VALUATIONS ON HISTORICAL SERIES OF PRECIPITATIONS IN PIEDMONT (NW ITALY)

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I. INTRODUCTION

The study of the precipitations deserves great attention because being part of a recent past, they allow us to analyze in detail the variations which have occurred and their causes.

In order to correctly study these variations we must have at our disposal some homogeneous series. A climatic series is considered homogeneous when its variations are only due to climatic events (Maugeri et al., 2006; Peterson et al., 1998). Unfortunately, most of the series present non climatic factors that may hide the real changes. The discontinuity can be due to a change in the location of the station, to a replacement of the instruments or to a variation in the surrounding environment.

In this report, we have studied the daily pluviometric series of 21 meteorological stations in Piedmont.

In each locality we have both analyzed and compared the series belonging to two different institutions: ARPA Piedmont and SIMN (Hydrographic and Marigraphic National Service). They series have different length but presents a superimposition of some measurements. We have directly compared the series because, during the 2002, a national law has transferred the competences of SIMN to the regional ARPA, with the necessity of make uniform the observation system.

Then we have reconstructed the monthly series and we have applied the homogeneity test SNHT (Alexandersson et al., 1997). We have also studded their trends and the main members through the spectrum analysis.

II. PRESENTATION OF RESEARCH

The meteorological stations, belonging to SIMN, have been operating with continuity during 53 years, from 1951 to 2003.

As a first step, we have done a historical research (concerning each station) which has allowed us to determine the variations due either to the location or to the replacement of the equipment.

In the direct comparison between the daily pluviometric series, for each year and both the series we have neglected the values missing in at least one station.

For each year we have computed the monthly, seasonally and annual coefficient of correlation during the period of overlapping of the measurements. In order to estimate whether the compared series admit the same distribution, we have applied the Kolmogorov-Smirnov test to the series concerning amount of monthly precipitations.

We have computed the series of the ratios:

$$R = \frac{P_{rain,SIMN}}{P_{rain,ARPA}}$$

For each new series we have carried out a statistical analysis. Data out of a range of distribution below the quantile 0,2 and above 0,98 have been neglected. Then we have calculated the average, the standard deviations, the frequency of the ratios.

Subsequently we have reconstructed some monthly amounts for creating a serially complete (no missing data). We have chosen four different methods of spatial interpolation (Eischeid et al., 1995; Eischeid et al., 2000). These are defined as the 1) normal ratio method (NR), 2) simple inverse distance weighting (IDW), 3) multiple linear regression (MLR) and 4) median of the previous three method (MED).

1) NR weights for the surrounding stations used are found according to:

$$W_i = \frac{r_i^2(n_i - 2)}{1 - r_i^2}$$

where *r* is the correlation coefficient for each monthly time series between the target station and the *i*th surrounding station, *n* is the number of points used to derive *r*.

2) IDW the weight function W_i is derived from the inverse of the distance from the target station to the *i*th surrounding station.

3) MLR is the multiple linear regression method.

4) MED is the median value obtained from the above estimation methods.

Surrounding stations are selected based on their relationship with the target station. A first difference series $(X_{i+1} - X_i)$ is computed for each monthly time series from the raw dataset and then ranked the correlation coefficient between the candidate station and its neighbours. The stations with the largest positive coefficient *r* are subsequently used.

Then we have applied the Standard Normal Homogeneity Test (SNHT) to the series. This method allows to estimate and individuate the gradual or sudden change of the average value of a particular series comparing it to the reference series which has been obtained by evaluating the result of the adjacent series and which is considered homogeneous. In this way we have got the homogeneous series on which trends have been computed and then we have applied some methods of spectrum esteem in order to estimate the correctly statistics proprieties of interannual fluctuations in precipitation and quantify their correlation on large-scale.

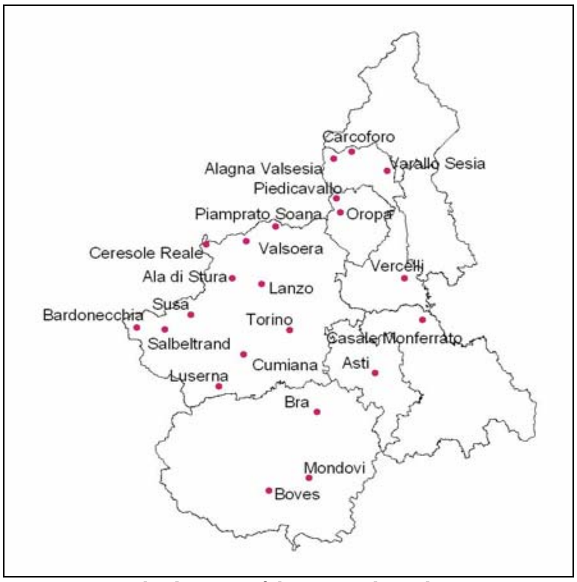

FIG. 1: Geographic location of the meteorological stations.

STATION	E S (m)	E A (m)	D (m)	P
Ala di Stura (TO)	1013	1006	70	1993-03
Asti (AT)	152	117	2350	1998-03
Bardonecchia (TO)	1350	1353	850	1991-03
Boves (CN)	590	575	1782	1988-03
Bra (CN)	290	285	5	1993-03
Carcoforo (VC)	1150	1290	2525	1997-03
Casale M. (AL)	113	118	20	1988-03
Ceresole R. (TO)	2260	2304	920	1996-03
Cumiana (TO)	290	327	2800	1988-03
Lanzo (TO)	540	580	2250	1989-99
Luserna S. G. (TO)	476	475	760	1988-03
Mondovi (CN)	555	422	390	1993-03
Oropa (BI)	1180	1162	5	1990-02
Valprato S. (TO)	1550	1555	760	1988-03
Piedicavallo (BI)	1050	1040	180	1996-03
Salbeltrand (TO)	1031	1010	1250	1991-01
Susa (TO)	510	520	813	1990-03
Torino (TO)	269	240	830	1990-03
Locana (TO)	2410	2365	250	1987-03
Varallo Sesia (VC)	453	470	2040	1990-03
Vercelli (VC)	135	132	1360	1994-03

TABLE I: Meteorological stations analyzed, E S = elevation (m a.s.l.) SIMN stations, E A= elevation (m a.s.l.) ARPA stations, D = distance (m) and P = period of overlapping of the measurements.

III. RESULTS AND CONCLUSIONS

All the series of the precipitation, in the period of overlapping, admit very high correlation coefficient. The direct comparison points out that in eleven of twenty-one locations the recording rain gauges of these stations measure the same amount of rain and the Kolmorgov-Smirnov test highlights that data have the same distributions.

We have enforced the homogeneity test (SNHT) to climate data set and have detected and adjusted several inhomogeneities that correspondents to the factor that make these data unrepresentative of the actual climate variation occurring over time.

These method have afforded to estimate the real trend on every series. Consecutively we have determined and quantify their correlation with large-scale atmospheric pattern and global indices such as the North Atlantic Oscillation (NAO), the Scandinavian pattern (SCAN) and European Blocking (EB).

The positive phase of the Scandinavian pattern and the presence of frequent blocking episodes are found to be significantly correlated with fall precipitation in the study area.

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