

## 1. ABOUT THE DATASET

**Title:** Atmospheric electricity data from the Bavarian Alps 1972-1983

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**Rights-holder(s):** University of Reading, Max-Planck-Institut für Aeronomie

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**Description:** Atmospheric electricity and other environmental measurements were made close to Garmisch-Partenkirchen, by Reinhold Reiter, at Mount Wank (1780 m, 47° 30' N, 11° 09' E). This archive contains recovered hourly measurements made at Wank from 1st August 1972 to 31st December 1983.

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**Related publications:** R.G. Harrison and K. Schlegel, Atmospheric electricity observations by Reinhold Reiter around Garmisch-Partenkirchen, *History of Geo- and Space Sciences*, 14 (1), <https://doi.org/10.5194/hgss-14-71-2023>, 2023.

R.G. Harrison, Long-range correlations in measurements of the global atmospheric electric circuit, *J. Atmos. Solar-Terrestrial Phys.*, 66, <https://doi.org/10.1016/j.jastp.2004.05.001>, 2004.

## 2. TERMS OF USE

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## 3. PROJECT AND FUNDING INFORMATION

Atmospheric electricity measurements were made at several sites close to Garmisch-Partenkirchen throughout four decades from 1950 to 1990 by Dr Reinhold Reiter, together with other environmental measurements. The surviving data records from this activity are presented in this archive.

These data records were retrieved from magnetic tapes in summer 2000 in an initiative led by Kristian Schlegel, then working at the Max-Planck-Institut für Aeronomie (MPAe) in Katlenburg-Lindau. This was with the help of one of Reiter's collaborators, who retained some limited knowledge of what had been done. No external project funding has been received. The data was originally made available on a CDROM (see fig 1), distributed through the collaborative network provided by the SPECIAL scientific community (Rycroft and Füllekrug, 2004).

The files provide hourly values, from the site on Mount Wank (1780m, 47°30'N, 11°09'E), and span 1st August 1972 to 31st December 1983. The wide range of quantities recorded is summarised in Table 1. Related information and context for these measurements is available in Reiter (1992).

The atmospheric electricity quantities determined include the atmospheric potential gradient (PG), the vertical current and the ion concentrations.

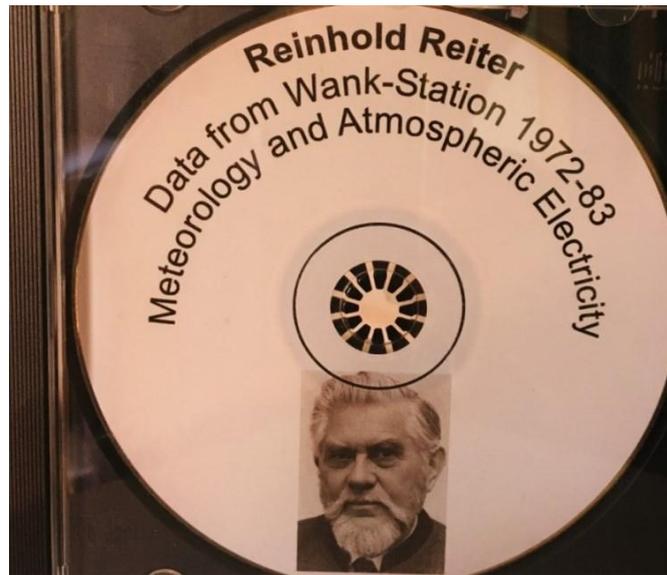


Figure 1. The original CDROM distributed to the SPECIAL scientific community in 2000.

#### 4. CONTENTS

The original CDROM contained 33 files, with one or more files for each year from 1972 to 1983. Their filenames are of the form

**dvawankYY\_N.txt**

where YY represents the year as two digits (72 to 83), and N is the number of the data file within that year. This varies between  $N=1$  for 1972,  $N=1,2$  for 1973, and  $N=1,2,3$  for 1974 to 1983. The files have broadly similar formats, although the quantities recorded vary as the recording system progressed, with 1972/3 data different from the later years.

In detail, the files are all plain ascii text with space-separated entries, with a consistent but intricate structure. They contain a range of meteorological and atmospheric electrical quantities, with a symbol describing the quantity measured on the line preceding the numerical values. Hourly values ("STUNDENWERTE") are provided on the next two lines, with the first value the average quantity between 2330 of previous day and 0030 on the day concerned, the next between 0030 and 0130 and so on, until 2230 to 2330.

After these, averages for consecutive parts and then all of the day follow, specifically:

"INTERVALLMITTEL A" mean of nocturnal parameters (2130 - 0930)

"INTERVALLMITTEL B" mean of morning parameters (0930 - 1230)

"INTERVALLMITTEL C" mean of afternoon parameters (1230 - 1630)

"TAGESMITTEL" mean of all daily values.

Table 1 lists the major physical quantities measured, although some files contain short periods of other quantities, such as NO<sub>x</sub> concentrations. In most cases hourly values were recorded, using

averages centred on the UTC (Greenwich) hour, calculated from values sampled thirty minutes before and after the hour.

The sensor sampling rate is unknown and physical units are not available for all the quantities, although it may be possible to infer these from Reiter's textbook (Reiter, 1992). There is also no additional information on processing or calibration. However, some processing was clearly undertaken, due to the morning, night, afternoon and daily mean values computed from the hourly values.

Table 1. Quantities contained within the data files.

<i>Description of quantity</i>	<i>Symbol used</i>	<i>Unit (if known)</i>
<b>Meteorological and environmental</b>		
air temperature	T	°C
relative humidity	RF	%
water vapour partial pressure	E	hPa
specific humidity	SF	
potential temperature	TH	K
equivalent potential temperature	THE	K
wind speed	WG	m s <sup>-1</sup>
wind direction	WR	°
Sunshine duration	SD	
Global solar irradiance	GS	? cal cm <sup>-2</sup>
Sky radiation	HS	
UV intensity	UV	? cal cm <sup>-2</sup>
<b>Atmospheric electrical</b>		
Electric field (recorded as the Potential Gradient)	F	Vm <sup>-1</sup>
Zero crossing of F	DU	
Vertical current	I	
Positive ion concentration	N+	cm <sup>-3</sup>
Negative ion concentration	N-	cm <sup>-3</sup>
Total ion concentration	SN	cm <sup>-3</sup>
Positive ion conductivity	L+	? 10 <sup>-14</sup> S m <sup>-1</sup>
Negative ion conductivity	L-	? 10 <sup>-14</sup> S m <sup>-1</sup>
Total ion conductivity	SL	? 10 <sup>-14</sup> S m <sup>-1</sup>
Number concentration of condensation nuclei	K1, K2, K3	

information about distribution of nuclei	M1, M2, M3	
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An abbreviated sample from late in the records is given below, with some explanatory annotations added (in red).

WANK. 12.11.83 **date – 12<sup>th</sup> Nov 1983**  
 STUNDENWERTE: ← **hourly values**  
 T **T: air temperature (°C)**  
 +01.4 +01.4 +01.3 +00.5 +00.3 -00.3 -00.5 -00.1 +00.1 +01.0 +02.0 +03.1  
 +02.8 +02.6 +03.7 +03.2 +01.8 +01.1 +01.6 +02.0 +02.6 +03.3 +03.2 +03.4  
 RF **RF: Relative Humidity (%)**  
 67.7 68.8 61.6 71.1 74.3 74.9 75.3 74.9 74.2 68.1 64.6 60.5  
 59.7 61.2 57.0 58.0 64.1 64.2 52.2 49.8 49.4 36.0 36.5 29.9  
 E **E: vapour pressure (hPa)**  
 4.577 4.651 4.135 4.504 4.639 4.477 4.436 4.543 4.566 4.473 4.559 4.618  
 4.461 4.508 4.540 4.459 4.460 4.247 3.580 3.515 3.639 2.787 2.806 2.331  
 SF **SF: specific humidity**  
 3.469 3.525 3.134 3.414 3.516 3.393 3.362 3.443 3.461 3.390 3.456 3.500  
 3.381 3.417 3.441 3.379 3.380 3.219 2.713 2.664 2.758 2.112 2.126 1.766  
 .... **(entries omitted)**  
 TAGESMITTEL ← **daily averages**  
 T RF E SF TH THE  
 +01.7 060.6 4.146 3.142 290.8 299.2  
 WG WR SD SSD GS SGS HS SHS UV SUV  
 004.6 00073 00.39 09.36 009.6 230.4 002.2 052.8 0.086 02.06  
 F DU I N+ N- SN N+/N- L+ L- SL L+/L-  
 +0082 00000 +0.10 00585 00341 925.6 1.731 145.0 151.2 311.9 1.076  
 K1 K2 K3 M1 M2 MM  
 00.72 00.37 00.34 1.834 2.857 2.269  
 RL ISP NOX IN SICHT WK  
 +0.28 99.99 99.99 +0.00 38.53 551  
 WANK. 13.11.83 **next day – 13<sup>th</sup> Nov 1983**  
 STUNDENWERTE:  
 T  
 +03.3 +02.6 +02.1 +01.8 +01.5 +01.7 +01.6 +01.4 +01.2 +02.7 +04.5 +03.7  
 +01.9 +01.8 +00.9 +02.0 +00.7 -02.7 -04.2 -06.3 -06.4 -04.9 -06.2 -07.5  
 RF  
 ... **(entries omitted)**

NB “9999” indicates no value was available.

## 5. ADDITIONAL PROCESSING

Post-processing of the data files was carried out for the potential gradient (PG) data, at the time of the analysis described in Harrison (2004). (The PG is a measure of the vertical fair weather electric field in the atmosphere. It is determined from the equivalent potential at 1 m above the surface over open, flat ground, with units of volts per metre ( $\text{Vm}^{-1}$ ). In fair weather the PG is positive, and typically  $100 \text{Vm}^{-1}$  to  $150 \text{Vm}^{-1}$  (e.g. Harrison and Bennett, 2021) ).

The code for this further processing was written in Pascal, and extracted the hourly PG values for each day, which were written to a single file for all the days of measurements between 1st August

1972 to 31st December 1983. This data file is provided in the archive and called **ReiterPGdata.csv** . It is a comma-separated data file, with the first two lines header lines. Table 2 describes the quantities it contains. No value is entered where the original Reiter files contained “9999”.

*Table 2 Description of post-processed PG data file.*

Column number	Quantity	Description	unit
1	Day of month	Time variable (values runs from 1 to 31)	UTC
2	month	Time variable (value runs from 1 to 12)	UTC
3	year	Time variable (value runs from 1972 to 1983)	UTC
4	Year day	Day of year (1 to 365 or 366)	UTC
5	Decimal year	Decimal year value (e.g. 1972.582 for day 214 of 1972)	UTC
6 to 29	Measured average value centred on hour of day from 0 to 23	Potential Gradient	Vm <sup>-1</sup>

It should be noted that there is a step change in the data around the 15<sup>th</sup> March 1976 (day 75 of 1976), with the mean PG prior 35.2 Vm<sup>-1</sup> and 91.6 Vm<sup>-1</sup> afterwards. This is illustrated in the time series plotted in figure 2.

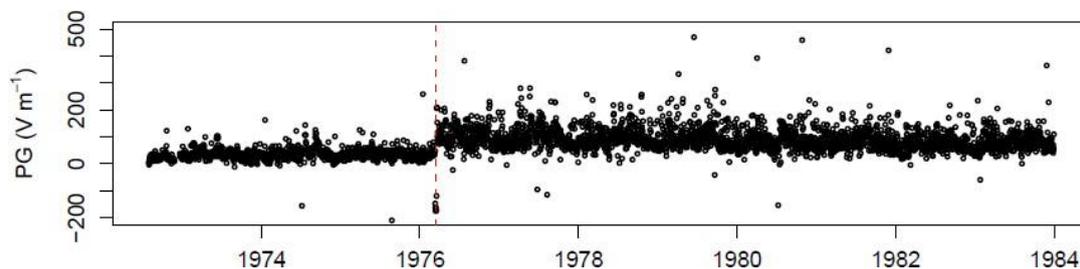


Figure 2. Time series of daily PG values from the Wank measurement site, showing the step change in the mean value in March 1976 (red line).

## References

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