



# Efficient provision and use of meteorological information in ATM

## Overview from the Engage KTN

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Engage thematic challenge 3 workshop

SESAR JU, 13NOV18



Founding Members



EUROPEAN UNION



EUROCONTROL

# Efficient provision and use of meteorological information in ATM

## Overview



- Background on Engage and thematic challenges
  - interdisciplinary collaboration warmly welcome
- Context for thematic challenge 3
  - traffic – weather interaction
  - different information requirements
  - climate change impact
  - heads-up for the discussion session
- Wrap-up and next steps
  - funding opportunities

# Background on Engage and thematic challenges



# – the SESAR Knowledge Transfer Network

UNIVERSITY OF  
WESTMINSTER



**FREQUENTIS**



[engagektn.com](http://engagektn.com)

# Industry partners



Advanced Logistics Group (ALG)  
 AGIFORS - Airline Group of the International Federation of Operational Research Societies  
 Air Traffic Controllers European Unions Coordination (ATCEUC)  
 airBaltic  
 Airport Regions Conference (ARC)  
 American Airlines  
 ANS CR  
 Aslogic  
 Association for the Scientific Development of ATM in Europe (ASDA)  
 Autoridade Nacional da Aviação Civil (ANAC)  
 Barcelona Supercomputing Center (BSC)  
 Belgocontrol  
 Boeing Research and Technology Europe (BR&T-Europe)  
 Bundesaufsichtsamt für Flugsicherung (BAF)  
 Civil Aviation Authority (CAA)  
 COOPANS Consortium  
 Department for Transport (UK)  
 Direction des Services de la Navigation Aérienne (DSNA)  
 Direktorat civilnog vazduhoplovstva Republike Srbije (DCV)  
 European Meteorological Services Network (EUMETNET)  
 European Passengers' Federation (EPF)  
 Executive Airlines  
 Ferrovial Agroman  
 Finnair  
 FlightGlobal  
 Flughafen München / Munich Airport  
 Gestair SL  
 Helios  
 HEMAV - High Endurance Multipurpose Aerial Vehicles  
 Honeywell Aerospace  
 HungaroControl  
 Icelandair  
 IFSTTAR - Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux  
 INFORM - Institut für Operations Research und Management GmbH  
 International Air Transport Passenger Association (IATPA)  
 International Federation of Air Traffic Controllers' Associations (IFATCA)  
 Irish Aviation Authority (IAA)  
 LFV - Luftfartsverket  
 London Luton Airport  
 Lufthansa Systems  
 Manchester Airport  
 NATS  
 Navair  
 Network Manager - nominated by the European Commission  
 NEXTOR II Consortium - University of California, Berkeley and University of Maryland  
 PACE Aerospace Engineering & Information Technology  
 Pegasus Airlines  
 QinetiQ Ltd  
 Raytheon UK  
 Sabre Airline Solutions  
 SWISS - Swiss International Air Lines  
 Thomas Cook Airlines  
 TÜBİTAK - The Scientific and Technological Research Council of Turkey  
 Turkish Airlines

# The Engage KTN

## Overview



## Key features and objectives (2018-2021)

- Better integrate more applied/industrial & exploratory research (two-way process)
  - mutual benefit, integrated into the fabric, funded; interdisciplinary
- Education and training: future ATM skilled workforce
  - “develop new talent with a deep knowledge of the future ATM scientific research needs ... stimulating the next generation of ATM staff”
  - PhD and graduate thesis Call (appx. €1m, open until 01NOV18)
  - 3 summer schools (2019: Belgrade); ATC training courses; lecture progs
  - SESAR Innovation Days (03-07DEC18, University of Salzburg)
- Knowledge hub as a ‘go-to’ source, single point of entry for ATM knowledge
  - popular demand: improved search functionality; consolidated repository
- Not only larger concepts, but sum of large number of support actions
  - multiple grants; ‘light touch’

free  
of charge

thematic  
challenges

# Thematic challenges and workshops

## Overview

[HOME](#)[ABOUT](#)[KNOWLEDGE HUB](#)[PARTICIPATE](#)[EVENTS](#)[CONTACTS](#)

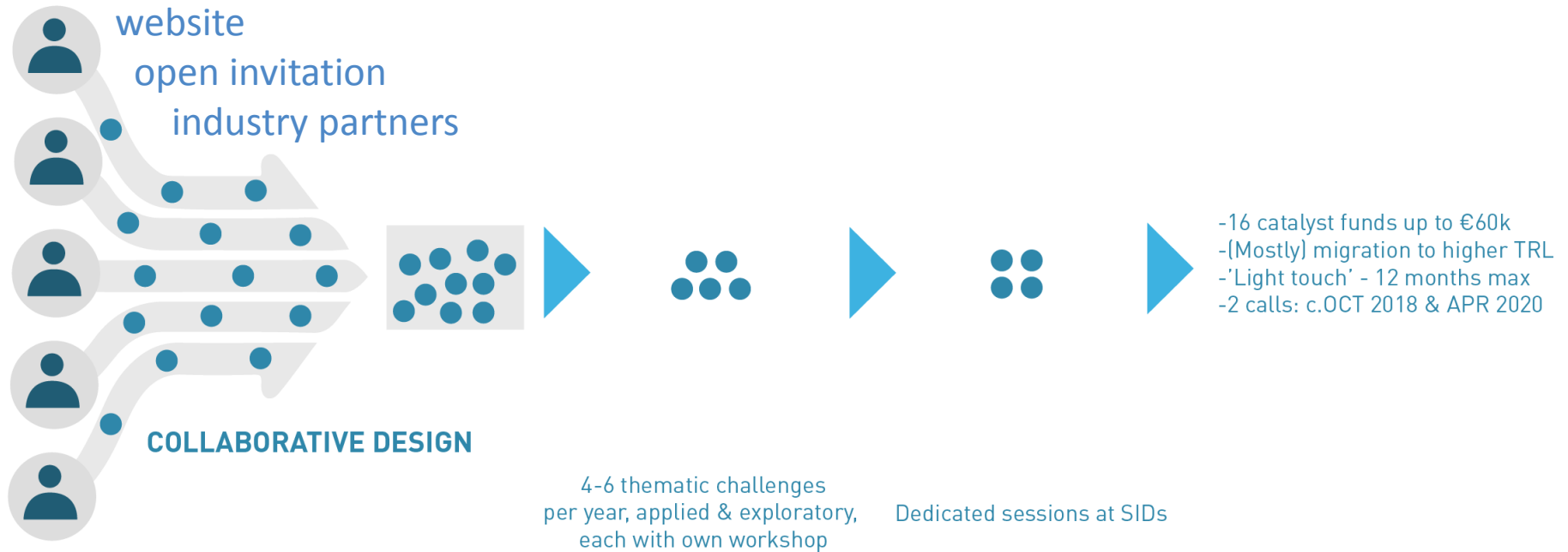
## Engage Thematic Challenges

At the core of the KTN is the definition of various thematic challenges: new ideas suggested by the research community, not already included within the scope of an existing SESAR project. They are developed along with the ATM concepts roadmap and complementarily with some of the network's PhDs and theses.



# Thematic challenges and workshops

## Overview



- Thematic challenges at core: applied-orientation; help to mature exploratory research
- Industry partners: willingness to share information and data
- Each challenge has (a) dedicated workshop(s)
- Selected challenges may be investigated further through, e.g.:
  - (1) Engage catalyst funding (NB. consortium members ineligible), Call published by 16NOV18
  - (2) Engage PhDs/theses



## Thematic challenge 1 – Vulnerabilities and global security of the CNS/ATM system

**Workshop:** Date/location TBC – Bringing together the ATM community and security experts to enable a more privacy-preserving, cyber-resilient, fault-tolerant and secure ATM system.



CNS/ATM components (e.g., ADS-B, SWIM, datalink, Asterix) of the current and future air transport system present vulnerabilities that could be used to perform an 'attack'. Further investigations are necessary to mitigate these vulnerabilities, moving towards a cyber-resilient system, fully characterising ATM data, its confidentiality, integrity and availability requirements. A better understanding of the safety-security trade-off is required. Additional security assessments for legacy systems are also needed to identify possible mitigating controls in order to improve cyber-resilience without having to replace and refit. Future systems security by design is essential: a new generation of systems architectures and applications should be explored to ensure confidentiality, cyber-resilience, fault tolerance, scalability, efficiency, flexibility and trust among data owners. Collaborative, security-related information exchange is essential to all actors in aviation. This is specially challenging in a multi-stakeholder, multi-system environment such as ATM, where confidentiality and trust are key.

[Fuller text here](#)

# Thematic challenges and workshops

## Thematic challenge 2 – Data-driven trajectory prediction

**Workshop:** 06 November 2018, Universitat Politècnica de Catalunya (UPC), Barcelona, Spain – ATM stakeholders and data scientists discussing the airspace users' needs, methodologies and benefits of improved trajectory prediction.

**Draft programme here.** Please use the [contacts](#) page to register.

Accurate and reliable trajectory prediction (TP) is a fundamental requirement to support trajectory-based operations. Lack of advance information and the mismatch between planned and flown trajectories caused by operational uncertainties from airports, ATC interventions, and 'hidden' flight plan data (e.g., cost indexes, take-off weights) are important shortcomings of the present state of the art. New TP approaches, merging and analysing different sources of flight-relevant information, are expected to increase TP robustness and support a seamless transition between tools supporting ATFCM across the planning phases. The exploitation of historical data by means of machine learning, statistical signal processing and causal models could boost TP performance and enhance the TBO paradigm. Specific research domains include machine-learning techniques, the aggregation of probabilistic predictions, and the development of tools for the identification of flow-management 'hotspots'. These could be integrated into network and trajectory planning tools, leading to enhanced TP.

[Fuller text here](#)

## Thematic challenge 3 – Efficient provision and use of meteorological information in ATM

**Workshop:** 13 November 2018, SESAR Joint Undertaking (SJU), Brussels, Belgium – Atmospheric scientists and ATM stakeholders shaping a more efficient provision and use of meteorological information in future aviation.

**Draft programme here.** Please use the [contacts](#) page to register.



The main objective of this challenge is to improve overall ATM system performance by providing better user-support tools based on improved meteorological ('met') products. The focus is on the synergy of several methods and techniques in order to better meet the needs of operational users and to support aviation safety (e.g., through creating early warning systems) and regulation-makers (e.g., moving from text-based to graphical information provision). All stakeholders may benefit from this synergy: ANSPs (e.g., sector reconfiguration and separation provision), airlines (e.g., storm avoidance), airport operators (e.g., airport management under disruptive events), and the Network Manager (e.g., demand-capacity balancing). The challenge is, therefore, to bring the following perspectives closer: (a) for meteorological/atmospheric science, the development of products tailored to ATM stakeholders' needs, which are unambiguous and easy to interpret; (b) for stakeholders, the identification of the most suitable information available and its integration into planning and decision-making processes.

[Fuller text here](#)

## Thematic challenge 4 – Novel and more effective allocation markets in ATM

**Workshop:** 25 October 2018, University of Westminster (UoW), London, UK – A range of speakers from the behavioural sciences, economics, and ATM, debating approaches to improved modelling and methods in this new interdisciplinary area.

**Final programme here.** Please use the [contacts](#) page to register.



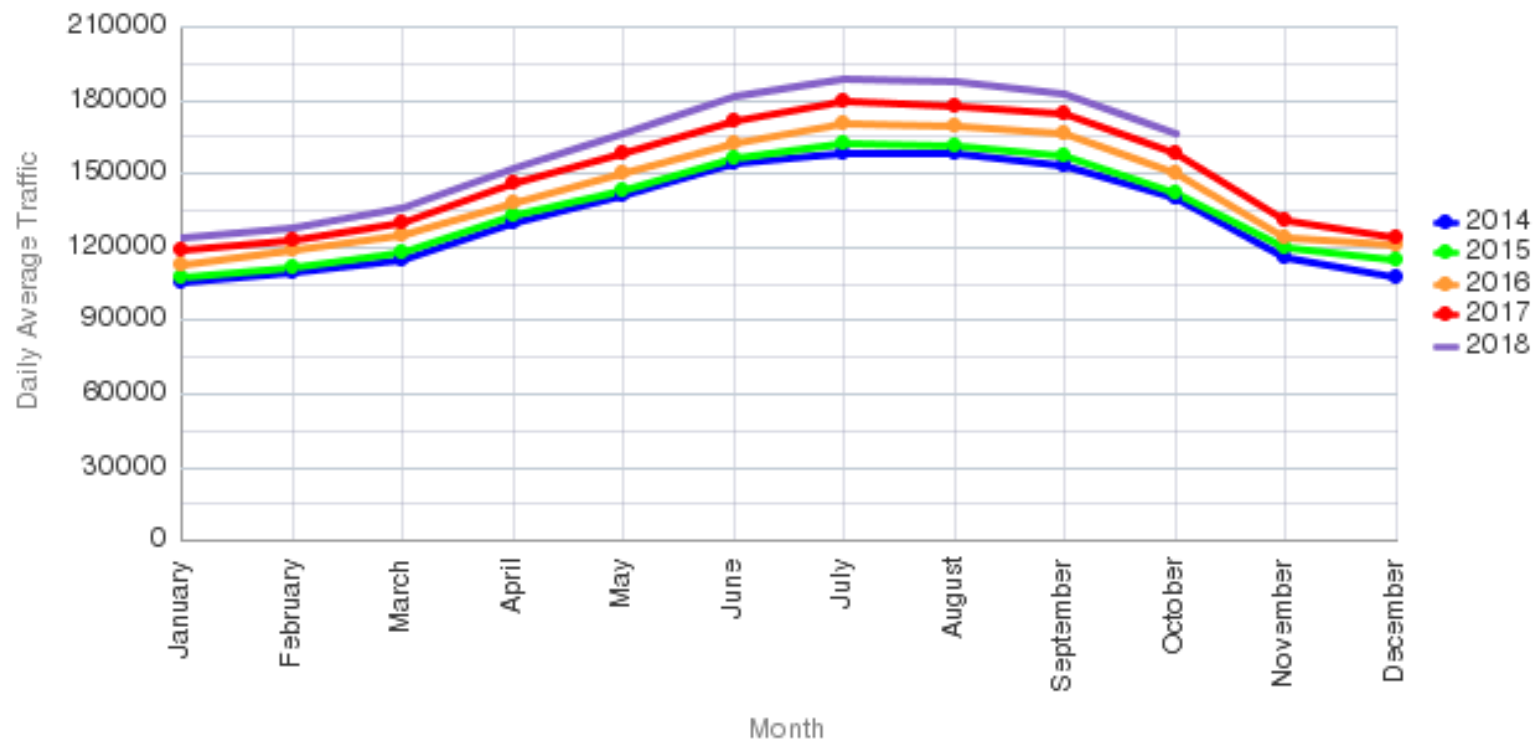
This research explores the design of new allocation markets in ATM, taking into account real stakeholder behaviours. It focuses on designs such as auctions and ‘smart’ contracts for slot and trajectory allocations. It seeks to better predict the actual behaviour of stakeholders, compared with behaviours predicted by normative models, taking into account that decisions are often made in the context of uncertainty. Which mechanisms are more robust against behavioural biases and likely to reach stable and efficient solutions, equitably building on existing SESAR practices? The research will address better modelling and measurement of these effects in ATM, taking account of ‘irrational’ agents such as airline ‘cultures’. A key objective is to contribute to the development of improved tools to better manage the allocation of resources such as slots and trajectories, and incentivising behaviour that benefits the network – for example by investigating the potential of centralised markets and ‘smart’ contract enablers.

[Fuller text here](#)

## Context for thematic challenge 3

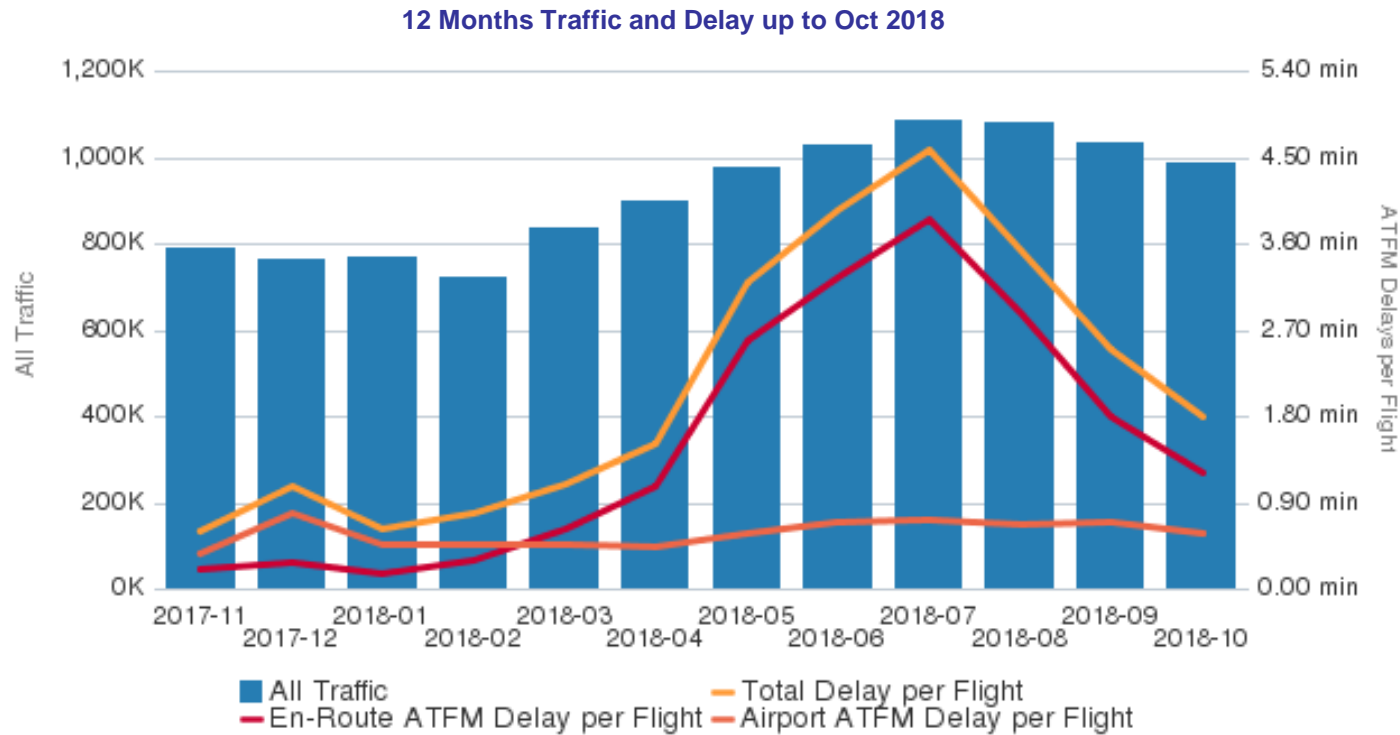
# Context for thematic challenge 3

Network Traffic Evolution Per Month (Daily Averages)



Source: EUROCONTROL's Network Dashboard

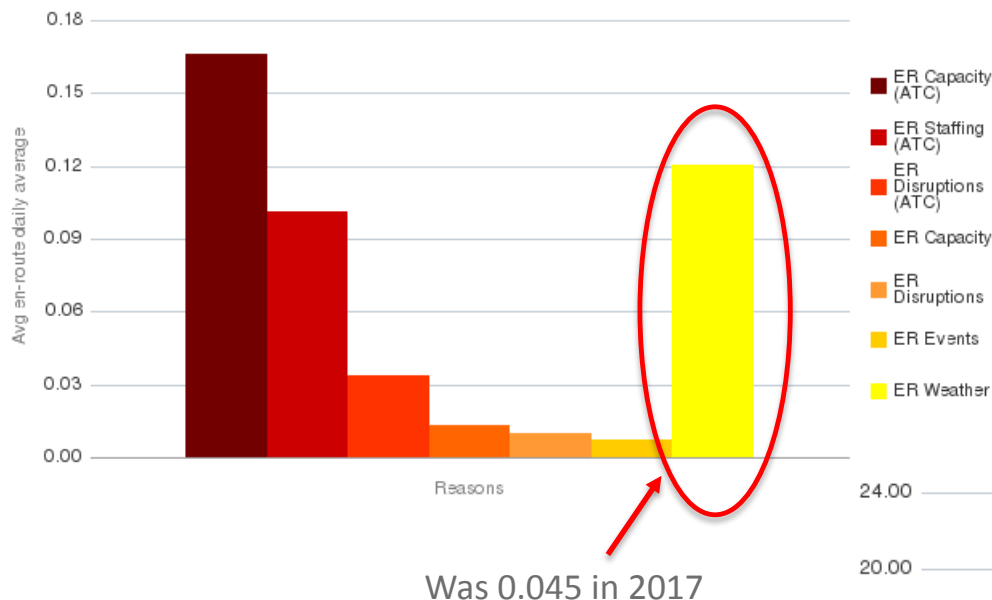
# Context for thematic challenge 3



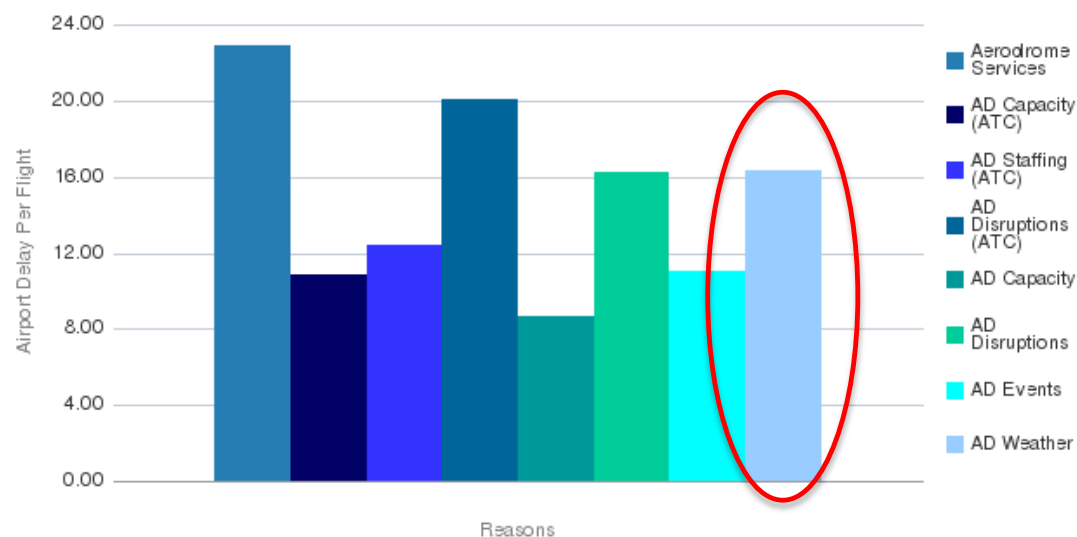
Source: EUROCONTROL's Network Dashboard

# Context for thematic challenge 3

Reasons -YTD Delay per flight up to Oct 2018



Reasons - YTD Delay Per Flight delay up to Oct 2018



Source: EUROCONTROL's Network Dashboard



# Context for thematic challenge 3

- Airports – different conditions (e.g. rain, fog, snow) can cause capacity reductions and even closures of airports;
- En-route – winds impact aircraft speed, weather cells can cause ANSPs to change flights' trajectories, etc;
- Airlines – trajectory changes, delays and schedule disruption occur, resulting in various types of cost (e.g. passenger reaccommodation);
- Network level – the Network Manager coordinates and circulates the information to all stakeholders regarding local weather impacts on flow management, without taking decisions on local weather related actions, apart from facilitating network-level harmonisation;
- An overarching, reliable and shared view on weather is still not in place in the European network
- USA – Aviation Weather Center and decision support tools

# Context for thematic challenge 3



- High intensity and extreme precipitation are expected to become more frequent in Europe
- There is a suggestion of a significant increase in cyclone intensity and the number of intense cyclones over northwest, central and western Europe, under future climate conditions
- Improvements in the observations and NWP models :
  - LIDARs, satellites (several dedicated to atmospheric observations)
  - models for air quality in megacities that consider topography and resolution of under 100m
  - data assimilation techniques use in NWP

# Context for thematic challenge 3

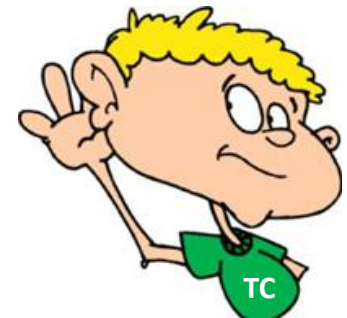


- The initial step towards delivering the improved met information needed for more efficient air traffic management consists;
  - learning about improvements in the atmospheric sciences, and
  - learning about ATM needs in the light of the uncertainty that weather imposes on the network (and related uncertainty management) and,
  - associated regulatory issues.

## Heads-up for the discussion session

# Heads-up for the discussion session

- We are going to ask you to suggest:
  - what **specific follow-up research** is likely to be useful to **mature the state of the art** (incl. flagging what may be addressed by catalyst funding)
  - what **measures of success** could be used to assess progress of challenge:
    - **short-term:** wholly within catalyst-funded project
    - **longer-term:** outside/beyond such a project (could be *identified* within it)
  - what are **likely barriers** to prevent progress towards maturing challenge – how might we overcome them?
- **listening mode:** to refine (dynamic) challenge text



# Housekeeping

## Wrap-up and next steps

# Wrap-up and next steps



[engagektn.com](http://engagektn.com)

## Conclusions from discussion

## Next steps

- refresh the challenge text and re-publish
- presentations on the website
- catalyst funding Call (by 16NOV18; SESAR e-news)
- maturing from exploratory to applied-orientation
- up to €60k, 12 months, 'light touch' (also 'open')
- presentation at the SESAR Innovation Days
- posters; consortium members available
- feeds final stages of ER4 Call (appx.€40M; Q1 2019)





# Novel and more effective allocation markets in ATM

## Overview from the Engage KTN

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# Thank you



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Founding Members



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