

# KERRY CAWSE-NICHOLSON

## SCIENTIST

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### About Me

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I am an Earth scientist focused on the visible to thermal portion of the electromagnetic spectrum with a special interest in information content or intrinsic dimensionality. With a generalist applied math background, I have carried out research in the fields of geology, ecology, and biodiversity. I have roles in science leadership in ECOSTRESS and SBG, and I enjoy working at the interfaces between science and engineering, and science and data systems.

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### Education

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#### PHD COMPUTATIONAL AND APPLIED MATH

University of the Witwatersrand (2009 - 2012)

#### MS COMPUTATIONAL AND APPLIED MATH

University of the Witwatersrand (2008 - 2009)

#### BS COMPUTATIONAL AND APPLIED MATH

University of the Witwatersrand (2004 - 2007)

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### Professional Experience

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#### SCIENTIST

Jet Propulsion Laboratory (2016 – present)

*Project leadership, product generation, and scientific research in the fields of geology, ecology, and biodiversity.*

#### IMAGE PROCESSING SPECIALIST

TerraCore Africa (2015 – 2016)

*Mineral mapping and statistical analysis of hyperspectral imagery of drill core.*

#### REMOTE SENSING SPECIALIST

Southern Mapping Company (2014 – 2015)

*Procurement and processing of a variety of satellite imagery. Analysis included mineral mapping, environmental rehabilitation, landcover classification, etc..*

#### POSTDOCTORAL RESEARCH ASSISTANT

Center for Imaging Science, Rochester

Institute of Technology (2012 – 2014)

*Full waveform lidar and hyperspectral-lidar fusion for forest ecology research.*

#### GRADUATE RESEARCHER

Council for Scientific and Industrial Research

(CSIR), South Africa (2009 – 2012)

*Research related to land degradation in Southern Africa using airborne hyperspectral imagery.*

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### Research Interests

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- Using spectroscopic imagery to study the properties of Earth's surface
- Dimensionality estimation for the study of diversity on land and in water
- Fusion of different data sources for a full understanding of scene composition
- The use of evapotranspiration in water resource management
- Uncertainty characterization

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### Current Roles/Projects

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- SBG-TIR deputy project scientist
- ECOSTRESS science lead
- SBG co-lead of algorithms working group
- ROSES PI ECOSTRESS Evapotranspiration
- ROSES PI ECOSTRESS Data improvements
- ROSES PI South African Biodiversity
- ROSES PI South African Geodiversity
- ROSES Co-I (x7 current projects) MEaSUREs land surface temperature; USPI: Copernicus LSTM; VIIRS thermal validation; AIST massive datasets; fire vulnerability; Urban heat; LCLUC.

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### Selected Awards

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- JPL Voyager Award, 2024
- JPL Group Achievement Award, 2024
- Excellence in ECOSTRESS Science Leadership, 2022
- NASA Early Career Public Achievement Medal, 2020
- NASA Honor Award (Group Achievement Award), 2020
- JPL Voyager Award, 2020
- JPL Group Achievement Award, 2019
- JPL Voyager Award, 2017
- Best PhD Thesis in Computational and Applied Mathematics, 2012
- Best Honours Student in Computational and Applied Mathematics, 2008

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### Experience as a Mentor/Advisor

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- Founder of the section mentoring program
- Postdoc mentor
- Annual summer interns
- DEVELOP mentoring

## Selected Publications

- Aragon, B., **Cawse-Nicholson, K.**, Hulley, G., Houborg, R., Fisher, J.B. (2023) K-sharp: a segmented regression approach for image sharpening and normalization. *Science of remote sensing*, 100095. <https://doi.org/10.1016/j.srs.2023.100095>
- Hu, T., Mallick, K., Hitzelberger, P., ... **Cawse-Nicholson, K.** (2023). Evaluating European ECOSTRESS Hub Evapotranspiration Products Retrieved from Three Structurally Contrasting SEB Models over Europe. *Water Resources Research*, <https://doi.org/10.1029/2022WR034132>
- **Cawse-Nicholson, K.**, Raiho, A. M., Thompson, D. R., Hulley, G. C., Miller, C. E., Miner, K. R., ... & Zareh, S. K. (2023). Surface Biology and Geology imaging spectrometer: A case study to optimize the mission design using intrinsic dimensionality. *Remote Sensing of Environment*, 290, 113534. <https://doi.org/10.1016/j.rse.2023.113534>
- Poulter, B., Currey, B., Calle, L., Brookshire, J., Campbell, P., Chlus, A., **Cawse-Nicholson, K.**... & Stutz, J. (2023). Simulating global dynamic surface reflectances for imaging spectroscopy spaceborne missions-LPJ-PROSAIL. *Journal of Geophysical Research: Biogeosciences*, 128 (1), e2022JG006935. <https://doi.org/10.1029/2022JG006935>
- Bhattacharya, B. K., Mallick, K., Desai, D., Bhat, G. S., Morrison, R., Clevery, J. R., ... & Baldocchi, D. (2022). A coupled ground heat flux–surface energy balance model of evaporation using thermal remote sensing observations. *Journal of Geophysical Research: Biogeosciences*, 19(23), 5521-5551. <https://doi.org/10.5194/bg-19-5521-2022>
- Raiho, A.M., **Cawse-Nicholson, K.**, Chlus, A., Dozier, J., Gierach, M. et al. (2022) Exploring mission design for imaging spectroscopy retrievals for land and aquatic ecosystems. *Journal of Geophysical Research: Biogeosciences*, 128(4), e2022JG006833. <https://doi.org/10.1029/2022JG006833>
- **Cawse-Nicholson, K.**, Raiho, A., Thompson, D. R., Hulley, G., Miller, C. E., Miner, K., ... & Zareh, S. K. (2022). Intrinsic dimensionality as a metric for the impact of mission design parameters. *Journal of Geophysical Research: Biogeosciences*, 127 (8), e2022JG006876. <https://doi.org/10.1029/2022JG006876>
- Stavros, E. N., Chronis, J., **Cawse-Nicholson, K.**, Freeman, A., Glenn, N. F., Guild, L., ... & Schimel, D. (2022). Designing an Observing System to Study the Surface Biology and Geology (SBG) of the Earth in the 2020s. *Journal of Geophysical Research: Biogeosciences*, e2021JG006471. <https://doi.org/10.1029/2021JG006471>
- Desai, D., Mallick, K., Bhattacharya, B., Bhat, G. S., Morrison, R., Clevery, J., Woodgate, W., Beringer, J., **Cawse-Nicholson, K.**, Ma, S., Verfaillie, J., and Baldocchi, D. (2022) A Coupled Ground Heat Flux-Surface Energy Balance Model of Evaporation Using Thermal Remote Sensing Observations, *Journal of Geophysical Research: Biogeosciences*, <https://doi.org/10.5194/bg-2021-356>
- Gorokhovich, Y., **Cawse-Nicholson, K.**, Papadopoulos, N., Oikonomou, D. (2022). Use of ECOSTRESS data for measurements of the surface water temperature: Significance of data filtering in accuracy assessment, *Remote Sensing Applications: Society and Environment*, 100739, <https://doi.org/10.1016/j.rsase.2022.100739>
- Cira, M., Bafna, A., Lee, C.M. Kong, Y., Holt, B., Ginger, L., **Cawse-Nicholson, K.**, Rieves, L., Jay, J.A. (2022). Turbidity and fecal indicator bacteria in recreational marine waters increase following the 2018 Woolsey Fire. *Nature Scientific Reports* 12, 2428 (2022). <https://doi.org/10.1038/s41598-022-05945-x>
- Halverson, G.H., Lee, C.M., Hestir, E.L., Hulley, G.C., **Cawse-Nicholson, K.**, et al. (2022). Decline in Thermal Habitat Conditions for the Endangered Delta Smelt as Seen from Landsat Satellites (1985–2019). *Environmental Science & Technology* 56 (1), 185-193 <https://doi.org/10.1021/acs.est.1c02837>
- Sousa, D., Brodrick, P., **Cawse-Nicholson, K.**, Fisher, J. B., Pavlick, R., Small, C., & Thompson, D. R. (2022). The Spectral Mixture Residual: A Source of Low-Variance Information to Enhance the Explainability and Accuracy of Surface Biology and Geology Retrievals. *Journal of Geophysical Research: Biogeosciences*, 127(2), e2021JG006672. <https://doi.org/10.1029/2021JG006672>

- Gustine, R.N., Lee, C.M., Halverson, G.H., Acuña, S.C., **Cawse-Nicholson, K.** et al. (2021). Using ECOSTRESS to Observe and Model Diurnal Variability in Water Temperature Conditions in the San Francisco Estuary. *IEEE Transactions on Geoscience and Remote Sensing*, 60, 1-10. <https://doi.org/10.1109/TGRS.2021.3133411>
- **Cawse-Nicholson, K.**, Anderson, M., Yang, Y., Yang, Y., Hook, S. J., Fisher, J., ... & Novick, K. (2021). Evaluation of a CONUS-wide ECOSTRESS DisALEXI evapotranspiration product. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. <https://doi.org/10.1109/JSTARS.2021.3111867>
- Thompson, D. R., Brodrick, P. G., **Cawse-Nicholson, K.**, Dana Chadwick, K., Green, R. O., Poulter, B., ... & Turpie, K. R. (2021). Spectral fidelity of Earth's terrestrial and aquatic ecosystems. *Journal of Geophysical Research: Biogeosciences*, 126(8), e2021JG006273. <https://doi.org/10.1029/2021JG006273>
- Fahlen, J. E., Brodrick, P. G., Thompson, D. R., Herman, R. L., Hulley, G., **Cawse-Nicholson, K.**, ... & Miller, C. E. (2021). Joint VSWIR-TIR retrievals of earth's surface and atmosphere. *Remote Sensing of Environment*, 267, 112727. <https://doi.org/10.1016/j.rse.2021.112727>
- Konings, A. G., Saatchi, S. S., Frankenberg, C., Keller, M., Leshyk, V., Anderegg, W. R. L., Humphrey, V., Matheny, A. M., Trugman, A., Sack, L., Agee, E., Barnes, M. L., Binks, O., **Cawse-Nicholson, K.**, Christoffersen, B. O., Entekhabi, D., Gentine, P., Holtzman, N. M., Katul, G. G., ... Zuidema, P. A. (2021). Detecting forest response to droughts with global observations of vegetation water content. *Global Change Biology*, 00, 1– 20. <https://doi.org/10.1111/gcb.15872>
- **Cawse-Nicholson, K.**, et al. (2021) NASA's surface biology and geology designated observable: A perspective on surface imaging algorithms. *Remote Sensing of Environment*, 257, 112349. <https://doi.org/10.1016/j.rse.2021.112349>
- Chen, W., Pinker, R.T., Ma, Y., Hulley, G., Borbas, E., Islam, T., **Cawse-Nicholson, K.A.**, Hook, S., Hain, C. and Basara, J., (2021). Land Surface Temperature from GOES-East and GOES-West. *Journal of Atmospheric and Oceanic Technology*. <https://doi.org/10.1175/JTECH-D-20-0086.1>
- Hulley, G. C., Göttsche, F. M., Rivera, G., Hook, S. J., Freepartner, R. J., Martin, M. A., **Cawse-Nicholson, K.**, Johnson, W. R. (2021). Validation and quality assessment of the ECOSTRESS level-2 land surface temperature and emissivity product. *IEEE Transactions on Geoscience and Remote Sensing*, 60, 1-23. <https://doi.org/10.1109/TGRS.2021.3079879>
- Loveless, M., Borbas, E.E., Knuteson, R., **Cawse-Nicholson, K.**, Hulley, G., Hook, S. (2021). Climatology of the Combined ASTER MODIS Emissivity over Land (CAMEL) Version 2. *Remote Sensing*, 13(1), 111. <https://doi.org/10.3390/rs13010111>
- Anderson, M.C., Yang, Y., Xue, J., Knipper, K.R., Yang, Y., Gao, F., Hain, C.R., Kustas, W.P., **Cawse-Nicholson, K.**, et al. (2021). Interoperability of ECOSTRESS and Landsat for mapping evapotranspiration time series at sub-field scales. *Remote Sensing of Environment*, 252, 112189. <https://doi.org/10.1016/j.rse.2020.112189>
- Kang, E.L.; Li, M.; **Cawse-Nicholson, K.**; Braverman, A. (2021). Modeling Large Multivariate Spatial Data with a Multivariate Fused Gaussian Process. *Journal of the Indian Statistical Association*. Vol. 592.
- Carmon, N., Thompson, D.R., Bohn, N., Susiluoto, J., Turmon, M., Brodrick, P.G., Connelly, D.S., Braverman, A., **Cawse-Nicholson, K.**, Green, R.O., Gunson, M. (2020). Uncertainty quantification for a global imaging spectroscopy surface composition investigation. *Remote Sensing of Environment*, 251, 112038. <https://doi.org/10.1016/j.rse.2020.112038>
- **Cawse-Nicholson, K.**, Braverman, A., Kang, E.L., Li, M., Johnson, M., Halverson, G., Anderson, M., Hain, C., Gunson, M., Hook, S. (2020). Sensitivity and uncertainty quantification for the ECOSTRESS evapotranspiration algorithm–DisALEXI. *International Journal of Applied Earth Observation and Geoinformation*, 89, 102088. <https://doi.org/10.1016/j.jag.2020.102088>
- Fisher, J.B., Lee, B., Purdy, A.J., Halverson, G.H., Dohlen, M.B., **Cawse-Nicholson, K.** et al. (2020). ECOSTRESS: NASA's next generation mission to measure evapotranspiration from the International Space Station. *Water Resources Research*, 56(4), e2019WR026058. <https://doi.org/10.1029/2019WR026058>

- Hook, S.J., **Cawse-Nicholson, K.**, Barsi, J., Radocinski, R., Hulley, G.C., Johnson, W.R., Rivera, G., Markham, B. (2019). In-Flight Validation of the ECOSTRESS, Landsats 7 and 8 Thermal Infrared Spectral Channels Using the Lake Tahoe CA/NV and Salton Sea CA Automated Validation Sites. *IEEE Transactions on Geoscience and Remote Sensing*, 58(2), 1294-1302. <https://doi.org/10.1109/TGRS.2019.2945701>
- **Cawse-Nicholson, K.**, Hook, S.J., Miller, C.E., Thompson, D.R. (2019). Intrinsic Dimensionality in Combined Visible to Thermal Infrared Imagery. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 12(12), 4977-4984. <https://doi.org/10.1109/JSTARS.2019.2938883>
- Schimel, D., Schneider, F.D., JPL Carbon and Ecosystem Participants (incl **Cawse-Nicholson, K.**) (2019). Flux towers in the sky: global ecology from space. *New Phytologist*, 224(2), 570-584. <https://doi.org/10.1111/nph.15934>
- Thompson, D.R., **Cawse-Nicholson, K.**, Erickson, Z., Fichot, C.G., Frankenberg, C., Gao, B.-C., Gierach, M.M., Green, R.O., Jensen, D., Natraj, V., Thompson, A. (2019). A unified approach to estimate land and water reflectances with uncertainties for coastal imaging spectroscopy. *Remote Sensing of Environment*, 231, 111198.
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- Pinker, R.T., Ma, Y., Chen, W., Hulley, G., Borbas, E., Islam, T., Hain, C., **Cawse-Nicholson, K.**, Hook, S., Basara, J. (2019). Towards a unified and coherent land surface temperature earth system data record from geostationary satellites. *Remote Sensing*, 11(12), 1399. <https://doi.org/10.3390/rs11121399>
- **Cawse-Nicholson, K.**, Fisher, J. B., Famiglietti, C. A., Braverman, A., Schwandner, F. M., Lewicki, J. L., Townsend, P. A., Schimel, D. S., Pavlick, R., Bormann, K. J., Ferraz, A., Kang, E. L., Ma, P., Bogue, R. R., Youmans, T., Pieri, D. C. (2018). Ecosystem responses to elevated CO<sub>2</sub> using airborne remote sensing at Mammoth Mountain, California, *Biogeosciences*, 15, 7403-7418. <https://doi.org/10.5194/bg-15-7403-2018>
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- A. Robin, **K. Cawse-Nicholson**, A. Mahmood, M. Sears. (2015). Estimation of the Intrinsic Dimension of Hyperspectral Images: Comparison of Current Methods, *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 8(6), 2854 – 2861. <https://doi.org/10.1109/JSTARS.2015.2432460>
- D. Kelbe, J. van Aardt, P. Romanczyk, M. van Leeuwen, **K. Cawse-Nicholson**, Single-scan stem reconstruction using sparse terrestrial laser scanner data, *Journal of Selected Topics in Applied Earth Observation and Remote Sensing (JSTARS)*, Vol. 8 (7), pp. 3414 – 3427, 2015. <https://doi.org/10.1109/JSTARS.2015.2416001>
- J. McGlinchy, J. van Aardt, B. Erasmus, G. Asner, R. Mathieu, K. Wessels, D. Knapp, T. Kennedy-Bowdoin, H. Rhody, J. Kerekes, E. lentilucci, J. Wu, D. Sarrazin, **K. Cawse-Nicholson**, Extracting structural vegetation components from smallfootprint waveform lidar for biomass estimation in Savanna ecosystems, *Journal of Selected Topics in Applied Earth Observation and Remote Sensing (JSTARS)*, Vol. 7 (2), pp. 480 – 490, 2014. <https://doi.org/10.1109/JSTARS.2013.2274761>
- **K. Cawse-Nicholson**, S. Damelin, A. Robin, M. Sears, Determining the intrinsic dimension of a hyperspectral image using Random Matrix Theory, *IEEE Transactions on Image Processing*, Vol. 22 (4), pp. 1301 –1310, 2013. <https://doi.org/10.1109/TIP.2012.2227765>
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