WINTER STORM KLAUS: FINDINGS FROM THE AIR DAMAGE SURVEY

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EDITOR'S NOTE: In the early hours of January 24, 2009, a violent winter storm swept out of the Atlantic Ocean into the Bordeaux region of southwest France. Klaus—as the extratropical cyclone was named—was the worst storm to hit France in nearly a decade, causing damage across southwestern France and northern Spain. In the days following the event, AIR's post-disaster survey teams visited areas in France affected by Klaus to assess the damage. This article presents their findings.

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INTRODUCTION

On the night of Thursday, January 22, a mid-latitude storm formed in the subtropical North Atlantic Ocean, west of the Azores Islands. Exhibiting a period of very rapid strengthening known as "explosive cyclogenesis," the system's central pressure dropped from about 1000 millibars late Thursday to a minimum pressure of 967 millibars early Saturday morning. As Klaus moved into the Bay of Biscay on Friday night, Météo France issued a red alert—its highest—for five departments in the southwest, warning of exceptionally intense winds and urging residents to remain indoors. It was the first red alert since the warning system was introduced in October 2001, after winter storm Martin devastated France in 1999.

Klaus came ashore on Saturday morning in the Bordeaux region with maximum wind speeds of 161 km/h, surpassing previous records. By about 8:00 a.m. local time (CET), as the storm moved east over the Pyrenees, red alerts were in effect for nine departments.

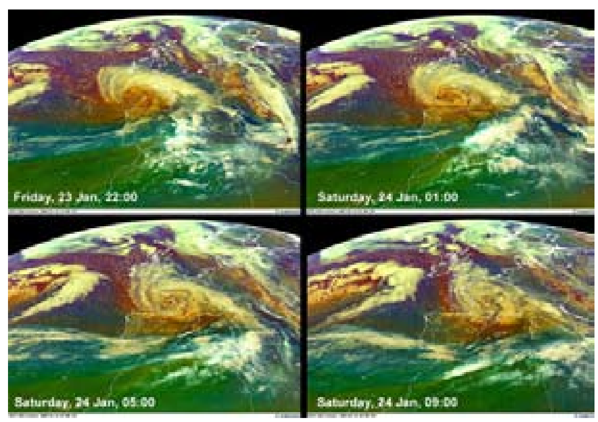

Figure 1. Satellite images showing the progression of winter storm Klaus (Source: EUMETSAT)

By the evening of January 24, as Klaus moved into the Adriatic Sea, the fiercest of Klaus' winds had subsided, but the storm had left more than 1.7 million households in France without electricity and hundreds of thousands without telephone service. The storm's cold front brought torrential downpours to some regions, and thirteen departments were placed on orange alert for flooding. Transportation was severely disrupted, as many airports in the region cancelled flights. Downed trees blocked roads and halted service on several main rail lines.

Two days after the passage of Klaus, AIR dispatched post-disaster survey teams to affected areas of France to assess the damage. Figure 2 shows Klaus' maximum recorded wind speeds, as well as the region surveyed by AIR (outlined in pink).

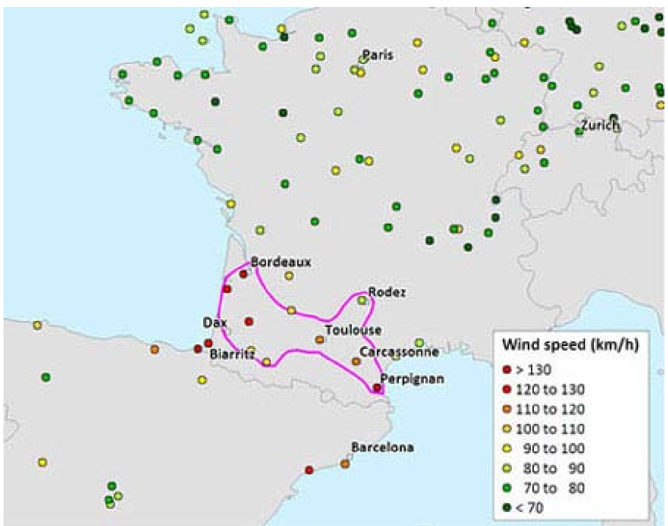

Figure 2. METAR data for winter storm Klaus. Pink outline represents the area visited by AIR's post-disaster survey teams

The teams spent three days traveling throughout the affected region, cataloging damage observations using detailed survey forms that capture information on individual structures, including their geocoded location, and factors affecting vulnerability (such as age, construction, roof type and occupancy). Some of their key findings are detailed below.

BORDEAUX AND THE AQUITAINE COAST

This area experienced some of the highest wind speeds within the storm's footprint, which was consistent with damage observations. However, in the well-maintained city center of Bordeaux, damage was minimal and largely restricted to that caused by uprooted trees falling on nearby structures (Figure 3).

Figure 3. Fence damage at the Jardin Public in Bordeaux (Source: AIR)

In the residential areas surrounding Bordeaux, wind damage was more widespread, though still observed in less than 5% to 10% of buildings. Damage was generally restricted to minor roof tile damage and occasional chimney damage. The dominant residential construction in this area is one- to two-story detached masonry houses and taller three- to four-story apartment blocks of reinforced concrete. The damage to roof tiles on the latter was more significant because of the higher profile of such buildings (wind speeds increase with height). However, no structural damage was observed to either construction type.

Figure 4. Roof tile damage to low-rise masonry construction in Avenue de la Republic (left) and to four-story reinforced concrete construction in Pessac (right) (Source: AIR)

Beginning about 65 km southwest of Bordeaux, tree damage became more common. In the coastal towns of Gujan-Mestras and Saguinet (Figure 5), the team observed many instances of trees that had fallen on properties, causing significant structural damage. At the campsite "les Grandes Pins" in Saguinet, an estimated 150 caravans (mobile homes) were destroyed by downed trees. Significantly—and with implications for actual wind speeds on the ground—few trees appeared to have been snapped by high winds; instead, they had been uprooted due to the combination of wind and heavily saturated soils.

Figure 5. Damage caused by fallen trees in Gujan-Mestras (left) and Saguinet (right) (Source: AIR)

Throughout this region, the team observed a consistently higher incidence of damage to older buildings than to newer ones. Churches, often the oldest and tallest structures in town, and vulnerable to dynamic wind loads because of their slender structures, were particularly hard hit (Figure 6).

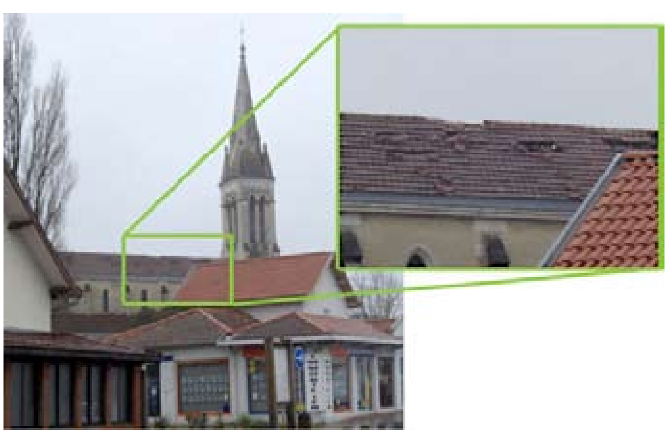

Figure 6. Churches across the region sustained significant damage to roof tiles (Source: AIR)

South and inland from the Bordeaux area, the team traveled through Landes, where Klaus is reported to have downed over 60% of the trees in Europe's largest maritime forest. The forests, mostly privately owned, account for about a third of France's lumber production. Forestry officials estimate that 50 million cubic meters of timber was toppled by Klaus. According to the French Private Forestry Federation, only 5% of privately owned forests are covered by property insurance, which includes windstorm coverage. Nevertheless, commercial forestry damage remains a significant source of uncertainty with respect to ultimate insured losses.

Figure 7. Toppled forests (left) and utility workers repairing power lines (right) in the Landes region (Source: AIR)

Further south toward Dax, the team continued to observe a high incidence of uprooted trees and even trees sheared off. The first significant damage to commercial structures was seen in Dax, where sheet metal roofs or siding had been peeled off (see Figure 8).

Figure 8. Roof and siding damage to low-rise light metal commercial buildings in Dax (Source: AIR)

Light metal construction with large spans can be highly vulnerable even at a low to moderate wind speeds. One hangar of the Dax Helicopter Museum suffered significant roof damage (see Figure 9).

Figure 9. One out of the four hangars at the Dax Helicopter Museum experienced significant damage to metal sheeting covering the roof (Source: AIR)

The most noticeable damage to residential properties in Dax occurred to the roofs of taller apartment buildings (four to five stories), where tiles at the roof ridge or eves had been blown off or displaced. In some cases, structures with large overhangs experienced damage to the soffits. Wind can become trapped under these overhangs, creating turbulence and large localized wind loads. Overhang damage can lead to more significant failure of the overall roof of a building, though this was not observed. More extensive structural damage to residential properties was observed in a few cases where large trees had been uprooted and had fallen onto houses.

Figure 10. Roof overhang damage in Dax (Source: AIR)

From Dax, as the team travelled east and inland from the coast, property damage was increasingly less frequent and typically limited to the roof tiles of older houses in states of poor repair. Tree damage decreased as well. However, the team observed significant flooding on the way from Dax to Salies de Bearn. The River Adour had burst its banks, flooding nearby roads (Figure 11). In some places, floodwaters were still threatening residences, although in no instance did the team actually observe flooded properties.

Figure 11. In and around Dax, the River Adour had burst its banks, flooding nearby roads (Source: AIR)

AROUND TOULOUSE AND THE MEDITERRANEAN COAST

In the rural areas surrounding Toulouse, residential construction is predominated by low-rise unreinforced masonry buildings with low pitched, gable roofs. Common in this area are "canal" roof tiles, curved clay tiles that are overlaid in an overlapping pattern to hold them in place. Because they are not mechanically attached to the roofs, these tiles are typically the first to suffer damage during a windstorm. Corners and ridges experience the highest wind loads and indeed these damage patterns were the ones observed most frequently in the field. Newer roofs that featured flatter, more angular tiles with a lower profile fared much better. There were also instances of toppled chimneys, antennas, and satellite dishes (Figure 12).

Figure 12. Damage to canal roof tiles outside of Muret (left) and in Villefranche-de-Lauragais (right) (Source: AIR)

Utility repair crews were seen working on virtually every road on this part of the survey course. Indeed, losses to utility companies may account for a significant percentage of ultimate insured losses.

Figure 13. Utility repair crews were out in force across Southern France. (Source: AIR)

North of Toulouse, observed damage levels were consistent with the lower reported wind speeds here. Toward Rodez (about 150 km northwest of Toulouse), buildings were typically newer and constructed of concrete masonry and interlocking slate roof tiles (Figure 14). Despite the taller profile of the buildings and higher elevation of the town, minimal damage was seen.

Figure 14. More modern construction and lower wind speeds resulted in minimal damage in Rodez (Source: AIR)

As the team travelled southeast from Toulouse, they observed an increase both in the severity and frequency of damage, which is again consistent with Klaus' recorded wind speeds. The incidence of damage was estimated at around to 1 in 20 buildings in Carcassonne (about 100 km to the southeast), where the team observed roof and overhang damage to residential buildings and a few incidences of structures damaged by fallen trees. However, commercial buildings in Carcassonne, which are generally of low-rise masonry wall construction with light metal roofs, escaped largely unharmed.

Figure 15. Non-structural damage to balcony awning. (Source: AIR)

About 70 km southeast of Carcassonne, St. Paul de Fenouillet, which is situated atop an exposed hill in a large valley in the Pyrenees, experienced some of the highest wind speeds recorded during the storm—up to 177 km/h. Here, the incidence of damage was considerably higher, at around 1 in 10. Roof damage in St. Paul de Fenouillet was more severe than observed in previous areas, with large section of tiles damaged in some cases. There was also significant damage to commercial structures. These were of similar construction observed elsewhere in the region, but appeared to be noticeably older (Figure 16).

Figure 16. Roof and siding damage to a low-rise commercial structure in St. Paul de Fenouillet (Source: AIR)

Some of Klaus' highest recorded wind speeds were in the region near Perpignan, though the highest of these occurred in the mountains. In the city itself—a popular tourist area—the buildings were clearly well-maintained and no significant damage was observed.

CONCLUSION

Klaus was the most intense winter storm to affect France since Martin in December of 1999, which caused an estimated €2.5 billion in insured losses in France at the time. Klaus' wind speeds broke several records across southwestern France. However, while the maximum wind speeds from Klaus were in some cases higher than for Martin, Klaus' footprint of damaging winds was smaller.

Based on the results of AIR's post-disaster survey, the intensity of damage from winter storm Klaus' was consistent with expectations given the reported wind speeds and dominant construction types. With the exception of those instances in which trees had fallen onto properties, or where properties were in poor repair, the team observed very few instances of significant structural damage. Instead, direct wind damage from Klaus was generally limited to roof tile damage for residential properties and roof and siding damage to light metal commercial properties. However, the *frequency* of damage was somewhat higher than expected.

Since AIR issued its initial loss estimates on January 27, three days after winter storm Klaus swept across southern France, AIR has obtained and analyzed additional wind speed data from a meso-network of observing stations run by Metéo France. The new data represent wind gust values from more than 700 weather stations across France. In addition, AIR engineers have had the opportunity to evaluate the detailed data collected in the course of the damage survey discussed in this article.

Armed with this new information, AIR currently estimates that insured property losses from Klaus in France will range between about €500 million and €1 billion. However, it should be noted that there are several sources of uncertainty that may cause losses to go even higher. One is the magnitude of losses to the forestry industry, as noted above. In addition—and closely related to the widespread uprooting of trees which in turn brought down power lines across the region—losses to utility companies may be significant. Another unknown is the extent to which power outages may have resulted in Business Interruption losses. There is also some question as to whether insurers in France will waive deductibles. If they do so, the impact on insured losses could be significant given the large number of claims that Klaus is likely to engender.

The damage observed by AIR's survey teams was, in general, of relatively low intensity but relatively high frequency. As a result, it may be quite some time before losses fully develop. The AIR extratropical cyclone modeling team will monitor loss development closely as they continue to analyze both meteorological data and damage data for this storm.

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