Sval_Imp: precipitation
procedure for downscaling precipitation based on the Linear Theory of orographic enhancement (LTmodel) by Smith&Barstad (2004)

Smith, R. B. and Barstad, I.: A Linear Theory of Orographic Precipitation, Journal of the Atmospheric Sciences, 61, 1377–1391, https://doi.org/10.1175/1520-0469(2004)061<1377:ALTOOP>2.0.CO;2, 2004.

Short usage description.

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File overview

LT_2014

	LT_matlab_2014_06_19.m	Main function to be executed
Utils	Apply_LTmodel2014.m	Here the LT is applied, called from main
	Asciigridread.m	Tool to import ARC-ASCII DEMs
	Calculate_thermodyn_4levels_grid_qweighted.m	Thermodynamical quantities are calculated and vertical averaging, called from main
	CalculateTau_lineartransition.m	Calculate advection time scales, called from main
	Deg2utm.m	Tool to convert LatLon to UTM coordinates
	Deg2utm33.m	Same as above but fixed to UTMzone 33
	ERAintOrography2014.mat	Global orography as used by ERAinterim, used by main
	Get_TpzRH_monthly_mat.m	Import met-variables from mat-formatted files, one per month. Called from main
	Get_TP.m	Import background precip fields, called from main
	Inter_mixingratio_weighting.m	Vertical averaging for variables between

		pressure levels, called from calculate_thermodyn…
	Linear_transition.m	Calculate value between 2 boundaries, called from calculateTau…
	Mixingratio_weighting.m	Vertical averaging for variables at pressure levels, called from calculate_thermodyn…
	preprocDEM2014.m	Import high-res DEM, coordinate handling etc, called from main
	preprocORO2014.m	Import low-res DEM (=ERA orography), coordinate handling, called from main
User	User_specs_LT2014.m	Defines the model application and parameter values to be used, user options to be selected, called from main. Ideally this is the only file to be edited by USER
Results_monthly		Monthly results written to this folder
Postproc	Comp_LT_snow_2004_11.m	Example script for postprocessing: aggregate seasonal precip (winter) and compare to snow profiles
	Comp_LT_TP_Eklima.m	Another postproc example: compare original and downscaled precip to records from weather stations
	Make_monthprec.m	Aggregate 6h precip to monthly sum

Example data

Convert_E4_pl_tar_2mat.m	Pre-processing script, convert tar archive to mat-file, data from pressure levels (PL), for ERA40
Convert_E4_sf_tar_2mat.m	Similar but for data at surface level (SF)
Convert_pl_tar_2mat.m	Same as above but ERAint
Convert_sf_tar_2mat.m	Same as above but ERAint
Pl1979.tar	Example for a PL-tar
Sf1979.tar	Example for a SF-tar
Ei_pl_197901.mat	One example for PL after conversion
Ei_sf_197901.mat	One example for SF after conversion
splitBigData.m	Split huge file containing entire period into files per month

ATTENTION: the ERA40 options are presumably not relevant for your application. Most of the preprocessing here is very specific for the format how I have obtained the ERA data. Most of this may be obsolete…have a look at the *update2016 files, which do the preprocessing for nc-files directly obtained from the ECMWF server using a python script, see here:

http://apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc/

ATTENTION 2: the pre-processing scripts here make use of the SNCTOOLS package which can be obtained from: http://mexcdf.sourceforge.net/

For later matlab versions (after R2013) this is not necessary any longer, but then the scripts need to be adjusted to use the matlab netcdf functions.

USER specifications defined by **`user_specs_LT2014.m`**

(I have many comments in the code explaining most of the entries. Nevertheless, I add more description here)

L5-13: define disk for work directory and data; I have data spread over 2 different disks, so I define 2 datadisks, you have to adjust this to your setting. (I also define the path for windows and linux systems to keep compatibility for both. Usually I develop code on my windows laptop but do the long model runs on a more powerful linux server).

L22/23: start and stop times need to be adjusted to your case

L25: to keep consistency with ERA40, I always used 6h steps, but ERAint is available at 3h steps, so this could be changed, ATTENTION: this would affect the preprocessing as well, currently everything is at 6h resolution!!

L26: define datapath

L37: define path to directory where the results are written

L51: define area boundary box in lat lon [min(lon) max(lon) min(lat) max(lt)]

L52: region=name the area of interest. This string is used in the filename for the results

L55/56: if you have options for parallel processing (requires multicore hardware and matlab parallel computing toolbox)

Potential parts for further adjustment

`LT_matlab_2014_06_19.m`

L175-185: horizontal averaging is done over the entire domain; other possibilities could be averaging over a subset of the domain, for instance an upstream region, or another pre-defined mask

In her application, Aurora has been playing around with alternatives to the hard-wired settings for the calculation of delay timescales defined in **`calculateTau_lineartransition.m`**

There the fall speeds for solid and liquid hydrometeors are defined in L3/4. In reality, there is not a single speed for each of these classes but spectra having each a characteristic distribution. At the end, I think this does not matter a lot, given the many assumptions inherent in the model theory and the (maybe even more important) uncertainties related to observations (i.e. the possibility to validate our results).

In addition, the transition can be defined here in L7-9: we assume 100% solid precip at T=267K and 100% liquid at T=273K, the center (xm) and width (sigma) of the transition can be specified. Further, we assume that the transition is linear, but other functions could be applied, for instance arctan for a smoother transition. Again, at the end this does not really matter, in my view.