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MEETING

The Science Behind Laboratory-Scale Models of the Earth

Workshop on Advances in Quantitative Analogue Modelling (AiQAM); Potsdam, Germany, 23–25 September 2013

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Deformation processes involve systems of tens to hundreds of kilometers moving at highly variable rates. Because direct kinematic observations have proven difficult, geoscientists are sometimes found in the lab creating analogs, or laboratory models of the Earth. The main scope—and a key challenge—of laboratory modeling of Earth systems is to provide a quantitative approach for understanding geological processes. Since the last decade, various image analysis techniques in laboratory modeling have been designed and used to constrain the kinematics of the simulated processes at an unprecedented resolution. These techniques prove to be the key quantification tools in experimental modeling, not only allowing mechanical analysis of the experiments but also producing experimental data sets that are directly comparable to geophysical and geodetic data in nature and numerical models.

Reporting and integrating these advancements was the objective of an international workshop on Advances in Quantitative Analogue Modelling (AiQAM), held at the German Research Center for Geosciences (GFZ) in Potsdam. The workshop was attended by 32 researchers in the fields of tectonics, volcanology, remote sensing, and fluid dynamics from research centers in Europe, the Americas, and Asia. The focus was on image processing and analysis methods for quantitative deformation analysis. The workshop was followed by a short practical course on application of particle image velocimetry (PIV) in the experimental laboratory.

The aims of the six invited talks and the poster presentations were threefold: to list the state-of-the-art image analysis techniques used in the laboratory for the experimentalist community, to identity the outcome data sets of each presented method (2-D, 3-D, or 4-D), and to discuss in detail the procedures to process and mechanically interpret these data sets. These presentations and the following plenary discussions made the experimentalist community aware of the pros and cons of each method and helped participants identify the relevant method for their specific needs.

The workshop had several major outcomes. First, the community learned about the theoretical concepts behind each presented method, which is crucial for optimized use. It is essential for users to understand the limitations of each technique, which have often been used as press-button “black boxes.”

Second, the group agreed to write a methodological review paper listing the main image analysis techniques discussed during the workshop, which would be useful for the experimentalist community.

Third, the group defined and discussed two main future challenges of tectonic and volcanological laboratory modeling, including quantifying stresses within the models and integrating the quantitative data sets with geophysical, geodetic, and numerical modeling results. To these aims, a dedicated session on methodology (in both numerical and analog modeling) and a short course on the derivation and implementation of deformation laws have been planned at the upcoming GeoMod meeting for modelers in solid Earth geoscience, to be held in September 2014 at GFZ Potsdam.

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