PRELIMINARY AGENDA AND PARTICIPANT INFORMATION

As of 17 April 2024

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BACKGROUND

The conference series on the use of space technology for water management started in 2008 and is part of the UNOOSA Space for Water Project in cooperation with the Prince Sultan Bin Abdulaziz International Prize for Water. The purpose of the conferences is to increase the number of developing countries that have developed the capacity to use space science and technology, as well as related applications, for water management and water-related scientific research. With a scientific and technical focus, the conferences of this series involve experts from all world regions but have a focus on regional needs and challenges. Speakers consist of experts who will present how concrete technical actions have improved water management in their area of expertise, and experts who will debate in panel discussions about either technical or policy topics. Besides the main event, practical hands-on experience opportunities, like demonstration sessions or workshops, have taken place to complement the more theoretical and scientific presentations and panel discussions.

In 2024, UNOOSA, Costa Rica and the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW) will jointly organize the sixth conference on the use of space technology for water management with the support of the Inter-American Institute for Cooperation on Agriculture (IICA).

To feed a growing population while maintaining access to clean drinking water and sanitation, and ensuring the water needs of healthy ecosystems, humanity needs to change the way water is used in food production. Agriculture uses 70% of freshwater resources worldwide, and the World Bank estimates that we will also need a 70% higher output from agricultural production by 2050 to nourish an increasing population.

OBJECTIVES

The objectives of the conference are:

- To raise awareness on and expand the use of space technologies and space-based data for better application in hydrology, water resource management, ecosystem preservation and within the context of the Water-Food Nexus;
- To further the active exchange of knowledge between government authorities, technical experts and academia, the private sector and civil society via technical presentations, panel discussions and networking opportunities;
- To demonstrate how projects using space applications have successfully informed decision-making and policy;
- To demonstrate space-related activities, services and cooperation programmes among different user groups, in particular government officials, the diplomatic community, UN and international agencies as well as NGOs;
- To build capacity on topics relevant to Latin America and the Caribbean;
- To exchange on and co-develop solutions for pressing water challenges; and
- To report to the UN Committee on the Peaceful Uses of Outer Space through the Scientific and Technical Sub-committee.

THEMES

Technical sessions, panels and lightning talk sessions for poster presentations will focus on space technologies and data supporting the assessment, monitoring, research and reporting on topics related to hydrology, water resource management, ecosystem preservation and within the context of the Water-Food Nexus. The main conference themes read as follows below and a full description of the themes is available on the website[1].

1. Water Scarcity: Space technologies to adapt agriculture to climate variabilities

2. Space technology and data for water quality monitoring and sustainable agriculture

3. Satellite communication - a facilitator for IoT-supported water applications

4. Space technologies monitoring forests, agroforestry, watersheds and their interplay

5. Space technology and data for glacier monitoring

VENUE AND ARRIVAL

The Conference will be hosted at the Headquarters of the Inter-American Institute for Cooperation on Agriculture in San José, Costa Rica.

Headquarters. 600 m. northeast of the Ipís-Coronado intersection.
Vázquez de Coronado, San Isidro 11101 - Costa Rica. San José, Costa Rica

Phone (+506) 2216 0222
iicahq@iica.int

Information on how to get to the registration desk will be added here soon.

ONLINE CONNECTION

The meeting will be hosted in Zoom. Please make sure to have installed zoom for your online participation. The link to connect to the meeting, as well as to sessions in which you will meet your moderator online will be shared in the coming weeks.

[1] https://www.unoosa.org/oosa/en/ourwork/psa/schedule/2024/UN-CostaRica-PSIPW-water.html

PRELIMINARY PROGRAMME

An updated version of the programme will be published, in case adjustments need to be made.

Day 1, Tuesday, 7 May 2024 – 9:00 – 18:00

09:00 – 09:30	Registration (On-Site only)
	• Registration for the conference takes place at the registration desk • Registration for social dinner and field trip
09:30 – 10:25	High-Level Opening Ceremony Moderator: Nina Kickinger (UNOOSA)
	• **Opening remarks** – High-Level Representative of the Ministry of Foreign Affairs and Worship, Costa Rica • **Opening remarks** – Resident Coordinator of the United Nations in Costa Rica • **Opening remarks** – Manuel Otero, Director General, Inter-American Institute for Cooperation on Agriculture (IICA) • ***Opening remarks*** – Driss El Hadani, Senior Advisor, United Nations Office for Outer Space Affairs (UNOOSA) ***Opening remarks*** – Representative of the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW)
10:25– 10:30	Group Photo
10:30 - 11:00	Coffee break and lightning talks

11:00 - 12:30	Technical Opening Session Moderator: Nina Kickinger (UNOOSA)
	• Keynote by a representative of the United Nations in Costa Rica • Keynote: Space technologies and data for water management, hydrology and aquatic ecosystem preservation – Driss El Hadani, UNOOSA • Keynote by IICA tbc • The Space4Water Project - Nina Kickinger, UNOOSA
12:30 – 13:00	Lightning talks
13:00 – 14:00	Lunch (and lightning talks for online participants)
14:00 – 15:30	T1S1. Water scarcity: space technologies to monitor precipitation, soil moisture and drought Moderator: tbc
14:00	• ***Leveraging in-situ Precipitation Measurements to Improve Satellite-Based Precipitation Estimates*** - Rodrigo ZAMBRANA PRADO online Climate change-induced climate variability requires continuous assessment and correction of existing hydrometeorological solutions. Space-based precipitation estimation tools are no different. Over the last few decades, we've seen massive improvements in Satellite Precipitation Products (SPPs) thanks to new processing algorithms and more recent, higher-resolution sounders in newer satellite constellations. These improvements came riding on the back of existing, and throughout the years, growing, in-situ, precipitation-measuring networks comprised of always-improving radar and gauge networks. Sadly, these in-situ networks move at severely differing paces worldwide, and the lack of validated, high-resolution quantitative precipitation estimates (QPEs) in the inter-tropical region translated into a slower improvement of the SPPs around these regions. Here, we propose a framework in which we can quickly leverage existing weather radar networks or, in cases where these are not available, backhaul telecommunication networks-based precipitation estimates to improve existing SPPs in the region rapidly. In weather-radar impoverished areas such as the inter-tropical region, improved SPPs can offer themselves as a solution to estimate water budgets better and drive policy change in these high-stakes territories.

14:15	• ***Water stress from the Andes to the Amazon, using SPEI global drought index data and ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station*** – Freddy Angel SORIA CESPEDES Water use efficiency (WUE) is the amount of biomass produced per unit of water used by a plant. When droughts occur, plants partially close their stomata to limit their evaporative water loss, at the expense of carbon uptake by photosynthesis, maximizing WUE. Questions remain on how WUE varies spatially. The evaluation is in Bolivia, from the Andes to the Amazon, using global Standardized Precipitation Evapotranspiration Index (SPEI) drought data and WUE from the ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station. By K-means clustering, WUE were associated to one and three-month SPEI, i.e., short-term soil moisture and crop stress, regardless vegetation or elevation (m above sea level, MASL). WUE differed on scales; WUE reached 1 g C kg-1 H2O in arid-semiarid areas with sparse shrubs, moderate-severe (3900 MASL) to mild (2500 MASL) droughts. WUE reached 2 g C kg-1 H2O in the Amazon (300 MASL) where moderate to severe droughts may occur in the short term. The highest WUE was 4 g C kg-1 H2O in arid inter-Andean valleys with croplands and evergreen forests, where extreme droughts are frequent. Thus, where soil water content is under pressure, plants maximize WUE, with implications in irrigation, drainage and water management.
14:30	• ***Assessment and monitoring of soil moisture and drought conditions in the Oranie region, Algeria using the SMAP Global soil moisture datasets and the Vegetation Condition Index (VCI)*** - Rabia Samah CHOUKRI (University of Oran 2, Algeria) online Drought evaluation and monitoring has become a primary issue in recent times since it affects agricultural land capacity and generates food scarcity. The assessment of soil moisture is an important component in determining drought conditions. The current study followed a methodological framework using the Google Earth Engine (GEE) platform to provide effective monitoring of soil moisture in a time series from 2015 to 2022 through the SMAP Global soil moisture datasets, and VCI index calculated from MODIS data. The study was conducted out in the region of Oranie that in the west of Algeria, which is drought-prone and known for its long term droughts due to long term low rainfall and its semi-arid climate. The results showed that the mean value of the surface soil moisture anomaly from 2015 to 2022 is -0.051 which is a negative value indicating a high drought, while the lowest drought in 2018 with 0.516 and the highest drought value was -0.069 in 2019. As for the Surface soil moisture, the mean value detected throughout the time series was 6.052, which suggests severe drought. The results demonstrated the effective, quick, and cost-effective use of the GEE platform in monitoring the risk.
14:45	• ***The effect of meteorological drought on crop yield in North Bank Region, The Gambia*** - Momodou J.A. SENGHORE, National Early Warning and Response Mechanism Coordination Centre, the Gambia

	Increased crop yield is required to meet the needs of future population growth, but drought causes significant yield reductions for rain-fed crops. This study generally evaluates the effects of meteorological drought on the yield of crops in the North Bank Region of The Gambia from 1990 to 2018. Rainfall and crop yield data analysed was collected from Department of Water Resources and Ministry of Agriculture respectively. It established the relationship between below normal rainfall and the yield of crops in the region. The methods used includes, the arithmetic mean method, single mass curve, correlation analysis and standardized precipitation index. Results show variability in rainfall as 15years of below-normal rainfall amount recorded in the region and the lowest was in 2011 with an amount of 533mm and SPI value of -1.5 which is a severely dry category of drought. Results also indicate positive correlation between below-normal rainfall amount and crops yield. It may be beneficial for North Bank Region agricultural production to increase the hectarage of sorghum and other grains especially during drought periods. This study provides valuable information that can be used to adopt appropriate measures to cope with future drought challenges in drought-prone regions.
15:00	• *Geospatial Mapping and Analysis of Surface Water Demand, Consumption, Withdrawal and Availability in the Tano River Basin of Ghana* - Bernard OTCHERE, University of Energy and Natural Resources, Sunyani, Ghana This study addresses the imminent freshwater scarcity issue by conducting a comprehensive assessment of surface water dynamics in the Tano River Basin, Ghana. Analyzing 28 districts, the research integrates hydrologic records, population data, and GIS techniques to evaluate water demand, consumption, withdrawal, and availability. Utilizing factors like Land Use Land Cover Change, soil, slope, temperature, and rainfall, the study employs the Soil Water Analysis Tool and ArcGIS with Analytic Hierarchy Process (AHP) for weighting. Results reveal a stark contrast between domestic water demand (63.87 million cubic meters annually) and the available supply (4.8 million cubic meters per year), presenting a substantial 92.5% deficit. The basin's total water demand, spanning irrigation, domestic use, industry, and livestock, is estimated at 225.748 million cubic meters yearly. Projections for 2030, 2053, and 2063 underscore the influence of climate change, particularly temperature variations, on water demand. Notably, the study employs the Soil and Water Assessment Tool to derive potential surface water stress maps, categorizing zones into very low (4%), low (15%), moderate (42%), and high stress (40%). These findings emphasize the urgency of implementing sustainable water management strategies to address the escalating water scarcity challenges in the Tano River Basin.
15:15	• *Integrated Remote Sensing and in situ data for Precise Soil Moisture Estimation in Agricultural Landscapes in Central Tunisia* – Mohamed Rajhi, University of University of Miskolc online

	Effective soil moisture (SM) management is crucial for agricultural practices and earth surface processes. While remote sensing has proven valuable for SM estimation, accurately describing horizontal and vertical availability as well as the temporal redistribution of soil moisture remains a challenge. This study addresses this gap by developing a sophisticated soil hydrological model to precisely estimate variations in soil moisture, crucial for efficient land resource planning. Various methods utilizing optical or radar satellite data have been developed for SM estimation under diverse climatic conditions and geographical distributions. The focus is on the agricultural region of Kairouan in central Tunisia. Our approach involves analyzing the relationship between optical satellite data indices (e.g., NDVI and NDWI) and radar data. Additionally, we explore correlations among different backscatters (V, H), optical data, Digital Elevation Model (DEM), environmental covariates, and in-situ data from soil moisture sensors. The aim is to extract the highest correlation and most informative data sources for input into our model. The study revealed a strong correlation between radar data (VV and VH polarization), optical data (NDVI and NDWI), and soil types, indicating their potential in explaining soil water regime and its connection to vegetation conditions. The correlation method, combined with local knowledge, proved a promising tool for soil moisture characterization, offering valuable insights for decision-making in land use and water resource management.
15:30	• *Estimate soil moisture from multi-sensor (FLDAS, ESA, SMAP)* - Abdolnabi ABDEH KOLAHCHI, Soil Conservation and Watershed Management Research Institute online (tbc) The aim of this study is to evaluate the effectiveness of estimated soil moisture data obtained from three sources of remote sensing sensor databases with the measured soil moisture in the poor rangeland area of Telo region which located North-East of Tehran. To investigate the spatial and temporal variation of soil moisture the soil moisture measured by TDR compare with the three estimated soil moisture from the FLDAS_NOAH database, ESA center and SMAP products during two-year period (2020-2022). Estimated soil moisture data were evaluated against observed data using R2, RMSE and other statistics analysis. The results showed that the SMAP satellite is associated with underestimation and the FLDAS model and the ESA satellite are associated with overestimation of soil moisture. However, in general, the estimated soil moisture values of the three mentioned sources have good accuracy and have the monthly trend of the observed data. When the values of TDR compare to the combine values of three sources of soil moisture, it is expected to have better correlation and trend as well.
15:30 – 16:00	Coffee break and lightning talks

16:00 – 18:00	T1S2. Informed decision-making for agricultural interventions and irrigation decisions Moderator: Driss El Hadani (UNOOSA)
16:00	• ***The WaPOR project*** - Jorge Gutierrez (Food and Agriculture Organisation, Colombia)
16:15	• ***Sustainable agriculture in the Lower Limpopo Basin: A remote sensing approach to assessing irrigation performance in Mozambique*** – Karthikeyan MATHESWARAN, Consortium of International Agricultural Research Centers (CGIAR) The effective management of irrigation systems is crucial for bolstering agricultural productivity, ensuring food security, and safeguarding water resources in Mozambique. In the Lower Limpopo River basin, a focal point for irrigated infrastructure, numerous challenges impede optimal performance and realization of design objectives in irrigation schemes. Leveraging readily available datasets from the Food and Agriculture Organization's Water Productivity through Open Access Remotely sensed data (WaPOR) in a stakeholder-centric collaborative tool development approach, this study conducts a swift and comprehensive appraisal of multiple irrigation schemes, ranging from 1300 to 39,000 hectares. Derived from both WaPOR datasets and in-situ measurements, this research encompasses diverse array of indicators addressing different facets of land and water productivity. The Level-2 100 m spatial resolution WaPOR data, forms the basis for indicators focusing on actual evapotranspiration and net primary productivity during the period 2010 to 2022 deriving irrigation block-level metrics on land utilization across growing seasons. Field-based and hybrid indicators provide insights into system/sub-system level efficiency, complementing standalone remote sensing data. The assessment, differentiating performance at both scheme and intra-scheme levels, reveals water use hotspots, low land utilization areas, productivity gaps and system component efficiency, guiding stakeholders in designing targeted interventions for sustainable irrigation management.
16:30	• ***Zimbabwe water management using satellite, drones and ground technology*** - Victor MUKUNGUNUGWA (Zimbabwe National Geospatial and Space Agency (ZINGSA) ZINGSA has also incorporated ground-based geotechnical techniques such as resistivity surveys, magnetic surveys, gravity surveys, and ground-penetrating radar to map underground water and underground voids. The surveys have extensively been used to support agriculture projects that includes the construction of irrigation canals in dry areas that receive minimum rains. ZINGSA also made an Automatic Weather Station mounted in remote areas to

	automatically measure rainfall and relay the data to the satellite ground station via the satellite for further processing.
16:45	• *IRRISAT-MAROC : Operational irrigation management based on Remote Sensing data* - Mohammed Faouzi SMIEJ, Centre Royal de Télédétection Spatiale online Morocco is characterized by a contrasted climate and a rainfall regime marked by strong spatio-temporal irregularity resulting in limited water resources potential and an uneven distribution across the country's regions. This inherent water scarcity is exacerbated in the recent year under the combined effect of climate change and of the growth of water demand. The agricultural activity is at the top of the sectors impacted by the problem of water resources. In this perspective and in parallel to the strategy of water resources control and mobilization carried out by the public authorities, the Green Morocco Plan, especially its Sixth Pillar, aims at sustaining the development of Moroccan agriculture. Indeed, saving irrigation water is one of the strategic axes of adaptation to climate change of this plan to ensure a more productive and sustainable agriculture. The SCO IRRISAT-Morocco project aims at providing inputs for a better use of water in agriculture at different management scales (plot, farm, block, sector, irrigated perimeter, and watershed) by joining two complementary platforms, IRRISAT, and SAT'IRR. IRRISAT (CRTS, since 2015) is an operational irrigation optimization system based mainly on satellite data, where the Surface Energy Balance Algorithm for Land model (SEBAL) (Bastiaanssen,2002) produces a set of variables namely evapotranspiration, biomass and soil moisture. These products allow generation of comprehensible indicators at different scales on water consumption, demand, and productivity also irrigation recommendations to provide to users (farmers, regional agricultural development office ORMVA, Water Basin Agencies ABH etc.). The data is processed at spatial resolution of 30m and temporal resolution of 8 days from Landsat data, and 100m and one day from NPP/VIIRS-PROBA-V data. SAT'IRR (IRD-UCA, since 2013) is a platform that aims at forecasting the irrigation demand up to 5 days at the plot scale. The FAO-56 dual coefficient method under water stress conditions (Allen et al., 2005) is combined with vegetation-related coefficients (vegetation cover fraction Fc and transpiration coefficient Kcb) obtained from optical satellite imagery (Duchemin et al., 2006). The platform itself allows to combine different weather inputs (WMO, local station), satellite data input (Landsat, Sentinel-2), and local plot measurements (irrigation, soil moisture). The SCO IRRISAT-Morocco aims to improve the reliability of products generated by the platforms and combine them through: • The production of annual crop maps, allowing generating more accurate indicators, at the plot scale, on water consumption, productivity and irrigation recommendation. • The improvement of the spatial resolution of the products generated by the techniques of fusion of VIIRS-375m thermal products with Sentinel2 optical data.

	• The implementation of a monitoring system for pilot plots in order to collect the necessary data (weather, inputs, soil moisture, agronomic data, Eddy-Covariance flow data) for the validation of the generated products and to have the system tested by farmers. • To create a synergy between the two platforms IRRISAT and SAT'IRR by harmonizing the input data of the two platforms as well as the generated indicators. • To achieve dissemination service of generated products to the users. Preliminary results of the different actions of the IRRISAT-Morocco project will also be presented.
17:00	• *Space based technologies interventions in Pradhan Mantri Fasal Bima Yojana (PMFBY) the world's largest crop insurance scheme* - Vijayasekaran DURASAIMI, United Nations Development Programme Pradhan Mantri Fasal Bima Yojana (PMFBY) is currently the world's largest crop insurance scheme, covering over 55 million farmers across India. The PMFBY was launched as a means for farmers to cope with crop losses occurring due to natural disasters and climate change induced factors such as water scarcity, fluctuating weather patterns etc. Better management of agricultural risks is one of the important strategies to address the current challenges of food security and climate resilience in Indian agriculture. Yield Estimation System based on Technology (YES-TECH) is an important component introduced into the PMFBY, which incorporates space based technologies for yield and loss estimation. Satellite based crop mapping is mandatory in YES-TECH and also the crop yield estimation different models are piloted and rolled out. Addressing the challenge of sparse weather station distribution, the Weather Information and Network Data System (WINDS) program has been another feather in our technological cap. By establishing a network of automatic weather stations and rain gauges, WINDS provides hyper-local weather data. This wealth of information not only aids in sending timely crop advisories to farmers but also plays a crucial role in crop loss assessments and modelling. It harnesses advanced weather data analytics to provide stakeholders with actionable insight to make informed weather decisions on agriculture. Another major integration is Collection of Real-time Observations and Photographs of Crops (CROPIC). This initiative has changed the game for ground-level data collection, allowing field agents to capture real-time crop data through photographs. The transparency brought by CROPIC, with options for geotagging and offline functionality, seamlessly integrates with the National Crop Insurance Portal. Moreover, it helps to ascertain the temporal health of the crops by using the picture analytics results as an input into crop yield estimation and building a two-step mechanism to handle issues related to add-on claims. This study presents the technological interventions in PMFBY, particularly for the systems for crop mapping and yield predictions, integration of dense weather networks for crop loss assessment and initiatives for photograph based information extraction using advanced deep learning models. This study also presents the data acquisition, analysis and dissemination from and to a wide range of stakeholders, including UNDP, Government of India, State Governments, Insurance companies and farmers.

17:15	• ***Utilizing Misrsat-2 Satellite Data to Identifying and Analyse Water Resources in New Delta of Egypt*** - Mohamed YASSER AYOUB, Egyptian Space Agency onlineonline Water scarcity is a pressing global concern, profoundly affecting numerous countries across the world. Additionally, climate change compounds the issue by altering precipitation patterns and increasing temperatures, leading to greater uncertainty in water availability. Egypt is located in a predominantly arid region and heavily relies on the Nile River for its agricultural needs. Water scarcity has become a significant challenge for Egyptian agriculture needs. Traditional flood irrigation methods result in excessive water loss due to evaporation and runoff. Also, outdated infrastructure and inadequate maintenance further exacerbate this problem. In addressing these challenges, the establishment of a wastewater treatment plant (El-Hammam plant) to re-utilize and prevent the disposal of wastewater into the Mediterranean Sea demonstrates a significant commitment by the Egyptian government to address both environmental concerns and water scarcity challenges. This paper focuses on utilizing remote sensing techniques using the MISRSAT-2 satellite data to monitor water resources and agricultural expansion in the New Delta of Egypt (newly reclaimed land). Consequently, identifying and calculating the length and distribution of the water drainage channels, and calculating the area of newly cultivated land that uses pivot irrigation technology.
17:30	• ***Technology and spatial data for water monitoring and precision agriculture*** - Cheikh Sadibou FAYE, l'Ecole Polytechnique de Thiès, Senegal – online The spatio-temporal monitoring of rice-growing areas utilizes Sentinel 2 satellite observations throughout the plant's growth cycle. Analyzing Sentinel 2 images at one-month intervals from January to July 2020, processed through the Google Earth Engine (GEE) platform, involved seven scenes. This monitoring relies on spectral indicators derived from multispectral transformations of Sentinel satellite channels, focusing on crop vegetation and soil moisture mapping. Crop vegetation is monitored using periodic calculations of vegetation indicators (NDVI and EVI), while moisture stress is assessed through NDWI and MNDWI. Analysis of Sentinel 2 time series reveals spatial and temporal variations in vegetation and soil moisture, identifying areas with specific needs linked to poor plant development, senescent plants, or water scarcity. Cross-referencing maps depicting intra-cell variability in vegetation, water, and nutrients allows the creation of an intra-cell modulation map. This map guides interventions and decision-making by assessing and locating interventions in both time and space. The keywords emphasize the significance of Sentinel 2, spatial monitoring, indices, crop vegetation, water stress, intra-plot variability, and modulation in this comprehensive approach to monitoring rice cultivation.

17:45	• *COALA Space based Irrigation scheduling* – Francesco VUOLO, University of Natural Resources and Life Sciences, Austria online The COALA API, is a cutting-edge solution developed by the Geoinformatics Institute of BOKU. This technology leverages satellite data to revolutionize daily crop water requirements, offering data-driven insights for efficient irrigation practices. Developed for precise crop management decisions, COALA API calculates daily water needs, optimizing irrigation efficiency and reducing production costs. With a focus on sustainability, the API integrates complex modeling capabilities, empowering users to generate customized maps tailored to specific requirements. This innovation, originating from the Geoinformatics Institute of BOKU, represents a significant advancement in precision agriculture, contributing to water conservation, improved fertilization practices, and sustainable crop management on a global scale.

Day 2, Wednesday, 8 May 2024 – 9:00 – 17:30

9:00 – 10:30	T1S3. Space technologies and their relevance for groundwater monitoring Moderator: Ameria BAITU, Ministry of Lands, Housing and Human Settlements Development, Tanzania
9:00	• ***Assessing Vulnerability and Co-Designing Climate-Resilient Water Management Strategies for Rural Communities Using Geospatial Datasets*** - Hafsa AEMAN, International Water Management Institute, CGIAR, Pakistan and University of Wuhan, China Vulnerability assessments are crucial for designing adaptation and mitigation strategies for the regions susceptible to climate risks and exposures. This study employs an integrated approach, utilizing spatiotemporal parameters to assess the vulnerability of agriculture-dependent communities in the Okara district, Pakistan, to climate change impacts on groundwater availability. Factors such as risk exposure, sensitivity, and adaptation capacity are analyzed. Primary data sources include satellite imagery, ground truthing surveys, and discussions with farmers. Using Principal Component Analysis (PCA), approximately 35% of the district faces severe groundwater depletion risk. The threefold increase in demand for groundwater tubewells from 2010 to 2022 has led to a 1066 cm drop in the average groundwater level, significantly increasing irrigation costs for farmers. This reduction disproportionately affects marginalized farming livelihoods, with 86% of farmers spending over 6,000 PKR/acre for water pumping. The study identifies areas with high groundwater vulnerability and limited adaptive capacity, emphasizing the need for enhanced adaptive and management strategies in these regions. The farming communities, acknowledging this challenge, express a willingness to adopt climate-resilient practices, with 57% indicating readiness for adaptation. The study recommends that policymakers prioritize initiatives to improve adaptive and management strategies in highly susceptible areas.
9:15	• ***Remote Sensing for the management of transboundary aquifers shared between Algeria, Tunisia, and Libya in Africa*** - Badia CHELLI, Water Research and Technologies Center, Tunesia The SASS Project (the North-Western Sahara Aquifer System referred to as SASS (acronym from the French "Système Aquifère du Sahara Septentrional") is a groundwater resource and freshwater reserve underlying parts of Algeria, Libya and Tunisia. It occurs at varying depths (as deep as 1000 m) and has negligible recharge. The SASS groundwater resource is sufficient for many centuries to come (500-600 years at projected consumption rates), but intense development by the three countries in the past thirty years has exposed the aquifer to a serious risk of groundwater table drawdown, loss of artesian pressure, salinisation, salt water intrusions along the coast, and deterioration of water

	quality across the national borders. The situation is aggravated by growing population pressure and a strong development of irrigation schemes. A comprehensive characterisation of the SASS is given in the literature, for example OSS (2003). Cooperative management of internationally shared aquifers aims at ensuring the sustainable provision of water to the population and avoiding international conflicts. The SASS project focus on the development and demonstration of Earth Observation based products and services which support national authorities and international institutions in the transboundary management, internationally shared groundwater resources - aquifers - in Africa. All products and related documentation will be presented in full detail and interpretation in this presentation.
9:30	• ***Cloud Computing and Remote Sensing Data for Potential Groundwater Recharge Estimation in Water Resources Management*** - Elizabeth GUZMÁN HIDALGO, Faculty of Engineering at the National Autonomous University of Mexico Estimating groundwater recharge is crucial for effective water resources management in Mexico, where 80% of these resources are used for agriculture. Challenges due to the large amount of spatio-temporal data and computational resources can be addressed through recent advances in cloud computing services. In this study, we adapted the Thornthwaite-Mather method within Google Earth Engine (GEE) through Google Colab to estimate the potential groundwater recharge on a monthly scale in the Mexico Basin from 2001 to 2022. All required model inputs, including precipitation, potential evapotranspiration, and soil-vegetation data, were sourced from the GEE dataset catalogue. Potential recharge estimations are sensitive to the satellite product resolution, rooting depth, terrain slope, soil type, vegetation, and irrigation, among others. Nevertheless, our simplified model performs well compared to more robust methodologies used in the Mexico Basin, such as the USGS Soil Water Balance. One of the main advantages of utilizing cloud computing tools is the easy and immediate access to results for decision-makers involved in water resource management, as well as anyone interested in assessing potential recharge using open code.
9:45	• ***f-hydra - groundwater vulnerability mapping in Ghana*** - Amos Kabo-Bah University of Energy and Natural Resources, Ghana online In Ghana and most of Africa, groundwater is the major source of water supply for most communities. However, the impacts of climate change, large scale anthropogenic activities such as land use changes due to deforestation, mining, unregulated settlements and poor siting of sanitation infrastructure pose a potential risk to the groundwater safe use for domestic purposes. Existing groundwater vulnerability models usually requires large sets of data both from remote sensing and in-situ measurements. In developing country like Ghana, it is very difficult to obtain all these datasets. As a result, f-hydra was developed

	based on the use of Digital Elevation Model and land use land cover maps obtained from remotely sensed data. The newly developed model was validated in a number of basins across Ghana and the results obtained show usefulness for data-scarce regions for groundwater vulnerability mapping. Discussions are being held with the Water Resources Commission of Ghana to replicate the application of this model for a country-wide assessment.
10:00	• ***Delineation of Fresh Groundwater Potentiality Zones in Saline Coastal Aquifers, Southwest Bangladesh using Remote Sensing and GIS Approaches*** - Rakib HOWLADER, University of Rajshahi online The southwestern coastal zone in Bangladesh faces freshwater scarcity as aquifers are more vulnerable to seawater intrusion resulting increase its salinity level. But here fresh groundwater resource badly needed for drinking, agricultural, and industrial uses to sustain livelihood. The present study has made attempt to demarked available fresh groundwater zones in Khulna district in the southwestern coastal zone using multi-criteria decision making (MCDM) tool and analytical hierarchy process (AHP) with remote sensing (RS) and GIS approach. To delineate fresh groundwater potential zones, twelve thematic parameters such as groundwater salinity, groundwater electrical conductivity, groundwater chloride, rainfall, concentration of soil salinity, land slope, geomorphology, surface geology, land use and land cover, drainage density, lineament density, topographic wetness index have processed utilizing ArcGIS overlay analytic tool. Accordingly, the area has classified as very good [18 km2 (0.52%)] - safe for drinking and agriculture; good [858 km2 (25%)] - useful only for agriculture purposes; low [354 km2 (11%) - use for irrigation of certain high salinity tolerate crops having high risk for human consumption; and very low [2148 km2 (64 %)] - unsuitable to use due to seawater intrusion or high salinity of the total area. The salinity-prone zone covers 75 % of the total area requires especial management approach. Finally, findings will aid in identification of fresh groundwater potential zone for human consumption and agriculture in salinity effected coastal zone of the country to ensure sustainable groundwater use and extraction in this coastal areas, and findings of the present study can be utilized as a guide for addressing groundwater issues for this region.
10:15	• ***Hydrogeological Investigation, Delineation of Safe Yield and Water Stressed Zones (GSZ) in Dry-Land Barind, Northwest part, Bangladesh*** - Monirul Islam ISHA, University of Rajshahi online tbc Unplanned groundwater development and severe strain on groundwater supplies are the results of the expansion of agriculture in the Barind Tract in northwest Bangladesh. The low precipitation levels, long-term decline in annual and seasonal rainfall, thick top clay layer, low soil infiltration capacity, and potential aquifer for groundwater development at deeper depths have all put the region's groundwater resources and water security under concern. The current research region is exhibiting an increasing trend of water stress, as seen by the declining trend of the groundwater table (GWT). Groundwater stress is a significant issue affecting agriculture and economically marginalized communities, making it a challenging and challenging task. Using the multi-

	criteria decision-making (MCDM) tool of GIS and RS techniques, the water stress zone has been defined in this study. The groundwater stress zone (GSZ) map identifies various stress levels, including 16% in the "highly water stress" zone, 54% in the "moderately stress" zone, 28% in the "low stress" zone, and 2% in the "very low stress" zone. The study recommends raising awareness and implementing the Bangladesh Water Rules (2018) and Bangladesh Water Act (2013) to address issues like overexploitation, water stress, and rising demand.
10:15	• ***Assessment of interactions between land use change and groundwater recharge under urban Heat Islands Remotely Sensed Signatures, in Santa Cruz-Bolivia*** - Ana RODRIGUEZ, IdeasHub - backup Santa Cruz-Bolivia, 1.2 million population, central-western Amazon, depends on groundwater for drinking water supply (DWS). The major issues are: the lack of an environmental monitoring network, and the loss of Amazonian forest due to urban expansion, increasing Land Surface Temperature (LST), affecting evapotranspiration (ET) and groundwater recharge. Satellites are fundamental under the economic limitations of the country. LST data was collected from MODIS Terra and Aqua platforms, from February 2000 to December 2023, at 1 km resolution. Sites were sampled from the imagery in downtown, the city outskirts and locations over groundwater recharge areas where deforestation occurs. Results indicate: 1) LST distributions are close to normality, except for the right-skewed dry winter; winters are becoming warmer; 2) At sampled points away from downtown, LST reduces 1 degree Celsius in average; 3) On the area gradually deforested in the mid 2010´s, LST were 3 degrees Celsius lower that the other two areas, but increased in the second decade of the 2000´s in average 2 to 3 degrees. 4) With Thorntwaite´ estimated evaporation highly correlated to temperature, an increase in ET occurs, land use alters soil infiltration, hence water balance suggest impacts on groundwater recharge that will affect DWS.
10:30 – 11:00	Coffee break and lightning talks
11:00 – 12:30	**T1S4. Space technologies monitoring flood risk and impact, and relevant climate change adaptations in agriculture** **Moderator: Mandira SHRESTHA, International Centre for Integrated Mountain Development, Harriette Adhiambo OKAL (Stockholm Environment Institute, Kenya)**
11:00	• ***Identifying Annually Flood-Prone Areas to Aid Communities in Developing Improved Agricultural Practices*** - Ana Mirian Villalobos Velásquez, Ministry of Environment, El Salvador In El Salvador, Synthetic Aperture Radar (SAR) images from the Sentinel satellite have been crucial for identifying flood-affected areas after severe weather events. However, the country's varied topography presents unique challenges. These variations can affect the accuracy and utility of SAR data, particularly

	during local heavy rainfalls and thunderstorms where SAR images may not detect flood areas accurately. This research focuses on the Cerrón Grande, El Salvador's largest natural water reservoir, located in the north-central region. Essential for agriculture, hydropower, and drinking water supply to the capital, this reservoir is a lifeline for nearby communities. These communities depend on the reservoir's water cycle for farming, especially in low-lying areas susceptible to flooding during intense rainfall or certain times in the rainy season. Such flooding often leads to significant crop loss. Our study emphasizes the need for precise identification of areas that flood annually and determining the specific periods of flooding. This information is crucial for local communities to prepare better and plan crop cycles more efficiently. The goal of our findings is to aid in more effective agricultural planning, minimize the risk of crop failure due to flooding, and promote sustainable farming in these at-risk areas.
11:15	• ***Flood Modelling of Cagayan De Oro Watersheds*** - Fe OCIONES, Ecosystems Research and Development Bureau, The Philippines Flood modelling was conducted in the 5 major watersheds that transect the City using terrain analysis. Terrain analysis involves the geomorphological and spatial assessment of a watershed in terms of watershed shape, relief features and channel morphology. Hydrological parameters used included circulatory and bifurcation ratios, stream densities and frequencies and relief ratio. Results show that Cagayan De Oro and Iponan are the most flood prone watershed in Cagayan de Oro City. The critical parameters in the flood modelling are the bifurcation and circulatory ratios. Critical areas to flooding was also determined by spatially delineating low lying areas in the deposition zones with 1-5 meters masl as the most critical to flooding, followed by 5-10 masl and 10-15 masl elevations. A buffering system of the two flood prone rivers was formulated based on the result of the flood modelling to determine areas that need riverbank stabilization. Reforestation is recommended for steep slopes 30 percent and above, and strict protection measures are needed in the remaining close canopy forests. Protection should be instituted through land use planning and local ordinances.
11:30	• ***Leveraging multi-satellite remote sensing data and machine learning for flood risk assessment in Nam Ngum river basin, Lao*** PDR - Sackdavong MANGKHASEUM, Kyushu Institute of Technology, Japan The study focuses on flood susceptibility in the Nam Ngum River Basin, Lao PDR, an area prone to annual flooding due to monsoons and rainstorms. Flooding in this region significantly threatens human life, causes economic losses, and damages communities and agriculture. The study employs advanced remote sensing and machine learning techniques, including random forest (RF), support vector machine (SVM), and artificial neural networks (ANN), to address these issues and create detailed flood susceptibility maps. The machine learning models used historical flood data, Sentinel-1 SAR imagery from 2018 to 2020, and open-source flood data for training and validation. The resulting flood susceptibility map reveals that 25-44% of the basin area is highly susceptible, predominantly in low-elevation and low-slope regions. Likewise, 85 to 90% of

	the people are highly vulnerable to flooding within 260 to 280 km2 of built-up area. The study proposes a new approach to using machine learning and readily available remote sensing data for flood susceptibility mapping. The findings of this study provide essential insights for policymakers, aiding in disaster risk reduction and facilitating sustainable development planning in Lao PDR.
11:45	• ***Catchment modeling and remote sensing for sustainable water management in the Wala basin, Jordan*** - Esraa TARAWNEH, Mutah University, Jordan The Wala Dam in Jordan faces significant sedimentation issues, prompting proposals to increase its height. This study employs an optimized SWAT model for the Wala catchment to assess catchment management scenarios, focusing on land-use alterations. Plantation scenarios, particularly cultivating barley and olive are examined for their impact on discharge and sediment yield to the dam from 1979 to 2013. The study indicates that the dam's current capacity could fill up with sediment in 65.63 years, emphasizing the need for intervention. The ongoing dam expansion is projected to extend its lifespan by approximately 283%. Remote sensing data, crucial in catchment modeling, highlights spatial variations in the simulated effects of altering plantations. While land-use alterations do not necessarily improve dam lifespan, the study emphasizes the importance of careful examination of management plans. The water-energy-food nexus is a complex system, and retaining water for ecological benefits can have trade-offs. However, the model suggests that land restoration, particularly under cropping scenarios, has marginal impacts compared to the benefits of dam heightening. Notably, the study underscores the potential of catchment modeling, particularly with remote sensing data, to target land restoration measures effectively for maximum ecological benefits, including water conservation and erosion reduction.
12:00	• ***Analysis of Drought Flood Abrupt Alternation Events and their Agricultural Impacts in Kenya*** - Betty MAKENA, University of Nebraska Linkoln Drought and Floods are two sides of the same coin. After a prolonged drought precipitation is always a welcome sight allowing regeneration of vegetation and aquifer. However, recent climate change has disrupted this equilibrium, where drought periods are followed by intense rainfall within a short period resulting in superimposed impacts of droughts and floods. This phenomenon, known as Drought-Flood Abrupt Alternation (DFAA), exacerbates vulnerabilities in communities and agriculture. In Kenya, there has been a notable increase in DFAA events, notably the 2019-2022 prolonged dry period followed by intense rainfall in 2023, causing devastating consequences. Current disaster management plans often overlook DFAA events, as they primarily focus on either floods or drought. The aim of this study is to identify the impacts of abrupt shift between drought and floods to communities. The study will analyze the spatial distribution, temporal variation, and intensity of DFAA events from 1990 to 2023 using the Long Cycle Drought-Flood Abrupt Alteration Index (LDFAI) and integrate with the impacts to understand the impacts of these events on

	agriculture, water scarcity. The findings of this research will inform decision-making processes, facilitating the development of more dynamic early warning systems to address the challenges posed by climate change.
12:15	• *Q & A, Discussion*
12:30 – 13:00	Lightning talks
13:00 – 14:00	Lunch break (and lightning talks for online participants)
	T2S1. Space technology and data for water quality monitoring and sustainable agriculture Moderator: tbd
14:00	Satellite Remote Sensing in Support of Water Quality Management – Steven GREB, Space Science and Engineering Dept. of University of Wisconsin- Madison Our surface waters provide us with a number of environmental and economic benefits as well as contribute to our quality of life. Timely and effective water quality monitoring is critical to proper management and anticipating and mitigate water quality issues. Budgetary cuts and staffing shortages have exacerbated efforts to effectively monitoring our surface waters. GEO AquaWatch https://www.geoaquawatch.org/ is a global organization of water quality experts who are building the capacity and use of satellites to empower organizations and professionals of the water quality community with the relevant resources to utilize in-situ data, 19odelling and satellite technology to monitor and manage these precious resources.
14:15	• ***Remote sensing estimations of water quality dynamics in the Asian mega deltas*** - Mahesh JAMPANI, International Water Management Institute, Sri Lanka / CGIAR In the Asian Mega Deltas, Mekong, Irrawaddy, and Ganges, millions of people depend on the aquatic environments for livelihoods. Inhabitants in these delta systems often face health risks that are amplified by anthropogenic pollution loads from terrestrial environments and tidal incursions from coastal environments. The water quality deterioration in these delta systems is complex, often due to a lack of wastewater treatment capacities, upstream activities, climate change implications, and inefficient water management practices. These impacts often lead to the contamination of both riverine and coastal ecosystems, adversely affecting local livelihoods and economies. Therefore, there is an urgent need to understand water quality dynamics within these deltas. The current research leverages multi-sensor satellite imagery in

	combination with predictive 20modelling to address these challenges. Overall, this research aims to evaluate the spatial and temporal variations of water quality and provide an essential understanding of contaminant plume extent, seasonal dynamics, and pollution occurrence based on events. This research and analysis provide insights into pollution dynamics, evaluating impacts, and developing robust strategies to improve water management in delta systems, thereby mitigating public health risks.
14:30	• ***Space technologies and data for monitoring water quality and sustainable agriculture in Uzbekistan*** – Bekzod MUKHAMEDOV Uzbekspace agency, tbc In an era of innovation, the impact of space technologies becomes a fundamental aspect of enhancing agriculture and maintaining high water supply standards. Advanced satellite technologies provide precise monitoring of soil conditions, enabling the optimization of planting and harvesting periods, ultimately contributing to efficient resource utilization. Data analysis from space plays a crucial role in improving water quality. Satellites help identify and forecast pollution zones, monitor water levels in reservoirs, and prevent water supply issues. This collaborative synergy between space technologies and data opens perspectives for developing sustainable agricultural models, promoting not only increased crop yields but also the preservation of ecological balance. This contemporary approach to agricultural and water resource challenges underscores the importance of innovation in shaping a sustainable future for our planet.
14:45	• ***Above and beyond: Space technologies revolutionizing agriculture and water sustainability*** – Mirabdalla MIRSODIKOV, Space monitoring centre, Uzbekistan, tbc This article explores the pivotal role of space technologies and data in monitoring water quality and fostering sustainable agriculture practices in Uzbekistan. With a focus on leveraging satellite-based observations, Geographic Information Systems (GIS), and remote sensing, the study investigates the potential impact of these technologies on enhancing water management strategies and promoting agricultural sustainability. The article highlights the integration of machine learning and artificial intelligence techniques in processing and analyzing satellite imagery for accurate water quality assessment and crop monitoring. The findings underscore the significance of these advancements in addressing environmental challenges and ensuring the efficient utilization of water resources in the context of Uzbekistan's agricultural landscape.
15:00	• ***Harnessing space technologies for water quality monitoring and sustainable agriculture in Burundi*** – Landry SIBOMANA, Permanent Mission of Burundi to the United States of America, tbc

	This presentation aims to explore the transformative role of space technologies and data in monitoring water quality and promoting sustainable agriculture practices in Burundi. Leveraging satellite imagery, remote sensing, and geospatial data, the study focuses on assessing water resources and their impact on agricultural ecosystems. By integrating advanced technologies, the research aims to identify potential pollutants, evaluate water quality parameters, and analyze their implications for sustainable farming practices. The findings provide crucial insights for policymakers, farmers, and environmentalists to develop informed strategies for ensuring water security and fostering resilient agricultural systems in Burundi. This interdisciplinary approach showcases the potential of space technologies in addressing the complex challenges at the intersection of water quality, agriculture, and environmental sustainability in the region.
15:15	• *Hyperspectral imaging (I) and artificial intelligence for the detection and quantification of agrochemical (i.e. Chlorothalonil) utilization in Carta–o* - Alexander SOLIS QUESADA, Delta Lab at Instituto Tecnológico de Costa Rica Chlorothalonil, a recently banned fungicide in Costa Rica, has been linked to potential health concerns in the province of Cartago. Aiming to contribute to food safety and sustainability in Costa Rica, by helping to regulate the use of agrochemicals, this project investigates the use of Hyperspectral Imaging (HSI) and artificial intelligence for the detection and quantification of substances such as Chlorothalonil in Cartago´s fields. We propose an artificial intelligence-based system to identify the spectral signatures of various concentration ranges of agrochemicals in crops, trained on and intended to be deployed to interpret hyperspectral satellite data. Multiple machine learning methodologies will be employed to identify a single definitive solution that is highly accurate, has low hardware requirements, and can be updated in real time. While traditional methods for agrochemical detection are often laborious and invasive, HSI offers a non-destructive and remote alternative. It has already shown its effectiveness in detecting various food hazards, including agrochemicals, increasing its potential for larger scale testing. The spectral signature identification methodology will adapt previous work based on hyperspectral data obtained in a laboratory to employ only freely available satellite data. Ultimately, it will be made accessible to local farmers, government officials, and other stakeholders.
15:30 -16:00	Coffee break and lightning talks

16:00	T2S2. Space technology and data for water quality monitoring Moderator: Steven Greb, (University of Wisconsin)
	• *Uncertainties while classifying cyanobacterial and micro-algae blooms* - Francisco NEMIÑA, Comisión Nacional de Actividades Espaciales The advent of new generations of hyperspectral satellites will provide access to novel operative datasets, enabling the generation of innovative water quality indicators. In this context, the utilization of in-situ, laboratory, and simulated spectroradiometric data becomes essential for the development of these new algorithms. In this study, we show how these three sources of spectroradiometric data can be synergistically leveraged with existing hyperspectral satellites to analyze the quality and uncertainties associated with current algorithms. This work will present the uncertainties associated with the separation of cyanobacterial blooms from other microalgae. It will also explore the potential application of this procedure to a hypereutrophic reservoir, specifically San Roque Reservoir, located in Córdoba, Argentina. Finally we will show other research lines of our work group which focus on the use of spectroradiometric and hyperspectral data for water and snow quality indicators.
	• *The National Water Resource Information System, Nicaragua* - Mildred RIVERA ORTEGA, National Water Authority (ANA), Nicaragua, online tbc The national water resources information system is a system that allows you to view interactive maps, tools that allow users to explore and visualize geographic data and offer additional functionalities to obtain more detailed information on the topic of water resources and describe the data of the ANA Spatial Data Infrastructure that contains a record of information related to the country's Water Resources
	• *Risk management tool for water utilities* - Natalia RODRÍGUEZ ALFARO, Casa de Agua, Costa Rica Presentation of a Risk Management tool for water utilities, the Gestión Integral de Riesgos en Asadas (GIRA), nowadays implemented at a national level in Costa Rica. This tool analyzes vulnerabilities and threats that allow the management of risks that affect the provision of water and sanitation services. The vulnerabilities are measured according to a survey that evaluates each type of management (operational, infrastructure, sanity and administrative), and considers a general risk indicator based on a geospatial database, for each sub-basin and each threat. The Risk Management tool uses the methodology suggested by the Sendai Framework, which focuses on taking action on the three dimensions of disaster risk (hazard exposure, vulnerability and capacity, and hazard characteristics) in order to prevent the creation of new risks, to reduce existing risks and to increase the resilience.

	• *Monitoring water pollution over the Weija water reservoir using Earth observation data* - Patrick LAMPTEY, Ghana Space Science And Technology Institute, Ghana Atomic Energy Commission, online tbc Ghana is currently grappling with extreme levels of water pollution from practices that have negatively impacted its water quality such as improper land use, illegal mining, agriculture, and industrial waste disposal. Due to poor monitoring, enforcement of legislation and regulations the situation has gotten to an alarming rate which has resulted in the destruction of aquatic lives and livelihoods. Large sections of rivers have become visibly turbid even in the dry seasons when there is no rainfall run offs to account for such. The Government of Ghana initiated has initiated several joint security operations to curb these activities but has all proven futile. This is primarily because the illegal mining activities take place in remote forest areas making it difficult to access. To offer support, the Ghana Space Science and Technology Institute is exploring the use of Earth observation techniques to identify and monitor pollution sources in water bodies to help in combating water pollution through both legal and illegal means. Researchers at GSSTI used satellite images over the Weija water reservoir (the main source of drinking water) in the capital Accra and were able to identify a major source of water pollution from agricultural activities into the reservoir.
	• *Importance of space-based technology for water quality monitoring in Mundal Lagoon Sri Lanka* - SBD DISSANAYAKE MUDIYANSAELAGE (Institute of Development Studies) - online Mundal Lagoon is linked to Puttalam Lagoon to the north by a channel in Puttalam, Sri Lanka. It is surrounded by a wide variety of agricultural products, the largest shrimp farms in the country, and salt fields. The lagoon is home to mangrove swamps, seagrasses and salt marshes, sand dunes, and a variety of fauna. This fragile lagoon ecosystem is threatened by human activities; agriculture and large-scale shrimp farms add high amounts of nutrients, chemicals, and sediments to the lagoon, which leads to decreased salinity, eutrophication, and biodiversity loss. During drought season, the lagoon almost becomes a dead lagoon condition. Water quality monitoring is necessary in order to gain a better understanding of its cause-effect relationship and to safeguard this ecosystem. Monitoring water quality can help identify the source of pollution and the most effective ways of controlling it. It can also help identify areas that need protection and put in place regulations. This study examined the water quality monitoring in Mundal Lagoon through remote sensing data and parameters such as turbidity levels, chlorophyll-a levels, and biological factors. Landsat 8 data were used. Spatial and temporal patterns of biophysical parameters were analyzed over 10 years across the lagoon. Correcting for atmospheric effects is crucial when monitoring water quality.

	• ***Separate land use land cover and hydro-climatic effects on cyanobacterial harmful algal blooms in Güija Lake*** - David ZAMORA, Stockholm Environmental Institute, Colombia Worldwide, the proliferation of cyanobacterial harmful algal blooms (HAB) is among the major undesirable effects resulting of eutrophication. To date, environmental factors that contribute to their global expansion include increased nutrient inputs via anthropogenic activities and temperatures and CO, concentrations due to changing global climate. Despite knowing the relevance of cyanobacteria in causes and effects, the monitoring programs in several countries need to be stronger or more valid to measure chlorophyll-a (Chl-a) for monitoring HAB in inland water bodies. There are some products to recollect in situ and remote sensing to assess the Chl-a dynamics, as GLObal Reflectance community dataset for Imaging and optical sensing of Aquatic environments (GLORIA) data evidence that Central and South America and Africa continent has a few data of Chl-a. This condition is more critical in the tropical zone, where Güija Lake is located in the transboundary Lempa River basin (Guatemala, Honduras and El Salvador countries). HAB events are more frequent, with high fish mortality. Although the environmental authority from El Salvador have been monitoring the Chl-a dynamics in the last years, they needed to strengthen the in-situ data with other monitoring alternatives to define the causes of Chl-a increases in different zones and moments of the year. We estimated the Chl-a concentrations from bands of Landsat 8 image from 2013 to 2021 and compared them with in-situ data found as proper to monitor the water quality, despite the relative coincidence amount their dates of register. With streamflow and nutrient concentrations of the main influents of the Güija Lake and precipitation in the Lempa River basin, we can define the leading cause of the Chl-a increases are related to the reduction in water volume in the Lake.
	• ***Benefits that space technology provides in monitoring quality, management and administration of water to obtain results: Mexican experience*** - Jesus Roberto ROMERO RUIZ, Deputy Director of Space Security, Mexican Space Agency (backup) The Mexican Space Agency and the National Water Commission, an organization whose responsibility is to manage, regulate, control and protect the national waters in Mexico, have expanded the use of space technologies and data obtained from space for a better application in the management and administration of the water. Particularly, the information generated from remote sensing has been added to the tools for evaluation and analysis in various activities and the active exchange of knowledge between government authorities, technical and academic experts, the private sector and civil society has been promoted. In terms of hydrological studies, they are used to estimate the average availability of surface waters in the country's basins, where the seasonality and annual variability due to the effects of precipitation or evaporation in water bodies can be monitored. As well as to identify changes in land use over time to estimate some physiographic characteristics of the basins. Likewise, they are used to complement topobathymetric studies carried out in dams, lakes or lagoons, by comparing changes in volume and surfaces with water that occur on certain dates, in order to prepare elevation-area curves. –

	capabilities. Likewise, the modifications in the shape of the terrain in the vicinity of dams and bodies of water are known remotely, since it is perceived from the oldest images, if some recent significant change has occurred in the surroundings, which can impact in reservoir storage. For example, new cultivation areas, the increase in urban areas or some drought situations have been observed over time. In addition to the above, variations in runoff and sediments in the country's most important rivers have also been identified through satellite images. As well as the evolution of sediments in coastal or deposit areas, in the circulation of marine currents and in the dynamics of the areas that receive wastewater discharges. Regarding the effects caused by hydrometeorological events, the information from remote sensors has been very useful to analyze and delimit the flood zones and affected surfaces in their stages of evolution. Since these polygons have made it possible to calibrate the results obtained from mathematical models developed in Conagua for the purposes of evaluation, forecasting or prevention in areas susceptible to flooding, for example in the Tabasco plain in the south of the country. On the other hand, in terms of water quality monitoring, in Mexico through Conagua, systematic evaluation and monitoring is currently carried out using conventional methods in the main bodies of water in the country, the above allows knowing the conditions of quality and detect possible sources of contamination in a timely and specific manner. However, this process has some limitations, such as inaccessibility at some sites of interest or the sampling areas are too large. Therefore, in this area, strengthening is required for the creation of mathematical models from satellite images that can be correlated with the water quality results obtained previously described. This methodology would provide benefits such as: • Formulation of plans and programs for monitoring the water quality of rivers, lakes, wetlands and coasts of the country. • Monitoring in inaccessible areas or large areas of water bodies, at a lower cost. Speed in collecting water quality data. • Evaluation of non-point pollution, considering the spatial distribution of non-point sources of pollution. • Monitoring of contaminants in bodies of water, in the event of ecological disasters such as industrial spills. Even sites due to diffuse contamination that can impact groundwater at a regional level. For example, products accidentally spilled from tailings dams as a result of mining extraction in certain areas of the country. You can also know the emitting source of a certain pollutant due to a fuel spill, and identify the populations potentially exposed to the incident.
19:00	SOCIAL EVENT - Conference dinner at Jardin de Lolita
	A conference dinner at ***Jardina de Lolita*** situated at the market of San José. Those who wish to participate need to register during registration This event is a great opportunity to connect. Please note, every is kindly asked to pay for their own meal. https://www.jardindelolita.com/san-jose

Day 3, Thursday, 9 May 2024 – 9:00 – 17:30

Early morning – 12:30	Field trip to selected venues at the Reventazón River watershed
Departure time to be announced	This initiative is poised to offer insights into the use of technology for water management in agriculture, showcasing the confluence of innovation, sustainability, and collaboration. Spanning across a significant portion of Costa Rica, the Reventazón River watershed is not just a geographical landmark but a vital artery that supports both the natural ecosystem and the agricultural landscape of the region. It is here, amidst the lush biodiversity and the varied terrains, that the field trip aims to shed light on the innovative approaches being employed to harness, manage, and conserve water by local rural communities. All international participants are invited to join if they register during the on-site registration upon their arrival at IICA!
12:30 – 13:00	Lightning talks
13:00 – 14:00	Lunch (and lightning talks for online participants)
14:00 – 15:30	T5S1. Space technology and data for glacier monitoring Moderator: Amjad Ali (Space & Upper Atmosphere Research Commission (SUPARCO), Pakistan)
14:00	• *Increasing risk of glacial lake outburst floods across the Hindu Kush Himalayan region* - Mandira SHRESHTA (Senior Water Resources Specialist International Centre for Integrated Mountain Development, Nepal) The Hindu Kush Himalayan (HKH) region is vulnerable to glacial lake outburst floods (GLOFs) with sudden release of water. In the last decade there has been an increase in the impacts from GLOFs on the lives and livelihoods of people living downstream of these lakes and increasing effects on infrastructure such as hydropower projects. Climate change is affecting the cryosphere, causing increased glacier retreat, often leading to the formation of a glacial lake increasing the risk of a GLOF. Analysing satellite imageries, ICIMOD has identified 25,614 glacial lakes of area greater than 0.003km2. The rate of glacier mass loss increased by 65%, from an average of –0.17 metres water equivalent (m w.e.) per year for the period 2000–2009 to –0.28 m w.e. per year for 2010–2019. To

	understand the effectiveness of early warning systems (EWS) downstream of such lakes, four GLOFs from the HKH and their impacts to lives and infrastructure downstream are studied [South Lhonak, Melamchi, Bhote Koshi and Lemthang Tsho]. The presence and effectiveness of EWS for each GLOF is investigated, and the capacity of local and national disaster management agencies to act on knowledge of glacial lakes from remote sensing and in situ measurements.
14:15	• ***Application of space technologies for mass balance estimations in Patagonian glaciers*** - Ailin Sol ORTONOE LOIS (*Haedo Regional Faculty, National Technological University*) Spegazzini glacier has currently a total surface area of 126,95 km2, and is one of the largest glaciers in Los Glaciares National Park, in Argentine Patagonia. Furthermore, it is considered one of the most stable because, visually, its front and sides showed no changes for decades. In this work, we prove that the visual stability of its front and surface observed through satellite images is not sufficient in order to evaluate the condition of a glacier, and it becomes necessary to resort to other study tools, such as volumetric analysis. Mass balances were carried out by means of the geodetic method between free Digital Elevation Models such as SRTM, ALOS, TanDEM and ASTER from different dates. We develop an analysis methodology and generate the necessary corrections to be able to compare them correctly in the same vertical and horizontal reference systems. In addition, meteorological and ENOS data from NOAA and NASA'S MERRA-2 Project were used to determine a relationship between temperatures and precipitation with mass balance. Preliminary results show a positive relationship between meteorological data and mass balance, with pooled analysis being essential to understand the dynamics of these formations. This methodology is also probed in other glaciers within the National Park, with similar results.
14:30	• ***Appraising the Potential Implications on Vulnerable GLOF Sites in High Mountain Asia through Geospatial Techniques: A Case Study of Northern Pakistan*** - Syeda Saleha Fatim ALI, Assistant Manager for Climatology at National Emergency Operation Centre, National Disaster Management Authority, Pakistan and Institute of Space Technology, Pakistan The deglaciation due to global warming and changing climate has given rise to the formation and expansion of numerous glacial lakes, particularly in the High Mountain Asia (HMA) region. Many of these glacial lakes are susceptible to experiencing glacial lake outburst floods (GLOFs) events which can release millions of cubic meters of water and debris, leading to widespread impacts on lives, property, infrastructure, agriculture and livelihoods amongst remote and impoverished downstream communities in Pakistan. The research investigates the potential of multi-source data, focusing on District Chitral in Northern Pakistan, with elevated potential implications for GLOF and associated risk. A total of 12 vulnerable GLOF sites are chosen from Pakistan Meteorological Department's (PMD) GLOF inventory, out of which 5 are highly susceptible to GLOF. A spatio-temporal analysis of the vulnerable sites have been carried out considering key contributing factors with high impact potential including, lake

	area change, elevation, slope, aspect, temperature and precipitation, LULC, change in snow and glacier cover area, distance from fault line, and proximity to impact area, among others. A pronounced decline in the snow and glacial cover, and an increase in land surface temperature (LST) retrieved from satellite data could be responsible snow/glacial melting resulting to higher frequency of GLOFs and flash floods. The potential implications on population, infrastructure, schools, forest and agriculture, and water quality of District Chitral have been estimated. The findings are of great significance for policymakers and disaster management authorities, providing valuable insights to formulate efficient and effective measures for mitigating the identified risks.
14:45	• *High Mountain-Andes: Utilizing NASA Remote Sensing and Hydrological Modeling for Assessment of Water Resources and Cascading Geo-Hazards in Peru* - Yang HONG (University of Oklahoma) High Mountain Andes (HMA), is among the world's largest reservoir of perennial glaciers and snow outside of the Earth's polar ice sheets and HMA supplies water to surrounding countries with more than a billion people. Recent advanced satellite remote sensing (e.g., CloudSat-CALIPSO, AIRS, PMM, SMAP etc) and extensive in situ observations offer the opportunity to characterize the process-level studies on the changes in the region's glaciers, snow, and precipitation patterns that have altered the water supply, while also transforming into cascading hazards such as floods and landslides. Melting of glaciers/snow and precipitation variability continuously alter the patterns and risks of water-related hazards such as glacial lake outburst, floods, and landslides. These water-related hazards are often interconnected and usually occur in a cascading multi-hazard chain. Previous studies have been individual hazard oriented or local in nature. This project develops the HMA-Andes toolset for modeling the water resources and water-related cascading multi-hazards across the HMA region through an integrated multi-scale approach, and to improve the capacity for assessing water availability and hazards risks and their social impacts. Toward this goal, we propose an integrated multiscale research framework that includes the following research: (1) utilize multi-source satellite products and ground observations to build precipitation reanalysis (1980-2022) by accounting for various complexities over HMA; (2) produce a record of snow and glacier extent and dynamics in HMA (2002-2022) based on remote sensing and a state-of-the-art ice flow model; (3) develop a multiscale hydrological modeling system, through a distributed hydrologic model (CREST) at 1km landscape scale, and a glacial lake outburst model at 30m slope scale are coupled in a nested fashion; (4) Assess the water resource variability and streamflow extremes with the multiscale hydrological modeling continuum; (5) design a multi-hazard risk assessment module to evaluate risks for regional planning and policy making; (6) integrate the above hazard models with the hazard risk assessment module to form the HMA-Andes Toolset; and (7) implement the toolset in HMA and selected basins and to assess multi-hazard risks to support regional planning for countries such as Peru, Colombia etc. The presentation provides a methodology to facilitate sustainable solutions to enhancing societal resilience that can be scaled and applied to other hazard-prone communities. This project is expected to advance our capability for multi-hazards forecasting, and to benefit society by sharing the toolset with broader community, with a focus on SDG6 (Water),

	SDG2(Agriculture/Food/Land), SDG13 (Climate), and SDG11 (Sustainable Communities).
15:00	• ***Status of major glaciers stability in Gilgit Baltistan Basin*** - Mirza Muhammad WAQAR, CONTEC Gilgit Baltistan is home to the largest mass of non-polar glaciers, including Siachen, Baltoro, and Hisper glaciers. Global warming is increasing the rate of melting glaciers, causing floods, and disastrous effects are more severe each year. Due to rapid glacier melting, most of the glaciers in the region are unstable. Time-series InSAR technique provides an effective approach to mapping the slowly occurring land displacement. Small Baseline Subset (SBAS) and Compressed SAR (ComSAR) were utilized to analyze the major glaciers in the region and their respective displacement rate and net displacement during 2018-2023 were mapped and analyzed.
15:15	• Q&A & Discussion
15:30 -16:00	Coffee break and lightning talks
16:00 – 17:30	T3S1. Satellite communication - a facilitator for IoT-supported water applications *Moderators: Shanlong LU* (tbc), *Aerospace Information Research Institute, Chinese Academy of Sciences, China*
16:00	• ***Supervising agricultural and water management resources through Space-based IoT Technology***, Somaia MOHAMED (Egyptian Space Agency) Climate change affects both natural resources and the health of diverse organisms. To protect our resources, it is crucial to closely track these changes. Our research delves into using Space-based Internet of Things (IoT) to monitor agricultural and water management resources. This cutting-edge approach could help tackle water scarcity in Africa and the Middle East, boosting crop yields. By collaborating and deploying IoT satellites, these regions can better combat the impacts of climate change. The Egyptian Space Agency organized numerous workshops in Egypt, collaborating with various entities across agriculture, water management, and environmental sectors. The workshops aim to introduce advanced solutions leveraging Space technology, particularly IoT technology. Our goal is to assist these sectors in addressing challenges and enhancing their operations through innovative approaches.

	This work introduces an IoT payload designed for various missions, like cub-sats or as an add-on for nano and micro satellites. This payload seamlessly connects with different sensors, whether placed in urban areas, rural areas or remote areas. Space technology enables access to regions lacking internet infrastructure, with the IoT satellite serving as the link. The IoT Space system enhances water management monitoring by placing nodes in different regions to track water levels and consumption, particularly in agricultural irrigation.
16:15	• *Applications of internet of things (IoT) and sensors technology to increase food security and agricultural Sustainability* - Mutaz Al-Alawi (Director, Jordan Space Agency) online Agriculture must overcome escalating problems in order to feed a growing population while preserving the environment and natural resources. Recently, it has become clear that sensors and the Internet of Things (IoT) are effective tools for boosting agricultural sustainability and food security. The state of the art in IoT and sensor technologies for agriculture is examined in this paper, along with some of their potential uses, including 1) irrigation monitoring systems, 2) fertilizer administration, 3) crop disease detection, 4) monitoring (yield monitoring, quality monitoring, processing monitoring logistic 30 onitoring), forecasting, and harvesting, 5) climate conditions monitoring, and 6) fire detection. Additionally, this paper offers a number of sensors for agriculture that can detect parameters like soil NPK, moisture, nitrate, pH, electrical conductivity, CO2, temperature, humidity, light, weather station, water level, livestock, plant disease, smoke, flame, flexible wearable. Subsequently, this study highlights the advantages of IoT in smart agriculture, including superior efficiency, expansion, reduced resources, cleaner method, agility, and product quality improvement. However, there are still issues that need to be resolved in order for IoT technology to be used in agriculture where covered in this paper, and also provide insights into future research directions and opportunities.
16:30	• *Integrating Satellite, Drone, and In-situ Sensor Data for Precision Water Monitoring in Aldvancing Cacao Farming Practices in Peru* - Avid ROMAN GONZALES (Universidad Nacional Tecnológica de Lima Sur, Peru) This project addresses the imperative need for innovative water monitoring techniques to enhance cacao cultivation in Peru. With cacao exports exceeding US $200 million in 2014 and a subsequent 15% expansion of cultivable acreage to around 50,000 hectares in 2015, the economic significance of the crop underscores the importance of optimizing farming practices. The project proposes a comprehensive approach to water monitoring, leveraging satellite, drone, and in-situ sensor data. Collaborative efforts with key stakeholders, including the Association of Cocoa Producers of the Convention Valley (APROCAV) and the Central Cooperatives of the Convention Valley (COCLA), are integral to the successful implementation of this monitoring system. The goal is to achieve precision water management, enabling more efficient irrigation practices, improved risk assessments, and ultimately enhancing crop yields. Anticipated outcomes include elevated economic contributions to Peru's cacao

	industry, provided the proposed water monitoring system proves effective with a reasonable investment. The proof of concept involves continuous observation throughout the entire cacao growth cycle, covering aspects such as irrigation patterns, soil moisture levels, and their correlation with farming practices. The project aims to contribute to sustainable cacao farming while promoting efficient water resource management in the region.
16:45	• *Water Quality Monitoring System based on IoT and Earth Observation nanosatellite constellation systems* - Giao Nguyen (Prométhée, France) Technological advances in the fields of IoT and in situ sensors now enable the collection of ultra-precise local information benefiting from hyper-responsive telecom infrastructures for to become decision support tools, these information must be transmitted in real time to an operational center. However, they must be readjusted with regard to their geomorphological context in order to reduce the level of uncertainty as much as possible. This is where space and scientific models from earth observation capabilities come in, making it possible to correlate and merge all of these data to provide consistent and reliable products and services. In addition to their own informational capabilities, IoT and spatial sensors can interact with each other based on specific events. In the case of a water monitoring service, IoT sensors can send data concerning water quality and issue a local alert regarding cyanobacteria levels, for example. This alert can then be sent automatically to a constellation of satellites which will acquire data for the entire area concerned, enabling the possible identification of the potential source of the contamination and the projection of its overall impact.
17:00	• *Bridging the Water Infrastructure Gap in Africa with Twisted Waveguides for Satellite-Driven IoT Solutions* - Beverley Chelsea Saungweme (Siberian Federal University, Russia) Africa faces a severe water infrastructure gap that hinders sustainable development and poses a significant threat to human health and well-being. Conventional communication technologies struggle to reach remote areas, thereby limiting the potential of IoT-enabled solutions to address water challenges. Twisted waveguides, a novel type of waveguide with unique properties, offer a promising solution for bridging the water infrastructure gap in Africa. By integrating twisted waveguides into satellite communication, we can enable cost-effective and reliable IoT connectivity in remote areas, facilitating real-time monitoring, control, and data transmission for water management applications. In this paper, the stress and deflection of behavior of twisted waveguides under bending conditions using Euler-Bernoulli beam theory was investigated. The results demonstrate that twisted waveguides exhibit exceptional mechanical performance, withstanding significant bending loads without compromising signal integrity. This mechanical robustness makes twisted waveguides well-suited for deployment in challenging environments, such as the rugged terrain and unpredictable weather conditions often encountered in Africa. The integration of twisted waveguides into satellite

	communication has the potential to revolutionize water management in Africa. By enabling real-time data transmission from remote water sources, twisted waveguides can support a range of IoT-enabled applications, including real-time water quality monitoring and monitoring of water infrastructure.
17:15	• *Monitoring water and sanitation projects in Africa using geospatial data and satellite-imagery to account for project progress in diverse and often remote locations* – Asmaa MAOULAININE (Arab Bank for Economic Development in Africa, BADEA) The BADEA-UNITAR-UNOSAT platform is a space-based solution addressing the following water related challenge: monitoring water and sanitation projects in Africa using geospatial data and satellite-imagery to account for project progress in diverse and often remote locations.

Day 4, Friday, 10 May 2024 – 9:00 – 17:00

9:00 – 10:35	T4S1. Space technologies monitoring forests, agroforestry, watersheds and their interplay Moderators: Edgar ESPINOSA-CISNERO, Assoc. Prof. of Geography, University of Costa Rica and Jim NELSON, Prof., Brigham Young University, GEOGloWS
9:00	***Keynote: Leveraging GEOGLOWS Global Streamflow Information for addressing Sustainable Development Goals*** - Jim Nelson, Brigham Young University, GEOGloWS The United Nations Sustainable Development Goals (SDGs) provide a framework for global action to address pressing socio-economic and environmental challenges, including important water security issues. This presentation highlights the important role that reliable water information plays in advancing progress across multiple SDGs. Access to timely and reliable water information is essential for effective water resources management, disaster risk reduction, and climate change adaptation. Earth observing technologies have emerged as valuable tools for providing actionable water information on a global scale. Remote sensing data provides information for key indicators on watershed activities and health, enabling policymakers and stakeholders to make informed decisions and allocate resources efficiently. Furthermore, the integration of earth observations with advanced modeling techniques allows for the development of global hydrological models, which provide insights into complex water systems and facilitate short- and long-term planning and forecasting. GEOGLOWS is a global hydrological model, providing an 80-year historical record of streamflow and daily 15-day forecast on more than 7 million rivers. This information can play a critical role in enhancing water security, promoting sustainable water management practices, and supporting the achievement of multiple SDGs beyond SDG 6 which is focused on clean water.
9:20	• ***Quantitative assessment of land degradation and watershed using space technologies*** - Amjad Ali, *Pakistan Space and Upper Atmosphere Research Commission (SUPARCO)* Pakistan is facing severe challenges due to land degradation and watershed management. The present study aims to assess the interplay of food, land, climate, and water for the assessment of land degradation and watershed management in Potohar (Punjab) and Balochistan areas. For quantitative assessment of erosion and soil loss, a spatially explicit Revised Universal Soil Loss Equation (RUSLE) model has been used. The input parameters like rainfall erosivity factor, soil erodibility factor, length slope factor, land cover factor, and erosion control practices were derived from satellite remote sensing data. The

	results showed that Potohar is subject to land degradation with an average annual soil loss up to 19 tons ha-1yr-1 of which the maximum erosion (>100 tons ha-1yr-1) was near the river channels and hilly areas. The study explored that the sediment yield due to erosion is as high as 148 tons ha-1yr-1 with an average of 4.3 tons ha-1yr-1. In the case of Balochistan, satellite-based watershed analysis based on a multi-criteria parametrical weighted approach helped to delineate multiple rainwater harvesting sites along with a quantitative assessment of watershed management parameters. Space technology plays an important role in studying the interplay of terrain, climate, and watersheds and its interplay.
9:35	• *Space Tech Fusion: A Novel Approach for Environmental Monitoring and Policy Making* - Nodira TILLAYEVA, Center for Space Monitoring and Geoinformation Technologies, Uzbekistan National Space Agency This paper introduces an innovative approach, dubbed Space Tech Fusion, to address the urgent need for effective environmental conservation. It focuses on integrating high-resolution satellite imagery with a network of IoT sensors to create a comprehensive, real-time view of environmental changes. Multispectral satellite technology monitors key indicators such as deforestation, soil erosion, and water stress, while IoT sensors on the ground provide vital data on moisture levels, air quality, and water conditions. The combination of these technologies allows for the detection of subtle environmental shifts that are often overlooked. The data collected through this method is synthesized into accessible formats like maps and dashboards. These tools provide clear, actionable insights for policymakers, enabling them to devise more effective and targeted environmental strategies. This approach not only aids in understanding the current state of ecosystems but also assists in anticipating future changes, allowing for proactive measures. The decline of the Aral Sea serves as a poignant example of the consequences of environmental neglect. Hopefully, the idea born within the conference in Costa Rica, based on our local tragedy, will be impactful globally!
9:50	• *Rufiji Mangrove Forest Mapping and monitor with Space Technologies* - Ameria BAITU, Ministry of Lands, Housing and Human Settlements Development, Tanzania The Rufiji Delta, located in Tanzania, is home to the largest tidal mangrove wetland on the eastern coast of Africa. This vital ecosystem covers an impressive area of 54,500 hectares within the delta. The mangroves in this region are protected by the Mangrove-Rufiji Forest Reserves. Among the seven genera of mangroves found here, Rhizophora, Avicennia, and Heritiera dominate. These mangroves play essential roles, including providing habitat for migratory birds, supporting diverse marine life, stabilizing the shoreline, and trapping sediment and nutrients from the Rufiji River. Measurements of forest cover and change are vital to understanding the global carbon cycle and the contribution of forests to carbon sequestration. Many nations are engaged in international agreements such as the Reducing Emissions from Deforestation and Degradation (REDD+) initiative, which includes tracking annual deforestation rates and developing early warning systems of forest loss. Remote sensing data are integral to data

	collection for these metrics, however, the use of optical remote sensing for monitoring forest health can be challenging in tropical, cloud-prone regions. Radar remote sensing overcomes these challenges because of its ability to "see" the surface through clouds regardless of day or night conditions. In addition, the radar signal can penetrate through the vegetation canopy and provide information relevant to structure and density. Although the capabilities and benefits of SAR data for forest mapping and monitoring are known, it is underutilized operationally due to data complexities and limited user-friendly.
10:05	• *Comparative Hydrological Dynamics and Water Security in Sundarijal Watershed: A RHESSys Modeling Approach for Broadleaf and Conifer Forests* - Tejendra KANDEL, University of Virginia Nepal has initiated a reforestation program to restore steep, mountainous watersheds impacted by forest loss and land degradation, involving the creation of forest conservation areas and community empowerment in forest governance for sustainable management, especially water. This study examines the ecohydrological impact of reforestation, focusing on the Sundarijal watershed in the Kathmandu Valley, Nepal. Experiencing extensive deforestation from 1980 to 2000, the watershed was designated a protected zone in 2000, prompting reforestation initiatives. Using satellite-derived 30-meter Shuttle Radar Topography Mission (SRTM) elevation data, Landsat land use information, and on-site hydrological and meteorological data, the research employs the Regional Hydro-Ecologic Simulation System (RHESSys) model for the period 1998 to 2017 to scrutinize hydrologic and ecosystem recovery. Protective measures post-2000 increased forest cover, resulting in decreased streamflow. Comparative analysis of scenarios with Sal (broadleaf) and Pine (conifer) forests within the watershed reveals variations in streamflow, evapotranspiration, and water table depths. Broadleaf forests, especially Sal, crucially contribute to water security by enhancing groundwater recharge and Springwater reliability. This research emphasizes the intricate relationship between reforestation, forest types, and ecohydrological dynamics in the Sundarijal watershed, providing insights for watershed management and stressing the importance of broadleaf forests in ensuring water security for local communities.
10:20	• *Space based technologies for monitor vegetation cover changes of Tropical rainforest of Sinharaja and watershed management in Sri Lanka* – Padmi Ranasinghe, University of Texas at Arlington, United Nations University "Sinharaja Rain Forest" (a UNESCO World Heritage Site, Man and the Biosphere (MAB) is the remnant tropical lowland rainforest in Sri Lanka. Flora and fauna have high levels of endemism, and many species are endangered. The Sinharaja forest provides ecosystem services such as clean air and microclimates, maintaining biodiversity, enhancing water infiltration, and reducing soil erosion, flooding, and landslide risks. As there is no foliage, it plays a vital role in carbon sequestration and cooling the plant by evapotranspiration year long. The perennial waterways start in the Sinharaja and nourish the watersheds of the

	"Kalu" and "Gin" rivers. Plantations, other agricultural activities, and rapid infrastructure related to tourism and settlements have resulted in ongoing deforestation. This study analyzes the spatial and temporal changes of land use and land cover in the Sinharaja forest to monitor deforestation and the watersheds. Landsat 7 and 8 images were used to conduct NDVI analysis to monitor vegetation cover and NDWI to analyze the water bodies from 2000, 2010, and 2020 and the COVID-19 period (2023). The LULC changes, and forest vegetation changes were observed. This is to ensure sustainable water management, disaster mitigation, and climate change adaptation and mitigation.
10:35 – 11:00	Coffee break and lightning talks
11:00 – 11:45	**T4S1. Space technologies monitoring forests, agroforestry, watersheds and their interplay [continued]** **Moderator Jim Nelson (Brigham Young University, GEOGloWS)**
10:35	• ***Integrating Hydrographic Intelligence in Spatial Databases: The Innovation and Global Application of PgHydro*** - Alexandre DE AMORIM TEIXERA, GIS Specialist, *Brazilian National Water and Sanitation Agency – ANA* PgHydro, an innovative PostgreSQL extension for hydrographic applications, pioneers intelligence integration into spatial database systems for water resources management. It utilizes the sub-catchment network model and Pfafstetter basin coding system, providing an array of hydrographic elements like tables, queries, functions, or views. These elements enhance water resource decision-making as part of the free, open-source pgHydro project, in collaboration with the National Water and Sanitation Agency of Brazil. PgHydro serves as an add-on to spatial database systems, notably PostgreSQL/PostGIS. It ensures data integrity by adhering to geometry constraints of mapped objects and logical objects based on Pfafstetter coding, aligning with the ISO SQL/MM spatial relationship standards. The pgHydro extension facilitates handling large datasets and complex queries with a simplified hydrography model, leveraging existing tools and languages in spatial databases. This framework paves the way for future water resource-related extensions. The methodology, proven effective across various Brazilian regions and extended to countries in South and Central America, the Caribbean, and Mexico, underlines the project's scalability and adaptability in diverse hydrographic contexts.
10:50	• ***Assessing ERA5-Land Performance for Hydrological Modeling in Data-Scarce Sub-Saharan Africa Regions*** - Harriette Adhiambo OKAL, Stockholm Environment Institute, Kenya

	Hydrological model efficacy depends on data availability for output validation and uncertainty assessment, especially in streamflow predictions. This study addresses data scarcity challenges in certain Sub-Saharan Africa (SSA) regions, hindering robust hydrological model establishment and monitoring platforms. Within SSA's data-sparse zones, critical ground data for informed water resource decisions are frequently lacking, necessitating alternative data sources and simplified modelling approaches. Satellite and climate reanalysis data, notably the ERA5-Land dataset, emerge as pivotal resources for watershed modelling in poorly gauged regions, covering variables like precipitation, evapotranspiration, soil moisture, and runoff. Leveraging Google Earth Engine, this research retrieves ERA5-Land datasets (monthly precipitation, monthly potential evapotranspiration, and daily runoff), comparing them against local WR2012 datasets across 121 catchments in Eswatini, Africa, for the overlapping period 1950-2010. Constraints, including MMQ, MMR, Q10, Q50, Q90, and % of zero flows, were generated from both datasets. The paper offers a detailed ERA5-Land performance analysis across catchments with diverse climatic, land use, water use, and geomorphological characteristics, providing a valuable reference for its application in understanding hydrological processes across SSA river basins.
11:05	Q & A, Discussion
11:45 – 13:00	Panel discussion: Space-based services for governmental institutions working with water Moderator: Driss EL HADANI (UNOOSA)
11:30	This panel represents a unique convergence of expertise, featuring space agencies, service providers, and actors from government ministries and international organizations focused on water resources management. The discussion aims to explore how current and emerging space-based data and technologies can be harnessed to foster sustainable water management practices. Our panellists will bring a wealth of knowledge, offering insights into the utilization of cutting-edge space technologies and satellite applications pertinent to water resource management and aquatic ecosystem preservation. The panel discussion is structured to provide a comprehensive understanding of how space-based solutions can support end users in governmental institutions. We will delve into the specific data and value-added services needed for effective water resource management, emphasizing the importance of capacity building for better implementation of space-based data in policy development. Additionally, the panel will address the practical challenges that actors in water management face in utilizing space technologies. These insights will be pivotal in identifying potential areas where governmental institutions can be effectively supported with space-based data and services. Furthermore, the panel will offer a governmental perspective on how space data informs decision-making and policy development, with a focus on monitoring

	progress towards achieving Sustainable Development Goals related to water access and sanitation. This aligns with UNOOSA's strategic objectives of making space data available, accessible, and affordable, and integrating it into national, regional, and global policymaking. By highlighting how space data is utilized in addressing water-related challenges, and environmental sustainability, the panel will illustrate the critical role of space technology in enhancing governance and management of water resources. We anticipate a dynamic and enlightening discussion at the panel, underscoring the significant role of space technology in water resource management and its broader impact on global sustainability efforts. Panellists: • Mr. Amjad Ali, *Pakistan Space and Upper Atmosphere Research Commission (SUPARCO)* • Ms. Ameria BAITU, Ministry of Lands, Housing and Human Settlements Development, Tanzania • Mr. Alexandre DE AMORIM TEIXERA, *Brazilian National Water and Sanitation Agency – ANA* • Mr. Francisco NEMIÑA, Comisión Nacional de Actividades Espaciales, Argentina • Mr. Jesus Roberto ROMERO RUIZ, Mexican Space Agency (tbc) • Mr. Momodou J.A. SENGHORE, National Early Warning and Response Mechanism Coordination Centre, the Gambia • Mr. Sunil Dubey, Mahalanobis National Crop Forecast Centre, India (tbc) • Ms. Ana Mirian Villalobos Velásquez, Ministry of Environment, El Salvador
13:00 – 14:00	Lunch break (and lightning talks for online participants)
14:00-14:30	Lightning talks
14:30 – 15:30	Technical closing session with conclusions and recommendations by moderators Moderator: Nina Kickinger, UNOOSA
15:30 -16:00	Coffee break and lightning talks

16:00 – 17:00	Closing session Modeator: Driss El HADANI, UNOOSA
	• Closing remarks, Representative of the Costa Rica Ministry of Foreign Affairs and Worship • Closing remarks, United Nations Costa Rica (tbc) • Closing remarks, IICA • Closing remarks, Driss El-Hadani, UNOOSA

Day 5, Saturday, 11 May 2024 – 9:00 – 12:30 (for selected registered participants only)

8.00 or 9.00 - 12.00	Training on Earth observation information for Water Quality Monitoring, Steven Greb, GEO AquaWatch, University of Wisconsin - registration required
	Satellite remote sensing is increasingly recognized as a tool for assessment and monitoring of inland and coastal waters. This training session reviews and discusses current software tools used to obtain water quality information from satellite imagery. The session will discuss various approaches to obtaining water quality products, from cloud-based data discovery tools of existing products to freely available PC software products that allow the user to process imagery and generate their own datasets. The session will be a mix of lectures and hands-on training. Optionally participants can stay longer. This is to be discussed on-site with Mr. Greb, who is hosting the training. Minimum requirements /skills needed: PC/Internet skills, Microsoft Office tools, GIS preferred Maximum capacity: 20 persons
8.00 or 9.00 - 12.00	Training on GEOGloWS European Centre for Medium-Range Weather Forecasts (ECMWF) Streamflow Services, Jim Nelson, BYU University – registration required
	To enable participants to proficiently utilize the GEOGloWS ECMWF Streamflow Services for effective streamflow forecasting and water management by

	understanding and applying the capabilities of the ECMWF ensemble weather forecasting system and leveraging over 40 years of historical flow data. This objective is aimed at hydrologists, water resource managers, and environmental scientists who are keen on integrating advanced hydrological modeling and forecasting technology into their work. Participants will develop skills in interpreting and applying daily updated forecasts for enhanced decision-making in water resources management. Learning objectives: 1. Understand the Basics: Learn the fundamentals of the Global Flood Awareness System (GloFAS) and how it integrates with the European Centre for Medium-Range Weather Forecasts (ECMWF). 2. Explore the Services: Discover the different components of the GEOGloWS ECMWF Streamflow Services, including global hydrological predictions, historical simulations, and statistical return periods. 3. Hands-On Experience: Engage in practical sessions where you'll use real case studies to understand how to access, interpret, and apply the streamflow forecasts for decision-making in water management. 4. Advanced Techniques: Dive deeper into advanced topics such as calibration techniques, uncertainty analysis, and integrating forecasts into water management strategies. 5. Networking and Collaboration: Connect with other professionals and experts in the field, share experiences, and discuss potential collaborative projects. Minimum requirements/skills needed: Microsoft Excel and use of online tools Maximum capacity: 20 persons

LIGHTNING TALKS

	All lightning talks are available here for online participants to watch during lunch and coffee breaks. A selection of the best lighting talks will be screened during dedicated sessions taking place each day 12:30 – 13:00. Furthermore, on-site participants can view the poster cards during coffee breaks and scan the QR codes on the cards, to access the recorded lightning talk video.
7 May 2024 13:30 – 14:00	Theme 1: Space technologies to adapt agriculture to climate variabilities
	• *Soil Erosion Assessment Using RUSLE Model and Google Earth Engine in the Cauvery-Delta Zone of Tamil Nadu, India* – Venkandesh SAMYKANU, India Meteorological Department Tamil Nadu is situated in the southern peninsular region of India, known for its diverse landscapes, faces a critical environmental challenge: soil erosion. The study area is a part of the 'rice belt' of the state Tamil Nadu in India, which is known for high acreage of Paddy crops. Due to the abundance of alluvial soil and the most fertile stretch in the Cauvery basin, it is regarded as the state's rice bowl. The Cauvery-delta zone (CDZ) stands out, characterized by its fertile lands and extensive agricultural practices. Understanding the dynamics of soil erosion in this region is paramount for sustainable land management and agricultural productivity. To address this concern, a comprehensive study was undertaken to estimate soil erosion rates within the CDZ. Leveraging the Revised Universal Soil Loss Equation (RUSLE) model in the Google Earth Engine (GEE) platform, the research aimed to provide insights into erosion patterns and associated risks. The RUSLE model, renowned for its simplicity and accuracy, considers multiple parameters influencing soil loss, including runoff-rainfall erosivity factor (R), soil erodability factor (K), topographic factor (LS), cropping management factor (C), and support practice factor (P). By integrating these variables, the model facilitates a holistic assessment of soil erosion dynamics. The soil erosion rate categorized into five classes viz., Slight (<10), Moderate (10-20), High (20-30), Very high (30-40) and Severe (>40) based on the erosion severity. The study revealed alarming findings: the annual average soil loss within the CDZ was estimated at approximately 49.08 metric tonnes per hectare per year. The amount of soil loss increases significantly as an increasing trend is observed from the north-eastern part of the study area towards the north, north-eastern and south-eastern parts with mean soil loss 49.08 tons/ha/year. More concerning was the distribution of erosion risks within the study area: 45% of the CDZ faces a very high erosion risk, while 42.6% is categorized under severe erosion risk, with an additional 8.4% classified as high risk. Slight and moderate erosion collectively accounted for a mere 4% of the total area, highlighting the severity

	of the erosion challenge. From 2015 to 2021, the classification of soil severe erosion, very high erosion, and high erosion, in the Cauvery-Delta zone were 60.09%, 31.04%, and 6.24%, respectively. In conclusion, the study highlights the critical role of advanced modelling techniques and technological platforms like GEE in addressing complex environmental challenges such as soil erosion. The findings serve as a clarion call for policymakers, land managers, and stakeholders to implement proactive measures aimed at conserving soil resources and preserving the ecological integrity of the Cauvery-delta zone and beyond. Only through concerted efforts and innovative solutions can we safeguard the environmental sustainability and agricultural resilience of Tamil Nadu's vulnerable landscapes against the looming threat of soil erosion.
	• *Earth Observations and Water-Food connections in the Basin of the Red River of the North (RRBN)* - Richard LAWFORD, Retired Senior Scientist at Morgan State University The Water and Food sectors are intimately connected in the transboundary Basin of the Red River of the North (North America). These interactions are most important at the farm and river basin scales. Earth Observations (EO) can provide information to help for planning and implementing actions at each of these scales. This talk introduces an information system pilot initiative that plans to use data and services under the new open data and open science policies of NASA. It also considers some of the complications in developing information services in a transboundary basin. The presentation concludes with a concept for an integrated information system or platform that could bring the most up-to-date information to farmers and water managers in all parts of the Red River Basin. This project is part of a Group on Earth Observations (GEO) pilot initiative related to the EO4WEF Nexus.
	• *Combating Water Scarcity in Semi Arid Tropics of India with Space-based Technologies: A case study from India* - Lening Babu KAMEPALLI (Institute for Social and Economic Change, India) Water use efficiency in Asian agriculture is suboptimal, leaving considerable room for improvement. As demand for water rises across various sectors such as urban centres and industries, conflicts over water resources seem inevitable in the near future. Additionally, agriculture must grapple with the challenges posed by climate change. Precision farming presents a viable solution to mitigate water scarcity issues; however, its adoption is hindered by the prohibitive cost of implementing Internet of Things (IoT) technology, especially considering that the majority of farms are small-scale (less than two hectares). Lowering the cost of sensor-based precision farming through economies of scale and state support could significantly reduce the agricultural sector's consumption of freshwater resources. Adoption of space-based technologies need to be explored to protect the small and marginal farmers across the Asian countries.

	• *Open data for information on water accessibility by women in Samburu County, Kenya* – Nancy MARANGU, Chemichemi Foundation, Kenya Women in Samburu County are vulnerable to water scarcity and poverty due to inaccessible water systems catalysed by climate change impacts. Additionally, poor water quality due to lack of the technical capacity and knowledge to monitor water quality despite the availability of open data. The skill deficit on open data access has further been exacerbated by the nomadic lifestyle exposed to women due to search for pasture for their livestock on one hand. On the other hand, open data promotes equitable and sustainable water management practices revolutionising access to free water-related data, providing timely and accurate information on water availability, quality and accessibility by women. Besides, their needs to be an establishment of community-based water monitoring systems that enhance women agro-pastoral practices, resilience and adaptability.
	• *Assessment of interactions between land use change and groundwater recharge under urban Heat Islands Remotely Sensed Signatures, in Santa Cruz-Bolivia* – Ana Beatriz RODRIGUEZ ALARCON, IdeasHub, Bolivia Santa Cruz-Bolivia, a 2 million population in central-western Amazon, depends on groundwater for drinking water supply (DWS). 1-km resolution Land Surface Temperatures (LST) from MODIS Terra collected from February 2000 to December 2023, was used to evaluate interactions between land use change and groundwater recharge (GWR), under the parameter Precipitation (P) - Evapotranspiration (ETP) as a proxi for soil water balance (SWB). Results are: 1) The LST in downtown is in average 3oC to 4oC higher than in areas where urbanization processes are ongoing in the city outskirts, suggesting a Heat Island signature; 2) in GWR zones, LST were altered by deforestation, increasing from 28oC in average in the 2000´s to unsteady trends around 33oC since year 2010; 3) although ETP has increased, impacts on SWB and DWS are not straightforward, because surface runoff and infiltration were altered, but also rainfall has increased in intensity in the last two decades.
	• *A panoramic view of the legal and ethical issues of space technologies in African agricultural sectors* – Judith MURUNGI, Research Network YARN, Kenya The use of state-of-the-art spatial technology and data has the potential to increase agricultural production in Africa. Some African countries like Ethiopia are also victims of their topography and location coupled with low adoptive capacities which leads to high vulnerabilities to the impacts of climate change. This paper will demonstrate how African countries can leverage space technologies in their agricultural sectors in order to resolve the climate change impacts. It will also entail the legal and ethical issues encountered in the use of these technologies in the African context. These include: lack of legislation,

	fragmented legislation and others. It will include a comparative study with the United Kingdom (UK) which has regulated the use of space technologies in agriculture with an aim to draw lessons for the African continent. These will inform the basis for recommendations for law and policy advocacy for the African continent in this area.
	• *Integrating GIS for Water, Food, and Climate Nexus Assessment: A Case Study of the Upper Bandama Subwatershed, Ivory Coast* - Tanyo Patrick Bertrand HORO, Pan-African University - Institute of Water and Energy Sciences including Climate Change This study addresses water management in the Upper Bandama sub-basin, critical for agriculture and food security amidst climate change challenges. It highlights the contribution of GIS in water management assessment, emphasizing the need for a holistic and systemic approach to understanding the interconnected Water-Food-Climate (WFC) nexus. By studying land use dynamics, Principal Component Analysis (PCA), and seasonal and interannual climate analysis, the research unveils spatiotemporal fluctuations in water resources influenced by humidity, the Normalized Difference Moisture Index (NDMI), and land use. Particularly, intensified agriculture near wetlands, notably in Korhogo, restricts water availability due to high demographic demand. Seasonal and yearly climate variations, with significant precipitation changes since 2007, underscore the urgency of sustainable practices. The study advocates for robust policies to ensure sustainable agriculture, preserve water resources, and ensure food security, requiring collaborative efforts across the entire Upper Bandama sub-basin.
	• *The Impacts of Drought on the Rural Communities of Msinga in Kwa-Zulu Natal, South Africa* – Annika MANIRAM, University of Kwa-Zulu Natal, South Africa Drought, a hallmark of climate change, brings prolonged dry spells, heightened temperatures, and heatwaves. As a significant event in the hydrological cycle, it ranks among the most devastating natural disasters globally. Predictions suggest its severity will escalate due to climate change and human activities. Defined by Brown (2016) as below-average precipitation leading to dry conditions, this study delves into socio-economic droughts, focusing on their impact on rural communities in Msinga, South Africa. Droughts, affecting food production, water resources, and livelihoods, have directly impacted 1.5 billion people this century, with 55 million affected annually worldwide. South Africa's topography and location render it vulnerable, exemplified by the severe 2015/2016 drought catalyzed by El Niño. Demographic data from Msinga reveal a female-majority, largely unmarried population, with disproportionate age distribution and high unemployment rates, exacerbating the socio-economic toll of droughts, including malnutrition, food insecurity, and poverty. Mitigation strategies,

	including indigenous knowledge and government assistance, alongside early warning systems, are essential for resilience against future droughts.
	• *The use of space technology for water resources management in Syria* – Marwan KOUDMANI, Remote Sensing and Space Sciences Office (RSSSO), Syria Many manned and unmanned spacecraft are now roaming space at different altitudes, whose mission is to stare deeply around the Earth, discover its hidden resources and wealth, and monitor its environment and disasters. Many countries in the world complain of water problems especially our region, complains of great water shortage. This problem increases greatly in result of great increasing of the population, agricultural projects and investments. That will make additional pressure on water resources. Also, the water storage had begun complaining of pollution problems. The new technologies of remote sensing, geographic information system and global positioning system had a great importance in groundwater exploration. Whereas the space images taken by Landsat TM, radar images by European Remote Sensing satellite ERS, using geographic information system GIS, global positioning system GPS and previous geological, tectonic, hydrological and hydrogeological studies of study regions contributed as ideal method in exploration of groundwater in Syria.
	• *Utilising data from space to evaluate the hydro-meteorological factors that cause landslides and floods in Zimbabwe's Chimanimani District* – Webster GUMINDOGA, University of Zimbabwe Zimbabwe has seen a rise in the frequency and size of landslides. This study focuses on the Chimanimani area, which was severely damaged by Cyclone Idai and is still at risk from both climatic and human-caused threats. To ascertain the lowest likely level for landslides, the study employed landslide forecasting and satellite rainfall threshold analysis. A positive trend that was statistically significant was revealed by trend analysis of rainfall and streamflow data collected during years of high rainfall brought on by cyclonic occurrences (Cyclones Eline in 2000, Japhet in 2003, Dineo in 2017, and Idai 2019). The rainfall that the area receives is positively impacted by these tropical cyclones. The Chimanimani district's rainfall threshold values, according to the Rapid Mass Movement Simulation Model, ranged from 53.3 mm/day to 190 mm/day. The results suggest that rainfall thresholds based on satellite data could be used for both emergency response planning and the prediction of rainfall-induced debris flows in dynamic hydroclimatic regimes. The integrated debris flow susceptibility map can be utilised as a planning tool for development pathways that are climate resilient as well as for spatial development.
8 May 2024 13:30 – 14:00	Theme 2 – Space technology and data for water quality monitoring and sustainable agriculture

	• *Unveiling Water Quality and Sustainable Agriculture with Space Technologies* – Mayar FAHIM, Egyptian Space Agency Ensuring water quality is paramount for sustainable agriculture. This presentation explores how space technologies empower us to monitor water resources and support eco-friendly farming practices. Satellite imagery provides a synoptic view, enabling us to track changes in water turbidity, chlorophyll levels, and harmful algal blooms. This information helps identify potential pollution sources beyond the water body itself, allowing targeted mitigation strategies. Furthermore, space-based data on soil moisture and evapotranspiration can optimize irrigation practices, minimizing water waste and promoting resource conservation. The presentation will also explore the potential of monitoring sustainable agriculture practices, such as organic farming, through remote sensing techniques. By analyzing changes in vegetation health and land cover, we can assess the impact of these methods on water quality. This presentation sheds light on how space technologies bridge the gap between monitoring water resources and promoting sustainable agricultural practices, paving the way for a more secure future.
	• *Evaluation of Different Soil Salinity Indices Using Remote Sensing Techniques in Siwa Oasis, Egypt* – Omina SALEM, Yangzhou University, Ministry of water resources and irrigation, Egypt Detecting and monitoring changes in soil salinity through remote sensing provides an opportunity for field assessment in regions where on-site measurements are limited. Using Landsat 5 and 7 satellite images, we evaluated various soil salinity indices based on 56 on-site ground measurements. Eleven spectral indices were calculated for nine scenes captured in different months. Different approaches were employed and conducted correlation analysis. The initial approach SI index demonstrated the highest correlation coefficient of 0.38. In the second scenario, the index S2 exhibited the highest correlation of 0.96 for moderate salinity samples. The third scenario showed that the index S1 achieved the highest correlation value of 0.99 for moderately saline areas. In the fourth scenario, the SI index exhibited the strongest correlation among all four ponds, with correlation coefficients of 0.23, 0.23, 0.18, and 0.61. Additionally, remote sensing methods detected a 48% increase in total vegetated area over 17 years, showing the potential of remote sensing techniques in salinity monitoring for expanding agriculture and improving land management.
	• *Monitoring Water Quality of Lake Chivero in Zimbabwe using Digital Earth Africa –* Muongeni Tamara MANDA, Chinhoyi University of Technology Lake Chivero a Ramsar wetland located in Zimbabwe provides the main water supply for Harare and habitat for birds. However, over the years the lake has faced pollution, siltation, and invasion of water hyacinth due to urban growth and climate change. DE Africa was used to study the changes in water extent and quality over time and made comparisons with rainfall data from Climate Hazards

	Group InfraRed Precipitation with Station data (CHIRPS).The results highlighted drought and provide crucial inputs for government agencies such as the Ministry of Lands, who are managing the Lake Chivero site and monitoring this vital nesting and breeding ground for birds. By mapping correlations between findings and bird counts, efforts can be made to protect this important habitat into the future as Zimbabwe continues to battle with the effects of variable rainfall on its delicate ecosystems and inform Sustainable Development Goals (SDGs), leaving no one behind.
	• *Hydrogeochemical Evolution and Geospatial Mapping of Groundwater Salinization in a Typical Urban Coastal Aquifer in Southeastern Ghana* – Emmanuel Daanoba SUNKARI, University of Mines and Technology, Ghana This study aimed to assess the hydrogeochemical characteristics, identify sources of groundwater constituents, and evaluate processes and sources that contribute to groundwater salinization in the Ga West Municipality in Ghana. Multi-methods, including laboratory analysis with ICS-90 ion chromatography, calculation of Revelle Index, chemometric analysis, and geographic information system (GIS) were employed. The results indicate that the predominant water types are Na-HCO3-Cl (24.4%) and Na-Ca-HCO3-Cl (17.2%), with other mixed forms. The results of the chemometric analysis revealed that groundwater constituents are mainly derived from anthropogenic sources and salinization with limited contribution from geogenic and evaporation crystallisation processes. Revelle Index values range from 0.10 to 5.99, indicating that about 58.6% of the boreholes in the study area are affected by salinization. Geospatial mapping using GIS reveals that groundwater salinization affected boreholes towards the southeastern fringe of the study area, which is very close to the Gulf of Guinea.
	• *Remote Sensing Applications for Water Quality Assessment: A Case Study on the North Lakes of Egypt* – Bassant ELGHITANY, Egyptian Space Agency Effective monitoring of water quality in lakes and water sources is crucial for sustainable development. However, Traditional techniques encounter challenges such as time-consuming processes and insufficient spatial-temporal analysis. A new approach has been followed in recent years, utilizing enhanced satellite image resolution, and generating substantial remote sensing data volumes. Which offers nuanced insights into environmental conditions and contributes to water management, agriculture, and addressing climate change. Our research focuses on the issue of water lacks in northern Egypt, which has encountered various challenges arising from both natural phenomena, such as detrimental algae that obstruct the natural flow of water, causing adverse impacts on marine life, and human activities factors such as agricultural runoff and urban stormwater contribute to diverse sources of pollution, complicating the identification of a singular contamination origin in lakes.

	This study focuses on using remote sensing techniques, utilizing MISR SAT-2 satellite data along with other satellite sources, to classify the northern lakes in Egypt using different techniques, and employ various analytical techniques to measure water quality in this region and detect harmful algae. By leveraging remote sensing capabilities over large temporal and spatial scales, this research contributes to a more comprehensive understanding of water quality dynamics in the specified area.
	• *Classification algorithms for avocado crops* – Andrea del Pilar SANCHEZ *CHAVEZ*, Ministerio de Ciencia Tecnología e Innovación, Colombia The purpose of this study is to validate the optical inputs of satellite platforms in the classification of avocado crops in the vicinity of bodies of water and to identify the most efficient algorithms in the classification of coverage.
	• *Open Cloud Platforms as Tools for Policymakers: Measuring Turbidity in Lake Kariba, Zimbabwe using Digital Earth Africa* – Thando Obert MATHE, Spatial Sense, Zimbabwe Lake Kariba is the largest lake in Zimbabwe and is in the top four largest man-made lakes in Africa. It supports key ecosystems and economies in agriculture, power, fishing and wildlife for Zambia and Zimbabwe. Policymakers have struggled to acquire accurate quality data at low cost for evidence-driven decision-making. Furthermore, local authorities lack sufficient infrastructure and skills to process this data. This article demonstrates how low-cost and open access cloud platforms for remotely sensed earth observation data can be strategically implemented to support policymaking organizations. The Digital Earth Africa platform was utilized due to its efficiency and availability of dedicated tools for data processing such as the Water Observation from Space. The article illustrates how turbidity measurements are acquired, compared and visualized without need for massive local compute. Such data is crucial for planning agricultural activity in irrigation, power generation and tourism which are critical economic pillars.
	• *Insights into aquatic ecosystem dynamics: spatiotemporal analysis of water quality parameters in the Arabian Gulf* – Aysha Yusuf ALMAHMEED, National Space Science Agency, *Bahrain* The Arabian Gulf region is an area with the active economic and social development of agriculture and tourism, facing increasingly prominent environmental problems with rapid urbanization. Understanding the variation regularity of water extent can provide insights into the aquatic conservation and management in the region. This research paper investigates the water quality parameters, specifically chlorophyll concentration, turbidity, and total suspended solids (TSS), in the territorial water of the Kingdom of Bahrain for the timeframe between 2022 to 2024 using the Google Earth Engine platform. By employing advanced geospatial tools, we analyze spatiotemporal variations in these parameters, providing a

	comprehensive understanding of the region's aquatic ecosystem dynamics. The study covers an area of 7,482.5 km2, and a comparison between the examined parameters; chlorophyll concentration, turbidity, and TSS has been conducted within the study timeframe. In addition to indicating the extreme degradation and improvement to emphasizes the interconnectedness of water quality, and the overall resilience of ecosystems and human societies in the study region. The outcome of this research serves as a crucial resource for policymakers, environmental agencies, and stakeholders, offering data-driven recommendations to enhance water management strategies, promote sustainable development, and safeguard the livelihoods of communities reliant on the Gulf's aquatic resources.
	• *Space Technology for Enforcing the Correlative Rights Doctrine: A New Paradigm for Groundwater Management in Indian Agricultural Sector* – Manini SYALI, The Energy and Resources Institute (TERI) -School of Advanced Studies In India, 70-80% of the farmers remain dependent on groundwater. However, this crucial resource is increasingly depleting due to inefficient regulatory mechanisms. This necessitates innovative approaches to governance and legal enforcement. In this regard, a foundational principle of groundwater law, i.e., the Correlative Rights Doctrine (CRD), needs to be revisited, which implies that landowners must use the shared groundwater resources 'equitably and 'reasonably' with their neighbours. This presentation will attempt to look at the CRD from the lens of space technology's capacity to enforce it in the Indian agricultural context. The researcher will first analyze the contours of CRD and its importance for groundwater management. She will then explore the capacity of space technology in its implementation for the conservation and sustainable usage of groundwater resources. Further, to illustrate the challenges and successes of integrating space technology for groundwater management, case studies from different regions in India will be discussed.
	• *Effects of sewage leakges in Zimbabwe and issues with water and wastewater management* – Tapiwa Wallace GARA, Geospatial society, Zimbabwe This study aims to provide evidence to back up appropriate development authorities in carrying out the necessary actions on trying to reduce untreated sewage disposal in freshwater bodies. The study seeks to focus on how the river has changed for three years as a result of sewer leakages which caused the growth of water hyacinth along the river and also compare the differences between aerial imagery of the same region taken at various times for effective monitoring and evaluation of data. Change detection helps understand the change in water hyacinth. The study can also show how a piece of Geographic information (GIS) could be used to map areas where hyacinth is mostly distributed along the Shagashi River. GIS can help organize the collected information on a computer system that connects the database to an output map. As a result, it will act as a guide for people, developers, the government,

	and other organizations involved in urban planning and related fields, for further research and decision-making. As the storm intensifies, it poses a serious threat to everyone involved in the study's safety. This makes remote sensing appropriate for this investigation since it can gather information across a vast area with less time investment compared to other available approaches. Since it is the only choice in such hazardous locations, remote sensing can be used to conduct research there. Through the use of remote sensing, trends in rapidly spreading phenomena, such as water hyacinth, can be easily identified from an airborne perspective. Remote sensing offers information about the past that was not considered important at the time but has a big impact on the future.
	• *Space technology and data for water quality monitoring and sustainable agriculture* – Egemen DEMIRER, Yalova University, Turkey In the face of a growing population and dwindling resources, ensuring clean water and sustainable food production are critical challenges. It highlights how satellite-based remote sensing can revolutionize water quality monitoring, providing real-time data on pollution levels, algal blooms, and water scarcity. This enhanced data empowers scientists and farmers alike to optimize irrigation practices, minimize water use, and protect freshwater resources. Furthermore, advanced sensors and space-based monitoring can track soil health, nutrient levels, and crop stress, enabling precision agriculture techniques that minimize fertilizer and pesticide use while maximizing yields. Finally, it explores the challenges and opportunities for wider adoption of these technologies, emphasizing the need for international collaboration, capacity building, and equitable access to space-based resources. By embracing the interconnectedness of space, water, and agriculture, we can envision a future where satellite eyes guide the hands of farmers, ensuring food security and clean water for generations to come.
9 May 2024 13:30 – 14:00	Miscellaneous topics
	• *Enhanced Hydrological Insights: Breakthroughs in Remote Sensing Technology for Rivers, Lakes, and Reservoirs – Shanlong LU*, Aerospace Information Research Institute, Chinese Academy of Sciences, China Real-time monitoring of river discharge, lake, and reservoir water levels is crucial for precise water resource management and disaster mitigation against floods and droughts. However, the scarcity of river hydrological observation stations and underwater terrain data in lakes and reservoirs globally hampers our understanding of hydrological dynamics, impacting our ability to respond effectively to water scarcity and disasters in the face of climate change. This study addresses these challenges by leveraging high-resolution satellite remote sensing data to develop innovative methods for simulating underwater terrain and estimating river flow and water storage. By creating a global dataset covering lakes over 50 square kilometres and establishing remote sensing virtual

	hydrological stations in key Chinese river basins, the study offers novel solutions for efficient water resource management across different regions.
	• *Plugging the water scarcity gap using IoT in Kenya* – Erick Villah OKEYO, Kenya Space Agency Kenya has a population of 50 million, about 20 million lack access to safe drinking and cooking water. The loss of pasture and water points for livestock have led to the death of over 10,000 animals annually. The ever-growing population and water demand and water scarcity have turned into a notable challenge in Kenya. Issues to do with Climate change, urbanization, water pollution and poor management of water resources have aggravated the issue of the water crisis, which affects economic activities, food security, education, and health. These challenges are especially evident in rural areas and urban slum areas. With advancements in IoT capabilities, intelligent water management solutions like water quality monitoring, water treatment plants and smart meters are now benefiting the water sector. By delivering cutting edge integrated IoT tech, it has brought about reduced wastage and proper water storage measures. Therefore, there is need for proper training and capacity building for persons in this sector so that they are able to apply this smart technology to curb water crisis and to educate citizens of latest methods of water conservation.
	• *Flood risk calculation in developing countries* – Adolfo QUESADA-ROMÁN, University of Costa Rica This study focuses on understanding and managing flood risks in Costa Rica, a common challenge in many developing countries. By analysing 82 municipalities, the research classifies them based on flood hazard, exposure, and vulnerability. A practical flood risk index is then developed, offering a local-level understanding of risk factors. The findings highlight higher flood risk in flatlands, large areas in both the Pacific and Caribbean basins, as well as borderlands and coastal regions. This approach, often lacking in national policies, provides valuable insights for developing countries with limited baseline information, aiding in the formulation of effective flood risk assessment plans for short, mid, and long-term conditions.
	• *Identifying Suitable Sites for Emergency Shelters* – Eulampius FREDERICK, Government of Saint Lucia With the approach of the 2024 Atlantic Hurricane Season commencing on June 1st, the National Emergency Management Advisory Committee (NEMAC) needs to publish a final list of approved Emergency Shelters for households that need to evacuate flood prone areas. The NEMAC Chairperson drafted a set of criteria to guide the Selection Subcommittee members in their decision making. A key requirement is that a candidate facility should not be prone to the impacts of flooding and landslide events which are likely to occur within a 200 m radius from the Emergency Shelter's point of location.

	The Selection Subcommittee is challenged with finding a scientific and objective method for determining whether or not the criteria have been met by the applicants. The focus of the research was to utilise FOSS GIS applications along with raster and vector data to determine which building facilities should be disqualified and then identify optimal locations for Emergency Shelters as a replacement for the disqualified candidate sites, based on various criteria including distance away from hazard risk areas, proximity to a motorable roadway and building size.
10 May 2024 13:30 – 14:00	**Theme 4 - Space technologies monitoring forests, agroforestry, watersheds and their interplay**
	• *Río Humo modeling to research population water uses availability* – Rosario UREÑA MENA, Universidad de Costa Rica Cañón del Guarco is a community in Cerro de la Muerte mountain in Costa Rica, inhabited by a rural population. There are strong difficulties in finding drinking water sources caused by geological and topographical conditions. Hydrology modeling is applied to understand Río Humo behavior influenced by rain and temperature variations, around 3000 masl.The research objective is to determine how much water flow could be assigned to population consumption for local economic development, preserving ecosystem health. Alos Parsal digital elevation model is used to describe watershed elements, Chirps, and GPM rain estimations are compared with meteorological available in situ data. Free remote sensing data is a helpful tool for researching allocations with local-specific data scarcity conditions.
	• *Monitoring water extents within Lake Naivasha using satellite-based technologies* – Viola Kemunto ORINA, Kenya Space Agency `Lake Naivasha, Kenya, plays a critical role as a vital resource in the region, influencing ecology, agriculture, and local communities. This study centers on the ecological health of Lake Naivasha, which is crucial for both local communities and wildlife. Recognizing its significance in agriculture and the broader ecosystem, it becomes imperative to comprehend and address any adverse changes that might impact its biodiversity and the livelihoods of those dependent on it. Acknowledging the pivotal role of Lake Naivasha in the region's ecology and local communities, this study showcases the practical application of space technology in monitoring water extents. Aligned with the theme "Space Technology for Water Management" for the 2024 United Nations/Costa Rica/PSIPW conference, the research aims to provide tangible solutions for sustainable water management. The study involves the development of a comprehensive water extent monitoring system, utilizing high-resolution satellite imagery and remote sensing techniques. Through the creation of a water extent impact catalog and land cover assessments, the research seeks to enhance the understanding of water dynamics within Lake Naivasha.

	• *Remote sensing-driven inundation modelling for large-scale wetland restoration* – Jan KREIBICH, University of New South Wales Sydney Wetlands, among the world's most biodiverse and productive ecosystems, are under severe pressure from water resource development and, increasingly, climate change. We investigated the impacts of river regulation on the nationally important Lowbidgee Floodplain (325,000ha) in semi-arid Australia. This floodplain, which includes the indigenous-managed Gayini Wetlands, has a rich cultural heritage and supports a range of threatened and endangered native species. We utilized satellite data to map wetland inundation patterns from 1988 to the present. Through the analysis of discharge data from the floodplain's river gauges, we modelled the extent and frequency of wetland inundation under variable water availability scenarios, resulting from river regulation and climate change. Our study aims to highlight the importance of environmental flow management for large-scale restoration of the floodplain wetlands, in collaboration with their indigenous landowners, the Nari Nari Tribal Council.
	• *Space based technologies for monitor forest cover changes of Tropical rainforest "Sinharaja" and watershed management in Sri Lanka* – Padmi RANASINGHE, University of Texas at Arlington, United Nations University – CRIS Sri Lanka's lush lowland rainforests covers 2% of its total land area, home to many endemic and threatened species. The "Sinharaja" tropical evergreen Forest, a UNESCO World Heritage Site and Man and the Biosphere (MAB), is the last viable remnant of Sri Lanka's tropical lowland rainforest, and nourishes the watersheds of "Kalu" and "Gin" watersheds. To prevent deforestation and for sustainable forest and watershed management, "Sinharaja" forest lands need to be monitored by geospatial data. Therefore, this study examined the spatial and temporal changes in forest cover, LULC and water features within the Sinharaja and its watershed from 2000, with 10 year intervals and during the Covid-19 period. NDVI and NDWI are used to monitor vegetation cover and water features within the watershed. To mitigate the observed LULC changes and changes in water features, a comprehensive geospatial analysis is crucial for sustainable watershed management, biodiversity conservation, disaster mitigation, and climate change adaptation.
	• *Identification of groundwater potential zones in data-scarce mountainous region using explainable machine learning* – Sandesh SHARMA, Naxa Pvt. Ltd., Nepal Groundwater is a critical resource, yet its detailed assessment in mountainous regions is challenged by varying topography, complex hydrogeological characteristics and limited data. In this study, machine learning approaches were used to analyze the groundwater potential in five different watersheds in Nepal. Explainable machine learning models (EBM and GAMI-net) were used to identify zones with different groundwater potentials and controlling factors. The models were validated with k-fold cross-validation using the area under the receiver operating characteristics curve for the two groundwater potential models with

	unseen validation dataset of 0.87 and 0.88 respectively. We found that precipitation, elevation, soil bulk density, slope and lineaments primarily controls the groundwater potential in the study regions. The expected impact of each of the factors on groundwater potential was complex and multimodal. The results of this study can be used to improve water resource management and ensure sustainable groundwater use in the region.
	• *Preserving Nepal's Water Tower: A Geospatial Approach to Revitalizing the Chure Region for Sustainable Water Management* – Alison SHILPAKAR, Antarikchya Pratisthan Nepal The Chure region, often referred to as the "water tower" of Nepal, covers 12.78% of the country and is indispensable for supplying water to millions in the southern plains. Degradation of Chure region has resulted in declining water levels, directly impacting the Ground water table (GWT). Using Google Earth Engine and Landsat imagery, the study detected a 33% increase in impermeable surfaces over a decade. Furthermore, by strategically utilizing the Digital Elevation Model (DEM) and contours of the Chure region, potential natural storage areas are identified, promoting the construction of check dams along rivers and proposing the establishment of recharge ponds. The stored water from these initiatives will serve a dual purpose. First replenishing aquifers then irrigating the agricultural lands. This approach addresses immediate water scarcity challenges targeting to achieve SDGs like climate action, zero hunger, clean water and sanitation
	• *Utilizing data from space for mapping and monitoring water catchment areas* - Merceline Awuor OJWALA, Directorate of Resource Surveys and Remote Sensing, Kenya Forests have a vital role in socioeconomic growth, therefore human overreliance on them is likely to persist. In Kenya, forests are valuable national assets in terms of socioeconomic, cultural, and environmental importance (such as water catchment areas). However, overreliance on forest resources has outstripped their ecological capacity to provide ecosystem services, exerting pressure and jeopardizing their sustainability. Water is a crucial agenda item in most developing countries, therefore, conversations around conservation of water catchment areas and water-related scientific research are equally important. Understanding the status and trends of forests over time is also critical for planning and decision making. Focusing on the objectives of this workshop, the study is keen on presenting how space derived data can help in ensuring that conservation, preservation, and management of water catchment areas is achieved, as well as developing a robust knowledge base for better forest monitoring, enhanced restoration, and improved management.
	Use of Geospatial Tools to monitor a Hydrological Emergency – The case of Caregato, Colombia – Hector Mauricio RAMIREZ DAZA, CUATRO CONCEPTOS SAS On August 28, 2021, the Cauca River broke a natural levee causing a flood that affected over 125,000 people. Eighteen months after the incident, a

	methodology was developed to construct a framework to end the emergency. Geospatial tools of various types such as aerial photographs, optical and radar satellites, LiDAR and echo sounders were used to monitor and control these actions. This helped determine the status of interventions and their effectiveness, allowing for the redirection of new actions on the territory as needed. The use of these diverse tools together with the active participation of the community ensured timely and adequate actions were taken. This facilitated the subsequent closure of the breaking point and provided the appropriate tools for public institutions to effectively intervene in the territory.
	CanSat Prototype for Plant Condition Characterization through Vegetation Indices - Juan José DÍAZ ZULUAGA, Universidad de Antioquia, Colombia This presentation aims to illustrate the design, development and results obtained by the CanSat IRVI (Infrared Vision Image). It explores the application of vegetation indices, emphasizing their potential to safeguard Colombian ecosystems. Beyond environmental protection, the discussion extends to making these tools accesible, within the context of a developing country. The speech delves into the details of CanSat subsystems that enable this dual objective. By showcasing both the conceptualization of vegetation indices for ecological preservation and the practical subsystems supporting CanSat operations, the session intends to shed light on the symbiotic relationship between technology and environmental sustainability.