Regional Biodiversity Observation and Monitoring Network

CASRE's contribution

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2nd GMES Workshop
1 – 2 April 2009, Kiev, UKRAINE
Outline

- Background
- Purpose
- Previous work
- Tasks & Solutions
- Prospective Results
- References
Biodiversity - the variability within and among living organisms and the systems they inhabit. Biodiversity provides goods and services that underpin sustainable development in many important ways:

- supports the ecosystem functions essential for life on Earth;
- provides products such as food, medicines and materials for industry.

Finally, biodiversity is at the heart of many cultural values.

One of the targets is to assess and monitor biodiversity, its state and trends

Monitor, through sampling and other techniques, the components of biological diversity

(Convention on Biological Diversity: Article 7. Identification and Monitoring)

Implement national and regional programmes to assess and monitor the status and trends of biodiversity within protected area systems and sites

(Convention of the Parties 7: Decision VII/28, Article 8)

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Understanding, monitoring and conserving biodiversity

**Task BI-07-01: Biodiversity Observation Network**

Facilitate the establishment of monitoring systems that enable frequent, repeated, globally coordinated assessment of trends and distributions of species and ecosystems of special conservation merit.

**European Biodiversity Observation Network**

Development of a cost effective system of biodiversity data collection at regional, national and European levels.

**Working improvements:**

- Improvement through higher spatial resolution
- Improvement through better integration of Satellite EO and in-situ
- Improvement though higher temporal resolution
- Improvement through better and improved models (models informed by observations)
Purpose

To develop the methodological support for regional biodiversity observation and monitoring network, that provides timely and relevant information required for management of ecosystems of special conservation merit.
Biodiversity Assessment and Mapping Technique using Multispectral Space Images

Ecosystem Approach & Model

Environmental conditions
- Warm
- Moisture
- Sunlight
- Relief

Biota
- Vegetation cover
- Land cover types

Species composition
- Species composition (animals)

Species
- Species composition analysis
- Species richness estimation

Multispectral Remote Sensing Data
- Soil temperature
- Moisture index
- Solar irradiation
- Height above sea level
- Vegetation indexes
- Leaf area index
- Land cover classes

Specialized Processing

Estimation of impact

Potential biodiversity assessment

$B = \mu_0 B_0$

$N_0$ – number of species in certain area;
$\mu(F)$ – membership function for all range of possible values.

(Stankevich S.A., Kozlova A.O., 2007)
Results

Biodiversity Assessment and Mapping Technique using Multispectral Space Images of...

Low Spatial Resolution

<table>
<thead>
<tr>
<th>EOS/MODIS Data Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOD12Q1 – Land Cover Type</td>
</tr>
<tr>
<td>MOD03A2 – Geolocation Data Set</td>
</tr>
<tr>
<td>MOD05L2 – Total Precipitable Water</td>
</tr>
<tr>
<td>MOD11A1 – Surface Temperature</td>
</tr>
<tr>
<td>AMSR_E_L3 – Surface Soil Moisture</td>
</tr>
<tr>
<td>MOD13Q1 – Vegetation Indices</td>
</tr>
<tr>
<td>MOD15A2 – Leaf Area Indices</td>
</tr>
<tr>
<td>MOD17A3 – Primary Productivity</td>
</tr>
</tbody>
</table>

Medium Spatial Resolution

Environmental Variables

- Surface Solar Irradiation
- Land Surface Temperature
- Soil Moisture
- Vegetation Indices
- Digital Terrain Elevations Data

Land Cover

26 land cover classes adjusted from 5 ones of IGBP Classification

Species

343 – Plants, 44 – Mammals, 33 - Birds

- Previous work -
Web Service for Biodiversity Estimation using Remote Sensing Data


http://biodiversity.ikd.kiev.ua
Ukrainian Test Areas for Remote Sensing Validation

Proposed Version

Methodological support for:
- Requirements development
- Certification
- Harmonization

(lyalko v.i., popov m.a., 2008)

- Previous work -

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Tasks

1. Estimation and mapping of selected species diversity using Earth observation data

2. Ecosystems assessment and mapping on the base of satellite and in-situ data on the Shatsk test area

3. Biotopes and ecotones recognition and mapping technique using high/medium resolution multispectral satellite imagery
Estimation and Mapping of Selected Species Diversity using Earth Observation Data

Model for selected species diversity estimation

\[ B = - \sum_{i=1}^{N} P_i \log_2 P_i \]

\[ p_i \sim \mu_i, \sum_{i=1}^{N} p_i = 1 \]

\[ \mu_i = \mu_i^{(1)} \ast \mu_i^{(2)} \]

\( N \) – a set of diagnostic species; \( P_i \) – a quantitative part of an \( i \)-species in a given biotope; \( \mu_i \) – total membership function of an \( i \)-species; \( \mu_i^{(1)} \) – an \( i \)-species membership function considered external drivers influence; \( \mu_i^{(2)} \) – an \( i \)-species membership function considered mutual influences between species

Demo map illustrated the selected species diversity distribution within the Crimea

Drivers – EOS/MODIS Data Products:
- MOD12Q1, MOD03A2, MOD05L2
- MOD11A1, AMSR-E_L3, MOD13Q1
- MOD15A2, MOD17A3

Species – 14 diagnostic plants
Ecosystems Assessment and Mapping on the base of Satellite and *In-situ* Data on the Shatsk Test Area

**Steps**

1. Ecosystem classification for the Shatsk test area
   that is coordinated with the main Ecosystem and Land Cover classification systems and adapted to using multispectral satellite imagery of medium spatial resolution
   (a) Ground truth data collection within test sites
   (b) Certification of test sites and ecosystems test elements
   (c) Integration of satellite and in-situ data

2. Set of ecological maps for Shatsk National Nature Park

3. Ecosystems assessment within Shatsk National Nature Park
Biotopes and Ecotones Recognition and Mapping Technique Using High/Medium Resolution Multispectral Satellite Imagery

Why are ecotones important?

1. Represent the boarders between different communities;
2. Indicate changes;
3. Can be areas of high biodiversity (and also low biodiversity)


Steps

1. Biotopes recognition;
2. Biotopes classification;
3. Transition zones modeling on the basis of fuzzy sets;
4. Ecotones recognition.

Ecotones and fuzzy sets

Prospective test site in the Rivne Nature Park

- Solutions - 1 – 2 April 2009, Kiev, UKRAINE
Prospective Results

Methodological Support

1. Improved model that provides estimation of selected species diversity taking into account relative abundance of the species and influence of ecological factors on them. Algorithm for the estimation using Earth observation data.

2. Regional ecosystem classification validated on the Shatsk test site and coordinated with the main global and regional ecosystem and land cover classifications. Algorithms for satellite and in-situ data integration.

3. Model that provides recognition of transition zones between biotopes formalizing expert estimations towards the pattern of this zones. Algorithm for ecotone recognition using high/medium resolution multispectral satellite imagery

Observation Products

- Maps
- Status indicators
- Change metrics
- Trends

Profits

✔ providing timely and relevant information about the ecosystems of special conservation merit;

✔ improving long-term monitoring, management and conservation of ecosystems within protected areas

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References


