# An investigation of fog and low cloud (FLC) life cycles and their interaction with biomass burning aerosols (BBA) in the Namib


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## Motivation

- In the coastal parts of the Namib desert, fog is the most relevant non-rainfall water source for animal and plant species.
- However, the potential effects of aerosols on FLC in the region have yet to be investigated.
- **Hypothesis:** During the biomass burning season, BBA plumes results in more, lower-lying FLCs that persist longer:

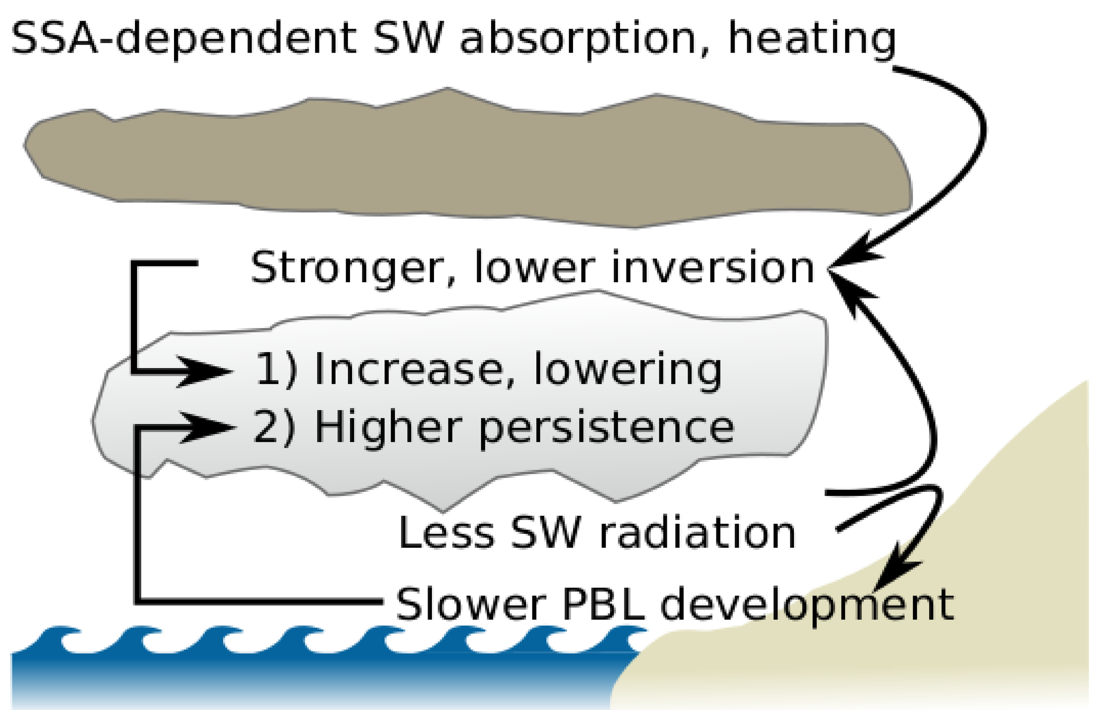


*Figure 1.* Illustration of the hypothesized effects of BBA on Namib-region FLCs.

## References


Andersen, H. and Cermak, J.: First fully diurnal fog and low cloud satellite detection reveals life cycle in the Namib, Atmos. Meas. Tech., 11, 5461–5470, https://doi.org/10.5194/amt-11-5461-2018, 2018

Pauli, E., Cermak, J., & Andersen, H. (2022). A satellite-based climatology of fog and low stratus formation and dissipation times in central Europe. Quarterly Journal of the Royal Meteorological Society, 148 (744), 1439–1454.doi: 10.1002/qj.4272

Andersen, H., Cermak, J., Fuchs, J., Knippertz, P., Gaetani, M., Quinting, J., Sippel, S., and Vogt, R.: Synoptic-scale controls of fog and low-cloud variability in the Namib Desert, Atmos. Chem. Phys., 20, 3415–3438, https://doi.org/10.5194/acp-20-3415-2020, 2020.


## Data & Methods

### Study area

Two areas of the Namib Desert with high frenquency of FLC occurrence:

- Central Namib (CN: 22-24°S)
- Angolan Namib (AN: 15-17°S)

### Satellite-based FLC formation and dissipation time data set

- Same methods as in Pauli et al. 2022
- Spatial resolution: 3 km
- Temporal resolution: 15 minutes
- Daily data from 2004 to 2018

### ERA5 reanalysis data

- Mean sea level pressure (MSLP)
- Relative humidity (RH)
- 2m temperature (T2M)
- Sea surface temperature (SST)
- Boundary layer height (BLH)
- Estimated inversion strength (EIS)

### CAMS reanalysis data

Black carbon aerosol optical depth at 550 nm (BCAOD) was used to define two groups:

- High BBA days (BCAOD > 75th percentile)
- Low BBA days (BCAOD < 25th percentile)

### Ridge regression

Used to build a meteorologically constrained statistical model to predict FLC dissipation times with ERA5 data as predictors:

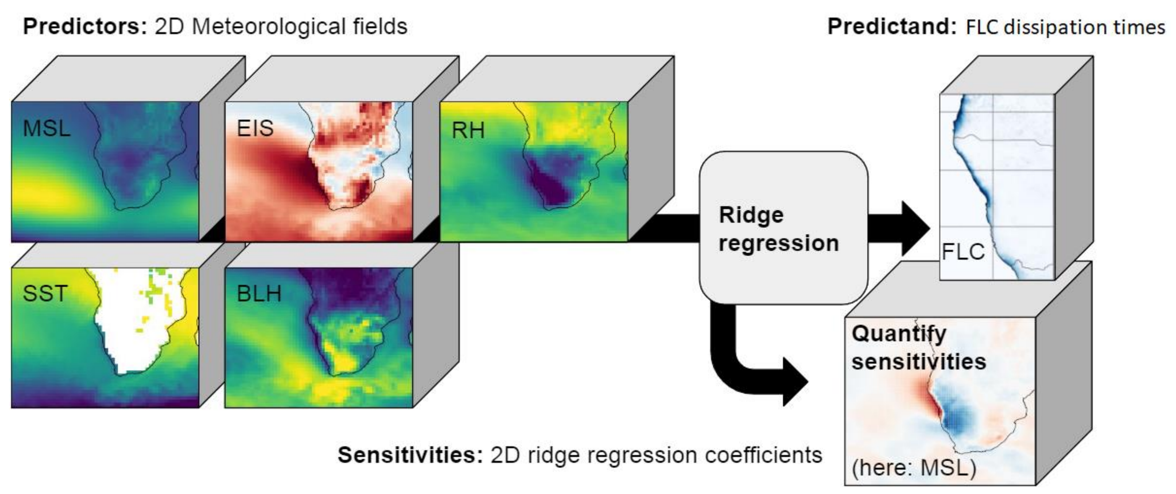


*Figure 2.* Schematic of the ridge regression method used in the study.

## Results

**Angolan Namib** | **Central Namib**

**The dissipation time of FLCs in the Namib feature a pronounced seasonal cycle, with later dissipation during the dry season:**

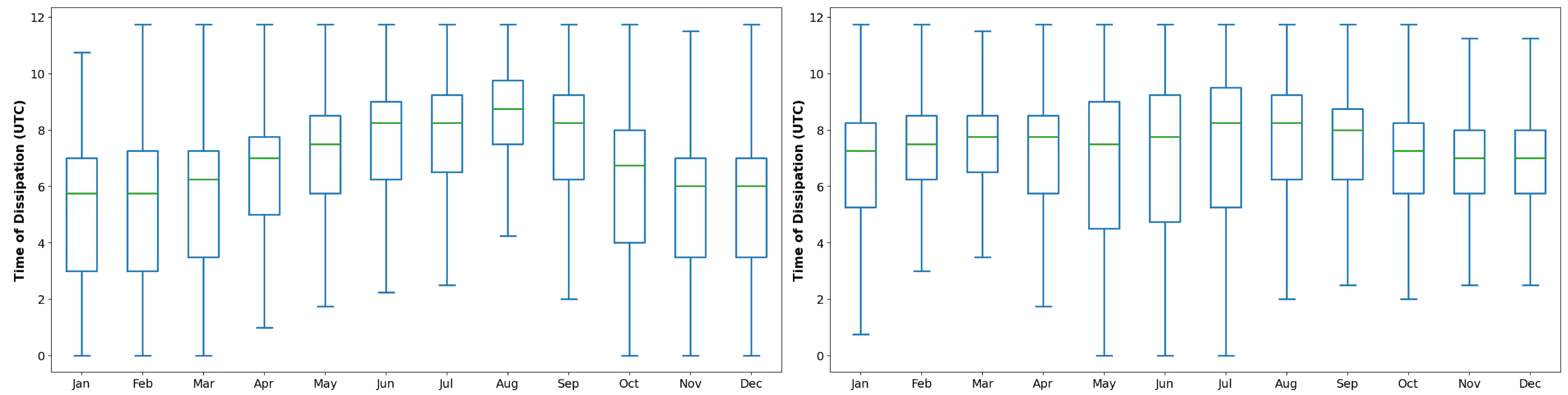


*Figure 3.* Monthly FLC dissipation time in the two regions. A seasonal cycle is present with later dissipations between May and October. With maximum persistence during the BBA season. Differences between the two regions are attributed to local meteorological processes.

**Within the BBA season, FLC dissipates significantly later on high BBA days, however, most of this difference can be explained by meteorology (statistical model):**

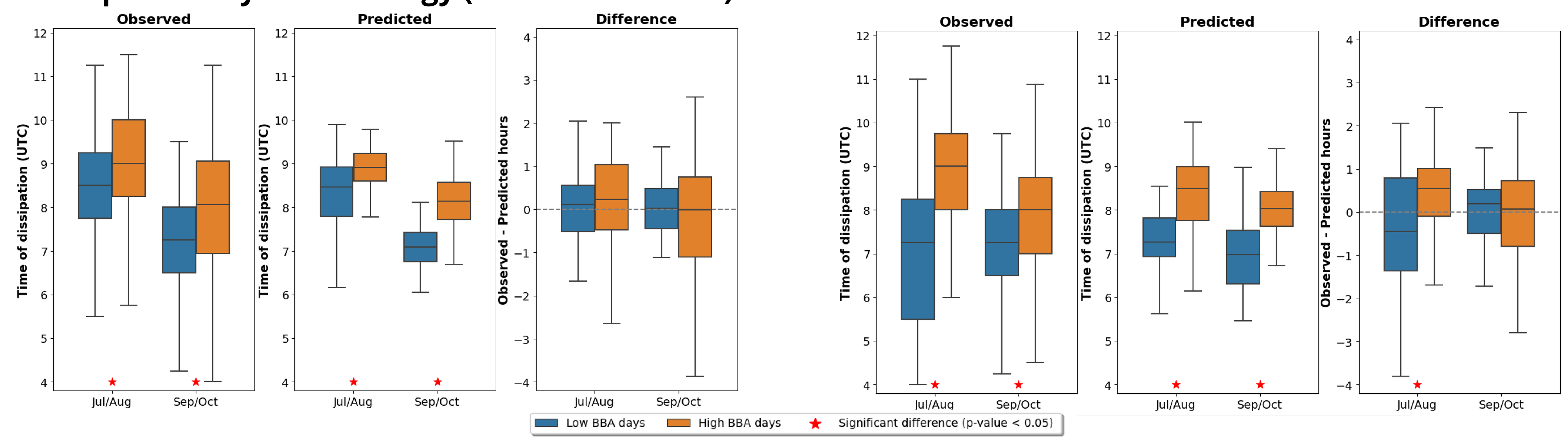


*Figure 4.* Observed and predicted FLC dissipation times, in the two regions and during the BBA season, separated into high and low BBA days. Except for Jul/Aug, no significant differences between the BBA groups are found when comparing the observed and predicted data.

## Conclusions & Outlook

- There is a clear seasonal cycle of FLC dissipation, with maximum FLC persistence during the BBA season.
- The statistical model that is trained on meteorological variables can reproduce the majority of the observed differences between the two BBA groups. This shows that most of the differences can be explained by meteorology.
- However, the BBA loading in the Namib is correlated with meteorological factors (especially dynamics which control the advection of BBA to the Namib), therefore back-trajectories could help isolate aerosol effects.