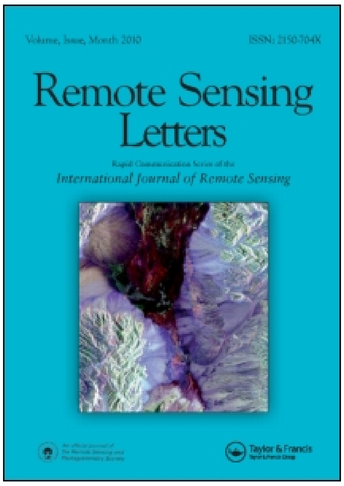

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Using the earthquake vapour theory to explain the French airbus crash

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Air France Flight 447 crash killed 228 people on 1 June 2009. Its cause was not well explained. This letter proposes a hypothesis based on the earthquake vapour theory to explain the sudden disappearance of airplanes. Earthquake data reveal a high coincidence between the crash location and the mid-Atlantic faults. Further, satellite images show that erupting earthquake vapours appeared around the crash location before the crash time, became bigger and higher, and finally disappeared after the crash. Temperature data depict that the vapours were accompanied by enormous heat around the crash time and location. A strong, variable thermal current can create convections that cause the airbus to crash. We suggest that half-hourly satellite images and temperature data be made available to the public to facilitate predictions.

1. Introduction

According to the *Europe News* (Regalado and Michaels 2009), Air France Flight 447 heading towards Paris (48.87°N, 2.35°E) departed from Rio de Janeiro (22.92°S, 43.28°W) at Universal Time Coordinated (UTC) 22:03 on 31 May 2009. At 1:33 on 1 June, the Brazilian air traffic control was in normal radio contact with the plane. At 1:48, the airbus left Brazilian radar coverage, travelling normally at 10,668 m. At 2:00, the flight passed through a storm. At 2:14, the plane sent an automated message indicating an electrical failure. At 2:20, the flight crew failed to make a scheduled contact with the Brazilian controllers. Plane debris was later found at about 640 km northeast of Fernando de Noronha, an Atlantic island (4°S, 33°W). The plane had 'a very experienced crew' whose pilot had clocked 11,000 h of flying time. The plane was of A330 model, which had a very strong safety record. There was 'a relatively intense storm' in the zone, said Marcelo Seluchi, a researcher at Brazil's Institute for Space Studies, 'but nothing out of the normal for that area, which has constant storms and is very well known by pilots'. According to its published map (Regalado and Michaels 2009), the airbus was over (1.45°N, 31.1°W) at 2:14 and might have been over (1.9°N, 30.7°W) at 2:20, and the debris were found at (0.39°N, 31.1°W) and (0.79°N, 30.7°W). The disappearance was reported to be as fast as a bomb even though no bombing events were suspected (Samuel 2009).

Currently, the airbus crash was suspected to have resulted from its failed air speed sensor (Wald 2009) after getting caught in strong and rapidly developing convective clusters (Space Science and Engineering Center 2009). What could have generated convection? Here, we provide a hypothesis that could explain the sudden development

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of convection and disappearance of the aircraft. Our hypothesis is based on the earthquake vapour theory (Shou 1999, Harrington and Shou 2005, Shou 2006a). When a huge rock is stressed by external forces, its weak parts break first and small shocks occur. Because a large earthquake produces a big rift in earth, small shocks could generate small crevices that reduce the cohesion of the rock. Next, underground water percolates into the crevices. Water's expansion, contraction, corrosion, and fluid friction further reduce rock cohesion. Friction heats the water and eventually generates vapour at high temperature and pressure. The vapour, termed earthquake vapour, erupts from an impending hypocentre to the surface through the crevices and rises up. If encountering cold air, it forms a cloud, denoted an earthquake cloud. If, on the other hand, its heat dissipates part of an existing cloud, it will create a cloudless space, and this phenomenon is denoted geothermal eruption or geoeruption.

After the earthquake vapour erupts, the yield strength of the rock begins to drop sharply (Kirby and McCormick 1990, Shou 1999, Harrington and Shou 2005, Shou 2006a). Once weakened sufficiently, the rock yields and consequently an earthquake occurs. According to more than 500 observations made by Shou (2006b), the longest time span from vapour eruption to subsequent earthquake is 112 days and the average is 30 days.

This theory has many pieces of supporting evidence. For instance, meteorology could not explain why the Bam cloud appeared suddenly and persisted at the vapour source for 24 h (http://www.earthquakesignals.com/zhonghao296/Animation/20031220Bam0.2.gif). In contrast, Shou predicted that a big earthquake of magnitude $\geq$5.5 would happen at the fixed vapour source Bam within 60 days from 20 December 2003 – the date of cloud appearance. The magnitude 6.8 Bam earthquake on 26 December 2003 proclaimed the success of his theory by being the only one in the predicted area and magnitude in history.

The earthquake vapour theory predicts that the initial temperature of earthquake vapour is identical to that of its origination hypocentre, which can range from 300°C to 1520°C (Koch and Masch 1992, Maddock 1992, Magloughlin 1992, O'Hara 1992, Spray 1992, Swanson 1992, Techmer *et al.* 1992). The earthquake vapour's tremendous heat can increase the temperature of its surroundings. For instance, a pulse of surface temperature increase from 12°C to 24°C was recorded by the Kerman airport (30.2°N, 57°E) near Bam at UTC 16:20 on 20 December 2003 (20:20 local time) when the Bam cloud was erupting in a cold evening (http://www.wunderground.com/global/stations/40841.html). Moreover, 24°C was the highest temperature among available regional temperatures on that date recorded from 1998 to 2008. In contrast, the second highest temperature was 22°C in 1998, and its temperature increase was only 3°C in the afternoon.

The earthquake vapour theory predicts that the earthquake vapour should have high pressure because of its high temperature. Supporting evidences have been found (Harrington and Shou 2005, Shou 2006a). For instance, Shou (2006b) calculated that the vapour from magnitude 9 Sumatra quake must have had a pressure of at least 151,500,000 Pa (1500 atm) to rise above 16.1 km ocean water to form a cloud.

In summary, earthquake vapour has sudden appearance, localized sources, high temperature, and high pressure, which distinguishes it from weather vapour generated from a vast area at $\leq$30°C and at a normal pressure of near 101,000 Pa (1 atm). The high temperature and pressure of earthquake vapour can generate rapidly developing convection clusters that could cause the airbus to lose balance and disappear mysteriously.

2. Data source

MSG2_10 Images are taken by Europe's Operational Meteorological Satellite Organization and transformed and offered to the public by Dundee University, UK, at a frequency of four images a day (http://www.sat.dundee.ac.uk/). Earthquake data are from the United States Geological Survey (http://earthquake.usgs.gov/). Temperature data are from the Weather Underground Company (Wunderground http://www.wunderground.com/). Information of a small airplane crash in Tennessee, USA, on 18 April 2009 is from the National Transportation Safety Board (http://www.ntsb.gov/). Information of convection analysis is from Wisconsin University (http://cimss.ssec.wisc.edu/goes/blog/archives/category/goes-10).

3. Coincidence between the French airbus crash and the Atlantic fault

Figure 1(*a*) shows a coincidence between the French airbus crash (red square) and the mid-Atlantic fault defined by recorded quakes (dark blue dots). The airbus was over (1.45°N, 31.1°W, green circle) at 2:14, and supposed to be over (1.9°N, 30.7°W, red square) at 2:20. The debris was found later (cyan squares). The crash did not happen during a long travelling time of 4 h and 11 min, but in the moment of 6 min coincidently over the mid-Atlantic fault. The smaller rectangle was magnified in figure 1(*b*) and the bigger rectangle was further studied by satellite images in figures 2 and 3 to show what happened at the moment of the plane crash over the mid-Atlantic fault.

4. Evidence of erupting earthquake vapour

MSG2_10 satellite image series from UTC 0:00 on 31 May to 12:00 on 1 June 2009 reveals evidence of erupting earthquake vapour around the crash time and location (see figure 2). At 0:00 on 31 May 2009 (figure 2(*a*)), no cloud was around the accident location, but a grey earthquake cloud of intermediate vapour density (marked with pink edge) appeared about ~1000 km away eastward. This intermediate cloud density could be due to condensation of earthquake vapour upon encountering cold air, while continued supply of hot vapour prevented the accumulation of denser clouds. At 6:00 (figure 2(*b*)), a wind from the east, marked by blue arrow 1, blew the cloud (pink edge) to the west. A few white clouds (orange edge) converged around the accident location. The white clouds presumably formed when warm earthquake vapour generated near the accident location condensed upon encountering cooler air. At 12:00 (figure 2(*c*)), the white clouds coalesced to a dense cloud (orange edge). At 18:00 (figure 2(*d*)), the cloud became much bigger and denser (orange edge). Simultaneously, a few dark lines marked by red edges emerged. Meteorology cannot explain this sudden appearance of dark lines in clouds. However, the earthquake vapour theory proposes that hot erupting earthquake vapours dissipated a part of existing clouds away, a phenomenon termed geoeruption.

At 0:00 on 1 June 2009 (figure 2(*e*)), more geoeruptions (red edge) and grey earthquake clouds (pink edge) occurred, and we mark their main parts. At 6:00 (figure 2(*f*)), geoeruptions (red edge), grey cloud (pink edge), and the white cloud (orange edge) all became much stronger suddenly. Comparing figures 2(*f*) with (*d*), it is easy to find the above three kinds of increases heading north together because of a wind from the

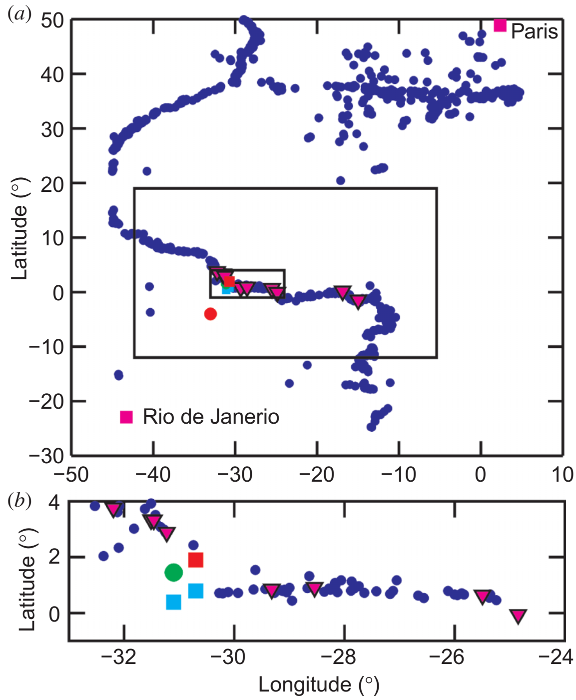

Figure 1. Coincidence between the Air France crash and the mid-Atlantic fault. (*a*) All earthquakes of magnitude 4 or above in the area of 25° S–50° N and 45° W–5° E from 1 January 2005 to 8 April 2009 are plotted (blue dots) to indicate the mid-Atlantic fault. Also plotted are the locations of the airbus origination Rio de Janeiro (22.92° S, 43.28° W) and destination Paris (48.87° N, 2.35° E, pink squares); the locations of plane debris (cyan squares) at 640 km northeast of Fernando de Noronha (4° S, 33° W, red dot); the location of the airbus at UTC 2:14 (1.45° N, 31.1° W, green circle) when an automated electric failure message was released; and the location of the airbus at 2:20 (1.9°N, 30.7° W, red square) when the crew failed to make a scheduled contact with Brazilian controllers. Consistent with our prediction, 10 moderate earthquakes of magnitude 4.4–5.3 occurred afterwards between 24 June and 30 August. Their locations are marked by pink triangles. (*b*) A magnified view of the small rectangle in (*a*). Two earthquakes, one at 3.33° N, 31.48° W and the other at 3.27° N, 31.52° W, were too close to be distinguished even here.

south, marked by cyan arrow 2. Earthquake clouds and geoeruptions are phenomena linked in space and time and are unique in the mid-Atlantic for at least the six months (1 January to 30 June 2009) that we have investigated. At 12:00 (figure 2(*g*)), those geoeruptions disappeared and the dense white cloud became thinner. In all figures, only clouds from locations near the accident site are commented on.

In short, these series of images reveal a dense earthquake cloud forming over and above the accident location, and enlarging from 0:00 to 6:00. This cloud (orange outline) initially came from a source east of it (figure 2(*a*)), but its enlargement depended on eruptions at near the accident location. It is in stark contrast with tropical storms: it is not cyclonic and its accumulation originated from a fixed location rather than from a large area of warm ocean. During this time, the airbus entered into the dangerous region. The animation found at http://www.earthquakesignals.com/Zhonghao296/Animation/20090601FranceCrash shows the above process.

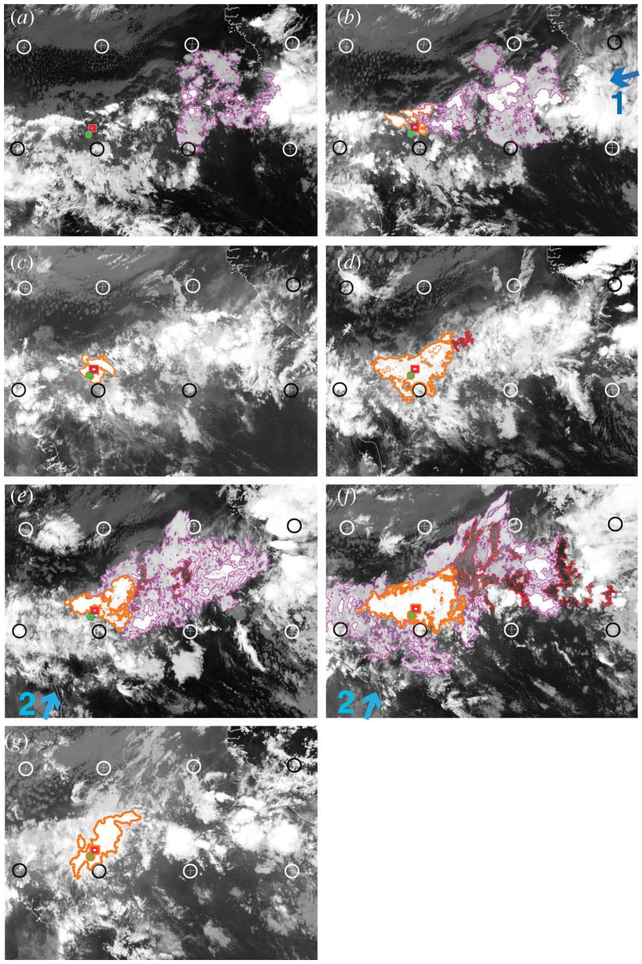

Figure 2. A series of seven images surrounding the accident location at (*a*) 0:00, (*b*) 6:00, (*c*) 12:00, and (*d*) 18:00 on 31 May 2009; and (*e*) 0:00, (*f*) 6:00, and (*g*) 12:00 on 1 June 2009 (UTC). The locations of the airbus at 2:14 and 2:20 are plotted by green circle and red square, respectively. Two adjacent circular marks on the satellite images indicate a latitudinal or longitudinal 10° difference. Detailed explanations are presented in the text.

5. Abnormal temperature

Earthquake vapour and geoeruption imply the presence of a tremendous amount of heat. To test whether a sudden pulse of heat elevates the ground temperature, we have investigated temperature change around vapour sources from 18 airports, marked by colour circles with letters 'a' through 'r' in figure 3 and listed in table 1.

Six airports, Ziguinchor (d), Conakry (f), Lungi (g), Accra (j), Abidjan (k), and Fernando (o), reached or surpassed each highest daily maximum temperature on the same date in respective data history, whereas all others did not. The daily maximum temperature in five airports, Dakar (b), Banjul (c), Bissau (e), Lome (i), and Sao Luis (l), increased by 1–4°C from 31 May to 1 June. Three airports:

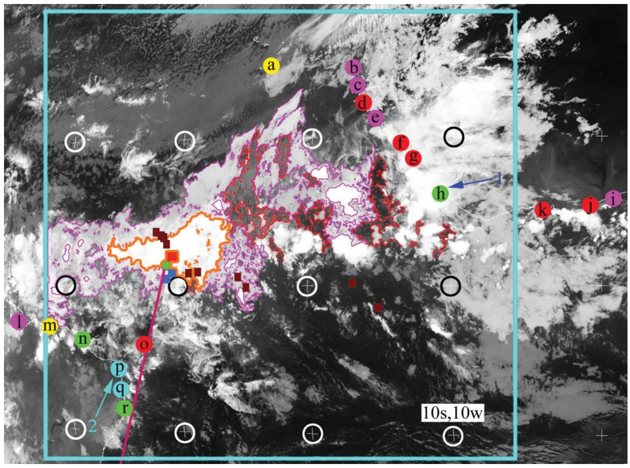

Figure 3. Erupting earthquake vapour from the mid-Atlantic at UTC 6:00 on 1 June 2009 and the temperature change in its surrounding airports. The cyan rectangle is equivalent to the bigger rectangle in figure 1(*a*). The unmarked green circle, red square, and blue squares are the same as those in figure 1. Eighteen colour circles marked by letters 'a' through 'r' are airports around the vapour sources. Their temperature changes are summarized in table 1. The wind directions are from figures 2(*b*) and (*e*). Brown rectangles are the 10 earthquakes after the airbus crash. Two adjacent circular marks on the satellite images indicate a latitudinal or longitudinal 10° difference.

Roberts (h), Fortaleza (n), and Recife (r) maintained the same temperature in the two days. Two airports Praia (a) and Parnaiba (m) had no data. The daily maximum temperature of two airports Natal (p) and Joao Pessoa (q) decreased 2–3°C from 31 May to 1 June.

We assign red to the six airports for reaching or surpassing their respective historical daily maximum temperature, and yellow to Praia and Parnaiba for no data. For the remaining airports, we assign pink, green and blue if their daily maximums increased, had no change, or decreased, respectively, from 31 May to 1 June. The distribution of colour circles in figure 3 shows that all red and pink circles were located at the places where the warm vapour rushed and all blue circles at the places where a wind blew from the cool south (see also figure 2(*e*) and (*f*)). The three green circles were located at the places that probably received an equal amount of cold wind and warm vapour. Furthermore, the more vapour an airport received, the higher temperature it reached. This inference is supported by the observation that airports Banjul (c), Ziguinchor (d), and Bissau (e) where temperature increased more than others were located downwind from the sources of earthquake clouds and geoeruptions.

Additionally, temperature usually falls at night, but many airports showed a temperature increase during the evenings of 31 May or 1 June. For example, the daily maximum temperature in Natal (p) decreased 3°C from 31 May to 1 June, but its temperature increased 1°C from 25°C at 0:00 on 1 June (7 pm on 31 May local time) to 26°C at 1:00 (8 pm) and then returned to 25°C at 2:00 (9 pm).

The above two facts suggest earthquake vapour containing enormous heat increased the temperature of a vast area of the mid-Atlantic Ocean.

Table 1. Daily maximum temperature around the accident location on 31 May and 1 June 2009.

Label	Name	Latitude	Longitude	31 May	1 June	Colour	Historical maximum	Temperature change (°C)
a	Praia, Cape Verde	14.9°N	23.5°W	NA	NA	Yellow		
b	Dakar	14.7°N	17.5°W	25	26	Pink		+1
c	Banjul	13.4°N	16.8°W	30	34	Pink		+4
d	Ziguinchor	12.6°N	16.3°W	36	38	Red	Y in 6	+2
e	Bissau	11.9°N	15.6°W	36	38	Pink		+2
f	Conakry	9.6°N	13.6°W	32	31	Red	Y in 11	−1
g	Lungi	8.6°N	13.2°W	30	31	Red	Y in 7	+1
h	Roberts	6.3°N	10.8°W	31	31	Green		0
i	Lome	6.2°N	1.2°E	31	32	Pink		+1
j	Accra	5.6°N	0.2°W	32	33	Red	Y in 11	+1
k	Abidjan	5.2°N	3.9°W	32	31	Red	Y in 11	−1
l	Sao Luis	2.5°S	44.3°W	29	30	Pink		+1
m	Parnaiba	2.9°S	41.8°W	NA	NA	Yellow		
n	Fortaleza	3.8°S	38.6°W	30	30	Green		0
o	FernandoDeNoronha	3.8°S	32.4°W	30	30	Red	Y in 8	0
p	Natal	5.9°S	35.2°W	30	27	Blue		−3
q	Joao Pessoa	7.1°S	34.9°W	30	28	Blue		−2
r	Recife	8.1°S	34.8°W	28	28	Green		0

Note: Columns 'Label' and 'Colour' are the same as figure 3 to depict the location and temperature change of each airport, whose name, latitude, and longitude are in columns 2, 3, and 4, respectively. Columns 5 and 6 show the daily maximum centigrade temperature on 31 May and 1 June 2009 local time, respectively. 'NA' means no data. Column 8 marks whether either 31 May or 1 June or both reached or surpassed the respective equivalent-day historical maximums. 'Y' means 'Yes'. Its following number indicates span of years for which temperature data are available. For example, '6' in row 'd' means 6 years from 2004 to 2009. An airport gets red colour if it has 'Y'. The last column indicates temperature change from 31 May to 1 June 2009. An airport is coloured with pink, green, blue, and yellow if it does not have 'Y' and its temperature change is plus, zero, minus, and no data, respectively.

6. Earthquake predictions

Based on the above analysis of the earthquake cloud (orange outline in figures 2 and 3) and the temperature increases (table 1), on 12 July 2009, one of the authors (Zhonghao Shou) predicted to the Editor-in-chief of this journal Dr Foody at least six moderate earthquakes before 20 September 2009 in the mid-Atlantic fault. Ten moderate earthquakes, ranging from magnitude 4.4 to 5.3, indeed happened exactly at the vapour sources in the mid-Atlantic fault during the predicted period of time. These earthquakes are plotted in figures 1 and 3. It is consistent with our hypothesis that earthquake clouds and geoeruptions that destroyed the French airbus are followed by earthquakes. In addition, six of the ten quakes were in 0–4°N, 28–32°W, close to the accident location. In this area, the probability of six moderate quakes in 112 days is only 13.8%.

7. Hypothesis

A standard atmosphere has a temperature of –1.2, –4.5, and –49.9°C at altitude 2500, 3000, and 10,000 m, respectively (Ahrens 1991). In the standard atmosphere, a cloud or a storm exists at an altitude below 3000 m, so an airbus flies safely at an altitude of 10,668 m. However, high clouds in the tropical region can sometimes reach 6000–18,000 m (Ahrens 1991). The airbus travelled normally at 10,668 m at 1:48 and passed through storm at 2:00 (Regalado and Michaels 2009), so the storm or the dense cloud reached or surpassed 10,668 m.

On the other hand, even over sunny terrains, a plane can engage in rocking motion because of a tiny thermal current. For example, the National Transportation Safety Board (2009) reported a small aircraft accident in Church Hill (36.31°N, 82.45°W), Tennessee, on 18 April 2009 that 'was sunny with thermal updraft and downdraft'. Coincidentally, an M2.7 quake occurred at 35.59°N 84.16°W on 23 May that was the only shock in the area of 30–50°N, 81–95°W from 18 April to 15 July 2009 (the date the draft of this letter was prepared). These data suggest that the earthquake vapour released before a small M2.7 shock could cause a small plane to crash. Therefore, vapours preceding 10 moderate shocks should have sufficient power to turn over the airbus.

Therefore, we propose the following hypothesis: earthquake vapours erupted from mid-Atlantic faults to the sea surface with high temperature and pressure. They rose up and caused strong convections. Interestingly, an analysis of temperature differences between the Meteosat-9 water vapour and the IR channels suggests that the water vapour that was pushed above the cloud top emitted radiation at a warmer temperature than the actual cloud by 3~5°C (Space Science and Engineering Center 2009), consistent with our theory. The analysis further suggests that convection clusters developed rapidly near the accident location, which is also consistent with sudden eruption of earthquake vapours at high temperature and pressure.

Earthquake vapours released an enormous amount of heat that increased the temperature of a vast area of the mid-Atlantic Ocean, including several airports. Two winds, one from the east and the other from the south, blew and condensed hot erupting vapours to the accident location where a dense cloud formed and became bigger and bigger. Simultaneously, the cloud was pushed up higher and higher by the warm vapour newly produced from the sources near the accident location. The cloud finally reached or even surpassed the altitude of 10,668 m where very experienced pilots were used to thinking of being safe. Hot vapour rose up continuously that made the cloud vary dramatically and quickly. In such a surrounding, the airbus lost its balance and fell down as quickly as a bomb.

8. Discussions

The little-known earthquake vapour storm is very different from other types of conventional storms. This should have been what the 'very experienced crew' had not known.

Recently, we found abnormal surface temperatures before big earthquakes. For instance, the temperature of Kerman, Iran, reached 141°C at UTC 14:20 on 15 December 2004 (6:20 pm local time, reported by the Wunderground) when the vapour preceding the M6.5 Kerman earthquake was erupting (Shou 2006a). Thus, we suggest that governments measure surface temperature half-hourly and provide data to the public. We also suggest airports recording temperature data frequently that may also help controllers. In addition, we urge owners of all satellites to allow receiving stations to offer half-hourly images to the public, so that predictions guided by the earthquake vapour theory may be generated. If so, large or moderate earthquakes would be more readily identifiable and similar tragedies could be avoided.

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