UN/Romania International Conference on Space Solutions for Sustainable Agriculture and Precision Farming

LIST OF ABSTRACTS

Session 1: Space for Sustainable Agriculture and Precision Farming

Applications of digital soil mapping for precision agriculture in developed and developing countries

John Triantafilis - UNSW Sydney, Australia

Soil and water security are increasingly important considerations for developed and developing countries. This is because increasing urbanisation and demands on irrigation are placing great stress on the soil and water resource and owing to degradation of the environment from inefficient fertilisers application (pollution) and rising water tables (salinisation). Information about how soil and water resources vary in space and time are therefore required to manage these resources through precision agriculture and improves fertiliser and water application rates. In this presentation, some of the latest 3-d mapping and monitoring methods will be described with case studies presented from developed countries (e.g. Australia, US, UK, Portugal and Spain) and developing countries (e.g. Morocco, Iran, India, China and Thailand). The presentation will include ground-breaking research in the application of state-of-the-art multi-coil electromagnetic (DUALEM-421) data and cutting-edge-software (EM4Soil) to make 3-d maps of soil physical (clay) and chemical (salinity) properties; with special application in time-lapse soil moisture monitoring in irrigated alpha-alpha (US) and cotton (Australia). The presentation will also demonstrate fusion of EM and gamma-ray spectrometry data to map individual soil properties to manage pH in the UK and identify management zones which can be used to ameliorate sodicity (e.g. ESP) in India and Australia. The applications emphasise the application of geospatial data derived from proximal soil sensing instruments and with heavy reliance on satellite-borne GPS units and data.

Assessment of nutrients and organic matter balance response to fertilization and programmed crop yield

Elina Zakharchenko - Sumy National Agrarian University, Ukraine

Sustainable farming is determined by three key principles as soil health, economic benefits, social and social responsibility. If everything is clear with economic benefits, the conscious farmers always remember about the health of the soil, but those who rent the land for a short time will not see the result of their activity that lead to soil degradation. Farmers use new highly productive varieties and hybrids of crops, which intensively uptake take nutrients from the soil, and, accordingly, from organic substances. Harvesting, plant residues remain on the field for further decomposition and protection of soil from water and wind erosion. It should be noted in Ukraine in the 1960s 11.5 t/ha of manure was applied to 1 hectare of arable land in the country, at this moment - less than 0.5 t/ha. The number of livestock farms has decreased and soil degradation is visible - a negative balance of nutrients and humus. However, the use of green manure and soil protection tillage gives positive result to stable situation. By the way, a small part of the straw now goes to get biogas.

It is necessary to encourage experiments with high yield-crops, which need to applying more fertilizers and thereby will increase the uptake of nutrient from the soil. The balance method is usually ised to determine the rate of fertilizers. When calculating the balance of humus, the coefficients of humification and mineralization under each crop are estimated, taking into account its yield. The higher the crop yield, the more deficiency of nutrients could be especially under removing of straw from the field and without fertilization. Leaving crops residue on the surface or incorporate it, content of mobile forms potassium increases with a significant decrease in the deficit of phosphorus and nitrogen. If the deficit of nutrients is set under fertilization, it shoul be determined the dependence of the increase of yield depend on the norms of fertilizers. The increase in crop yield can be calculated by the method, the essence of which is to assess the increase in crop yield from the rate of fertilizers, which is described by dome-like dependence. We have calculated similar dependencies for chernozem and gray soils for the main crops, for example, for winter wheat ΔУ = -0.82x2 + 6.94X (centner/hectare), where ΔУ is the growth of crop yield (centner / hectare) from applying fertilizers (X, centner of the active substance / hectare). The humus balance and programmed yield level should be analysed. Next steps are estimation of natural fertility (without using fertilizers), calculations of the deficit of elements (no fertilization), the increase of yields from mineral fertilizers and fertilizer required rate (and the ratio of nitrogen, phosphorus and potassium), calculation of additional deficiency of elements of the use of fertilizers and the total deficit of elements in the soil by the formula (semigraphical method).

Technology for Local and Regional-Scale Assessment of Agricultural Landscape Dynamics Within the Framework of EU Common Agriculture Policy (CAP)

Mihai Alexandru Chitea, Olimpia Copacenaru, Elisabeta Rosu, Cristian Flueraru, Violeta Florian, Doru Mihai - Institute of Agricultural Economy, Romanian Academy

Mapping crop types in support of sustainable agriculture and precision farming

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Satellite applications in the agriculture has a long history. Crop type mapping is one of key applications and also the fundamental product to support sustainable agriculture and precision farming. In recent years, many high resolution satellite data become freely available for the agricultural applications. The high resolution satellite series, short name for GF, are being developed in China. GF-1 data has a 16 meters ground sampling in 4 bands, such as blue, green, red and near infrared spectra. In Europe, the Copernicus project ensures the stable Sentinel satellite series and provides multispectral and 10-meter resolution optical satellite images to the worldwide end users. USGS's LANDSAT 8 data has been accessible free of charge online since 2013. These satellite images become the rich data sources for the crop type mapping with the machine learning algorithm nowadays. In support of the provincial agricultural monitoring, we have developed an approach to use GF, Sentinel 2 and Landsat 8 images to mapping crop types in irrigation area of the yellow river of Ningxia, China. Field sample photos were taken with the GPS camera in summer 2017 and 2018 respectively and thereafter the crop types for the ground truth data were interpreted with a software, named GPS Photo Data Processor. With the support of these ground truth samples, more samples for the training and validation were further visually added over a clear sky image in key crop growth stage. The Random Forest was used as the classifier for this study as many literatures have reported that the RF algorithm overperformances other algorithms in many cases, such as SVM, Maximum Likelihood. The classification results of crop type

map were evaluated with the error confusion matrix, in particular, OA (overall accuracy) and F1 Score. The performance for crop type mapping with time series of each of these 3 kinds of data sources was analyzed and compared. The preliminary results show that the accuracies were between 84-93%. The accuracy of crop type mapping with GF data was the lowest due to less bands and other limitations. The accuracy of crop type mapping with all bands of Sentinel 2A/B reached the highest due to more key bands and higher resolution while the accuracy of crop type mapping from Landsat 8 was slight lower than Sentinel 2. The utilization of huge volume of the high-resolution satellite images is challenging to the researchers.

Resolving food security through technology

Maria Zubair - Punjab Information Technology Board, Pakistan

Number of personal computing devices are ever growing since 1990s in form of personal computers, laptops and smart phones. This rapid increase is resulting in global environmental concerns like energy consumption and climate change. Recently, a lot of work is being done to find energy-efficient solutions for high-performance computing that can decrease overall energy consumption. On the other hand, it is a well-known fact that resources are underused most of the time. In this paper, we explore BOINC to harness the computing power of idle resources for identification of crops using satellite data which itself is a CPU-intensive task. There is no such thing as environment friendly computation. However, when the costs of computing are low to zero and resources currently at hand are deployed then it becomes a resource friendly computation. Several approaches have been explored in this regard and most countries across the globe are benefiting from those. However, developing countries face the challenge of using crop yield prediction computation tools which are costly. Volunteer computing is not only cost effective, it is also energy efficient as it eliminates the need for additional machines. Crop classification and yield estimation using high resolution multi-spectral imagery of Sentinel 2A of 1 tile applying QGIS's maximum likelyhood (MLH) takes 5 to 6 hours (depending on the number of signatures) with no pre-processing accounted for.

The impact of climate change on rice production in Thailand

Jainta Chomtoranin, Eric Strobl, Robert Elliott, Elodie Blanc - University of Birmingham; Ministry of Agriculture and Cooperatives of Thailand

We estimate climate change impacts on rice production in Thailand during 2001-2014, covering two main rice growing seasons: rain-fed and irrigated rice seasons. We employ a synergy of remote sensing, econometric analysis, and climate change prediction to evaluate the impact of climate change on rice production, aiming to obtain more accurate and timely results. Initially, we apply a satellite product named MODIS/Terra Surface Reflectance 8-day L3 Global 500m SIN Grid V005 (MOD09A1). In this regard, we modify the rice field detection algorithm to detect three major rice ecosystems at 500-m resolution across the country. We then determine the current climate change impacts using econometric analysis to evaluate factors that might affect rice production. To this end, we estimate the variation of spatial precipitation and temperatures in rice production locations derived from Tropical 307 Rainfall Measuring Mission (TRMM) and MODIS Land Surface Temperature instead of climate statistics from weather stations. These climate variables then link with the rice pixels. This approach enables us to capture directly the climate variation effect covering large rice production areas on a very localised scale, removing all non-rice pixels. We also examine the impact of climate change on rice

production loss areas for the two rice seasons. The findings indicate that rain-fed rice relies solely on the amount of precipitation, whereas irrigation water is crucial for irrigated rice. Both minimum and maximum temperatures have less effect on the two rice seasons. Interestingly, the rice pledging scheme, can induce rice farmers to grow irrigated rice for multiple cycles. In addition, an expansion of rice field can help to increase the yield of both rice seasons, while fertiliser application benefits only rain-fed rice. Moreover, the study results show that weather fluctuation has more adverse effects on rain-fed rice than on irrigated rice, causing rice production areas loss for rain-fed rice significantly. We estimate the future climate change impact on rice production using six climate models. We also link climate factors with the rice pixels to specify the weather variation effect directly on the rice fields, removing all non-rice growing areas from our analysis. In this regard, we propose a new method to project irrigation water since the water is essential for irrigated rice. The results indicate a rising trend of precipitation and irrigation water over the 21st century for the two crop cycles. Additionally, the projected minimum temperature tends to decrease whilst the projected maximum temperature is likely to increase over the 21st century. Rain-fed rice yield tends to decrease whereas irrigated rice yield is likely to increase over the same period.

Innovative digital solutions for a sustainable and productive Agriculture

Joe Cotti - Airbus DS, Germany/France

Global Supply Chain and Satellite Technology to Support the Agriculture Sector in Central America

Luis Alfaro - El Salvador Aerospace Institute, El Salvador

Agriculture is undoubtedly one of the most important sectors for the human being; Agriculture is the provider to meet the needs, basic nutrition, proper use and distribution of land. Historically, agriculture occupies a privileged position in the use of land and is also one of the sectors with the greatest water use for its sustainability. This situation is related both directly and indirectly to our societies in daily life. Curiously, the countries that are less developed are those who have a higher percentage of exploitation of this sector, mainly dedicated to the production of one or two agricultural products that are used for export rather than local consumption. A potential way to reach a high level of distribution, export, supply chain operations, etc. it can be possible by doing a combination of agriculture and technology, so that a path to achieve better distribution, monitoring and equity in the use of land. Being the case of space technology, a journey of remote monitoring techniques, data analysis, this sector can achieve better benefits. This document is a conceptual framework developed by its author and pretends to achieve the necessity to explore more deeply the use of aerospace technology in Central America, taking into account the small progress that are already available, but ultimately, it still lacks points to a precedent for the favor of doing a better economy. As the aerospace technology in the coming years may be a priority activity in developing countries of the region, the diversify to connect the adoption of global sustainability goals promoted by the UN agency is a mandatory statement. The theoretical framework and the use of satellite image proposed in this research, require a rethinking of the current situation of public policies, and the search for a greater regional in terms of sustainability of agriculture and aerospace technology as a tool for progress.

Session 2: Space for Sustainable Agriculture at the national level

Remote sensing and geospatial databases for the Brazilian agriculture sustainable development

Edson Luis Bolfe - Brazilian Agricultural Research Corporation (Embrapa), Brazil

The global consumption of food, water, fibers and energy is growing at exponential rates. Nowadays, Brazil has become a player of the world economy by becoming an important agricultural producer and the country has technical and agronomic conditions to produce with quality and sustainability. However, there is need for a more site-specific natural resource management for judicious use of agricultural inputs to promote productivity and also ecosystem services. This is particularly urgent as population in rural areas are migrating to cities for several reasons. Science can decisively contribute with sustainability the agriculture through management procedures which use remote sensing and precision farming. Remote sensing monitoring plays a critical role in supporting strategic decision-making and the definition of private and public policies. New research and innovations are changing rapidly due to advances in information technology and geotechnology, supported by greater data availability, new processing algorithms, data fusion, and developments in data mining. This paper objective to present actions of Embrapa (Brazilian Agricultural Research Corporation) and collaborating organizations in the application of remote sensing and geospatial databases in the planning of Brazilian agriculture in the context of the 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015 [6]. The Brazilian processes of agricultural/forestry expansion, contraction, conversion, degradation and diversification are complex and require innovative, fast and accurate approaches for spatial analysis. Will be presented results of: i) Land-use and land-cover mapping of the Brazilian Savanna based mainly on satellite images; ii) Modelling and mapping agroforestry aboveground biomass in the Brazilian Amazon using airborne lidar data; iii) Assessment of the pastures conditions in the Brazilian Savanna by means geotechnologies; iv) Rural development: the importance of geographical indications; and v) Brazilian agricultural geodatabase: strategic planning and development. The results of these actions support public and private decision-making in rural planning and collaborate with the 17 Sustainable Development Goals (SDGs). Highlighting: i) knowledge of technology & innovation about the adoption of techniques and technologies with adequate agriculture and ecosystem management; ii) integrated applications of remote sensing and geodatabase providing solutions and information for planning and implementation of agricultural projects to public and private; iii) use and applications of the emerging space technologies like LiDAR, WebGIS, Big Data for agriculture planning and natural resources monitoring towards more sustainable rural practices.

Beneficial uses of space technology in the Mexican Agroalimentary sector

Verania Echaide - Mexican Space Agency, Mexico

Mexico is a country that stands out because of the heterogeneous and specialized nature of its agricultural regions. As a result, activities are carried out with very unequal levels of productivity and wages. In recent years, this situation has intensified in such a way that globalization has unevenly transformed the economic structure of countries. National economies have been integrated by very diverse agents that cooperate and compete at the same time in the same markets, thus becoming very complex economic and productive systems. The interactions generated from the above are not stable, they change over time and generate very dissimilar technological trajectories and productive results in the regions. The Mexican agrifood sector is currently undergoing a series of adjustments and

technological changes that have affected its basic production structure. Such changes have occurred in agrarian property and in the intensification of productive rhythms. This situation is evident in the rapid technological and productive specialization of agricultural regions. In that sense, a shared assumption is that the use of technology in the agricultural sector has served as a mediating tool between man and nature; hence, its basic function in theory has been to contribute to transforming natural resources into inputs for the benefit of people who live in the countryside. As well as agriculture, Mexico has valuable resources in the scientific and academic field, so the sum of this human capital with innovative actions and technologies offers a great potential and positive impact for the well-being of the community. Space technology can be a great support to generate solutions through strategic projects that link government, academia and industry capable of supporting decision-making by farmers and thereby optimize farming techniques, take care of the environment and benefit the finances of the producers, all sustainable and sustainable strategies in the medium and long term.

CAP monitoring in Romania using Copernicus data – Challenges and Perspectives

Florin Serban, Cristian Flueraru - Terrasigna, Romania

Satellite Application in Agriculture in Bhutan

Tenzin Dendup - Ministry of Agriculture & Forests, Bhutan

Bhutan is currently in the initial stages of exploring satellite technology for use in Agriculture and Forestry sector. This presentation will be a brief outline on Bhutan's vision and plans in terms of policy and technology use.

Session 3: Emerging technologies and integrated applications in Agriculture

Geo-Big Data and Digital Augmentation for Sustainable Agri-Food Systems

Chandrashekhar Biradar - ICARDA-CGIAR, Egypt

Integrated system approach becomes key pillar for sustainable agri-food systems under changing climate, diet and demography. The digitization of the agroecosystems (e.g., geotagging, agrotagging, farm-typology) become most essential entry point for any sustainable developmental entities whether it is breeding site specific varieties, crop diversification and intensification, efficient use of farm inputs, agronomic practices, stable economic return, to ecosystem services management. Recent advances in Earth Observation System (EOS), Open-Access (OA), Artificial Intelligence (AI), Machine Learning (ML), Information, and Communication Technologies (ICTs), Cloud Computing Platforms (CCP) along with smartphone-enabled Citizen Science (CS) increasingly making geo-big data based GeoAgro analytics become much smarter, interoperable and useful than ever before. This has opened tremendous opportunities to address the decision gaps at multiple levels (e.g., gaps@ data, yield, ecology, economy, resilience) for demand-driven interventions. The eco-smart water use become driving force for return per acre (compound-yield, nutrition, income and ecology) and ‘a drop for every crop’ is seemly a norm for evolving agri-food systems in the dry areas. These processes require up-to-date and timely information at field level to landscape redesigning the farming systems. Ongoing efforts in the digital augmentation aim at quantifying farm typology, production dynamics and drivers to target site-specific developmental interventions and scaling such as intensification of pulses in cereal based systems, desert forming, rejuvenation of rainfed systems, adoption of feedback mechanism, bridging the yield

gaps, geo-localization of the research and impact reporting. Here we present some of the ongoing efforts in dry areas for accelerating agroecological intensification for rural welfare and sustainable development.

Hyperspectral remote sensing and fluorescence methods for wheat phenological change monitoring

Bogdan Zagajewski, Marlena Kycko - University of Warsaw, Poland

In the following years European legislation will regulate the acceptable toxin thresholds permitted for edible grain usage. The main expected outcome and impact of this activity is to reduce toxin content in wheat for food production. The research intends to develop a robust, efficient and non-destructive method to determine toxin concentrations caused by Fusarium and Claviceps infestations in wheat fields. Field campaigns: 13-14.05.2018 (I), 25-26.05.2018 (II), 14-15.06.2018 (III); aimed at measurements of hyperspectral properties of plants (ASD FieldSpec 4+ASD PlantProbe), chlorophyll content in leaves (OptiScience CCM300) and chlorophyll fluorescence (OptiScience OS1p). Simultaneously were conducted other measurements and multispectral image acquisition from airborne level using the UAV's Tatracam Micro-MCA6). The research was carried out on 3 winter wheat fields (variety: solehio), with various crop history and microclimate: I – after "sweet" maize, relatively wet microclimate; II (western part) – after regular maize, relatively wet microclimate; III – after oil rape and ~30 km away in drier microclimate. Each field has 5 pairs of experimental plots (6x6 m each), located in zones of differing productivity. In each pair, one plot will be treated with fungicide (as the bulk of the field), and one will not be treated.
The analysis of spectral curves and remote sensing of vegetation indicators showed statistically significant differences in the state of wheat condition between the studied periods and between each pair, one plot was treated with fungicide (as the bulk of the field), and one wasn't be treated. Differences in the range of electromagnetic spectrum between polygons were visible in the range of spectrum describing of the amount of water in the plant as well as the ratio of chlorophyll to carotenoids. Statistical differences in the spectral reflection curves during the phenological period were the most important between the first and the second measurement period, which was related to the maturation of wheat.
Based on these measurements, harvest and logistic strategies will be created to separate contaminated and noncontaminated grains using GIS-technology. For farms with severe infestations, preventive methods will be developed to avoid food contamination.

Simplifying Precision Agriculture using the ArcGIS Platform

Lucian Zavate - ESRI Romania

Multiple Derived Outcomes of satellite image processing for different stakeholders

Gunjan Shetye, Tushar Kulkarni - Black & Veatch Pvt. Ltd, India

In the recent years, there is a giant leap in satellite imagery's contribution in overall remote sensing data. There are many reasons for this significant change including innovations in Earth Observatory satellite designs, reduced launching cost and increased demand of satellite imagery for various monitoring and analytical applications. These were previously dominated by traditional engineering methodologies. Satellite image analysis-based results are independently used for various applications.

These results are still being verified with results from different traditional methodologies. Based on the outcome of this verification, optimal solutions can be derived. Therefore, within different stakeholders, the acceptance of the satellite image analysis will highly depend on its compatibility with traditional solution and the value of the derived outcome. One such application is being the crop detection analysis which can help all the stakeholders in the agricultural industry. Institutional land owners, policy makers and small farm owners would benefit from the above analysis with outcomes like expected resource requirement, crop area production forecast and drought assessment and monitoring. Institutional land owners would also benefit from the regular agriculture land monitoring which ensures optimum production. In this presentation, we are going to look at such applications and how they are on the verge of closing the gap between research and industry implementation.

Session 4: Agricultural mapping and risk assessment

Water Footprint SaaS Application

Bertil Abbing - Ecometrica, United Kingdom

Problem Setting: Water risk presents itself broadly in two forms, scarcity and abundance, leading to competition and flooding respectively. Many water intense industries like agriculture and energy production compete for water amongst each other and communities in the same catchment area. As a result, water is becoming an increasingly more important (economic) commodity and a growing risk that companies need to include in their decision-making process. However, for many companies it is currently unknown how the (global) supply chain impacts the direct and indirect water availability and quality they rely on.

Solution & Methodology: The Water Footprint Application determines the green & blue water footprint by modelling the evapotranspiration (ET) of a crop from seed to harvest. Using satellite data, a time series model has been built to determine the crop's water requirements (ET). When compared to the area's available precipitation we can determine if the ET is solely a Green Water footprint. However, if the crop's ET requirements during the growing period is higher than the available precipitation the remaining part of the ET will be accounted for by irrigation sourced from ground or surface water. This part of the ET will be the blue water footprint. The grey water footprint of a crop depends on the amount of water needed to assimilate any contamination caused by Pesticides, Fertilisers, Nitrogen, and Phosphorus used during the growing of the crop and is calculated based on 11 factors, divided in chemical factors, environmental factors and agricultural practices. The environmental factors, ranging from soil type to rain intensity, can all be mapped while unknown chemical factors can be taken from our database. The only client input will be about their agricultural practices.

Benefits: The Ecometrica water footprint application will allow our clients to assess the water footprint of their agricultural products using maps on cloud-based apps and specific data usually available within their organisation. This innovation will also support companies to adopt a more informed selection process of agricultural suppliers, sensitive to more sustainable use of water resources. Additionally, with these water footprint results organisations can determine their potential sustainability impacts like; water pollution and the contribution to water scarcity or abundance. Moreover, they can determine where to apply measures to reduce water impacts, facilitate water efficiency and optimisation, and report and communicate their water footprint.

Mapping and assessment of soil ecosystem services

Paulo Pereira, Eric Brevik - Mykolas Romeris University; Dickinson State University

Maps are a simple and effective way to communicate complex information. Soils provide a wide range regulating (e.g carbon storage, flood control), provisioning (e.g food, raw materials and support for human activities) and cultural (e.g heritage values and recreation) ecosystem services (ES). Mapping can contribute for a better assessment of soil conditions and soil ES supply. The spatial dimension is important to identify areas that are highly degraded and need restoration. This falls under the United Nations Sustainable Development Goals (SDGs) strategy for 2030. Soil ES are linked directly or indirectly with all SDG's; therefore, a correct assessment is crucial to meet the proposed challenges by 2030. In the last years, several studies have been developed about soil ES supply, but few attempts have been done in mapping and assessing it. Several ES mapping and assessment models (e.g Invest, Aries) use soil data to estimate regulating and provisioning ES. Nevertheless, one of the main shortcomings of using these software's is that the results are not validated with external data. This is a crucial step to know the degree of uncertainty of the models and the accuracy of the results. In this key lecture, we will do an overview about the methods used to map and assess soil ES and propose a multi-criteria framework to map soil formation at national level, using different data sources, geological, topographic, soil, climate, land use and expert assessment.

A geographic information system for assessing the suitability of Romanian land to crops and land use

Andrei Dornik, Marinela Chetan, Lucian Dragut, Horea Cacovean - West University of Timisoara-Romania

Impact of Soil and Water Conservation Practices on Hydrological Properties Using SWAT Model

Dede Sulaeman - World Resources Institute Indonesia

Floods and drought are among the most common natural disaster in Indonesia. Those disasters can severely affect so many sectors, including agriculture that can be affected not only the food production at the farm level but also the national economy and the overall food and water security as well. The study was conducted in Ciujung watershed, the biggest and considered as one of the most important watersheds in Banten Province, due to the disasters that take place almost every year in the area. The aim of this study was to: (1) determine how soil and water conservation practices with vegetative and engineering method affect the hydrological properties (2) determine the best management practice to maintain watershed condition. Inputs required for the Soil and Water Assessment Tool (SWAT) model were extracted from readily available global remotely sensed satellite datasets. These include landcover map from Landsat 8, stream networks and watershed boundaries from SRTM 30 m data. Other inputs required including soil map and climatic data. There are some steps in running SWAT model, including: (1) delineate watershed; (2) create Hydrological Response Units (HRU's); (3) HRU definition; (4) climate data input; (5) write SWAT input files; (6) run SWAT model; (7) calibration and validation; and (8) soil and water conservation practices simulation to determine its effect on the hydrological properties. Three soil and water conservation practices were implemented in the simulation process, including: (1) vegetative method using strip cropping and agroforestry; (2) engineering method using contouring and dam; (3) simulate vegetative and engineering methods simultaneously. The study showed that SWAT model can be implemented to simulate flow discharge in Ciujung watershed. The model resulted a good

performance in predicting flow discharge with coefficient of determination (R2) and Nash-Sutcliffe Efficiency coefficient (NSE) values in calibration process by 0.78 and 0.67 respectively. Validation process produced R2 value by 0.75 and NSE value by 0.67. Implementing soil and water conservation with vegetative and engineering methods simultaneously is the best management practice regarding to maintain watershed condition. The scenario produced the best river regime coefficient by 65 (moderate), reduced surface runoff by 46 %, and increased lateral and return flow by 32 and 80% respectively.

Session 5: Monitoring agriculture space and aerial platforms

Determination of the Soil Physical and Chemical Properties via Using Unmanned Aerial Vehicles Equipped Multispectral Camera

Turgay Dindaroglu - Kahramanmaras Sutcu Imam University, Turkey

Soil and water security are increasingly important considerations for developed and developing countries. This is because increasing urbanisation and demands on irrigation are placing great stress on the soil and water resource and owing to degradation of the environment from inefficient fertilisers application (pollution) and rising water tables (salinisation). Information about how soil and water resources vary in space and time are therefore required to manage these resources through precision agriculture and improves fertiliser and water application rates. In this presentation, some of the latest 3-d mapping and monitoring methods will be described with case studies presented from developed countries (e.g. Australia, US, UK, Portugal and Spain) and developing countries (e.g. Morocco, Iran, India, China and Thailand). The presentation will include ground-breaking research in the application of state-of-the-art multi-coil electromagnetic (DUALEM-421) data and cutting-edge-software (EM4Soil) to make 3-d maps of soil physical (clay) and chemical (salinity) properties; with special application in time-lapse soil moisture monitoring in irrigated alpha-alpha (US) and cotton (Australia). The presentation will also demonstrate fusion of EM and gamma-ray spectrometry data to map individual soil properties to manage pH in the UK and identify management zones which can be used to ameliorate sodicity (e.g. ESP) in India and Australia. The applications emphasise the application of geospatial data derived from proximal soil sensing instruments and with heavy reliance on satellite-borne GPS units and data.

Use of Drones in Crop Insurance

Benard Sabwa - Davacc Tech Ltd, Kenya

Crop insurance is meant for cushioning farmers from losses that are likely to occur as a result of natural causes. In Agriculture Insurance farmers are protected against losses that are likely to be incurred from disasters such as floods, drought, pests and disease outbreak. Despite its importance especially in Agriculture, insurance penetration has been very low with less than one percent of farmers covered in Kenya. Innovative farmer friendly insurance can be possible since it will integrate innovative technologies and partnerships into the insurance industry. Through space technologies/earth observation, it will be easier for farmers to access insurance and claim settlement. It will be faster and convenient. Smartphones will be used throughout the process i.e. from registration of farmers, mapping of farms, drawing up the insurance policy to settling of claims. Drones will take periodic pictures of the farms and this images analyzed will be able to

detect crop diseases, burns, hailstorm damage, windstorm damage among others. Drones are preferred because they are cheaper than satellite images, they can survey a small area and the problem of cloud cover is not there. Integrated technologies will assist in sending data on prevailing weather conditions such as rainfall, sunlight, temperature and speed of wind. The data is then used to trigger a response whenever the prevailing weather conditions are below the expected levels, as well as to determine the severity of the loss to farmers. The data will also be important to farmers (if shared) and it can help them avert any looming danger of bad weather or upsurge of diseases. Farmers can also use the data to optimize their production whenever the conditions are favorable.

Sentinel-2 for Agriculture Project: Towards Sentinel-2 Exploitation for Agriculture Monitoring

Cosmin Cara - CS ROMANIA SA, UCLouvain, Belgium, CESBIO, France, European Space Agency

Satellite and Drone Images to Help Cacao Farming in Peru

Avid Roman Gonzalez - Universidad de Ciencias y Humanidades, Peru

Cacao farming is a critical economic field in Peru, and this work addresses the needs of optimized cacao farming within an ecological environment that has to be preserved. According to Bessombes (2015), Peru is the second largest exporter of cacao in the world, which means a significant impact on the country's economy. The principal regions of Peru where cacao is produced are Cusco, Ayacucho, San Martin, Junin, and Piura. Cacao also becomes an alternative crop for farmers currently being engaged in coca farming. In last year, the Peruvian National Commission for Development and Life without Drugs (DEVIDA) expected to recover 56,000 hectares from coca growing. As a consequence, the primary challenge in Peru is to support precision farming by using very high-resolution images taken by drones combined with satellite images to identify those parameters that characterize cacao crops and their evolution over time. This strategy is a novel approach that has to be trained and optimized during the next years.

Session 6: Monitoring land and soil degradation

Long term land use change affects soil erosion in the Nepal Himalayas

Devraj Chalise - University of New England, Australia

Soil erosion is a global environmental threat and land use land cover changes (LUCC) have great impacts on it. Nepal, being a mountainous country, has significant soil erosion issues as well. To examine the effects of LUCC on soil erosion, we studied the LUCC in Sarada, Rapti and Thuli Bheri river basins of Nepal during the 1995 – 2015 period using Remote Sensing and calculated average annual soil loss using the Revised Universal Soil Loss Equation (RUSLE) and Geographical Information System (GIS). Our results suggest that an increase in the agricultural lands at the expense of bare lands and forests escalated the soil erosion through the years; rates being 5.92, 6.66 and 7.79 t/ha/year in 1995, 2007 and 2015, respectively. Of the different land uses, agriculture was the most eroded land use and the forests were least eroded. Agricultural lands, particularly those on the steeper slopes, were severely eroded and need urgent soil and water conservation measures. Our study confirms that the long term LUCC has considerable impacts in

shaping the fate of soil loss in the study area and these results have very good potential to be used in similar river basins in combination with other soil erosion models.

Assessment of land degradation neutrality (LDN) based on earth observation datasets in Southern Tunisia

Bouajila Essifi - Institut des Regions Arides, Tunisia

Land Degradation Neutrality (LDN) is “a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems”. LDN intends to maintain/improve the sustainable delivery of ecosystem services, productivity and food security. In addition to increasing resilience of the land and populations dependent on the land and seeking synergies with other socioeconomic and environmental objectives. The Institut des Regions Arides (IRA) has established since its inception a specific program on natural resources management and desertification surveillance for decision making in drylands assessment. This oral presentation, with its main aim to provide an overview of IRA specific program on land degradation assessment with a special focus on LDN by combining geospatial data and tools with field investigation, will emphasize the use of geospatial data and techniques for vulnerability and risk assessment of climate change impacts in arid Tunisia. Based on the recent advances in geo-informatics and remote sensing data and tools, the present research is an important component for integrated spatial decision-making in agroecosystems of Tunisian drylands.

Soil Classification Techniques on Local Areas Based on Satellite Data

Dorian Gorgan, Teodor Rusu - Technical University of Cluj-Napoca/USAMV Cluj

Soil Damage of Eastern Herzegovina By Radionuclides

Vesna Tunguz - Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina

Coal mine and thermal power plant in Gacko field is a very important industrial facility not only for this region but also for the Republic of Srpska.Gacko field is a karst field and is virtually the only oasis of arable land in the region studied. The content of radionuclides of the soil was examined at Gacko area, slag, ash and mullock dumps in the thermal power plant Gacko and soils of dumps in the process of re-cultivation. The results point to the necessity of regular monitoring of radioactivity in eastern Herzegovina in order to assess the impact of the technologically increased natural radioactivity.