ANSO
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Highlight

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ANSO Highlight is to share the new ideas, methodologies, datasets and technologies of sustainability research by summarizing the latest progress and achievements of scientific projects funded by ANSO and ANSO partners. Through this publication, we would like to stimulate active collaboration and communication among ANSO members and partners.

ANSO-MISSPAD

Summary

ANSO-MISSPAD (Multi-model-Integrated Subseasonal-to-Seasonal Prediction and Application in Disaster Risk Reduction) is a joint cooperative research project launched by the ANSO in January 2020. This three-year project will share and apply the Subseasonal-to-Seasonal (hereafter 'S2S') weather and climate forecasts in the Belt and Road (hereafter 'B&R') regions, aiming to improve the capability for climate disaster prevention in related countries, in order to safeguard food security and the ecological environment, and promote sustainable development (SDGs 2 and 13).

Period: January 1, 2020 to December 31, 2022
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P2-P6

ANSO CropWatch-ICP

Summary

Food security in developing countries is a prominent issue. The constraints of technology and funding have caused most developing countries to lack the ability to monitor and/or generate agricultural information in real or near-real time. The lack of crop production information often puts these countries at a risk in food trade, adding challenges to the achievement of zero hunger required by the United Nations Sustainable Development Goals (SDGs). The CropWatch Innovative Cooperation Programme for Agricultural Monitoring funded by the Alliance of International Science Organization (ANSO CropWatch-ICP) aims to enhance the capacity of developing countries to independently carry out agricultural monitoring and fill the food-related information gaps to address national food security. The main activities it carries out are training and capacity building as well as system customization to meet country-specific requirements, and providing support for model calibration and validation in priority countries.

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ANSO Highlight

ANSO-MISSPAD

Objectives

Countries along the B&R, due to their unique geographic locations, climatic environments, and poor economic conditions, are susceptible to meteorological and climatic disasters such as typhoons, torrential rains, droughts, sandstorms, heatwaves, and cold waves. Therefore, strengthening the capacity building of meteorological forecasting and disaster prevention services in these countries is the key to responding to natural disasters and achieving UN SDGs.

Dr. Erkin Isaev (2nd from left) of the Hydro-meteorological Service of the Ministry of Emergency Situations of Kyrgyzstan discusses cooperation plans with project team members on November 26, 2019.

Prof. Bao visited Tribhuvan University and Kathmandu Science and Education Center of Chinese Academy of Sciences in Nepal on October 18, 2019.

FV3

FAMIL2

FGOALS-f2

FV3 100km 25km

CMME

The two specific foci of this proposal are:

- To share and apply the S2S weather and climate forecasts in the B&R regions
- To strengthen cooperation and improve the capability for climate disaster prevention in the B&R regions

With partners in Kyrgyzstan, Thailand, Sri Lanka, and Nepal, this project will help to safeguard food security, ecological environment and socio-economic development, and promote sustainable development in the B&R countries.

Methodology

ANSO-MISSPAD is based on the FGOALS-f2 weather-climate dynamic ensemble forecast system. The core architecture of FGOALS-f2 includes four fully coupled components, atmospheric, oceanic, land, and sea ice modules. FGOALS-f2 has two standard horizontal resolutions: 100 km and 25 km. The dynamic core of the atmospheric component (FAMIL2) is FV3. The real-time prediction system covers the timescale from days to seasons. And the prediction products cover both the global and regional climate system (e.g., El Nino/Southern Oscillation (hereafter 'ENSO'), Arctic sea ice, land processes, typhoons). It provides forecasting services for disaster prevention and mitigation of extreme weather in countries and regions along the B&R.

Fig.1. Dr. Erkin Isaev (2nd left) of Agency of hydrometeorology under the Ministry of Emergency Situations of the Kyrgyz Republic discusses the cooperation plan with team members on November 26, 2019

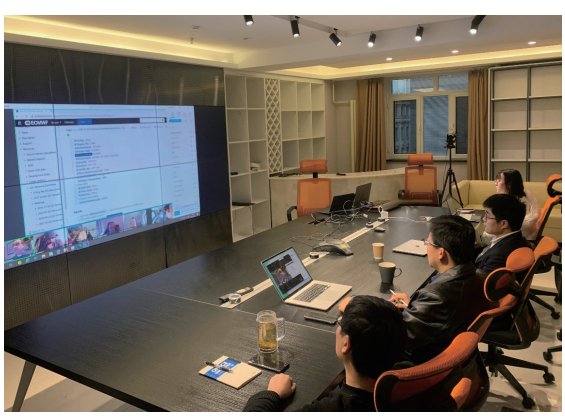
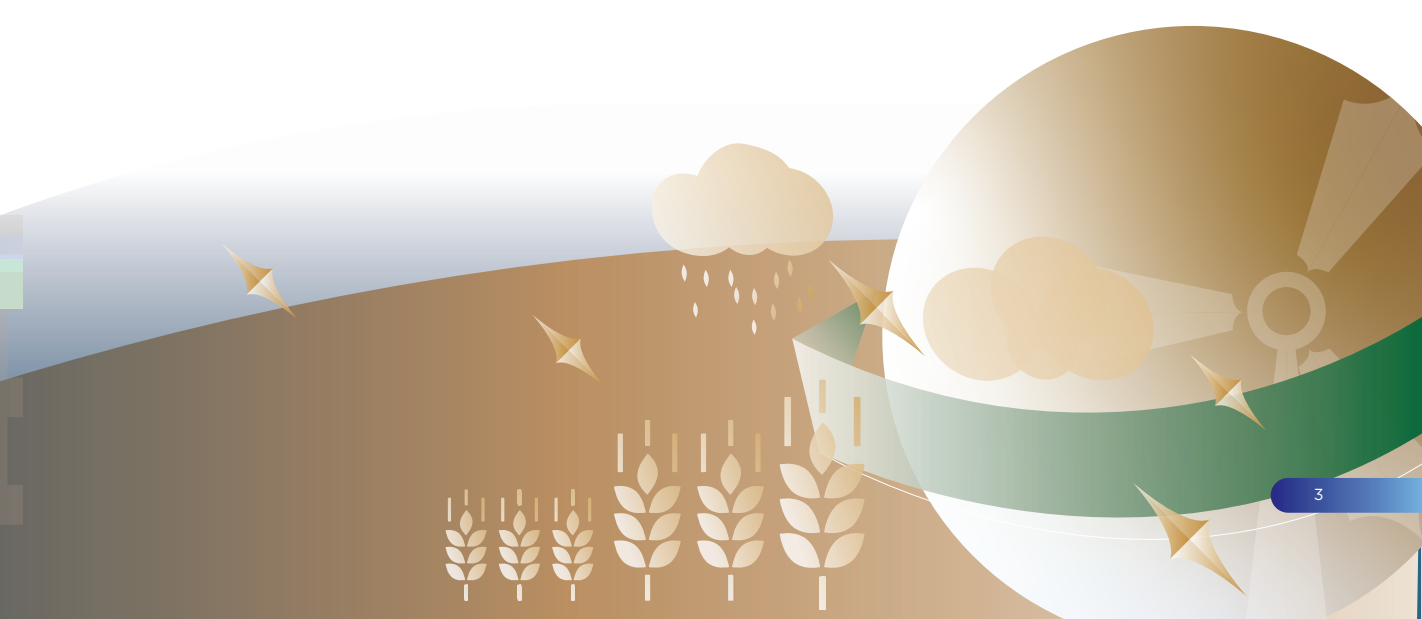


Fig.2. On 19 January 2020, the MISSPAD team participated in a web-meeting of the Technical Committee on S2S Forecasts hosted by ECMWF



Main Progress

The ANSO-MISSPAD project has released 18 seasonal forecasts for Central Asia, Southeast Asia, and South Asia, and 4 forecasts for Arctic sea ice. In October 2020, the team joined the S2S project, which was launched by the World Meteorological Organization (WMO), and provided forecast products for global users, such as temperature, pressure, precipitation, sea ice, typhoons, ENSO, etc.

On 3 September 2020, a mega tanker loaded with 270,000 tons of oil caught fire off the east coast of Sri Lanka. The MISSPAD team launched the emergency forecast of Indian Ocean cyclones and ocean currents and submitted the prediction results to the relevant organizations and rescue organizations in Sri Lanka as soon as possible. They also reminded nearby ships via media to heed the recent situation and forecast, avoid the relevant sea areas in advance, and monitor the changes in wind direction and ocean currents. The team was acknowledged by Sri Lanka and also the Chinese Embassy in Sri Lanka.

For the prediction of Arctic sea ice, MISSPAD submitted the Sea Ice Outlook of the pan-Arctic September sea-ice extent (SIE) to the Sea Ice Prediction Network (SIPN) in June, July, and August 2020. The 2020 Post-Season Report shows that the team had predicted the SIE with high precision and consistency.

The MISSPAD team precisely predicted severe winter drought in Nepal. The prediction information has been adopted by the Nepal Department of Hydrology and Meteorology (DHM) under the Ministry of Energy, Water Resources and Irrigation in its Climate Outlook issued in December.

FGOALS-f2 weather and subseasonal to seasonal Ensemble Prediction System (http://project.lasg.ac.cn/FGOALS_f2-S2S/index.php)

Emergency forecast predicted by the FGOALS-f2 S2S prediction system for the mega tanker fire in Sri Lanka. The figure shows the characteristics of the wind circulation at the end of September. There is a 60% probability of a tropical cyclone (typhoon) event at the end of September, and the intensity of the low-pressure centre will reach the level of a tropical cyclone.

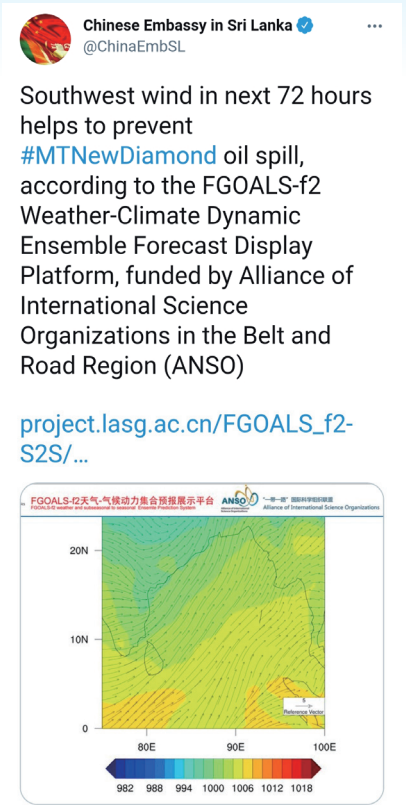


Fig.3. The Chinese embassy in Sri Lanka tweeted its thanks to MISSPAD for providing scientific and technological support in the rescue of a burning oil tanker off the coast of Sri Lanka

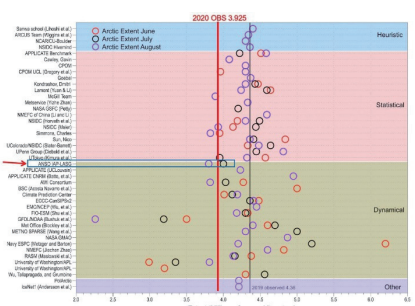


Fig.4. Forecast of Arctic sea ice in September 2020 by institutions in SIPN, the result marked by the red arrow as the ANSO-MISSPAD forecast is the numerical model closest to the actual observations.

Highlights

1) Participate in the World Meteorological Organization (WMO) S2S program and provide forecast products for global users
2) Participate in the international Sea Ice Prediction Network (SIPN), with international recognition of prediction results
3) The quality of seasonal forecast for Central Asia, Southeast Asia, and South Asia is consistenr and highly acknowledged.
4) Provide emergency forecast service to the rescue of an oil tanker in Sri Lanka sea area in September 2020

Future plans

1) Participate in the WMO S2S program, and evaluate the forecast application
2) Develop drought and water resources forecasting products for the B&R regions.
3) Further improve Arctic sea ice prediction, and provide prediction services for the “Silk Road”
4) Promote S2S application in the B&R regions and organize relevant international seminar

Certification and IP

No	Patent Name	Intellectual Property	Status	Application Number
1	A global seamless typhoon dynamic ensemble prediction method and system	Invention	Initial review qualified	202110043790.1
2	A global model relates to a method and system for dynamical seasonal prediction	Invention	Pending	
3	A global green weather-decadal prediction method and system	Invention	Pending	
4	General circulation model FAMIL typhoon detection system V1.0	Copyright	Registered	2018SR575432
5	Testing system of cloud correlation parameterization scheme for general circulation model FAMIL V1.0	Copyright	Registered	2018SR575427
6	FGOALS-f2 prediction system data transcoding system V1.0	Copyright	Registered	2020SR1632500
7	Data initialization processing system of FGOALS-f2 prediction system V1.0	Copyright	Registered	2020SR1634404
8	General circulation model FAMIL cloud simulator V1.0	Copyright	Registered	2018SR470499
9	Atmospheric general circulation model FAMIL sub-grid vertical motion system V1.0	Copyright	Registered	2019SR0476106
10	Resolving convective precipitation in FAMIL model	Copyright	Registered	2017SR101701
11	The FGOALS-f2 weather-climate dynamic ensemble forecast display platform	Copyright	Registered	2020SR0010519

Principal Investigator

Qing Bao PhD, Professor

Prof. Bao engages in the R&D of weather and climate system models. He leads a team to establish a real-time seamless forecasting system of weather and climate at LASG/IAP/CAS. This seamless prediction system has quickly realized operational applications in three national centres, where the Arctic sea ice prediction subsystem serves China's "Ice Silk Road" strategy. He is a Board Member of the China Society of Emergency Management. His awards include the XIE Yibing Young Scientist Award, IAP Science Innovation Award, Langchao-Tsinghua Young Scientist Award of Earth Sciences, and TIANHE Star Awards for Excellence Application awarded by National Supercomputer Centre.

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ANSO CropWatch-ICP

Objectives

The major objective of the Programme is to facilitate and stimulate agricultural monitoring, with the support of CropWatch Cloud, addressing information gaps of food security in developing countries, particularly in the “Belt and Road” region, thus assisting realization of the SDG goal of zero hunger. The Programme will carry out training, capacity building and system customization with support of calibration and validation of crop models, cropland mapping and disaster assessment that takes climate and land characteristics into account, as well as regional workshops for knowledge sharing and dissemination. It will enhance the capacity of developing countries to implement agriculture monitoring for addressing the SDG 2 Zero Hunger (Figure1).

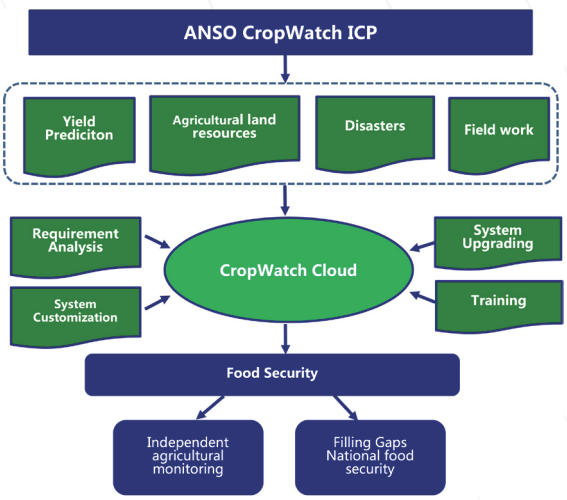


Figure 1. Technical Roadmap

Methodology

Under the coordination of UNCTAD and UN ESCAP, the pilot countries from Asia and Africa will be selected to join the Programme. Training courses will be organized both on theory and methods of crop monitoring, and practices of CropWatch Cloud.

The joint researches include field observations, model calibration and validation of crop yield models, cropland mapping and disaster monitoring (drought, dzud and insect pests); customization of CropWatch Cloud for countries’ requirement and training of technical persons; organization of regional workshops on food security; and production of ANSO Food Security Reports.

United Nations
Sustainable Development Goals
Zero Hunger

Main progress

1. Online Training Workshops of CropWatch

Due to the COVID-19 pandemic, a new modality of integrating online training and offline practices was developed when organizing two workshops on CropWatch applications for agricultural monitoring. The first workshop from 5 August to 26 August 2020 provided technical support in utilizing a cloud platform for monitoring crop condition and production of rice at national/sub-national levels for Lower Mekong countries. In total 47 people from government agencies or research institutions of Cambodia, Myanmar, Thailand, and Vietnam participated in this training program. The second workshop, which took place from 23 March to 28 May 2021, was joined by 24 participants from 14 countries.

Figure 2. Photo for closing ceremony of CropWatch online training on 26 August, 2020

2. Joint research on drought and duzd model

Due to the COVID-19 pandemic, the summer and winter field projects were carried out by the staff from the National Remote Sensing Center of Mongolia through virtual mentoring and online training during 2020-2021. The 1620 grassland samples at fixed points were taken in August 2020, and 1479 snow samples were taken in ten typical counties from February to March 2021. A remote sensing based dzud risk model was proposed during the two months of online training in 2021, and the field data were used for model validation.

Figure 3. Photo for CropWatch online training on 29 March, 2021

Figure 4. Photos of field work in August 2020 and in February 2021

3. Joint research on rice monitoring for countries in Southeast Asia

After training and discussion with participants from Cambodia, a method based on the crowd-sourced samples and the characteristics of backscattering coefficients of SAR data was developed to identify the rice planting area. The phenological information of rice was included to improve the extraction accuracy of the paddy area, particularly for the rice regions with two or three crops per year.

4. Drought and its impact on rice production in the lower Mekong River

Two special reports were completed in response to the drought in the lower Mekong River Basin and its impact on food production. The droughts from February to April 2020 in five countries in the Mekong River Basin and Yunnan province of China were monitored to analyze the change of drought occurrence, as well as drought development and mitigation in those countries. The analysis of the impact of droughts from September 2019 to April 2020 on rice production in the lower Mekong River Basin was carried out, and it was found that the drought had an adverse effect on dry season rice only and had limited impact on the overall rice production.

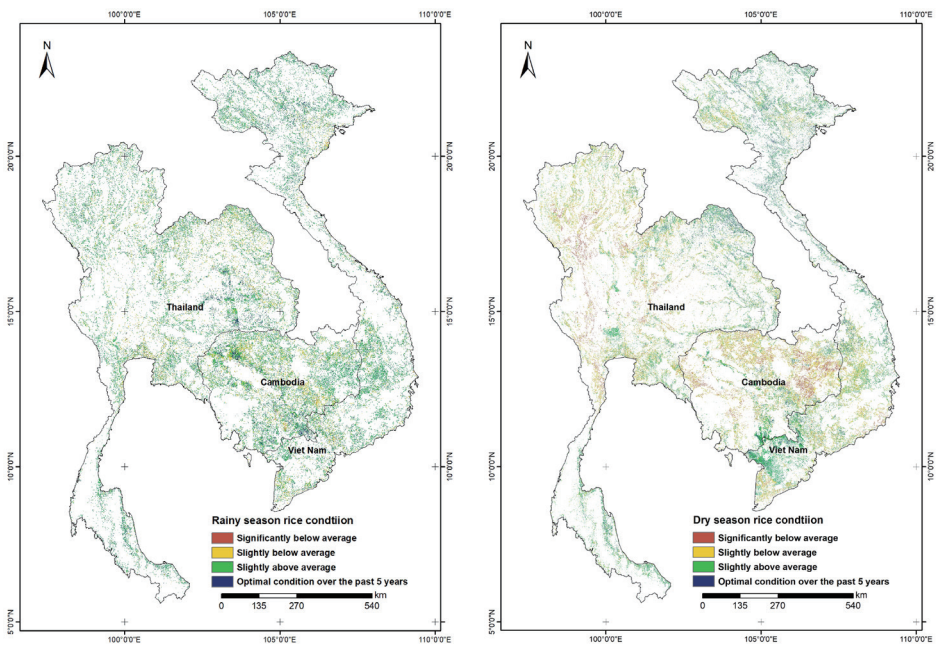


Figure 5. Rice growth condition in Cambodia, Thailand and Vietnam during the rainy season (left) and dry season (right) in 2019-2020

5. Impacts of the COVID-19 on the global grain production

The impacts of the COVID-19 pandemic on crop condition and production from October 2020 to the end of March 2021 in 36 major food producing and exporting countries around the world were analyzed. Argentina and Brazil in the southern hemisphere have been severely affected by the COVID-19 pandemic, which has led to substantial reductions in soybean and corn production. The COVID-19 pandemic has also affected crop production in the northern hemisphere, resulting in a significant decrease in wheat sown areas in India and Russia. Due to effective control measures, the planting area of winter crops increased, and the production is expected to increase.

Highlights

Two training courses were organized by integrating online training and practice, involving 16 countries and more than 70 technical personnel. After training, the participants from eight countries — Algeria, Mymmar, Nigeria, Syria, Thailand, Mauritius, Cambodia and Vietnam — can now complete their respective national crop monitoring analysis independently using the CropWatch agroclimatic and agronomic indicators, highlighting the strengthen of CropWatch Cloud for developing countries that lack the financial resources for the development and maintenance of crop monitoring systems, and demonstrating the value of CropWatch Cloud in COVID-19.

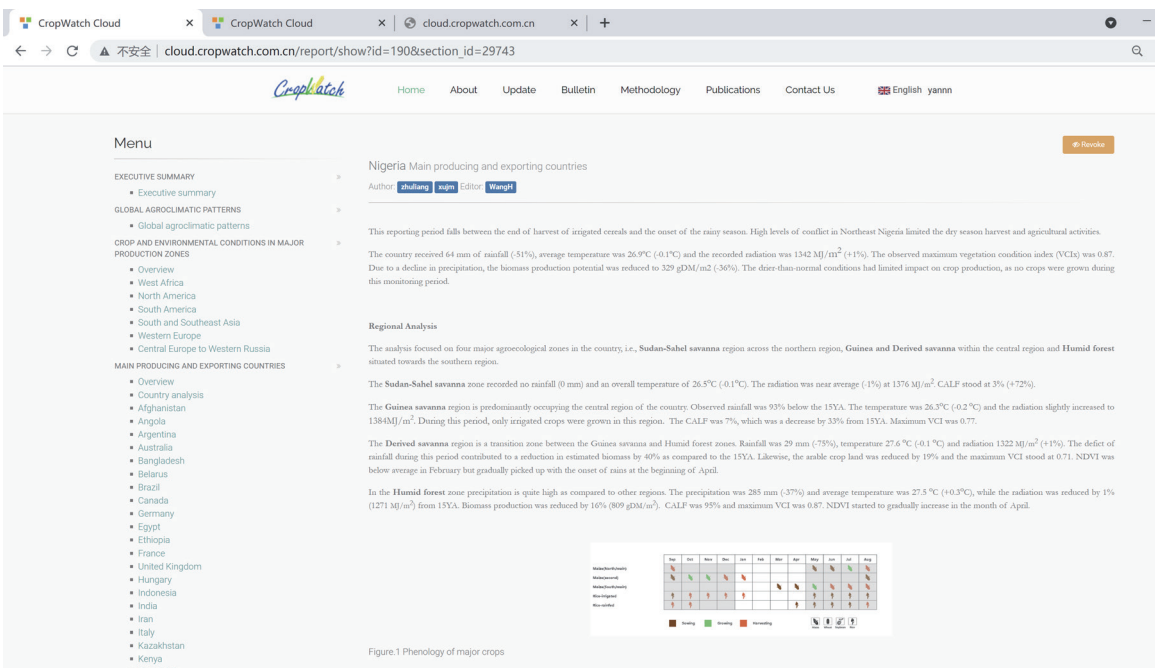


Figure 6. The country analysis for May 2021 CropWatch Bullein completed by Nigerian participants (released at http://cloud.cropwatch.com.cn/)

A letter of appreciation was sent by UNCTAD to ANSO on the successful completion of the online training workshop and satisfactory progress of the first phase of the CropWatch-ICP programme.

The agricultural monitoring and analysis results show that the droughts in early 2020 had limited impact on rice production in the lower Mekong basin, while the new COVID pandemic has produced a greater impact on food production in the northern and southern hemispheres in early 2021. The information from CropWatch identfied the global food security crisis during the pandemic period.

Figure 7. The discussion on the first phase of the Programme

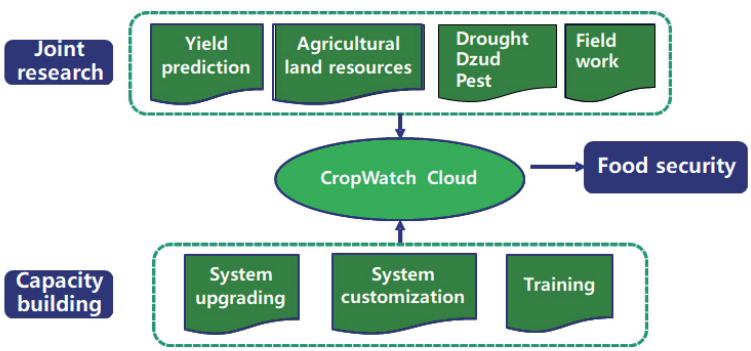
Future plan

The Programme will focus on joint research and capacity building in the next stage, including the holding of regional food security workshops in Thailand and Kenya in 2022, joint field work and model research, the calibration and verification of the model and the customization of systems according to plant characteristics and requirements from the pilot countries, and training on agricultural monitoring technology and customized systems for technical personnel in pilot countries.

Published Articles

Bofana J., Zhang M., Nail M., Wu. B, et al. Comparison of different cropland classification methods under diversified agroecological conditions in the Zambezi River Basin. Remote Sens. 2020, 12, 2096; doi:10.3390/rs12132096.

Chang, S., Chen H., Wu B., Nasanbat E., Yan N., Davdai, B. A Practical Satellite-Derived Vegetation Drought Index for Arid and Semi-Arid Grassland Drought Monitoring. Remote Sens. 2021, 13, 414. https://doi.org/10.3390/rs13030414



Principal Investigator

Bingfang Wu, Professor

Dr. Bingfang Wu currently is a professor of Aerospace Information Research Institute (AIR), Chinese Academy of Sciences (CAS). He is co-chair of GEO GEOGLAM flagship since 2009; Chair of Digital Belt and Road (DBAR) Agriculture Working Group; Chair of China Ecology Association Remote Sensing Technical Committee,.

His research interests are remote sensing methodologies and applications in agriculture, water resources and ecosystems, especially in the monitoring of crops, evapotranspiration (ET), and droughts. He and his team have developed remote sensing based operational monitoring systems such as CropWatch since 1992, DroughtWatch since 1999, ETWatch since 2002, which have been customized and deployed fort many stakeholders.

Dr. Bingfang Wu has published 9 monographs and more than 300 peer-reviewed papers.

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