THE SPATIAL DIMENSION OF CLIMATE ADAPTATION

Assessment of spatial sensitivity of European national climate adaptation policy planning, monitoring and evaluation activities

Theses of the doctoral dissertation

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31.08.2026.

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I. Research background and topic

The research focuses on European climate adaptation policies and aims to contribute to improving their effectiveness. It examined the extent to which these policies are capable of taking into account and responding to geographical spatial characteristics and differences in the context of climate adaptation. In the dissertation, we refer to this capacity as the "spatial sensitivity" of climate adaptation policies, introducing it as a new scientific concept. The dissertation examines the spatial sensitivity of climate adaptation policies in European countries through a comparative study that analyses national-level policy instruments (planning, monitoring, and evaluation documents and activities).

Significance and importance of the topic

The challenges caused by the impacts and consequences of climate change are key issues both globally, and in Europe (SÜTŐ, 2024; 2025B). **Europe, especially the EU, plays a leading role in fighting against climate change at the** policy level (SÜTŐ, 2025B). Since the second half of the 1980s, the EU has established itself as an international leader in climate policy, having significantly enhanced both its external representation and its internal climate policies (OBERTHÜR & ROCHE KELLY, 2008; SCHMIDT-THOMÉ & KLEIN, 2011). As a consequence of the processes mentioned above, within development policy the climate policy; and within climate policy, its adaptation pillar started to demand attention (SCHMIDT, 2009). Nevertheless, **there is a significant difference between the two climate policy pillars.** While GHG emissions cause global problems and their management requires multilateral cooperation and negotiations; adaptation must provide spatially tailored solutions for specific regional/local climate impacts (HEIDRICH ET AL., 2016; BIRCHALL & BONNET, 2021; BIRCHALL ET AL., 2022; SÜTŐ, 2023, SÜTŐ 2025B). Consequently, **adaptation faces geographically (spatially) specific challenges.** Therefore, **it can only be effective if it is able to take into account spatial differences**. With some exaggeration, we can say that one key question arises: **whether climate**

adaptation policy, and among them the planning, monitoring, evaluation and reporting activities, **take these spatial aspects into account properly or not**? The dissertation seeks to answer this basic question.

Research objectives, questions and hypotheses

The rarity of qualitative/quantitative examinations of adaptation's spatiality and the relatively low number of comprehensive analyses of related national policy activities were identified as a significant research gap by the literature review: examination of climate adaptation's spatial dimensions have so far been carried out for only a few cases, and barely any international comparative study of the spatial sensitivity of adaptation policies has been conducted at all. This, together with the general importance of the geographical space in climate adaptation, is the starting point of the research.

The long-, medium-, and short-term changes in climatic factors occur in spatial reality and exhibit significant diversity across different geographical locations, resulting in spatially distinct climate change impacts and consequences. Policy responses to these challenges could be appropriate and effective only if the spatial aspects/differences are properly considered. The dissertation aims to further strengthen the potential of climate adaptation policies to address the geographical manifestation and spatial dimensions of the present and future consequences of climate change. For this reason, my work examines the extent to which spatial dimension is reflected in the practice of adaptation policies. To capture this, the dissertation introduces the spatial sensitivity of policies as a key concept and examines it through an analysis of three key instruments of adaptation policy: planning, monitoring, and evaluation.

The dissertation's main aim is to reveal the spatial sensitivity of current European national climate adaptation policies. For this aim

(1), it creates the scientific concept of (geographical) spatial sensitivity of climate adaptation policies (conceptualisation);

(2) develops a system of analytical aspects capable of measuring this spatial sensitivity (as operationalisation);

(3) empirically assesses the spatial sensitivity of national climate adaptation policies by analysing four main tools of climate adaptation policy planning (strategies, programmes/action plans, evaluation reports and monitoring materials);

(4) analyses the connection between spatial sensitivity and different determinants;

and **(5)** formulates recommendations for making policy practices more spatially sensitive.

The research aims primarily to examine the current presence of spatial emphases in adaptation policymaking, specifically in planning and monitoring/reporting/evaluation (hereinafter: MRE) activities. To conduct this research, as a first step, we must **define the essence of this spatial content**: what we understand under spatiality? Moreover, we must find a way to measure the degree to which climate adaptation policy instruments are sensitive to these spatial dimensions and how they contain them. The concept of space can, of course, be interpreted in different reference systems that are much smaller (e.g., in architecture) or much larger (e.g., in space exploration) than the geographical scale. We emphasise that the **research specifically examines** the **spatiality of climate adaptation at the geographical scale**. Among the space-related concepts **the dissertation definitely focuses on space itself** as a limitless, general, abstract concept as opposed to territory (which refers to delimited units, basically with administrative or functional purposes) or place/region (which concepts refer to rather lower-level localities in space with perceptorial and statistical-analytical content).

To achieve the main objective of the research mentioned above, the dissertation concentrates on one main research question and five sub-questions.

RQ: To what extent are European national climate adaptation policies spatially sensitive?

- *RSQ1: What does spatial sensitivity mean in climate adaptation policies?*
- *RSQ2: How can spatial sensitivity be assessed in climate adaptation policies?*

- *RSQ3: To what extent is spatiality emerging in national adaptation policy planning and MRE instruments of the European countries?*
- *RSQ4: Do the geographical characteristics of the European countries influence the spatial sensitivity of national adaptation policies?* The question analyses whether the national adaptation planning and MRE activities' spatiality reflects the different geographical natural/social/economic endowments of states or not.
- *RSQ5: Are there any macro-regional characteristics in European national adaptation policies' spatial sensitivity?* (If there exist good practices, are they from the same macro regions of Europe, e.g. where adaptation planning and MRE systems are in a more advanced state, or is there no connection between location and the level of planning and MRE activities' spatial sensitivity?)

The hypotheses of the dissertation (in harmony with the structure of the research questions) are as follows:

Main hypothesis: Due to the importance of geographical space and spatial differences/structures in climate adaptation, sensitivity to spatial considerations emerges in national adaptation practices across Europe.

- *Hypothesis#1 (H1): The ability of climate adaptation policies to recognise spatially specific (geographical) contexts and to tailor their interventions accordingly can be captured by a common concept.*
- *Hypothesis#2 (H2): Spatial sensitivity of national adaptation policy activities can be examined and measured by the analysis of their instruments.*
- *Hypothesis#3 (H3): Sensitivity to spatial dimensions emerges in national adaptation policy instruments in Europe, but to a limited extent.*
- *Hypothesis#4 (H4): Geographical characteristics of European countries fundamentally influence the spatial sensitivity of national adaptation policies of states.*

- *Hypothesis#5 (H5): Some macro regional differences can be identified in the presence of spatial sensitivity in European countries' national adaptation policy activities due to their differences in policy culture, with better performances of Western/Northern European countries.*

Through the expected results, the dissertation might support the improvement of climate adaptation policy activities in Europe, moving them in a direction that makes them capable of proper and spatially/territorially conscious planning of adaptation interventions, monitoring and regular evaluation of climate impacts, changes in vulnerability status, level of adaptive capacity and concrete actions' contribution to adaptation (SÜTŐ, 2023).

II. Materials and Methods

Research design

During the research I analysed European adaptation policy planning and MRE practices and monitoring and/or evaluation system development examples (especially the internal logic of the MRE systems and the applied indicator sets) according to the degree of their spatial orientation (SÜTŐ, 2025B). To reveal the level of spatial aspects' presence in the policy planning and MRE instruments (namely strategic planning, monitoring and evaluation documents), a new concept, spatial sensitivity, has been created. This spatial sensitivity depicts the weight of spatial aspects, content and considerations in the instruments. Space concepts and interpretations of different scientific disciplines and policy fields were reviewed to make a tailored understanding for the spatial sensitivity of the analysed instruments; and, based on this and the different spatial concepts, an analytical tool (in the form of an aspect system) has been established for the empirical analysis of the European national adaptation documents / systems.

The dissertation **used mostly qualitative methods**, conducting (1) a comprehensive literature review of spatiality in climate adaptation; and different space concepts and interpretations of space-oriented disciplines and practical fields; (2) widespread desk research and document analyses, in

cases complemented these with (3) questionnaire-based e-mail interviews. Throughout these empirical analyses, special attention has been paid to the practical applicability of the results.

The literature review provided the context for the research (clarifying the concepts of climate adaptation and adaptation policy, planning, monitoring, and evaluation, as well as describing the main spatial levels and challenges of adaptation policy planning worldwide and in Europe). The review also identified the main research gap: the rarity of assessment of the spatial dimension in climate adaptation. Special subchapters are dedicated to the space interpretations of chosen geographical and social space-oriented disciplines. Among the different spatial/territorial levels of adaptation planning, monitoring, and evaluation the national and regional ones have received relatively weaker emphasis so far, compared to the local level. So, the dissertation concentrates on national adaptation-oriented strategic planning, and beyond that, monitoring, reporting and evaluation activities, and their characteristics in Europe (as the pioneer continent of climate adaptation policy planning).

A key element of the empirical analysis's qualitative toolkit was a **comparative document analysis**, focusing on existing national planning documents, monitoring and evaluation reports, and methodological background materials. At the centre of the analyses were, on the one hand, the national strategic planning documents of adaptation. Under the term national planning documents, similarly to Timo Leiter's 2021 analysis and using his umbrella definition, I understand both national adaptation strategies (NAS) and national adaptation programmes or action plans (NAP). These can be either documents covering both mitigation and adaptation or strategies concentrating only on adaptation. On the other hand, I also examined national-level monitoring and evaluation reports and assessments, methodological materials, and indicator descriptions elaborated or commissioned by national governmental organisations. **Based on** the results of the **comparative analysis, a composite indicator** was

elaborated to measure the spatial sensitivity of climate policy activities of the analysed countries.

To complement the comparative document analysis's outcomes, questionnaire-based e-mail interviews have also been conducted, targeting all countries. Subjects (interviewees) were the related stakeholders of national policymaking and planning. The interviews, together with the comparative analysis, enabled the collection of detailed information on the spatial content of the analysed activities and on the attitudes of planners/decision-makers toward spatial issues. **The selection of the interviewees** followed an institutional logic, focusing on persons working at the national level of climate adaptation administration (in relevant ministries, governmental agencies, and background institutions).

In a next step, the dissertation **identified the main determinants of adaptation tools' spatial performance,** through comparing the elaborated spatial sensitivity composite indicator of the given states to other national level social/economic/geographic or spatial administration-/spatial planning-/adaptation planning- or climate vulnerability- related indices in the form of a correlation analysis to **identify whether geomorphologic, natural geographic, social, economic or planning issues** influence more the spatiality of national adaptation policies.

Again, in a next step, **macro-regional determination** was also sought in the final ranking of the spatial sensitivity composite indicators **of European national adaptation activities** to determine which group of countries performs better in this field and whether there is a relationship between a country's macro-regional position and its spatial performance in climate adaptation. In the dissertation's Annex #4, the cases of the best-performing countries are presented in more detail based on the final ranking of the composite indicator.

The logic behind selecting the sample of benchmark countries was based on the final results of the empirical analysis and the macro-regional classification. In Europe, the Anglo-Saxon countries with large planning and MRE traditions perform exceptionally well in climate policy and climate

adaptation, too. From this group, Germany, the Netherlands, Austria and Scotland got dedicated subchapters in Annex #4a. Their pioneer role is represented by the fact that even adaptation MRE system development has already been started in them, or they already have a functioning system. These countries can even serve as good examples for Eastern-Central European states, since members of this latter group are mostly yet to undertake their adaptation-oriented MRE system-building actions. Among the generally well-performing Northern European countries, Sweden, Norway, and Finland are presented in detail in Annex #4b. From Southern and Eastern Europe, the best-performing examples were introduced in the dissertation's Annex #4, too: Türkiye and Spain (Annex #4c); Poland and Hungary (Annex #4d).

Finally, **the responses for the RQs and hypotheses** and the presentation of **recommendations for climate adaptation policy practice** compose the first parts of the "*Conclusions and discussion*" Chapter. These are followed by the **dissertation's actual conclusions,** the introduction of **new scientific results**, together with the description of the **research's limits** and the **potential future research directions** (Figure 1).

Literature and scientific context

The growing intensity of adaptation policy activities and the increasing number of strategic documents at different spatial levels indicate serious progress in this field. The international **literature**, dealing with the local, regional and national adaptation policies and measures **goes rarely further than identifying planning practice-, approach- or method-related problems and structural or financial limitations** at different spatial levels (SÜTŐ, 2023).

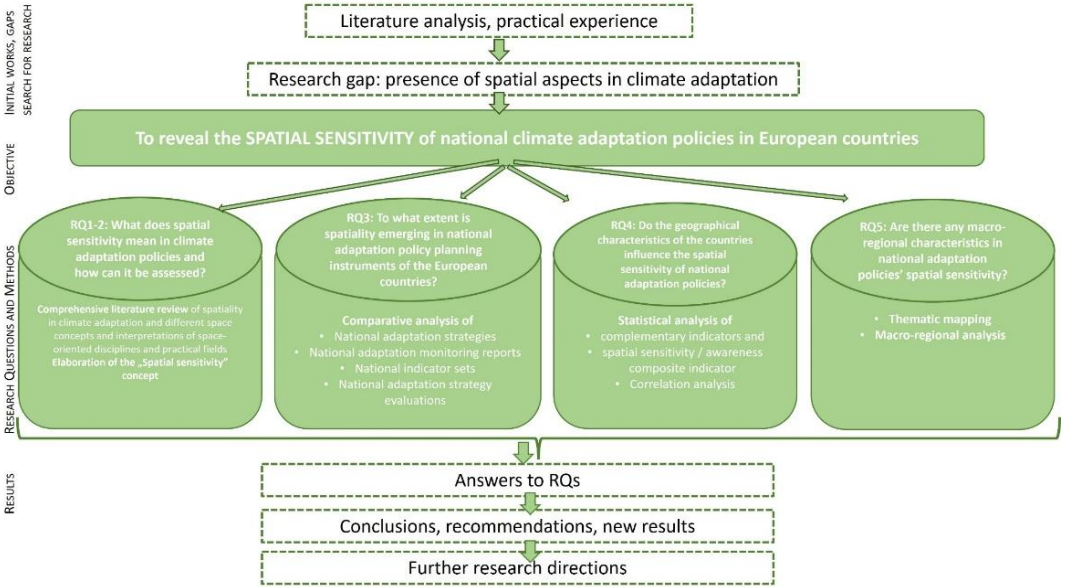

Figure 1: Design and internal logic of the doctoral research. *Source: own editing.*

Only a limited number of studies use comprehensive / **comparative analysis**, and most of them **concentrate on local examples**; national strategies are analysed less frequently. Additionally, the larger proportion of these few **national-level oriented ones** are from the grey literature (GIZ, 2013; PRINGLE ET AL., 2017; EEA, 2020 and 2022; OECD, 2023; LEITER ET AL., 2024), e.g., technical reports introducing national-level adaptation planning and MRE in Europe with the most crucial challenges and current processes. Beyond these evidence-base reports **real scientific studies are rarer** (e.g., SCHUSTER, 2008; DOSCH ET AL., 2008; SWART ET AL., 2009; GREIVING&FLEISCHHAUER, 2010 and 2012; MORGAN ET AL., 2019; WOODROFF & REGAN, 2019; LEITER, 2021) (SÜTŐ, 2025B).

Spatiality in adaptation is usually examined implicitly, through some space-related topics. Several authors analyse *regional geography and its tools* as a space-oriented discipline in the understanding of the spatiality of climate change (RANDALLS, 2017; CHANG&WI, 2018; FARBOTKO, 2018; COLVEN&THOMSON, 2018; TAYLOR&O'KEEFE, 2021, TAYLOR, 2023; PIETTA, 2023; PAASI, 2023); others focus on *linkages between adaptation planning and spatial planning* [both with physical (FLEISCHHAUER ET AL., 2007; SCHMIDT-THOMÉ, 2007; GREIVING ET AL., 2007; GREIVING & SCHMIDT-THOMÉ, 2013) and spatial development (DOSCH ET AL., 2008; SWART ET AL., 2009; GREIVING&FLEISCHHAUER, 2010 and 2012; ROGGEMA, 2012; OECD, 2023) planning] or *adaptation planning and urban planning* (UITTENBROEK ET AL., 2013; WHEELER, 2013; BIRKMANN ET AL., 2014; BRUNETTA&CALDARICE, 2018; SALAMIN, 2018; MARAGNO ET. AL., 2021). Some authors focus on the speciality of the challenge of climate change and the *need for new ways/methods of planning* (LOMBARDI ET AL., 2011; MALEKPOUR ET AL 2015); some even recommend the *use of approaches such as horizontal and interdisciplinary thinking* from the wicked problem phenomena (ROGGEMA, 2012; KEREKES, 2021). The role of spatial planning in adaptation or the growing importance of hazard assessments and risk information in spatial planning also have been recognized in some cases (SÜTŐ, 2023). However, while adaptation's and risk management's role in spatial planning is quite well described

(e.g. SCHMIDT-THOMÉ, 2007; GREIVING & SCHMIDT-THOMÉ, 2013), **the possible use of spatial aspects in adaptation policy making and in the related tools do not get proper emphasis**, which fact underlines the novelty of the dissertation's empirical part (Figure 2).

The **importance of proper, spatially conscious planning, monitoring and evaluation; the role of spatial approach and aspects in these activities simply do not appear directly in the reviewed literature items** (SÜTŐ, 2025B): neither from scientific point of view, nor in a comprehensive way, using comparative analysis of these national-level instruments.

Subject of the empirical research

In the research the **comparative assessment of national-level policy planning tools from European countries** was conducted. Although spatial diversity can be considered stronger at the regional level than at the ab-ovo coordinative, comprehensive national one, some spatial characteristics, if they exist, could also be grasped in state-level documents and activities as well.

Adaptation policy planning instruments

What we consider adaptation policy instruments in the framework of the research is the **entirety of the tools related to the climate adaptation-oriented strategic planning cycle,** from strategic planning through monitoring and reporting to evaluation. Consequently, the empirical research implemented a comparative analysis of European countries' national-level adaptation planning (national adaptation strategies – NASs; and programmes/action plans - NAPs) and MRE materials (monitoring background materials, indicator set descriptions, evaluation methodology studies, actual monitoring and evaluation reports, etc.). Due to time and resource constraints, different generations of the documents (e.g. NASs, NAPs) have not been compared to each other; so, monitoring the possible changes in approaches and spatial emphases in a given country was not part of the research.

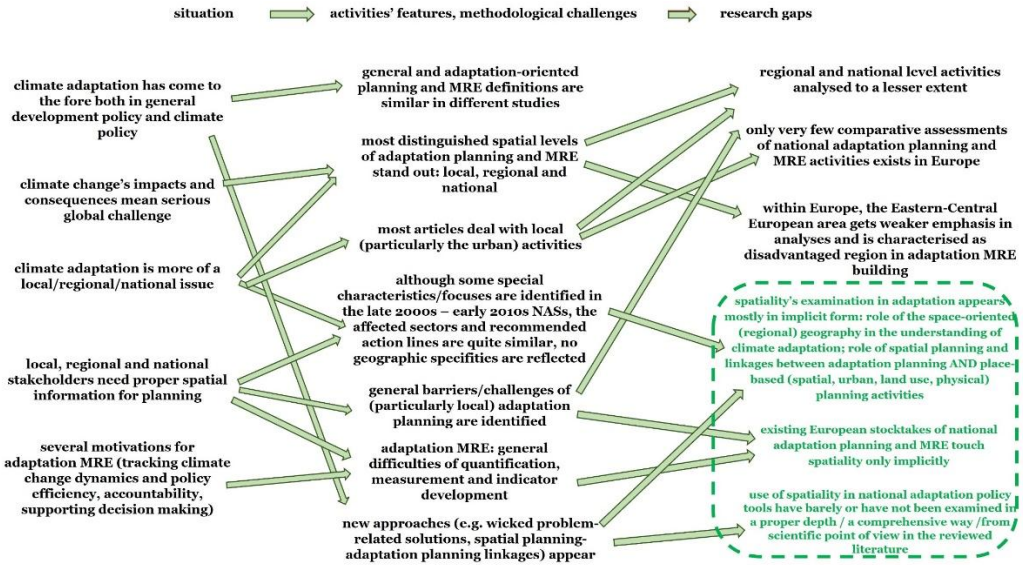

Figure 2: Main outcomes of the literature review. *Source: own editing.*

At the same time, in each analysed country, when more generations of NAS/NAP documents were available, I examined only the most up-to-date and accessible ones.

The **number of available MRE materials was significantly smaller** – in these cases we tried to **consider all available documents, even more generations of them from a given country**. All in all, the vast majority of the analysed materials were NASs/NAPs.

Geographical and time context

The empirical research covered the EU countries, complemented with Iceland, Norway, Switzerland and the UK (within the latter, England, Scotland, Wales and Northern Ireland separately because of the strong devolution process affecting even adaptation policy) from the European Economic Area, all of the Western Balkan states as countries that strongly strive for EU accession and Türkiye (Figure 3) (SÜTŐ, 2025B).

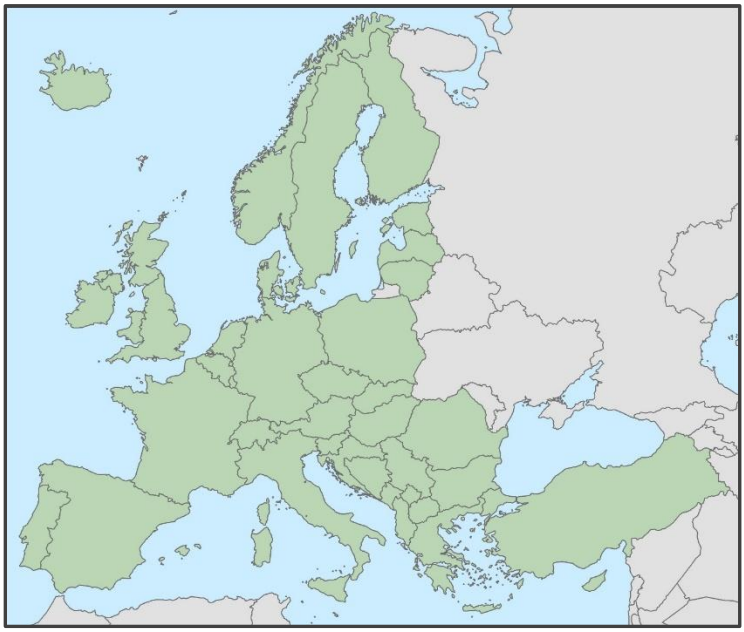

Figure 3: Delimitation of the analysed area. *Source: own editing.*

Regarding **the time scope**, considering that adaptation is a relatively new field (the EU-level strategic frameworks has been recently established and regular national/regional/local planning cycles have only begun since the early 2010s in Europe) the research concentrates on **the period of the last 1-1,5 decades**, comparatively analysing the national level planning and MRE documents of adaptation policy, and results of the first complete MRE cycles from the different states (SÜTŐ, 2025B). As we have already mentioned, **the analysis is static, focusing on the most recent planning documents**. **The collection of materials was closed in August 2025.** NAS, NAP or MRE documents that were published or made available only after that date had not been taken into consideration in the research.

Context of macro regional differences

The most frequent examples of European macro regions in the different literature items or policy documents are basically the results of the traditional Northern/Western/Southern Europe division, complemented with Eastern Europe. The first three macro regions' delimitation is more or less clear. A similar group of countries are classified into these regions in different works. At the same time, Eastern-Europe is a bit odd-one-out. **In my geographical and political-historical delimitation, I basically follow the mixture of the EUCRA and TSP-classifications, with some adjustments** (Table 1).

Table 1: Classification of the analysed countries into macro regions. *Source: own editing, based on EUCRA and TSP 2011.*

Macro regions	Northern Europe	Western Europe	Southern Europe	Eastern-Central Europe
States	FIN, DRK, SWE, ISL, NOR	UK (ENG, SCO, WAL, NIR), IRL, FRA, BEL, NDL, LUX, DEU, CHE, AUT	ESP, PRT, ITA, GRC, TUR, MLT, CYP, MKD, KOS, BIH, ALB, MON	HUN, CZE, SVK, SVN, ROU, BRG, POL, EST, LTU, LTV, SRB, CRO

The Northern, Western and Southern regions are more or less the same as the EUCRA ones. However, in my research, the Eastern region's delimitation is based on Eastern-Central European (Mitteleuropa, Zwischeneuropa, TSP's Central-Eastern region) concepts with greater emphasis on historical and cultural roots, connections and development pathways than on natural environmental issues. I practically complemented the EUCRA's Eastern region, adding the Baltic states and the three southern Slavic countries of the Carpathian Basin (Slovenia, Croatia, and Serbia), plus Bulgaria. I considered other Balkan countries, similarly to the EUCRA, as part of Southern Europe. Another difference is that my Western Europe category comprises even Ireland and the parts of the UK as opposed to the pure climate impact-based EUCRA classification.

Measuring spatial sensitivity

To define the spatial content, or more exactly, the sensitivity to spatial content of the above-mentioned policy planning instruments (planning and MRE documents), or in other words, to measure the degree of spatial approach within them, a new notion/concept, "spatial sensitivity" is introduced by the research. This complex model tries to integrate the most important, utilisable elements of different space interpretations and approaches into an integrative concept (see the dissertation's Annex #2 and Chapter 3.6) (SÜTŐ, 2025B).

Summarising the usability of these different space approaches and interpretations, we can draw the conclusions in the form of an indicative definition for spatiality in adaptation policy planning. So, a **spatially focussed approach,** in our point of view, means the consideration of the spatial/territorial aspects and interpretations listed by the dissertation's Annex #2 and Chapter 3.6. in thinking and activities. **Spatiality in policy making** means the constant and consequent taking of external and internal spatial elements and their geographic characteristics, spatial/territorial differences and spatial order into consideration within the absolute or relative space in the examined activities, namely planning and MRE. In other words, if the examined policy documents, their content, development

directions and actions are significantly influenced by the geographic characteristics, spatially/territorially different natural/social/economic endowments and spatial structures (SÜTŐ, 2024); furthermore, they use some or any of the introduced space concepts and interpretations, which is understood as the presence of spatiality. It means the conscious consideration and analysis of regional differences, the application of a place-based and spatially integrative approach and the setting of spatially tailored objectives and actions for spatial units / region types.

Consequently, we consider **climate adaptation policy activities spatially sensitive** if they put significant weight on spatial dimensions and use any of the introduced space concepts and interpretations both in their evidence seeking phases (during elaboration of situation analyses, climate vulnerability or risk assessments), during decision making (climate adaptation vision- and objective system design and elaboration of adaptation measures), during setting up climate adaptation indicator sets, and conducting evaluations or establishing adaptation-oriented decision supporting systems. If these aspects are at least equal to the weight of the traditional sectoral approach (i.e. separated handling of different thematic fields parallel with each other) or even dominate it, then we can talk about a **spatially oriented approach**, or **spatial sensitivity** of these activities (SÜTŐ, 2025B). It is very important to note that the described connection between the currently observable two main directions of planning logic (the spatial and the prevailing sectoral approach) is not mutually linear: we do not suggest that if we diminish the weight of sectoral approach in adaptation planning and MRE it automatically means that spatial emphases would be growing. Nevertheless, if the consideration of spatial aspects and dimensions is increasing in the above-mentioned activities, it means that the former sectoral focus would diminish, as a matter of course.

Analytical aspects of national adaptation policy planning's spatial sensitivity

The comparative assessment of spatial sensitivity of the analysed countries' national adaptation policy planning was based on a predefined analytical aspect system, applying 7 main factors and for each factor 3-8 (altogether 34) sub-factors (Table 2). The exact methodology has been constantly refined over the last 3 years, articles published during the research show a continuous development (e.g. SÜTŐ, 2025B; SÜTŐ, 2025C). Through the analytical aspects (factors) and sub-aspects (sub-factors) the dissertation compared national-level adaptation planning and MRE-related documents of European countries. The analysis takes a critical lead, offering not just the description of the national characteristics parallel with each other but really compares the different countries' performances (SÜTŐ, 2025B) - the explicit system of analytical aspects serves this comparison.

The identification and selection of the final pool of aspects and sub-aspects followed a logic based on consideration of the available resource materials, the weight of the different phases within the planning cycle and complementary information. Taking into account these parameters, the majority of the analytical aspects concentrates on the strategic adaptation policy planning documents (NASs and NAPs) and their characteristics, dedicating 1-1 main analytical aspect for the situation analyses and the objective systems, 1-1 main aspect for the NASs' general international spatial and geopolitical emphases and for the coherence of these documents with spatial policy priorities. A further main aspect concerns the spatiality of NAP actions. The reason for this is that within the planning cycle the actual planning itself still plays the most crucial role compared to the later phases (implementation, monitoring and evaluation), serving as a foundation of the later steps. Moreover, NAS and NAP documents are more widely available than MRE-related materials in the majority of the countries (mainly in Eastern, Northern and Southern Europe). Monitoring and evaluation are also important parts of the adaptation planning cycle, but they could be considered relatively less developed activities in this field so far, thus get

only one main aspect in the analysis. At the same time, the assessment of the general spatial issues-related sub-aspects (the space phraseology of the documents, the emphasis on lower spatial levels' adaptation actions and planning activities) as well as the MRE- and the inter- and transnational spatial activities-related sub-aspects were based beyond the document analysis on information received from interviews. (Nevertheless interview-based soft information has also been used in the case of analytical aspects #2 and #3 as well) (Figure 4). The

The following Table 2 summarises the analytical aspects, sub-aspects and their disciplinary connections and foundations – thus making connections between the actual analysis and its theoretical base. Through the table, one can follow the internal logic of the analytical aspect system – in case of each sub-aspect the table indicates those disciplines/practical fields, whose main space concepts/interpretations meant the basis of the given analytical sub-factor. The actual list of analytical main and sub-aspects is introduced by the dissertation.

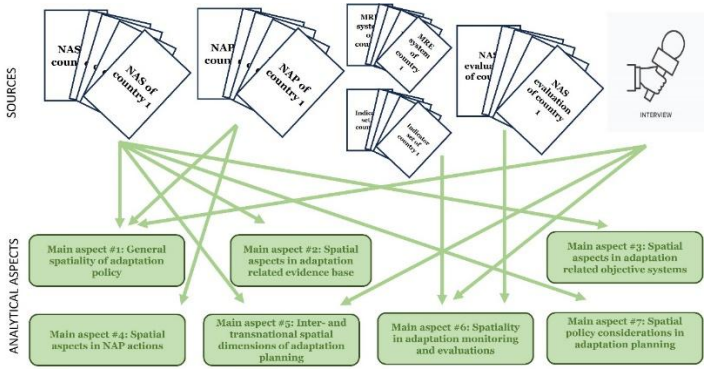

Figure 4: Logic of the empirical work phase: sources and aspects of the comparative analysis. *Source: own editing.*

To complement the document analyses with soft or complementary information, I also conducted a questionnaire-based survey in the form of e-mail interviews targeting adaptation policy professionals, decision makers, planners in the examined countries. Unfortunately, from the 41 states/country parts I approached only 13 (Slovakia, Slovenia,

Romania, Austria, Germany, the Netherlands, Lithuania, Estonia, Poland, France, Türkiye, Sweden, Finland) responded, but at least in their cases the national analyses could work with more nuanced information base. The transcripts of the interviews are presented by the dissertation's Annex #5a. Annex #5b also contains additional interview results from another, related applied research project of mine, from 2020, with useful parts that have been utilised during my phD studies (parts from interviews with adaptation professionals from Wales, the Netherlands, Germany and Switzerland).

As the main outcome, complex spatial sensitivity indicators have been calculated for each analysed country, based on the above-listed aspects. For each sub-factor, a country gets a given value: 5 points if the state were classified in the best, 3 if in the upper-middle, 1 if in the lower-middle and 0 if in the worst category. Attributed to each sub-factor the proper principles/rules of classification were defined in advance to avoid subjectivity as much as possible (SÜTŐ, 2025B).

III. The dissertation's scientific results

Empirical results and conclusions

Altogether 176 documents were analysed during the empirical work phase. Out of these, there were 45 national adaptation strategies or integrated national climate change strategies, 20 operational adaptation action plans, 14 MRE methodology studies and 57 actual monitoring and evaluation reports. After conducting the analysis, the results of the 7 main aspects and their 34 sub-aspects were grouped into 7 main subchapters.

Conclusions by research questions

The research's starting points were the one main and five sub-questions (and the one main and five sub-hypotheses) introduced by the dissertation's Chapter 2.2. and the first main chapter of this thesis booklet. The following pages go through these 1+5 elements, introducing those results of the dissertation that support the responses to the hypotheses and the question raised.

RSQ1: Defining the concept of spatial sensitivity in adaptation policies

The dissertation's comprehensive literature review itself brought several examples to prove the assumption that geographical space and climate adaptation are closely related to each other. Nevertheless, proportion of literature items dealing explicitly with adaptation policy's spatiality is still low.

To answer the first research question, the dissertation also overviewed the most important space-oriented disciplines' and practical fields' different space concepts and interpretations to make proper foundations for the empirical analysis of the weight of spatiality and the emergence of spatial approaches in climate adaptation policy activities. As the dissertation's "*Theoretical framework and literature analysis*" chapter's 3.6. subchapter and Annex #2 describe, during the overview a wide variety of interpretations of relevant disciplines and policy domains emerged: absolute and objective space interpretations of natural sciences and environmental geography; the relative approach of social and economic geography, regional geography and geopolitics; and partly interpretations of those disciplines that focus on internal space concepts, too (political and administrative studies, and partly even the regional studies). On top of these even some practical fields' (regional development policy, strategic spatial, urban and land use planning) spatial approaches and related concepts (territorial cohesion and is sub-concepts) were also examined. To create its own spatial sensitivity definition, the dissertation makes use both of absolutist (the container-like, 3-dimesional space) and relative interpretations (where the relation system between spatial elements is the basic regulator). The former is utilizable in the depiction of the geographical space as the place where climate change processes occur. The relativist approach can be used in the analysis of spatial dimensions as differences and structures, as climate policy monitors different spatial impacts of and adaptive capacities/vulnerabilities to climate change in given territorial units. Vulnerability assessments also use relative space interpretations. The interpretative approach is also remarkable, because adaptation policy crosscuts several sectors, harmonizing different sectoral considerations that

often requires harmonizing the different interpretations of space. Relativist, constructivist spatial approaches also emphasise the relational dimension, regarding space as a direct product of society made up from societal relations. These socially constructed internal and social space interpretations can influence society's practical administrational spatial structures, too. In this regard, the research is interested in the extent to which differences in national adaptation planning and MRE system-building practices in different countries are rooted in national administrative and governmental features. Finally, as the subjects of the research, climate adaptation planning and MRE are practical issues, even applied policy-oriented space interpretations were used (e.g. regional development policy's territorial cohesion-oriented conceptual background) as well as terminologies of the related strategic and spatial planning activities.

The dissertation's 4.1. subchapter summarises the usability of different space approaches and interpretations of the examined disciplines and draws the conclusion in the form of an indicative definition for spatiality / spatial approach in adaptation policy planning and the sensitivity to this spatial approach. In general, spatiality in a given activity can mean the prevalence of the spatial/territorial considerations (focus on spatial elements and geographical endowments; examination of the spatial differences of a given topic and the spatial configuration of a given phenomenon) in the examined approaches, decisions and actions: these are significantly influenced by geographic characteristics, spatially/territorially different natural/social/economic endowments, and spatial structures.

During the research under the term spatiality in policy making, the dissertation understands the conscious, constant and consequent taking of external and internal spatial elements and their characteristics, territorial/spatial differences, and their spatial order into consideration within the absolute or relative space in planning and MRE.

Based on these, the dissertation considers an adaptation policy planning or MRE activity spatially conscious/sensitive, if it puts significant weight on the above-listed spatial dimensions, both in its evidence-seeking phase and decision-making, during the

setting-up of adaptation indicator sets, conducting evaluations and establishing climate adaptation decision-supporting systems. If these aspects are at least equal with the weight of the traditional sectoral approach (i.e. separated handling of different thematic fields parallel with each other) or even dominate it, then we can talk about a spatially oriented approach, or spatial sensitivity of these activities.

All in all, hypothesis #H1: *"The ability of climate adaptation policies to recognise spatially specific (geographical) contexts and to tailor their interventions accordingly can be captured by a common concept"* has proved to be basically true. Although the related scientific and grey literature started to recognise the importance of geographical diversity, they did it mostly implicitly; examples of explicit analysis of climate adaptation's spatiality are still rare. Consequently, to capture the essence of spatiality in climate adaptation policy planning and MRE, the dissertation has developed its own complex spatiality and spatial sensitivity concepts.

RSQ2 Assessing spatial sensitivity in climate adaptation policies

Based on the answer to RSQ1, RSQ2 searched for ways of assessing spatial sensitivity in adaptation policy planning and MRE within the dissertation. The applied solution became a comparative analysis of European national-level adaptation policy planning tools (strategic planning documents, MRE background materials and actual reports, indicator and decision support system descriptions), based on the definition of spatiality and spatial sensitivity and involving a large number of analytical aspects (7 main and 34 sub-factors). The aspects and sub-aspects derive from the different space concepts, approaches and interpretations of the earlier-introduced space-oriented disciplines and fields. The dissertation's "*Material and methods of the empirical research*" chapter's "*Measuring spatial sensitivity*" subchapter presents the logic of the comparative analysis and the disciplinary/thematic roots of its sub-aspects.

The comparisons took a critical lead, providing not just the description of the national characteristics - the use of an explicit

system of analytical aspects (instead of ad-hoc considerations) serves this. The identification and selection of the final pool of aspects and sub-aspects followed a logic based on consideration of the available resource materials, the weight of the different phases within the planning cycle and complementary information. Taking into account these parameters, the majority of the analytical aspects concentrated on the characteristics of adaptation policy-related strategic planning documents. The reason for this is that within the planning cycle the actual planning itself still plays the most crucial role compared to the later phases (implementation, monitoring and evaluation) as planning is still the foundation and basis of the later phases. Moreover, NAS and NAP documents are more widely available than MRE-related materials in the majority of the analysed countries. Monitoring and evaluation are also important parts of the adaptation planning cycle, but they are so far relatively less developed activities in this field – they are represented by 1 main comprehensive analytical aspect in the empirical assessment. On top of the document analysis, the general spatial issues-related sub-aspects (consisting of the space phraseology of the documents, the emphasis on lower spatial levels' adaptation actions and planning activities) as well as the sub-aspects focusing on MRE activities and inter- and transnational dimensions were based partly on information received from questionnaires/e-mail interviews.

The composite indicator was calculated on the basis of the analytical sub-aspects: at the end of the analysis spatial sensitivity of national adaptation policies has been measured by an aggregated indicator, calculated by adding the scores corresponding to the classification for each sub-aspect of a given country together. Best categories meant 5 points; upper-middle categories 3; lower-middle categories 1; the lowest and irrelevant categories 0 points in each sub-aspect.

As for hypothesis #H2 *"Spatial sensitivity of national adaptation policy activities can be examined and measured by the analysis of their instruments"*, the dissertation in itself is the positive answer: it elaborated a complex, comprehensive analytical aspect system to conduct the comparative assessment of European countries' national adaptation policy planning

activities, offering a solution to examine and measure the sensitivity of adaptation planning and MRE instruments to spatial issues.

RSQ3: The extent of spatiality emerging in European national adaptation policy instruments

The basis of the calculation was the sum of the values of all the analytical sub-aspects in each country. Medium-level category means values above 75 points; weak-medium-level category 51-75 points; weak category 26-50 points; insignificant category 25 points and below. Maximum available points in the whole comparative analysis: 170 (Figure 5).

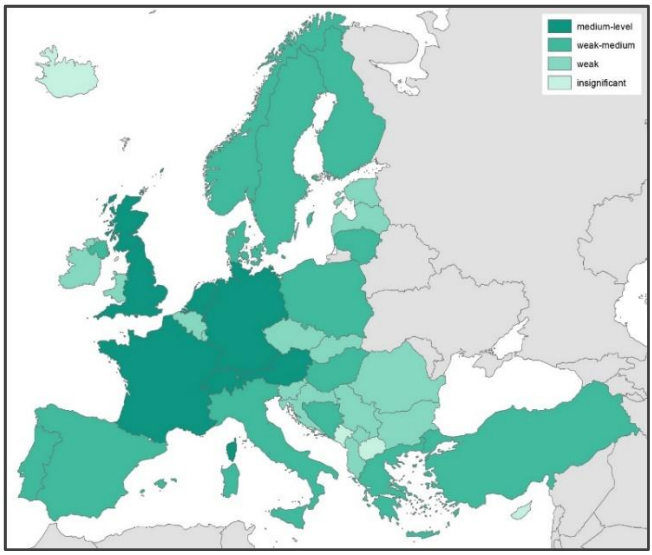

Figure 5: Aggregated spatial sensitivity of the analysed countries' adaptation policy planning and MRE. *Source: own editing.*

The overall answer is that spatiality is emerging in European national adaptation policy instruments to a limited extent. To describe the situation in a more detailed way, basically weak results can be registered. Even the best-performing states of the analysis show only medium-level results (from the maximum available 170 points, the best-performing Austria reached 97 points, its direct followers in the ranking stand between 76-84

points) - that is around 50 (+/- 8) % performance at maximum. These outcomes verify that in European national adaptation policies the sectoral approach still prevails.

Out of the analytical aspects, general spatiality (space phraseology, general policy planning logic, active role of spatial levels and propagation of lower-level planning activities in adaptation) and coherence with European /domestic national spatial development policy objectives performed generally better. However, the spatial performance of the NAS situation analyses, objective systems and NAP actions, the international spatial/geopolitical outlooks and MRE activities' spatiality aspects showed only a few very good country examples, while the majority of the countries performed mediocre or weak.

Altogether, hypothesis #*H3* "*Sensitivity to spatial dimensions emerges in national adaptation policy instruments in Europe, but to a limited extent*" proved to be true. Sensitivity to spatial dimensions emerges in national adaptation policies indeed, but in a varied degree, mostly only implicitly and with low weight.

RSQ4: The main determining factors of national adaptation policies' spatial sensitivity

The research in its 4th step also tried to identify the main determining factors of adaptation planning and MRE tools' spatial performance, by comparing the values of the elaborated spatial sensitivity composite indicator to other social/economic/geographic/spatial administration-related or spatial planning-/adaptation planning-/vulnerability-related indices to identify whether geomorphologic, natural geographic, social or economic characteristics or spatial or adaptation policy-related issues' influence is the strongest driving force. Although the correlation analysis did not bring exclusively significant results, some basic conclusion can be drawn (Table 2). The strongest influencing factors of national adaptation policy making' spatial performance are the indices of spatial governance, experiences in adaptation planning, and the combined climate vulnerability-preparedness of a given country, indicating the traditions and level of development both in spatial organisation; adaptation policy-related planning and the general climate risk-exposure of a state. But even these

indices show at maximum above-than-medium-level connection with the spatial sensitivity indicator. These indices are followed by physical (population, size and complex vulnerability of the country) or social indices (HDI) showing weaker-than-medium level connections. Summarily, similarly to the results of former studies in the field (SWART, 2009; GREIVING&FLEISCHHAUER, 2010 AND 2012; LEITNER, 2021), the national level adaptation policy strategies (and, according to my results, MRE-related documents), still do not show significant national characteristics and spatially tailored approaches, rather follow a uniformed, sector-oriented logic. Spatial sensitivity/performance of national level adaptation policy planning activities seemingly depends more on individual national circumstances and environment of climate policy planning than on physical endowments, geographical characteristics or climatic trends, let alone the degree of economic or social development. The most determining factors could be the different approaches, attitudes of planner groups and communities and the level of institutionalization of adaptation planning or spatial administration forms in a given country.

So, hypothesis #*H4: "Geographical characteristics of European countries fundamentally influence the spatial sensitivity of national adaptation policies of states"* has proved to be only partly (or rather barely) true: though some physical, geographical characteristics show weaker-than-medium level correlation with the spatial composite indicator of the analysis; the most decisive factors seem to be the type of spatial administration, the development level of adaptation policy planning and the combined vulnerability-preparedness of the state.

Table 2: Correlation matrix of spatial sensitivity composite indicator of European national adaptation activities and the potential determinants. *Source: own editing. Medium blue cells: stronger-than-medium-level connection; light blue cells: weaker-than-medium-level connection; white cells with bold italic numbers: the strongest weak connections; general white cells: weak or lack of connection.*

	spatial sensitivity	*country size*	*nr. of climate regions*	*population*	*pop. density*	*degree of urbanization*	*GDP/ capita*	*GINI-index*	*pop. with tertiary edu.*	*HDI*	*Life expectancy at birth*	*spatial gov. type*	*spatial planning sector's type*	*nr. of adapt. pl. cycles*	*% of renewable energy in e. prod.*	*comb. vuln. & readiness score*	*complex vuln. score*	*climate-rel. econ. losses*
spatial sensitivity	1,000																	
size of the country	**0,460**	1,000																
nr. of climate regions	0,174	0,458	1,000															
population	**0,470**	0,767	0,325	1,000														
population density	-0,163	-0,173	-0,190	0,046	1,000													
degree of urbanization	0,046	0,241	-0,118	0,090	0,309	1,000												
GDP per capita	0,154	-0,005	-0,038	-0,045	0,148	0,475	1,000											
GINI-index	-0,010	0,227	0,048	0,293	-0,133	-0,213	-0,224	1,000										
pop. with tertiary education	0,223	-0,055	-0,335	-0,107	0,042	0,212	0,399	0,126	1,000									
HDI	**0,405**	0,136	-0,092	0,144	0,197	0,561	0,652	-0,585	0,306	1,000								

	spatial sensitivity	*country size*	*nr. of climate regions*	*population*	*pop. density*	*degree of urbanization*	*GDP/ capita*	*GINI-index*	*pop. with tertiary edu.*	*HDI*	*Life expectancy at birth*	*spatial gov. type*	*spatial planning sector's type*	*nr. of adapt. pl. cycles*	*% of renewable energy in e. prod.*	*comb. vuln. & readiness score*	*complex vuln. score*	*climate-rel. econ. losses*
Life expectancy at birth	***0,308***	0,177	0,059	0,166	0,302	0,489	0,564	-0,407	0,333	0,737	1,000							
spatial gov. type	**0,616**	0,147	0,222	0,233	0,059	0,225	0,164	-0,227	0,157	0,526	0,411	1,000						
spatial planning sector's type	***0,285***	-0,014	-0,152	-0,084	-0,140	0,195	0,352	-0,399	0,399	0,510	0,260	0,303	1,000					
nr. of adapt. planning. cycles	**0,595**	0,247	-0,029	0,397	-0,021	0,030	0,182	0,001	0,114	0,259	0,104	0,308	0,426	1,000				
% of renew. energy in e. prod.	0,186	-0,029	0,081	-0,172	-0,247	0,256	0,361	-0,101	0,039	0,327	0,208	0,198	0,334	0,059	1,000			
comb. vuln. & readiness score	**0,528**	0,091	-0,144	0,047	0,025	0,493	0,560	-0,353	0,783	0,850	0,637	0,581	0,717	0,383	0,350	1,000		
complex vulnerability score	**-0,465**	-0,079	0,063	-0,066	-0,082	-0,386	-0,441	0,258	-0,683	-0,669	-0,652	-0,550	-0,444	-0,255	-0,102	-0,832	1,000	
climate-related econ. losses	***0,362***	0,282	0,194	0,689	0,119	0,064	0,038	0,074	-0,046	0,225	0,161	0,352	0,093	0,464	-0,090	0,198	-0,195	1,000

RSQ5: Macro-regional characteristics in spatial sensitivity performances of states

The last part of the empirical work phase directly dealt with the issue raised by the fifth RSQ, but actually already the earlier analytical results (the calculation of the spatial sensitivity composite indicator and the ranking of the European countries according to it) gave proper response to the question. In the comparative analysis the strongest spatial performances of national adaptation policies emerged in the traditionally outstanding spatial and adaptation policy planner *Western-European* (*Austria, The Netherlands, Scotland, France, Germany, Switzerland, England*) states, thanks to the great emphases they put on subnational level adaptation activities and their balanced, above-average performance throughout the entire comparative analysis. These states are also go-ahead ones with the development or operation of their adaptation MRE systems. In the second best group *Northern* and *Western-European* countries (*Sweden, Norway, Finland, Denmark, Northern Ireland*) appear, too; together with *Eastern-Central* (*Hungary, Poland, Lithuania*) and *Southern-European* (*Spain, Portugal, Greece, Türkiye, Italy, Bosnia*) states, due to their relatively well-performing NAS situation analyses (Easterners), or international spatial outlook and coherence with European/national spatial development policy objectives (Southerners, Westerners).

On the other side of the scale, the weakest performances can be experienced in the *South-eastern European* (*North-Macedonia, Montenegro, Albania, Kosovo, Bulgaria, Romania*) and smaller *Southern-European* countries (*Malta, Cyprus*), with some surprisingly weak results from other macro regions. E.g. *Iceland* emerges here, thanks to its quite basic and narrow-contented NAS – although in the recent years serious development initiatives started in the field of MRE and GIS-based decision support in the country; or the exceptionally sectoral-minded *Luxemburg*. At the same time, these are mostly smaller (Luxemburg) or geographically homogenous (Iceland) states where consideration of spatial differences

within the national frameworks is not the first priority of adaptation planning.

Altogether, although the macro regional position of a given country does not directly influence the spatial performance of adaptation policy planning activities, nevertheless, some geographical pattern can be experienced in the spatial sensitivity of national adaptation policies within Europe. These results (even if we take into consideration some surprising out-of-line performances) only underline the well-known Northwest-Southeast divide in Europe in economic and social development and historical/political development pathways; no unexpected research results have come up in this case.

The three variance analyses conducted also show that there is connection between the different macro regional categorisation of the examined states and their adaptation policies' spatial performance. Altogether all 3 categorizations (EUCRA, TSP and the dissertation's own) have a significant effect on the spatial sensitivity composite indicator values of the countries, a fact shown by the p values. Similarly, the F statistics, comparing the factors of the total deviation are bigger than 1 in all cases, with the highest value shown by the EUCRA classification, followed by my dissertation's classification and the TSP categorization.

Moreover, after a remark came up in the internal thesis discussion three complementary cluster analyses were conducted, too, to analyse, whether there are any joint movement between given countries regarding the different main aspects of the comparative analysis. The cluster analyses' results finally showed that beyond the general and mediocre-level macro-regional determinations no clear groups of countries can be clearly identified showing strong correlation in their given analytical aspect-specific performances beyond few similarly strong situation analysis- or action planning-related results from countries with totally different geographical positions and historical development pathways.

It means that, as for the feedback to hypothesis #H5 *"Some macro-regional differences can be identified in the presence of spatial sensitivity in European countries' national adaptation policy activities due to their differences in policy culture with*

better performances of Western/Northern European countries", the dissertation's results verified this assumption.

Main RQ: The extent of spatial sensitivity in national climate adaptation policies of European countries

According to my results, the main research question of the dissertation is basically answered positively: based on the elaborated analytical aspect system for the comparative assessment of European national climate adaptation policy planning instruments, there are some signs of sensitivity to spatial issues/dimensions in the analysed documents/activities. According to the literature review, studies and articles have started to deal with the topic, but mostly implicitly. However, the actual emergence of spatial emphases in climate adaptation policy planning and MRE activities has not or only barely been analysed so far. The dissertation takes the first steps in this direction, showing that, according to its analysis, there are definite traces of spatial considerations in the national level adaptation planning and MRE documents.

However, these traces of spatial content are mostly weak and implicit. The vast majority of the analysed countries showed weaker-than-medium level or simply weak results in their composite indicator value. Nonetheless, there is at least one or a few states that perform well (in cases even outstandingly) in each analytical sub-aspect, which fact indicates that, according to some national planners, spatial considerations are by no means useless or pointless, futile ingredients of the strategic planning, monitoring or evaluation activities in climate adaptation. On the contrary, in such a geographical space-oriented horizontal field as climate adaptation, the adequate taking into account of spatial/geographical dimensions provides the proper basis of effective policy decisions.

Nonetheless, the general outcome of the research is that these spatial considerations and sensitivity to the use of them are basically weak. The experience of the interviews just underlined these lessons learned: the interviewees /those professionals who responded to the questions/ although theoretically recognising the importance of spatial issues, believe rather in the omnipotence of sectoral planning.

Consequently, the result regarding to the main hypothesis "*Due to the importance of geographical space and spatial differences/structures in climate adaptation, sensitivity to spatial considerations emerges in national adaptation practices across Europe*" is positive, with the slight emergence of spatial considerations in national adaptation planning and MRE in Europe, as the empirical work phase's outcomes proved that. However, the mostly weaker-than-average or simply weak national results of the comparative analysis indicate that several further steps are needed in this field in the future.

Conclusions of the dissertation

Regarding the whole dissertation, the first and basic message of the material is unambiguous, and coherent with the works of other related authors (e.g. QURESHI, 2019; EEA, 2020; BIRCHALL & BONNET, 2021; OECD, 2023): climate change is one of the key global challenges of our era (if not the greatest; but at least we can say it is part of that system of challenges that compose the multilayered structure of global crises of the present time). The topic of climate change has been gathering more and more attention and is getting into the centre of attention within general development policy, and parallel with this process, climate adaptation has come to the fore within climate policy during recent decades. At the same time, the two main pillars of the climate policy approach (the geographical) space in significantly different ways. While, mitigation seeks international, supranational cooperation-based answers to a global problem, then adaptation requires explicitly spatially tailored responses to special local/regional challenges (climate impacts and their economic, social or physical environment-related consequences). Therefore, we presume that effective climate adaptation cannot exist without the consequent and constant taking of geographical and spatial aspects into consideration.

The strategic planning-related instruments of climate adaptation policy (actual strategic planning, monitoring, reporting, evaluation and decision support system-development) could help to find these spatially defined solutions, facilitating the implementation of actual practical

place-based adaptation interventions at different spatial levels. These basic spatial levels of adaptation planning and MRE stand out clearly if we examine adaptation activities more closely: municipalities and micro regions / regions represent the subnational level; while the national level mainly coordinates and supports these lower ones. There are also signs of adaptation-oriented cooperations and activities at the macro regional level, but the main emphasis lies on the national and subnational ones.

In the last one and a half decades, an increasing number of literature items has dealt with adaptation activities of these spatial levels in Europe, one of the leading continents of adaptation policy. However, a definite research gap takes form here: though several literature items concentrate on the challenges, methodologies or results of adaptation activities at these spatial levels, particularly at the local one, the actual examination of the presence/weight of spatial dimensions in these activities is lacking or barely appears in the scientific research activities.

My dissertation tries to be among those studies/analyses that take the first steps in this relatively new field. The foundations of my research logic come from approaches of spatially oriented disciplines and policy fields: the space concepts and interpretations of these have been examined/synthesized to compose a new analytical concept of spatial sensitivity of climate adaptation policy planning. The dissertation analysed according to this framework the spatial performance of national-level adaptation policy planning instruments in 38 European countries. To implement this task, a set of analytical criteria was set up, analysing the national adaptation policy planning activities' general spatial approach, the national adaptation strategies' spatial performance throughout their situation analyses, visions and objective systems, the emergence of inter- and transnational spatial dimensions in them and their coherence with European and national level spatial policy priorities. The analytical aspect system covers also the appearance of spatiality in national adaptation action plans' measure systems, and spatial emphases in the monitoring and

evaluation methodological background documents and actual monitoring and evaluation reports of the analysed countries.

To summarise our findings, basically we can say that the spatial sensitivity/performance of national-level climate adaptation policy planning and MRE activities depends more on individual national circumstances and climate policy planning environment than on physical endowments, geographical characteristics or climatic trends, let alone the degree of economic or social development. The most important determinants might be the different approaches and attitudes of different planner schools, planning workshops, institutions responsible for these tasks in a given country, together with spatial administration forms, and level and type of institutionalisation of adaptation policy in a given state. This is not good news, because it calls our attention to the eventuality of national spatial awareness, and the chances to improve this situation are in question, to say the least. On the other hand, if we consider the fact that spatial sensitivity of adaptation planning and related activities is almost independent from any crucial national geographic/economic/social factors, this makes the possibility theoretically to strengthen these geographical and general spatial dimensions anywhere, in any country's planning; if the political and professional willingness for such a development direction is available.

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