

Figure S1.

SkewT chart (ECMWF profile) for the Pedrógão Grande area at 18:00 UTC, 17th June 2017. Dry bulb air temperature (black line, to the right), dew point temperature (blue line, to the left) parcel trajectory (dashed orange curve) and wind barbs at different levels are represented. The Lifted Condensation Level (LCL) and the Level of Free Convection (LFC) are depicted over the height scale.

Figure S2.

Skew-T chart for the location Proença-a-Nova (379 m a.m.s.l.), forecast 15:00 UTC, 17th June 2017 (based in the 00:00 UTC, 17th June 2017 ECMWF analysis; location is indicated in Fig 8). Dry-bulb air temperature (black line), dew point temperature (green line) and wet-bulb pseudopotential temperature (pink line) are represented. Winds are depicted every 300 m (model levels) in barbs notation. Zero-degree isotherm also represented.

Figure S3.

Profile of the system-relative winds extracted from the ECMWF forecast 15:00 UTC, 17th June 2017 (based in the 00:00 UTC analysis) for the location indicated in Fig 8). The wind direction values are represented in arrow notation and were determined every 300 m, by subtracting the estimated storm motion vector from the environmental wind profile (represented, left, extracted from Figure S2). Wind magnitudes are indicated in the same profile (m/s), as well as the relative humidity and the zero-degree level.

Figure S4.

(a) PPI of reflectivity, 1.9° tilt, at 17:00 UTC, 17th June 2017, C/CL radar. Cross sections in segments AB and CD were directed from the front (southwest) to the rear (northeast) of the MCS, along the system motion. Red arrows represent storm relative inflows across several layers (magnitudes scaled by arrow length) in accordance with the storm relative winds (see Figure 11) and the system motion. (b) Cross-section AB on reflectivity in a more stratiform region of the MCS. (c) Cross-section CD on reflectivity in a more active convection region of the MCS. In (b) and (c) the 1.9° tilt and the 0°C isotherm were represented for context. Border with Spain is represented by the brown line.

Figure S5.

PPI of reflectivity, 0.1° tilt, at 16:30 UTC (a), 16:40 UTC (b), 16:50 UTC (c) and 17:00 UTC (d), 17th June 2017, C/CL radar. Weather stations Proença-a-Nova (PN), Tomar (TO), Alvega (AL) and Benavila (BE) are represented. Thin reflectivity line was marked with a cold front notation. Reflectivity scale was stacked above 30 dBZ for better analysis.

Figure S6.

Weather observations at the AWS: Alvega (**AL**), Benavila (**BE**), Tomar (**TO**), Proença-a-Nova (**PN**), Pampilhosa-da-Serra (**PA**) and Castelo Branco (**CB**). 2 m air temperature (red), relative humidity (blue), magnitude of 10 m wind gusts (green cyan), magnitude of 10 m average wind (dotted black line) and direction (arrows) observed during 15:00-20:00 UTC, 17th June 2017.

Figure S7.

(a) PPI of reflectivity (up to 100 km range was extracted from the Doppler scan; over 100 km range was extracted from the reflectivity scan), 0.1° tilt, at 15:10 UTC, 17th June 2017, C/CL radar. The marked azimuth was accessed for detecting the southernmost small-scale divergence signature at that time approximate time (see Figure 5b). (b) Cross-section over the reflectivity volumetric scan, where the three lowermost elevations of the Doppler scan are represented (0.1°, 1.5° and 4.0°), highlights the regions of the MCS that were sampled by each tilt of the Doppler scan. Border with Spain is represented by the brown line.

Figure S8.

(a) PPI of reflectivity (up to 100 km range was extracted from the Doppler scan; over 100 km range was extracted from the reflectivity scan), 0.1° tilt, at 16:30 UTC, 17th June 2017, C/CL radar. The marked azimuth was accessed for detecting the northernmost small-scale divergence signature at that approximate time (see Figure 6b). (b) Cross-section over the reflectivity volumetric scan, where the three lowermost elevations of the Doppler scan are represented (0.1°, 1.5° and 4.0°), highlights the regions of the MCS that were sampled by each tilt of the Doppler scan. Border with Spain is represented by the brown line.

Figure S9.

PPI of storm-relative velocity, 1.5° tilt (a), 0.1° tilt (b), 16:46 UTC; PPI of reflectivity, 0.9° tilt (lines delimit the insertion of the observed area in (a)) (c), 0.1° tilt (lines delimit the insertion of the observed area in (b)) (d), 16:40 UTC. 17th June 2017, C/CL radar. **PE AL**, **PE RN** represent Alvelos and Rendeiros windmill parks (**PE PS** Pampilhosa Park is outside the area, to the north). **PN** represents Proença-a-Nova AWS. **MAX** indicates the location of maximum inbound winds in the lowest tilt. **RIJ** indicates the signature of low-level inflow of a rear inflow jet. **FRJ** indicates the signature of a low-level front to rear flow located beneath the RIJ. **RIN** indicates the signature of a rear inflow notch.

Figure S10.

PPI of storm-relative velocity, 1.5° tilt (a), 0.1° tilt (b), 17:06 UTC; PPI of reflectivity, 0.9° tilt (lines delimit the insertion of the observed area in (a)) (c), 0.1° tilt (lines delimit the insertion of the observed area in (b)) (d), 17:00 UTC. 17th June 2017, C/CL radar. **PE AL**, **PE RN** represent Alvelos and Rendeiros windmill parks (**PE PS** Pampilhosa Park is outside the area, to the north). **PN** represents Proença-a-Nova AWS. **MAX** indicates the location of maximum inbound winds in the lowest tilt (15.9 m/s). **RIN** indicates the signature of a rear inflow notch. **MARC** stands for mid altitude radial convergence (represented by azimuthal segments).

Figure S11.

PPI of storm-relative velocity, 1.5° tilt (a), 0.1° tilt (b), 17:16 UTC; PPI of reflectivity, 0.9° tilt (lines delimit the insertion of the observed area in (a)) (c), 0.1° tilt (lines delimit the insertion of the observed area in (b)) (d), 17:10 UTC. 17th June 2017, C/CL radar. **PE AL**, **PE RN** represent Alvelos and Rendeiros windmill parks (**PE PS** Pampilhosa Park is outside the area, to the north). **PN** represents Proença-a-Nova AWS location. **MAX** indicates the location of maximum inbound winds in the lowest tilt (17.7 m/s). **RIN** indicates the signature of a rear inflow notch. **MARC** stands for mid altitude radial convergence (represented by azimuthal segments).

Figure S12.

PPI of storm-relative velocity, 1.5° tilt (a), 0.1° tilt (b), 17:26 UTC; PPI of reflectivity, 0.9° tilt (lines delimit the insertion of the observed area in (a)) (c), 0.1° tilt (lines delimit the insertion of the observed area in (b)) (d), 17:20 UTC. 17th June 2017, C/CL radar. **PE AL**, **PE RN** represent Alvelos and Rendeiros windmill parks (**PE PS** Pampilhosa Park is outside the area, to the north). **PN** represents Proença-a-Nova AWS. **MAX** indicates the location of maximum inbound winds in the lowest tilt (11.2 m/s). **RIJ** indicates the signature of low-level inflow of a rear inflow jet. **RIN** indicates the signature of a rear inflow notch.

Figure S13.

PPI of storm-relative velocity, 1.5° tilt (a), 0.1° tilt (b), 17:56 UTC; PPI of reflectivity, 0.9° tilt (lines delimit the insertion of the observed area in (a)) (c), 0.1° tilt (lines delimit the insertion of the observed area in (b)) (d), 17:50 UTC. 17th June 2017, C/CL radar. **PE AL**, **PE RN** represent Alvelos and Rendeiros windmill parks (**PE PS** Pampilhosa Park is outside the area, to the north). **PN** represents Proença-a-Nova AWS. **MAX** indicates the location of maximum inbound winds in the lowest tilt (17.7 m/s). **RIJ** indicates the signature of low-level inflow of a rear inflow jet. **FRJ** indicates the signature of a low-level front to rear flow located beneath the RIJ. **RIN** indicates the signature of a rear inflow notch.

Figure S14.

PPI of storm-relative velocity, 1.5° tilt (a), 0.1° tilt (b), 18:06 UTC; PPI of reflectivity, 0.9° tilt (lines delimit the insertion of the observed area in (a)) (c), 0.1° tilt (lines delimit the insertion of the observed area in (b)) (d), 18:00 UTC. 17th June 2017, C/CL radar. **PE AL**, **PE RN** represent Alvelos and Rendeiros windmill parks (**PE PS** Pampilhosa Park is outside the area, to the north). **PN** represents Proença-a-Nova AWS. **MAX** indicates the location of maximum inbound winds in the lowest tilt (21.9 m/s). **RIJ** indicates the signature of low-level inflow of a rear inflow jet. **FRJ** indicates the signature of a low-level front to rear flow located beneath the RIJ. **RIN** indicates the signature of a rear inflow notch.

Figure S15.

PPI of storm-relative velocity, 1.5° tilt (a), (b) 0.1° tilt (b), 18:16 UTC; PPI of reflectivity, 0.9° tilt (lines delimit the insertion of the observed area in (a)) (c), 0.1° tilt (lines delimit the insertion of the observed area in (b)) (d), 18:10 UTC.

17th June 2017, C/CL radar. **PE AL**, **PE RN** represent Alvelos and Rendeiros windmill parks (**PE PS** Pampilhosa Park is outside the area, to the north). **PN** represents Proença-a-Nova AWS. **MAX** indicates the location of maximum inbound winds in the lowest tilt (26 m/s). **RIJ** indicates the signature of low-level inflow of a rear inflow jet. **FRJ** indicates the signature of a low-level front to rear flow located beneath the RIJ. **RIN** indicates the signature of a rear inflow notch.

Figure S16.

PPI of storm-relative velocity, 1.5° tilt (a), 0.1° tilt, 18:26 UTC (b); PPI of reflectivity, 0.9° tilt (lines delimit the insertion of the observed area in (a)) (c), 0.1° tilt (lines delimit the insertion of the observed area in (b)) (d), 18:20 UTC. 17th June 2017, C/CL radar. **PE AL**, **PE RN** represent Alvelos and Rendeiros windmill parks (**PE PS** Pampilhosa Park is outside the area, to the north). **PN** represents Proença-a-Nova AWS. **MAX** indicates the location of maximum inbound winds in the lowest tilt (30.7 m/s). **RIJ** indicates the signature of low-level inflow of a rear inflow jet. **RIN** indicates the signature of a rear inflow notch.

Figure S17.

(a) PPI of reflectivity (dBZ), 0.1° tilt, C/CL radar. (b) PPI of correlation coefficient (dimensionless), -0.1° tilt, A/PG radar. 16:40 UTC, 17th June 2017. Cross identifies the centroid of the pyroconvective element detected on reflectivity at the lowest level of C/CL scan.

Figure S18.

(a) PPI of reflectivity (dBZ), 0.1° tilt, C/CL radar. (b) PPI of correlation coefficient (dimensionless), -0.1° tilt, A/PG radar. 18:30 UTC, 17th June 2017. Cross identifies the centroid of the pyroconvective element detected on reflectivity at the lowest level of C/CL scan.

Figure S19.

(a) PPI of correlation coefficient (ρ_{hv} , dimensionless), 1.0° tilt, 16:40 UTC. Segment **AB** over ρ_{hv} is marked over the PPI and identifies the cross-section (panel b); **X** identifies the centroid of the pyroconvective element that was detected on low-level reflectivity and the circle shows the area where low ρ_{hv} (< 0.7) was observed at the higher altitude (plume top, also pinpointed by arrow in the vertical slice, panel b). Cross-section vertical distance markers are every 2 km and horizontal distance markers every 10 km. A/PG radar, 17th June 2017.

Figure S20.

(a) PPI of correlation coefficient (ρ_{hv} , dimensionless), 1.0° tilt, 18:30 UTC. (b) PPI of correlation coefficient (ρ_{hv} , dimensionless), 3.7° tilt, 18:40 UTC. Segment **AB** over ρ_{hv} is marked over the PPI in (a) and (b) and identifies the cross-section (in panels (c) and (d)); **X** (in panels (a) and (b)) identifies the centroid of the pyroconvective element that

was detected on low-level reflectivity and the circle (in panels (a) and (b) shows the area where low q_{hv} (< 0.7) was observed at the higher altitude (plume top, also pinpointed by arrow in the vertical slice, panels c and d). Cross-section vertical distance markers every 2 km and horizontal distance markers every 10 km. A/PG radar, 17th June 2017.

Figure S21.

MAXZ at 17:00 UTC, 17th June 2017, C/CL radar. Range rings are marked every 50 km. Cross section AB was directed from the front (southwest) to the rear (northeast) of the MCS, intersecting the approximate fire areas (red circle indicates the lowest level of the smoke plume location near the buoyancy source at 18:06 UTC). Cross section (to the right) highlights the presence of a large anvil formation over the fires.

Figure S22.

PPI of reflectivity (dBZ), 0.1° tilt from 17:40 UTC (a) to 18:30 UTC (f), 17th June 2017, C/CL radar. Red circle highlights the lowest level reflectivity maxima in the smoke plume location near the buoyancy source at 18:06 UTC and black segments reference the orientations of the low-level plume along the reflectivity pattern.

Figure S23.

(a) Dust load (g/m²) and 3000 m wind (arrows) and (b) Total Cloud Cover over North Africa and Iberia, from DREAM8b model forecast (BSC) for 12:00 UTC, 17th June 2017. MCS depicts the area where the model was positioning the forecasted mesoscale system.