Three-Dimentional Analysis of Mediterranean Cyclones – The Conveyor Belt Paradigm

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The 3-D structure of the Mediterranean cyclones was analyzed, using the conveyor belt conceptual model. This model refers to 3 airstreams, which constitute the air-transport that take place in mid-latitude cyclones; warm and cold conveyor belts, and a dry air intrusion. The warm belt contains warm air that is ascending along the way poleward. It is manifested as a thick cloud band and is regarded as the main rain contributor in the cyclone. Since the Mediterranean is located south of the global mid-latitude storm track, and is surrounded by complex terrain, it is interesting to compare the winter cyclones there to the classical mid-latitude cyclones. The study is based on 8 winter cyclones. The analysis uses isentropic streamline maps, satellite imagery and air trajectories. In the isentropic maps the wind was taken relative to the cyclone velocity.

The warm and the cold conveyor belts, as well as the dry air intrusion, were clearly identified in the isentropic maps. The cloud bands associated with the warm and with the cyclonic branches of the cold belts appeared clearly in satellite imagery. However, those associated with the warm belt were feeble in several cases. The anticyclonic branch of the cold conveyor belt was found only in part of the cyclones but even then had no signature in the satellite imagery.

It is shown that the Mediterranean cyclones are well described by the conveyor belt paradigm, except for two aspects: 1) The warm belt is not the main precipitation contributor, due to the arid origin of the warm air; 2) The dry air intrusion is originating north to the cyclone and extends southward above it, unlike its common northwest-southeast orientation. This may explain the absence of an anticyclonic branch in the cold belt in several cyclones. The existence of dry air intrusion indicates that, like the classical mid-latitude cyclones, stratospheric intrusions play a role in the genesis of the Mediterranean cyclones. An analysis of the meridional extension of the conveyor belts shows that the Mediterranean cyclones mix warm air masses originating from the Saharan Desert with cold air originating from southern Europe and, sometimes, from the Mediterranean itself.