

WHITE PAPER

Climate risk and raw materials:

Adaptation does not stop at the company's doors

JULY 2026

A significant proportion of a company's climate risk does not lie within its own premises, but in the production basins on which it depends. However, it is still necessary to be able to pinpoint this risk, basin by basin.

THE PARADOX OF ADAPTATION

In 2024, global economic losses linked to climate-related events reached **\$320 billion**. Yet barely **6.5** per cent of companies currently regard their supply chains as a priority material risk, and only **one in five** of them has a proper adaptation **plan in place**.

The contrast is striking. Companies are investing to protect their sites, infrastructure and critical systems, yet they often continue to ignore the risk where it is now most concentrated: in the **production basins** on which they depend. The core of their climate exposure no longer lies solely in the assets they own, but in the **regions that sustain their operations**.

A NEW GEOGRAPHY OF DEPENDENCIES

For several years now, adaptation strategies have focused on directly controlled assets: factories, warehouses, data centres and logistics networks. Whilst this approach is important, it is reaching its limits. This is because **actual exposure to physical risk is largely outsourced**. In the **agri-food sector**, for example, more than **70 per cent of the value produced depends on the value chain**, a significant proportion of which comes from agribusiness – one of the sectors most exposed to droughts, heatwaves and water stress.

A parallel with carbon emissions helps to illustrate our point. Driven by **regulations** and **investors**, companies have learnt to **account for their indirect emissions** – particularly Scope 3 emissions – both upstream and downstream of their operations. The same logic needs to be applied to physical risk. The question is the same: **where does the company's critical exposure actually lie?** Rarely at its headquarters, but often in the agricultural, mining or industrial regions that fuel the global economy.

This reality is already reshaping industrial decision-making: diversification of suppliers, securing critical raw materials, partial relocations or 'friendshoring'. **Climate is gradually becoming a key factor**, on a par with **labour costs, access to energy** or **political stability**.

WHY IS THIS IMPORTANT FOR A BUSINESS LEADER OR INVESTOR?

These dynamics are not a matter for distant forecasting; they are already having an impact today on **returns, supply costs and margins**. A **disruption** in a production region can cause the price of a raw material to fluctuate, make a key input more expensive or reduce available volumes, with a **direct impact on profitability**. **Geographical concentration amplifies this effect**: when a handful of territories supply the bulk of a resource, a localised shock becomes a systemic shock for the entire sector.

The **speed at which such shocks spread** is another **key** factor. A sector can be paralysed within a matter of days, as was the case in 2024 in the Brazilian state of Rio Grande do Sul, where record floods submerged fields, inundated silos and cut off access to ports. Several major supply chains were affected simultaneously, led by soya, rice, maize and wheat, with tobacco – for which the state accounts for the bulk of Brazil's exports – also being affected. In addition to this **physical exposure**, there is a growing **regulatory exposure**: the CSRD, duty of care, deforestation regulations and the Critical Raw Materials Act now require these dependencies to be identified, documented and reduced. The issue is therefore no longer merely **operational**; it has become a matter of **compliance and reporting**.

For a senior executive, this sector-by-sector analysis informs **strategic decisions**: securing critical materials, diversifying suppliers, and making trade-offs regarding sourcing and location. **For an investor**, it becomes a **valuation criterion** in its own right, on a par with carbon exposure: a risk factor affecting valuation, but also an indicator of management quality when the company understands the extent of its actual exposure and has already planned for it. In both cases, the prerequisite is the same: **having a clear picture of exposure, region by region, and its level of risk across different time horizons**.

CLIENT INSIGHT

“Thanks to this new feature in Altitude, we now have a much clearer picture of our climate exposure across the sites of our portfolio companies. The platform has enabled us to understand and pinpoint our actual dependencies and to focus our attention on the production regions where the risk is most significant.”

Daniel Toledano, Managing Director & Global Head of Sustainability at **Quilvest Capital Partners**, and beta tester of the new “Commodities” feature for Altitude

HOW ALTITUDE SHEDS LIGHT ON THIS EXPOSURE

With its **new ‘Commodities’ feature**, Altitude now enables a **shift from a site-level resilience approach to a sector-level resilience approach** in three stages.

Identify dependencies.

There are three possible scenarios.

In the first case, the user **is unaware of the raw materials on which their upstream supply chain depends**. Altitude then suggests the main commodities to which their sector is generally exposed.

In the second scenario, the user knows they depend on a raw material but **is unaware of its exact origin**. This is the most common scenario: Altitude identifies the main production areas for this commodity worldwide and estimates their likely exposure.

In the third scenario, the user **knows the exact origin of their resources**. Altitude then directly assesses the risk in the relevant basins. In all cases, the user retains control to adjust the commodities and basins, adding or removing them as required.

Assessing risk.

By drawing on AXA Climate's expertise in commodities, Altitude covers the entire spectrum of commodities: agricultural products, livestock, mining products, fossil fuels and metals. For each basin and each commodity, the platform identifies the **main hazards based on bespoke climate indicators designed** to assess each commodity according to its specific characteristics, then assigns a **risk level** for each **climate scenario** and **time horizon**, thereby enabling the user to distinguish what constitutes a genuine risk.

To illustrate the financial implications of such climate-related shocks, Altitude provides, for each commodity, examples of past disruptions and their impact on commodity prices, as well as the associated price variations.

Decide.

Once the risk has been identified, Altitude formulates **concrete recommendations** for integrating climate change into the supply chain. These measures may rely on direct levers, such as risk mitigation at a local level or the geographical diversification of supply sources to reduce reliance on an exposed region. However, taking action within one's own value chain is often more complex. It is therefore necessary to prioritise more indirect levers, such as engaging in discussions with suppliers to assess their level of resilience or incorporating climate resilience clauses into procurement contracts.

The aim is not to control everything, but to **gain a clearer picture in order to anticipate better**.

The following three scenarios illustrate what this sector-by-sector analysis actually changes in practice.

Case study no. 1 • soft wheat

Every year, nearly 800 million tonnes of wheat are produced worldwide, but this production is concentrated in a few major regions, one of which is already under climate-related pressure. And **without adaptation, the risk there will become high by 2050.**

The Indo-Gangetic Plain, which alone accounts for nearly 14 per cent of global production, is facing two interrelated challenges: extreme heat that is already

well beyond materiality thresholds, and warmer winters that encourage the spread of crop diseases and pests. In a globalised market, a shock to this region is not confined to the local area: it has knock-on effects on prices, available volumes and margins across the entire supply chain. This is precisely the kind of exposure we can anticipate, provided we are first able to measure it.

Take, for example, a food processor whose many products rely on wheat, purchased as flour or ingredients via several intermediaries. The company knows it is heavily dependent on this raw material, but it has no visibility over its actual origin. This is a very common situation: the dependence is clear, but the geography is not.

Altitude then maps out the main wheat-producing regions worldwide and reveals a reality the company had not previously considered: a significant proportion of global supply is concentrated in a few major regions, including India – one of the world's top three producers – where cultivation is largely concentrated in the Indo-Gangetic Plain.

MARKET INSIGHT

India is the world's third-largest wheat producer, behind China and the European Union, with around 113 million tonnes in the 2024–2025 crop year, accounting for nearly 14 per cent of global production. Cultivation is heavily concentrated in the Indo-Gangetic Plain, with Uttar Pradesh, Madhya Pradesh and Punjab alone accounting for over 70 million tonnes (source: USDA, 2024–2025 crop year).

EXPERT INSIGHT

“Soft wheat (*Triticum aestivum*) is an annual cereal. Native to the Fertile Crescent, it is one of the most widely cultivated cereals in the world. As with most cereals, it is susceptible to frost (to a greater or lesser extent depending on the stage affected), heat stress, seedling waterlogging and the fulfilment of its water requirements.

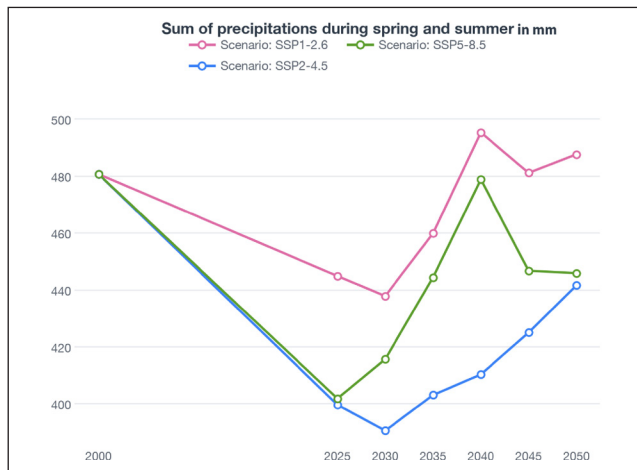
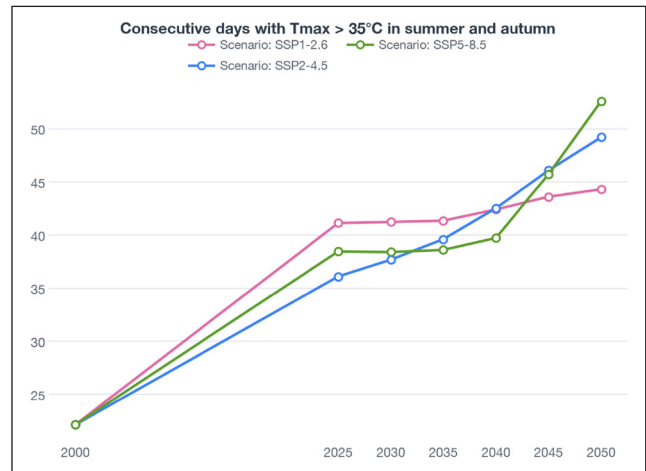
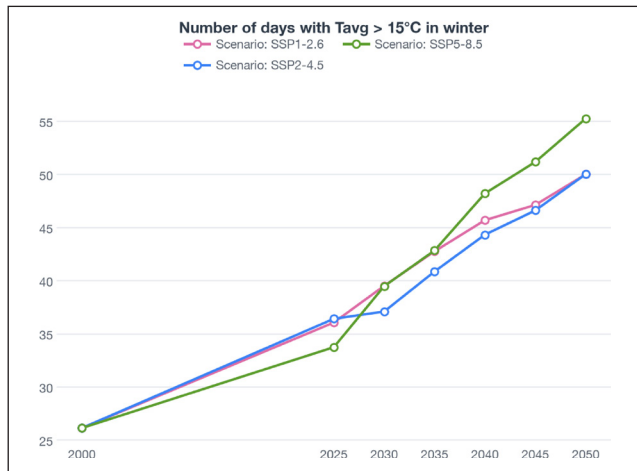
We therefore prioritise the study of:

- High temperatures during grain filling (> 35°C)
- Cold temperatures at flowering, which reduce pollen fertility: < 4°C
- Meeting water requirements: ideally 300 mm between stem elongation and flowering
- The risk of aphid infestation, which can spread disease and weaken the plant, is directly linked to the number of days with temperatures above 15°C”

Jean-Baptiste Ornon, Agricultural Engineer at AXA Climat

N.B.: The threshold values given here are for guidance only. They may vary from one study to another depending on the information provided by experts regarding local specificities (varieties that are more or less susceptible, agricultural practices that offer greater or lesser protection, etc.)

When the user enters their data into Altitude, this is what appears for the Indo-Gangetic Plain, indicator by indicator.



Source: Altitude, 2050 outlook

For each indicator, Altitude plots the basin's value against risk thresholds calibrated for wheat cultivation.

Indicator	Medium-risk threshold	High-risk threshold
Diseases and pests (days with average temperature > 15°C, winter)	≥ 30 days	≥ 45 days
Precipitation (total for spring and summer, mm)	< 240 mm	< 200 mm
Extreme heat (consecutive days with Tmax > 35°C, summer and autumn)	≥ 10,5 days	≥ 15,75 days

Source: Altitude analysis

N.B.: for heat and pests, the risk increases above the threshold; for rainfall, the risk corresponds to a deficit, i.e. a cumulative total below the threshold.

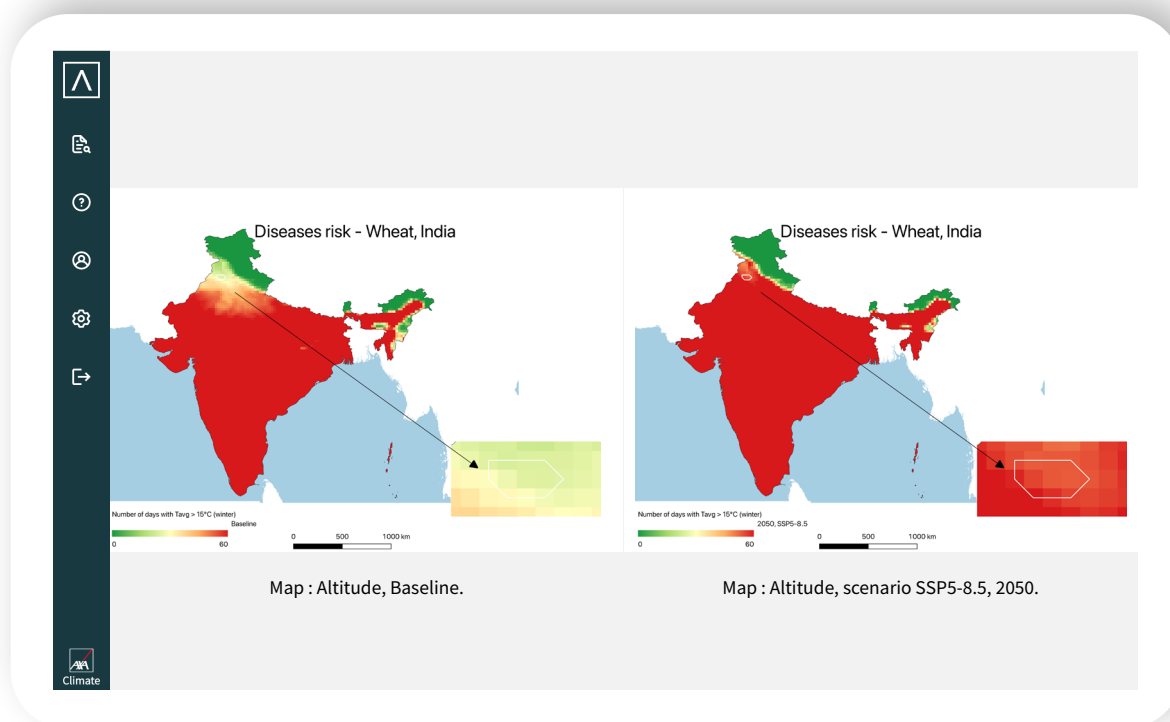
In the Indian sub-region, two indicators define the risk.

Firstly, **extreme heat** (consecutive days with $T_{max} > 35^{\circ}\text{C}$), which is already well above the high-risk threshold in the baseline scenario and continues to worsen, exceeding 50 days by 2050 in the most pessimistic scenario.

But above all, the **rise in winter temperatures** (days with $T_{avg} > 15^{\circ}\text{C}$) is the key indicator here: low in the baseline scenario, it moves to medium-risk from 2025 onwards in

all scenarios, then to high risk across all scenarios by 2050. It is this indicator that reflects the risk of the development of wheat diseases and pests, particularly aphids, and it is this that is mapped below, comparing the baseline situation with the 2050 scenario.

The indicator relating to **spring and summer rainfall**, however, has been excluded, as the cumulative total remains well above the 240 mm threshold throughout the period, covering the plant's water requirements.



Recommendation for action

In this region, two factors warrant the user's attention: extreme heat, which is already at a high risk level, and, above all, the rise in diseases and pests, which is set to worsen significantly by 2050. Altitude recommends two complementary approaches. At **a local level**, monitor these indicators and engage suppliers (where possible) in adaptation practices: heat-tolerant and pest-resistant crop varieties,

adjustments to the cropping calendar, irrigation management and enhanced plant health monitoring at critical growth stages. At **sector level**, plan for a partial diversification of supply towards less exposed regions, as medium-risk thresholds have already been exceeded and exposure is set to continue deteriorating by 2050.

Use case no. 2 · palm oil

Palm oil is the world's leading vegetable oil, with nearly 80 million tonnes produced each year. It is found in numerous consumer products ranging from food to cosmetics. In a producing region such as Thailand, however, extreme heat is shifting the crop's risk classification from low today to medium by 2050. For an investor, this presents two interrelated

challenges: diffuse physical exposure within the supply chains of portfolio companies, which is difficult to map, and a regulatory deadline already set by the EU regulation on deforestation. These are two reasons to **incorporate them into due diligence processes before they begin to weigh on valuation.**

Let us now take the example of a sustainability manager at a private equity fund. Their portfolio comprises dozens of companies across the agri-food, consumer goods and cosmetics sectors. They know that some are exposed to climate risks through their supply chains, but they are unable to identify which ones, or which raw materials are involved. This is the most common starting point from an investor's perspective: diffuse exposure that is difficult to map across different portfolio companies.

Based on each company's sector of activity, the Altitude platform will therefore enable them to identify the main raw materials to which it is exposed. In this case, palm oil quickly comes to the fore, as it is present in both the food and cosmetics sectors. Altitude then pinpoints the production regions, including Thailand, the world's third-largest producer, and assesses the risk indicator by indicator.

MARKET INSIGHT

Palm oil production is highly concentrated: Indonesia and Malaysia alone account for over 80 per cent of global supply (source: Statista, 2024).

Thailand is the world's third-largest producer, with around 3.5 million tonnes per year, with over 80 per cent of plantations concentrated in the southern provinces (sources: Statista; Reportlinker, 2024).

EXPERT INSIGHT

"The oil palm (*Elaeis guineensis*) is a tree native to the tropical forests of the Gulf of Guinea. It is adapted to a mild, humid climate. It is therefore highly sensitive to cold, but also cannot tolerate extreme heat. It has significant water requirements.

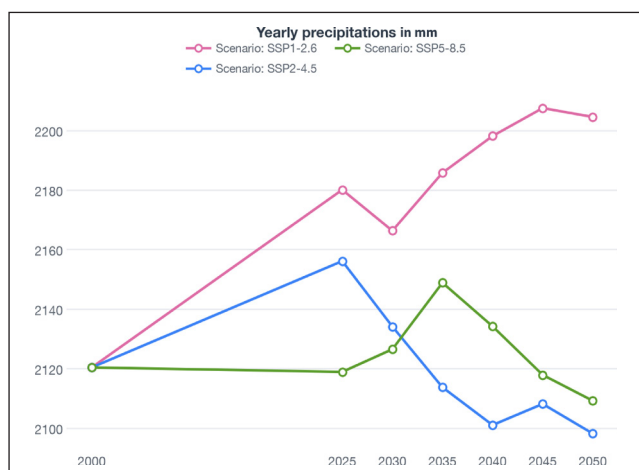
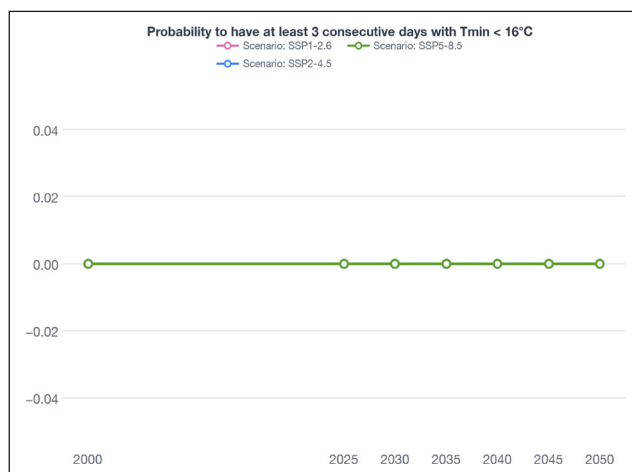
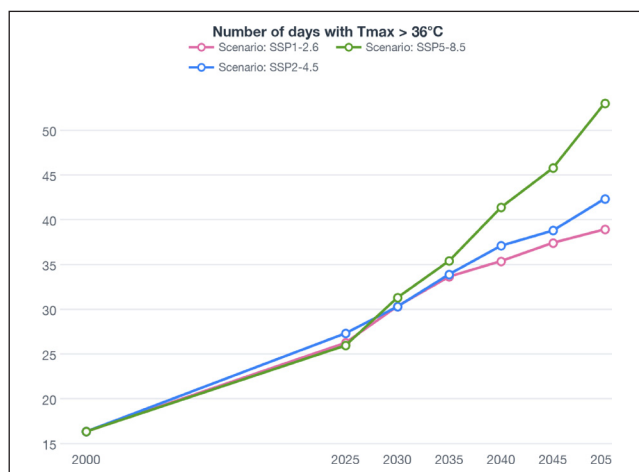
We are therefore prioritising year-round research into its range, which will be constrained by:

- Cold temperatures, which impair its metabolism: $< 16^{\circ}\text{C}$.
- Extreme heat, which impairs its metabolism: $> 36^{\circ}\text{C}$
- Meeting its water requirements: ideally 1,800 mm/year

Notable fact: The oil palm requires a weevil (*Elaeiodobius*) for pollination. However, this weevil mummifies if the weather becomes too hot ($> 30^{\circ}\text{C}$) and dry ($< 75\%$)"

Jean-Baptiste Ornon, Agricultural Engineer at AXA Climat

When the user enters their data into Altitude, here is what emerges for the Thai basin, indicator by indicator.



Source: Altitude, 2050 outlook

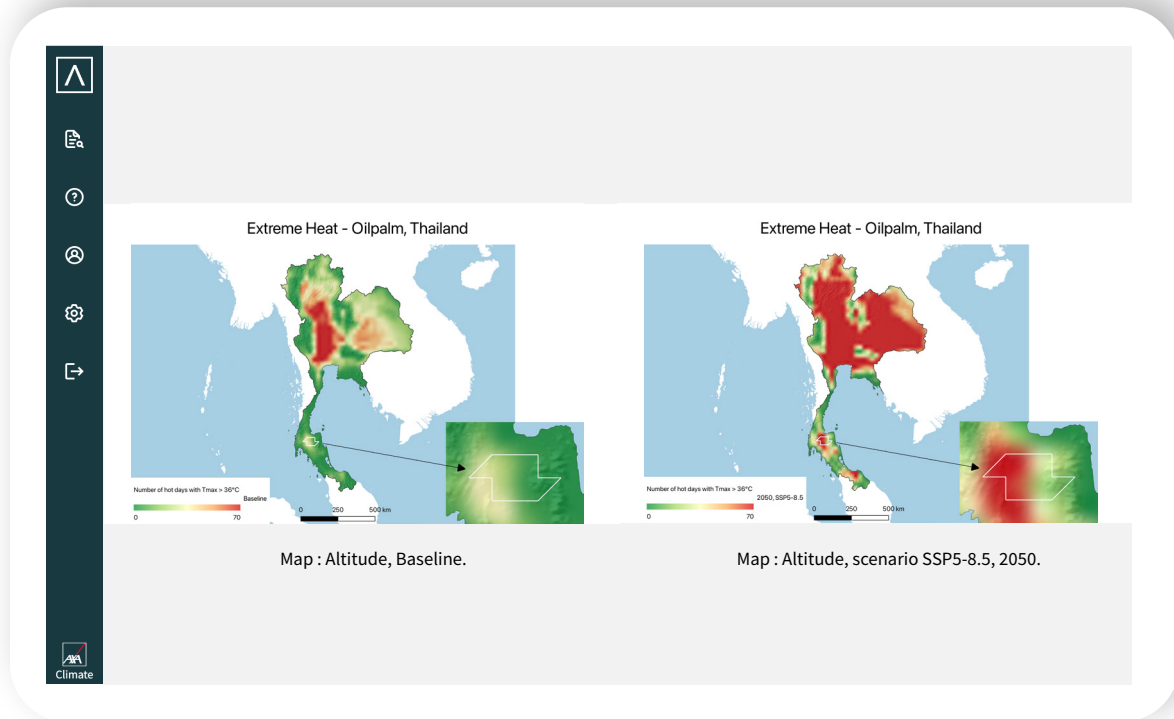
For each indicator, Altitude compares the basin's value against risk thresholds calibrated for oil palm cultivation.

Indicator	Medium-risk threshold	High-risk threshold
Extreme heat (days per year with Tmax > 36°C)	≥ 45 days	≥ 67,5 days
Precipitation (annual total, mm)	< 1200 mm	< 1067 mm
Cold weather (annual probability of a spell of 3 consecutive days where Tmin < 16°C)	≥ 3%	≥ 10%

Source: Altitude analysis.

N.B.: for heat and cold, the risk increases above the threshold; for precipitation, the risk corresponds to a deficit, i.e. a cumulative total below the threshold.

The indicator at greatest risk here is extreme heat. Here is how it can be visualised on Altitude, comparing the baseline scenario with the 2050 projection.



Recommendation for action

In this region, the key indicator is extreme heat, which is set to rise from low risk today to medium risk by 2050 under the most pessimistic scenario. For an investor, the challenge is not to take action on the ground, but to incorporate this analysis into their investment management. Altitude enables investors to map exposure at portfolio level, to

incorporate physical risk into due diligence and valuation processes, and to prioritise dialogue with the most exposed portfolio companies. Added to this is the regulatory dimension: verifying companies' ability to comply with the European regulation on deforestation is becoming a marker of management quality.

Use case no. 3 · aluminium

With over 70 million tonnes produced each year, aluminium is a key material in modern industry, from transport and construction to packaging, but its production is concentrated in a few major regions. In the Canadian region, the risk is not a distant prospect; it is already a reality: pluvial flooding there has already exceeded the materiality threshold and

is not expected to decrease under any scenario by 2050. For a manufacturer whose supply chain relies on a single source, this immediate challenge must be addressed now, by ensuring the resilience of the supplier's site and securing the continuity of supply.

Let us take the example of a major industrial construction group whose production relies heavily on aluminium. Its risk director knows exactly which material the company depends on and knows precisely where it comes from: he is so familiar with its supply zones that he can map out their boundaries himself. This represents the highest level of maturity – that of a company which has already mapped its dependencies and is seeking to quantify them in detail.

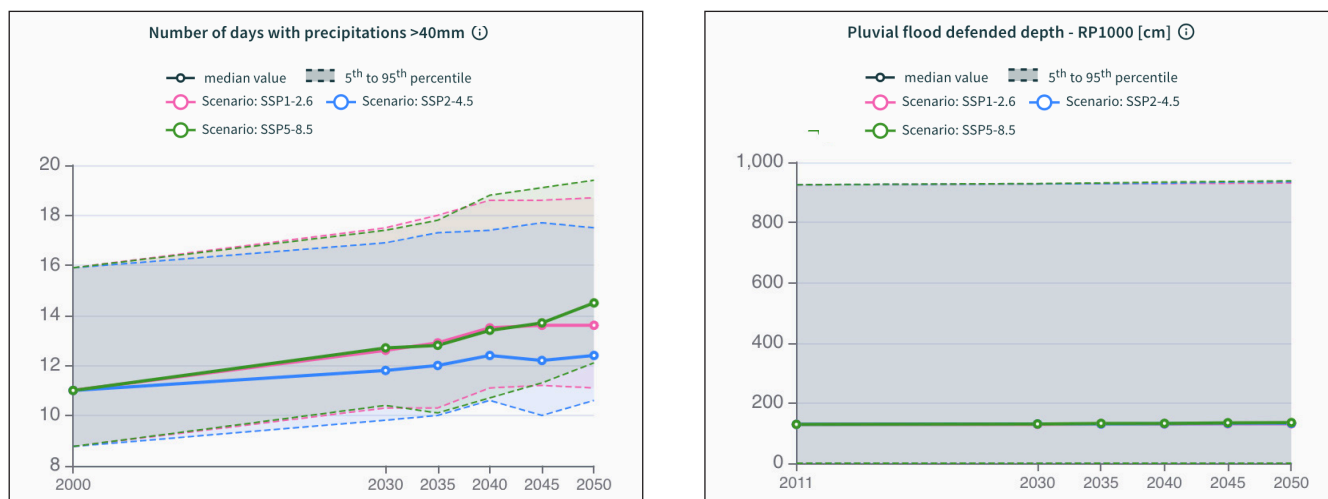
Altitude then offers him complete control over the scope of the analysis. Rather than relying on a predefined catchment area, he draws the exact polygon of his production area directly within the platform and obtains a risk assessment tailored to this bespoke scope, indicator by indicator

MARKET INSIGHT

Aluminium production is highly concentrated: China accounts for nearly 60 per cent of global primary aluminium production, out of a total of around 72 million tonnes in 2024 (sources: USGS; Transition Asia).

Canada is the world's fourth-largest producer, with around 3.3 million tonnes of primary metal in 2024, behind China, India and Russia. What sets Canada apart is its energy mix: its smelters, concentrated in Quebec and British Columbia, rely heavily on hydroelectricity, giving them one of the lowest carbon footprints among major producers (source: Natural Resources Canada).

Once the polygon has been drawn, Altitude assesses the risk within this exact area. The resulting profile is clear-cut: the risks of coastal and river flooding are zero, but the risk of pluvial flooding is very high.



Charts: Altitude analysis

For each indicator, Altitude assesses the area against calibrated risk thresholds.

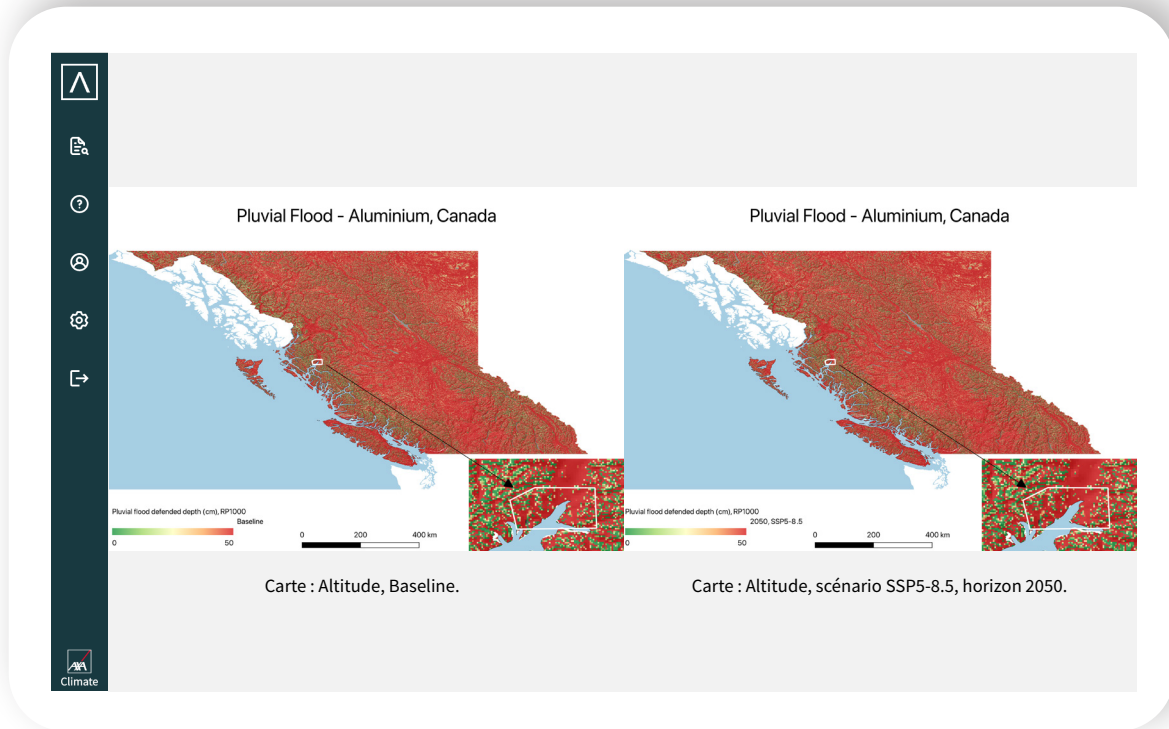
Indicator	Medium-risk threshold	High-risk threshold
Pluvial flooding (water depth, 1,000-year return period)	≥ 10 cm	≥ 40 cm
Heavy rainfall (days per year with rainfall > 40 mm)	≥ 10 days	≥ 20 days

Source: Altitude analysis

N.B.: Pluvial flooding is measured by the water level reached during an extreme event (1,000-year return period), in centimetres; heavy rainfall is measured in terms of the number of days per year. In both cases, the risk increases above the threshold.

The most critical indicator is pluvial flooding, and its distinctive feature lies as much in its intensity as in its stability. The risk is already very high today, and it will remain virtually unchanged by 2050, regardless of the scenario. It is therefore not a future threat to be anticipated, but an existing and structural constraint.

Here is how the indicator can be visualised on Altitude, comparing the baseline scenario with the 2050 outlook.



Recommendations for action

For a manufacturer who knows the exact origin of their metal, Altitude recommends two complementary approaches.

At a local level, engage in dialogue with the supplier regarding the site's resilience: protection of electrical installations and critical areas, drainage capacity, keeping sensitive equipment above water, and securing logistics and port access.

At sector level, incorporate this exposure into the supply strategy. The highly concentrated nature of global production, the single source of this region and a pluvial flood risk that does not diminish under any scenario all argue in favour of planning for business continuity: identifying alternative sources, establishing buffer stocks for this critical input and making exposure to physical risk a criterion for supplier selection and contract negotiation.

Conclusion

Supply chains are now subject to a multitude of exogenous shocks, due to growing geopolitical, economic and health-related tensions. Whilst the precise timing of these shocks remains difficult to predict, climate change modelling, based on robust scenarios, makes it possible to quantify long-term trajectories. This relative predictability represents a rare opportunity for businesses and investors, provided they act on it early enough. In the future, the most resilient players will not only be those who have secured their own sites, but those who have understood that their actual exposure is shaped well in advance, amongst their suppliers and in the regions that produce the raw materials on which they depend. By providing clear visibility of these risks, basin by basin and commodity by commodity, Altitude enables this dimension to be factored into decisions today, rather than being discovered only when a crisis strikes. It is this foresight that will distinguish robust supply chains from those that remain vulnerable in the future.

Altitude now enables you to identify the raw materials on which your business depends, locate the production basins that supply them, and assess their climate exposure, basin by basin and over different time horizons. The challenge is not to predict everything, but to turn a blind spot into a decision: securing a critical supply, deciding on a sourcing strategy, engaging a supplier or documenting a regulatory requirement, before the risk materialises.

Are you an Altitude customer? You can start exploring your own dependencies on the platform today.

To discover the platform and its features, request a demonstration here: axa-altitude.com



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