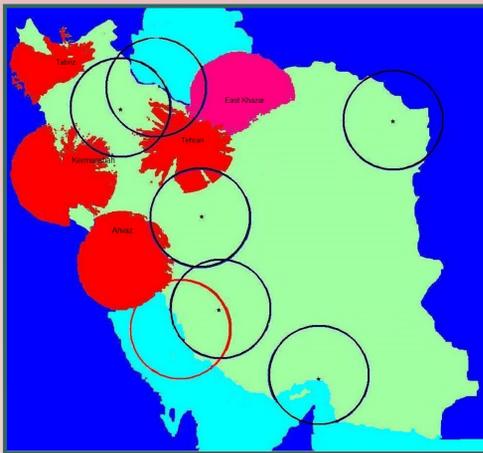


Hail Detection by using Radar data based on Two Methods

F.Arkian, A.Saneei

Marine Science and Technology Faculty, Tehran North branch, Islamic Azad University

f.arkian@gmail.com

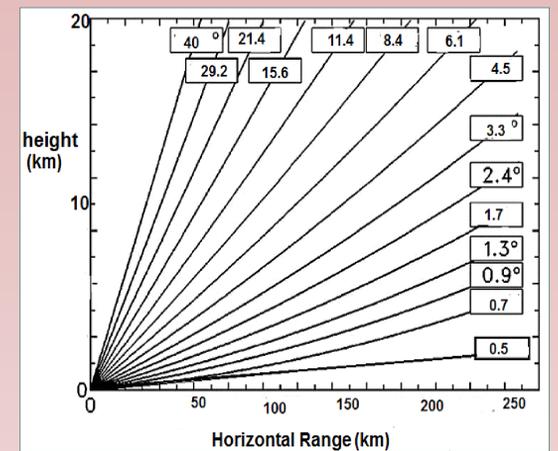


Map of radar network of Iran

Radar data were analyzed for severe thunderstorms that produced severe hail. A dataset containing 32 reports of hail include parameters such as freezing level, echo-top, 45 dBZ Reflectivity Max Heights and Vertical Integrated Liquid (VIL).

Research framework

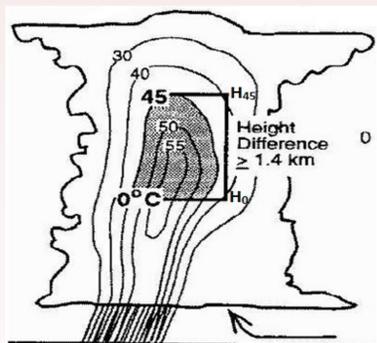
- 1) Find probability of hail detection by using radar data based on criterion of the Waldvogel hail algorithm.
- 2) Try to find a threshold of VIL for issuing hail warnings in study region.



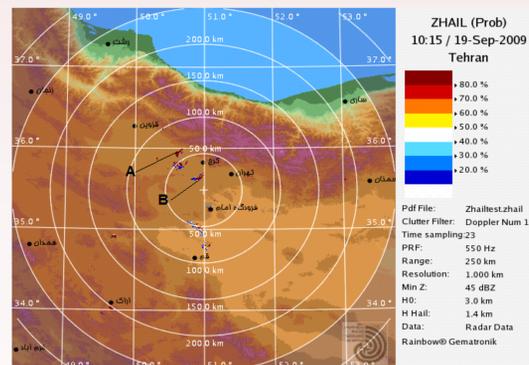
Volume coverage pattern of radars

First Method

NEXRAD method is based on criterion of the Waldvogel hail algorithm that uses the maximum altitude at which a reflectivity of 45 dBZ is found in relation to the height of the freezing level. It is evident from left figure in below, that when the 45 dBZ reflectivity extends to 1.4 km or more above the freezing level, the presence of hail is likely, and the probability of the presence of hail increases with increasing height of this reflectivity core above the freezing level. $H_{Z45} - H_{Freezing\ level} > +1.4$



Schematic of a hail storm and the design Of Hail Detection Algorithm



The probability of hail

Conclusion

The results show that for height difference greater than 4.5 km, the probability of hail detection is 100% for our region. This value depending on warm and cold climate can be varied up to 1 km.

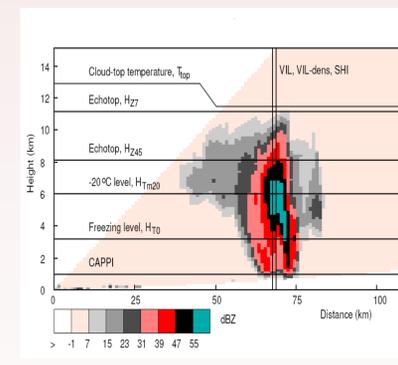
Second Method

Vertically Integrated Liquid water (VIL):

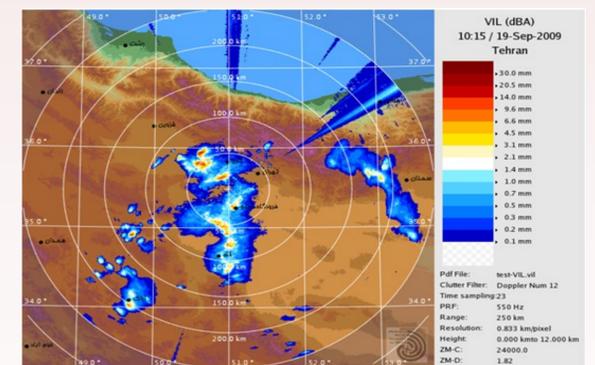
VIL is expressed in kg/m^2 or in mm of "potential rainfall" and the height in km. The first step in the calculation of VIL is to convert all reflectivity's to liquid water content (M) using the semi empirical relation between M in g/m^3 and Z (reflectivity of radar) in mm^6/m^3 :

$$M = 3.44 \times 10^{-3} Z^{4/7}$$

$$VIL = \int M \cdot dh = 3.44 \times 10^{-3} \int Z^{4/7} dh$$



Vertical cross-section through volume data



The VIL product

Conclusion

Thresholds for VIL-based hail warnings have been calculated $10 kg/m^2$.

