Potential Collaboration Topics with Joanneum and IRB

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What are Knowledge Technologies?

- Information Technologies for the Knowledge-Based Society
  - Decision Support
  - Human Language Technologies
  - Knowledge Discovery from Data (Data Mining/Machine Learning)
  - Knowledge Management
- Support the acquisition, storage/retrieval, management and use of knowledge

Most relevant for Joanneum & IRB

- Knowledge Discovery from Data
  (Data Mining/Machine Learning)
  - Agriculture
  - Forestry
  - Aquatic ecosystem
  - Environmental epidemiology
- Decision Support
  - Agriculture & Forestry (GMOs)
  - Includes environmental and sociological aspects

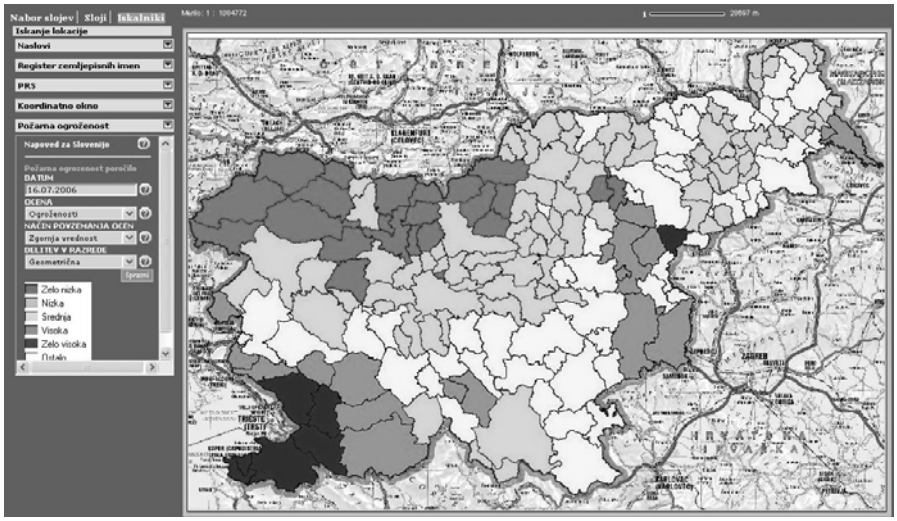
PaleoClimatology

- From tree-ring data + meteorology data over the last 20 years
- Learn models for predicting e.g.
  - Temperature
  - Precipitation
- Use these to infer past climate
- Cooperation with Forestry Institute Ljubljana

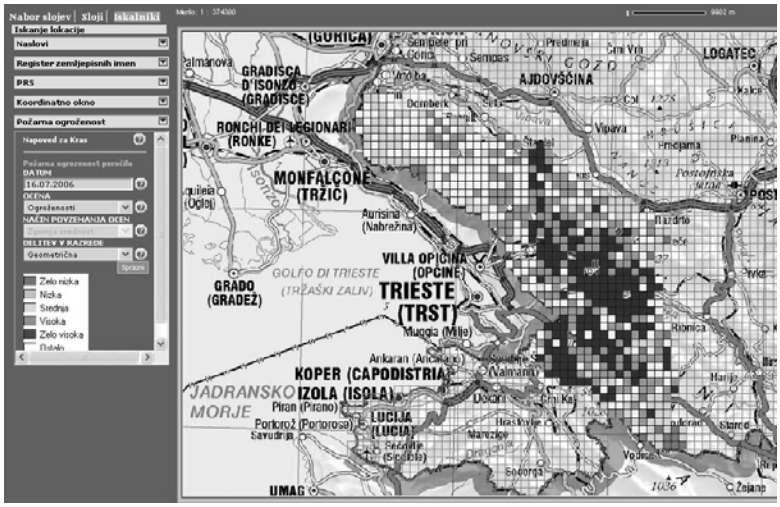
Natural Hazards

- Predicting floods
  - Predicting run-off from rainfall and past run-off at the watershed level
  - Predicting earthquakes from soil radon
  - Predicting risk of forest fires
    - **GIS** data (Infrastructure, Land use, Relief)
    - Multi-temporal **MODIS** data
    - Meteorological **ALADIN** data
    - Fire fuels

Fire danger predictions for the whole of Slovenia



Fire danger predictions for the Karst Region

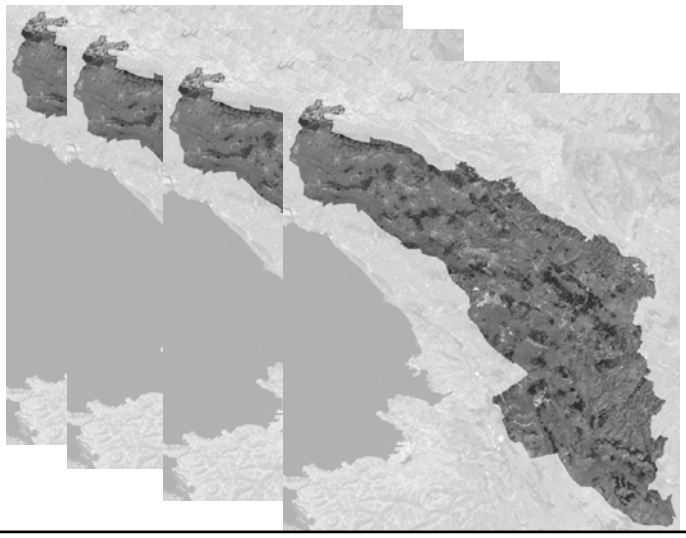


Forest monitoring by remote sensing

- Detecting the forest border from satellite images (important because of spontaneous afforestation)
- LIDAR
  - Developing new methods for processing LIDAR data (steep terrain, heterogeneous forest)
  - Using LIDAR to asses accurately forest state
  - Learning to asses the state of the forest directly from satellite images (not using LIDAR anymore)

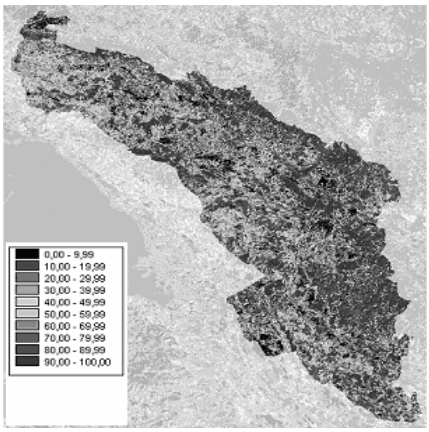
The Input: Landsat ETM+ Images

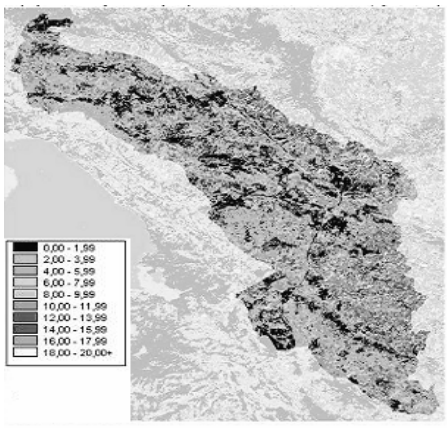
- Multi-temporal (4 time points), Multi-spectral (5 channels)



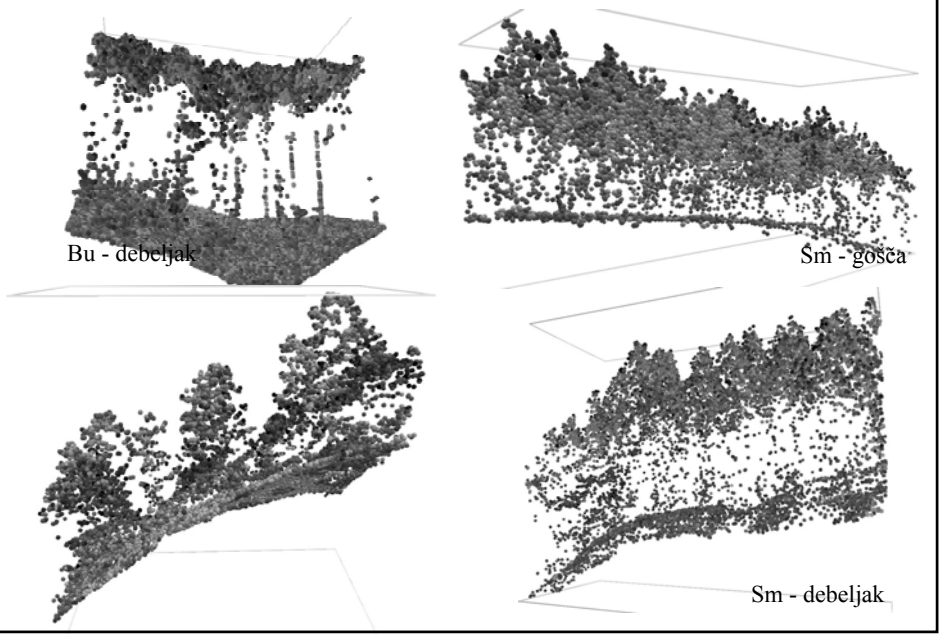
The use: Maps of FSH and CC

- Monitoring the forest biomass accumulation and CO_2 sink
- Other uses: study of forest habitats;
  visibility analysis for cell-phone networks





Input: LIDAR Data – A sample



The output:
A multi-objective regression tree

```
b7s1_avg > 60.16
+--yes: d3s1_avg > 69.52
|       +--yes: b2s1_std > 2
|       |       +--yes: [10.147239,0.626994,9.984663,5.033252,4.306319,3.77362,2.926442,2.444724,2.054908,1.775767,
|       |       +--no:  a4s1_std > 7.01
|       |               +--yes: [8.375,0.67625,7.125,7.48625,6.91875,6.42375,5.48125,4.98,4.6475,4.43375,4.34125] (
|       |               +--no:  c4s1_avg > 64.06
|       |                       +--yes: c2s1_std > 1.98
|       |                       |       +--yes: [9,0.474,9.1,7.452,6.778,5.737,4.707,3.973,3.537,3.253,3.122] (3)
|       |                       |       +--no:  a7s1_std > 1
|       |                       |               +--yes: [4.288577,0.266713,4.148297,2.196613,1.89984,1.658337,1.334
|       |                       |               +--no:  [5.714286,0.507143,5.142857,8.504286,7.587143,6.694286,5.37
|       |                       +--no:  a4s2_avg > 79.3
|       |                               +--yes: [9.707865,0.564073,9.713483,4.59441,3.932669,3.436292,2.666011,2.23
|       |                               +--no:  [2.408333,0.232583,2.358333,1.729,1.643917,1.485583,1.2455,1.083667
|       +--no:  c2s1_std > 1.82
|               +--yes: [17.095436,1.004481,16.713693,6.832116,5.595519,4.819461,3.682241,3.018382,2.500415,2.16365
|               +--no:  a3s1_avg > 67
|                       +--yes: [3.656716,0.262438,3.781095,2.742537,2.535771,2.266567,1.879502,1.639005,1.424776,1
|                       +--no:  c4s1_max > 91
|                               +--yes: [3.68,0.2608,3.413333,2.578533,2.138133,1.895067,1.506533,1.238933,1.0124,0
|                               +--no:  c4s1_avg > 62.18
|                                       +--yes: c4s2_min > 49
|                                       |       +--yes: [10.875,0.571798,10.664474,5.050833,4.322303,3.807149,3.044
|                                       |       +--no:  b7s2_std > 9.45
|                                       |               +--yes: [31.52381,2.156667,31.095238,9.232381,7.34,6.202381
|                                       |               +--no:  d3s1_std > 4.23
|                                       |                       +--yes: [47,4.051667,50.166667,13.421667,9.843333,7
|                                       |                       +--no:  b5s2_max > 128
|                                       |                               +--yes: [4.241935,0.229677,4.209677,2.49919
|                                       |                               +--no:  b2s2_min > 64
|                                       |                                       +--yes: [6.525547,0.382117,6.554745
|                                       |                                       +--no:  [4.859551,0.318427,4.780899
```

Other topics

- Influence of climate change on Slovenian forests
  - Damages
  - Species distribution
  - Combine with CC scenarios
- Invasive species
  - Species properties
  - Location properties
  - Does the combination of the two lead to invasion
- Environmenatl epidemiology
  - Changing habitat of vectors due to CC
  - Impact on incidence, e.g., Tick-borne diseases

Potential IRB collaboration

- IRB Work on Ecological Modeling, IJS Work on Automated Ecological Modelling
- Aquatic ecosystems (domain knowledge for modeling them, could be used for e.g. modeling plankton growth with Rovinj data)
- Molecular ecotoxicology (structure-activity relationships for toxicity), learning SAR models from data on structure and toxicity as assesed in laboratory