The impact of Climate Change on the European Regional Tourism Demand

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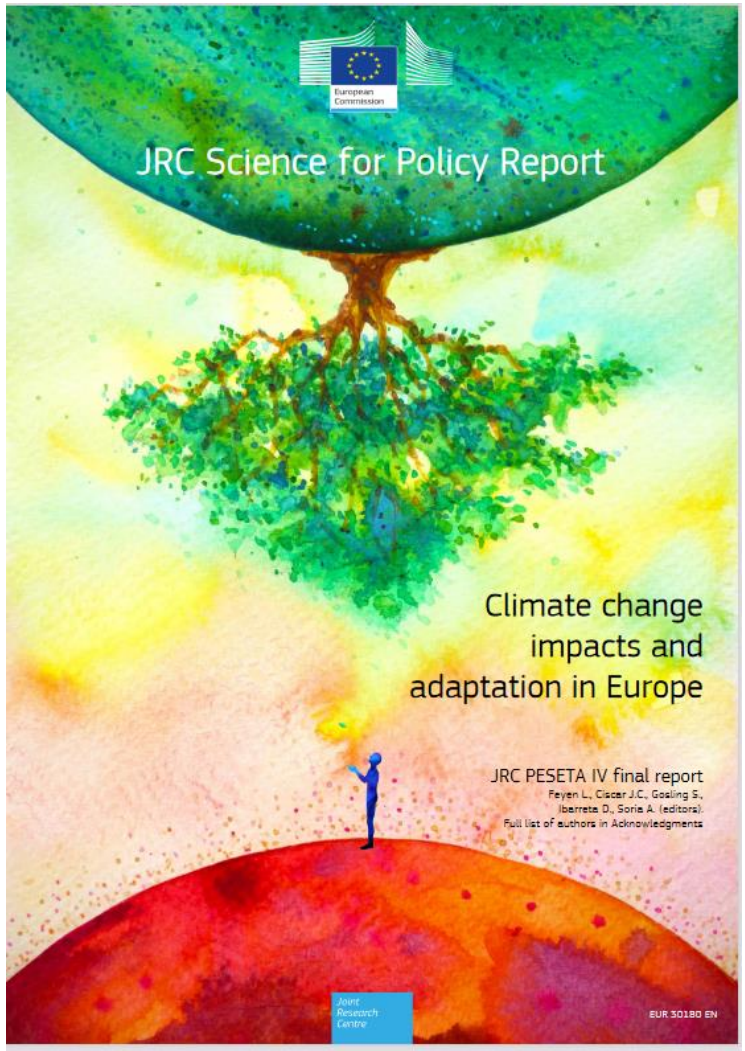
Shaping Climate-smart Tourism Business

9 September 2025

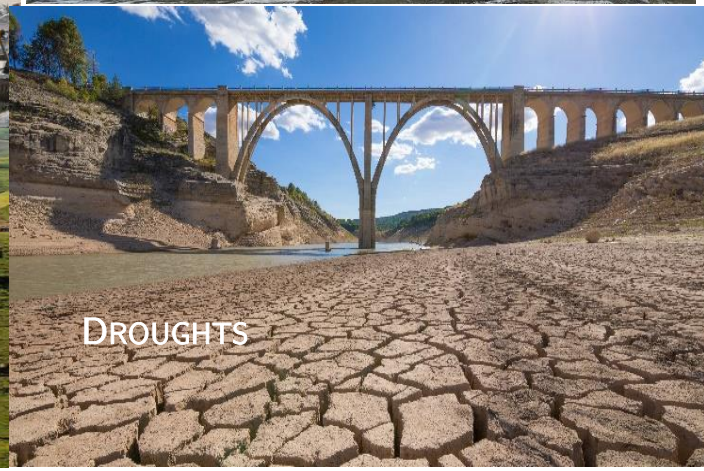
Context



Feyen et al. (2020)

- **JRC PESETA** programme (**P**rojection of **E**conomic impacts of climate change in **S**ectors of the EU based on bottom-up **A**nalysis)
  - Assessing climate risks in Europe: a quantitative and consistent long-term scientific analysis to support EU climate policies.
  - Analyzing the socioeconomic impacts of climate change and potential of adaptation measures for different climate impact sectors in the EU
  - Contributing **to EU Climate Policy through High-Resolution Models**
    - **EU Climate Adaptation Strategy** and its Impact Assessment
    - What if we do not act – The European Green Deal **cost of non-action**
    - Develop and map co-designed demographic and regional climate impact indicators relevant for EU Cohesion Policy
      - What are the distributional or asymmetric impacts from climate change on regional demography and economy?
      - Where to prioritize regional climate-related investments of EU Cohesion Policy?

PESETA – Climate Impact Areas

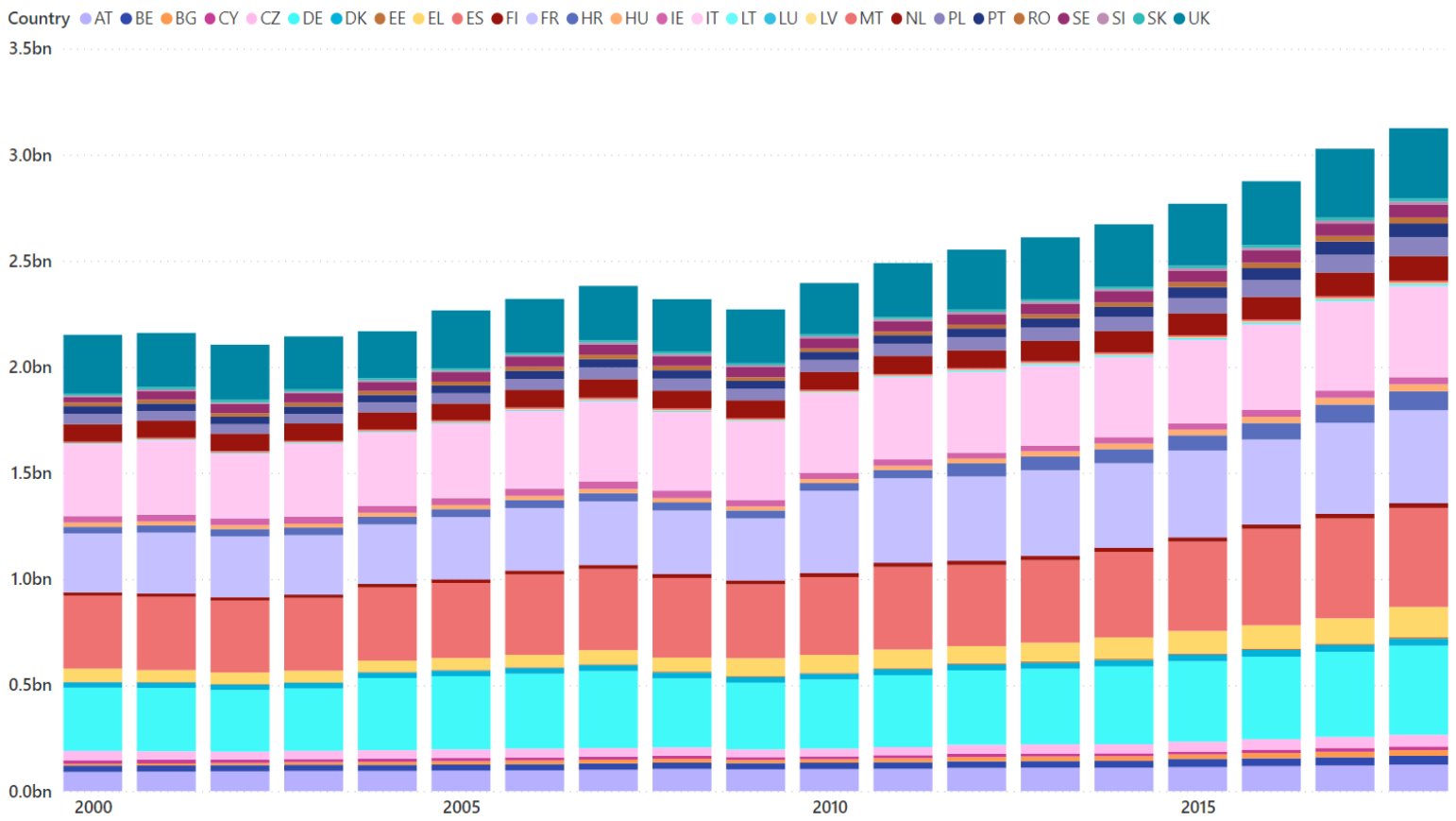


Tourism

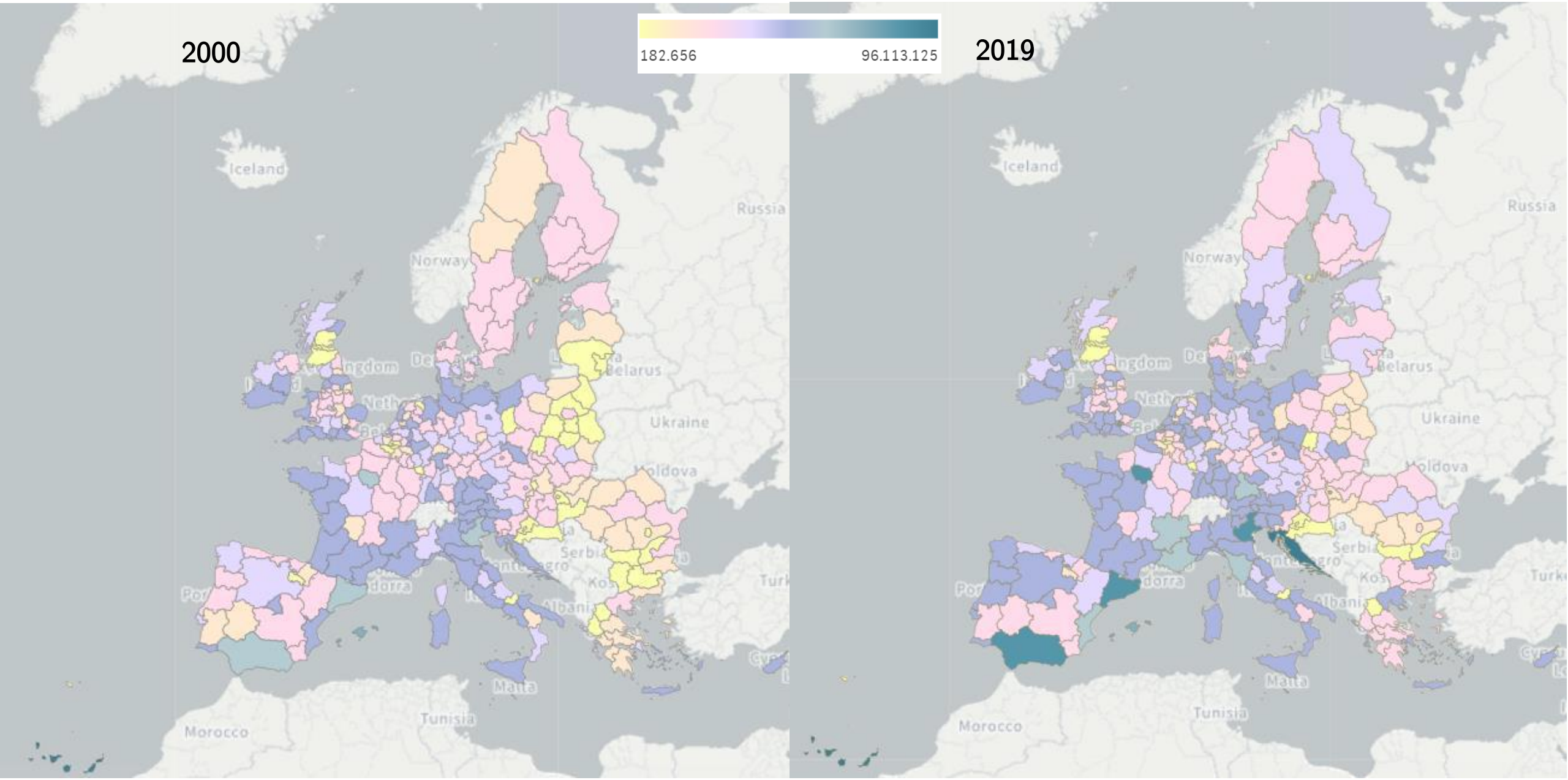
- **Tourism** is major sector in the European economy
  - accounting for more than half of the world's international arrivals
  - 10.3% of the European GDP and 11.7% of total EU employment, in 2019

- **Objective of the study**
  - how climate change will affect European tourism demand for various future global warming levels.
  - estimate and isolate the effect of climate based on monthly historical data, while controlling for various factors that influence demand
  - assess climate change risk on future tourism demand, by generating monthly and regional tourism demand projections for four climatic futures

Evolution of the annual number of bednights over the 2000-2019



Tourism Demand - Number of Bednights



Modelling Tourism Demand

- We estimated the **historical role** of **climate on tourism demand** across EU regions controlling for several confounding factors: seasonality and spatial patterns, economic activity, tourism typology:

$$\ln BedNights_{itm} = \alpha + \beta_1 lnTCI_{itm} + \beta_2 lnGDP_{itm} + \beta_3 lnHICP_{itm} + \beta_4 lnTCI_{itm} * Tclass_i + d_s M_s + \varepsilon$$

  - a monthly m, multi-region i extensive panel dataset across 20 years t
    - **269 NUTS 2 European regions** over 240 time periods (2000 – 2019)
  - by using advanced statistical techniques
    - **Fixed effects panel model**
    - Controlling for disturbances in the data i.e. auto-correlation, cross-sectional dependence, stationarity of variables etc.
- Bednights: number of nights spent at tourism accommodation establishment, GDP, HICP (EUROSTAT)
- Accounting for the **climatic preferences of the tourists and the destination climate comfort** (level of distress of tourists)
    - The **Tourism Climate Index:** integrates seven climate variables considered relevant to tourism and has become the most widely used to describe the *attractiveness of certain tourists' destinations*. The index consists of five sub indices, describing daily thermal comfort – temperature and humidity (*CIA*), precipitation (*P*), hours of sunshine (*A*) and wind speed (*W*) (Rutty et al. 2020)

$$TCI = 5CIA + 2P + 2A + W$$

- **Tourism typologies:** Urban, Coastal, Nature, Snow Mountain, Rural, and Mixed (Batista et al. 2021)

Historical Results

lnBedNights	Estimate	Drisc/Kraay std. err.
Constant	5.415	
lnTCI	0.569	(0.045)***
lnGDP	0.318	(0.079)***
lnHICP	0.519	(0.167)***
lnTCI*Urban	-0.009	(0.033)
lnTCI*Coast	0.651	(0.031)***
lnTCI*Nature	-0.186	(0.029)***
lnTCI*SnowMount	-0.439	(0.031)***
lnTCI*Rural	-0.071	(0.025)***
lnTCI*Mixed	0	(empty)
Winter	-0.176	(0.02)***
Spring	0.036	(0.023)
Summer	0.542	(0.026)***
Autumn	0	(empty)
Observations	64524	
R^2 -within	0.632	
F-statistics	564.32***	

- a **statistically significant** relationship between the evolutions of bednights and the climatic index considered
  - higher climate comfort level is estimated to have a positive effect on the monthly evolution of tourism flow for every 1% increase in TCI ⟶ ~ 0.56% increase in number of bednights
- **TCI** has and **additional impact** on tourism demand that varies in magnitude according to the tourism typology considered
  - An additional positive effect is estimated for Coastal
  - Snow Mountain, Nature and Rural regions have an additional negative effect
- the two economic control variables have a positive and statistically significant effect on the number of bednights
  - a 1% increase in GDP leads to around 0.31 % increase in tourism demand.
- **Seasons** have a strong impact on the European tourism demand
  - confirming that the summer period has a strong positive effect on the number of bed nights, while the winter months negatively affect the tourism demand when considering the entire European panel dataset.

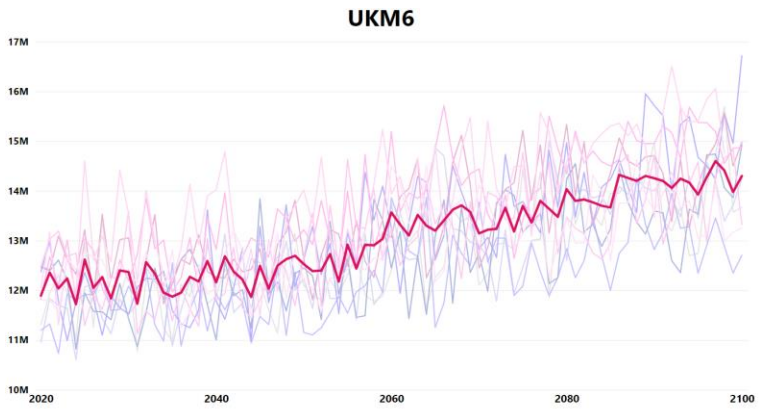
Future Projections

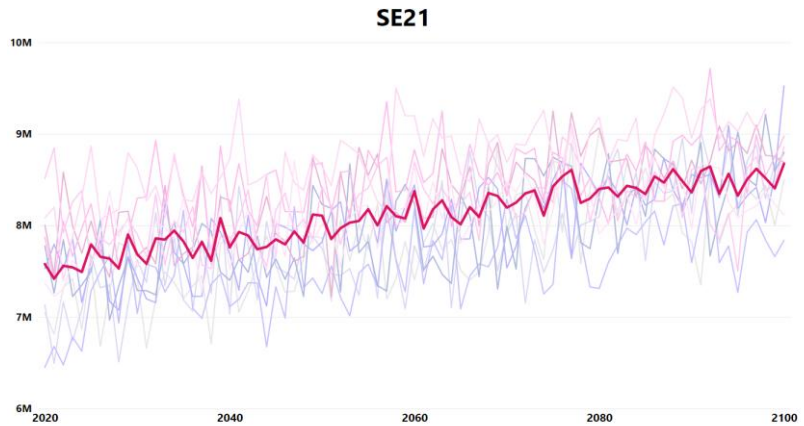
- Future simulations on the possible climate change impacts on the **future regional demand of tourism**
  - Projections based on an ensemble of **11 regional climate model** (RCMs) provided by the EURO-CORDEX initiative (Coordinated Regional-climate Downscaling Experiment over Europe) (Dosio, 2020)
  - under **two emission scenarios**: RCP 4.5 & RCP 8.5
  - impacts are estimated for the global warming targets set out in the Paris Agreement targets (+1.5°C and +2°C) as well as two higher warming level (+3°C and +4°C).

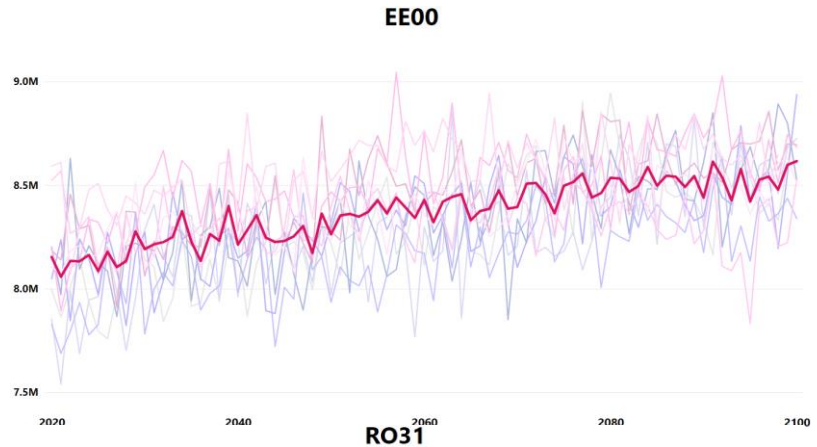
		RCP 4.5				RCP 8.5			
RCM	**GCM**	**Y1.5C**	**Y2.0C**	**Y3.0C**	**Y4.0C**	**Y1.5C**	**Y2.0C**	**Y3.0C**	**Y4.0C**
CLMcom-CCLM4-8-17	CNRM-CERFACS-CNRM-CM5	2035	2057			2029	2044	2067	2089
SMHI-RCA4	CNRM-CERFACS-CNRM-CM5	2035	2057			2029	2044	2067	2089
CLMcom-CCLM4-8-17	ICHEC-EC-EARTH	2033	2056			2026	2041	2066	2090
DMI-HIRHAM5	ICHEC-EC-EARTH	2032	2054			2028	2043	2065	2086
KNMI-RACMO22E	ICHEC-EC-EARTH	2032	2056			2026	2042	2065	2087
SMHI-RCA4	ICHEC-EC-EARTH	2033	2056			2026	2041	2066	2090
WRF331F	IPSL-IPSL-CM5A-MR	2023	2042			2021	2035	2054	2073
SMHI-RCA4	IPSL-IPSL-CM5A-MR	2023	2042			2021	2035	2054	2073
SMHI-RCA4	MOHC-HadGEM2-ES	2021	2037	2069		2018	2030	2051	2071
CLMcom-CCLM4-8-17	MPI-M-MPI-ESM-LR	2034	2064			2028	2044	2067	2089
SMHI-RCA4	MPI-M-MPI-ESM-LR	2034	2064			2028	2044	2067	2089

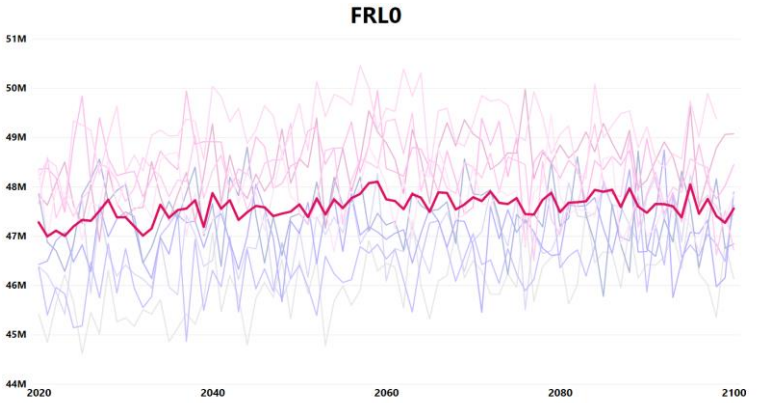
- The input that **the impact variables** have on tourism demand will remain **stable over the projection period** (2020 – 2100).
  - Moreover, the economic determinant of the tourism demand will also be held constant to the base year 2019.

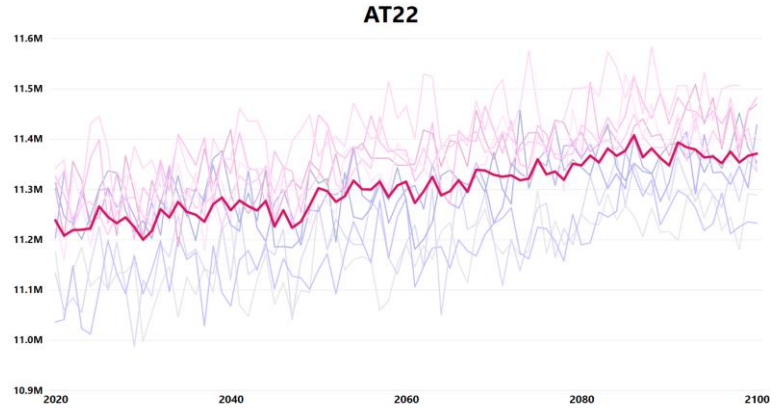
Future Tourism Demand

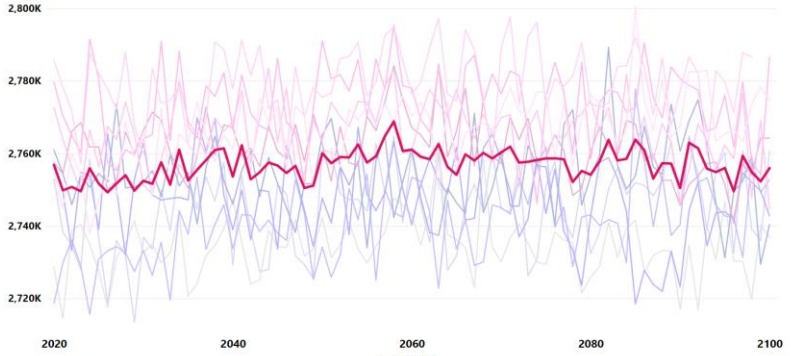


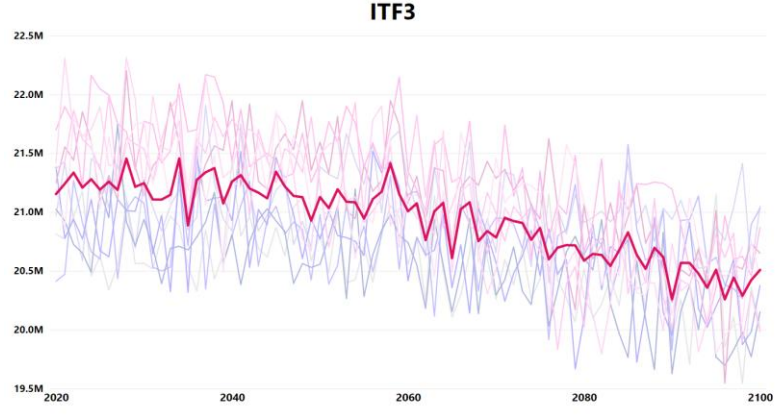


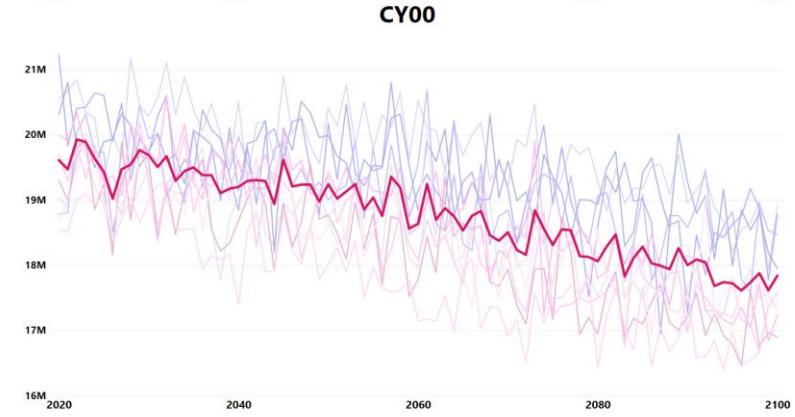






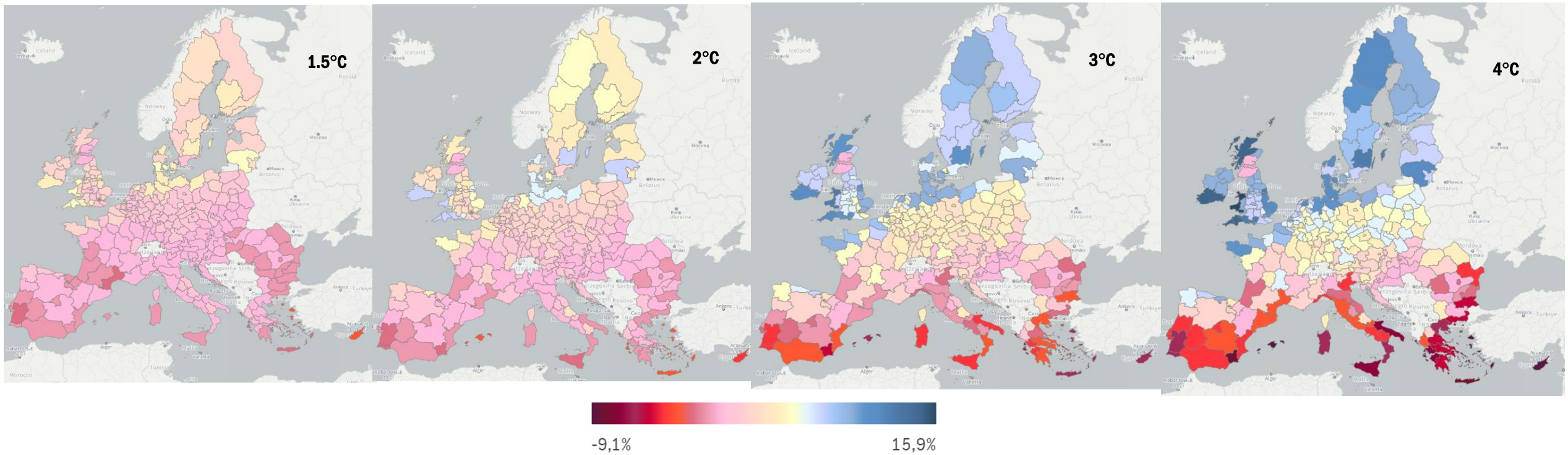






Future Tourism Demand – regional shift

Projected evolution of the European regional tourism demand for the different levels of global warming compared to the present (2019), %



Climate change affects EU regions unevenly, with a **clear shift in tourism patterns**. **Mediterranean and Southern Europe** are projected to face declines in tourist volumes, while **Northern** regions are expected to benefit from longer peak seasons and higher demand..

Under a 1.5°C warming climate scenario:

- Around 80% of regions experience only minor changes (–1% to +1%).
- The largest decline is projected in Cyprus (–1.86%).
- The largest increase is projected in a Finnish coastal region (+3.25%).

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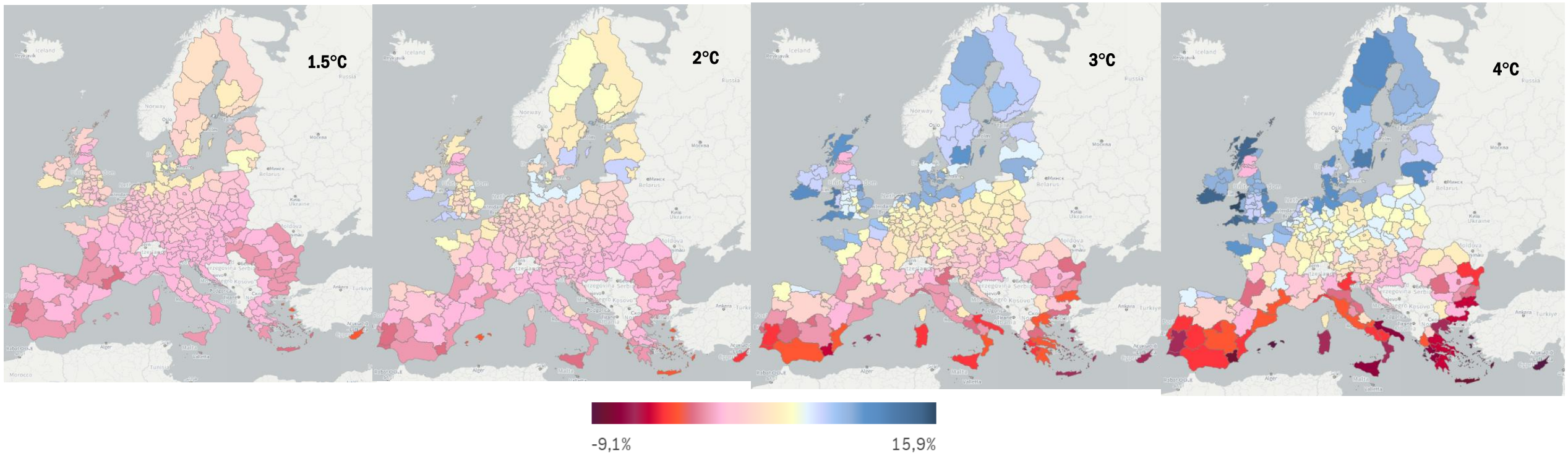
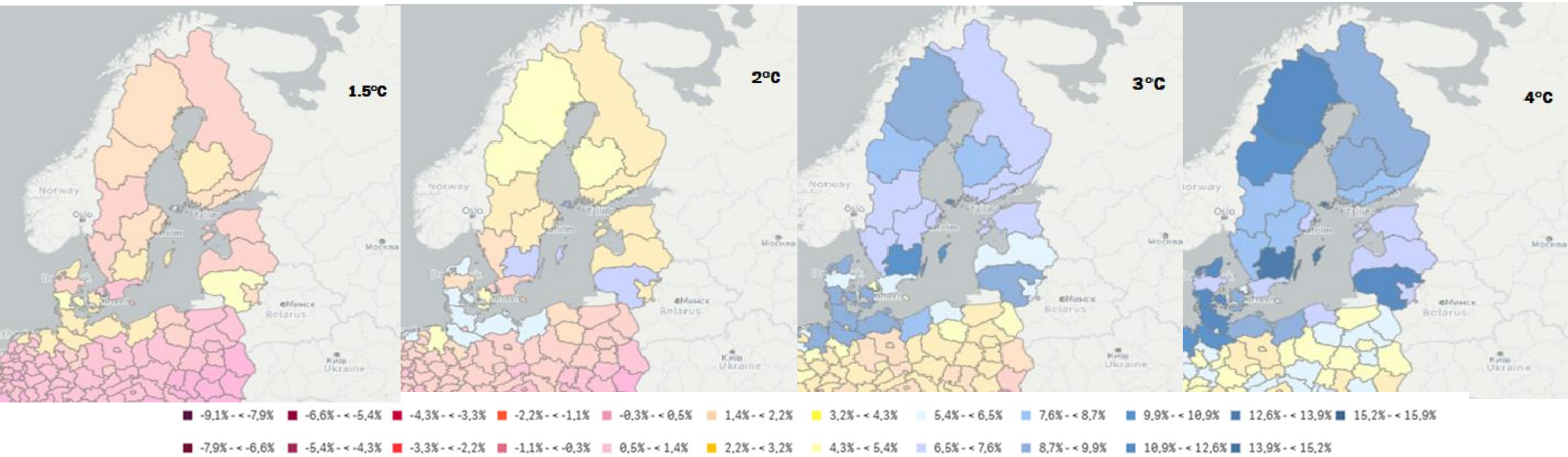


Projected Tourism Demand under 4°C Warming (End of Century)

- Significant shifts in demand patterns projected for Europe.
- Central & Northern Europe → more attractive for year-round tourism.
- Southern & Mediterranean regions → projected declines in demand.
- At 4°C warming:
  - 80% of regions see increased tourism compared to 2019.
  - 106 regions show considerable growth (>+3% bed nights).
  - 22 regions (from BG, GR, CY, ES, FR, IT, PT, RO) projected to lose tourists.

Future Tourism Demand – Regional Shift Baltic



Consistent growth and overall positive trend in **Northern & Baltic Europe**, intensifying with higher warming.

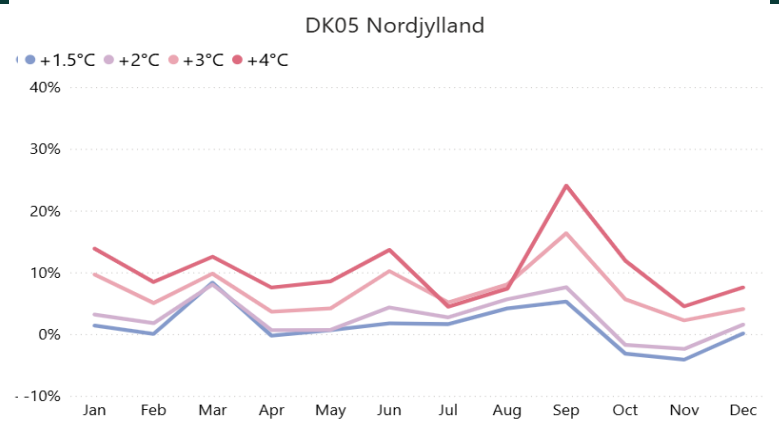
- Maximum increase in Finland (Coastal FI20 *Åland*) under the 4°C
- Other large gains SE21 Coastal- *Småland and the islands* +11.43%, DK05 Coastal *Nordjylland* +9.89%.

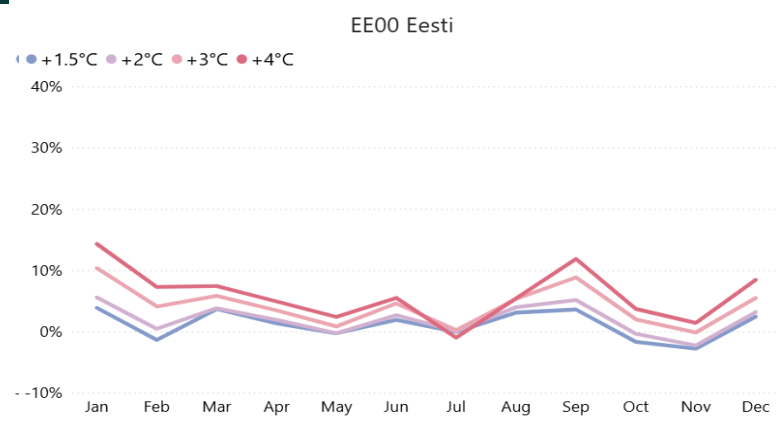
Regional patterns

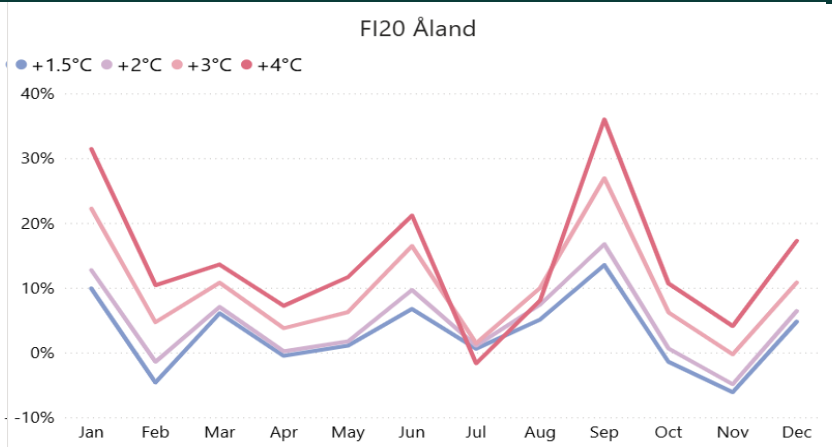
- Coastal regions benefit most [+7,3% PL42 *Zachodniopomorskie* ; +11.65% FI20]
- Urban and mixed regions show moderate but steady increase [2.5% PL91 *Warszawski stołeczny* ;+8.9% SE33 *Upper Norrland*]
- Nature and rural areas: smaller gains [+2% PL82 *Podkarpackie* , +6% FI1D *Pohjois- ja Itä-Suomi*]

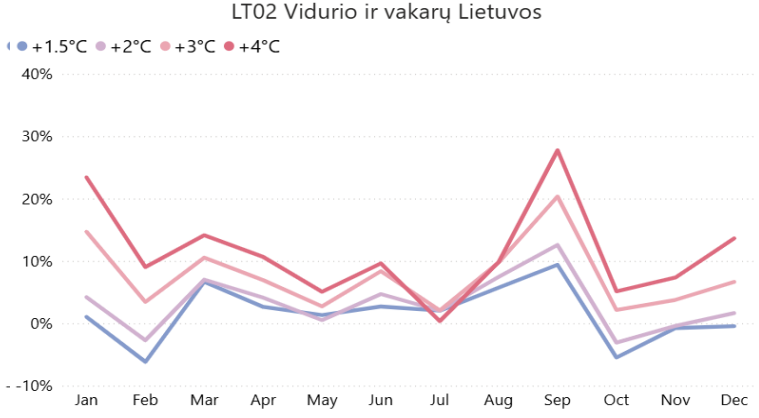
Future Tourism Demand – Seasonal Shift

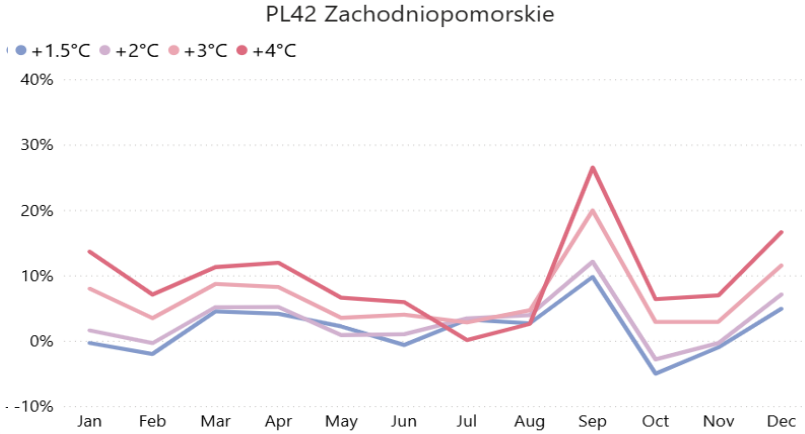
Future Tourism Demand – Seasonal Baltic Sea

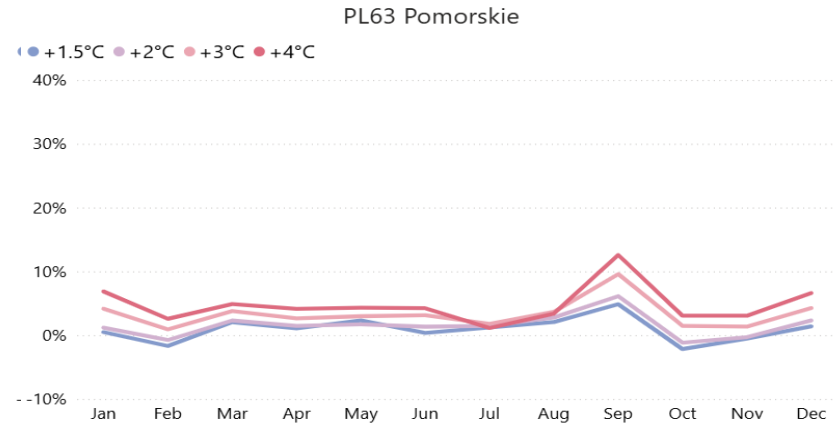


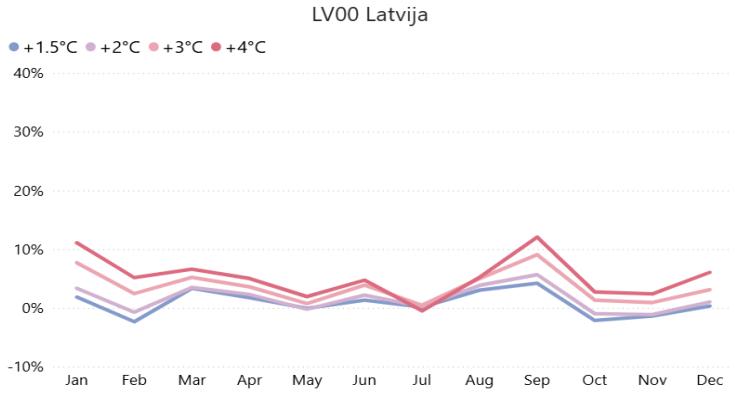


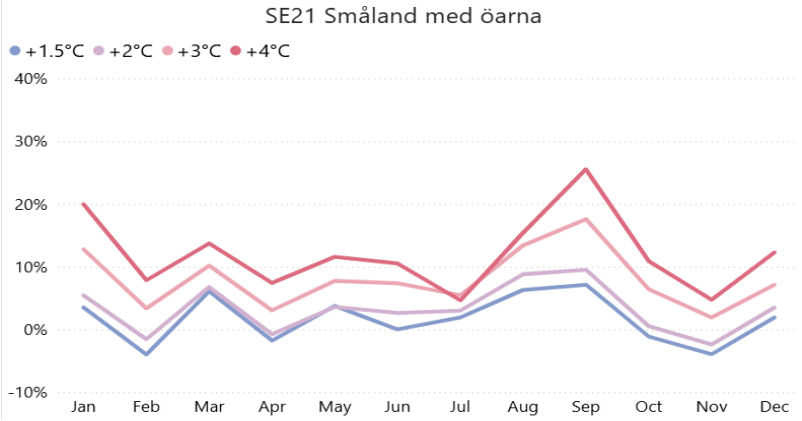


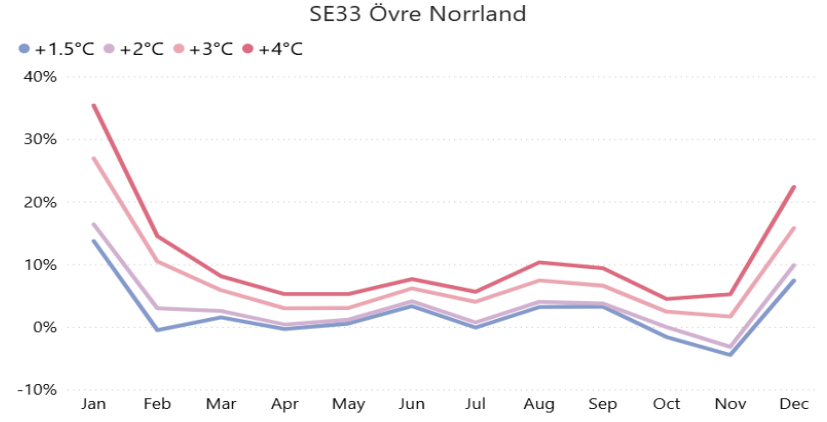




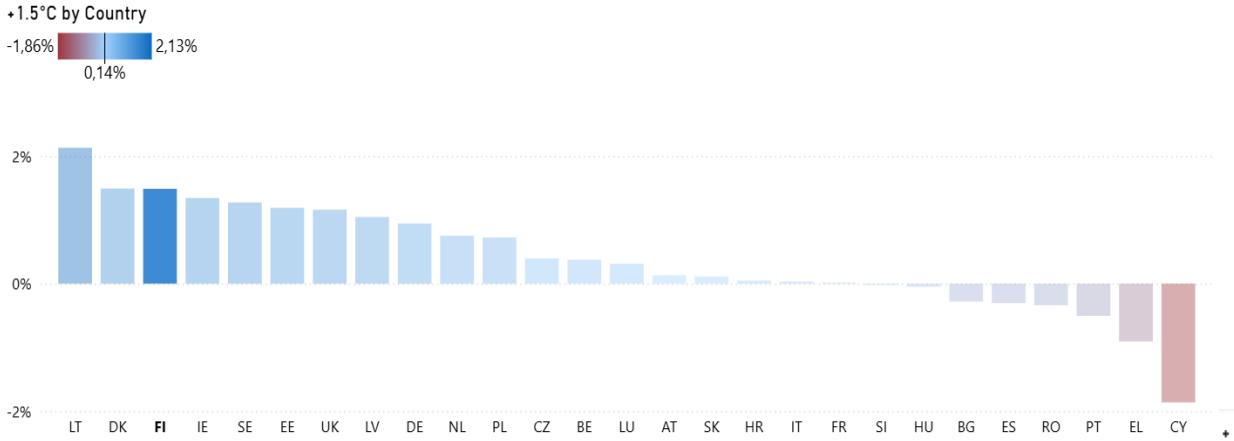


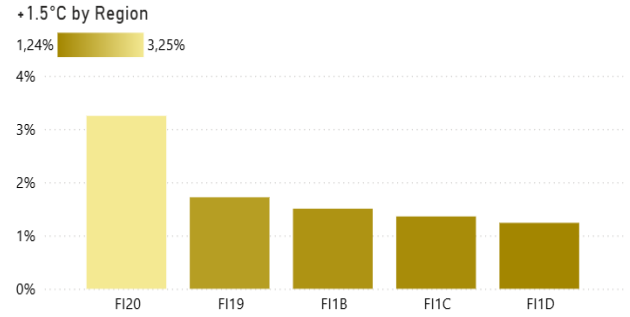


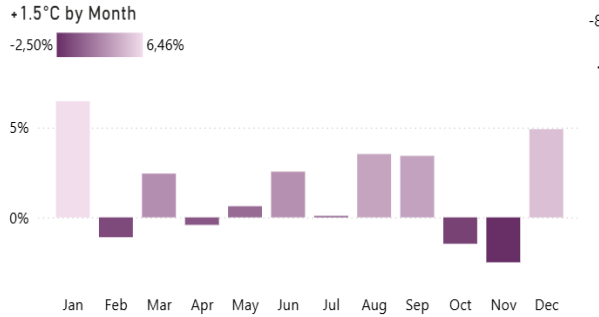


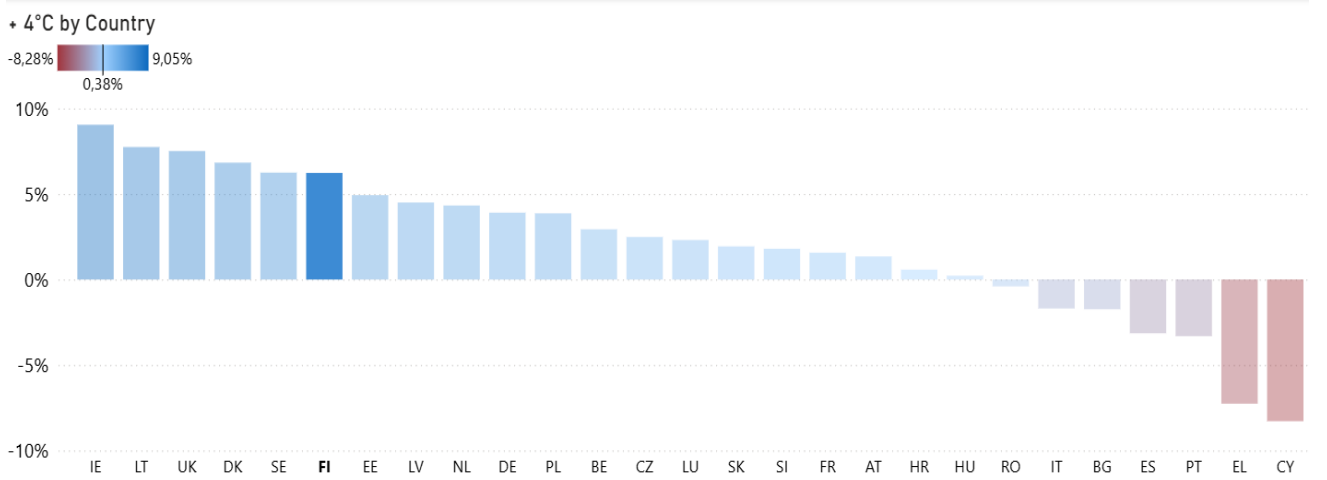


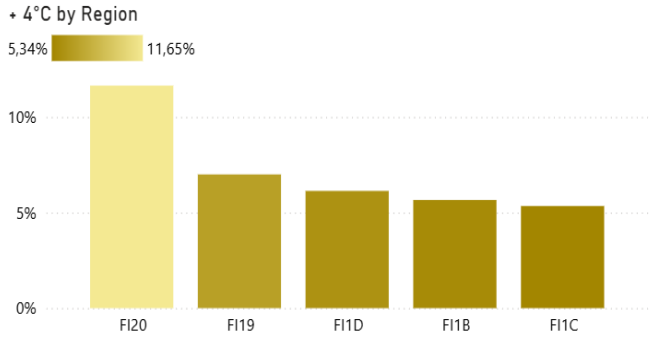
Future Tourism Demand – Finland

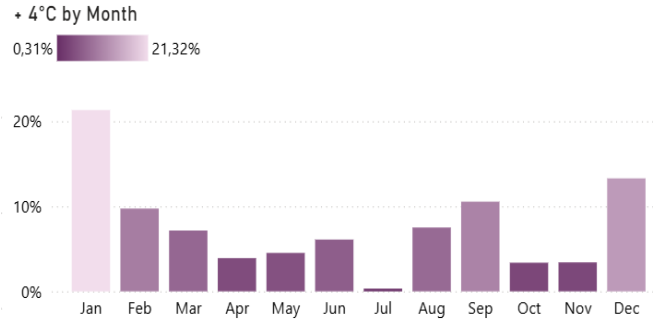




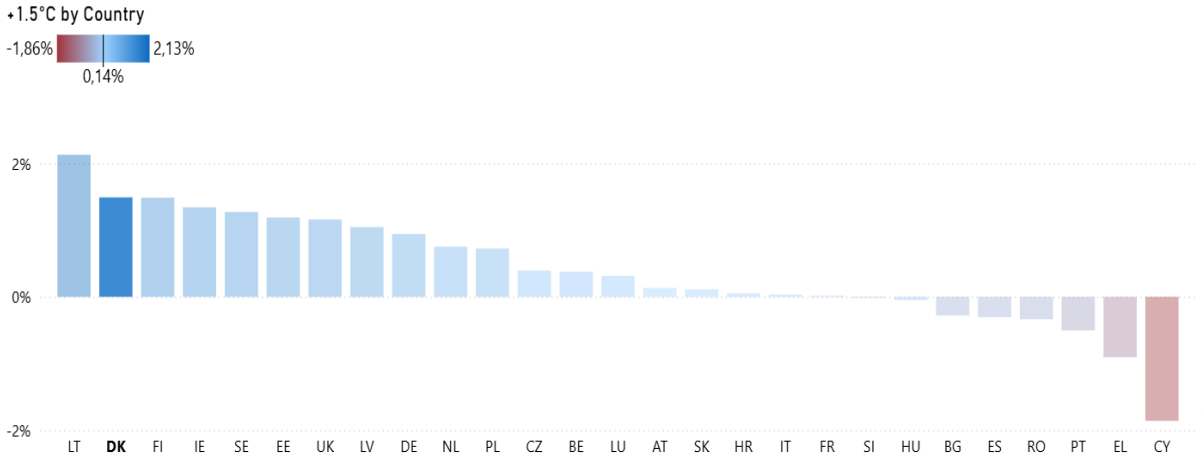


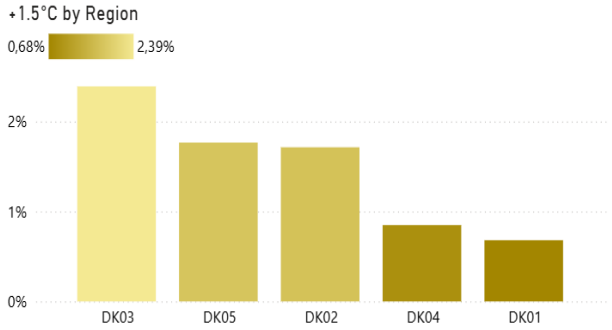


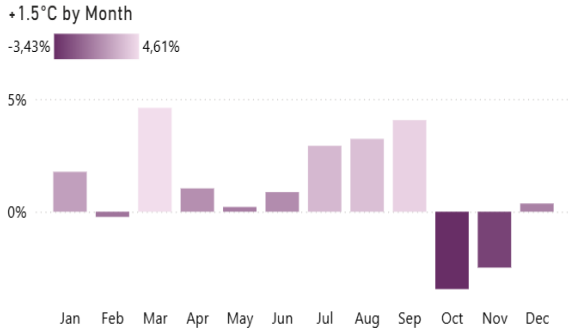


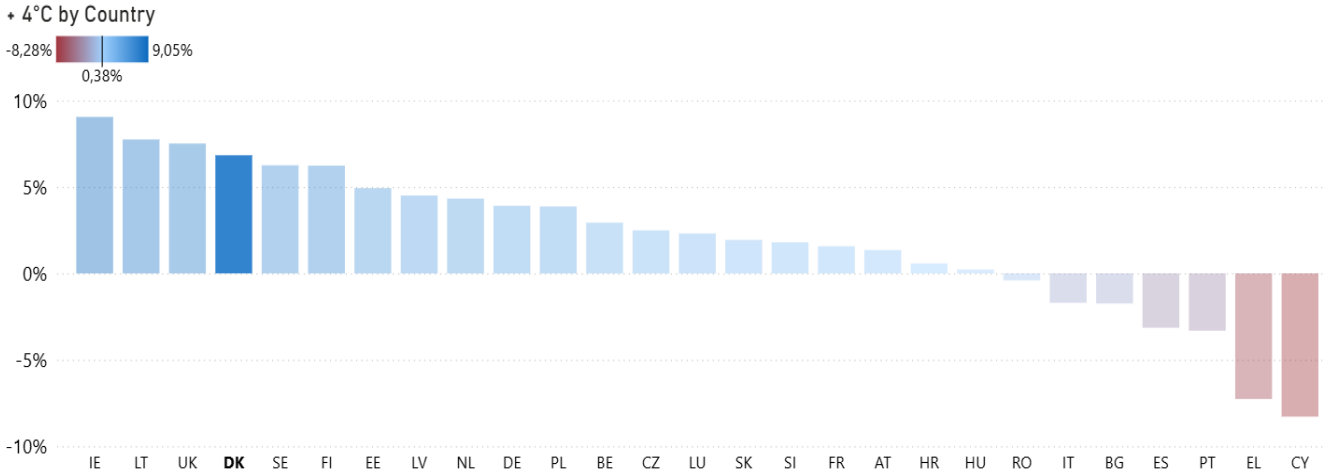


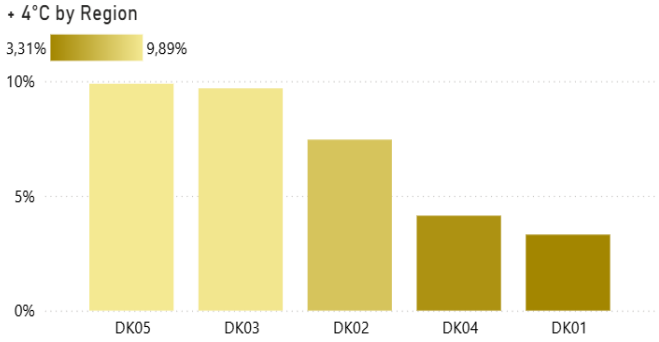
Future Tourism Demand – Denmark

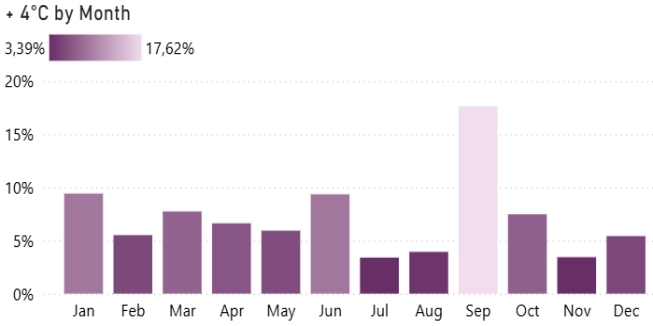




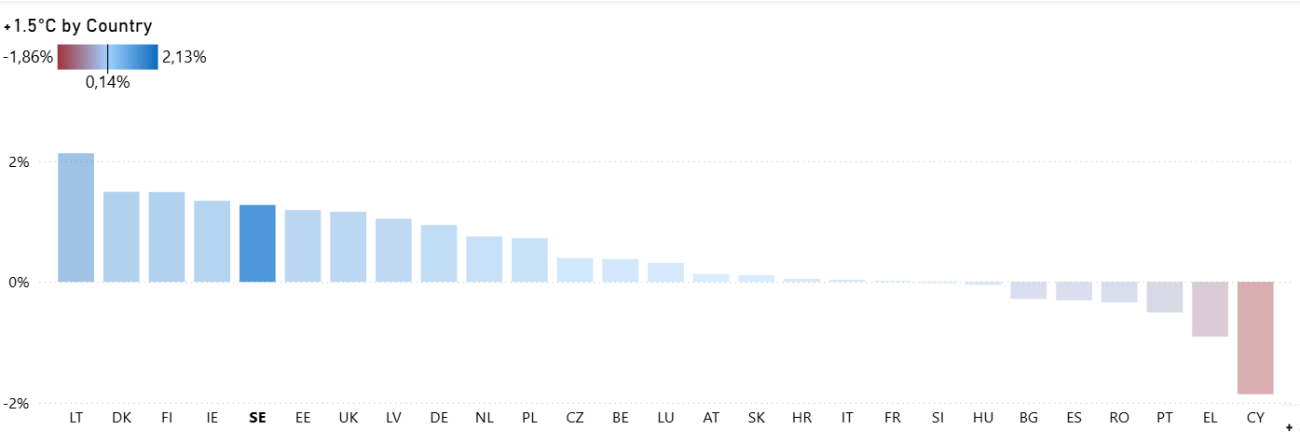


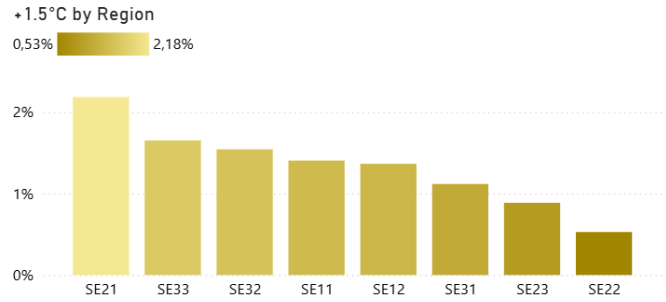


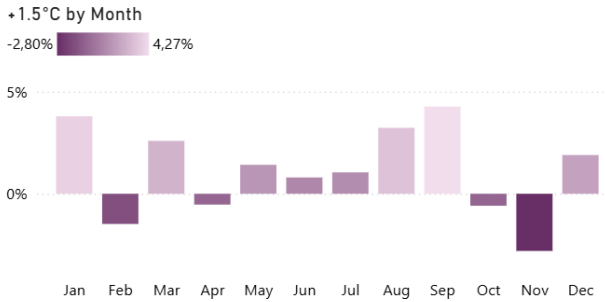


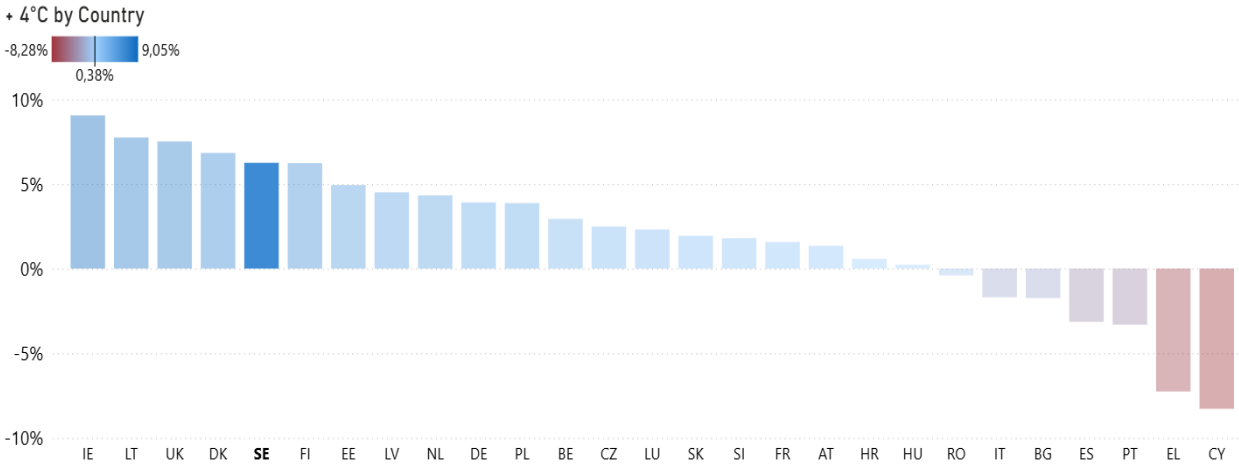


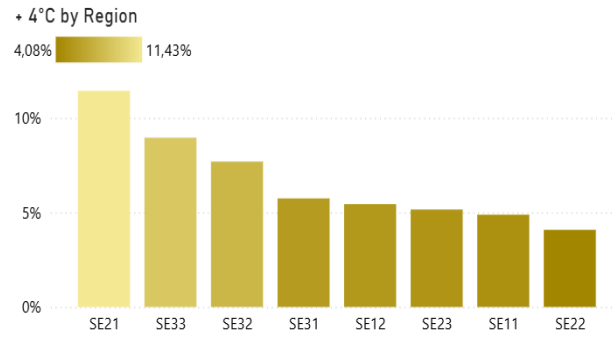
Future Tourism Demand – Sweden

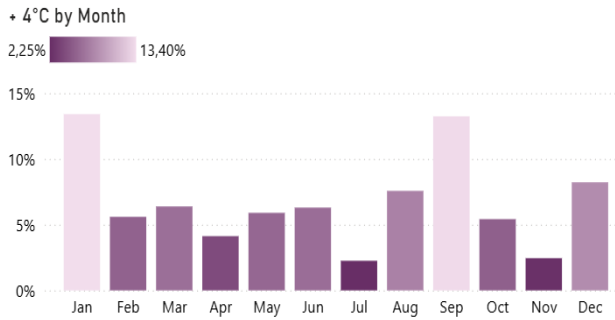












Conclusions

What we did

- estimated the **historical role of climate** on the European tourism demand using an extensive monthly panel dataset (269 NUTS-2regions, 2000-2019), controlling for seasonality and spatial patterns, economic activity, tourism typology
- Projected monthly & regional tourism demand to assess the possible effects of future climate change for four warming levels: +1.5°C, +2°C +3°C, +4°C

What we found

- Tourism Demand in Europe is **positively** and **significantly correlated** with climate conditions, costal destinations being more climate-sensitive
  - A clear **north-south pattern of demand** impacts caused by climatic variations
  - Tourism **seasonality patterns** are expected to change, high degree of heterogeneity across regions.

The regional impacts ultimately projected will depend greatly on the **flexibility demonstrated by institutions and tourists** as they react to climate change, with substantial implications for both spatial and temporal redistribution of tourism activities.

  - Capacity & preparedness gaps in northern regions to accommodate the projected increases in demand
  - Investment priorities to meet the potential increase: infrastructure, workforce, coastal resilience etc.
  - Climate adaptation measures should be both regional and seasonal

Thank you for your attention

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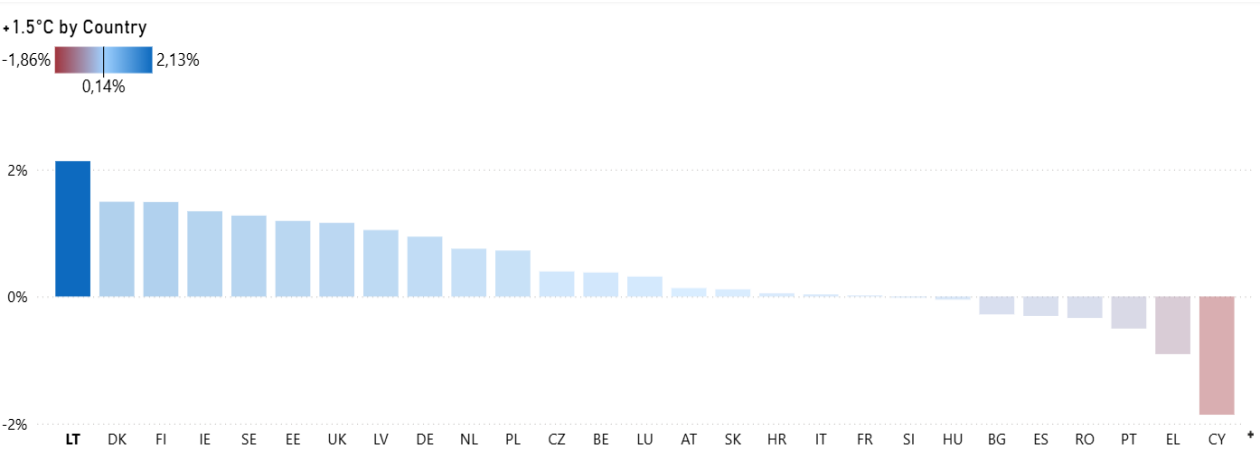
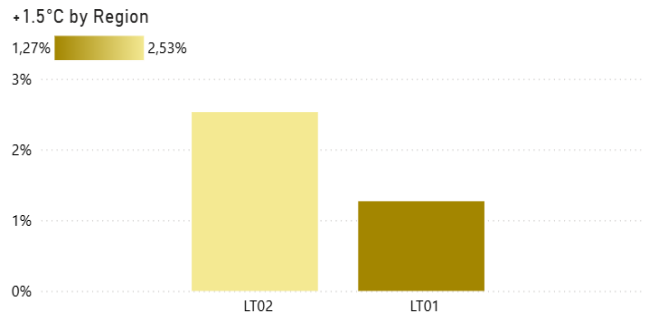
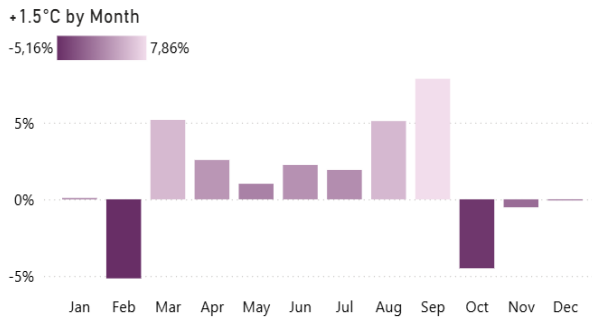
Based on work carried out at the Joint Research Centre -European Commission; views expressed are solely my own.

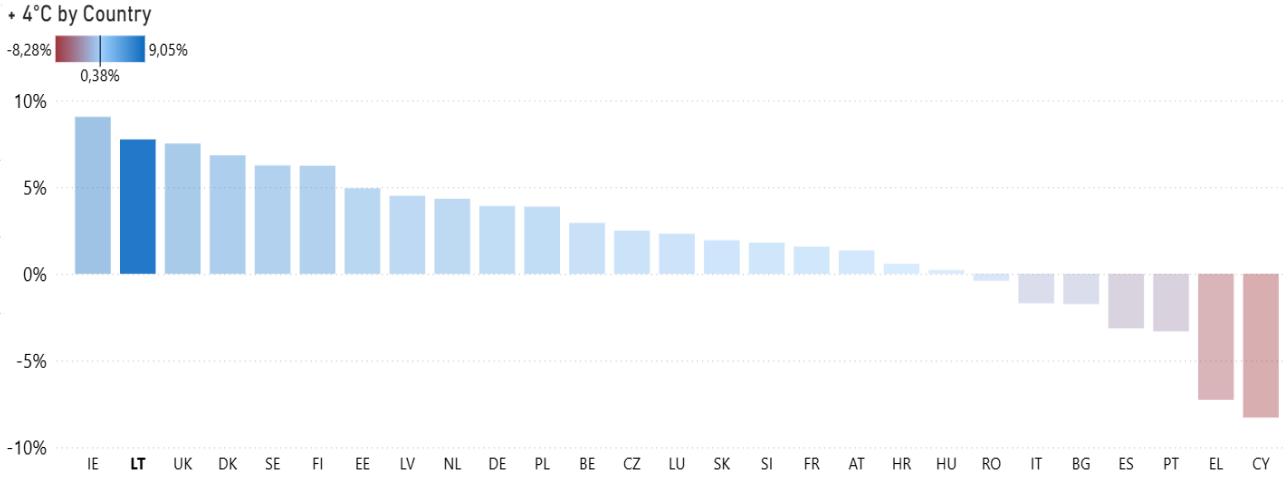
Additional Material

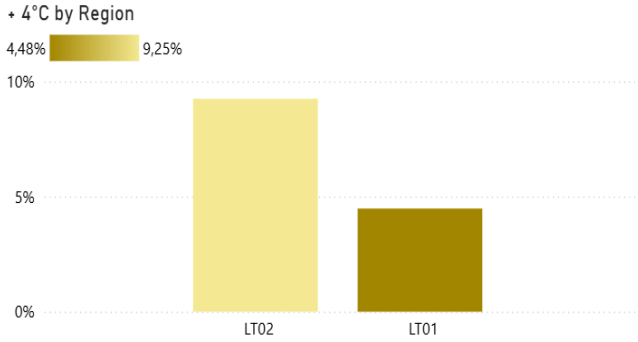
Future Tourism Demand – Lithuania

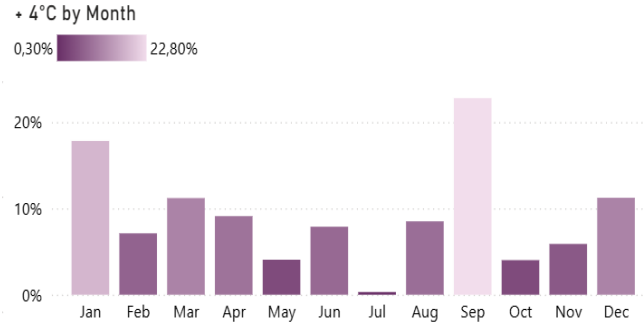




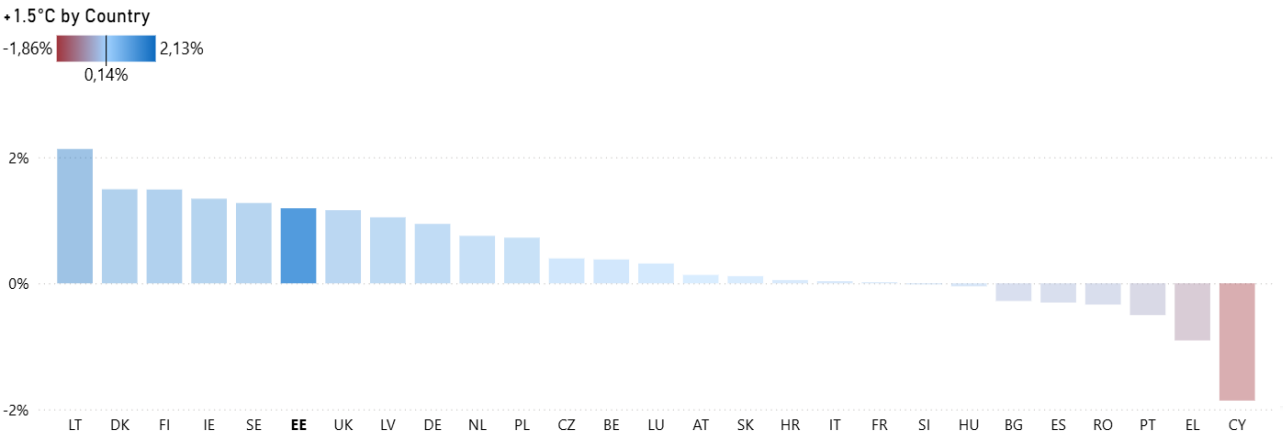


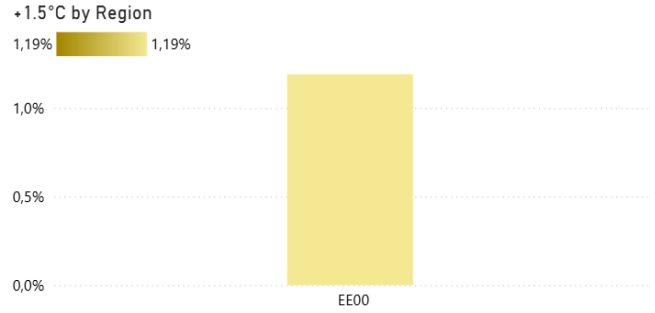


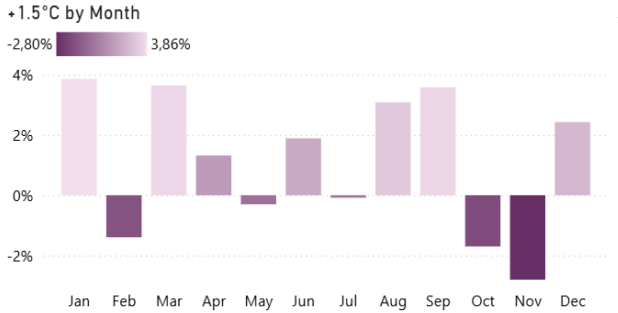


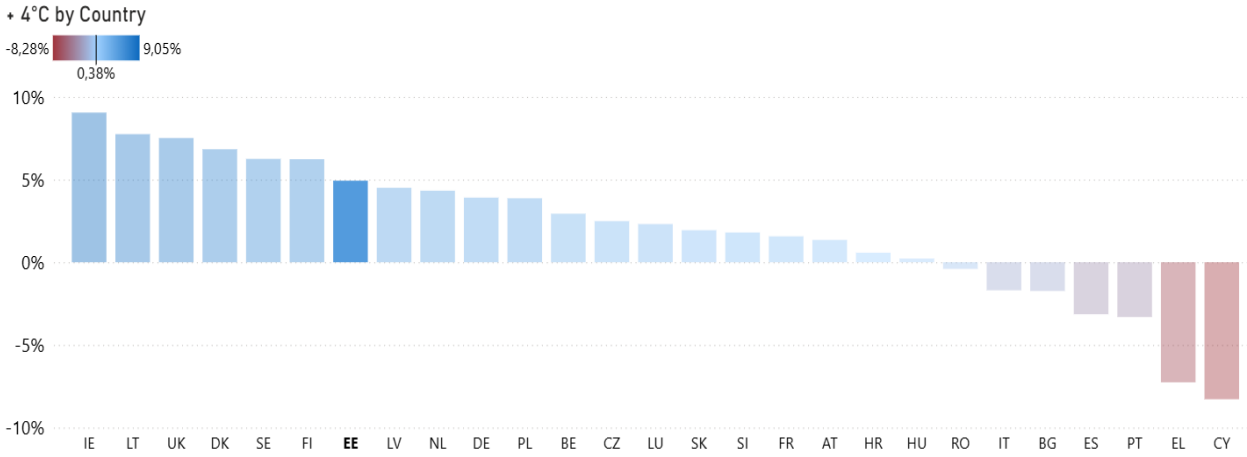


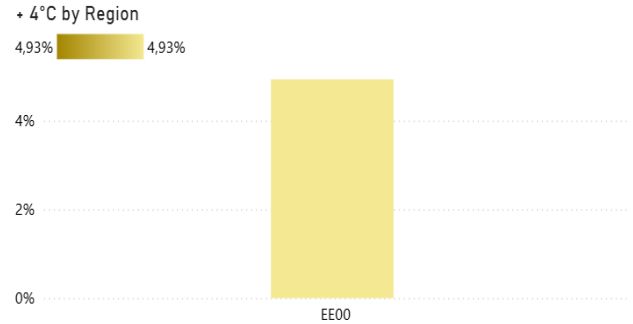
Future Tourism Demand – Estonia

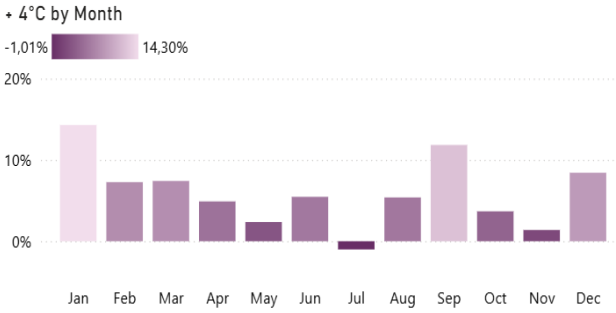




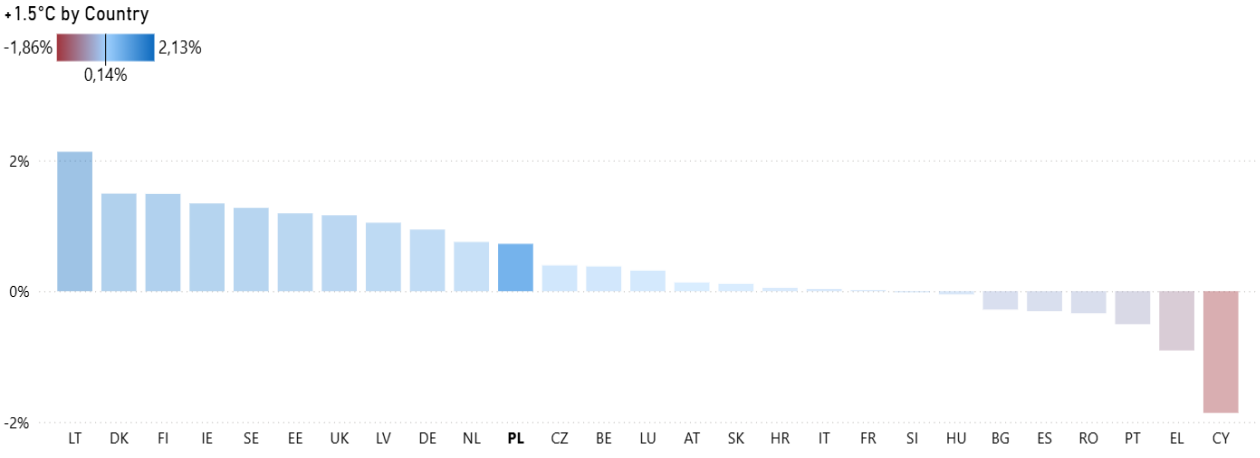


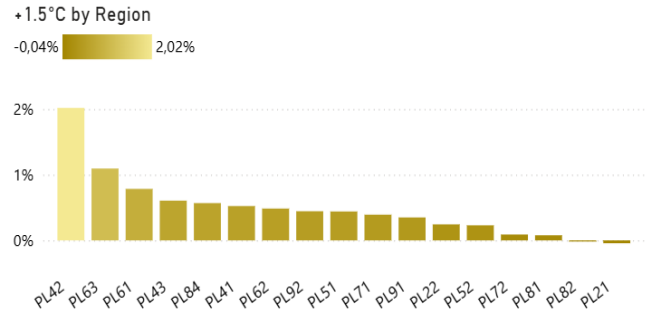


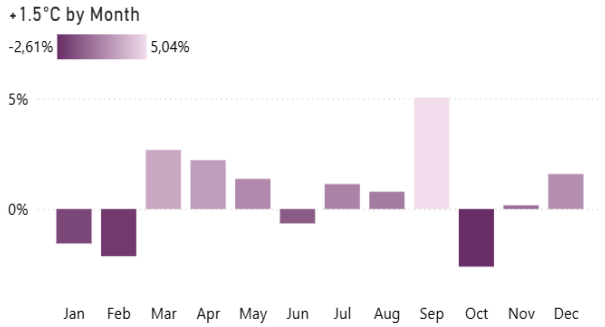


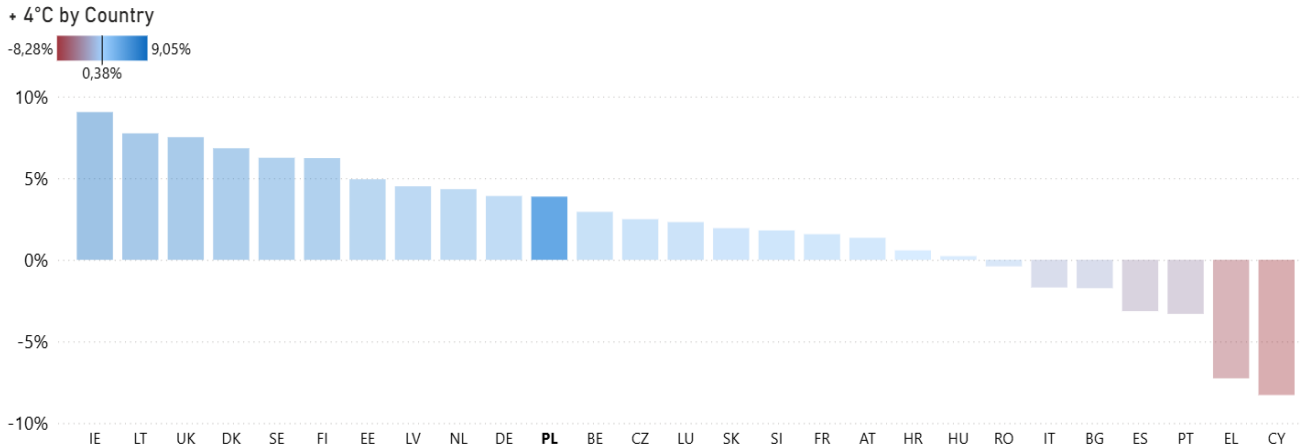


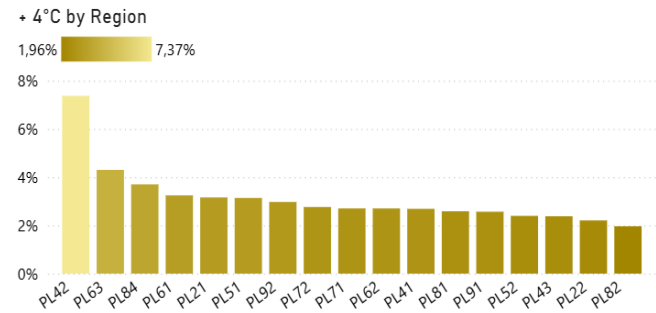
Future Tourism Demand – Poland

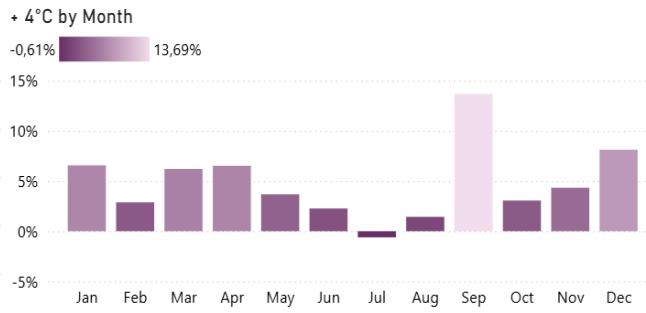




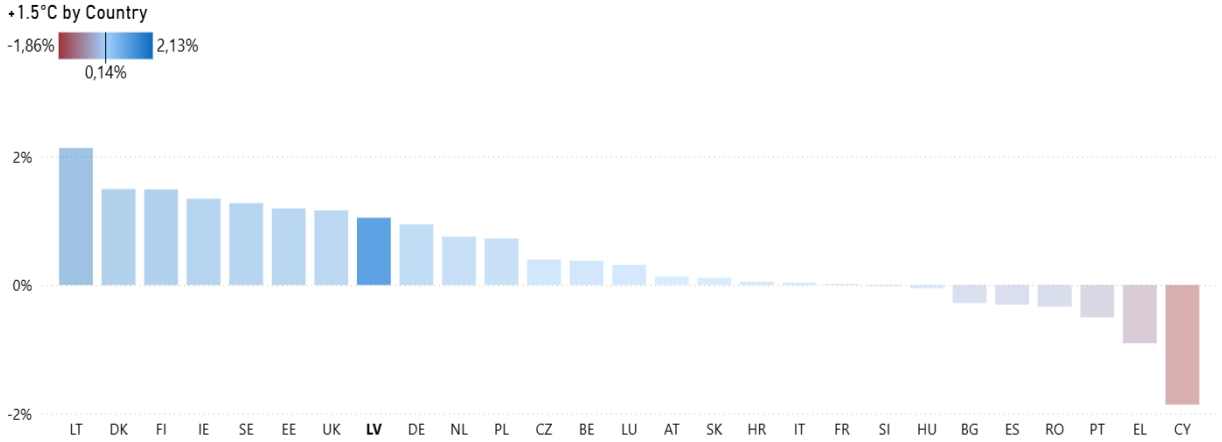


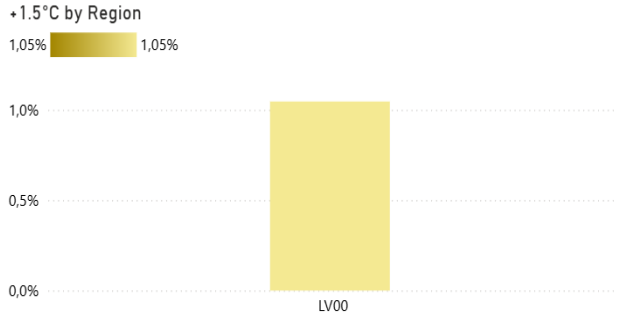


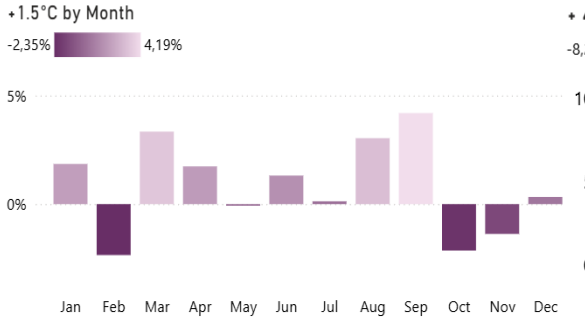


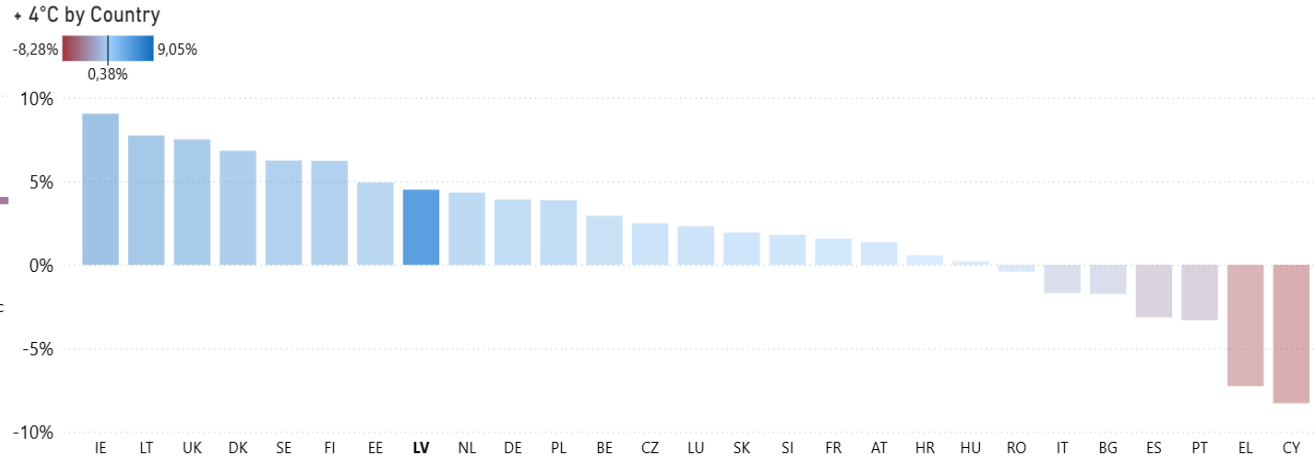


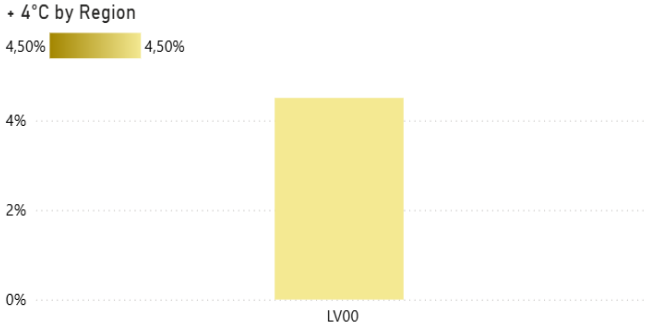
Future Tourism Demand – Latvia

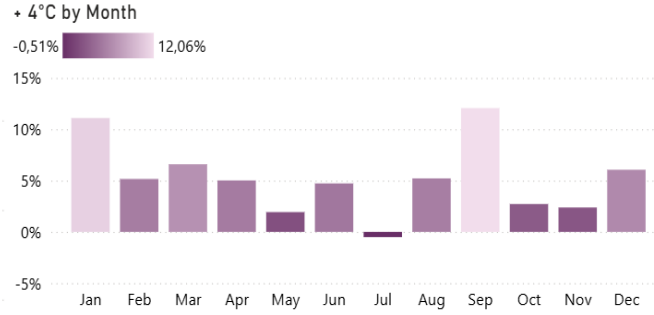












Future Tourism Demand – country Level

Projected evolution of the tourism demand at country level compared to the present (2019) in percentage terms, for the different **global warming levels**

	+1.5°C	+ 2°C	+3°C	+ 4°C
AT	0.13%	0.30%	0.88%	1.35%
BE	0.38%	0.82%	2.07%	2.93%
BG	-0.28%	-0.11%	-0.48%	-1.74%
CY	-1.86%	-2.69%	-5.32%	-8.28%
CZ	0.39%	0.74%	1.77%	2.49%
DE	0.94%	1.48%	3.03%	3.91%
DK	1.49%	2.48%	5.27%	6.83%
EE	1.19%	1.92%	3.78%	4.93%
EL	-0.91%	-1.51%	-4.07%	-7.26%
ES	-0.31%	-0.41%	-1.60%	-3.14%
FI	1.49%	2.36%	4.66%	6.23%
FR	0.01%	0.53%	1.41%	1.57%
HR	0.05%	0.53%	1.08%	0.58%
HU	-0.05%	0.09%	0.28%	0.22%
IE	1.34%	2.25%	6.15%	9.05%
IT	0.03%	0.06%	-0.54%	-1.69%
LT	2.13%	3.24%	5.99%	7.75%
LU	0.31%	0.67%	1.68%	2.31%
LV	1.05%	1.71%	3.40%	4.50%
NL	0.75%	1.35%	3.16%	4.33%
PL	0.72%	1.29%	2.81%	3.87%
PT	-0.50%	-0.54%	-1.49%	-3.31%
RO	-0.34%	-0.11%	0.03%	-0.40%
SE	1.27%	2.16%	4.58%	6.25%
SI	-0.01%	0.38%	1.26%	1.80%
SK	0.11%	0.39%	1.27%	1.94%
UK	1.16%	2.10%	5.22%	7.51%
EU	**0.35%**	**0.71%**	**1.45%**	**1.58%**