Supporting European Aviation

EUROCONTROL

Artificial Intelligence and Sustainable Aviation

Can Artificial Intelligence help Aviation address Environmental and Societal issues?

Aviation Sustainability Unit
EUROCONTROL
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CONSORTIUM COORDINATOR sesar DEPLOYMENT MANAGER

FOUNDING MEMBER sesar JOINT UNDERTAKING

NETWORK MANAGER

Sustainable Aviation

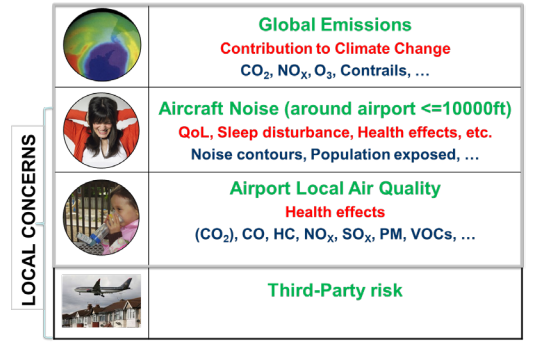
EUROCONTROL

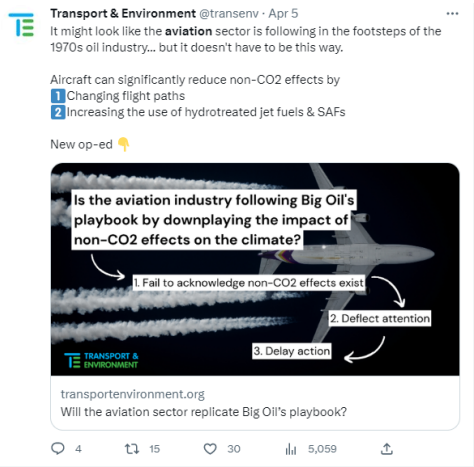
Aviation has an impact on the environment and society...

- Need to monitor and measure precisely these impacts (Noise, Pollution, Climate Change, …)

… but environmental and societal issues also have an impact on aviation

- Need to measure and accurately predict environmental impacts on aviation
- Need to better understand public sentiment regarding the aviation industry's environmental and societal impacts





Artificial Intelligence: A Key Enabler for a Greener, Sustainable Aviation Future

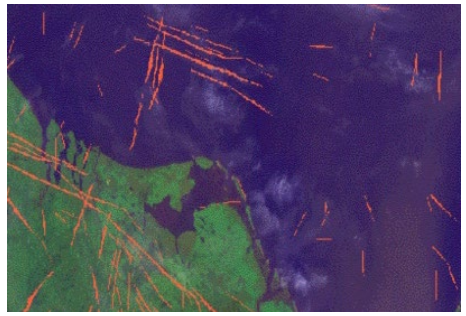
- **Observational Data and Computer Vision** techniques can improve environmental impact assessments

- **Machine Learning** can help estimate the impact of climate change on ATM … and the impact of aviation on environment

- **NLP and Information Retrieval** allow to better understand the public perception of aviation

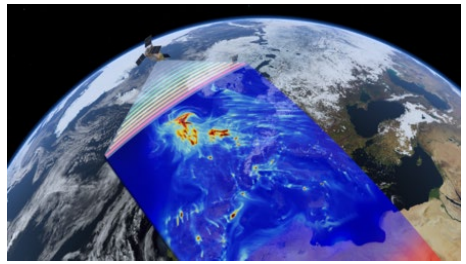
Observational Data and Computer Vision

Observational techniques complement the computations provided by physical models



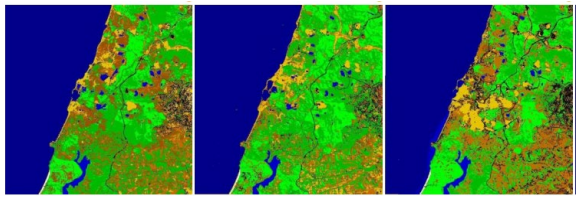
➢ Contrails Monitoring and Prediction

Monitor and predict contrail formation, and accurately measure climate impacts



➢ Atmospheric observation of pollutants

Measure atmospheric concentrations of pollutants (CO2; NOx; SOx …) and correlate observations with physical models

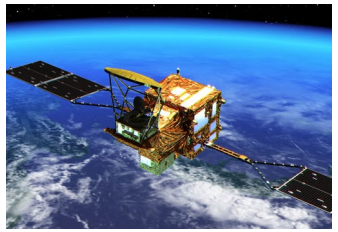


➢ Land Use Planning & Sea Level Rise

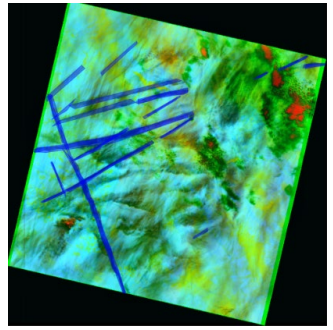
Monitor population living around airports and their exposure to noise levels and monitor and anticipate risks of extreme flooding events

Computer Vision and Contrail Observations

Detection and segmentation of contrails on images will play an important role in ongoing contrail mitigation efforts



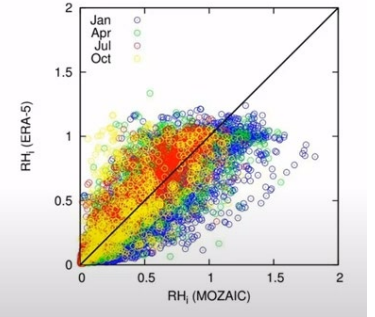
- Monitor of contrails and compute their environmental impact



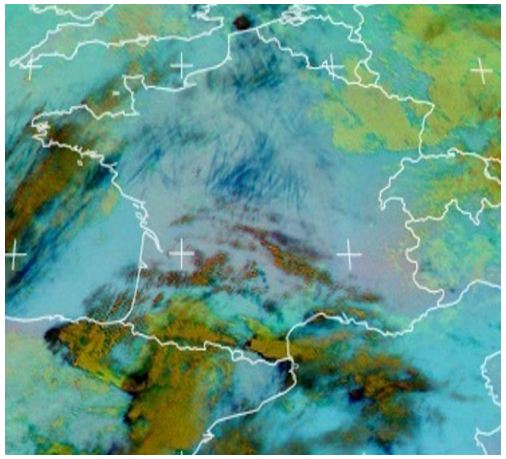
- Map of observed contrails to actual flights.

  Confirmation of the success of avoidance manoeuvres.

- Improve short-term contrail predictions as physical models are too limited by weather forecasts

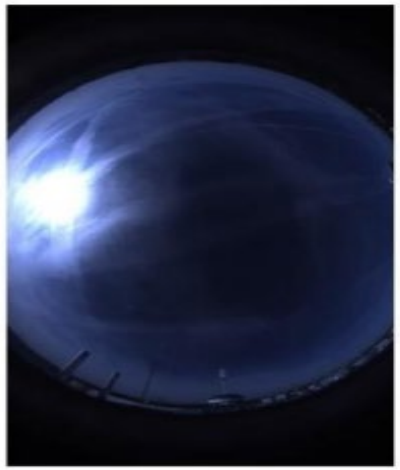


The Difficulty of the Contrail Segmentation Task



- The resolution of geostationary satellites (3-5 km/pixel) is coarse and leads to inaccuracies in detection results

- Ground based camera can be used as a benchmark to estimate the accuracy of satellite detection and better understand contrails formation

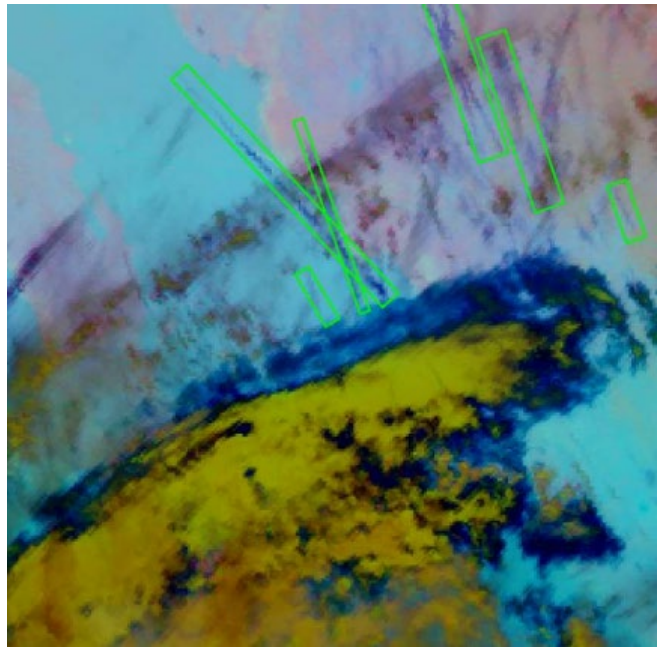


- Ongoing advances in Computer Vision (Fusion methods, Super-Resolution, …) could improve the performances of segmentation models.

A Data-Centric approach: Building a Contrail's Observation network

Providing open curated/labelled datasets of segmented contrails to the community is mandatory.

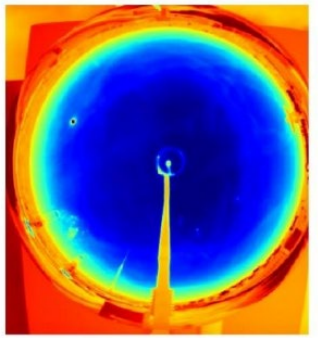
- Much of our effort this year will be devoted to organizing several labelling campaigns
  - ✓ Labelling images of ground base camera images
  - ✓ Labelling images of high-resolution Satellite images (MTG in Europe, Himawara in Asia)

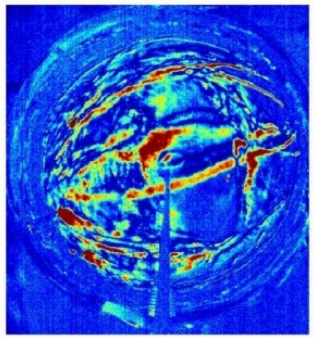


Ground Cameras at EUROCONTROL

EUROCONTROL has purchased a ground-based camera system (from REUNIWATT)

- A hemispheric camera in the visible range:
  - ✓ Daytime contrails are easy to identify (Cooling effect)
  - ✓ Wide-angle fish-eye lens monitors contrails over long-time scales
- A hemispheric camera in the LWIR range:
  - ✓ Contrails are also observed at night (Warming effect)
  - ✓ Efficient pre-processing to enhance contrast in relevant spectral bands
  - ✓ Calculations of the effective radiative forcing
- This composite system will serve as a benchmark and provide a better understanding of the early stage of persistent contrails formation





Assessing the Societal Perception of Aviation

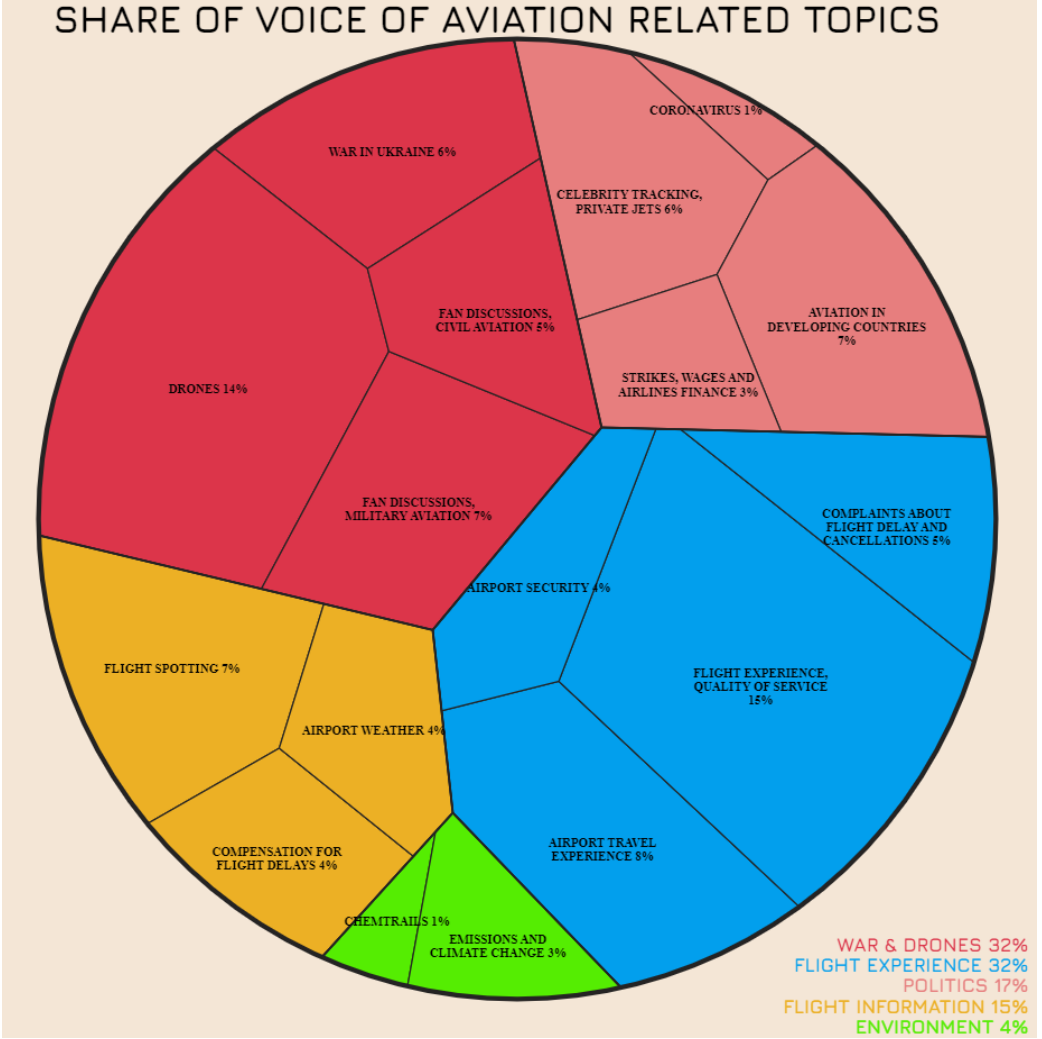
- What are the main aviation-related topics mentioned on the internet, research work and social networks (ex: Twitter)? Are environmental issues a growing topics of interest?

- The Classical (Pre-ChatGPT) NLP framework for exploring large text corpora is tedious:
  - ✓ Clustering a data sample to discover topics
  - ✓ Validating/Re-defining topics with experts
  - ✓ Launching a labelling campaign
  - ✓ Building a supervised algorithm

- Natural Language Processing advances allow to explore large text corpora more efficiently

Finding Topics with latest Language Models

- The results presented here are preliminary and based on a sample dataset (December 2022)
- Latest embeddings generation (ex: OpenAI GPT) lead to cleaner clusters (topics)
- LLMs engines and automatic prompting allow to interpret those clusters automatically
- Share of Voice for each topics (cluster) is then easily computed



Building your own EnvironementGPT