

The Trenberth Symposium: Agenda
Monday, 16 March 2020
NCAR – Boulder, CO - Mesa Lab - Main Seminar Room
Webcast – with chat support: <http://www.fin.ucar.edu/it/mms/v2/ml-msr-chat.html>

Career Overviews

- 8:45 Introductory Remarks, *John Fasullo, NCAR*
- 8:55 Kevin as a Colleague; *Peter Gent and Joe Tribbia, NCAR*
- 9:10 Reflections on Kevin Trenberth as a Mentor and Colleague; *James Hurrell, Colorado State University*
- 9:25 Kevin Trenberth's influence through the years; *Gerald Meehl, NCAR*
- 9:40 A Life of Research and Impact; *John Abraham, Univ. of St. Thomas*

Coffee Break (9:55-10:15)

The Energy Budget

- 10:15 Comparing CMIP6 AMIP and CERES TOA Fluxes During Recent Unprecedented Changes in Earth's Radiation Budget; *Norman Loeb, NASA, remote presentation via Zoom*
- 10:30 Energy, Golf and Maintaining a Constant Axis of Vorticity; *Mark Serreze, National Snow and Ice Data Center*
- 10:45 What Satellite Measurements of Sea Level Are Telling Us About Our Changing Climate; *Steve Nerem, Univ. of Colorado*
- 11:00 Energy conservation from a model developer's perspective; *Peter Lauritzen, NCAR*
- 11:15 The Lasting Legacy of the Sutcliffe-Trenberth Omega Equation; *Lance Bosart, Univ. of Albany*
- 11:30 California drought and waveguide teleconnections, *Haiyan Teng and Grant Branstator, NCAR*
- 11:45 Personal tributes: *Tom Karl, Susan Hassol, Mike Nelson, and Soroosh Sorooshian*

Lunch Break (11:55-12:50)

- 11:55 Cafeteria
- 12:35 Group Hike; *NCAR Weather Trail*

The Water Cycle

- 12:50 Kevin Trenberth's Impact on the NCAR Water System Program; *Roy Rasmusson, NCAR*
- 1:05 Characteristics of precipitation based on the hourly CMORPH product; *Yongxin Zhang, NCAR*
- 1:20 How well do global precipitation estimates agree? *Maria Gehne, NOAA*
- 1:35 Observing long-term variations in stratospheric water vapor from satellites; *Bill Randel, NCAR*

Community Engagement

- 1:50 Kevin's role in climate data sets and the Climate Data Guide; *Clara Deser and David Schneider, NCAR*
- 2:05 Public Outreach: value, challenges of and Kevin; *Jadwiga Richter, NCAR*
- 2:20 Kevin's dedication to communicating climate research; *David Hosansky, NCAR*
- 2:35 Global Climate Change Law & Policy: Hot Topics, High Stakes, and Harbingers of Hope in International Frameworks; *Kristi Disney Bruckner, Sustainable Development Strategies Group*

Remote Presentations (pre-recorded, Q&A via Zoom)

- 2:50 Perspectives on oceans and their role in global warming and the water cycle; *Lijing Cheng, IAP/COMS, China, pre-recorded, Q&A via Zoom*
- 3:05 Variability of the Southern Hemisphere circulation: Kevin Trenberth in his pre-NCAR period, *David Karoly, NESP Earth Systems and Climate Change Hub, CSIRO, Australia*
- 3:20 How did Kevin and I start to work on streamflow and drought? *Aiguo Dai, Univ of Albany*

Coffee Break (3:35-4:00)

Trenberth Lecture (4 pm) Perspectives on Understanding Climate Change: *Webcast: <https://www.ucar.edu/live>*

Available Abstracts

The Lasting Legacy of the Sutcliffe-Trenberth Omega Equation

Lance Bosart, University of Albany

Kevin Trenberth published a paper entitled "On the Interpretation of the Diagnostic Quasi-Geostrophic Omega Equation" in the Monthly Weather Review in 1978. In his short abstract, Kevin wrote "The usual interpretation of the quasi-geostrophic omega equation can be ambiguous, and an alternative but complementary approach is suggested. In the middle troposphere, upward motion is shown to be the consequence of the cyclonic advection of vorticity by the thermal wind. This relates to several empirical-dynamical rules of synoptic meteorology." In this short presentation I will link Kevin's equation, hereafter the Sutcliffe-Trenberth equation, from his 1978 paper back to Sutcliffe Development Theory. I will also comment on how the Sutcliffe-Trenberth equation can be used to provide a first-order physical understanding of atmospheric circulations in a warming climate.

California drought and waveguide teleconnections

Haiyan Teng and Grant Branstator, NCAR

California droughts are often caused by high-amplitude and persistent ridges near and off the west coast of North America without apparent connections with ENSO. Here with a hierarchy of climate models, it is demonstrated that extreme ridges in this region are associated with a continuum of zonal wavenumber-5 circumglobal teleconnection patterns that originate from midlatitude atmospheric internal dynamics. Although tropical diabatic heating anomalies are not essential to the formation and maintenance of these wave patterns, certain persistent heating anomalies may double the probability of ridges with amplitudes in the 90th percentile occurring on interannual time scales. Those heating anomalies can be caused by either natural variability or possibly by climate change, and they do not necessarily depend on ENSO. The extreme ridges that occurred during the 2013/14 and 2014/15 winters could be examples of ridges produced by heating anomalies that are not associated with ENSO. This mechanism could provide a source of subseasonal-to-interannual predictability beyond the predictability provided by ENSO.

Characteristics of precipitation based on the hourly CMORPH product

Yongxin Zhang, NCAR

Precipitation is characterized by a marked variability both in space and time and needs to be sampled with high spatial and temporal details. An hourly precipitation product is at least required for studying the full characteristics as an hour is reasonably consistent with the timescale of convective events. In this talk, I will briefly review the research work that Kevin and I have carried out on precipitation characteristics based primarily on the hourly CMORPH data and secondly on the CESM data and the TRMM data. Three specific questions we would like to ask are (a) what is the intermittency in precipitation? (b) how often does it rain? and (c) what are the patterns of precipitation spatial correlation?

Perspectives on oceans and their role in global warming and the water cycle

Lijing Cheng, International Center for Climate and Environment Sciences, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China, 100029, Center for Ocean Mega-Science, Chinese Academy of Sciences, Qingdao, China, 266071.

This presentation will summarize the perspectives on oceans and their role in global warming and the water cycle, based on the collaborated works with K. Trenberth in the past 5 years. For energy budget, ocean stores more than 90% of the global warming energy, so ocean heat content (OHC) is a vital climate indicator, and it is also the key in understanding Earth's energy budget. In the past five years, we have provided a gridded temperature dataset at upper 2000m ocean since 1940 with the goal of minimizing associated sampling error. The new dataset provide a more accurate OHC estimate than before, showing that changes in OHC are relatively small before about 1980; since then, OHC has increased fairly steadily and, since 1990, has increasingly involved deeper layers of the ocean. The dataset and OHC estimate have broad impact in both society and scientific community, and have already been extensively used. Moreover, we also worked together in understanding ocean heat changes related to tropical cyclones and ENSO. For water cycle, ocean salinity records the hydrological cycle and its changes. But again, data scarcity substantial inconsistencies among current salinity reconstructions have limited analyses. We have presented a new observational estimate of changes in ocean salinity since 1960 from the surface down to 2000 m. We show that the salinity change since 1960 emerges clearly as an anthropogenic signal from the expected background noise of natural variability, and is consistent with an enhancement of the hydrological cycle to date.

Variability of the Southern Hemisphere circulation: Kevin Trenberth in his pre-NCAR period

David Karoly, NESP Earth Systems and Climate Change Hub, CSIRO, Australia

In the 'bad' old days pre-FGGE, daily numerical analyses of the atmospheric circulation in the Southern Hemisphere were very limited and of uncertain quality. While at the University of Illinois, Kevin pioneered the use of SH numerical analyses to investigate this atmospheric laboratory south of the equator, to contrast with the better-studied Northern Hemisphere. He used the SH gridded numerical analyses available from the Australian Bureau of Meteorology from 1972 to describe many aspects of the mean circulation and its variability in the Southern Hemisphere. I will briefly describe some highlights of his research in that period and why the SAM should really be called the 'high latitude mode'.

Global Climate Change Law & Policy: Hot Topics, High Stakes, and Harbingers of Hope in International Frameworks

Kristi Disney Bruckner

International frameworks offer opportunities to align policy positions and strategies, support research and innovation, fund capacity building and technology transfer, and build global awareness to address the vast issue of climate change. This brief presentation will highlight some of the hot topics arising in international frameworks led by United Nations bodies in response to the demands of Indigenous Peoples, youth, and other sectors for whom stakes are high in our collective ability to address climate change. Where can we find signs of hope on the international level, and does this hope help or hinder our ability to act on climate change?