Guide Book
Session 8:
Final project

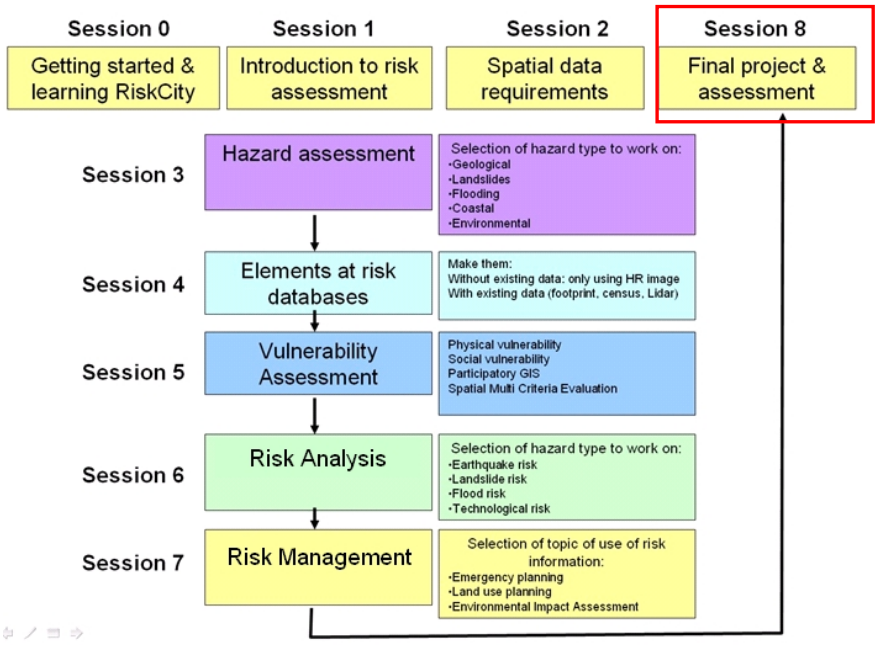
Objectives
After this session you should be able to:

- Translate a problem statement (related to hazards, elements at risk, vulnerability, risk assessment or risk management) into a plan of analysis
- Outline a flowchart and indicate the steps required to solve the problem
- Carry out an analysis using GIS and the RiskCity dataset
- Draw conclusions from the results of the analysis
- Write a small report with the procedure and result of your analysis and present this.

In this session you will use your knowledge obtained from studying the Guidebook and doing the RiskCity exercises by analyzing a particular problem by yourself, without the help of a fully written out exercise. This session contains a list of 25 topics from which you can select one. In the distance education course you will select a topic for yourself, and in a classroom course you select a topic for a group. In the classroom course the size of the group is determined by the overall group size of the course participants, but will be generally 2 to 3 people.
After selecting the topic from the list given in the following pages, you will evaluate which data you will need to analyze the problem. The data will be mostly coming from the Riskcity exercises, but it may be also required to do an additional literature study.

Part	Topic	Task	Time
8.1	Define the topic	Select the topic and inform the coordinator	2 h
8.2	Develop work plan	Make the work plan, division of tasks and discussion with staff	2 h
8.3	Data analysis	Carry out the analysis, produce output.	2 days
8.4	Report writing	Write the report and submit	1 day
8.5	Presentation and oral exam	Prepare presentation	4 hours
		Present yours and evaluate others	4 hours
		Total	**4.5 days**

8.1 Introduction to the final project



This last session deals with the final project in which you apply what you have learned in this course. You can select from a large list of 25 different topics that are related to session 3 (hazard assessment), 4 (Elements at risk assessment), 5 (Vulnerability assessment), 6 (risk analysis) and 7 (risk management). In fact most of the topics are related to the topic of risk management. Some of the topics can only be selected if you had done some related exercises in the earlier part of the course. Otherwise they would take too much time.

We start by selecting a topic:

Task 8.1: Selection of the final project (duration 4 hours)

- (In a classroom course: make groups of 3-4 persons)
- Read the topic descriptions below.
- Select one of the topics from the list below, and inform the course coordinator which topic is selected.
- Send an e-mail to the course coordinator with the name(s) of the group member(s) and the selected topic. If the topic is already selected, the course coordinator will reply you that you need to select another topic.
- A topic can only be selected by one person/group on “first come first serve basis”

After selecting the topic, start making a work plan. You will be assigned a staff member as your supervisor. This staff member is available every working day during one period of the day. Discuss this with the staff member, in order to make a schedule of supervision time.

Task 8.2: Make the work plan (duration 4 hours)

- For classroom courses:
  - Discuss with your group members how you are going to deal with the problem
  - Make a division of tasks in the group, and write down the tasks of the group members. The final report should contain this information, in order to be able to assess you individually. For example you can make one group member responsible for the report writing, one for the presentation, and one for the generation of figures. Divide also the analysis parts among the group members.
- Also gather the required information. IMPORTANT: you use the information that was provided to you in the Riskcity exercises. Use ILWIS to copy the relevant datasets for your project in a new directory.

After you have made the flowchart and have discussed this with your supervisor, you can start working on the analysis.

Task 8.3: Data analysis (duration 3 days)

- Classroom course:
  - Divide the analysis in different parts, and see if members of the group can work on the different steps simultaneously.
- Keep track of the results, and make sure to give meaningful file names to the maps and tables that you generate. Otherwise you might loose track.
- When you have intermediate results, make sure to make a presentable output map / graph of it directly and store it in the Word file or Powerpoint file that you will use for the report/presentation.
- If you don't have the data, you can also "invent" it, but then mention it in the report
- Critically analyze the results. If the analysis results are not what you expected try to find the reason for it. Describe in the report why the results are different then what you expected.
- During the analysis phase you can get supervision during 1 period per day.

During your project the report and Powerpoint files will slowly grow with the results that you have obtained. At some point you have to decide to stop with the analysis and concentrate on the report writing and the presentation.

Task 8.4: Report writing (duration 1 day)

- Classroom course:
  - One of the group members should have the main responsibility for the report writing, one for the generation of output maps, and one for the generation of the Powerpoint presentation
- The report should be maximum of 10 pages, including maps, and a minimum of 5 pages.
- The structure of the report should be:
  - Problem statement
  - Flowchart
  - Input data
  - Analysis and results
  - Discussion and conclusion
  - Subdivision of tasks in the project between group members.
  - References and websites used
- We will also evaluate the report on the following aspects:
  - Clearness of the report
  - Soundness of the methodology used
  - Creativity in analyzing the data and presenting the results
- The report should be submitted by the date indicated by the course coordinator.

Table 8.1: List of topics for the final project

Class	NR	Topic	Brief explanation
Hazard Assessment	1	Earthquake hazard assessment	Design an improved method to generate an earthquake hazard map for Riskcity with return periods derived from the earthquake catalog, and including local ground effects.
	2	Technological hazard assessment	Use the ALOHA model to generate scenarios for industrial accidents including wind speed and wind direction.
	3	Landslide hazard assessment	Improve the landslide hazard map by combining statistical, deterministic and heuristic methods, and use size probability information
	4	Flood hazardment	Improve the results of the exercise on flood modeling as input for the flood hazard assessment
Elements at risk	5	Multi-temporal analysis	Use the multi-temporal imagery to make map showing the development of RiskCity in the past 4 decades.
	6	Participatory GIS	Design an optimal method to carry out a larger PGIS survey for Elements at risk characterisation, vulnerability assessment and risk assessment
	7	Improved cost estimation	Design a method for an improved estimation of the costs of buildings and building contents.
	8	Improved building classification	Use the Lidar data and the image data to make an improved building classification with respect to land use.
Vulnerability	9	Stage damage curves	Design a method for generating stage damage curves for flooding based on the participatory approach for different building types and number of floors.
	10	Vulnerability with SMCE	Design an improved method for the generation of a comprehensive vulnerability assessment using SMCE and the GTZ method.
Risk Assessment	11	Earthquake risk for buildings	Design a method for calculating the earthquake risk to buildings by using individual buildings, including slope effects and different levels of groundshaking.
	12	Earthquake casualty estimation	Desing a method for estimating the expected number of casualties in case of an earthquake in a daytime and nighttime scenario
	13	Improved landslide risk assessment	Design a method for improved landslide risk assessment, based on individual buildings, by incorporating detailed landslide vulnerability and expected landslide sizes.
	14	Shelter need assessment	Design as method for estimating the number of people that may need shelter after the occurence of a disaster, and evaluate whether the shelter capacity is adequate in RiskCity
	15	Risk prior to disaster	Calculate the risk prior to the 1998 disaster event and compare the risk with the losses from the disaster.
	16	Public/Private risk	Make a multi-hazard risk assessment in which you differentiate losses between private losses, business losses and public losses.
	17	Uncertainty in risk assessment	Design a method to evaluate the degree of uncertainty in risk assessment, based on uncertainties of the input parameters.
Risk Management	18	Risk communication strategy	Design an optimal risk communication strategy that involves all relevant stakeholders, and makes use of the appropriate media
	19	Risk Visualisation strategy	Design an optimal risk visualisation strategy that provides the different stakeholders with the right information in a spatial manner
	20	Insurance policy	Design an insurance policy for RiskCity that is based on the expected losses and number of households & companies that may buy an insurance in order to estimate the insurance premium.
	21	Earthquake risk reduction	Design a method for evaluating the best earthquake risk reduction measures in the city, based on a cost-benefit analysis
	22	Landslide risk reduction	Design a method for evaluating the best earthquake risk reduction measures in the city, based on a cost-benefit analysis
	23	Rapid damage mapping	Design a method for rapid building damage assessment after the occurrence of a major disaster
	24	Risk and Planning	Design a method to use the risk information together with other data for the planning of new neighbourhoods in RiskCity.
	25	Disaster preparedness	Design a method for an improved disaster preparedness planning based on the simulation exercise.

Topic 1. Earthquake hazard assessment
Prerequisite: You should have selected earlier the exercise on Earthquake hazard assessment
Objective: Design an improved method to generate an earthquake hazard map for Riskcity with return periods derived from the earthquake catalog, and including local ground effects.

Description: In the exercise on earthquake hazard assessment you looked at different seismotectonic zones within the country. Each one of them could be characterized with a magnitude-frequency relationship based on the earthquake catalog. Using the attenuation function this would allow to calculate what would be the relationship between MMI and return period for earthquakes from each zone, thus allowing a better frequency magnitude estimation for RiskCity. Also the local soil amplification effects could be better estimated using the information in the second part of that exercise. Work this out further and present this information. Combine this with the building loss estimation to evaluate how the risk curve would change based on this.

Topic 2. Technological hazard assessment
Prerequisite: You should have selected earlier the exercise on Technological risk assessment
Objective: Use the ALOHA model to generate scenarios for industrial accidents including wind speed and wind direction.

Description: In the exercise on technological risk assessment we used simple effect distance calculations to estimate the area that will be affected by Poolfire and BLEVE. Improve this method first by generating different effect distances related to different degree of damage and make a better estimation of the vulnerability of people within these zones. Additionally you can use the ALOHA model that calculates effect distances taking into account also the wind directions and windspeeds. Since this is a new topic, there is a document which generally describes the steps to follow for this project. This will be made available to you when you select this topic.

Topic 3: Landslide hazard assessment
Prerequisite: You should have selected earlier the exercise on landslide hazard assessment
Improve the landslide hazard map by combining statistical, deterministic and heuristic methods, and use size probability information

Description: In the exercise on landslide hazard assessment you used two methods: statistical and deterministic methods separately. In this exercise we didn't compare them. The aim of the project is to improve the landslide hazard map. This can be done in various ways. First of all you can use other factor maps in the statistical analysis that are more relevant for landslide occurrence. You can also make hazard maps for different landslide types. Secondly you could use the methods used in the previous module with a simple groundwater model to derive in fluctuations of the water level. You could also use the results of the deterministic assessment as factor maps in the statistical analysis. And you can also bring in heuristic rules to change the hazard of certain areas. Present success rates in your report. Finally you can also look at the size-frequency distribution to be able to say something on the probability of having a certain landslide size.

Topic 4. Flood risk assessment
Prerequisite: You should have selected earlier the exercise on flood hazard assessment
Use the results of the previous module on flood discharge modeling as input for the flood hazard assessment.

Description: The aim of this project is to carry out several model runs for rainfall of different return periods to come with a Magnitude-Frequency estimation for discharges in RiskCity.

One of these could be used in SOBEK to model the flood height and flow velocity in Risk City and compare this with the PGIS results.

Topic 5. Multi-temporal analysis
Prerequisite: none
Use the multi-temporal imagery to make map showing the development of RiskCity in the past 4 decades.

Dwescription: In the second exercise we have looked at the airphotos and satellite images from different periods. We have images from the 1970's, 80's , 90' and after 2000. You could use this information to make a evaluation of the growth of RiskCity. Based on teh building map of 1997 make an interpretation of the ages of the different parts of the city. Use this to calculate the growth rate of the city. Also analyze which landuse types have had the largest growth over the past decades, and evaluate the relation between hazard zones and newly developed areas.

Topic 6: Participatory GIS
Prerequisite: none
Design an optimal method to carry out a larger PGIS survey for Elements at risk characterisation, vulnerability assessment and risk assessment

Description: The aim of this project is to design a method to complement the information available from the building database with community based information. As we have seen the available information on population characteristics is limited to large areas within the city (wards or districts). We would like to involve more the local communities in the risk assessment, and we would like to obtain information on the vulnerability and capacity, the risk perception and the way disaster risk is evaluated in comparison with other types of risk for the local community. Information should be collected in such a way that it can complement the available GIS databases. Design a data collection project: which data will be collected, how the data will be collected, how local communities will be approached, how representative data at community level can be used to characterize the mapping units of RiskCity. Also "invent" the data for a number of sample points and show how this can be used in further analysis.

Topic 7: Improved cost estimation
Prerequisite: none
Design a method for an improved estimation of the costs of buildings and building contents.

Description: in the exercise on economic loss estimation we have used a very simple method for estimating the costs of buildings, by using an average cost per building and contents per square meter and multiplying that with the floorspace of the building. The aim of this project is to improve this. This can be done by analyzing the building costs and the contents costs separately in more detail. Building costs could be analyzed in two ways: by finding information on building prices from real estate agents. You can for example take your own city as example and look at websites of real estate agents. The second method is to look at construction costs per square meter, based on the construction type and the landuse. For the content cost estimation develop a method where you take a number of buildings as example and describe the items that would be in such a building (e.g. electrical appliances, furniture etc.) Then use these standard contents packages to make a better estimate of the building costs per landuse class. Also include the aspect of intangible costs (that you cannot express in money) and also try to make a differentiation in costs per floor which would be important for flood risk assessment.

Topic 8: Improved building classification
Prerequisite: none
Use the Lidar data and the image data to make an improved building classification with respect to land use.

Description: the building classification that is used in RiskCity is often not so very accurate. If you look at the building_map_1988 it contains a description for each building of the number of floors, land use, building type and number of people. Develop a method with which you could check the quality of the existing building map, and with which you could improve it. For instance, very large building in squatter area are most probably not squatter buildings but others. You can also use the high resolution image available to make samples to check the landuse type. Also make use of Google Earth and evaluate what information is available about Tegucigalpa that could improve the building classification. Finally also make an estimation of the error that would be involved in the risk assessment due to the wrong classification of buildings.

Topic 9. Stage damage curves
Prerequisite: none
Objective: Design a method for generating stage damage curves for flooding based on the participatory approach for different building types and number of floors.

Description: In the exercise on the use of PGIS for stage damage curves we generated a general stage damage curve for all building using the average water height values. Try to improve this by estimating the variation in damage that would result if we would use the full range of recorded damage values and not just the average. Also make vulnerability curves for sperate building types, and see if it is possible to do that also for different number of floors. Compare the stage damage curves with others derived from the literature. Finally make a plan how you could make similar stage damage curves for earthquakes and landslides (you could also invent some damage survey to ilustrate your method).

Topic 10 Vulnerability assessment with SMCE
Prerequisite: none
Objective: Design an improved method for the generation of a comprehensive vulnerability assessment using SMCE and the GTZ method.

Description: The aim of this exercise is to improve the results of the analysis of vulnerability in RiskCity using the Spatial Multi-Criteria Evaluation tool of ILWIS. Based on the exercise that was done in the course you are asked to improve the vulnerability and capacity indicators, and obtain better results for the various types of vulnerability. You are also asked to include other types of vulnerability, such as economic vulnerability, and environmental vulnerability, and to select suitable indicators for that as well.

Topic 11. Earthquake risk for buildings
Prerequisite: none
Objective: Design a method for calculating the earthquake risk to buildings by using individual buildings, including slope effects and different levels of groundshaking.

Description: In the RiskCity exercise we have made a calculation of earthquake risk for mapping units, making use of building estimations that were made according to exercise 4ª (generating an elements at risk database from scratch). This estimation was based on a number of sampled mapping units, where the actual numberof buildings was counted, and was then extrapolated over the other mapping units with the same landuse type. Now you will use the building map (building_map_1988) to make a more accurate estimation of the building losses for the different earthquake scenarios. Use the minimum and maximum expected building losses. Check the literature for other vulnerability curves used for earthquakes and try to use these with the dataset as well. Evaluate the difference in the output.

Topic 12 Earthquake casualty estimation
Prerequisite: you should have done the exercises on earthquake hazard and risk assessment
Desing a method for estimating the expected number of casualties in case of an earthquake in a daytime and nighttime scenario

Description: based on the building loss calculation for earthquakes and the population information per building it is also possible to estimate the population losses in 4 severity classes discussed in the lectures. Use the population information per building and calculate the minimum and maximum casualties for both a daytime and a nighttime scenario.

Topic 13 Improved landslide risk assessment
Prerequisite: you should have done the exercises on landslide hazard and risk assessment
Design a method for improved landslide risk assessment, based on individual buildings, by incorporating detailed landslide vulnerability and expected landslide sizes.

Description: In the exercise on landslide risk assessment we have made a number of shortcuts or simplifications. We calculated the number of buildings affected per mapping unit, and we made a very simple vulnerability estimation. In this project use the building map (building_map_1998) as the basis. Calculate for each building whether it is located in a high, moderate or low susceptible area. Design a method to make a vulnerability estimation for every individual building based on the building type and the floorspace. Also evaluate whether buildings are located close to existing landslides, which would increase their vulnerability. Then include the hazard information and calculate the risk per building. Aggregate the results per mapping unit and also for the whole city.

Topic 14 Shelter need assessment
Prerequisite: none
Objective: Design as method for estimating the number of people that may need shelter after the occurence of a disaster, and evaluate whether the shelter capacity is adequate in RiskCity

Description: in the case of a major disaster there will be a number of people that will be homeless, and need to go to shelters. This topics analyses the number of people that need shelter and the availability of shelters. For calculating the number of people that need shelter, you will first have to select certain scenarios for earthquakes, flooding , landslide and technological hazards. For these you have to use the calculated building losses that were evaluated in session 6. Based on the information of the number of people per house you then have to estimate the number of people without a house (think about whether you use daytime or nighttime population and for which landuse type). For the shelter availability also use the landuse as the basis. Is the building itself still intact, and which buildings can be used as shelters?

Topic 15 Risk prior to disaster
Prerequisite: none
Objective: Calculate the risk prior to the 1998 disaster event and compare the risk with the losses from the disaster.

Description: In 1998 there was a major disaster in RiskCity which generated a lot of damage due to landslides and due to flooding. The aim of this exercise is to evaluate the risk situation prior to the 1998 event, and compare this with the actual damage that happened in 1998. We have a map showing the buildings in 1997. Use this as a basis for doing a landslide and flood risk assessment. Look particularly to the 100 year return period,

which was the return period of the event. Compare the results then with the actual number of destroyed buildings in 1997. How good was the risk assessment?

Topic 16 Public/Private risk
Prerequisite: none
Objective: Make a multi-hazard risk assessment in which you differentiate losses between private losses, business losses and public losses.

Description: In the loss estimations that we have done in the exercises we looked at the overall risk to all buildings, without making any distinction between losses to residential buildings, commercial and industrial buildings and to public buildings. The aim of this project is to calculate the building losses and associated economic losses separately for residential buildings, commercial buildings and public buildings. You would have to separate the buildings based on the landuse, and make a separate loss estimation for them. Then you can also look at how this could be used to make a general estimation of the indirect losses. For instance for each residential building you know the number of people, and from the PGIS survey the number of workers. You could calculate how many days the households would be without work, and make an estimation of the indirect losses due to loss of income. Also for the businesses you could calculate how many people work there and estimate the loss of production assuming general production figures per employee.

Topic 17: Uncertainty in risk assessment
Prerequisite: none
Design a method to evaluate the degree of uncertainty in risk assessment, based on uncertainties of the input parameters.

Description: Loss assessment also has a large degree of uncertainty. This is coming from the number of elements at risk, the vulnerability and the hazard. The aim of this project is to evaluate which components of the risk assessment have the highest level of uncertainty, and describe these conceptually. Also it might be possible to illustrate the uncertainty for a certain type of hazard (e.g. for earthquakes) by calculating the minimum and maximum losses.

Topic 18. Risk communication strategy
Prerequisite: none
Objective: Design an optimal risk communication strategy that involves all relevant stakeholders, and makes use of the appropriate media

Description: The risk information which was estimated in the RiskCity exercises should be communicated to the local authorities, communities and to other actors. The aim of this small topic is to define who are the actors? How can we involve the actors? Which activities should be involved? How can we visualize the risk? Which information should be made available for whom? Please use examples from RiskCity to illustrate these. Would it be useful to make the materials available using a WebGis application? Which data should be shown?

Topic 19: Risk Visualisation strategy
Prerequisite: none
Design an optimal risk visualisation strategy that provides the different stakeholders with the right information in a spatial manner

Description: The risk information which was estimated in the RiskCity exercises should be communicated to the local authorities, communities and to other actors. The aim of this topic is to make different types of output maps to different actors? How can we visualize the risk? Which information should be made available for whom? Use examples from RiskCity to illustrate these. Use the WebGis application that has been developed for RiskCity as well?

Topic 20. Insurance policy
Prerequisite: none
Objective: Design an insurance policy for RiskCity that is based on the expected losses and number of households & companies that may buy an insurance in order to estimate the insurance premium.

Description: One of the ways to reduce the risk in RiskCity is to implement a system for disaster risk insurance for buildings. Suppose you are asked to design disaster insurance at municipal level. The insurance is on a non-profit basis, and is of course based on the principle of solidarity. Many people will pay insurance premium for their house, and the accumulated insurance premium should be sufficient to cover disaster damage costs for the persons having such insurance. Companies may pay higher premiums than individuals, and residents can pay premium depending on their socio-economic level. Think about how such a system should be designed, and use the information on the economic loss estimation for the various types of hazards calculated in the exercises. Perhaps you may even use a cost-benefit analysis to evaluate the height of premiums. See for a start for example: http://en.wikipedia.org/wiki/Insurance

Topic 21. Earthquake risk reduction
Prerequisite: none
Objective: Design a method for evaluating the best earthquake risk reduction measures in the city, based on a cost-benefit analysis

Description: Based on the work done in the exercise on cost-benefit analysis, it would be good to make a list of the possible disaster risk reduction measures for earthquake hazards. You may have to carry out a new risk assessment taking into account these risk reduction measures, or you would have to estimate how much they would reduce the risk. For a number of these you could carry out a basic cost-benefit analysis, but also include other important non-economic considerations for the implementation of these measures.

Topic 22. Landslide risk reduction
Prerequisite: none
Objective: Design a method for evaluating the best earthquake risk reduction measures in the city, based on a cost-benefit analysis

Description: Based on the work done in the exercise on cost-benefit analysis, the aim is to make a list of the possible disaster risk reduction measures for landslide hazards. You may have to carry out a new risk assessment taking into account these risk reduction measures, or you would have to estimate how much they would reduce the risk. For a number of these carry out a basic cost-benefit analysis, but also include other important non-economic considerations for the implementation of these measures. Take also into account that there are a lot of non-economic issues involved as well.

Topic 23. Rapid damage mapping
Prerequisite: none
Objective: Design a method for rapid building damage assessment after the occurrence of a major disaster

Description: The results of the building and population loss estimation for RiskCity can also be used to plan a rapid damage assessment, after a major disaster has occurred, such as an earthquake. Important questions to be answered are: where are the damages to be expected to be the highest? How many people should be trained for the rapid damage assessment? Where should they be located? How should the data they collect be incorporated in the database? Design a method and show an example based on the RiskCity

case study. To give you an idea of what to do, have a look at the Msc thesis of Diana Contreras from UPM programme in 2009.

Topic 24. Risk and Planning
Prerequisite: none
Objective: Design a method touse the risk information together with other data for the planning of new neighbourhoods in RiskCity.

Description: In this exercise you have to evaluate the best location for an urban extension. The municipality of RiskCity would like to construct housing for 5000 people in the coming 5 years. However, they don't know the best location yet. You are asked to provide them with several alternatives. In this exercise you will have to use SMCE and develop a decision tree with different groups of factors. Obviously the hazards are an important factor, but also other factors play a role, such as the distance to the city centre, the slope steepness, the ecological value of the land, and the land ownership. One option is also to upgrade the squatter areas to residential areas with more floors. Decide also what type of buldings should best be constructed, and with how many floors. Present the options in order of preference and include then reasons for it.

Topic 25. Disaster preparedness
Prerequisite: none
Objective:Design a method for an improved disaster preparedness planning basic on the simulation exercise.

Description: Consider the risk assessment that was done in RiskCity, and which areas are mostly at risk, also defining the types of hazards. Based on this information design a method for improved disaster preparedness: e.g. what types of disaster preparedness could be carried out and for which types of hazards. Look at community awareness, early warning systems, location of emergency response centers, evacuation shelters. How many people need to be involved in awareness raising activities, which organizations should be involved in early warning, can early warning also be done at community level? Where should new evacuation centers be constructed?