A Meta-disciplinary Approach

Educational Efforts on Water

Water scarcity problems require a meta-disciplinary approach. Therefore, meta-disciplinary education activities are needed to tackle the likely future challenge of water resources management. To start the process meta-disciplinary education the Centre for Geoinformatics (Z_GIS) at the Paris-Lodron University Salzburg (PLUS) hosted a Winter School on "Analysing, mapping and evaluating spatio-temporal water scarcity problems". The event took place from February 7 - 18, 2011 and the outcome and proceedings are described below.

By Hermann Klug

Water Scarcity

Water scarcity problems in Europe and the Alps are of spatial-temporal nature and result from limited natural water provision and high water demand. Water resources demands are inherently meta-disciplinary and is affecting environment with its flora and fauna but also human with respect to near all socio-economic sectors. In parts of the world and also Europe water shortages have reached crisis points. This is on the one hand based on climate change with rising temperature values resulting in higher evapotranspiration and seasonally lower precipitation rates. On the other hand, water demand in certain sectors is constantly increasing. This for instance has been valid during the past two decades for agricultural water use across Europe and New Zealand. But also public water demand has increased and is influenced by numerous factors such as population growth, household size, technological progress and most of all consumer behaviour. Especially tourism can markedly increase seasonal public water use, especially in summer or winter tourism dominated areas.

While climate change analysis made progress in the last years, water demand analysis towards a water resources management approach is still in its infancies. Nevertheless, the European Union recognised the challenges posed by water scarcity and droughts in a 2007 and 2009 communication. This might be a result of the year 2003 where major European areas suffer from water scarcity, also the Alps in Europe. Considering recent papers from European Environment Agency (EEA) water shortages and their countermeasures can only be suitably addressed with updated water consumption measures at high spatial and temporal scales. This will guide politicians and decision makers towards locations and scales of water stress for human and environment. In connection with information on water availability, this approach might help in analysing trends of water scarcity and will guide decisions towards a more sustainable use and allocation of the water resource.

With the Water Framework Directive established in the year 2000, most analysis and measures are placed on river basins. However, information on River Basin Management Plans especially in huge areas do not provide sufficient information on the problem of regional or even local problems to water shortages. Thus, information should be available on a monthly or at least seasonal basis, since averages on an annual

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basis are unable to detect time and space relevant peak levels of water stress.

Present findings show the shift of water shortages from Southern Europe towards the north. This means water scarcity is presently also affecting the Southern Alps. But also the inner Alps regionally suffer from available water decrease. Measurements from Carinthia and Slovenia report a constant decrease of ground water recharge during the last decades. These studies also underpin that significant variance in demography, economic structures, cultures and values, land use pattern and distribution of public and private partnerships have effects on the scale of water demand.

Water Scarcity Projects

Water is nearly ubiquitous and of trans-disciplinary nature. It can only be understood and managed in an integrated way. In the EU (e.g. the Alp-Water-Scarce project) and around the world (e.g. the GLOWASIS project, www.glowasis.eu/) a great deal of research are linked to the quality and quantity of water, drinking water supply, water use and management, water scarcity and water demand and supply crisis. Even New Zealand, well known as a very water rich country, recently addressed the water quality and water quantity issue. In a Sandpit on surface and groundwater bodies ten interdisciplinary European experts (Austria, Italy, United Kingdom, The Netherlands, and Portugal) and 12 participants from New Zealand identified together with stakeholders and mentors the challenges of water recourse overexploitation and the lack of water information and procedures of water allocation. This explains that water issues are manifested in a large number of disciplines and meta-disciplinary education activities are needed to tackle the likely future challenge of water resources management.

Educational Efforts on Water Scarcity

To start the process meta-disciplinary education the Centre for Geoinformatics (Z_GIS) at the Paris-Lodron University Salzburg (PLUS) hosted a Winter School on "Analysing, mapping and evaluating spatio-temporal water scarcity problems". The event took place from February 7 - 18, 2011 and was co-financed by the Alp-Water-Scarce-Project, the Socrates / Erasmus Intensive Programme (IP) under the umbrella of the Lifelong Learning Programme and co-organized with the six partner universities from University of Savoy (France), Aristotle University of Thessaloniki (Greece), University of Pecs (Hungary), Gazi University (Turkey), Ca´Foscary University Venice (Italy) and the University of Ljubljana (Slovenia).

The intensive programme was clearly aiming at a multidisciplinary audience of international students from social, economic, and physical science sharing a common background in spatio-temporal modelling and awareness rising of water availability, water demand, and water supply. Because of the very complex topic, geographies, geologists, meteorologists, hydrologists, climatologists, agronomists, pedologists, sociologists, economists, and also politicians were welcome to participate in this event. Applicants were screened regarding their prior knowledge in GI Science and their ability to clearly communicate their interest in water management, hydrology and climatology. The selection process further aimed at a geographically diverse roster of students.

Twenty-eight MSC/PhD students and participants from private companies (12 female, 16 male) from nine disciplines and thirteen countries (Italy, Germany, Greece, Austria, Turkey, Slovenia, Hungary, France, USA, Bolivia, Nigeria, Iran, und Bangladesch) studied methods and techniques to assess the interplay and mutual benefits of GIS, Hydrology and Climate Sciences. In altogether 48 presentations, hands-on sessions and group works 28 instructors lectured participants e.g. in semi-operational data capturing methodologies using ArcGIS ModelBuilder and python scripting. The core tasks of spatial modelling have been supported with readily available and recognized software products. In order to encourage cross-vendor software skills, students worked with different software products during the course of the programme. These products were, PostGIS, PostgreSQL, SGEMS, and others open source products. Participants were provided with an overview of planning procedures, gained skills to apply the theoretical framework and studied methods and techniques to assess regional space and time related water scarcity problems. These experiences have been deepened by statistical modelling and interpolation routines of point datasets before using this data for different hydrological modelling purposes. Participants gained special insight in output visualisation skills. However, visualisation was not only done in advanced 3D visualisation but also in a WebGIS environment.

Programme

The intensive programme in depth focused on the climatological, hydrological and socio-economic processes and functions inherent in landscapes across Europe related to water scarcity. The IP analysed local and regional water resources constraints, present ecosystem examples of water scarcity problems from north to south and east to

west in Europe. For water management and planning purposes it is necessary to analyse the main processes, potentials and functions operating the system and contributing to the demands and requirements of society at a typical meso-scale of 1:50.000. Students were provided with an overview of planning procedures (data acquisition, data preparation, data processing, and result interpretation) and gained skills to apply the theoretical framework. Participants studied methods and techniques to assess regional space and time related water scarcity problems. Students learned how to implement an early warning system against water shortage based on existing operational methodologies (e.g. Meteorisk) and to characterize main anthropogenic and natural defined surface water and groundwater systems. They further learned how different water usages such as drinking water, hydropower, agriculture (irrigation), tourism and artificial snow production play together and affect water shortages in specific regions. Risks of droughts were studied and assessed using generic tools from spatial analysis and advanced techniques for spatial, hydrological, regional and sub-basin modelling. Participants were guided from "simple" discipline oriented approaches to more sophisticated multidisciplinary, holistic methods aiming at an integrated assessment of water management and planning.

With the skills gained in the Winter School, participants returned to their home country contributing to the dissemination of advanced knowledge and technical capabilities advocating the use of sound policy decisions which are based on concepts, approaches, theories and methods in the domains of Hydrology, Climatology and Social and Earth Sciences applied to water scarcity problems.

Excursion

On a mid-event field trip to the Salzach Valley (Werfenweng and Großarl) participants got in contact with local stakeholders and politicians to elaborate on water scarcity problems mainly referred to topics in the winter season. The excursion gave an overview of the strategic water and energy management and the use of artificial snow production facilities which guaranty good snow conditions for tourists throughout the whole winter season. Furthermore discussions with the town mayor in Werfenweng and tourism experts, hoteliers, and tourism managers including the cable car company in Großarl helped to get an impression of the differences of water consumption during summer and winter season. Present water consumption and future water demand was discussed on the basis of changing tourism activities and artificial snow production. At the end of the field trip, an approximately 3 km nocturnal sledge ride and a drink in a cosy, warm mountain hut has been the final activity.

The consortium of universities proposing this ERASMUS Intensive Programme have joint research experience and are working together towards a tighter integration of their postgraduate programmes. Making the participation in international Winter Schools a highly recommended and in some cases even compulsory component in study programmes has been an important step towards furthering the internationalisation and 'European dimension' of study programmes. All partner institutions have a strong focus on Water / Spatial Sciences and Hydrology and accredit the course at their home universities. Some of the institutions work together in the Alp-Water-Scarce project and would like to transfer their research experience into course development and teaching.

Dr Hermann Klug, Researcher and Project Manager at University of Salzburg, Centre for Geoinformatics

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www.zgis.at/summerschools
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www.alpwaterscarce.eu
FRENZ Freshwater Sandpit:
www.frenz.org.nz/Activities/Sandpits/Sandpit1FreshwaterResources.aspx