



FZK

DFG-Round Table
"Near- and Onshore Tsunami Effects"
April 23 - 24. 2007 Hannover, Germany

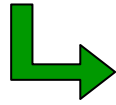
LWI

Research Needs Towards Risk Mitigation by Tsunami Defence

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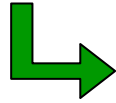
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i. Non-preparedness for extreme threats and large-scale impacts



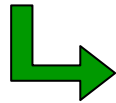
Prediction of extreme Tsunamis and their impacts
(Paleo-tsunami and risk analysis)

ii. Insufficient knowledge of “before-state” of impacted coastal areas:



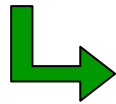
Continuous up dating of state of coastal areas (IKZM)
(Validation of models)

iii. High-spatial variability nearshore



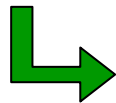
Improvement/Development of near reliable tsunami propagation models
(More account of 3D- and complex topography)

iv. High spatial variability onshore



Improvement of run up modelling
(also important for coastal hazard and risk mapping)

v. Insufficient knowledge/modelling for impact assessment



Development of new models for the interaction of tsunami with

- near- and onshore structures, incl. tsunami loading
- sea bed, beach and dunes
- forest and further vegetation
- floating debris

1. Flooding (Up Rush Flow)

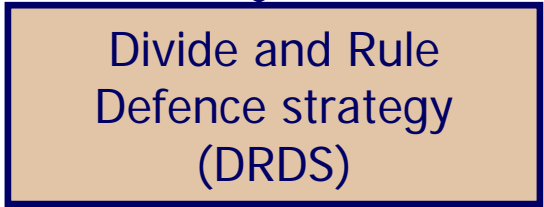
- ↳ (a) Improvement of operational depth-averaged models (2D- NSW and BOUSSINESQ)
- ↳ (b) Optimisation of 2D- and 3D flow models (RANSE)
- ↳ (c) Coupling of depth-averaged models (farfield) and RANSE models (nearfield) for tsunami structure interaction
- ↳ (d) Transport potential

2. Back Wash Flow

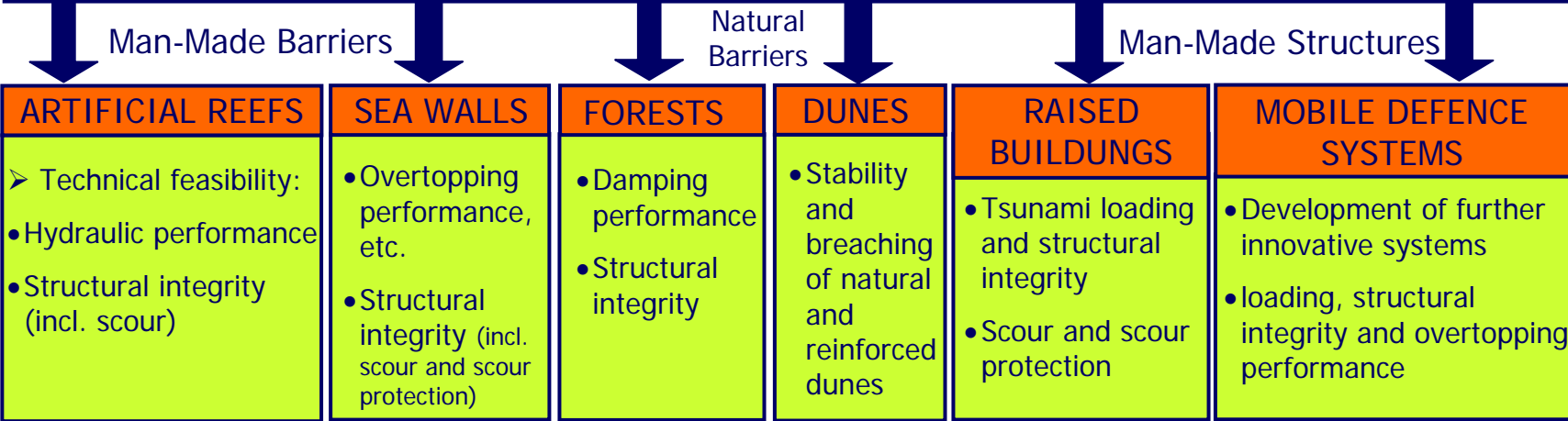
- ↳ (a) Flow modelling for complex shore topographies and morphologies
- ↳ (b) Innovative counter-measures to reduce the impact of drag flow

3. Erosion, Transport and Deposition of Sediments and Floating Debris

- ↳ (a) Modelling of transport potentials of tsunami up rush and down rush flow
- ↳ (b) Modelling of local scour around man-made structures and natural obstacles
- ↳ (c) Modelling of floating debris, incl. impact loading

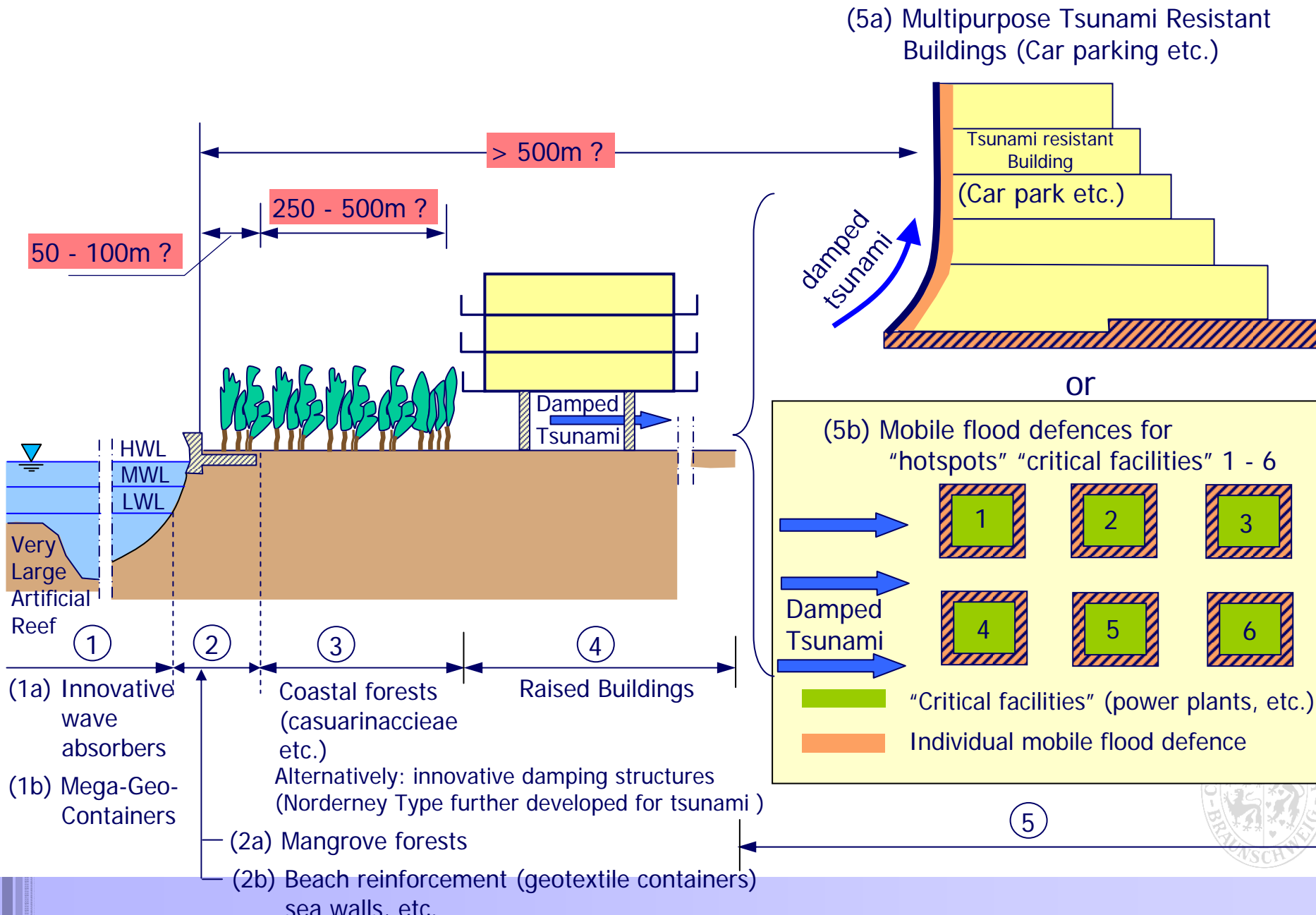


Multiple Defence Lines, with the types, number and size of barriers to be adapted to local conditions and vulnerability of flood prone area

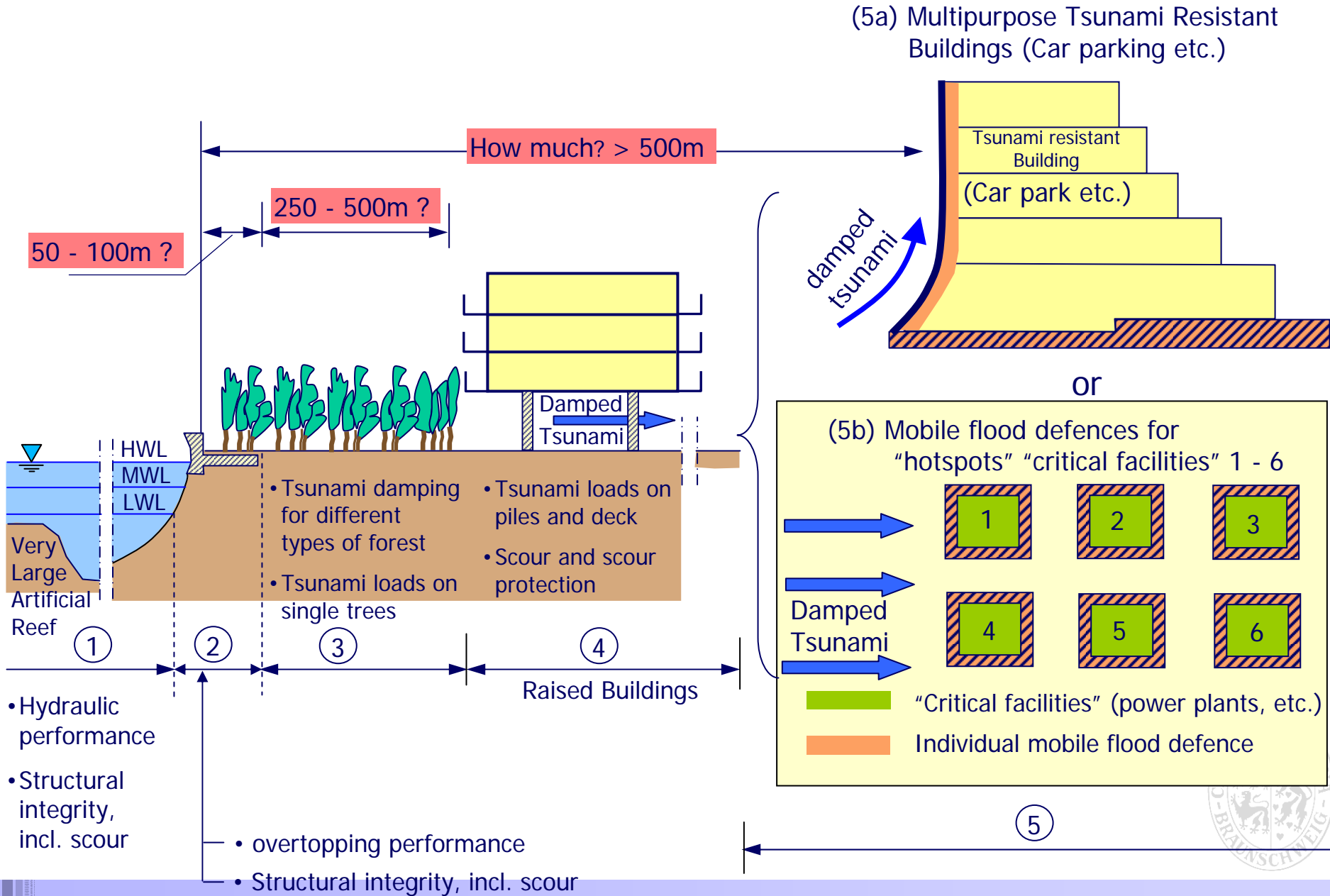


Tsunami →
Guidelines for functional and structural Design

Multiple Defence Lines Strategy for Densely Urbanized Areas (schematic)



Research Needs to implement the multiple defence line system for the full range of Tsunami periods (T=5-60min).



1. Modelling of Near- and Onshore Tsunami Propagation

- 1.1** Development/Improvement of a set of selected simple analytical/numerical models for tsunami propagation, transformation wave breaking, wave boundary layer, run-up and run-down.
- 1.2** Development of a hybrid community model for tsunami propagation, including a phase-resolving model for the farfield and a more detailed flow model for the nearfield. The modules should be easily substituted/upgraded any time new knowledge/information becomes available.
- 1.3** Performance of experiments for validation, including development/improvement of techniques for tsunami generation in the laboratory.
- 1.4** Collection and analysis of field measurement for model validation.

2. Erosion, Transport and Deposition of Sediments

- 2.1 Sediment transport modelling under tsunami (sheet-flow), including conceptual, analytical and numerical models as well as fundamental experimental investigation (offshore, inshore and onshore)
- 2.2 Morphodynamic modelling in the case of tsunami-sediment-structure interaction and resulting morphological changes, including local scour as well as large-scale erosion transport and deposition.
- 2.3 Hydrodynamic information from onshore and offshore deposits, including both sediment and boulders. These will also include both physical and numerical modelling, using field data in order to extract all hydraulic information required to hindcast historic and pre-historic tsunamis. In view of the very scarce historic data on extreme tsunami, this is very important to make use of prehistoric information to obtain the extreme statistical distribution needed for any design and decision to mitigate tsunami risk.
- 2.4 Hydraulic stability of scour protection, including a set of appropriate structural alternatives (rubble material, geotextile sand containers, etc.).

3. Hydraulic Performance and Tsunami Loading of Man-made Structures and Natural Barriers

- 3.1** Development of criteria for the selection of a set of appropriate types of man-made structures and natural barriers for each defence line and preliminary verification of the hydraulic performance (reflection, transmission, energy dissipation and waver overtopping).
- 3.2** Development of models for natural and artificial reefs, including the performance of experiments for the validation of both hydraulic performance and loading.
- 3.3** Development of models for the hydraulic performance and loading of coastal forests (beach and mangrove forest), including experiments for validation.
- 3.4** Development of models for the stability of natural and reinforced sand dunes to tsunami, including overwash and breaching processes.
- 3.5** Development of models for the hydraulic performance and tsunami loading of soft tsunami attenuation structure, having a protective function similar to coastal forest.
- 3.6** Development of innovative solutions and materials for movable defence to protect critical facilities in the run-up zone, including the development of models to predict their hydraulic performance and tsunami loading.

4. Geotechnical Engineering Aspects of Tsunami Defences

- 4.1 Tsunami-induced shear stresses, pore pressure and total stresses in the sea bed, including soil failure (slip failure, fluidisation, etc.).
- 4.2 Effect of soil failure on the stability of man-made structure and natural barriers.
- 4.3 Innovative counter-measures and material to mitigate soil failure.

5. Debris Flow and Impact Loads Induced by Floating Debris

- 5.1 Development/validation of models for a set of different types of debris flow
- 5.2 Development of conceptual, analytical and numerical models for the prediction of impacts loads induced by floating debris on persons, structures, vegetation, and other barriers.
- 5.3 Innovative solutions to reduce the hazard associated with the impact of debris flow.

6. Integration, Implementation and Demonstration (Pilot sites)

- 6.1** Integration of all modelling tools to predict the tsunami attenuation performance of the entire defence system composed of different defence lines and types of barriers, including the prediction of the structural integrity of the constitutive defence components.
- 6.2** Implementation of the proposed multiple defence line strategy for three selected pilot sites (demonstration projects) for coastal areas with high, moderate and low vulnerability.
- 6.3** Elaboration of a consistent basic document, systematically including the required knowledge, and modelling tools developed in this project or/and available elsewhere, but also the types of data needed as input parameters to design a multiple defence line for any location and local conditions. This document is also intended to serve as a scientific/technical basis for the elaboration of a "Coastal Engineering Design Manual for Tsunami Protection" by a wider working group and within a wider integrated risk analysis and management framework.