Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U03-01 Room:301A Time:May 20 09:05-09:30

The giant tsunami had been forecasted, but not been included in disaster design

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Following the forecast of tsunami issued by the Earthquake Research Committee (ERC) of the Headquarters for Earthquake Research Promotion, Tokyo Electric Power Company (TEPCO) had estimated the height of tsunami as 15.7m at the southern part of the Fukushima No.1 nuclear plant, but had taken no measure by the time the giant March 11 tsunami flooded the site as high as 11.5-15.5m (Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company (ICAFNPSTEPCO), 201). The forecast by ERC is scientific and if it had been included in disaster design, it would have significantly reduced the number of dead and missing. One of the reasons why the forecast was ignored would be *idee fixe* that a large earthquake shall not occur where no large quake has been recorded. The government's misjudgment caused the massive loss of lives and the serious nuclear accident.

The long-term forecast that a tsunami earthquake as large as the 1896 Meiji Sanriku event has chances of occurring anywhere along the Japan Trench was issued in July 2002 (ERC, 2002). On the other hand in May, TEPCO calculated the design height of tsunami as 5.7m at Fukushima No.1 nuclear plant following Tsunami Evaluation Subcommittee of the Japan Society of Civil Engineers' Nuclear Civil Engineering Committee (2002). The design earthquake that causes the tsunami is a quake off Fukushima Prefecture. For tsunami evaluation, the seismic province map (Hagiwara, 1991) is suggested to use for unexpected events, but the map itself is based on the previous seismicity and was ineffective to raise the design height. The design was eventually determined by the highest recorded, which is closely related to the fixed idea. After the forecast of tsunami earthquake by ERC, TEPCO did not take any measure. In 2008, TEPCO examined the forecast and calculated the height of tsunami at Fukushima No.1 site as high as 15.7m but thought such a high tsunami never really takes place and took no measure (ICAFNPSTEPCO, 2011).

Central Disaster Management Council set up in 2003 a technical investigation committee on trench-type earthquakes in the vicinity of the Japan Trench and the Chishima (Kurile) Trench. The committee selected three earthquakes, an earthquake off northern Sanriku coast, an earthquake off Miyagi Prefecture, and the Meiji Sanriku earthquake for tsunami damage forecast. These events are all located in the northern part of the vicinity of the Japan Trench and no measures against tsunami are taken in the central and southern part. Most of the lives are lost on the coast where the height of the March 11 tsunami exceeded more than twice that forecasted.

A long-term forecast of tsunami earthquakes is important for ERC because tsunami earthquakes caused severe damage in the vicinity of the Japan Trench (22,000 killed by the Meiji Sanriku earthquake and 5,000 by the 1611 Keicho Sanriku earthquake). Tanioka and Satake (1996) showed the Meiji Sanriku earthquake fault is close and parallel to the axis of the Japan Trench. Historical documents show evidence that both the Keicho Sanriku and the 1677 Empo Boso earhtuquakes are tsunami earthquakes and suggest their source areas are far off the coast, which is consistent with an idea that a tsunami earthquake takes place in a belt-like area along the Japan Trench. If the location of the 1896 Meiji Sanriku earthquake fault was well constrained, that source area would be assigned as an area of low probability of occurrence for tsunami earthquake because its repeat time was estimated as 530 years. However since it was not, the long-term forecast that a tsunami earthquake will take place anywhere in the belt was issued. Central Disaster Management Council considered a repeat of the 1896 Meiji Sanriku earthquake to the contrary. This is inappropriate decision from the seismological viewpoint, apparently affected by the fixed idea.

Keywords: giant tsunami, long-term forecast, nuclear accident

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U03-02 Room:301A Time:May 20 09:30-09:55

Generation mechanism of the 2011 Tohoku-oki earthquake - what are resolved and what are left unresolved

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Beneath northeastern Japan, the Pacific plate subducts west-northwestward at a rate of ˜8 cm/yr along the Japan Trench, which causes extremely high seismic activity mainly along the plate interface. Many large destructive earthquakes with M7.5-8 have occurred repeatedly along the megathrust beneath the Pacific Ocean. Seismic waveform inversion studies have shown that large slip areas of repeating large interplate earthquakes overlap each other, supporting the asperity model for the generation of earthquakes in this subduction zone (e.g., Yamanaka and Kikuchi, 2004). Long-term forecast of earthquake occurrence by Earthquake Research Committee of the Headquarters for Earthquake Research Promotion based on the records of large earthquakes for the last 100 years or so released a very high probability of occurrence of M7.5 class earthquake along the plate interface in the off Miyagi region. Seismic coupling coefficient at the plate interface east of northern Tohoku estimated from the last ˜70 years data is ˜25 %, while that at the plate interface east of southern Tohoku is ˜10 % or less (e.g., Kanamori, 1977; Seno, 1979; Peterson and Seno, 1984; Pacheco et al., 1993). However, both backslip inversions of GPS data (e.g., Suwa et al., 2006) and small repeating earthquake analyses (Uchida et al., 2011) based on data for the last 10 years or more show much higher interplate coupling coefficients of about 70-80 %.

It is along this plate interface that the 2011 M9.0 Tohoku-oki earthquake, the greatest earthquake in the modern history of Japan, occurred. Its slip area extends about 500 km long and about 200 km wide with the average slip of roughly about 10 m, rupturing about two thirds of the megathrust east of the entire northeastern Japan arc. It caused severe damage to northeastern Japan; especially tsunami excited by this earthquake was huge and killed many people near the Pacific coast of northeastern Japan. It is particularly important for the mitigation of earthquake hazards to understand how and why such a great earthquake with magnitude 9.0 did occur along this plate boundary, since the occurrence of such a great earthquake there was not predicted in the report of the long-term forecast of earthquake occurrence by Earthquake Research Committee of the Headquarters for Earthquake Research Promotion.

In this presentation, I will try to discuss 1) what are resolved and what are left unresolved, 2) what were not known before the earthquake, 3) what were lacking in earthquake research, and 4) what sort of investigations and studies we need to do from now, in order to understand the generation mechanism of this great earthquake and to develop research on earthquake forecast.

Keywords: 2011 Tohoku-oki earthquake, generation mechanism of earthquake, interplate coupling, earthquake research

U03-03 Room:301A Time:May 20 09:55-10:20

Role of the atmosphere numerical model at the time of the nuclear power plant accident and the earthquake disaster

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1. Introduction

About 30,000 people of life were taken with the tsunami by the earthquake that occurred on March 11, 2011. And, tsunami took all the power supplies of the 1st Fukushima nuclear power plants. As a result, many radioactive substances were emitted into the atmosphere and the ocean. Many of the radioactive deposited around Fukushima Pref. and the citizen is exposed to long time radiation.

2. Nuclear power generation accident and refuge action

Fig.1 shows the refuge route associated with the 1st Fukushima nuclear power plant accident. Many of the refuge routes are passing a high dose rate area. The numerical simulation model such as SPEEDI was predicted a completely the high dose area. However, the result of this model sometimes is not utilized effectively. If we are able to use the result of the model effectively we don't exposed by the high radiation in the early period. The numerical simulation model is very useful in the dispersion prediction of a radioactive substance. We can use it effectively when the accident occurred by disclosing the result of the model. It is important to use the daily application system of the simulation model result.

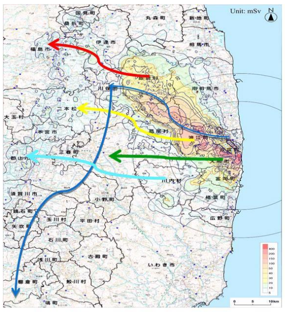
3. Role of atmospheric model

The model can predict the contamination situation of the radioactive substance. And the model can understand contamination distribution as the area. The prediction is effective in our low expose. The understanding as the area of the radioactive substance is important to know the movement. It is necessary to understand of the exact composed process and move process of the radioactive substance. There is indeterminacy in the simulation model. Therefore, we need to compare the result of several models. It is important at the time of a disaster that we disclose one conclusion as the result.

4.Conclusion

The atmosphere simulation model collects the essence of science and technology. The model is the indispensable tool to disaster prediction. However, many of the nations don't know the usefulness of the model. It is important to always disclose the result for the advanced utilization, accuracy improvement of the model.

Keywords: Numerical simulation model, SPEEDI, exposure dose, radioactive contamination, natural disaster, artificial disaster



Japan Geoscience Union Meeting 2012
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U03-04 Room:301A Time:May 20 10:45-11:10

Terrestrial Trasfer of fallout radionuclides by hydrogeomorphological process by Fukushima NPP accident

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Experimental catchments have been established in Yamakiya district, Kawamata Town, Fukushima prefecture, located about 35 km from Fukushima power plant, and designated as the evacuated zone. Approximate Cs-137 fallout in this area is 200-600k Bq/m2. We established 3 forest sites: broad leaf tree forest and two Japanese cedar forest plantation (young and mature). In each site we installed towers of 8-12 meters. Using these towers, we sampled tree leaves, and measure Cs-137 and Cs-134 in the laboratory, and also we have measure Cs-137, Cs-134 content at various height in each forest using a portable High Purity Germanium (HPGe) detector (Ortech; Detective-EX). We also measured the throughfall, stem flow and litter fall inside of the forest. Experimental catchments have been established in Yamakiya district, Kawamata Town, Fukushima prefecture, located about 35 km from Fukushima power plant, and designated as the evacuated zone. Approximate Cs-137 fallout in this area is 200-600k Bq/m2. We established 3 forest sites: broad leaf tree forest and two Japanese cedar forest plantation (young and mature). In each site we installed towers of 8-12 meters. Using these towers, we sampled tree leaves, and measure Cs-137 and Cs-134 in the laboratory, and also we have measure Cs-137, Cs-134 content at various height in each forest using a portable High Purity Germanium (HPGe) detector (Ortech; Detective-EX). We also measured the throughfall, stem flow and litter fall inside of the forest. 5 runoff plot from USLE standard plot have been constructed, and also experimental paddy field has been established. Also total 6 suspended sediment samples, turbidity meters were installed in the Kuchibuto river and 2 sites in downstream Abukuma river.

The monitoring is now ongoing but we found significant amount of Cs-134 and Cs-137 has been trapped by cedar forest plantations especially young trees, but not so much in broad leaf trees. The trapped Cs-137 and Cs-134 is then washed by rainfall and found into throughfall.

Runoff from USLE standard plot has been monitored and found to be less than 1% of Cs-137 has been removed in this season. High concentration of suspended sediment has been detected (>50K Bq/kg). To decrease the environmental contamination by radionuclides, minimizing the sediment yield in the catchment will be required.

Keywords: Cs-137, runoff, sediment yield, forest, suspended sediment, land use

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U03-05 Room:301A Time:May 20 11:10-11:35

Significance of Tectonic Geomorphology in the Prediction of Plate Boundary Earthquakes around Japan

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Active faults observed on sea floor are resultants of repeated large earthquakes. However, fundamental information for prediction of large earthquakes such as the detailed distribution of active faults was not well known mainly due to lack of data regarding seafloor topography. To make a more precise submarine active fault map along the trench, we have made detailed seafloor topographic images based on 90m and 150m DEM processed from the original data obtained by Japan Coast Guard and JAMSTEC. Then we have produced anaglyph images of seafloor for interpretation of active faults, similar in manner we use air-photo stereo sets for inland active fault interpretation. In anaglyph images, we can easily observe seafloor relief throughout wide area, and it is no so difficult for most of us to identify active faults that dislocate seafloor. Escarpments or flexure slopes were formed by reverse faulting, whether a fault reaches seafloor or terminates in depth. Slopes tectonically formed are convex in their profiles, and are associated with tectonic bulge to their west. Active fault distribution along and around the Japan Trench is rather simple compared with that of the Nankai Trough.

Active faults along the Japan Trench area are grouped into the following three fault zones; from east (1) normal faults on Outer Rise, (2) extensive thrust faults on the trench slop, and (3) lineaments on the shelf slope. One of the continuous thrusts extends from off-Sanriku to off-Ibaraki for over 400km, and is probably related to the source fault of ”The 2011 off the Pacific coast of Tohoku Earthquake”. We compare location of hypocentral regions of historical earthquakes (Earthquake Research Committee, 1999) and distribution of tectonic landform such as submarine active faults and tectonic bulges. Some of the hypocentral regions are located on tectonic bulges, suggesting that extent of seismic source faults in depth will be detected from distribution of tectonic bulges. Source fault for Meiji Sanriku earthquake (M8.2 - 8.5) may be related to a 200km-long active fault along the trench off Sanriku. Numerous lineaments of normal faulting are distributed on the outer-rise slope and they are generally short, and may cause M7 class earthquakes. The 1933 Sanriku earthquake (M8.1-Mw8.4) is believed as one of the Outer Rise earthquakes, but we do not find any long normal fault that matches to the extent of a M8 class earthquake. One of the aftershocks of the 311 Earthquake probably took place along a long NNE-SSW normal fault on the Outer Rise off Fukushima. Normal faults are also densely distributed on the uplifted zone by extensive thrusting along the west of the trench, and they may suggest location of asperities on the earthquake source fault.

The Nankai Trough is a candidate site for the occurrence of large earthquakes of M8 class in near future. The trough has been well studied by many marine geologists, and they have revealed characteristic structure of the plate boundary. As mapped by previous works (Research Group for Active Submarine Faults off Tokai; 1999, Tokuyama and others; 2001, Kimura and Kinoshita eds., 2009), there are several trough-parallel north-dipping thrusts. We defined location and geometry of active faults much more accurately than those previously known. We depicted two candidate active faults for two large historical earthquakes; 1944 Tonankai and 1946 Tokai. The former one extends eastward from off southeast coast of Kii peninsula across Kumano Trough for over 100km, and the latter extends eastward from off southeast coast of Kii peninsula across Shionomisaki submarine canyon and along southern foot of Tosabae, and outer ridge south of Tosa Basin until it reaches far off Ashizuri peninsula. Several extensive strike-slip faults are also found in Tosa Basin, suggesting that these faults will generate earthquakes with strong ground motion with smaller tsunami in future.

Keywords: submarine active fault, plate boundary, large earthquake, Japan Trench, Nankai trough

U03-06 Room:301A Time:May 20 11:35-12:00

Disaster management about the Nankai Earthquakes after the 2011 off Pacific coast of Tohoku Earthquake

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We need further preparing for large-scale earthquakes like a Nankai Earthquake in near future. We need more knowledge about living earth and searching ability for living ground. We need more efforts for long-term education and experience through passed to the next generation. Systematic efforts have been continued to know the historical earthquakes and geological records.

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U03-07 Room:301A Time:May 20 13:45-14:10

Geography and disaster prevention teaching in Kanai area learnt from the Great East Japan Earthquake's lesson

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Massive earthquake and tsunami on May11,2011, triggered nuclear power plant accident in East Japan, left a strong imprint on students' mind. In the flood of the copious information, teachers bear responsibility in educating students to bring up the ability to grasp the damage precisely. Moreover, it is also important that students contribute to society in the process of rehabilitation with proper prevention and energy-saving consciousness. It is an urgent and essential matter, however, there is a big gap between Kansai area and East Japan about the preparedness to earthquake/aftershocks and the student's power-saving awareness.

This report is aimed to discuss their awareness gap as premise, and to propose the significance of teaching earthquake-related geography and materials for learning incooperation with two secondary school teachers, KOIZUMI Kunihiko, Kami-koshien Junior High School, and SHIMOMURA Katsuhiko, Tsuna Senior High School, Hyogo Prefecture. Both had experienced the Great Hanshin-Awaji Earthquake in 1995 as teachers.

Three Case studies conducted are in the followings.

[1] Class practice (3hr) of 2nd year at junior high school, "atural disasters in Japan"

1) Know the situation of the Great Hanshin-Awaji Earthquake using video.

Check the damage of earthquake tremors and learn about the situation of earthquake disaster reconstruction and shelter life.

2) Learn about the Great East Japan Earthquake

Learn about earthquake damage from the point of plate-tectonic theory.Review tsunami and the damage in Tohoku area on Pacific Ocean.

3) Learn people's response to earthquake and tsunami

A teacher instructs students to think about the emergent action in the region where they live by using "Hazard Map in Nishinomiya City". How to protect oneself from the earthquake or what about the tsunami forecast and judgment are essential matters for students.

These practices are aimed to remind the students from taking advantage of school districts and city field excursion. However, students understand tsunami through only images, so that students are easy to fade memory and disaster prevention consciousness.

[2] Class practice (4hr) of 2nd year at high school, "geography A"

1) Understand East Japan Earthquake

Explain the distribution of tsunami and earthquake damage and its extent by using photos, Google Earth or information obtained from junior high school teachers in Ishinomaki City.

2) Understand the situation of the Great Hanshin-Awaji Earthquake

Awaji Island was seriously hit by the earthquake, but the memory has been forgotten by residents. In this connection, we showd the damage of school district by using statistics, thus, in the end we induce students to the total damage in Awaji City.

3) Learn about tsunami disaster

Extending the plate tectonic theory in the textbook, we explain them the plate-type earthquake and its cycle occurred by huge tsunami.

4) Response to tsunami disaster

Using "Disaster Prevention Map in Awaji City", the teacher organizes students' discussion in the class room about where we refuge and how we manage the refuge area. Then, the teacher instructs their role during the hazard and suggest the present limitation and problem that tsunami level was estimated below 2.5m to them .

[3] Class practice (90 minutes) at university "Introduction to human geography"

Despite this earthquake and tsunami were expected off Sanriku coastal area, why was the result of "unexpected"? In human geographical aspect, the idea of disaster reduction can more contribute to us.

In summary, our mission as teachers is to continue to narrate the disaster memory, and to suggest students that they should learn the disaster prevention or minimization to support and contribute to the affected areas or people. The most important point is that student learn the disaster knowledge on its history, present condition and mesures through field studies/woks by themselves with feet firmly fitted attitude by osmosis. Mental care to them is also essential.

Keywords: Great East Japan Earthquake, geography teaching, disaester prevention teaching, Kansai area

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U03-08 Room:301A Time:May 20 14:10-14:35

How to apply the disaster lessons from the East Japan earthquake to the next ”unexpected” disasters

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This is a Invited Talk. There is no abstract about this lecture.