

Data:

- **MODIS: AOD at 550nm data from MODIS/Aqua and MODIS/Terra**
- **ERA5: Selected atmospheric variables from ERA5 reanalysis**

Code:

- **Combine_impute_AOD.ipynb**

Extracted, regridded and/or imputed MODIS AOD data and selected ERA5 variables for Saharan region (see extend in Fig.1). This dataset is ready to use for forecasting with Machine Learning. These long-term daily timeseries (2003-2022) are provided as n-dimensional NumPy arrays (15 in total).

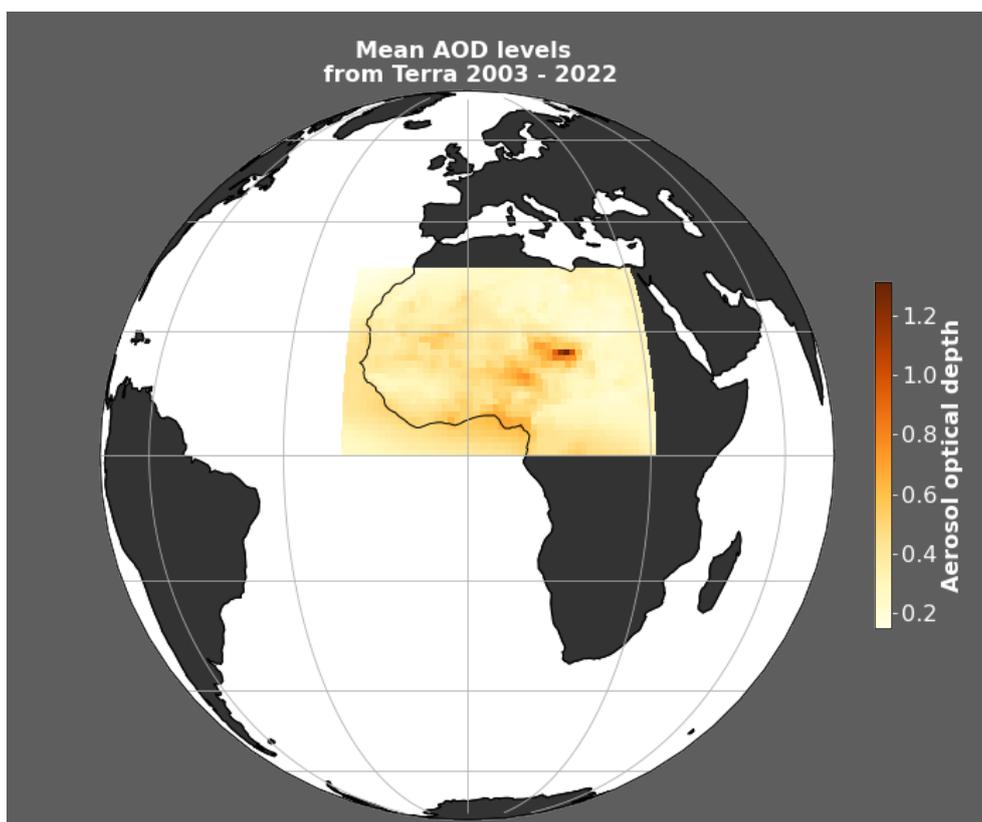
The **ERA5 variables** (11 in total) are provided at 5 pressure levels and represent atmospheric conditions from ground level (1000hPa) up to ~5km (550hPa).

The **MODIS AOD data** are provided here at 3 pre-processing levels:

- raw AOD values from MODIS Aqua (MYD) and MODIS Terra (MOD) where missing values are represented as NAN's and missing days are included as empty arrays (NAN's); data files 1 and 2; (Fig. 2B and A respectively)
- mean AOD values between Aqua and Terra where missing values were decreased, but still present; data file 3 (Fig. 2C)
- mean AOD values between Aqua and Terra where remaining missing values were fully imputed with Lattice Kriging method (output data from Combine_impute_AOD.ipyn); data file 4 (Fig 2. D)

The **Python code for 3D array imputation** is included as Jupyter Notebook. This code was written by Dr. S. Siegert and adapted to 3D arrays by T.E. Nowak.

Fig. 1. Extend of the study area



Extend of the study area illustrated with the mean AOD values from MODIS/Terra mean 2003-2022.

All 15 arrays included in the .zip folder have:

- **Format:** NumPy
- **Resolution:** 1° x 1°
- **Location:** Northern Africa (0°S - 31°N, 20°W - 31°E)
- **Length:** 7305
- **Date:**
 - start: 1st Jan 2003
 - end: 31st Dec 2022

MODIS AOD:

- **1_AOD_myd.npy**

Variable: level 3 'AOD_550_Dark_Target_Deep_Blue_Combined_Mean'

Dataset: MYD08_D3 - MODIS/Aqua Aerosol Water Vapor Ozone Daily L3 Global 1Deg

Shape: (7305, 31, 51) (contains 32.8% NAN's)

- **2_AOD_mod.npy**

Variable: level 3 'AOD_550_Dark_Target_Deep_Blue_Combined_Mean'

Dataset: MOD08_D3 - MODIS/Terra Aerosol Water Vapor Ozone Daily L3 Global 1Deg

Shape: (7305, 31, 51) (contains 30.9% NAN's)

- **3_AOD_mean.npy**

Dataset: MODIS/Terra and MODIS/Aqua (mean values)

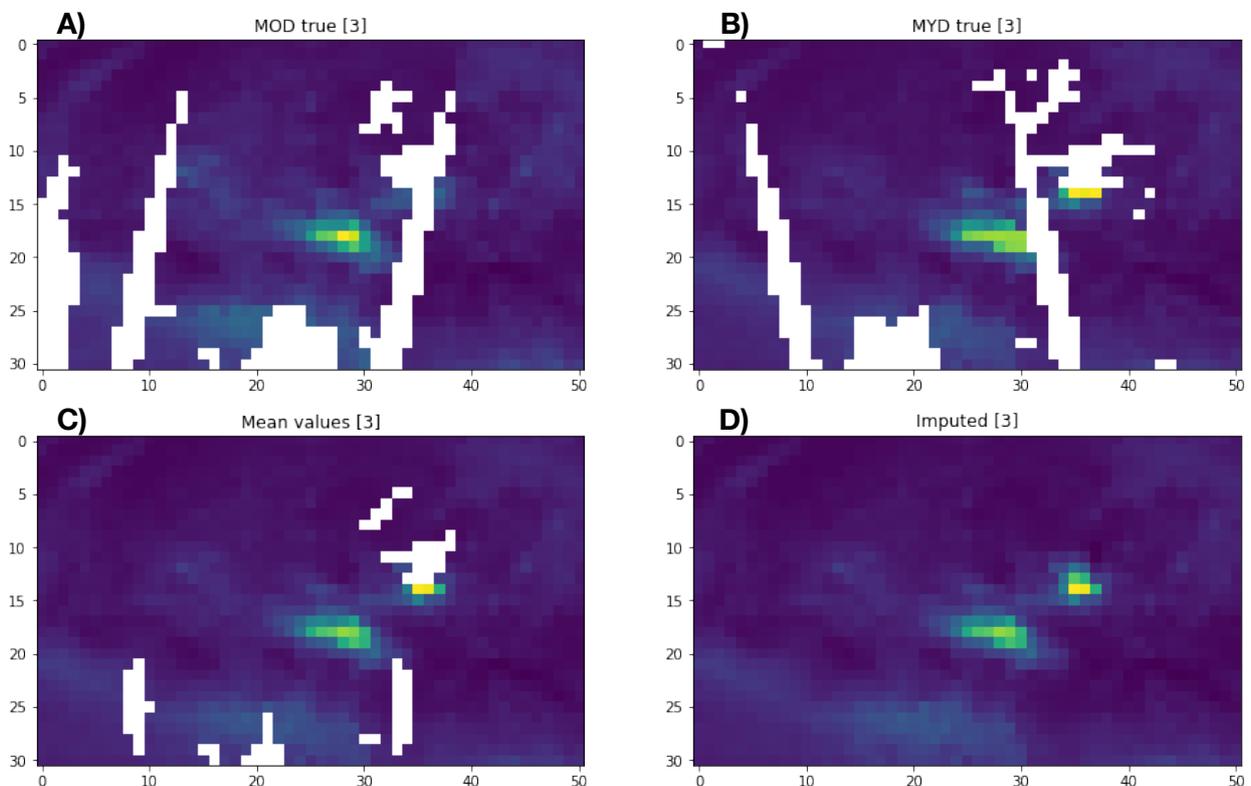
Length: 7305 days (contains 19.9% NAN's)

- **4_AOD_impued.npy**

Dataset: MODIS/Terra and MODIS/Aqua (mean values)

Shape: (7305, 31, 51) (fully imputed)

Fig. 2. Visual assessment of imputed AOD values



Comparison of the AOD values from the 3rd index of each timeseries file (4th Jan 2003), for **A)** raw, un-imputed values for Terra (AOD_MOD), and **B)** raw, un-imputed Aqua (AOD_MYD), **C)** mean between Aqua and Terra, **D)** mean AOD imputed using Lattice Kriging method.

ERA5:**Time: 12:00 UTC****• 5_rh_ground.npy**

Variable: 'Relative humidity' (%)

Pressure Level: 1000hPa

Shape: (7305, 31, 51)

• 6_rh_950-550hPa.npy

Variable: 'Relative humidity'

Pressure Level: 950hPa, 850hPa, 750hPa, 550hPa

Shape: (7305, 31, 51, 4)

• 7_temp_ground.npy

Variable: 'Temperature' (°C, calculated from K)

Pressure Level: 1000hPa

Shape: (7305, 31, 51)

• 8_temp_950-550hPa.npy

Variable: 'Temperature' (°C, calculated from K)

Pressure Level: 950hPa, 850hPa, 750hPa, 550hPa

Shape: (7305, 31, 51, 4)

• 9_vv_ground.npy

Variable: 'Vertical velocity' (Pa/s)

Pressure Level: 1000hPa

Shape: (7305, 31, 51)

• 10_vv_950-550hPa.npy

Variable: 'Vertical velocity' (Pa/s)

Pressure Level: 950hPa, 850hPa, 750hPa, 550hPa

Shape: (7305, 31, 51, 4)

• 11_wind_ground.npyVariable: 'U-component of wind' (m/s), 'V-component of wind' (m/s), 'Wind speed' (m/s, calculated from u and v), 'Wind power' (m³/s³, calculated from u and v)

Pressure Level: 1000hPa

Shape: (7305, 31, 51, 4)

• 12_wind_powerx4.npyVariable: 'Wind power' (m³/s³, calculated from u and v)

Pressure Level: 950hPa, 850hPa, 750hPa, 550hPa

Shape: (7305, 31, 51, 4)

• 13_wind_speedx4.npy

Variable: 'Wind speed' (m/s, calculated from u and v)

Pressure Level: 950hPa, 850hPa, 750hPa, 550hPa

Shape: (7305, 31, 51, 4)

• 14_wind_u_x4.npy

Variable: 'U-component of wind' (m/s)

Pressure Level: 950hPa, 850hPa, 750hPa, 550hPa

Shape: (7305, 31, 51, 4)

• 15_wind_v_x4.npy

Variable: 'U-component of wind' (m/s)

Pressure Level: 950hPa, 850hPa, 750hPa, 550hPa

Shape: (7305, 31, 51, 4)