



# The fourth level of the LULC classification in the Integrated Environmental Monitoring in Poland



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## Introduction

The Integrated Environmental Monitoring (IEM) functions within the State Environmental Monitoring Programme in Poland since 1994. Its task involves long-term research, both abiotic and biotic of elements of the natural environment, based on planned and organized stationary tests. The aim of the IEM is to provide data for defining the current environmental status and, based on multi-year observation cycles, to present short- and long-term environmental changes in the conditions of climate changes and growing human impact on the environment.

One of the research programs under the Integrated Environmental Monitoring (IEM) is the monitoring of land cover and land use. The purpose of this monitoring is retrodiction, current inventory and anticipating environmental changes within the selected geocoecosystems in terms of local and regional spatial scale and short-, medium- and long-term time scale.

## Study area

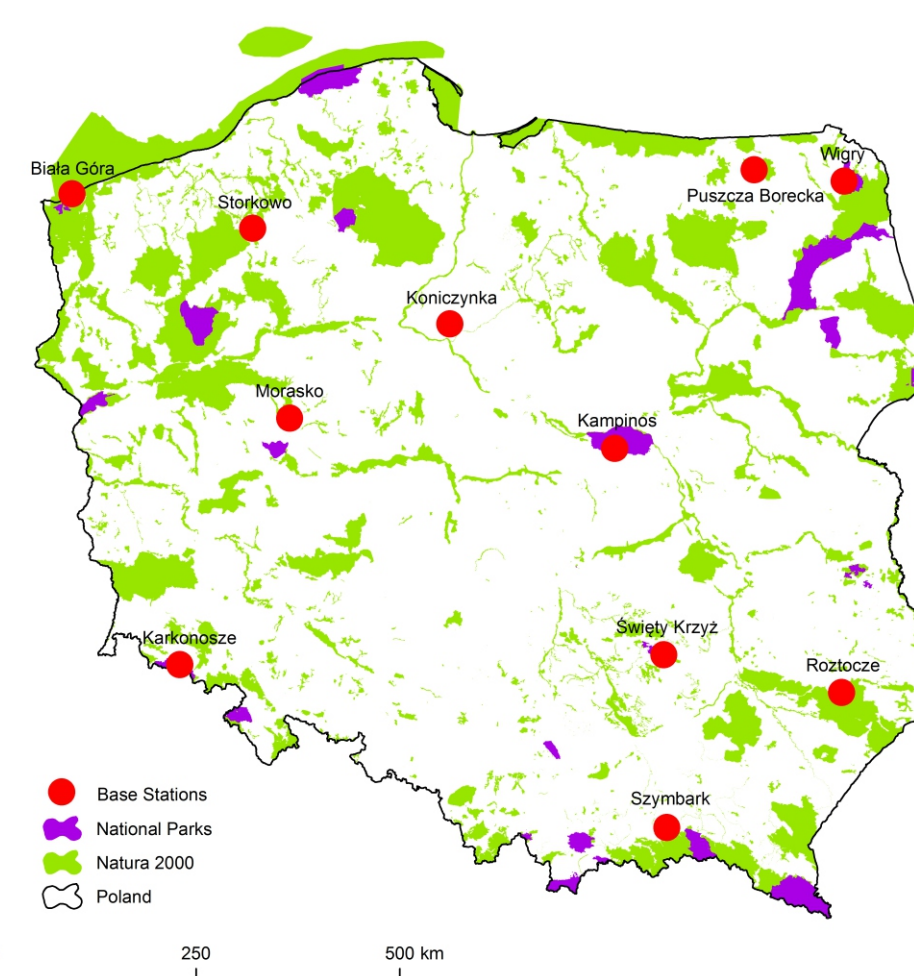
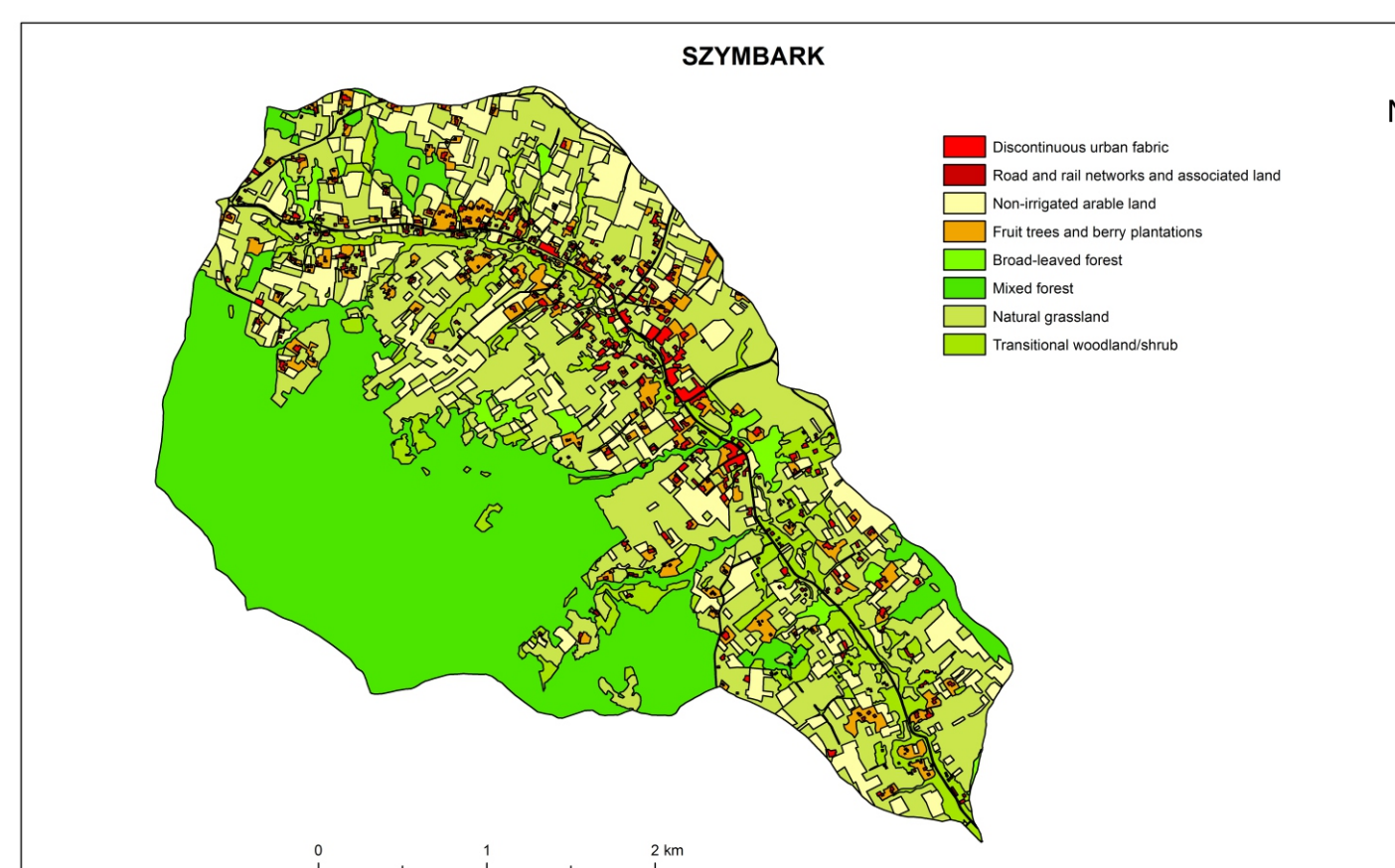
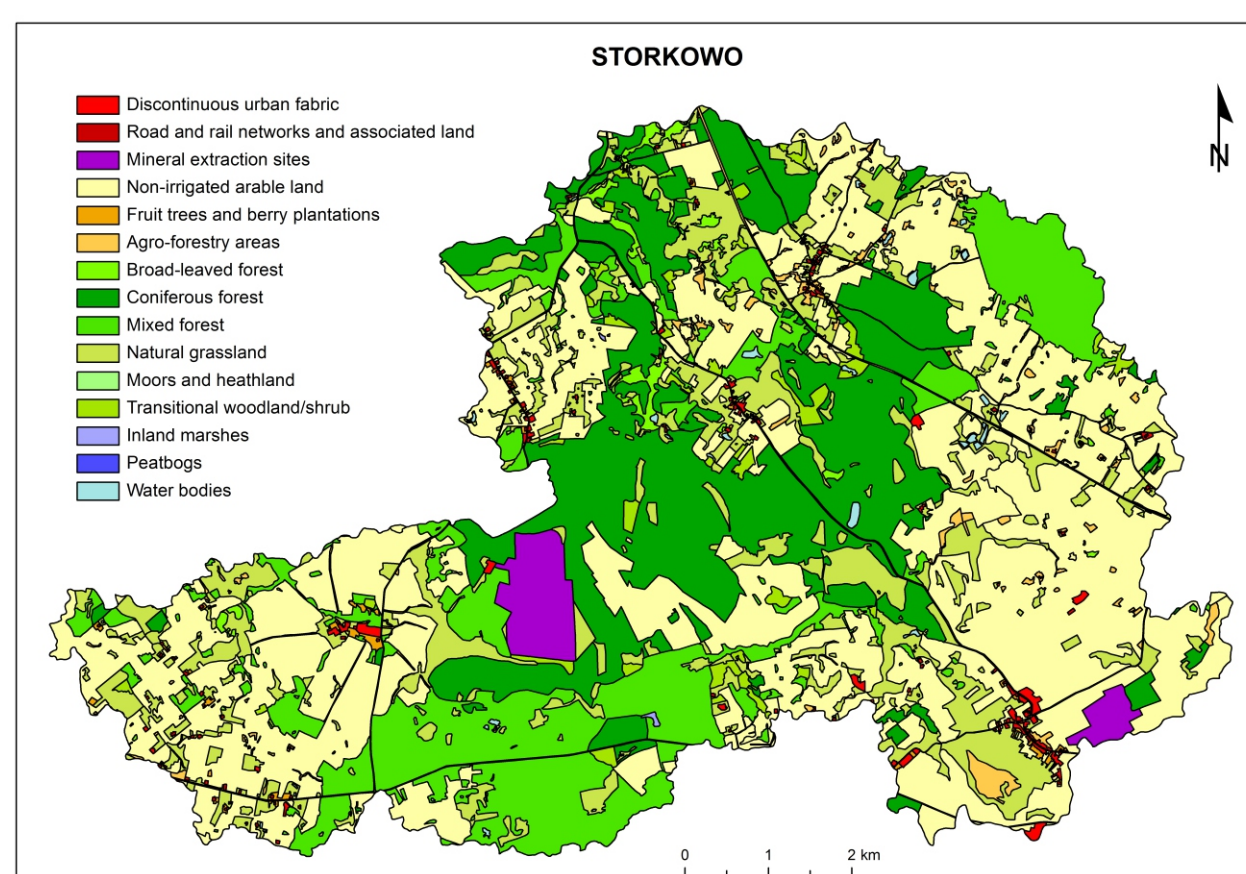
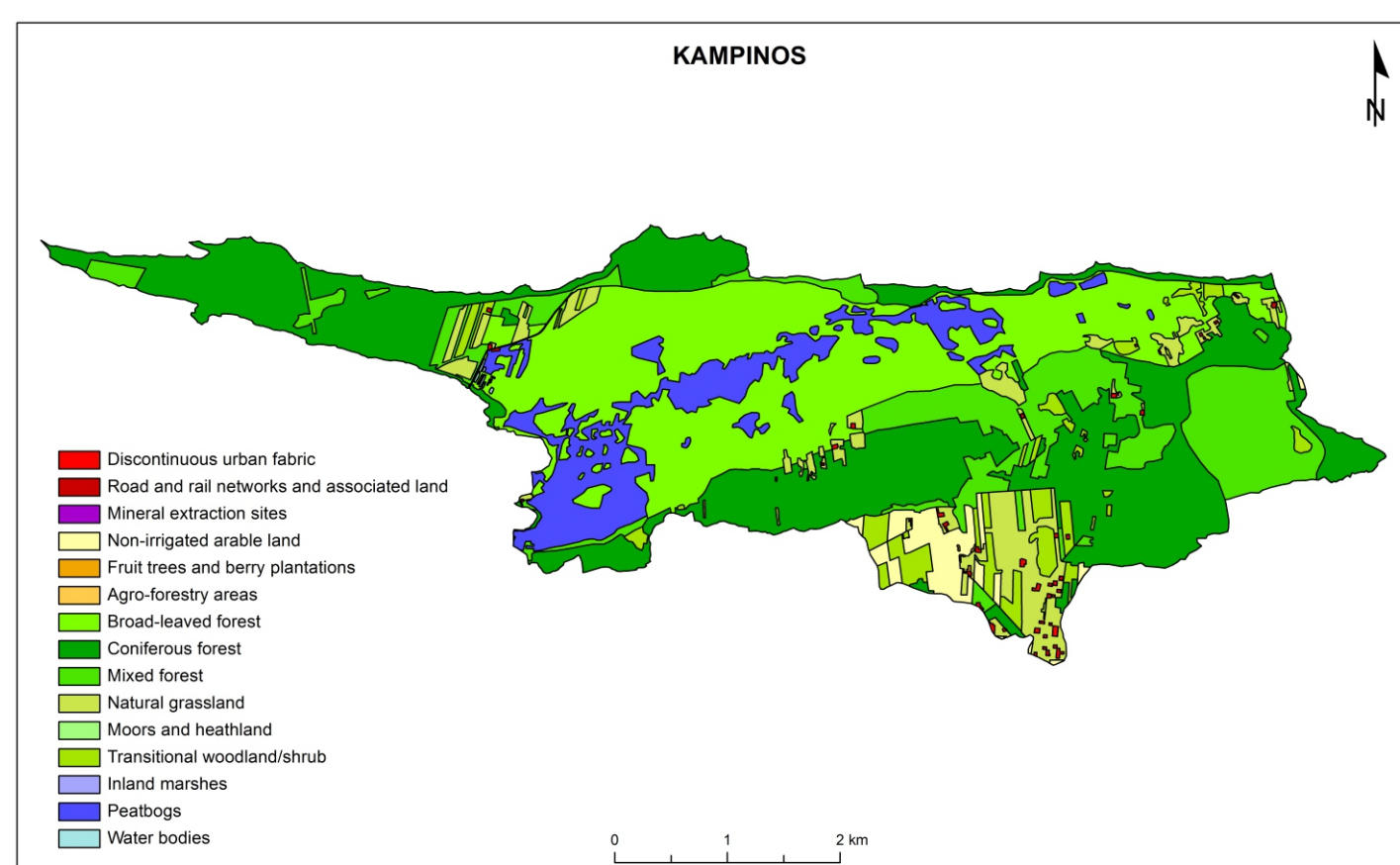


Fig. 1. The location of Integrated Environmental Monitoring Base Stations.

The basic object of IEM research is the river or lake catchment area. A broad range of complementary stationary research is conducted according to standardised methods at 11 IEM Base Stations in the entire country and at the Polar Base Station in Spitsbergen as a reference station for the assessment of the condition of the natural environment in Poland. 6 catchments are located in the Polish National Parks and 8 catchments are located in the area of Natura 2000 sites.

## Land Cover/Land Use maps



According to the classification based on the CLC nomenclature maps of land cover and land use for the catchments were prepared. Source data were SPOT satellite images from 2010. However, monitoring within catchments of the IEM requires another 4th level, which details the classification in order to indicate the more accurately type and direction of changes in land cover and land use.

Fig. 2. Land-cover/Land-use maps for the selected catchments (CLC 3rd level).

## 4th Level CORINE Land Cover nomenclature for the IEM

| ARTIFICIAL SURFACES |  |         |   |
|---------------------|--|---------|---|
| CODE                | LEVEL 3                                    | CODE    | LEVEL 4   |
| 1.1.1               | Continuous urban fabric                    | 1.1.1.1 | Continuous urban center built-up areas          |
|                     |  | 1.1.1.2 | Continuous urban built-up areas                 |
| 1.1.2               | Discontinuous urban fabric                 | 1.1.2.1 | Discontinuous multifamily built-up areas        |
|                     |  | 1.1.2.2 | Discontinuous singlefamily built-up areas       |
| 1.2.1               | Industrial or commercial units             | 1.2.1.1 | Industrial- storehouse areas                    |
|                     |  | 1.2.1.2 | Production and service of agriculture areas     |
|                     |  | 1.2.1.3 | Specialized technical infrastructure areas      |
|                     |  | 1.2.1.4 | Commercial-service areas                        |
|                     |  | 1.2.1.5 | Public areas                                    |
| 1.2.2               | Road and rail networks and associated land | 1.2.2.1 | Road networks and associated land               |
|                     |  | 1.2.2.2 | Rail networks and associated land               |
| 1.2.3               | Port areas                                 | 1.2.3.1 | Seaports  |
|                     |  | 1.2.3.2 | Inland ports                                    |
|                     |  | 1.2.3.3 | Shipyards                                       |
| 1.2.4               | Airports                                   | 1.2.4.1 | Airports with artificial surface                |
|                     |  | 1.2.4.2 | Airports with grassy surface                    |
|                     |  | 1.2.4.3 | Airports - terminals and hangars                |
| 1.3.1               | Mineral extraction sites                   | 1.3.1.1 | Clastic and clay raw materials extraction sites |
|                     |  | 1.3.1.2 | Quarries  |
|                     |  | 1.3.1.3 | Open-cast mines                                 |
|                     |  | 1.3.1.4 | Restored and overgrowing extraction sites       |
| 1.3.2               | Dump sites                                 | 1.3.2.1 | Dump solid waste sites                          |
|                     |  | 1.3.2.2 | Dump liquid waste sites                         |
|                     |  | 1.3.2.3 | Mining heaps                                    |
|                     |  | 1.3.2.4 | Municipal dump sites                            |
|                     |  | 1.3.2.5 | Restored and overgrowing dump sites             |
| 1.3.3               | Construction sites                         | 1.3.3.1 | Buildings under construction                    |
|                     |  | 1.3.3.2 | Excavations                                     |
|                     |  | 1.3.3.3 | Urban parks                                     |
| 1.4.1               | Green urban areas                          | 1.4.1.1 | Urban parks                                     |
|                     |  | 1.4.1.2 | Lawns and squares                               |
|                     |  | 1.4.1.3 | Allotment gardens                               |
|                     |  | 1.4.1.4 | Cemeteries                                      |
|                     |  | 1.4.1.5 | Areas with no economic use                      |
| 1.4.2               | Sport and leisure facilities               | 1.4.2.1 | Sport areas                                     |
|                     |  | 1.4.2.2 | Swimming pools                                  |
|                     |  | 1.4.2.3 | Recreation and camping areas                    |

| AGRICULTURAL AREAS |  |         |  |
|--------------------|--|---------|--|
| CODE               | LEVEL 3  | CODE    | LEVEL 4  |
| 2.1.1              | Non-irrigated arable land  | 2.1.1.1 | Cereal crops   |
|                    |  | 2.1.1.2 | Legume plants crops                                      |
|                    |  | 2.1.1.3 | Oil plants crops   |
|                    |  | 2.1.1.4 | Root plants crops  |
|                    |  | 2.1.1.5 | Fibre plants crops                                       |
|                    |  | 2.1.1.6 | Vegetables crops   |
|                    |  | 2.1.1.7 | Flowers crops  |
|                    |  | 2.1.1.8 | Greenhouse crops   |
|                    |  | 2.1.1.9 | Fallow and set-aside land                                |
| 2.1.2              | Permanently irrigated land   | 2.1.2.1 | Canal-irrigated arable land                              |
|                    |  | 2.1.2.2 | Sprinkle-irrigated arable land                           |
| 2.1.3              | Rice fields  | 2.1.3.1 | Flooded rice fields                                      |
|                    |  | 2.1.3.2 | Mountain rice fields                                     |
| 2.2.1              | Vineyards  | 2.2.1.1 | Private vineyards  |
|                    |  | 2.2.1.2 | Commercial vineyards                                     |
| 2.2.2              | Fruit trees and berry plantations  | 2.2.2.1 | Private orchards   |
|                    |  | 2.2.2.2 | Commercial orchards                                      |
| 2.2.3              | Olive groves   | 2.2.3.1 | Private olive groves                                     |
|                    |  | 2.2.3.2 | Commercial olive groves                                  |
| 2.3.1              | Pastures   | 2.3.1.1 | Permanent pastures                                       |
|                    |  | 2.3.1.2 | Periodically pastures                                    |
|                    |  | 2.3.1.3 | Arable land associated with permanent crops              |
| 2.4.1              | Annual crops associated with permanent crops   | 2.4.1.1 | Pastures associated with permanent crops                 |
|                    |  | 2.4.1.2 | Complex cultivation with predominance of permanent crops |
| 2.4.2              | Complex cultivation  | 2.4.2.1 | Complex cultivation with predominance of annual crops    |
|                    |  | 2.4.2.2 | Complex cultivation with predominance of permanent crops |
| 2.4.3              | Land principally occupied by agriculture, with significant areas of natural vegetation | 2.4.3.1 | Irregular mid-field trees and scrub                      |
|                    |  | 2.4.3.2 | Mid-field shelterbelts                                   |
| 2.4.4              | Agro-forestry areas  | 2.4.4.1 | Arable land with trees and shrubs                        |
|                    |  | 2.4.4.2 | Pastures with trees and shrubs                           |

Uniform colour legend is designed for developed classification. The legend corresponds to the pallet used in CLC database with slight modifications of some colours as well as assigning hatches to individual issues on the fourth level. The pallet was developed in the form of thematic layer with symbolization of objects stored in the format \*.lyr for the fourth level.

| FORESTS AND SEMI-NATURAL AREAS |                                 |          |  |
|--------------------------------|---------------------------------|----------|--|
| CODE                           | LEVEL 3                         | CODE     | LEVEL 4                                  |
| 3.1.1                          | Broad-leaved forest             | 3.1.1.1  | Alder forest                             |
|                                |                                 | 3.1.1.2  | Riparian forest                          |
|                                |                                 | 3.1.1.3  | Oak-hornbeam forest                      |
|                                |                                 | 3.1.1.4  | Beech forest                             |
|                                |                                 | 3.1.1.5  | Sycamore and maple-linden forest         |
|                                |                                 | 3.1.1.6  | Oak forest                               |
|                                |                                 | 3.1.1.7  | Pine forests                             |
|                                |                                 | 3.1.1.8  | Spruce forest                            |
|                                |                                 | 3.1.1.9  | Fir forest                               |
|                                |                                 | 3.1.1.10 | Mixed forest with pine                   |
|                                |                                 | 3.1.1.11 | Mixed forest with spruce                 |
|                                |                                 | 3.1.1.12 | Mixed forest with fir                    |
| 3.1.2                          | Coniferous forest               | 3.1.2.1  | Dry meadows                              |
|                                |                                 | 3.1.2.2  | Typical meadows                          |
| 3.1.3                          | Mixed forest                    | 3.1.3.1  | Wet meadows                              |
|                                |                                 | 3.1.3.2  | Moors and heathland                      |
|                                |                                 | 3.1.3.3  | Moors and heathland                      |
| 3.2.1                          | Natural grassland               | 3.2.1.1  | Chappral scrub                           |
|                                |                                 | 3.2.1.2  | Garigue                                  |
|                                |                                 | 3.2.1.3  | Mountain pine                            |
|                                |                                 | 3.2.1.4  | Forest-tree nurseries                    |
| 3.2.2                          | Moors and heathland             | 3.2.2.1  | Afforestation areas                      |
|                                |                                 | 3.2.2.2  | Deforestation areas                      |
|                                |                                 | 3.2.2.3  | Degraded forest                          |
|                                |                                 | 3.2.2.4  | Beaches                                  |
| 3.2.3                          | Sclerophyllous vegetation       | 3.2.3.1  | Beaches                                  |
|                                |                                 | 3.2.3.2  | Dunes                                    |
|                                |                                 | 3.2.3.3  | River shoals                             |
|                                |                                 | 3.2.3.4  | Sands outside the sea coastal zone       |
| 3.2.4                          | Transitional woodland shrub     | 3.2.4.1  | Rocks                                    |
|                                |                                 | 3.2.4.2  | Rock debris                              |
| 3.3.1                          | Beaches, dunes, and sand plains | 3.3.1.1  | Sparsely vegetated areas on sandy ground |
|                                |                                 | 3.3.1.2  | Sparsely vegetated areas on rock debris  |
| 3.3.2                          | Bare rock                       | 3.3.2.1  | Burnt areas                              |
|                                |                                 | 3.3.2.2  | Glaciers                                 |
| 3.3.3                          | Sparsely vegetated areas        | 3.3.3.1  | Glaciers                                 |
|                                |                                 | 3.3.3.2  | Glaciers                                 |
| 3.3.4                          | Burnt areas                     | 3.3.4.1  | Perpetual snow covers                    |
|                                |                                 | 3.3.4.2  | Perpetual snow covers                    |
| 3.3.5                          | Glaciers and perpetual snow     | 3.3.5.1  | Perpetual snow covers                    |
|                                |                                 | 3.3.5.2  | Perpetual snow covers                    |

| WETLANDS     |                  |         |                                 |
|--------------|------------------|---------|---------------------------------|
| CODE         | LEVEL 3          | CODE    | LEVEL 4                         |
| 4.1.1        | Inland marshes   | 4.1.1.1 | Marshes                         |
|              |                  | 4.1.1.2 | Periodical marshy grounds       |
|              |                  | 4.1.1.3 | High bogs                       |
| 4.1.2        | Peatbogs         | 4.1.2.1 | Lowland bogs                    |
|              |                  | 4.1.2.2 | Transition bogs                 |
|              |                  | 4.1.2.3 | Salt marshes with vegetation    |
| 4.2.1        | Salt marshes     | 4.2.1.1 | Salt marshes without vegetation |
|              |                  | 4.2.1.2 | Unexploited salines             |
| 4.2.2        | Salines          | 4.2.2.1 | Exploited salines               |
|              |                  | 4.2.2.2 | Unexploited salines             |
| 4.2.3        | Intertidal flats | 4.2.3.1 | Intertidal flats                |
|              |                  | 4.2.3.2 | Intertidal flats                |
| WATER BODIES |                  |         |                                 |
| 5.1.1        | Water courses    | 5.1.1.1 | Rivers                          |
|              |                  | 5.1.1.2 | Streams                         |
|              |                  | 5.1.1.3 | Creeks                          |
| 5.1.2        | Water bodies     | 5.1.2.1 | Canals                          |
|              |                  | 5.1.2.2 | Natural water bodies            |
|              |                  | 5.1.2.3 | Artificial water bodies         |
| 5.2.1        | Coastal lagoons  | 5.2.1.1 | Lagoon lakes                    |
|              |                  | 5.2.1.2 | Sandbar lakes                   |
| 5.2.2        | Estuaries        | 5.2.2.1 | Open estuaries                  |
|              |                  | 5.2.2.2 | Bar-built estuaries             |
| 5.2.3        | Sea and ocean    | 5.2.3.1 | Open seas                       |
|              |                  | 5.2.3.2 | Inland seas                     |
|              |                  | 5.2.3.3 | Oceans                          |

The result of the undertaken analytical work is detailed classification of land cover and land use covering 123 different issues. Developed expanded classification would take into account local environmental conditions of representative catchments of the IEM.

As a result of the classification process the number of distinguished issues increase in the class of artificial surfaces from 11 on the third level to 36 on the fourth level, in the class of agricultural areas from 11 to 29, in the class of forests and semi-natural areas from 12 to 35, in the class of wetlands from 5 to 10, and in the class of water bodies from 5 to 13.