PRESS RELEASE
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Intense atmospheric rivers shown to weaken ice shelf instability at the Antarctic Peninsula

Atmospheric rivers landfalls shown to induce extreme conditions that destabilize Antarctic Peninsula ice shelves according to a new study from researchers1 from the Université Grenoble Alpes, CNRS, Sorbonne Université and Aix Marseille Université, and from Portugal, Belgium, Germany, and Norway. Their study will be published in the journal of Communications Earth & Environment on April 14, 2022.

80% of the total Antarctica ice output flow through ice shelves confined in huge bays by a buttressing effect which transfers upstream the friction along the edges and from contact with oceanic rock outcrops. The disintegration of these ice shelves leads to a massive acceleration of the glaciers that are normally restrained.

In the past 30 years, the large and dramatic collapses of two major ice shelves along the Antarctic Peninsula (Figure 1), the Larsen A in austral summer 1995 and Larsen B in austral summer 2002, along with other major ice shelves raised fears for the fate of other ice shelves controlling the outgoing continental ice. Causes of these destabilizations were investigated and individual oceanic or atmospheric factors were proposed. Here the researchers identify atmospheric rivers as the generator of a combined chain of factors responsible for the potential short-term ice-shelf destabilization.

Atmospheric rivers represent narrow corridors in the atmosphere that transport water vapor from the tropics towards higher latitudes. This study shows that atmospheric rivers correspond with the vast majority of temperature and rainfall extremes over the Antarctic Peninsula including the Antarctic continent maximum temperature record of 18.3° C set at Esperanza station on February 6th, 2020. These extreme temperatures lead high surface melt rates. After the snow surface becomes saturated, water collects in lakes and eventually fill crevasses, contributing the shelf instability via hydrofracturing. Atmospheric rivers also provoke the disintegration of sea ice around the edges of the ice shelves, allowing incoming ocean swells to cause strain along the ice shelf fronts (Figure 2). Without the sea-ice buffer, open-ocean swells can directly impact the ice shelves. These effects of atmospheric rivers were observed during the collapses of the Larsen A and B ice shelves, and 60% of large iceberg calving events after 2000. In fact, the most intense atmospheric rivers generate a combined chain of impacts (summarized in Figure

1) inducing extremes in temperature, surface melt, sea-ice disintegration, or large swells; all processes known to destabilize the ice shelves.

The Larsen C is the largest remaining ice shelf on the Antarctic Peninsula. It could become the next at-risk ice shelves in a warming climate. After the Conger Ice Shelf collapsed during an apparent major atmospheric river event over East Antarctic in mid-March 2022, scientists are examining the causality and if other ice shelves around Antarctica maybe vulnerable to atmospheric river activity.

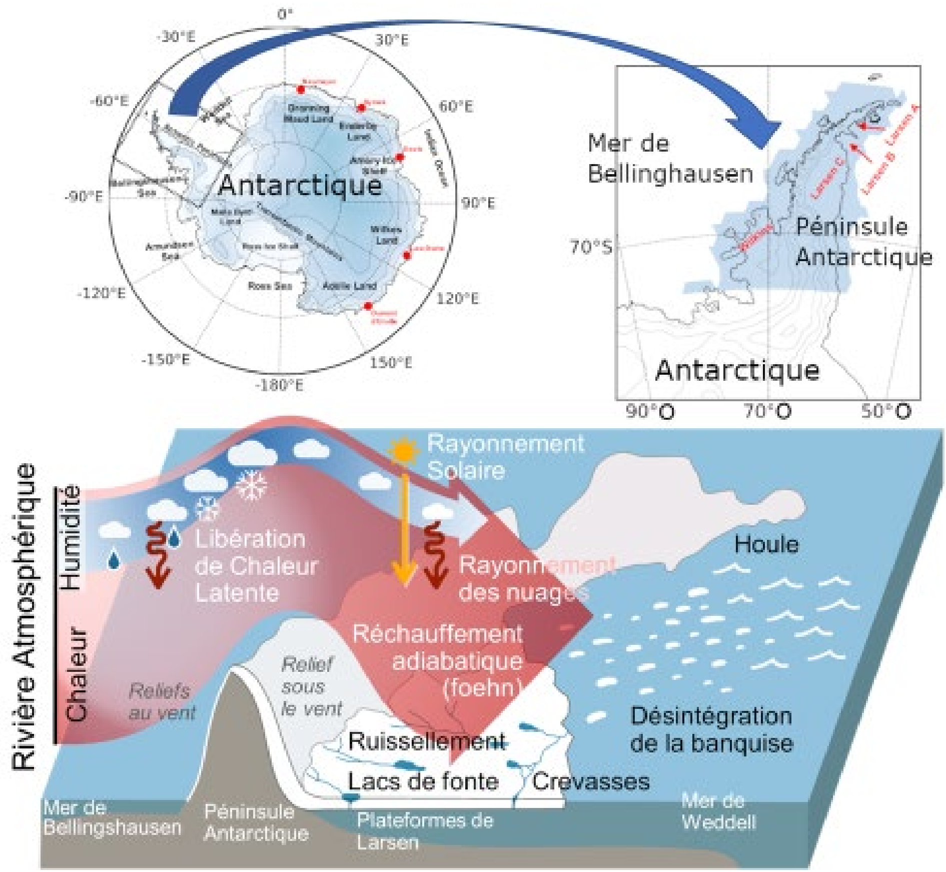

Figure 1: Location of the ice shelves along the Antarctic Peninsula and illustration of a typical intense atmospheric river over the northern Antarctic Peninsula and the associated observed meteorological features and impacts consequential to ice-shelf stability. Figure taken from the *Communications Earth & Environment article*.

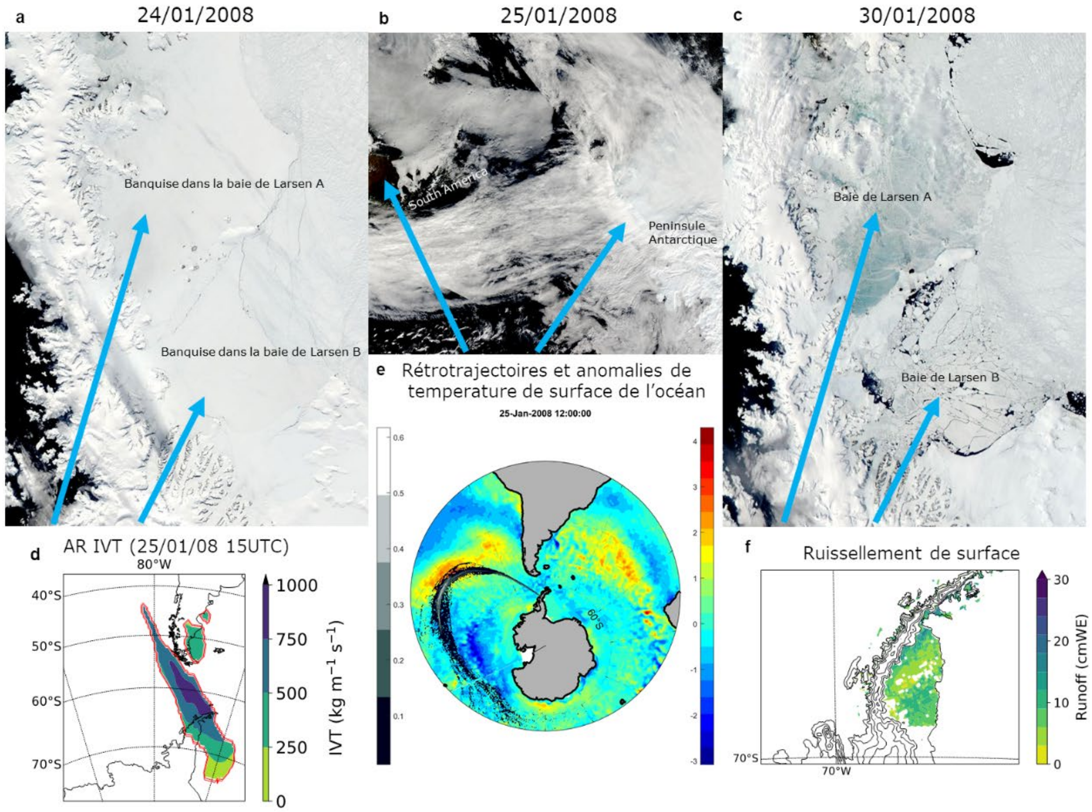

Figure 2: Satellite imagery from a 24/01/08 and c 30/01/08 showing the land-fast ice and sea ice decay after the passing of an atmospheric river as seen in b 25/01/08. d The shape and intensity of the detected atmospheric river on 25/01/08 15 UTC. e Back trajectory of air masses associated with the atmospheric river over the course of ten days. Sea surface temperature anomaly calculated for the 19-01-08 to 23-01-08 period with respect to the 1980-2010 period. f The total runoff that occurred from 25/01/08 - 30/01/08. Figure taken from the *Communications Earth & Environment article*.

[1] **The laboratories involved are:**
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