Downscaling climatico per studi di impatto

Il problema dello iato spaziale fra proiezioni climatiche e necessità degli studi di impatto locale

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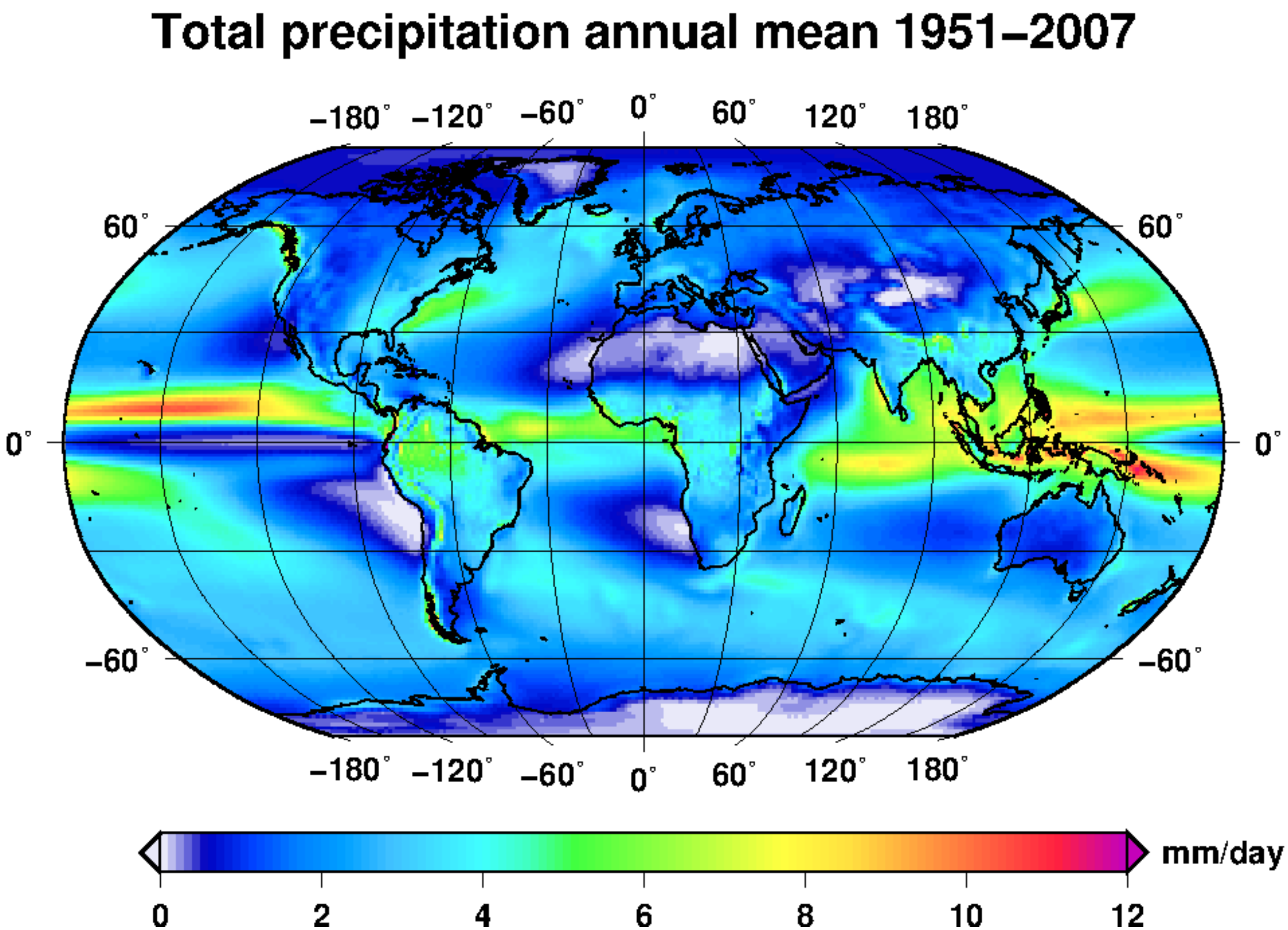
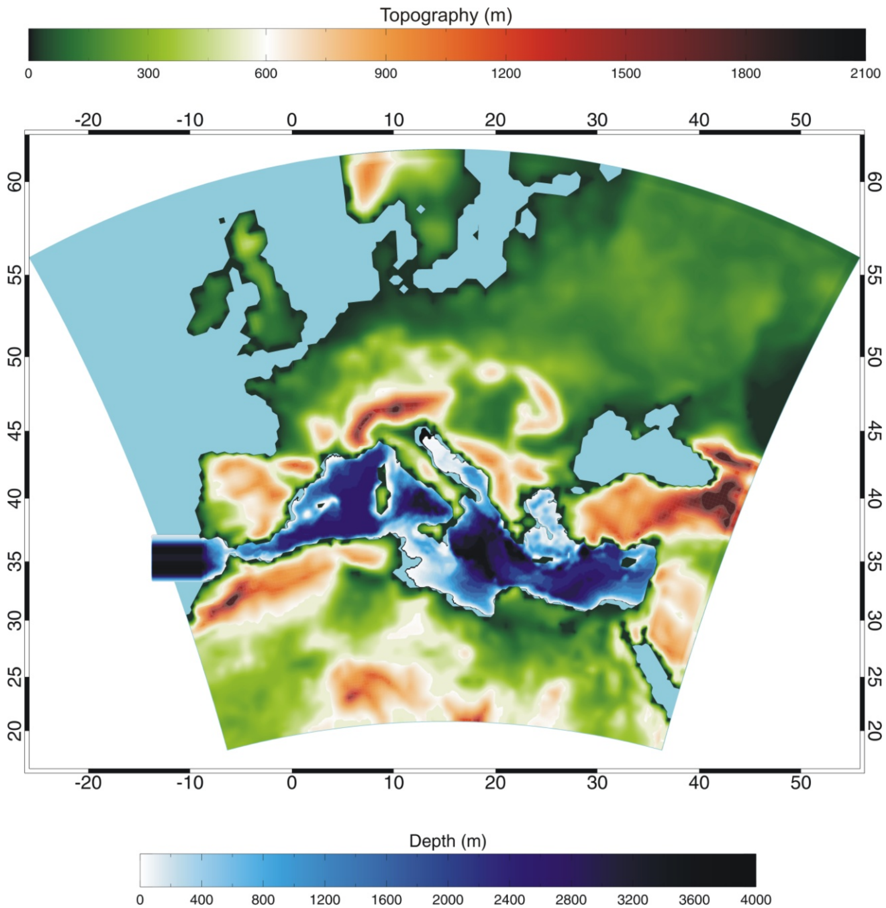


esempio: modello EC-Earth 2.3, risoluzione≈ 120 km

Regional climate model “Protheus” – ENEA UTMEA-CLIM



Computational domain

“An Atmosphere-Ocean Regional Climate Model for the Mediterranean area: Assessment of a Present Climate Simulation”. The Protheus Group, Clim. Dynamics. 2009

Components of the regional model

RegCM3

18 sigma vertical levels

30 Km horizontal resolution

BATS + IRIS

BATS: **Biosph.-Atmosph. Transfer Scheme**

IRIS: interactive RIvers Scheme

SST

OASIS 3
Freq. 6h

HF-WF-Wind

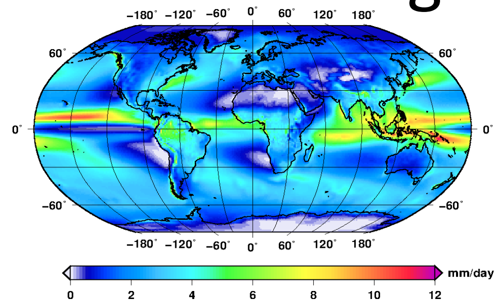
MedMIT

42 vertical levels

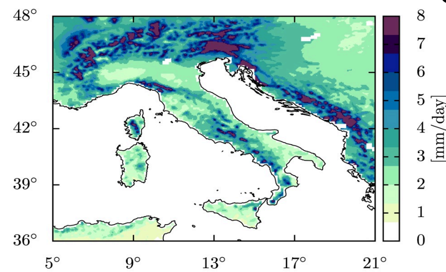
1/8° x 1/8° horizontal resolution

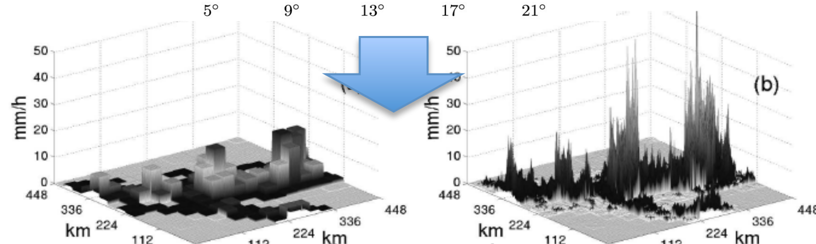
A collaboration between ENEA UTMEA-CLIM and ICTP

Modelli climatici globali



Modelli climatici regionali





Downscaling climatico

Approcci al downscaling climatico:

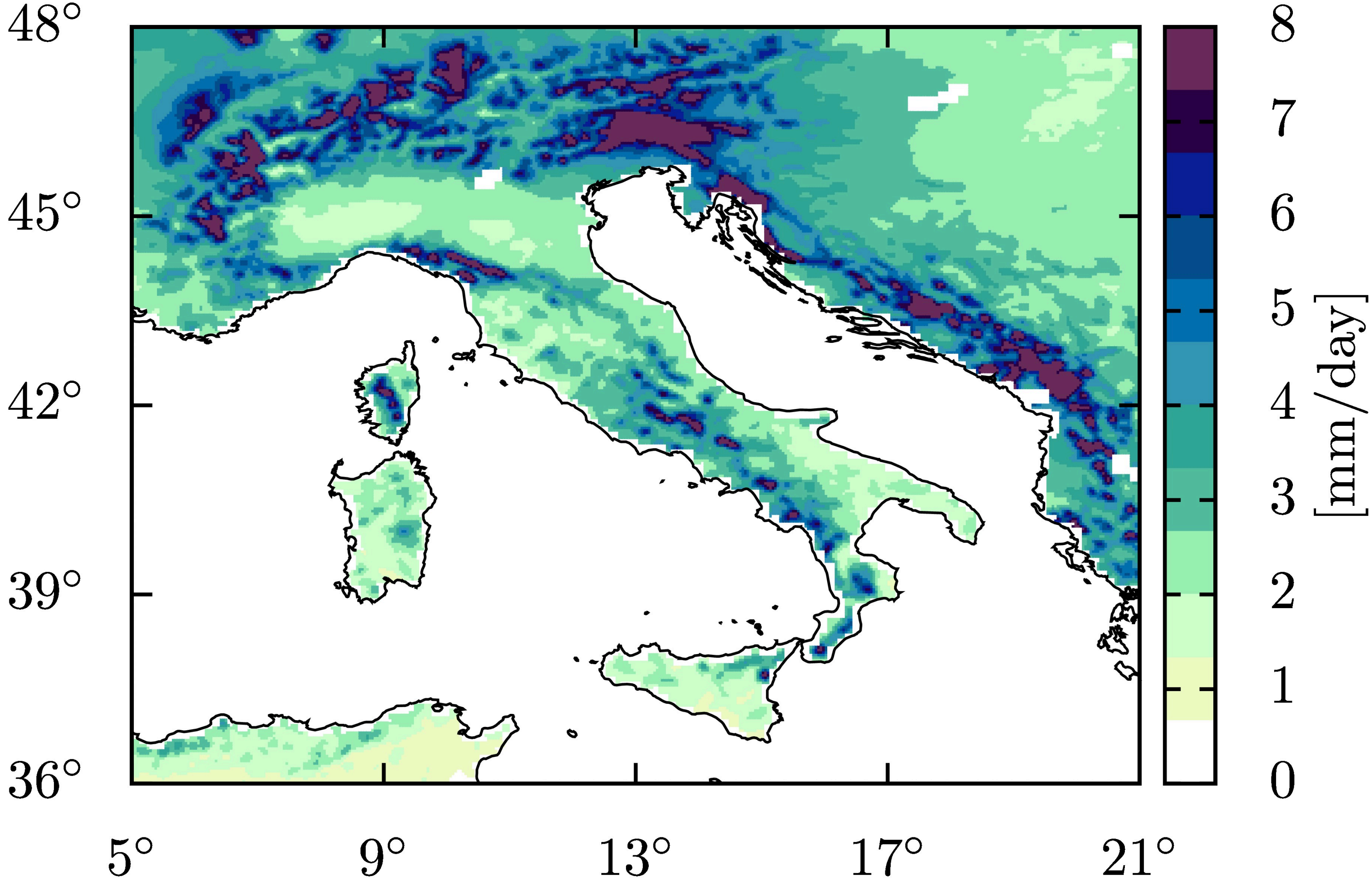
Downscaling dinamico

Modelli non idrostatici

(eg COSMO-CLM, WRF)

Downscaling statistico

Downscaling stocastico della precipitazione



Simulazione della precipitazione totale nel 1979 con risoluzione 4km.

WRF – simulazione A. Pieri, J. von Hardenberg, A. Parodi

Problemi del downscaling dinamico:

Richiesta di enormi risorse di calcolo

Condizioni al contorno

Nesting multipli

Propagazione dell'incertezza, difficoltà a realizzare ensemble

Downscaling statistico:

Trovare relazioni statistiche
fra i predittori a grande scala (indici)
e i predittandi locali a piccola scala:

1. Determina un predittore a grande scala
2. Determina la correlazione
fra predittore e predittando
3. Utilizza il valore futuro del predittore
per determinare il futuro valore del predittando

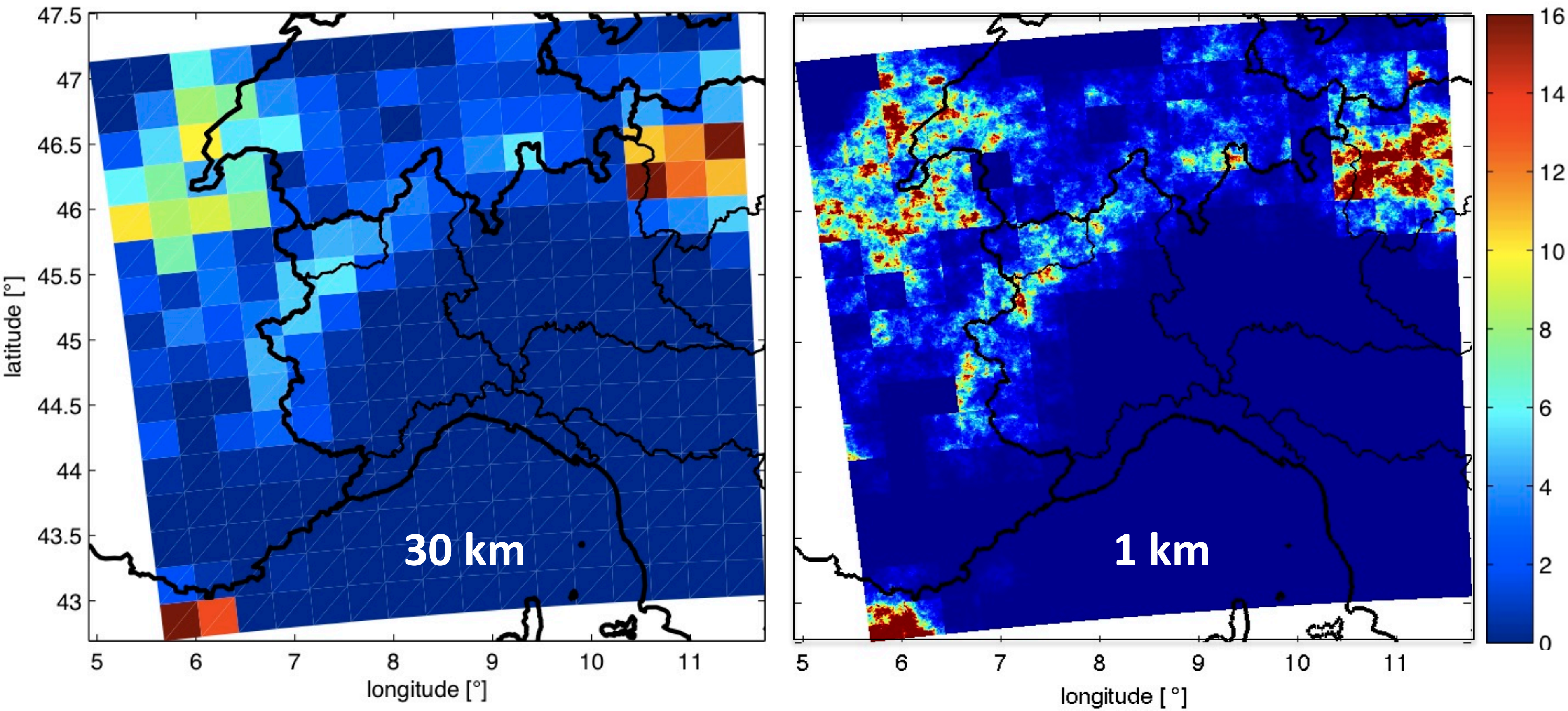
Downscaling stocastico:

Campi fortemente intermittenti come la precipitazione possono essere difficili da trattare con il downscaling dinamico/statistico.

Il downscaling stocastico
genera ensemble di possibili realizzazioni
con le “giuste” proprietà statistiche

RainFARM downscaling: un esempio

Autumn (SON) 1958



Precipitation field from PROTHEUS

Stochastic realization of the PROTHEUS downscaled field, obtained with RainFARM

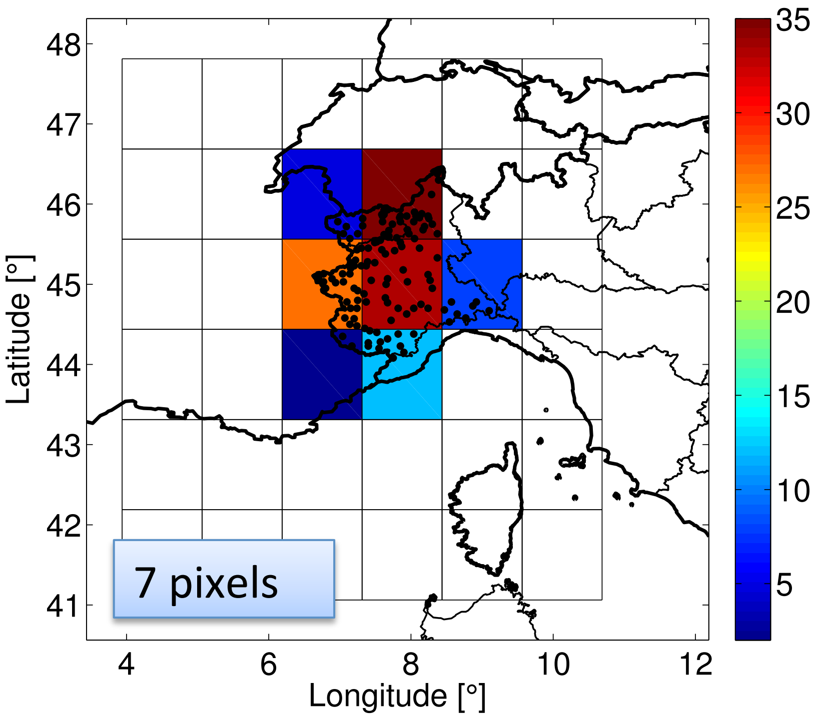
Pluviometri, Modello Regionali, Rianalisi

- 122 rain gauges
- 1958-2001
- Daily resolution

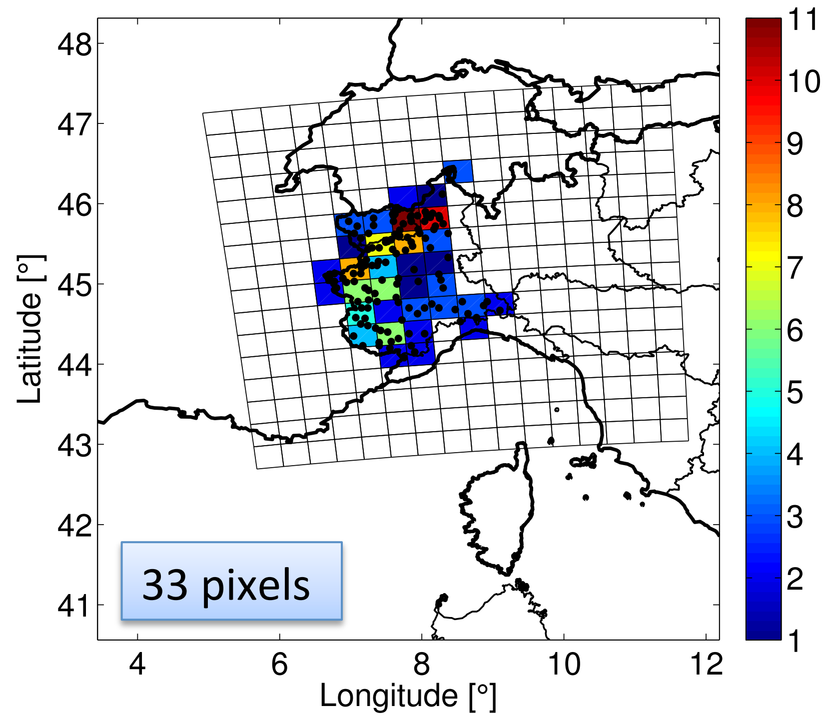
- Altitude max: 2526 m
- Altitude min: 127 m

Ciccarelli et al., *Global and Planetary Change*, 2008

ERA40: Δx≈88km, Δy≈125km



PROTHEUS: Δx≈30km



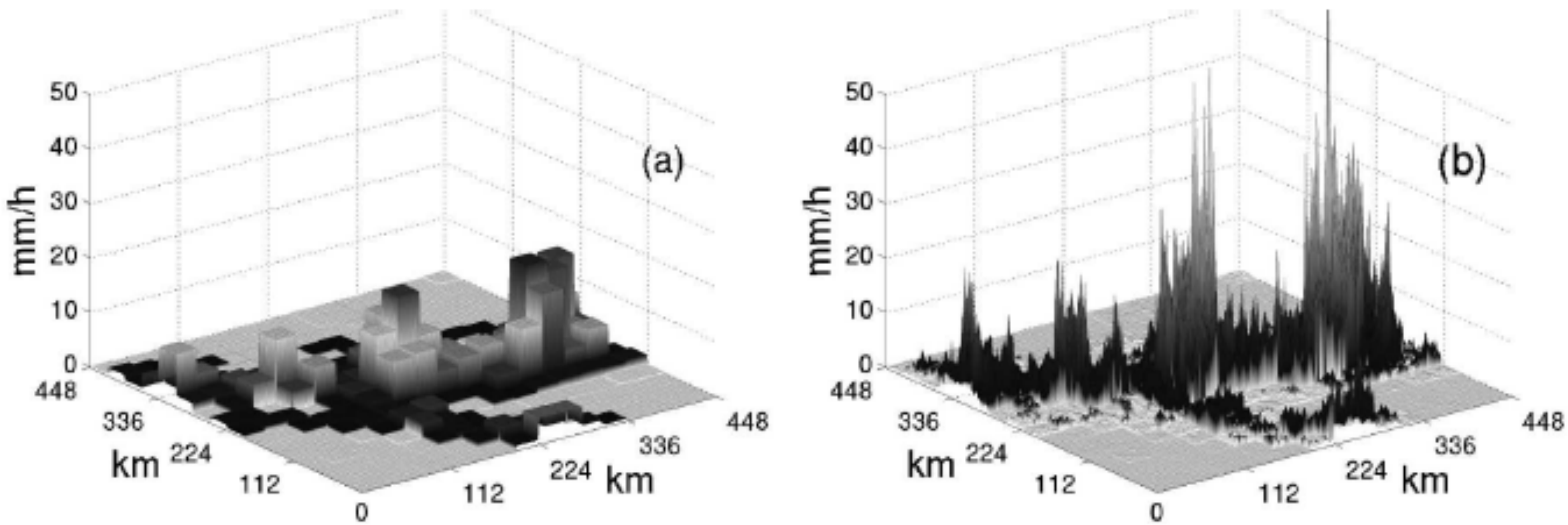
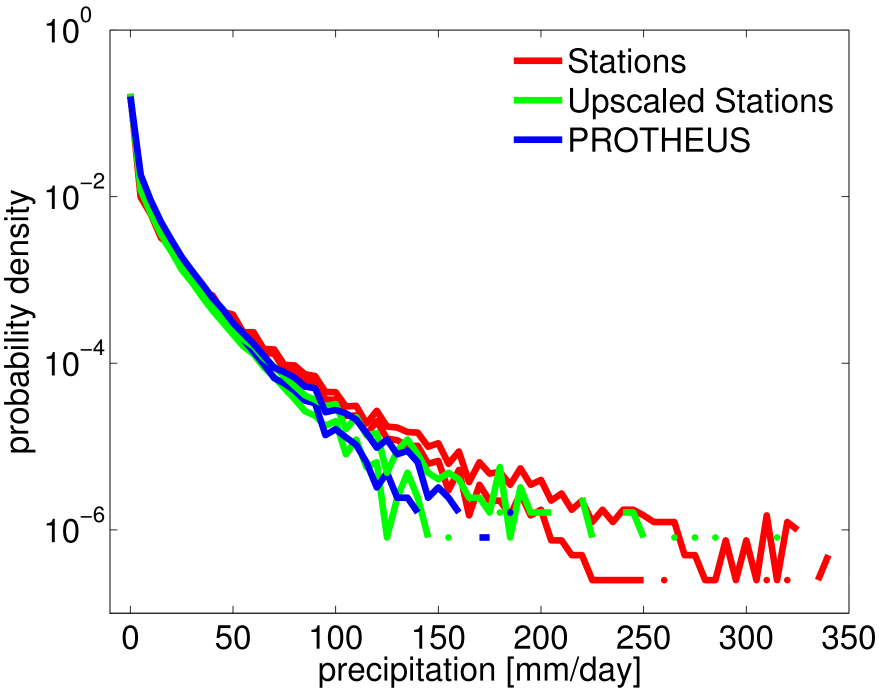


FIG. 10. (a) A snapshot of the forecasted rain field obtained from the LAM forecast and (b) one example of a downscaled field obtained by application of the RainFARM. The vertical scale indicates precipitation intensity (mm h^{-1}) and it is the same for the two fields.

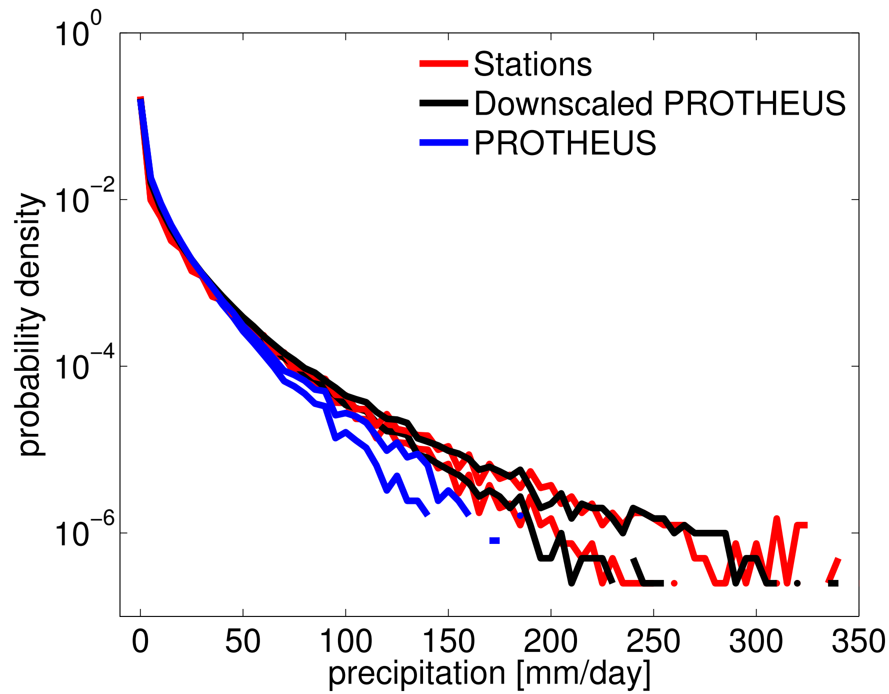
Upscaling: PROTHEUS and D-PROTHEUS vs upscaled and individual raingauge data

PDFs of total daily precipitation

PROTHEUS

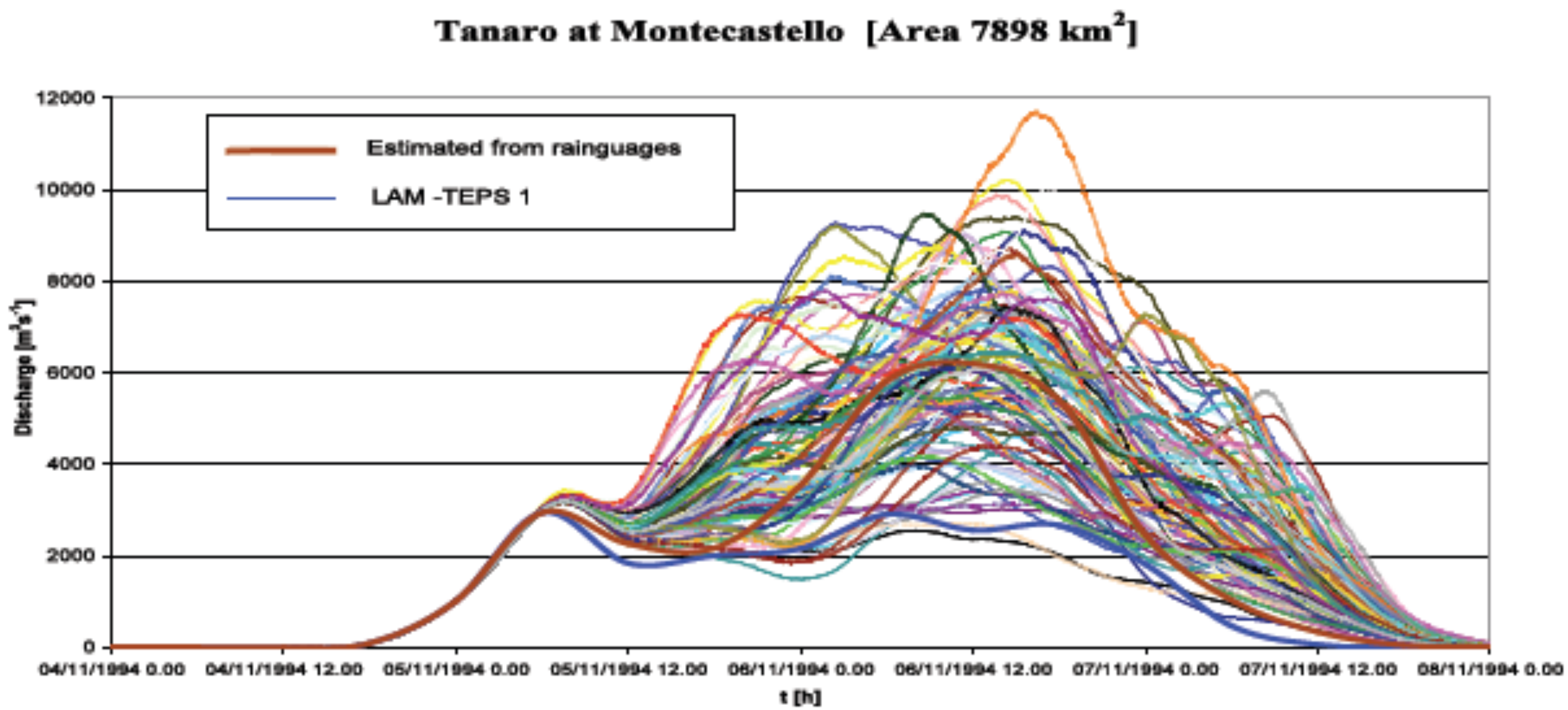


D-PROTHEUS



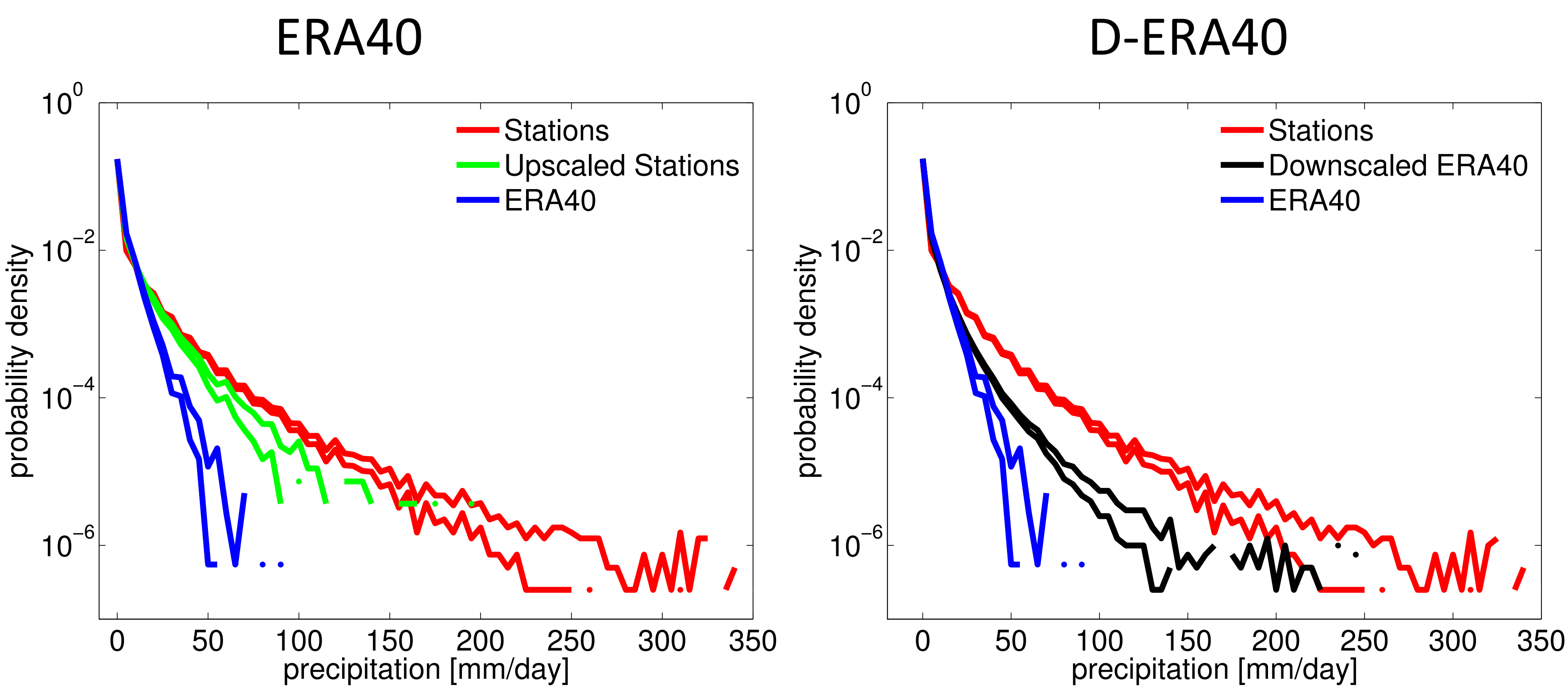
The two lines for each PDF indicate the 5% and the 95% percentiles in each class, obtained by using a Jack-knife subsampling

Stochastic downscaling is best suited for ensemble predictions



Downscaling: ERA40 and D-ERA40 vs individual raingauge data

PDFs of total daily precipitation



The distribution of downscaled ERA40 fields is wider than the original one, but still underestimates the probability of occurrence of intense rainfall events at all amplitudes

Grand Challenge:
generare un ensemble di
campi di variabili climatiche
(temperatura e precipitazione)
disaggregate alle scale di interesse
per studi di impatto