C.N.M.C.A. - PRATICA DI MARE - ITALIA VIS 23-MAY-2003 10:00

CNMCA

**Severe weather. Some case studies for medium-range forecasting**

**T. La Rocca, Department of Synoptic Meteorology, Italian Met. Service, Rome.**

- **The Met Alert Messages by the Watch Office of the Public Safety Agency, represent a very important activity for the Italian Meteorological Service**

# The issue time scale:

- At  T+12h -24h  nowcasting     is intens
  D-   day
- at  T+24- 48 h     short range    is warning
  D-1 day
- At T+48-60 h    medium range is pre warning
  D-2 day

- In particular, the issue of meteorological
  alert message in medium range forecast
  consists of a pre-warning

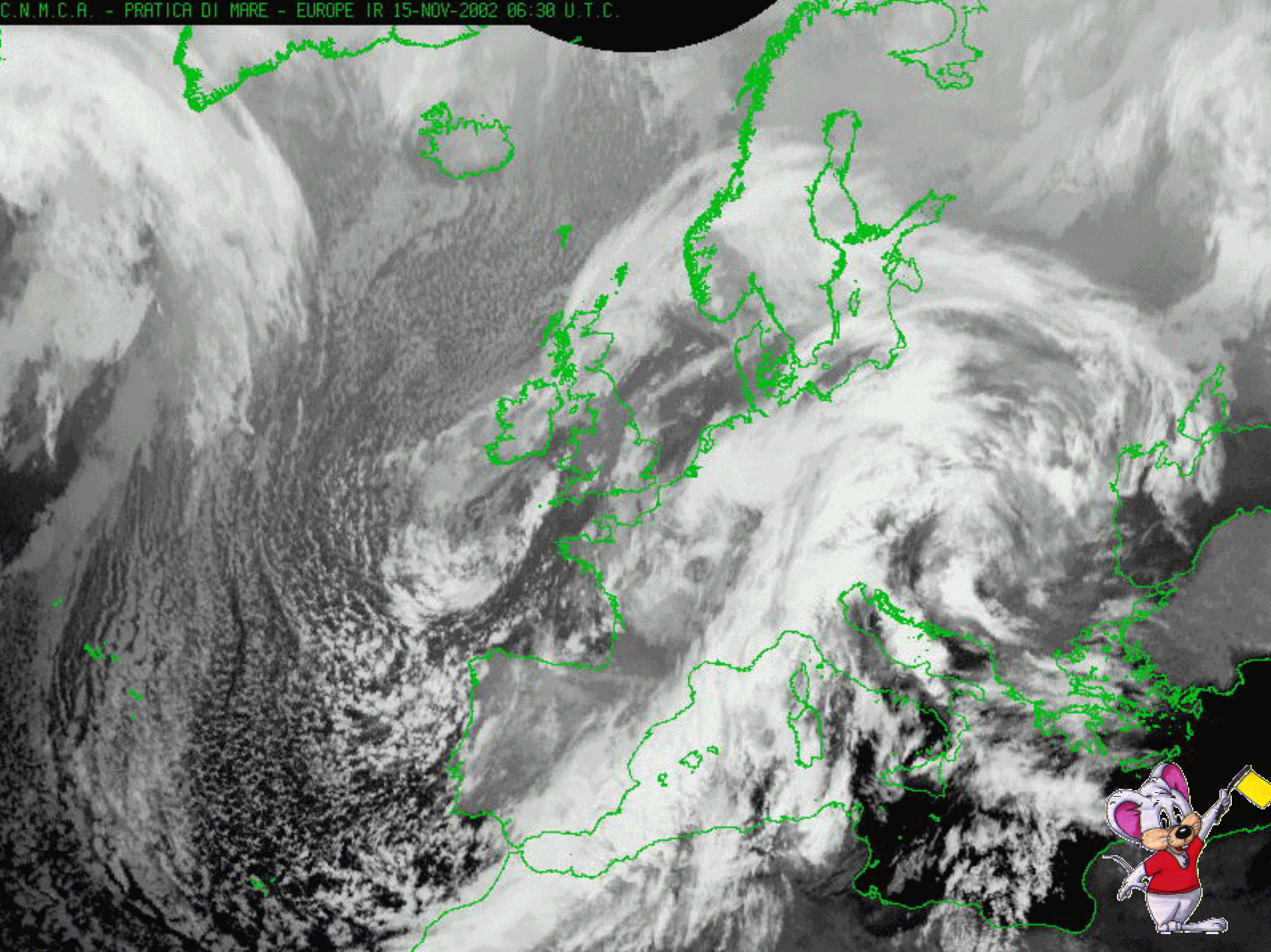# Phenomena and thresholds leading to meteorological alert at Itl. Weather Service

- Rainfall More than 50 mm/24 h on wide area (regional areas); more than 40 mm/6 h on local areas (heavy showers);
- Snowfall More than 10 cm/12 h on the plain on regional areas; more than 50 cm/24 h on mountain areas;
- Thunderstorm, Hail Heavy thunderstorms or thunderstorms with hail Strong wind Mean speed more than 33 knots;
- Gusts speed more than 33 knots Sea state Very rough or more (Sea state 6, wave height more than 4-6 meters)
- Temperature Decrease 10° C or more in 24 h; Rise, above 32° C, for 48 h at least
- .Fog On wide area, for at least 48 h

- **The Forecast in severe weather involves the operational use of conceptual models**

- **The severe weather type, and related synoptic or meso-synoptic characteristics, routinely diagnosed by forecaster on the basis of conceptual models justify numerical models output in the decisional process for issuing Met Alert**

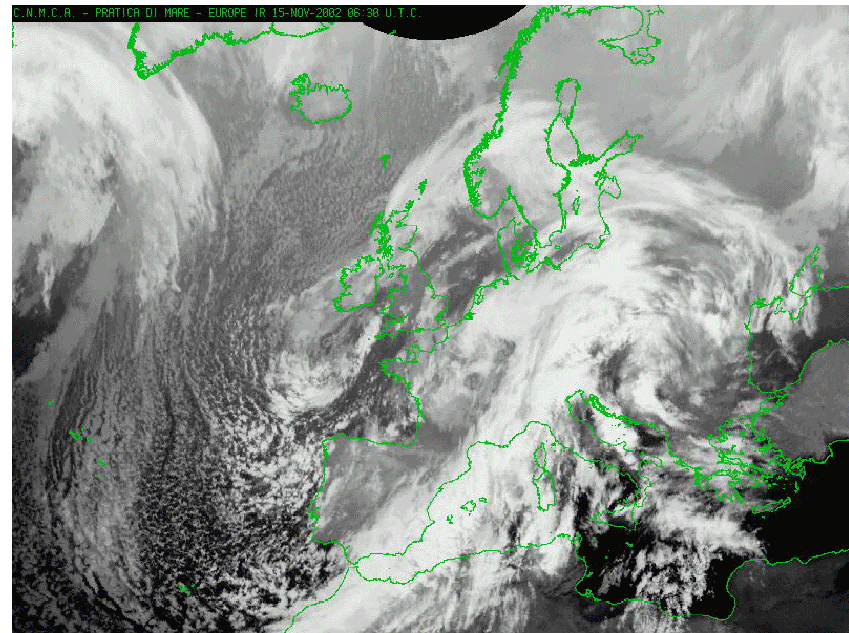| Phenomena | Synoptic or meso-synoptic characteristics | Forecast | | |
|---|---|---|---|---|
| | | Medium range | short range | nowcasting |
| **Heavy and persistent precipitations** | ● **V-shaped trough, with a stationary warm conveyor belt** | **yes** | | |
| | **Frontal and post-frontal convergence lines** | | | yes |
| | **Interaction between continental pseudo-cold front and occlusion** | | occasional | yes |
| | **Frontal system deformation due to topographical interactions ( Topographical S-shape )** | | yes | |
| Strong winds | **Deep and rapid cyclone development** | | yes | |
| Ssnowfalls over the plain | **Interaction between continental pseudo-cold front and occlusion** | | occasional | yes |
| | **Eddy Vortex from Eastern Europe** | | occasional | yes |
| | **Warm conveyor belt over cold lake in Valle Padana** | **very occasional** | occasional | yes |
| Heavy thunderstorms | **Post-frontal or isolated commas from upper eddy vortexes ( Possible topographical effects )** | | yes | |
| | **Frontal and post-frontal convergence lines** | | | yes |
| | **Heat thunderstorm** | | occasional | yes |
| Squall lines | **Induced over Po Valley by cold front North of the Alps** | | occasional | yes |
| Wide area fog | **Intense anticyclone developing over Italy** | | yes | |
| Heat waves | **Anticiclonic belt** | **yes** | | |
| Cold spells | **Continental pseudo-cold front** | **occasional** | yes | |
| Forest Fire | **Anticiclonic subtropical continental air masses currents from Africa ( very hot and dry air in sunny and windly weather conditions )** | **yes** | | |

**Severe weather types, and related synoptic or meso-synoptic characteristics, routinely diagnosed on the basis of conceptual models to justify numerical model outputs in the decisional process for issuing meteorological alerts**

C.N.M.C.A. - PRATICA DI MARE - EUROPE IR 15-NOV-2002 06:30 U.T.C.

# Some Aspects weakening the predicibility of numerical precipitation output loaded by a V-Shaped Trough are:

- Cumulative precipitations depend on the high of condensation level

- Forcing for orographic effect is too sensible to the wind

- probable convectivity in Conditional Simmetric Instability


- **Employment of EPS products:**
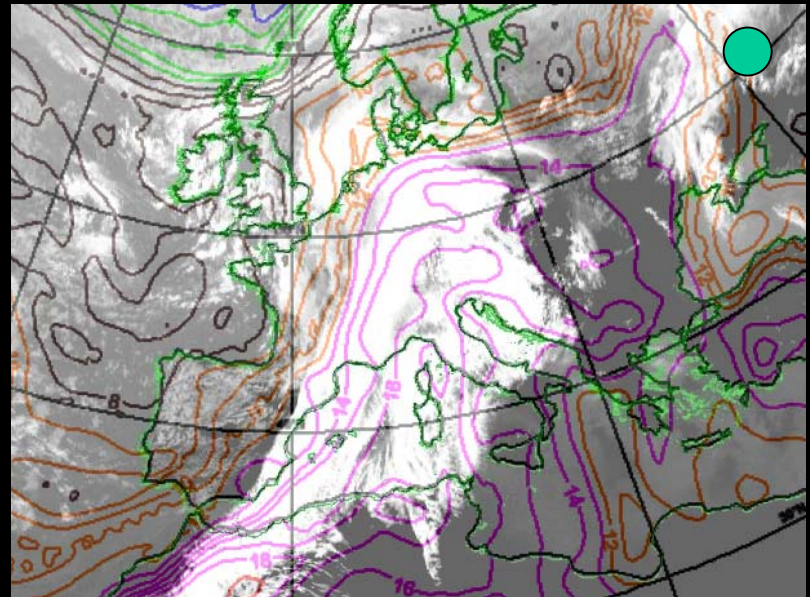- **Precipitation accumulated over last 120h EPS Extreme Forecast Index**
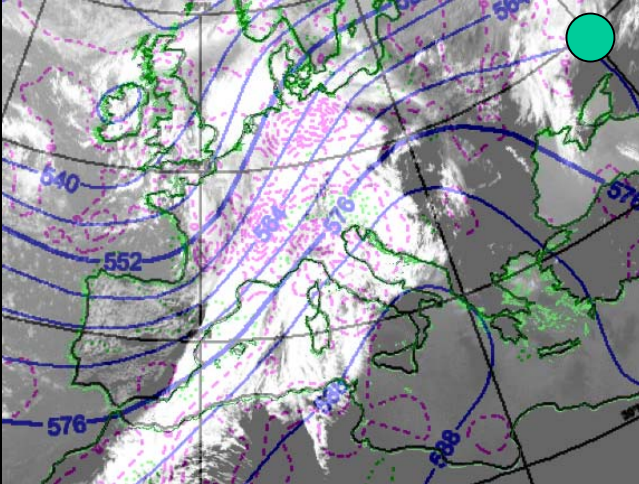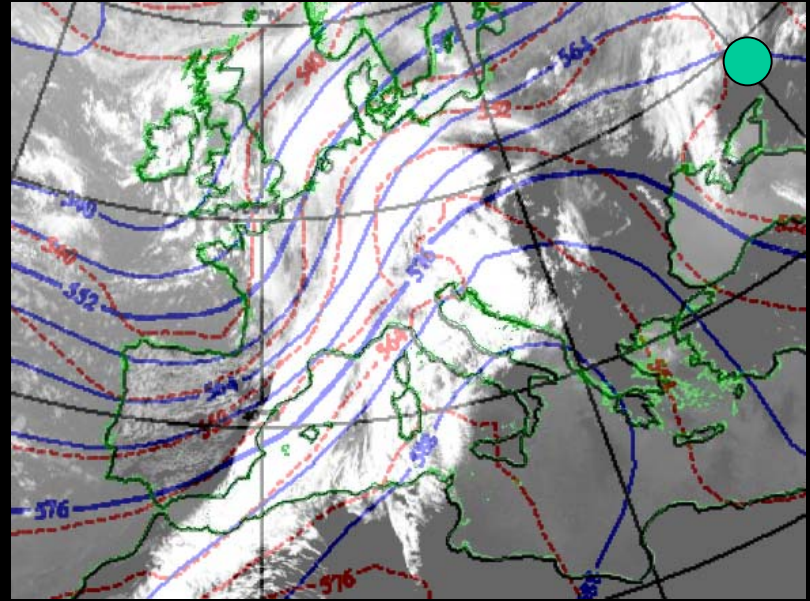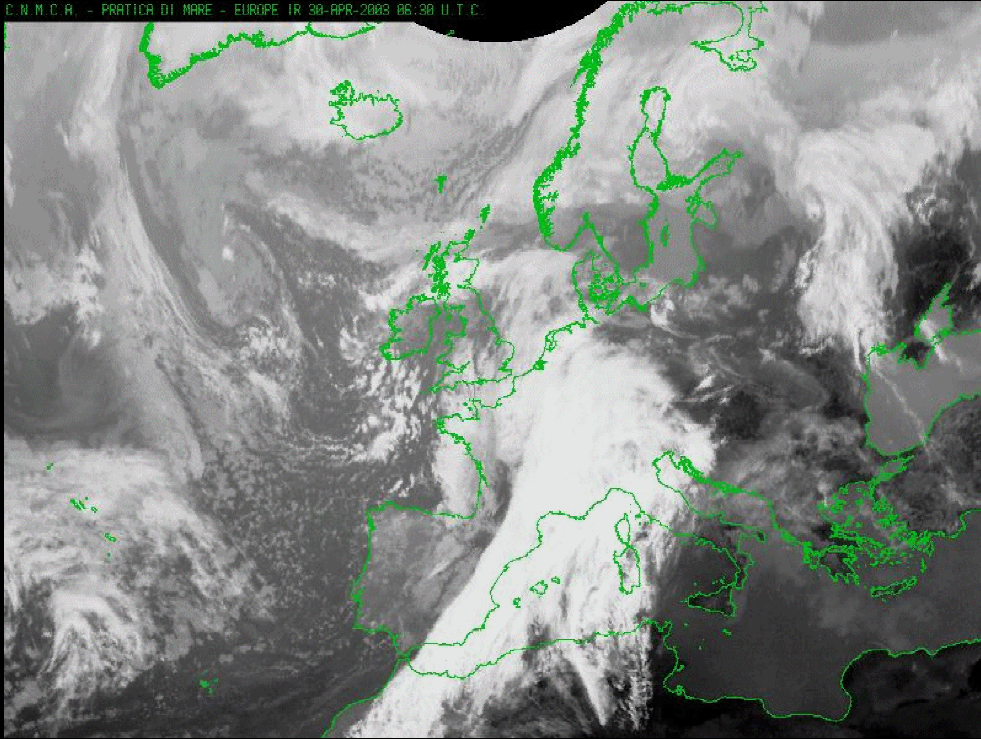
| Phenomena | Synoptic or meso-synoptic characteristics | Forecast | | |
|---|---|---|---|---|
| | | Medium range | short range | nowcasting |
| **Heavy and persistent precipitations** | V-shaped trough, with a stationary warm conveyor belt | yes | | |
| | Frontal and post-frontal convergence lines<br>Interaction between continental pseudo-cold front and occlusion<br>Frontal system deformation due to topographical interactions ( Topographical S-shape ) | | occasional<br>yes | yes<br>yes |
| **Strong winds** | Deep and rapid cyclone development | | yes | |
| Ssnowfalls over the plain | Interaction between continental pseudo-cold front and occlusion<br>Eddy Vortex from Eastern Europe<br>Warm conveyor belt over cold lake in Valle Padana | very occasional | occasional<br>occasional<br>occasional | yes<br>yes<br>yes |
| **Heavy thunderstorms** | Post-frontal or isolated commas from upper eddy vortexes ( Possible topographical effects ) | | yes | |
| | Frontal and post-frontal convergence lines | | | yes |
| | Heat thunderstorm | | occasional | yes |
| **Squall lines** | Induced over Po Valley by cold front North of the Alps | | occasional | yes |
| **Wide area fog** | Intense anticyclone developing over Italy | | yes | |
| **Heat waves** | Anticiclonic belt | yes | | |
| **Cold spells** | Continental pseudo-cold front | occasional | yes | |
| **Forest Fire** | Anticiclonic subtropical continental air masses currents from Africa ( very hot and dry air in sunny and windly weather conditions ) | yes | | |

**Severe weather types, and related synoptic or meso-synoptic characteristics, routinely diagnosed on the basis of conceptual models to justify numerical model outputs in the decisional process for issuing meteorological alerts**

Snowfall over the plain:

Some Aspects weakening the predicibility of numerical precipitation output loaded by warm conveyor belt over Padania  are:
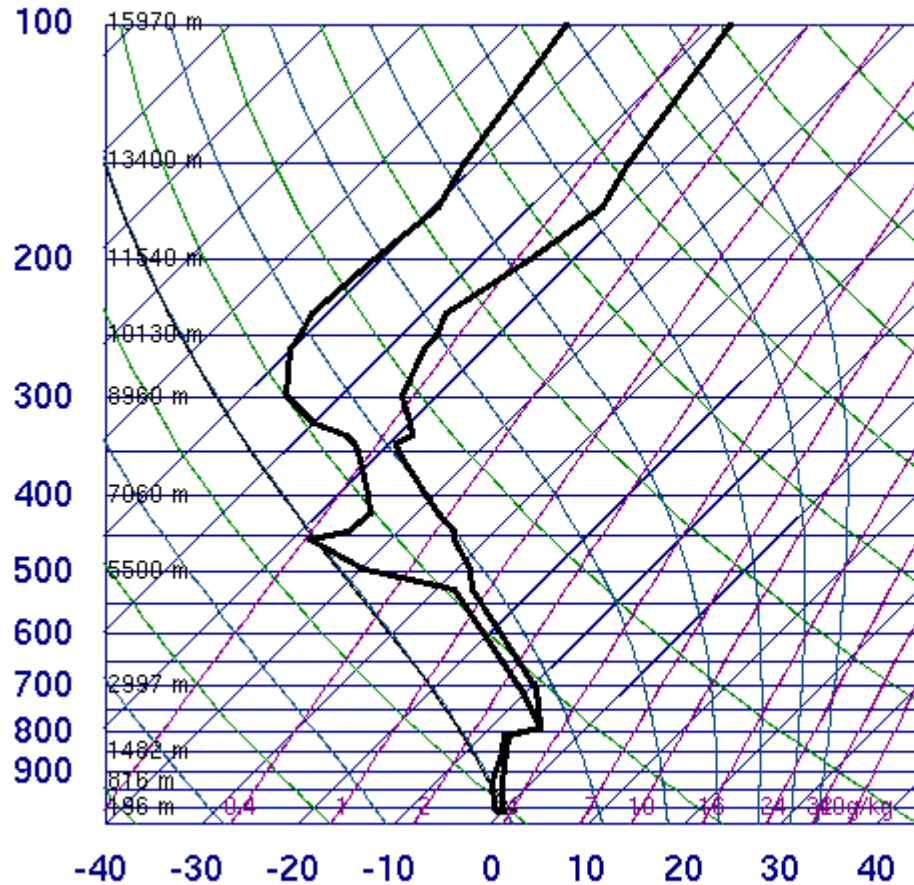
- the lapse rate of the " cold lake"
-  Lapse rate and wind of the warm conveyor belt

**Employment of EPS products:**
**2 meters temperature EPS Extreme Forecast Index**

16080 LIML Milano

00Z 18 Jan 2001

| | |
|---|---|
| SLAT | 45.43 |
| SLON | 9.28 |
| SELV | 103.0 |
| SHOW | 9.33 |
| LIFT | 13.44 |
| LFTV | 13.45 |
| SWET | 75.76 |
| KINX | 14.70 |
| CTOT | 22.10 |
| VTOT | 22.40 |
| TOTL | 44.50 |
| CAPE | 0.00 |
| CAPV | 0.00 |
| CINS | 0.00 |
| CINV | 0.00 |
| EQLV | -9999 |
| EQTV | -9999 |
| LFCT | -9999 |
| LFCV | -9999 |
| BRCH | 0.00 |
| BRCV | 0.00 |
| LCLT | 270.9 |
| LCLP | 967.9 |
| MLTH | 273.4 |
| MLMR | 3.37 |
| THCK | 5304. |
| PWAT | 12.49 |

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| Phenomena | Synoptic or meso-synoptic characteristics | Forecast | | |
|---|---|---|---|---|
| | | Medium range | short range | nowcasting |
| **Heavy and persistent precipitations** | V-shaped trough, with a stationary warm conveyor belt<br><br>Frontal and post-frontal convergence lines<br>Interaction between continental pseudo-cold front and occlusion<br>Frontal system deformation due to topographical interactions<br>( Topographical S-shape ) | yes | <br><br><br>occasional<br>yes | <br><br>yes<br>yes |
| **Strong winds** | Deep and rapid cyclone development | | yes | |
| **Ssnowfalls over the plain** | Interaction between continental pseudo-cold front and occlusion<br>Eddy Vortex from Eastern Europe<br>Warm conveyor belt over cold lake in Valle Padana | <br><br>very occasional | occasional<br>occasional<br>occasional | yes<br>yes<br>yes |
| **Heavy thunderstorms** | Post-frontal or isolated commas from upper eddy vortexes<br>( Possible topographical effects )<br><br>Frontal and post-frontal convergence lines<br><br><br>Heat thunderstorm | | yes<br><br><br><br><br><br>occasional | <br><br><br>yes<br><br><br>yes |
| **Squall lines** | Induced over Po Valley by cold front  North of the Alps | | occasional | yes |
| **Wide area fog** | Intense anticyclone developing over Italy | | yes | |
| **Heat waves** | Anticiclonic belt | yes | | |
| **Cold spells** | Continental pseudo-cold front | occasional | yes | |
| **Forest Fire** | Anticiclonic subtropical continental air masses currents from Africa<br>( very hot and dry air in sunny and windly weather conditions ) | yes | | |

**Severe weather types, and related synoptic or meso-synoptic characteristics, routinely diagnosed on the basis of conceptual models to justify numerical model outputs in the decisional process for issuing meteorological alerts**

# Heat waves

- **Heat waves represent one of few events with high social impact, wich have good predicibility**
- **synoptic configuration: an intense anticiclonic area deriving by subtropical belt extending to the north**

# Some aspects concerning Heat Waves Forecast

- **High predicibility in Summer and late Spring**

- **Predicibility is correlated to the length of the anticiclonic wave**

- **Some problems for duration, depending on the interaction between anticyclone and atlantic troughs**

- **The main feature: geopotential over Mediterraneo more than 5880 mgp**


- **Employment of EPS products:**
- **2 meters temperature EPS Extreme Forecast Index**

# EPS tubes based on 500hPa Z, t+ 96, 0 tubes, domain: 57.5 -15.0 32.5 17.5

Sunday 8 June 2003 12UTC ECMWF EPS Central Cluster FC t+48 VT: Tuesday 10 June 2003 12UTC
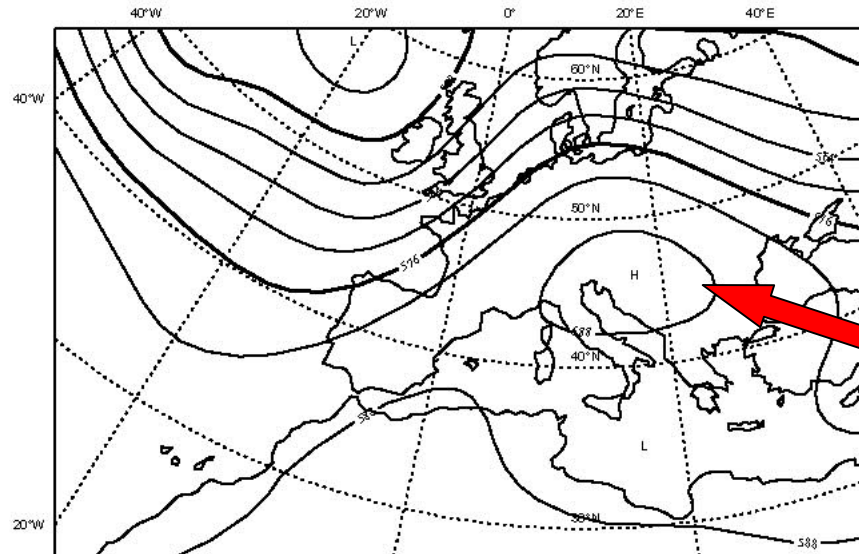500hPa geopotential height - Tube Number 0 (51 members), radius 61m, Ensemble standard deviation 34m
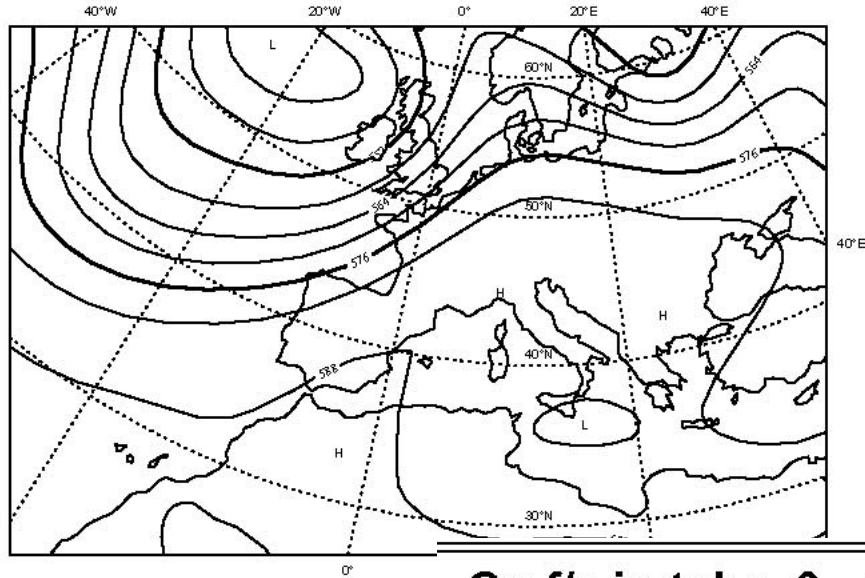
Sunday 8 June 2003 12UTC ECMWF EPS Central Cluster FC t+72 VT: Wednesday 11 June 2003 12UTC
500hPa geopotential height - Tube Number 0 (51 members), radius 61m, Ensemble standard deviation 34m
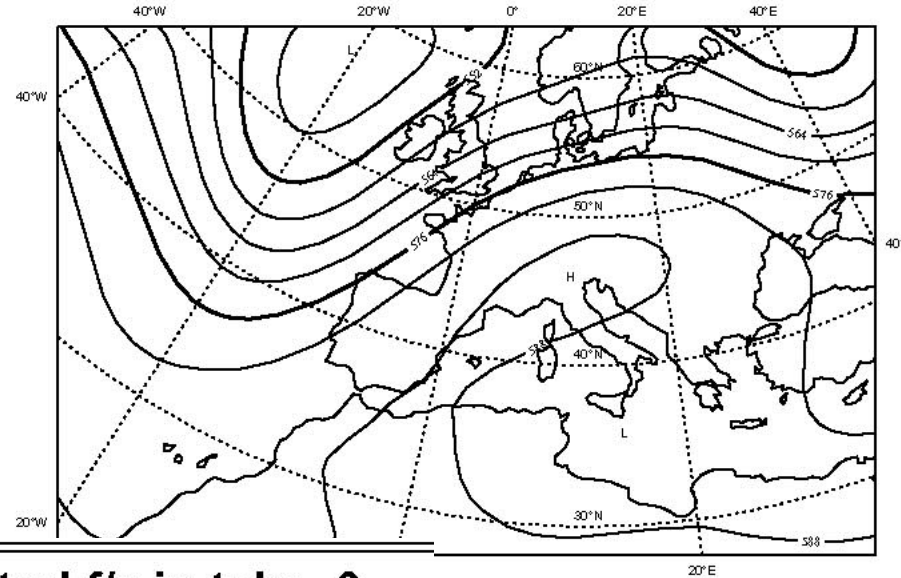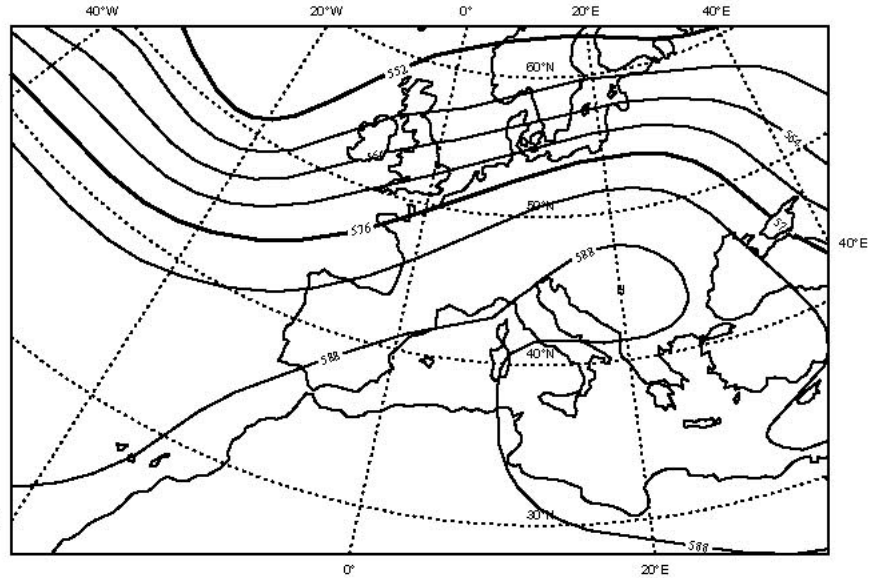
## Op f/c in tube 0, Control f/c in tube 0

Sunday 8 June 2003 12UTC ECMWF EPS Central Cluster FC t+96 VT: Thursday 12 June 2003 12UTC
500hPa geopotential height - Tube Number 0 (51 members), radius 61m, Ensemble standard deviation 34m
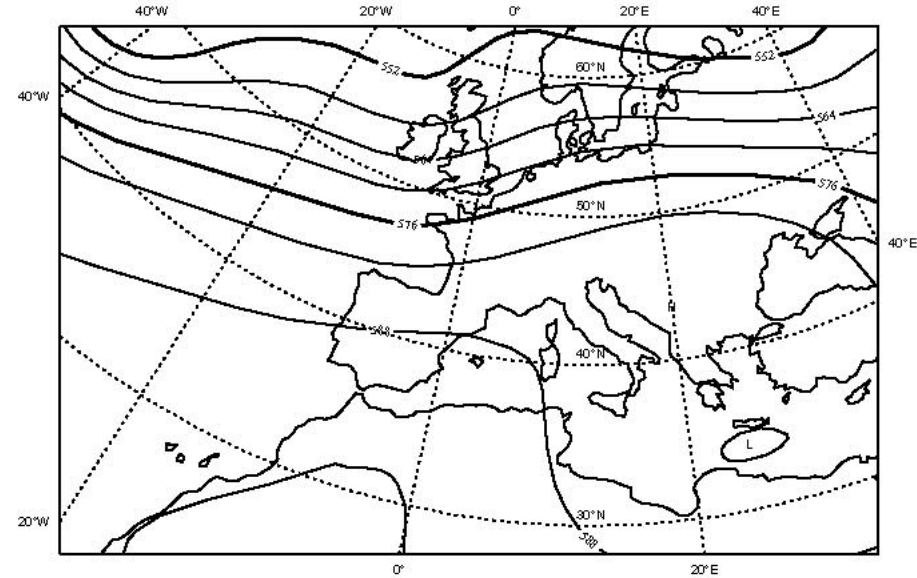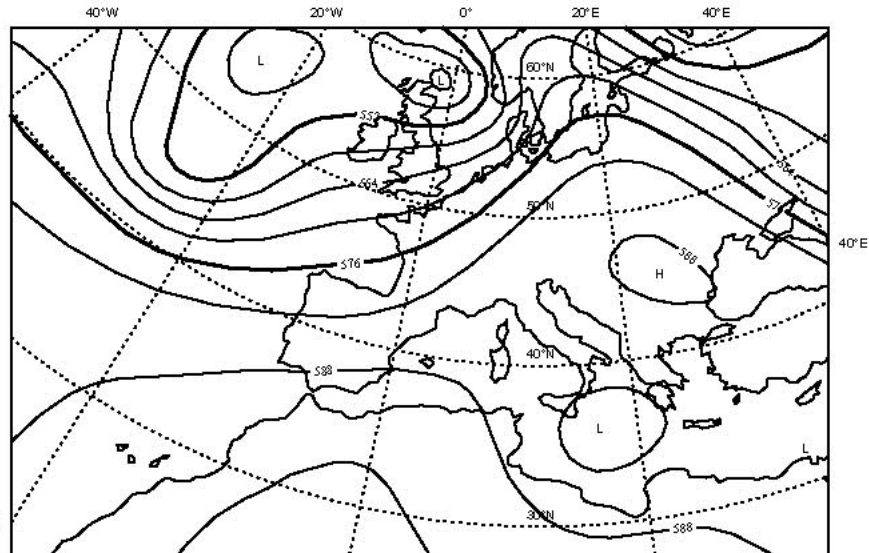
**5880 mgp**

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Sunday 8 June 2003 12UTC ECMWF EPS Central Cluster FC t+120 VT: Friday 13 June 2003 12UTC
500hPa geopotential height - Tube Number 0 (50 members), radius 79m, Ensemble standard deviation 49m
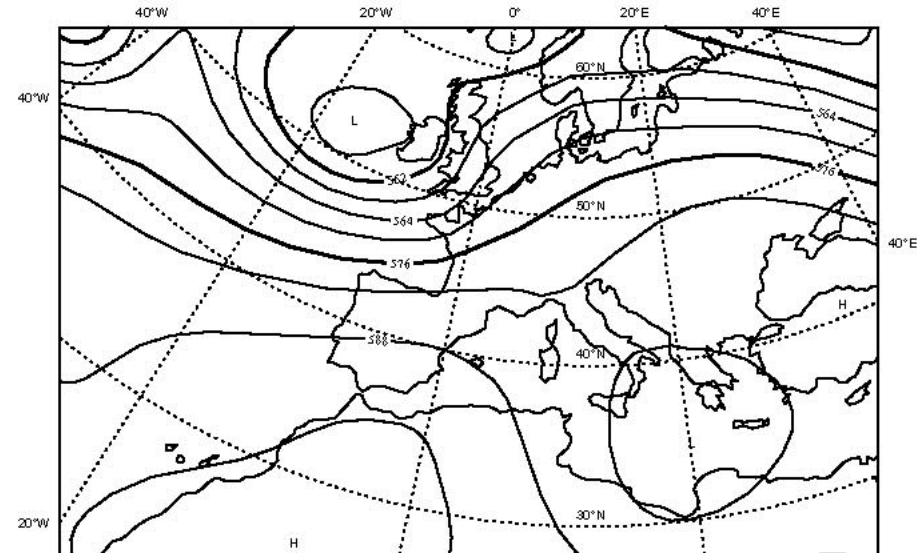
Sunday 8 June 2003 12UTC ECMWF EPS Central Cluster FC t+144 VT: Saturday 14 June 2003 12UTC
500hPa geopotential height - Tube Number 0 (50 members), radius 79m, Ensemble standard deviation 49m

Sunday 8 June 2003 12UTC ECMWF EPS Tube FC t+120 VT: Friday 13 June 2003 12UTC
500hPa geopotential height - Tube Number 1 (1 members) of 1 - Extreme EPS member number 2 at 81m from Ensemble mean

Sunday 8 June 2003 12UTC ECMWF EPS Tube FC t+144 VT: Saturday 14 June 2003 12UTC
500hPa geopotential height - Tube Number 1 (1 members) of 1 - Extreme EPS member number 2 at 81m from Ensemble mean

Sunday 8 June 2003 12UTC ECMWF EPS Central Cluster FC t+168 VT: Sunday 15 June 2003 12UTC
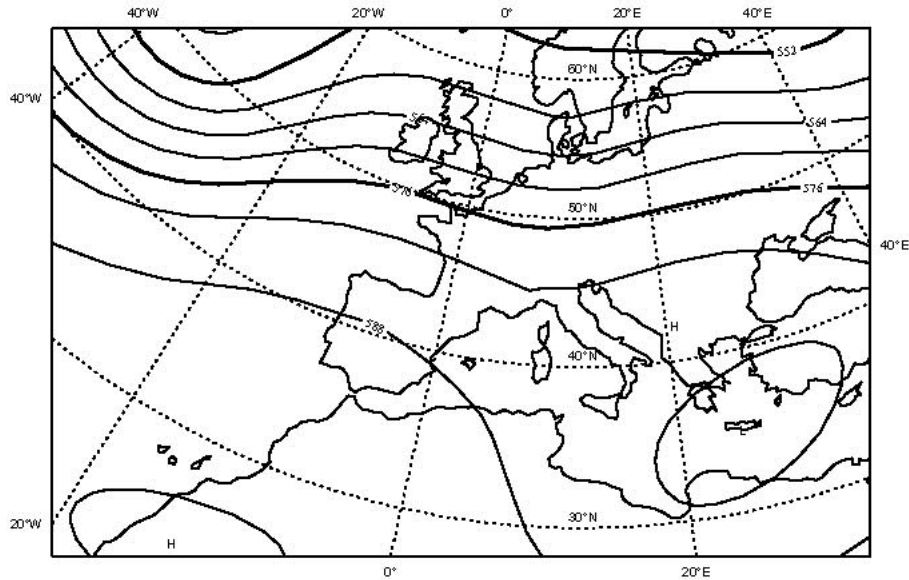500hPa geopotential height - Tube Number 0 (50 members), radius 79m, Ensemble standard deviation 49m



Sunday 8 June 2003 12UTC ECMWF EPS Tube FC t+168 VT: Sunday 15 June 2003 12UTC
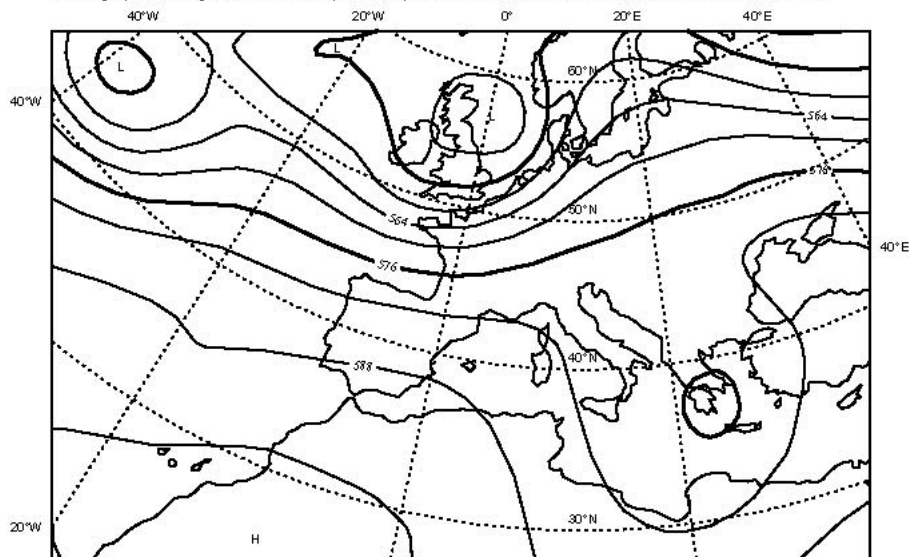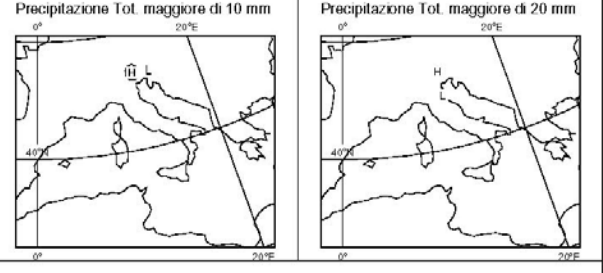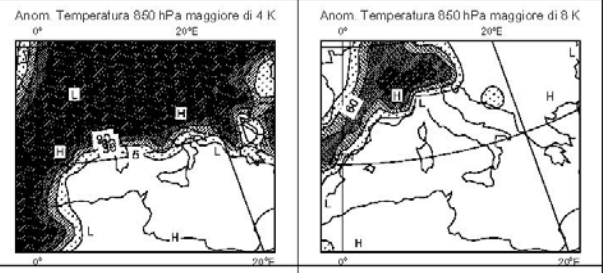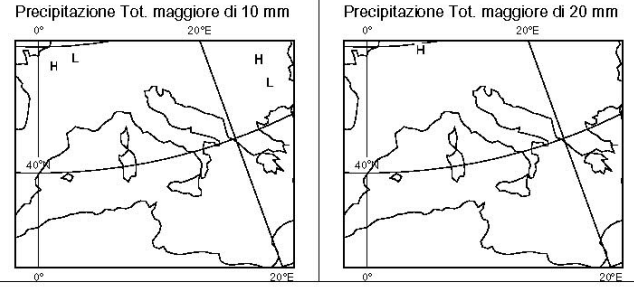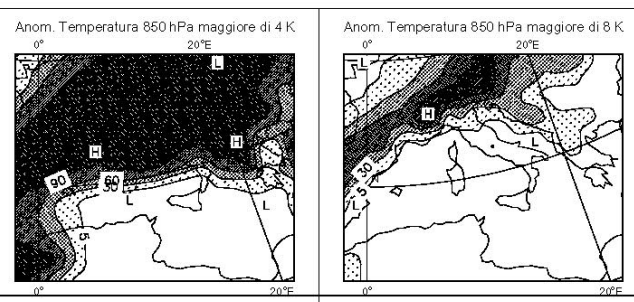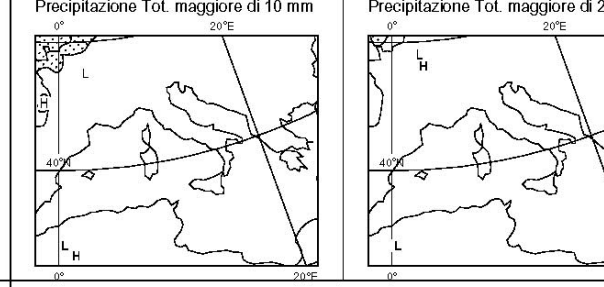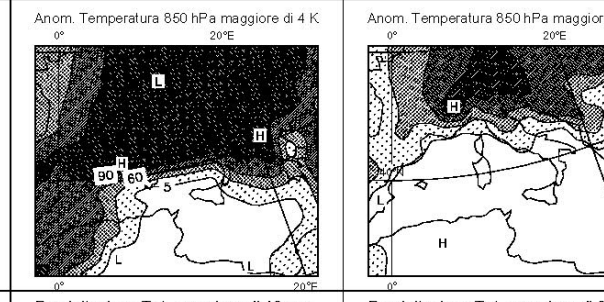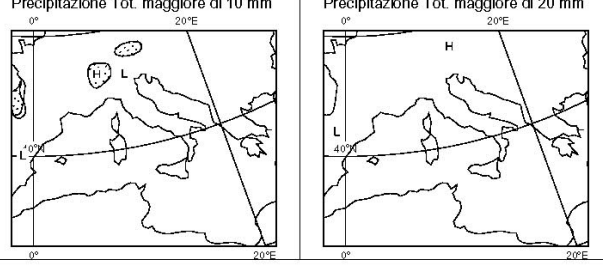500hPa geopotential height - Tube Number 1 (1 members) of 1 - Extreme EPS member number 2 at 81m from Ensemble mean
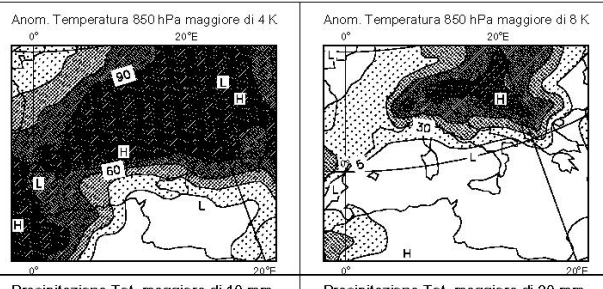


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**Panel 1 (top-left):**

Anom. Temperatura 850 hPa maggiore di 4 K

Anom. Temperatura 850 hPa maggiore di 8 K

Precipitazione Tot. maggiore di 10 mm

Precipitazione Tot. maggiore di 20 mm

Domenica   8 Giugno 1903 12z ECMWF Forecast t+ 48  VT: Martedi 10 Giugno 1903 12z
EPS - PREVISIONI PROBABILISTICHE
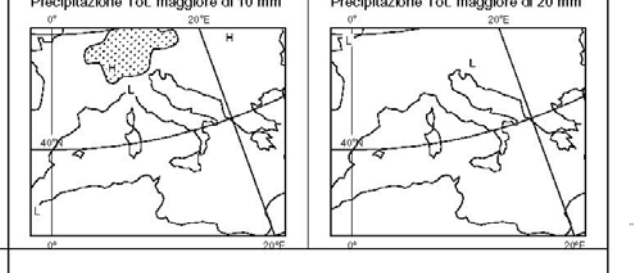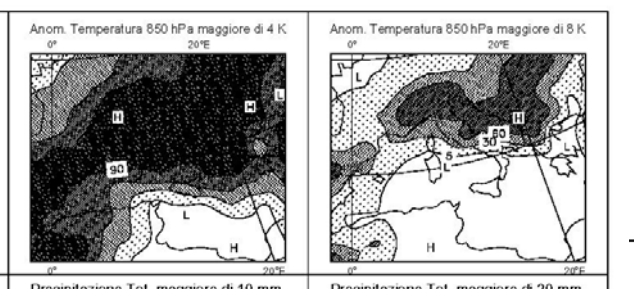LIVELLI DI PROBABILITA : 5% 30% 60% 90%

**Panel 2 (top-middle):**

Anom. Temperatura 850 hPa maggiore di 4 K

Anom. Temperatura 850 hPa maggiore di 8 K

Precipitazione Tot. maggiore di 10 mm

Precipitazione Tot. maggiore di 20 mm

Domenica   8 Giugno 1903 12z ECMWF Forecast t+ 72  VT: Mercoledi   11 Giugno 1903 12z
EPS - PREVISIONI PROBABILISTICHE
LIVELLI DI PROBABILITA : 5% 30% 60% 90%

**Panel 3 (top-right):**

Anom. Temperatura 850 hPa maggiore di 4 K

Anom. Temperatura 850 hPa maggiore di

Precipitazione Tot. maggiore di 10 mm

Precipitazione Tot. maggiore di 2

Domenica   8 Giugno 1903 12z ECMWF Forecast t+ 96  VT: Giovedi   12 Giugno 1
EPS - PREVISIONI PROBABILISTICHE
LIVELLI DI PROBABILITA : 5% 30% 60% 90%

**Panel 4 (bottom-left):**

Anom. Temperatura 850 hPa maggiore di 4 K

Anom. Temperatura 850 hPa maggiore di 8 K

Precipitazione Tot. maggiore di 10 mm

Precipitazione Tot. maggiore di 20 mm

Domenica   8 Giugno 1903 12z ECMWF Forecast t+120  VT: Venerdi   13 Giugno 1903 12z
EPS - PREVISIONI PROBABILISTICHE
LIVELLI DI PROBABILITA : 5% 30% 60% 90%

**Panel 5 (bottom-middle):**

Anom. Temperatura 850 hPa maggiore di 4 K

Anom. Temperatura 850 hPa maggiore di 8 K

Precipitazione Tot. maggiore di 10 mm

Precipitazione Tot. maggiore di 20 mm

Domenica   8 Giugno 1903 12z ECMWF Forecast t+144  VT: Sabato  14 Giugno 1903 12z
EPS - PREVISIONI PROBABILISTICHE
LIVELLI DI PROBABILITA : 5% 30% 60% 90%

**Panel 6 (bottom-right):**

Anom. Temperatura 850 hPa maggiore di 4 K

Anom. Temperatura 850 hPa maggiore di 8 K

Precipitazione Tot. maggiore di 10 mm

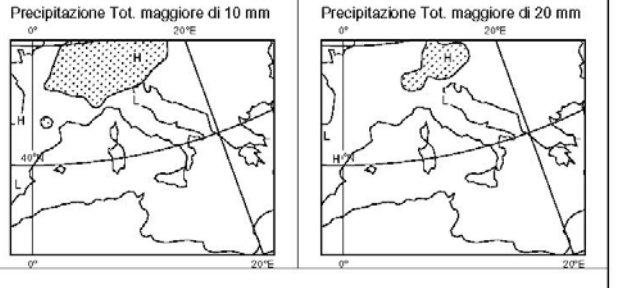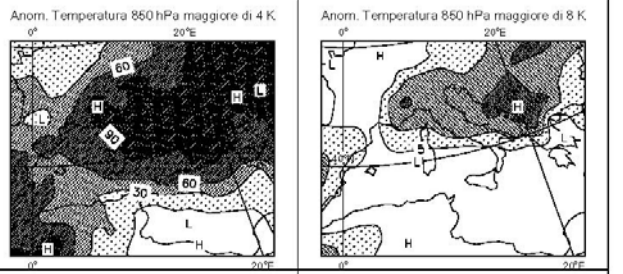Precipitazione Tot. maggiore di 20 mm

Domenica   8 Giugno 1903 12z ECMWF Forecast t+168  VT: Domenica   15 Giugno 1903 12z
EPS - PREVISIONI PROBABILISTICHE
LIVELLI DI PROBABILITA : 5% 30% 60% 90%

| Phenomena | Synoptic or meso-synoptic characteristics | Forecast | | |
|---|---|---|---|---|
| | | Medium range | short range | nowcasting |
| **Heavy and persistent precipitations** | **V-shaped trough, with a stationary warm conveyor belt** | **yes** | | |
| | **Frontal and post-frontal convergence lines**<br>**Interaction between continental pseudo-cold front and occlusion**<br>**Frontal system deformation due to topographical interactions**<br>**( Topographical S-shape )** | | occasional<br>yes | yes<br>yes |
| **Strong winds** | **Deep and rapid cyclone development** | | yes | |
| **Ssnowfalls over the plain** | **Interaction between continental pseudo-cold front and occlusion**<br>**Eddy Vortex from Eastern Europe**<br>**Warm conveyor belt over cold lake in Valle Padana** | **very occasional** | occasional<br>occasional<br>occasional | yes<br>yes<br>yes |
| **Heavy thunderstorms** | **Post-frontal or isolated commas from upper eddy vortexes**<br>**( Possible topographical effects )**<br><br>**Frontal and post-frontal convergence lines**<br><br>**Heat thunderstorm** | | yes<br><br><br><br>occasional | <br><br>yes<br><br>yes |
| **Squall lines** | **Induced over Po Valley by cold front North of the Alps** | | occasional | yes |
| **Wide area fog** | **Intense anticyclone developing over Italy** | | yes | |
| **Heat waves** | **Anticiclonic belt** | **yes** | | |
| **Cold spells** | **Continental pseudo-cold front** | **occasional** | yes | |
| **Forest Fire** | **Anticiclonic subtropical continental air masses currents from Africa**<br>**( very hot and dry air in sunny and windly weather conditions )** | **yes** | | |

Severe weather types, and related synoptic or meso-synoptic characteristics, routinely diagnosed on the basis of conceptual models to justify numerical model outputs in the decisional process for issuing meteorological alerts

# Cold spells

- **High predicibility in winter, low in Autumn and Spring**

- **Employment of EPS products:**

- **2 meters temperature EPS Extreme Forecast Index**

| Phenomena | Synoptic or meso-synoptic characteristics | Forecast | | |
|---|---|---|---|---|
| | | Medium range | short range | nowcasting |
| Heavy and persistent precipitations | V-shaped trough, with a stationary warm conveyor belt | yes | | |
| | Frontal and post-frontal convergence lines | | | yes |
| | Interaction between continental pseudo-cold front and occlusion | | occasional | yes |
| | Frontal system deformation due to topographical interactions ( Topographical S-shape ) | | yes | |
| Strong winds | Deep and rapid cyclone development | | yes | |
| Ssnowfalls over the plain | Interaction between continental pseudo-cold front and occlusion | | occasional | yes |
| | Eddy Vortex from Eastern Europe | | occasional | yes |
| | Warm conveyor belt over cold lake in Valle Padana | very occasional | occasional | yes |
| Heavy thunderstorms | Post-frontal or isolated commas from upper eddy vortexes ( Possible topographical effects ) | | yes | |
| | Frontal and post-frontal convergence lines | | | yes |
| | Heat thunderstorm | | occasional | yes |
| Squall lines | Induced over Po Valley by cold front  North of the Alps | | occasional | yes |
| Wide area fog | Intense anticyclone developing over Italy | | yes | |
| Heat waves | Anticiclonic belt | yes | | |
| Cold spells | Continental pseudo-cold front | occasional | yes | |
| Forest Fire | Anticiclonic subtropical continental air masses currents from Africa ( very hot and dry air in sunny and windly weather conditions ) | yes | | |

**Severe weather types, and related synoptic or meso-synoptic characteristics, routinely diagnosed on the basis of conceptual models to justify numerical model outputs in the decisional process for issuing meteorological alerts**

# Forest Fires

- **Favorable weather conditions: very hot and dry air in sunny and windly weather conditions**
- **Typical synoptic configuration: upwind area of stationary anticiclonic area in eastern part of mediteranean basin**
- **Employment of EPS products:**
- **2 meters temperature EPS Extreme Forecast Index**
- **10 m Wind Speed EPS Extreme Forecast Index**

# Conclusions

- At the moment, only few types of severe weather in medium-range

- It depends mainly on the frequent development of transients in mediterranean area, which weaken reliability of the model

- Large use of EPS products and EFI. The forecaster recognizes the conceptual model, the reliability of operative has to be confirmed with EPS products and finally with EFI

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