Schedule of the course

| Unit 1: 19. May 2010 | Organisational matters (Dates, students contribution and requirements)  
Introduction to the subject (Recent flood events in Europe, Experiences, deficits and future strategies, protection measures) |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Unit 2: 26. May 2010</td>
<td>Integrated flood risk management; example of operational flood forecasting system</td>
</tr>
</tbody>
</table>
| Unit 3: 2. June 2010 | Students presentations: Flood warning systems  
Different types of forecast models (statistical model); information of the public and reporting; actual flood situation (Lower Austria) |
| Unit 4: 10. June 2010 9:00-11:00h | Students presentation: Risk zoning maps; Flood documentation  
Preparation for role game |
| Unit 5: 16. June 2010 | Students presentation: Urban planning and flood risk; Vienna's Flood Management; Role Game: Post flood event discussion (groups: victims, farmers, decision makers, operators of hydropower schemes, hazard protection team leaders, press) |
| Unit 6: 23. June 2010 | Poster presentation and poster award,  
Final test / protokol or report of the role game. |
### Gruppeneinteilung Floodforecast 2010:

#### Gruppe 1:

<table>
<thead>
<tr>
<th>Name</th>
<th>Referat</th>
<th>Termin</th>
<th>Poster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guger Leo</td>
<td>Flood warning systems (a general review)</td>
<td>2.6.10</td>
<td></td>
</tr>
<tr>
<td>Poland Corey</td>
<td>Potential environmental risks from climate change</td>
<td></td>
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</table>

#### Gruppe 2:

<table>
<thead>
<tr>
<th>Name</th>
<th>Referat</th>
<th>Termin</th>
<th>Poster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolf Martin</td>
<td>Risk zoning maps (requirements, classes, dissemination)</td>
<td>10.6.10</td>
<td></td>
</tr>
<tr>
<td>Stadlmajer Helmut</td>
<td>Structural measures to prevent private buildings and properties from floods</td>
<td></td>
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</tbody>
</table>

#### Gruppe 3:

<table>
<thead>
<tr>
<th>Name</th>
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<th>Termin</th>
<th>Poster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Todary. Michael</td>
<td>Urban planning with respect to flood risk (status, responsibilities, future demands)</td>
<td>16.6.10</td>
<td></td>
</tr>
<tr>
<td>Rotteneder Leonhard</td>
<td>Methods to create flood inundation maps</td>
<td></td>
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</table>

#### Gruppe 4:

<table>
<thead>
<tr>
<th>Name</th>
<th>Referat</th>
<th>Termin</th>
<th>Poster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wechner Sarah</td>
<td>Flood protection and flood management for the city of Vienna</td>
<td>16.6.10</td>
<td></td>
</tr>
<tr>
<td>Danescu Adrian</td>
<td>Conventional flood protection measures (dams, retention basins, technical function, design)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Gruppe 5:

<table>
<thead>
<tr>
<th>Name</th>
<th>Referat</th>
<th>Termin</th>
<th>Poster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aigner Marina</td>
<td>Documentation of a selected flood event in my home country</td>
<td>10.2.10</td>
<td></td>
</tr>
<tr>
<td>(Stockinger Michael)</td>
<td>Estimation of specific damage and loss functions of rural areas</td>
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#### Gruppe 6:

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<tr>
<th>Name</th>
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<th>Poster</th>
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<tbody>
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</tbody>
</table>
Estimation of Loss Function

Ermittlung der Schadensfunktion

Definition of Flood Risk

- There is a random event $Q$
- This event has a probability of occurrence $f(Q)$
- This event has consequences (damages) $D(Q)$
- The risk is understood here as

$$ R(X^*) = \int_{X^*}^{\infty} f(Q) \cdot D(Q) \cdot dQ $$

From NACHTNEBEL, 2005
Risk Assessment

Risk
(Expected Loss / Schadenserwartung)

The risk (annual expected total loss) can be calculated as follows:

\[ S_G = \int_{Q_A}^{HHQ} s(Q) \cdot h(Q) \cdot dQ \]

where

- \( S_G \) ... risk (annual expected total loss)
- \( Q_A \) ... Runoff capacity of cross section
- \( HHQ \) ... Highest flood
- \( S \) ... Loss function
- \( h \) ... Flood density function (without measures)
Student task – Risk assessment

- Identify potential flood losses and sort them by sectors
- Identify costs for flood protection measures
  a) dams (group 1)
  b) retention basin (group 2)
  c) non structural measures (group 3)

Damage categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Tangible</th>
<th>Intangible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Primary</td>
<td>Secondary</td>
</tr>
<tr>
<td></td>
<td>Direct</td>
<td>Impact</td>
</tr>
<tr>
<td>Examples</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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</tbody>
</table>

From Dutta et al. (2003), Journ. of Hydrology, 277, 1-2
Loss estimation data requirements

Table 6: Input spatial parameters required for establishing loss estimation model

<table>
<thead>
<tr>
<th>Damage category</th>
<th>Damage data required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban damage</td>
<td>Residential building: Total floor area, Type of structure, Value of app. structure per unit floor area, Building height, Household distribution</td>
</tr>
<tr>
<td></td>
<td>Non-residential building: Total floor area, Type of non-residential building, Number of non-residential building per type, Property, stock and outside property value of non-residential building per worker per type, Total workers of non-residential building per type</td>
</tr>
<tr>
<td></td>
<td>Rural damage: Total number of farms, Farmhouse property, stock and outside property value per farm</td>
</tr>
<tr>
<td></td>
<td>Crop and vegetables: Type of crops/vegetables cultivated, Area of cultivation per crop, Cultivation season per crop, Yield per crop per unit area, Earnings per unit weight of crop</td>
</tr>
<tr>
<td></td>
<td>Farm infrastructure: Distribution of farm house infrastructure, Replacement costs of different infrastructure</td>
</tr>
<tr>
<td>Infrastructure damage</td>
<td>System: Type of lifetime system, Number of components in each type of lifetime system, Replacement cost</td>
</tr>
<tr>
<td></td>
<td>Service interruption: Loss per day for disruption of any component</td>
</tr>
<tr>
<td></td>
<td>Transportation interruption: Road network, Total volume of transport, Traffic volume in each road in standard scale, Average velocity of each mode in each road, Maximum traffic capacity in each road, Flowing cost parameters, Delay cost per unit time</td>
</tr>
</tbody>
</table>

From Dutta et al. (2003), Journ. of Hydrology, 277, 1-2

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Wozu braucht man Schadenmodelle?

Demand on flood loss models

1. Bewertung von Hochwasserschutzkonzepten (Kosten-Nutzen-Analysen)
   Benefit Cost and Cost Effectiveness Analysis

2. Comparative risk assessment

3. Probable Maximum Loss (PML)

4. Verbesserung der Risikowahrnehmung durch Risikokarten
   Improvement of Risk Awareness

From THIEKEN (modified)
Theoretical Loss Models

Vulnerability of a household =
\[ f(\text{Social + economical variables, Property and infrastructure variables, Flood variables, Warning variables, Response variables}) \]

aus: Penning-Rowsell (1990), Environments 27(1): 70-95

Flood damage = \( f(\text{flood characteristics, building characteristics}) \)

Flood characteristics:
- time duration of the flood
- contamination content
- flood depth

Building characteristics:
- velocity flow of flood
- physical location
- nature of furnishing
- construction characteristics

aus: Nicholas et al. (2001), Structural Survey 19(4): 163-172

Applied Loss Models

Schadenmodelle in der Praxis

Datenbasis:
Empirische Daten „What-If“-Analysen

(Mürl, 2000: Pot. HW-Schäden am Rhein in NRW)

From THIEKEN (modified)
Verfügbare Schadendaten in Deutschland: HOWAS

Loss Data Base of Germany

HOWAS: Datenbank des Bayerischen Landesamtes für Wasserrirtschaft

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Nutzungssektoren</th>
<th>Schadensfälle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Private Wohngebäude</td>
<td>1735</td>
</tr>
<tr>
<td>2</td>
<td>Öffentliche Infrastruktur</td>
<td>165</td>
</tr>
<tr>
<td>3</td>
<td>Dienstleistungsbereich</td>
<td>623</td>
</tr>
<tr>
<td>4</td>
<td>Bergbau und Baugewerbe</td>
<td>68</td>
</tr>
<tr>
<td>5</td>
<td>Verarbeitendes Gewerbe</td>
<td>261</td>
</tr>
<tr>
<td>6</td>
<td>Land- und Forstwirtschaft</td>
<td>518</td>
</tr>
<tr>
<td>7</td>
<td>Garagen</td>
<td>648</td>
</tr>
<tr>
<td></td>
<td>insgesamt</td>
<td>4038</td>
</tr>
</tbody>
</table>

(Merz et al. 2004, NHESS, 4(1): 153-163)

HOWAS: Parameterliste pro Schadensfall

List of inventory parameters

- Jahr des Ereignisses, zugehörige Gemeinde
  Event date, municipal units
- Gebäudenutzung: vierstelliger Nutzungsc ode,
  Einteilung in sechs Wirtschaftsbereiche,
  z. T. Angaben zum Alter des Gebäudes und zur Bauweise
  Beispiel: 1110 = Einfamilienhaus, Massivbau, vor 1924
- Wasserstand: Höhe über Erdgeschossboden oder Kellerboden
- Schaden: Kellerschaden (Gebäude, festes/mobiles Inventar)
  Schaden im Erdgeschoss (Gebäude, festes/mobiles Inventar)
  Schaden am Grundstück
  Schaden an Nebengebäuden

Erhebung der Daten durch Sachverständige / Expertenbegehungen

Expert judgement

Einheitliche Kostensätze

Unique cost estimates
Reduzierung der Unsicherheit
Reduction of Loss uncertainties for loss estimation at private houses

Scaling by expert knowledge
Skalierung mit Expertenwissen:
- New / big buildings
- Valuable inventory
- No / short warning lead time
- long flood duration
- old / small buildings
- Low value inventory
- long warning lead time
- short flood duration

Mittlere Funktion: $S = 47 \cdot W^{1.2}$
Loss estimation

Case study Gleisdorf/Raab

816.325 Flood forecasting and flood protection
Clemens Neuhold, 30.05.2008
Case study area

Methodology

- Identification of hazards
- Definition of scenarios
- Modelling (hydrology, hydrodynamic, sediment transport)
- Damage potential evaluation
- Derive damage function
- Overlay utilization-inundation
- Persons at risk
- Monetary damages
- Communication of uncertainties and alternatives
Methodology

• Hydrology:
  – Input hydrographs of different recurrence interval
• Hydrodynamics:
  – Inundations due to different scenarios
• Loss estimation:
  – Detailed mapping
  – Census data
  – Questionnaires
  – Interviews with chief operating officers
• Expected annual losses
  – Coupling of damage/event - probability

Alternatives SM-NSM

• Alternative 1
  – Structural measures (implemented)
    • Dyke
    • Flood wall
    • Retention basin
• Alternative 2
  – Non structural measure (hypothetical)
    • Spatial planning
• Alternative 3
  – Non structural measure (hypothetical)
    • Spillway
### Results example: HQ$_{300}$

- Recent state of utilisation
- The red circle left picture marks a densely populated area
- Influence of spillway
- Persons at risk in residential houses could be reduced from 254 to 53 (2001).

From Neuhold (2008)
Conclusions

- Results strongly depend on the quality of data and information
- Risk assessment is subjected to uncertainty
  - Data
  - Parameters
  - Models
- Cost-effectiveness and benefit-cost analysis can be used as decision support
- Implementation of NSM can lead to a decrease of expected annual losses and a reduction of the residual risk

From Neuhold (2008)

Role play

Public Discussion forum of flood affected parties

The role play is based on the situation, that different parties are attending a public post flood event discussion. The parties reflect different degrees of involvement like victims of flood, politicians and decision makers (experts). Representatives of press (newspaper, television) are documenting / moderating the discussion.
Parties:

Victims:  - Farmer (Maize)
         - Private household (house) (Bungalov)
         - Small enterprise (carpenter) (Timber)
         - Fisherman (Salmon)
         - Weekend cottage

Press:       - newspaper writer (local press) (Blackink)
             - newspaper writer (national press)
             - TV moderator (Discussion leader) (Tewee)

Politician: - mayor of flooded town (Arwee)
             - district senator (Proud)

Experts:    - head of water management board (Waterlevel)
             - officer of hazard protection team (Jeff Help)
             - operator of upstream hydro power plant (Giga Watt)
             - assurance company

Victims

Farmer (Mrs. Maize / Marina Aigner)

Mr. Maize is a farmer producing both corn and maize (arable land) as well as milk (grass land). Unfortunately during the big flood most of his arable land was flooded due to a dam break and the total crop of maize was lost. Some people argue, that the conditions of the old dams were bad due to low maintenance. The recovery costs are only partly (50%) covered by the catastrophe fund. His farmland was never flooded in the past, but in recent years the flood events occurred more frequent and it can be expected, that the frequency of big flood will even increase due to climate change.

Private Household (Mrs. Bungalov – Martin Wolf)

The house of Mr. Bungalov is located in the centre of the town Bluewater. During the flood his house cellar was flooded and the water level rose up to 1 Meter above the zero floor. Damages were due to water and fine sediments. Also the car, which was parked in the cellar garage was totally destroyed. The warning by the hazard team was only one hour before the flood occurred. Surprisingly the entrance of water was not from the riverside, but rather from the backside of the house. The municipal community assumes the upstream hydropower as the main contributor of fine sediment.

Small enterprise (Mr. Timber -)

Mr. Timber is the owner of a carpenters enterprise. He has 8 employees. In his firm area he stores the wooden base materials. In the building machineries of high value are installed. The flood caused a damage of the 30% of the stored wood. But the highest loss was due to partial destruction of the machines, which lead to a three week interruption of the operational work. Years ago the settlement of the firm was attracted by some public funding given by the municipality of Bluewater City. The area was expected to be save due to dam impoundments.
Mr. Salmon is the president of the local fishing association. The big flood was associated with a high load of suspended sediment. It was argued, that this load was mainly driven by sediment release from the upstream hydropower plant. The spawn and juvenile fish species were totally destroyed. As a consequence of flood the higher vegetation on the bankments of the river were eliminated afterwards by the water authority to reduce potential obstacles and debry drift.

Myhome is a conservative newspaper strongly related with the governing party. Mrs. Blackink participates to the discussion forum to investigate the experiences of the flood hazard management and to write a report. The objective of the report is the documentation of the good collaboration of the catastrophy-teams and of the first aid initiatives of the public administration.

Mr. Tewee has to initiate and moderate the public discussion forum. The objective of the discussion is to assess the consequences of the flood, to hear the position of the victims, demonstrate the operational performance of the hazard teams, to identify weak points and future demands. Mrs. Tewee acts as a discussion leader with the objective to give all involved persons a voice.

As being the mayor of Bluewater City Mr. Arwee is the responsible authority for municipal planning including the definition of restriction zones (hazard mapping) for building construction. To attract enterprises to settle in his town he offered valuable construction grounds near the river, where also Mr. Timber settled with his enterprise. During the flood the hazard teams permanently reported the stage of actions to him and his team as he was accompanied by press and technical staff of the municipality.

Senator Proud of the black panther party is in his final year of the legislation period. His political focus was/is to strengthen the economy in rural areas. His party is both responsible for infrastructure and environment. He initiated the flood protection measures (embankments) of the upstream City of Damsite, where only minor flooding occurred during the event.

The water management board is responsible for the flood warning. As no direct warning system existed during the flood, the board had to rely on the online data of rainfall and runoff observations. Some of the runoff gauges were destroyed during the event. Therefore the gain of information was via telephone with partners and hazard teams being at the hot spots. The operational work was permanently interrupted by calls from press and suffering people.
Officer of hazard protection team (Mrs. Jenny Help – Sarah Wechner)

Mr. Help had to coordinate all different emergency teams like fire police, red cross, military services. The communication was not completely satisfying as only sparse information of upstream development were available downstreams. The teams could not estimate the development of flood (increase or decrease) during the event. It took quite a long time to organize the required materials (bags, sand) and transport.

Operator of upstream hydropower plant (Mr. Giga Watt – Adroan Danescu)

The hydropower plant at the river Brookley is operated as a storage power plant with approx. 70 Mio m³ storage capacity. The flood release is through a surface spillway. The operational emergency release sluice provides a maximum runoff capacity of 15 m³/s. To run the storage for flood retention, some forecast of the expected discharge is demanded. The in advance release is not allowed to exceed an annual flood.

Preparatory work and discussion:

Teacher:  - Definition of roles for students
           - short discussion of individual experiences
             and responsibilities
           - Provision of event description

Students:  - preparation for role (personal experiences, search
          for responsible actors, search for financial
          funding, etc.)
          - introduction of personal role during discussion
          - contribution to general discussion representing the
            assigned role (arguments, reply, etc.)
Goals and conclusions:

Goals:
- Recognition of different aspects and views
- Identification of obstacles in communication
- Proposal for improvements and demands
- Written final conclusions of all parties

Professional Resume:
- Did you find attention and understanding for your viewpoint
- Are solutions and compromises between parties possible
- Who should take responsibility for future flood management

Personal Resume:
- How did you experience your position during the discussion
- Did you feel handicapped by the language
- What are your recommendations to improve the discussion

Layout of the poster:

Format: portrait, A1 (height=84cm, width=59.4 cm)
Header: University, Institute, course title and ID
Title of poster
Authors (name and affiliation)
Structure of content
- Introduction
- Subtitles
- References (papers, books, url, etc.)

Keep a nice balance of text and figures. The clients for your poster should be the public, not experts.
Submit the file to Prof. Holzmann before 17. 6. 10:00h, he will print it at BOKU.