HELMHOLTZ AI | ARTIFICIAL INTELLIGENCE COOPERATION UNIT

DKRZ DEUTSCHES KLIMARECHENZENTRUM

Unlocking the Potential of ML for Earth and Environment Researchers

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AI Consultants Earth & Environment @DKRZ

Helmholtz AI

Artificial Intelligence Cooperation Unit

Mission

Bring applied AI / ML techniques to your research questions and datasets

6 LOCAL UNITS

- Earth @ HZG
- Energy @ KIT
- Matter @ HZDR
- Space @ DLR
- Health @ HMGU
- Info @ FZJ

Each Unit

- Young Investigator Group
- AI Consultants

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AI Consultants for Earth & Environment

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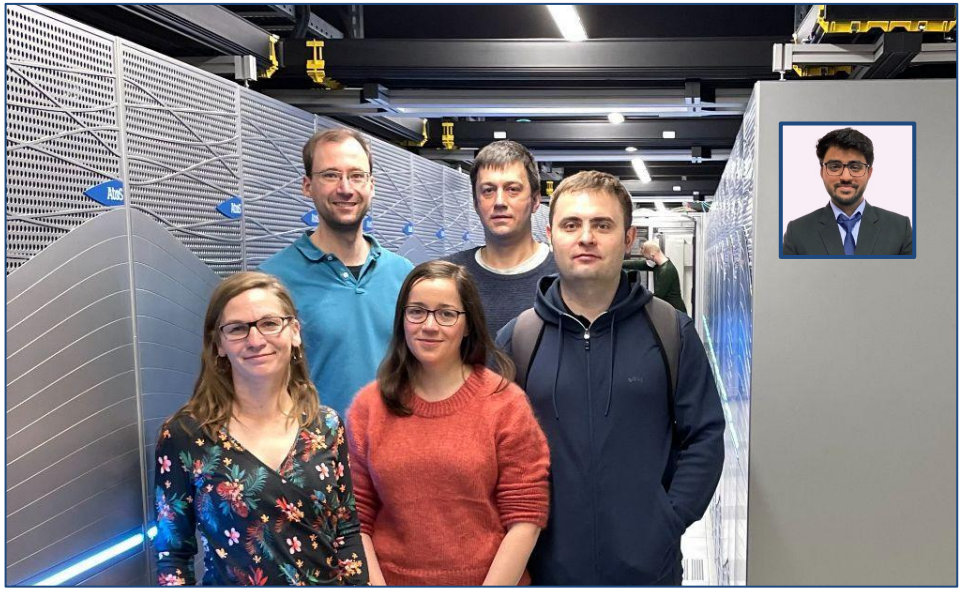


Vouchers from all
Earth & Environment
Helmholtz Centers

AWI
GFZ Helmholtz-Zentrum Potsdam
GEOMAR
UFZ HELMHOLTZ Zentrum für Umweltforschung
DLR Deutsches Zentrum für Luft- und Raumfahrt
JÜLICH Forschungszentrum
Helmholtz-Zentrum hereon
KIT

Vouchers

Selected user questions

Consultation

„I already use ML for my research project, however most of my colleagues work with different techniques.“

We act as a „sparring partner“, give feedback and suggestions, research minor issues, …

Implementation

„I have data at hand and I know what I want to achieve, but I need help with my ML research project.“

We implement code for ML training, data processing, …

Performance

„I have running ML code but it does not scale well / does not run fast enough.“

We support you with performance analysis and code review

Your question?

No voucher is like the other – contact us for help with your machine learning project!

Focus Areas for Support

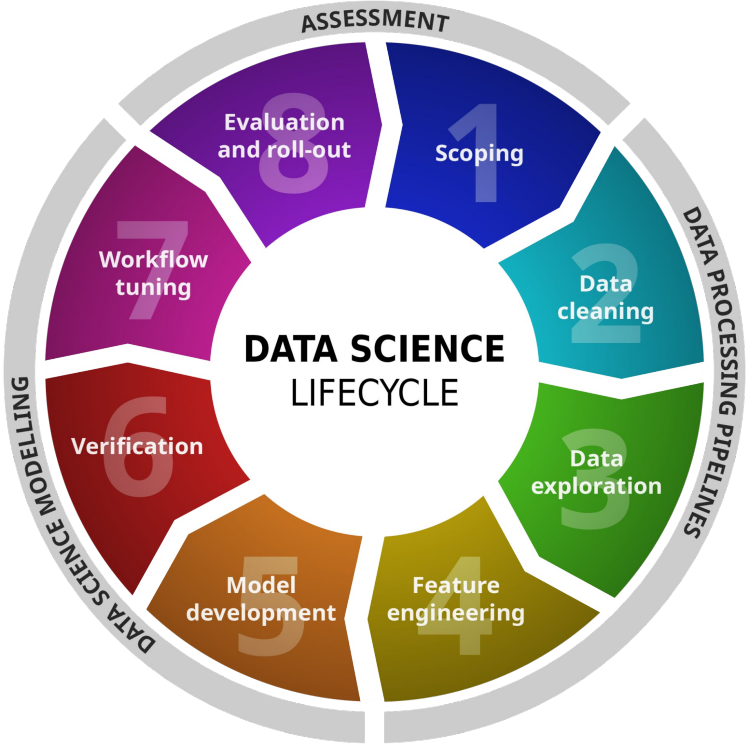
ML for Earth System Modelling

- **Building ESM-ML hybrids**
- Parametrizations for ICON
- Prototype ML models and integration with ESM code
- Interactive digital twins for extrapolation

ML on Earth observation data

- **Support for training, testing, tuning, deploying EO workflows with ML**
- Time series, example: Seismology
- Image-like data (e.g. jpg-images or Satellite images), example: Dead Sea Lakebed Segmentation

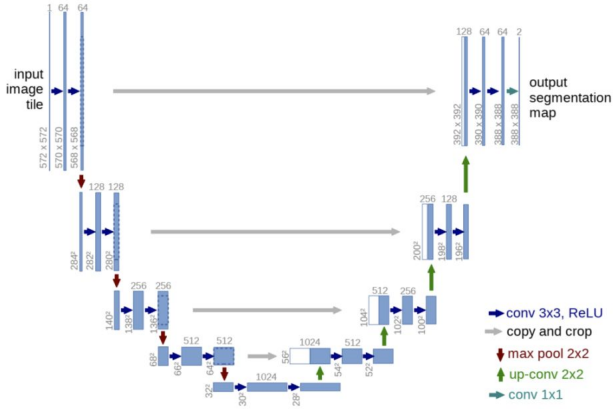
Full Data Science Lifecycle



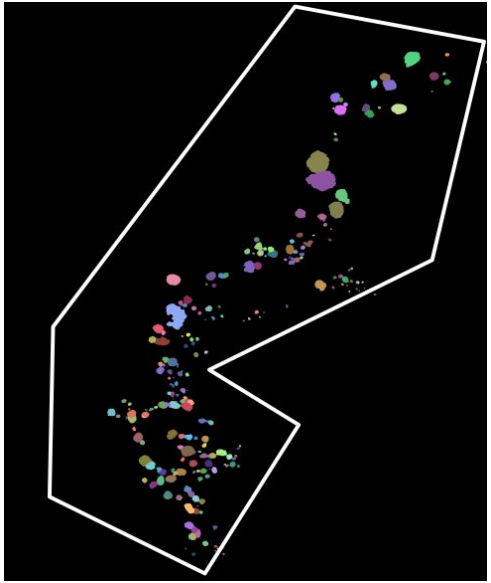
Dead Sea Lakebed Segmentation

Objective:
Perform sinkhole **Instance Segmentation** using deep learning techniques

Input



UNet Architecture



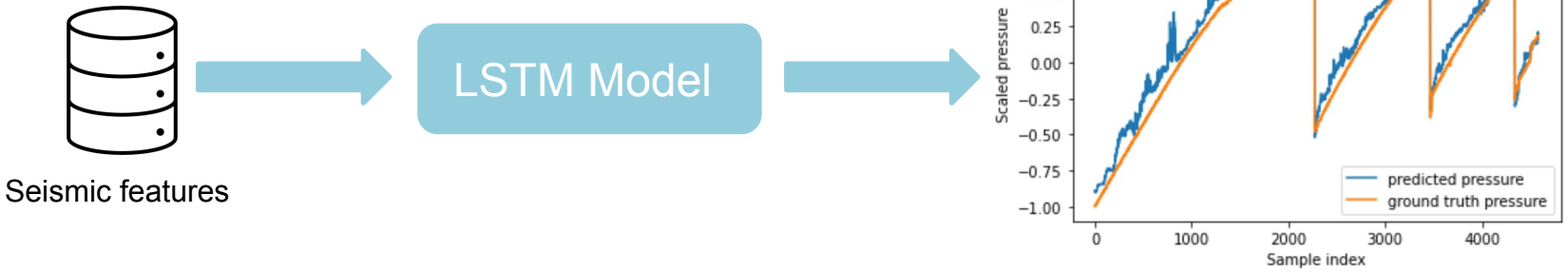
Sinkhole Instance Segmentation

Seismology

GFZ Helmholtz-Zentrum Potsdam

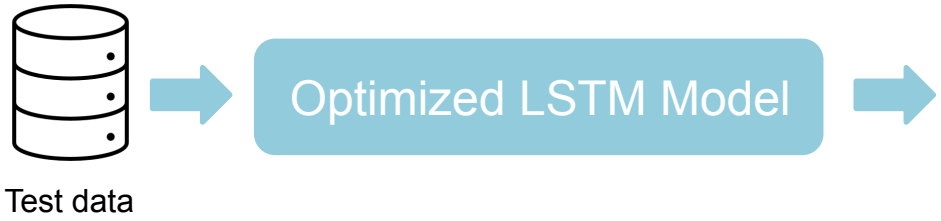
Objective:
Importance of **scientifically established** seismological features through the eyes of a neural network

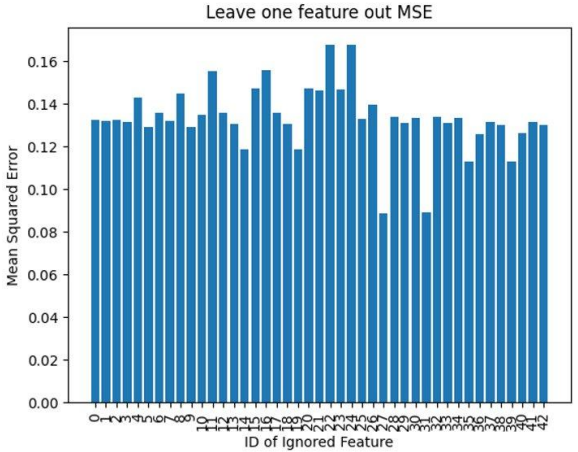
Phase 1:
Train optimal sequence model using a **Long Short Term Memory** neural network to predict pressure



Seismology

Phase 2:
Using **test** data and the **optimized** model from phase 1 to compute the error when one feature is ignored

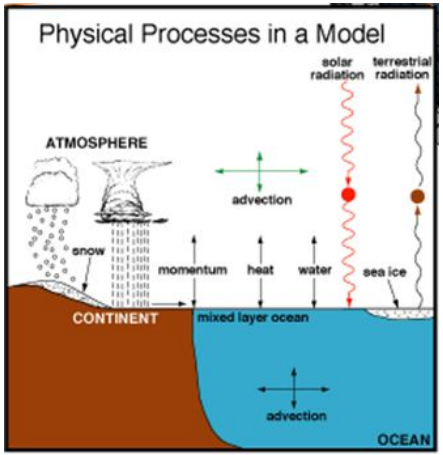




ML Emulators in Earth System Models (ESMs)

- ESM: few km grid resolution
- Processes on smaller scales, e.g.
  - convection
  - atmospheric chemistry
- Treatment in the ESM
  - parameterization
  - neglected due to computational effort

ICON: ICOsahedral Nonhydrostatic model



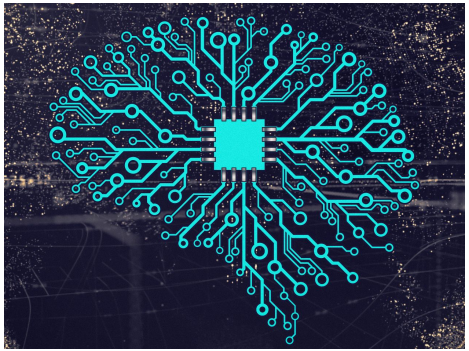
Replace sub-grid scale process by ML prediction

- "Easy" to train offline with good accuracy
- Need to test online - coupled to the ESM

Hybrid Models: Rapid Development

FORTRAN / CPU

Python / GPU or CPU



Voucher request

- Call Python ML inference inside Fortran ESM
- Should allow for iterative development - not hard coded
- Should be performant to run experiments

What is required for a good Voucher Problem?

(Big) data

A challenge

A client

Contact us to jumpstart your AI project:
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