The University of Maryland has been a UCAR member since 1967. University of Maryland (UMD) programs in the atmospheric, oceanic and earth system sciences are located on the College Park campus (UMDCP), and lie within the Department of Atmospheric and Oceanic Sciences (AOSC) and the Earth System Science Interdisciplinary Center (ESSIC). UMDCP is the University of Maryland system's flagship institution and is undergoing a period of sustained growth. AOSC is one of three environmental science units, along with Geology and ESSIC, within the new College of Computer, Mathematical and Natural Sciences (CMNS). The National Research Council 2010 report rated AOSC in the Top 10 in Geosciences departments across the United States based on statistics from 50 atmospheric and oceanic sciences graduate programs. AOSC was the highest ranked program on the U.S. Eastern seaboard. AOSC was externally reviewed in February 2011 by a committee consisting of M. McPhaden (NOAA Pacific Marine Environmental Laboratory), J. Galloway (University of Virginia), and J. Snow (University of Oklahoma). A previous external review was in January 2003 by a committee consisting of M. Wallace (University of Washington Seattle), M. Cane (Columbia University), I. Fung (University of California Berkeley), and W. Brune (Penn State). Both review contingents are well known, highly regarded academicians from across the U.S. Clearly, the program(s) at UMDCP are on an upward trajectory.

AOSC has grown over the past few decades from a research center in an institute to Top 10 status in graduate programs in the U.S. The period was marked by: a change of name (Meteorology to AOSC); rapid expansion of data assimilation, air chemistry, and earth system science; launching of the professional MS program and the AOSC undergraduate program of studies and research (in 2011); and development of the new M-Square University research campus, where both ESSIC and NOAA’s National Center for Weather and Climate Prediction are located. AOSC currently has 13 tenured faculty, 28 research faculty, and approximately 70 graduate and 40 undergraduate students. AOSC operations are sustained by state support (~$1.3M/y) and AOSC faculty research grants (total ~$4M/y). Productivity has been outstanding as evidenced by faculty and student publications, honors and awards, graduate student placements, MS and Ph.D. degrees granted, professional recognition of faculty and students, and professional service conducted.

ESSIC is a joint center between the departments of AOSC, Geology, Geography and the Earth Sciences Directorate at the NASA/Goddard Space Flight Center. Its goal is to enhance understanding of how the atmosphere, ocean, land, and biosphere components of the Earth interact as a coupled system, and to investigate the influence of human activities on this system. This goal is being accomplished by studies of the interaction of the physical climate system with biogeochemical and anthropogenic influences. ESSIC has 120 research scientists (100 with PhDs), nine academic faculty with split appointments between ESSIC and their home tenure departments, and 12 staff. All AOSC faculty have joint appointments in ESSIC. ESSIC’s annual budget, including the NOAA Cooperative Institute for Climate and Satellites (CICS’s), is approximately $34M/y. ESSIC was externally reviewed in November 2006 by a committee consisting of C.Kennel (Scripps/UCSD Chair), M. Cane (Columbia), James Mahoney (NOAA), and D. Skole (Michigan State). CICS is hosted by ESSIC and consists of CICS-MD, CICS-NC and a broad consortium of participating scientists and institutions. CICS-MD focuses on the collaborative research in satellite observations and Earth System modeling conducted by the Center for Satellite Applications and Research (STAR) of NOAA/ NESDIS and the National Center for Environmental Prediction (NCEP) of NOAA/ NWS. It hosts the Satellite Climate
Each year, 8-12 PhD were awarded across the atmospheric, oceanic and related earth system sciences, with particularly strong emphasis in Atmospheric Chemistry and Air Pollution, Mesoscale to Global Numerical Weather Prediction, Data Assimilation, Earth Sciences and Climate, Physical Oceanography, Remote Sensing, and Dynamics with Predictability. These programmatic strengths and advantages for students, both undergraduate and graduate are reinforced by active collaborations with NASA/GSFC, State of Maryland’s Departments of the Environment and of National Resources, and NOAA’s National Center for Weather and Climate Prediction, Satellite (NESDIS) and Air Research (ARL) laboratories, all of which are co located on the University’s M-Square Research Campus since 2012. Interdisciplinary programs exist with the Departments of Geology, Physics, Chemistry, Mathematics, Computer Sciences, Geography, the Marine-Estuarine Environmental Science (MEES), and Hydrology (within the School of Engineering).

The major research thrusts of ESSIC are studies of Climate Variability and Change, Atmospheric Composition and Processes, the Global Carbon Cycle (including Terrestrial and Marine Ecosystems/ Land Use/Cover Change), and the Global Water Cycle. The research is accomplished via analyses of in situ and remotely sensed observations together with component and coupled ocean- atmosphere-land models. Together this provides a foundation for understanding and forecasting changes in the global environment and regional implications. Data assimilation and regional downscaling provide the means by which the observations and models are linked to study the interactions between the physical climate system and biogeochemical cycles from global to regional scales.

CICS conducts research, education and outreach programs in collaboration with NOAA to: Develop innovative applications of national and international satellite observations and to advance transfer of such applications to enhance NOAA operational activities; Investigate satellite observations and design information products and applications to detect, monitor and understand the impact of climate variability and change on coastal and oceanic ecosystems; Identify and satisfy the satellite climate needs of users of NOAA climate information products, including atmospheric and oceanic reanalysis efforts; Improve climate forecasts on scales from regional to global through the use of satellite derived information products, particularly through participation in the NOAA/NWS/NCEP Climate Test Bed; Develop and advance regional ecosystem models, particularly aimed at the Mid-Atlantic region, to predict the impact of climate variability and change on such ecosystems; and to establish and deliver effective and innovative strategies for articulating, communicating and evaluating research results and reliable climate change information to targeted public audiences. These comprehensive undertakings have enriched the opportunities for students to become future leaders in science, technology and public policy.

Between 2003 and 2010 program faculty and students produced 745 peer-reviewed publications, or ~90/y. ISI ranks the program amongst the top 20 organizations in numbers of citations for papers in . Two AOSC faculty, E. Kalnay and R. Salawitch, are listed among the 32 ISI Highly Cited Researchers. Faculty, published 5.3 papers/y, citations/paper is 30, and the Hirsh Index is 25; highly commendable.

Awards and professional presence in the community between 2003 included the: 2009 WMO International Meteorological Organization Prize, Foreign Member of the Academia Europaeae, Member of the Argentine Academy of Exact and Natural Sciences, and Doctor Honoris Causa,
University of Buenos Aires to E. Kalnay; AGU Yoram Kaufman Award to R. Salawitch; Walter Orr Roberts Interdisciplinary Science Lecturer to A. Busalacchi; AGU Fellows A. Busalacchi, R. Dickerson, and E. Kalnay; AMS Fellows H. Berbery, A. Busalacchi, J. Carton, S. Nigam, and D. Zhang; AAAS Fellows R. Dickerson and E. Kalnay; and 2011 Leopold Leadership Fellow, R. Murtugudde.

Examples of faculty editorships, NRC committees, and major national and international committees include: Co-Chair of the Scientific Steering Group for the World Climate Research Programme on Climate Variability and Predictability (CLIVAR), 1999-2006, Chair of the NAS/NRC Climate Research Committee, 2003-2008, Chair of the NAS/NRC Committee on Earth Science and Application: Ensuring the Climate Measurements from NPOES and GOES-R, 2007-2008, Chair of the Joint Scientific Committee for the World Climate Research Programme, Co-Chair, NAS/NRC Committee on National Security Implications of Climate Change on US Naval Forces, 2009-present, Chair, NAS/NRC Committee on Earth Science and Application: Ensuring the Climate Measurements from NPOESS and GOES-R, 2007-2008, Member, IOM/NRC Committee on the Effect of Climate Change on Indoor Air Quality and Public Health, 2010, Member, NAS/NRC Committee on the Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions, 2009-present, Member, NAS/NRC Committee on America’s Climate Choices: Panel on Advancing the Science of Climate Change, 2009-2010, and Chair of the NAS/NRC Board on Atmospheric Sciences and Climate, all A. Busalacchi; Member of the EPA SAB Committee on Integrated Nitrogen Committee and Member of the NAS/NRC Committee for Air Emissions from Animal Feeding Operations Current Knowledge, Future Needs, R. Dickerson; Member of the NAS/NRC Climate Research Committee S. Nigam; Editor of Weather and Forecasting, 2006-present, and Co-Chief Editor, Advances in Atmospheric Sciences, 2002-2008, D. Zhang; Co-Chief Editor of Earth System Dynamics, 2006-present, N. Zeng; Co-Chair of Editorial Board of Acta Oceanologica Sinica (English Edition), and Member of Editorial Board of Chinese Journal of Oceanology and Limnology (English Edition), Q. Zheng.

Participation in UCAR Activities: AOSC and ESSIC faculty have been actively engaged in UCAR/NCAR science and governance over the past decade. UMDCP’s current member representatives to UCAR are J. Carton and S. Nigam. S. Nigam currently serves on the UCAR Nomination Committee. UMDCP faculty often visit Capitol Hill and offer advice to Congressional representatives and have given testimony at Congressional hearings in the support of science and technology; particularly for the atmospheric, oceanic and related sciences and public policy.

The UMDCP program is one of the very strongest in the UCAR constellation of national programs. The undergraduate programs are robust, the graduate programs are excellent. Faculty scholarship is impressive. The external reviews speak to the outstanding instruction, research and public service activities across AOSC and ESSIC and NRC rankings of educational and research programs in the atmospheric, oceanic and related sciences and technology place UMDCP amongst the few institutions in the very top tier in the U.S.

Recommendation: Renew UMDCP membership without reservation and with kudos.