ClimateWater Final Symposium

Budapest 13-14 October 2011

Report on WP4: Identification of research needs
Summary of Sub-WP reports 4.1-4.12

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Content of the Report on Research Needs:

WP 4.1 The simplified IMAU

WP 4.2 Ecohydrological strategies

WP4.3 Climate change induced pollution

WP4.4 Alternative waste water strategies

WP 4.5 Water stress and drought

WP 4.6 Drinking water supply

WP 4.7 Groundwater

WP 4.8 Sustainable agriculture

WP 4.9 Paleogeology

WP 4.10 Hydropower and navigation

4.11 Flood forecast and defence

A scoring matrix was developed to be filled by each Project partner. The simplified scoring matrix is shown in the Table

Table for the simplified scoring for the estimation of the index of "Impact Magnitude and Action Urgency [IMAU]"

Impact as of WP2	West Europe		Middle Europe		East Europe		North Europe		South Europe		Remark
	magnitude	urgency	magnitude	urgency	magnitude	urgency	magnitude	urgency	magnitude	urgency	
WP 2.1.1: Direct impacts on the life and health of the population and the wealth of the nations											
Floods and excess water											
Water supply											
Water quality											
Drought and scarcity											
WP 2.1.2 Indirect impacts on the society through direct impacts on economic activities											
Water management											
Agriculture and food											
Navigation											
Energy and power prod											
Other industries											
Recreation and tourism											
Landuse planning											
WP2.2 Water-related impacts on nature, the terrestrial and aquatic ecosystem											
Aquatic ecosystems											
Terrestrial ecosystems											
Terra-Aqua Ecotones											

WP 4.1: IMAU, Research needs according to the magnitude of water-related impact and the urgency of counter action, by P1 VITUKI

The partners were also requested to give explanation of their scores for both the magnitude of impact and the urgency of counter action.

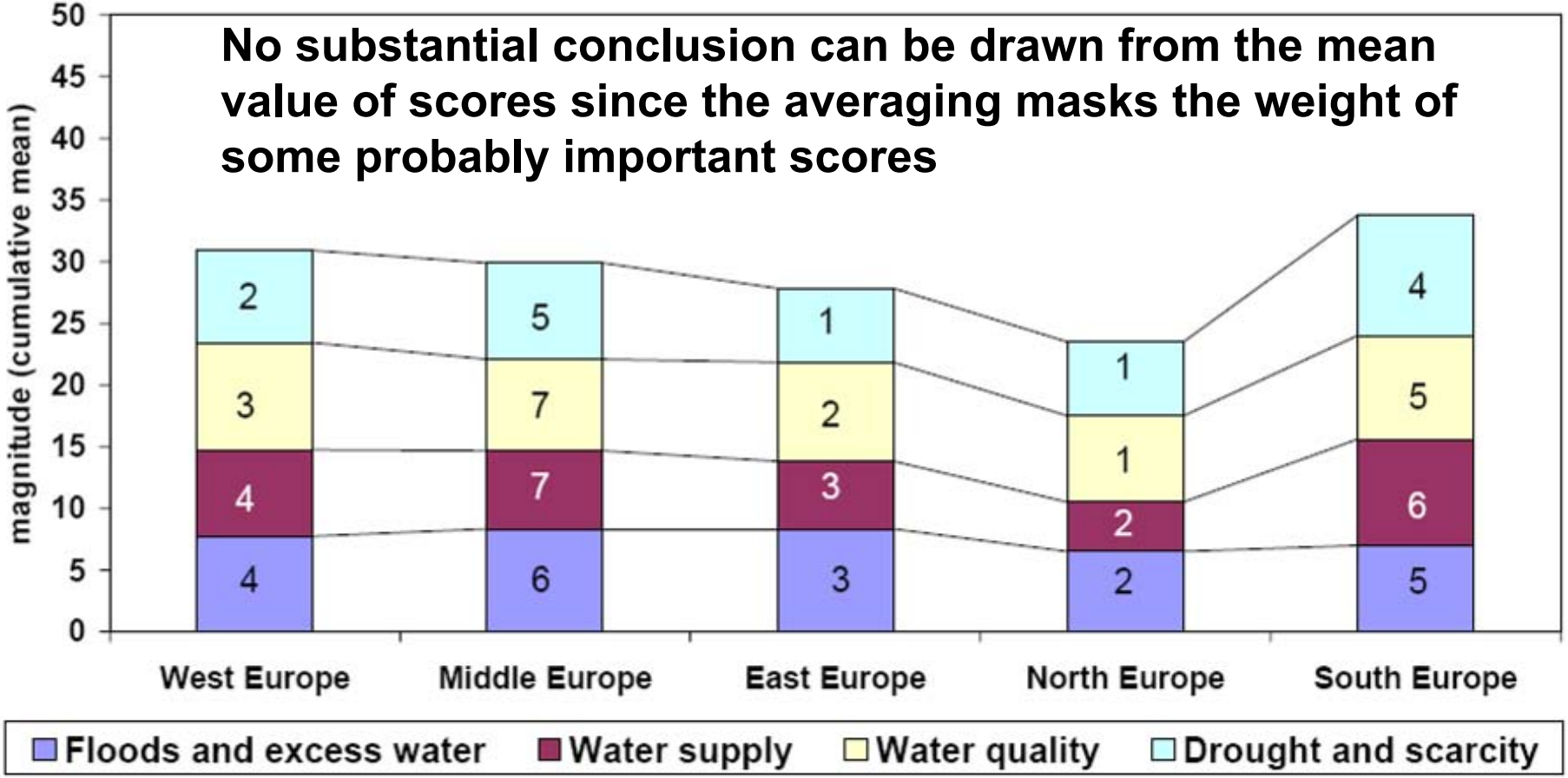
Table for the simplified scoring for the estimation of the index of "Impact Magnitude and Action Urgency [IMAU]" with explanation of the scoring (an example as that of Partner 1, the Co-ordinator)

Impact as of WP2	West Europe magnitude	West Europe urgency	Middle Europe magnitude	Middle Europe urgency	East Europe magnitude	East Europe urgency	North Europe magnitude	North Europe urgency	South Europe magnitude	South Europe urgency	Remark
WP 2.1.1: Direct impacts on the life and health of the population and the wealth of the nations											
Floods and excess water			9	10							Flood impact magnitude is very high overall in middle Europe and seem to be growing in frequency and intensity with special regard to small mountain creeks, It gets the highest score for the urgency of action also in connection to the extreme danger of flooding of populated places and the potential of causing epidemics
Water supply											
Water quality			10	10							Water quality got the highest score because in addition to the known and much discussed impacts of high temperatures, low flows, high diffuse loads of many pollutants a recently observed serious problem is the bursting of wastewater up from the drains (manholes) of populated places causing very high contamination and health risk.
Drought and scarcity			9	10							In many places –like in Hungary- serious drought problems might follow the flood induced problems on the same site and in the same year. And the observed growing drought is real problem for food production in these places as they were already on the verge of existence with the 400-500 mm earlier multiannual average precipitation.
WP 2.1.2 Indirect impacts on the society through direct impacts on economic activities											
Water management			6	9							Here we consider water management as policy- or regulation-making activity (since actual-physical management falls into other water related blocks). The impact magnitude is medium and already induced water managers to change policies. The urgency is rather high as both too much and too little water and the danger of releasing polluted water demands new policies especially in international river basins. These new policies (conventions, agreements) must take care of securing the equitable use of water quantity and the assurance of avoiding pollution (which is not assured by any existing policy, agreement, convention due to foot notes and annexes that allow the escape from such obligations).
Agriculture and food			8	9							As in a large part of Middle Europe agriculture should and could provide food for entire Europe the impact of too much, too little and too polluted waters is rather large. Even larger is the urgency of action, since several "ecohydrological" actions offer the solution and it can and must be provided, for securing the living of people. These actions can serve the solutions of other problems (flood protection, nature conservation etc.). It is to be noted that the cost will be much more than what the present policy makers think of and are willing to spend.
Navigation			8	8							River navigation is rather seriously impacted by the decreasing flows of drier regions and might need either the reform or rather replacement of the entire cargo fleets or the full canalization (impoundment) of the rivers Maritime navigation will be rather hit by the rising see levels and growing wind induced surges, needing the strengthening of harbours and ports (and/or building of protection walls.
Energy and power prod			4	4							Much of Middle Europe is low in hydropower and therefore the impact magnitude is relatively low. Urgency of action is similar and there is a warning not to replace missing energy by such biofuels, which might be grown in places instead of food products.
Other industries			5	5							Most industries need water and many will be impacted by too little or to much water. Nevertheless appropriate water management and nature conservation policies (fees, charges, penalties, subsidies) may relatively easily induce the industry owners to solve the climate change induced problems.
Recreation and tourism			6	8							Recreation and tourism that may even be positively impacted in warming northern places could be rather severely hit by growing heat and changing bathing waters, drying out nature. Urgency of action is higher as the ecohydrological water management of places of interest could also be a helping to solve other climate change induced problems.
Landuse planning			5	10							There is not much impact on the possibilities of landuse planning, but it is one of the major tool for the ecohydrological management actions that can solve a series climate change induced problems and can (should) basically influence RBMP in helping to aid climate change induced nonpoint source pollution.
WP2.2 Water-related impacts on nature, the terrestrial and aquatic ecosystem											
Aquatic ecosystems			7	7							Nature and within this terrestrial and aquatic ecosystems will be rather severely impacted by too much and too little water and especially by growing water pollution. Urgency of action is similarly high and the solution lies with the appropriate management of water with special regard to terrestrial-Aquatic ecotones the high level protection of which could provide a tool for the entire ecohydrological River Basin Management Planning.
Terrestrial ecosystems			7	7							
Terra-Aqua Ecotones			7	7							

This unreadeable table shows the Co-ordinator's own scores and explanations for Middle Europe

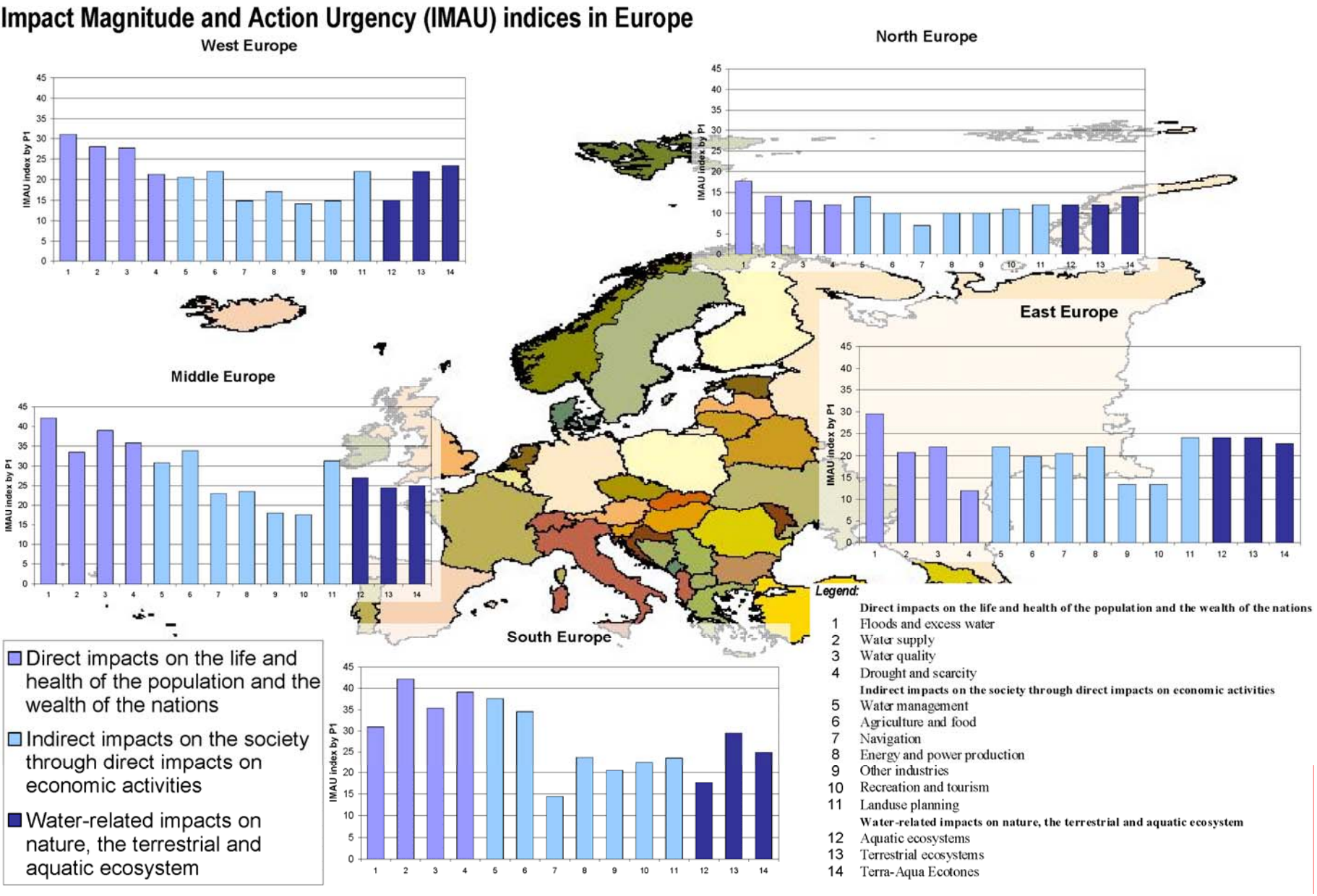
The scoring method of the simplified approach of Partner 1, is also simple and it reads as follows: Index or Indicator= (Arithmetic mean of the scores of Impact magnitude + Urgency of action) x (Square root of the number of answering partners). Reasoning: The weighting multiplier might (?) lessen the weight of too small number of partners voting and of much differing answers.

Direct impacts on the life and health of the population and the wealth of the nations

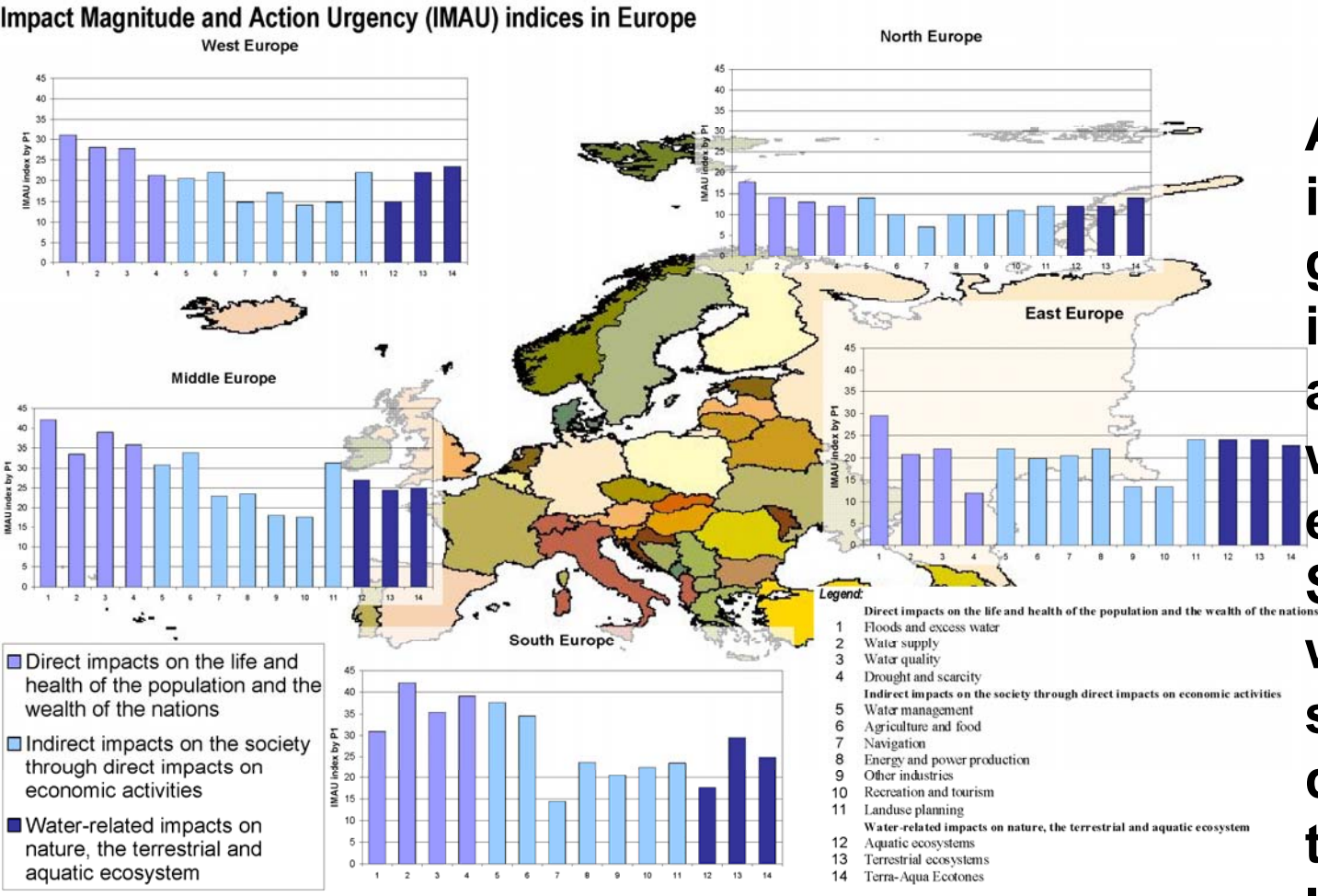


The first series of figures shows the actual scoring of Partners. The number within the block of a column is the number of partners giving scores, while the vertical size of the column is the 1-10 arithmetic average magnitude of the score

Impact Magnitude and Action Urgency (IMAU) indices in Europe



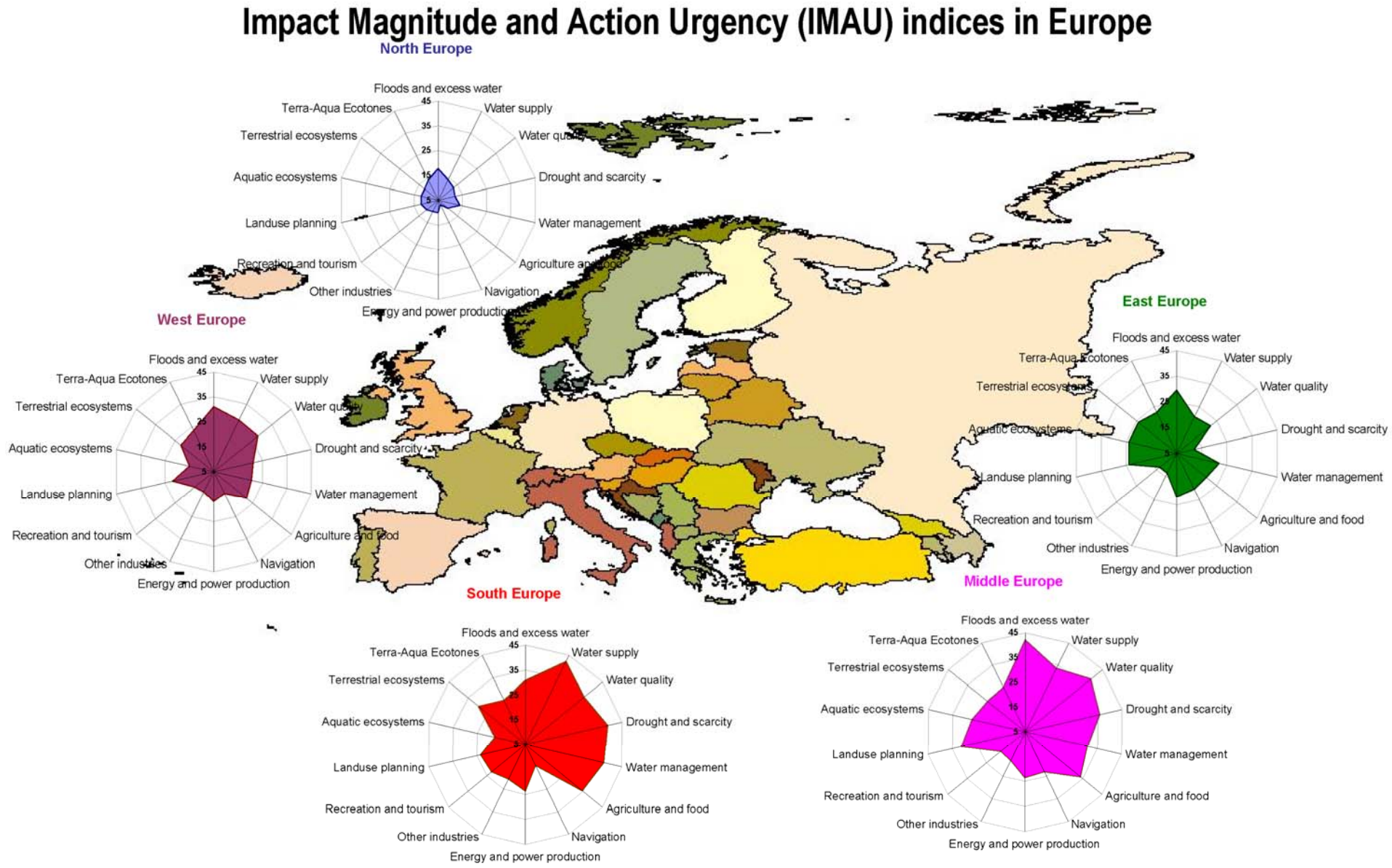
Some conclusions may be drawn from another way of data processing shown in the Figures (The figures illustrate quite well the major conclusions that are well known to all scientists and managers (policy makers?)

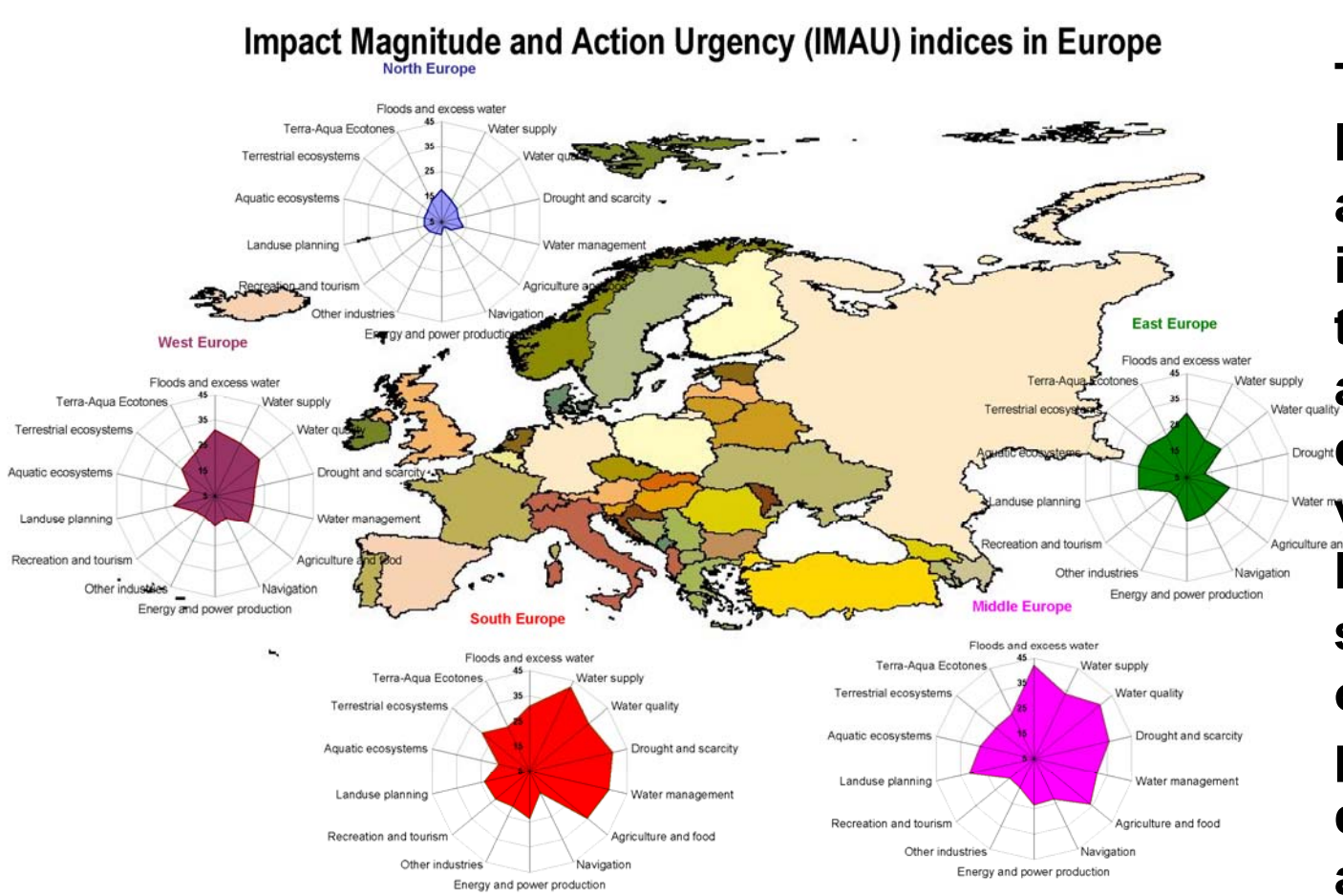


Among direct impacts flood got the highest indicator value all over Europe with the exception of South Europe where water supply and drought are the dominating IMAU values.

In among the indirect impacts agriculture and food production values are high, while landuse planning seems to need urgent development. Impact magnitude and action urgency in the terrestrial and aquatic ecosystems and their ecotones got rather uniform values with the exception of Southern Europe, where terrestrial ecosystem got the highest value

Another type of illustration of the IMAU values was made with the SPIDER diagram. The conclusions which can be drawn from this figure are similar to those above.



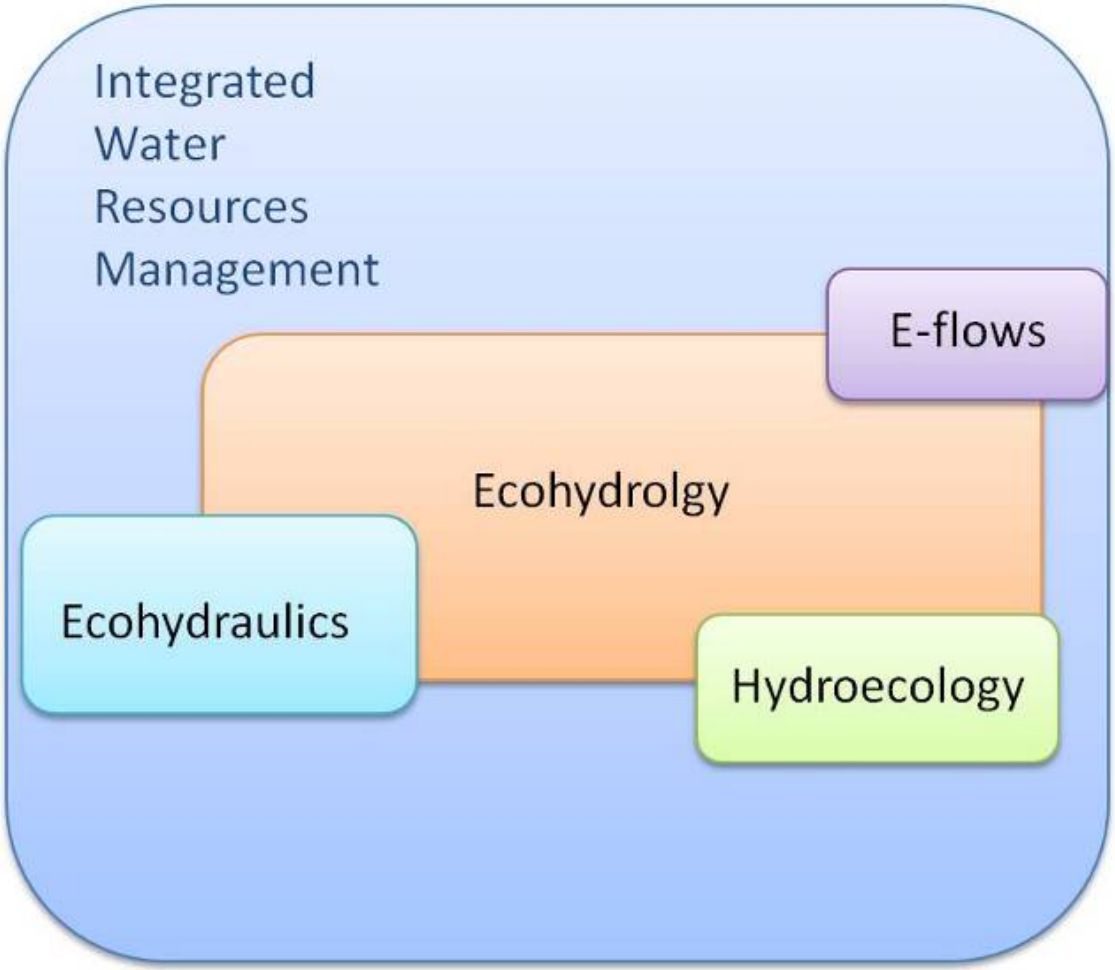


A conclusion from this simplified IMAU method is that in spite of the simplicity it yields the expectable action urgency in the investigated climate change impact fields. Nevertheless we also might approve the Consortium decision made in the first Rome meeting, namely that no index can give much real help to solve the problems they were created for.

The high flood IMAU values are also clear in this illustration, while the water supply and drought dominating IMAU values of Southern Europe can also be seen. The urgency of landuse planning development is also clear. The small values of North Europe indicate the lack of scores for this region

Do not forget that one of the most Urgent counter Actions to alleviate the impacts of climate change is to learn what happens and thus to increase monitoring also with field measurements, like what the co-authors of the IMAU presentation are doing here in two other EU projects. This will also support the Ecohydrological approach needed

WP 4.2: Ecohydrological water and ecosystem management strategies by P7 UVIEN



The authors wrote that: An ecohydrological approach in water management postulates detailed knowledge of ecosystem interactions and site specific hydrology. Other concepts in the field of water management are Integrated Water Resources Management (IWRM), hydroecology, Environmental Flow and ecohydraulics. These concepts are closely interconnected as shown in the Figure

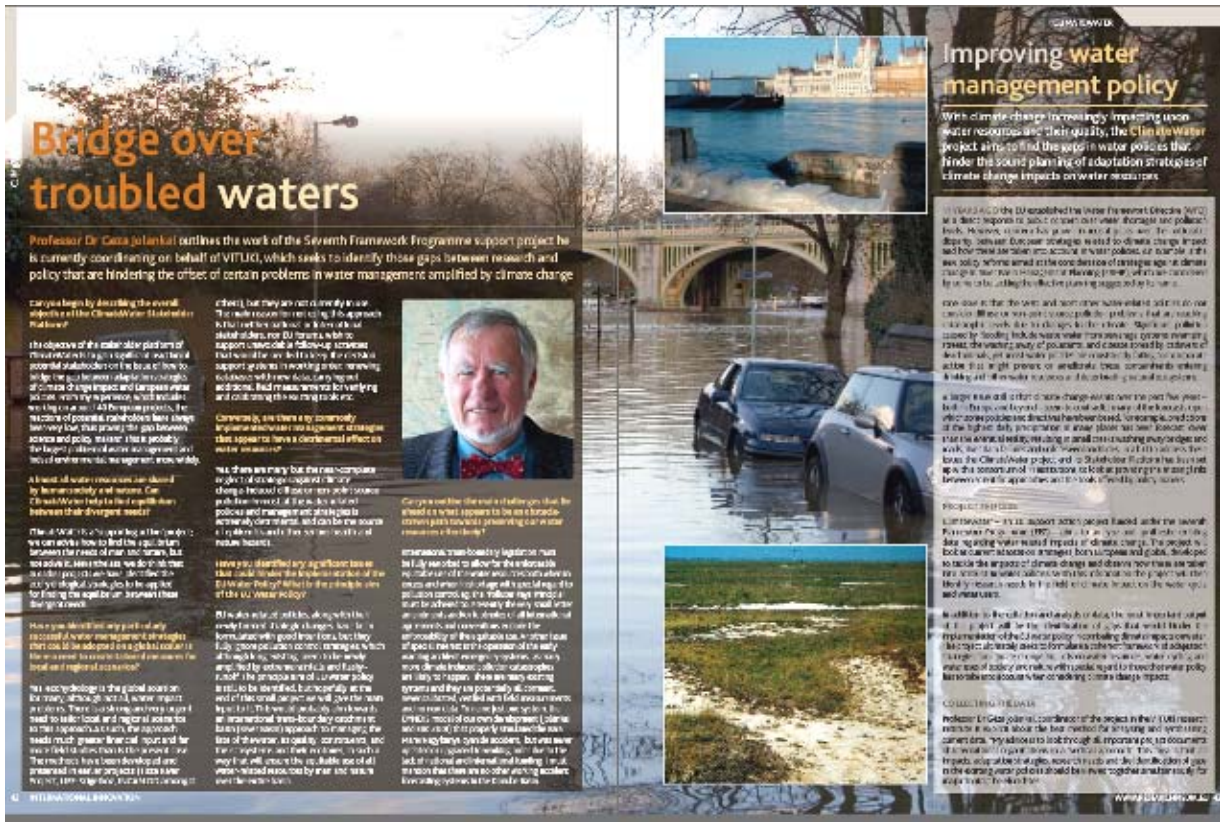
The authors surly will explain the source of the figure and what E-flow means (JG: in what units?)

Flooding after heavy rainfall in Vienna, July 2010 (Credits: ORF, Birgit Hadler)

Natural cooling units like vertical gardens or green roof tops are proposed for implementation in urban planning and architecture. Larger areas of vegetation covered

The Co-ordinator strongly believes that this is the major climate change impact of very serious health risk when combined sewer outbursts inundate streets of large cities

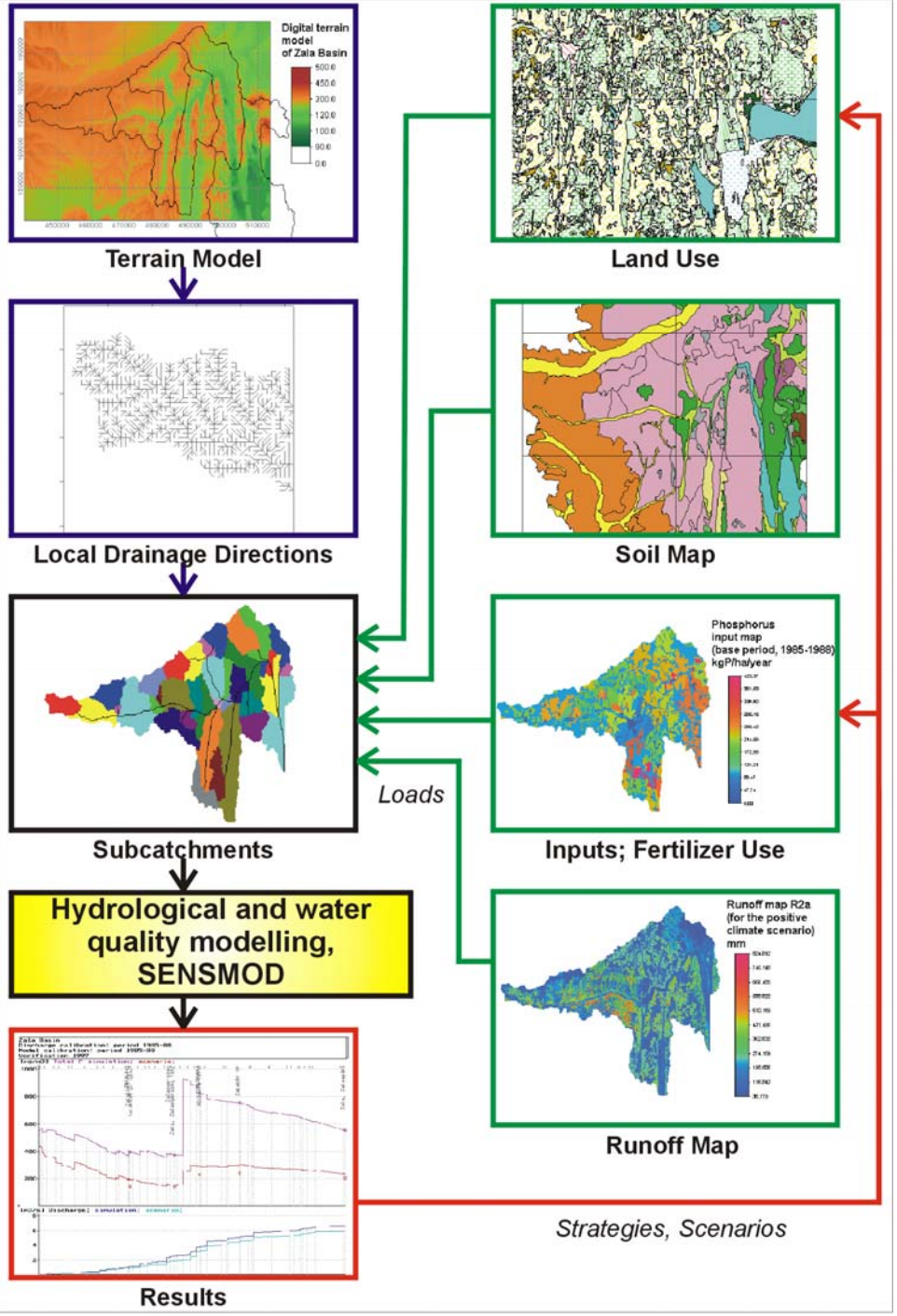
The approach I offer as a tool for solving some of the climate-change adaptation issues was developed at UNESCO in the framework of the Ecohydrological Programme (managed by myself upon my official commissioning by the that time head of Science), It was carried out as a kind of continuation of the ecotone programme that was also referred above. The essence of this approach was very recently (See Figure below for the cover page and the publication) published in April 2011 and is available as hard copy publication. The publication can also be downloaded from the homepage of our project



The essence of ecohydrology is:

to save aquatic ecosystems by indentifying sources of degradation problems (sedimentation, excess nutrient loads, other pollutants, too little or too much flow) and find hydrological and pollution control solution (also by modelling), while enhanced ecosystems will provide means of controlling flows and water quality.

Research needs can also be summarized as those into ecohydrology (strategies of ecology, hydrology, hydraulic construction and pollution control of point and nonpoint sources)



Another important feature of ecohydrology is that modelling might give help for the designing of the appropriate management strategies. In earlier EU projects (*INCAMOD, The Tisza River Project, the LIFE Szigetkoz Project*) we have further developed a relatively simple modelling tool called SENSMOD (*Jolánkai, 1986, 1992*). In my publications and university lectures related to ecohydrological subjects the Figure shown here frequently appears. It is a kind of flowchart for catchment basin management and design using hydrological and ecological models. It was created from the INCAMOD project results for the Zala river catchment Hungary

WP 4.3: Research into climate change induced causes of pollution by P8 UNILEI

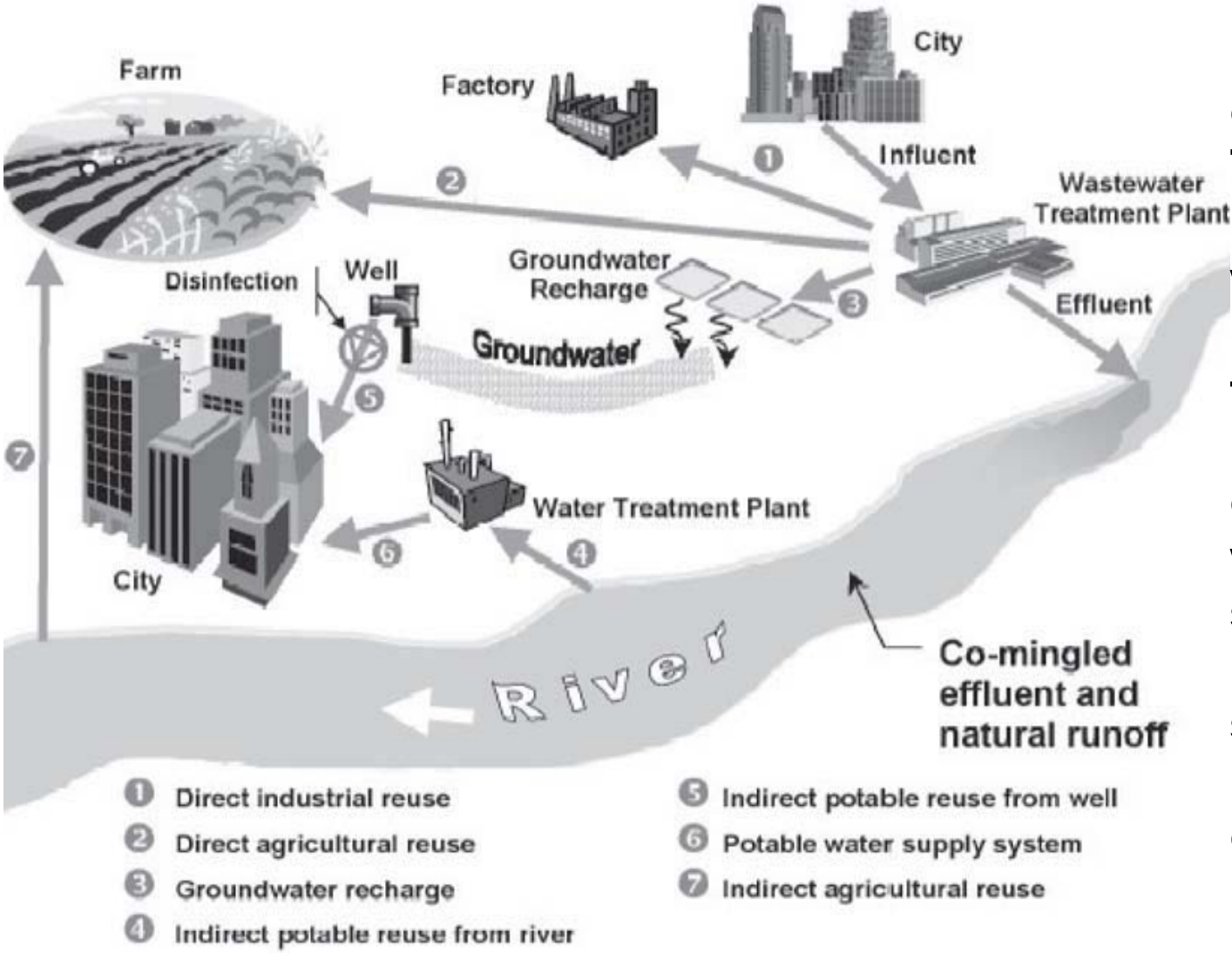
An important paragraph from the authors: A general conclusion from the analysis of many of the Climate-Water project documents and publications, is that the increasing frequency and intensity of rainstorms and the accelerated melting of snow cover will result in additional pollutant loads of runoff-induced non-point source origin. Another very general conclusion is that the weight of non-point sources is increasing with the increase of sewage and wastewater treatment investments (a prerequisite in complying with the Water Framework Directive). It is also a well-known general conclusion in the field of water pollution control, that non-point sources have dominated the overall pollutant budgets for many parameters (e.g. nutrients, BOD, COD, many micropollutants) in practically all densely-populated catchments of the world for many decades.
The overriding research need for non point-source pollution is the need for models which can be accurately calibrated and verified through extensive field work studies and continuous monitoring at the catchment scale.

One of the reasons is that due to WFD point sources of pollution are being rapidly eliminated (treated) all over Europe and thus the weight of non-point sources is increasing every day.

The other one is the above also mentioned climate change induced growth of the severity on NPS runoff loads both in urban and in rural-agricultural environment. The highest ever daily precipitation and rainfall intensity, measured in many regions in Europe results in catastrophic washing away of all waste disposal sites and in the bursting out of waste water from sewers, which becomes extremely hazardous when combined sewers are involved and untreated sewage water flows over the streets.

Bursting sewer in Miskolc, Hungary, 2011

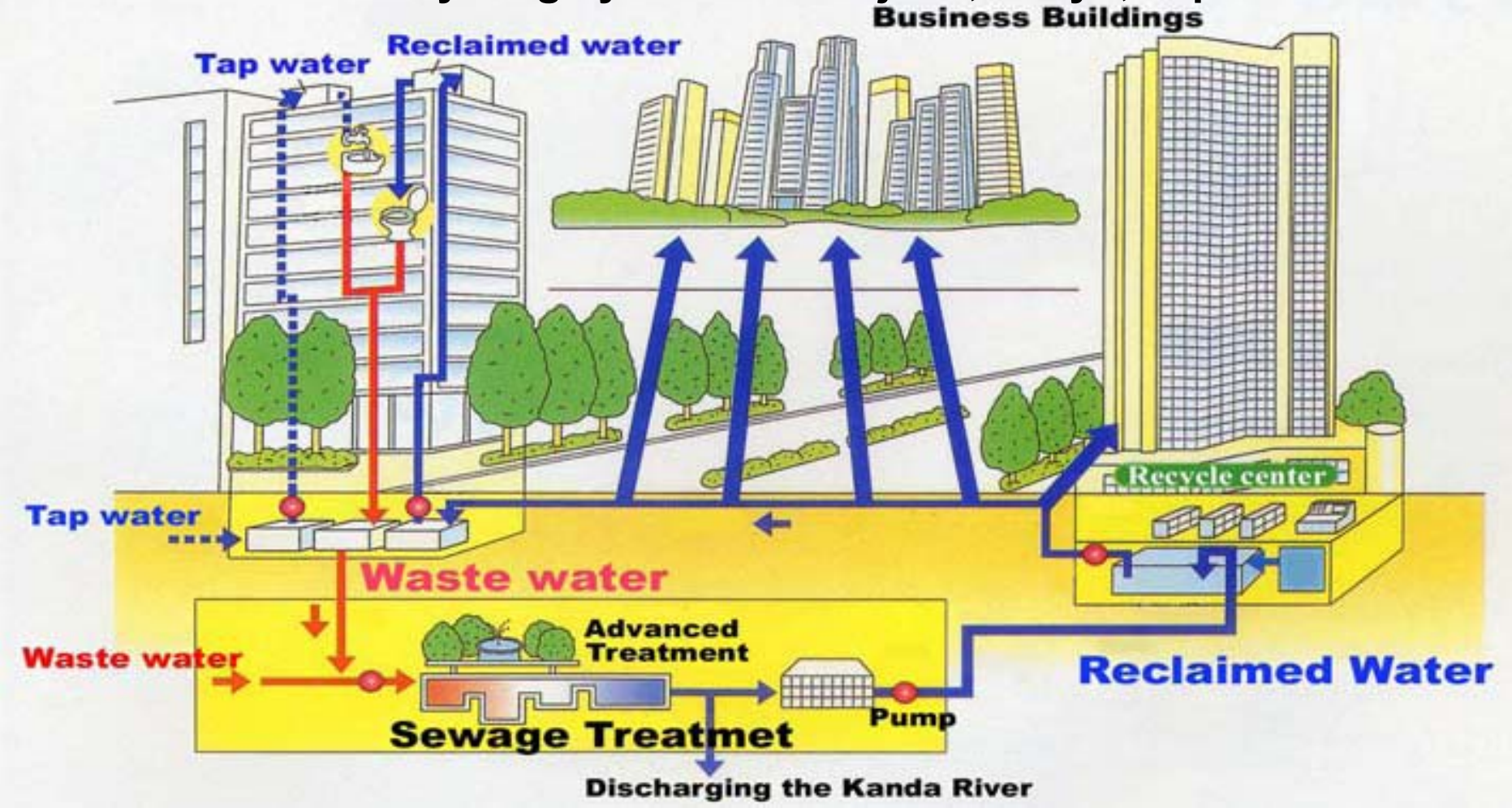
WP 4.4: Research into alternative waste- and sewage water treatment and reuse technologies by P3 CNR-IRSA



From conclusions:
To solve these problems, wastewater managers and the public must begin to consider wastewater as a source of water besides that as a source of products that can be treated, recycled.

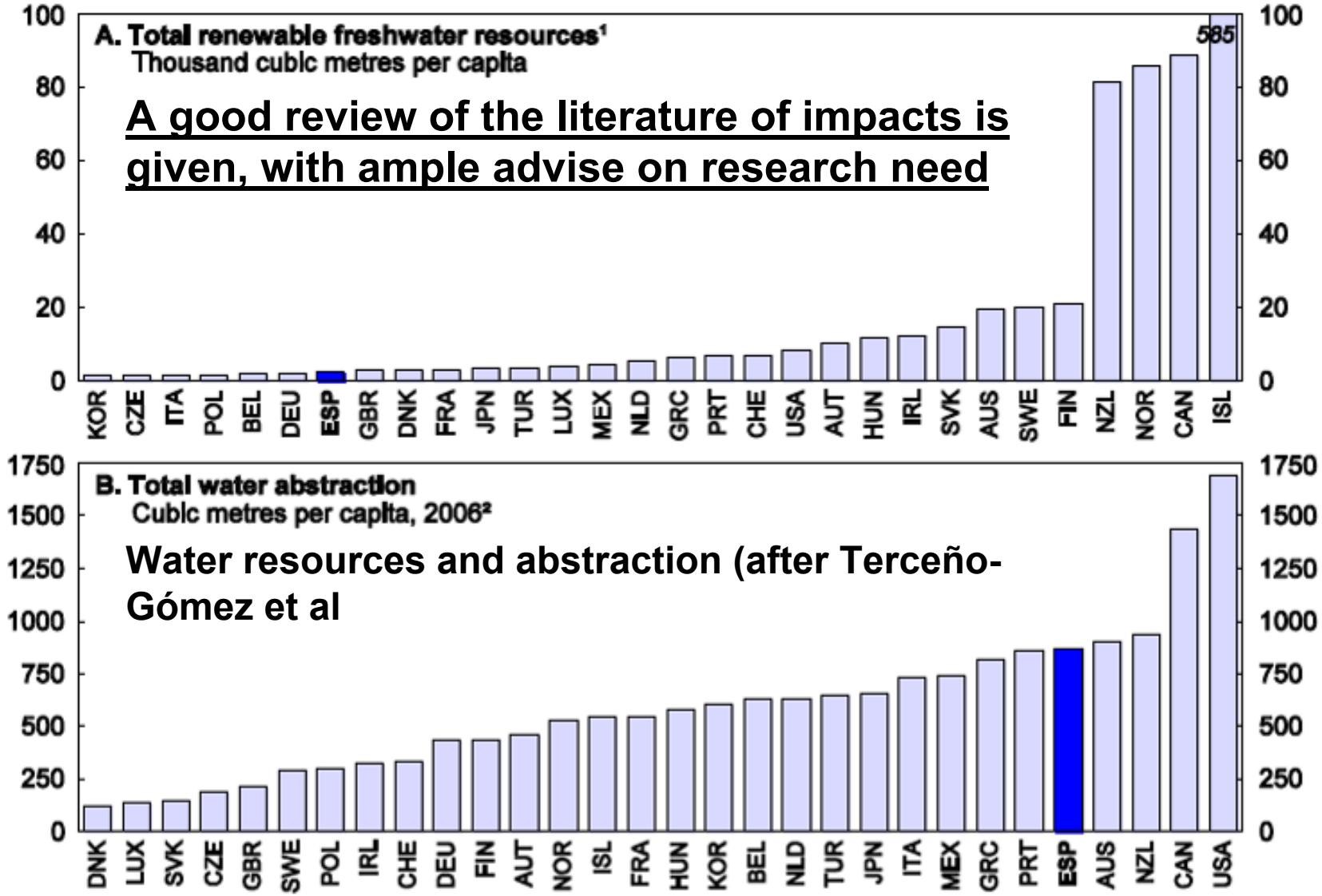
Water cycle with included wastewater treatment and reuse (after Angelakis and Durham, 2008).

Scheme of area recycling system in Shinjuku, Tokyo, Japan

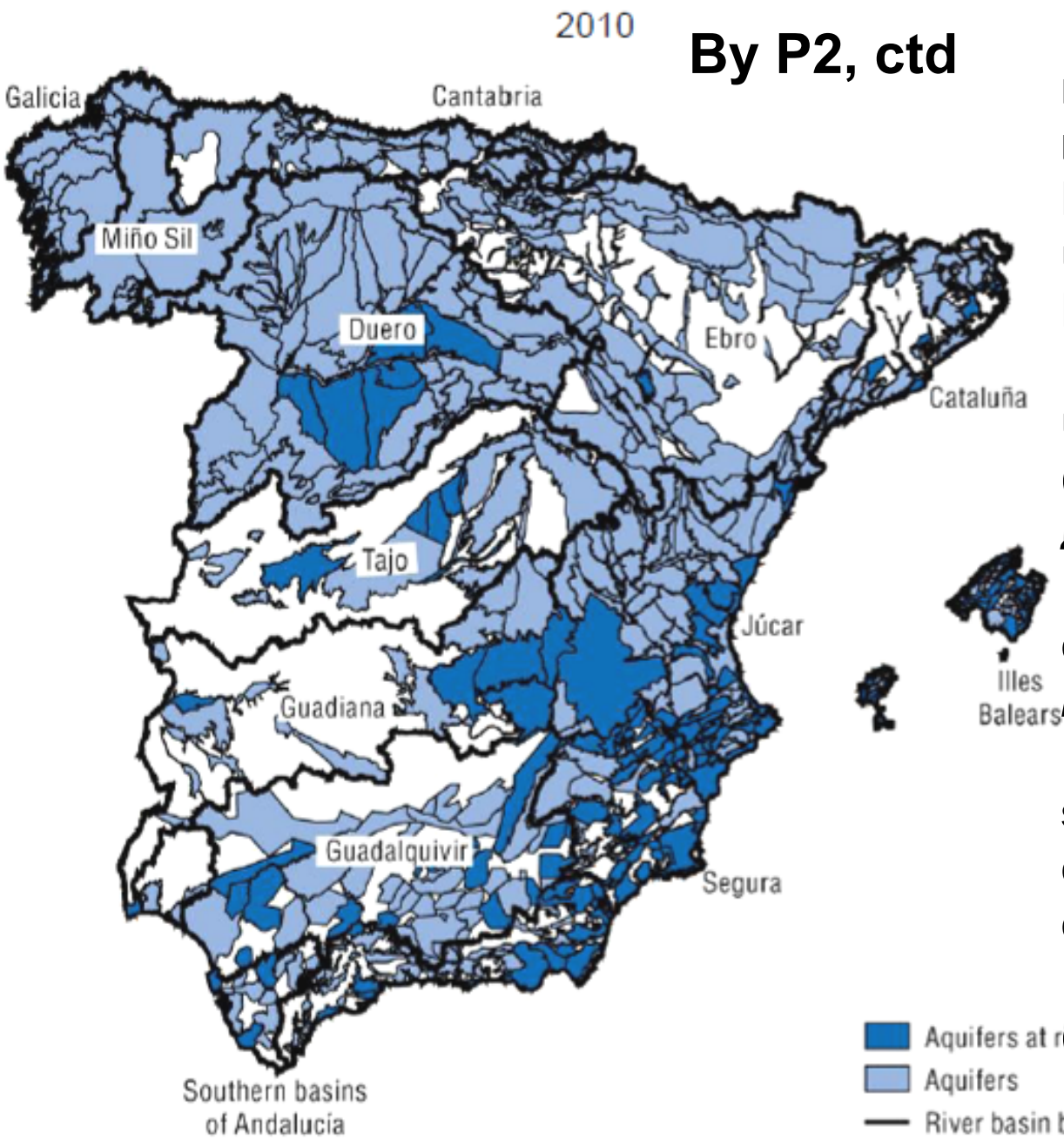


JG's comment : There is a long list of strategies in the report by P3, all good ones, but I am strongly against the one called „ Expanded use of wetlands for wastewater treatment"!! This is against an European Nature Conservation agreement. Except wetlands to be abandoned for some other reason, this strategy is advisable only with the construction of artificial wetlands.

WP 4.5: Research into water stress and droughts, by P2 UNIDEB



By P2, ctd



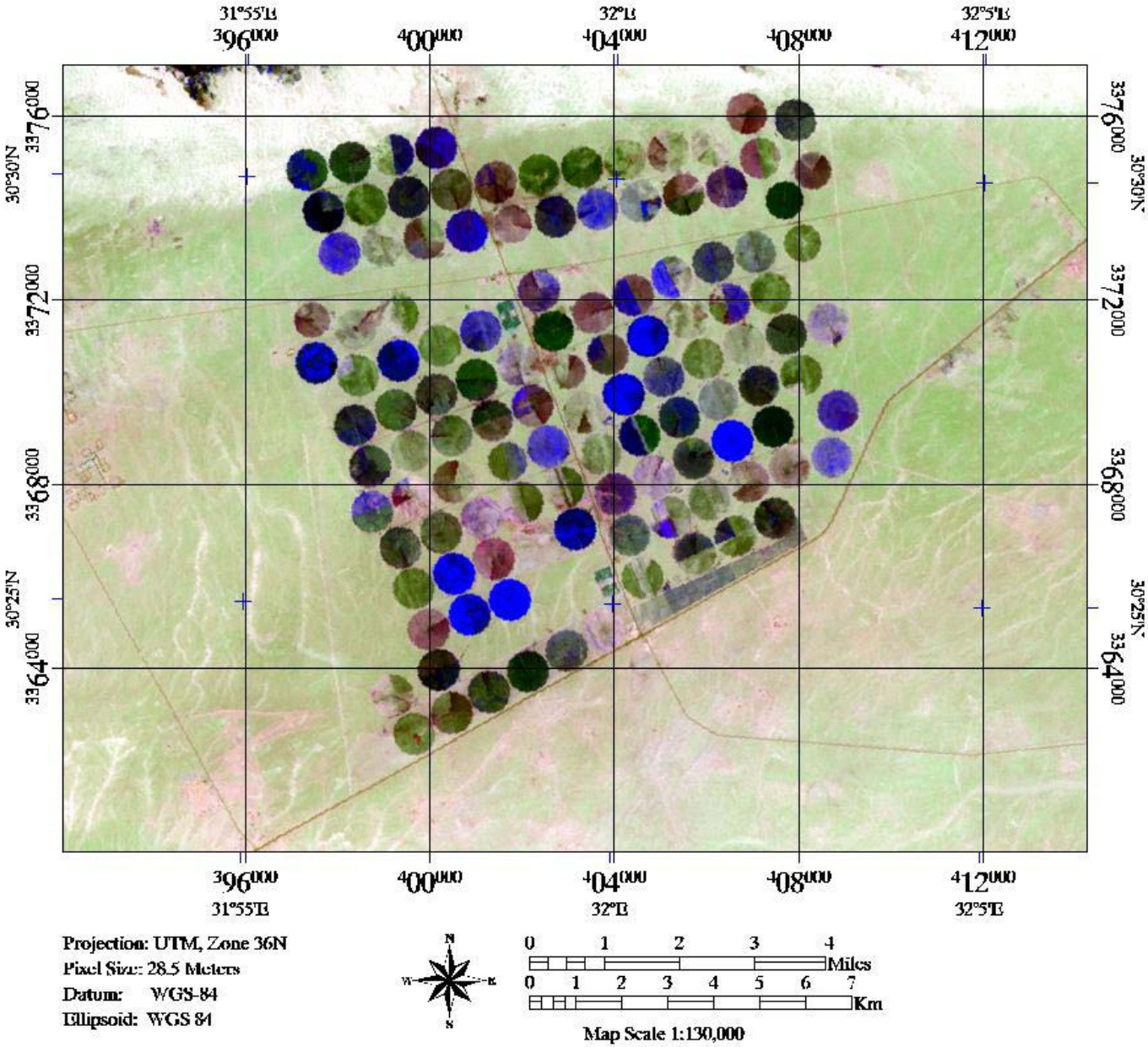
Research needs regarding drought modelling

Models and process understanding- hydrological models are important to help us to understand process. (*Lanen and Fendeková, 2008*)

Drought forecasting- development (*Lanen and Fendeková, 2008*)

Development of decision support models for the dissemination of drought-related information to end users (*Lehner and Döll, 2001*)

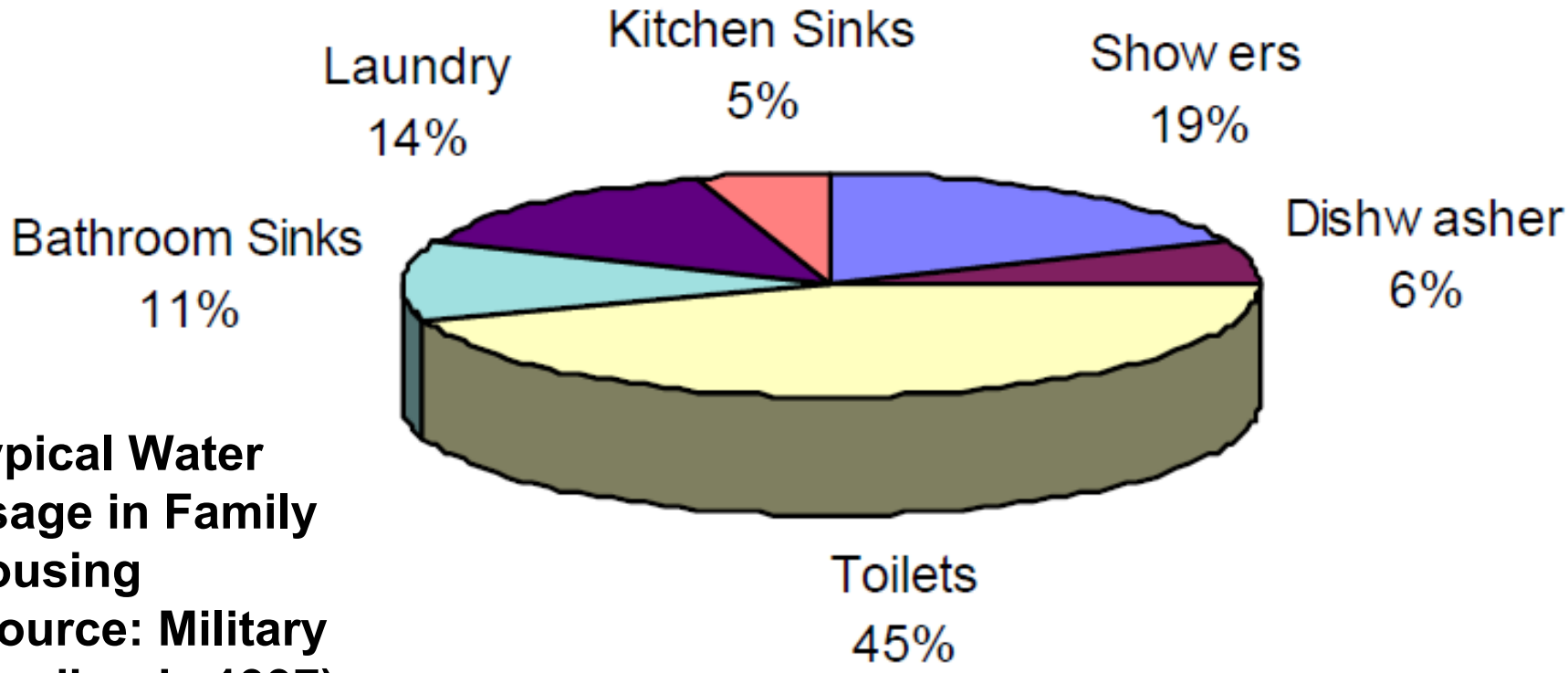
Aquifers at risk of not attaining a quantitatively good status 2010, (Source: Ministerio de Medio Ambiente y Medio Rural y Marino.)



JG: Research into drought indices is proposed (by several literatures), but as we proved with IMAU index above, no real extra knowledge can be gained with any indices. If good they might just yield the expectable, rule of the thumb answer, to drought importance and water stress

Land use map for a farm using remote sensing in combination with soil analysis (Abou-Hadid, 2006)

WP 4.6 Research into drinking water supply by P2 UNIDEB



Typical Water Usage in Family Housing (Source: Military Handbook, 1997)

JG commented A good review of the literature of impacts is given, with ample literature advise on research needs

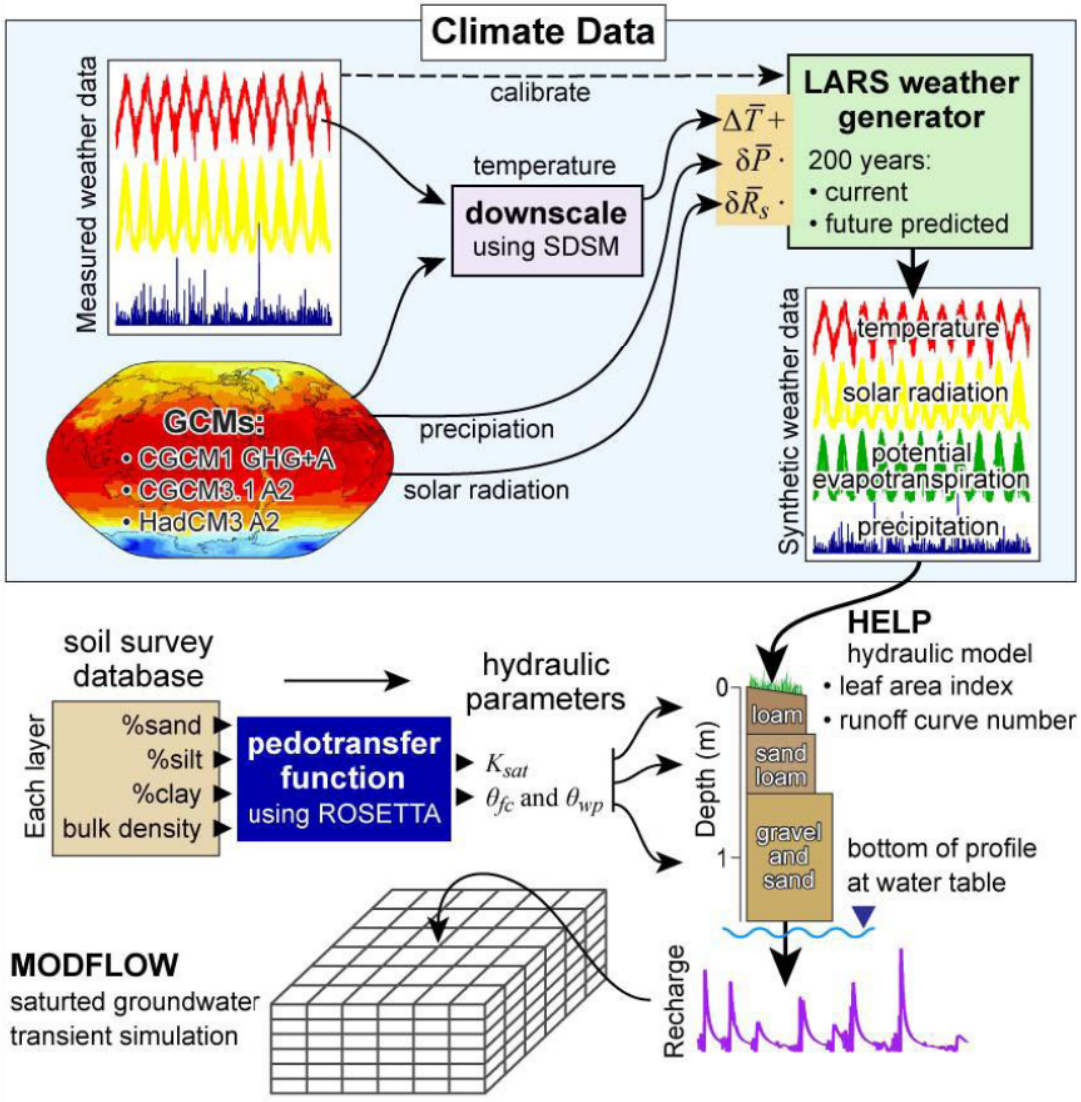
in the conclusions the research needs should be specified**.**

Research need in Stormwater harvesting (samples only after unidentifiable source) by, P2

Further research by hydrologists, civil engineers, water planners, and water managers is needed to fill this gap, as is broader training of scientists in the universities.
Substantial improvements in methods to downscale climate information are needed to improve our understanding of regional and small-scale processes that affect water resources and water systems.
More research on how the severity of storms and other extreme hydrologic events might change is necessary.
Increased and widespread hydrologic monitoring systems are needed. The current trend in the reduction of monitoring networks is disturbing.
There should be a systematic reexamination of engineering design criteria and operating rules of existing dams and reservoirs under conditions of climate change. And there are many more

JG commented: I do hope that UNIDEB will explain these and other very pressing research needs in the presentations

WP 4.7 Research into groundwater by Partner 9 SHMU



Flow Chart of Tasks (Toews et al., 2007)

Samples of the research needs related to impact of climate change on groundwater are:

Changes in precipitation and evaporation on groundwater recharge, water levels, and base flow in shallow and deep aquifer systems;

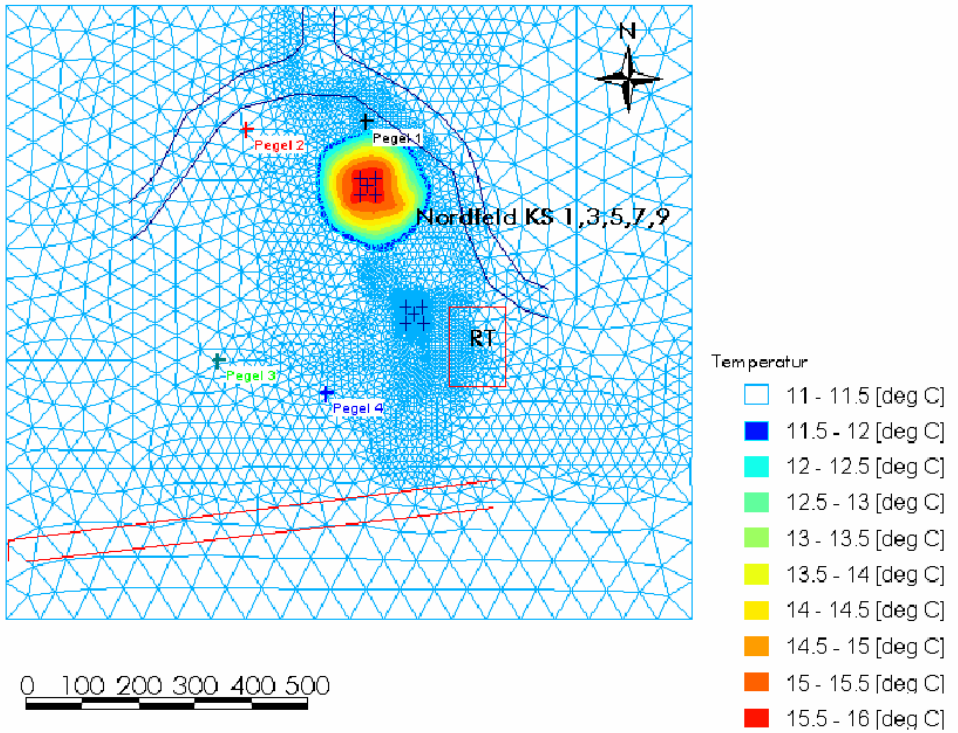
Assessment of hydrologic interactions between ground water and surface water systems

Assessment of the impact of increased demand for ground water on sustainability of groundwater supply and groundwater quality;

Assessment of activities at the land surface may affect ground water recharge rates and water quality;

Assessment of monitoring need

Számított talajvízhőmérséklet emelkedés a Reichstag ATES projekt területén (Sanner-Kabus-Seibt-Bartels 2005)

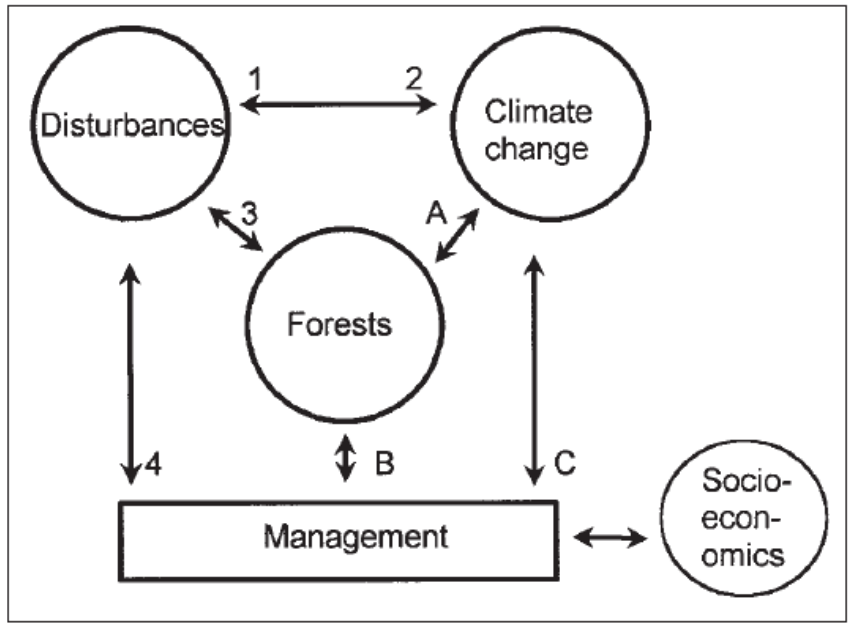


JG: Commented:I got this Figure from Dr Ferenc Székely (former VITUKI employee) and this approach (variable grid size groundwater models) might provide the solution

SHMU Concludes: Predicting the long-term effect of a dynamic system is very difficult because of limitations inherent in the models, and the unpredictability of the forces that drive the earth. A physically based model of a groundwater system under possible climate change based on available data is very important to prevent the deterioration of regional water-resource problems in the future. Although uncertainties are inevitable, new response strategies in water resource management based on the model may be useful

WP 4.8 Research into sustainable agricultural production in drought ridden regions, by P2 UNIDEB

Pepper cultivation in perlite substrate that reduce the risk of salt accumulation
(Source: Zayed et al., 1989)



Interactions among disturbances, climate change, forests, and management strategies The numbered arrows are the focus of research questions (Source: Dale et al., 2001)

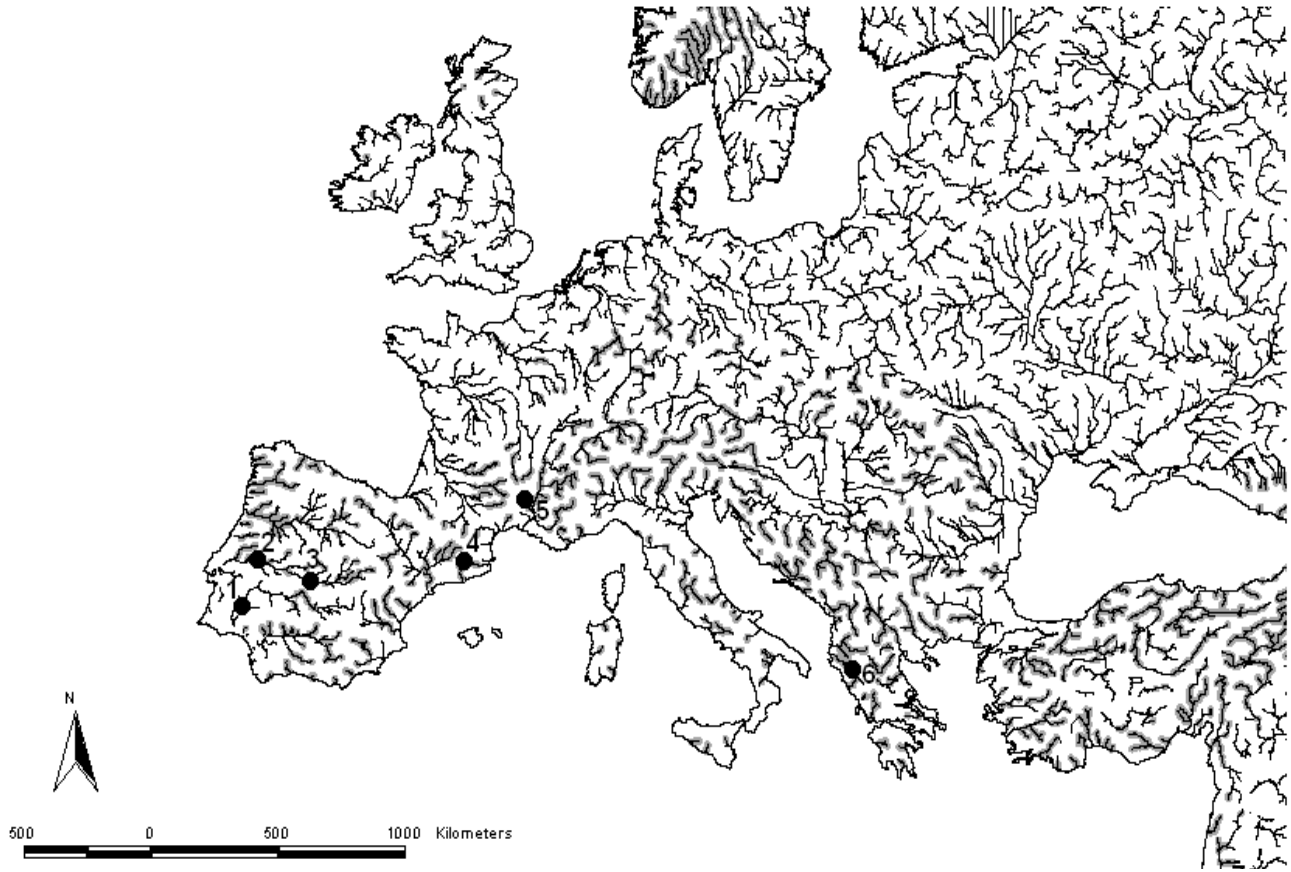
These are the two figures of the report and some of the conclusions will be quoted in the next slide

Selected quotation from the conclusion of WP 4.8 report by P2 UNIDEB. aimed at „research needs”:

Most of the text of the conclusion is a good text on adaptation strategies and the text below mentions research needs.

There is a so-called adaptation approach which says that adaptation is carried out in response to the observed and experienced impacts of climate change on society and ecosystems. These responses ensure that the vulnerability to the impacts is reduced (*Schipper, 2007*). This can be a misconception because adaptation only means to adjust to new conditions by choosing adequate techniques for production. However it may in turn ensure that less is lost each time a climate-related hazard takes place, which means risk is reduced. With reduced risk, development can be more sustainable.
To adjust to this concept uncertainty levels of projected impacts on crop productivity must be reduced. This is still a research topic of high importance, although there exist already a lot of results.

WP 4.9: European research of Pleistocene and (palaeo)geology by P6 GEONARDO



Map showing the first cut of potential reaches suitable for palaeoflood studies (grey highlight reaches, versus the distribution representative actual SWD-PSI palaeoflood sites in the region. (Benito, 2003)

Search for rivers in Europe, where palaeoflood methods are applicable and develop new methods for alluvial rivers. The EU funded SPHERE project has built a database (Casas planes, 2003), which is a good start for further studies. The figure shows rivers potentially suitable for palaeoflood studies

Exploring paleo-isotopes is also an interesting field of research, which aims at gathering information about past climates through studying stable isotope composition (e.g. oxygen-18 and hydrogen-2) of past precipitations (*Knox et al. 1997*). Deep ice cores and laminar lake deposits can provide sufficient information to reconstruct past climates, the behaviour of the water cycle and its links with climate change. The authors also state that the applicability of palaeo-isotopic information in hydrology should be further studied and the limitations has to be defined. These limitations can be considered in the context of environmental type (humid, arid, polar, tropical) or in the context of time scale (event basis, seasonality effects etc.).

The applicability of palaeo-hydrology will have to be clarified. Knox et. al. write (1997) that palaeo-hydrological information can be part of the everyday hydrological practise only if parameters like peak discharge, flood volume, event duration and flood recurrence frequencies can be determined and this can be clearly defined and introduced to specialists in the field of hydrology and water management. This is a an important task of the future.

WP 4.10 Hydropower and Navigation. By P10 SOGREAH

Budapest at high flood (source Dr. Bakonyi), my be a real osbtacle to inland navigation

JG: At drought flow either all shallow fords must be eliminated or all freighter and tourist fleets must be reduced. Construction of more river dams is a potential solution (see also Hydropower)

From Conclusions:
Navigation is a very old mean of transportation but new technologies are still possible and desirable. Research is needed to reduce vessel fuel consumption, to reduce water consumption in inland channels, and have navigation a very low GHG emission transportation mean Research is needed for the maintenance and development of the infrastructures to insure to be able to deliver tomorrow the expected services

WP 4.10 Continued with Hydropower

Tiszalök Hydropower station, River Tisza Hungary

From the Conclusions:

Hydropower is a mature technology and technological innovation might be somewhat limited. When enlarging the scope of work to energy, the question is quite different and research is needed to develop new forms of energy, particularly renewable energies, as well as to store intermittent energy. These innovations will be needed to progressively replace fossil energies and face the future demand of energy whilst producing energy with very low greenhouse gas emissions.

WP 4.10 Conclusions contiued: Attention shall be paid to fact that the adaptation works on infrastructures will have to be done in a more and more constrained environment. Anticipation is therefore needed and policies will be needed, duly justified by research work, to encourage virtuous strategies, to smooth the development procedures and to facilitate the acceptance of the construction works.

The Co-ordinator predicts high future to dwarf hydropower stations (In Hungary 6 are being rebuilt and built), wave power stations and other means like traditional water wheels.

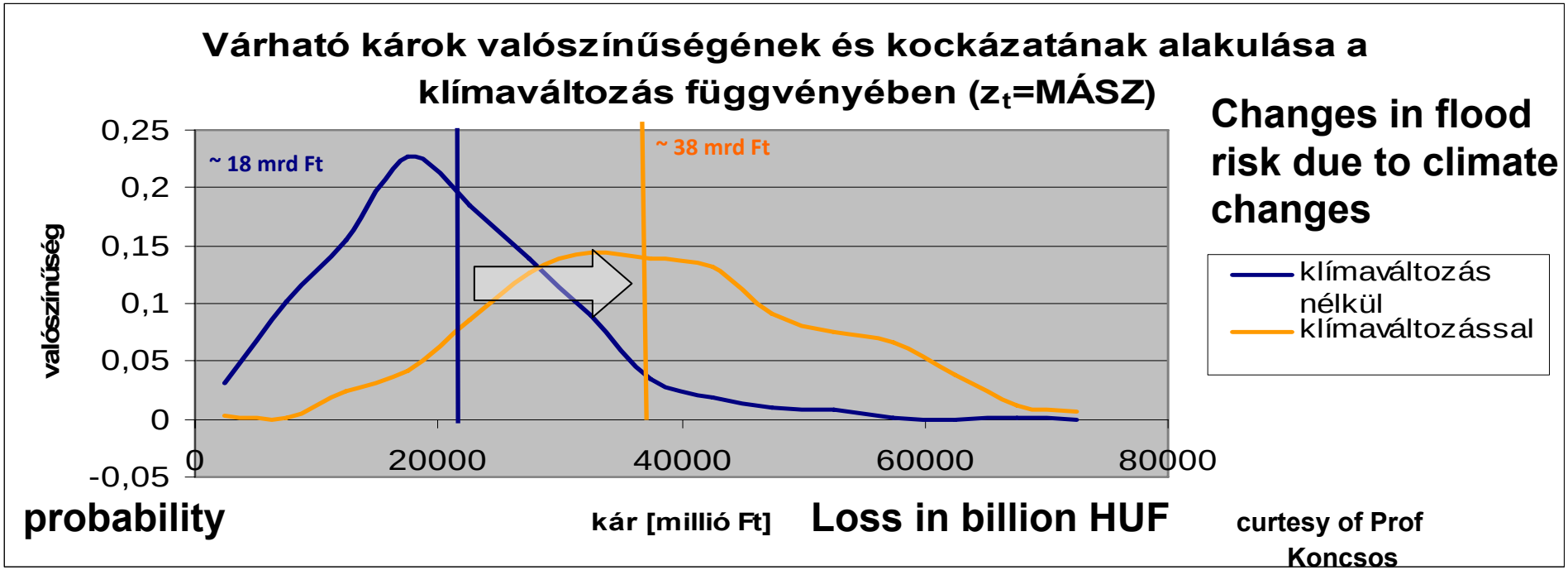
WP 4.11: Research needs in flood forecast and defence by P6 GEONARDO

Bódva River Flood, Hungary

French Riviera Flood

<u>Research need in flood forecast from the report</u>: Flood forecast and alert systems will play an important role in flood protection and flood loss mitigation. It is a rapidly developing field ..thanks to the numerical weather prediction systems. These systems however need to be further developed as their coarse spatial resolution is not adequate for accurate midterm forecasts. Ensemble prediction systems already proved their ability to reduce uncertainty, but their re-verification and re-forecast can be beneficial, and for the calibration of rainfall-runoff models

WP 4.11: Research needs in flood forecast and defence by P6 GEONARDO, continued, risk assessment and management



Research should focus on fields of advanced risk management, improved forecast technologies, increased lead in times and the application and maintenance of forecast systems. Flash floods will be in the focus of research as risk of life is rapidly growing and the frequency of occurrence of devastating floods are extremely high

With appropriate series of flood control the probability of high losses can be decreased

Research needs: Summarizing conclusions by the Co-ordinator





It would be very difficult to give an overall detailed summary conclusion of all the 11 chapters of this report. Some major are as follows:

In each chapter the partners identified research needs as that of the scientific field they discuss would need in the future. All fields seem to need much development in research.

Other task of Partners was to find research needs that stem from the gaps identified in the relevant policies, which prevents or hinders the coping with the determination of adaptation strategies and measures that could counteract the climate change induced impacts on the social and natural uses of waters. Many but not all partners identified such research needs and they have all expressed the need for basic changes in all water related policies. A characteristic example is the WFD and its main tool the river basin management planning (RBMP).

Research needs: Summarizing conclusions by the Co-ordinator, continued





Another conclusion that came out from the sub-WP reports was that nearly all scientists of the project demanded much more detailed monitoring of all waters and even regular field studies. This is highly against the present system of water-monitoring development of the EU, which practically eradiated all kind of field measurements, and have a trend to relay on modelling only, which is to the knowledge of the Co-ordinator (who was present at the development of computer models back in the 60-ies and 70-ties) will not solve anything until they are calibrated and verified against annually repeated field measurement data

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Thank you for your attention

And we will hopefully learn more about research needs by other project participants