Analysis of Subdaily Meteorological Measurements by Louis Morin in Paris, 1665–1713 CE

Thomas Pliemon[1], Ulrich Foelsche[2], Christian Rohr[3], Christian Pfister[4]

1 Institute for Geophysics, Astrophysics and Meteorology/Institute of Physics (IGAM/IP), University of Graz, Graz, Austria
2 Wegener Center for Climate and Global Change (WEGC), University of Graz, Graz, Austria
3 Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland
4 Institute of History, Section of Economic, Social and Environmental History (WSU), University of Bern, Bern, Switzerland

Recent decades have witnessed a growing interest in past climate variability and climate change. This is related to the study of global warming resulting from the anthropogenic enhancement of the greenhouse effect. Prior to the 17th century and prior to the establishment of national meteorological networks, information on past climates must necessarily be drawn from non-instrumental man-made sources and from proxy evidence obtained from natural archives. In the 17th century in Europe, either the first measuring instruments were developed or significantly further developed for various meteorological values. Thus, weather events began to be quantified and the first meteorological networks were created.
Louis Morin achieved outstanding: In the period between 1665 and 1713, he recorded various meteorological values and documented them in tabular form. The data sets consist of instrumental measurements (temperature, air pressure and humidity) and descriptive observations (precipitation, cloud motion direction, cloud cover and others). Furthermore, it is impressive that the measurements/observations were performed and noted almost daily. Due to his strictly planned daily routine he measured/observed three times a day at fixed times.
Based on copies of the original data (source: Oeschger Centre for Climate Change Research) we perform climate reconstructions for Paris. The focus lies on the following meteorological variables: temperature, cloudiness, moving direction of clouds, precipitation and humidity. We compare the early instrumental temperature dataset with statistical methods and proxy data to validate the measurements in terms of inhomogeneities and claim that they are, apart from small inhomogeneities, reliable. The so called Late Maunder Minimum (LMM; 1675-1715) is characterized by cold winters and falls and moderate springs and summers with respect to the reference period of 1961–1990. Winter months show a significantly lower frequency of the westerly direction in the movement of the clouds. This reduction of advection from the ocean leads to a cooling in Paris in winter. Consequently, the unusually cold winters in the LMM are largely caused by a lower frequency of the westerly direction in the movement of the clouds. An impact analysis reveals that the winter of 1708/09 was a devastating one with respect to consecutive ice days, although other winters are more pronounced (e.g., the winters of 1676/77, 1678/79, 1683/84, 1692/93, 1694/95, and 1696/97) in terms of mean temperature, ice days, cold days, or consecutive cold days.
An investigation of the cloud cover data revealed a high discrepancy, with the winter season (DJF, −14.0 %), the spring season (MAM, −20.8 %), the summer season (JJA, −17.9 %), and the fall season (SON, −18.0 %) showing negative anomalies of total cloud cover with respect to the 30-year mean of the ERA5 data (1981–2010). Further, using Morin's observations, we

created reconstructions of precipitation on a daily basis. According to our reconstruction outstanding wet seasons with precipitation totals greater than 250 mm occurred in MAM 1682, JJA 1682, SON 1687, JJA 1697 and JJA 1703. Difficult, however, is the interpretation of the humidity measurements, which he led from 1701 to 1711.
In summary, Morin's measurements and observations are exceptional, and can be used to describe climatological conditions between 1665 and 1713 and also, due to the daily resolution, to describe the daily weather.