

Journal of the Atmospheric Sciences

The JOURNAL OF THE ATMOSPHERIC SCIENCES (*JAS*) publishes basic research related to the physics, dynamics, and chemistry of the atmosphere of Earth and other planets, with emphasis on the quantitative and deductive aspects of the subject.

Chief Editor

ANNE K. SMITH
National Center for Atmospheric Research

Editors

PETER BARTELLO
McGill University
MARY BARTH
National Center for Atmospheric Research
WILLIAM R. BOOS
University of California, Berkeley
ELIE BOU-ZEID
Princeton University
EDMUND KAR-MAN CHANG
Stony Brook University
JOHANNES DAHL
Texas Tech University

JERRY HARRINGTON
The Pennsylvania State University
ADELE IGEL
University of California, Davis
YOSHIO KAWATANI
Japan Agency for Marine-Earth Science
and Technology
DAVID MECHEM
University of Kansas
LORRAINE REMER
University of Maryland, Baltimore County
CHRISTOPHER ROZOFF
National Center for Atmospheric Research

TIFFANY SHAW
University of Chicago
DANIEL STERN
University Corporation for
Atmospheric Research
SUSAN VAN DEN HEEVER
Colorado State University
ZHUO WANG
University of Illinois at
Urbana-Champaign
FENG XU
University of Oklahoma

Associate Editors

MARTA ABALOS
Universidad Complutense de Madrid, Spain
MARCELO CHAMECKI
University of California, Los Angeles
XIAOMIN CHEN
NOAA/AOML
BRICE COFFER
North Carolina University
YAIR COHEN
Climate Modelling Alliance, California
Institute of Technology
JESSIE CREAMEAN
Colorado State University
JEROME FAST
Pacific Northwest National Laboratory
MATTHEW FLOURNOY
Cooperative Institute for Mesoscale
Meteorological Studies
VIRENDRA P. GHATE
Argonne National Laboratory
MARCO GIOMETTO
Columbia University
PETER HAYNES
University of Cambridge
ERIC HENDRICKS
National Center for Atmospheric Research
CHRISTOPHER HOLLOWAY
University of Reading

ALEXEY YU. KARPECHKO
Finnish Meteorological Institute
CHANH KIEU
Indiana University, Bloomington
GERARD KILROY
Max-Planck-Institut für Meteorologie
CHRISTOPHER G. KRUSE
National Center for Atmospheric
MATTHEW KUMJIAN
The Pennsylvania State University
ZACHARY J. LEBO
University of Wyoming
MANUELA LEHNER
University of Innsbruck
DAN LI
Boston University
YANLUAN LIN
Tsinghua University
DAVID LORENZ
University of Wisconsin-Madison
ROBERT NYSTROM
National Center for Atmospheric Research
PAUL A. O'GORMAN
Massachusetts Institute of Technology
MARIKO OUE
Stony Brook University
JOHN PETERS
Naval Postgraduate School

RIWAL PLOUGONVEN
Laboratoire de Météorologie Dynamique/IPSL,
Ecole Polytechnique, Institut Polytechnique de Paris
JADWIGA (YAGA) RICHTER
National Center for Atmospheric Research
ROSIMAR RIOS-BERRIOS
National Center for Atmospheric Research
ADITI SHESHADRI
Stanford University
ELIZABETH SMITH
NOAA/National Severe Storms Laboratory
KARA SULLA
University at Albany, State University of New York
DANDAN TAO
Colorado State University
JOAO TEIXEIRA
Jet Propulsion Laboratory
MARCUS VAN LIER-WALQUI
Columbia University and NASA GISS
ADAM C. VARBLE
Pacific Northwest National Laboratory
MICHAEL WAITE
University of Waterloo
SHUGUANG WANG
School of Atmospheric Sciences, Nanjing University
LIGUANG WU
Fudan University
YANG ZHANG
Nanjing University
PABLO ZURITA-GOTOR
Universidad Complutense de Madrid
and Instituto de Geociencia

Editorial Staff

AMS Lead Technical Editor for JAS
RICHARD R. BRANDT

AMS Lead Copy Editor for JAS
RAMESH PILLAY

Peer Review Staff
FELICIA GULLOTTA
(Assistant to Dr. Smith)
CRISTINA BARLETTA
TIFFANY BISCHOFF

HAYLEY CHARNEY
ERIN GUMBEL
ANDREA HERBST-HORNER
ROBBIE MATLOCK
CHRISTINE ZIEBARTH

AMS Scientific and Technical Journals Staff

Director of Publications
GWENDOLYN WHITTAKER
*Senior Manager for Publishing
Operations*
MICHAEL A. FRIEDMAN
Peer Review Support Manager
GWENDOLYN WHITTAKER
*Publications Billing and
AMS Office Manager*
CAITLIN GARRISON

Production Manager
SHEILA F. GAFVERT
Production Team Coordinator
LIZ WRIGHT

Production Assistants
DANIELLE M. JOYCE
WALTON REA
ABBY WOODWARD

Managing Technical Editor
MARK E. FERNAU

Senior Technical Editors
HOLLIS E. BAGUSKAS
RICHARD R. BRANDT

Managing Copy Editor
JESSICA A. LAPOINTE

Senior Copy Editors
KRISTIN GILBERT
RAMESH PILLAY
NICOLE E. RIETMANN
ANDREA L. SCHEIN

© Copyright 2022 American Meteorological Society (AMS). For permission to reuse any portion of this work, please contact permissions@ametsoc.org. Any use of material in this work that is determined to be "fair use" under Section 107 of the U.S. Copyright Act (17 U.S. Code § 107) or that satisfies the conditions specified in Section 108 of the U.S. Copyright Act (17 USC § 108) does not require AMS's permission. Reproduction, systematic reproduction, posting in electronic form, such as on a website or in a searchable database, or other uses of this material, except as exempted by the above statement, require written permission or a license from AMS. All AMS journals and monograph publications are registered with the Copyright Clearance Center (<https://www.copyright.com>). Additional details are provided in the AMS Copyright Policy statement, available on the AMS website (<https://www.ametsoc.org/PUBSCopyrightPolicy>).

The JOURNAL OF THE ATMOSPHERIC SCIENCES (ISSN 0022-4928) is published monthly by the American Meteorological Society at 45 Beacon Street, Boston, MA 02108. Subscription rates for this and other AMS titles are available online at <https://www.ametsoc.org/index.cfm/ams/publications/subscription-information>. For information on becoming an AMS member and/or subscribing to the Society's journals, visit the AMS website: <https://www.ametsoc.org/ams/>. Subscription orders, claims for missing numbers, changes of address, and other business correspondence should be sent to amsinfo@ametsoc.org (or to the American Meteorological Society, 45 Beacon Street, Boston, MA 02108-3693). Periodical postage paid at Boston, MA, and at additional mailing offices. POSTMASTER: Send address changes to the *Journal of the Atmospheric Sciences*, American Meteorological Society, 45 Beacon Street, Boston, MA 02108-3693.