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Implications of 2 °C global warming in European summer tourism

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ABSTRACT

Tourism is highly dependent on the climatic conditions of a given destination. This study examines the impact of two degrees global warming on European summer tourism from a climate comfort perspective. The changes in summer tourism climate comfort are realized with the aid of the Tourism Climatic Index (TCI). Four ENSEMBLES Regional Climate Models (RCMs) provided the data for Europe under the A1B emission scenario that are used in the analysis of potential changes in tourism favorability. Results show that the change in climate will positively affect central and northern Europe, increasing the potential of further economic development in this direction. Mediterranean countries are likely to lose in favorability during the hot summer months whereas will tend to become more favorable in the early and late summer seasons. Considering that the two degrees period is focused between 2031 and 2060, the estimated shifts in the climate favorability of Mediterranean countries indicate a need in early adaptation strategies.

Practical implications

Climate consists of a necessary resource of summer outdoor tourism. Subsequently, changes in climate could possibly affect tourism flows. The conducted study quantified the possible effects of the +2 °C global warming to the European summer tourism. The projected increase in temperature and sunshine may positively influence the comfort related to summer tourism in the central and northern European countries by making it warmer compared to the present-day climate. However, in the southernmost European countries the already favorable or almost favorable climate will become warmer than the ideal, mainly in the present-day peak summer season of June to August. This may alter the long term tourism flows by redirecting visitors of southern European countries to northern European countries. Nevertheless, the same negatively affected countries are expected to become more appealing during pre and post summer periods, creating new opportunities for the tourism industry and the related players. The analyzed data showed that on average, the projected changes will occur between 2031 and 2060.

Projected changes in the tourism climate favorability point the directions of adaptation measures that tourism policy makers should take into consideration for long term planning. The adaptation capacity of the tourism sector is high due to the dynamic nature of the sector, and therefore there will be important opportunities to reduce climate change induced vulnerability. For the Southern European countries, policy makers should plan changes based on the prospect that the seasonality of climate favorability could slightly decrease in the mid-summer while spring and autumn become more susceptible for tourism, and thus invest on infrastructures and activities to this direction. For the central and northern European countries, the climate for the entire summer season is projected to become more appealing to a wider range of different summer tourism activities. Key players of the tourism sector should take advantage of this climate opportunity to extend the capacity of existing facilities and invest on related tourism activities in their long term plans.

While the methods used in this work do not provide quantification in strict financial terms, they provide comparative results about which countries and in which degree will be affected by changes in climate. It was found that the most negatively affected areas in June to August tourism climate favorability are likely the southern Iberian Peninsula, Balearic Islands, the coastal region of Lion gulf, a significant part of coastal Italy, Sicily and Sardinia, central and southern Greece and Cyprus (Fig. 6). At the same time, some of the

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most visited areas of the same period of the year belong to the most affected regions, with the Mediterranean coastal areas from Portugal to Liguria Sea, Balearic Islands, parts of Italy and Greece, and Cyprus to have over 2 million overnight stays per prefecture in the June to August period (Fig. 6). Adaptation measures for Portugal, Spain and France should consider the lengthening of tourism season in the southern parts that will be negatively affected. Moreover, a further development of the tourism industry at the northern Portugal and the coastal areas of Biscay Bay might be possible as more favorable conditions for summer tourism activities are projected in the future. Italy, Greece and Cyprus should point to the lengthening of the tourism season and the development of additional tourism activities that are resilient to higher temperature. Coastal areas of UK, Denmark and south Sweden (Fig. 6) already have a large number of visitors in the summer. It is projected though that they will be further benefited under +2 °C, which provides the opportunity of expansion of the summer related tourism activities.

Tourism is a dynamic industry with increased adaptation potential. Climate will create both problems and opportunities for the summer destination areas in Europe. The changes should be considered along with the projected timing of occurrence to form an early framework of adaptation and mitigation measurements that will further develop this leading industry of Europe.

Introduction

Tourism is a key factor of global economic growth and development. The World Tourism Organization (UNWTO) estimates that the tourism accounts for the 2–12% of GDP in advanced, diversified economies, up to 40% in developing economies and up to 70% in some small Island economies (Ashley et al., 2007). It is also estimated that tourism offers the 1 in every 11 jobs worldwide (UNWTO, 2014).

Climate has a key influence on tourism activity (Perry, 1997). Good weather conditions favor the outdoor tourist and recreational activities and thus play a key role in the selection of tourism destinations (Gómez Martín, 2005). In fact, Eurobarometer (2012) reports that 50% of the European citizens decide whether to return to the same place for another holiday, based on the weather of the location. Moreover 28% of respondents report that they went on holiday for the sun or the beach.

Climate elements that have a direct impact on the human perception are temperature, humidity, sunshine, radiation, precipitation and wind (Gómez Martín, 2005; Hamilton and Lau, 2005; Stern et al., 1999) and thus determine a large share of international tourism flows. Several statistical analyses in literature have shown the relevance of climate components as determinants of touristic demand (Hamilton, 2004; Lise and Tol, 2002; Maddison, 2001). Gössling et al. (2012) state that the role of perceptions is insufficiently understood due to their complexity and might even result in abrupt changes and longer-term modification in travel behavior. Additionally, it is difficult to quantify the effect of climate change on tourism due to its relatively slow pace compared to other socioeconomic factors such as political stability, the economic environment, and fashion trends, which make the quantification difficult. Although climatic effect on tourism might not be directly measurable, its underlying effect and the long term changes are certain in a changing climate world (Amelung and Viner, 2006).

The assessment of climate resources for tourism activities is mainly based on the evaluation of climatic variables related to the human comfort. Common variables used for climate favorability estimation are air temperature, humidity, precipitation, wind and sunshine duration (Matzarakis and de Freitas, 2001; Mieczkowski, 1985). The climatic variables are often considered in monthly averages (Mieczkowski, 1985) or in daily time step (Matzarakis, 2007). The Tourism Climatic Index (TCI) (Mieczkowski, 1985) proposed an index that correlates the general findings of human comfort to the specific activities related to recreation and tourism (Amelung and Moreno, 2009). It summarizes and combines seven climate variables that affect climate favorability for outdoor tourism. It has been used in a number of studies (Amelung and Nicholls, 2014; Clark et al., 2011; Goh, 2012; Rosselló-Nadal, 2014; Scott and Schwartzentruber, 2008) to quantify the effect of climate in tourist destination favorability and determine ideal climatic coefficients. The TCI is favored as an index because it comprises one of the most comprehensive metrics that integrate all three essential climate facets relevant to tourism. These facets are thermal comfort, physical aspects such as rain and wind, and the aesthetical facet of sunshine/cloudiness (de Freitas, 2003). At the same time it makes use of climate variables that are commonly available from weather stations or climate models, making data provision simple. Evidently, different tourism activities impose different climatic requirements, i.e. sunbathing, skiing and surfing, all require quite specific and different conditions, making widely accepted the fact that there is not a single index that can rate the climate for all these specific activities together. However the TCI focuses on the common and general tourism activities of sightseeing and similar light outdoor activities.

The TCI exhibits a number of shortcomings. While Mieczkowski (1985) initially was based on extensive previous literature of climate classification for common tourism activities (Crowe, 1976) and other biometeorological literature dealing with human comfort (Kandror et al., 1974), the final weighing of the different sub-indices was ultimately based on his expert judgment rather than empirical verification (Perch-Nielsen et al., 2010). Nonetheless, a later survey of de Freitas et al. (2008) on beach activities showed that temperature and sunshine were tied as the most important climate components, followed by the absence of rain and the absence of wind, which verifies the (Mieczkowski, 1985) rank of the different climate variables used in TCI. Moreover, the non-specialization of TCI to a specific type of activity is appropriate for a macroscopic level analysis of potential shifts in climatic favorability, due to changes in climate conditions (Amelung et al., 2007). Rosselló-Nadal (2014) notes that TCI is a good predictor of tourist arrivals, as it shows strong correlation with the currently popular destinations. Other works in literature focused on the specification of TCI to specific types of activity. Morgan et al. (2000) attempted a calibration procedure using on site surveys in beach environments in Wales, Malta and Turkey, in order to modify the TCI index to better describe specifically the sun-sand-sea (3S) tourism. Similarly, Scott et al. (2008) modified the optimum effective temperature from 20 °C–27 °C to 24 °C–31 °C to better describe the beach oriented tourism.

In 2009, G8 world leader Summit agreed on the upper limit of +2 °C global warming above preindustrial levels. Many experts believe that this target has become unrealistic as we are currently on the 4 °C path (Betts et al., 2010, 2015; Sanderson et al., 2011); however the global community has committed itself to holding warming below 2 °C to prevent "dangerous" climate change. The best available methods are being utilized by the scientific community to quantify the effect of a 2 °C warming on different social and economic sectors. The EU FP7 project IMPACT2C (http://www.impact2c.eu) aims to enhance the knowledge and quantify the climate change impacts, vulnerabilities and economic cost in pan European scale, from a 2 °C global warming. The present study attempts the impact assessment of a 2 °C warming to the summer tourism of Europe.

Methodology

The TCI is a summary of ratings of five human comfort indices related to sightseeing tourism. The sub-indices related to thermal comfort are weighted to 50% of the total sub-indices weights, reflecting the importance of the heat comfort to exercise outdoor activities (Mieczkowski, 1985). Specifically, the 40% of the weight is carried by daytime comfort index which is an estimate of the daytime comfort. The remaining 10% is carried by the daily comfort index, because it reflects conditions of thermal comfort over the full 24 hours, including the night hours when the tourist activity is significantly lower than in the daytime. According to Mieczkowski (1985) daily comfort index is related to the physiological effect of the cool night/hot day sequence which is related to the fact that after a comfortable night one is better able to stand up to an uncomfortable day (Hounam, 1967). The thermal comfort components estimation was based on Missenard (1933) equation which is shown in Eq. (1).

$$CI = T - 0.4(T - 10)(1 - R_h/100) \quad (1)$$

where T is monthly means of temperature (°C) and R_h the relative humidity (%). The **CID** sub-index which accounts for the daytime comfort is estimated from Eq. (1) using maximum daily temperature and minimum daily humidity. The **CIA** sub-index which represents the average daily thermal comfort is estimated by Eq. (1) from mean daily temperature and humidity. The third sub-index **R** is the mean monthly precipitation (mm), the fourth sub-index **S** is the mean monthly daily sunshine duration (hours/day) and finally the sub-index **W** is the monthly mean wind speed (m/s). Each sub-index is then rated using the rating scale of Mieczkowski (1985) (Table 1). As shown in Table 1, the thermal comfort indices **CIA** and **CID** have an optimal range, while values higher or lower of that range are rated with lower scores. For the **R** and **W** sub-indices the nonexistence of rainfall/wind is rated as the optimal states for these sub-indices. Moreover, the sub-index of sunshine duration **S** is rated proportionally to its duration. Finally the five sub-indices lead to the estimation of TCI through Eq. (2).

$$TCI = 8 \cdot CID + 2 \cdot CIA + 4 \cdot R + 4 \cdot S + 2 \cdot W \quad (2)$$

The results of Eq. (2) are finally categorized according to the descriptive scale of Table 2.

Table 2
Tourism Climatic Index final classification.

TCI	Category
90–100	Ideal
80–89	Excellent
70–79	Very good
60–69	Good
50–59	Acceptable
40–49	Marginal
30–39	Unfavorable
20–29	Very unfavorable
10–19	Extremely unfavorable
<10	Impossible

Study area and datasets

The change in TCI was estimated for 42 countries (Table 3) within the European domain. Data from four RCM models of the climate experiment ENSEMBLES (http://ensembles-eu.metoffice.com/) under the A1B emission scenario (Nakicenovic and Swart, 2000) were used for the estimation of TCI. The used RCMs are shown in Table 4. Two periods were considered, a reference period between 1971 and 2000 and a future period where the +2 °C of global warming is projected to occur under the considered emission scenario (hereafter referred to as +2 °C period). The +2 °C period was explicitly defined for each RCM model as the period in which each driving GCM reaches this specific level of global warming relatively to the preindustrial period 1881–1910. Details about the definition of the warming levels are found in Vautard et al. (2014). The +2 °C period for each of the four driving GCM models is shown in Table 4. The RCMs achieve the +2 °C within the period 2031–2060. The horizontal resolution of the RCM data was 25 km × 25 km. The precipitation and temperature variables were obtained already adjusted for systematic biases using the quantile mapping technique described in Themeßl et al. (2011). The observational dataset of the bias correction procedure was the E-OBS v5.0 (Haylock et al., 2008). The rest of the variables were obtained in their raw form. The analysis of TCI was carried out for two different periods within the year. The first period considered was May to October that includes the summer months, along with the late spring and early autumn periods. In these months, almost the summary of the summer tourism activities takes place in the European countries according to Eurostat data for Nights spent by non-residents at tourist accommodation establishments (dataset name *tour_occ_ninrmw* found in http://ec.europa.eu/eurostat/web/tourism/data/database) between 2007 and 2010. Additionally, a second period between June and August was considered. These three months represent the high season of summer tourism activities in Europe.

Table 1
Tourism Climatic Index sub-indices rating scales.

Rates	Thermal comfort (°C)	Precipitation (mm)	Sunshine duration (hours/day)	Wind speed (km/h)
5	20–27	0.0–14.9	>10	<2.88
4.5	19–20 or 27–28	15.0–29.9	9–10	2.88–5.75
4	18–19 or 28–29	30.0–44.9	8–9	5.76–9.03
3.5	17–18 or 29–30	45.0–59.9	7–8	9.04–12.23
3	15–17 or 30–31	60.0–74.9	6–7	12.24–19.79
2.5	10–15 or 31–32	75.0–89.9	5–6	19.80–24.29
2	5–10 or 32–33	90.0–104.9	4–5	24.30–28.79
1.5	0–5 or 33–34	105.0–119.9	3–4	28.80–38.52
1	(−5) to 0 or 34–35	120.0–134.9	2–3	>38.52
0.5	35–36	135.0–149.9	1–2	
0	(−10) to (−5)	>150.0	<1	

The Thermal Comfort scale applies both in CIA and CID sub-indices.

Table 3
List of the countries considered in the analysis with their centroid latitude.

Country		Centroid	Country		Centroid
Cyprus	CY	35.05	Moldova	MD	47.20
Greece	GR	39.04	Austria	AT	47.59
Turkey	TR	39.07	Slovenian Republic	SK	48.71
Portugal	PT	39.60	Ukraine	UA	49.00
Spain	ES	40.23	Czech Republic	CZ	49.74
Albania	AL	41.14	Luxembourg	LU	49.78
FYROM	FYROM	41.60	Belgium	BE	50.64
Andorra	AD	42.55	Germany	DE	51.11
Kosovo	KS	42.59	Poland	PL	52.13
Bulgaria	BG	42.76	Netherlands	NL	52.25
Italy	IT	42.79	Ireland	IE	53.18
Montenegro	ME	42.79	Belarus	BY	53.54
Bosnia-Herzegovina	BA	44.17	United Kingdom	UK	54.16
Serbia	RS	44.24	Lithuania	LT	55.34
Croatia	HR	45.04	Denmark	DK	55.96
Romania	RO	45.84	Latvia	LV	56.85
Slovenia	SI	46.12	Estonia	EE	58.67
France	FR	46.56	Russia	RU	58.95
Switzerland	CH	46.80	Sweden	SE	62.78
Liechtenstein	LI	47.14	Norway	NO	64.46
Magyarorszag	HU	47.17	Finland	FI	64.47

Table 4
List of the ENSEMBLES RCMs that were used.

GCM	RCM	+2 °C central year	+2 °C period	RCM key reference
bccr_bcm2_0-r1	DMI-HIRHAM	2052	2038–2067	Christensen et al. (2007)
HadCM3Q0	METO-HC_HadRM3Q0	2035	2021–2050	Collins et al. (2006)
HadCM3Q3	SMHI-RCA	2047	2033–2062	Kjellstrom et al. (2005)
mpi_echam5-r3	MPI-REMO	2048	2034–2063	Jacob et al. (2001)

Results

First, the TCI was estimated for the reference and the +2 °C periods. Fig. 1 presents the average TCI for the May to October (TCI_{M-O}) and June to August (TCI_{J-A}) for the two periods considered. The highest TCI_{M-O} scores for the reference period are achieved near the Mediterranean areas (Fig. 1a). For TCI_{J-A} (Fig. 1b) the same pattern occurs, except for southern parts of Spain and Portugal that are already warmer than the ideal comfort zone, as it will be discussed later in detail. For the +2 °C period, climate model projections indicate noteworthy change of the TCI across the European domain (Fig. 1c and d). More specifically, for the northernmost Europe (northern UK and northern Scandinavian Peninsula), minor changes are projected for both TCI_{M-O} and TCI_{J-A}, with the TCI to remain in the range of 45–55, or marginal to acceptable, according to the descriptive scale of TCI. The central European regions, the European Russia part, the majority of the sub-Mediterranean region as well as the Atlantic Europe are projected to face a noteworthy increase in the TCI_{M-O} and TCI_{J-A} in the range of 1–5 TCI units (Fig. 2a and b). Moreover, the increase is projected to be more profound in the TCI_{J-A} for the Pyrenees, Alps, Balkan mountainous areas, Northern Spain, Brittany, southern parts of Ireland, southwestern UK, North Sea coast of UK, Denmark, coastal areas of Netherlands and Norway, and parts of the Baltic Sea coast in Sweden that are expected to have an improvement in TCI higher than 5 TCI units. In the south Europe and especially in the Mediterranean region, TCI is expected to exhibit a substantial decrease. Specifically, TCI_{M-O} is projected to present a large increase in parts of southern Iberian Peninsula, Greece and Cyprus. Furthermore, in the period of June to August, TCI is projected to exhibit a substantial decrease in the majority of central and southern Iberian Peninsula, south coastal France, coastal Italy, Sicily and Sardinia, the entire Greek territory and Western Turkey. Moreover, Cyprus, Crete and southern half of Spain are expected to face the greatest negative impact that will exceed the –5 TCI units.

Although TCI may vary significantly within a single country, aggregates were also estimated for the 42 European countries to provide a national impact overview of the +2 °C warming in terms of TCI score. Fig. 3 summarizes the projected changes in TCI of May to October and June to August for the reference and +2 °C periods. The standard deviation of TCI among the RCMs is also included in horizontal error bars giving a perception about the variability among the four RCM results. The countries in Fig. 3 are placed in descend-

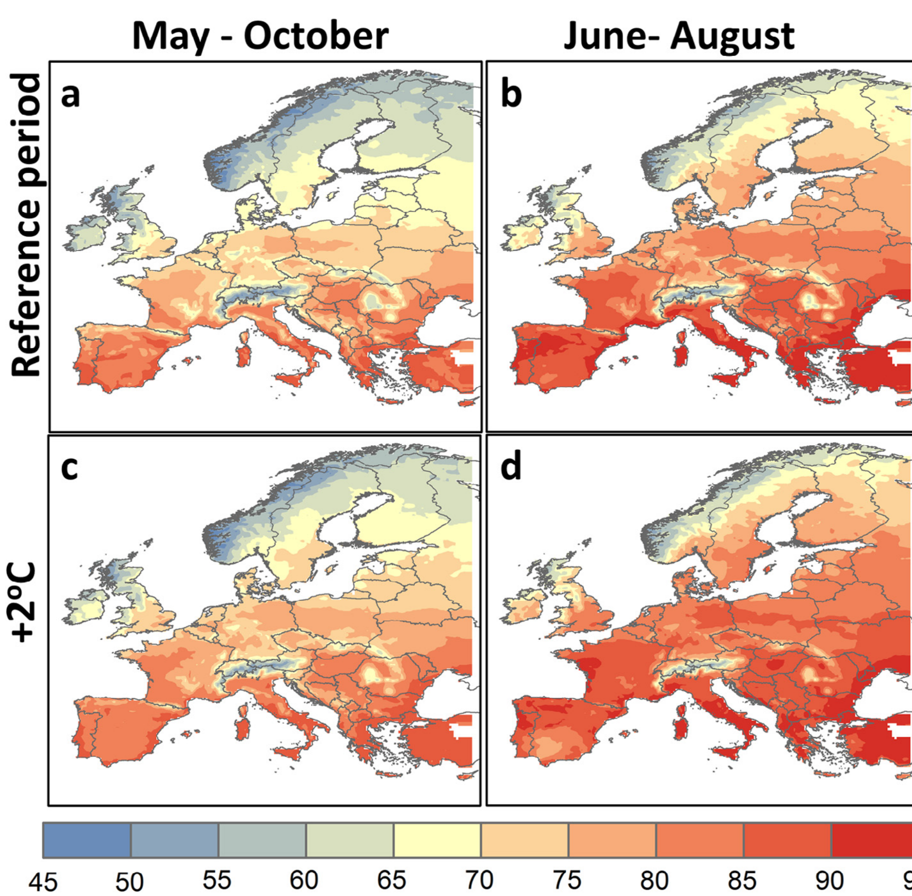

Fig. 1. Ensemble TCI for the reference (a, b) and the +2 °C (c, d) periods for May to October (left) and June to August months (right).

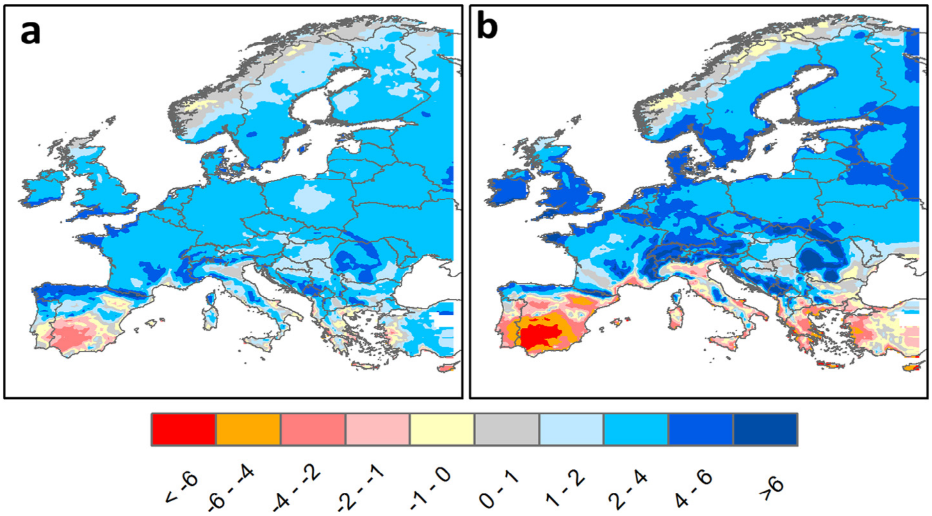

Fig. 2. Difference between +2 °C and the reference periods for May to October (left) and June to August months (right).

ing order according to each country centroid latitude (Table 3), featuring the general remark that the further south a country is, the better tourism climate favorability it exhibits. Lichtenstein, Switzerland and Andorra are exceptions due to their high mean elevation. As shown in the figure, the TCI_{J-A} is expected to increase

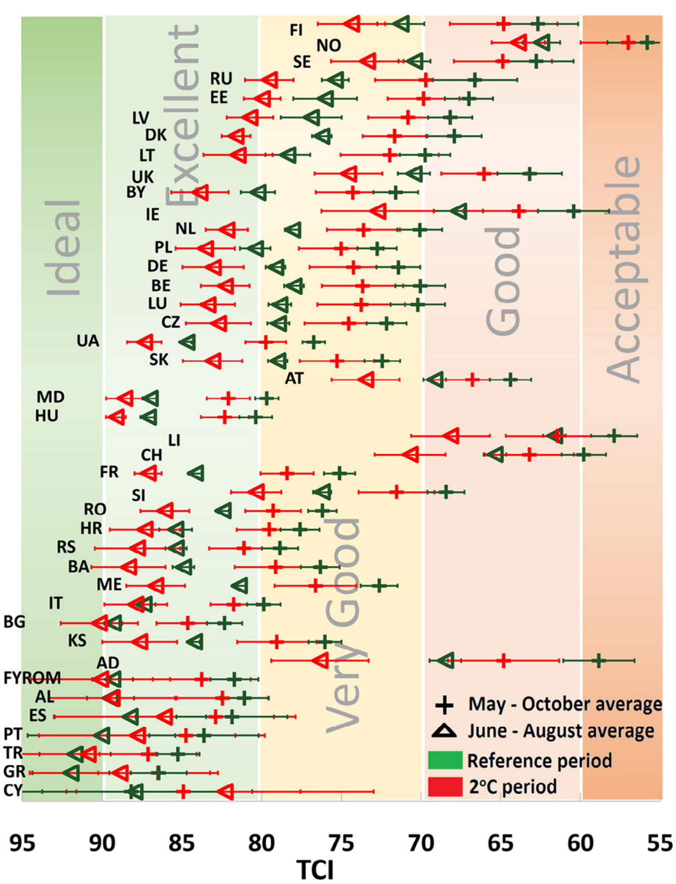

Fig. 3. Country average TCI for the reference (green) and the +2 °C (red) periods for May to October (crosses) and June to August (triangles). Error bars indicate the standard deviation among the RCM results.

in all countries north of Albania, while all countries except Cyprus present an increase in TCI_{M-O}.

The change of each country TCI between reference and +2 °C periods is shown in Fig. 4a and b, ranked in descending order of TCI change, revealing the most winning and losing in terms of TCI countries. Cyprus is expected to exhibit loss both in TCI_{M-O} and TCI_{J-A}, which is also an indicator of the severe projected change in Mediterranean region climate, and especially the temperature increase (Tsanis et al., 2011). Greece is negatively affected in the June to August trimester while no changes are expected in May to October. Spain, Portugal and Turkey TCI values are projected to decrease in June to August but increase in May to October periods.

Fig. 5 shows the average monthly variation TCI for the reference and the +2 °C periods for 42 countries in Table 3, beyond the averages of June to August and May to October analyzed earlier. It is shown that Greece, Spain, Portugal and Turkey are expected to exhibit loss in June to August while for the May to October, the loss is counterbalanced by the increase in the May, September and October months. Cyprus is expected to exhibit a decrease in TCI from June to September, which is the most severe change in magnitude and duration from the analyzed countries. The TCI decrease in Spain, Portugal, Turkey, Albany and Greece is attributed to July and August months (Fig. 5c). Nonetheless, April, May and October TCIs are expected to increase significantly. The northern countries are projected to exhibit an increase in TCI mainly between May and September, with the majority of them to show the larger increase in June and August (Fig. 5c). The cases of Greece and Cyprus are unique due to the double peak in TCI that is projected to exhibit in the +2 °C (Fig. 5b), instead of a single peak in the summer season of the reference period (Fig. 5a).

The Electronic Supplementary Material (ESM) Fig. S1 and Fig. S2 show the May to October and June to August ratings, respectively, of each TCI sub-index for the reference and the +2 °C periods for each individual ensemble RCM. The comparison of the TCI components between the RCMs can reveal differences in the simulations, such as wind and sunshine duration. It is interesting to note the positive effect of bias correction on temperature and precipitation, which can be deduced from the similarity of different RCM results for CIA, CID and PRC sub-indices. To better understand the drivers that lead to the analyzed changes of TCI, the differences between the sub-indices of the reference and the +2 °C periods are also presented in Figs. S3 and S4. It is shown that the major changes in +2 °C TCI are driven by the changes in temperature (and humidity) as they

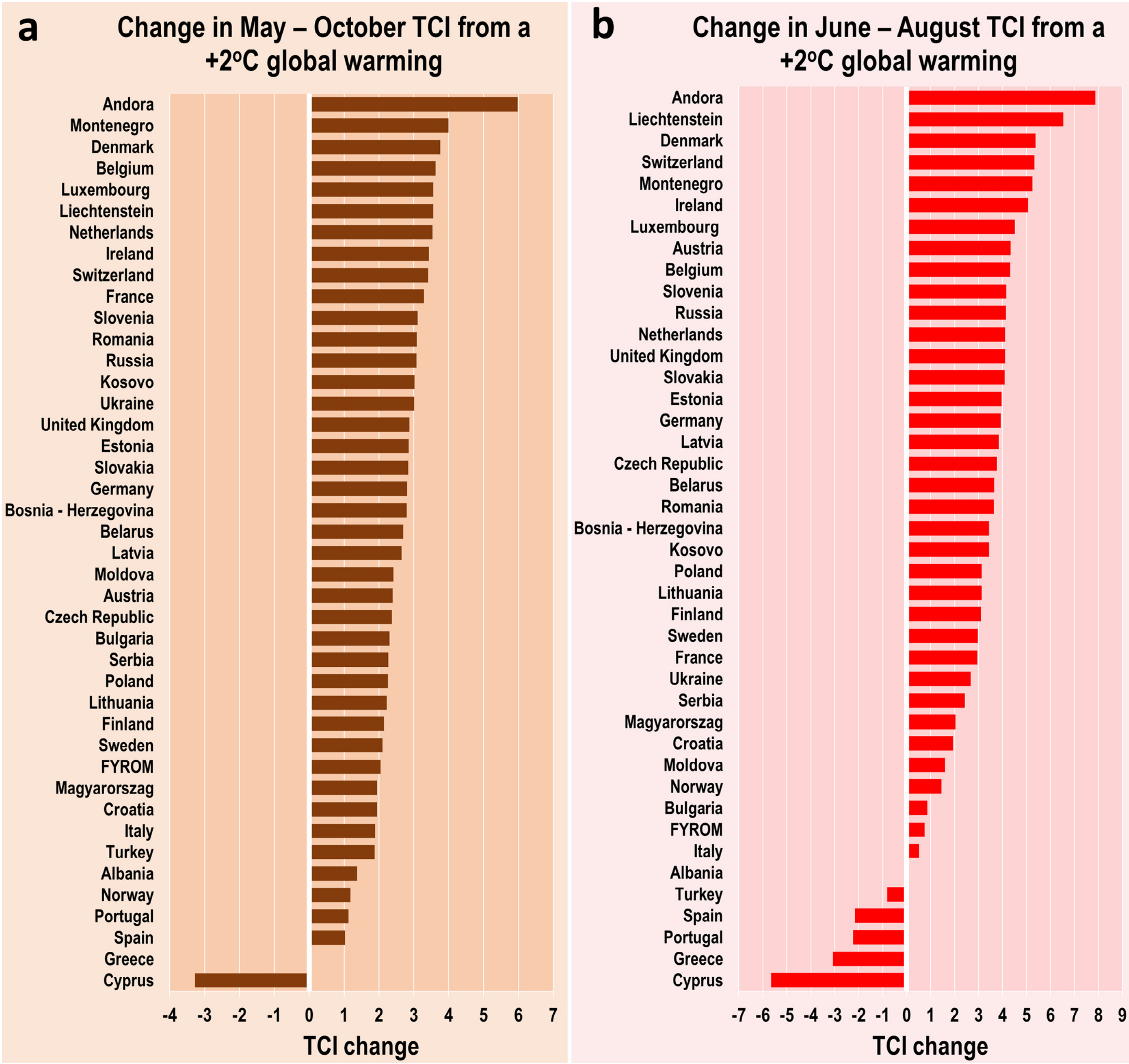

Fig. 4. Net change in TCI between reference and +2 °C periods per country. Countries are arranged by their average change in TCI of May to October period (left) and June to August (right).

are expressed mainly by the daytime comfort index CID. The negative impacts on Mediterranean areas are shown to be driven mainly by the maximum daily temperature and by a marginal increase in precipitation. In the central Europe, the increase in TCI is a combined result of increase in mean and maximum daily temperature, while France, Italy and Balkans also exhibit a strong decrease in precipitation (Fig. S3). Finally the strong positive effect of temperature increase in Scandinavia is mitigated by the also strong increase in precipitation. Sunshine duration is not projected to change significantly over Europe, except for a marginal increase in northern Iberian Peninsula and a respective decrease in Scandinavia (Fig. S3). The latter changes, however, do not contribute significantly to changes of TCI (Fig. S4). Finally, the wind is found to be the most unchangeable climate parameter, with the less contribution to the future TCI projections.

Conclusions

The analysis of TCI emerges important information about potential impacts of +2 °C global warming on climate favorability for light outdoor activities in Europe. The RCMs provided consistent information about the projected changes in climate favorability related to summer tourism activities under the 2 °C of global warming. In total, the climate is expected to be more favorable for outdoor activities under 2 °C, and this is the case for the majority of the European countries. The increase of TCI mainly for the early and later summer months is expected to lengthen the season characterized as “Very good” in the TCI scale. The countries that experience a decrease in summer TCI are expected to become more attractive than in the present, in early and late summer seasons. In the cases of Greece and Cyprus, the expected reduction of TCI in the summer

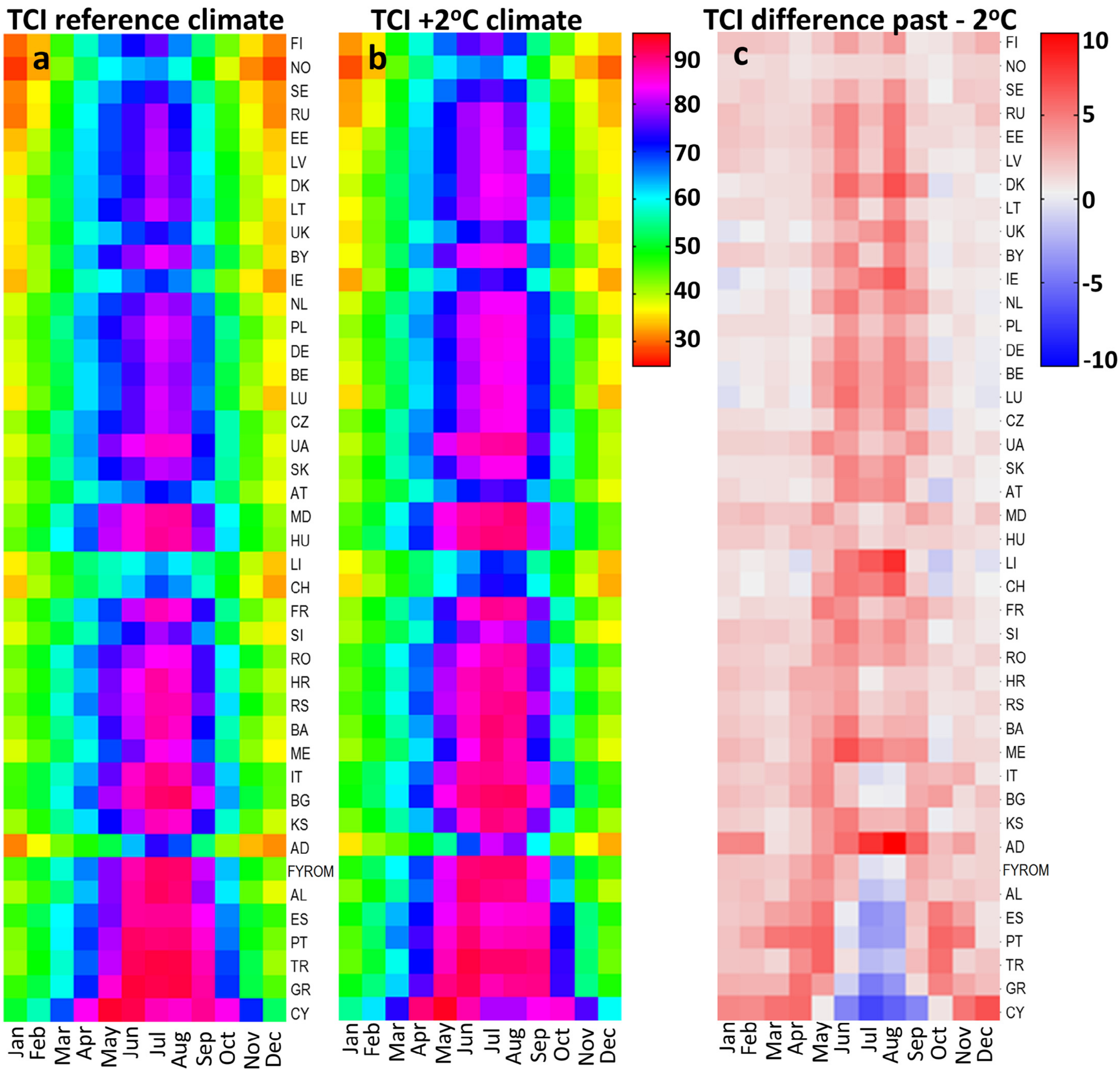

Fig. 5. Monthly values of TCI of the reference period (left), +2 °C period (center) and their difference (right) per country. Countries are arranged in descending order by their centroid latitude.

months may create double peaks in the annual TCI curve rather than the single TCI optimum in July. Estimating the average change of TCI, the top five countries that will gain the most in a +2 °C world under the A1B emission scenario are Andorra, Montenegro, Denmark, Belgium, and Luxemburg in the average of May to October season, while in the June to August period, Switzerland and Liechtenstein are replacing Luxemburg and Belgium in the list. On the other hand, countries that traditionally attract "sun and sand" tourists are expected to experience decrease in TCI even at the entire summer (May to October) season as it was shown for Cyprus. In the summer peak season of June to August, Cyprus is in the top five countries that are expected to experience the largest TCI decrease. Greece, Portugal, Spain and Turkey follow. Therefore in a +2 °C world climate, European countries, except those in Mediterranean region, are expected to be favored of the change in climate in the strict context of the TCI. Moreover, it should be stressed out that Mediterranean countries are projected again to exhibit very high TCI values compared to other European areas. This means that the major impact will be the increased climate competitiveness of the European destinations that will gain in TCI.

Although the tourist industry is highly affected by social and economic parameters, trends, marketing, etc., the recognition of the potential climate stress on tourism should urge the tourist industry and the related organizations of the southernmost European countries to develop and implement strategies to tackle the projected changes and to take preventive actions. Moreover, as every

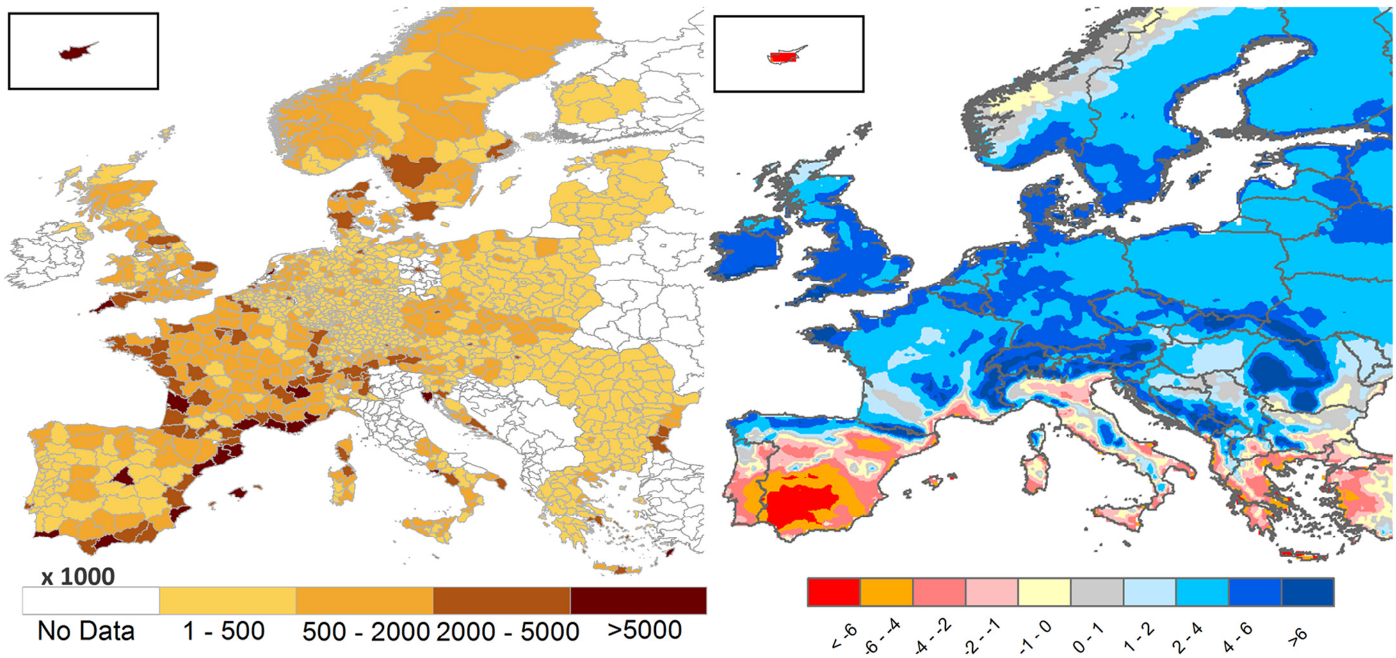

Fig. 6. Past period overnight stays per NUTS3 region (upper) and change in TCI (lower) for the June to August period.

bad situation has some good aspect to it, the lengthening of the favorable conditions to spring and autumn months points a direction of adaptation such as the development of milder tourism that will last longer in the year.

The results of the analysis are subject to the inherent limitations of the TCI methodology, discussed earlier. TCI has a certain skill to describe summer tourism and recreational activities that involve light body utilization. In that context, the presented results do not describe activity types such as Cycling, Hiking, Sailing and Golf that include higher levels of body activity (Bafaluy et al., 2013).

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Appendix: Supplementary material

Supplementary data to this article can be found online at doi:10.1016/j.cliser.2016.01.001.

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