Extrema der Luftschadstoffe Ozonextrema

Outline

This exercise consists in a case of study of observed maximum daily 8-h of ozone (MDA8 O3) in three different locations over Germany. Along with the observational data set, simulations from a regional model (LOTOS-EUROS) will be used to assess the ability of the model to reproduce the observed relationship between O3 and meteorological conditions. Furthermore, the meteorological sensitivities of high/extremes levels of MDA8 O3 will be examined.

key-questions:

1. Regional model (LOTOS): Is the model able to capture the main features of MDA8 O3? how is the meteorology reproduced by the model? Is there any significant difference between seasons?
2. What are the most important variables of MDA8 O3? Differences between observations and model: is the modeled data close to the observed meteorological sensitivities of MDA8 O3?
3. Extremes: Is the model able to reproduce the extremes of MDA8 O3? and the sensitivities to extremes?

Data

- Observations: The MDA8 O3 data is extracted from a gridded data set obtained from observations (see Otero et al. 2016) and corresponds to three different locations. A total of seven meteorological variables are obtained from the ERA Interim reanalysis: maximum temperature(tmax), boundary layer height(blh), total cloud cover(tcc), sea level pressure(msl), relative humidity (rh), surface solar radiation (ssrd), wind speed (ws), wind direction (Direction).
- Model: Model simulations are extracted from the air quality model LOTOS-EUROS and the respective meteorological fields from the RACMO2 (which is the meteorological input used). See more details in Otero el al. 2018.

The data expands 11 years 2000-2010 (January-December) and as mentioned they are daily data.

Note: the data provided is (.Rda) a list of three elements, one for each location: data_loc[loc1],data_loc[loc2],data_loc[loc3]. For each location there are two data.frame (obs, and loto). The locations correspond to the following coordinates (longitude, latitude): *loc1= c(8,49), loc2=c(10,50), loc3=c(13,52)

Procedure

The following steps can be applied for each location.

1. Analyse the data (observations and simulations). Split the data into seasons, since there is a strong seasonal component (ozone season usually is defined from April-September). Consider to use only spring (MAM) and summer (JJA) for the regression.
2. Assess the simulations (e.g. correlations between observations and model simulations for both ozone and meteorology).
3. Apply MLR regression analysis to identify the most important predictors (recommendations: fit a model for each season)

4. Apply GLM for the extremes. Select a threshold to define ozone exceedances (e.g. 50 or 60 ppb, which are based on the target values).

References

Otero, N., Sillmann, J., Schnell, J.L., Rust, H.W., Butler, T., 2016. Synoptic and meteorological drivers of extreme ozone concentrations over Europe. Environ. Res. Lett. 11 (2).

Otero, N., et al.: A multi-model comparison of meteorological drivers of surface ozone over Europe, Atmos. Chem. Phys., 18, 12269–12288, https://doi.org/10.5194/acp-18-12269-2018, 2018.

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