Summer Tourism in Austria and Climate Change

Rudel, E. [1], A. Matzarakis [2] and E. Koch [1]

[1] Central Institute for Meteorology and Geodynamics, Vienna, Austria
[2] Meteorological Institute, University of Freiburg, Germany
Email: ernest.rudel@zamg.ac.at

Keywords: *summer tourism, climate change scenarios*

EXTENDED ABSTRACT

Weather and climate as well as topographical and orographical conditions, vegetation and fauna play a prominent part in the assessment of tourism and leisure facilities. However, they are limiting and controlling factors, too. Therefore climate change will have considerable consequences on summer tourism in Austria. But of course additionally, several other factors for tourism play a significant role: starting from the weather conditions at home and the weather experience of the last holidays to the variety of activities, advertising campaigns and last but not least costs and prices. Some existing studies take into account all the influencing factors. In the present contribution the main issue was set on the variability of weather and climate conditions of specific destination areas and secondly on a subjective assessment of the climate sensitivity of different kind of holidays.

An analysis of relevant meteorological and climatological parameters for tourism climatology and human biometeorology is based on climate conditions for 1961 – 1990 and scenarios of the period 2021 - 2050 calculated by the Max-Planck-Institute for Meteorology in Hamburg. We used the A1B emission scenario.

The contribution is focussed on the thermal - bioclimate and on precipitation conditions, because these parameters represent the most important factors for tourism and recreation. Instead of the often used monthly average values, the frequencies of these parameters are calculated in the high temporal resolution of 10 days - each month is divided into three time intervals. To describe the thermal facet of the climate for tourism purposes we used the physiologically equivalent temperature PET, which considers the influence of the complete thermal environment (i.e. air temperature, air humidity, wind velocity as well as short and long-wave radiation) on humans. The frequency of certain PET classes quantifies thermal suitable conditions for leisure and recreation and gives information about cold and heat stress. Additionally the term „Sultriness“ is calculated with the classical criterion of the excess of a certain water vapour pressure.

For qualifying the aesthetic facet we used factors such as duration of sunshine, cloudiness and fog, range of visibility and day length. We integrated this aspect with the amount of cloudless or bright days as well as with the number of days with fog.

The factors high wind velocity and precipitation (days with few or no rain as well as long lasting precipitation events) specify the physical facet, which comprises influences such as wind, rain, snow conditions, air quality and extreme weather situations.

For Austria it can be expected that in the future (2021-2050) the summer tourism period will start earlier and end later in the year than now. The period for recreation and leisure will be extended, also the spring and fall months will offer comfortable thermal conditions for outdoor activities. However, this positive trend is opposed by an increase of frequency and intensity of heat stress and by an increase of days with sultriness in areas below 1000 m above sea level. It is also likely that there will occur a slight increase of days with longer rain events. The decrease of the amount of days with light or no rain will not be able to compensate that. The Climatic Tourism Information Scheme CTIS which we developed gives an overall view on the climatic conditions on a certain location and makes it also possible to compare the present situation with the future.

1. INTRODUCTION

According to the 4th assessment report 4AR of IPCC the increase of global air temperature in 21st Century will be strongest over the continents in higher northern latitudes and an increase of extremely hot temperatures and heat waves is very likely (probability > 90%). Austria - situated between 46 and 49° northern latitude - and its economy are strongly affected by climate change and its consequences. Two thirds of the GDP comes from the service sector, where Austria profits particularly from tourism. The effect of climate change on winter sports has been topic of many scientific studies but additionally also summer tourism will be affected. The outcome of most of these studies was that a shortening of the winter sports season will occur in the next decades. The logical conclusion is an extension of the summer season. The climatic tourism potential which can be determined with meteorological parameters will change in future. In the present investigation special attention is given on summer tourism.

But first of all one has to answer the question whether one can solve the problem just to apply simple climate parameters like e.g. air temperature, or snow cover, etc. to describe the present und future climatic tourism potential conditions or one has to use interdisciplinary approaches. In the context of the project "StartClim 2006" we decided to use an integral attempt which is based on climatological, human-biometeorological and climatic – tourism (leisure time and tourism) methods. This approach combines the thermal conditions with physical elements (rain, wind) and aesthetic factors (sunshine, clouds, visibility) and gives thus a comprehensive quantitative description of the climatic tourism potential.

The physiologically equivalent temperature PET, which considers the influence of the complete thermal environment (i.e. air temperature, air humidity, wind velocity as well as short and long-wave radiation) on humans describes the thermal facet of the climate for tourism purposes. The frequency of certain PET classes quantifies thermal suitable conditions for leisure and recreation and gives information about cold and heat stress. Additionally the term „Sultriness" is calculated with the classical criterion of the excess of a certain water vapour pressure.

The aesthetic facet covers factors such as duration of sunshine, cloudiness and fog, range of visibility and day length. We integrated this aspect with the amount of cloudless or bright days as well as with the number of days with fog.

The physical facet, which comprises influences such as wind, rain, snow conditions, air quality and extreme weather situations, is described with the factors high wind velocity and precipitation (days with few or no rain as well as long lasting precipitation events).

Basis for the investigation are climate data of the Central Institute for Meteorology and Geodynamics (ZAMG) of the period 1950 - 2005 of eleven selected stations well distributed over the country to give a representative cross section of the different landscape – and climate regions.

The future climatic tourism potential of Austria is calculated by scenario runs of the REMO model of the Max-Planck Institute for Meteorology in Hamburg and covers the period 1961-2050. We used the A1B emission scenario.

First we focussed on the thermal - bioclimate and on precipitation conditions, because these parameters represent the most important factors for tourism and recreation. Instead of the often used monthly average values the frequencies of these parameters are calculated in the high temporal resolution of 10 days - each month is divided into three time intervals (see figure 1 and 2).

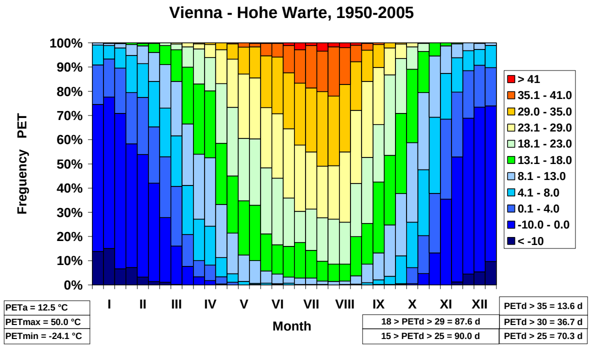

Figure 1. Bioclimate diagram (PET-frequencies) for Vienna for 1950 - 2005 and amount of days with PET-threshold values

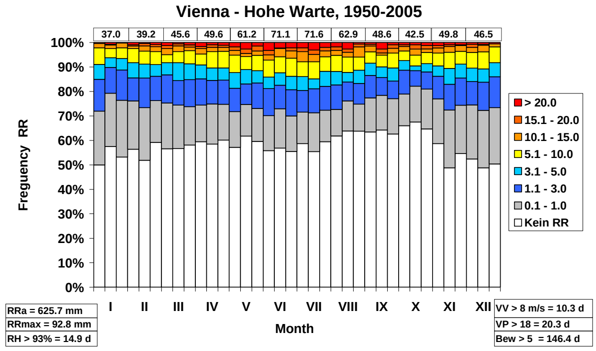

Figure 2. Precipitation frequencies in Vienna for 1950 – 2005

In the next step we developed and applied a flexible Climatic Tourism Information Scheme (CTIS) to get an integral description of the climatic tourism potential. Flexible means one can select and include as the different climatic parameters that are relevant for a specific tourism-sector in a specific climate region. For summer tourism in Austria we chose CTIS factors as thermal suitability for recreation and leisure (like cold stress, heat stress, sultriness), sunshine duration, precipitation poverty, fog situations, rain conditions as well as stormy days. Because the diagram covers the whole year it can be used also for winter tourism and the ski potential. It is here described by the days with snow cover of more than 10 cm. Figure 3 shows the CTIS diagram for 1961 to 1990 and figure 4 for the period 2021 to 2050 both for Vienna.

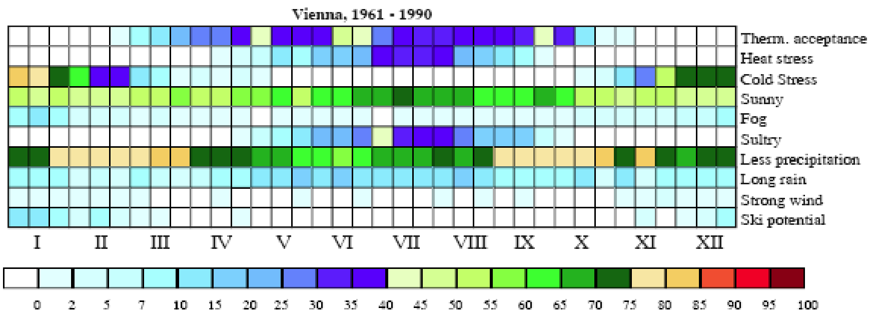

Figure 3. CTIS-Diagram for Vienna based on the A1B-climate scenario for the period 1961 – 1990

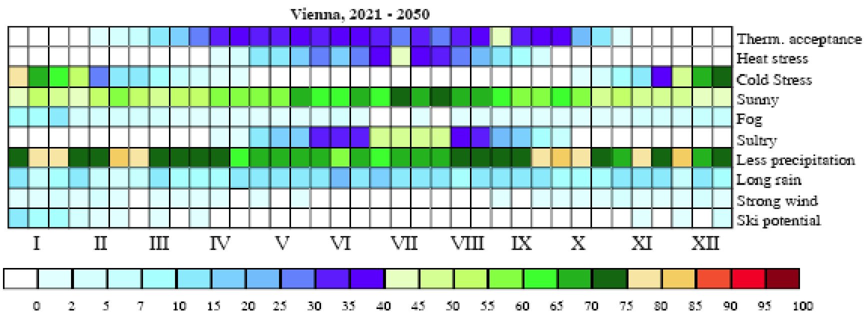

Figure 4. CTIS-Diagram for Vienna based on the A1B-climate scenario for the period 2021 – 2050

2. CONCLUSIONS

Summing up the climate simulations for the period for 2021-2050 we come to following results:

- The amount of the days with cold stress decreases up to 20 days. Especially in the south and south-east of Austria there is a tendency to a shortened period with cold stress.
- thermal comfortable conditions will increase up to approx. 10 days. But the trends are ambiguous - urban areas show no trend. In the annual course the thermal suitability for recreation and leisure is extended into the late fall.
- According to the scenario the number of days with heat stress will rise in future. However, areas with an elevation above 1000m are not affected. In the southeast of Austria more than 40 days with heat stress will occur and in generally the heat stress periods will extend. Also the days with sultry conditions will increase nearly in the same manner.
- The number of cloudless and bright days will increase especially in higher elevations. The number of foggy days generally decreases
- In generally there is a slight increasing trend for the days with high precipitation. The frequency of days with few or no precipitation as well as of days with long precipitation events will experience an increase in the summer.
- About the change of strong wind conditions (especially for recreation and leisure) no concrete statement can be made but it seems that there is a slight decreasing trend.
- The potential for ski sports decreases, however, in the higher elevations (above 1600m) it is ensured.

The future bioclimatic conditions for the summer tourism in Austria show us an extension of the season with pleasant thermal conditions into the late fall. The increase of the days with sultriness can be seen positively for the lake tourism in Austria however, for health and wellness tourism this can represent an impairment and last but not least the decrease of the summer precipitation events based on the used climate scenario will affect nearly all sectors of the summer tourism favourably.

3. ACKNOWLEDGEMENTS

This work has been supported by the StartClim 2006 and the Austrian Ministry of Science.

4. REFERENCES:

Abegg, B. (1996) Klimaänderung und Tourismus. Schlussbericht NFP 31. - vdf Hochschulverlag AG an der ETH Zürich.

Amelung, B., Blazejczyk, K., Matzarakis, A., Viner, D. (eds.) (2004) Climate Change and Tourism: Assessment and Coping Strategies. Kluwer Academic Publishers, Dordrecht. (in Druck).

Bühring, M., Jung, E.G. (1992) UV-Biologie und Heliotherapie. Stuttgart, Hippokrates.

Davies, N.E. (1968) An optimum summer weather index. Weather 23, 305-317.

De Dear, R., Pickup, J. (1999) An outdoor thermal comfort index (OUT_SET*) – Part II – Applications. In: Biometeorology and Urban Climatology at the Turn of the Millenium. In: (ed. by R.J. de Dear, J.D. Kalma, T.R. Oke and A. Auliciems). Selected Papers from the Conference ICB-ICUC'99, Sydney, WCASP-50, WMO/TD No. 1026, 285-290.

De Freitas, C.R. (1990) Recreation climate assessment. Int. J. Climatol. 10, 89-103.

De Freitas, C.R. (2001) Theory, concepts and methods in climate tourism research. In: A. Matzarakis and C. R. de Freitas (eds). Proceedings of the first international workshop on climate, tourism and recreation. International Society of Biometeorology, Commission on Climate Tourism and Recreation. December 2001. 3-20.

De Freitas, C.R. (2003) Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector. Int. J. Biomet.. 48, 45-54.

EPA (1999) Guideline for reporting of daily air quality – air quality index (AQI). United

States Environmental Protection Agency, EPA-454/R-99-010.

Fanger, P. O. (1972) Thermal comfort. New York, McGraw Hill.

Harlfinger, O. (1985) Bioklimatischer Ratgeber für Urlaub und Erholung. Gustav Fischer Verlag.

Höppe, P. (1999) The physiological equivalent temperature – a universal index for the biometeorological assessment of the thermal environment. Int.l J.Biomet. 43, 71-75.

IMBW (1994) Städtebauliche Lärmfibel. Hinweise für die Bauleitplanung. Innenministerium Baden-Württtemberg.

Jacob, D., U. Andrae, G. Elgered, C. Fortelius, L. P. Graham, S. D. Jackson, U. Karstens, Chr. Koepken, R. Lindau, R. Podzun, B. Rockel, F. Rubel, H.B. Sass, R.N.D. Smith, B.J.J.M. Van den Hurk, X. Yang, (2001) A Comprehensive Model Intercomparison Study Investigating the Water Budget during the BALTEX-PIDCAP Period. Meteorology and Atmospheric Physics 77, 19-43.

Kaiser, M. (2002) How the weather affects your health. Michelle Anderson Publishing, Melbourne.

Kiefer, J. (Hrsg.) (1977) Ultraviolettes Strahlen. Berlin, New York, Walter de Gruyter.

Koch, E., Marktl, W., Matzarakis, A., Nefzger, H., Rudel, E., Schunder-Tatzber, S., Zygmuntowski, M. (2005) Klimatherapie in Österreich. Broschüre zu den Potentialen der Klimatherapie in Österreich. Bundesministerium für Wirtschaft und Arbeit.

Lecha, L., Shackleford, P. (1997) Climate services for tourism and recreation. WMO Bulletin 46, 46-47.

Matzarakis, A. (2001) Die thermische Komponente des Stadtklimas. Wiss. Ber. Meteorol. Inst. Univ. Freiburg Nr. 6, 265 pp.

Matzarakis, A. (2002) Examples of climate and tourism research for tourism demands. 15th Conference on Biometeorology and Aerobiology joint with the International Congress on Biometeorology. 27th October to 1st November 2002, Kansas City, Missouri, 391-392.

Matzarakis, A. (2006) Weather and climate related information for tourism. Tourism and Hospitality Planning & Development 3, 99-115.

Matzarakis, A. (2007) Entwicklung einer Bewertungsmethodik zur Integration von Wetter- und Klimabedingungen im Tourismus. Ber. Meteor. Inst. Univ. Freiburg Nr. 16, 73-79.

Matzarakis A., de Freitas, C.R. (Ed.) (2001) Proceedings of the First International Workshop on Climate, Tourism and Recreation. International Society of Biometeorology, Commission on Climate Tourism and Recreation. December 2001. http://www.mif.uni-freiburg.de/isb

Matzarakis, A., de Freitas, C.R. (2005) Neueste Entwicklungen aus der Tourismus-Klimatologie. Mitt. DMG 1/2005, 2-4.

Matzarakis, A., Mayer, H. (1996) Another kind of environmental stress: Thermal stress. WHO Colloborating Centre for Air Quality Management and Air Pollution Control, NEWSLETTERS 18, 7-10.

Matzarakis, A., Mayer, H. (1997) Heat stress in Greece. Int. J. Biomet. 41, 34-39.

Matzarakis, A., de Freitas, C., Scott, D., 2004 (eds.): Advances in tourism climatology. Ber. Meteorol. Inst. Univ. Freiburg Nr. 12.

Matzarakis, A., Karatarakis, N., Sarantopoulos, A. (2005) Tourism climatology and tourism potential for Crete, Greece. Annalen der Meteorologie 41, Vol. 2, 616-619.

Matzarakis, A., Mayer, H., Iziomon, M. (1999) Heat stress in Greece. Applications of a universal thermal index: physiological equivalent temperature. Int. J. Biomet. 43, 76-84.

Matzarakis, A., Rutz, F., Mayer, H. (2000) Estimation and calculation of the mean radiant temperature within urban structures. In: Biometeorology and Urban Climatology at the Turn of the Millenium. In: R.J. de Dear, J.D. Kalma, T.R. Oke and A.

Auliciems (eds). Selected Papers from the Conference ICB-ICUC'99, Sydney, WCASP-50, WMO/TD No. 1026, 273-278.

Matzarakis, A., Rutz, F., Mayer, H. (2007) Modelling Radiation fluxes in simple and complex environments – Application of the RayMan model. Int. J. Biomet. 51, 323-334.

Matzarakis, A., Zygmuntowski, M., Koch, E., Rudel, E. (2004) Mapping the thermal bioclimate of Austria for recreation tourism. In: Matzarakis, A., de Freitas, C., Scott, D. (eds.) Advances in tourism climatology. Ber. Meteorol. Inst. Univ. Freiburg Nr. 12, 10-18.

Mayer, H., Kalberlah, F., Ahrens, D., Reuter, U. (2002) Analysis of indices for the assessment of the air. Gefahrstoffe-Reinhaltung der Luft 62, 177-183

Mieczkowski, Z. (1985) The tourism climate index: A method for evaluating world climates for tourism. The Canadian Geographer 29, 220-233.

Rudel, E., Matzarakis, A., Koch, E. (2005) Potential increase of heat load on humans in a changing climate. World Resource Review 17, 32-44.

Shackleford, P., Olsson, L.E. (1995) Tourism, climate and weather. WMO Bulletin 44, 239-242.

TA-Lärm (1968) Technische Anleitung zum Schutz gegen Lärm. Allgemeine Verwaltungsvorschrift über genehmigungsbedürftige Anlagen nach § 16 der Gewerbeordnung.

UBA (2005) Klimawandel in Deutschland. Vulnerabilität und Anpassunkstrategien klimarelevanter Systeme. - Climate Change 08/05.

VDI (1985) VDI 2058, Blatt 1, Beurteilung von Arbeitslärm in der Nachbarschaft. Berlin, Beuth Verlag.

VDI (1993) VDI 3883 Blatt 2, Wirkung und Bewertung von Gerüchen. Ermittlung von Belästigungsparametern durch Befragungen: Wiederholte Kurzbefragung von ortsansässigen Probanden. Berlin, Beuth Verlag.

VDI (1998) Methoden zur human-biometeorologischen Bewertung von Klima und Lufthygiene für die Stadt- und Regionalplanung, Teil I: Klima. - VDI-Richtlinie 3787 Blatt 2. Berlin, Beuth-Verlag.

WHO (2002) Global Solar UV Index: A practical guide. WHO.

WMO (1999) Climate and human health. World Climate News 14, 3-5.

WTO (2003) Climate Change and Tourism. Proc. of the 1st International Conference on Climate Change and Tourism. WTO.

Zaninovic, K., Matzarakis, A., Cegnar, T., (2006) Thermal comfort trends and variability in the Croatian and Slovenian mountains. Meteorologische Zeitschrift 15, 243-251.