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The relation between surface wind regimes and synoptic variables using self-organizing maps

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This study objectively defines and automatically reconstructs surface wind regimes over Israel. Unlike other previous studies subjectively examining case studies or applying the semi objective synoptic classification as a predictor to the wind regimes, this study shows the ability of the self-organizing maps (SOM) method to directly define well known wind regimes at the synoptic hours (0,6,12,18UTC). This ability lays the groundwork for future statistical climatological analysis and applications.

The investigation is made by analyzing surface wind measurements from 53 Israel Meteorological Service (IMS) stations during 2006-2012. The connection between the synoptic variables and the wind patterns is revealed from the averages of synoptic variables (geopotential height (gph), temperature, humidity and synoptic wind) at each SOM wind regime. The synoptic data is derived from ECMWF ERA-INTERIM reanalysis.

The semi objective classification relates to the depth of the pressure gradients under lows, however, it does not do so for the other synoptic groups. The inspection of wind regimes and their gph anomaly averages has shown that wind regimes relate to the gradient of the pressure anomalies rather than the specific pattern of the isobars under each semi objective synoptic class. Two main wind regimes: strong western and strong eastern are well known over this region. During day time, SOM classification identifies these two regimes, while the semi objective synoptic classification reveals only strong western regimes.

In accordance with others previous subjective studies, two main groups: winter lows and highs and/or Red Sea troughs are related to the strong westerly or easterly wind regimes with low diurnal variability and high daily persistence. Regimes under shallow pressure gradients have higher diurnal variability, relatively lower steadiness and weaker speed. Their daily persistence is not necessarily low.