Dominik Strebel

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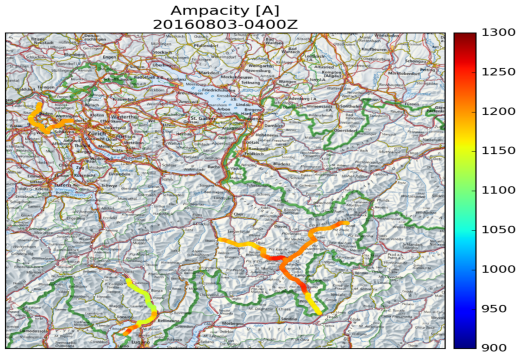
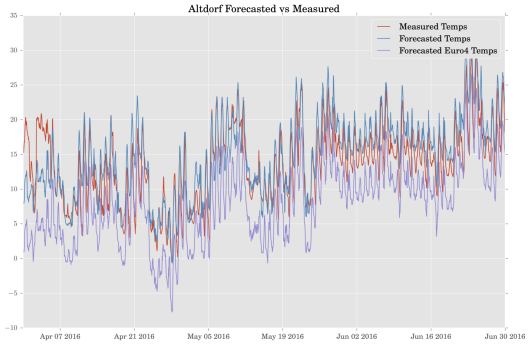
| Students | Dominik Strebel |
| Lecturers | Prof. Dr. Jasmin Smajic |
| Advisors | Michael Boesch , EKT , Arbon , TG |
| Topic | Environmental Engineering |
| Project Partners | Meteomatics GmbH , St. Gallen , SG |

# Development of a model and an application for optimizing electrical energy flow in high voltage grids

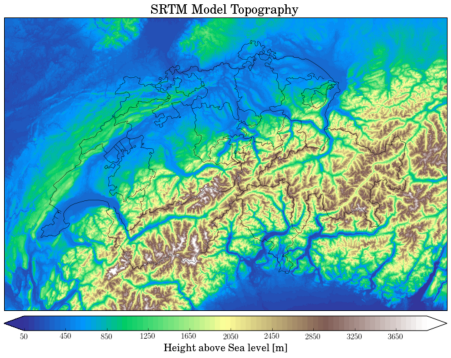
## by using high resolution weather data




Ampacity of several high voltage conductor lines on 03.08.2016 at 04:00 UTC




Temperature interpolation performance in Altdorf from 31.03.2016 until 30.06.2016




High resolution topography for temperature interpolation

Introduction: Weather has a significant influence on the capacity of high voltage overhead lines. The temperature of the conductor determines the thermal expansion and therefore the sag of the lines between two pillars. At a smaller scale, the temperature also determines the resistance of the line due to the thermal dependence of the specific resistance of the conductor material. The thermal expansion is the limiting factor of the grid operation. The conductor temperature must not exceed 80° C. The maximal allowed current which not violates this constraint is called the ampacity.

Objective: By combining weather forecast data with an appropriate physical conductor model, the author develops a model and an application for optimizing the electrical energy flow in high voltage grids. The goal of the project is to create maps containing the calculated temperatures and ampacities of certain locations. For calculating those quantities, he develops a temperature interpolation algorithm to correct the elevation difference between the model surface and the real elevation of the location. This is necessary as the resolution of the used weather data is not fine enough for the Swiss topography. The author implemented the project in Python. The application contains three parts

- Conductor Models

There are two conductor models available to choose and to compare: The Kirn and the IEEE model. Both simulate the conductor out of the general energy balance and can be solved for ampacity.

- Temperature Interpolation

The author developed a new interpolation algorithm for the surrounding temperature by taking into account several kind of weather situations.

- Data Processing

Data processing is necessary to fetch the weather data and draw the maps.

Result: The project was a success. The implemented application can be used in production for high voltage grid operators. The two conductor models performed well with similar patterns over time, although they were separated by an offset of 100 A. The temperature interpolation also performed well. The next step is to evaluate the influence the different weather influences on the interpolation performance.