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# Machine learning methods to improve spatial predictions of coastal wind speed profiles and low-level jets using single-level ERA5 data

**Christoffer Hallgren et al.**

*Correspondence to:* Christoffer Hallgren (christoffer.hallgren@geo.uu.se) and Jeanie A. Aird (jaa377@cornell.edu)

Table S1: ERA5 variables chosen as possible predictors for the two ML models and two prediction tasks.

| **ERA5 variable** | **Abbreviation** | **Unit** | **Importance for wind profile (physical motivation)** |
|---|---|---|---|
| 10 m wind speed | ws10 | m $s^{-1}$ | Wind speed conditions at lower levels are frequently coupled to upper wind speed conditions and are also associated with atmospheric stability regimes, synoptic scale weather events and sea state |
| 10 m wind direction | wdir10 | deg | wdir10 is associated with inherited properties of the air (onshore or offshore fetch), synoptic weather regimes, as well as meso-scale weather events |
| Sea surface temperature | SST | K | Temperature at the sea surface, describes seasonality and diurnal cycles and influences the atmospheric stability |
| Mean sea level pressure | MSLP | Pa | MSLP is linked to the synoptic regime |
| Total precipitation | precip. | m $h^{-1}$ | Depth of all precipitation that falls to the surface, includes information about stability, synoptic scale weather events, seasonal variability and humidity |
| Convective available potential energy | CAPE | J $K^{-1}$ | A measure of potential instability aloft derived for a lifted parcel, as a description of convection and general stability of the troposphere |
| Surface sensible heat flux | SHF | J $m^{-2}$ | SHF describes the turbulent transport of heat between the surface and the atmosphere, as a description of stability and the diurnal and seasonal variability |
| Surface all-wave net radiation | Rn | J $m^{-2}$ | Total sum of all shortwave and longwave radiation, both incoming and outgoing, as a description of seasonal and diurnal variability of surface energy availability |
| Low cloud cover | LCC | – | Fraction of the grid box covered by low clouds, as a description of seasonal and diurnal variability, mesoscale phenomena and synoptic scale weather conditions |

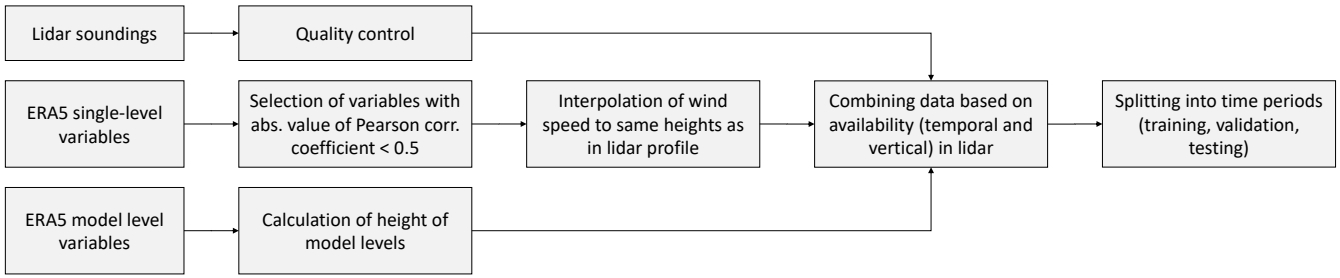


Figure S1: Flow chart of pre-processing of data from lidar profiles, ERA5 single-level variables and data on ERA5 model levels, before the ML methods were applied.

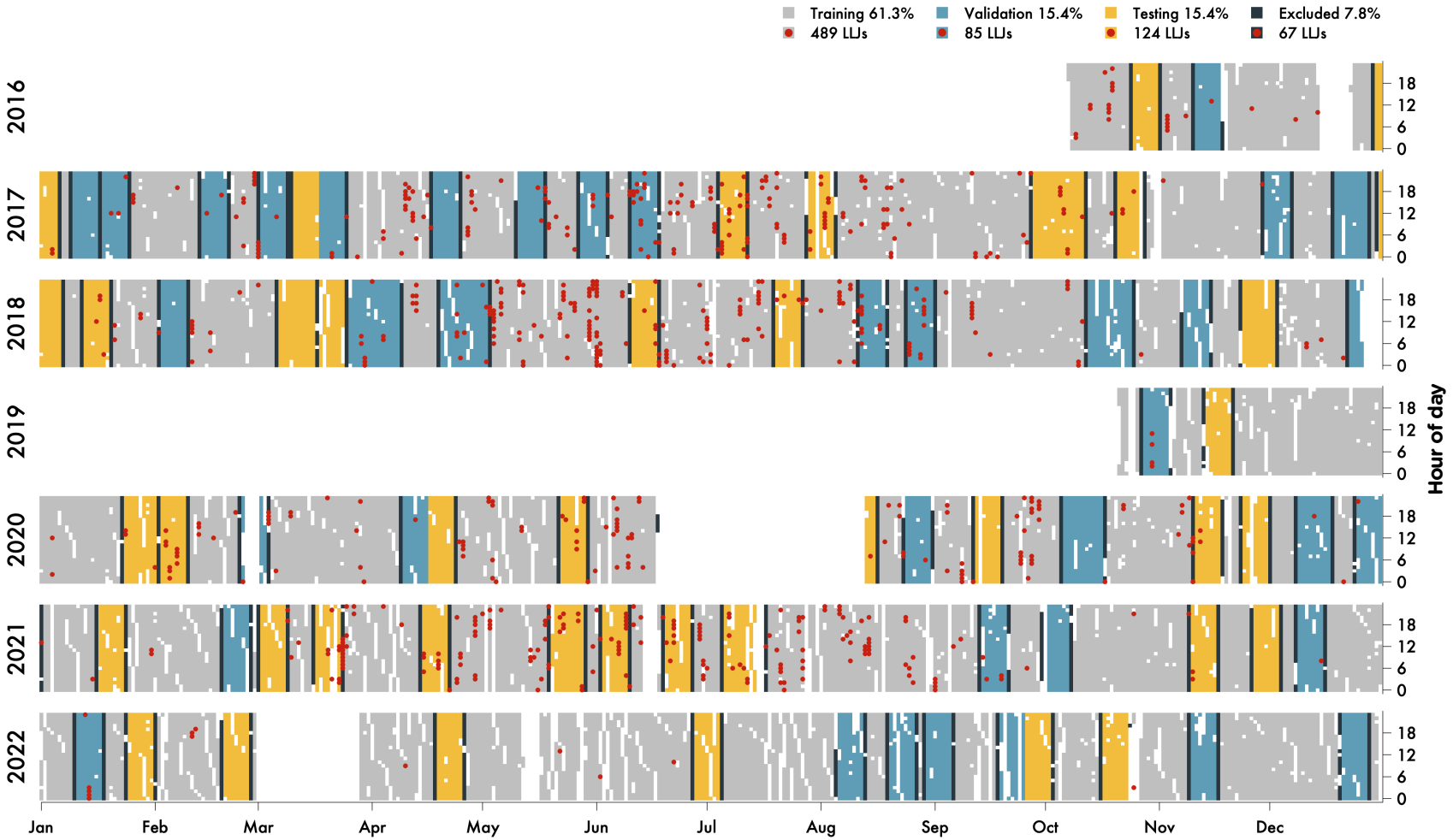


Figure S2: Overview of the data split for the ASIT time series (Oct. 2016 – Dec. 2022). The data is split into training (light gray), validation (blue), and testing (yellow) subsets and to minimize temporal auto-correlation one day of data before and after blocks of validation and testing are excluded (dark gray). Hours where there is an LLJ in the lidar profile are marked with red circles.

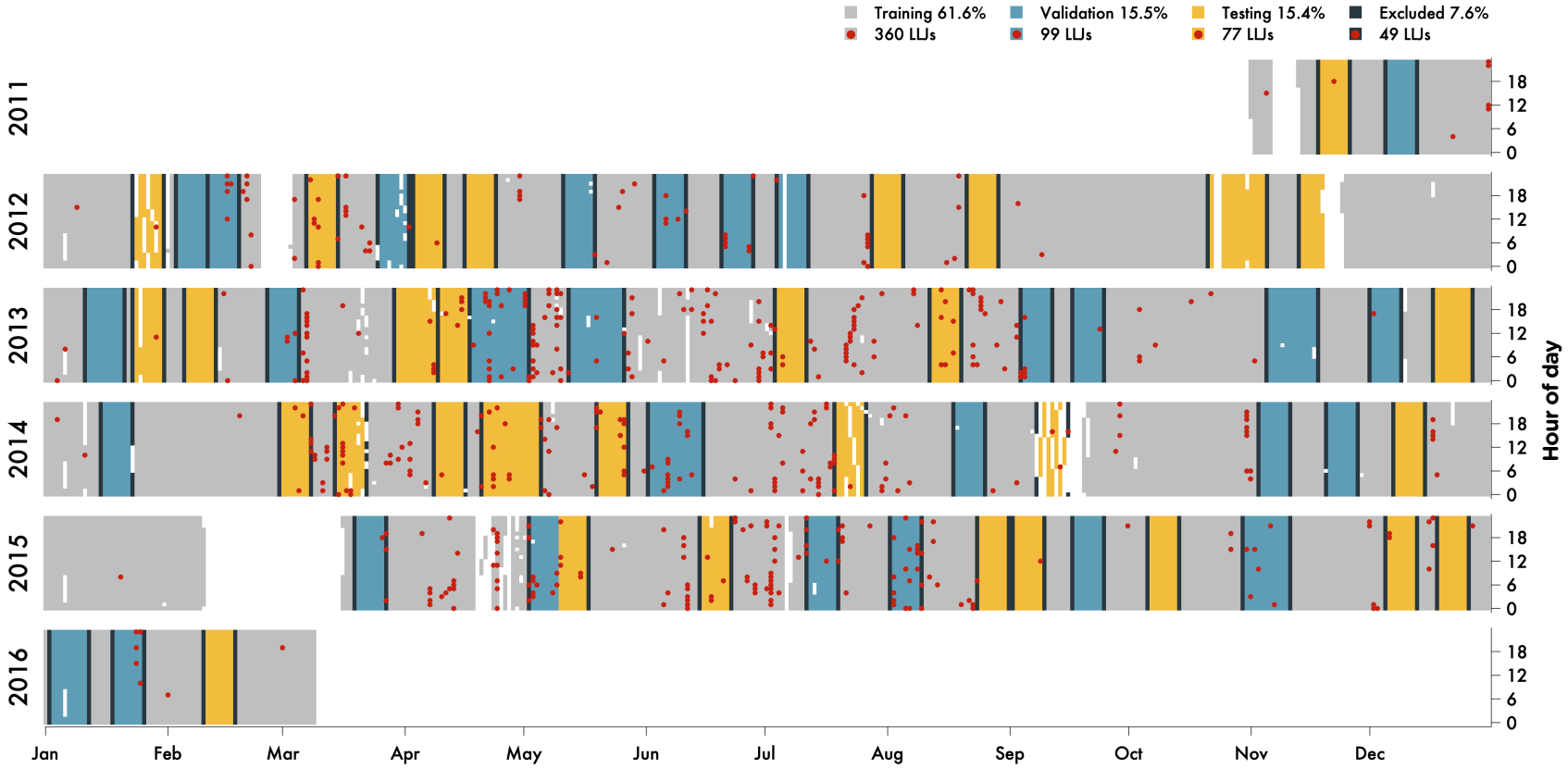


Figure S3: Overview of the data split for the MMIJ time series (Nov. 2011 – Mar. 2016). The data is split into training (light gray), validation (blue), and testing (yellow) subsets and to minimize temporal auto-correlation one day of data before and after blocks of validation and testing are excluded (dark gray). Hours where there is an LLJ in the lidar profile are marked with red circles.