Toward Greater Clarity: Reanalyzing Solomon's Depiction of the Ross Ice Shelf Atmospheric Dynamic

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Abstract

Dr. Susan Solomon's influential interpretation of the meteorological conditions surrounding Captain Scott's South Pole expedition emphasizes the role of extreme weather. However, a reassessment of her characterization of atmospheric dynamics over the Ross Ice Shelf—particularly regarding katabatic winds and airstream structure—reveals discrepancies with established meteorological understanding. Drawing on satellite data, historical records, and current polar research, this article aims to clarify the scientific context and invite a careful reconsideration of Solomon's conclusions.

Introduction

In *The Coldest March: Scott's Fatal Antarctic Expedition*, Solomon (2002) presents a detailed account of Captain Robert Falcon Scott's journey to the South Pole. Solomon (p. 319) concludes that it is "a virtual certainty" the blizzard described by Scott (1913, p. 410)—which halted the progress of Scott, Dr. Edward Wilson, and Lieutenant Henry Bowers—did not occur as reported. Solomon (2002, p. 327) further asserts that "the scientific constraints of modern meteorology" render such a blizzard implausible. A decade later, Solomon (2012) reiterated this position in a lecture at the Royal Society of Chemistry.

Solomon's conclusion has been widely reflected in popular media. Articles in *The Guardian* (Glancey, 2001) and the *Los Angeles Times* (Hotz, 2001) echoed Solomon's suggestion of "a desperate Scott vainly attempting to save legacies rather than lives," contributing to a narrative of tragic heroism and questionable decision-making that has influenced public perceptions of the expedition.

In a previously published study, Zinkova (2025) presented evidence that the blizzard likely did occur and that its characteristics closely aligned with Scott's original account. The present article does not revisit that conclusion. Instead, it examines Solomon's interpretation of the Ross Ice Shelf atmospheric dynamic. A detailed analysis indicates that several meteorological processes may have been inaccurately represented, which in turn affects the broader conclusions regarding the storm's severity. This article aims to clarify those processes and reassess the applicability of the "scientific constraints of modern meteorology" cited by Solomon (2002, 2012), in light of satellite data, historical records, and contemporary polar meteorological research. An overview map of the Ross Ice Shelf is presented in Figure 1.

Figure 1. Overview map of the Ross Ice Shelf and its surrounding terrain, including the Transantarctic Mountains to the west and Marie Byrd Land to the east. A red pointer marks Ross Island, home to McMurdo Station.

Data and Methods

This analysis uses infrared satellite imagery from NASA's Worldview platform (NASA, 2025) to evaluate Dr. Susan Solomon's (2002, 2012) meteorological findings about the nature of the Ross Ice Shelf atmospheric dynamic. The imagery provides clear, empirical evidence of atmospheric patterns over the region. Bromwich et al. (1992) demonstrated that katabatic winds traversing glacier valleys in the Transantarctic Mountains often produce warm signatures on thermal satellite imagery. That is why they are easy to spot from space. Historical accounts by the Terra Nova expedition's meteorologist George Simpson (1919) and expedition member Apsley Cherry-Garrard (1922) are also incorporated.

By comparing Solomon's statements—drawn from her book *The Coldest March* (Solomon, 2002) and her public presentation hosted by the Royal Society of Chemistry (Solomon, 2012)—with observable satellite data, historical records and contemporary scientific literature, this study demonstrates that nearly every conclusion she makes regarding the atmospheric dynamic of the Ross Ice Shelf is not supported by the available data.

Results

Let us examine the "scientific constraints of modern meteorology," which, as Solomon (2002, p. 319) contends, would have made the occurrence of the Final Blizzard virtually impossible.

Constraint #1: According to Solomon (2002, 2012), The Ross Ice Shelf is as a cyclone-free zone of pure katabatic descent

During her 2012 presentation, Solomon (2012) was asked to clarify her assertion that blizzards on the Ross Ice Shelf cannot persist beyond four days, if one was caused by a cyclone, for example. She responded as follows:

> *I didn't mean to imply that there's no place else on the continent where you could have blizzards longer than four days long. That's, clearly not correct. There's plenty of places where you can have much longer blizzards because as you say, you can have cyclones that can last longer than that. The conditions on the barrier are pretty strongly katabatic. I mean, when you have this kind of blizzard, that's normally what you're getting, because you're shielded so well from, and from cyclones moving in from the, from the coast. So it's a very different kind of meteorology.*

Atmospheric conditions over the Ross Ice Shelf are not governed solely by katabatic winds. Rather, the region’s wind regime reflects a dynamic interplay among barrier winds—driven by the topographic blocking by he Transantarctic Mountains—gravity-driven katabatic flows, and synoptic and mesoscale winds associated with cyclones and mesocyclones traversing the Ross Sea and Ross Ice Shelf (Seefeldt et al., 2007).

Moreover the Ross Ice Shelf is not shielded from cyclones. In the vicinity of Scott’s Last Camp and Corner Camp, nearly all extreme wind events—whether katabatic (Figure 2, Figure 3) or barrier (Figure 4)—are driven by passing cyclones or mesocyclones, as evidenced by infrared satellite imagery. This dynamic weather pattern was well documented by Schwerdtfeger (1984) and King and Turner (1997), long before Solomon’s book appeared. Bromwich et al. (1992) showed how a large-scale cyclone could drive katabatic winds across the Ross Ice Shelf, linking storm systems directly to surface wind behavior. O’Connor et al. (1994) described two primary scenarios in which barrier winds typically develop: one involves the passage of a mesocyclone across the northwestern Ross Ice Shelf, while the other is associated with synoptic-scale cyclones approaching from the north and east, moving through the Ross Sea and Ross Ice Shelf regions (Seefeldt et al., 2007).

Interestingly, both her book (Solomon 2002, p. 312) and her presentation (Solomon, 2012) featured a satellite image showing the propagation of katabatic winds across the Ross Ice Shelf and clearly depicts a synoptic-scale cyclone—an essential driver of the pressure gradients that enabled the katabatic flow to traverse hundreds of kilometers across the shelf.

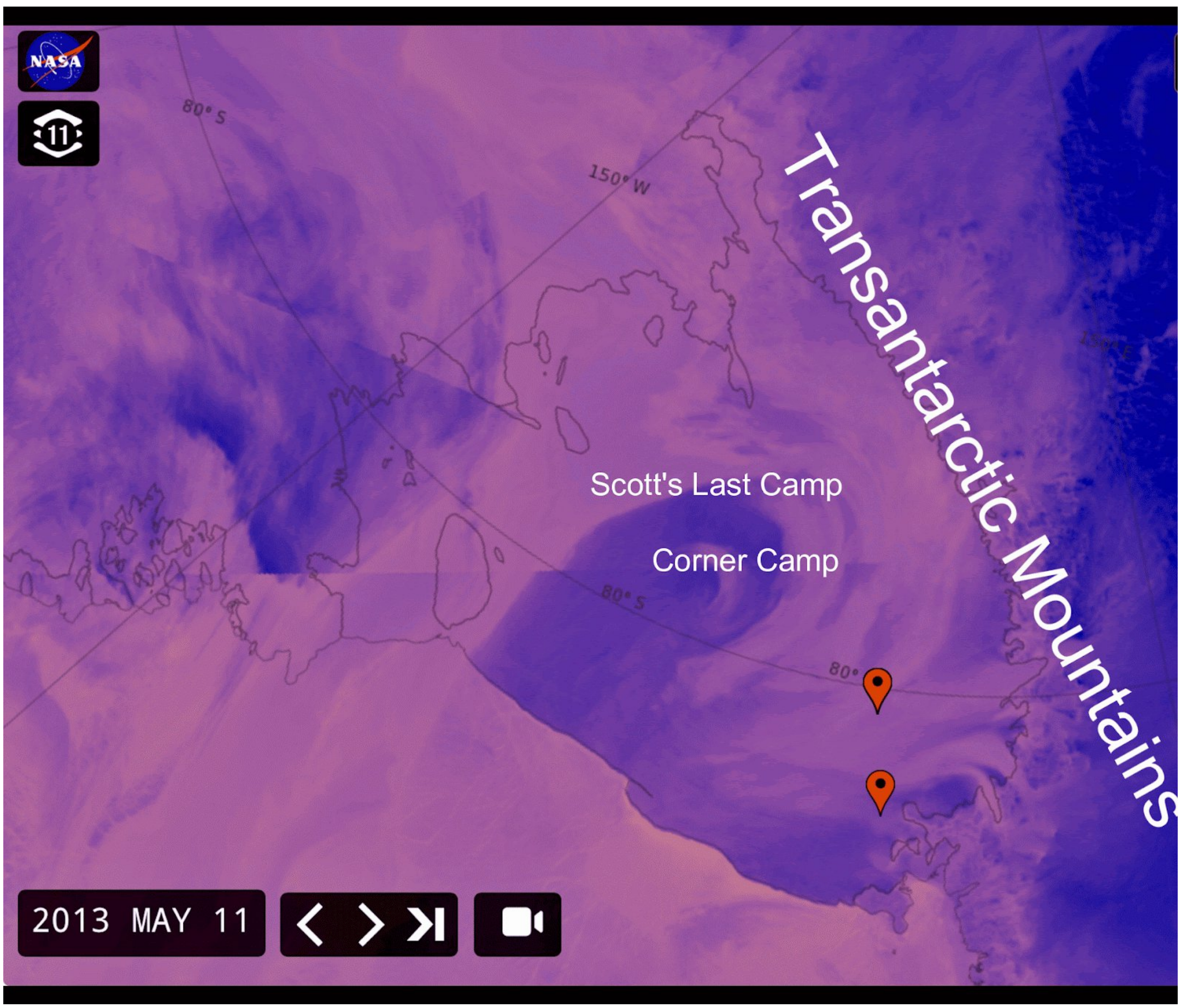

Figure 2. The NASA (2025) satellite infrared image shows a large cyclonic storm swirling over the Ross Ice Shelf in Antarctica on May 11, 2013. Two locations, Scott's Last Camp and Corner Camp, are marked. The image also reveals subtle signatures of katabatic winds. These appear as lighter (warmer), linear features flowing off the Transantarctic Mountains.

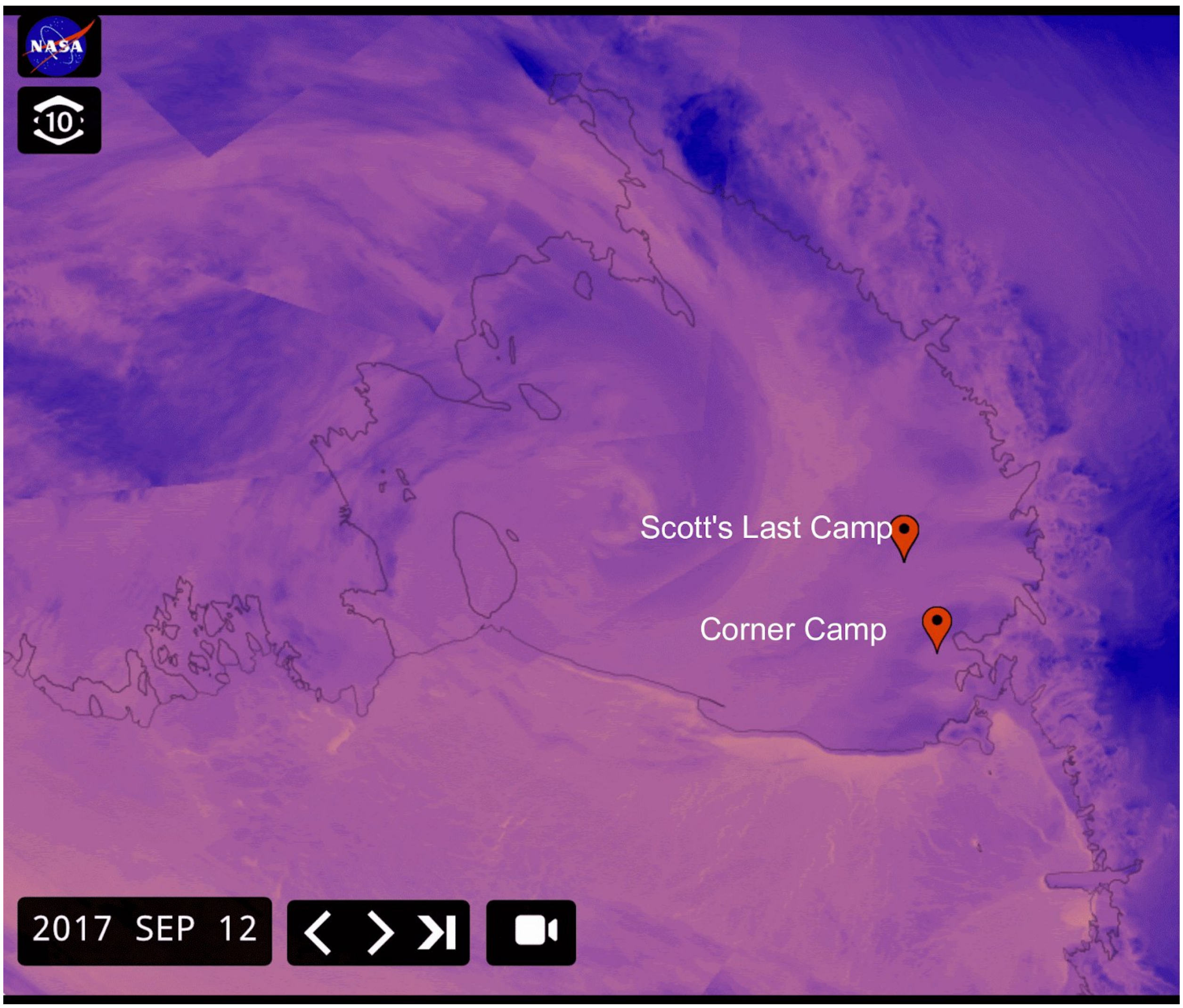

Figure 3. The NASA (2025) satellite infrared image shows a large cyclonic storm swirling over the Ross Ice Shelf in Antarctica on September 12,

2017. Two locations, Scott's Last Camp and Corner Camp, are marked. The image also reveals subtle signatures of katabatic winds. These appear as lighter (warmer), linear features flowing off the Transantarctic Mountains.

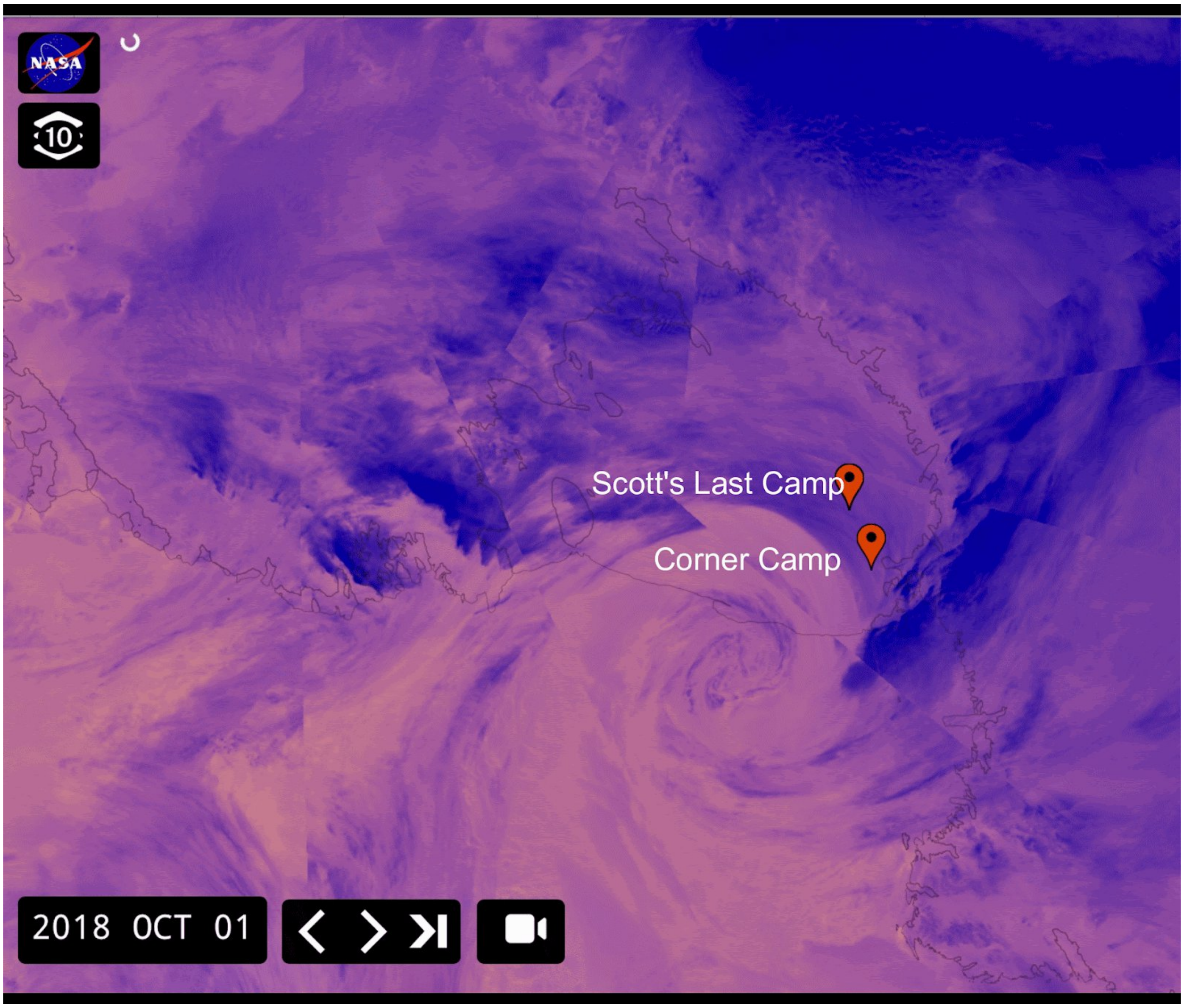

Figure 4. The NASA (2025) satellite infrared image shows a large cyclonic storm swirling over Ross Sea and the Ross Ice Shelf in Antarctica on September 12, 2017. Two locations, Scott's Last Camp and Corner Camp, are marked. This cyclone resulted in the barrier wind.

Constraint #2: According to Solomon (2002, 2012), historical records show that a blizzard in this area cannot last more than 4 days.

Solomon's (2012) characterization of the Ross Ice Shelf as being "pretty strongly katabatic" winds appears to underpin a further assertion: namely, that because katabatic winds depend on the descent of cold air from the Polar Plateau, a blizzard cannot persist for longer than four days. In her presentation, Solomon (2012) stated:

> *The pool of cold air that can form on top of the plateau has to be finite. The longest blizzards that have been seen yet in this region lasted about four days. Bowers wrote that a typical blizzard was only about two days long. I've been in two-day long blizzards, I've even been in three-day long blizzards. I've never seen one that lasted more than about three days. The longest one in the record that we have is about four days. So, if the blizzard lasted 11 days, it was really the storm of the century.*

There are no credible references supporting the existence of cold air pools atop the Antarctic Plateau.

In her book, Solomon (2002, p. 311) writes:

> *Once that air has spilled down from the heights, building up another frigid reservoir takes time. And so the blizzard must cease.*

While speaking about the records, it's worth noting George Simpson's (1919, p. 13) account from Cape Evans about the longest recorded blizzard in June 1912—less than three months after Scott and his companions perished on the Ross Ice Shelf.

> *The longest blizzard occurred in June 1912 when from 20 hours on the 7th until 11 hours on the 14th , i.e. , for 6 days and 14 hours , the anemometer recorded more than 20 miles in every hour and the mean velocity during the period was 48 miles an hour*

Simpson clearly described a barrier not a katabatic blizzard. How do we know that Simpson's (1919) blizzard was a barrier blizzard? We know this because Weber et al. (2016) concluded that all extreme wind events at Ross Island included in their study were caused by the barrier wind regime. Therefore, the blizzards Solomon experienced herself (probably at McMurdo Station, Ross Island), were all most likely barrier, not katabatic, blizzards.

While considering the potential duration of a blizzard on the Ross Ice Shelf, it is important to recognize that a barrier blizzard can and often does transition into a katabatic blizzard with little or no interruption. This seamless shift can substantially extend the total duration of blizzard conditions at certain locations. For instance, the barrier blizzard at Cape Evans described by Simpson lasted nearly seven days. Based on the dynamics of a regime shift, this event would likely have manifested as a 10–11 day barrier–katabatic blizzard at Scott's Last Camp. Initially, both sites would have been affected simultaneously by the barrier regime. However, as the cyclone shifted southeast and reoriented, the katabatic component would have continued to impact Scott's camp alone (Zinkova, 2025).

And what about katabatic winds? Do they have to stop when the reservoir of cold air is "emptied," as Solomon stated? Actually, no—the cold-air reservoir on the Polar Plateau cannot be emptied because it is continuously replenished by radiative cooling (Parish and Cassano, 2003), especially during the polar night. Its vast size and stable stratification mean cold air accumulates faster than it can be drained. Katabatic wind can continue for many consecutive days. Katabatic winds were observed in satellite imagery (NASA, 2025) over a 16-day stretch from August 13 to 28, 2004.

Constraint # 3. According to Solomon (2002, 2012), katabatic winds follow the direction of the flow, and thus the absence of a blizzard at Corner Camp implies none occurred at Scott's Last Camp.

An additional proposed "constraint of modern meteorology" appears to stem from Solomon's interpretation of katabatic wind behavior over the Ross Ice Shelf. In her 2012 presentation, Solomon (2012) stated:

> *The barrier [the Ross Ice Shelf] is just this big flat ice shelf, so to a large extent the wind can only follow the direction of the flow, there's nothing to break it up.*

And therefore

> *If there had been a blizzard upstream here in the middle of the barrier, I find it hard to see how there could not have been one at Corner Camp.*

In essence, Solomon is concluding that katabatic winds can “only follow the direction of the flow,” which leads her to argue that the absence of a katabatic blizzard at 78°3’S, 168°59’E (Corner Camp) necessarily implies its absence at 79°40’S, 169°30’E (Scott’s Last Camp) as well.

This interpretation does not accurately reflect the dynamics of katabatic winds. Katabatic winds are primarily gravity-driven, with their trajectories influenced by several factors, most of all the evolving pressure gradients associated with passing cyclones. Infrared satellite imagery (Figure 5, Figure 6, Figure 7, and Figure 8) and numerous studies (Bromwich et al, 1992) (Seefeldt et al, 2007), (Zinkova, 2025) reveal a far more intricate pattern of katabatic propagation across the Ross Ice Shelf characterized by lateral shifts and localized surges that contradict Solomon’s (2012) depiction.

In her book, Solomon, (2002, p. 311) describes the propagation of katabatic as follows:

> *Winds also flow down to the eastern side of the Barrier from the area now known as Marie Byrd Land. Once these variable winds reach the flat Barrier, they turn to the west until they encounter the obstacle of the Transantarctic Mountains on the western side. There they are largely diverted by the formidable topographic barricade to sweep the Barrier from south to north. As the wind flows north, it joins with*

the winds rushing down from the Beardmore, Nimrod, and Byrd glaciers. These physical features produce the prevailing Barrier winds from the south and southwest…

This description appears to conflate separate wind systems (katabatic and barrier) and does not align with established katabatic dynamics in the region. Winds from Marie Byrd Land descend from the south, not the east, and do not turn westward across the Ross Ice Shelf (Bromwich et al.,1992). These flows are not capable of forming Barrier winds, which arise from different mechanisms and topographic influences.

Below is Solomon's (2012) description of the origin of katabatic winds:

Why does a blizzard happen? The main reason is because of the katabatic winds of Antarctica. On the high plateau, temperatures drop and very, very cold air pools. What can happen is that there's a front come through, and it literally will push the cold air off the plateau. It comes roaring down the glaciers.

Actually unlike the Ross Ice Shelf, the plateau is not a thoroughfare for frontal systems and katabatic winds do not require a frontal "push" to descend; they are gravity-driven flows of dense, radiatively cooled air that naturally spill downslope from the Polar Plateau (Parish and Cassano, 2003). It is only when katabatic winds reach the lower elevations of the Ross Ice Shelf that cyclonic activity may assist in their further propagation (Seefeldt and Cassano, 2012).

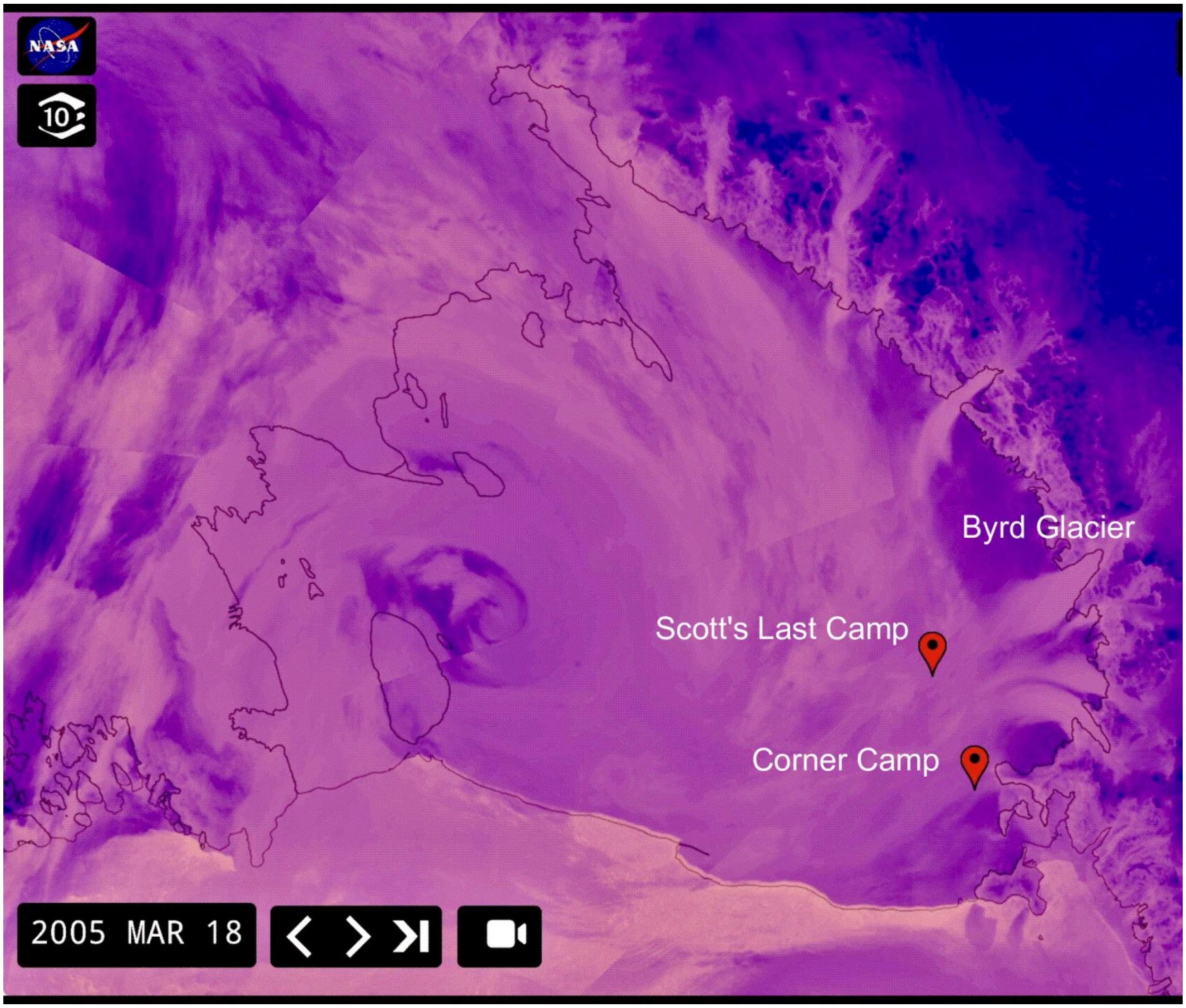

Figure 5. The NASA (2025) satellite infrared image shows a large cyclone swirling over the Ross Ice Shelf in Antarctica on March 18, 2005. Two locations, Scott's Last Camp and Corner Camp, are marked. The image also reveals warm signatures of katabatic winds. These appear as lighter (warmer), linear features flowing off the Transantarctic Mountains. A katabatic blizzard is occurring in the vicinity of Scott’s Last Camp, driven by a surge descending from Byrd Glacier. In contrast, conditions at Corner Camp remain calm.

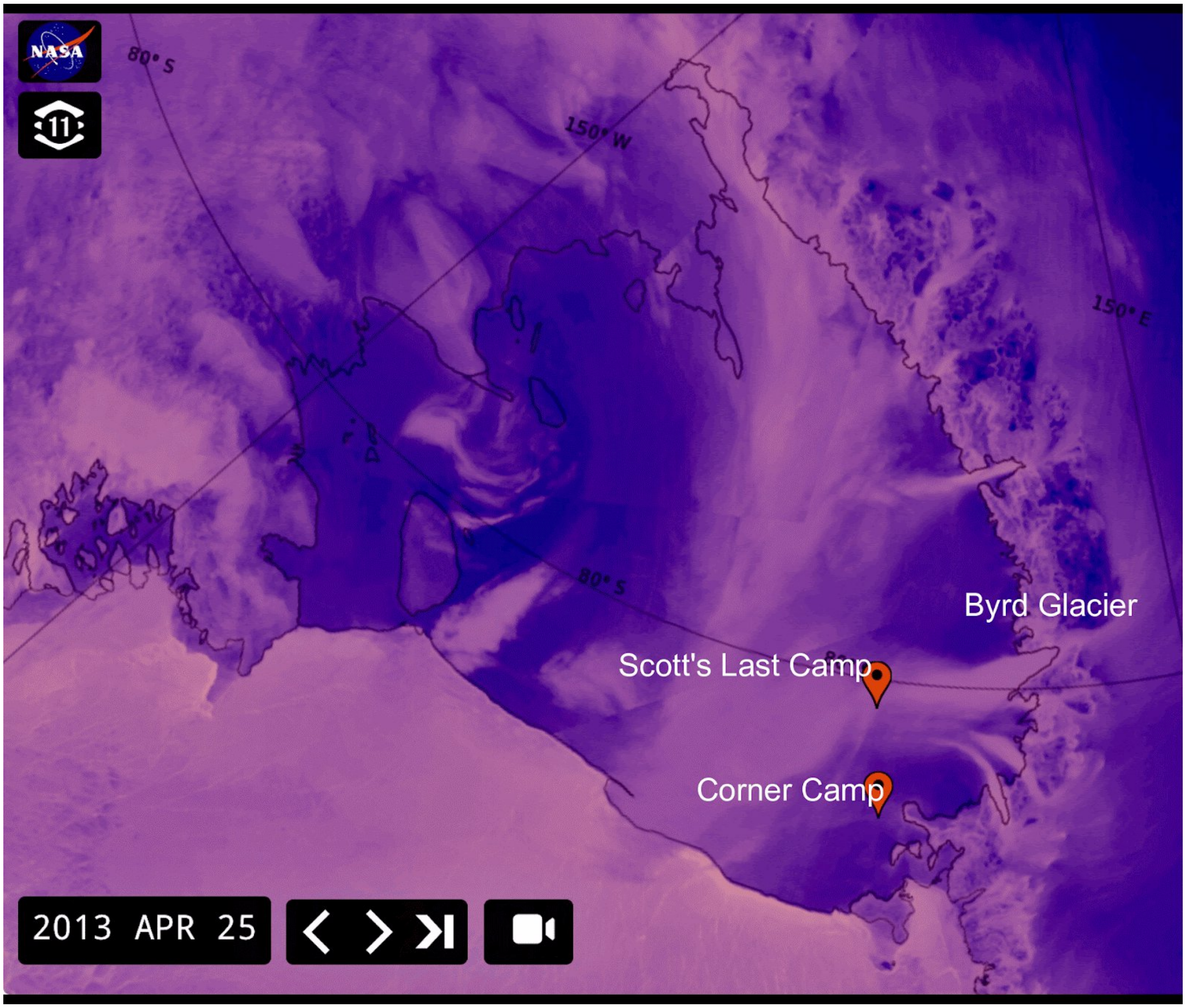

Figure 6. The NASA (2025) satellite infrared image shows a large cyclone swirling over the Ross Ice Shelf in Antarctica on April 25, 2013. Two locations, Scott's Last Camp and Corner Camp, are marked. The image also reveals warm signatures of katabatic winds. These appear as lighter (warmer), linear features flowing off the Transantarctic Mountains. A katabatic blizzard is occurring in the vicinity of Scott’s Last Camp, driven by a surge descending from Byrd Glacier. In contrast, conditions at Corner Camp remain calm. The katabatic surge from the southern Marie Byrd

Land does not affect either the area of the Scott’s Last Camp of Corner Camp.

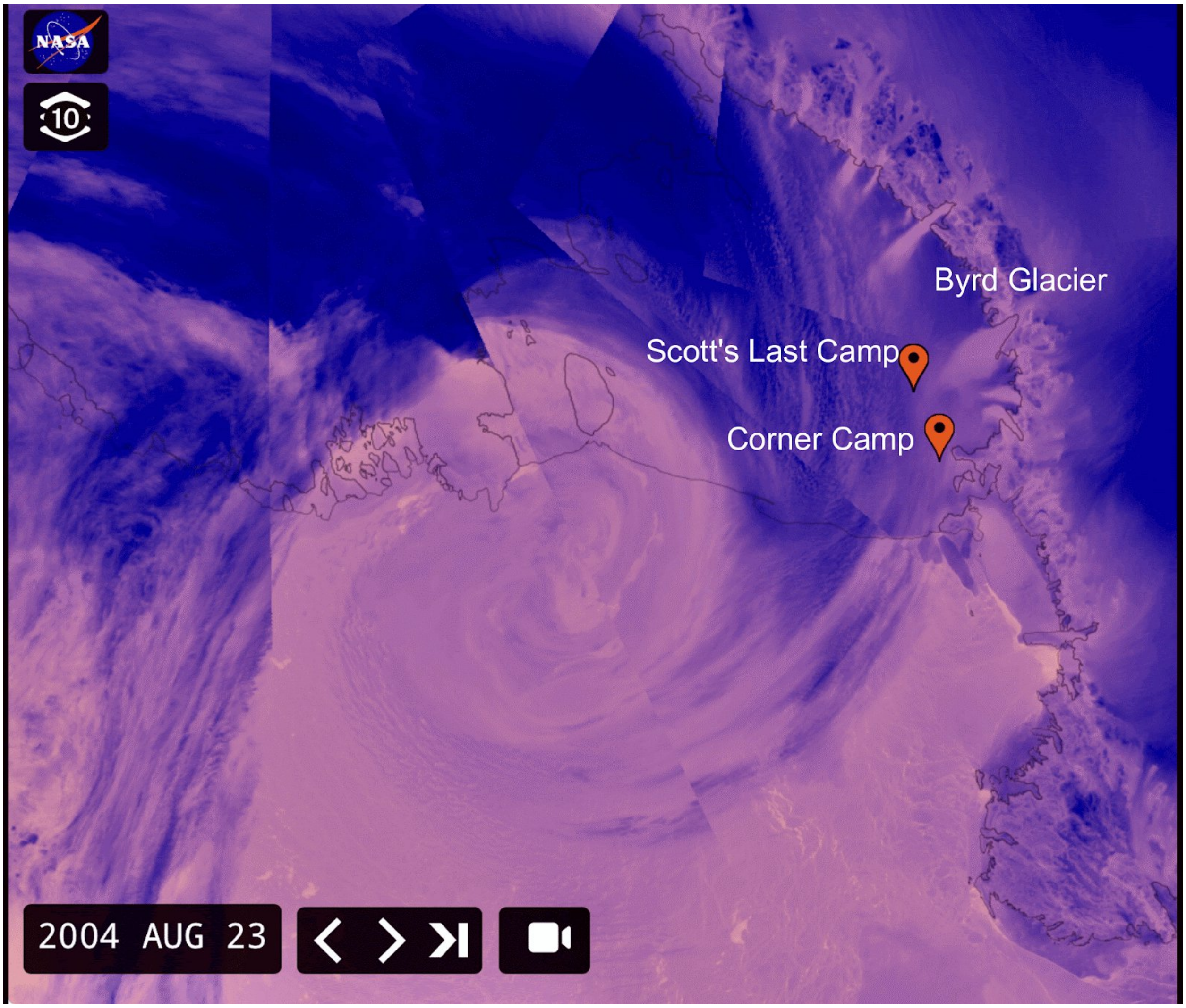

Figure 7. The NASA (2025) satellite infrared image shows a large cyclone swirling over the Ross Sea and the Ross Ice Shelf in Antarctica on August 23, 2004. Two locations, Scott's Last Camp and Corner Camp, are marked. The image also reveals warm signatures of katabatic winds. These appear as lighter (warmer), linear features flowing off the Transantarctic Mountains. A katabatic blizzard is occurring in the vicinity of Scott’s Last

Camp, driven by a surge descending from Byrd Glacier. There is a barrier blizzard at Corner Camp.

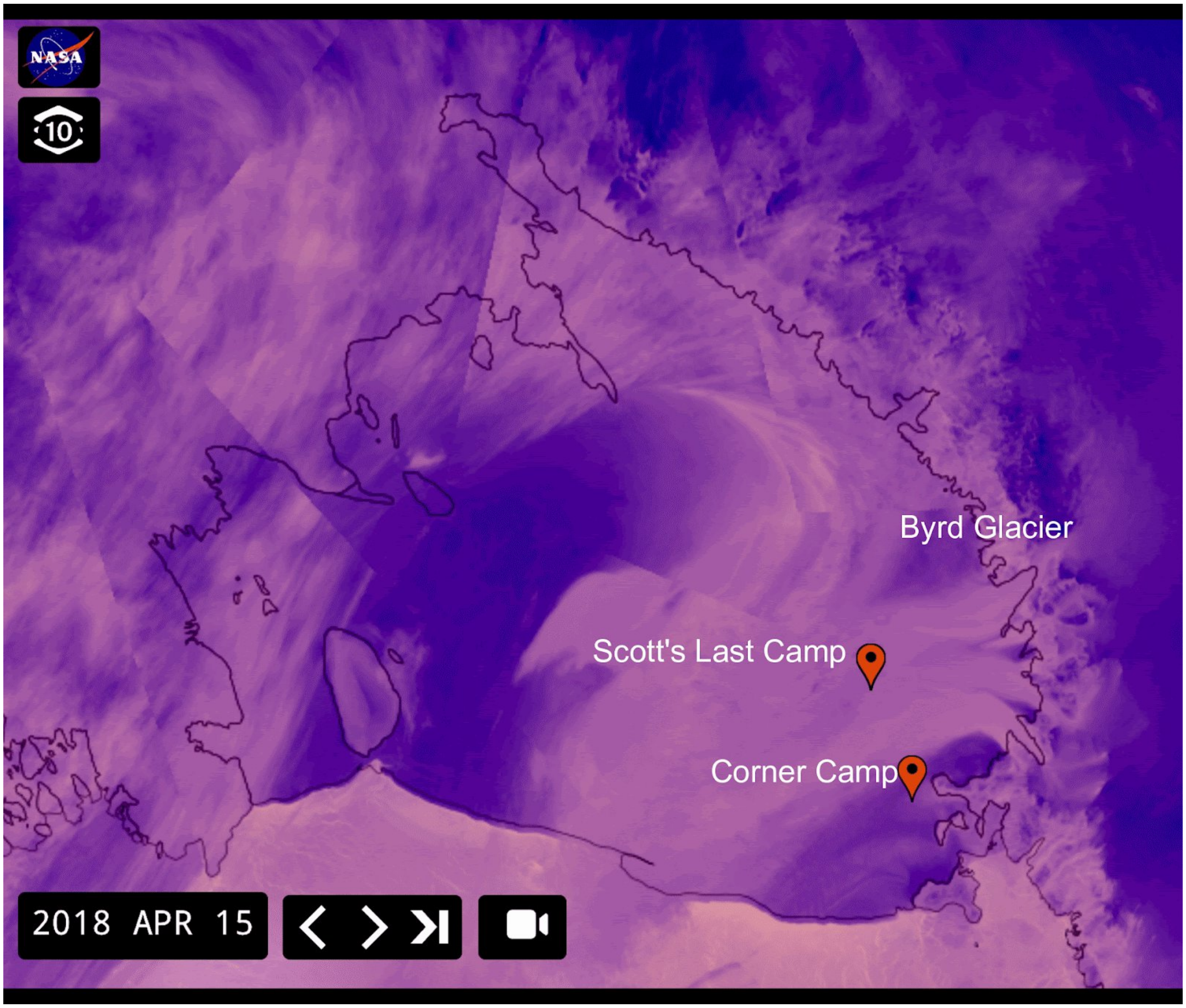

Figure 8. The NASA (2025) satellite infrared image shows a large cyclone swirling over the Ross Ice Shelf in Antarctica on April 15, 2018. Two locations, Scott's Last Camp and Corner Camp, are marked. The image also reveals warm signatures of katabatic winds. These appear as lighter (warmer), linear features flowing off the Transantarctic Mountains. A katabatic blizzard is occurring in the vicinity of Scott’s Last Camp, driven by

a surge descending from Byrd Glacier. In contrast, conditions at Corner Camp remain calm.

Neglected Data and Selective Interpretation

Northerly winds

Solomon (2002, p. 171) describes an instrument at Corner Camp that recorded the direction of prevailing winds and writes:

> *It strikingly confirmed the strong southwesterly winds of the Barrier, the flow from behind that should help speed the return journey.*

Then Solomon (2002, p. 317) described after a blizzard wind pattern:

> *… after a blizzard, winds generally continue to blow, albeit much more lightly. The flood subsides, but a stream continues. The prevailing direction of those breezes is southerly, like the blizzards.*

This leads Solomon (2002, p. 322) to speculate why no explorer attempted to reach the depot 18 km north and return to Scott's Last Camp with a fresh supply of food and oil.

> *A round trip from the last camp to the depot therefore would have required not just an easy outbound journey with the sail but also an excruciating trek back with the wind in the sledger's face.*

While the southern direction is indeed a prevailing feature of the Ross Ice Shelf Airstream, it is not a constant. Once again, Solomon overlooks Simpson's (1992, p.250) observations:

> *As a matter of fact northerly winds most often occur immediately on the termination of a blizzard…*

Moreover, what value is there in speculating based solely on prevailing wind patterns? The year 1912 was far from typical. Studies have documented the historically significant December 1911 blizzard—a four-day event that was wet, warm, and affected both the Ross Ice Shelf and the Polar Plateau(Solomon, 2002), (Fogt et al., 2017). This blizzard was likely driven by an atmospheric river (Zinkova, 2024). Additionally, the summer months saw extraordinarily high air pressure and temperatures on the Polar Plateau (Fogt et al., 2017), followed by freezing conditions in late February and early March 1912 on the Ross Ice Shelf (Scott, 1913), Solomon, 2002, 2012). These anomalies have no modern analogs (Solomon and Stearns, 1999; Solomon, 2002, p. 317). If the air temperature and pressure were not playing by the rules, why expect the winds to follow them? Why not turn to Captain Scott's own journals, where he frequently laments the presence of northerly headwinds? A few examples include:

> *March 12, 1912. Not a breath of favourable wind for more than a week, and apparently liable to head winds at any moment* (Scott, 1913, p. 407).

March 14. 1912. Yesterday we woke to a strong northerly wind with temp. -37°. Couldn't face it, so remained in camp …(Scott, 1913, p. 407).

March 18. …had to stop marching; wind N.W., force 4, temp. -35°. No human being could face it, and we are worn out nearly. Scott, 1913, p. 409).

An example of the northerly wind over the Ross Ice Shelf is presented in Figure 9.

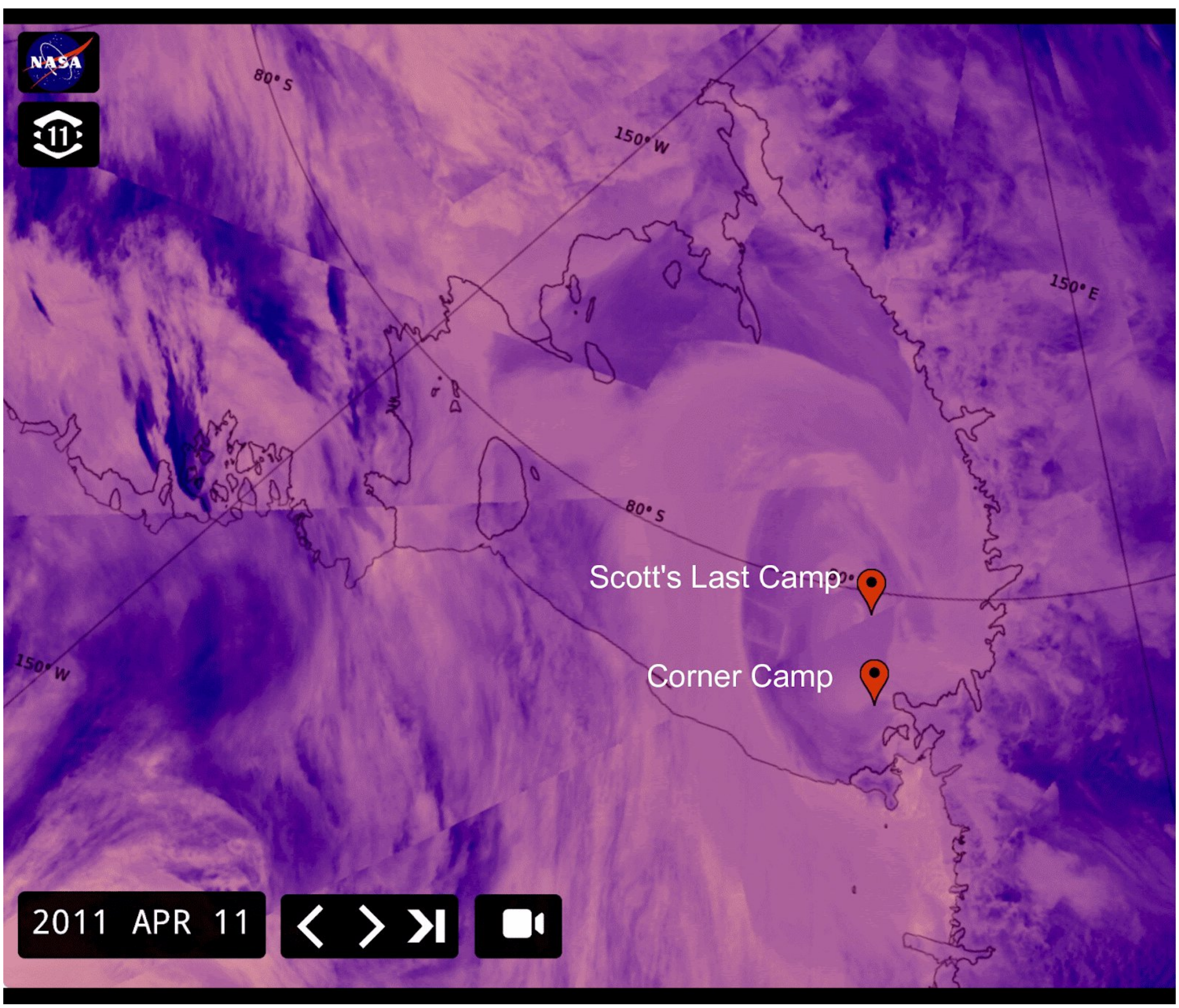

Figure 9. The NASA (2025) satellite infrared image shows a large cyclonic storm swirling over Ross Sea and the Ross Ice Shelf in Antarctica on April 11, 2011. Two locations, Scott's Last Camp and Corner Camp, are marked. This cyclone resulted in the strong northerly wind in the area of Scott’s Last Camp.

“A textbook example of a katabatic blizzard”

In her book, Solomon (2002, p. 311) cites a story from Cherry-Garrard’s *The Worst Journey in the World*:

> *The ferocious wind that spirited away the tent of the Cape Crozier party and threatened the survival of Wilson, Bowers, and Cherry-Garrard in July 1911 was a textbook example of a katabatic blizzard. It blew with hurricane force at more than seventy miles per hour, but the trio survived the storm in large part because it subsided in less than forty-eight hours, when the reservoir of cold air was emptied.*

However, at the same page and just a few sentences below Cherry-Garrard (1922, p. 282) writes:

> *I knew that parties which had come to Cape Crozier in the spring had experienced blizzards which lasted eight or ten days.*

The omission of the “eight or ten days” blizzards in Solomon (2002) is puzzling. Moreover, the July 1911 event that Solomon (2002, p. 311) described as a “textbook example of a katabatic blizzard”—appears more consistent with the characteristics of a barrier wind regime.

Conclusion

Dr. Susan Solomon's interpretation of Ross Ice Shelf meteorology appears to rest on several assumptions that warrant reconsideration in light of established observational and theoretical evidence. The suggestion that the region is "shielded" from cyclonic activity does not account for documented synoptic incursions, nor does it reflect the complex interactions between large-scale atmospheric systems and local topography.

Likewise, the description of conditions at the Ross Ice Shelf as "strongly katabatic" overstates the dominance of katabatic flow in an area characterized by multiple wind regimes. Barrier winds and cyclonic winds—both frequently observed in the region—are governed by distinct dynamics and should be considered alongside katabatic processes when assessing local climatology.

The assertion that a blizzard cannot persist beyond four days due to a "finite" reservoir of cold air atop the plateau lacks support from both theoretical models and empirical data. Moreover cold-air drainage from the plateau is not the sole driver of blizzard conditions, which may also result from cyclonic and barrier wind activity—phenomena that are not directly linked to the plateau's thermal characteristics.

Furthermore, the inference that katabatic winds must follow a singular directional flow—and that the absence of a blizzard at Corner Camp necessarily implies its absence elsewhere—does not align with the spatial variability commonly observed across the Ross Ice Shelf. Localized weather phenomena can differ markedly even within relatively short distances.

These interpretations reflect a set of constraints that do not appear to be grounded in the full spectrum of meteorological principles. Clarifying these points is important not only for scientific accuracy but also for preserving the integrity of historical accounts associated with the region.

Given that Solomon's (2002) book was published by Yale University Press—a respected academic publisher—there is an added institutional responsibility to ensure that scientific findings presented in such works are both accurate and well-supported. Addressing these issues is essential to upholding the standards of scholarly rigor and protecting the historical record from interpretive inconsistency.

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Author contributions

Mila Zinkova -100%.

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Data Availability Statement

Infrared satellite imagery used in this analysis is publicly accessible via NASA's Worldview platform at https://worldview.earthdata.nasa.gov. Historical expedition accounts by George Simpson (1919) and Apsley Cherry-Garrard (1922) are available through public archives and published sources. Susan Solomon's book *The Coldest March* (2002) is available from Yale University Press, and her 2012 public presentation hosted by the Royal Society of Chemistry is available on YouTube at https://youtu.be/5LoWsLqcizA.

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