TOURKLIM

Bioclimate and tourism information for Austrian health and tourism resorts

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This document is part of a presentation and not complete without the oral explanations.

Meteorological Institute

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- Introduction
- Methods applied
  - Stations: PET, RR, CTIS etc. (1), (2), (3), (4)
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Tourism Climate Index (TCI)

$$TCI = 8*Cld + 2*Cla + 4*R + 4*S + 2*W$$

Cld	Day comfort index, $T_{a,max}$ (°C) mean daily maximum air temperature and lowest mean relative humidity RH (%),
Cla	day comfort index, consisting of mean T_a (°C) and mean relative humidty (%),
R	precipitation (mm),
S	sunshine-hours per day (h),
W	mean wind velocity (m/s).

Each parameter is weighted,

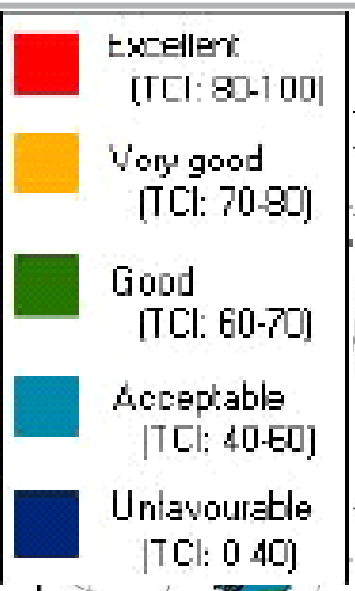
Each parameter can reach 5 points

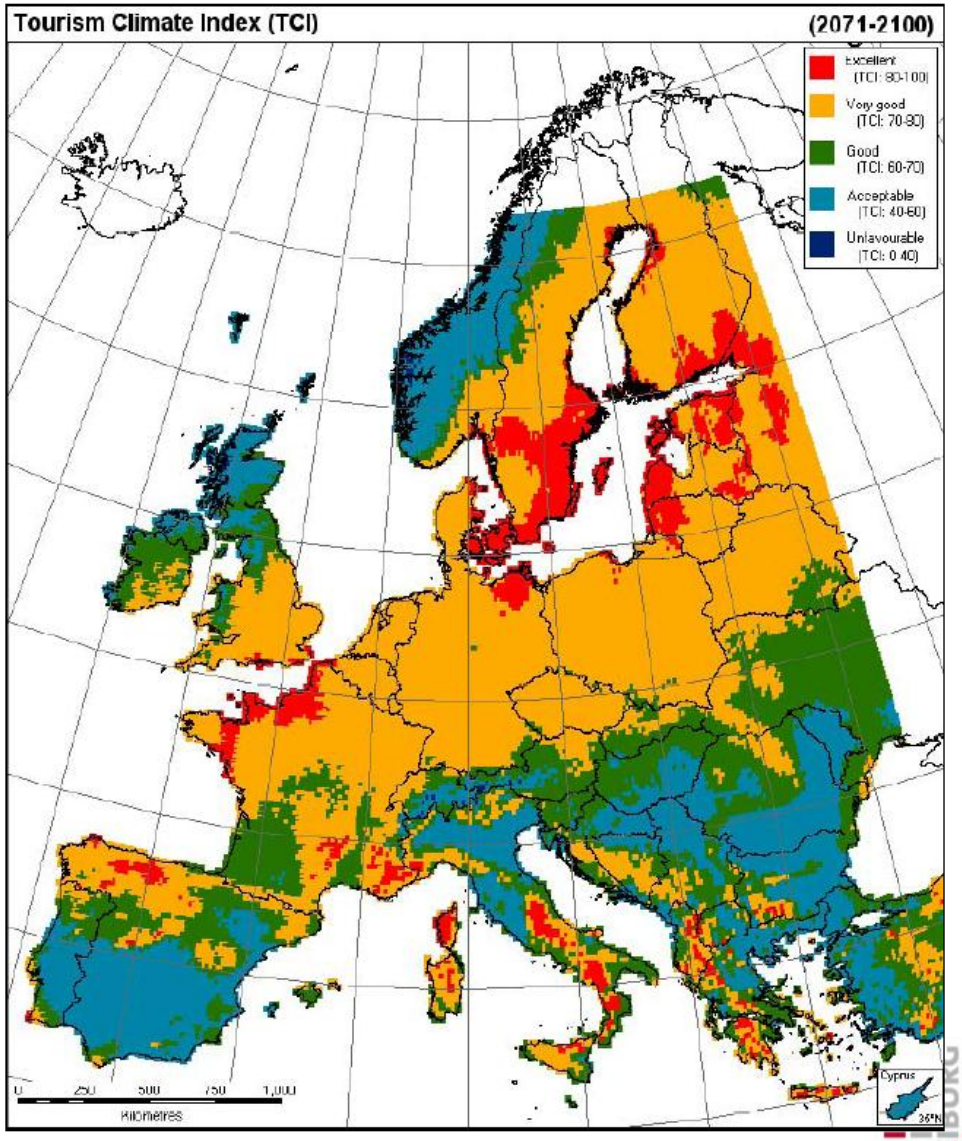
→ TCI maximum score of 100

< 40	***unfavourable or difficult conditions for tourism***
40 – 59	***moderate, acceptable conditions***
60 – 79	***good – very good conditions***
≥ 80	***excellent conditions***

Tourism Climate Index (TCI)

- Only summer and classical conditions
- Thermal comfort not based on HEB
- Not quantified

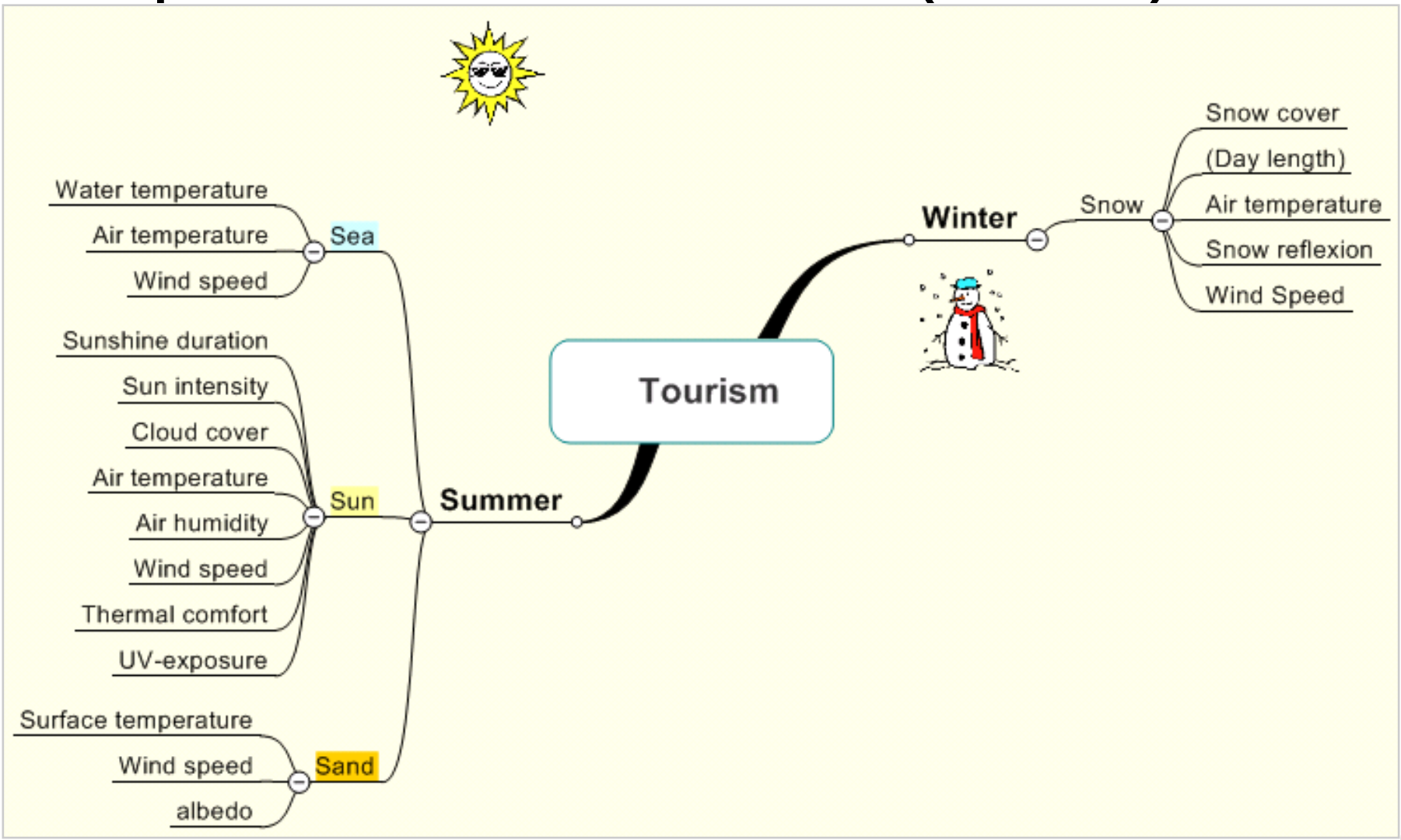




http://ec.europa.eu/environment/climat/adaptation/index_en.htm

Different views: Climatology and Tourism

Climate parameters relevant for tourism (selection)



(Matzarakis, 2006)

Facets of climate in tourism

Aesthetic

Sunshine duration

Visibility

Fog

Length of day

→ Attractiveness, Enjoyment

Physical

Wind

Rain

Snow/Ice

Extreme Weather

Air quality

UV

Odours/Noise

→ Annoyance, danger, activity, …

Thermal

Synergetic effects of air temperature, wind velocity, relative humidity, long- und short wave radiation, metabolism, activity, clothing

→ Thermal comfort/stress

(from de Freitas 2003, Matzarakis 2006; modified)

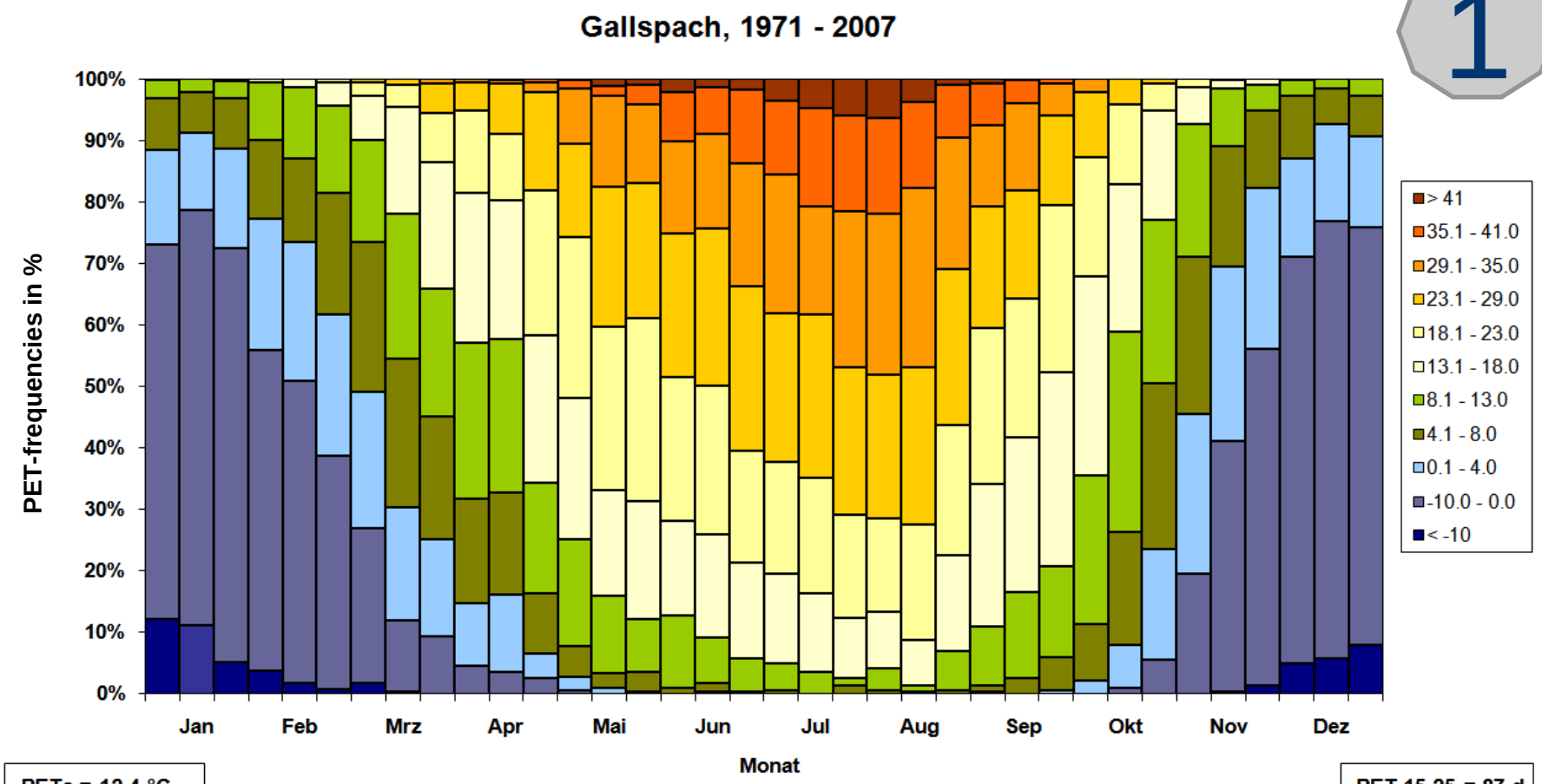
The 37 analyzed locations

(The red frame shows the location corresponding to the following diagrams.)

Physiologically Equivalent Temperature (PET)

PET-frequency diagram for Gallspach (period: 1971-2009), plotted in 10-day-intervals (monthly decades) from January to December.

1



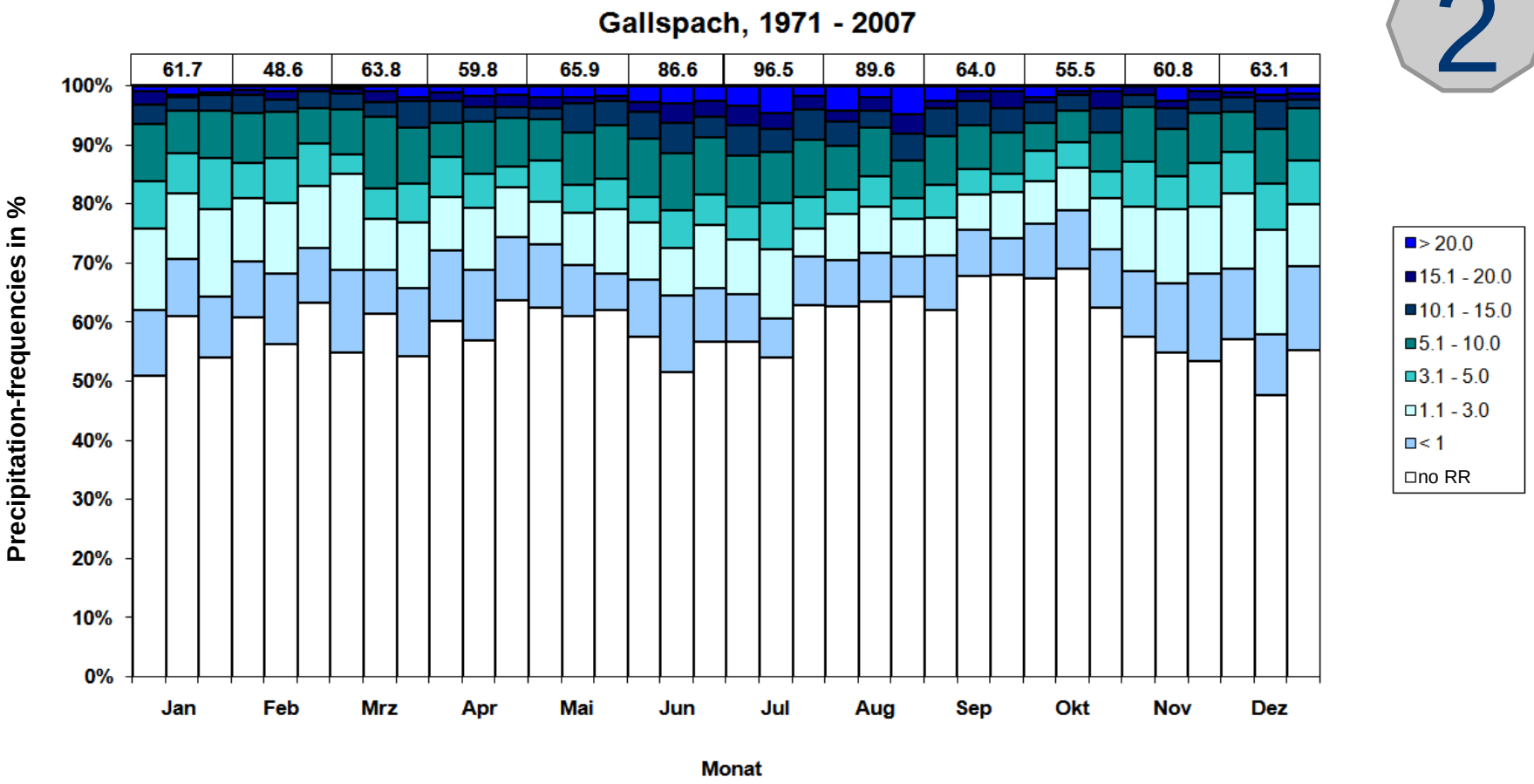
PETa = 12.4 °C	
PETmax = 49.8 °C	PET < 0 = 78 d
PETmin = -24.1 °C	PET < 8 = 149 d

	PET 15-25 = 87 d
PET > 30 = 39 d	PET 18-23 = 45 d
PET > 35 = 17 d	PET 18-29 = 84 d

Precipitation, cloud cover etc.

Precipitation-frequency diagram for Gallspach (period 1971-2009), plotted in 10-day intervals from January to December

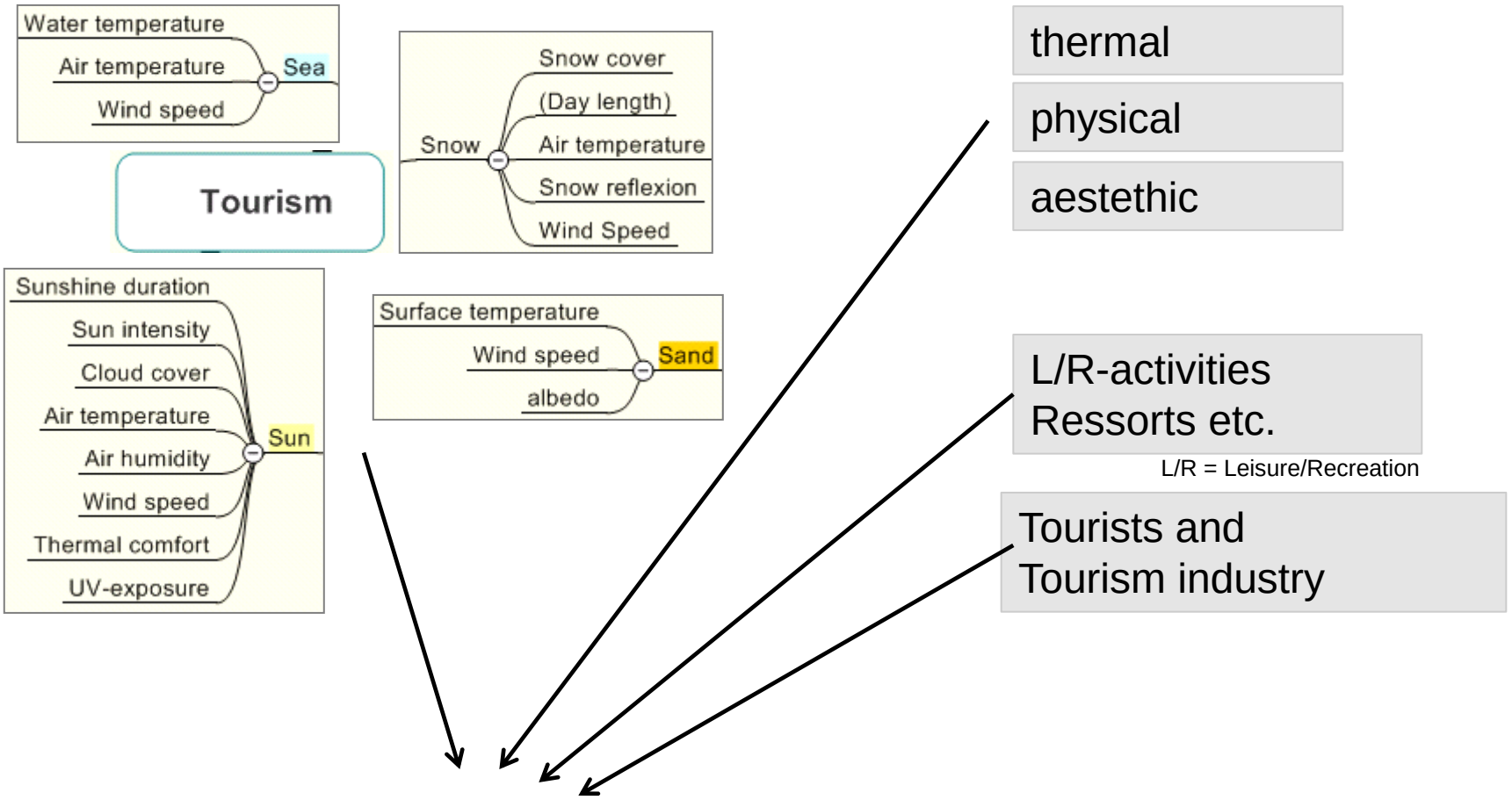
2



RRa = 815.9 mm	RR > 5 mm = 54 d	RR < 1 mm = 254
RRmax = 96.5 mm	SN > 10 = 21 d	SN > 30 = 3 d

Cloud < 4 = 121 d	VP > 18 hPa = 9 d
RH > 93 % = 30 d	Wind > 8 m/s = 17

Climate Tourism/Transfer Information Scheme



The Climate-Tourism/Transfer-Information-Scheme is based on:

- Basic climate parameters ((air temperature, air humidity not direct), wind velocity, cloud cover, precipitation) in daily values,
- Temporal information in **monthly decades** (division of the month in three intervals),
- Incorporation of climatological and human-biometeorological conditions which base on **frequencies and threshold values**,
- Incorporation of thermal comfort (PET), heat stress, cold stress and sultriness,
- Incorporation of precipitation (type and amount) as influencing factor,
- Incorporation of fog, abundance of sun and/or clouds,
- Incorporation of windy conditions.

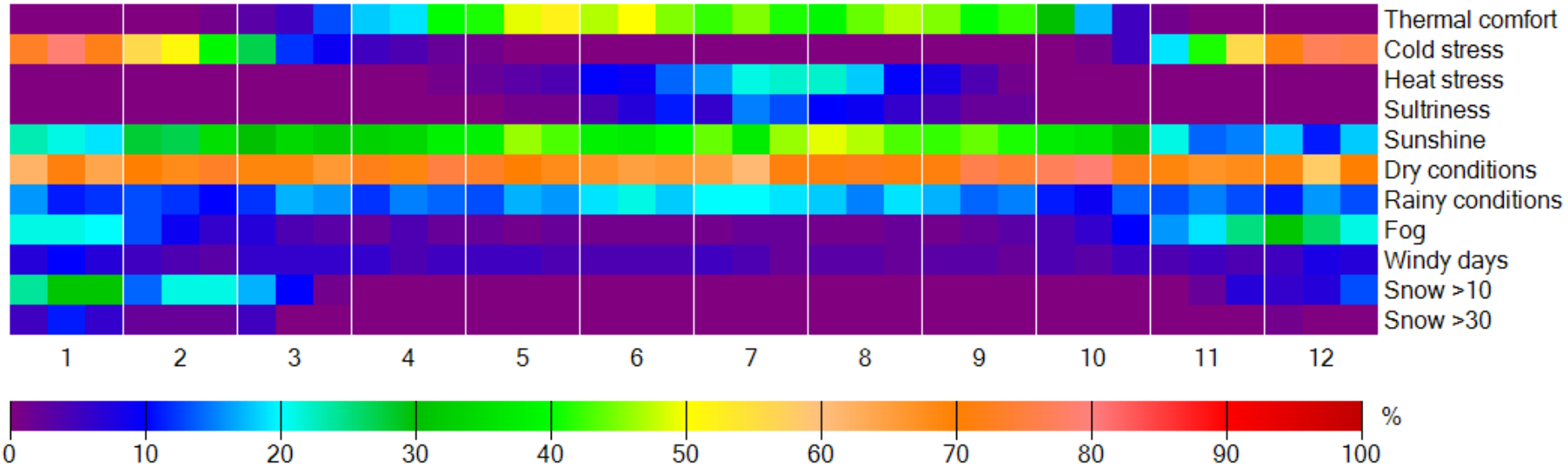
Analyzed parameters and their threshold values

Thermal comfort	(18 °C < *PET < 29 °C)
Heat stress	(*PET > 35 °C)
Cold stress	(*PET < 0 °C)
Sunshine	(cloud cover < 5/8)
Fog	(relative humidity > 93 %)
Hot-humid, sultriness	(vapour pressure > 18 hPa)
Day without rain	(precipitation ≤ 1 mm)
Rainy day	(precipitation > 5 mm)
Day with stormy weather	(wind velocity > 8 m/s)
(Skiing potential)	[snow cover > 10 cm /30 cm])

** PET = Physiologically Equivalent Temperature*

CTIS

Climate-Tourism-Information-Scheme (CTIS) for Gallspach for the period 1971-2009, plotted in monthly decades from January to December



3

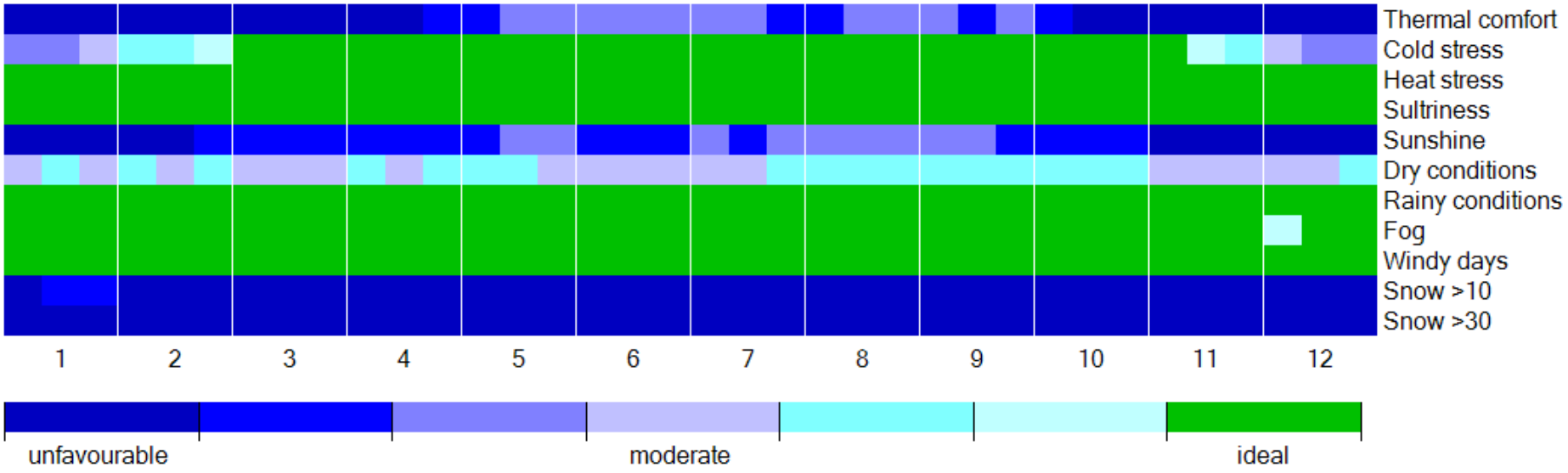
Percent-type of plotting (frequency of the parameter in each monthly decade = each 10-day-interval)

Scale for assessment (rating)

color	range of per cent values	description
	< 14%	unfavourable
	14 % - 28 %	↕
	28 % - 42 %	↕
	42 % - 56 %	moderate
	56 % - 70 %	↕
	70 % - 84 %	↕
	> 84 %	ideal

CTIS

Climate-Tourism-Information-Scheme (CTIS) for Gallspach for the period 1971-2009, plotted in monthly decades from January to December



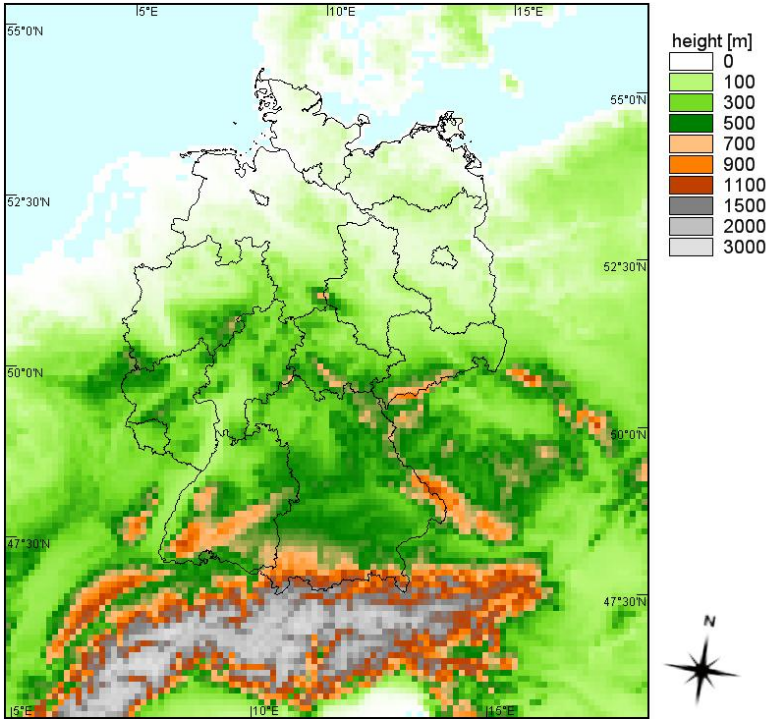
4

„Assessment“-type (rated CTIS)

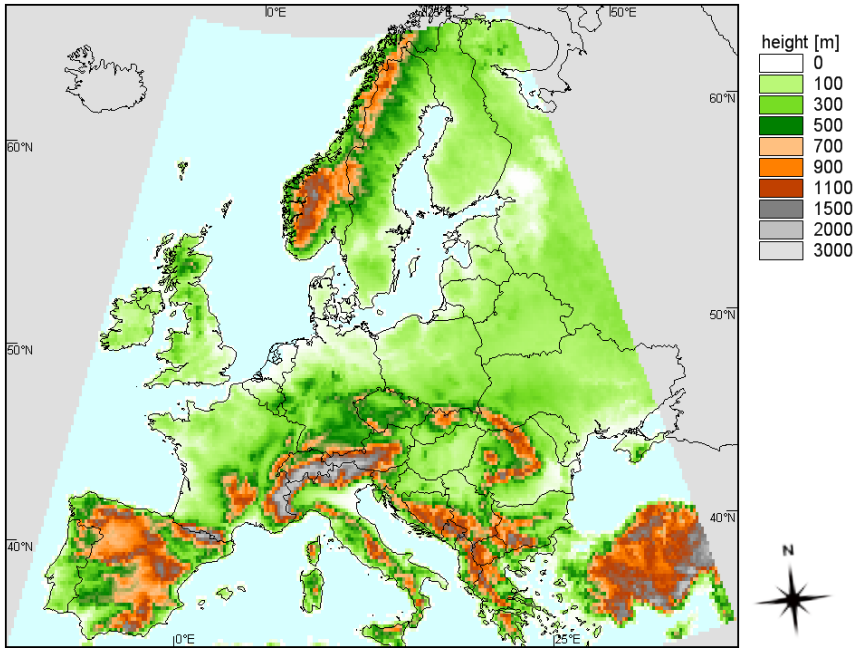
Used climate model data

Methods and Data: Regional climate models

REMO (~10 km)

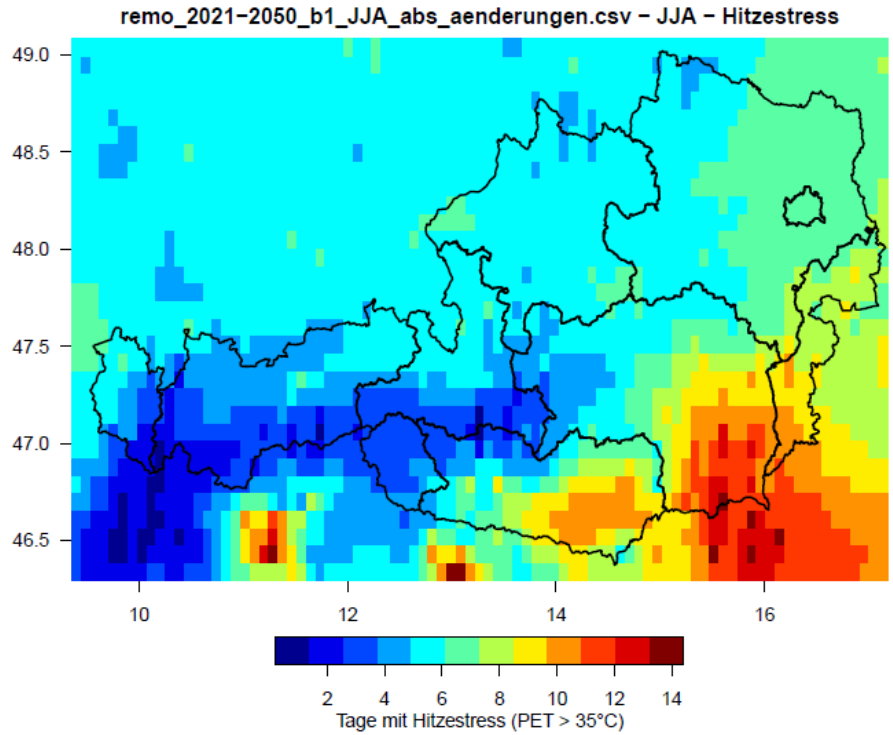


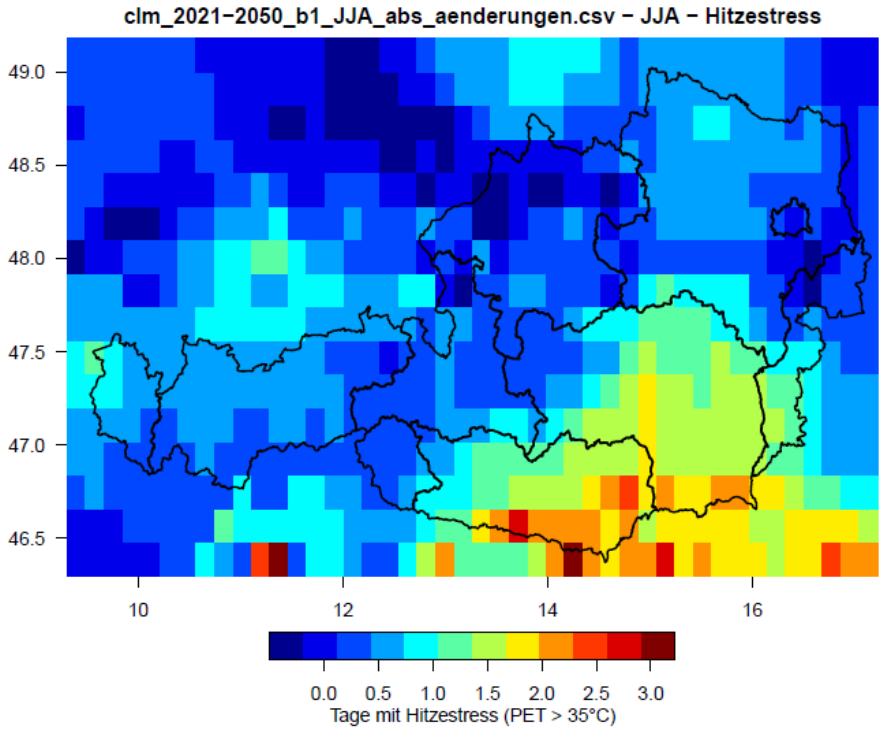
CLM (~18 km)



Maps creation of CTIS-Factors

Number of additional days with heat stress in summer in Austria.
Comparison between periods 1971 – 2000 and 2021 – 2050, scenario B1.
Left figure: REMO, right fig. CLM.





Qualitative assessment

Qualitative assessment for the **whole area** of Austria (period: 2071 – 2100)

Parameter	CLM		REMO		Tendency
Thermal comfort	A1B: ++	B1: +	A1B: +	B1: +	moderate increase (+)
	+		+		
Cold stress	A1B: - -	B1: - -	A1B: - -	B1: - -	distinct decrease (- -)
	- -		- -		
Heat stress	A1B: ++	B1: +	A1B: +	B1: +	moderate increase (+)
	+		+		
Sultriness	A1B: +	B1: +	A1B: ++	B1: ++	moderate increase (+)
	+		++		
Dry conditions	A1B: -	B1: -	A1B: +	B1: +	no tendency (0)
	-		+		
Rainy conditions	A1B: +	B1: +	A1B: -	B1: -	no tendency (0)
	+		-		
Skiing potential	A1B: - -	B1: - -	A1B: - -	B1: - -	distinct decrease (- -)
	- -		- -		
Windy days	A1B: 0	B1: 0	A1B: +	B1: 0	no tendency (0)
	0		0		
Sunshine	A1B: +	B1: +	NIL	NIL	moderate increase (+)
	+		NIL		
Fog	A1B: - -	B1: -	A1B: 0	B1: +	moderate decrease (-)
	-		0		

Classes for the qualitative assessment (according to Endler und Matzarakis 2010 S. 160f)

* Used for „Sunshine“ in REMO because the model does not offer this parameter.

Symbol	Degree of change
- -	distinct decrease
-	moderate decrease
0	no tendency
+	moderate increase
++	distinct increase
NIL*	(no data)

Summary

- Analysis for the whole year!
- High temporal resolution (CTIS)
- Maps of important CTIS-parameters (periods 1961-1990, 2021-2050, 2071-2100) from REMO- and COSMO-CLM-runs
- Summarizing and quantitative assessment of REMO/CLM-results
- Basics first, then climate change
- Winners and losers! – Focus also on other climate- and tourism-regions
- Flexibility of the travelers (tourists) and providers (tourism industry)

Thank You

Ευχαριστώ πολύ