SUPPORTING EUROPEAN AVIATION

Observational Data and AI to Detect Contrail Formation

EUROCONTROL Aviation Sustainability Unit

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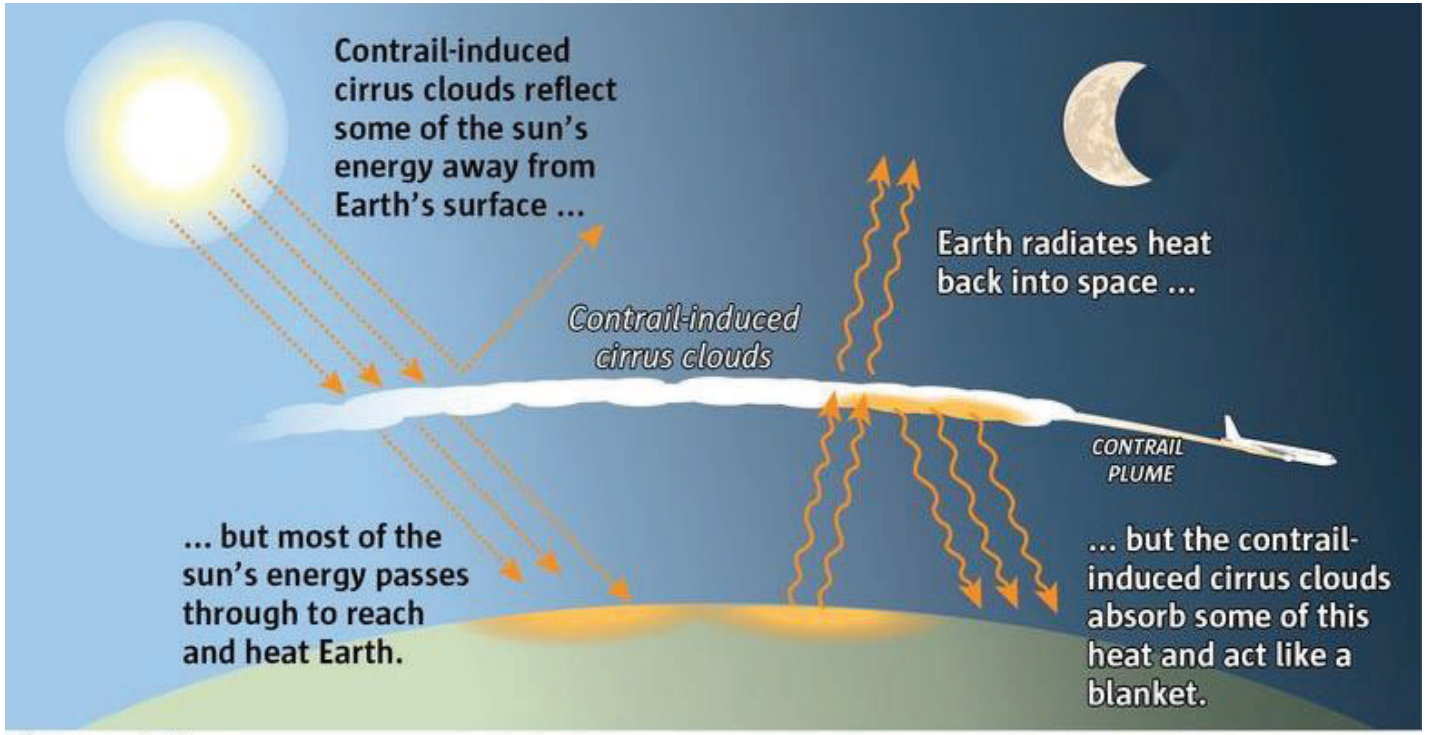
CO2 and non-CO2 effects of aviation

- For any type of emissions or cloud induced effects, **radiative forcing** results from the imbalance between the reflection of the incoming solar radiation an outgoing terrestrial radiation



The climate impact of non-CO2 could be of the same order of magnitude as CO2 emissions

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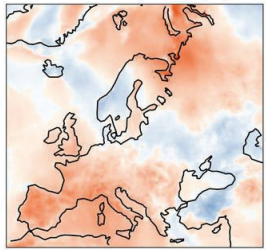
Observational Data and AI to Detect Contrail Formation

Weather observations

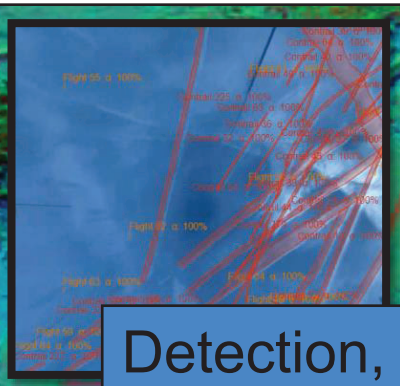


Traffic

Physical models (+observations)
Contrail formation & development
Radiative forcing

Satellite observation

Ground-camera observation



Detection, tracking, and flight attribution

Colocation

Detection and tracking

Objectives:

- **Scientific:** modelling contrails
- **Operational:** monitoring their impact

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Contrail research in the Aviation Sustainability Unit

- **Labelled datasets** of contrails on remote sensors
- **Models** and **algorithms** for contrail detection, tracking and flight attribution
- **ContrailNet,** a data portal to support contrail research
- Participation to **NEATS**, a system to **monitor, report and verify** non-CO2 effects of aviation
- Other research topics (altitude estimation, climate surrogate models, uncertainty quantification …)

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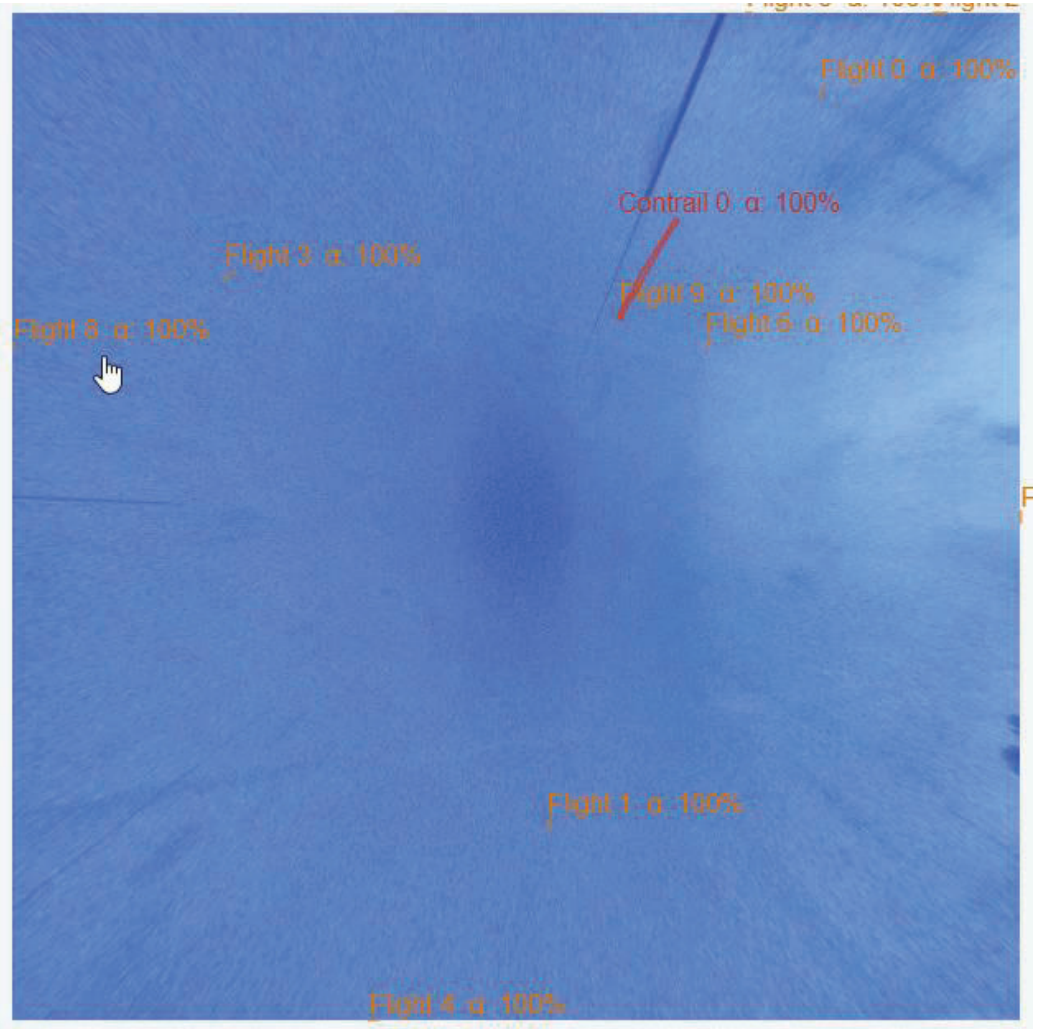
A labelled dataset for contrail detection, tracking and flight attribution

- **90** sequences of 1 or 2 hours, with an image every 30 sec
- **18K** images
- Contrails are **instances** (sets of polygons) consistently labelled throughout the sequence
- **Forming** vs. **legacy** contrails
- For forming contrails, the corresponding **flight** is provided



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A *panoptic* segmentation approach to contrail detection and tracking



- Fine-tunned a cutting-edge **transformer** universal segmentation model with
  - Things: Contrails
  - Stuff: Sky
- Trivial extension to learn from sequences (**videos**)
- **All-in-one** contrail detection and tracking framework (and attribution?)

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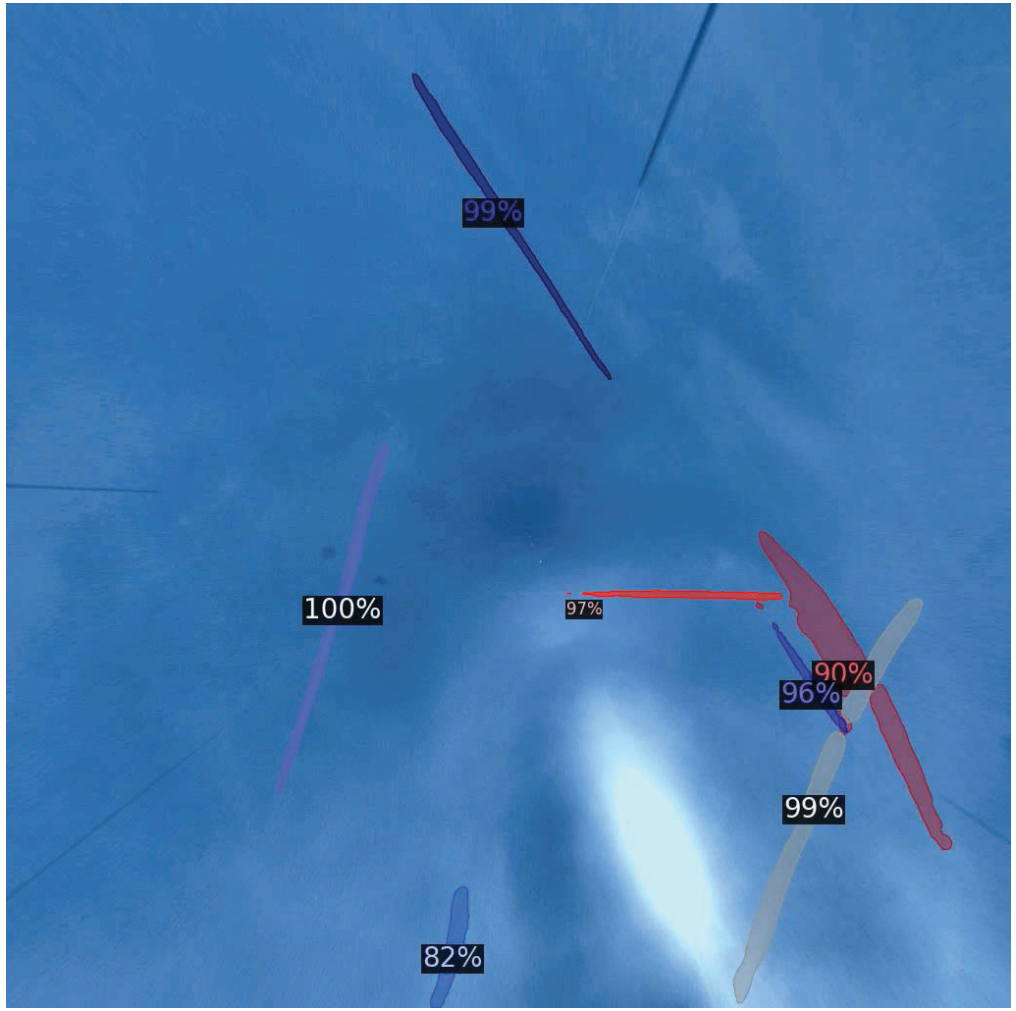
Early successes and ongoing research

- Learning from videos **outperformed** training on single frames
- Working on the flight **attribution** task
- To train the model on a labelled dataset of **satellite** observations
- To **collocate** ground-based camera and satellite observations
- To compare with (and calibrate / improve / complement) **physical** models



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Thank you!

ramon.dalmau-codina@eurocontrol.int
www.eurocontrol.int

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