

Tsunami Hazard Maps for Bali

Technical Documentation of a Multi-Scenario Approach

THE INITIATIVE

Bali is 'paradise' for many of the thousands of tourists who come to visit the island every year. During recent decades Bali's economy has become highly dependent on the tourism industry. Many of Bali's major developments, especially those related to tourism, are located directly on the shorelines facing the Indian Ocean. Below the same ocean, a couple of hundred kilometres south of Bali, lies one of the Earth's major tectonic collision zones, which is a major source of tsunamigenic earthquakes. Thus, geologists and tsunami scientists consider Bali a high risk tsunami area, because a large tsunami within range of the island would have a severe impact on its densely populated coastlines.

Development of preparedness strategies requires a good understanding of the hazard. An official tsunami hazard map is needed as the basic reference and most important planning tool for developing evacuation strategies and setting up tsunami early warning in Bali.

TSUNAMI SOURCES

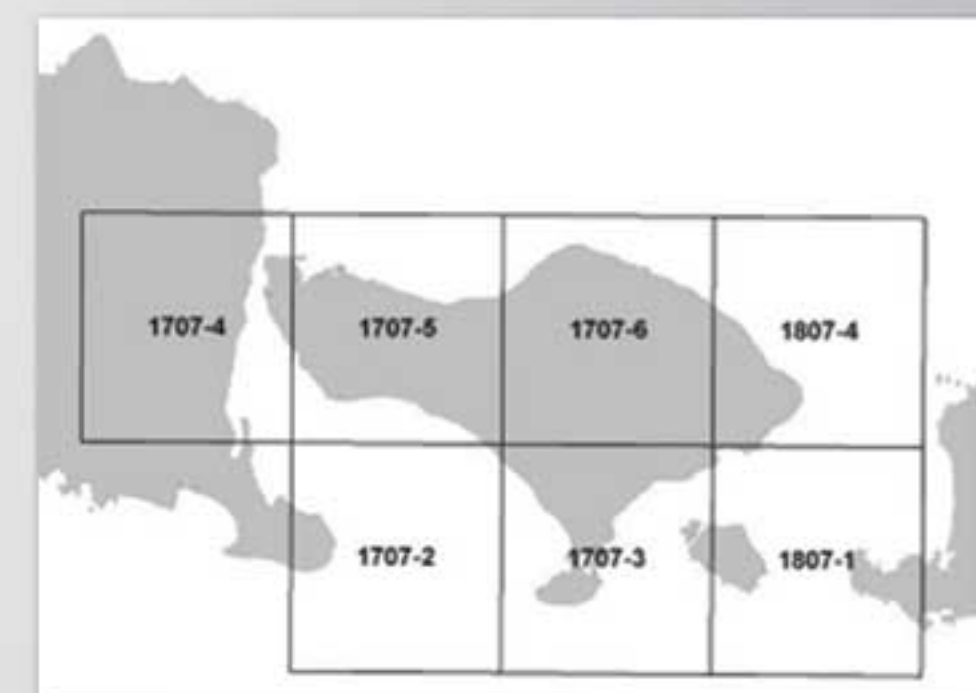
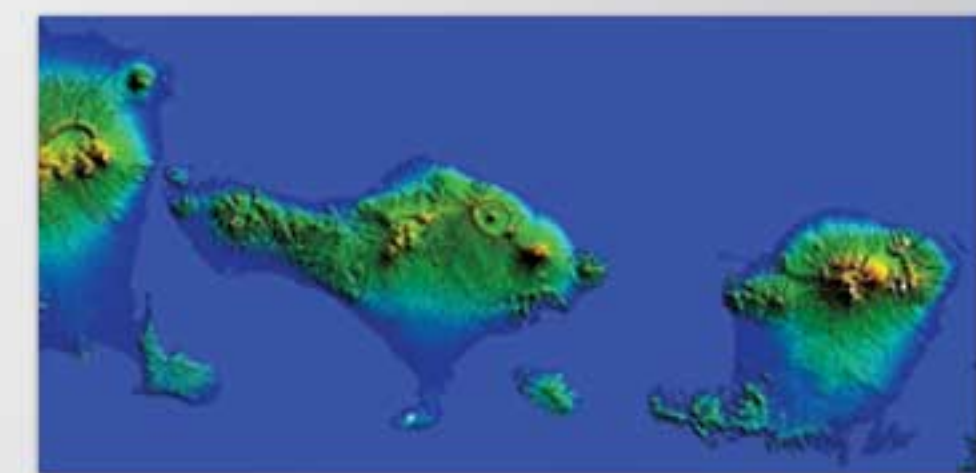
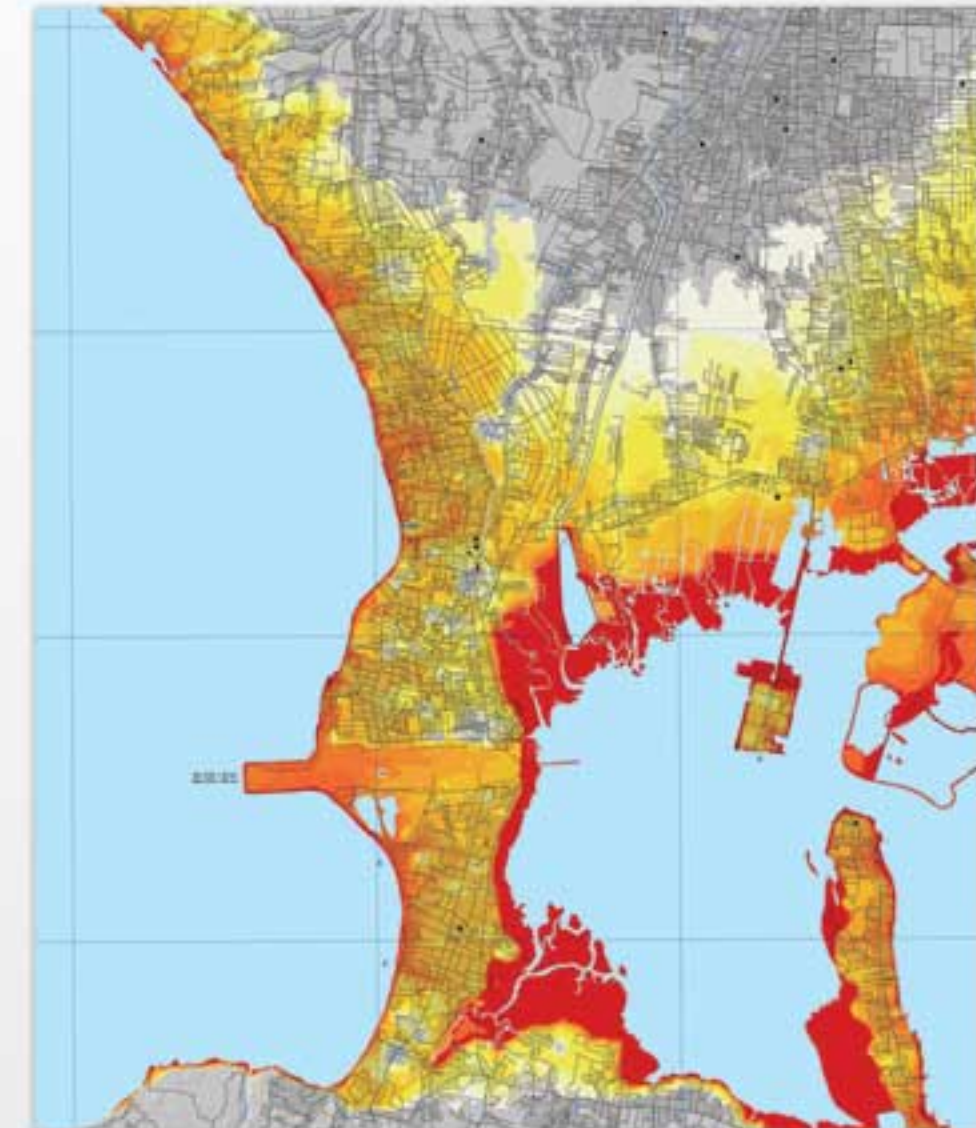
The analysis of the geo-tectonic situation of Bali leads to the identification of four possible tsunami sources around Bali: (1) Sunda Trench, (2) Back Arc, (3) Submarine landslides, and (4) Volcanic activities. Recent historical tsunami records in Bali are related to Sumba (1977) and Banyuwangi (1994) events.

Regarding the question what scenarios are expected for southern Bali, it was concluded that a vast variety of scenarios are possible from all four sources for tsunamis. Currently all research is focusing on the Sunda Trench and possible impact on southern Bali. No solid data was available for the other three sources – therefore for the moment no conclusions could be given. Current knowledge does not allow identification of one specific scenario as the most credible.

THE MULTI SCENARIO APPROACH

Due to the fact that current scientific knowledge, as well as historical experiences, are not considered sufficient to identify a most probable scenario for Bali, researchers recommended the development of a multi-scenario approach.

A multi-scenario approach combines the impacts of a large number of calculated tsunami scenarios (generated by numeric modelling) on one map. It was agreed that the German Aerospace Centre (DLR) integrate the scenarios developed by GITEWS and the scenarios from the Indonesian partner institutions into a Multi-Scenario Tsunami Hazard Map for Southern Bali. The database for this approach consists of the results of tsunami modelling performed by Alfred Wegener Institute (AWI) at epicentre locations for tsunami scenarios provided by the German Research Centre for Geosciences (GFZ).



Map Above Shows Available Multi Scenario Tsunami Hazard Maps for Bali (1:100.000)

In July 2009, a set of large scale tsunami hazard maps (1:100,000) for the entire Indian Ocean coastline of Bali were handed over.

DETAILED MAP FOR SOUTHERN BALI

For the area around Badung District in southern Bali, a more detailed Tsunami Hazard Map of a scale of 1:25,000 was developed. The main difference in comparison with the large scale maps is the application of improved bathymetry and topography data as well as a spatial resolution between several hundreds of meters to ten meters for modelling. Modelling was performed by GITEWS partners GKSS and DHI-Wasy using MIKE21 FM.

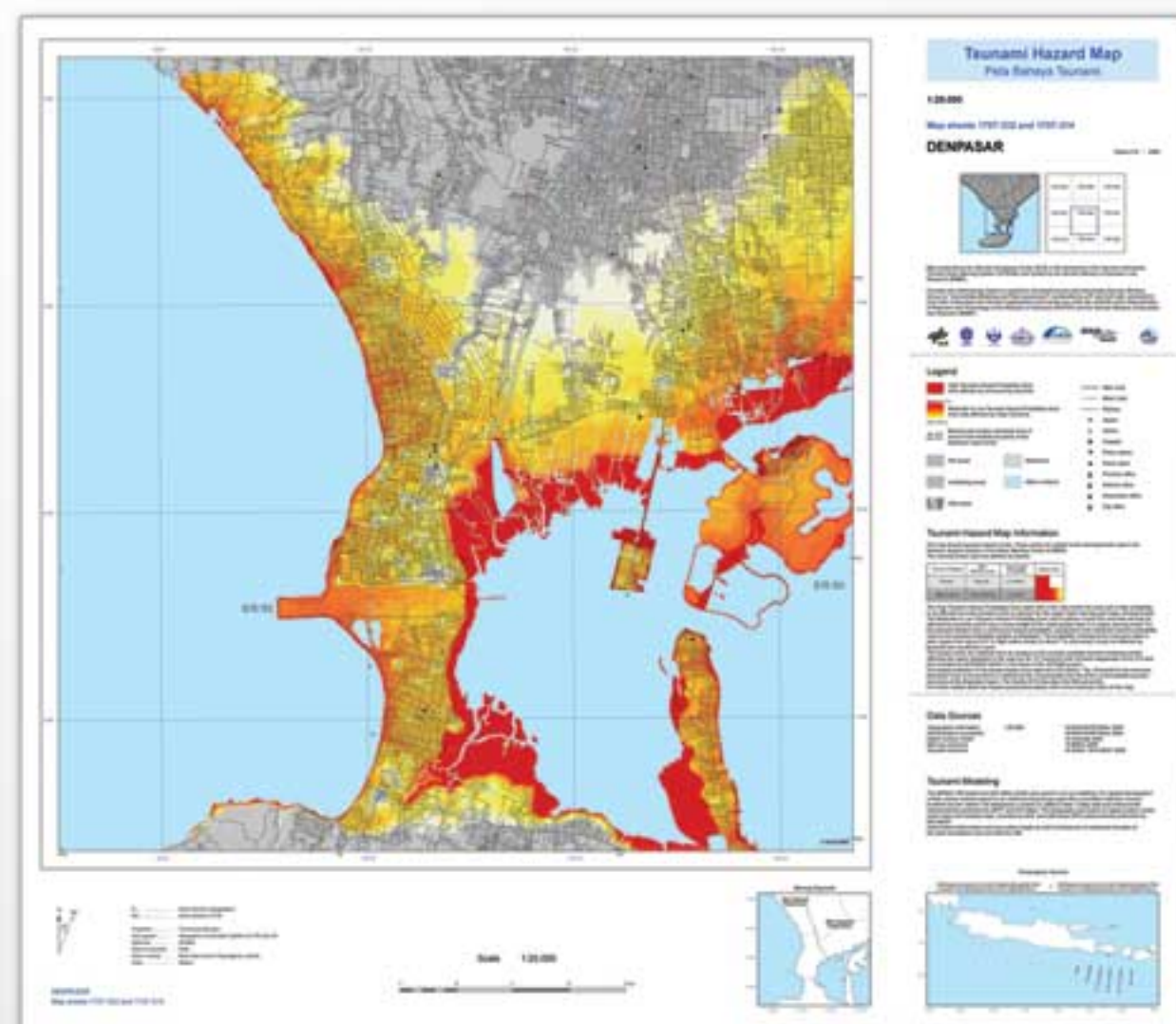
TECHNICAL DOCUMENTATION

In order to provide decision-makers in Bali and other stakeholder with background information regarding the tsunami hazard mapping process, the underlying technical concepts and the final products a Technical Document was drafted by DLR and the German Technical Cooperation (GTZ IS).

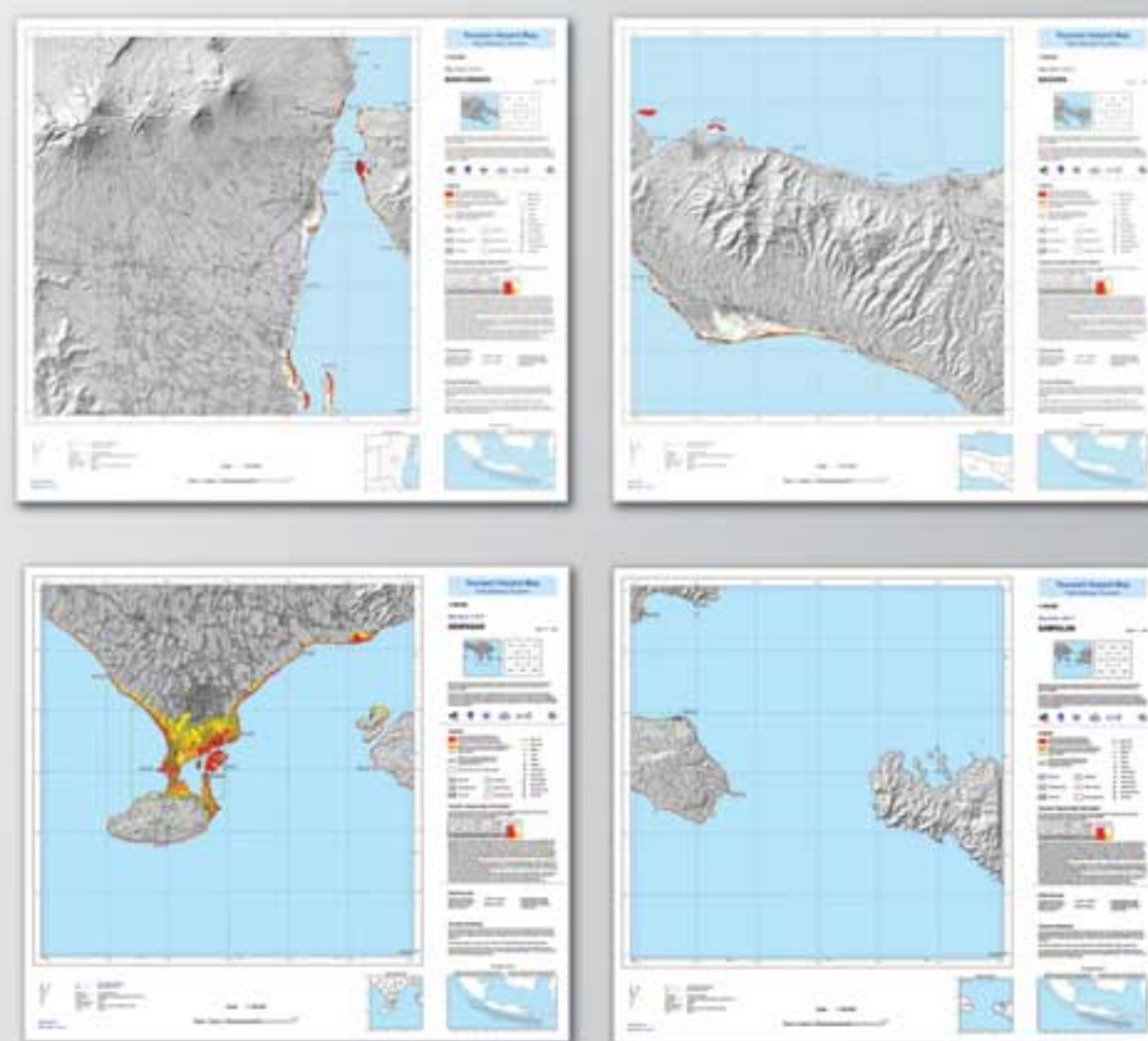
The document was revised by the Balinese Working Group for Tsunami Hazard Mapping in March 2009. The document was updated to incorporate results from detailed inundation simulations in July 2009.

ACKNOWLEDGEMENTS

The Tsunami Hazard Maps for Bali are the product of a multi-institutional effort including the Balinese government institutions (BAPPEDA, KESBANGLINMAS, PU, TNI) and other Balinese stakeholder (IDEP, PMI, SAR, SEACORM), Indonesian science institutions (BAKOSURTANAL, BPPT, BMKG, CGS, CVGHM, DKP, LAPAN, LIPI) and partners from the GITEWS Project (AWI, DHI-Wasy, DLR, GFZ, GKSS, GTZ). The institutions involved agreed on the mapping approach and methodology. The maps were produced by DLR.



Tsunami Hazard Maps for Southern Bali (1:25.000)



Tsunami Hazard Maps for Bali (1:100.000)



Technical Document: Tsunami Hazard Maps for Bali with zoning based on wave height at coast (in line with the InaTEWS warning levels) as well as probability of areas being affected by a tsunami - DLR / GTZ IS, August 2009

Author:

Harald Spahn
harald.spahn@gtz.de

Published by:

Deutsche
Gesellschaft für
Technische
Zusammenarbeit
(GTZ) GmbH

Maps:

© DLR

GTZ Office Jakarta
Menara BCA 46th Floor
Jl. M.H. Thamrin No.1
Jakarta 10310
T: +62-21-2358 7111
F: +62-21-2358 7110
E: gtz-indonesien@gtz.de
I: www.gtz.de/indonesia

Further information:

KESBANGLINMAS Province Bali: +62-361-245395
DLR: www.dlr.de
GITEWS: www.gitews.org

The **Technical Document** and the **Hazard Maps** are available as digital copies in the TSUNAMI-KIT or as downloads at:
www.gitews.org/tsunami-kit