A CASE STUDY OF HAILSTORMS OVER HATAY TURKEY BY USING DUAL POLARIZATION RADAR DATA

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ABSTRACT

The Hail storm cause damage to agriculturel lands, cars and buildings in effected regions. Intensity of damage depends on the hail size [1-2]. For this reason, it is necessary to investigate dynamic and physical structure of hail storm for forecaster. Despite the severe hail is most likely occured in the afternoon and evening in spring and summer, particularly in May and June [3] hail storm occured with the waterspout in winter 2016/January 1500Z over Hatay/Iskenderun located south of Turkey. The aim of the study investigate the hail storm which occured in 08.01.2016 in Hatay Turkey. Also show the synoptic occurence, radar picture and time synchronized thermodynamic diagram and numerical weather prediction datas belong to ECMWF. Radar pictures which are Zdr, RhoHV, phiDP and VIL datas is discussed and hail size has been estiemated via VIL datas.

Keywords: *VIL, dual polarization, Kdp, Zdr, RhoHV, Hail size*

1. INTRODUCTION

Correlation coefficient is the correlation between the signal at horizontal and vertical polarization.The correlation is high when the radar measurement volume is filled with homogenous population of targets such as raindrops or snowflakes only, and low when there is a mixture of different particles such as raindrops together with hail or snow. HV is above 0.99 in rain; it can drop down below 0.90 in hail or the melting layer; much lower (0.7) values are expected in chaff. HV decreases slightly at high antenna rotation speeds [4].

The aim of the VIL product is to give an instantaneous estimate of the water content residing in an atmospheric layer. VIL converts reflectivity data (Z), which are the direct measurement of a weather radar, into equivalent liquid water content (M), through the semi-empirical relation between M (kg/m^3) and Z.

2. MATERIAL AND METHOD

2.1. Specific Diferantial Phase, KDP

Specific differential phase shift *KDP* allows discrimination between statistically isotropic and anisotropic hydrometeors; isotropic hydrometeors produce similar phase shifts for horizontally and vertically polarized waves. Therefore, differences are due to anisotropic constituents. In general, the magnitude of *KDP* increases as both oblateness (or prolateness) and dielectric constant increase [5]. *KDP* is useful for locating regions of heavy precipitation [6], and regions of high *KDP* often overlap regions of high *ZH*; however, the main difference between enhancements in *ZH* and *KDP* is that *ZH* is affected by liquid and frozen hydrometeors, whereas *KDP* is mainly affected by the presence of liquid water. *KDP* is particularly useful for rainfall estimation in cases when hail is mixed with rain [7-8]. In addition, *KDP* is nearly linearly related to rainfall rate and can be considered a good measure of the amount of liquid water in warm-season precipitation [9].

Specific differential phase or KDP is defined as the range derivative of DP. KDP is a way to capture the DP changes over very short ranges, which gives us more useful information. You can think of it as a “local” variable. Thus the units for KDP are degrees per km. The specific differential phase is a comparison of the returned phase difference between the horizontal and vertical pulses.

In this study the Kdp value is has been shown at Figure 1 and calculated Kdp=0,28. It is possible to tell if the result is positive due to the shape of the filling.

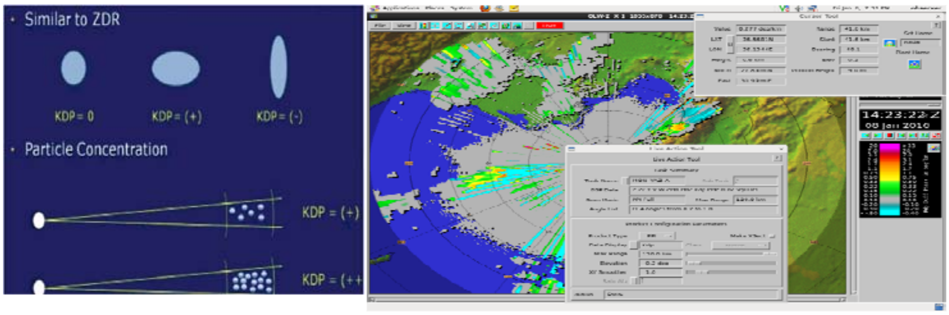

Figure 1 : Specific Differantial Phase, Kdp

2.2. Hydrometeor Classification Algorithm, HCA

Hydrometeor classification algorithm derived from different tilts and used to determine which rain rate algorithm is used at each azimuth/range bin.

It can see in Figure 2, it is possible to say that the result is in the Hail class.

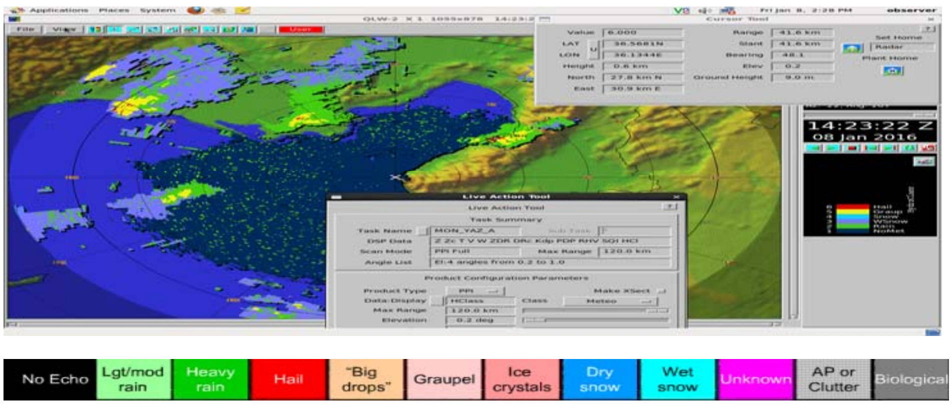

Figure 2 : Hydrometeor Classification Algorithm, Hca

2.3. Diferantial Reflectivity, ZDR

Differential reflectivity *ZDR* is related to the axis ratio and size of hydrometeors [10]. *DR* is a measure of the reflectivity-weighted mean axis ratio of hydrometeors in a volume [5]. The hydrometeors with their major axis aligned in the horizontal plane produce positive *ZDR* and hydrometeors with their major axis aligned in the vertical direction produce negative *ZDR*. *ZDR* is also affected by the physical composition or density of hydrometeors. For the hydrometeors of given size and shape, *ZDR* is enhanced as the complex refractive index increases. The complex refractive index of liquid water is much greater than that of ice. Thus, the *ZDR* of an oblate water drop is larger than the *ZDR* of an ice pellet of the same size and shape, which in turn is larger than the *ZDR* of lower-density ice hydrometeor (e.g., graupel or snow aggregate) of the same size and shape [11-12].

The differential reflectivity is a ratio of the reflected horizontal and vertical power returns. Among other things, it is a good indicator of drop shape. ZDAR polarimetric parameters include parameters that depend on the shape of the hidrometeor. It can see at figure 3 the diferantial Reflectivity and DBZ value respectively ZDR=0, DBZ=57,5 dbz and
It can be said that the shape is round due to the result being ZDR=0.

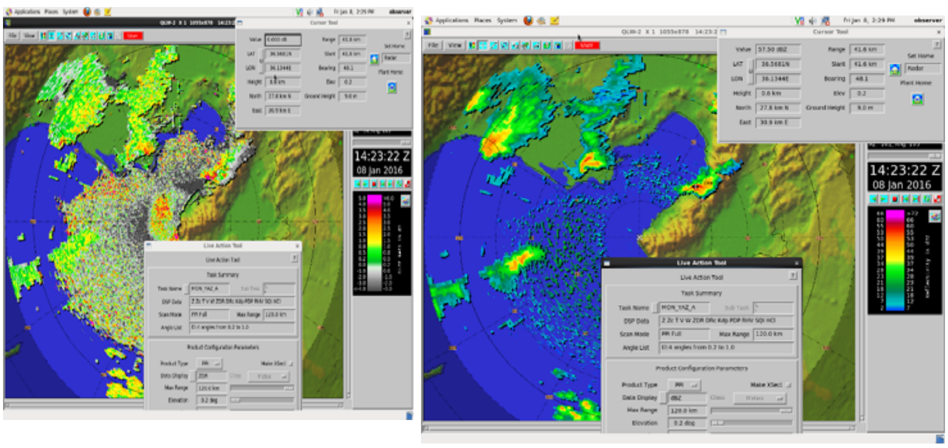

Figure 3 : Diferantial Reflectivity, Z_{DR}

2.4. Corelation Coefficient, ρ_{HV}

Correlation coefficient ρHV is the determination of the correlation between the horizontal polarization pulse signals and vertical polarization pulse signals. Modeling and observation studies show that ρHV decreases with increasing diversity of hydrometeor orientations and shapes [7]. Moreover, ρHV is lower when there are mixtures of hydrometeor types rather than when just one type is present [13].

A statistical correlation between the reflected horizontal and vertical power returns. It is a good indicator of regions where there is a mixture of precipitation types, such as rain and snow [14].

It can see at Figure 4 the Corelation Coefficient value as 0,94. It shows that the precipitation formed is rain.

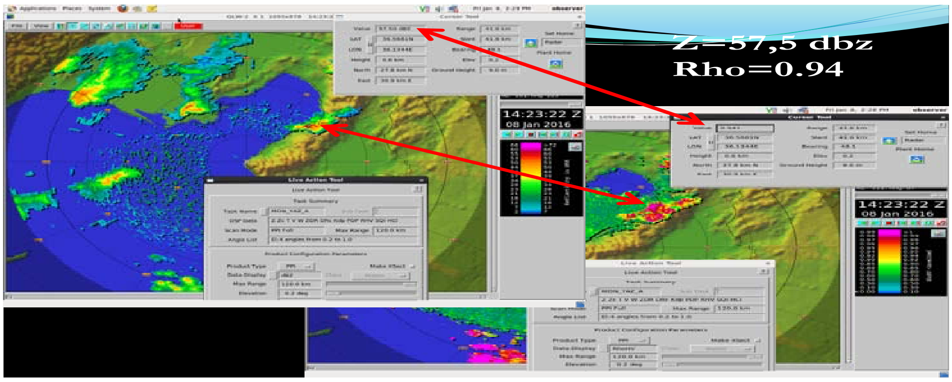

Figure 4 : Corelation Coefficient, Rho

2.5. Vertically Integradet Liquid density method, VIL

VIL is a nonlinear function of reflectivity and converts weather radar reflectivity data into estimates of equivalent liquid water content based on theoretical studies of drop size distributions and empirical studies of reflectivity factor and liquid water content [15]. When the VIL is ''normalized'' using the echo top, the resulting VIL density can be used to quickly identify thunderstorms with high reflectivities relative to their height. The Vertically Integrated Liquid (VIL) was proposed as a proxy of storm cell severity [16].

VIL density is simply the VIL (kg/m2) divided by the echo top (m). The quotient is multiplied by 1000 to yield units of g/m3 .

VIL density= VIL/echo top [16].

It can see at Figure 5 the reflectivity and VIL density valu are respecticely 35 and 3,5. ıt can be classification on severe weather according to the Steve and Amburn [16].

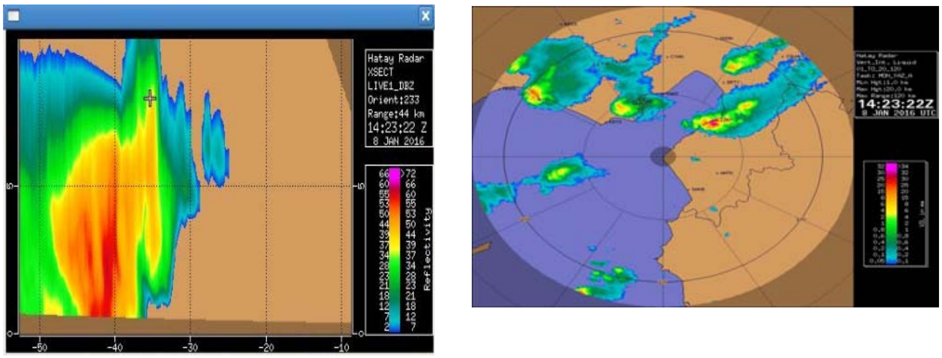

Figure 5 : Vertical Integradet Liquid, VIL

3. CONCLUSİON

In winter, hail occurs in situations where cold air comes in at level of atmosphere. Sometimes, they are pockets of cold air in upper layer with temperatures below -28 in the 500 hPa. These pockets usually show up on the surface in form of low pressure areas. This situation causes a high dynamic instability (Instability indexes are (Lifted, ShowAlter, K, TotalTotal) are proper for the thunderstorm. Espacially CAPE index which value is 635 show the instability rainfall although it is on the winter season.) In this paper we include event whish is happen in January in South Turkey. This Spesific Character caused hail in winter seasion.VIL density can provide warning forecasters with a greater capability to assess the hail potential of thunderstorms [17]. Combined with the knowledge of thunderstorm structure, VIL density should lead to improved warnings for severe hail. In this case, small-sized and dense hail occured. The reason why the value of the vil density is lower than 4 is that hale drops are small-sized ones. Because there appeared, at the same time, no significant difference between hail drops radius the Rho value is 0.94.

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