Carl Talsma

Research Scientist | **Carbon Solutions LLC**

Carl Talsma is a Research Scientist and Data Professional at Carbon Solutions LLC, a startup focusing on low-carbon energy Research & Development and Software & Services, including CO_2 capture and storage (CCS), energy storage, geothermal energy, and wind energy. His work focuses on harnessing the power of geospatial and satellite-based data to better inform infrastructure siting and impacts. Carl's work leverages AI and machine learning to provide insights into methane emissions from industrial sources. Before working for Carbon Solutions, Carl worked as a Research Technologist at Los Alamos National Laboratory where he focused on large scale watershed modeling and using machine learning approaches for analysis and understanding of water fluxes in the natural world. Carl currently lives in New Paltz, NY.

Contact

Phone:
+1-406-871-4059
Email:
talsmac83@gmail.com
LinkedIn:
linkedin.com/in/carl-talsma-58a805102

Education

M.Sc. | Water Resources Engineering | Oregon State University
2016-2018 | Graduate coursework in Remote Sensing, Machine Learning and Statistics

B.Sc. | Environmental Engineering | Cornell University
2011–2015 | Coursework in GIS, Statistics, and Computer Programming

Professional Experience

Research Scientist | Carbon Solutions LLC | 2021–Present

Data Analysis & Machine Learning:
Developed machine learning models to detect and quantify methane plumes and emissions using satellite-based imagery. Created operational machine learning algorithms for a software tool to estimate the cost and capacity of geologic CO2 sequestration. Tested and trained neural network models to emulate physics-based geologic simulations using keras and sci-kit learn in python.

***Project Management*:**
Applied for, won, and led a Phase I Small Business Innovation Research grant from NOAA. Managed a team of scientists as the principal investigator. Successfully developed a web-based prototype to detect and analyze methane emissions using satellite-based data, computer vision, and machine learning.

***Software Development*:**
Led backend development for multiple pieces of software using both Julia and Python programming languages. Created geospatial workflows for large vector and raster data. Implemented graph theory-based algorithms for routing of CO2 pipelines and MILP optimization models using CPLEX. Integrated APIs and developed frontend web maps using GeoServer, PostgreSQL, OpenLayers, and JavaScript.

Research Technologist | Los Alamos National Laboratory | 2020–2021

Post Masters Researcher | Los Alamos National Laboratory | 2018–2020

Data Analysis & Machine Learning:
Developed unsupervised and supervised machine learning models for frost prediction, gas well production, and forecasted hydrologic behavior. Published multiple peer-reviewed papers using machine learning techniques and contributed to SmartTensors, a novel machine learning library and a R&D100 award winning research tool.

Hydrologic Modeling:
Conducted large-scale hydrologic modeling using forecasted climate data and remote sensing-based data. Used machine learning and traditional statistical methods to interpret model results and determine future hydrologic impacts under climate change.

Graduate Research Assistant | **Oregon State University** | **2016–2018**

Remote Sensing of Evapotranspiration:

Validated and evaluated remote sensing-based evapotranspiration models from MODIS, the European Space Agency, and NASA's Jet Propulsion Laboratory. Determined the error associated with several models and their partitioning of evapotranspiration components. Used geospatial software and analysis tools included ArcGIS, QGIS, and Google Earth Engine.

Statistical Sensitivity Analysis:

Conducted a Monte Carlo sensitivity analysis of parameter uncertainty in evapotranspiration models to determine significant sources of error that might contribute to observational inaccuracy for each model.

Awards/Grants

- NOAA SBIR/STTR Phase I Award | MethaneDART | **2024**
- R&D 100 Information Technology Award | SmartTensors | **2021**
- R&D 100 Market Disruptor – Sevices Award | SmartTensors | **2021**
- SPOT Award | *Los Alamos National Laboratory* | **2019**
- Betty Minor Engineering Fellowship | *Oregon State University* | **2017**
- Irwin Jacobs Engineering Fellow | *Cornell University* | **2011-2015**

Skills

Programming Languages:

Python, Julia, JavaScript, MATLAB, R, Java, Bash, SQL

Software & Packages:

Scikit-learn, Keras, Git, ArcGIS, QGIS, Jupyter, GDAL, ArchGDAL.jl, Pygdal, Pandas, Numpy, Scipy, etc.

Key Publications

- **Talsma, C.J.**, Middleton, E., and Middleton, R. (2022). Costmappro: Addressing the Massive-Scale Co2 Pipeline Challenge. SSRN Electronic Journal. doi: 10.2139/SSRN.4273192
- **Talsma, C.J.**, Solander, K. C., Mudunuru, M. K., Crawford, B., and Powell, M. (2022). Frost Prediction Using Machine Learning and Deep Neural Network Models for Use on Iot Sensors. SSRN Electronic Journal.
- **Talsma, C. J.**, Bennett, K. E., and Vesselinov, V. V. (2022). Characterizing drought behavior in the Colorado river basin using unsupervised machine learning. Earth and Space Science 9.
- Bennett, K., **Talsma, C.J.**, Boero, R., (2021). Concurrent Changes in Hydroclimate Events in the Colorado River Basin. Water, 13(7), 978; *https://doi.org/10.3390/w13070978*
- Bennett, K., Miller, G., **Talsma, C.J.**, Jonko, A., Bruggernman, A., Atchley, A., Lavdie-Bulnes, A., Kwicklis, E., Middleton, R., (2019). Future Water Resources Shifts in the High Desrt Southwest of Northern New Mexico, USA. Journal of Hydrology: Regional Studies.
- **Talsma, C.J.**, Good, S.P., Jimenez, C., Martens, B., Fisher, J.B., Miralles, D.G., McCabe, M.F., Purdy, A.J., (2018). Partitioning of evapotranspiration in remote sensing-based models. Agriculture & Forest Meteorology. doi:10.1016/j.agrformet.2018.05.010
- **Talsma, C.J.,** Good, S.P., Miralles, D.G., Martens, B., Fisher, J.B., Jimenex, C., Purdy, A.J., McCabe, M.F., (2018). Sensitivity and Partitioning in Remote Sensing Based Evapotranspiration Models. Graduate Thesis, Oregon State University, Corvallis, OR. http://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/k643b6454.
- **Talsma, C.J.**, Good, S.P., Miralles, D.G., Martens, B., Fisher, J.B., Purdy, A.J., Jimenez, C., (2018). Sensitivity of transpiration, soil evaporation, and interception in remote sensing-based evapotranspiration models using a Monte Carlo analysis. Remote Sensing.

Proceedings & Key Presentations

- **Talsma, C.J.**, Bennett, K., Urrugo-Blanco, J.R., 2019. Changes in Joint Climate Extremes in the Colorado River Basin. American Geophysical Union, Fall Meeting 2019, Abstr. #H51P-1701
- **Talsma, C.J.,** Solader, K., Steinzig, M., Goddard, G., Sackos, J., 2019. Remote and Automated Monitoring in Agriculture to Devlop Site-Specific Mitigation and Crop Damage. U.S.-Mexico Border Water Sumit. Las Cruces, N.M. 24-25 April, 2019.
- **Talsma, C.J.,** Good, S.P., Jimenez, C., Martens, B., Fisher, J., 2017. Evaluation of Evapotranspiration Partitioning in Remote Sensing Models. American Geophysical Union, Fall Meeting 2017, Abstr. #H11M-08.
- **Talsma, C.J.,** Good, S.P., Jimenez, C., and Miralles, D. 2017. Evaluation of Evapotranspiration Partitioning in Satellite Driven Models. Pacific Northwest Water Research Symposium. Corvallis, Oregon. 6-7 March.