# INTERPOLAZIONE SPAZIALE DEI DATI DI PRECIPITAZIONE MENSILE PER LE VALUTAZIONI DEL BILANCIO IDROLOGICO NAZIONALE CON IL MODELLO **BIGBANG**

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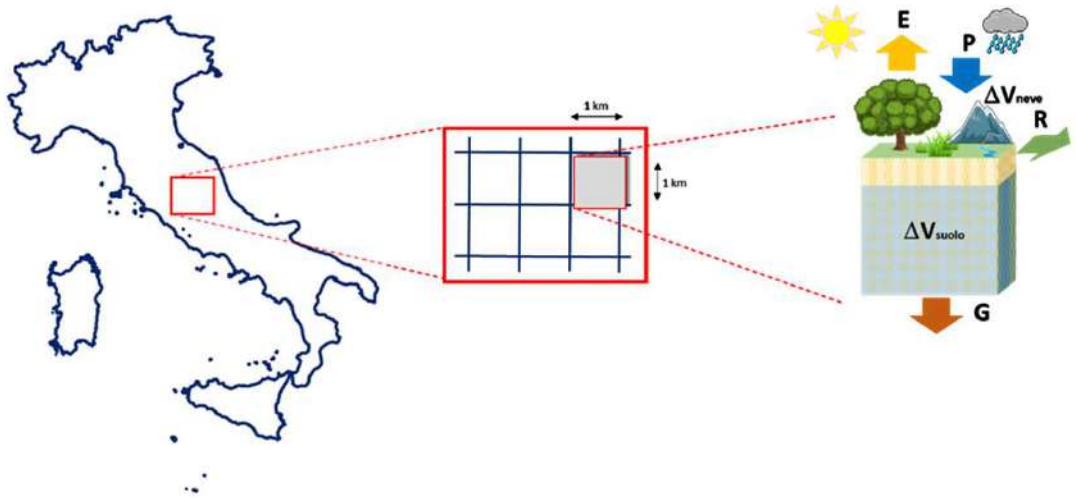
# MODELLO BIGBANG

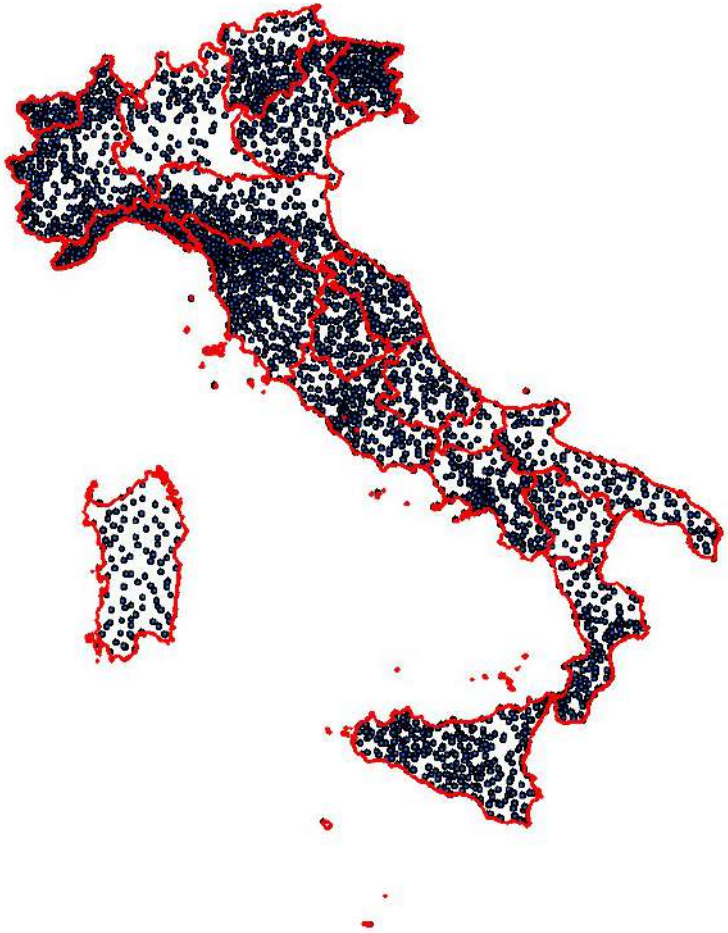
## BILANCIO IDROLOGICO GIS BASED A SCALA NAZIONALE SU GRIGLIA REGOLARE

MODELLO DISTRIBUITO

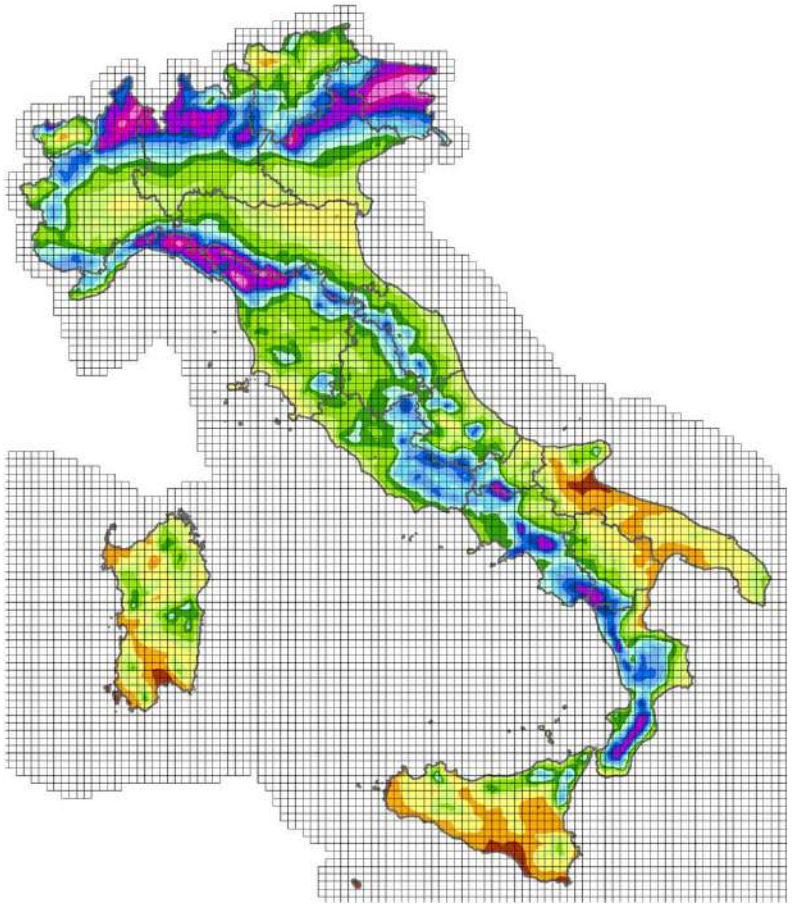



# PROBLEMA ?

Vector (point)

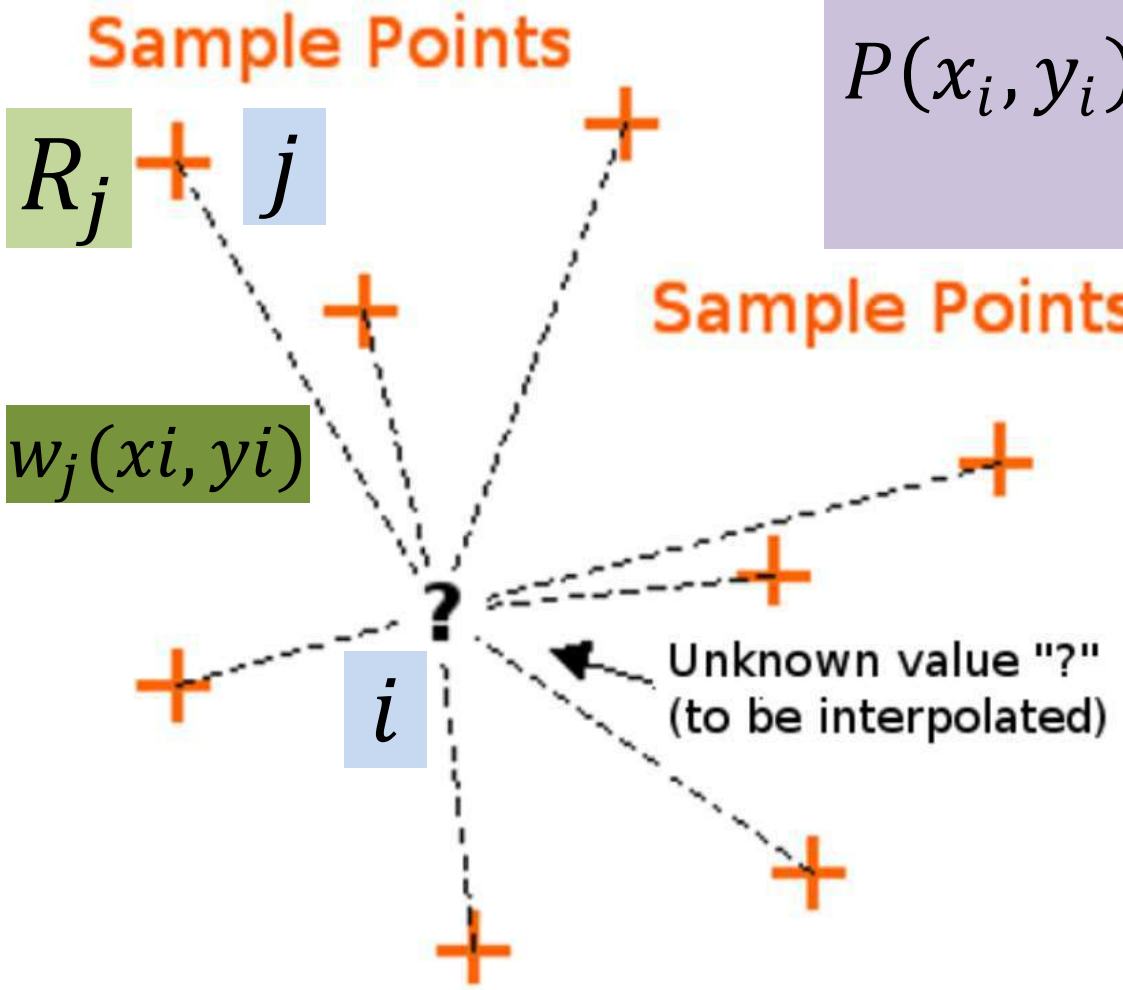


Raster 1 km x 1 km



# INTERPOLAZIONE SPAZIALE

$$P(x_i, y_i) = \sum_{j=1}^{N} w_j(x_i, y_i) R_j$$

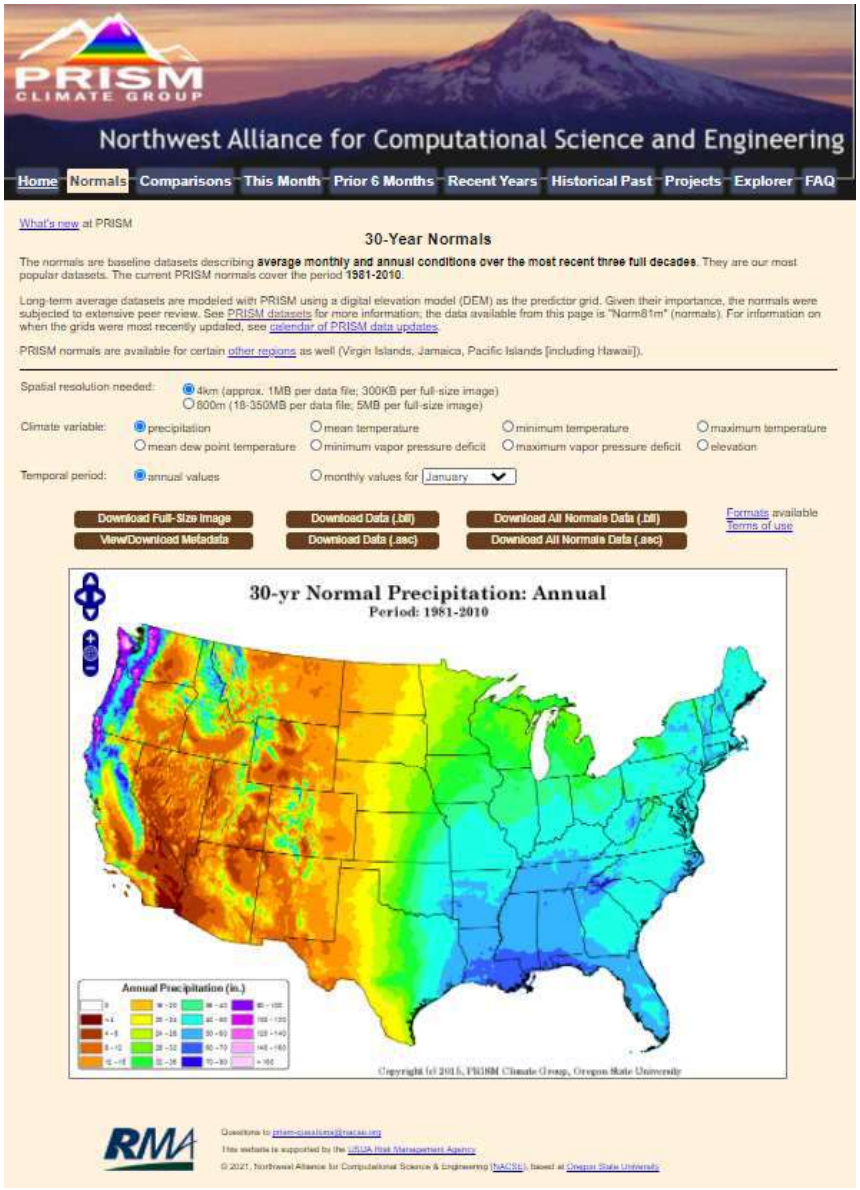


# PRINCIPALI METODOLOGIE

- NEAREST NEIGHBOURS (POLIGONI DI THIESSEN)
- **NATURAL NEIGHBOURS (INTERPOLAZIONE VORONOI)**
- IDW (INVERSE DISTANCE WEIGTHED)
- TIN (Interpolation Delaunay Triangulation)
- SPLINE
- POLINIOMIAL FITTING
- RADIAL BASIS FUNCTIONS
- GEOSTATISTICAL METHODS - KRIGING (OK, UK, BK, IK, RK, DK, CoK, ecc.)
- REGRESSION MODELS (es. PRISM-**P**arameter-elevation **R**egressions on **I**ndependent **S**lopes **M**odel)
- …..

- **D**ETERMINISTICO
- **S**TOCASTICO
- **E**SATTO
- **A**PPROSSIMATO
- **U**NIVARIATO
- **M**ULTIVARIATO
- **L**OCALE
- **G**LOBALE

# PRISM




https://prism.oregonstate.edu/

# PERCHÈ IL METODO NATURAL NEIGHBOURS?

## PRO

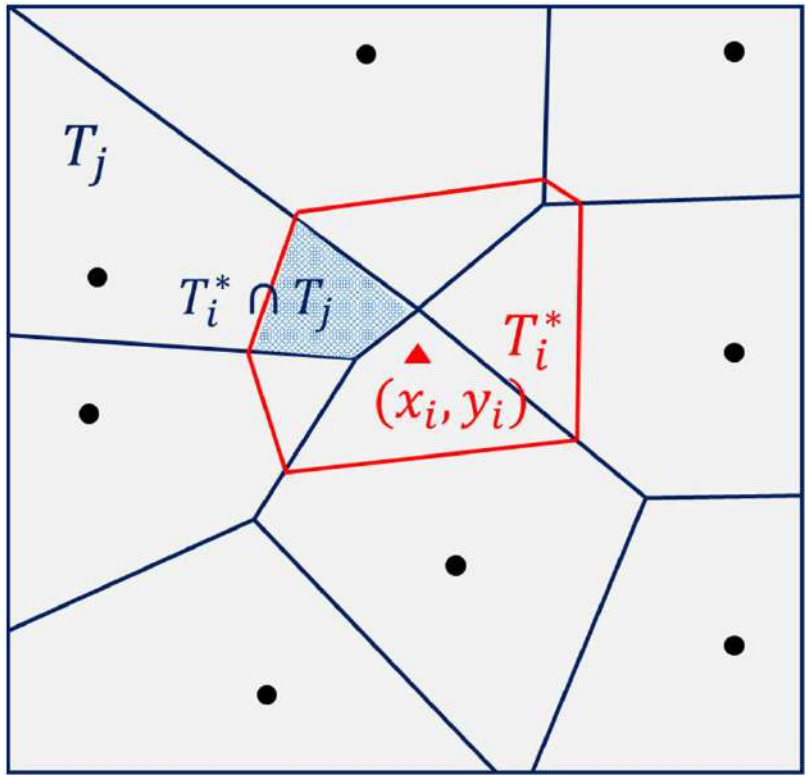
- è implementato nei tools dell'ambiente GIS utilizzato;
- è un metodo deterministico di semplice interpretazione;
- è un interpolatore esatto;
- non richiede parametri di taratura;
- presenta normalmente in maniera ridotta l'effetto "bull's eye";
- richiede un impegno computazionale inferiore rispetto alla famiglia dei metodi kriging;
- produce una superficie continua con la derivata prima (tranne che nei punti di misura)
- è utilizzato in studi di climatologia;

## CONTRO

- interpola solo nell'inviluppo convesso (convex hull)

# SCHEMA DI CALCOLO DEI PESI

$$P(x_i, y_i) = \sum_{j=1}^{N} w_j(x_i, y_i) R_j$$




$$w_j(x_i, y_i) = \frac{area(T_i^* \cap T_j)}{area\,(T_j)}$$

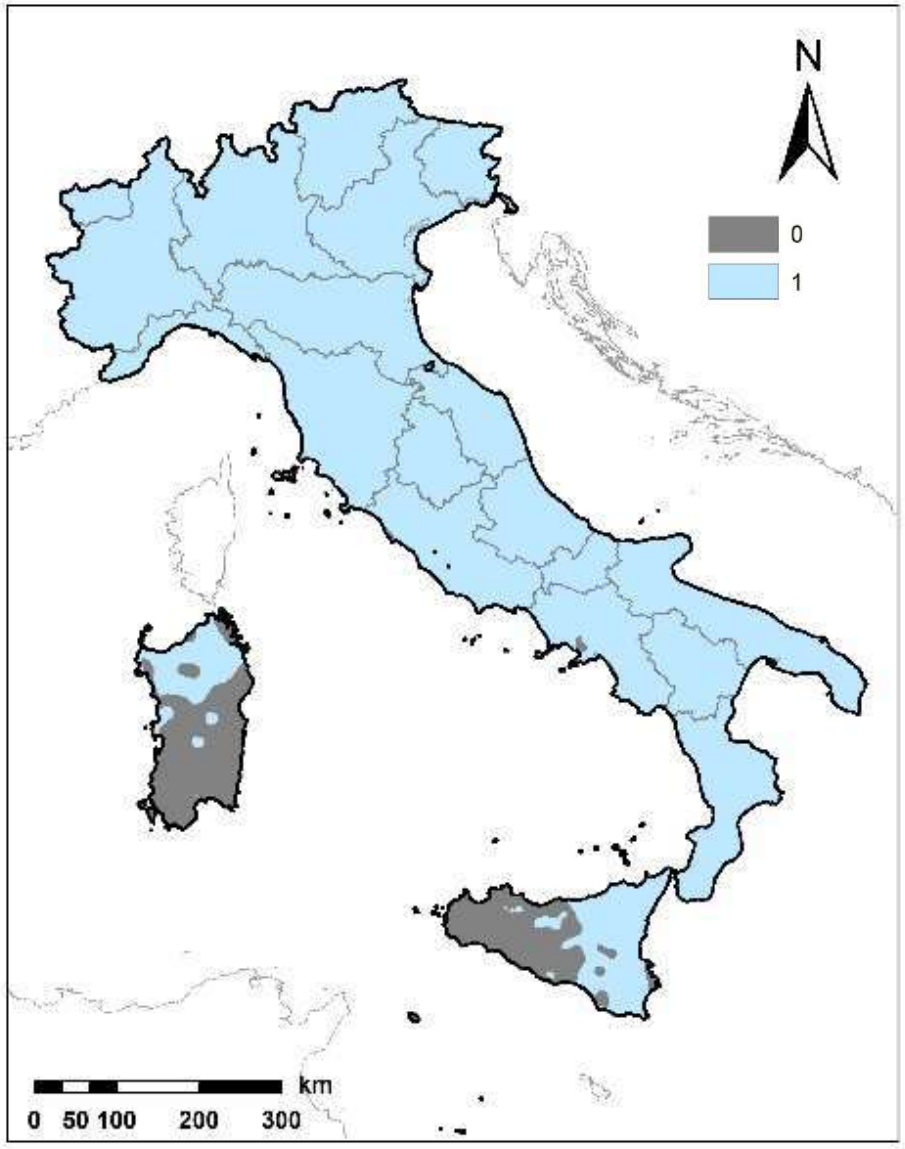
# NATURAL NEIGHBOURS: 1° STEP

Nel primo passo viene interpolata una variabile binaria indicatrice di evento $i$, definita su ciascun punto di misura per "indicare" l'accadimento dell'evento di precipitazione

$$i = \begin{cases} 1 & se\ P > 1\ mm \\ 0 & se\ P \leq 1\ mm \end{cases}$$

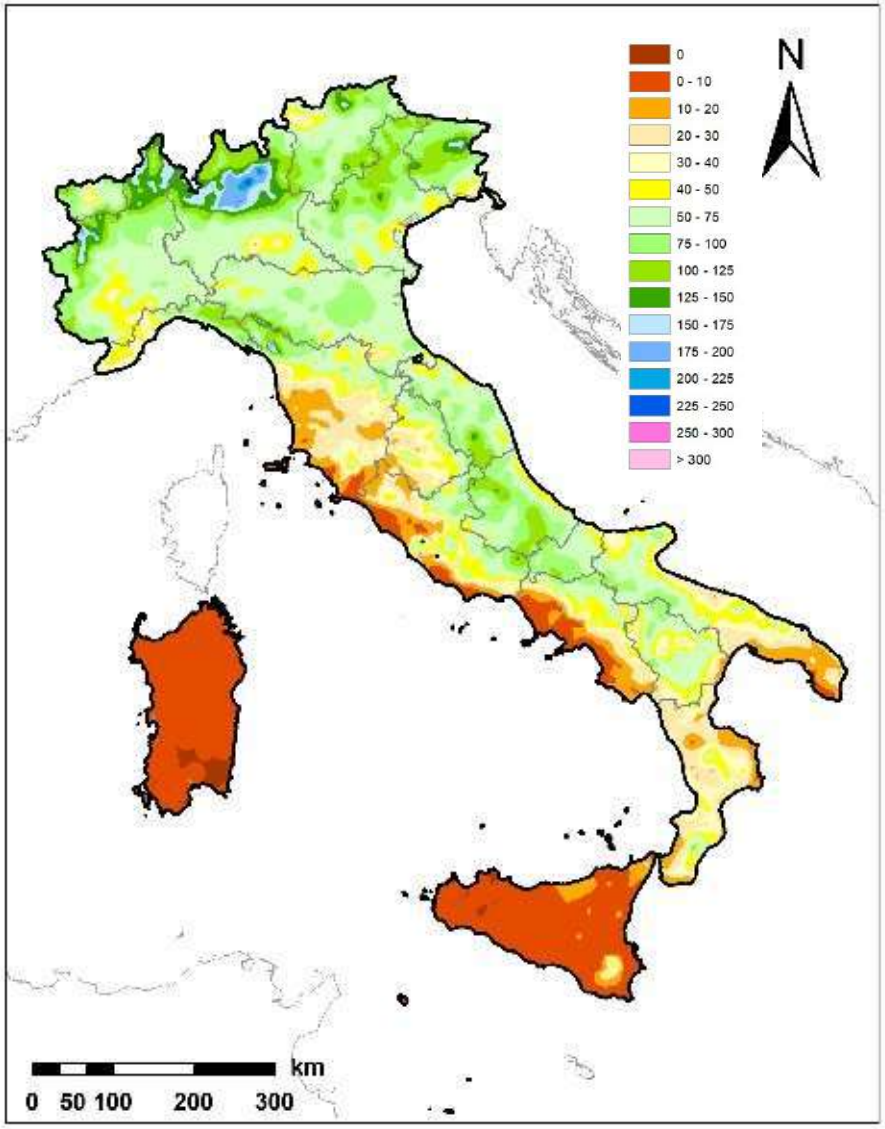
Si pongono uguale a 1 i valori maggiori di 0.5 e uguale a zero i valori minori o uguali a 0.5.

Il campo binario che ne deriva fornisce una chiara rappresentazione delle aree con precipitazione mensile nulla

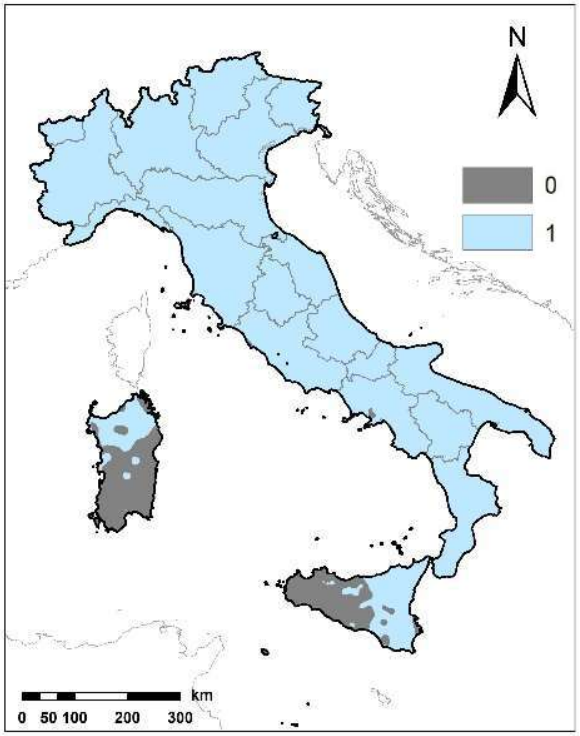


# NATURAL NEIGHBOURS: 2° STEP

Nel secondo passo viene interpolata la variabile climatica



# NATURAL NEIGHBOURS: RISULTATO FINALE

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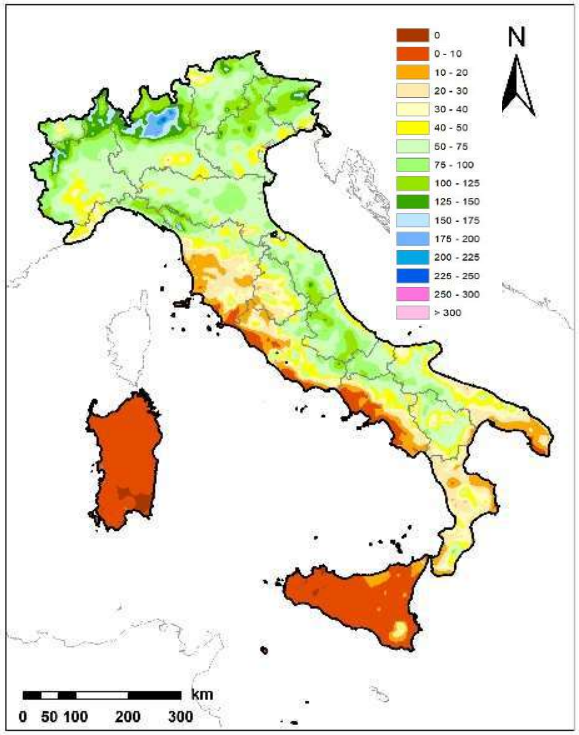


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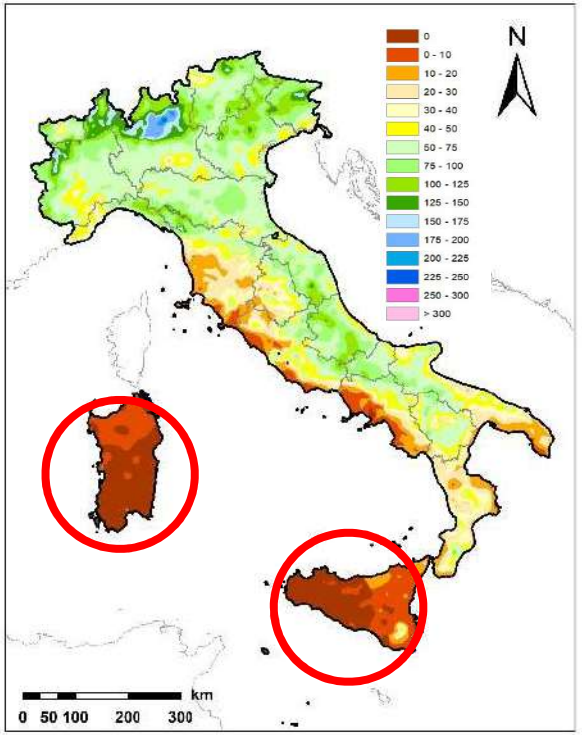
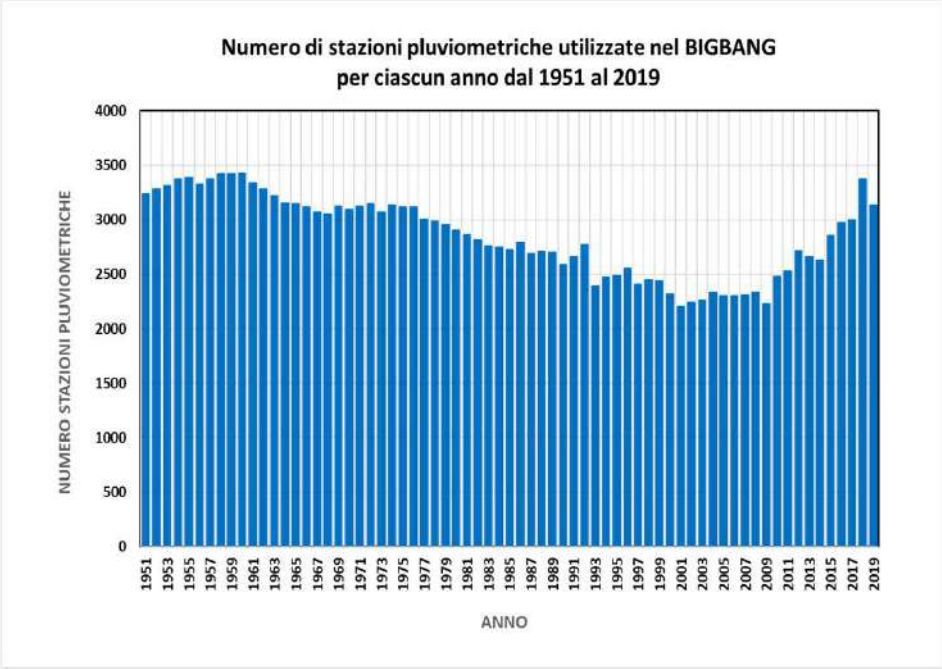
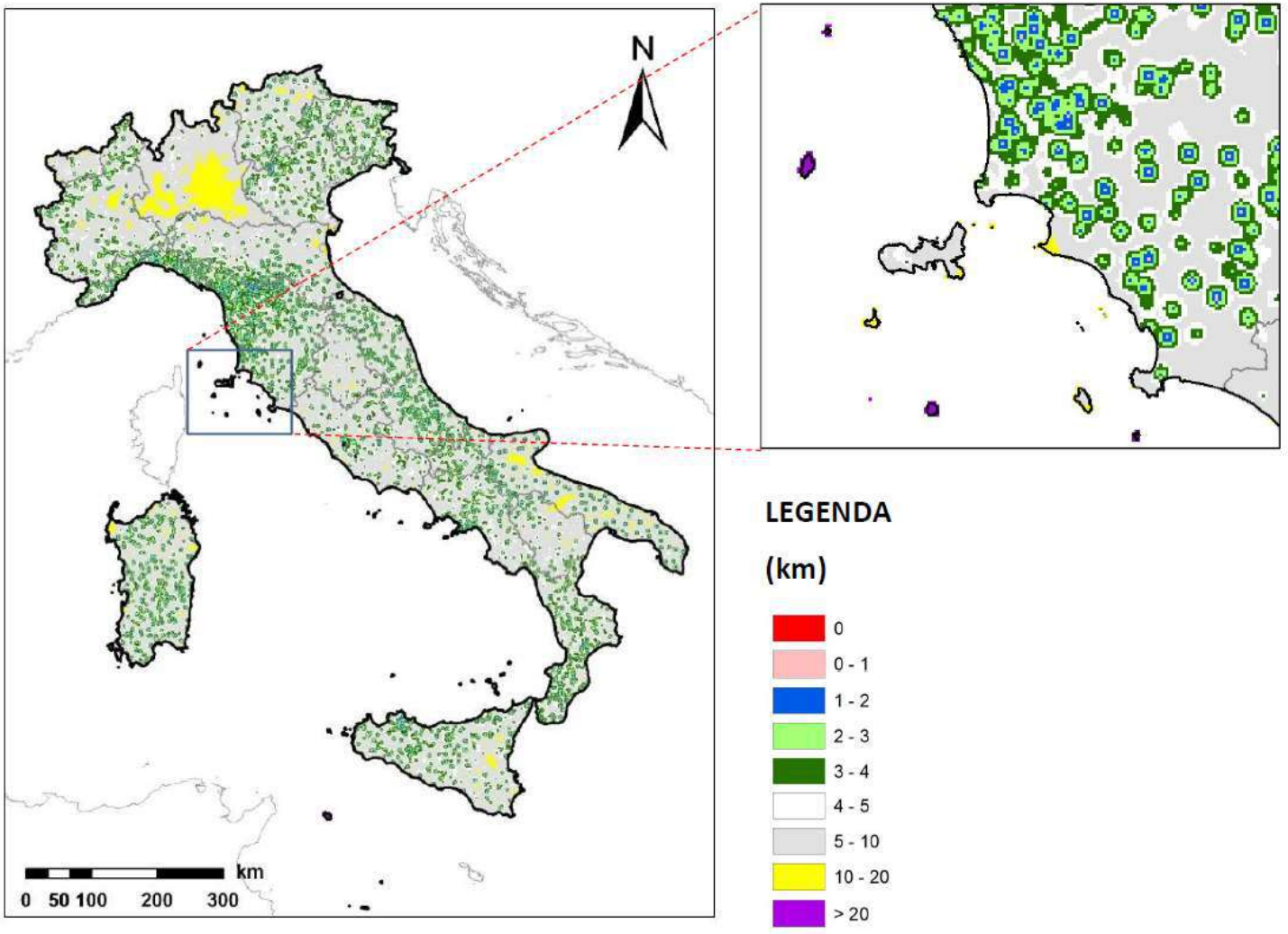


# STAZIONI PLUVIOMETRICHE

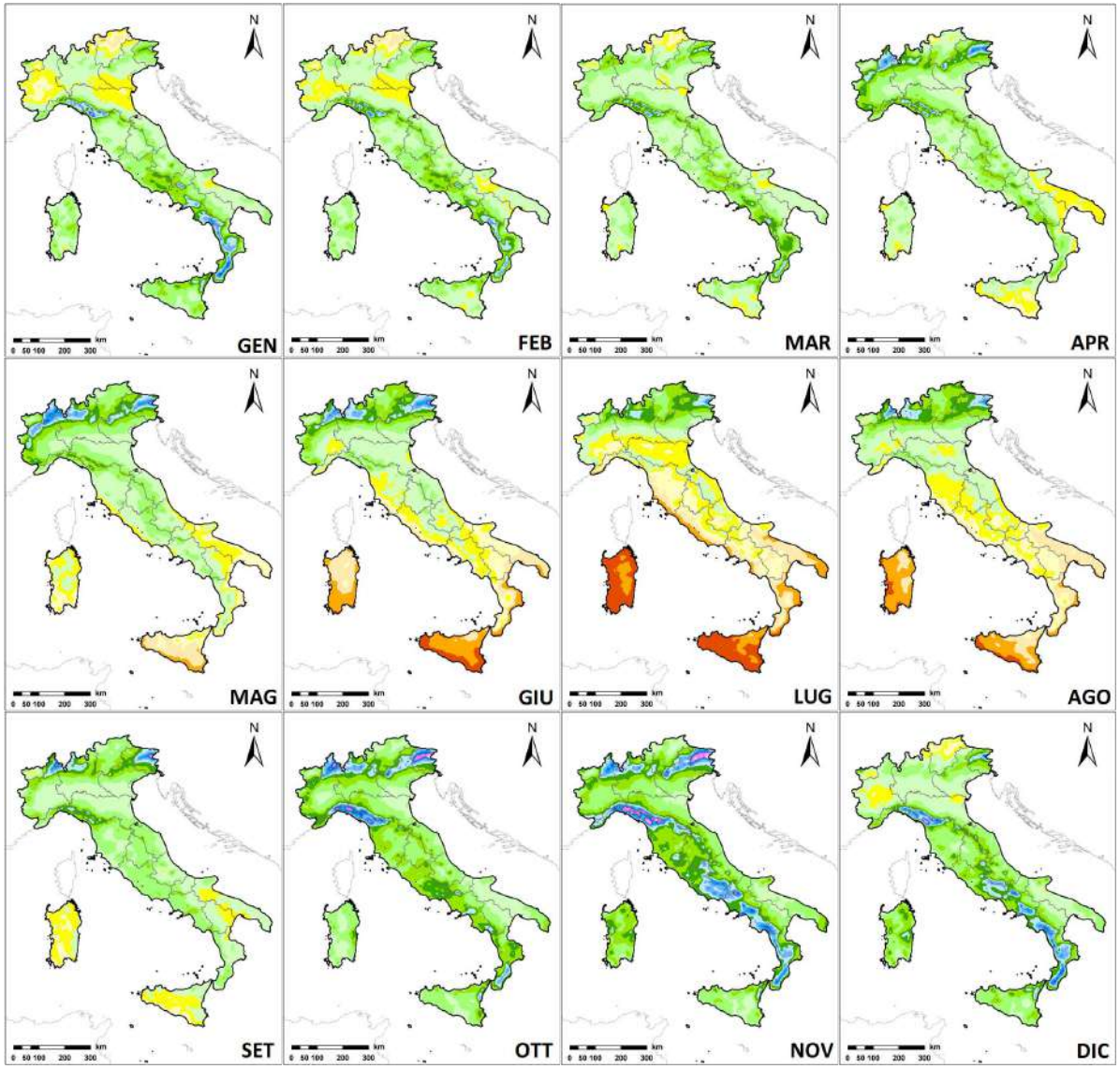



# CALCOLO DELLE MEDIE

## "*grid then average*" o "*average then grid*" ?



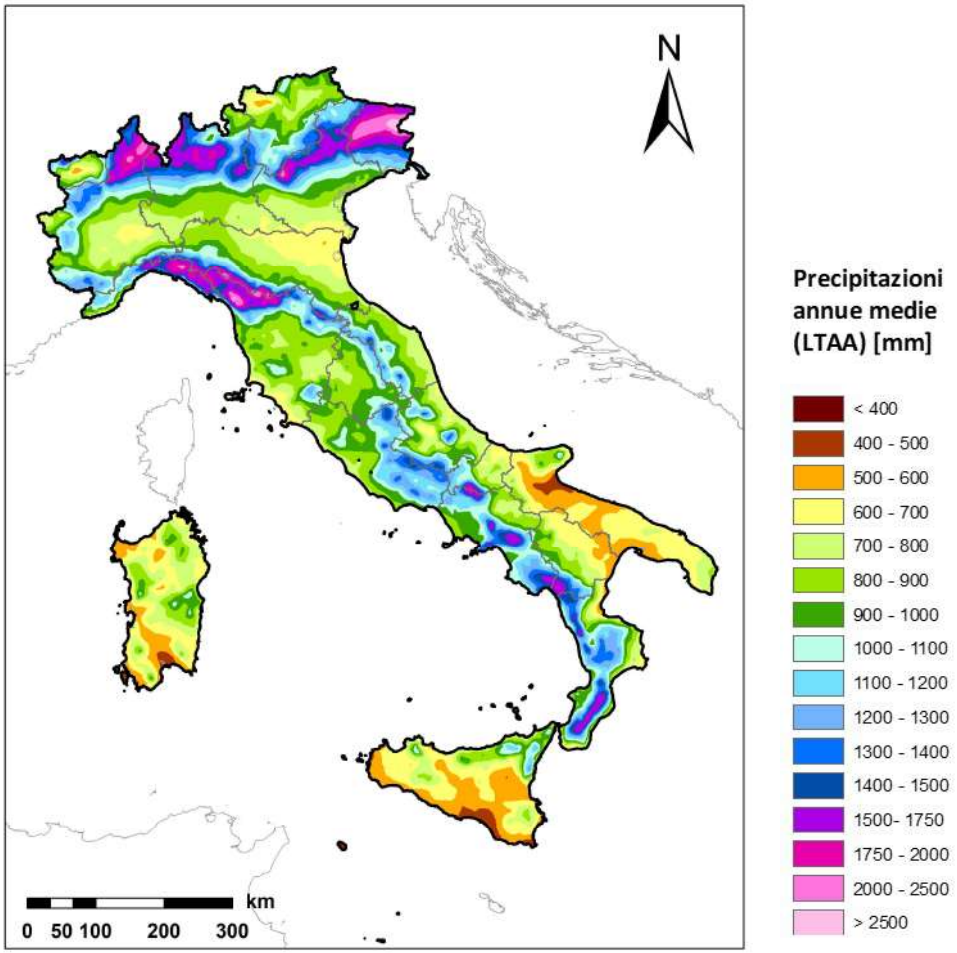
# PRECIPITAZIONI MENSILI MEDIE




**Precipitazioni mensili medie (LTA) [mm]**

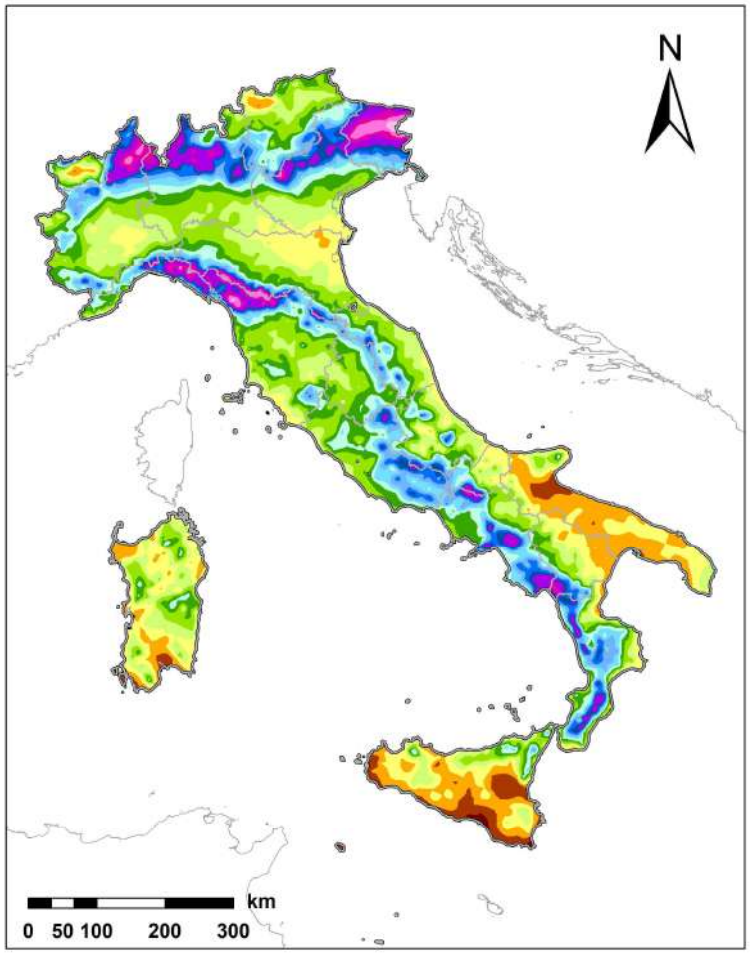
- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 75
- 75 - 100
- 100 - 125
- 125 - 150
- 150 - 175
- 175 - 200
- 200 - 225
- 225 - 250
- 250 - 300
- > 300

# PRECIPITAZIONI ANNUE MEDIE




Precipitazioni annue medie (LTAA) [mm]

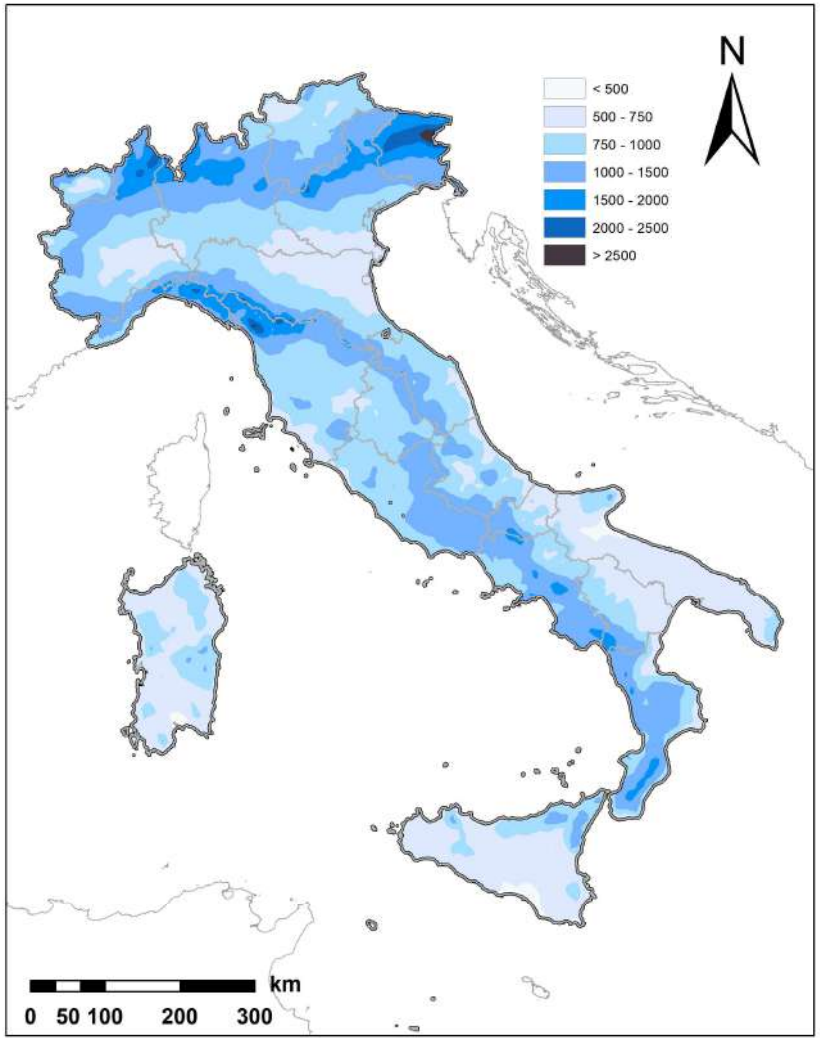
- < 400
- 400 - 500
- 500 - 600
- 600 - 700
- 700 - 800
- 800 - 900
- 900 - 1000
- 1000 - 1100
- 1100 - 1200
- 1200 - 1300
- 1300 - 1400
- 1400 - 1500
- 1500- 1750
- 1750 - 2000
- 2000 - 2500
- > 2500

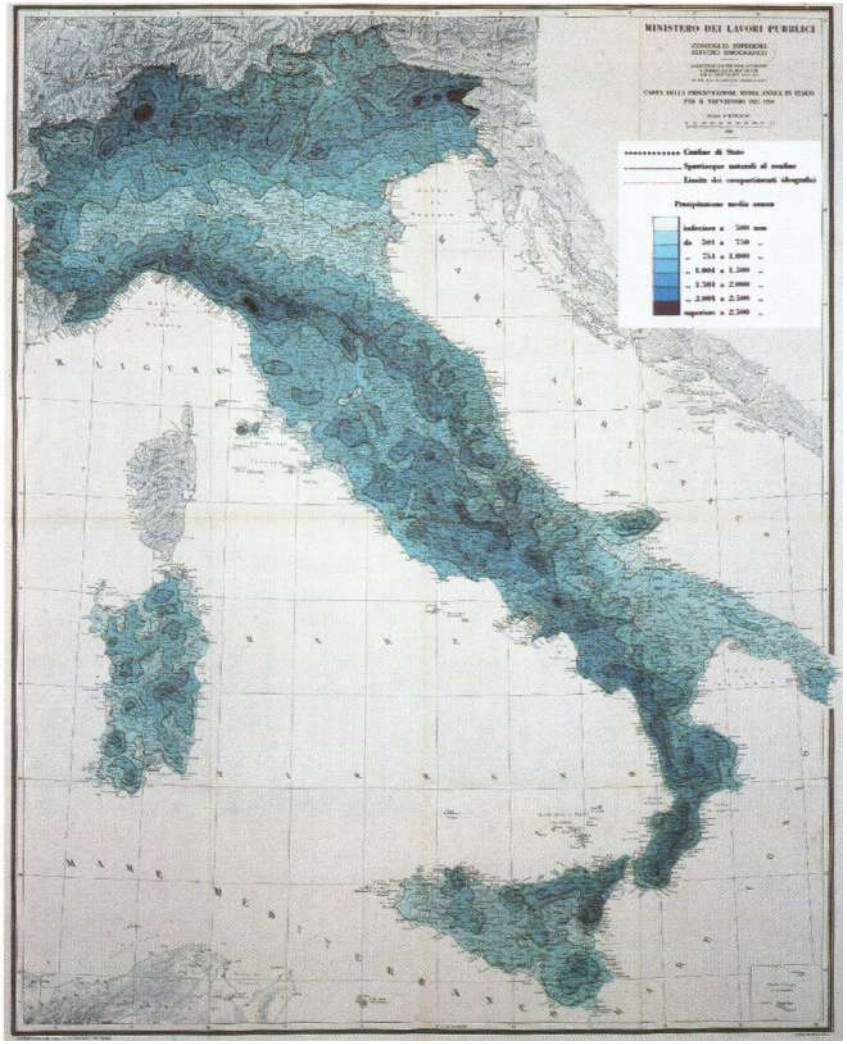



**BIGBANG 4.0 [1951–2019]: 953 mm**

**BIGBANG 4.0 [1961–1990]: 938 mm**

# CONFRONTO 1



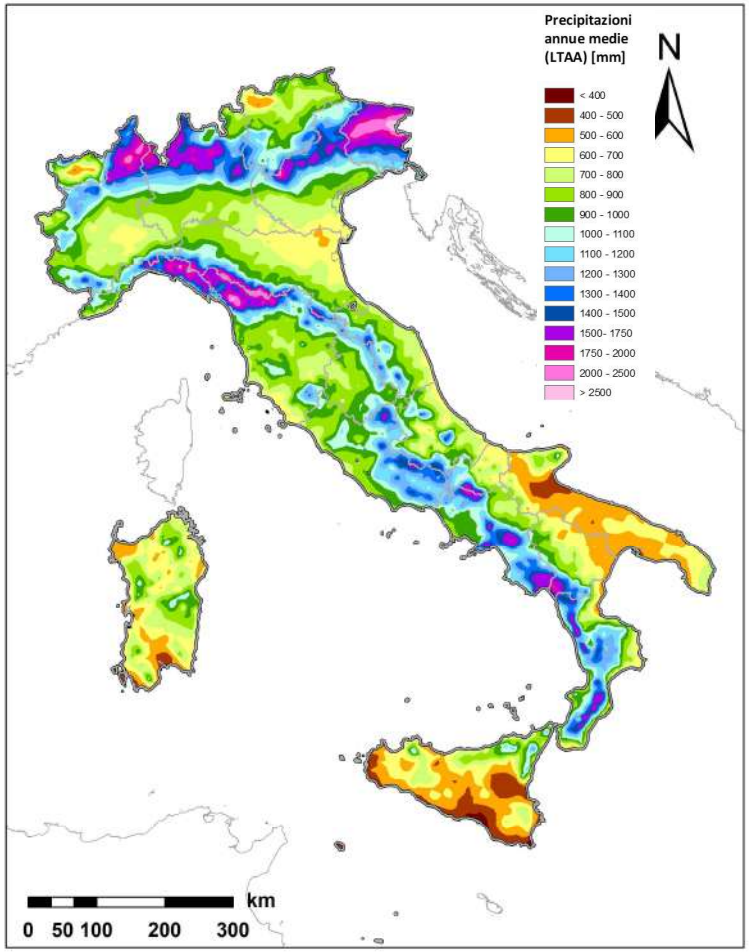




**BIGBANG 4.0 [1951–2019]: 953 mm**

**Servizio Idrografico [1921–1950]: 990 mm**

# CONFRONTO 2

## BIGBANG 4.0 [1961-1990]: 938 mm




## Crespi et al. 2018 [1961-1990]: 964 mm

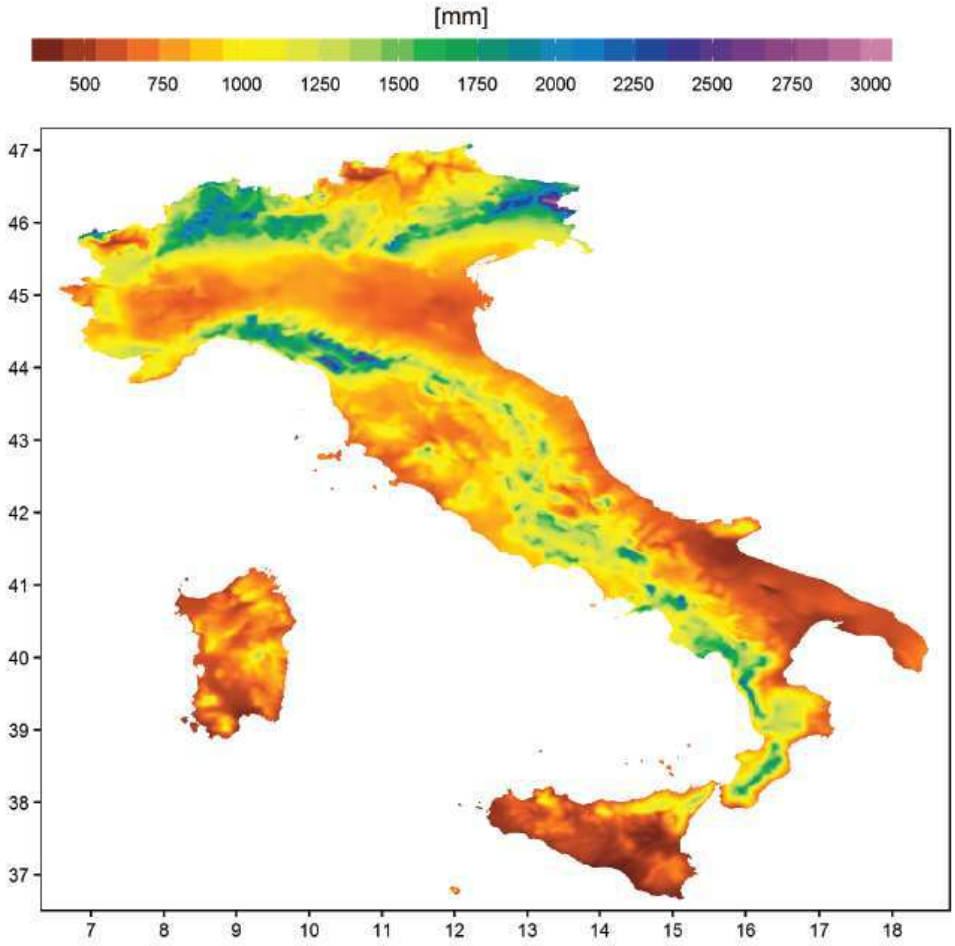
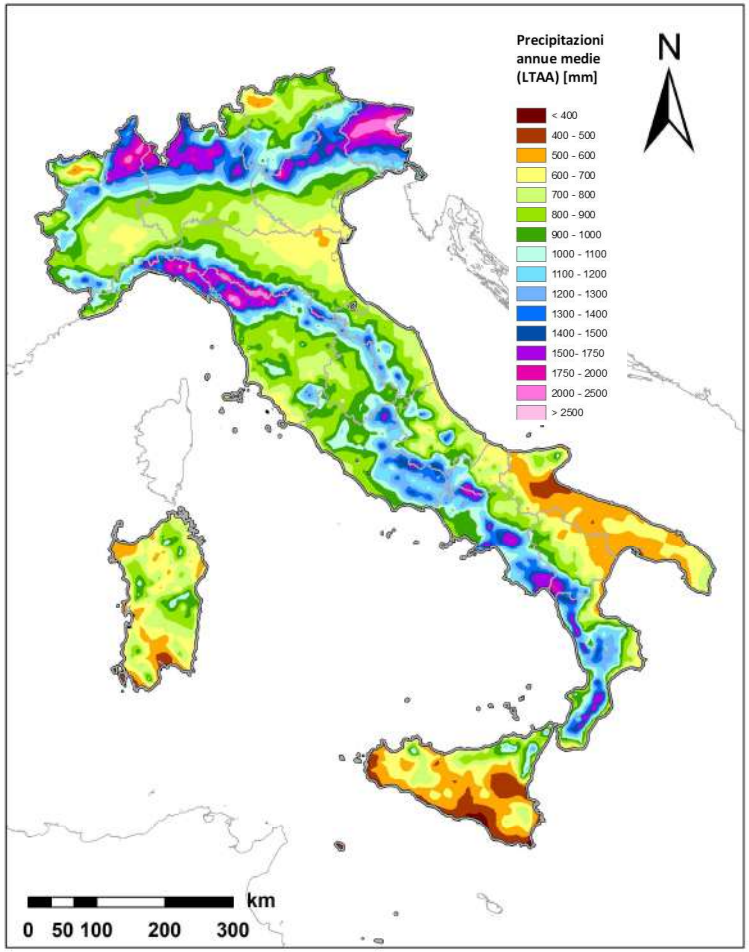



Figure 12. Annual LWLR precipitation climatology.

Crespi A., Brunetti M., Lentini G., Maugeri M., 2018, 1961–1990 high-resolution monthly precipitation climatologies for Italy, Int. J. Climatol. 38: 878–895 DOI: 10.1002/joc.5217

# CONFRONTO 2

## BIGBANG 4.0 [1961-1990]: 938 mm




## Crespi et al. 2018 [1961-1990]: 960 mm

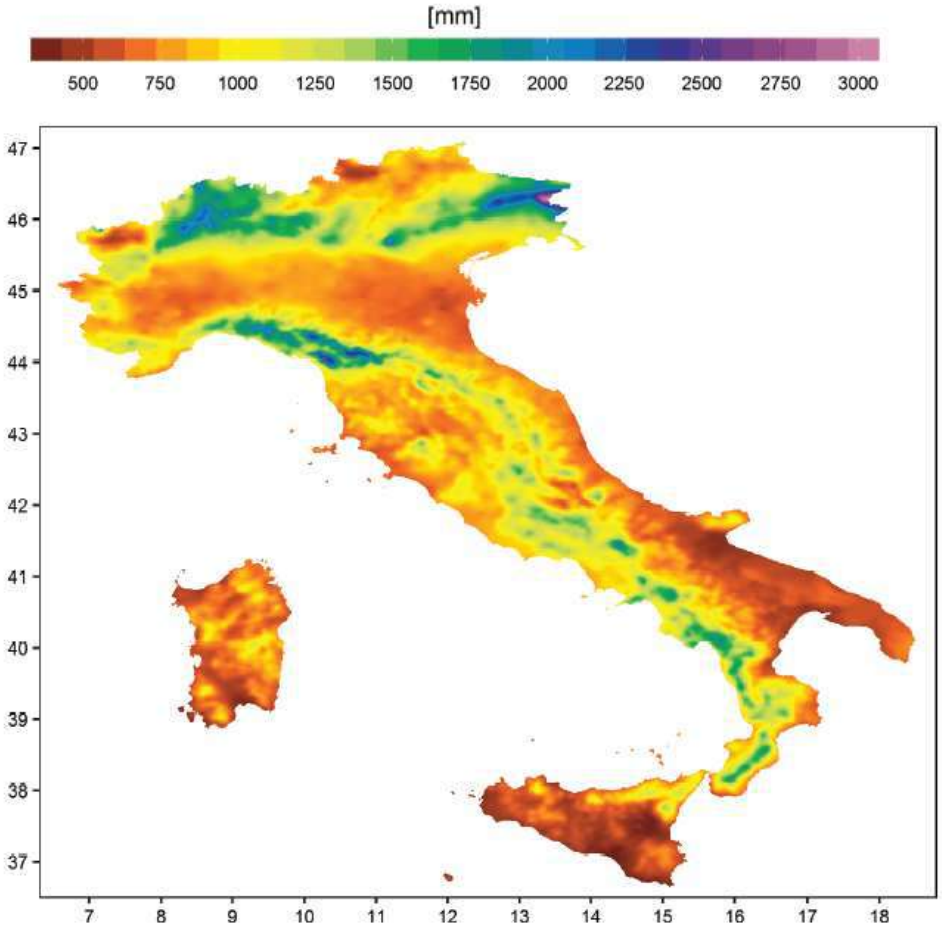
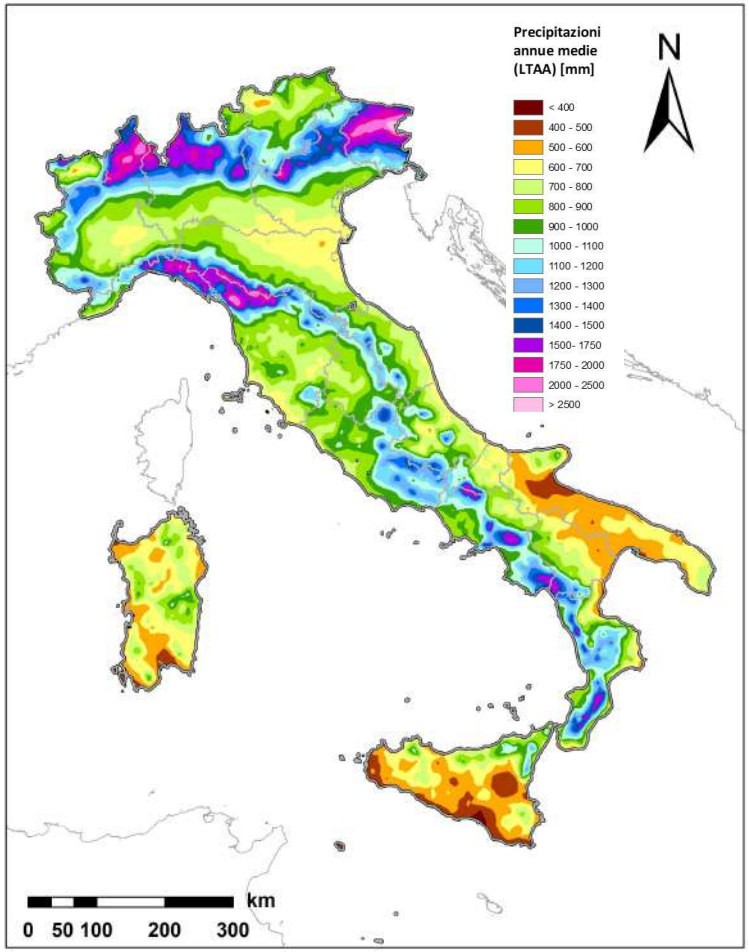



Figure 13. Annual RK precipitation climatology.

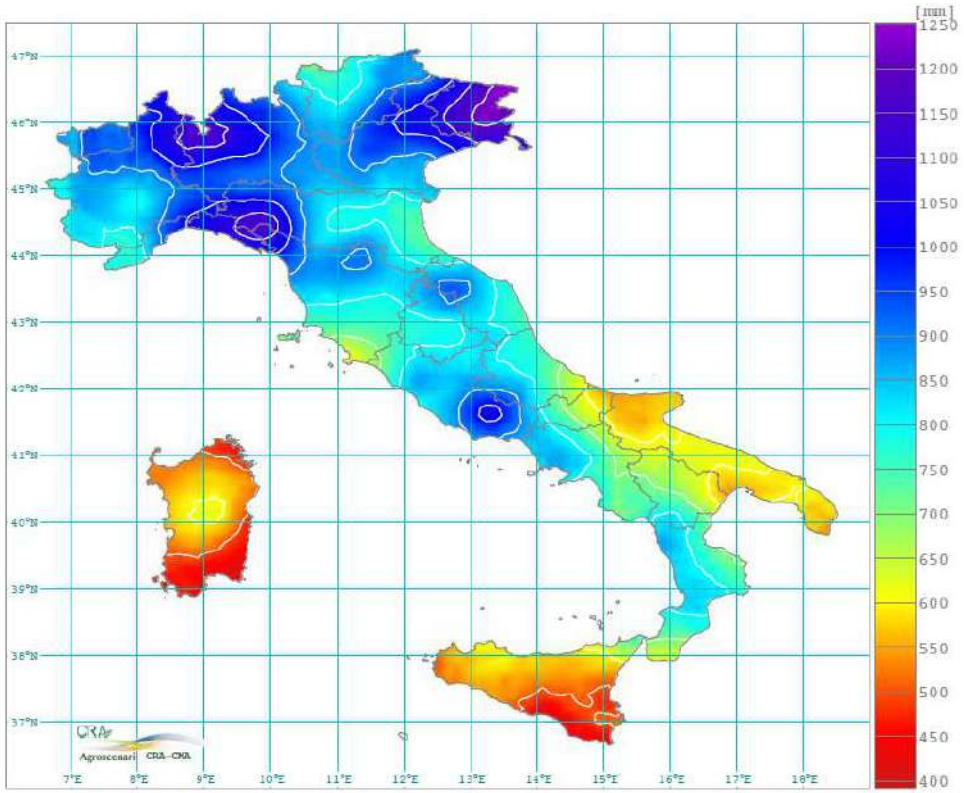
Crespi A., Brunetti M., Lentini G., Maugeri M., 2018, 1961–1990 high-resolution monthly precipitation climatologies for Italy, Int. J. Climatol. 38: 878–895 DOI: 10.1002/joc.5217

# CONFRONTO 3

## BIGBANG 4.0 [1971-2000]: 922 mm



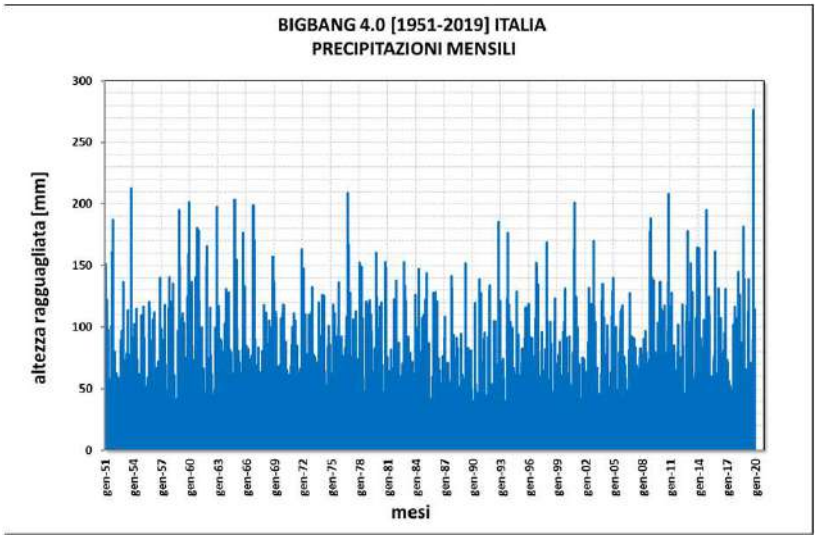

## Esposito et al. 2015 [1971-2000]: 765.3 mm

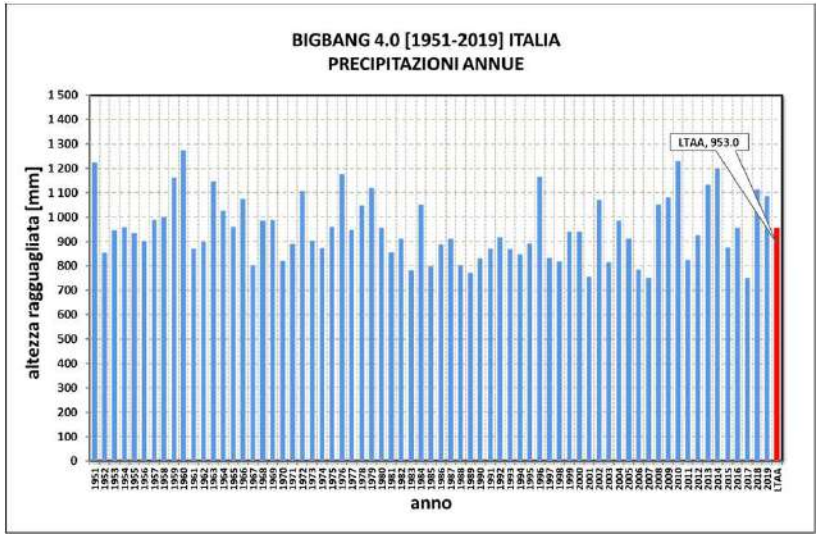


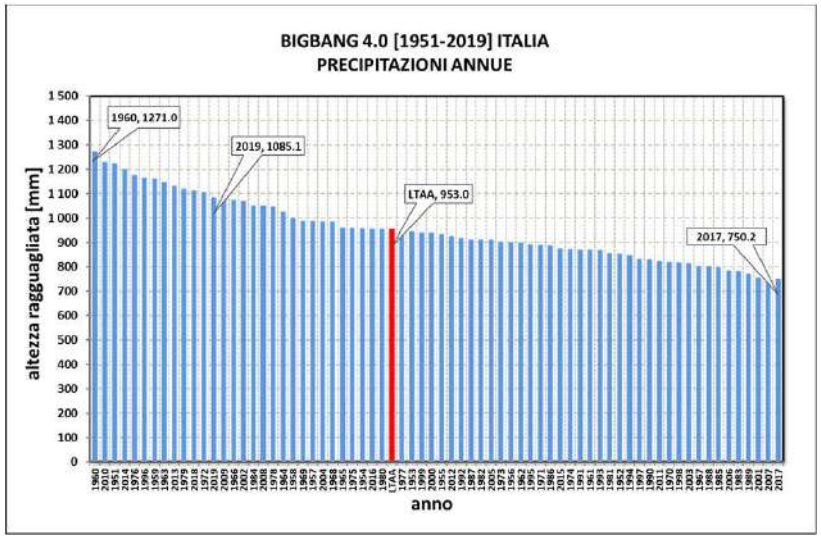

Precipitazione totale annua (1971-2000)

Esposito S., Beltrano M. C., De Natale F., Di Giuseppe E., Iafrate L., Libertà A., Parisse B. e Scaglione M., 2015 - ***Atlante italiano del clima e dei cambiamenti climatici***. Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Unità di ricerca per la climatologia e la meteorologia applicate all'agricoltura. Roma, pp. 264.

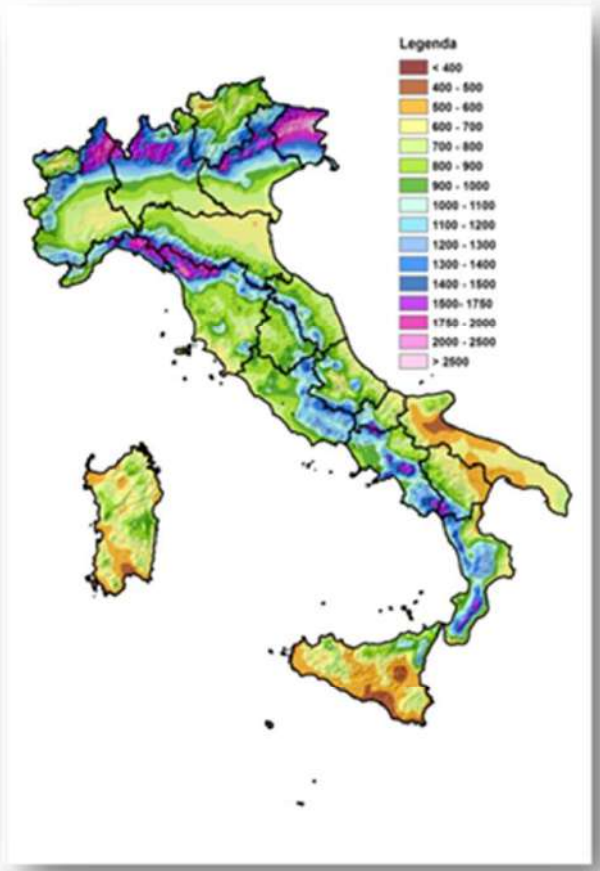
# SERIE STORICA PRECIPITAZIONI



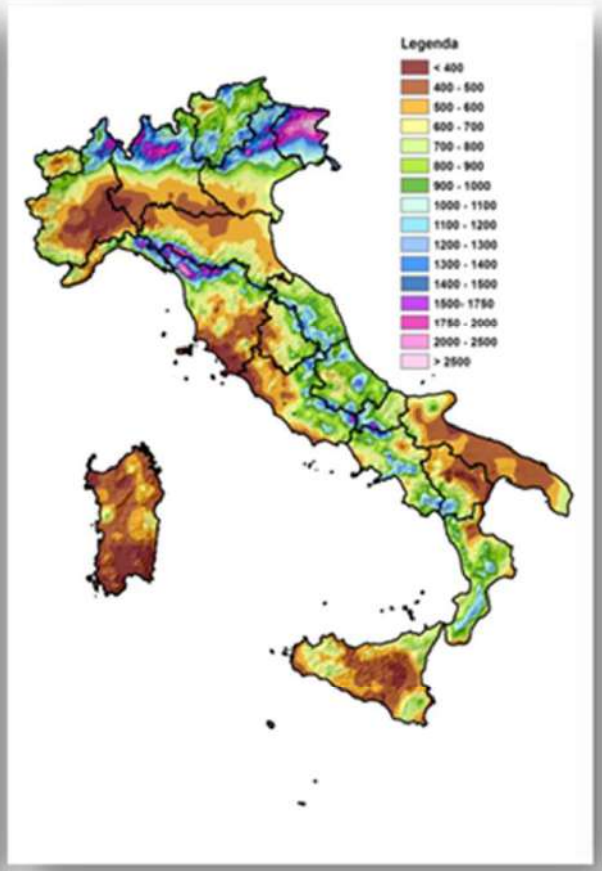



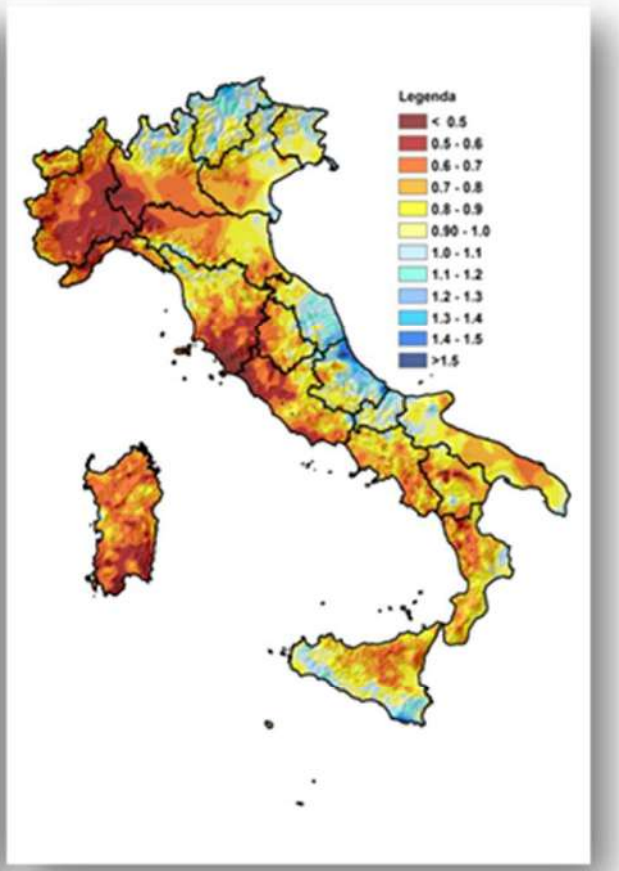
# PRECIPITAZIONE ANNUA 2017




Precipitazione annua media 1961–2017

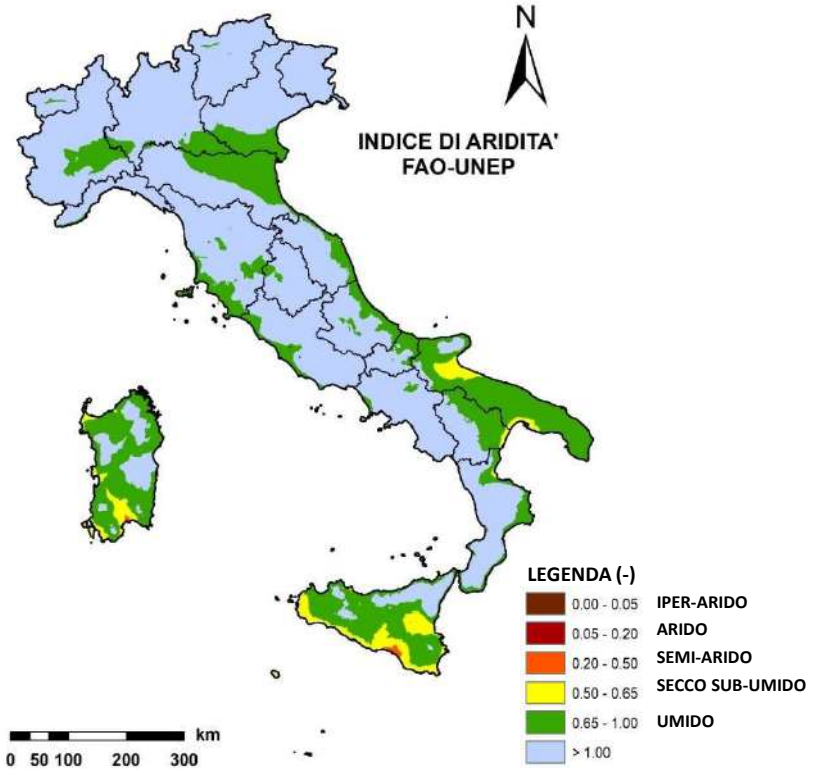



Precipitazione annua 2017



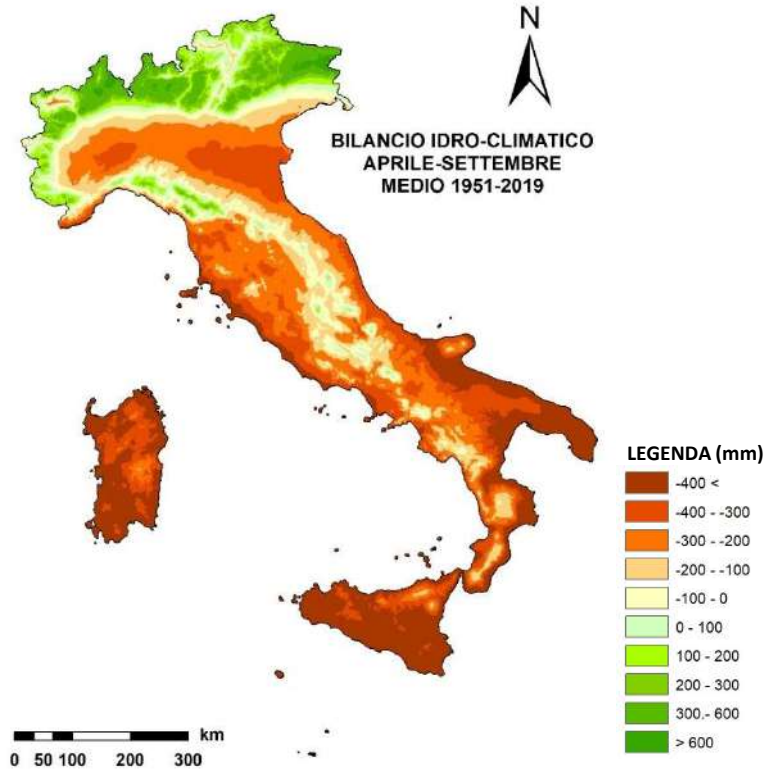

Rapporto $P_{2017}/P_{media}$

# INDICATORI BASATI SULLE PRECIPITAZIONI




**Indice di aridità FAO-UNEP (AI): valori medi relativi al periodo 1951–2019**

$$AI = \frac{\bar{P}}{\overline{PET}}$$

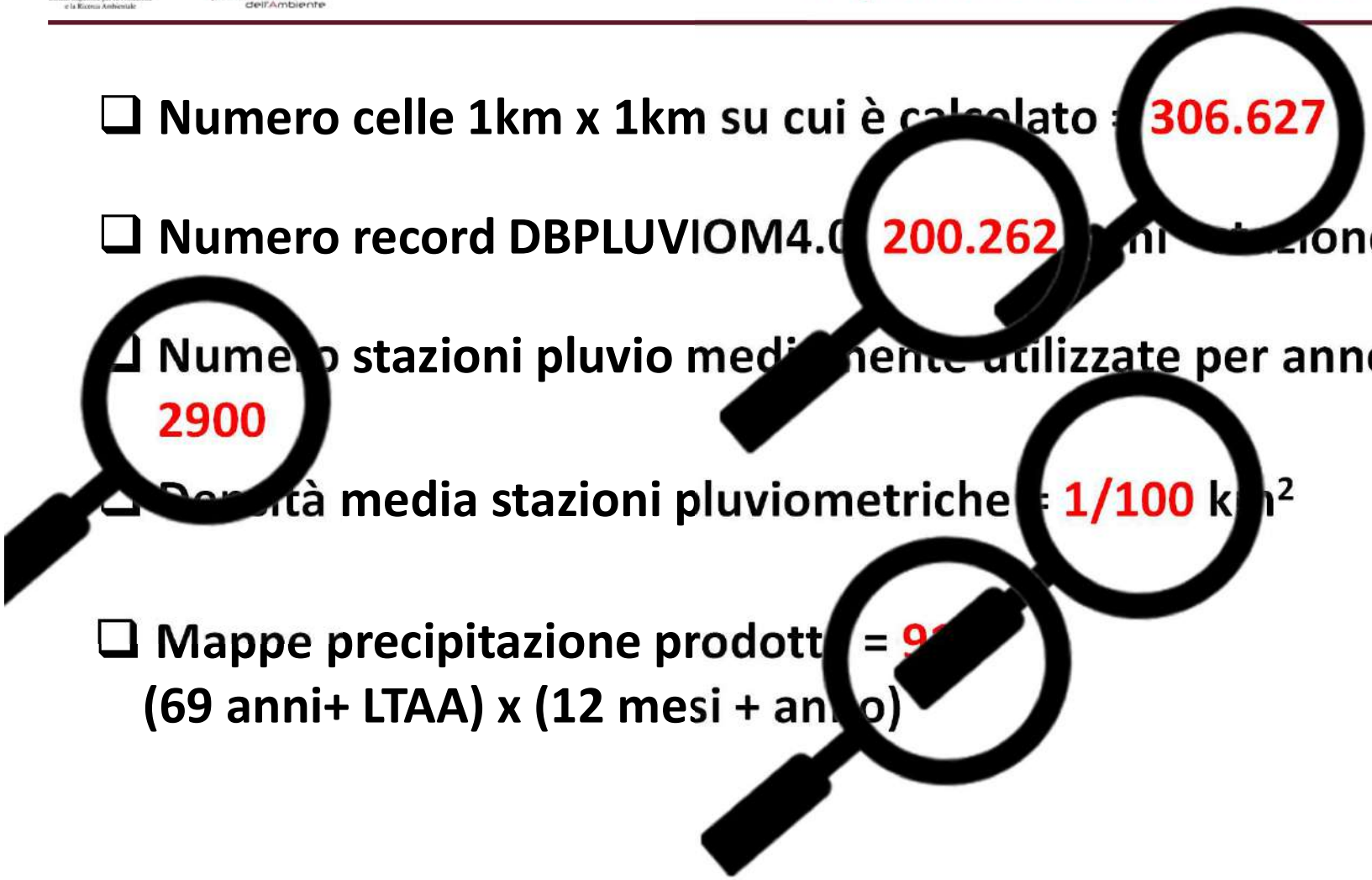



**Bilancio idro-climatico (BIC): aprile-settembre medio 1951–2019**

$$BIC_{\Delta t} = (P - PET)_{\Delta t}$$

# … qualche numero su BIGBANG 4.0

- Numero celle 1km x 1km su cui è calcolato = 306.627
- Numero record DBPLUVIOM4.0 = 200.262 [illegible]
- Numero stazioni pluvio mediamente utilizzate per anno = 2900
- Densità media stazioni pluviometriche = 1/100 km$^2$
- Mappe precipitazione prodotte = [illegible]
  (69 anni+ LTAA) x (12 mesi + anno)



# Grazie per l'attenzione!

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stefano.mariani@isprambiente.it


**Rapporto BIGBANG:**
https://www.isprambiente.gov.it/it/pubblicazioni/rapporti/il-bilancio-idrologico-gis-based-a-scala-nazionale-su-griglia-regolare-bigbang

**Elaborazioni BIGBANG (grids & tables)**



http://groupware.sinanet.isprambiente.it/bigbang-data/library/bigbang40
http://groupware.sinanet.isprambiente.it/bigbang-data/library/bigbang40/excel-tables