Jagadish Shukla
University Professor, George Mason University (GMU)
Research Hall, Room 105, MSN: 2B3, 4400 University Drive, Fairfax, VA 22030 USA
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Selected Honors and Awards

2016: Honorary Member, American Meteorological Society

2015: India's Prime Minister's Council on Climate Change (PMCCC)

2014: Virginia Governor's Commission on Climate Change (2008 & 2014)

2012: Padma Shri, National Award from the President of India

2009: Faculty Award for Scholarship and Creative Activities, College of Science, GMU

2008: Fellow, American Geophysical Union (AGU)

2008: Commissioner on the Virginia Governor's Commission on Climate Change

2007: Lead Author, IPCC Working Group 1 Report, Climate Change 2007
(IPCC shared the 2007 Nobel Peace Prize with Al Gore)

2007: International Meteorological Organization (IMO) Prize
(*Highest honor in the world in Meteorology)*

2005: Rossby Medal of the American Meteorological Society (AMS) (*Highest honor awarded by AMS*)

2004: Scientist of the year, Association of Indians in America (AIA)

2001: Walker Gold Medal of the Indian Meteorological Society (IMS)
(*Highest medal of the IMS; first recipient of the medal*)

1999: Founded Gandhi College for women in a village in India
(*See the article in the New York Times, 17 August 2003)*

1996: Third World Academy of Sciences (TWAS, Associate Fellow)

1996: Fellow, Indian Meteorological Society

1993: Founded Institute of Global Environment and Society (IGES) (*See www.iges.org)*

1989: Helped establish super computer center for monsoon forecasting, New Delhi
(At the behest of the then Prime Minister, Rajiv Gandhi)

1988: Started weather and climate program at ICTP, Trieste, Italy
(At the behest of Dr. Abdus Salam, founder of ICTP)

1986: Invited to lecture at the Pontifical Academy, Vatican, Italy (*Audience with Pope John Paul II)*

1983: Founded, Center for Ocean-Land-Atmosphere (COLA)
(COLA is considered one of the premiere centers in the world for climate research)

1982: Exceptional Scientific Achievement Medal of NASA
(Highest medal given by NASA to a civilian)

1979: Chief Scientist, MONEX experiment in the Bay of Bengal
(*Leader of an expedition of three aircrafts and 150 scientists to Calcutta)*

CURRICULUM VITAE OF JAGADISH SHUKLA:

ADDRESS:

Distinguished University Professor, George Mason University (GMU)
President, Institute of Global Environment and Society, Inc. (IGES)
4400 University Drive, MSN: 2B3, Fairfax, VA 22030 USA, Tel: 703-993-5700
E-mail: shukla@iges.org http://www.iges.org/

EDUCATION:

Primary School	(1953) – Under a banyan tree; village – Mirdha, Ballia, U.P., India
High School	(1958) – S.R.S. H.S. School, village – Sheopur, Ballia, U.P., India
B.Sc. (Honors)	(1962) – Banaras Hindu University (Physics, Math, Geology)
M.Sc.	(1964) – Banaras Hindu University (Geophysics), India
Ph.D.	(1971) – Banaras Hindu University (Geophysics), India
Sc.D.	(1976) – Massachusetts Institute of Technology (Meteorology), USA

PROFESSIONAL EXPERIENCE:

2003- present	Chairman, Climate Dynamics, George Mason University
1994 - present	Professor of Earth Sciences and Global Change, George Mason University
1991 - present	President, Institute of Global Environment and Society
1984 - 2004	Director, Center for Ocean-Land-Atmosphere Studies
1984 - 1993	Professor, Department of Meteorology, University of Maryland
1979 - 1983	Senior Scientist, NASA/Goddard Space Flight Center
1978 - 1979	Visiting Associate Professor, Massachusetts Institute of Technology
1976 - 1977	Research Associate, Princeton University
1971 - 1976	Research Assistant, Research staff (M.I.T., Princeton)
1965 - 1971	Junior Scientific Officer, Indian Inst. of Tropical Meteor., Pune, India

HONORS AND AWARDS

Padma Shri, National Award from President of India, 2012
Fellow, American Geophysical Union, 2008
International Meteorological Organization (IMO) Prize, 2007
Rossby Research Medal (Amer. Met. Soc.), 2005
Scientist of the year, 2004, Association of Indians in America
Sir Gilbert Walker Gold Medal (Ind. Met. Soc.), 2001
Associate Fellow, Third World Academy of Sciences, 1996
Fellow, Indian Meteorological Society, 1996
Fellow, American Meteorological Society, 1986
Exceptional Scientific Achievement Medal, NASA, 1982
Exceptional Performance Award, Goddard Space Flight Center, NASA, 1981
Outstanding Contribution to First GARP Global Experiment, 1980
Fulbright Travel Grant, 1971
United National Fellowship, 1967

SCIENTIFIC PUBLICATIONS AND LECTURES:

Author/co-author of 250 scientific papers, 20 reports
Editor/contributor: five books; About 300 invited lectures/seminars
Ph. D. thesis adviser for 20 students at M. I. T., Univ. of Maryland, GMU
Chair/member of about 50 national/international panels

NATIONAL/INTERNATIONAL COMMITTEES, PANELS:

Member, 2008; 2014, Virginia Governor's Commission on Climate
Chairman, 2008 – present, International Advisory Panel for Weather and Climate (Govt. of India)
Member, 2005 – 2012, Board of Trustees, Sehgal Foundation, India
Chairman, 2006-2012, Asia Pacific Climate Center Science Advisory Committee, Korea
Chairman, 2008, World Modelling Summit for Climate Prediction (May 6-9, ECMWF)
Chairman, 2005-2007, WCRP Modeling Panel (WMP)
Member, 2005-2008, WCRP Observations and Assimilations Panel (WOAP)
Member, 2001-2008, Joint Scientific Committee (JSC), World Climate Research Program (WCRP)
Member, 2000-2001, Asian Australian Monsoon Working Group, US CLIVAR
Chairman, 1999- 2001, Seasonal-Interannual Modeling Panel (SIMAP), US CLIVAR
Chairman, 2001, International Conference on Monsoons, New Delhi, India
Member, 2001-, Editorial Board, Earth & Planetary Sciences, Indian Academy of Sciences
Member, 1998-2000, Science Steering Committee, Climate Variability, US CLIVAR
Member, 1997-2000, Science Steering Committee, Climate System Modeling (CSM), UCAR
Member, 1995-2000, PAGES/CLIVAR Working Group, WCRP
Member, 1995-1998, TOGA Numerical Experimentation Group (TOGA-NEG), WCRP
Member, 1996-1998, CLIVAR Monsoon Panel, WCRP
Member, 1996-1997, Science Working Group, International Pacific Research Center (IPRC), Hawaii
Member, 1994-1997, U.S. Panel on GOALS, National Research Council (NRC), NAS
Member, 1993-1996, Climate Data Analysis (CDAS), Advisory Committee for NCEP, UCAR
Member, 1991-1995, International Scientific Steering Committee, (CLIVAR), WCRP
Co-chairman, 1994, International Conference on Monsoons, Trieste, Italy
Member, 1992-1994, Atlantic Climate Change Program (ACCP), OGP/NOAA
Chairman, 1992, Steering Committee for Study Conference on GOALS, NRC/NAS
Director, 1992, Workshop on Mediterranean Processes, August 1992, Venice, Italy
Scientific Coordinator, 1991-1994, Int. Inst. for Earth, Env. and Marine Sci. and Tech., Trieste, Italy
Member, 1991-1993, GEWEX Panel on Continental Scale Project (GCIP)
Member, 1991-1993, External Advisory Group, ECMWF Reanalysis (ERA)
Member, 1991-1998, Scientific Advisory Committee, Venice Center for Marine Sciences
Director, 1991, NATO Avd. Res. Workshop on Prediction of Interannual Clim. Vari., Trieste, Italy
Chairman, 1989, Organizing Committee, TOGA Ad-hoc, panel meeting on Reanalysis
Chairman, 1989-1992, U.S. Panel on Tropical Ocean Global Atmosphere (TOGA), NRC/NAS
Member, 1989-1994, International Monsoon Numerical Experimentation Group (MONEG)
Member, 1989-2000, Editorial Board, Journal of Indian Meteorological Society, MAUSAM
Scientific Advisor, 1989-1990, National Center for Medium Range Weather Forecasting, India
Member, 1983-1988, U.S. Panel on TOGA (NRC/NAS)
Member, 1984-1989, International Scientific Steering Group on TOGA,WCRP
Member, 1987-1991, Panel on Dynamical Extended Range Forecasting (DERF), NRC/NAS
Member, 1987-1990, Air-Sea Fluxes Working Group, WCRP
Director, Summer school on physical climatology, May-June, 1988, ICTP, Trieste, Italy
Member, 1988-1991, Scientific Steering Comm. for International Center for Earth Sciences, Trieste, Italy
Member, 1986-1989, Science Steering Committee for TRMM, NASA
Chairman, 1985, Organizing Committee, Meeting on Interannual Variations of Monsoon (US TOGA)
Member, 1984-1987, Indian Ocean Panel, Committee on Climate Change and Ocean (CCCO)
Program Leader, 1984-1990, U.S.-India Science and Technology Initiative (STI) on Monsoon
Member, 1982-1985, Climate Research Committee, NRC/NAS
Member, 1982-1984, Advisory Board, Equatorial Pacific Ocean Climate Studies, (EPOCS)
Member, 1983-1986, Committee on Climate Variations, American Meteor. Soc., (AMS)
Lead Scientist, 1983, Global Habitability Program, GSFC/NASA
Member, 1975-1983, Panel on Monsoon Experiment (MONEX), NRC/NAS
Chief Scientist, 1977 - 1979, Monsoon Experiment (FGGE/GWE) in Bay of Bengal (NSF)

Professional Biography of Jagadish Shukla

Jagadish Shukla was born in 1944 in village Mirdha in the Ballia district of Uttar Pradesh, India. This village had no electricity, no roads or transportation, and no primary school. Most of his primary education was received under a large banyan tree until his father established a primary school in the village. He passed high school from the S.R.S. High School, Sheopur, in 1958 with distinction in Mathematics and Sanskrit. He was unable to study science in high school because none of the schools near his village offered science education. His father, the late Shri Chandra Shekhar Shukla who was headmaster of a middle school in a nearby village (Sukhpura), bought science textbooks for classes sixth to tenth and insisted that he study them during the summer holidays before admission to the next grade. After passing the twelfth grade from the S. C. College, Ballia, he went to Banaras Hindu University (B.H.U.) where, in 1962, he passed the B.Sc. (honors) with Physics, Mathematics, and Geology, and in 1964 received the M.Sc. in Geophysics. He received a Doctor of Philosophy (Ph.D.) in Geophysics from BHU (1971) and a Doctor of Science (Sc.D.) in Meteorology from the Massachusetts Institute of Technology (MIT) in 1976.

Dr. Shukla is a Distinguished University Professor and the Founding Chairman of the Department of Atmospheric, Oceanic and Earth Sciences at George Mason University (GMU), Virginia, USA. He is also President of the Institute of Global Environment and Society (IGES), Maryland, USA.

In 2008, he was appointed by the Governor of Virginia as a member of the Commission on Climate Change. He was one of the Lead Authors of the 2007 report of the Intergovernmental Panel on Climate Change (IPCC), which shared the Nobel Peace Prize with Vice President Gore. In 2007, he received the International Meteorological Organization (IMO) Prize, considered to be the highest prize in meteorology in the world. In 2005, he received the Rossby Medal, considered the highest medal of the American Meteorological Society (AMS) in the USA; in 2001, he received the Walker Gold Medal, considered the highest medal of Indian Meteorological Society (IMS) in India; in 1982 he received the Exceptional Scientific Achievement Medal of NASA, the highest medal given by NASA to a civilian.

He is a Fellow of the American Geophysical Union, the American Meteorology Society, India Meteorology Society, and an Associate Fellow of TWAS (the academy of sciences for the developing world). He has been the Ph. D. thesis adviser for about 20 students at MIT., Univ. of Maryland, and George Mason University. Professor Shukla has exerted a tremendous influence on the field through his publication of over 200 scientific papers, reports and book chapters, his direction of 20 Ph.D. students' dissertation research, his leadership of several national and international advisory and planning panels.

Professor Shukla has contributed to the science of meteorology and to governments, research organizations, and institutions of higher learning throughout the world, through fundamental scientific advances, institution building, and international cooperation in meteorology for the betterment of humankind worldwide.

He has made fundamental contributions to the study of climate dynamics that have led to the development of a scientific basis for the prediction of climate beyond the limit of the predictability of daily weather, which derives from the influence of the slow variations of the atmosphere's lower boundary conditions. This pioneering work helped lay the scientific foundation for dynamical seasonal prediction at a time when the community was quite skeptical about its prospects. This idea launched a large community research effort to investigate the effects of boundary conditions on climate variability and predictability, and it lead to routine dynamical seasonal prediction. Beyond that, Professor Shukla has helped launch global programs to measure, quantify, and exploit the Earth's climate variability and predictability. He has helped establish institutions for the purposes of studying the predictability of seasonal to interannual climate fluctuations as well as for making actual climate predictions.

Professor Shukla has also contributed greatly to establishing the importance of land surface processes in determining the seasonal and longer predictability of climate. Toward that end, he established the Center for Ocean-Land-Atmosphere Studies (COLA) to conduct basic research on climate predictability with the idea that air-sea and air-land interactions are both important. The COLA group is now recognized as one of the outstanding research centers in the world focused on climate dynamics and climate predictability. Professor Shukla and colleagues at COLA have conducted several studies of global deforestation, desertification and monsoons as examples of phenomena in which interactions between the atmosphere and the land surface play a critical role. This emphasis on land surface processes was a fundamental advance of the science, which has lead to numerous research programs, field experiments and space-missions.

Another major contribution made by Professor Shukla was his development and proof of the concept of retrospective analysis of atmospheric observations. As in the case of dynamical seasonal prediction, he had the foresight and the vision to push forward this idea and conduct a pilot reanalysis as proof of concept at a time when the community was somewhat skeptical about its feasibility. Reanalysis efforts in the U.S., Europe and Japan inspired by Professor Shukla's work have led to invaluable data sets that form the basis for climate analysis research today and for the foreseeable future worldwide.

Professor Shukla is an institution builder. He is well known for the establishment of the Institute of Global Environment and Society and the Center for Ocean-Land-Atmosphere Studies (COLA) in the US. He also helped to form a weather and climate research group at the International Centre for Theoretical Physics in Trieste, Italy, which provides training to many scientists from developing countries. He helped establish the National Center for Weather Forecasting in New Delhi, India, which was the result of a landmark agreement between President Reagan and Prime Minister Rajiv Gandhi. He has played a key role in the establishment of a new Department of Atmospheric and Oceanic Sciences in Allahabad University, India. He was a founding member of the committees for the establishment of the International Research Institute for Climate Prediction (IRI) at Columbia University and the International Pacific Research Center (IPRC) at the University of Hawaii. He led the creation of a Ph.D. program in Climate Dynamics at George Mason University, which became the Department of Atmospheric, Oceanic, and Earth Sciences with Professor Shukla serving as its inaugural chairman. In 2008, he was chairman of the highly successful World Modeling Summit for Climate Prediction. In 2009, he helped launch the South Asian Climate Outlook Forum which culminated with a meeting at the ICTP, Trieste, Italy of the Directors General of the weather services of the South Asian countries, the Secretary General of the World Meteorological Organization (WMO), and the Director of ICTP.

Professor Shukla has also begun to build institutions in his native India for the purpose of bringing higher education to the poorest villages, especially the women, where the crushing poverty prevents even the simplest forms of scientific or technical advance from being put in place. He has established Gandhi College in his native village for the education of rural girls.

He has been a member of numerous national and international programs, including the Monsoon Experiment (MONEX), the Tropical Ocean Global Atmosphere (TOGA) Program, and the Climate Variability (CLIVAR) Program. Most recently, as a member of the World Climate Research Program (WCRP) Joint Scientific Committee (JSC), he has inspired the creation of the WCRP Coordinated Observation and Prediction of the Earth System (COPES) strategy.

In summary, Professor Shukla's contributions represent a unique combination of major scientific accomplishments and substantive community service including the development of scientific programs, creation of new institutions, and fostering of further international cooperation in weather and climate research, to ensure that the fruits of scientific research are harvested for the benefit of society

Research Activities of Professor J. Shukla in India

Professor J. Shukla has been a leader in advancing the science of weather and climate in India. He has developed active collaboration with the Indian researchers at many Indian institutions engaged in weather and climate research. While in the US, he has visited Indian research institutions and his native village every year for the past 40 years. Some of his collaborative activities are briefly summarized below:

1. Dr. Shukla is the Chairman (2008-present) of the International Advisory Panel for weather and climate for the Ministry of Earth Sciences (MOES).

2. He was the scientific leader in establishing the supercomputer center for weather forecasting at the National Center for Medium Range Weather Forecasting (NCMRWF) in New Delhi, India. This was the first Indian center that received, under a special agreement between President Reagan and Prime Minister Rajiv Gandhi for monsoon research. The government of India invited Professor Shukla to establish the scientific infrastructure of the center. This has enabled India to make weather forecasts using a state-of-the-art global dynamical model.

3. He helped establish a weather and climate research group at the Allahabad University. This group has now developed into a full fledged Department of Atmospheric and Oceanic Sciences.

4. He was instrumental in the establishment of the private sector in the weather and climate enterprise of India. This has enabled the private sector to provide value-added weather and climate information to the Indian stakeholders.

5. He established Gandhi College for the education of rural women in the village of his birth in India. This college follows the Gandhian philosophy of honesty and provides an educational opportunity to girls from the neighboring villages.

6. He was the leader of the bilateral US-India Science and Technology Initiative (STI) for monsoons.

7. He was the scientific leader of the Bay of Bengal MONEX experiment in 1979.

SCIENTIFIC CONTRIBUTIONS:

Predictability in the Midst of Chaos

He conducted innovative numerical experiments to demonstrate that the tropical atmosphere is so strongly forced by the boundary conditions (SST) at the Earth surface that even large differences in the initial conditions of the atmosphere converge to the same circulation. This has clarified an apparent contradiction between the lack of weather predictability beyond two weeks and predictability of seasonal means for periods well beyond the limit of weather predictability. This work along with the research by other scientists who showed that the boundary conditions can be predicted lead to the establishment of operational dynamical seasonal prediction. He was awarded the International Meteorological Organization (IMO) prize with the following citation:

"In recognition of his research on monsoons and ocean-land-atmosphere interactions establishing a scientific basis for predictability of climate in the midst of chaotic weather, leading to the introduction of routine operational dynamical seasonal prediction, and his contributions to fostering international cooperation in weather and climate research by developing and leading numerous international research programs, and creating new institutions worldwide for improving weather and climate research, and betterment of global society."

Scientific Basis for Dynamical Seasonal Prediction (DSP)

One of his most significant contributions was the advancement of the hypothesis that the spatially and temporally averaged atmospheric circulation is dynamically predictable for periods beyond the limits of deterministic weather prediction. This work, in conjunction with Miyakoda's pioneering research on monthly forecast experiments, provided a scientific basis for Dynamic Extended Range Forecasting (DERF). His innovative GCM experiments on the predictability of monthly averages and his sensitivity experiments on the influence of boundary conditions were crucial in persuading an otherwise skeptical community that there is a physical basis in dynamically predicting monthly and seasonal averages. It is likely that, in the not too distant future, seasonal predictions of the atmospheric circulation and rainfall will be done routinely using dynamical models. He was awarded the Rossby Research Medal of the American Meteorological Society with the following citation:

"For fundamental contributions and inspired leadership in understanding the variability and predictability of the climate system on seasonal-to-interannual time scales."

Boundary Forcings as a Mechanism for the Interannual Variability of the Atmospheric Circulation

He presented a simple paradigm for mechanisms that determine the interannual variability of the atmospheric circulation. He suggested that for conceptual simplicity it is useful to consider the total variability as consisting of that due to the internal dynamics and that due to variations in the boundary conditions. He carried out a large number of GCM sensitivity experiments and diagnostic studies to model the effects of variations in different boundary conditions. He was awarded the NASA Gold Medal for Exceptional Scientific Achievement with the following citation:

"For distinguished scientific contributions to the physical understanding of the role of the earth surface boundary forcings on the predictability of the large scale climate fluctuations through observational analysis and numerical modeling experiments, and for management and leadership of an outstanding climate modeling group."

Predictability of the Tropical Atmosphere

He was the first to point out (Shukla 1981) that the theoretical limit of deterministic prediction for the tropics is considerably smaller (3-7 day) than that for the mid-latitudes (2-3 weeks). This is because the tropical errors, largely influenced by moist-convection, reach their climatological saturation values much

more quickly than in mid-latitudes. The magnitudes of these saturation values are small compared to those for mid-latitudes. He also pointed out that, for the same reason, monthly and seasonal averages are potentially far more predictable in the tropics because they are primarily determined by variations in the boundary conditions.

Monsoon Dynamics

In his Ph.D. thesis he proposed a theory for the formation of monsoon disturbances, locally referred to as monsoon depressions, that form over the Bay of Bengal and move over India. He showed that these disturbances represent on instability of the horizontally and vertically shearing monsoon winds modified by moist convection. This was the first attempt to carry out linear instability analysis with horizontal and vertical shear and moist convection as represented by the Arakawa and Schubert parameterization.

Monsoon predictability

Both his pioneering numerical experiment on the influence of Arabian Sea SST on the Indian monsoon using the GFDL model and diagnostic studies with D. Hahn at GFDL on the relationship between Eurasian snow cover and the Indian monsoon rainfall formed the basis for Charney and Shukla to suggest that monsoons have a degree of predictability due to the effects of the boundary conditions.

Long Range Forecasting of Monsoons

In a collaborative study with Paolino he showed that the summer monsoon rainfall over India is far more strongly correlated with the tendency of the Southern Oscillation in the preceding winter and spring season than the Southern Oscillation itself. This simple diagnostic result gave a clear explanation for the failure of Walker's attempt to forecast monsoon rainfall using the Southern Oscillation.

Land-Climate Interactions (deforestation, desertification)

An idealized study by Shukla and Mintz (1982) on the role of land surface evapotranspiration on climate combined with the earlier works of Charney on the influence of changes in albedo helped establish the importance of land surface processes in climate variability and predictability. He and his colleagues have shown that: Amazon deforestation can produce significant changes in temperature, evaporation and rainfall; the climatic effects of deforestation are largely determined by changes in albedo; although the Sahel drought was probably initiated by planetary scale atmosphere-ocean-land interactions, the local land-surface effects play an important role in perpetuating the drought; and initial values of soil wetness are important in determining seasonal mean temperature and rainfall.

Predictability of Weather and Climate

He has carried out a large number of predictability studies using atmospheric GCMs to investigate the predictability of weather, predictability of monthly and seasonal averages; predictability of tropical oceans; and predictability of the coupled ocean-atmosphere system.

Reanalysis

He is one of the pioneers of reanalysis. As a member of the US TOGA panel and the scientific steering group of the international TOGA, he put forward the idea of reanalysis. Bengtsson and Shukla published a paper in 1988 advancing the concept of reanalysis. To test the feasibility of reanalysis, COLA carried out a pilot reanalysis project. His suggestions on reanalysis to produce climate data sets, which were not well received in the beginning, have now been accepted by the entire community and several groups around the world are carrying out reanalysis to produce data for climate research.

SELECTED 18 HIGH IMPACT PUBLICATIONS

DelSole, T., and J. Shukla, 2012: Climate models produce skillful predictions of Indian summer monsoon rainfall. *Geophys. Res. Lett.*, **39**, doi:10.1029/2012GL051279.

Shukla, J., T.N. Palmer, R. Hagedorn, B. Hoskins, J. Kinter, J. Marotzke, M. Miller, and J. Slingo, 2010: Towards a New Generation of World Climate Research and Computing Facilities. *Bulletin of the American Meteorological Society*, **91**, 1407-1412.

Shukla, J., R. Hagedorn, B. Hoskins, J. Kinter, J. Marotzke, M. Miller, T.N. Palmer, and J. Slingo, 2009: Revolution in climate Prediction is Both Necessary and Possible: A Declaration at the World Modelling Summit for Climate Prediction. *Bulletin of the Amer. Meteo. Soc.,* **2** 175-178.

Shukla, J., 2007: Monsoon Mysteries. *Science*, **318**, 204 – 205.

Shukla, J., T. DelSole, M. Fennessy, J. Kinter, and D. Paolino, 2006: Climate Model Fidelity and Projections of Climate Change. *Geophysical Research Letters,* **33**.

Shukla, J. and J. L. Kinter III, 2006: Predictability of seasonal climate variations: Predictability of Weather and Climate, T. Palmer and R. Hagedorn, eds.: Cambridge Univ. Press, p. 306-341.

Shukla, J. (editor), 2001: Dynamics of Large-Scale Atmospheric and Oceanic Processes: Selected Papers of Jule Gregory Charney. A. Deepak Publ. (Hampton, VA, 611 pp).

Shukla, J., et. al., 2000: Dynamical Seasonal Prediction, *Bull. Amer. Meteor. Soc.*, **81**, 1-14.

Shukla, J., 1998: Predictability in the Midst of Chaos: A scientific basis for climate forecasting. *Science*, **282**, 728-731

Huang, B., and J. Shukla, 1997: Characteristics of interannual and decadal variability in a general circulation model of the tropical Atlantic Ocean. *J. Phys. Oceanogr.*, **27**, 1693-1712. 5**4**, 777-790

Nobre. P., and J. Shukla, 1996: Variations of sea surface temperature, wind stress and rainfall over the tropical Atlantic and South America. *J. Climate*, **9**, 2464-2479.

Shukla, J., 1995: On the initiation and persistence of Sahel drought, Natural Climate Variability on Decade to Century Time Scales. National Academy press, Washington, D.C., pp. 44-48.

Dirmeyer, P.A. and J. Shukla, 1994: Albedo as a modulator of climate response to tropical deforestation. *J. Geophys. Res.*, **99**, 20863-20877.

Goswami, B.N. and J. Shukla, 1991: Predictability of a coupled ocean-atmosphere model .*J. Clim.* **3**,2-22.

Shukla, J., C. A. Nobre and P. J. Sellers, 1990: Amazonia deforestation and climate change. Science, 247, 1322 1325.

Shukla, J. and Y. Mintz, Influence of land surface evapotranspiration on the earth's climate. Science 215 (1982): 1498 1501.

Moura, D. A. and J. Shukla, 1981: On the dynamics of droughts in northeast Brazil: Observations, theory and numerical experiments with a general circulation model. *J. Atm. Sci.*, 38, 2653 2675.

Shukla, J., 1981: Dynamical Predictability of Monthly Means. *J. Atm. Sci*. **Vol. 38, No.12**, 2547 – 2572.

SERVICE TO COMMUNITY:

a. Scientific Programs

He has been chairman/member of numerous national and international panels and committees concerned with the advancement of the atmospheric and oceanic sciences including the monsoon climate program of the World Meteorological Organization. He was the **founding member/chair** of the scientific steering group of the following national and international programs:

- MONEX – Monsoon Experiment (US and WCRP)
- STI – Science and Technology Initiative (US – India)
- TRMM – Tropical Rain Measurement Mission (NASA)
- DERF – Dynamical Extended Range Forecasting (NAS/NRC)
- TOGA – Tropical Ocean Global Atmosphere (US and WCRP)
- GOALS – Global Ocean Atmosphere Land Systems (NAS/NRC)
- CLIVAR – Climate Variability (International SSG)
- ERA – External Advisory Committee on ECMWF Reanalysis
- GCIP – GEWEX Continental Scale Project (CLIVAR)
- ACCP – Atlantic Climate Change Program (NOAA)
- SIMAP – Seasonal-Interannual Modeling & Prediction (US CLIVAR)
- AAMWG – Asian Australian Monsoon Working Group (US CLIVAR)
- JSC – Joint Scientific Committee of WCRP
- COPES – Coordinated Observation and Prediction of the Earth System (WCRP)
- WMP – WCRP Modeling Panel (WCRP)
- WMS – World Modelling Summit for Climate Prediction (WCRP)
- SASCOF – South Asian Climate Outlook Forum

b. Institution Building

i. COLA and IGES, USA

He is the founder of the Institute of Global Environment and Society (a non-profit institute registered in Maryland) and the Center for Ocean-Land-Atmosphere Studies (COLA). IGES and COLA freely provide models, data, and data analysis and display software (GrADS) to the research community. COLA has also developed a desktop weather forecast system that can be used for research and operational forecasts.

ii. NCMRWF, India

When India received the first supercomputer from the USA under a special (Ronald Reagan-Rajiv Gandhi) agreement for monsoon forecasting, he was invited by India to establish the scientific infrastructure of the monsoon forecast supercomputer center in New Delhi. He was the scientific leader in establishing the National Center for Medium Range Weather Forecasting (NCMRWF) in New Delhi, India. He helped recruit the scientific staff and implemented a global data analysis-assimilation-forecast system in India to make weather forecasts using a global model.

iii. Physics of Weather and Climate, Italy

He conducted regular workshops, symposia and training courses for the benefit of the scientists from developing countries at the International Center for Theoretical Physics (ICTP), Trieste, leading to the establishment of a permanent research group at ICTP.

iv. IRI, USA

He was one of the members of the group that proposed the scientific plan for the establishment of the International Research Institute for Climate Prediction at Columbia University, New York.

v. IPRC, USA

He was one of the members of the Science Working Group that prepared the scientific plan for the establishment of the International Pacific Research Center at Univ. of Hawaii, Honolulu.

vi. Gandhi College, India

He has established a degree college for the education of students, especially women, in the rural village of Mirdha in the Ballia district of India.

vii. Climate Dynamics, GMU, USA

He was the founding chair of the Climate Dynamics Ph.D. program at George Mason University (GMU).

viii. AOES, GMU, USA

He was the founding chair of the Department of Atmospheric, Oceanic, and Earth Sciences at GMU.

SCIENTIFIC WORKING GROUPS: Joint Modeling Experiments; Committees

AMIP, CLIVAR NEG-1, DSP, ECMWF-ERA, MONEG, NCEP-CDAS, NCAR-CSM, SMIP, TOGA-NEG, TPOP; MONEX, TRMM, TOGA, GOALS, CLIVAR, ACCP, JSC

INSTITUTION BUILDING:

Climate Dynamics Ph.D. Program, George Mason University (GMU)
Dept. of Atmospheric, Oceanic and Earth Sciences, GMU
Center for Ocean-Land-Atmosphere Studies (COLA), Maryland, USA
Institute of Global Environment and Society (IGES), Calverton, Maryland, USA
National Center for Medium Range Weather Forecasting (NCMRWF), New Delhi, India
Physics of Weather and Climate, ICTP, Trieste, Italy
CPTEC, Brazil, Organizer training of Brazilian scientists at COLA
International Pacific Research Center (IPRC), U. Of Hawaii, Co-author, Initial Science Plan.
International Research Institute for Climate Prediction (IRIPC-IRI), Co-author, Initial Proposal
Gandhi Degree College, Village - Mirdha, Ballia, UP, India

SCIENTIFIC COLLABORATORS: Coauthors of Papers in Refereed Journals

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SCIENTIFIC COLLABORATORS: Coauthors of Panel and Committee Reports

D. Anderson, Arkin, Austin, Baker, Barnett, Barber, Bengtsson, Blackmon, Boville, Branstator, Brown, F.Bryan, K. Bryan, Busalacchi, Cane, Charney, Chelton, Clark, Dahl, Duplessy, Elachi, Esbensen, Fuguno, Garstag, Gates, Gent, Ghil, Goodrich, Gordon, Halpern, Harrison, Houze, Hudlow, Kiehl, Krishnamurti, Lukas, Mahlman, Manton, Matsuno, McBean, Molinari, Moritz, Murakami, Neelin, Niiler, North, Randall, Rasmusson, Sarachik, Schott, Simpson, Solomon, Spencer, Stommel, Sumi, Suomi, Thiele, Trenberth, Wallace, F. Webster, P. Webster, Weinman, Weller, Wilheit, Young, Zipser

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