Real Estate Asset Climate Testing (REACT) Tool

A quick, simple, and transparent assessment of real estate flood risk

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1. Introduction

This document provides background information and guidelines on the Real Estate Asset Climate Testing (REACT) tool for flood risk assessments. The tool is designed to estimate the risk (in euro/year) for individual assets making use of a simplified risk calculation. The goal of the tool is to offer simple, open, and transparent insights for real estate managers and policymakers to assess different types of flood risks (coastal, riverine, pluvial) for their assets, using free and open European scale data. The tool should be used by data analysts who have some Geographic Information System (GIS) knowledge, though no extensive GIS or flood knowledge is required. There is a basic calculation where a generic estimate of the value of an asset is used, whereas the advanced calculation allows for a more detailed approach where the user can specify the value of the asset, and, when applicable, include the elevation of the asset above surface level, presence of floodproofing measures, and changes in flood probability due to climate change.

It should be noted that this tool offers relatively quick, simple, and transparent insights into the current and future state of flood risk. The approach of this tool should be considered a first step or screening of the physical flood risk of assets, and not a full-fledged risk analysis for which more tailored flood risk models and input data would be required (e.g., de Moel et al., 2014; Al Assi et al., 2023). The purpose of the tool is to go beyond qualitative indicator-based assessments which are often difficult to compare and interpret. Moreover, the upside is that it moves away from relying on 'black-box' models (Arribas et al., 2022; Kelder et al., 2023), enabling analysts to perform risk assessments on their portfolios themselves and allowing for subsequent tweaking and integration in internal processes.

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2. Outcomes

The approach used is common in flood catastrophe models (De Moel et al., 2015), where flood hazard, exposure, and vulnerability are combined to express flood risk in terms of Expected Annual Damage (EAD). This tool, which is offered as an Excel workbook, gives insight into flood risk for **individual assets** as well as **entire asset portfolios**. The local-level approach offers insights into potential adaptation strategies for asset managers. The portfolio approach allows for both an absolute and relative assessment of portfolio risks. The absolute approach is the sum of the EAD of all individual assets. In the relative portfolio risk assessment, a location score can be assigned to all individual assets. By assigning the same absolute asset value to all assets, the EAD per individual asset allows for comparison in location risks between these assets.

An advantage of the approach in the Excel tool and technical documentation is the transparency of the assessment of flood risks. The first step is to fill in input data for all individual assets manually, but it is also possible to prepare tables with the relevant information and fill in the Excel tool for entire portfolios.

The input for the tool consists of four parts: (1) information on the flood protection standard of the area where the asset is located, (2) the water depth and probability associated with a relatively frequent (low return period) event, (3) the water depth and probability associated with a very rare event (high return period); and (4) the location and first floor area of the asset. Pointers are given to free and open European and Global level GIS datasets that could be used to retrieve this information, but it should be noted that constantly new datasets are produced and more local flood maps are generally superior than continental or global maps for this purpose.

The output consists of a rough estimate of the risk in terms of Average Annual Loss (AAL, in euro/year, with base year 2010), also referred to as Expected Annual Damage (EAD). In case the first floor area is kept the same for all assets (e.g. 100 m^2), these numbers should not be regarded as absolute risk estimates but result in a consistent comparison of all asset locations in a relative way as an initial screening.

3. Stepwise approach

The next section describes the input data required for both the basic and advanced approaches. The basic approach is designed to be able to run on two data points for flooding, flood protection standards, and real estate exposure. The advanced approach allows for more tailoring by including asset elevation, adjustments in asset value, asset-level adaptation strategies, and climate change projections. Figure 3 below gives a general overview of the approach of the REACT tool.

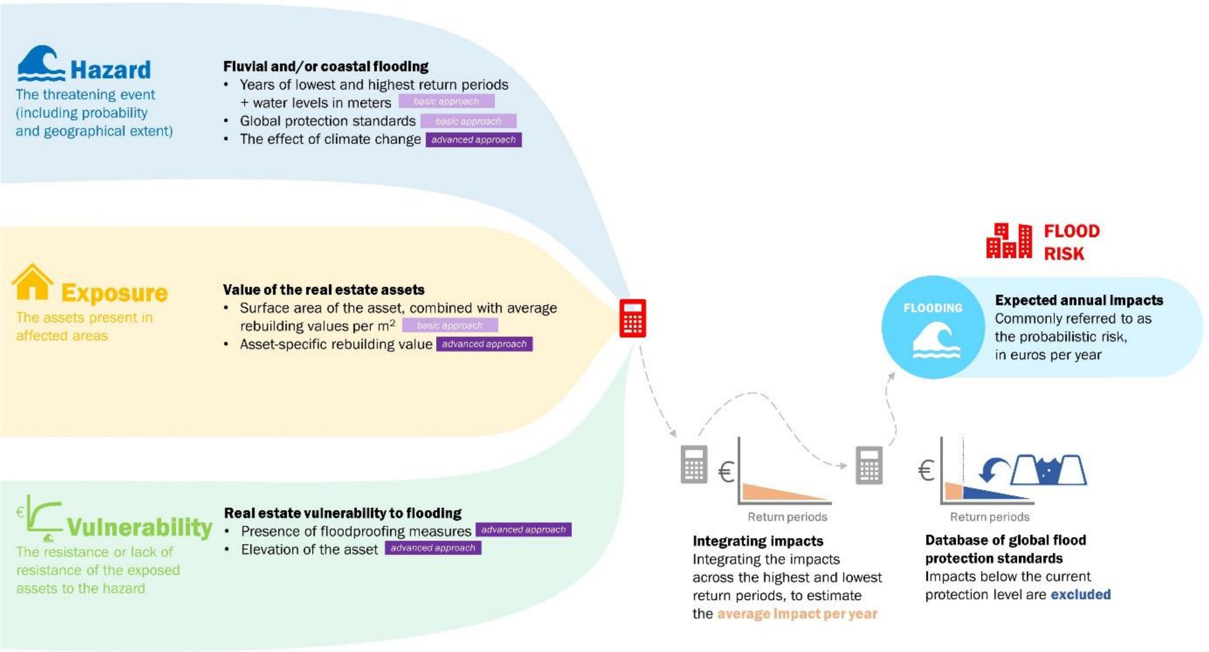

Figure 3. *Flood risk expressed in terms of Expected Annual Damage (EAD) as the function of hazard, exposure, and vulnerability.*

Basic approach

1. Country in which the asset is located (dropdown menu).

Flood risk is dependent of the economic value exposed to flooding, which greatly differs per country. If the exact value of the asset is unknown, the country in which the asset is located will provide insights into average rebuilding values per m^2. Combining this rebuilding value with the surface area of the asset gives an approximation of the economic value at risk of flooding.

2. The protection standard up to which the area in which the asset is located is protected by flood defenses (years) (default=10).

Protection standards avoid flooding up to certain return periods, meaning that flood scenarios with higher probabilities will not be incorporated in the risk calculation. The FLOPROS database offers an open-access overview of global protection standards (Scussolini et al., 2016). It is also possible to use more specific regional information instead.

Input data for flood protection standards can be found HERE.

3. The return period for which the asset in question will be flooded for the first time, along with the water depth that would then occur at the location of the asset (years of return period + water level in meters).

The user needs to provide information on probabilities and water levels to which the asset is exposed. This information can be derived from a set of flood maps with different return periods. For the first step, the **lowest return period** where the asset in question is flooded should be selected [start]. This information needs to be extracted from hazard datasets on fluvial or coastal flooding. See the Data_Sources tab for links to relevant websites. Note that these are more generic global or continental resources, but if national or local flood maps are available this information is preferred over global/continental datasets because local flood maps are generally of higher spatial resolution and may better incorporate local characteristics and conditions.

Note that this start return period where the asset is flooded cannot be lower than the protection standard of the area. This can be found as many (global/continental) flood map datasets do not incorporate levees in their calculations. In such a case, the flood protection standard is taken as the flood scenario with the highest probability.

Input data for flood return periods and inundation depths can be found HERE.

4. The return period, and corresponding water depth, of the highest return period in the dataset where your asset is flooded (years of return period + water level in meters).

This is to be derived from the same set of flood maps used for the previous point, but now pick the **highest return period** available in that set. [max]

5. The surface area (footprint) of the asset in question in square meters (m^2).

The footprint of the asset in question in square meters is combined with the maximum rebuilding value per country to make an approximation of the building value at risk of flooding. Note that this is not the total amount of square meters of the entire asset (with all floors), but only the surface area of the ground floor (i.e. the footprint).

	A	B	C	D	E	F	G	H	M
1	Asset	Country	Protection_Standard	Start_Prob	Start_WL	Max_Prob	Max_WL	Size	
2	(name or number)	(dropdown)	(years)	(years)	(m)	(years)	(m)	(m2)	Risk (euro/yr)
3									
4	Home	Netherlands	1	50	0.1	1000	4	55	435

Figure 1. *Screenshot of the basic approach*

Advanced approach

The advanced approach builds further upon the basic approach, and thus, uses the same input data, with one exception. In the advanced tab, either the surface area (footprint) of the building is necessary, or an absolute value related to the asset. This enables the integration of asset-specific values if they are available. The advanced approach offers multiple ways to expand upon the basic approach, where it is also possible to include some new indicators. If you don't want to use one of them, the default option should be used for the unused indicators.

1. The asset-specific rebuilding value (€) (default = empty).

When a specific asset value is added, this will become the basis of the damage and risk calculation. In this case, the size is not needed anymore as that only functioned to estimate the asset value. You should use the value associated with the first two floors of the building as the depth-damage used in the tool goes up to 6m (i.e. two floors).

➔ Unknown? One can simply keep the field for value empty and use the surface area approach from the basic calculation. The tool automatically uses the surface area of the asset when the value field is left blank.

Note that the specific asset value should NOT be market value (as this includes location characteristics and values), but rather construction costs (i.e. costs that would be incurred when the asset needs to be rebuilt) or even depreciated construction costs (as a newly constructed asset will have a higher value as opposed to one that has been around for years). In the Basic calculation depreciated construction costs for residential buildings are used, also including an 'undamagable' part (i.e. part of the asset that even with huge water levels need not be rebuilt, such as underground foundations). See Huizinga et al. (2017) for more details on the Basic values used in this tool.

2. Elevation of the lowest level of the asset with respect to outside surface elevation (meters) (default = 0).

Flood maps generally depict flood depths with respect to the elevation of the surface. However, assets can be elevated with respect to the surrounding area (either as a purposeful flood adaptation measure or just by design). Here the elevation of the asset with respect to the surrounding surface can be inserted as input. Note that also negative values can be inserted in case an asset is lower than the terrain (such as souterrains).

3. The presence of floodproofing measures in the asset [0/1] (default = 0).

There may be assets that have been adapted to flood conditions to withstand water or minimize damage. Empirical studies in Germany and the Netherlands point to damage reduction levels of around 25% when such measures are taken. Here the presence of floodproofing measures can be included. The size of the damage-reducing effect is taken from the Lookup tab (default risk-reducing effect is 25%, and can be adjusted there).

4. The effect of climate change (years [>0]) (default = 100).

To estimate the effect of climate change, ideally, datasets are used where climatic effects are dynamically incorporated in flood hazard and risk models. However, given the complexity of such models and the number of future scenarios that are ideally considered this can quickly become very cumbersome. A pragmatic solution is to determine changes in the probability of the hazard conditions (e.g. water levels of the sea, discharge in the river). On this, there are studies available that can provide estimates of how probabilities may change in a future scenario (see Data_Sources). In theory, such changes in probability can differ between frequent (low return periods) and rare (high return periods) events. However, to keep things manageable a middle estimate can also be used for the whole situation. Here we advise using the change in the 100-year return period (of river discharge, or coastal water level) to estimate the effect of climate change. In the advanced sheet, the return period under climate change corresponding with the current 100-year event can be entered (e.g. if the probability of a 1/100-year event would double, this would be 50 years), which will then be integrated into the calculation. This is done by adjusting the return periods of the start and max situations with that factor). There is space to include estimates of two separate future scenarios (S1 and S2) to evaluate a high and low scenario. Input data for how climate change affects flooding probabilities can be found HERE.

	A	B	C	D	E	F	G	H	I	J	K	L	M	T	U	V
1	Asset	Country	Protection_Standard	Start_Prob	Start_WL	Max_Prob	Max_WL	Size	ADVANCED							
2	(name or number)	(dropdown)	(years)	(years)	(m)	(years)	(m)	(m2)	Value	Elevation	Floodproofing	Climate change S1	Climate change S2	Current Risk	Risk CC S1	Risk CC S2
3									(euro)	(m)	(0/1)	>0	>0	(euro/yr)	(euro/yr)	(euro/yr)
4	Home	Netherlands	10	50	0.1	1000	4	55	200000	0	0	100	100	1797	1797	1797
5																

Figure 2. *Screenshot of the advanced approach*

A practical list of steps to perform can be found in the Annex.

4. Input data sources

The following section describes open-access sources for the input data required for the use of the tool. These databases often have global coverage, where it is also possible to use other databases at a lower spatial scale (e.g., national, local). For a single asset, values can just be read manually from the relevant maps. However, especially for entire portfolios, developing the input data probably encompasses most of the effort in the risk screening.

Flood protection standards

It is advised to gather information from national sources on flood protection levels of the area in which the assets are located. In case this is not available/known, the open-access global FLOPROS database can be used (Scussolini et al., 2016). The database includes a shapefile that gives return periods of flooding against a certain area that is protected. These returns periods are determined based on the protection measures present for a certain area. The database has a design layer, which means that the standards are known to be in place, and a policy layer which gives regulation on flood protection standards. Finally, there is a modeled layer that provides estimated flood protection standards when there was no other information available. Generally, the design layer (DL, standard for the actual levees) is deemed most realistic, followed by the policy (PL, stated but may not be realized) and modeled (if nothing is known) layer.

Flood return periods and inundation depths

First, one should consider which type of flooding needs to be taken into account. There are multiple possibilities for data on flood return periods and corresponding inundation depths for coastal and riverine flooding (note that pluvial flooding is usually not considered in global or coastal datasets). Again, it is advised to search for national (or even sub-national) flood maps. For the European scale, JRC has created flood maps for fluvial flood risk at a resolution of 100 meters. Available return periods are 10, 20, 50, 100, 200, and 500 years (for documentation: Dottori et al., 2022).

At the global scale, WRI (2020) has flood maps available for both riverine and coastal flood risk at a relatively coarse spatial resolution (1km). The return periods considered are 2, 5, 10, 25, 50, 100, 250, 500, and 1000 years (for documentation: Ward et al., 2020). There is also a possibility to include flood maps that consider the consequences of climate change in the WRI maps. Note that when using these maps that include climate change, the climate change fields should be set to the default of 100 in the advanced approach, as the flood maps already consider changes in flood probabilities.

Deltares has developed global coastal flood maps. The resolution of the maps depends on the resolution of the digital elevation map (DEM) used (90 km, 5 km, 1 km). Return periods considered are 0, 2, 5, 10, 25, 50, 100, and 250 years. Note that Python code is necessary to access the data (see their Example Notebook) (for documentation: Deltares, 2021).

Climate change probability change

Climate change influences the probability and severity of flooding (IPCC, 2021). To account for this, we calculate a factor of how the probability of a 100-year return period changes. Whilst many countries and regions have developed climate change scenarios, this is usually for meteorological variables. In case changes in the probability of specific (e.g., 1/100 years) discharge can be established, this can be used as a proxy for changes in flood probability.

For riverine flooding, Hirabayashi et al. (2013) developed a global map showing how the 1/100 years discharge changes globally (i.e., what the new return period for that discharge is). These findings were also included in the IPCC AR5 report at the time. Information is available for several representative concentration pathways RCP2.6, RCP4.5, RCP6.0, and RCP8.5. Figure 1a in the main document and Figure S9 in the supplement give the changes in probability. Note that no underlying dataset is currently available, only the picture in the paper and supplement.

Climate change projections for extreme sea levels have been estimated by Vousdoukas et al. (2018). They show how a 1/100-year return period of extreme sea-level changes for RCP4.5 and RCP8.5. These projections are made until 2050 and 2080. Figure 8 in the documentation gives these projections. The underlying dataset is available through the JRC data portal. Some small processing is likely required to calculate changes in probabilities.

5. Background of the approach

The Excel Tool follows the risk setup as stated by Kron (2005), where flood risk is expressed as a function of hazard, exposure, and vulnerability. The general set-up of such flood risk models is visualized in Figure 3.

Flood **hazard** refers to the probability and magnitude of a flood event. In the hazard component, we typically consider several flood scenarios with different return periods (i.e., flood probabilities)(Ward et al., 2011). For each return period, an inundation map is considered for the area of interest. When considering flood hazard, it is essential to incorporate flood protection standards, as they avoid flooding up to certain probabilities. For instance, when levees have a protection standard of 1/100 years, all flood scenarios with probabilities larger than that return period should in principle be avoided. This can be achieved by not including those calculations, or by excluding it during the estimation of EAD. Different dynamics affect different components of risk. With respect to the hazard, climate change affects the probability/severity of flooding (IPCC, 2021). This can be achieved by using new flood maps that have been developed using climate change scenarios (adjusting severity), or by adjusting the probabilities of existing flood maps (adjusting probability) in the integration of the damages into EAD. It should be noted that population growth and urbanization affect exposure and adaptation measures affect flood vulnerability. As such, different approaches are necessary to accommodate such risk dynamics, such as adjustments in the input data (e.g., land use map, flood map, damage curves) and probabilities (i.e., adjusting for changes in frequency).

The **exposure** component of the framework represents the economic value at risk of flooding, in this case, the location and value (or area) of the real estate assets in the portfolio. There are multiple ways to consider economic exposure in catastrophe models. The first option is to consider land use type with its corresponding value. The option considered in this tool is a maximum damage value per m^2 of a building based on Huizinga et al. (2017), who based this on international building surveys, through a function with GDP/capita per country. An option in the advanced approach is for the user to fill in the rebuilding value of the building. Note that this should consider replacement costs, instead of market values, as market values also represent other building characteristics, such as location.

The final component is **vulnerability**, which reflects real estate vulnerability to flooding, often denoted using depth-damage functions. These functions describe the pattern of flood damage based on inundation depth. Huizinga et al. (2017) offer an open-access global dataset of these damage functions, although more regional depth-damage functions can be used as well. Note that in principle, a depth-damage curve is very specific for a particular (type of) asset. The most detailed assessment methodologies therefore differentiate various types of assets such as different types of houses, shops, hotels, workshops, schools, etc. However, empirical evidence on which to base depth-damage curves is usually very limited outside of houses. As a result, there is often relatively limited differentiation between depth-damage curves for different types of assets, unless very specific attention is given to this. There is more often differentiation in the value of buildings (i.e. exposure), as that is easier to determine. In this tool, a general residential depth-damage curve (Europe residential from Huizinga et al., 2017) is used to make the risk estimate for the assets.

Combining these three components allows for the calculation of flood damage per return period, which is essentially done twice in this tool: once for a frequent event, and once for a very rare event. Figure 4 represents the simplified Exceedance Probability Loss (EPL) curve that results from the calculations for these two return periods. The area below the EPL curve is the EAD (AAL). The approach from this Excel tool differs from other flood risk models, as it uses an approximation of flood risk by only using two data points in terms of flooding, instead of half a dozen or more. The two data points that are used are the first return period where a certain asset will be flooded and the return period with the lowest probability.

The return period where the asset first will be flooded is shown on the right of Figure 4, in this example a return period of 1 in 10 years (probability of 0.01). The Excel tool calculates expected flood damage based on this inundation depth (Y-axis). The second datapoint is the lowest probability scenario considered by the flood maps, in this example 1 in 1000 years. The area below this curve would be the EAD (i.e., areas I, II, and III).

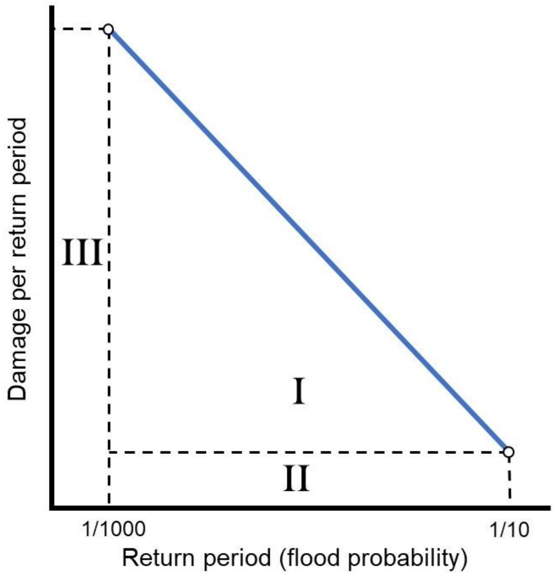

Figure 4. *Simplified Exceedance Probability Loss (EPL) curve, using only two data points.*

An advantage of this approach is that it requires only two data points, in contrast to other flood models that consider more flood probabilities. The implication of this approach is that the outcomes are likely to be less accurate. Next, it is assumed that the shape of the EPL curve is linear, which is not necessarily the case as damage may go up quite far with lower return periods (making it more inverse exponential). Lastly, this simplified approach cannot consider any probabilities smaller than the lowest probability on the flood map (1/1000 years in the example of Figure 4). These low-probability scenarios are also not considered in more advanced flood risk models as they also rely on such flood maps. As such area III should in reality be slightly larger (going up towards the y-axis). However, as this concerns very low probabilities (i.e. 0.001 for 1/1000 years), the area is relatively small, making the contribution of this underestimation to the total EAD almost negligible.

Another way the tool is simplified compared to more advanced flood risk models is through the incorporation of climate change. Generally, climate change is incorporated through several scenarios and time scales using tailored flood maps. In this simplified approach to climate change, a single factor is determined of how the probabilities of flooding change, essentially shifting the blue line in Figure 4 to the left or right.

6. Beyond the Excel Tool

One objective of this Excel Tool is to be transparent and allow successive tweaking by the user. This is very case specific as it depends heavily on the nature of the assets considered, the purpose of the screening/assessment, the availability and detail of specific input data, and the available human resources. As such, this section cannot be comprehensive or specific, but regardless we want to detail some points that can be thought of in order to extend this initial screening/assessment:

- Naturally, the quality of the input data determines to a large extent the quality of the results. The more specific the input data, the better the risk estimate from the tool will become. The flood maps are important here, and where possible more local and higher (spatial) resolution flood maps should be taken. Theoretically, also more return periods can be taken, though this would result in considerable expansion of the Excel calculations.
- For the value of an asset, different baselines can be taken. Generally, the (depreciated) replacement cost is used. However, for some applications, it may make more sense to use something such as the outstanding loan (or mortgage value). When using values in the advanced tab, make sure that the value is representative for the first two floors of your asset, as flooding generally does not get to higher levels and the damage curve in the Tool goes up to 6m (i.e. two floors).
- Also, more specific vulnerability information could improve the risk assessment, for instance, related to exact estimates of the elevation above the surrounding area, exact value/surface area, etc. (advanced parameters). Consultation with local asset managers could provide more insights into this.
- From a methodological point of view, improving vulnerability generally revolves around the depth-damage curve used, which in the tool is just a generic residential curve. Using a depth-damage curve more specific for the type of asset that is being assessed, and/or incorporating specific adjustments (e.g. elevation of the first floor above the surrounding land surface elevation) would make the estimate much more precise. Note that the tool currently only allows for one curve, so different spreadsheets per type of asset could be created where the curve on the 'Lookup' tab is changed to represent the type of asset in question. For inspiration of curves for different asset types, check for instance the Hazus (2022), Multi-coloured Manual (Penning-Rowsell et al., 2014), SSM (2017) models from the US, UK, and the Netherlands respectively.
- As many buildings, regardless of type, often have a similarly shaped damage curve (unless it is a fundamentally different type of asset), different types of assets can also be differentiated by differentiating values.
- Depth-damage curves for specialized infrastructure and industrial assets are often very scarce, so the use of a more generic curve is often necessary. For road infrastructure, there has been some recent work by Van Ginkel et al. (2021).
- This tool only considers water depth as the factor driving flood damage. Whilst very important, this is not the only hazard variable that can be relevant. Therefore, some models differentiate depth-damage curves related to different flow velocities, pollution, timing, preparation, etc.

When addressing various of the above points, one gradually moves towards a full-fledged flood risk assessment, and automizing the procedure using coding becomes preferable. At this point, it becomes worthwhile to consult the (academic) literature on flood risk assessments and associated scripts on e.g. Github (e.g. https://github.com/VU-IVM/DamageScanner).

7. Further considerations

There are considerations and assumptions when it comes to estimating flood risk. It is worthwhile to keep a couple of things in mind when estimating flood risk; both in using our tool for a first screening estimate, as well as when expanding on the tool or when moving towards a full-fledged flood risk analysis. Here some points are discussed:

- Generally, three **types of flooding** are considered: fluvial, coastal, and pluvial. This latter one concerns flooding directly because of heavy rainfall. This is the most local form of flooding and no global (nor continental or even national) assessments exist as a result. Generally, pluvial flooding requires very detailed modeling with very high-resolution elevation data, and preferably also information on the drainage/sewer network. This is mostly at the scale of a city, or even a district within a city. As such this is difficult to assess for a portfolio covering a wide geographic area.
- The **largest contribution to the Expected Annual Damage** comes from the right part of the EPL curve, i.e. the relatively frequent (low return period) events.
- As such, the role of **protection standards**, which essentially cap the EPL curve on the right, is very influential in determining the EAD. This means that uncertainty in this has a considerable impact. This is even more pronounced in areas with high protection standards where flooding is more related to, very uncertain, failure probabilities such as the Netherlands.
- When trying to project flood risk due to a changing climate, we rely on **Global and or Regional Climate Models** (GCMs and/or RCMs). On top of this, these models are forced by greenhouse gas (Representative Concentration Pathways; RCP) scenarios, such as RCP2.6 or RCP8.5. It has been observed that variations between different climate models (with the same RCP) are often considerably larger than the variation between different RCP scenarios (from the same climate model). As such, for a proper picture of how future climate (and associated flood risk) could play out, it is more important to consider multiple climate models than it is to consider different RCP scenarios.
- Note that **depth-damage curves** in literature can be based on many different things. This includes curves for buildings or curves for land-use classes (e.g. a grid cell of urban land). Moreover, depth-damage curves can be very specific in terms of what value they relate to. For instance, some curves go up to 100%, but others go up to 60%, implying that some part of the value chosen will never be damaged. In such a case it is imperative to understand what is included in the value and what is not. It is therefore very important not to just take curves and apply them without checking if they correspond well to your type of asset and value at risk used.
- This tool, and most flood risk assessments concern direct physical damage. However, a flood can also cause **second-order (or indirect) impacts** such as production losses/business interruption. This usually requires a very different approach (e.g. economic modeling) to incorporate but can be very relevant given the purpose of the flood risk assessment.
- This tool and many flood risk studies are based on flood maps of certain **return periods**. This is not the same as a specific flood event, which is often more limited in space and can have different return periods in different places (usually higher return periods upstream; decreasing downstream). As such, average losses can be calculated with this, but not losses of a specific event. As a result, models in the insurance industry typically work event-based, but this is often more complex and requires a lot of events in order to capture all the possibilities (as opposed to flood maps of half a dozen return periods).

8. Disclaimer

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ANNEX I – Practical list of steps

The pre-processing is best done by an analyst with some basic GIS capacity. It mainly involves creating a (point) shapefile of assets/locations (which will become the rows in Excel), downloading some GIS datasets, and sampling these datasets with the points. More specifically:

1. Develop a list of assets with location (lat/lon) for your assets. In case you have a dataset with polygons, the centroids of the polygons can be taken. When working with a land use map, centroid points per urban grid cell can be determined, and then you use the urban grid cell points as rows in Excel. Make sure to properly determine the value you want to associate with each grid/point. This step depends heavily on the data available for the assets for which the risk estimate is intended.
2. Create a (point) shapefile of all locations with some identifier so you can trace back the asset, and/or the type, and/or the geographic region for which you want to be able to report results after the assessment
3. Download the dataset on flood protection (i.e., the JRC one when working in Europe, see the Data_Sources tab)
4. Download the highest and lowest return period fluvial flood maps. When working in Europe, we suggest using the JRC maps, which should have return periods of 10 yrs and 500 yrs. Alternatively, global flood maps can be used (such as the Aqueduct maps (WRI, 2020) but these are considerably more coarse in spatial resolution)
5. With the point shapefile of the locations, sample all three layers (so flood protection, 10yrs flood map, 500yrs flood map)
6. Export the attribute table of the shapefile to an Excel file
7. You should now have all information to fill in the REACT tool Excel file, with every location becoming a new row. Fill this in, and make sure to copy the risk calculation fields down. And also copy the conditional formatting of the first row (as it will give red colors when, for instance, the start probability is lower than the protection standard).
8. You can give each row the same size in order to compare all locations and have a first result (this gives a relative score for each asset, similar to some type of 1-to-5 indicator value)
9. If you also know the value of the assets (or you disaggregate the market value of the different assets/rows), you can use the Advanced tab and simply fill in the same information but also fill in the Value column (column I; when left blank it will use the size in column H). This should then give you per asset an indication of the actual flood risk in euro/year. Obviously, there are nuances related to the number of stories, generalization due to a single damage curve, etc.
10. Post-processing will include aggregating assets/rows that belong to the same type or geographic region to get total risks (for which you wanted some identifiers).