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Catastrophic Equatorial Icing events crash aircraft with increasing frequency

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ABSTRACT

Mysterious aircraft crashes in 2007, and twice again in 2014 (MH 370 on March 8, 2014, and QZ8501 in December, 2014), have occurred in Indonesian-Malaysian equatorial waters. These three tragedies and the Atlantic-equatorial crash AF 447 in 2009 implicate a deadly, low-latitude combination of turbulence and turbulent mixing behaviors termed Catastrophic Equatorial Icing (CEI). Extremely intermittent turbulence and powerful winds, currents and turbulence reflect maximal water evaporation rates and small Coriolis forces near the equator. Fossil turbulence internal waves radiate huge quantities of supercooled surface water vapor near-vertically to cruising altitudes in buoyant turbulent columns that doom any planes they encounter by rapid icing. Pieces of the MH370 aircraft have recently been located on Reunion Island and in the Mozambique channel that could not possibly have originated in the South Indian Ocean where the search has concentrated, assuming foul play. The Reunion island fragment arrived in only 115 days because March 8 is the beginning of the South China Sea winter monsoon, when currents are to the south. The crash debris was carried south out the Sunda Strait into the western trade wind drift, suggesting the rest of the plane is on the bottom where it went missing. There was no pilot error or conspiracy.

1. Introduction

Crossing the equator exposes aircraft to a previously unrecognized risk of rapid icing at cruising altitude, despite numerous aircraft passing simultaneously unharmed through the same region (journalofcosmology.com, volumes 21-24). It requires “new” turbulence, where the turbulence cascade is always from small scales to large, and “BZTMA” mixing chimneys (http://journalofcosmology.com/JOC21/indexVol21CONTENTS.htm). This intermittent and highly complex phenomenon is termed Catastrophic Equatorial Icing (CEI). CEI events result from extreme maxima of stratified turbulence produced at the air-sea interface of the ocean and atmosphere, permitted by the lack of Coriolis forces on horizontal turbulence and aggravated by buoyant forces of water strongly evaporated at the equator. Hundreds of kilometer length scales of hurricanes and typhoons demonstrate the latitudes at which Coriolis forces constrain the cascade of horizontal turbulence, and the available power. The range is from Kolmogorov viscous scales of a millimeter to hundreds of kilometer Rossby (Coriolis) scales. Millions of tons of water per second are

evaporated near the equator, at maximum rates in the Eastern Pacific (Budyko 1958), possibly raining out all condensation nuclei (including airplanes) even at high altitudes.

Because Coriolis forces vanish on the equator the length scale range of the horizontal surface turbulence cascade increases, increasing the turbulence intermittency and danger of extreme turbulence values (Gibson and McConnell 1970, Gibson 1980). Personal income has the same lognormal statistics as turbulence because both are highly nonlinear. Baker and Gibson (JPO 1987) show from ocean microstructure studies that the mean to mode ratio of oceanic turbulence dissipation rates on the equator is ~30,000/1 compared to only ~2,000/1 at mid-latitudes. These large ratios will have increased with the tropical increases in surface winds and surface temperatures of global warming.

Figure 1 shows red stars at the latitudes of aircraft crashes suggested in the present paper as CEI events. On the right is the June 1, 2009 Air France 447 at 3 N -13 E in the Atlantic, wrongly blamed on pilot error after a long investigation following the recovery of the two black boxes (voice recorder and data recorder) in 2011. June 1 was the first day of hurricane season and the weather was bad. CEI was not considered by the investigation despite many symptoms of the phenomenon (heated pitot tubes clogged by ice, loss of control of pitch and roll, failure of auto-pilot, rapid loss of altitude).

Figure 1. Catastrophic Equatorial Icing (CEI) events are shown by red stars. The cause is a rare combination of Equatorial hot water evaporation and intermittent surface winds.

Keeler, Bondur and Gibson (2005 GRL) show the generic mechanism of oceanic stratified turbulent mixing is BZTMA (Beamed Zombie Turbulence Maser Action)

mixing chimneys. Internal waves are radiated in a nearly vertical direction (~ 45 ^{o}) by fossil turbulence waves. Combining extreme turbulence events of the equator with a mixing chimney of supercooled steam gives the equivalent of a brick wall at aircraft cruising altitudes, with about four minutes between the time all pitot tubes ice over until the doomed plane hits the water. Nothing could be done except to cut the engine power before impact. It was not pilot error.

THEORY

It is generally recognized that the ocean, atmosphere, and cosmos are mixed by turbulence. However, it is not agreed that turbulence can be defined in such complex natural fluids, or in any fluids anywhere. Turbulence is often described as the outstanding unsolved problem of classical physics. It is intrinsically nonlinear, and mathematical techniques are not available that solve nonlinear problems. According to "new" turbulence, the cascade always begins at the smallest (Kolmogorov) scales with critical Reynolds number, and then cascades to large scales (Ozmidov, Rossby) where the turbulence fossilizes by buoyancy or Coriolis forces, numerical simulations are not helpful unless they resolve both the smallest and largest relevant length and time scales. In this discussion we solve the turbulence problem by restricting it to only those flows dominated by the nonlinear term of the momentum equation (**v x w**).

We define "new" turbulence as an eddy-like state of fluid motion where the inertial vortex forces of the eddies are larger than any other forces that tend to damp the eddies out. Inertial vortex forces **v x w** are lift forces perpendicular to the velocity **v** and the vorticity **w**, where **w** is the curl of **v** and **v** . del **v** = **v x w** – grad (**v.v** / 2). The second term is part of the Bernoulli group of energy terms, including the specific enthalpy p/rho, the lost work –ell, and other terms whose gradients are often near zero along stream lines. The forces that damp the turbulent eddies in natural fluids are viscous forces, buoyancy forces and Coriolis forces. By definition, these are isolated using hydrodynamic phase diagrams based on locally averaged Reynolds number, Froude number, and Rossby numbers (Lueng and Gibson 2004).

This "new" turbulence definition is the physical basis of the three Kolmogorov-Obukhov universal similarity laws of turbulence, and requires that turbulence must always cascade from small scales to large, contrary to the direction wrongly suggested by G. I. Taylor and the well-known L. F. Richardson turbulence "poem"[1]. Kinetic energy indeed cascades from large scales to small, but it is not a turbulence cascade. The mechanism of the turbulence cascade is that eddies with the same vorticity adjacent to each other induce inertial vortex forces on each other that cause them to merge and grow larger. This is why boundary layers, jets, and vortex sheets thicken to about five times the Kolmogorov

[1] "Big whorls have little whorls, that feed on their velocity. And smaller whorls have smaller whorls, and so on to viscosity (in the molecular sense)", L.F. Richardson (1920).

length scale $L_K = (\nu/\gamma)^{1/2} = (\nu^3/\varepsilon)^{1/4}$ before they become turbulent at a universal critical Reynolds number ~ 25 at the Kolmogorov time scale $T_K = \gamma^{-1} = (\nu/\varepsilon)^{1/2}$, where ε is the viscous dissipation rate of kinetic energy per unit mass. The first similarity law claims that only the fluid kinematic viscosity ν and the rate of strain γ are necessary to characterize a turbulent flow. The second similarity law claims Reynolds number independence of ν, so that only γ is relevant. By dimensional analysis, the turbulent kinetic energy spectrum must therefore obey a power law $\sim k^{-5/3}$, where k is the spatial frequency. Turbulent kinetic energy therefore always cascades from small scales to large[2]. Turbulent eddies always originate at Kolmogorov scales and grow by inertial vortex forces until constrained (fossilized) by larger scale forces. The range of scales determines the intermittency. Laboratory flows typically have only a decade or two of turbulence scales (Gibson et al. 2006). Astrophysical flows cascade eleven decades in the "great power law on the sky" and to even larger scales from the big bang event (http://journalofcosmology.com/JOC21/115GibsonPhysicaScripta10.pdf).

The third (intermittency) similarity law of Kolmogorov and Obukhov (1963) was triggered by the immediate criticisms of the two (1941) laws by Landau, who pointed out that unequivocal universal statistical similarity of turbulence was impossible because the parameters γ and ε were Reynolds number dependent. Modification of the first two (K41) laws was accommodated in terms of the intermittency factor σ^2, defined as the variance of the natural logarithm of the viscous dissipation rate ε. The surprising CEI phenomenon is a direct consequence of this (K63) Kolmogorov third law, and can be understood from oceanographic microstructure measurements, as interpreted by Baker and Gibson (1987).

Measurements of the universal intermittency constant in the K63 third law were carried out in the marine atmospheric boundary layer by Gibson, Stegen and McConnell (1970) from the SIO research vessel FLIP.

MODEL OF CEI EVENTS

Figure 2 illustrates the CEI event model. East to west winds (trade winds) are generated by Coriolis forces as the air, driven to high altitude by equatorial evaporation and buoyancy and dried out by rains, returns to its origin by these Hadley cells. In the north, south winds are turned to the right (to the west), and in the south north winds are turned to the left (also to the west) by Coriolis forces.

The first well documented CEI event was Adam Air 574 in 2007, for which both black boxes were recovered. Many of the symptoms of the crash matched those of AF447, but

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[2] "Little whorls on vortex sheets, form and pair with more of, whorls that grow by vortex forces, Slava! Kolmogorov", C. H. Gibson (1980).

included the seasonal Eastern Pacific tropical thunderstorms encountered by QZ8501. The AA574 plane suddenly vanished from radar, with no time for communication. Large amplitude roll angles of ~90 ^{o} were recorded for both AF447 and AA574, suggesting strong icing of control surfaces a few minutes before hitting the water with high vertical speed.

Both Adam Air 574 and the more recent Air Asia flight QZ8501 originated at the Indonesian airport of Surabaya (Fig. 1), headed northeast and northwest respectively, and both crashed at ~ 4 ^{o} North. Both QZ8501 black boxes have been recovered, but at the time of this writing, the results and interpretations of the recordings have not been released.

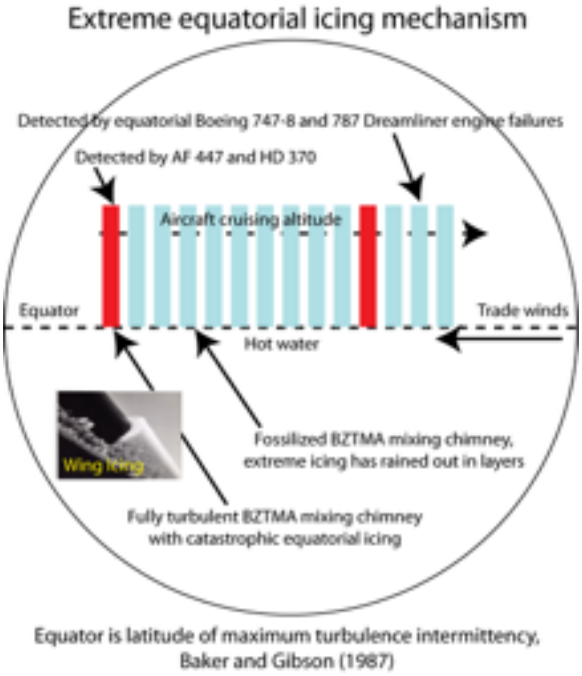


Figure 2. Model of Catastrophic Equatorial Icing events, shown as rare red columns extending from the sea surface to aircraft cruising altitudes ~ 10 km, containing supercooled water vapor that can ice wings and control surfaces (insert). Blue columns are less dangerous because rain and ice have already formed.

The first indication of a strong icing problem such as a CSI event is likely to be an ice clogging failure of one or more of the three heated pitot tubes used to determine the aircraft speed, followed by disconnection of the auto-pilot. Pitot tubes are strongly heated to prevent such icing failures, since the auto-pilot depends on this air speed information to control the airplane. Aircraft engines may also fail by shutting down completely due to equatorial icing, as shown in Figure 3.

Figure 3. Six engine failures at normal cruising altitudes occurred at equatorial latitudes for Boeing 747 Dreamlifter airplanes during six months of 2013. Fortunately the new General Electric engines could be restarted at lower heights.

These engine failures prove that columns of supercooled water vapor (blue in Fig. 3) exist at equatorial latitudes extending to aircraft crusing altitudes. Some of these supercooled water vapor chimneys may be capable of causing CEI events (red in Fig. 3) such as MH 370, even when no rain, clouds, or ice crystals of equatorial storms are evident.

Some Dreamlifter customers (eg. Japanese Airlines) delayed their orders for planes and cancelled flight plans due to this unexpected high altitude but non-catastrophic equatorial icing problem that fortunately failed to cause crashes. Nowhere is the obvious point raised that if supercooled water vapor can reach sufficient altitudes near the equator to shut down aircraft engines it can also catastrophically ice over heated pitot tubes, aerodynamic control surfaces (flaps), aircraft wings and tails, and shut down autopilots. Boeing engineers believe they can simply reprogram the engine control software to prevent future NEI engine failures.

AIR FRANCE 447 and MH370 CEI EVENTS

The most completely documented CEI event was the 2009 crash of AF 447, where both black boxes (voice recorder, flight recorder) were finally discovered in 2011. Figure 4 (from journalofcosmology.com vol. 21) shows the track of the doomed AF447 plane as it spiraled > 35,000 ft from cruising altitude into the Atlantic during the last six minutes of the flight (insert upper right).

Authorities in both cases have attempted to blame the pilots, co-pilots, and passengers for the crashes, claiming that “planes don’t just vanish”. Debris and bodies were found soon after the AF447 crash near the point where the plane vanished. Chinese satellite images (journalofcosmology.com vol. 21) appeared on the internet for two hours showing the MH370 wreckage on the surface at the correct latitude (6.7 N), but at a likely mistaken

longitude (104 E not 103 E) that misdirected the Vietnamese air search. Longitudes are reported manually for Chinese satellite images, making such a mistake easy. The images were removed from the internet without comment or subsequent repudiation. Bizarre conspiracy theories about MH370 directed the search efforts to the South Indian Ocean off Australia, where millions of dollars are still being wasted in fruitless searches.

High winds and high waves plus political tensions in the region complicated searching for the MH370 crash where it vanished, even though the South China Sea location is shallow; that is, only ~ 300 m deep.

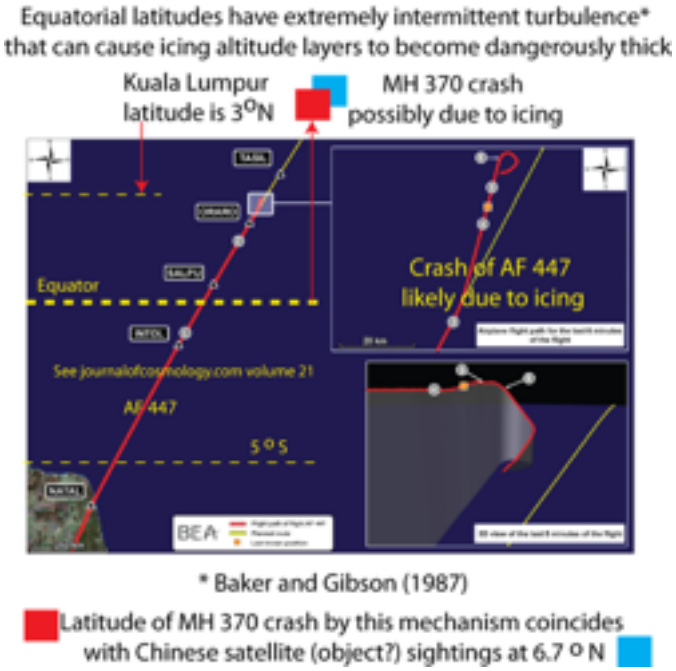


Figure 4. Comparison of the AF447 crash at 3N -13E Atlantic with the 6.7 N 103 E MH370 crash in South China Sea. Black boxes from MH370 have not been recovered because authorities have not looked at the position where they are most probably located (blue square, 6.7 N 103 E).

A major difference between the AF447 and MH370 crashes was the weather. The weather was clear for MH370, but terrible for AF447, as shown in Figure 5.

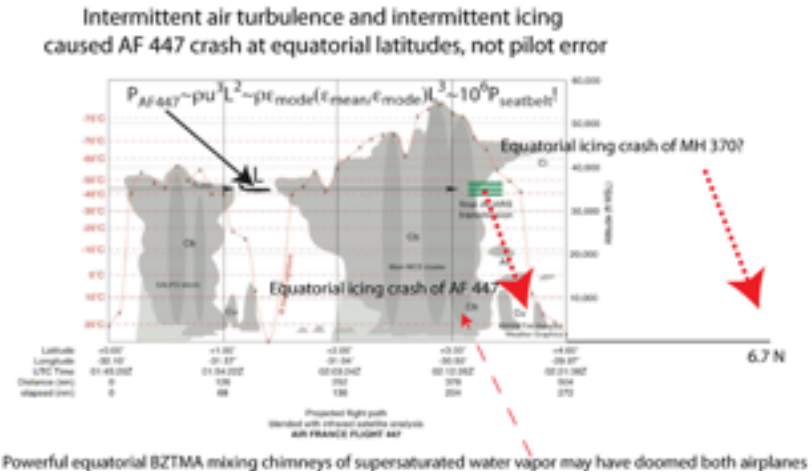


Figure 5. Flights AF447 and MH370 were both probably crashed by Catastrophic Equatorial Icing, but under very different weather conditions. AF447 flew on June 1, 2009, the first day of hurricane season, passed near the worst thunderstorms in the region, which extended to 58,000 feet, possibly into a MH370-like, clear-air, CEI mixing chimney.

Most of the equatorial solar energy (by a factor of about 40) produces latent heat of evaporation rather than increased temperature. About 4 meters per year on average of equatorial sea water is pumped by the sun into the Indian ocean atmosphere, significantly more than in the Atlantic or Pacific (Budyko 1958). Under conditions of modern global warming and reports of high surface winds and waves where MH370 went missing, ample evidence exists to support the possibility that a CEI event crashed MH370 at 6.7 N as suggested in Fig. 1 and Fig. 5, particularly the discovery of the MH370 flaperon on Reunion Island only 115 days after the March 8, 2014 disappearance.

The vertical transport mechanism of vertically stratified turbulent transport is complex and intermittent (journalofcosmology.com volume 21), involving radiated and re-radiated fossil turbulence waves and beamed zombie turbulence maser action (BZTMA) mixing chimneys that follow previous vertical mixing channels like lightning bolts follow the ionized paths of previous lightning bolts. The complex, intermittent, BZTMA mixing chimney mechanism is supported by a variety of astrophysical and cosmological observations, starting with the "big bang" cosmological event. Fossils of the initial turbulence and its cascade to larger scales are preserved by cosmic microwave background patterns, Gibson (2004).

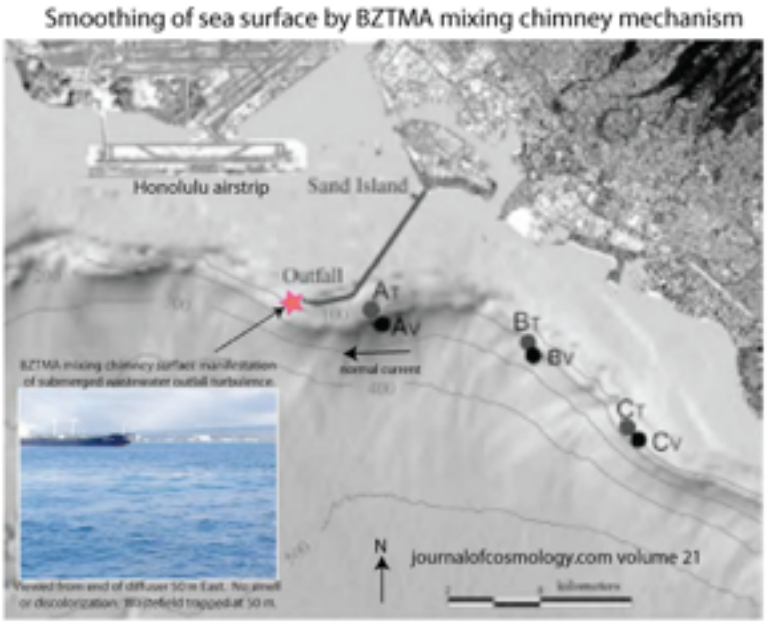
Gibson (2005) shows the big bang is a turbulent combustion instability powered by inertial-vortex forces beginning at Planck scales of 10^{-35} m. Spinning Planck particle and anti-particle pairs are similar to spinning electon-positron pairs (positronium). Positronium and pair production explain the intense neutrino radiation from supernovae II. However, the much smaller scales and more intense spin ~ 10^{43} radians s^{-1} of

"Planckonium" pairs must be described by the Kerr metric (Peacock 2000). Negative stresses < -10^{113} Pa generated by inertial vortex forces of big bang turbulence are sufficient to extract mass-energy from the vacuum (Fortov 2013) to create the universe. Dark energy and its anti-gravitational forces are not needed. Einstein's cosmological constant Λ is zero as originally proposed by Einstein's general relativity theory.

Rather than neutrinos, the Planck particle pairs produce a spinning gas of Planck particles with such a large Reynolds number that the gas becomes turbulent until the fire ball cools from Planck temperatures of ~10^{32} K to ~ 10^{27} K where quarks and gluons are possible. Gluon viscous stresses damp the Planck particle turbulent combustion by producing needle-like BZTMA mixing chimneys pointing in the direction of vortex stretching and powering inflation of space from Planck scales of 10^{-35} m to the present universe scale of 10^{50} m. Our local spin "axis of evil" appears as the coldest spot on the cosmic microwave background sky. Radio telescope observations show the low densities of our local big bang turbulence vortex line has triggered formation of an expanding > 10^{25} m radius void starting early in the plasma epoch.

Figure 6 shows a manifestation of fossil turbulence waves and BZTMA mixing chimneys at the Sand Island municipal outfall of Honolulu, Hawaii, where the phenomenon was discovered. A variety of space satellites, helicopters, and the international space station were used to detect the horizontal spectral elements of the sea surface brightness.

Internal wave energy was found to be mostly in wavelengths corresponding to the internal tide turbulent bottom boundary layer thickness, which fossilizes at Ozmidov scale wavelengths of ~ 100-200 meters, much larger than the ~ 10 m fossilization scales of the outfall turbulence in the wastewater plume. The BZTMA energy transfer mechanism is tilting of the strong density layers at the top and bottom of the outfall fossils by the radiated boundary layer fossil turbulence waves to produce vorticity and "zombie turbulence". The zombie turbulence of the vorticity layers fossilizes and re-radiates zombie fossil turbulence internal waves in nearly the vertical direction.



Sand Island outfall in Mamala Bay (Bondur et al. 2015) showing locations of temperature and current velocity measurement stations. Rarely, surface manifestations of the outfall turbulence would appear (red star) about 50 m west of the end of the diffuser pipe, interpreted as a BZTMA (beamed zombie turbulence maser action) mixing chimney. Vertical microstructure profiles showed the turbulent wastewater plume was trapped and fossilized at 50 m below the surface. The observed surface smoothing was accompanied by little discoloration and no smell, proving it was the result of radiated fossil turbulence and zombie turbulence internal waves.

Figure 6. Surface smoothing manifestations resulting from the BZTMA mixing chimney (photograph insert) phenomenon were detected (on rare occasions) near the west end of the Sand Island outfall. Figure based on Bondur et al. (2013, fig. 1).

The ability of such BZTMA mixing chimneys to bring supercooled water vapor to > 10 km high altitudes in sufficient quantities to cause catastrophic icing is considered the most likely scenario responsible for the four CEI events identified in Fig. 1. An important factor is the removal of condensation nuclei by the repeated storms of the tropical eastern pacific. This could have contributed to the MH370 clear air turbulence crash. All of the other CEI candidates of Fig. 1 were in conditions of heavy tropical rain, for example Figure 7, center left, for QZ8501. The QZ8501 crash was predicted (Gibson 2014).

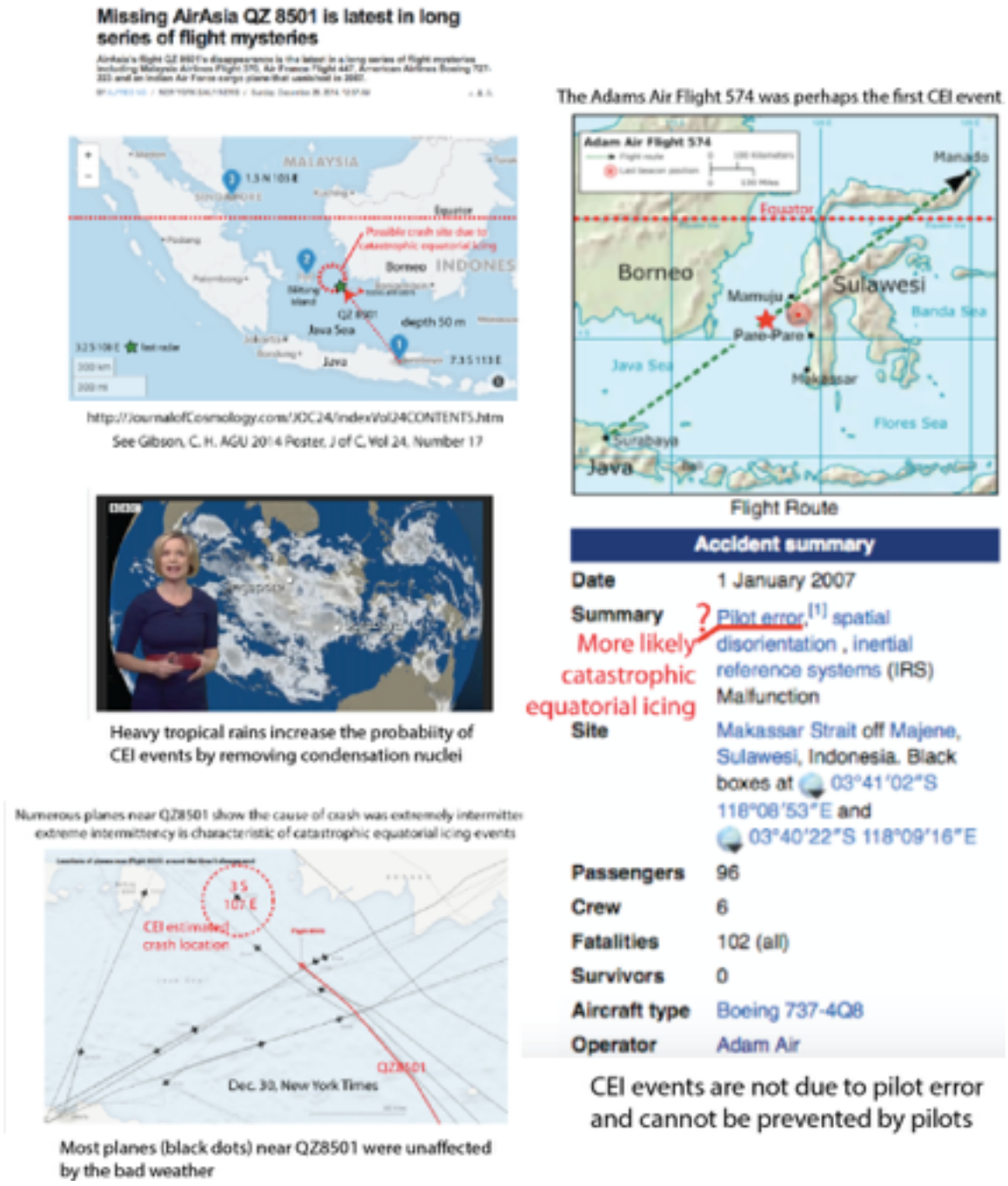


Figure 7. A pattern of mysterious airplane crashes points to Catastrophic Equatorial Icing events, especially in the Eastern Tropical Pacific (journalofcosmology.com vol 24) where both maximal surface evaporation and maximal winds are enhanced by global warming.

DISCUSSION

Heat, mass, momentum and information are transferred vertically in the atmosphere and ocean by rare BZTMA mixing chimney events. In the tropical Eastern Pacific BZTMA

mixing chimneys are likely responsible for three tragic crashes with 100 % loss of life, two in 2014. The mechanisms of CEI events and big bang turbulence are shown in Figure 8.

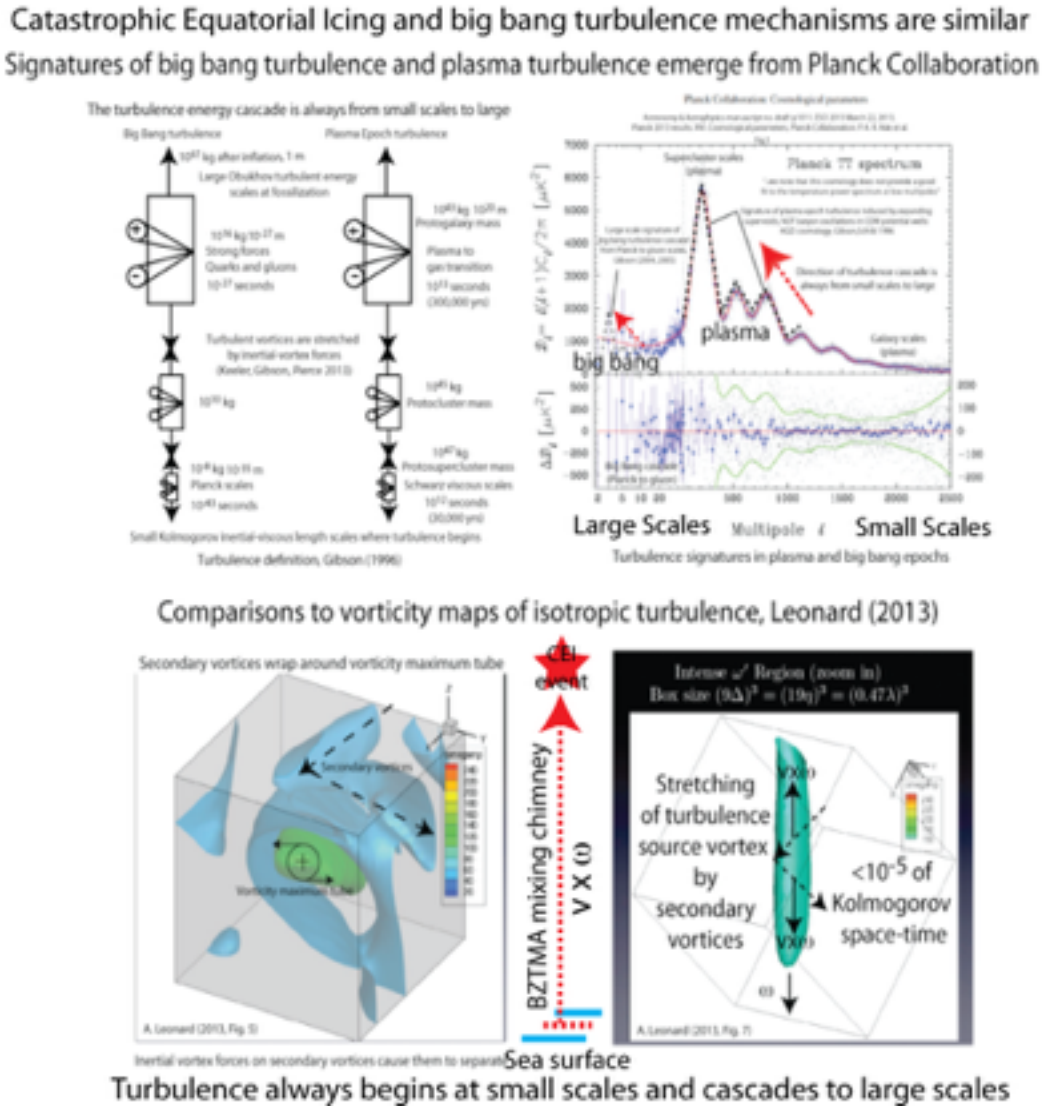


Figure 8. The mechanisms of CEI events and Big Bang turbulence are remarkably similar. Both cascade from small scales to large, driven by inertial vortex forces. Both extract power from the quantity they are mixing (supercooled steam and Planck particles, respectively). Both are limited at large scales by fossil turbulence internal waves that dominate future dynamics. Both are extremely intermittent.

RESULTS AND CONCLUSIONS

Evidence has been presented that aircraft in the tropics are subject to Catastrophic Equatorial Icing events. Several hundred lives have already been lost and more are in

danger if no steps are taken to prevent these tragedies. Two CEI crashes in 2014 suggest the risks are increasing. Statistical studies of small scale turbulence and mixing at the Equator should be initiated to test the phenomenology presented. Ignorance of modern turbulence theory, fossil turbulence internal waves, and modern turbulent transport processes should not be blamed on aircraft pilots, who are included among the victims.

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