

---

# ANNUAL MEETING 2011

## IAEA Cooperation – Karisma Benchmark Task: Soil Response Analysis

R.W. Romeo

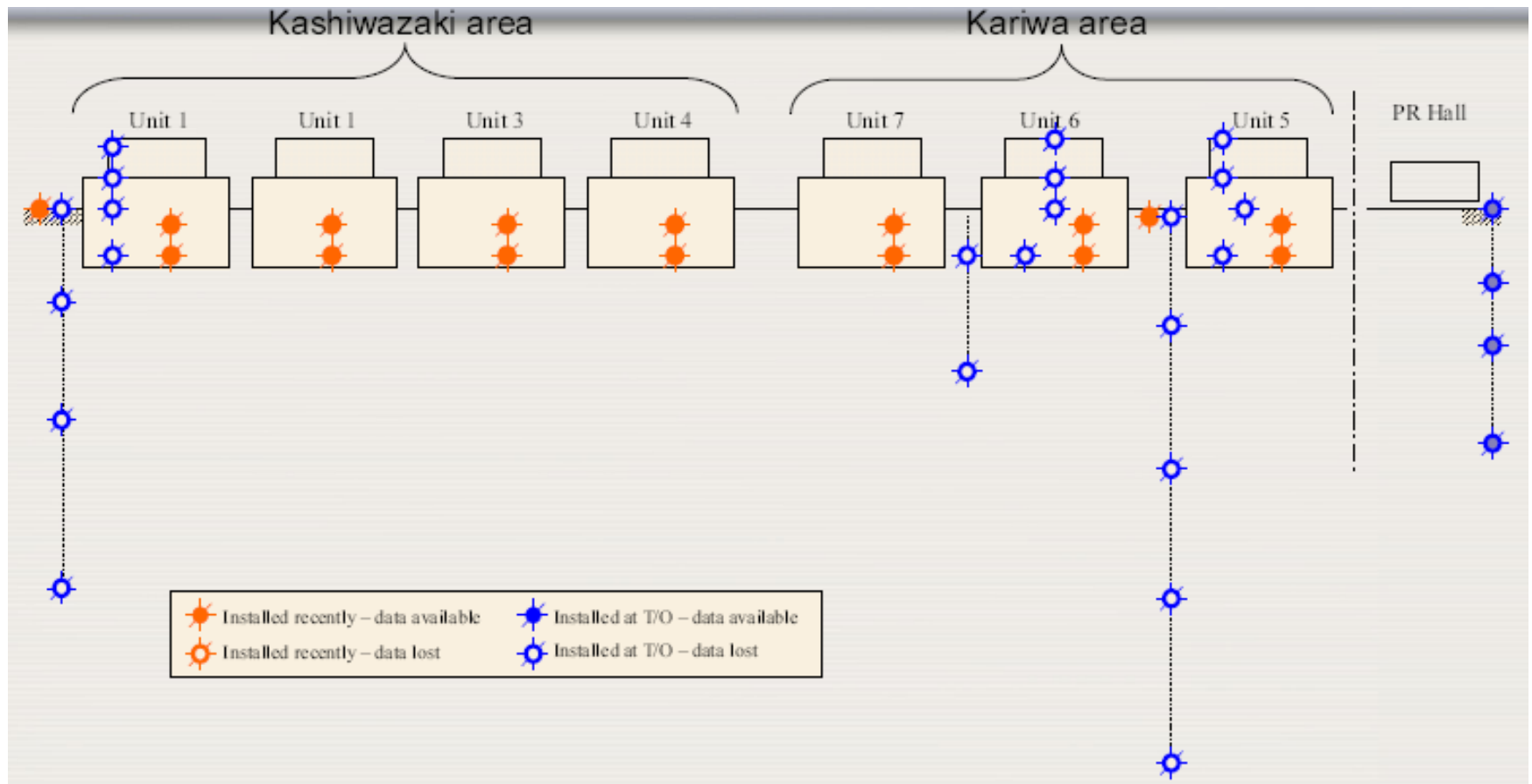
# Aim of the SRA in the Karisma project

---

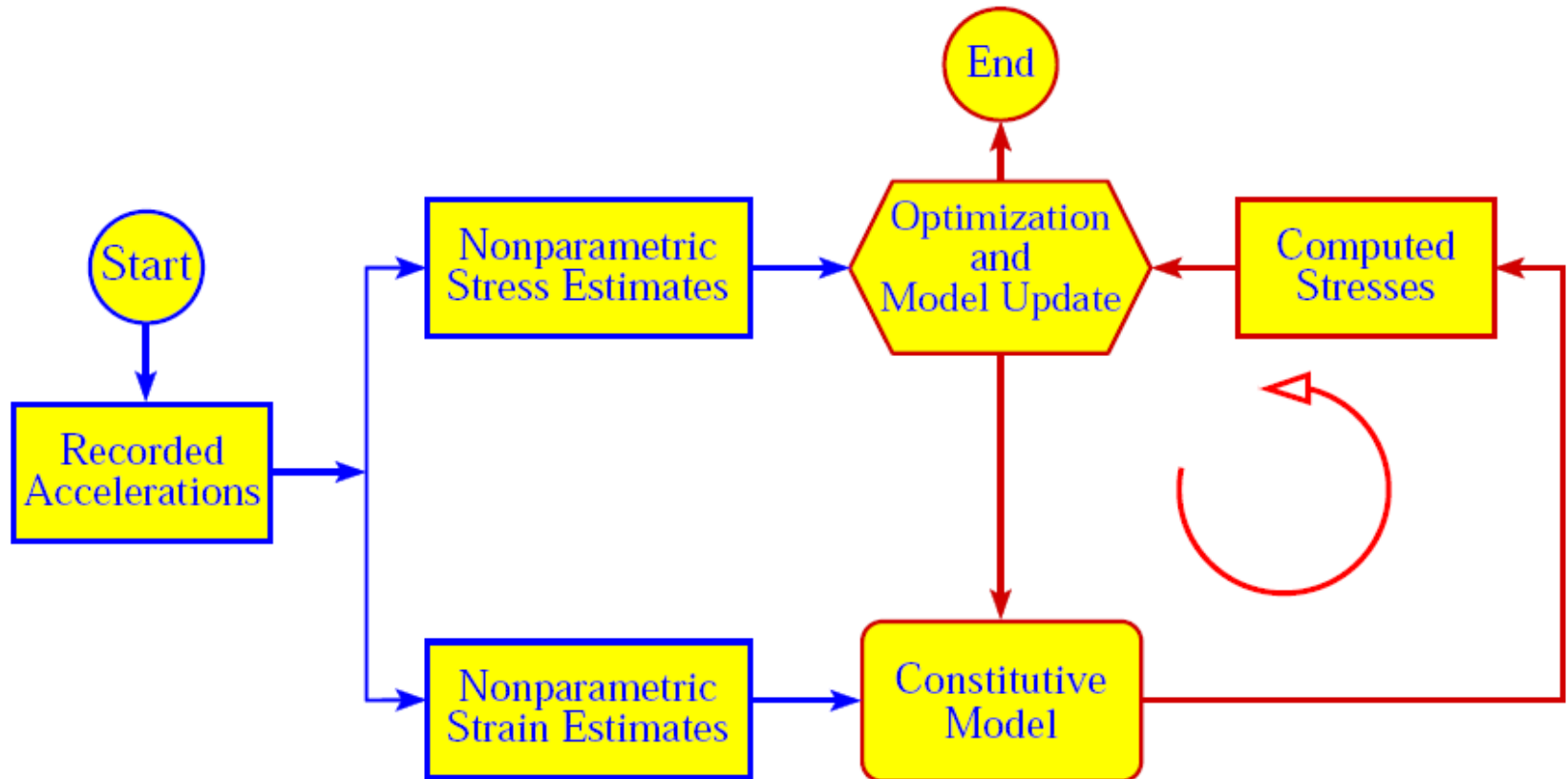


- Understanding what happened to the soil and structures during the July 2007 NCOE
- Understanding of margins: quantifying what will happen both in soil and in structure, when the input is increased
- Non linear effects in the soil and structures (SSI)
- Measurement of accelerations in the soil (boreholes) and in some in-structure points
- Comparison between observations and results of simulations

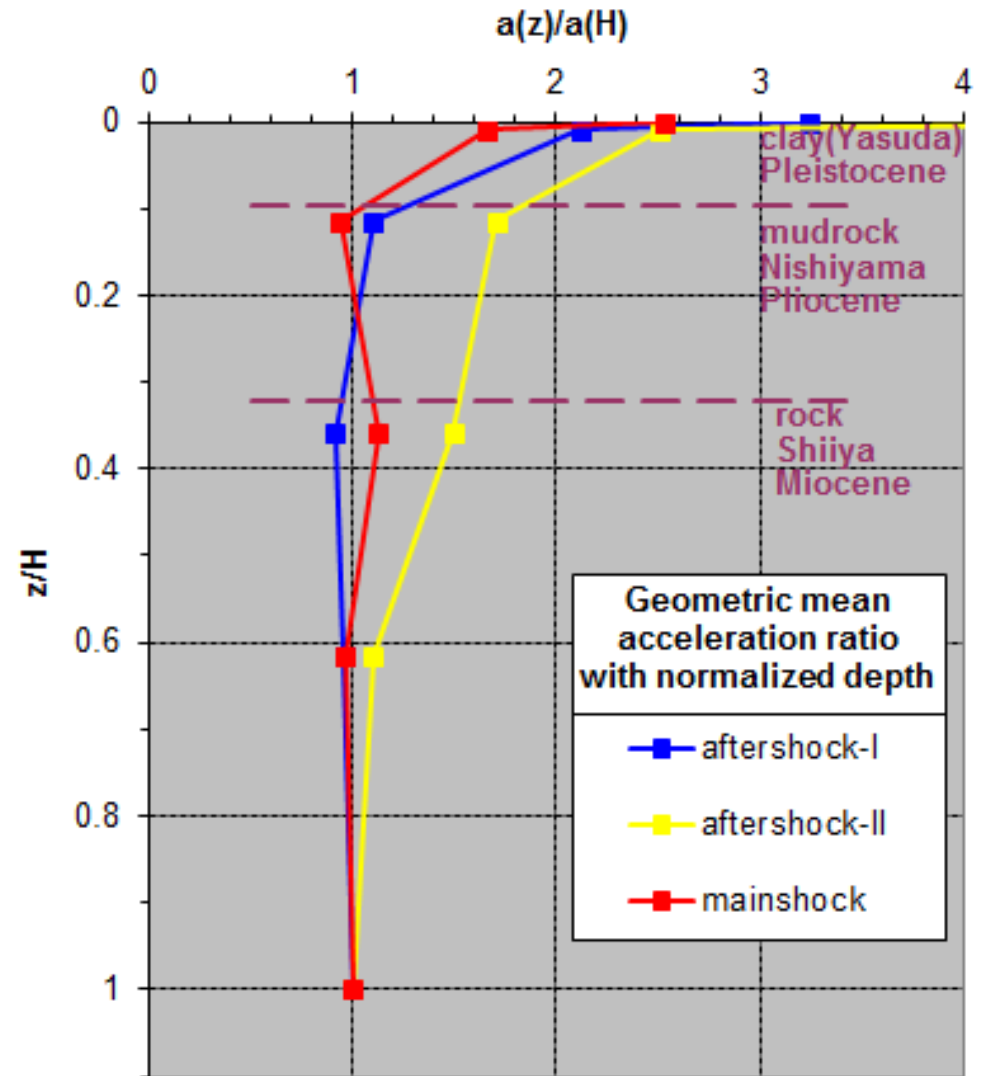
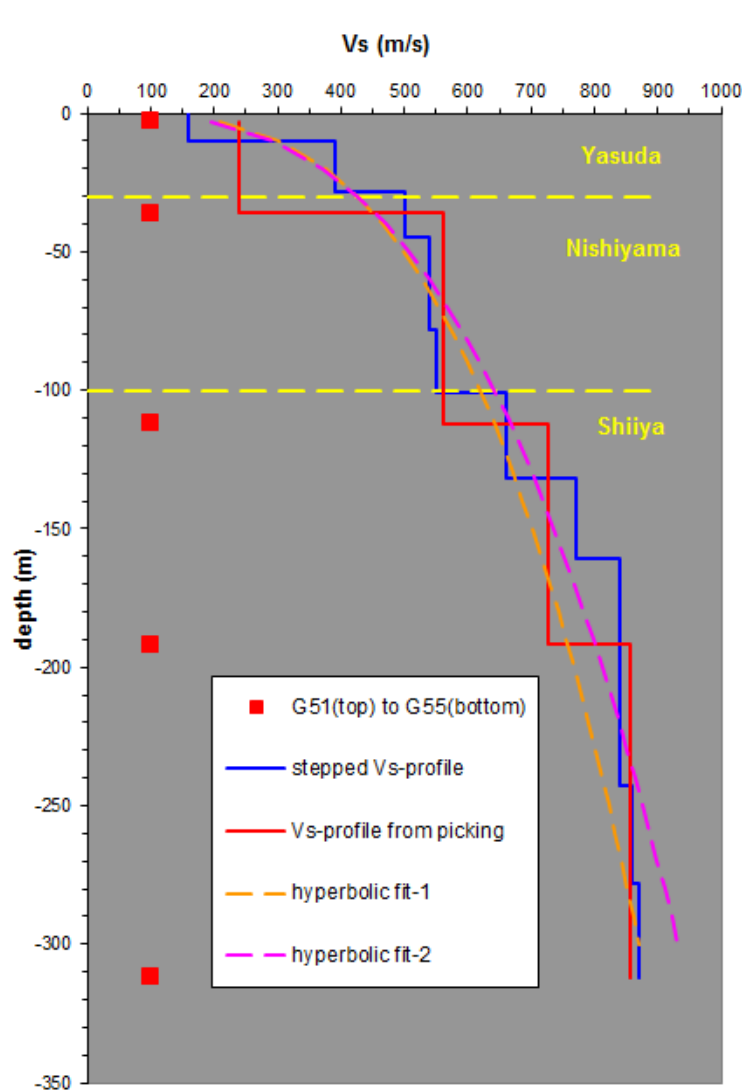
# Seismic observation points



# Flow-chart of the SRA modeling



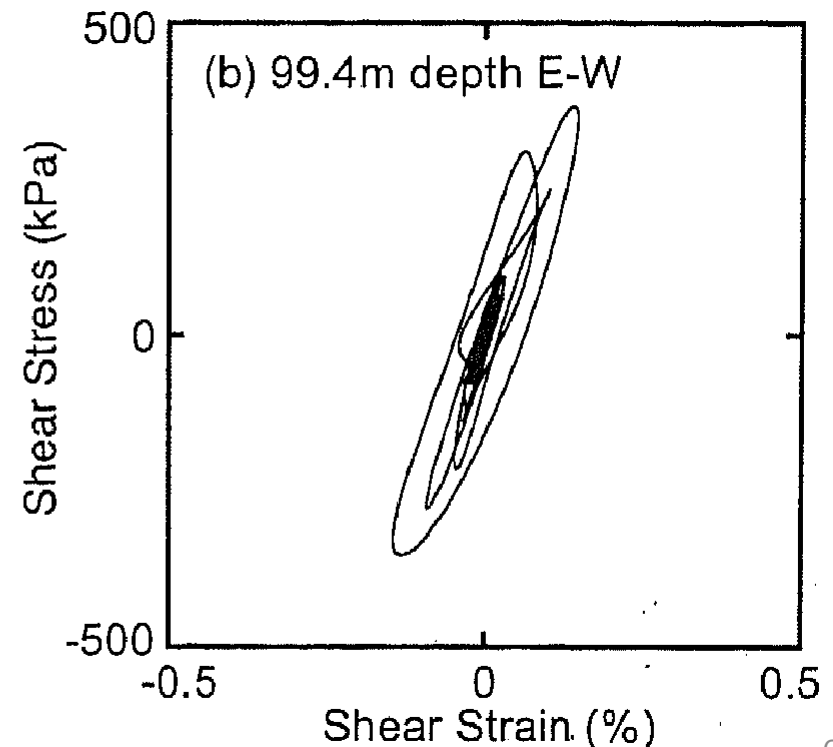
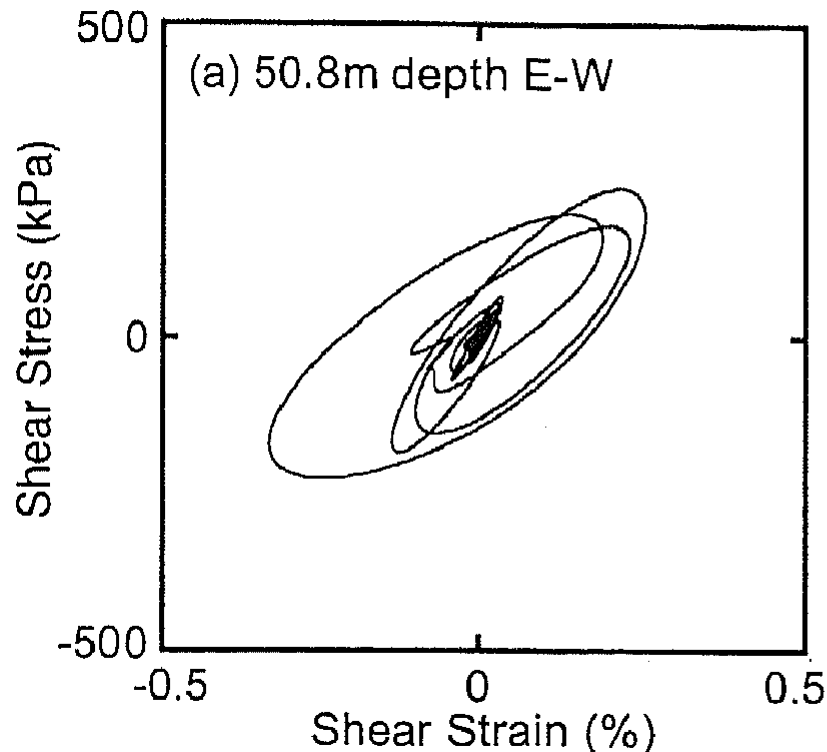
# Vertical arrays



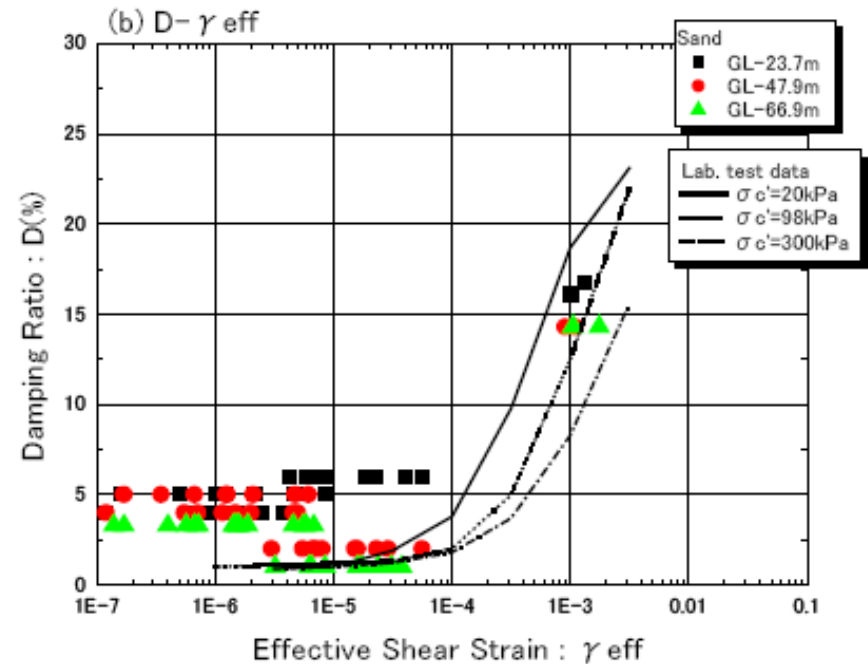
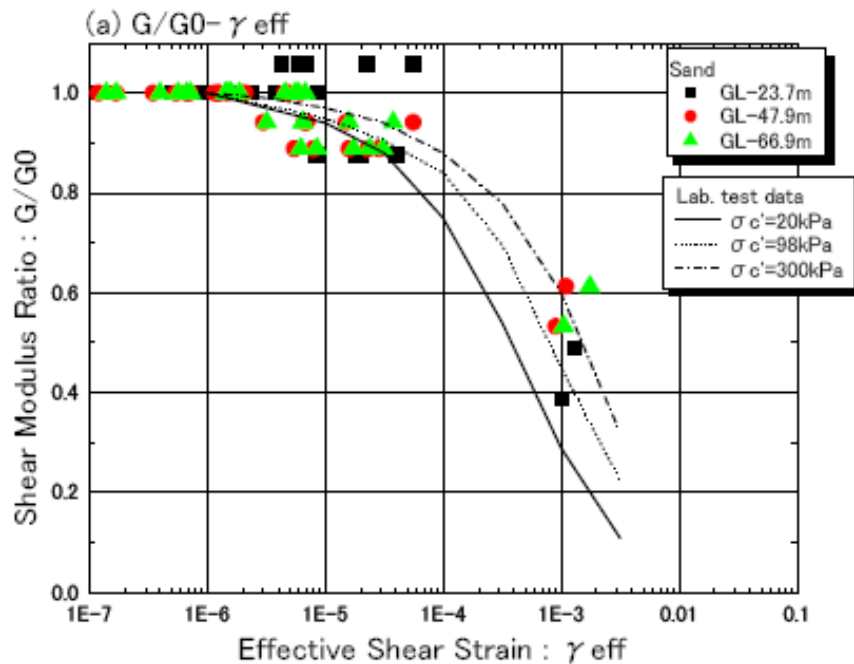
# Stress-strain at various depths

$$\tau_i(t) = \tau_{i-1}(t) + \rho_i \frac{\ddot{u}_{i-1} + \ddot{u}_i}{2} \Delta z_i, \quad \tau_o = 0, \quad i = 1, 2, 3, \dots$$

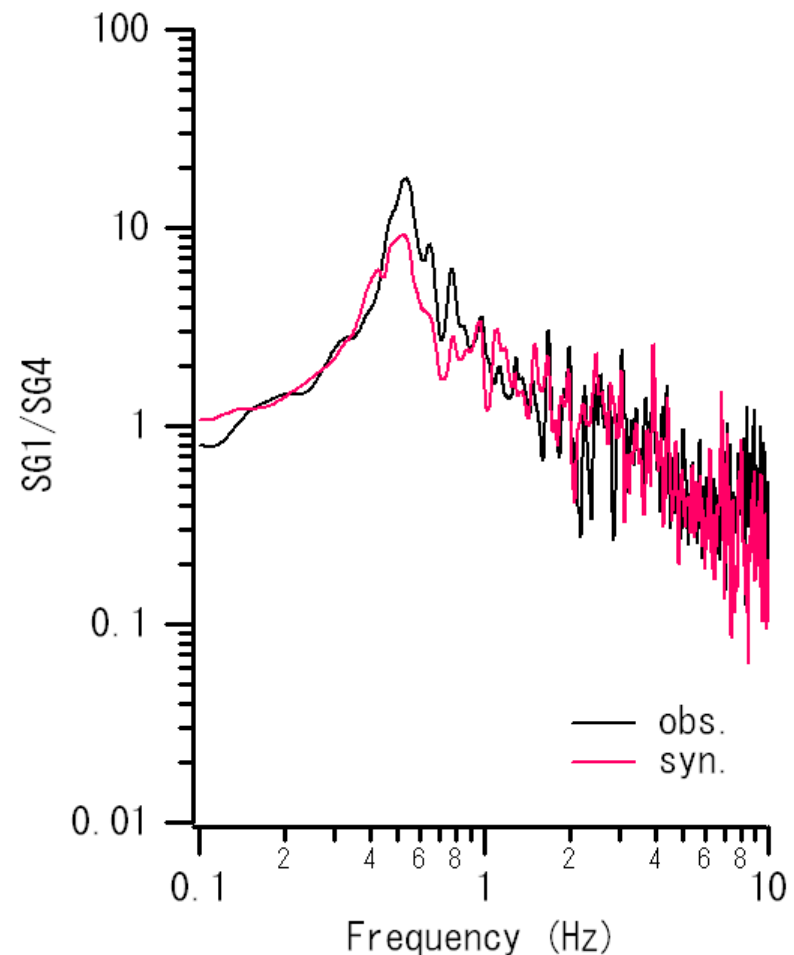
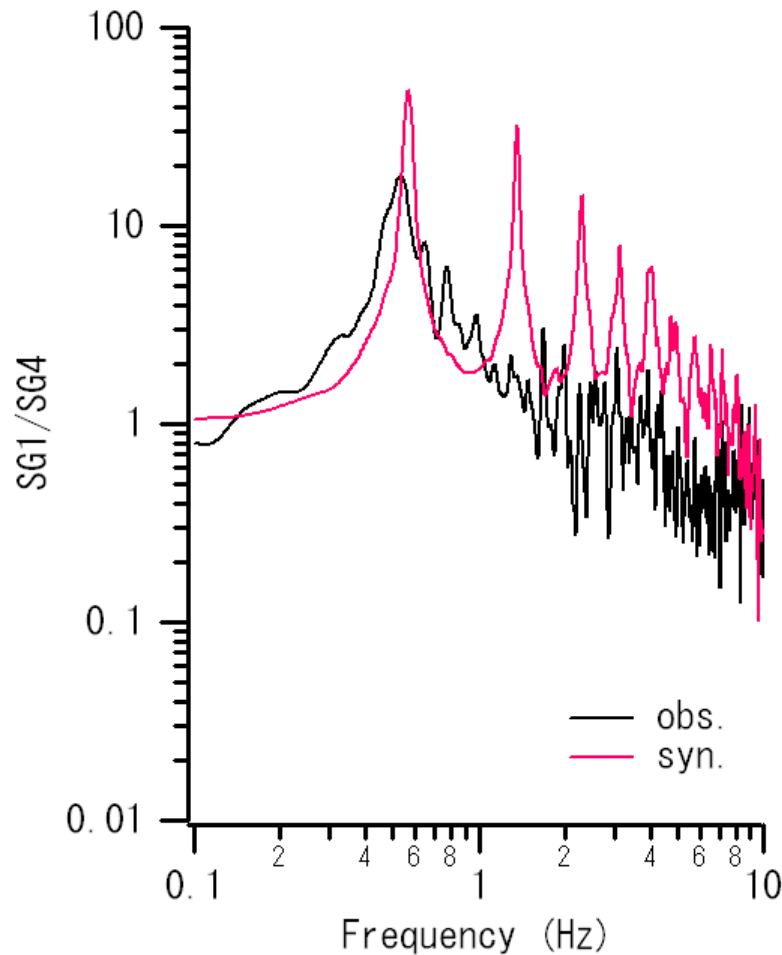
$$\gamma_i(t) = \frac{1}{\Delta z_i + \Delta z_{i+1}} \left( (u_{i+1} - u_i) \frac{\Delta z_i}{\Delta z_{i+1}} + (u_i - u_{i-1}) \frac{\Delta z_{i+1}}{\Delta z_i} \right), \quad i = 1, 2, 3, \dots$$



# Evaluating nonlinear soil properties

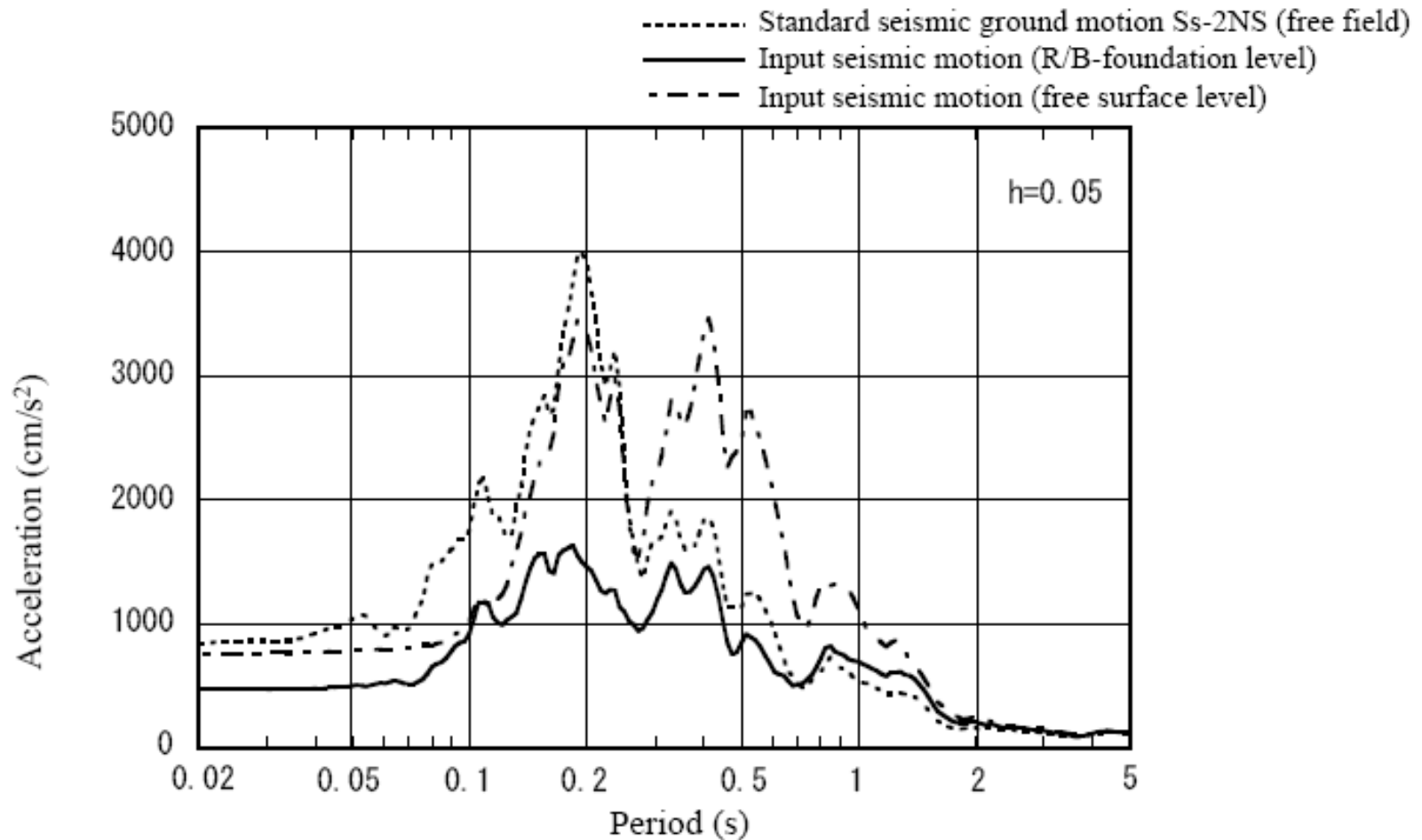


# Observed vs. simulated t.h.





# Seismic input motion for SSI analyses



# Role of ITER in IAEA-WA1, Seismic Hazard



**WA3 Seismic Safety**

**WA4 DIP**

**WA2 Seismic Design**

(Soil-structure interaction)



**Task 1.1: CAV and JMA intensity**

**Task 1.2: Site response & GMPE**

**ITER-Ls**

**Task 1.3: Development of detailed guidance on seismic hazard assessment methods in relation to:**

**Subtask 1.3.1: Nearby fault modelling**

**Subtask 1.3.2: Diffuse seismicity**

**Subtask 1.3.3: Fault displacement assessment**

**Subtask 1.3.4: Slope stability and liquefaction**

**ITER-CoLs**

**Subtask 1.3.5: Supporting document**

**Task 1.4: Deep borehole observation system**

**Task 1.5: Environmental Seismic Intensity Scale (Paleoseismological Survey)**



**WA2 Seismic Design**

From DBGGM to the input ground motions for the structures

**WA3 Seismic Safety**

**WA5 Tsunami Hazards**

(WA9 Information & Notification System)