Dr. Thomas William Nicholas HAINE

Curriculum Vitae, November 8, 2022

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Employment

- 2012 – 2018 **Morton K. Blaustein Professor and Chair of Earth & Planetary Sciences, Johns Hopkins University, Baltimore, MD.**
- 2006 – **Professor at Earth & Planetary Sciences, Johns Hopkins University, Baltimore, MD.**
- 2002 – 2006. **Associate Professor at Earth & Planetary Sciences, Johns Hopkins University, Baltimore, MD.**
- 2000 – 2002. **Assistant Professor at Earth & Planetary Sciences, Johns Hopkins University, Baltimore, MD.**
- 1996 – 2000. **University Lecturer in Physics at Atmospheric, Oceanic & Planetary Physics, University of Oxford, Oxford, UK. Research Fellow of Wolfson College, Oxford.**
- 1994 – 1996. **Post Doctoral Research Scholar, Earth, Atmospheric & Planetary Sciences, MIT, Cambridge, MA.**
- 1992 – 1994. **Post Doctoral Research Associate, School of Environmental Sciences, University of East Anglia, UK.**
- 1988 – 1989. **Applied Interactive Technology Ltd., Henley, Oxon., UK.**

Academic Education

- 1993. **PhD Department of Oceanography, University of Southampton, UK and Plymouth Marine Laboratory, UK.** Thesis title: "The Use of Transient Tracers to Study Upper Ocean Processes" [3].
- 1988. **Master of Arts, and Bachelor of Arts, St. Catharine's College, University of Cambridge, UK.**

  2.1 Honours degree in Physics and Theoretical Physics.

- 1988 : Part II Natural Sciences Tripos.
  Physics and Theoretical Physics
  Options : Physics of the Earth as a planet, Physics of stars and galaxies
  Project : Physics Education Project [1].
- 1987 : Part IB Natural Sciences Tripos.
  Advanced Mathematics, Advanced Physics
- 1986 : Part IA Natural Sciences Tripos.
  Mathematics, Physics, Chemistry, Crystalline State

Specialized Education

- 1995, 2001, 2002 : Visitor at the Woods Hole Geophysical Fluid Dynamics summer school, WHOI, MA.
- 1998: Attended NATO ASI Winter School on Ocean Modeling and parametrization, Les Houches, France.
- 1997: Attended summer school on Inverse Methods and Data Assimilation, Oregon State University, OR.
- 1992: Attended Geophysical and Environmental Fluid Dynamics summer school, DAMTP, University of Cambridge, UK.
- 1991: Scholarship to Global Environmental Change summer school, Bermuda Biological Station, Bermuda.
- 1990: Scholarship to Ocean Circulation and Geochemical Cycling course, University of Washington, WA.

External Funding

Principal Investigator on 21 grants worth over $8.7M from 9 different research agencies. Co-investigator or senior personnel on 10 other grants worth an additional $14.6M.

- 2022–2025. Co-PI on *Using satellite surface salinity measurements to derive and predict changes in dense water properties in the Labrador Sea*, NASA, $332,391.
- 2022—2025. Co-PI on *Subinertial variability across and around the Greenland-Scotland Ridge and its impacts on the ocean circulation*, NSF, $289,618.
- 2022–2023. Participant in *Physics-informed AI Climate Model Agent Neuro-symbolic Simulator (PACMANS) for Tipping Point Discovery*, DARPA, $???,???
- 2021–2026. Co-PI on *Frameworks: Advanced Cyberinfrastructure for Sustainable Community Usage of Big Data from Numerical Fluid Dynamics Simulations*, NSF, $3,992,109.
- 2021–2022. PI on *Collaborative Research: Global ocean repeat hydrography, carbon, and tracer measurements, 2015–2020*, Sub award to support field work, $12,796.
- 2020–2021. PI on *Towards the Development of Scale-Dependent, Non-Local, Turbulent Closures in Rotating Stratified Flows*, JHU IDIES Seed grant, $25,000.

- 2020–2023. PI on *Advancing Knowledge of the Arctic/Sub-Arctic Freshwater Cycle and its Impacts on North Atlantic Ocean Circulation*, NASA, $631,603.
- 2018–2022. PI on *Collaborative Research: Framework: Data: Toward Exascale Community Ocean Circulation Modeling*, NSF, $1,850,538 to JHU, $2.8M in total including MIT and Columbia.
- 2018–2021. Co-PI on *The Dynamics behind Subinertial Variability along the Southeast Greenland Coast*, NSF, $401,000.
- 2017–2020. Partner on *PATHWAY: Pathways, processes, and impacts of poleward ocean heat transport*, Norwegian Research Council.
- 2016–2020. Senior Personnel on *Democratizing Massive Fluid Flow Simulations via Open Numerical Laboratories and Applications to Turbulent Flow and Geophysical Modeling*, NSF-IIS, $952,000.
- 2016–2019. Co-PI on *Transient tracer fingerprints of Atlantic Meridional Overturning Circulation in Observations and Models*, NOAA-CVP, $569,701.
- 2016–2017. PI on *Towards the Johns Hopkins Ocean Circulation DataBase: Method Development and Prototype*, JHU IDIES Seed grant, $25,000.
- 2015–2018. PI on *Sea-surface dynamics diagnosed from satellite data and coupled models*, NSF, $434,000.
- 2015–2018. PI on *Oceanographic controls on Arctic sea ice and its future evolution*, NOAA-CVP, $595,000.
- 2014–2017. PI on *Collaborative Research: Mechanisms of Freshwater Exchange Across the East Greenland Shelf*, NSF, $372,000.
- 2013–2018. PI on *Frontiers in Earth System Dynamics: The impact of the ozone hole on the climate of the Southern Hemisphere*, NSF, $4,800,000.
- 2013–2015. PI on *Creating a Doctoral Concentration/Certificate in Sustainability & Health at the Johns Hopkins University*, Johns Hopkins University PhD Innovation Initiative, $75,000.
- 2012–2015. PI on *Collaborative Research: Submarine Melting of Greenlands Glaciers: What are the relevant ocean dynamics?*, NSF, $293,160.
- 2011–2012. PI on *International Workshop/School on Tracer and Timescale Methods for Understanding Complex Geophysical and Environmental Processes*, NSF, $35,148.
- 2009–2014. PI on *Collaborative Research: Petascale Arctic, Atlantic and Antarctic Virtual Experiment*, NSF, $736,041.
- 2009–2014. PI on *IGERT: Modeling Complex Systems - The Scientific Basis of Coupling Multi-Physics Models at Different Scales*, NSF, $3,000,000.
- 2007–2011. PI on *Collaborative Research: Shelf-Basin Exchange South of Denmark Strait: Forcing, Dynamics, and Large-Scale Impact*, NSF, $386,842.
- 2007–2010. PI on *On the Distribution of Colored Dissolved Organic Carbon in the Southern Ocean and the Potential for Photoproduction of CO2 and CO*, NASA, $200,000.

- 2006–2009. PI on *Exploiting laboratory experiments in the teaching of Meteorology, Oceanography and Climate: Phase II*, NSF, $30,000, collaboration with MIT.
- 2006–2009. PI on *Space-Based Estimates of Arctic/Sub-Arctic Exchange using Data Assimilation and Ocean Models*, NASA, $600,402.
- 2005–2008. PI on *Quantifying Uncertainty in Ocean State Estimation*, NSF (CMG), $620,000.
- 2005. Award from Program in Atmospheres and Oceans, Princeton University for summer Collaboration at GFDL, $23,146.
- 2004. Award from Program in Atmospheres and Oceans, Princeton University for summer Collaboration at GFDL, $20,536.
- 2004–2007. co-PI on *Anthropogenic Carbon in the Oceans Estimated Using Transit Time Distributions*, NOAA, $396,499.
- 2003–2006. PI on *Collaborative Research: Transport Timescales, Pathways, and Carbon Uptake in the North Atlantic Ocean*, NSF, $542,283
- 2003. Travel grant from EPS.
- 2002–2004. Recognized Researcher on "Arctic and Sub-arctic outflows timeseries of transient tracers (ASOF-TESTT)", NERC (UK), £200,000.
- 2002–2005. PI on *Mechanisms of Climate Variability in the North Atlantic Ocean*, NSF, $315,000.
- 2001–2002. William R. Kenan, Jr. Fund for improvements to undergraduate computer classroom, $1,700.
- 2000–2003. PI on *Diagnosing ocean transport timescales and water-mass composition from tracers*, NSF (OCE–9911318), $288,000.
- 2000–2003. Co-I. on *Maintenance and predictability in the North Atlantic/European sector*, NERC COAPEC Special Topic (GST/02/2865), (£160,000).
- 1998–2000. PI on *Dynamic and thermodynamic mechanisms of upper ocean variability in the extra-tropics*, NERC (GR3/11177), £78,378.
- 1998–2000. Co-I. on Climate Variability and Predictability on Seasonal to Decadal Timescales, British Council Anglo-German Research Collaboration.
- 1996–1998. PI on *Oceanic Ventilation determined by tracers and models*, NERC WOCE Special Topic (GST/02/1685), £63,892.

Honours and Awards

- Elected member of Homewood Academic Council (2022–2026).
- Bjerknes Fellow at the University of Bergen (2022).
- University of Southampton Hartley Circle (2021).
- Boy Scouts of America Order of the Arrow Brotherhood member (2019).

- American Geophysical Union 25 year member Pin (2019).
- Royal Meteorological Society Silver Pin (2017).
- Dean's award for Excellence in Research and Teaching (2014).
- Morton K. Blaustein Chair and Professor of Earth & Planetary Sciences (2012–2018).
- NASA Group Achievement Award for outstanding accomplishments and interagency collaboration, Southern Ocean GasEx Project (2009).
- Visiting Scientist at NOAA GFDL (2004–2008).
- Guest Investigator at Woods Hole Oceanographic Institution (2003).
- Invited participant at National Academy of Sciences, Kavli US Frontiers of Science Symposium (2003).
- Invited Visiting Professor at Catholique Université de Louvain-la-Neuve, Belgium (2002).
- Elected to Sigma Xi (1994).
- Fellow of the Royal Meteorological Society (1992).

Field Experience

- 1988. Research scuba diver, Great Barrier Reef, Australia.
- 1988. RV *James Kirby*, Great Barrier Reef, Australia.
- 1988. RV *Sunbird*, Great Barrier Reef, Australia.
- 1989. Research scuba diver, Bonaire, Dutch Antilles.
- 1989. R.R.S. *Charles Darwin*, North East Atlantic.
- 1990. RV *Aranda*, Denmark Strait.
- 1991. RV *Charles Darwin*, North East Atlantic. Two VIVALDI cruises.
- 1993. R.R.S. *Discovery*, Southern Ocean ADOX cruise.
- 1994. R.R.S. *Discovery*, Southern Ocean, Indian Ocean, ADOX cruise.
- 2003. RV *Oceanus*, South East Greenland.
- 2004. R.R.S. *James Clark Ross*, South East Greenland.
- 2006– Ultramarathon runner.
- 2007. FAAM detachment to Keflavik, Iceland for GFDex.

Teaching Experience

- Undergraduate courses in: The Ocean, The Fluid Earth, Oceans & Atmospheres, Introductory Physical Oceanography, Introductory Dynamical Oceanography, Geophysical Fluid Dynamics, Combining Measurements & Models, and Geoscience Modeling.
- Graduate courses in: Geophysical Fluid Dynamics, Ocean General Circulation, Numerical Methods in Oceans and Atmospheres, and Inverse Modeling & Data Assimilation.
- Graduate seminar classes in: Physics of Climate Variability, Thermocline Theory, Ocean/Atmosphere Interaction, and Instabilities in Oceans and Atmospheres.
- Academic advisor, pastoral advisor, and examiner of more than 30 doctoral students.
- Tutor in Physics of Atmospheres and Oceans and Mathematics.
- Finals Examiner in Physics of Atmospheres and Oceans.
- Senior Demonstrator in practical classes to physics undergraduates.
- British Sub-Aqua Club Advanced Diver, Advanced Instructor.

Synergistic Activities and Service

- Guest editor for Special Issue of *Oceanography* magazine on The New Arctic Ocean (2020–2022).
- Member of Program Advisory Board for UK NERC project "Transient tracer-based Investigation of Circulation and Thermal Ocean Change (TICTOC)."
- Program Chair for Energy, Policy, and Climate; Environmental Sciences and Policy; and Geographical Information Systems (Master of Science programs of the Johns Hopkins Advanced Academic Programs; 2015–).
- Johns Hopkins Members' Representative to the University Corporation for Atmospheric Research (2011–).
- Deputy Director of Johns Hopkins Center for Environmental & Applied Fluid Mechanics.
- Chairperson of Arctic-Subarctic Ocean Flux (ASOF) program (2008–2015) and International Scientific Steering Group member since 2000. Coordinator for ASOF program in Subpolar Gyre.
- American Meteorological Society Atmospheric & Oceanic Fluid Dynamics Committee Member (2007–2013). Organiser of 17th and 18th Atmospheric & Oceanic Fluid Dynamics Meetings (2009, 2011).
- US CLIVAR Atlantic Meridional Overturning Circulation Planning Team Member (2007).
- Scientific Steering Committee member of North Atlantic Subpolar Gyre Workshop (2007).
- Steering group member for US Department of Energy strategic planning in climate modeling (2010). Contributing author to Climate Research Roadmap Workshop: Summary Report, DOE/SC-0133, U.S. Department of Energy Office of Science, 2010.

- Contributing author to report to the Arctic Ocean Sciences Board: iAOOS: An ocean-observing system for Northern Seas during the legacy phase of the International Polar Year, 2011.
- Core Lecturer on The Oceanic Inverse Problem at Oxford/RAL Spring School in Quantitative Earth Observation, Oxford (UK; 1999, 2000, 2001, 2004).
- Lecturer at Transport and Mixing in Complex and Turbulent Flows, Institute for Mathematics and its Applications, University of Minnesota (2010).
- Convener of sessions at AGU Meetings (2001, 2008, 2012, 2018), EGU General Assembly (2001, 2002, 2005, 2015), International Polar Year Science Conference (2010), Workshop on Arctic-Subarctic Interactions, Ecosystems Studies of Sub-Arctic Seas Open Science Meeting (2011), International Association for the Physical Sciences of the Oceans (2017, 2019).
- Organiser of and Lecturer at Tracer and Timescale Methods for Understanding Complex Geophysical and Environmental Processes workshop, 2011.
- Organiser of WOCE Tracer Meeting 2002.
- NOAA, DoE, NSF OCE, NSF OPP, and NSF OCI panelist.
- Associate editor of *The Quarterly Journal of the Royal Meteorological Society* (2006–2012).
- Guest editor for special issue of *Environmental Fluid Mechanics* (2009-2010).
- Reviewer for: *Nature, Science, Scientific Reports, Science Advances, J. Phys. Oceanogr., J. Fluid Mech., J. Atm. Oc. Tech., J. Climate, J. Geophys. Res. Oceans, J. Geophys. Res. Atmospheres, Geophys. Res. Lett., Rev. Geophys., Deep-Sea Res., Theoret. Appl. Climatol., Tellus, Geophys. Astrophys. Fl. Dyn., J. Mar. Sys., Dyn. Atmos. Ocean., Annales Geophysicae, Mar. Chem., Environ. Fl. Mech., Proc. Roy. Soc., Phil. Trans. A., Q. J. Royal Met. Soc., Ocean Modelling, Mar. Env. Res.*, Cambridge University Press, Princeton University Press, John Wiley, AGU, NSF, NOAA, NASA, NSERC, CRDF, RCN, EU, and NERC.
- Outreach activities to kindergarten and elementary school classes, high school teachers, Boy Scouts, and academic historians on the medieval Atlantic.

Advisors & Advisees

Doctoral thesis advisors: Prof. Steve Thorpe (FRS), Prof. Kelvin Richards, Prof. Andy Watson (FRS).

Postdoctoral advisors: Dr. Bob Dickson (CBE, FRSE), Prof. John Marshall (FRS).

Undergraduate students Mike Squibb, George Reynolds, Brennan Greene, Erica Barth, Anthony Denny, Deepak Cherian (IIT, Karagpur), Louis Dumas, Robert Nedbor-Gross, Richard Kelson, Emily Marshall, Megan Sullivan.

Master's students: Fiona Eccles, Paul Williams, Kumar Jeev, George Ehrhardt, Oliver Hall, James Brooks, James Chesher, Matthew Cunliffe, Han Dong, John Hunter-Brown, Hadi Moussavi, Jonathan Shin, Helen Tyler, Sarah Thorns, Chris Paternostro, Mei-Lin Chen.

Doctoral students: Daniel Lea, Fiona Eccles, Paul Williams, Hong Zhang, Bin Zhao, Dawn Ring, Stephen Jeffress, Alex Fuller, Ben Warfield, Mattia Almansi, Atousa Saberi, Ali Siddiqui, Wenrui Jiang, Joan Bonilla Pagan, external committee member of David Sutherland and Wilken-Jon Van Appen (MIT/WHOI Joint Program).

Postdocs/Assistant Research Scientists: Sue Gray, Martina Junge, Daniel Lea, Erik Kvaleberg, Hong Zhang, Maëlle Nodet, Santha Akella, Suneet Dwivedi, Marcello Magaldi, Matthew Hoffman, Inga Koszalka, Kial Stewart, Renske Gelderloos, Aleksi Nummelin, Miguel Jimenez Urias.

Professional Affiliations

Fellow of:

- The Royal Meteorological Society,

Member of:

- The American Geophysical Union (life member),
- The European Geophysical Union,
- The American Meteorological Society,
- The American Association for the Advancement of Science,
- Sigma Xi,
- New York Academy of Sciences,
- The Oceanography Society,
- The National Association of Geoscience Teachers,
- Natural History Society of Maryland.

Reviewed Publications (Link to citation data)

[1] Haine, T. W. N. An experiment to investigate mechanical resonance. *Physics Education*, **25**, 221–223, 1990. URL http://dx.doi.org/10.1088/0031-9120/25/4/408.

[2] Cunningham, S. A. and T. W. N. Haine. On Labrador Sea Water in the Eastern North Atlantic. Part I: A synoptic circulation inferred from a minimum in potential vorticity. *J. Phys. Oceanogr.*, **25**(4), 649–665, 1995. URL http://dx.doi.org/10.1175/1520-0485(1995)025<0649:lswite>2.0.co;2.

[3] Cunningham, S. A. and T. W. N. Haine. On Labrador Sea Water in the Eastern North Atlantic. Part II: Mixing dynamics and the advective-diffusive balance. *J. Phys. Oceanogr.*, **25**, 666–678, 1995. URL http://dx.doi.org/10.1175/1520-0485(1995)025<0666:lswite>2.0.co;2.

[4] Haine, T. W. N. and K. J. Richards. The influence of the seasonal mixed layer on oceanic uptake of CFCs. *J. Geophys. Res.*, **100**, 10727–10744, 1995. URL http://dx.doi.org/10.1029/95jc00629.

[5] Haine, T. W. N., A. J. Watson, and M. I. Liddicoat. Chlorofluorocarbon-113 in the northeast Atlantic. *J. Geophys. Res.*, **100**, 10745–10753, 1995. URL http://dx.doi.org/10.1029/95jc00630.

[6] Visbeck, M., J. Marshall, T. Haine, and M. Spall. Specification of eddy transfer coefficients in coarse-resolution ocean circulation models. *J. Phys. Oceanogr.*, **27**, 381–402, 1997. URL http://dx.doi.org/10.1175/1520-0485(1997)027<0381:soetci>2.0.co;2.

[7] Haine, T. W. N. and J. C. Marshall. Gravitational, symmetric and baroclinic instability of the ocean mixed layer. *J. Phys. Oceanogr.*, **28**, 634–658, 1998. URL http://dx.doi.org/10.1175/1520-0485(1998)028<0634:gsabio>2.0.co;2.

[8] Haine, T. W. N., A. J. Watson, M. I. Liddicoat, and R. R. Dickson. The flow of Antarctic bottom water in the southwest Indian ocean estimated using CFCs. *J. Geophys. Res.*, **103**, 27637–27653, 1998. URL http://dx.doi.org/10.1029/98jc02476.

[9] Lea, D. J., M. R. Allen, and T. W. N. Haine. Sensitivity analysis of the climate of a chaotic system. *Tellus, Ser. A*, **52A**, 523–532, 2000. URL http://dx.doi.org/10.1034/j.1600-0870.2000.01137.x.

[10] Gray, S. L. and T. W. N. Haine. Constraining a North Atlantic ocean general circulation model with chlorofluorocarbon observations. *J. Phys. Oceanogr.*, **31**, 1157–1181, 2001. URL http://dx.doi.org/10.1175/1520-0485(2001)031<1157:canaog>2.0.co;2.

[11] Haine, T. W. N. and S. L. Gray. Quantifying mesoscale variability in ocean transient tracer fields. *J. Geophys. Res.*, **106**, 13861–13878, 2001. URL http://dx.doi.org/10.1029/1999jc000036.

[12] Junge, M. M. and T. W. N. Haine. Mechanisms of North Atlantic wintertime sea surface temperature anomalies. *J. Climate*, **14**(24), 4560–4572, 2001. URL http://dx.doi.org/10.1175/1520-0442(2001)014<4560:monaws>2.0.co;2.

[13] Meredith, M. P., A. J. Watson, K. A. Van Scoy, and T. W. N. Haine. Chlorofluorocarbon-derived formation rates of the deep and bottom waters of the Weddell Sea. *J. Geophys. Res.*, **106**, 2899–2919, 2001. URL http://dx.doi.org/10.1029/2000jc900119.

[14] Thuburn, J. and T. W. N. Haine. Adjoints of nonoscillatory advection schemes. *J. Comput. Phys.*, **171**(2), 616–631, 2001. URL http://dx.doi.org/10.1006/jcph.2001.6799.

[15] Haine, T. W. N. and T. M. Hall. A generalized transport theory: Water-mass composition and age. *J. Phys. Oceanogr.*, **32**(6), 1932–1946, 2002. URL http://dx.doi.org/10.1175/1520-0485(2002)032<1932:agttwm>2.0.co;2.

[16] Haine, T. W. N. and P. D. Williams. The role of nonhydrostatic dynamics in controlling development of a surface ocean front. *Ocean Modelling*, **4**, 121–135, 2002. URL http://dx.doi.org/10.1016/s1463-5003(01)00014-2.

[17] Hall, T. M. and T. W. N. Haine. On ocean transport diagnostics: The idealized age tracer and the age spectrum. *J. Phys. Oceanogr.*, **32**, 1987–1991, 2002. URL http://dx.doi.org/10.1175/1520-0485(2002)032<1987:ootdti>2.0.co;2.

[18] Hall, T. M., T. W. N. Haine, and D. W. Waugh. Inferring the concentration of anthropogenic carbon in the ocean from tracers. *Glob. Biogeochm. Cycles*, **16**(4), 78–1–78–15, 2002. URL http://dx.doi.org/10.1029/2001GB001835.

[19] Lea, D. J., T. W. N. Haine, M. R. Allen, and J. Hansen. Sensitivity analysis of the climate of a chaotic ocean circulation model. *Q. J. R. Meteorol. Soc.*, **128**, 2587–2606, 2002. URL http://dx.doi.org/10.1256/qj.01.180.

[20] Waugh, D. W., M. K. Vollmer, R. F. Weiss, T. W. N. Haine, and T. M. Hall. Transit time distributions in Lake Issyk-Kul. *Geophys. Res. Lett.*, **29**, 2002. URL http://dx.doi.org/10.1029/2002GL016201.

[21] Haine, T. W. N., K. J. Richards, and Y. Jia. Chlorofluorocarbon constraints on North Atlantic ventilation. *J. Phys. Oceanogr.*, **33**, 1798–1814, 2003. URL http://dx.doi.org/10.1175/1520-0485(2003)033<1798:cconav>2.0.co;2.

[22] Waugh, D. W., T. M. Hall, and T. W. N. Haine. Relationship among tracer ages. *J. Geophys. Res.*, **108**, 2003. URL http://dx.doi.org/10.1029/2002JC001325.

[23] Williams, P. D., P. L. Read, and T. W. N. Haine. Spontaneous generation and impact of inertia-gravity waves in a stratified, two-layer shear flow. *Geophys. Res. Lett.*, **30**, 2003. URL http://dx.doi.org/10.1029/2003GL018498.

[24] Eyink, G. L., T. W. N. Haine, and D. J. Lea. Ruelle's linear response formula, ensemble adjoint schemes, and Lévy flights. *Nonlinearity*, **17**(5), 1867–1889, 2004. URL http://dx.doi.org/10.1088/0951-7715/17/5/016.

[25] Hall, T. M. and T. W. N. Haine. Tracer age symmetry in advective-diffusive flows. *J. Mar. Sys.*, **48**, 51–59, 2004. URL http://dx.doi.org/10.1016/j.jmarsys.2003.01.001.

[26] Hall, T. M., D. W. Waugh, T. W. N. Haine, P. E. Robbins, and S. Khatiwala. Estimates of anthropogenic carbon in the Indian Ocean with allowance for mixing and time-varying air-sea CO_2 disequilibrium. *Glob. Biogeochm. Cycles*, **18**(1), n/a–n/a, 2004. URL http://dx.doi.org/10.1029/2003GB002120.

[27] Waugh, D. W., T. W. N. Haine, and T. M. Hall. Transport times and anthropogenic carbon in the subpolar North Atlantic Ocean. *Deep Sea Res., Part I*, **51**, 1475–1491, 2004. URL http://dx.doi.org/10.1016/s0967-0637(04)00145-1.

[28] Williams, P. D., T. W. N. Haine, and P. L. Read. Stochastic resonance in a nonlinear model of a rotating, stratified shear flow, with a simple stochastic inertia-gravity wave parameterization. *Nonlinear Proc. Geophys.*, **11**, 127–135, 2004. URL http://dx.doi.org/10.5194/npg-11-127-2004.

[29] Williams, P. D., P. L. Read, and T. W. N. Haine. A calibrated, non-invasive method for measuring the internal interface height field at high resolution in the rotating, two-layer annulus. *Geophys. Astrophys. Fluid Dyn.*, **98(6)**, 453–471, 2004. URL http://dx.doi.org/10.1080/03091920412331296366.

[30] Williams, P. D., T. W. N. Haine, and P. L. Read. On the generation mechanisms of short-scale, unbalanced modes in rotating, two-layer flows with vertical shear. *J. Fluid Mech.*, **528**, 1–22, 2005. URL http://dx.doi.org/10.1017/s0022112004002873.

[31] Zhang, H., T. W. N. Haine, and D. W. Waugh. Relationships between tracer age and dynamical fields in double gyre circulation. *J. Phys. Oceanogr.*, **35**, 2250–2267, 2005. URL http://dx.doi.org/10.1175/JPO2812.1.

[32] Zhao, B. and T. W. N. Haine. On processes controlling seasonal North Atlantic sea surface temperature anomalies in ocean models. *Ocean Modelling*, **9**(3), 211–229, 2005. URL http://dx.doi.org/10.1016/j.ocemod.2004.05.001.

[33] Eccles, F. J. R., P. L. Read, and T. W. N. Haine. Synchronization and chaos control in a periodically forced quasi-geostrophic two-layer model. *Nonlinear Proc. Geophys.*, **13**, 23–39, 2006. URL http://dx.doi.org/10.5194/npg-13-23-2006.

[34] Haine, T. W. N. On tracer boundary conditions for geophysical reservoirs: How to find the boundary concentration from a mixed condition. *J. Geophys. Res.*, **111**, C05003, 2006. URL http://dx.doi.org/10.1029/2005JC003215.

[35] Lea, D. J., T. W. N. Haine, and R. F. Gasparovic. Observability of the Irminger Sea circulation using variational data assimilation. *Q. J. R. Meteorol. Soc.*, **132**(618), 1545–1576, 2006. URL http://dx.doi.org/10.1256/qj.05.77.

[36] Hall, T. M., T. W. N. Haine, D. W. Waugh, M. Holzer, F. Terenzi, and D. A. LeBel. Ventilation rates estimated from tracers in the presence of mixing. *J. Phys. Oceanogr.*, **37**(11), 2599–2611, 2007. URL http://dx.doi.org/10.1175/2006JPO3471.1.

[37] Haine, T., C. Böning, P. Brandt, J. Fischer, A. Funk, D. Kieke, E. Kvaleberg, M. Rhein, and M. Visbeck. North Atlantic Deep Water formation in the Labrador Sea, recirculation through the subpolar gyre, and discharge to the subtropics. In *Arctic-Subarctic Ocean Fluxes: Defining the role of the Northern Seas in Climate*, edited by R. R. Dickson, J. Meincke, and P. Rhines, pages 653–701. Springer-Verlag, 2008. ISBN 978-1-4020-6774-7. URL http://dx.doi.org/10.1007/978-1-4020-6774-7_28.

[38] Haine, T. W. N. What did the Viking discoverers of America know of the North Atlantic environment? *Weather*, **63**, 60–65, 2008. URL http://dx.doi.org/10.1002/wea.150.

[39] Haine, T. W. N. Correction to: What did the Viking discoverers of America know of the North Atlantic environment? (vol 63, pg 60, 2008). *Weather*, **63**, 112, 2008. URL http://dx.doi.org/10.1002/wea.254.

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