A continuous hyperspatial monitoring system of evapotranspiration and gross primary productivity from Unmanned Aerial Systems

General information
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Organisations: Department of Environmental Engineering, Water Resources Engineering, National Space Institute, Geodesy, Atmospheric Environment
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Ecological restoration of groundwater-dependent vegetation in the arid Ejina Delta: evidences from satellite evapotranspiration

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Organisations: Department of Environmental Engineering, Water Resources Engineering, Chinese Academy of Sciences
Authors: Kai, L. (Ekstern), Garcia, M. (Intern), Yu, J. (Ekstern), Zhang, Y. (Ekstern), Wang, P. (Ekstern), Wang, S. (Intern), Liu, X. (Ekstern)
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Effects of diffuse radiation on carbon and water fluxes of a high latitude temperate deciduous forest

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Authors: Wang, S. (Intern), Ibrom, A. (Intern), Pilegaard, K. (Intern), Bauer-Gottwein, P. (Intern), Garcia, M. (Intern)
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Optical remote sensing for soil mapping and monitoring

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Authors: Escribano, P. (Ekstern), Schmid, T. (Ekstern), Chabrillat, S. (Ekstern), Rodríguez-Caballero , E. (Ekstern), Garcia, M. (Intern)
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Optimizing sensitivity of Unmanned Aerial System optical sensors for low zenith angles and cloudy conditions

Satellite-based imagery in optical domains cannot provide information on the land surface during periods of cloud cover. This issue is especially relevant for high latitudes where overcast days and low solar zenith angles are common. Current remote sensing-based models of evapotranspiration or carbon assimilation are biased towards clear sky conditions,
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Publication: Research › Poster – Annual report year: 2017

Hyperspatial mapping of water, energy and carbon fluxes with Unmanned Aerial Vehicles

Having spatially distributed estimates of energy, water and carbon fluxes between the land and the atmosphere is of critical importance for improving water resource management, agricultural production, weather forecasting, and climate prediction. Traditionally, satellite based remote sensing data of vegetation or temperature has been used as inputs into land surface models (LSMs). However, the coarse resolution of satellite based remote sensing (3-90 km) data could not accurately capture spatial heterogeneity in fluxes due to changes in topography, soil types, and vegetation. With significant advances in navigation, flight control, miniaturized platforms and sensors, Unmanned Aerial Vehicles (UAVs) can provide ultra-high spatial resolution imagery (1 cm to 1 m). This presents a good opportunity to improve land surface modeling. From this perspective, our study explores the possibility to incorporate UAV-based remote sensing into LSMS. A site growing an energy crop with field sensors (eddy covariance, radiation or soil moisture) at DTU-Rise is chosen for the pilot study. A hexacopter (Tarot) equipped with a six band multispectral camera (Visible and near infrared), a thermal camera and a digital camera regularly flew over the flux site. In the near future, a smart UAV platform combining rotary and fixed wing functionality will be used as platform. The imagery acquired by UAVs will be used to retrieve the vegetation indices and land surface temperature. These data used for land surface modeling to estimate biomass, plant diseases or stress, water uptake.

General information
Revisiting the paper "Using radiometric surface temperature for surface energy flux estimation in Mediterranean drylands from a two-source perspective"

The recent paper by Morillas et al. [Morillas, L. et al. Using radiometric surface temperature for surface energy flux estimation in Mediterranean drylands from a two-source perspective. Remote Sens. Environ. 136, 234–246, 2013] evaluates the two-source model (TSM) of Norman et al. (1995) with revisions by Kustas and Norman (1999) over a semiarid tussock grassland site in southeastern Spain. The TSM - in its current incarnation, the two-source energy balance model (TSEB) - was applied to this landscape using ground-based infrared radiometer sensors to estimate both the composite surface radiometric temperature and component soil and canopy temperatures. Morillas et al. (2013) found the TSEB model substantially underestimated the sensible H (and overestimated the latent heat LE) fluxes. Using the same data set from Morillas et al. (2013), we were able to confirm their results. We also found energy transport and exchange behavior derived from primarily the observations themselves to differ significantly from a number of prior studies using land surface temperature for estimating heat fluxes with one-source modeling approaches in semi-arid landscapes. However, revisions to key vegetation inputs to TSEB and the soil resistance formulation resulted in a significant reduction...
in the bias and root mean square error (RMSE) between model output of H and LE and the measurements compared to the prior results from Morillas et al. (2013). These included more representative ground-based vegetation greenness and local leaf area index values as well as modifications to the coefficients of the soil resistance formulation to account for the very rough (rocky) soil surface conditions with a clumped canopy. This indicates that both limitations in remote estimates of biophysical indicators of the canopy at the site and the lack of adjustment in soil resistance formulation to account for site specific characteristics, contributed to the earlier findings of Morillas et al. (2013). This suggests further studies need to be conducted to reduce the uncertainties in the vegetation and land surface temperature input data in order to more accurately assess the effects of the transport exchange processes of this Mediterranean landscape on TSEB formulations.

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**Organisations:** Department of Environmental Engineering, Water Resources Engineering, USDA-ARS Hydrology and Remote Sensing Lab, Spanish Research Council Institute for Sustainable Agriculture, University of British Columbia, Utah State University, Universidad Pablo de Olavide, Consejo Superior de Investigaciones Científicas

**Authors:** Kustas, W. P. (Ekstern), Nieto, H. (Ekstern), Morillas, L. (Ekstern), Anderson, M. C. (Ekstern), Alfieri, J. G. (Ekstern), Hipps, L. E. (Ekstern), Villagarcía, L. (Ekstern), Domingo, F. (Ekstern), Garcia, M. (Intern)

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A bi-weekly actual evapotranspiration dataset derived from NOAA-AVHRR images across the Iberian Peninsula and the Balearic Islands, 1981-2015

Using the complete set of diurnal NOAA-AVHRR images from 1981 to 2015, in this study we developed a bi-weekly high-spatial resolution (1.1-km) actual evapotranspiration (ETa) dataset covering the Iberian Peninsula and the Balearic islands. Daily ETa was estimated by applying the algorithm developed by Sobrino et al. (2007), which is based on the S-SEBI model. The 35-year NOAA-AVHRR images were geometrically and radiometrically corrected, including a topographic correction of visible and near-infrared spectral channels. Satellite changes and orbit drifts were also corrected using post-launch calibration coefficients, and surface temperature (Ts) estimated using a split-window algorithm by optimized coefficients according to the corresponding sensor effective wavelength (Lahraoua et al., 2013). Relative normalization for solar-zenith and sensor-view angles was applied to the Ts daily time-series. For an accurate quantification of daily ETa, cloud cover was removed applying the algorithm developed by Azorin-Molina et al. (2013), and the evaporative fraction estimated by means of the “triangle method”, using the spatial relationship between Ts and albedo for each daily image. The daily time series were transformed to a bi-weekly temporal resolution and biweekly images were smoothed using a temporal filtering approach to reduce the observed noise. For validation purposes, annual series of ETa were compared with water balances in hydrological basins with different vegetation, water use and management conditions. Finally, the resulting bi-weekly ETa time-series were compared with reference evapotranspiration series for Spain to detect periods and regions affected by an evapotranspiration deficit. The created dataset can be useful to identify drought extent and to characterize land cover changes characterized by abrupt and progressive modifications in the evaporation conditions.

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Assessing regional crop water demand using a satellite-based combination equation with a land surface temperature component

Quantification of daily evapotranspiration at regional levels is fundamental for improving agricultural and hydrological management, especially in water-scarce and climatic change vulnerable regions, like the Mediterranean basin. Regional estimates of daily crop evapotranspiration (ET) have been historically based on combination equations, such as Penman-Monteith or Priestley-Taylor, forced with weather-data inputs. However, the requirements for long term in-situ data, limit the application of such traditional approaches and algorithms using satellite-data without field calibrations bridge this gap by estimating long-term ET at the pixel level from local to global scales. Land surface temperature is a key variable tracking land surface moisture status. However, it has not been included in satellite ET approaches based on combination equations. In this study, a land surface temperature component was used to estimate soil surface conductance based on an apparent thermal inertia index. A process-based model was applied to estimate surface energy fluxes including daily ET based on a modified version of the Priestley-Taylor Jet Propulsion Laboratory (PT-JPL) model at 1km pixel resolution during a chrono-sequence spanning for more than a decade (2002-2013). The thermal-PT-JPL model was forced with vegetation, albedo, reflectance and temperature products from the Moderate-resolution Imaging Spectroradiometer (MODIS) from both Aqua and Terra satellites. The study region, B-XII Irrigation District of the Lower Guadalquivir, is one of the largest irrigated areas in Spain but it has scarce in-situ micrometeorological or eddy covariance data. The final aim of this study is to evaluate the thermal version of PT-JPL model versus a lumped hydrological model to assess crop evapotranspiration deficits and long-term water consumption trends in the area. The results showed that the thermal-PT-JPL model is a suitable and simple tool requiring only air temperature and incoming solar radiation apart from standard satellites-products freely available. Our results show that in comparison with the hydrological model conceptual rainfall-runoff model, requiring several meteorological and in-situ data to quantify irrigation, the satellite-based model presents a great advantage for regionalization of ET.
Ecosystem properties of semi-arid savanna grassland in West Africa and its relationship to environmental variability

The Dahra field site in Senegal, West Africa, was established in 2002 to monitor ecosystem properties of semiarid savanna grassland and their responses to climatic and environmental change. This article describes the environment and the ecosystem properties of the site using a unique set of in situ data. The studied variables include hydroclimatic variables, species composition, albedo, normalized difference vegetation index (NDVI), hyperspectral characteristics (350-1800 nm), surface reflectance anisotropy, brightness temperature, fraction of absorbed photosynthetic active radiation (FAPAR), biomass, vegetation water content, and land-atmosphere exchanges of carbon (NEE) and energy. The Dahra field site experiences a typical Sahelian climate and is covered by coexisting trees (~3% canopy cover) and grass species, characterizing large parts of the Sahel. This makes the site suitable for investigating relationships between ecosystem properties and hydroclimatic variables for semiarid savanna ecosystems of the region. There were strong interannual, seasonal and diurnal dynamics in NEE, with high values of ~7.5 g C m⁻² day⁻¹ during the peak of the growing season. We found neither browning nor greening NDVI trends from 2002 to 2012. Interannual variation in species composition was strongly related to rainfall distribution. NDVI and FAPAR were strongly related to species composition, especially for years dominated by the species Zornia glochidiata. This influence was not observed in interannual variation in biomass and vegetation productivity, thus challenging dryland productivity models based on remote sensing. Surface reflectance anisotropy (350-1800 nm) at the peak of the growing season varied strongly depending on wavelength and viewing angle thereby having implications for the design of remotely sensed spectral vegetation indices covering different wavelength regions. The presented time series of in situ data have great potential for dryland dynamics studies, global climate change related research and evaluation and parameterization of remote sensing products and dynamic vegetation models.

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Organisations: Department of Environmental Engineering, Water Resources Engineering, National Space Institute, Microwaves and Remote Sensing, Department of Applied Mathematics and Computer Science, Université Cheikh Anta Diop de Dakar, University of Copenhagen, Karlsruhe Institute of Technology, DHI Denmark, Lund University
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Global Ecosystem Restoration Index

The Global ecosystem restoration index (GERI) is a composite index that integrates structural and functional aspects of the ecosystem restoration process. These elements are evaluated through a window that looks into a baseline for degraded ecosystems with the objective to assess restoration improvements or declines in a more integrated manner.

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Accuracy of the Temperature-Vegetation Dryness Index using MODIS under water-limited vs. energy-limited evapotranspiration conditions

Water deficit indices based on the spatial relationship between surface temperature (Ts) and NDVI, known as triangle approaches, are widely used for drought monitoring. However, their application has been recently questioned when the main factor limiting evapotranspiration is energy. Even though water is the main control in dryland ecosystems, these can also undergo periods of energy and temperature limitation. In this paper we aimed to: (i) evaluate the TVDI (Temperature-Vegetation Dryness Index) to estimate water deficits (e.g. ratio between actual and potential evapotranspiration), and heat surface fluxes using MODIS data; and (ii) provide insights about the factors most affecting the accuracy of results. Factors considered included the type of climatic control on evapotranspiration, λE, (i.e. water-limited vs. energy-limited), the quality of Tair estimates, the heterogeneity of land cover types and climatic variables in the region, or the algorithm to extract hydrological boundaries from the images. The TVDI was compared with eddy covariance (EC) data from two shrublands with different climatic controls for λE in South Spain. Evaluations showed that it could be used to estimate the water deficit when water was the main limiting factor (R=0.81-0.88; Mean Average Error, MAE=0.16-0.17) but not in energy-limited situations (R

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Vegetation greenness indices from remote sensing are increasingly used in population ecology studies assuming that land surface reflectance can reflect the availability of nutritional resources for primary consumers. However, the relationship between these indices and the characteristics of the herbivore diet has been insufficiently tested. We hypothesized that in drylands, where water availability is a prime control of ecosystem functioning, remote sensing indicators of vegetation drought stress are critical to predict the nutritional quality of herbivore habitats. This hypothesis was analyzed by measuring the dynamics in diet quality for the European rabbit, a key prey in Mediterranean communities. Rabbit nutrition was measured in six habitats throughout a year using faecal nitrogen (FN) content, an indicator of the levels of ingested protein. Then we tested the accuracy for predicting diet quality of the Enhanced Vegetation Index (EVI) and two remote sensing vegetation stress indicators: the Temperature Difference Vegetation Index (TVDI) and a latent heat flux index (Hr) calculated from the dynamics of surface temperature at each site. Generalized mixed models showed that temperature indices significantly contributed to explain the dynamics of diet quality: models including either TVDI or Hr shower a better fit than those exclusively based in EVI (R² = 0.43—0.60). Whereas FN showed a positive relationship with EVI, the effect of TVDI and Hr was negative. Extracting the temporal component further allowed us to characterize the overall quality of each habitat and to relate it with rabbit abundance. Results have far-reaching implications for assessing habitat quality and the effects of functional ecosystem changes on a keystone prey herbivore and associated communities.
Environmental factors affecting the accuracy of surface fluxes from a two-source model in Mediterranean drylands: Upscaling instantaneous to daytime estimates

The temperature-based two-source model (TSM) of Norman et al. (1995) has not been properly evaluated under the water stress conditions that are typical in natural Mediterranean drylands. In such areas, the asynchrony between precipitation and energy supply strongly reduces evapotranspiration, $E$ (or latent heat flux, $LE$, if expressed in energy terms), making sensible heat flux ($H$) the dominant turbulent heat flux. In this study, we present a detailed analysis of the main environmental factors affecting the TSM effectiveness under such challenging conditions. The accuracy of the TSM, evaluated via errors in 15-min $H$ estimates, was shown to have a diurnal variation. Accuracy was clearly reduced for solar elevation angles lower than 25° and during marginal hours of daytime, before 10 am and after 3 pm. The surface to air temperature difference ($TR - Ta$) and the wind speed were the two environmental factors showing the strongest effect on the TSM accuracy. In contrast with results observed in other ecosystems, in this Mediterranean tussock grassland the TSM accuracy was not clearly reduced by cloudiness and it was improved under highly stressed vegetation conditions. The parallel resistances scheme of the TSM (TSMP) showed overall lower errors and a lower tendency to underestimate at high $H$ values, but the series resistances scheme of the TSM (TSMS) increased the model accuracy under some specific circumstances such as low energy supply and atmospheric neutral conditions.

Finally, two extrapolation methods to obtain daytime ($Rn > 55$ W m$^{-2}$) turbulent fluxes from the 15-min estimates of TSM were compared: (i) assuming the self-preservation of the evaporative and the non-evaporative fraction ($EF$ and $NEF$ method) and (ii) averaging the total daytime instantaneous fluxes ($Averaging$ method). Despite the assumption of daytime self-preservation of $EF$ and $NEF$ showed consistent, this method retrieved less accurate daytime estimates of $H$, and $E$ than the Averaging method as a result of inaccuracies affecting estimates of $EF$ and $NEF$ from the TSM at our site. Moreover, better daytime estimates of $H$ and $E$ were obtained when using instantaneous fluxes from the TSMP than from the TSMS. Thus, reliable daytime estimates of $H$ were obtained from the TSMP in a Mediterranean dryland, with mean errors of 20% and high correlations ($R^2 = 0.85$). However, daytime $E$ was strongly overestimated (125%) using the TSM by both methods, although a good correlation with eddy covariance measurements was found ($R^2 = 0.84$).
Remote sensing from UAVs for hydrological monitoring

The potential of Unmanned Aerial Vehicles (UAVs) has significantly increased over the last five years due to cost reductions and improved sensors. In addition, advanced real time kinematic GPS techniques have enabled cm-accuracy navigation and flight control for UAVs. UAVs have numerous advantages compared to other technologies: compared to field based techniques, remote sensing with UAVs is a non-destructive technique, less time consuming, ensures a reduced time between acquisition and interpretation of data and gives the possibility to access remote and unsafe areas. Compared to full-size aircrafts and spaceborne systems, environmental surveys carried out with UAVs are economically efficient, ensure a higher spatial accuracy and resolution and offer more flexibility in terms of payload design and deployment.

This study is part of the “Smart UAV” project, which is a collaboration between DTU Environment, DTU Space and the company Sky-Watch A/S. The project aims to develop an innovative prototype that will combine the different advantages of fixed wing and rotary wing UAVs. The Smart UAV will not exceed a total weight of 7 kg., including payload (external sensors) of 1.5 kg. It will be able to fly a total distance of 20 km or hover for 20 min. The prototype will carry a water level ranging sensor, a 6-band multispectral camera and a thermal camera. The water level sensor will determine the orthometric water level in rivers and reservoirs at an accuracy of 10 cm or better. The multispectral camera will be able to record the spectral signatures of water and land surfaces with a pixel resolution of around 15 cm, whereas the thermal camera will sense water and land surface temperature with a resolution of 40 cm. Post-processing of data from the thermal camera will allow retrieving vegetation and soil temperature, whereas data from the multispectral cameras will enable estimation of vegetation cover, chlorophyll-carotenoids content and plant stress indices.

The main goal is to retrieve innovative real time data to inform hydrological simulation models and land surface energy balance models over agricultural and forestry sites. The acquired data will enhance estimation of evaporation from land surfaces and transpiration from plants. Water level and actual ET observations will be assimilated to hydrological model to enhance their forecast skill. Data assimilation and model fusion will enable us to assess the water cycle at local scale, through evaluation of surface evapotranspiration, surface run-off, channel run-off and water storages. The multispectral imagery will allow retrieving indices such as NDVI, OSAVI, carotenoid contents and PRI. NDVI and OSAVI are retrieved to determine fractional vegetation cover and senescence progression, carotenoids content is useful to understand the reaction of organism to changing environmental light condition and the uptake rate of carbon dioxide by foliage and PRI is an estimation of vegetation productivity and stress. Implementations of soil–vegetation–atmosphere transfer models (SVAT) will give access to a detailed description of soil and vegetation canopy processes allowing us to estimate water and energy fluxes continuously. Moreover, our research has great potential future for phenotyping evaluations such as non-invasive and accurate identification of senescence progression, biomass estimation, nutrient deficiencies, canopy nitrogen amounts, diseases, water deficiency or surplus.

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Sensitivity of a satellite-derived drought index under soil moisture-limited vs. energy-limited evapotranspiration.

Actual evapotranspiration in drylands derived from in-situ and satellite data: Assessing biophysical constraints

Actual evapotranspiration in drylands derived from in-situ and satellite data: Assessing biophysical constraints

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Organisations: Department of Environmental Engineering, Water Resources Engineering, National Space Institute, Microwaves and Remote Sensing, Estación Biológica de Doñana, Universidad Pablo de Olavide, Estación Experimental de Zonas Áridas
Authors: Garcia, M. (Intern), Fernandez, N. (Ekstern), Villagarcia, L. (Ekstern), Domingo, F. (Ekstern), Puigdefabregas, J. (Ekstern), Sandholt, I. (Intern)
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Actual evapotranspiration in drylands derived from in-situ and satellite data: Assessing biophysical constraints

Improving regional estimates of actual evapotranspiration (lambda E) in water-limited regions located at climatic transition zones is critical. This study assesses an lambda E model (PT-JPL model) based on downscaling potential evapotranspiration according to multiple stresses at daily time-scale in two of these regions using MSG-SEVIRI (surface temperature and albedo) and MODIS products (NDVI, LAI and f(PAR)). An open woody savanna in the Sahel (Mali) and a Mediterranean grassland (Spain) were selected as test sites with Eddy Covariance data used for evaluation. The PT-JPL model was modified to run at a daily time step and the outputs from eight algorithms differing in the input variables and also in the formulation of the biophysical constraints (stresses) were compared with the lambda E from the Eddy Covariance. Model outputs were also compared with other modeling studies at similar global chyland ecosystems.

The novelty of this paper is the computation of a key model parameter, the soil moisture constraint, relying on the concept of apparent thermal inertia (f(SM-ATI)) computed with surface temperature and albedo observations. Our results showed that f(SM-ATI) from both in-situ and satellite data produced satisfactory results for lambda E at the Sahelian savanna, comparable to parameterizations using field-measured Soil Water Content (SWC) with r(2) greater than 0.80. In the Mediterranean grasslands however, with much lower daily lambda E values, model results were not as good as in the Sahel (r(2)= 0.57-0.31) but still better than reported values from more complex models applied at the site such as the Two Source Model (TSM) or the Penman-Monteith Leuning model (PML).

PT-JPL-daily model with a soil moisture constraint based on apparent thermal inertia, f(SM-ATI) offers great potential for regionalization as no field-calibrations are required and water vapor deficit estimates, required in the original version, are not necessary, being air temperature and the available energy (Rn-G) the only input variables required, apart from routinely available satellite products. (c) 2012 Elsevier Inc. All rights reserved.

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Organisations: Columbia University, University of Copenhagen, Université de Toulouse, Consejo Superior de Investigaciones Científicas
Authors: Garcia, M. (Intern), Sandholt, I. (Intern), Ceccato, P. (Ekstern), Ridler, M. (Ekstern), Mougin, E. (Ekstern), Kergoat, L. (Ekstern), Morillas, L. (Ekstern), Timouk, F. (Ekstern), Fensholt, R. (Ekstern), Domingo, F. (Ekstern)
Pages: 103-118
Operational monitoring and Forecasting system for Resilience of agriculture and forestry under intensification of the Water cycle: a Big Data approach

Department of Environmental Engineering
Water Resources Engineering

TSK
Period: 01/07/2017 → 01/09/2019
Number of participants: 1
Acronym: FORWARD
Project participant:
Garcia, Monica (Intern)

Agricultural Water Innovations in the Tropics

Department of Environmental Engineering
Water Resources Engineering
Period: 01/04/2017 → 01/05/2020
Number of participants: 1
Acronym: AgWIT,
Project participant:
Garcia, Monica (Intern)

Airborne and satellite remote sensing for hydrologic modelling applications

Department of Environmental Engineering
Period: 01/02/2017 → 31/01/2020
Number of participants: 4
Phd Student:
Kittel, Cecile Marie Margaretha (Intern)
Supervisor:
Garcia, Monica (Intern)
Tøttrup, Christian (Ekstern)
Main Supervisor:
Bauer-Gottwein, Peter (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

SMAP Soil Moisture Data To Improve Remotely Sensed Global Estimates of Evapotranspiration

Evapotranspiration is a key variable in the hydrological cycle, however it cannot be measured directly using remote sensing data. This project aims to integrat SMAP NASA soil moisture products directly into global remote sensing evapotranspiration algorithms to improve modelin and assess regional droughts.
Development of sectorial drought indices in the Iberian Peninsula: improving monitoring and early warning of droughts in Spain (in Spanish)

Department of Environmental Engineering
Water Resources Engineering
Period: 01/08/2016 → 01/08/2018
Number of participants: 2
Project participant:
García, Monica (Intern)
Fisher, Josh (Ekstern)
Project

Hyperspatial mapping of water, energy and carbon fluxes with Unmanned Aerial Vehicles

Department of Environmental Engineering
Water Resources Engineering
Period: 01/07/2016 → 01/07/2018
Number of participants: 2
Project participant:
García, Monica (Intern)
Vicente-Serrano, Sergio (Ekstern)
Project

Development of Global biodiversity Indicators

GEO BON (the Group on Earth Observations Biodiversity Observation Network) consortium involving researchers and organizations around the world has developed a novel set of global indicators to address important gaps in our understanding of biodiversity change across scales, from national to global. These indicators are embedded in open online analysis platforms following GEO data sharing principles and have the long-term commitment of established research institutions.

Department of Environmental Engineering
Water Resources Engineering
Group on Earth Observations Biodiversity Observation Network
Period: 09/09/2015 → 07/10/2017
Number of participants: 1
Project participant:
Garcia, Monica (Intern)
Documents:
GBCI_Version1.2_low_Biodiversity_Index
Project
Innovative optical Tools for proximal sensing of ecophysiological processes (OPTIMISE). ESSEM COST Action ES1309

Important European and international initiatives (SPECNET, BIOSPEC and COST Action ES0903) explored the use of proximal optical sensing of ecosystem where carbon and water vapor flux is estimated by eddy covariance techniques. Such optical observations provide data at the high spectral, temporal and spatial resolutions necessary to more fully comprehend the links between light use, plant physiology and ecosystem functioning and provide key validation datasets for satellite remote sensing, such as the Sentinel missions, and the flux communities.

The recent advances in UAV platforms and optical sensors provide unprecedented opportunities for high spatial, spectral and multi-angular near-ground Earth observations. This will enable scientists to answer ecological and physiological questions at multiple scales through integrated empirical and modeling methods. Important progress is also being made in remote sensing of steady-state fluorescence, the most direct proxy for photosynthesis. The FLuorescence EXplorer (FLEX) mission, selected for further studies, will also benefit as this Action will support FLEX validation and calibrations campaigns. Furthermore, scientists have recognized the need to develop a ‘smart’ on-line platform to process and analyses optical data along with biophysical and water/carbon flux measurements and share these with other scientific communities and stakeholders which will also be addressed in this Action.

Department of Environmental Engineering

Water Resources Engineering
Period: 01/07/2014 → 30/04/2017
Number of participants: 1
Acronym: OPTIMISE
Working partner:
Garcia, Monica (Intern)

Relations
Activities:
Optimise Workshop
Project

Environmental Monitoring with Unmanned Airborne Vehicles

Department of Environmental Engineering
Period: 01/05/2014 → 30/08/2017
Number of participants: 3
Phd Student:
Bandini, Filippo (Intern)
Supervisor:
Garcia, Monica (Intern)
Main Supervisor:
Bauer-Gottwein, Peter (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Improving Weather Risk Management in West Africa: Evaluation of Remote Sensing for Index Insurance

The Weather Risk Management Facility (WRMF)1 is a joint initiative between two United Nations agencies, the International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP). It has been working to address the challenges weather risk (particularly drought) poses for smallholders producing crops in rural areas. One way the WRMF does this is by developing and supporting innovative weather and climate risk management tools – including index insurance – that improve rural livelihoods and reduce hunger. Launched in 2008 with the support of the Bill and Melinda Gates Foundation, the WRMF draws on IFAD’s experience in rural finance and on WFP’s expertise in disaster-risk reduction and management.

Building on lessons learned from carrying out pilots and research, the WRMF identified key constraints and success factors in the uptake, sustainability and scalability of index insurance2. Index insurance offers structural opportunities where, as part of a larger package of risk management strategies and services, it can be delivered through risk aggregators, such as agricultural finance providers, input suppliers and contract farming organizations. Indexation can also form a basis for risk financing and insurance for governments, relief agencies, at a more aggregated level.

This latest project, ‘Improving Weather Risk Management in West Africa: Evaluation of Remote Sensing for Index Insurance’, is designed to test the feasibility of index implementation for poor rural smallholders using innovative remote sensing technology. The project will address implementation needs, and research and evaluate methodologies, focusing on selected test locations in West Africa (e.g. Senegal). The rationale for this project is that conventional weather index insurance (using weather stations) and area yield index insurance (using crop yield data), suffer from significant
constraints, such as lack of appropriate weather station coverage and adequate yield information. In many cases these constraints represent a severe limitation to the introduction and scaling up of insurance products – both traditional crop and indexed insurance. By removing some of the obstacles encountered by such approaches, and despite a different set of technical, organizational and financial challenges, remote sensing may offer new opportunities for development of new insurance instruments for indexation. The specific goal of this project is to research and develop sustainable index insurance products for smallholder farmers who are producing crops in drought-prone areas of developing countries. Any successfully piloted methodologies could then feed into existing IFAD and WFP programmes such as R43 and other ongoing operations.

This briefing note is primarily written for organizations, research centres, and firms which are involved in remote sensing and agricultural productivity monitoring, to explain about the project and the way in which the WRMF hopes to engage with them during phase 2 and potentially beyond.

Consultancy project. Member of the Evaluation Committee.

Department of Environmental Engineering
Water Resources Engineering

International Fund for Agricultural Development
Period: 31/07/2013 → 30/04/2014
Number of participants: 1
Project participant:
Garcia, Monica (Intern)

Relations
Activities:
Workshop Evaluation Meeting Commitee
Project

Activities:

Development of Global Biodiversity Indicators (Group On Earth Observations Biodiversity Observation Network) GEO-BON (External organisation)
Period: 1 Sep 2015 → 1 Sep 2017
Monica Garcia (Member)

Department of Environmental Engineering
Water Resources Engineering

Description
Development of a global indicator of the restoration level of degraded ecosystems, to comply with the Target 15 of the Aichi Biodiversity targets from the Convention for Biological Diversity.

Body type: GEO-BON
Degree of recognition: International
Documents:
GBCI_Version1.2_low_Biodiversity_Index

Related external organisation
Development of Global Biodiversity Indicators (Group On Earth Observations Biodiversity Observation Network) GEO-BON
Activity: Membership › Membership in committee, council, board

Workshop Evaluation Meeting Commitee
Period: 1 Dec 2014
Monica Garcia (Invited speaker)

Department of Environmental Engineering
Water Resources Engineering

Description
Technical implications of adopting different methods of estimating evapotranspiration for index insurance purposes.

Related event

Workshop Evaluation Meeting Committee: Weather Risk Management in West Africa. Drought insurance with remote sensing
01/12/2014 → 02/12/2014
Rome, Italy
Activity: Participating in or organising an event › Participating in or organising workshops, courses, seminars etc.

Optimise Workshop
Monica Garcia (Participant)
Department of Environmental Engineering
Water Resources Engineering
Description
Participation as a representative of Denmark (Member) in the workshop related to Cost action

Related event

Optimise Workshop
07/10/2014 → 10/10/2014
Milano, Italy
Activity: Participating in or organising an event › Participating in or organising workshops, courses, seminars etc.

Global Energy and Carbon Cycles
Monica Garcia (Participant)
Department of Environmental Engineering
Water Resources Engineering
Links:
http://gewex.org/2014conf/info.html

Related event

Global Energy and Carbon Cycles
14/07/2014 → 17/07/2014
Den Haage, Netherlands
Activity: Participating in or organising an event › Participating in or organising workshops, courses, seminars etc.