PIISA

Piloting Innovative Insurance Solutions for Adaptation

D3.6 Lessons learned from testing usage in Lyon, France

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Disclaimers

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Summary

The Clay Shrink Swell Building Damage Assessor (CSSBDA and referred to in the Grant Agreement and previous deliverables as the PIISA climate adaptation dashboard) is an online website designed to educate homeowners about the financial risks associated with inadequate insurance cover for property damage caused by clay shrink swell (CSS) events.

The CSSBDA contributes to the following PIISA Specific Objectives:

- SO5: Localised piloting
- SO6: Activating Climate Resilience Dialogue
- SO8: Enabling insurance market growth

Deliverable 3.5: Preliminary dashboard specification articulated the methodology and data which will be used in the CSSBDA. It also summarised the background research on the CSS topic and various aspects of the user journey/interface which may be embedded in the CSSBDA (although acknowledging that the user journey/interface will be under constant iteration during the software development phase). Finally, it included the contracting information to instruct a third party to develop the CSSBDA.

Following submission of *Deliverable 3.5*, the Sustainable Finance Observatory (SFO) (formerly Asso 2° Investing Initiative (2DII)) undertook a procurement process to select a software developer to convert the specification into the online website which forms the CSSBDA. The CSSBDA was then piloted and tested in the City of Lyon.

This document analyses lessons learnt from pilot testing in the City of Lyon during the period from March to August 2025 which will be integrated into our planning and work activities for replicating the CSSBDA at French national level. It is structured as follows:

- Section 2 articulates key lessons from the procurement and contracting process to select and contract a software developer to convert the specification into the online website which forms the CSSBDA. Some key lessons here relate to ensuring we prioritise profiles with much higher response rates on the procurement platform, shortening the waiting period before following up to 2–3 business days and reaching out to additional IT freelancers.
- Section 3 articulates key lessons learned from data work (i.e. cleaning the underlying datasets to make them appropriate for use in the CSSBDA) and working with the software developer to convert the specification into the online website which forms the CSSBDA. Key lessons here for cleaning the datasets relate to the importance of understanding how the data behaves including recognising patterns, identifying irregularities and being prepared to choose appropriate statistical tests accordingly – this will be especially important when preparing the underlying datasets for replication at

national level. For working with the software developer, we found that developing backend logic in parallel with user interface (UI) design is feasible when supported by a modular architecture. In this case, the short timeline and clearly defined feature requirements helped guide and justify the architectural choices. Close collaboration between SFO and the software developer is highly beneficial for quality and milestone validation.

- Section 4 articulates key lessons learned from pilot testing in the City of Lyon including efforts to publicise the CSSBDA and feedback received from user testing. Key lessons here include the value of combining targeted local engagement with both digital and in-person communication efforts. The most successful elements included direct messaging via social media, outreach to real estate and wealth advisors, and in-person visibility during the Ethical Finance Forum. However, a key lesson learned is the challenge of converting awareness into measurable website traffic. While residents responded positively to the CSSBDA during in-person sessions, online engagement proved less effective for reaching individual homeowners. Limiting the focus of the pilot phase to the Lyon area also limited the effectiveness of our publicity campaign. Lyon was selected as the pilot city because CSS risk is apparent there and partners could assist with publicising the CSSBDA tool during the pilot phase. However, CSS risk is elevated in other areas of France (which we would assume means there is increased homeowner interest). In addition, focusing on the City of Lyon only meant that PIISA project communication tools as a whole were less useful (as they are not tailored to be used for such a specific geographic area) which made it difficult to generate broad momentum. Another issue to address when the CSSBDA gets promoted at a national level, is the language in which information is disseminated.
- Section 5 articulates planned changes to the CSSBDA to address feedback we received from user testing which will be implemented prior to replicating the CSSBDA at national level in France.
- Section 6 includes an updated roadmap of activities which will be carried out during the final stage of the project.

This document is a result of Task 3.2.2 which develops one of the five pilots of PIISA WP3.

Abbreviations and acronyms

Acronym	Description
WP	Work Package
CSS	Clay shrink swell
SFO	The Sustainable Finance Observatory

1 Introduction

The Clay Shrink Swell Building Damage Assessor (CSSBDA and referred to in the Grant Agreement and previous deliverables as the PIISA climate adaptation dashboard) is an online website designed to educate homeowners about their financial risks associated with inadequate insurance cover for property damage caused by clay shrink swell (CSS) events.

Information Box: Background on the causative factors of clay shrink swell and the insurance position in France

A clay shrink swell (CSS) event can occur if the relevant local factors are present and are combined with the relevant climate factors:

- Local factors: These include aspects such as the constitution of the soil (it needs to contain clay), the inclination of the area, the hydrological context of the area, surrounding vegetation etc. (British Geological Survey, Undated). As the name indicates, there must be clay in the soil composition. It is estimated that a CSS event can occur if the soil composition is of at least 10% clay (Boivin et al., 2006).
- Climate factors: Triggering factors of evapotranspiration and precipitation from weather events such as droughts, heatwaves and rainfall can potentially trigger a CSS event in areas where the relevant local factors are present.

Clay soil consistency can easily change depending on the soil's water content. When it rains, clay soils absorb water and dilate just like a sponge. The water contained in the clay evaporates and the clay soil shrinks. The drying out of the soil creates both horizontal cracks on the surface and vertical hydromechanical settlement under the weight of the structures (Assemblée Nationale, 2023). Simply put, CSS events occur when a drought is followed by heavy rain, causing soil to move and change shape significantly in a short period of time.

CSS events mainly affect single-family homes and are widespread in France. It is estimated that 48% of the national territory is at medium or high risk of this phenomenon and around 10.4 million single-family homes are at medium or high risk of CSS events, representing 54% of all single-family homes (Sénat, 2023).

If a homeowner suffers property damage caused by a CSS event, insurance cover is provided by the typical multi-risk home insurance policy together with the Cat Nat scheme. However, an insurance payout will only take place when the State officially recognises the occurrence of a natural catastrophe under the Cat Nat mechanism. Where there has been damage caused by a CSS event but there is no State recognition of a natural catastrophe, there is no insurance payout. Even if a natural catastrophe is recognised by the State, there will be no insurance payout if the homeowner has not complied with all preventative measures which are applicable for the property and articulated in the natural risk prevention plan (PPRN). And furthermore, even if a natural catastrophe is recognised by the State, the length of time to receive State recognition of a natural catastrophe (and the consequent length of time to receive compensation) is challenging for homeowners as it prolongs their recovery process and adds to their financial burden.

Further details on CSS events and the insurance position in France can be found in *Deliverable 3.5.*

Deliverable 3.5 articulated the methodology and data which will be used in the CSSBDA. It also summarised the background research on the CSS topic and various aspects of the user journey/interface which may be embedded in the CSSBDA (although acknowledging that the user journey/interface will be under constant iteration during the software development phase). Finally, it included the contracting information to instruct a third party to develop the CSSBDA.

Following submission of *Deliverable 3.5*, the Sustainable Finance Observatory (SFO) undertook a procurement process to select a software developer to convert the specification into the online website which forms the CSSBDA. The CSSBDA was then piloted tested in the City of Lyon.

This document analyses lessons learnt from pilot testing in the City of Lyon during the period from March to August 2025 which will be integrated into our planning and work activities for replicating the CSSBDA at French national level. It is structured as follows:

- Section 2 articulates key lessons from the procurement and contracting process to select and contract a software developer to convert the specification into the online website which forms the CSSBDA.
- Section 3 articulates key lessons learned from data work (i.e. cleaning the underlying datasets to make them appropriate for use in the CSSBDA) and working with the software developer to convert the specification into the online website which forms the CSSBDA.
- Section 4 articulates key lessons learned from pilot testing in the City of Lyon including efforts to publicise the CSSBDA and feedback received from user testing.
- Section 5 articulates planned changes to the CSSBDA to address feedback we received from user testing which will be implemented prior to replicating the CSSBDA at national level in France.
- Section 6 includes an updated roadmap of activities which will be carried out during the final stage of the project.

2 Procurement and contracting of the software developer

This section articulates key lessons from the procurement process to select and contract a software developer to convert the specification into the online website which forms the CSSBDA.

2.1 Procurement

SFO's Procurement Policy (August 2023 edition) sets out clear procedures for acquiring goods and services with a focus on maintaining transparency, regulatory compliance and cost-effectiveness. It guarantees that all procurement activities at SFO are carried out with integrity, fairness and in accordance with legal requirements and best practices. For purchases exceeding €50,000, a formal competitive tendering process is required.

Annex 1: Procurement process sets out the process which SFO followed for procurement including:

- Platform used for procurement
- Freelancer pool and shortlisted selection
- Shortlisted meeting and decision

Lessons learned: *Despite providing a clear and detailed description of the technical skills, availability, and experience level required, it is common on Malt not to receive a prompt response from the IT freelancers we reach out to. Often, they are busy or experiencing heavy workloads. Because of this, we waited at least 4 business days for a response before following up, yet six IT freelancers still did not respond to our email. In the future, we should prioritise profiles with much higher response rates, shorten the waiting period before following up to 2–3 business days, and reach out to additional IT freelancers.*

2.2 Contracting

On 29 November 2024, Expert 14 (RM, ♀), formally accepted the offer and a contract for services template was shared with her. On 2 December 2024, Expert 14 (RM, ♀) requested amendments to the contract template and a meeting was held on 3 December 2024 to review the proposed changes, resulting in a consolidated version of the contract for services agreed the same day. On 4 December 2024, the final contract (the Contract) was signed by both parties.

Further information on the basic principles of the Contract and the Contract timeline are available in *Annex 4: Contract details*.

Lessons learned: *A key lesson learned was that working closely with the software developer to plan workflow and anticipate upcoming obstacles was essential to complete the software development in the required timescale. In this regard the weekly project updates between the software developed and relevant SFO team members were essential for tracking progress. Despite this there were some delays caused by administrative tasks such as purchasing the domain name or integrating the CSSBDA into the PIISA website where coordination with the Leader of WP4 was needed (however now that this has been achieved this problem will not be apparent when replicating the CSSBDA at national level). Moreover, the core team responsible for developing the CSSBDA was small, with no replacements available when members were on annual leave or needed to prioritize other tasks during short periods of heavy workload.*

Otherwise, we consider that we have designed the contract terms and budget appropriately to accommodate replication of the CSSBDA at French national level and provide ongoing maintenance throughout the remaining duration of the PIISA project. In this regard there is a significant remaining budget to accommodate this work but it is too soon to review the tangible outputs of this.

3 Data work and software development

This section articulates key lessons learned from the process of working with the software developer to convert the specification into the online website which forms the CSSBDA.

3.1 Data cleaning

As mentioned in *Deliverable 3.5 (Section 4.3 Estimating the value of the property)*, property value data will be obtained from France's public database Explorateur de données foncières (BDNF), which compiles the Demandes de Valeurs Foncières (DVF). The database contains information on real estate transactions such as sale price, address, date, cadastral details, property size and land use across France. The database was used to integrate into the CSSBDA a property value estimate based on public data on residential property values.

The property value estimate relies on two methods: (i) if the property was sold in the last three years, the property estimate value will correspond to the last recorded sale price; (ii) if the property was sold more than three years ago or has no sale record, the property estimate value would be calculated by multiplying the average price per square meter in the cadastral area by the property's floor area. This estimation process, linked to the cadastral "parcelle" code and address, will allow users to access a property value estimate directly within the CSSBDA.[1]

We applied a series of selection criteria to ensure the relevance and consistency of the dataset to measure the price per square meter:

- Select type of building, apartments or houses properties.
- Filter residential land use types.
- Transactions were considered only if they resulted from a completed sale.
- Only sales that occurred after 2020 were retained, to focus on the most recent market dynamics.
- Transactions with a positive sale value were selected to exclude incomplete or invalid records.

The filtered dataset contained 23,823 observations for the City of Lyon. We calculated the average price per square meter for each property. Figure 1 shows the distribution of these values where it can be seen the resulting distribution does not follow a normal pattern. Instead, the data show substantial dispersion and are heavily skewed, indicating the presence of extreme values and asymmetry in the market.

[1] For further information please refer to *Deliverable 3.5.*

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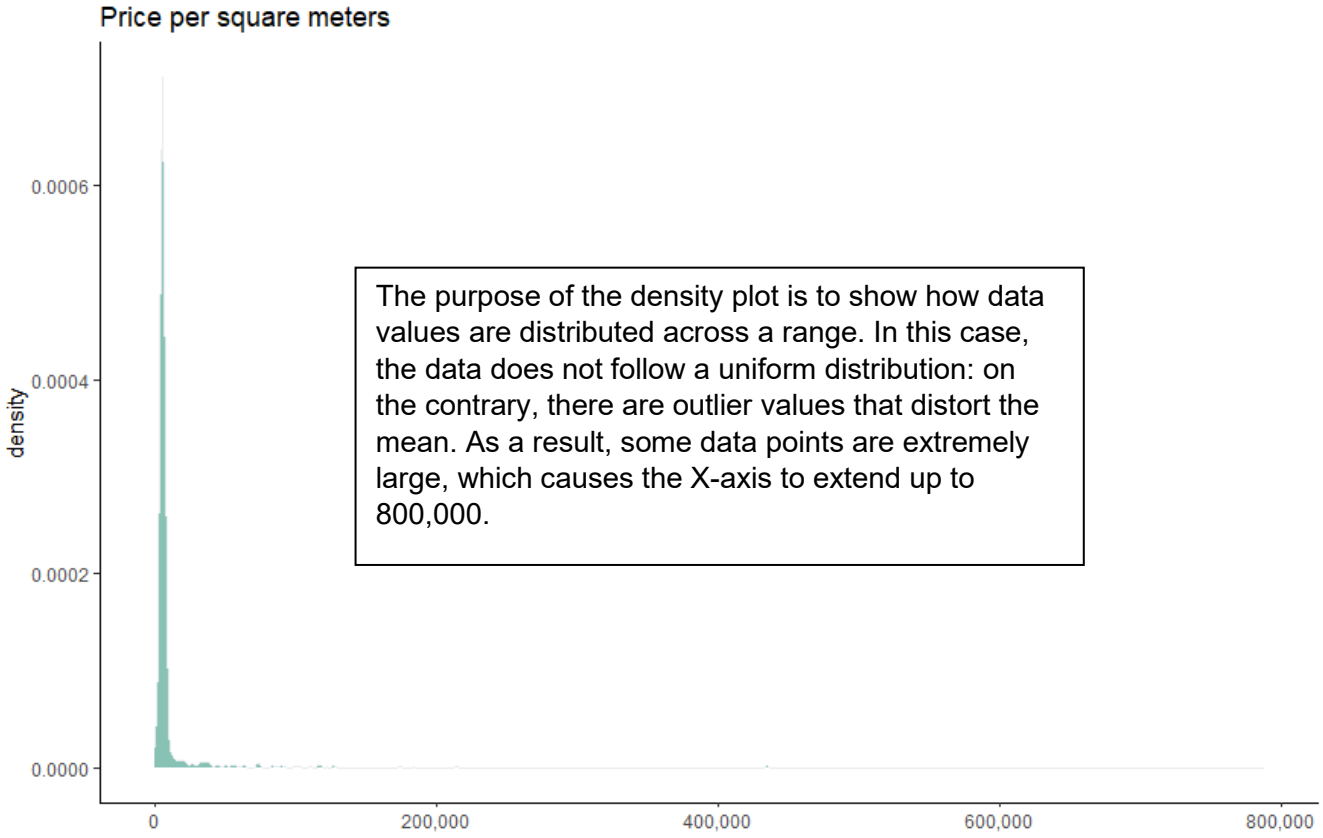

Figure 1: Distribution of average price per square meter for properties in the City of Lyon

3.1.1 Outlier treatment

Given that the initial analysis revealed a skewed distribution with the presence of atypical values, we generated a boxplot (see Figure 2 below) to explore the behaviour of the data across deciles. This visualisation allowed for a clearer identification of the spread, central tendency and the influence of outliers within the dataset. By analysing the distribution in deciles, it was possible to assess that the decile 10 exhibited significant deviation, implying the concentration of outliers on the extreme values of the distribution.[2]

[2] The tenth decile represents the 10% of observations with the highest price per square meter. This decile shows a substantially wider range of values compared to the lower deciles, indicating significant heterogeneity within the upper segment of the market. The presence of numerous outliers (points outside the box) suggests that, while most properties in this decile are priced at a high level, there exists a subset of extremely expensive properties that drive the upper tail of the distribution. As a result, Decile 10 not only captures the premium segment but also highlights the extreme concentration of exceptionally high prices within the dataset.

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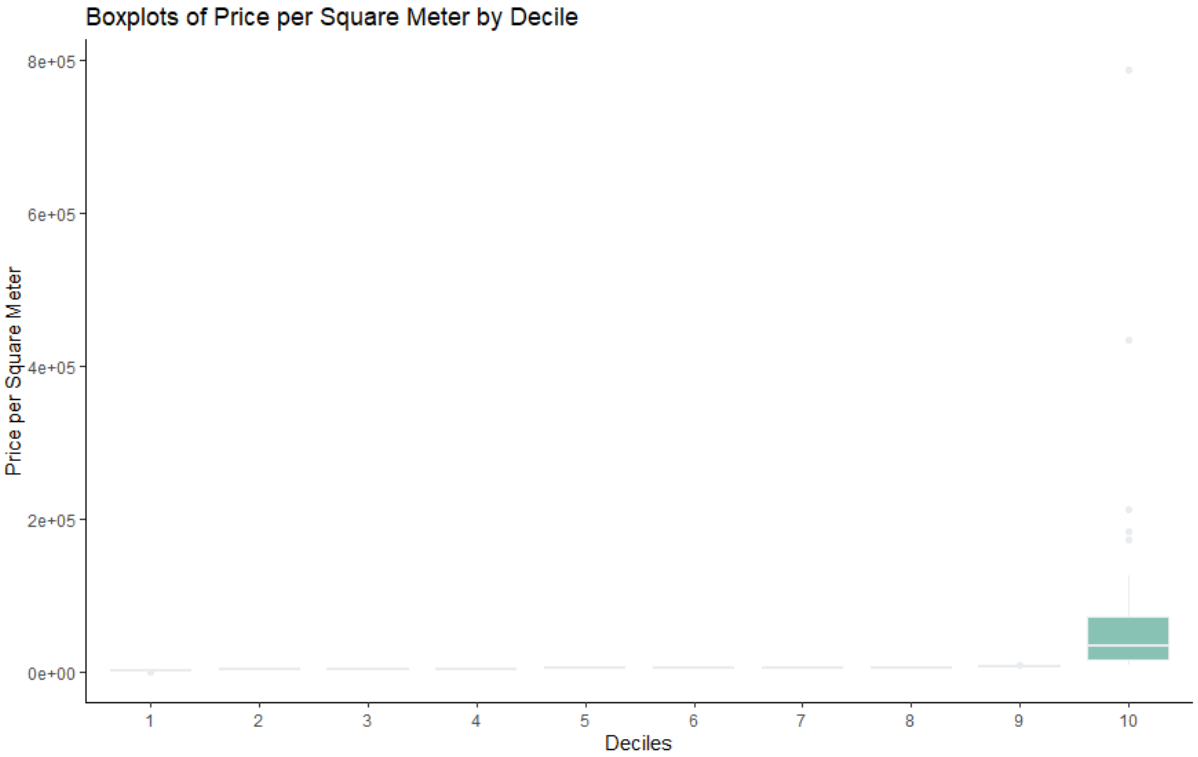

Figure 2: Boxplots of the price per square meter by decile

Therefore, we decided to apply a winsorizing procedure which is a data transformation technique that limits extreme values in order to reduce the influence of outliers. This step was essential to ensure a more robust and representative analysis by removing atypical values from the sample without discarding valid observations entirely. The final database contains 19055 observations for the City of Lyon.

Figure 3 below shows a histogram with the final distribution of property prices per square meter. Although this transformation reduced the impact of extreme values, the distribution still appears to be moderately left-skewed (more data is focussed to the left side), meaning that the data is not symmetrically distributed around the mean – the grey line shows how the distribution would be if the data follows a normal distribution.

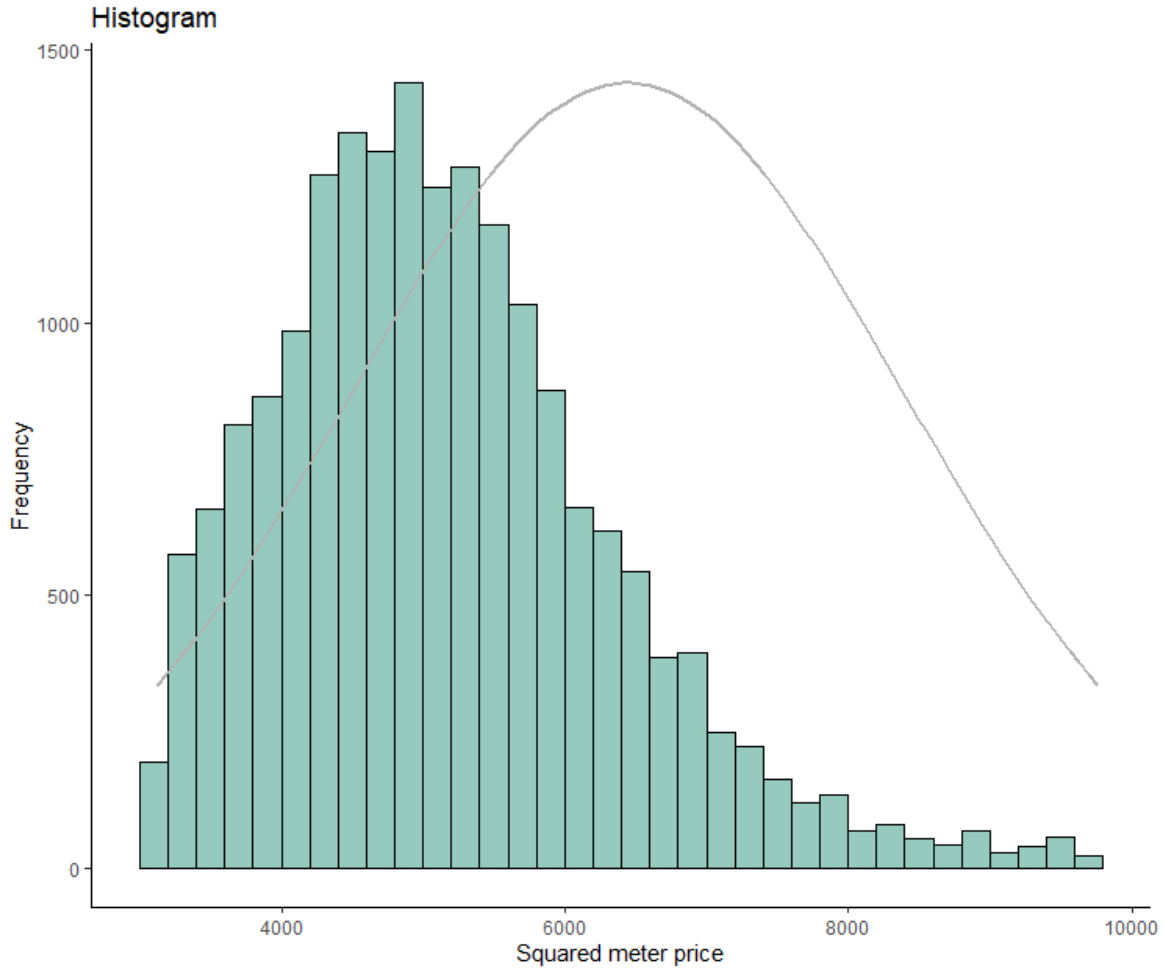

Figure 3: Histogram of the price per square meter after the data transformation

3.1.2 Test normality

As a last step, even if the former graph shows that the distribution is left-skewed, we conducted two tests to analyse the final database to demonstrate that it does not follow a normal distribution.

The first test applied was the Q–Q plot (quantile–quantile plot), which is a graphical tool used to visually assess whether a dataset follows a normal distribution. This plot compares the quantiles of the actual data with those of a theoretical normal distribution. In an ideal case, if the data were normally distributed, the points would align closely along a reference line (red line). However, in this case, the points deviate significantly from that line, especially at the extremes, indicating that the data does not follow a normal distribution.

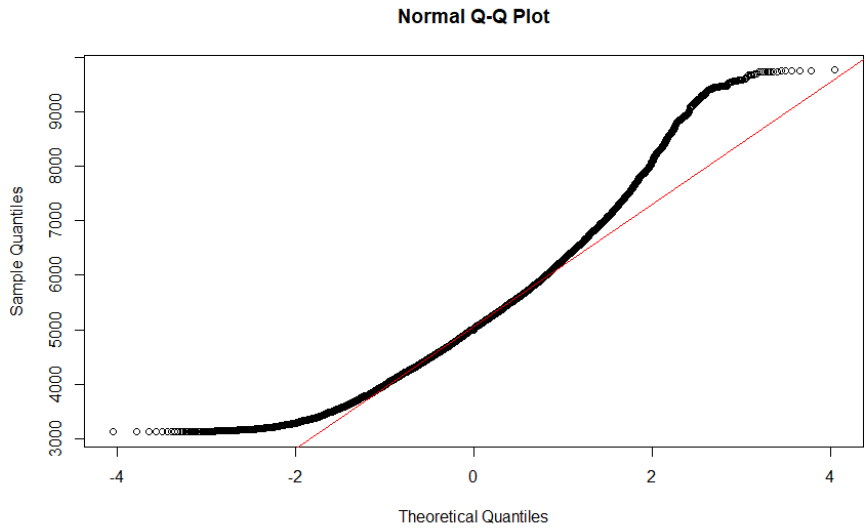

Figure 4: Normal Q-Q Plot

The Anderson–Darling test for normality yielded a p-value of 2.2e−16, strongly rejecting the null hypothesis of normality at any conventional significance level.

```
        Anderson-Darling normality test

data:  df_lyon_def$prix_m
A = 135.46, p-value < 2.2e-16
```

Given this evidence, it is statistically inappropriate to rely on the mean as a measure of central tendency, as it is sensitive to skewness and potential remaining outliers. Instead, the median is adopted as a more robust indicator of the typical value within the dataset. The advantages of using the median in this context include:

- Resilience to outliers: Unlike the mean, the median is unaffected by extreme values.
- Better representation of skewed distributions: It provides a more accurate central value when the data are not symmetrically distributed.
- Interpretability: The median directly reflects the 50th percentile, offering a clear and intuitive sense of the "middle" property value.
- Stability: The median remains stable across variations in the tails of the distribution, making it more reliable in real estate markets with heterogeneous pricing.

As a result of this analysis, the median price per square meter by arrondissement was selected as the reference value for analysis (see Table 1 below). This approach ensures robustness against skewed distributions and the influence of outliers. As outlined in *Deliverable 3.5*, this median value is used exclusively in cases where no sales data are available within the dataset for a given property. It serves as a fallback estimation method to fill informational gaps without introducing distortions from potentially unrepresentative individual transactions.

Code postal	Price per square meter (Median)
69001	5466.6
69002	5837.2

69003	5000.0
69004	5454.6
69005	4500.0
69006	5957.1
69007	4888.5
69008	4593.9
69009	4525.4

Table 1: Median price per square meter by arrondissement

Lessons learned: *The main challenge we faced during this data cleaning process was that the database was not clean to begin with. The database came from administrative records, and presented several issues such as missing values, outliers, inconsistences and potentially erroneous entries. These limitations required significant time and effort to correct before any analysis could be conducted. Therefore, the key lesson learned was the importance of understanding how the data behaves: recognising patterns, identifying irregularities and being prepared to choose appropriate statistical tests accordingly.*

For the new version of the CSSBDA using the complete dataset for France, the same inconsistencies were identified. Additionally, three departments, located in the region "Grand Est" — Moselle, Bas-Rhin and Haut-Rhin — do not report any data. Therefore, we will apply the same methodology for outlier values and use the median value in cases where data coverage is missing, in order to ensure robustness for the results.

3.2 Development of the Climate Dryness Index

Deliverable 3.5 described the idea behind the Climate Dryness Index (CDI), a compound index to describe the combined effect of drought and heatwaves. This index is different from the one currently used in the French Cat Nat scheme (i.e. the Soil Wetness Index), which has limitations when applied in the context of a changing climate.[3] The two components of CDI, namely SPI (Standardized Precipitation Index) and SHI (Standardized Heatwave Index), were computed using long-term climate projections of total precipitation and maximum temperature from the Coupled Model Intercomparison Project Phase 6 (CMIP6). SPI is a widely used precipitation-based index (McKee et al., 1993) to describe drought events and their time scale, probability and intensity. SPI can be aggregated at different month scales, enabling flexibility in assessing precipitation patterns over different periods: for instance, a 3-month SPI (SPI3) assesses precipitation anomalies over 3-month accumulation periods. SHI is a novel index developed by Amigo and derived as a modification of an existing heatwave index developed by Russo et al. (2014), widely adopted for monitoring heatwaves.[4] A subset of five CMIP6 models has been selected, and simulations were conducted under two specific Shared Socioeconomic Pathways (SSPs): SSP3-7.0 and SSP5-8.5. These SSPs represent high-emission, high-impact climate futures as defined in the IPCC Sixth Assessment Report (AR6, 2021). SSPs are scenario

[3] For further discussion, please refer to *Deliverable 3.5.*
[4] For further discussion, please refer to *Deliverable 3.5 (Section 4.1 The Climate Dryness Index).*

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frameworks that describe different socio-economic developments and their implications for greenhouse gas emissions. In our case, the two most pessimistic scenarios were chosen to highlight the potential severity of future extreme climate conditions. However, the methodology can be extended to other SSPs if necessary.

As described in *Deliverable 3.5*, we applied a bias correction and downscaling procedure to the selected climate projections. This approach corrects systematic errors in raw model outputs and improves their spatial resolution. The method follows the procedure described in Trentini et al. (2025) and targets the two key variables for CDI computation: maximum temperature (for SHI) and total precipitation (for SPI).

In computing the CDI, we focused specifically on the months from May to October. This seasonal window was chosen for two primary reasons:

- CSS related subsidence typically occurs during the warm, dry summer months, when soil moisture levels are at their lowest and thermal stress is highest; and
- Including both the preceding and subsequent months around peak summer allows us to better capture the cumulative and delayed effects of moisture deficits, which can significantly influence subsidence dynamics over time.

The CDI was then calculated using the following procedure[5]:

1. Compute the ensemble mean of CDI across the five models over the historical period (1990-2020) and in the future period (until 2050);
2. Establish the CDI threshold based on historical baseline values: we took the second highest value found over a historical period;
3. Count the number of exceedances over this threshold; and
4. Aggregate the exceedance counts over 5-year periods.

The main findings from the analysis are shown in Figure 5 and indicate an increase in the CDI over time under both SSP3-7.0 and SSP5-8.5 scenarios. This trend reflects a projected increase in the frequency, duration, and intensity of extreme dryness events in the coming decades. Such conditions may exacerbate soil subsidence risks, with serious implications for houses and infrastructures.

[5] Note that the bounding box used in the analysis is roughly 300 km², a bigger area which includes also the City of Lyon.

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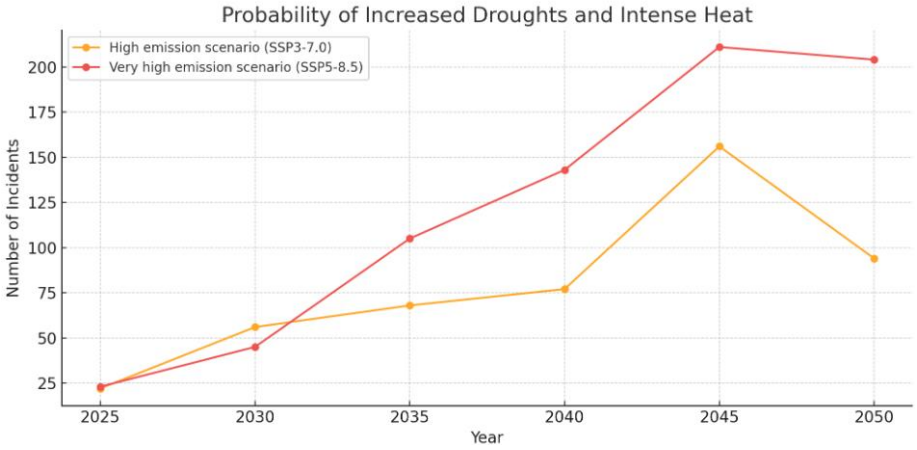

Figure 5: Projected number of extreme dryness events (CDI exceedances) under high (orange line) and very high (red line) emission scenarios

A preliminary validation of CDI was carried out by comparing its historical values to years identified in the literature as particularly severe for subsidence in France. According to Charpentier et al. (2022), the years 2003, 2005, 2011, and 2018 stand out as the most critical in terms of soil subsidence impacts. When examining the CDI values over the historical record (see Figure 6), we observe that these years consistently correspond to local peaks in the index. This alignment provides encouraging evidence that the CDI effectively captures compound drought and heatwave conditions associated with increased subsidence risk and may serve as a reliable proxy for anticipating such hazards.

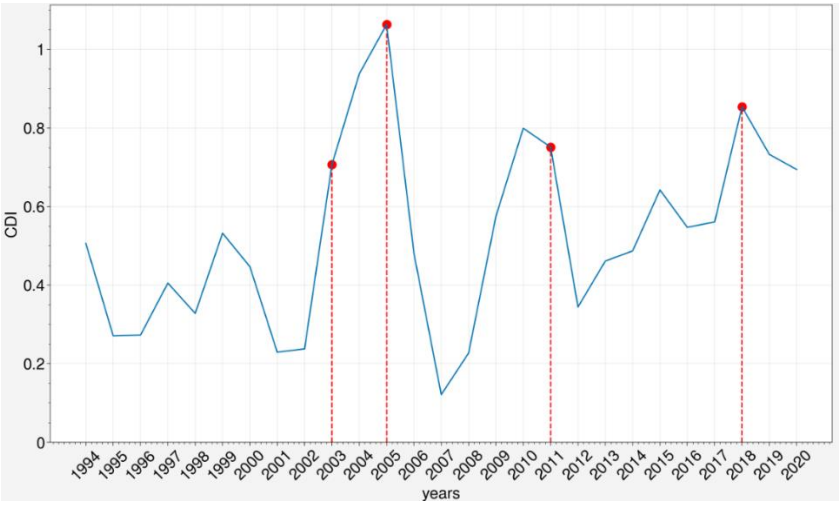

Figure 6: Average annual CDI values from 1994 to 2020 over the Lyon metropolitan area. The index captures compound drought and heatwave conditions during the critical months of May to October. The peaks in the 2003, 2005, 2011, and 2018 (red dots), have been identified by Charpentier et al. (2022) as years with particularly severe subsidence impacts in France.

Lessons learned: *Until now, the CDI analysis has been conducted for the geographic area surrounding the City of Lyon which served as a pilot region to test and validate the methodology. This has demonstrated that the methodology is sound and a good basis for replicating the CSSBDA at national level in France. For this replication at national level in France the CDI will be computed at the national level across France. The web platform will display a map of France that*

highlights projected increases in the frequency of compound drought and heatwave events. This replicability effort responds to the need for broader spatial insights and will allow stakeholders to explore future climate risks for various regions at a 9 km spatial resolution.

3.3 Software development

3.3.1 From specifications to project scope

Software development began with the specifications detailed in *Deliverable 3.5* which outlined in a very extensive and clear way, information about the vision, objectives and expected functionalities of the CSSBDA. This document served as the foundation for establishing the scope of work, website structure (pages), required features and technical constraints.

A development timeline of two months was scheduled, starting in December 2024. This early planning step was crucial to align expectations and ensure feasibility of delivery within the proposed time frame. The CSSBDA was scheduled to be online by the beginning of February, before expected dissemination planning by March 2025.

Lessons learned: *Early delivery of well-scoped and complete documentation in Deliverable 3.5 significantly accelerated technical planning and helped identify the main website features quickly.*

3.3.2 Design and front-end preparation

From the beginning, a versatile team was created which included expertise in both software engineering and product design. A dedicated product designer was responsible for creating mock-ups to ensure the CSSBDA would be visually engaging, intuitive to navigate and aligned with the PIISA project's communication goals. This was essential to deliver a strong user experience, particularly given the complexity and volume of information to present.

To stay on schedule for delivery of the CSSBDA, we adopted a parallel workflow in which backend development and data integration began while the visual designs were still being created. The design mock-ups were initially scheduled for SFO feedback and validation in early January 2025. However, as full feedback on the proposed text and visuals could not be provided at this point, software development was continued using the available text and visuals to avoid delays. Thanks to this approach, the CSSBDA was delivered in a test environment by the end of January, in line with the initial project schedule.

Full design feedback was provided in February 2025, which led to necessary updates to the mock-ups and significant adjustments to the implemented pages. These changes extended the development timeline but were essential to align the final CSSBDA with the intended communication goals and user expectations.

Lesson learned: *Clear communication and respect for design validation milestones are critical. Feedback delays should be anticipated in planning, with buffer time to adjust if necessary.*

3.3.3 Backend development and data integration

The backend work started early, focusing on API connections and data handling. Integration was implemented with:

- API Adresse (Gouv.fr) for address autocompletion.
- API GeoRisques for clay risk data in France.

- CSV imports for real estate prices ("données foncières"), publicly available online. Data is collected and pre-processed by SFO.
- Data for probability of severe droughts and intense rainfall, provided by Amigo project partner.

A modular backend architecture (Node.js / Express / PostgreSQL) allowed for incremental development and website performance. The frontend was built using Astro (Server Side Rendering) with React components.

An important part of the process was the validation of calculated data and results of the CSS risk assessment report. The software developer worked closely with Ana Katherine Rivera, Data Analyst. Ana led the work on behalf of the SFO in relation to developing the CSSBDA and was available and reactive to ensure the accuracy and consistency of data inputs and outputs throughout the platform.

Lesson learned: *Developing backend logic in parallel with user interface (UI) design is feasible when supported by a modular architecture. In this case, the short timeline and clearly defined feature requirements helped guide and justify the architectural choices. Close collaboration between SFO and the software developer is highly beneficial for quality and milestone validation.*

3.3.4 Public platform vs admin platform: dual requirements

The CSSBDA was structured into two functional parts:

- Public Website: Designed for homeowners to learn about clay shrink swell and assess their risk. Includes maps, risk assessment report generation, and educational content.
- Admin Back Office: Built for project team members to manage translations, update real estate data, track user-generated reports, and receive user feedback submissions.

These components were built with different usage patterns and users in mind. The Admin Back Office interface required secure login and included tools to:

- import and replace data sets for real estate pricing;
- edit page translations; and
- view usage metrics (PDF downloads, report requests).

Lessons learned: *Building separate interfaces for public vs internal use was essential and successful. Early architecture planning allowed for both to coexist securely and efficiently.*

3.3.5 Final delivery and handover

At the conclusion of the initial development phase, and to support the transition into maintenance, the software developer delivered comprehensive technical and functional documentation including:

- Project architecture and infrastructure setup
- Admin user guide for managing site content and data
- Proper Gmail account with access to:
    - Google ReCaptcha (form security)
    - Google Analytics (site traffic)
    - Google Search Console (SEO, pages referencing)
    - Figma (design files)

- GitHub (source code repository)

Hosting provider account was handled by the client through Amazon Web Services, which contains DNS, deployment containers (Docker) and website hosting resources.

Lesson learned: *Providing a fully documented and self-contained handover package is essential to support long-term maintenance.*

4 Pilot testing the CSSBDA in the City of Lyon and feedback from users

This section articulates key lessons learned from pilot testing in the City of Lyon including efforts to publicise the CSSBDA and feedback received from user testing.

4.1 Publicising the CSSBDA

4.1.1 Online outreach

Following launch of the CSSBDA we used a variety of communication and publicity efforts to draw users to the tool.

Social media

Working with PIISA project partner LGI's Lyon-based team, we published weekly posts on a dedicated PIISA LinkedIn page over a period of six weeks. Each post highlighted a key aspect of the CSS phenomenon in France, ensuring that the core message was clear prominent, and engaging.

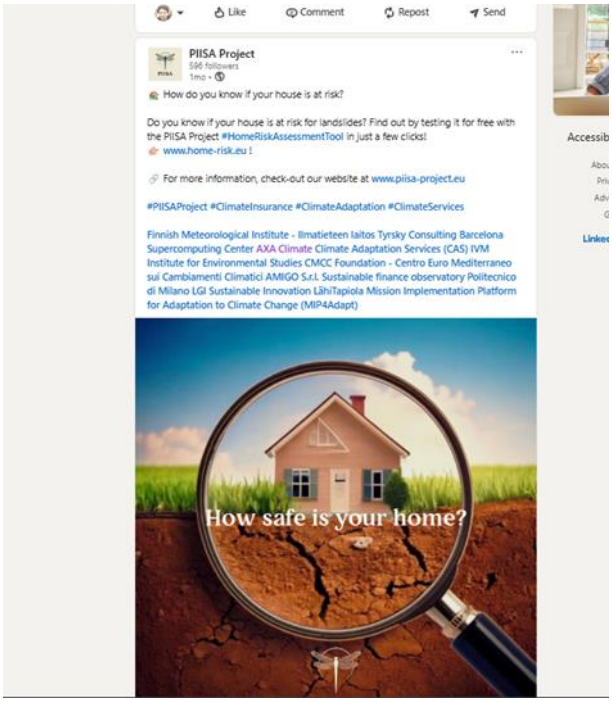

Figure 7: PIISA post on LinkedIn

Additionally, we used several social media platforms to broaden the reach of the CSSBDA. Alongside posts on our PIISA LinkedIn page, we ran targeted campaigns on Facebook, Instagram, email and Twitter. Content was shared in dozens of Lyon-based community groups and we sent over 250 direct messages to residents in the region. Residents were selected using the groups on social media based in Lyon (many groups were targeted to homeowners or those seeking to buy property) where randomly selected members from those groups were contacted on social media.

POST	DATE	IMPRESSIONS	NUMBER OF PEOPLE REACHED	CLICS	CTR	ENGAGEMENT RATE	REACTIONS	REPOSTS	COMMENTS
1	24/04/2025	204	119	1	0,49%	6,40%	9	3	0
2	29/04/2025	110	65	6	5,45%	10%	5	0	0
3	02/05/2025	314	198	13	4,14%	9,60%	15	2	0
4	07/05/2025	113	65	3	2,65%	7,10%	5	0	0
5	09/05/2025	208	114	2	0,96%	4,30%	6	1	0
6	20/05/2025	172	97	5	2,91%	7%	7	0	0

Figure 8: PIISA LinkedIn account statistics

Figure 8 above shows the first batch of statistics for the PIISA LinkedIn account, covering April and May 2025. Unfortunately, we are unable to provide data from Twitter (X), as it's not accessible through free accounts, which is the case in our situation. So far, our promotional efforts have been limited to social media posts and website updates. However, the campaign continued through June, July, August and September, with additional visibility in the PIISA Project Newsletter published on 25 June 2025.

Targeted outreach

We conducted targeted outreach to key stakeholders in the Lyon area who we identified as being a means to disseminate information about the CSSBDA to local residents.

- Given their potential links to property owners, we identified real estate and wealth advisors as strategic entry points to amplify the CSSBDA's reach. We began by compiling a list of 38 real estate agencies operating in the Lyon area and contacted each one to present the CSSBDA, encouraging them to present the platform to their clients.
- We also contacted 32 local city halls across the Lyon region. Particular attention was given to regions located in high-risk zones as identified by the CSSBDA platform, ensuring the platform reached the areas most affected by CSS risks.

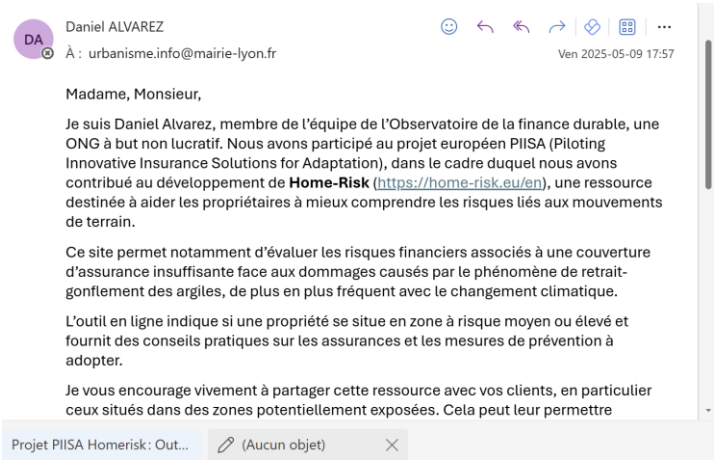

Figure 9: Example of targeted outreach to a local city hall in the Lyon region

4.1.2 In person outreach

SFO secured a stand at the 4th annual "Forum de la Finance Éthique" (Ethical Finance Forum) on 17 May 2025 in order to showcase the CSSBDA and other tools developed by the SFO.[6] This event was held at the City Hall in the heart of Lyon, was open to the public and offered an opportunity to explore a range of local initiatives. Other participating organisations included La Gonette, CIGALES AURA, and Toits en Transition – UDTS.

Figure 10: SFO attendance at the Forum de la Finance Éthique (Ethical Finance Forum)

This free public event provided a valuable opportunity to raise awareness among Lyon residents about the risks associated with CSS events, and to receive personal feedback from the public on the CSSBDA.

After an introductory discussion, respondents were invited to test the CSSBDA. They were guided through the various subpages of the CSSBDA, with an emphasis put on the risk map that visualises CSS risk zones and their potential impacts on their personal property. Once the respondents had been able to navigate through the CSSBDA we asked them questions to receive their feedback on how useful and clear they found the website to be.[7]

Together, these efforts show a comprehensive and locally grounded communication strategy that combined institutional partnerships, targeted stakeholder engagement, and broad public outreach. By leveraging both digital and in-person methods, we not only expanded visibility of the CSSBDA but also helped identify areas for improvement based on feedback from residents.

Lessons learned: *The initial pilot phase of CSSBDA outreach in the City of Lyon demonstrated the value of combining targeted local engagement with both digital and in-person communication efforts. The most successful elements included direct messaging via social media, outreach to real estate and wealth advisors, and in-person visibility during the Ethical Finance Forum.*

However, despite these efforts, a key lesson learned is the challenge of converting awareness into measurable website traffic. While residents responded positively to the CSSBDA during in-

[6] https://www.lyon.fr/evenement/festival/forum-de-la-finance-ethique-choisir-la-finance-responsable-et-solidaire
[7] Around 200 people attended the Ethical Finance Forum. The SFO was able to interview 20 of them.

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person sessions, online engagement proved less effective for reaching individual homeowners. This observation was particularly apparent for LinkedIn (see below) which we conclude is not the best platform for targeting individual homeowners.

Limiting the focus of the pilot phase to the Lyon area also limited the effectiveness of our publicity campaign. Lyon was selected as the pilot city because CSS risk is apparent there and partners could assist with publicising the CSSBDA tool during the pilot phase. However, CSS risk is elevated in other areas of France (which we would assume means there is increased homeowner interest). In addition, focusing on the City of Lyon only meant that PIISA project communications tools as a whole were less useful (as they are not tailored to be used for such a specific geographic area) which made it difficult to generate broad momentum.

Another issue to address when the CSSBDA gets promoted at a national level, is the language in which information is disseminated. Most of our communication regarding the CSSBDA was shared in French. However, LinkedIn posts were not. Within the LinkedIn page, weekly posts were shared about the CSSBDA together with other activities under the PIISA Project with everything written in English. For the French focus of the CSSBDA, communicating in English was not ideal as we did not communicate in the native language of our target audience.

Using LinkedIn was not the most effective choice for promoting the CSSBDA to our core user base, as LinkedIn primarily attracts professional white-collar workers. This approach risks excluding other important audiences, such as older or retired individuals, or those outside of LinkedIn's typical user base.

For replication of the CSSBDA at national level, we will adjust our channel strategy by emphasising platforms more appropriate for homeowners (e.g. Facebook groups, local press, and associations) and refining our messaging to highlight clear value for users. Additionally, paid, geotargeted social media campaigns could offer a cost-effective way to reach broader and more relevant demographics. Future outreach should embrace a more inclusive, user-centred digital strategy, and build on the platform's clear added value as a free, trusted resource that helps homeowners understand and reduce their financial exposure to climate risks.

4.2 Feedback from user testing

4.2.1 Feedback from in person event

During our exchanges with Lyon residents, we introduced a short questionnaire designed to raise awareness about CSS risks and gauge understanding of the issue. This included the following questions:

1. Are you familiar with the problem of building damage due to clay shrink-swell cycles, and how widespread this issue is in France?
2. Are you aware of the financial risks linked to the absence of insurance coverage for damage resulting from clay shrink-swell?
3. Did you find the platform easy to navigate?

A significant majority (83%)[8] expressed that they were unaware of the CSS phenomenon or its consequences. 83% of respondents also admitted they had not realised just how serious the

[8] Around 200 people attended the Ethical Finance Forum. The SFO was able to interview 20 of them.

financial consequences of CSS could be – particularly in terms of property damage and limited insurance cover. These results provide broad support for the primary objective of the CSSBDA to educate homeowners about the financial risks from inadequate insurance cover for property damage caused by CSS events.

The first two questions of the survey served to introduce the topic of CSS and assess how well it is understood before presenting the CSSBDA platform. These interactions with the audience allowed us to receive user feedback on the platform. Nearly 75% of respondents also provided positive feedback on the website including its layout and messaging.

Several participants found the CSSBDA's concept relevant and appreciated the clarity of its design. The visual presentation of the risk map was particularly well received, with many highlighting its simplicity and ease of use. The platform was also described as informative and well-structured, offering a user experience that felt both accessible and purposeful. We consider that these results provide broad justification of the parameters that have shaped the development of the CSSBDA. Homeowners must be assumed to be non-experts on the subject therefore communicating to this audience requires transparency, simplicity and clarity.

However, a few limitations were noted. Most notably, the current version of the risk map does not yet cover the entire geographic area for the City of Lyon.[9] As a result, some users who were interested in assessing the CSS risk associated with their property were unable to do so, as their neighbourhoods were not yet included in the map's coverage.

Another suggestion for improvement concerned the inclusion of a property value estimate. Some users felt this feature was unnecessary, as most homeowners already have a sense of their property's worth. Including such information may risk undermining the perceived credibility or focus of the CSSBDA.

Lessons learned: The pilot in the City of Lyon demonstrated that the CSSBDA could attract considerable interest and achieve widespread reach at the national level. The practical and free resources provided on the CSSBDA meet this demand and foster strong user engagement.

The feedback gathered during the in-person testing phase further confirmed both the relevance of the CSSBDA and key areas for improvement. Notably, 83% of respondents were unaware of the CSS phenomenon and its financial consequences — validating the platform's educational mission. Around 75% of participants gave positive feedback on the CSSBDA's usability and content, particularly praising the clarity of the risk map and the website's overall design. However, the limited geographic coverage of the risk map led to frustration among some users whose neighbourhoods were not yet included — underlining the importance of ensuring full regional coverage before any national promotion. Similarly, the inclusion of a property value estimate was perceived as unnecessary and potentially counterproductive, which should be removed in future iterations (see above).

[9] In the version of the CSSBDA which was pilot tested in the City of Lyon, the map only included data for department 69, but in the latest online version we already have national-level data; however, in the report itself we only display information within a 10 km radius of the given address, and areas without Georisques FR estimates are shown as 'très faible risque'.

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4.2.2 Feedback from interaction data

In addition to qualitative feedback from the in-person event, we also tracked user interaction data to better understand how website visitors navigated CSSBDA using the free version of a software called Hotjar.

Hotjar is an analytics and feedback platform that helps website owners gain a deeper understanding of how users interact with their site. It offers tools such as heatmaps, session recordings, and on-site surveys to visualise user behaviour.

On average, users spent approximately five minutes on the site. This is an encouraging sign that the CSSBDA was easy to use and the content engaging.[10] The most frequently visited section was the risk assessment tool, confirming its central role in the user experience.

Data collected from another tracking source on the CSSBDA showed that 67% of visits to the CSSBDA culminated in the user downloading the risk report for their property while the remaining 33% only consulted the risk information without proceeding to a download.[11] The high download rate points to strong user engagement and a clear interest in accessing detailed property risk data.

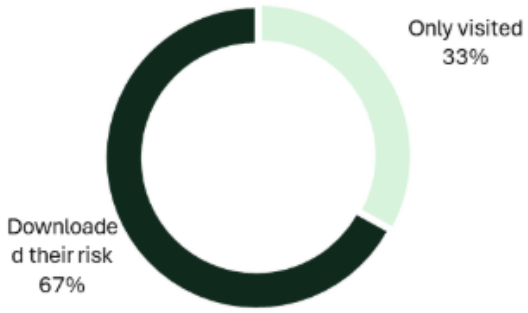

Figure 11: Percentage of users whose experience culminates in downloading the risk report

The data also showed that website traffic was highest in areas with the most expensive property prices per square meter, suggesting a potential link between property value and interest in risk-related information. For instance, 39% of all visits came from Lyon's 6th arrondissement. The 1st and 7th arrondissements also recorded significant traffic. These areas are either located near the Saône River or contain many older and historic buildings, which may contribute to greater user interest in understanding property risks.

86% of users accessed the CSSBDA via desktop rather than mobile devices. This corroborates the approach that we adopted to ensure the design of the website was mobile friendly in order to ensure accessibility and engagement.

[10] Users usually don't spend much time on a website or tool that is not user-friendly — they tend to log out quickly. In this case, we notice they spent around 5 minutes, which is a solid KPI indicating usability.
[11] Data relates to 149 visits.

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4.2.3 Feedback from communication experts

In addition to feedback from users of the CSSBDA we also took the decision to have feedback from a communication perspective by members of the communication team at the SFO. The objective of this feedback was to thoroughly vet the information and messaging in the CSSBDA to ensure that it was a clear as possible and communicated in the best way.

This review of the CSSBDA from a communication and user experience perspective highlights several practical improvements to enhance clarity, engagement, and trust in the tool. First, the homepage currently lacks a strong and compelling value proposition — which is key to immediately capturing the user's attention. It is recommended to feature a concise tagline such as 'Know your clay risk in 3 minutes,' along with a clear call-to-action like 'Start Risk Assessment.'

The review also points to the importance of transparency around the interactive map. When data is unavailable for certain areas, users should be clearly informed — for example, with a message like 'Data not yet available – leave your email for updates.' The inclusion of a property value estimate is also seen as unnecessary and potentially confusing; most users already know the value of their home, and this information may distract from the CSSBDA's core purpose.

Finally, the structure of the content could be adjusted to prioritise the user's risk result and practical next steps, before introducing more detailed background information. This would support the CSSBDA's main goal: helping homeowners better understand their insurance risks from CSS events.

Lessons learned: *Altogether, the communication and user experience review confirms that while the CSSBDA shows strong potential and has been positively received, several improvements can strengthen its clarity and usability. There are no fundamental flaws in the concept or structure, but a number of refinements are recommended to better serve its target audience. These include improving the homepage messaging to immediately convey the CSSBDA's purpose, enhancing transparency where map data is incomplete, and removing the unnecessary property value estimate to avoid confusion. The mobile experience can also be optimised, and the user journey reorganised to prioritise results and next steps. These suggestions are not critiques of the CSSBDA's foundation, but rather enhancements that will support wider adoption and ensure a more intuitive and informative experience for users as the CSSBDA is developed further and rolled out nationally.*

5 Planned changes to the CSSBDA following pilot testing

This section articulates planned changes to the CSSBDA to address feedback we received from user testing which will be implemented prior to replicating the CSSBDA at national level in France.

5.1 CSSBDA homepage

Feedback from communication experts stated that the homepage currently lacks a strong and compelling value proposition — which is key to immediately capturing the user's attention. It was recommended to feature a concise tagline such as 'Know your clay risk in 3 minutes' which will be incorporated in the CSSBDA homepage. Furthermore, the current text 'Get my personal assessment' (see Figure 12 below) will be replaced with a clear call-to-action like 'Start Risk Assessment.'

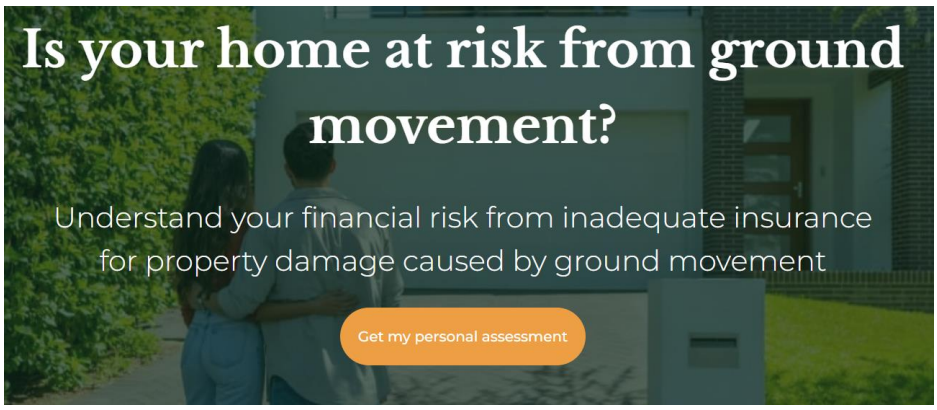

Figure 12: Current homepage text which will be amended

5.2 Assess your risk webpage

5.2.1 Make property value less prominent and not the first thing a user sees

In the version of the CSSBDA which was piloted in the City of Lyon, the estimate of the property value is the first thing which is seen in the personalised information following the risk assessment.

Figure 13: Screenshot showing the estimated property value from CSSBDA

However, feedback from the in-person event and communication experts articulated that many homeowners have an accurate estimate of their property value as this is likely to be their largest asset. As described in Section 3.1, the CSSBDA includes an *estimate* of the property value which has been derived through a process of data cleaning and using a median average to account for outliers. As an estimate, this means that there is a high potential that the estimate will not correspond exactly to a homeowner's more knowledgeable own assessment. But if this is the first piece of information which a user sees, and they dispute this information based on their own understanding of the property value, this is a sub optimal start to the interaction with the CSSBDA.

For this reason, we will change the order of the information in the personalised information following the risk assessment so that it does not lead with this estimate of the property value. Instead, it will lead with the estimate of the CSS risk level as the primary information.

In addition, we will also integrate a facility for users of the CSSBDA to input their own estimate of the property value if they disagree with the initial property value estimate provided by the CSSBDA.

5.2.2 Geographical distribution of clay and clay shrink swell risk zones

From our feedback there was broad support for the map as a useful visualisation tool to reveal the areas at risk of CSS events (note that this will be risk of CSS events only and will not include e.g. landslide risk or other risks). Therefore, we will keep a map when replicating at national level so that in the personalised information following the risk assessment there is a map which shows the local geographic area for the user and the areas at risk of CSS events.

5.2.3 Likelihood of CSS events increasing over time

When replicating the CSSBDA at national level in France, the CDI will now be computed at the national level across France. The CSSBDA will display a map of France that highlights projected increases in the frequency of compound drought and heatwave events. This replicability effort responds to the need for broader spatial insights and will allow stakeholders to explore future climate risks for various regions at a 9 km spatial resolution.

5.2.4 Cost of repairs for property damage caused by CSS

We will improve the visualisation of the infographic here – at the moment it looks quite basic (see Figure 14) and does not communicate a story well about the likelihood of different ranges for the cost of repairs.

Figure 14: Infographic on the cost of repairs for property damage caused by clay shrink swell

5.2.5 Decrease in property value caused by clay shrink swell

As mentioned above in Section 5.2.1, the personalised information following the risk assessment will lead with the estimate of the CSS risk level as the primary information and remove the information on property value. Therefore, the information on property value (e.g. either the property value estimate or the user's own estimate of the property value) will only appear in this section of the personalised information following the risk assessment.

5.3 PDF download

5.3.1 General presentation

We will seek to make the general presentation of the PDF download more polished. At the moment there are lots of redundant spaces in document format and the infographics from the Asses your risk webpage do not render as well as they could in the PDF document. The changes we will make to the general presentation of the PDF download include the following:

- Include the PIISA logo as a banner;
- Ensure PIISA colour palette covers the entirety of the PDF page and that the colours which are used work in the context of users printing out the PDF download; and
- Address spacing and font size of the text.

5.3.2 Corresponding changes from changes to Assess your risks webpage

The changes we have identified for the Assess your risks webpage above will also be reflected in the changes to the PDF download.

5.3.3 Guidance for how to reduce your financial risks

Feedback from communication experts identifies that while the CSSBDA has a clear narrative in relation to articulating the risk to homeowners from inadequate insurance for property damage caused by CSS events, it is less clear in relation to articulating what homeowners can do to protect themselves. On the one hand this is to be expected, as the objective for the CSSBDA is to shine a light on the issue in the hope that this will increase pressure on the insurance industry to address the problem but there is very little in terms of immediate and tangible steps homeowners can do to protect themselves

However, the information which is included in the PDF download is minimal and we will therefore improve with the following changes:

Replicate more of the information from the Take action webpage: At the moment the PDF download only covers the headings of the four categories of activity which homeowners should do to protect themselves and their property. We will therefore include more of the information which is in the Take action webpage to ensure the information in the PDF download is more complete:

- Ask the right questions before buying a property: In addition to including the information in the Take action webpage for this category of action we will also include more information about how to find and access a Natural Risk Prevention Plan.
- Ensure preventative measures are in place: In addition to including the information in the Take action webpage for this category of action we will also include more information about different types of work which can constitute horizontal and vertical measures.[12]
- Use your voice as a citizen: In addition to including the information in the Take action webpage for this category of action we will also include links to other websites in France which are community groups designed to leverage pressure on the State and the insurance industry in relation to property damage caused by CSS events. These may include:
  - The national association: *Les oubliés de la canicule* which aims to increase awareness of the drought phenomenon and its effects, the drought hazard map, and parameters for assessing sensitive soil. This association also aims to provide complementary information to legal institutions (local authorities, insurers etc.) and to support homeowners through providing information and advice on the main repair techniques and the choice of repair companies. The association has launched two petitions (one to the President of the Republique and one to the Minister of the Interior) asking for a better indemnification of CSS.
  - The *Association française pour la prévention des catastrophes naturelles et technologiques* aims to create a permanent, cross-disciplinary, multi-hazard platform of players (legal entities and individuals) involved in preventing and managing disaster risks and reducing their consequences.
  - The *Association Nationale des Assurés Sinistrés Sécheresse* aims to help and assist with administrative procedures for policyholders who are victims of drought affecting their property, and more generally support them in following procedures aimed at compensation of their claim.

  - There are also local associations which are generally listed in the city website, such as *Association Ardéchoise des Sinistrés de l'Ardèche – CatNat*. They do not have a website, but they organise meetings and pressure at local level for the recognition of the state of Cat Nat.

[12] As described in *Deliverable 3.5*, vertical measures are those which relate specifically to the property to prevent CSS. They are very effective but expensive and cost between €21,000 to €76,000. Horizontal measures involve acting on the surrounding environment to prevent soil movement (for example, the installation of anti-root screens or drainage systems). While their effectiveness is not perfect they are less invasive than vertical measures and cost an average of €10,000 (Sénat, 2023).

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6 Roadmap

This section includes an updated roadmap of activities which will be carried out during Loop 3 for the final stage of the project.

As referred to in *Deliverable 3.5*, the next steps for the remainder of the project should primarily focus on replicating the CSSBDA in other cities or regions in France. However, in view of broader replicability aspects and securing legacy of the PIISA project, we will also include research and outreach to publicise and ideally create demand for replication of the CSSBDA in other EU countries. This will include:

- Researching CSS risk level and insurance framework for other EU countries to identify likely demand for development of a similar kind of tool as the CSSBDA (potentially with AXA, BSC, FMI and other PIISA consortium members); and
- Outreach to consumer organisations and other stakeholders (e.g. local authorities, environmental bureaus etc.) in hotspot risk areas to publicise and create demand for replication of the CSSBDA in that area.

6.1 Researching CSS risk level

The aim is to perform a limited mapping of risk factors of CSS damage to buildings including:

- Exposure: identify regions characterised by high clay soil content
- Vulnerability: perform preliminary survey on awareness and potential impacts of CSS events
- Hazard: identify regions where hydro-meteorological conditions may potentially cause CSS events to occur and where events may intensify with climate change

To research the risk level and the insurance framework related to the CSS event in other EU countries, the following countries were chosen for a brief analysis: Finland, Germany, Italy, Luxembourg, Spain and Sweden. These countries were selected based on having regions with high clay soil content (exposure), as indicated by Figure 15, or due to practical considerations such as language accessibility for the researcher team. It should be noted that the clay percentages shown in Figure 15 refer to the share of clay in the topsoil, which does not necessarily correlate with the presence of swelling clay event.

To understand the vulnerability to CSS event, the first step will be to determine whether CSS events cause damage to buildings in these countries and, if so, how prevalent such damage is. The second step involves assessing the level of awareness, current liability practises of damage costs and existing adaptive measures related to CSS-caused damage (vulnerability), in order to understand current risk management approaches and further the potential demand for an educational tool similar to the CSSBDA in these countries. The vulnerability assessment will be conducted utilizing web-based searches (e.g. related websites, grey literature and to limited extent -scientific literature) and purposeful discussions with a small number of selected stakeholders, such as impacted homeowners, municipality representatives, and housing associations, in one or more of the selected countries. Additionally, a literature review is conducted to identify regions where climatic conditions are conducive for CSS events (hazard), and to understand how the occurrence of hydro-meteorological conditions for CSS events is projected to develop with changing climate in Europe.

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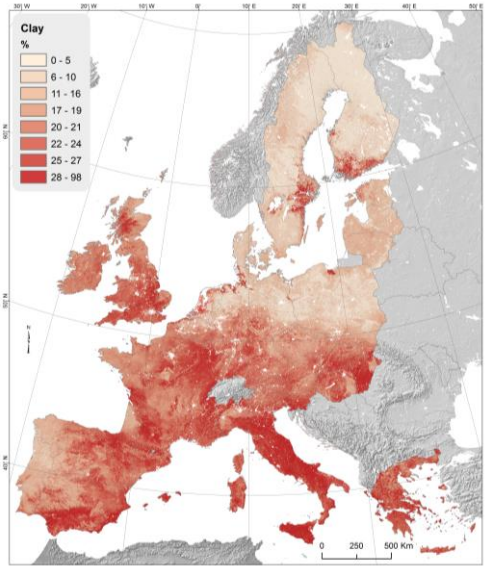

Figure 15: Clay content (%) in topsoil (0-20cm). Source: Ballabio et al. (2016)

6.2 Researching insurance framework

To research the insurance framework for the hotspot countries in terms of CSS risk, SFO is using the Trustlaw platform administered by Thomson Reuters Foundation. Trustlaw is a completely free service for civil society organisations to receive pro bono legal advice from law firms and corporate legal teams globally.

As at the date of this document, SFO has submitted a request for assistance to the Trustlaw platform and has received an offer from a law firm to provide a legal memo setting describing the advice for all of the hotspot countries in terms of CSS risk identified above. SFO expects to receive this legal memo in September 2025 and will use the information therein to inform next steps in terms of outreach to publicise and ideally create demand for replication of the CSSBDA in other countries.

6.3 Updated Roadmap

Figure 16: Updated Roadmap for Task 3.2.2 below articulates an updated version of the roadmap for future work activities for the remainder of the project which reflects this dual focus of: (1) replicating the CSSBDA itself in other cities and regions in France; and (2) further work and activities to publicise and ideally create demand for replication of the CSSBDA in other EU countries.

	LOOP 1 (M6-M19)	LOOP 2 (M19-M25)	LOOP 3 (M25-M33)	Legacy of PIISA
Tool development	1. Background research in France 2. Research information available in public databases in France 3. Methodology for the CSSBDA 4. Specifications for web developer 5. Contract web developer 6. Develop prototype of CSSBDDA 7. Internal testing	1. Launch CSSBDA in City of Lyon 2. Publicise CSSBDA in City of Lyon through online and in person events 3. Testing	1. Replicate CSSBDA at French national level (including English version) 2. Publicise CSSBDA at national level	
Piloting	1. Develop Roadmap 2. Feedback survey	1. Collect user feedback and survey 2. Iterate CSSBDA to address user feedback	1. User feedback & survey 2. Assess and address to the user feedback	More EU countries develop national versions of CSSBDA
Upscaling		1. Integrate lessons learned from publicising CSSBDA in City of Lyon to publicise at national level. 2. Research CSS risk level and insurance framework for other EU countries to identify potential demand for replication CSSBDA 3. Assess and identify third party stakeholders 4. Develop outreach plan for Loop 3	1. Webinar and workshop 2. Implement outreach plan to stakeholders in other EU countries 3. Guidance for replication of CSSBDA in other EU countries	Recognised tool for homeowners to assess risks
		D3.6	D3.11, D3.14, D3.2	

Figure 16: Updated Roadmap for Task 3.2.2

Annex 1: Procurement process

A1.1 Platform used for procurement

Malt[13] (formerly known as Hopwork) is an online marketplace that links business with freelance digital professionals. SFO established an account on 8 October 2024 and initiated a project entitled "Creation of a climate adaptation dashboard for financial assessment" on 10 October 2024. The description of the mission was finalised over the period 10-11 October 2024 and is shown in *Annex 2: Description of the mission*.

A1.2 Freelancer pool and shortlisted selection

By 5 November 2024, a total of 14 freelance digital professionals had been contacted via Malt. Table 2 below shows the results of the initial contact with each freelance digital professional.

N	Name	Profile	Status	Contacted	Daily rate
1	Expert 1 (AB, ♂)	Senior software developer	Quote received | Nov 4, 2024	Oct 25, 2024	€ 530
2	Expert 2 (AM, ♂)	Software Engineer	Quote rejected	Oct 25, 2024	€ 600
3	Expert 3 (ZN, ♂)	Senior Developer	Quote not received	Oct 25, 2024	€ 640
4	Expert 4 (JK, ♂)	Software Engineer	Quote rejected	Nov 4, 2024	€ 500
5	Expert 5 (KW, ♂)	Senior Software Engineer	Quote rejected	Nov 4, 2024	€ 780
6	Expert 6 (PB, ♂)	Software Engineer	Quote rejected	Nov 4, 2024	€ 600
7	Expert 7 (SC, ♂)	Software Engineer Fullstack	Quote not received	Nov 4, 2024	€ 550
8	Expert 8 (AF, ♂)	Software architect	Quote not received	Nov 5, 2024	€ 752
9	Expert 9 (AA, ♂)	Software Engineer Fullstack	Quote not received	Nov 5, 2024	€ 460
10	Expert 10 (BT, ♂)	Software Developer	Quote not received	Nov 5, 2024	€ 620
11	Expert 11 (JphK, ♂)	DevOps/Software engineer	Quote received | Nov 7, 2024	Nov 5, 2024	€ 650
12	Expert 12 (MC, ♂)	Senior Software Developer	Quote not received	Nov 5, 2024	€ 550

[13] https://www.malt.fr/

13	Expert 13 (OR, ♂)	Software Engineer	Quote received | Nov 11 2024	Nov 5, 2024	€ 500
14	Expert 14 (RM, ♀)	Software Engineer	Quote received | Nov 8, 2024	Nov 5, 2024	€ 500

Table 2: Results of the initial contact with freelance digital professionals

SFO carried out an internal evaluation of the received quotes on 19 November 2024. The evaluation was conducted by: (1) David Cooke, Law and Policy Lead and Researcher Lead representing SFO in the PIISA project; (2) Ana Katherine Rivera, Data Analyst who led the work on the behalf of SFO in relation to developing the CSSBDA; and (3) Javier Sandin Llorente, Operations and Grants Manager. Additionally, feedback from Amigo project partner was sought and taken into consideration during the internal assessment of the received quotes. Table 3 below shows results of this internal evaluation and the freelance digital professionals that were shortlisted for interview.

Quote received	Assessment of the quote	Outcomes
Expert 1 (AB, ♂)	Option 1: Complete Team with parallel planning. 1x Tech Lead (overseeing and leading the project's critical phases), 1x Junior Developer (assisting with development tasks), and 1x Integrator (contributing as needed to ensure seamless integration). The quote is adequately detailed. The quote is overpriced (€77,090). It exceeds substantially the indicative budget allocated for these contract services. The estimated effort-days are significantly overestimated (169 full-time working days).	NOT SHORTLISTED
	Option 2: Experienced Developer for All Phases, where a single experienced developer would handle all phases of the project. The quote is adequately detailed. The quote is overpriced (€69,010). It exceeds substantially the indicative budget allocated for these contract services. The estimated effort-days are significantly overestimated (123 full-time working days).	NOT SHORTLISTED
Expert 11 (JphK, ♂)	The quote is adequately detailed. A realistically priced quote (€17,300) that aligns with the total budget for these contract services. The estimated effort-days are realistic (30 full-time working days).	SHORTLISTED FOR INTERVIEW
Expert 13 (OR, ♂)	The quote lacks sufficient detail. A realistically priced quote (€17,300) that aligns with the total budget for these contract services. The estimated effort-days are overestimated (55 - 60 full-time working days), nearly double compared to other quotes.	NOT SHORTLISTED
Expert 14 (RM, ♀)	The quote is sufficiently detailed. A realistically priced quote (€20,400) that aligns with the total budget for these contract services. The estimated effort-days are realistic (34 full-time working days).	SHORTLISTED FOR INTERVIEW

Table 3: Internal evaluation of received quotes

A1.3 Shortlisted meeting and decision

On 19 November 2024, the shortlisted candidates were invited to attend a meeting to: (1) further understand the technical requirements for the CSSBDA; and (2) adjust their quote. SFO aimed to provide additional details about the PIISA project and address any questions shortlisted candidates might have.

Deliverable 3.5 was made available to the shortlisted candidates prior to the meeting to provide them an opportunity to review and gain a better understanding of the work to be undertaken. *Deliverable 3.5* outlines the preliminary specifications for the CSSBDA (including the methodology and data it will incorporate), summarises background research and highlights aspects of the user journey and interface design, which will evolve during the software development phase.

Each interview meeting was attended by: (1) David Cooke; (2) Ana Katherine Rivera, Data Analyst who led the work on the behalf of SFO in relation to developing the CSSBDA; (3) Javier

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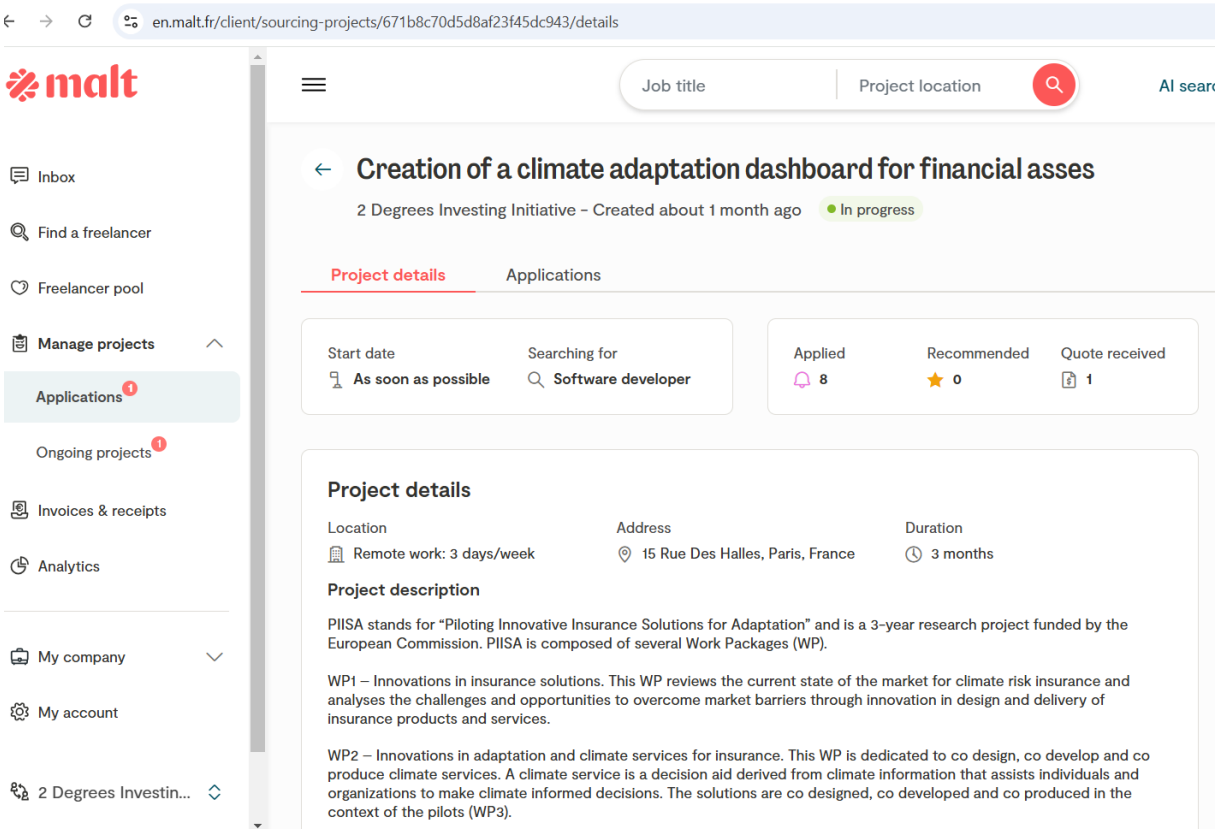
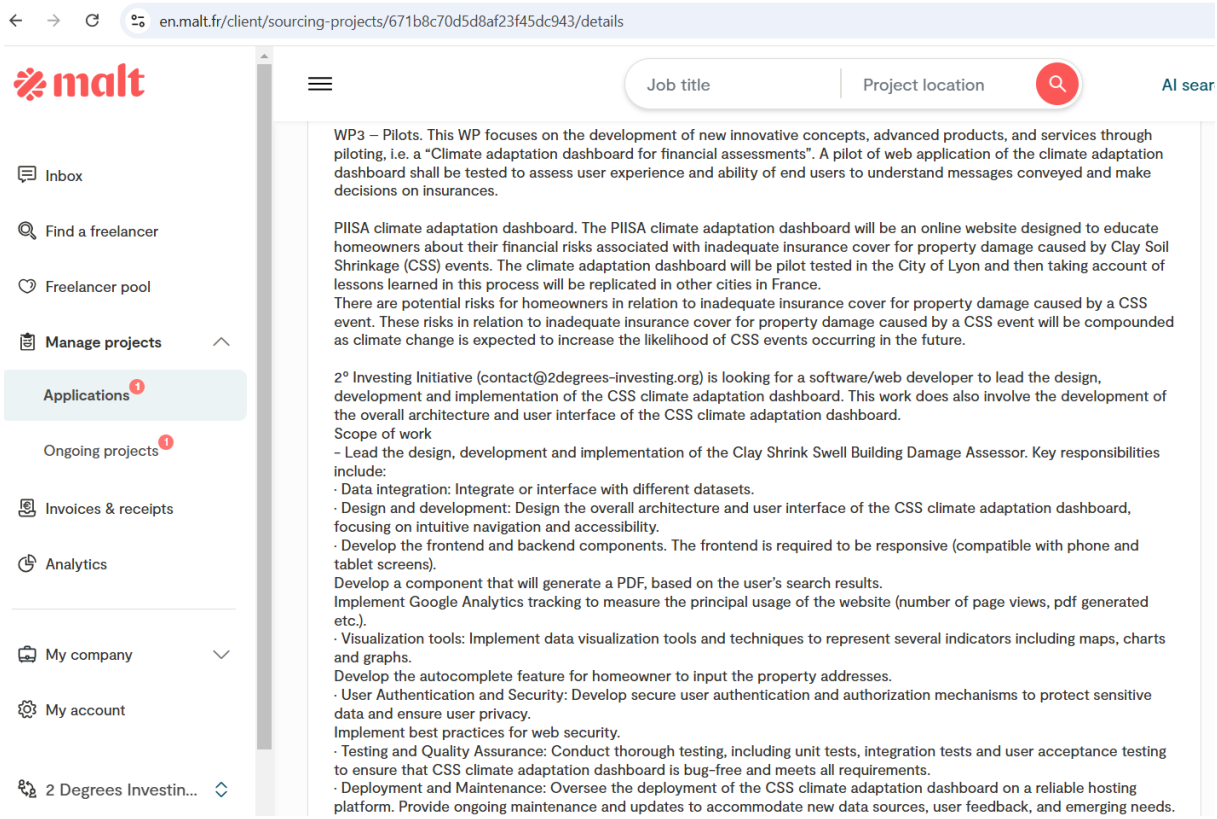
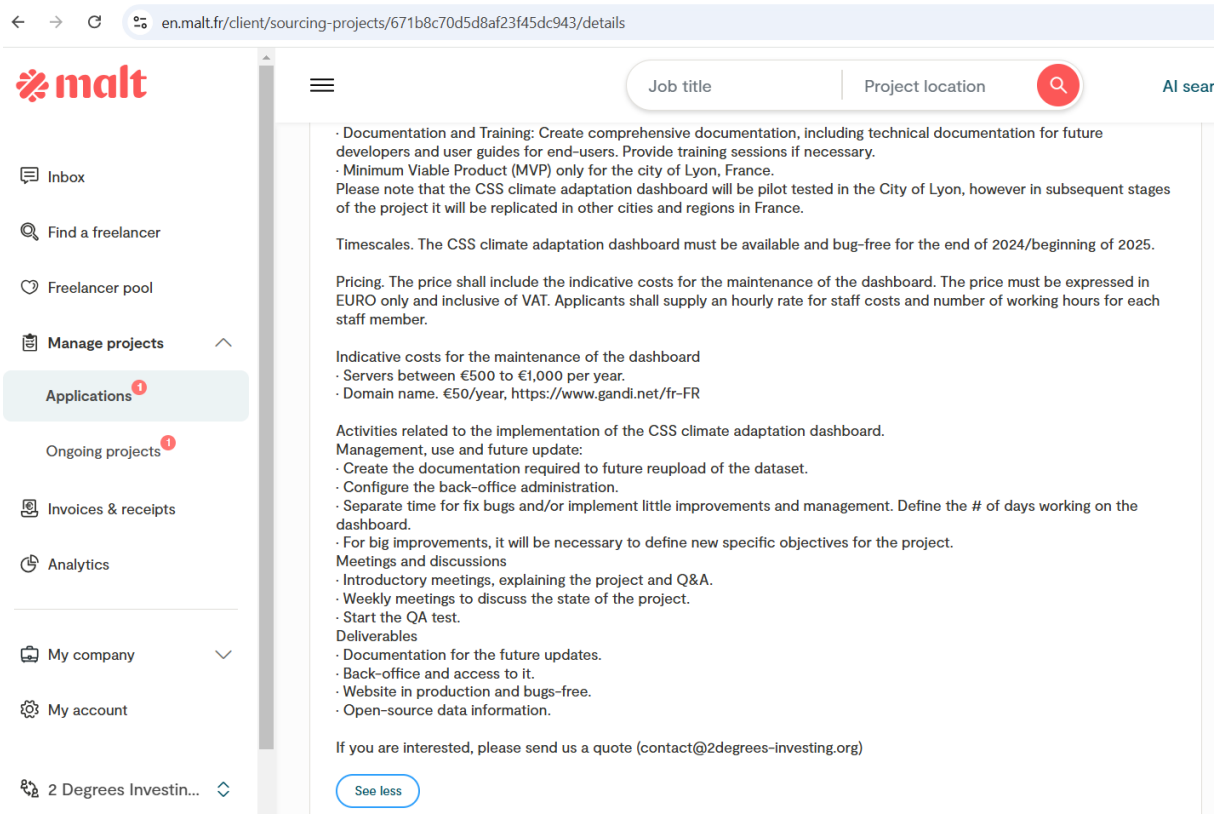
Sandin Llorente, Operations and Grants Manager; (4) an external IT consultant who advised SFO on aspects of the contracting specification; and (5) the shortlisted candidate. The evaluation of each meeting with a shortlisted candidate is shown in *Annex 3: Evaluation of each meeting with shortlisted candidates*.

On 28 November 2024, the selected candidate, Expert 14 (RM, ♀), was notified of the final decision and invited to confirm her acceptance at her earliest convenience to initiate the contract negotiation and signing process. On 29 November 2024, Expert 14 (RM, ♀), formally confirmed her acceptance of the offer and other candidates were subsequently notified of this outcome.

Annex 2: Description of the mission



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Project location
Inbox
Find a freelancer
Freelancer pool
Manage projects
Applications
Ongoing projects
Invoices & receipts
Analytics
My company
My account
2 Degrees Investin...
· Documentation and Training: Create comprehensive documentation, including technical documentation for future developers and user guides for end-users. Provide training sessions if necessary.
· Minimum Viable Product (MVP) only for the city of Lyon, France.
Please note that the CSS climate adaptation dashboard will be pilot tested in the City of Lyon, however in subsequent stages of the project it will be replicated in other cities and regions in France.
Timescales. The CSS climate adaptation dashboard must be available and bug-free for the end of 2024/beginning of 2025.
Pricing. The price shall include the indicative costs for the maintenance of the dashboard. The price must be expressed in EURO only and inclusive of VAT. Applicants shall supply an hourly rate for staff costs and number of working hours for each staff member.
Indicative costs for the maintenance of the dashboard
· Servers between €500 to €1,000 per year.
· Domain name. €50/year, https://www.gandi.net/fr-FR
Activities related to the implementation of the CSS climate adaptation dashboard.
Management, use and future update:
· Create the documentation required to future reupload of the dataset.
· Configure the back-office administration.
· Separate time for fix bugs and/or implement little improvements and management. Define the # of days working on the dashboard.
· For big improvements, it will be necessary to define new specific objectives for the project.
Meetings and discussions
· Introductory meetings, explaining the project and Q&A.
· Weekly meetings to discuss the state of the project.
· Start the QA test.
Deliverables
· Documentation for the future updates.
· Back-office and access to it.
· Website in production and bugs-free.
· Open-source data information.
If you are interested, please send us a quote (contact@2degrees-investing.org)
See less

Annex 3: Evaluation of meetings with shortlisted candidates

Quote received	Expert 11 (JphK, ♂)
Date of the interview	Monday, Nov 25, 2024, 12h00 to 13h00
Assessment of the meeting	Interview • The candidate didn't come prepared to the meeting, demonstrating an insufficient level of (technical) understanding regarding the potential (technical) challenges the dashboard may encounter during its creation and implementation. • The candidate didn't provide thorough answers to the panel's questions. • The candidate asked only a limited number of questions; none of which were technically relevant. • The candidate didn't communicate clearly and effectively during the interview. Quote • The quote is comprehensive and includes additional requirements discussed during the meeting. However, the quote does not include the administration back office, which we mentioned during the interview (it only mentions the authentication but not the administration). • Additionally, the time assigned for the replication phase is unrealistic. It is estimated between a minimum of 30 and a maximum of 40 full-time days. • The quote presents a significant gap between the estimation minimum and maximum number of working days, resulting in a €11,700 difference in the budget. • The amended quote, based on the minimum estimated effort (€35,370), represents a 70.38% increase from the initial quote of €20,760. The maximum estimate (€47,070) reflects a 126.30% increase from the initial quote. • The composition of the project team remains unclear. • The timeframe for the activities is insufficiently specified.
Outcomes	REJECTED
Quote received	Expert 11 (JphK, ♂)
Date of the interview	Monday, Nov 25, 2024, 12h00 to 13h00

Assessment of the meeting	Interview • The candidate didn't come prepared to the meeting, demonstrating an insufficient level of (technical) understanding regarding the potential (technical) challenges the dashboard may encounter during its creation and implementation. • The candidate didn't provide thorough answers to the panel's questions. • The candidate asked only a limited number of questions; none of which were technically relevant. • The candidate didn't communicate clearly and effectively during the interview. Quote • The quote is comprehensive and includes additional requirements discussed during the meeting. However, the quote does not include the administration back office, which we mentioned during the interview (it only mentions the authentication but not the administration). • Additionally, the time assigned for the replication phase is unrealistic. It is estimated between a minimum of 30 and a maximum of 40 full-time days. • The quote presents a significant gap between the estimation minimum and maximum number of working days, resulting in a €11,700 difference in the budget. • The amended quote, based on the minimum estimated effort (€35,370), represents a 70.38% increase from the initial quote of €20,760. The maximum estimate (€47,070) reflects a 126.30% increase from the initial quote. • The composition of the project team remains unclear. • The timeframe for the activities is insufficiently specified.
Outcomes	REJECTED
Quote received	Expert 14 (RM, ♀)
Date of the interview	Friday, Nov 22, 2024, 12h00 to 13h00
Assessment of the meeting	Interview • The candidate demonstrated extensive technical expertise. • The candidate covers all the necessary technical skills to deliver high-quality work, including web design, analytics, and the development of disability-friendly apps/tools, which will undoubtedly add value to the final product. • The candidate came well-prepared to the meeting, and the panel appreciated, for instance, her knowledge of some technical aspects of the dashboard, such as the French Cat Nat scheme.

	• The candidate provided thorough and detailed answers to the panel's questions. • The candidate asked insightful questions that align with potential technical challenges that could arise during the creation and implementation of the dashboard. • The candidate communicated clearly and effectively during the interview. Quote • The quote is highly detailed and incorporates all additional requirements discussed during the meeting. • The pricing of the quote is realistic and reasonable. It aligns well with the overall budget for the contracted services. • The amended quote (€ 29,400) reflects a 40.1 % increase from the initial quote (€ 20,400). • The composition of the team is clearly outlined, including individual portfolios. • A comprehensive work plan with a detailed timeframe for the activities is provided.
Outcomes	SELECTED

Annex 4: Contract details

A4.1 Basic principles of the Contract

The Contract is governed by the following core principles to ensure transparency, accountability, and professionalism in the execution of the agreed contract:

- Mutual Agreement. Both parties agreed the scope, deliverables, and timelines outlined in the Contract, ensuring clarity and mutual understanding from the outset. The scope of the Contract is twofold: (1) creation of the CSSBDA that will be an online website designed to educate homeowners about their financial risks associated with inadequate insurance cover for property damage caused by CSS events, and (2) testing and replication of the CSSBDA at French national level and ongoing maintenance of the CSSBDA.
- Independence of the expert (provider). Expert 14 (RM, ♀) operates as an independent contractor, not as an employee, and retains full autonomy in how the services are delivered, within the agreed parameters.
- Confidentiality and data protection: Provisions are included to ensure the protection of sensitive information and compliance with applicable data protection laws.
- Payment terms. Compensation is clearly outlined, including the payment schedule, invoicing procedures, and conditions for payment.
- Duration and termination. The Contract defines the start and end dates of service delivery, with clauses allowing for early termination under agreed circumstances.
- Dispute resolution. Mechanisms are included for resolving any potential disputes in a fair and efficient manner.

A4.2 Contract timeline

The key contractual milestones are as follows:

- signature of the contract (4 December 2024) (completed);
- delivery of the CSSBDA for pilot testing in the City of Lyon and administrative back-office features for testing (end March 2025) (completed);
- Mid-term delivery. Maintenance and initial deployment in selected new cities (by July 2025) (pending), and
- Final delivery. Completion of maintenance services and deployment across all new cities, no later than 31 December 2025 (pending).

Bibliography

Assemblée Nationale. (2023). Rapport d'information sur l'évaluation et la prise en compte du retrait gonflement des argiles. Retrieved from https://www.assemblee-nationale.fr/dyn/16/rapports/cec/l16b1003_rapport-information.pdf

Ballabio, C., Panagos, P., & Monatanarella, L. (2016). Mapping topsoil physical properties at European scale using the LUCAS database. *Geoderma*, *261*, 110–123. https://doi.org/10.1016/j.geoderma.2015.07.006

Boivin, P., Garnier, P., & Vauclin, M. (2006). Modeling the soil shrinkage and water retention curves with the same equations. *Soil Science Society of America Journal, 70*, 1082–1093. Retrieved from https://www.researchgate.net/publication/237223382_Modeling_the_Soil_Shrinkage_and_Water_Retention_Curves_with_the_Same_Equations

British Geological Survey. (n.d.). Swelling and shrinking soils. Retrieved March 29, 2024, from https://www.researchgate.net/publication/237223382_Modeling_the_Soil_Shrinkage_and_Water_Retention_Curves_with_the_Same_Equations

Charpentier, A., James, M., & Ali, H. (2022). Predicting drought and subsidence risks in France. *Natural Hazards and Earth System Sciences*, *22*(7), 2401–2418. https://doi.org/10.5194/nhess-22-2401-2022

Sénat. (2023). Rapport d'information La sécheresse ébranle les fondations du régime CatNat. Retrieved from https://www.senat.fr/rap/r22-354/r22-354_mono.html

Trentini, L., Venturini, M., Guerrini, F. *et al.* Identifying climate extremes in Southern Africa through advanced bias correction of climate projections. *Bull. of Atmos. Sci.& Technol. 6*, 9 (2025). https://doi.org/10.1007/s42865-025-00097-y