

# Convective dust storm climatology of Poland

**Filip Skop\***

\*Department of Climatology, Adam Mickiewicz University, Krygowskiego  
10, 61-680 Poznań, Poland

11th European Conference on Severe Storms

Bucharest, Romania

8 – 12 May 2023



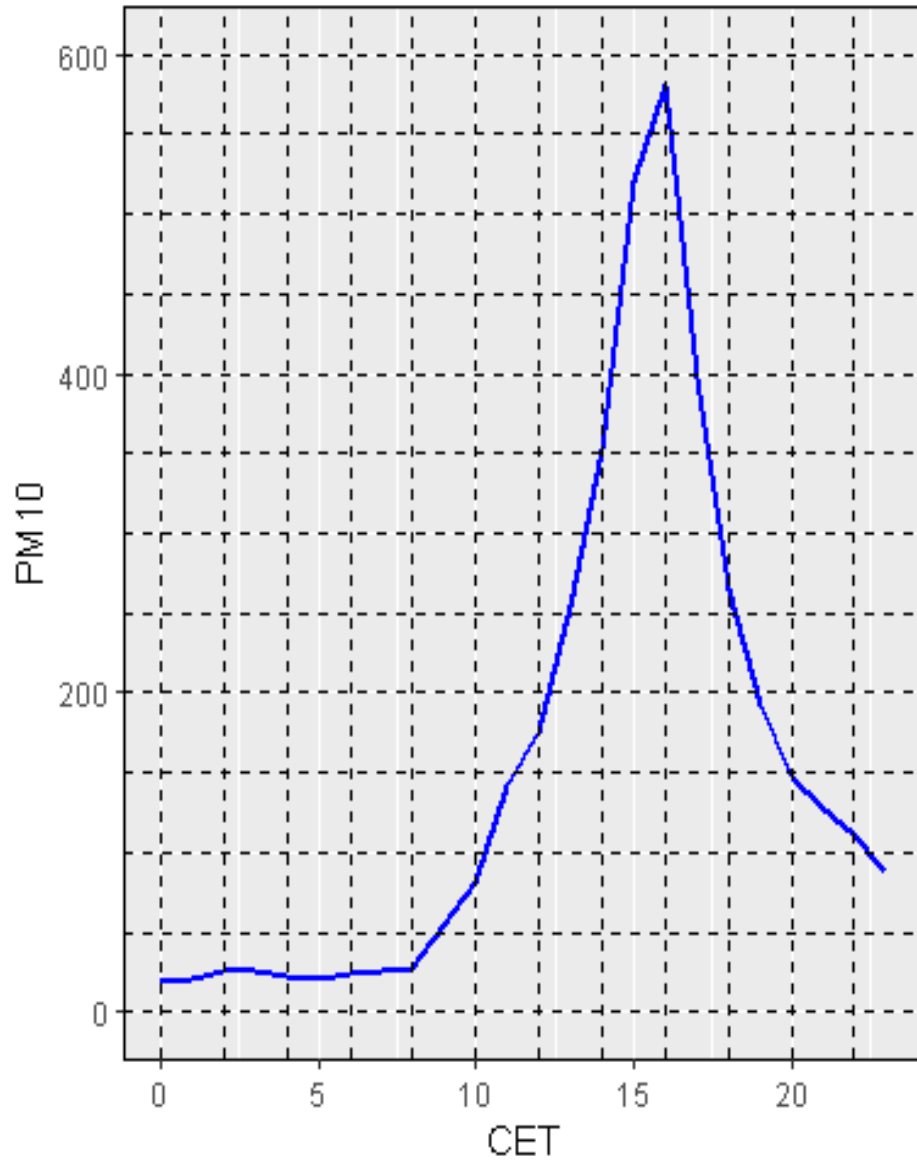
# Dust storm definition

- a)** An unusual, frequently severe weather condition characterized by strong winds and dust-filled air over an extensive area. (<https://glossary.ametsoc.org>).
- b)** Result of surface winds raising large quantities of dust into the air and reducing visibility at eye level (1.8 m) to less than 1000 m ([McTainsh and Pitblado 1987](#)).

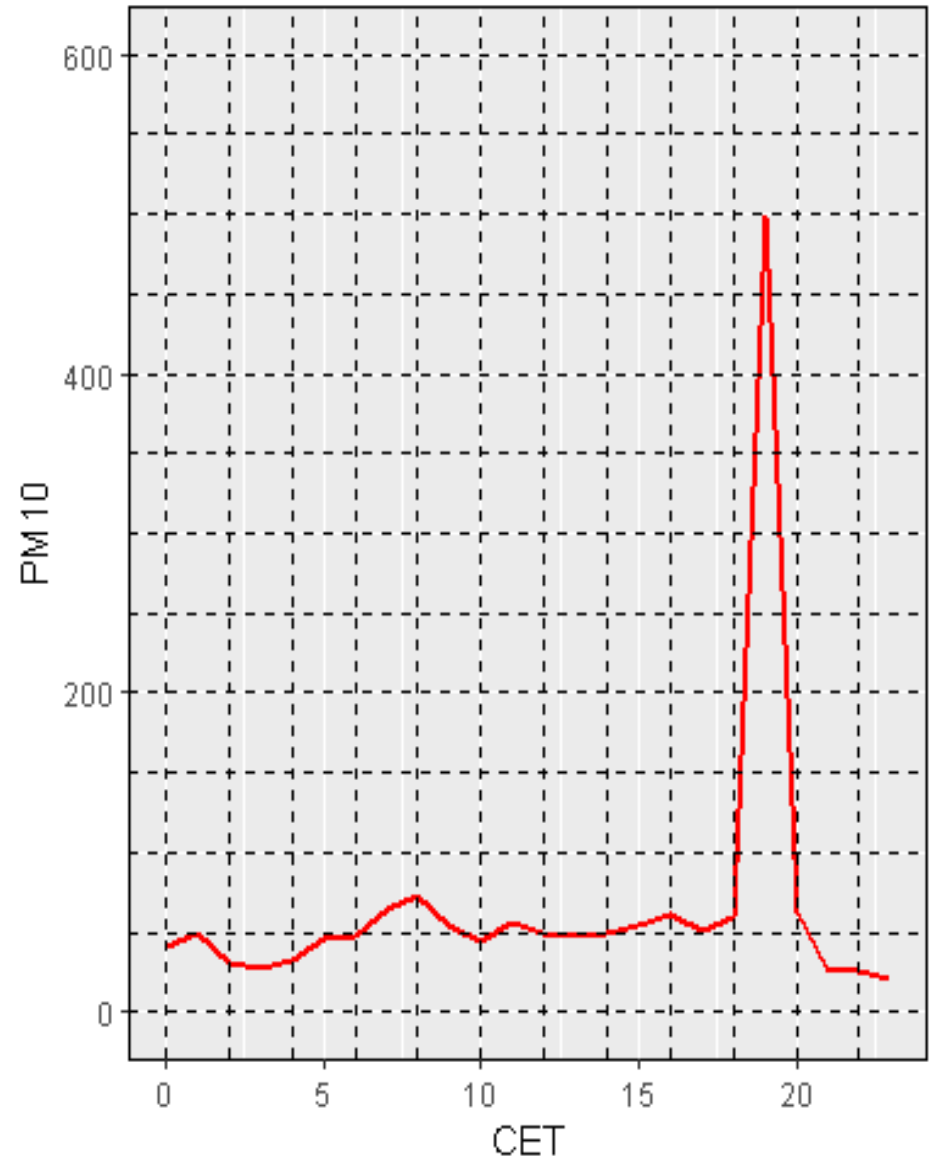
# Convective dust storms

- Sudden and short lasting increase in PM10 concentration ([Ardon-Dryer, K., & Kelley, M. C., 2022](#); [Raman et al. 2014](#)).
- Significant air temperature drop ([Idso et al., 1972](#); [Vukovic et al., 2014](#)).
- Significant atmospheric pressure rise ([Idso et al., 1972](#); [Vukovic et al., 2014](#)).
- Caused by thunderstorm's outflow/cold pool ([Idso et al., 1972](#); [Vukovic et al., 2014](#)).
- Rarely reported on meteorological stations in Poland.

Koszalin, 23.04.2019

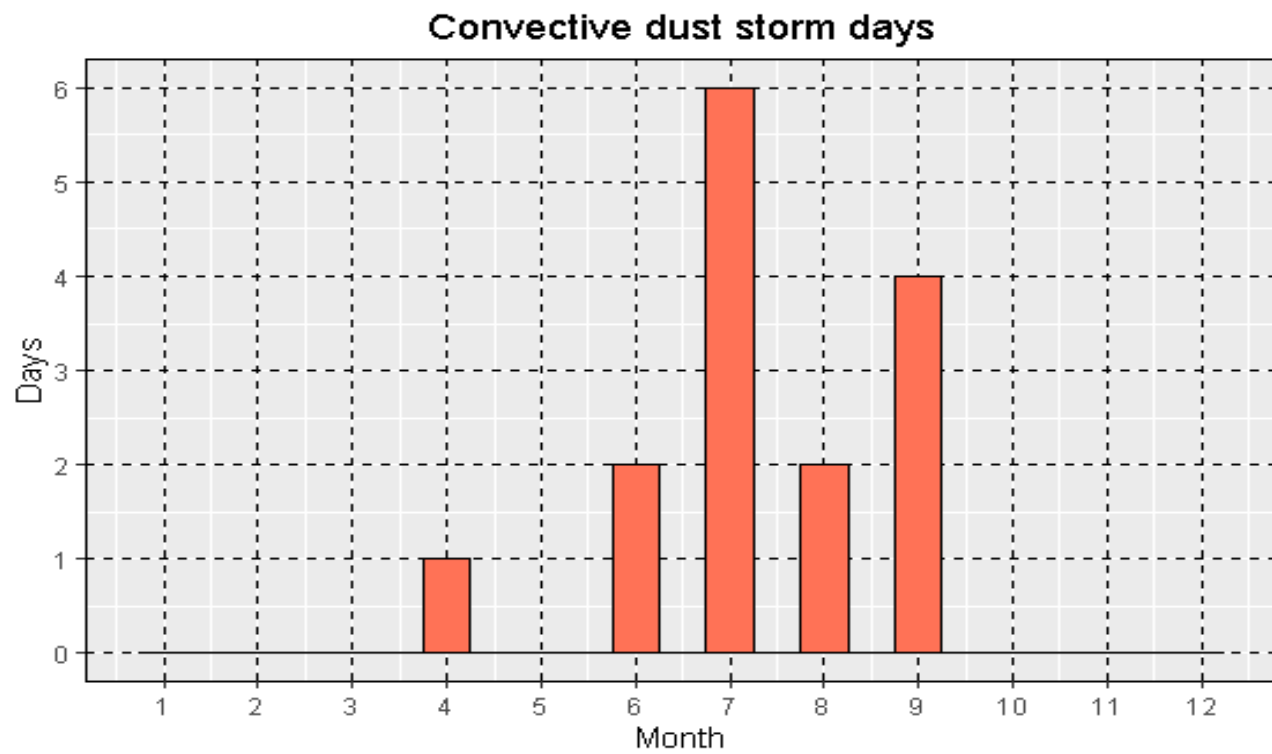
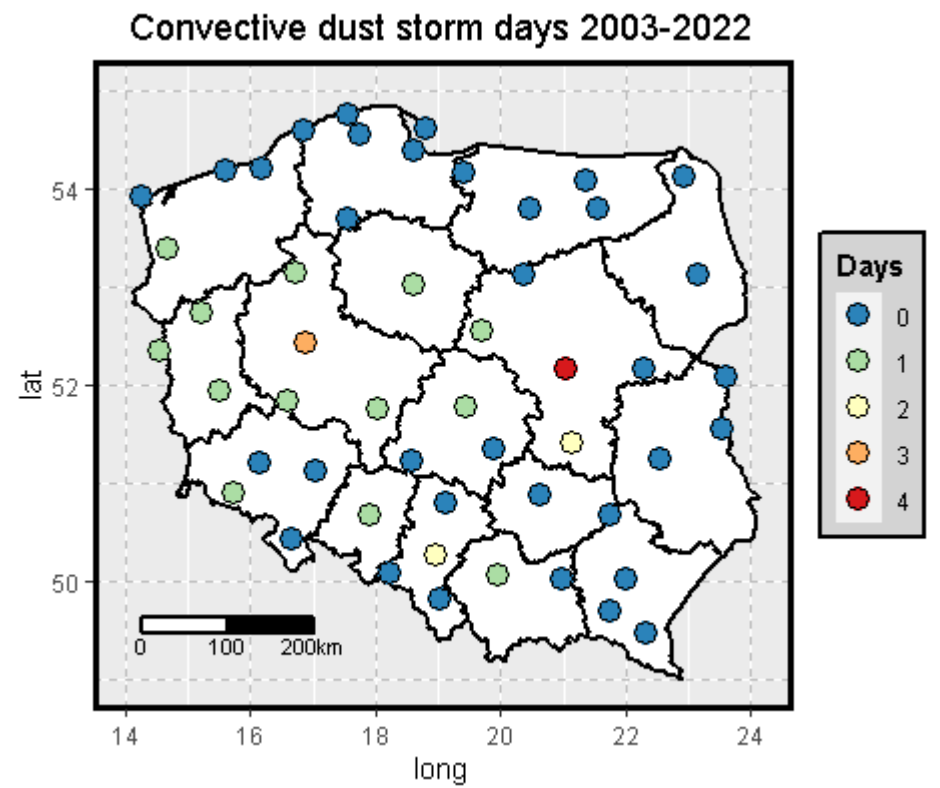
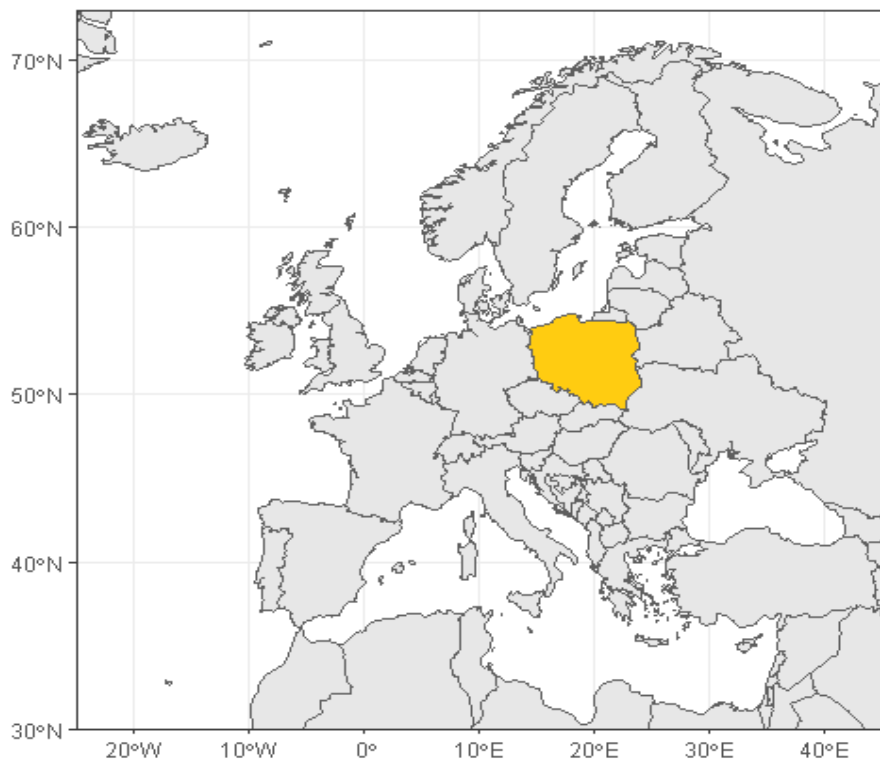


Warsaw, 21.06.2018



# Dust storm identification

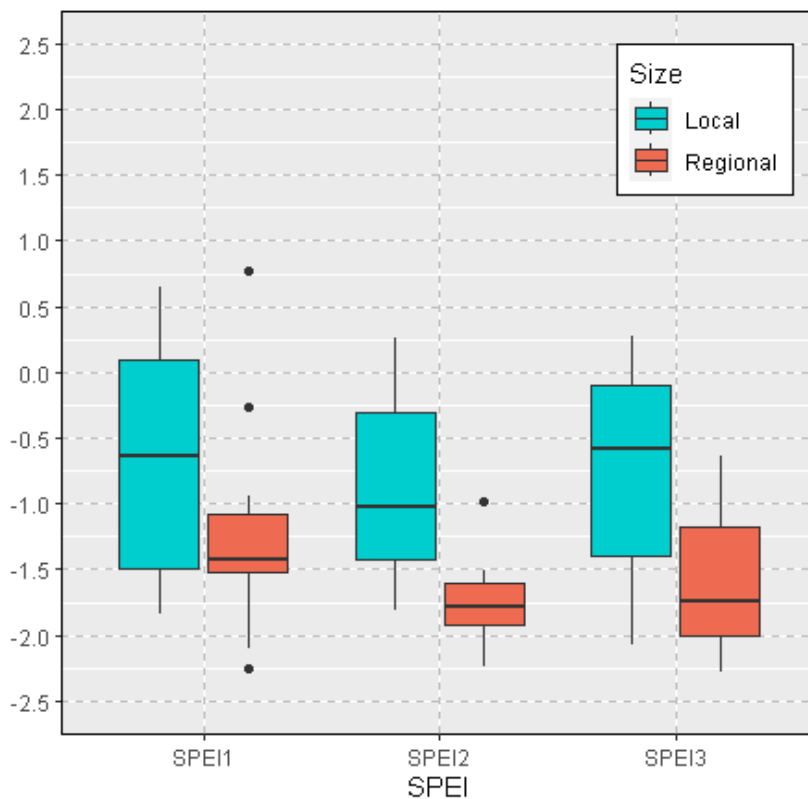
- Air quality stations:  $>200 \mu\text{g}/\text{m}^3$  hourly PM10 concentration  
([Hoffman et al., 2008](#))
- Witnesses reports: photos/videos
- Meteorological stations: Blowing dust/dust storm observations, sudden temperature drop/pressure rise
- Radar data





Fot: Marcin Jankowski

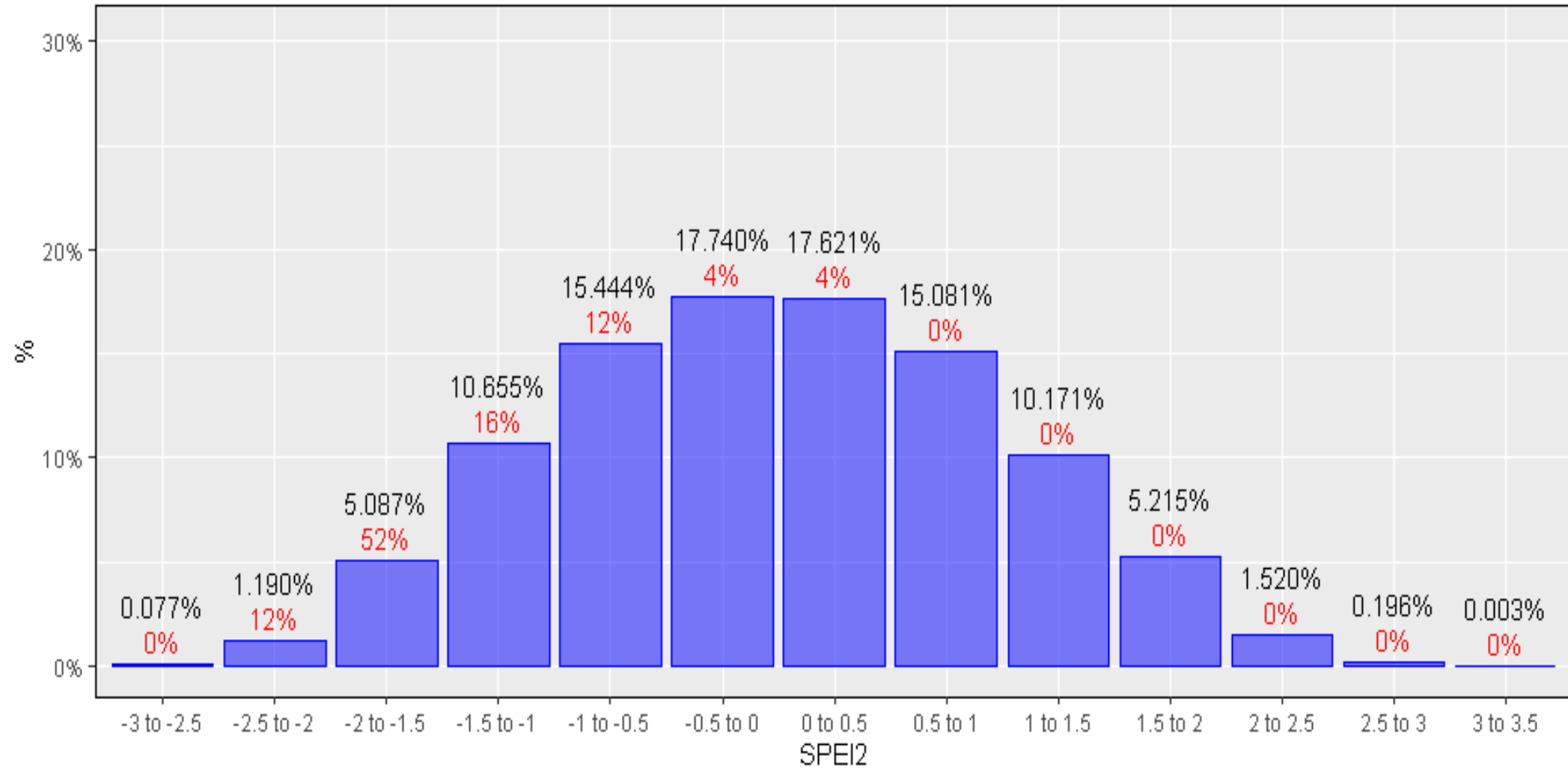
Categories	SPEI Values
Extreme drought	Less than $-2.00$
Severe drought	$-1.99$ to $-1.50$
Moderate drought	$-1.49$ to $-1.00$
Near normal	$-0.99$ to $0.99$
Moderately wet	$1.00$ to $1.49$
Severely wet	$1.50$ to $1.99$
Extremely wet	More than $2.00$

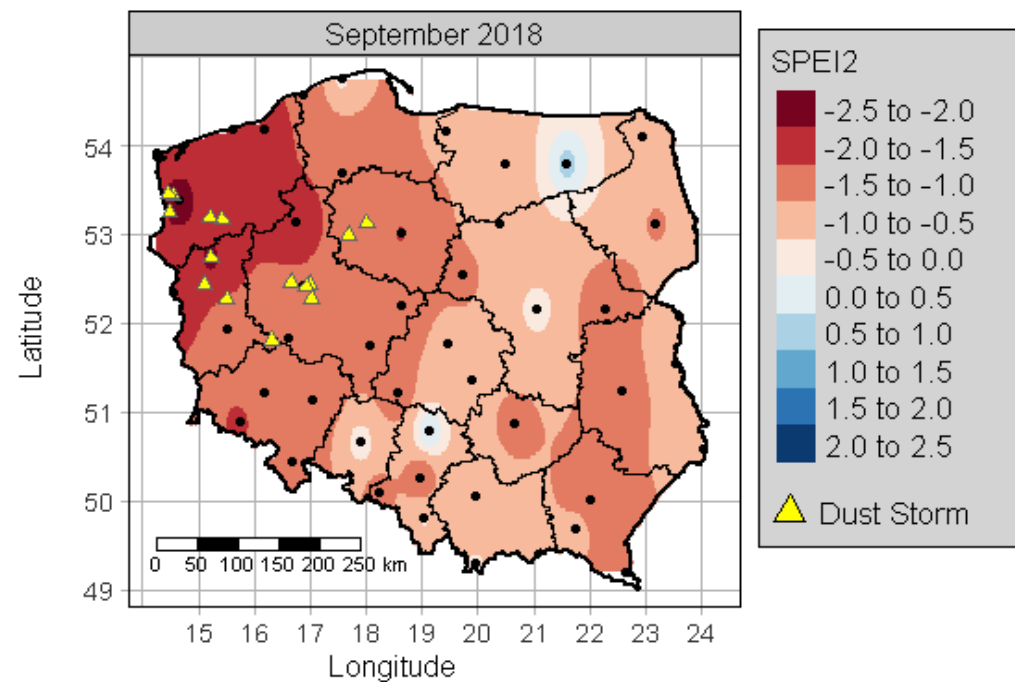
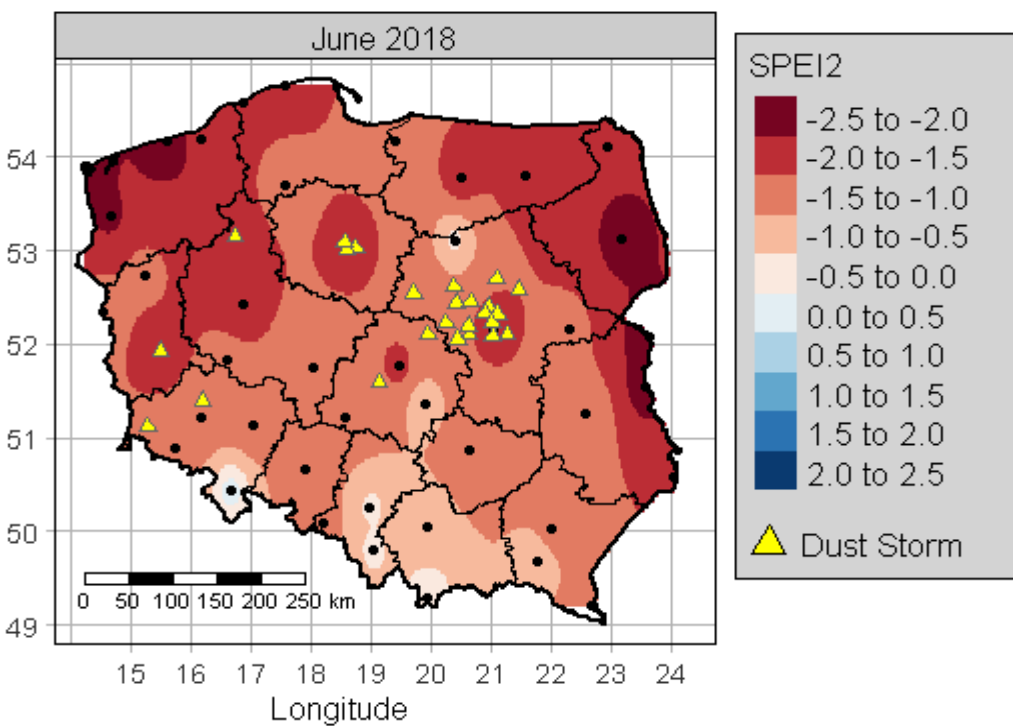
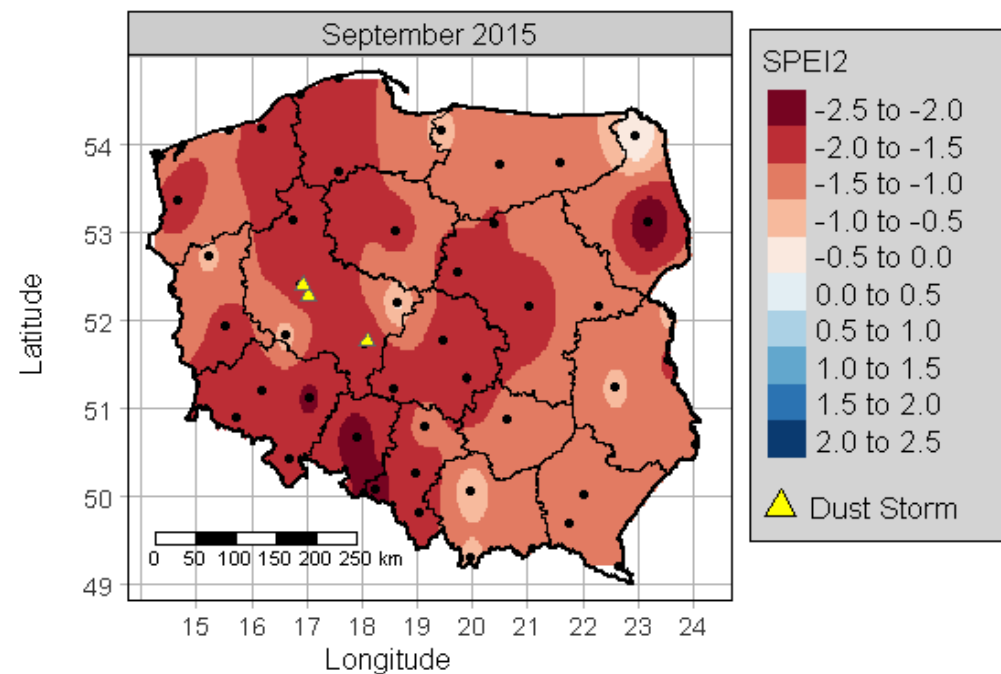
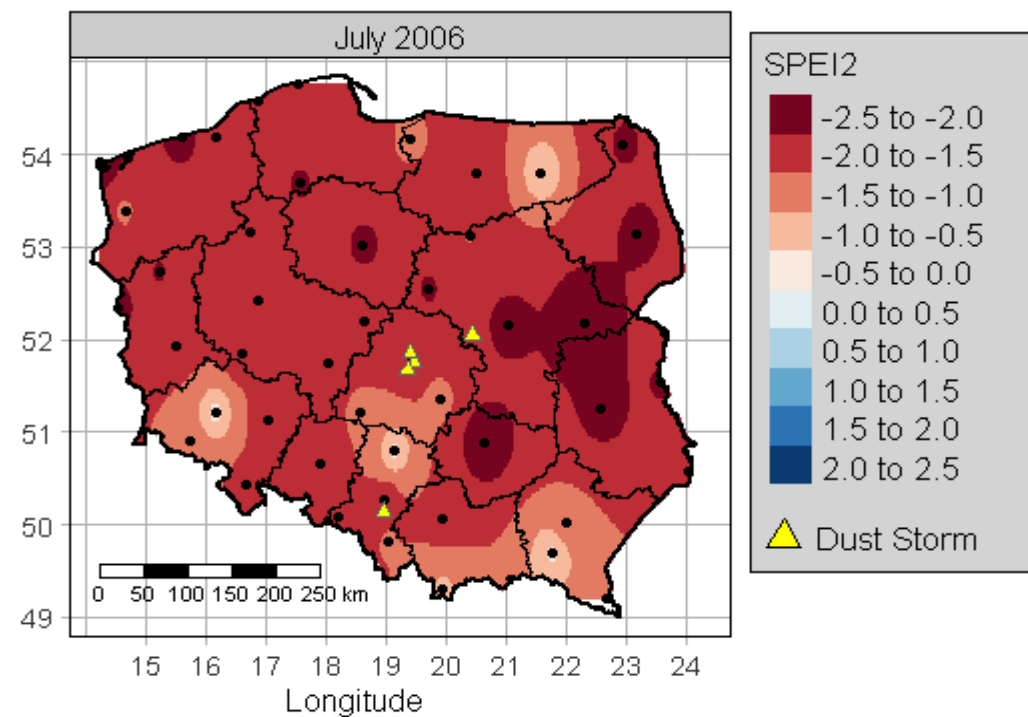


**Regional dust storm:  
>2 locations, 30 km apart**

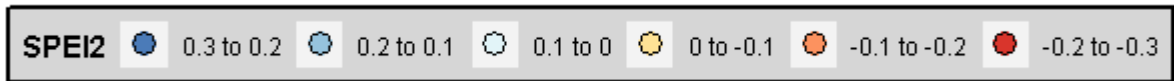
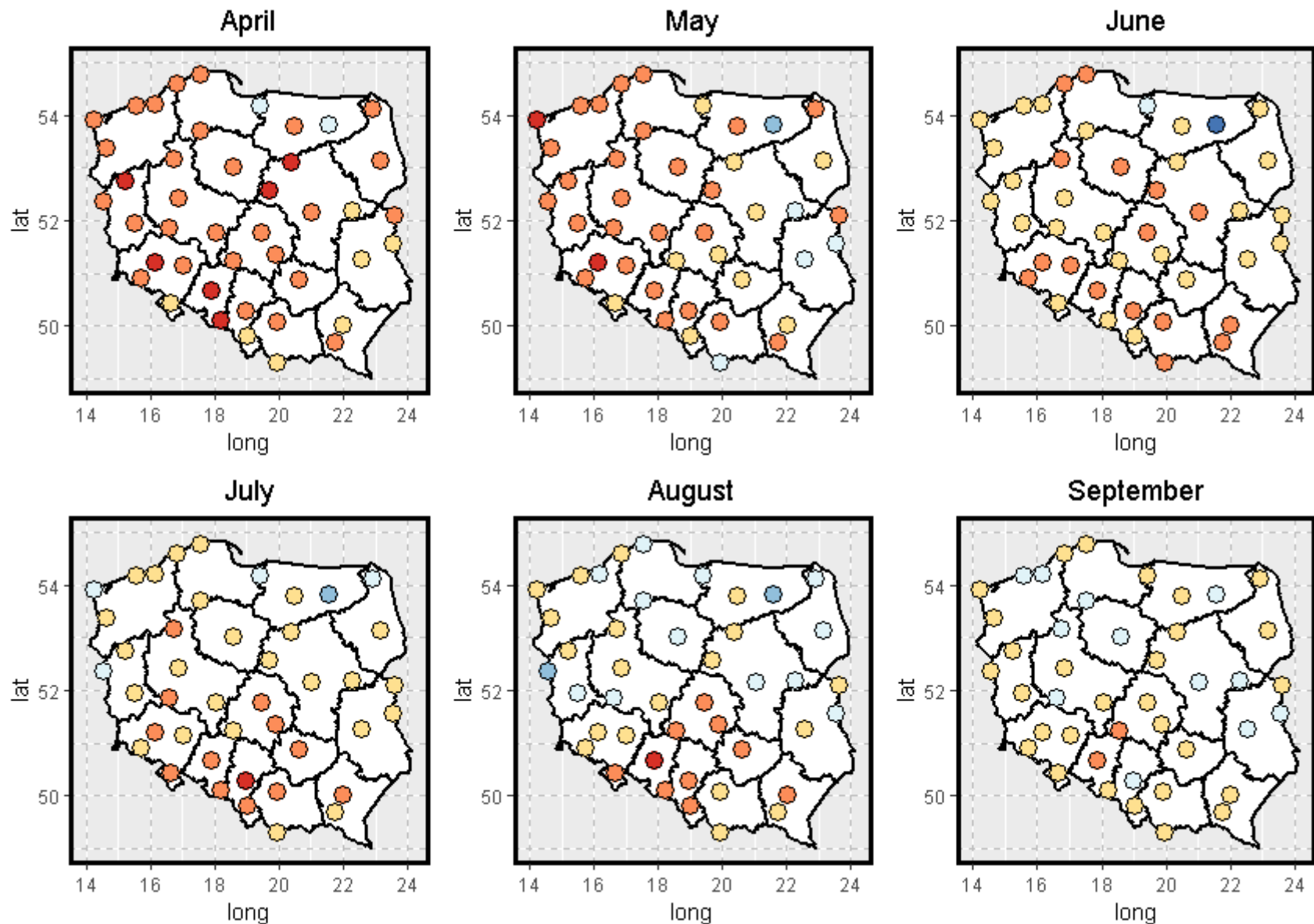


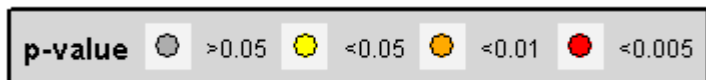
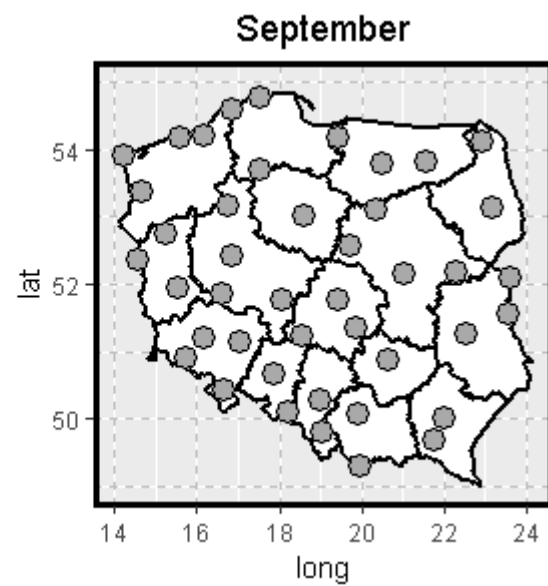
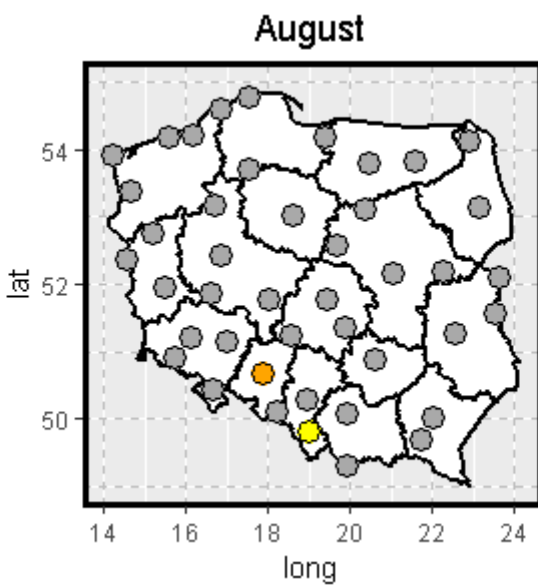
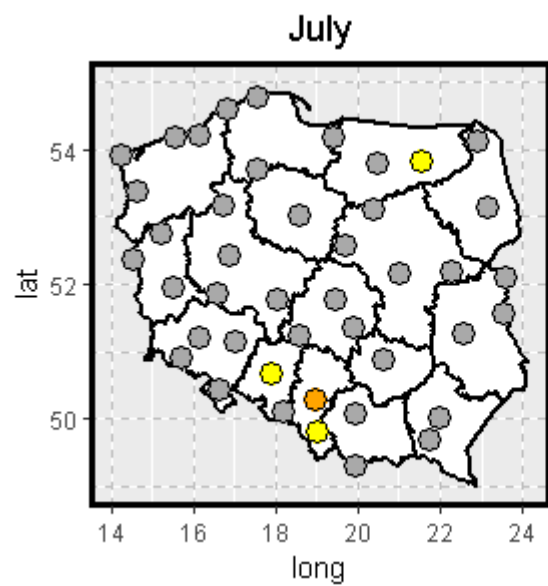
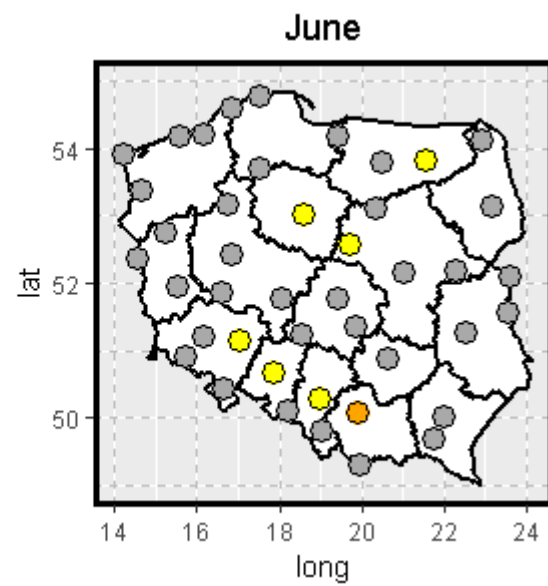
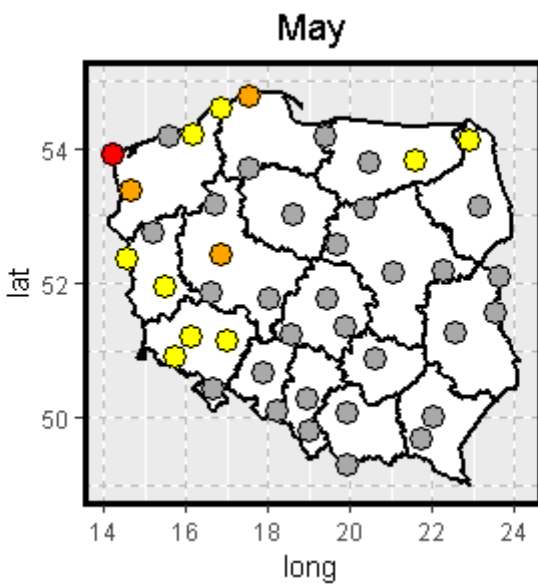
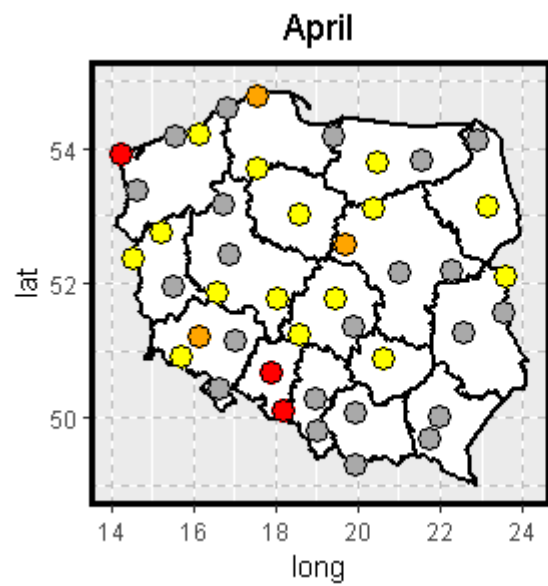
# SPEI2 frequency



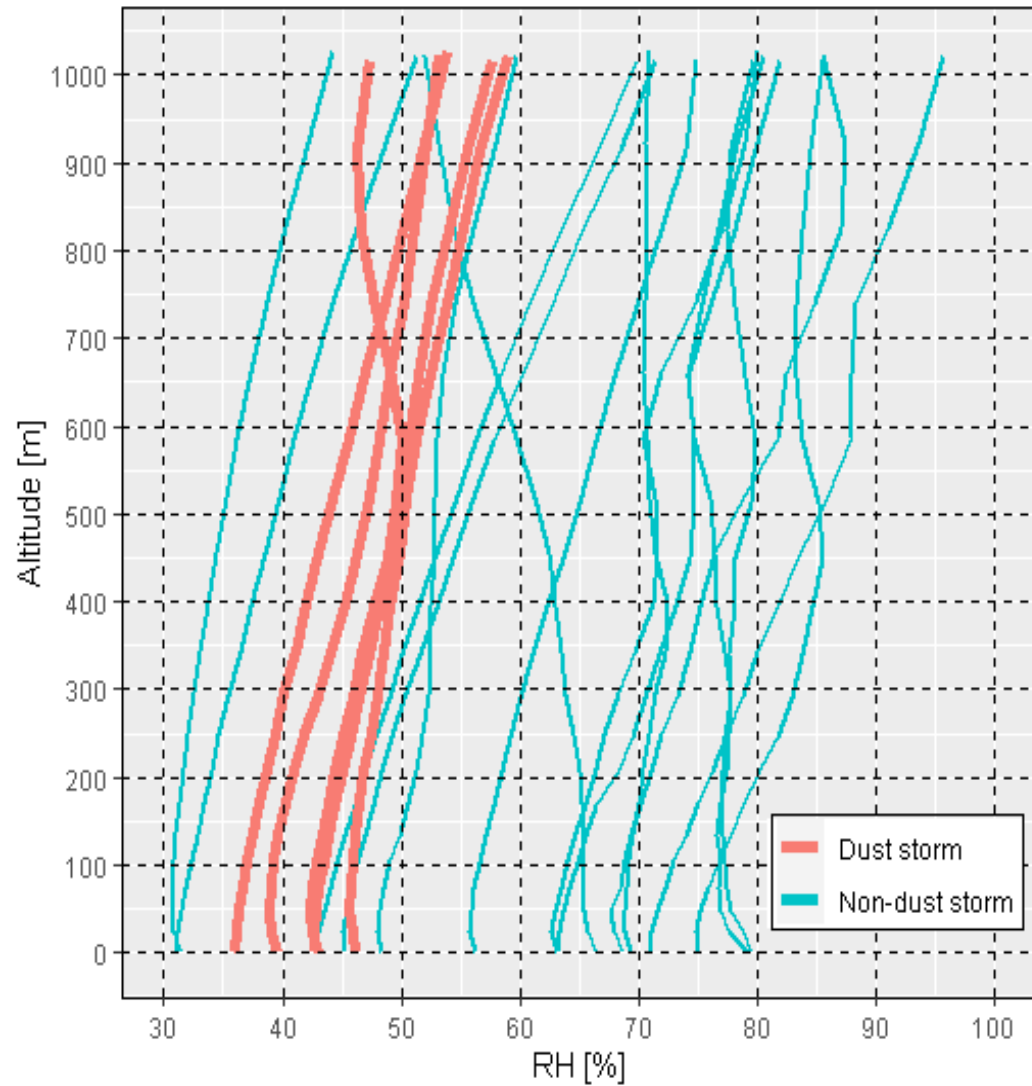
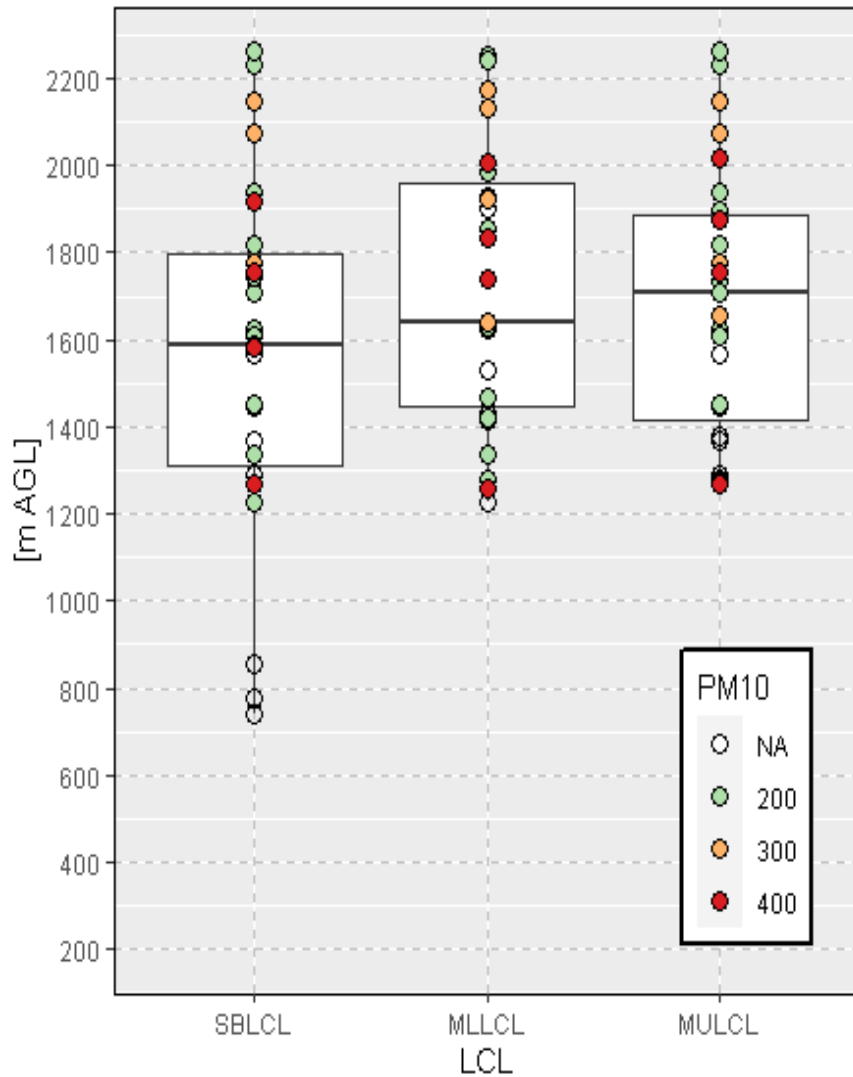


# Decadal SPEI2 trends

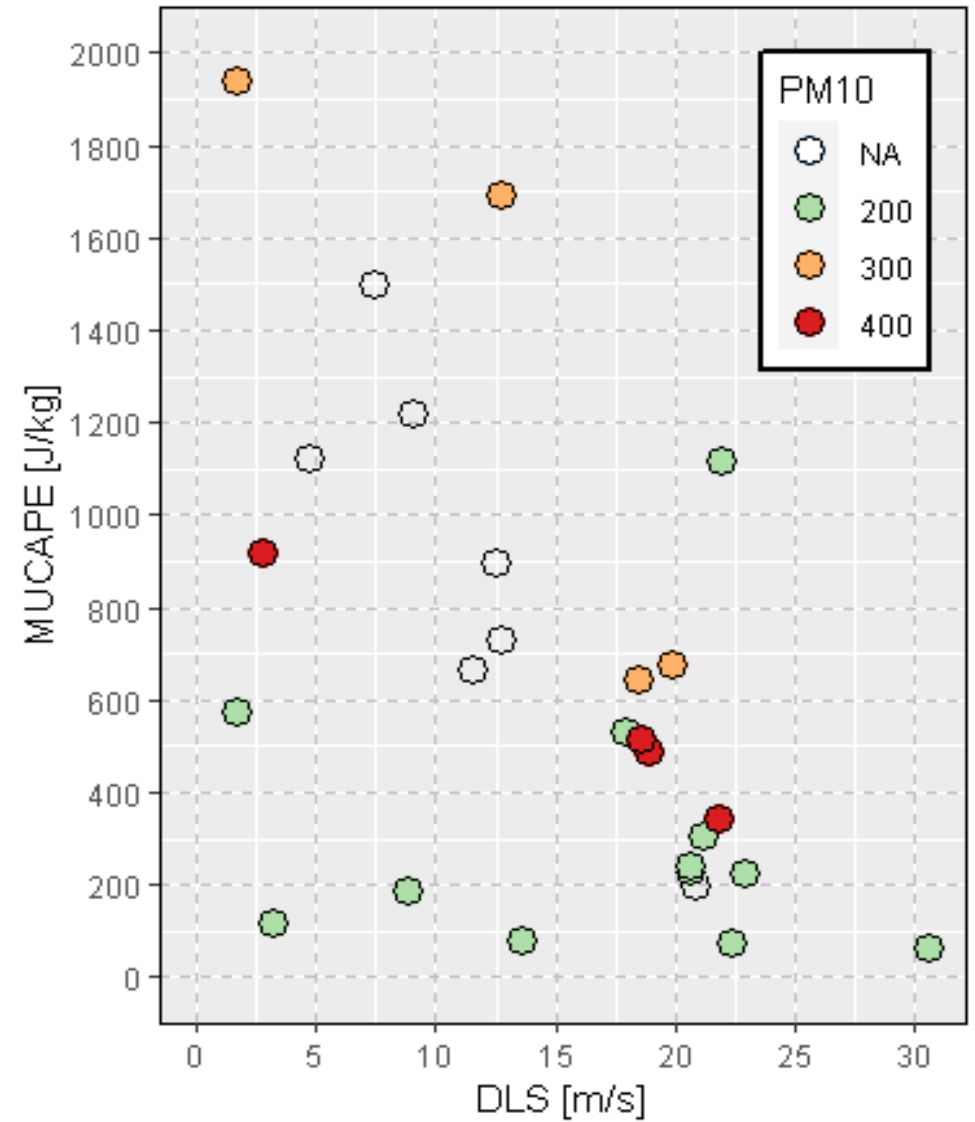
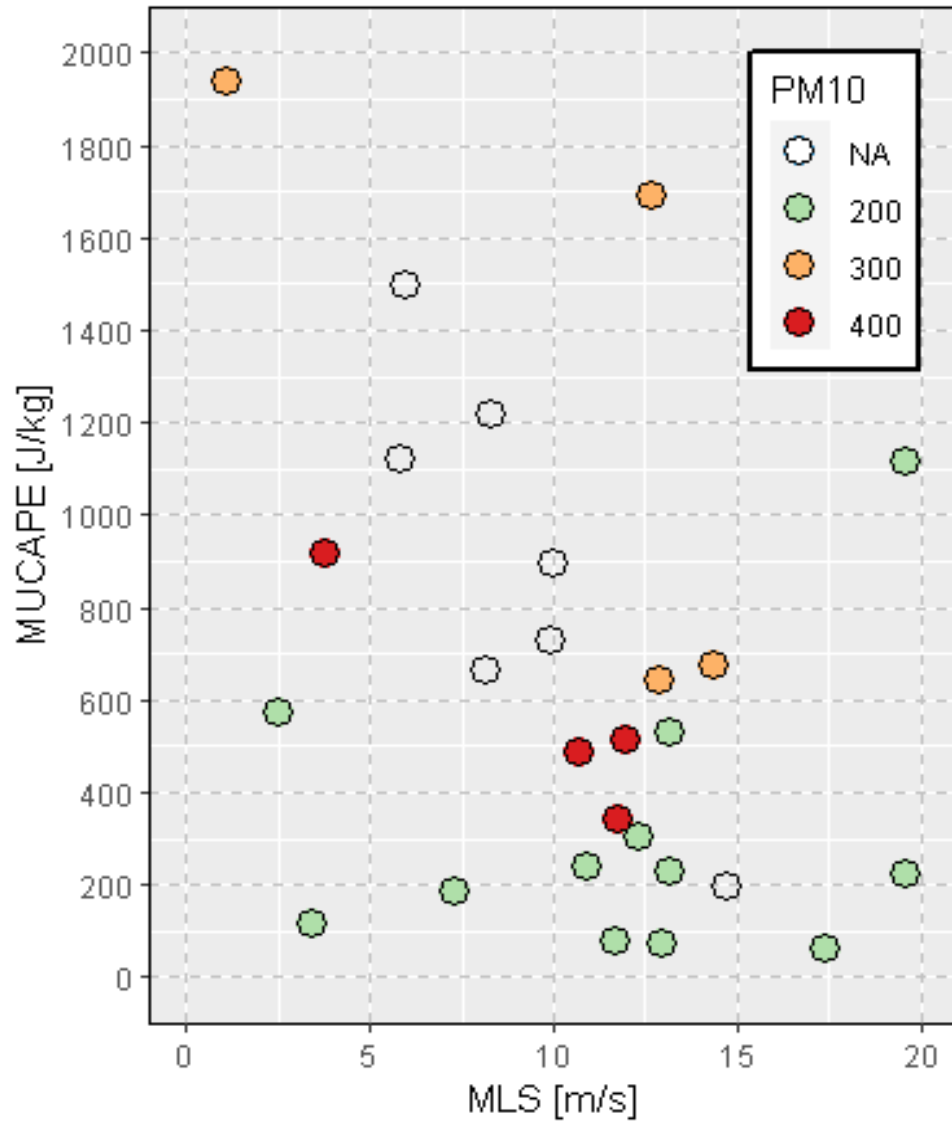




# ERA5 LCL/Vertical humidity profiles



# CAPE vs Shear



# Conclusions

- Convective dust storms occur mostly within central Poland area.
- SPEI2 values of -1.5 and below are most optimal for dust storms formation in Poland.
- Convective dust storms' formation require relatively high LCL height with maximum relative humidity values of less than 60% below 1 km agl in more severe cases.
- Most of significant convective dust storms formed within high shear-low cape environment.

- **Ardon-Dryer, K., & Kelley, M. C. (2022).** Particle size distribution and PM concentrations during synoptic and convective dust events in West Texas. *EGUsphere*, 1-19.
- **Beguiría, S., Vicente Serrano, S. M., Reig, F., & Latorre, B. (2014).** Standardized - precipitation evapotranspiration index (SPEI) revisited: parameter fitting, evapotranspiration models, tools, datasets and drought monitoring. *International journal of climatology*, 34(10), 3001-3023.
- **Hoffmann, C., Funk, R., Wieland, R., Li, Y., & Sommer, M. (2008).** Effects of grazing and topography on dust flux and deposition in the Xilingele grassland, Inner Mongolia. *Journal of arid environments*, 72(5), 792-807.
- **Idso, S. B., Ingram, R. S., & Pritchard, J. M. (1972).** An American haboob. *Bulletin of the American Meteorological Society*, 53(10), 930-935.
- **McTainish, G.H, and Pitbaldo, J.R. (1987).** Dust storms and related phenomena measured from meteorological records in Australia. *Earth Surface Processes and Landforms* 12, 415–424.
- **Raman, A., Arellano Jr, A. F., & Brost, J. J. (2014).** Revisiting haboobs in the southwestern United States: An observational case study of the 5 July 2011 Phoenix dust storm. *Atmospheric Environment*, 89, 179-188.
- **Seigel, R. B., & Van Den Heever, S. C. (2012).** Dust lofting and ingestion by supercell storms. *Journal of the atmospheric sciences*, 69(5), 1453-1473.
- **Vukovic, A., Vujadinovic, M., Pejanovic, G., Andric, J., Kumjian, M. R., Djurdjevic, V., ... & Sprigg, W. A. (2014).** Numerical simulation of" an American haboob". *Atmospheric Chemistry and Physics*, 14(7), 3211-3230.