3.2 MICROMETEOROLOGICAL MONITORING OF A PINE FOREST IN GERMANY WITH PARTICULAR EMPHASIS ON TEMPERATURE

Lutz Jaeger* and Albrecht Kessler
University of Freiburg, Germany

1. INTRODUCTION

We analyse the long-term variations of upward and downward terrestrial (*E*) and atmospheric (*A*) long-wave radiation fluxes above a pine stand. This forest is situated in the southern part of the upper Rhine valley plain. Our work is based on time series extending over 27 years of monitoring. This is done using and treating monthly mean values.

2. METHODS AND MATERIALS

First, equivalent blackbody radiant temperatures of the canopy and the equivalent blackbody radiant temperatures of the atmosphere are calculated. Then the results are compared to the air temperatures of climatic sites in the vicinity of the forest.
Other radiative fluxes and energy transfers at the outer active layer of the pine stand and the radiation fluxes at the outer edge of the atmosphere are utilised to explain the mean annual pattern of *A* and *E*. With this we stress the importance of the divergence of the horizontal heat flux and the large scale advection.

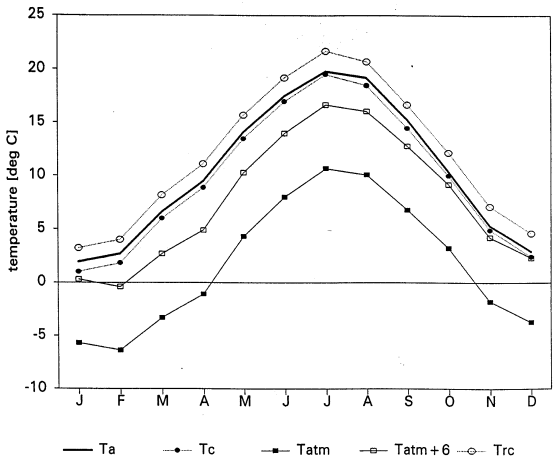

Fig. 1. Long-term monthly mean values of: T_a screen temperature Bremgarten (1974 – 1998), T_c equivalent blackbody temperature of the pine canopy (1974 – 2000), T_{atm} equivalent blackbody radiant temperature of the atmosphere above the Hartheim pine stand (1974 – 2000) (T_{atm} + 6K), T_{rc} equivalent real radiant temperature of the pine canopy (infrared emissivity ε = 0.97); [^oC]

* *Corresponding author address*: Lutz Jaeger, Univ. of Freiburg, Meteorological Institute, Werderring 10, D-79098 Freiburg, Germany;
e.mail: lutz.jaeger@meteo.uni-freiburg.de

Based on 324 monthly values each, we analyse the linear correlation between *A* and *E*, and between *A* and the global radiation (*G*). *A* and *E* are highly correlated; the correlation between *A* and *G* is comparatively poor.
It was possible to simulate satisfactorily monthly mean values for the atmospheric long-wave radiation (*A*) by using data on air temperature, water vapour content of the air and total cloud amount.

3. RESULTS

The average yearly patterns of the different types of temperature are shown to be closely connected. The long-term yearly average of the equivalent blackbody radiant temperature of the canopy reads .6 K lower than the temperature of the air. Linear correlation of the temperature of the air and the equivalent blackbody temperature is very high.
Only minimal, insignificant increases in the three sorts of temperature could be observed in relation to the question of long-term changes. Despite the enormous forest growth, it is surprising that the ratio of the emission temperature of the canopy to air temperature did not change significantly.
In investigating the relations between the changes in the general atmospheric circulation and the equivalent terrestrial blackbody temperatures of the canopy we only used values measured at night in order to minimise measuring errors. Daylight values of long-wave downward radiation may be incorrect due to the influences of direct solar radiation. We were able to demonstrate the effects of a long-term change in the north- and southward rotation of the general air current on the terrestrial blackbody radiant temperature.

4. References

Jaeger, L., H.-J. Garthe and A. Kessler, 1986: The climatological site Hartheim: its philosophy, design and special measuring results. *Freiburger Geogr. Hefte*, **26**, 189 –199.

Kessler, A. and L. Jaeger, 1999: Long-term changes in net radiation and its components above a pine forest and a grass surface in Germany. *Int. J. Climatol.*, **19**, 211 – 226.

Kessler, A. and L. Jaeger, 2002: Analysis of long-term time series of long-wave radiation fluxes above a pine forest. *Theor. Appl. Climatol.*, **71**, in print.

Mayer, H., L. Jaeger, A. Matzarakis, G. Fernbach and D. Redepenning, 2000: Forstmeteorologische Meßstelle Hartheim des Meteorologischen Institutes der Universität Freiburg. *Ber. Meteorol. Inst. Univ. Freiburg*, **5**, 55 – 84.