Hochschule Neubrandenburg
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User Documentation

Rekonstruktion ionosphärischer Schlüsselparameter der F2 - Schicht mittels Kriging

Deutsches Zentrum
DLR für Luft- und Raumfahrt

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Content

1 Introduction

The project „Rekonstruktion ionosphärischer Schlüsselparameter der F2-Schicht mittels Kriging“ is about the global reconstruction of the NmF2- and hmF2-Layer. For more information about the project itself, take a look at the Masterthesis, belonging to this file.

The project is developed in Python and a short part is extended in the programming language R (variogram estimation). Anyways, if you do not have R installed or the compiled R libraries ready on your computer, the program will find out and estimate the variogram parameters with Python. You will lose some accuracy in your estimation, by not using the variogram calculation in R. For the calculation in R you also need the R (registered) library „RgeoStats“ (rgeostats.free.fr) and the library „Rccp“. The registration is for free and a documentation is on the web site. All results from the calculation will be written as pictures (.png) or ASCII-Files. But before starting the calculation, the parameters in the configuration file must be choosen.

2 Where is the project stored?

The project is stored in the subversion (svn) on the DLR - Servers.

3 Getting Started

Before getting started, please choose the parameters of the configuration file. All parameters will be presented in the next subchapter. The developed program is very tolerant with the parameter, but however make sure you do not change the names of the variables. If you choose parameters or options, which are not working with this program, it will be abort and you will get an error massage on your shell. Additionally make sure you have reading and writing rights in the directories you choose.

3.1 Configuration File

In this chapter all parameter of the configuration file will be presented, with its meaning and examples. Also some standard values will be presented.

Value	Meaning	Example
time	UTC - Time; Format HH:MM	"12:00"
timeintervall	time in minutes; The intervall is defined as (timeintervall / 2) <= time < (timeintervall / 2). The mean of the values in the intervall will be used for further calculations.	10
startdoy	Start Day of the Year	11
enddoy	End Day of the Year	11
layer	NmF2 or hmF2. Additionally, if both parameters should be calculated, you can choose "hmF2NmF2" or "NmF2hmF2"	"hmF2"
pathspdir_hmf2	The path to the datafiles from the SPIDR provider for the hmF2 - parameter	""
pathdata_all_hmf2	The path to all datafiles to from all providers for the hmF2 - parameter. The Python modul, which reads and compares the files from the providers usually stores the files at the directory: /.../data_all	""
pathdidb_hmf2	The path to the datafiles from the DIDB provider for the hmF2 - parameter	""
pathngdc_hmf2	The path to the datafiles from the NGDC provider for the hmF2 - parameter	""
pathspdir_Nmf2	The path to the datafiles from the SPIDR provider for the NmF2 - parameter	""
pathdata_all_Nmf2	The path to all datafiles to from all providers for the NmF2 - parameter. The Python modul, which reads and compares the files from the providers usually stores the files at the directory: /.../data_all	""

pathdidb_Nmf2	The path to the datafiles from the DIDB provider for the NmF2 - parameter	""
pathngdc_Nmf2	The path to the datafiles from the NGDC provider for the NmF2 - parameter	""
resolution	The resolution describes the accuracy of the global kriging prediction, on which degrees a value should be predicted. Make sure, if you want to compare it with other prediction methods, to choose the same resolution.	2.5
validationfile	Boolean variable; If you want to compare the results with other prediction methods like *IO*, *OI with forecast*, *SCM* and *MSCM*, choose True, if not choose False.	True
refStations	An Array of reference station (ID of the station), which will not be used for the kriging prediction, but for the variogram estimation. In the results the reference stations will be marked as a circle. If you choose "False" at the "validiationfile" parameter, this variable will not be obsorved.	['CS31K', 'DB049']
pathToValidationFileNmF2	The path to the file, which contains the values for NmF2 from the other prediction methods. If you choose "False" at the "validiationfile" parameter, this variable will not be obsorved.	""
pathToValidationFilehmF2	The path to the file, which contains the values for hmF2 from the other prediction methods. If you choose "False" at the "validiationfile" parameter, this variable will not be obsorved.	""

lagDistance	The lag distance, which will be used for the variogram estimation. Depending on the data and the variogrammodel a shorter or larger lag distance will be best for the variogram estimation. Note: If you choose more variogrammodels, the lag distance will be used for every model. During the programming and experimenting a lag distance from 800 is doing quite good.	800
variogrammodel	This modul supports four kind of variogrammodels. You can choose between "sph" for the Spherical Model, "exp" for the Exponential Model, "gau" for the Gaussian Model and "pow“ for the power model. If you want a prediction for more than one model, you can compare the shortcuts of the models, like "sphgau" or sphgauexppow"	"sph"
variogrammodelNo Structure	This variable defines, if the variogram calculation should be with no given (variogram-) structure in R, or not. The first results showed some errors and some bad variogram fitting. If the value is 1, the no particular variogram structure will be used, every value != is for the variogramstructures in the config file. This only works with R and make sure that the variable *variogrammodel* is valid. See for more details: documentation of RgeoStats (model.auto)	0

isotropyAnisotropy	The value of this parameter is either „isotropy“ or „anisotropy“, depending which variogram calculation you prefer.	„isotropy“
backgroundmodel	To delete the systematic error in the measurement values, you have to choose a backgroundmodel. By writing the model name it will be used. You can choose between NPDM, NPHM and NeQuick. If you want all models you can write them together, like "NeQuickNPDMNPHM". Note: Of course you cannote choose combinations like the NmF2 layer and only the NPHM model.	"NeQuick"

4 Start the calculation

Before starting the calculation make sure you downloaded it from the subversion repository and you installed all required Python Packages. All packeges are listed in the *requirements.txt*. Additionally and as already mentioned, make sure you choose the right parameters in the configuration file. If you cannot install the package „rpy2“, you probally have not R installed. It is only an optinal package for the communication with R, but if you want to improve your estimation, read the chapter „Introduction“ again and install R and the needed R packages.

4.1 From another Python Script

Starting the Calculation from another Python Skript is very simple. First you have to import the *Reconstruction Class* file with the command ***import reconstruction.Reconstruction as reconstruct***. In this case your starting routine is in the same folder as the folder *reconstruct*. You can then start the estimation with the command line ***reconstruct.calcReconstruction().runReconstruction***. If you want to

plot the residuals between measurement value of the reference stations and the estimated values you need to add the command line ***reconstruction calcReconstruction().plotHistMeasurementEstimation()***.
Building your own script around the modul, will make it easy for you to calculate the estimations over a large time intervall. An example is shown in the *runReconstruction.py*.

4.2 From shell

Starting the kriging modul from the shell, i would recommend the usage of the script *runReconstruction.py*. You only need to start it, the rest will do the modul by itself.

5 Results

All results are stored in the path of the configuration file (*outputfolder*). All logs, in particular the error log and the textfile with all filenames of the generated files, are stored in the path of the variable *outputfolderLogs*.

6 Help

If you have any questions or you need any help, please ask me (torben.boje@dlr.de or lg10126@hs-nb.de) or my supervisor Dr. Tatjana Gerzen (tatjana.gerzen@dlr.de) or David Minkwitz (david.minkwitz@dlr.de).