Amir is a geophysicist that specializes in marine electromagnetic modelling and inversion. He received a PhD in 2016 from the University of Cologne for his research on offshore groundwater aquifers located along the Mediterranean coast of Israel. He joined GEOMAR in 2018 and currently works on processing, interpretation, and integration of marine geophysical data acquired for offshore groundwater and ore exploration.

Project Summary: Uncertainty quantification of automated machine learning strategies used to interpret marine data – A showcase from deep-sea lithological mapping and mineral exploration

A holistic understanding of the earth and the processes that dictate the interaction of humans with their environment requires a thorough analysis of multivariate data that cross existing Earth science disciplines and earth compartments. In order to cope with the mass of data that environmental scientists are confronted with, methodologies from Data science offer a promising toolbox that guarantee coherent workflows and processing chains. Yet, a successful integration of these methodologies demands tailored procedures that meet the specific requirements of environmental research. One of these issues is related to uncertainty quantification of the interpretation based on quantifiable uncertainty, e.g. random (gaussian) noise, unquantifiable uncertainty, e.g. systematic measurement errors, or uncertainties associated with the applied learning kernel of the Data science workflow. In this field, the Helmholtz Centre for Environmental Research - UFZ is leading the frontier for Earth related data science. The framework of the Bridging Postdoc offers the possibility to establish a collaborative transfer of expertise from UFZ to the
Helmholtz Centre for Ocean Research - GEOMAR, thereby pushing forward in the field of uncertainty quantification using multivariate data analysis. The presented research objectives are in principle applicable to a broad spectrum of applications in earth science, but will be exemplified through a specific showcase from marine mineral exploration and lithology mapping. The developments will not only enable an automated categorization of seafloor lithology, but are expected to benefit all domains of marine research activities at GEOMAR through a more robust understanding of uncertainty in Data science practises.

Figure 1: Measured geophysical and geological data from the TAG hydrothermal field at the Mid-Atlantic Ridge. (a) Locations and interpretations of gravity cores throughout the survey area. (b) Grab samples from several SMS locations in the area. (c) Marine transient electromagnetic data measured in small-scale regions. d) Local, AUV-based self-potential data interpolated on a local scale. (e) AUV- and ship-based bathymetry mapping at different resolution scales of 2 m and 30 m. (f) Overlay of bathymetry, AUV-based magnetics and CSEM conductance. Figures e and f are from Gehrmann et al. (2019), (a), (b) and (d) from Petersen et al. (2016b).