Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

AHW02-01 Room:102B Time:May 21 09:05-09:25

On the Establishment of Maritime Continent Center of Excellence (MCCOE) in Indonesia

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Indonesia Maritime Continent (IMC) with its complex topography and bathymetry are surrounded by large scale ocean and climate systems along Pacific and Indian Oceans to Asian and Australian continents. They are at the central importance of El Nino Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) and Asian monsoon so that their strategic location could influence directly on the Pacific and Indian oceans heat and water mass transport affecting on regional and even global climate changes. A small change in Sea Surface Temperature (SST) transmitted from Pacific to Indian oceans through the current system what so called Indonesian throughflow will affect the magnitude of monsoon and climate over the regions. In this critical perspective, the IMC in a whole system of earth, atmosphere, and ocean play important roles in regulating global climate changes. Because of its position and roles, they could be also very reluctant with the natural disasters come from the ocean and atmosphere, such as tsunami, drought, flood, and many others in more local impacts due to topography. In this presentation, we are going to introduce Maritime Continent Center of Excellence (MCCOE) as one of our ultimate goals of ongoing JST/JICA SATREPS project (2010 ? 2014) in Indonesia. This will be a one step international research center to study IMC in the perspectives of land, ocean, atmosphere, and their interactions among other. The MCCOE office is located in the Puspiptek, Serpong, 35 km from the central Jakarta, Indonesia. We are going to launch the MCCOE in this coming October 2013 and from that opening will be a milestone where International community could work together with us to study the importance of IMC to the global climate changes. The facilities and opportunities as well as the scientific frame work that MCCOE could offer to the international communities will be presented in the meeting.

Keywords: MCCOE, Indonesia Maritime Continent, Climate change

Japan Geoscience Union Meeting 2013
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AHW02-02 Room:102B Time:May 21 09:25-09:45

Coastal Heavy Rainbands Formed along Sumatera Island Studied by HARIMAU Project in Indonesia

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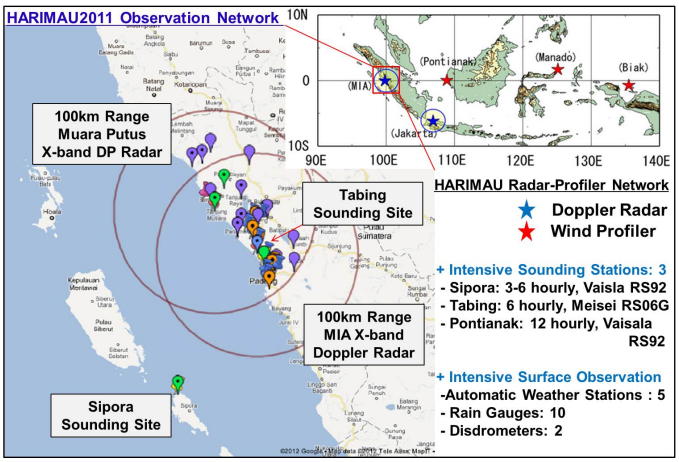
Coastal heavy rainbands (CHeRs) are widely identified over Asian monsoon region (e.g., Western Ghats, Bay of Bengal, Gulf of Thailand, southwestern Sumatera Island, northwestern Kalimantan Island, and western Philippines) by satellite observations. Some of them are explained well by synoptic wind-terrain interaction (Xie et al., 2006 JC) because they are anchored along mountain ranges face to southwest direction and predominant during boreal summer southwesterly monsoon season. Most Asian megacities are located in coastal regions, thus they have much risk to be suffered from torrential rainfall embedded in CHeRs which may cause flash floods in downtown cities and landslides in mountainous regions. Moreover, rainfall amount over the coastal land varies quite largely if those CHeRs change their lateral location a little, therefore water resource management for social community is seriously sensitive to their variability.

Satellite observations show that CHeRs are modified by various kinds of environmental variations, e.g., diurnal, intraseasonal/MJO, monsoonal, ENSO, and IOD. However, climatology, structure, and mechanism of CHeRs have not been examined in detail from mesoscale points of view because there are quite few studies based on ground based radar observations. Previous studies (e.g., Mori et al. 2004 MWR, 2011 JMSJ; Sakurai et al. 2009, 2011 JMSJ; Yamanaka et al. 2008 JDR; Wu et al. 2007 SOLA) showed most CHeRs in Indonesia are identified along coastlines where convective diurnal variation is predominant, and coastal heavy rain are brought mainly in the nighttime observed with a radar-profiler network deployed by Hydrometeorological ARray for Intraseasonal variation (ISV) - Monsoon AUtomonitoring (HARIMAU) project. In addition, they are confirmed even in the seasons when the wind-terrain interaction cannot explain them well. These results suggest that CHeRs are formed by not only the synoptic wind-terrain effect but also mesoscale convections which developed nocturnally everyday along coastlines.

We carried out HARIMAU2011 campaign observation over Sumatera Island during 01-31 December 2011 to study the CHeR formed along southwestern coastline of Sumatera Island by using an X-band Doppler and a dual-polarimetric (DP) radars, intensive soundings at two stations, disdrometers, and surface observation network. Overview of the campaign is presented and its preliminary results mainly observed with two radars are discussed at the presentation.

Keywords: mesoscale convective system, diurnal variation, radar meteorology, Asian monsoon, MAHASRI



Japan Geoscience Union Meeting 2013
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AHW02-03 Room:102B Time:May 21 09:45-10:00

The Impact of Trans-equatorial Asian Winter Monsoon and the MJO on Extreme Precipitation over Western Java Island

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An extreme precipitation/flood event that occurred in the Indonesian capital of Jakarta in Java Island in the middle of January 2013 coincided with an active phase of the Madden-Julian Oscillation (MJO) with the enhanced convective phase centered the western Pacific. Analyzing upper-air sounding data showed that strong upper westerly winds persisted over the island prior to and during the heavy rain event, which were caused by the active phase of the MJO. Ocean surface winds from the WindSat satellite showed a persistent trans-equatorial monsoonal flow from the Northern Hemisphere in mid-January prior to and during the extreme precipitation event. Meteorological radar observations indicated regular genesis of convection at night over the sea to the northwest of the island, and southeastward propagation over the island from the nighttime to early morning. The results suggest that the eastward propagation of an active phase of the MJO exerted a strong influence on the formation of extreme heavy rain over western Java Island.

Keywords: heavy rainfall, Asian winter monsoon, MJO

Japan Geoscience Union Meeting 2013
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AHW02-04 Room:102B Time:May 21 10:00-10:15

Effects of the cross equatorial northerly surge to interannual rainfall variability over northwestern Jawa

Jun-Ichi Hamada[1*], HATTORI, Miki[1], WU, Peiming[1], MORI, Shuichi[1], MATSUMOTO, Jun[1], YAMANAKA, Manabu D.[1], HARYOKO, Urip[2], LESTARI, Sopia[3], SYAMSUDIN, Fadli[3]

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Hamada et al. (2012) investigated that interannual rainfall variability in northwestern Jawa over the Indonesian maritime continent and its relation to the Indian Ocean Dipole (IOD) and El Nino-Southern Oscillation (ENSO) events. IOD events clearly influence interannual rainfall variation in the dry season (May-October) in northwestern Jawa. Droughts conditions during the dry season occur in conjunction with simultaneous development of positive IOD and El Nino events, whereas wet conditions tend to appear in negative IOD (with our without La Nina) rather than single La Nina events.

On the other hand, interannual rainfall variation in the rainy season (November-April) is not closely related to ENSO/IOD, but rainfall tends to be abundant in neutral (non-ENSO/IOD) years. From the correlation analysis among rainfall, SST, and wind, the rainy season rainfall may be influenced by Asian winter monsoon strength and/or variability. Hattori et al (2011) statistically showed that cross-equatorial northerly surges (CENS) over South China Sea and Jawa Sea were related to increased rainfall over the northern coastal region of Jawa Island in the rainy season. Thus, in this study, we aim to investigate effects of Asian winter monsoon, especially for the CENS events, to interannual rainfall variability in the rainy season over northwestern Jawa.

By following the definition of Hattori et al (2011), the CENS event was defined as the area-averaged northerly wind exceeding 5 m/s over South China Sea and Jawa Sea (105E-115E, 5S-EQ) based on the QuikSCAT sea surface wind data. During the analysis period (December 1999-March 2008), 53 CENS events were extracted. We used surface daily rainfall data at 9 stations in northwestern Jawa to investigate the rainfall variability and its relation to the CENS events.

As for the intraseasonal variations, CENS events and northwestern Jawa average rainfall peaks were well-corresponded including the Jakarta flood events in January 2002 and February 2007. Greater rainfall amount was observed during the CENS events (18.0 mm/day) in the rainy season (average is 10.1 mm/day). This rainfall increase tends to be dominated in the coastal stations than the inland stations. Though the occurrence frequency of CENS events was about 20%, the contribution of CENS rainfall amount to the total rainfall amount in the rainy season was about 30-40%.

As previous studies pointed out, interannual rainfall variations in the rainy season over northwestern Jawa were not closely related with ENSO. On the other hand, interannual variations of CENS events rainfall were well-corresponded to the interannual variations of the rainy season rainfall (simultaneous correlation coefficient is 0.82). Thus, it is suggested that CENS rainfall is one of the important factor to determine rainy season rainfall. It will be also suggested the CENS events would influence the rainfall variability in the rainy season over the southern part of the maritime continent, especially for the northern coast of the islands.

Keywords: maritime continent, rainfall variability, monsoon, ENSO, rainy season

Japan Geoscience Union Meeting 2013
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AHW02-05 Room:102B Time:May 21 10:15-10:30

Simulation of the diurnal cycle of Ciliwung River, Jawa, Indonesia

Reni Sulistyowati[1*], Ratih Indri Hapsari[2], Hamada Jun-Ichi[4], Shuichi Mori[4], Fadli Syamsudin[3], Satoru Oishi[1], Manabu D. Yamanaka[1]

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This study focuses on a simulation of the diurnal cycle of Ciliwung river water level observed during the intensive observational period of HARIMAU2010 (15 January to 15 February 2010) over JABODETABEK (greater Jakarta) region, by using a distributed hydrological model (the CDRMV3 model).

Rainfall data over this region have been obtained from a C-band Doppler radar (CDR), by using Marshall-Palmer formula. We have found that there are diurnal cycles of rainfall migrating in the meridonal direction from south (mountain) to north (coastline) mainly in the afternoon and in the opposite direction mainly in the morning. Therefore, we consider that such rainfall characteristics may cause the diurnal cycle of water level over Ciliwung river basin.

Using the CDR rainfall data, the CDRMV3 model has been used to simulate runoff for each sub catchment in the Ciliwung river basin. Discharges from simulation results have been verified with the discharge from observational data. Simulations for the cases of meridional migration of rainfall with diurnal cycle provide large discharges as observed actually.

Keywords: Weather radar, Diurnal Cycle, Distributed hydrological model, Rainfall, Runoff

Japan Geoscience Union Meeting 2013
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AHW02-06 Room:102B Time:May 21 10:30-10:45

Monitoring emission through GOSAT over Indonesian area

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[1]BPPT, Indonesia

The Greenhouses Gases Observation Satellite (GOSAT) is a spacecraft that launched on January 23, 2009 aimed to monitor the dynamics of greenhouse gases in the earth's surface. GOSAT spatially measures carbon flux (including CH4 and aerosols) in the regional to continental level and temporal scales from synoptic to interannual. This can be exploited to gather new knowledge about the global distribution and temporal variation of greenhouse gases will also be able to know at the same time the global carbon cycle and its influence on climate. GOSAT can also potential be used to predict future climate change and its impact through developing a new methodology for the measurement of greenhouse gases. This study aimed to monitor GHG emission over Indonesian area by coupling with relevant data (hot Spot, wind, etc). Based on the initial analysis represents that the raising trend of both CO2 and CH4 concentration occured since 2009 until June 2012 over Indonesian area. Even if the trend after June 2011 represents the slight slump, yet the general trends indicate the increase form. Based on the analysis as well they depict that the occurrence of hot spot (forest fire) have correlation with the raising trend of CO2 and CH4. In general phenomena and based the historic data during this time, the hot spot usually achieve the peak condition in dry season. The field condition during that time implies the direct or indirect correlation with distribution concentration of CO2 and CH4 during the July (2009, 2010 and 2011). This condition is not so much severe during January (2009, 2010 and 2011), where the rain fall was still high (rainy season). For the near future analysis, the uncertainty of the actual source of emission need more investigation and prove based by coupling with historical data of wind, as emission is a mix concentration (value) that come from some sources.

Keywords: GOSAT, monitoring, emission, Indonesia

Japan Geoscience Union Meeting 2013
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AHW02-07 Room:102B Time:May 21 11:00-11:15

Heavy precipitation events in central Vietnam during boreal autumn and its relationship to MJO activity

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Rainy season in central Vietnam is from late September to early December. Heavy rainfall events were mostly occurred during the rainy season. VPREX2010 was conducted in central Vietnam during autumn of 2010, and five heavy rainfall events were observed. Wu et al. (2012) analyzed a heavy rainfall event, and pointed out that interaction between an westward moving tropical depression from the western North Pacific to the South China Sea and convective active region of MJO approaching the Maritime Continent (MC) have influence to produce the heavy rainfall event. In this study we investigated impact of MJO on heavy rainfall events in central Vietnam using 26-years long surface daily rainfall data.

We defined ”heavy rainfall over broad area (HRBA)” as the day when heavy rainfall was observed at more than 15 stations. RMM (Wheeler & Hendon, 2004) was utilized for creating statistics of rainfall for each MJO phase. We found that 69% of HRBA events are concentrated in Phase 4 to 6, those phase correspondents to convective center appearing in the MC. Composite map of rainfall anomaly in Vietnam based on APHROTIDE rainfall data showed that positive rainfall anomaly was appeared in central and southern part of Vietnam when MJO existed around the MC. These results suggest that convection center of MJO around the MC plays important role for preparing regional scale circulation during heavy rainfall events in central Vietnam, at least in a statistical sense.

Keywords: Vietnam, Heavy precipitation, MJO

Japan Geoscience Union Meeting 2013
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AHW02-08 Room:102B Time:May 21 11:15-11:35

Simulation of 1961-2000 summer monsoon onset over Vietnam using a regional climate model

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[1]Department of Meteorology, Hanoi University of Science, Vietnam

This study aims to investigate summer monsoon onset dates over Vietnam and surrounding regions by using the Regional Climate Model version 4.2 (RegCM4.2) driven by the ERA-40 reanalysis data. Comparison of the 1960-2001 averages of wind fields at 200 and 850 hPa shows the consistency of RegCM4.2 with ERA-40. However, there are large differences in air temperature at the low level of 850 hPa, which are mainly attributed to the resolution difference between RegCM4.2 and ERA-40. Over Vietnam, monsoon onset date varies considerably among the regions. During the 1960-2001 period, the earliest onset generally occurs around April 15 in the western part of the Highland region and the latest onset occurs early June in the north. A long-term trend analysis shows that the monsoon onset dates over South Vietnam (North Vietnam) have shifted to approximately 0-10 days earlier (0-15 days later) in recent decades.

Keywords: Asian summer monsoon, monsoon onset, regional climate model, trend analysis

Japan Geoscience Union Meeting 2013
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AHW02-09 Room:102B Time:May 21 11:35-11:50

Variations In Rainfall In Vietnam Under The Global Warming

quan trananh[1*]

[1]Quan Tran Anh, School of Environmental Design, Kanazawa Univ., [2]Assoc. Prof. Kenji Taniguchi, Faculty of Environmental Design, Kanazawa Univ.

Recently, global warming due to intensifying greenhouse effect could cause profound climate change. It is becoming a serious problem in the world that must be accepted. Although the warming effect caused by emission of greenhouse gases has some uncertainties as in all climate observations, several observations indicated that the earth is warmer now than in the past century. Located in the South East Asia (SEA), with more than 3200 km coastal line next to the western Pacific Ocean, Vietnam has been known as one of the most affected countries in the world due to climate change. In the recent decade, Northern Vietnam has been facing terrible weather regime disturbances, while more storms and floods come in the rainy season, more drought and water shortage often occur in the dry season. The variation of rainfall has become further complicated.

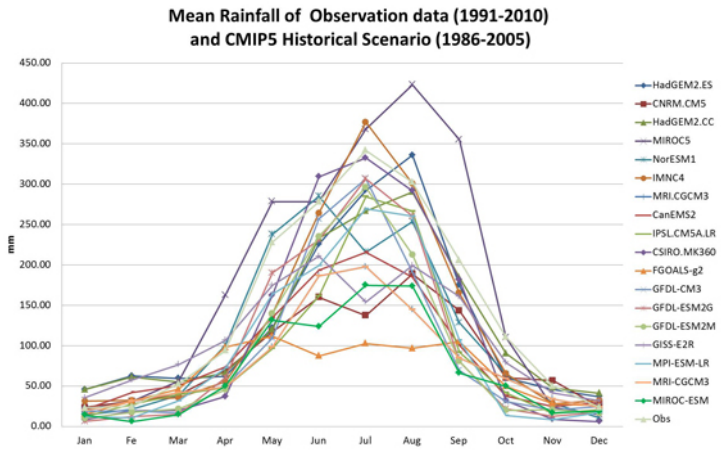
In order to address the changes in rainfall in Vietnam, this study has two main purposes. The first purpose is to investigate the behaviour of rainfall in the past to find out the happened trend as well as annual variation and second is to examine the future variation of rainfall in Northern regions of Vietnam.

To examine the behaviour of climate change in the past, the observation data of Northern Vietnam has been used to make the analysis. Rainfall data of 11 provinces in Northern Vietnam was collected with different time series ranging from 1950-2010. This research also used the updated dataset of 5th phase of climate model inter-comparison project (CMIP5). Meteorological data reproduced from 17 simulation models of CMIP5 follow 3 different scenarios: Historical, RCP4.5, RCP8.5 have been used for comparison with the observation data and investigate inter-annual and seasonal variation of rainfall. The first term of the research focused on comparing the observed data with the simulated data from Historical scenario to examine the reproducibility of CMIP5 models. The second term is, using regenerated data of RCP4.5 and RCP8.5 scenarios, to investigate inter-annual and seasonal variation of temperature and rainfall.

Results of the research have shown a significant decrease of total rainfall amounts during roughly 5 decades from 1960-2010. Observed rainfall data of 11 provinces show annual rainfall ranging from 1,453-2,480mm.yr-1. While the total rainfall in rainy season (JJA - Jun, July, August) accounted for 38.7-64.2% of the year, dry season (DJF - December, January, February) only accounted for 0.6-9.4% of the total. The average rainfall of the area from 1960-2010 is 1,677 mm.yr-1. Among 17 models in Historical scenario, 9 models show the same significant decrease trend with the observed data. Both observation data and most of the CMIP5 models show the largest rainfall in Jun, July and August and the lowest rainfall in December, January and February. Correlation coefficients of seasonal variation shown of all models are varying from 0.84-0.97 with 16 models higher than 0.9.

Initial results of the research using RCP4.5 and RCP8.5 scenarios also shows in the coming future, there will be large inter-annual variation of total amount of rainfall. There might be an increase in rainfall in Northern Vietnam in the end of 21st century with the increments mostly happen the rainy months. In dry season, the variation of rainfall is unclear and unpredictable.

Keywords: rainfall, Vietnam, CMIP5, global warming, climate change



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AHW02-10 Room:102B Time:May 21 11:50-12:05

Generalized dynamics of monsoon and sea-land breeze circulations

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[1]MCCOEPO-BPPT / RIGC-JAMSTEC / DEPS-CPS-KobeU

In the maritime continent the diurnal cycle is the most dominant component of wind (sea-land breeze) and rainfall, and other components such as the annual cycle (rainy season or monsoon, in particular in the southern-hemispheric part) appear as amplification of the diurnal cycle. The diurnal and annual cycles are both induced by the insolation varying astronomically with time (local time and season) and location (latitude and longitude). If the Earth's rotation is much slower (like Venus), these two periodicities are not clearly distinguished. If the Earth is an aqua planet without lands or a land planet without seas, only global modes between winter-summer hemispheres (like Martian atmosphere and Earth's middle atmosphere) or between day-night hemispheres (i.e., diurnal tide) are generated. Because of land-sea heat contrast, local modes around the coastlines are generated and are more dominant.

A quasi-two-dimensional (zonally uniform but permitted to move) linear convection equation on the equatorial beta-plane for a periodically-oscillating equatorially-anti-symmetric heating such as the case of a coastline along the equator (between the northern and southern hemispheres covered totally by land and sea, respectively) is analytically solved. For a periodicity shorter than the local Coriolis period (e.g., diurnal cycle near the equator) the solution becomes a sea-land breeze circulation (purely meridional in this case) consisting of a pair of internal (almost non-inertial) gravity waves, and the motion becomes non-hydrostatic and ageostrophic. For a periodicity longer than the earth's rotational period (e.g., annual cycle in the extratropics) the solution becomes a monsoon circulation consisting of mixed Rossby-gravity and Rossby waves with zero zonal wavenumber, and the motion is quasi-hydrostatic and quasi-geostrophic. In the latter vertical velocity is associated mainly with inertia-gravity waves, as so far shown by Kosaka and Matsuda (2005) for a steady heating.

In the Earth's history continent-ocean distribution is varied with 10^2 Myears, and glacier-interglacier oscillation is with 10^2 Kyears (due to variation of the Earth's rotation and revolution, known as Milankovic cycle). Variations of tropical rainfall and their effects on the global climate are discussed.

Keywords: monsoon, diurnal cycle, air-sea-land interaction, climate history, planetary rotation and revolution

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AHW02-11 Room:102B Time:May 21 12:05-12:25

AMY-reanalysis: atmospheric reanalysis data using JRA-55 system and Asian Monsoon Years observation

Kenji Kamiguchi[1*]

[1]Meteorological Research Institute

Global atmospheric reanalysis data is indispensable for meteorology. Japan Meteorological Agency (JMA) is now creating a new state-of-the-art reanalysis data JRA-55 (Ebita et al., 2011) with a period after the mid-20th century which will be completed during 2013. The biggest improvement from the previous version JRA-25 is data assimilation system, four-dimensional variational data assimilation (4D-Var) with Variational Bias Correction (VarBC) is used in JRA-55 which enables not only to directly handle observed physical elements such as radiation by satellite but also to ingest non-scheduled observation data. Accordingly, we are developing an extra reanalysis data AMY-reanalysis for the years 2008-2010 by putting a special observation data collected by AMY (Asian Monsoon Years) project into the reanalysis system and the observation data used in JRA-55. In this presentation, the impact of AMY observation on making atmospheric reanalysis data will be presented.

Keywords: atmospheric reanalysis data, observation

Japan Geoscience Union Meeting 2013
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AHW02-12 Room:102B Time:May 21 12:25-12:45

Water isotope modeling and observations toward reconstruction for Asian hydroclimatology

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Asian hydroclimatology in the past has very important to understand the climate system and likely for the evolution of the historical civilizations. However direct measurement data is quite limited, so some proxy data for example water isotope information conserved in tree cellulose, speleothem, and/or coral shell, etc. would be highly useful. As a very preliminary step, this study presents idealized tests of a newly-developed data assimilation system for assimilating high-frequency vapor isotope observations from satellites, using an ensemble Kalman filter with the isotope-incorporated general circulation model. An LETKF-based four dimensional data assimilation system was newly developed for the first time to obtain dynamically and physically consistent analysis of both water isotope and meteorological variables. Moreover, we also aim at assessing the isotope observation impact on the dynamical fields (wind, temperature, humidity, pressure). Several numerical experiments have been performed with various synthetic observations using a model simulation as the ”nature run”. The control experiment assimilates conventional rawinsonde-like observations, and the test experiments with additional isotope observations showed general improvement in both isotopic fields and dynamical fields. The positive impact on the dynamical fields was surprisingly larger when the number of conventional observations was decreased. These results are promising, so that the satellite isotopic data could be very useful to analyze the atmospheric states, particularly for the past (before 19th century) when isotopic measurement data were a major source of observations.

Keywords: water isotope ratio, climate reconstruction, general circulation model, ensemble Kalman filter

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AHW02-13 Room:102B Time:May 21 14:15-14:30

Lightning observation network in SE-Asia as a tool for monitoring of atmospheric convection in thunderstorm

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SE-Asia is one of the most important regions in the world, which is closely related to the important meteorological phenomena, such as Madden Julian Oscillation, El Nino, etc. Also very sever weathers sometimes happen in this area, which leads to loss of human lives and estates. Therefore, monitoring and understandings of atmospheric activities in this region is quite important. However, it is not easy only with existing observation equipments and the limited number of advanced facilities such as expensive meteorological radars. Lightning observation in frequency range of VLF would be a very effective methodology to monitor the activity of thunderstorms, which are driving the global atmospheric circulation and may cause significant disasters. We have been developing Asia VLF observation network: AVON, which now consists of 3 stations located at Taiwan, Thailand and Indonesia. The geolocation will be carried out by time-of-arrival method with an error of 10 km. From AVON data, we could estimate the charge moment change of the lightning stroke, which might be a good proxy of meteorological parameters in thunderstorm. In order to improve the accuracy of geolocation and to achieve the redundancy, we plan to add 2 or 3 more stations in SE-Asian countries, such as Philippines, Vietnam. Based on information of lightning, we will try to establish the methodology for prediction of thunderstorm location and strength. Here we discuss the scope of AVON observation including various possibilities of applications to meteorology and climate studies in SE-Asia.

Keywords: lightning, network, thunderstorm, monitoring, SE-Asia

Japan Geoscience Union Meeting 2013
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AHW02-14 Room:102B Time:May 21 14:30-14:45

Effects of increase of observation data input on terrestrial climatological mean temperature data over Asia

Natsuko Yasutomi[1*]

[1]RIHN

We created a daily mean gridded temperature dataset of monsoon Asia (15S-55N, 60E-150E) for the period of 1961-2007, with a 0.50 x 0.50 degree grid.

We analyzed this dataset based on station observations collected and a quality control and interpolation system developed through the activities of the Asian Precipitation – Highly Resolved Observational Data Integration Towards Evaluation of Water Resources (APHRODITE) project. The number of stations is up to 2 times the number of stations based on the Global Telecommunication System (GTS), which have been used to obtain other gridded temperature products. Especially, we obtained daily surface observation of Nepal in collabollation with local agency.

Comparison between monthly mean temperature datasets, CRU_TS3.0 and Univ. of Delaware, and APRHODITE daily mean temperature dataset (AphroTemp V1204R1) is made to estimate the effect of the increase of surface observation input.Significant difference is not shown over coastal and plain region over Monsoon Asia. However, differences of 5-6 degC are shown in mountainous region of Tibetan Plateau and Central Asia.

Another product (AphroTemp_V1204R1g), using on-line available surface observaion data and adapting same interpolation algorithm, is derived to estimate the difference attributed to the increase of input data. Significant difference is shown around Nepal. Similar difference is found in comparison with other monthly datasets (CRU_TS3.0 and Univ. of Delaware).

In and around Nepal, it is found out to be warmer than preceding estimates. On the other hand, significant differences are not found in other places such as China, Mongolia and Taiwan, where we also obtained original inputs.

Keywords: temperature dataset, Monsoon Asia, climatological mean temperature

Japan Geoscience Union Meeting 2013
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AHW02-15 Room:102B Time:May 21 14:45-15:00

Future changes and uncertainties in Asian precipitation simulated by ensemble experiments with high-resolution MRI-AGCMs

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[1]Meteorological Research Institute

This study focuses on projecting future changes in mean and extreme precipitation in Asia, and discusses their uncertainties. Time-slice experiments using a 20-km-mesh atmospheric general circulation (AGCM) were performed both in the present-day (1979?2003) and the future (2075?2099). To assess the uncertainty of the projections, 12 ensemble projections (i.e., combination of 3 different cumulus schemes and 4 possible different sea surface temperature (SST) patterns) were conducted using 60-km-mesh AGCMs. For the present-day simulations, the models successfully reproduced the pattern and amount of mean and extreme precipitation, although the model with the Arakawa?Schubert (AS) cumulus scheme underestimated the amount of extreme precipitation. For the future climate simulations, in South Asia and Southeast Asia, mean and extreme precipitation generally increase, but their changes show marked differences among the projections, suggesting some uncertainty in their changes over these regions. In East Asia, northwestern China and Bangladesh, in contrast, mean and extreme precipitation show consistent increases among the projections, suggesting their increases are reliable for this model framework. Further investigation by analysis of variance (ANOVA) revealed that the uncertainty in the precipitation changes in South Asia and Southeast Asia are derived mainly from differences in the cumulus schemes, with an exception in the Maritime Continent where the uncertainty originates mainly from the differences in the SST pattern.

Keywords: future projection, rainfall, Asia, high-resolution model, ensemble projection

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AHW02-16 Room:102B Time:May 21 15:00-15:15

Relationship between future changes in summertime precipitation and topography in the Japanese islands

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This study investigated future changes in summertime precipitation over the Japanese islands and their relations to the topography by analyzing data from 20-km resolution regional climate model downscalings of MIROC3.2-hires 20C3M and SRES A1B scenario data. To obtain the geographical distributions of simulated daily precipitation amounts in Japan during the periods of 1981-2000 (hereafter ”recent climate”) and 2081-2100 (”future climate”), we analyzed results of long-term numerical simulations performed by three RCMs: Non-Hydrostatic Regional Climate Model (NHRCM; Saito et al., 2006; Ishizaki and Takayabu, 2009), Regional Atmospheric Modeling System V 4.3 (Pielke et al., 1992) modified by National Research Institute for Earth Science and Disaster Prevention (NRAMS; Dairaku et al., 2008), and Weather Research and Forecasting model (Skamarock et al., 2008) V 3.1.1 modified by University of Tsukuba (T-WRF; Kusaka et al., 2012). Each simulation was carried out with a 20-km horizontal grid resolution, as part of the Japanese research project of Multi-Model Ensembles and Downscaling Methods for Assessment of Climate Change Impact (S-5-3; e.g., Ishizaki et al., 2012). Results of the analyses indicate that future increases in June-July-August mean daily precipitation amounts are noticeable in the west and south sides (windward sides) of the mountainous regions, especially in Western Japan where heavy rainfall is frequently observed in the recent climate. The large precipitation increases are likely to occur not only in high altitude areas but also at low altitudes. The model grid points where the future increases in JJA mean daily precipitation exceed 3 mm and 5 mm are shown in Figure 1 (a figure shown in this abstract) after dividing the topographical heights at every grid points into several elevation zones at an interval of 300 m. In the west and south sides of the mountainous regions, the precipitation increases of more than 3 mm day-1 can be seen not only in high altitude areas but also at low altitudes below 300 m above mean sea level (AMSL) (Figures 1a-c). Note that the precipitation increases exceeding 5 mm day-1 are widely distributed at the low altitude areas in the western part of Kyushu (Figures 1d-f). In those areas, the occurrence frequencies of precipitation amounts greater than 100 mm day-1 would also increase under the future climate scenario (A1B). One of the main causes of these precipitation changes appears to be the intensification of southwesterly moist air flows in the lower troposphere, which is likely to be associated with future increases in the north-south atmospheric pressure gradient, especially at latitudes south of 35 degrees north. The intensified southwesterly moist air flows that impinge on the western and southern slopes of the mountains can generate stronger upslope flows and well-developed clouds, leading to the increased precipitation. In contrast, the future changes of the simulated precipitation amounts in the lee sides of the mountainous regions, such as the Tokyo metropolitan area would be comparatively small.

Acknowledgements
This study was conducted as part of the research subject ”Vulnerability and Adaptation to Climate Change in Water Hazard Assessed Using Regional Climate Scenarios in the Tokyo Region” of Research Program on Climate Change Adaptation (RECCA) funded by Ministry of Education, Culture, Sports, Science and Technology, Government of Japan. Also, this work was supported by the SOUSEI Program of Ministry of Education, Culture, Sports, Science, and Technology. The regional climate scenarios simulated by NHRCM, NRAMS, and T-WRF were provided by the research project of the Multi-Model Ensembles and Downscaling Methods for Assessment of Climate Change Impact (S-5-3) funded by Ministry of the Environment, Government of Japan.

Keywords: Future changes in summertime precipitation, Topography, Regional climate modeling, Multi-model, Dynamical downscaling, Dynamical mechanism of future precipitation changes

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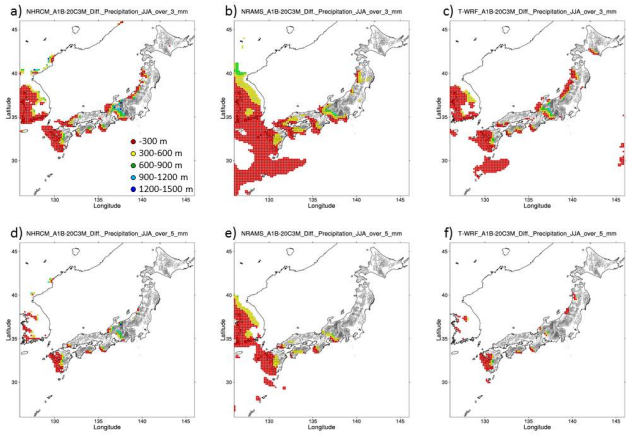

Japan Geoscience Union Meeting 2013
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AHW02-17 Room:102B Time:May 21 15:15-15:30

Future risk assessment of two types of climate-related disasters: fluvial flood risk and tropical cyclone risk in Asia

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This presentation will consist of two parts. Both are recent attempts on large-scale risk assessment of climate-related disasters particularly in Asia. This presentation will be done on behalf of many other collaborators.

Firstly, we estimated future changes in tropical cyclone risk in the Western North Pacific using a Stochastic Typhoon Model (STM). Information derived from CMIP3-based four AOGCM outputs was introduced into the STM. The STM was used to generate typhoons for two sets of hypothetical 1000 years (possibly 10000 years); one is under the current climate condition and the other is under a future climate condition. This kind of simple stochastic modeling framework is useful for risk assessment of extremes like tropical cyclone because such a risk assessment should be probabilistic in its nature. The changes in exposure to tropical cyclones in coastal areas of WNP countries will be presented.

Secondary, we computed future changes in flood risk at the global scale, using daily river discharge derived from 11 AOGCMs forced by the CMIP5 future scenarios. We also computed the future time series of global exposure to flooding that is global population potentially affected by inundation. Projected future risk is very remarkable in Asia.

These attempts will provide us indispensable information for the adaptation to the impact of future climate change. In addition, these attempts would be useful to set a mitigation target.

Keywords: climate change, tropical cyclone, flood

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AHW02-P01 Room:Convention Hall Time:May 21 18:15-19:30

Effect of the diurnal variation on the hydrological cycle over the maritime continent

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The climate of the maritime continent is characterized by huge amounts of precipitation throughout the year. The unique environment in this region with complex distribution of islands and warm pool favors the development of deep and frequent convection. The deep convection accompanied by heavy precipitation is generally observed over islands and its surrounding ocean rather than open seas. Major islands combined with surrounding warm seas, therefore, are most likely to play an important part in the energy and water cycle processes driving the complex atmospheric circulation pattern.

To understand the time-space characteristics of the hydro-climate in islands and ocean, we examined the climatological hydrological cycle from 1998-2010. The characteristics of water budget are separated between Island (including its surroundings ocean) and open seas in the maritime continent.the Seasonal variation of precipitation over Borneo and the surrounding ocean is very small compared with those over other tropics. The vertically-integrated moisture flux fields show divergence throughout the year over the Borneo, suggesting that evapotranspiration from the island surface is a major source of moisture to atmosphere. In contrast, other major islands in the maritime continent, such as New Guina, the seasonal cycle of moisture flux convergence is observed. On the other hand, the contribution of moisture flux convergence to precipitation is noticeable over the surrounding ocean of the major islands. The diurnal variance of the hydrological components is large over Island region and its surrounding oceans. Diurnal cycle of local atmospheric circulation plays an important role in exchange of water between the island and the surrounding ocean. The intraseasonal oscillation (ISO) is also a dominant mode of rainfall over this region. The influence of the ISO on the water budget appears stronger over the ocean than over the island. The vertical profile of the moisture flux and specific humidity indicate large difference in low-middle level between ocean and island.

Keywords: Diurnal cycle, Atmospheric water budget, Intraseasonal oscillation, Maritime Continent

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Water Origin over Indonesia Maritime Continent with Isotope Circulation Model

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By using the data obtained by a global Rayleigh-type circulation model with the Japanese long-term re-analysis project, we determined the seasonal changes of water sources trajectory to Maritime Continent. The model output was validated by the observation data of the Oxygen-18 and Deuterium content in precipitation at nine stations. The model performed well statistically in reproducing the simulated stable isotope in precipitation. The model demonstrates the seasonal characteristics of the water origin in three climatic patterns: (1) the semi-annual pattern, in which seasonal changes are indicated by the alternating presence of water from the northern and southern Maritime-Continent seas, (2) the anti-monsoonal pattern, represented by the alternating presence and absence of water from the southwest Pacific Ocean, southern Maritime Continent, and tropical Maritime-Continent sea, and (3) the monsoonal pattern, characterized by the alternating presence and absence of water from the northern Maritime Continent sea and Indian Ocean.

Keywords: Stable Isotope in Precipitation, Isotope Circulation Model, Water Origin, Asian-Australian Monsoon, Maritime Continent

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AHW02-P03 Room:Convention Hall Time:May 21 18:15-19:30

Monitoring of lightning activity in the Maritime Continent based on electromagnetic measurement in ELF and VLF range

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Lightning observation has been focused on as a useful way for monitoring and nowcasting of thunderstorm activity which causes extreme weather, such as torrential rain. Torrential rainfall causes flood and damages to large cities especially in the Southeast Asia. Previous studies show that spatial distribution of lightning discharge has been used as an effective proxy of the presence or absence of atmospheric vertical convection which give rise to thunderstorm.

Recent lightning observation shows that there is extremely huge lightning whose scale is more than hundreds times bigger than that of averaged event. This result indicates that not only place but also scale of each lightning discharge should be estimated for quantitative evaluation of vertical convection.

In this study, lightning observation network in the Maritime Continent is introduced. This network is designed to estimate not only spatial distribution but also scale distribution of lightning activity. This network is consisted of sensors which make it possible to record the electromagnetic waveforms radiated from lightning discharges by multipoint observation. Geolocation is determined based on time of arrival method and its accuracy is evaluated as less than 10km. Furthermore, charge moment is evaluated as a scale of each lightning discharge by using electromagnetic waveform.

We have already constructed observation stations at Tainan in Taiwan (23.1N, 121.1E), Saraburi in Thailand (14.5N, 101.0E), Pontianak in Indonesia (0.0N, 109.4E) and Los Banos in Philippines (14.18N, 121.25E). Now, we plan to install the monitoring system at Hanoi in Viet Nam. Data obtained by multipoint observation is synchronized by GPS receiver installed at each station.

At the presentation, initial result of geolocation and derivation of charge moment value based on the measurement of ELF and VLF sferics are shown.

Keywords: lightning, severe weather, ELF, VLF, sferics

Japan Geoscience Union Meeting 2013
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Spatiotemporal variability and trends of rainfall extremes in the Philippines: Linkage with ENSO and monsoon

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Due to the recent extreme rainfall events that led to disaster in the Philippines, long-term trend and variability of rainfall extremes in the country are investigated using daily rainfall data from 35 meteorological observing stations during 1951?2010. Seven extreme precipitation indices that characterize daily rainfall in terms of intensity, accumulation and duration in a seasonal perspective are used. The non-parametric Mann?Kendall test is implemented in combination with moving block bootstrap to detect significant trends. Results indicate a tendency toward wetter condition during boreal summer (July?September, JAS) while a drying condition during boreal fall (October?December, OND) in the Philippines. The influence of El Nino?Southern Oscillation (ENSO) and Western North Pacific (WNP) summer monsoon on the extreme precipitation indices are further explored by means of composite analysis and rank correlation technique. Around 20%?60% drier (wetter) condition is associated with El Nino events during OND (JAS); however, ENSO influence is more pronounced during OND as compared to JAS. On the other hand, strong WNP summer monsoons are generally associated with high values of wet extreme precipitation indices during JAS, specifically at stations located on the western section of the Philippines. A weak strengthening of the WNP summer monsoon is detected; however, the spatial incoherency of trends found in extreme precipitation indices, and the influence of tropical cyclones and other tropical disturbances with short temporal-scale suggest that found trends could not be attributed to a single factor but to combinations of several factors directly or indirectly affecting extreme precipitation over the Philippines.

Keywords: rainfall extremes, ENSO, monsoon, long-term trend, Philippines

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Climatological onset date of summer monsoon in Vietnam

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The objectives of this study are to investigate the summer monsoon onset date in Vietnam by using 5-day averaged of 1) observed rainfall, maximum temperature, minimum relative humidity at 54 selected meteorological stations in the region and 2) horizontal winds, temperature, specific humidity and geopotential height at pressure levels form JRA25 reanalysis data during the 1979-2003 period. The averaged convective activity is also examined by the OLR (Outgoing Longwave Radiation) data provided by NOAA (National Oceanic and Atmospheric Administration).

The result suggested that the summer monsoon onset date varies considerably among sub-climatic regions in Vietnam. The earliest onset is generally found in the northwestern mountainous region around late April. Later, the westerlies summer monsoon start dominating over the Indochina Peninsula in mid-May, bringing the rainy season in the Red river delta in the north and Mekong river delta in the south of Vietnam. In case of central coastal area, being very different from others, as a result of Foehn wind, from mid- to late- May, sudden increase of temperature and gradual decrease of minimum relative humidity are indicted as summer monsoon onset date for this region. Over the Indochina and SCS (South China Sea) region, the most significant changes of convective activity and 850-hPa circulation fields occur in 28th pentad (16-20 May). Moreover, there is clear linkage between the beginnings of Meiyu season with the onset of summer monsoon in the SCS. In addition, in the upper atmosphere (200-hPa level), the retreat northward of sub-tropical westerly jet and the formation of TSE (Tropical Strong Easterly), consequence from the difference in heating over Indian inland and cooling over ocean, also play an important role in summer monsoon circulation.

Keywords: summer monsoon, monsoon onset, tropical strong easterly, Meiyu front, Vietnam, Foehn wind

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AHW02-P06 Room:Convention Hall Time:May 21 18:15-19:30

Recent Interdecadal Variations of Autumnal Precipitation in Vietnam

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In some parts of Southeast Asia, (e.g., central Vietnam), a large amount of rainfall occurs in boreal autumn to early winter (September-December: SOND). In the present study, we investigate interdecadal variations of rainfall in SOND in Vietnam and its vicinity for the period 1961-2010, based on rain gauge observational data obtained from the Southeast Asian countries. As a result, it is very obvious that rainfall have increased [decreased] to the south [north] of 17N along the coastal area of Vietnam. There are many stations with statistically significant decrease over the Red River Delta region (north of 20N; denoted as region A hereafter). In this region, SOND rainfall has decreased since late 1980s. In northern part of central Vietnam (17-20N; denoted as region B), the rainfall decrease has been observed since late 1990s. In southern part of central Vietnam (12-17N; denoted as region C), on the other hand, SOND rainfall has largely increased since late 1990s. From comparison of seasonal marches of rainfall over the 3 regions between 25-year averages of 1961-85 and 15-year averages of 1996-2010, we find that the amount of rainfall in region A has clearly decreased in August-October, indicating the recent earlier withdrawal of summer rainy season. In region B, rainfall has decreased during a whole rainy season in boreal autumn. In region C, on the other hand, the rainfall increase is very obvious and long-lasting during a whole period of August to December. Atmospheric circulation changes based on some gridded datasets suggest that recent stronger lower-tropospheric cyclonic circulation over the southern part of the South China Sea might be responsible for the recent increasing trend of rainfall over region C, though the significance of the atmospheric changes varies between the gridded datasets.

Keywords: climate variations, Vietnam, precipitation

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Rainfall pattern in the middle of Indochina Peninsular during 2009-2010 summer monsoon

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Rainfall patterns during summer monsoon in 2009 and 2010 in the middle of Indochina Peninsular (ICP) are investigated using daily radar rainfall (DRR). The DRR is calibrated using rain gauge data before proceeding to further analysis. The empirical orthogonal function (EOF) analysis applied to DRR shows that the first three modes explain 40% of the total rainfall variance. The first mode shows only positive value over the radar observation area with high value near the foot of Annam range in the east of radar site. The second and third EOF show dipole patterns and explain 7% and 6% of total variance, respectively. The Cumulative Density Function (CDF) is applied to the score of the EOF results in order to find a physical meaning of EOF modes. A composite analysis of reanalysis data is employed by selecting dates above and below 90% and 10% of CDF in each EOF modes. The first and second modes are consistent with vorticity and wind directions. The third EOF mode indicates a suppression of rainfall by topography.

Keywords: monsoon, indochina peninsular, rainfall pattern, radar rainfall, EOF

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Future Water Stress under a Warming Climate over the Indochina Peninsula

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We focused to estimate water stress over the Indochina Peninsula. Trends in the total population under high water stress now and in the future (we call this total HWSP) and the population exposed to high water stress in the future but not now (we call this add-HWSP) are dependent on differences in each scenario, not the temperature increase. We indicated the sensitivities of climate change, water withdrawal, and population growth on total HWSP and add-HWSP to separate the influences of climate change and socio-economic change. Climate change and socio-economic factors (water withdrawal and population growth) decreased and increased add-HWSP, respectively. Because these factors are related to anthropogenic activities, it is necessary to consider the change in water withdrawal and population when we discuss how to avoid high water stress in the future.

Keywords: SRES, IPCC, uncertainty, water stress assessment

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Interannual variation in the summer monsoon onset dates over South China sea

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Kajikawa and Wang(2012) pointed out an advance in the onset dates for 15 years average on the South China Sea summer monsoon around 1993/94. In this study, we compare meteorological fields around South China Sea in the change of onset dates not only for 15 years averages but also the annual variability. For analysis, we use the 850hPa horizontal wind from the JRA-25/JCDAS and OLR (Outgoing Longwave Radiation) from NOAA. We define South China Sea monsoon onset date as th area averaged zonal wind changed from easterly to westerly over 5-15 degrees north latitude, 110-120 degrees east longitude. 4 groups divided by 1979-1993 (prior period) and 1994-2008 (later period) and by 3 years early onset dates and 3 years late onset dates are compared the meteorological fields around South China Sea.

In the result, in the group of early onset dates in prior period, the convective activity in Bay of Bengal are strong in late April, but the genesis of convection in the South China Sea are delayed after the onset. And, the variation of South China Sea summer monsoon onset dates is different defined as OLR between zonal winds.

Keywords: monsoon

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Interdecadal variability of the atmospheric circulations at the onset of the western North Pacific summer monsoon

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The low-frequency variability with periods of interdecadal variations or longer was examined for the atmospheric circulations associated with the onset of the western North Pacific summer monsoon (WNPSM). The region of WNPSM, (138?-160?E, 15?-25?N), is first determined in the western North Pacific (WNP) as the region with positive values in precipitation difference between the periods before (mid-July) and after (late July) the WNPSM onset (after - before). The time series analysis is then performed for the areal mean precipitation rate of the region after removing the linear trend. To extract the components with periods longer than 11 years, we employed the harmonic analysis and summed the components of wave numbers 1-3 for the time series of 1979-2010 (32 years). The low-frequency variability clearly shows the interdecadal tendency concurrent with the Pacific decadal oscillation (PDO) in the North Pacific even in boreal summer. In the first positive phase after 1979, i.e., 1985-93, the WNPSM begins in its own region, while the region shifts westward off the Philippines in the following negative phase of 1994-2000. In the next positive phase in 2001-07, the WNPSM is again established in its own region. The positive, negative, and positive SST anomalies in and around the WNPSM region with the PDO induce such interdecadal tendency in atmospheric circulations around the WNPSM onset. The linear trend removed, i.e., the lower-frequency variability, shows a tendency that the precipitation before the WNPSM onset increases, while it after the onset is almost unchanged in and around the WNPSM region. The similar tendency is identified in the tropical cyclone activity: it is stronger before the onset. It is confirmed that the onset of WNPSM has been unclear during the latest few decades.

Keywords: western North Pacific summer monsoon, PDO, accumulated cyclone energy

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Possible factors affecting interannual variability of spring rainfall over southeastern

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We examined the possible impacting factors controlling interannual variability (IAV) of the spring rainfall (SPR) over southeastern China using the NCEP-NCAR reanalysis data and APHRODITE precipitation data from 1951 to 2007. The SPR amount accounts for about 35-40% in the annual rainfall amount over southeastern China. Therefore, the IAV of SPR is important as well as the IAV of summer monsoon rainfall. The IAV of SPR is dependent on the moist southwesterly over southwestern China at the lower troposphere. This southwesterly is mainly induced by the east-west gradient between the western pacific and the Indochina peninsula. As a result of correlation analysis, the IAV of SPR is associated with the El Nino-Southern Oscillation (ENSO) via the variability of the western Pacific subtropical high. However, we found the clear difference in the ENSO effect on the IAV at different stage of SPR. Based on the correlation analysis using the 10-day mean precipitation over eastern China and Southern Oscillation Index (SOI), we separate in to two periods; the first part (Feb. 10 to Mar. 20) and the second part (Apr. 1 to May. 10) on the SPR period. This correlation analysis denotes the significant negative correlation during first part and the nearly no correlation in second part. Thus, the mechanisms for the modulating the east-west gradient are different between first part and second part in the SPR period.

Keywords: Spring rainfall, East Asia, Interannual variability

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Back-trajectory Analyses of Water Vapor Precipitated in Northern Mongolia

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Prediction of precipitation variability and understanding of its mechanisms are essential in Northern Asia [Yatagai and Yasunari, 1994]. The objective of this study is to investigate linkages between the interannual variability of precipitation sources and that of precipitation amount in this area.

For this purpose, a back-trajectory model [Merrill et al., 1986] of atmospheric water vapor was developed and applied to the rainfall during the warm season from 2003 to 2009 at semi-arid grassland Kherlenbayan-Ulaan (KBU) in northern Mongolia, where an air parcel is tagged with the ambient potential temperature where it is precipitated, and is tracked adiabatically above the planetary boundary layer (PBL). When a parcel is tracked back into the PBL, its potential temperature is adjusted to the value at the top of PBL. In addition, diffusion process of water vapor evaporated from the ground surface into the atmosphere and the altitude raindrops are formed are calculated using the Monte Carlo simulation [Dirmeyer and Brubaker, 1999]. The model uses JRA-25/JCDAS [Onogi et al., 2007] reanalysis data set with 6hour intervals.

The results show that the major precipitation sources of rainwater at KBU are the local area of Mongolia and the central and the western Asia. Water vapor evaporated from the local area of Mongolia is approximately 20% of the total summer precipitation, and this ratio is particularly higher in Mongolia in compared with the other area on the globe [Dirmeyer et al., 2009]. This result consists with Yatagai and Yasunari, [1995] which suggested that the variability of precipitation in the arid areas in the northeastern Asia has higher correlation with the local atmospheric circulation, and Sato et al., [2007]. Moreover, this paper clearly exhibits that this ratio is fairly constant over the years in spite that the total precipitation varies.

Moreover, it was found that water vapor supply from the central and the western Asia is approximately 30-40% of the total summer precipitation at the target point, and has larger interannual variations that is consistent with those of the total summer precipitation. Therefore, the central and the western Asia may explain a major portion of variations in the total precipitation.

In addition, the year 2003 and 2004 were found to here, anomalous relation. It is discovered that larger precipitation in the autumn of 2003 [Hirata et al., 2008] was followed by the increased contribution of the local evaporation to the precipitation in the following 2004. Shinoda et al., [2011] claimed that the cold season climate with low evapotranspiration and strong soil freezing acts to prolong the decay time scale of autumn soil moisture anomalies to the next spring over the eastern part of Mongolia. Therefore, it is considered that soil moisture at the local region in the autumn may be preserved during the winter up to the next spring and contribute to precipitation in summer in northern Mongolia.

Keywords: trajectory analysis, precipitation source, water vapor

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Long-Term Variability of Extreme Low-Temperature in Winter in Mongolia

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The characteristics of extreme low-temperature events in Mongolia are examined using JRA-25/JCDAS reanalysis data for 1979-2010. In this study, Extreme Cold Day (ECD) which is an index to evaluate low-temperature events is defined by a daily mean surface air temperature difference lower than -10 degree within 2 days at each grid point.

The geographical distribution of winter mean ECD frequencies differs for every winter and are limited at the northern Eurasian Continent. Interannual variations in the area-averaged frequency of ECD in Mongolia during the 1980s-1990s showed decreasing trends. But in the 2000s, some year with high frequency existed.

The number of occurrence of ECD every ten years was changing spatially. In the 1980s,it mainly occurred over western part of Mongolia. On the other hand, in the 2000s,northern part of Mongolia had high number of occurrence. When cold surge in Mongolia which brings ECD occurred, atmospheric circulation tended to localized in the 2000s, compared with the 1980s. This may cause of limitation of the occurrence areas.

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Estimation of mass change of glaciers using a precipitation data set with fine spatial resolution in High Mountain Asia

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In High Mountain Asia, estimates of glacier mass change using reanalysis, glacier models or GRACE still have uncertainty. To estimate glacier mass change in High Mountain Asia glacier models have important roles because there are sparse mass balance observations of glacier and also this region is intensive irrigated area.

Results of glacier models are critically sensitive to the quality of precipitation input. In addition, accumulation of glaciers in High Mountain Asia is driven more by high precipitation than other colder regions. Although, there are large spatial variations of precipitation on glacier mountain areas, reliable precipitation data is not well established in these areas because this remote region lacks a dense gauge network.

In this study, we developed a precipitation data set with high spatial resolution as input precipitation for a glacier model. And we calculated glacier mass change using the glacier model and evaluated the effect of spatial distribution of precipitation for glacier mass change. The precipitation data set with fine special resolution from 1998 to 2007 at daily time scales using satellite radar observation and rain gauge observation has developed. We basically used satellite observed precipitation data with 4-km spatial resolution, which directly estimates precipitation well even in high mountain area. And then we combined the satellite based data and gridded data on the basis of rain gauge observation with daily time step. Finally, we will show the results of examination of glacier mass change calculation by different precipitation data sets.

Keywords: glaciers, mass change, precipitation radar, spatial resolution