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).

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, advanced partial phase). Photo: Alexandra Herrgott / Enastros.

6 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 this dynamics was spatially structured according to local topography. These *in situ* documented observations highlight the need to integrate coastal micro-reliefs into fine-scale modeling of the atmospheric response during total solar eclipses.