Number	Presenter	Presenter Affiliation	Title	Abstract	Email
4	Andy Chiodi	JISAO/University of Washington	An OLR perspective on La Niña and El Niño seasonal weather impacts over North America	El Niño-Southern Oscillation (ENSO) impacts on seasonal weather anomalies form the basis for skillful statistical seasonal weather prediction in the regions around the globe where the statistical links between ENSO and seasonal weather anomalies are strong. Tropical Pacific sea surface temperature (SST), sea level pressure (SLP) and outgoing longwave radiation (OLR) all provide measures of the coupled ENSO anomaly state, but of these OLR is most closely connected to the tropical Pacific atmospheric heating anomalies that allow ENSO to influence seasonal atmospheric circulation and weather anomalies elsewhere. A unique warm-ENSO (El Niño) index based on outgoing longwave radiation (OLR) conditions in the tropical Pacific has recently been proposed and found to have an especially close statistical linkage to seasonal weather anomalies over the contiguous U.S. A complimentary OLR-based cool-ENSO (La Niña) index is proposed and this pair of OLR-based ENSO indices is evaluated for their respective connections to interannual seasonal weather and atmosphericcirculation anomalies over North America using composite analysis. We find that over the period for which satellite-based OLR observations are available, almost all of the useful(statistically significant and consistent from event to event) ENSO impacts on seasonal precipitation are due to the years distinguished by the OLR-based ENSO indices ("OLR El Niño"; "OLR La Niña"). On the other hand, composites based on other years with ENSO status based on the current NOAA definition do not have nearly as robust orstatistically significant anomaly patterns as the OLR ENSO events. The OLR El Niño and OLR La Niñayears are typically (9 of 10) distinguished from others by the respective OLR indices prior to the start of the strongly affected winter season. Thus, to the extent this observed behavior holds in the coming decades, OLR diagnostics can serve as indicators of times in which greater confidence can be placed in seasonal forecasts than has perhaps been previously realized. It should be noted also, however, that such times occur only in a subset of the conditions now commonly identified as ENSO years.	andy.chiodi@noaa.gov
422834541	Anthony Barnston	IRI, Columbia University	Developing a More Reliable and Usable ENSO Prediction Plume	The existing ENSO prediction plume shows forecasts for the Nino3.4 SST index from a large number of dynamical and statistical ENSO prediction models. The forecasts are shown in a raw format in which only the ensemble means of the dynamical model predictions appear. In such a format, uncertainty is expressed in terms of the spread among the different models, but ignored are the implied uncertainties within each dynamical model (expressed in the ensemble member spread) or each statistical model (expressed in the hindcast-based standard error with respect to the observations). Additionally, the anomaly forecasts of some of the models are not expressed with respect to the preferred climatological base period of 1981-2010.Toward achieving a plume with a more explicit and reliable uncertainty distribution, the set of dynamical models in the National Multi-model Ensemble (NMME) project are used for forecast experiments. Six of these NMME models produce real-time forecasts, as well as have hindcasts during the 1982-2010 period, and these models will participate in the initial experiments.Tests are carried out varying the methods for consolidating the ensemble forecasts of the models to form a full probability distribution, to determine the method(s) that deliver highest deterministic and probabilistic skill. We also consider a highly usable and actionable format for the final forecast graphic.Among the skill-maximizing (and thus uncertainty distribution-minimizing) strategies to be attempted, we will try all, or a subset (if all are not finished by mid-October), of the following:(1) Weighting by hindcast skill, using the correlation skill metric, independent of the correlations among the individual model forecasts themselves; (2) same as (1), but now dependent on the correlations among the individual model forecasts (as in multiple regression); (3) weighting additionally by the varying number of ensemble members among the models; (4) use of ensemble spread, which varies from forecast to forecast, versus (or combined with) the uncertainty distribution implied by hindcast skill, and (5) possible use of individual model bias correction prior to consolidation (including the special case of dual climatology calibration for CFSv2, due it its known changing initial condition bias).Although this beginning to an improved ENSO prediction plume may lack the number of models found in the existing plume, the resulting uncertainty distribution and expected skill may be better defined, and perhaps superior, and may serve as a prototype for a larger model set.	tonyb@iri.columbia.edu
564801354	Augustin Vintzileos	UMCP - ESSIC	Predictability and forecast of the MJO: Beyond the RMM index	The Madden-Julian Oscillation (MJO) is among the most important sources of predictability at subseasonal time scales. It modulates the statistics of tropical cyclones across multiple ocean basins during summer and can alter the mid-latitude circulation resulting in substantial pattern changes and in some cases leading to extreme events. The MJO has also been shown to affect the reliability of weather forecasts over Europe and weekly precipitation amounts over poorly irrigated areas such as India during the monsoon. Benefits resulting from reliable operational forecasts of the MJO cannot be over-emphasized. Thus far, even a theoretical explanation of the MJO has been elusive due to the lack of comprehensive observations. An international field campaign CINDY2011 was designed to aid this issue. The Dynamics of the MJO (DYNAMO) was the US component of this campaign.The Climate Program Office of NOAA funded NOAA/CPC and the University of Maryland-ESSIC to provide operational monitoring and forecast support to the campaign. A series of MJO events occurred during DYNAMO making it a very successful observational campaign. In this paper we present a synthesis of experience gained on understanding the MJO using data from the NCEP coupled and uncoupled model forecasts and DYNAMO observations. We first compare the evolution of observed large scale Outgoing Longwave Radiation (OLR) for each of the DYNAMO MJO events to the evolution of forecast OLR. We show that for each of these events the GFS was systematically suppressing near equatorial convection as the enhanced convective phase of the MJO was propagating from the western to the eastern Indian Ocean. This equatorial suppression of convection was leading to an unrealistically subduing of the forecast MJO. We then try to shed light on this forecast behavior by focusing on differences between D YNAMO station observations and GFS forecasts. We finally compare forecast skill between the uncoupled GFS and coupled CFS during DYNAMO and explore hypotheses on the importance of air – sea interaction on the evolution of MJO. We conclude with a list of challenges to address in order to improve future subseasonal forecasting systems.	Augustin.Vintzileos@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
615535833	Barrie Bonsal	Environment Canada	An Assessment of Canadian Prairie Drought: Past, Present, and Future	Droughts are one of the most dramatic manifestations of extremes in the water cycle. Prolonged, large-area droughts are among the world's costliest natural disasters having major impacts on agriculture, forestry, industry, municipalities, recreation, human health and society, and aquatic ecosystems. Within Canada, the Canadian Prairies are particularly drought-prone mainly due to their location in the lee of the western cordillera. Although previous studies examined the occurrence of Canadian Prairie droughts during instrumental, pre-instrumental and to a lesser extent, future periods, none have specifically focused on their trends and variability over all three scales. Using the Palmer Drought Severity Index (PDSI) and Standardized Precipitation Index (SPI) as drought indicators, this investigation assesses the variability of summer drought occurrence over a core region of the Canadian Prairies during a) the pre-instrumental record extending back several centurie s (as inferred from tree rings), b) the instrumental record (1901-2005), and c) the 21st century as projected by several Global Climate Models with multiple emission scenarios. Results show that pre-instrumental droughts were generally more prolonged and severe than those during the 20th century. Projected changes to future droughts differ between the two drought indicators. The PDSI suggests increases in drought frequency and in some cases, severity particularly, after 2050. Conversely, SPI generally shows no significant changes to future drought frequency over the region. All future scenarios for PDSI and SPI do, however, suggest increased variability in drought-related extremes. This study can be considered an initial step toward quantifying and understanding Canadian Prairie drought occurrence over several centuries as determined from paleo, instrumental, and climate model data sources.	Barrie.Bonsal@ec.gc.ca
569370040	Ben Kirtman	University of Miami	The Diversity of ENSO in the NMME Prediction Experiment	The longitudinal position of the center of maximum sea surface temperature anomaly (SSTA) associated with El Niño has become the subject of considerable scientific interest and debate. Much of the debate centers on whether there are two kinds of El Niño - the canonical El Niño that has its maximum close to the coast of South America and the second kind that has its maximum in the central Pacific – or whether there is simply a continuum of events. This second kind of El Niño has several different names in the literature, e.g. "dateline El Niño", "El Niño Modoki", "Central Pacific El Niño" and "Warm Pool El Niño". The above debate is important because there appears to be largely different teleconnections associated with the two types of El Niño and there is some evidence that the relative frequency of these two types changes with a changing climate. In this work, we are agnostic with respect to whether t here are two kinds of El Niño or a continuum. We simply acknowledge that there is considerable variability in the central longitude of the maximum SSTA, and we ask whether the current generation of climate prediction systems can capture this variability.Our approach is to assess whether current models capture the variability in the location of maximum warming within the context of the North American Multi-Model Ensemble (NMME) prediction experiment. The NMME experiment includes nine state-of-the-art coupled ocean-land-atmosphere models in which retrospective forecast have been initialized each month of 1982-2009, and six of the nine models continue to make forecasts in real-time. Our analysis focuses on the retrospective forecasts in the tropical Pacific, and we assess the forecast quality in terms of SSTA and rainfall anomalies. This large ensemble also allows us to assess whether the NMME models detect predictability differences associated with the variability in the longitude of maximum SSTA. Here we propose two simple measures of predictability that can be applied on a forecast-by-forecast case basis. The first predictability metric is a signal-to-noise ratio where we define the signal as the square of the ensemble mean anomaly and we define the noise as the deviation about the signal. The second predictability metric measures how well correlated the individual ensemble members are to the ensemble mean.	bkirtman@rsmas.miami.edu
7	Bertrand Denis	Canadian Meteorological Centre (CMC)	Soil moisture biases and their correction in CanSIPS operational forecasts.	The Canadian Seasonal to Interannual Prediction System (CanSIPS) is based on two versions of CCCma's coupled climate model, and has been generating Environment Canada's operational seasonal forecasts since December 2011. In September 2012, CanSIPS forecasts began contributing to the NMME. (The two models, CanCM3 and CanCM4, are labeled CMC1 and CMC2 in NMME products.) Forecast initial conditions are provided through a set of assimilation runs, one for each ensemble member, in which atmospheric temperature, specific humidity and horizontal winds are constrained by values from six-hourly gridded analyses through a simple assimilation procedure. In the current version of CanSIPS, the land surface is initialized entirely through the model response to the data-constrained atmospheric conditions. This strategy became problematic when the source of assimilated atmospheric data was changed from the ERA-40/Interim reanalyses for the hindcast period to the CMC analysis for the operational forecasts, as necessitated by the availability of the latter in real time but not for the full historical period. Following this change, soil moisture began drifting gradually toward dryer climatologies in both models, especially in CanCM3. One consequence of this drift was a tendency for predicted summer warm and dry anomalies over land to be exaggerated. This presentation will describe the formulation and performance of a procedure, implemented in June 2013, that maintains the hindcast soil moisture climatology in CanSIPS operational forecasts.	bertrand.denis@ec.gc.ca
712847262	Bohua Huang	Center for Ocean-Land-Atmosphere Studies, Institute of Global Environment and Society, Calverton, Maryland, USA	Mechanism and predictability of Southern Subtropical Pacific Dipole Mode in the NCEP CFSv2	By evaluating the climate hindcasts for 1982-2009 from the NCEP Climate Reanalysis and Reforecast (CFSRR) Project using the Climate Forecast System, version 2 (CFSv2), this study identifies two substantial areas of high prediction skill of the sea surface temperature (SST) in the South Pacific. The SST prediction skill in these areas is the highest in the extratropical oceans on seasonal-to-interannual time scales, having scores only slightly lower than for predictions of El Niño and the Southern Oscillation (ENSO). The two regions with the highest SST prediction skill in the South Pacific coincide with the centers of action of the southern subtropical Pacific dipole (SSPD) mode, a seesaw between the subtropical and extratropical SST in the South Pacific. The mechanism of the SSPD mode is also examined, using a 50-yr simulation of the CFSv2 and 50-yr observation-based ocean-atmosphere monthly analyses (1961-2010). The results show that the warm SST anomalie s (SSTA) are initiated by weakened westerly winds over the central South Pacific, which suppress the surface evaporative heat loss and reduce the oceanic mixed layer depth, both contributing to increasing the SSTA. The wind-SST-mixed layer anomalies then evolve coherently in the next two seasons while the cold SSTA develops to the north. The wind perturbations are in turn a response to ENSO, which force an atmospheric planetary wave train, the Pacific-South American pattern, through an anomalous heat source to the east of Australia. As a result, the SSPD has high predictability on multi-season time scales.	guanyh@nuist.edu.cn

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
881833971	Boniface Opoku Fosu	Utah State University	Bay of Bengal Monsoon Onset and Cyclones in a Changing Climate	Bay of Bengal Monsoon Onset and Cyclones in a Changing ClimateAsian monsoon rainfall is essential for agriculture, economic development and the general well being of the people. This study presents analysis of monsoon onset, intraseasonal oscillation, and tropical cyclones in the Bay of Bangel (BoB) over the period of 1975 to 2012. Using ERA-Interim/40 reanalysis and precipitation data from the Asia Precipitation-Highly Resolved Observational Data Integration Toward Evaluation of Water Resources (APHRODITE), we found evidence that monsoon onset in the region is occurring 5-10 days earlier compared to that in the 1970s. Because the Madden Julian Oscillation (MJO) is one of the driving factors for the monsoon rainfall as well as the formation of tropical cyclones, we investigate the extent to which the coupling between the BoB monsoon onset and the MJO may have changed.Indian monsoon depressions (IMDs) originating in, or propagating across, the BoB are the most prolific rain producers during the summer monsoon season. Previous studies have attributed about half of the summer monsoon rainfall in northern India to IMDs. During the pre and post-monsoon seasons, these depressions have the tendency of growing into tropical cyclones which can be very destructive to both shores of the BoB. We examine the changes in the frequency and intensity of IMDs and tropical cyclones over the period of 1975-2012. The transient single forcing experiments performed by the Community Earth System Model version one (CESM1) reasonably depict these depressions and indicate that, while greenhouse gases may be largely responsible for the observed increase in IMDs, aerosol forcing plays a more direct role in the increase of pre-monsoon tropical cyclones and particularly those that impact Myanmar.	bonifosu@aol.com
710313642	Bradfield Lyon	IRI/Columbia University	Tropical Pacific Forcing of a 1998-99 Climate Shift	Observational data and climate model simulations and experiments are utilized to document an abrupt shift in Pacific sea surface temperatures (SSTs) and associated atmospheric conditions, which occurred in 1998-99. Emphasis is placed on the March-May (MAM) season, as the motivation for the work is to extend a recent study that reported an abrupt decline in East African MAM rainfall at that time. An empirical orthogonal function analysis of MAM SSTs over the last century following the removal of the concurrent influence of the El Niño-Southern Oscillation and global warming trend by linear regression reveals a pattern of multidecadal variability in the Pacific similar to the Pacific Decadal Oscillation. Examination of MAM precipitation variations since 1940 indicates, among other findings, that recurrent drought events since 1999 in East Africa, central-southwest Asia, parts of eastern Australia and the southwestern US are all regional manifestations of a global scale multidecadal pattern. Associated shifts in the low-level wind field and upper-level stationary waves are discussed.Simulations using an atmospheric climate model forced with observed, global SSTs capture many of the salient precipitation and atmospheric circulation features associated with the observed shift. Further, when the model is forced only with observed SSTs from the tropical Pacific it also captures many of the observed atmospheric changes, including the abrupt shift in 1999. The results point to the fundamental role played by the tropical Pacific in driving the response to multidecadal variability of SSTs in the basin and provide important context for recent seasonal climate extremes in several regions of the globe.	blyon@iri.columbia.edu
599092527	Hyemi Kim	Stony Brook University	Potential and limitations for the MJO prediction in operational dynamical models	We examine both the potential and the limitations of the MJO prediction using the hindcasts from the most recently upgraded coupled forecast systems of ECMWF VarEPS and NCEP CFSv2. The VarEPS hindcasts were initialized twice per week for the period 1993-2009 with 5-ensemble members whilst the CFSv2 hindcasts were initialized daily for the period 2000-2009 with 4-ensemble members. Real-time Multivariate MJO index (RMM) is used to extract the MJO component for both observation and hindcasts. In both systems, on the average of MJO phases, a strong MJO is predictable about 30 days in advance. Following the strong MJO, the system is predictable about 4-weeks in the ECMWF VarEPS and 3-weeks in CFSv2. In both hindcasts, the skill is relatively low when the models are initialized with the MJO in the Indian Ocean or when the prediction is targeted for a strong MJO in the Maritime Continent, indicating the Maritime Continent limits prediction. A weak dry anomaly over the western Pacific in models could lead to a weak or the absence of an MJO propagation over the Maritime Continent, as the resultant suppressed convection could result in a favorable condition for convection to propagate eastward. A limitation of the MJO prediction skill may result from the rapid drop of the MJO amplitude and from the slow propagation in models. Observations show that the amplitude decreases gradually below the threshold (1.5) after 12-days, whereas the amplitude reaches the threshold faster at 10-days in CFSv2 and at 6-days in VarEPS. The average MJO phase speed is 6.2°/day for observation, 5.1°/day for VarEPS, and 4.9°/day for CFSv2.	
416883530	Craig Long	NOAA/NWS/NCEP/Clima Prediction Center	Evaluation of the CFSv2 45 day forecasts to capture stratospheric-tropospheric events	The NCEP Climate Forecast System version 2 (CFSv2) (Saha, 2010) is a coupled atmosphere, land, ocean model. At every 6 hour cycle the system uses the high resolution (T574L64) analysis from the CFS reanalysis to generate one 9-month lower resolution (T126L64) run and 4-45 day runs. We will present an evaluation of how well the 45-day runs are able to capture significant stratospheric events such as sudden stratospheric and final warmings in the winter hemisphere. We will evaluate how far in advance the model captures these events, their downward propagation, and influence upon the troposphere. We will also present how well the CFSv2 forecasts stratospheric conditions for subtle or enhanced ozone depletion in the SH and any ozone depletion in the NH during their respective late winter/early spring seasons. Initial results indicate that the CFSv2 only captures events once the trigger has taken place. The model does a good job thereafter, modifying the thermal and wind fields and the downward propagation. However, the model fails to extend the events across the tropopause and influence the tropospheric polar temperatures and wind fields.	craig.long@noaa.gov
623659195	D. Nelun Fernando	Univ. of Texas at Austin/Texas Water Development Board	Developing a framework to incorporate climate change projections in water availability modeling for Texas	Developing a framework to incorporate climate change projections in water availability modeling for TexasD. Nelun Fernando and Rong FuWater planning in the state of Texas comes under the aegis of the Texas Water Development Board. Water Availability Models (known as WAM) that use naturalized stream flow, pan evaporation and water rights as input form the basis of water planning in the state. The WAM models are used to assess firm yield at all reservoirs in the state. Firm yield of a reservoir is the amount of water that can be supplied without system failure under a repeat of the worst drought conditions experienced by the state during the 1950s drought-of-record. Climate change projections are not, as yet, factored into water resources planning in Texas. There is a mismatch between the information needs of WAM model users and the format in which climate change information is presently available. We develop a three-step framework by which climate change projections could be incorporated into WAM models if, in the near future, the Texas Water Development Board is mandated by the Texas Legislature to incorporate climate change in water resource planning. As the first step, we explore the empirical relationship between naturalized flow in 13 rivers and rainfall over these river basins over the historical period. Second, we explore the empirical relationship between pan evaporation and evapotranspiration – given that climate models provide evapotranspiration and not evaporation as output. Third, we obtain ranges of possible naturalized flows and pan evaporation in the mid- and late-21st centuries using rainfall and evapotranspiration from the CMIP5 RCP4.5 and RCP8.5 projections and the empirical relationships obtained in steps 1 and 2. We use these ranges to estimate the sensitivity of reservoir firm yield in two sample river basins, the Colorado and the Brazos.	nelun.fernando@jsg.utexas.edu

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
636728571	Dan Collins	NOAA Climate Prediction Center	Climate change and the predictability of extreme events	Climate forecasts at sub-seasonal timescales are believed to derive skill from various sources, such as slowly varying modes of the atmosphere-ocean system, Madden-Julian Oscillation, and persistence. While decadal changes can be a large fraction of interannual variability and a source of predictability in seasonal forecasts, climate change has generally not been examined as a potential source of predictability for sub-seasonal timescales. Recently, there has been an increased interest in the impact of climate change on weather events, especially extremes, defined as the tails of the distribution of potential weather and climate events. There is evidence in observations that climate change impacts the frequency of extreme events and the potential maximum intensity of such events by shifting the distribution, creating a new normal, and with it a new potential for extremes. Identifying the changing frequency of extremes may allow attribution of these events, in a probabilistic sense, to climate change as a cause. In addition to altering the probabilities of extreme events, climate change may also be affecting the fundamental predictability of these events by changing background conditions that can impact the chaotic dynamics of the climate system. Quantifying changes in the predictability of events at sub-seasonal timescales may be important for several reasons, including: 1) Identifying the impact of climate change and decadal variability on changes in forecast skill, especially associated with the prediction of extremes; 2) Determining appropriate adjustments for non-stationarity in the calibration of forecast systems; and 3) Advancing ourfundamental knowledge of how predictability may change in a changing background state. By determining shifts in the statistics of such events, this analysis will use ensemble forecasts with a multi-decade set of hindcasts to examine the predictability of extreme events and how this predictability has changed over time.	dan.collins@noaa.gov
852923846	Daniel Barandiaran	Utah State University	Shifts in the low-level jet and associated precipitation patterns, and their effect on recent droughts in the Central U.S.	We present findings on the changing characteristics of the warm-season low-level jet (LLJ) and associated precipitation over the Central Plains of North America. This circulation feature is key to the transport of moisture from the Gulf of Mexico into inland regions and its variability is tied to recent stormy and drought events. Using the North American Regional Reanalysis dataset (NARR) we found that the LLJ is becoming active earlier in the season, reaching farther inland, and has strengthened overall for the period 1979-2012. There is a concurrent earlier onset of springtime convective rainfall throughout the Central Plains, as well as a northward shift of accumulated and extreme precipitation, resulting in a drying trend south of ~39°N and increased moisture north of this latitude. The month of April saw increased amounts of precipitation throughout the Great Plains, which is explained largely by an increased frequency of extreme rain events. During the month of May the LLJ has strengthened and expanded considerably leading to increased (decreased) frequency and intensity of precipitation events in the Northern Plains (Southern Plains). These changes are manifest as linear trends over the 1979-2012 period and the roles of natural climatic cycles and anthropogenic forcing are discussed. Such changes can amplify drought conditions, especially in the Southern Plains such as what occurred during the 2011 drought, or deliver spring rainfall too soon for agricultural interests to benefit from early season moisture. When combined with increasing temperatures during summer months, earlier delivery of springtime moisture could lead to larger soil moisture deficits and subsequently enhance drought during the summer, placing additional pressure on all water users in the region.	dbarandiaran@gmail.com
438795189	Daniel Tong	NOAA/OAR/ARL	Development long-term climatology of giant dust storms for national climate assessment in the western U.S.	Dust activity is an important indicator to regional climate change. The Dust Bowl in the 1930s was one of the largest natural catastrophes in the North America history, caused by extended drought and poor land management. Although the severity and duration of the 1930s drought was exceptional, reconstructed paleo-climatic records show that the central U.S. plains have experienced severe droughts about once or twice a century over the past 400 years. Dust record is hence an integral component of the national climate assessment (NCA). This work presents our recent efforts to develop a climate-quality indicator of local windblown dust storms in the U.S. For the arid and semi-arid regions of the western United States, we have developed a novel approach to identify local windblown dust events through routine ambient aerosol monitoring (Tong et al., 2012). This work uses the dust identification algorithm to develop a dust storm dataset (dust indicator), and rely on sate llite dust detection and model dust prediction as independent data sources to test, cross-check and validate the dust indicator. This work will extend our research capabilities to contribute developing new climate indicators that are especially aimed at needs of local environmental managers in the Southwestern communities.	daniel.tong@noaa.gov
619579576	David Meyer	Statistical Solutions LLC	Using Ensembled, Statistical-Dynamical Forecasting Methods to Skillfully Forecast Tropical Cyclone Formation in the Western North Pacific: Capitalizing on the Strengths and Mitigating the Weaknesses of CFS Version 2	Abstract Submission to38th Annual Climate Diagnostics and Prediction WorkshopAuthorsDavid Meyer and Tom MurphreeAbstract Submitted byDavid MeyerStatistical Solutions LLC3746 Mesquite Dr.Beavercreek, OH 45440David.statistical.solutions@gmail.comAbstract CategoryEither of the following:• Exploring potential sources of predictability on intra-seasonal to interannual (ISI) time scales• Realizing prediction skill by improving forecast tools and techniques through dynamical models and statistical methods, forecaster practices and protocols, data quality and assimilation, and scientific best practicesPresentation PreferenceOral presentationTitleUsing Ensembled, Statistical-Dynamical Forecasting Methods to Skillfully Forecast Tropical Cyclone Formation in the Western North Pacific: Capitalizing on the Strengths and Mitigating the Weaknesses of CFS Version 2AbstractDuring 2010-2013, we have provided one and two week outlooks for CPC's Global Tropical Benefits/Hazards Assessments regarding the probability of tropical cyclone (TC) formation in the western North Pacific. produce these outlooks, we have developed an ensemble, statistical-dynamical forecasting system that produces TC formation probability forecasts at lead times of 1-90 days. The dynamical components of our system are derived from CFS version 2 (CFSv2) outputs. The statistical components are generated by a logistic regression model that we have developed that processes the CFSv2 output to generate TC formation probabilities at a 1.0 degree spatial resolution and at daily, weekly, and monthly temporal resolution.CFSv2 has both strengths and weaknesses. For example, CFSv2 tends to overstate the number and strength of synoptic tropical vortices, which leads to a significant over-prediction of TCs (this problem also arises in other dynamical Intraseasonal forecasts, such as those from ECMWF). But for forecasting TC activity, CFSv2 does relatively well at predicting large-scale environmental factors that strongly influence the formation of TCs (for example, the large scale variations in low level vorticity and vertical shear associated with the active and suppressed phases of the MJO). We exploit these CFSv2 strengths by using CFSv2 forecasts of the large scale factors to force the statistical model, which then forecasts the times and locations of high and low TC formation probabilities. We use extensive lagged ensembling to generate our system's final forecasts, which greatly increases the forecast skill, especially at leads greater than two weeks. We will present forecasts and sk ill score results for the 2012 and 2013 TC seasons in the western North Pacific, including results that assess the ability of our forecast system to predict the impacts on TC formations of the MJO, El Nino-La Nina, and other climate variations.	david.statistical.solutions@gmail.com

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
477724081	David Unger	NOAA/NWS/CPC	Verification of CPC's Degree Day Outlooks	CPC produces long-lead degree day outlooks based on the CPC seasonal temperature outlooks. These predictions are for population weighted state and regional averages of both heating and cooling degree day totals valid for calendar months. The forecasts are produced by statistically disaggegating the seasonal temperature outlooks to make estimates of monthly anomalies. Degree day totals for NCDC climate divisions are then estimated from the forecast monthly temperature anomalies by statistical relationships derived from climatology. Predicted totals for climate divisions are then projected onto state and regional boundaries to form population weighted averages. This paper will summarize the performance of the CPC degree day outlooks. Because degree day totals are a good estimator of weather-related energy demand, this evaluation provides an estimate of the value of CPC's seasonal outlooks to the energy industry. Results are evaluated by the continuous ranked probability score and show nationwide improvement over climatology of between 5 and 10 percent during the seasons of peak heating and cooling energy demand. Highest skill is evident in the southern and western parts of the nation, although most regions show at least modest skill (3 percent improvement over climatology or higher).	david.unger@noaa.gov
289566007	Emily Becker	CPC	The North American Multi-Model Ensemble: verification of real-time monthly-mean forecasts	The North American Multi-Model Ensemble (NMME) for Intra-Seasonal to Interannual Prediction has been delivering real-time forecasts since August 2011. Recently, five additional forecast variables (soil moisture, runoff, maximum and minimum temperature, and Z200) have joined the original three fields of 2 m surface temperature, precipitation, and sea-surface temperature. During August 2011 – July 2012, the NMME included seven models (CFSv1, CFSv2, GFDL-CM2.2, IRI-ECHAM4-a and –f, CCSM3.0, and GEOS5). As of August 2012, CFSv1 and ECHAM4-a and -f have stopped, and two models from Environment Canada have joined the effort. These forecasts are employed by Climate Prediction Center forecasters in developing the official monthly and seasonal forecasts. In this study, the skill of the monthly-mean forecasts from the individual models and the multi-model ensemble is assessed using various skill measures, and compared to the skill of the official forecasts. The focus of thi s study is primarily on the three original forecast variables, but the additional fields are briefly considered.	Emily.Becker@noaa.gov
794678027	Emily Becker	CPC	Aspects of land surface hydrology in the NMME	Lower boundary conditions are thought to provide a source of skill for monthly or seasonal prediction. In addition to sea surface temperature, the land surface is frequently mentioned in this context. Here, the North American Multi-Model Ensemble (NMME) hindcast data is studied in two different ways. First, the time-lagged correlation between monthly precipitation (P) and temperature (T) in summer is investigated. It has previously been hypothesized that the negative correlation between P and T is caused by a land surface feedback (i.e., wet surface begets cool T). The strength of this land surface feedback in models can be gauged by studying the correlation between P and T in the hindcasts of nine NMME models. Almost all models are found to have a stronger negative P,T correlation than observations, and are thus likely overdoing the surface feedback. The second study is more direct: examining the actual anomalies in the initial soil moisture. Are they realistic? This is the counterpart of asking whether we can initialize SST anomalies in these models, given that we know how important El Niño/La Niña are for the forecast. Obviously, the wrong initial anomalies can do more harm than good, especially in models with a too-strong surface feedback. As soil moisture is one of the five additional variables in NMME "Phase I extended", this can be assessed in real time. The early summer of 2013 featured strong anomalies over the US (a dry west and a wet east), providing a well-defined state for a case study. Of the six models contributing to NMME in summer 2013, only one has initial soil moisture anomalies that look realistic.	Emily.Becker@noaa.gov
115812301	Emily Riddle	NOAA CPC	CFSv2 ensemble prediction of the wintertime Arctic Oscillation	Lagged ensembles from the operational Climate Forecast System version 2 (CFSv2) seasonal hindcast dataset are used to assess skill in forecasting interannual variability of the December – February (DJF) Arctic Oscillation (AO). We find that a small but statistically significant portion of the interannual variance (>20%) of the wintertime AO can be predicted at leads up to two months using lagged ensemble averages. At leads of 1-3 months, our results suggest that using large ensemble averages of up to 60 or more lagged members may be beneficial if older runs are available. We find that the CFS forecast skill is slightly higher when a weighted ensemble is used that rewards forecast runs with the most accurate representations of October Eurasian snow cover extent (SCE), hinting that a stratospheric pathway linking October Eurasian SCE with the AO may be responsible for the model skill. However, further analysis reveals that the CFS is unable to capture many im portant aspects of this stratospheric mechanism.	emily.riddle@noaa.gov
606596243	Eric F Wood	Princeton University	A NMME-based global seasonal hydrologic forecasting system	A critical goal of any Global Drought Information System (GDIS) is to achieve demonstrable skill in predicting drought conditions as an integral part of the climate system up to seasonal to inter-annual scales. Based on the National Multi-Model Ensemble (NMME) data and the Variable Infiltration Capacity (VIC) land surface hydrologic model, we are developing a global seasonal hydrologic forecasting system that can provide 6-month predictions of a set of terrestrial variables key to drought forecasting and water resources management, such as precipitation, soil moisture and runoff. Assessments of both the deterministic and probabilistic hindcast skill will be carried out over several WCRP Global Energy and Water Exchange (GEWEX) basins globally to demonstrate how the system can be used to advance the GEWEX Regional Hydroclimatic Projects (RHPs) for different continents, and how the system facilitates global drought early warning.Based on the joint probability distribution between observations and model hindcasts, the monthly precipitation and temperature forecasts from multiple climate forecast models are we bias corrected, downscaled to a daily time scale and used to drive the VIC land surface model to produce a set of seasonal hydrologic hindcasts globally at one degree resolution. The hindcast experiments are initiated on the 1st of each calendar month during 1982-2009 with multiple ensemble members. A parallel run using the Ensemble Streamflow Prediction (ESP) forecast method, which is based on climatological forcings, is also carried out for comparison. Analysis is being conducted for the predicted soil moisture and runoff over several GEWEX RHP basins, and is targeted to explore the global baseline hydrologic predictability from ESP, and to see whether there are added values from seasonal climate prediction models in specific regimes.Preliminary result for meteorological drought (SPI6) forecast shows that climate models have significantly higher drought onset detectability than ESP over the Mississippi, Amazon, La Plata, and Murray-Darling river basins. The NMME can offer additional skill over those basins that have relatively high skill, but could not help more beyond individual models where the skill is low. Diagnostic studies based on drought forecast at all 1-degree land grid cells indicate that the models tend to predict a drought condition (no matter whether a correct or a false alarm forecast) when the potential predictability is high. While for those drought events that the models cannot capture, their potential predictability is also low. A similar feature is found for the Niño3.4 SST anomaly conditional on the joint distribution of observed and forecasted drought event, where the SST has a smaller anomaly when the climate models fail to capture the global drought onset. Given the high fal se alarm ratio, probabilistic forecast assessment shows that reliability is more important than the sharpness in order to obtain a skillful probabilistic drought forecast. Further analysis for drought and wet spells interpreted by precipitation, soil moisture or basin accumulated runoff is being undertaken to investigate the predictive capability of the system under different hydrologic conditions.	efwood@princeton.edu

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
476893139	Erik Swenson	APEC Climate Center, Busan, Korea	Scaled SVD Analysis and its application to tropical-extratropical teleconnections	Various multivariate statistical methods have been established and proven useful for isolating linear relationships in climate datasets. Popular methods include Canonical Correlation Analysis (CCA), Maximum Covariance Analysis (MCA), and Redundancy Analysis (RDA) which are optimal at maximizing squared correlation, squared covariance, and variance explained, respectively. A generalization of these methods is formed and introduced here as Scaled Singular Value Decomposition Analysis (SSVD), a continuum of methods that allows the role of amplitude to be specified. SSVD is proposed as a particular useful alternative for isolating relationships in under-sampled data. An example of its application is illustrated for relating tropical Indo-Pacific precipitation and extratropical 500 hPa geopotential height during boreal winter. For a range of scaling values, SSVD is shown to better isolate the leading teleconnections associated with ENSO and ENSO Modoki in terms of cross-validated standard measures of relation.	swenson@apcc21.org
993255080	Gabriel A. Vecchi	NOAA/GFDL	NOAA/GFDL Predictions of Hurricane Activity	Methodologies for predicting various measures of hurricane activity at different lead times, from multi-month to multi-year to multi-decade, are explored using GFDL modeling systems. Skillful interannual predictions of seasonal basinwide frequency of storms and hurricanes, and measures of activity that convolve frequency, duration and intensity, such as the Power Dissipation Index (PDI) and Accumulated Cyclone Energy (ACE) are found as early as the winter preceding the hurricane season. Retrospective skill in the predictions is tied to the model's ability to recover the difference in the evolution of tropical Atlantic and tropical mean sea surface temperature. On multi-year timescales there is indication of potential for skillful predictions, but confidence is limited due to a small sample size and the dominance of the 1994-1995 shift in hurricane activity in the Atlantic on estimates of past performance. Changing radiative forcing, particularly associated with ch anges in tropospheric aerosols, is a key component of multi-year and multi-decade hurricane predictability, and possibly impacting seasonal prediction skill as well.	Gabriel.A.Vecchi@noaa.gov
913045359	Hailan Wang	NASA/GMAO and SSAI	Attribution of extreme dry conditions over the western United States during early 2013	This study investigates the extreme dry conditions over the western U.S. during early 2013. Observations, MERRA Reanalysis and NASA GEOS-5 AMIP simulations are used. The results show that factors contributing to the strong precipitation deficits over western U.S. include the SST anomalies in the Pacific, the atmospheric internal variability, and modulations from climate variations on decadal and longer time scales including the negative PDO and long-term globally warming trend.The extreme precipitation deficits during early 2013 resulted from considerably less north Pacific storms reaching west coast of the U.S., under the influence of notably weakened upper-level zonal wind at and to the east of the North Pacific jet exit region. Such weakened upper-level zonal wind was primarily maintained by anomalies in vorticity transients that were related to changes in both SST and atmospheric internal variability. While the Pacific had weak ENSO and PDO during early 2013, the general cold SST anomalies in the tropical Pacific and over the northeast Pacific off west coast of North America, and the warm SST anomalies in central north Pacific considerably contributed to the dry anomalies over southwestern U.S. Finally, the impacts of the negative PDO and globally warming trend on the extreme event will be discussed.	Hailan.Wang@nasa.gov
571580762	Hannah Aizenman	City College of New York	Evaluating ensemble seasonal forecasts using information metrics	Seasonal forecasts obtained by running sophisticated numerical models of the climate system need to be accompanied by well-calibrated uncertainty measures to be fully useful. Measures of information gain may be used to evaluate and calibrate such probabilistic forecasts, but have not been widely applied to the seasonal prediction context.Here, we consider as an example the NOAA Climate Forecast System Reanalysis and Reforecast Project (CFSRR) hindcasts of one-month-ahead global temperature and precipitation fields for 1982-2009. We find that the model outputs need substantial bias correction to even be competitive with the baseline prediction of the climatologicalprobability distribution. Even after bias correction, the model ensemble spread is often too narrow compared with both climatology and the verifying observations, resulting in low information skill scores. Our findings suggest the need for new thinking on how to robustly find windows of appreciable model skill (good predictive capability) amid a generally uninformative background.	nkrakauer@ccny.cuny.edu
245979157	Holly C. Hartmann	University of Arizona	Linking forecast applications and evaluations	Forecasts serve as a key link between decision makers and operational climate services, because almost all resource management decisions require, whether explicitly or implicitly, some sort of climatic forecast, and progress in climate services capacity is often judged in terms of improved predictability. Consideration of the panoply of forecast applications reveals the need for an expanded array of metrics for evaluating forecasts, their performance, and impacts of their application. Further, while advances in predictability are desirable, alone they are insufficient for more extensive application of forecasts or better decision and societal outcomes. For example, many decision makers have difficulty placing forecast information in appropriate historical and regional contexts. "Downstream" forecasts that reflect impacts of climatic variability typically have more relevance to decisions than forecasts of driving forces. Pervasive forecast misinterpretation and unc ertainty about forecast accuracy present formidable barriers. User-centric tools for self-directed learning, customized evaluation of predictions, placing predictions in context with supporting information, and use of best practices in communicating uncertainty offer a practical pathway for meeting the needs of diverse decision makers in assessing whether climate forecasts, or any predictions, are 'good' enough. Guidance that helps users align their forecast applications consistent with decision sensitivity, varying forecast skill levels, and varying predictive uncertainty, is also needed. One approach finding resonance with users and climate services intermediaries is to place forecasts within a variety of decision approach frameworks, from those that use quantitative characterizations of uncertainty, to those that embrace even qualitative expressions of extreme uncertainty.	hollyoregon@juno.com

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
869099642	Huan Wu	ESSIC, UMD	Real-time Global Flood Forecasting Using an Enhanced Land Surface Model with Satellite-based and NWP Forcings	Real-time Global Flood Forecasting Using an Enhanced Land Surface Model with Satellite-based and NWP ForcingsHuan Wu1, 2*, Robert F. Adler1, 2, Yudong Tian1, 21 Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD 207402 NASA Goddard Space Flight Center, Greenbelt, MD 20771*Email: huanwu@umd.eduA community land surface model (LSM), Variable Infiltration Capacity (VIC) model, was enhanced by coupling with a newly developed hierarchical dominant river tracing-based runoff-routing model. The Dominant river tracing-Routing Integrated with VIC Environment (DRIVE) model formed the new core of an existing real-time global flood monitoring system (GFMS). It is the first time to use satellite-based real-time precipitation (with other data) to drive a state-of-the-art LSM for real-time flood monitoring for global domain at relatively high spatial (~12km) and temporal (3-hourly) resolution. The new GFMS accuracy in flood event detection and flood magnitude estimation was evaluated based on retrospective simulations for ~15 years (1998~) using DRIVE model driven by NASA TMPA research (DRIVE-V7) and real-time (DRIVE-RT) precipitation products respectively. The DRIVE-RT and DRIVE-V7 derived very close probability of detection (0.90 vs. 0.93) and false alarm ratio (0.88 vs. 0.84) against archived flood events with duration greater than one day. The DRIVE-V7 derived positive daily and monthly Nash-Sutcliffe coefﬁcient (NSC) for 362 (32.3%) and 675 (60.2%) gauges, out of 1,121 in total from global rivers with observed daily streamflow data, with a mean of 0.39 and 0.212 respectively. It is promising considering the model was using only a priori parameters. The model performance generally decreases from tropics toward higher latitudes at annual, seasonal and daily scales, with DRIVE-V7 generally better than DRIVE-RT. However, their performances at daily scale had no significant difference for almost all regions except the northern mid-latitudes where TMPA V7 research product has much better quality than real-time data because of gauge data based corrections. Based on the generally good model performance using satellite-based precipitation, we extended the GFMS for 3~5 days flood forecasting using precipitation estimations from two global nume rical weather prediction models, i.e. the NASA Goddard Earth Observing System Model, Version 5 (GEOS-5) and the NOAA Global Forecast System. The model performances in flood forecasting were evaluated based on retrospective simulation results against observations. The real-time global flood monitoring and forecasting system has been running routinely and accessible at http: //flood.umd.edu.	huanwu@umd.edu
782824259	Huug van den Dool	CPC	A more nuanced view of the climatological annual cycle.	Many at CPC have used an harmonically smoothed annual cycle as climatology. What we normally call “the” annual cycle is associated with a variation in incoming solar radiation with a period of about 365.25 days (i.e. not 365 or 366). Upon further inspection there are actually two annual variations, one associated with the distance to the sun, the other with the earth’s obliquity as earth goes around the sun. The net effect of the two is not just additive, because it also contains a multiplication. This makes a decomposition in additive sine waves challenging. The author has designed an iterative scheme to include the multiplicative aspects. Applied to locations with a very large annual cycle in temperature (such as North Dakota) the observations of surface air temperature indeed suggest two annual cycles with nearly opposite phase. The stronger annual cycle has a maximum temperature in July, the 2nd (with 5-10% amplitude) a maximum late in the year.Considering that model error (long time series of daily global forecast minus analysis fields) has several leading EOFs with the annual cycle as time series it is fair to ask how models are treating the annual cycle.As an aside we also present a method of dealing with leap days, both on the input side and for user application.	huug. vandendool@noaa.gov
377583534	J. Brent Roberts	NASA MSFC	Evaluating NMME seasonal forecast skill for use in NASA SERVIR hub regions	The U.S. National Multi-Model Ensemble seasonal forecasting system is providing hindcast and real-time data streams to be used in assessing and improving seasonal predictive capacity. The coupled forecasts have numerous potential applications, both national and international in scope. The NASA / USAID SERVIR project, which leverages satellite and modeling-based resources for environmental decision making in developing nations, is focusing on the evaluation of NMME forecasts specifically for use in driving applications models in hub regions including East Africa, the Hindu Kush-Himalayan (HKH) region and Mesoamerica. A prerequisite for seasonal forecast use in application modeling (e.g. hydrology, agriculture) is bias correction and skill assessment. Efforts to address systematic biases and multi-model combination in support of NASA SERVIR impact modeling requirements will be highlighted. Specifically, quantile-quantile mapping for bias correction has been implemen ted for all archived NMME hindcasts. Both deterministic and probabilistic skill estimates for raw, bias-corrected, and multi-model ensemble forecasts as a function of forecast lead will be presented for temperature and precipitation. Complementing this statistical assessment will be case studies of significant events, for example, the ability of the NMME forecasts suite to anticipate the 2010/2011 drought in the Horn of Africa and its relationship to evolving SST patterns.	jason.b.roberts@nasa. gov
792982484	Jack Settelmaier	NOAA National Weather Service SRHQ	Using the NOAA Weather and Climate Toolkit to Aid in Preparing and Evaluating Weather and Climate Model Forecast Output while Collaboratively Engaging Decision-Making Users	[Note the 3 authors, that I could not see an easy way to add above.]Steve AnsariPhysical ScientistNational Climatic Data CenterJack SettelmaierDigital Techniques MeteorologistNational Weather Service Southern Region HeadquartersDave JonesCEO, StormCenter Communications, Inc.The National Weather Service (NWS), as an integral decision-support agency withinthe National Oceanic and Atmospheric Administration (NOAA). The NWS deliversmission-critical weather and climate information to decision makers via datasets,products, and services available in gridded formats. These gridded formats, with the aidof the freely-available NOAA Weather and Climate Toolkit (W&CT) to aid in the data-mining and preparation of graphics, make it easier for decision makers to consume theavailable information to inform their mission-critical decisions. By easing the processthrough which numerical weather/climate modelers, researchers, and users can access andvisualize this information, collaborative tools can then be used to more easily engage usersin the evaluation of the these weather and climate forecast data.I will show:a) how the W&CT can be used to access, prepare, and customize data available in gridded formats for display, b) numerous examples of weather/climate forecast information, such as the CFSv2, afterbeing prepared for visualizing via the W&CT, andc) collaborative tools available to assist modelers, researchers, and users in engaging eachother as they evaluate the assess the forecast information.	jack.settelmaier@noaa. gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
722717947	Jae-Kyung Schemm	CPC/NCEP/NWS/NOAA	Evaluation of the NCEP CFSv2 45-day Forecasts for Predictability of Intraseasonal Tropical Storm Activities	Evaluation of the NCEP CFSv2 45-day Forecasts forPredictability of Intraseasonal Tropical Storm ActivitiesJae-Kyung E. Schemm, Lindsey Long and Stephen BaxterClimate Prediction Center, NCEP/NWS/NOAA Predictability of intraseasonal tropical storm (TS) activities is assessed using the 1999-2010 CFSv2 hindcast suite. Weekly TS activities in the CFSv2 45-day forecasts were determined using the TS detection and tracking method devised by Carmago and Zebiak (2002). The forecast periods are divided into weekly intervals for Week 1 through Week 6, and also the 30-day mean. The TS activities in those intervals are compared to the observed activities based on the NHC HURDAT and JTWC Best Track datasets. The CFSv2 45-day hindcast suite is made of forecast runs initialized at 00, 06, 12 and 18Z every day during the 1999 – 2010 period. For predictability evaluation, forecast TS activities are analyzed based on 20-member ensemble forecasts comprised of 45-day runs made during the most recent 5 days prior to the verification period. The forecast TS activities are evaluated in terms of the number of storms, genesis locations and storm tracks during the weekly periods. The CFSv2 forecasts are shown to have a fair level of skill in predicting the number of storms over the Atlantic Basin with the temporal correlation scores ranging from 0.73 for Week 1 forecasts to 0.63 for Week 6, and the average RMS errors ranging from 0.86 to 1.07 during the 1999-2010 hurricane season. Also, the forecast track density distribution and false alarm statistics are compiled using the hindcast analyses. In real-time applications of the intraseasonal TS activity forecasts, the climatological TS forecast statistics will be used to make the model bias corrections in terms of the storm counts, track distribution and removal of false alarms. An operational implementation of the weekly TS activity prediction is planned for early 2014 to provide an objective input for the CPC's Global Tropical Hazards Outlooks.	Jae.Schemm@noaa.gov
434779981	Jennifer Adams	IGES/COLA	New Graphics Capabilities in GrADS	The Grid Analysis and Display System (GrADS) is a widely-used interactive tool for easy access, manipulation, and visualization of earth science data. GrADS handles both gridded and station data, and supports all commonly used data file formats. This presentation will be about the changes to the graphics capabilities in version 2.1 of GrADS. The new version of GrADS will use the Cairo library for rendering all graphics. A variety of graphical display techniques are already supported in GrADS, including (but not limited to) line and bar graphs, box and whisker plots, scatter plots, smoothed contours, shaded contours, streamlines, wind vectors, grid boxes, shaded grid boxes, and station model plots. Cairo will make all of the existing graphic output types look better because it uses anti-aliasing for line drawing. Cairo will also enable the use of fonts, transparent colors, and pattern filling. Available hardcopy o utput formats are PNG (for images) and PS, EPS, PDF, and SVG (for vector graphics.)	jma@iges.org
432696265	Jian-jian Wang	University of Maryland College Park	Climatological Means and Variations of Tropical Precipitation and Its Relationship With Surface Temperature from 15 years of TRMM Data	One of the key goals of the Tropical Rainfall Measuring Mission (TRMM, launched in late 1997) has been to define the spatial and seasonal climatological rainfall in the tropics as accurately as possible in order to quantify this key component of the hydrological cycle. A climatology of tropical surface rain has been developed based on a composite of fifteen years (1998-2012) of precipitation products from recent TRMM Version 7 (V7) data. The TRMM Composite Climatology (TCC) V7 consists of a merger of selected TRMM rainfall products over both land and ocean to give a "TRMM-best" climatological estimate.In addition to the mean precipitation estimate, the TCC also includes the variation among the three estimates at each point to give an estimate of the uncertainty in the mean value. For evaluation and validation purposes, a series of inter-comparisons will be carried out among TCC components, and ground-based observations. The TCC may have broad applications and should be useful to the user community interested in climate monitoring, climate variability studies, model initialization and verification, and comparison with other non-TRMM rainfall analyses.The first-time use of both active [Precipitation Radar (PR)] and passive microwave [TRMM Microwave Imager (TMI)] instruments onboard the TRMM also provides the opportunity to examine the relations between tropical rainfall and surface temperature, using measurements from both passive and active microwave sensors. In an earlier study of 9-year TRMM V6 data analysis (Wang et al. 2008, JGR), it was found that the PR-based surface precipitation-temperature slopes do not confirm slopes based on passive microwave observations. We will re-examine the relation between tropical rainfall and surface temperature with the fifteen-year TRMM V7 data. These relations will also be compared to those derived from Global Precipitation Climatology Project (GPCP) analyses.	jjwang@umd.edu
385051530	Jiarui Dong	NOAA/NCEP/EMC	Accurate Downscaling Application of Temperature Data in High Spatial Resolution Land Surface Modeling for in Support of US Drought Monitoring Efforts	One important component of high spatial resolution land surface modeling is the accurate downscaling of the typically coarse resolution atmospheric forcing data to better match the land surface complexity. We have investigated the temporal and spatial characteristics of lapse rate defined here as the vertical changes of 2-meter air temperature along the terrain surface using the in-situ observations from the SNOwpack TELemetry (SNOTEL) network, Remote Automatic Weather Stations (RAWS), and US Historical Climate Network (USHCN) in the western United States. Lapse rate magnitudes are found to be larger over the southern than the northern states, and larger in the summer than in the winter over continental regions. Additional differences were found for the coastal regions, where the oceanic influence reduced lapse rates further during the summer than in the winter. Such significant spatial and temporal variations in lapse rate suggest that the typical utilization of a constant l apse rate for downscaling temperature data is not adequate, and that a proxy is required to adequately better predict these lapse rate variations for the downscaling of atmospheric forcing data to drive land models. We demonstrate a linear relationship between the lapse rate near the land surface and 2-meter air temperature. We also perform a fitting and validation experiment by deriving the relationship between temperature and lapse rate from 1991-2010, using 2011 as an independent test period. In combination with a high-resolution digital elevation map (DEM) data, this regression equation and the resulting lapse rates will support and improve a wide range of applications which are dependent on downscaling, such as the production of North American Land Data Assimilation System (NLDAS) forcing data for US drought monitoring.	Jiarui.Dong@noaa.gov
784214140	Jieshun Zhu	Center for Ocean-Land-Atmosphere Studies	The role of air-sea coupling in seasonal prediction of Asia-1 Pacific summer monsoon	This study examines the role of air-sea coupled process in the seasonal predictability of Asia-Pacific summer monsoon rainfall by comparing seasonal predictions from two carefully designed model experiments: Tier-one (fully coupled model) and Tier-two (AGCM with prescribed SSTs). In these experiments, identical AGCM is used in both Tier-one and Tier-two predictions; the daily mean SSTs from Tier-one coupled predictions are prescribed as boundary condition in Tier-two predictions. Both predictions start from April during 1982-2009, with four ensemble members for each case. The model used is the Climate Forecast System, version 2 (CFSv2), the current operational climate prediction model for seasonal-to-interannual prediction at the National Centers for Environmental Predictions (NCEP). Comparisons indicate that Tier-two predictions not only produce higher rainfall biases but also unrealistically high rainfall variations in the tropical western North Pacific (TWNP) a nd some coastal regions as well. While the prediction skill in terms of anomaly correlations does not present significant difference between the two types of predictions, the root-mean-square errors (RMSEs) are clearly larger over the above regions in Tier-two prediction. The reduced RMSE skills in Tier-two predictions are due to the lack of coupling process in AGCM-alone simulations, which, particularly, results in an unrealistic SST-rainfall relationship over the TWNP region. It is suggested that for prediction of summer monsoon rainfall over the Asia-Pacific region it is necessary to use coupled atmosphere-ocean (Tier-one) prediction system.	jieshun@cola.iges.org

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
770799414	Jim Kinter	COLA/GMU	ISI Climate Prediction: Requirements for High-Resolution Coupled Models and Large Ensembles	Results from several recent experiments, including both climate simulation and climate prediction experiments with coupled models having a weather-resolving global atmospheric component or an eddy-resolving global ocean component, will be reviewed with respect to implications for prediction on intra-seasonal to interannual time scales. In particular, climate simulations and retrospective forecasts generated during the Athena, Minerva and PetaApps projects will be considered. It will be shown that weather-resolving global atmosphere models substantially and significantly improve the quality, acuity, and fidelity of climate simulations, albeit at a high computational cost. It will also be shown that these improvements extend to standard metrics of forecast quality at all time scales from intra-seasonal to interannual. It will also be shown that eddy-resolving global ocean models qualitatively and quantitatively improve coupled climate simulations, such that sizable improvement of forecast performance can be expected. Finally, a comparison of retrospective climate forecasts with relatively small (< 10 members) ensembles and with relatively large (> 40 members) will be used to delineate ensemble size requirements.	kinter@cola.iges.org
523547346	John Bates	NOAA NCDC	Climate Monitoring from Space – Architecture for Sustained Observations	The task of climate monitoring has requirements that extend beyond the current paradigm of one-time research missions and operational satellite systems in existence today. Recognizing these needs, international research and operational Space Agencies have formed a new Working Group on Climate that has defined an architecture that ensures delivery of sustained observations over the time frames required for analysis of the Earth's climate system. The Working Group has released a report that establishes a framework for international collaboration to address critical issues such as:• In general, current observing systems have not been primarily designed with a climate perspective, therefore, inventories are needed to document the contributions of current and planned observing systems for climate purposes.• Requirements for mission continuity and contingency need improvement through international collaboration of space agencies.• Sustained Climate Data Record (CDR) programs will provide an avenue to replace heritage algorithms and data sets with improved versions once they are successfully demonstrated, validated and available.• There is an imperative to ensure traceability along harmonized practices.	john.j.bates@noaa.gov
284915374	John T. Allen	International Research Institute for Climate and Society, Columbia University, Palisades, New York	Associating Hail Occurrence and Large Scale Environment for the Continental United States 1979-2012	Hail can often be thought of as the poor child of severe storms research. Despite posing the risk of locally incredible damage and a higher frequency of large loss swathes than tornadoes, little attention has been given to developing a relationship between environmental characteristics and hail occurrence. While thermodynamic sources of energy are essential to promote the strong updrafts that support hail, the enhancement of these updrafts via changing wind speed and direction with height (vertical wind shear) is a very important contribution to large hail formation. However, other complex interactions likely on the microphysical scale, moisture loading and structure of the vertical temperature profile can influence the potential for relatively large hail, meaning that indices for other severe phenomena (e.g. tornadoes) may not be representative of the appropriate set of ingredients.Observations of hail, like those of other severe thunderstorm phenomena suffer from a number of non-meteorological temporal and spatial inhomogeneties. Using this dataset, environment relationships that describe the probability of occurrence of severe hail are determined using an objective fitting of pre-defined convective variables to a Poisson distribution. This allows an extended climatology of hail to be produced via a hail 'index'. This index for monthly climatological likelihood is based on environmental data from the North American Regional Reanalysis (NARR) over the continental United States for the period 1979-2012. The index has been found to differ notably from that for tornadoes and provides a reasonable approximation to the spatial and temporal distribution of severe hail (greater than 1 inch) over the continental United States. In addition, the index shows improved performance in capturing the spatial distribution of severe hail as compared to environmental rela tionships that consider all severe thunderstorm phenomena. Here, seasonal and inter-annual variability of hail occurrence will be presented, along with an analysis of the limitations of the index.	jallen@iri.columbia.edu
441903897	Jon Gottschalck	NOAA / Climate Prediction Center	CPC operational outlooks: Current methods and recent verification	The Climate Prediction Center is charged with preparing and disseminating climate forecasts across time scales from the extended range (Week-2) out to and beyond the seasonal time horizon. An overview of the overall forecast process and launch schedule will be outlined and the current techniques and forecast tools used in preparing the official CPC outlooks will be presented. As time permits, forecast skill over the past year and historically will be presented along with upcoming plans to improve CPC official outlooks.	Jon.Gottschalck@noaa.gov
547540240	Judith Perlwitz	CIRES/University of Colorado and NOAA/ESRL Physical Sciences Division	The impact of the record 2011 Arctic ozone los on the extreme spring Northern Annular Mode event	An unusually strong Arctic stratospheric polar vortex and low polar stratospheric temperatures in winter-spring 2011 led to massive chemical ozone depletion. Estimated chemical ozone loss reached 80% at 18-20 km by late March and the estimated deficit of total ozone column due to chemical loss reached 47% at 80°N by early April. The observed pattern of the tropospheric circulation in April following the ozone depletion event was characterized by a strongly positive phase of the Northern Annular Mode (NAM). In the Southern Hemisphere, the Antarctic ozone depletion has been recognized as an important driver of climate change with impacts possibly extending into the subtropics. However the impacts of the Arctic ozone loss on the tropospheric climate remain poorly quantified. In this study we determine the impacts of the Arctic ozone depletion 2011 and observed lower boundary conditions on the troposphere by using the atmospheric general circulation model ECHAM5. Sea surface temperature and sea ice concentration (SST/SIC) and atmospheric ozone (O3) anomaly fields based on the observational data are used to force the model. By performing a set of 50-years long simulations we analyze the response of the model to SST/SIC and O3 forcings separately and also to the combined SST/SIC and O3 forcing (ALL). We find that in all three experiments the tropospheric response is characterized by an increased probability of the positive NAM events between mid-March and mid-April. The largest increase of the probability is simulated in the ALL experiment. In all three experiments the tropospheric response is preceded by a strengthening of the stratospheric westerly winds, consistent with the canonical pattern of downward anomaly propagation. We find that the average response of the tropospheric circulation to the O3 forcing alone is weak compared to the internal variability, and that the circulation changes in the ALL experiments are mostly consistent with the SST/SIC forcing. However the combined effect of the two forcing on the circulation is not additive suggesting that non-linear interaction between ozone-induced stratospheric cooling and a tropospheric forcing associated with the SST/SIC anomalies contributed to the large atmospheric climate anomalies observed in spring 2011. The implications of the modeling results for improving a seasonal climate forecast system will be discussed.	judith.perlwitz@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
163583243	Karen Grissom	NOAA/NWS, National Data Buoy Center	Improvements to Real-Time Quality Control of TAO High-Resolution Data	The Tropical Atmosphere Ocean (TAO) array is a major observational component of ENSO forecasts and climate prediction research. As part of the TAO Technology Refresh project executed by a team of scientist and engineers at the National Data Buoy Center (NDBC), a web-based console was developed to monitor and control data management and quality control processes. Recent improvements to NDBC data management have resulted in the creation of the TAO Automated Statistical quality-control Console (TASC). The goal of TASC is to provide a real-time automated and consistent methodology based upon 20 years of historical climatology for providing quality-controlled data to NCEP forecasts. The work focuses on the following aspects: (1) identifying metrics for each station based upon monthly and seasonal averages; (2) using subsurface temperature correlation to locate depth of ENSO signal penetrations; and (3) developing an adaptive quality-control process using spatial and s easonal variability during the past two decades. We discuss the results and problems encountered so far and show comparisons of TASC with earlier manual methods.	karen.grissom@noaa.gov
635924614	Kathy Pegion	University of Colorado/CIRES & NOAA/ESRL/PSD	A Preliminary look at MJO Forecast Skill in the NMME	A Preliminary look at MJO Forecast Skill in the NMMEKathy Pegion (University of Colorado/CIRES & NOAA/ESRL/PSD)Ben P. Kirtman (University of Miami/RSMAS)Matthew Newman (University of Colorado/CIRES & NOAA/ESRL/PSD)The skill of the Madden-Julian Oscillation (MJO) will be investigated using the North American Multi-Model Ensemble (NMME) retrospective forecasts to assess the benefit of a multi-model to MJO forecast skill. The skill of forecasting MJO from each of the models participating in the NMME project that have provided daily output of outgoing longwave radiation (OLR) and zonal winds at 200 hPa (U200) and 850 hPa (U850) with sub-monthly initializations will be evaluated individually and as an equal-weights multi-model ensemble. We anticipate at least three NMME models will provide this data for a minimum of ten ensemble members. Although all of these data may not be available at the time of the workshop, we will provide this initial preliminary assessment with all data that are available at the time. This skill will also be compared with the skill of an empirical linear inverse model (LIM) of 5-day running mean anomalies of OLR, U200/850, and SST (run in near-realtime at http:// www.esrl.noaa.gov/psd/forecasts/clim/) as a baseline. The LIM will also be included as an additional model with the NMME models to demonstrate the potential skill improvement from adding an additional skillful model. The complimentary skill contributed by each model will also be evaluated.	Kathy.Pegion@noaa.gov
677842456	Kingtse Mo	Climate Prediction Center	Predictability of Hydroclimate Forecasts over the United States	We investigated whether seasonal forecasts from the National Multi-model Ensemble System (NMME) contribute to the skill of seasonal soil moisture (SM) and Standardized runoff index (SRI) forecasts relative to a climatology alternative, specifically Ensemble Streamflow Prediction (ESP). The benchmark ESP forecasts were performed using the Variable Infiltration Capacity (VIC) hydrologic model (termed ESP_VIC) and it incorporates information about hydrologic conditions at the beginning of the forecast period, but resamples climatologic forcing during the forecast period. We compared the ESP_VIC forecasts to multi model ensemble mean (NMME) SM and runoff forecasts performed using the VIC with the same initial conditions, but with forcing derived from bias-corrected precipitation, temperature, and wind forecasts from each model for forecast period from 1982 to 2010 with initial conditions of January 1, April 2, July 5 and Oct 3 (NMME_VIC).Overall, forecast skill is seasonally and regionally dependent. Forecast skill is higher for the NMME than individual models. For Lead month 1, the initial conditions play a dominant role. As the lead time increases, the forcing starts to contribute. The skills for all indices are high over the dry areas where both the mean precipitation and the precipitation variations are low. For these areas, the ESP_VIC forecasts are as skillful as the NMME_VIC. The forecasts for all indices are lower over areas where precipitation depends on dynamical forcing and detailed moisture flux convergence. If precipitation forecasts are skillful, then the NMME forecasts will improve forecast skill over these areas	kingtse.mo@noaa.gov
328764298	Kirsti Hakala	Utah State University	Hydrologic and Climatologic Conditions That Shape Interior West's Groundwater Resources	In Utah, the declining trend of groundwater level, combined with the rapid growth of urban population and water withdrawal, are already a cause for concern for water planners throughout the state. Previous research has identified a significant link between the region's hydroclimate to Pacific climate oscillations. Upon further comparing these findings to groundwater levels in northern Utah and water supply for the Colorado River Basin, we find that an area, much larger than was previously expected, derives its hydrologic behavior from the same climate oscillations. Using this newly found cohesion in hydrologic variations, we further involve the use of global climate models to predict groundwater levels for expected future climate. The Community Earth System Model (CESM) output shows a significant ability to replicate the quasi-decadal climate oscillation (QDO) and teleconnection patterns, which are the predominant climate drivers for the region of interest. Build ing upon the ability of the model to replicate these climate oscillations, this study analyzes the modeled affects of greenhouse gas (GHG) on groundwater. we find that the model output shows a troubling future. This study divulges these findings and discusses the effects of GHG on groundwater in modeled CESM simulations. Deciphering the climatic controls within the model and their ability to affect groundwater, will lead to a greater understanding of how GHG currently is and will affect future groundwater in the Interior West.	Kirsti.hakala2@gmail.com
3	Klaus Wolter	NOAA/ESRL/PSD and U. Colorado	Statistical seasonal precipitation forecasts for the Interior Southwestern U.S.	Improved "climate divisions" can be used for the statistical prediction of seasonal precipitation anomalies in the interior southwestern U.S. Such forecasts were first issued in late 2001, and have been provided on a seasonal basis to the Colorado Water Availability Task Force since then (http://cwcb.state.co.us/public-information/floodwater-availability-task-forces/Pages/main.aspx). This presentation will report on lessons learned and skill achieved during 13 years of quasi-operational forecasts. Seasonal forecast skill for the interior southwestern U.S. appears to be linked not only to ENSO (and its various 'flavors'), but also to SST regions further afield (Indian Ocean) as well as closer to the U.S. (eastern subtropical Pacific and Caribbean). Other useful predictors include northern hemispheric teleconnection patterns, and antecedent regional precipitation anomalies. Verification skill for the last 13 years exhibits large regional and seasonal variations, but has remained positive for all seasons, even though ENSO-related skill has not been as high as hoped for. This report will include recommendations for future updates to this empirical forecast system.	klaus.wolter@noaa.gov
718777822	Laifang Li	Duke University	Southeastern United States Summer Rainfall Framework and its Implication for Seasonal Prediction	A new rainfall framework is constructed to describe the complex probability distribution of Southeastern United States (SE US) summer (June-July-August) rainfall, which cannot be well represented by traditional kernel fitting methods. The new framework is based on the configuration of a three-cluster finite Normal mixture model and is realized by Bayesian inference and Markov Chain Monte Carlo (MCMC) algorithm. The three rainfall clusters reflect the probability distribution of light, moderate, and heavy rainfall in summer; and are linked to different climate factors. The variation of light rainfall intensity is likely associated with combined effects of La Nina and tri-pole Sea Surface Temperature Anomaly (SSTA) over the North Atlantic. Heavy rainfall concurs with a “horseshoe-like” SSTA over the North Atlantic. In contrast, moderate rainfall is less correlated with SSTA and likely caused by atmospheric internal dynamics. Rainfall characteristics and their linkag es with SSTA help improve seasonal predictions of regional climate. Such a new framework has important implication to understanding the response of regional hydrology to climate variability and climate change; and it can be extended to other regions and seasons.	laifang.li@duke.edu

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
828418702	Li-Chuan Chen	Cooperative Institute for Climate and Satellites/Earth System Science Interdisciplinary Center, University of Maryland, College Park	Meteorological Drought Prediction Using a Multi-Model Ensemble Approach	In the United States, drought is among the costliest natural hazards, with an annual average of 6 billion dollars in damage. Drought prediction from monthly to seasonal time scales is of critical importance to disaster mitigation, agricultural planning, and multi-purpose reservoir management. Started in December 2012, NOAA Climate Prediction Center (CPC) has been providing operational Standardized Precipitation Index (SPI) Outlooks using the National Multi-Model Ensemble (NMME) forecasts, to support CPC's monthly drought outlooks and briefing activities. The current NMME system consists of six model forecasts from U.S. and Canada modeling centers, including the CFSv2, CM2.1, GEOS-5, CCSM3.0, CanCM3, and CanCM4 models. In this study, we conduct an assessment of the meteorological drought predictability using the retrospective NMME forecasts for the period from 1982 to 2010. Before predicting SPI, monthly-mean precipitation (P) forecasts from each model were bi as corrected and spatially downscaled (BCSD) to regional grids of 0.5-degree resolution over the contiguous United States based on the probability distribution functions derived from the hindcasts. The corrected P forecasts were then appended to the CPC Unified Precipitation Analysis to form a P time series for computing 3-month and 6-month SPIs. The ensemble SPI forecasts are the equally weighted mean of the six model forecasts. Two performance measures, the anomaly correlation and root-mean-square errors against the observations, are used to evaluate forecast skill.For P forecasts, errors vary among models and skill generally is low after the second month. All model P forecasts have higher skill in winter and lower skill in summer. In wintertime, BCSD improves both P and SPI forecast skill. Most improvements are over the western mountainous regions and along the Great Lake. Overall, SPI predictive skill is regionally and seasonally dependent. The six-month SPI forecasts are skillful out to four months. For shorter lead months, the ensemble SPI forecast skill is comparable to that based on persistence. The spread of SPI forecasts among models is small, and the predictive skill comes from the observations appended to the P forecasts. For longer lead months, model forecasts contribute to the meteorological drought predictability. The ensemble SPI forecasts have higher skill than those based on persistence and individual models.	lichuan.chen@noaa.gov
687965190	Lisa Goddard	IRI/Columbia University	Estimating Forecast Uncertainty in Seasonal-to-Decadal Predictions	Seasonal predictions are increasingly acknowledged as a valuable resource to inform management of risks and opportunities. There is also growing awareness of the role that decadal variability plays in longer-term planning, as well as society's experience of climate change. The problem is that predictions across these timescales taken directly from dynamical models carry various model biases, including probabilistic unreliability, unless they are recalibrated. The climate community has considerable experience in transforming model predictions into probabilistic seasonal forecasts through bias correction and other statistical approaches. Although some successful forecast strategies may be applicable for decadal predictions, others are not due to limited historical records and limited ensemble sizes. This presentation will illustrate the sensitivity of various forecast systems to statistical recalibration. As part of our funded MAPP project, we examine the appropriat e level of complexity of recalibration scheme for a given prediction problem, quality of ensemble predictions, and design of hindcasts: in the face of small hindcast samples or small ensemble sizes, more complex schemes may actually degrade the predictions through the addition of noise. This presentation will focus on quantitative estimates of the ability to successfully recalibrate predictions from specific forecast systems, whose data is available from the IRI and from CMIP5. These results will be compared with those from mathematical models that synthetically represent the ensemble prediction and observation time series, and the relation between the two.	goddard@iri.columbia.edu
1	Marina Timofeyeva	NOAA/NWS/CSD, NWS/SR, NWS/CR	NWS Climate Information and Tools for Decision Support Services	NOAA National Weather Services (NWS) is moving toward provision of Decision Support Services (DSS) as a part of the Roadmap on the way of achieving Weather Ready National (WRN) strategy. Both shortterm and long-term weather, water, and climate information is critical for DSS and emergency services and exercised in NWS in the form of pilot projects run by National and Regional Operation Centers (NOC and ROCs respectively) as well as several local offices focusing their efforts in provision timely and actionable guidance for specific tasks such as DSS in Coastal Environment and Integrated Environmental Studies. Climate information in DSS will help to guide long-term preparedness for severe weather events and extreme conditions. On July 1, 2013, NWS launched a new Local Climate Analysis Tool (LCAT), which enables many local climate studies needed for to create efficient guidance for DSS. LCAT allow analyzing trends in local climate variables and identifying local impacts of climate variability (e.g., ENSO) on weather and water conditions. In addition to LCAT, NWS working together with North East Regional Climate center released xmACIS version 2, a climate data mining tool, for NWS field operations. During the talk we plan to demonstrate LCAT and xmACIS and outline several examples of their applications to DSS. The examples include LCAT-based temperature analysis for energy decisions, guidance on weather and water events leading to increased algal blooms and red tide months in advance, local climate sensitivities to droughts, probabilities of hot/cold conditions and their potential impacts on agriculture and fish kills or fish stress.	marina.timofeyeva@noaa.gov
663402032	Martin Hoerling	NOAA Earth Systems Research Laboratory	Causes and Predictability of the 2012 Central Great Plains Drought	Central Great Plains precipitation deficits during May-August 2012 were the most severe since at least 1895, eclipsing the Dust Bowl summers of 1934 and 1936. Drought developed suddenly in May, following near-normal precipitation during winter and early spring. Its proximate causes were a reduction in atmospheric moisture transport into the Great Plains from the Gulf of Mexico. Processes that generally provide air mass lift and condensation were mostly absent, including a lack of frontal cyclones in late spring followed by suppressed deep convection in summer owing to large-scale subsidence and atmospheric stabilization.Seasonal forecasts did not predict the summer 2012 central Great Plains drought development, which therefore arrived without early warning. Climate simulations and empirical analysis suggest that ocean surface temperatures together with changes in greenhouse gases did not induce a substantial reduction in summertime precipitation over the central Great Plains during 2012. Yet, diagnosis of the retrospective climate simulations also reveals a regime shift toward warmer and drier summertime Great Plains conditions during the recent decade, most probably due to natural decadal variability. As a consequence, the probability for severe summer Great Plains drought may have increased in the last decade compared to the 1980s and 1990s, and the so-called tail-risk for severe drought may have been heightened in summer 2012. Such an extreme drought event was nonetheless still found to be a rare occurrence within the spread of 2012 climate model simulations. Implications of this study's findings for U.S. seasonal drought forecasting are discussed.	martin.hoerling@noaa.gov
135213396	Matt Newman	CIRES, U. of Colorado and NOAA/ESRL/PSD	ISI Predictability overview (invited)	In this talk, we will discuss current predictability research on intraseasonal to interannual time scales. Both empirical approaches (such as determining signal-to-noise ratios from observations or skill masks from hindcasts), theoretical measures (such as recent work based on information theory), and model approaches (such as perfect model experiments) will be assessed, particularly in the context of realized forecast skill. Examples highlighting the challenges of using predictability research in operational prediction of both ENSO and the MJO will be presented, and some ideas will be proposed concerning how predictability research can enhance operational prediction.	matt.newman@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
205173795	Melissa Ou	CPC	Sensitivity study of the skill of the CPC Week-2 Reforecast Tool to Reforecast Sampling	CPC currently uses a calibrated NCEP medium-range forecast model (Global Ensemble Forecast System (GEFS)) reforecast tool that significantly contributes to the skill of operational 6-10 and week-2 forecasts. Therefore, CPC requires a set of reforecasts to be generated with each model upgrade, including the major GEFS upgrade planned for early 2014. The reforecasts currently used in CPC's tool were produced by ESRL but is expected to be transferred to NCEP in 2014. It is understood that available resources will limit the configuration of the upgraded GEFS reforecasts. Therefore, CPC has performed a sensitivity study to provide feedback to NCEP to ensure that any reduction of reforecast data does not significantly reduce the skill of CPC operational forecasts. These reforecast datasets are planned to be used for producing real-time 6-10 day and week-2 temperature and precipitation forecasts and week-2 probabilistic hazard outlooks at CPC. This study assess the impact of reducing the number of years, number of ensemble members, and frequency of reforecasts on the skill of week-2 GEFS calibrated surface temperature and precipitation forecasts using the current GEFS model reforecasts. The model evaluated in this study is the GEFS model with physics operational during 2012. CPC evaluated skill using three types of skill scores - Heidke, RPSS, and reliability from February 2012 to June 2013. Results indicate that the decrease in number of reforecast years causes the greatest decrease in nearly all skill measures, and the drop in number of ensemble members results in the least reduction in skill. Based on this analysis, we submitted requirements to NCEP for a minimum of 20 years of reforecast data, but preferably 30 years to match the climatology period (1981-2010), plus recent years to present (2011-2013). Each reforecast should contain at least 5 ensemble members (plus the control member). The loss of skill using weekly or bi-weekly reforecasts is tolerable given the minimum requested years.	melissa.ou@noaa.gov
348165051	Meng-Pai Hung	CPC/NCEP/NWS/NOAA	Prediction of the MJO events from CFSv2 during DYNAMO Intensive Observing Period	This study analyzes the prediction of the Madden-Julian Oscillation (MJO) events during the DYNAMO Intensive Observing Period (1 October 2011 - 15 January 2012). We will first assess the overall performance of the model in predicting the three MJO events during this period. We will then focus on the event during late November to early December 2011 to investigate the impacts of model physics. Experiments for this event are carried out to test the use of (1) alternative convection schemes, (2) different settings for convection parameters, and (3) different configurations for the ocean.	Mengpai.Hung@noaa.gov
2	Michelle L'Heureux, Anthony Barnston	NOAA/NWS/NCEP/CPC IRI, Columbia University	Is the Nino-3.4 SST region optimal for monitoring ENSO and its impacts on North America?	The Nino-3.4 SST region of the east-central equatorial Pacific Ocean (5N-5S, 120-170W) has been a primary component of operational ENSO monitoring and prediction over the last couple decades. At the time, the SST region was chosen on the basis of the strength of its relationship with Pacific sea level pressure and subsurface temperatures (Barnston et al., 1997). Here, we evaluate the relationship of Pacific SST anomalies with outgoing longwave radiation (OLR), which others have suggested may be more appropriate variable for diagnosing ENSO-related precipitation and temperature impacts over the United States (e.g. Chiodi and Harrison, 2013). A variety of different empirical strategies are presented in order to better understand the relationship between SSTs and OLR across the Pacific and how well they relate to temperature and precipitation anomalies over the U.S. Barnston, A.G., Chelliah, M., & Goldenberg, S.B. Documentation of a highly ENSO-related SST region in the equatorial Pacific. Atmos.-Ocean, 35, 367-383 (1997) Chiodi, A.M., Harrison, D.E. El Nino impacts on seasonal atmospheric circulation, temperature, and precipitation anomalies: the OLR-Event Perspective. J. Climate, 26, 822-837 (2013).	michelle.lheureux@noaa.gov
623605121	Mike Charles	CPC	Using Reforecasts to Improve CPC's Week 2 Forecasts	Reforecasts are past weather forecasts generated with a "frozen" numerical model. They are generated by running one constant version of a model over a specified period. A reforecast dataset can be used to diagnose the performance of a model over a long period of time, allowing one to correct for certain systematic biases in the model. The benefits of using this dataset of past model runs have been outlined by many studies, particularly Hamill et al. 2004 which showed that reforecasts could be used to improve the skill and reliability of week 2 GEFS forecasts.CPC currently issues probabilistic 6-10 day and week 2 forecasts of surface temperature and precipitation every weekday. The CPC forecasters utilize many tools to make their forecast, including ensemble forecast systems from several centers and several statistical tools. One of the most-used tools is a calibrated forecast developed by the Earth System Research Laboratory (ESRL) in 2006, which is one of CPC's most skillful forecast tools. However, this tool is built upon a 16 year-old model, which limits skill of the model, even after statistical correction using the reforecast dataset. ESRL will be discontinuing this tool, so it will soon become unavailable to the CPC forecasters. However, ESRL recently generated a reforecast dataset using the latest (2012) version of the GEFS. In order to take advantage of this new dataset and to replace the deprecated ESRL tool, CPC started a new project to develop a reforecast-calibrated forecast system that would be run in-house, using ES RL's latest reforecast dataset. Long-term statistics were calculated using the reforecast dataset, and then used to adjust real-time GEFS forecasts to account for error in the mean and spread of the ensemble.After adjusting the real-time GEFS forecasts, they become much more reliable and skillful than the uncalibrated GEFS forecasts, more skillful than the deprecated ESRL tool, and one of the most skillful tools for the CPC forecasters.	mike.charles@noaa.gov
644637987	Ming Cai	Florida State University	CFSv2 Prediction Skill of Stratospheric Temperature Anomalies	This study evaluates the prediction skill of stratospheric temperature anomalies by the CFSv2 reforecasts for the 12-year period from January 1, 1999 to December 2010. The goal is to explore if the CFSv2 forecasts for the stratosphere would remain skillful beyond the inherent tropospheric predictability time scale of at most 2 weeks. The anomaly correlation (AC) between observations and forecasts for temperature field at 50 hPa (T50) in winter seasons remains over polar stratosphere above 0.3 at the lead time of 28 days whereas its counterpart in the troposphere at 500 hPa drops very quickly and below the 0.3 level at 12 days. We also prove that the CFSv2 has a high prediction skill both in an absolute sense and in terms of gain over persistence except in the equatorial region where the skill mainly comes from the persistence of the QBO signal. Based on the mass circulation theory, we conjecture that as long as the westward tilting of planetary waves in the str atosphere and their overall amplitude can be captured, the CFSv2 forecasts would still be very skillful in predicting zonal mean anomalies even though it cannot do so for the exact locations of planetary waves and their spatial scales. This explains why the CFSv2 has a high skill for the first EOF mode of T50, the intraseasonal variability of the annular mode associated with poleward propagation of zonal mean anomalies, despite that its skill degrades rapidly for higher EOF modes associated with stationary waves. This also explains why the CFSv2's skill closely follows the seasonality and its interannual variability of the meridional mass circulation and stratosphere polar vortex. In particular, the CFSv2 is capable of predicting mid-winter polar stratosphere warming events in the Northern Hemisphere and the timing of the final polar stratosphere warming in spring in both hemispheres 3-4 weeks in advance.	qin.zhang@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
705562093	Mong-Ming Lu	Central Weather Bureau, Taiwan	Recent unusually high extremity of Taiwan rainfall extremes and the modulation of Interdecadal Pacific Oscillation	Variations of the extremity of the extreme rainfall frequency (EERF) in Taiwan and their influential large-scale climate factors during the period of 1961-2012 are analyzed. EERF is the sum of extreme rainfall event counts at 21 stations on yearly basis. The time series of EERF shows a clear contrast of the extremity of the extremes before and after 1998 for the events with duration longer than 24 hours. The unusually frequent extremes reached a plateau during 2004-2008. After separating the events to typhoon and non-typhoon types, we find that the sharp increase of the typhoon type can be attributed to the enhanced Pacific zonal thermal contrast associated with the interdecadal Pacific oscillation (IPO) mode of climate variability. For the non-typhoon type of extremes, the unusually frequent extremes can be attributed to the enhanced strong southwesterly monsoon flow associated with the stronger than normal western Pacific subtropical high (WPSH) that straddles t he South China Sea and Philippine Sea. The WPSH in June, the establishing phase of the Asian summer monsoon, was unusually strong during the past decade as an Indo-Pacific response to the IPO mode.	lu@rdc.cwb.gov.tw
518232840	Muthuvel Chelliah	CPC/NCEP/NWS	Towards filling the gap in NOAA's seamless suite of forecast products. Prospects of "useful" predictions for weeks 3 & 4?	Abstract:In NOAA's seamless suite of forecast products spanning weather and climate starting from hours through days, weeks, months, seasons and years, we now have official forecast products in all time spans except in the so called "3-4 weeks forecast hole" time period. While every effort continues to be made by researchers and forecasters alike to fill this void, reliable and useful forecasts in this 3-4 weeks period has always remained a major challenge. Forecasts for actual temperature and rainfall for every specific day up to 5 days or so, and then for averaged time periods such as for 6-10 days and week 2 (days 8-14) are among the most used of weather forecast products. There is a great need for some sort of weather guidance in upcoming weeks 3 and 4 for all sorts of planning purposes from average public to businesses alike. At present, the conventionally accepted evaluation measure such as traditional "anomaly" correlation coefficient for say, 500 mb geopotential hei ght, 2m-temperature or rainfall for weeks 3 & 4 on the average is very low (0.0-0.25). In this talk, using NCEP CFS V2's 45day ensemble forecast runs available since 1999, full field (such as used in next few days' weather forecasts) and an alternately defined "anomaly" forecast correlations in three basic variables noted above(H, T2m & P) will be presented. Historical evaluations of the full field and alternatively defined "anomaly" forecasts for the 12 year (1999-2010) period as well as for most recent months over the global domain and the United States will be made. With an open mind we will explore the potential usefulness of these forecasts for weeks 3 and 4	Muthuvel. Chelliah@noaa.gov
381999464	Nathaniel C. Johnson	IPRC, University of Hawaii at Manoa	Skillful wintertime, intraseasonal North American temperature forecasts based on the state of ENSO and the MJO	Previous work has shown that the combined influence of the El Niño-Southern Oscillation (ENSO) and Madden-Julian Oscillation (MJO) significantly impacts the wintertime circulation over North America for lead times of up to four weeks, which suggests that both the MJO and ENSO may prove beneficial for generating a seamless prediction link between short-range deterministic forecasts and longer-range seasonal forecasts. To test the feasibility of this link, we generate wintertime (December – March) probabilistic two-meter temperature (T2m) forecasts over North America solely on the basis of the linear trend and statistical relationships with the initial state of the MJO and ENSO. Overall, we find that such forecasts exhibit substantial skill for some regions and some initial states of the MJO and ENSO out to a lead time of approximately four weeks. In addition we find that that the primary ENSO T2m influence regions are largely orthogonal to the primary MJO T2m influence regions, which suggests that the MJO and ENSO generally excite different members within the continuum of large-scale atmospheric teleconnection patterns. The strong forecast skill scores for some regions and initial states confirm the promise that information from the MJO and ENSO may offer forecasts of opportunity in weeks 3 and 4, which extend beyond the current NOAA CPC extended range outlooks, and an intraseasonal link to longer-range probabilistic forecasts.	natj@hawaii.edu
836397806	Neena Joseph Mani	JIFRESSE, University of California	Predictability of Tropical Intrasesonal variability (ISV) in the ISV Hindcast Experiment (ISVHE)	The Madden Julian oscillation (MJO) represents the prominent mode of tropical intraseasonal variability with strongest amplitude during winter and the boreal summer monsoon intraseasonal oscillation is its summer counter part. In addition to these, during boreal summer, there exists a prominent intraseasonal oscillation over the tropical eastern Pacific (EPISO). With its influence extending over multitude scales, efforts for predicting the MJO has been underway for a long time and the last decade has witnessed marked improvement in dynamical MJO prediction. While it has been known that the EPISO mode also exerts significant influences on the regional weather/climate systems, prediction capabilities of the dynamic models for this mode has never been assessed. Using the Intrseasonal Variability Hindcast experiment (ISVHE) platform, in this study, the predictability of the winter MJO and the summer EPISO modes are investigated in different coupled model hindcasts. Th e focus is on the of these intraseasonal modes based on perfect model approach. A deterministic predictability of 20-30 days and is observed for the MJO in most models. The deterministic prediction skills of all the models fall short by at least 5-7 days from the theoretical predictability limit of MJO. While the eastern Pacific summer intraseasonal variability has a predictability close to that of the MJO, most of the dynamic models seem to have relatively lower skill in predicting this mode. The dependence of the intraseasonal predictability on the amplitude, phase and nature of the MJO in hindcast initial conditions is also examined.	Neena.J.Mani@jpl.nasa. gov
480653036	Paul Dirmeyer	George Mason University	Validation and Attribution of Summer 2013 CFSv2 Forecasts Given Observed Spring Boundary Anomalies	Extremely dry soil over much of western North America and La Niña conditions in the tropical Pacific during spring 2013 presaged a potential summer drought and heat wave over much of the United States. Operational CFSv2 forecasts at 6-hourly output intervals have been collected beginning in mid-April, and are examined for their predictions of temperature, precipitation and indices of land-atmosphere feedback at a variety of lead-times and initial dates. With 16 forecasts per day, the archive of operational forecasts represents a rich database to determine statistically significant responses to evolving land-surface, ocean and atmospheric circulation conditions. We attempt to determine how and why certain ensembles of forecasts have (or have not) validated well, particularly in the context of the mechanisms of land-atmosphere feedbacks, which are generally presumed to amplify drought and heat wave responses in the mid-latitudes during summer. Validation and attribution will inform model development for both atmospheric model parameterizations and the land surface scheme in CFSv2.	pdirmeye@gmu.edu

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
754261553	Peitao Peng	CPC/NCEP/NWS/NOAA	Climate Mean, Variability and Dominant Patterns of the Northern Hemisphere Wintertime Mean Atmospheric Circulation in the NCEP CFSv2	In this study, the climate mean, variability and dominant patterns of the Northern Hemisphere (NH) wintertime mean 200 hPa geopotential height (Z200) in a CMIP and a set of AMIP simulations of the NCEP CFSv2 are analyzed and compared with that in NCEP/NCAR reanalysis.For the climate mean, it is found that part of the bias in stationary waves, characterized with wave trains emanating from the tropics to both hemispheres, can be attributed to the precipitation deficit over the Maritime continent. The systematic latent cooling associated with the precipitation deficit may have served as the forcing of the wave trains.For the variability of the seasonal mean, both the CMIP and AMIPs successfully simulated the geographical locations of the major centers of action, but the simulated intensity was generally weaker than that in the reanalysis , particularly for the center over the Davis Strait-southern Greenland area. It is also noted that the simulated action center over Aleutian Islands was southeastward shifted to some extent. The shift was likely caused by the eastward extension of the Pacific jet. Differences also existed between the two model simulations, with the center of actions over the Aleutian Islands stronger in the AMIP and the center over the Davis Strait-southern Greenland area stronger in the CMIP simulation.In the mode analysis, the El Nino-Southern Oscillation (ENSO) teleconnection pattern in each dataset was first retrieved from the data, and a rotated EOF (REOF) analysis was then applied to the residual. The purpose of this separation procedure was to avoid possible mixing between the ENSO mode and those generated by the atmospheric internal dynamics. It was found that the simulated ENSO teleconnection patterns from both model runs well resembled that from the reanalysis, except for a small eastward shift. Based on the REOF modes of the residual data, six dominant modes of the reanalysis data had their counterparts in each model simulation, though with different rankings in explained variance and some distortions in spatial structure. By evaluating the temporal coherency of the REOF modes between the reanalysis and the AMIP, it was found that the time series associated with the equatorially displaced North Atlantic Oscillation (ED_NAO) in the two datasets were significant ly correlated, suggesting a potential of predictability for this mode.	Peitao.Peng@noaa.gov
826056130	Philip Klotzbach	Colorado State University	The surprisingly quiet 2013 Atlantic basin hurricane season	The 2013 Atlantic basin hurricane season has been extraordinarily quiet, defying pre-season expectations for a very active season. In general, most seasonal forecast busts in the past have been due to challenges with forecasting ENSO, but this was not the case this year. Despite a warmer-than-normal tropical Atlantic and neutral ENSO conditions, TC activity in 2013 has the potential to be the quietest since the start of the so-called active era in 1995. Potential reasons for the very inactive season will be discussed. A preliminary analysis indicates that dynamic conditions such as vertical wind shear and low-level vorticity were not particularly unfavorable, but thermodynamic conditions were quite harsh. Mid-level moisture values were the driest on record, with anomalous subsidence also dominating the Atlantic Main Development Region. Precursor signals that could have tipped us off to the quiet season will also be briefly discussed.	philk@atmos.colostate.edu
10	Pingping Xie	NOAA/CPC	CPC High-Resolution Global Precipitation Analyses Suite for Improved Monitoring, Assessments and Diagnostics of Global Climate	As part of the CPC Unified Precipitation Products Project, a suite of hourly and daily precipitation analyses have been constructed on a 0.25 a 15-year period from 1998 to the present, by combining information derived from CMORPH high-resolution satellite estimates, CPC unified daily gauge analysis, and the long-term low-resolution pentad GPCP product. Special attention has been paid in the development of this products suite to ensure quantitative consistency of this highresolution but relatively short precipitation analysis with long-term climate record. For the first step of this project, the CMORPH estimates have been extended backward in time from the December 2002 operational initiation to 1998 and reprocessed from 2003 to present using the most recent passive microwave (PMW) retrieval algorithm version from all available low earth orbiters and infrared (IR) observations from geostationary platforms. Bias correction is then performed for the raw CMORPH over the entire data period from 1998 to the present. Over land, the bias in the raw CMORPH is removed by matching the probability density function (PDF) of the CMORPH with that of the CPC unified daily gauge analysis in two sequential steps. Bias in the raw CMORPH is first removed using PDF tables established for each 0.25deg lat/lon grid box for each calendar day using co-located CMORPH – gauge data pairs collected over a sliding window of +/-15 days centered at the target calendar day over a 15-year period from 1998 to 2012 and over a spatial domain centering at the target grid box. The output of this first step is then calibrated against the daily gauge analysis using PDF tables established using data over a 30-day period ending at the target day to remove year-to-year variations of the CMORPH bias. The bias-corrected CMORPH precipitation estimates are further combined with the gauge analysis through an optimal interpolation (OI) technique, in which the bias-corrected CMORPH is used as the first guess while the gauge data is used as observations to modify the first guess over regions with station coverage. Seasonal, interannual, intraseasonal and diurnal variations of global precipitation are examined using the 15-year high-resolution global precipitation analyses and compared to those in three sets of new generation global reanalyses and precipitation fields generated by other NCEP global model. Detailed results will be reported at the workshop.	pingping.xie@noaa.gov
639010970	Qin Zhang	CPC/NCEP/NWS/NOAA	On the upward temperature trend (1982-present) in the NMME hindcasts	It is a small secret that over the period 1980-2010 the verification scores of seasonal forecasts are greatly helped when the method/model to be verified includes a successful representation of the upward trend in temperature that has been observed in these years. The NMME project attempts to produce seasonal prediction out to about 7 months. While this may not sound like a climate prediction, the skill of NMME prediction of seasonal means is influenced significantly by trend. Here we check the trend in global mean land and global mean ocean temperature as seen in the hindcasts of nine models that participate(d) in the NMME. These models are CFSv1, CFSv2, NCAR-CCSM3, GFDL, NASA, IRIa, IRIf, CMC1 and CMC2. Hindcasts of monthly mean SST and T2m over a common period (1982-2009 or more) are used to estimate the trend over land and ocean respectively for lead of 1 to 7 months. There are different schools of thought about the origins of trends in such data sets. One obv ious thought that it relates to increases in GHG concentrations. Some NMME models include this feature, other don't. Another thought is that the trend over land is largely controlled by the trend in SST over the ocean. So providing the initial SST condition alone (which all models attempt to do) will give an upward trend in the ocean temperature, certainly in the early leads, and even over land and no explicit increase in GHG concentration would be required. Particularly interesting will be to see the development from CFSv1 to CFSv2. Previous work with CFSv1, which has the constant 1988 CO2 concentration throughout, showed that the trend decreased as a function of lead and was already too small at the start. We can now compare trends in CFSv2, which has prescribed realistic CO2 increases, to those in CFSv1	qin.zhang@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
875160928	Rachael Jonassen	GWU	A different kind of guidance for climate adaptation planning	CEQ guidance for climate change adaptation expects use of the ‘best science’ about future climate. Adaptation practitioners generally invoke IPCC GCM projections for that purpose. Although the IPCC reports the deficiencies of GCMs and differentiates between projections and predictions, practitioners confuse the two, pick exemplars or downscaled versions to identify climate change impacts and recommend adaptation actions, and justify this method as ‘best available science’ given the lack of authoritative long-term climate predictions.NOAA's CPC climate predictions do not extend to time periods relevant to climate adaptation. Decadal forecasts do not demonstrate skill and remain research topics with distant prospects of utility. NOAA's GFDL provides GCM projections for IPCC that are conditioned on concentration pathways and designed to support climate mitigation policy. Conditional projections cannot serve as ‘best science’ for climate adaptation planning, which depends upon risk analysis informed by at least ordinal-scale impact likelihoods. Thus, adaptation decisions lack NOAA support, although NOAA's climate goal specifically includes support for climate adaptation decisions.The projection paradigm is inappropriate for the task of adaptation. A new paradigm may be advanced by examination of prediction traditions in the full range of scientific fields (such as seismology for example) to ensure the dialogue is broadly representative of scientific traditions of prediction. Such examination in no way ensures success but introduces variety, which may be our best ally in this dilemma. The climate science community would do well to broaden the conversation, and consider an alternative paradigm. Such action requires courage, conviction, and collaboration. Existing projections imply this course.	rachaelj@gwu.edu
105405810	Ravi P. Shukla	Center for Ocean Land Atmosphere Studies (COLA), Calverton, Maryland 20705, USA	On the Leading Mode of Intraseasonal Variability of the South Asian Summer Monsoon in 19 CMIP5 Models	Rainfall over southeast Asia varies both in space and time during the summer monsoon seasons, and it exhibits a broad range of variability on daily, sub-seasonal, interannual and decadal time scales. The monsoon rainfall plays an important role in agricultural planning, and disaster and water resource management on the Indian subcontinent, so correctly simulating and projecting monsoon rainfall is very important. In the present study, the simulation of the monsoon intraseasonal oscillation (MISO) over southeast Asia during June through September has been analyzed in the historical runs of 19 of the models that participated in the Coupled Model Inter-comparison Project Phase-5 (CMIP5). In this paper, we propose new diagnostics and skill metrics for characterizing and quantifying the performance of models with respect to their representations of intraseasonal variability. For a few CMIP5 simulations, the spatial structure of the mean rainfall and its intraseasonal v ariability within the monsoon season are remarkably well represented. The variability of the rainfall is overestimated in some of the models and underestimated in other models. Based on our new skill metrics and error analysis, we have selected a few high-quality models for which we also discuss the nature of intraseasonal variability in the future (RCP85) and the past (piControl).	ravis@cola.iges.org
559090252	Robert E Livezey	Retired NWS	Revisiting OCN and the Hinge for Seasonal Prediction and Interannual Detrending/Signal Separation	Climates are dominantly warming so official normals are dominantly cold biased. This leads to two challenges: (1) Estimating normals as “expected values” rather than as retrospective references, and (2) tracking the normal history for signal separation/detrending. The first is important so that seasonal temperature forecasts are properly biased to account for climate change and the second for proper estimation of probabilities and conditional (say to ENSO) probabilities of temperature.Since 1994 CPC has continued to address both of these challenges through use of a 10-year retrospective running-mean, a version of the Optimal Climate Normal (OCN). This is despite suggestions that tracking a temperature normal with a “hinge” model (Livezey et al., 2007) in many instances is superior for both challenges. Certainly, a 10-year running mean applied to smooth a temperature series retains too much low-frequency “natural variability” for effective detrending, but it is less clear that the hinge fit would generally produce better estimates of current normals. A common concern voiced about use of the hinge are the arbitrary imposition of zero climate change before the mid-1970s and the specification of 1975 as a fixed change point, regardless of whether the choices were well-motivated.Recently, Wilks (2013) has tested both the CPC OCN and the hinge fit on mega-climate division data independent (ie subsequent) to the respective test periods used to initially calibrate their performance for 1-year lead seasonal prediction. For these particularly challenging (because of an unusual recent multi-year cold spell) test periods, the most robust performer (in terms of squared error) turned out to be a 15-year OCN that greatly outperformed the hinge fit with the 10-year OCN generally uncompetitive. The hinge fit had the least overall bias. Another important result strongly supported the “arbitrary” choices for the hinge model. These results strongly argue for a reassessment of CPC’s use of a 10-year OCN.Livezey and Wilks (2013) conducted further tests to determine the sensitivity of Wilks’ results to the temperature data set used. In addition to mega-division data, station data with similar corrections to the mega-division data and fully-homogenized station data were used. All of Wilks results were confirmed except for the relative performance of the 15-year OCN and the hinge fit on the homogenized station data; the OCN still had lower overall squared error than the hinge, but its advantage disappeared when measured in terms of number of seasons/regions with lower squared error with each having 5 out of 12. These results reinforce the need to reassess the use of the 10-year normal, but also argue for use of fully-homogenized data in CPC operations.	bobbilbo@msn.com
572784588	Robert Pincus	NOAA/ESRL/PSD and U. Colorado	Evaluating clouds for ISI predictions	This talk will describe issues in evaluating the simulation of clouds with remote sensing data for ISI predictions. I'll review methods for bridging the gap between the model representation of clouds and the quantities observable using remote sensing, especially from satellite platforms. I'll describe why the most obvious comparison -- of cloud occurrence -- is in fact quite a fragile metric, and propose other measures that respect the observational uncertainty while retaining diagnostic utility. I'll briefly describe the findings of the WGNE/WGCM panel on metrics for climate models and how these relate to metrics for ISI predictions.	Robert.Pincus@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
909206735	Rongqian Yang	EMC/NCEP/NWS/NOAA	Summer-Season Forecast Experiments with Upgrades in the Land Component of the NCEP Coupled Forecast System (CFS)	The Noah LSM version 2.7.1 is currently used in the operational NCEP CFS to update soil moisture, soil temperature, skin temperature, snowpack depth, snowpack water equivalent, canopy water content, and to compute the energy and water flux terms of the surface energy and water balance. It is the version which was implemented in the operational GFS in May 2005. Since then, the Noah LSM has had a lots enhancement. Comparing to the earlier version, the latest version Noah LSM 3.4.1 (released in August 2012) has improved treatments on saturation slope, background albedo, emissivity, roughness length, snow albedo, and potential evapotranspiration among others. In addition, the new Noah land model makes use of the newly available MODIS/IGBP vegetation classification and STATSGO soil texture datasets which are more representative of recent land-use changes.To improve seasonal prediction skill and to examine the impact from using these advances in the NCEP CFS, summer-season T126 CFS reforecast experiments are carried out using both old and new versions of the Noah LSM for 1982, 1987, 1996, 1988, 2000, 2007, 1986, 1991, and 1999 with four ensemble members whose initial conditions are from 00z of May 1- 4 in each year. The nine years are composed of three ENSO-cold, three ENSO-warm, and three ENSO-neutral years, respectively. Using anomaly correlation as a primary measure, the summer-season prediction skill of the CFS using the two versions of the Noah LSM is assessed for SST, precipitation, and 2-meter air temperature over the Contiguous United States (CONUS) on an ensemble basis and at the seasonal time scale. Results from the CFS experiments indicate that upgrading from the Noah 2.7.1 to the Noah LSM 3.4.1 has a positive impact on the SST prediction skill over the Atlantic Ocean, the Indian Ocean, and the western Pacific Ocean in the Northern Hemisphere, but not over the eastern equatorial Pacific Ocean. The differences in June-August (JJA) mean precipitation and 2-meter air temperature prediction skill generally reflect the disagreement in predicting SST anomalies over the coastal states. The largest differences are found to be in the inland states where the CFS with the new version of Noah LSM shows a better performance in predicting precipitation anomaly over the central Great Plains and 2-meter air temperature anomaly over the western CONUS, illustrating that ocean is still the main control and land impact is only pronounced where the land-atmospheric coupling strength is strong.	Rongqian.Yang@noaa.gov
922078216	Ruiyu Sun	IMSG/EMC/NCEP	A new cloud fraction scheme for the GFS – A CPT project transitioning to operations	A new cloud fraction scheme for the GFS – A CPT project transitioning to operationsRuiyu Sun and Hua-Lu Pan (IMSG/EMC/NCEP/NWS/NOAA)Collaborators:Joao Teixeira (JPL)Chris Bretherton(U. of Washington)Clouds have an enormous influence on Earth's energy balance, climate, and weather. However, our imperfect understanding of the complicated feedbacks among many physical processes affects the skill of cloud predictions of the weather and climate system on all time scales. National Centers for Environmental Prediction (NCEP)'s Global Forecasting System (GFS) and Climate Forecasting System (CFS) are among the models that suffer from the systematically inadequate representation of cloud. This is evident from the diagnostics of the results from a 50 year free run of the GFS-MOM4 coupled model completed by the Stratocumulus-to-Cumulus Transition CPT. The coupled system produced less cloud cover and cloud condensate path than observed and resulted in the biases in the cloud radiative forcings. Based on the assumption of uniform distribution of total water, we designed a new cloud cover scheme. The new cloud cover is used in both radiation and microphysics and ensures the consistency between the two schemes. Based on the same assumption we also modified the cloud macrophysics and reduced the dependence of condensation and evaporation on the constant RHc. Following Tompkins et al. (2007) and Karcher and Lohmann (2002) we added homogeneous nucleation of ice to deal with the supersaturation issue. The results of a few month data assimilation experiment shows that the cloud condensate path increased. Cloud radiative forcing is improved. The RMSE of tropical winds is also reduced except at low levels. This new scheme is scheduled to be tested for the next operational GFS and will be a strong candidate for the next CFS. It represents one of several projects tested in the CPT for transition to operations.	ruiyu.sun@noaa.gov
246589370	Rym Msadek	NOAA/GFDL	Assessing the predictive skill of Arctic sea ice extent on seasonal to inter-annual timescales using the GFDL forecast system	Assessing the predictive skill of Arctic sea ice extent on seasonal to inter-annual timescales using the GFDL forecast systemRym Msadek, Gabriel Vecchi, Mike WintonImproved understanding and predictions of the Arctic climate system are essential for robust assessments of climate impacts across many sectors. There have been recent encouraging results indicating that initialized global coupled models may provide useful information on seasonal sea ice extent (Wang et al. 2012, Sigmond et al. 2013). Here, we present results from the GFDL initialized forecast systems in which both the atmosphere and the ocean are initialized over 1982-2012 using initial conditions from the fully coupled GFDL reanalysis ECDA3.1 (Zhang et al. 2007; Zhang and Rosati 2010). We compare the results from two versions of the model that differ by their atmospheric resolution (CM2.1 and FLOR). We investigate the level of predictability of sea ice extent arising from the model initialization and compare the results to perfect model experiments and to uninitialized forecasts. While most of the forecast skill arises from predicting the strong decreasing trend observed du ring the past few decades, comparing the performance of the initialized and uninitialized versions of the same system indicates that initializing the coupled model improves retrospective correlation, in particular for September sea ice extent, by helping capture some of the deviations from the recent linear trend. Interdecadal changes are found in the apparent skill of the forecast system, with inter-annual variations in the mid-1990s captured better than those of the 2000s, suggesting a state-dependence of the predictability of the system. To quantify the predictability of the Arctic environment on seasonal to inter-annual timescales, and provide recommendations on required developments in operational prediction systems it is important to understand the key physical processes that determine the predictability of Arctic climate, including the relative importance of ocean and sea-ice initial conditions, and of sea-ice thickness versus sea-ice cover. Currently, the GFDL predic tion system does not explicitly assimilate sea ice concentration or thickness. We discuss the potential improvement that could arise from sea ice assimilation and the challenges that it represents given the limited observations of sea-ice thickness.References:Sigmond, M., J.C. Fyfe, G. M. Flato, V. V. Kharin, and W. J. Merryfield 2013: Seasonal forecast skill of Arctic sea ice area in a dynamical forecast system, Geophys. Res. Lett., doi:10.1002/grl.50129Wang, W., M. Chen, and A. Kumar, 2012: Seasonal prediction of Arctic sea ice extent from a coupled dynamical forecast system. Mon. Wea. Rev. doi:10.1175/MWR-D-12-00057.1, in press.Zhang, S., M.J. Harrison, A. Rosati, and A.T. Wittenberg, 2007: System design and evaluation of coupled ensemble data assimilation for global oceanic climate studies. Mon. Wea. Rev., 135, 3541–3564.Zhang, S., and A. Rosati, 2010: An inflated ensemble filter for ocean data assimilation with a biased coupled GCM. Mon. Wea. Rev., 138(10), 3905-3931.	Rym.Msadek@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
740771742	Sanjiv Kumar	COLA and NCAR	CFSv2 Reforecasts: Where is the observation in the Forecast Ensemble Space?	CFSv2 provides useful information that is embedded in its 24-member ensemble forecasts. Recent studies have verified CFSv2 reforecasts using the ensemble mean (EM) or some variant of EM, e.g., Ranked Probability Skill Score. These studies have found little skill in CFSv2 reforecast beyond 0-month lead. In this study we argue that the EM may not be the best information available in CFSv2 forecasts. A full spectrum analysis considering forecast variability across the 24-member forecasts and removal of systematic error from the forecast are needed to fully explore the usefulness of CFSv2 forecasts.We have verified CFSv2 reforecasts against CFSv2 reanalysis data for a 27-year period (1982 to 2008). We define a new skill score that measures the distance between observations and the ensemble mean forecasts in terms of ensemble standard deviations. For example, a skill score of 0 means that the observation is indistinguishable from the ensemble mean, and a skill score of 1 means that the observation is one standard deviation away from the ensemble mean forecast. This new metric allows us to explore the full ensemble space and quantifies the position of the observations in the ensemble space.We found that removal of systematic error significantly improves the forecast skill. We removed the systematic error by subtracting the 28-year reforecast climatology for each months and respective lead-time; and comparing the reforecast monthly anomaly against the reanalysis monthly anomaly. The summer (JJA) and winter (DJF) temperature forecasts skill score improves from 1.75 (without removing the systematic error) to 0.90 after removal of the systematic error. We also found that temperature anomaly skill scores are approximately the same for 0-month lead to 9-month lead forecasts. This result indicates that there is potentially useful information at all lead-times in CFSv2 forecasts. We also found a strong seasonality in the temperature forecast ensemble spread over land. We found 50% higher ensemble spread in winter compared to summer, irrespective of lead-time. These higher ensemble spreads were found in snow-covered regions. Overall, the observed temperature anomaly i s 0.90 standard deviation away from the ensemble mean anomaly in the CFSv2 reforecast ensemble space. We will also present results for the precipitation forecasts.	sanjiv@cola.iges.org
829662151	Scott Weaver	NOAA CPC	Advancing the Nation's Capability to Anticipate Tornado and Severe Weather Risk	Recent tornado outbreaks over the U.S. have caused devastating societal impacts, prompting the need to identify and understand sources of predictability that may lead to extended range severe weather prediction. At present, tornado and severe weather outlooks do not extend beyond one week. The latest science gives evidence that tornado activity can be predicted further in advance than was previously believed and provides improved understanding of the links between large-scale climate variability and tornado activity. A recent grass roots effort amongst a small group of Federal and University climate scientists has examined this issue in detail and disseminated their findings via a white paper. This white paper summarizes existing US tornado and severe weather prediction capability, outlines desired scientific advances, and presents an implementation plan combining research and institutional strategies for achieving those goals.	scott.weaver@noaa.gov
791055066	Shan Sun	NOAA Earth System Research Laboratory	Global Coupled Atmosphere/Ocean Model for Climate and Seasonal Forecast Applications	A coupled global model aimed at intra-seasonal and interannual prediction is under development at NOAA's Earth System Research Laboratory. It uses the FIM atmospheric model and an ocean model based on HYCOM ("iHYCOM"). Both FIM and iHYCOM are 3-dimensional grid point models, laid out on a common icosahedral horizontal grid and using an adaptive hybrid-isentropic/isopycnic vertical coordinate. The atmospheric model shares column physics with GFS.Initial results using GFS and CFSv2 physics showed that regional biases in cloud cover, and hence shortwave radiation flux, are large in both coupled and uncoupled (FIM-only) global simulations, and needed to be reduced in many geographic regions. For this reason, we have developed and tested modifications for shallow and deep convection and vertical discretization and conducted several 1-year AMIP tests on sensitivity to these changes/parameters.Results of these tests and optimal configuration so far of the FIM-iHYCOM coupled model and its latest simulations compared to CFSv2 and NASA/GEWEX Surface Radiation Budget data will be presented.	shan.sun@noaa.gov
733046530	Siegfried Schubert	NASA Global Modeling and Assimilation Office	Drought Predictability on Intraseasonal to Seasonal and Longer Time Scales	This talk will review our current understanding of the causes of drought and the implications for predictability with a focus on the role of SST forcing. Issue that will be examined include the competing/reinforcing impacts of the different ocean basins, the modulating/amplifying influences of land-atmosphere feedbacks, and the importance of internal atmospheric noise. Examples will be presented of efforts to predict/simulate recent high impact drought events, taking advantage of the results from various AMIP-style simulations, the NMME coupled model hindcasts, and recent advances made by members of the NOAA Drought Task Force.	siegfried.d. schubert@nasa.gov
201156254	Stefan Tulich	Stefan Tulich	Some hindcast simulations of an ensemble of MJO events	A strategy for evaluating MJO simulation and prediction is proposed, involving hindcasts of an ensemble of MJO events that are aligned in phase space. This strategy is shown to be especially effective for evaluating and improving models that are currently too costly to run as traditional climate models. For example, in the case of a superparameterized version of the global WRF model, this approach reveals how model performance can be improved through changes in horizontal resolution, as well as through changes in bulk physics schemes.	stefan.tulich@noaa.gov
919045879	Suranjana.Saha	Environmental Modeling Center	Gauging Systematic Errors of NMME models	Even when skill in predicting anomalies is modest, there is merit in evaluating a model in terms of reproducing the observed climatological mean. One might call it a second line of verification. The difference of the modeled and observed climatology is an estimate of the systematic error, hereafter referred to as SE. We study nine ocean-atmosphere-land coupled models that are/were part of the NMME. These models are CFSv1, CFSv2, NCAR-CCSM3, GFDL, NASA, IRIa, IRIf, CMC1 and CMC2. The mean of all the models (NMME) will also be studied, to test the hypothesis that different models have different, and in fact cancelling errors, which is one of the original selling points of MME. Hindcasts of monthly mean SST, T2m and prate over a common period (1982-2009 or more) are used to estimate the SE for lead of 1 to 9 months out. The smaller the SE the better, obviously. The comparison among models includes the evolution over time of the systematic error from CFSv1 to CFSv2, i .e. from an older to a newer system. There is some linkage to studies of global climate change because in that context the fidelity of the model's climate is just about the only verification one can think of. We only compare the annual mean SE in this study. Conclusions include1. SE in CFSv2 is remarkably smaller than in CFSv1, a testimony of the improvements made.2. SE for T2m and prate in CFSv2 and CFSv1 have similar looks, but SE in SST is quite different.3. SE tends to saturate very quickly and is in place at lead 1 month, and changes only little out to lead 9 months.	Suranjana.Saha@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
101051019	Thomas M. Smith	NOAA/NESDIS/STAR/S(and CICS	Analysis of Oceanic Precipitation before the Satellite Era	Ocean-area precipitation is a critical component of the hydrologic cycle that is expected to change with warming sea-surface temperatures (SSTs). Theory and models say that the global-average precipitation should increase in a warming world due to the increased saturation vapor pressure of a warmer atmosphere, which tends to increase the strength of the hydrologic cycle. For the satellite period, roughly 30 years, there is evidence that this has occurred over the oceans. However, a longer record is needed to better validate the models and theory. To address this need a reconstruction of monthly-average precipitation was produced beginning 1900. The reconstruction is a global analysis that uses statistics from the satellite-based Global Precipitation Climatology Project (GPCP), which is available beginning 1979. Historical values were produced using spatial covariance from precipitation gauges, correlations between oceanic precipitation and related variables, and inputs from a dynamic reanalysis of the 20th century. First an annual average analysis is produced using a combination of correlations between combined SST and SLP and oceanic precipitation, and annual-average gauge estimates. The annual averages are adjusted using monthly increments computed using spatial covariance and monthly gauge increments. For both estimates high latitude estimates from the reanalysis of the 20th century are also included. Test analyses are produced with and without individual data inputs show that analyses are generally consistent but including additional data inputs influences the strength of the reconstructed values. Cross-validation testing indicates that large-scale multi-year variations in the reconstruction are reliable over remote oceanic regions, but many month-to-month variations may not be reliable over the oceans. Globally the reconstructions validate the theory and model-based conclusion that oceanic precipitation is increasing with warming SST.	tom.smith@noaa.gov
8	Timothy DelSole	COLA	Does the Multi-Model Ensemble Enhance Skill?	In this talk we propose an objective procedure to address the question of whether a multi-model ensemble enhances skill relative to a given forecast. More precisely, we assess whether the error of a multi-model ensemble is significantly less than the error of a single model. We show that this question can be framed as a standard hypothesis test in linear regression. Results of applying this objective procedure to seasonal hindcasts of the National Multi-Model Ensemble are shown. For ENSO hindcasts, we find that each model has periods in which combining it with the multi-model mean of all other models significantly enhances skill. In other words, no model can claim that it generates forecasts that cannot be improved by the multi-model ensemble for all lead times and initial start dates.	tdelsole@gmu.edu
323176506	Vasu Misra	Florida State University	Florida Climate Institute-FSU Seasonal Hindcasts at 50km (FISH50)	This paper shows demonstrable improvement in the global seasonal climate predictability of boreal summer (at zero lead) and fall (at one season lead) seasonal mean precipitation and surface temperature from a two-tiered seasonal hindcast forced with forecasted SST relative to two other contemporary operational coupled ocean-atmosphere climate models. The results from an extensive set of seasonal hindcasts are analyzed to come to this conclusion. This improvement is attributed to:i) The multi-model bias corrected SST used to force the atmospheric modelii) The global atmospheric model which is run at a relatively high resolution of 50km grid resolution compared to the two other coupled ocean-atmosphere modelsiii) The physics of the atmospheric model, especially that related to the convective parameterization scheme. The results of the seasonal hindcast are analyzed for both deterministic and probabilistic skill. The probabilistic skill analysis shows that significant forecast skill can be harvested from these seasonal hindcasts relative to the deterministic skill analysis. The paper concludes that the coupled ocean-atmosphere seasonal hindcasts have reached a reasonable fidelity to exploit their SST anomaly forecasts to force such relatively higher resolution two tier prediction experiments to glean further boreal summer and fall seasonal prediction skill.	vmisra@fsu.edu
952188592	Viviana Maggioni	ESSIC/UMD	An Error Model for High-Time Resolution Satellite Precipitation Products	A new framework (PUSH: Precipitation Uncertainties for Satellite Hydrology) is proposed to provide time varying, global estimates of errors for high time resolution, multi-satellite precipitation products using a technique calibrated with high-quality validation data. The framework proposes different modeling approaches for each of the following cases: correct no-precipitation detection (both satellite and gauges measure no precipitation), missed precipitation (satellite records a zero, but the gauges detect precipitation), false alarm (satellite detects precipitation, but the reference is zero), and hit (both satellite and gauges detect precipitation). Each case is explored and explicitly modeled using a unified approach to combine all four scenarios. Errors are estimated for the Tropical Rainfall Monitoring Mission (TRMM) Multi-satellite Precipitation Analysis (TMPA) 3B42 product at daily/0.25° resolution, using the NOAA CPC-UNI gauge analysis as the benchma rk. Results show that the probability distribution and the spatial pattern of the error are adequately reproduced by PUSH, and a good agreement between observed and estimated errors is observed that is independent of season. The model is also able to capture missed precipitation and false detection uncertainties, whose contribution to the total error can be significant. The resulting error estimates could be attached to the standard satellite precipitation products for the scientific community to use.	viviana@umd.edu
345809080	Wanqiu Wang	CPC/NCEP/NWS/NOAA	An assessment of the CFSv2 real-time seasonal forecasts for 2011-2013	The NCEP Climate Forecast System version 2 (CFSv2) was implemented in March 2011 and is currently used as one of the forecast tools in the consolidation of the CPC/NCEP seasonal climate forecast. In this study, we review CFSv2 forecasts produced in real time during 2011-2013. The following aspects are analyzed: (1) how well the CFSv2 reproduces observed interannual sea surface temperature (SST) variations in the tropics and how the real-time forecasts compare with the hindcasts; (2) to what extent the CFSv2 capture the observed surface air temperature and precipitation anomalies; and (3) how skillful the CFSv2 is in forecasting the observed sea ice extent.	Wanqiu.Wang@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
344422796	Wassila M. Thiaw	NOAA Climate Prediction Center	Precipitation interannual variability and predictions for Africa from the National Multi-Model Ensemble dataset	The ability of coupled climate models from the national multi-model ensemble (NMME) dataset to reproduce the basic state and interannual variability of precipitation in Sub-Saharan Africa and associated teleconnections is examined. The analysis is for the period 1982-2010 for most of the models, which corresponds to the NMME hindcast period, except for the CFS version 1 (CFSv1) which covers the period 1981-2009. The satellite based Global Precipitation Climatology Project (GPCP) data is used as proxy for observed rainfall and to validate the models. Sub-Sahara Africa lies across both the northern and southern hemispheres, and therefore its climate in most regions is dependent on the apparent seasonal march of the sun. We examine rainfall patterns during the four main seasons in DJF, MAM, JAS, and OND. Models are able to reproduce the northward migration of precipitation from winter when the area of maximum precipitation is located in southern Africa to the s ummer when it is in northern Sub-Saharan Africa and the later return to the south. Models also appropriately place precipitation over central Africa during the equinoxes in MAM and OND. However, there are considerable differences in the representation of the intensities and locations of the rainfall. Almost all the models have a dry bias in eastern southern Africa during the DJF season. of the models including the two versions of the NCEP CFS and the NASA models also have a systematic dry (wet) bias over the Sahel (Gulf of Guinea region) during the summer rainfall season, while the others show alternating wet and dry biases across West Africa. The models also exhibit a systematic dry bias in equatorial eastern Africa during MAM and OND. All models have spatially averaged values of standard deviation lower than that observed. Models are also able to reproduce to some extent the main features of the precipitation variability maximum, but again with deficiencies in the amplitudes and locations. The areas of highest variability are generally depicted, but there are significant differences among the models, and even between the two versions of the CFS. Teleconnections in the models are investigated by first conducting an EOF in the precipitation anomaly fields and then perform a regression of the first or second EOF time series onto the global SST. Focusing on JAS rainfall season, only the CFSv1 and the NASA models were able to depict the dipole pattern between the Sahel and the Gulf of Guinea rainfall. However, none of the models was able to reproduce the observed upward trend of Sahel rainfall in the last decade. The relationship to SST is also examined. The observed influence of tropical north Atlantic SST on the Sahel rainfall is only partially represented even in the CFSv1, while the NASA model inconsistently emphasizes the role of the tropical South Atlantic. A majority of the models show a partial ENSO teleconnection comb ined with the tropical south Atlantic mode. However, observations indicate that the influence of ENSO on northern Sub-Saharan summer rainfall has been very weak over the past 30 years. Results for DJF, MAM, and OND are also presented. The influence of model errors on the predictions of African rainfall is presented. Canonical correlation analysis (CCA) is employed to correct the model simulations. A new ensemble based on models corrected forecasts is then formed and the results are presented.	wassila.thiaw@noaa.gov
934882284	Yan Xue	Climate Prediction Center/NCEP/NOAA	Prediction Skill and Bias of Tropical Pacific Sea Surface Temperatures in the NCEP Climate Forecast System Version 2	The prediction skill and bias of tropical Pacific sea surface temperature (SST) in the retrospective forecasts of the Climate Forecast System Version 2 (CFSv2) of the National Centers for Environmental Prediction were examined. The CFSv2 was initialized from the Climate Forecast System Reanalysis (CFSv2) over 1982-2010. There was a systematic cold bias in the central-eastern equatorial Pacific during 1982-1998 that reaches -2.5C during summer/fall. The cold bias suddenly reduced to -1C around 1999 due to a sudden change in equatorial ocean heat content bias in the CFSR.SST anomaly (SSTA) was computed by removing model climatology for the period 1982-1998 and 1999-2010 separately. The standard deviation (STD) of forecast SSTA agreed well with that of observation in 1982-1998, but in 1999-2010 it was about 200% too strong in the eastern Pacific and 50% too weak near Dateline during winter/spring. The shift in STD bias was related to change of ENSO characteristics: central-Pacific (CP) El Niños are more frequent than eastern-Pacific (EP) El Niños after 2000. The CFSv2 had a tendency to delay the onset phase of the EP El Niños in 1980s and 1990s, but predicted their decay phases well. In contrast, the CFSv2 predicted the onset phase of the CP El Niños well, but prolonged their decay phase. In 1982-1998 the CFSv2 forecasts beat the persistence for almost all initial months and lead months, but in 1999-2010 they are less skillful than the persistence for winter season forecast starting from summer/fall, indicating ther e is a room for improvement.	yan.xue@noaa.gov
649369707	Yehui Chang	NASA/GSFC, GMAO/GESTAR/MSU	Improvement of the middle latitudes summer precipitation in the GEOS 5 model	This study is to examine and to improve the summer precipitation in the GEOS 5 model. It is in part a problem with zonal wind bias, weak transients and reduced precipitation throughout the middle latitudes. This study is extending GEOS 5 replay runs, including mean bias correction of the u-wind at different time scales. The hope is that given an unbiased middle latitude zonal wind the model will spin up more transients - and these should contribute to reduce the precipitation bias. Given an unbiased middle latitude zonal wind the model will also generate more realistic Rossyby wave propagation in the middle latitude. This could explore the potential sources of predictability on intra-seasonal time scale.	yehui.chang-1@nasa.gov
509558090	Matt Newman	CIRES, U. of Colorado and NOAA/ESRL/PSD	Diagnosing subseasonal predictability of tropical atmospheric anomalies	An empirical modeling approach that can be used to make tropical forecasts and evaluate the processes contributing to and detracting from their predictability on subseasonal time scales is discussed. The model used, a “coupled” linear inverse model (CLIM) derived from observed simultaneous and time-lag correlation statistics of 5-day running mean anomalous SST, OLR, and 200 and 850 mb winds, has been run in near-realtime for the first few years, with forecasts available at http://www.cdc.noaa.gov/forecasts/clim/. It makes forecasts whose skill is competitive with CFS2. Overall CLIM skill is actually higher on average for leads greater then about 10-15 days, but for RMM1 and RMM2 forecasts CFS2 skill is slightly higher for forecast leads of up to 20 days. The geographical and temporal variations of forecast skill are also generally similar between the LIM and CGCMs. This makes the much simpler CLIM an attractive forecast benchmark that is also a tool for assessing and diagnosing overall predictability of both itself and the CFS2. It is shown that certain initial conditions, derived from a singular vector analysis of the CLIM system propagator, result in both maximum anomaly amplification and greater realized forecast skill in both the CLIM and CFS2. Additionally, the eigenvectors of the system's dynamical evolution operator separate into two distinct, but nonorthogonal, subspaces: one governing the nearly uncoupled daily-to-subseasonal dynamics, and the other governing the strongly coupled longer term dynamics. These subspaces arise naturally from the CLIM analysis; no bandpass frequency filtering is applied. This allows an analysis of which processes drive predictability on different time scales, showing that greatest forecast skill occurs as initially destructive interference between these two subspaces evolves to yield constructive interference.	matt.newman@noaa.gov

Number	Presenter	Presenter Affiliation	Title	Abstract	Email
	Zeng-Zhen Hu	NOAA/NWS/NCEP/CPC	Why Were Some La Niñas Followed by Another La Nina?	This paper investigates why some La Niña events are followed by another La Niña and some others are not. We propose two preconditions that result in continuation of a La Niña. The first one is that La Niña must be a strong event (a major La Niña). This insures that the reflected Rossby wave signal at the eastern boundary of the Pacific has a strong westward propagating cold ocean temperature anomaly over the off-equatorial region. The off-equator cold anomaly may not be conducive to the equatorial recharge process, and as a result, may favor the persistence of cold ocean subsurface temperature anomaly and prevent the transition from La Niña to El Niño.The second precondition is whether there are eastward propagating downwelling Kelvin waves during the decay phase of a major La Niña. Eastward propagating downwelling Kelvin waves could lead to demise for a tendency for a follow-up La Niña. The equatorial Kelvin wave activities are associated with fluctuations of surface wind in the equatorial far-western Pacific. The analysis suggests that both the surface wind in the equatorial far-western Pacific and the recharge/discharge of the equatorial Pacific are indicators for occurrence or no occurrence of a follow-up La Niña event.	zeng-zhen.hu@noaa.gov
	Barbra Brown	NCAR	Progress and prospects in forecast evaluation methods:Spanning weather, sub-seasonal and seasonal time scales	Over the last 15 years, the science and practice of forecast evaluation has undergone significant development and been extended into areas that couldn't be imagined 30 years ago. Some examples include the evaluation of very high resolution precipitation and cloud predictions, the application of uncertainty measures to examine the statistical significance of verification results, the development of new approaches for the evaluation of extremes, the development of methods to evaluate the performance of ensembles, and the application of image analysis approaches to investigate spatial attributes of forecast performance. In addition, numerous software packages and tools have been implemented that make the job of verification more feasible. With these advances, new challenges have also become evident, including the need to appropriately account for observation uncertainty in verification studies and the need to apply methods that are appropriate for specific applications (e.g., for specific climate decision-making applications). Developing methods that are appropriate for such specific applications requires an understanding of the processes connecting the different components of the forecasting and application system, identification and interpretation of new observation sources (e.g., from remotely sensed measurements), and understanding the links between the various components of the systems. This talk will consider the current status of forecast verification science and practice and discuss some of the challenges that still remain. In addition, prospects for coping with some of these challenges will be considered.	bgb@ucar.edu
	Hans-Peter Plag	Climate Change and Sea Level Rise Initiative (CCSLRI) Old Dominion University	Towards an Interannual to Decadal Local Sea Level Forecasting System	Societal and environmental effects of sea level rise are among the major impacts of climate change. The USA is one of the countries most exposed to high economic costs of sea level rise and the resulting coastal flooding, and the U.S. East Coast is a "hotspot of accelerated sea level rise."Recent assessments of future local sea level (LSL) rise mostly addressed the next 50 to 200 years, and they revealed a very large range of plausible LSL trajectories, which provides little actionable decision support. However, rapid LSL changes far exceeding those experienced over the last 6,000 years or those considered plausible in most recent assessments of future changes can not be excluded, not even for the next few decades. Such changes pose an unparalleled threat to humanity. A reliable interannual LSL forecasting service would provide "early warning" in case of an onset of rapid LSL rise with necessary lead time for actions to mitigate the impact of such a low-probability, high-impact event. We are implementing a semi-operational system model for decadal coastal LSL forecasts. As far as possible, the LSL system model makes use of existing model components. LSL is the combined output of many Earth system processes acting on spatial scales from global to local, and including mass relocation and exchange between ice sheets, glaciers, land water storage, and oceans; deformation of the solid Earth and gravity-field changes caused by the mass relocation; changes in ocean heat storage and ocean currents; changes in atmospheric circulation; tectonic processes; and natural and anthropogenic local coastal subsidence. Our system model for LSL forecasting is designed to interface with existing modular Earth system models. The scalable framework can easily be adapted to any coastal location. Modules of the system model include global models (climate, ocean, ice sheets, glaciers, continental hydrosphere); regional models for steric effects; local models for vertical land motion; and physical models to convert global processes into local effects. Initially, some of the modules are weakly coupled and based on input from complex models (both internal and external), while other modules are networked locally. The modular nature of the system allows improvements of individual modules, thus enabling rapid integration of advances within modules. Assimilation of observations on global to regional scales (e.g., gravity field, Earth rotation, sea surface heights) and on local scale data (e.g., InSAR, GNSS) provide additional constrains. The system model ensures global consistency for key Earth system parameters, such as mass and momentum conservation. The model will be validated with observations covering ca. 1970 or earlier to the present. Focus will be on the assessment of the predictive capabilities of individual modules, where some of the modules will have strong capabilities on global scales, while others will add regional and local scales or facilitate the down-scaling of the global processes. Performance is being assessed using NCEP's metrics. Depending on performance, the validated system model could be a key element of a pilot decadal forecasting service for LSL changes for integration in the portfolio of NOAA's climate services. Although many scientific issues need to be addressed before reliable forecasting is achieved, it is important to start forecasting as soon as possible to further assess the forecasting capabilities.	hpplag@odu.edu