Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

La pioggia nelle montagne: osservazione e previsione

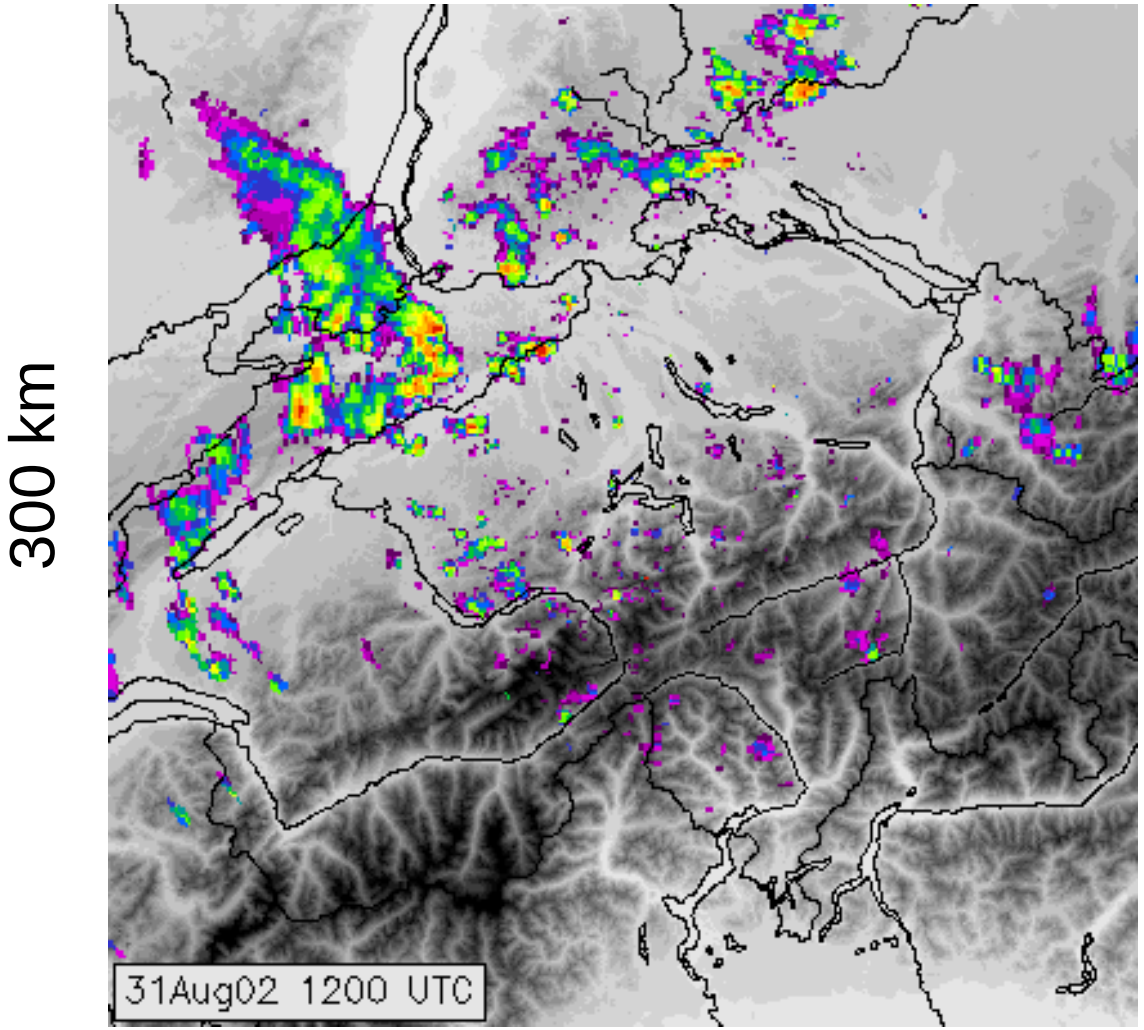
Luca Panziera
Team Radar e Satelliti – MeteoSvizzera Locarno Monti

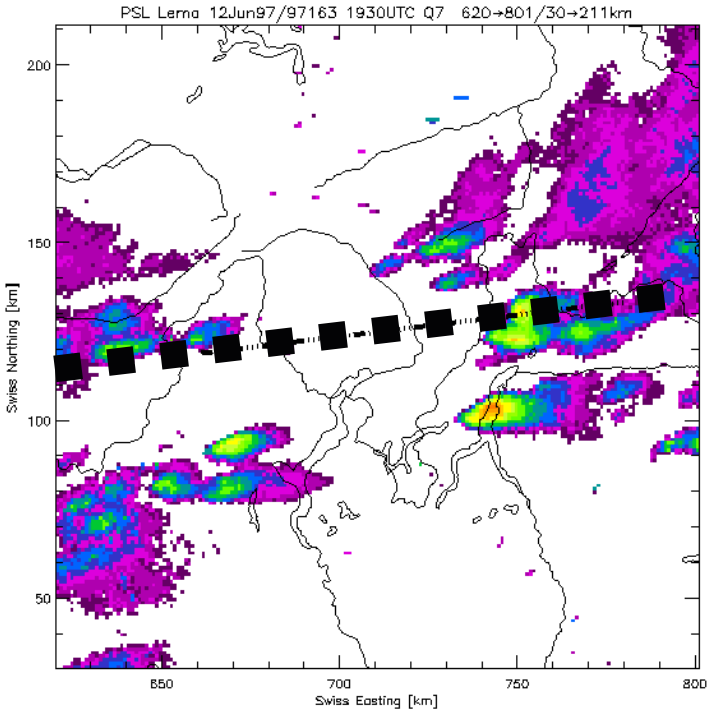
Bellinzona
Incontro Amici della Meteorologia

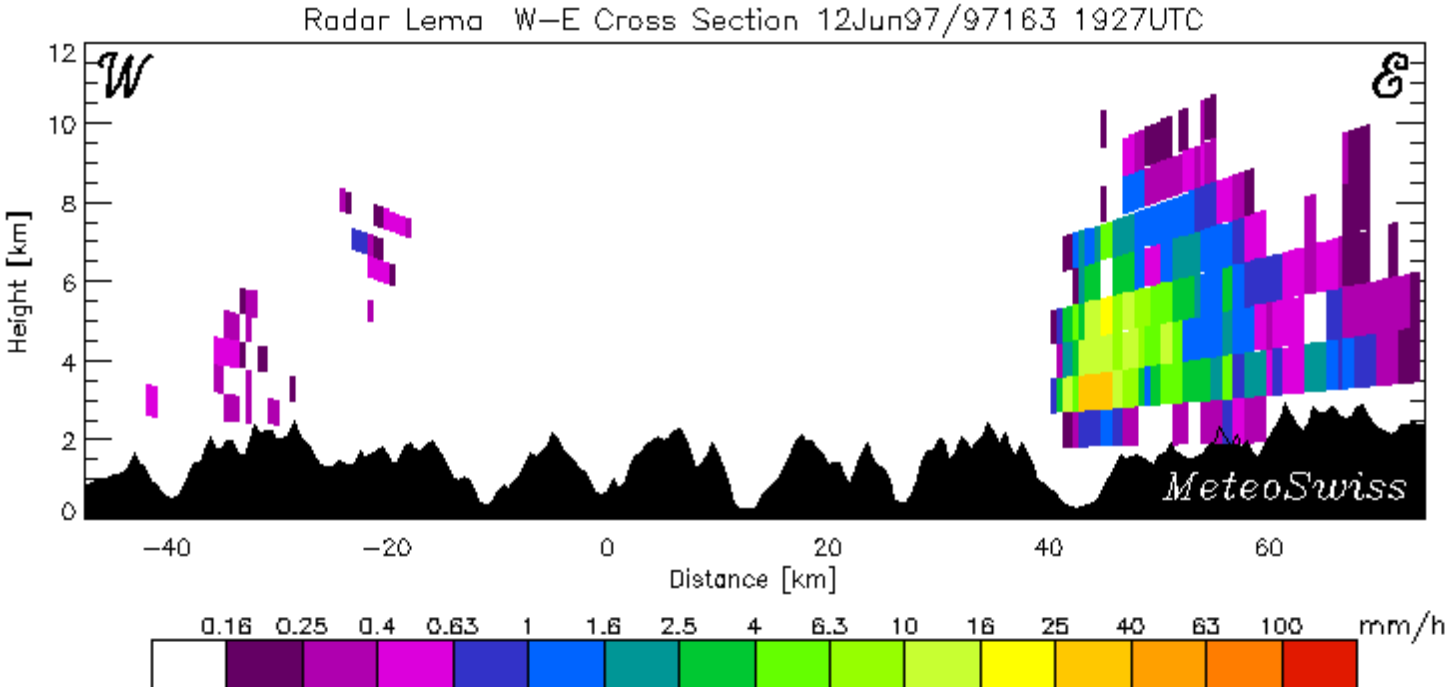
Osservazione:

La sfida

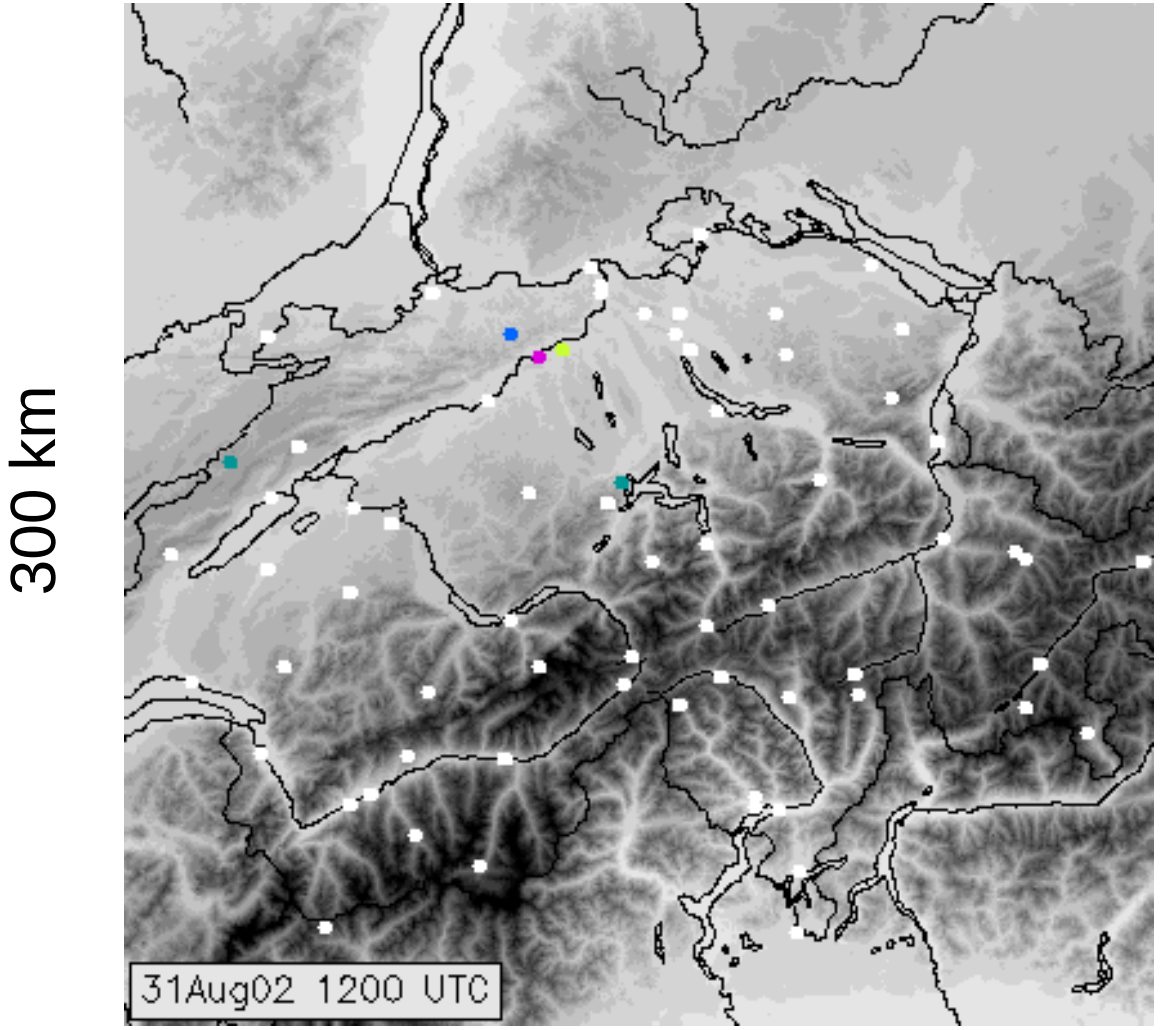
Radar meteorologico



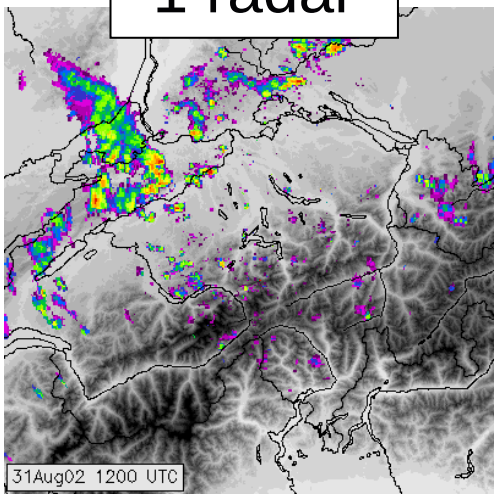

PSL Lema 12Jun97/97163 1930UTC Q7 620→801/30→211km
Swiss Northing [km]
200
150
100
50
650
700
750
800
Swiss Easting [km]


Radar Lema W–E Cross Section 12Jun97/97163 1927UTC
W
E
Height [km]
12
10
8
6
4
2
0
−40
−20
0
20
40
60
Distance [km]
MeteoSwiss
0.16 0.25 0.4 0.63 1 1.6 2.5 4 6.3 10 16 25 40 63 100 mm/h

72 pluviometri automatici

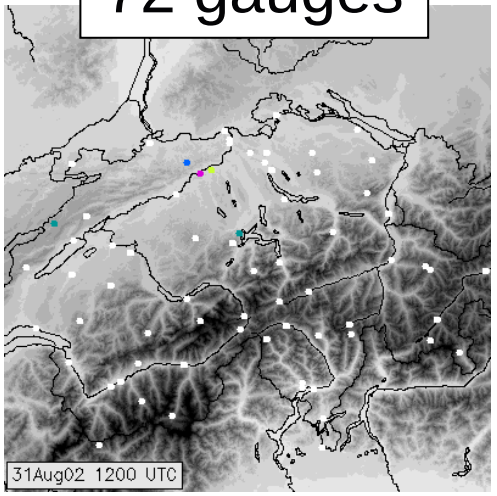


1 radar

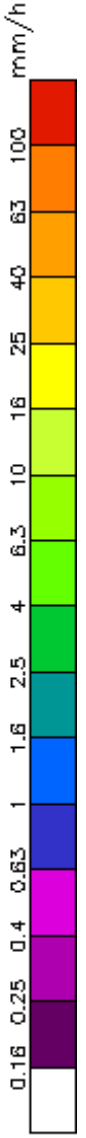


300 km

72 gauges



300 km



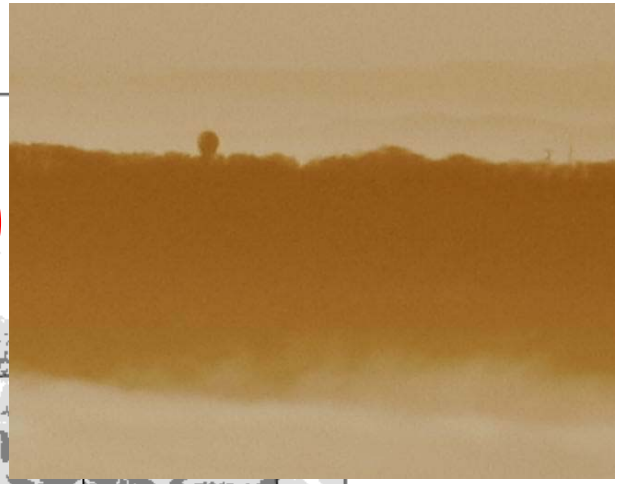
Radar:
- 400km
- 5min, 1km
- misura indiretta della pioggia

Gauge network:
- 0.1 m
- 10min, 25km
- misura diretta della pioggia

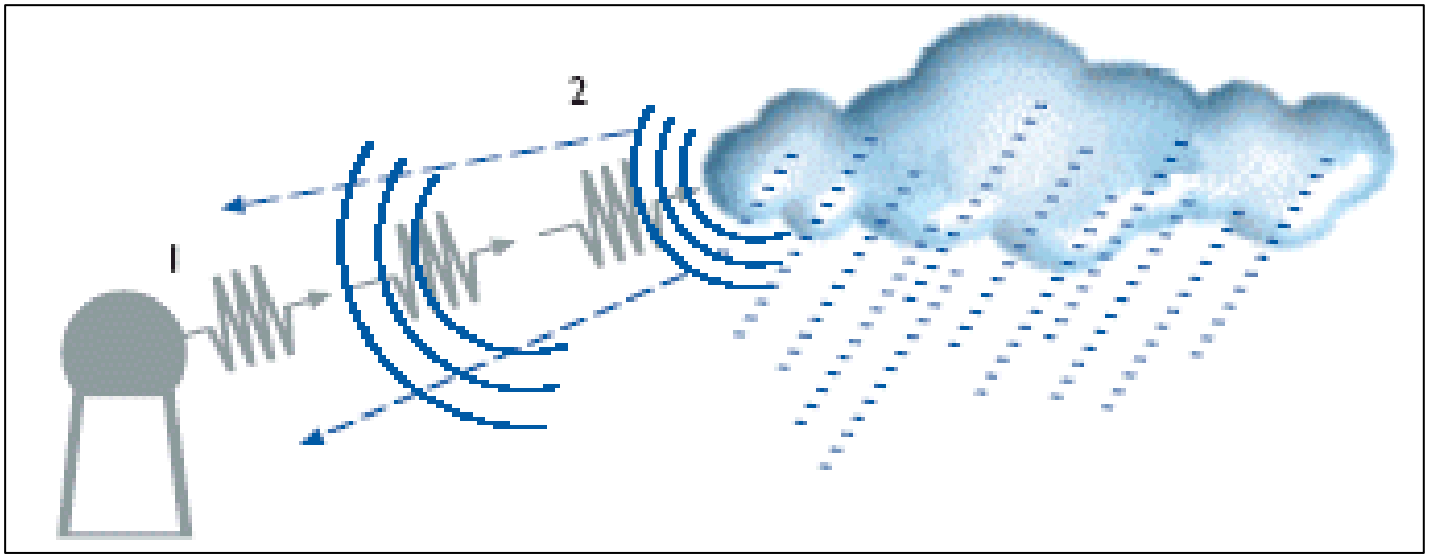
Il radar meteorologico è l`unico strumento che fornisce:

- in tempo reale
- Una misura tridimensionale della precipitazione
- Con un‘alta risoluzione spaziale e temporale (1 km, 5 min)
- Su una vasta zona (dist. di circa 250 km).

Rete radar di MeteoSvizzera



Cosa misura il radar meteorologico?

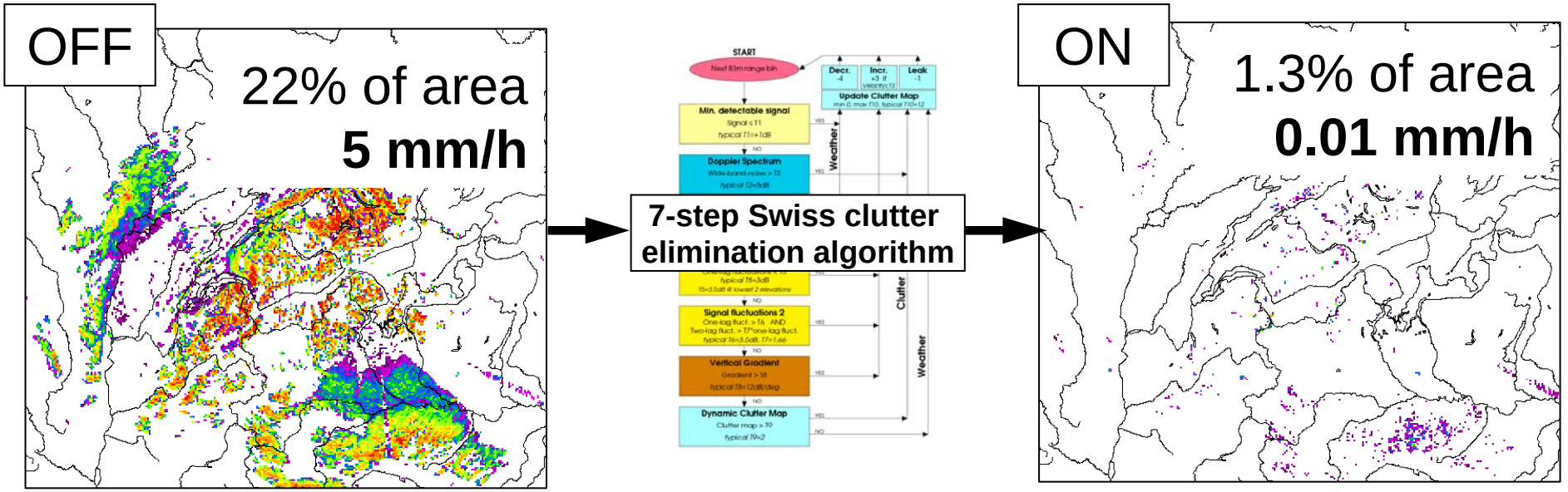


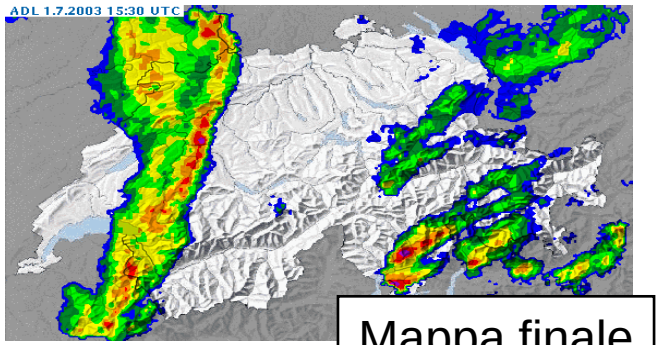
Il radar misura diverse grandezze:

- la **riflettività** (~ intensità della pioggia)
- il **cambiamento di fase** Doppler (~ componente radiale del vento)
- **quantità polarimetriche** (~ forma e orientamento delle gocce)

Oggetti che riflettono:

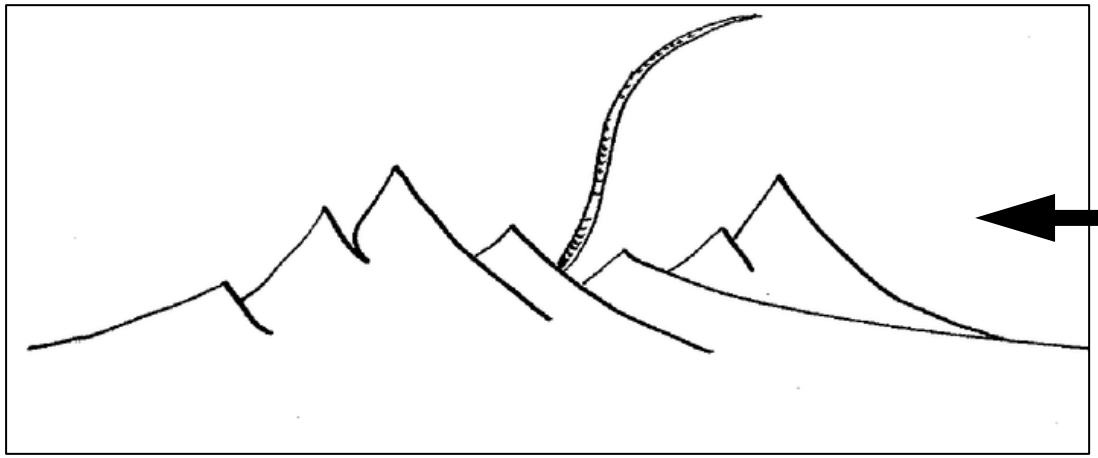
Meteo: gocce, fiocchi di neve, cristalli di ghiaccio, grandine, etc.
Altro: montagne, edifici, uccelli, laghi, aerei, etc.



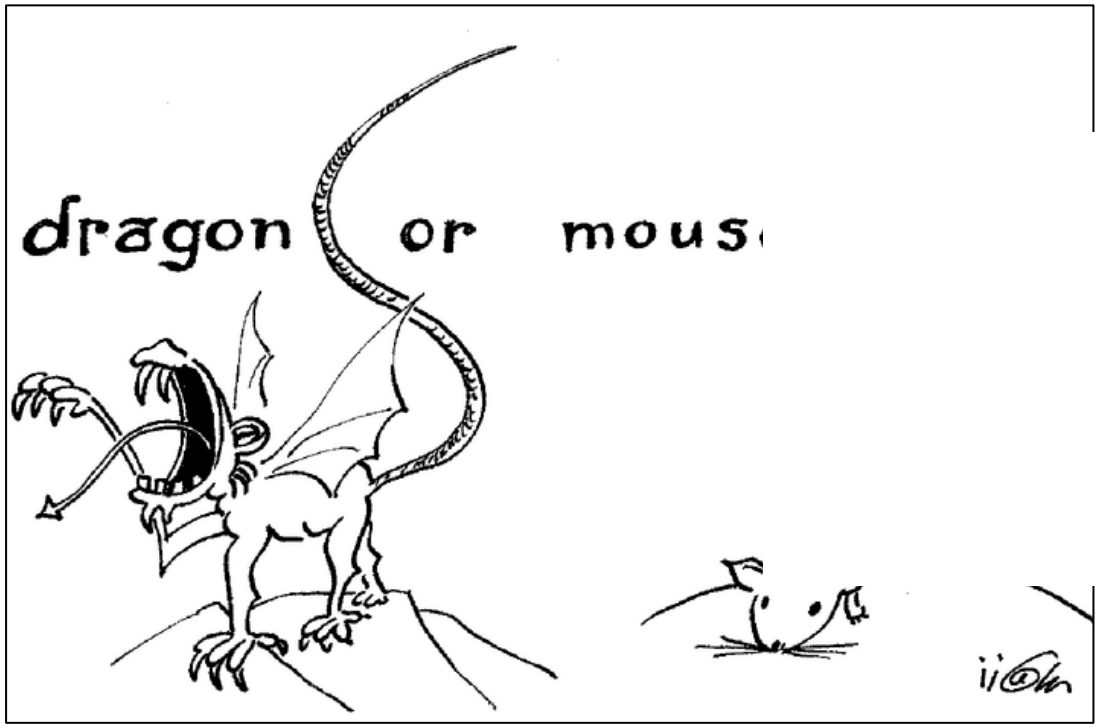


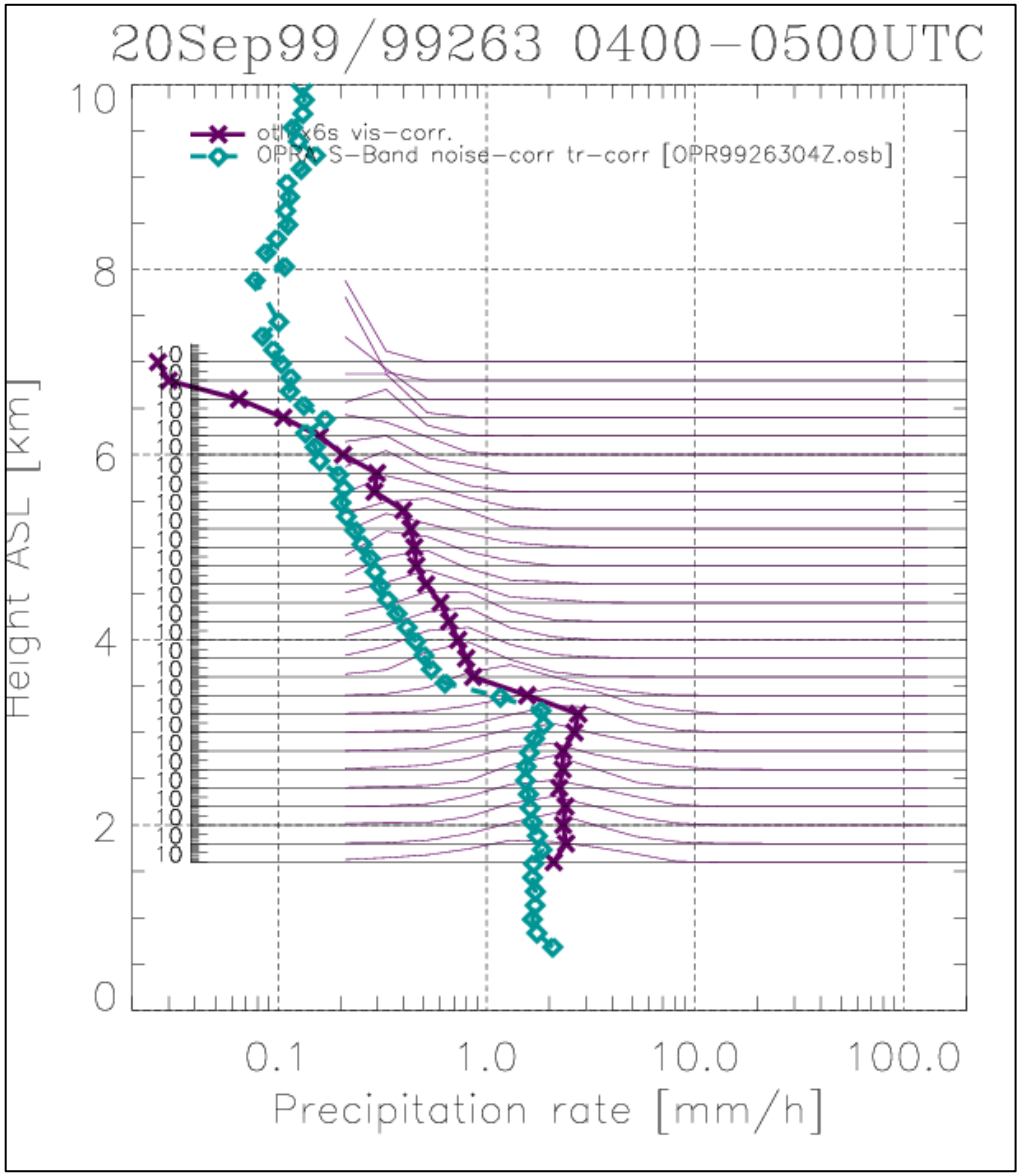
Mappa finale

Dragon or mouse?

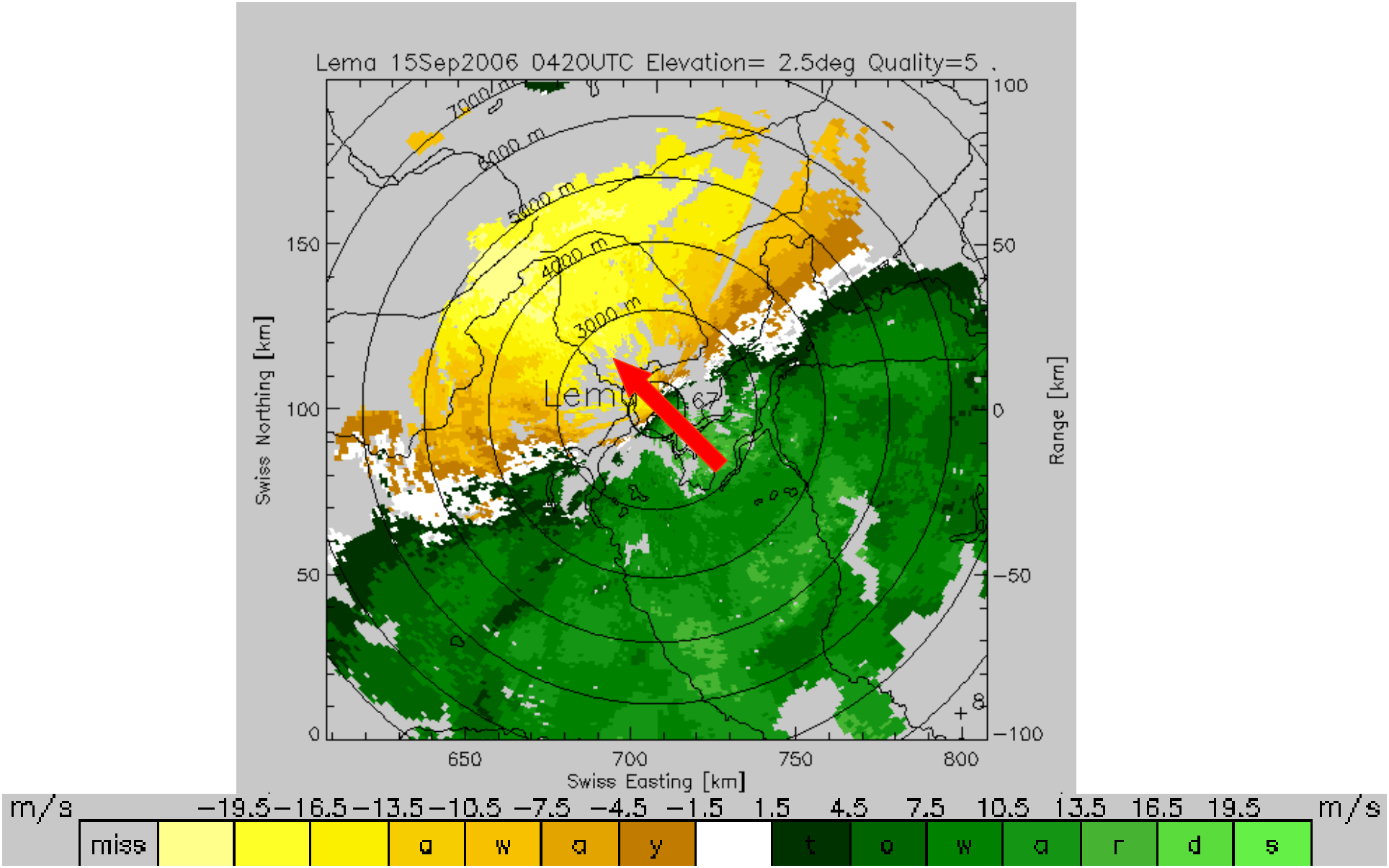


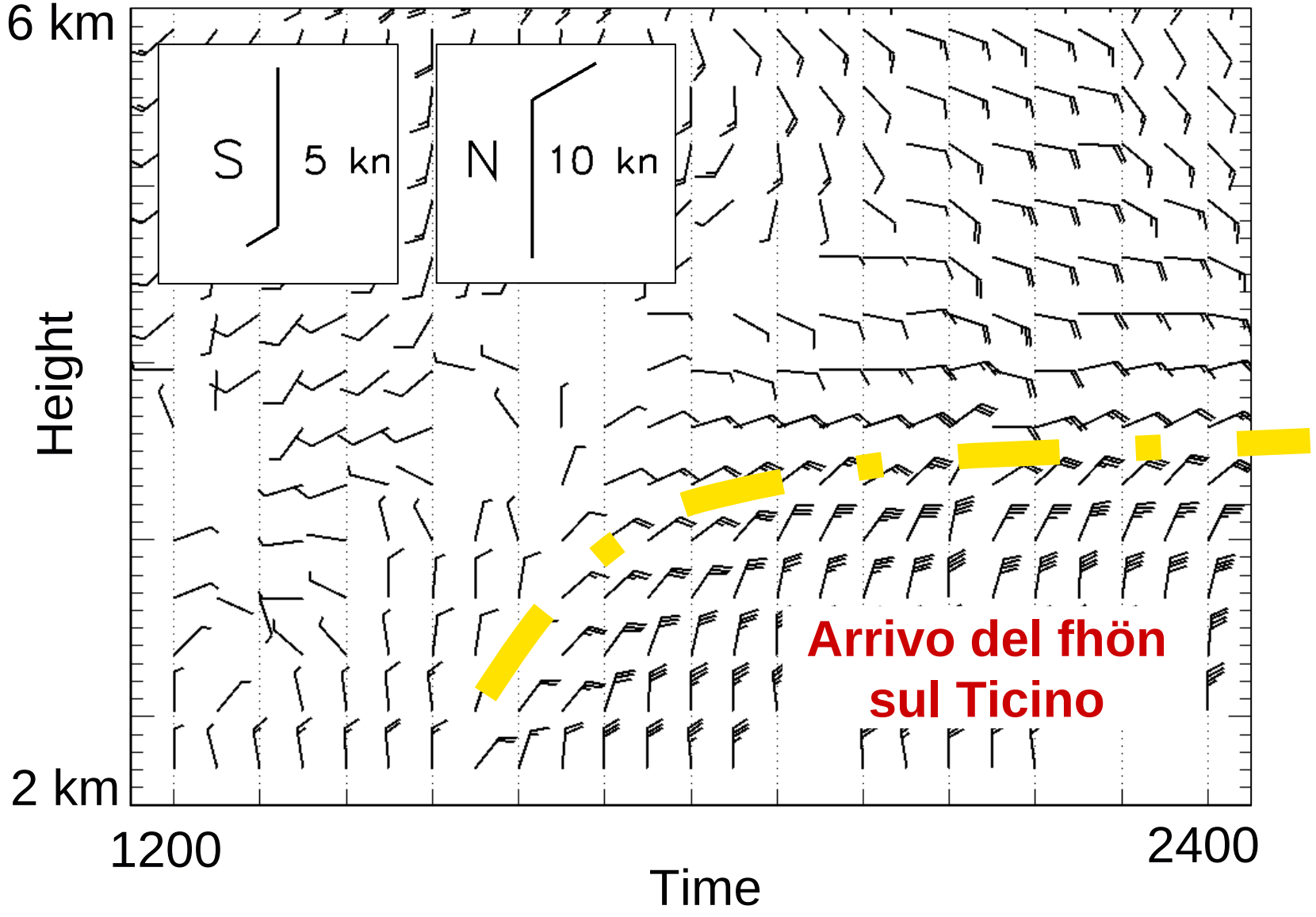
Ecco cosa
vede il radar




20Sep99/99263 0400–0500UTC
10
8
6
4
2
0
Height ASL [km]
0.1
1.0
10.0
100.0
Precipitation rate [mm/h]

Velocità radiale

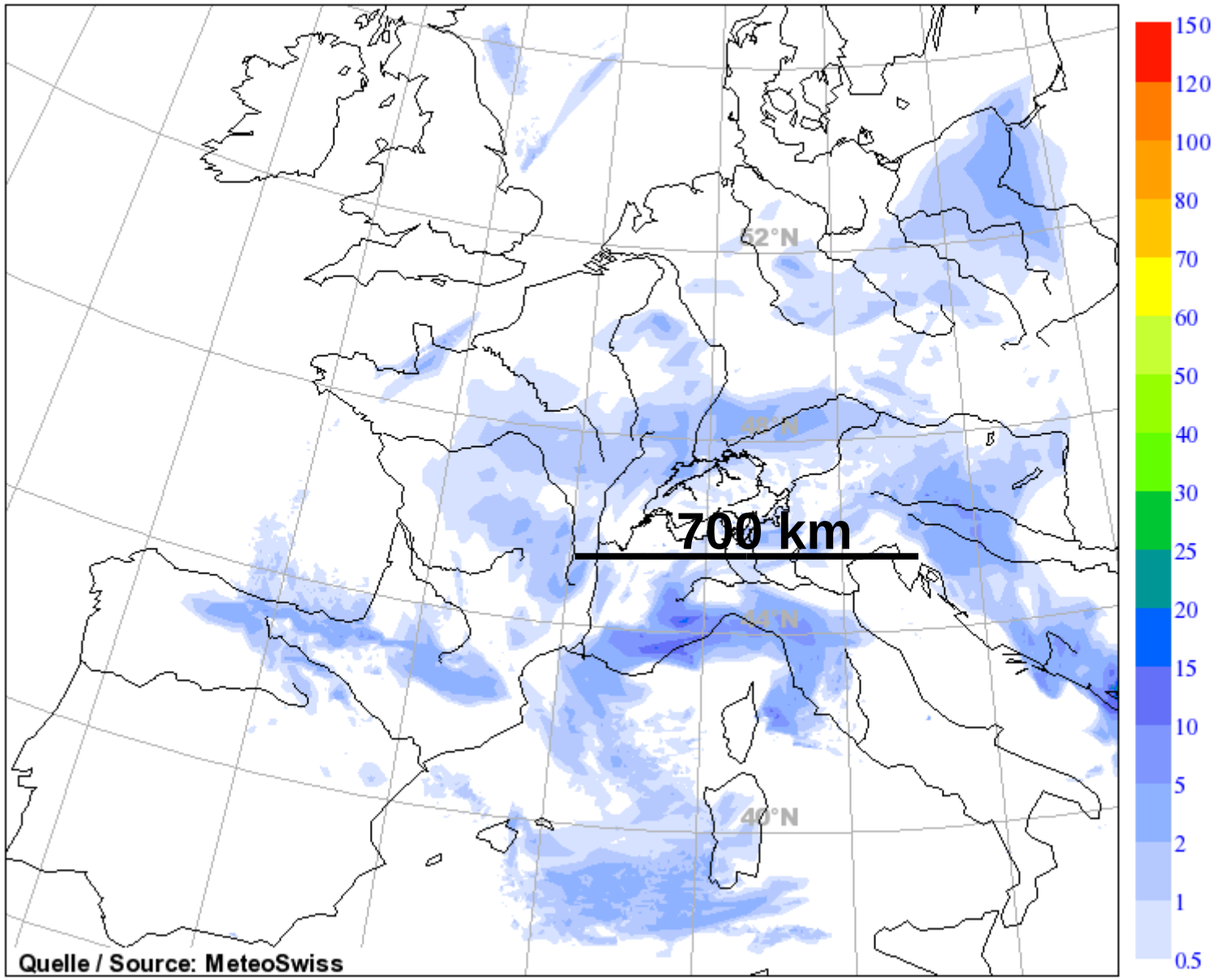


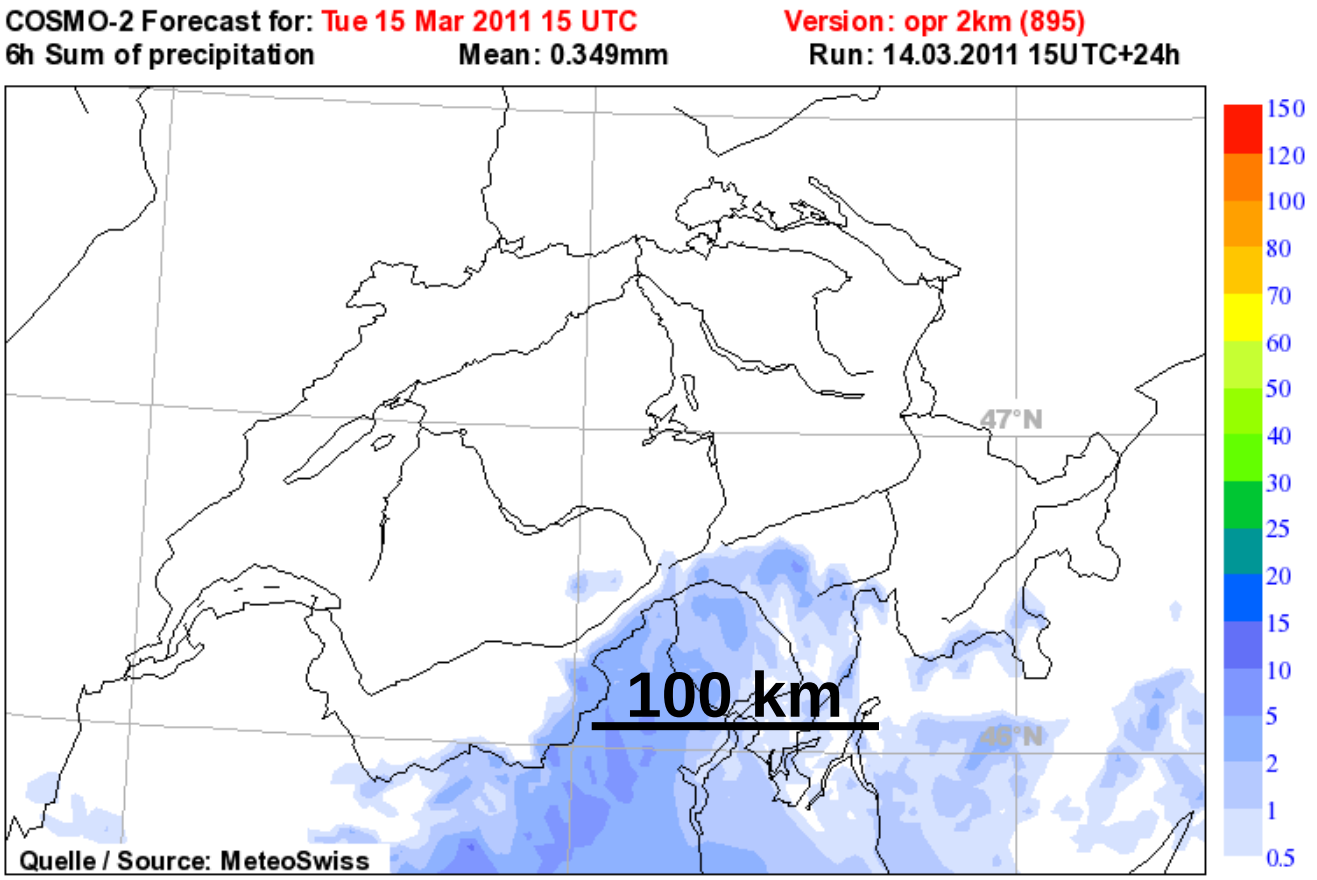

6 km
2 km
Height
S
5 kn
N
10 kn
Arrivo del fhön
sul Ticino
1200
2400
Time

Previsione:

La sfida

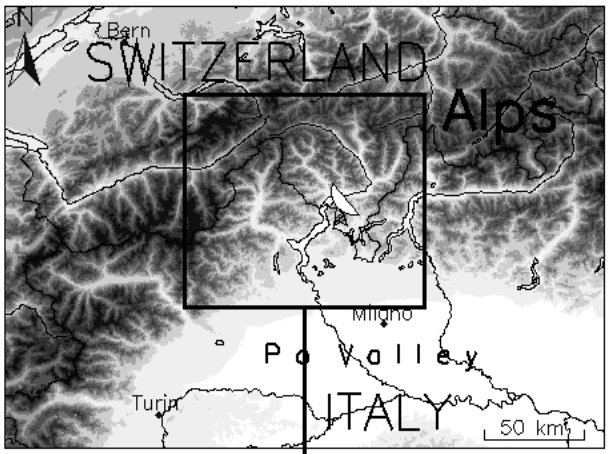
COSMO-7 Forecast for: Thu 11 Feb 2010 18 UTC
6h Sum of precipitation Mean: 0.41mm
Version: opr 7km (877)
Run: 11.02.2010 12UTC+6h



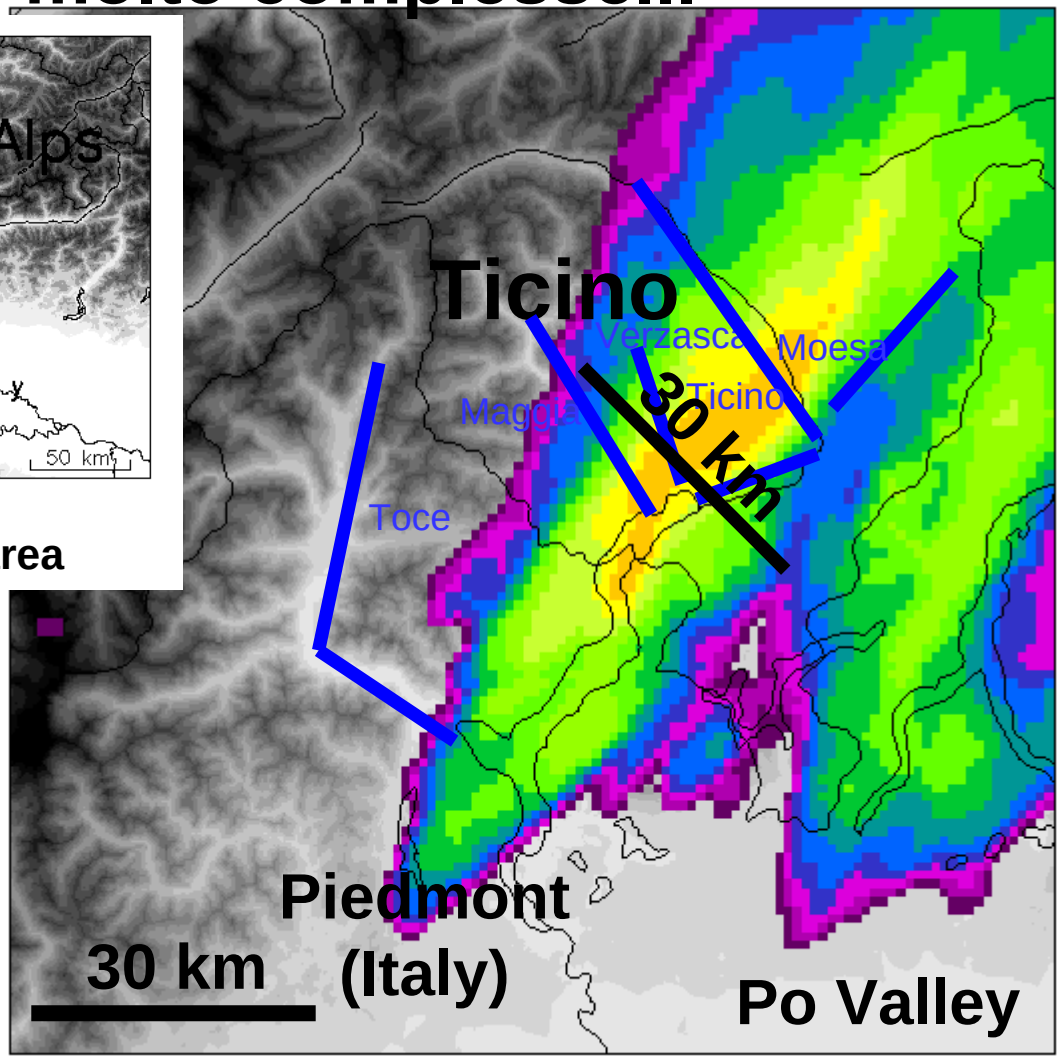

COSMO-2 Forecast for: Tue 15 Mar 2011 15 UTC
Version: opr 2km (895)
6h Sum of precipitation
Mean: 0.349mm
Run: 14.03.2011 15UTC+24h
47°N
100 km
Quelle / Source: MeteoSwiss
150
120
100
80
70
60
50
40
30
25
20
15
10
5
2
1
0.5

Blenio, 29 agosto 2003

Strutture molto complesse...



Lago Maggiore area



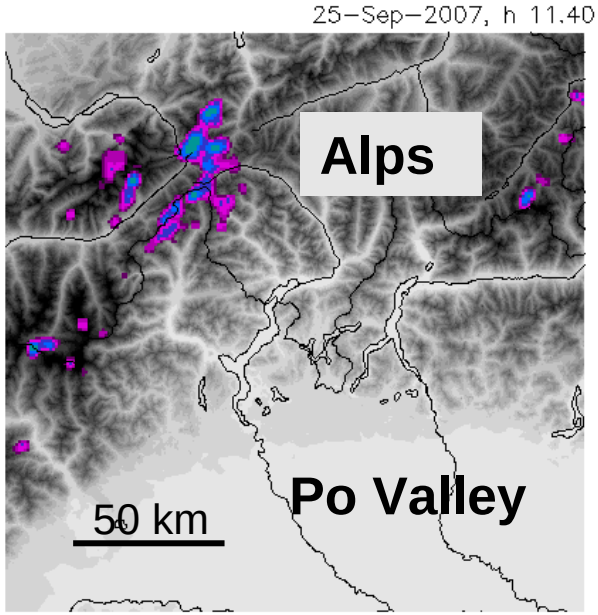
Pioggia accumulata in 1 ora

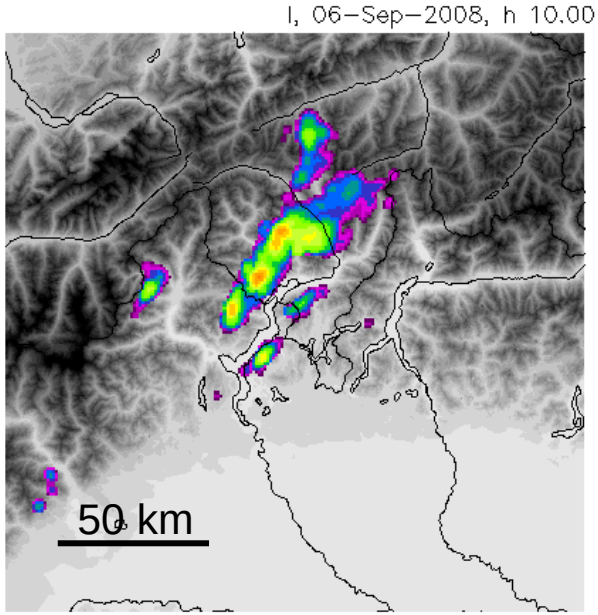
3 Oct.2006, 17:30 – 18:30

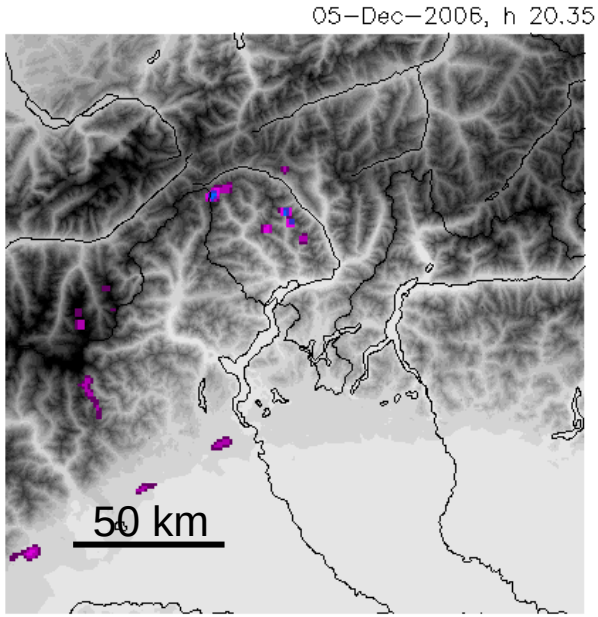
Accumulated rainfall [mm]

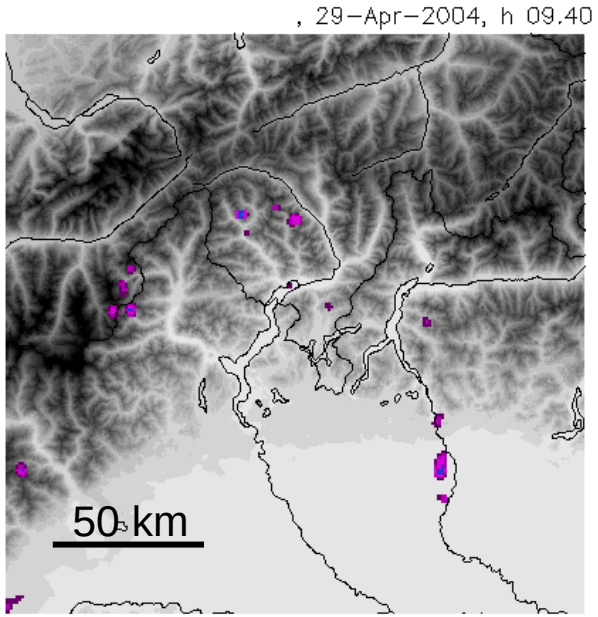
0.16 0.25 0.4 0.63 1 1.6 2.5 4 6.3 10 16 25 40 63 100

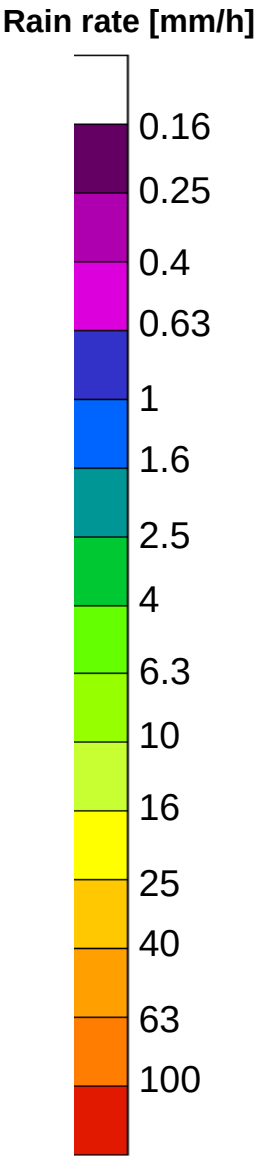
Varietà di eventi









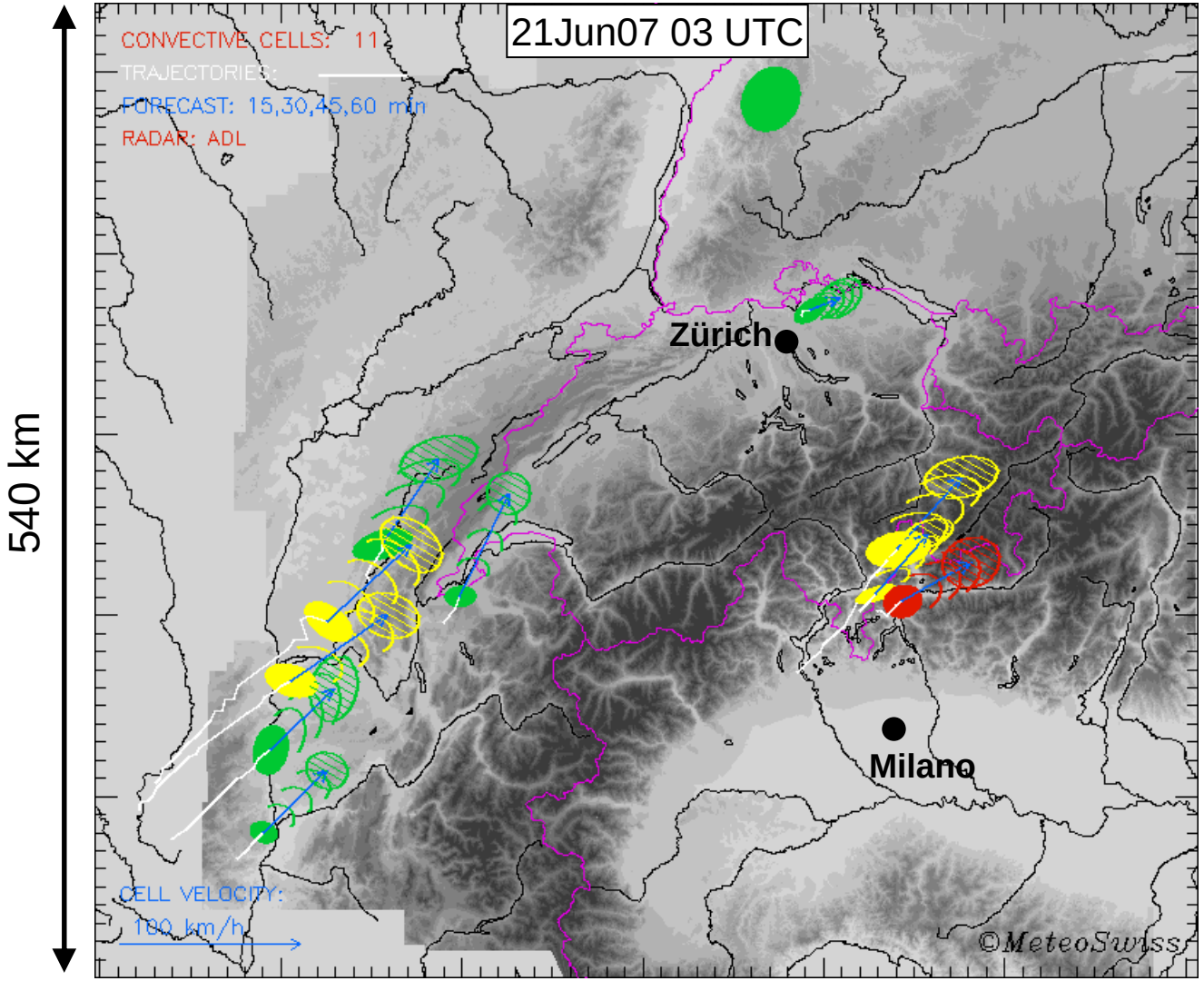



10 km²
TRG pipeline
TRANSITGAS
Radar ALARM L1, 2011-03-10 15:00UTC; Precip 0.5h = 62.1 mm Spreitlaui-East
Ship containers for wall protection
Pipeline
Pipeline exposed

Nowcasting

L´ultima possibilità di prevedere il futuro
prima che il futuro diventi presente!

Nowcasting dei temporali



Classificazione temporali:

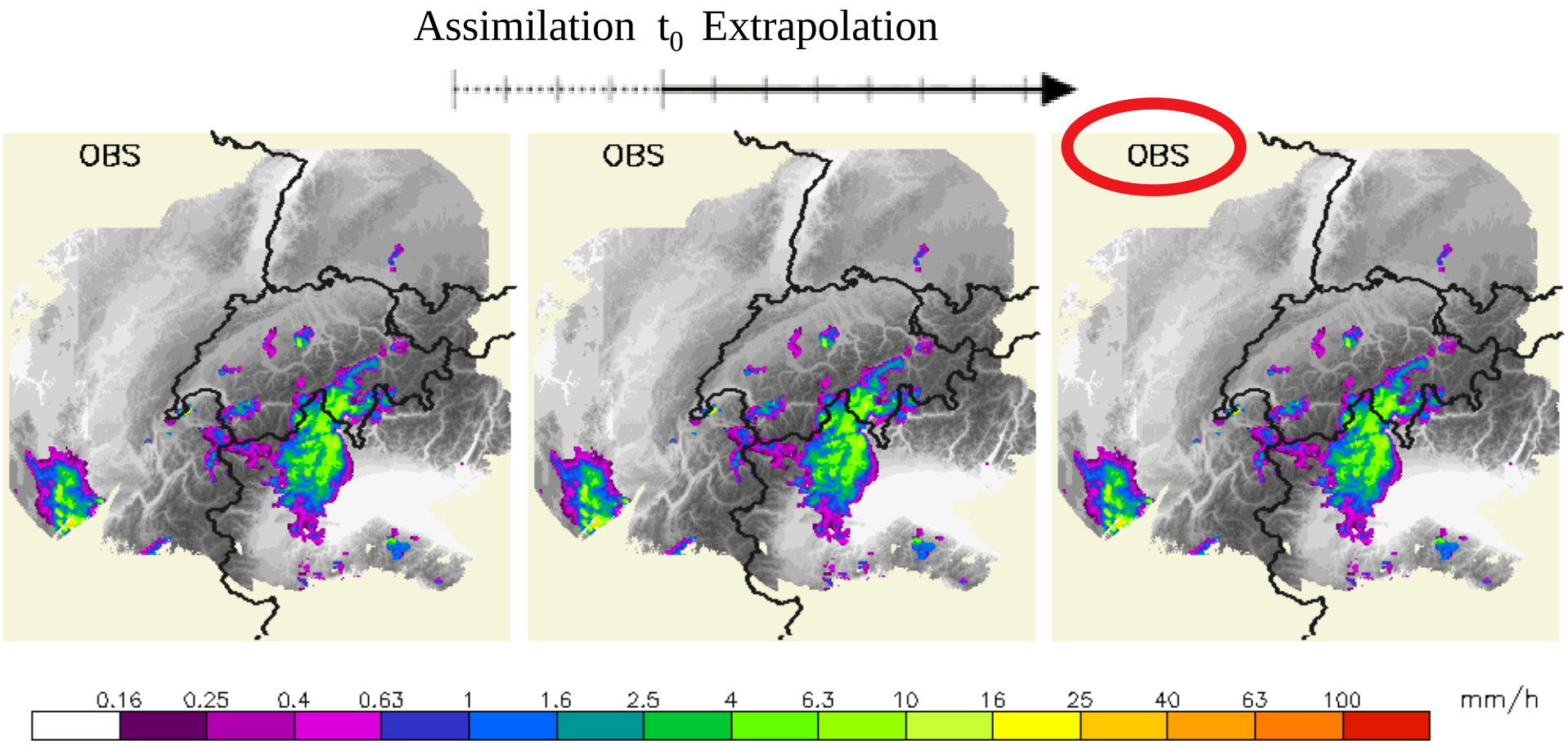
DEBOLI

MODERATI

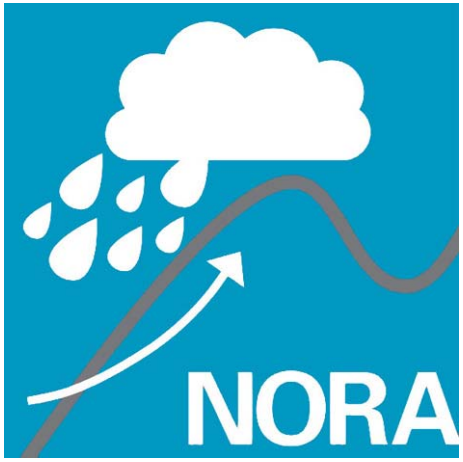
FORTI

basata sul contenuto d'acqua integrato verticalmente, e particolari soglie di riflettività radar.

Nowcasting della pioggia
Estrapolazione



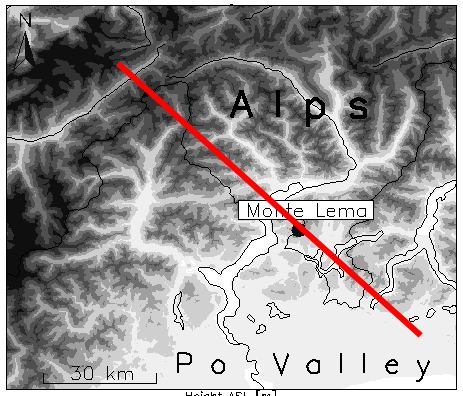
Nowcasting della pioggia
Metodo degli analoghi

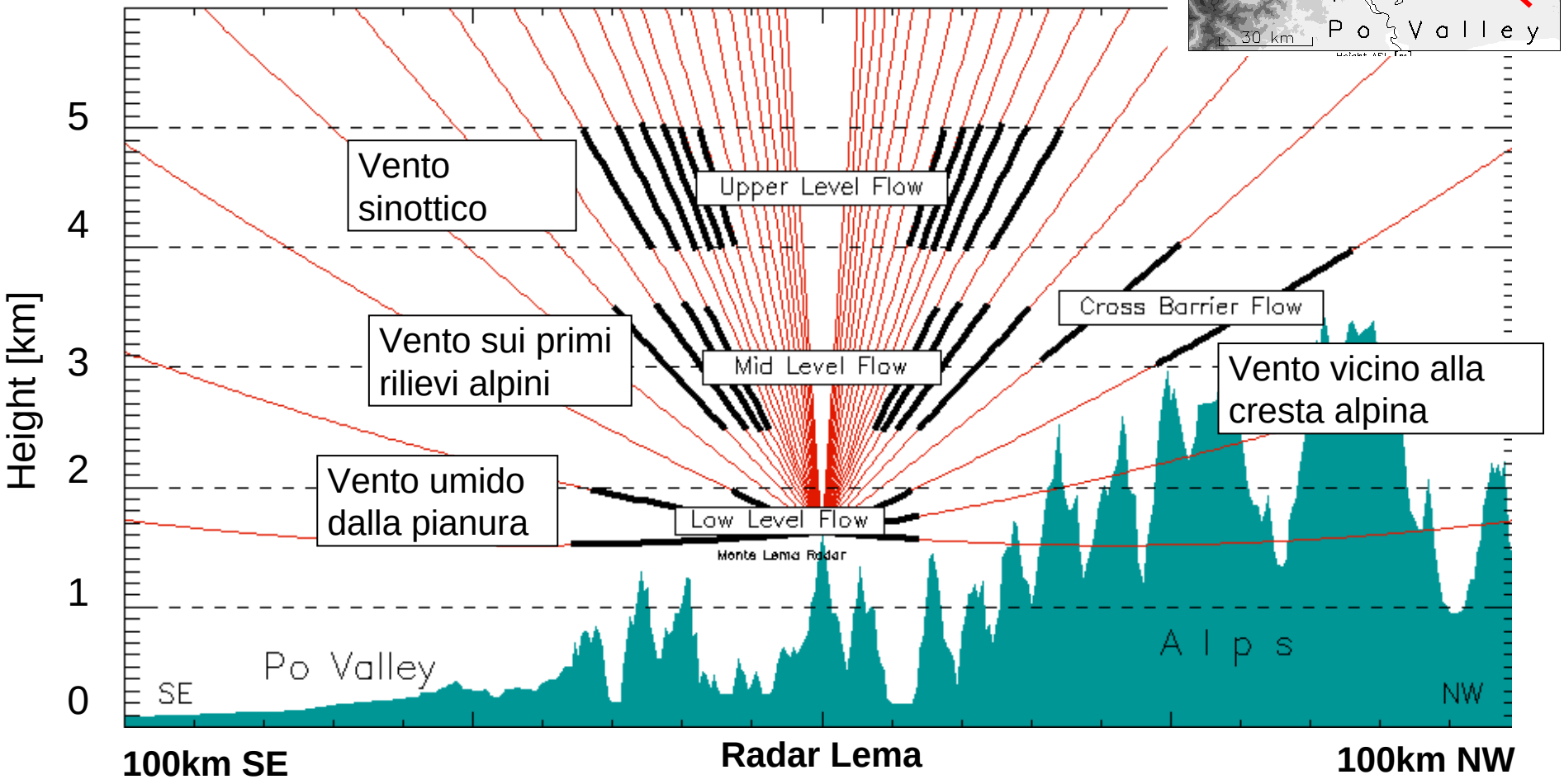


Nowcasting of Orographic Rainfall by means of Analogs

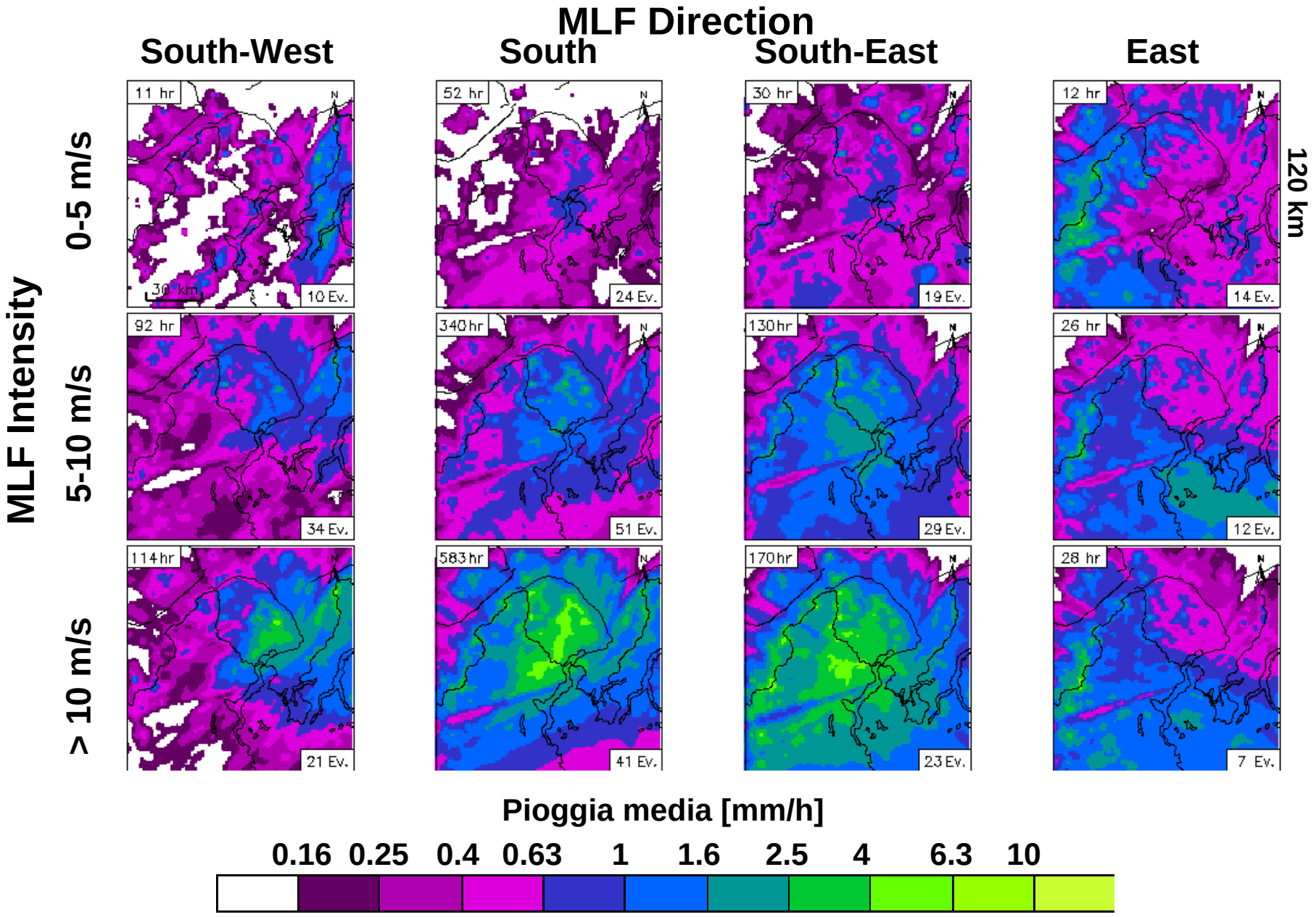
IDEA DI FONDO: usare i *venti a mesoscala* e la *stabilità* dell'aria come predittori della pioggia nelle montagne.

Venti a mesoscala

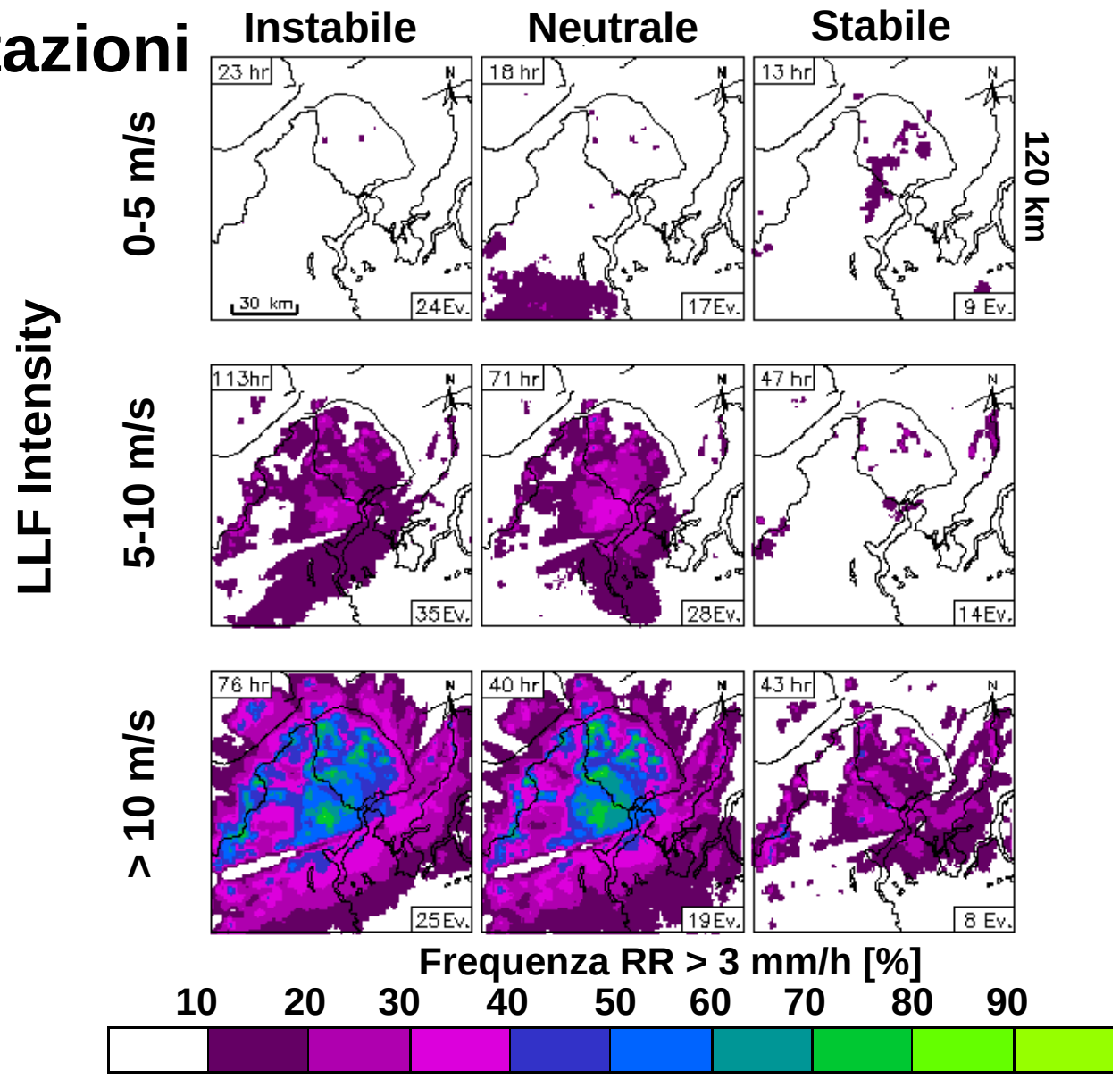




Analisi della pioggia media: Mid Level Flow



Analisi della frequenza della pioggia: Low Level Flow da Sud-Est + Stabilità dalle stazioni

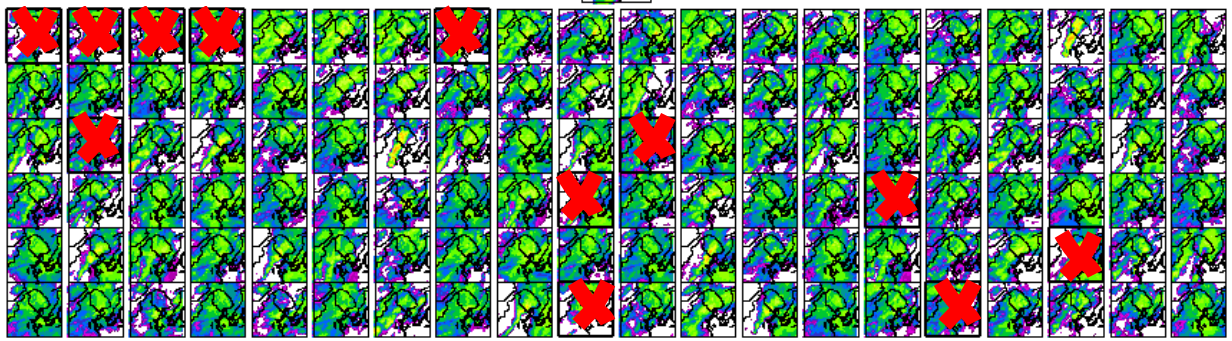


Metodo analoghi

current field

+ predictors

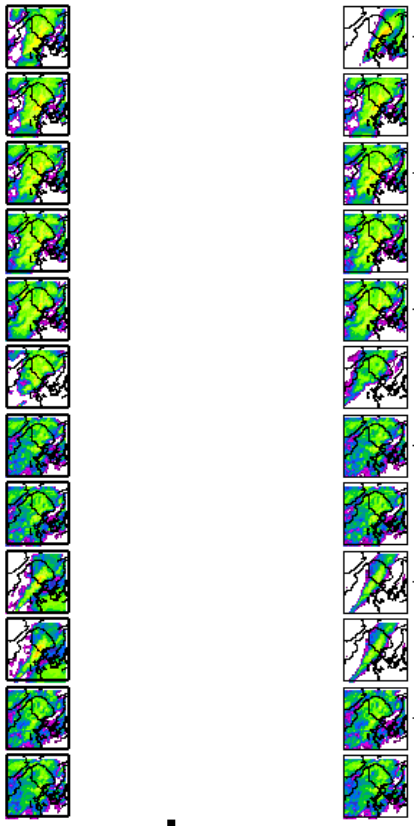
Analoghi Meteo
(venti e stab. simili)



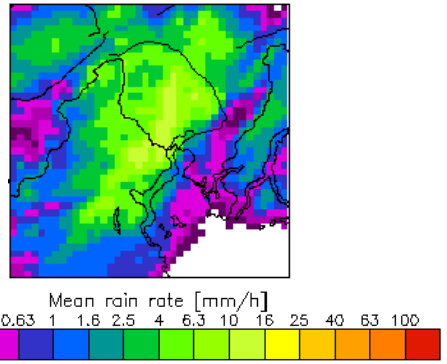
Ricerca in 127 giorni di pioggia.

12 ensemble members

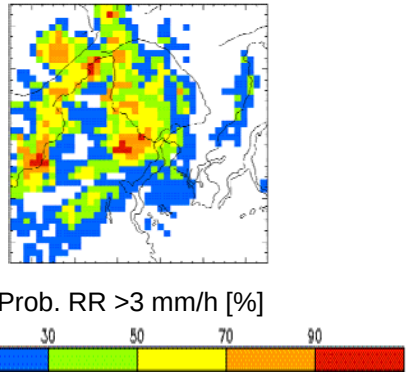
Analoghi finali
(venti, stabilità e immagine radar simili)



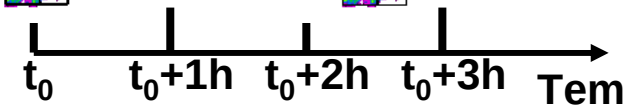
Prev. deterministica



Prev. probabilistica

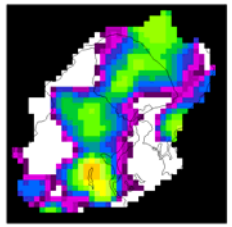


campo radar piu' simile



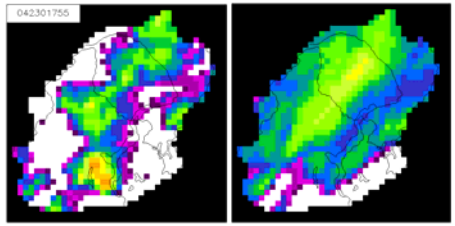
Esempio: 17 Agosto 04 17:50. Previsione 0-4 ore

Euler

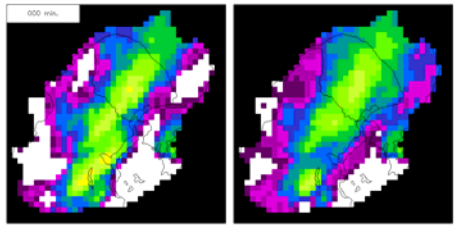


animation mean

OBS.

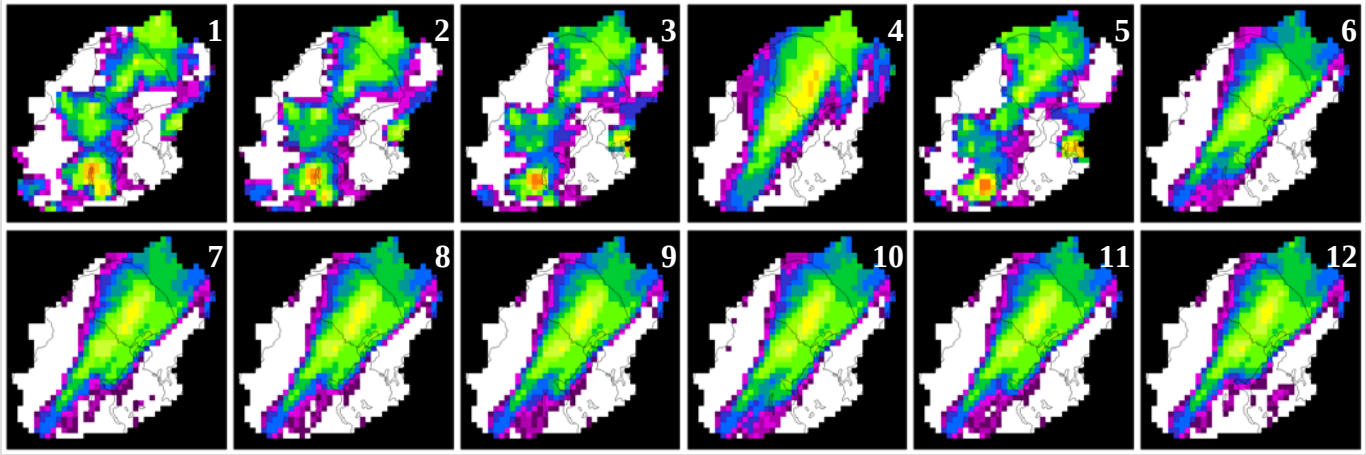


NORA



Analog Ensemble

NORA ensemble members 0-4 hours



Per riassumere

- Il radar meteorologico è lo strumento piu‘ adatto a misurare la pioggia nelle montagne in tempo reale su vaste zone.
- Il radar meteorologico è indispensabile per le previsioni di pioggia a corta scadenza.
- I metodi usati per prevedere la pioggia nelle montagne dipendono dal tipo di evento e dalla previsione richiesta
- Vi è una crescente richiesta per previsioni di pioggia sempre piu‘ precise su aree ristrette.

Grazie!