Progress Report

National Institute of Geophysics
Geodesy and Geography
Bulgarian Academy of Sciences
(NIGGGG – BAS)

May 2013 – June 2014
Content

1. Recruitment of personnel
2. Research visits and events
3. Dissemination
4. Synergies to other groups/projects
5. Future plans
6. Scientific achievements
Recruitment of personnel

PhD Thesis:
Web-based GIS applications supporting the integrated water management

Main Research Topics:
Climate change & water demand, Water governance issues, Integrative hydrological modeling under climate change, GIS

Project responsibilities
WP1 – Hydrologic modeling, Climate change models, water availability
WP3 – WFD
WP4 – Geospatial database
Recruitment of perconel

PhD Thesis:
Landscape and ecosystem services in the Danube plain between rivers Timok and Iskar

Main Research Topics:
Ecosystem services supply and demand, Public participation, GIS

Project responsibilities
WP1 – Water related ecosystem services
WP2 – Public participation in water management
Tucson Basin case study – Expert based ES assessment
Recruitment of perconel

Sofia Kostadinova
Ms Student
Sofia University
Internship in
Department of Geography
NIGGG-BAS

Ms Thesis:
Spatial analysis of ecosystem services in Strumeshnitsa watershed

Main Research Topics:
Ecosystem services supply and demand, ES relation to WFD, GIS based tools for landscape assessment

Project responsibilities
WP1 – Water related ecosystem services,
WP4 – Land Cover classification, web mapping
TAMA case study – Ecosystem services assessment
Research visits and events

Kremena Boyanova | Research visit January-May 2013

Study
- Development of trans-disciplinary approach addressing water management challenges and it’s application in post normal science.
- Comparative analysis of the flood regulating ecosystem services in Bulgaria and Arizona by applying the VIC and KINEROS hydrological models.

Participation
- Weekly SWAN meetings

Classes at UA:
- Geographic Applications of Remote Sensing - Prof. Stuart Marsh
- Spatial Analysis and Modeling – Prof. Phillip Guertin
Research visits and events

Tanya Trenkova Research visit September-December 2013

Study: Web GIS: Principals & applications

- Start working on TAMA case study
- Join Wednesday meetings

Participation in: 3rd Progress Meeting of SWAN “New Scenarios for Water Management. Increasing Cooperation Between the Natural and Social Sciences” in October

- Attended the course: Systems Approach To Hydrologic Modeling of Prof. Hoshin Gupta
- Attended to Seminars & Symposiums:
  - Hydrology & Water Resources Seminars;
  - Research Insights in Semiarid Ecosystems (RISE) Symposium;
  - Mobile Matters Symposium: Innovation in action etc.
Research visits and events

ROSITS'A YANEVA | Research visit February-May 2014

Study - Expert based assessment of the provision of ecosystem services conducted through interviews

Step 1 - Online survey “IMPORTANCE OF ECOSYSTEM SERVICES IN TUCSON ACTIVE MANAGEMENT AREA”
Target groups: stakeholders from the UofA (Academia), SWAN members, UofA students
Assessment matrix – Capacity, Supply & Demand

Participation in “Water Resources & Policy Group”, Udall center, University of Arizona. The collaboration of the students from this group significantly contributed to the survey results.
Research visits and events

Regular NIGGG-BAS SWAN team meetings
2013 – 5 meetings, 5 students
  presentations 3 of them
  have already joined
  the project
2014 – 2 meetings, 2 students
  presentations

“Payment for Ecosystem Service” workshop in Bristol,
September 13, 2013,
Chad Staddon, Lorraine de Souza - UWE
Stoyan Nedkov, Kremena Boyanowa - NIGGG
Chris Short, Mark Everard, Bendjamin Burkhard
Guest Researchers
Dissemination

Publications


Dissemination

Work papers


Deliverable 3.1: Key data and information requirements in the context of current debates on water management. Authors: María Fernanda Pita, Belén Pedregal, Nuria Hernández-Mora, Natalia Limones y Leandro del Moral (US). Substantial contribution: Stoyan Nedkov, Tanya Trenkova and Kremena Boyanova (BAS-NIGGG)

Dissemination

Conference presentations and posters


IALE European Congress “Changing European Landscapes” September 2013. Presentations by Stoyan Nedkov and Kremena Boyanova


Workshop: Integrated Drought Management in Central & Eastern Europe (Sofia, Bulgaria; 3 April 2014) – T. Trenkova

Some information for the SWAN project was included in a report of Ministry of Environment Affairs Bulgaria for national stakeholders.
Synergies to other groups/projects

Institute for Natural Resource Conservation, University of Kiel, Germany.
Common research and collaboration with Dr. Benjamin Burkhard, Research stay of Kremena Boyanova in 2012, Seminar by Benjamin Burkhard at UA, in 2013

Global Water Partnership – Bulgaria – workshops on sustainable water use, Integrated Drought Management etc. Participation in Stakeholders committee

OHMI project (leading partner – CNRS through UMI at UofA)
Future plans

Rositsa’s study - Expert based assessment of the provision of ecosystem services conducted through interviews
Step 2 of the investigation “SUPPLY AND DEMAND OF ECOSYSTEM SERVICES IN TUCSON BASIN”
Mapping ecosystem goods and services
To be accomplished by the end of 2014

Research Visit of Kremena Boyanova September – November 2014
Preparations already started

Study - Work on the quantification and mapping of the water-related ES in Tucson basin. Integration of the results in post-normal science concept. Collaboration with social scientists

Research Visits of Tanya Trenkova and Sofia Kostadinova planned for January – May 2015
Scientific achievements

- Development of trans-disciplinary approach addressing water management challenges and its application in post-normal science (1)
- Comparative analysis of the flood regulating ecosystem services in Bulgaria and Arizona by applying the VIC and KINEROS hydrological models (2)
- Development of approach for integrating Water footprint concept and SWAT hydrological model for quantification of ecosystem services water provision and water purification (applied only for Bulgaria)
Scientific achievements

Expert based assessment of the provision of ecosystem services conducted through interviews

Step 1 - Online survey “IMPORTANCE OF ECOSYSTEM SERVICES IN TUCSON ACTIVE MANAGEMENT AREA”

Target groups: stakeholders from the UofA (Academia), SWAN members, UofA students

Assessment matrix – Capacity, Supply & Demand

Which are the most relevant ecosystem services in the TAMA case study in scale from 0 to 5?

- 0 = no relevance
- 1 = low relevance
- 2 = relevance
- 3 = medium relevance
- 4 = high relevance
- 5 = very high relevance
**Scientific achievements**

**Climate Change Vulnerability Assessment**

\[
\text{Risk} = \frac{\text{Hazard} \times \text{Exposure}}{\text{Vulnerability}}
\]

- **Hazard**
  - Climate change
- **Exposure**
  - Sensitivity
- **Vulnerability**
  - Adaptive capacity

**Vulnerability** in the context of the impact of climate change is measured by the ratio between the sensitivity and adaptive capacity of the exposed systems.

**Vulnerability Index (VI):**

\[
\text{VI} = \frac{S}{Ac}
\]

Where:
- **S** – Sensitivity
  \[
  S = \frac{\sum (S_n \text{ max scores})}{\sum (S_n \text{ scores})} / n
  \]
- **n** – number of climate change indicators

**Ac** – Adaptive capacity

1. Insufficient adaptive capacity - no action is taken to address the risk of climate change;
2. Sufficient adaptive capacity - partly implemented directives, strategies and programs for adaptation and mitigation of climate change;
3. High adaptive capacity - executed directives, strategies and programs for adaptation and mitigation of climate change.

<table>
<thead>
<tr>
<th>Vulnerability Index Value</th>
<th>Vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.80 – 1.00</td>
<td>Extremely vulnerable</td>
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<tr>
<td>0.50 – 0.79</td>
<td>Very vulnerable</td>
</tr>
<tr>
<td>0.20 – 0.49</td>
<td>Moderately vulnerable</td>
</tr>
<tr>
<td>0.01 – 0.19</td>
<td>Vulnerable</td>
</tr>
</tbody>
</table>
## Scientific achievements

### Climate change impact and sensitivity assessment (2081-2100)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>IPCC AR5</th>
<th>RCP (2081-2100)</th>
<th>Expected impact: positive (+); neutral (0) or negative (-)</th>
<th>Sensitivity: Low -1  Moderate – 2  High - 3</th>
<th>Ac: 1-Low 2-Medium 3-High</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>RCP Scenario</td>
<td>∆T°C</td>
<td>∆P%</td>
<td>Ex</td>
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<td>Water Temperature</td>
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## IPCC AR5 ICP’s Scenarios

<table>
<thead>
<tr>
<th>RCP</th>
<th>Radiation pressure</th>
<th>CO₂ eq. (ppm)</th>
<th>Median of temperature anomaly (°C)</th>
<th>Trend</th>
<th>Equivalent to the SRES scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCP 8.5</td>
<td>8.5 W/m² in 2100 r.</td>
<td>1370</td>
<td>4.9</td>
<td>Increase</td>
<td>SRES A1F1</td>
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<tr>
<td>RCP 6.0</td>
<td>6 W/m² in 2100 r.</td>
<td>850</td>
<td>3.0</td>
<td>Stable</td>
<td>SRES B2</td>
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<tr>
<td>RCP 4.5</td>
<td>4.5 W/m² after 2100 r.</td>
<td>650</td>
<td>2.4</td>
<td>Stable</td>
<td>SRES B1</td>
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<tr>
<td>RCP 2.6</td>
<td>3 W/m² before 2100 r., to 2.6 W/m² in 2100 r.</td>
<td>490</td>
<td>1.5</td>
<td>Increase</td>
<td>No equivalent</td>
</tr>
</tbody>
</table>

Source: Assessment of risk..., MOEW, 2014
Data

KNMI Climate Change Atlas  http://Climate Change Atlas.htm

http://Climate Change Atlas.htm
Climate change projections IPCC AR5

Temperature

mean rcp45to85 temperature 2014-2100 minus 1961-1990 Jan-Dec full CMIP5 ensemble

[Celsius]
Climate change projections IPCC AR5 Temperature (CCA, 2013)
Climate change projections IPCC AR5

Precipitations

mean rcp45to85 relative precipitation 2014-2050 minus 1960-1990 Dec-Jan full CMIP5 ensemble
Climate change projections IPCC AR5

Precipitations

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<td>RCP 2.6</td>
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<td>1.5-2.0</td>
<td>0.0-10↓</td>
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<tr>
<td>RCP 4.5</td>
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<td>2.0-3.0</td>
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## Results

### Climate change vulnerability assessment

**Vulnerability Index**  \( VI = \frac{S}{Ak} \)

**S** - Sensitivity  \( S = \sum (\frac{\sum S_{n \text{ max scores}}}{\sum S_{n \text{ scores}}}) / n \)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Sum</th>
<th>( \Delta T^\circ C )</th>
<th>( \Delta P% )</th>
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<th>n</th>
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<td>S sc.</td>
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<td>0.65 – Very vulnerable</td>
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<td>0.66</td>
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<td>0.79 - Very vulnerable</td>
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Thank you for your attention!