Previsione e monitoraggio dell'alluvione del Piemonte 1994 con i prodotti di informazione di ECMWF-2019

Forecasting and Monitoring of Piedmont 1994 Flood (PF94)

A 25 anni dall'alluvione del Piemonte del 1994

I progressi fatti nella previsione degli eventi estremi e quanto resta ancora da fare

6 novembre 2019

Aula magna DISIT, ore 9.30

Alessandria, V.le T. Michel 11

Coordinamento scientifico: **Prof. Enrico Ferrero**

Dipartimento di Scienze e innovazione tecnologica, UPO

Interventi:

Dino Zardi (AISAM e Università di Trento) *La meteorologia in Italia: oggi situazione, opportunità e prospettive*; **Renata Pelosini** (ARPA Piemonte), *L'inquadramento dal punto di vista meteorologico dell'evento alluvionale*; **Fabio Luino** (IRPI – CNR), *L'evento alluvionale del 5-6 novembre 1994: luogo, il bacino del Tanaro*; **Carlo Cacciamani** (Dipartimento della Protezione Civile), *Il sistema di allertamento: come per gli eventi alluvionali*; **Francesco Della Corte** (CRIMEDIM, UPO), *Le conseguenze di interesse sanitario negli eventi alluvionali*; **Gianpaolo Balsamo** (ECMWF), *Progressi nelle previsioni meteorologiche alla scala globale e prospettive future*; **Federico Grazzini** (Meteorological Institute, München/ Arpae Bologna), *Classificazione degli eventi di precipitazione estrema: sette-otto-nove, la precursoria grande scala*; **Giorgio Melchioni** (Coordinamento Protezione Civile Provincia di Alessandria), *Il volontariato della Protezione Civile di Alessandria*.

Confronto tra le simulazioni dell'evento alluvionale fatte con i modelli odierni e quelle fatte con i modelli di allora. Presiede **Roberto Buizza** (Scuola Universitaria Superiore Sant'Anna di Pisa); **Massimo Milelli** (ARPA Piemonte), *Il modellistica ad area limitata: la Luna: COSMO*; **Silvio Davolio** (ISAC-CNR), *La modellistica previsionale del CNR*; **Antonio Parodi** (Fondazione CIMA), *La modellistica meteo-idrologica previsionale di Fondazione CIMA*; **Valerio Capecchi** (Consorzio LAMMA), *La modellistica previsionale del LAMMA*; **Riccardo Bonanno** (RSE), *Il dataset di reanalisi meteorologica MERIDA (Meteorological Reanalysis Italian DAtaset)*; **Gianpaolo Balsamo** (ECMWF), *Previsione ensemble e monitoraggio dell'alluvione del Piemonte 1994 con i prodotti di informazione di ECMWF-2019*; **Claudio Cassardo** (Università di Torino), *La modellistica previsionale del Dipartimento di Fisica*; **Stefano Alessandrini** (NCAR), *Simulazioni meteorologiche ad alta risoluzione dell'alluvione del 1994*.

Gianpaolo Balsamo, partecipazione al Convegno UPO 6-Novembre 2019

Climate Change Service
climate.copernicus.eu

ERA5 has now replaced ERA-Interim Climate Reanalysis

ERA-Interim not available for dates beyond **August 2019**

Migration to ERA5 completed for most variables.

Skill of ERA5 re-forecasts:

Up to one day gain with respect to ERA-Interim

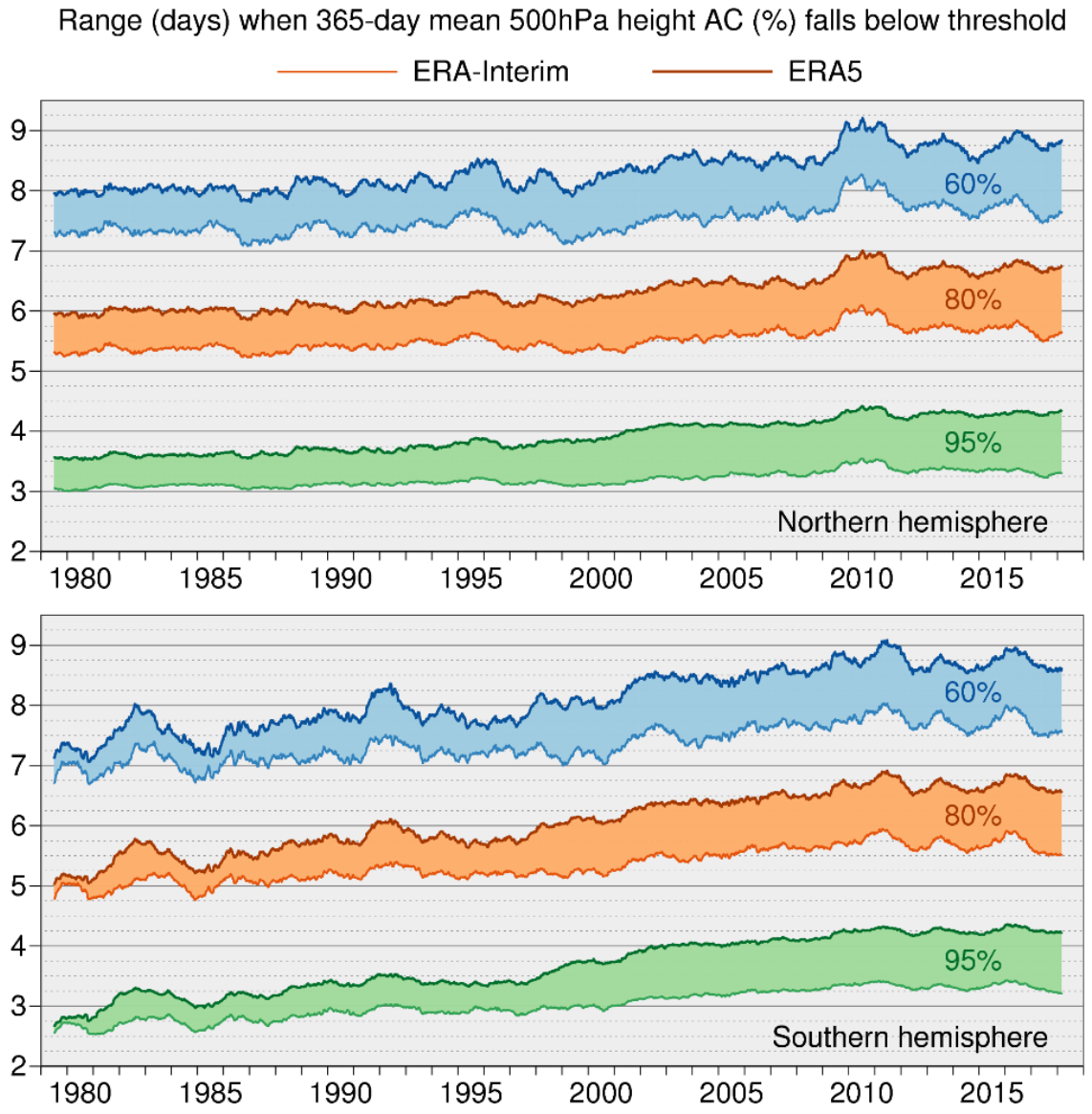
Improvements compared to ERA-Interim:

- Benefit from 10 years model development (2006 to 2016)
- Much higher resolution; **31km** versus 80km
- More and better input data
- **Hourly output**
- 10-member EDA-based **uncertainty estimate** (at 63km)

ERA5 is available in the C3S climate data store (CDS):

Currently: **1979 onwards**, 2-3 months behind real time

By end 2019: **timely updates**, ERA5T, 2-5 days latency



ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

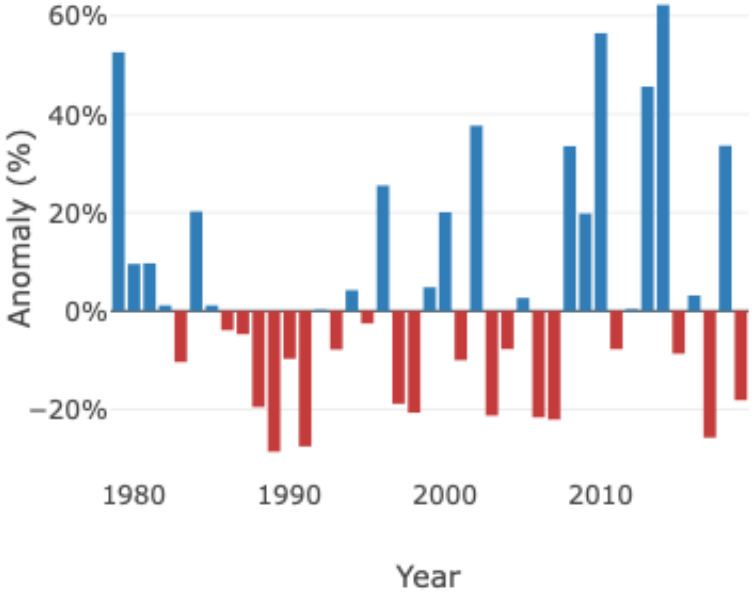
Alessandria climate from the Copernicus Climate Data Store (ERA5-based)

Climate Change Service
climate.copernicus.eu

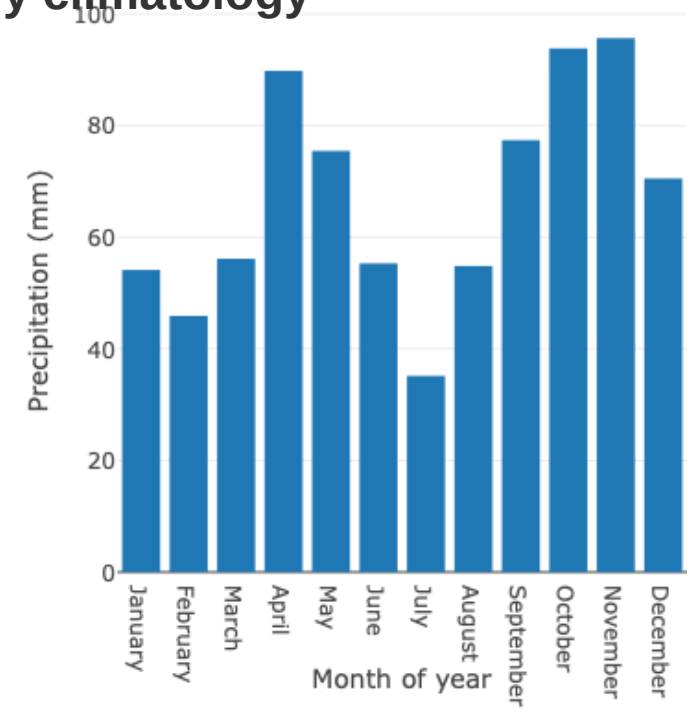
+1.2 °C in 2018

Warming stripes for Alessandria (1979-2018)

Annual precipitation anomaly for Alessandria (1979-2018) and average monthly climatology



The **1981-2010** is used as reference period. The climate-change signal is **1.2 °C in 2018**. The average annual total precipitation in Alessandria is **804** mm. Monthly average precipitation totals ranged from **35** mm (July) to **96** mm (November).
The plot on the left shows the **precipitation anomaly** for each year in the 1979-2018 period, or how much more (blue) or less (red)



Monitoring PF94

Reanalysis	Provider	Modelling	Analysis
ERA5 (31 km)	Copernicus C3S	ECMWF IFS 41r2	ECMWF IFS 41r2
ERA-Interim (80 km)	Copernicus C3S	ECMWF IFS 31r2	ECMWF IFS 31r2
UERRA (11km)	Copernicus C3S	HARMONIE/V1	HARMONIE/V1
MERIDA (7 km)	RSE	WRF	ERA5-Downscale

https://cds.climate.copernicus.eu/

Forecasting PF94 – Dedicated Experiments

Experiment Id (for MARS retrieval)	User Id	Dates
3738 (Analysis and Forecasts experiments) at TL1279 (18km IFS as operational in June 2016)	eras	https://apps.ecmwf.int/mars-catalogue/?stream=oper&levtype=sfc&expver=3738&month=oct&year=1994&type=an&class=ea https://apps.ecmwf.int/mars-catalogue/?stream=oper&levtype=sfc&expver=3738&month=oct&year=1994&type=fc&class=ea
h6bg (Forecast HRES 45r1)	pad	Experiment submitted to assess the 45r1 quality in reproducing the PF94 (one month forecast to evaluate scored w.r.t. ERA5). Contacts:Linus Magnusson and Gianpaolo Balsamo https://apps.ecmwf.int/mars-catalogue/?levtype=sfc&type=fc&class=rd&stream=oper&expver=h6bg
h9xi (Forecast HRES 46r1)	dag	Experiment (with Oper Output) submitted to assess the 46r1 quality in reproducing the PF94 https://apps.ecmwf.int/mars-catalogue/?levtype=sfc&type=fc&class=rd&stream=oper&expver=h9xi
h9zy (Forecast HRES 46r1) 3-4-5-6 November 1994	dag	Experiment (with Oper Output) submitted to assess the 46r1 quality in reproducing the PF94 https://apps.ecmwf.int/mars-catalogue/?stream=oper&levtype=sfc&expver=h9zy&date=1994-11-03&type=fc&class=rd
ha6i (Forecast ENS 46r1)	diad	Ensemble forecast initialised from ERA5 on 1994-11-03 00Z https://apps.ecmwf.int/mars-catalogue/?stream=enfo&expver=ha6i&date=1994-11-03&class=rd

https://confluence.ecmwf.int/display/~pad/Piedmont+flood+1994+25-year+later

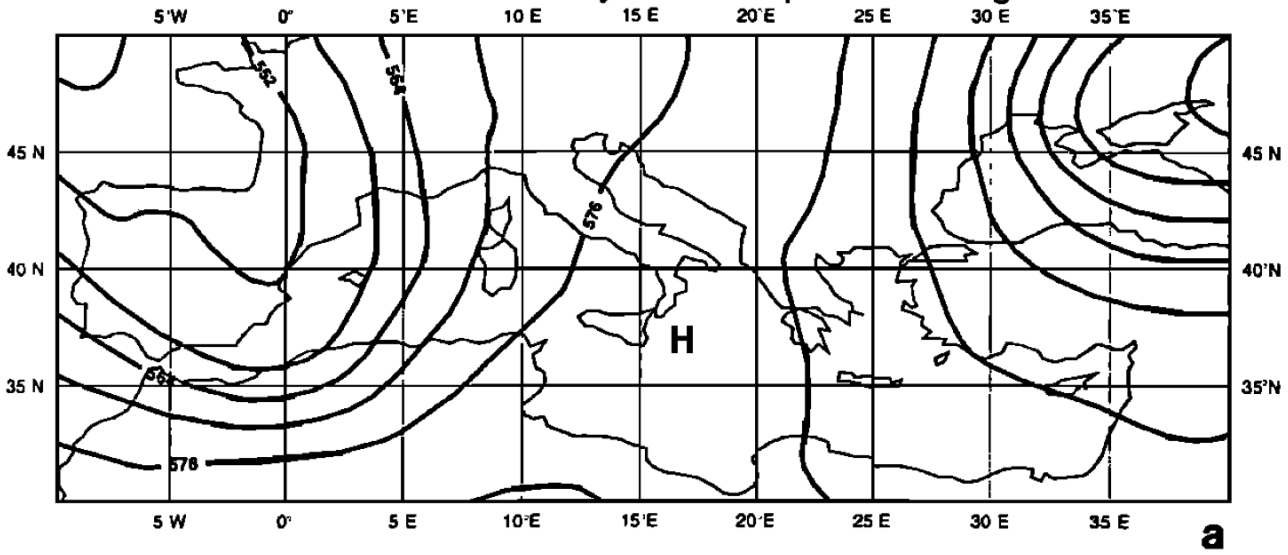
ECMWF

Forecasting PF94 – Operational in 1994

In 1994 the operational forecasts was HRES T213L31 about 100km resolution (Petroliagis et al. 1996) with Ensemble at T63L19 at about 300km…with perspectives to run EPS at T106L31 at 200km resolution.

PETROLIAGIS ET AL.: ENSEMBLE PREDICTION OF RAINFALL

5 November 1994 12 UTC - Analysis of Geopotential Height 500 hPa



ECMWF

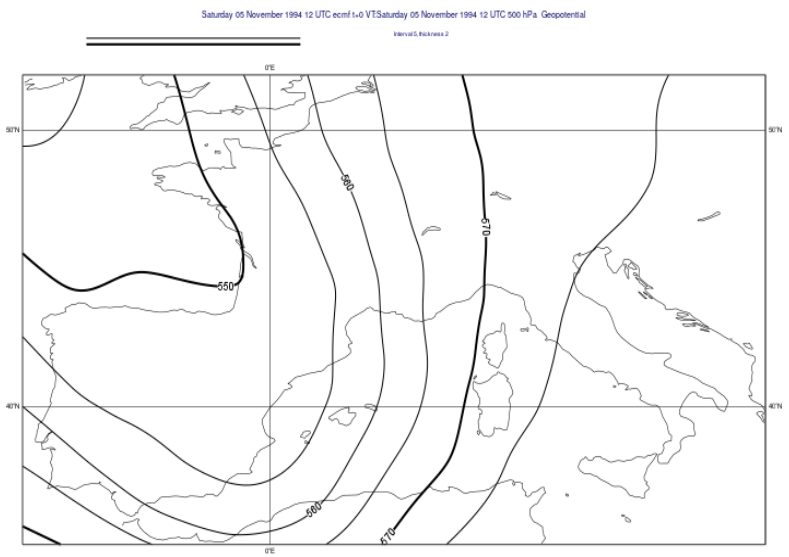
ECMWF nel 1994 (100km)
ERA-Interim (80km)
ERA5 (31km)
ECMWF nel 2019 (9km)



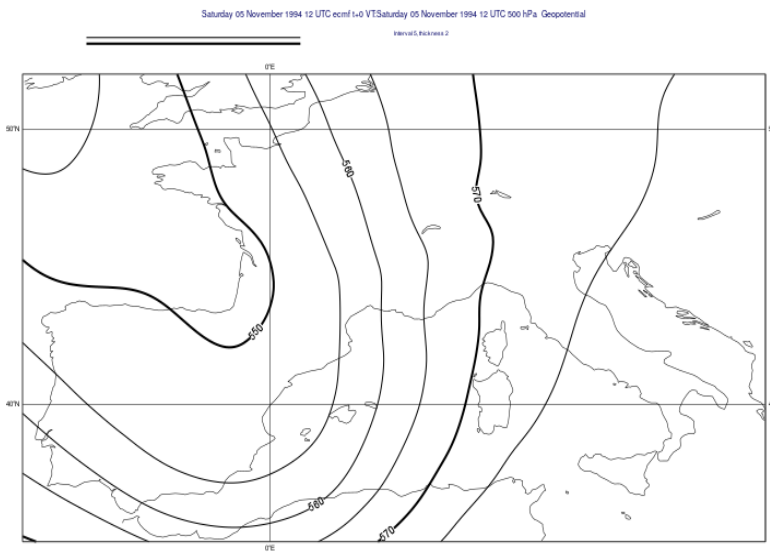



Geopotential Z500 (m) on Saturday 5th November 1994

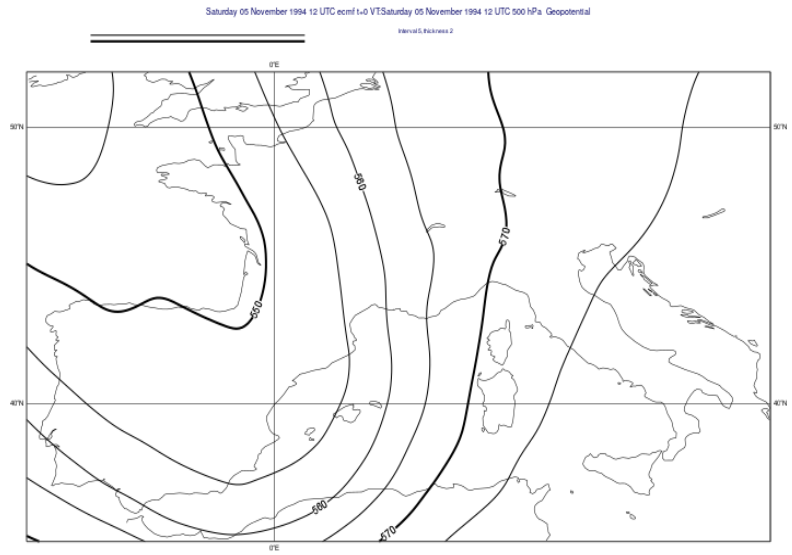
Oper T213L31 100km FC+60-hour



ERA-Interim T255L62 80km



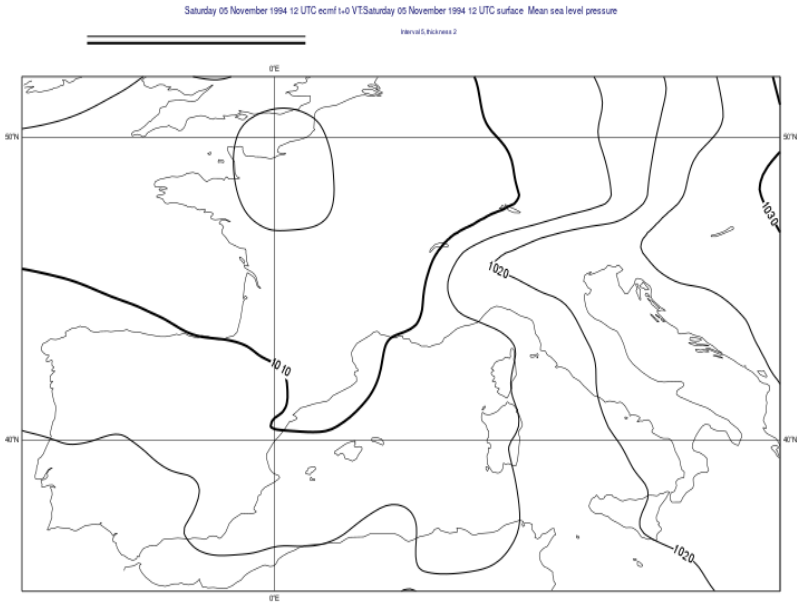
ERA5 T634L91 31km



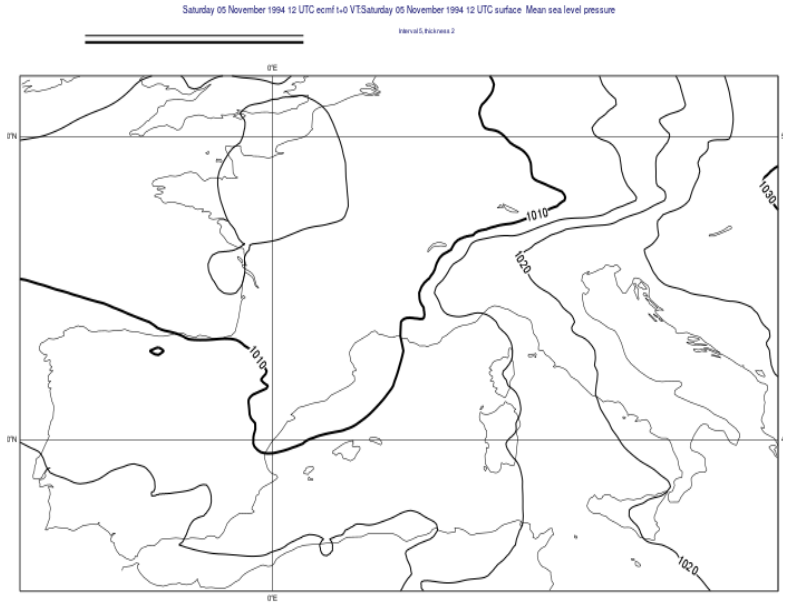
ECMWF

Mean Sea-Level Pressure (hPa) on Saturday 5th November 1994

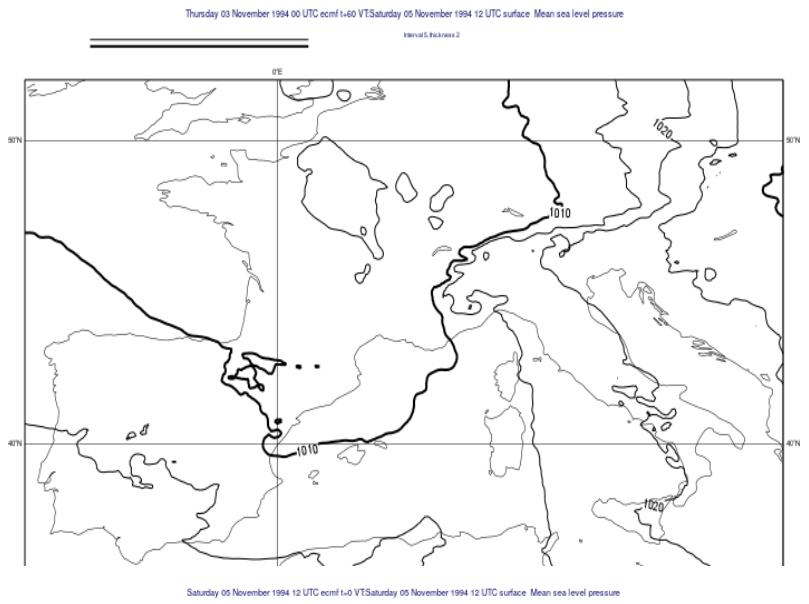
ERA-Interim T255L62 80km

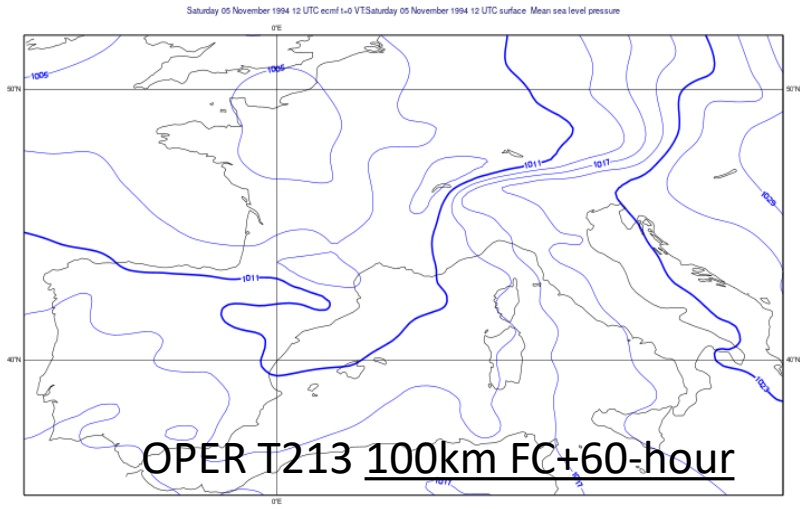


ERA5 T634L91 31km



RD TCo1279 9km FC+60-hour



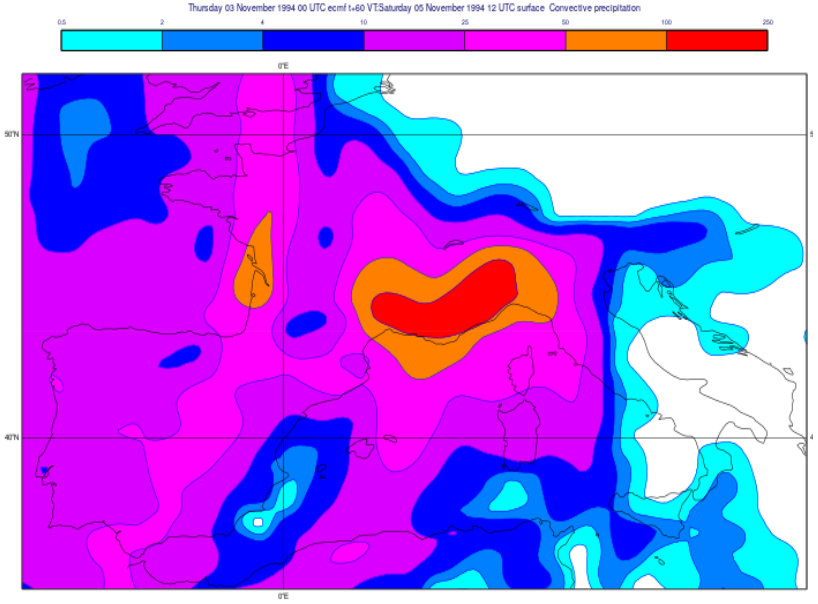


OPER T213 100km FC+60-hour

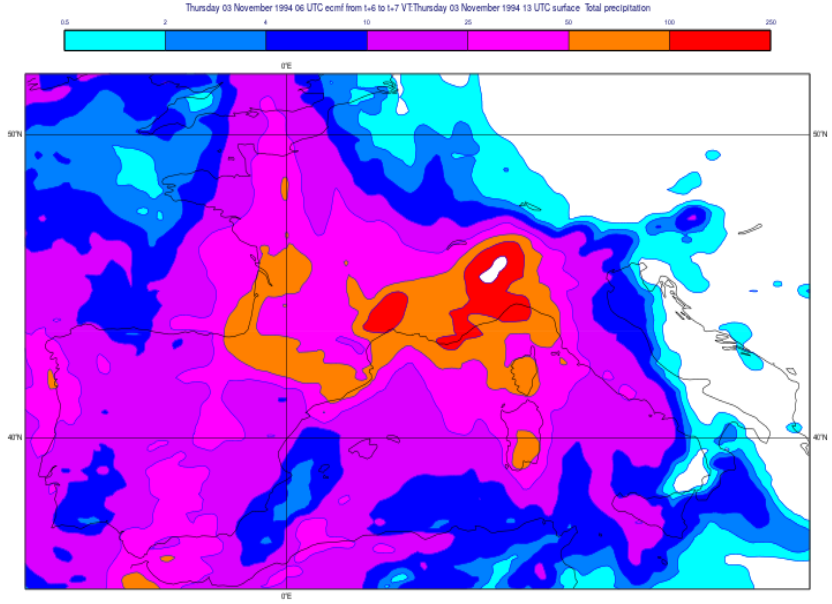
ECMWF

Total Precipitation (mm) on Saturday 5th November 1994

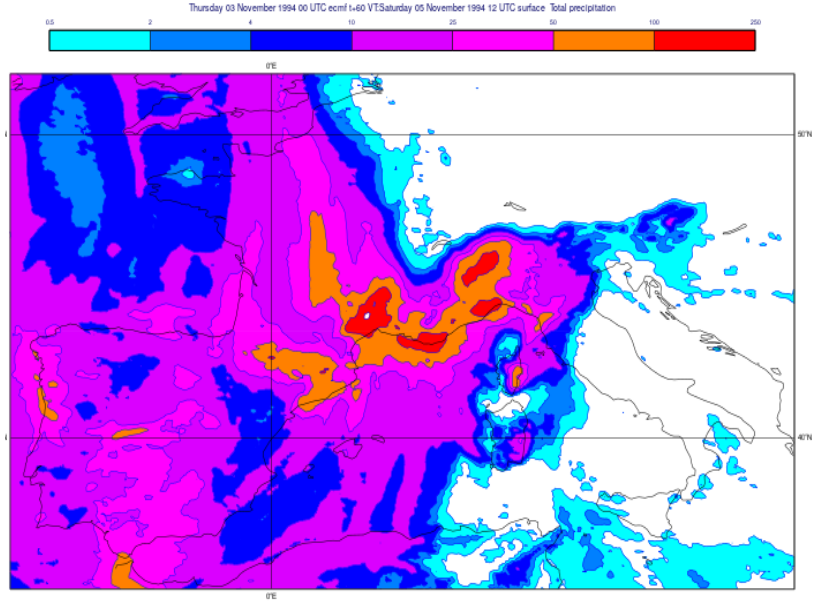
ERA-Interim T255L62 80km

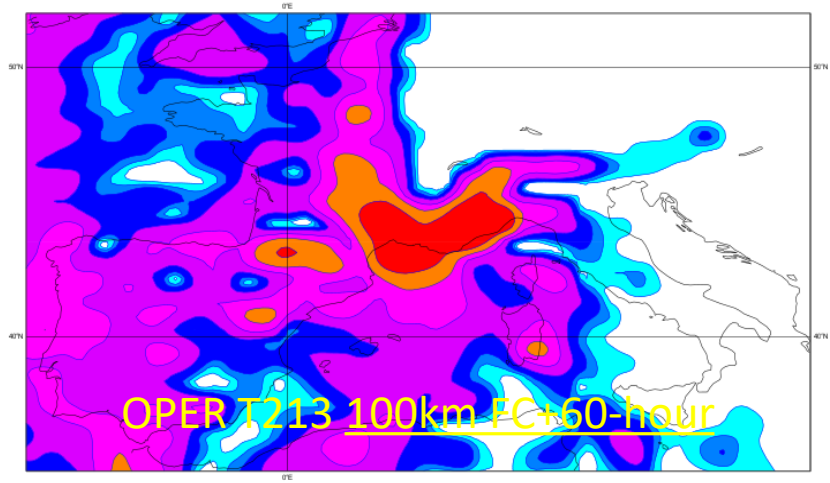


ERA5 T634L91 31km



RD T1279 9km



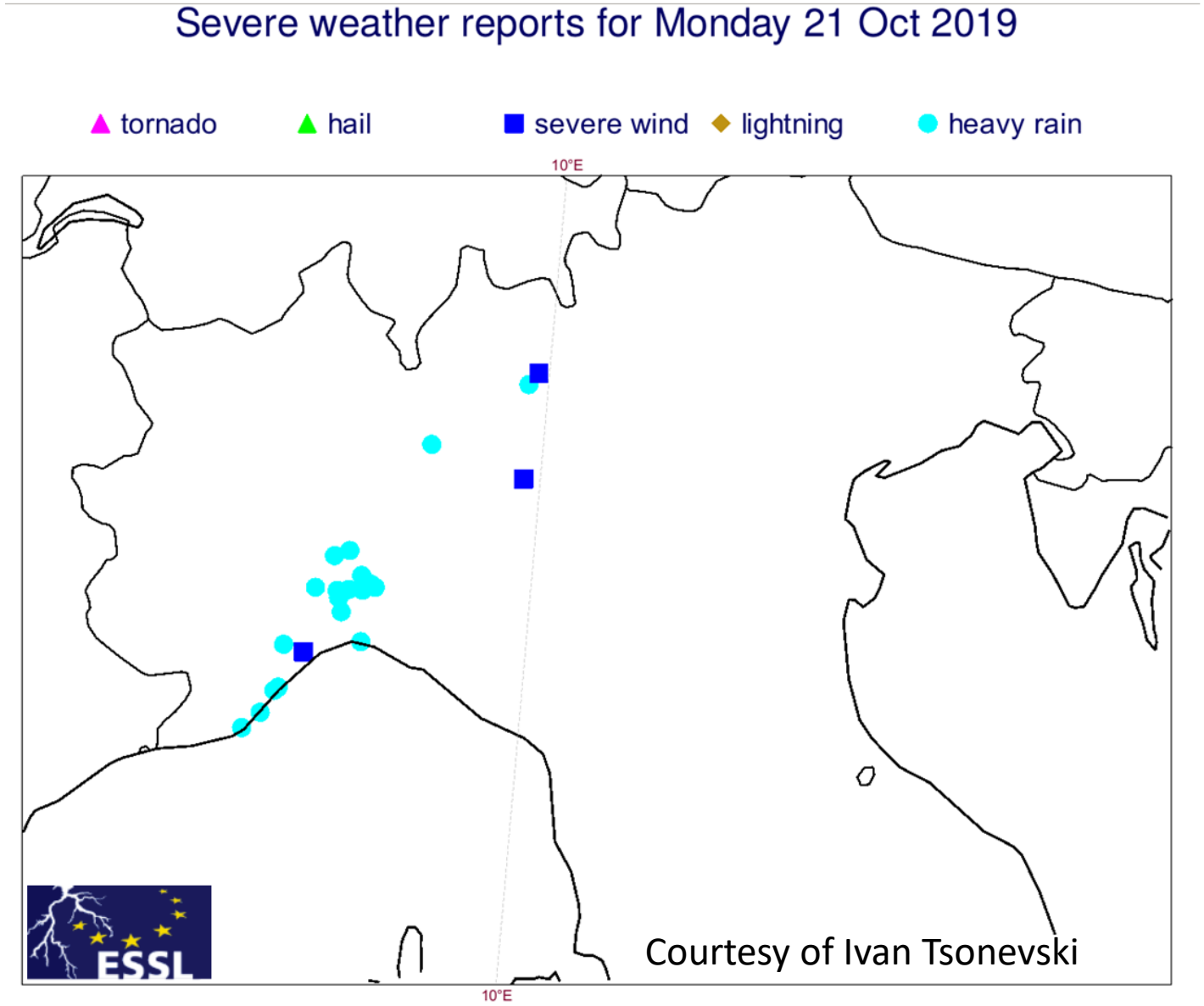


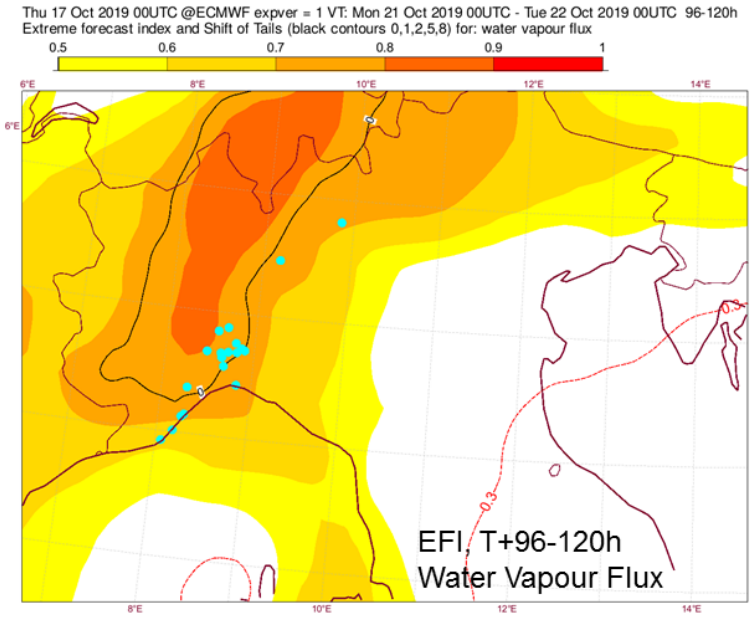
The plot on the left shows the **precipitation cumulated** for in **60-hour** from 3rd of November 00 to 5th of November 12 UTC

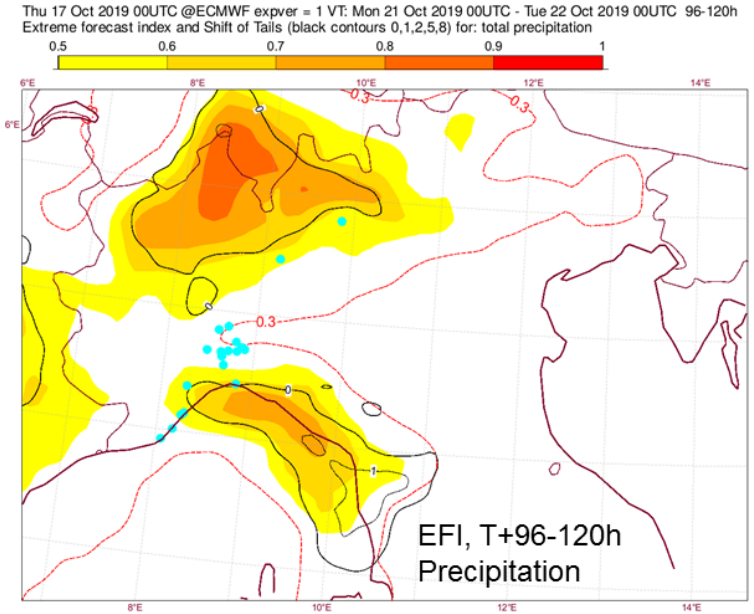
ECMWF

Alluvione Ottobre 2019

The event of 21st October 2019







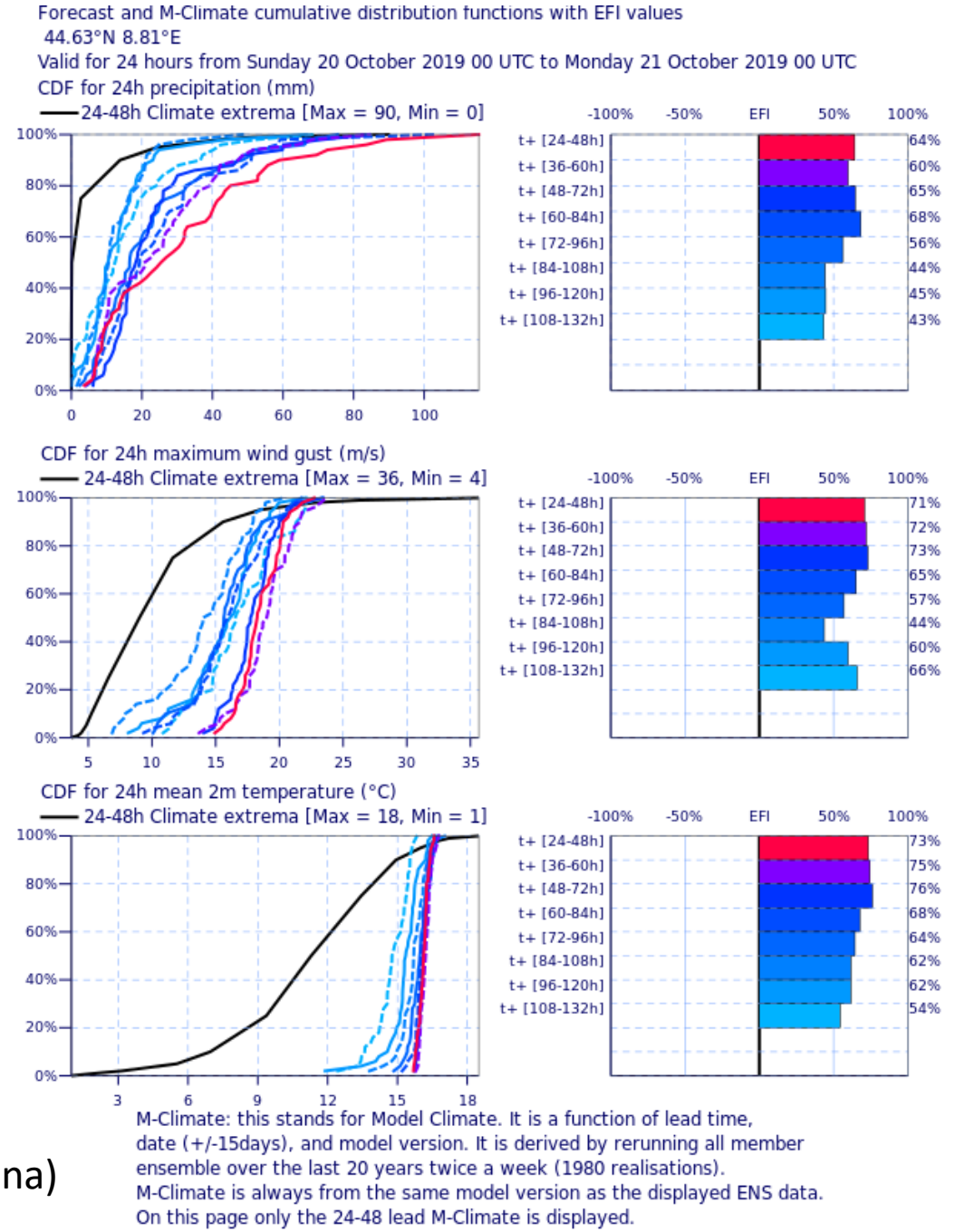
A difficult forecast

More than 480 mm observed.

Underestimated systematically by ENS system

Difficulty to represent night-time convection

Need for higher resolutions to represent convection (see morning presentation)



Courtesy of Roberto Buizza (Santanna)

Conclusioni e prospettive

L’Alluvione del 1994: una buona previsione a 3-5 giorni
L’impatto di risoluzione e migliorie della modellistica ECMWF nel pattern
Le consoscenze climatologiche si sono ampliate con migliore accesso al dato
Eventi convettivi in interazione fisico-dinamica con l’orografia la sfida per il futuro

Le migliorie del Sistema di Allertamento e Protezione Civile sono la chiave per ridurre l’ impatto (crescente) sia sul territorio che sulla popolazione

Aknowledgements / Ringraziamenti

- **Participants shared efforts:**
- Enrico Ferrero (UPO), Dino Zardi (AISAM e Università di Trento), Fabio Luino (IRPI-CNR), Renata Pelosini (ARPA Piemonte), Massimo Milelli (ARPA Piemonte),
- Carlo Cacciamani (PROTEZIONE CIVILE), Francesco Della Corte (CRIMEDIM, UPO), Silvio Davolio (ISAC-CNR)
- Roberto Buizza (Scuola Universitaria Superiore Sant'Anna di Pisa), Antonio Parodi (CIMA), Valerio Capecchi (LAMMA), Simone Sperati (RSE), and others.
- **ECMWF shared efforts**:
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