UMBC ATMOSPHERIC PHYSICS SECOND ANNUAL EARTH DAY SYMPOSIUM

ORAL PRESENTATIONS:

Name: Dr. Pengwang Zhai
Title: Phytoplankton photocompensation: radiative transfer modeling and applications
Abstract: Solar induced fluorescence of chlorophyll a in phytoplankton is an important source of information for studying phytoplankton biomass and physiology variations. Fluorescence signal is primarily influenced by chlorophyll concentration. The signal is also strongly impacted by environmental and physical factors such as plankton health, pigment packaging effects, photochemical quenching, and the availability of nutrients (notably biologically-available iron). A radiative transfer model that can simulate fluorescence under different physiological factors is a necessity for developing remote sensing algorithms for the use of fluorescence. We here report the first radiative transfer model that can simulate the impacts of both photochemical and nonphotochemical quenching effects on the phytoplankton fluorescence signal. Sensitivity studies have been performed to demonstrate the dependence of the fluorescence signal on chlorophyll a concentration, aerosol optical depths and solar zenith angles. Our model can be used to perform systematic studies of fluorescence in response to environmental factors and ocean water inherent optical properties, which in turn leads to better and more accurate remote sensing algorithms.

Name: Dr. Pius Lee
Title: The Challenge of Air Quality Forecasting especially for place downwind of larger polluters
Abstract: The National Air Quality Forecasting Capability (NAQFC) was mandated by the Congress in 2002. There were numerous advances in upgrading the service to safeguard sensitive groups from adverse effects of air pollution. There are liability implication such as attainment calculation of state implementation plans (SIP). SIP exercises are virtually running the same numerical models as NAQFC. Both are extremely difficult for places downwind of larger polluters. This is even harder for coastal urban cores such as Baltimore due to the complexity of land see breeze and strong heterogeneity in emissions, such as ports and power plants,..etc. We will take a in depth look on these challenges together.

Name: Dr. Christopher P. Loughner
Title: Impact of historical air pollution emissions reductions on human health during extreme heat
Abstract: Much of the eastern half of the United States experienced extreme heat during July 2011. Hot, stagnant weather conditions contributed to unhealthy air pollution levels. For example, in Maryland 14 code orange days (maximum 8 hr average ozone greater than 75 ppbv) and 3 code red days (maximum 8 hr average ozone greater than 95 ppbv) were observed during this month. However, the air quality during July 2011 could have been worse if it were not for air pollution regulations curtailing emissions that had been put in place since 2002. There have been significant NOx emissions reductions since 2002 in the eastern and central US through a combination of the Environmental Protection Agency (EPA) NOx State Implementation Plan (SIP) call (which required 22 states and the District of Columbia to regulate NOx emissions to mitigate

ozone transport), the NOx Budget Trading Program, subsequent EPA rules, court-orders, and state regulations. As reported by the EPA's National Emissions Inventory (NEI), NOx emissions nationwide have been reduced 37% between 2002 and 2011. The benefit of these emissions reductions on ambient ozone concentrations and human health will be presented using the CMAQ air quality model and BenMAP, a tool for estimating health and economic impacts due to changes in air quality. The modeling domain in this study includes 22 states covering the northeast and parts of the South and Midwest. The CMAQ model suggests that historical emissions reductions likely prevented 9-13 ozone exceedances (using the 2011 maximum eight hour average ozone standard of 75 ppbv) throughout much of the Ohio River Valley and 3-9 ozone exceedances throughout much of the Washington, DC – Baltimore, MD metropolitan area in July 2011. BenMap estimates 2,781 lives were saved in 22 states and the Disctrict of Columbia during July 2011 due to the reduction of air pollution emissions since 2002.

Name: Dr. Christopher Barnet (STC)
Title: What can weather satellites tell us about climate
Abstract: Advanced hyperspectral infrared and microwave sounding instruments have been onboard Earth orbiting satellites since 2002 and measure the total integrated radiance emitted by Earth's surface and atmosphere. Designed to be sensitive to day-to-day variation in the vertical atmospheric state, the primary purpose of these instruments is to improve weather forecasting. However, with an archive spanning more than 15 years we can now turn our attention to questions about seasonal and annual change on a global scale. Using the same set of sounding instruments to answer questions about both climate and weather is feasible only if the measurements are properly calibrated and well understood. This presentation will give an overview of modern sounding capability with a focus on current scientific knowledge gaps and the challenges we face in creating a long-term climate record from weather observations.

Name: Dr. Peter Colarco (NASA GSFC)
Title: Impact of simulated dust particle size on direct radiative forcing and dust lifetime in the NASA Goddard Earth Observing System (GEOS) model
Abstract: The literature suggests that most atmospheric models treating dust aerosol transport tend to (i) emit particles that are too small compared to observations and (ii) not maintain coarse dust particles anyway even when they are considered in emissions. The implication of (i) is that models tend to make dust relatively strongly scattering in the shortwave. Even by correcting (i), the implication of (ii) is that dust models still tend to underestimate longwave warming. There is an apparent discrepancy between models and observations in the net dust radiative effect, with models tending to show dust cooling the climate system, while observations suggest dust may be in fact be warming. We discuss the relevant issues for both and summarize the current capabilities and limitations of the Goddard Earth Observing System (GEOS) model simulations of the dust particle size distribution and its impact on dust lifetime, surface concentration, and radiative forcing.

Name: Dr. Amir Ibrahim

Title: Atmospheric correction for hyperspectral ocean color sensors

Abstract: NASA's heritage Atmospheric Correction (AC) algorithm for multi-spectral ocean color sensors is inadequate for the new generation of spaceborne hyperspectral sensors, such as NASA's first hyperspectral Ocean Color Instrument (OCI) onboard the anticipated Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) satellite mission. The AC process must estimate and remove the atmospheric path radiance contribution due to the Rayleigh scattering by air molecules and by aerosols from the measured top-of-atmosphere (TOA) radiance. Further, it must also compensate for the absorption by atmospheric gases and correct for reflection and refraction of the air-sea interface. We present and evaluate an improved AC for hyperspectral sensors beyond the heritage approach by utilizing the additional spectral information of the hyperspectral sensor. The study encompasses a theoretical radiative transfer sensitivity analysis as well as a practical application of the Hyperspectral Imager for the Coastal Ocean (HICO) and the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) sensors.

Name: Dr. Barry A. Klinger

Title: Ocean Circulation, Heat Uptake and Climate

Abstract: The ocean circulation influences the climate through a number of heat transport mechanisms. The talk briefly introduces a newly-completed textbook on ocean circulation designed to be accessible to students in a variety of disciplines. The remainder of the talk shows how ocean heat uptake caused by global warming can be influenced by circulation. The rate at which heat penetrates the ocean affects evolution of surface atmospheric temperature. Heat is advected downward by ocean currents, but also absorbed by "redistribution," which occurs when global warming alters currents. Previous studies have implied that a weakening of the Atlantic Meridional Overturning Circulation (AMOC) causes redistribution to increase the ocean uptake of heat. Here numerical experiments show that redistribution occurs in the Pacific as well, and that even with a weakening AMOC, redistribution can decrease ocean heat uptake instead.

Name: Dr. Zhibo Zhang

Title: The Aerosol Cloud Radiation Observation and Simulation (ACROS) Group at UMBC

POSTER PRESENTATIONS:

Name: Brain Carroll
Title: Boundary Layer Structure and Low-Level Jets
Abstract: The boundary layer is the most important layer of the atmosphere for air quality and weather. The boundary layer has a common diurnal cycle featuring calm conditions at night with a stable surface layer, but this model can be destroyed by strong wind events at low altitudes (low-level jets). This presentation investigates these effects, showcasing nocturnal turbulence and neutral stability related to low-level jets.

Name: Christopher A. Shuman
Title:

Name: Zaiyu Wang
Title: Remote impacts of tropical biases in climate simulations

Name: Nick Lybarger
Title: Quantifying the Effect of the Madden-Julian Oscillation on El Niño

Name: Lipi Mukherjee
Title: Single scattering properties of hydrosols
Abstract: Traditionally, hydrosols have been modeled as spherical particles. Measurements show that hydrosols can be of various sizes and shapes. Two new parameters are defined to quantify the degree of optical non-sphericity (DONS) and investigate the dependence of DONS on refractive index, size, and aspect ratio. The sensitivity of this quantity towards particle's refractive index, size, and shape, makes it important for particle identification.

Name: Meng Gao
Title: Retrieval of aerosol properties and water-leaving reflectance from multi-angular polarimetric measurements over coastal waters
Abstract: Ocean color remote sensing is an important tool to monitor water quality and biogeochemical conditions of ocean. Atmospheric correction, which obtains water-leaving radiance from the total radiance measured by satellite-borne or airborne sensors, remains a challenging task for coastal waters due to the complex optical properties of aerosols and ocean waters. We report a research algorithm on aerosol and ocean color retrieval with emphasis on coastal waters, which uses coupled atmosphere and ocean radiative transfer model to fit polarized radiance measurements at multiple viewing angles and multiple wavelengths.

Name: Chamara Rajapakshe
Title: Seasonally Transported Aerosol Layer Over Southeast Atlantic are Closer to Underlying Clouds Than Previously Reported
Abstract: The relative distribution of smoke aerosols and Marine Boundary Layer (MBL) clouds in South-East (SE) Atlantic region is investigated by using new NASA's space-borne lidar CATS (Cloud-Aerosol Transport System) at ISS (International Space Station). The smoke layer is found to be much closer to the underlying clouds than previously expected from

CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation) Observations. This suggests potentially important microphysical indirect effects of smoke aerosols through cloud top entrainment.

Name: Qianqian Song
Title: Observation-based Estimate of Dust Net Radiative Effects in Tropical North Atlantic Through Integrating Satellite Observations and In Situ Measurements of Dust Properties

Name: Zhifeng Yang
Title: Comprehensive Study on the role of the Chesapeake Bay to ozone pollution in Maryland
Abstract: Inspired by findings of ozone pollution maxima unaccounted by modeling forecast over Maryland, this study investigates the influence of the Chesapeake Bay on the local ozone concentration through the integration of both surface observation and model simulation. The Weather Research and Forecast model coupled with Chemistry (WRF-Chem) was used to simulate the ozone generation and transportation near the Bay. We also utilized the surface ozone measurements from the Environmental Protection Agency (EPA) Airnow to evaluate the model performance. We conducted a case study on June 3, 2015 with two sensitivity experiments that switched the surface type (land/no water or water) over the Bay, and then analyzed the difference between water and no water simulations. Here we critically look the results from both chemistry and dynamics perspectives. Under the northeastern prevailing wind conditions, the ozone was transported to the western coast from the Bay. The ozone concentration over the Bay increased during both daytime and nighttime, a result of sunlight and bay breeze dynamics. During daytime, with sunlight, more NOx was generated under the higher water vapor concentration condition over water. Then bay breeze transported ozone from the Bay to the west coastal areas and increases the ozone concentration over the downwind regions. Ozone increase of up to 20% on daytime and 5% at night was found because of the Bay dynamics effect. In addition, the boundary layer was higher during daytime due to higher surface temperature and active vertical convection, so ozone was mixed and diluted up to 1.2 km, while that depth dropped to 0.4 km at night. Another interesting result stems from the southern Bay connection to the Atlantic Ocean. This large water border led to stronger bay breeze circulation and more water vapor, which resulted in more ozone generated over the southern Bay.

Name: Hua Song
Title: The Importance of Considering Sub-grid Cloud Variability When Using Satellite Observations to Evaluate the Cloud and Precipitation Simulations in Climate Models

Name: Anin Puthukkudy
Title: Microphysical and Optical properties of Novarupta (1912), Mt. Spurr (1992) and Mt. Okmok (2008) volcanic ash particles

Name: Brent McBride
Title: Hyper-angular imaging polarimetry for microphysical retrievals of aerosol and clouds

Name: Frank Werner
Title: Satellite remote sensing of cloud properties for partially cloudy pixels: Case studies with high-resolution ASTER data

Abstract: There are significant biases in retrieved cloud optical thickness and effective droplet radius for satellite pixels that are only partially covered with clouds. By means of cloud observations by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) at a horizontal resolution of 30m these biases are quantified. Moreover, techniques to mitigate the effects of clear sky contamination are discussed.

Name: Robert Coleman
Title: What are Solar Energetic Particles?
Abstract: Solar Energetic Particles are energetic charged particles that travel through space at speeds near that of light. These particles originate from Solar Particle Events, such as solar flares and coronal mass ejection, and Galactic Cosmic Radiation, such as supernovas. Once ejected, these particles are accelerated by fast flowing wind plasma and directed by the various magnetic fields of the solar system. These particles pose threats to humans due to the radiation they contain. These particles also threated spacecraft, as they can cause corruption and physical degradation.

Name: Grace Kenlaw
Title: An Analysis of the Correlation between Temperature and Geomagnetic Activity in the Plasma Sheet Associated with the Magnetotail of the Earth's Magnetosphere
Abstract: This project examines the existing relationship between particle temperature and geomagnetic activity in and around the Earth's plasma sheet. Datasets from the Kp index and the A.R.T.E.M.I.S. mission were consulted to demonstrate a correlation between the two. The conclusion reached was that a direct correlation exists between particle temperature and geomagnetic activity, but further research will need to be conducted to determine potential causation factors.