Thermodynamic and Topoclimatic Impact of the Total Solar Eclipse of August 12, 2026, on the Coastal Boundary Layer in A Coruña

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Abstract

On August 12, 2026, the total solar eclipse observed in A Coruña (Galicia, Spain) provided an opportunity to analyze the direct interaction between the lunar shadow and the oceanic microclimatic dynamics. While synoptic models predicted a clear day, the progressive obscuration of the solar disk caused a surface thermal drop that led to the sudden formation of an advection fog. This study presents a comparative analysis over three days (August 11–13) and examines the asymmetrical thermodynamic response across three micro-sites (Tower of Hercules, Orzán Beach, Portiño Promenade). To quantify the radiative forcing, two counterfactual simulations (absence of the eclipse and a zenithal eclipse) complete this analysis.

1 Introduction

The interception of solar irradiance flux during a total eclipse causes abrupt modifications to the surface radiation balance. On August 12, 2026, the trajectory of the lunar shadow crossed the northern Iberian Peninsula. On the coast of A Coruña, the forced cooling interacted with the marine boundary layer, resulting in a rapid condensation phenomenon. This article documents this singular thermodynamic response, catalyzed by local topography.

2 Comparative Meteorological Data

Data were recorded during the critical time window (19:00 – 21:00 CEST) over three consecutive days, surrounding the day of the eclipse.

Table 1: Evolution of meteorological parameters in A Coruña (August 11–13, 2026)

Parameter	**August 11 (T-1)**	**August 12 (Eclipse)**	**August 13 (T+1)**
Temperature at 19:00	22.1 °C	21.5 °C	22.4 °C
Minimum temp. (20:28)	20.8 °C	16.8 °C	21.0 °C
Dew point (T_d)	15.2 °C	16.6 °C	15.5 °C
Relative humidity	65 %	98–100 %	63 %
Cloud cover / Visibility	Clear sky (> 10 km)	Low fog (< 300 m)	Clear sky (> 10 km)

3 Synoptic Thermodynamic Analysis

Under normal conditions (August 11 and 13), coastal nocturnal cooling occurs according to a post-twilight residual thermal gradient of approximately $\frac{dT}{dt} \approx -0.6\,^{\circ}\mathrm{C/h}$. During the passage of the lunar shadow, between the first contact (19:35) and totality (20:28), the air temperature plummeted, establishing an exceptional rate:

$$\left.\frac{dT}{dt}\right|_{\text{eclipse}} \approx -5.6\,^{\circ}\mathrm{C/h} \tag{1}$$

This drastic decrease canceled the land-sea thermal gradient, consequently weakening the sea breeze and promoting air mass stagnation.

4 Topoclimatic Micro-analyses

The coastline of A Coruña presents a heterogeneous geomorphology that induced asymmetrical responses during saturation:

- **Tower of Hercules** ($\sim$ 50 m, rocky promontory): Orographic lifting condensed the air into stratus clouds clinging to the relief, generating a dense fog that limited visibility in the immediate altitude.
- **Orzán Beach** (0–10 m, enclosed sandy bay): The high concentration of marine aerosols (acting as condensation nuclei) facilitated the appearance of an advection fog layer skimming the water surface.
- **Portiño Promenade** (5–15 m, open rocky cove): Primary impact zone of westerly fluxes. Trapping under the thermal inversion caused the frontal arrival of a thick wall of fog, masking totality.

5 Saturation Mechanism at Portiño

At the Portiño Promenade, the rock temperature dropped faster than that of the ocean ($T_{\text{rock}} < T_{\text{sea}}$ starting at 20:10 CEST). The saturation vapor pressure $e_s(T)$ dropped

according to the August-Roche-Magnus proportionality relationship:

$$e_s(T) = 6.112 \times \exp\left(\frac{17.67 \times T}{T + 243.5}\right) \tag{2}$$

The measured temperature drop from 21.5 °C to 16.8 °C reduced the saturation vapor pressure from 25.6 hPa to 19.1 hPa. The ambient air, already characterized by a high dew point ($T_d \approx 16.6$ °C), thus reached the critical saturation threshold ($RH = 100\,\%$), transforming the radiative deficit into a massive advection fog (see Figure 1).

Figure 1: Observation of the solar crescent filtered through the nebulous layer and the forming fog from the Portiño Promenade (August 12, 2026). Photo: Alexandra Herrgott / Enastros.

6 Counterfactual Modeling

To isolate the impact of the eclipse, two theoretical simulations were developed.

6.1 Scenario A: Absence of the Eclipse (19:00 – 21:00)

If the eclipse had not occurred, the evening would have followed a classic summer diurnal cycle. Notably, the A Coruña meteorological center observed clouds advecting from inland between 17:00 and 18:00. In the absence of an eclipse, these clouds would have acted as a radiative shield, trapping outgoing longwave infrared radiation. Consequently, the normal nocturnal cooling rate (-0.6 °C/h) would have been further attenuated. Starting at 21.5 °C at 19:00, the temperature would have barely dropped, remaining above 20.5 °C by 21:00. With the dew point around 16.6 °C, the psychrometric depression ($T - T_d$) would have remained largely positive (relative humidity $< 75\,\%$). The marine advection fog would

absolutely not have formed, confirming that the saturation was exclusively driven by the eclipse's sudden radiative forcing breaking through this mild dynamic.

6.2 Scenario B: Mid-Afternoon Eclipse (14:00 – 16:00)

Simulating the eclipse during peak insolation drastically alters the atmospheric response. In the mid-afternoon, the baseline coastal temperature would have reached approximately 25.5 °C, with a dew point of $T_d \approx 15.5\,^{\circ}\mathrm{C}$. The sudden interception of zenithal irradiance would have triggered a more severe thermal drop ($\Delta T \approx -6.5\,^{\circ}\mathrm{C}$) due to the higher initial sensible heat flux. However, the minimum temperature during totality would have only dropped to about 19.0 °C. Because $T_{\min}(19.0\,^{\circ}\mathrm{C}) > T_d(15.5\,^{\circ}\mathrm{C})$, saturation would not have been reached (relative humidity peaking near 80 %). While the eclipse would have disrupted the local sea breeze, the sky would have remained clear of surface condensation, preventing the formation of stratus or fog.

7 Conclusion

The eclipse of August 12, 2026, acted as a powerful microclimatic forcing on the peninsula of A Coruña. The loss of irradiance not only precipitated the condensation of the marine boundary layer, but the modeling emphasizes that the late hour of the phenomenon was the decisive factor for fog formation. These observations highlight the need to integrate insolation chronology and local cloud dynamics into fine-scale modeling of the atmospheric response during total solar eclipses.