Second Session of the
East Asia winter Climate Outlook Forum

29 – 31 October 2014

Tokyo, Japan

Tokyo Climate Center
Japan Meteorological Agency

Abstracts

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Seasonal Climate Prediction Operation in Beijing Climate Center

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Abstract

China is located in the East Asia monsoon region where climate is characterized by strong annual monsoon cycle and variability. Precipitation exhibits spatial uneven distribution and reduces from southeast coastland to northwest inland in China. Meteorological disasters such as drought, flood and typhoon occur frequently. Precipitation prediction in flood season is the most important in climate prediction operation. Monsoon onset, rainfall belt process and main rainfall belt location in summer are all focused on every year. The East Asian summer monsoon system with many components is very complex. It is influenced by lots of physical factors including tropical sea surface temperature, thermal condition over the Tibetan Plateau, snow cover over Eurasia and so on. These possible influence factors are discussed in every prediction conference about summer climate. The first generation dynamical climate prediction system set up in Beijing Climate Center (BCC) about ten years ago. From then on, coupled ocean-atmosphere general climate model (CGCM) has played an important role in seasonal climate prediction in China. The next generation of CGCM of BCC has been developed and will be operational soon. In addition, objective climate prediction systems based on dynamical model have been developed recent years. The Forecast System on Dynamical and Analogy Skills (FODAS) and Multi-model Downscaling Ensemble Prediction System (MODES) provide helpful information in seasonal prediction operation of BCC.

Recent development of JMA's climate services

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Abstract

As the national climate center in Japan, the Japan Meteorological Agency (JMA) is providing several kinds of climate services, such as climate system monitoring, seasonal forecasting, El Niño outlook, and global warming projection. Also, JMA's Tokyo Climate Center (TCC), as a WMO Regional Climate Center, supports the climate services of NMHSs in the Asia-Pacific region through the provision of climate information, data and products, and capacity-development activities. In my talk, recent development of JMA's climate services is introduced including the following topics.

1. Operational use of JRA-55

In 2013, JMA has completed the second Japanese global reanalysis, known as JRA-55 (Kobayashi et al., 2015, accepted by JMSJ), which covers a period of 55 years extending back to 1958. In order to use for operational climate system monitoring, JMA continues the production of JRA-55 dataset on a near real-time basis. Since the data cover period was extended and many of the deficiencies seen in JRA-25 have been eliminated or reduced, JRA-55 dataset will contribute to improving JMA's climate system monitoring activity including decadal climate variation monitoring. In March 2014, almost all climate system monitoring products generated using JRA-25 data on the TCC website replaced by versions generated using JRA-55 data.

2. Major upgrade of One-month EPS

In March 2014, JMA implemented a major upgrade of its Ensemble Prediction System (EPS) for one-month forecasting (One-month EPS). Major changes in the new One-month EPS are increased horizontal resolution of AGCM from TL159 (110 km) to TL319 (55 km), introduction of a stochastic physics scheme in consideration of model uncertainties, and so on. In advance of the upgrade, a full set of hindcasts for the 30-year period from 1981 to 2010 has been executed using the new system. Since verification of the hindcasts indicated significant prediction skill enhancement, JMA changed the issue date of one-month forecasting from Friday to Thursday without change of the valid date.

As for seasonal forecasting, the new EPS system will be implemented in the middle of 2015. Outline of the new EPS system including prediction skill is introduced by Matsukawa et al. (2015)

3. Promotion of the use of climate information for CRM

In May 2013, to promote the use of climate information for Climate Risk Management (CRM), JMA launched a dedicated website (in Japanese) on CRM with the following contents: 1) Clarification of the basic CRM concept and the related process, 2) Information on good practices in CRM conducted by JMA together with partner organizations in the user sectors such as agriculture, health, energy and retailing, 3) Historical data (observations and statistics) and prediction data to support CRM. To share internationally the information on the good practices, JMA also launched an English website in September 2014 (http://www.data.jma.go.jp/gmd/risk/en/index.html).

4. TCC products and services

TCC plays a leading role in the implementation of the WMO RA II Pilot Project on Information Sharing on Climate Services. After collecting information on climate services provided by NMHSs as well as details of good practices on the application of climate information in society via a questionnaire survey, TCC developed and launched a dedicated website in March 2014 (http://ds.data.jma.go.jp/tcc/pilot/index.html).

The web-based ClimatView interactive climate database has been upgraded (http://ds.data.jma.go.jp/gmd/tcc/tcc/products/climate/climatview/frame.php). The new version is designed to allow browsing without plug-ins using PHP and its graphic library. It enabled viewing with web browsers including Firefox and Google Chrome in addition to Internet Explorer.

In March 2014, TCC started providing a new product, *Monthly Discussion on Seasonal Climate Outlooks* (http://ds.data.jma.go.jp/tcc/tcc/products/model/index.html). The Monthly Discussion is intended to assist NMHSs in the Asia-Pacific region in interpreting and assessing GPC Tokyo's products for three-month prediction and warm/cold season prediction and understanding the current conditions of the climate system.

In August 2014, TCC started providing early warning products, which are made from JMA's one-month EPS, for extreme weather events covering the period up to two weeks ahead (http://ds.data.jma.go.jp/tcc/tcc/gpv/EFI/index.php). Only registered NMHSs can access the products page.

Long-Range Forecast Services in KMA

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Abstract

The Korea Meteorological Administration (KMA) has installed new climate prediction system, named GloSea5 (Global Seasonal Forecasting System ver.5), which is the joint seasonal forecasting system with the UK Met Office (MO). KMA and MO share their ensemble members. GloSea5 has the model version of HadGEM3 GA3.0 and the horizontal resolution of 60km in 2013. It is operationally running for KMA long-range forecast (LRF).

Based on GloSea5, KMA has produced probabilistic long-range forecasts including 1-month and 3-month forecasts, and seasonal climate outlook for the season after the coming season since June this year. They are available on the KMA web site of www.kma.go.kr.

KMA plays an important role in the field of global climate services. KMA as GPC_Seoul is performing its duties providing global prediction results of GloSea5. Moreover, KMA is operating the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME) which started implementing its mission in 2009. Using 12 GPCs data, LC-LRFMME produces global MME prediction results by various MME methods and provides them to WMO Members on its web site of www.wmolc.org.

Development of seasonal forecasting service in Mongolia

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Abstract

From middle of 1960's, National Hydro-Meteorological Agency of Mongolia has started to provide public by a monthly weather forecast. At present, National Agency of Meteorology and Environment Monitoring (NAMEM) releases a monthly weather outlook and seasonal outlooks. Forecast elements can vary according to all or some of following: monthly mean temperature anomaly, precipitation ratio and wind event. The monthly weather outlook is issued at the end of month. The monthly weather forecast includes more detail information about change of weather condition both in time and place. The seasonal forecast includes temperature anomaly, precipitation ratio for each month during the season. The seasonal forecast is issued two times a year in late March /Warm season/ in late August /Cold season/. Seasonal and monthly outlooks are distributed via internet to the public.

Monthly and seasonal outlook operation is very subjective. However, it uses several statistical models. Main two of them are not updatable every month. Therefore, seasonal outlook issued only two times a year. Therefore, cooperating with Pusan National University (PNU), NAMEM is planning to apply dynamic model in long range weather forecasting service in near future.

PNU Global Ocean-Atmosphere Prediction System –coupled CGSM would be key component of the system. The coupled model consists of AGCM-CCM, OGCM-MOM3 and elastic-viscous-plastic sea-ice model. The spatial is T42L18 in an atmosphere and ~2.8^{o},L40 over ocean. The system will produce 10 ensemble members with 8 month lead time. Dynamic downscaling will be applied over Mongolia using WRF. Its horizontal resolution would be 60km and less. The experiment to the create model climate is going to start on PC cluster system. After expanding computing power of our SC, the system will be moved to it.

Based on study results, we also planning to develop statistical methods which use climate indexes and tele-connection indexes as predictors.

JMA's New Seasonal Prediction System: JMA/MRI-CGCM2

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Abstract

The Japan Meteorological Agency (JMA) plans to update its operational atmosphere-ocean coupled seasonal forecast system in collaboration with Meteorological Research Institute.

The next system includes several new features as follows: 1) enhanced horizontal and vertical resolution both in atmospheric and oceanic models; 2) expansion of the oceanic model to global region with the tripolar grid and introduction of interactive sea-ice model; 3) atmosphere and land initial conditions from a new JMA reanalysis (JRA-55), and ocean initial conditions from a new ocean data assimilation system (MOVE/MRI.COM-G2); 4) more sophisticated description of historical and projected greenhouse gases (6 gases prescribed with RCP4.5 scenario); 5) abolishment of momentum and heat flux adjustment; 6) introduction of a stochastic physics scheme for better representation of uncertainty; and lots of improvements in physics schemes in atmospheric and oceanic models.

Performance of the new system is evaluated using the hindcast experiment for the 30-year period from 1981 to 2010. JMA/MRI-CGCM2 shows improvement of El Niño-Southern Oscillation (ENSO) prediction skill in longer lead time particularly over the spring barrier and amplitude of SST interannual variability. Furthermore, it improves atmospheric prediction skill particularly of 2-m temperature and precipitation for 3-month forecast, sea-ice interannual variability and decreasing trend in Arctic region, warming trend of 2-m temperature over land, and MJO amplitude which is too small compared with analysis in the current system.

These improvements result mainly from above-mentioned newly introduced features. The new coupled forecast system will be implemented in the middle of 2015.

Seasonal predictability of tropical cyclone formation by the JMA/MRI-CGCM

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Abstract

Seasonal prediction of tropical cyclone (TC) activity is important for mitigating socio-economic damage due to TCs in the Asia and Pacific regions. The TC activity in the western North Pacific (WNP) has a strong interannual variability related to the El Niño-Southern Oscillation (ENSO). Namely, the monsoon trough, the most common region for TC formation in the WNP, tends to extend (retreat) eastward (westward) during El Niño (La Niña). Therefore, it is important to well predict the sea surface temperatures (SSTs) variability in the tropical Pacific associated with the ENSO.

We have examined the capability of TC seasonal prediction from June to October in the WNP using a 30-year (1981-2010) hindcast dataset with the JMA operational atmosphere-ocean coupled seasonal forecast model (JMA/MRI-CGCM). We detected TCs from the hindcast dataset by an objective algorithm and verified with the best track dataset of the Regional Specialized Meteorological Center, Tokyo. The results show that the JMA/MRI-CGCM has a good skill in predicting interannual variability of tropical SSTs and atmospheric circulation variability responding to it, and it is capable of well predicting the interannual variability in terms of the number and the location of TC formation in the WNP.

The JMA/MRI-CGCM will be upgraded in 2015 to the next generation model (JMA/MRI-CGCM2), with modifications of a higher horizontal and vertical resolution, a new sea-ice model, some improved physical schemes. The prediction skill of interannual variability of TC formation with the JMA/MRI-CGCM2 in the WNP is almost comparable to that with JMA/MRI-CGCM. In contrast, the JMA/MRI-CGCM2 has a less systematic error in the climatological mean longitude of TC formation, because it has less precipitation biases over the monsoon trough region and a better reproducibility of low-level circulation over the South China Sea and the east sea of Philippine. The seasonal prediction of TC formation with the JMA/MRI-CGCM2 is expected to provide more useful information than that with the JMA/MRI-CGCM.

Subseasonal predictability in negative phases of the Arctic Oscillation

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Abstract

Negative phases of the Arctic Oscillation (AO) sometimes result in extreme cold conditions over hemispheric-scale regions in boreal winter, and give significant impacts on various socioeconomic sectors. Reliable forecast of such events is important. In this study, we investigated the predictability initiated in the negative phases of AO using a suite of hindcasts with the latest Japan Meteorological Agency One-month Ensemble Prediction System. Three phases, namely negative, normal and positive phases are defined using AO index with thresholds of -1.0, 1.0 standard deviations of the index. The AO index is computed by projecting daily sea level pressure (SLP) fields to the first leading mode of empirical orthogonal function analysis of monthly SLP. Using anomaly correlation coefficients (ACCs) as measures of prediction skill and stratifying ACCs of 28-day averaged forecasts for SLP and geopotential height at 500hPa (Z500) for the cases initiated in negative, normal and positive phases, a rate of ACCs above 0.7 for SLP (Z500) in the negative phases is roughly 25 (15) percent higher than that for normal phases. This suggests that predictability initiated in the negative phases is higher than that in normal phases. Though that in the positive phases is also higher than that for normal phases, we found that the predictability of negative phase events was even higher. Further diagnostics indicate that synoptic and planetary wave-mean flow interaction is a key dynamical basis for high predictability. More details will be shown in the presentation.

The JRA-55 Reanalysis: General specifications and basic characteristics

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Abstract

The Japan Meteorological Agency (JMA) conducted the second Japanese global atmospheric reanalysis JRA-55. It covers the period starting in 1958, when regular radiosonde observations began on a global basis. JRA-55 is the first comprehensive reanalysis that has covered the last half century since the ERA-40 reanalysis, and is the first one to apply four-dimensional variational data assimilation (4D-Var) to this period. The main objectives were to address issues found in previous reanalyses and to produce a comprehensive atmospheric dataset suitable for studies of climate change and multidecadal variability. The observations, data assimilation system and forecast model used to produce JRA-55 as well as the basic characteristics of the JRA-55 products are introduced. JRA-55 has been produced with the TL319 version of JMA's operational data assimilation system as of December 2009, which was extensively improved since the JRA-25 reanalysis. It also uses many newly available and improved past observations. The resulting reanalysis products are considerably better than the JRA-25 products. Two major problems of JRA-25 were a cold bias in the lower stratosphere, which has been diminished, and a dry bias in the Amazon basin, which has been mitigated. The temporal consistency of temperature analysis has also been considerably improved. This presentation also assesses the impacts of model biases and changes in the observing system.

Recent JMA's activities for climate related decision making
- Climate Risk Management in the Apparel Industry -

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Abstract

Climate Prediction Division, Japan Meteorological Agency (CPD-JMA), takes activities to make best practices for promoting the use of climate forecasts (especially temperature) and observation data together with user side organizations in some sectors. In my presentation, I'll introduce researches about practical use of weather and climate information for apparel-fashion industries.

1. Background

JMA has been conducting a project to promote climate risk management (CRM), which involves reducing weather risks caused by extreme events such as heat waves or cold spells, in various sectors using extended-range weather forecasting, especially using the "Early Warning Information on Extreme Weather"(a two-week forecast).

2. CRM Research in the Apparel Industry

Together with Japan Apparel Fashion Industry Council (JAFIC), JMA investigated the relationship between fashion items and weather factors, especially temperature. For example, sales volumes of long boots tend to increase remarkably when average temperature falls below 20°C. Additionally, we investigated how to use the two-week forecast for sales promotion to get more benefit.

3. Implemented Action Plans for CRM

- Deciding a proper time for increasing/decreasing the number of each item
  For example, for late summer heat, you will keep items suitable for high temperature (replace cut-and-sew dresses and pants with blouson).
- Modifying the supply volume from warehouses to stores
  For example, when temperature is forecasted to exceed the threshold where sales of sandals increase remarkably, you will increase the number of colors and sizes of sandals to prevent stock-out.
- Strengthening visual merchandising (VMD) such as point of purchase (POP) placement
  For example, if we expect knit hats sales to increase, you will move knit hats to the aisle space (eye-catching area for customers).
- Preparing sales talks for customers
  For example, when temperature is forecasted to fall to the threshold, where innerwear is required, store assistants will ask customers to prepare for cold weather with innerwear.
- Arranging sales floor plans
  For example, if the late summer heat continues and knit hat sales do not increase, you will keep cut-and-sew items suitable for high temperature.

4. Demands from Experts and Future Strategies

- We now provide 2-week forecast as average temperature, but it is not easy to understand intuitionally in many industries, so forecasting for the maximum or minimum temperature would be preferable.
- As each area possibly has a different threshold temperature, in actual use, more precise analysis for individual regions should be conducted.
- Considering errors in forecasts, guidelines should be prepared on how to use JMA's probabilistic forecasting (for example, action plans according to ranks).

Global warming hiatus:its mechanisms and role of internal decadal variability

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Abstract

It is well recognized that the global-mean surface temperature rising is paused during the last 15 years, contrasting to the rapid warming in the late 20th century. This warming slowdown, called the global warming hiatus, has attracted great attention from climate science community and society, but the mechanisms are yet fully clarified. Of particular concern is the extent to which the hiatus is caused by internal and external drivers of the climate system. Recent observational studies showing the TOA excess energy continuing in the 2000s, increasing global-mean sea level, and rapid warming of ocean interior all indicate that the global warming itself is not paused, the excess radiative energy absorbed by deep oceans instead. This increasing ocean heat uptake may be linked with the anomalous surface temperature pattern during the hiatus, akin to the negative phase of the Pacific decadal oscillation. This suggests a vital role of internal decadal fluctuations in the hiatus. Using a coupled GCM to which observed tropical wind stresses have been assimilated, we present robust estimate of the fractional contribution of the internal variability to decadal-mean global temperature changes, which is considerably large not only for the hiatus but for the warming acceleration periods.

Roles of the Planetary Wave Reflection in the Stratosphere-Troposphere Dynamical Coupling

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Abstract

It has been widely recognized that there is a strong mutual linkage between stratospheric variability and anomalous weather patterns in the troposphere. The stratospheric sudden warming (SSW) event is a typical example of the upward influence of the tropospheric anomalous weather pattern, such as the blocking event, on the stratospheric circulation through upward propagating planetary waves. On the other hand, the consensus on the downward influence of the stratospheric anomalies on the surface climate has not been fully established. Although the annular mode (AM) might be a promising dynamical framework for such downward influence, observational studies reveal that large negative northern annular mode (NAM) events in the stratosphere associated with SSW events are not always followed by negative tropospheric NAM anomalies. In this talk, we propose an alternative candidate for the downward influence mechanism of the stratospheric circulation through the reflection of planetary waves in the stratosphere based on the analysis of a reanalysis dataset and a series of ensemble reforecast experiments.

First, the relationship between stratospheric planetary wave reflection and blocking formation in the troposphere is elucidated by case studies. The enhanced upward propagation of a planetary wave packet from the Eurasian sector, involving a Euro-Atlantic blocking, leads to a SSW. Following the weakening of the stratospheric westerly jet due to polar warming, the stratospheric planetary wave packet then propagates downward over the American sector, inducing a ridge over the North Pacific as well as a trough over eastern Canada in the upper troposphere. The ridge promotes the formation of a Pacific blocking. This result explains why Pacific blockings tend to form after SSW.

Second, to reveal the occurrence mechanism and the predictability characteristics of a typical splitting type SSW in January 2009, we have conducted a series of ensemble reforecast experiments by using the MRI-EPS (Meteorological Research Institute-Ensemble Prediction System). In this experiment, we find that for failed forecasts of the vortex splitting, upward propagating planetary waves from the troposphere are reflected by preexisting polar night jet and propagate downward into the troposphere, which in turn produces a Pacific blocking.

These facts suggest an important role of planetary wave reflection in the stratosphere for the formation of tropospheric anomalous weather patterns, especially in the Pacific sector.

Various ENSOs and East Asian winter monsoon

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Abstract

Parts of seasonal-scale atmospheric predictability come from atmospheric responses to ENSO because of its originally owned high seasonal predictability. This may be the case for East Asian winters. The prediction about ENSO occurrences is successfully accomplished by operational numerical prediction techniques. A possible next step is to predict more details of individual ENSOs.

A statistical study reported here is made to know the effect of various ENSO-type sea surface temperature anomalies (SSTA) on East Asian winters. The results may be helpful for understanding each East Asian winter climate and what to be improved in numerical seasonal predictions.

The empirical orthogonal function (EOF) analysis is applied to a winter-to-winter variability of tropical SSTA within 10S-15N from the Indian Ocean to the eastern Pacific during 1980/81-2003/04. The impacts of each SSTA pattern on precipitation (PR), 850hPa air temperature, 200 and 850hPa stream-functions over East Asia are estimated by calculating their regression on the temporal variability of the obtained SSTA EOF coefficients. The first EOF (which explains 42.5% of the total variability) indicates a typical ENSO SSTA, the second one (15.7%) is Modoki (Ashok et al., 2007) or CP-ENSO SSTA, the third one (13.1%) represents EP-ENSO, the fourth one with negative SSTA and PR anomaly intensified over the western Pacific.

The 1-4th EOFs for the tropical SSTA characterize the longitudinal locations of PR anomalies. This is critical for individual East Asian winter climate because PR anomalies in tropical Indian Ocean to the western Pacific produces a northern atmospheric response off the equator, creating warm and moist low-level northeastward air flow toward extra-tropics and inducing cold and dry flow in other longitudes from high-latitudes. The example for a typical ENSO may be known well; when the 1st EOF is dominant, warm and moist air flow passes through East Asia. When the 2nd EOF modifies SSTA and PR significantly, East Asia may be occupied with cold and dry air.

The fourth and fifth EOFs are related to north-south and east-west SSTA contrasts over the tropical Indian Ocean. These SSTA also feature PR anomaly influential to East Asian winters.

Arctic Sea Ice and East Asian winter monsoon

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Abstract

Summertime Arctic sea-ice cover has experienced an accelerated decline during the last 10 more years. After the recent sea-ice reduction of the Arctic ice extent, however, strong cold waves often attacked the European and Central-to-East Asian countries in the following winters. Observational evidence shows that significant cold anomalies over the Far East in early winter and zonally elongated cold anomalies from Europe to Far East in late winter are associated with the decrease of the Arctic sea-ice cover in the preceding summer-to-autumn seasons. In this study, through a sensitivity experiment using an AGCM, influence of low Arctic sea-ice minima in early autumn on the wintertime climate over Eurasia is investigated.

The summer Arctic sea-ice reduction along the Siberian coast tends to reduce ice cover of the Barents–Kara Seas in late autumn. Near-surface anomalous diabatic heating associated with the anomalous sea-ice cover becomes apparent in autumn, which tends to excite a stationary Rossby wave train in late autumn. The wave train propagates southeastward, and forms anticyclonic anomalies over the Barents Sea and cyclonic anomalies over central Eurasia in the upper troposphere in the light ice case. The upper tropospheric height anomalies thus-formed are maintained through feedback forcing from high frequency transient eddies. Eastward propagation of the height anomalies toward the Far East in early winter tends to induce near surface amplification of the Siberian high in the light ice case, which intensifies cold northerlies over the Far East. The zonally elongated cold anomalies over Eurasia in late winter are also reproduced in our experiment, which is associated with the negative phase of the North Atlantic Oscillation.

The relationship between Japan's recent temperature and decadal variability

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Abstract

Since the late 1990s, surface temperature has been higher than (near or lower than) normal for summer/autumn (winter/spring) over Japan, indicating that the seasonal temperature contrast has become enhanced. In order to relate this to global-scale variability on decadal timescale, atmospheric re-analysis and ocean assimilation datasets were analyzed. It is suggested that the La Niña-like conditions which have been frequently observed in the tropical Pacific oceanic and atmospheric fields in the last decade have contributed to these temperature tendencies observed in Japan. These global characteristics are consistent with the global warming hiatus. The results presented here indicate that not only interannual variability and century-scale long-term trends but also decadal variability in global oceanic and atmospheric fields significantly affect Japan's temperature.

The results shown in this presentation indicate that the impacts of decadal variability are important for understanding Japan's climate. In addition, atmospheric datasets in longer time scale such as JRA-55 make it possible to investigate the relationship between decadal variability and global/regional climate. Based upon these issues, we are planning to improve diagnostics and explanations about decadal variabilities provided in JMA HP in this year. Such progresses in understanding of decadal variability will also contribute to seasonal forecasting and further studies are required.

Statistical relationship between ENSO and East Asian climate

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Abstract

ENSO is the most dominant mode of the climate system and the most reliable signal for seasonal prediction. To this day, when numerical prediction techniques are advanced well, ENSO is still important as the source of predictability.

In order to promote the understanding of the influence of ENSO on atmospheric circulation and support seasonal prediction, JMA produced the products on statistical relationship between ENSO and the climate system using the reanalysis dataset (JRA-25) between 1979 and 2008 as atmospheric circulation data, the COBE SST analysis dataset and ground-based observations (CLIMAT reports), and provides the products through the Tokyo Climate Center (TCC) website[1].

JMA is currently producing new statistical products using the second Japanese global reanalysis (JRA-55), which covers the period starting in 1958, and plans to update the web contents of the ENSO statistics in next year (2015).

As the period for the analysis is extended from 1979-2008 to 1958-2012, the new statistical products are more reliable than the current products, which is expected to be make us expand understanding of relationship between ENSO and climate.

In the presentation, some interesting statistics on relationship between ENSO and East Asian climate will be introduced.

[1] http://ds.data.jma.go.jp/gmd/tcc/tcc/products/clisys/newoceanindex/index.html
http://ds.data.jma.go.jp/gmd/tcc/tcc/products/climate/ENSO/index.htm

The Characteristics of Northern China Drought in Summer 2014 and its Relationship with East Asian Summer Monsoon

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Abstract

From June 1 to August 22nd, 2014, precipitation is 50% less than normal in many regions of northern China, including central and southern Northeast China, eastern North China, the regions between Yellow River and Huaihe River, southeastern Northwest China and northern Hubei Province. Less precipitation, higher temperature and more soil evaporation were the main factors to cause the severe droughts in most parts of northern China. The droughts this summer were very severe especially in Henan, Liaoning provinces and characterized by long duration, wide coverage and rapid developing, occurring in the key period of crop growth and yield-forming of autumn grain crop. Since the drought-stricken provinces have dense population, developed economy and they are major grain producing areas, the droughts had a huge impact on agriculture and human well-being.

The external forcing factors and circulation anomalies causing the drought event were analyzed. Warmer SST in tropical India Ocean and Pacific Ocean caused the Western North Pacific Subtropical High stronger and its location more south than normal. East Asian summer monsoon was weaker than normal and warm moist air maintained mainly in the regions south of the Yangtze River, which ultimately resulted in high temperature and deficient rainfall weather lasting for a long time in northern China.

Facing the severe drought event, BCC/CMA and local meteorological departments provided services for the local governments and the masses, such as real-time drought monitoring information, rolling forecasts and plentiful impact assessment materials, which received widespread praises.

Weakening of stratospheric polar vortex by Arctic sea-ice loss

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Abstract

Successive cold winters of severely low temperatures in recent years have had critical social and economic impacts on the mid-latitude continents in the Northern Hemisphere. Although these cold winters are thought to be partly driven by dramatic losses of Arctic sea-ice, the mechanism that links sea-ice loss to cold winters remains a subject of debate. Here, by conducting observational analyses and model experiments, we show how Arctic sea-ice loss and cold winters in extra-polar regions are dynamically connected through the polar stratosphere. We find that decreased sea-ice cover during early winter months (November– December), especially over the Barents–Kara seas, enhances the upward propagation of planetary-scale waves with wavenumbers of 1 and 2, subsequently weakening the strato-spheric polar vortex in mid-winter (January–February). The weakened polar vortex preferentially induces a negative phase of Arctic Oscillation at the surface, resulting in low temperatures in mid-latitudes.

Variations of the Arctic Oscillation and its impact on East Asian winter

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Abstract

The variations of the Arctic Oscillation (AO) and its impact on East Asian winter was investigated by using the second Japanese global atmospheric reanalysis JRA-55 which covers the period starting in 1958. In this study, we analyzed long-term variations of the AO for winter (December-January-February) using the AO index after Thompson and Wallace (1998), focusing on its relationships with the Pacific Decadal Oscillation (PDO) and El Niño/La Niña, and investigated the relationship between temperature and precipitation during East Asian winter and the AO. SST anomalies averaged in the NINO.3 area were adopted as the index for El Niño/La Niña.

The negative AO frequently appeared for the period from late 1950s to late 1980s and after late 1990s. Extreme negative AO was observed in 2009/10 winter. The positive AO frequently appeared during the 1990s. No statistically significant correlation between the AO index and the PDO index, and that between AO index and ENSO index are detected. When focusing on the winter seasons when the AO index exceeds a threshold of 0.5, however, the positive AO tend to occur under the negative PDO three times more frequently than the positive PDO. Occurrence of the negative AO is more often than the positive AO under the El Niño phase (i.e., when five-month moving average of the ENSO index exceeds +0.5 for six consecutive months).

In East Asian winter, surface temperatures are related to the AO. In the positive AO, positive temperature anomalies were observed around northern East Asia. In the negative AO, negative temperature anomalies were seen in most of East Asia. The total amount of the precipitation rate was above normal around the eastern China in the positive AO.

We will show the details of the investigation at the presentation.

Relationship between AO, NAO and EAWM indexes and climate of Mongolia

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Abstract

Large-scale atmospheric circulation patterns explain much of the variability and trends in precipitation and temperature at the regional scale. Among these, the Arctic Oscillation (AO) and North Atlantic Oscillation (NAO) are one of the dominant atmospheric circulation patterns over the extra-tropics of the Northern hemisphere.

The East Asian winter monsoon (EAWM) system is one of the most active components of the global climate system. The Siberian High (SH) is the key component of EAWM. Mongolia locates under direct impact of SH, thus, there could have whether direct or indirect relation between EAWM and winter climate of Mongolia. The study investigate the correlations statistically not in deep physically.

It is found that AO has higher impact not only on winter temperature but also on spring temperature of Mongolia. The impact is stronger over Orkhon –Selenge River Basin and Eastern steppe of Mongolia. But correlation between AO and precipitation is insignificant. Compared with influence of the AO, NAO shows less impact on temperature. However, it is higher than that is on precipitation. Also, there is no specific spatial pattern in the impact of NAO.

The study defined that EAWM has higher impact on winter climate compared to EASM impact on summer condition of Mongolia. There are many EAM indexes. However, the most common 22 EAWM and 15 EASM indexes were selected and identified the most correlated one with climate of Mongolia. EAWM index of Zhu (2008), which is defined on zonal wind at 500hpa has the highest correlation (-0.8) with winter temperature of Mongolia and Chen et. al. (2000)'s index, which is calculated on meridional wind at 10m height, has highest correlation (-0.38) with winter precipitation. After modifying the coverage of indexes of Zhu (2008) and Wang and Jiang (2004), the correlation coefficients for temperature and precipitation are increased up to -0.83 and 0.40, respectively.

Further goal of the study is to develop statistical method to predict winter climate of Mongolia based on climate indexes and large scale variables including tele-connection indexes.

Improvement in simulation of Eurasian winter climate variability with a realistic Arctic sea ice condition in an atmospheric GCM

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Abstract

The present study investigates how much a realistic Arctic sea ice condition can contribute to improve simulation of the winter climate variation over the Eurasia region. Model experiments are set up using different sea ice boundary conditions over the past 24 years (i.e., 1988–2011). One is an atmospheric model inter-comparison (AMIP) type of run forced with observed sea-surface temperature (SST), sea ice, and greenhouse gases (referred to as Exp RSI), and the other is the same as Exp RSI except for the sea ice forcing, which is a repeating climatological annual cycle (referred to as Exp CSI). Results show that Exp RSI produces the observed dominant pattern of Eurasian winter temperatures and their interannual variation better than Exp CSI (correlation difference up to 0.3). Exp RSI captures the observed strong relationship between the sea ice concentration near the Barents and Kara seas and the temperature anomaly across Eurasia, including northeastern Asia, which is not well captured in Exp CSI. Lagged atmospheric responses to sea ice retreat are examined using observations to understand atmospheric processes for the Eurasian cooling response including the Arctic temperature increase, sea-level pressure increase, upper-level jet weakening and cold air outbreak toward the mid-latitude. The reproducibility of these lagged responses by Exp RSI is also evaluated.

Characteristics of 2014 summer over Korea

So-Young Yim, E-Hyung Park, and Hyun-Sook Jung
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Abstract

South Korea experienced near normal temperature and precipitation in 2014 summer. The summer mean temperature over South Korea was 23.6°C , which was the same as normal (1981~2010 average). The June, July, and August temperature anomalies were +0.7°C, +0.6°C and -1.3°C, respectively. Furthermore, the summer mean precipitation was 599.8mm, which was 84% of normal. The monthly precipitation ratios to normal were 50%, 53% and 138% for the June, July and August, respectively.

In early June, upper level ridge has developed over the Sea of Okhotsk which blocked the eastward air flow over East Asian region. The upper level cold and dry air flowed into the Korean Peninsula and induced severe atmospheric instability. This frequently led to rain shower and thunderstorm over central and southern regions of South Korea. The Changma started on 17 June from Jeju Island, which is 2 or 3 days earlier than normal. However, in southern and central part of South Korea Changma started on 2 July and ended on 29 July, which represents late onset and retreat Changma compared to normal. Total amount of Changma rainfall was less than half of normal precipitation because the front was frequently located near Jeju Island and central and southern regions were under anomalous anticyclone.

In August, the pronounced anticyclone anomaly was seen in the western North Pacific, which enhanced southwesterly winds along the flank of the anomalous anticyclone. The other anticyclone was seen over the Sea of Okhotsk, which brought cold air from north to meet with warm and moist southwesterlies. As a result, South Korea had frequent rainy days(18.2 day/month) than normal, which is the 2nd record since 1973.

Characteristics of East Asian summer monsoon 2014

Yoshinori Oikawa, Kengo Miyaoka, Kazuto Takemura, and Shotaro Tanaka
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Abstract

Temperatures in the East Asian monsoon region averaged over the three months from June to August 2014 were above normal in northern Japan, northeastern China, southeastern China, and southeastern Mongolia, and were below normal in western Japan, eastern China and northern Mongolia. Precipitation amounts for the monsoon season were above normal in northern Japan, western Japan, and southern China, and were below normal in northeastern China and parts of Mongolia. Convective activity around the Philippines was enhanced in July and suppressed in August. Reflecting the change in convective activity, cyclonic circulation anomalies in the lower troposphere around the Philippines observed in July was replaced by anti-cyclonic circulation anomalies in August. During the season a total of 8 tropical cyclones of tropical storm intensity or higher were generated over the western North Pacific and 7 among them approached or made landfall on East Asian countries and the Philippines.

From late July towards late August, Japan experienced above-normal rainfall and below-normal sunshine duration nearly nationwide. Most notably the monthly precipitation for August averaged over the Pacific side of western Japan was the highest since 1946 and exceeded three times as much as its normal. The causes of this extremely wet conditions are analyzed to be threefold: (i) Typhoon Nakri and Typhoon Halong in early August, which moved northward at low speed and influenced western Japan for a longer time than otherwise; (ii) synoptic-scale fronts around the mainland of Japan in mid- to late August, which were associated with the southward meandering of the subtropical jet stream to the west of Japan; (iii) the Pacific High that was enhanced to the southeast of Japan, combined with anti-cyclonic circulation anomalies in the lower-troposphere around the Philippines, leading to persistent moist air flow into western Japan. One of the primary factors that are thought to have contributed to the jet stream meandering and the anti-cyclonic circulation anomalies is presumably suppressed convective activity around the Philippines. The suppression of convective activity in turn was associated with enhanced convective activity in the eastern Pacific and the eastern Indian Ocean, as well as the tropical intra-seasonal variability that coincidentally came into the phase of inactive convection around the Philippines.

An Overview of Climate Characteristics of 2014 Summer over China

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Abstract

In this study, the climate characteristics of summer over China in 2014 will be presented. During the summer of 2014, the seasonal surface air temperature averaged over China was 21.1°C, with 0.2°C above normal (20.9°C). The mean precipitation was 320.1mm over China, which was 1.6% below normal (325.2mm). For the season, extremes of High Temperature (HT), Consecutive High Temperature Days (CHTD), Daily Precipitation (DP) and Consecutive Precipitation Days (CPD) were observed in China.

The Beijing Climate Center (BCC) monitoring showed that both of two monitoring indices of the South China Sea (SCS) summer monsoon onset exceeded their thresholds since the 2nd pentad of June (6th to 10th), namely the mean potential pseudo-equivalent temperature above 340k and the zonal wind changing from easterly to westerly over the monitoring area (10°-20°N, 110°-120°E). It was 3 pentads later than normal (the 5th pentad of May). The recent monitoring showed that the SCS summer monsoon in 2014 ended in the 6th pentad of September, with the same date as the normal. The intensity of the SCSSM was a bit weaker than normal. During the summer (JJA) of 2014, the intensity of the East Asia Summer Monsoon was slightly weaker than normal, with the intensity of -0.20. For the rainy season of 2014, the total precipitation over eastern China showed “more in South and less in North” feature.

ENSO outlook

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Abstract

Japan Meteorological Agency makes public ENSO monitoring information and outlook monthly. Latest ENSO conditions and outlook are presented in this talk.

In September 2014, the NINO.3 SST was near normal with a deviation of +0.4°C. SSTs were remarkably above normal in the western equatorial Pacific. Subsurface temperatures were above normal in most regions from the western to eastern equatorial Pacific. Atmospheric convective activities were near normal from near the date line to the eastern equatorial Pacific, and easterly winds in the lower troposphere were also near normal in the central equatorial Pacific. These oceanic and atmospheric conditions indicate that ENSO neutral conditions continued in the equatorial Pacific.

The subsurface warm waters in the equatorial Pacific in September tend to maintain warmer-than-normal SSTs in the eastern part. The JMA's El Niño prediction model predicts that the NINO.3 SST will be near normal or above normal during the northern hemisphere autumn and winter. In conclusion, the possibility of development of El Niño conditions during the northern hemisphere autumn and winter is comparable to that of continuation of ENSO neutral conditions.

Seasonal Outlook of the Climate in 2014/2015 Winter over China

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Abstract

Dynamical models and statistical analyses will be discussed focusing on East Asian winter monsoon (EAWM), seasonal temperature and precipitation outlook for 2014/2015 winter over China.

There are several abnormal external forcing factors have to be considered. Firstly, the tropical SST over middle and east Pacific Ocean and Indian Ocean are warmer than normal and most of dynamical and statistical models predict that the situations will continue, and an El Niño event is very likely to be developed this winter. Secondly, the Arctic sea ice cover in early autumn of 2014 is smaller than normal and is close to the counterpart in the same period of last year. Besides, it is noted worthy that the SST over northern Pacific is much warmer than normal.

Responding to all-around impacts of the abnormal external forcing mentioned above, the Arctic Oscillation (AO) index may be negative which is slightly weaker than normal, the Northwestern Pacific subtropical high is likely to be stronger and more westward, the Siberian high will be weaker, the East Asian trough will be shallower and the EAWM will be also weaker in 2014/2015 winter. The prediction of key circulation systems produced by Coupled General Climate Model (CGCM) from Beijing Climate Center (BCC) show the similar characters. Under such general circulation anomaly distributions, it is predicted that the air temperatures in northeastern China and North China may be colder than normal, and in most other parts of China will be warmer than normal. In general, the temperature anomalies in China will be above normal in 2014/15 winter, and such character will be more significant in late winter than in early winter. As for the prediction of precipitations, it will be above-normal in northeastern China, the eastern part of Jiangnan and South China, and the eastern regions of northwestern China, but in the other regions will be near or below normal.

Cold Season Outlook for Winter 2014/2015 over Japan

Masayuki Hirai
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Abstract

1. Outlook summary (Figure 1)

JMA issued its outlook for the coming winter (December 2014 – February 2015) over Japan in September and updated it in October. The presentation will illustrate the outlook updated on 24 October 2014.

According to the outlook, mean temperatures in winter are expected to be near- or above-normal, both with 40% probability, in western Japan and Okinawa/Amami and to be near-normal range in eastern and northern Japan. Cold season precipitation amounts are expected to be near- or above-normal, both with 40% probability, on the Pacific side of western Japan and Okinawa/Amami and to be near-normal range over the remaining region.

2. Outlook background (Figure 2)

Figure 2 is the conceptual diagram on expected large scale characteristics of ocean and atmosphere in winter. The outline of outlook background is as follows.

* Sea surface temperatures are expected to be above-normal from the west of dateline to the eastern part of the equatorial Pacific. According to the El Niño Outlook, the possibility of development of El Niño conditions during the coming winter season is comparable to that of continuation of ENSO neutral conditions.
* Convections over the tropics are expected to be more active than normal around the dateline of the tropical Pacific, while more inactive than normal from the Indian Ocean to the Maritime continent.
* Subtropical jet stream is expected to shift southward over the Eurasian continent, in association with inactive convections from the Indian Ocean to the Maritime continent. Accordingly, southwestward anomalies of the upper flow are expected around west of Japan, which would enhance the impact of low pressure around the region.
* The Aleutian low is expected to be more enhanced than climatology in the southeastern part.
* The model predicts positive AO pattern and weak tendency of the Siberian high. However, forecasters assume those characteristics to be no signal, in consideration of prediction skill based on the hindcast.
* Considering all, north-westerly monsoon is expected to be near-normal from northern to eastern Japan and to be weaker than normal in western Japan and Okinawa/Amami.

		Temperature			Precipitation		
Category		−	0	+	−	0	+
Northern Japan	Sea of Japan side	30	**40**	30	30	**40**	30
	Pacific side				30	30	**40**
Eastern Japan	Sea of Japan side	30	30	**40**	30	**40**	30
	Pacific side				30	30	**40**
Western Japan	Sea of Japan side	20	**40**	**40**	30	**40**	30
	Pacific side				20	**40**	**40**
Okinawa/Amami		20	**40**	**40**	20	**40**	**40**

Probability (%) 50 40 Below normal; 40 50 Above normal (Temperature)
Probability (%) 50 40 Below normal; 40 50 Above normal (Precipitation)

(Category −: below normal, 0 : normal, +: above normal, Unit : %)

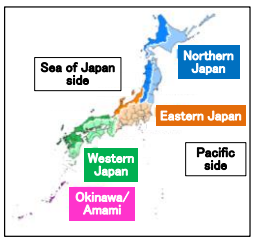

Figure 1: Outlook for winter 2014/15 over Japan

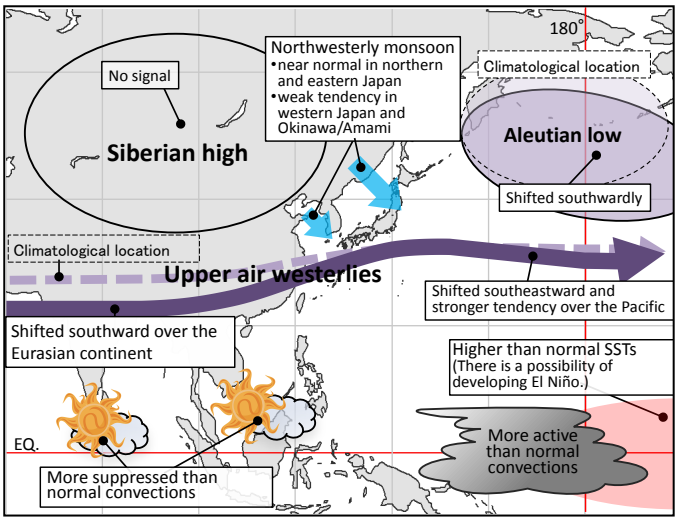

Figure 2: Conceptual diagram on expected large scale characteristics of ocean and atmosphere in winter 2014/15

Climate Outlook For Winter 2014-15 Over Korea

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Abstract

Currently, the sea surface temperature (SST) anomalies in Niño3.4 lasted above normal condition from mid August. The KMA's ENSO forecast model predicts that oceanic conditions across the equatorial Pacific Ocean are tending towards weak El Niño conditions.

A tentative seasonal outlook for winter 2014-15 over Korea based on the comprehensive analysis of climate monitoring, the climate prediction model results of the Korea Meteorological Administration (KMA) and the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (WMO LC-LRFMME) will be presented.

Recent climate feature and seasonal outlook for winter 2014/15 in Mongolia

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Abstract

During the summer 2014, Mongolia has experienced, in general, near normal summer. However, month to month variation was different, June temperature was 16.1^{o}C, -0.4^{o}C below normal almost all over the country, and precipitation was 51.3mm, mainly 155% above normal. July and August temperature were 17.1-19.2^{o}C, 0.4-0.5^{o}C above normal and precipitation were 30-33mm, 61-62% below normal except eastern area.

In terms of general circulation, in sea level pressure field, positive anomaly dominates almost all over the country during the summer.

The beginning of last decade of July was comparatively hot as climatology, during that time the soil was relatively humid. It makes the condition favorable to generate convective related extreme events. As a result, on 26th July, during the passage of cold front system over central area of the country, strong multi-cell squall line with Tornado observed over the area. The Tornado was F3 category according to Fujita scale and first ever recorded by camera. However, scale of the area affected by Tornado is small; the economic loss reached 1 trillion tug and it caused 2 fatalities.

Based on results of the statistical methods and model outputs from other centers, 2014/2015 winter outlook issued subjectively as follows. Winter temperature is expected to be mostly near normal and precipitation will be above normal almost all over the country.

APCC Climate Prediction for Winter 2014/2015

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Abstract

APCC has provided 3-month climate forecast information operated by its proprietary Multi-Model Ensemble (MME) every month from 2007. Since then, the 3-month prediction information has been provided in the developing countries in the APEC regions. Further, APCC has provided 6-month MME prediction information in response to developing countries demand for better adaptation to climate-related risk management since September, 2013. APCC provides deterministic and probabilistic MME global prediction via the website (http://www.apcc21.org). Currently, 17 climate centers and research institutes participate in the APCC operational MME prediction providing the ensembles of global forecast fields. The seasonal outlook for winter 2013/2014 is generated with initial condition of October, 2013.

Prediction map of Simple Composite Method (SCM) MME of 2m-temperature indicates anomalously warm condition over the East Asia. Specifically, warm temperature anomalies are over 0.6 in the East Asian land area. The warmer-than-normal probabilities are over 50% in the same region. The warmer condition is closely related to the sea level pressure (SLP) prediction map of same SCM MME, shows anomalously low SLP in the northern part of the Eurasian continent. Negative SLP implies the weakness of the Siberian High, which is significantly important in the East Asian winter monsoon.

APCC also provides El Niño-Southern Oscillation (ENSO) 6-month deterministic forecast information based on MME prediction. The ENSO forecast information indicates the development of El Niño remains by the end of boreal winter. The El Niño event implies that the East Asian winter monsoon can possibly weak, which means warm surface temperatures.