1. Activity Reporting.

Activity 913-2014

Downscaling methods comparison workshop and analysis

Status	On going	Milestone	4.2.1 2014 (2)
Start date	2014 Jan	End date	2014 Jan

Description: The spatial and temporal downscaling of outputs from global and regional climate models is inevitable for the foreseeable future, given the coarse resolution (not to mention inadequacy) of most climate models. A wide variety of different downscaling methods exists, each with advantages and disadvantages related to complexity, conceptual appropriateness, and ease of use. In 2014 CIP will lead a comparative assessment of downscaling methods used in CCAFS and draft a paper highlighting the process, results and lessons learnt

Status: On going. Daily rainfall estimates from TRMM (approximately 28 km) over the Andean high plateau was downscaled to approximately 1 km. Downscaled data was cross-validated with independent rain gauges in the area. To further ascertain the quality of the downscaled estimates the hydrology Model HEC-HMS was calibrated to simulate river flow to compare simulations with gauge data. 24 weather stations over a watershed of 14,700 km2 were interpolated using the spline function built within the ANUSPLIN software. The gridded interpolated data was the control run against which downscaled data was compared. The experiment was complemented by rainfall estimated using the NDVI reconstruction methodology developed by CIP-CCAFS. The results showed that the downscaled data was the best predictor. Extreme events were much better predicted by the downscaled data than the ANUSPLIN control. The NDVI data simulated the measured trend but not the peak discharge occurring both in wet and dry years. The Geo-Solanum model was was used to simulate the expected impact of changes in rainfall on potato production for different genotypes. Results, as indicated by local potato experts, were very close to attainable yields. The results were presented in the workshop Tools and Methods for the planning and Decision-making in Agriculture and Climate Change organized by CCAFS in Lima during the COP20 meeting. A video containing the highlights of the process and the results is included herewith. Data used are loaded under Activity 669-2014.
Our partners at UCSB finished running the Weather Research and Forecasting (WRF) regional model for Peru. In 2015 we will downscale the WRF data from 15 km to 1 km and ascertain its quality.

Gender Component: Not defined

Objectives:

1. Test downscaling methods used by CCAFS partners by comparing downscaled with control data (type and quality to be agreed upon) in sites selected by participating institutions

Deliverables:

Description	Type	Year	Status	Justification
Gridded data for testing sites including control and downscaled data	Data	2014	On going	Please see Activity 669-2014
Report of the process and discussions plus a draft collective paper on findings and recommendations	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	On going	New data has been made accessible by the Peruvian Met Service and thus it is now possible to increase the number of years for a robust comparative assessment and publication of a scientific paper

Partners:

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2- Centro Internacional de agricultura Tropical (CIAT):
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Location(s):

Global

Activity 981-2014

Participatory assessment of Potato and Sweet Potato yield gap with existing and new germplasm under progresive climate change (beta 1 version of intelligent systems to estimate the impact of pest and diseases will be included in at least one region)

Status	On going	Milestone	1.2.1 2015 (1)
Start date	2013 Oct	End date	2015 Dec

Description: In previous years we have developed potato and sweet potato models and the model parameters calculator. With those tools we plan to conduct participatory assessment of potato and sweet potato yield gap in key countries in Asia, Africa and Latin America. We are initiating with potato yield gap in Africa with NARS partners in 13 countries. A community of practice is being formed and the idea is to utilize the tools they are learning to use for priority setting and information to policy. Validation experiments will be established as part of the community of practice and links established with the national research programs and the climate smart villages, whenever feasible. We intend influencing national programs research agenda to become climate smart. Once this step is completed we will introduce the geospatial analyses, including downscaled climate information to consolidate the use of CCAFS tools. We want to replicate this in LAM and SEA for Potato and funding permitting SP for both EA and WA.

Status: On going. The community of Practice in Africa was consolidated through field experiments in seven countries. The experimental protocol developed by CIP was implemented with different degree of success. A workshop to jointly analyze the data and to run scenarios was held in Uganda. Currently a survey to rank yield gap drivers sent to a large sample of potato agronomists around the continent is under way. That is the last step prior to publishing the paper quantifying present and future yield gap in the potato crop plus a qualitative prioritization of yield gap drivers.
Two yield gap modeling workshops were held in Manila, The Philippines and Beijing. Over 30 participants from China, Vietnam, Laos, The Philippines, Indonesia, and Bangladesh were trained in the use of modeling concepts and tools to ascertain yield gaps in potato and sweet potato. A common finding was that heat/drought-tolerant varieties released by National Programs using CIP material maintain a potential productivity much higher than current attainable yields. Therefore we are eliciting the perceptions based on field experience from root and tuber agronomists to prioritize the management interventions needed to cope and adapt to extreme events and future climate. The intelligent system was programmed in Visual studio (Software available, for the time being, in Spanish only). The knowledge base has been validated by potato experts from Peru, Bolivia and Panama. The expert system has several functions e.g. diagnosis, management recommendations, and yield reductions due to pest and diseases. In 2015 the expert system will be linked to the Solanum model to incorporate the pest and diseases limited productivity, in addition to the existing potential and water limited routines.A smart phone version will be ready by April 2015.

Gender Component: Not defined

Objectives:

1. Build crop modeling and yield gap analysis capacity in NARIS to address the challenges posed by progressive climate change
2. Conform communities of practices to intensify exchange of knowledge, practices, and germplasm to respond to the challenges ahead
3. Communicate findings to the scientific community, decision-makers and the general public

Deliverables:

Description	Type	Year	Status	Justification
Scientists in at least two of the regions listed trained in the use of modeling tools to estimate yield gap analyses under progressive climate change	Capacity	2014	On going	Field experiments are conducted in several countries in Africa. A yield gap drivers survey is being conducted in Africa. A paper will be submitted to a scientific journal by mid 2015, after processing the yield gap survey results.
One paper describing the results of the yield gap analyses in at least one region with co-authorship with regional scientists and decision-makers contributing to the analyses.	Peer-reviewed journal articles	2014	On going	Delayed field experiments and a survey to ascertain yield gap drivers will be finalized in 2015
At least two communities of practice where potato and sweet potato scientists and decision-makers learn the use of modeling tools and discuss the impact of progressive climate change on yield gap and jointly design research and policies to reduce the negative impact	Workshop	2014	On going	A few of the participating countries are finalizing the field trials to validate modeling results. In addition, the survey to African potato experts to rank potato yield gap drivers, the last piece of information being elicited to finalize the paper produced by the community of practice, has to be completed.
Potato and sweetpotato modeling software and description. It includes videos used in the workshop to teach how to collect data for modeling as well as the description of the model. It also includes short videos with fundamental research to feed the models with remotely sensed information.	Models (i.e. Agronomic Trials)	2014	Complete	

Partners:

Partners not defined

Location(s):

Global

Activity 982-2014

Empowering women in rural farming communities for adapting to climate change, improving their houlseholds livelihood capitals and contributing to climate smart agriculture through the enhancement of their knowledge, skills and attitudes in the face of climate change, their nutritional literacy and their market oriented enterpreneurship.

Status	Extended	Milestone	2.1.3 2015
Start date	2013 Oct	End date	2015 Dec

Description: This work builds on previous work in the Andean Plateau with elementary and high schools as well as with women groups. The first product would be a report from educational psychologists on the appropriate tools and methods to empower the youth and women. The focus of the report would be on how to enhance fluid (Gf) and Crystallized (Gc) intelligence in school age kids and women. Gf can be enhanced through ludic tools (e.g. games) although usefull for all ages the best results seem to be obtained at ages up to 25 years. Decision-making and social cognition abilities have been shown to be rapidly incremented especially at ages 10-15. Gc, is augmented with the experience end exposure to real-life situations but the literature shows that by increasing Gf, the rate of enhancing Gc increases as well. We will start with groups of mothers and schools where we have been working as a lab but searching for funding to scale the experience out. The work with women will be closely developed with CIAT in LAM and other CCAFS region. Regarding the youth, we aim at developing "climate-Smart Schools" in the Andean Plateau as the prototype and research on methods to rapidly replicate the lessons learnt in other regions, first in LAM and later elsewhere. We are starting with 16 schools in five districts with the participation of the district directors of the Ministry of Education. They want to get the support from the local government to scale-up the experience to all the school in the Department of Puno. In the process, we expect to develop narratives for elementary school children and to build games containing what CCAFS is learning about CC & agriculture, recreating the local environment using Artificial Intelligence (AI) combined with mathematical models and virtual reality. The literature confirms that today´s kids are prepared to use ludic tools and are the teachers that require more attention at the beginning. Models do not required to be accurate but precise and must represent local conditions. Levels of complexity are also demanded to avoid the roof syndrome, hampering the growth of advanced students. Models will be completed with hands-on exposure using CCAFS recommendations. In our recent experience, using hands-on exposure in different schools, we reached not only the students but the mothers, being the rural teachers the "extension agents that promoted change. We want to scale up this experience now combined with ludic tools designed by education psychologists. We strongly believe that education is the best way to prepare the farmers that will face the changes expected in say 30 years, and those farmers are in the school today. Since the mothers shape the gender role in new generations we also see this approach as an innovative tool to empower gender.

Status: Extended. This activity was put on hold for lack of funding to bring on board the psychologists

and IT people. CIP and CCAFS-LAM are working with the Link Americas Foundation (LAF) to adapt their experience in the USA reducing the literacy gap developing tools and contents for smart phones. We are applying for funding to different donors including the UN, USAID and NSF. We were invited to present a proposal in march to the UN.

Gender Component: This is an activity that specifically addresses gender issues focusing on youth through education. The rationale is to produce a new generation of social change agents able to lead gender empowerment and using information and knowledge about climate change.

Objectives:

1. Design and test a comprehensive and scalable program of training and capacity building particularly oriented to fill the needs of women and schoolchildren in rural farming communities.
2. Implement a prototype Internet-based distant education program to train School teachers on CSA and empowerment of rural women

Deliverables:

Description	Type	Year	Status	Justification
A comprehensive and scalable program of training and capacity building particularly oriented to fill the needs of women and schoolchildren in rural farming communities	Articles for media or news (radio, TV, newspapers, newsletters ,etc.)	2014	Extended	We are fundraising for the full implementation of this activity
A group of trainers and schoolteachers familiarized with the training program and the required training methods.	Capacity	2015	Incomplete	
A cadre of women and schoolchildren strongly empowered to face the challenges imposed by climate change and the demands of climate smart agriculture.	Capacity	2016	Incomplete	
Published description of the methods and achievements (blogs, reports, papers submitted every year starting 2014)	Peer-reviewed journal articles	2014	Extended	We are fundraising for the full implementation of this activity.

Partners:

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Location(s):

Countries: Peru,

Activity 983-2014

Validating an AI based decision support system in the regions using gender differentiated and systematized local climatic perceptions, knowledge and forecasting coupled to scientific knowledge and crop and pest modeling tools adapted to predominant crops and environmental conditions.

Status	On going	Milestone	2.3.2 2014
Start date	2013 Jan	End date	2014 Dec

Description: Most ancient Agrarian societies use bio-/ethnoclimatology indicators to inform planting and other farming decisions. In the context of increased climate variability and change, this information is used to develop adaptation strategies. These societies have also developed formal and informal information networks to communicate about the season's conditions, and making planting decisions. With increasing uncertainties such as the onset of rainfall and rainfall patterns, there is need for long term monitoring of changes in the behavior of bioindicators, their use in decisions about farming, and the relationship between the behavior of indicators and climate forecasts in relation to outcomes of decisions. This activity will elicit knowledge and lessons learnt from existing studies on local perceptions of climate risks, communication networks, and adaptation strategies to cope with climate variability; asses local communication networks and ways to channel CCAFS forecast information using appropriate packaging; test the feasibility and pertinence of using artificial intelligence to formalize local perceptions and integrate local (heuristic) and scientific (numeric) knowledge on climate risks and potential options for improving decision making at the local level.

Status: On going. The AI system was conceptualized and the algorithm developed. The knowledge base was completed and currently under analysis by software programmers. Original consultant took another and thus delayed the implementation of the AI system. HIs replacement is already in the team and analyzing the components described above. Therefore, the validation workshop with local experts had to be postponed. Notwithstanding scholars, experts in the use of natural climatic indicators, were consulted and the approach used was approved by them.
The work was expanded from the Southern Andes, where originated, to the Northern Andes, where CIP and CIAT collaborated in implementing a first level assessment. The idea is to validate the AI in other settings.
Advances were communicated in different fora e.g. COP20, Global Landscape Forum and CSA (abstract accepted). A proposal was submitted to Fulbright Nexus climate change program and athe grant was awarded.

Gender Component: The general assumption is that men and women farmers have a differentiated perception of climate change indicators. They also have different roles in preserving and transmitting this knowledge to new generations. The activity will explore these gender differences.

Objectives:

1. Gather and systematize existing knowledge on ethnoclimatology in different agrarian societies and climatic conditions
2. Understand, decode and learn about local communication networks and mental decision making models
3. Attempt to elicit the most important common features in the use of bioindicators and decision making
4. Assess the feasibility and pertinence of formalizing and reproducing local knowledge with the use of artificial intelligence
5. Characterize the information needs to incorporate CCAFS forecasting into the local “language” and networks
6. Explore and identify ways of building synergies between traditional and numeric forecasts to improve decision making in agriculture
7. Learn and take advantage of participatory processes used by farmers to develop new knowledge.

Deliverables:

Description	Type	Year	Status	Justification
A freely available decision suport system tested and validated in the Andean Region through participatory methods. The first version will be posted in 2014 and improved afterwards	Other	2014	On going	We had some inconvenience during the formulation of the flow diagram during the year 2014. We first hired a consultant expert on Artificial Intelligence that create this flow diagram. However this person could not continue with us due to personal problems. The formulation of the flow diagram was postponed for many months and just toward the end of the year we find a person that could continue with this task.
Training workshops to familiarize stakeholders with the decision support tool.	Workshop	2014	Extended	Expert System Validation Workshop. This workshop has been postponed due to the delay on the construction of the software of the Expert System Climate. As explained before, the expert on Artificial Intelligence in charge to create the software could not continued and the new person just join the team. The Expert System Climate is planned to be ready for the first semester of the 2015. Thus the validation workshops would be conducted once the first trial of the SEC is ready.
A submitted paper fully describing the tool.	Working Paper	2014	Extended	As explained before we suffered the retirement of our initial expert on Artificial Intelligence that was in charge to build the Expert System Climate. We just found the right person who can continue the work. It would take about half year to finish the Expert System. Once the process is complete, this working paper will be ready.
A community of practice oriented to the implementation of the tool.	Capacity	2015	Incomplete	

Description	Type	Year	Status	Justification
Natural Indicators of Climate in Cauca, Colombia. This complementary study in the Cauca Valley, Colombia was done for future scenarios of the Expert System Climate (ESC). CIAT has been also collecting some natural indicators used by with farmers of the Cauca to predict the climate of an agricultural year. Once the ESC is prepared, it is planned to validate the tool in other geographic scenarios like Cauca in Colombia.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	
Knowledge database for Expert System Climate. This database contains the information necessary for the construction of the Expert System Climate and was elaborated with primary and secondary information of different sources. This data base contains 1057 cases and was grouped in 108 plants (329 cases), 119 animals (494 cases), 18 stars (92 cases) and 26 meteorological phenomenon (142 cases).	Databases	2014	On going	This knowledge data base is still ongoing because it can asked to be modified according the Software programmers. Right now the data base is under the revision of software programmers who are evaluating the content.
CSA 2015 abstract.This is an abstract submitted to the Climate Smart Agriculture (CSA) Global Science Conference to be held on March 16-18, 2015 at Montpellier, France. This abstract addresses how the new social dynamic of agrarian societies of the Peruvian Altiplano also affects the traditional knowledge and the practice of climate smart strategies they had to face climate variability and change. When creating the Knowledge Data Base for the Expert System Climate, we realized that there are also other factors than climate change contributing to increase farmer´s vulnerability.	Seminar paper	2014	On going	This study will be presented on March 2015. This abstract is going to be developed into a scientific paper after the conference.

Description	Type	Year	Status	Justification
Proposal submitted to Fulbright Nexus Program on Climate Change. This project was proposed to complement the ongoing activity Expert System Climate since one of the main facts data showed was that local forecast are less available. This not only increases the uncertainty and stress of farmers, mainly women who remain at the farm for food secuity. The objective of this study is to analyses the adaptive capacity of women farmers of the Peruvian Altiplano to the loss of local forecast information for agriculture planning.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	On going	This study is going to be implemented this year 2015.
COP20 gender event. This event was organized by IFPRI and counted with the participation of Cecilia Turin addressing the role of Traditional Knowledge (local forecasts based on natural indicators) on reducing the vulnerability of the agrarian societies of the Peruvian Altiplano to climate variability and change. A flyer prepared jointly with Corinne Valdivia of University of Missouri and Elizabeth Jimenez of University Mayor San Andres of Bolivia was prepared to summaries shared experiences in the Peruvian and Bolivian Altiplano regarding gender roles in climate change adaptation.	Social media outputs (including web sites, blogs, wikis, linkedin group, facebook, yammer, etc.)	2014	Complete	

Description	Type	Year	Status	Justification
COP20 Side event: Global Landscape Forum. Gender and resilience across the landscape – from Latin America, Africa and Asia. It counted with the participation of Cecilia Turin in the table of panelists. Cecilia Turin addressed the need to make things different (policies, science, development, etc) under climate change scenario. She stated the idea that in order to be Climate Smart it goes through been first Gender Smart.	Social media outputs (including web sites, blogs, wikis, linkedin group, facebook, yammer, etc.)	2014	Complete	

Partners:

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Location(s):

Countries: Bolivia, Peru,

Activity 669-2014

SPDSM coupled with Crop models: CIP Geospatial Root & Tubers model and generic interfaces to other geospatial crop models

Status	On going	Milestone	4.2.1 2014 (3)
Start date	2011 Jan	End date	2015 Dec

Description: Crop-simulation models are important tools for assessing the potential implications of seasonal forecasts on agriculture. However, the coarse spatial resolution of global and regional circulation models used in seasonal predictions makes it generally necessary to downscale these predictions to scales suitable for driving crop models. Precipitation and temperature downscaling improve the coarse resolution and poor local representation of global climate models and help end users to assess the likely hydrological impacts of climate change and should also enhance modelers' ability to generate more realistic climatic-change scenarios. In the case of rainfall, end users demand reliable representations of precipitation intensities and temporal and spatial variability, as well as, physical consistency, independent of region and season.Remaining gaps are: uncertainties arising from sparse data; representation of extreme summer precipitation, sub daily precipitation, and full precipitation fields on fine scales; capturing changes in small-scale processes and their feedback on large scales; and errors inherited from the driving global climate model and its propagation towards regional models. Unfortunately, conventional downscaling methods do not seem to account for the spatial variations across scales. The non-linear approaches used in this activity are anchored in statistical physics and are hypothesized to better account for physical and orographic processes influencing spatial climatic variability. We thus expect to deliver products more in line with the demands of the end-users and complementary to other CCAFS downscaling efforts. In close collaboration with Climatic research groups, downscaling products will be used as input to crop models to ascertain the performance of downscaling protocols comparing different climate input and contrasting modeling results with historical yield data and expert knowledge. Models will also be used to assess how global warming will affect the ability to grow food, at different spatial and temporal scales.

Status: On going. After 15 months of iterations with reviewers and editors, the paper "Spatial Random Downscaling of Rainfall Signals in Andean Heterogeneous Terrain" was accepted for publication in the Nonlinear Processes in Geophysics Journal. Daily rainfall data estimated by the Tropical Rainfall Measuring Mission (TRMM) over the Andean plateau, from 1998-2014, was downscaled from 28 to 1 km. The downscaled data is available in our web site and the link provided in this report. The product was used as input for hydrology and crop growth models. River flow estimates using downscaled rainfall data as input for a hydrology model predicted measured values closer than interpolated rainfall data using a dense network (24) of weather stations. Water limited potato simulations for native and improved varieties in the Andean Plateau generated good predictions of attain potato yields in the zone as judged by local experts. Downscaling and modeling tools were presented in the

tools and methods workshop organized by CCAFS in COP 20, Lima. Links to the tools are also provided as well as videos describing them.

Gender Component: Not defined

Objectives:

1. Develop a climate downscaling methodology –using the advantages provided by non-linear tools and neural networks - capable of considering the orographic characteristics of different regions, as well as, the physical processes involved in local climatic variables.
2. Make comparative analyses with other CCAFS downscaling methodologies using remotely-sensed derived climatic data and outputs from RCMs e.g. ETA.

Deliverables:

Description	Type	Year	Status	Justification
Training materials and courses for professionals in CCAFS regions: SPDSM and links with crop and hydrology models.	Social media outputs (including web sites, blogs, wikis, linkedin group, facebook, yammer, etc.)	2014	On going	Peruvian Met Service has requested a training workshop to use the tools. Met Services in Central America will be trained under the AGROCLIMAS Project
Final version of the SPDSM available in CCAFS server.	Platforms - Data Portals for disseminati on	2015	Incomplete	
Downscaled data available at CCAFS sites as produced, since 2013	Data	2015	Incomplete	
Starting by the end of 2012, CIP-CPAD & CCAFS: blogs, facebook, twitter, youtube and newsletters.	Articles for media or news (radio, TV, newspaper s, newsletters ,etc.)	2015	Incomplete	

Description	Type	Year	Status	Justification
Remotely sensed data are often used as proxies for indirect precipitation measures over data-scarce and complex-terrain areas such as the Peruvian Andes. Although this information might be appropriate for some research requirements, the extent at which local sites could be related to such information is very limited because of the resolution of the available satellite data. Downscaling techniques are used to bridge the gap between what climate modelers (global and regional) are able to provide and what decision-makers require (local). Precipitation downscaling improves the poor local representation of satellite data and help end-users acquire more accurate estimates of water availability. Thus, a multifractal downscaling technique, complemented by a heterogeneity filter was applied to TRMM3B42 (Tropical Rainfall Measurement Rainfall) gridded data (spatial resolution 28km) from the Peruvian Andean high plateau or Altiplano to generate downscaled rainfall fields that are relevant at an agricultural scale (spatial resolution of about 1km).	Peer-reviewed journal articles	2014	Complete	
Gridded daily rainfall at a 1 km spatial resolution from three sources: 1) Interpolation using ANUSPLIN with 24 weather stations; 2) NDVI-derived using the wavelet-based multi-resolution approach (Quiroz et al 2011), and 3) TRMM corrected (Heidinger et al., 2012) and downscaled (Posadas et al., 2015)	Data	2014	Complete	

Description	Type	Year	Status	Justification
Annual report from our partner University of California at Santa Barbara	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	

Partners:

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Location(s):

Global

Activity 985-2014

A user friendly generic tool- based on joint multifractals- that accounts for the bias introduced in modeling agricultural productivity when landscape and soil attributes are ignored, available in CCAFS servers for online assessment of CC scenarios

Status	On going	Milestone	4.2.1 2014 (2)
Start date	2012 Jan	End date	2014 Dec

Description: Efficient site-specific agricultural management requires a thorough quantitative knowledge of (i) spatial and temporal variability of crop yield within an agricultural field or a region and ii) factors and interactions influencing crop yields. The main factors influencing crop yields are field topography and soil properties, including soil fertility and moisture. Complexity of crop yield variability often could not be fully characterized by traditional statistical approaches and thus are difficult to incorporate when modeling at different spatial scales. That is why we are proposing a new methodology based on multifractal analyses to account for the bias introduced by spatial heterogeneity, using joint multifractal techniques. This approach aims at reducing the uncertainty of forecasted yields under climate change scenarios thus improving the reliability of CCAFS outputs needed for decision making. In 2013 the paper describing a methodology to account for spatial variability, using the potato crop as a model, was submitted to a journal. The bias estimated in that study was larger than the estimated changes induced by climate change. A second paper on how to infer important, but difficult to measure attributes, from proxies such as those estimated using remote sensing but considering a family of coefficients representing spatial or temporal variations (the heart of the joint multifractal concept) will also be available. We also aim at developing training manuals for practitioners and funding permitting, train professionals from the regions in the use of the new concepts and tools

Status: On going. A methodologyto reduce the uncertainty introduced by ignoring the potential yield reduction explained by spatial variability was proposed and tested. The sequential steps in the proposed methodology are: 1) determine whether scaling is an issue, by identifying singularities; 2) using Normalized Difference Vegetation Index (NDVI) to estimate net primary productivity (NPP) as an indicator of spatial variability; 3) segmenting and clustering pixels according to their NPP through an easy-to-implement multifractal procedure; 4) generation of a weighting matrix that accounts for the spatial variation; and 5) assessing the biased yield estimation caused by ignoring the scale dependency generated by the spatial variation. The methodology was validated in Southern Idaho – where geospatial data on potato productivity exist – and then extrapolated to the Andean high plateau, using the potato crop as an example. We thus showed that the methodology is robust, as demonstrated in a data-rich environment. We have also shown that the methodology is adaptable to data-scarce areas; where most smallholder farmers operate.
Links to the tools programmed in R language are provided in the present report.

Gender Component: Not defined

Objectives:

1. Develop a joint multifractal-based methodology capable of improving the accuracy of geospatial simulation of crop yields across space by modeling the intrinsic nature of the spatial heterogeneity yield limiting factors other than climate e.g. soil properties, topography and pests
2. Analyze the multi-scale spatial heterogeneity of soil properties, topographic factors, and (data permitting) pests and their relationships using joint multifractal approaches.
3. Develop a methodology to assess and how to account for the bias introduced by spatial heterogeneity when modeling the impact of climate change on crop production at different spatial scales

Deliverables:

Description	Type	Year	Status	Justification
User-friendly software (R programming language) available in CCAFS servers.	Tools (i.e. search engines, games, etc)	2014	On going	Methodology has been validated at 1 km spatial resolution. We are currently working with remotely sensed data registered with UAV-based platforms for very high resolution analyses. A paper validating the methodology in Idaho and the Andean Plateau will be submitted to an open source journal. the research with UAV-based data is in progress and we hope to publish a paper by the end of 2015.
An introductory paper describing the principles and comparing the uncertainties generated by climate models, crop models and geospatial variation in selected sites in LAM and EA jointly written with different CCAFS partners.	Peer-reviewed journal articles	2014	On going	A draft manuscript is in the final stages prior to its submission to an open source journal.

Partners:

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Location(s):

Global

Activity 589-2014

Influence strategic research planning and decision making through bio-economic technology assessment: Development of new virtual crop parameters for assessment of potential investments to improve resilience to climate change for potato and sweet potato.

Status	On going	Milestone	4.3.2 2014
Start date	2012 Jan	End date	2014 Dec

Description: Breeders are interested in applications of crop growth models to explore the performance of a particular clone or variety in different environments and to assess the performance of so called “virtual cultivars”. The experiences recorded in the present activity may add valuable information and can contribute to the ongoing communication between breeders and crop modelers at CIP about this issue.
This activity is aligned with the Global Futures for Agriculture Project / Strategic Foresight coordinated by IFPRI. It contributes mainly to the crop modeling activities related to climate change that take place in this project, and its contributions will directly feed into the analysis carried out in the scope of the overall project.

Status: On going. Activity is still ongoing because two deliverables have been completed, and two are ongoing because journal papers are still under preparation or review. See details in each deliverable report.

Gender Component: Not defined

Objectives:

1. To explore the effect of changes in the different coefficients of the SUBSTOR potato crop model on simulated fresh weight tuber yields.
2. To assess the possibility and improve the capability of using SUBSTOR for virtual crop modeling.

Deliverables:

Description	Type	Year	Status	Justification
1) Development of virtual crop model parameters relevant to the analysis of climate change impacts under alternative technology scenarios, improved version of potato crop model	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	On going	Consultancy report by SUBSTOR creator (Joe Ritchie, Michigan State University) submitted in May 2014 with the suggested changes to the SUBSTOR model. Currently under consideration by the University of Florida.
2) Report on bio-economic simulation analysis of promising potato varieties (CIP SHS working paper by12/2014)	Working Paper	2014	Complete	
3) Journal paper on virtual potato crop modeling (tentative title “The impact of genetic variation on potato yields in contrasting environments”, to be submitted to crop systems research journal) (12/2014)	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	On going	One paper and one summary note published, three papers still under preparation and one additional paper is under review.
Report on priority setting results for submission to CGIAR (draft report by 12/2014, final report 06/2015) and contribution to Global Futures project activities and own activities to disseminate research results and achieve policy impact at level of CGIAR program planners (center planning, CRP RTB)	Working Paper	2014	Complete	

Partners:

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Location(s):

Global

2. Succinct summary of activities and deliverables by Output level.

Output: 1.2.1

Summary: Three potato and sweetpotato Yield Gap Analysis workshops were conducted in Asia (Manila and Beijing) and Africa (Uganda) in 2014. Participation in Manila included 18 potato researchers and 8 sweetpotato workers. Participation in Beijing included 12 potato scientits. In Uganda trainees were 6 scientists from Tanzania, Democratic Republic of Congo, Burundi, Kenya and Uganda. All these scientists are members of the Communities of Practice organized in Asia and Africa, fully trained in the use of yield gap analyses tools. A training video for the use of the SOLANUM model for Yield Gap analysis has been developed for further training of practitioners.

Output: 2.1.3

Summary: Unfortunately this activity was put on hold for lack of funding to bring on board the psychologists and IT people. CIP and CCAFS-LAM are working with the Link Americas Foundation (LAF) to adapt their experience in the USA reducing the literacy gap developing tools and contents for smart phones. We are applying for funding to different donors including the UN, USAID and NSF. We were invited to present a proposal in March to the UN. This work builds on previous work in the Andean Plateau with elementary and high schools as well as with women groups. The first product would be a report from educational psychologists on the appropriate tools and methods to enhance cognitive capacity of children through ludic tools (e.g. games). Decision-making and social cognition abilities have been shown to be rapidly incremented especially at ages 10-15. Work with women will be developed with CIAT in LAM and other CCAFS region. Regarding the youth, we aim at developing "climate-Smart Schools" in the Andean Plateau as a prototype research on methods for replication to other regions, first in LAM and later elsewhere. We are starting with 16 schools in five districts with the participation of the district directors of the Ministry of Education. They want to get the support from the local government to scale-up the experience to all schools in the Department of Puno. We expect to develop narratives for elementary school children and to build games containing what CCAFS is learning about CC & agriculture, recreating the local environment using Artificial Intelligence (AI) combined with mathematical models and virtual reality. The literature confirms that today´s kids are prepared to use ludic tools with the teachers requiring more attention at the beginning. Models do not required to be accurate but precise and must represent local conditions. Levels of complexity are also demanded to avoid the roof syndrome, hampering the growth of advanced students. Models will be completed with hands-on exposure using CCAFS recommendations. In our recent experience, using hands-on exposure in different schools, we reached not only the students but the mothers, being the rural teachers the "extension agents that promoted change. We want to scale up this experience now combined with ludic tools designed by education psychologists. We strongly believe that education is the best way to prepare the farmers that will face the changes expected in say 30 years, and those farmers are in the school today. Since the mothers shape the gender role in new generations we also see this approach as an innovative tool to empower gender.

Output: 2.3.2

Summary: Progress has been made in the process of gathering and systematizing traditional knowledge on climatology and weather forecast.A workshop on the use of Bio-indicators for agricultural decision making was conducted in La Paz, Bolivia with the participation of AI experts and 11 farmers from Peru and Bolivia. A data based has been organized and is in the process of validation. The data will be used to develop the expert system.

Output: 4.2.1

Summary: The paper "Spatial Random Downscaling of Rainfall Signals in Andean Heterogeneous Terrain" was accepted for publication in the Nonlinear Processes in Geophysics Journal. Daily rainfall data estimated by TRMM over the Andean plateau, from 1998-2014, was downscaled from 28 to 1 km. The data is available in our web site. The product was used as input for hydrology and crop growth models. Water limited potato simulations for native and improved varieties in the Andean Plateau generated good predictions of potato yields. Downscaling and modeling tools were presented in the tools and methods workshop organized by CCAFS in COP 20, Lima.

Output: 4.3.2

Summary: Crop growth models will be used to asses the performance of “virtual cultivars” under different environmental conditions. The present activity will contribute to communication between breeders and crop modelers working under different scenarios of climate change. Activity is still ongoing. Two deliverables were completed, and two additional will be delivered on 2015.

3. Communications.

Media Campaigns:

Please see http://cipotato.org/press-room/ for media coverage related to CIP-CCAFS work

Blogs:

http://www.scidev.net/global/technology/multimedia/assessing-stressed-crops-from-the-sky.html

http://cipotato.org/press-room/blogs/invasion-of-the-potato-drones

http://cipotato.org/es/press-room/cip-in-the-news/umbrales-agricultura-y-tecnologia/

https://www.youtube.com/watch?v=H45oHeGkpwQ

http://ccafs.cgiar.org/blog/improving-potato-yields-farmers-usambara-highlands?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+CgiarClimateBlogs+%28CGIAR+Climate+blogs%29#.VMJD_dgcRC9

https://cgspace.cgiar.org/bitstream/handle/10568/41815/SmartAG Partner_April_June 2014 Online version.pdf

http://cipotato.org/press-room/blogs/oktokopter-new-comer-sky-sub-saharan-africa-agricultural-applications/

http://www.iied.org/unmissable-opportunity-build-food-security-reduce-ghgs-paris-cop

Websites:

http://cipotato.org/

Social Media Campaigns:

Please see http://cipotato.org/press-room/ for media coverage related to CIP-CCAFS work

Newsletters:

https://cgspace.cgiar.org/bitstream/handle/10568/41815/SmartAG Partner_April_June 2014 Online version.pdf

Events:

Interview to Dr. Quiroz: http://plt.fm/z6egp

Participation in COP20 meetings and side events:

• Global Landscapes Forum
• Approaches and Tools for Agriculture and Climate Change Planning
• Gender and CC policy workshop
• Climate smart agriculture innovations to raise rural incomes under climate change (Official UNFCCC side event)
• farmers. Agriculture and the UNFCCC
• Potato park visit and Learning Exchange
• Preparando la respuesta a los retos y oportunidades para la agricultura en el contexto internacional de cambio climático
• Side Event Scientific Cooperation on Climate Change in The Pacific Alliance: Biodiversity Monitoring
• “Formulación de Políticas Públicas en el Sector Agropecuario con Enfoque de Género: Construyendo una Iniciativa Regional para Afrontar el Cambio Climático en América Latina” -workshop organized by CCAFS and CATIE
• Int’l Symposium Biodiversity and Climate Change: Contributions from science to policy for sustainable development – organized by MINAM and CONCYTEC
• Seminar on Food and Nutrition Security, Agriculture and Climate Change - 6 Food Security Issues that COP20 must address

Booth at a space open to general public "Voices for Climate"

Videos and other Multimedia:

A series of short promotional videos were designed and assembled. Theses videos explain the results of work or provide a description of papers published. The generic link is provided below together with a list of titles. Each video has been linked to its respective activity.

http://inrm.cip.cgiar.org/home/videos.php

1) UAVs_CIP_BMGF.mov

2) Image Stitching V2.mov

3) Discrimination against C in potato leaflets and tubers.mov

4) Leaf greenness as a drought tolerance related trait in potato.mov

5) SOLANUM A potato production simulation model.mov

6) IMAGE CANOPY Software to analyze Canopy Cover Images.mov

7) Spatial Downscaling using Multifractal Technique.mov

8) EPAPA Expert System for the Cultivation of Potato.mov

9) Climate downscaling and modeling applications in heterogeneous terrain.mov

Other Communications and Outreach:

CCAFS-CIP teams have participated in several conferences, presenting the results: e.g. conferences prior to, during and after the COP20 meeting in Lima; CIP is co-leading the AgMIP potato Project; R. Quiroz was an invited speaker at the European Space Agency conference in Paris. Yield gap modeling workshops conducted in Asia, and Africa

4. Case studies.

Case Study #1

Title: A sustainable revolving credit fund for promoting climate smart agriculture in the Peruvian-Bolivian Altiplano

Author: International Potato Center (CIP), Centro de Investigacion de Recursos Naturales y Medio Ambiente (CIRNMA), Canadian International Development Agency (CIDA)

Type: Capacity enhancement; Participatory action research ; Food security;

Project Description:

Poverty is prevalent in the Peruvian-Bolivian Altiplano. Besides climatic variability, high altitude and land fragmentation, limited access to markets and financial resources affect the complex farming and livelihoods systems. A systems approach was used to enhance agricultural productivity and family income, improve markets, strengthen women's participation in decision-making and improve child nutrition. A critical intervention was the creation of a sustainable credit scheme for financing technical interventions which were based on the competitive advantage of production options. Work included 8,399 beneficiaries in 129 rural communities. Different crops, livestock value-added activities and alternative sources of income, such as trout farming were integrated into the farming and livelihood systems. Organic quinoa production was promoted with the participation of 1,175 families. Quinoa raised annual family income from US$ 72 in 2006 to US$ 700 in 2010–2011. Milk production was initially limited by feed shortage and weak markets. Alfalfa and forage oats were introduced, silage was elaborated and producers were organized in groups to run small dairy factories which produced cheese and yogurt for the local market. Organized farmers delivered milk to 14 cheese factories. Annual dairy income per family increased from US$ 29 to US$ 767 by 2011. The cheese factories generated an average yearly income of US$ 3,328 per family. The revolving fund was also important for promoting trout farming. Over five years, farms produced 4421 t of trout with a gross value exceeding US$ 11 million. Annual income per participating family ranged from US$ 784 to US$ 7788. Women's participation was close to 48 %. The revolving fund is still in operation and is administered by CIRMA, CIP's local partner in the Peruvian Altiplano. As to 2012, a total of US$ 172,226 was mobilized in 4.6 cycles of operation, with a repayment rate higher than 90 %.

Introduction / objectives:

The project aimed at contributing to five of the millennium development goals: sustainable management of natural resources; poverty reduction; strengthening of women's participation; reduction in child mortality; and improved maternal health.The project's first goal was to generate income for rural families.The second goal was to seek mechanisms for an efficient participation of women in the generation of income and added value. A third goal of the project was to identify mechanisms that contribute to improving child nutrition and health. The project's fourth goal was to increase the knowledge of peasant women to make them agents of change.

Project Results:

The project promoted organic quinoa production, an activity in which 1,175 families participated. Annual family income generated by quinoa increased from US$ 72 in 2006 to US$ 700 in 2011 as a result of an increase in cropping area, higher yields and exports. As to dairy, increased production and sales raised annual family income from US$ 29 to US$ 767. The cheese factories generated an average yearly income of US$ 3,328 per family, showing the importance of value-added produce.

The project organized 84 families in seven groups, and provided training and credit to start trout farms. The groups managed the production process, built the basic infrastructure, standardized the product and marketed their produce. Over five years, they produced 4421 t of trout with a gross value exceeding US$ 11 million. Annual income per family ranged from US$ 784 to US$ 7788. The activity created 5 to 16 permanent jobs per year per producer, plus 10 temporary jobs per month per producer. Women's participation was close to 48 %.

Production of vegetables in both family and school greenhouses contributed not only to family income but also improved nutrition. Greenhouses were constructed with the participation of mothers and schoolchildren. By 2011, 185 greenhouses with a total roofed area of 14,676 m2 were in operation with the participation of 175 families. A sample of 29 % of the greenhouses showed a production of 13,250 kg of 29 different species. Of this, 80 % was for home consumption, collectively saving families US$ 10, 159 by no longer having to buy vegetables from the market.
The revolving fund mobilized a total of US$ 172,226 in 4.6 cycles of operation, with a repayment rate higher than 90 %. In Puno, the average credit was US$ 790 with average monthly interest rates of 2 %.

Partners:

Centro de Investigación de Recursos Naturales y Medio Ambiente (CIRNMA) - Puno.
Alternativas Agropecuarias, Bolivia
Canadian International Development Agency (CIDA)
Instituto Nacional de Innovación Agraria (INIA-Peru)
Universidad Nacional del Altiplano - Puno
PROINPA - Bolivia
Universidad Nacional de San Andrés - Bolivia

Links / sources for further information:

http://link.springer.com/article/10.1007%2Fs12571-013-0305-5/fulltext.html

5. Outcomes.

Outcome #1:

Farmers in Lushoto-Tanzania do believe in climate smartness and performance of CIP introduced potatoes

What is the outcome of the research (i.e. use of research results by non-research partners)?

Asante, one of the varieties introduced in Lushoto, Tanzania and preferred among several others by farmers in long rainy season of 2014 was multiplied by 34 farmers in the subsequent short rainy season for seed bulking and distribution to others farmers. Also farmers are now applying in their own fields the best practices taught through a well-structured training-of-trainers (ToT).

What outputs produced in the three preceding years resulted in this outcome?

Participating farmers to the participatory action study conducted in Lushoto Tanzania selected five genotypes out of the eight introduced on the basis of their own preferences in terms of crop vegetation, resistance to Late Blight, yielding ability and tuber characteristics. Those materials are CIP398208.29, CIP392979.22, CIP388676.1, Shangii and Asante. During the ToT that was accompanied with this participatory varietal evaluation, farmers were taught how to use the equivalent of two caps of Fanta of fertilizer NPK17-17-17 per plant. This technique was compared with farmers' practices and other techniques taught by other development actors. During field visits conducted during the subsequent season revealed that farmers adopted the CIP technique in their own potato fields.

More details on the outputs outlined here could be obtained from the poster provided in appendix and presented at the CCAFS side events at COP20 held in Lima,

What partners helped in producing the outcome?

This work is being conducted in close partnership with Selian Agricultural Research Institute of Arusha (SARI-Arusha) and Agricultural Research Institute of Mbeya (ARI-Uyole). SARI-Arusha is the local counterpart institution in this initiative funded by CCAFS and ARI-Uyole supplied clean seed of Asante and provided advices to farmers. Key scientists include Stephen Kuoko, George Sayula and Gladness Brush (SARI-Arusha) and Owekisha Hermas Kwigizile (ARI-Uyole).

Who used the output?

The first level of users comprises SARI-Arusha and ARI-Uyole as they are accessing farmers' preferences on potential materials for scale in Tanzania. But the ultimate beneficiaries are potato farmers in Lushoto as they access for free climate smart potatoes with very high yielding ability.

How was the output used?

Asante seed was distributed to 34 decentralized seed multipliers in three villages of Lushoto: Kwesine, Boheloi and Maringo. Farmers expect to harvest tenfold what they planted despite heat and

insufficient rainfall. This seed will then be distributed to over 500 farmers for wider spread in the district.

What is the evidence for this outcome? Specifically, what kind of study was conducted to show the connection between the research and the outcome? Who conducted it?

The involvement of 34 seed producers of Asante seed in 3 districts of Lushoto

Outcome #2:

An agro- business model in the Altiplano for supporting smallholders acces to produce markets

What is the outcome of the research (i.e. use of research results by non-research partners)?

The outcome is the formation of a small business (AGRIBUSINESS CIRNMA), based on the results of long term collaborative research between CIP and CIRNMA. This business supports the value chain of organic products, particularly quinoa, potatoes, cañihua and fava beans, enhancing the income of farmers, whose processed products are favourably placed in regional and local markets. The venture also supports the role of women in the chain from production to consumption, focusing on her training in marketing and family nutrition.

What outputs produced in the three preceding years resulted in this outcome?

Agriculture in the Peruvian Highlands is diverse and complex. The producer aims to minimize the risk and sustainable rural development is a strong challenge. CIP and CIRNMA have collaborated for many years with the aim of reducing poverty, malnutrition and environmental degradation. Research oriented to systems approaches has shown that technological interventions have to be supported by a favourable articulation with markets, access to credit and the constant training based on participatory research and scientific knowledge. The training of future farmers has proven to be essential for sustainable development. The most important results are the technologies for the production of quinoa and dairy products together with the training of producers.

What partners helped in producing the outcome?

Core members have been and are CIP and CIRNMA. However, over the years it has counted with the participation of partners, funders and implementers. Among the former are CIDA, IDRC, INIA-Spain, AECI, CIDEAL, BIOVERSITY, McKnight Foundation, CONDESAN, ADEX-AID and the Regional Government. Among the executors are INIA-Puno and the University of the Altiplano, among others.

Who used the output?

Quinoa, potatoes and faba beans-producing families use the technologies with organic certification. They are articulated to the market in an efficient way and with economic benefits. Following CIP-CIRNMA example, there are now several institutions that guide their actions to this type of productive alternatives whose final beneficiaries are rural families.

How was the output used?

The comprehensive approach orients the alternatives and is conducive to income generation. It strengthens the role of women in household dynamics. By accepting the benefits of the alternatives, women open the way for its use. The approach considers the formation of youth as future farmers.

What is the evidence for this outcome? Specifically, what kind of study was conducted to show the connection between the research and the outcome? Who conducted it?

AGRIBUSINESS CIRNMA has attracted the attention of and is starting to work with Alicorp (Multinational food processor) and Sierra Exportadora (presidential development Program). They are

expanding the work initiated by CIP-CIRNMA and farming communities.

7. Outcome indicators.

Outcome Indicator:

One to five flagship technical and/or institutional approaches identified and developed with farmers, key development and funding agencies (national and international), civil society organizations and private sector in three regions, which would directly enhance the adaptive capacity of the farming systems to the climate change conditions

Achievements:

Outcome 1:

Asante seed was distributed to 34 decentralized seed multipliers in three villages of Lushoto: Kwesine, Boheloi and Maringo. Farmers expect to harvest tenfold what they planted despite heat and insufficient rainfall. This seed will then be distributed to over 500 farmers for wider spread in the district.

Outcome 2:

A new business model was based on the results of the systems-oriented research that was conducive to income generation. It strengthens the role of women in household decision making.

Evidence:

Outcome 1:

The involvement of 34 seed producers of Asante seed in 3 districts of Lushoto.

Outcome 2:

AGRIBUSINESS CIRNMA has attracted the attention of and is starting to work with Alicorp (Multinational food processor) and Sierra Exportadora (presidential development Program). They are expanding the work initiated by CIP-CIRNMA and farming communities.

8. Leveraged funds.

There is no Leverage funds

9. Publications.

Publication #1:

Drought and Heat Tolerance Evaluation in Potato (Solanum tuberosum L.)

Citation:

The citation is not defined yet.

Identifier	CCAFS Themes	Type	Access
DOI: 10.1007/s11540-014-9263-3	Not defined	Peer-reviewed journal articles	Limited

Publication #2:

Managing Potato Biodiversity to Cope with Frost Risk in the High Andes: A Modeling Perspective

Citation:

The citation is not defined yet.

Identifier	CCAFS Themes	Type	Access
DOI: 10.1371/journal.pone.0081510	Not defined	Peer-reviewed journal articles	Green

Publication #3:

Is Discrimination of 13C in Potato Leaflets and Tubers an Appropriate Trait to Describe Genotype Responses to Restrictive and Well-Watered Conditions?

Citation:

The citation is not defined yet.

Identifier	CCAFS Themes	Type	Access
	Not defined	Peer-reviewed journal articles	Limited

Publication #4:

Leaf greenness as a drought tolerance related trait in potato (Solanum tuberosum L.)

Citation:

The citation is not defined yet.

Identifier	CCAFS Themes	Type	Access
doi:10.1016/j.envexpbot.2014.09.006	Not defined	Peer-reviewed journal articles	Limited

Publication #5:

Simulating the influence of the South Atlantic dipole on the South Atlantic convergence zone during neutral ENSO

Citation:

Bombardi, R., L. M. V. Carvalho, and C. Jones, 2013: Simulating the influence of the South Atlantic dipole on the South Atlantic Convergence Zone during neutral ENSO. Theoretical and Applied Climatology DOI 10.1007/s00704-013-1056-0

Identifier	CCAFS Themes	Type	Access
DOI 10.1007/s00704-013-1056-0	Not defined	Peer-reviewed journal articles	Gold

Publication #6:

CMIP5 simulations of low-level tropospheric temperature and moisture over tropical Americas

Citation:

Carvalho, L. M. V., and C. Jones, 2013: CMIP5 simulations of low-level tropospheric temperature and moisture over tropical Americas. Journal of Climate, 26, 6257-6286.

Identifier	CCAFS Themes	Type	Access
DOI 10.1175/JCLI-D-12-00532.1	Not defined	Peer-reviewed journal articles	Limited

Publication #7:

The Monsoons and Climate Change: observations and modeling

Citation:

Carvalho, L. M. V., and C. Jones (Editors): The Monsoons and Climate Change: observations and modeling. Springer Publisher

Identifier	CCAFS Themes	Type	Access
	Not defined	Books	

Publication #8:

The Madden-Julian Oscillation and the Monsoons

Citation:

Jones, C. The Madden-Julian Oscillation and the Monsoons. In: The Monsoons and Climate Change: observations and modeling (Carvalho and Jones, Eds). Springer Publisher

Identifier	CCAFS Themes	Type	Access
	Not defined	Book chapters	