

MATTHEW R. ARCHER

Physical Oceanographer

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Email: archer@jpl.nasa.gov

Phone: (+1) 818 354-2315

Web: <http://matthewarcher.github.io>

Jet Propulsion Laboratory,
4800 Oak Grove Dr, M/S 300-329
Pasadena, CA 91109-8099

Research interests: submesoscale and mesoscale ocean variability; satellite altimetry; novel ocean observing technology; data visualization; data assimilation.

EDUCATION

2010 – 2016 **Ph.D. in Meteorology and Physical Oceanography**

University of Miami, Rosenstiel School of Marine & Atmospheric Sciences, USA

Advisor: Lynn K. Shay

2006 - 2009 **B.Sc. in Ocean Science** (1st Class Honors)

University of Plymouth, UK

Advisor: Daniel Conley

RESEARCH EXPERIENCE

2020 – **Research Technologist**, Ocean Altimetry missions
present Jet Propulsion Laboratory, Pasadena, CA, USA

Working on the Surface Water and Ocean Topography (SWOT) satellite mission, to solve mission-related scientific problems via data analysis, ocean modeling, data assimilation, and visualization

2018 – **Postdoctoral Research Scientist**
2020 *Jet Propulsion Laboratory, Pasadena, CA, USA*
Supervisor: Lee-Lueng Fu

I worked within a specialized team focusing on Cal/Val activities for the SWOT mission. My contributions include:

- Validation of a multi-scale data assimilation system (MSDA) using multi-platform observations (altimeters, radiometers, moorings, glider, HF radar)
- Analysis of observing system simulation experiments for the post-launch Cal/Val based on the MSDA
- Mapping along-track altimetry measurements in the California Current system to produce the highest-possible resolution sea surface height maps for the Cal/Val site

2016 – **Postdoctoral Research Fellow**
2018 *School of Mathematics and Statistics, University of New South Wales, Australia*
Supervisors: Moninya Roughan and Shane Keating

- Research: East Australian Current structure and variability and its influence on shelf circulation, based on observations from moorings, HF radar, drifters, and satellite imagery

- **Project Management:** managed deployment of two new radar sites, from site permits, to installation, and data processing. Inter-organizational planning: use of Slack and conference calling to plan activities between 4 institutions over multiple time zones
- **Fieldwork:** Led the physical oceanography 'Blue Team', tracking eddies onboard the R/V Investigator during 19d cruise "The Whole Enchilada: From predation to production in Tasman Sea's ecosystems". Obtained 26 drifters from NOAA and Pacific Gyre and deployed in a targeted study to investigate cross-shelf transport driven by an eddy dipole

2010 –
2016

Graduate Research Assistant

Upper Ocean Dynamics Laboratory, RSMAS, University of Miami, USA

Supervisor: Lynn K. Shay

- **Thesis:** On the submesoscale and mesoscale variability of the Florida Current, based on observational analysis of HF radar, satellite imagery, ADCP, and CTD data
- **Fieldwork:** regular radar maintenance at three operational sites in South Florida
- **Modeling:** ran a 2-layer quasi-geostrophic model to study effects of varying the bottom slope on baroclinic instability (class project)

Apr - Aug
2014

Project Manager | Chief Scientist

WHARF Experiment (Wave Heights And Currents in the Florida Straits)

Principle Investigator: Lynn K. Shay

- Experiment planned around the Student Equipment Grant I was awarded by NortekUSA: the deployment of a subsurface mooring in the Straits of Florida to measure in-situ wave height and current velocity profiles. Played a key role in the experimental design and writing the proposal manuscript submitted to SECOORA end of 2013. Collaborated with mooring specialists to design a mooring for the 4-month deployment. Leadership role as Chief Scientist aboard two research cruises onboard the R/V Walton Smith in the Straits of Florida

Apr
2012

Consultant (Subcontract to UM)

US Pacific Command: Ship Tracking East of the Philippines Archipelago

Program Manager: Andy Wood | Principle Investigator: Pierre Flament

- Worked in a small consulting team to develop a real-time long-range ship tracking system in the South China Sea. Successfully identified dozens of ships, verified by our collaborator Lockheed Martin's aerial unmanned vehicles. Fieldwork: deployed 16 MHz HF radar system in remote Zambales region of Philippines

Jul - Sep
2009

Research Intern

Department of Oceanography, University of Hawaii at Manoa, USA

Supervisor: Pierre Flament

- Processed and analyzed HF radar current and wind data to quantify seasonal patterns in oceanic and atmospheric conditions off the coast of Panay, Philippines. Research cruise: 5 days aboard R/V Kilo Moana (*Hawai'i Ocean Time-series*)

Jun - Aug
2008

Research Intern

Skidaway Institute of Oceanography, USA

Supervisor: Dana Savidge

- Applied HF radar to map wind direction over the South Atlantic Bight
- Research cruise: 4 days aboard R/V Savannah

REFEREED PUBLICATIONS

Tchonang, B. C., **Archer**, M. R., Gopalakrishnan, G., Cornuelle, B., Mazloff, M., Wang, J., Fu, L.-L. (accepted), Evaluation of a 4DVAR assimilation system in the California Current at the SWOT Calibration/Validation site. In: *Journal of Atmospheric and Oceanic Technology*.

Suthers, I. M., Schaeffer, A., **Archer**, M. R., Roughan, M., Griffin, D.A., Chapman, C.C., Sloyan, B.M. and Everett, J.D. (2023), Frontal eddies provide an oceanographic triad for favorable larval fish habitat. In: *Limnol Oceanogr*. <https://doi.org/10.1002/lno.12326>

Wang, J., Fu, L., Haines, B., Lankhorst, M., ..., **Archer**, M. R. et al. (2022). On the development of SWOT in-situ Calibration/Validation for short-wavelength ocean topography, *Journal of Atmospheric and Oceanic Technology*. <https://doi.org/10.1175/JTECH-D-21-0039.1>

Archer, M. R., Li, Z., Wang, J., & Fu, L.-L. (2022). Reconstructing fine-scale ocean variability via data assimilation of the SWOT pre-launch in situ observing system. *Journal of Geophysical Research: Oceans*, 127, e2021JC017362. <https://doi.org/10.1029/2021JC017362>

Archer, M. R., Li, Z., & Fu, L.-L. (2020). Increasing the space-time resolution of mapped sea surface height from altimetry. In: *Journal of Geophysical Research: Oceans*, 125, <https://doi.org/10.1029/2019JC015878> [Data: <https://doi.org/10.5281/zenodo.3858442>]

Archer, M. R., A. Schaeffer, S. R. Keating, M. Roughan, R. Holmes, & L. Siegelman (2020). Observations of submesoscale instability and frontal subduction within the mesoscale eddy field of the Tasman Sea. In: *Journal of Physical Oceanography*. <https://doi.org/10.1175/JPO-D-19-0131.1>

Malan, N., M. R. **Archer**, M. Roughan, P. Cetina-Heredia, M. Hemming, C. Rocha, A. Schaeffer, I. Suthers, E. Quiroz (2020). Eddy-Driven Cross-Shelf Transport in the East Australian Current Separation Zone. In: *Journal of Geophysical Research: Oceans*, 125, <https://doi.org/10.1029/2019JC015613>.

Schaeffer, A., M. R. **Archer**, Q. Baumard, M. Roughan, & C. Kerry (2020). An assessment of the East Australian Current as a renewable energy resource. In: *Journal of Marine Systems*, 204, <https://doi.org/10.1016/j.jmarsys.2019.103285>.

Oke, P. R., M. Roughan, P. Cetina-Heredia, G. S. Pilo, K. R. Ridgway, T. Rykova, M. R. **Archer**, R. C. Coleman, C. G. Kerry, C. Rocha, A. Schaeffer, E. Vitarelli (2019). Revisiting the circulation of the East Australian Current: its path, separation and eddy field. In: *Progress in Oceanography*, 176, <https://doi.org/10.1016/j.pocean.2019.102139>.

Todd, R. E., F. Chavez, S. Clayton, S. Cravatte, M. Goes, M. Graco, X. Lin, J. Sprintall, N. Zilberman, M. R. **Archer**, et al. (2019). Global Perspectives on Observing Ocean Boundary Current Systems. In: *Frontiers in Marine Science*. [doi: 10.3389/fmars.2019.00423](https://doi.org/10.3389/fmars.2019.00423).

Archer, M. R., S. R. Keating, M. Roughan, W. E. Johns, R. Lumkpin, F. Beron-Vera, & L. K. Shay (2018). The kinematic similarity of two western boundary currents revealed by sustained high-resolution observations. In: *Geophysical Research Letters*, 45 <https://doi.org/10.1029/2018GL078429>. [This work is featured in EOS *Editors Highlights*.]

Archer, M. R., Roughan, M., Keating, S. R., & Schaeffer, A. (2017). On the variability of the East Australian Current: Jet structure, meandering, and influence on shelf circulation. In: *Journal of Geophysical Research: Oceans*, 122, 8464–8481. <https://doi.org/10.1002/2017JC013097>.

Archer, M. R., Shay, L. K., & Johns, W. E. (2017). The surface velocity structure of the Florida Current in a jet coordinate frame. *Journal of Geophysical Research: Oceans*, 122, 9189–208, <https://doi.org/10.1002/2017JC013286>.

Archer, M. R., L. K. Shay, B. Jaimes, & J. Martinez-Pedraja, (2015). Observing frontal instabilities of the Florida Current using high frequency radar, In: *Coastal Ocean Observing Systems*, Liu, Y., H. Kerkering, R. H. Weisberg, eds. Elsevier. <https://doi.org/10.1016/B978-0-12-802022-7.00011-0>.

OTHER PUBLICATIONS + GRANTS

Archer, M. R., Tchonang, B. C., Wang, J., Fu, L-L., Gopalakrishnan, G., Cornuelle, B., Mazloff, M. (2022). ECCO-SWOT (v1): A regional implementation of the MITgcm-ECCO 4DVAR system in the California Current system for the SWOT satellite mission. In: *Jet Propulsion Laboratory Technical Document (Dec 2022)*.

Archer, M. R. (2016). The Florida Current: Mean Jet Structure, Meandering, and Velocity Fluctuations Observed with HF Radar. *Open Access Dissertations*: https://scholarlyrepository.miami.edu/oa_dissertations/1648

Archer, M. R., Shay, L. K., & Martinez-Pedraja, J. (2015). Evaluation of WERA HF Radar Observations: Currents, Winds and Waves. In: *Current, Waves and Turbulence Measurements (CWTM)*, 2015 IEEE/OES 11th (pp. 1-9). <https://doi.org/10.1109/CWTM.2015.7098148>

Shay, L. K., **M. R. Archer**, B. K. Haus & F. Zifteh (2013). Regional Coastal Ocean Observing System: Evaluating Significant Wave Heights from High Frequency Radars. Proposal to SECOORA for \$60,000 [awarded]

Savidge, D., J. Amft, A. Gargett, **M. R. Archer**, D. Conley, G. Volgaris, L. Wyatt & K.-W. Gurgel (2011). Assessment of WERA Long-Range HF-radar Performance from the User's Perspective. *CWTM IEEE/OES 10th* (pp 31-38). <https://doi.org/10.1109/CWTM.2011.5759520>

Archer, M. R. (2008). WERA HF radar measurements of wind direction in the South Atlantic Bight, B.Sc Ocean Science Dissertation, Uni. Plymouth, 40 pages: <https://pdfs.semanticscholar.org/05fa/46f232e385864006ee5dded44d0b911800ea.pdf>

TEACHING + MENTORING

- 2022–
present **Mentor** to Babette Tchonang (Postdoctoral Research Fellow – JPL)
- Postdoc working on data assimilation and surface quasi-geostrophic theory for the SWOT satellite mission.
- 2021 **Mentor** to Emma Gurcan (Summer Undergraduate Research Fellowship – SURF)
- Undergraduate student at Caltech worked on simulating SWOT sea surface height fields in the California Current system.
- 2018 **Mentor** to Quentin Baumard (intern at UNSW)
- Undergraduate student at Le Cnam Intechmer, Cherbourg, France
 - Project title: “*Quantifying the hydrokinetic energy resource of the East Australian Current using in situ and remote measurements of the ocean current field*”
 - I outlined the research project for Quentin based on his interests in ocean engineering and ocean renewable energy. He presented his work at the Australian Coastal and Oceans Modelling and Observations Workshop, and we published a paper in 2020.

- 2017-18 **Lecturer** “Topics in Australian Marine Science” at Sydney Institute of Marine Science
- 2 semesters of the Master’s degree course. I taught the physical oceanography component (four 1-hour lectures each followed by a 2.5-hour data analysis lab)
 - Lectures consisted of introductory physical oceanography topics and data analysis
 - I updated the course and created new content, including new datasets to analyze. I wrote the final exam questions.
- 2012-13 **Teaching Assistant** “MSC 243 Weather Forecasting” at University of Miami
- 2 semesters of the Undergraduate degree course with Professor Sharan Majumdar
 - Helped prepare homework, gave 2 lectures, graded all homework and exam questions, and answered student questions.

KEY SKILLS

Computing:

- *Operating Systems*: Windows, Linux, and Mac.
- *Coding*: Matlab (experienced), Python, Git, FORTRAN, GIS, PERL (familiar)
- *Supercomputing*: NASA Advanced Supercomputing facility
- *Website*: HTML, CSS

Fieldwork:

In addition to the open ocean research cruises and HF radar installations/maintenance listed under ‘Research Experience’: numerous day coastal excursions aboard University of Plymouth’s R/V Catfish. Experience with side scan sonar, CTD and ADCP deployment. Ex-RYA certified: VHF radio, powerboat handling and sea survival. In my own time I have sailed five trips between Miami and the Bahamas, and once from Panama to Colombia.

Communication:

I am committed to improving my science communication in all forms – especially publications and oral presentations - and actively seek out opportunities to learn.

- *Writing*: Dallas Murphy Workshop, Nature Masterclass Scientific Writing, MetOcean Solutions Workshop, UNSW Climate Change Research Center Scientific Paper Writing Workshop
- *Oral*: Consortium for Ocean Science Exploration and Engagement (COSEEE) Presentation Bootcamp (standard and advanced)
- *Leadership*: JPL Multipliers Leadership 2-day workshop (2021)

SERVICE + ACTIVITIES

Reviewer: *Geophysical Research Letters, Journal of Geophysical Research: Oceans, Journal of Physical Oceanography, Remote Sensing, Journal of Marine Systems, Estuarine Coastal and Shelf Science, Oceanography magazine, Deep-Sea Research Part II, Continental Shelf Research.*

Session Chair: (1) Ocean Sciences 2020 in San Diego. Session Title: “*Boundary Currents and Shelf-Deep Ocean Exchange*”. (2) Australian Meteorological and Oceanographic Society 2018 Annual Meeting in Sydney, Australia. Session Title: “*Ocean Variability on Timescales from Days to Decades*”.

NASA Panel Reviewer: ROSES Future Investigators in NASA Earth and Space Science and Technology (Physical Oceanography), 2019-2023.

Board Member: Caltech Postdoc Association (2019-2020). As the division representative for JPL, I advocate for the postdoc community, conducting surveys, and organizing career/social events. I

participated in the Caltech & Claremont Coaching Program in 2019-2020, in which I received 16 coaching sessions on career and leadership.

Outreach: Booth volunteering at: (1) Explore JPL day 2019, (2) CARTHE Tortuga outreach 2014-2016. School outreach: Science assembly talks at the UK elementary school Powers Hall Academy to 5 to 11-year-old school children, 2018.

Committees: Chair of the Student Travel Fund (2012-2016) fundraising and fund distribution to graduate students to travel for research activities. Member of the RSMAS Student Seminar Series (2013-2014), I organized and facilitated voting by faculty and students to determine the best annual student seminar and distribute prizes for exceptional presentations.

Technical Advisory Panel: National Ocean Sciences Bowl (2012-2013) – Physical Oceanography Question Reviewer in Washington DC. Competition judge in the 2013 Miami Ocean Sciences Bowl.

AWARDS + SCHOLARSHIPS

- *Australian Meteorological and Oceanographic Society Annual Meeting 2017 Research Award* – Scholarship for travel and registration to present
- *IEEE/OES CWTM 2015 Student Award* – Scholarship for travel and registration to present
- *Graduate Student Association Scholarship* – To attend the Dallas Murphy Writing Workshop
- *PICES 2013 Summer School Scholarship* – Ocean Observing Systems and Ecosystem Monitoring Summer School. Travel award to Hatfield Marine Science Center, Newport, OR
- *Nortek Student Equipment Award 2013* – Awarded an AWAC (Acoustic Wave and Current Profiler) for a 3-month deployment. Travel grant to present at an international conference
- *Harry D. Vernon Scholarship 2013* – For excellence in oceanographic research
- *2012 Ocean Sciences Meeting (TOC/ AGU/ ASLO)* – Outstanding Student Presentation Award
- *Weather (Wx) Challenge 2011/ 2012* - Graduate Student City Winner
- *Fugro & IMAREST Undergraduate Award 2009*– Best Student Dissertation

PROFESSIONAL MEMBERSHIPS

American Association for the Advancement of Science (*member since 2015*), American Geophysical Union (*member since 2014*), Association for the Sciences of Limnology and Oceanography (*member since 2016*), The Oceanography Society (*member since 2011*), The Institute of Marine Engineering, Science & Technology (*2009 student member*).

SELECTED CONFERENCES + INVITED TALKS

Archer, M. R., Wang, J, Fu, F-F., 2024 *The impact of SWOT beyond conventional altimetry @ Ocean Sciences Meeting - [poster]*

Archer, M. R., Wang, J, Fu, F-F., 2023 *What's in the daily difference of SWOT sea surface height? @ SWOT Science Team Meeting, Toulouse, France - [poster]*

Archer, M. R., Wang, J, Fu, F-F., Mazloff, M. R., Gopalakrishnan, G., Cornuelle, B., Gille, S., 2022 *ECCO-SWOT: a high-resolution adjoint-based ocean state estimate for the California Current system at the SWOT Calibration/Validation site @ Ocean Sciences Meeting - Virtual [virtual talk]*

- Archer, M. R., Z. Li, J. Wang & L-L Fu, 2020. *An assessment of the data assimilation system developed for the SWOT satellite mission* @ Ocean Surface Topography Science Team Meeting **[virtual poster]**
- Archer, M. R., 2020. *Toward Satellite Altimetry Measurements of Fine-Scale Ocean Variability* @ CASPO Seminar, Scripps Institute of Oceanography **[invited virtual talk]**
- Archer, M. R., Z. Li, J. Wang & L-L Fu, 2020. *An assessment of the data assimilation system developed for the SWOT satellite mission* @ AGU Fall Meeting, USA **[virtual poster]**
- Archer, M. R., Z. Li, & L-L Fu, 2019. *Increasing the resolution of mapped Sea Surface Height in the California Current system* @ Ocean Surface Topography Science Team Meeting, Chicago, USA **[poster]**
- Archer, M. R., Z. Li, & L-L Fu, 2019. *Increasing the resolution of mapped Sea Surface Height in the California Current system* @ SWOT Science Team Meeting, Bordeaux, France **[oral + poster]**
- Archer, M. R., 2019. *Observations of submesoscale instability and frontal subduction within the mesoscale eddy field of the Tasman Sea* @ Caltech **[invited talk]**
- Archer, M. R., 2019. *Submesoscale Instability in the East Australian Current System* @ Scripps Institute of Oceanography **[invited talk]**
- Archer, M. R., 2018. *Observations of frontal subduction and instability across an eddy dipole jet* @ University of East Anglia **[invited talk]**
- Archer, M. R., S.R. Keating, M. Roughan, R. Lumpkin, F. Beron-Vera, & L. K. Shay, 2018. *The similarity of two western boundary currents in a jet coordinate frame* @ AGU/ASLO Ocean Sciences Meeting, Portland, OR, USA **[oral]**
- Archer, M. R., S.R. Keating, M. Roughan, R. Lumpkin, F. Beron-Vera, & L. K. Shay, 2018. *Inter-comparison of two analogous western boundary currents* @ Australian Meteorological and Oceanographic Society (AMOS) Meeting, Sydney, NSW, Australia **[oral]**
- Archer, M. R., M. Roughan, S.R. Keating & A. Schaeffer, 2017. *The East Australian Current: Jet Variability and Influence of Shelf Circulation* @ Australian Meteorological and Oceanographic Society (AMOS) Meeting, Canberra, ACT, Australia **[oral]**
- Archer, M. R., M. Roughan, S.R. Keating & A. Schaeffer, 2016. *Meandering of the East Australian Current at 30°S* @ Australian Coastal and Oceans Modelling and Observations (ACOMO) Workshop, Canberra, ACT, Australia **[poster]**
- Archer, M. R., L. K. Shay & W. E. Johns, 2015. *HF radar observations of the Florida Current in a Stream Coordinate System* @ Radiowave Oceanography Workshop (ROW), Woods Hole, MA, USA. **[oral]**
- Archer, M. R., & L. K. Shay, 2015. *The Florida Current in Stream Coordinates: On the Effects of Meandering at 25°N to 26°N* @ Asia Oceania Geosciences Society (AOGS) Annual Meeting, Singapore **[oral]**
- Archer, M. R., L. K. Shay, B. Jaimes & J. Martinez-Pedraja, 2015. *Coastal Ocean Observing in the Straits of Florida using HF Radar: An Overview of Recent Work* @ Southeast Coastal Ocean Observing Regional Association (SECOORA) Annual Meeting, Jacksonville, FL, USA **[poster]**

Archer, M. R., L. K. Shay, B. Jaimes & J. Martinez-Pedraja, 2015. *Evaluation of WERA HF Radar Observations: Currents, Winds and Waves @ IEEE/OES 11th Current, Waves and Turbulence Measurement Workshop*, St Petersburg, FL, USA **[oral]**

Archer, M. R., L. K. Shay, & J. Martinez-Pedraja, 2014. *Sensing oceanic cyclones and anticyclones across a western boundary current using WERA high frequency radars* AOGS Annual Meeting, Sapporo, Japan **[oral presented by L.K. Shay]**

Archer, M. R., L. K. Shay, B. Jaimes, & J. Martinez-Pedraja, 2014. *A near-inertial signal in a background current with strong horizontal shear: HF radar observations in the Straits of Florida @ Radiowave Oceanography Workshop (ROW)*, Savannah, GA, USA **[oral]**

Archer, M. R., L. K. Shay, J. Martinez-Pedraja & A. B. Parks, 2012. *Application of High Frequency Radar and the Okubo-Weiss Parameter to Analyze Submesoscale Variability in the Florida Current @ AGU/ASLO Ocean Sciences Meeting*, Salt Lake City, UT, USA **[oral]**

Shay, L. K., J. Martinez-Pedraja, M. R. Archer, B. K. Haus, & A. B. Parks, 2012. *Submesoscale Surface Current Variability along the Florida Current @ AGU/ASLO Ocean Sciences Meeting*, Salt Lake City, UT, USA **[poster presented by M. R. Archer]**

Archer, M. R., & P. Flament, 2009. *HF radar measurements of wind direction in the Sulu Sea: Preliminary results @ The Philippines Straits Dynamics Experiment (PhilEx) Meeting*, Honolulu, HI, USA **[oral]**