

1 **CLIMATE VARIABILITY AND CHANGE IN THE GREATER ALPINE REGION OVER**
2 **THE LAST TWO CENTURIES BASED ON MULTI-VARIABLE ANALYSIS**

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1 **ABSTRACT**

2 An extensive analysis of the HISTALP multi-variable database is presented with the aim of giving a
3 comprehensive picture of secular climate variability and change in the Greater Alpine Region
4 (GAR, 4°E-19°E, 43°N-49°N). The HISTALP database encompasses 242 sites and concerns
5 temperature, pressure, precipitation, cloudiness, sunshine duration, vapour pressure and relative
6 humidity. The analyses are based on 4 regional mean records representing the different GAR low-
7 level areas and on an additional mean record representing all GAR high-level locations. Such data
8 records are available on the web site of the Austrian Central Institute for Meteorology and
9 Geodynamics.

10 The first goal of the paper is to give an overview of the seasonal and annual records for the different
11 variables aiming to highlight both variability on decadal time scale and long-term evolution. Then it
12 focuses on trend and correlation analysis. Trends are presented both for the period of common data
13 availability for all regional average series and for moving windows that permit to study the trends
14 over a wide range of periods and time scales. Correlations among the different variables are
15 presented both for the regional average series and for high-pass-filtered versions of them.

16 The analyses, beside highlighting a GAR warming that results about twice as large as the global
17 trend referred by IPCC, also show that the different variables have responded in different and
18 complex ways to this warming and that the mutual interactions linking the different variables are
19 often present only at specific temporal scales and only in parts of the GAR and in defined seasons.
20 In spite of this complex behaviour, that may also be due to some residual inhomogeneities still
21 affecting the HISTALP database, the analyses give evidence that the HISTALP database has an
22 excellent internal consistency and show that the availability of a multi-variable database turns out to
23 be a very useful tool in order to evaluate the reliability of the reconstruction of each variable and to
24 better understand the behaviour and the mutual interactions of the different meteorological
25 variables.

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