The Max Planck Institute for Biogeochemistry (MPI-BGC) in Jena is dedicated to interdisciplinary fundamental research in the field of Earth system sciences with a focus on climate and ecosystems. The internationally renowned institute, which currently employs around 230 people, will celebrate its 25th anniversary in 2022. Jena is known for high-tech industry, internationally renowned research institutions and a modern university, but it also has a beautiful natural setting in the green Saale valley with steep limestone slopes. The city of Jena has an active student scene and a diverse cultural life. For the Global Diagnostic Modeling group (tinyurl.com/nvchen6u79) within the Department of Biogeochemical Integration, we are inviting applications for a

**PhD position on combining physically-based modeling and deep learning for coupled water-carbon cycle modeling (m/f/d)**

*(full-time, 3 years)*

**Background and position description:**

The combination of deep learning and physically-based modeling (hybrid modeling) has been proposed recently for solving some of the current challenges in the Earth sciences (Reichstein et al., 2019, tinyurl.com/3svye3ym). The representation of uncertain processes with flexible deep learning approaches within physically-based models could improve the predictability and understandability of highly complex environmental processes. The applicability of hybrid modeling on large scales has been demonstrated by Kraft et al. (2021, tinyurl.com/6hpu9k9a) by combining a hydrological model with a deep learning approach. The next step is the coupling with the carbon cycle, as the two cycles are known to strongly interact (Jung et al., 2017, tinyurl.com/38wpwrby). The project emphasizes the quantification of uncertainties to guide model development effectively.

In this project we seek to develop a hybrid model of the coupled global water and carbon cycles, building upon the approach described in Kraft et al. (2021). The candidate (m/f/d) will explore pathways to constrain the model with various Earth observation datasets and prior knowledge. The project is conducted in close collaboration with a companion PhD project at the Technical University of Munich (TUM) Computer Vision Research Group (tinyurl.com/3z8sjsen) at the Chair of Remote Sensing Technology, which focusses on formal uncertainty quantification of deep neural networks.

**Your tasks:**

- Developing a hybrid model of the coupled carbon and water cycle building upon the existing model from Kraft et al. (2021)
- Add additional data and knowledge constraints to improve model robustness
- Analyze simulated carbon-water cycle covariations
- Quantify and attribute model uncertainties in collaboration with the TUM
- Interact with researchers across the group, the department, and with the external project collaborators
- Publish papers in peer-reviewed journals

**Your profile:**

We are looking for a motivated candidate (m/f/d) with a strong interest in Earth sciences, data analysis, and machine learning. The successful candidate (m/f/d) will work in close collaboration with an international and diverse research team. Requirements are:
- A Master's degree (or equivalent) in computer science, geoinformatics, geosciences, remote sensing, or similar
- Strong programming skills, preferably in Python
- Knowledge in processing and analyzing large data sets, machine-learning, statistical analysis
- Ideally experience with deep learning frameworks (e.g., PyTorch)
- Self-driven personality able to work both independently and in a team
- Excellent oral and written communication skills in English

Our offer:
The PhD position offers a unique opportunity in the field of data driven Earth system modeling in close collaboration with domain, machine learning, and remote sensing experts. The position is expected to start in early 2022, and will be in collaboration with Prof. Dr. Markus Reichstein, Dr. Martin Jung, MSc. Basil Kraft, and Dr. habil. Marco Körner. Payment will be 65% TVöD E13, but additional bonuses are possible, for more information please contact bkraft@bgc-jena.mpg.de.

The Max Planck Society (MPS) strives for gender equality and diversity. The MPS aims to increase the proportion of women in areas where they are underrepresented. Women are therefore explicitly encouraged to apply. We welcome applications from all fields. The Max Planck Society has set itself the goal of employing more severely disabled people. Applications from severely disabled persons are expressly encouraged.

Your application:
For further inquiries, please contact Basil Kraft (bkraft@bgc-jena.mpg.de). Are you interested? Please send us your application with cover letter, curriculum vitae as well as names and contact information of two references summarised in a PDF file (max. 10 MB) by e-mail to bewerbung@bgc-jena.mpg.de or to the

Max-Planck-Institut für Biogeochemie
Personalbüro: Kennwort “Doktorand für Wasser-Kohlenstoff-Modellierung”
Hans-Knöll-Straße 10
07745 Jena

by September 30, 2021, quoting the reference number 22/2021. We kindly ask you not to submit copies of your application documents only, as your documents will be destroyed in accordance with data protection regulations after completion of the application procedure.

We look forward to receiving your application!