



MAKING WAVES

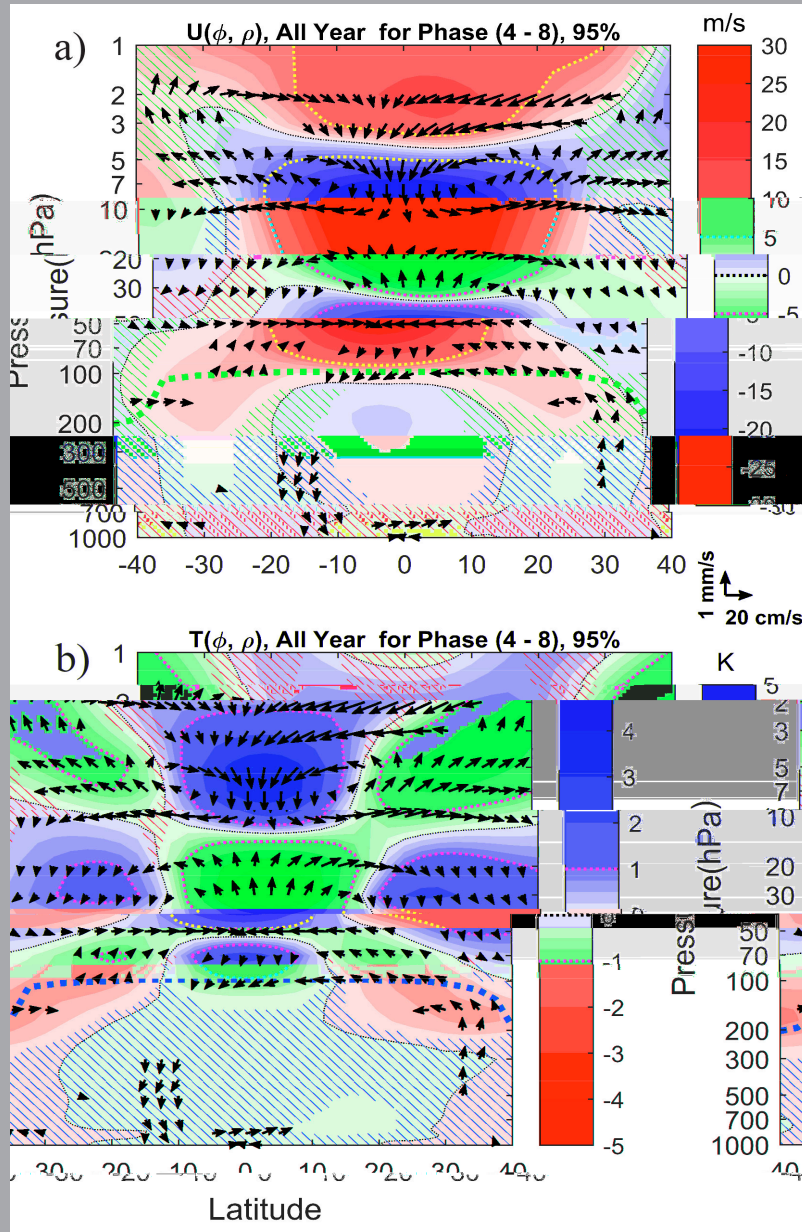


Figure Caption. Time mean ERA-Interim QBO W-E differences during the 40-yr period 1979 – 2018, for a) zonal wind and b) temperature, with superimposed arrows showing QBO W-E differences in the MMC (Fig. 21 from Hitchman et al. 2001).



CHAIR'S LETTER



“May you live in interesting times”

This phrase is sometimes written as a

fortune, but its intention is to serve more as a curse.

We certainly live in “interesting times”, in another year in the grips of our ongoing pandemic and a reckoning with systemic injustice. As the new chair of AOS, I find the repercussions of these embedded in every decision we are making right now. But I also know that what can be chaos inside the “fog of war” (to borrow meteorology puns), can lead to jettisoning of unhelpful downdrafts of tired routines and the convective blossoming of new activity

That is to say, the department is back and bigger and better than ever! Classes are in-person, students and faculty boast vaccination rates in the high 90s percent, and with our six new faculty hires, including two starting this year, a recent record in faculty numbers! Faculty, staff, and their protégés are conducting ground-breaking research of the Earth system and teaching and mentoring an increasingly diverse body of students who come from all corners of the world to be here in Madison.

There is another use of “interesting” more vernacular to the upper Midwest. In that usage, depending on tone and context, “interesting” confers some sense of apprehension or aversion or even disinterest in

what the speaker described.

My biggest wish is that you take a look at what’s going on in our department, in this newsletter, but not with that outlook. Rather, read with “interest”, seeking expansion and growth of your appreciation of our little world here at 1225 W Dayton and the impact it makes in the wider universe through exciting prospects by all of you!

We have many initiatives underway as we undertake revision of our long-term strategic plans. These plans are leading to new activity in recruiting, diversity and inclusion, field experiences, research initiatives, and different routes in the program, such as our growing professional master’s degree, now in its 2nd year.

Please send notes of memories of your times here, alumni meet-ups, new jobs, career highlights, “interesting” weather phenomena, or found photos. We’d love to publish those here, share others with our students, or display at our AMS alumni reception! Not to forget – support in the name of our scholarships and department funds that allow us to recognize excellence throughout AOS.

Take interest!

Ankur Desai, Professor and Chair

Design: Sarah Morton, College of Letters & Science
ON THE COVER graphs of QBO

Save the date

AMS Annual Reception Night

Tuesday, January 25th,
from 6:30 - 9:30pm
in room GB E at the
Hilton Americas -
Houston, TX

For more information
turn to page 7

A Message From Dean Wilcots

This fall marks a return to in-person classes and events, and it is exciting to be back on campus with students and colleagues! Our classrooms are full, our labs are humming and the frisbees are flying again on Bascom Hill. The university's COVID-19 protocols are continually adjusted based on the shifting state of the virus. With safe behavior and a campus vaccination rate of more than 90 percent, I am hopeful that we will successfully navigate the fall and winter.

There is much good news to share. UW-Madison welcomed our largest-ever freshman class, with more than 8,400 new students arriving in early September. In October, we celebrate the conclusion of the wildly successful All Ways Forward campaign, which has raised \$4 billion for UW-Madison, and \$652 million for the College of Letters & Science. Annual giving, too, is on track this year, mirroring strong pre-COVID giving trends. I would like to extend my deepest gratitude to alumni whose unwavering support through the hardest of times enabled us to emerge

stronger and ready to meet future challenges.

We have great news on capital projects to share. The Wisconsin legislature has approved funding for a new academic building for the College of Letters & Science. Departments and classes currently housed in the deteriorating Humanities Building will be relocated to a modern, interactive and world-class space that will transform the student learning experience.

A new building for our School of Computer, Data & Information Sciences is also underway, paving the way for this powerhouse new unit to meet a global need for students trained in computational thinking, big data, AI and related fields.

Finally – our highly-anticipated new Chemistry Building should open in 2022, and the impact on our STEM programs will be profound.

It feels great to look forward to so much. As always, a heartfelt thank you for all you do to support L&S. It means the world to us.

On, Wisconsin!

2021 UW-AOS Alumni Award for Outstanding Achievement Recipient



It gives us great pleasure to announce the recipient of this year's AOS Distinguished

Alumni Award. Dr. William ("Bill") L. Smith Sr. received his M.S. (1964) and Ph.D. (1966) in the then-Meteorology Department at the University of Wisconsin-Madison. He made fundamental

contributions to ground, aircraft, and satellite based infrared radiation measurements for infrared sounding the Earth's atmosphere. The award will be formally conferred at the AOS Alumni Reception to be held in conjunction with the American Meteorological Society Annual Meeting in Houston, TX, on Tuesday Jan 25, 2021. A fuller biography can be found on our website:

<https://www.aos.wisc.edu/>

Alumni Engagement Board

Like the rest of the world, the UWAEB was plunged into the virtual world for generally the entirety the 2020-2021 school year. Despite working from our kitchens, living rooms, and front porches, we did manage to give presentations to the senior capstone course, were able to speak at the virtual graduation ceremony, and assisted with and participated in the virtual AMS meeting. Some of us have also helped students with resumes as well as job applications, and we continue to post these opportunities as we see them, to both the alumni Facebook group as well as through the UWAEB twitter feed (@UWAOS_AEB). Although we have had to cancel the fall open house in 2021, we will have some members attending the AMS meeting in January, and, COVID permitting, will encourage alumni to participate in Founders Day events across the nation in February. We also hope to have a presence at the spring graduation ceremony. We still aim to focus on being a liaison between the alumni and the department, so don't hesitate to reach out if you need anything from us!

<https://www.aos.wisc.edu/alumni/board/>

Current members: Kris Craven (co-chair), Jennifer Stroozas (co-chair), Brett Hoover, Daniel Knuth, Kaitlyn Krzyzaniak, Brian Miretzky, Pete Pokrandt, Alan Robock, James Simkins, Josh Weber, and Skylar Williams

It has been 60 years since the QBO was discovered

By Matthew H. Hitchman



It has been 60 years since the discovery of the stratospheric quasi-biennial oscillation (QBO) in time series of tropical radiosonde profiles. The cover figure is a landmark achievement: the first quantification of the QBO mean meridional circulation (MMC) and its relationship to anomalies in zonal mean temperature and zonal wind. It represents the joint development of theory, observations, and global analysis over many decades. UW-Madison scientists who have studied the effects of the QBO include myself, Stefan Hastenrath, Chip Trepte, Ken Bywaters, Megan McKay, Chia-Yi (Joyce) Yao, Phil Politowicz, Joleen Kugi-Feltz, Amihan Huesmann, Chris Collimore, and Dave Martin. A key aspect which has enabled quantification of the QBO MMC is the contribution by satellite and radiation specialists in SSEC and AOS which have led to increasingly reliable global analyses since 1978. The QBO is characterized by alternating layers of westerly winds (W) and easterly winds (E), which descend in the stratosphere, exhibiting a variable period of 24 – 32 months. The QBO is mostly driven by momentum fluxes associated with vertically-propagating equatorial waves generated by tropospheric convection.

From theoretical considerations in the 1960s it was known that there must be a MMC associated with the QBO: westerly wave driving leads to convergence, descent, and an equatorial warm anomaly, flanked by rising motion and subtropical cool anomalies, while easterly wave driving leads to ascent and an equatorial cool anomaly, flanked by sinking and subtropical warm anomalies. Until recently it was not possible to quantify the QBO MMC.

Hitchman et al. (2021) describe the history of observational studies regarding the influence of the QBO on the tropical and subtropical upper troposphere and lower stratosphere (UTLS). Results from the periods 1958-1978 and 1978-2000 using NCEP reanalyses were compared with modern updates using MERRA2 data for 1980-2017, and ERA-Interim data for 1979-2018.

The cover figure shows the spatial relationship between the QBO MMC (arrows) and QBO W-E differences for zonal mean a) zonal wind (color range -30 m/s to 30 m/s, and b) temperature (range -5 to 5 K) in the domain 0 – 50 km (1000 -1 hPa), 40°S – 40°N. Reference vector scales of 1 mm/s for vertical and 20 cm/s for meridional motion are shown. The heavy-dashed lime-green line indicates the time-mean tropopause. Monthly mean data were analyzed with the EOF method of Wallace et al. (1993). Phases 4 and 8 correspond to QBO W and E maximizing in the lower stratosphere near 50 hPa. Diagonal green hatching indicates regions with less than 95% statistical significance.

Note the ‘tic-tac-toe’ pattern in QBO temperature anomalies and

the corresponding ‘horseshoe-shaped’ patterns in QBO zonal wind anomalies. The influence of the QBO on the tropical and subtropical UTLS is known as the “QBO direct effect”. When QBO regimes descend into the UTLS, they modulate the stability and wind shear environment of deep cumulus convection. When the tropical tropopause is warm during QBO W, the UTLS is colder in the subtropics and midlatitudes. The influence of the QBO on the stratospheric winter polar vortex is called the “Holton-Tan effect”, where the QBO modulates the behavior of stratospheric planetary waves, with QBO W favoring a stronger, more stable polar vortex. This depiction of the QBO MMC as a coherent structure that extends from the troposphere to lower mesosphere, and from the tropics to extratropics, is useful for understanding a wide array of QBO effects on midlatitude weather systems. It celebrates the culmination of concerted efforts by many atmospheric scientists over a long period of time. I am grateful to have been able to participate. I would like to thank the University of Wisconsin – Madison for providing a sabbatical leave during spring 2020 and Prof. Shigeo Yoden for hosting me at Kyoto University, where I completed this paper.

Hitchman, M. H., S. Yoden, P. H. Haynes, S. Tegtmeier, and V. Dabas, 2021: An observational history of the direct influence of the stratospheric Quasi-biennial Oscillation on the tropical and subtropical upper troposphere and lower stratosphere. *J. Meteorol. Soc. Jpn.*, 99(2), 239-267. <https://doi.org/10.2151/jmsj.2021-012>

Ed Hopkins' Historical Corner

Record Heat in Wisconsin

By Edward J. Hopkins, PhD, Assistant Wisconsin State Climatologist

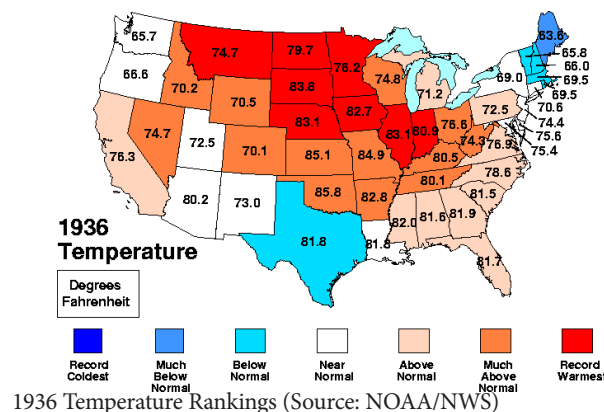
According to NOAA's National Centers for Environmental Information (NCEI), the three-month (June-August) meteorological summer of 2021 essentially tied the summer of 1936 as the hottest across the contiguous United States since sufficiently reliable climate records began in 1895. Although the 1936 summer in Wisconsin was not as warm as the record summer of 1988, that summer 85 years ago has long been remembered for a killer July heat wave that ran for at least nine days (6-14 July) when temperatures at essentially all 89 observing stations across Wisconsin exceeded 100°F at least once. Nearly all these stations established all-time high temperature records during this heat wave. Only the U.S. Coast Guard station on Plum Island off the Door Peninsula reported a high temperature (94°F) during the month that did not reach triple-digits. Eight Midwestern states experienced more than 3900 heat-related fatalities, with 330 deaths estimated to have been in Wisconsin. The heat wave's worst days in Wisconsin peaked on the 13th and 14th. The popular tourist destination of Wisconsin Dells (Columbia County) holds the record for the highest temperature in state history, a record that currently remains. On the 13th, the cooperative observer at the Wisconsin Power and Light Company hydroelectric plant recorded a maximum air temperature of 114°F, breaking the state record of 111°F set 35 years earlier in Brodhead (Green County). Several Wisconsin cities reached all-time record high temperatures on the 13th: Eau Claire (111°F), Green Bay (104°F) and Rhinelander (108°F). The following day the U.S. Weather Bureau (USWB) city office at La Crosse reported a

record high with 108°F; this record was tied in 1995 at the airport on French Island. On the same day, the temperature at the Madison USWB Office atop North Hall on the University campus reached an all-time station record high of 107°F, which followed a string of five consecutive days of daytime highs above 100°F. Nighttime minimum temperatures across the state were above 70°F at nearly 80 stations for at least one night during the heat wave, with a dozen stations having 80°F minimum temperatures. The USWB office in downtown Milwaukee had

of July 1936 was the driest July in Wisconsin's history, with a statewide average precipitation of 0.96 inches, which was 2.80 inches below the July 20th century (1901-2000) average for the state. The neighboring states of Minnesota, Iowa and the Dakotas also experienced the driest July on record. The lack of significant summer rain, along with poor agricultural methods, killed vegetation and parched the soil. According to NCEI, the Palmer Drought Severity Index (PDSI) across the Midwest and Plains States had worsened by July 1936. PDSI incorporates temperature and rainfall

information in a formula to determine abnormal dryness or wetness of the soil over prolonged time intervals. The Dakotas, along with sections of Iowa and northwestern Illinois, had reached PDSI values by July 1936 that were well within the extreme

category, while most of Minnesota and Wisconsin remained in severe drought. The lack of evaporative cooling from parched soils resulted in temperatures that reached triple digits across many of the Midwest and the Plains States. Over one week before Wisconsin recorded its state record high, a station in North Dakota registered a reading of 121°F and another in South Dakota reaching 120°F, which remain as records for these two states. This superheated air mass spread across the Badger State. Eventually, 14 state records were set during July 1936 from the Plains to the Middle Atlantic.



a minimum temperature of 81°F on the 8th, while Madison had temperatures of 80°F on the 11th and 13th. Undoubtedly, these elevated nighttime temperatures contributed to many deaths. The Midwest July 1936 heat wave was due to an atmospheric circulation regime that created widespread drought conditions. A nearly stationary high pressure ridge was centered over the Plains in early to mid-July 1936. While Wisconsin had experienced drought in 1934, drought conditions deepened as it shifted westward across the Plains during 1936, resulting in the infamous Dust Bowl. The month

Professional Master's Program Update

By Kaitlyn Heinlein, Program Coordinator

One year down, many more to go! Our inaugural cohort finished strong this past August, with all of its students having successfully secured a job within the field. Now, in our second year of the program, we find ourselves growing with a new cohort of 13 students, which is about four times the size of last year's. With a larger class, we had to make some creative adjustments on the 8th floor of AOSS. What used to be the Department Administrator's office is now an office/lounge space for the Professional Master's students – feel free to check it out and visit the students next time you find yourself in the building!

Overall, a majority of this year's cohort are specializing the Meteorological Forecasting and Modeling pathway, while a few tackle the Climate Science, Risk Management, and Communications pathway. In their search for summer

2022 internships, the students have expressed interest within the following areas: operational forecasting (some specifically noting aviation weather), emergency management, science communications, broadcast meteorology, and climate risk analytics. Please reach out to us (profms@aos.wisc.edu) if you are aware of an opportunity, can potentially offer one, or just want to connect.

Otherwise, recruitment for Fall 2022 is underway. Admissions are open, and applications are already rolling in. If you know anyone who may be interested in the program, please encourage them to check out our website (<https://www.aos.wisc.edu/academics/profms/>) and apply. We are proud of what the Professional Master's program has accomplished since its start in 2020 and excited to see what its future holds!

Solstice Party 2022

The best social gathering hosted by the The Student Chapter of the American Meteorological Society at the University of Wisconsin-Madison is scheduled for:

Mid-February 2022

Tickets will go on sale mid-January 2022. Watch our social media platforms and email. We hope you will join us!

CPEX-AW Field Campaign Reflection

By Ben Rodenkirch, Graduate Student

This past August, I had the privilege of participating in NASA's Convective Processes Experiment – Aerosols & Winds (CPEX-AW) field campaign based in St. Croix, USVI. For two weeks, I served three main roles for the campaign. Primarily, I supported science flight planning operations as both a lead and support forecaster. Additionally, I flew aboard NASA's DC-8 aircraft for five science flights, a few of which were through Ida before it matured into a hurricane. On the science flights, I was tasked with taking detailed logs of the convective modules and even got to deploy a few dropsondes! Finally, while I wasn't busy with forecasting duties nor aboard science flights, I assisted with, and eventually led, radiosonde launches multiple times for any given day.

Overall, the CPEX-AW field campaign provided me with countless invaluable experiences, and I am honored to have worked with and befriended so many amazing people along the way. It is truly one of the highlights of my life! The CPEX-AW campaign serves the needs of numerous atmospheric research groups across the world. The data collected during the field campaign will help validate the European Space Agency's Aeolus Doppler wind lidar satellite, the first of its kind. Additionally, the data will assist researchers in better understanding convective influence on tropical boundary layer structure and dry, dusty Sahara Air Layer modulation of tropical convection. More critical to my research are the collocated near-storm

Airborne Precipitation Radar (APR) and Doppler Aerosol WiNd Lidar (DAWN) vertical profiles, which, along with the aforementioned dropsondes, offer rare, detailed glimpses into the near-cloud convective environment. This data, coupled with similar data from the initial 2017 CPEX field campaign, will help myself and my advisor, Dr. Angela Rowe, improve understanding of the underlying dynamical and microphysical properties associated with tropical convection throughout storm lifecycle. Our current work is focused on determining environmental controls on tropical convective type, with future work geared towards tropical convective inflow/outflow quantification and relation to convective properties.

What AOS has done for me:

By Kris Craven, Meteorologist-in-Charge (MIC), National Weather Service Topeka

I have always loved things related to natural science. From being fascinated by bugs, dinosaurs, and icebergs as a kid, to staring for hours at the maps on the walls of my Grandma's house, I was always drawn to things in the natural world. In the process of getting my Environmental Studies Degree from the University of Kansas in the early 90s, I found myself finding any way I could to watch radar data - at which point, I figured if I was going to watch the weather all the time, I might as well

do it for a living. After some booster math and science courses at KU in Geophysics, I came up to UWAOS for work on a Masters Degree. The degree requirements gave me the coursework I would need to work in the National Weather Service as a meteorologist and forecaster, and better yet, the foundations to work on the radar/warning desk! The work that I did both as a teaching assistant and as a research assistant while at UW were also invaluable - the research gave me considerable

insight into how weather modeling and numerical weather prediction work, and teaching continued to hone my organizational and 'people' skills. I have now been in the NWS for over 20 years, starting out as an intern in Key West, moving on to Colorado, and now to Kansas - where I have moved up to the Meteorologist in Charge. Needless to say, coming to the UWAOS program had a huge impact on my life and career.

On Wisconsin!



Photo by Jeff Miller / UW-Madison

2022 AMS UW-AOS Reception

WE'RE BACK!

The 2022 AMS annual reception will take place from 6:30-9:30 PM CST on Tuesday, January 25, 2022 at the Hilton Americas- Houston, TX, room GB E.

Join us to hear what's going on in the department, meet up with old friends and meet new friends. We will bestow our recipient of the UW-AOS Alumni Award for Outstanding Achievement as well.

AMS has updated its statement on health and safety on hosting this year's annual meeting. Please read more at:

<https://bit.ly/3lWNWke> and <https://bit.ly/3vvp4H>

See you there!

Alumni Awards

NOAA Bronze Medal: Jordan Gerth, Walter Wolf and Dave Tomalak

NOAA Distinguished Career Award: Tom Black and Marty Hoerling

NOAA Administrator's Award: Jacob Beitlich and Dave Turner

AMS' Editor's Award winner - Monthly Weather Review: Andrew Winters

AGU's Stephen Schneider Lecture: Alan Robock

Faculty Awards

NOAA Distinguished Career Award: Adjunct Prof Jeff Key

NOAA Administrator's Award: Adjunct Prof Jim Kossin

CSU's Outstanding Alumni Award: Tristan L'Ecuyer

Student Awards

Horn Scholarship: Grant Gilcrease

Sunkel: Nate Falkinham

Lettau-Wahl Scholarship:

Jack Richter

Lettau: Maggie Bruckner

Schwerdtfeger: Ian Beckley and

Ian Cornejo

Wahl: Patrick Beaty

Department Student Service:

Zoë Brooke-Zibton

****Please notify the AOS Department if you or an alum receives an award at: aos@aos.wisc.edu**



Department of Atmospheric
and Oceanic Sciences
UNIVERSITY OF WISCONSIN-MADISON

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