Case study

Seasonal tourism spaces in Estonia: Case study with mobile positioning data

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Abstract

The study analysed the seasonality of foreign tourists’ space consumption in Estonia using mobile positioning dataset with anonymous roaming data. The method which uses mobile phone positioning coordinates in space–time movement studies in Estonia is called the social positioning method. The dataset allowed analysis of the distribution of foreigners’ country of origin in Estonia with the precision of network cells of mobile operators. Privacy of mobile phone holders was guaranteed according to EU regulation. It was concluded that seasonality produces very different and sometimes even opposite tourists’ space consumption patterns in Estonia. Coastal areas are popular for summer tourism and not so popular in winter; continental inland areas were used more for winter tourism. The popular summer tourism areas along the Baltic Sea beaches are dominated by one nationality: the Finnish in western Estonia, and the Russians in eastern Estonia. Latvians made up a higher percentage in Saaremaa and Pärnu during summer and in Otepää and Lake Peipsi in winter. The mobile positioning data have great potential for tourism studies and monitoring, but is a sensitive issue due to the fear of surveillance.

Keywords: Tourism geography; Seasonality; Mobile positioning; Roaming; Seasonal tourism; Estonia; Human geography

1. Introduction

Tourism is a seasonal phenomenon; the majority of tourism destinations are seasonal because of variations in climate and the fact that tourists’ homelands have traditional holiday seasons and seasonal traditions (Higham & Hinch, 2002). This phenomenon generates seasonal tourism spaces which are popular and frequented during the high season and forgotten during off-season. Tourist destinations have correlated with seasonal landscapes that directly and indirectly produce most attractions for tourists (Ahas, Aasa, Silm, & Roosaare, 2005; Palang, Fry, Jauhiainen, Jones, & Sooväli, 2005; Silm & Ahas, 2005). Those direct and indirect values of seasonal landscapes have been studied by several authors from the point of view of tourism (Gustafson, 2002; Terkenli, 2005). The results show that seasonality can generate tourism spaces and in some cases grounds for anti-tourism phenomena and the need to manage off-season periods in contrast to crowded high-season periods and spaces (Fernandes-Mozales, 2003; Lundtorp, Rassing, & Wanhill, 2001). The seasonality of tourism also has a great influence on the local economy, regional development and welfare. Therefore the seasonal phenomena of tourism are studied most intensively in the socio-economic and occupational context (Jeffrey & Barden, 2001; Nadal, Font, & Rossello, 2004). The economic dimension of the seasonality of tourism generates a need for spatial analyses of seasonal tourism phenomena and regional planning measures. Another reason why the seasonality of tourism is studied today is changing climate. As tourism is very dependent on weather and timing, small changes in seasons and weather patterns can generate great differences in regional tourism (Ahas, Aasa, & Mark, 2005).

In studying the seasonality of tourism, one important aspect is to find relevant indicators that can describe these phenomena. Different authors use different indicators such as border crossing or accommodation statistics; tourist censuses or street surveys; cash flows or occupation...
statistics (Nadal et al., 2004; Higham & Hinch, 2002). All of these data sources have advantages and disadvantages in different research fields and applications.

One new and interesting source of data for tourism studies is information recorded in cellular networks (Ahas & Mark, 2005; Ahas 2005; Ratti, 2005; Raubal, Miller, & Bridwell, 2004; Spinney, 2003). If tourists use mobile phones in recreational areas, their country of origin can be recorded and used for analysis. Mobile positioning data has great potential, as mobile phones are widespread in society, and this helps to describe the real movement patterns of tourists. This potential is used in different applications, in behaviour studies and urban planning. This method is called the social positioning method (Ahas & Mark, 2005; Positium, 2006) and it describes an individual’s movement pattern using the positioning coordinates of their mobile phone combined with the owner’s personal characteristics. Similar techniques are used in other studies and applications (Ohmori, Harata, & Nakazato, 2005).

The objective of the current study is to analyse the seasonality of foreign tourists’ space consumption (space–time variability; spatial patterns) in Estonia. Mobile positioning roaming datasets were used for analysis. The first working hypothesis is that despite its small size, Estonia has very different tourist spaces for the summer and winter seasons. Coastal areas of the Baltic Sea are popular during summer and less popular in winter. Winter tourism is much smaller and is more oriented to inland landscapes. The second hypothesis is that tourists’ national composition changes in connection with space–time variability—different nations use seasonally different spaces. This can be connected with geography of the neighbouring countries.

Anonymous foreigners’ mobile phone roaming data were used from the biggest Estonian cellular network, EMT. This data allows analysis of the distribution of foreigners’ country of origin in Estonia at the precision level of network cells. The operator recorded the following data: country of origin, time and network cell of call events, for a total of 9.2 million entries. Due to the availability of data, the study period was not standard: 1.04.2004–21.04.2005. The term “tourist” here, means all foreign visitors who visited Estonia and used their mobile phone. Tourists’ country of origin is determined by registering the country of origin of the mobile phone used in Estonia.

The second objective was to evaluate the data and develop a method for how to use mobile positioning data in geographical and tourism research. Mobile positioning data has great advantages in the study of tourism geography in local places or, for exact dates, more detail than regular tourism statistics. The use of mobile positioning data is a very sensitive issue, because of the fear of surveillance, as with all electronic media and suspicion of scientists using these data sources for research. This study used an anonymous dataset which was considered to be no more intrusive than a typical census performed upon registration in a hotel. This, however, is a matter for future discussions concerning electronic media and databases.

2. Study area and data

2.1. Estonia and seasons

Estonia is located between 57.5° and 59.5°N on the eastern coast of the Baltic Sea. Estonia’s land area is 45,215 km², and its population is 1.4 million. The majority of the population lives in urban areas, a third of the population is concentrated in the urban region of Tallinn on the Northern Estonian coast. The rest of Estonia consists of local centres, villages and disperse settlement. The north-eastern part of the country has mining and industrial landscapes, and the coastline of the Baltic Sea and western islands Saaremaa, Hiiumaa and Muhumaa is a popular tourist area. The majority of tourists visit the capital of Estonia, Tallinn, which has an attractive medieval old town (Fig. 1).

With its Nordic location, Estonia is a region with a diverse seasonal cycle. Four major seasons—spring, summer, autumn, winter are clearly distinguishable in Estonia (Ahas et al., 2005; Jaagus & Ahas, 2000). The seasonal cycle is one of the main factors that influences tourism destinations. In the summer period, the holiday areas are located on the coastline of the Baltic Sea; the main destinations are Pärnu, Haapsalu, Kuressaare, Lahemaa National Park and Narva-Jõesuu. During the winter, the inland ski areas of Otepää, Haanja and Aegviidu are most popular.

The alternation and duration of the seasons in Estonia is dominated by the westerly atmospheric circulation and the temperature inertia of the Baltic Sea. The distributions of solar radiation and temperature have similar annual curves that are typical of the Baltic Sea region. Usually, the average spring air temperature exceeds 0°C on 18 March and goes below 0°C on 21 November. Spring weather and seasonality is very variable in Estonia; seasons can shift more than 20 days.

The active growing season, denoted by the period when daily air temperature is over +5°C, lasts an average of 185 days (22 April–24 October). For Estonian tourism conditions, the duration of winter and snow cover is important, as winter sports are of an international scale in Estonia. The average spring air temperature exceeds 0°C on 18 March and goes below 0°C on 21 November. Spring weather and seasonality is very variable in Estonia; seasons can shift more than 20 days.

The mean air temperature of the last 11 years and a comparison with the study period 1.04.2004–21.04.2005 is presented in Fig. 2.

2.2. Estonian tourism statistics

Tourism has an important role in the Estonian economy. According to the research conducted in co-operation with the Statistical Office of Estonia and the Estonian Institute
of Economics of Tallinn Technical University, the share of tourism in Estonia’s gross domestic product at current prices was approximately 8.2% in 1997–2000 (ESA, 2003). In 2003 Estonia had 1.112 million arrived tourists and in 2004 1.374 million arrived tourists at all accommodation establishments (EAS, 2005). The estimated total number of visitors was 3–4 million. The high number of 1-day visits is connected with the 1-day tours of Scandinavian tourists and cruise ship tourists. Scandinavian (mostly Finnish) tourists visit during 1-day trips, mostly to Tallinn, one reason for which is shopping (Unwin, 1998; Jaakson, 1996). The seasonal distribution of tourists in Estonia is presented in Fig. 3.

The nationality of all visitors in 2003 was as follows: Finns 52.9%; Latvians 12.3%; Russians 8.8%; Swedes 4.4%; Lithuanians 3.8%; Germans 3.1%; Americans 2.5% and other countries 12.3% (ESA, 2004). Due to the changes in the border regime after Estonia joined the EU, there are no statistics for 2004 and 2005. In 2004, 66% of foreign tourists at accommodation establishments were holiday tourists, 5% were conference tourists, 18% were other business tourists and 11% were tourists travelling for other purposes such as medical services etc. (EAS, 2005).

The geographical distribution of tourists in Estonia is visible in the hotel accommodation statistics for 2004: 56% in Tallinn and 8% in the rest of northern Estonia; 21% in Pärnu and 10% in rest of West Estonia; 3.5% in Tartu and 2.5% in the rest of southern Estonia (EAS, 2005). Finnish and Swedish tourists’ hotel stay in Tallinn is relatively short, as they tend to spend more nights in western Estonian spa hotels (Worthington, 2003). For overnight stays in hotels, Latvians have an important share on Saaremaa Island and Russians in north-eastern Estonia. Representatives of distant countries such as Americans, Japanese, Italians and Britons stay mostly (in more than 80% of cases) in Tallinn, the capital of Estonia.

2.3. Mobile network

For this study the roaming data of the Estonian GSM network EMT (EMT, 2005) was used. The basic technical characteristics of the positioning network are as follows: a nation-wide GSM network using the 900 MHz frequency band, as well as 1800 MHz in city centres and 3G Tallinn; the total area covered is 90,000 km², and the network includes around 900 base station sites and serves approximately 600,000 mobile subscribers. The population pattern
determines the location and density of the mobile network (Fig. 4). The EMT network is the biggest in Estonia in terms of subscribers and radio coverage. The network used in this study includes an Mobile Positioning System based on Ericsson’s GSM network and the CGI + TA method (Cell Global Identity and Timing Advance) for mobile positioning.

2.4. Mobile positioning dataset

A depersonalised dataset was used of roaming foreign mobile phones in Estonia, from 1 April 2004 to 21 April 2005, collected by the mobile positioning company Positium (Positium, 2005) from the EMT network.

Roaming means that mobile telephones registered in countries other than Estonia can be used on the Estonian network, and the operator is able to recognise the country of origin of the phone.

The depersonalised dataset means that all respondents (foreign phone identities) remained anonymous, and the operator provided generalised data: country identification and the cell coordinates for where the phone was used.

The roaming activities were recorded during any active use of a mobile phone on the networks: calling out and in; SMS out and in; internet or GPRS services; location-based services; etc. This means that if a person has a mobile phone switched on during a visit to Estonia but they never use it, their presence was not recorded in this database.

It is estimated (personal communication with expert J. Laineste 12.08.2005) that roaming services (using homeland phone number) are usually used by persons who stay for a short time in a foreign country as tourists or business travellers. The minimum length for changing a telephone contract to a local one depends on many factors such as call demand and prices, comfort and the need to use local services etc. In addition, some persons who stay longer in a foreign country keep their homeland phone.
active because of business contacts, but there are relatively few such users.

In this study, the location of a phone was determined by the level of the GSM network cell (area near one antenna). Therefore, the location accuracy was low, from 200 m² to 400 km².

The database received from EMT was anonymous and included: the time of activity; arbitrary database row number, which was used as the ID of one entry (randomly generated number); country code; x and y coordinates of the antenna. This data format is free from surveillance problems in accordance with the Directive on privacy and electronic communications of the European Parliament and of the Council (DIRECTIVE, 2002/58/EC), and this was confirmed by the Estonian Data Protection Inspectorate (EAI, 2005).

The database consisted of a total of 9,224,331 positions (rows) of roaming activities of 720,000 different phone IDs (persons) during the studied period. The roaming data of call activities had the following distribution: 71% on weekdays and 29% on weekends. Seasonal distribution: 19% during winter months (DJF), 27% during spring (MAM); 33% during summer (JJA); and 26% during fall (SON). EMT had technical problems with saving roaming data for 2 days in July 2005, therefore there is a visible gap in the dataset. These days were included with the monthly mean value in the study (Table 1).

The database consisted of mobile phones from 70 countries, a group of the 24 most common tourist nations represented in the roaming data are listed in Table 2. On studying the spatial distribution of the roaming data of foreign phones, it must be remembered that boarder areas have a relatively high rate of bias from cross-border roaming. This means that near borders, phones are often automatically switched to a neighbouring country’s network, even if the owner remains in his homeland. The same problem exists with coastal areas, as phones from ships use the networks of coastal areas. Coastal base stations and antennae are very often empowered to provide radio coverage to the open sea. Thus the coastal cells can detect many phones on ships that never enter this region or even this country.

### Table 1

<table>
<thead>
<tr>
<th>Time</th>
<th>ID (rand)</th>
<th>State</th>
<th>x</th>
<th>y</th>
<th>Fiï</th>
<th>Type</th>
</tr>
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<td>510193</td>
<td>Latvia</td>
<td>E24-52-24.00</td>
<td>N59-26-12.00</td>
<td>15</td>
<td>OMNI</td>
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<td>N59-26-36.00</td>
<td>160</td>
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</tr>
<tr>
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<td>Finland</td>
<td>E24-44-37.00</td>
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<td>01.04.2004 00:00:24</td>
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<td>Russia</td>
<td>E27-44-38.00</td>
<td>N57-52-12.00</td>
<td>180</td>
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<td>260</td>
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<td>N59-25-27.00</td>
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</tr>
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<td>01.04.2004 00:00:59</td>
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<td>N59-26-04.00</td>
<td>340</td>
<td>SECTOR</td>
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### Table 2

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage, %</th>
<th>Country</th>
<th>Percentage, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>56.03</td>
<td>Spain</td>
<td>0.80</td>
</tr>
<tr>
<td>Sweden</td>
<td>7.48</td>
<td>France</td>
<td>0.68</td>
</tr>
<tr>
<td>Russia</td>
<td>6.35</td>
<td>Czech Republic</td>
<td>0.53</td>
</tr>
<tr>
<td>Latvia</td>
<td>4.26</td>
<td>Switzerland</td>
<td>0.47</td>
</tr>
<tr>
<td>Germany</td>
<td>4.26</td>
<td>Austria</td>
<td>0.41</td>
</tr>
<tr>
<td>Lithuania</td>
<td>3.47</td>
<td>Belgium</td>
<td>0.39</td>
</tr>
<tr>
<td>Norway</td>
<td>2.78</td>
<td>Hungary</td>
<td>0.38</td>
</tr>
<tr>
<td>UK</td>
<td>2.77</td>
<td>Ukraine</td>
<td>0.32</td>
</tr>
<tr>
<td>Poland</td>
<td>2.04</td>
<td>USA</td>
<td>0.31</td>
</tr>
<tr>
<td>Italy</td>
<td>1.71</td>
<td>Philippines</td>
<td>0.24</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.95</td>
<td>Greece</td>
<td>0.20</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.84</td>
<td>Portugal</td>
<td>0.18</td>
</tr>
</tbody>
</table>

In using such roaming data special aspects of the data must be noted: the database has data on any foreign visitor who used a mobile phone not registered in Estonia. It was assumed that most visitors use phones registered in their country of residence. The database is also dependent on the number of call activities made by these visitors. The number of phones and calls per phone is different for different countries, cultures and traveller groups. It was assumed that businessmen use their phones more often than pensioners from a cruise ship. Different cultures use phones more often than normal for example, during important holidays in their home country, for congratulations, etc. It was also assumed that Scandinavians use their phones more often than central Europeans. Analysis showed that during the study period the average number of call activities during the 387 days of the study period, by one phone ID, was: Latvia 22, Denmark 19, Norway 18, Lithuania 17, Russia 13, Finland 12, UK 11, Poland 11, Germany 9, Sweden 9. This average value is also dependent on the number and length of visits. For example, the closest neighbours can stay less than 1 day and use their phone only a few times.

The study (after a discussion with tourist guides in Tartu on tourism day) showed that at same time some traveller groups, like pensioners from central Europe, who do not
use their mobile phones every day at home, take their phones on trips so that they can keep in contact with their family. So these statistics may be different and need further study. The great number of activities and IDs in the sample gives a general overview of space–time movement for some types of foreign tourists in Estonia.

The quality of the roaming dataset, used in this study, was controlled with a correlation analysis to a dataset of accommodation. The correlation between the monthly accommodation of tourists (ESA, 2005) and the call activities on a county level was 0.97. This shows that the data is of relatively good quality.

2.5. Methods

For statistical analysis the dataset, which was recorded with the precision of network cells was interpolated to Estonia’s network of 241 municipalities (cities, parishes, see Fig. 1), as these administrative units are more similar in size than are the network cells. If a municipality had several network antennae, these data were summed. Twenty-five municipalities had no network antenna, and these were not included in the analyses.

The mobile network cells are not connected with administrative borders, but they instead follow population and transportation network density to provide the best radio coverage for consumers. During use, the phone is normally connected to the closest antenna (the one with the strongest radio signal), but in the case of a crowded network or physical barriers, the phone can be connected to another distant antenna. There is a geographical radio coverage limit for the GSM network—65 km, which is the maximum distance from antennae in regular conditions.

For every municipality the daily number of recorded call activities was summed for all 387 days. (The nationality of the roaming partners was not included in this analysis). As a result of data management, a matrix of 387 days and 224 municipalities (Estonian administrative map 01.01.2005) was formed, which was used for analyses with Statistica 7. Exploratory factor analysis was applied on the method of principal components (Manly, 1997). The mapped factor loadings show the correlation between tourist movement in specific municipalities and factor loads.

3. Results

The results of factor analyses show that tourists’ space consumption has a seasonal pattern in Estonia, and mobile positioning data enables study of its space–time dynamic. The factor analysis of the matrix with the positioning data of 387 days in 224 municipalities determined 20 factors with distinguishable seasonal variance, but only four factors have a significant data load (Table 3). The rest of the factors (from 5 to 20) each described less than 2.5% of the total variance, and have limited spatial or temporal distribution. Load number 1 describes 27.4% of the total variance in data, load number two 4.2%, load three 3.2% and load four 2.6%.

3.1. Summer tourism areas

The first set of variables that describe the seasonal pattern of tourism, in almost 60 parishes in Estonia, demonstrates the peak of the tourist season as arriving in summer (Fig. 5). The number of tourists in these municipalities grows during the spring and falls during the autumn. The high season is from 15 May to 10 September when the number of tourists in Estonia is higher than the annual mean. Those summer tourism areas have a very clear geography; they are predominantly on the Baltic Sea coastline and the islands (Fig. 6). The following regions have the most clear pattern of summer tourism:

- Pärnu region.
- Haapsalu region.
- Saaremaa and Hiiumaa islands.
- Lahemaa National Park.
- Narva-Jõesuu.

A notable number of parishes with summer tourism activities (correlations of 0.5–0.6) are also concentrated in

<table>
<thead>
<tr>
<th>Factor</th>
<th>Eigenvalue</th>
<th>% Total variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>56.9</td>
<td>27.4</td>
</tr>
<tr>
<td>2</td>
<td>8.6</td>
<td>4.2</td>
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<td>3</td>
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<td>3.2</td>
</tr>
<tr>
<td>4</td>
<td>5.5</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Fig. 5. Factor no. 1 describes tourist flows in the summer period.
popular inland regions such as the Otepää uplands, which has a landscape reserve and sporting activities, and the town of Viljandi, which is a summer tourism magnet due to the famous folk music festival at the end of July. The parishes along the main highways connecting important tourist routes also have a visible pattern of increased tourism during the summer season.

The share of tourists in the main summer tourism regions is similar, as shown for Pärnu city in Fig. 7A. The holiday areas in western and northern Estonia have a constant national composition in all seasons—dominated by Finns and followed by Russians, Latvians and Swedes. The Narva-Jõesuu holiday region has a different national composition—during the summer Russian tourists predominate in the region, as this is a renowned resort for those from St. Petersburg (Fig. 7B). Latvians and Germans are also present in noticeable numbers in southern Estonia and Saaremaa island.

3.2. Winter tourism areas

The second factor load has a high correlation with areas with winter activities. This factor describes only 4.1% of the variance in the dataset and a total of 8.6 municipalities. This factor demonstrates the maximum amount of tourism as falling during the period between 1 December and 1 March, and a noticeable rise in activities during July and August (Fig. 8). This factor has the strongest correlation (0.5–0.8) with Aseri, Kiviõli and Alajõe municipalities in northeastern Estonia (Fig. 9). In those municipalities, the number of Finnish and Russian tourists rises during the winter months. This can be connected with the popular winter tourism areas and the famous spa hotels in those municipalities.

The Alajõe parish in northeast Estonia is popular because of the summer holidays and winter fishing on Lake Peipsi. This region is popular among Russians.
tourists, who predominate here, representing 41.2% of all tourists. Other common nationalities are Finns (27.0%) and Germans (12.1%). From January to March 2005, the distribution of nations was more even: Russians 21.3%, Finns 26.7%, Germans 18.2%, Latvians 12.3%. Germans were present in this region permanently in the winter period.

There is also a close correlation (0.5–0.6) with winter tourism areas such as the Kõrvemaa and Otepää regions. In the Otepää region, the annual mean percentage of Finns is smaller than the Estonian mean, 40.3%; Russians represent 15.2% and Latvians 10.9%. During the winter ski season (January–March in 2005), the number of Finns was even lower, at 36.3%, Russians 12.1% and Latvians 14.1%. Latvians predominate in this region because of popular down-hill and snowboarding facilities. Summer activities in these regular “winter sport” regions can be connected with the general interests of tourists in renowned ski and hiking landscapes. The Otepää region is also actively used by
tourists during the summer because of two major events: the international roller-ski competition and the car rally. The peak tourist days of the winter season in the Otepää area are also connected with international sporting events: the World Ski Championship Cup in Otepää (beginning of January) and the Tartu Ski Marathon in Otepää (beginning of February). Both events have hundreds of fans, sportsmen and team members. (Fig. 10)

3.3. Weekly pattern of tourist flow

The third factor load, which describes the weekly pattern of tourist flow, describes only 3.1% of total variables. This component has a very clear temporal curve—a weekly sinusoid (Fig. 11). The weekly pattern of tourists’ movements is connected with two types of tourists. The first type is business travellers, who are active during the weekdays; this correlates with factor load no. 3 (Fig. 12). The spatial pattern of this factor load is correlated with parishes along the main highways: Tallinn-Ikla; Tallinn-Tartu-Luhamaa; Narva-Tartu-Valga and Tallinn-Narva (Fig. 13). This factor is also correlated with the main highway border stations: Narva, Misso, Valga and Häädemeeste.

The second type is connected with weekend tourists, and correlates with factor load no. 13 (Fig. 12). This factor does not have a strong spatial correlation (strongest with Viimsi parish near Tallinn, \( R = 0.54 \)), but is visible in most of the popular summer tourism destinations and bigger cities.

3.4. Other seasonal spaces

There are several other minor factors in this dataset which occupy a very small proportion of the dataset but have a clear spatial distribution. One interesting factor is number 4, which describes 2.6% of total variance (Fig. 14).

This factor has a different winter tourism pattern (10.01.2005–20.02.2005), a correlation with the wetlands in central Estonia (Kolga-Jaani, Albu parishes) and northeastern Estonia (Tudulinna parish) (Fig. 15). This factor may also be year specific—it may be typical only of the year 2005, when Estonia had relatively warm and rainy weather in December and January. Analysis was made of a few points in this factor load. In the Kolga-Jaani region, for example (the spatial correlation with factor 4 was 0.9), there was an invasion of Finnish tourists between 13.01.2005 and 20.02.2005, with 40–130 call events per day. This may be connected with some seminar or hunting event in the area. Normally this parish has less than 5 foreign phone calls per day.

A second interesting seasonal pattern can be seen in eastern Estonian parishes near Lake Peipsi, where Latvian fishing tourists predominate during the ice-fishing season on Lake Peipsi, i.e. from February to March (Figs. 16 and 17). This seasonal tourism pattern shows a hidden tourism potential in this province and along the highway from Latvia to the region. The presence of Latvians in Peipsi region is known but the actual numbers were unclear as this area has minimal infrastructure and administration.

Latvians visit this area during the weekends and comprise 73% of the total number of annual tourists in the region. The correlation with factor load 5 is 0.92.

3.5. Seasonality in cities

Seasonal tourist patterns in the biggest cities in Estonia were studied separately, as factor analyses do not draw out urban areas, which have a very diverse pattern of seasonal visitors. The capital of Estonia, Tallinn, has a correlation of 0.5 with summer tourism load (1) and a correlation of 0.51 with weekly pattern load (3) (Fig. 18). The national composition of the weekly patterns of Tallinn tourism was dominated by Finns (53.2%), Latvians (6.7%), Swedes (6.2%), Russians (5.1%) and Norwegians (5.0%). At the same time, Russians predominated during New Year’s Eve,
as this is a popular time for Russians to come and party in Tallinn. On 31 December and 1 January, Russians had 22,304 call events in Tallinn, and Finns only 16,075.

The second largest city in Estonia, University City Tartu, had even less seasonal variability. There was little (0.4–0.5) correlation with factors 1, 3 and 13. Tartu has a seasonal tourism pattern only in the network cell which covers the touristic centre of the old town.

The divide between “business day” tourists as Swedes, Lithuanians and Germans, and “weekend” tourists as Finns, Russians, and Britons, in the whole database is also interesting. If the purpose of the visit is different, the seasons and areas those nationalities occupy can differ too.

4. Discussion and conclusions

The tourist roaming database containing 9.2 million call events involving foreign mobile phones, which was used in the current study, was useful for describing the seasonal pattern of tourism in Estonia. This conclusion is partly supported by the verification of the results with the accommodation database of Estonian tourist statistics. This also means that mobile positioning data can be used as an additional source for data collection. On the regional level, this database is even better, as hotels are concentrated in cities, but mobile phones can also be traced in daily routes. Those daily routes are rarely described in the tourist statistics in Estonia, as the country is small and most places can be reached from one point, for instance the capital Tallinn.

The objective of this study was to analyse seasonal tourism spaces, the results showed that the data and method were adequate for that purpose. This dataset and factor analysis helped to separate areas with different seasonal tourism patterns. The hypotheses were connected with summer and winter tourism spaces, and they were verified during the study. Coastal areas are popular summer tourism areas and inland areas (having a more continental climate with snow) were used for winter tourism. Additional information suggested that summer tourism areas are dominated by one nationality: the Finns in western Estonia, and the Russians in eastern Estonia. Smaller shares of nationalities...
were observed as high percentage Latvians in Saaremaa and Pärnu during summer and in Otepää and Lake Peipsi in winter. Seasonal patterns of other nationalities, such as Swedes and Germans were also detected in different places. These results are logical for persons who know Estonian conditions and tourism well. The advantages of the mobile positioning dataset, as used in this study, provides a better data source to measure seasonal tourism patterns and for tourism planning and monitoring.

As a result of seasonality studies, it can be concluded that seasonality produces very different (even opposite) space consumption patterns of tourists in Estonia. There are also different target groups for tourism marketing. At the same time, it can be said that seasonal tourism creates regional occupation problems, as inland areas have fewer tourists during the summer, and coastal areas have fewer tourists during the winter. Only the coastal spa hotels in Pärnu, Haapsalu, Kuressaare and...
These potential tourists (thousands) are not described in any database. Local authorities and tourism industries can detect such flows with mobile positioning data and use these data for better marketing and services. Another problem is that such use of positioning data is very disturbing for tourists. Even if everything is anonymous and at a similar level as other tourism statistics (border surveys or hotel statistics), mobile tracking is much more sensitive, as mobile phones are personal, even intimate (Lilian & Konstantinos, 2003). Therefore mobile surveys can generate a negative attitude on the part of tourists and this can be a real problem. In future there is great potential for the use of mobile positioning in geographical and tourism research, but the use of all such data must be explained carefully.

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**References**


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**Fig. 17.** The distribution of foreign (dominated by Latvians) call events in the Alatskivi parish in Lake Peipsi area.

**Fig. 18.** Distribution of calls in Tallinn. ($R_{13} = 0.51$ and $R_{11} = 0.50$).

Narva-Joesuu are occupied during the winter season in the coastal areas.

Distances are small in Estonia, but this seasonal difference still generates an unequal pattern of regional development. Estonian tourism grew 30% in 2005 (EAS, 2005), and this means that there will be an over-concentration of tourists in most of the popular places/seasons. In this case, the seasonal information can help prevent places becoming overcrowded or develop strategies for the redistribution of tourism flows. Therefore, the seasonal tourism information can be an interesting data source for the planning of sustainable tourism. This roaming database was applied in tourism strategies in three tourism regions in Estonia.

The potential of positioning data lies not only in the location coordinates of persons/activities but also in recorded time. As the use of phones is recorded with temporal precision (more exact than location), it is easy to analyse the temporal movement and activities of tourists. This temporal analysis has great potential in tourism analyses and applications. The timing of visitors and events is an important part of tourism planning.

The great potential of positioning data is that it can help to record invisible flows of transit tourists that normal databases do not describe. A good example is the flow of Latvian fishermen to Lake Peipsi via the Tartu region.


**Further reading**