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ACTIVE THE AUSTRIAN CLIMATE AND HEALTH TOURISM INITIATIVE

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Abstract
Austria has a long tradition in health tourism: climate health resorts are well known. As concepts for the execution of climatic cures in the Austrian climatic health resorts were missing almost completely a scientific multidisciplinary project (ACTIVE*) was launched.
Within ACTIVE the generation of bases for the improved use of the natural cure climate in Austria was provided. The first part of the project applied for gathering specialized knowledge of climatic cure concepts, needs, literature studies as well as the composition of concept ideas. Main focus have been set in the development of a bioclimatological landscape zoning of Austria on the basis of the Physiological Equivalent Temperature (PET).
The final part of the project the "synthesis" contains the conversion and transfer of the single results to "products" like region-referred suggestions for Austrian climatic health resorts with new indication data and bioclimatic evaluations as well as recommendations for the title of climatic health resorts. The project results contribute substantially to the improved use of the natural cure "climate" in Austria.

*ACTIVE = Austrian Climate and Health Tourism Initiative

Key Words
Health tourism, Bioclimate, Austria, Human Energy Balance

Introduction

According to its geographical situation Austria owns a multitude of regions with favourable bioclimatic conditions. Unfortunately in many cases this is not used in an adequate way as in the neighbouring countries. Therefore the Federal Ministry of Economics and Labour of the Republic of Austria initiated the project ACTIVE with the goal “to provide the scientific bases for the improved use of the natural resource climate in Austria” (Koch et al., 2005, Rudel et al., 2005).
By interdisciplinary co-operation between physicians, climatologists and tourism authorities the following topics were analysed:

- State of art of climatic cure concepts,
- Current offer of climate cure concepts in Austria and in the neighbouring countries,
- Human-bioclimatic conditions in Austria,
- Specific climate treatment at Austrian climate and mountain resorts,
- Potentials for development of climate cures,
- Improvement of legal federal guidelines which define and protect the approved quality mark “climate and mountain resort” which is only awarded to places which can scientifically prove the therapeutic effectiveness of their climate and a permanent high air quality.

In this paper we focus on the human thermal bioclimate.

Method and Material

The human heat balance equation and PET

The thermal bioclimatic complex comprises the meteorological variables, which affect the human being in a thermo-physiologically way: air temperature, air humidity, wind speed, as well as short and long-wave radiation from its entire surrounding area. Their importance for the well-being and health depends on the close linkage between thermal regulation and circulation (Fanger, 1972; Jendritzky et al., 1990; VDI, 1998).

Originally simple climatic indices were used for the assessment of thermal comfort, e.g. heat stress index, Discomfort Index (Thom, 1959) or Wind-chill index (Steadman, 1971). These indices consider only a part of the relevant meteorological parameters (e.g. windchill: air temperature and wind speed) and do not consider e.g. radiative fluxes and they do not account at all for the human physiology.

On the basis of this understanding since about 30 years heat balance models of the human body have gained acceptance in the field of assessment the thermal comfort. The heat balance equation of the human body takes into account the metabolic rate (internal energy production by oxidation of food), the physical work output, the net radiation of the body, the convective heat flow, the latent heat flow to evaporate water into water vapour diffusing through the skin, the sum of heat flows for heating and humidifying the inspired air, the heat flow due to evaporation of sweat and the storage heat flow for heating or cooling the body mass.

The heat balance equation of the human body reads as follows (units in W):

$$M + W + Rn + L + QL + QSW + QRe + S = 0,$$

M:	Metabolic rate (internal energy production by oxidation of food)
W:	Physical work output
Rn:	Net radiation of the body
L:	convective heat flow
QL:	latent heat flow to evaporate water into water vapour diffusing through the skin
QSW:	sum of heat flows for heating and humidifying the inspired air
QRe:	heat flow due to evaporation of sweat
S:	storage heat flow for heating or cooling the body mass

All required components for the heat balance equation can be calculated using synoptic/climatological and astronomical data (VDI, 1998, Matzarakis et al, 2000) plus physiological parameters. The full application of the energy balance equation of the human body gives detailed information on the effect of the thermal environment on humans (VDI, 1998).

The necessary meteorological inputs are air temperature, air humidity, wind speed, short and long wave radiation fluxes which are difficult to deal with, because measuring data are more often than not available (the mean radiant temperature parameterizes the radiant fluxes accounting for the special geometry of a human being (VDI, 1998) as well as physiological parameters as sex, weight-height-skin surface, activity level and clothing factor. Here the internal heat production was set to 80 W and the heat transfer resistance of the clothing to 0.9 clo (Matzarakis and Mayer, 1996).

Outputs of the heat balance equation are mean skin temperature, skin wetness and shivering rate. Thermo-physiologically indices based on these outputs give information about the thermal comfort of man as PMV (Predicted Mean Vote, Fanger, 1972), PET (Physiological Equivalent Temperature, Matzarakis and Mayer 1997, VDI, 1998, Höppe, 1999, Matzarakis et al, 1999), SET* (Standard Effective Temperature, Gagge et al., 1986) or Outdoor Standard Effective Temperature (Out_SET*, Spangolo and de Dear, 2003) and Perceived Temperature (Tinz and Jendritzky, 2003).

In this work we used the physiologically equivalent Temperature (PET) (Höppe, 1993 and 1999) based on energy balance equation of the human body of the MEMI model (Höppe, 1993). PET is defined as the air temperature at which in a typical indoor condition the heat budget of the human body is balanced with the same core and skin temperature as under the complex outdoor conditions to be assessed. The idea is to transfer actual thermal conditions to an equivalent indoor environment in which the same thermal sensation is expected. The advantage of PET compared to other thermal indices also obtained from the human energy balance is the widely known unit °C. In addition PET can be used all year round and in different climates. Table 1 depicts PET against the grade of physiological stress and the thermal perception.

Table 1: Classification of PET and PMV with the known grades of thermal perception for human beings and grade of physiological stress, with an internal heat production of 80 W an a heat transfer resistance of the clothing of 0.9 clo (after Mayer and Matzarakis, 1996)

PET	Thermal perception	Grade of Physiologic Stress
	very cold	extreme cold stress
4° C	----------	----------
	cold	strong cold stress
8° C	----------	----------
	cool	moderate cold stress
13° C	----------	----------
	slightly cool	slight cold stress
18° C	----------	----------
	comfortable	no thermal stress
23° C	----------	----------
	slightly warm	slight heat stress
29° C	----------	----------
	warm	moderate heat stress
35° C	----------	----------
	hot	strong heat stress
41° C	----------	----------
	very hot	extreme heat stress

Results

Bioclimatic conditions in Austria

The assessment in terms of PET (monthly means or frequency of extremes) at station level is transferred into the area using GIS-techniques to construct bioclimatic maps. The resolution of the maps is 1 km for Austria (Zygmuntowski, 2004)

Maps were constructed for each month showing the distribution at 2 p.m. CET and maps of number of days with a certain PET – level.

The following graph shows the regional distribution of the mean annual number of days with PET > 35°C, i.e. days with strong heat stress at 2 p.m. central European time. It can be seen clearly that orography is the main influencing factor, the alpine regions above an altitude of about 1500 m do not suffer heat stress at the given physiological conditions.

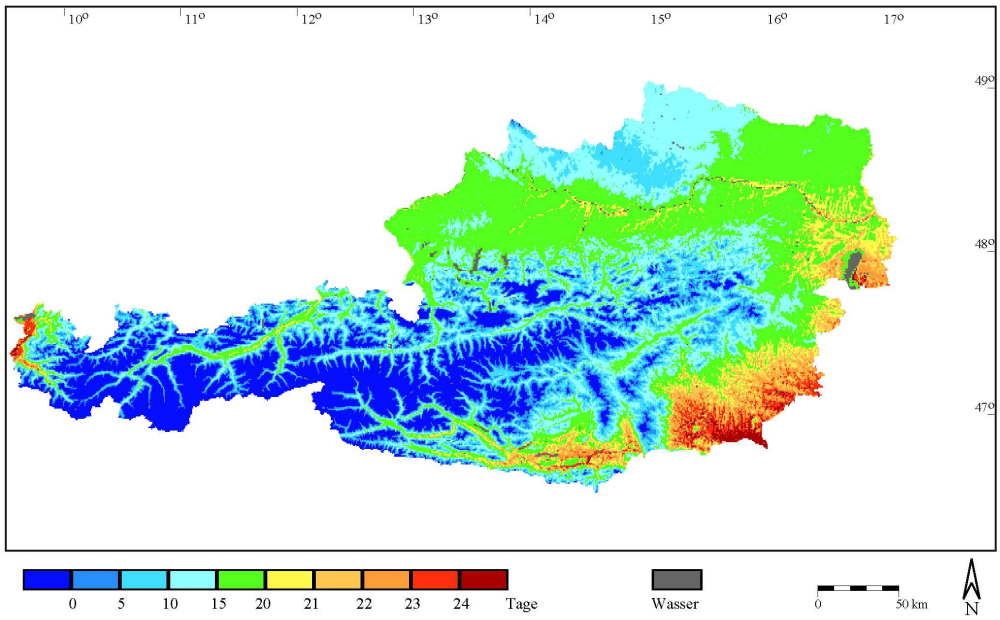


Figure 1: Mean annual number of days with PET > 35 °C at 14 CET, 1991-2000

Information on health resorts about bioclimate, given (legal) and proposed (by ACTIVE) indications

At present there are 40 climatic health and mountain resorts in Austria and some more sites are undergoing the procedure to be awarded this state-approved quality mark.

Within ACTIVE a brochure http://www.bmwa.gv.at/NR/rdonlyres/9E673239-C359-4EC6-A040-E6AB9B1454D1/17290/ClimateActive.pdf was produced that describes each of the health and mountain resorts with its specific bioclimate with special emphasis on the thermal complex and gives an overview of the offered therapies and the recommended medical (see following example of the mountain resort Weissensee in Carinthia, southern Austria).

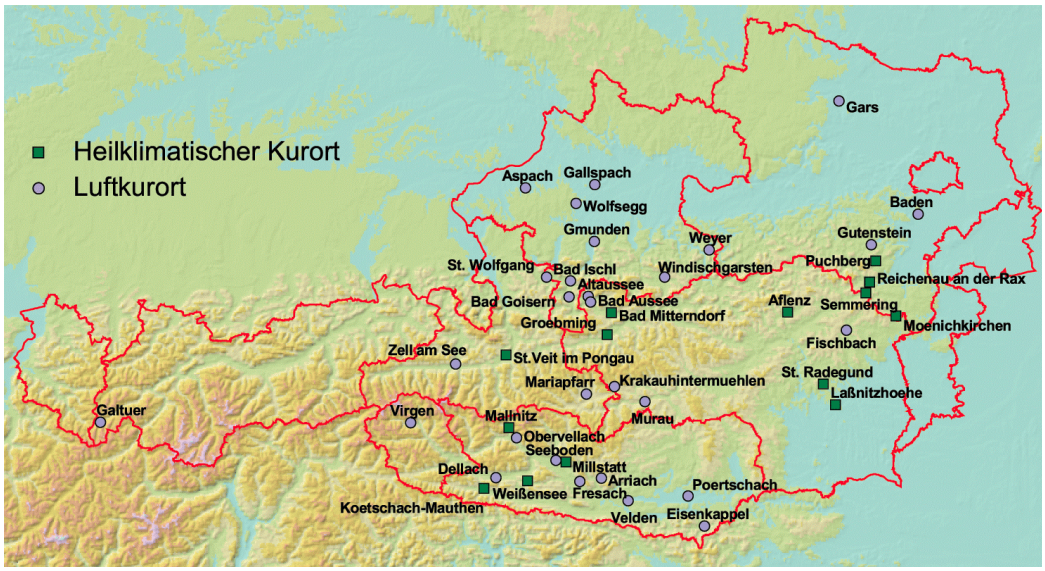


Figure 2: Climatic health and mountain resorts in Austria, status of 2005

A page of the above mentioned brochure follows, giving a graph and description of the thermal component of the climate but also short information on precipitation, air pressure, wind conditions and sunshine, cloudiness, fog. Then follows the valid and proposed medical indications, information on offered therapies, medical and touristic infrastructure.

Table 2: 2 pages of the brochure "Klimatherapie in Österreich" http://www.bmwa.gv.at/NR/rdonlyres/9E673239-C359-4EC6-A040-E6AB9B1454D1/17290/ClimateActive.pdf

Weissensee

Location

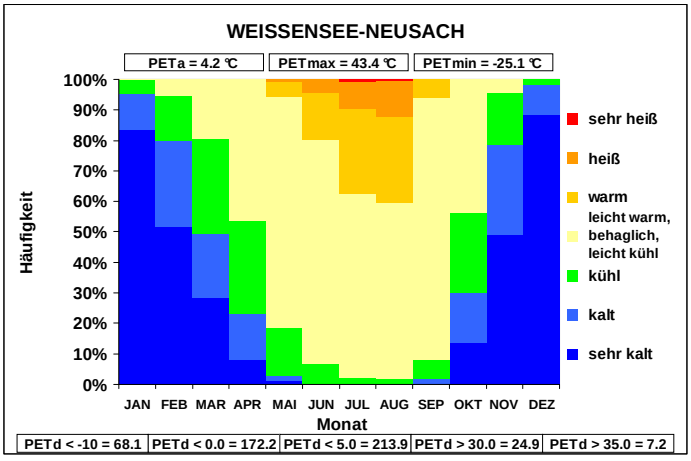
Height from 930 to 2221m, centre 945m a.s.l., imbedded in the Gailtaler Alps

Climatic health resort

Carinthia

Bioclimatic conditions

Thermal component
Weak strong or extreme grade of hot thermal perception (PET>35°) mean value 7 days per y., in the months May, June, July , August and September more than 50 % of all days are comfortable (see figure). Cold stress on more than 50 % of all days in January, February and December can be alleviated by increasing the personal stages of activity or by wearing thicker clothes.



Climate station:

13°19'00" eastern longitude

46°43'00" northern latitude

Thermal sensation:
Monthly frequencies of certain thermal perceptions in% (100% correspond all days of the month). Basis of classification: Physiologically Equivalent Temperature (PET), Period 1991-2000

Wind:
Main wind direction: Northwest and east, in the summer months thermal wind system with forced ventilation during daytime, during the night and the winter months mostly calm, low frequency (<7 days) of strong winds(>Bf 6) low frequency of Foehnwind (<5 days)

Precipitation:
Mean yearly sum 1260 mm on 106 days, 24 days with snowfall and 108 days with snow cover

Air pressure
Mean annual value between 912 hPa in 900 m und 767 hPa in 2300 m a.s.l.l

Sunshine, cloudiness, fog:
Yearly sum 1780 hours, 110 days with no sun, 25 days with fog,

Legal indications	Need for recovery of all age groups: disease prevention by hardening treatment (therapies to increase resistance), promotion of body and soul balance, elimination of health impairments caused by civilization, convalescence after diseases and surgery, chronic diseases of the respiratory tract – especially caused by exposition in polluted areas, functional heart disorders (hypotension, labile hypertension, functional circulatory disorders, neuro -vegetative regulation disorders (prostration, stress), negative effects of obesity, lack of physical exercise and inphysiological strain of the musculoskeletal system
ACTIVE Proposal for indications	Convalescence Vegetative regulation disorders Chronic fatigue syndrome (incl. sleeping disorders) Chronic disease of the respiratory tract Heart disorders
Additional therapies	Massage, health promotion programmes (Autogenic Training, Yoga, back health gymnastic, Wagyment, Stretching, …) conducted by certified trainers, health promotion specialists, "Movement in the healthy climate" – different altitudes and climate stimuli. 140 km marked hiking trails, 80 km Mountain bike-trails, 12 marked trails for jogging, and 8 trails for Nordic Walking. During winter: Winter-hiking, skating, jogging and Nordic Walking
Health care	Health doctors with pharmacies
Lodging	Hotels/accommodations: 4000 beds
Further Information	Weissensee Information A-9762 Weissensee Techendorf 78 Tel.: +43 (0) 47 13 / 22 20 Fax: +43 (0) 47 13 / 22 20 44 e-mail: info@weissensee.com
Homepage	http://www.weissensee.com

Proposals for a new legal regulation

Each of the nine provinces of Austria, which is a federal republic, has its own principles and provincial enforcement laws that define and describe the legal requirements of acquiring and maintaining the legally protected title of "heilklimatischer Kurort" and "Luftkurort". Besides requirements on medical and touristic infrastructure air quality etc. there are three major points to be found in each provincial law concerning meteorology:

I. Existence of natural, scientifically approved climatic conditions to cure diseases or stimulate recuperation; e.g. the lack of severe weather conditions like long lasting fog, little sunshine, frequent sultriness, high cooling power.

II. Running a climate station with registration of several meteorological parameters like air-temperature, humidity, sunshine duration, air pressure, wind speed, precipitation.

III. Every 10 years an expert opinion has to prove the climatic conditions have not changed.

The specifications issued in the early 1960's do not contain any quantitative threshold of meteorological and of air quality parameters, which is a big disadvantage.

In our study we present a proposal of a new legal regulation to define and protect the title climatic health- and mountain resort. Several quantitative thresholds, which were found in the course of the study, are proposed (Koch and Rudel, 2004).

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