Interview with Dr. Mong-Ming Lu

Hans von Storch

Dr Mong-Ming Lu gave a talk at CWB open house (2011).

Dr. Mong-Ming Lu received her B.S. degree from National Taiwan University, and completed her Ph.D. at UCLA, both in Atmospheric Sciences. Her early research focused on studies of interannual variability of equatorially trapped waves and their excitation mechanisms. Before returning to Taiwan in 1992, she did post doctoral research at GSFC/NASA, University of Munich, and the Paul Scherrer Institute in Switzerland. She is currently the chief researcher in the Research and Development Center at the Central Weather Bureau of Taiwan. Her research interests include analyzing and interpreting climate data and building statistical forecast models, and she is the leader of the research team on climate forecast. She oversees the development of CWB's monthly-to-seasonal climate forecast system and the design of operational products. She has published papers on seasonal prediction of typhoon activity, East Asian summer and winter monsoons, and analysis of the climate/weather extremes in Taiwan.

Dr. Lu, you are a Taiwanese atmospheric scientists with the Central Weather Bureau in Taipei. Could you describe your current interests for our readers?

The main focus of my current research is weather forecasts beyond two weeks. I am not a numerical modeler. My research is to develop conceptual and statistical tools that can be used for making sense of, or making use of, the products generated by the numerical weather/climate forecast systems of the Central Weather Bureau (CWB). Another research interest is studying the variability of long-term climate. The CWB has maintained a high-quality meteorological observation record since 1896. I am interested in knowing how Taiwan's climate, especially the extreme weather and climate events can be influenced by the variations of major climate patterns, in particular over the Asian and northwestern Pacific monsoon region.

Being a Taiwanese scientist means to be cut off the international scientific "business" to some extent; there is no membership at WMO, and no participation at IPCC, for instance. How do you deal with this isolation?

Unfortunately, during the past forty years, "isolation" is indeed a cruel reality to governmental agencies in Taiwan. We need to be pragmatic in dealing with such isolation. For example, we pay for some services that are free to the "members", and we work closely with research communities for capacity building.

There are still not many women among the "higher" ranks, such as professors, department heads and the like. Are meteorology and climate science still "male territory"?

AMS Tropical Meteorology Conference in Miami, at Steve Lord's Home. From left: Nitta, Lu, Esbensen's wife, Yanai, Esbensen, and Lord, Lord's wife and Lloyd Shapiro (1983). (Curtesy of the Michio Yanai Syposium Booklet)

The field of meteorology and climate science is rather small in Taiwan. In terms of the number of students and government employees, females may not be the minority. But in the "higher" ranks, it is certainly still mostly "male territory". I think the main reason is due to lack of interest or ambition. Most women I know who are trained in atmospheric science tend to put family at a higher priority than science or career. This often extends even beyond their own family of origin, to the family of the husband. Being a professor or department head implies depriving a woman of the time for her family or relatives. To settle in a more family centered life is much more preferred by most women.

Science is a cultural practice - and the Chinese culture differs strongly from the western culture - therefore the question: Is there a specific Chinese way of doing science?

It is not easy to define "Chinese culture" in Taiwan, as there are different roots and elements. In addition, Taiwan is strongly influenced by Japanese culture in doing science, particularly during the years before 1980s. Since the 1980s, many scientists trained in the United States have returned to Taiwan for faculty positions at universities. The American way of doing science gradually became Taiwan's mainstream. Even so, I think the cultural factor is very deep. For example, Taiwanese generally like practical or applied topics much more than theoretical or philosophical ones. Besides Chinese cultural influence, this preference is further rooted in the island and immigrant culture of the Taiwanese people.

What would you consider the most significant achievement in your career?

I feel the most significant achievement in my entire career is leading a team to establish the first monthly-to-seasonal dynamical-statistical climate forecast system at the CWB. Actually, I did not feel this way in the beginning. On the contrary, I often thought of my work as insignificant, since it was more or less a repetition of what has already been done at other leading operational centers. The forecast system we built is a multi-model multi-member ensemble forecast system, which generates the monthly and seasonal forecasts for the global atmosphere, with lead times of one to nine months. It also produces the categorical probabilistic temperature and precipitation forecasts at nine weather stations in Taiwan. The station forecast is done by a statistical downscaling module depending on the global forecast. The forecast calibration and evaluation are based on 25 years of retrospective forecasts. It took eight years (2002-2009) for us to establish the system. The operational run started in January 2010. After seeing the steadily produced forecast information, I began to realize the significance of the project. With the capacity of producing forecast information, CWB can on the one hand be an active promoter of monthly-to-seasonal forecasts for potential economic and societal applications, and on the other hand, be an active participant in the forecast business.

When you look back in time, what where the most significant, exciting or surprising developments in atmospheric science?

Looking back, I think the progress in numerical weather and climate prediction is the most significant, exciting and surprisingly successful in atmospheric sciences. I went to UCLA in 1980 to study equatorially trapped waves with Professor Michio Yanai. When my first paper was published in 1983, we used the dataset of 200 mb level winds of the latitude belt 25°S-45°N for two summer seasons of 1967 and 1972. The data was objectively analyzed by Professor Krishnamurti and his associates at Florida State University. At that time, it was the best dataset to our knowledge for studying planetary scale tropical waves. When FGGE Level III-b data became available in early 1980s, I witnessed an exciting period, during which some previously conjectured wave characteristics by few sounding stations were confirmed and detailed by the multi-variable multi-layer global data. The revived

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interest in Madden-Julian oscillation and its influence on the intraseasonal variability of Indian monsoons is one example, and the new research excited by the 1982-83 El Niño event is another. Think about the availability of so many fine-quality reanalysis datasets we have now. It is already an incredible achievement that would have been hard to imagine in the early 1980s. Although to forecast Madden-Julian oscillation remains a challenge today, history teaches us that pushing further to extend the forecast by one or two days can achieve much greater things than mere forecast.

Is there a politicization of atmospheric science?

In a democratic political system, the governmental power is legitimized by the agreement of the governed through election. In this sense, in any democratic country, being completely free from "politicization" seems impossible. The agenda perceived by the political entity will have influence on science, in particular the more publicly visible atmospheric science, and in places like Taiwan where typhoons and other natural disasters abound.

What constitutes "good" science?

Science helps people to think logically and to understand what the truth is. I think "good" science constitutes of facts and logic. Good science carries the power of revealing some simple rules that can be widely applied.

What is the subjective element in scientific practice? Does culture matter? What is the role of instinct?

Instinct and practice are cultivated by culture deeply. Culture and tradition can influence all aspects of human behavior, including science practice. I think the ability to think rationally and the belief in truth are important subjective elements in the practice of science. Such elements can be influenced by education and religion.

The opinions expressed in this interview do not necessarily represents those of the reviewer or the AGU.

Studying Boundary Layer and Air Quality Processes in a Suburban Environment

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Over the past ten years a unique multi-institutional and multi-agency partnership has endeavored to develop an observing program at the Howard University Beltsville Campus (HUBC) to study planetary boundary layer (PBL) processes in an evolving urban-rural interface that are particularly relevant to numerical weather prediction (NWP), and climate and air quality prediction. A second but equally important goal is training students with emphasis on understanding atmospheric processes through extensive experience with state of the art atmospheric observing systems and analytical methods. To these ends a suite of core observing systems have been deployed at HUBC. Government sponsors include NOAA, through the NOAA Center for Atmospheric Sciences at Howard University (NCAS), NASA through the Beltsville Center for Climate System Observation (BCCSO) – a NASA University Research Center (URC), and the Maryland Department of the Environment (MDE). University partners include Pennsylvania State University (PSU), State University of New York at Albany (SUNYA), University of Maryland Baltimore County, University Maryland College Park, University of Virginia at Charlottesville, and others. The 2008 National Academies study "Observing Weather and Climate from the Ground Up: A Nationwide Network of Networks" by the Board on Atmospheric Science and Climate called for a national effort to improve understanding of PBL processes for the purposes of NWP and air quality predictions. As noted by the study the effort at Howard University and its government, industry and university partners may represent a model of the types of partnership and focus that could be replicated toward this and other areas of national need. The following highlight accomplishments this past summer.

During summer 2011 an intensive observing period (IOP) was conducted at HUBC primarily focused on understanding processes that influenced local air quality. Although air quality was the focus the opportunity to leverage other research objectives was fully exploited.

The NASA Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality (DISCOVER AQ) experiment was a central feature of the IOP. The scientific objectives of DISCOVER-AQ are to: relate column observations to surface conditions for aerosols and key trace gases (O_3, NO_2, and CH_2O); characterize differences in diurnal variation of surface and column observations for key trace gases and aerosols; examine horizontal scales of variability affecting satellites and model calculations. DISCOVER-AQ measurements strategy included the deployment of aircrafts (NASA P3B-Orion and B-200) and surface sites with in situ and remote sensing instruments to acquire systematic and concurrent observation of column-integrated, surface, and vertically-resolved distributions of aerosols and trace gases as they evolve throughout the day with respect to air quality. Details on DISCOVER-AQ can be found at http://discover-aq.larc.nasa.gov/.

The HUBC was one of six sites that provided ground support for DISCOVER-AQ. Coincident with profiles of the NASA P-3B over HUBC, meteorological and ozone sondes were launched and a moored balloon was flown to provide profiles of volatile organic compounds (VOC), ozone and size resolved aerosol concentration. Four Lidars systems were deployed at the site. Continuous observations were recorded of surface trace gas concentrations, size resolved aerosol concentration, column integrated quantities from Multi-filter Rotating Shadowband Radiometers (cloud and aerosol), AERONET (aerosol) and Pandora (trace gas) sun photometers, and much more. Science and measurement objectives of DISCOEVER-AQ are synergistic with BCCSO and NCAS. Additional research pursued during the IOP, however, include for example studies to understand, monitor and inter-compare the evolution of the PBL properties from multiple sensors (Lidars, wind profiles, microwave radiometers, etc) and to understand aerosol-cloud interaction. A subset of the research conducted is highlighted below.

VOCs in Urban-Rural Environment

One of the unanswered questions for both air quality research and climate science, is the chemistry that occurs when rural and urban air masses interact. In theory, NOx limited air from the rural areas could mix with VOC limited air from the urban environments, and produce high amounts of ozone and other oxidants, but other factors, such as increased deposition and advection of cleaner air masses, also play an important role. In addition to the direct impacts of poor air quality, some of the eventual reaction products of VOCs are oxygenated compounds that have a low vapor pressure, allowing them to condense and cause

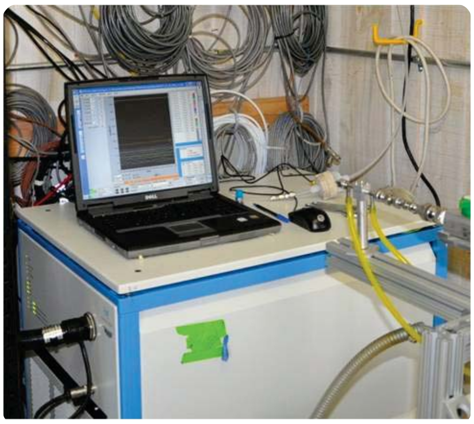

Figure 1: The PTR-MS operating in the shed at Beltsville, M.D.

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