SOUTH EAST EUROPE
Transnational Cooperation Programme

Co-funded by the EUROPEAN REGIONAL DEVELOPMENT FUND

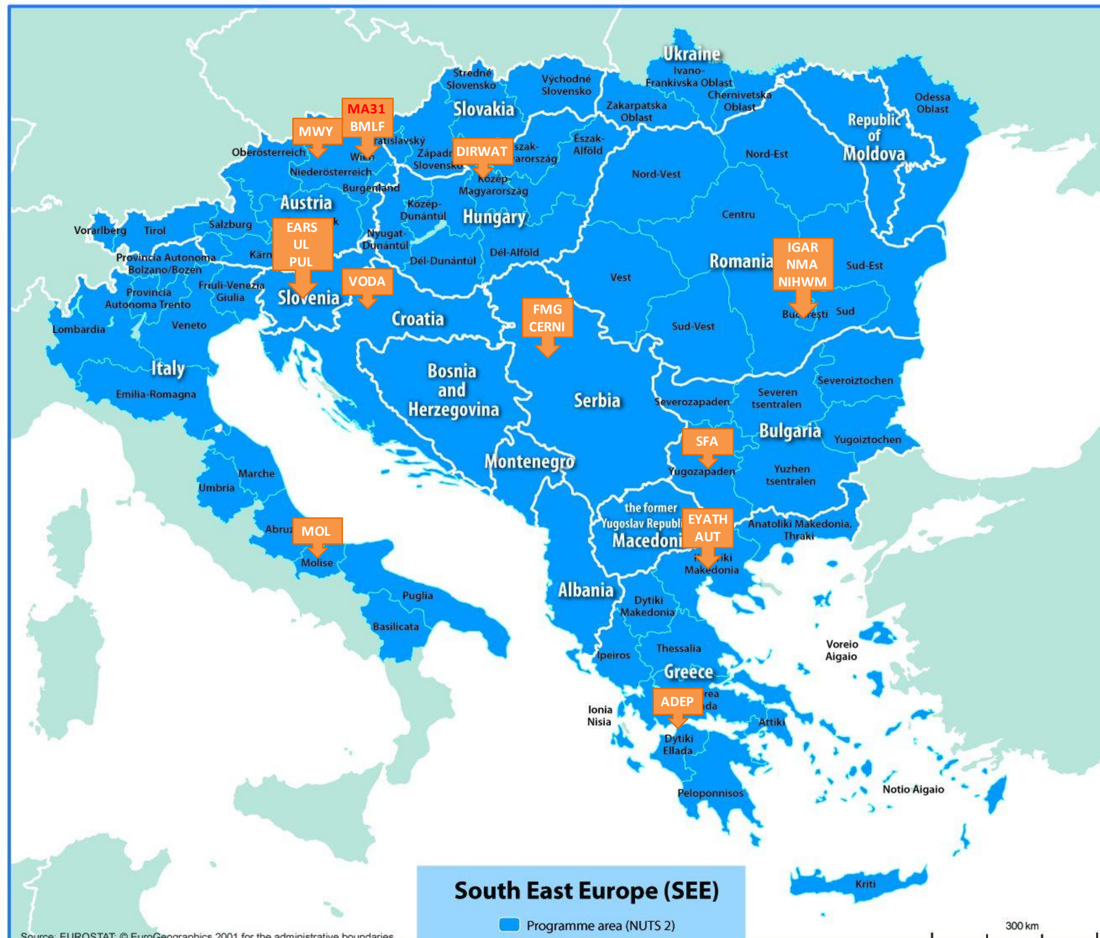
# CC-WaterS

## Climate Change and Impacts on Water Supply

Jointly for our common future

## Countries participating in the project CC-WaterS

| | |
|---|---|
| **Austria** | **Croatia** |
| **Bulgaria** | **Macedonia** |
| **Greece** | **Albania** |
| **Hungary** | **Bosnia Herz.** |
| **Italy** | **Montenegro** |
| **Romania** | **Serbia** |
| Slovakia | **Maldova** |
| **Slovenia** | **Ukraine** |



# Challenges

Drinking water supply is indispensible for social and economic development.

Climate Change may have severe effects on water supply.

Water suppliers are aware of potential problems induced by Climate Change.

To get information on catchment scale (10-10.000km²)

Adaptation of supply and demand management.

# Objectives

**Water ressources availability**
Safeguarding of a sustainable water supply for citiziens in different european regions till 2100 considering climate change

**Landuse**
Those will change according to climate change. Therefore methods will be developed to assess the impacts of those land use changes on water

**Water Supply**
Implementation of measures in order to adapt watermanagemnt to climate and land use changes.

**The participating partners represent the geographical and meteorological diversity of SEE and show complementary expertise. Three types of partners from 9 countries, representing a multi-sectoral consortium, complement their functions and implement the activities to achieve the project objectives.**

# Target groups

**Water works**
The project aims at providing methods and tools for water works in order to help them supplying the citiziens with drinking water.

**Governmental Institutions**
Description of problems and solutions regarding water supply

**Research Institutions**
They support the project with scientific and applied input.

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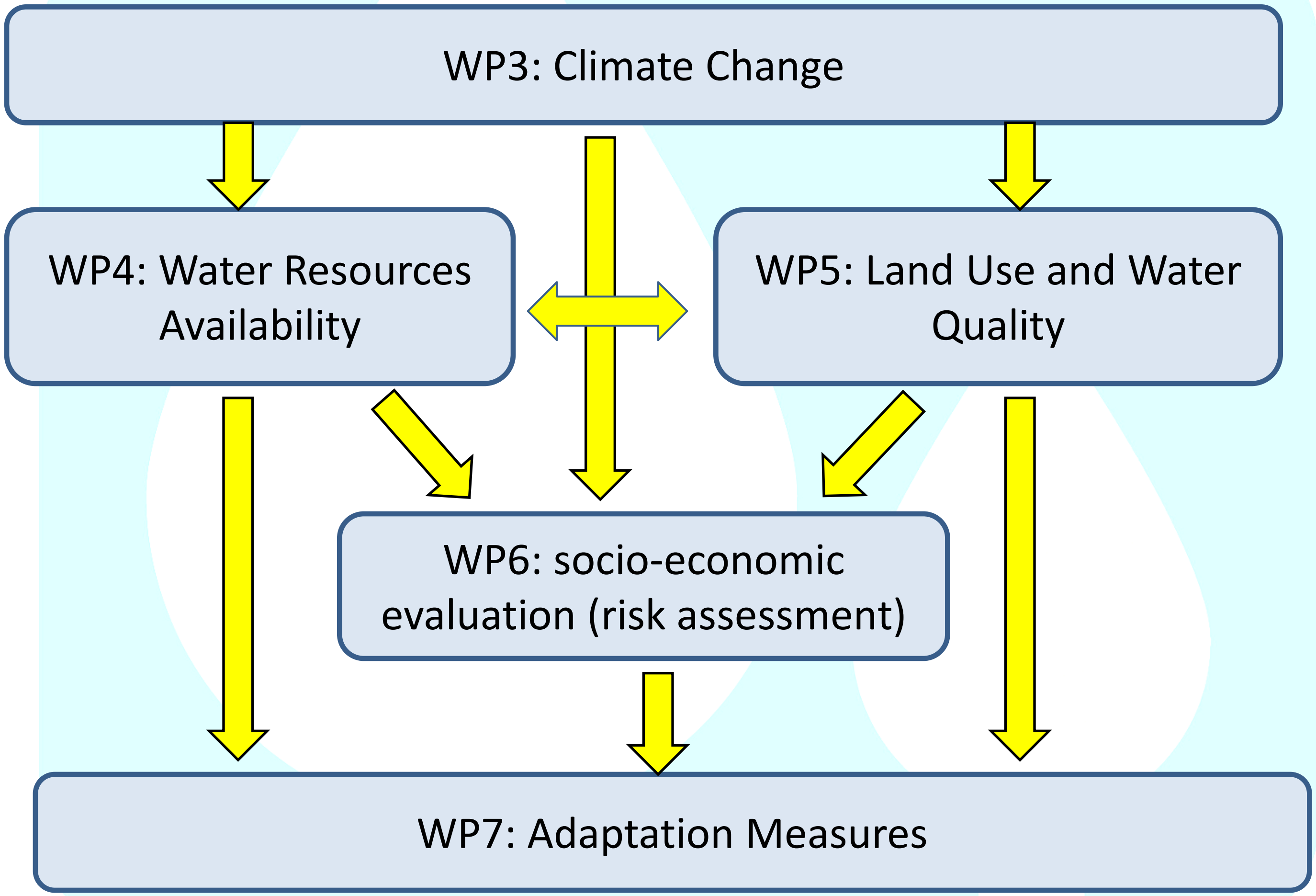
# Working structure



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# Results Climate Change

- Meteorological data base available for third parties

- Daily and monthly series for precipitation and temperature for 2000-2100 for europe

- Comparison and evaluation of different regional climate models.

- Assessment of the uncertainties

1.Expected changes in precipitation until 2050

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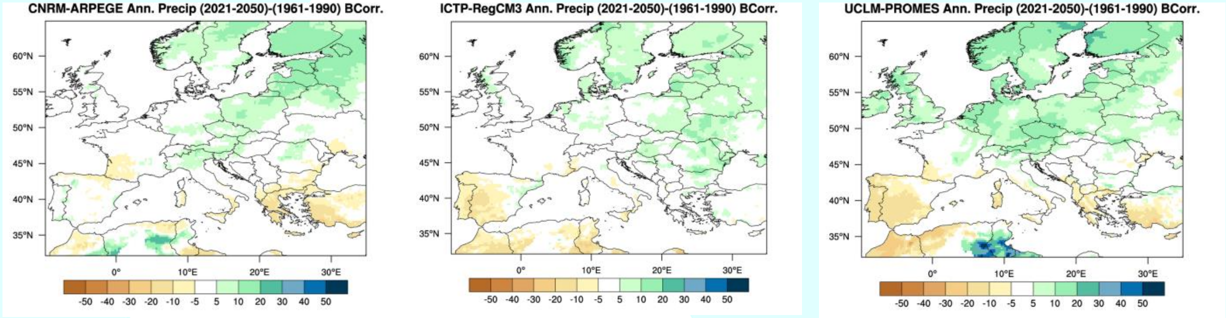
# RESULTS

## Changes of precipitation until 2050




*Bias corrected climate change signal - mean annual precipitation for the period 2021-2050.*

## changes of temperature until 2050

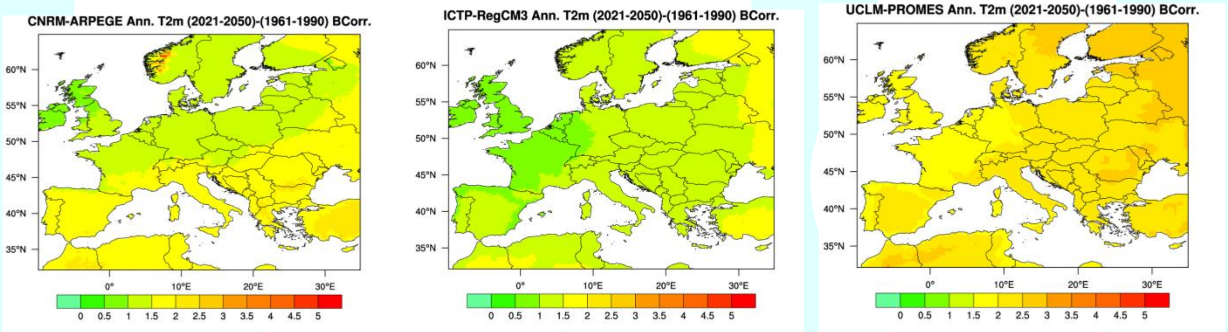



*Figure 14: Bias corrected climate change signal - mean annual temperature for the period 2021-2050.*

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# RESULTS

## changes of precipitation till 2100

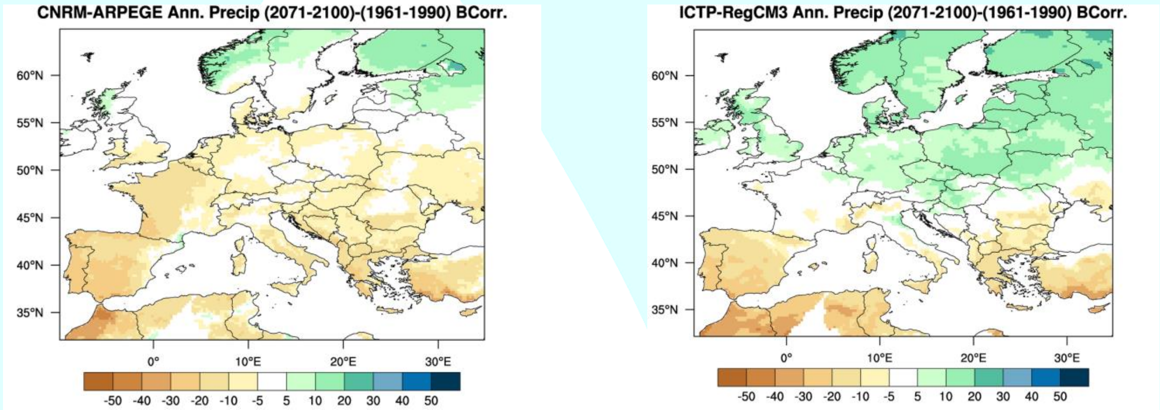


*Figure 17: Bias corrected climate change signal - mean annual precipitation for the period 2071-2100.*

## Changes of temperature till 2100

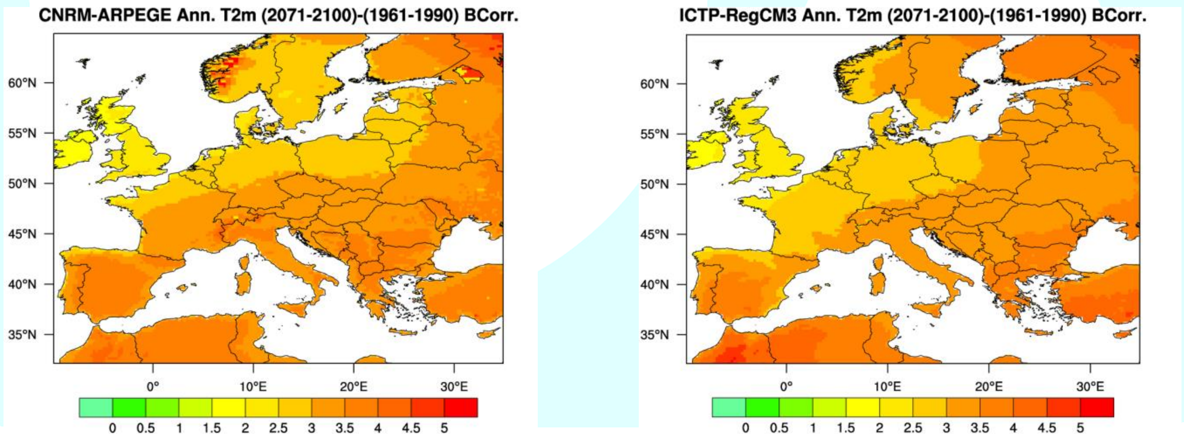


*Figure 19: Climate Change signal [°C] of the annual temperature of the CNRM-ARPEGE model (left side) and RegCM3 (right side) for the period 2071-2100 versus 1961-1990.*

## Summary of precipitation changes until 2050

•Spatial precipitation pattern over Europe is similar in the different RCMs an increase in mean annual precipitation towards the North while a decrease can be expected in the South, especially in the South-West of Europe.

•ARPEGE model: annual rainfall over central Europe (Austria, Slovenia) is expected to increase by about 10-20 %.

•No changes were detected for major parts of Romania, Serbia, Croatia and Hungary while a decrease by about 20-30 % is found in Bulgaria and Northern Greece.

•RegCM3 model: stable conditions and in some countries like Hungary, Romania, Bulgaria a slight increase.

•PROMES model: an increase in annual precipitation for central Europe (Austria, Slovenia) by about 10-20 %, and stable conditions for the rest of the Balkans except Greece where the rainfall should decrease by about 20 % .

**It can be summarized that the climate change signal in precipitation is rather weak and it is also differently reflected by the selected models.**

# Summary of temperature changes until 2050

- The ARPEGE and the RegCM3 model yield an increase of about 1 – 1.5 °C in the mean temperature for the winter half year
- PROMES model: the increase is about 2 – 2.5 °C.
- ARPEGE and the PROMES model: the increase in the summer half year is higher and goes up to 3 °C.
- RegCM3 model: similar results for the winter and the summer period

**Temperature simulations are more consistent**

# Results Water Availability

- Setup of a transnational hydrological database

- Assessment of actual and future water resources considering climate change and climate change induced land use changes also applying downscaling methods and local measurements

- Assessment of the sensitivity regarding climate change in different regions and different types of aquifers.

- Actual water demand vs. actual water resources

- Conclusions for socio-economic impacts and water management.

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# Results Water Availability

## Changes in surface runoff, recharge and renewable water resources

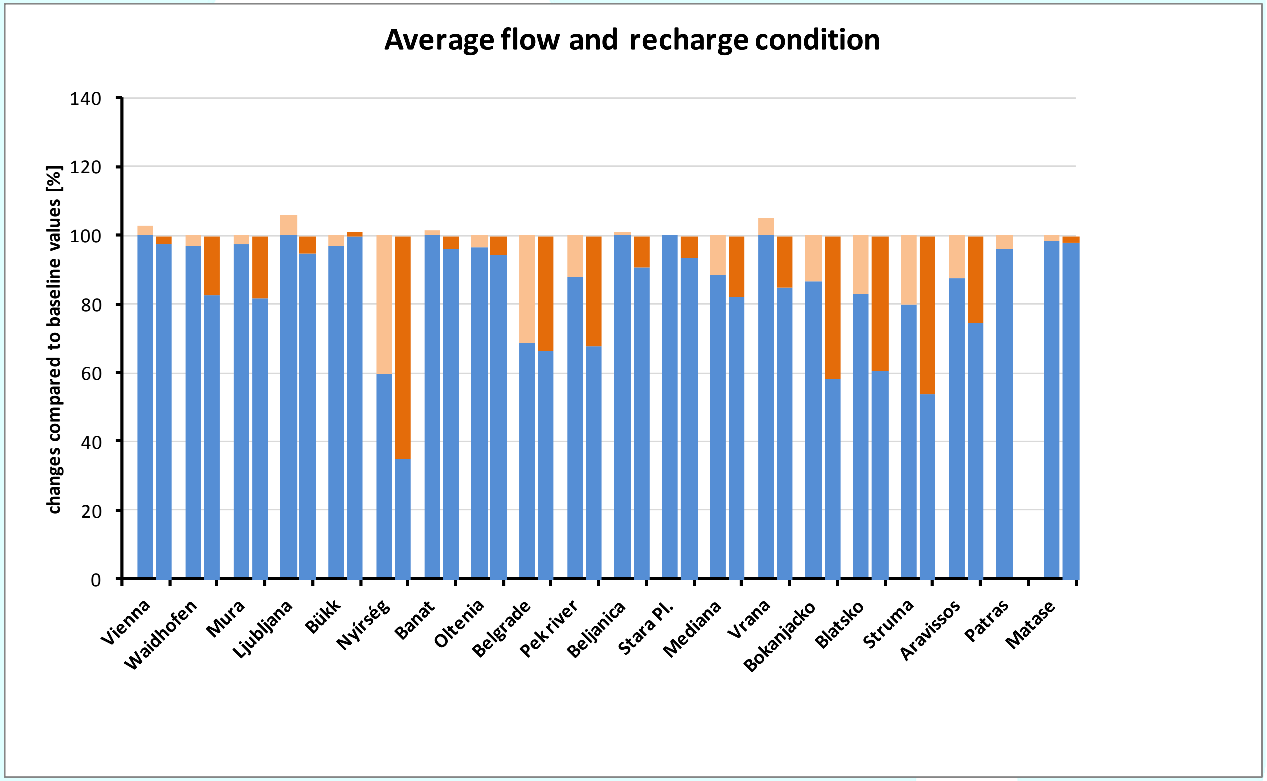



***Figure 15: Changes in the water resources due to the climate change as percentage of the baseline values (1961 – 1990).***

left bar = 2050

right bar = 2100

# RESULTS

## Ranking of the test areas according to problems in the field of water supply

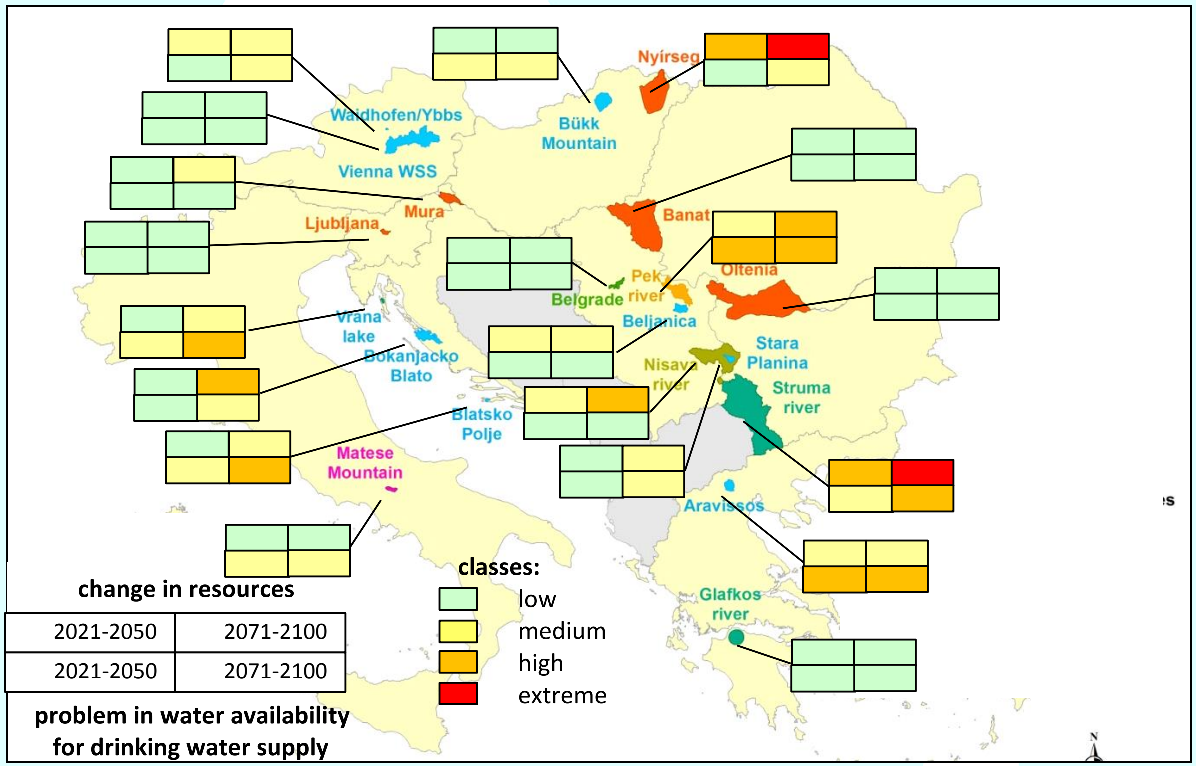



*Figure 20: Classification of the test areas according to water availability problems, in particular related to drinking water supply.*

# Results Land Use Activities

- Hydrological characterisation of test areas

- Analyses of actual land use activities and designing of land use maps.

- Compilation of water quality data and analyses of selected parameters regarding possible trends.

- Impact of climate change signals on actual land use activities and generation of land use scenarios.

- Assessment of probable impacts of future land use activities on water quality.

- Analyses and synthesis using the DPSIR method.

# RESULTS (selected examples)

## Mountain pasture (Molise)

Climate change causes increased load of facel micro organisms.

Possible measures:

-Change of protection areas

-Reduction of cattle or other domestic animals

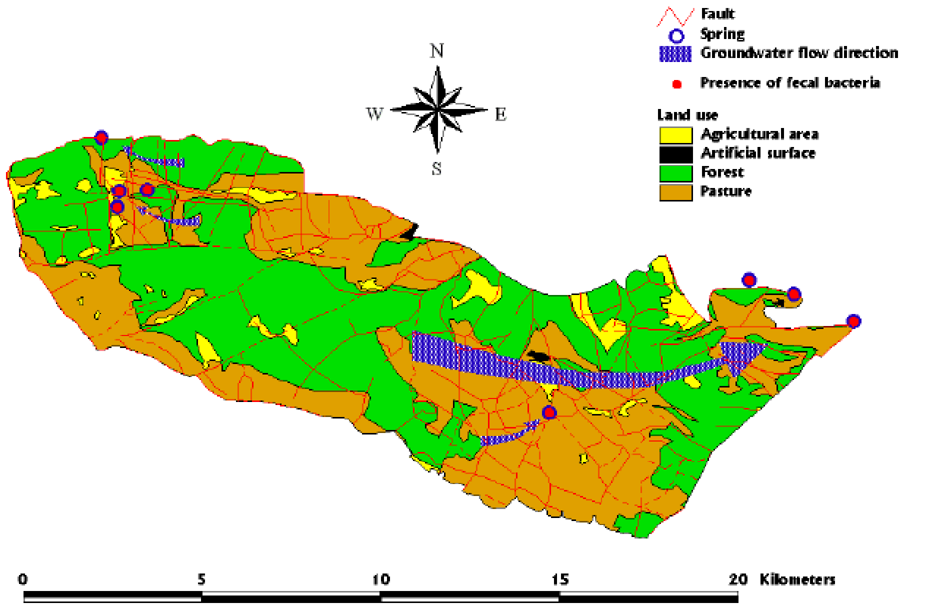



*Figure 12: Land use map of the Monti del Matese test area.*

# RESULTS

## Agriculture (Serbia)

**Climate change causes**

- Need for intensified irrigation
- Increased erosion
- Need for increase application of pesticides

Table 3. Future agricultural land use in test areas 18, 19, 20

| YEAR | Belgrade groundwater source (ha) | The Pek River catchment area (ha) | The Nisava River catchment area (ha) |
|---|---|---|---|
| 2008 | 13359 | 41685 | 93625 |
| 2020 | 12902 | 40326 | 93381 |
| 2050 | 11759 | 36928 | 92770 |
| 2070 | 10997 | 34662 | 92363 |
| 2100 | 9854 | 31264 | 91752 |

# RESULTS

## Forestry (Vienna)

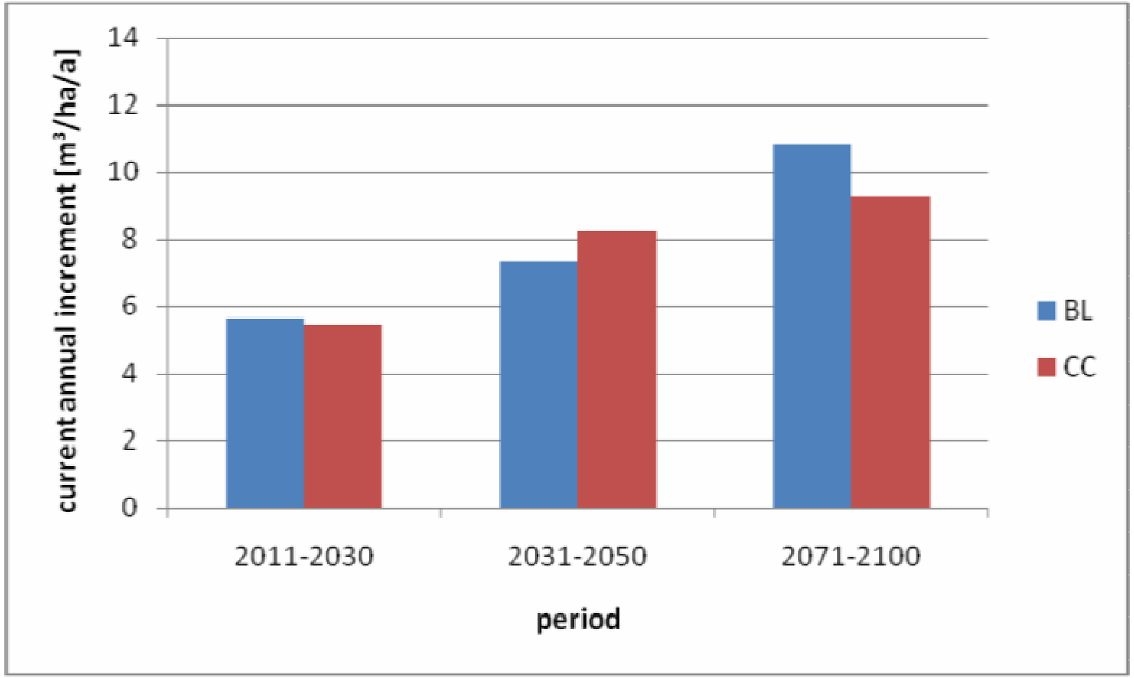



Figure 9: Current annual increment in the forest area managed by the municipality of Vienna. Illustrated are averages of simulations under BAU management for the baseline (BL) and the climate change scenario (CC) for 3 analysis periods.

# RESULTS

## Urban developement (Ljubljana)

**Future land use activities in water mangement typical for urban areas are governed by planning policies and are (almost) not dependent from climate change.**
**In Ljubljana this is also due to no change in water availibility**

# Socio-economic evaluation – risk assessmet

**Risk is defined as a possible gap between supply and demand**

**This gap exerts influence on socio, economic and environmental sectors**

**Therefore, water supply has to manage resource allocation**

# Results socio-economic evaluation

-Story line for the socio-economic assessment of the status quo and of the future development trends.

- Assessment of the water demand of different economic sectors

- Assessment of economic impacts on water management caused by climate and land use changes.

-Assessment of impacts on environment.

-(based on expert knowledge)

# Measures

- Presentation and mutual exchange of “best practices”

- devise different management options for adapted water supply

- Assessment and ranking of those management options

# RESULTS (decimaker)

## Results Vienna Water

*Table 1. Values of the relevant indicators for the Vienna test area*

| INDICATOR | | Relative weight | Balancing factor | Ideal value | Worst value |
|---|---|---|---|---|---|
| Water Quality Risk | **SAC** (Abs/m) | 0,3 | 1 | 0,5 | 12 |
| | **CFU** (CFU / 100 ml water) | 0,4 | 1 | 0 | 10.000 |
| | **Turbidity** (FTU) | 0,3 | 1 | 0,5 | 20 |
| Water Quantity Risk | **Demand per Capita** ($m^3$/day) | 0,2 | 1 | 110 | 150 |
| | **Population Growth (people)** | 0,1 | 1 | 1.700.000 | 2.100.000 |
| | **Losses** (%) | 0,1 | 1 | -4 | -10 |
| | **Different Sources/Reservoirs** (l / sec) | 0,6 | 1 | 6.025 | 3.000 |
| Realization | **Acceptance** (0-100 %) | 0,6 | 1 | 100 | 0 |
| | **Lag time** (years) | 0,2 | 1 | 0 | 100 |
| | **Cost** (€ / $m^3$ water) | 0,2 | 1 | 1,8 | 2,5 |

# RESULTS

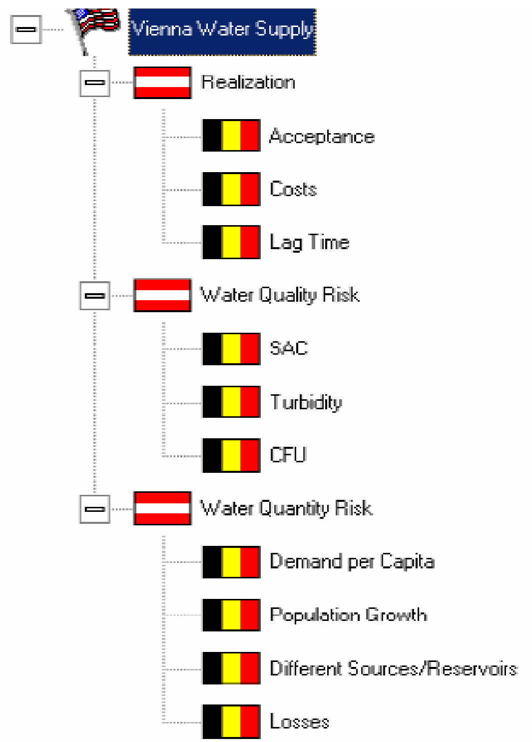
## Results Vienna

### Management options (scenarios)

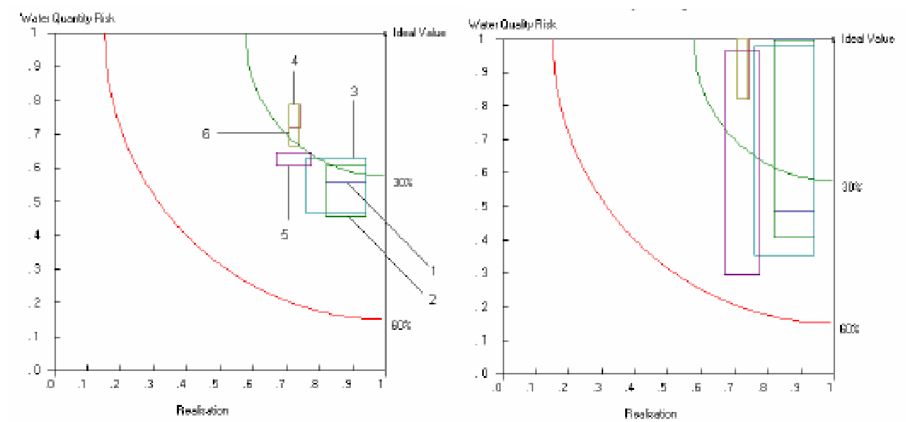
1. Reduction of water quantity risk: reduction of water losses, integration of new sources and water demand management
2. Reduction of water quality risk: limitation of cattle grazing and application of best practices in forestry, both within drinking the drinking water protected areas
3. Combination of management option 1 and 2

(Pachel et al. 2012)

### Basic indicators




### Ranking of management options



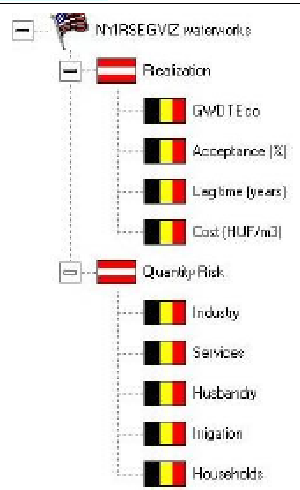

| | Scenario | FCI: |
|---|---|---|
| 1 | Base | 0,74 |
| 2 | Base CC 2050 | 0,72 |
| 3 | Base CC 2100 | 0,71 |
| 4 | Combined Quant. & Qual. | 0,80 |
| 5 | Water Quantity Risk | 0,68 |
| 6 | Water Quality Risk | 0,78 |

# RESULTS

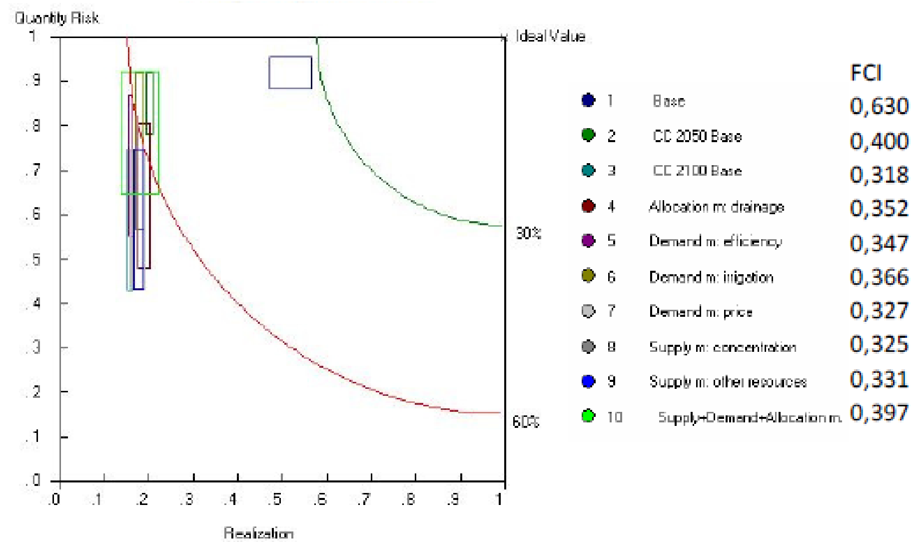
## Results Nyírségvíz

Improvement of water quantity:

1. Allocation: less water for artificial drainage
2. Demand: using water more efficiently in settlements (households, industry and services)
3. Demand: more efficient irrigation
4. Demand: higher water price
5. Supply: concentration of supply structure (closing small well fields and intensifying large well fields)
6. Supply: Transfer water from other resource
7. Combination of all scenarios




(Bogardi et al. 2012)



# Practical information

-monograph: comprehensive handbook intended to support water suppliers in their daily work

-Reports for detailed further information

-General information for broad public

-Can be downloaded from:

www.ccwaters.eu

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