

The Vienna Temperature Series: Strengths and weaknesses for the use in climate change analyses

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Early measurements: 1697, 1734 – 1774 : many gaps, only few data have been recovered, no application in climate time series analyses

The **HISTALP Vienna** temperature series is a composite of old University, (1775-1852), Favoritenstraße (1852- 1872) and Hohe Warte (since 1873). To know more about HISTALP: <http://www.zamg.ac.at/histalp>

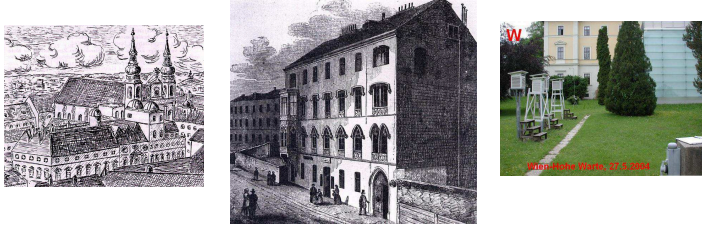


Figure 1: Locations of temperature measurements of the Vienna series: from left to right: tower terrace of the astronomical observatory of the old University, measurements of Favoritenstraße, the recent station at Hohe Warte.

2. Original data

The earliest version of „original data“ have been recovered, printed in Carl von Littrow, Carl Hornstein, Edmund Weiss (1860-1863, 1866). HISTALP data have been digitized from published pre-homogenized data. (The inhomogeneities introduced by relocations have been homogenized by Hann, 1901; or Kreil, 1854, documentation of the applied methods is missing.

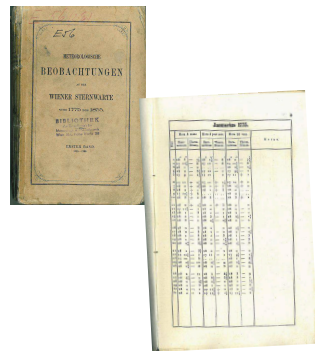


Figure 3: Meteorological measurements at the astronomical observatory of the old Vienna University published by Littrow (1860), Volume 1.

Temperatures measured in urban areas are modified by the urban heat island. Auer et al., 1989 assessed the mean heat surplus of Wien Hohe Warte in the order of 0.5°C against the undisturbed surroundings. However this heat surplus turned out to be not constant. Thus, this additional trend has to be removed before the series can find input into global datasets. COST ES0601 UBRIS* group (www.cost.esf.org) has been working on the problem.

*) Working group on „Urban bias remaining in instrumental series“

3. Series in urbanized areas

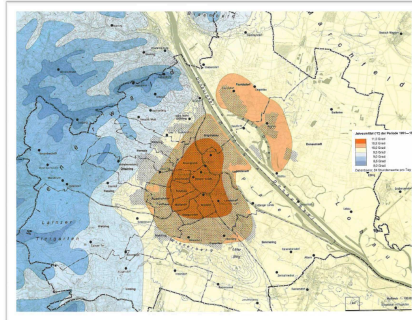


Figure 4: Mean temperature in and around Vienna, (1951-1980)

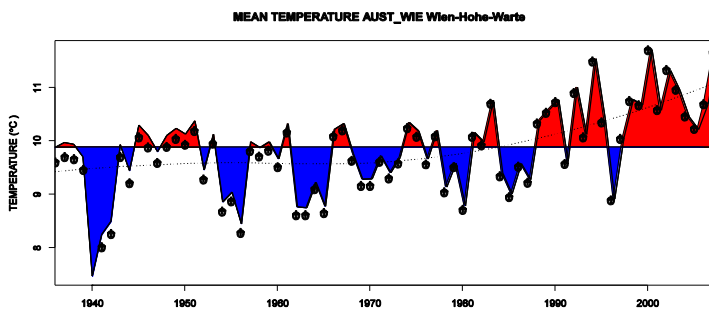


Figure 5: Time series of annual mean temperature : suburban Wien-Hohe Warte corrected from urban effect (solid), compared to non corrected (+), 1951 - 2009

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1. Insufficient sheltering of thermometers

Littrow, (1860) describes the thermometer installation at the astronomical observatory with insufficient sheltering. This early instrumental bias (EI) has been corrected by Böhm et al., (2009) based on parallel measurements of Kremsmünster and intensive metadata studies. As expected, the corrections showed an annual course with maximum values in summer.

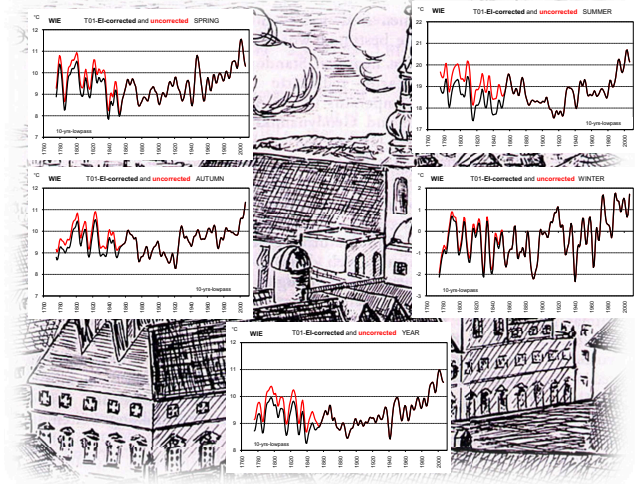


Figure 2: El-corrected and uncorrected temperature series (°C) of Vienna for spring, summer, autumn, winter and the year, 10years Gauß smoothing.

STRENGTHS:

Uninterrupted time series since 1775 with extensive metadata.

Trends of the urban heat island have been mainly corrected

WEAKNESSES

Remaining uncertainties in the very early measurements due to insufficient thermometer sheltering

Remaining uncertainties in respect to original data

OUTLOOK – NEXT STEPS

- To work on recently recovered measurements 1768 – 1769 in collaboration with the astronomical observatory in Wien Währing.
- To revisit the “original data“ collected by Littrow, Hornstein and Weiss.
- To work on the homogenization of daily data with tools recommended by COST ES0601. Homogenized daily maximum and minimum temperature series for the last sixty years seem to be feasible. For older instrumental measurements no sufficiently high correlated series will be available.

References:

- Auer I, Böhm R, Mohl H. 1989. Klima von Wien. Beitr. z. Stadtforschung, Stadtentwicklung und Stadtgestaltung 20, Magistrat der Stadt Wien, p. 270.
- Auer I, Böhm R, Jurkovic A, Lipa W, Orlik A, Potzmann R, Schöner W, Ungersböck M, Matulla C, Briffa K, Jones PD, Efthymiadis D, Brunetti M, Nanni T, Maugeri M, Mercalli L, Mestre O, Moisselin J-M, Begert M, Müller-Westermeier G, Kveton V, Bochnicek O, Stastny P, Lapin M, Szalai S, Szentimrey T, Cegnar T, Dolinar M, Gajic-Capka M, Zaninovic K, Majstorovic Z, Nieplova E (2007). HISTALP – Historical instrumental climatological surface time series of the greater Alpine region 1760-2003. Int J Climatol 27: 17-46.
- Böhm R, Jones PD, Hiebl J, Frank D, Brunetti M, Maugeri M. 2009. The early instrumental warm-bias: a solution for long central european temperature series 1760-2007. Climatic Change, DOI 10.1007/s10584-009-9649-4.
- Hann J. 1901. Die Meteorologie von Wien nach den Beobachtungen an der k.k. Meteorologischen Centralanstalt 1850-1900. Denkschriften der Kaiserlichen Akademie der Wissenschaften, math.naturw. Klasse, 73. Band, 1-66.
- Kreil K, 1854 (Hrsg). Mehrjährige Beobachtungen in Wien vom Jahre 1775 bis 1850. In: Jahrbücher der k.k. Central-anstalt für Meteorologie und Erdmagnetismus, 1. Band, 35-74.
- Littrow Carl von, Hornstein C, Weiss E. (1860 -1863, 1866). Meteorologische Beobachtungen an der k.k. Sternwarte in Wien, 1775 bis 1855. Band 1: 1775-1796, Band 2: 1797-1809, Band 3 1810-1822, Band 4: 1823-1838, Band 5: 1839-1855.
- Steinhaus F, 1940. Die 165jährige Wiener Temperaturreihe (1775-1939); Quellen und Reduktionsgrößen. Jahrbuch der Zentralanst. f. Meteorologie und Geodynamik in Wien, Jg. 1938. Anhang A
- Steinmayr, 1933. Anton Pilgram und die meteorologische Forschung gegen Ende des 18. Jahrhunderts. Publizierter Vortrag vom 11. Jänner 1933.
- Strakosch-Graßmann G, 1932. Neue Quellen zur Geschichte der Witterung in Europa vom 16. Bis zum 18. Jahrhundert. Met. Zeitschr. 1932, S 397.

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