EMS Annual Meeting Abstracts
Vol. 16, EMS2019-563, 2019

Characterization of weak-wind and clear-sky nights that contribute to the chilling hours

Maria A. Jiménez, Antoni Grau, and Joan Cuxart

Universitat de les Illes Balears, Edifici Mateu Orfila, Physics Department, Meteorology group, Palma de Mallorca, Spain (mantonia.jimenez@uib.cat)

During nighttime and in flat and homogeneous terrain, the observed temperature (for instance at 2 m above the ground, T2m) decreases together with the radiative cooling of the surface. Instead, in complex terrain regions physical mechanisms like cold pools or thermally-generated winds might be present enhancing or diminishing the observed cooling at 2 m. It is important to characterize the temperature patterns in agricultural areas since many plants need a certain amount of time under cold temperatures, especially during winter dormancy, when buds and seeds are unable to grow mainly due to hormonal factors. The chilling hours (CH) is a parameter that counts the number of hours below a certain temperature threshold during the cold period of the year. The aim of this work is to characterize the weather conditions that contribute to the number of CH in the island of Mallorca (Western Mediterranean Sea). The anual CH are computed (from 1st September to 31 August next year) during 10 years (2008-2018) using observations of T2m from the Automatic Weather Stations (AWS) of the Spanish Meteorological Agency (AEMET). As in other temperate climates like the Mediterranean, here 7°C is taken as a threshold value to compute the CH.

Results show that in Mallorca the observed CH are between 100 and 2000, depending on the local weather conditions (i.e. mountain slopes, foothills, plain or close to the coastline). It is found that the instants that contribute to the CH have the following features: (a) winds are frequently less than 1 m s^{-1} and occasionally strong larger-scale winds associated with cold advection; (b) locally-generated winds prevail; (c) most of the events take place during nighttime and the cold season (from December to March); (d) clear-sky conditions are present but for 20% of the events clouds are reported, being half of the times related to fog formation (simultaneously clouds and weak winds). Hourly satellite-derived Land-Surface Temperatures (LST) from Meteosat Second Generation are used to built a map over Mallorca of the number of CH during the studied period. The spatial resolution of the LST fields (4×4 km^2 in Mallorca) does not include the thermal variability of Mallorca and the CH derived from the satellite fields are sometimes biased in comparison to those computed from the AWS. However, the analysis of the satellite fields show that the largest coolings are found in the bottom parts of the three main basins (cold pools are generally formed) whereas the smallest are placed in coastal regions, in agreement to the AWS results. Finally, formulations to estimate the CH from daily minimum and maximum temperatures and averaged minimum temperatures during winter are found from the AWS and satellite data. Although they are valid for the studied site, the proposed methodology to compute the number of CH can be applied to everywhere if a network of observations and satellite-derived LST are available.