


Lukas Kugler

Curriculum Vitae

Postdoctoral research scientist at the University of Vienna

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RESEARCH VISION

A vast amount of information from satellite observations is not used to its full potential.

I am working towards unlocking this potential to understand and predict atmospheric processes through advancing data assimilation. I contributed to this mission by studying the assimilation of satellite and radar observations, leveraging the synergistic benefit of multiple satellite channels, and analyzing the consequences of violated assumptions by nonlinear observation operators.

PUBLICATIONS

Kugler, L., & Weissmann, M. (2025). Effects of observation operator nonlinearity on the assimilation of visible and infrared radiances in ensemble data assimilation. QJRM. Advance online publication.

<https://doi.org/10.1002/qj.4970>

Kugler, L., & Weissmann, M. (2025). The synergy of assimilating visible and infrared radiances and radar observations. QJRM. Advance online publication. <https://doi.org/10.1002/qj.4938>

Necker, T., Wolfgruber, L., **Kugler, L.**, Weissmann, M., Dorninger, M., & Serafin, S. (2024). The fractions skill score for ensemble forecast verification. QJRM, 150(764), 4457-4477. <https://doi.org/10.1002/qj.4824>

Kugler L. (2024). Assimilation of cloud-affected satellite observations for convective-scale numerical weather prediction. PhD thesis, University of Vienna. <https://doi.org/10.25365/thesis.75648>

Kugler, L., Anderson, J. L., & Weissmann, M. (2023). Potential impact of all-sky assimilation of visible and infrared satellite observations compared with radar reflectivity for convective-scale numerical weather prediction. QJRM, 149(757), 3623-3644. <https://doi.org/10.1002/qj.4577>

Kugler L. (2019): The Added Value of Machine Learning in Forecasting Wind Turbine Icing. MSc thesis, University of Vienna. <https://doi.org/10.25365/thesis.60595>

CONFERENCE PRESENTATIONS

04/2025 General Assembly of the European Geosciences Union, Vienna, AT
Poster: *Ambiguity and nonlinearity in the assimilation of visible and infrared observations*

10/2024 10th International Symposium on Data Assimilation, Kobe, JP
Talk: *On the Potential Impact of Visible and Infrared Radiance Assimilation and the Effect of Nonlinear Observation Operators*

06/2024 ISDA seminar on convective-scale data assimilation (online)
Talk: *Ambiguity and nonlinearity in the assimilation of visible and infrared observations*

10/2023 9th International Symposium on Data Assimilation, Bologna, IT
Talk: *Comparing the assimilation of visible and infrared satellite observations to radar reflectivity for convective-scale numerical weather prediction*

05/2023	Meeting of the Austrian Meteorological Society, Innsbruck, AT Poster: <i>The potential impact of assimilating cloud-affected visible and infrared satellite observations for convective-scale numerical weather prediction</i>
04/2023	General Assembly of the European Geosciences Union, Vienna, AT Talk: <i>Assimilating cloud-affected visible & infrared satellite observations in idealized simulations</i>
06/2022	8 th International Symposium on Data Assimilation, Fort Collins, CO, USA Talk: <i>Assimilating visible & infrared satellite observations for convective scale NWP</i>
05/2022	General Assembly of the European Geosciences Union, Vienna, AT Talk: <i>Assimilating visible & infrared satellite observations for convective scale NWP</i>
11/2019	1st Artificial Intelligence for Copernicus workshop, Reading, UK Invited talk: <i>Machine learning techniques for high-impact-weather (flood forecasts)</i>
09/2019	Workshop of the European Summer of Weather Code (ESoWC), Reading, UK Invited talk: <i>Machine learning techniques for high-impact-weather (flood forecasts)</i>

WORK / RESEARCH POSITIONS

08/2024 - 07/2025	Project Scientist (Postdoctoral Research Scientist) Department of Meteorology and Geophysics, University of Vienna • Employed in the project "Demonstrating parameter estimation with ensemble-based DA" (doi: 10.55776/P37259)	Vienna, AT
03/2020 - 04/2024	University Assistant (Doctoral Research Assistant) Department of Meteorology and Geophysics, University of Vienna • Research on the topic "All-sky assimilation of visible and infrared satellite observations for convective-scale numerical weather prediction" • Teaching of Bachelor and Master tutorials (see Teaching section)	Vienna, AT
10/2017 - 08/2019	Assistant Model Developer UBIMET GmbH (private weather service) • Taking care of continuously running forecast models from a software and meteorological perspective • Experiments for improving the used parametrizations and source-code development for the land-surface-model parametrization • Developing data-driven blending methods of forecast models • Rewriting legacy code in python to improve the speed of execution • Providing code to handle large data volumes for the most used file formats in python for plotting, verification, analytics	Vienna, AT

EDUCATION

03/2020 - 04/2024	PhD Meteorology (Dr.rer.nat) Department of Meteorology and Geophysics, University of Vienna Topic: "Data assimilation of cloud-affected satellite observations for convective-scale numerical weather prediction"	Vienna, AT
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10/2017 - 01/2020	MSc Meteorology Department of Meteorology and Geophysics, University of Vienna Thesis topic: Added Value of Machine Learning in Forecasting Wind Turbine Icing	Vienna, AT
10/2013 - 09/2017	BSc Meteorology Department of Meteorology and Geophysics, University of Vienna Thesis topic: Parameterizing the asphalt surface temperature (in German)	Vienna, AT

CONFERENCE PRESENTATIONS

04/2025	General Assembly of the European Geosciences Union, Vienna, AT Poster: <i>Ambiguity and nonlinearity in the assimilation of visible and infrared observations</i>	
10/2024	10 th International Symposium on Data Assimilation, Kobe, JP Talk: <i>On the Potential Impact of Visible and Infrared Radiance Assimilation and the Effect of Nonlinear Observation Operators</i>	
06/2024	Online International Symposium on Data Assimilation, (online) Talk: <i>Ambiguity and nonlinearity in the assimilation of visible and infrared observations</i>	
10/2023	9 th International Symposium on Data Assimilation, Bologna, IT Talk: <i>Comparing the assimilation of visible and infrared satellite observations to radar reflectivity for convective-scale numerical weather prediction</i>	
05/2023	Meeting of the Austrian Meteorological Society, Innsbruck, AT Poster: <i>The potential impact of assimilating cloud-affected visible and infrared satellite observations for convective-scale numerical weather prediction</i>	
04/2023	General Assembly of the European Geosciences Union, Vienna, AT Talk: <i>Assimilating cloud-affected visible & infrared satellite observations in idealized simulations</i>	
06/2022	8 th International Symposium on Data Assimilation, Fort Collins, CO, USA Talk: <i>Assimilating visible & infrared satellite observations for convective scale NWP</i>	
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11/2019	1st Artificial Intelligence for Copernicus workshop, Reading, UK Invited talk: <i>Machine learning techniques for high-impact-weather (flood forecasts)</i>	
09/2019	Workshop of the European Summer of Weather Code (ESoWC), Reading, UK Invited talk: <i>Machine learning techniques for high-impact-weather (flood forecasts)</i>	

TEACHING EXPERIENCE

Summer 2021 - Summer 2022	“Physical Concepts” , Bachelor Meteorology, University of Vienna The course covered the basics of thermodynamics, radiation and hydrodynamics and was conducted for students of Meteorology and Astronomy as a collaboration between the Department for Meteorology and the Department for Astrophysics
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Winter 2022	<p>“Dynamics of the Atmosphere”, Bachelor Meteorology, University of Vienna</p> <p>The course covered fundamental forces, equations of motion in various coordinates, approximations to the equations, vorticity equation, atmospheric waves.</p>
Summer 2023	<p>“Advanced Data Assimilation”, Master Meteorology, University of Vienna</p> <p>I pioneered a hands-on course where students could learn concepts of data assimilation with practical examples using the Data Assimilation Research Testbed (DART) and forecast data from the Weather Research and Forecasting Model (WRF). The course introduced DART, WRF and covered Bayes theorem, forecast verification, sequential assimilation, localization, inflation, overfitting of observations and the theoretical optimum for spread.</p>

AWARDS

09/2019	<p>Awardee of the ESoWC challenge</p> <p>Our two-person team was awarded € 5k in a challenge hosted by ECMWF-Copernicus for developing and disseminating Machine Learning river flood forecast models trained on ERA5 reanalysis data</p>	Reading, UK
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PROGRAMMING

- **Programming languages, etc:** Python, Fortran, Bash, Matlab, Git, LaTeX
- **HPC knowledge/skills** from various HPC systems; for speed-up and efficiency of code using MPI (python/Fortran) and OpenMP; learned through experience, semester-long elective courses “Computer Architecture and High Performance Computing”, “Databases and Visualization”, “Algorithms and Data Structures”, and PRACE HPC workshops in Barcelona and Amsterdam (2018)
- **Open-source software projects:**
 - [DART-WRF](#): Digital lab for observing-system simulation experiments with WRF, DART, and RTTOV to quickly iterate through a large number of various configurations, managing concurrently running experiments and program dependencies through HPC queueing systems.
 - [RTTOV-WRF](#): Simulate SEVIRI satellite observations from WRF NWP model output.
 - [ECMWFCode4Earth/ml_flood](#): Demonstrator and tutorial for ML in river flood forecasting and other projects
- **Contributions to other software projects:**
 - [NCAR/DART](#): Testing and bug fixes of the RTTOV radiative transfer interface

OTHER

- **Languages:** German (native), English (C2)
- **Citizenship:** Austrian