ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

CASE STUDY REPORT //

ESPON-TITAN Territorial Impacts of Natural Disasters

Dresden Region

Final Report // June 2021

This Applied Research is conducted within the framework of the ESPON 2020 Cooperation Programme, partly financed by the European Regional Development Fund.

The ESPON EGTC is the Single Beneficiary of the ESPON 2020 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States and the Partner States, Iceland, Liechtenstein, Norway and Switzerland.

This delivery does not necessarily reflect the opinions of members of the ESPON 2020 Monitoring Committee.

Coordination:
Carolina Cantergiani, Efren Feliu, TECNALIA Research & Innovation, Spain

Authors
Mark Fleischhauer, Polina Mihal, Maren Blecking, Pauline Fehrmann, Stefan Greiving, Technnische Universität Dortmund, Germany

Advisory group
Project Support Team: Adriana May, Lombardy Region (Italy), Marcia Van Der Vlugt, Ministry of the Interior and Kingdom Relations, Spatial Development Directorate (the Netherlands)

ESPON EGTC: Zintis Hermansons (Project Expert), Caroline Clause (Financial Expert)

Acknowledgements
This case study was supported by interviews with and feedback from the following regional stakeholders whom we would like to thank for their cooperation: Peter Seifert (Regionaler Planungsverband Oberes Elbtal/Osterzgebirge), Dr. Uwe Müller (Sächsisches Landesamt für Umwelt Landwirtschaft und Geologie), Andreas Rümpel (Landeshauptstadt Dresden, Feuerwehr), Dr. Christian Korndörfer (formerly Landeshauptstadt Dresden, Umweltamt).

Information on ESPON and its projects can be found at www.espon.eu.
The website provides the possibility to download and examine the most recent documents produced by finalised and ongoing ESPON projects.

ISBN: 978-2-919816-06-4

Layout and graphic design by BGRAPHIC, Denmark

Contact: info@espon.eu

ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

CASE STUDY REPORT //

ESPON-TITAN Territorial Impacts of Natural Disasters

Dresden Region

Final Report // June 2021

Table of contents

List of figures

Abbreviations

APA	Aktionsplan Anpassung (German Adaptation Action Plan)
CCA	Climate Change Adaptation
DAS	Deutsche Anpassungsstrategie (German Adaptation Strategy to Climate Change)
DIN	Deutsches Institut für Normung (German Institute for Standardisation)
DRM	Disaster Risk Management
ECP	Energy and Climate Programme of the Free State of Saxony (Energie- und Klimaprogramm des Freistaates Sachsen)
EU FRMD	EU Flood Risk Management Directive 2007/60/EC
FBC	Federal Building Code (Baugesetzbuch, BauGB)
FRPA	Federal Regional Planning Act (Raumordnungsgesetz, ROG)
HQ_{100}	100-year flood (flood event that has a 1 in 100 chance)
$HQ_{extreme}$	Extreme flood event (EHQ)
KLSR	Karte der Erosionsgefährdung in Abhängigkeit von Bodenart, Hanglänge, Hangneigung und Regenerosivität (Map of the risk of erosion depending on soil type, slope length, slope inclination and rain erosiveness)
LEP	Landesentwicklungsplan (Saxon State Development Plan)
LfULG	Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (Saxon Office for Environment, Agriculture and Geology)
OEOE	Oberes Elbtal/Osterzgebirge (Upper Elbe Valley/Eastern Ore Mountains)
REGKLAM	Regionales Klimaanpassungsprogramm Modellregion Dresden (Regional climate adaptation program, model region Dresden)
ReKIS	Regionales Klimainformationssystem (Regional climate information system)
RPV	Regionaler Planungsverband (Regional Planning Association)
SächsBRKG	Sächsisches Gesetz über den Brandschutz, Rettungsdienst und Katastrophenschutz (Saxon State Law on Fire Safety, Emergency Services and Civil Protection)
SächsFwVO	Sächsische Feuerwehrverordnung (Saxon Regulation on Fire Fighters)
SME	Seismology Network for Earth Observation in Central Germany (Seismologie-Verbund zur Erbebenbeobachtung in Mitteldeutschland)
SMEKUL	Seismologie-Verbund zur Erbebenbeobachtung in Mitteldeutschland (Seismology Network for Earth Observation in Central Germany)
UFZ	Umweltforschungszentrum
WEREX	WETTREG version adapted to the Federal State of Saxony
WETTREG	Wetterlagen-basierte Regionalisierungsmethode (Weather situation-based regionalisation method)
WHG	Wasserhaushaltsgesetz (Water Management Act)
ZSKG	Zivilschutz- und Katastrophenhilfegesetz (Civil Defence and Disaster Relief Act)

1 Introduction

The area of the Dresden case study is located in the federal state of Saxony, in the East of Germany. It is identical with one of the four planning regions of the federal state, the Upper Elbe Valley/ Eastern Ore Mountains ("Oberes Elbtal/ Osterzgebirge"). Eponymous for the whole region are the Eastern Ore Mountains and the upper valley of the river Elbe which traverses and shapes the whole area. The planning region consists of the counties of Meißen ("Landkreis Meißen") and Saxon Switzerland-Eastern Ore Mountains ("Landkreis Sächsische Schweiz-Osterzgebirge") and the capital of the federal state, the city of Dresden ("Landeshauptstadt Dresden"). A German county ("Landkreis") is a territorial authority and the primary subdivision within federal states. Formally it belongs to the local level as it is a local government association composed of a number of municipalities. The Dresden case study region, compare Fig. 1, borders directly on the Czech Republic in the East, the federal state of Brandenburg in the North, the counties of Bautzen in the North-East and the counties of Central Saxony and North Saxony in the West and South-West (cf. RPV OEOE n.d.).

Fig. 1: Overview of the planning region Upper Elbe Valley/ Eastern Ore Mountains and its counties (RPV OEOE n.d.b)

The Upper Elbe Valley/ Eastern Ore Mountains is the smallest Saxon planning region in terms of area, it covers a territory of 3,440 square kilometres, but is meanwhile the most densely populated region with roughly 300 inhabitants per square kilometre. Approximately 800,000 people live in the agglomeration of Dresden and about one million inhabitants in the entire planning region (cf. AG REGIONALVERBÄNDE n.d.). The number of inhabitants of the agglomeration of Dresden and adjacent municipalities is predicted to rise in future while for peripheral areas population losses are expected (cf. RPV OEOE n.d.). The high population density in general, but principally the contrasting developments of Dresden and the periphery are and will be challenging for regional planning (cf. AG REGIONALVERBÄNDE n.d.).

Fig. 2: Overview of the planning region, displaying elevation layers, major towns and the course of the river Elbe (RPV OEOE n.d.)

The landscape of the region is characterised by great diversity (compare Fig. 2). In the north-west are lowlands and primarily agricultural areas, whereas the southern part is mountainous due to the Eastern Ore Mountains and the Saxon Switzerland. Besides, the latter is the German part of the Elbe Sandstone Mountains, which partly belong to the Czech Republic. The river Elbe runs through the region from South-East to North-West. Furthermore, some notable industries have settled down in the region. In Dresden and its surroundings, the largest site of European semiconductor industry can be found and in Nünchritz on the Elbe is the largest chemical site in Saxony (cf. RPV OEOE n.d.). Further, Dresden is home to various higher education facilities and research and development institutions while in the county of Saxon Switzerland-Eastern Ore Mountains small precision engineering and metal processing companies can be found (cf. EUROREGION ELBE LABE 2020).

2 Main characteristics of the administrative structure and planning system

In accordance with the federalist principle of the German constitution, the authority of the state is subdivided between the national level ("Bund"), also referred to as Federation, and sixteen federal states ("Bundesländer"), which have their own individual constitution, legislation and state authority. Generally, it can be distinguished between three governmental as well as administrative levels and the spatial planning system is organised through legally determined distribution of responsibilities and tasks between these levels. Hence the German planning system is decentralised. Since 2006, the Federation has received competence in spatial planning in the context of concurrent legislation (formerly framework legislation) (cf. ARL 2020). On the national level, not legally binding spatial development principles ("raumordnerische Leitbilder") and strategic planning schemes ("Leitbilder") exist which function as the basis for future development and planning at the federal state level and superordinate specifications in terms of sectoral planning (cf. GREIVING 2006). Spatial planning, however, must consider decisions from sectoral planning authorities with spatial significance, e.g. the designation of protected areas under water law or the designation of legally fixed floodplains that result in a general ban on the development of construction projects.

Spatial development plans ("Raumordnungspläne") at the state level ("Landesentwicklungsplan") and at the regional level ("Regionalpläne") are required for the management of land-use policies and need to be drawn up by the federal states according to the Federal Regional Planning Act (FRPA – "Raumordnungsgesetz") (cf. GREIVING et al. 2006). Both plans define principles and goals of spatial planning, which have a legally binding effect for all authorities on all administrative levels, hence for the federation, the federal state and the municipalities. Therefore, in the federal state of Saxony the "Saxon State Development Plan" ("Landesentwicklungsplan", LEP) is issued at federal state level. On this basis the four regional planning authorities of Saxony (planning regions of Leipzig-Westsachen, Chemnitz-Erzgebirge, Oberes Elbtal/Osterzgebirge, Oberlausitz-Niederschlesien) draw up regional plans and concretise the general objectives and principles according to the regional specialities and an evaluation of the current state of nature and landscape as well as the regional development (cf. SÄCHSISCHES STAATSMINISTERIUM FÜR REGIONALENTWICKLUNG n.d.). Regional planning is prioritised over sectoral planning, in particular over water management, as its objectives have to be considered and included in spatially significant planning measures and procedures. By means of the regional level a link between a state-wide perspective on development and decisions that influence the local level is established. In addition to this top-down element of spatial planning, the German planning system is also characterised by the so called "principle of countervailing influence" (also: mutual feedback principle) which means that local, regional and supra-regional planning each influences, and in turn is influenced by, the other levels of planning (cf. GREIVING 2006; ARL 2020).

At the local level, urban land-use planning is the most important tool for the guidance and organisation of urban development in Germany. The formal process consists of two stages and is legitimised in the Federal Building Code (FBC – "Baugesetzbuch"). The preparatory land-use plan ("Flächennutzungsplan") is drawn up for the entire municipal territory and determines the land-use of areas, for instance for public infrastructure, the built environment or for measures to protect, preserve and develop the environment and landscape. Based on this, the detailed land-use plan ("Bebauungsplan") is created which is legally binding and regulates in which manner properties may be developed and, in this context, how to deal with areas that need to be kept free from development. Usually these two plans are drawn up at a scale of 1:500 – 1:5,000 (cf. GREIVING 2006), but as some of the Saxon municipalities grew in size the scale of their land-use plans decreased. For instance, the city of Dresden issues plans at a scale of 1:15,000 (cf. LANDESHAUPTSTADT DRESDEN 2019: 27).

3 Hazard profile and economic impacts of past natural disasters in the Dresden region

The **flooding** risk for the planning region Upper Elbe Valley-Eastern Ore Mountains is above average on the one hand due to flash floods in mountain streams in the Ore Mountains, which are tributaries to the Elbe, and on the other hand due to flooding of the Elbe itself. As for both risks a future increase is expected, the planning region is challenged to take preventive measures to this, especially because the residents along the major river courses are frequently affected by floods (cf. BMVBS 2013b: 95). In the past the case study area was affected by severe floods of the Elbe.

- In 2002, the Elbe and its tributaries burst their banks and an area of 40,000 ha was flooded in Saxony. 21 persons lost their lives, 110 were injured, 21 dikes broke, and approximately 800 km of public roads and more than 25,000 residential buildings have been damaged (cf. UNDINE n.d.). Private and public buildings and infrastructure were damaged, such as streets, bridges, residential buildings, hospitals and schools but also companies and hence their employees were affected (cf. NATURGEFAHREN SACHSEN n.d.). In the aftermath of the flooding, environmental pollution has been detected. As a result of the Elbe flood in August 2002, pollutants were released from contaminated sites in the Elbe catchment area and contaminated sediments were remobilised as well as industry areas were flooded and mineral oil from leaking fuel tanks was distributed over a large area (cf. STADT DRESDEN n.d.a). It was the most severe event in Saxony in the past decades and caused an economic loss of approximately 1.8 billion Euros (of which 1.35 billion in the city of Dresden).
- The monetary loss due to the 2010 flood mainly occurred along the eastern tributaries to the river Elbe and accounted roughly 850 million Euros. Apart from the abovementioned sectors and infrastructures, also drinking and sewage systems, water bodies and cultural heritage were affected (cf. LFULG 2013: 170).
- When the river Elbe stepped over its banks in 2013, a damage of 560 million Euros occurred in the area of the case study region. Major damage was done to water infrastructure like dikes, dams and reservoirs (250 million Euros) and residential buildings (approximately 170 million Euros). Notified economic losses in the agricultural and forestry sector were significantly lower (cf. SÄCHSISCHE STAATSKANZLEI 2013: 12f.).

Drought is a hazard of increasing importance in Saxony, as the summers of 2018, 2019 and the very dry spring of 2020 already had significant impacts on agriculture and forestry. For the federal state of Saxony several drought related problems and impacts have been recorded. Some Saxon villages, which are relying on own wells had difficulties regarding the supply of fresh water (cf. MÜLLER 2020). The whole planning region is affected by droughts. The agricultural productivity in Saxony has been affected negatively as considerable yield losses were registered. The inflow in dams decreased extremely and the fall of groundwater levels is predicted to continue. Moreover, droughts lead to the worst bark beetle infestation in Saxon forests since 1947 (cf. KLIMA SACHSEN n.d.).

In general, on any steeper slope **landslides**, rock falls or rock avalanches can occur, therefore in Saxony in the low mountain range regions and the Elbe valley the risk is particularly higher. A speciality are mining regions, because when cavities in the subsoil collapse and masses of soil, roads and sometimes buildings are torn down, massive craters are left behind. Although this risk cannot be completely ruled out, in the past no dangerous sinkholes have been recorded (cf. NATURGEFAHREN SACHSEN n.d.). Moreover, the Saxon State Office for Environment, Agriculture and Geology (LfULG – "Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie") states that more than half of the arable land within the federal state is already at high risk of **erosion** (cf. LFULG 2010 & LFULG n.d.).

In the northern part of Saxony areas with the highest risk of **forest fires** can be found due to low amounts of annual rainfall, continental climate features, water-permeable sandy soils and vast territories with easily inflammable pine trees (cf. WALD SACHSEN n.d.). According to the classification of forest fire hazard in Saxony, the risk is low in the county Saxon Switzerland-Eastern Ore Mountains, medium in the more southern

city of Dresden and high in the northern located county of Meißen (cf. WALD SACHSEN n.d. & GREIVING 2006: 61f.). Apart from forest fires, all forestry districts in Saxony have been affected by **windstorms**. For instance, in 2007 the storm "Kyrill" lead to more than 1.8 million cubic meters of broken and thrown wood in Saxon forests. A number, which roughly corresponded to the annual average amount of felling. Subsequent damage by bark beetle infestation and renewed storms in the near future seem to be unavoidable (cf. MARTENS n.d.). Further, the area of the Großenhainer Land within the county of Meißen was affected by a tornado in 2010 with peak velocities of 250 km/h. One person lost its life, 50 were injured and 61 had to evacuated as their houses were severely damaged. The total monetary loss due to the damage of private and public buildings, industries, urban infrastructure and green spaces was estimated 100 million Euros (cf. MDR SACHSEN 2020).

The **extreme precipitation** behaviour in Saxony was analysed and evaluated on the basis of daily precipitation within a one kilometer grid between 1961 and 2015. It was revealed that the occurrence frequency and the medium intensity of extreme precipitation events had increased within 70 percent of the federal state's territory. Moreover, evidence has been found for the intensification of convective heavy rainfall (cf. LFULG 2017: 30).

The case study region itself is hardly prone to **earthquake** hazards. Hence the seismic hazard in the entire planning region is rather moderate. However, in the federal state of Saxony, the Vogtland, which is approximately 120 km south-west of the case study region, is one of the four most seismically active regions in Germany. Typical for the Vogtland are swarm earthquakes, which are characterised by a sequence of seismic activities/earthquakes occurring in a certain area within a relatively short period of time. A major earthquake in 1985 accounted a magnitude of 4.5 on the Richter scale and lead to cracks in masonry and buildings. In 2011 was the latest major earthquake with a magnitude of 4.0 on the Richter scale (NATURGEFAHREN SACHSEN n.d.).

The research has shown that the case study area is affected by several hazards, primarily by floods and droughts. Detailed information on economic losses could merely be found for floods. Even there the processing was difficult, as within the data on economic impacts no distinction was made regarding the case study area and the entire state of Saxony. Hence, a general lack of (regional) information on impacts and by natural hazards, especially economic ones became apparent.

4 Disaster risk management in the Dresden region

4.1 General remarks

In line with the federalist principle of the German constitution, the federation only owns framework competences regarding risk assessment and risk management. Instead the executive power is at the federal level, whereas the federation concentrates on spatial observation, for instance of long-term trends like demography or environmental issues. Since 2009 risk assessment is legally included in the Civil Defence and Disaster Relief Act (ZSKG - "Zivilschutz- und Katastrophenhilfegesetz") and in line with § 18 ZSKG the Federation cooperates with the federal states and a nationwide, interdepartmental risk analysis in civil protection is conducted. In addition to that, a method for risk analysis in civil protection and a guideline on risk analysis in civil protection ("Leitfaden Risikoanalyse im Bevölkerungsschutz") has been developed. The latter primarily for those experts in counties and larger cities (so called "county-free cities") that have been assigned with the task of analysing hazard scenarios. Due to the guideline framework conditions regarding the detailed procedure of the analysis and evaluation of hazard control are regulated. Thus, it serves as a test for the coping capacities of general hazard prevention and disaster control (cf. BBK n.d.).

4.2 Disaster Risk Management

The LfULG, the Saxon State Office for Environment, Agriculture and Geology, is in charge of the detection of potential **flood** source areas according to § 76 SächsWG ("Sächsisches Wassergesetz" – Saxon Water Act) and those areas that are defined as areas for improving water retention in the regional plan (cf. RPV OEOE 2020a: 104). The consideration of flood source areas as a water law category, which already intended to counteract the occurrence of floods, was a special matter in Germany and unique for Saxony until flood retention areas were considered at national level in 2018 in line with § 78d WHG (Water Management Act - "Wasserhaushaltsgesetz") (cf. SÄCHSISCHES STAATSMINISTERIUM DES INNEREN n.d.a: 8).

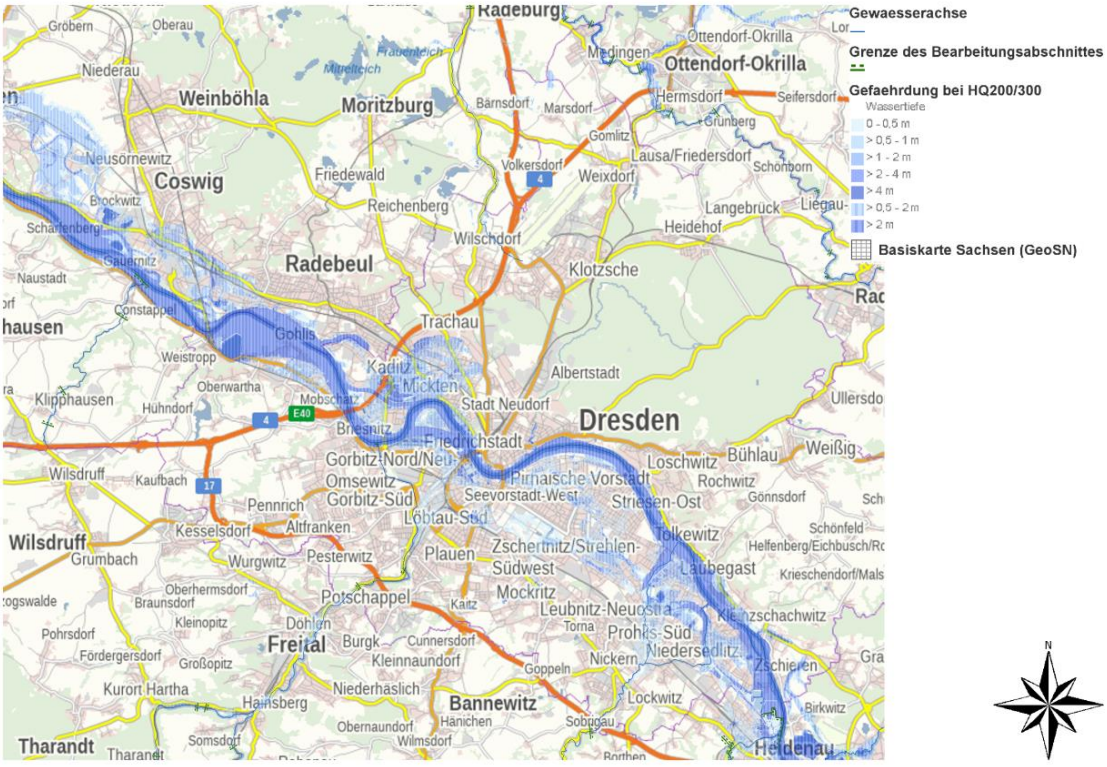

Fig. 3: City of Dresden and its surrounding area during a flood event with a return period of 200/ 300 years. Excerpt from an interactive flood hazard map for the federal state of Saxony (UMWELT SACHSEN 2020)

The Saxon State Flood Control Centre ("Landeshochwasserzentrale") observes water levels and critical changes are immediately reported to the counties and municipalities, who are in charge of flood prevention. For smaller rivers flood warnings for at least six to twelve hours notice or for the Elbe 48 hours in advance are possible (cf. WASSER SACHSEN n.d.a). After the floods in 2002 and 2010 the water level monitoring systems has been technically improved and extended (cf. KIRCHBACH et al. 2013). Early and accurate information and warnings are necessary to initiate effective flood defence measures. In order to support this, all responsible public and private institutions must work closely together (LFULG 2013: 178). Moreover, flood hazard and flood risk maps are created according to the implementation of the EU Flood Risk Management Directive 2007/60/EC (EU FRMD). The former illustrate the hazard for contiguous settlement areas alongside watercourses, while it can be chosen between extreme floods and different statistical recurrence intervals in years, ranging from 20 to 300 (compare Fig. 3 for a flood event with a return period of 200 to 300 years). A detailed report entails a description of specific local situations for the respective municipality with a scale of 1:5,000. Therefore, flood hazard maps can be used for local construction planning or operational flood defence (cf. LFULG 2019b). The latter, flood risk maps, display not only the aerial extent of flooding/affected area, moreover they contain information on variables like water depth or flow velocity (Article 73 III WHG). Hence, at least major industrial installations have to be included in such maps as they can pose a threat to human health and the environment in the case of a flooding event (cf. LFULG 2019a). At local level, the pilot project "Municipal Flood Information Maps and Municipal Hazard Zone Maps" was adapted for five cities, amongst others Radebeul and Meißen which belong to the case study region. The resulting maps and information should be useful for urban land-use planning and enhance municipally coordinated recommendations for actions (cf. GRÄFE 2010).

In Saxony different steps are undertaken in order to assess **droughts**. A comprehensive overview of the status quo of knowledge regarding meteorological, agricultural and hydrological drought indices and monitoring was carried out in 2014. In addition, an applicability assessment of data requirements and significance was conducted. The results of those two assessments were then brought together and converted into statements on dry indices in Saxony and a concept for improved recording and characterisation of droughts in terms of climate change impacts was developed. Moreover, since 2018 the atmospheric framework conditions concerning droughts will be examined alongside new climate projections for Saxony (cf. UBA 2019a) and the UFZ Leipzig, a research institution, provides drought monitoring information for Saxony (cf. MÜLLER 2020). As droughts are a hazard of increasing importance, the corresponding management and information system was regularly advanced throughout the last years. Additionally, a so-called Basic Conception Water Supply has been drawn up (cf. ibid).

At federal state level, the individual seismic services and further local networks are in charge of investigations and the collection of data (cf. GREIVING 2006: 59) regarding **earthquake/seismic hazards**. The Seismology Network for Earth Observation in Central Germany (SMEKUL - "Seismologie-Verbund zur Erbebenbeobachtung in Mitteldeutschland") is a collaboration of individual seismological observatories and institutions. For instance, they have set up a monitoring network with more than 50 stations with automatic evaluation of the gathered data and publish reports on earthquake monitoring in Central Germany every three years. The LfULG is head of the SMEKUL and in charge of the coordination between the several observatories and is also the contact point for governmental and public authorities (cf. LFULG n.d.b). For the Vogtland region, famous for its swarm earthquakes, the SMEKUL cooperation established a geodetic monitoring network (cf. ibid). Information about seismic hazards is provided by the geological surveys of the federal states. Saxony is one of the few German federal states in whose territory earthquake danger zones are located and for which maps have been developed as a binding planning basis. Such earthquake zone maps have been developed for a few Saxon municipalities (including the Erzgebirgskreis), subdividing the area into earthquake zones one or two according to the German standard DIN 4149:2005-04 (cf. SÄCHSISCHE STAATSKANZLEI 2012 & GFZ n.d.).

As a national legal basis for dealing with **landslides** is missing in Germany, the Engineering Geology Department of the Saxon State Office for Environment, Agriculture and Geology maintains a database for mass movements. The events are all registered with a GIS link and serve to record mass movements respectively geological hazards like rock avalanches, landslides or debris flows etc. The database is then used for further engineering-geological evaluations like for instance the creation of hazard warning maps (cf. LFULG 2013: 160). As part of a research project of the LfULG to evaluate the Saxon hazard in terms of karstification and subrosion processes as well as the practical implementation for spatial planning requirements. The outcome was a hazard warning map of karstification and subrosion-prone areas (cf. LFULG n.d.a).

Different **erosion** hazard maps have already been created by the LfULG, showing the extent to which the soil can be affected by erosion due to heavy rainfall. For the evaluations various impact factors have been considered, which determine the extent of soil erosion. The KLSR map displays the erosion risk on the basis of a function with the variables soil type, slope inclination and rain erosivity (potential of a rainfall to cause soil erosion), while others show steep slopes or runoff path that are particularly prone to erosions (cf. SMEKUL n.d. & BRÄUNIG 2013). Further, an interactive online erosion portal can be used by the Saxon citizens to draw attention to the topic of soil erosion (cf. SMEKUL n.d.).

An analysis and evaluation of the Saxon **extreme precipitation** behaviour was conducted on the basis of daily precipitation in a one-kilometer grid for the period from 1962 to 2015. Heavy rain events were defined by local 90 to 95 percentiles in the reference period from 1961 until 1990, as it was defined by the World Meteorological Organization (cf. UBA 2019a).

4.3 Disaster risk management on the regional level

4.3.1 Emergency response

In §3 SächsBRKG is stated that the State of Saxony, the counties and larger county-free cities are the responsible bodies for **disaster control and emergency response**. The civil protection authorities are organised on three different levels: The State Ministry of the Interior is the highest authority for fire protection, rescue services and disaster control. In charge of upper fire protection, rescue services and disaster control are three provincial directorates, analogous to this the lowest level is controlled by the counties and larger county-free cities (cf. SÄCHSISCHES MINISTERIUM DES INNEREN n.d.b). An Integrated Regional Control Centre for Fire and Rescue Services, responsible for fire defence and protection, emergency rescue, disaster relief, ambulance services, civil protection and management of emergency calls is operated by the Dresden Fire and Disaster Protection Office. This institution is responsible for all events related to the abovementioned tasks within the territory of the county-free city of Dresden and the counties of Meißen and Saxon Switzerland/Eastern Ore Mountains, thus also for the case study area. The Saxon Regulation on Fire Fighters (SächsFwVO –“ Sächsische Feuerwehrverordnung”) as well as the Saxon State Law on Fire Safety, Emergency Services and Civil Protection (SächsBRKG – “Sächsisches Gesetz über den Brandschutz, Rettungsdienst und Katastrophenschutz”) serve as the basis for fire protection and defence. The latter legislation was drawn up aiming to emphasise the synergies, networking and cooperation of all involved parties, such as emergency services and civil protection joined under the umbrella of a single operations centre. Cross-border interaction with the Czech Republic and Poland is common, since several Saxon municipalities are adjacent to the two countries (cf. COR 2016: 28f.; KORNDÖRFER 2020).

4.3.2 Water management

The WHG is the primary legal framework for disaster risk management (DRM) regarding floods. It is affirmed and implemented in accordance with the federal states water acts (in Saxony the Sächsisches Wassergesetz – SächsWG) with the common goal of determining procedures and responsibilities for the designations of flood zones (cf. GREIVING et al. 2006). These designations (usually HQ_{100} water level) have a strong binding effect and have to be taken into account by regional planning. In addition to these designations (made by lower water authorities), regional planning can contribute to flood risk management in areas beyond the HQ_{100} water level, based on flood risk maps. In accordance with § 74 WHG flood risk maps have to be drawn up for all areas that are significantly prone to floods pursuant to the requirements of the EU FRMD. Such maps shall indicate potential adverse flood-related impacts in the affected areas (cf. LFULG 2019a). Principles that are binding for spatial planning in terms of regional planning are laid down in section 2 FRPA and flood protection is mentioned in § 13 V 2d FRPA. In line with this legal norm regional planning and regional plans must contain provisions for preventive flood protection. Especially regional development plans should include provisions on the spatial structure, for instance to realise open space to ensure preventive flood prevention (§ 13 V 2d FRPA).

4.3.3 Regional planning

In Germany, regional planning is the most decisive spatial planning level regarding risk management. Regional planning can have manifold positive contributions to preventive risk management, ranging from the identification of spatially significant risks and their technical containment to risk management strategies and screening processes (cf. BMVI 2015: 30). Main purpose of preventive risk management is the identifi-

cation of hazards and vulnerabilities as well as the assessment of risks that are relevant for spatial planning or to which extent hazards can have an effect on spatial planning relevant threats. Overall, risk management aims to avoid and reduce risks that are relevant for spatial planning and to develop measures in order to enhance the adaptation to the impacts of potential events (cf. GREIVING 2011). Regional plans contain special obligations and are binding for urban land-use planning. In accordance with § 1 No. 6 Federal Building Code, natural hazards have to be considered in land-use planning at local level, whenever it is necessary as special attention shall be paid at general requirement for living and working conditions, which are conductive for health and safety or the people at home and at work. Further, public and private interests shall be duly weighed while preparing land-use plans (cf. § 1 No. 7 FBC).

The most commonly used instrument is the designation of certain areas for risk mitigation within regional planning that unfold binding effects for local land-use as well as sectoral planning. A distinction between three different types is made:

- Firstly, priority areas ("Vorranggebiete") are designated for particular regionally important functions, thus they exclude other regionally relevant uses in this area when they are inconsistent with the priority functions (§ 8 Par. 7 Nr. 1 FRPA), amongst others the exclusion of human settlements within flood plain areas. As priority areas are weighed in a definite manner, they represent goals of spatial planning that are finally set. Priority areas are thus the strongest of these three spatial planning instruments.
- Secondly, by the designation of space as restricted areas ("Vorbehaltsgebiete") special importance is attached to certain regionally important functions, balancing with competing spatially significant uses (for instance in the case of potentially threatened areas behind dikes or dams). However, the restricted areas have not yet been weighed in a definitive manner and are therefore only to be considered in the weighing process when making decisions at the lower planning levels and are not to be strictly observed. Restricted areas shall be considered in subsequent planning, review and approval processes (§ 8 Par. 7 Nr. 2 FRPA).
- Thirdly, suitable areas ("Eignungsgebiete") are areas suitable for certain spatially significant actions or uses in the exterior area under planning law (§ 35 FBC) and preclude these land uses elsewhere in the planning area (§ 8 Par. 7 Nr. 3 FRPA).

The coordination of spatially relevant planning and measures is a task of the state and the federal states create spatial development plans for their territory. Moreover, in almost all federal states regional development plans for smaller areas, dividing the territory in regions, which are called regional plans, must be drawn up according to § 8 FRPA. Depending on the federal state, regional planning can be under responsibility of the federal state or under responsibility of associations consisting of local/municipal members. The federal state of Saxony has delegated the task of drawing up spatial development plans for parts of its territory to four regional planning associations that are formed by the local/municipal authorities. The regional planning association Upper Elbe Valley/Eastern Ore Mountains („Planungsverband Oberes Elbtal/Osterzgebirge") is the responsible authority for regional planning in the area, consisting of the city of Dresden and the counties of Meißen and Saxon Switzerland/Eastern Ore Mountains. It was founded in 1992 in accordance with the provisions of the first Federal State Regional Planning Law in Saxony ("Landesraumordnungsgesetz") (cf. AG REGIONALVERBÄNDE n.d.). The association is organised in an association assembly, planning committee and the chairman of the association plus two substitutes (cf. RPV OEOE n.d.). On the basis of legal regulations, the tasks of the regional planning association include amongst others spatial observation or the creation and updating of the regional plan as well as the monitoring of the environmental impacts connected with its implementation. Additionally, they participate in the preparation of the regional development plan and in the preparation of programmes and plans of the sectoral authorities. Advice is given by them to private and public planning institutions regarding their plans and measures. Furthermore, the cross-border cooperation with spatial planning authorities in the neighbouring Czech Republic is on their agenda plus the coordination with regional planning associations (cf. RPV OEOE n.d. & AG REGIONALVERBÄNDE n.d.).

The regional planning association Upper Elbe Valley/ Eastern Ore Mountains started to work on a new approach to deal with flood risk during the final months of the Interreg project ELLA in 2006 (BBSR n.d.). After that the planning association has dealt more intensively with flood precaution regarding priority and reservation areas, because within the planning region more and more high-quality buildings should be realised on flood plain areas and therefore concerns grew that the damages would be more severe than ever before in case of a future extreme flood event (cf. RPV OEOE 2020a). On grounds of this, a novelty

in terms of planning methodology for the designation of flood prevention areas was introduced by the regional planning association. They decided to no longer designate such areas based on occurrence probability and rather do it on the basis of the hazard intensity, while considering parameters like flow velocity or water depth. Further, extreme flood events will be taken for orientation instead of hundred-year floods and priority areas can be designated in the inner zone of the municipality. The juridical feasibility of such a procedure was examined and approved with the constraint to not impose blanket building bans in the inner zone. Consequently, the new methodology was implemented in the updated regional plan for the Upper Elbe Valley/Eastern Ore Mountains and inter alia it became mandatory in detailed land-use plans to build adapted to floods in priority areas. An inspection order was brought on the way for areas in municipalities where the water height during flood events will rise above four metres and the implementation will be accompanied by intensive educational work (cf. BMVBS 2013c). In the meantime, the methodology has been changed. The legally binding regional plan now defines reservation areas ("Vorbehaltsgebiete") with the function of "adapting (land) uses – high hazard" ("Anpassung von Nutzungen – hohe Gefahr"). These are in general based on an extreme flood event ($HQ_{extreme}$, EHQ) with water depths of 2 m, but also include areas with shallower depths, if these, e. g., are caused by landfill. This change in the methodology for identifying the reservation areas was a decisive new quality to overcome the patchwork of several heterogeneous water depth maps (SEIFERT 2020).

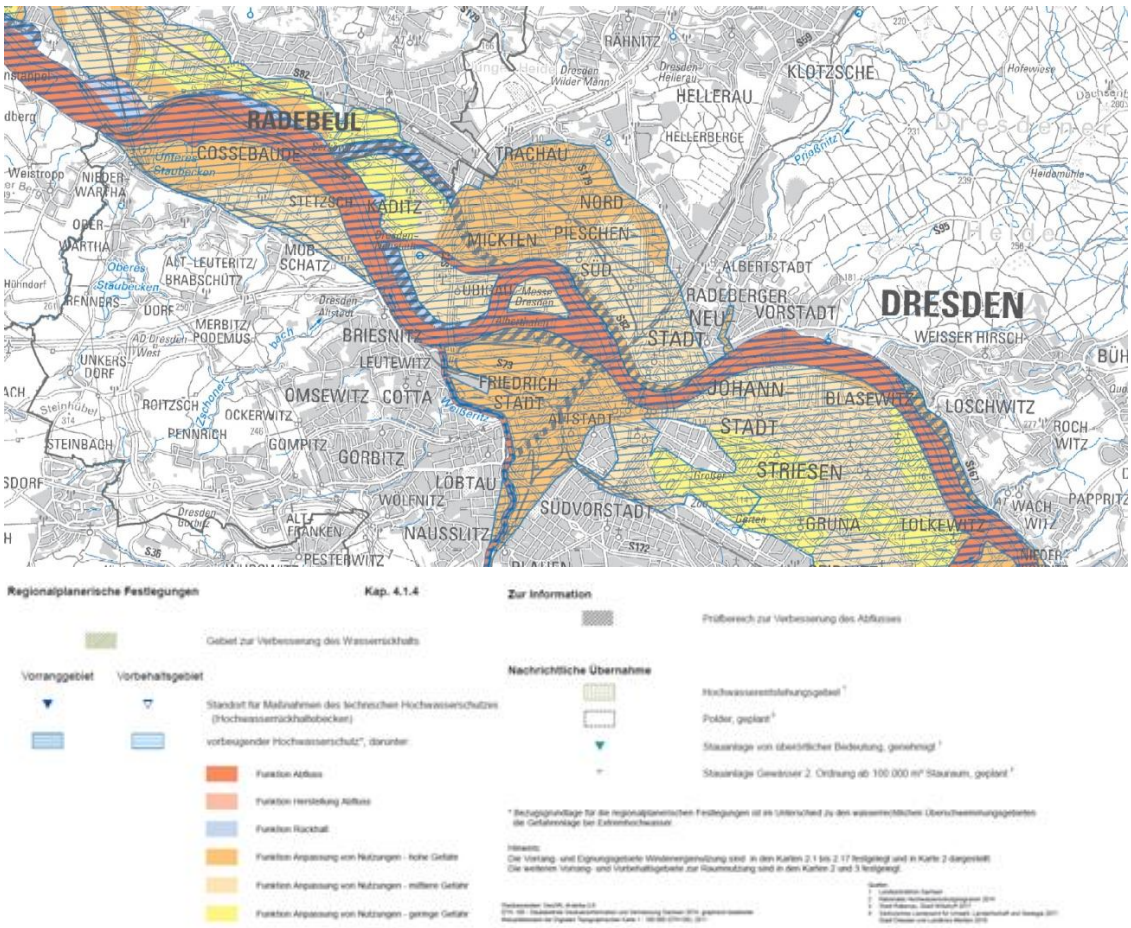

Fig. 4: Preventive flood protection in the area of the city of Dresden. Excerpt from regional development plan of the planning region Upper Elbe Valley/ Eastern Ore Mountains (RPV OEOE 2020b)

In detail, the aforementioned new multistage concept with regard to preventive flood protection consists of four precautionary stages: 1. natural retention of water in the catchment area, 2. technical retention by water-retaining technical installations, 3. water retention in flood plains and 4. the adaptation of uses in flood plains. The application of the aforementioned concept on the river Elbe, results in the fact that almost 60 percent of flood plains areas, expected in the event of an extreme flood, are designated as priority and reservation areas for the functions "runoff", "production of runoff" and "retention". The other flood plains are designated as reservation areas for the function "adaptation of uses - high/ medium/ low hazard". Overall, the impact of the concept is more extensive than a combination of flood and risk areas related to water

law, as the largest possible extent in the respective catchment areas is subject to the designation of reservation areas for runoff and retention in settlement areas. This was evaluated as legally compliant by the licensing authority (RPV OEOE 2020a: 105ff. & SEIFERT 2020). Fig. 4 shows an excerpt from the regional plan with priority and reservation areas (hatchings), their decisive functions (colours) and their validity for settled areas in the area of the city of Dresden and its surroundings.

Based on flood hazard and flood risk maps the respective federal state authorities establish flood risk management plans (§ 75 I WHG), which contain all measures necessary for the management of flood risk and non-structural measures should be explicitly included, where they are needed. The flood in 2002 was a crucial event for the genesis of Saxon flood risk management. In the aftermath of the event flood protection concepts were drawn up for the Elbe as federal waterway and 1st order watercourses. Flood hazard maps were also included, and the flood protection concepts were the basis for all actions regarding the implementation of flood protection measures and the information of the population alongside the floodplains of the watercourses. Hence, very important basic principles of flood risk management were already implemented and active in Saxony before the mandatory introduction of the EU FRMD (GERBER et al. 2016: 383f.). Nevertheless, the need for implementing the EU FRMD helped to back the arguments of water management authorities and environmental management units to support flood protection and management, especially at the local level (cf. KORNDÖRFER 2020).

Apart from the abovementioned steps and measures, various projects were conducted in order to enhance DRM with regard to floods. The Interreg III B project ELLA focussed on the creation of a transnational applicable strategy for future steps and contents of spatial planning in the Elbe catchment area for preventive flood protection. It was a cross-border project between, amongst others, Germany and the Czech Republic (cf. WASSER SACHSEN n.d.b). As a part of the ELLA project the interactive and informative hazard map INGE was developed for the municipal flood protection (cf. MÜLLER 2020). Furthermore, shortly after the Elbe flood in 2002 the regional initiative Weißeritz-Regio was formed due to the severe impact the flood had on the area along the water course of the Weißeritz, a tributary of the Elbe. Embedded in the overall strategy of Saxon flood protection ("Gesamtstrategie des sächsischen Hochwasserschutzes") the initiative aimed in particular at self-provision, flood prevention and communication with potentially affected persons (cf. SMUL 2007: 26). However, this regional initiative is no longer active these days.

The federal states are authorised by the WHG to issue statuary ordinances regulating the reduction of agricultural land erosion and the reduction of adverse impacts on water bodies, as agriculture is of particular importance for flood risk management (§ 78 V 2 WHG, cf. UBA 2011: 49). Regional planning concepts are developed in order to protect the topsoil from water erosion. In order to achieve this, runoff paths and steep slopes have to be identified and investigated (cf. HOLZWEIßIG 2013). According to sectoral planning authorities in such areas, which are under the threat of erosion, only measures for permanent greening or reforestation would enable successful rehabilitation of the soil. This is included in the regional development plan as a requirement and a mandate for action was issued to the regional planning authorities based on the Saxon State Development Plan so they can designate these areas and formulate corresponding specifications (cf. UBA 2011: 43).

In Germany, earthquakes only have to be considered at the level of building permits. The so-called "DIN 4149" is a special technical building standard for areas under threat and was developed by the German Institute of Construction ("Deutsches Institut für Bautechnik"). Along with the DIN comes a probabilistic earthquake map with a scale of approximately 1:4,500,000 that subdivides Germany into earthquakes zones, ranging from 1 to 4, reflecting the mathematically determined probability of the occurrence of an earthquake of a certain magnitude in a certain area (cf. LFULG n.d.b). However, no specific legal basis regulating the coping with earthquakes in spatial planning exists in Germany (cf. GREIVING et al. 2006). The geological survey of Saxony is consulted during the preparation of regional and land-use plans. Neither seismic activities in general, nor earthquakes in particular are included in the regional plan of the case study area. With respect to the selected case study area and the regional plan existing there, it has to be noted that seismic activities and earthquakes are not included in this regional plan of the planning region Upper Elbe Valley/Eastern Ore Mountains. This is the case, because risk management activities are only related to building permissions, which are granted on the basis of the aforementioned DIN 4149. When constructions are particularly vulnerable, additional norms have to be applied, for instance a standard norm for dam systems like DIN 19700 by which also safety standards against extreme events are prescribed (cf. MÜLLER 2020). But Saxon municipalities located in areas prone to earthquakes do refer in their detailed land-use plan to the fact that construction must be carried out in accordance with the earthquake-compliant building standards of Germany (cf. STADT LENGENFELD n.d.).

5 Climate change adaptation in the Dresden region

5.1 General remarks

Long-term observations have shown that in the past 50 years a continuous warming in all seasons took place in Saxony with an increased heat load in summer. Further, the frequency and intensity of extreme precipitation accelerated (cf. UBA 2019a). According to calculations of the WEREX climate model for the federal state of Saxony, the mean annual temperatures will rise in future by two to three degree Celsius until 2100, especially in winter. Also the amount of dry- and heat days will increase, while the mean annual precipitation is predicted to decrease by 10 percent in general and by 40 percent during summer months. For the planning region Upper Elbe Valley/Eastern Ore Mountains itself, so far a climate change impact assessment has not been carried out. However, the region was part of the REGKLAM project, which developed an integrated regional climate adaption programme, based on a regional climate change analysis (PROJEKT REGKLAM n.d.). Further, sectoral analyses from the federal state's environmental agency (cf. LFULG 2020) as well as the results of the neighbouring planning regions Leipzig-Western Saxony and Upper Lusatia-Lower Silesia can be transferred to approach changes due to climate change impacts. The changes of the meteorological parameters will also influence qualitatively and quantitatively the groundwater. Consequently, the ecosystem will be affected and changes in the land-use patterns become inevitable (cf. RPV OEOE 2020a).

5.2 Climate change impact assessment

The WETTREG-Model ("WETTerlagen-basierte REGionalisierungsmethode) is one of the four most important regional climate models in Germany and is used at national level. Known data from local climate stations is statistically associated with data from large-scale weather situations. Due to this, relationships between global and local climate variables can be projected and analysed (cf. UBA 2019a). At the level of the federal state of Saxony, the most validate modelling can be generated by the use of the climate model WEREX. It is the Saxon version of a WETTREG-model and enables pre-dictions/forecasts until 2100 (cf. RPV OEOE 2020a: 38; 175).

Possible future climate developments and their consequences can be assessed, and the possible consequences can be used for the preparation and evaluation of regional adaptation strategies and local adaptation measures such as spatial land-use units, inter alia agricultural or structural areas (cf. UBA 2019a). In addition to the WEREX-model exists the regional climate information system ReKIS ("Regionales Klimainformationssystem") which is an interactive tool for the professional provision, documentation, interpretation and evaluation of climate data and information of the federal states of Saxony, Saxony-Anhalt and Thuringia. Maps and graphics are available and tools for the analysis and the processing of climate data or evaluation tools can be used.

Moreover, an update of ReKIS is pursued by one of the listed strategies of the action plan of the Saxon ECP (Energy and Climate Programme of the Free State of Saxony - "Energie- und Klimaprogramm des Freistaates Sachsen"), and the cross-border cooperation with Poland and the Czech Republic as well as with other federal states shall be enhanced. Another project, running from 2008 until 2016, is KLIWES ("Auswirkungen der prognostizierten Klimaänderungen auf den Wasser- und Stoffhaushalt in den Einzugsgebieten der sächsischen Gewässer") with which the impact of climate change for Saxony on water and material balance in the catchment areas of its water bodies is assessed. Calculations of the water balance for the current status and under climate and land use scenarios can be generated for the whole federal state of Saxony. To achieve this, results from climate models like WEREX are linked with water balance models and models for the simulation of material flows (cf. UBA 2019a).

Saxon climate impact monitoring is one activity amongst many others of the action of the latest version of the ECP. The way for monitoring was paved in 2012 and indicators on climate impacts for the topics of biodiversity, agriculture, forestry, water management and soil were introduced. Status indicators supplemented the other indicators, describing the climate development in Saxony. Indicators from the non-environmental sector and on adaptation measures will be added in future.

However, it is not clear whether this monitoring is taken into account at regional level. Further, similarities with the monitoring within the framework of the national adaptation strategy DAS can be found (cf. UBA 2019a). Moreover, a vulnerability assessment for the whole federal state of Saxony, not only for the selected case study area, has been conducted in 2015.

5.3 Climate change adaptation

At national level, the German Adaptation Strategy to Climate Change (DAS - "Deutsche Anpassungsstrategie an den Klimawandel") was introduced in 2008 as a political and legal framework for climate change adaptation. Possible consequences of climate change in various fields are presented within the document and there from options for action are derived. Thus, it serves as a basis for a medium-term process aiming at enhanced resilience in Germany to the effects of climate change while simultaneously reducing the vulnerability of society, economy and environment and maintaining or even increasing the country's adaptive capacity. On the one hand spatial, regional and urban land-use planning and on the other hand civil protection and disaster control are focussed in the DAS as cross-cutting topics (cf. UBA 2018). In addition to the DAS, the Adaptation Action Plan (APA - "Aktionsplan Anpassung") was adopted in 2011 with concrete measures to support the strategy. The DAS progress report was published in 2015 (followed by an update in 2020) and adopted together with the Second Action Plan on Adaptation. In the latter document both current and future measures for dealing with climate change and its impacts are presented. It was drawn up by several federal ministries and beyond that federal states, municipalities, science and other social actors were involved (cf. UBA 2019b).

In 2011 the so-called Climate Protection Amendment (Law on the promotion of climate protection in the development of cities and municipalities - "Gesetz zur Förderung des Klimaschutzes bei der Entwicklung in den Städten und Gemeinden") came into force and by this a climate protection clause was added to the Federal Building Code in order to enhance climate-friendly urban development (cf. § 1a V FBC). Both urban development measures that meet the requirements of climate protection and adaptation to climate change are meant by this (cf. BMVBS 2013a: 71). The climate protection amendment of the German FBC makes clear that municipalities are responsible for climate adaptation at local level. In the amendment the planning objective of sustainable urban development is outlined and climate protection as well as adaptation are brought into urban land-use planning (cf. § 1 V FBC). Furthermore, climate protection and climate change adaptation (CCA) have to be equally weighed out alongside other concerns in planning considerations (cf. §1 V 1 FBC). In general, regional planning and land-use planning authorities have instruments at hand to integrate adaptation measures into spatial planning. Most important is the opportunity to designate the use of certain areas within inner zone of a municipality with binding effects for both local land-use as well as sectoral planning (cf. GREIVING 2010: 9f.).

The basic document for CCA policy in Saxony, the ECP, was adopted in 2013. The programme is a combination of climate protection and adaptation to climate change and contains a medium-term plan for energy and climate policy until 2020. An action plan is included in the Annex of the ECP, featuring measures in the field of climate adaptation. A renewed version is scheduled for 2020 and an overview of the status quo of Saxon adaptation can be found in the publication "Climate change in Saxony – we adapt" (2015) (cf. UBA 2019a & SMEKUL 2012). Apart from this, in the State Development Plan Saxony, published in 2013, principles and objectives for spatial planning and development are set out and links to CCA exist. Additionally, the development of regional climate adaptation concepts is recommended, and the so-called climate check is integrated into obligatory environmental reports. Those reports examine the contribution of the Saxon State Development Plan (Landesentwicklungsplan, LEP) concerning support and relief of rural development regarding the impacts of climate change in terms of precautionary adaptation. Statements made by the LEP are used to update regional plans as a planning framework (cf. UBA 2019a). One activity of the action plan of the ECP is the climate impact monitoring which has been initiated in 2010. With the help of such a monitoring climate-related changes can be identified and monitored at an early stage and can be used, amongst others, for goal orientated planning and implementation of CCA measures and strategies (KLIMA SACHSEN n.d.).

Several other projects, like the following ones, are from importance regarding the assessment and/or adaptation to climate change impacts in the case study region or entire Saxony. In 2015 a vulnerability assessment has been conducted in Saxony. Within the REGKLAM project (2008-2013) an integrated regional climate adaptation programme for the model region Dresden was developed and tested. The project area is mainly identical with the case study area, but adjacent parts of the counties of Bautzen and Central Saxony with the city of Freiberg were added. Different stakeholders from science as well as public and

private institutions collaborated (e.g. Dresden Groundwater Research Centre e.V. or Leibniz Institute for Ecological Spatial Development). They evaluated climate trends, developed possible scenarios for the future and derived adaptation measures from these, which can/should be implemented in future. The project was subdivided in four packages and the fourth one aimed at the coordination of regional actors and informational events for citizens (cf. PROJEKT REGKLAM n.d). Another approach was the model project KLIMAfit (2009-2011), which concerned the area of the case study respectively the area of the regional planning association Upper Elbe Valley/Eastern Ore Mountains. It was one out of eight German model projects of regional planning ("Modellvorhaben der Raumordnung") in order to develop strategies and concrete actions to tackle climate change (PROJEKT KLIMAFIT 2011). Apart from that, a cooperation exits within the framework of a work group on climate change impacts ("AG Klimafolgen") that brings experts from the Saxon State Ministry for Energy, Climate Protection, Environment and Agriculture and the Saxon State Ministry of the Interior together. In addition, authorities, universities and research institutes joined their forces in form of the climate network Saxony ("Klima-Netzwerk Sachsen") to strengthen their existing successful relation by coordinating their activities more precisely. It is a think tank dealing with future-oriented questions regarding the topic of regional climate change. Proposals for future strategies and their influence on the development of Saxony are discussed (cf. UBA 2019a).

All in all, it does not become clear what data is available and used in the case study area. Regarding the projects no information can be found whether and how the implementation into practice has been successful. Also, it remains vague whether the results of the climate impact monitoring were further processed and used. The same applies to the integrated climate adaptation programme, which has been drawn up during the REGKLAM-project and it is doubtable if it has been implemented. One good practice example is the strategy of the ECP action plan with the update of ReKIS, as the transboundary and regional networking between the actors shall be improved. In addition to that, another strategy aims at securing the regional planning objectives for CCA in the context of updating the Saxon State Development Plan (cf. UBA 2019a).

6 Vertical and horizontal cooperation system in DRM and CCA in the Dresden region

Generally, several cooperation could be identified within this case study. For instance, the Integrated Regional Control Centre for Fire and Rescue Services is operated by the Dresden Fire and Disaster Protection Office and responsible for the whole case study region and coordinates the emergency response in case of an extreme event. Moreover, they also cooperate across the border with the Czech Republic. In the past, several further cooperation between Saxon municipalities and districts that are adjacent to Poland or the Czech Republic have been established and intensified (cf. CoR 2016). The city of Dresden maintains transnational contacts in manifold ways, for instance due to the Euroregion Elbe/Labe, with relevant Czech waterboards and with further private and public stakeholders. In addition, the City of Dresden and the Czech water management authority Povady Labe at Hradec Kralove signed a contract that allows local authorities in Dresden to directly get access to flood-related data from upstream the river Elbe. Thus, important preconditions and requirements for cross-border disaster risk management and spatial planning are made due to the mutual exchange of information and agreements (cf. RPV OEOE 2020a: 17f.). However, the research has shown that the majority of the cooperation take place with regard to flood risk management or flood prevention and to a wide lesser extent for other hazards.

As the municipal level is in charge of regulating building areas and determining the land use in flood plain or catchment areas, they are key players of preventive DRM. However, flood protection is often one point amongst others and entails financial disadvantages for the municipality or causes conflicts with profit-driven private investors or developers. Consequently, its priority is only as high as the restrictions of land use, given by the water authority, are rigid. Nevertheless, the need for an adaptation of the way of implementation becomes quite evident, because in fact, risk reduction could be a very strong instrument through spatial planning (cf. DKKV 2004). Further, sectoral planning authorities provide information on flood hazards to local planning departments. In turn, the departments pass the information on to potential property buyers, whenever land is sold and store it by a registration in a real estate cadastre (cf. Müller 2020).

Digitalisation seems to be a driving force for enhancing the cooperation between different levels and general data availability. Private and local authorities as well as households are to some extent involved in the DRM process due to interactive online tools. Several informative hazard mapping applications exist, for instance the interactive map for municipal flood protection INGE, which improve the data availability and user-friendliness. It has to be noted that the majority of such interactive tools is only available for floods. Nevertheless, also some tools also exist for other hazards, such as the RAINMAN toolbox, which was developed to support municipalities and regions to cope with the hazards of heavy rain and to mitigate heavy rain risks as far as possible (cf. Müller 2020). Moreover, the application iDA (“Interdisziplinäre Daten und Auswertungen”) grants access to interdisciplinary data and evaluations of environmental data and map stocks. The collected data originates from specialist information systems and from measurement and investigation programmes of the LfULG (cf. Ibid; Umwelt Sachsen n.d.).

The research on the case study area has shown that formal agreements are beneficial in order to achieve sustainable and effective cooperation that are going to last long. But to revive such co-operations an atmosphere must exist that is filled with personal connections, mutual trust and that encourages and invites to share experiences (cf. Korndörfer 2020, Müller 2020, Rümpel 2020).

7 Lessons learned

One good practice example is the close cooperation and exchange with the adjacent Czech Republic on the regional case study level. Manifold connections have been established throughout the years. Meanwhile other parts of Saxony are connected with neighbouring Poland.

The already mentioned examples of research and cooperation projects, as well as several others, often give new impulses to areas and structures. With regard to the case study area it could be observed that new topics were introduced, new methods tested, and stakeholders were bond to certain topics and objectives with a close connection to DRM and CCA. But after the project funding period ended the implementation of the projects often came to hold (cf. KORNDÖRFER 2020, MÜLLER 2020, SEIFERT 2020).

Another point to mention is that it seemed as if the authorities and inhabitants of the case study area had forgotten the danger emanating from the Elbe, because the research revealed that after the event in 2002 many things changed. Various deficits in preventive and protective flood management and the general administrative organisation came to light and events of this magnitude in the consciousness of the people. Therefore, the improvement of flood protection was for some years a high priority task of the city of Dresden and for instance several detailed land-use plans at the municipal level were changed (cf. STADT DRESDEN n.d.a). The situation is ambivalent, though, as currently more than a thousand new apartments are built and planned along the river Elbe (city quarter Dresden-Mickten with 900 apartments, HafenCity with 350 apartments, Marina Garden with 13,000 m² living space).

Further, in consequence of the flood event the Weißeritz-Regio initiative came to life (in the meantime terminated, though) and the regional planning association Upper Elbe Valley/Eastern Ore Mountains began to develop specific measures to minimise the impact of floods. They developed methodologies way before the EU FRMD came into force in 2007, but the development was immensely enhanced by its introduction. Moreover, the impression that EU directives, like Water Framework Directive 2000/60/EG or EU FRMD, can have a crucial impact on the establishment and implementation, especially of new issues, was reaffirmed by the case study interviews. They can be used as valid arguments when it comes to debates about the need of specific actions in relation with DRM or CCA (cf. KORNDÖRFER 2020).

Regarding hazards apart from floods it became apparent that (huge) gaps exist at regional level as well as other administrative levels in terms of risk and hazard analysis of drought, earthquakes, storms and landslides. In addition to that, not sufficient information on the coping with drought in the region can be found, even though in 2014 and two years later, there have been projects for the simulation and characterisation of drought. Similar gaps exist regarding the management of landslides and storms. The majority of the available information was with regard to floods and most of it has been issued after the flood event in 2002.

References

AG REGIONALVERBÄNDE (n.d.): Website of the Regionalverbände. Available at: https://www.ballungsraumverbaende.de/index.html (last retrieval: 27.10.2020)

ARL – Akademie für Raumentwicklung in der Leibniz-Gesellschaft: Bundesraumordnung. In: https://www.arl-net.de/lexica/de/bundesraumordnung?lang=en

BBSR – Bundesinstitut für Bau-, Stadt- und Raumforschung (n.d.): ‚Land unter' war gestern. Das Leuchtturmprojekt Ella. Interreg B. Available at: https://www.interreg.de/INTERREG2014/DE/Projekte/GuteBeispiele/UmweltundNatuerlicheRessourcen/DL/DL_ELLA.pdf?__blob=publicationFile&v=2 (last retrieval: 26.01.2021)

BBK – Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (n.d.): Risikomanagement. Available at: https://www.bbk.bund.de/DE/AufgabenundAusstattung/Risikomanagement/risikomanagement_node.html (last retrieval: 27.10.2020)

BMVBS – Bundesministerium für Verkehr, Bau und Stadtentwicklung (2013a): Flexilibisierung der Planung für eine klimawandelgerechte Stadtentwicklung. Verfahren, Instrumente und Methoden für anpassungsflexible Raum- und Siedlungsstrukturen. BMVBS-Online-Publikation 16/2013. Available at: https://www.bbsr.bund.de/BBSR/DE/veroeffentlichungen/ministerien/bmvbs/bmvbs-online/2013/DL_ON162013.pdf;jsessionid=2827F0A5F1E239076BA771E97F62566A.live21302?__blob=publicationFile&v=1 (last retrieval: 27.10.2020)

BMVBS – Bundesministerium für Verkehr, Bau und Stadtentwicklung (2013b): Wie kann Regionalplanung zur Anpassung an den Klimawandel beitragen? Ergebnisbericht des Modellvorhabens der Raumordnung „Raumentwicklungsstrategien zum Klimawandel" (KlimaMORO). Forschungen Heft 157. Available at: https://www.raum-energie.de/fileadmin/Downloads/Projekte/KlimaMORO/17_KlimaMORO_Broschuere_Wie-Kann-Regionalplanung-zur-Anpassung-an-den-Klimawandel-beitragen.pdf (last retrieval: 27.10.2020)

BMVBS – Bundesministerium für Verkehr, Bau und Stadtentwicklung (2013c): KlimaMORO Infobrief. Ausgabe 04/2013. Available at:https://www.raum-energie.de/fileadmin/Downloads/Projekte/KlimaMORO/Phase_II/17_KlimaMORO_Phase-2_Infobrief4.pdf (last retrieval: 27.10.2020)

BMVI – Bundesministerium für Verkehr und digitale Infrastruktur (2015): Vorsorgendes Risikomanagement in der Regionalplanung (MORO) Endbericht, AZ 10.05.06-13.6. Available at: http://www.agl-online.de/fileadmin/62agl/medien/Downloads/agl_PRC_MORO-Risiko_Endbericht_20150727web.pdf (last retrieval: 27.10.2020)

BRÄUNIG, A. (2013): Erosionsgefährdungskarten Freistaat Sachsen – Erläuterung. Available at: https://www.boden.sachsen.de/download/boden/Erosionskarten_Erlaeuterung.pdf (last retrieval: 27.10.2020)

COR – European Committee of the Regions (2016): Implementation of the Sendai Framework at the EU level: the take-up of resilience measures by Local and Regional Authorities. Available at: https://cor.europa.eu/en/engage/studies/Documents/Implementation%20of%20the%20Sendai%20Framework%20at%20the%20EU%20level.pdf (last retrieval: 27.10.2020) DOI: 10.2863/301173

DKKV - Deutsches Komitee für Katastrophenvorsorge e.V. (2004): Flood Risk Reduction in Germany. Lessons learned from the 2002 Disaster in the Elbe Region. Summary of the Study. Bonn. DKKV Publication 29e. Available at: https://www.dkkv.org/fileadmin/user_upload/Veroeffentlichungen/Publikationen/DKKV_29_Lessons_Learned.pdf (last retrieval: 27.10.2020)

EUROREGION ELBE LABE (2020): Economical and social situation. Available at: https://www.elbelabe.eu/en/region/economical-and-social-situation/ (last retrieval: 27.10.2020)

GERBER, S., JENTSCH, S.& T. KOPP (2016): Der Übergang von den Hochwasserschutzkonzepten zur Hochwasserrisikomanagementplanung im Freistaat Sachsen Schwerpunkt Gefahren- und Risikokarten. IN: TECHNISCHE UNIVERSITÄT DRESDEN, Institut für Wasserbau und technische Hydromechanik (ed.): Ge-

wässerentwicklung & Hochwasserrisikomanagement - Synergien, Konflikte und Lösungen aus EU-WRRL und EU- HWRM-RL. Dresdner Wasserbauliche Mitteilungen 57. Dresden: Technische Universität Dresden, Institut für Wasserbau und technische Hydromechanik. 2016. p. 383-390. Available at: https://izw.baw.de/publikationen/dresdner-wasserbauliche-mitteilungen/0/41_Gerber_ÜbergangHochwasserschutzkonzepten.pdf (last retrieval: 27.10.2020)

GFZ - Deutsches Geoforschungszentrum: Erdbebenzonen (n.d.). Die erdbebengerechte Baunorm DIN EN 1998-1/NA (Fassung 2011-01) und die Zuordnung von Orten zu den Erdbebenzonen. Available at: https://www.gfz-potsdam.de/DIN4149_Erdbebenzonenabfrage/ (last retrieval: 27.10.2020)

GRÄFE (2010): Hochwasserkarten im Freistaat Sachsen. Presentation. Available at: https://docplayer.org/26234130-Hochwasserkarten-im-freistaat-sachsen-meeting-dresden.html (last retrieval: 26.10.2020)

GREIVING, S. (2006): Dealing with natural hazards in Germany's planning practice. IN: GREIVING, S., FLEISCHHAUER, M. & S. WANCZURA (eds.): Natural Hazards and Spatial Planning in Europe. Dortmunder Vertrieb für Bau- und Planungsliteratur. Dortmund 2006.

GREIVING, S. (2011): Methodik zur Festlegung raum- und raumplanungsrelevanter Risiken. IN: POHL, J. (ed.): Risikomanagement als Handlungsfeld in der Raumplanung. ARL Arbeitsmaterialien Nr. 357. Hannover. pp. 22-30.

GREIVING, S., FLEISCHHAUER, M. & S. WANCZURA (2006): Management of Natural Hazards in Europe: The Role of Spatial Planning in Selected EU Member States. IN: Journal of Environmental Planning and Management, Vol. 49, No. 5, pp. 739-757.

GREIVING, S., FLEISCHHAUER, M. & S. WANCZURA (eds.) (2006): Natural Hazards and Spatial Planning in Europe. Dortmunder Vertrieb für Bau- und Planungsliteratur. Dortmund.

GREIVING, S. (2010): Klimaanpassung und informelle Handlungsformen auf kommunaler und regionaler Ebene. In: VON STORCH, H. & M. CLAUSSEN (ed.): Klimabericht für die Metropolregion Hamburg. Berlin, Heidelberg. Springer Verlag.

HOLZWEIßIG, M. (2013): Schutz des Oberbodens vor Bodenerosion. Available at: https://rpv-elbtalosterz.de/wp-content/uploads/Erosionsschutzkonzept_1-5.pdf (last retrieval: 18.05.2020)

KIRCHBACH, H.-P., POPP T. & J. SCHRÖDER (2013): Bericht der Kommission der Sächsischen Staatsregierung zur Untersuchung der Flutkatastrophe 2013. Sächsische Staatskanzlei, Dresden, November 2013.

KLIMA SACHSEN (n.d.): Webpräsenz der Klimaforschungsstelle des LfULG Sachsens. Available at: https://www.klima.sachsen.de/index.html (last retrieval: 27.10.2020)

KORNDÖRFER, C. (2020): Interview with Dr. Christian Korndörfer, Landeshauptstadt Dresden, Amt für Umweltschutz, ehem. Amtsleiter, Dresden, Germany; 18 August 2020.

LANDESHAUPTSTADT DRESDEN (ed.) (2019): Flächennutzungsplan in den Stadtgrenzen vom 1. Januar 1999. Begründung. Fassung vom 6. Juni 2019 – Feststellungsbeschluss. Available at: https://www.dresden.de/media/pdf/stadtplanung/stadtplanung/spa_FNP_D2_Begruendung.pdf (last retrieval: 26.01.2021)

LFULG – Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (ed.) (2013): Ereignisanalyse. Hochwasser im August und September 2010 und im Januar 2011 in Sachsen. Dresden. Available at: https://www.umwelt.sachsen.de/umwelt/infosysteme/lhwz/download/Ereignisanalyse-2010_gesamt_120dpi.pdf (last retrieval: 27.10.2020)

LFULG - Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (2017): Starkregenereignisse von 1961 bis 2015. Schriftenreihe des LfULG, Heft 5/2017. Available at: https://publikationen.sachsen.de/bdb/artikel/28372 (last retrieval: 27.10.2020)

LFULG - Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (2019a): Hochwasserrisikokarten. Available at: https://www.umwelt.sachsen.de/umwelt/wasser/13503.htm (last retrieval: 27.10.2020)

LFULG - Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (2019b): Hochwassergefahrenkarten. Available at: https://www.umwelt.sachsen.de/umwelt/wasser/8843.htm (last retrieval: 27.10.2020)

LFULG - Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (n.d.a): Verkarstungsphänomene im Freistaat Sachsen. Available at: https://www.geologie.sachsen.de/verkarstungsphaenomene-im-freistaat-sachsen-25900.html (last retrieval: 27.10.2020)

LFULG - Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (n.d.b): Erdbebengefährdung. Available at: https://www.geologie.sachsen.de/erdbebengefaehrdung-27230.html#a-12717 (last retrieval: 27.10.2020)

LFULG – Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (2020): Herausforderung Klimawandel in Sachsen. Online: https://www.lfulg.sachsen.de/herausforderung-klimawandel-in-sachsen-16112.html (last retrieval: 03.11.2020)

LFULG - Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (2010): Erosionsschutz in reliefbedingten Abflussbahnen. Available at: https://publikationen.sachsen.de/bdb/artikel/11386 (last retrieval: 27.10.2020)

MARTENS, S. (n.d.): GIS-basierte Schätzung des relativen Sturmschadenrisikos für Fichtenbestände in Sachsen. Sachsenforst. Available at: https://www.waldwissen.net/waldwirtschaft/schaden/sturm_schnee_eis/sbs_sturmschaden/sbs_sturmschaden_artikel.pdf (last retrieval: 27.10.2020)

MDR SACHSEN (2020): Vor zehn Jahren: Tornado verwüstet Großenhainer Land. Available at: https://www.mdr.de/sachsen/dresden/grossenhain-riesa/zehn-jahre-tornado-ausstellung-100.html (last retrieval: 26.02.2021)

MÜLLER, U. (2020): Interview with Dr.-Ing. habil. Uwe Müller, Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie, Abteilung Wasser, Boden, Wertstoffe, Abteilungsleiter, Dresden, Germany; 13 August 2020.

NATURGEFAHREN SACHSEN (n.d.): Gefahren in Sachsen. Available at: https://www.naturgefahren.sachsen.de/gefahren-in-sachsen-3981.html?_cp=%7B%22accordion-content-3996%22%3A%7B%222%22%3Atrue%7D%2C%22previousOpen%22%3A%7B%22group%22%3A%22accordion-content-3996%22%2C%22idx%22%3A2%7D%7D (last retrieval: 27.10.2020)

POHL, J. (ed.) (2011): Risikomanagement als Handlungsfeld in der Raumplanung. ARL Arbeitsmaterialien Nr. 357. Hannover.

PROJEKT KLIMAFIT (2011): Das Projekt KLIMAfit in der Planungsregion Oberes Elbtal/ Osterzgebirge. Handlungsempfehlungen für die Praxis. Radebeul/ Dresden. Available at: https://rpv-elbtalosterz.de/wp-content/uploads/Klimafit_Produkt2.pdf (last retrieval: 27.10.2020)

PROJEKT REGKLAM (n.d.): Regionales Klimaanpassungsprogramm Modellregion Dresden. Available at: http://www.regklam.de/ueber-regklam (last retrieval: 27.10.2020)

RPV OEOE - Regionaler Planungsverband Oberes Elbtal/Osterzgebirge (ed.) (2020a): Regionalplan Oberes Elbtal/Osterzgebirge 2. Gesamtfortschreibung 2020, beschlossen als Satzung durch Beschluss VV 02/2019 der Verbandsversammlung am 24.06.2019, genehmigt mit Bescheid des Sächsischen Staatsministeriums für Regionalentwicklung vom 08.06.2020, wirksam seit 17.09.2020 mit Bekanntmachung der Genehmigung im Amtlichen Anzeiger des Sächsischen Amtsblattes Nr. 38/2020 vom 17.09.2020. Available at: https://rpv-elbtalosterz.de/wp-content/uploads/rpl/Regionalplan_Text.pdf (last retrieval: 08.04.2021)

RPV OEOE - Regionaler Planungsverband Oberes Elbtal/Osterzgebirge (2020b): Karte 4 Vorbeugender Hochwasserschutz. Regional Plan Oberes Elbtal/Osterzgebirge 2. Gesamtfortschreibung 2020. Available at: https://rpv-elbtalosterz.de/wp-content/uploads/rpl/04_Vorbeugender_Hochwasserschutz_A0.pdf (last retrieval 08.04.2021)

RPV OEOE - Regionaler Planungsverband Oberes Elbtal/Osterzgebirge (n.d.): Website Regionaler Planungsverband Oberes Elbtal/ Osterzgebirge. Available at: https://rpv-elbtalosterz.de/ (last retrieval: 26.10.2020)

RÜMPEL, A. (2020): Interview with Andreas Rümpel, Landeshauptstadt Dresden, Geschäftsbereich Ordnung und Sicherheit, Brand- und Katastrophenschutzamt, Amtsleiter, dresden, Germany; 20 August 2020.

SÄCHSISCHE STAATSKANZLEI (2012): Sächsisches Amtsblatt. Sonderdruck Nr. 3/2012 vom 30. April 2012, Bekanntmachung des Sächsischen Staatsministeriums des Innern über die Liste der eingeführten Technischen Baubestimmungen (LTB) vom 12. April 2012.

SÄCHSISCHE STAATSKANZLEI (ed.) (2013): Der Wiederaufbau im Freistaat Sachsen nach dem Hochwasser im Juni 2013. Available at: https://publikationen.sachsen.de/bdb/artikel/20553 (last retrieval: 27.10.2020)

SÄCHSISCHES STAATSMINISTERIUM DES INNEREN (n.d.a): Vorsorgende Hochwasserschutzmaßnahmen durch transnationale Raumordnung (ELLA). Available at: https://www.landesentwicklung.sachsen.de/download/Landesentwicklung/ELLA_DE.pdf (last retrieval: 27.10.2020)

SÄCHSISCHES STAATSMINISTERIUM DES INNEREN (n.d.b): Katastrophenschutz: Aufgaben. Available at: https://www.sicherheit.sachsen.de/20511.htm (last retrieval: 18.05.2020)

SÄCHSISCHES STAATSMINISTERIUM FÜR REGIONALENTWICKLUNG (n.d.): Regionalpläne. Available at: https://www.landesentwicklung.sachsen.de/regionalplaene-4880.html (last retrieval: 26.01.2021)

SEIFERT, P. (2020): Interview with Peter Seifert, Regionaler Planungsverband Oberes Elbtal/Osterzgebirge, Radebeul, Germany; 4 August 2020.

SMEKUL - Sächsisches Staatsministerium für Energie, Klimaschutz, Umwelt und Landwirtschaft (ed.) (2012): Energie- und Klimaprogramm. Available at: https://www.klima.sachsen.de/energie-und-klimaprogramm-sachsen-22623.html (last re-trieval: 27.10.2020)

SMEKUL - Sächsisches Staatsministerium für Energie, Klimaschutz, Umwelt und Landwirtschaft (n.d.): Erosionsgefährdungskarte. Available at: https://www.boden.sachsen.de/erosionsgefahrdungskarten-19346.html (last retrieval: 27.10.2020)

SMUL – Sächsisches Staatsministerium für Umwelt und Landwirtschaft (2007): Die Sächsische Hochwasserschutzstrategie.

STADT DRESDEN (n.d.a): Hochwasser in der Vergangenheit. Available at: https://www.dresden.de/de/stadtraum/umwelt/umwelt/hochwasser/vergangenheit.php (last retrieval: 27.10.2020)

STADT DRESDEN (n.d.b): Regional- und Landesplanung. Available at: https://www.dresden.de/de/stadtraum/planen/stadtentwicklung/stadtentwicklung/Regionalplan.php (last retrieval 17.11.2020)

STADT LENGENFELD (ed.) (2019): Bebauungsplan mit Festlegung von seismischen Gefährdungszonen. Available at: http://www.stadt-lengenfeld.de/inhalte/lengenfeld/_inhalt/unsere_stadt/stadtentwicklung/stadtplanung/bauleitplanung/bebauungsplan/planurkunde.pdf (last retrieval: 27.10.2020)

TECHNISCHE UNIVERSITÄT DRESDEN, Institut für Wasserbau und technische Hydromechanik (ed.) (2016): Gewässerentwicklung & Hochwasserrisikomanagement - Synergien, Konflikte und Lösungen aus EU-WRRL und EU- HWRM-RL. Dresdner Wasserbauliche Mitteilungen 57. Dresden: Technische Universität Dresden, Institut für Wasserbau und technische Hydromechanik. Available at: https://izw.baw.de/publikationen/dresdner-wasserbauliche-mitteilungen/0/41_Gerber_ÜbergangHochwasserschutzkonzepten.pdf (last retrieval: 27.10.2020)

UBA – Umweltbundesamt (2011): Hochwasser. Verstehen, Erkennen, Handeln. Available at: https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/uba_hochwasser_barrierefrei_new.pdf (last retrieval: 27.10.2020)

UBA – Umweltbundesamt (2018): Deutsche Anpassungsstrategie. Available at: https://www.umweltbundesamt.de/themen/klima-energie/klimafolgen-anpassung/anpassung-auf-bundesebene/deutsche-anpassungsstrategie#die-deutsche-anpassungsstrategie-an-den-klimawandel (last retrieval: 27.10.2020)

UBA – Umweltbundesamt (2019a): Regionale Klimaanpassung in Sachsen. Available at: https://www.umweltbundesamt.de/themen/klima-energie/klimafolgen-anpassung/anpassung-regional-sektoral/regionale-anpassung-in-sachsen#landerspezifische-klimaanderungen (last retrieval: 27.10.2020)

UBA – Umweltbundesamt (2019b): Aktionsplan Anpassung zur Deutschen Anpassungsstrategie. Available at: https://www.umweltbundesamt.de/themen/klima-energie/klimafolgen-anpassung/anpassung-auf-bundesebene/aktionsplan-anpassung#aktionsplan-anpassung-der-deutschen-anpassungsstrategie (last retrieval: 27.10.2020)

UMWELT SACHSEN (n.d.): Datenportal iDA. Available at: https://www.umwelt.sachsen.de/umwelt/46037.htm (last retrieval: 28.10.2020)

UMWELT SACHSEN (2020): Ausschnitt einer interaktiven Hochwassergefahrenkarte für den Raum Dresden. Available at: https://www.umwelt.sachsen.de/umwelt/infosysteme/ida/pages/map/default/index.xhtml;jsessionid=865F3ED048A1FA711AC27BCCE7880E19?mapId=180dda25-9a5a-4e84-b539-d766daef3f2f&overviewMapCollapsed=false&mapSrs=EPSG%3A25833&mapExtent=389374.0018424987%2C5632230.463856919%2C448808.17040537373%2C5679282.513969194 (last retrieval: 17.11.2020)

UNDINE (n.d.): Informationsplattform: Hochwasserereignisse im Elbegebiet. Das Sommerhochwasser 2002. Available at: http://undine.bafg.de/elbe/extremereignisse/elbe_hw2002.html (last retrieval: 27.10.2020)

WALD SACHSEN (n.d.): Waldbrandgefährdung. Available at: https://www.wald.sachsen.de/waldbrandgefaehrdung-4186.html (last retrieval: 27.10.2020)

WASSER SACHSEN (n.d.a): Landeshochwasserzentrum (LHWZ). Available at: https://www.umwelt.sachsen.de/umwelt/wasser/72.htm?hc_location=ufi (last retrieval: 27.10.2020)

WASSER SACHSEN (n.d.b): ELLA – ELBE-LABE- Vorsorgender Hochwasserschutz durch transnationale Raumordnung. Available at: https://www.umwelt.sachsen.de/umwelt/wasser/15351.htm (last retrieval: 27.10.2020)

Legislation

DIN 4149:2005-04 Earthquake standard = Erdbebennorm

EU FRMD EU Flood Risk Management Directive 2007/60/EC

FBC Federal Building Code = Baugesetzbuch BauGB

FRPA Federal Regional Planning Act = Raumordnungsgesetz ROG

SächsBRKG Saxon State Law on Fire Safety, Emergency Services and Civil Protection = Sächsisches Gesetz über den Brandschutz, Rettungsdienst und Katastrophenschutz

SächsFwVO Saxon Regulation on Fire Fighters = Sächsische Feuerwehrverordnung

SächsWG Saxon Water Act = Sächsisches Wassergesetz

WHG Water Management Act = Wasserhaushaltsgesetz

ZSKG Civil Protection and Disaster Assistance Act = Zivilschutz- und Katastrophenhilfegesetz

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

ESPON 2020

ESPON EGTC
4 rue Erasme, L-1468 Luxembourg
Grand Duchy of Luxembourg
Phone: +352 20 600 280
Email: info@espon.eu
www.espon.eu

The ESPON EGTC is the Single Beneficiary of the ESPON 2020 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States, the United Kingdom and the Partner States, Iceland, Liechtenstein, Norway and Switzerland.