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Air temperature variability in Sfax between 1970 and 2002 (Middle Eastern Tunisia)

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Global warming is a "modern complicated" problem, involving the entire world. Since a half century and particularly during the three last decades, the world knew a relative rise of the air temperatures. Everywhere in the world, this rise is more significant in minimum temperatures; it is the case around the Mediterranean Sea. Our main objective is to make a significant contribution to the understanding of the air temperatures changes characteristics between 1970 and 2002 in Sfax, located in southern Middle East of Tunisia. This agglomeration is characterized by an important industrial activities and high urban density (500 000 habitants). The Mediterranean Sea has a significant impact on the weather and climate in this coastal plane.

To study the Temperature Change over the period 1970-2002, we use daily maximum and minimum air temperature data recorded in "Sfax-el-Maou station". Besides of latter, the following data-sets have been used in this study: The North Atlantic Oscillation (NAO), time series have been taken from Climatic Research Unit (CRU) data-set and other relevant North Hemisphere teleconnection patterns from National Center for Environ-mental Prediction (NCEP). Air temperature series were analysed with statistical methods and several statistical tests.

At first, the tests for detection of break, such as Buishand's test, non parametrical Pettitt's method, Lee and Heghinian's Bayesian method and Hubert's segmentation show a considerable increase in annual minimum air temperatures during the recent three decades. These last grow from 12.7˚C between 1970 and 1982 to 14.9˚C between 1999 and 2002. The rise of the maximum temperatures does not exceed 1.2˚C for the same periods. The main break was recorded in 1983 according to all the tests. The thermal rise can be justified by urban heat island effect, the North Atlantic Oscillation (NAO)

and with the nebulosity increase. Results show that the large inter-annual variability of minimum temperatures is largely modulated by the NAO. The correlation between NAO index and minimum temperatures (0.68) is consistently higher than these obtained with maximum temperature (0.53).

The temperature changes are related to natural causes: the consultation of the metadata of the "Sfax-el-Maou" station shows the absence of breakdown, of the material displacement and of station environment.

Secondary, regional warming has been mainly associated with the extension of hot season. To classify the seasons and discern their limits according to the minimum and maximum daily temperature, we use the technique of Agglomerative Hierarchical Clustering. The index of similarity used is Euclidean distance and aggregation criterion selected is ward's method. The *Center/Reduce* options were selected to avoid having group creation influenced by scaling effects. Classification results are presented by the dendogram.

Every month is divided into 5 consecutive day's period (6 days for the last period of the 31 days months and 3 days for that of February). Each year is then divided into 72 periods. The maximum and minimal averages temperatures of each one of these periods are calculated every year. Thus, 3 seasons are classified: cold, hot and intermediate seasons.

An important inter-annual variability of season's extent was found. For example, in 1994, according to the method described above, the cold season was covering 13 periods against 35 for the hot season. In 1970, the hot season doesn't exceed 25 periods but the cold one reaches 35 against 22 periods for the tow seasons in 1984.