Eunsang Cho

Department of Civil and Environmental Engineering &
Earth Systems Research Center, Institute for the Study of Earth, Oceans, and Space (EOS),
University of New Hampshire
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Education

University of New Hampshire, Durham, NH, USA — Aug 2015 - **present**
Ph.D. candidate, Civil and Environmental Engineering
Advisor: Dr. Jennifer M. Jacobs

Hanyang University, Seoul, South Korea
M.S., Civil and Environmental Engineering — Sep 2012 - Aug 2014
Advisor: Dr. Minha Choi, Dr. Yongsik Cho
B.S., Civil and Environmental Engineering — Mar 2006 - Feb 2010

Research Interests

Science Areas

Terrestrial hydrology, Cold-land processes, Floods (Snow, Soil moisture, Freeze/thaw)
Human impacts (irrigation, drainage system, LULC) on hydrological responses
Climate change impacts on extreme events

Methods/Techniques

Remote sensing (Satellite Microwave, Gamma Radiation, Unmanned Aerial Systems, LiDAR)
Land surface model & Regional climate model
Machine learning, Cloud computing, Google earth engine

Publications

(**Bold**: first author; ***Bold&Italic***: co-author)

Peer-reviewed Journal Articles

- *To be submitted*
  21. **Cho, E.**, J.M. Jacobs, S. Kumar, Quantifying Impacts of Subsurface Drainage Expansion on Regional Hydrologic Responses using Noah-MP (*in preparation*)
  20. McCrary, R.R., ***E. Cho***, J.M. Jacobs, L.O. Mearns, Evaluation of Snow Water Equivalent and Snowmelt Processes in the NA-CORDEX Regional Climate Simulations (*in preparation*)
  19. **Cho, E.**, R.R. McCrary, J.M. Jacobs, Future Snow Water Equivalent and Snowmelt Extremes from Regional Climate Model Ensembles *(in preparation)*
  18. **Cho, E.**, J.M. Jacobs (2020) Ground Snow Loads in the United States *(in preparation)*
  17. **Cho, E.**, J.M. Jacobs (2020) Extreme Value Snow Water Equivalent and Snowmelt for Infrastructure Design over the Continental United States, ***Water Resources Research*** *(in preparation) preprint: https://doi.org/10.1002/essoar.10501588.1*
- *Under review / in revision*
  16. Jacobs, J.M., A.G. Hunsaker, F. Sullivan, M. Palace, E.A. Burakowski, C. Herrick, ***E. Cho*** (2020) Shallow snow depth mapping with unmanned aerial systems lidar observations: A case study in Durham, New Hampshire, United States, ***The Cryosphere*** *(under review) https://doi.org/10.5194/tc-2020-37*
- *Published*
  15. Forgotson, C., P.E. O'Neill, M. Carrena, S. Bélair, N.N. Das, I.E. Mladenova, J. Bolten, J.M. Jacobs, ***E. Cho,*** V.M. Escobar (2020) How Satellite Soil Moisture Data Can Help to Monitor the Impacts of Climate Change: SMAP Case Studies. ***IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*** https://doi.org/10.1109/JSTARS.2020.2982608
  14. **Cho, E.**, J.M. Jacobs, R. Schroeder, S.E. Tuttle, C. Olheiser (2020) Improvement of airborne gamma radiation snow water equivalent measurements using SMAP soil moisture, ***Remote Sensing of Environment***, 1
  13. **Cho, E.**, J.M. Jacobs, C. Vuyovich (2020) The value of long-term (40 years)

airborne gamma radiation SWE record for evaluating three observation-based gridded SWE datasets by seasonal snow and land cover classifications, ***Water Resources Research***, 56(1), https://doi.org/10.1029/2019WR025813 ***[AGU's EOS research spotlight** "Snowpack data sets put to the test", Eos, 101, https://doi.org/10.1029/2020EO141900. 30 March 2020]*

12. Kraatz, S., J.M. Jacobs, R. Schroeder, ***E. Cho***, H. J. Miller, C. Vuyovich (2020) SMAP freeze-thaw retrievals for pavements using effective soil temperature from GEOS-5: Evaluation against in situ road temperature data over the U.S., ***Remote Sensing of Environment***, 237, 111545, https://doi.org/10.1016/j.rse.2019.111545
11. **Cho, E.**, J.M. Jacobs, X. Jia, S. Kraatz (2019) Identifying Subsurface Drainage using Satellite Big Data and Machine Learning via Google Earth Engine, ***Water Resources Research***, 55(10), 8028-8045, https://doi.org/10.1029/2019WR024892
10. Schroeder, R., J.M. Jacobs, ***E. Cho***, C. Olheiser, M. DeWeese, B. Connelly, M. Cosh, X. Jia, C. Vuyovich, S.E. Tuttle. (2019) Assessment of satellite passive microwave and modeled snow water equivalent estimates in the Red River basin of the North. ***IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing***, 12(9), 3233–3246, https://doi.org/10.1109/JSTARS.2019.2926058
9. Kraatz, S., J.M. Jacobs, R. Schroeder, ***E. Cho***, M. Cosh, M. Seyfried, J. Prueger, S. Livingston (2018) Evaluation of SMAP freeze/thaw retrieval accuracy at core validation sites in the contiguous United States, ***Remote Sensing***, 10(9), 1483. https://doi.org/10.3390/rs10091483
8. Tuttle, S.E., J.M. Jacobs, C. Vuyovich, C. Olheiser, ***E. Cho*** (2018) Intercomparison of Snow Water Equivalent Observations in the Northern Great Plains, ***Hydrological Processes,*** *32(6), 817-829.* https://doi.org/10.1002/hyp.11459
7. **Cho, E.**, Tuttle, S.E., Jacobs, J.M. (2017) Evaluating Consistency of Snow Water Equivalent Retrievals from Passive Microwave Sensors over the North Central U. S.: SSM/I vs. SSMIS and AMSR-E vs. AMSR2, ***Remote Sensing***, *9*, 465. https://doi.org/10.3390/rs9050465
6. Kim, H., Z. Muhammad, ***E. Cho***, Y.H. Kerr, M. Choi (2017) Development and assessment of the sand dust prediction model by utilizing microwave-based satellite soil moisture and reanalysis datasets in east Asian desert areas, ***Advances in Meteorology***, https://doi.org/10.1155/2017/1917372
5. **Cho, E**., C.-H. Su, D. Ryu, H. Kim, M. Choi (2017) Does AMSR2 produce better soil moisture retrievals than AMSR-E over Australia?, ***Remote Sensing of Environment***, 188C, 95-105, https://doi.org/10.1016/j.rse.2016.10.050
4. **Cho, E.**, A. Zhang, M. Choi (2016) The seasonal difference in soil moisture patterns considering the meteorological variables throughout the Korean peninsula, ***Terrestrial, Atmospheric and Oceanic Sciences****,* https://doi.org/10.3319/TAO.2016.07.12.01
3. **Cho, E.**, M. Choi, W. Wagner (2015) An assessment of remotely sensed surface and root zone soil moisture through active and passive sensors in northeast Asia, ***Remote Sensing of Environment****,* 160, 166-179, https://doi.org/10.1016/j.rse.2015.01.013
2. **Cho, E.**, H. Moon, M. Choi (2015) First Assessment of Advanced Microwave Scanning Radiometer 2 (AMSR2) Soil Moisture Contents in Northeast Asia, ***Journal of the Meteorological Society of Japan****,* 93(1), 117-129, https://doi.org/10.2151/jmsj.2015-008
1. **Cho, E.**, M. Choi (2014) Regional scale spatio-temporal variability of soil moisture and its relationship with meteorological factors over the Korean peninsula, ***Journal of Hydrology***, 516, 317-329, https://doi.org/10.1016/j.jhydrol.2013.12.053

Book Chapters

1. Tuttle, S.E., ***E. Cho***, P. Restrepo, X. Jia, C. Vuyovich, M. Cosh, J.M. Jacobs (2017) Remote Sensing of Drivers of Spring Snowmelt Flooding in the North Central U.S. ***Remote Sensing of Hydrological Extremes***, edited by V. Lakshmi. Springer International Publishing, 21-45, https://doi.org/10.1007/978-3-319-43744-6

Awards and Honors

UNH Dissertation Year Fellowship	2019 – 2020
CUAHSI Pathfinder Fellowship (NSF Award No. 1849458)	2020
UNH Summer Teaching Assistantship Fellowship	2018
UNH College of Engineering and Physical Sciences (CEPS) Fellowship	2015 – 2016

1st Paper Presentation Award, 2013
Chuncheon Global Water Forum
Excellent Paper Award in 2013, 2013
Korea Water Resources Association Annual Conference
Brain Korea21 PLUS (BK21+) Fellowship 2012 - 2014
Brain Korea21 (BK21) Fellowship 2012

Professional Experiences

Graduate Research Assistant, NASA Applied Water Resources Science Grant (NNX15AC47G), *Project title: Satellite Enhanced Snowmelt Flood Predictions in the Red River of the North Basin*, University of New Hampshire, *Supervisor: Dr. Jennifer Jacobs* Aug 2015 - **present**

Visiting Research Student, NASA GSFC, Hydrological Science Laboratory, Greenbelt, MD, USA *Supervisor: Drs. Sujay Kumar and Carrie Vuyovich* Feb – Mar 2020

Participant, CUAHSI-iSWGR Snow Measurement Field School, Yellowstone Alliance Adventure, Bozeman, MT. *Instructors: Drs. Matthew Sturm, Kelly Elder, and Jessica Lundquist et al.* Jan 2019

Participant, NASA Land Information System Workshop, GSFC, MD. *Instructors: Dr. Sujay Kumar et al.* Dec 2018

Participant, CUAHSI Training Workshop: The Community WRF-Hydro Modeling System, NCAR, Boulder, CO, *Instructors: Dr. D. Gochis, K. Sampson, A. Dugger* May 2017

Volunteer Participant, Soil Moisture Active Passive Validation Experiment 2016 (SMAPVEX16) field campaign**,** Des Moines, IA, *Supervisor: Dr. Michael Cosh* May - Jun 2016

Research Associate, Environment and Remote Sensing Lab. Graduate School of Water Resources, Sungkyunkwan University, *Supervisor: Dr. Minha Choi* Sep 2014 - Jul 2015

Graduate Research Assistant, Civil and Environmental Engineering, Hanyang University, *Supervisor: Dr. Minha Choi* 2012 - 2014

- Establishing advanced technology for flood and drought assessments based on remote-sensing and land surface modeling
- Development of the enhanced spatial mapping of evapotranspiration and soil moisture using remote sensing technology (MODIS, AMSR-E, and ASCAT)

Teaching Experience

Lab Instructor, Department of Civil and Environmental Engineering, University of New Hampshire, *Lecturer: Dr. Tom Ballestero* Sep 2017– Dec 2018

- Fluid Mechanics (Fall 2017, Fall 2018)

Lab Instructor, Department of Civil and Environmental Engineering, Hanyang University, Korea 2013

- Geographic Information System (Spring 2013)

Graduate Teaching Assistant, Department of Civil and Environmental Engineering, Hanyang University, Korea 2012 - 2013

- Water Resources Engineering (Fall 2013)
- Hydrology (Fall 2012)

Other Experience

Engineer officer (Rank: First lieutenant), Defense Installations Agency, Ministry of National Defense 2012
Engineer officer, Corps of Engineers, Republic of Korea Army 2010 - 2011
Army cadet, Reserve Officers' Training Corps (ROTC), 2008 - 2010

Republic of Korea

Professional Memberships & Activities

American Geophysical Union (since 2013)
American Meteorological Society (since 2019)
European Geosciences Union (since 2020)
Young Earth System Scientists (YESS) Community (since 2019)
Reviewer for Journal of Geophysical Research-Atmosphere
Journal of Hydrology
Remote Sensing
Int. J. Appl. Earth Observation & Geoinformation
International Journal of Climatology

Invited Talks

5. The value of long-term (40 years) airborne gamma radiation SWE record: Evaluating CONUS SWE datasets by seasonal snow and land cover classifications. *University of Virginia*, Sep 2019, Hosted by Prof. V. Lakshmi.
4. Identifying Agricultural Drainage System from Satellite Big data and Machine Learning via Google Earth Engine, *Sungkunkwan University*, South Korea, Sep 2019, Hosted by Prof. M. Chol.
3. Human Modifications and Climate Change Impacts on Regional Water Balance Change in the Northern Great Plains, *University of New Hampshire*, Oct 2018, Hosted by CEE.
2. Agricultural Tile Drainage Detection from Satellite-based Vegetation and Thermal Data Using Google Earth Engine, *Bois de Sioux Watershed District*, MN, May 2018, Hosted by Prof. X. Jia.
1. Human and climate change impacts on hydrological responses in the north-central U.S., *North Dakota State University*, May 2018, Hosted by Prof. X. Jia.

Conferences & Workshop Presentations

(**Bold**: first author; ***Bold&Italic***: co-author)

26. Historical and Projected Extreme Snow Accumulation and Melt Events for Infrastructure Design using the NA-CORDEX Ensemble of Regional Climate Models, **E. Cho**, R. R. McCrary, J. M. Jacobs, *2020 AMS Annual Meeting. Boston, Jan 2020. (Oral)*
25. Evaluation of snow water equivalent and snowmelt processes in the NA-CORDEX regional climate simulations, R. R. McCrary, ***E. Cho***, J. M. Jacobs, L. O. Mearns, *2020 AMS Annual Meeting. Boston, Jan 2020. (Poster)*
24. Snow Ensemble Uncertainty Project (SEUP): Exploring variability and uncertainty in modeled SWE estimates using an ensemble-based approach, C. Vuyovich, S. Kumar, R. S. Kim, L. Mudryk, J. Lundquist, P. Houser, J. Johnston, M. Durand, N. Cristea, J. Pflug, ***E. Cho***, A. Barros, M. Wrzesien, C. Garnaud, B. Forman, M. Sandells, Y. Cao, *2019 AGU Fall Meeting. San Francisco, Dec 2019. (**Invited talk**)*
23. Quantifying Impacts of Subsurface Drainage Expansion on Regional Hydrologic Response in the Red River of the North Basin, **E. Cho**, J. M. Jacobs, S. Kumar, *2019 AGU Fall Meeting. San Francisco, Dec 2019. (Poster)*
22. The value of long-term (40 years) airborne gamma radiation SWE record: Evaluating CONUS SWE datasets by seasonal snow and land cover classifications, **E. Cho**, J. M. Jacobs, C. Vuyovich, *2019 AGU Fall Meeting. San Francisco, Dec 2019. (**Invited talk**)*
21. New York State Mesonet Snow Network: Review of 2018-2019 data and Plan for 2019-2020, Junhong (June) Wang, Jerald Brotzge, Nathan Bain, Scott McKim, Justin Minder, Pat Naple, ***E. Cho***, *The Northeast Regional Operational Workshop (NROW), Albany, NY, November 6-7, 2019 (Talk)*
20. Trend and Design of Annual Maximum Snowmelt Events over the Conterminous United States (CONUS), **E. Cho**, J. M. Jacobs, *The 76th Eastern Snow Conference (ESC), Fairlee, VT, 4-6 Jun 2019. (Poster)*
19. Mapping Agricultural Tile Drainage Expansion from Satellite-based Vegetation and Thermal Data Using Google Earth Engine Machine Learning, **E. Cho**, J. M. Jacobs, Xinhua Jia, Simon Kraatz, *2018 AGU Fall Meeting. Washington DC, Dec 2018. (Talk)*
18. Evaluation and Application of Remotely Sensed Soil Moisture for Snowmelt Flood Predictions in the Red River of the North Basin, **E. Cho**, J.M. Jacobs, R. Schroeder, S.E.

Tuttle, C. Olheiser, *The 5th Satellite Soil Moisture Val/App Workshop, George Mason University, Fairfax, VA, Oct 24-25, 2018. (Talk)*

16. Improvement of airborne gamma radiation snow water equivalent estimations with spaceborne soil moisture observations, **E. Cho**, J.M. Jacobs, S. Tuttle, R. Schroeder, C. Olheiser, *The 75th Eastern Snow Conference (ESC), College Park, MD, 6-8 Jun 2018. (Talk)*
16. 2018 Hubbard Brook Field Experiment: Snow Observations in a North-Eastern U.S. Forested Region, C. Vuyovich, A. Langlois, A. Roy, T. Letcher, J. Jacobs, J. Parno, R. Schroeder, S. Kraatz, Z. Courville, ***E. Cho***. *The 75th Eastern Snow Conference (ESC), College Park, MD, 6-8 Jun 2018. (Talk)*
15. Tile Drainage Expansion Detection using Satellite Soil Moisture Dynamics, Jennifer M. Jacobs, Eunsang Cho, Xinhua Jia, *AGU Fall Meeting, New Orleans, LA, Dec 2017. (Talk)*
14. Detection of the Timing of Snowmelt using In-situ Snow Temperature and Wetness Signals and Satellite Microwave Measurements, **E. Cho**, R. Schroeder, C. M. Vuyovich, J. M. Jacobs, *The 74th Eastern Snow Conference (ESC), Ottawa, Canada, 6-8 Jun 2017. (Poster)*
13. Comparison between AMSR2 and AMSR-E Snow Water Equivalent using SSM/I over the North Central U.S., **E. Cho**, S. Tuttle, J. M. Jacobs, *The 73th Eastern Snow Conference (ESC), Columbus, Ohio, 14-16 June, 2016. (Poster)*
12. Comparison of Satellite Passive Microwave, Airborne Gamma Radiation Survey, & Ground Survey SWE Estimates in the Northern Great Plains, S. Tuttle, ***E. Cho***, C. Vuyovich, C. Olheiser, and J. M. Jacobs, *The 73th Eastern Snow Conference (ESC), Columbus, Ohio, 14-16 June, 2016. (Talk)*
11. Intercomparison of AMSR2 and AMSR-E Soil Moisture Retrievals with MERRA-L data set over Australia, **E. Cho**, M.Choi, C.-H. Su, D. Ryu, H. Kim, J. M. Jacobs, *2015 AGU Fall Meeting, San Francisco, USA, 2015. (Poster)*
10. Applicability of Spatio-temporal Soil Moisture Monitoring based on Satellite Microwave Sensor in the Korean peninsula, **E. Cho**, M. Choi, *Smart Water Grid International Conference 2014, Incheon, South Korea. 25-27 Nov 2014. (Talk)*
9. Links between soil moisture and meteorological variables with seasonality in the northeast Asia, A. Zhang, ***E. Cho***, M. Choi, *The 3rd Remote Sensing and Hydrology Symposium & 3rd International Conference of GIS and Remote Sensing in Hydrology, Water Resources and Environment, Guangzhou, China. 24-27 Aug 2014. (Poster)*
8. Validation Study of Active Microwave Soil Moisture Products in Korea and Brazil, **E. Cho**, G. A. Vasconcelos, M. Choi, *3rd International Conference on Civil Engineering and Architecture (ICCEA 2014), Campinas City, Brazil. 30 July–1 Aug 2014*. *(Poster)*
7. Evaluating harmonized multi-satellite surface soil moisture in the Korea peninsula, **E. Cho**, M. Choi, *International Symposium on Remote Sensing (ISRS) 2014, The Pukyong National University Daeyeon Campus, Busan, South Korea. 16-18 Apr 2014. (Talk)*
6. Soil moisture estimation through Active and Passive sensors: An intercomparison and validation study in Northeast Asia, **E. Cho**, M. Choi, *2013 AGU Fall Meeting, San Francisco, Dec 2013. (Poster)*
5. Comparison and Validation study of Soil Moisture using AMSR-E and ASCAT sensors in Korea peninsula, **E. Cho**, M. Choi, *Chuncheon Global Water Forum, Chuncheon, South Korea. 12-13 Sep 2013. (Talk, In Korean)*
4. Soil moisture estimations through SMOS and ASCAT sensors: An intercomparison and validation study in Korea, M. Choi, ***E. Cho***, *2013 Satellite soil moisture validation & application workshop, Frascati, Italy. 1 – 3 Jul 2013. (Poster)*
3. ASCAT Soil moisture: Evaluation of the Meteorological Operation (Metop) Satellite for the East Asia, **E. Cho**, M. Choi, 2013, *The 6th Civil engineering conference in the Asian Region (CECAR). Jakarta, Indonesia. 20 – 22 Aug 2013. (Poster)*
2. Validation Study on Soil Moisture Using Satellite Remote Sensing Active/Passive sensors in Korea, M. Choi, ***E. Cho***, 2013, *Proceedings of Korea Water Resources Association. pp.89, (Poster, In Korean)*
1. Validation Study on Soil Moisture measured at Metop Satellite On-board ASCAT in Korea, M. Choi, ***E. Cho***, 2013, *Proceedings of Korean Society of Hazard Mitigation. pp.210. (Poster, In Korean)*

Technical Skills

Programming Language: R, MATLAB, Fortran, Java script, IDL, Python

Software & System: Linux, Google Earth Engine (GEE), ArcGIS, ENVI, JMP pro, SPSS