DOPPLER WEATHER RADAR PRODUCTS

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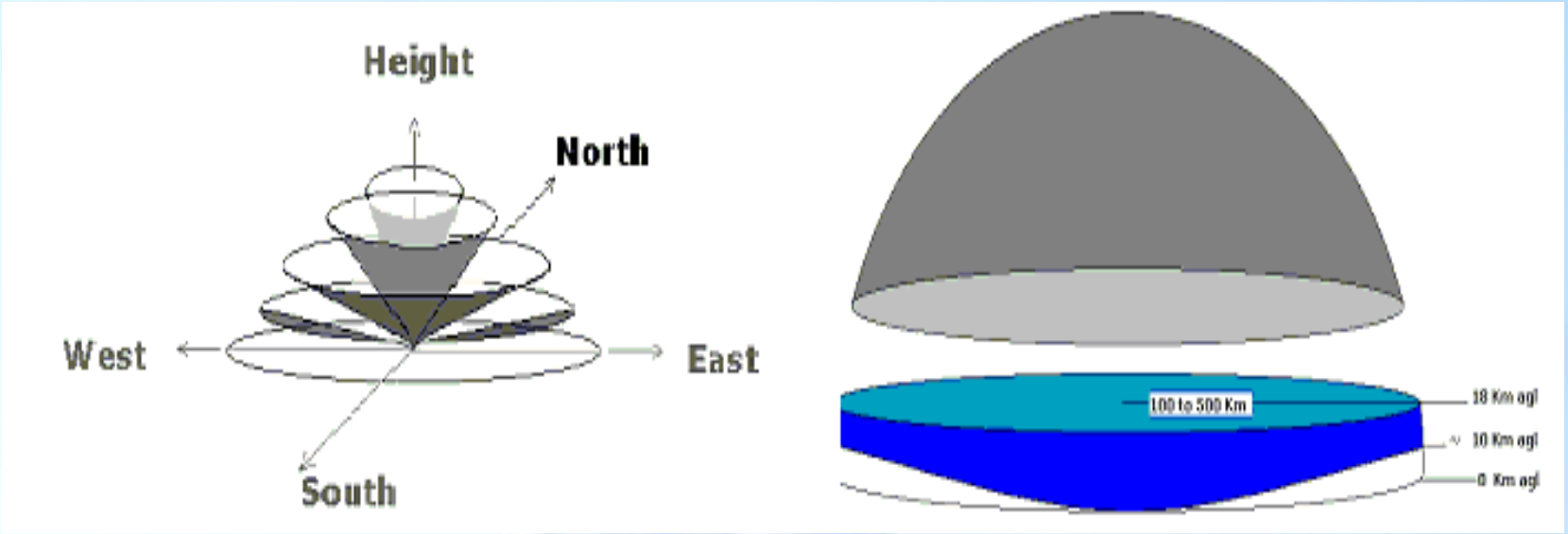
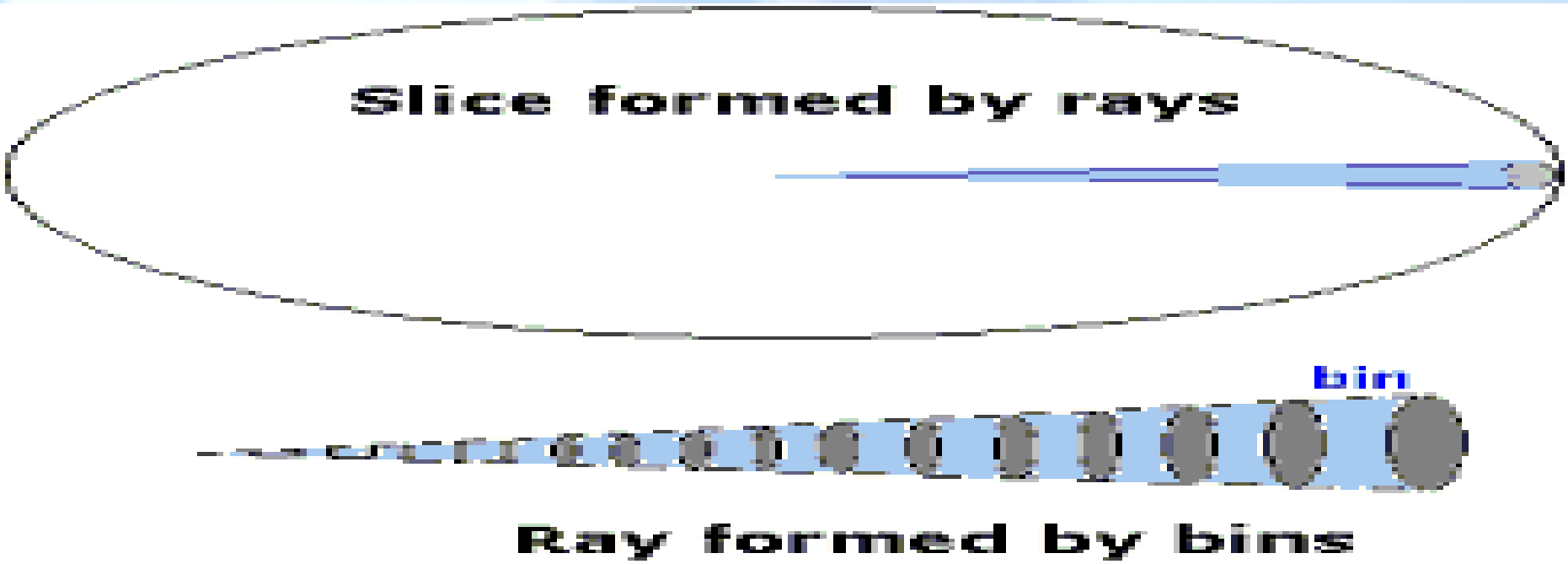
INDIA METEOROLOGICAL DEPARTMENT

Data collection

- 1 .Azimuth Scan (PPI mode)
- 2 .Elevation Scan (RHI Mode)
- 3. Volume Scan (PPI for 10 different angles)


Height
North
West
East
South
100 to 500 Km
18 Km agl
10 Km agl
0 Km agl


Slice formed by rays
bin
Ray formed by bins

Base Products of DWR

1. Base Reflectivity (Z)
2. Radial Velocity (v)
3. Spectral Width (w)

Base Products of DWR

- **Reflectivity (Z)**: Calculated from the reflected power measured by the Radar
- **Radial Velocity (v)**: Calculated from change in frequency measured by the radar
- **Spectral Width (w)**: Calculated from the velocity distribution in the sampling volume. In fact, variance of the velocity distribution is the spectral width. It's a measure of turbulence in the clouds.

Base Reflectivity (Z)

- Base reflectivity is a radar product that displays the amount of power returned to the radar after it has reflected off particles in the atmosphere.
- The actual amount of energy returned is not displayed. What is displayed is a term called reflectivity (hence why this product is named base reflectivity), and is measured in decibels (dBZ).

Base Reflectivity (Z)

- Base Reflectivity values can be negative since the reflectivity scale is actually a logarithmic scale, which means the numbers on the scale are actually powers of 10.
- The value of reflectivity in a bin of data is actually the average of all the reflectivity values detected within that bin.

Radial Velocity (v)

- Radial velocity is a radar product that displays the average wind speed (and in some sense, the direction, hence velocity) of particles that are detected by the radar.
- The radar can measure the speed due to a phenomenon called the **Doppler Effect**, in which the frequency of a wave changes as it bounces off a particle that is moving with respect a stationary object .

Radial Velocity (v)

- Looking at a display of base velocity, you are looking at the wind speed either directly towards or directly away from the radar.
- Positive values of velocity mean that there is a positive correlation between distance and direction. This means the wind direction is away from the radar when values are positive and vice versa.

Spectral Width (w)

- Spectrum Width is calculated from the velocity distribution in the sampling volume. In fact, variance of the velocity distribution is the spectral width. It's a measure of turbulence in the clouds.

Amplitude Scope" or "A-scope

- A-scope" refers to an "amplitude scope" or "A-scope," which is a display method used to visualize radar signals.
- The A-scope presents a one-dimensional representation of the radar returns, typically plotting signal amplitude (or strength) against time or distance.

Cont..

- This allows operators to see the strength of radar echoes from targets over time, helping to identify their distance and size based on the amplitude of the returns.
- It's a useful tool in radar systems for interpreting data and making real-time decisions based on the detected signals.

DWR Products

Plan Position Indicator (Z)

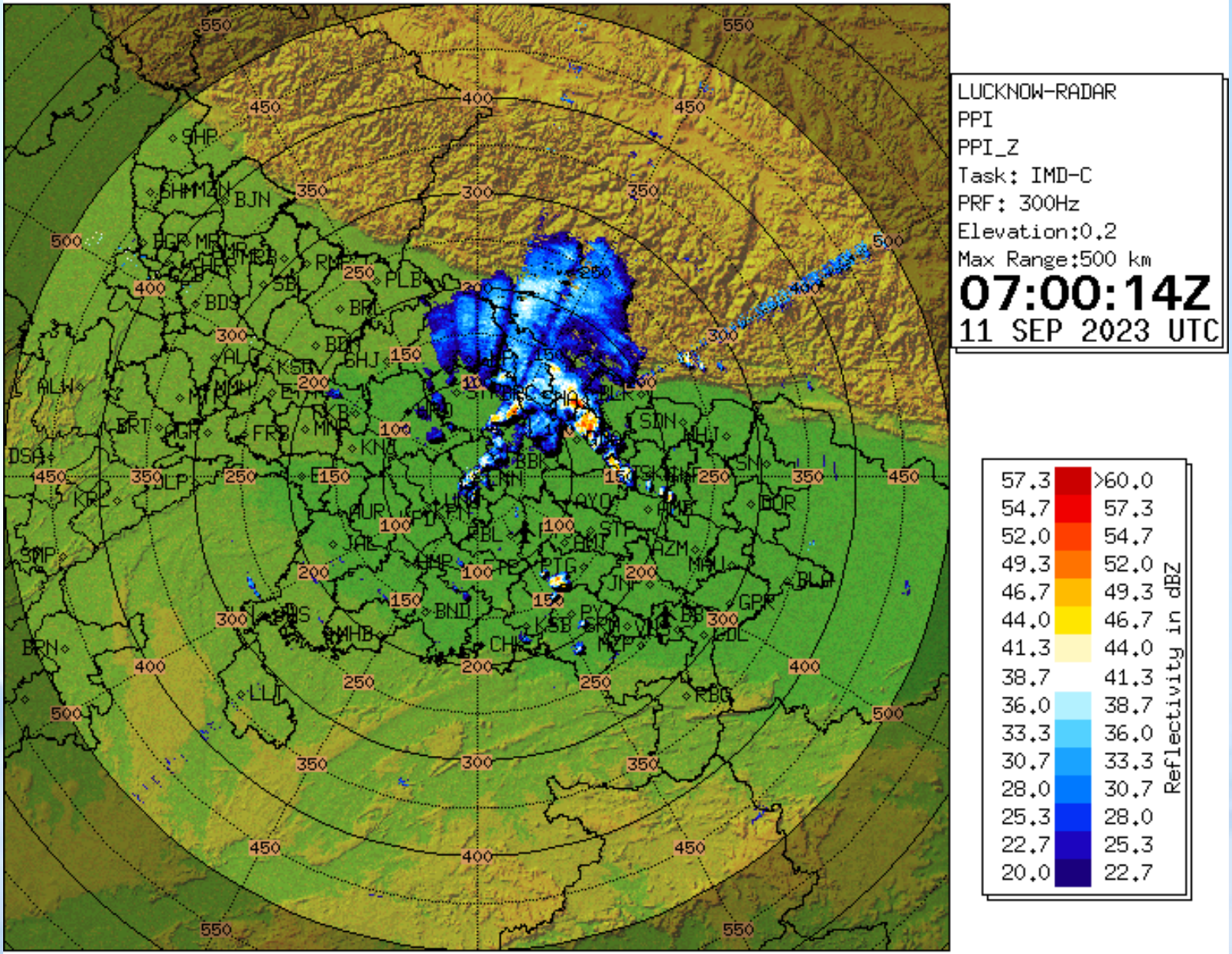
- This product is obtained at a certain elevation by azimuth scanning of the antenna for 500 km range and shows all echoes received in the radar range.
- The intensity of the echoes is expressed in dbZ scale.

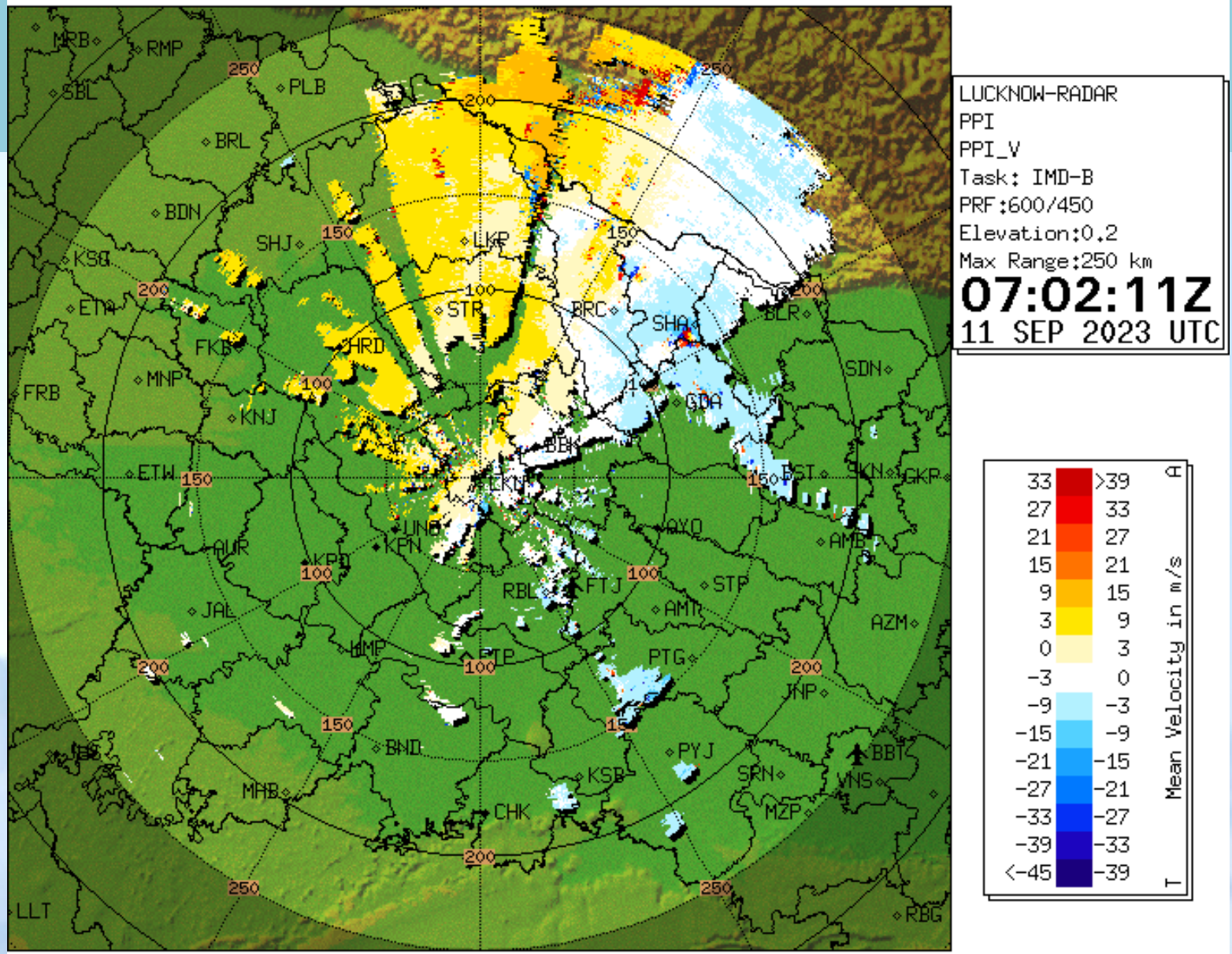
Plan Position Indicator (Z)

- The PPI product shows the distribution of the selected data parameter on a constant elevation angle surface — the classic radar display
- The product is useful in weather surveillance of all kinds of severe weather activities.

Plan Position Indicator (Z)

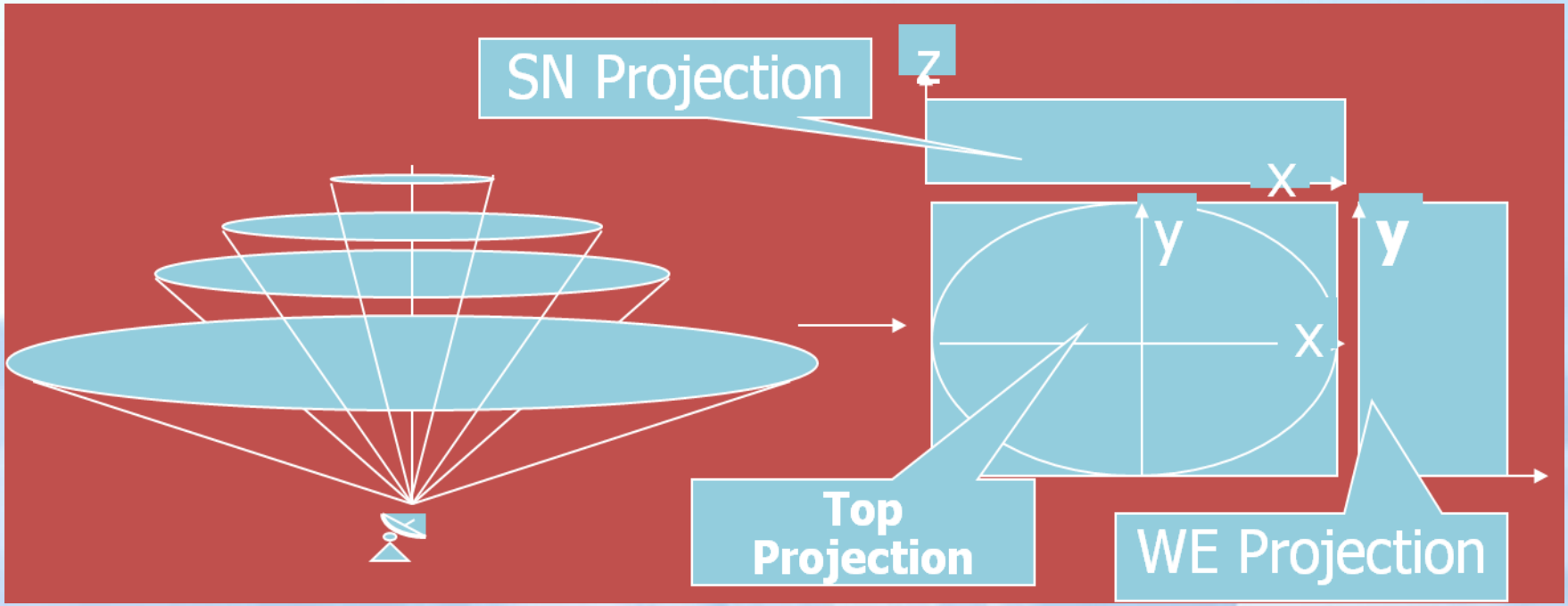
- Depending upon the range of the target and the angle of elevation the height of the echo is estimated.
- The nearby echoes correspond to lower heights where as the farther echoes correspond to higher altitude depending upon the range and angle of elevation.
- The height of the radar beam increases with the range due to curvature of the earth.


LUCKNOW-RADAR
PPI
PPI_Z
Task: IMD-C
PRF: 300Hz
Elevation:0.2
Max Range:500 km
07:00:14Z
11 SEP 2023 UTC
57.3 >60.0
54.7 57.3
52.0 54.7
49.3 52.0
46.7 49.3
44.0 46.7
41.3 44.0
38.7 41.3
36.0 38.7
33.3 36.0
30.7 33.3
28.0 30.7
25.3 28.0
22.7 25.3
20.0 22.7
Reflectivity in dBZ


LUCKNOW-RADAR
PPI
PPI_V
Task: IMD-B
PRF:600/450
Elevation:0.2
Max Range:250 km
07:02:11Z
11 SEP 2023 UTC
Mean Velocity in m/s
33 >39
27 33
21 27
15 21
9 15
3 9
0 3
-3 0
-9 -3
-15 -9
-21 -15
-27 -21
-33 -27
-39 -33
<-45 -39
MRB
RMP
SBL
PLB
BRL
BDN
SHJ
LKP
KSG
ETW
STR
BRC
SHA
BLR
FKB
HRD
FRB
MNP
KNJ
SDN
GDA
ETW
BST
GKP
UNB
KPN
AUR
AMB
RBL
FTJ
STP
JAL
AMT
AZM
HMP
PTP
PTG
JNP
BND
PYJ
BBT
KSB
SRN
VNS
MHB
CHK
MZP
LLT
RBG

Max - Maximum display (MAX)

Maximum product displays three partial images

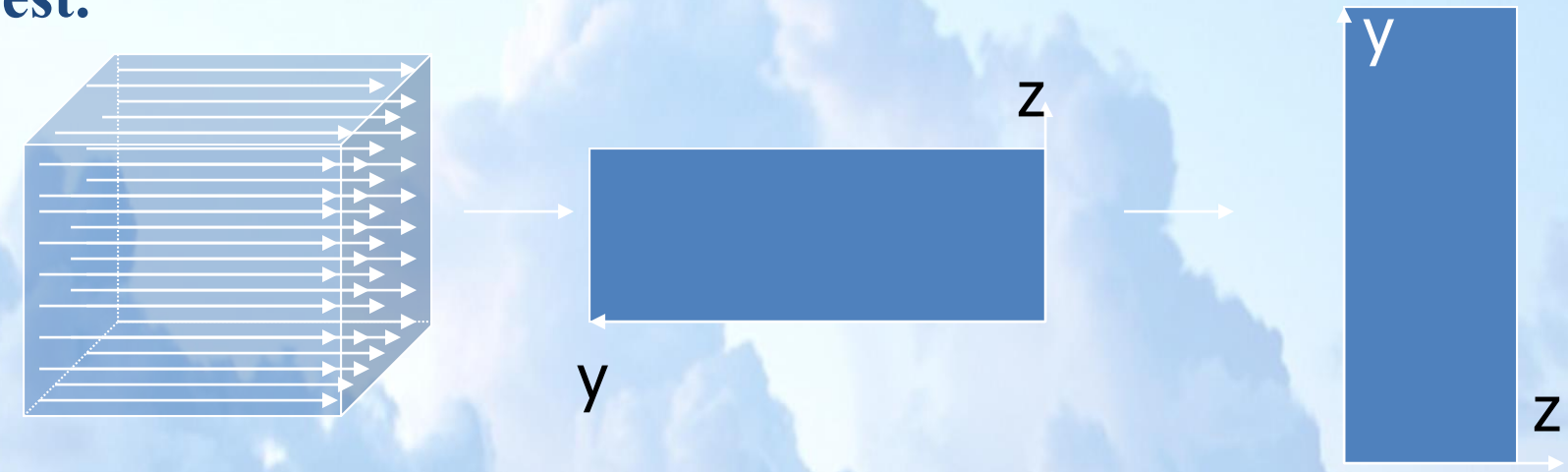


(1) Top Projection

A top view as the highest measured values in Z-direction. This image shows the highest measured value for each vertical column, seen from the top of the Cartesian volume.

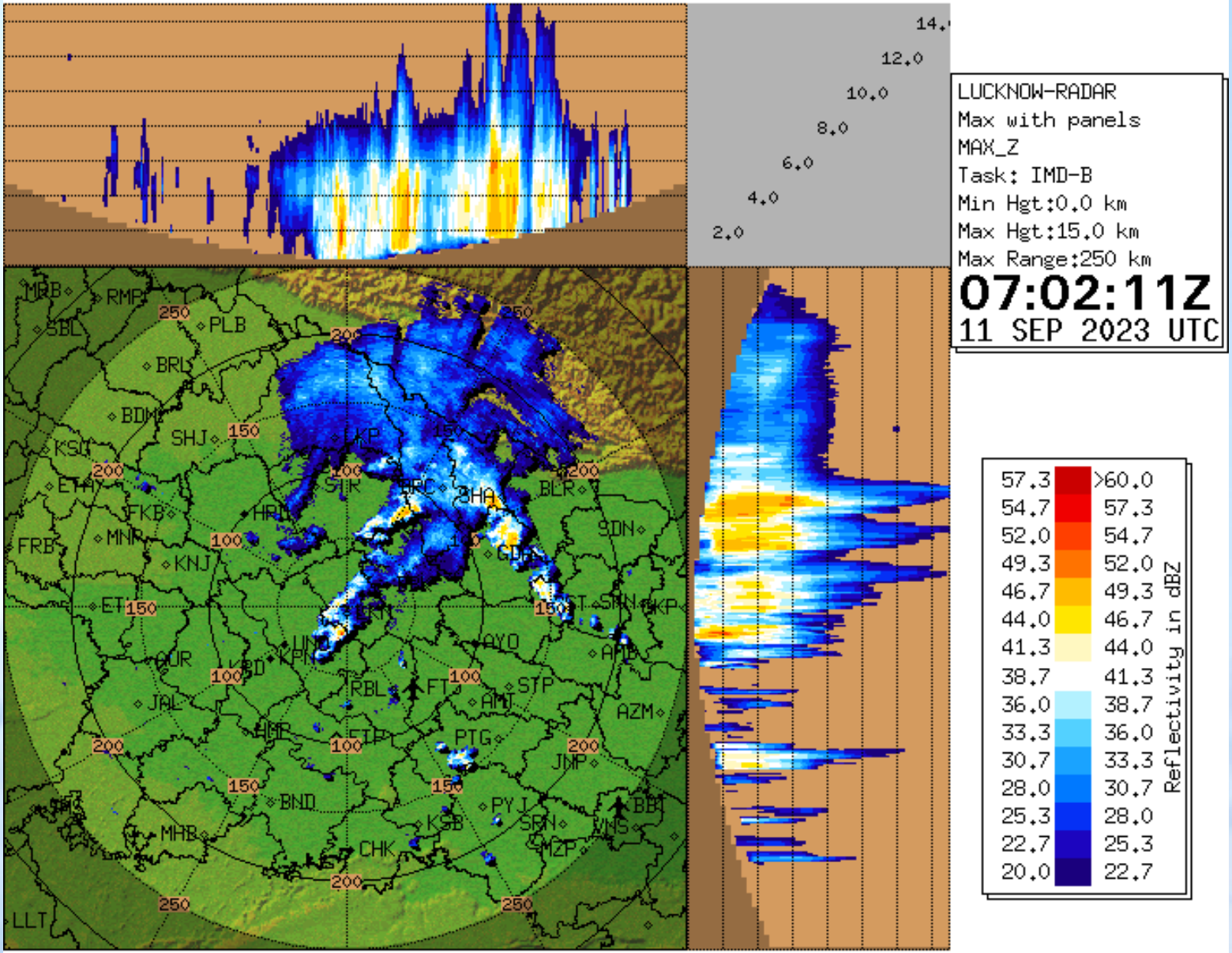
(2) W-E Projection

A E-W view of the highest measured values in X-direction. This image is appended to the right of the top view and shows the highest measured value for each horizontal line scan from east to west.



(3) SN Projection

N-S view of highest measured values in Y-direction. This image is appended above top view and show highest measured value for each horizontal line scan from north to south.


14.0
12.0
10.0
8.0
6.0
4.0
2.0
LUCKNOW-RADAR
Max with panels
MAX_Z
Task: IMD-B
Min Hgt:0.0 km
Max Hgt:15.0 km
Max Range:250 km
07:02:11Z
11 SEP 2023 UTC
57.3 >60.0
54.7 57.3
52.0 54.7
49.3 52.0
46.7 49.3
44.0 46.7
41.3 44.0
38.7 41.3
36.0 38.7
33.3 36.0
30.7 33.3
28.0 30.7
25.3 28.0
22.7 25.3
20.0 22.7
Reflectivity in dBZ
MRB
RMP
SBL
PLB
BRL
BDM
SHJ
KSJ
ETAY
FKB
HRI
FRB
MNR
KNJ
ET
GDA
SDN
AYO
APB
AUR
JAL
RBL
FT
STP
AMT
AZM
PTG
JNP
BND
PYJ
SRN
VNS
BBI
MHB
KGB
CHK
MZP
LLT
250
200
150
100

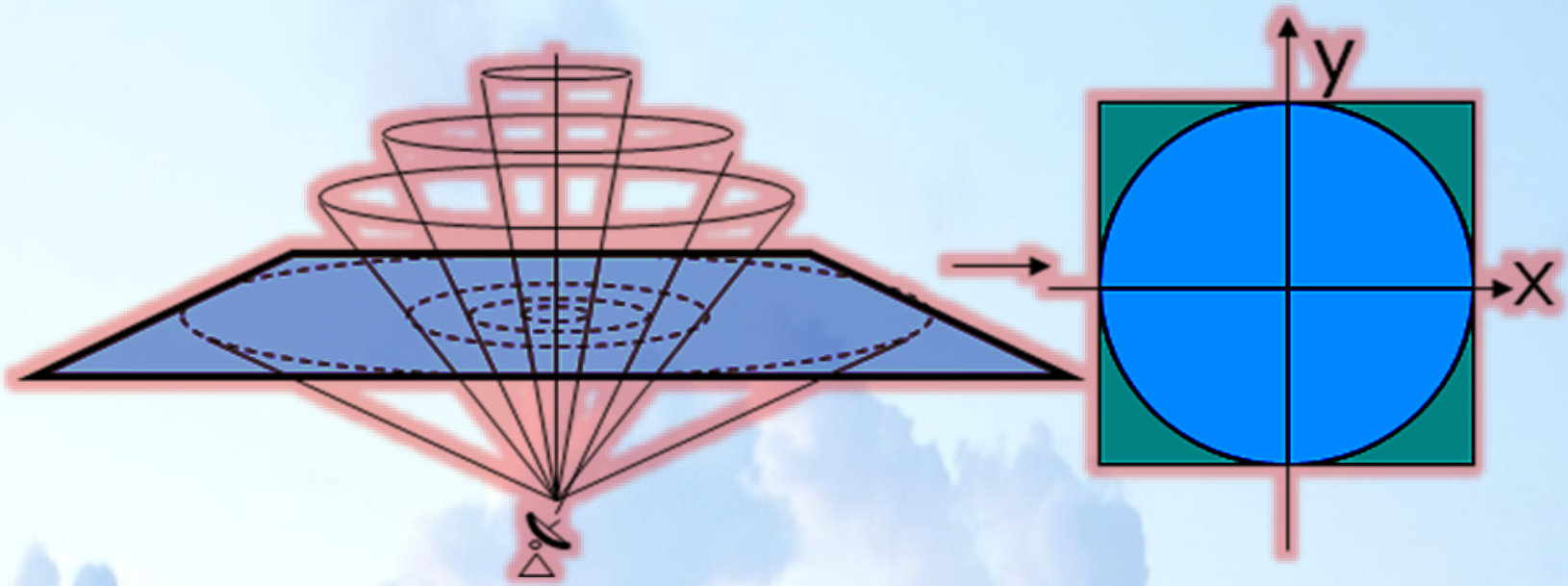
Constant Altitude PPI (CAPPI)

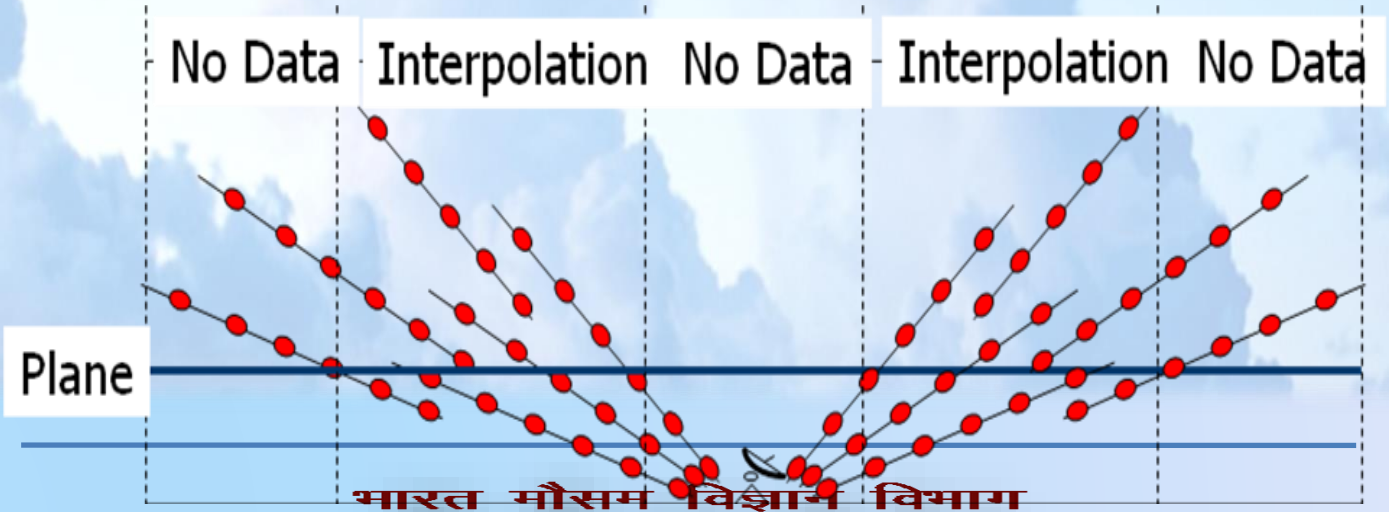
This is a colour coded display for an user defined altitude surface of any of the Z, V and W in a PPI scope.

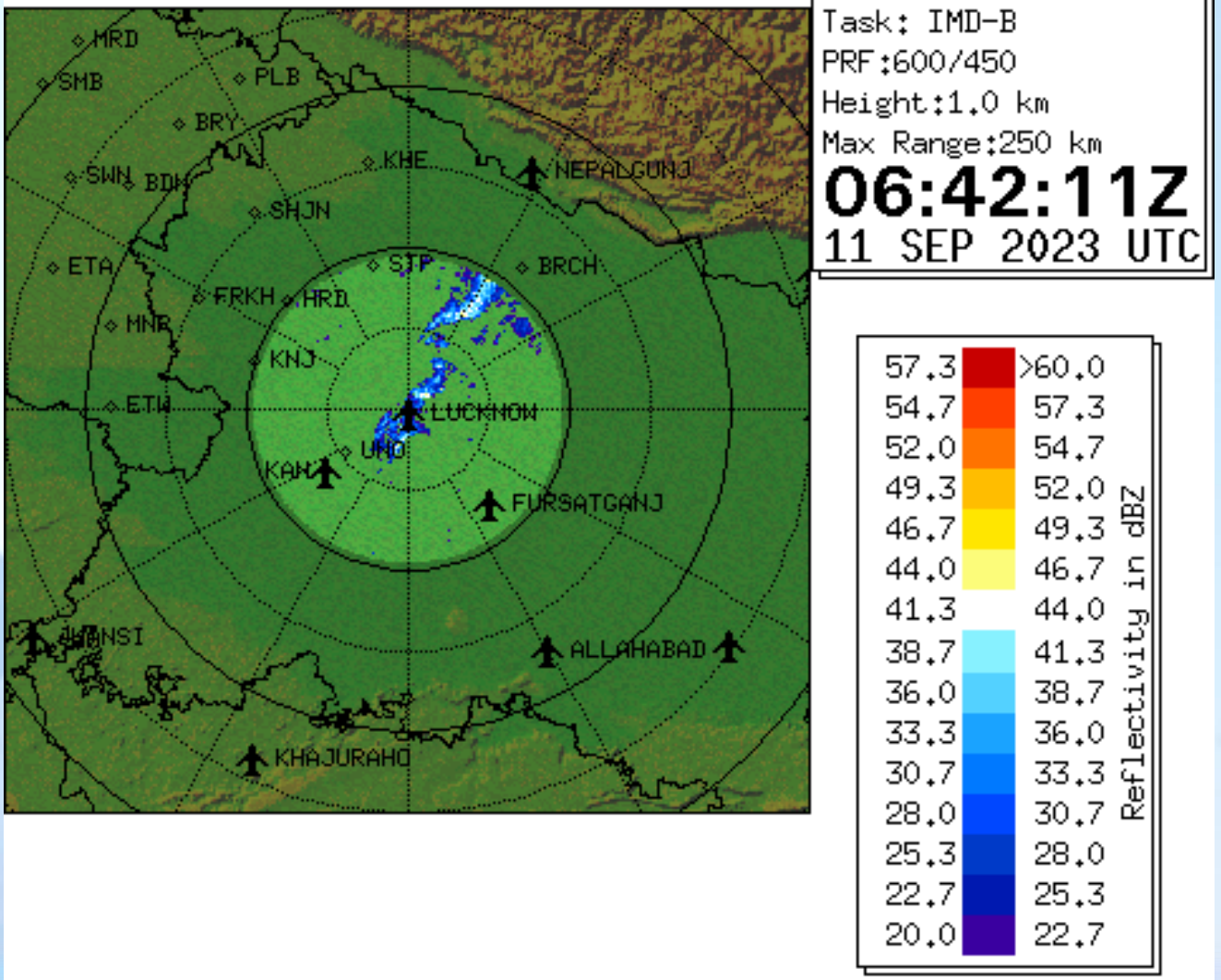
Constant Altitude PPI (CAPPI)

- This product displays echoes at user defined altitude (above mean sea level).
- The range of this product extends up to 500 km and height varies from 1 km to 18 km. However, no data places are left blank in the image as shown in figure on next slide.

Constant Altitude PPI (Reflectivity)

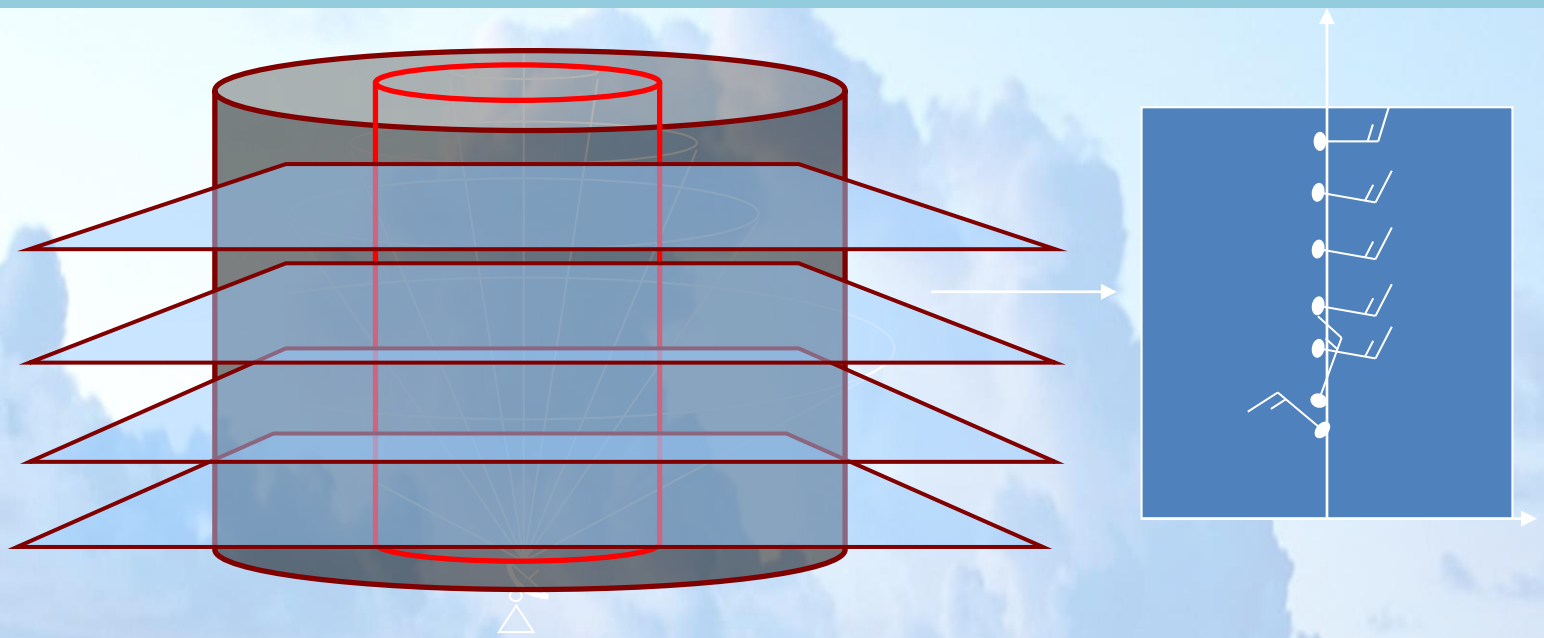


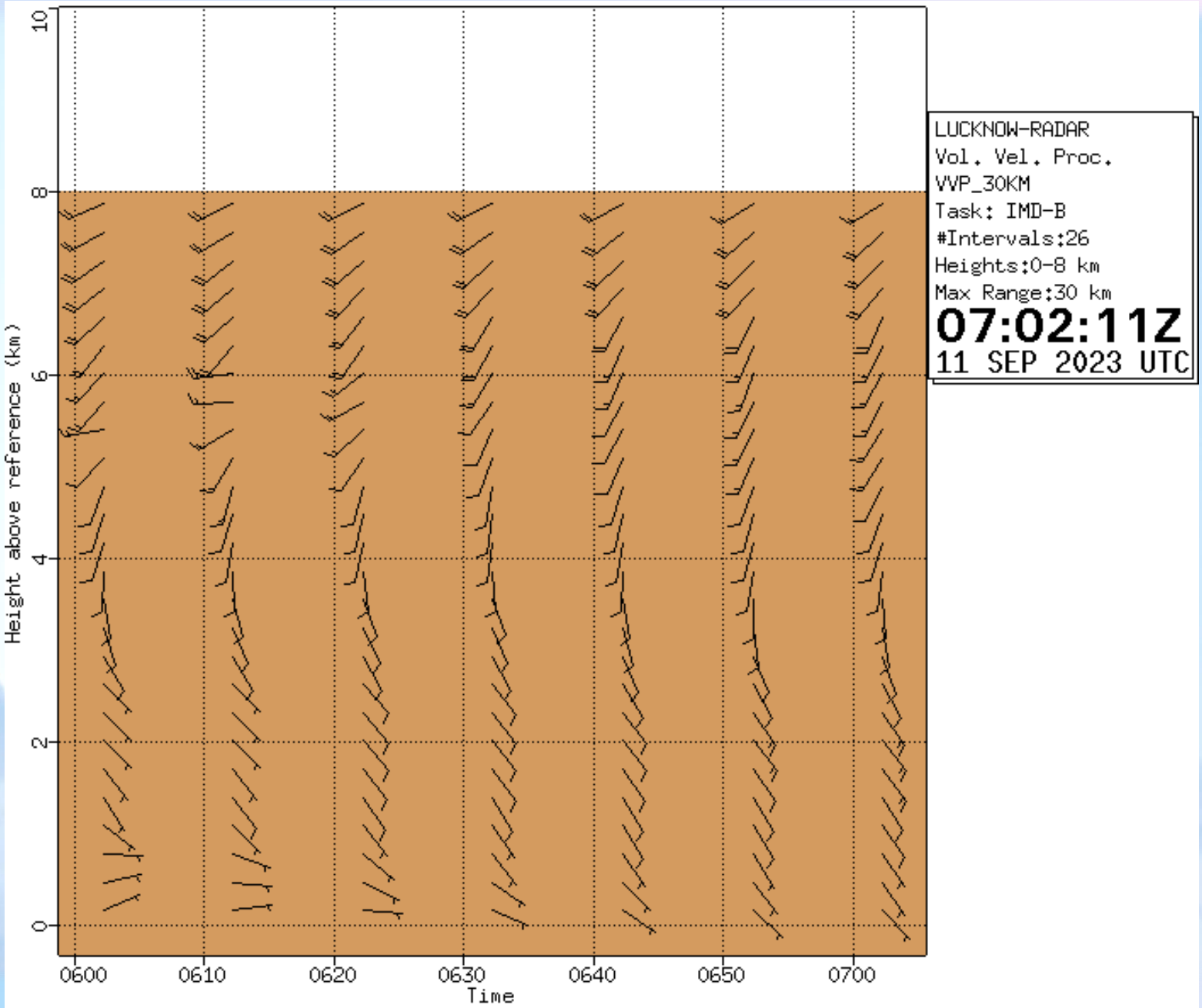



LUCKNOW-RADAR
CAPPI
Z_250KM
Task: IMD-B
PRF:600/450
Height:1.0 km
Max Range:250 km
06:42:11Z
11 SEP 2023 UTC
MRD
SMB
PLB
BRY
KHE
NEPALGUNJ
SWN
BDN
SHJN
ETA
STP
BRCH
FRKH
HRD
MNR
KNJ
ETW
LUCKNOW
UNO
KAN
FURSATGANJ
ALLAHABAD
KHAJURAHO
57.3 >60.0
54.7 57.3
52.0 54.7
49.3 52.0
46.7 49.3
44.0 46.7
41.3 44.0
38.7 41.3
36.0 38.7
33.3 36.0
30.7 33.3
28.0 30.7
25.3 28.0
22.7 25.3
20.0 22.7
Reflectivity in dBZ

Volume Velocity Processing 2 (VVP2)

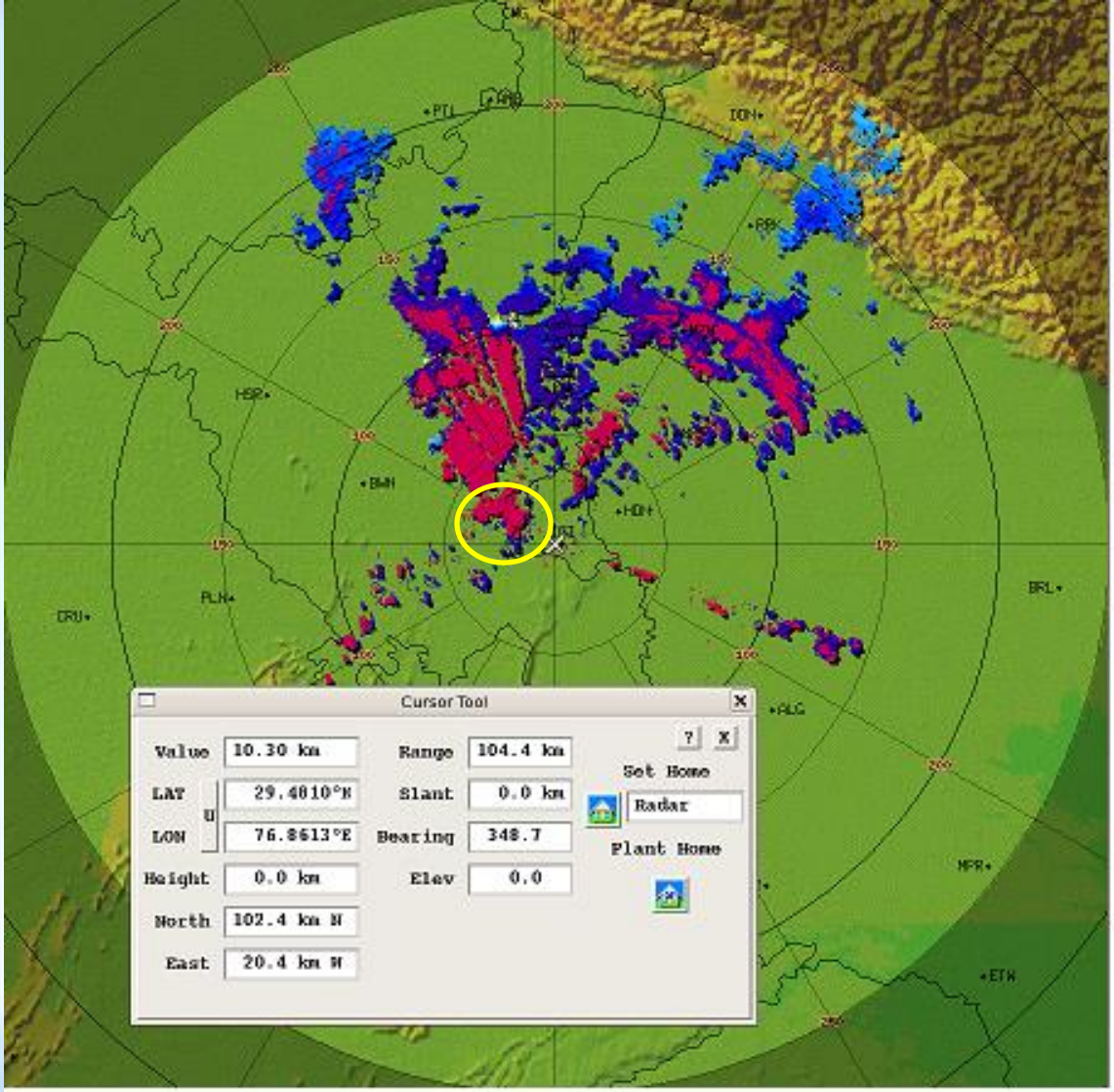
This product displays wind velocity profile over the radar station. Wind velocities (speed direction are calculated at different vertical layers and are displayed in the form wind barbs.

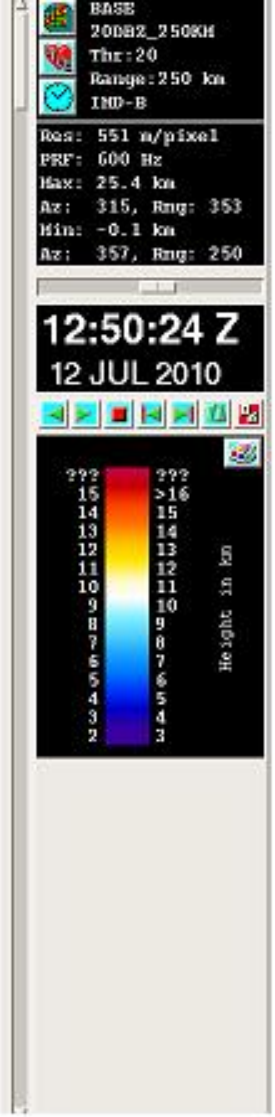



LUCKNOW-RADAR
Vol. Vel. Proc.
VVP_30KM
Task: IMD-B
#Intervals:26
Heights:0-8 km
Max Range:30 km
07:02:11Z
11 SEP 2023 UTC
Height above reference (km)
0
2
4
6
8
10
0600
0610
0620
0630
0640
0650
0700
Time

Echo-base product

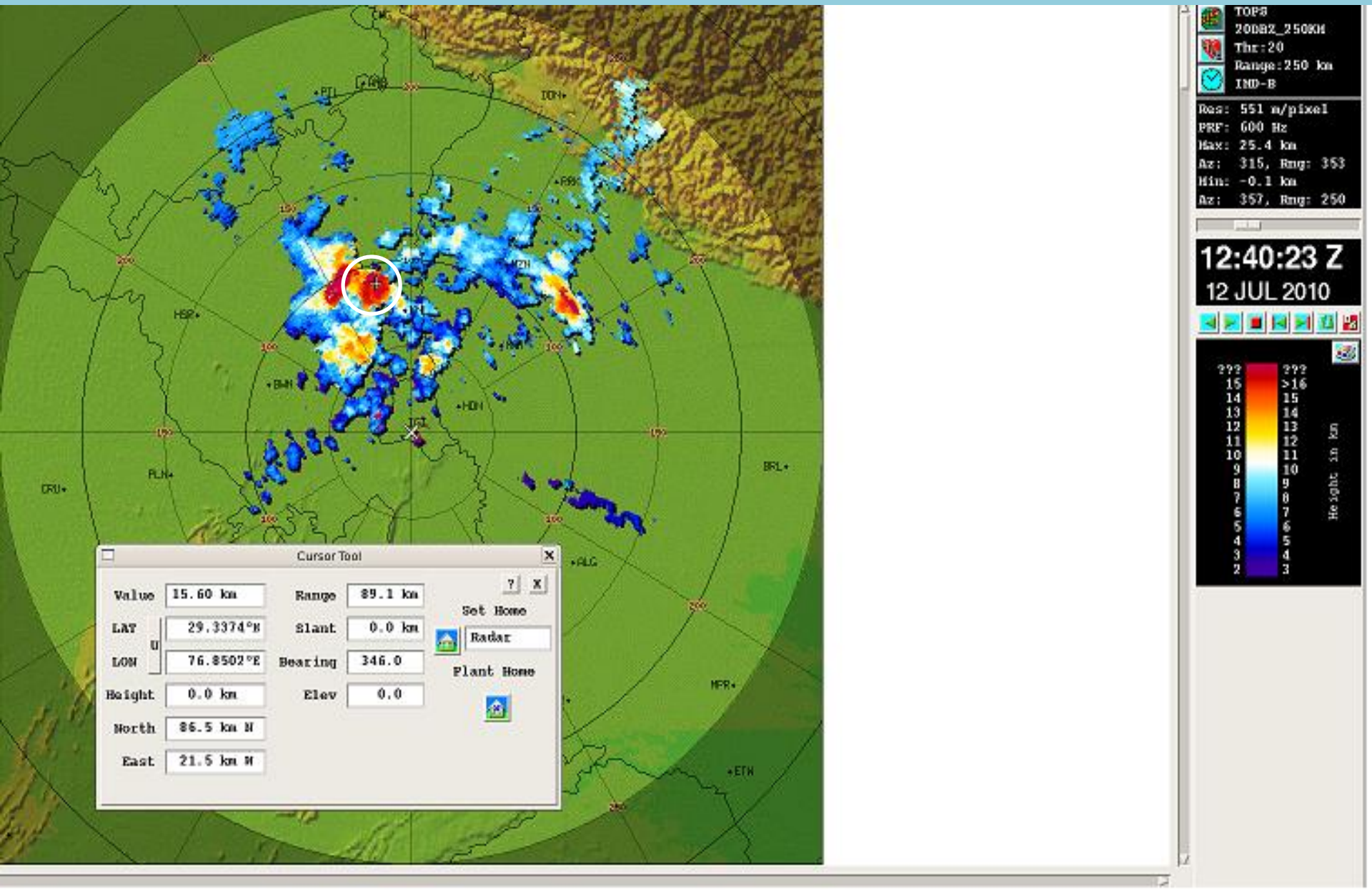
The echo base product is used to detect the base of echoes in terms of height in Kms for user selectable range of reflectivity.


Cursor Tool
Value 10.30 km
Range 104.4 km
LAT 29.4010°N
Slant 0.0 km
LON 76.8613°E
Bearing 348.7
Height 0.0 km
Elev 0.0
North 102.4 km N
East 20.4 km N
Set Home
Radar
Plant Home
PTI
IGN
RPR
HSR
BHN
HDH
PLH
DRU
BRL
ALG
MPR
ETN


BASE
20DBZ_250KM
Thr:20
Range:250 km
IND-B
Res: 551 m/pixel
PRF: 600 Hz
Max: 25.4 km
Az: 315, Rng: 353
Min: -0.1 km
Az: 357, Rng: 250
12:50:24 Z
12 JUL 2010
Height in km

Echo-top product:

Tops product is similar to the base product. It gives the height of the top of the cloud in kms for the threshold value defined by user



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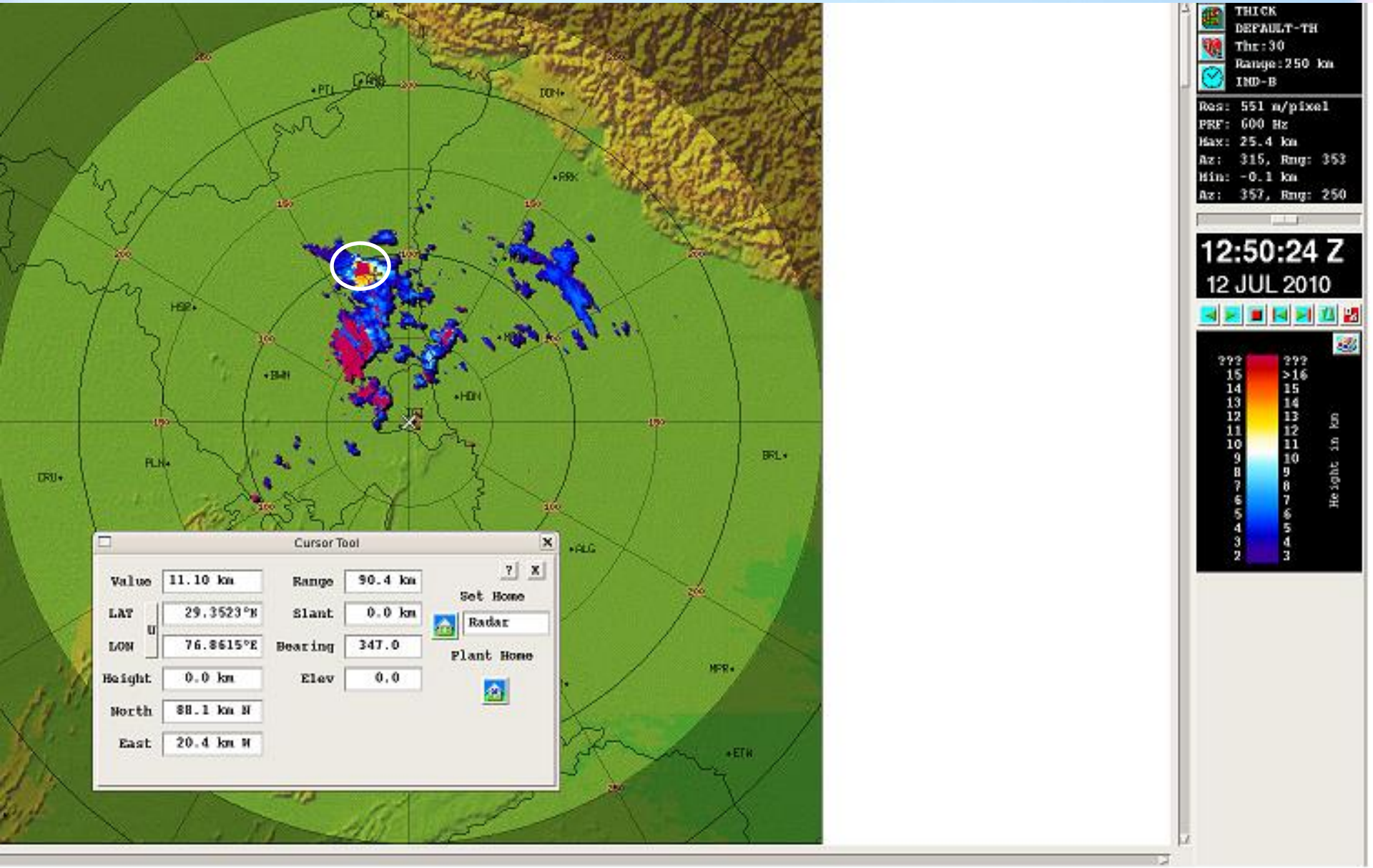
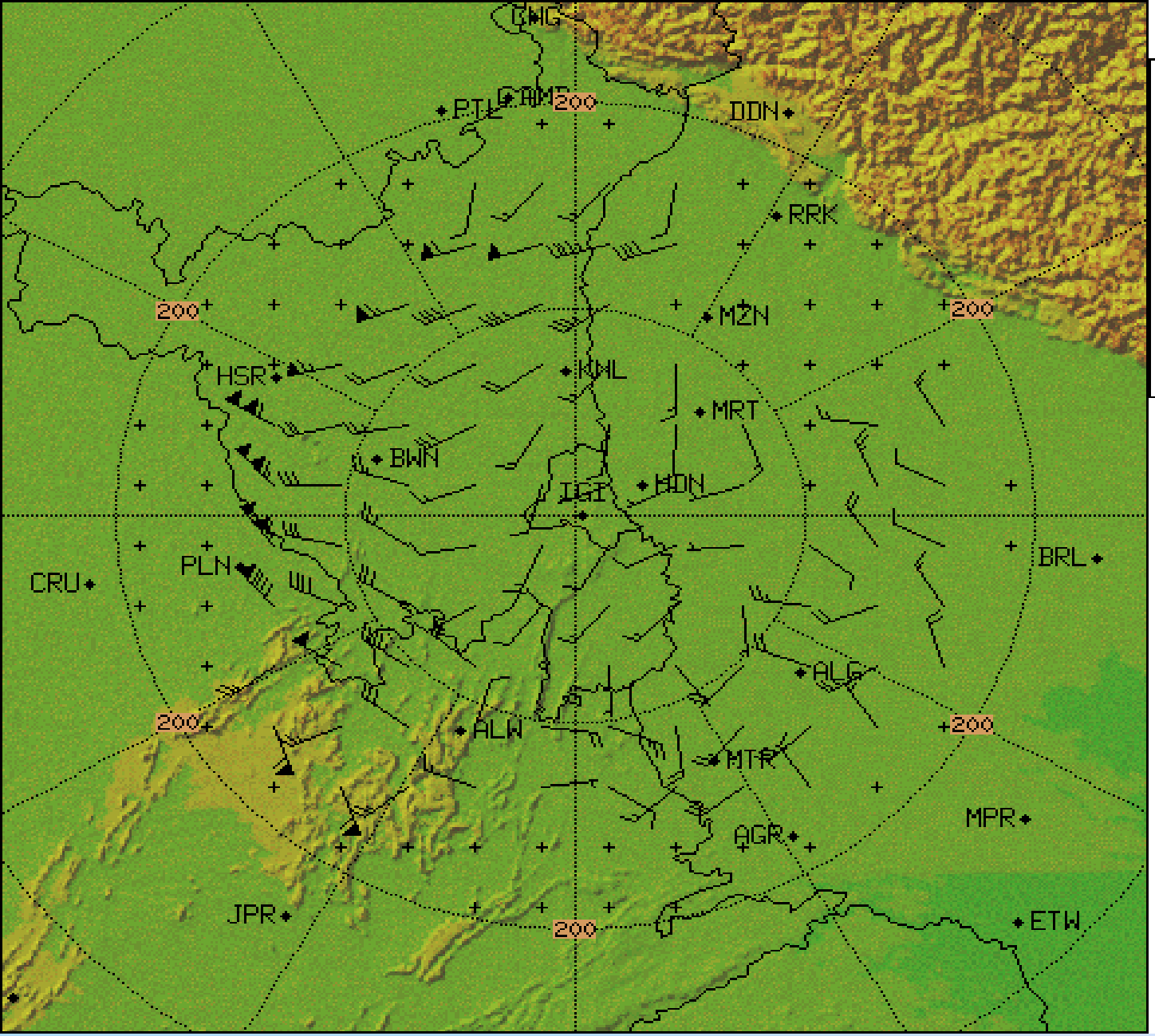
Thick product

- Thick product is used to determine the thickness of the cloud in between the threshold value defined by the user e.g. If thr=>20dbz then thickness of the cloud will be given in kms for the values where the dbz=>20 (thickness=top-base in kms)


THICK
DEFAULT-TH
Thr:30
Range:250 km
IND-B
Res: 551 m/pixel
PRF: 600 Hz
Max: 25.4 km
Az: 315, Rng: 353
Min: -0.1 km
Az: 357, Rng: 250
12:50:24 Z
12 JUL 2010
Height in km
Cursor Tool
Value 11.10 km
Range 90.4 km
LAT 29.3523°N
Slant 0.0 km
LON 76.8615°E
Bearing 347.0
Height 0.0 km
Elev 0.0
North 88.1 km N
East 20.4 km N
Set Home
Radar
Plant Home
PTL
DON
RRK
HSP
BWN
HDN
PLN
CRU
BRL
PLG
MPR
ETW

Wind Product:

- The wind barbs for the user selectable height and range
- It shows wind speed and direction for user defined height



DWRDELHI(PALAM)
Horizontal Wind
HEIGHT_1KM
Task: IMD-B
PRF:600/450
Hgt: 0.5-1.5 km
Max Range:250 km

14:12:22Z
7 FEB 2011 UTC

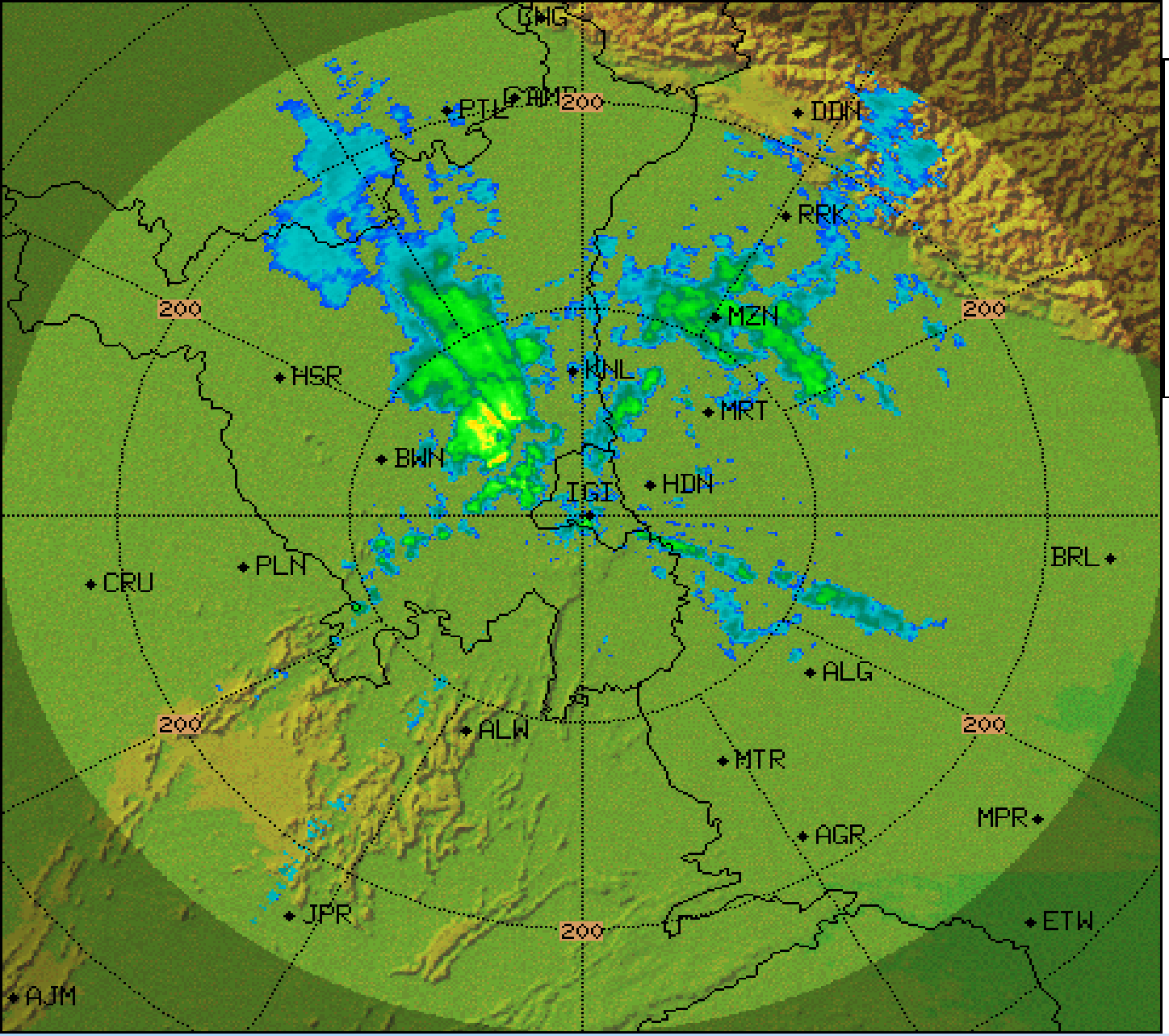
Surface Rainfall Intensity (SRI)

It is an image of the rainfall intensity (in mm/hr) in a user selectable surface layer. It is calculated based on Marshall-Palmer equation

$$Z=AR^b$$

where R is the rainfall intensity and A and b are constant. The value of A & b varies from season to season and place to place.

SRI is mainly used as an input product to generate rain1 (hourly rain accumulation) product.



DWRDELHI(PALAM)
Surface Rainfall
R_250KM
Task: IMD-B
PRF:600/450
Melt:6.0 km
Max Range:250 km

12:40:23Z
12 JUL 2010 UTC

500	>800
200	500
100	200
80	100
50	80
20	50
10	20
8	10
5	8
2	5
1	2
0.8	1
0.5	0.8
0.2	0.5
0.1	0.2
0.05	0.1

Rainfall Rate in mm/hr

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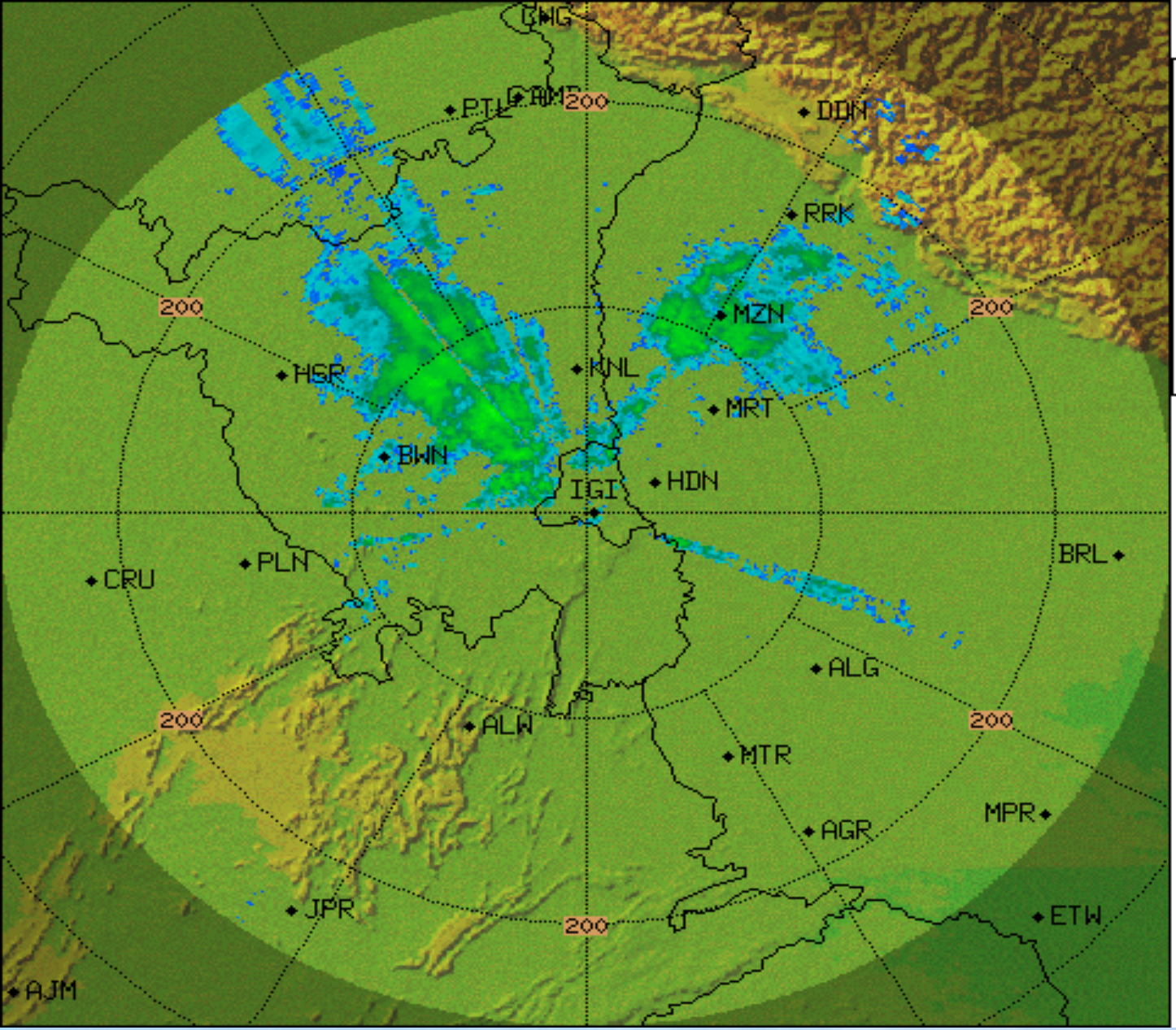
Hourly accumulation product (RAIN-1)

Input for this product is SRI or CAPPI for user selectable height and range. It gives hourly accumulation of rain in mm.



DWRDELHI(PALAM)
Hourly Rainfall
HOUR_01
Task: IMD-B
PRF:600/450
Inputs:6, 60 min
Max Range:250 km

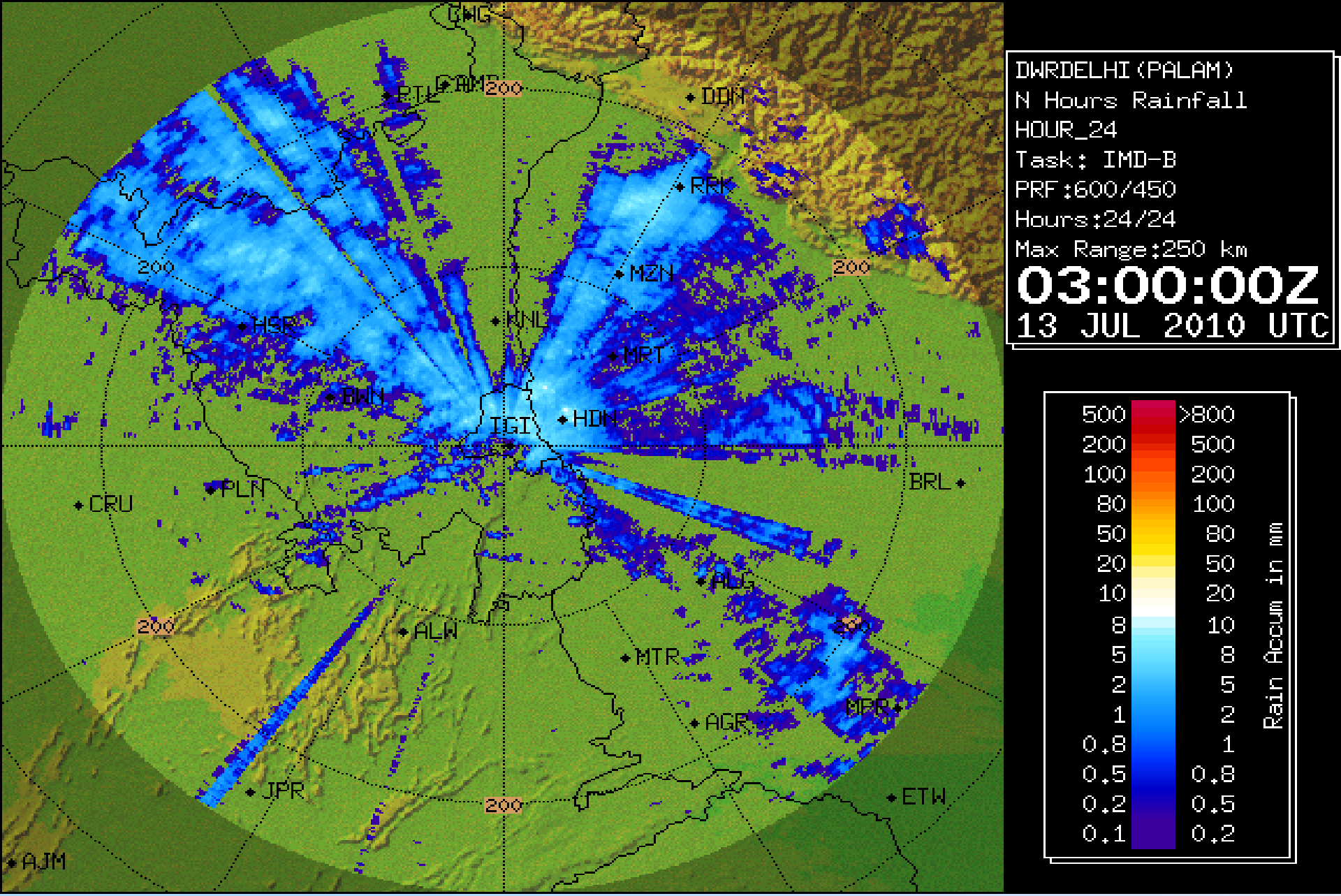
13:00:00Z
12 JUL 2010 UTC

800	>1100
500	800
200	500
100	200
80	100
50	80
20	50
10	20
8	10
5	8
2	5
1	2
0.8	1
0.5	0.8
0.2	0.5
0.1	0.2

Rain Accum in mm

RAINN product
(Rain accumulation for ‘N’ hours)

Input to this product is RAIN1 product. It displays rain accumulation for ‘N’ hours e.g. for 24 hours rain accumulation it sums up the rain1 accumulation for last 24hours
(e.g. 0300utc to 0300utc(next day)



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Vertical Integrated Liquid (VIL)

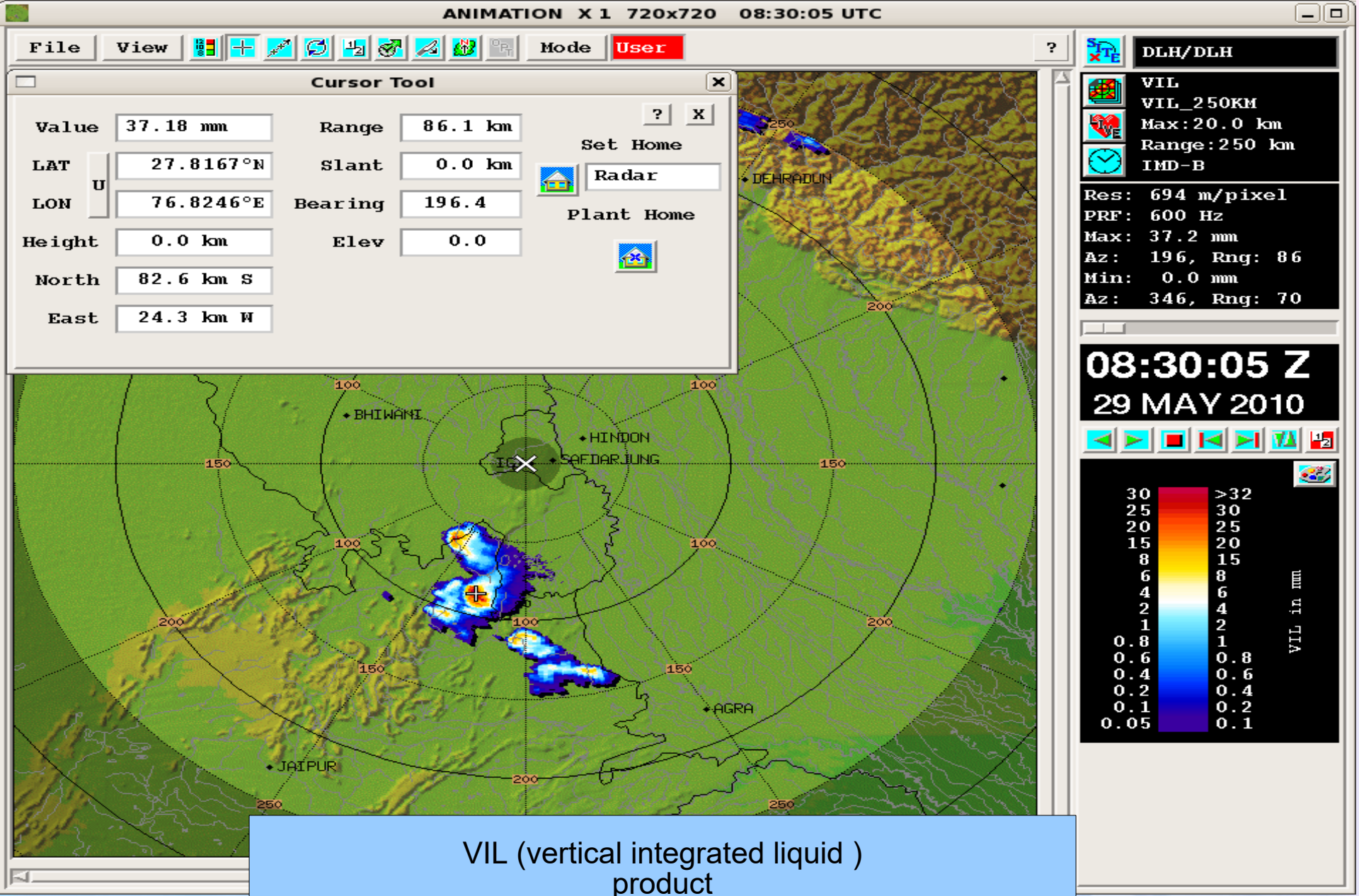
The VIL display gives an instantaneous estimate of water content in an user defined atmospheric layer.. Reflectivity data from volume scan is extracted and converted into liquid water content data. For each vertical column the liquid water content is integrated within user defined boundaries of the atmosphere and the resultant is displayed in a PPI type image. The Water Liquid Content is calculated using the formula:

$$Z = C * MD$$

Where Z **–** ***reflectivity [mm6/m3]***

M **–** ***LWC [g/m3]***

C and D are constants



VIL (vertical integrated liquid) product

Thanks