

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



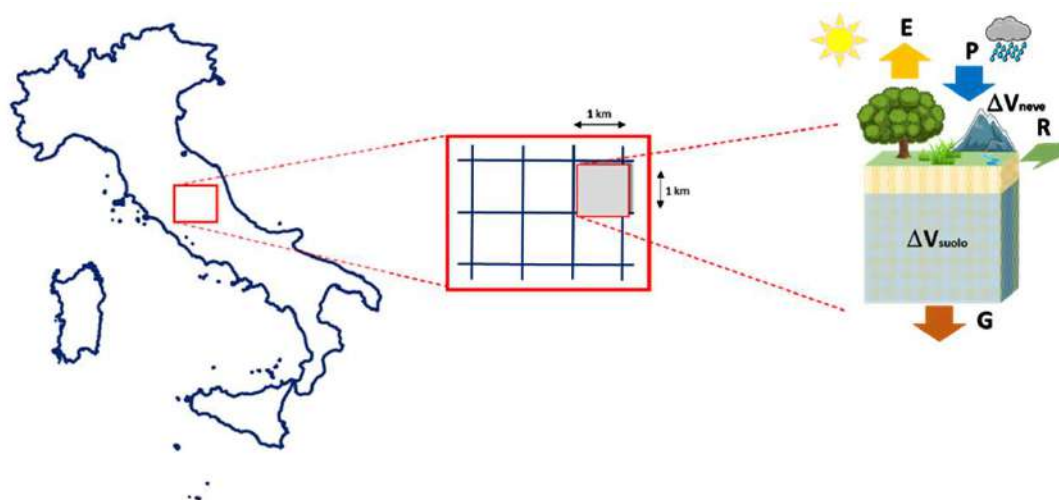
Giovanni Braca e Stefano Mariani

Dipartimento per il monitoraggio e la tutela dell'ambiente e per la
conservazione della biodiversità

Area per l'idrologia, l'idrodinamica e l'idromorfologia, lo stato e la dinamica
evolutiva degli ecosistemi delle acque interne superficiali

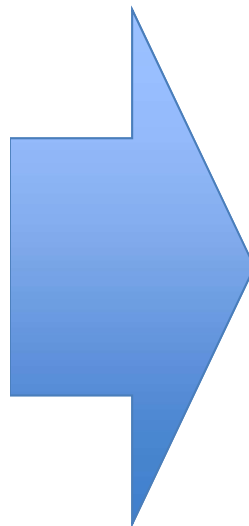
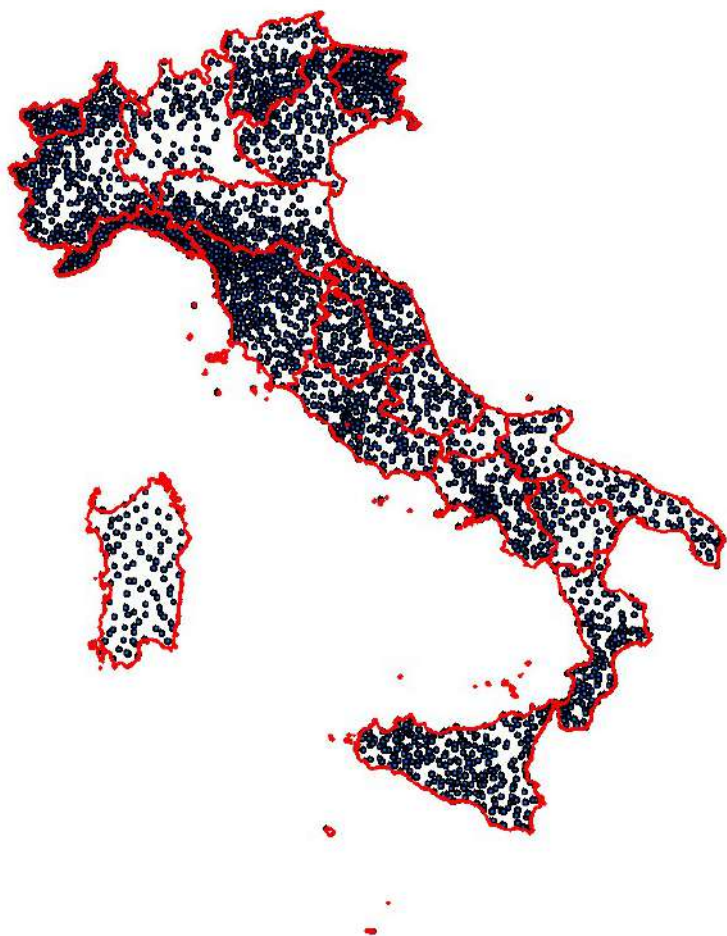
BILANCIO IDROLOGICO GIS BASED A SCALA NAZIONALE SU GRIGLIA REGOLARE

MODELLO DISTRIBUITO

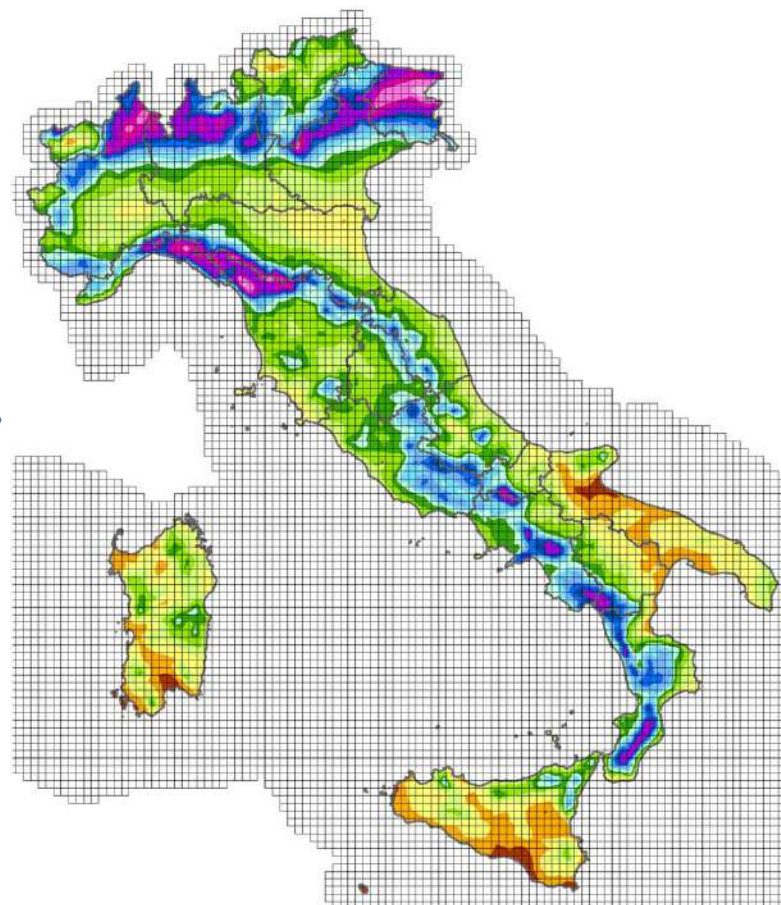


$$P - E = R + G + \Delta V$$

Vector (point)

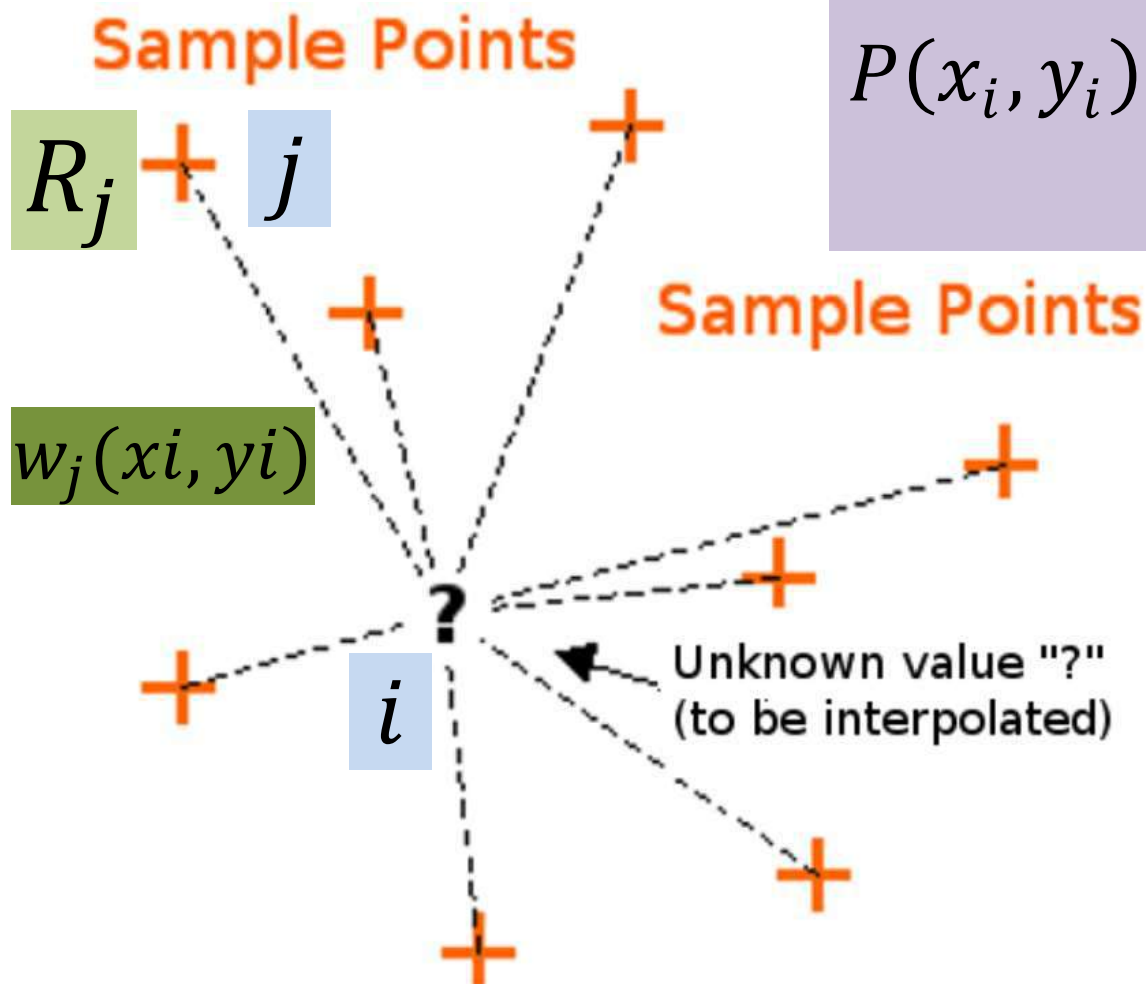


Raster 1 km x 1 km



INTERPOLAZIONE SPAZIALE

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



- NEAREST NEIGHBOURS (POLIGONI DI THIESSEN)
- **NATURAL NEIGHBOURS (INTERPOLAZIONE VORONOI)**
- IDW (INVERSE DISTANCE WEIGHTED)
- TIN (Interpolation Delaunay Triangulation)
- SPLINE
- POLINOMIAL FITTING
- RADIAL BASIS FUNCTIONS
- GEOSTATISTICAL METHODS - KRIGING (OK, UK, BK, IK, RK, DK, CoK, ecc.)
- REGRESSION MODELS (es. PRISM-Parameter-elevation Regressions on Independent Slopes Model)
-

- | | | | |
|-------------------------|-----------------------|-----------------------|------------------|
| • <u>DETERMINISTICO</u> | • <u>ESATTO</u> | • <u>UNIVARIATO</u> | • <u>LOCALE</u> |
| • STOCASTICO | • APPROSSIMATO | • MULTIVARIATO | • GLOBALE |
-

<https://prism.oregonstate.edu/>



PRISM
CLIMATE GROUP

Northwest Alliance for Computational Science and Engineering

Home Normals Comparisons This Month Prior 6 Months Recent Years Historical Past Projects Explorer FAQ

What's new at PRISM

30-Year Normals

The normals are baseline datasets describing **average monthly and annual conditions over the most recent three full decades**. They are our most popular datasets. The current PRISM normals cover the period **1981-2010**.

Long-term average datasets are modeled with PRISM using a digital elevation model (DEM) as the predictor grid. Given their importance, the normals were subjected to extensive peer review. See [PRISM datasets](#) for more information; the data available from this page is "Norm81m" (normals). For information on when the grids were most recently updated, see [calendar of PRISM data updates](#).

PRISM normals are available for certain [other regions](#) as well (Virgin Islands, Jamaica, Pacific Islands [including Hawaii]).

Spatial resolution needed: ☒ 4km (approx. 1MB per data file; 300KB per full-size image) ☐ 800m (18-350MB per data file; 5MB per full-size image)

Climate variable: ☒ precipitation ☐ mean temperature ☐ minimum temperature ☐ maximum temperature
☐ mean dew point temperature ☐ minimum vapor pressure deficit ☐ maximum vapor pressure deficit ☐ elevation

Temporal period: ☒ annual values ☐ monthly values for January

Download Full-Size Image

Download Data (.bil)

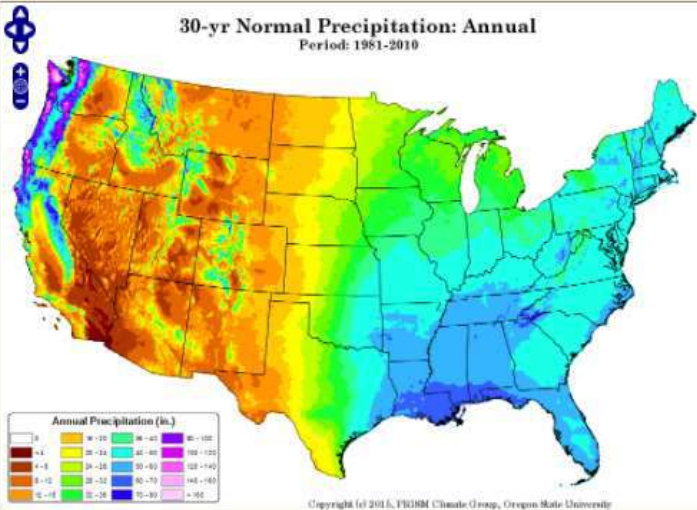
Download All Normals Data (.bil)

View/Download Metadata

Download Data (.asc)

Download All Normals Data (.asc)

[Formats available](#)
[Terms of use](#)



30-yr Normal Precipitation: Annual
Period: 1981-2010

Annual Precipitation (in.)

0-4	4-8	8-12	12-16	16-20	20-24	24-28	28-32	32-36	36-40	40-44	44-48	48-52	52-56	56-60	60-64	64-68	68-72	72-76	76-80	80-84	84-88	88-92	92-96	96-100	100-104	104-108	108-112	112-116	116-120	120-124	124-128	128-132	132-136	136-140	140-144	144-148	148-152	152-156	156-160	160-164	164-168	168-172	172-176	176-180	180-184	184-188	188-192	192-196	196-200	200-204	204-208	208-212	212-216	216-220	220-224	224-228	228-232	232-236	236-240	240-244	244-248	248-252	252-256	256-260	260-264	264-268	268-272	272-276	276-280	280-284	284-288	288-292	292-296	296-300
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Questions to prism-questions@oregonstate.edu
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PERCHÈ IL METODO NATURAL NEIGHBOURS?

PRO

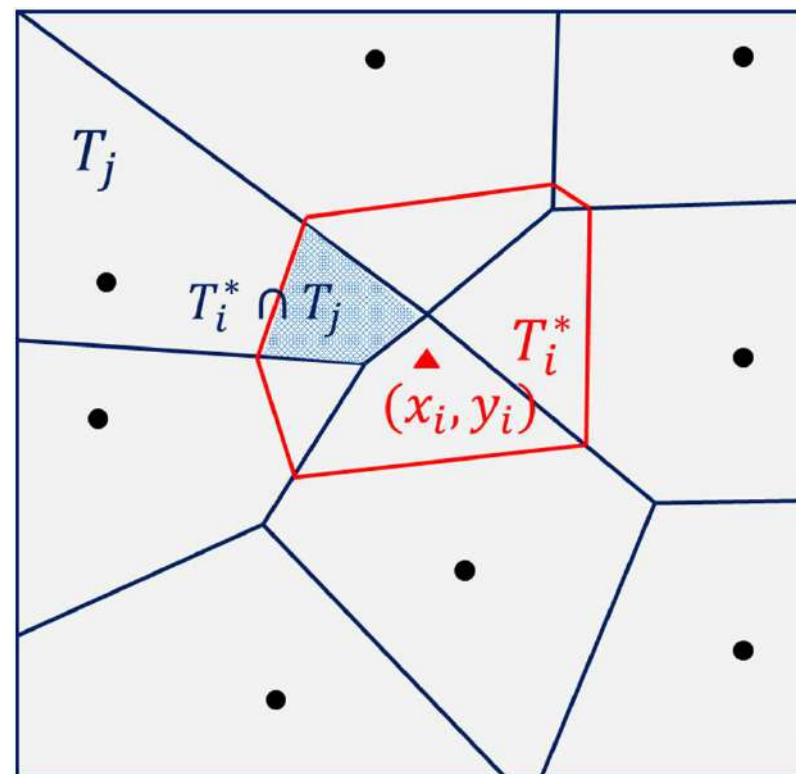
- è implementato nei tools dell'ambiente GIS utilizzato;
- è un metodo deterministico di semplice interpretazione;
- è un interpolatore esatto;
- non richiede parametri di taratura;
- presenta normalmente in maniera ridotta l'effetto "bull's eye";
- richiede un impegno computazionale inferiore rispetto 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'involuppo convesso (convex hull)
-

SCHEMA DI CALCOLO DEI PESI

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



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

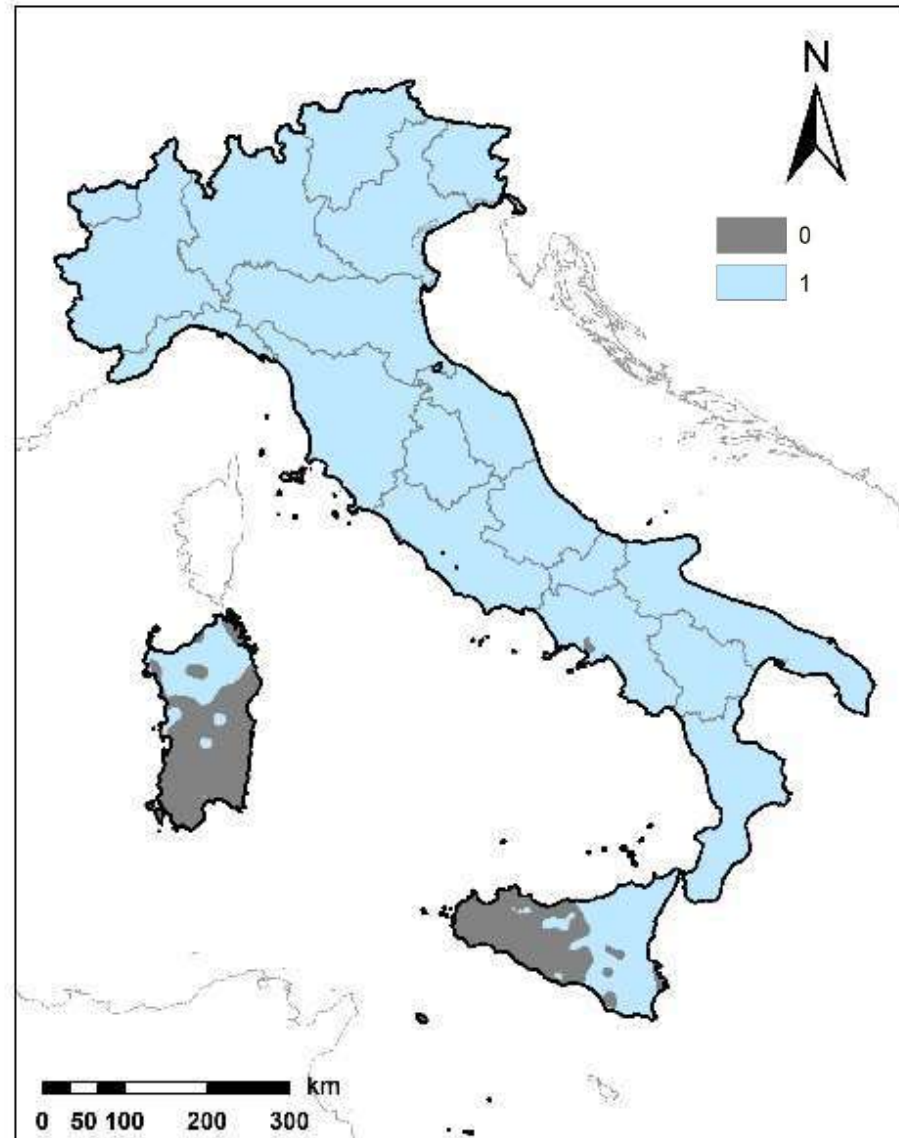
NATURAL NEIGHBOURS: 1° STEP

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

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

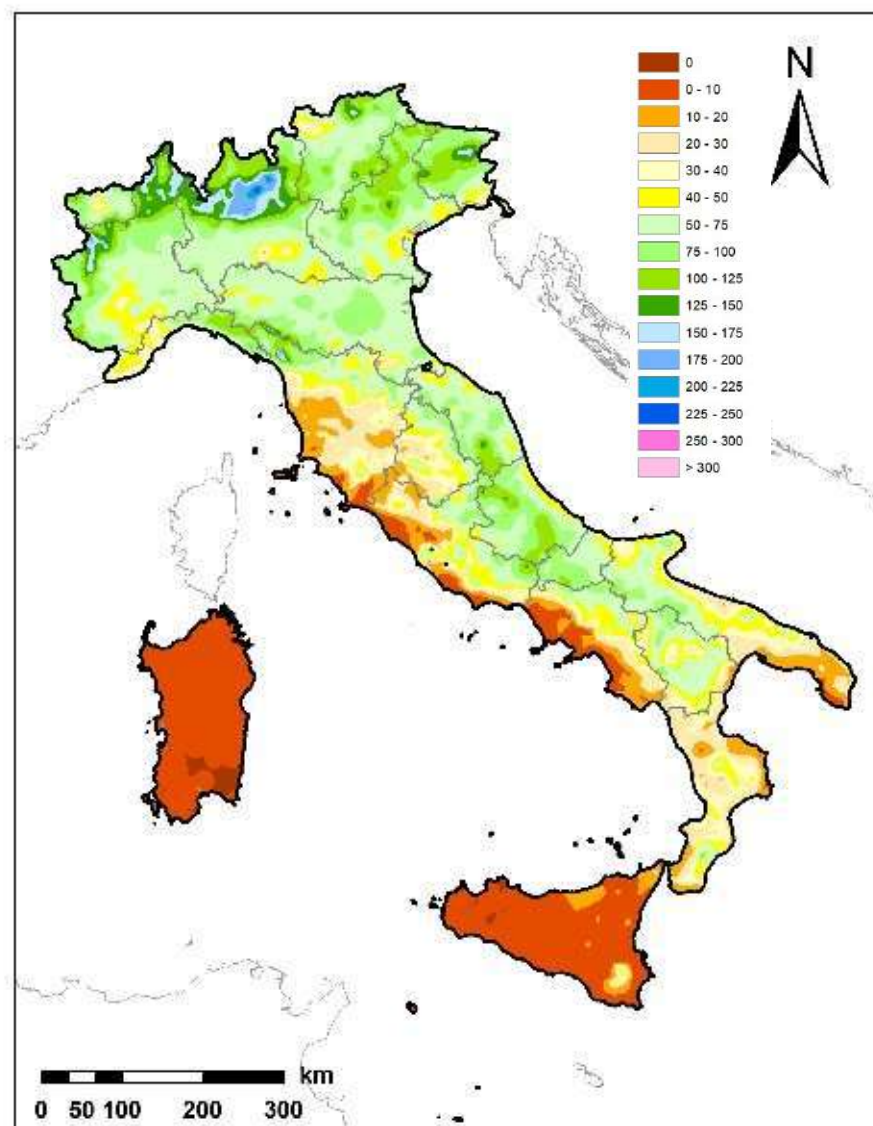
Si pongono uguale a 1 i valori maggiori di 0.5 e uguale a zero i valori minori o uguali a 0.5.

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

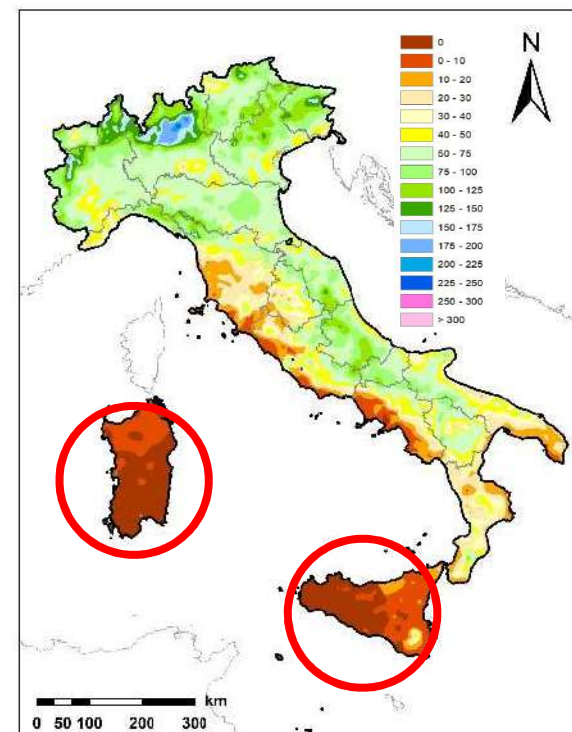
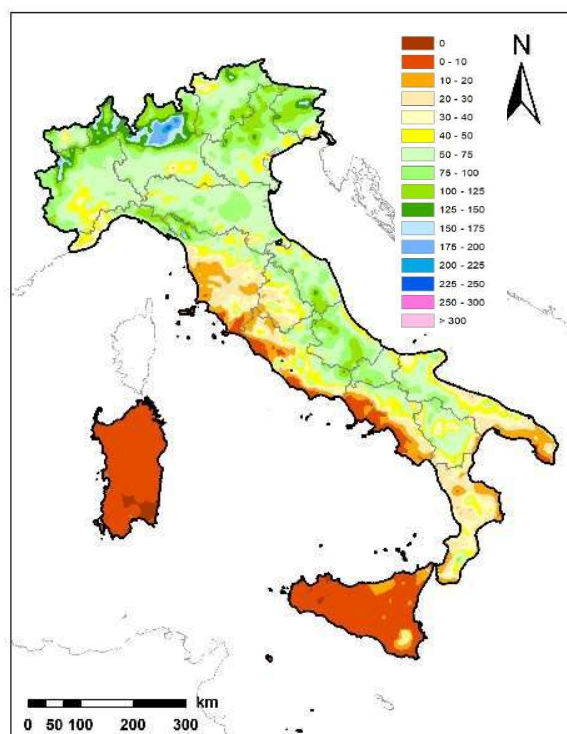
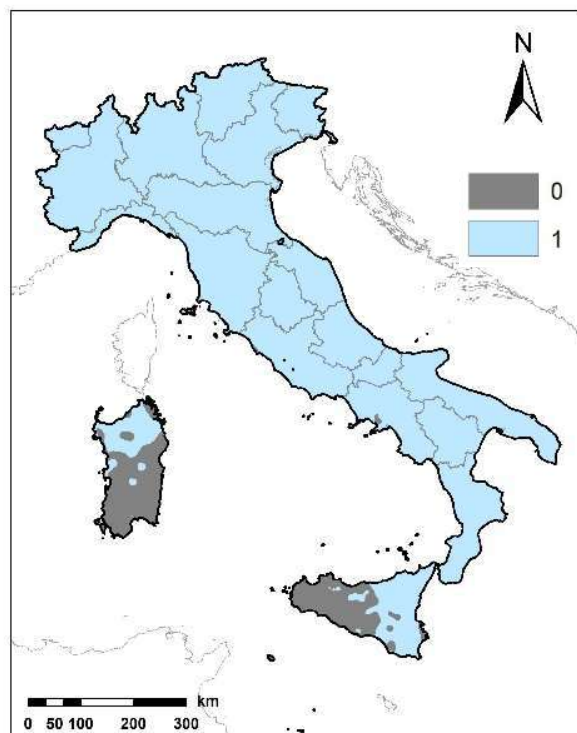


NATURAL NEIGHBOURS: 2° STEP

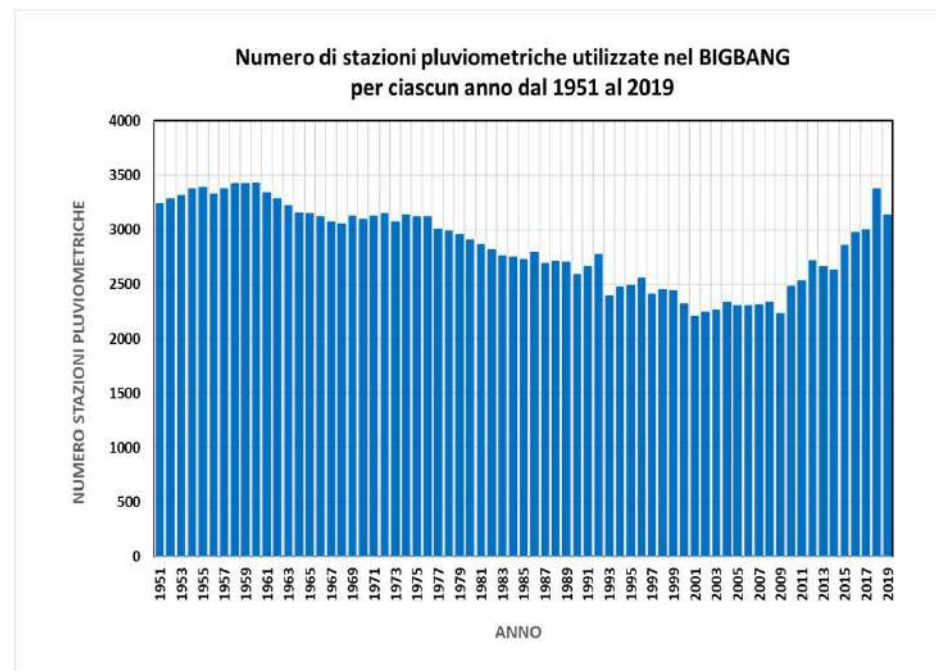
Nel secondo passo viene interpolata
la variabile climatica



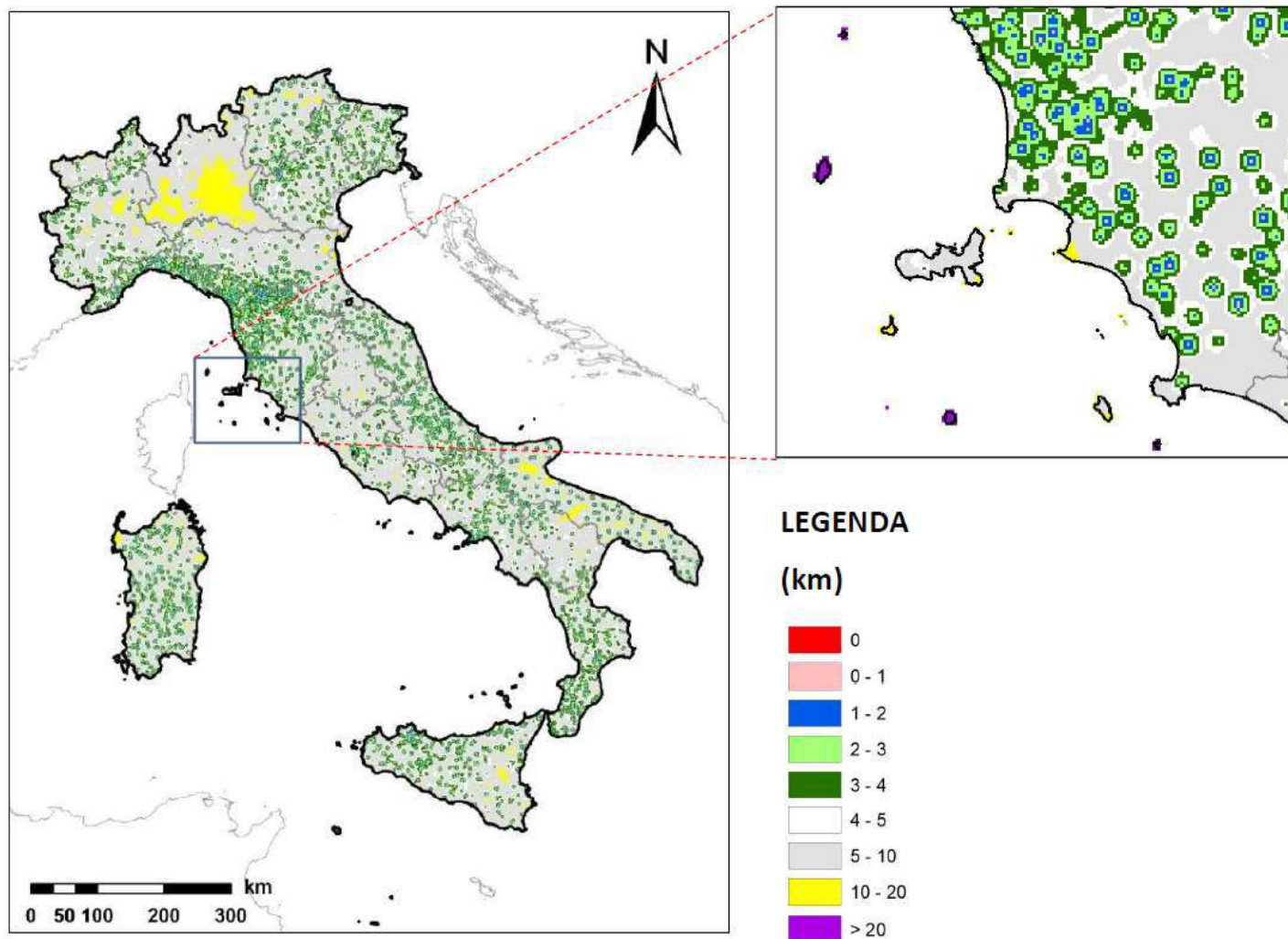
NATURAL NEIGHBOURS: RISULTATO FINALE



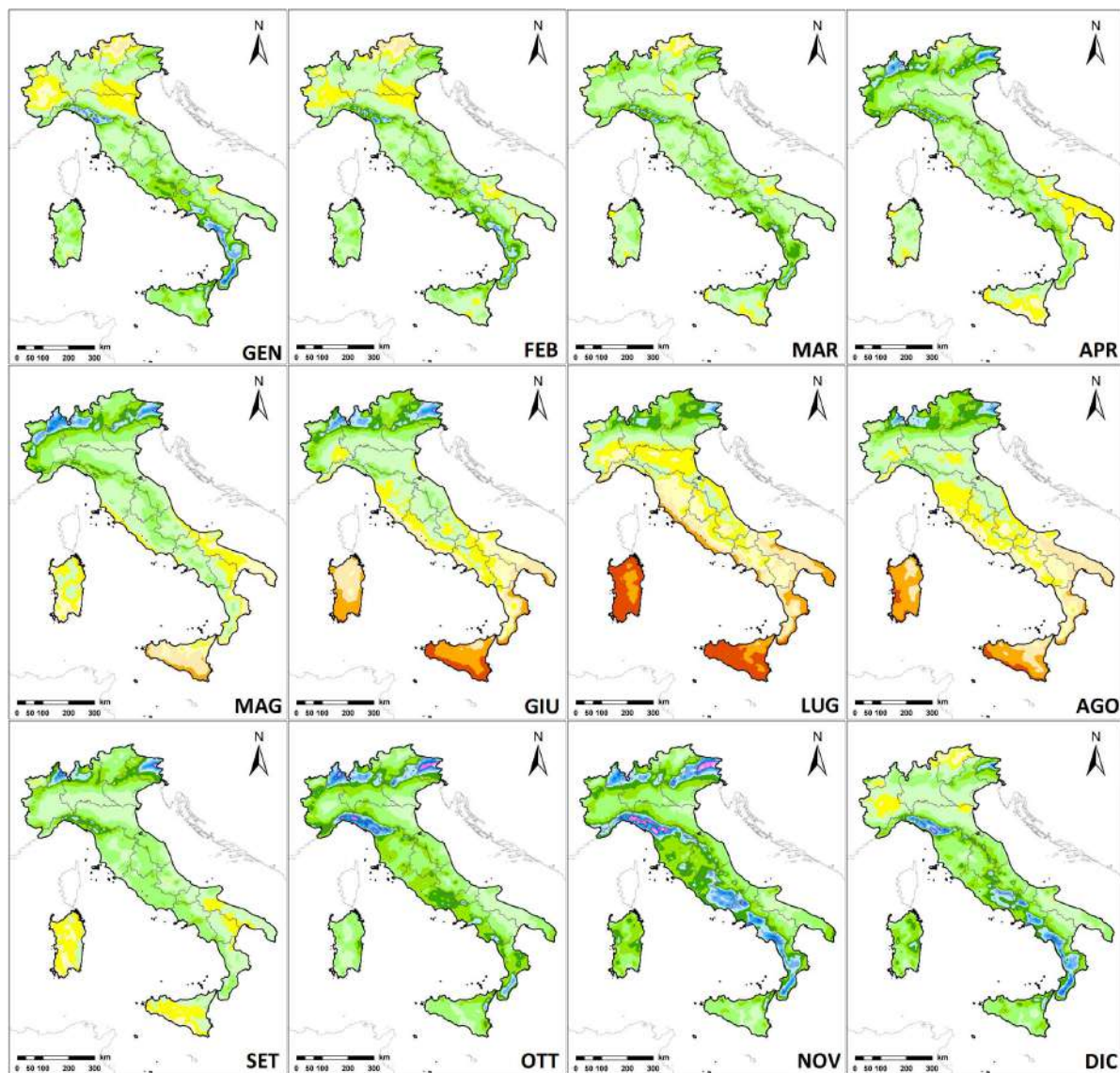
STAZIONI PLUVIOMETRICHE



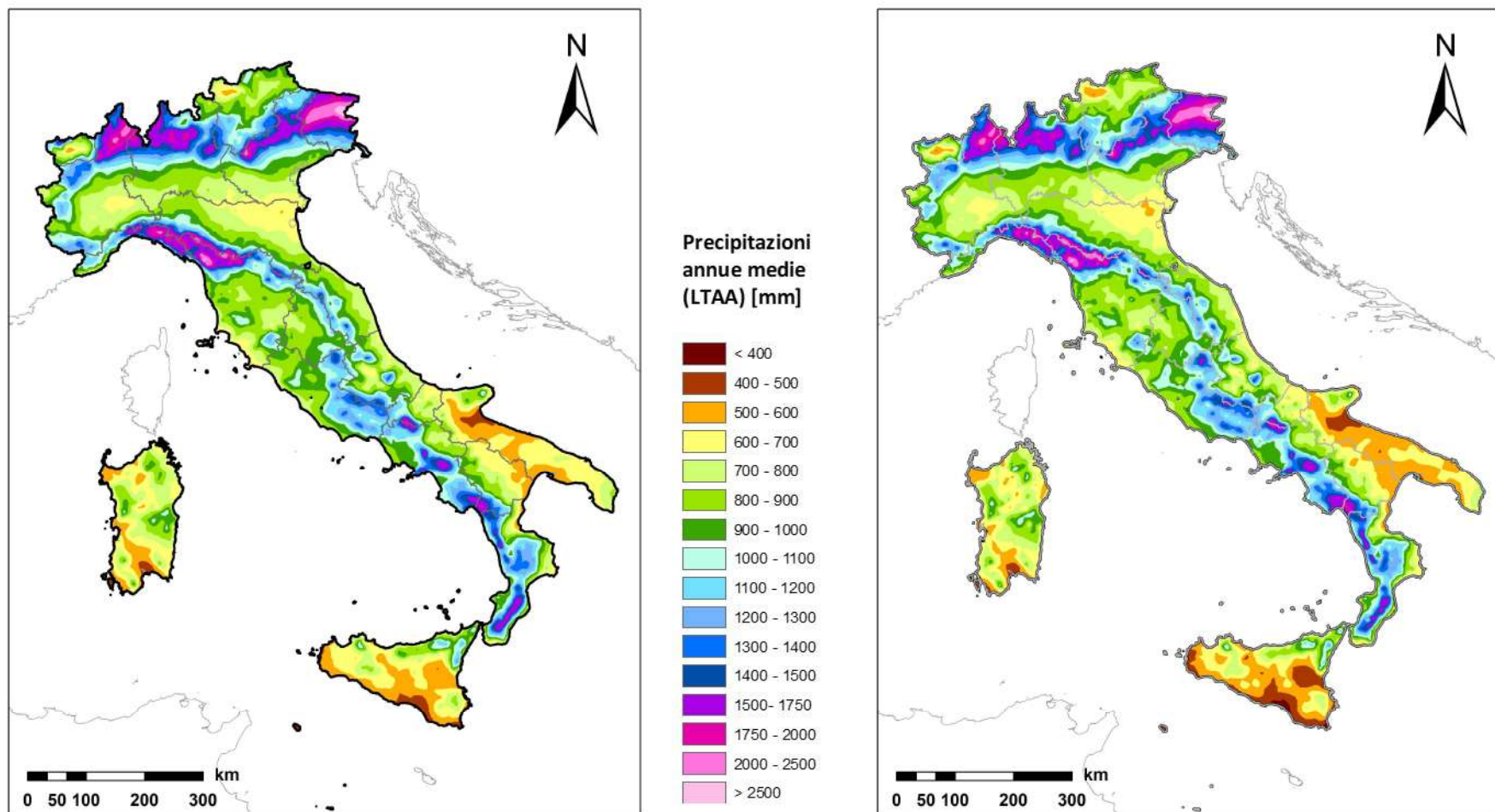
“grid then average” o *“average then grid”* ?

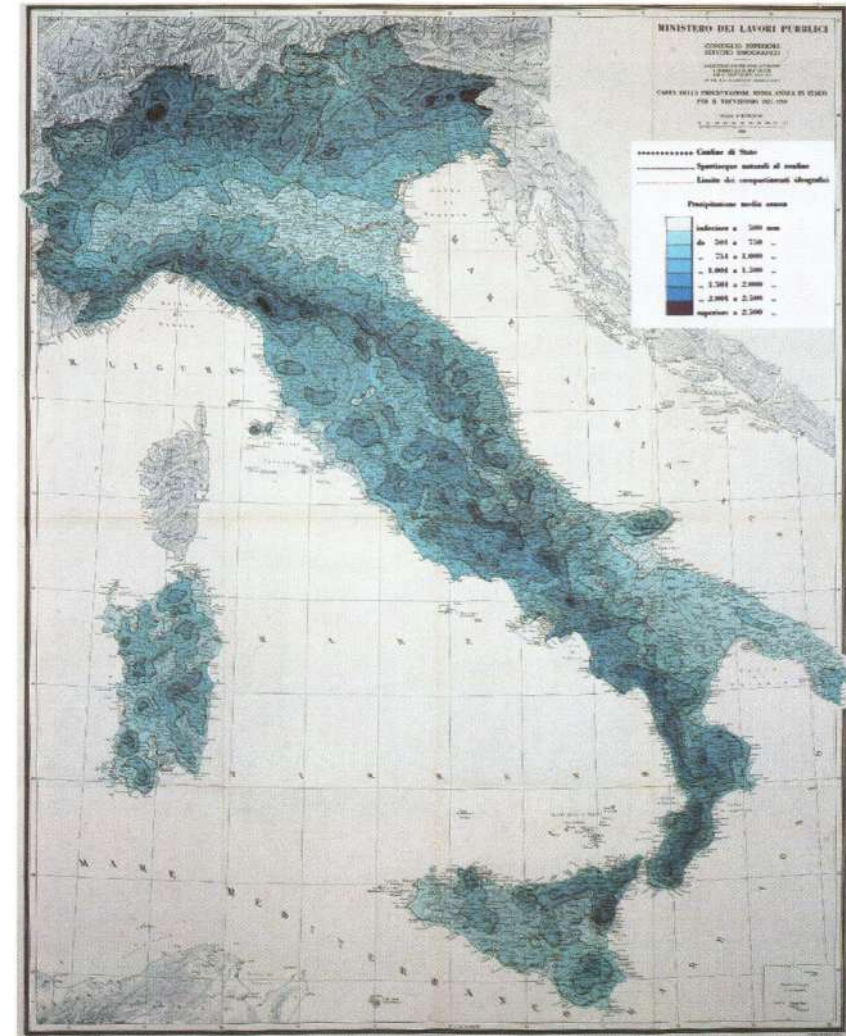
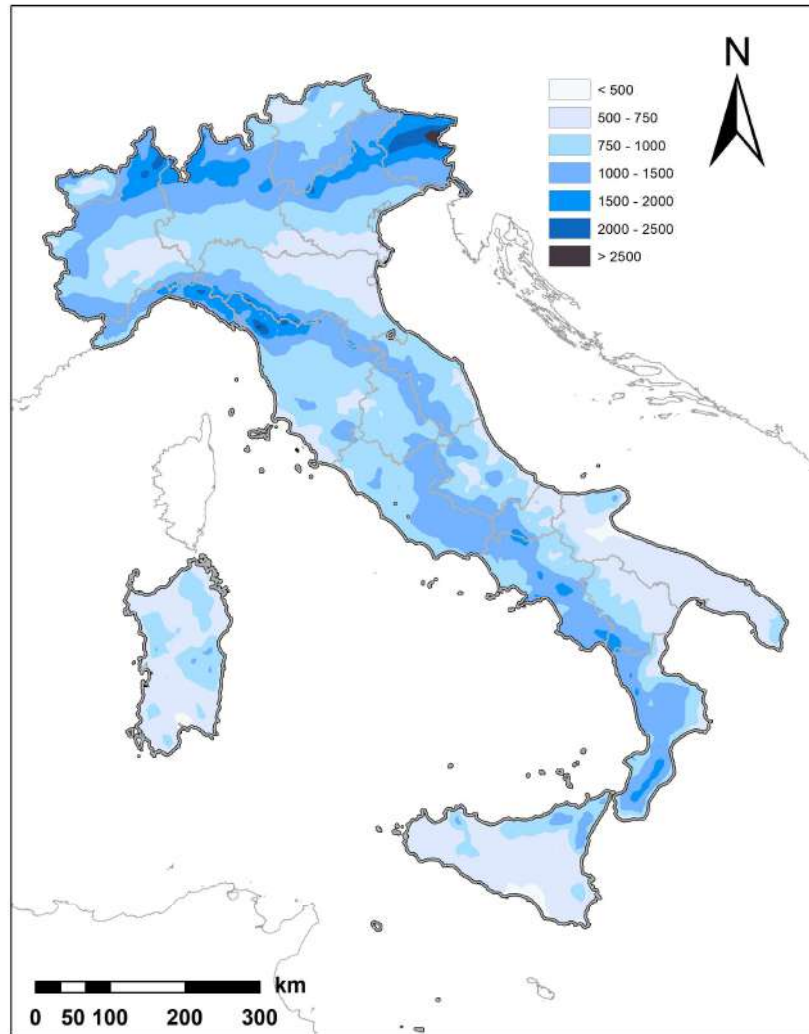


PRECIPITAZIONI MENSILI MEDIE



PRECIPITAZIONI ANNUE MEDIE





BIGBANG 4.0 [1951–2019]: 953 mm

Servizio Idrografico [1921–1950]: 990 mm

BIGBANG 4.0 [1961-1990]: 938 mm

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

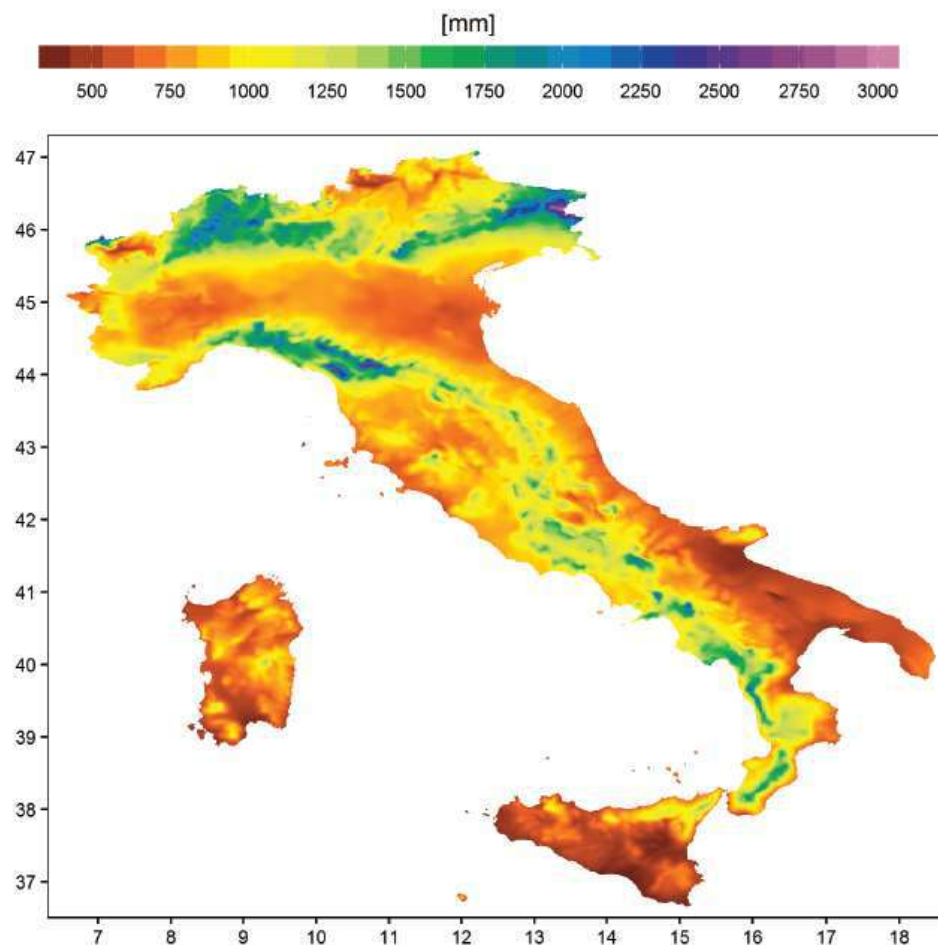
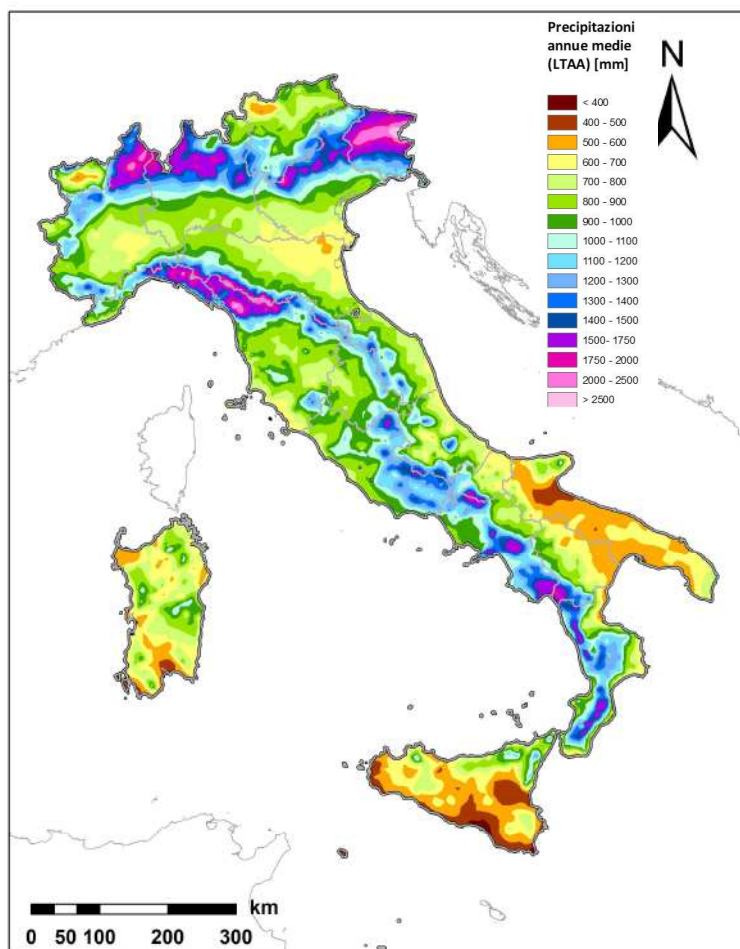


Figure 12. Annual LWLR precipitation climatology.

BIGBANG 4.0 [1961-1990]: 938 mm

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

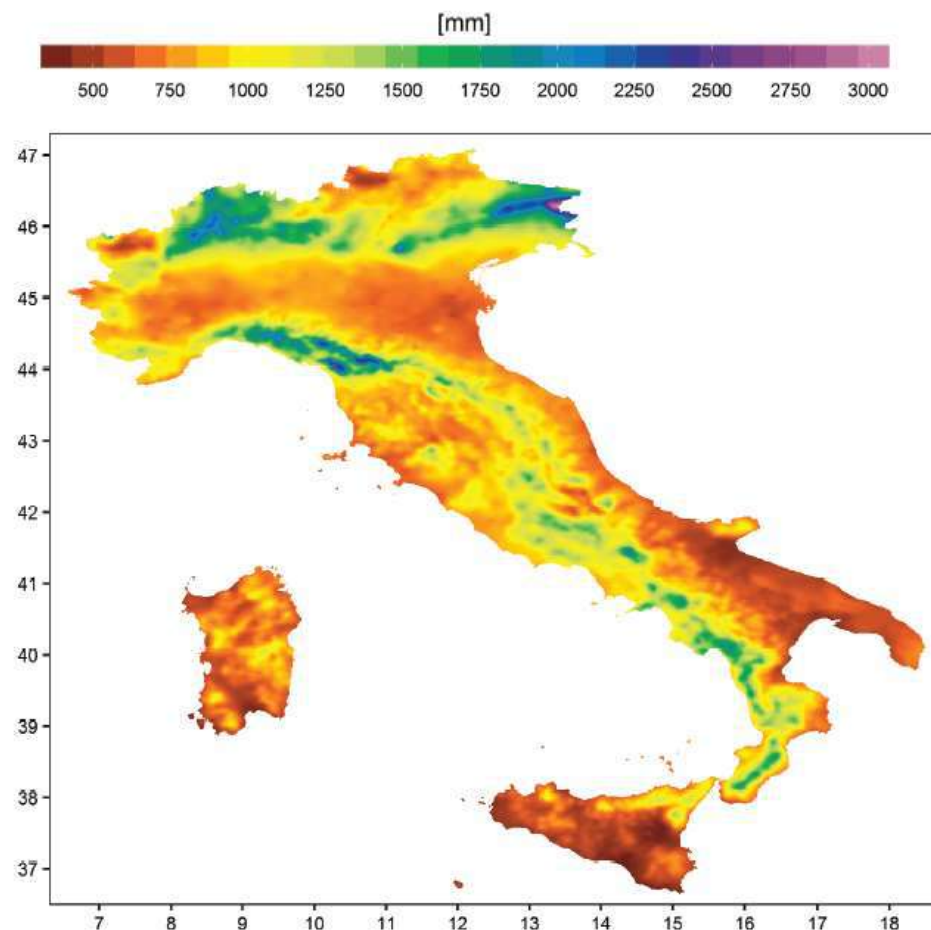
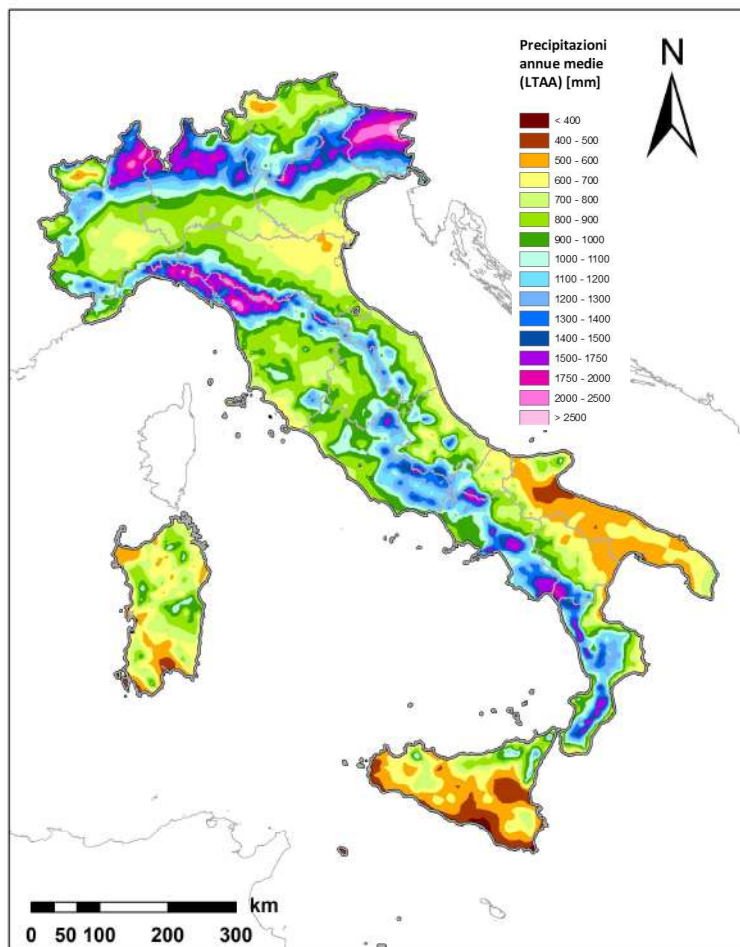
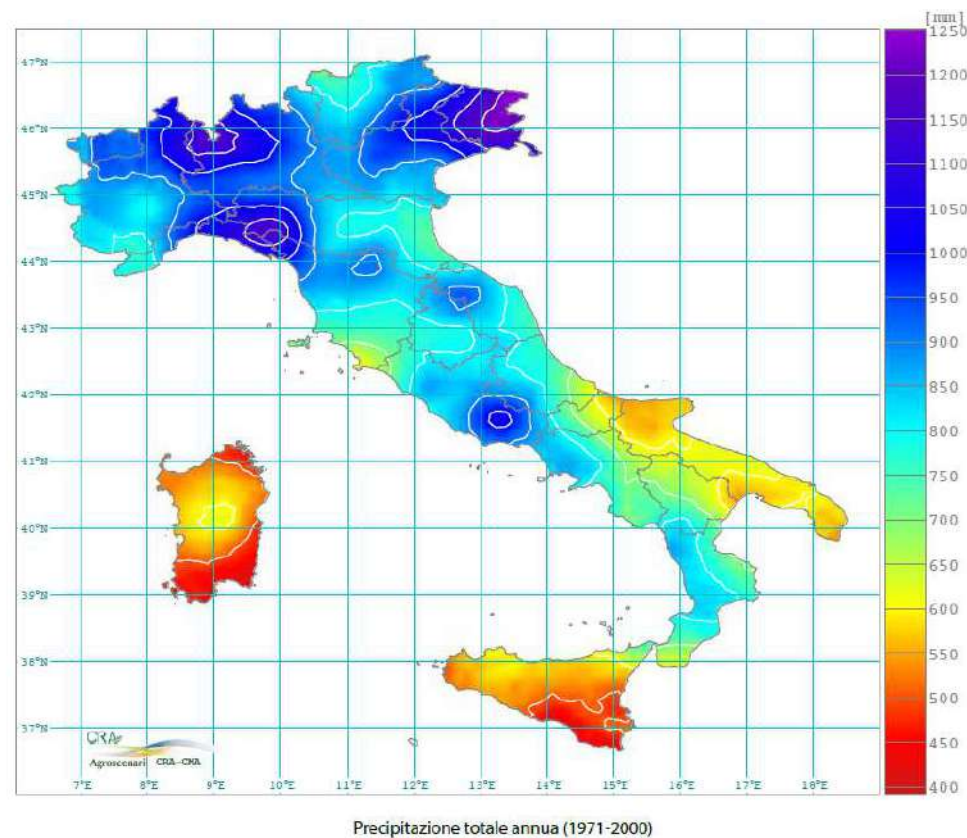
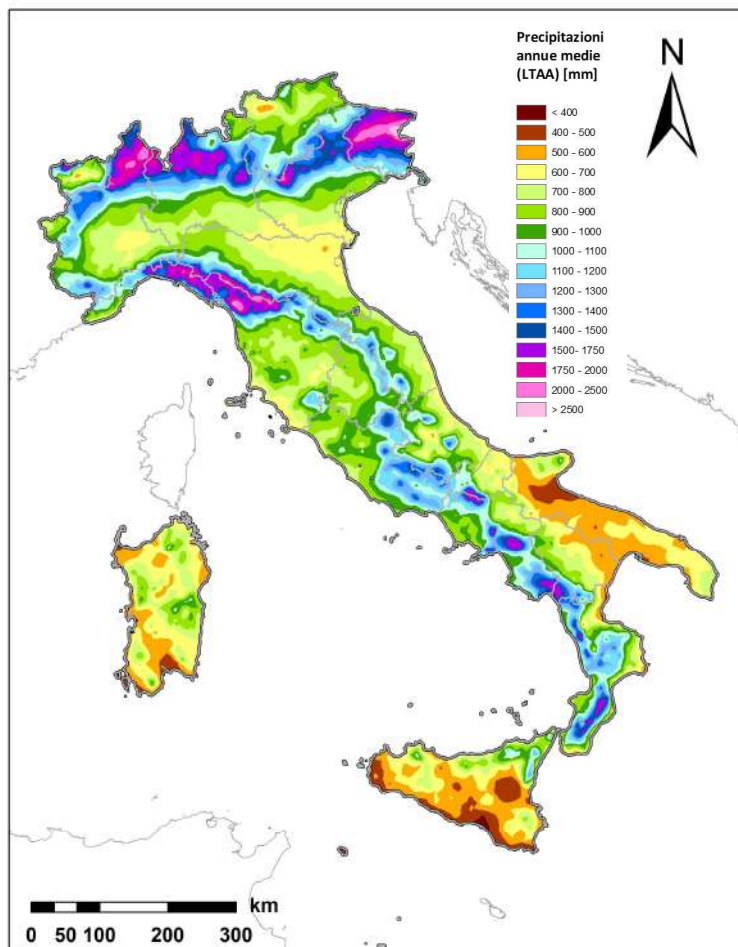


Figure 13. Annual RK precipitation climatology.

BIGBANG 4.0 [1971-2000]: 922 mm

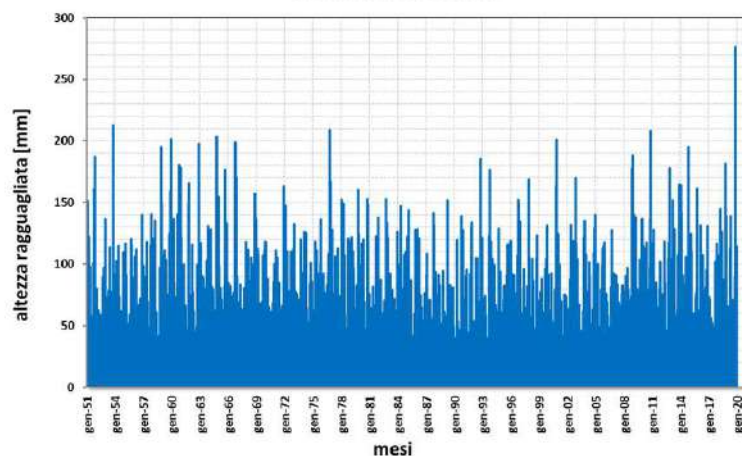
Esposito et al. 2015 [1971-2000]: 765.3 mm



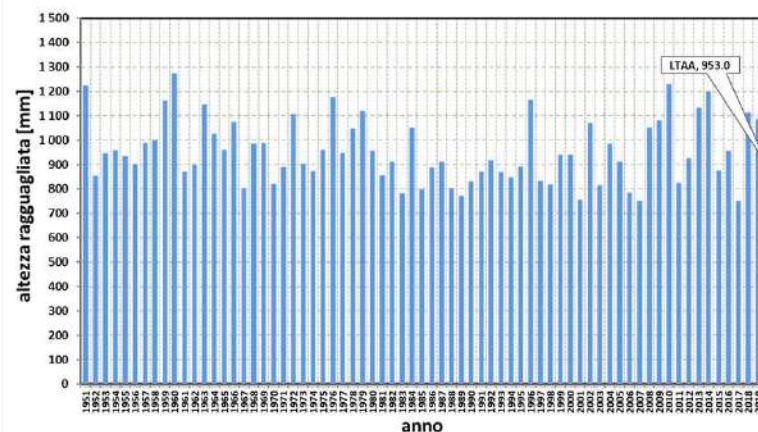
Esposito S., Beltrano M. C., De Natale F., Di Giuseppe E., Iafrate L., Libertà A., Parisse B. e Scaglione M., 2015 - *Atlante italiano del clima e dei cambiamenti climatici*. Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Unità di ricerca per la climatologia e la meteorologia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

SERIE STORICA PRECIPITAZIONI

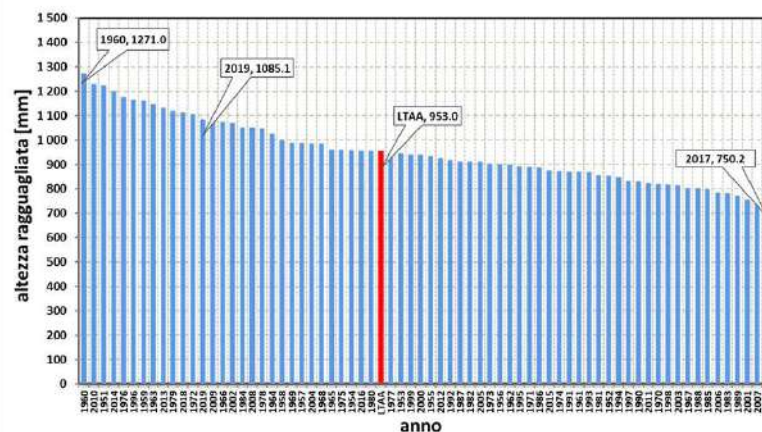
BIGBANG 4.0 [1951-2019] ITALIA
PRECIPITAZIONI MENSILI



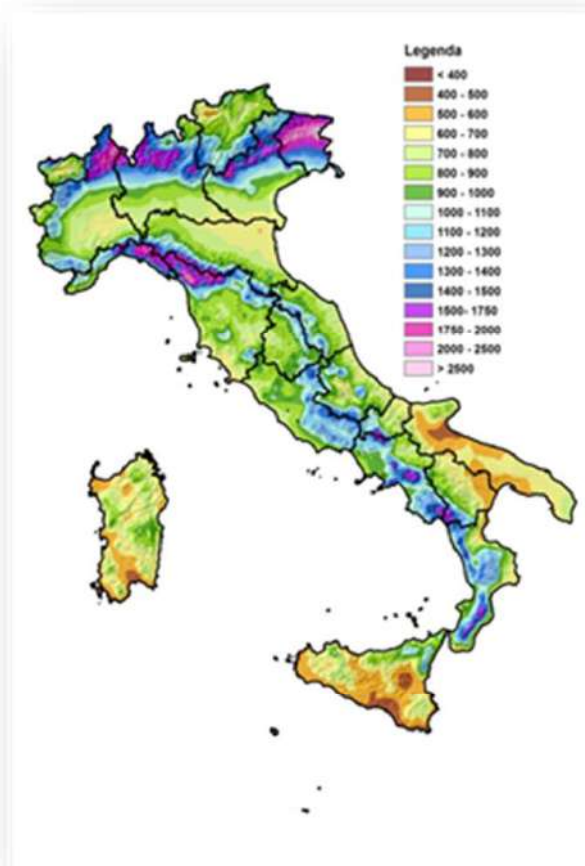
BIGBANG 4.0 [1951-2019] ITALIA
PRECIPITAZIONI ANNUE



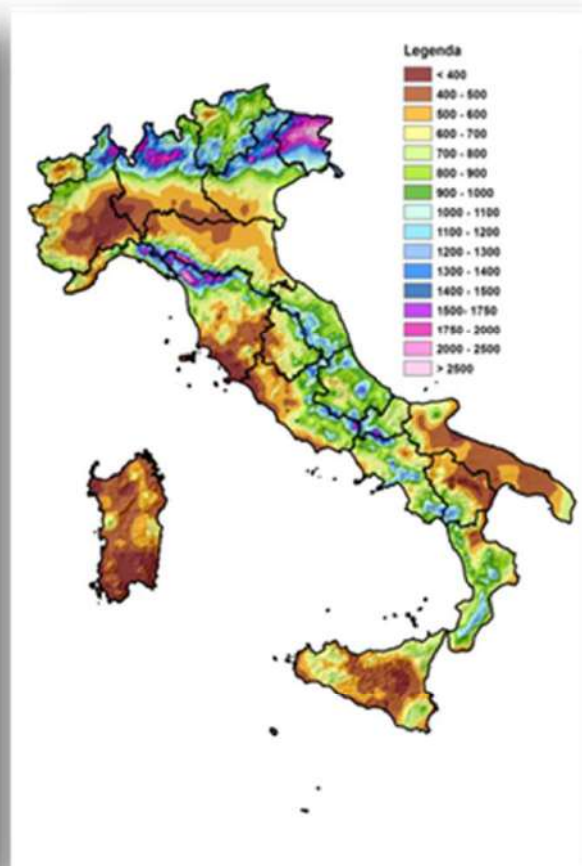
BIGBANG 4.0 [1951-2019] ITALIA
PRECIPITAZIONI ANNUE



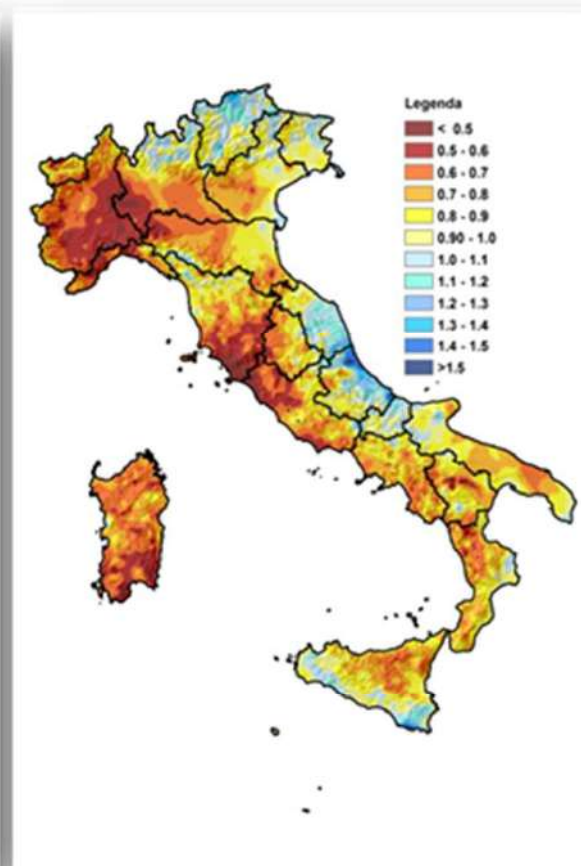
PRECIPITAZIONE ANNUA 2017



**Precipitazione annua
media 1961–2017**

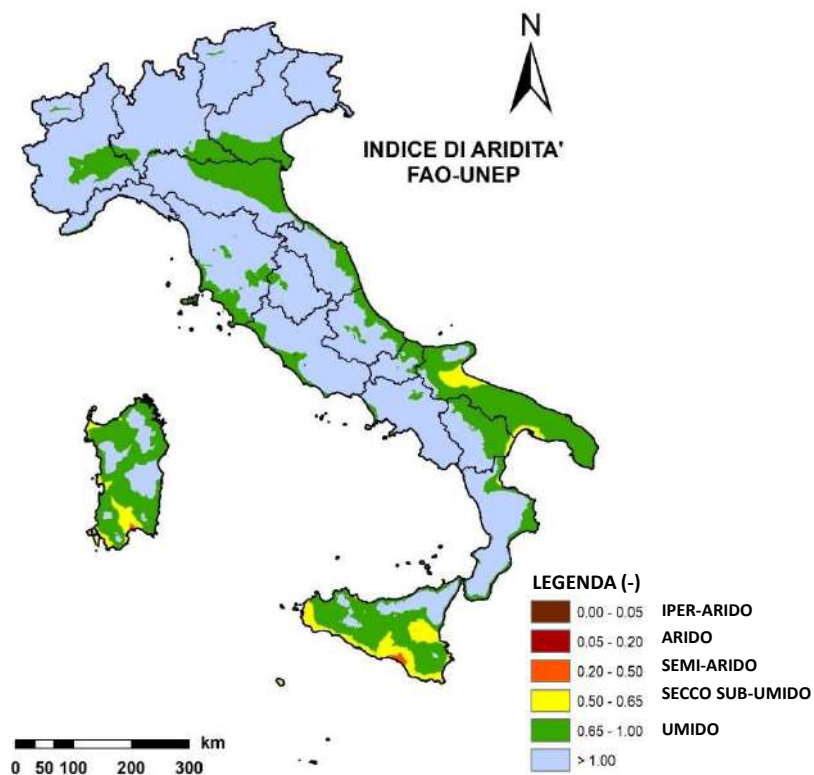


**Precipitazione
annua 2017**



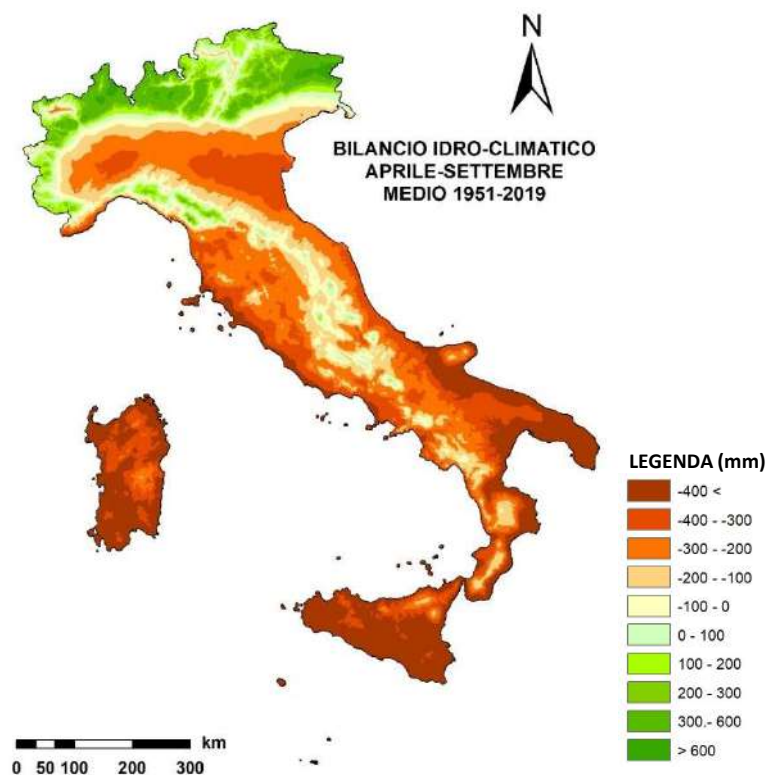
**Rapporto
 P_{2017}/P_{media}**

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** per stazione
- ❑ Numero stazioni pluvio mediamente utilizzate per anno = **2900**
- ❑ Densità media stazioni pluviometriche = **1/100** km²
- ❑ Mappe precipitazione prodotte = **92**
(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)

IOLD2-Italian Open Data License v2.0

<https://www.isprambiente.gov.it/it/amministrazione-trasparente/altri-contenuti/g8-open-data/open-data-ispra/iold2.pdf>

<http://groupware.sinanet.isprambiente.it/bigbang-data/library/bigbang40>

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

