ThermoCorrection

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An atmospheric and emissivity correction for georeferenced thermal infrared images from close range sensing based on Caselles et al. (1996), Kodimalar et al. (2020), Wiecek (2011) and Minkina et al. (2016).

Input:

- Georeferenced thermo raster images (.tif) + timeinfo (.csv)
- DSM (.tif)
- FVC (.tif)
- Red Band (optional) (.tif)
- Cam location
- Vertical gradients air temperature and humidity (.csv)
- Emissivity for soil/vegetation
- Cloud cover (optional)

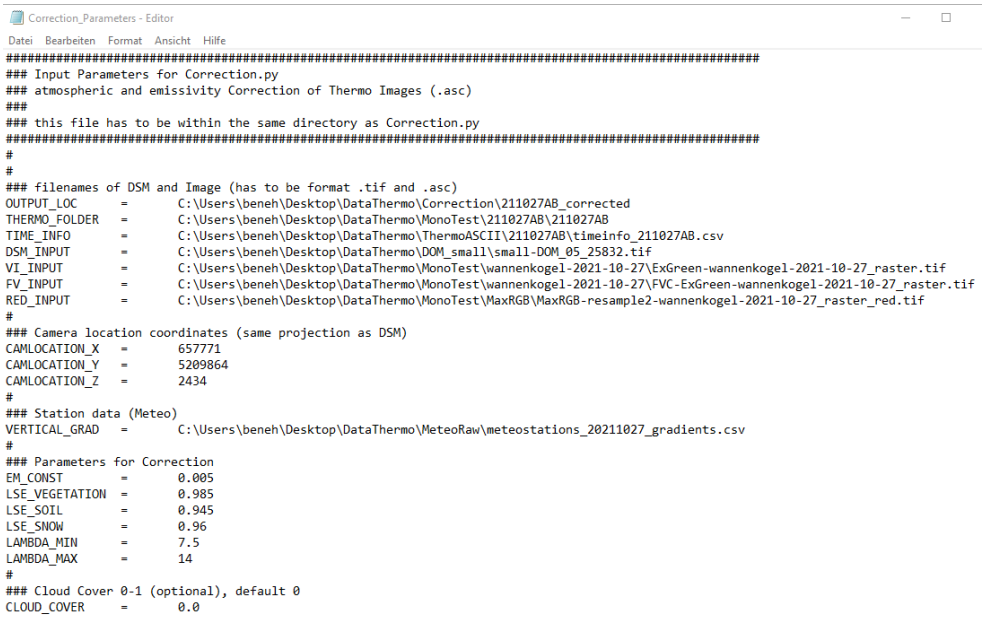
Output:

- LSE map
- Corrected thermo raster images

Two files:

ThermoCorrection.py

Correction_Parameters.txt



Correction_Parameters - Editor

Datei Bearbeiten Format Ansicht Hilfe

```
#################################################################################################
### Input Parameters for Correction.py
### atmospheric and emissivity Correction of Thermo Images (.asc)
###
### this file has to be within the same directory as Correction.py
#################################################################################################
#
#
### filenames of DSM and Image (has to be format .tif and .asc)
OUTPUT_LOC      =       C:\Users\beneh\Desktop\DataThermo\Correction\211027AB_corrected
THERMO_FOLDER   =       C:\Users\beneh\Desktop\DataThermo\MonoTest\211027AB\211027AB
TIME_INFO       =       C:\Users\beneh\Desktop\DataThermo\ThermoASCII\211027AB\timeinfo_211027AB.csv
DSM_INPUT       =       C:\Users\beneh\Desktop\DataThermo\DOM_small\small-DOM_05_25832.tif
VI_INPUT        =       C:\Users\beneh\Desktop\DataThermo\MonoTest\wannenkogel-2021-10-27\ExGreen-wannenkogel-2021-10-27_raster.tif
FV_INPUT        =       C:\Users\beneh\Desktop\DataThermo\MonoTest\wannenkogel-2021-10-27\FVC-ExGreen-wannenkogel-2021-10-27_raster.tif
RED_INPUT       =       C:\Users\beneh\Desktop\DataThermo\MonoTest\MaxRGB\MaxRGB-resample2-wannenkogel-2021-10-27_raster_red.tif
#
### Camera location coordinates (same projection as DSM)
CAMLOCATION_X   =       657771
CAMLOCATION_Y   =       5209864
CAMLOCATION_Z   =       2434
#
### Station data (Meteo)
VERTICAL_GRAD   =       C:\Users\beneh\Desktop\DataThermo\MeteoRaw\meteostations_20211027_gradients.csv
#
### Parameters for Correction
EM_CONST        =       0.005
LSE_VEGETATION  =       0.985
LSE_SOIL        =       0.945
LSE_SNOW        =       0.96
LAMBDA_MIN      =       7.5
LAMBDA_MAX      =       14
#
### Cloud Cover 0-1 (optional), default 0
CLOUD_COVER     =       0.0
```

Python requirements

Os, math, matplotlib.pyplot, numpy, rasterio, pandas

USAGE PARAMETER FILE

DONT CHANGE FILE FORMATTING!!

OUTPUT_LOC

Full path to directory where output should be stored in

New folder will be created containing:

- Corrected Thermo Images
- LSE map

THERMO_FOLDER

Full path to directory where uncorrected georeferenced thermo images are stored in (.tif)

TIME_INFO

Full path to time information about thermo images

As the georeferenced raster images usually contain no information about time, a additional .csv file is necessary for connection to station data.

Name of the image, date and time (dd.mm.YYYY hh:mm)

	A	B
1	Name,Datetime	
2	AC081100,11.08.2021 18:00	
3	AC081101,11.08.2021 18:15	
4	AC081102,11.08.2021 18:30	
5	AC081103,11.08.2021 18:45	
6	AC081104,11.08.2021 19:00	
7	AC081105,11.08.2021 19:15	

DSM_INPUT

Full path to DSM/DEM (.tif), clipped tot he same extent and same coordinate system as thermo images

FV_INPUT

Full path to Fractional Vegetation Cover Map.

At the moment only one raster (.tif) can be chosen (which is sufficient for a multiday measurement, but not for longer periods).

RED_INPUT

As snow has high emissivity values (0.99) but low VI values a simple snow detection via threshold in the red band of the image was implemented. Set to NA if not necessary.

CAMLOCATION_...

XYZ Coordinates of camera location

VERTICAL_GRAD

Full path to .csv file with information about air temperature and relative humidity gradients.

The gradients for air temperature and relative humidity are used to calculate air temperature and relative humidity for each raster cell on the DSM. A linear regression from several stations near the study area can be used. Please name the columns as following:

time, TL_intercept, TL_ coefficient, RH_intercept, RH_coefficient

	A	B	C	D	E	F	G	H
1	time,TL_intercept,TL_coefficient,RH_intercept,RH_coefficient							
2	19.07.2021 00:00,16.9755769244135,-0.005187975847287143,93.39637987315115,0.0005022162124454374							
3	19.07.2021 00:10,17.232277495179265,-0.005304790669023556,92.48878971555925,0.0008014608802915788							
4	19.07.2021 00:20,17.238026738186782,-0.005341536627161220 6,94.04993331670434,0.0005461054303962051							
5	19.07.2021 00:30,16.83169128452801,-0.005213511392276683,94.32099145357229,-3.230555338898135e-05							
6	19.07.2021 00:40,16.74093226876882,-0.005183586925492068,92.37879278136914,0.0007377507252017551							
7	19.07.2021 00:50,16.57270232221585,-0.005107031773477064,93.41340129598039,0.0002669391144571599							

Note: The timesteps do not have to match the thermo timesteps. The coefficent and intercept values will be interpolated within the script.

EM_CONST

EM_CONST is a constant that describes cavity effects within the vegetation. 0.005 is the value suggested by Kodimalar et al. (2020). If NA default value is 0.005.

LSE_VEGETATION

Land Surface Emissivity for areas with full vegetation cover (in most studies values between 0.98 and 0.99 are suggested)

LSE_SOIL

Land Surface Emissivity for areas with bare soil (in most studies values between 0.94 and 0.95 are suggested)

LSE_SNOW

Land Surface Emissivity for snow covered areas (values between 0.94 and 0.99 are suggested)

LAMBDA_...

Wavelength intervall the thermal camera is measuring in (e.g. 7.5 to 14 microns)

CLOUD COVER

Default = 0 (if set to NA). Accounts for cloud cover when calculating downwelling radiance. Values between 0 and 1.