# EVOKED

## Enhancing the value of climate data

Deliverable 2.3

Template for communicating scientific information and results

Work Package 2 – Co-develop

Deliverable Work Package Leader:
Kiel University (CAU)

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# Project information

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| Project partners: | Norwegian Geotechnical Institute, Norway (p.nr. 20170408)<br>Swedish Geotechnical Institute, Sweden<br>Deltares, the Netherlands<br>Christian-Albrechts University Kiel, Germany<br>Larvik Municipality, Norway<br>Värmland County Administrative Board, Sweden<br>Province of North Brabant, the Netherlands<br>Waterboard Drents Overijselse Delta, the Netherlands<br>City of Flensburg, Germany |

EVOKED

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# Summary

In the framework of the EVOKED project scientific information on different types of potential climate-change impacts has been developed. The aim is to translate these climate data into valuable and useful climate services. One aspect we are focusing on is the visualisation of this climate related information to specific target groups, while also considering the communication of risk and uncertainty. Currently, there are different types of visualization tools available, such as scenarios, maps, or even web applications such as story maps.

In this context we have developed a prototype story map template for communicating and visualising scientific information to different stakeholders in an understandable way. This document discusses the use of story maps for displaying environmental information and data, presents the developed template, and describes its components. Further it highlights the technical requirements for its use. This template is readily available online and can be easily adopted by other project partners or stakeholders for communicating scientific information on a wide range of climate-impact-related topics.

# Contents



# Appendix



# Review and reference page

# 1 Introduction

This document describes the development of a story map template for communicating scientific information on climate parameters and environmental impacts. The general template is employed for the compilation of a specific story map that has been produced in EVOKED for the German case study of Flensburg. More detailed information on the case study can be found in NGI (2019). The template aims to provide web developers with a framework for programming a story map themselves, using different contextual components.

The first part of this document provides a general background of storytelling with maps and how to use story maps as a communication tool. As EVOKED focuses on the development of climate services (SGI 2018), we also provide a more in-depth introduction on the use of story maps as climate services. After this introductory information, we provide a technical description of the different available components, following a template structure. In the template, we also provide a first overview about the information we have included for the case study of Flensburg. The last section gives an overview of the advantages and limitations of the developed story map template as a tool for communicating scientific information.

## 1.1 Storytelling with Maps

Maps are a valuable tool for storytelling as they can display and visualise a large amount of information (Kerski 2015; Harder & Brown 2017). For example, changes over time or information about phenomena and relationships in space can be represented (Marta & Osso 2015). According to Kerski (2013) “maps are a rich source of information, showing spatial relationships between climate, vegetation, population, landforms, river systems, land use soils, natural hazards, and much more”. Until recently, stories and maps were rather standalone elements instead of being combined with each other in the form of a story map (Harder & Brown 2017).

Especially with the support of digital media storytelling has recently developed rapidly in recent years. Story maps can be used for various topics such as geography, science, environmental issues, politics, and others. For example, Patterson & Bickel (2016) describe their story telling for an online El Nino education tool while Antoniou et al. (2018) produced a story map on the history of the Methana Peninsula. Usually, different elements such as text, graphics, videos, and pictures are used to display the information (Marta & Osso 2015; Harder & Brown 2017).

## 1.2 Story Maps as a Communication Tool

Story maps are an interactive and a powerful communication tool and can be applied for education and information purposes, but also to get the audience involved (Marta & Osso 2015). Storytelling has a large potential to raise awareness for a specific topic (Harder & Brown 2017) and can help to simplify complex information or to make it even more relevant for a specific target group. Story maps are also a valuable instrument

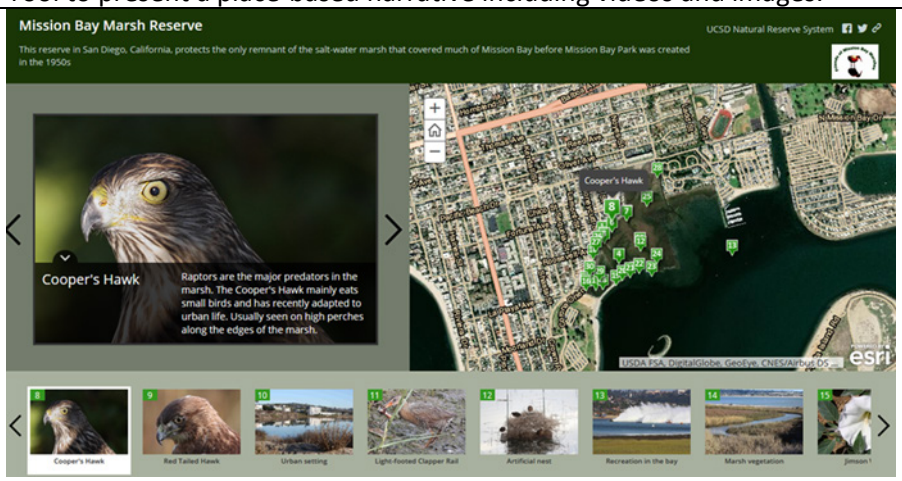
to communicate scientific information to non-experts (Patterson & Bickel 2016, Cope et al. 2018). An advantage is that story maps can be easily accessible through the web via different types of devices such as smart phones, tablets, and laptops (Marta & Osso 2015, Kerski 2015, Cope et al. 2018).

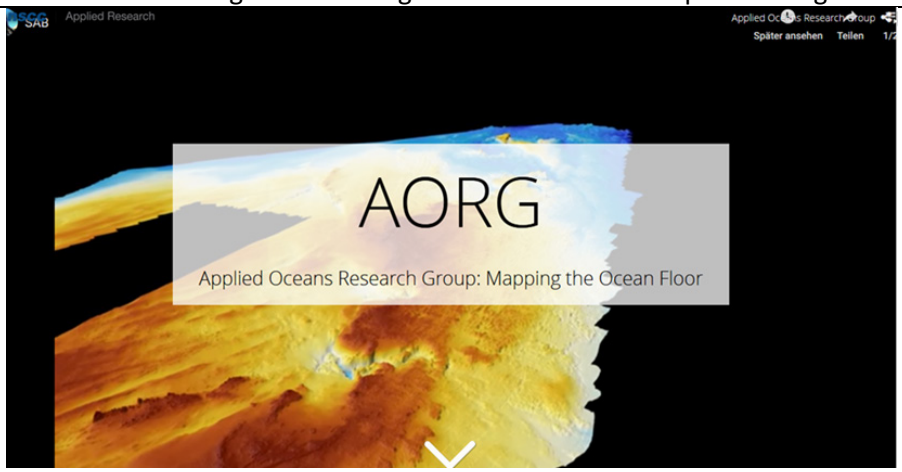
Different software solutions for web mapping are already available. Some of the most commonly employed ones are the Environmental Systems Research Institute (ESRI) Story Maps and CartoDB. ESRI (2018) identified five principles to be considered for an effective story map:

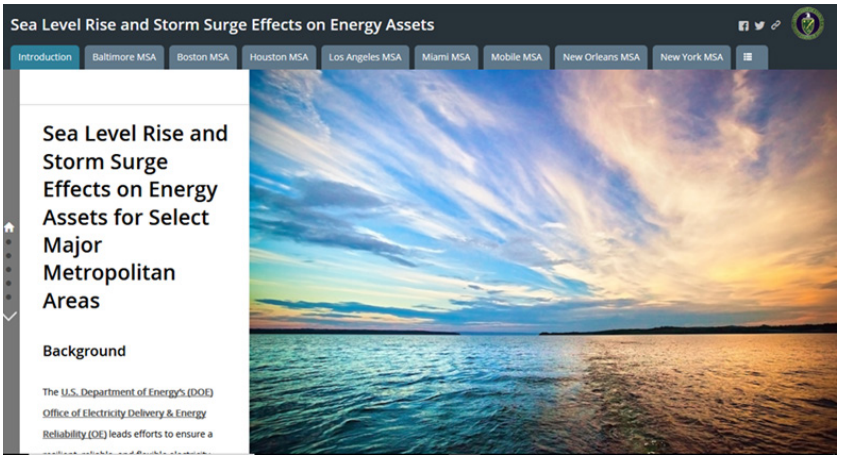
1. Content of the story map should match with the target audience.
2. Story map should start with an eye-turner.
3. Select the best format for the user.
4. Maps need to be easy readable and understandable.
5. Keep it as simple as possible.

ESRI provides open access to a range of story map templates (Harder & Brown 2017). Table 1 we provide an overview of some of the templates with respective examples. Further templates such as ESRI Story Map Crowdsource, ESRI Story Map Shortlist, ESRI Story Map Swipe, ESRI Story Map Spyglass, and ESRI Story Map Basic are described in Harder & Brown 2017.

*Table 1: Examples of ESRI story maps*

| **Template** | ESRI Story Map Tour:<br>Tool to present a place-based narrative including videos and images. |
|---|---|
| **Example** |  |
| http://www.arcgis.com/apps/MapTour/index.html?appid=0442449a3cf04e1f939f0b664fc5153c# | |

| | |
|---|---|
| **Template** | Esri Story Map Journal:<br>Enables to create multimedia narratives by combining narrative text with maps. |
| **Example** |  |
| http://www.arcgis.com/apps/MapJournal/index.html?appid=e909c616b26c44ef8d43e3aef5da71f7 | |
| | |
| **Template** | Esri Story Map Cascade:<br>Full-screen scrolling tool including narrative text with maps and images. |
| **Example** |  |
| https://cogsnscc.maps.arcgis.com/apps/Cascade/index.html?appid=0389e702fcc941a0974551f4d925a986 | |

| | |
|---|---|
| **Template** | Esri Story Map Series:<br>With this template a series of maps via tabs can be shown. Besides the maps also videos and images can be embedded. |
| **Example** |  |
| https://icfgeospatial.maps.arcgis.com/apps/MapSeries/index.html?appid=58f90c5a5b5f4f94aaff93211c45e4ec | |

## 1.3 Story Maps as a Climate Service

Climate services offer information about climate change (Goosen et al. 2014). Ideally, they are science-driven and inform the user (Lourenço et al. 2016) and follow a co-developing and production process (Hewitt et al. 2017; Räsänen et al. 2017), in a stepwise approach (Goosen et al. 2014). Instead of communicating in a top-down direction (Brasseur & Gallardo 2016), user and provider should communicate and collaborate through climate services (Lourenço et al. 2016), in a two-way communication process (Gianni et al. 2016).

Several researchers recommend that climate services should be easy to understand and usable (Guido et al. 2013; Hewitt et al. 2017; Räsänen et al. 2017) and relevant for users (Guido et al. 2013; Hewitt et al. 2017; Räsänen et al. 2017; Swart et al. 2017). Stakeholders primarily would like to understand climate change impacts, obtain information on uncertainties in future climate change as well as develop ideas on how to improve management such as land use planning or disaster preparedness (Gianni et al. 2016). Furthermore, climate services should also translate the consequences of climate change impacts and their implications for the users (Goosen et al. 2014).

In the past, web applications and web tools on climate change aspects have been developed, but they have rarely been connected with the concept of climate services. Thus, research is very limited on how effective such web applications are as climate services. One of the first reviews that assesses web portals as climate services recommends that these should take a wide diversity of users into account, assure and manage quality of data presented, be complemented by additional services, take care of continuity (also after a project has finished), and ensure that their guidance is appropriate

(Swart et al. 2017). Despite the existing uncertainties, story maps, as web-based applications, may be an effective tool to function as a climate service, taking all the characteristics and challenges of climate services into account.

Most of the web applications involve websites that provide data and maps while some also include guidelines and graphical information. The aim is to address multiple audiences and stakeholders, including politicians, knowledge providers, and practitioners (Swart et al. 2017). Similarly, adaptation platforms (online resources that provide information and guidance in support of adaptation) provide data, tools, guidance, and information, which is needed for the decision makers to develop adaptation plans and strategies. In those platforms, various dimensions of adaptation have been evaluated in order to understand in which way they are useful and in which way they are used (Palutikof et al. 2019). Currently, various web applications and story maps focusing on climate change impacts exist, but most are not explicitly intended to function as a climate service. The application of story maps as climate services is, however, seldom, to date.

One of the few available tools in this context is the interactive sea-level rise (SLR) viewer, which has been developed under the title Mapping Interface for Research Applications–Coastal Dynamics of SLR (MIRA–CDSLR). The MIRA-CDSLR is a data visualization tool that communicates the potential effects of SLR at the coast. Its main purposes are the visualization of sea-level rise projections and the subsequent ecological changes, as well as communicating sea-level rise impacts in general (Stephens et al. 2015). However, this tool does not include story telling.

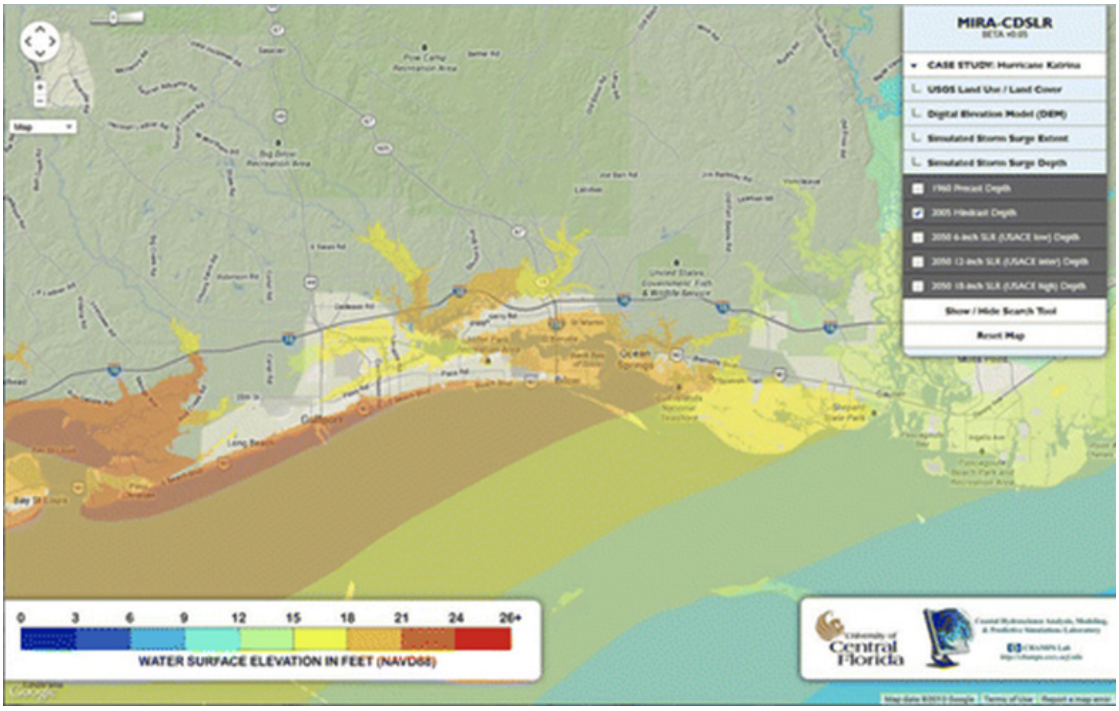



*Figure 1: MIRA–CDSLR screenshot showing Hurricane Katrina water surface elevation in Mississippi, modelled from 2005 conditions (Stephens et al. 2015).*

Another example is the Dutch Climate Adaptation Atlas, which functions as a climate adaptation service for the Netherlands. The atlas visualises scientific information on climate change impacts, for example flood modelling, urban heat island effect, crop drought sensitivity, and sensitivity to droughts via an online Geoportal. Maps are used to support spatial adaptation planning (Goosen et al. 2014).

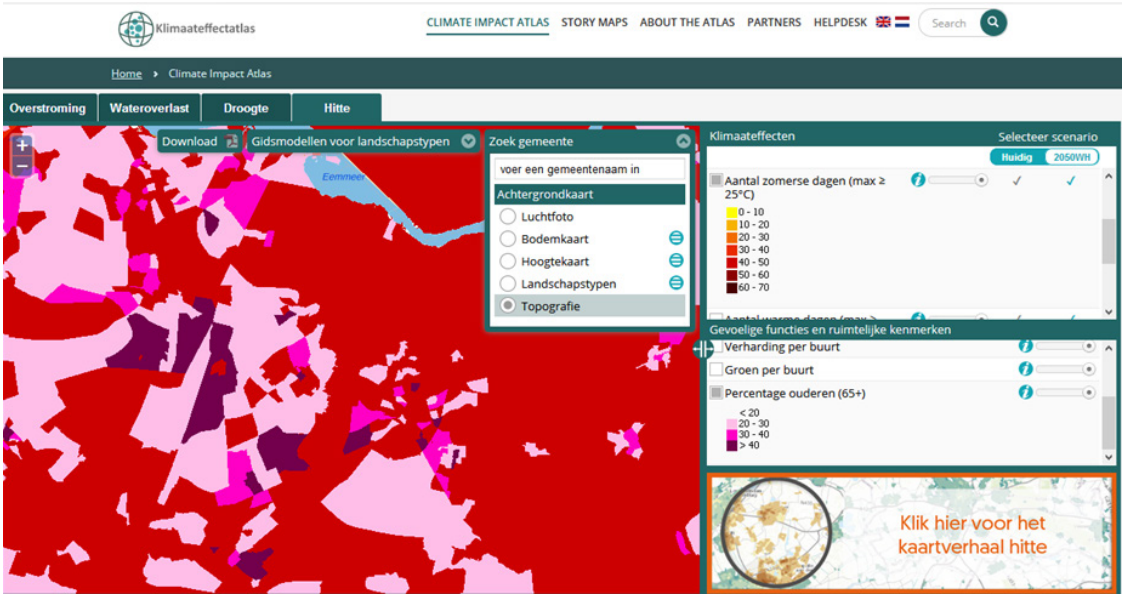



*Figure 2: Climate Adaptation Atlas showing the number of days over 25 degrees by 2050 and the human age distribution for a specific area in the Netherlands that could be affected by heat stress. Accessible via: http://www.klimaateffectatlas.nl/en/*

There is also a limited number of story maps on climate change impacts available online. In the following we present some examples for such story maps. The first story map has been developed by Lück-Vogel et al. (2019) and focuses on coastal flooding in South Africa (Figure 3). First background information on coastal processes and coastal hazards is provided. Then, exposure indicators such as extent of area, number of buildings and population exposed to coastal flooding is presented. Last some policy relevant recommendations are presented.

The second story map has been developed by the Provincie Noord-Brabant (2019) and focuses on climate-change induced drought and associated impacts in the province of North Brabant in the Netherlands in 2018 (Figure 4). This story map has also been employed in the beginning of the EVOKED project. The story map first discusses information on droughts, specifically in the context of the province of North Brabant. Next potential consequences related to drought, such as forest fires, blue-green algae and low water level for inland navigation, are shown based on local examples.

A third example is the story map produced by Xia (2019), which focuses on the impacts of sea level rise of the Californian coast (Figure 5). Different areas affected by sea level rise and coastal flooding are shown along the coast. Possible adaptation options such as

sea walls and managed retreat (an adaptation option involving relocation of property from the shoreline to the hinterland, see Alexander et al., 2012) are discussed.


*Figure 3: Story map on coastal flood impacts in South Africa. Accessible via: https://pta-gis-2-web1.csir.co.za/portal/apps/GBCascade/index.html?appid=0bd477eac462450c9d6e528c2d195434*


*Figure 4: Story map used in EVOKED for the North Brabant case study explaining the impacts of drought. Accessible via: http://climadapserv.maps.arcgis.com/apps/Cascade/index.html?appid=4f42450134394bd390b711f1466240b7*


*Figure 5: Story map on sea-level rise and managed retreat for the coast of California. Accessible via: https://www.latimes.com/projects/la-me-sea-level-rise-california-coast/*

# 2 Story Map on Sea-Level Rise for Flensburg

In the context of EVOKED, the project partners have produced scientific information on various types of potential climate change impacts for the case study areas (Kiel University 2019a, Kiel University 2019b). In order to visualise and to communicate this type of complex information we have produced a pilot story map as a climate service focusing on sea-level rise in Flensburg. As sea-level rise and the adaptation to potential impacts are new topics to the city of Flensburg our story map has the goals to:

- Raise awareness and inform about sea-level rise in Flensburg.
- Contribute to decisions in dealing with local sea-level rise.
- Support the adaptation process in Flensburg.

The target group of the story map is the general public. Further, the story map has four main characteristics:

- Usability: the story map should be easily understandable and usable.
- Storytelling: the story map should tell a story.
- Visualisation: the story map visualises the topic.
- Translation: the story map translates complex information.

The story map includes information on the physical process of global sea-level rise and its possible evolution in Flensburg. The first part includes short information on the background, such as global mean sea-level rise trends, uncertainty, risk of coastal flooding, and coastal adaptation. The next part visualises coastal flood risk and provides information on areas vulnerable to coastal flooding with the assistance of maps. The

third part of the story map contains information on adaptation options in general, primarily in text-based form. Finally the story map presents potential adaptation measures in various parts of Flensburg.

The story map for Flensburg is accessible via: http://meeresspiegelanstieg-in-flensburg.info

# 3 Template for Communicating Scientific Information – A Story Map Example

Instead of using already available solutions (e.g. ESRI templates) of story maps for EVOKED, we have developed a new story map template. This enables us to share the source code and hereby remove any restrictions otherwise imposed on the format, design functionalities of the story map; and also allows more flexibility in the visualisation of the scientific information as well as in the co-production and co-development process as it gives room to adjust the product according to the feedback and requirements of the stakeholders. The source code is available on github under the MIT license agreement. The template consists of a web application that offers ready-made components for web developers to quickly assemble a story map without setting limitations on how it can be customized according to specific user requirements.

## 3.1 Story Map Design

The general design of the story map template aims to mimic a story-telling approach by creating a clear reading flow from top to bottom. Users who prefer to jump to a specific section can do so by expanding the menu. The template is optimised for desktop and handheld devices and its usability was tested to cater for users with different levels of computer literacy.

### Components

The ready-made components reflect common-use cases to communicate climate change information. Particular attention was paid to visualising geospatial information, e.g. in the context of a city, as well as providing an attractive scheme to collect user feedback. The intention is hereby to create a smooth user experience that focuses the user's attention and increases his or her willingness to participate.

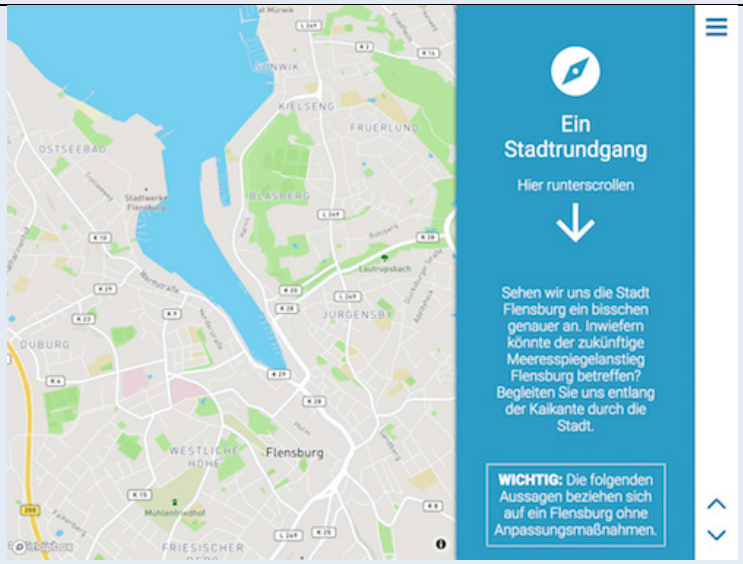
## Title Slide

| | |
|---|---|
| **Description of Component** | The title slide aims to capture the audience attention. Important is to highlight the topic and the geographical focus of the story map. |
| **Implementation for Flensburg** |  |
| **Displayed Content** | For the case study of Flensburg we concentrate on the topic sea-level rise and used a local picture as an eye-turner. |

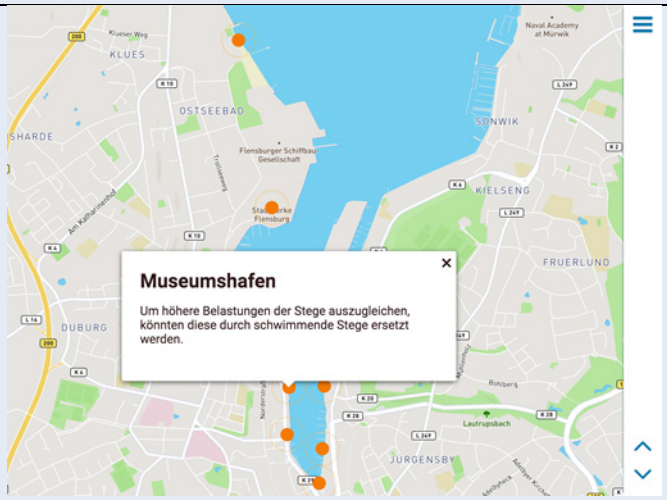
## Horizontal Slider

| | |
|---|---|
| **Description of Component** | The horizontal slider is a convenient way to break long texts into smaller text snippets. The accompanying symbols help users to quickly contextualise information. |
| **Implementation for case study Flensburg** |  |
| **Displayed Content** | In the Flensburg story map, background information about the main concepts related to the topic such as sea-level rise, uncertainty, risk, and adaptation is given in the first horizontal slider. The second horizontal slider informs about adaptation and its categories in a more specific way. |

## Fly-by Map

| | |
|---|---|
| **Description of Component** | The Fly-by Map provides an attractive way to visualise geospatial information. The map flies to given locations based on the scroll position of the slider to the right. It is the online equivalent of 'taking the user by the hand'. |
| **Implementation for case study Flensburg** |  |
| **Displayed Content** | In the case of Flensburg we used the Fly-by Map to focus on areas vulnerable to sea-level rise and associated flooding along the coast of the city. The user attention is directed to how these are directly affected by sea-level rise, e.g. by describing daily life examples (going to the beach, eating in a restaurant, walking along the pier). These examples have an emotional connotation. In other places, the user would be indirectly affected through interferences of other actors (i.e. disturbance in production by the local industry, current changes of future spatial development plans). |

## Pop-up Map

| | |
|---|---|
| **Description of Component** | Similar to the Fly-by Map, the Pop-up Map also visualises geospatial information. However, here the user decides which information to display by clicking on the hotspots on the map. |
| **Implementation for Flensburg for case study** |  |
| **Displayed Content** | In the Flensburg story map, the Pop-up Map visualized the same places as the Fly-by Map, but we included information on future potential adaption measures. |

## Tool-tips

| | |
|---|---|
| **Description of Component** | Tool-tips are a convenient way to provide on-demand quick access to further information. This is particularly useful for definitions that may not be part of the user's background knowledge. It allows to scale information for different target audiences without bloating the website unnecessarily. |

# 4 Feedback

One specific purpose of the EVOKED project is to increase the usability of the climate services through a feedback loop. Thus, we have included a feedback form at the end of the story map. Here the user has the possibility to provide feedback on the story map via open and closed questions. Based on the feedback our aim is to adapt the story maps by increasing their readability and usability.

The feedback form has been divided into steps to make long forms appear less weary. If desired, novel forms of input, such as sliders, toggles or pickers, can be included.

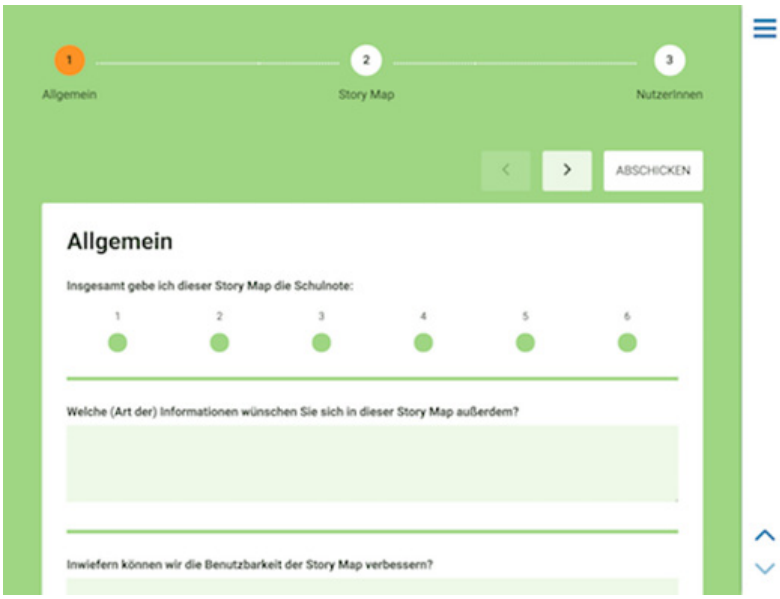



*Figure 6: Screenshot of the feedback form used to improve the usability and readability of the story map for Flensburg.*

# 5 Conclusions and Outlook

## 5.1 Concluding remarks

Climate Service online tools and similarly, adaptation platforms, are often used to present scientific information and data on climate change and its impacts. Their main goal is to communicate information and make data accessible for specific target groups. Different applications for the creation of story maps are available and a small number of story maps focusing on climate change and impacts are also already available on the web. If a story map has an educational purpose, some limitations exist; for example Cope et al. (2018) highlight that there is no scientific peer-review process yet that ensures the educational value of a story map content.

Story Maps combine elements, characteristics, and goals that differ from those of online tools and adaptation platforms. The usability and the visualization as main characteristics of the story map are similar to those of the other tools, whereas the storytelling based on maps is the main difference from these other tools. For example, in the Flensburg story map, quantitative information is often translated into qualitative information and the elements follow a specific story line (from generic information to place-specific information, the Fly-By map takes the user by the hand). Little is known about the effectiveness of story maps as climate services. Future research should therefore evaluate story maps as climate services and compare examples in order to identify the key success factors in the communication process.

## 5.2 Outlook

Story maps as climate services constitute a new field of research but appear to have a high potential to serve as a climate service. Usability and readability can be increased through feedback processes of the specific target group. In the course of EVOKED, the template will be further developed based on the user feedback form and on direct stakeholder feedback, e.g. during workshops. One possible extension is a map-based component that allows users to display and compare from a set of overlays, such as modelled flood extents, a feature which is already implemented in commonly used GIS systems. Another application of this component could be to validate modelled flood extents by allowing users to add their comments to the map. However, every case study and user case will pose different challenges to the story map and generate different feedback from its users. For this reason, the template does not intend to provide an 'out-of-the-box' solution to create story maps, it is rather a convenient starting point for development. In order to increase the usability and readability of the climate services, interdisciplinary research teams are essential (Christel et al., 2018). Hence, depending also on the content of the story map, we propose that besides natural and social scientists, a web developer with knowledge of the development environment (see Appendix) participates in the process. Furthermore, it is advisable to include a communication designer, a person with local knowledge who is aware of particularities of the locality and the local language, as well as a professional writer to ensure correct wording and use of symbols, as these appear to considerably enhance the communication of information.

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# Appendix A

Technical Details

Web developers make use of different programming languages and frameworks which are subject to constant high speed development and therefore vary greatly from one project to the next. The following describes the development environment used for this project and is addressed to a web developer to ensure a seamless continuation of development.

**Development environment:**

Docker
Node: v8.11.1
Next.js: ^8.1.0
React: ^16.8.6
Express: ^4.17.1
Git with GitHub account

# Review and reference page

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