Dear

Thank you for your recent enquiry regarding condensation trails from high altitude aircraft and how they might impact upon weather forecasts. I hope the following information will be helpful and clarify matters.

The Met Office does not explicitly include aircraft condensation trails (contrails) in the forecast process, but it is not neglected either.

Our forecast process takes in several million observations a day from a wide range of sources, of which a very large proportion are satellite observations of radiances recorded at many different wavelengths. We also incorporate surface observations of solar radiation which is affected by upper cloud. Through our data assimilation system which incorporates all these observations into the forecast model, we build up a detailed picture of the structure of temperature, moisture and cloud through the depth of the atmosphere. This means that where contrails have already formed sufficient "cloud" to have an impact on the radiation balance (leading to changes in surface temperature for example) these same clouds and the associated moisture will be *observed in the satellite radiances and assimilated into the model* for use in the forecast. Even where clouds have not yet formed, the model will normally identify where the atmosphere is near-saturated and therefore prone to cloud development, and will often then form high-level cloud affecting the radiation balance at the surface in the forecast.

There are a number of reasons why we would not explicitly include aircraft in the modelling process. Most importantly we do not have the information about where aircraft are flying, and in particular at what heights. We know that aircraft will sometimes specifically adjust their altitude to minimize their creation of trails, but there are many other constraints on their freedom to do this (Air Traffic Control and fuel economy, for example) so we cannot just use "climatological" flight routes and altitudes. Secondly, this would introduce a significant extra feedback into the forecast process because the forecast would depend on how people were responding to the previous forecast. If pilots changed their behaviour in response to the forecast, this could itself make the forecast go wrong. In any case, given what is said above about modelling many of the processes required to produce high-level cloud in the forecast, we would not expect it to make a significant difference to our forecasts if we did explicitly include it.

It is also worth mentioning that we now make extensive use of ensemble forecasting to understand the uncertainties related to chaotic behaviour in the atmosphere. In an ensemble we run the forecast model many times making small changes to the initial conditions to assess the sensitivity to small errors in the analysis. Thus if the atmosphere is in a state where it is sensitive to formation of high cloud (near-saturated) then these small changes would likely have a very similar effect to explicitly modelling the aircraft. What the ensemble gives us is error bars on the forecast, including for example the surface temperature affected by radiation from above.

If your concern stems from the possibility of temperature errors due to condensation trails, we routinely measure our accuracy and are within 2 degrees on over 90% of occasions in the 1-day ahead forecast - and that is not including the additional information available from the ensemble-based error bars.

This message has tried to explain a necessarily complex process which we hope has helped to settle your concerns. Thank you for taking the time to get in touch.

Yours sincerely

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