Smart Forest

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Content

1. Hydro-meteorological monitoring
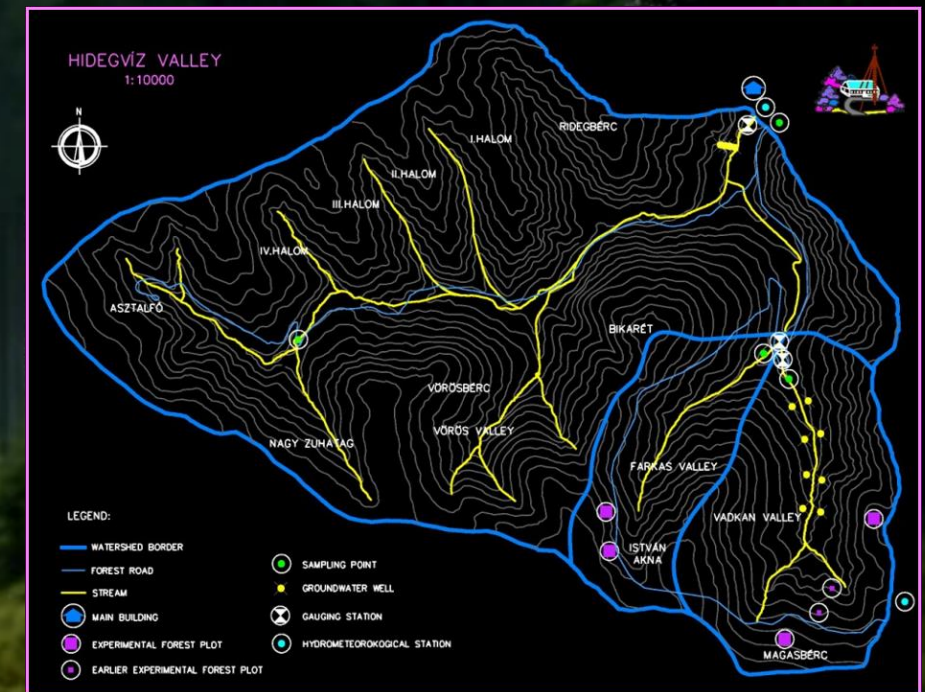
- Long experiment since 1980
- Small water catchment area
- Several hydrological components
  - Measuring runoff, ground water
- Hydro-meteorological gardens
  - Traditional instruments
  - Home developed instruments

HIDEGVÍZ VALLEY
1:10000

LEGEND:
- WATERSHED BORDER
- FOREST ROAD
- STREAM
- MAIN BUILDING
- EXPERIMENTAL FOREST PLOT
- EARLIER EXPERIMENTAL FOREST PLOT
- SAMPLING POINT
- GROUNDWATER WELL
- GAUGING STATION
- HYDROMETEOROKOGICAL STATION

1.1. Hydro-meteorological analysis

- Long term analysis
  - Runoff, ground water
  - Hydrological models
  - Evapotranspiration
  - Interception
- Model development
- Many scientific relationships
- Many publications
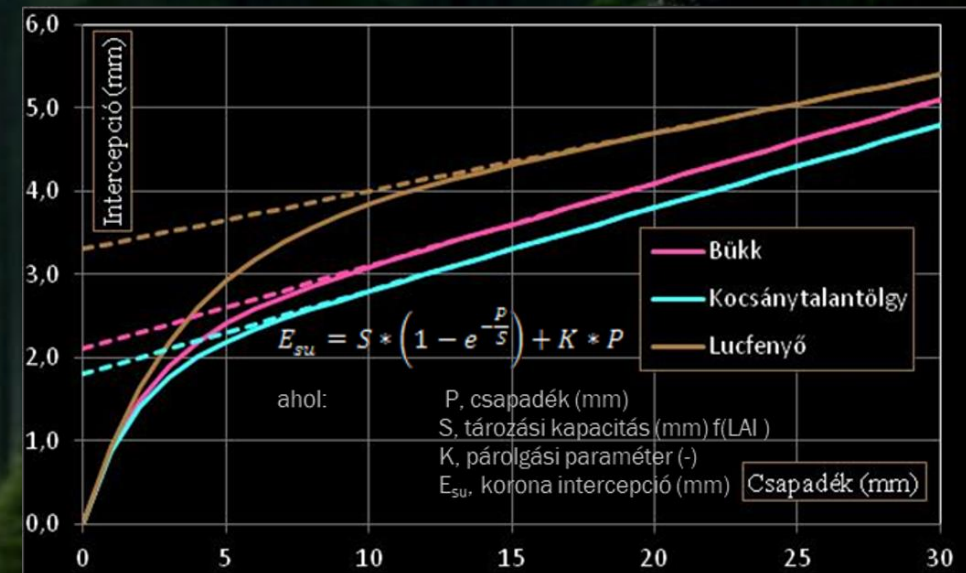
1.2. Hydro-meteorological sensors

- Analogue/Manual sensors
  - Precipitation, Runoff
  - Interceptions, Ground water
- Autonomous/Digital sensors
  - Temperature, Precipitation
  - Air humidity, Wind
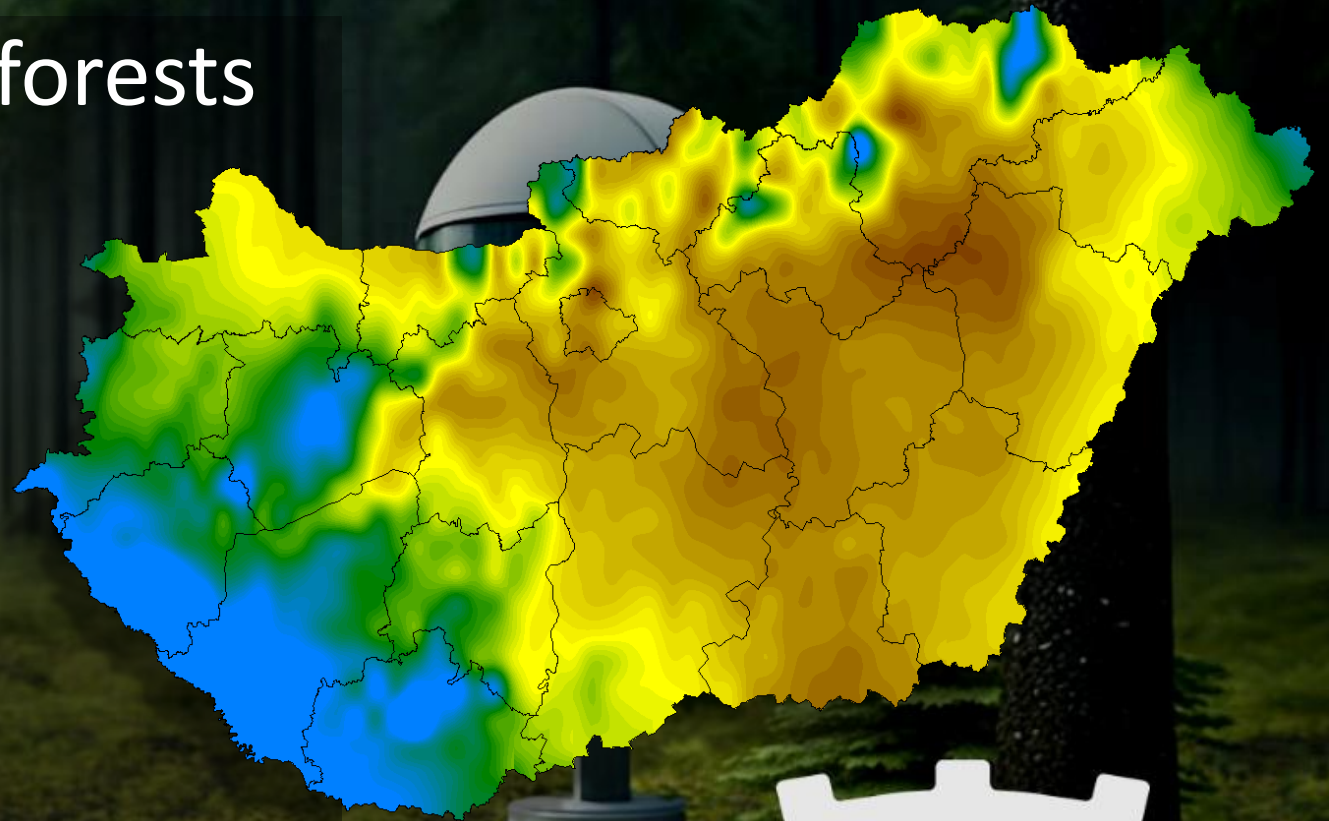 - Digital data storage
  - No communication

1.3. Home-developed sensors

- Design and develop of sensors
- Open technology
- ARM CPU, C programming
- Data storage
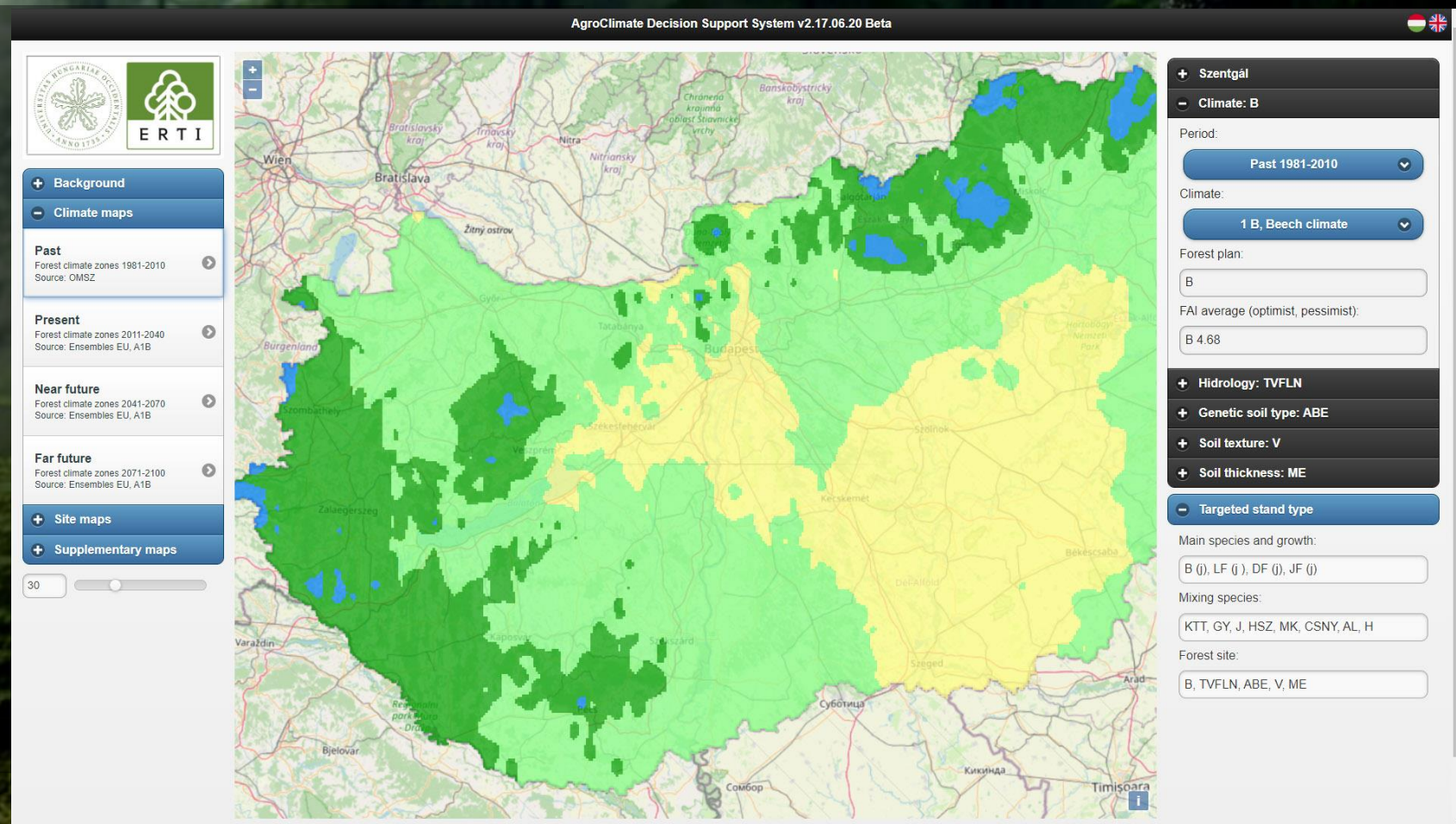- 3D printing
- No online communication
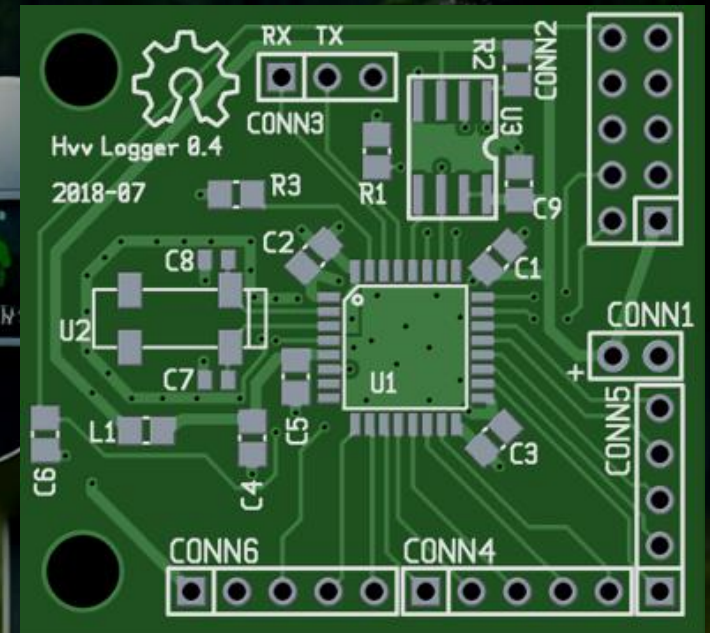
2. Climate modeling

- Climate change impact on forests
- Investigation since 2001
- Several related projects
  - AgroClimate 1, 2
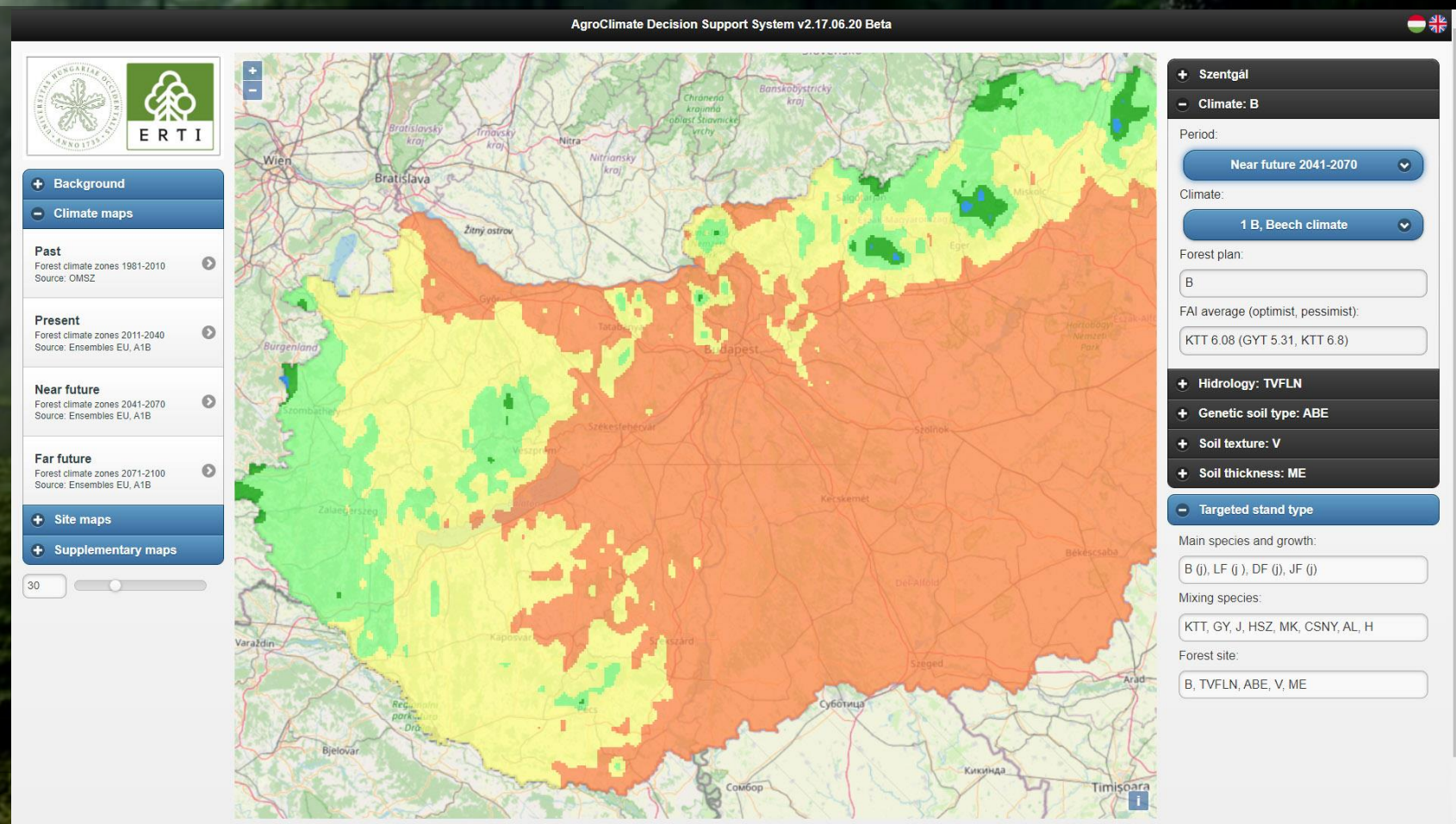- Development of DSS
  - upcoming presentation

2.1. Climate modeling

- Past 1981-2010
- Climate Zones
- Tree species
- Yield maps

2.2. Climate modeling

- Future 2041-2070
- Climate Zones
- Tree species
- Yield maps

2.3. Project Conclusions

- Weather stations are located in cities far from forest
- Forested areas are mainly hilly, mountainous areas
- Extrapolation of these data differs from reality
- We need sensors in the forests

3. Precision Forestry

- Meaning of Precision
  - Accurate Geographic Position
- Geographic Information Systems
- Forestry GIS, Precision GIS
- Precision Forestry GIS: precise geospatial models of single trees
- Precision Forestry

3.1. Laser scanning

- Very detailed 3D Survey
- Aerial, Terrestrial …
- Point Cloud Processing
- Single tree models
- Stem, branches
- Crown, height
- Social situation
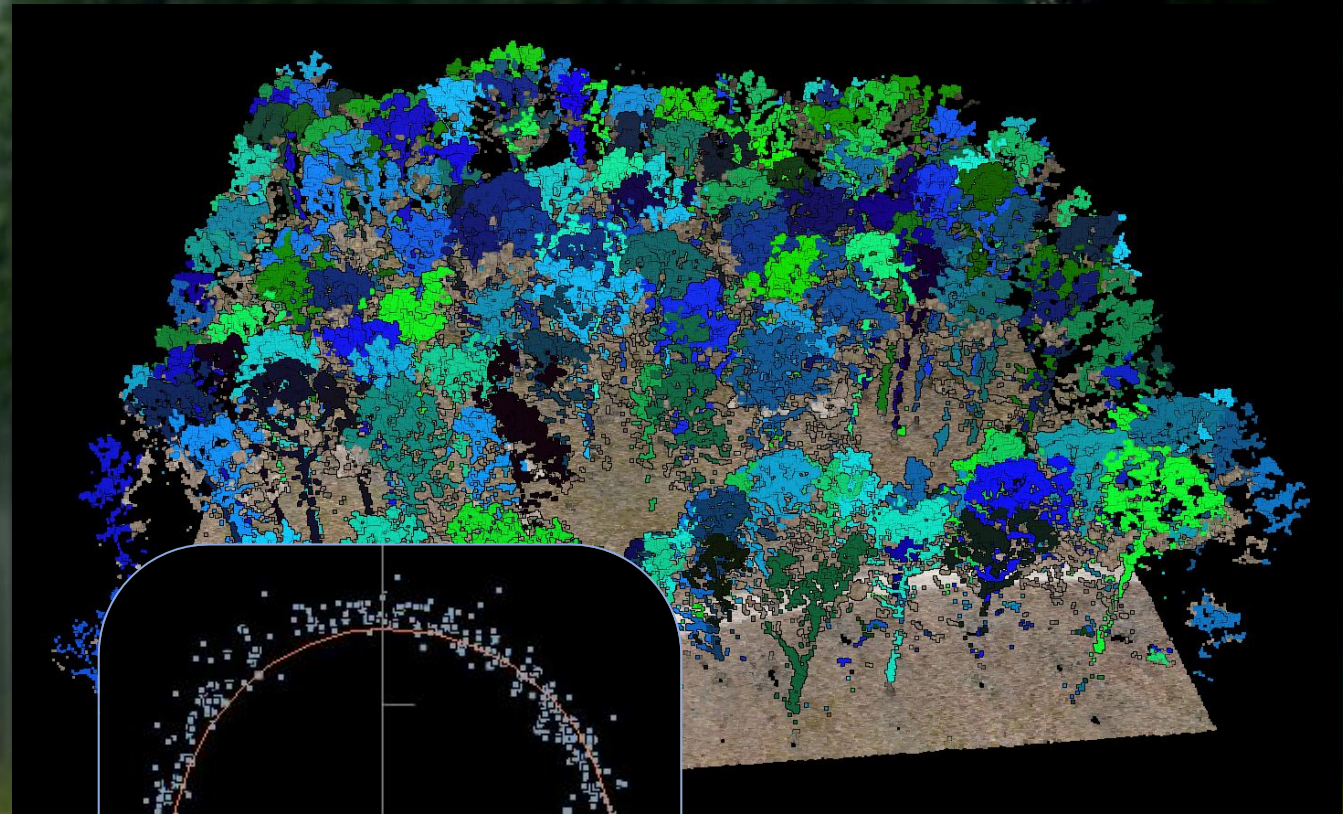
3.2. Satellite & airborne sensing

- Sentinel-2 & UAV images
- 10 m & 1 cm spatial resolution
- 5 day temporal resolution
- Usage of satellite images:
  - Tree species classification
  - Forest cover changes
  - Forest health changes
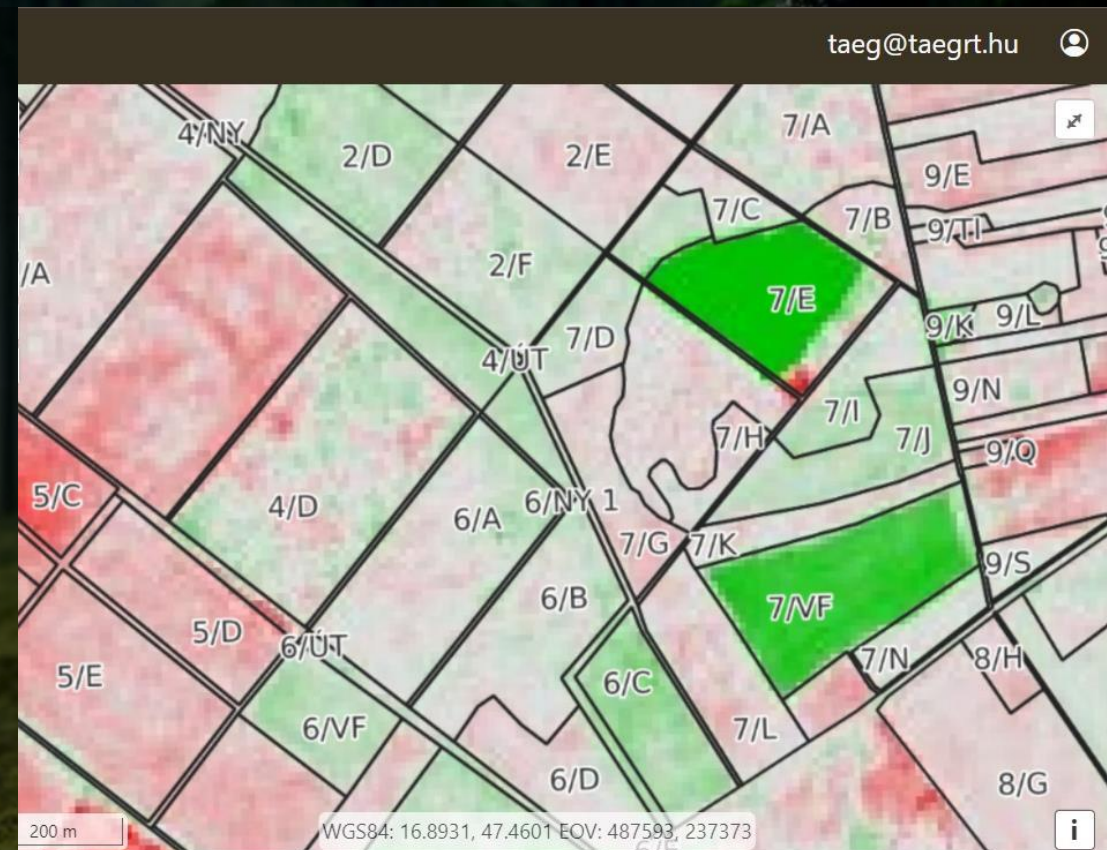
4. Smart Sensors

- Meaning of "SMART"
  - Phone, TV, home, city, contract …
  - Autonomous, advanced tasks
  - Sensors, programs, connections
- Smart Sensors
  - Various digital sensors
  - CPU and data storage
  - Communication, Battery

4.1. Smart Sensors

- Independent operation
- Can measure many environmental parameters
- NB IoT: narrow band Internet of Things sensor
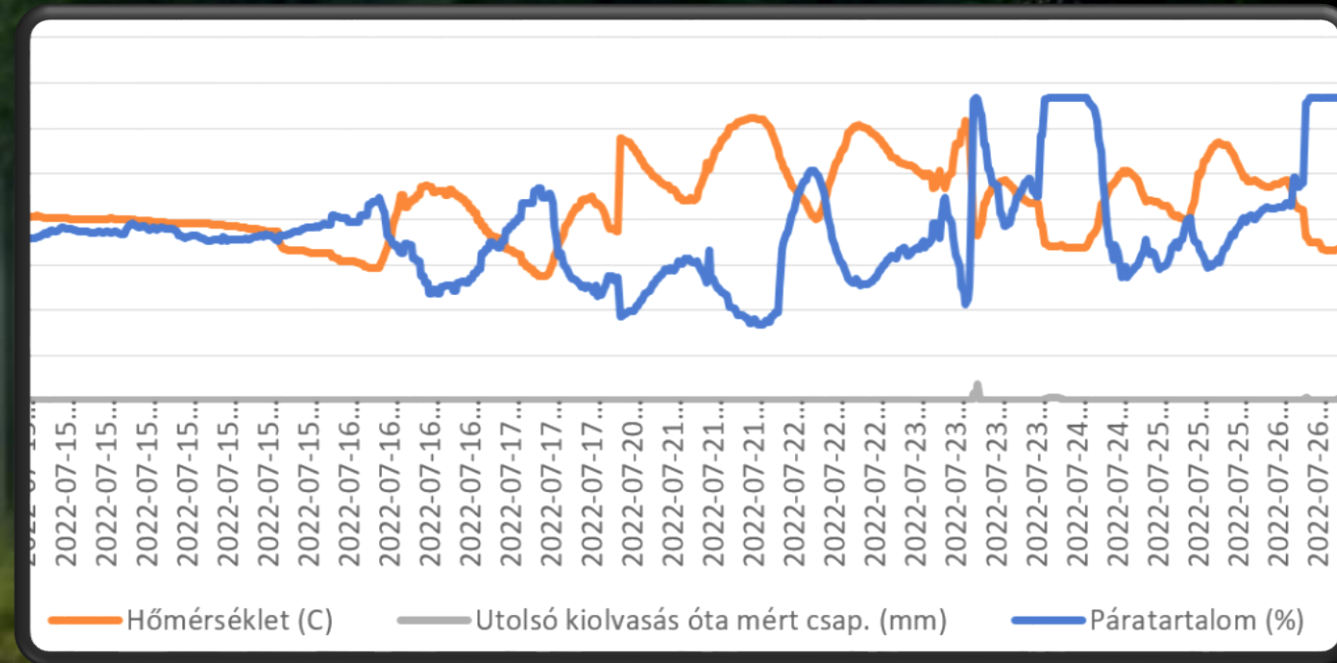- Sending data to Cloud
- Network of Sensors

4.2. Smart Sensors

- Complex sensor
  - Temperature
  - Precipitation
  - Soil moisture
  - Diameter growth
- Small sensors
 - Temperature, humidity
  - Movement

4.3. Smart Sensors

- Collected data transferred into the Cloud
  - Temperature
  - Precipitation
  - Humidity
  - Soil moisture
  - Diameter growth
  - Movement

4.4. Web-based data analysis

- Warning, current conditions
- Climate and drought analysis
- Multivariate analysis & aggregation
  - Temperature, Precipitation
  - Hydrological models
  - Soil moisture changes
  - Stem diameter increment
- Biotic damage analysis
- Number of visitors
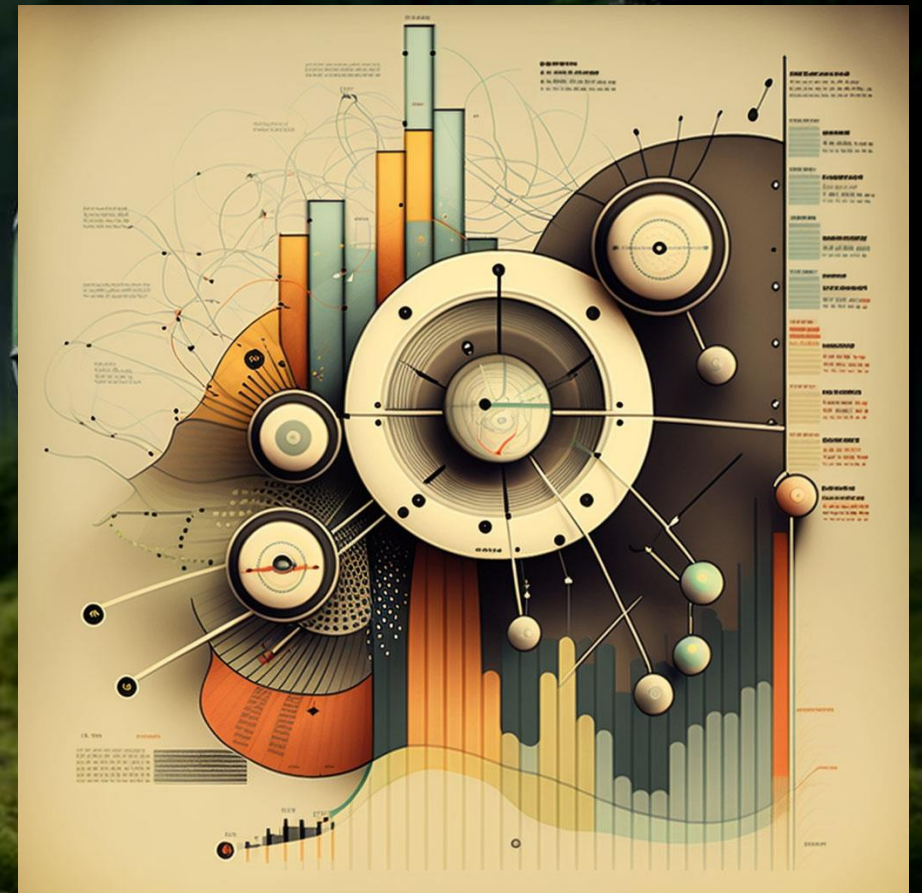
5. Smart Forest

- Real time monitoring of trees' responses to the environment
- Smart Forest is a novel, precise and online model about our trees and forests
- This model can synthetize many forestry disciplines, and provide data for complex analyses

5.1. Smart Forest

- Precision Forestry + Smart Sensors
- Short-term (days)
  - Alarm system (motion, fire), environmental condition, response
- Mid-term (years)
  - Monitoring, relations & trend analysis
- Long-term (decades)
  - Tree species selection, adaptation and mitigation strategies

6. Further Synthesis

- Bioinformatics
  - Pest analyses
  - Selection of Resistant entities
- Bioremediation
- Preemptive forest protection
- Hydrological planning
- Disseminations
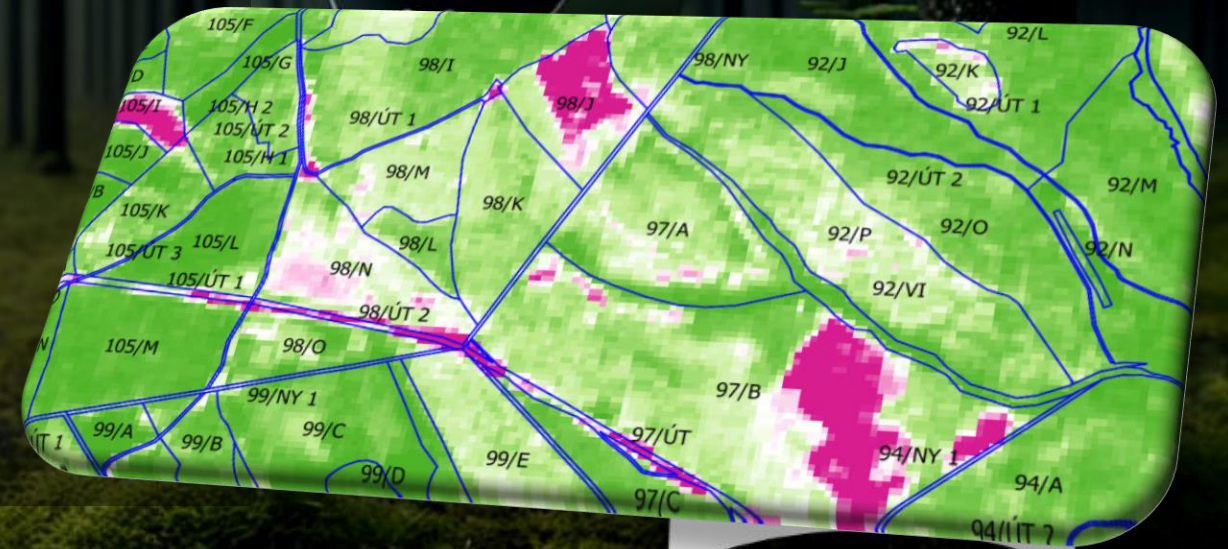
6.1. Dissemination

- 2021. University model change
- University contracted with a Communication Company
- Our innovations were reviewed
- Smart Sensors/Forest selected
- Communication campaign started

6.2. Communication Campaign

- Fall 2021. – Spring 2022
- 2 pages press release „Smart options in Forests"
- 80+ written appearances
- 7 radio interviews
- 5 TV interviews

Thank You for Your Attention

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