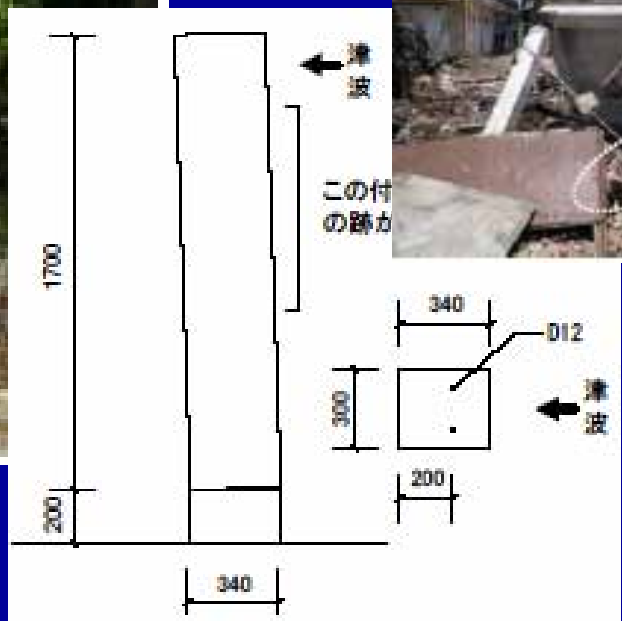
GPS Points, Type Of Building, No. of Stories, Alignment, Foundation, Damage, Remarks, Photo number

Tsunami Strength

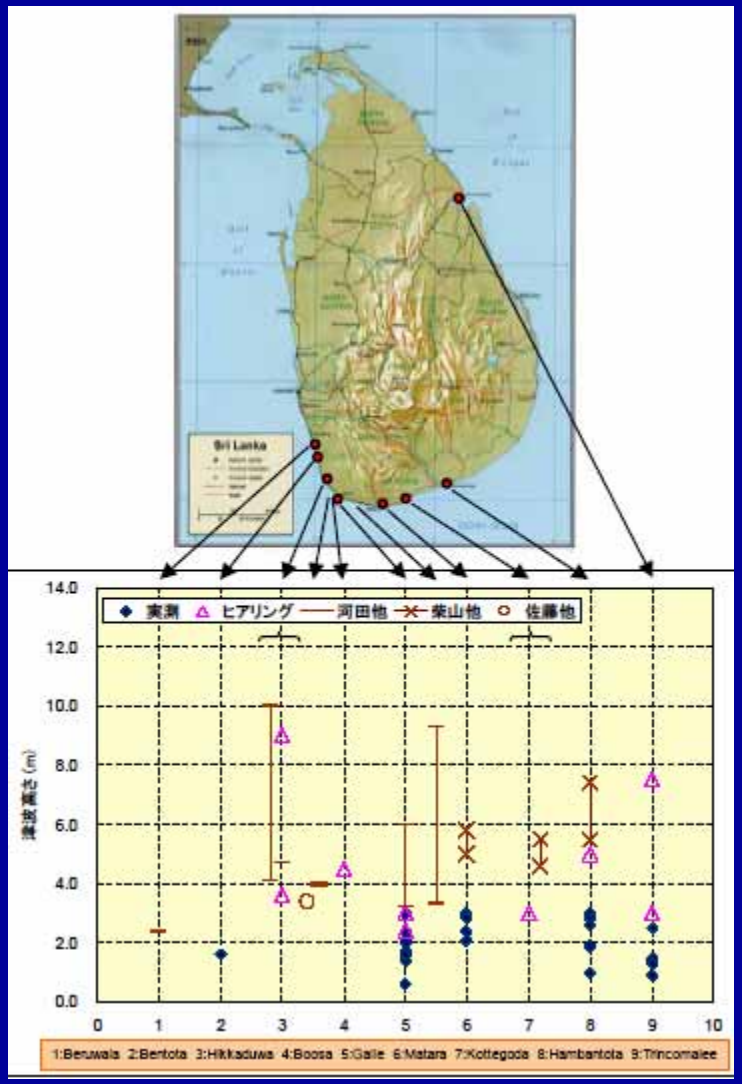
- Estimation of tsunami strength by analyzing building damage
- Selection of simple structures
- Analysis of large number of simples
- Find a simple way to estimate - by relating tsunami force to wave height

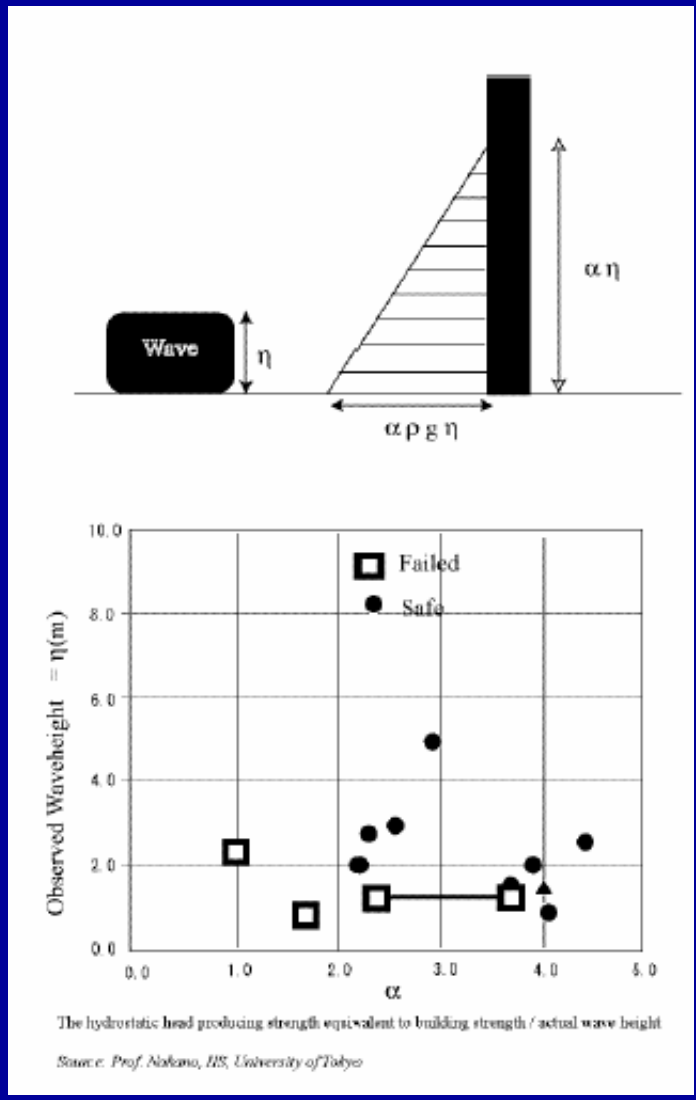
Samples of member failurs

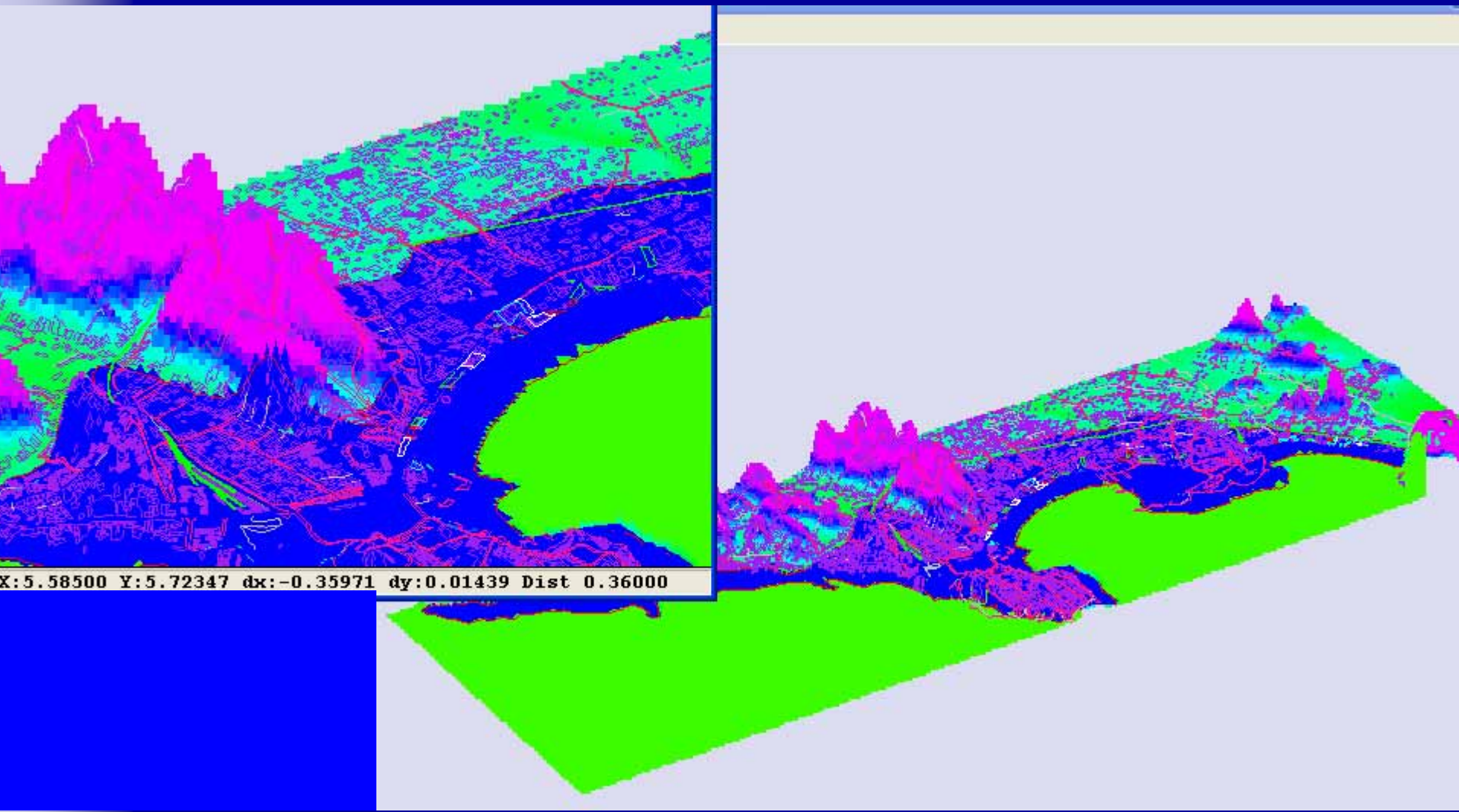
写真１：転倒した高架水槽②と衝突したバス



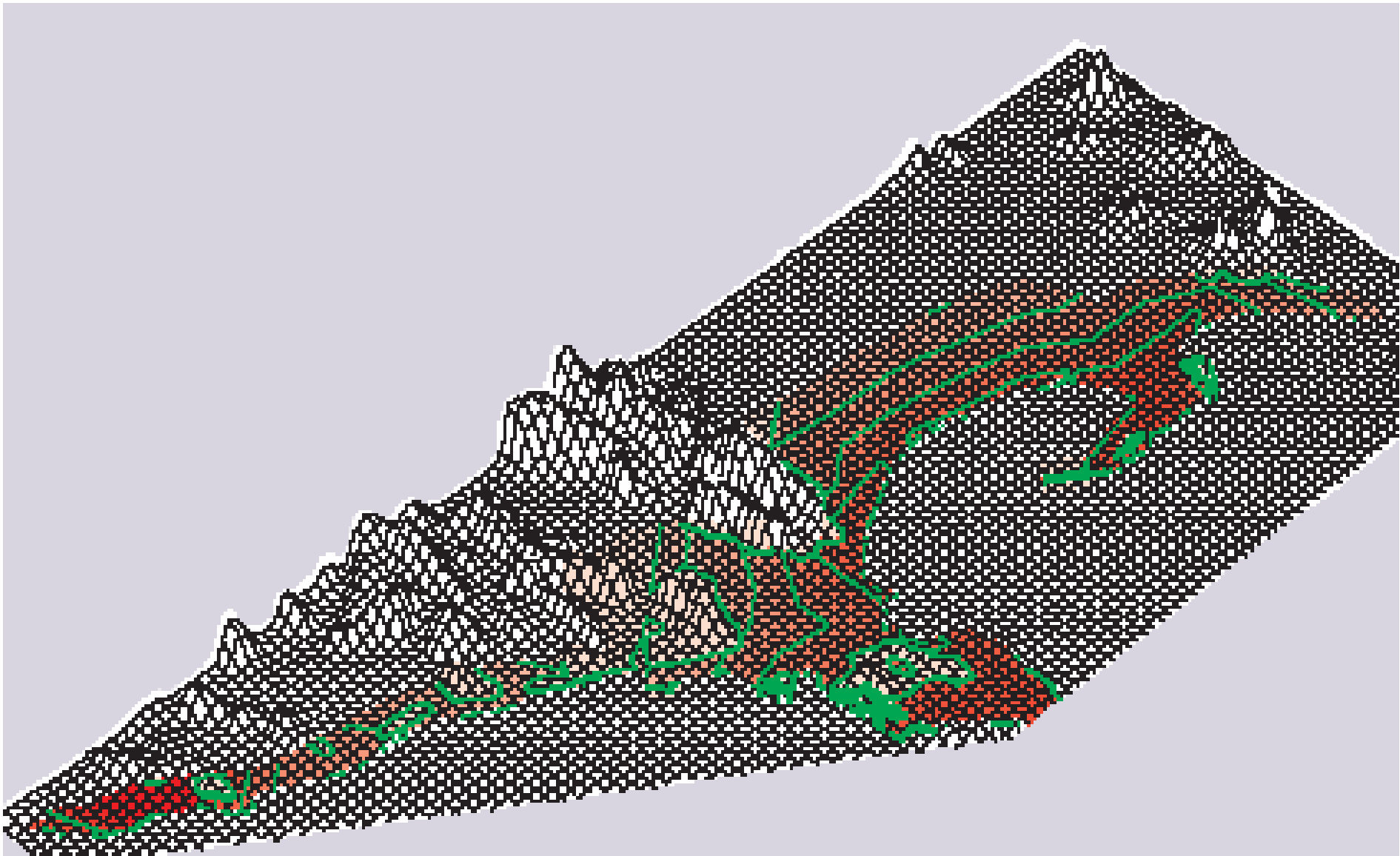
Summary results

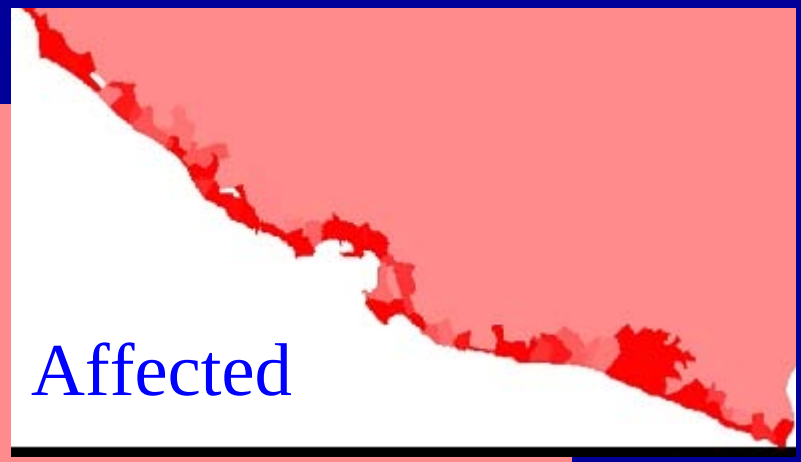





X:5.58500 Y:5.72347 dx:-0.35971 dy:0.01439 Dist 0.36000

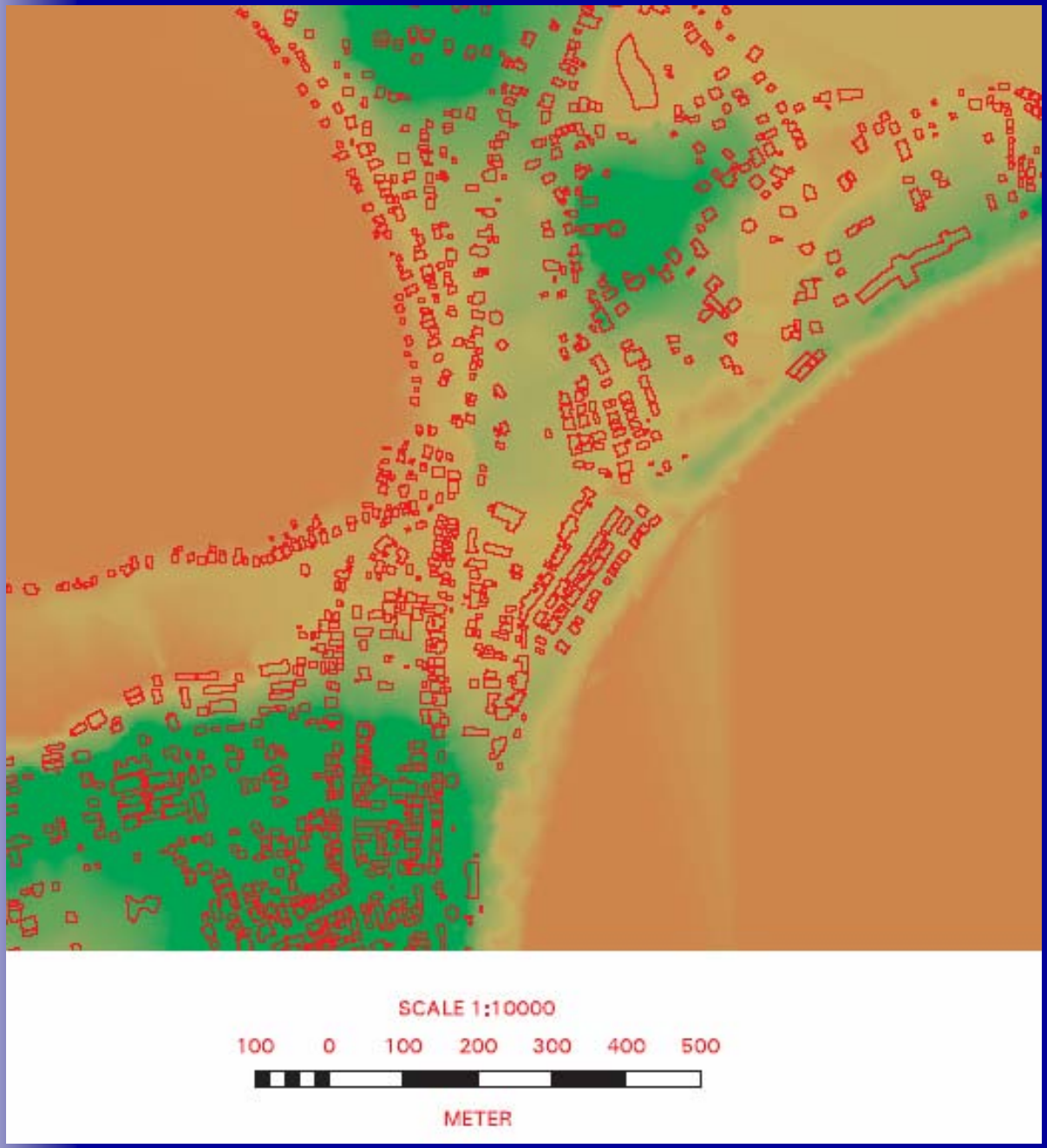
The maximum force (structures taller than the wave)




Affected

Buildings Damaged

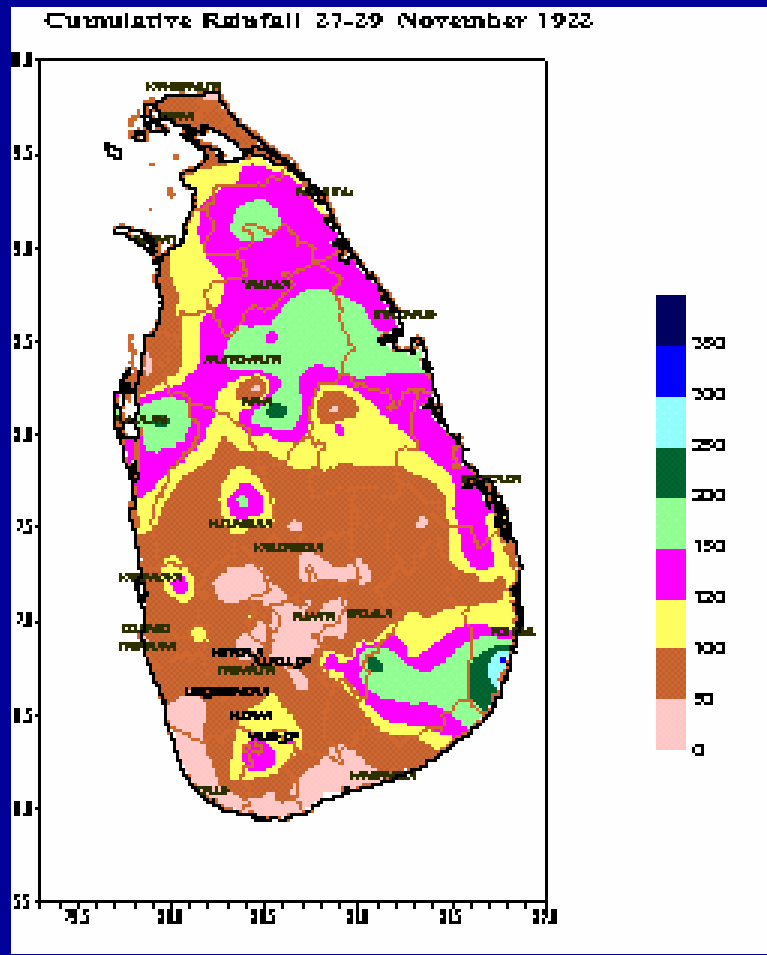
Hambantota



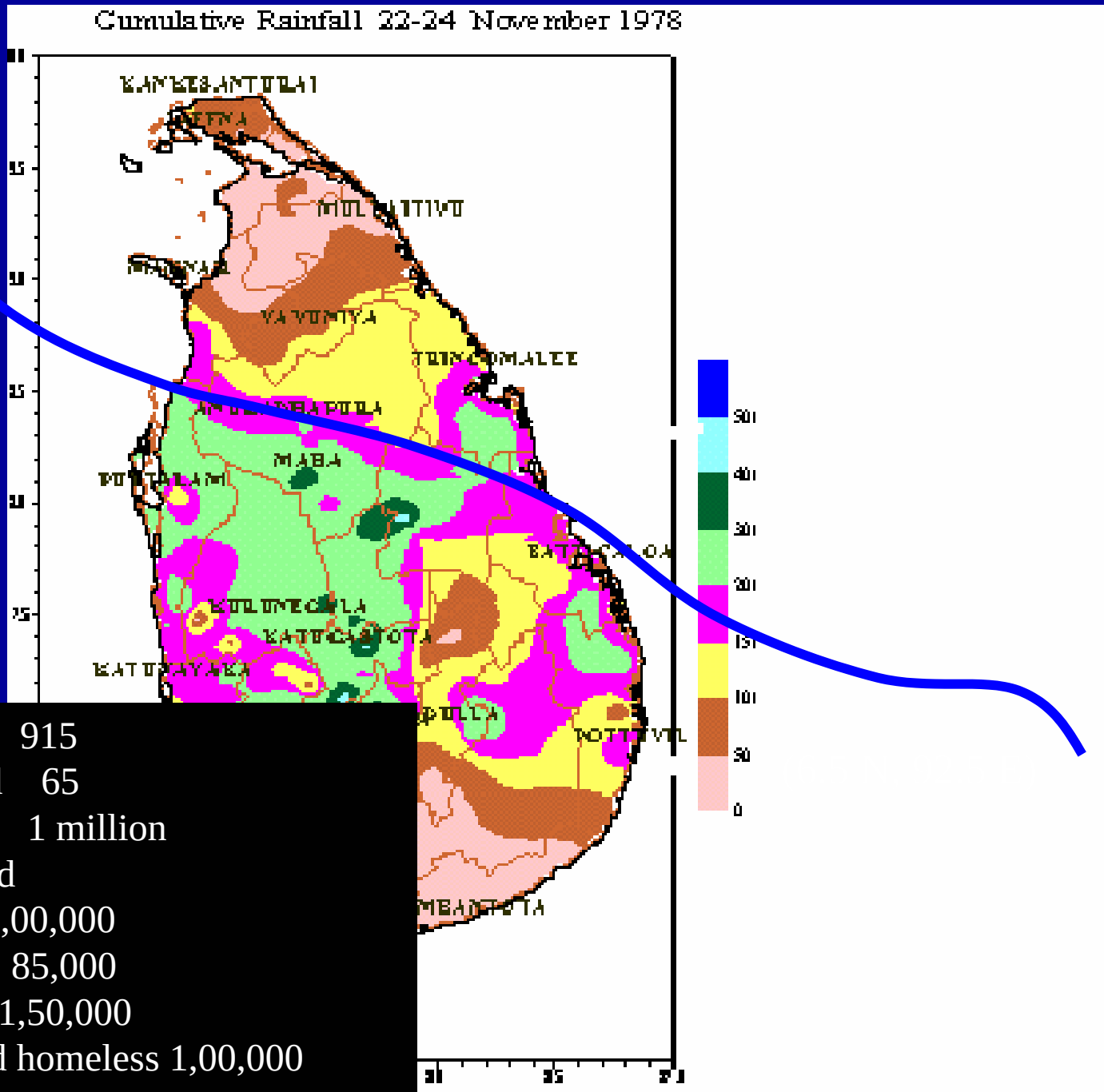
Dense building layout before the Tsunami

Multi-Hazard Approach

- It is important to take a holistic approach to hazard reduction by considering not only the Tsunami, but other hazards which are more frequent and as damaging
- A multi-hazard map for the area comprising of
  - Tsunami
  - Floods
  - Extreme rains
  - Storm surges



November 1922, Cyclonic Storm, Met Dept.

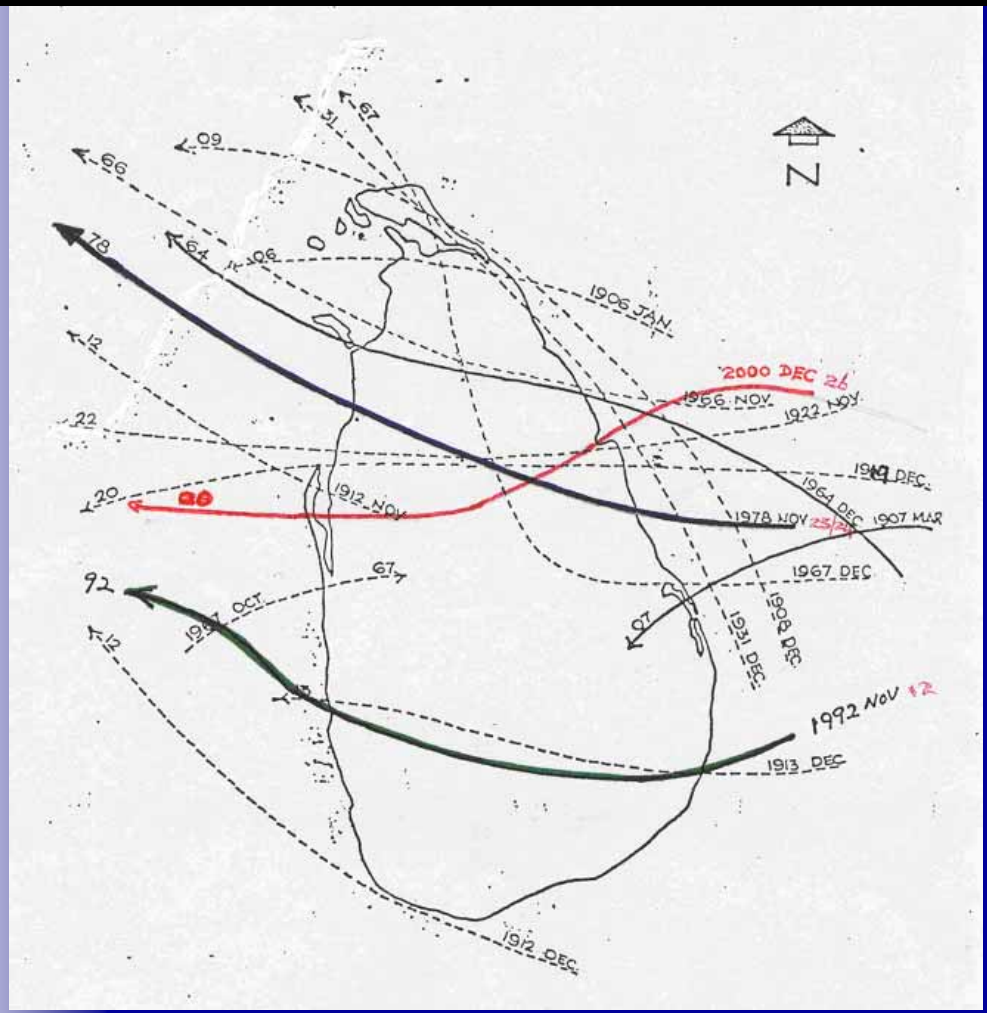


People killed 915
People disabled 65
People affected 1 million
House Damaged
1.extremely 1,00,000
2.Seriously 85,000
3.Slightly 1,50,000
people rendered homeless 1,00,000

Floods and other potential threats

- Southern region as well as Trincomalee in the north-east face frequent flooding
- The flood extent maps are being prepared and need to be incorporated in the multi-hazard map
- Other risks, sea-level rise, storm surges, etc., need to be incorporated
- A several sets of risk maps, high frequency to low frequency need to be developed.

- 27% of the Cyclones have crossed Eastern coast of Sri Lanka during November
- 60% of the Cyclones have crossed Eastern coast of Sri Lanka during December
- Tsunami Warning ←→ Cyclone Warning



Cyclone Tracks – last 100 years

2004 Tsunami victims

Poverty

- The coastal areas are poor even before the Tsunami
- 80% families spent less than 100 US$/month (less than US$ 1/day per family of 5)
- 35% spent less than 50 US$/month → below the poverty line
- 30% of population spent 75% of income on food

Reconstruction Challenges

Conventional

- **Rebuild Quickly**
- **Do not rebuild the disaster**
- **Build for the future**

Current Sri Lankan

- **Poverty reduction (build for the future)**
- **Rebuild quickly**
- **Do not rebuild the same disaster**

An Integrated Approach

- **Multi-purpose infrastructure**
  - Community centers for evacuation and social development
  - Roads for evacuation and economic development
- **Multi hazard perspective**
  - Evacuation for Tsunami
  - Drainage for floods and extreme rains
  - Building design for Cyclones and Tsunami

Conclusions

- Experience
- In the aftermath of unprecedented disaster
  - Excellent response by civil society and the government
  - Quick relief, absence of epidemics, lootings, etc.
- Slow response in reconstruction
  - Political divisions
  - Lack of appropriate Institutions
  - Centralized approach

Conclusions

- Needs
- Development of a strong institutional framework for disaster management
  - Multi-disciplinary approach
  - Move away from relief
  - Use of science and technology with social development and poverty reduction as a goal

Thank you