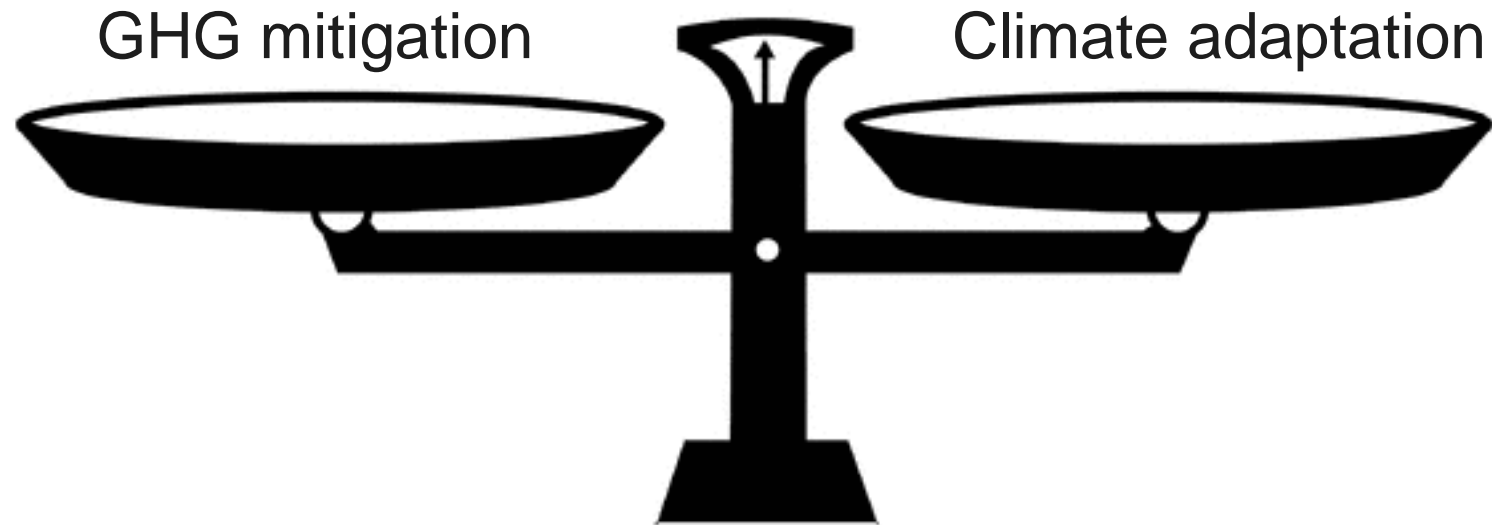


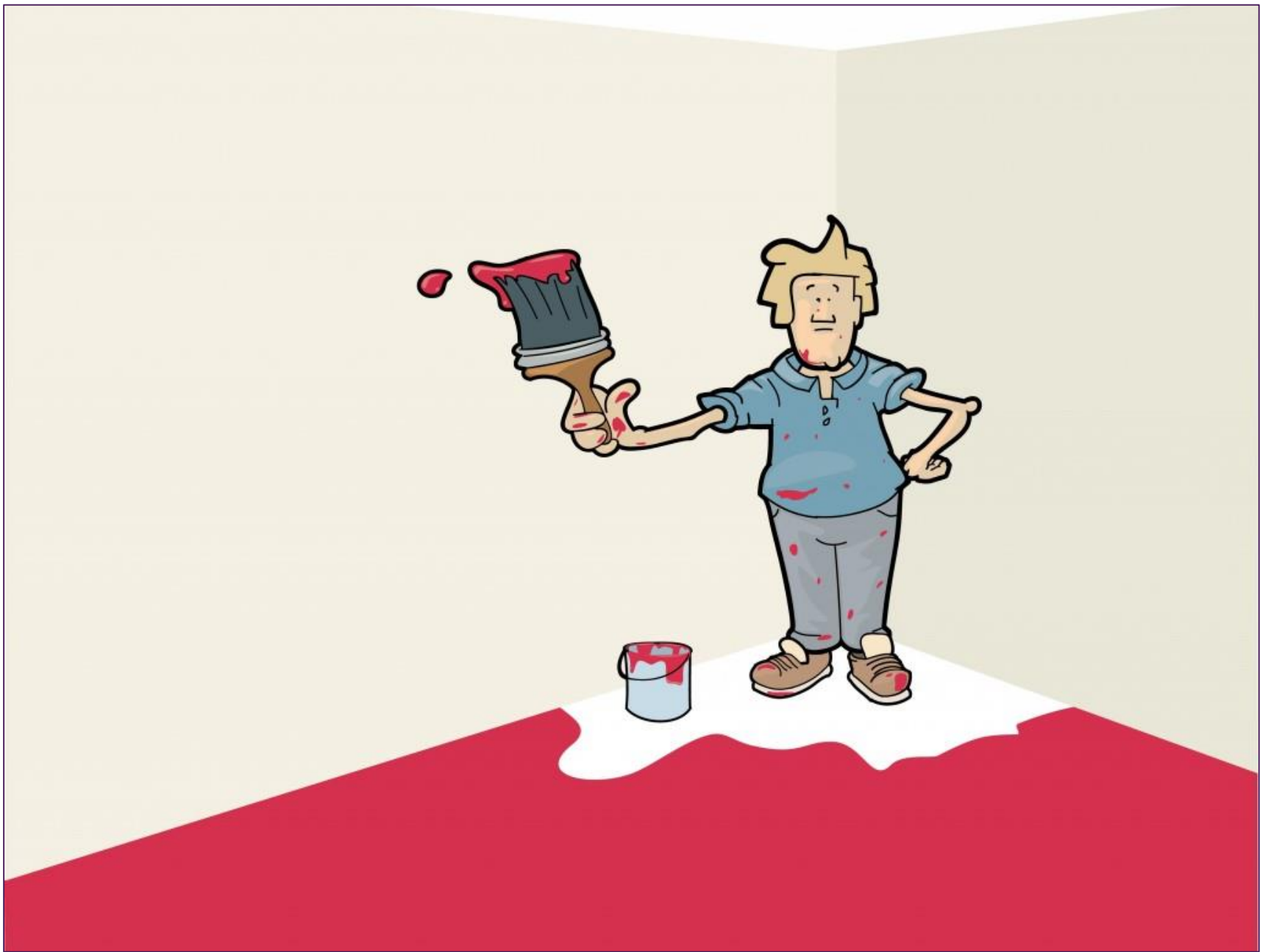


AVIATION AND CLIMATE ADAPTATION IN NORWAY

N-ALM, Helsinki 15 NOV 2016
Olav Mosvold Larsen

- **Avinor is responsible for Air Navigation Services (ANSP) and operate 46 airports in Norway**
- **Our modern society is totally dependent on aviation**





CREATING ISLANDS OF RESILIENCE IN AN OCEAN OF VULNERABILITIES ...

OCT 2012: Hurricane Sandy, NY. Goldman Sachs HQ had a back up generator.



roadkillrefugee @rkref

Follow

Goldman Sachs remains illuminated against a dark sky, like a giant middle finger to the rest of New York.
businessinsider.com/goldman-sachs-...

4:12 AM - 30 Oct 2012

STORTINGET / PARLIAMENT: GREEN PAPERS AND WHITE PAPERS



[There are more...]

SEVERAL ONLINE RESOURCES

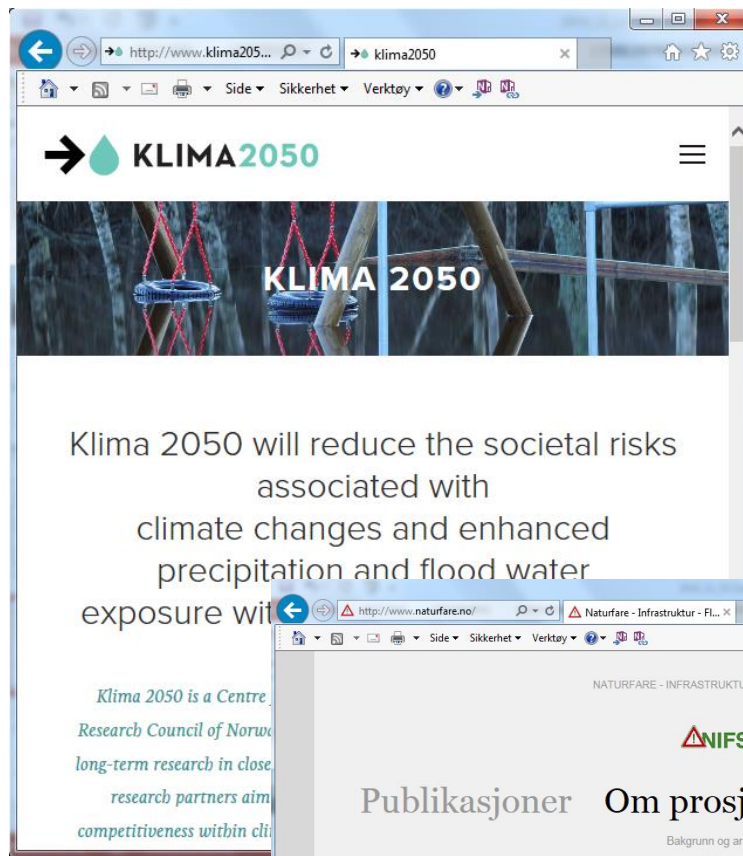
The screenshot shows a web browser window displaying the Norwegian Climate Change Adaptation Portal. The browser's address bar shows the URL <http://www.klimatilpasning.no/infosider/english/>. The page header features the logo "Klimatilpasning" and the "MILJØ-DIREKTORATET" logo. A navigation menu includes links for "Planlegging i kommunen", "Sektorer", "Klimautfordringer", "Veiledere", "Eksempler", and "Hva er klimatilpasning?". A search bar is located on the right side of the menu. The main content area has a breadcrumb trail "Klimatilpasning / English" and a large heading "The Norwegian Climate Change Adaptation Portal". Below the heading is a paragraph: "The Norwegian portal for climate change adaptation (CCA) is intended to support the society in Norway in preparing for the consequences of climate change. The portal offers comprehensive information about ongoing work on climate change adaptation in Norway, lessons learned and relevant research, developments and publications." At the bottom of the page, there is a text block: "As of 1 January 2014 the Norwegian Environment Agency assists the Ministry of the Environment in CCA matters and is responsible for maintaining and developing Klimatilpasning.no. The first White Paper on CCA was adopted by Stortinget (The Norwegian Parliament) in 2013, outlining national policies and guidance for adaptation in Norway. The White Paper represents" followed by an image of a red barn by a lake. The Windows taskbar at the bottom shows various application icons and the system clock displaying 12:27 on 15.11.2016.

THE NORWEGIAN TRANSPORT SECTOR HAVE BEEN LOOKING INTO CLIMATE ADAPTATION SINCE 2001



The Royal Ministry of Transport and Communication and the process related to the National Transport Plan has been instrumental!

RESEARCH – EXAMPLES



Basic research → Applied research → Actual projects

CLIMATE CHALLENGES NORTHERN EUROPE

- ✓ Warmer
- ✓ Wetter
- ✓ Wilder

→ Regional differences



MAIN CHALLENGES – NOT

- Airports are flat
 - Placed in open areas due to operational issues
 - Limited direct risk for avalanches and slides
 - But what about surface access? Telecon? Electricity?
-
- NB: RWYs and airspace monitored 24/7. Can be shut down if required.



WARMER:

- Svalbard airport, Longyear (Spitsbergen)



- Permafrost level at construction (1973): Approx 2,5 metres
- Permafrost level 2009: Approx 4,5 metres
- ➔ Settling damages on parts of RWY

WETTER = Drainage

Surface water

- Big flat sealed areas
- Freezing/melting

Ground water levels

- Electrical infrastructure

Avinor airport design handbook:

- Specific requirements for rilling/creasing
- Future climate factors for design of water mains and sewage systems
- OSL T2: 50% increase in dimensions



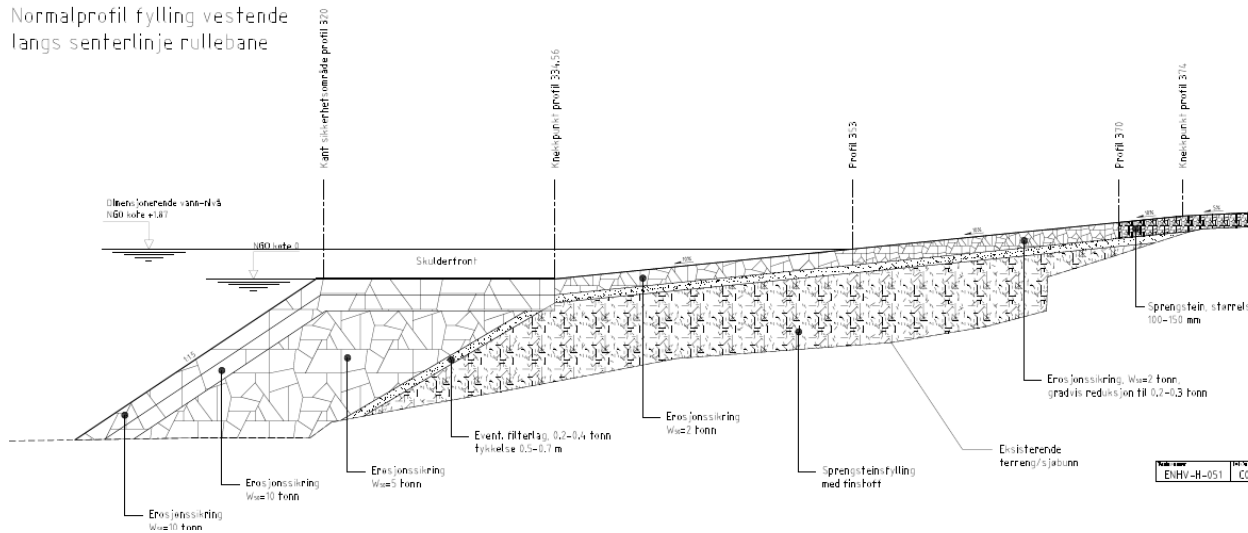
WILDER

Storm «Berit», Vaeroy Heliport (Nov 2011)



WAVES AND EROSION PROTECTION

Normalprofil fylling vestende langs senterlinje rollebane



AVINOR APPROACH AND STANDARDS

- AVIOR AIRPORT DESIGN HANDBOOK:
 - Requirements for erosion protection
 - RWY's not to be built lower than 7 metres above sea level
 - Specific requirements for rilling/creasing
 - Future climate factors for design of water mains and sewage systems
 - OSL T2: 50% increase in dimensions
- STANDARD FOR BULDINGS (BRAND NEW!)
 - Climate adaption given central role
 - Building materials
 - Electric systems
 - Drainage
- COMPREHENSIVE RISK ANALYSIS (2013-2014)

ICAO – SINCE 2010



ADAPTING AIRPORTS TO A NEW CLIMATE

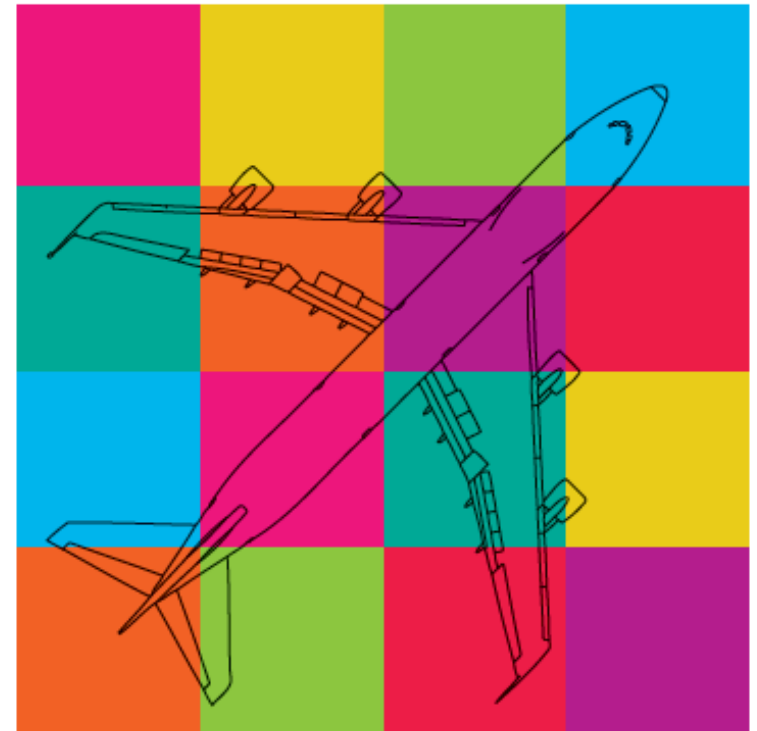
BY OLAV MOSVOLD LARSEN (AVINOR)
AND KRISTIN FJELLHEIM (AVINOR)

In five consecutive reports since 1990, the International Panel of Climate Change (IPCC) has documented that global climate is changing. The latest report states: "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased"¹. There is virtually no doubt that even if we could eliminate all of humanity's carbon emissions this afternoon the delay in the atmospheric response would – according to scientific projections – make the future climate significantly different from that of today.

... (2000 onwards), the global mean temperature is projected to rise, but

ON BOARD

A SUSTAINABLE FUTURE



2016 ENVIRONMENTAL
REPORT



Northern Europe

- Temperature rise larger than European average
- Increased winter storm risk
- Reduction in ground frost depth and duration
- Increase in winter precipitation
- Reduction in snow cover but potential heavier snow events

North-Western Europe

- Increase in winter precipitation
- Increased winter storm risk
- Increased flood risk (river/coastal)
- Increased strong winds

Mountain regions

- Temperature rise larger than European Average
- Reduced snow cover

Coastal zones

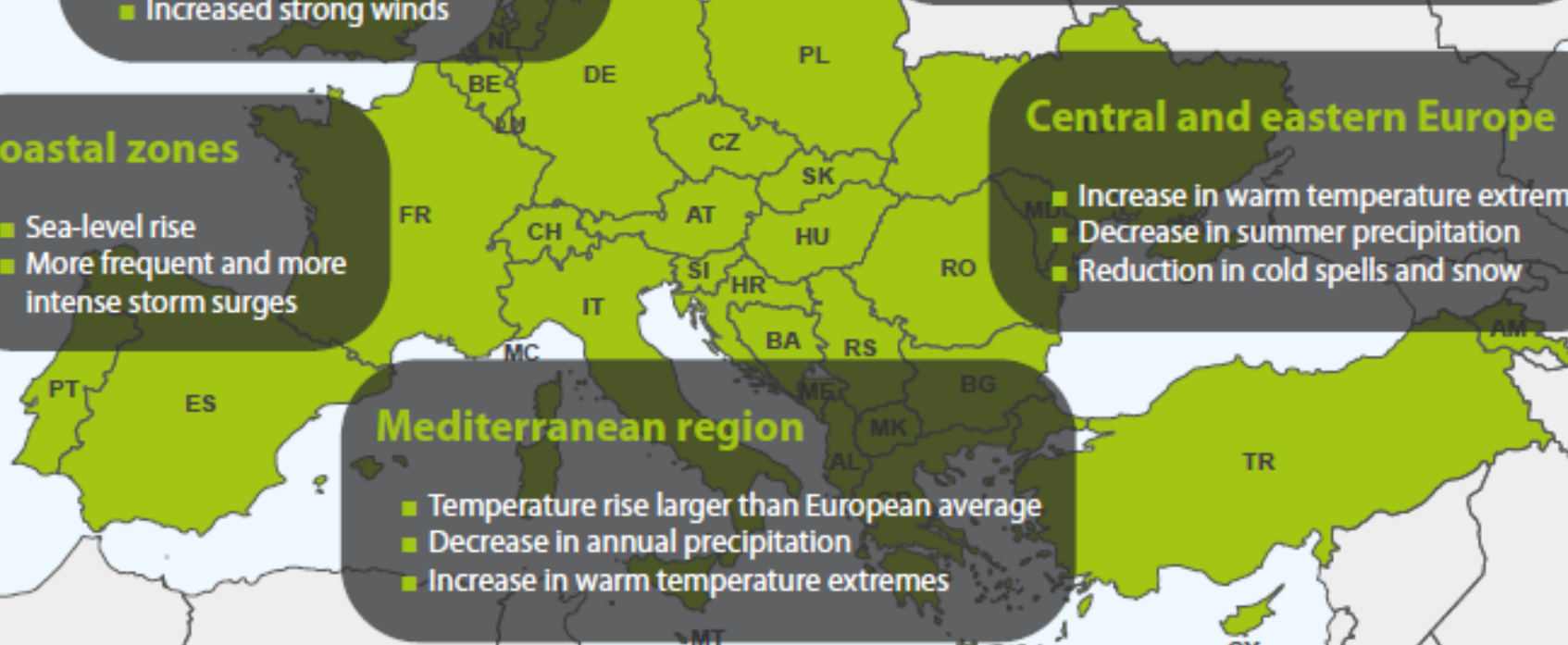
- Sea-level rise
- More frequent and more intense storm surges

Central and eastern Europe

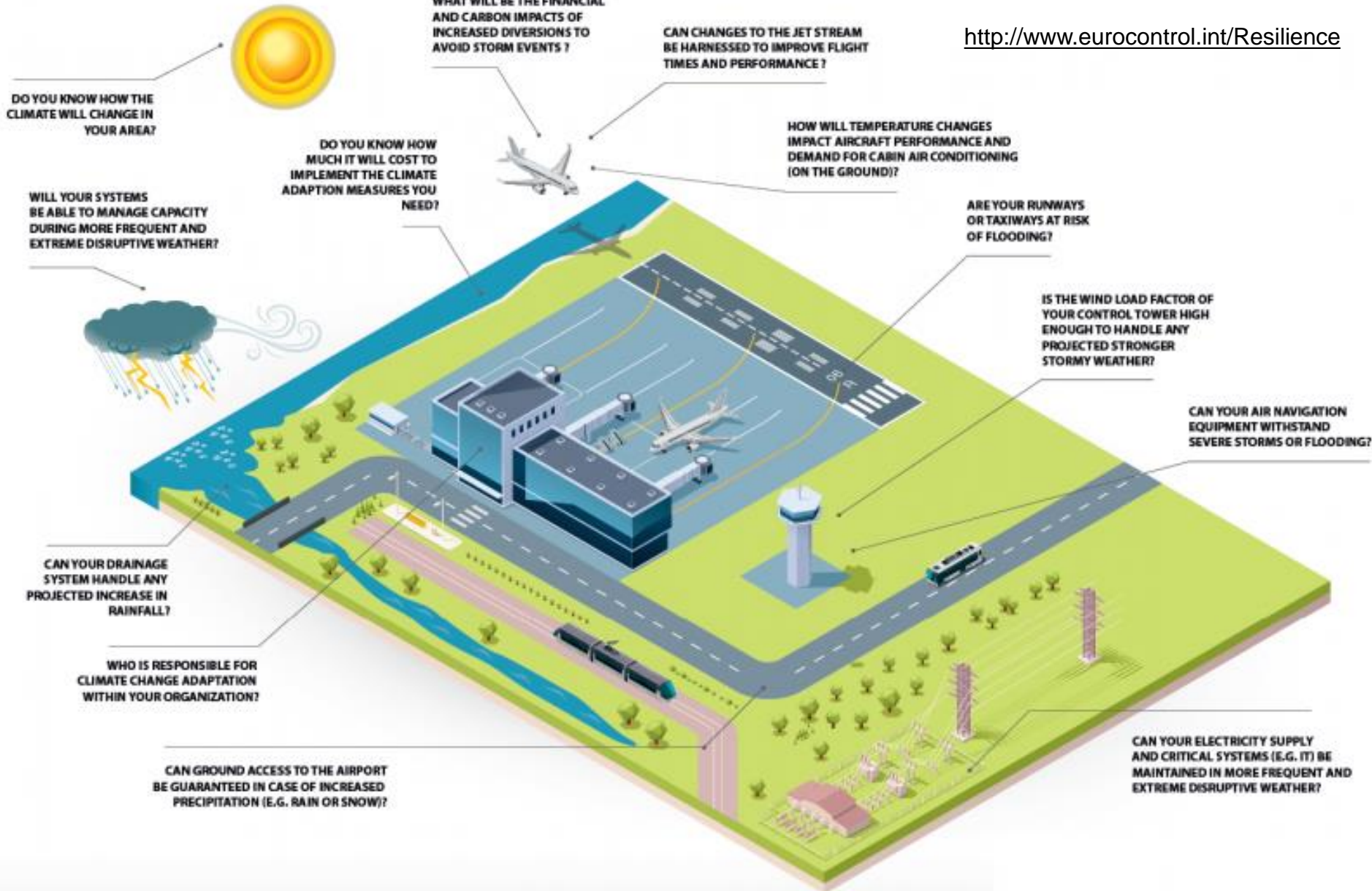
- Increase in warm temperature extremes
- Decrease in summer precipitation
- Reduction in cold spells and snow

Mediterranean region

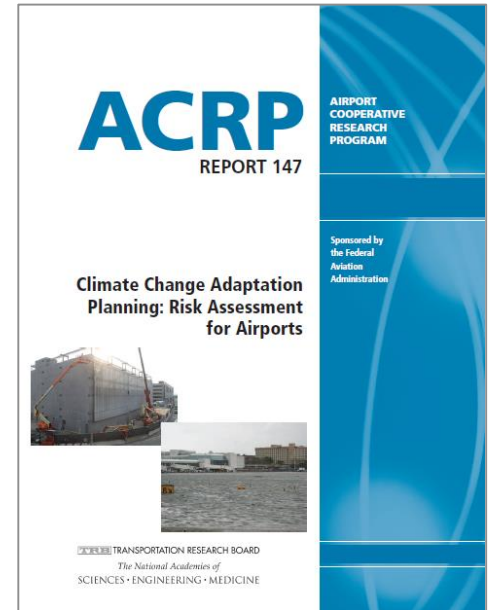
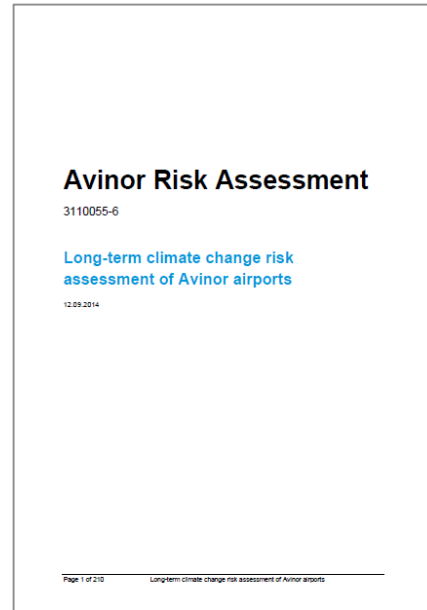
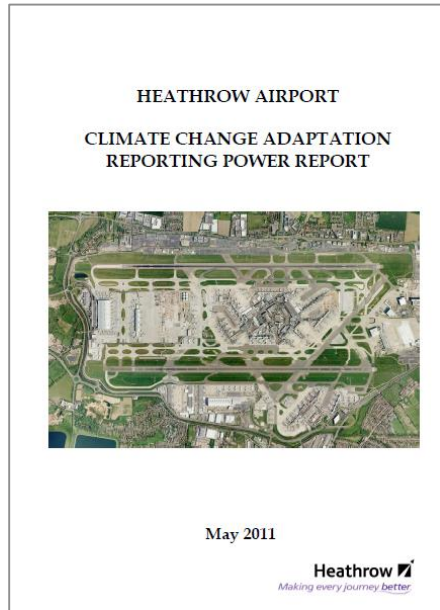
- Temperature rise larger than European average
- Decrease in annual precipitation
- Increase in warm temperature extremes



<http://www.eurocontrol.int/Resilience>



THE LITTERATURE ON AVIATION AND CLIMATE ADAPTATION IS GROWING



CONCLUSIONS

- The weather is changing
 - Local and regional variations
 - Will affect aviation
 - To have a well functioning aviation infrastructure in future Europe, everybody have to do their homework
- ➔ Carry out a risk assessment and get started!



I DON'T BELIEVE IN
GLOBAL WARMING
GLOBAL WARMING
I DON'T BELIEVE IN

15.11.2016

olav.mosvold.larsen@avinor.no

 AVINOR