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Exercise 10

Homework and Exercise on January 17

The topic of this exercise is the work with the output of Metos3D simulations. We will do a statistical analysis of this output.
We recommend that you use *Python* for that programming task.
You find on *OLAT* 100 data sets with the name *N_output.petsc*. They are in folders with the name *Parameter_00000* up to *Parameter_00099*. Use the *N_output.petsc* file in the folder *Parameter_00000* as the reference. We want to reconstruct this data with the other data files. Before we can do this, we have to reduce the amount of data in each file.
For that purpose, do the following:

- Read in the *N_output.petsc* files from the folders *Parameter_00000*, and *Parameter_00010* to *Parameter_00059*. (Use an efficient way to read these files. That means: Do not write, for example, 50 nearly identical lines to read in the data sets.) For reading the files, the function *read_PETSc_vec* could be helpful.
- Read in the file *landSeaMask.petsc*. The function *read_PETSc_matrix* could be helpful.
- Reshape the data sets into a 3D vector. You could find *reshape_vector_to_3d* helpful for it.
- Reduce the data to the upper surface.
- Transform the data again into a 1D vector.
- Put all the data sets into one matrix except for the data set from the folder *Parameter_00000*. (Each data set corresponds to one line in the matrix.)
- Replace *NaN* values by 0 for the matrix and the reference data from *Parameter_00000*.
- Calculate the Singular value decomposition of this matrix. A library function for calculating the Singular value decomposition could be helpful. (Do not use the data set from the folder *Parameter_00000* for calculating the Singular value decomposition.)
- Reconstruct the data set in the folder *Parameter_00000* with the calculated eigenvalues. (See page 44 in the lecture *Methods of Data Analysis*.)
- Reshape the reconstructed and the reference data into a two-dimensional field.
- Plot both two-dimensional fields and compare them. (For that step, you should replace zero with *NaN* again.)

You find the data, the land-sea mask, and the three *Python* functions in the *OLAT* course.