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Terrestrial cross-calibrated assimilation of various datasources

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We introduce a novel software tool, ANACLIM, for the efficient assimilation of multiple two-dimensional data sets using a variational approach. We consider a single objective function in two spatial coordinates with higher derivatives. This function measures the deviation of the input data from the target data set. By using the Euler-Lagrange formalism the minimization of this objective function can be transformed into a sparse system of linear equations, which can be efficiently solved by a conjugate gradient solver on a desktop workstation.

The objective function allows for a series of physically-motivated constraints. The user can control the relative global weights, as well as the individual weight of each constraint on a per-grid-point level. The different constraints are realized as separate terms of the objective function: One similarity term for each input data set and two additional smoothness terms, penalizing high gradient and curvature values. ANACLIM is designed to combine similarity and smoothness operators easily and to choose different solvers.

We performed a series of benchmarks to calibrate and verify our solution. We use, for example, terrestrial stations of BSRN and GEBA for the solar incoming flux and AERONET stations for aerosol optical depth. First results show that the combination of these data sources gain a significant benefit against the input datasets with our approach.

ANACLIM also includes a region growing algorithm for the assimilation of ground based data. The region growing algorithm computes the maximum area around a station that represents the station data. The regions are grown under several constraints like the homogeneity of the area. The resulting dataset is then used within the assimilation process. Verification is performed by cross-validation. The method and validation results will be presented and discussed.