Sesión Especial

North American Monsoon Experiment (NAME) 10th Anniversary Symposium

Organizadores:

Theodore J. Bohn
Jaime Garatuza Payan
Enrique R. Vivoni

SE01-1

CLIMATE VARIABILITY AND CHANGE AND THE NORTH AMERICAN MONSOON: WHAT HAVE WE LEARNED SINCE NAME AND WHERE ARE WE GOING?

Castro Christopher
University of Arizona
castro@atmo.arizona.edu

One of the two major scientific objectives of the North American Monsoon Experiment was to assess the long-term variability of the monsoon, on seasonal forecast timescales and longer. This presentation will summarize progress towards this end made in the last decade, emphasizing approaches that involve data analyses and dynamical modeling. Seasonal variability of the monsoon is related to large-scale atmospheric teleconnections, antecedent land surface conditions and variations in sea surface temperatures in the Gulf of California and eastern Pacific. With appropriate consideration of these factors, there may be some skill in deterministically predicting the monsoon on seasonal forecast timescales. Climate change projections of the monsoon have been considered in the context of Coupled Model Intercomparison Project (CMIP) global models (Version 3 and 5) or by downscaling these models. These will be collectively discussed in the context of long-term changes in atmospheric and thermodynamic conditions. Consideration of the recent observational record would suggest that some of the projected changes are probably already occurring. To address the major outstanding physical uncertainties in seasonal forecasting and climate change projection will ultimately require high-resolution modeling at a convective-permitting scale, where organized convective structures can be realistically represented.

SE01-2

A PARTIAL MECHANISTIC UNDERSTANDING OF THE NORTH AMERICAN MONSOON

Mitchell David y Erfani Ehsan
Desert Research Institute
david.mitchell@dri.edu

An understanding of the North American monsoon's (NAM) major governing processes is necessary to guide improvement in global and regional climate modeling of the NAM, as well as the NAM's impacts on the summer circulation, precipitation and drought over North America. A partial mechanistic understanding of the NAM is suggested by incorporating local- and synoptic- scale processes. The local scale mechanism describes the effect of the temperature inversion over the Gulf of California (GC) on controlling low-level moisture during the North American Monsoon Experiment (NAME) in 2004. The strong low-level inversion inhibits the exchange between the moist air in the marine boundary layer (MBL) and the overlying dry air. This inversion weakens with increasing GC sea surface temperatures (SSTs) and generally disappears once SSTs exceed 29°C, allowing the moist air trapped in the MBL to mix with free tropospheric air. This leads to a deep, moist layer that can be transported inland by low-level jets or onshore sea breezes to form thunderstorms. More recent research provides additional observational evidence for this local mechanism based on the 2012 NAM season. Satellite measurements of SST, rainfall, cloud top height and deep (convective) cloud frequency were used to show that once SSTs in the lower 2/3 of the GC exceeded 29°C, rainfall amounts and the frequency of deep convection over the NAM core region (NW Mexico) dramatically increased. Moreover, a few days after SSTs in the northern GC attained 29.5°C, rainfall over Arizona dramatically increased. This is consistent with previously published research. On the synoptic scale, climatologies from 1983 to 2010 exhibit a temporal correspondence between coastal warm tropical surface water, NAM deep convection, the NAM anticyclone center and NAM-induced strong descent. A hypothesis is proposed to explain this correspondence, based on limited soundings south of the GC (that suggest this local mechanism may also be active in that region), these climatologies and the relevant literature. The hypothesis states that the warmest SSTs moving up the coast may initiate NAM convection and atmospheric heating, advancing the position of the anticyclone and the region of descent northwards. By advancing the position of the anticyclone northwards, the SSTs affect the general circulation pattern, bringing in mid-level tropical moisture to fuel the NAM.

SE01-3

THE NORTH AMERICAN MONSOON IN A 7KM MESH GLOBAL MODEL

Mapes Brian[1] y Adams David[2]
[1]*University of Miami*
[2]*UNAM/CCA*
mapes@miami.edu

Resolution is a major challenge for modeling the North American Monsoon (NAM). We will examine the NAM as depicted in a unique new data set: the 7km, two-year "nature runs" of the NASA GEOS-5 non-hydrostatic global model with explicit convection and high-resolution topography. High resolution models have had difficulties in properly organizing convection on the mesoscale. The consequences are non-trivial as up to 70% of NAM convection has its origins in mesoscale convective complexes. Does this new, high resolution model overcome this challenge? To address this question, we will examine case studies and weather loops. Because topography and coastlines are adequately resolved, station observations from NAME and the more recent North American Monsoon GPS Transect Experiment 2013 can be meaningfully compared to grid point values in a quantitative, albeit statistical manner.

SE01-4

CHALLENGES IN UNDERSTANDING AND PREDICTING RAINFALL EXTREMES IN THE NORTH AMERICAN MONSOON

Cavazos Tereza[1], Torres-Alavez Abraham[2], De Grau Pamela[1] y Cerezo-Mota Ruth[3]
[1]*Centro de Investigación Científica y de Educación Superior de Ensenada, CICESE*
[2]*University of Nebraska*
[3]*SISAL, UNAM*
tcavazos@cicese.mx

Since the late 1990s, the overall goal of the Pan American CLIVAR Research on the North American Monsoon System (NAMS) has been to determine the sources and limits of predictability of warm season precipitation with emphasis on time scales ranging from daily to interannual. Following this goal, some of the objectives of the North American Monsoon Experiment (NAME) were to examine the nature, forcing, predictability and impacts of the monsoon system in the region. A very significant aspect of monsoon precipitation is to understand local and remote forcing mechanisms associated with extreme precipitation under current and climate change conditions. A review of some of these mechanisms is presented here, as well as some of the challenges for improving the diagnosis, short-term prediction, and projections of extreme precipitation under climate change conditions.

SE01-5

LONG-TERM GRIDDED METEOROLOGICAL OBSERVATIONS OVER THE CONTINENTAL US, MEXICO, AND SOUTHERN CANADA, 1950-2013: ASSESSMENT OVER THE NORTH AMERICAN MONSOON REGION

Bohn Theodore[1], Livneh Ben[2], Muñoz Arriola Francisco[3],
Robles-Morua Agustin[4], Vivoni Enrique[1], Pierce David[5] y Vose Russell[6]
[1]*School of Earth and Space Exploration, Arizona State University*
[2]*Earth System Research Laboratory, National Oceanographic and Atmospheric Administration*
[3]*School of Natural Resources, University of Nebraska*
[4]*Departamento de Ciencias del Agua y del Medio Ambiente, Instituto Tecnológico de Sonora*
[5]*Scripps Institution of Oceanography*
[6]*National Climate Data Center, National Oceanic and Atmospheric Administration, Asheville, NC, USA*
theodore.bohn@asu.edu

The North American Monsoon (NAM) is a critical component of the water resources of the arid regions on both sides of the US-Mexico border. Gridded datasets of observed surface meteorology play a key role in furthering our understanding of the behavior and governing mechanisms of the monsoon, both through observational analyses and as forcings for hydrologic models. Here we present the first dataset of gridded meteorology that covers the entirety of both Mexico and the USA and the southern portion of Canada, at 1/16 degree spatial resolution, with consistent gridding across the border. Observations in the US and Mexico were taken from the 20,000-station NOAA Cooperative Observation (COOP) network and the 5,000-station Servicio Meterologico Nacional (SMN) network, respectively, covering the period 1950-2013. The available data fields include observed daily precipitation, air temperature and wind speed, as well as derived shortwave and longwave radiation and humidity. In addition, hourly versions of all fields were derived from the daily quantities. Gridded precipitation values were rescaled to match a monthly climatology over North America over the period 1981-2010 derived from the GHCN network, which accounts for changes in precipitation with elevation. We will compare this dataset to the North American Regional Reanalysis (NARR) and the North American Land Data Assimilation (NLDAS) datasets, with an emphasis on performance over the NAM region.

SE01-6

ASSESSING CHANGES IN THE SPATIAL AND TEMPORAL EXTENT OF THE NORTH AMERICAN MONSOON AND ASSOCIATED ECOSYSTEM CHANGES FROM 1982 TO 2008.

Scheftic William y Zeng Xubin
The University of Arizona
scheftic@email.arizona.edu

Variations in the North American Monsoon climate will influence how monsoon-dependent ecosystems change. The purpose of this work is to improve our understanding of the physical extent, seasonality and interannual variability of the monsoon and whether there are related changes in the phenology of vegetation within the monsoon domain. In this project, using North American

Regional Reanalysis (NARR) and North American Land Data Assimilation System (NLDAS) data from 1982 to 2008, we create an objective monsoon onset and withdrawal identification based on a monsoon being defined as a sharp warm-season increase in precipitation or moisture as a result of a change in the wind velocity. Preliminary results suggest that the length of the meteorological monsoon has decreased over the past three decades over most of the monsoon region, whereas the length of the NDVI-based greening period of vegetation has increased slightly over the core monsoon region but has decreased outside of the region. Furthermore, analysis of the precipitation has shown that while monsoon-based precipitation has remained steady or even decreased slightly over monsoon areas, the percentage of annual precipitation that has occurred during the monsoon has actually increased.

SE01-7

LAS INTERACCIONES ATMÓSFERA-TIERRA DURANTE EL MONZÓN DE AMÉRICA DEL NORTE

Vivoni Enrique
Arizona State University, ASU
vivoni@asu.edu

A partir del Experimento del Monzón de América del Norte se han logrado avances importantes sobre el conocimiento del sistema climatológico y su interacción con la superficie terrestre. En esta plática, se hace un resumen sobre el papel que tienen los ecosistemas diversos de la región del Monzón sobre el desarrollo y la persistencia de dicho fenómeno. Este enfoque ecohidrologico permite decifrar los lazos entre la atmósfera, la superficie terrestre y el rol activo de los ecosistemas. Se presenta evidencia de la variación geográfica de dichas interacciones en base a análisis de datos de campo, de percepción remota y el uso de modelos ecohidrológicos a niveles locales y regionales. Ademas, discutimos los mecanismos ecohidrológicos causados por el enverdecimiento de los ecosistemas sobre los flujos de agua en la superficie terrestre, principalmente la evapotranspiración y su partición en componentes de la evaporación de suelo desnudo, la transpiración y la evaporacion de agua interceptada en el dosel de las plantas. Finalmente, se discuten las avenidas de investigación que posiblemente ilustren la importancia relativa de los ecosistemas regionales en el desarrollo dinámico del Monzón de América del Norte.

SE01-8

THE IMPACT OF THE NAME – 10 YEARS ON

Douglas Michael
Cooperative Institute for Mesoscale Meteorological Studies, University of Oklahoma
douglasnoaa@gmail.com

The North American Monsoon Experiment (NAME) took place during the summer of 2004, mostly over northwestern Mexico and the extreme southwestern USA. Special observations ranged from simple enhancements of the raingauge network to complex (and expensive) measurements by research ships, radars, and aircraft. As in most field programs, there was funding for follow-on research and a substantial number of publications resulted from the effort. This talk does not focus on the results of such publications but rather what did not happen with some of the observations collected. In particular, certain data sets appear to not have been extensively used by the Mexican research community - especially observations from the research aircraft and the composite meteorological sounding network. Much information remains to be gained from examination of these observations. The reasons for this likely include 1) the assumption that such observations remain proprietary to the researchers, 2) the lack of awareness of the observations by non-participants of NAME, and perhaps most seriously, 3) the lack of a substantial "weather" research community in Mexico (or at least northern Mexico) - as opposed to the substantial Mexican "climate" research community. The lack of such a research community has limited the impact of NAME observations (which were fundamentally "weather" observations because of their short duration) on Mexican operational weather and climate prediction services and their products. For example, the current observational and forecasting capabilities over the core NAME area (northwestern Mexico) appear no better than prior to NAME. The talk concludes with a call for a reexamination of the NAME observations by the Mexican scientific community, with a parallel effort to transfer some of the knowledge to the Mexican institutions involved in weather and climate prediction. Some specific suggestions are offered, including 1) a compilation of NAME research results that can be understood - and applied, by the operational communities in Mexico and 2) a white paper discussing NAME, its components, and what was gained by the Mexican meteorological community (and perhaps where to go from here?). The latter could prove to be a valuable exercise for the Mexican atmospheric science research community.

SE01-9

LONG-TERM SURFACE CARBON DIOXIDE AND WATER FLUX MONITORING AT A SUBTROPICAL SHRUBLAND IN THE CORE OF THE NORTH AMERICAN MONSOON REGION

Garatuza-Payan Jaime[1], Tarin Tonantzin[1 y 2], Rodríguez Julio Cesar[3], Méndez-Barroso Luis[4 y 5], Robles-Morua Agustin[1], Watts Christopher J.[3], Vivoni Enrique[6] y Yepez Enrico A.[1]
[1]*Instituto Tecnológico de Sonora, ITSON*
[2]*University of Technology Sidney*
[3]*Universidad de Sonora, UNISON*
[4]*Arizona State University*
[5]*Instituto Tecnológico de Sonora*
[6]*Arizona State University, ASU*
garatuza1@gmail.com

In the North American Monsoon (NAM) region, climate conditions and the concomitant responses of the surface vary widely intra- and inter annually which demands a monitoring system capable of detecting change rapidly and over time. Real time and continuous measurements of CO2 and water exchange at the surface-atmosphere interphase are key to understand environmental controls of ecosystem performance and the surface feedback to the atmosphere. Relying on measurements of CO2 and water fluxes with the eddy covariance technique, the present work presents results from a long-term monitoring effort (2008-2013) at a subtropical shrubland within the NAM core region in north western México. Results suggest that the capacity for assimilating or emitting CO2 to the atmosphere of this ecosystem is highly variable within seasons and across years, but that the annual balance depends on the quantity and temporal frequency of precipitation events during the growing season associated with the NAM. Furthermore, legacies of soil moisture and the capacity of water transport by the vegetation, as well as the availability of substrates for organic matter decomposition controlling ecosystem´s metabolic capacity seem determinant for the net ecosystem transfer of CO2 to the atmosphere and therefore control carbon sequestration capacity and water balance of this system. A thorough understanding of the temporal variability of these parameters and their interaction allow generating a baseline of fundamental knowledge of this system that will contribute to develop an early warning system for climate change within the NAM region. Keywords: Eddy Covariance, MexFlux, Net Ecosystem Exchange, Ecohydrology, Rayon.

SE01-10

A 10 AÑOS DEL NAME , PERSPECTIVA DEL USO DEL GPS PARA EL ESTUDIO DEL MONZÓN DE NORTEAMÉRICA/ THE USE OF GPS TO STUDY THE NORTH AMERICAN MONSOON (NAME: 10 YEARS LATER)

Minjarez Carlos
Universidad de Sonora, UNISON
carlos.minjarez.s@gmail.com

En 2004 fue desarrollado el Experimento del Monzón de Norteamérica (NAME, por sus siglas en ingl'es) teniendo como foco el suroeste de Estados Unidos y Noroeste de México. En aquel tiempo, en esta región, era apenas incipiente la red de monitoreo de vapor de agua usando antenas receptoras de GPS basadas en tierra. Hoy, a 10 años del NAME, la red de monitoreo se ha multiplicado representando una excelente fuente de datos y oportunidades tangibles de investigación del monzón norteamericano. Incluso se desarrolla una red de monitoreo mexicana llamada TLALOCNET En esta charla, hablaremos brevemente de la técnica del uso del GPS para monitorear vapor de agua atmosférico y se darán las perspectivas de estudio del Monzón de Norteamérica usando la misma. In 2004, the North American Monsoon Experiment (NAME) was implemented mainly in southwest U.S. and northwest Mexico. Those years, the GPS network for the monitoring of atmospheric water vapor was emerging in this region. Now, 10 years later, the NAME network has grown and represents an extraordinary source of data and research opportunities for the monsoon. Furthermore, a Mexican network called TLALOCNET is in the process of development. In this presentation, we will provide a short explanation of the technique to estimate atmospheric water vapor and provide some research perspectives regarding the study of the monsoon by using the GPS technique.

SE01-11

THE NORTH AMERICAN MONSOON GPS TRANSECT EXPERIMENT 2013

Adams David y Ramos Pérez Omar
Centro de Ciencias de la Atmósfera, UNAM
dave.k.adams@gmail.com

The need for observations in Northwest Mexico strongly motivated the NAM GPS TRANSECT Experiment 2013; however, the goals of this experiment are much broader. The GNSS/GPS technique for providing water vapor measurements has now been used for almost two decades, particularly for validation, observational studies and forecasting. But these applications have been essentially confined to the mid- latitudes, and scarcely employed in the Tropics. Furthermore, GPS PWV has rarely been utilized for small-scale, process-oriented studies of deep

convection and its organization.With this in mind, the Transect Experiment has three principal aims:(1) to address basic science questions regarding the role of water vapor fluxes in the SMO in initiating deep convection and growth into MCSs by utilizing a novel measurement technique.(2) to improve NAM operational forecasts through PWV data assimilation(3) to build strong international long-term collaborative efforts between Mexico and the U.S. focusing on the climate and meteorology of Northwest Mexico and the Southwest US. The Transect Experiment consisted of 10 GPS meteorological stations in addition to 7 existing Suominet sites (http://www.suominet.ucar.edu/) . Three specific transects, each with a particular observational goal, constituted the experiment. The first transect from Bahía de Kino to Chihuahua City crossed the highest reaches of the SMO and, hence, was ideal for evaluating the diurnal evolution of water vapor fields and convective initiation over complex terrain. The second transect along the Gulf of California (GoC) coastal plains was designed to capture surges of low-level moisture “gulf surges” propagating up the GoC in addition to other tropical disturbances. The third transect, Los Mochis to Badiraguato, captures the strong precipitation gradient between the GoC and the foothills of Sinaloa, as well as frequent nocturnal MCSs.We present initial results on the diurnal cycle of precipitable water vapor as a function of elevation for both convective and non-convective days. In addition, we introduce typical deep convective timescales derived from GPS precipitable water vapro for convective development across the SMO and along the GoC. We conclude with future work on GPS data assimilation into regional forecast models.

SE01-12 CARTEL

GULF OF CALIFORNIA SEA SURFACE TEMPERATURES AND THE NORTH AMERICAN MONSOON: MECHANISTIC IMPLICATIONS FROM MODELING

Mitchell David[1], Ivanova Dorothea[2] y Erfani Ehsan[1]
[1]*Desert Research Institute*
[2]*Embry-Riddle Aeronautical University*
david.mitchell@dri.edu

Satellite observations suggest that sea surface temperatures (SST) in the northern Gulf of California (GC) may play a critical role in the timing and amount of summer rainfall over the U.S. southwest. In particular, the onset of relatively heavy rainfall occurs after these SSTs exceeded 29oC. Here we explore this idea in a modeling context using the NCAR/Penn State Mesoscale Model Version 5 (MM5) to simulate the onset of the North American monsoon (NAM) in Arizona (AZ) for 1999. This study explores the impact of GC SSTs on factors affecting deep convective precipitation: the regional atmospheric circulation, water vapor mixing ratio, convective available potential energy (CAPE) and convective inhibition (CIN). The impact of GC SSTs on rainfall is also addressed. After analyzing the predicted evolution of the above properties, and their dependence on GC SSTs in numerous MM5 simulations conforming to conditions at the beginning of the 1999 monsoon onset period for AZ, a new understanding emerges as to how the lower atmosphere over the GC may interact with SSTs to release moisture for monsoon rainfall. When the GC SST is 29oC or less, an inversion is present over the GC due to warmer air aloft. When GC SSTs reach 30oC or higher, moist marine boundary layer (MBL) air may become buoyant relative to the drier overlying air. This buoyancy can erode the marine inversion and allow MBL air to mix with the free troposphere. This enhances the moisture content of low-level southerly winds during favorable synoptic conditions, enhancing the moisture flux into AZ. The predicted dependence of the AZ regional rainfall rate on the northern GC SST is remarkably similar to the observed dependence, featuring an abrupt increase in rainfall rate when the SST exceeds 29oC. Both modeling and observations indicate the existence of a threshold SST in the northern GC, which when exceeded results in an abrupt increase in rainfall over AZ. A boundary layer parameterization having high vertical resolution with an accurate treatment of physical processes appears essential for capturing the sensitivity of AZ rainfall to GC SSTs.

SE01-13 CARTEL

MAPEO ISOTÓPICO DE AGUA EN POZOS SOMEROS EN LA CUENCA DEL RÍO CUCHUJAQUI EN LA REGIÓN DEL MONZÓN DE NORTE AMÉRICA

Castro-Lopez Ariel, Lugo-Escorcia Livia D., López-Mercado María E., Javalera-Rincón Fabiola, Garatuza-Payan Jaime, Robles-Morua Agustin y Yepez Enrico A.
Instituto Tecnológico de Sonora, ITSON
mecanik@hotmail.com

Los mapas isotópicos (isoscapes) son una herramienta que permite describir las variaciones espacio-temporales de concentraciones de isótopos estables en diversas matrices ambientales en función de la variabilidad bioclimática. El uso de los mapas isotópicos toma mayor importancia en sitios y regiones con poca exploración isotópica como en México ya que con herramientas geoestadísticas se pueden predecir rangos de variación isotópica de sistemas hidrológicos y que sirvan de apoyo en el manejo de los recursos hídricos. El objetivo de este trabajo es evaluar el mapa isotópico para aguas subterráneas someras de Wassenaar et al. (Geochem. Exp. 2009, 102:123) de la cuenca del Río Cuchujaqui en el noroeste de México, con la finalidad de tener una herramienta validada de utilidad para planeación de recursos hídricos en la región del monzón de Norte América (NAM). Se aplicó el modelo isotópico lineal de Wassenaar et al. para generar el mapa isotópico de ?18O y deuterio ?D en la cuenca del Río Cuchujaqui utilizando un sistema de información geográfica alimentado por variables de elevación, latitud y precipitación anual. Se utilizó un modelo de elevación digital (DEM) (GTOPO30) y la base de datos de WORLDCLIM (~1950-2000) para la precipitación anual media en la cuenca. Los resultados del mapa isotópico para el sitio de estudio fueron comparados con la composición isotópica de muestras de agua de 8 pozos someros distribuidos a lo largo de la cuenca durante la primavera de 2014. El modelo de Wassenaar et al, indico valores de ?D entre -43 y -53 ‰ y para ?18O entre -6 y -7 ‰ mientras que el rango isotópico de las muestras de pozos someros en ?D fue de -42 a -44 ‰ y para ?18O de -4 a -5 ‰. El rango de variación de la composición isotópica de la lluvia entre 2011y 2013 vario en un rango de (-45 a -46) ‰ para ?D y de (-5 a -7) ‰ para ?18O en la zona de estudio o cual sugiere una probable recarga local de los acuíferos. Los resultados sugieren que el modelo de Wassenaar et al es robusto para una cuenca en la zona central de la región del NAM por lo que su utilización como primera aproximación para exploración hidrogeológica de la región del NAM es útil.
Palabras Clave: Isoscapes, deuterio, oxigeno 18, isotopos estables, ecohidrología.