Chinese-American Ocean-Atmosphere Association

(C O A A)

2002 Annual Meeting

Conference on Earth-Observing and Atmosphere-Land-Ocean Interaction

October 26, 2002

Enterprise Hall, Room 80
George Mason University
Fairfax Virginia 22030-4444

COAA 2002 Board Members

Dr. Song Yang ..... President
301-763-8000 x7012 (NOAA/NWS) song.yang@noaa.gov

Dr. Benjamin Fong Chao ..... Vice President
301-614-6104 (NASA/GSFC) chao@bowie.gsfc.nasa.gov

Dr. Eueng Nan Yeh ..... Secretary
301-614-5071 (SAIC at NASA) enyeh@dao.gsfc.nasa.gov

Dr. Te-Jung Henry Wang ..... Treasury
703-751-5344 wanght@ns.kreative.net

Dr. William Tseng, ... Program
301-763-8142 x124 (NOAA/NESDIS) william.tseng@noaa.gov

Dr. Long S. Chiu, ... Program
301-614-5141 (George Mason Univ) lchiu@gmu.edu

Dr. Yuejian Zhu ..... Membership

301-763-8000 x7275 (SAIC at NOAA) yuejian@noaa.gov

Dr. Si Kang Yang, ... Publicity

(301) 763-8000 ext 7559 (RSIS at NOAA) sk.yang@noaa.gov

Dr. Julian X.L.Wang ..... Newsletter
(301)713-0295 x124 (NOAA/OAR) Julian.Wang@noaa.gov

Program Committee

Dr. Long S. Chiu, ... Pogram Co-Chair

Dr. William Tseng, ... Program C0-Chair

Dr. Du Jun, ... Member

Dr. Benjamin Chao, ... Member

Dr. Xiaofeng Li, ... Member

Dr. Dongliang Yuan, ... Member

A g e n d a

8:30-9:00 AM: Registration and Breakfast
9:00-9:10 AM: Logistics —— Dr. Long Chiu
9:10-9:15 AM: Welcome from COAA —— Dr. Song Yang
9:15-9:20 AM: Welcome from GMU —— Prof. Menas Kafatos
9:20:-9:30 AM: COAA 2003 Conference —— Dr. Dalin Zhang

Invited Talks: 9:30AM – 10:50AM

1. **"Sea Level Change in Hong Kong and Its Relation With ENSO"**

   Zheng Dawei, Hong Kong Polytechnic University
   Ding Xiaoli, Chen Yongqi, Huang Cheng, ChenWu

2. **"A coupled atmospheric-hydrological modeling study of the 1996 Ha! Ha! River basin flash flood in Quebec, Canada"**

   Charles A. Lin, McGill University

3. **"Sediment control for China's Yellow River"**

   George Y. Leung, University of Massachusetts Dartmouth

4. **"VAccess/MAGIC: Remote Sensing and GIS for Regional Environmental Applications"**

   Menas Kafatos, CEOSR, George Mason University

10:50-11:20 AM — Coffee Break — Poster set up

presentations: 11:20AM --- 12:00PM

1. **"On the Mean East-West Asymmetry and ENSO Variability in the Equatorial Pacific Basin"**
   Ming Cai, University of Maryland\
2. **"Diagnostics of Climate Variability and Trend Using Potential Vorticity Maps"**
   Ming Cai, University of Maryland\
3. **"Diurnal Cycle of Precipitation from TRMM"**
   Long S. Chiu, George Mason Univertsity
   Jeanarai Vongssard, Alfred T-C. Chang
4. **"Challenge of Future Weather Prediction: Deterministic or Stochastic?"**
   Jun Du, National Centers for Environmental Prediction/NOAA
5. **"On the impacts of the Indian summer monsoon on ENSO in a coupled GCM"**
   Renguang Wu, Center for Ocean-Land-Atmosphere Studies
   Ben P. Kirtman
6. **"A Shallow-CISK-Deep-Equilibrium Mechanism for the Interaction between Large-Scale Convection and Large-Scale Circulation in the Tropics"**
   Zhaohua Wu, Center for Ocean-Land-Atmosphere Studies
7. **"Dynamical Implications of the Shape of Atmospheric Low-Frequency Eddies"**
   Song Yang, Climate Prediction Center, NCEP/NOAA
   Ming Cai, Huug van den Dool, and Vernon Kousky
8. **"Evaluating the newly implemented NCEP cloud/radiative parameterizations with CERES"**
   S-K Yang, Climate Prediction Center/NCEP/NOAA
   Y-T Hou, S. Moorthi, K.A. Campana, and A-J. Miller
9. **"The GEOS Retrospective Data Assimilation System: The 6-hour lag case"**

Yanqiu Zhu, Data Assimilation Office, NASA/GSFC
Ricardo Todling, Stephen E. Cohn, Michael Navon, and Yan Yang

10. **"On mesospheric ozone remote sounding techniques: Stellar occultation versus infrared limb emission"**
    Xun Zhu, Johns Hopskin's University
11. **"Characteristics of Landfalling Tropical Cyclones in the United States Climatology and Interannual Variability"**
    Yaping Zhou, Climate and Radiation Branch, GSFC, NASA /SSAI
    Joshua Larson and Wayne Higgins
12. **"Gulf Stream North Wall Breach and other significant events observed on NOAA/AVHRR SST images"**
    Xiaofeng Li, NOAA/NESDIS
    T. F. Donato, Q. Zheng, W. G. Pichel, P. Clemente-Colón[1]
13. **"The Global Oceanic Internal Wave Database and the Dynamics Analysis in the South China Sea"**
    Zhongxiang Zhao, Center for Remote Sensing, University of Delaware
    Victor Klemas, and Quanan Zheng
14. **"Time-variable gravity from space: Quarter century of observations, mysteries, and prospects"**
    Benjamin Chao, Goddard Space Flight Cente,/NASA
15. **"TRMM and Gauge Rainfall Estimates over New Mexico"**
    Long S. Chiu, Goddard Space Flight Center,/NASA; CEOSR, GMU
    Z. Liu, J. Vongsaard, S. Morain, A. Budge, C. Bales and T. Wolff[3]
16. **"Flash Flood Risk Estimation in GIS using Morphometric Parameters"**
    Hesham El-Askary, CEOSR, George Mason University
    M. Hegazy, S. Jackson, M. Kafatos, D. Wong and L. Chiu
17. **"EL NINO Southern Oscillation impact on Virginia Precipitation"**
    Hesham El-Askary, CEOSR, George Mason University
    S. Sarkar, L. Chiu, M.Kafatos, and T. El-Ghazawi
18. **"Soil Moisture as an Antecedent Precipitation Index For Tracking Satellite Rainfall Underestimates in Continental Dry Regions"**
    Yixiang Nie, CEOSR, George Mason University
    Long S. Chiu
19. **"TRMM Data Reprocessing and New Data Products"**
    Hualan Rui, NASA/Goddard Space Flight Center
    B. Teng, J. Bonk, L. Chiu, Z. Liu, P. Hrubiak, N. Pollack,
    L. Lu and G. Serafino

12-3:00 PM	Lunch and Poster Session
3:00-3:15 PM	——— Coffee Break ———
3:15-4:45 PM	Panel Discussion
4:45 PM	Announcement of New board members
4:45 PM	Day Conference Adjourned
4:45-5:00 PM	Executive Session —— All board members

Invited Talk 1:

Sea Level Change in Hong Kong and Its Relation With ENSO

Zheng Dawei[1, 2], Ding Xiaoli[1], Chen Yongqi[1], Huang Cheng[2], ChenWu[1]

[1] Department of Land Surveying and Geo-Informatics, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China

[2] Center for Astrogeodynamics Research, Shanghai Astronomical Observatory, Chinese Academy of Sciences, 80 Nandan Road, Shanghai 20030, China.

Tel: (852)-2766 6701 or (852)-27665965
Fax: (852)-2330 2994

E-mail: lszheng@polyu.edu.hk or lsxlding@polyu.edu.hk

Some tide gauge records of Hong Kong covering the past forty-five years are adopted to analyze the basic features of sea level changes in the region. The data sets of local and global atmospheric pressure, southern oscillation index and sea surface temperature during the same time span are also used to find the possible links between the sea level changes in Hong Kong and some local and global oceanic and atmospheric processes. The results from the study indicate that there is a rising trend of 1.9±0.4 mm per year in the sea level of Hong Kong. The effect of local atmospheric pressure variations on the amplitude of the annual sea level change is about 30% of the amplitude. It is also found that the interannual variations in the sea level of Hong Kong are related to the El Nino and La Nina events that happen frequently in the tropical Pacific. It is also projected from the extrapolation of the current trends of seal level rise and ground subsidence that the possible maximum relative mean sea level change when considering the various temporal variations can be as high as closing to 50 cm in the next half century.

Invited Talk 2:

A coupled atmospheric-hydrological modeling study of the 1996 Ha! Ha! River basin flash flood in Quebec, Canada

Charles A. Lin

Department of Atmosphere and Ocean Science
McGill University
Montreal Canada

Email: lin@zephyr.meteo.McGill.ca

We use a high-resolution regional atmospheric model coupled to a hydrological model, and an off-line routing module to simulate a hydrograph during the 1996 July flash flood that occurred in the Saguenay region of eastern Québec. The hydrograph is at the outlet of the Ha! Ha! Lake in the Ha! Ha! River basin. The former has a drainage area of 250 km2 and is covered by 6 model grid squares; the precipitation at these grid squares compare well with observations at the nearest available rain gauge located 20 km south of the basin. The hydrological model is a modified version of a land surface scheme which consists of three soil layers, and the routing module is based on the geomorphological unit hydrograph. The simulated hydrograph is compared with another reconstructed hydrograph in the published literature.

Invited Talk 3:

Sediment control for China's Yellow River

George Y. Leung

Physics Department

University of Massachusetts Dartmouth

N. Dartmouth, MA 02747

Email: gleung@umassd.edu

We propose a scheme to finance the construction of check dams in Yellow River's sediment production area, called the loess plateau, to prevent sediment flow into the river and to achieve gradual reduction of sediment in the rivers on a long-term basis. The check dams will not only trap sediment but also retain water, which is extremely valuable for the arid loess plateau. It is estimated that the with the available water resource, irrigated farmland can be created leading to improved agricultural production, and if managed well part of the added incomes of the farmers can be used to repay the funding of the check dam construction. Thus, with the availability of loan to such projects sediment trapping is funded naturally under a market economy. The local farmers belong to one of the poorest segments of the Chinese society, and these dam projects can take them out of poverty, with immediate outlook in poverty alleviation.

Invited Talk 4:

VAccess/MAGIC: Remote Sensing and GIS for Regional Environmental Applications

Menas Kafatos

Center for Earth Observing and Space Research,
School of Computational Sciences, Fairfax, VA 22030-4444, USA

Email: mkafatos@gmu.edu

Virginia Access/Mid-Atlantic Geospatial Information Consortium (VAccess/MAGIC) is a regional, remote sensing and Geographical Information Sciences project among several educational institutions. It is a prototype for regional projects in other states and other countries, and is funded by NASA's applications program. The user communities VAccess serves are the Commonwealth of Virginia and State of Maryland, local and regional users represented in a Technical Advisory Committee. Remote sensing data include global NASA and NOAA data tailored for regional applications as well as high-resolution multispectral (Landsat, MODIS, etc.), hyperspectral, LIDAR and SAR data sets. Broad beam LIDAR technology can provide canopy structure as well as other information for environmental concerns such as the state of wetlands. The data information system is based on a distributed architecture to serve remote sensing and GIS data to a variety of users via the WWW. Several remote sensing and GIS-based environmental and Earth systems science applications projects are discussed here, including flood and fire hazard mitigation, forestry, land use/land cover and epidemiology projects; as well as innovative data fusion, data access and analysis and various tools serving the users and their applications.

Keywords: Regional Applications, Remote Sensing, GIS, Flash Floods, NDVI, LAI, Epidemiology, Oil Pollution, WebGIS, ArcIMS

Abstracts:

On the Mean East-West Asymmetry and ENSO Variability in the Equatorial Pacific Basin

Ming Cai
Department of Meteorology, University of Maryland
College Park, MD 20742
Email: cai@atmos.umd.edu

This paper proposes a mechanism that explains how the coupled dynamics alone can spontaneously give rise to a realistic west-east asymmetric mean state and an ENSO-like interannual variability without requiring the existence of an external pre-existing west-east asymmetry in circulation. The essence of the newly proposed mechanism is that the basin-wide ocean-atmosphere coupling acts to reduce the effective restoring force. As a result, the coupled oceanic waves travel more and more slowly within the equatorial ocean basin as the coupling strength increases. When the coupling strength reaches a critical value, the zonally leveled thermocline becomes unstable as a result of the weakening of the effective restoring force, at which the theoretical limit of the traveling time scale would be infinite without nonlinearity. Due to nonlinearity in the coupled system, this primary air-sea interaction instability leads to a west-east asymmetric mean state in which the atmosphere has a prevailing easterly and the ocean basin has a deep-in-west/shallow-in-east thermocline with a warm-west/cold-east sea surface temperature. The direction of the west-east asymmetry in the mean state is dictated by a planetary factor of the Earth, namely, that the Coriolis parameter changes sign at the equator. As the coupling strength further increases, the asymmetry in the mean state amplifies and the phase speeds of the coupled equatorial oceanic waves begin to decrease gradually towards an asymptotic limit equal to the full speed in the uncoupled situation.

Using the coupling coefficient that is consistent with the observation, the fully coupled model can produce a realistic mean state in which the basin-wide SST (thermocline depth) difference is 4.2°C (116 meters) and the westward wind stress at the central Pacific basin is 0.54 dyne/cm^2. The self-sustained oscillation has a primary period of 3.7 years. The SST in the west (east) oscillates between 27.5°C and 28.5°C (between 25.2°C and 22.5°C).

Diagnostics of Climate Variability and Trend Using Potential Vorticity Maps

Ming Cai

Department of Meteorology, University of Maryland,

College Park, MD 20742, USA

Email: cai@atmos.umd.edu

This paper proposes a potential vorticity intrusion index (denoted as PVI) as an alternative diagnostic tool to study the observed climate variability/trend of the surface temperature. The PVI index is defined as the percentage area of upper lever PV intrusion in the extratropics at any given time. Abundance (shortage) of extreme cold surface air temperature episodes in high latitudes coincides with a high (low) PVI index. The interannual variability of the PVI index exhibits a strong QBO- like signal. The high (low) PVI index prevails when the equatorial zonal mean zonal wind at 50 hPa is easterly (westerly). The probability distribution map of PV intrusion activities shows a shift of the preferred regions of frontogenesis from the oceans to the continents when the PVI index is high. This explains directly why more extreme cold events are observed over the northern Eurasian and Northern America continents when the PVI index is high.

Diurnal Cycle of Precipitation from TRMM

Long S. Chiu and Jeanarai Vongssard
Center for Earth Observing and Space Research, MSN 5C3
George Mason University, Fairfax Virginia USA 22030-4444

Alfred T-C. Chang
Code 974, Laboratory for Hydrospheric Sciences
NASA/Goddard Space Flight Center, Greenbelt Maryland USA 20771

Email: lchiu@gmu.edu or aching@Rainfall.gsfc.nasa.gov

One stringent test for Global Circulation Models (GCMs) or regional forecast models is their ability to reproduce the phase and amplitude of the diurnal cycle of precipitation. However, detail precipitation measurements at that diurnal temporal scale, especially over the oceans, are lacking. The Tropical Rainfall Measuring Mission (TRMM), with the low earth orbit and off-diurnal sampling, provide the needed data to carefully examine the precipitation diurnal cycle. We examine the spatial and temporal distribution of the diurnal cycles derived from seasonal averages of three hourly rain rates at 10 latitude by 10 longitude grids based on the TRMM Precipitation Radar (PR), TRMM Microwave Imager (TMI), and TRMM Combined Instrument (TCI) algorithms. Over the Tropics and subtropics (40S-40N), nocturnal to early morning maximum and late evening minimum are found over the major oceanic rain belts. Over the continental regions of South American and Africa, early afternoon maximum and late morning minimum are found. In the maritime continent and in most coastal regions, there are distinct shifts of the rainfall maximum over the course of the day, with maximum rainfall over land in the early afternoon shifting to maximum coastal rainfall in the nocturnal to early morning hours. The oceanic amplitudes are consistent with earlier estimates from derived from the Special Sensor Microwave Imager (SSM/I). The TMI rain rates are consistently higher than the PR and TCI rain rates over the course of the day, except during the late morning to early afternoon hours when they agree over land. This bias is interpreted as an excess ice signal in the microwave retrieval. This apparent lag of the TMI maximum diurnal rainfall behind PR over land suggests that microwave algorithms should consider life cycle of convection, as have been done with IR and visible techniques

Keywords: Diurnal Cycle, Precipitation, TRMM

Challenge of Future Weather Prediction: Deterministic or Stochastic?

Jun Du

National Centers for Environmental Prediction/NOAA

Email: jun.du@noaa.gov

In scientific community, it is gradually but slowly recognized that uncertainty associated with a weather forecast is as important as, if not more important than, a forecast itself in recent years. Ensemble forecasting is a dynamically meaningful approach to quantify such uncertainty in a numerical forecast.

In this presentation, the author would like to preach the following ideas which might be seemingly against the way of traditional science is heading to: (1) future numerical weather prediction should be stochastic or probabilistic rather than deterministic in format and content; (2) how to use weather forecasting information should be user specific based on their own economic value, i.e. a decision (which weather condition to chose) made by end-users rather than decided by a weatherman for users); and (3) however, forecaster's human role in the post processing of future numerical weather prediction will increase rather than decrease as it is now.

Education to both scientific community and public is the key to the success of effectively and wisely utilizing future numerical weather prediction information.

On the impacts of the Indian summer monsoon on ENSO in a coupled GCM

Renguang Wu[1] and Ben P. Kirtman[1,2]

Center for Ocean-Land-Atmosphere Studies[1]and George Mason University[2]
Email: renguang@cola.iges.org

This study explores the impacts of the Indian summer monsoon (ISM) on the El Niño-Southern Oscillation (ENSO) evolution by utilizing two coupled general circulation model simulations. The first simulation uses the COLA anomaly coupled model and the second simulation employs a new coupling strategy, interactive ensembles, that is designed to increase the signal to noise ratio. We separate the effects of monsoon variability related and unrelated to ENSO through composites in terms of both Niño-3.4 sea surface temperature (SST) and Indian summer monsoon rainfall (IMR) anomalies. It was found that ENSO-related monsoon variability has significant impacts on warm events. In the interactive ensemble simulation, a weak (strong) monsoon enhances (weakens) an ongoing warm event. The monsoon impacts are manifested in the surface zonal wind stress anomalies in the western-central equatorial Pacific. In the anomaly coupled simulation, the monsoon-ENSO relationship is difficult to detect. The ongoing cold events are only weakly affected by monsoon variability. Monsoon variability that is unrelated to ENSO also induces noticeable SST anomalies in the equatorial central Pacific in the following winter. In the interactive ensemble model, a weak (strong) monsoon induces noticeable warm (cold) SST anomalies. In the anomaly coupled model, both weak and strong monsoons favor the development of cold SST anomalies.

Taking advantage of the long period model outputs, we analyze the long-term change of the ISM-ENSO relationship. The fluctuations of the IMR-Niño-3.4 SST correlation are larger in the anomaly coupled model than in the interactive ensemble model. No apparent relation is found between the long-term change of the correlation and that of the monsoon and ENSO anomalies or variances. In the interactive ensemble simulation, the IMR and concurrent Niño-3.4 SST variances show in-phase long-term changes. In the anomaly coupled simulation, the long-term changes of the IMR and summer Niño-3.4 SST variances have an out-of-phase relation.

A Shallow-CISK-Deep-Equilibrium Mechanism for the Interaction between Large-Scale Convection and Large-Scale Circulation in the Tropics

Zhaohua Wu

Center for Ocean-Land-Atmosphere Studies
4041 Powder Mill Road, Suite 302, Calverton, MD 20705-3106

Email: zhwu@cola.iges.org

In this paper, the circulations driven by deep heating and shallow heating are investigated through analytically solving a set of linear equations and examining circulations simulated by a dry primitive equation model. Special emphasis is placed on the low-level mass (moisture) convergence associated with the forced circulation and the maintenance of the shallow and deep heat sources.
It is found that the forced circulation driven by shallow heating is more likely to be trapped horizontally near the heating area but relatively extended in the vertical. As a consequence, diabatic heating can not balance adiabatic cooling due to upward motion. At the levels slightly above the top of the heating, a negative vertical gradient of temperature perturbation appears. For the atmosphere driven by deep heating, however, the temperature perturbation cannot accumulate because the heating signals propagate away very fast, allowing an approximate equilibrium between the convective diabatic heating and adiabatic cooling due to upward motion.

The converged moisture associated with circulation driven by shallow heating exceeds the amount needed to maintain the heat source. However, the circulation driven by deep heating does not feed back effectively to the moisture convergence, and thus can not be self-sustaining.

Based on these results, a new mechanism is proposed for the interaction between the large-scale convection and large-scale circulation. The new mechanism states that shallow heating drives a strong low-level moisture convergence so that the system of shallow heating and the forced large-scale circulation is unstable. When the unstable system reaches a certain amplitude, the stable cap layer immediately above the shallow heating erodes, and deep convection arises, which consumes most of the converged moisture at low levels without much feedback to the low-level convergence of moisture. The whole heating-circulation system develops and dies; the estimated lifetime of such a system based on the timescale of adjustment of tropical atmosphere to forcing is on an intraseasonal timescale.

Related observational and modeling evidence that support the new mechanism is discussed.

Dynamical Implications of the Shape of Atmospheric Low-Frequency Eddies

Song Yang[1], Ming Cai[2], Huug van den Dool[1], and Vernon Kousky[1]

[1]Climate Prediction Center, NCEP/NOAA， Camp Springs, MD 20746
Email: Song.yang@noaa.gov

[2]Department of Meteorology, University of Maryland,
College Park, MD 20742

In this study, we have used the multi-decade daily data from NCEP/NCAR Reanalysis to pinpoint some dynamical aspects of atmospheric variability in the Northern Hemisphere. In particular, energetics analysis is applied to understand different behaviors of the wintertime high-frequency (HF; <10 day) and low-frequency (LF; 10-90 day) eddies.

The energetics of HF eddies can be easily explained by the baroclinic instability theory. As in the literature, we confirm that LF eddies extract kinetic energy from background flow. However, it is found that LF eddies also extract potential energy from the basic flow as in the case of HF eddies. The baroclinic energy extraction rate by LF eddies is nearly as large as barotropical energy extraction. Furthermore, unlike HF eddies, there is little energy conversion from potential energy to kinetic energy for LF eddies. In light of these findings, we attempt to argue that in a three dimensional world purely barotropic instability may not be observable. We put forward a notion of "equivalent barotropic instability" to describe this type of mixed barotropic/baroclinic energy extraction from the mean flow without energy exchange between potential and kinetic energy. We argue that kinetic and potential energy extractions have to work together in order to maintain the equivalent barotropic structure of LF eddies. Results also show that kinetic energy extraction by LF eddies is primarily due to stretching deformation of the mean flow, consistent with the fact that LF eddies are primarily zonally elongated. This may explain why the maximum variability of LF eddies locates further downstream of the jet core, compared to HF eddies.

The feedback tendencies induced by LF and HF eddies have also been calculated. It is found that LF eddies act primarily to reduce zonal gradient associated with stationary waves whereas HF eddies tend to reduce meridional temperature gradient, particularly in the region where local meridional temperature is strongest due to modulation by stationary waves. This difference between HF and LF eddies seems to be related to the difference in shape, namely, LF eddies are zonally elongated and HF eddies are meridionally elongated. In other words, HF eddies primarily transport heat poleward and momentum into the jet stream; on the other hand, LF eddies mainly transport both heat and momentum in zonal direction, diminishing the amplitude of stationary waves.

Evaluating the newly implemented NCEP cloud/radiative parameterizations with CERES

S-K Yang[1], Y-T Hou [2], S. Moorthi[2]., K.A. Campana[2] , and A-J. Miller[1]

[1] Climate Prediction Center/NCEP/NOAA
[2] Environmental Modeling Center/NCEP/NOAA

Email: sk.yang@noaa.gov

The recent release of CERES data provides a timely opportunity for validating the newly implemented cloud/radiation physics in the NCEP operational global forecast system. NCEP replaced the original diagnostic cloud parameterization with a prognostic cloud condensate formulation in the May 2001. Radiative transfer calculations now incorporate optical thickness from the predicted cloud condensate path. Cloud properties, such as ice/liquid water path, and radiative fluxes from CERES are now can be utilized for comparison with model outputs. Estimated surface fluxes from CERES observations are also relevant for evaluating NCEP Regional Reanalysis.

A first comparison of operational GDAS OLR with CERES ERBE-Like fluxes shows substantial improvement from the new model. The global mean bias was reduced from 3..4 W/M^2 to 2.1 W/M^2, a reduction of ~ 40%, and erroneous regional stratification in the mid-high latitudes are virtually eliminated. Further details regarding validation of NCEP cloud property and radiative flux forecasts, as well as model formulation specifics will be presented.

The GEOS Retrospective Data Assimilation System: The 6-hour lag case

Yanqiu Zhu, Ricardo Todling, Stephen E. Cohn
Data Assimilation Office, NASA/GSFC

Michael Navon, and Yan Yang
Department of Mathematics and C.S.I.T, Florida State University
Email: zhu@dao.gsfc.nasa.gov

The fixed-lag Kalman smoother (FLKS) has been proposed as a framework to construct data assimilation procedures capable of producing high-quality climate research datasets. Fixed-lag Kalman smoother-based systems, referred to as retrospective data assimilation systems, are an extension to three-dimensional filtering procedures with the added capability of incorporating observations not only in the past and present time of the estimate, but also at future times. A variety of simplifications are necessary to render retrospective assimilation procedures practical.

In this article, we present an FLKS-based retrospective data assimilation system implementation for the Goddard Earth Observing System (GEOS) Data Assimilation System (DAS). The practicality of this implementation comes from the practicality of its underlying (filter) analysis system, i.e., the physical-space statistical analysis system (PSAS). The behavior of two schemes is studied here. The first retrospective analysis (RA) scheme is designed simply to update the regular PSAS analyses with observations available at times ahead of the regular analysis times. Although our GEOS DAS implementation is general, results are only presented for when observations 6-hours ahead of the analysis time are used to update the PSAS analyses and thereby to calculate the so-called lag-1 retrospective analyses. Consistency tests for this RA scheme show that the lag-1 retrospective analyses indeed have better 6-hour predictive skills than the predictions from the regular analyses. This motivates the introduction of the second retrospective analysis scheme, which, at each analysis time, uses the 6-hour retrospective analysis to replace the first-guess normally used in the PSAS analysis, and therefore allows the calculation of a revised (filter) PSAS analysis. Since in this scheme the lag-1 retrospective analyses influence the filter results, this procedure is referred to as the retrospective-based iterated analysis (RIA) scheme. Results from the RIA scheme indicate its potential for improving the overall quality of the assimilation.

On mesospheric ozone remote sounding techniques: Stellar occultation versus infrared limb emission

Xun Zhu

Johns Hopskin's University
Email: xun.zhu@jhuapl.edu

The mesosphere is a critical region of the atmosphere for studying both the influence of solar ultraviolet radiation from the Sun and anthropogenic effects from the Earth because in this region photochemistry and dynamics are strongly coupled. Studies of the coupled atmospheric dynamics-photochemistry and the related ozone (O3) variability in this region can serve several purposes. The prediction of the current atmospheric O3 and temperature and their future changes due to anthropogenic pollutants is a subject of continuing concern among atmospheric scientists and the public. The mesospheric region with its relatively simple photochemistry and radiative transfer processes provides an excellent workbench for testing our physical understanding and numerical modules that can be part of more complicated models for the lower atmospheres. Furthermore, because solar activity is a primarily natural forcing component in the mesosphere, an understanding of the atmospheric response to solar variability will reduce uncertainties in assessing any superimposed human-induced changes.

Keywords: Mesosphere, Radiative transfer, Ozone

Characteristics of Landfalling Tropical Cyclones in the United States Climatology and Interannual Variability

Yaping Zhou
Climate and Radiation Branch, GSFC, NASA /SSAI

Joshua Larson and Wayne Higgins
Climate Prediction Center, NCEP/NOAA

Email: yzhou@climate.gsfc.nasa.gov

Precipitation due to landfall tropical cyclones (TC) in warm season in US and Mexico is examined using the daily gridded US and Mexico precipitation data and the 6-hourly best storm track data. The tropical cyclones from Atlantic and the Northeast Pacific are both considered.

The monthly climatology shows that the south and west Mexico is the area most frequently struck by TC and has the largest mean percentage of tropical cyclone precipitation (TCP) in the study domain. The mean percentage precipitation due to TC can be more than 15% during the peak months (September, October) for both the east and the west coastal area and the maximum percentage can be more than 90%.

This study also discovered interesting relationship between the TCP and the Arctic Oscillation. The difference in the relationship between TCP and non-TCP in association with ENSO and the high skewness of the statistics require discreet notice from the seasonal forecasters.

Gulf Stream North Wall Breach and other significant events observed on NOAA/AVHRR SST images

Xiaofeng Li [1], Timothy F. Donato[2], Quanan Zheng[3], William G. Pichel[1], Pablo Clemente-Colón[1]

[1]NOAA/NESDIS, E/RA3, Room 102, WWBG, 5200 Auth Road,
Camp Springs, MD 20746-4304, U.S.A.
Email: xiaofeng.li@noaa.gov

[2] US Naval Research Laboratory
Remote Sensing Division/Radio Infrared and Optics Branch, Code 7212
Washington DC 20375

[3] College of Marine Studies, University of Delaware, Newark, DE 19716

A patch of cold shelf water breech of the Gulf Stream north wall near Cape Hatteras is observed on a series of NOAA AVHRR sea surface temperature (SST) images from October 2 to 5, 2001. Unlike the warm/cold core rings generated by the Gulf Stream mender, the cold patch of water eventually cut through the Gulf Stream. After that, the cold jet maintained its penetration and crossed the entire Gulf Stream path. This unique satellite observation is analyzed using the wind data measured by a nearby CMAN station. We find that a strong (over 12 m/s) and persistent (3 days) alongshore wind event happens prior to the breech. The 11-year time series wind measurements between 1991 and 2001 show that similar strong and persistent wind situation only sparely occurs (< 1 event/year) which explains why the large-scale surface shelf water breech of the Gulf Stream has not been reported.

In this poster, we also report the accuracy of current NOAA operational SST retrieval algorithms, and other significant oceanic events, i. e. coastal lee waves, hurricane induced sea surface cooling etc.

The Global Oceanic Internal Wave Database and the Dynamics Analysis in the South China Sea

Zhongxiang Zhao, Victor Klemas, and Quanan Zheng

Center for Remote Sensing
College of Marine Studies, University of Delaware
Newark, DE 19716
Email: zheng@newark.cms.udel.edu

A global database of ocean internal waves has been developed at the Center for Remote Sensing, University of Delaware. Each case of internal wave includes images, interpretation maps, text describing oceanographic properties of the imaged features, and references. Currently we have collected more than 500 images of internal waves around the globe. The database homepage is accessible to the Internet users at the web site http://atlas.cms.udel.edu.

We studied the internal waves in the South China Sea, where more than 100 remote sensing images have been collected. The statistical characteristics and dynamical analysis are presented.

Time-variable gravity from space: Quarter century of observations, mysteries, and prospects

Benjamin Chao

Goddard Space Flight Center
Email: chao@bowie.gsfc.nasa.gov

Any large mass transport in the Earth system produces changes in the gravity field. Via the space geodetic technique of satellite-laser ranging in the last quarter century, the Earth=s dynamic oblateness J2 (the lowest-degree harmonic component of the gravity field) has been observed to undergo a slight decrease -- until around 1998, when it switched quite suddenly to an increase trend which has continued to date. The secular decrease in J2 has long been attributed primarily to the post-glacial rebound in the mantle; the present increase signifies an even larger change in global mass distribution whose J2 effect overshadows that of the post-glacial rebound, at least over interannual timescales. Intriguing evidences have been found in the ocean water distribution, especially in the extratropical Pacific basins, that ay be responsible for this J2 change. New techniques based on satellite-to-satellite tracking will yield greatly improved observations for time-variable gravity, with much higher precision and spatial resolution (i.e., much higher harmonic degrees). The most important example is the GRACE mission launched in March 2002, following the success of the CHAMP mission. In addition, although less precise than GRACE, the GPS/Meteorology constellation mission COSMIC, with 6 mini-satellites to be launched in late 2005, is expected to provide continued and complementary time-variable gravity observations. Such observations are becoming a new and powerful tool for remote sensing of geophysical fluid processes that involve larger-scale mass transports.

Keywords: time-variable gravity, surface mass change, global change

TRMM and Gauge Rainfall Estimates over New Mexico

Long S. Chiu [1,2], Zhong Liu [1,2], Jearanai Vongsaard[2]
Stan Morain[3], Amy Budge[3], Chandra Bales[3], and Tasha Wolff[3]

[1]Goddard Earth Science Enterprise Distributed Active Archive Center, NASA/Goddard Space Flight Center, Greenbelt Maryland 20771 USA

[2]Center for Earth Observing and Space Research,
School of Computation Sciences, George Mason University, Fairfax, Virginia 22030-4444 USA

[3]Earth Data Analysis Center, University of New Mexico, Albuquerque, New Mexico

Email: lchiu@gmu.edu

We compared rain rate derived from the TRMM combined algorithms, specifically the TRMM Precipitation Radar (PR, TSDIS 2A25), TRMM Microwave Imager (TMI, 2A12), TRMM and other satellites (3B42) and TRMM and other sources (includes operational gauges, 3B43) with gauge analysis reported by the water districts (WDs) over New Mexico, USA. The TRMM and other source algorithm shows a low bias compared to the WD gauges while the TRMM and other satellite algorithm shows a high bias. The low bias is attributed to the non-inclusion of rain events that are under-reported by the operational network. Seasonal averages of PR and TMI estimates show reasonable seasonal cycle, but are 2-3 times larger than the WD estimates, respectively. The discrepancy between satellite and gauge estimates are attributed to sampling error, evaporation of drops (virga), and algorithm assumption such as a global Drop-Size-Distribution used in the PR algorithm.

Keywords: Satellite Rainfall, Rain Gauge Measurements, Virga

Flash Flood Risk Estimation in GIS using Morphometric Parameters

Hesham El-Askary Mohamed Hegazy, Steven Jackson[1], Menas Kafatos, David Wong[1] and Long Chiu

Center for Earth Observation and Space Research
School of Computational Science
George Mason University, Fairfax, VA 22030

[1] Department of Geography, George Mason University
Email: helaskar@scs.gmu.edu

Floods are considered to be one of the weather-related natural disasters. Flash floods as one type of floods are dangerous because they are so fast and are highly unpredictable. They occur when heavy rain is collected in a stream or gully, turning the normally calm area into an instant rushing current quickly. Many methods exist to provide qualitative estimations of the risk level of flash flood hazard within a watershed. In this paper, we will focus on using the morphometric analysis by combining the watershed geomorphologic characteristics to estimate the flash flood risk levels of sub-watersheds within the watershed. These characteristics are the drainage network and drainage watershed (basin) characteristics. Each characteristic is captured by a set of network and basin parameters that are relevant to the flash flood risk. Some of the primary drainage network parameters are computed easily from the spatial data within a Geographic Information System (GIS) framework. For example, drainage segment numbers (N) are counted and computed easily in most GIS by enumerating the data describing the drainage network. Basin area (A) and perimeter (P) are often stored as attributes of the polygon features. Some secondary parameters are derived from those parameters computed directly from the spatial data. On the other hand, some other parameters are detailed structural properties of the drainage network, such as the ordering of the streams and the basin length (L). These parameters are more complicated because they cannot be computed directly with built-in functions within GIS. In order to derive these parameters, we developed a simple algorithm to derive the basin length parameter by computing the length from each node to every other node in the polygons representing the basin. Then the maximum length obtained from any pair of nodes within the basin is regarded as the length of the basin. To derive the orders of streams, more complicated steps and procedures are needed. Assuming that the topological structure of the drainage network data is completed and accurate, we have to ensure that the flow direction (or the orientation) of the drainage network is correctly depicted by the data. That is the upstream end of a segment is uphill of the downstream end of the segment. To verify the accuracy of the segment direction, we have to use elevation data to verify that the elevations at the two ends of the stream are consistent with the direction of the flow. If the end of the stream segment has an elevation level higher than the elevation at the beginning of the stream segment, then the direction of that stream segment should be reversed. After the orientation of all segments are verified or corrected, then they can be ordered using the developed algorithms within GIS. Based upon the previously calculated parameters, we can compute the flash flood risk in several steps. First, based upon the relationship between the parameter values and the risk of flash flood, we normalize each morphometric parameter value to 0-1. Then we sum the normalized parameter values to obtain a morphometric number for each basin. Based upon these numbers, we can categorize basins according to their risk of having flash floods. After formulating this morphometric analysis framework, we tested it using GIS data from the County of Fairfax, Virginia. These data layers include the stream network, topography in contour lines, and watershed boundaries. Corrections on the flow direction of the stream were made using the already developed algorithms. In addition, we used digital orthophotos to evaluate the accuracy and completeness of the drainage data. When missing and/or inaccurate data were identified through the photos, they were corrected or added based upon the information provided by the photos. Then using both ArcView 3.2 and ArcGIS, we completed the morphometric analysis of the Pond Branch basin within the County. Sub-basins of the Pond Branch basin were classified into levels of flash flood risk.

Keywords: Flash Flood, Morphometric Analysis, Risk Estimation

EL NINO Southern Oscillation impact on Virginia Precipitation

H. EL-Askary[1], S. Sarkar[1], L. Chiu[1], M.Kafatos[1], and T. El-Ghazawi[2]

[1]Center for Earth Observing and Space Research, George Mason University, Fairfax, VA 22030, USA
[2]Electrical and Computer Engineering Department, George Washington University, Washington DC, USA.
Email: helaskar@scs.gmu.edu

El-Nino/Southern Oscillation (ENSO) event has a strong impact on local and regional scale climatic dynamics through strong teleconnection events affecting the coupled ocean-atmosphere land system. Recent studies have pursued the effects of such periodic events on different climatological and meteorological parameters. This study focuses on ENSO impact on local precipitation patterns. We study the precipitation patterns derived from gauge stations over Virginia, USA. Forty years of the Hourly Precipitation gauge Data (HPD) jointly by the National Climatic Data Center (NCDC) and the Forecast Systems Laboratory (FSL) at 5 gauges in Virginia are considered. High frequency random noise at each station is removed through wavelet decomposition. A Morlet wavelet basis function is then fitted to the non-seasonal data to derive the interannual and longer periodic signals. Three to five years cycles are observed in the anomaly signal in keeping with the 2-8 year period of ENSO signals reported in literature. An Empirical Mode Decomposition (EMD) is applied to the data set. The signal is found to correlate reasonably well with the Southern Oscillation Index (SOI) with a correlation coefficient of 0.68 at a confidence level of 95% for the stations. One of the major outcomes of this study is that ENSO cycles can be reliably observed from local precipitation data. Our work focuses on a specific region of the eastern coast in terms of forty years of rain gauge station data. This is the first work of its kind that takes an in-depth look at the precipitation pattern in the eastern coast and its relation with ENSO. Several interesting observations are made in this regard that shed some light on the way precipitation pattern has behaved in terms of ENSO for the past forty years. The relation of precipitation with ENSO seems to vary within the pilot area. This is presented from the behavior of stations towards the coast as they show a more consistent relation with ENSO in terms of their lag effect with respect to ENSO, more than those further inland that show a varying relationship. This is explained by the presence of other competing effects at local scales as these sites are not far from each other but have different local conditions (e.g. topography, weather, etc.). It is interesting to note that the relationship with ENSO might be mediated through the effects of tropical storms which are known to be substantial rainfall producers. The limited sample examined here does not allow us a complete validation of this hypothesis but we expect significant variations from the coastal to the inland stations as suggested here. The last eleven years from 1987-1997 turn out to be the most affected by ENSO for all the stations irrespective of their locations. Such result may suggest a possible global teleconnection pattern. The results show that despite the ENSO have its effects over the eastern coast which though not as dominant as over the western coast, still has its distinct signature.

Keywords: ENSO, Rain Gauge, Wavelet, Empirical Mode Decomposition

Soil Moisture as an Antecedent Precipitation Index For Tracking Satellite Rainfall Underestimates in Continental Dry Regions

Yixiang Nie, and Long S. Chiu

Center for Earth Observing and Space Research
School of Computational Sciences, George Mason Univeristy
Email: ynie@gmu.edu

Comparison of satellite rainfall estimates over continental regions with gauge measurements show large discrepancies. Part of the reason is that rain drops usually evaporate before they hit the ground. This phenomenon is known as virga.

In this study, we propose to use the 10GHz TMI (TRMM Microwave Imager) brightness temperature data, which can be interpreted as an indicator of surface soil moisture change, as an Antecedent Precipitation Index to estimating the TRMM satellite's overestimation of rainfall in continental dry regions. A case study of rainfall in Sevilleta, New Mexico during August 2000 has been examined. TRMM standard products of TRMM and other satellite rainfall (TSDIS reference 3B42, 1×1 degree daily), calibrated TMI brightness temperature (TB) at 10GHz (TSDIS 1B11) and the rain gauge network maintained by the Earth Data Analysis Center (EDAC) of the University of New Mexico at the Sevilleta Long Term Ecological Reserve (NWR/LTER) were used in our analysis. The Sevilleta gauge network rain rates compare favorably with gauge estimates provided by the New Mexico Water Divisions. The total rainfall computed by TRMM 3B42 algorithm is much higher than the rain gauge records in this case. We use the daily mean and rate of change of 10GHz TB to classify rain events. These parameters reflect the changing condition of surface soil moisture, and hence may be used to identify the rain events that reach the ground surface. We plan to study the effect of virga by incorporating other data sets, such as surface temperature, vegetation, soil texture into a model. The model will also be examined in conjunction with the TRMM precipitation radar profile and TRMM soil moisture and land surface temperature products for quantifying the effect of virga in rain over-estimation in these continental dry regions.

Keywords: Soil Moisture, Antecedent Precipitation Index, Continental DryRegion

TRMM Data Reprocessing and New Data Products

Hualan Rui[1], Bill Teng[1], John Bonk[1], Long Chiu[2], Zhong Liu[2], Patricia Hrubiak[1], Nathan Pollack[1], Li Lu[1], and George Serafino[3]

GSFC Earth Sciences (GES), Data and Information Services Center (DISC)
Distributed Active Archive Center (DAAC)
NASA/Goddard Space Flight Center, Greenbelt Maryland, USA 20771

([1]Science Systems and Applications, Inc.; [2]George Mason University,
3current affiliation: NOAA.NCEP, NESDIS)

Email: rui@daac.gsfc.nasa.gov

The Tropical Rainfall Measuring Mission (TRMM), a joint mission between NASA and the National Space Development Agency (NASDA) of Japan, is designed to monitor and study tropical rainfall and the associated release of energy. TRMM has acquired more than five years of data since its launch in November 1997. All TRMM standard products are processed by the TRMM Science Data and Information System (TSDIS) and archived and distributed to general users by the Goddard Earth Sciences Distributed Active Archive Center (GES DAAC). In addition to the standard products, the GES DAAC generates and/or maintains a set of derived TRMM products (e.g., satellite coincidence subsets, parameter subsets, resampled gridded subsets, GIS-compatible files) to facilitate use of TRMM data by the general public.

The TRMM satellite algorithms are continually being evaluated and improved by the TRMM Science Team. TRMM data are periodically reprocessed to incorporate the improved science algorithms, currently at version 5. A brief history of TRMM reprocessing of product version 1 to 5 is provided, including the distinction between versions 5 and 5A related to TRMM's satellite operating altitude change in 2001. The upcoming TRMM version 6 reprocessing is discussed, including major changes in the algorithms, improvements to the products, release of new data products, and enhancements to GES DAAC data access and visualization tools that reflect these changes.