**Kyle A. Hilburn**

Cooperative Institute for Research in the Atmosphere (CIRA)

Colorado State University (CSU)

**Research Interests**

Satellite remote sensing, machine learning, data assimilation, coupled modeling

**Professional Preparation**

Colorado State University Atmospheric Science PhD 2023

Florida State University Meteorology MS 2002

University of North Dakota Atmospheric Science BS 2000

**Professional Appointments**

Research Associate IV CIRA/CSU 2019-present

Research Associate III CIRA/CSU 2016-2018

Lead Software Developer Remote Sensing Systems 2011-2015

Scientist Remote Sensing Systems 2002-2010

**Publications *(Google Scholar: h-index = 22, citations = 3187)***

Ebert-Uphoff, I., and K. **Hilburn**, 2023: The outlook for AI weather prediction. *Nature*, **619**, 473-474, <https://doi.org/10.1038/d41586-023-02084-9>.

**Hilburn**, K. A., 2023: Understanding spatial context in convolutional neural networks using interpretable GREMLIN. *Artif. Intell. Earth Syst.*, **2**, 220093, <https://doi.org/10.1175/AIES-D-22-0093.1>.

Bansal, A. S., Y. Lee, K. **Hilburn**, I. Ebert-Uphoff, 2023: Leveraging spatiotemporal information in meteorological image sequences: From feature engineering to neural networks. *Environmental Data Science*, 2: e31, 1-27, <https://doi.org/10.1017/eds.2023.26>.

Yang, Y., H. Chen, K. **Hilburn**, R. J. Kuligowski, R. Cifelli, and M. R. Azimi-Sadjadi, 2023: Deep learning for precipitation retrievals using ABI and GLM measurements on the GOES-R Series. *IEEE Trans. Geosci. Rem. Sens.*, in review.

Lee, Y., and K. **Hilburn**, 2023: Validating GOES radar estimation via machine learning to inform NWP (GREMLIN) product over CONUS. *J. Appl. Meteor. Climatol.*, in review.

Marinescu, P. J., D. Abdi, K. **Hilburn**, I. Jankov, and L.-F. Lin, 2023: An evaluation of NOAA modeled and in situ soil moisture values and variability across the continental United States. *Wea. Forecasting*, in review.

Mandel, J., J. Hirschi, A. K. Kochanski, A. Farguell, J. Haley, D.V. Malia, B. Shaddy, A. A. Oberai, K. A. **Hilburn**, 2023: Building a fuel moisture model for the coupled fire-atmosphere model WRF-SFIRE from data: From Kalman filters to recurrent neural networks. <https://arxiv.org/abs/2301.05427>.

Ebert-Uphoff, I., and K. **Hilburn**, 2022: What did my neural network learn? Using neural networks to work with meteorological images. *Bull. Amer. Meteor. Soc.*, **103**, 427-430, <https://www.mydigitalpublication.com/publication/?m=43726&i=752170&p=1&ver=html5>.

Ebert-Uphoff, I., R. Lagerquist, K. **Hilburn**, Y. Lee, K. Haynes, J. Stock, C. Kumler, and J. Q. Stewart, 2021: CIRA Guide to Custom Loss Functions for Neural Networks in Environmental Sciences – Version 1. <https://arxiv.org/abs/2106.09757>.

Mandel, J., A. Farguell, A. K. Kochanski, D. V. Mallia, and K. **Hilburn**, 2021: Simple finite elements and multigrid for efficient mass-consistent wind downscaling in a coupled fire-atmosphere model. <https://arxiv.org/abs/2101.08453>.

Farguell, A., J. Mandel, J. Haley, D. V. Mallia, A. Kochanski, and K. **Hilburn**, 2021: Machine learning estimation of fire arrival time from level-2 active fires satellite data. *Rem. Sens.*, **13**, 2203, <https://doi.org/10.3390/rs13112203>.

**Hilburn**, K. A., I. Ebert-Uphoff, and S. D. Miller, 2021: Development and interpretation of a neural network-based synthetic radar reflectivity estimator using GOES-R satellite observations. *J. Appl. Meteor. Climatol.*, **60**, 3-21, <https://doi.org/10.1175/JAMC-D-20-0084.1>.

Ebert-Uphoff, I., and K. A. **Hilburn**, 2020: Evaluation, tuning and interpretation of neural networks for meteorological applications. *Bull. Amer. Meteorol. Soc.*, **101**, E2149-E2170, <https://doi.org/10.1175/BAMS-D-20-0097.1>.

Rutledge, S. A., K. **Hilburn**, B. Fuchs, K. Reimel, and S. D. Miller, 2020: Evaluating lightning flash rates from the Geostationary Lightning Mapper within intense convective storms. *J. Geophys. Res. Atmos.*, **125**, e2020JD032827, <https://doi.org/10.1029/2020JD032827>.

Apke, J. M., K. A. **Hilburn**, S. D. Miller, and D. A. Peterson, 2020: Towards objective identification and tracking of convective outflow boundaries in next-generation geostationary satellite imagery. *Atmos. Meas. Techs.*, **13**, 1593-1608, <https://doi.org/10.5194/amt-13-1593-2020>.

Grasso, L., D. Bikos, J. Dostalek, T.-C. Wu, K. **Hilburn**, E. Szoke, J. Torres, J. Zeitler, B. Line, and A. Cohen, 2020: Application of the GOEs-16 advanced baseline imager: morphology of a preconvective environment on 17 April 2019. *E-Journal of Severe Storms Meteorology*, **15**, 1-24, <https://ejssm.org/archives/2020/vol-15-2-2020/>.

Marchand, M., K. **Hilburn**, and S. D. Miller, 2019: Geostationary Lightning Mapper and Earth Networks lightning detection over the contiguous United States and dependence on flash characteristics. *J. Geophys. Res. Atmos.*, **124**, 11552-11567, <https://doi.org/10.1029/2019JD031039>.

Mandel, J., M. Vejmelka, A. K. Kochanski, A. Farguell, J. D. Haley, D. V. Mallia, and K. **Hilburn**, 2019: An interactive data-driven HPC system for forecasting weather, wildland fire, and smoke. *Urgent HPC*, 35-44, <https://doi.org/10.1109/UrgentHPC49580.2019.00010>.

Zhang, R. & Wang, Z., and **Hilburn**, K., 2018: Tropical cyclone rainfall estimates from FY-3B MWRI brightness temperatures using the WS algorithm. *Rem. Sens.*, **10**, 1770, <https://doi.org/10.3390/rs10111770>.

**Hilburn**, K. A., T. Meissner, F. J. Wentz, and S. T. Brown, 2015: Ocean vector winds from WindSat two-look polarimetric radiances. *IEEE Trans. Geosci. Remote Sens.*, **54**, 918-931, <https://doi.org/10.1109/TGRS.2015.2469633>.

Gentemann, C.L. and K.A. **Hilburn**, 2015: In situ validation of GCOM-W1 AMSR2 sea surface temperatures. *J. Geophys. Res. Oceans*, **120**, 3567-3585, <https://doi.org/10.1002/2014JC010574>.

Kruk, M.C., K. **Hilburn**, and J.J. Marra, 2015: Using microwave satellite data to assess changes in storminess over the Pacific Ocean. *Mon. Wea. Rev.*, **143**, 3214–3229, <https://doi.org/10.1175/MWR-D-14-00280.1>.

Rodell, M., H. K. Beaudoing, T. S. L’Ecuyer, W. S. Olson, J. S. Famiglietti, P. R. Houser, R. Adler, M. G. Bosilovich, C. A. Clayson, D. Chambers, E. Clark, E. J. Fetzer, X. Gao, G. Gu, K. **Hilburn**, G. J. Huffman, D. P. Lettenmaier, W. T. Liu, F. R. Robertson, C. A. Schlosser, J. Sheffield, and E. F. Wood, 2015: The observed state of the water cycle in the early 21st century. *J. Climate*, **28**, 8289-8318, <https://doi.org/10.1175/JCLI-D-14-00555.1>.

L'Ecuyer, T. S., H. K. Beaudoing, M. Rodell, W. Olson, B. Lin, S. Kato, C. A. Clayson, E. Wood, J. Sheffield, R. Adler, G. Huffman, M. Bosilovich, G. Gu, F. Robertson, P. R. Houser, D. Chambers, J. S. Famiglietti, E. Fetzer, W. T. Liu, X. Gao, C. A. Schlosser, E. Clark, D. P. Lettenmaier, and K. **Hilburn**, 2015: The observed state of the energy budget in the early twenty-first century. *J. Climate*, **28**, 8319-8346, <https://doi.org/10.1175/JCLI-D-14-00556.1>.

Wang, S.-Y. S., J. Santanello, H. Wang, D. Barandiaran, R. T. Pinker, S. Schubert, R. G. Gillies, R. Oglesby, K. **Hilburn**, A. Kilic, and P. Houser, 2015: An intensified seasonal transition in the Central U.S. that enhances summer drought. *J. Geophys. Res. Atmos.*, 120, 8804-8816, <https://doi.org/10.1002/2014JD023013>.

Barandiaran, D., S.-Y. Wang, and K. **Hilburn**, 2013: Observed trends in the Great Plains low-level jet and associated precipitation changes in relation to recent droughts, *Geophys. Res. Letts.*, **40**, 6247-6251, <https://doi.org/10.1002/2013GL058296>.

Weissman, D.E., B.W. Stiles, S.M. Hristova-Veleva, D.G. Long, D.K. Smith, K.A. **Hilburn** and W.L. Jones, 2012: Challenges to Satellite Sensors of Ocean Winds: Addressing Precipitation Effects, *J. Atmos. Oceanic Technol.*, **29**, 356-374, <https://doi.org/10.1175/JTECH-D-11-00054.1>.

Syed, T.H., J.S. Famiglietti, D.P. Chambers, J.K. Willis, and K.A. **Hilburn**, 2010: Satellite-based global-ocean mass balance estimates of interannual variability and emerging trends in continental freshwater discharge, *Proc. Nat. Acad. Sci.*, **107**, 17916-17921, <https://doi.org/10.1073/pnas.1003292107>.

**Hilburn**, K.A. and F.J. Wentz, 2008: Mitigating the impact of RADCAL beacon contamination on F15 SSM/I ocean retrievals, *Geophys. Res. Letts.*, **35**, L18806, <https://doi.org/10.1029/2008GL034914>.

**Hilburn**, K.A. and F.J. Wentz, 2008: Intercalibrated passive microwave rain products from the unified microwave ocean retrieval algorithm (UMORA), *J. Appl. Meteor. Climatol.*, **47**, 778-794, <https://doi.org/10.1175/2007JAMC1635.1>.

Wentz, F.J., L. Ricciardulli, K.A. **Hilburn** and C.A. Mears, 2007: How much more rain will global warming bring?, *Science*, **317**, 233-235, <https://doi.org/10.1126/science.1140746>.

**Hilburn**, K.A., F.J. Wentz, D.K. Smith and P.D. Ashcroft, 2006: Correcting active scatterometer data for the effects of rain using passive microwave data, *J. Appl. Meteorol. Climatol.*, **45**, 382-398, <https://doi.org/10.1175/JAM2357.1>.

**Hilburn**, K.A., M.A. Bourassa, and J.J. O'Brien, 2003: Development of scatterometer-derived surface pressures for the Southern Ocean, *J. Geophys. Res.*, **108**, 3244, <https://doi.org/10.1029/2003JC001772>.

**Top Five Most Cited Publications**

Wentz, F.J., et al., 2007: How much more rain will global warming bring? *Science*, 317, 233-235, <https://doi.org/10.1126/science.1140746>.

Rodell, M., etl al., 2015: The observed state of the water cycle in the early 21st century. *J. Climate*, **28**, 8289-8318, <https://doi.org/10.1175/JCLI-D-14-00555.1>.

**Hilburn**, K.A. and F.J. Wentz, 2008: Intercalibrated passive microwave rain products from the unified microwave ocean retrieval algorithm (UMORA). *J. Appl. Meteor. Climatol.*, 47, 778-794, <https://doi.org/10.1175/2007JAMC1635.1>.

L'Ecuyer, T. S., et al., 2015: The observed state of the energy budget in the early twenty-first century. *J. Climate*, **28**, 8319-8346, <https://doi.org/10.1175/JCLI-D-14-00556.1>.

Syed, T.H., et al., 2010: Satellite-based global-ocean mass balance estimates of interannual variability and emerging trends in continental freshwater discharge. *Proc. Nat. Acad. Sci.*, 107, 17916-17921, <https://doi.org/10.1073/pnas.1003292107>.

**Book Chapters**

Gentemann, C. L., F. J. Wentz, M. Brewer, K. **Hilburn**, and D. Smith, 2010: Passive microwave remote sensing of the ocean: An overview. *Oceanography from Space, revisited*, Barale V., Gower J,. Alberotanza L., Eds, Spinger, Heidelberg, 13-33.

**Report Contributions**

Contributed to the Precipitation section for over-ocean precipitation in the *AMS State of the Climate* reports for eight years in a row (2009-2016).

**Recent Conference Presentations**

**Hilburn**, K., 2023: Utilization of satellite-derived information for improved wildland fire behavior forecasting. *NOAA CoRP Symposium*, July 25.

**Hilburn**, K., 2023: Connecting observations and models for proactive fire management to support decision making. Panelist at *Remote Perspectives for Living with Wildfires Townhall*. *AMS Annual*, January 10.

**Hilburn**, K., A. Kochanski, A. Farguell, J. Mandel, and J. Haley, 2023: A workflow for initializing wildfires in WRF-SFIRE for real-time forecasting. *AMS Annual*, January 10.

**Invited Talks**

**Hilburn**, K., 2023: GREMLIN: GOES Radar Estimation via Machine Learning to Inform NWP. *TOWR-S Satellite Book Club Seminar*, April 20, <https://www.youtube.com/watch?v=vrVlGAAVy3Y&list=PLJzZC8w9vPV3kIBVNmQYzZfHO6vGZeNhN&index=15>.

**Hilburn**, K., 2022: Active fires: Directionality and impact. *NASA Earth Science Applications Week*, August 11, <https://www.youtube.com/watch?v=TYDVvvr3qfI>.

**Hilburn**, K., 2022: GOES radar estimation via machine learning to inform NWP (GREMLIN). *Korea Meteorological Administration Seminar*, May 12.

**Hilburn**, K., 2022: Machine learning using satellite data aids weather prediction. *NOAA Science Report*, March 9.

**Hilburn**, K., 2019: Using GOES-16/17 to Improve Short Term Forecasts. *University of North Dakota Atmospheric Sciences Graduate Seminar,* Grand Forks, North Dakota, August 29.

**Hilburn**, K. A., 2009: Studying oceans and climate with microwave satellite data. *Seminar at The University of Washington,* Seattle, Washington, February 26.

**Hilburn**, K., and F. Wentz, 2008: The next generation of passive microwave retrievals in the GPM era. *IEEE International Geoscience and Remote Sensing Symposium (IGARSS),* Boston, Massachusetts.

**Hilburn**, K., 2006: Studying oceans and climate with microwave satellite data. *Seminar at The National Institute of Oceanography,* Dona Paula, Goa, India, November 27.

**Media Interactions**

Waldman, H., 2023: AI in weather forecasting: How the technology can improve predictions in life-threatening situations. *KCRA NBC Sacramento*, 26 July, [https://www.kcra.com/article/weather-california-forecasating-our-future-artificial-intelligence/44653106](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.kcra.com%2Farticle%2Fweather-california-forecasating-our-future-artificial-intelligence%2F44653106&data=05%7C01%7CKyle.Hilburn%40colostate.edu%7C66412f08046342446e8608db8ec74c27%7Cafb58802ff7a4bb1ab21367ff2ecfc8b%7C0%7C0%7C638260758901268523%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=NLTRAz7xZAeaaaUDp1U0p3nkXj1UbJkbOZRVaTKc%2BAw%3D&reserved=0).

Payne, E., 2023: Fact Check: Video of Quebec Wildfires Starting ‘At the Same Time’ Does NOT Prove Fires Were Coordinated. *LeadStories.com*, 8 June, <https://leadstories.com/hoax-alert/2023/06/fact-check-video-of-quebec-wildfires-starting-at-same-time-does-not-prove-fires-were-coordinated.html>.

**Hilburn**, K., 2022: Fighting Fires from the Skies. *NASA Earth Science Applications Guidebook*, <https://appsci.sterlingriber.com/v10/>.

**Hilburn**, K., 2022: Atmospheric Researcher Kyle Hilburn on Wildfire Anxiety. *The Seattle Psychiatrist Interview Series*, September 22, <https://seattleanxiety.com/psychology-psychiatry-interview-series/2022/9/19/kyle-hilburn>.

**Datasets**

* **Hilburn**, K. A., 2023: GREMLIN CONUS1 Manually Selected Storms Dataset, *Dryad*, Dataset, <https://doi.org/10.5061/dryad.m905qfv60>.
* **Hilburn**, K., 2023: GREMLIN CONUS3 Dataset for 2020, *Dryad*, Dataset, <https://doi.org/10.5061/dryad.h9w0vt4nq>.
* **Hilburn**, K., 2023: GREMLIN CONUS3 Dataset for 2021, *Dryad*, Dataset, <https://doi.org/10.5061/dryad.zs7h44jf2>.
* **Hilburn**, K., 2023: GREMLIN CONUS3 Dataset for 2022, *Dryad*, Dataset, <https://doi.org/10.5061/dryad.2jm63xstt>.
* **Hilburn**, K. A., 2022: GREMLIN CONUS2 Dataset. *Colorado State University*. <http://dx.doi.org/10.25675/10217/235392>.

**Code Repositories**

* <https://github.com/kylehilburn/SatelliteSummerSchool2019.git>
* <https://github.com/kylehilburn/conus2_ml.git>
* <https://github.com/kylehilburn/Interpretable_GREMLIN.git>

**Awards and Fellowships**

* 2023 NOAA CoRP Symposium Honorable Mention Presentation
* 2020 CIRA Exceptional Service Award
* 2001 American Geophysical Union Outstanding Student Paper Award
* 2000-2002 NASA Earth Science Enterprise Graduate Fellowship
* 2000 University of North Dakota Atmospheric Sciences Outstanding Student Researcher
* 1998-2000 American Meteorological Society Undergraduate Industry Fellowship

**Synergistic Activities**

* *Conferences*
  + AMS Artificial Intelligence Conference Co-Chair for AMS Annual 2024
  + Co-Chair AMS Annual 2023 Sessions:
    - Coupled Numerical Modeling of Wildfire and Wildfire Hazards: Current Status, Innovations, Applications, and Future Developments
    - Machine Learning for Wildfire Prediction, Modeling, and Processes
    - Applications of Machine Learning to Remote Sensing of Aerosol, Clouds, and Precipitation Properties
  + Co-convener “Calibration, Validation and Early Science from AMSR2” at the 2013 AGU Fall Meeting
* *Mentoring*
  + CSU Data Science Research Institute Mentoring, Nathan Mitchell, Summer 2023
  + M.S. Candidate Eric Goldenstern (Chris Kummerow) 2020-2021
  + M.S. Candidate Adam Clayton (Steve Rutledge) 2018-2019
  + ESMEI REU Caleb Wood (Chris Kummerow) Summer 2018
* *Webpages*
  + Fire Forecast Dashboard, <https://www.engr.colostate.edu/~hilburn/ngfs/index.html>
  + CIRA SLIDER: GLM and MRMS product visualization, <http://rammb-slider.cira.colostate.edu>
  + Satellite Crossing Times, <http://www.remss.com/support/crossing-times>
  + Atmospheric River Watch, <http://www.remss.com/about/projects/atmospheric-river-watch>
  + Python code to read Remote Sensing Systems binary data, [ftp.ssmi.com](ftp://ftp.ssmi.com)
* *Reviewer activities*
  + NOAA Small Business Innovation Research (SBIR) Phase 1 Reviewer, 2023
  + CSU Pride Center LGBTQIA Scholarship Reviewer, 2023
  + NOAA WPO Innovations for Community Modeling Reviewer, 2023
  + Precipitation Measurement Missions Science Team (2013, 2015, 2018, 2021)
  + Ocean Vector Winds Science Team (2014, 2018)
  + Numerous journal article reviews
    - *Journal of Applied Meteorology and Climatology*, *Journal of Geophysical Research*, *Remote Sensing*, *Weather and Forecasting*, *Atmosphere*, *Sensors*, *Artificial Intelligence for the Earth Systems*, *Journal of Atmospheric Science*, *Environmental Data Science*, *Journal of Climate*, *Journal of Hydrometeorology*, *Remote Sensing of the Environment*
* Collaborator with NSF AI Institute for Research on Trustworthy AI in Weather, Climate, and Coastal Oceanography (AI2ES)
* Taught the class “Reading/Manipulating ABI data with Exercises” at the 2019 Satellite Summer School at CIRA/CSU
* On-Air Weather Anchor for UND Studio One, Fall 1998
* Student Volunteer at Grand Forks National Weather Service Office, Summer 1998

**PI Projects (Total $6,488,432)**

* NASA: Technology Development to Integrate Innovative Observation Capabilities into Coupled Wildfire Models for Improved Active Fire Forecasting ($2,945,252)
* NASA: Improving NU-WRF through Assimilation of Latent Heating from GOES-R Observations ($420,505)
* NASA: Integration and Evaluation of WRF-SFIRE Application for Interoperability in Wildfire Decision Making ($189,241)
* NASA: Coupled Interactive Forecasting of Weather, Fire Behavior, and Smoke Impact for Improved Wildland Fire Decision Making ($800,826)
* NOAA: GREMLIN Implementation on GeoCloud ($48,544)
* NOAA: Utilization of Satellite-derived Information for Improved Wildland Fire Behavior Forecasting ($461,395)
* NOAA: Assimilating GOES-R Latent Heating in FV3 using Machine Learning ($597,889)
* NOAA: GOES-R ML ABI Airmass ($213,592)
* USDA-USFS: Improving Fire-Management Decision Making ($811,188)