Monitoring the El Nino – Southern Oscillation and its Impacts on the Weather

Sponsored by the AMS Committee on Satellite Meteorology, Oceanography, and Climatology

The American Meteorological Society (AMS) Committee on Satellite Meteorology, Oceanography, and Climatology (SatMOC) is pleased to offer a short course titled “Monitoring the El Niño – Southern Oscillation and its Impacts on the Weather" during June – July 2024. This short course will consist of four 3-hour virtual training sessions described below. The training sessions are scheduled for 1:00 PM to 4:00 PM ET on June 18, 25, 27, and July 16. This series of four training sessions will demonstrate the use of environmental satellite data to monitor the El Niño – Southern Oscillation (ENSO) cycle and three weather impacts commonly associated with the ENSO cycle: flooding, drought, and severe weather. These training sessions will provide hands-on experience for selecting and applying environmental satellite data products for monitoring ENSO and assessing several weather impacts associated with ENSO. Certificates of completion will be issued to students who participate in a minimum of 3 training sessions and the participation in each session must exceed one hour. The short course is primarily designed for undergraduate and graduate college students but others who are changing careers or moving to a position requiring increased environmental satellite knowledge will benefit from the course. Registration for the short course is available here.

~~~Training Session 1: Monitoring the El Niño - Southern Oscillation (ENSO)~~~
June 18, 2024, 1 - 4 PM ET

Session Description: This session will focus on a general overview of the El Nino - Southern Oscillation (ENSO) and the teleconnections, regional trends, and effects, including drought, flooding, etc. We will focus on presenting different satellite tools that can be used for the monitoring and forecasting of ENSO. This includes a description of the tool, access and application methods. As a practical exercise, we will visit past ENSO transitions and use the satellite tools available at those times to forecast ENSO trends, and then verify if our predictions were appropriate.

Instructors:

José Manuel Gálvez, PhD (Meteorology), Research Meteorologist for Axiom/WPC International Desks/NWS/NOAA, College Park, MD

José Gálvez is an instructor, researcher, forecast tool developer and forecaster of extreme rainfall events at the NOAA Weather Prediction Center International Desks in College Park, Maryland. He has a M.Sc. and Ph.D. in meteorology from the University of Oklahoma and a B. Sc. in Science-Meteorology from Universidad Nacional Agraria La Molina, Perú.

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Bonnie Acosta, Trainer and Forecaster, NOAA Weather Prediction Center's International Desks in College Park, Maryland

Bonnie Acosta is a trainer and forecaster for the NOAA Weather Prediction Center's International Desks in College Park, Maryland since late 2022. She works in providing training on weather and climate for the WMO Regions III and IV, which include Mexico, Central America, the Caribbean, and South America, with emphasis on forecast techniques and satellite products. Bonnie works with the rest of the team at the International Desks to provide Quantitative Precipitation Forecasting (QPF) for the regions, to develop forecasting tools, and provide assistance both in English and Spanish. She received her B.S. in Atmospheric Sciences from Cornell University, and M.S. in Emergency Management from Millersville University in Pennsylvania.

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~~~Training Session 2: Extreme Hydro-meteorological Forecasting and Flood Mapping~~~
June 25, 2024, 1 - 4 PM ET

Session Description: “Atmospheric Rivers” of moisture, what satellite meteorologists as far back as the 1990s referred to as moisture plumes, would never have been recognized without both low earth orbiting (LEO) microwave-sensor and geostationary satellites. These “atmospheric rivers of moisture are clearly visible at least somewhere on the earth every day and can result in extremely, sometimes catastrophic heavy precipitation any time of the year and during any ENSO cycle if the right instability and lift are available to wring out that moisture. Satellites also provide a global source of observed flood extents that are valuable for flood monitoring. In this workshop we will demonstrate processing water fraction maps from NOAA’s Visible Infrared Imaging Radiometer Suite (VIIRS) satellite that can be correlated with global hydrologic data to forecast flood maps as synthetic satellite images. We will highlight the capabilities of the GEOGLOWS global hydrologic model historical simulation and forecast for retrieving streamflow data. Finally, we will demonstrate combining the observed VIIRS water fractions and GEOGLOWS streamflow data using Forecasting Inundation Extents using REOF analysis (FIER) to generate forecasted inundation extents.

Instructors:

Sheldon Kusselson, Research Associate, CIRA/Colorado State University Sheldon Kusselson worked for 36 years as an operational satellite meteorologist for NOAA’s National Environmental Satellite, Data, and Information Service (NESDIS). Specializing in the geostationary (GEO) and low earth orbiting (LEO) satellite analysis of precipitation, he interacted with NOAA National Weather Service (NWS) weather and atmospheric river

forecasters. Since 2018, he has worked as a research associate for the Cooperative Institute for Research in the Atmosphere (CIRA)/Colorado State University from his home in Maryland and collaborates with his colleagues on the revising of current and the development of new satellite moisture products and applications for forecasters. In addition, Sheldon continues to mentor young meteorologists in how to remain relevant with the inclusion of satellite data/imagery and how to apply that information to make improved high impact weather forecasts in the ever-changing world of atmospheric sciences**.**

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Dr. Jim Nelson, Professor of Civil and Construction Engineering, Brigham Young University, Provo, UT

Dr. Nelson has been a pioneer in developing geospatial hydrologic modeling and hydroinformatics tools and is the principal developer of the Watershed Modeling System (WMS) which since the 1990's has been widely disseminated and used for development of hydrologic models and visualization of results. In recent years he and his colleagues at BYU developed Tethys Platform, free and open-source tools that lower the barrier for engineers to create web-applications for hydroinformatics. Tethys has been a foundational element of the GEOGLOWS ECMWF Global Streamflow Services which provide a 40-year historical simulation and 15-day forecast on every river of the world daily (https://youtu.be/j3-ishNx104).

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Lyle Prince, master's student of Civil & Construction Engineering at Brigham Young University, Provo, Utah

Lyle Prince's research includes development of case studies using the FIER method and integration of these models with GEOGLOWS and the National Water Model.

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Amirhossein Rostami, Ph.D. research assistant in Civil and Environmental Engineering, University of Houston, Texas

Amirhossein Rostami has worked on designing and developing reliable and efficient flood early warning systems using remotely sensed data and artificial intelligence methods. Recently, he and his colleagues at the University of Houston developed Flood Inundation Extent using REOF analysis (FIER), a flood forecasting tool that relies on historical inundation reflected in satellite images and its relationship with hydrological variables. FIER has been successfully tested over the Mekong River and, just recently, over some regions in the U.S. FIER is going to be expanded over the whole U.S. using National Water Model (NWM) forecasts and global inundation forecasting, leveraging the GEOGLOWS ECMWF Global Streamflow Services, which provide 15-day forecasts on every river in the world daily.

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~~~Training Session 3: Using AI to Predict Convective Weather Hazards~~~
June 27, 2024, 1 - 4 PM ET

Session Description: Satellite, radar, lightning and numerical model data all contain information that can be used to predict the onset of convective hazards. Machine learning trains a model to learn linear and non-linear relationships between the best predictors and the predictand, or the target (“truth”) that the model is designed to predict. Historical or archive data are used to train algorithms in order to predict future events. This Training session will incorporate three different machine-learning tools have been developed at CIMSS to predict different aspects of convective weather: NOAA/CIMSS ProbSevere (that uses ABI, radar, NWP model, and lightning data), IntenseStormNet (that relies on ABI and GLM data only) and LightningCast (that uses only ABI data); the products can be used operationally to monitor the development and evolution of severe weather, strong convection, and lightning, and the hands-on activities of this session will help the user understand how the products were created, and how the different data sources drive the probabilistic output.

Instructors:

John Cintineo, Research Meteorologist, NOAA/OAR/NSSL, Warning Research and Development Division

John Cintineo received his bachelor's degree in atmospheric science from Cornell University and his master's degree in meteorology from the University of Oklahoma. As a research meteorologist for the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin -- Madison, he served as the primary developer of the ProbSevere portfolio of machine-learning models, some of which are in widespread use by NOAA's National Weather Service. ProbSevere products use remotely sensed observations from satellite, radar, and lightning platforms, as well as environmental data, for the short-term forecast of convective

hazards. At CIMSS, he has also been involved in research projects supporting volcanic ash cloud detection and diagnosis, as well as NOAA's Next-Generation Fire System. John recently moved to NOAA's National Severe Storms Laboratory, where he continues to research and develop methods to improve the operational prediction of convective hazards.

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Scott Lindstrom, Scientist/Trainer, CIMSS, University of Wisconsin - Madison.

Scott Lindstrom has a BS in Meteorology (and one in Comp Sci) from Penn State, and a Masters and Phd from the UW-Madison. For the last 20 years, much of his work has centered on advocating for the use of Satellite Data and products in the forecast process. He creates various training products for the National Weather Service (Quick Guides, Quick Briefs, Blog Posts), for the Hazardous Weather Testbed, and for JPSS (with an especial focus on NUCAPS). He has done in-person training internationally on Satellite imagery and Tropical and Synoptic Meteorology and has also helped with earlier SATMOC short course presentations.

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~~~Training Session 4: From Satellites to Solutions: Drought Monitoring with Google Earth Engine~~~

July 16, 2024, 1 - 4 PM ET

Session Description: Droughts pose a critical threat to water resources, agriculture, and ecosystems worldwide. This hands-on workshop will teach you how to harness the power of Google Earth Engine (GEE) to monitor and analyze drought patterns. GEE's vast repository of satellite data and powerful cloud computing capabilities will streamline your drought research and decision-making.**Instructor:**

Dr. Qiusheng Wu, Associate Professor of Geography and Sustainability, University of Tennessee, Knoxville

Dr. Qiusheng Wu is an Associate Professor in the Department of Geography & Sustainability at the University of Tennessee, Knoxville. In addition, he holds positions as an Amazon Visiting Academic and a Senior Research Fellow at the United Nations University. Specializing in geospatial data science and open-source software development, Dr. Wu is particularly focused on leveraging big geospatial data and cloud computing to study environmental changes, with an emphasis on surface water and wetland inundation dynamics. He is the

creator of several open-source packages designed for advanced geospatial analysis and visualization, including geemap, leafmap, and segment-geospatial.

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