РЕЗЮМЕТА НА НАУЧНИ ТРУДОВЕ

на гл. ас. д-р Милен Русев Чанев

представени за участие в конкурс за академичната длъжност „Доцент", обявен в Държавен вестник брой 82, от дата 7.10.2025 г., от Института за космически изследвания и технологии - БАН в област на висше образование 4. Природни науки, математика и информатика, професионално направление 4.4. Науки за земята, научна специалност „Дистанционни изследвания на Земята и планетите", за нуждите на секция „Дистанционни изследвания и ГИС".

Група „В"

Хабилитационен труд-научни публикации в издания, реферирани и индексирани от WoS или Scopus:

В4.1

Abstract

Barley is an ecologically adaptable crop widely used in agriculture and well suited for organic farming. Satellite imagery from Sentinel-2 can support crop monitoring and yield prediction, optimising production processes. This study compares two types of Sentinel-2 data—standard (S2) data with 10 m and 20 m resolution and Sentinel-2 Deep Resolution 3 (S2DR3) data with 1 m resolution—to assess their (i) relationship with yield in organically grown barley and (ii) utility for winter crop mapping. Vegetation indices were generated and analysed across different phenological phases to determine the most suitable predictors of yield. The results indicate that using 10×10 m data, the BBCH-41 phase is optimal for yield prediction, with the Green Chlorophyll Vegetation Index (GCVI; $r = 0.80$) showing the strongest correlation with yield. In contrast, S2DR3 data with a 1×1 m resolution demonstrated that Transformed the Chlorophyll Absorption in Reflectance Index (TCARI), TO, and Normalised Difference Red Edge Index (NDRE1) were consistently reliable across all phenological stages, except for BBCH-51, which showed weak correlations. These findings highlight the potential of remote sensing in organic barley farming and emphasise the importance of selecting appropriate data resolutions and vegetation indices for accurate yield prediction. With the use of three-date spectral band stacks, the Random Forest (RF) and Support Vector Classification (SVC) methods were used to differentiate between wheat, barley, and rapeseed. A five-fold cross-validation approach was applied, training data were stratified with 200 points per crop, and classification accuracy was assessed using the User's and Producer's accuracy metrics through pixel-by-pixel comparison with a reference raster. The results for S2 and S2DR3 were very similar to each other, confirming the significant potential of S2DR3 for high-resolution crop mapping.

B4.2

Chanev, M., & Dimitrov, Z. (2025). Study the Applicability of SENTINEL-2 Optical Data, as Well as Benefits from the SENTINEL-1 SAR Data, for Predicting the Yield of Organic Barley. Aerospace Research in Bulgaria, 37, 82-92. JCR-IF (Web of Science):0.1 Линк

Abstract

The barley crop is widely used in the economic life of humanity and is characterized by great ecological plasticity. It is a good competitor to other cereals, which is why it is extremely suitable for growing in organic farming. The multispectral data obtained from the COPERNICUS Sentinel-2 satellites has proven in numerous scientific works its applicability to support crop monitoring. In that way, that data is invaluable in optimizing the production processes. In this study, a comparison was made between satellite data products derived from the COPERNICUS Sentinel-2 optical and Sentinel-1 SAR data, as well as studying their statistical relationship with the yield of the organically grown barley. The spatial resolution of all products is 10 m. The utilization of both satellite data types for monitoring and forecasting the yield of organically grown barley has been verified. The BBCH-41 phase was found to be the most suitable for the utilization of Sentinel-2 optical data to generate a different set of vegetation indices for yield prediction. In that phase, most of the tested vegetation indices showed successful yield prediction. The most relevant is the Green Chlorophyll Vegetation Index (GCVI; $r = 0.80$), which has the highest correlation with the yield. Considering SAR data, the backscatter in co- and cross-pol were derived in terms of Sigma-Nought. The Radar Vegetation Index in dual-pol (dRVI) was also calculated. As reported in other studies, a correlation is observed between dRVI and vegetation indices (e.g., NDVI). Whole output SAR products are sensitive to the geometrical properties of the crop and represent in various extent the phenological development of the organic barley. In this regard, SAR data complements optical data and provides reliable information on crop conditions during periods of high cloud cover. Bearing in mind that very often these periods coincide with phenological phases that are critical in crop development.

B4.3

Kamenova I, **Chanev M,** Dimitrov P, Filchev L, Bonchev B, Zhu L, Dong Q. Crop Type Mapping and Winter Wheat Yield Prediction Utilizing Sentinel-2: A Case Study from Upper Thracian Lowland, Bulgaria. Remote Sensing. 2024; 16(7):1144. https://doi.org/10.3390/rs16071144 Q1 Линк

Abstract

The aim of this study is to predict and map winter wheat yield in the Parvomay municipality, situated in the Upper Thracian Lowland of Bulgaria, utilizing satellite data from Sentinel-2. The main crops grown in the research area are winter wheat, rapeseed, sunflower, and maize. To distinguish winter wheat fields accurately, we evaluated classification methods such as Support Vector Machines (SVM) and Random Forest (RF). These methods were applied to satellite multispectral data acquired by the Sentinel-2 satellites during the growing season of 2020–2021. In accordance with their development cycles, temporal image composites were developed to identify suitable moments when each crop is most accurately distinguished from others. Ground truth data obtained from the integrated administration and control system (IACS) were used for training the classifiers and assessing the accuracy of the final maps. Winter wheat fields were masked using the crop mask created from the best-performing classification algorithm. Yields were predicted with regression models calibrated with in situ data collected in the Parvomay study area.

Both SVM and RF algorithms performed well in classifying winter wheat fields, with SVM slightly outperforming RF. The produced crop maps enable the application of crop-specific yield models on a regional scale. The best predictor of yield was the green NDVI index (GNDVI) from the April monthly composite image.

B4.4

Abstract

Purpose: This study estimates rice crop height using multi-temporal Sentinel-1 and Sentinel-2 data, collected alongside field measurements conducted in Türkiye and Bulgaria during 2023 and 2024. Method: To evaluate the efficacy of the datasets in estimating the rice height, we developed three Quantile Regression Forest (QRF) models. The QRF, an extension of Random Forest Regression (RFR), provides conditional quantiles for epistemic uncertainty estimation. Specifically, the first model (M1) utilized Sentinel-1 dual-polarimetric data, their ratios, and Radar Vegetation Index. The second model (M2) incorporated Sentinel-2 spectral bands and a range of spectral indices, while the third model (M3) combined Sentinel-1 and Sentinel-2 data. To address variability in flooding and drainage periods across growth stages and management practices, the models were trained and evaluated using the complete, flooded, and non-flooded datasets. Results: The results indicated that M3 yielded the most accurate predictions, with an RMSE of 12.35 cm on the flooded test dataset. Notably, the models with the flooded datasets generally exhibited lower uncertainty and more consistent predictions. However, all models struggled with underestimations for heights exceeding 100 cm, indicating limited predictive capability for extreme values. Interestingly, while M1 and M2 models showed different results for complete and flooded datasets, the M3 model gave similar results for both conditions, which is a practical advantage that eliminates the need to distinguish the flooded and non-flooded samples. Conclusion: In summary, combining radar and optical data with machine-learning improves rice height estimation, while uncertainty estimates enhance reliability for agricultural and environmental applications.

B4.5

Abstract

Above-ground biomass (AGB) is considered an essential climate variable that underpins our knowledge and information about the role of forests in mitigating climate change. The availability of satellite-based AGB and AGB change (ΔAGB) products has increased in recent years. Here we assessed the past decade net ΔAGB derived from four recent global multi-date AGB maps: ESA-CCI maps, WRI-Flux model, JPL time series, and SMOS-LVOD time series. Our assessments explore and use different reference data sources with biomass re-measurements within the past decade. The reference data comprise National Forest Inventory (NFI) plot data, local ΔAGB maps from airborne LiDAR, and selected Forest Resource Assessment country data from countries with well-developed monitoring capacities. Map to reference data comparisons were performed at levels ranging from 100 m to 25 km spatial scale. The comparisons revealed that LiDAR data compared most reasonably with the maps, while the comparisons using NFI only showed some agreements at aggregation levels <10 km. Regardless of the aggregation level, AGB losses and gains according to the map comparisons were consistently smaller than the reference data. Map-map comparisons at 25 km highlighted that the maps consistently captured AGB losses in known deforestation hotspots. The comparisons also identified several carbon sink regions consistently detected by all maps. However, disagreement between maps is still large in key forest regions such as the Amazon basin. The overall ΔAGB map cross-correlation between maps varied in the range 0.11–0.29 (r). Reported ΔAGB magnitudes were largest in the high-resolution datasets including the CCI map differencing (stock change) and Flux model (gain-loss) methods, while they were smallest according to the coarser-resolution LVOD and JPL time series products, especially for AGB gains. Our results suggest that ΔAGB assessed from current maps can be biased and any use of the estimates should take that into account. Currently, ΔAGB reference data are sparse especially in the tropics but that deficit can be alleviated by upcoming LiDAR data networks in the context of Supersites and GEO-Trees.

Група „Г 7"

Научни публикации в издания, реферирани и индексирани от WoS или Scopus:

Г7.1

Abstract

This publication is a review of the application of remote sensing methods for wildlife population monitoring in zoology. Remote sensing methods are divided into four categories. The first category of methods examines the application of camera traps, the second is about application of Unmanned Aerial Vehicles (UAV), the third category examines the application of satellite images, and the fourth category is summarizing studies focused on GPS tracking. The use of camera traps for monitoring wildlife populations proved to be a very applicable and reliable field method for collecting appropriate data on large mammals. Monitoring animal populations through satellites is a method that allows many biogeographic hypotheses related to migration and species distribution.

Data obtained from satellite platforms is used as an indirect method in zoology to assess the habitats and food base of animals, as well as to create models of species distribution. Images obtained from UAVs are a new method for conducting studies of wildlife populations, showing greater accuracy and efficiency than conventional methods. GPS tracking is an extremely suitable method used to identify breeding and wintering sites, migration routes, and resting places of many species of migratory birds and mammals. The literature review shows that monitoring animal populations through remote sensing methods are cost and time effective methods that can be successfully performed without exposing researchers to risk. It allows monitoring of difficult-to-access places and large territories as well as to create models of species distribution.

Г7.2

Chanev, M., Bonchev, B., Valcheva, D., Filchev, L. (2025). Monitoring Organic Einkorn Yields with Sentinel-2 Data. In: Dobrinkova, N., Fidanova, S. (eds) Environmental Protection and Disaster Risks (EnviroRisks 2024). EnviroRISKs 2024. Lecture Notes in Networks and Systems, vol 883. Springer, Cham. https://doi.org/10.1007/978-3-031-74707-6_16 Q4 Линк

Abstract

The consumption of organically produced foods is gaining increasing popularity. Simultaneously, the areas under organic control are expanding. Data obtained from the Sentinel-2 satellite are exceptionally suitable for agricultural monitoring, as the mission provides data every 2–3 days, allowing for the tracking of changes in crops. Einkorn, known as the oldest wheat, finds wide application in various food products and is highly suitable for use in organic farming due to its resistance to weeds, various diseases, and pests. It is also highly suitable for crop rotation. In this study, we demonstrate the potential for monitoring yields of organic einkorn using Sentinel-2 satellite data. We tracked the development of the crop by selecting three different phenological phases: tillering, heading, and milk ripeness. We used images from these three phases, taken when we observed a mass entry of the crop into a given phase (minimum of 75% of plants in the crop in the respective phenological phase). Sampling sites were determined, with three different values of the Normalized Difference Vegetation Index (NDVI) established in the tillering stage: low, medium, and high. Upon reaching the technical ripeness phase, samples were taken in four replications at the three differences. Biometric measurements were taken, and the biological yield of the crop was determined. Correlation analysis was performed between ground-based yield data and Sentinel-2 satellite data. The study identified the phenological phases and vegetation indices most suitable for monitoring and predicting yields.

Г7.3

Chanev, M., Filchev, L.. Review of the Application of Satellite Remote Sensing in Organic Farming – Part II. Aerospace Research in Bulgaria, 36, Space Research and Technology Institute – Bulgarian Academy of Sciences (SRTI-BAS), 2024, ISSN:1313-0927, DOI:10.3897/arb.v36.e18, 201-209. JCR-IF (Web of Science):0.1 Линк

Abstract

The use of remote sensing methods for monitoring, managing, and decision support in agriculture is increasingly intensifying. With the advancement of technologies, they become more accessible, while the quality and security of the obtained data are improving. To improve the quality of the environment and its preservation, expanding the areas occupied by organic farming will allow us to achieve these goals. At the same time, this type of agriculture provides healthy and safe food. For this reason, it is essential to start applying satellite data in organic farming as quickly as possible. In Part II of the "Review of the applications of satellite remote sensing in organic farming," we examine the various areas of satellite data application in organic farming. Five areas of satellite data application in organic farming have been identified, including satellite remote sensing monitoring of weeds, remote sensing of crop stress and irrigation needs, yield forecasting using remote sensing methods, and remote sensing monitoring of plant nutrition. From the conducted review, we found that satellite data can significantly support and facilitate the transition to organic farming, adequate fertilization, application in phytosanitary monitoring of crops, and assessment of crop stress.

Г7.4

Filchev, L., Dimitrova, M., Trenchev, P., **Chanev, M.,** Jelev, G.. From Space to Health: The Impact of Earth Observation Research on the Smart4COV19 Telemedicine project. IOP Conference Series: Earth and Environmental Science, 1418, IOP Publishing, 2024, ISSN:I1755-1315, DOI:doi:10.1088/1755-1315/1418/1/012049, 012049. SJR (Scopus):0.199 Линк

Abstract

This study investigates the potential of Earth observation research in improving air quality management and supporting telemedicine initiatives in response to the COVID-19 pandemic. Utilizing ground stations in Sofia and Burgas, we collected hourly measurements of N02, CO, PM10, and PM2.5. Satellite data from TR0P0MI-S5p and ground-based air quality observations were integrated to assess the spatial distribution of surface particulate matter concentrations. Our results demonstrate the feasibility of leveraging satellite-derived atmospheric chemistry data to enhance air pollution modeling and urban-scale air quality management. Furthermore, the technology developed for Burgas has the potential for expansion to other Bulgarian cities and replication in different urban centers. Overall, this research highlights the importance of Earth observation research in addressing critical environmental and public health challenges. Telemedicine via smartphones can help manage these risks by offering assistance to patients with mild symptoms, thereby minimizing their exposure to COVID-19 patients. The study also presents the findings of models used to convert TROPOMI - S5p aerosol data into PM concentrations in Burgas, Bulgaria.

Г7.5

Filchev, L., **Chanev, M..** Remote Sensing in Climate Change Research. Environmental Protection and Disaster Risks (EnviroRisks 2024), 883, Springer Nature Link, 2025, ISBN:978-3-031-74706-9, DOI:https://doi.org/10.1007/978-3-031-74707-6_17 , 147-166 Линк

Abstract

Remote sensing has been used for improving understanding of the climate system and its changes. It enables to monitor the Earth's surface, ocean and atmosphere at several spatio-temporal scales, thus allowing climate system observations, as well as investigating climate-related processes or long and short-term phenomena. Remote sensing techniques, and specifically satellite images, have been successfully used in a wide range of climate change fields, such as for (i) investigating global temperature trends, both at the ocean surface and in the atmosphere, (ii) detecting changes in solar radiation affecting global warming, (iii) monitoring aerosols, water vapour concentration, and changes in precipitation regime, (iv) studying the dynamics of snow extension and ice cover, (v) monitoring sea-level changes and coastal modifications, (vi) monitoring vegetation status and change, (vii) monitoring water resources and impact due to droughts and dry periods, (viii) monitoring fire events and fire emissions, (ix) predicting disaster risk, such as cyclone, floods, and drought, (x) guiding decision-making processes on climate change adaptation. In conclusion, remote sensing has been instrumental in climate change research by providing data and information about various aspects of the Earth system. It has allowed scientists to monitor changes in the Earth's climate system over time and to investigate the underlying processes driving these changes. This information is critical for understanding the impacts of climate change on our planet and for developing effective strategies for adapting to its effects.

Г7.6

Abdikan, S., Ganeva, D., Narin, O.G., Sekertekin, A., Dimitrov, Z., Bayik, C., **Chanev, M.,** Filchev, L., Ustuner, M., Esetlili, M.T., Sanli, F.B., Kurucu, Y.. Exploring Sentinel-1 and Sentinel-2 Time Series Sensitivity to Rice Height. 2024 IEEE International Workshop on Metrology for Agriculture and Forestry, MetroAgriFor 2024, Institute of Electrical and Electronics Engineers Inc., 2025, ISBN:979-835035544-4, DOI:10.1109/MetroAgriFor63043.2024.10948853, 672-676. JCR-IF (Web of Science):0.25 Линк

Abstract

The rice plant is one of the most widely consumed crops globally, and its height is a key indicator of growth. This study explored the relationship between rice plant height, measured in situ in Bulgaria and Türkiye, and multi-temporal data from Sentinel-1 and Sentinel-2 satellites to develop models for height estimation. The strongest correlation was observed when integrating the Radar Vegetation Index (RVI) and the Normalized Difference Vegetation Index (NDVI), yielding a correlation coefficient of r = 0.69. Additionally, using VV polarization in a multi-linear regression analysis resulted in the lowest error rate, with a root mean square error (RMSE) of 14.14 cm. The findings suggest that combining synthetic aperture radar (SAR) and optical data holds significant potential for accurately estimating rice plant height.

Г7.7

Saygin Abdikan, Dessislava Ganeva, Omer Gokberk Narin, Petar Dimitrov, Aliihsan Sekertekin, Zlatomir Dimitrov, Caglar Bayik, **Milen Chanev**, Lachezar Filchev, Mustafa Ustuner, Mustafa Tolga Esetlili, Fusun Balik Sanli, Yusuf Kurucu. LAI ESTIMATION OF PADDY RICE USING SENTINEL-2 VEGETATION INDICES. 2025 International Conference on Machine Intelligence for GeoAnalytics and Remote Sensing (MIGARS), Bucharest, Romania, 2025,, 2025, ISBN:979-8-3315-7920-3, DOI:DOI: 10.1109/MIGARS67156.2025.11231787, 1-4. JCR-IF (Web of Science):0.25 Линк

Abstract

The growing demand for rice products highlights the importance of maximizing yield and closely monitoring crop development. In this context, spectral vegetation indices (VIs) play a key role in characterizing plant growth. This study evaluated the performance of 20 vegetation indices derived from multi-temporal Sentinel-2 imagery for estimating the Leaf Area Index (LAI) in rice crops. In-situ LAI samples were collected at various phenological stages from selected regions in Bulgaria and Türkiye, in coordination with field campaigns conducted in parallel with Sentinel-2 image acquisition. Among the indices, GOSAVI showed the highest Pearson correlation with LAI ($r = 0.74$). The Random Forest algorithm was employed to estimate LAI from each index, with SAVI yielding the highest accuracy ($R2 = 0.59$, RMSE = 1.4). The findings indicate that it can effectively support practical and efficient LAI estimation with Sentinel-2 data for data collected from different regions and help improve rice crop monitoring studies.

Г7.8

Abstract

In recent years, remote sensing of the Earth's surface has greatly expanded in scope. This method has gained widespread use and has become a key part of archaeological research, providing a non-destructive approach. Within the framework of remote sensing for archaeological purposes, techniques such as aerial photography of archaeological sites in the visible spectrum, digital photogrammetry, and the creation of various spatial 2D and 3D models—such as orthophoto mosaics, digital surface models (DSM), and digital elevation models (DEM, DTM)—have been developed. Geographic Information Systems (GIS) help integrate data collected from satellite or unmanned aerial vehicle (UAV) images, along with subsequent processing and analysis. This study aims to highlight the development and application of UAV technologies and GIS, which have proven to be very useful, non-destructive methods in archaeological research. The analysis is based on information from scientific literature, showcasing the achievements of international researchers in this field, and field research carried out in the period 2022-2023. UAV flights were conducted over terrain in northern Bulgaria and Germany, and the data collected were processed using GIS software. UAV-based orthophotography proves to be a reliable alternative to traditional in situ archaeological surveys. In archaeology, GIS is used in two main ways: at a micro level, it is employed in surface surveys and archaeological excavations by improving the accuracy and efficiency of data collection and processing; and at a macro level, it is used to analyze individual sites in a broader geographical context or to identify patterns across multiple sites in a given region.

Г7.9

Abstract

As a respiratory disease, the epidemiological spread of Covid-19 may be influenced by atmospheric pollutants, particularly fine particulate matter. The aim of the present study is to examine the impact of air pollution on the spatial distribution of Covid-19. In this context, we utilize satellite data from the GOME-2 (onboard of Metop satellites series) and TROPOMI (onboard of Sentinel-5P) instruments, along with ground-based measurements, covering the period from June 2020 to July 2024, to construct the spatial distribution of particulate matter pollution over Bulgaria. Another significant atmospheric pollutant relevant to the Bulgarian context is NO2. Using satellite data from the TROPOMI instrument, we develop the spatial distribution of NO2. We analyze daily in situ data on the spread of Covid-19 across the 28 municipalities in Bulgaria in its correlation with the atmospheric pollutants. In this study, we present an assessment of the impact of the averaged pollution profile on the overall distribution of Covid-19 cases in the country.

Г7.10

Abstract

This review article provides a comprehensive analysis of Earth Observation (EO) applications for soil health assessment in Europe and abroad. The study explores the effectiveness of EO in capturing contextual information about various soil properties and conditions, as well as its role in monitoring soil health over time. The authors examine the current state of operational, semi-operational, and developing EO products and services relevant to soil health indicators. These include vegetation cover, forest cover, soil organic carbon, soil structure, landscape heterogeneity, and the presence of soil pollutants, excess nutrients, and salts. The review identifies gaps in existing knowledge and highlights potential areas for future research, such as improving spatial and temporal resolutions of EO products, developing better models for soil biodiversity assessment, and integrating EO data with ground-based measurements. The article discusses how contextual information derived from EO can contribute to sustainable soil management practices and policies in Europe. It also addresses technical challenges associated with EO applications in soil health assessment, including limitations in detecting subsurface soil properties and the need for improved data processing techniques. The authors conclude that while EO offers significant potential for soil health monitoring, further research and development are needed to fully leverage its capabilities for comprehensive and accurate soil health assessment across Europe.

Г7.11

Abstract

Over the past 50 years, various satellite missions have collected and provided data about our planet. Since the late 1980s, this data has also been used for archaeological research. The idea has emerged that archaeology can successfully use not only data from the visible spectrum but also from the infrared, NIR, and by combining data from several spectral channels. Thus, the application of vegetation and soil indices in archaeological studies gradually began. This report aims to present the possibilities for using vegetation indices in archaeological research generated from different satellite platforms. Several limitations in the use of vegetation indices for archaeological purposes are also noted, as well as some approaches to overcoming them. The study was conducted by searching for scientific publications with relevant keywords in established academic journals in databases such as ScienceDirect, Scopus, WoS, MDPI, ResearchGate, and Google Scholar. The analysis is based on information extracted from scientific literature presenting the achievements of various researchers in this field. Many of the studies are still experimental, aiming to refine the methodology for applying vegetation indices in archaeology. The main vegetation indices that have found application at this stage for identifying different archaeological structures are presented. The main satellite platforms used to generate the vegetation indices applied in archaeological research are also listed. This publication may be useful for future work in this direction. In a broader sense, it contributes to improving knowledge transfer within interdisciplinary research.

Г7.12

Abstract

Phenocams that capture images of a given area in the RGB or near-infrared (NIR) spectrum have been used for more than a decade to estimate phenology in natural landscapes and crop fields. The aim of our study is to estimate phenological parameters, start (SOS) and end (EOS) of season, for barley, from RGB and NIR Phenocam and compare them with in-situ observations from two sites, one with growing season 2014/2015 and the other with growing season 2021/2022. Time series of Phenocam Green Chromatic Coordinate (GCC) and Normalized Difference Vegetation Index (NDVI) were computed then scaled to Harmonized Landsat-8 and Sentinel-2 surface (HLS), available for both sites, and Sentinel-2 (S2), available for only one site, datasets. The HLS and S2 datasets were gap filled with classical and machine learning methods before the scaling. Phenological parameters were extracted from the scaled GCC and NDVI Phenocam data and from the gap filled HLS and S2 datasets. Our preliminary results show that the SOS can be modelled with one day difference compared with the in-situ observed with the scaled Phenocam NDVI and a week difference compared with the in-situ observed with gap filled HLS and S2 datasets with both vegetation indices.

Г7.13

Ganeva, D., **Chanev, M.,** Valcheva, Darina, Filchev, L., Jelev, G.. Modelling barley biomass from PHENOCAM time series with multi-output Gaussian processes. Proceedings of 22nd International Multidisciplinary Scientific GeoConference SGEM 2022, 22, 2.1, SGEM, 2022, ISBN:978-619-7603-40-8, ISSN:1314-2704, DOI:10.5593/sgem2022/2.1/s08.15, 123-129. SJR (Scopus):0.12 Линк

Abstract

Biomass is monitored in many agricultural studies because it is closely related to the growth of the crop. The technique of digital repeat photography that continuously capture images of a given area with an RGB or near-infrared enabled cameras, Phenocams, has been used for more than a decade mainly to estimate phenology. Studies have found a relationship between Phenocam data and above-ground dry biomass. In this context we investigate the modeling of barley fresh above and underground biomass with Green chromatic coordinate (Gcc) colour index, extracted from Phenocam data, and multi-output Gaussian processes (MOGP). We take advantage of the available very high temporal resolution data from the phenocam to predict the biomass. The MOGP models take into account the relationships among output variables learning a cross-domain kernel function able to transfer information between time series. Our results suggest that MOGP model is able to successfully predict the variables simultaneously in regions where no training samples are available by intrinsically exploiting the relationships between the considered output variables.

Научни публикации в рецензирани издания, неиндексирани в Scopus или WoS

Г7.14

Ganeva, D., **Chanev, M.,** & Filchev, L. Requirements for near-surface remote sensing data acquisition and processing as an alternative to traditional in-situ phenology observations of crops in Bulgaria. In proceedings seventeenth international scientific conference Space Ecology Safety 2021, Sofia, ISSN 2603 – 3313 p. 217 – 223 Линк

Abstract

PhenoCams networks have been operating for more than a decade over vegetated areas to estimate phenology. They apply digital repeat photography that continuously capture images of a given area with an RGB or/and near-infrared enabled cameras. For the first time in Bulgaria, as part of Pheno-Sense project, a PhenoCam will be installed and connected to the PhenoCam cooperative network (https://phenocam.sr.unh.edu/webcam/) that archives and distributes imagery and derived data products from digital cameras deployed at research sites across North America and around the world. The goal of this research is to identify the requirements for near-surface remote sensing data acquisition and processing as an alternative to traditional in-situ phenology observations for crops in Bulgaria.

Г7. 15

Chanev, M., Filchev, L., & Valcheva, D. (2022). Methodology for remote sensing monitoring of organic wheat crops. Ecological Engineering and Environment Protection, ISSUE 2/2022, ISSN:1311–8668 p 56-59. Линк

Abstract

In the presented methodology for aerospace monitoring of autumn wheat crops, grown under the conditions of organic farming, the ways of applying ground and aerospace methods are discussed in detail. This includes field experiments, phenological observations, GIS and remote sensing methods and data (data from Sentinel-2 satellite and WingtraOne unmanned aerial vehicle with MicaSense RedEdge-MX multispectral camera and RGB camera) and statistical analyses. In order to achieve the aim and objectives of the study, an experiment was conducted on a organically certified production field sown with einkorn (Triticum monococum) in the period 2020-2021. The field is part of the holding of ET "Borislav Slavchev" in the village of Byala Reka, Parvomai Municipality, South-Central Bulgaria on the soil type of leached chernozem clays, with a size of 136 da.

Г7.16

Чанев, М., Попов, П., Александров, К.. Приложение на безпилотните летателни платформи в археологическите изследвания. Proceedings SES 2023, Space Research and Technology Institute Bulgarian Academy of Sciences, 2023, ISSN:2603-3313, 219-225 Линк

Abstract

Аерокосмическите методи традиционно намират голямо приложение в археологията. Проблемът при тях е, че са скъпи и с ниска времева и пространствена разделителна способност. С развитието на технологиите през последните години системите за безпилотни летателни апарати (БЛА) стават все по-подходящи за прилагане в археологията [Rinaudo et al. 2012]. Последните подобрения в БЛА платформите и анализа на обработката на изображения могат да бъдат използвани в подкрепа на археологическите изследвания. През последното десетилетие в литературата се съобщава за увеличеното използване на сензори за дистанционно наблюдение и техните продукти за археологически науки и проучвания на културното наследство [Argyrou et al. 2023]. В този доклад са представени част от възможностите, които БЛА и представят за археологически изследвания. Необходимо е да се спомене, че в доклада не са разгледани всички типове сензори и данни, които могат да се предоставят от БЛА платформите. Данните от БЛА помагат на археолозите за онагледяване на фактическата обстановка, както в самите археологически обекти така и за забелязване на детайли, невидими от земята и позиционирането им в околния ландшафт. Данните придобити от БЛА се доказват като много ценни при археологически изследвания, но са необходими още изследвания в тази област.

Г7.17

Чанев, М., Филчев, Л., Бончев, Б., Вълчева, Д., Желев, Г.. Сравнителен анализ между два типа на обработка на данни, получени чрез БЛА от биологично поле от лимец (*Triticum Monococcum* L.). Proceedings SES 2022, Space Research Technology Institute Bulgarian Academy of Sciences, 2022, ISSN:2603-3313, 216-222 Линк

Резюме

Целта на настоящото изследване е да се установи кой тип на обработка на данни получени от безпилотен летателен апарат (БЛА) е по-подходящ за прогнозиране на добивите от културата лимец отглеждана в условията на биологично земеделие. Сравнението е направено между данни получени от БЛА на ниво пиксел с големина 7 × 7 cm и при агрегиране на пикселите до големина на пиксела 1 × 1 m. Експериментът е проведен през стопанската 2020–2021 г. на сертифицирано биологично поле, намиращо се в община Първомай, област Пловдив.

Г7.18

Чанев, М., Филчев, Л., Бончев, Б., Вълчева, Д.. Приложение на вегетационните индекси генерирани от БЛА за определяне добива на биологичен лимец (*Triticum monococcum* L.). Proceedings SES 2022, Space Research and Technology Institute Bulgarian Academy of Sciences, 2022, ISSN:2603-3313, 211-215 Линк

Резюме

Целта на настоящото изследване е да се установи група от вегетационни индекси генерирани от данни получени от безпилотен летателен апарат за прогнозиране на добивите от лимец отглеждан в условия на биологично земеделие. Експериментът е проведен през стопанската 2020-2021 г. на сертифицирано биологично поле, намиращо се в община Първомай, област Пловдив.

Г7.19

Михаела Цветкова, **Милен Чанев**, Николай Долапчиев. Приложения на дистанционните методи и географски информационни системи в горската екология. Екологично инженерство и опазване на околната среда, 3, 2025, ISSN:1311-8668, 28-42

Резюме: През последните десетилетия дистанционните методи и географските информационни системи (ГИС) се утвърдиха като едни от най-важните инструменти за наблюдение, анализ и устойчиво управление на горските екосистеми. Тези технологии дават възможност за проследяване на големи територии с висока пространствена и времева резолюция, което значително подобрява оценката на биомасата, здравословното състояние на горите, пожарите и влиянието на човешката дейност. Обзорът представя развитието на основните сателитни и въздушни платформи (Landsat, Sentinel, MODIS, LiDAR, UAV), използваните вегетационни индекси (NDVI, EVI, NDMI, NDRE, CCCI) и аналитични подходи (машинно обучение, статистическо моделиране, интеграция на климатични данни). Разгледани са водещи международни и български изследвания, очертани са ключовите предизвикателства и са предложени насоки за бъдещи приложения. Резултатите от анализа показват, че комбинирането на дистанционни данни с ГИС и съвременни алгоритми на изкуствен интелект значително подобрява точността при оценка на състоянието, структурата и продуктивността на горите. Подчертава се нуждата от по-добро калибриране на моделите чрез теренни наблюдения и комбиниране на различни типове данни – оптични, радарни и лазерни. В заключение, дистанционните технологии и ГИС предлагат устойчив и ефективен подход за опазване и управление на горските ресурси в условията на климатични промени и засилено антропогенно въздействие.

Г7.20

Chanev, M., Bonchev, B., Valcheva, D., Filchev, L.. Using satellite data to identify heterogeneity in wheat crop development from organic einkorn. Proceedings, 9th International Conference on Cartography and GIS, 16-21 June 2024, Nessebar, Bulgaria, Bulgarian Cartographic Association, 2024, ISSN:1314-0604, 164-170 Линк

Abstract

The BBCH (Biologische Bundesanstalt, Bundessortenamt and Chemical) scale was used to determine crop phenology. Ground data were collected in phases BBCH 29, 45 and 75. In phase BBCH 29, zones with three differences in the vegetation index NDVI were determined, respectively NDVI – 0.86, 0.74 and 0.63. In the field, in the three zones with different NDVI values, a permanent plot of 10×10 m was organized, at the end of which markers were placed, permanent plots were organized and GPS coordinates were taken. From these four permanent plots, during the phenological phases BBCH 29, 45 and 75, biometric measurements were performed. Statistical processing of the data proved the differences in the field. This suggests that vegetation indices can be generated and studied from data generated by the Sentinel-2 satellite to describe crop condition as described by land mass values.

Г7.21

Filchev, L., Dimitrova, M., Trenchev, P., Jelev, G., **Chanev, M.,** Cahyadi, M.. Preliminary Results from Smart Integrated Devices for Telemedicine to Combat COVID-19 Toward New Resilience City - Smart4COV19/Telemedicine Project. Proceedings of 3rd National Workshop with international participation under the EU Copernicus programme, Space Research and Technology Institute, Bulgarian Academy of Sciences (SRTI-BAS), 2023, ISBN:978-619-7490-16-9, DOI: https://doi.org/10.5281/zenodo.10439070, 56-63 Линк

Abstract

The primary goal of this research is to create a health integration system for the swift identification of COVID-19 and similar pandemic infections. Given the rapid transmission rate of this disease, it's crucial to develop advanced technology to prevent human-to-human transmission.

This system incorporates a 3D tool that utilizes a combination of GNSS (Global Navigation Satellite System) on smartphones, affordable GNSS, and LIDAR. These components generate a smart 3D city model for tracking individual information, accessible via a smartphone app linked with GNSS positioning and a COVID-19 spatial database. Additionally, the system includes environmental monitoring to assess the correlation between weather, air pollution, and COVID-19 risk. Telemedicine via smartphones can mitigate these risks by providing support to mildly ill patients, reducing their exposure to COVID-19 cases. The results of models for converting TROPOMI – S5p aerosol data to PM concentrations over Burgas, Bulgaria are also outlined.

Г7.22

Kamenova, I., **Chanev, M.,** Dimitrov, P., Filchev, L., Jelev, G., Dong, Q., Zhu, L.. Evapotranspiration estimation, case study in Bulgaria within Dragon-5 program. Proceedings SES 2023, Space Research and Technology Institute Bulgarian Academy of Sciences, 2023, ISSN:2603-3313, 182-186 Линк

Abstract

This publication comprises some results from Dragon-5 project "ID.57160: Monitoring Water Productivity In Crop Production Areas From Food Security Perspectives". Accurately measuring the amount of water (e.g., evapotranspiration—ET) and energy (e.g., of latent and sensible heat) that are exchanged at the Earth's surface is crucial for various applications in fields such as meteorology, climatology, hydrology, and agronomy. Having reliable estimations of these fluxes, particularly of ET, is considered essential for effective natural resource management. The distributed ET models are important tool for policy planning and decision-making in terms of calculating the water productivity in agricultural crops. However, the model calibration and validation present a crucial challenging task. The Sentinel-2 and Sentinel-3 satellite constellation contains most of the spatial, temporal and spectral characteristics required for accurate, field-scale actual evapotranspiration (ET) estimation. The one remaining major challenge is the spatial scale mismatch between the thermal-infrared observations acquired by the Sentinel-3 satellites at around 1 km resolution and the multispectral shortwave observations acquired by the Sentinel-2 satellite at around 20 m resolution. The Sen-ET SNAP Plugin bridges this gap by improving the spatial resolution of the thermal images. We have implemented the model for Purvomaj municipality study area in Bulgaria.

Г7.23

Чанев, М., Филчев, Л., Каменова, И., Митева, Н. Определяне на добивите от биологичен ечемик по сателитни данни от Sentinel-2. Proceedings of 3rd National Workshop with international participation under the EU Copernicus programme, Space Research and Technology Institute, Bulgarian Academy of Sciences (SRTI-BAS), 2023, ISBN:978-619-7490-16-9, DOI:https://doi.org/10.5281/zenodo.10438947, 22-27 Линк

Резюме

Настоящото изследване е проведено през селскостопанската 2022-2023 г. в землището на с. Бяла река, община Първомай в централна южна България. Наземните данни за добива са събрани от биологично сертифицирано поле засято с ечемик, което е част от стопанството на ЕТ „Борислав Славчев".
За идентифициране на фенологичните етапи на развитие на посева беше използвана скалата BBCH за житни растения. Данните от сателита Sentinel-2 бяха получени от платформата EOSDA LandViewer. Вегетационните индекси бяха генерирани в същата платформа като бяха подбрани такива, който са използвани в релевантни изследвания в конвенционалното земеделие. Използвани са четири изображения съответно за фенологичните фази BBCH-21 начало на братене, BBCH-30 вретенене, BBCH-51 изкласяване и BBCH-77 край на млечна зрялост. Стойностите на пикселите бяха извлечени чрез ГИС софтуера ArcGIS Pro. При достигане на фаза технологична зрялост BBCH-99 бяха събрани наземни проби за измерване на биологичният добив. С получените наземни и сателитни данни беше извършен корелационен анализ, като се установи кои вегетационни индекси са най-подходящи за определяне на добивите и в коя вегетационна фаза.

15

Г7.24

Abstract

Due to climate changes, a number of changes are observed in the world's oceans, such as a change in the amount of thermal energy and water temperature, a change in sea and ocean currents, as well as an increase in acidification. These changes lead to a change in sea water as a habitat for marine ecosystems. Since the beginning of the new millennium, many scientific researches have been focused on monitoring and studying ocean acidification as an important indicator of climate change. The use of satellite remote sensing data to study ocean acidification is gaining wide application and is emerging as a major research method in the near future. It enables continuous near-real-time monitoring, both globally and regionally. The aim of the present study is to investigate and evaluate the possibilities of applying the models for the study of marine acidification using satellite data for a limited coastal area in the Black Sea region. A review of the publications in various scientific databases related to the major projects of international and governmental organizations such as UNESCO, IALA, EC, NOAA, etc. was made. The study takes into account the gaps in the information on the acidification of the Bulgarian coastal waters by exploring the possibilities for satellite remote monitoring, which would allow the creation of spatio-temporal and prognostic models. The global and regional coastal studies of seawater acidification with satellite data, as well as the satellite studies of the Black Sea carried out so far, give us hope that in the near future we will be able to successfully apply satellite remote sensing methods in regions such as the Bulgarian coast. However, there are currently no data on quantitative analyzes based on satellite data for the Black Sea, such as the calculations of the parameters of the carbon cycle in sea water. This leads to the impossibility of conducting satellite monitoring of acidification in our region at the present time.

Г7.25

Abstract

The development of Geographic Information Systems (GIS) has profoundly transformed archaeological research by enabling precise spatial data acquisition, long-term storage, and advanced analysis. Initially emerging in the 1960s for land-use and urban planning, GIS has evolved into a multidimensional analytical platform supporting complex modelling, pattern recognition, and sophisticated visualisation. In archaeology, GIS facilitates rapid and accurate digital documentation in the field, particularly when integrated with complementary technologies such as UAVs, GPS, and Structure from Motion photogrammetry, as well as the execution of intricate spatial analyses.

This paper illustrates its field applications through two case studies: a UAV-based aerial survey around Varbitsa, Bulgaria (2022–2024), investigating the topography of three newly discovered sites, and the use of GIS and SfM modeling during rescue excavations at Schwäbisch Hall-Hessental, Germany (2022–2023), enabling precise documentation of a Middle Neolithic long house. In both cases, GIS supported accurate mapping and the integration of heterogeneous datasets, enhancing interpretative potential. These examples demonstrate that GIS functions not merely as a mapping tool but as a comprehensive platform for archaeological documentation and analysis, which enhances the interpretation of archaeological contexts and ultimately our understanding of past societies.

Г7.26

Георги Желев, Лъчезар Филчев, Мария Димитрова, Пламен Тренчев, **Милен Чанев**. ГИС база-данни по проект smart integrated devices for telemedicine to combat covid-19 toward new resilience city. Proceedings Twenty-first International Scientific Conference Space, Ecology, Safery 2025, 2025, ISSN:2603-3313, 341-346 Линк

Абстракт
Географските информационни системи предоставят възможност за оценка на риска свързан с различни рискови фактори, картографиране на различията, също за сравнения на карти на заболявания. Чрез използване на пространствени данни могат да се създадат здравни модели и чрез тях много по-добре да разберем рисковете за здравето възникващи за населението. Създадена е ГИС базата данни за избрани тестови райони – гр. София и гр. Бургас, включваща референтни данни, спътникови данни (метеорологични данни, данни за атмосферно замърсяване), данни за заболяемост от COVID-19 и данни от наземни измерванията със сензори на IQAir. Базата данни е основа за провеждания непрекъснат мониторинг на чистотата на въздуха в двата района. Анализирана е взаимовръзката между атмосферното замърсяване и заболеваемостта от COVID-19. Създадена е мрежа от сензори за отчитане на фините прахови частици в дадените райони.

Г7.27

Желев, Г., **Чанев, М.** Разпознаване на обекти върху спътникови изображения. Екологично инженерство и опазване на околната среда, 3, 2025, ISSN:1311–8668, 5-27 (Г7.28)

Абстракт

Дистанционните наблюдения получават бързо развитие през 60-те години на миналия век във връзка с бързия напредък на космическите изследвания и необходимостта от идентифициране (интерпретация) на обекти на земната повърхност от получените изображения. Статията разглежда както методите за дистанционно наблюдение, така и обектите на интерпретация. Разпознаването на изображения и обекти е ключов процес в анализа на данни, който включва класифицирането на елементите в различни категории. Те могат да бъдат класифицирани според различни критерии, като произход, размер и отражателна способност, наред с други. Физико-математическите и географските фактори служат като фундаментални основи за класификацията. Интерпретацията може да бъде общогеографска, предоставяща информация за земната повърхност, или тематична, фокусирана върху специфични характеристики.

Процесът на разпознаване и интерпретация е от съществено значение за многобройните приложения на дистанционното наблюдение, включително анализа на земната покривка и организацията на пространствените данни. Дистанционното наблюдение е разработено през 60-те години на миналия век във връзка с интензивното развитие на космическите изследвания и необходимостта от разпознаване (дешифриране) на обекти на земната повърхност от получените от тях изображения. Разпознаването на образи и обекти е ключов процес в анализа на данни и включва класифицирането на елементите в различни класове. Те могат да бъдат класифицирани според различни критерии, като произход, размер и отражателна способност и др. Физико-математическите и географските фактори се считат за основни при класификацията.

Г7.28

Желев, Г., **Чанев, М.** Използване на спектрални индекси и комбинация от спектрални канали в различни цветови модели за картографиране на спътникови изображения. Екологично инженерство и опазване на околната среда, 3-4/2024, 2024, ISSN:1311-8668, 26-47

Abstract

This paper discusses the intended use of spectral index and color (RGB) composite images obtained by theSENTINEL-2 pair of satellites as part of the space segment of the European Copernicus Earth observation program. The characteristics of the spectral channels are presented for their application in environmental studies. Some of the most used composite and index images generated by the SENTINEL-2 spectral channels are described in more detail, as well as their main application in the analysis of object characteristics by remote sensing. It is found that the NDVI vegetation index is most widely used mainly in precision agriculture and forest monitoring. The color composite and index images generated by the SENTINEL-2 pair of satellites find application in modeling and analyzing different stages of development of various types of agricultural crops, as well as predicting their yields, tracking vegetation, detecting disturbances caused by abiotic, biotic and anthropogenic origin in forest areas.

The data obtained by the SENTINEL-2 pair of satellites allow to assess the severity of burning in a given area, as well as the consequences of a fire and its size. This type of data also makes it possible to assess the degree of recovery after a fire in a given area. SENTINEL-2 data are also used for environmental monitoring and protection.

Г7.29

Chanev, M. Problems and perspectives in organic cultivation of cereals - overview. Ecological Engineering and Environment Protection, 2021, 2, National society Ecological Engineering and Environment Protection, 2021, ISSN:1311-8668, DOI: doi.org/10.32006/eeep.2021.2.6675, 66-75 **(Г7.30)** Линк

Abstract: In this study, an overview is made and a comparative analysis of articles, reports and materials dealing with organic farming of LWC, in the period 1970 to 2021 is performed. After analysing the literature, the following conclusions are made: Cereals occupy a particularly important place in organic farming, the main advantages of their cultivation are easy farming techniques, relatively easy mechanical weed control, disease control through rational crop rotation, opportunities for biological control of major pests. The soils in organic farming are better structured than those in conventional agriculture. Organic

farming practices are related to improving soil properties, including the addition of organic matter to the soil, increasing the population of earthworms, biodiversity, soil fertility and more. Biological management provides a more stable soil structure. The larger pores observed in biological management have a beneficial effect on the physical properties of the soil, such as water flow and water capacity. The greater porosity of the soil provides a good habitat for soil microorganisms. Organic farming contributes to creating a better soil structure. Organic farming systems have traditionally been based on crop rotation. The aim of organic farming is to achieve a balance between crops that reduce soil fertility and crops that restore fertility. Crop rotation is the main tool that integrates the maintenance and development of soil fertility with various aspects of plant production in biological systems. Specialised selection programmes for creating varieties suitable for organic farming are too few due to the small number of users and high costs. The most common practise includes testing the suitability of conventional varieties in biological conditions, propagation and distribution of the best in the biological sector. Sowing norms directly control the sowing density, as well as the nutrient area of each plant. Changing sowing rates is also an excellent method for controlling weeding in biological fields. Concerning yields from organic and conventional agriculture, organic farms are less productive than conventional ones and their productivity is lower. But if environmental variables are taken into account, organic farms show the same or higher efficiency. A major problem facing organic farming in the future is the protection of fields from pollution by genetically modified organisms. An option for protecting biological fields is to maintain a buffer zone between the farm and the neighbouring conventional fields to prevent accidental contamination with GMOs

Група „Г 8"

Публикувани глави от колективни монографии

Г8.1

Chanev, M., Filchev, L., Kamenova, I.. Estimation of Water Use Efficiency for Winter Cereals Through Evapotranspiration Using Remote Sensing Data. Climate, Environment and Agricultural Development, Springer Nature Link, 2024, ISBN:978-981-97-8362-5, DOI:https://doi.org/10.1007/978-981-97-8363-2_9, 15, 129-144 Линк

Abstract

The study presents findings on the assessment of actual evapotranspiration across croplands using vegetation index data, facilitated by the Google Earth Engine platform. This research emphasizes the importance of remote sensing in understanding water requirements for crops, contributing to improved agricultural practices and water management strategies. By employing methodologies that integrate remote

sensing measurements, the study aims to enhance the understanding of crop water productivity and its implications for sustainable agriculture. The results underscore the significance of monitoring vegetation health and water use efficiency, which are critical for addressing challenges related to agricultural drought and climate variability. Overall, the findings provide valuable insights for stakeholders in agriculture and environmental management, promoting informed decision-making to optimize resource use and enhance food security.

Г8.2

Chanev, M., Kamenova, I., Filchev, L.. Remote Sensing Monitoring of water productivity in agricultural crops - a review. River Conservation and Water Resource Management, Springer Singapore, 2023, ISBN:978-981-99-2604-6, DOI:https://doi.org/10.1007/978-981-99-2605-3_2, 17-26 Линк

Abstract

Water use efficiency and water productivity are becoming increasingly important for food security. The role of sustainable food production is emphasized by UN SDGs and is of particular importance in the new decade, where also water scarcity issues are going to exacerbate due to climate change and anthropogenic factors. The chapter will review the remote sensing applications in the peer-reviewed literature published in the past 10 years and focuses on the prospective new applications.