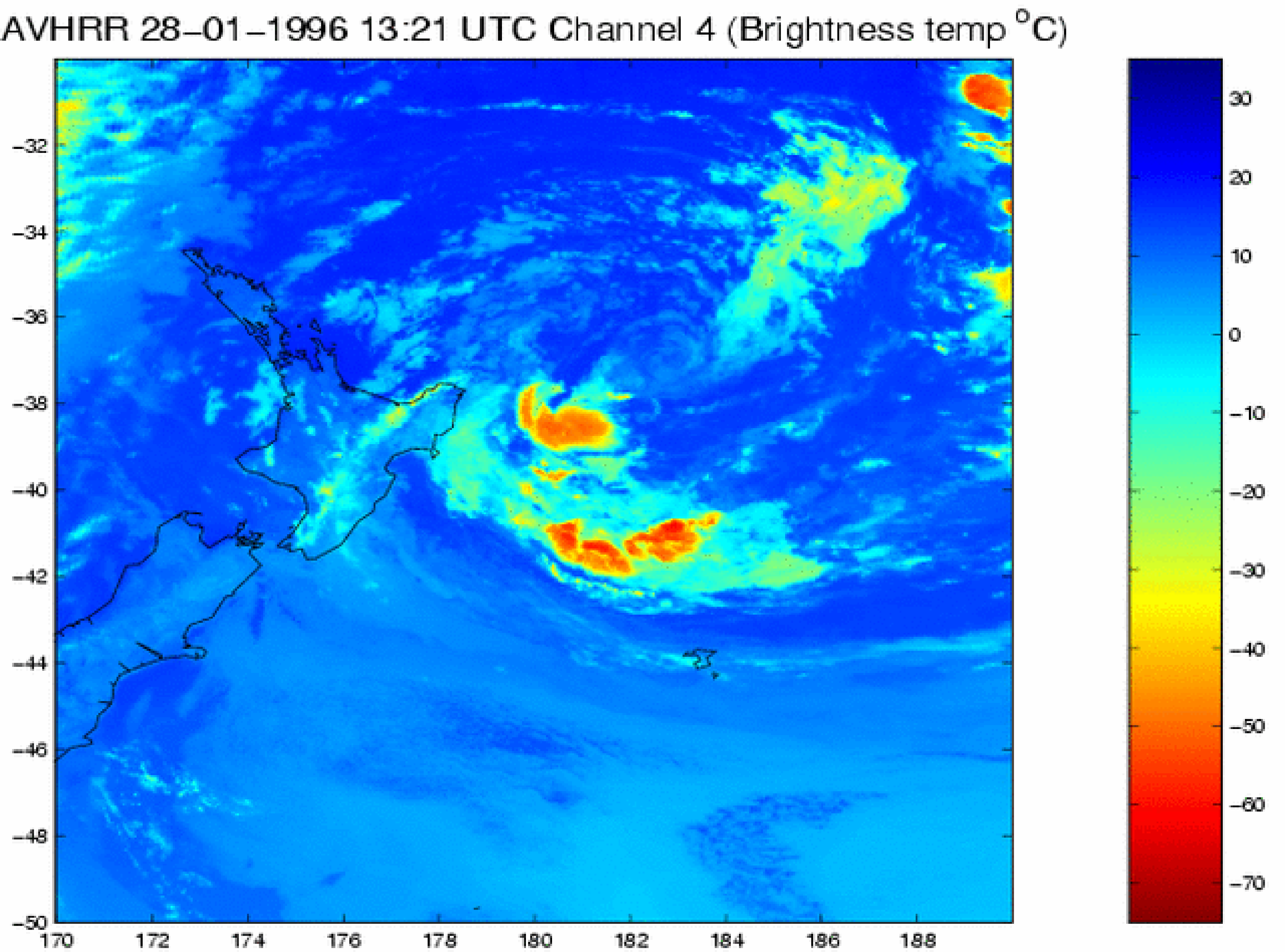
Nowcasting Orographic Rainfall: SALPEX and the Effect of Microphysical Processes

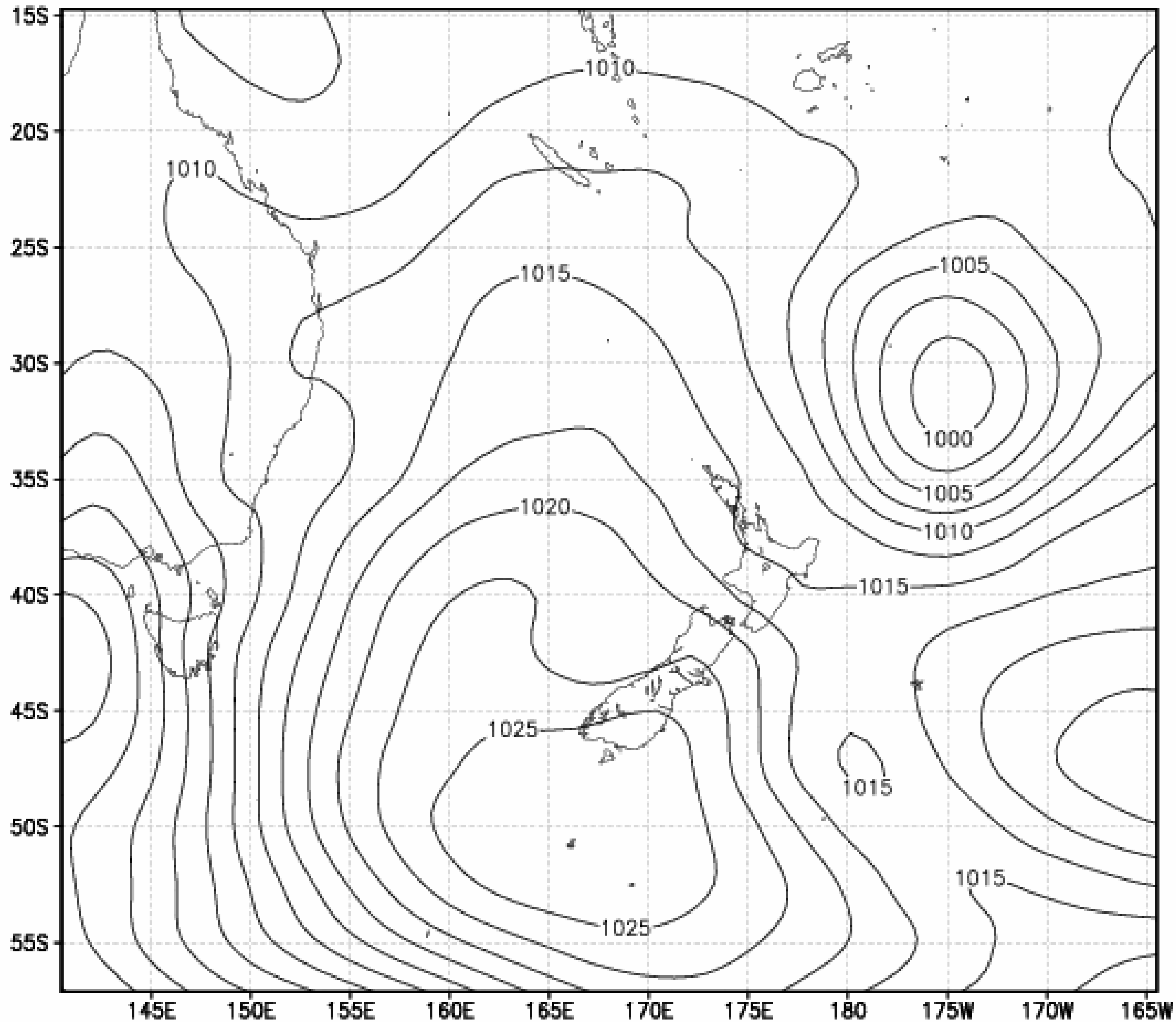
Geoff Austin

Atmospheric Physics Group
Department of Physics
The University of Auckland

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND


AVHRR 28-01-1996 13:21 UTC Channel 4 (Brightness temp °C)
-32
-34
-36
-38
-40
-42
-44
-46
-48
-50
170
172
174
176
178
180
182
184
186
188
30
20
10
0
-10
-20
-30
-40
-50
-60
-70

90 km Resolution Model Run
1996-01-24 0000 UTC



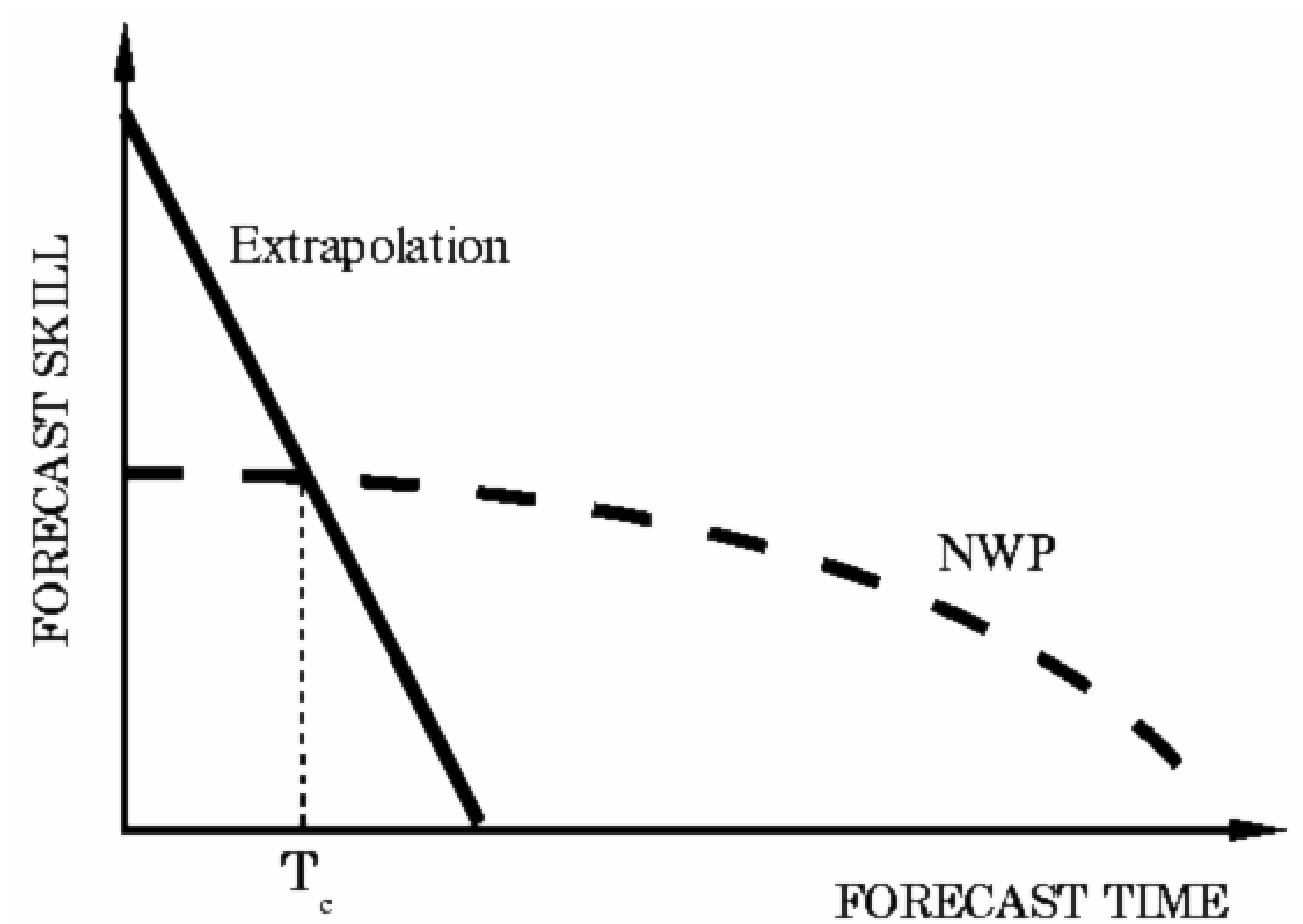
GrADS: COLA/IGES

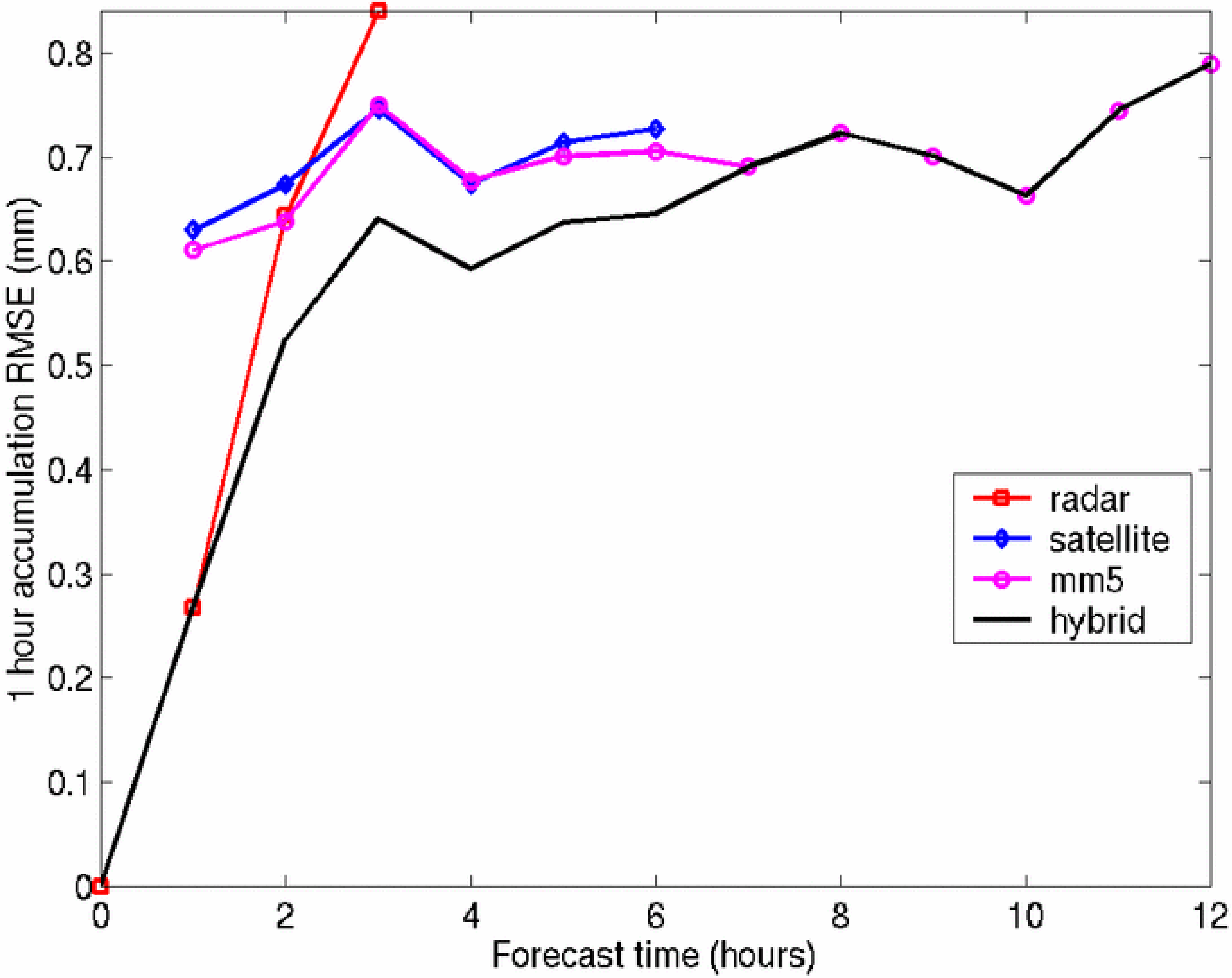
2001-10-31-07:48

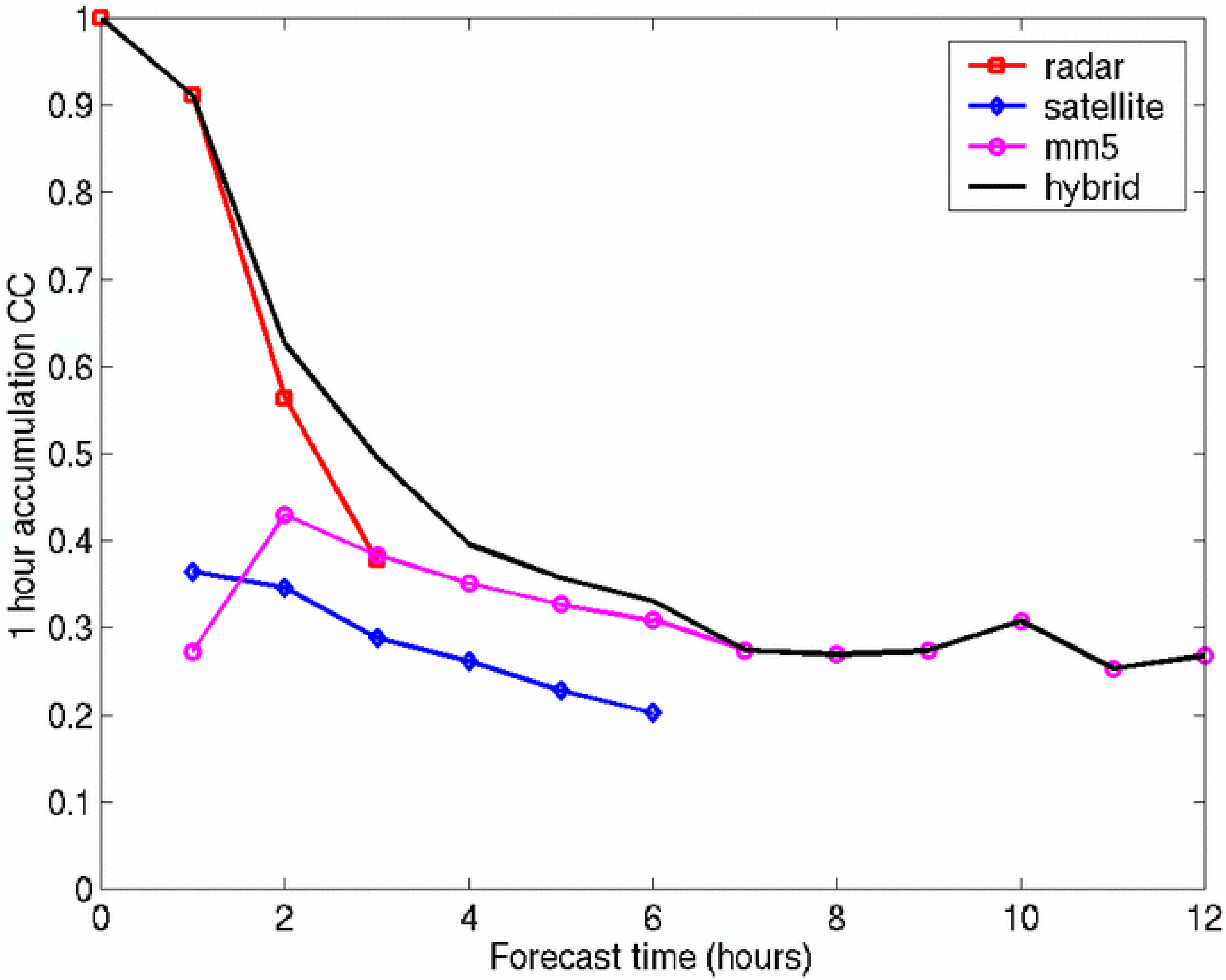
Southern Alps 1

- Rainfall -14 meters per year at divide (height about 2,000m), 5 at the coast and 2 on the lee side.
- Problem - strong north westerly winds take 15 minutes from coast to divide - insufficient time for raindrops to form.
- Reservoirs are almost all on the eastern side so the water resources are provided by rainfall on the eastern side.
- Events usually, but not always, produce heavy rain on the West Coast and light rain on the eastern side of the divide.
- Forecasting heavy rain on eastern side of Southern Alps is a difficult forecast problem.

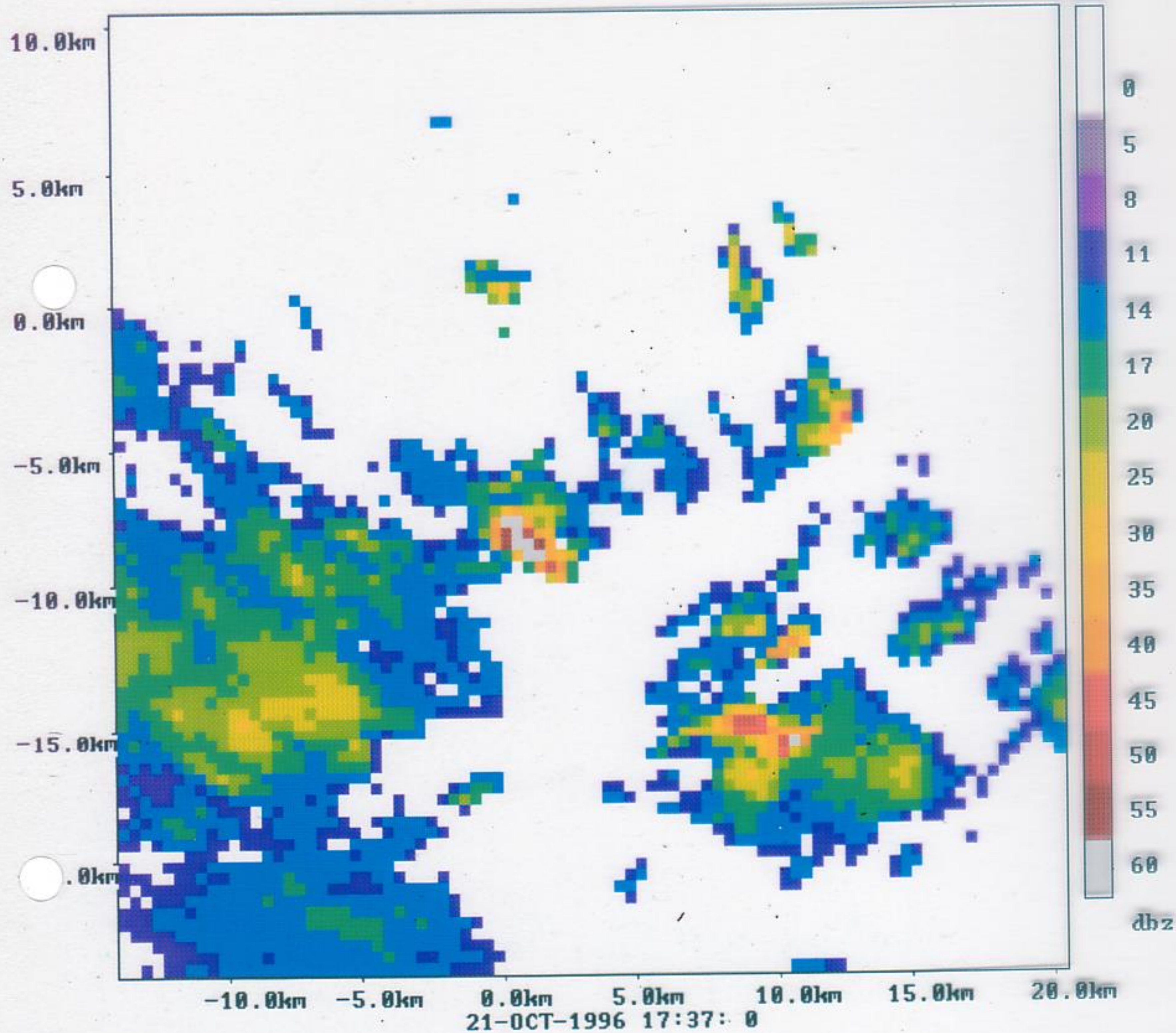
Extrapolation and NWP

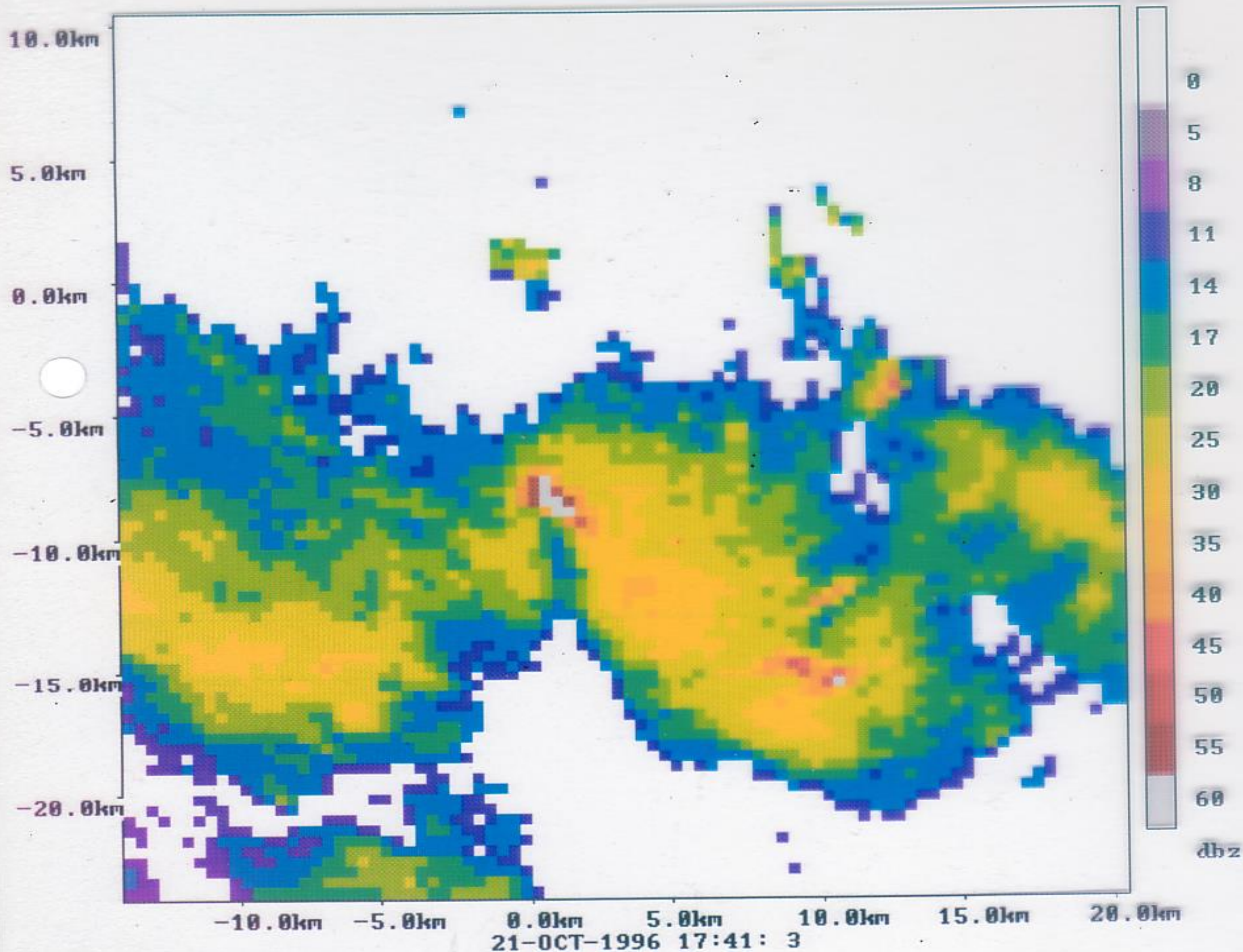


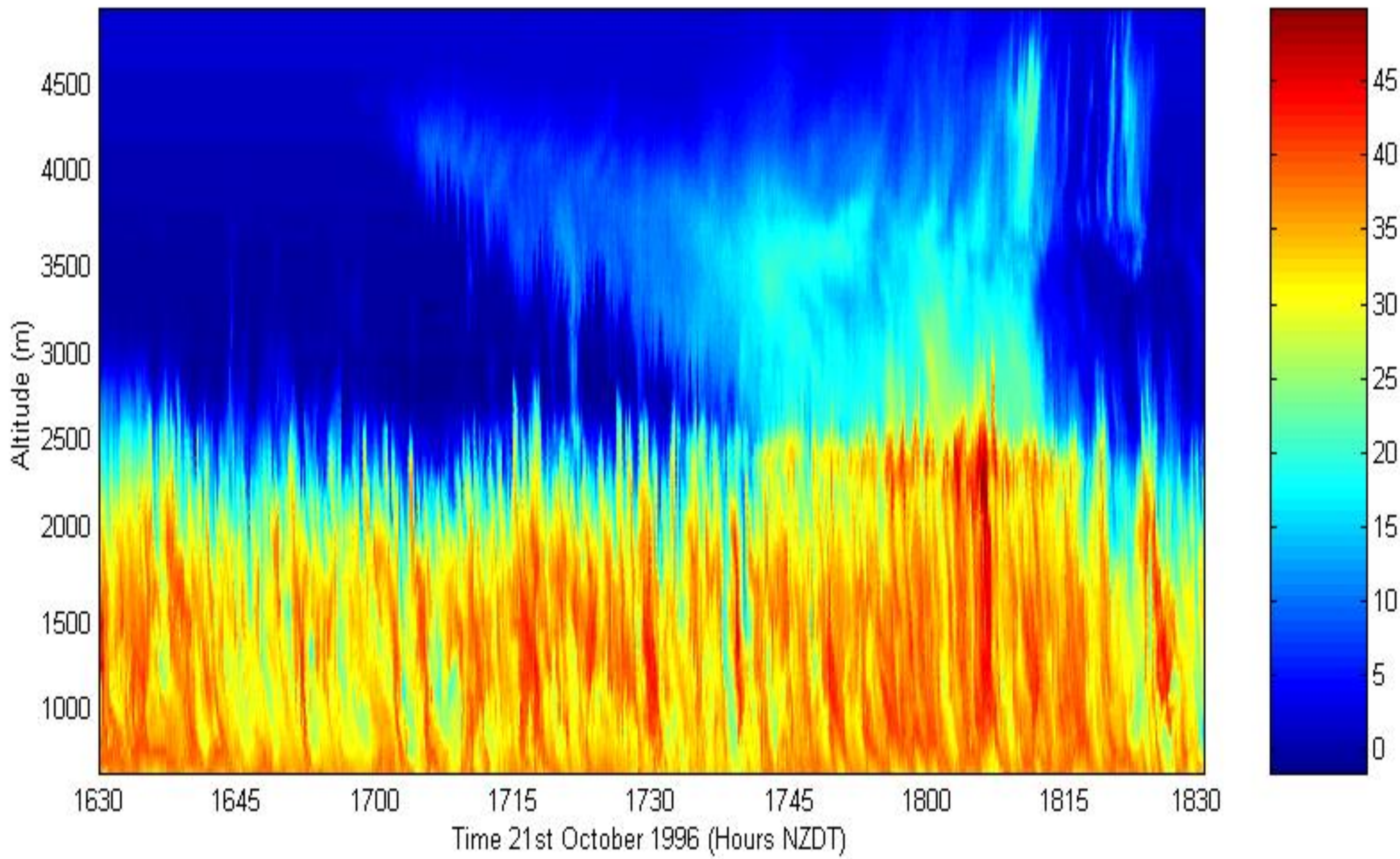

1 hour accumulation RMSE (mm)
Forecast time (hours)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
2
4
6
8
10
12
radar
satellite
mm5
hybrid



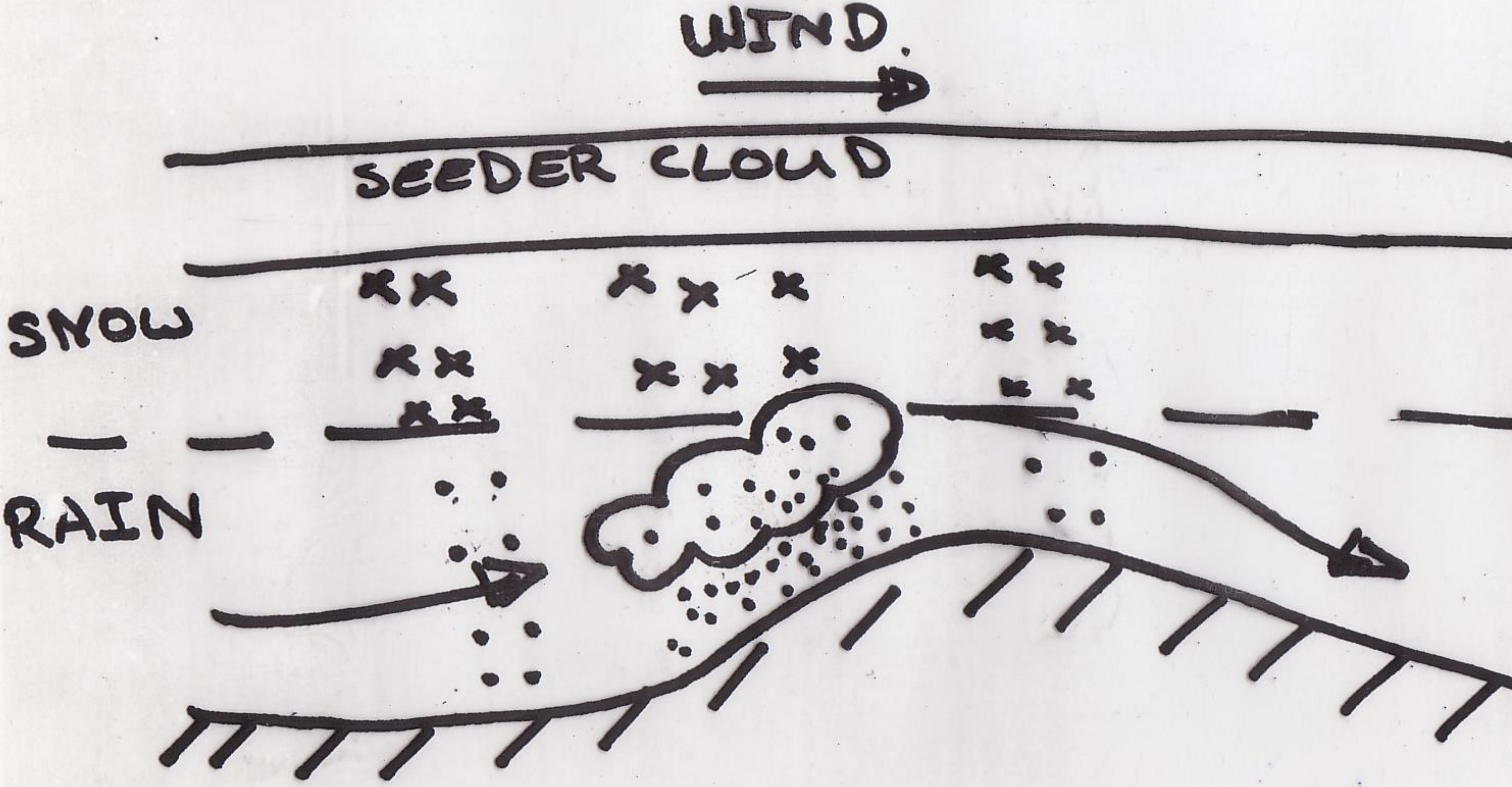
radar
satellite
mm5
hybrid
1 hour accumulation CC
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2
4
6
8
10
12
Forecast time (hours)


10.0km
5.0km
0.0km
-5.0km
-10.0km
-15.0km
0
5
8
11
14
17
20
25
30
35
40
45
50
55
60
dbz
-10.0km
-5.0km
0.0km
5.0km
10.0km
15.0km
20.0km
21-OCT-1996 17:37: 0


10.0km
5.0km
0.0km
-5.0km
-10.0km
-15.0km
-20.0km
-10.0km
-5.0km
0.0km
5.0km
10.0km
15.0km
20.0km
0
5
8
11
14
17
20
25
30
35
40
45
50
55
60
dbz
21-OCT-1996 17:41: 3



4500
4000
3500
3000
2500
2000
1500
1000
Altitude (m)
1630
1645
1700
1715
1730
1745
1800
1815
1830
Time 21st October 1996 (Hours NZDT)
45
40
35
30
25
20
15
10
5
0


WIND.
SEEDER CLOUD
SNOW
RAIN

Southern Alps 2

- Seeder-feeder process quite common.
- Predominant West Coast rainfall mechanism depends on the presence of large cloud droplets
- Nowcasting scheme that excludes West Coast rainfall at times when satellite data shows no pre-existing cloud offshore.
- Cirrus overcast periods can give false alarms.
- Essential in predicting rainfall is that pre-existing offshore cloud cloud physics be included alongside or in the mesoscale model.

Conclusions

- Orographic rainfall must be modeled at very high resolution.
- The predominant microphysical processes change at high space and time resolution which mesoscale models may have trouble resolving.
- Orographic rainfall prediction procedures need satellite cloud physics data and small radars in mountainous regions to allow direct observation of the dominant rainfall producing processes.