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Ulla Vänttinen, Gert-Jan Nabuurs, Leena Finér,
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Groupwork

Introduction

Globally, water and its quality and availability are of the highest importance, and forests which protect the quality of water reserves, and regulate the water flow, preventing other areas from flooding have an important role in the process. However, forests also use water and change its quality by intercepting rainfall, and by taking it up from the soil, and bringing it into the air. The second Joensuu Forestry Networking Week event gathered scientists, professionals and stakeholders in forestry from various regions in Europe to discuss the issues regarding forests and water in Europe. Scientific aspects, as well as governance and practical issues were addressed.

The Joensuu Forestry Networking Week (JFNW) is an initiative connecting and increasing the interaction between young and experienced scientists, professionals and stakeholders in forestry from different parts of Europe. JFNW 2010 was organised by Finnish Forest Research Institute (Metla), European Forest Institute (EFI), University of Eastern Finland and the North Karelia Univeristy of Applied Science.

The Joensuu Forestry Networking Week 2010 was successful and created a new research network hopefully initiating new research projects and activities lasting in this field. Altogether 47 participants from 11 countries participated to this second event. For next year the preparations are already underway, and we look forward to a large interest in the topic of “Forests and Energy”.

The programme of the Joensuu Forestry Networking Week was divided into lectures, workshops and an excursion. The topic of the week “Forest-water interactions in Europe” was discussed in four working groups addressing special conditions in Mediterranean, Temperate, Alpine and Boreal areas. The results of this work are published in the current report alongside with abstracts of the invited speakers and voluntary abstracts by the participants.

We are much obliged to the many sponsors without whom this would not have been possible. We thank Foundation of European Forest Research, Federation of Finnish Learned Societies, Metsämiesten Säätiö Foundation, Finnish Ministry of the Environment, Finnish Ministry of Agriculture and Forestry, OP-Pohjola Group, Regional Council of North Karelia and the City of Joensuu.

The Editors

Speaker Abstracts

European Issues of Forests and Water on Economical, Societal and Ecological Viewpoint

Franz Prinz zu Salm-Salm
The Forest Owners in Sachsen-Anhalt, Germany

Worldwide population and the need for water grows and freshwater becomes rare. In the global competition, water has become a "normal" asset, instead a "simple" staple food. The business booms and that includes that multinational global players try to secure the rights on springs, drillings and riparian rights. The European Community has realized that and acknowledges water pollution is something to be stopped not only on behalf of freshwater but because for environmental reasons as well. The EU "Water Framework Directive" (WFD) is the first European environmental framework, which explicitly uses economical instruments to get an environmental result.

This directive's purpose is to achieve a good water status of all waters in 2015. Therefore the member States of EU shall take account of the principle of recovery of the costs of water services, including environmental and resource costs, having regard to the economic analysis conducted according to Annex III of WFD, and in accordance in particular with the "polluter pays principle. In many countries of the EU, a rewarding of environmental benefits or issues – including environmental and resource costs – is not wanted by influential pressure groups. They are not honoured – paid – in all members of EU.

The relation of forests to water is well known. The obvious water retention and cleaning function of forests were attested in the WFD Inventory and Classification of waters. The results of the WFD inventory showed that water in forests is quite good and forestry is usually responsible for good water in many parts of Europe.

There is a link to the polluter pay principle in the WFD and to sustainability:

- The "polluter pays principle" Art 174 EU Treaty or Art 9 WFD applies as norm for a fair burden sharing, for the responsibility of the causer of a damage. That means who breeds a damage to a third person, shall pay for it. The causer shall not be able, to give those costs to the society or the damaged persons. This rule counts in respect to the WFD for every polluter, like – for example and not only – Energy and Water supply.
- The traditional definition of sustainability in German Forestry was and is an economical, ecological and social one. Sustainability characterizes the operation of a forest enterprise and means to earn continual and optimal quantity of timber, infrastructure services and other goods (Functions of forests for water, air - protection …) to the benefit of actual and future generations. This definition is next to the aims of WFD.

The Polluter pays principle is not negotiable in WFD and its programme of measures and so as well sustainability is not negotiable. It is the task of forestry to look and fight for those principles instead of only having a look for not paid forest management with respect to water relations. The WFD in this case is a opportunity for forestry which has to be used and not be missed.

Water Framework Directive, Preparation and Implementation on Finland

Johanna Ikävalko
Central Union of Agricultural producers and Forest Owners MTK, Finland

The EU Water Framework Directive (WFD) is implemented in Finland through a number of different laws and acts. These are the Act of Water Resources, the Decree on River Basin Districts, the Decree on Water Resources Management, the Decree on Hazardous Substance on Aquatic Environment, the Environmental Protection Act and the Water Act. The two latter Acts are the base for Finland's high standard of water protection, and therefore authorities follow strict procedures for environmental and water permits.

Finland is divided to eight River Basin Districts (RBD, Figure 1), and thus eight programmes for water management and measures were prepared during 2008–2009. The eight RBDs are:

1. Vuoksi
2. Kymijoki – Suomenlahti
3. Kokemäenjoki – Saaristomeri – Selkämeri
4. Oulujoki – Iijoki
5. Kemijoki
6. Torniojoki (shared with Sweden)
7. Teno, Näätämöjoki, Paatsjoki (shared with Norway)
8. Ahvenanmaa (autonomic)

The goal of WFD is to reach a good ecological status of all water bodies (surface and bottom) by year 2015(2021/2027). The ecological status for surface waters is measured by community structure and abundance of phytoplankton (unicellular algae), macrovegetation, benthic (bottom) animals, and fish community. The first evaluation of the ecological status of surface waters was published in 2008 (Figure 2). Ground waters should reach a good chemical status, and this is thus based on water chemistry.

Finland has 187 888 lakes, all of which have not been monitored and classified for WFD. Of all classified lakes 72% have a high or good good ecological status. While most large lakes have a good status, nearly $^{1}/_{3}$ of small lakes have a moderate or even poorer status due to eutrophication and thus algal blooms. There is n precise figure for the number of rivers in Finland, but approximately 400 have been evaluated for their ecological status. Nearly 50% of Finland's rivers have either good or high ecological status, and it deteriorates closer to the coastal areas in outlets of (large) rivers. Thus, SW Finland is a key region for WFD activities. In addition to eutrophication, increased acidity from sulfate rich soils in W Finland causes a poor status of the rivers of the region.

In order to reach the good ecological status of the surface waters agriculture has an array of water protection measures already within agri-environmental subsidy system.

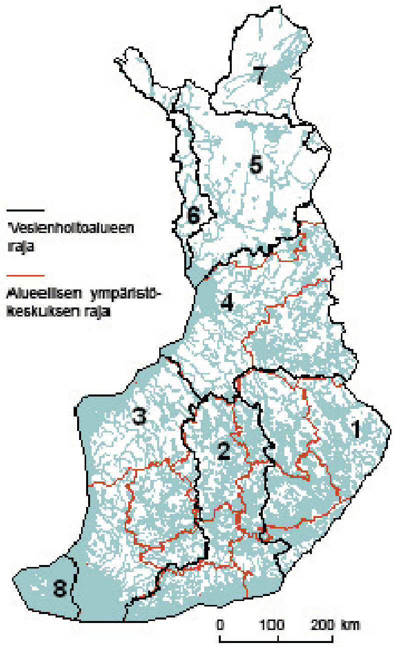

Figure 1. River Basin Districts in Finland. Source: www.ymparisto.fi

However, additional measures were included in WFD, such as increasing winter time plant coverage (grasslands), increase in the number of buffer zones and wetlands, controlled application of fertilizers, improved manure treatment and processing, and improved management of on sulphate-rich lands.

For forestry, WFD measures are mainly based on already existing guidelines such as the Forest Act (1997), the Act on the Financing of Sustainable Forestry, Forest Certification and Operators' own quality management systems. The Forest Act includes notable measures for sustainable forest management with respect to various environmental aspects, and the Environmental Protection Act and Water Act cover ditching and protection of small water bodies. Permits are always required if the natural state is altered or endangered, or of any deterioration of water quality is assumed to be caused during the process. However, for renovation ditching permits seldomly required.

In private forests water management measures are divided into

a) general rules of water protection within forestry and
b) habitat management projects

Environmental impacts of e.g. forest harvesting, preparation of soil, fertilisation and renovation ditching are included in the Forest Act, certification and operators' own quality systems, and guided in Forest Management Practice Recommendations by Tapio (updated in 2007). Common water management measures in renovation ditching are e.g. buffer zones and sedimentation basins.

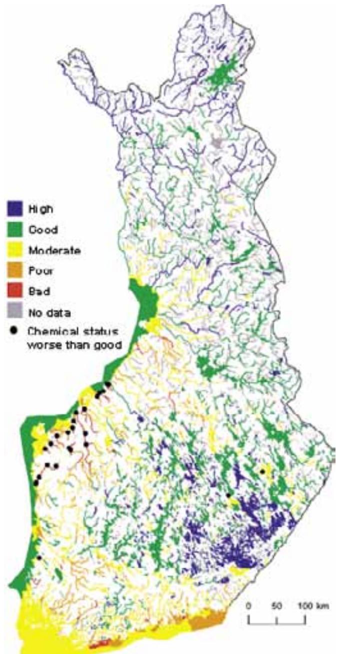

Figure 2. Ecological status of surface waters in Finland.

Nearly all actors and forest owners are within certification systems (PEFC, FFCS), and thus meet the requirements of sustainable forestry through e.g.buffer zones, no first-time draining of natural state wetlands, no use of chemical pesticides in bottom water areas, and no use of fertilisers in 1. class bottom water areas. The Act on the Financing of Sustainable Forestry (KEMERA) covers water management measures for high risk areas.

According to the national Water Protection Policy Outlines up to 2010 elemental measures for improved water management within forestry include:

- buffer zones
- infiltration areas
- careful use of fertilisers

However, even with all current measures nutrient load from forestry is not assumed to decrease, but increase with increasing loggings and fertilisation in the future. This increases the importance of the latest guidelines for e.g. ditching!

Additional, recommended WFD measures for forestry include:

- habitat management projects: increasing use of buffer zones (width), (multifunctional) wetlands, under-water dams
- water management planning based oin entire drainage area
- intensified education and advisory systems

Financing WFD measures within forestry comes mainly from resources within the Act on the Financing of Sustainable Forestry (KEMERA). This means, no "fresh" money was allocated to WFD forestry measures, which does not give an optimal start for the implementation of WFD. Responsibility of WFD implementation is on forest owners.

Remaining questions regarding WFD and forestry include e.g.

1) WFD targets are not to dictate the conditions for individual permits, but must come from already existing legislation → how do we control this?
2) How do we measure the effect of our actions? No real-time on-line monitoring is applied (agriculture, forestry), and it will take something between 20–50 years (depending on the water body) before biological response – permanently improved ecological status – can be measured.
3) How do we separate the detrimental effects of e.g. climate change, increasing rains and consequently (increasing nutrient run-off rom the other run-off?
4) How do we solve the conflicting interests between planned massive increase of renewable (forest) energy and water management?

Climate Change Impacts in Different Regions in Europe

Marcus Lindner
European Forest Institute

This presentation summarizes the existing knowledge about the observed and projected impacts of climate change on forests in Europe. Forests will have to adapt to changes in mean climate variables but also to increased variability with greater risk of extreme weather events, such as prolonged drought, storms and floods. Current climate change scenarios suggest that water availability throughout the year will change in many regions. While in most regions winter precipitation is projected to increase, summer precipitation is likely to decline especially in central and southern Europe. Climate models have still difficulties in realistically simulating current climate variability and extreme events. However, latest projections suggest more intense winter cyclones with heavy precipitation and less days with precipitation in the summer, leading to more frequent drought risk.

Sensitivity, potential impacts, adaptive capacity, and vulnerability to climate change are reviewed for European forests. The most important potential impacts of climate change on forests goods and services are summarized for the Boreal, Temperate Oceanic, Temperate Continental, Mediterranean, and mountainous regions. Especially in northern and western Europe the increasing atmospheric CO_2 content and warmer temperatures are expected to result in positive effects on forest growth and wood production, at least in the short-medium term. On the other hand, increasing drought and disturbance risks will cause adverse effects. These negative impacts are very likely to outweigh positive trends in southern and eastern Europe. From west to east, the drought risk increases. In the Mediterranean regions productivity is expected to decline due to strongly increased droughts and fire risks.

Potential impacts and risks are best studied and understood with respect to wood production. It is clear that all other goods and services provided by European forests will also be impacted by climate change, but much less knowledge is available to quantify these impacts.

Forest and Permanent Excess of Water – Peatland Forestry

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About one third of land surface area in Finland is peatland, where ground vegetation is characterized by mire species, or where the thickness of the peat layer on the mineral soil is more than 30 cm. Traditionally, peatlands have been consired as wastelands with inferior utilisation value, because they are not very suitable for agricultural or forest production as such. The problem that restricts plant production in peatlands is the excess water in rooting zone. When water content in soil is near saturation, soil water blocks the flux oxygen from the atmosphere to the roots, and the flux of carbon dioxide from the root zone to the atmosphere. As a rule of thumb, excess water restricts gas transfer if air filled porosity is less than 10 of volume. Growth conditions in peatlands can be improved by draining the excess water from the rooting zone. In forestry drainage is conducted using open ditch network with 60–100 cm depth and 30–60 m spacing.

In peatlands, the excess water in the rooting zone is a result of climatic and soil related factors. Climate in boreal zone is humid, which means that in annual scale the rainfall exceeds the evapotranspiration. The difference of the rainfall and evapotranspiration generates runoff, which accumulates to depressions in the topography. Local excess of water in depressions promotes formation of peat, and physical characteristics of peat support retention of water in soil. Typically a peat profile consists of low-humified top layer and a well humified bottom peat layer, underlain by mineral soil. Both low-humified and well humified peat materials have a high porosity, but saturated hydraulic conductivity in well-humified several orders of magnitude lower than that in low-humified peat material. Because of the very low hydraulic conductivity, well humified peat material typically remains wet throughout the growing season keeping the air filled porosity in the soil too low to support forest growth.

Ditching changes the conditions in the rooting zone, which extends ca. 10–20 cm below the soil surface. Water can be removed from the low-humified layer easily with drainage, however, the impact of the drainage on the humified layers is much smaller. Hydrologically, success of the drainage depends on the depth and spacing of the ditches, and on the depth of the permeable surface peat layer. Air filled porosity increases during the growing season with evapotranspiration that can remove water also from the humified layers. If the volume of the growing stock exceeds 100–150 m^3 ha^{-1} the evapotranspiration flux can be more important in drainage than the ditch flow.

About half of the peatland area in Finland has been ditched to enhance forest growth. In national scale the ditching campaign has been a very successful: it has increased the annual forest growth by ca. 25 millions of cubic meters, while the total annual growth is presently ca. 100 millions of cubic meters. The length of forest ditches – ca. 1 300 000 km – reveals the scale of the national ditching operation: the length of rivers in only 53 000 km. The large scale alteration of peatland hydrology has caused several drawbacks including deterioration of water quality in the recipient water courses. Ditching and ditch network maintenance increase especially export load of suspended sediments and organic matter. Wood harvesting and water protection are the future challenges of peatland forestry in Finland.

Process-based Modeling on Drought Stress in Trees

Carlos Gracia
Departament of Ecology, University of Barcelona and
CREAF (Center for Ecological Research and Forestry Applications)

This paper will present an introduction to the main ecophysiological constraints derived from the limited water availability in arid or semiarid environments. The hydrological response of a Mediterranean experimental catchment based on twenty years of records is analyzed and compared with the responses of temperate forests. Finally the cost, in terms of carbon and water, of the different organs and tissues of the trees is analyzed to conclude with some projections of process based models on the physiological response of Mediterranean forests by the end of the 21st century.

Water Footprint as an Environmental Tool

Helena Wessman
VTT Technical Research Centre of Finland

Water footprint is one of the newest calculation tools to assess the sustainability of products and services. Water footprint calculation method has been developed by researchers at the University of Twente in the Netherlands. Led by environmental NGOs and academics, interest in water footprint is growing fast but the methodology for forestry, industrial or agricultural processes is still open.

Water footprint is a local indicator, dependent on water scarcity and dilution conditions. Water footprint defines the sum of the water used in the various steps of the production chain, including direct and indirect water use. Water content of a product that is imported or exported between countries is called virtual water.

Water footprint expresses water volumes by using terms of blue water, grey water and green water (see Fig. 1). Blue water is the technical water used in the process (total water input, raw material water content, evaporated water during the process etc.) and grey water is polluted water (waste water to the recipient area). Green water is the water in soil and evaporated by trees during growth. Green water is closely linked to land use and land use change. Calculations made for product specific water footprints show that the influence of green water is significant.

Definitions and guidelines for data collection and calculation procedure are still open, and this concerns especially the ‘green water’. Preparation work for ISO Standardization (ISO 14046) has started and the actual standardization is expected to start in 2011.

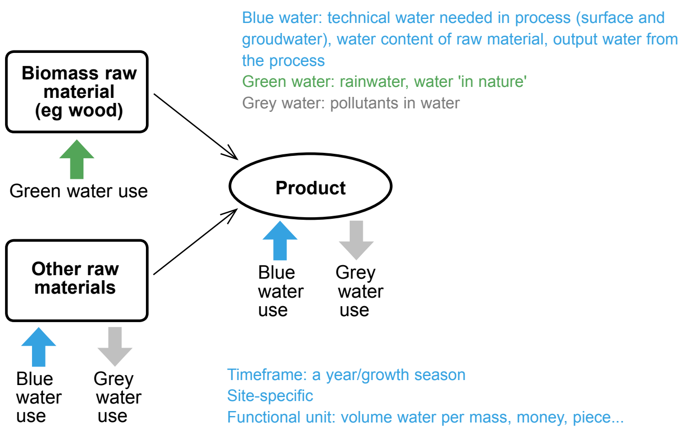

Figure 1. Structure of water footprint, wood-based product as an example.

Future Forests and Sustainable Waters in the Boreal Landscape

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The circumpolar boreal forest contains 60% of the world's fresh water. This vast but sparsely populated region is home to many peoples and cultures. Sustainable forests are vital to boreal survival; sustainable waters are the key to sustainable forests. Forestry is only sustainable when inputs, such as the base cation (BC) nutrients provided by mineral weathering, are less than outputs through harvesting.

Forests and forestry in the boreal are affected by several stresses including acidification, mining and climate change. Climate change may bring benefits to the boreal region; warmer temperatures imply a longer growing season in a region that is not often thought of as moisture limited. However, Goetz et al. (2005) have shown that photosynthetic activity declined over much of the Canadian boreal between 1981 and 2003 as a result of the direct and indirect effects of climate change.

Forest harvest can remove BC faster than they can be replaced by mineral weathering. Akselsson et al. (2004) have suggested that conventional and whole-tree harvesting removes BC more rapidly from Swedish forests than they can be replaced by weathering. This is not sustainable. However, Klaminder et al. (under review) have suggested that weathering estimates are not sufficiently precise to distinguish between the effects of whole-tree and conventional harvesting on nutrient removal.

Insights from many disciplines are needed if we are to understand the possible effects of climate change and increased demands on the boreal forest. In Sweden, MISTRA is funding Future Forests (www.futureforests.se). This large, interdisciplinary program has been established to analyze conflicting demands on forests systems so as to enable sustainable strategies under uncertainty and risk. Understanding the impacts of more intensive forest production and climate change on boreal waters in Sweden, and communicating these results to the scientific community, stakeholders and practitioners is a key part of the program.

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Forest Management and Water: Mediterranean Conditions

V. Ramon Vallejo
CEAM Foundation, Valencia, Spain

Mediterranean ecosystems have been subject to extensive and intensive exploitation over centuries, often producing land degradation and desertification. During the last decades, extensive land abandonment has resulted in the increase of forest surface, but also a parallel increase of large forest fires. Most Mediterranean forests have low timber productivity, therefore their management is focused on environmental services such as watershed protection, biodiversity, carbon sequestration, and recreation.

The main limitation for plant growth in the Mediterranean is water stress. Desertification processes, induced by human misuse of ecosystems in drylands, generate degradation loops driven by increasing reduction of available water and soil erosion. Forests consume and transpire large quantities of water. Reducing forest cover in the watershed (by deforestation, logging or burning) usually results in increased runoff and stream flow. However, forest cover is the most efficient in hydrological regulation, and this is especially relevant in torrential watersheds showing high erosion and flash flood risk. The question is how to plan the location of forests in the landscape, and how manage them, in order to optimise the regional water balance, water supply, reduction of hazards, and ecosystems conservation. For more than a century, afforestation has been a major strategy in watershed protection and hydrological regulation in the Mediterranean. Water availability is the main factor hampering forest restoration in dry and semi-arid areas. This is especially critical at the establishment phase in plantations to overcome transplanting shock. The major factor controlling seedling survival is the duration of the drought period during the first plantation year, and the available soil water holding capacity. Therefore restoration techniques should be oriented to optimize water use efficiency. Current techniques that may improve water availability and water use efficiency in plantations are: plant species selection, improving seedling quality, fog harvesting, increase the amount of water available in the planting hole through the application of inorganic amendments (hydrogels), and/or the construction micro-catchments for water-harvesting, and the use of tree-shelters. These techniques have proven to be efficient in increasing seedling survival and growth under extremely harsh conditions.

Assuming that climate change may directly increase stress in drylands (drought intensity and/or duration) and indirectly modify the disturbance regime (e.g. fires), the challenge for the near future is how restoration strategies and techniques can cope with the uncertain future responses of species, and the impacts on ecosystems.

Role of Forest Management in Affecting the Quantity and Quality of (Ground)water – Central European Conditions

Michael Bredemeier
Forest Ecosystems Research Center, University of Göttingen, Germany

The Central European perspective on current forest management and water issues is outlined in three focal areas: water supply, water quality, and water related hazards. Much of the results presented originate from work brought together within the European COST Action "Forest management and the water cycle (FORMAN)", which is operating 2007–2011.

Under the currently projected climate change scenarios for Europe, the humidity gradient across the sub-continent from moist Northwest to dry Southeast will probably intensify, bringing about potentially more flooding problems at the "wet end", and more drought and related problems (wildfires, salination) at the "dry end". The very interesting transition zone between the intensified extremes runs through Central Europe. It is shown that even there the shifts in climatic variables may bring about considerable shifts in competitiveness of forest tree species. Moreover, new forms of woody biomass plantations for bio-energy gain (short rotation coppice, SRC) are currently emerging, which habitually consume lots of water and may strongly decrease runoff and groundwater recharge. Careful planning of management is essential wherever tradeoff situations between forest growth and water yield emerge.

The water quality issue in Europe is not as pressing as it was a few decades ago. Much has been achieved on account of successful water- and air pollution control. Particularly the acidification pressure on forest soils and their related water systems was much relieved, due to strongly declining acidic deposition over the past 30 years.

Forests and their appropriate management for optimizing water retention can support flood control, but with clear limitations under very strong and catastrophic events. The contribution to flood control is more important under "normal" conditions than under extremes. Important controls are infiltration capacity and the status of water saturation prior to the rain event, i.e. the still available storage capacity.

The safeguarding of water quality is seen as the most important single aspect among forest-water relations in Central Europe.

Restoration of Flooding in the Alluvial forests of Eastern France and Change in Groundwater Quality

Michèle Trémolières
University of Strasbourg, France

Hydraulic works on large rivers have drastically modified the structure and the functioning of alluvial ecosystems. In particular they have led to the disconnection of anastomosing and/or braiding channels, and alluvial forests from the main channel. Nowadays floodplains are well recognized for their purifying capacity with respect to the nutriments like nitrate and phosphate (e.g. Lowrance et al. 1995, Nelson et al. 1995, Pinay et al. 1993). The reduction ratios which have been estimated (Sanchez et al 1999) depend on easily flooded surfaces, the duration and the frequency of the floods. Indeed the saturation of the soils by overflowing water generates strongly reducing hydromorphic zones, thus producing denitrification. The removal of the floods modified the cycle of nitrogen and resulted in particular in increases in nitrate of groundwater of average depth (5–6m) (Sanchez-Perez and Trémolières 2003).

Many restoration projects have been developed aiming at both flood retention and ecological restoration. The river ecosystem functions which are expected to be restored are exchange capacity, hydrological connectivity, water purification, diversity of habitats and species. Within the Upper Rhine floodplain (Eastern France), the “Erstein polder” is a pilot site which allows the monitoring of the impact of alluvial zones re-flooding. The re-flooding of the polder by flood waters, which are usually highly charged with suspended and soluble matter, may change the physical and chemical composition of different compartments – water, sediment and soil – of the alluvial system. To analyse the change in groundwater chemistry as a consequence of reflooding in an alluvial zone, we used the nitrogen model under the mineral forms nitrate, nitrite and ammonium.

The questions are: How does (re)flooding influenced the groundwater chemistry and more particularly the nitrate transfer into the groundwater? Does this change depend on intensity, frequency and duration of floods? Is there an impact of the successional types of alluvial forests?

The answers are based on a case study in the upper Rhine floodplain, the Erstein polder (Eastern France) which we compared with a functional alluvial zone which was always flooded in spite of hydraulic magement works. The Erstein polder comprises two sectors with two degrees of inundability, a sector unflooded for two centuries and a sector unflooded for 40 years.

Role of Forests in Runoff Generation and Flooding in Cold Regions

Harri Koivusalo[1], Ari Laurén[2], Teemu Kokkonen[1]
[1]Aalto University School of Science and Technology, Department of Civil and Environmental engineering, Finland
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Forest management practices have a clear impact on the components of water cycle, such as evapotranspiration, runoff, and storage of water in soils. In cold regions forests have notable effects on snow hydrological processes, which are important in controlling spring runoff generation and flood occurrences. Clear-cutting and thinning are the forest management operations that change the water balance through reduced canopy interception, reduced transpiration, increased snow accumulation, intensified snowmelt, and increased runoff. The removal of the entire tree canopy strongly changes the radiation and wind conditions above the ground, which leads to changes in the species composition of the understorey vegetation. The forest cuttings are typically followed by soil preparation, which further disturbs the understorey evapotranspiration capacity. Forest regeneration slowly alters the water cycle through gradually increasing canopy shading and interception, increasing surface roughness and evapotranspiration, and decreasing runoff. In Finland, drainage of peatlands is a characteristic feature of forestry, since about half of the 9 million ha of peatlands are drained for forestry. Drainage has changed the water balance of the original peatland areas by increasing the hydrological activity of the area through shortcut connections from peatland water storages to receiving surface waters. The effect of peatland drainage on hydrology is found to be controversial and site-specific, but short-term and long-term impacts can generally be distinguished.

The short-term hydrological effect of peatland drainage is the increased runoff due to the release of water stored in the original peatland and the decrease of transpiration after vanishing of peatland vegetation species that are not adapted to the dryer conditions. The long-term effect is determined by the success of the forestation after the drainage. In the case when the tree stand reaches high density with large interception and transpiration efficiency, runoff from the drained area decreases and becomes ultimately less than original runoff from the undrained peatland. In some cases excess water is not the only factor controlling the stand growth, and the drainage alone without fertilisation may lead to minor improvement in the stand growth. In such a situation, the drainage of the peatland can lead to a long-term increase in runoff. Long lasting increases in runoff after the drainage are also occurring, when peatlands fed by ground water discharge are drained.

Today pristine peatlands are no longer drained for forestry and the management aims at maintaining the drainage condition of the ditch networks through periodical cleaning. Ditch cleaning has less substantial impacts on peatland hydrology than the original ditching, although clear hydrological impacts presumably occur at sites where the cross sectional area of the ditches is tripled compared to the original ditches. Evidence from experimental peatland sites suggests that a large tree stand has a dominant role in the water balance of the peatland area during most of the growing season. In the case of a large evapotranspiration demand by the stand, the ditch cleaning and the improvement of the drainage conditions becomes unnecessary from the point of view of the stand growth conditions. The hydrological effects of forestry practices are distinctively observed in the spatial scale of the management units, whereas their impact is more difficult to observe in large spatial scales, where only a percent or two of the area is annually treated. In northern latitudes flooding at the outlet of a large watershed is typically induced by spring snowmelt. At the time of the spring melt the water storages over land areas become easily filled up close to their capacity.

According to studies conducted in middle Europe, blocking forest ditches and streams and subsequent retention of water has a visible impact on the middle size flood events, but a minor impact on large flood events. Control of large flood events calls for construction of dams and retention of large water volumes in inundated forested areas using dry reservoirs with a substantial size. Dry reservoirs are temporarily filled with water for a short period of time to cut down flood peak intensities.

Poster Abtracts

Soil Microbial Community Responses to Artificial Drought in Norway Spruce and Scots Pine Stands

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Drought experiments were conducted in a 40-year-old Norway spruce (*Picea abies* (L.) Karst.) and in a 60-year-old Scots pine (*Pinus sylvestris* L.) plantations in central Lithuania in 2003–2005. The sites were of, respectively, Myrtillo-oxalidosum and Pinetum vaccinio-myrtillosum types, where the artificial drought was proceed by using the roof constructions installed below the canopies. Experimentally induced drought on soil carbon (org. C), nitrogen ($N_{min.}$, NH_4-N, NO_3-N) and microbial population (bacteria and micromycetes as well as ammonifiers and nitrifiers) were investigated in samples from the organic layer and uppermost mineral soil (of 0–2 cm and 2–10 cm deep layers) in 2004 (18 months after the experiment installation).

As to compare with the control plots the drought induced the: (1) increase in the contents of org. C in the O-layer and mineral soil of 0–2 cm deep layer in both sites, even though, these differences were statistically not significant; (2) significantly increase of the contents of nitrogen (by 2–3 times in O-layer and mineral soil of 0–2 cm deep layer of the pine plantations, while, by 2 times only in O-layer of the spruce plantations); (3) significantly decrease in the abundance of organic soil bacteria communities (by 13 and 2 times, respectively, in pine and spruce plantations); (4) significantly increase in the abundance of organic soil micromycetes communities (by 4 and 3 times, respectively, in spruce and pine plantations); (5) significantly increase in the abundance of the ammonifiers and nitrifiers in organic soil (by 2 times in both sites).

Root Measurements by Electrical Resistance Methods

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The main function of roots is absorbing water and nutrients required for the development of plants. The increasing water shortage calls for a better understanding of root structure, root volume, and water uptake by roots in the soil-plant zone to serve as the base for a well directed and sustainable supply of water. In this article, we evaluate electrical resistance method as an alternative method for quantifying active zones of water uptake. Electrical resistances of roots and stems of hydroponically raised willows (*Salix schwerinii*) were studied and related with root morphology. Willow cuttings with and without roots were set in a constant electric field (effective voltage of 0.1 V, sine-AC, 128Hz) in a hydroponic solution. The results showed that the resistance decreased in relation to an increase in the contact surface area of the roots with the solution. However, the resistance depended strongly on the contact area of the stem with the solution, thus causing bias in the evaluation of root surface area. This work is a new contribution for the understanding of current pathways in the root system as exposed to an external electric field and for developing a non-destructive method to study plant roots accordingly.

Forest-water Interactions, the WFD, Flood Protection and Climate Change Adaptation

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Forest-water interactions and their potential application in the EU and Member state climate change adaptation policy framework are both significantly under-researched and rarely if ever implemented. Although there are several reasons for this – including compartmentalized sectoral negotiations on individual problem areas such as water management and afforestation strategies – there is also reason to assume that the lack of awareness of forest-water interactions and the paucity of proposed strategies for applying and implementing them are also to blame. Thus I propose a study that does two things: first, it will detail the current state of knowledge on forest-water interactions, and second it will assess both the degree to which knowledge on forest-water interactions has made its way into policy development and, where such interactions have failed to impact existing policy, it will assess the potential for integrating forest-water interactions into the existing EU and Member state policy framework. Since we might expect the advantages of exploiting forest-water interactions to vary across water-rich and water-stressed Member states, this study will employ two case studies to illustrate their potential benefits in each of these settings.

Assessing the Ecological Effects of Forestry Operations and Potential Mitigation Measures on Riverine Systems in Sensitive Regions of Ireland

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Exotic conifer plantation forestry has been identified as a potential source of diffuse pollution within Ireland in studies dating back several decades. Some of this pollution impact appears to arise from increased acidification linked to maturing plantations in acid-sensitive catchments, whilst other impacts such as sedimentation and eutrophication have been shown to be associated with clearfelling on peaty soils.

The poster illustrates findings to date on forestry-related acidification, sedimentation and eutrophication pollution in Ireland generated by the HYDROFOR study – currently Ireland's leading study on forest and surface water interactions.

The study investigates the spatial and temporal impacts of acidification resulting from the presence of mature coniferous forests on the macroinvertebrate communities in river catchments with a range of forestry cover (0%, 35%, >50%). Also under investigation are the sedimentation and eutrophication effects of clearfelling within forested catchments on peaty soils. More specifically, the study assesses the spatial and temporal impacts of nutrient and sediment runoff on the hydrochemistry and macroinvertebrate communities of selected catchments across various felling coup sizes.

HYDROFOR ultimately aims to determine the extent to which introducing certain mitigation measures reduces potential impacts on Ireland's forested waterways.

Assessment of Impacts of Forest Operations on the Ecological Quality of Water

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This project aims to assess experimentally the effectiveness of buffer strips following the clearfelling of forests on sediment and nutrient release, acidification and greenhouse gas (GHG) emissions. Two types of riparian buffer are studied in the Burishoole catchment in Co. Mayo: (1) a naturally revegetated peatland buffer and (2) a standing mature coniferous forest. The forest area upslope of the study site is due for clearfelling in 2010, allowing 4 years of regeneration on the riparian buffer zone.

Pre- and post-clearfelling data will be collected at the study site for surface water, subsurface flow and greenhouse gas (GHG) emissions. Surface and subsurface waters are sampled across the site regularly and during storm events, and chemically analysed for suspended sediment (SS), dissolved reactive phosphorus (DRP), total phosphorus (TP), ammonium-N (NH_4-N) and nitrate-N (NO_3-N).

Initial results obtained on site show there is an increase in DRP concentration moving from the forest edge to under the brash mat. This reduces again closer to the river. These initial indications show that a revegetated buffer is successful in reducing phosphorus concentrations from the forest to the river bank. Further data will be collected pre- and post-clearfelling to assess the effectiveness of two types of buffers.

Using Models to Explore the Implications of Enhanced Forest Production on Water Quality in the Boreal Forest

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Policy conflicts arise when actions to climate change mitigation adversely affect the natural environment. Meeting a policy goal of efficient energy use may make it more difficult to pass on to the next generation a society where major environmental problems have been solved. Sweden's energy policy promotes efficient energy use and a cost-effective energy supply with no adverse impact on health, the environment or climate. Key to more efficient energy use is a greater reliance on biofuels, implying more productive forests and greater rates of forest harvest.

Increased forest productivity and harvest may have negative impacts on water quality in the boreal forest. Sweden has identified sixteen Environmental Quality Objectives including "Natural Acidification Only", "A Non-Toxic Environment", "Zero Eutrophication", "Flourishing Lakes and Streams".

Models have a role to play in promoting dialogue about the possible effects of more intensive forestry on surface water quality in the forest landscape. They can be used to explore "what if" scenarios and can lead to a more informed understanding of possible conflicts between climate change mitigation and water quality in the forest landscape.

Estimation of Water Availability Using the k-Nearest Neighbor (kNN) Method in a Rural Village in Nepal

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The study was conducted in a project site of the Rural Village Water Resource Management Project (RVWRMP) in Nepal. RVWRMP is a bilateral development cooperation between the Governments of Finland and Nepal. The main objective of the study was to quantify water volume applying the kNN method. It was assumed that there are similar water volume conditions within a large reference area covered by the satellite data and its spectral values reflect the state of water resources. In the kNN method, field attributes are assigned to each pixel of a satellite image based on spectral similarity compared to the reference pixels. k-Nearest Neighbor algorithm was used to predict water volume in the entire study area based on the spectral information from Aster imagery and measured water volume in the sample plots.

The study is one of the first attempts to estimate water volume with kNN.Variability in sample plot data quality and physical effects, such as hillside shadows on satellite imagery, resulted to a relatively high RMSE (56 %)Spectral information of the original band was used in the present analysis. Derived measures such as band ratios in addition to the original spectral band information may improve estimation accuracy

Release of Dissolved Organic Nitrogen in the Decomposition as Affected by Enchytraeid Worms

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[2] Department of Biology, University of Eastern Finland, Finland

We studied how the nitrogen (N) released in decomposition is distributed into inorganic and organic forms, and how the enchytraeids, representing the effect of soil fauna, the quality of organic material, and abiotic factors affect this distribution. Samples of mor humus and *Carex* and *Sphagnum* peat in two different degrees of decomposition were incubated for five months at constant temperature and moisture conditions. In mor, most of the N release was in the form of dissolved organic nitrogen, while in well humified peat it was mostly NH4+. The presence of enchytraeid worms increased the N release. In poorly humified peat there was no net N release during the experiment.

The Flow of Carbon through a Boreal Forested Catchment – Connecting Trees to a Lake

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The circulation of carbon in terrestrial and aquatic ecosystems is tightly linked, as a part of carbon assimilated by terrestrial vegetation is transported with water and ending to aquatic ecosystems. Studies from temperate, tropical and northern regions have shown that for the proper estimates of carbon sink/source role of ecosystems at the landscape level both terrestrial and aquatic parts should be included. However, these ecosystems are often studied separately. Also inorganic part is often ignored although both DIC and DOC are important when evaluating the carbon budget.

The aim of this study is to increase the knowledge of boreal carbon cycling and especially to concentrate on the connection between terrestrial and aquatic parts of it. We study the carbon and water balance of a small boreal headwater lake Valkea-Kotinen and its catchment area. We have automatic continuous measurement of CO_2 concentration at different depths in riparian zone soil matrix, in the lake and in the brook. We also measure the DOC concentration of various aquatic compartments. We study the seasonal variation in the DOC and DIC concentrations in the different components of the water balance and pay special attention to time periods following rain events.

Effects of Simulated Drought Stress on Norway Spruce Clones

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[2]Norwegian Forest and Landscape Institute, Ås, Norway

We monitored the effects of drought stress on 20-year-old clones of Norway spruce (*Picea abies*) by using a range of instrumental methods. On two experimental plots (Hoxmark, Norway, 59°40’14”N, 10°47’36”E), draught was induced in a period between May and October 2009 by removing the throughfall using rain shelters and trenching. We collected data on soil moisture, stem and branch sap flow, xylem diameter, anatomical and calorimetric analysis of the needles, fine root biomass and dynamics and resistance to pathogens. Here we present the analysis of sap flow and xylem diameter in a period 1–17 August 2009.

The results show a significant difference in the shape of diurnal curves of transpiration as well as different time lag among the sap flow of the two plots and the potential evapo-transpiration. Also the differences in diurnal dynamics of the stem circumference suggested different xylem water potential in stressed and control trees. In the drought-stressed trees, the diurnal fluctuation in stem diameter was about 4 times higher and the total stem increment one third lower compared to the control trees.

The Effect of Manipulated Water Regime on Stem Increment of Norway Spruce

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Czech University of Life Sciences Prague, the Czech Republic

In order to describe a microsite water regime in a spruce stand we evaluated time scale data of climate, physiological and hydropedological processes in a plot of 18 sample spruce trees in the area of Brdy Mts, the Czech Republic. The 18 sampled trees were divided into six subplots located according to different microsite regimes: 2 plots (P1, P2) (control plots inside the stand), 2 plots (P5, P6) (edge of the stand) and 2 plots (P3, P4) (simulation of water deficiency). To simulate the water deficiency conditions we installed a roof system to prevent precipitation from entering the soil profile. To assess the water stress caused by water deficiency in P3 and P4, we evaluated the hourly measured data of stem diameter variation, water moisture and water potential in a period from April to October 2009. The difference of maximal and minimal stem increment of trees in plots P3 and P4 was 1.93 mm compared with control plots, 12.97 mm (P1, P2) and 23.34 mm (P5, P6). In plots P3 and P4 the results show that the effect of water deficit is statistically significant. The statistical difference of data from the inside stand plots and edge stand plots was also accomplished. The standard deviation of all measured parameters was the highest in stand edge plots (P5, P6).

Groupwork

Group Work Programme

Objectives and Goals

A concrete problem on the issue of forest and water is presented to the participants of each group in the first afternoon. The problem will be different for every group. The main focus of the group work for the four afternoons is to learn the process from identifying a problem to ending at a final advice/result in a multi disciplinary group.

The participants should be able to deliver a Powerpoint presentation by the end of the week both on the process and on the result. Participants will do this problem solving with a case from i) Boreal conditions ii) Alpine conditions iii) Temperate Atlantic conditions, or iv) Mediterranean conditions

The participants should utilize the JFNW 2010 program lectures, field trip information, their own experiences and any additional research (internet with electronic journals) or pertinent information when developing the group reports.

The lecturers participate in the group works when available as mentors. They are expected to bring their knowledge into the discussions and help the groups to formulate reports and plan the follow-up actions.

The group reports will be finalized and presented on Friday,

The general agenda:
Monday afternoon
- Read and analyse topic
- Participants: map expertise in group: personal and professional background, composing a chart of expertise
- Each group will select a chairperson and a secretary for the entire week
- Define exact problem, define workplan, roadmap, and who you address (brainstorm the subject)
- Prepare an outline for the reports.

Tuesday afternoon: to be defined by group
Thursday afternoon: to be defined by group
Friday afternoon: plenary presentation & discussion.

i) Boreal conditions

Combining wood production and water protection in peatland forests

A significant share of forest resources in Finland, Sweden and the Baltic countries are located on peatlands. Forest production potential of peatland sites varies widely according to hydrological conditions and nutrition status. Large scale ditch drainage has been conducted to enhance forest production on the peatlands; e.g. in Finland there is about 1.3 million kilometres of forest ditch. In the regional and national scale, ditching has considerably increased wood production, but there have been adverse effects too.

Peatlands as excessively wet areas are closely connected to water courses and therefore management of peatlands easily affects quality and quantity of runoff water. Ditching, ditch network maintenance, fertilisation, forest regeneration and site preparation may all increase dissolved nutrient export or export of suspended solids. Water protection methods differing in efficiency and cost have been introduced to abate the adverse effects of forestry. Forest harvesting and hauling on soft peat soils are also technically, environmentally and economically demanding questions.

In the group, you should assess how wood production and water protection in peatland forests can be combined. You can approach the work from the following perspective:

- compose an outline of water balance of a peatland forest
- compose an outline of the forest management practices particularly in peatlands
- define how forest management practices may affect water balance in peatlands,
- define problems related to changes in water balance caused by management practises
  - extension and scales of the problems
  - quality and uncertainties of the existing knowledge
  - which of the problems can be tackled with the existing knowledge and which not
- compose a summary of water protection methods and the mechanisms that they are based on
  - quality of knowledge
  - need of new research
- assess how wood production and water protection can be combined on peatlands
- outline possibilities for economically and environmentally sustainable forestry on peatlands

Or you may create an approach of your own. It is important to gather the expertise you have in your group and to assess the problem from a multi disciplinary aspect containing plant physiology, hydrology, limnology, microbiology, geology, soil science, forest technology, timber procurement, economics, environmental sciences, sociology, cultural studies or whatever field of research that you have expertise in.

ii) Alpine conditions

One or two important ones in the region could be selected - like floods or ground water related questions (to be specified).

Due to the abandonment of marginal agricultural land in most European mountain ranges, forest cover is increasing in these areas. This has positive consequences, for example, for biospheric carbon storage, as forests store ca. 10x more carbon in biomass compared to grasslands.

Simultaneously, increasing forest cover in a catchment has hydrological consequences as well. Because forests have a greater ability to store water (through a more extensive rooting zone) and their transpiration rate is higher on an annual basis. Therefore, increasing forest cover implies less runoff but higher evapotranspiration at the catchment scale. Reduced runoff may be problematic under a future climate that is most likely drier in summertime compared to current conditions, thus exacerbating drought problems not only in the mountains, but particularly in low-elevation areas (upland-lowland linkages) where water in summer is needed for various purposes (irrigation, hydropower, drinking water). Increased evapotranspiration is likely to have a feedback to regional climate, enhancing the moisture content of the atmosphere and possibly leading to increased precipitation (elsewhere). This feedback is not currently taken into account in regional climate model simulations.

The question thus is whether management should actively seek to keep landscapes open to avoid changes in current forest-water linkages in mountainous terrain.

iii) Temperate Atlantic

Monday afternoon: consider /identify the main issues in water and forest under climate change in this region. A topic could be flood control, and water retention areas.

The climate change scenarios for Atlantic central European area (UK, Ireland, western France, Belgium, Netherlands, Denmark), mostly predict wetter and warmer winters, and dryer and warmer summers. Also more severe events are expected like storms and intense rain events. This means that forest management in these densely populated areas faces new challenges.

The ecological sustainability is at danger, while at the same time new environmental services are being asked like water retention, and wood for bioenergy.

How should forest managers respond to this. Give insight in most likely impacts of climate change in this region of Europe (or a case study region), provide guidance for forest managers how to respond, and adapt their forest. Furthermore, what construction can be thought of to combine this with water retention, and biodiversity conservation. Should national forest policies be changed to accommodate this?

iv) Mediterranean conditions

In the Mediterranean region Potencial Evapotranspiration is, very often, much higher than precipitation. Normal reference figures can be: P around 500–600 mm and PET over 1000 mm. In these conditions, water is a limiting factor for the growth and sustainability of forest ecosystems. In addition most Mediterranean forests formed by resprouters like evergreen holm-oak (*Quercus ilex*) and other species, have been used historically to produce charcoal, leading at present to coppice structures with very high resprouts density which increase the respiration cost of these forests. Very commonly, at present, these forests are stagnated with an assimilation that just compensates the respiratory cost with no or very low net growth, usually less than 1 Mg/ha/y.

The region is extremely sensitive to climate change and most CGM or regional models project an increase of temperature (with the consequent increase in the respiration rates) and an important precipitation decrease so, in most cases, future conditions can be critical for the survival of some Mediterranean forests. Even more, the risk of forest fires will increase following the temperature increase and precipitation decrease.

At present dieback is observed in some forests of different species mainly Scots pine but also, *Quercus ilex*, Aleppo pine and others. Despite the low productivity, the forest cover plays a crucial role in the Mediterranean for their positive impact on the quality of water and their role as soil protectors against the erosion derived from the severe rainfall events.

Open questions are:

- How to improve the resistance of Mediterranean forests to the adverse effects of Climate Change?
- How to manage the increasing risks of forest fires?
- How managers can adapt to these new conditions?
- Can the reduction of trees population density be a solution in some critical areas?
- What forest restoration alternatives could be considered to face the adverse effects of climate change?

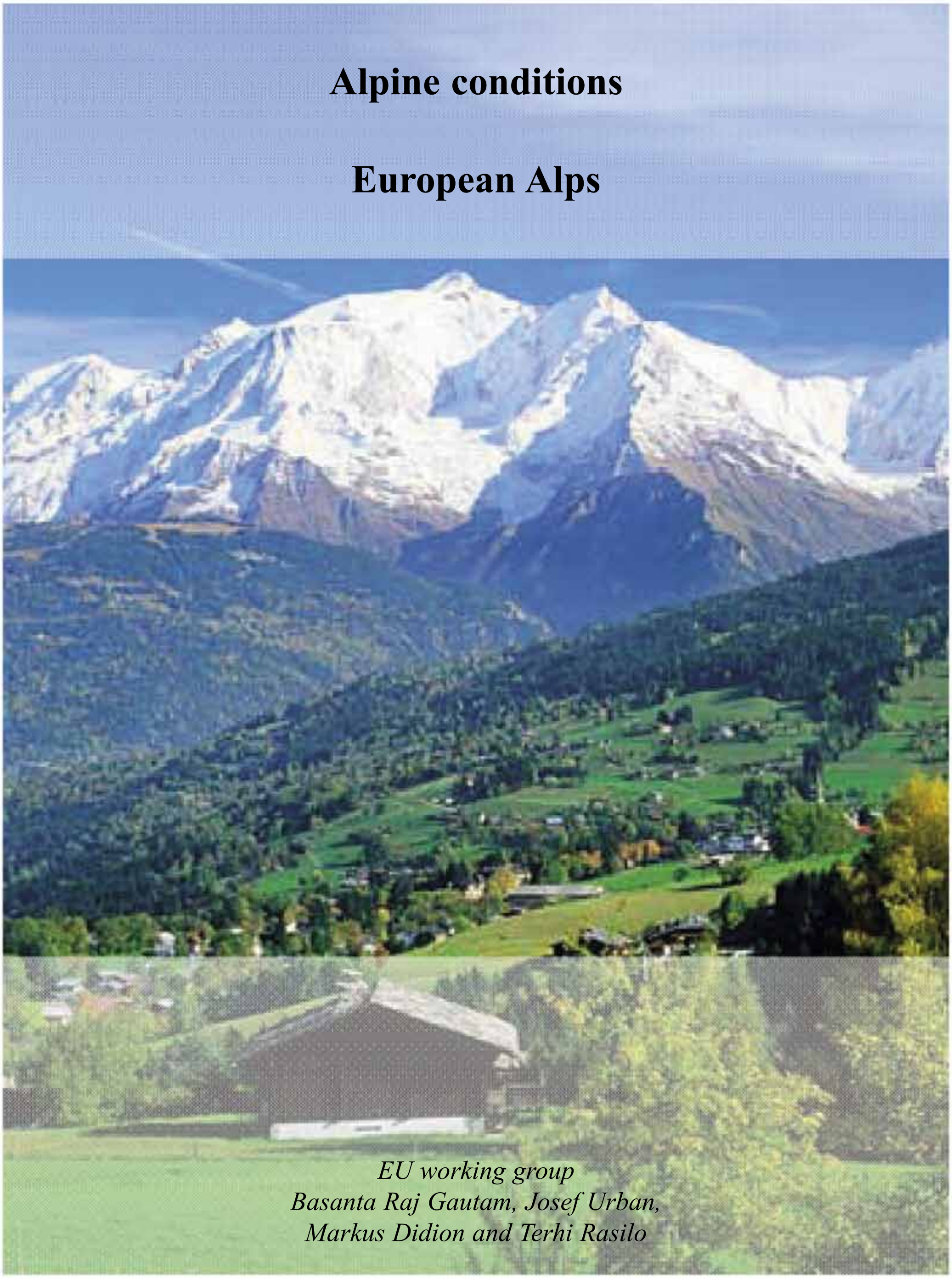
Alpine Conditions

European Alps

EU working group
Basanta Raj Gautam, Josef Urban,
Markus Didion and Terhi Rasilo

Alpine conditions

European Alps

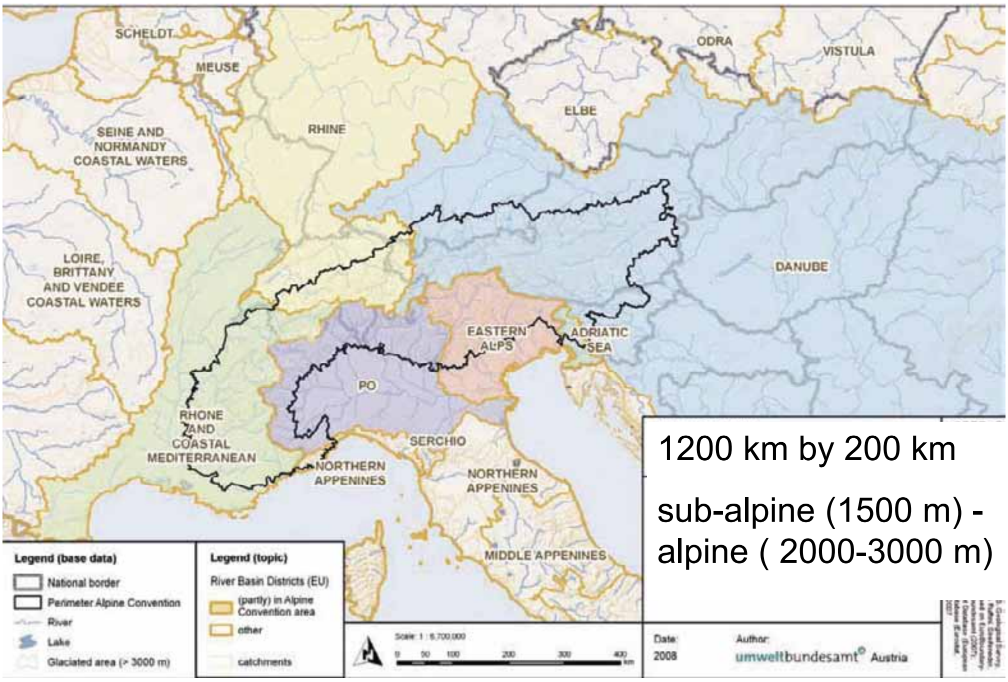


EU working group
Basanta Raj Gautam, Josef Urban,
Markus Didion and Terhi Rasilo

What should forest management look like to satisfy societal needs in a changing climate?

- The role of forest management to maintain hydro-ecological services in the long-term within financial constrains given the current socio-economic situation

European Alps



1200 km by 200 km

sub-alpine (1500 m) - alpine (2000-3000 m)

Alpine conditions

- Within the Temperate bioclimatic zone (Mediterranean – Continental)
- Short growing season
- > 50% forest (coniferous), 25% grasslands and mountain meadows (mostly semi-natural)
  - Naturally dominant trees *Picea abies, Pinus sylvestris, Abies alba (Mountain zone), Larix decidua, Pinus cembra (Subalpine zone)*
- Over 11 million people live + 100 million people visit
- 4% of the workforce in farming and forestry, 70% in the service sector (e.g. tourism)

Drivers behind forest-water interaction (1)

- Changes in climate
  - 20th century: +1.5C (twice global average)
  - By 2050: +2C (fall, winter, spring), +3C (summer)
  - Precipitation: summer↓ , winter ↑
  - Increased run-off, shorter snow cover
- Topography
  - Slope
  - Aspect
  - Bioclimatic region

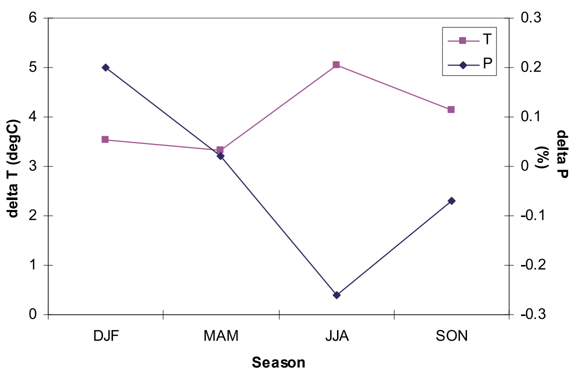


Figure based on Ensembles data set (16 climate models); cf. IPCC Fourth Assessment Report, (Solomon et al., 2007; supplementary material to chapter 11)

Drivers behind forest-water interaction (2)

- Land use change
  - Abandonment of pastures -> more tree/forest cover (feedback socio-economic)
  - Upslope movement of treeline due to T increase
  - Recreation (building, ski slopes, infrastructure)
- Socio-economic
  - Population migration / life-style change
  - Policies
    - reliance on local regional wood/forest products vs. globalisation and imported wood/timber)
    - subsidies

Stakeholders

- Forest owners
- Local communities - downstream / lowland population
- Policy at different levels (local to supranational)
- Tourism
- Energy
- Agriculture
- Industry
- Transport
- Others (NGO's, science community…)

Concerns

- Biodiversity
- Wood and non-wood products
- Carbon sequestration
- Recreation
- Protection

→Water retention and drinking water
  - Limited avl. data
  - Moderation of run-off peaks (erosion control, etc.)
  - Water quality

→Consequences - downstream/lowlands:
  - Increased forest cover → less available water (droughts)
  - Flood control (incl. dams)

Adaptive management

Direct and indirect measures:

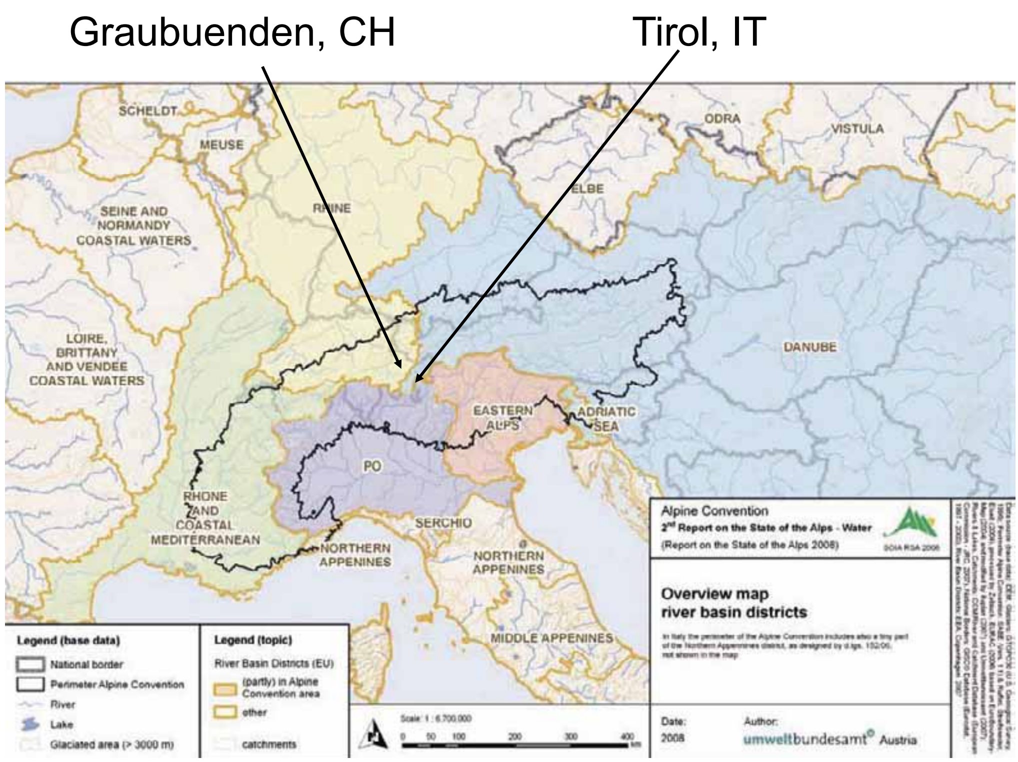
- Management of trees, stands, and combinations of stands in the landscape
- Activities changing the socio-economic and political frame of forest management

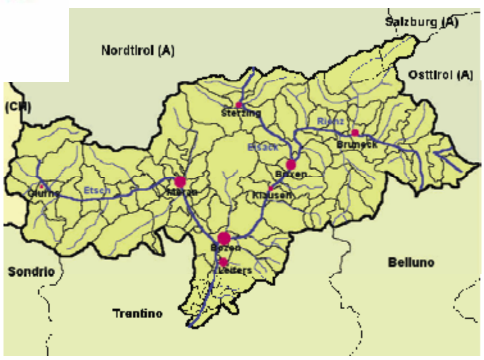
Direct measures

- Stand-scale
  - Regeneration: manipulate light conditions (thinning, gap-creation), species composition (planting, seeding)
  - Growth: intensity and frequency of thinning, rotation length, spatial design
- Landscape-scale
  - Mix of stand treatments (→ heterogeneity)
  - Forest connectivity

Indirect measures

- Policy and legislation
- Financial instruments (encourage people to stay, etc…)
- Alpine convention
- Water Framework Directive





Source: http://www.clisp.eu/content/?q=node/166 and http://en.wikipedia.org/wiki/Province_of_Bolzano-Bozen).

Case study - general

Graubünden

- 7106 km²

  (Glaciers 2.5 %)
- 230–4049 m

  alpine 1100–2600 m
- 190 000 inhabitants

South Tyrol

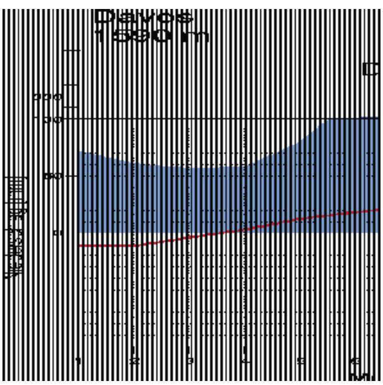
- 7400 km²
- 300–3905 m

  alpine 900–1700 m
- > 500 000 inhabitants

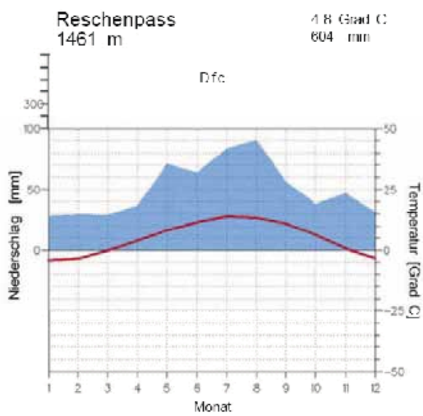
Case study - Climate

Graubünden

2.8 Grad C
999 mm



South Tyrol



Source:
http://www.klimadiagramme.de

Case study - Land use

Graubünden

- Agricultural 30%
- Forest 27%
- Unproductive land 42%

South Tyrol

- Agricultural 36%
- Forest 40%
- Unproductive land 22%

Case study - challenges

Graubünden

- Hazard protection
  - Erosion
  - Flood
  - Avalanches

→Forest expansion due to CC as chance; maintain continuous cover

South Tyrol

- Water supply
  - Agriculture
  - Drought
- Water quality

→Forest expansion due to CC exacerbates existing water supply limitations

Points for discussion

- On-the-ground implementation of available policy instruments
- Re-distribution of costs and benefits (i.e. "polluter pays principle")
- Stakeholder roundtables
- More integrated resource management
- Uncertainties and multiple feedbacks
- More workshops like this ☺

Literature

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Prospective of Forest and Water Management in Alpine Conditions

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[4]University of Helsinki, Finland

Alpine conditions are characteristic for high elevations of the mountain ranges within the temperate bioclimatic zone in Europe (e.g. Pyrenees, European Alps, Apennines, Carpathians; Lindner et al. 2007). Mountain forests provide several goods and services not only for the people living in the mountain region but also for the people living at lower elevation (Alpine Convention 2009; Sundseth 2009). Mountain forests are very important in particular for their protective function (e.g. avalanche an rockfall protection, erosion control, water resource protection; Frehner et al. 2005). The climate is typically cold with short growing season, in some aspect similar to the boreal climate. Naturally dominant tree species in the European Alps are *Picea abies, Pinus sylvestris,* and *Abies alba* in the Mountain zone and *Larix decidua* and *Pinus cembra* in the subalpine zone. The altitude of the treeline varies with the latitude. The treeline is very often lowered by the grazing.

For the purpose of this study we narrowed our focus on the European Alps. The Alps are the highest mountain chain in Europe. They are 1200 km long and 200 km wide, with several peaks above 4000 m (Sundseth 2009). The Alps cover eight countries, including France, Germany, Switzerland, Italy, and Austria. The height and extent of the vegetation zones varies with the exact location. Altitude is the main deciding factor for habitats and species alteration within the mountain range. Generally the upper border of the sub-alpine zone lies around 1500 m whereas the alpine zone may reach up to 2000–3000 m. Climate is a subject to the strong gradient from east to west and from north to south in terms of the precipitation and temperature. Vegetation of the Alps is composed of more than 50% coniferous forest and 25% of grasslands and mountain meadows (Sundseth 2009). Most of the meadows are seminatural or natural, often heavily influenced by grazing. The European Alps provide home for more than 11 million people (including the lowlands) and are also important in terms of tourism. Every year more than 100 million tourists visit the Alps. Therefore 70% of the people work in the service sector and only 4% in farming and forestry.

Land use change is becoming an important issue in the Alps (Chemini and Rizzoli 2003). The main driving factors for current land use change are changes in society, tourism and agricultural production methods. For example, the primary sector is nowadays heavily influenced by the moving of the workforce from the remote farms down to the valleys (i.e. depopulation), and in consequence, the pastures are abandoned and may become forested.

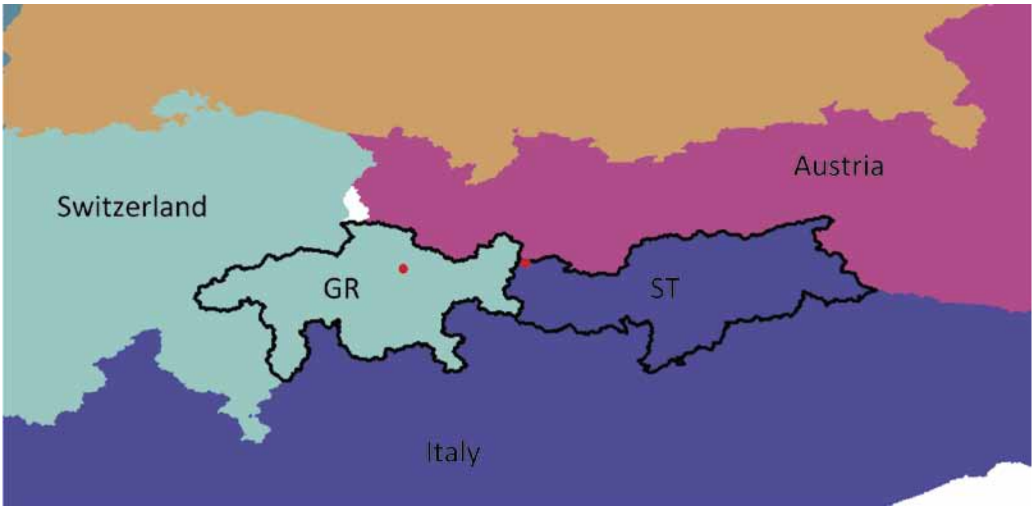

Figure 1. Location of Davos (red dot) in Graubünden (GR) and Reschenpass (red dot) in South Tyrol (ST).

The altitude of the natural treeline is due to increase in response to climatic change. Land use changes are also affected by tourism – forests are converted to skiing slopes, new buildings and roads are constructed. Production of hydroelectricity, as a renewable source of energy, requires building the new dams.

Typical topography of the Alps requires site-specific view. We picked up two contrasting areas: Graubünden in Switzerland and South Tyrol in northern Italy (Figure 1). Both of these regions are comparable in terms of size, which is ca 7000 km^2, but differ in the climatic conditions resulting in different land use (Table 1). While the South Tyrol region is drier, more populated and focused on agriculture, the Graubünden is wetter with a higher proportion of unproductive land (Figure 2).

Table 1. Comparison of the two case study areas in the Alps (based on data from http://www.clisp.eu/content/?q=node/166 and http://en.wikipedia.org/wiki/Province_of_Bolzano-Bozen).

Parameters	Graubünden	South Tyrol
Area	7.106 km2 (Glaciers 2.5 %)	7400 km^2
Altitude	230 – 4049 m	300 – 3905 m
Inhabitants	190 000	> 500 000
Agricultural	30%	36%
Forest	27%	40%
Unproductive land	42%	22%
Climate	Reschenpass 1461 m	Davos 1594 m
Mean annual temperature °C	4.8	2.8
Annual precipitation (mm)	604	999

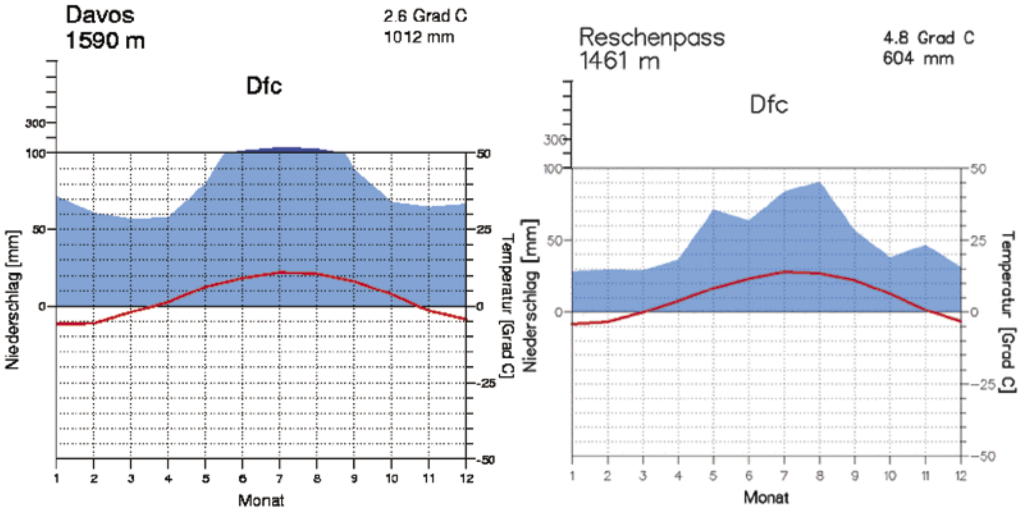

Figure 2. Climate diagrams for Davos (Graubünden) and Reschenpass (South Tyrol). Source: http://www.klimadiagramme.de, accessed 7/6/2010.

The main concerns influencing the final solution are: biodiversity, wood and non-wood production, carbon sequestration, recreation, nature and water related protection with focus on erosion and avalanches. All proposed solutions will have to take into account not only the climate and topography but also the socio-economical and political aspects. Every disturbance or change of the land use affects water yield in the terms of both quality and quantity. Frequent and large-scale disturbances in mountain forests may have a negative impact on the functioning of water protection forests by reduced ability to dampen run-off peaks or on the other hand to reduce the amount of the water supplied by the landscape.

Taking into the account the demographical development (i.e. moving of the workforce from the mountains to the valleys) within the framework of the global change, it will not be possible to maintain the current status quo of the land use. Without human influence, forest is going to take over the present pastures, affecting the water balance in the Europe. Possible consequences of increased forest cover will affect lowlands. Less available water will induce more drought periods, affecting not only agriculture in the South Tyrol region but also regions downstream, in terms of the amount and quality of drinking water, water for agricultural purposes and water for hydroelectricity production. On the other hand, forest will moderate the run-off and bring some small-flood protection. Protection against the bigger floods will have to include optimal use of the present and newly-build dams.

Regarding the two selected regions, the main challenge in the Graubünden is hazard protection (avalanches, floods, erosion). Therefore a desirable forest-water management objective is the maintenance and increase of forests and their protective function. The main challenge in the South Tyrol is maintenance of a constant water yield. Therefore the landscape management should be more focused on the maintaining of the present pastures providing higher water yield.

Realization of future management of the alpine region in both farming and forestry will have to include socio-economical aspects. If the maintenance of the present pastures is desired, society will have to subsidize the workforce in the mountain areas. A first question is, whether it is better to start to support presently living farmers there or to hire some labor? The main advantage of supporting the mountain people is that they understand the real situation and feel to be connected with the mountains. The support of the presently living farmers should not be only financial subsidies but it may include building e.g. infrastructure, bringing the social life and some kind of the "moral" support. The second question is who is going to pay for the benefits and how the payment should be arranged? Should the financial part be only the responsibility of the respective country (e.g. Austria will pay only to the farmers from the Austria) or shall all countries downstream pay some "water fee"? Shall the tourists visiting the Alps pay for the maintenance of water? Shall the "hydroelectricity" tax be included in the price of electricity? What should be the price of the flood protection? On the other hand, shall the alpine countries pay for non-supplying of the water? These financial instruments may be used to initiate water management schemes for the alpine regions.

In a nutshell, landscape management will depend on the implementation of the available policy instruments. The second point is redistribution of the costs and benefits. Uncertainties and feedback from the lowland areas are next key points influencing the headwater management. Participation of all the stakeholders and their active involvement in decision making will be necessary in the future.

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http://www.clisp.eu/content/?q=node/166 (accessed on 26.05.2010)

http://en.wikipedia.org/wiki/Province_of_Bolzano-Bozen (accessed on 26.05.2010) ing the new dams.

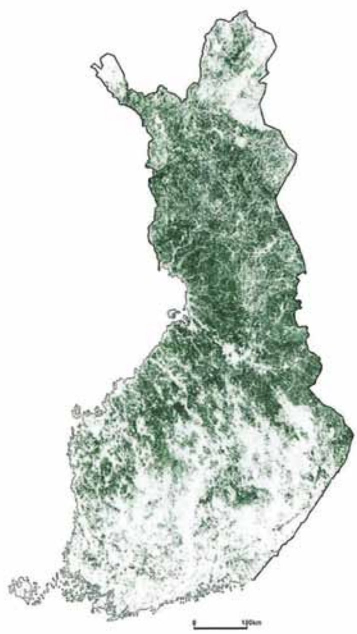
Combining Wood Production and Water Protection in Drained Peatlands

J. Aleinikoviene, M. Futter, A. Kaila, H. Koivusalo,
M. Lappalainen, A. Laurén, T. Repo, C. Yang

Forests and peatlands in Finland

Forest map (source EFI)

Peatland map (source GTK)



Distribution of mires in Finland.

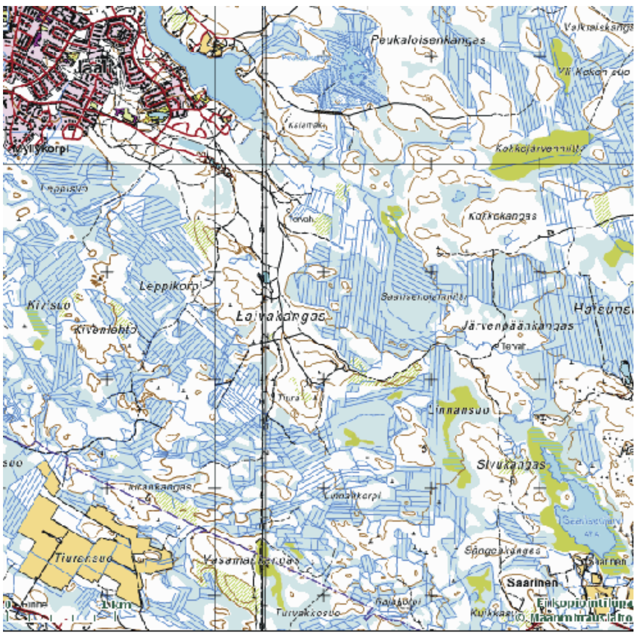
What is a peatland?

- Ground vegetation dominated by mire species
- Peat layer > 30 cm thick

Photos: Kimmo Virtanen

Ditches are everywhere

- Technique
  - 30-60 m spacing
  - 50-100 cm depth
  - Maintenance required
- Pristine peatlands are no longer drained



Map: Maanmittauslaitos 6/MYY/10

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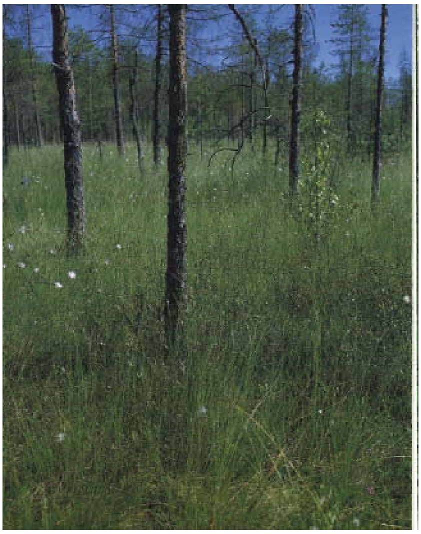
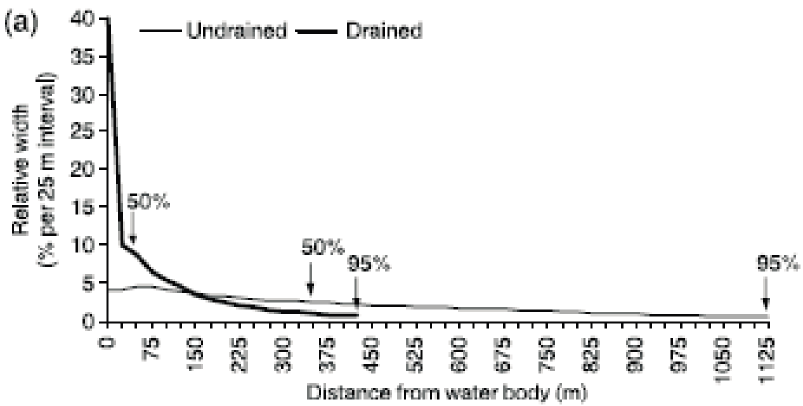
Before and after

Photos: Laine & Vasander 1990. Suotyypit



Scale of the ditching operations



Korkalainen, T., Laurén, A., Koivusalo, H. & Kokkonen, T. 2008. Impacts of peatland drainage on the properties of typical water flow paths determined from a digital elevation model. *Hydrology Research 39(5-6): 359-368.*

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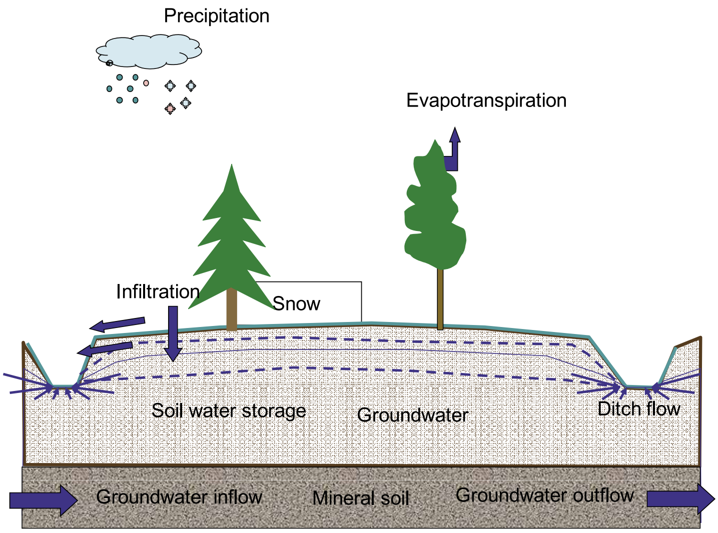
Conceptualisation of peatland hydrology

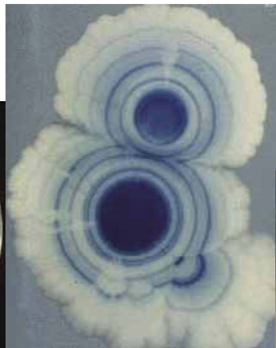


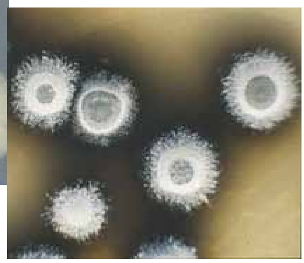
Below-ground response - roots

- C pool of root system in peatlands is one third higher than in mineral soil sites.
- Superficial roots, 50-80% in top 1o cm(oxygen deficiency).
- The marginal effect of distance to drainage ditch on the improvement of root-growing conditions was obvious after 2 years.
- The decline of root respiration following clearfelling .
- Root production is positively affected by soil temperature and aeration, nutrient (P, exchangeable K) on drained peatlands.

Sustainable forestry on peatlands with the concept of peatland microbiota

Because of the direct link of soils biological properties and many of the ecosystem-level processes (decomposition, nutrient mineralization) soil microbiota provide the valuable information on the ecosystem-level responses to existing disturbances (Wardle & Giller, 1996).





Sensitiveness of soil microbial parameters

•**Abundance** –

(*it was shown that abundance of microbiota depends on the soil type. Ordinary, it stays stable or is changing via long-lasting process)*

•**Diversity** –

(*mainly showing the changes between microbiota communities bacteria↔actynomycetes↔micromycetes, but changes inside the phylum is not well thought out*)

•**Activity** –
(mainly depends on the input of organic matter)

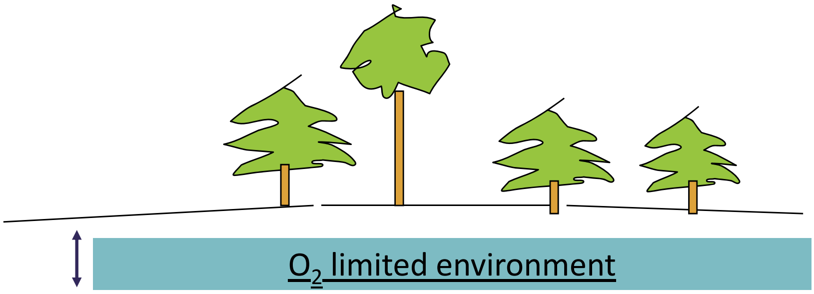
•**Biomass**

•**Biomass C, N and etc.**

(generaly responding on all the parameters)

In peatlands, hydrology is the most powerful factor influencing the microbiota activity (Thirukkumaran and Parkinson, 2000).

Peatlands without ditching



Microbiota

- *aerobic decomposition - controlled by water table and temperature;*
- *anaerobic decomposition - release carbon as $CH_4 + CO_2$;*
- *N mineralization - N_2O and N_2*

Ditching

Microbiota is able to maintain the organic carbon, keep the organic compounds locked into their biomass (preserving leaching of organic compounds)

Clear-cutting

Microbiota is suffering from the deficiency of nutrients will intensively mineralize the organic compounds decreasing in their biomass

Forest regeneration

Following the regeneration of forest stands after the clear-cuts microbiota is increasing in biomass in less extent then forest is left naturally to regenerate. Then tree seedlings are planted and increase in roots biomass, the microbial biomass is also increased

Fertilisation

Influence the increase in the growth of microbiota biomass as well as the accumulation of carbon

Productive peatland forestry

- There are number of criteria for evaluating the productivity of drained peatland
  - E.g. productive forest stands should be growing a minimum of 1 m^3 stemwood ha^{-1} yr^{-1}.
- A stand which meets the minimum growth criteria may not be suitable for forestry for a number of other reasons.
  - E.g. high biodiversity or water protection potential

Site suitability

- Income > costs
- Forest operations on peatlands are usually more expensive than on mineral soils
  - The total volume of usable timber is generally lower
  - greater fertilizer inputs are often needed
  - ditches may need to be maintained
- The suitability of a site for restoration should also be evaluated.
- Choice of management strategy should be informed by whether the site is a greenhouse gas (GHG) source or sink.

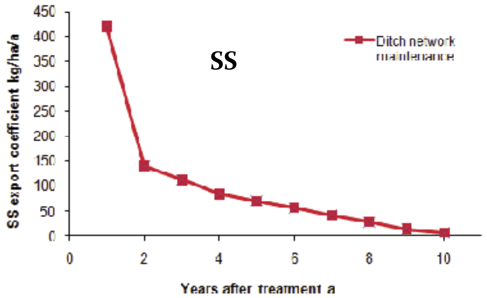
Peatland Forestry Classes

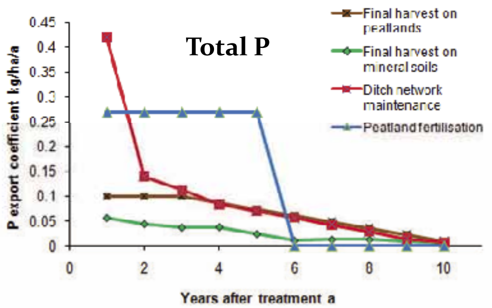
1) Currently profitable forests should be maintained and regenerated as forest
2)The costs and benefits of ditch-cleaning should be evaluated for forests where growth might be improved by ditching
3)Forests where the current stand is harvested and regeneration after clear felling is not economically feasible
4)Sites which are not suitable for wood production as the stand is not presently harvestable and cannot be successfully regenerated.

Legal Issues

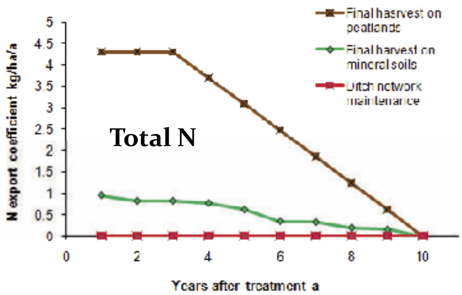
- Forest owners have a legal obligation to reforest
- forests cannot easily be taken out of production, even if there are good reasons for doing so

Water quality impacts





- Excess load caused by treatment
  - Reference is the situation before treatment



Conclusions

- **In parts of the peatlands forestry is sustainable (econ.&ecol.)**
- The policy framework may be inappropriate for restoration of drained peatlands previously managed for forest production.
  - **The law should be changed so that land which should not be used for forest production can be retired**
- “Polluter pays” –principle?
  - Important first to understand the principles if we are to introduce the principle. Otherwise, cost determination is arbitrary and disproportionate.
- Reference conditions are not clearly identified.

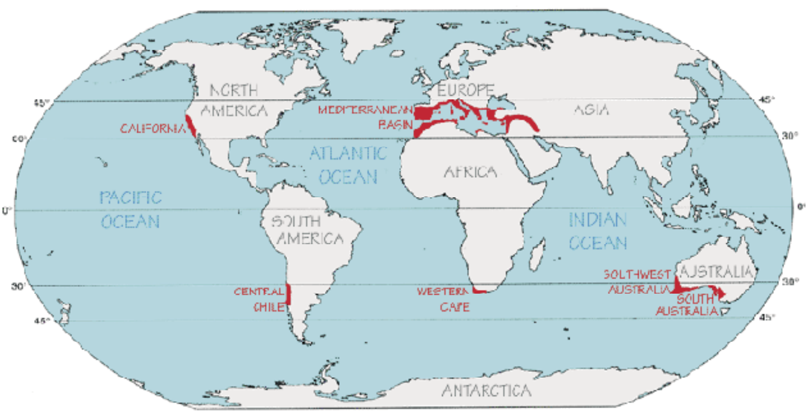
Mediterranean Conditions

*David Ellison, Carlos Gracia, Giovanni Santopuoli,
Mike Starr, Leena Stenberg and Ramon Vallejo*

Outline of Presentation

- Define Mediterranean
- Talk about climate change projections
- Use Case Study and Simulation to Analyze Selected Problems in the Mediterannean Climate:
  - Drought
  - Forest fires
  - Forest survival
  - Erosion
  - Watershed flow management/regulation
  - (Flood management)
  - (Water quality)
- Recommendations for public authorities (and forest owners?)
  - Based on *long-term* view of climate projections and possible impacts, outcomes

Mediterranean Conditions Defined



Mediterranean-Climate: combines cool or cold and wet winters, long, hot and dry summers. Summer drought is of variable duration. Water is the key limiting factor. Annual precipitation / PET = 0.2 – 0.65.

Mediterranean Forest: includes closed and open forests, shrubland
source. www.grabovrat.com/.../mapsViews800.gif

Mediterranean forests

Pinus sylvestris

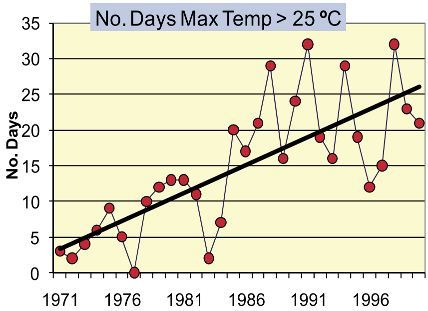
Quercus ilex

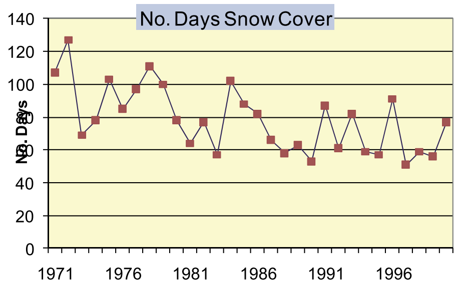
Photos Carlos Gracia

Mediterranean Role of Forests in the Water Cycle

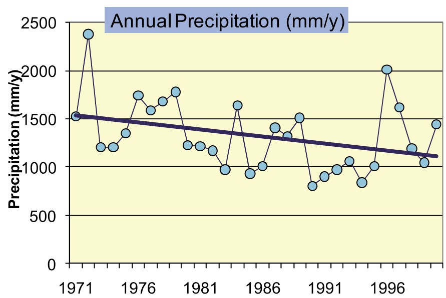
- Trees use more water than other natural vegetation cover and reduce stream flow
- Trees can reduce raindrop velocity, increase infiltration and regulate snowmelt, thus mitigating peak stream flows (flash floods) and reducing erosion
- Water quantity is more important than quality in the mediterranean region, but water quality is still improved by forests
- In some areas trees capture fog, may promote local precipitation and increase water input to the local ecosystem

What Change can be Observed Today?



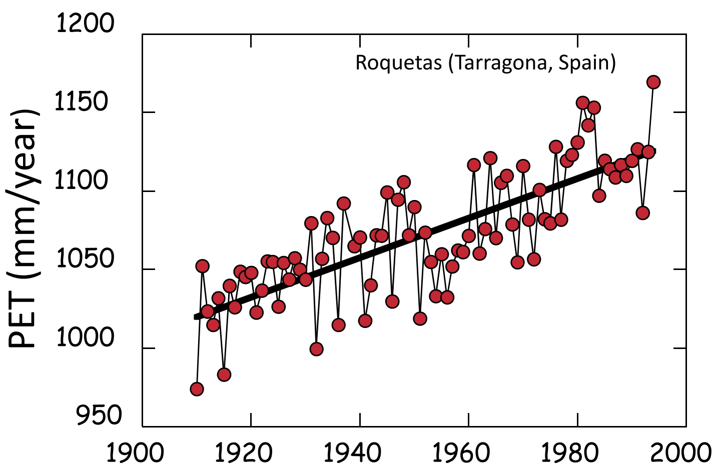


Observatory:
Navacerrada (Madrid)
Elev: 1860 m



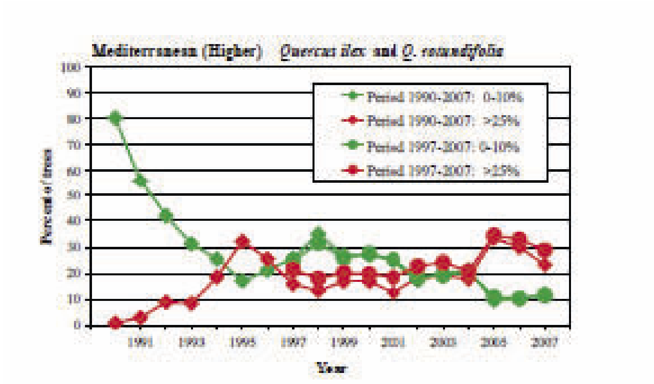
Source: F.J. Ayala, 2004

Observed Change in PET 1910-2000



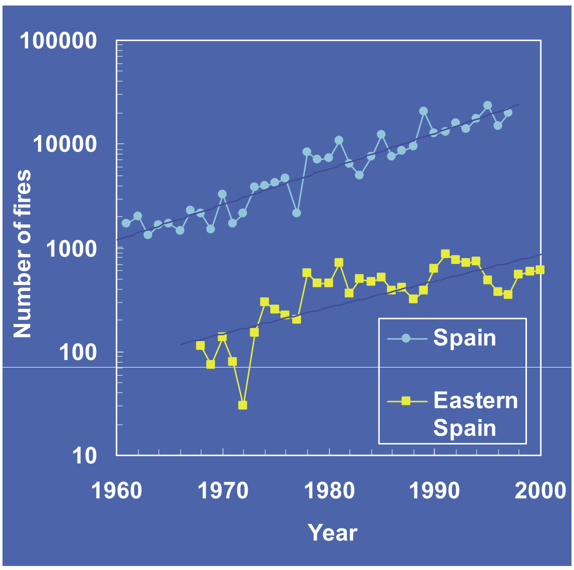
(Piñol et al. 1998)

Share of Trees with 0-10% and >25% Defoliation (1990-2007 and 1997-2007)



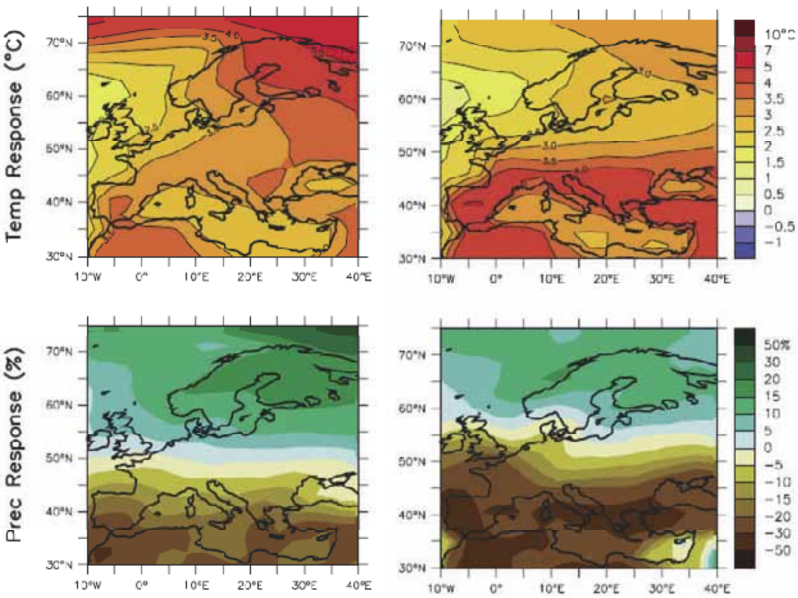
Most frequently reported damage cause for trees (classes 2 and 3: moderate and serious defoliation) was "drought", followed by insects, mainly defoliators, and to a lesser extent other causes (lack of light, competition, parasitic and epiphytic plants) (**2008 Technical Report of ICP Forests.** Spanish national report).

Forest Fires



Source: JRC, EFDAS

Climate Change Projections (2100)



IPCC, 4th Assessment report, 2007

Extreme Precipitation Events

Change in Seasonal Mean and 5-Day Mean
Exceeding 99th Percentile
(2071-2100 compared to 1961-1990)

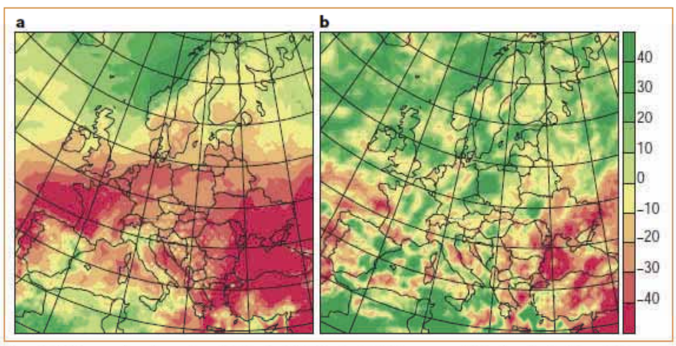


Figure 1 Relative percentage change in precipitation for July–September in the Intergovernmental Panel on Climate Change's A2 scenario with respect to the present day. Relative change is shown for **a**, the seasonal mean; and **b**, the five-day mean exceeding the 99th percentile.

Though summers will become drier, the incidence of ***severe precipitation*** is likely to increase.

Source: Christensen & Christensen, 2002

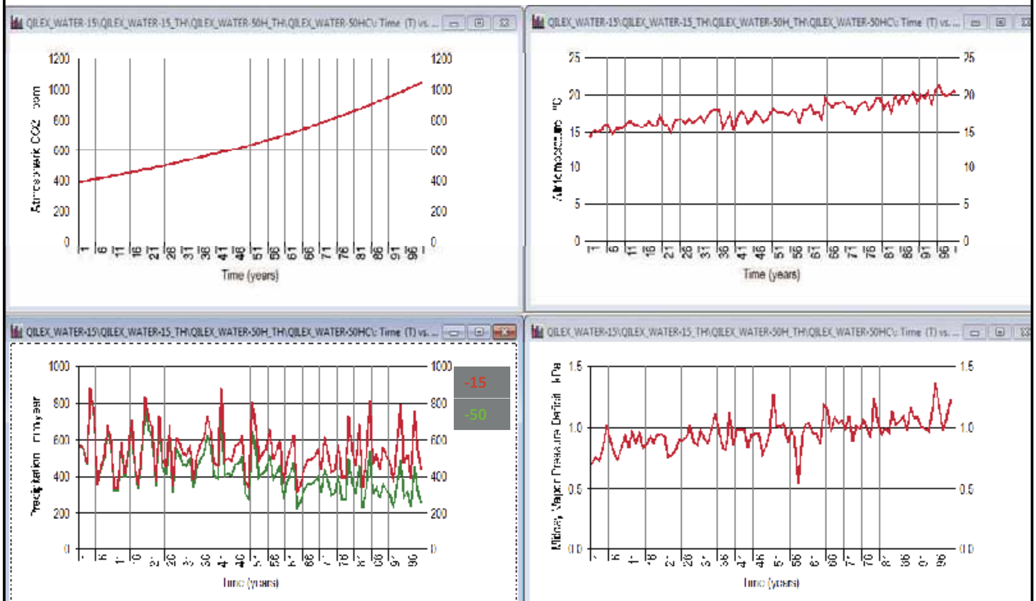
Relevance of Climate Change Projections for Mediterranean Climate

- Declining water availability
- Increased frequency, intensity and duration of drought
- Increased risk of forest fires
- Increased risk of soil erosion (desertification, loss of vegetation cover)
- Increasing vulnerability of forests
- Increasing rainfall intensity and flood events
- In many cases, these changes may be severe

Methodology and Simulations

- Process-based Modelling
  - GOTILWA+
- Simulations:
  - Mean and Max projected T, P Change
  - *Quercus ilex* and *Pinus sylvestris*
  - For *Quercus ilex*: with and without manual thinning
- Address Results Related To:
  - Water Budget
  - Tree/Forest Survival

GOTILWA+ Simulation Results
Climate Change Scenarios



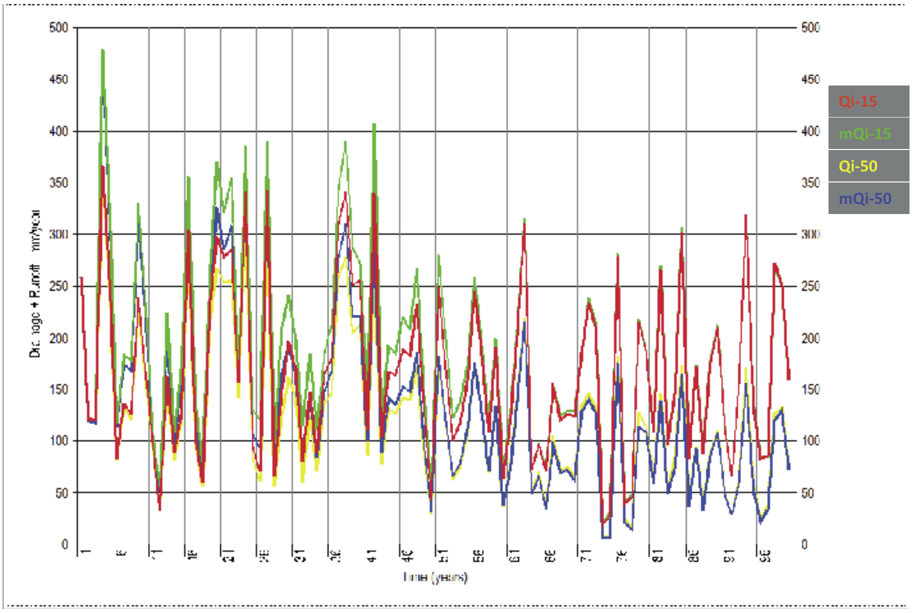
Source: group analysis in JFNW

Summary of Results

		Quercus ilex				*Pinus s.*
		Managed		Unmanaged		Unm.
	Precipitation loss	-15%	-50%	-15%	-50%	-50%
	Precipitation (mm)	529	341	532	324	330
	Transpiration (mm)	334	238	338	231	199
Water Budget	Transpiration/P	63%	70%	63%	71%	60%
	Runoff + Drainage (mm)	163	80	161	84	120
Survival	Tree density (stems/ha)	1100	1100	5700	2000	500
	Change in tree density	-0%	-0%	-43%	-80%	-38%
	LAI	3.75	2.46	3.74	2.29	0.66
	MCH (Mg/ha)	32	21.9	27.6	17.1	35.4
	Diameter (cm)	23	22	11	12	33.3
	AGB (t/ha)	243	200	243	115	286
	Fire Risk Index	3%	1%	4%	1%	1%
	Fire Damage Index	6%	6%	14%	13%	63%

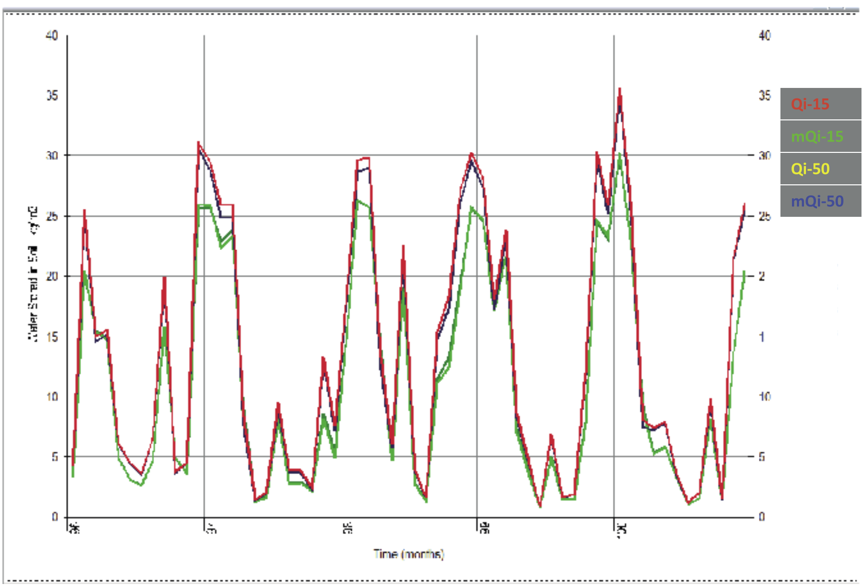
Source: group analysis in JFNW

Drainage + Runoff (mm/y) 2000-2100



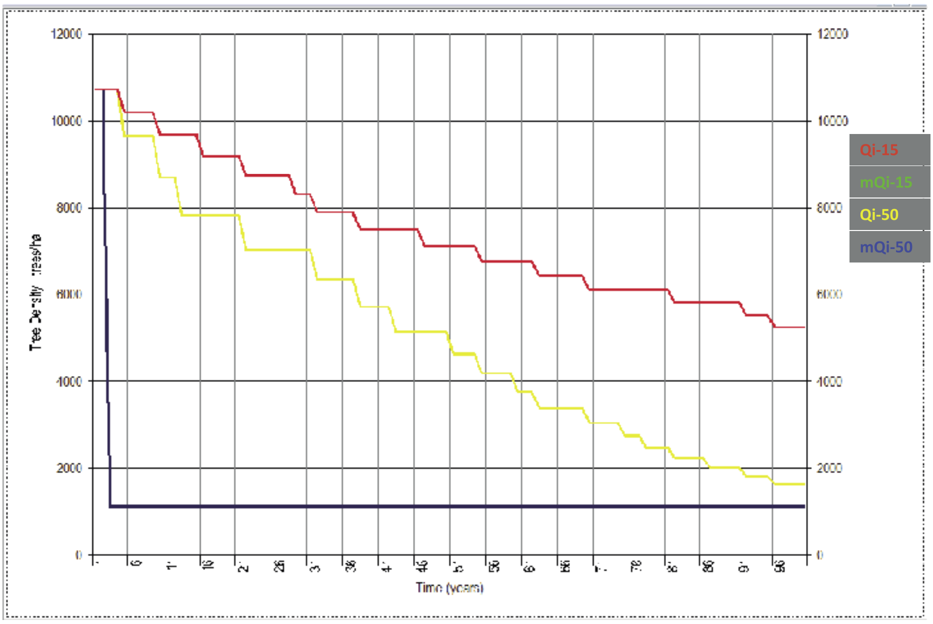
Source: group analysis in JFNW

Soil Water Storage (kg/m2) 2095-2100



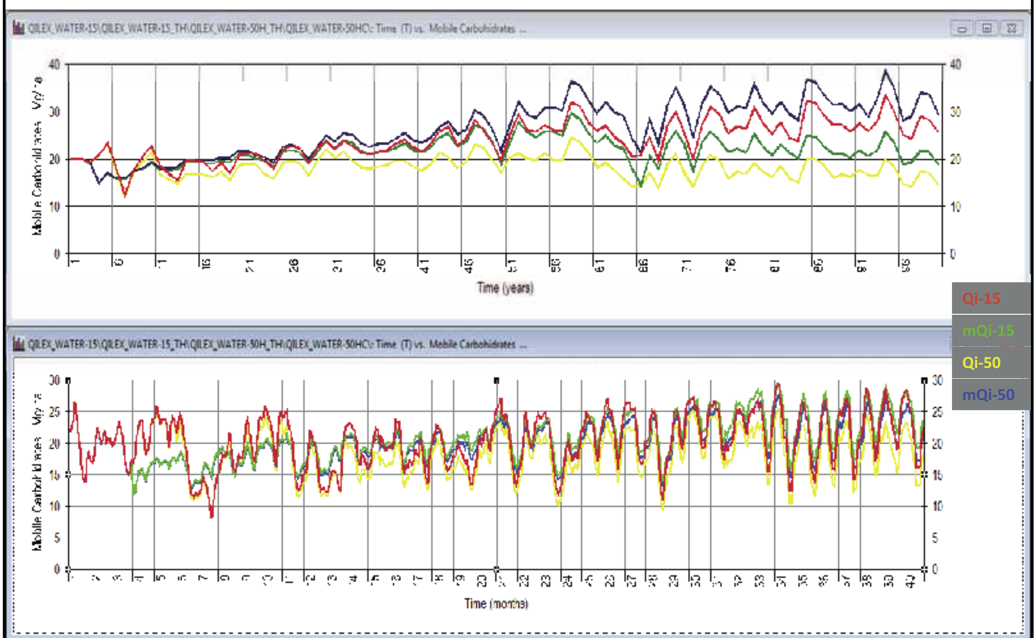
Source: group analysis in JFNW

Tree Survival (trees/ha) 2075-2100



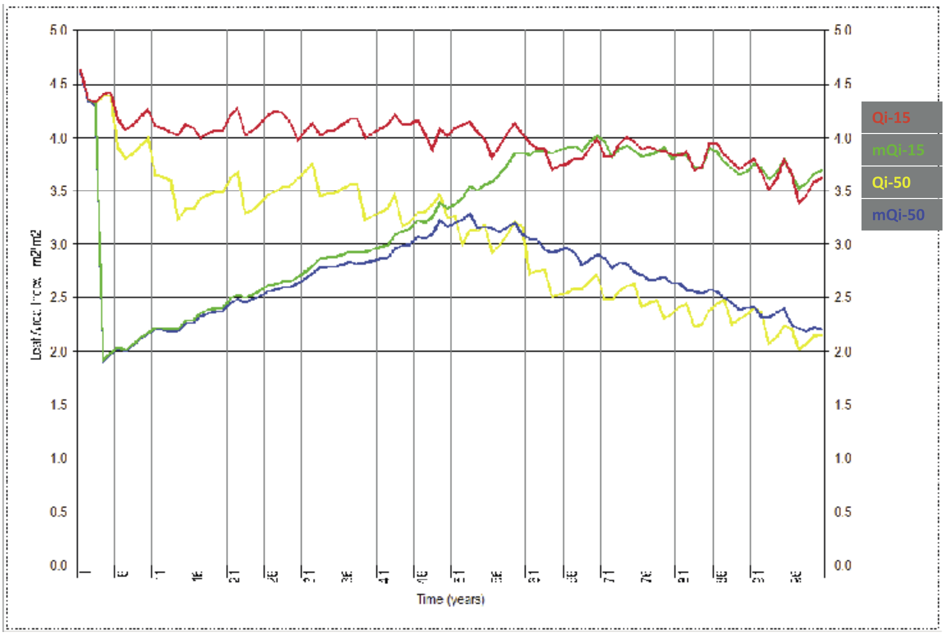
Source: group analysis in JFNW

Mobile carbohydrates (Mg/ha)



Source: group analysis in JFNW

Leaf Area Index: 2000-2100



Source: group analysis in JFNW

Management Strategies

- Drought
- Forest Survival
- Forest Fires
- Erosion

Drought

- Some solutions to managing water availability lie outside scope of report, in particular agriculture and energy sector water use
  - WFD, water-pricing schemes, Agriculture and Energy Policy, water-use efficiency
- But drought generally cannot be managed with forests/ shrubland
  - Except in coastal zones with fog
  - These areas should be afforested, preferably with drought tolerant broadleaf species

Forest Survival

- Forest cover loss should be minimized
- But, increasing forest cover may have undesirable consequences for water yield
  - This raises important questions about current afforestation strategies
  - Combating desertification and site location may justify future afforestation

Recommended management strategies

- Coppiced forest (oak and chestnut) conversion to high forest
  - Reducing stem and stand density increases potential forest survival and genetic variability
- Consider conversion of some conifer forest to more drought tolerant species (?)
- Increase fog capture, infiltration and retention with soft technology

Forest Fires

- Mediterranean forests can be managed to reduce the risk of forest fires!
- Forests must be managed in order to contain forest cover loss and increasing desertification
- Managed *Quercus ilex* stands may significantly improve survival rate
  - May double survival rate compared to unmanaged *Quercus ilex*
  - May have 10 times the survival rate of unmanaged *Pinus sylvestris*

Erosion

- Erosion is the first step to increasing desertification
- Forest fires are one of the major causes of increasing erosion
- Maintaining forest cover through forest management will minimize erosion

Conclusions

- Under the case study of climate change we have applied, forests will remain but stand structure changes
  - Greatly reduced tree density
- Our findings suggest that the choice of tree type or tree management regime have little affect on the water budget
  - Water availability is so low and PET so high that the ecosystem will remain strongly water limited
- However, management can reduce forest maintenance respiratory cost
- And management and tree type choice can help improve forest survival, reduce forest fire risk and damage, and potentially reduce erosion

Using Forests and Forest Management in Mitigating Extreme Rainfall Events in Temperate Regions

Temperate Region

Anne Rödl, Hugh Feeley, Leenka Zajickova, Joanne Finnegan, Philip O'Dea, Michèle Trémoliéres (mentor)

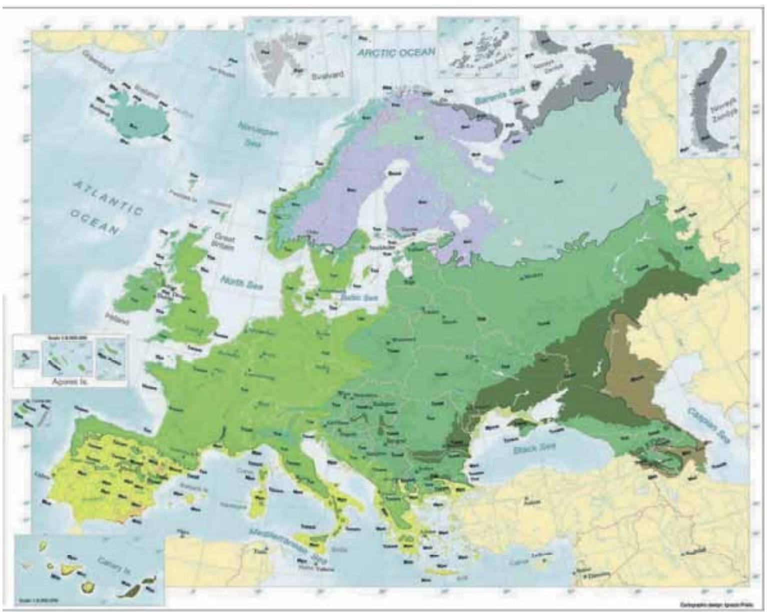

Using Forests and Forest Management in Mitigating Extreme Rainfall Events in Temperate Regions
Temperate Region Work Group
Anne Rödl, Hugh Feeley, Leenka Zajickova, Joanne Finnegan, Philip O'Dea, Michèle Trémoliéres (mentor)

Content

Context

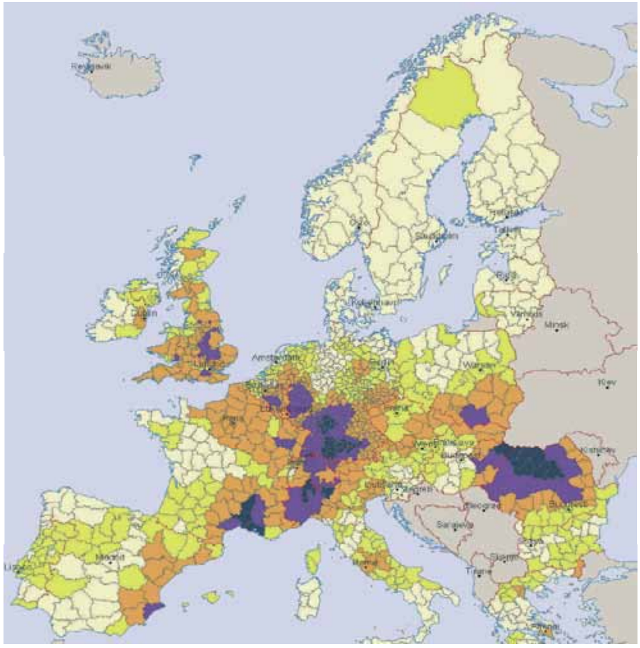
- Predicted climate change scenarios show an increase in both frequency and magnitude of rainfall across Europe (Lindner et al, 2010)
- Increase in extreme rainfall events is likely to occur in late spring to early autumn in Central Europe (Müller et al, 2009)
- Over the 5 years 1995–1999 the annual cost of flood damage in Europe averaged 2000 M Euro (Swiss Re, various dates)
- Forestry is known to mitigate against flooding (Chang, 2006)

Temperate Areas



Source: Lindner M,. 2010

Flood Hazard Areas in Europe



Source: NUTS3 Regions
1987-2002

Water Frame Work Directive Approach

Source	Pathways	Receptors	Measures
Heavy rain	Overland flow, streams, rivers	Forests (and other landuses)	Adaptation of forest management practices and recommendations

Source: Morris et al, 2010

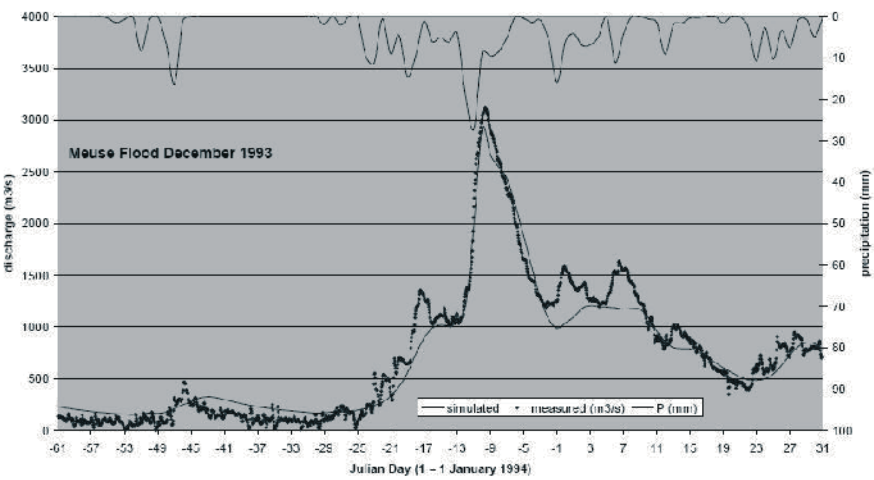
Source

Extreme Events in Terms of Rainfall?

- Extreme rain/intense rain is called storm rainfall
- In meteorology, large volumes of rainfall within a short period of time
- The definition varies between different regions
  - German standard (DIN 4049-3, 1994):
    'Storm rainfall is rain, that has a high intensity compared to its duration and is occurring seldom, on average only twice a year'
    - 17 mm/hour or 5 mm within 5 minutes (DIN 4049-3, 1994)
  - While in Atlantic Regions:
    - 10-50 mm/hour to >50 mm/hour (UK Met Office, 2007)

Pathway

Example of High Rainfall Event Resulting in High Discharge



Case Study – Meuse and Oder Model

Source: De Roo et al, 1999

Pathway

Factors Affecting Severity of Extreme Rainfall Events

Severity of an event is dependant on

- **Soil type and geology** – saturation and permeability
- **Topography** - slope
- **Land use type** – sealed (urban) or unsealed (agricultural and forestry)
- **Where in the catchment** – flood plain or headwaters

Receptor

Land Use

Source: Trémoliéres M., 2010

Source: Bredemeier M., 2010

Receptor

Impacts of Extreme Flood Events on Forests

Positive

- Nutrient storage on certain soil types
- Flood retention
- Biodiversity

Negative

- Erosion of forest soils to rivers and lakes
- Silt movement
- Nutrient loss
- Transportation of pollution
- Damages to infrastructure
- Loss of biodiversity (aquatic and terrestrial, flora and fauna)
- Economic loss - direct (reduced forest yield) or indirect (ammenity, fisheries)

Measures

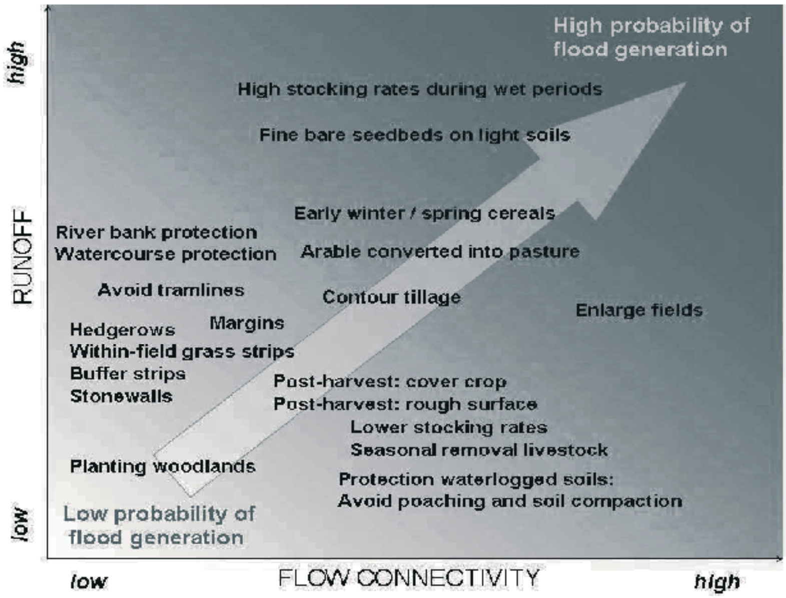
Benefits of Forests in Extreme Rainfall Events

- Typical soil moisture is distinctly lower under forests in comparison to other land use types therefore, infiltration and percolation on some forest soil types can be increased
- Forests stabilise the soils and reduce erosion
- Increased storage capacity in deeper soils
- Increased evapotranspiration and interception will result in reduced water discharge in comparison to other land use types
- Strategic location of forests within a watershed can mitigate impacts of high rainfall

Source: Wahren et al. 2007 and De Roo et al, 2000

Measures

Benefits of Forests Over Other Land Uses



Source: Morris et al, 2010

Measures

But……forests have limits!

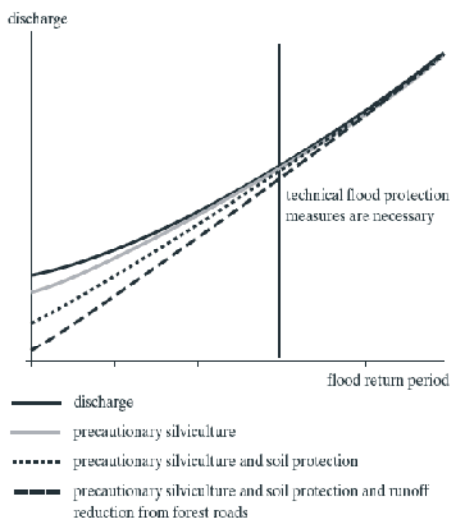


Fig. 5. Effects for discharge reduction by precautionary forestry management are shown in this unscaled graph. Different discharge curves vary according to the site and landscape structures. Intersection points and their assignment to a certain flood return period depend on the particular efficiency of the precautionary measures.

Source: Schüler (Michael Bredemeier)

Measures

Considerations when Making Recommendations to Improve Forest Management to Reduce Effects of Exteme Rainfall Events

Forest Design

- •Species selection
- •Drainage design
- •Stocking density
- •Forest area & location
- •Riparian area - estab & mgt
- •Road design & maintenance

Maturing Forest

- •Tree stability
- •Fire prevention
- •Pest and disease control
- •Age structure

Harvesting

Thinning and Final Clearfell

- •Methodology of felling
- •Machinery design
- •Coupe size
- •Age at clearfell
- •Time of year

Measures

Implementation of Proposed Recommendations

- •Policies, regulations and incentive
  - •River Basin District Management Plans
    - •Regional forest / water regulatory agencies
      - •Regulation and financial incentive
        - •Forest certification
- •Research
- •Education to forest sector and general public

Summary

- The Water Frame Work Directive (WFD) is the driving force to review forest policy in minimising extreme rainfall impacts
- Definitions of extreme rainfall events vary across Temperate Europe
- A wide variety of factors affect the severity of extreme rainfall events which can have positive and negative impact on forestry
- Forestry plays a key role in minimising impacts of extreme rainfall events
- However, forests have limits
- WFD Water Basin Districts management plans need to take on board the forestry life cycle
- While including policy and incentives in their plans
- Research needs to continue

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Annexes

Joensuu Forestry Networking Week 2010: Forest-water interactions in Europe 24-28 May 2010

Program

Monday 24.05.

Keynotes	European issues of forests and water on economical, technical, societal and ecological viewpoint
Chair	*Prof. Leena Finér, Finnish Forest Research Institute, Finland*

8:00-9:00	*Registration (address: Yliopistonkatu 6)*
9:00-9:30	Welcome address *Prof. Dr. Risto Päivinen, European Forest Institute*
9:30-10:00	European issues regarding forests and water on economical, societal and ecological viewpoint
10:00-10:15	*Mr. Franz Prinz zu Salm-Salm, the Forest Owners in Sachsen-Anhalt, Germany*
10:15-10:45	Discussion
10:45-11:15	*Coffee break* Policy overview on Water Framework Directive *Dr. Johanna Ikävalko, the Central Union of Agricultural Producers and Forest*
11:15-11:30	*Owners, Finland*
11:30-12:00	Discussion Introduction to the group work
12:00-13:00	*Dr. Ir. Gert-Jan Nabuurs, European Forest Institute*
13:00-13:15	*Lunch*
13:15-15:00	Group picture
15:00-15:30	Group work; case studies by regions
15:30-17:00	*Coffee*
17:00-18:00	Group work
19:00-21:00	Poster session Dinner, City of Joensuu, Villa Vainoniemi (address: Vainoniementie 3)

Tuesday 25.05.	

Keynotes	The role of forests in regulating the water cycle, and vice versa, the impacts of water and drought on forests in different regions in Europe
Chair	*Prof. Tarja Lehto, University of Eastern Finland, Finland*

9:00-9:30	Climate change impacts in different regions in Europe *Dr. Marcus Lindner, European Forest Institute*
9:30-9:40	Discussion
9:40-10:10	Peatland forestry; permanent excess water, *Dr. Ari Lauren, Finnish Forest Research Institute, Finland*
10:10-10:20	Discussion
10:20-10:45	*Coffee break*
10:45-11:15	Process-based modeling on drought stress in trees, *Dr. Carlos Gracia, University of Barcelona, Spain*
11:15-11:30	Discussion
11:30-12:00	Water footprint as an environmental tool *Ms. Helena Wessman, VTT Technical Research Centre of Finland, Finland*
12:00-12:15	Discussion
12:15-13:15	*Lunch*
13:15-15:00	Group work
15:00-15:30	*Coffee break*
15:30-17:30	Group work
	Free evening

Wednesday 26.05.	

8:15-	*Coffee*
9:30-9:00	Introduction to the field trip: *Prof. Leena Finér, Finnish Forest Research Institute, Finland*
9:00-22.00	Field trip to Tohmajärvi and the surroundings Scientific sites: Vääränlahti, Maijanpuro and Lääväjoki *Lunch* Nature attraction: bird-watching tower in Sääperijärvi *Dinner* at the OP-Pohjola Group cottage in Mölsänniemi, Rääkkylä *Sauna* (optional)

Thursday 27.05.

Keynotes	Role of forest management in affecting the quantity and quality of (ground) water
Chair	*Dr. Ari Lauren, Finnish Forest Research Institute, Finland*

9:00-9:30	Boreal conditions, *Dr. Martyn Futter, Swedish University of Agricultural Sciences, Department of Environmental Assessment, Sweden*
9:30-9:40	Discussion
9:40-10:10	Mediterranean conditions, *Dr. Ramon Vallejo, CEAM Foundation, Spain*
10:10-10:20	Discussion
10:20-10:45	*Coffee*
10:45-11:15	Central European conditions, *Prof. Dr. Michael Bredemeier, COST Action FP 0601: Forest Management and the Water Cycle (FORMAN)*
11:15-11:30	Discussion
11:30-12:00	Keynote: Restoration of flooding on the functioning of alluvial forest and especially on change of groundwater quality,
12:00-12:15	*Prof. Dr. Michèle Trémoliéres, University of Strasbourg, France*
12:15-13:15	Discussion
13:15-15:00	*Lunch*
15:00-15:15	Group work
15:15-16:30	*Coffee*
17:30-21:00	Group work finalization *Optional programme:* *Football with EFI team (address: Papinkatu 1 b, behind the Lutheran church)* *Sauna at EFI (address: Torikatu 34)*

Friday 28.05.

Keynotes	Role of forests in storage of (ground) water and regulating floods
Chair	*Dr. Ir. Gert-Jan Nabuurs, European Forest Institute*

9:00-9:30	Role of forests in runoff generation and flooding in cold regions *Prof. Harri Koivusalo, Helsinki University of Technology, Finland*
9:30-9:40	Discussion
9:40-10:10	Role of forests in sustaining drinking water of high quality *Ms. Irina Nordman, City of Turku, City Planning and Environment, Finland*
10:10-10:20	Discussion
10:20-10:30	Paper industry perspective to the topic, *Mr. Ulrich Leberle, Confederation of European Paper Industries*
10:30-10:45	*Coffee*
10:45-11:00	Introduction to the group work presentations and discussion
11:00-12:00	Presenting group work (2 groups)
12:00-13:00	*Lunch*
13:00-15:00	Presenting group work (3 groups), discussion, reflections to the future
15:00-15:30	Coffee

Joensuu Forestry Networking Week 2010: Forest-water interactions in Europe 23-28 May 2010

Participant list

1. Aleinikoviene Jurate, Institute of Forestry, Lithuanian Research Centre for Agriculture and Forestry, Lithuania
2. Asikainen Ulla, North Karelian University of Applied Sciences, Finland
3. Bredemeier Michael, University of Göttingen, Germany
4. Cao Yang, University of Eastern Finland, Finland
5. Didion Markus, Alterra, Wageningen University & Research centre, the Netherlands
6. Eerikäinen Kalle, Foundation for European Forest Research, Finland
7. Ellison David, Institute of World Economics, Hungary
8. Feeley Hugh, University College Dublin, Ireland
9. Finér Leena, Finnish Forest Research Institute (Metla), Finland
10. Finnegan Joanne, National University Ireland, Ireland
11. Futter Martyn, Swedish University of Agricultural Sciences, Sweden
12. Gautam Basanta Raj, Arbonaut Ltd., Finland
13. Gracia Carlos, Centre for Ecological Research and Forestry Applications, Spain
14. Hyttinen Pentti, Regional Council of North Karelia, Finland
15. Ikävalko Johanna, Central Union of Farmers and Forest Owners, Finland
16. Kaila Annu, Finnish Forest Research Institute (Metla), Finland
17. Kasurinen Sanna, Forestry Centre of North Karelia, Finland
18. Koivusalo Harri, Aalto University, Finland
19. Lappalainen Mari, Finnish Forest Research Institute (Metla), Finland
20. Laurén Ari, Finnish Forest Research Institute (Metla), Finland
21. Leberle Ulrich, Confederation of European Paper Industries (CEPI)
22. Lehto Tarja, University of Eastern Finland, Finland
23. Lier Markus, Finnish Forest Research Institute (Metla), Finland
24. Lindner Marcus, European Forest Institute
25. Mäkelä Jarmo, North Karelian University of Applied Sciences, Finland
26. Nabuurs Gert-Jan, European Forest Institute
27. Nordman Irina, City of Turku, City Planning and Environment, Finland
28. Nousiainen Mika, Forestry Centre of North Karelia, Finland
29. O'Dea Philip, Coillte Teo., Ireland
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31. Pitkänen Sari, University of Eastern Finland, Finland
32. Prinz zu Salm-Salm Franz, Forest Owners Association in Saxony-Anhalt, Germany
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34. Rasilo Terhi, University of Helsinki, Finland
35. Repo Tapani, Finnish Forest Research Institute (Metla), Finland

36. Rödl Anne, vTI Federal Research Institute for Rural Areas, Forestry and Fisheries, Germany
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38. Starr Mike, University of Helsinki, Finland
39. Stenberg Leena, Aalto University, Finland
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42. Urban Josef, Mendel University Brno, Czech Republic
43. Vallejo Ramón, University of Barcelona, Spain
44. Verkerk Hans, European Forest Institute
45. Vänttinen Ulla, European Forest Institute
46. Wessman Helena, VTT Technical Research Centre of Finland, Finland
47. Zajíčková Lenka, Czech University of Life Sciences, Czech Republic

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Photos

JFNW 2010 group picture in the front of the Metla House in Joensuu (Photo: UEF/Varpu Heiskanen)

JFNW 2010 morning session in the Käpy seminar room in the Metla House (Photo: Metla/Markus Lier)

JFNW2010 poster session in the hall of the Metla House (Photo: Metla/Markus Lier)

JFNW 2010 group work on boreal conditions (Photo: Metla/Markus Lier)

Networking during a coffee break in the Metla House (Photo: Metla/Markus Lier)

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