Dr. Nikolay Koldunov

Curriculum Vitae

✉ *nikolay.koldunov@awi.de*
http://koldunovn.github.io
Maried, three children

Education

2006–2010 **Ph.D. (Dr. rer. nat.), Physical Oceanography**, *University of Hamburg*, Hamburg.
Thesis: Variability of Arctic sea ice

2002–2004 **M.Sc., Applied Polar and Marine Science**, *Department of Geosciences, University of Bremen*, Bremen.

2002–2004 **M.Sc., Hydrometeorology**, *Faculty of Geography and Geoecology, State University of St. Petersburg*, St. Petersburg.

1998–2002 **B.Sc., Oceanography**, *Faculty of Geography and Geoecology, State University of St. Petersburg*, St. Petersburg.

Professional Experience

2022–present **Senior Scientist**, *Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research*.
Multiple projects

2020–2022 **Scientist**, *Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research*.
Project S1 (Diagnosis and Metrics in Climate Models) of the Collaborative Research Centre TRR 181 "Energy Transfer in Atmosphere and Ocean", second phase.

2016–2020 **Scientist**, *MARUM - Center for Marine Environmental Sciences,*.
Project S1 (Diagnosis and Metrics in Climate Models) of the Collaborative Research Centre TRR 181 "Energy Transfer in Atmosphere and Ocean".

2014–2016 **Scientist**, *Climate Service Center Germany (GERICS)*.
GLACINDIA Project.

2010–2014 **Scientist**, *Institute of Oceanography, University of Hamburg*.
Projects: EU FP7 MONARCH-A, ESA CCI Sea Ice ECV.

2006–2010 **PhD Student**, *Max Planck Institute for Meteorology*, International Max Planck Research School on Earth System Modelling.

2004–2006 **Research Assistant**, *Arctic and Antarctic Research Institute (AARI)*.

Technical Skills

Programming Python, UNIX/Linux shell scripting (bash, tcsh, zsh), MATLAB, FORTRAN, NCL, Julia, Go.

Software development git, Docker, advanced user of GitHub and GitLab, experience with continuous integration (GitHub actions, Travis CI)

Data analysis	Lead developer of pyfesom2 and fdiag. Jupyter and Jupyter notebooks, xarray, Dask, Pandas, SciPy, NumPy, Numba, netCDF4, cdo, Ferret, R.
Visualization	Matplotlib, Cartopy, Bokeh, Basemap, Seaborn, PyNGL, NCL, Tableau, Generic Mapping Tools (GMT), ParaView.
Numerical Modelling	FESOM (part of development team), MITgcm, AWI-CM, REMO, ECHAM5/MPIOM, ANUGA
Operating systems and Applications	Linux (advanced user), OS X (power user), Windows (power user). LaTeX, MS Offce, Open Offce, GIMP.
Web	Flask, Pelican, Content Management Systems (Wordpress, Drupal, Joomla), phpBB, phpMyAdmin, basics of MySQL, mongoDB, experience with cloud platforms (Amazon Web Services, Digital Ocean).

Teaching

2014–present	**Python for Geosciences**, *A one day course for colleagues*, many different occasions, 460 stars on GitHub.
2021–2024	**Working with climate model data**, *Block course*, Bremen University, Data Train.
2021–2024	**Getting started with Python**, *Block course*, Bremen University, Data Train.
2014–2016	**Data analysis in oceanography**, *Semester course*, HafenCity University, Hamburg.
2015	**Computer programming**, *Block course*, Jawaharlal Nehru University, New Delhi. India
2011	**Climate models data: present and future climate change simulations**, *Block course*, Summer School on Climate and Environmental Change, Russian State Hydrometeorological University.
2010	**Introduction to Programming for Geoscientists**, *Block course*, State University of St. Petersburg, POMOR master program.
2003–2005	**Oceanographic measurements**, *Field (summer) course for university students*, State University of St. Petersburg, Department of Oceanography.

Funding

2025–2028	**Digital Twin Of Earth System For Cryosphere, Land Surface And Related Interactions (TerraDT)**, *EU*, €1 460 000 for AWI, Work package lead.
2024–2026	**Destination Earth Program Climate Adaptation Digital Twin (Climate DT). Phase II**, *EU*, €2 700 000M for AWI, Several activity's lead and co-lead.
2024-2028	**Collaborative Research Center TRR 181 "Energy transfers in Atmosphere and Ocean" Phase III, subproject S1 "Diagnosis and Metrics in Climate Models"**, *DFG*, four E13 years for AWI (50% AWI contribution).
2024	**Efficient Climate Modeling: Developing a Modular Sea Ice Emulator for FESOM**, *AWI*, 1 FTE for a year, co-PI.
2024	**LLM-Based Chatbots at the Alfred Wegener Institute**, *AWI*, 2 FTE for a year, PI.

2024–2027 **Helmholtz Representation Model for Climate Science**, *Helmholtz Association*, € 987 508 for AWI, collaborator.

2024–2027 **Enabling Lagrangian Particle Tracking for High-resolution and unstructured Meshes (ELPHE)**, *BMBF*, no funds for AWI, collaborator.

2023–2026 **European Eddy-RIch Earth System Models (EERIE)**, *EU*, 110 PM (€1 039 532), WP co-PI.

For most of the projects before 2022 I never had a change to become a PI (in large due to DFG and EU regulations, that prohibit working on anything else while at 100% contract). However, I made significant contributions to writing the following proposals (only successful or submitted are listed):

2023–2024 **Destination Earth Programme Climate Adaptation Digital Twin (Climate DT)**, *EU*, 80 PM for AWI.

2022 **Booster for FESOM 2.1**, *Nationale Modellierungsstrategie (natESM)*, 6PM of natESM experts support for FESOM2 porting to GPU.

2022–2025 **Data-based Probabilistic Parameter Estimation for Ocean and Earth System Models**, *AWI INSPIRES/MarDATA*, 100% E13 for 3 years.

2021–2024 **Eddy Properties and Impacts in the Changing Arctic (EPICA)**, *BMBF*, 5 (3+2) E13 years (€700 000).

2021–2024 **Changes Across Scales in the Arctic Ocean (CASA)**, *AWI INSPIRES*, 80% E13 for 3 years.

2021–2024 **Enabling Dynamic and Intelligent Workflows in the Future EuroHPC Ecosystem (eFlows4HPC)**, *EuroHPC and BMBF*, 3 E13 years for AWI (€430 000).

2020-2024 **Collaborative Research Center TRR 181 "Energy transfers in Atmosphere and Ocean", subproject S1 "Diagnosis and Metrics in Climate Models"**, *DFG*, 4 E13 years for AWI (50% AWI contribution) out of total 13.5 E13 years for the subproject.

2020-2021 **Virtual Field Campaign, subproject in Advanced Earth System Modelling Capacity (ESM) project**, *HGF*, 1.5 years for AWI (€125 000) out of total 3 years for the subproject.

2020-2021 **Preparatory Access project "FESOM2 Finite volumE Sea ice Ocean Model enhancement", PRACE (Partnership for Advanced Computing in Europe)**, *PRACE*, 6PM of PRACE experts support for FESOM2 optimization.

2020-2021 **ESiWACE 2 Service proposal for porting parts of FESOM2 to GPU**, *ESiWACE*, We won in 2 calls and get in total 12 PM of support from ESiWACE experts.

2019-2022 **Machine learning approaches for sea ice-ocean modelling with FESOM2**, *Helmholtz School for Marine Data Science (MarData)*, 3 E13 years co-financed by ESM project.

Organisation of Scientific Meetings

2025 **WCRP Digital Earths global hackathon 2025 planning committee**, ≈ *500 participants*, MPI-M.

2024 **nextGEMS hackathon organizing committee**, ≈ *100 participants*, MPI-M.

2023 **EERIE Hackathon Organizing Committee**, ≈ *60 participants*, AWI.

2020 **FESOM days: Two-day meeting of FESOM users**, ≈ *80 participants*, AWI.

2015 **GLACINDIA: Stakeholder Workshop on Identifying Climate Change Information Needs and Training on Climate modeling and Climate Change Research, innovation and Services"**, *Jawaharlal Nehru University (JNU)*, New Delhi, India, ≈ 100 participants.

Field Experience

2003–2005, 2007 NABOS expedition to the Laptev Sea on diesel icebreaker "Kapitan Dranicyn" (2003, 2004, 2005) and RV "Viktor Buynitsky" (2007). Work as oceanographer and ice observer.

Language Competency

English Fluent spoken and written

Russian Mother tongue

German Intermediate

Publication activity

h-index Google scholar: 34, Web of Science: 27, Scopus: 28

Google scholar `https://scholar.google.com/citations?user=Zl6s_5UAAAAJ&hl=en`

ORCID `https://orcid.org/0000-0002-3365-8146`

Invited presentations

2024

KU11 außerplanmäßiges Wissenschaftsseminar, DWD, "LLMs for science: how can we use them now?", Online.

Annual meeting of PoF IV Topic 2: Ocean and Cryosphere in Climate Change, "AI for climate science applications", Potsdam

Using ECMWF's Forecasts (UEF2024), "Leveraging Large Language Models for Weather and Climate Information Retrieval", Online

RTG (TRR181) Spring School, "ML in Weather and Climate", Online.

Publications in Refereed Journals

Submitted/in preparation

Oziel, L., Gürses, Ö., Torres-Valdes, S., Hoppe, C., Rost, B., Danek, C., Juhls, B., Voelker, C., **Koldunov, N.**, Wang, Q. and Iversen, M., 2024. Climate Change and terrigenous inputs decrease the efficiency of the future Arctic Ocean's biological carbon pump.

Moon, J.-Y., Streffing, J., Lee, S.-S., Semmler, T., Andrés-Martínez, M., Chen, J., Cho, E.-B., Chu, J.-E., Franzke, C., Gärtner, J. P., Ghosh, R., Hegewald, J., Hong, S., **Koldunov, N.**, Lee,

J.-Y., Lin, Z., Liu, C., Loza, S., Park, W., Roh, W., Sein, D. V., Sharma, S., Sidorenko, D., Son, J.-H., Stuecker, M. F., Wang, Q., Yi, G., Zapponini, M., Jung, T., and Timmermann, A.: Earth's future climate and its variability simulated at 9 km global resolution, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2024-2491, 2024.

Koldunov, Nikolay, Thomas Rackow, Christian Lessig, Sergey Danilov, Suvarchal K. Cheedela, Dmitry Sidorenko, Irina Sandu, and Thomas Jung. "Emerging AI-based weather prediction models as downscaling tools." arXiv preprint arXiv:2406.17977 (2024).

Rackow, T., Pedruzo-Bagazgoitia, X., Becker, T., Milinski, S., Sandu, I., Aguridan, R., Bechtold, P., Beyer, S., Bidlot, J., Boussetta, S., Diamantakis, M., Dueben, P., Dutra, E., Forbes, R., Goessling, H. F., Hadade, I., Hegewald, J., Keeley, S., Kluft, L., **Koldunov, N.**, Koldunov, A., Kölling, T., Kousal, J., Mogensen, K., Quintino, T., Polichtchouk, I., Sármány, D., Sidorenko, D., Streffing, J., Sützl, B., Takasuka, D., Tietsche, S., Valentini, M., Vannière, B., Wedi, N., Zampieri, L., and Ziemen, F.: Multi-year simulations at kilometre scale with the Integrated Forecasting System coupled to FESOM2.5/NEMOv3.4, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2024-913, 2024.

2024

[72] Xu J, Wu H, Zhi X, **Koldunov NV**, Zhang X, Xu Y, Zhang Y, Guo M, Kong L, Fraedrich K. Validation of Multisource Altimeter SWH Measurements for Climate Data Analysis in China's Offshore Waters. *Remote Sensing*. 2024; 16(12):2162. https://doi.org/10.3390/rs16122162

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[70] Liu, C., Wang, Q., Danilov, S., **Koldunov, N.**, Müller, V., Li, X., et al. (2024). Spatial scales of kinetic energy in the Arctic Ocean. *Journal of Geophysical Research: Oceans*, 129, e2023JC020013. https://doi.org/10.1029/2023JC020013

[69] Müller, V., Wang, Q., **Koldunov, N.**, Danilov, S., Sidorenko, D., and Jung, T. (2024). Variability of eddy kinetic energy in the Eurasian Basin of the Arctic Ocean inferred from a model simulation at 1-km resolution. Journal of *Geophysical Research: Oceans*, 129, e2023JC020139. https://doi.org/10.1029/2023JC020139

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[66] **Koldunov, N.**, Jung, T. Local climate services for all, courtesy of large language models. *Commun Earth Environ* 5, 13 (2024). https://doi.org/10.1038/s43247-023-01199-1

2023

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2022

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2021

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2020

[50] Wang, Q., **Koldunov, N. V.**, Danilov, S., Sidorenko, D., Wekerle, C., Scholz, P., et al.. (2020). Eddy Kinetic Energy in the Arctic Ocean from a Global Simulation with a 1-km Arctic. *Geophysical Research Letters*, 47, e2020GL088550. https://doi.org/10.1029/2020GL088550

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2019

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