Abstracts
of publications

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Group №	Publications and abstracts
B4_1	**Nedkov, S**. 2011. Landscape Structure and Ecosystem Services of Etropole Municipality. In: Zhelezov, G. (Ed.) *Sustainable development in mountain region: South Eastern Europe, Springer, 85-94.* ISBN: 978-94-007-0130-4 Abstract: The paper represents an approach to investigate the landscape structure on municipality level and the possibilities of using it for the valuation of the ecosystem services. Landscape differentiation of the area was investigates using GIS based model. The most important ecosystem services of the Etropole municipality are provided by the forest landscapes. Only 27% of their total value belongs to the provisioning service, which is the most used at present. The importance of their regulation services, especially the regulation of the flood risk will increase in the future because of the climate change. The valuation of ecosystem services is considered as an important and useful activity for the achievement of sustainable development. It gives the opportunity to involve some resources and services, which are usually ignored in the process of regional planning. Further progress of the valuation and assessment methods will improve its preciseness and reliability.
B4_2	**Nedkov, S.** and B. Burkhard 2012. Flood regulating ecosystem services - Mapping supply and demand, in the Etropole municipality, Bulgaria. Ecological Indicators 21: 67-79. Abstract: Floods exert significant pressure on human societies. Assessments of an ecosystem's capacity to regulate and to prevent floods relative to human demands for flood regulating ecosystem services can provide important information for environmental management. In this study, the capacities of different ecosystems to regulate floods were assessed through investigations of water retention functions of the vegetation and soil cover. The use of the catchment based hydrologic model KINEROS and the GIS AGWA tool provided data about peak rivers' flows and the capability of different land cover types to "capture" and regulate some parts of the water. Based on spatial land cover units originating from CORINE and further data sets, these regulating ecosystem services were quantified and mapped. Resulting maps show the ecosystems' flood regulating service capacities in the case study area of the Malki Iskar river basin above the town of Etropole in the northern part of Bulgaria. There, the number of severe flood events causing significant damages in the settlements and infrastructure has been increasing during the last few years. Maps of demands for flood regulating ecosystem services in the study region were compiled based on a digital elevation model, land use information and accessibility data. Finally, the flood regulating ecosystem service supply and demand data were merged in order to produce a map showing regional supply-demand balances. The resulting map of flood regulation supply capacities shows that the Etropole municipality's area has relatively high capacities for flood regulation. Areas of high and very high relevant capacities cover about 34% of the study area. The flood regulation ecosystem service demand map shows that areas of low or no relevant demands far exceed the areas of high and very high demands, which comprise only 0.6% of the municipality's area. According to the flood regulation supply-demand balance map, areas of high relevant demands are located in places of low relevant supply capacities. The results show that the combination of data from different sources with hydrological modeling provides a suitable data base for the assessment of complex function–service–benefit relations.

B4_3	Burkhard, B., Kroll, F., **Nedkov, S**. and F. Müller 2012. Mapping supply, demand and budgets of ecosystem services. Ecological Indicators 21: 17-29. Abstract: Among the main effects of human activities on the environment are land use and resulting land cover changes. Such changes impact the capacity of ecosystems to provide goods and services to the human society. This supply of multiple goods and services by nature to humans should match the demands of society, if self-sustaining human-environmental systems and a sustainable utilization of natural capital are to be achieved. To describe respective states and dynamics, appropriate indicators and data for their quantification, including quantitative and qualitative assessments, are needed. By linking land cover information from e. g. remote sensing, land survey and GIS with data from monitoring, statistics, modeling or interviews, ecosystem services' supply and demand can be assessed and transferred to different spatial and temporal scales. The results reveal patterns of human activities over time and space as well as the capacities of different ecosystems to provide ecosystem services under changing use and locations of respective demands for these services. As maps are a powerful tool, they hold high potential for visualization of complex phenomena. We present a clear and easy to apply concept based on a matrix linking spatially explicit biophysical landscape units to ecological integrity and ecosystem service supply and demand. An exemplary application for energy supply and demand in a central German case study region and respective maps for the years 1990 and 2007 are shown. Based on these data, the concept for appropriate quantification and related spatial visualization of ecosystem services' supply and demand is elaborated and discussed more in detail.
B4_4	Kuhlemann, J., Gachev, E., Gikov, A., **Nedkov, S**., Krumrei, I., Kubik, P., 2013. Glaciation in the Rila Mountains (Bulgaria) during the last Glacial maximum, Quaternary International, 293, 51-62. Abstract: Relict glacial landform complexes have been studied in the mountains of the central Balkan Peninsula since the end of the 19th century. Since their existence was proved for the first time by Cvijic, various authors have debated the number of glacial phases, as well as their age. At present, the problem of age determination is being solved by the application of the new methods for numerical dating. This paper is a detailed study of the maximum glaciation in the Rila massif, which is the highest mountain in Bulgaria and in the whole Balkan Peninsula. The application of cosmogenic nuclide dating (10Be) on moraine samples confirmed that the largest extent of former glaciers that left moraine deposits was around the time of the Last Glacial Maximum. Most probably the maximum extent occurred in two phases, the first around the beginning, and the second around the end of the LGM (24e23 ka BP and 18e16 ka BP respectively), separated by a retreat phase during the coldest (but also driest) phase of the glacial stage. The GIS-processed calculations on the basis of field evidence of the former glacier extent, and the preliminary calculations of the Equilibrium line altitude (ELA) through the accumulation-ablation ratio (AAR) method, show that the ELA during the LGM had quite small differences throughout the Rila massif (from about 2150 to 2200 m a. s. l. in the NW to about 2250e2290 m in the SE), despite the considerable differences in terminal moraine depositional altitudes (from 1150 to 2000 m a. s. l.). This is due to both the complicated pattern in the directions of moisture supply and to the influences of local topography.
B4_5	Crossman, N. D., Burkhard, B. and **Nedkov, S**. 2012. Quantifying and mapping ecosystem services. International Journal of Biodiversity Science, Ecosystem Services & Management, vol. 8, issue 1-2, 1-4. Abstract: Since the publication of the Millennium Ecosystem Assessment's outcomes in 2005, there has been rapid growth in the science and policy of valuing ecosystem services and biodiversity for resource management decision-making. Most prominent at the global

	scale is The Economics of Ecosystems and Biodiversity, and at the national scale is the United Kingdom National Ecosystem Assessment. New initiatives, such as the World Bank's Global Partnership for Wealth Accounting and Valuation of Ecosystem Services (WAVES) and the GEF-funded Project for Ecosystem Services aim to get ecosystem service values into mainstream national accounting. The collection of papers we offer here provides examples of the many different ways ecosystem services can be quantified and mapped. The inconsistency in methods to quantify and map services is a challenge for developing robust values of ecosystem services for inclusion in national accounts and broader policy and natural resource management decision-making. The varied methods also make the commodification and trade of ecosystem service values very difficult because markets require certainty and clarity around the good being traded. We therefore argue that there needs to be a standard process for quantifying and mapping ecosystem services for robust decision-making, potential trade on markets and landscape planning. The Ecosystem Services Partnership as an international network organization is supporting these activities and a respective working group on modelling and mapping ecosystem services has just been established.
B4_6	Crossman, N.D., Burkhard, B., **Nedkov, S**., Willemen, L., Petz, K., Palomo, I., Drakou, E.G., Martín-Lopez, B., McPhearson, T., Boyanova, K. Alkemade, R., Egoh, B., Dunbar, M. and Maes, J. 2013. A blueprint for mapping and modelling ecosystem services. Ecosystem Services 4, 4-14. Abstract: The inconsistency in methods to quantify and map ecosystem services challenges the development of robust values of ecosystem services in national accounts and broader policy and natural resource management decision-making. In this paper we develop and test a blueprint to give guidance on modelling and mapping ecosystem services. The primary purpose of this blueprint is to provide a template and checklist of information needed for those beginning an ecosystem service modelling and mapping study. A secondary purpose is to provide, over time, a database of completed blueprints that becomes a valuable information resource of methods and information used in previous modelling and mapping studies. We base our blueprint on a literature review, expert opinions (as part of a related workshop organized during the 5th ESP conference) and critical assessment of existing techniques used to model and map ecosystem services. While any study that models and maps ecosystem services will have its unique characteristics and will be largely driven by data and model availability, a tool such as the blueprint presented here will reduce the uncertainty associated with quantifying ecosystem services and thereby help to close the gap between theory and practice.
B4_7	Burkhard, B., Crossman, N., **Nedkov, S**., Petz, K., Alkemade R. 2013. Mapping and modeling ecosystem services for science, policy and practice. Ecosystem Services, Ecosystem Services 4, 1-3. Abstract: Ecosystem services have become currently a significant research topic and numerous there are many modelling and mapping approaches have been developed and applied across the world . These approaches aimed at understanding, modelling and mapping the stocks, demands and flows of ecosystem services on different spatial and temporal scales. The integration of geo-biophysical processes and structure assessments provides insights into actual ecosystem service supply and its ecological and biodiversity base (ecosystem functions). Information and data on ecosystem service beneficiaries (demand), their actual rates of consumption and how these components are interconnected (flows and trade-offs) can be analysed, integrated and represented by available tools such as thematic mapping, GIS, remote sensing, multi-criteria analysis, and (dynamic) geo-biophysical and decision process models. The high quality and originality of the contributions in this Special Issue demonstrate that the development of ecosystem service modelling and mapping approaches and tools has made big steps forward toward practical application in science, policy and practice. The next steps for the ESP Thematic Working Groups on Mapping and Modelling Ecosystem Services are the further development of ecosystem service mapping and modelling approaches as well documentation and visualisation tools based on the blueprint, including a database of completed blueprints as a valuable information resource of methods and information used in previous modelling and mapping studies. Finally, the development of respective assessment standards will be

	carried out based on the knowledge, information and data gathered to date. This includes, however, a lot of work or - to put it more positively - a lot of challenges (perhaps a more gentle word for problems).
B4_8	Alkemade, R.; Burkhard, B.; Crossman, N.; **Nedkov,** S. & Petz, K. 2014. Quantifying ecosystem services and indicators for science, policy and practice. Special Issue. Ecological Indicators 37, 161-266 Abstract: Ecosystem services (ES) are a significant research topic and numerous modelling and quantification approaches have been developed and applied across the world. In addition, the 'enhancement of the benefits to all of biodiversity and ecosystem services' is one of the strategic goals of the Convention on Biological Diversity. Modeling and quantification approaches aiming at understanding and describing stocks, demands and flows of ecosystem services on different spatial and temporal scales provides insights into actual ecosystem service supply and its ecological and biodiversity base (ecosystem functions). These elements, in combination with information and data on ecosystem service beneficiaries (demand), their actual rates of consumption and how these components are interconnected (flows and trade-offs), form the basis of full ecosystem service analyses. Many papers were presented on the topic of indicators for ecosystem service assessment (including trade-off analyses, ES bundles, and decision making tools) during the recent follow-up conference, the 6th Ecosystem Services Partnership Conference 'Making Ecosystem Services Count" held at Bali, Indonesia in August 2013. The strong interest in the topic in Bali demonstrated the rapid growth in the subject matter, but also highlighted many areas of further investigation including a number of the questions raised by authors in this Special.
B4_9	**Nedkov, S**., Boyanova, K., Burkhard, B. 2015. Quantifying, modelling and mapping ecosystem services in watersheds. In: Chicharo, L., Muller, F., Fohrer, N., (Eds.) Ecosystem Services and River Basin Ecohydrology. Springer. 133-149. ISBN: 978-94-017-9845-7 Quantifying, modelling and mapping ecosystem services is an important step to the application of ecosystem services in practice and decision making. Watersheds are functional entities that provide an appropriate spatial scale for water flow analysis and integrate all the processes that occur within their boundaries. Multiple ecosystem functions occur within watersheds, providing water-related ecosystem services such as freshwater provision, groundwater recharge, water purification and flood regulation. A matrix approach was applied, linking different land cover types within watersheds to different ecosystem functions and services. Supply capacities of different land cover types and respective changes over time were assessed. By applying the watershed-based hydrologic model KINEROS and the GIS based AGWA tool, water retention functions of different land cover classes in the Bulgarian case study areas Malki Iskar, Vidima and Yantra were assessed. Based on the modelling results, flood regulating ecosystem service supply capacities were quantified and mapped in the three watersheds. A digital elevation model, land cover information and accessibility data were used to compile maps of demands for flood regulating ecosystem services. Supply-demand budgets were calculated and mapped for the study areas using the flood regulation supply and demand maps. The results quantify and illustrate complex ecosystem function–service–benefit relations in watersheds. Comparable procedures and calculation algorithms can be applied for other ecosystem functions and services relevant on the watershed scale. The approach is transferable to other regions and can provide important information for integrated watershed management.
B4_10	Boyanova, K., Niraula, R., Dominguez, F., Gupta H., **Nedkov, S**. 2016. Quantification of ecosystem services in the Upper Santa Cruz Watershed, Arizona. In: F Poupeau et al. (Eds.) Water Bankruptcy in the Land of Plenty. CRC Press/Balkema, Taylor & Francis Group, The Netherlands, 195-220. Abstract: The ongoing drought in the Southwestern United States places pressure on both scientists and practitioners to find new solutions to water-related issues. In the state of Arizona, this situation requires that the present state of the ecosystems and natural resources be re-evaluated to assess their capacity to sustain the future flow of ecosystem

	services to society. Ecosystem Services (ES) are the contributions of ecosystem structures and functions – in combination with other inputs – to human well-being. The methodology presented here provides new opportunities for the application of the SWAT hydrological model that unfold the potential for improved WRES analysis. The model simulations provide information that is not intuitive or measurable, and the interpretation of the results into ES provides enhanced possibilities for application into practice and management. The resulting tables, maps and diagrams can serve as tools to improve the dialogue with decision-makers and to bridge between specialized hydrological knowledge and a diverse group of stakeholders. Our methods and results are complimentary to ongoing research initiatives in the area, including the Targeted Watersheds Grant Program: Santa Cruz River, AZ and Mexico (EPA), Santa Cruz River Initiative (Sonoran Institute), the Santa Cruz Watershed Ecosystem Portfolio Model (SCWEPM) (USGS), and can contribute to the efforts to 'close the water demand-supply gap in Arizona'.
B4_11	Boyanova, K., **Nedkov, S.,** Burkhard, B. 2016. Applications of GIS-Based Hydrological Models in Mountain Areas in Bulgaria for Ecosystem Services Assessment: Issues and Advantages. In: Koulov, B., Zhelezov, G. (Eds.) Sustainable Mountain Regions: Challenges and Perspectives in Southeastern Europe, Springer, 35-51. ISBN 978-3-319-27903-9 Abstract: The application of hydrological models for the assessment of ecosystem services provides multiple opportunities for their quantitative analysis. Furthermore, GIS based models provide the possibility for spatially explicit analyses of the output variables and representation of results through maps. Broadly applied and freely available hydrological model is the Soil & Water Assessment Tool (SWAT). The tool for its application in ArcGIS is ArcSWAT. The application of the model in mountain areas in Bulgaria can provide better understanding on the supply of ecosystem services and especially the water-related ones, considering the big landscape diversity and weather differences within mountain watersheds. Still, data characteristics and limitations in Bulgaria can be restrictive for the quality of the model outputs. The ArcSWAT is created and actively supported by the USDA Agricultural Research Service at the Grassland and Soil and Water Research Laboratory in Temple, Texas, USA. Due to that, the soil and land cover typologies and their respective lookup tables that are built in the model database are based on freely available USA datasets. The weather data database integrated in the model is from stations throughout United States and doesn't cover other countries. This makes the application of the model out of United States more complicated. For Bulgaria, the most detailed soil and land cover datasets are using Bulgarian typologies, which have rarely been correlated to European or global ones and no correlation with USA typologies have been found in the literature. Additionally, information on the plants within the different natural and semi-natural land cover classes is not freely available. The access to daily weather data is also limited, especially for solar radiation, relative humidity and wind speed, which are harder to collect than temperature and precipitation. In this study we show how the application of SWAT hydrological model in mountain watersheds in Bulgaria is possible, even having the existent data limitations. The test watershed used for that purpose is the Upper Ogosta watershed. The benefits of running the model for the understanding of the hydrological cycle and the supply of ecosystem services within the area are discussed, as well as the issues and restrictions due to data limitations.
B4_12	Zhiyanski, M., Gikov, A., **Nedkov, S**., Dimitrov, P., Naydenova, L. 2016. Mapping Carbon Storage Using Land Cover/Land Use Data in the Area of Beklemeto, Central Balkan. In: Koulov, B., Zhelezov, G. (Eds.) Sustainable Mountain Regions: Challenges and Perspectives in Southeastern Europe, Springer, 53-65. ISBN 978-3-319-27903-9 Abstract: The paper presents results of land cover and carbon storage mapping in a study area located in Central Balkan Mountains. WorldView-2 satellite images and ortophoto map were used to define the land cover in the area. CORINE land cover classification at 4th level was applied for the mapping. The carbon stock was determined using InVEST model and results were validated with in-situ data from eight experimental sites in different land uses classes.
B4_13	**Nedkov, S**., Zhiyanski, M., Dimitrov, S., Borisova, B., Popov, A., Ihtimanski, I., Yaneva, R., Nikolov, P., Bratanova-Doncheva, S. 2017. Mapping and assessment of urban ecosystem condition and services using integrated index of spatial structure. One Ecosystem 2: e14499.

	https://doi.org/10.3897/oneeco.2.e14499 Abstract: Urban ecosystems are the areas where built infrastructure covers a large proportion of the land surface in combination with green infrastructure. They have their own structure and function which provide certain range of ecosystem services, but the main source of their provision is the green infrastructure. This provision is very much dependent on the particular combination of green spaces such as parks or vegetation belts and paved areas such as buildings and streets. The spatial arrangement of these elements is an important parameter which could be used for the assessment of ecosystem condition in the urban areas. We propose integrated index of spatial structure which incorporates built types and land cover from Local Climate Zones (LCZ) concept types with urban ecosystems classes developed on the base of MAES typology. It is integrated in the national urban ecosystem assessment in Bulgaria as an indicator that represents the abiotic heterogeneity of the urban ecosystems. We developed an algorithm for index generation using urban ecosystems database and remote sensing data. The index is used to define vegetation cover in urban ecosystems and assess their condition as a part of the assessment framework. It is also applied in the assessment of several ecosystem services through quantification of ecosystem services indicators or as an indicator in a complex assessment. The condition of urban ecosystems measured by the integrated index of spatial structure represents a complex assessment of ecosystem's characteristics related to the spatial arrangements of built and land cover types in combination with particular ecosystem subtype. The results show that most urban ecosystems in Bulgaria are assessed by moderate and good condition, very few of them have very good condition and about 3.5% have very bad condition. The highest scores are defined for urban green areas (J5) while the lowest are for transport networks (J7). The use of integrated index in urban ecosystem services assessment is represented with examples for global and local climate regulation. The results are used to develop maps of ecosystem services supply capacity for selected cities. The overall analysis indicates that the urban ecosystems in Bulgaria have a moderate to good capacity for local climate regulation and moderate to low capacity for global climate regulation (measured by carbon storage capacity). The integrated index of spatial structure provides appropriate basis for characterization and assessment of urban ecosystems condition and ecosystem services following the requirements of EU Biodiversity strategy and MAES process. The proposed approach enables to define the internal heterogeneity of the urban ecosystems at national level which is one of the main challenges in studying urban ecological systems.
B4_14	Burkhard B, Santos-Martin F, **Nedkov S**, Maes J 2018. An operational framework for integrated Mapping and Assessment of Ecosystems and their Services (MAES). One Ecosystem 3: e22831. Abstract: Mapping and Assessment of Ecosystems and their Services (MAES) are central to the EU Biodiversity Strategy to 2020. Action 5 of the Strategy's second target asks all EU member states to map and assess the state of ecosystems and their services in their national territories. Such comprehensive mapping and assessment builds on several individual tasks and their systematic integration. Therefore, an integrated and operational framework is needed, supporting and coordinating these activities. The presented framework builds on existing work done by the European Commission's MAES Working Group and provides a clear nine-step approach including the identification of relevant questions or themes to be addressed, identification and mapping of ecosystem types, ecosystem condition and ecosystem services, their integration and dissemination of results. This framework can be used to set-up related research and development initiatives and to guide involved scientists, decision-makers and practitioners through the different steps and related tasks of the process.
B4_15	**Nedkov, S**., Borisova, B., Koulov, B., Zhiyanski, M., Bratanova-Doncheva, S., Nikolova, M., Kroumova, J. 2018. Towards integrated mapping and assessment of ecosystems and their services in Bulgaria: The Central Balkan case study. One Ecosystem 3: e25428. https://doi.org/10.3897/oneeco.3.e25428 Abstract: The aim of the EU Biodiversity Strategy to 2020 is to maintain and enhance ecosystem services (ES) in Europe and requires all Member States to map and assess the state of ecosystems and their services in the respective national territories. The EU-funded project ESMERALDA analyses ES mapping and assessment methods and approaches in their biophysical, social and economical perspectives, as well as their application in different case studies. The project also aims at the development of an integrated and consistent assessment framework. In Bulgaria, methodological

	guides for evaluation and mapping of the services provided by the nine main types of ecosystems have been prepared together with the respective proposals for their implementation in the national assessment. The Bulgarian research team analyses and tests various aspects of ecosystem services mapping and assessment, such as alternative economic assessments, multi-criteria analyses and biophysical assessment approaches, mapping challenges and local population surveys. In this paper paper, we review the ES activities in Bulgaria and present selected mapping and assessment methods tested in the Central Balkan case study area. It provides relevant examples for the implementation of integrated mapping and assessment of ecosystem services at local and regional level, where different mapping approaches and techniques are embedded within diverse policy contexts. The main goal of the study is to investigate how the assessment results can support the integration of the ecological functions of the Central Balkan National Park with the economic opportunities that it creates for the local and regional communities. A tiered approach has been used to organize the mapping and assessment exercises in the study area, in order to meet the needs for integrated ecosystem assessment and overcome the limitations of data availability. At tier 1, the study performs identification and initial ES mapping of the whole area. At tier 2, it applies economic valuation for the Municipality of Karlovo by using statistical data and the contingent valuation method. At tier 3, the investigation applies modelling methods to assess carbon storage and flood regulation on a larger scale. The results are presented in the form of maps at all levels, which use a uniform 0 to 5 assessment scale. The integrated approach presented here ensures a clear communication of the end results to the respective decision-makers.
B4_16	Vihervaara, P., Viinikka, A., Brander, L., Santos-Martín, F., Poikolainen, L., **Nedkov, S.** 2019. Methodological interlinkages for mapping ecosystem services – from data to analysis and decision-support. One Ecosystem 4: e26368. https://doi.org/10.3897/oneeco.4.e26368 Abstract: A broad array of methods have been developed and applied to map ecosystem services and their values at various geographic scales. For example, the ESMERALDA project developed methods for ecosystem service mapping across Europe. This paper describes how different methodological interlinkages can be used in ecosystem service mapping and assessment and how the integration of information can be facilitated to assist in decision-making processes related to sustainable use and protection of ecosystem services. This paper is based on a literature review and expert consultations throughout the project. The accumulation of knowledge in ecosystem assessment processes will be described through multiple steps: 1) data compilation, 2) analyses run via independent or linked methods applications and tools, 3) integration of information from multiple analyses and 4) finally, feeding into the decision-support frameworks. The challenges and possibilities of using combinations of various datasets and methods will be discussed. This workflow is demonstrated with real-world applications. In addition, technical pitfalls and challenges, as well as linkages to overall ecosystem assessments and policy questions, are analyzed and discussed.
B4_17	**Nedkov, S**., Zhiyanski, M., Borosiva, B., Bratanova-Doncheva, S. 2018. Mapping and assessment of ecosystem condition and ecosystem services across different scales and domains in Europe. One Ecosystem, 3: e29288, Pensoft, 2018, ISSN:2367-8194, DOI:doi.org/10.3897/oneeco.3.e29288. Abstract: Mapping of ecosystems and their services is an important activity that can effectively contribute to understanding how ecosystems support human well-being and furthermore promote the sustainable use of natural resources. Action 5 of the EU Biodiversity strategy to 2020 calls for member states to map and assess their ecosystems and services they provide. As a follow up to the strategy, an initiative on Mapping and Assessment of Ecosystems and their Services (MAES) was launched and a working group of researchers, experts and stakeholders was established. During the last few years, several European countries conducted National Ecosystem Assessments (NEA). The general mapping and assessment frameworks presented in this collection provide a good basis for further harmonization of data collection and methods application which is an important contribution for the achievement of the EU Biodiversity strategy goals. The case studies present ES mapping predominantly on a national and local scale, with only one dealing with regional scale mapping. The methods used in the studies are based on all three value domains, but biophysical domains are predominant. The services, which are mapped and assessed, vary in different studies but there is a tendency towards the cover of more services in a single study as only two papers are focused on a single service. The studies on the assessment and mapping of the ecosystem condition, presented in the papers of this Special Issue, are still few and not well developed compared to ES studies. There

	are only two papers focused especially on ecosystem condition and they also deal with ecosystem services. The works from Greece and Bulgaria reveal some specifics for southeast Europe and demonstrate the progress in these countries in the MAES process which was also found in the EU funded ESMERALDA project*5. They can be used by the other countries in the region and the knowledge could be easily transferred through the ESP SEE regional chapter.
B4_18	Yaneva R, Zhiyanski M, Markoff I, Sokolovska M, **Nedkov S.** 2018. Assessment and mapping the dynamics of soil properties in selected forest stands from the region of Central Balkan National Park in the context of ecosystem services. One Ecosystem 3: e23156. https://doi.org/10.3897/oneeco.3.e23156 Abstract: Forests set natural conditions and embody a repository of biological diversity that represents a myriad of ecosystem services for human well-being. The spatial patterns and the forest ecosystems' dynamics over time make the forests of particular environmental significance for the provision of ecosystem services. The terrestrial biodiversity and the sustainable management strategies' demand for mapping and assessment of the dynamics for the condition of forest ecosystems by drawing attention to the soil properties. In order to take on that task, the data series obtained by the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) for the period 1986–2016 were found as appropriate quantitative indicators that convey information about the ecosystem's capacity to provide certain regulating ecosystem services. The ICP Forests Level I sites, located in the Central Balkan region, provide consistent information, which is collected on a regular basis about observed forest stands.
B4_19	**Nedkov, S**., Zhiyanski, M., Borisova, B., Nikolova, M., Bratanova-Doncheva, S., Semerdzhieva, L, Ihtimanski, I., Nikolov, P., Aidarova, Z. 2018. A geospatial approach to mapping and assessment of ecosystem services in Bulgaria. European Journal of Geography, Vol. 9, Number 4, 34-50. Abstract: The mapping of ecosystem services is essential for understanding how ecosystems contribute to human wellbeing and the EU Biodiversity Strategy require member states to map and assess the state of ecosystems and their services. Urban landscapes provide various services and their mapping necessitates prioritization, integration of data and application of geospatial approaches. We aim to develop a geospatial approach to assess and quantify the urban ecosystems in Bulgaria and produces ecosystem services maps at various scales. The assessment of ecosystem services is based on various indicators, which rely on different data sources with their own origins, scales, and levels of precision. We develop seven GIS-based approaches that comprise different procedures and tools to arrange the available data and produce ES maps. We produced maps at multiple scales for selected individual services and bundles of provisioning, regulating and cultural services. The results at the national level are summarized for municipalities and districts, while at the local level, they are presented for three selected cities in large-scale maps.
B4_20	**Nedkov, S**., Naydenov, K. Ravnachka, A. Ivanov, M. 2019. The new vision towards smart geography in south eastern Europe. European Journal of Geography, Vol. 10, Number 2, 6-11. Abstract: Global change comprises a variety of transformations in climate, ecosystems, natural resources and human society which have started in 20th century and continue with increasing intensity at present days. This led to significant planetary constraints regarding resources, climate and ecological resilience which are the main challenges the human society is currently facing and must deal with. The geography of the 21st century can offer evidence-based and place specific solutions to address such challenges. It offers an interdisciplinary base which can be used to address the integrated issues of our community thus to cope with the complex challenges of the global changes by providing "smart" spatial solutions. The contemporary geography is expected to facilitate the development of human capital and the knowledge society by offering place-specific "smart" spatial solutions. In view of the intensive migration and urbanization processes in today's world, cities are trying to offer such solutions in order to deal effectively with demographic and environmental pressures. Smart solutions through geospatial technologies have already been proposed in the geography education. The works presented in this special issue demonstrate the current trends in geography research in some countries of South-Eastern Europe which are in line with the new ideas of interdisciplinary and focus on implementation of the scientific achievement in practice. The case studies from Bulgaria, Romania, Hungary and Georgia deal with various aspects of

	demography, tourism and landscapes and propose spatial solutions applicable from local to national scale.
Г7_1	**Nedkov, S**., Koulov, B, Nikolova, M., Zhelezov, G., Naydenov, K. 2020. Smart Geography: 100 Years Bulgarian Geographical Society. Nedkov S. et al. (eds) Smart Geography, Springer, 1-9. Abstract: Geography of the twenty-first century is expected to contribute to the development of human capital and the knowledge society, to offer place-specific solutions for sustainable regional development and use of the planet's natural and human capital. With this idea, we prepared this book which presents selected contributions from the International Conference "Smart Geography: 100 years Bulgarian Geographical Society". They are focused on various themes related to smart spatial solution in different geographical disciplines as well as interdisciplinary studies with pronounced spatial aspect. The book illustrates the great variety of themes the contemporary geography is dealing with. Most of them have real potential to contribute by smart spatial solution to the human well-being. The examples presented in the book cover case studies from Bulgaria and many other countries worldwide.
Г7_2	Lyubenova, M., **Nedkov, S**., Zhiyanski, M., Popchev, G., Petrov, P. 2020. Assessment of Pollination Ecosystem Service Provided of Urban Ecosystems in Bulgaria. Nedkov S. et al. (eds) Smart Geography, Springer, 405-415. Abstract: The honeybee is the most important insect pollinator and the service they provide is among the most important regulation ecosystem services. The main problem in the assessment of ecosystem services of urban habitats in Bulgaria is the lack of data from the inventory. There is only aggregated data at municipality level about the number of beehives. The main objective of this work is to present an approach for assessment of pollination service provided by urban ecosystems in Bulgaria and the results of its mapping at national scale. The approach relies on application of two spatially explicit indicators which based on parameters such as density of bee families and minimal flying coverage. Following the matrix approach for spatially explicit ecosystem service assessments suggested, pollination supply capacities were assessed for all municipalities in Bulgaria. We used statistical data for beehive holdings and colonies per municipality provided 2010 and 2016. The results of the assessment were used to generate maps of the pollination supply capacity of urban ecosystems in Bulgaria. They provide appropriate information about the spatial distribution of this service throughout the country which can be used for the needs of regional planning. The high sensitivity of the sector, as well as its importance for the environment and the economy, require a careful and long-term state policy.
Г7_3	Nikolov, P., **Nedkov, S**. 2020. Flood Regulating Ecosystem Services—Mapping and Assessment Tool Based on ArcSWAT Output Data. Nedkov S. et al. (eds) Smart Geography, Springer, 391-404. Abstract: The ecosystem services (ES) are strongly related to the human well-being, and their mapping and assessment is among the main challenges. The regulating ecosystem services are not consumed directly by the society or the beneficiaries, but they offer important benefit. Flood regulation is such type of service which can mitigate or prevent the risk of the most frequent nature disaster in Europe. The paper presents an approach for mapping of flood regulating based on hydrological modeling and GIS tool. The tool is designed as ArcGIS script, connected with the ArcSWAT database. Three parameters derived from the hydrologic moldering results for each Hydrologic Response Unit are used as indicators to define the flood regulation capacity. The tool extracts the necessary data from the ArcSWAT results by user selected day, month and year and transforms them into qualitative estimations. The results are presented in form of maps of flood regulation ecosystem service in the case study area of Ogosta river basin.
Г7_4	Assenova, M., **Nedkov, S**., Assenov, A. 2018. Assessment and Mapping of cultural ecosystem services of urban ecosystems in Bulgaria. In: Marinov, V., Vodenska, M., Assenova, M., Dogramadjieva, E. (Eds) Traditions and Innovations in Contemporary Tourism, Cambridge Scholars Publishing, 238-358. ISBN:1-5275-0829-3 Abstract: The research is based on the understanding that ecosystem services describe the relationship between nature and human beings and refer broadly to the benefits people can obtain from urban ecosystems and thereby linking the social and the ecological systems. The cultural services include all non-material ecosystem outputs that have symbolic, cultural or intellectual significance. The paper focuses on the potential physical and intellectual interactions with biota,

	ecosystems and landscapes. It presents the results from the assessment and mapping of the recreation, scientific and educational, and cultural heritage ecosystem services of the urban landscapes of Bulgaria, classified in 10 urban sub-types.
Г7_5	Nikolova, M., **Nedkov, S.** 2018. Assessment and mapping of aesthetic ecosystem services in the city of Varna, Bulgaria. In: Marinov, V., Vodenska, M., Assenova, M., Dogramadjieva, E. (Eds) Traditions and Innovations in Contemporary Tourism, Cambridge Scholars Publishing, 259 - 272. ISBN:1-5275-0829-3 Abstract: According to the Common International Classification of Ecosystem Services (CICES) the class "Aesthetic ecosystem services" belongs to the section "Cultural ecosystem services". The assessment of aesthetic ecosystem services is characterized very often by a significant level of uncertainty caused by the specificity of the individual's perception and attitudes to the environment in general or to a particular landscape. Aiming to decrease this uncertainty we combine a photo-elicitation assessment and preference methods. The city of Varna is chosen as a case study area. The photo-elicitation assessment method provides information by counting the number of pictures uploaded to the Google Earth map in the urban ecosystem subtypes in Varna. The preference method is implemented by a survey aiming to assess the spatial distribution of aesthetic ecosystem services according to the perceptions and knowledge of the respondents (local population, stakeholders and visitors). The results are represented spatially on the city map using GIS tools. Knowledge about the potential of each urban ecosystem subtype to provide aesthetic ecosystem services may contribute to the optimization of spatial planning and to the improvement of the aesthetic value of the city of Varna as one of the famous tourist areas in the country.
Г8_1	**Nedkov, S.** 2008. Flood regulation function of the ecosystem services in small watersheds. Proceedings of Scientific conference Sozopol, 29 September 2008. Abstract: Floods are among the most severe natural hazards that affect the country's territory. Most vulnerable are the mountain areas, where the river high wave is formed in relatively small watersheds and its movement is very fast. The traditional practice to prevent such disaster is to build dikes in the most vulnerable areas. Less studied is the approach of the so called natural based solutions which relays on the regulation function of the natural landscapes in the watershed. The results of this study emphasize the importance of the regulation function of the forest landscapes during the formation of floods in the mountain areas. The results of the simulations show that the soil moisture is critical factor for the flood regulation.
Г8_2	**Nedkov S.** 2010. Modelling flood hazard due to climate change in small mountainous catchments. In: Car, A.,Griesebner, D., Strobl, J. (Eds.) Geospatial crossroads @ GI_Forum '10 - Proceedings of the Geoinformatics Forum Salzburg, 172-176. Abstract: Climate change is often represented by increase of extreme phenomena, like storms, torrential rains, and floods. Their regional and local dimensions vary from one area to another. This is especially valid for the regime and distribution of precipitation. Even for a country with relatively small territory, like Bulgaria, precipitation in some areas has increased during the last decades, while in others it has decreased. The main conclusion of this work is that, climate change causes an increase of torrential rains, which can lead to bigger and more disastrous floods. The model shows significant increase of the peak flow when rainfall quantity exceeds a particular "critical" level, after which the flood risk rises enormously. This level depends on the moisture conditions before the storm and seasonal state of the land cover. It also differs among catchments with different landscape features. The implementation of the presented approach provides an opportunity to assess the flood hazard in mountainous catchments and contribute to the development of early warning systems.
Г8_3	**Nedkov, S.,** Kotsev, A., Nikolova, M., Popov, A., Dimitrov, S., Koulov, B. 2010. Development of a GIS database for assessment and management of naturals hazard for archeological objects in Bulgaria. Proceedings of International conference "Geography and Regional development" NIGGG-BAS, 385-395 Abstract: The geospatial study and risk assessment of natural disasters in areas with a high concentration of significant archaeological sites requires an interdisciplinary approach. This approach should combine methods from different scientific fields - geography, archeology, geology, geomorphology, hydrology, climatology, statistics, engineering, etc. A wide range of spatial and temporal data is needed to analyze and assess the risk of natural disasters. GIS and other geo-information technologies provide very good opportunities for transforming the original spatial

	information depending on the set research goals. The main purpose of this paper is to present some of the results achieved in the implementation of a research project to assess the risk of dangerous natural phenomena in areas with a concentration of significant archaeological sites from a geospatial point of view.
Г8_4	Nikolova, M. and Nedkov, S. 2010. Methodological approach for differentia of the country in respect of the natural risk in areas with high concentration of significant archeological sites. Proceedings of International conference "Geography and Regional development" NIGGG-BAS, 248-255. Abstract: The paper presents methodological approach for spatial differentiation of the country's territory country in respect of the natural risk in areas with high concentration of significant archeological sites. We propose two groups of criteria to apply the differentiation and an algorithm to define test areas. An approach for identification of the areas with high density of archeological has been developed. It is based on the sites significance defined by the above mentioned criteria. The assessment is based on scoring of the sites significance which gives the opportunity to define and index of significance.
Г8_5	Gikov, A., **Nedkov, S**., and Gachev, E. 2011. Key issues for advancing of Paleoenvironmental Reconstructions in Bulgarian High Mountains. GEOREVIEW: Scientific Annals of Stefan cel Mare University of Suceava. Geography Series, Vol 20, No 2, 12-16. Abstract: The environment of the high mountains is very sensitive to any kind of impact; therefore they are appropriate case study areas for an investigation of the impact of global changes. The Pleistocene glaciations are the main landform and environment formation factor of the high mountains in Bulgaria. The paleoenvironmental reconstructions in these mountains would be very useful to solve issues related to contemporary impact on these complexes. Rila (2925 m) and Pirin (2914 m) are the highest Bulgarian Mountains which have been glaciated during the Pleistocene. The paleoglacial relief forms and lake sediments in these mountains contain valuable information for the paleoenvironment. Although, there are particular achievements in the investigations so far, there are still unresolved scientific issues. The paper makes a review on the state of the art of the investigation of high mountain landscapes in Bulgaria and outlines four main objectives facing the researchers studying the development of these landscapes during late Pleistocene and Holocene.
Г8_6	Vatseva, R., J. M. Sha, V. Dimitrov, X. M. Li, Y. F. Chen, **S. Nedkov**. 2011. Change Detection of Land Use and Land Cover in Coastal Zones of China (Fujian) and Bulgaria Using Multi-Temporal and Multi-Scale Remote Sensing Data. In: Problems of Geography, 3-4, pp. 67-82. Abstract: Land use and land cover change detection is a substantial process in monitoring and managing natural resources and urban development, as well as is central to the interests of the science of global environmental change. Up-to-date land cover information is of crucial importance to scientists, resource managers, and decision makers. Remote sensing is a powerful tool to provide land cover data with high temporal and spatial accuracy. The present study reveals that the coastal zones in Bulgaria and China, Fujian province, became most vulnerable in this time of rapid industrial development, urban modernization and tourism development for the past few decades. The baseline information generated on land use and land cover pattern of these areas would be of immense help in formulation of policies required for regional management and planning.
Г8_7	Nikolova, N., Zhelezov, G., Gikov, A., and **S. Nedkov**. 2011. Background contamination of trace elements in soils of Strandzha's reserves Tisovitsa and Sredoka. Proceedings of International Scientific Conference FMNS2011, 8-11 June 2011Blagoevgrad, vol. 2, 230-238. ISSN 134-0272 Abstract: The paper presents the results of the landscape-geochemical investigation carried out in two reserves that are part of nature park "Strandzha". These areas are considered as intact and the results can be treated as background for the concentrations of trace elements. The radial geochemical differentiation of some trace elements such as copper, lead, zinc, cadmium, cobalt and nickel in the soil layers and the vegetation cover has been studied. A comparison of other background areas in Bulgaria has been made.
Г8_8	Krumova, J, Nedkov, S. 2011. Map of the natural and cultural heritage in the Danube plain – database structure and design. Proceedings SES 2011 Seventh Scientific Conference with International Participation - SPACE, ECOLOGY, SAFETY, Sofia, Bulgaria. 29.11. – 01.12.2011.

	45-50. Abstract: Natural phenomena and objects of culture-historical heritage of a country are part of its unique identity. Their appropriate representation and visualization is of crucial importance for revealing the tourist potential of the country. The Danube plain is a poorly studied are in this respect. The elaboration of appropriate visualization tools and means will enable better understanding and promotion of the national heritage objects in this area to the broad public. It will also contribute to draw the attention of the local stakeholders towards improved management of this heritage. The paper represents the principles for development of a GIS database for such objects and the elaboration of cartographic design for the establishment of scientific-reference map in scale 1:500 000.
Г8_9	Nikolova, M., **Nedkov, S**. and Nikolov,.V. 2012. Risk from Natural Hazards for the archaeological sites along Bulgarian Danube bank. Proceedings of the first European SCGIS "Best practices: Application of GIS technologies for conservation of natural and cultural heritage sites" 21-23 May 2012, Sofia, Bulgaria. ISSN 1314-7749 Abstract: The research goal of this paper is to assess from a geospatial perspective the risk from natural hazards for the archaeological sites along Bulgarian Danube bank. On the basis of the contemporary geo-informational technologies and the related spatial-analytical methods are investigated and analyzed the main types of geo-hazards which threaten some of the most essential archaeological monuments in the investigated territory. A catalog of the existing essential archaeological monuments in North Bulgaria was created and the essential archaeological sites were categorized according the type and level of threat and from a spatial point of view. A GIS - based spatial models for assessment of the risk for specifically-chosen sites with high level of vulnerability were implemented. The results show that there are fife essential archaeological monuments along the Danube bank which are under high risk from floods, river bank erosion, landslides and other gravitation processes. Some recommendations about protection and prevention measures are proposed.
Г8_10	Nikolova, M., Nedkov, S., Krumova, J., Tchorbadjiska, E. 2012. Assessment of the tourist impact on the ecosystems in the Seven Rila lakes area. Proceedings SES 2012 Eigth Scientific Conference with International Participation - SPACE, ECOLOGY, SAFETY, Sofia, Bulgaria. 4-6 December 2012, 387-390. Abstract: The anthropogenic pressure in the region of the Seven Rila Lakes is growing at alarming rates in recent years. This leads to many discussions and disputes between the media, tourism businesses and local authorities in the nearby towns and the environmentalists across the country. The results of the survey of public opinion on these issues clearly indicate the rightful concern of tourists, locals and scientists about the ecological status of the lakes.
Г8_11	Nikolova, M., Zhelezov, G., Nedkov, S., Nozharov, P., Krumova, J., Nikolov, V., Gikov, A., Gachev, E. Environmental changes and contemporary state of the protected area "Seven Rila Lakes". Proceedings SES 2012 Eigth Scientific Conference with International Participation - SPACE, ECOLOGY, SAFETY, Sofia, Bulgaria. 4-6 December 2012, 377-386. Abstract: The paper presents intermediate results from the monitoring of the global changes in high mountains on a case study in the Seven Rila Lakes area. Investigated are the dynamic and change of the current morphogenetic processes and hydro-climatic conditions in the lakes area and the driving forces about these changes as well as the consequences of them for the lakes ecosystems.
Г8_12	Nikolova, M., **Nedkov, S**., and Nikolov, v. 2013. Flood Hazard in Bulgaria: Case Study of Etropolska Stara Planina. In: Loczy, D. (ed.) Geomorphological impacts of extreme weather. Case studies from central and eastern Europe. Springer Geography, 189-201. ISBN: 978-94-007-6300-5. Abstract: A case study on the Yantra River Basin dynamics under recent climate fluctuations and economic changes is carried out to demonstrate the important role of some geographical factors for successful flood hazard assessment and management practices. The number of the extreme precipitations and related to them flood events during last decade grow in the river basin in accordance to the same trends observed in North Bulgaria and Central and Eastern Europe. The implementation of geo-information technologies provides tools for integrated management of the

	flood hazards and of the exposure to it.
Г8_13	**Nedkov, S**., Tcherkezova, E. 2013. GIS database – an important component of hazard assessment. In: Zhelezov, G. (ed.) Hazard assessment and mitigation in the Danube floodplain (Calafat-Vidin – Turnu Magurele-Nikopol Sector). TerArt, Sofia, 24-53. Abstract: Geographical data and information are used in GIS applications in order to create, analyze and display different spatial objects and/or processes of the real world. The conceptual scheme of the specialized GIS for this project includes three main levels: i) Information level - basic data, including layers representing the main geographical features of the study area (relief, hydrology, climate, soils, population etc), spatial data on the hazardous phenomena in the study area derived from existing sources and developed during the project. These data were used as a main source for spatial information for the study area as well as to derive GIS data for the other levels; ii) Analytical level – includes manipulation and specialized analysis of the information from a point of view of the occurrence of natural and technological hazards and the geographic combination of these hazards with vulnerable areas; iii) Assessment level - detailed geo-spatial assessment of the different hazards in the area. At this level, spatial models for the occurrence of different hazardous phenomena will be performed.
Г8_14	Nikolova, M., Dragotă, G., Grigorescu, I., **Nedkov, S**., Kucsicsa, G. 2013. Climatic hazards, Frost hazard. In: Zhelezov, G. (ed.) Hazard assessment and mitigation in the Danube floodplain (Calafat-Vidin – Turnu Magurele-Nikopol Sector). TerArt, Sofia, 125-129. Abstract: The used methodology for the hazard assessment and mapping involves several steps starting from hazards identification and classification, assessment of the hazard frequency and probability; identification of hazard classes and assignment the most relevant indicators/indexes for hazard mapping delineation and ultimately regionalization and mapping. Hail suppression technologies are used for mitigation of the hail hazard. There are 4 polygons for hail suppression in Northwest part of Bulgaria: in Gramada (Gramada and the area of Vidin), Dolno Tserovene (Yakimovo and Valchedram) , Bardarski Geran (Biala Slatina and Borovan) and Dolni Dabnik (Pleven and Dolna Mitropolia). Theirs activity mitigate the hail hazard in the study area significantly but however it is a common threat there. Insurance is an alternative way for mitigation of the losses from hail hazard. Zoning and mapping of hail hazard is the best way to provide information for decision makers and stakeholders about the spatial dimensions of the hazard for more sustainable hazard management.
Г8_15	Nikolova, M., **Nedkov, S**., 2013. Flood hazard, In: Hazard assessment and mitigation in the Danube floodplain (Calafat-Vidin – Turnu Magurele-Nikopol sector), ed. G.Zhelezov, TerArt, ISBN: 978-954-9531-20-6, Sofia, 2013. pp. 174-185. Abstract: Flooding occurs when areas that are not normally under water have flooded due to the rising of the river level. The flood risk is a function of the frequency of flood occurrence, hazard exposure and possible damages in the affected areas. Flood hazard maps for the Danube plain in the Calafat-Vidin – Turnu Magurele-Nikopol sector are produced for three scenarios. The assessment of inundated areas and respective flood depths relies on hydraulic assumptions. The results show that the areas under flood hazard in Bulgarian part between Vidin and Nikopol are 5095 ha which comprises about 12% of the Bulgarian part of the study area.
Г8_16	Tcherkezova, E., Nedkov, S. 2014. DESIGN OF A GEODATABASE FOR ASSESSMENT OF NATURAL AND TECHNOLOGICAL RISK. CASE STUDY VIDIN – NIKOPOL, BULGARIA. Problems of Geography 1-2, 33-42. Abstract: Nowadays, the prevention and mitigation of human and infrastructure loss caused by natural and technological hazards are very important activities at local, regional, national and global scale. Therefore, detailed analysis and mapping of different natural, technological and antropogenic hazards and disasters become an important role for disaster studies. This study focuses on development of a conceptual geodata model using UML class diagrams as a base for geodatabase schema appropriated for analysis and mapping of natural and technological hazards in the Danube floodplain between Vidin and Nikopol (Bulgaria). The design, development and application of a coherent geodatabase for this purpose should be considered as fundamental steps in the project ROBUHAZ-DUN.
Г8_17	Boyanova, K., **Nedkov. S**., Burkhard, B. 2014. Quantification and Mapping of Flood

	Regulating Ecosystem Services in Different Watersheds – Case Studies in Bulgaria and Arizona, USA. In: Bandrova, T., Konechy, M., Zlatanova, S. (eds.), Thematic Cartography for the Society, Lecture Notes in Geoinformation and Cartography, Springer, 237-255. Abstract: There is great need for accurate and practical methods to assess the conditions of ecosystems, and the possible results of their interaction with social systems. The generation and interpretation of quantitative data for ecosystem service analysis is still not well established. Ecosystem service analyses demand an interdisciplinary approach that integrates knowledge with a high variety, and manifold verifications, of models and data. The presents an application and the verification of an approach for the quantification of flood regulating ecosystem services by using results from the watershed hydrological model KINEROS and the AGWA tool. It is applied in six watersheds - three in Bulgaria and three in Arizona,USA, in order to check its reliability in case studies with differing geographic characteristics. The model results are used to define the capacities of the land cover classes in the different watersheds and to prepare flood regulating supply capacity maps. Capacities for flood regulation differ within the case studies and their land cover classes. Forests still show generally high capacities in both Bulgaria and Arizona, while grasslands and pastures in Bulgaria show higher capacities for flood regulation than in Arizona.
Г8_18	**Nedkov, S**., Gikov, A., Nikolova, M., Dimitrov, P., Gachev, E. 2014. Mapping of ecosystem services in mountain areas: a case study of Seven Rila Lakes, Bulgaria. In: Bandrova, T., Konechny, M. (Eds.), 5th International conference on Cartography and GIS, June 15-20 Riviera, Bulgaria, 488-497. Abstract: Mountain ecosystems provide a number of vital services for people and society, such as biodiversity, water resources, carbon sequestration, and recreation. However, they are extremely vulnerable to different kinds of impact therefore their future capability to provide these services is determined by changes in socio-economic characteristics, land use and climate. In this paper we present an attempt to identify, assess and map ecosystem services supply for two different periods in a case study area in Rila Mountain. Land cover data, obtained from orthorectified aerial photographs, was used to define the spatial pattern of the ecosystems. Their capacity to supply services was assessed using relative scale and the results were presented as maps of ecosystem services supply. The results show that the ecosystems in the area of Seven Rila Lakes provide various services with focus on the cultural and regulating. The supply capacity of the cultural services is the highest which is due to the exceptional recreational, aesthetic and spiritual potential of the area. The supply capacity of regulating ecosystem services is predominantly high while provisioning services have relatively low supply capacity.
Г8_19	**Nedkov, S.** Gikov, A., 2014. Landscape differenciation of the northern slopes of the Sredna Stara Planina and Predbalkan. Proceedings of the conference “30 years Geography in Veliko Tarnovo university”. Abstract: The paper presents and approach for investigation of the landscape heterogeneity using regression dependencies and GIS tools to model the spatial pattern and produce landscape maps for the mountain areas. The functional scheme of the process includes four modules and results in producing GIS map layers. They were analyzed in order to create a map layer of the potential landscapes in the area. CORINE Land Cover data were used as a basis to create map layers for the contemporary landscapes. According to the accepted landscape typology the case study area is differentiated into one class, two types, two subtypes and three anthropogenic variations.
Г8_20	Dobrev, N., Benderev, A., Zhelezov, G., Kotsev, T., Berov, B., Ivanov, P., Krastanov, M., Nikolova, M., Nedkov, S., Therkezova, E. 2015. Geological and ecological risk of the floodplains in the western part of the Bulgarian sector of the Danube plain. Proceedings of the International congress “Velikie reki” 408-422. ISBN 978-5-528-00013-8; 978-5-528-00014-5 Abstract: The study of modern problems associated with the manifestations of geological and environmental threats is important to clarify their nature, place of manifestation and modeling. On the other hand, clarification of these problems and the obtained research results should increase the information content of the relevant authorities, as well as the local population. They can play a major role in organizing a holistic process of prevention and protection of the population, infrastructure and economy of certain regions. At its core, a high degree of prevention and protection against ecological and environmental threats is an element of the categorization of the quality of life in a

	given city, region or state. In cases where a higher intensity of a certain process is observed, it is possible to recommend the organization of monitoring and systematic scientific research. The object of this study is the bank of the Danube River and its neighboring sections on the territory of Bulgaria from the city of Vidin to the city of Nikopol. The most dangerous phenomena affecting the Danube are landslides. They affect 47.3% of the coastal zone. The main destabilizing factors are groundwater fluctuations and river erosion. The most intense degree of erosion on the banks of the Danube was found near Vidin. Significant erosion (but to a lesser extent) was found in the central part of the region and near Nikopol.
Г8_21	Markov, B., **Nedkov, S**. 2016. Mapping of erosion regulation ecosystem services. In: Bandrova, T., Konechni, M. (Eds) Proceedings, 6th International Conference on Cartography and GIS, 13-17 June 2016, Albena, Bulgaria. 97-109 ISSN: 1314-0604 Abstract: Ecosystem services are the benefits that humans receive from the environment. Soils provide many ecosystem services required to support human well-being. Soil erosion is one of the major and most widespread forms of soil degradation. This study examines how erosion regulation can be evaluated and mapped. To map the erosion regulation, as an ecosystem service, we use indicators that incorporate four USLE factors – soil erodibility (K), cover management (C) and slope length and steepness (LS). Erosion regulation map was generated by GIS-based overlay analysis of these factors. The capacity to provide erosion regulation service was assessed using relative scale that ranges from 0 (no relevant capacity) to 5 (very high relevant capacity. The results reveal the potential of the factors to supply ecosystem services. The assessment of ecosystem's capacity to regulate soil erosion can provide important information for environmental management.
Г8_22	**Nedkov, S.,** Zhiyanski, M., Nikolova, M., Gikov, A., Nikolov, P., Todorov, L. 2016. Mapping of carbon storage in urban ecosystems: a Case study of Pleven District, Bulgaria. In: Zhelezov et al. (Eds.) Proceedings of scientific conference "Geographical aspects of land use and planning under climate change", Varshets 23-25.09.2016, 223-233. ISBN: 978-619-90446-1-2. Abstract: Urban landscapes are the environment where most of the population live and perform their usual everyday activities. The continuous urban sprawl and the increasing demand on resources and energy provoke serious discussion on ensuring better human well-being in the settlements while preventing increasing loss in biodiversity. However, urban landscapes also provide a number of benefits for the human society through their ecosystem services. Mapping of ecosystem services has broad application potential since it is an extremely valuable method for visual representation of qualitative and quantitative spatial data. In this paper we present an approach to assess and map ecosystem services in urban areas at national scale in Bulgaria. It includes identification of urban ecosystem's subtypes according to the classification of National concept for spatial development (for the period 2013 – 2025) and based on MAES (Mapping and Assessment of Ecosystem and their Services) guidelines and EUNIS habitat classification, choice of indicators for ecosystem services, parameterization of these indicators, normalization of the parameters and elaboration of maps in GIS. The ecosystem services indicators set for the study were elaborated on the base of the EEA CISES classification by prioritization of the relevant services in urban ecosystems. The data for the parameters were stored in GIS database and their spatial distribution was analyzed using GIS tools. The approach is tested in a case study area of Pleven region. The results are presented in form of spatial analyses and maps for one of the most important ecosystem services for urban areas: climate regulation indicated with carbon storage in green infrastructure. The application of this approach in spatial planning and regional development could contribute for significant improvement of the urban environment and better human welfare.
Г8_23	**Nedkov, S.**, Naidenov, K., Nikolova, M., Zhelezov, G., Koulov, B., Borisova, B. 2016. Teritory and global changes. In: Zhelezov et al. (Eds.) Proceedings of scientific conference "Geographical aspects of land use and planning under climate change", Varshets, 23-25.09.2016, 10-16. ISBN: 978-619-90446-1-2. Abstract: The global changes in the environment during last years have various aspects. The main driving force is the human society which decisions shapes the interactions with the environment. This interaction is reflected in the land management. The results of the of the studies in this proceedings demonstrate that the geographers in Bulgaria works in the main and topical aspects in the fields related to the regional dimensions of the global changes. These results offer concrete decisions and

	innovative approaches for the land management of the country's territory. The wide application of interdisciplinary approaches in the presented papers undoubtedly emphasizes the significant advantages of geographical research as well as their important practical significance for the planning and use of the territory.
Г8_24	Zhelezov G., and **Nedkov, S.** 2016. Floods Vulnerability Assessment in the Area of Rivers Ropotamo and Veleka Southeastern Bulgaria. Zhelezov et al. (Eds.) Proceedings of scientific conference "Geographical aspects of land use and planning under climate change", Varshets, 23-25.09.2016, 65-71. ISBN: 978-619-90446-1-2. Abstract: The present research observe the problems related to floods and flood risk in the area of rivers Ropotamo and Veleka, Southeastern Bulgaria. The main objective of the investigation is to identify the flood vulnerability zones in the area of Veleka and Ropotamo river valleys. The realization of this objective is connected with check and analysis of data availability, delineation of the floodplains in Veleka and Ropotamo river valleys, identification of the land use within the floodplains and flood vulnerability analysis of Veleka and Ropotamo floodplains.
Г8_25	Palomo, I., Bagstad, K., **Nedkov, S.,** Klug, H., Adamescu, M., Cazacu, K. 2017. Tools for mapping ecosystem services. In: Burkhard B. and Maes J. (eds.) Mapping Ecosystem Services, Pensoft, 70-75. ISBN: 9789546428523 Abstract: Mapping tools have evolved impressively in recent decades. From early computerized mapping techniques to current cloud-based mapping approaches we have witnessed technological evolution that has facilitated the democratization of Geographic Information Systems (GIS). The use of GIS in ecosystem services mapping can take three general approaches: 1) analysis tools built into GIS software packages; 2) disciplinary biophysical models applied for ecosystem service assessment (e.g., hydrological models such as SWAT or VIC for water-related ecosystem services); 3) modeling tools designed specifically for ecosystem service assessment (e.g., InVEST, ARIES).
Г8_26	**Nedkov, S.,** Doncheva, S., Markov, B. 2017. Mapping of ecosystems in Bulgaria based on MAES typology. – In: Chankova, S., et al. (Eds.) Seminar of Ecology - 2016 with international participation, Proceedings. 21-22 April 2016, Sofia, pp. 61-67. ISBN: 979-853-476-132-4 Abstract: According to Action5 of the EU Biodiversity strategy the member states have to map and assess the state of ecosystems and their services in their national territory. A Working Group on Mapping and Assessment on Ecosystems and their Services (MAES) provided methodological framework for mapping of ecosystems at European scale. The main objective of this paper is to analyze the spatial distribution of the ecosystems in Bulgaria based on MAES typology and their dynamics for 20 year long period. We utilize CLC data to delineate and map ecosystems in Bulgaria. The information of ecosystems was organized in GIS database which includes data about four time series between 1990 and 2012 and the ecosystems' dynamics for this period were analyzed. The results show that Cropland and Woodland and forest ecosystems are the most spread in the country followed by Grasslands and Urban ecosystems. There are mixed trends in ecosystems change during the period 1990 – 2012. The area of urban ecosystems show steady increase until 2006 while the area of Woodland and forest ecosystems gradually decrease during the whole studied period. Cropland ecosystems show small changes in the first two periods and rapid increase during the third period. There are different reasons for such changes which are both subjective an objective. CORINE Land Cover is appropriate data source to delineate ecosystem types on the base of MAES framework at national scale but at larger scales finer sources are required
Г8_27	**Nedkov, S.** 2018. VI. Landscapes. In**:** Nikolova (Ed.) Nature and landscapes in park "Bulgarka", Issue of BGS, 173-224. ISBN 978-619-90446-0-5. Abstract: The landscape is a specific geographical area, representing a system of all natural components (rocks, soil, air, water, vegetation and animals), which changes over time under the influence of natural factors and human activity. The main goal of this work is to clarify the typological and regional structure of the landscapes on the territory of Bulgarka Nature Park, which should be used in the development of a park management plan. According to the developed classification, the typological structure at the level of potential landscapes on the territory of Bulgarka Nature Park covers one class, two types, two subtypes, nine groups and 19 kinds of landscapes. Based on the analysis of the typological structure of the landscapes, significant differences have been established between the eastern and western part of the park at almost all levels of the taxonomic scheme. The Shipka region occupies a larger area (53% of the park's territory) and is characterized by higher

	altitude and deeper cut of the relief, while in the Tryavna region there is a certain decrease in altitude and a tendency towards a more flat character of relief.
Г8_28	**Nedkov, S.** 2018. GIS based applications and models for mapping and assessment of ecosystem services. Journal of BGS, 39, 17-24. Abstract: Mapping and assessment of ecosystem services (ES) is a complex activity which includes spatial data acquisition, its organization into databases and generation of maps for the areas of ES supply and demand. GIS is an integral part of these activities and plays key role for the mapping and assessment of ES. There is a significant advance in the development of various tool and models for mapping and assessment during the last decade. The use of GIS in ecosystem services mapping can take three general approaches, analysis tools built into GIS software packages, disciplinary biophysical models applied for ecosystem service assessment and modeling tools designed specifically for ecosystem service assessment. This paper presents the main advantages of the GIS application in these three approaches through analysis of the available tools, models and techniques. The applications are illustrated by examples of mapping works in different areas in Bulgaria.
Г8_29	Crossman N.D., **Nedkov S.,** Brander L. 2019. Discussion paper 7: Water flow regulation for mitigating river and coastal flooding. Paper submitted to the Expert Meeting on Advancing the Measurement of Ecosystem Services for Ecosystem Accounting, New York, 22-24 January 2019 and subsequently revised. Version of 1 April 2019. Available at: https://seea.un.org/events/expert-meeting-advancing-measurement-ecosystem-servicesecosystem-accounting Abstract: The water flow regulation ecosystem service can be subdivided into river flood regulation and coastal flood regulation. They are quite different and there are major differences in biophysical processes, scientific disciplines, data, models and methods. The measurement of river flood regulation relatively is very well studied, whereas coastal flood regulation much less so. Water flow regulation in coastal and inland ecosystems is functionally related to the provision of multiple other services so care needs to be taken with defining ecosystem service boundaries. Beneficiaries can be spatially disjointed especially for river flood risk reduction where upstream vegetation mitigates damage downstream – this is a challenge for scale and selection of appropriate spatial units. The demand for water flow regulation by ecosystems is determined by the magnitude of the costs of flood risk (the minimized sum of incurring and/or mitigating the damage) which is highly context specific. It is not possible to generalize the value of the service using a fixed unit value (e.g. US$/ha/year) because both the demand for and supply of water flow regulation service are highly spatially variable.
Г8_30	Zhelezov, G., Nedkov, S. 2019. Development of the landscapes studies in Bulgaria. Problems of Geography.2, 71-85. Abstract: The article explores the development of landscape ideas, landscape researches and landscape science in Bulgaria. There are three periods marking the main achievements in the field of landscape science in Bulgaria. An overview of the publications in the field of landscape researches in Bulgaria, ecosystem services and the main landscape maps and map products are created.