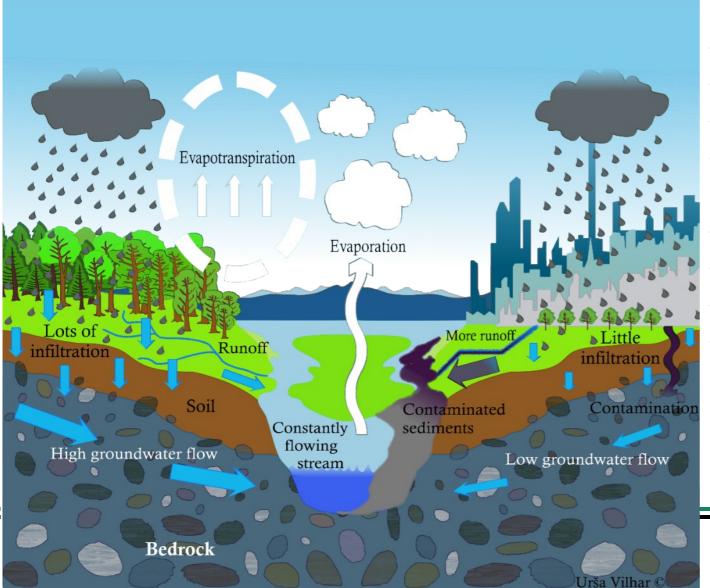
Vilhar Urša, Kermavnar Janez, Erika Kozamernik





#### **Ecological processes**

- Canopy interception
- Water flow
- Water quality
- Air pollution,...

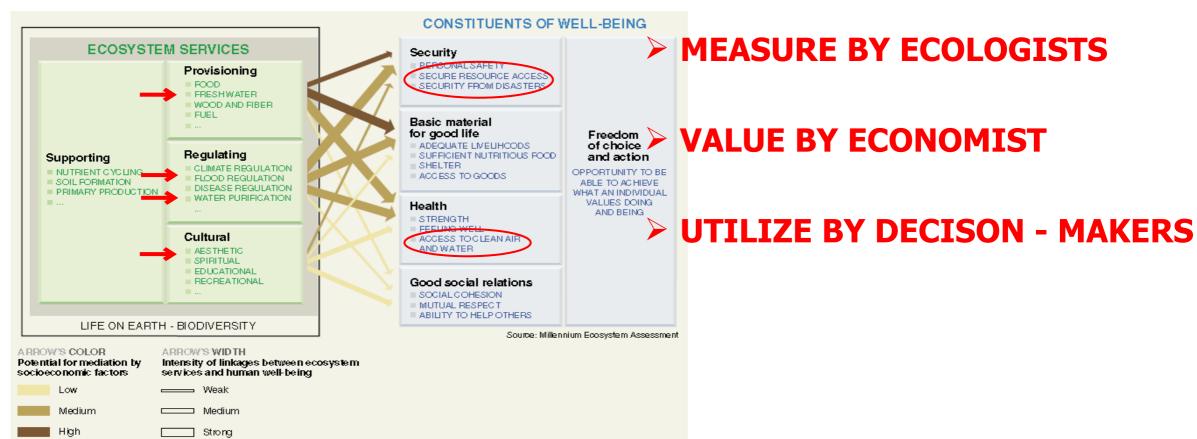
#### **Factors**

- Precipitation
- Forest structure
- Soil properties
- Parent material,...

#### **Indicators**

- Canopy interception
- Topsoil water infiltration
- Soil water holding capacity,...

Linking Ecosystem Services & Human Well-being to indicators



### **The City of Ljubljana**

Area: 275 km<sup>2</sup>

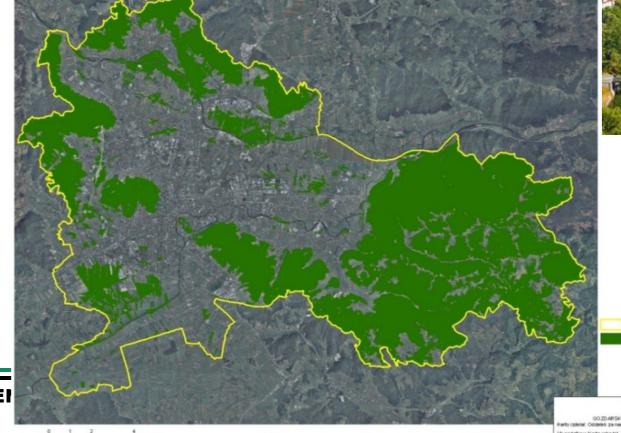
Population: 276.091

Population density:

1.004 indiv. km<sup>-2</sup>

Forest cover: 41 %

**The Green Capital of Europe 2016** 





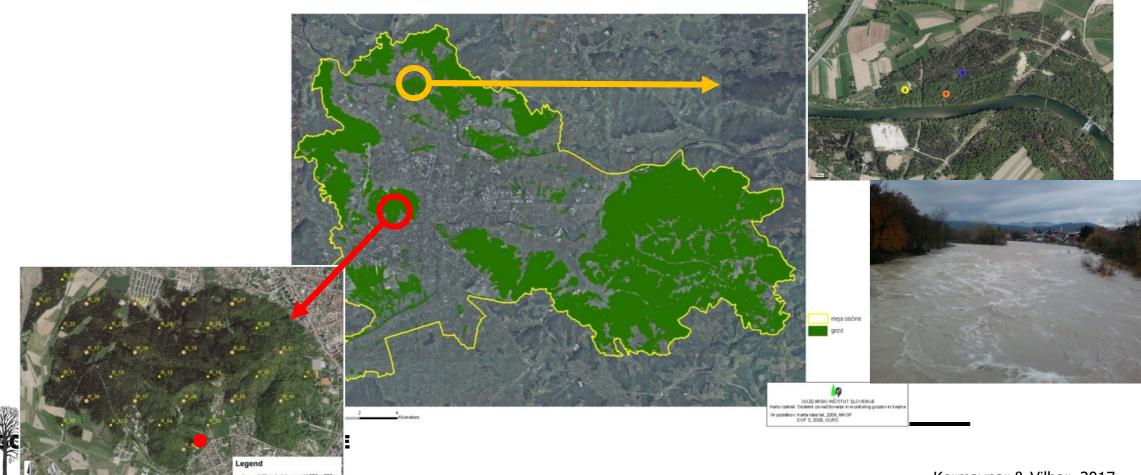




### **Canopy precipitation interception of riparian forests**

### Transect:

**Mixed forest** → **Riparian pine forest** → **Floodplain hardwood forest** 



#### Transect:

## MIXED FOREST IN CITY CENTER



FLOODPLAIN HARDWOOD FOREST



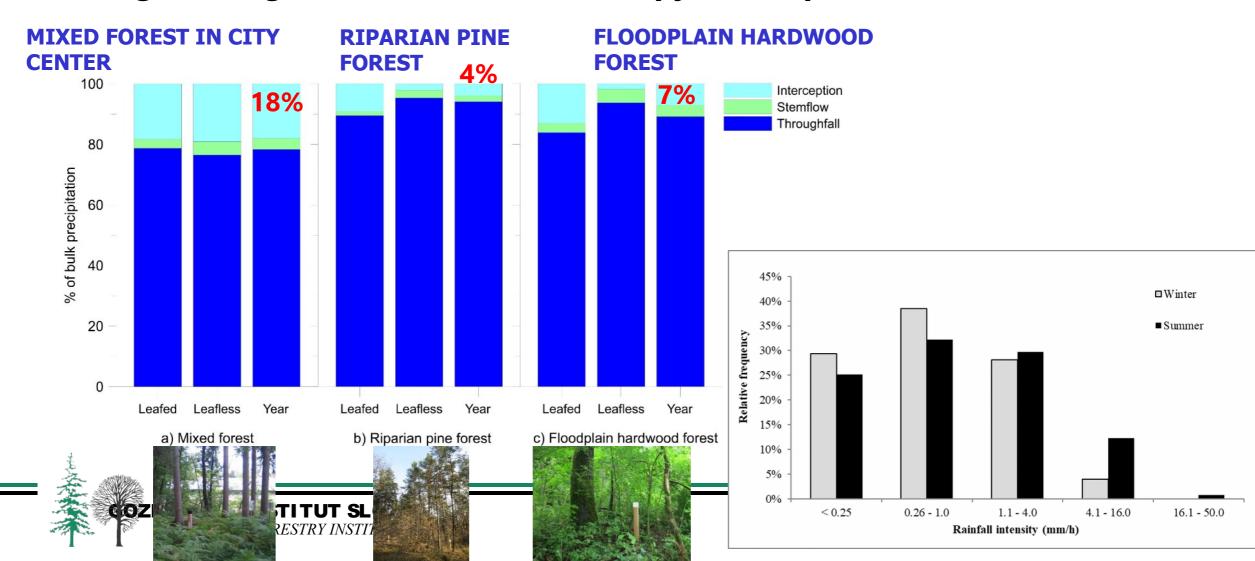




Dystric cambisols

Fluvisols (WRB 2007)

Average throughfall, stemflow and canopy interception from 2008 to 2013



### **The City of Ljubljana**

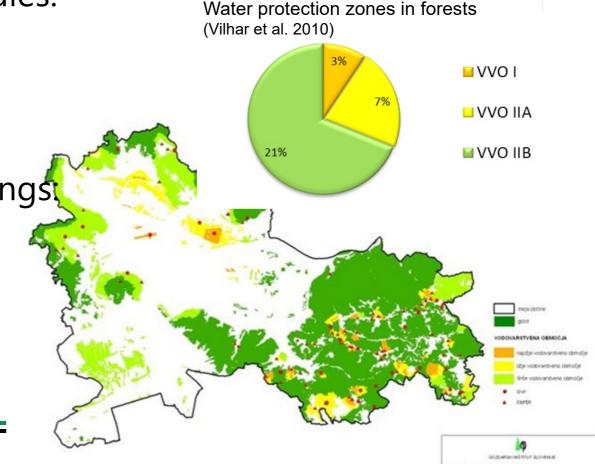
◆ Two important subsurface water-bodies:

1. aquifer Ljubljansko polje and

2. Ljubljansko Barje aquifer system.

102 potential water sources and springs

- > 5 located outside the forest,
- $\geq$  36 in the forest,
- ≥ 61 on the forest edge.



#### **Different land use categories**

the Glinščica river study area (1665 ha) in the City of Ljubljana, Slovenia:

Forest: 44.7 %

**Built-up areas: 31.4 %** 

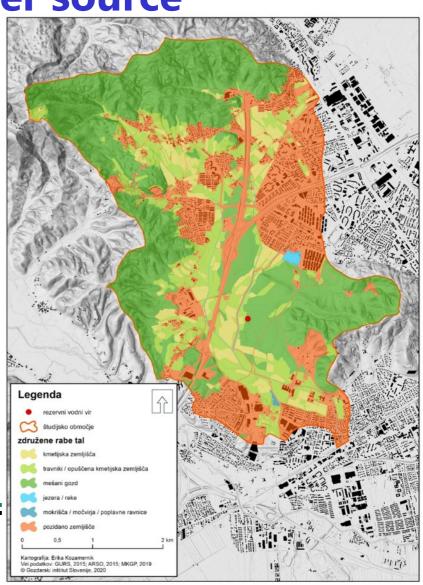
**Grassland and abandoned agricultural land: 16,0 %** 

**Agricultural land: 7.5 %** 

Wetlands, marshes and flood plains: 1.2 %

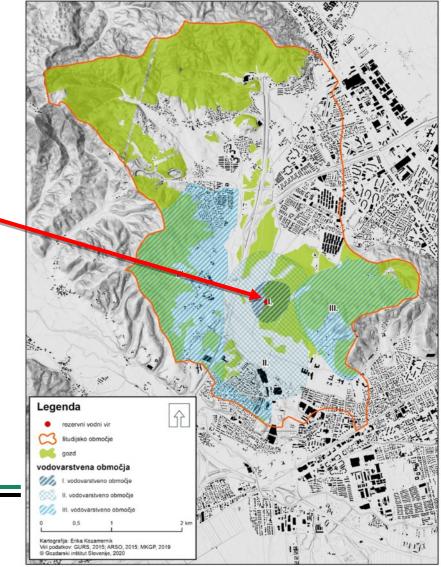
Lakes and rivers < 1 %





Water protection zones of the potential drinking water source

water protection zone VVO I: Forest cover 76 %





Process	Indicator	Reference	Relati
Water flow regulation	Canopy interception (% annual precipitation) Soil water holding capacity (g cm <sup>-3</sup> )	Kermavnar & \ Vilhar et al. 20 ICP Forests Da 2014, Life+ EMoNFU Ausec et al. 20	(Kosc
Water purification	Max. NO <sub>3</sub> concentration in the groundwater of Ljubljana aquifer (mg l <sup>-1</sup> ) Soil Bulk Density (g cm <sup>-3</sup> ) C/N ratio of soil	ICP Fore 2014, Life+ EN Ausec et al. 20 Loose et al. 20 Jamnik et al. 2	
Air pollution reduction	PM $_{10}$ - Annual concentration (µg m $^{-3}$ ) PM $_{10}$ - No. of days above daily threshold 50 µg m $^{-3}$ NO $_2$ - Annual concentration (µg m $^{-3}$ )	Ivančič & Vonč Koleša & Planin Loose et al. 201 Ogrin 2007a, Ogrin 2007b	•

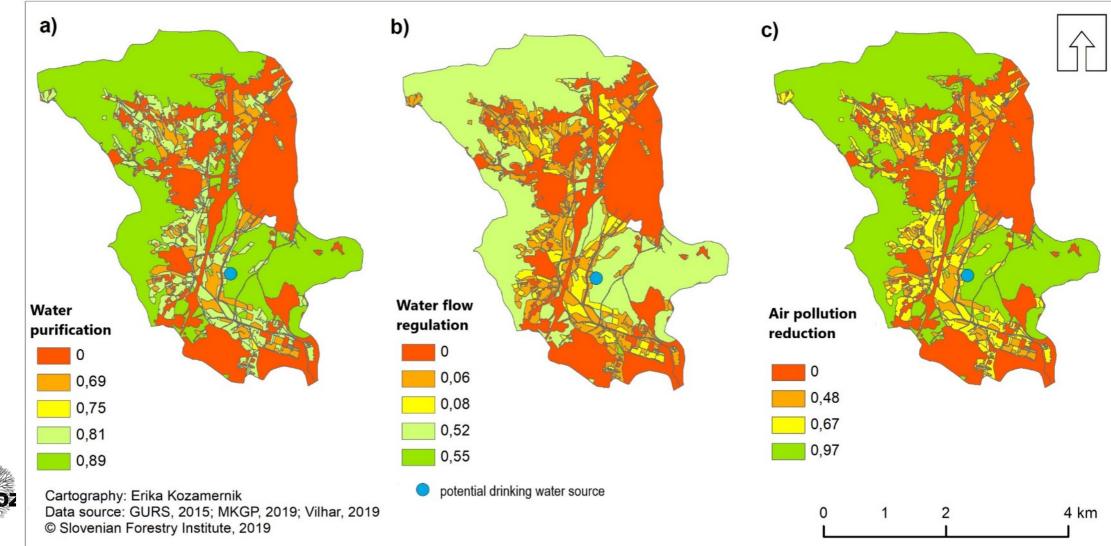
Relative values for indicators (Koschke et al. 2012):

- From 0 no relevant contribution
- to 1 maximum possible contribution

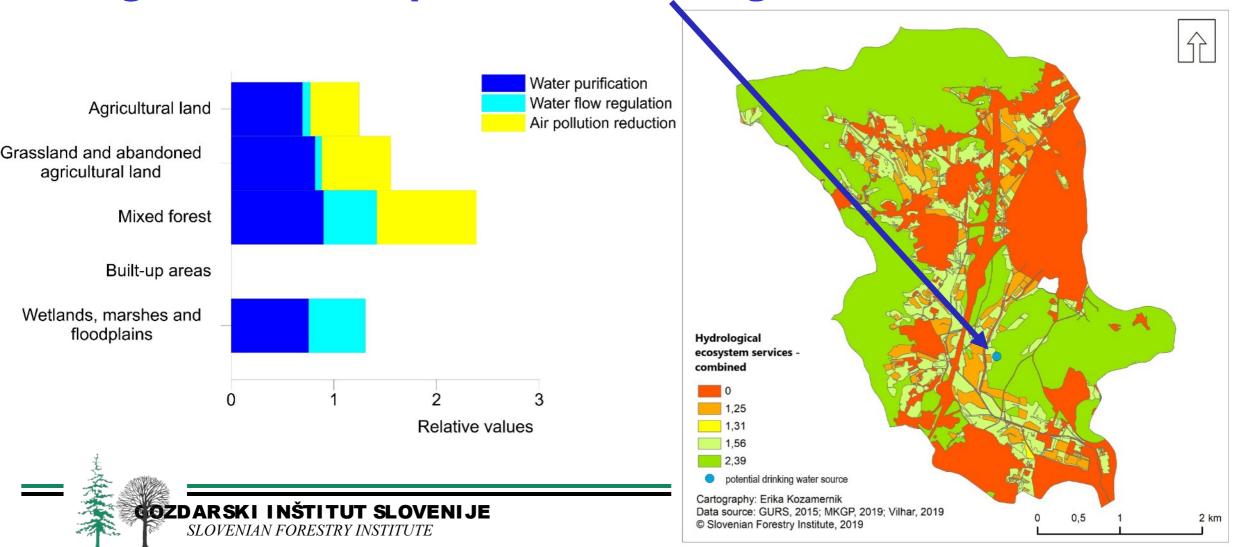




OZDARSKI INŠTITUT SLOVENIJE SLOVENIAN FORESTRY INSTITUTE







#### **Conclusions**

- Every riparian ecosystem is unique (structural traits, soil features and microsite conditions) – difficult to draw general conclusions about their hydrological ecosystem services.
- Canopy precipitation partitioning in riparian forests is strongly influenced by tree species composition, canopy cover and growing stock (i.e., tree dimensions) as well as rainfall spatial distribution and intensity.
- Riparian forests act as a natural filter for pollutants in the air, soil and water with their dense tree crowns, litter and forest soils.
- Hydrologically oriented forest management measures to improve riparian ecosystem services in urbanized watershed represent a nature-based solution.



#### **Acknowledgments**

- Postdoc applied research project, Target Research Project in the Target Research Program "Competitiveness of Slovenia 2006-2013",
- Master thesis at Faculty of Civil engineering, University of Ljubljana,
- Public forestry service, financed by Ministry of Agriculture and the Environment, Republic of Slovenia,
- ICP Forests and Intensive Monitoring of Forest Ecosystems in Slovenia (Public Service)
- Life+ EMoNFUr Project "Establishing a monitoring network to assess lowland forest and urban plantation in Lombardy and urban forest in Slovenia" (LIFE10 ENV/IT/000399)
- The Slovenian Research Agency, Research Core Funding No. 0404-501; the Programme group "Forest biology, ecology and technology" and basic research project J2-1749
- FPS COST Action FP1204 Green Infrastructure approach: linking environmental with social aspects in studying and managing urban forests
- Interreg project PROLINE-CE, co-funded by ESRR.

Vilhar Urša, Kermavnar Janez, Erika Kozamernik



