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Community Research

International Air Safety & Climate change conference

08-09 September 2010, Koln, EASA

Aviation and climate threats

a EU RTD perspective

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Directorate 'Transport', Directorate-General for Research

European Commission



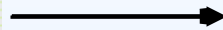


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a general perspective

Raise risk awareness



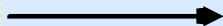
Are we aware of the problem?

Identify threats



What do we know about the threats with regards to the sustainability of the air transport system?

Assess risks



What should we address in priority ?

Treat risks



What should we do next ?



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a general perspective

Raise risk awareness



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a general perspective

Raise risk awareness



European
Commission
President
José Manuel
Barroso

*(From :Political Guidelines to the next
Commission, Brussels, 3 Sept. 2009)*

*“ the next commission needs to maintain the momentum towards a **low emission economy**, and in particular towards **decarbonising** our electricity supply and the transport sector – all transports, including maritime transport and **aviation**, as well as the development of clean and electric cars. (...)*

... not just about lessening our future impact on our climate.

*We also **need to deal with the legacy of past emissions** and the climate change that they will inevitably bring. Each and every Community policy will need to be assessed and if necessary adapted in the light of climate change (...)*

*I intend to launch a major initiative to help the EU anticipate the changes that need to be made (...). This work will involve marshalling all the necessary **scientific and economic data** that exists to help the EU to adapt its policies to the challenge of climate change.”*



EC potential inputs

Directorate General for Research

Directorate H: Transport, Unit 'Aeronautics'
Directorate I: Environment
(Framework Programme)

The best **BRAINS** in Europe
solving tomorrow's problems **today**



Directorate General for Mobility and Transport

Directorate F: Air Transport
(SES: Single European Sky)



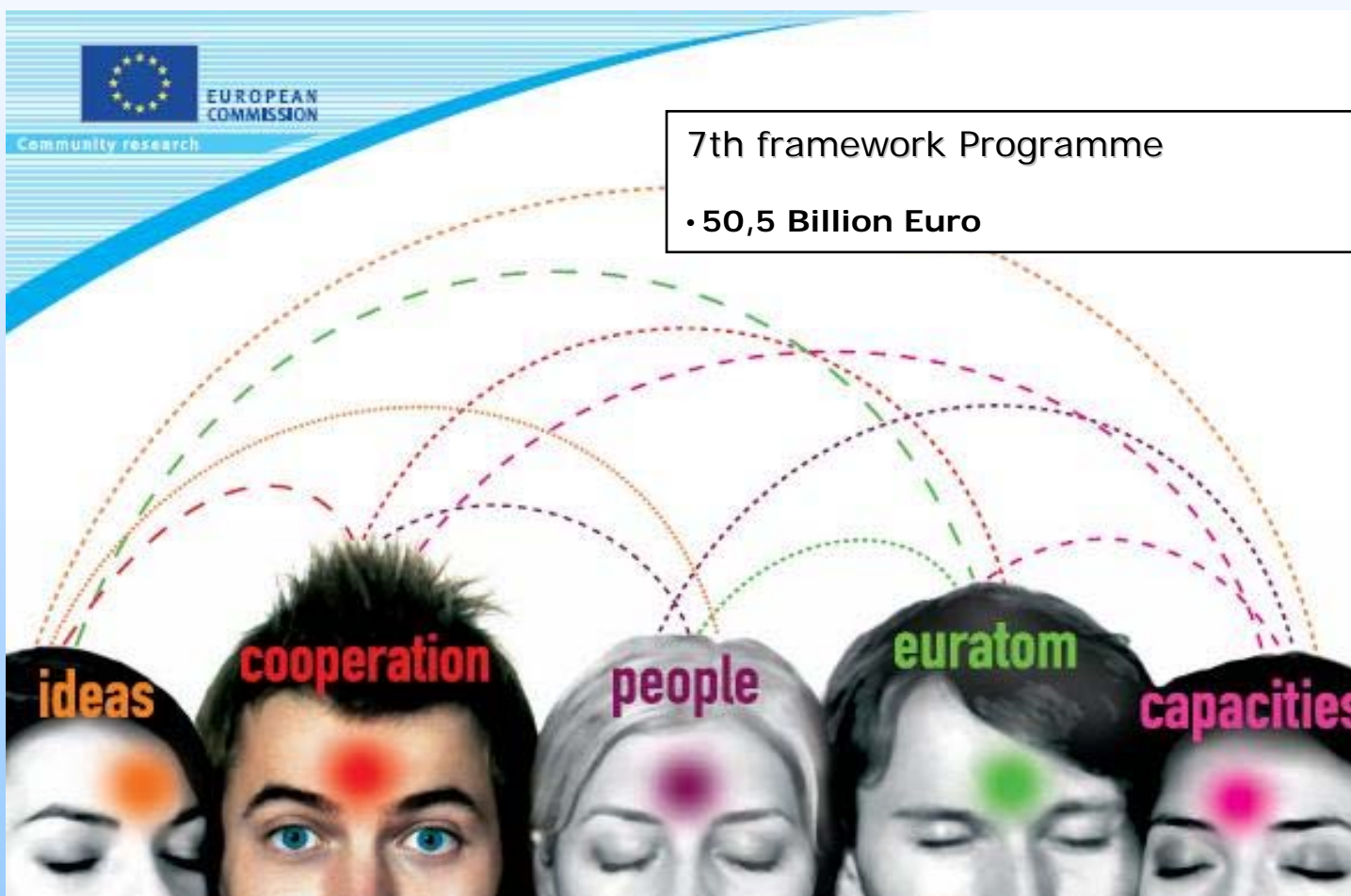
Directorate General Environment

Directorate C: Climate Change
(ETS: European Trading Schemes)



EC potential inputs

EU research activities - main funding instruments

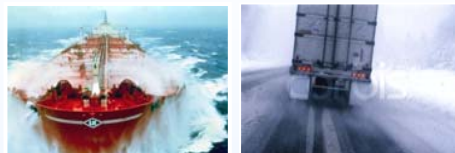




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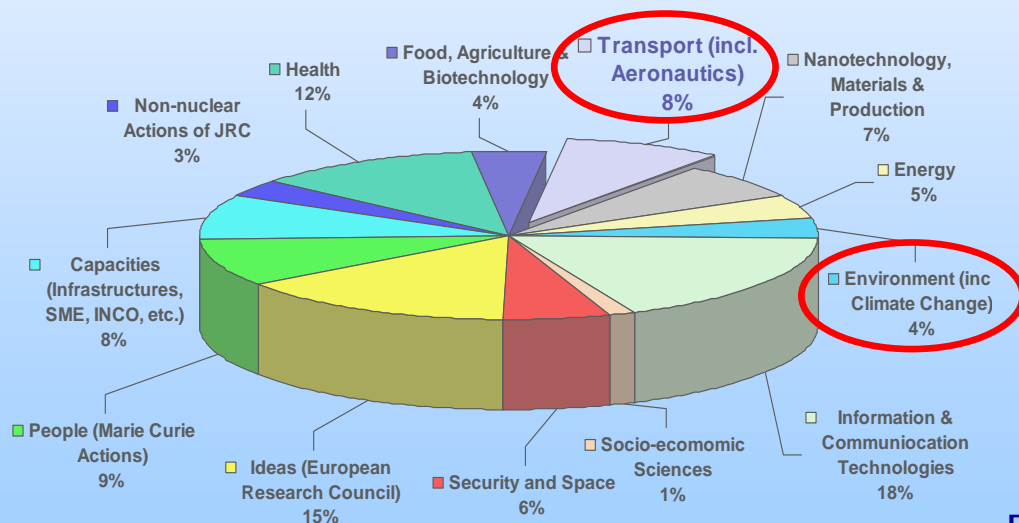
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EC potential inputs



Research on Transports (all modes)

(includes Air transport research & cross-cutting activities)



Environment
(including Climate change)

Research on Environment (all sectors)

(includes climate change, adaptation strategies and transport emissions)





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Exploring threats and vulnerabilities

Identify threats



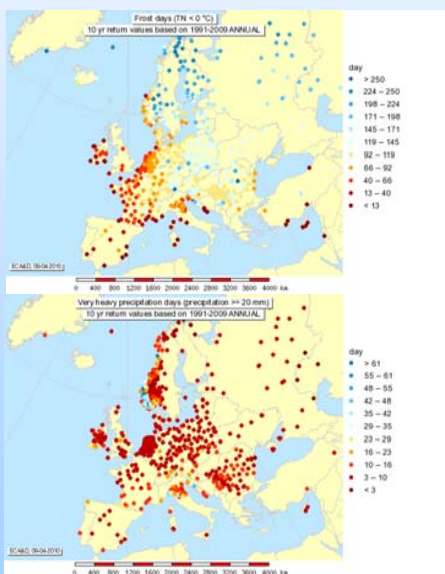
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Exploring threats and vulnerabilities

Environment
(including Climate change)

Transport



Extreme weather events...

(source FP6 project **Climate change** ENSEMBLES)

...a threat for aviation

(source FP6 project **Air transport** FLYSAFE)





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Exploring threats ...

Environment
(including Climate change)



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Exploring threats ...

Environment

(including Climate change)

I. Climate Processes, Observations and Projections

Global trends observations and modelling -- monitoring of tipping points and key climatic phenomena (Arctic glaciers, monsoons cycles, El niño,...)

I. Focussed analyses

- i. Global Carbon and Nitrogen Cycles — Greenhouse Gas Emissions
(incl. support to ETS policy making)
- ii. Climate Interactions with Stratospheric Ozone *(incl. assessment of aviation impact on ozone depletion)*
- iii. Climate Interactions with Atmospheric Composition Change *(incl. air quality assessment issues)*

II. Climate Change Impact

Regional or thematic analyses -- priority questions, (e.g. water supply, biodiversity, land use, sea level rise), incl. transports impact assessment

I. Climate Change related Natural Hazards and Extreme Events

Infrastructure for Observation, detection and alerting (incl. through GMES and volcanic activity), vulnerability assessment methodologies, lessons learned from 2003 heat wave, Hurricanes, tsunamis events

I. Climate Change Adaptation, Mitigation and policies

Macro-economic analyses (ETS) -- stimulation of international cooperation – assessment of technology-based mitigations – societal challenges and change management – priority areas like agriculture, forestry

Enough evidence have been gathered to justify policy action on climate change, but knowledge needs to progress further on the understanding of the climate system, on the evaluation of the impacts and on the identification and assessment of options for mitigation and adaptation assess.

research activities on Climate

(about 600 M€ from FP6&FP7 invested)



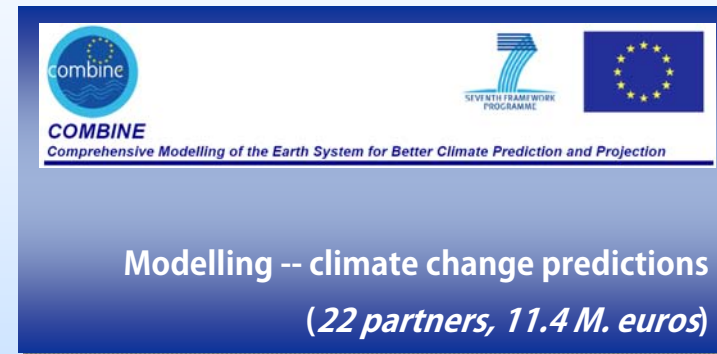


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Exploring threats ...

Environment
(including Climate change)



Climate Change 2007: Synthesis Report

Analysing and monitoring changes in extreme events, including drought, tropical cyclones, extreme temperatures and the frequency and intensity of precipitation, is more difficult than for climatic averages as longer data time-series of higher spatial and temporal resolutions are required.

Technical Summary Working Group I Report of the TAR :

"Recent analyses of changes in severe local weather (e.g., tornadoes, thunderstorm days, and hail) in a few selected regions do not provide compelling evidence to suggest long-term changes. In general, trends in severe weather events are notoriously difficult to detect because of their relatively rare occurrence and large spatial variability."





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Exploring threats ...

Environment

(including Climate change)

How can transport impact climate ?

Changes in radiative forcing can be caused by

- the emission of greenhouse gases, including long-lived species like CO₂ and N₂O, but also of water vapour;
- the emission of ozone precursors, like NO_x;
- the emission of particles and their precursors;
- triggering additional clouds (e.g., contrails, contrail cirrus) and by modifying natural clouds (e.g., ship tracks).

included in the
Kyoto Protocol,
apart from
water vapour

short-lived
effects NOT
included in the
Kyoto Protocol,
but of particular
importance for
aviation and
shipping



ATTICA

(9 partners, 0.7 M. euros)

European assessment of the Transport
Impacts on Climate Change and Ozone
Depletion



QUANTIFY

(41 partners, 12.8 M. euros)

Quantifying the Climate Impact of global and
European Transport Systems



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... and vulnerabilities

Transport





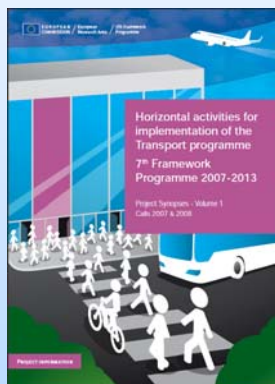
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research activities on all
transports



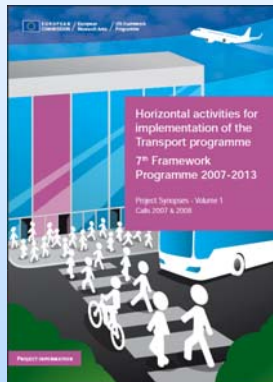


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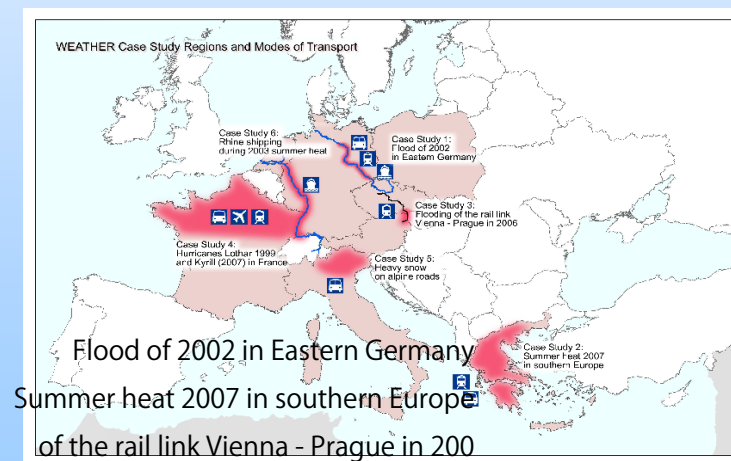
research activities on all
transports





WEATHER
(8 partners, 2 M Euros)

Weather Extremes: Assessment of Impacts on Transport Systems and Hazards for European Regions



Flood of 2002 in Eastern Germany

Summer heat 2007 in southern Europe

of the rail link Vienna - Prague in 2006

Hurricanes Lothar 1999 and Kyrill (2007) in France

Heavy snow on alpine roads

Rhine shipping during 2003 summer heat

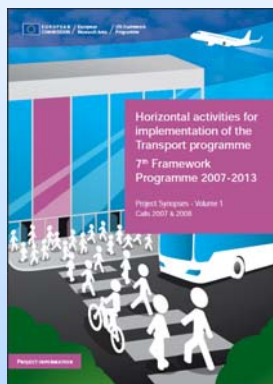




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research activities on all
transports



... and vulnerabilities





EWENT

(8 partners, 1.9 M Euros)

**Extreme Weather impacts on European
Networks of Transport**

Modal coverage

| Depth of analysis | Aviation | | Land transport | | | | | Marine & waterways | | |
|-------------------|-----------|---------|----------------|---------|-----------|---------|-------|--------------------|--------------------|-------------------|
| | Passenger | Freight | Road | | Rail | | Light | Ocean | Short sea /coastal | Inland ww Freight |
| | | | Passenger | Freight | Passenger | Freight | | | | |
| Detailed | X | X | X | X | X | X | | | | X |
| Brief | | | | | | | X | | X | |
| Excluded | | | | | | | | X | | |

The transport system is viewed from three angles:

- **infrastructure**; these are direct material damages or deterioration of physical infrastructures
- **operations**; these are harmful impacts on traffic safety and transport reliability (both freight and passenger)
- **indirect impacts to third parties**, e.g. supply chain customers and industrial actors.



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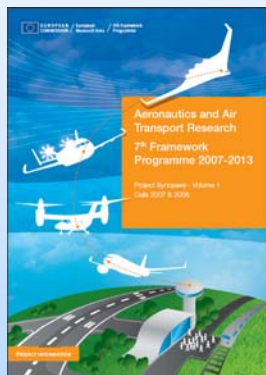
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research activities on Air transport

(about 2 Billion Euros for FP7)





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... and vulnerabilities

Transport



| | visibility | turbulence | Wind shear | Particles | Hail – Heavy rain | Snow - Ice | Thunder- storms | (Env impact) |
|--------------------------|------------|------------|------------|-----------|----------------------|------------|--------------------|-----------------|
| Flight Physics; | | | | | | | | |
| - Aero-structures; | | | | | | | | |
| - Propulsion; | | | | | | | | |
| - Systems / Equipment; | | | | | | | | |
| - Avionics; | | | | | | | | |
| - Design Tools; | | | | | | | | |
| - Production; | | | | | | | | |
| - Maintenance; | | | | | | | | |
| ATM / Flight Management; | | | | | | | | |
| - TMA / Airports; | | | | | | | | |
| - Human Factors. | | | | | | | | |

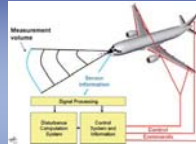


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... and vulnerabilities

GREEN-WAKE (11 partners, 3 MEuros)



LIDAR-based wake vortex detection system
incorporating an Atmospheric Hazard Map —



| | visibility | turbulence | Wind shear | Particles | Hail – Heavy rain | Snow - Ice | Thunder- storms | (Env impact) |
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... and vulnerabilities

DELICAT (11 partners, 5.6 Meuros)

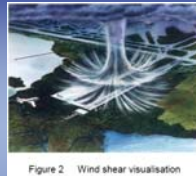


Figure 2 Wind shear visualisation

DEmonstration of **L**idar-based Clear Air
Turbulence detection



| | visibility | turbulence | Wind shear | Particles | Hail – Heavy rain | Snow - Ice | Thunder- storms | (Env impact) |
|--------------------------|------------|------------|------------|-----------|----------------------|------------|--------------------|-----------------|
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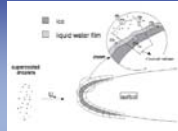


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EXTICE- EXTreme ICing Environment (13 partners, 4.2Me)

(super-cooled large droplets (SLD))



decrease in time and costs for aircraft design and certification; more reliable icing simulation tools for industry.

... and vulnerabilities



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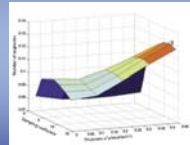


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ARTIMA

Aircraft Reliability Through Intelligent
Materials Application



Smart materials, auto-repair

... and vulnerabilities



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ALICIA

All conditions operations and
cockpit architecture

(43 partners, 47 MEuros)

... and vulnerabilities



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... and vulnerabilities



FLYSAFE

Airborne Integrated Systems for Safety Improvement, Flight Hazard Protection and All Weather Operations

(36 partners, 52MEuros)



| | visibility | turbulence | Wind shear | Particles | Hail – Heavy rain | Snow - Ice | Thunder- storms | (Env impact) |
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SESAR

Single European Sky ATM Research

(PPP, 2.1 B euros)

... and vulnerabilities



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CLEAN SKY

Large Scale demonstration

(about 100 permanent partners (+500 ad-hoc),
7 years, PPP, 1.6MEuros)

... and vulnerabilities

Transport



| | visibility | turbulence | Wind shear | Particles | Hail – Heavy rain | Snow - Ice | Thunder- storms | (Env impact) |
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Early observations

- Weather is an integrated constraint in air transport
- The aviation RTD community endeavours to find new solutions for better mitigating this constraint
 - ✓ With promising and quite well advanced works on *inter-alia* low visibility operations and icing conditions
 - ✓ With Increased aircraft autonomy in detecting & avoiding weather obstacles
 - ✓ With Significant efforts for improving air traffic management systems and processes related to weather





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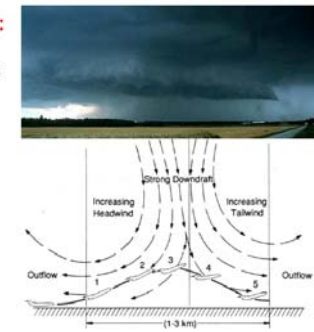
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- Extreme conditions constitute serious threats to the safety of air transport
 - ✓ Where « detect and avoid » is the rule
 - ✓ Where large-scale threats management is transferred to the ATM system and can possibly disrupt operations



Cb's pose a threat to aviation:

- wind shear & turbulence
- lightning stroke
- hail
- icing
- heavy rain
- visibility





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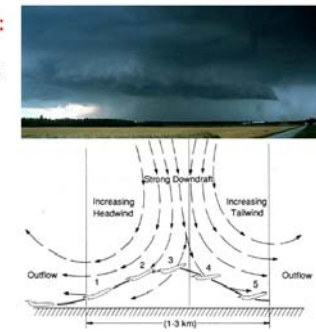
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 - ✓ With Increased aircraft autonomy in detecting & avoiding weather obstacles
 - ✓ With Significant efforts for improving air traffic management systems and processes related to weather
- Extreme conditions constitute serious threats to the safety of air transport
 - ✓ Where « detect and avoid » is the rule
 - ✓ Where large-scale threats management is transferred to the ATM system and can possibly disrupt operations
- Future trends on severity and frequency of severe weather episodes is still difficult to establish
 - ✓ Yet, a lot of efforts are put into further developing the capabilities of forecasting, anticipating and alerting
 - ✓ Worse case scenario may provoke increased concern on air transport business continuity



Cb's pose a threat to aviation:

- wind shear & turbulence
- lightning stroke
- hail
- icing
- heavy rain
- visibility



| WEATHER PHENOMENA | EFFICIENCY | | | SAFETY | | |
|----------------------|------------|----------|------|--------|----------|------|
| | strong | moderate | weak | strong | moderate | weak |
| Visibility | strong | | | strong | | |
| In-flight icing | | moderate | weak | strong | | |
| Wind | strong | | | | moderate | |
| Thunderstorms | strong | | | strong | | |
| Turbulence | | | weak | | moderate | |
| Snow and ice | | moderate | | | moderate | |
| Volcanic ash | | | weak | strong | | |
| Sandstorms | strong | moderate | weak | strong | | |
| Wake vortices | strong | | | | moderate | |



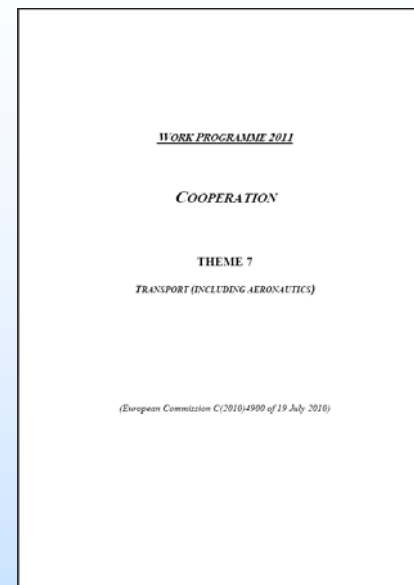
Way forward

CALL FOR COORDINATED RTD ACTION

Technology support for crisis coordination for the air transport system following major disrupting events

- cases of incidences and events with potential effects on a large geographic scale and with high safety requirements and a business driven approach as in air transport.
- incl. volcanic eruptions, earthquakes, **unusual weather conditions**, etc., as well as incidents resulting from human activities such as nuclear and other incidents/accidents, and terrorist attacks.
- **compile an inventory of recent and ongoing R&D activities** within relevant areas, and financed through different programmes at EU level (FP5/6/7, environment, space/GMES, aeronautics, security, etc.) as well as at national level, and within relevant institutions, such as ESA and Eumetsat.
- support to policy making and delivery of a R&D roadmap.

Open in call: FP7-AERONAUTICS and AIR TRANSPORT (AAT)-
2011-RTD-1





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Thank you

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<http://cordis.europa.eu/fp7/transport/>