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Development of a computing infrastructure for collaborative research on seismic noise sources

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Introduction of massively parallel computers opens new opportunities for solving Earth Science problems that have been previously considered intractable because of their computational complexity. Studying of seismic noise sources and their time- and space-dependent distribution represents a problem of this class. It requires massive cross-correlation of seismic noise records from all available seismic stations in the given region and is therefore highly computationally intensive. We have previously developed, in collaboration with the Swiss National Supercomputing Center (CSCS), a high-performance software platform for mapping seismic noise sources using the massively parallel supercomputer "Piz Daint".

Our current research is aiming at development of a computing infrastructure that will make this platform available to other researchers and enable collaboration in studying seismic noise sources. To facilitate the collaboration, we combined the super-computing system with a cloud platform thus building a heterogeneous distributed computing environment. With this approach, the supercomputer performs all computationally-intensive tasks like massive cross-correlation of seismic records and generation of source maps while applications running in a cloud are responsible for all other functions including acquisition of seismic data, interfacing with the end users, storing the data, and managing the entire workflow. Implementation of the solution posed various challenges, which include interfacing between the open cloud platform and a tightly-coupled software environment on the supercomputer as well as building a flexible solution for distributed workflow management.

Our present solution supports a pre-defined processing workflow. As part of our future research, we plan to implement facilities allowing end users to define their own workflows by combining and parameterizing available computational algorithms. We also plan to implement analytical tools facilitating the automated analysis of noise maps like a noise map classification tool based on machine learning.