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RECORDS IN THE SKY CIRRUS HOMOGENITUS AND CIRRUS HOMOMUTATUS

Abstract. Meteorological conditions deviate from the average climatological conditions, more or less. Condition generally are not in the focus of citizen's interest until some extreme event occurs. Then the print and digital media are full of reports about the consequences of the storm. Citizens of all professions become active participants and express their observations and opinions with their comments. On the one hand, this is good, but on the other, the comments often confuse public opinion, and in some cases even disturb. The reason is that most analysts and commentators do not have proper professional education and therefore do not understand meteorological processes sufficiently. As a consequence, the comments make assumptions, even claims, that episodes of extreme meteorological phenomena are the result of considerable, deliberate human action (conspiracy). Many comments refer to contrails, which are claimed to be chemtrails as part of a secret dusting program. The claim is based on the presentation of images, films and opinions without sufficient evidence. These specific "records in the sky" are indeed the result of human action, and they were created by known chemical and meteorological processes. They have been known since before the Second World War. In the Cloud Atlas they are classified as Cirrus homogenitus and Cirrus homomutatus. By burning aircraft fuel (hydrocarbons), hydrogen and carbon are produced, and their chemical reaction with oxygen produces carbon dioxide and a molecule of water vapor. The water vapor molecule further binds to the nucleus, which consists mainly of solid particles of jet fuel combustion. Due to the very low temperature at the height of the plane's flight, the microscopic droplet almost immediately changes to a solid state (crystal) and becomes visible. The retention and movement of aircraft trails (clouds) depends on a number of thermodynamic properties of the atmosphere. High pressure, low humidity and downward air flow cause rapid disappearance, and low pressure, high humidity and upward flow cause long-term retention of traces. High wind speed carries the tracks in the direction of the wind. In addition to the condensation trails of the aircraft, citizens are also suspicious of "strange-looking clouds", and those rare cloud forms have also long been observed, classified and recorded in the Cloud Atlas.

Keywords. aircraft tracks, meteorological conditions, cloud atlas.

1. Introduction

The retention and movement of aircraft tracks (clouds) depends on a number of thermodynamic properties of the atmosphere. High pressure, low humidity and downward air flow cause rapid disappearance, and low pressure, high humidity and upward flow cause long-term retention of traces. High wind speed carries the tracks in the direction of the wind. In addition to the condensation trails of the aircraft, citizens are also suspicious of "strange-looking clouds", and those rare cloud forms have also long been observed, classified and recorded in the Cloud Atlas.

Citizens of all professions become active participants and express their observations and opinions with their comments. On the one hand, this is good, but on the other, the comments often confuse public opinion, and in some cases even disturb. The reason is that most analysts and commentators do not have proper professional education and therefore

do not understand meteorological processes sufficiently. As a consequence, the comments make assumptions, even claims, that episodes of extreme meteorological phenomena are the result of considerable, deliberate human action (conspiracy). The consequences of this action are suspected to be strange cloud formations, strange rain, large pieces of hail, heavy rains, torrents, floods and droughts. Not only meteorological events are in the spotlight, but also other natural phenomena on the planet such as earthquakes, forest fires and tsunami waves. All these "unusual" phenomena are suspected to be the result of climate weapons, radiation from telecommunications antennas and HAARP. The claim is based on the presentation of images, films and opinions without sufficient evidence. Explanations are found in newspaper articles, in "secret and newly published" state and military archives and plans, arguments are pictures and hearsay stories and claims on social networks. The hypothesis of climate change as a consequence of human activity is imposed through hidden motives [2] such as concern for environmental protection. It has spread to almost all segments of society with the basic message that man is to blame. This then caused the suspicion that man is also to blame for many other events in nature for which scientific and logical explanations [3] do not reach the majority of the population.

Many comments refer to aircraft contrails (contrails), which are claimed to represent the release of chemical substances (chemtrails) as part of a secret program of dusting and poisoning the population or influencing meteorological processes in order to change the climate (SLAP – Sheriff's Labor Assistance Program).

2. Airplane tracks

There are a variety of visible trails left by airplanes. There are two basic groups of traces. The first group consists of traces created by the purposeful release of substances over a certain territory for various purposes, such as spraying agricultural areas with protective agents and means for the destruction of undesirable insects and pests. In such situations, propeller-driven aircraft fly low above the ground to drop the asset on the target area. Depending on what fuel they use, a dark trail of burning fuel remains clearly visible behind the aircraft. In addition, at air shows, substances of different colors are released from airplanes at low altitudes due to the effect on the audience. There have been intentional releases of chemical substances in some experiments at a limited area and in war events. A more well-known example is the seeding of forests with chemical substances (herbicides) carried out by the American army during the war in Vietnam in order to strip the terrain in order to more easily detect the positions of the opposing army. Clouds can be seeded with silver-iodide from airplanes with the intention of reducing hail or increase of precipitation, but all at a limited local level. The second group of traces consists of those that are not unintentionally created, but are unavoidable due to the combustion of aircraft fuel. At low altitudes they are not visible, but at higher altitudes they are. These are traces (contrails) left by jet-powered passenger planes during flights on regular routes in official corridors. These are precisely the traces that are suspected to represent the release of chemical substances (chemtrails) as part of a secret program of dusting and poisoning the population. Here is an explanation of the mechanism of their formation and the atmospheric conditions of their appearance or absence.

2.1 Aircraft condensation trails (contrails). These specific "records in the sky" are indeed the result of human activity (burning of jet fuel). Airplane tracks are created by

known chemical and meteorological processes. In appearance (structure, color, thickness, distribution, height at which they are located) they resemble clouds from the cirrus genus (Cirrus), which are created by natural mechanisms that are common to all clouds (Figure 1). They have been known since before the Second World War, especially after the introduction of jet engines and flying at high altitudes. There are also less visible aerodynamic traces due to the change in pressure during air flow on the wings of the aircraft.

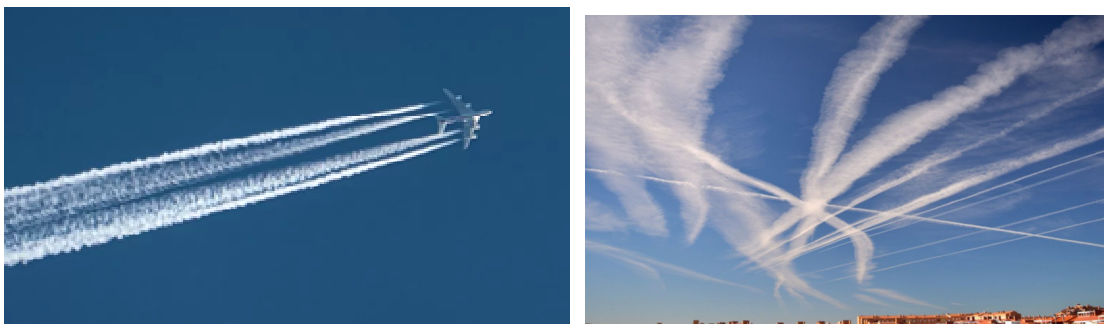


Figure 1. Airplane tracks on regular airplane flights (left <https://www.bbc.com/serbian/>; right <https://cloudatlas.wmo.int/en/home.html>)

2.2 The formation mechanism of aircraft condensation trails. Jet planes fly using powerful engines. Air enters the aircraft engine and the oxygen present helps burn the high-energy fuel (kerosene) which reaches a temperature of 760 °C to 1038 °C. Combustion of aviation fuel (hydrocarbons) produces hydrogen, carbon, carbon dioxide, carbon monoxide, sulfur dioxide and other gases. The gases have a high temperature, approximately the same as the temperature of the fuel. Gases escape from the rear of the engine and thus propel the aircraft forward. In addition to gases, small solid combustion particles (soot) also fly out of the engine as a product of combustion. Thinking ecologically, jet planes pollute the air and in higher concentrations near airports have an adverse effect on health. Cars and burning of coal in cities have a similar effect. Carbon dioxide in natural concentrations is not a poisonous gas, on the contrary, it is useful for life on the planet [3]. The increase in the concentration of carbon dioxide in the atmosphere due to the burning of hydrocarbons (coal, oil, jet fuel, etc.) is not important for the rise in temperature and potential climate change [2], [4].

The high temperature of hydrogen as a combustion product and oxygen passing through the engine enables their chemical reaction. By combining hydrogen and oxygen, carbon dioxide and a molecule of water vapor are formed. The water vapor molecule then binds to the nucleus, which consists mainly of solid particles formed by the combustion of jet fuel, and a microscopic droplet (liquid phase) is formed. The liquid phase lasts less than one second. Due to the very low temperature of the air at the altitude of the aircraft, the droplet turns into a solid state almost instantly. The resulting crystals become visible as a cloud (Figure 1). The tracks are not visible directly at the exit from the engine, but at a distance of several meters or tens of meters, depending on the speed of the aircraft. This is exactly the distance the plane moved in less than one second, which is the time it takes for the chemical reaction and crystal formation. By burning one ton of fuel through a chemical reaction, 1.2 tons of water vapor is obtained, which turns into a crystal [5].

2.3 General atmospheric conditions of formation and the possibility of forecasting. Tracks appear at heights of 5 to 12 km, and most often at the height of the air corridor (9-12 km). The temperature at those heights is from -40°C to -60°C . This is a necessary condition for water vapor as a product of fuel combustion to turn into ice crystals very quickly.

The first published reports of trail formation appeared shortly after the World War I. At first, scientists weren't sure how the tracks were formed. Then, since World War II, military planners have been interested in contrail forecasts. Aircraft of enemy forces can be located based on the tracks. Modern stealth technology cannot hide an aircraft if it leaves a clearly visible trail behind. In 1953, scientist H. Appleman published a chart (Figure 2) which can be used to determine the probability of formation of jet aircraft trails based on meteorological parameters [6]. The map shows the zones where tracks are formed (left), the transition zone where they are possible (in the middle) and the zone where they are not (right).

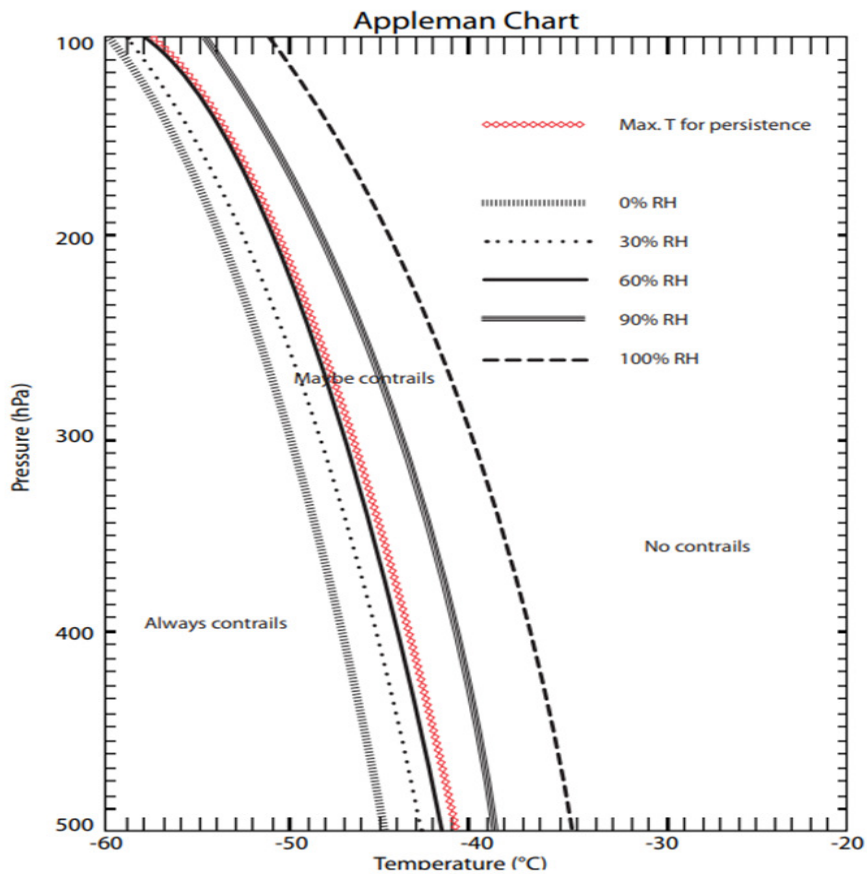


Figure 2. The Appleman Chart for flight above 18,000 feet (500hPa ~ 5500 m).
https://www.nasa.gov/sites/default/files/atoms/files/contrails_k-12.pdf/

Based on the data on temperature, humidity and wind up to a height of about 35 km (upper air sounding) entered on the map (emagram), the altitude zones where the conditions are favorable for the creation of tracks are determined (Figure 3). Prognostic data

(prognostic emagrams) are used to forecast the possibility of creating aircraft tracks several hours or days in advance.

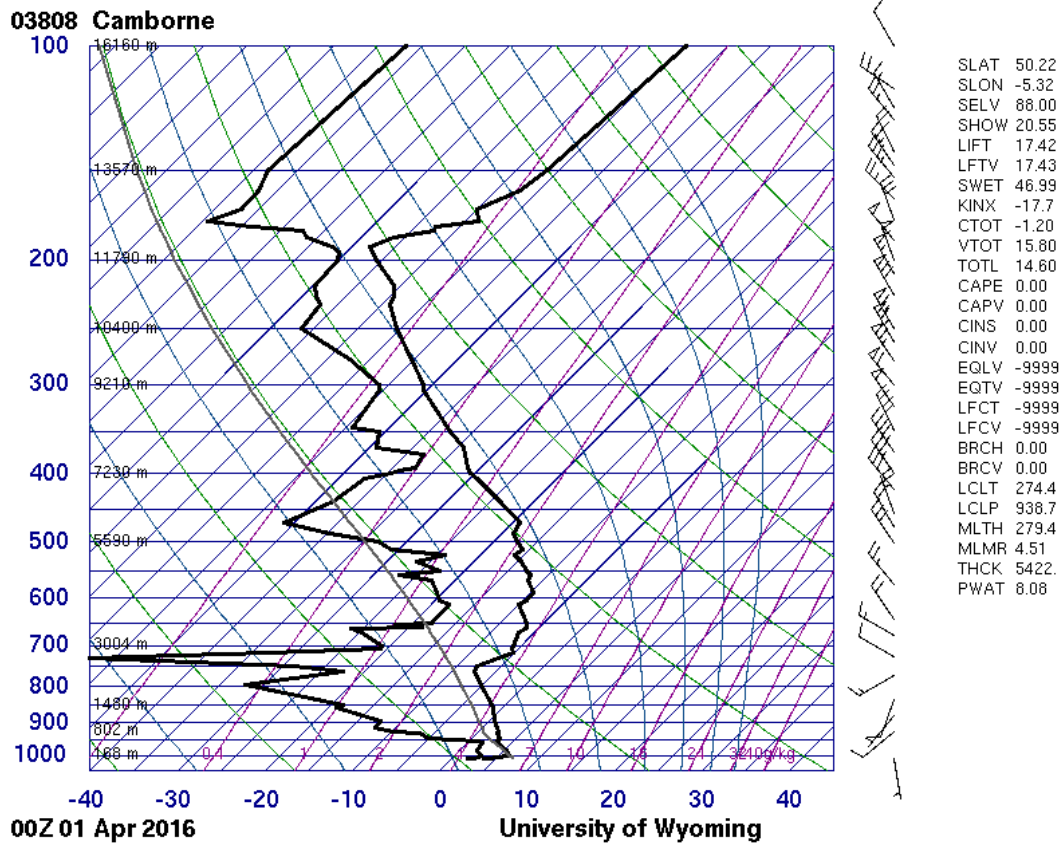


Figure 3. Upper-air soundings (emagram). The 0000 UTC upper-air ascent from Camborne in south-west England, UK would be representative of southern England later that morning. The ascent shows a moistening layer at about 7 500 m. (<https://cloudatlas.wmo.int/en/imgviewer-5622.txt>)

2.4 Thermodynamic conditions of formation and retention. The formation of aircraft tracks is conditioned primarily by temperature and humidity at a certain height (Figure 2). In different synoptic situations, the resulting tracks disappear quickly or remain for a long time. In the area of high atmospheric pressure (anticyclone) there is a downward flow of air, reducing the humidity (fen effect). In that situation, the traces formed are short and quickly disappear due to the evaporation of the crystals (clouds). In areas of low atmospheric pressure (cyclones), zones with upward currents of air prevail with increasing humidity (in areas with precipitation there are downward currents). In that situation, the conditions are favorable for the creation and long-term retention of traces of several hours with the constant creation of new traces. Then the sky is mostly covered with tracks (Figure 4). Aircraft tracks do not remain at the place of origin, due to the wind at altitude they are moved in the direction of the leading horizontal flow. In the area of high pressure, the wind speed is relatively low, so in addition to quickly disappearing, contrail are also weakly mobile. On the contrary, there are strong currents on the front side of the cyclone in the direction of movement. Tracks that persist for a few hours are quickly moved, during which

time they disappear from view, and are replaced by new or emerging tracks. For example, if they formed above Belgrade, the horizontal component of the wind will move them outside the borders of Serbia for 2-3 hours. Likewise, strong currents can bring long-lasting traces from surrounding states. Regardless of the synoptic situation and thermodynamic conditions, the aircraft tracks remain at approximately the same height at which they were created and do not reach the ground.

2.5 Examples of descriptions of anthropogenic clouds from the Cloud Atlas.

The resulting aircraft tracks are created at heights where cirrus clouds are created by natural mechanisms. There are ten genera of clouds, which are further classified into types, subtypes, accompanying clouds and clouds created by human action. A type of cirrus cloud formed from airplane tracks is called homogenitus. If their appearance changes further, the species get new names such as homomutatus or change to another species (e.g., spissatus, fibratus). A detailed description of all clouds with all technical characteristics is given in the Cloud Atlas. (Figures 4, 5 and 6).

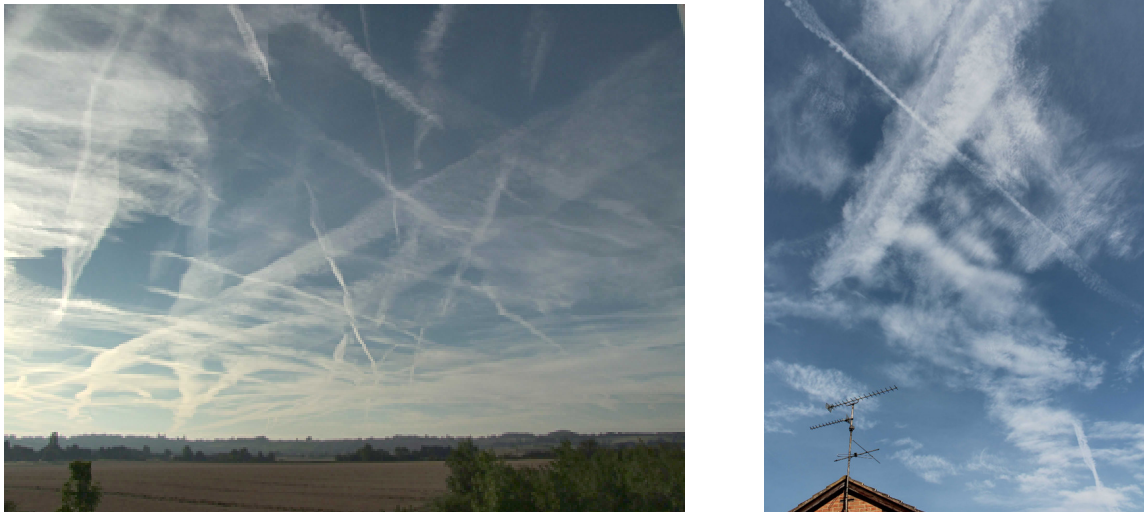


Figure 4. Cirrus homogenitus (contrails) and Cirrus homomutatus (left) и Cirrus spissatus homomutatus (right) (<https://cloudatlas.wmo.int/en/search-image-gallery.html>).

The main feature of the photo (right in Figure 4) is an area of Cirrus homomutatus that quickly, within just a few minutes, condensed into a dense cloud (species spissatus). Part of the cloud above the antenna has developed into a type of floccus. Other parts of the anthropogenic cloud mutate into flat filaments, indicating a fibratus species, and small cloud elements, suggesting a Cirrocumulus.

All the clouds in Figure 6 were created by spreading aircraft tracks and are homomutatus due to this anthropogenic origin. In the lower right corner of the picture there are two recently formed tracks (Cirrus homogenitus). Above this, on the right side of the image, the trace widens and shows small elements with an apparent width of less than 1° ; this is Cirrostratus homomutatus. To the left of this is a Cirrus with fine white filaments which are generally straight; this is Cirrus fibratus homomutatus. In the upper center of the picture there is a large area of Cirrus fibratus homomutatus. However, there are also some

small features on the left side that indicate Cirrocumulus. This cloud extended from the wake on his right, and appears to be at a different level from that of the Cirrus on his right, as evidenced by the shadow of the wake; subspecies *duplicatus* applies. In the lower left corner is a thicker and more extensive area of Cirroform *homomutatus*. The full extent cannot be seen as it is out of the picture, but the appearance of the clouds suggests Cirrostratus.

© Rodney Hale
Houghton Conquest, Bedfordshire, England, United Kingdom of Great Britain and Northern Ireland
Latitude: 52° 4' 5" N
Longitude: 0° 28' 18" W
20 August 2011 0730 (Local Time)
Camera direction: towards SE
Image P/S code: S.1.15
Image I.D.: 4803
 $C_L = 0, C_M = 0, C_H = 1$

Cirrus homogenitus (contrails) and Cirrus homomutatus

Persistent aircraft condensation trails at 1 and 2 (contrails) cover much of the sky in this picture. These contrails are classified as Cirrus homogenitus. The name homogenitus is used where the cloud has developed as a consequence of human activity. Because new or recently formed contrails may display a variety of transient shapes, no species, varieties or supplementary features are used in the classification.

Some of the older contrails can be seen to have spread out over time. These clouds have lost their original linear appearance and have transformed or mutated into cloud, taking on the appearance of a more natural-looking Cirrus. This cloud is Cirrus homomutatus at 3 and 4.

Links in the image description will highlight features on the image. Mouse over the features for more detail.

Figure 5. An example of a cloud description from the Cloud Atlas.
(<https://cloudatlas.wmo.int/en/search-image-gallery.html>).



Figure 6. Cirrus, Cirrocumulus and Cirrostratus homomutatus (<https://cloudatlas.wmo.int/en/search-image-gallery.html>)

2.6. The condensation aircraft trails as a sign of changing weather conditions.

Naturally occurring cirrus clouds are usually found on the periphery of the cyclone where, first at higher altitudes, and then in the lower layers, warm air flows. After a day or two, the cirrus cloudiness is replaced by the cloudiness of the middle altitude layer, and then low cloudiness. This is the usual distribution of cloudiness before the arrival of an atmospheric front, so it is considered that cirrus cloudiness is in most cases a sign of a change in the weather in terms of cloudiness and the beginning of precipitation. Aircraft contrails have similar properties to natural cirrus clouds in a similar synoptic situation. Condensation tracks of airplanes (contrails) indicate a change in weather, they can serve approximately to forecast the weather conditions for the coming days. Long contrails, across the entire sky, lingering for a long time, increasing the number of contrails and expanding existing ones are signs of the strengthening influence of an approaching low pressure area (cyclone). In that situation, there will be an increase in air humidity, cloud cover, strengthening wind, an increase in atmospheric instability and the arrival of precipitation. When there are no traces in the sky or they are of small length and quickly disappear, it means that the influence of the high pressure area is strengthening, a stable atmosphere is established and followed by clearness and warmer weather.

Based on the established laws of nature, it is possible to predict the future state of the atmosphere. The practice of weather forecasting confirms this. Based on the condensation tracks of the aircraft, it is possible to forecast the general state of the

atmosphere (cyclone-anticyclone). This confirms that aircraft tracks behave according to natural laws. In addition, technical persons employed in aviation and pilots confirm that the traces of the aircraft represent ice crystals formed by the chemical reaction of gases produced by the combustion of aircraft fuel [8].

3. Conclusion

More and more often, the public, primarily through social networks, make assumptions, even claims, that episodes of extreme meteorological phenomena are the result of considerable, deliberate human action. It is suspected that the plane's tracks represent the release of chemical substances as part of a secret program to influence meteorological processes with the aim of changing the climate or poisoning the population. The mechanism of origin is known and scientifically argued. (contrail - condensation tracks). Specific "records in the sky" in the form of aircraft tracks are the result of human action (modification by burning aircraft fuel). In terms of appearance (structure, color, thickness, distribution, altitude) aircraft tracks resemble clouds of the cirrus genus, which are created by natural mechanisms that are common to all clouds. Atmospheric thermodynamic conditions determine the formation and length of retention of traces. There is no evidence that the jet trails on scheduled routes represent the intentional release of chemical substances.

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