World Meteorological Organization

WMO is the United Nations' authoritative voice on weather, climate and water

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World Meteorological Organization (WMO)

- **United Nations Specialized Agency for meteorology, climate, operational hydrology and related geophysical sciences**
- **United Nations system's authoritative voice on the state and behaviour of the Earth's atmosphere and its interaction with the oceans, as well as on climate and the distribution of water resources**
- **Established on 23 March 1950; direct successor to the International Meteorological Organization founded in 1873**
- **Comprises 191 Members: 185 States and six territories**

WMO AERONAUTICAL METEOROLOGY PROGRAMME

PURPOSE

To assist Members in their efforts to further the application of meteorology to aviation

SCOPE

- Improve the provision of operational meteorological information required by aviation.
- Contribute to the safety, regularity and efficiency of air navigation.

Aviation and the Environment- Strong cooperation with ICAO

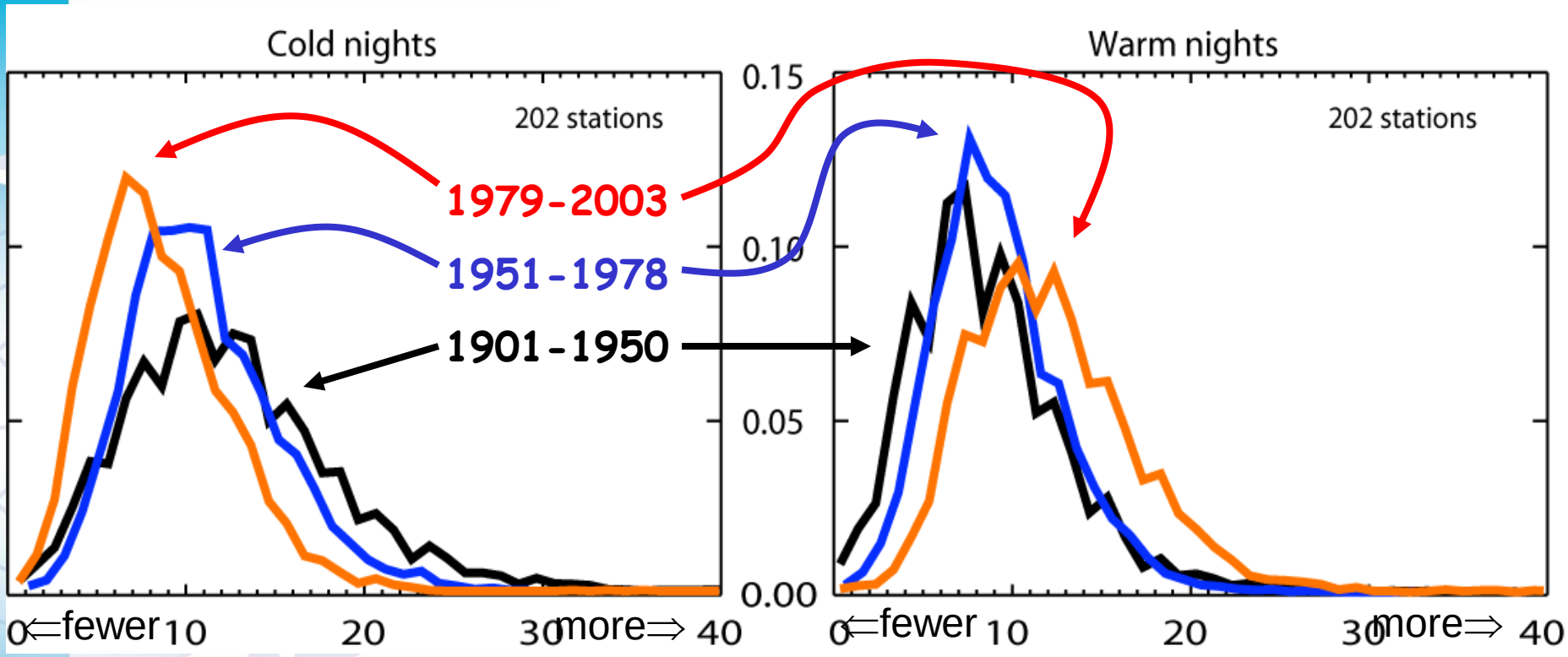
- Global Climate Change: Provision of climate assessment (IPCC) and Climate Services (GFCS)
- Local Air Quality: All aspects of Nox, PM10, PM2, aerosols, ozone, CO and CO2 addressed by the Global Atmosphere Watch (GAW)
- Noise: Propagation depending on atmospheric conditions, profile observations needed

Climate Change – what next?

- Public perception has changed dramatically, confusion about consequences
- Aviation contributing more than CO_2
- Operational measures for reducing impact need to include optimized use of meteorological information
  - Upper winds and temperatures
  - Terminal aerodrome optimization (holdings, continuous descent/ascent, runway changes)

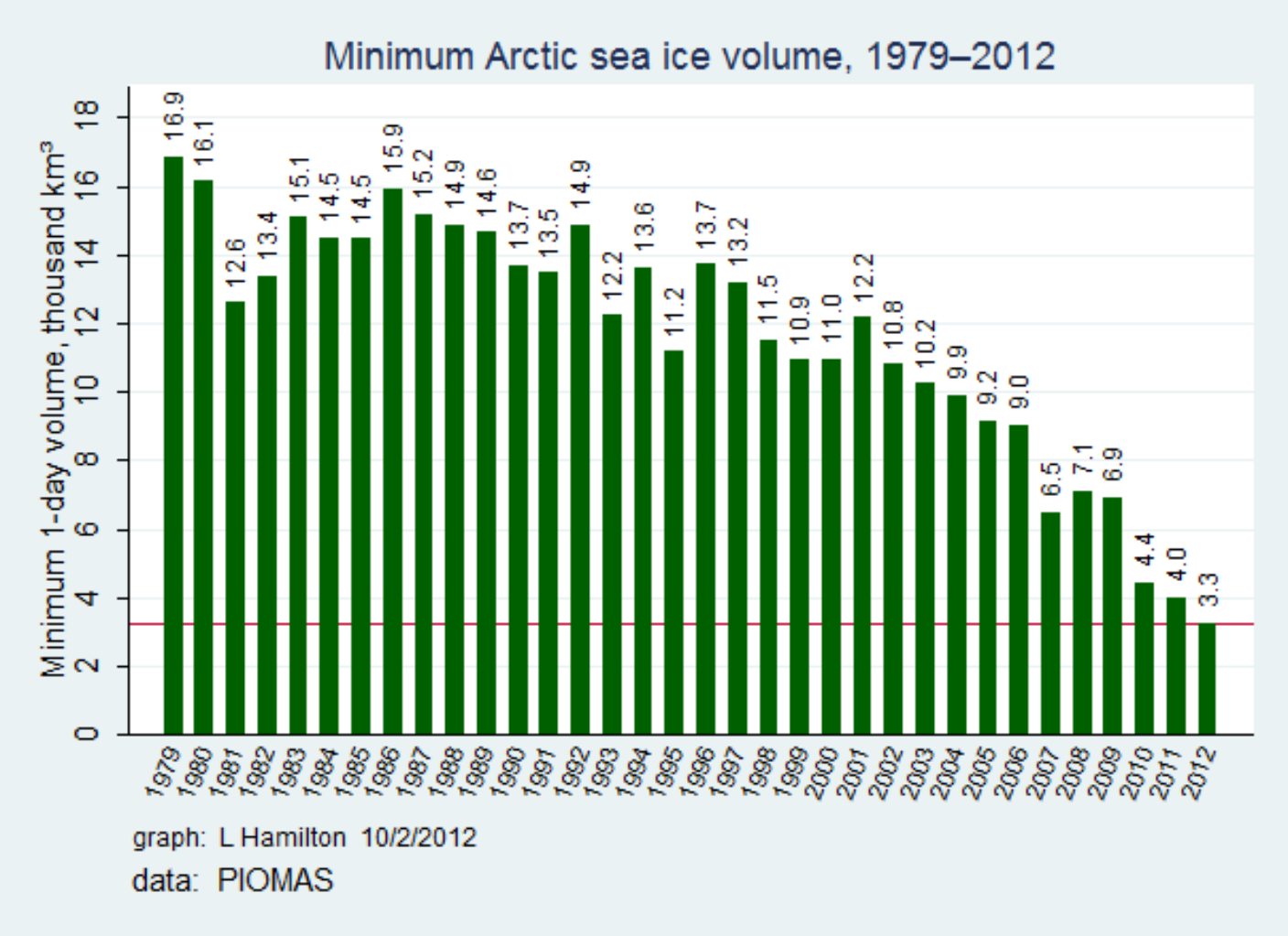
Contrails and Cirrus

- Moderate effect during daytime, larger warming during the night (no compensating reflection of short wave radiation)
- Role of thin cloud layers for Cryosphere seems to be large (Greenland, Alpine glaciers)
- Ci cotragenitus most frequent in pre-frontal warm ridges – positive feedback possible for Blocking pattern?
- Need for more environmental monitoring by aircraft (AMDAR, IAGOS, MOZAIC)

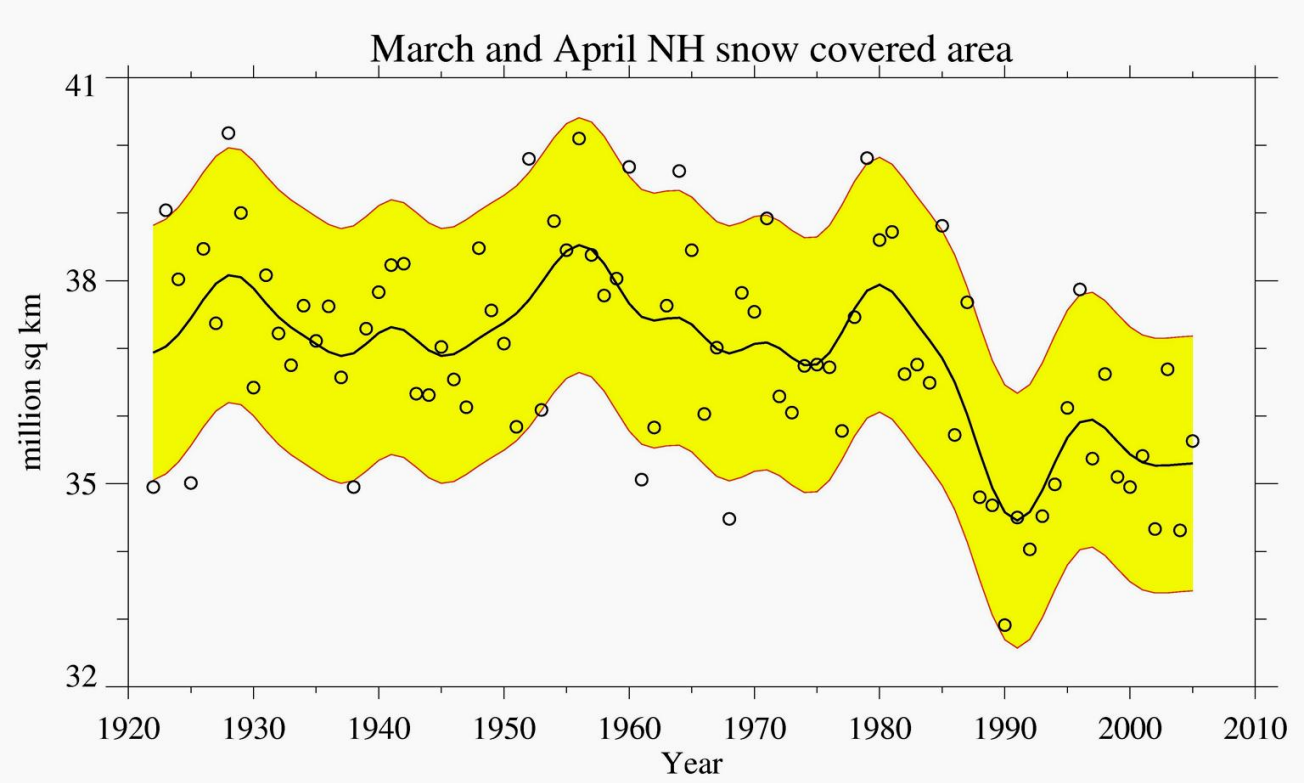


Frequency of occurrence of cold or warm temperatures for 202 global stations for 3 time periods:
1901 to 1950 (black), 1951 to 1978 (blue) and 1979 to 2003 (red).

Example: Arctic Sea Ice minimum volume



Effects on Tourist Destinations



Unexpected side-effects…

- Warm Eastern Atlantic and poleward shift of Jet may be instrumental in:
  - More frequent floods (Fall, Winter) in northern mid latitudes (e.g. British Isles)
  - Lack of Westerlies penetrating into Continental Europe leading to meridional flow pattern during early winter – severe cold outbreaks over Continental Areas

How Aviation Met can help to mitigate:

- Further improvements to wind & temp forecasts –reduced flight times & fuel!
- Enhanced cooperation with ATC/ATM: runway changes,avoidance of holdings, reroutings (MARIE-PT)
- Cooperation with airports: Winter operations, runway flooding, extreme heat, lightning warnings, capacity forecasts, wake vortex
- Increased Safety: Improved warnings of Convection, Icing, Turbulence (may increase in new climate scenarios)

What is needed?

- Higher Resolution of NWP (« Downscaling » of global pattern to typical local/regional scenarios such as Secondary cyclogenesis)
- Enhanced Monitoring from Space: New Satellites, more channels, higher resolution, but time-gap 2013-2016 over Americas,no profiles over land, thus
- Need for In Situ-Data: More Aircraft data, addition of humidity sensors, focus on DC
- Environmental monitoring (MOZAIC, IAGOS, etc)

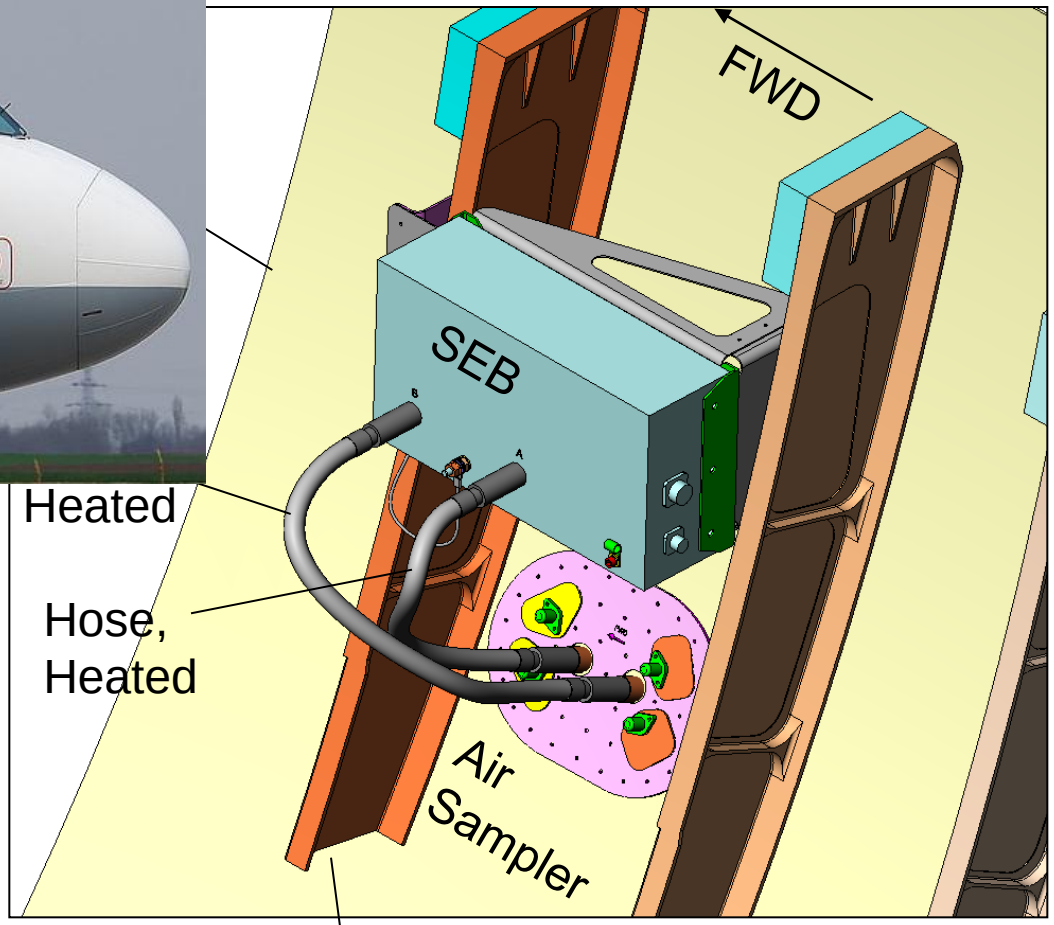
Why is AMDAR Data Needed?

Real time high quality vertical profiles of AMDAR temperature and wind have proven to contribute significantly to the improvement in short to medium-term forecasting applications. AMDAR is particularly useful for now-casting situations where conditions are changing rapidly and are therefore of special use to the aviation industry. Such applications include:

- Surface and upper air forecasts of wind and temperature;
- Thunderstorm genesis, location and severity;
- Wind-shear location and intensity e.g. dangerous low-level jets;
- Low cloud and fog formation, location and duration;
- Turbulence location and intensity; and
- Jetstream location and intensity.

AMDAR Humidity Measurement

Air Sampler



Adaptation

- High time for aviation to think about adaptation
  - Effects of climate change on population, migration, tourism
  - Effects on daily operations in severe weather situations that are becoming more violent and frequent
  - Role of aviation in emergency relief and rescue operations, reconstruction

Anticipated effects on Aviation (Demand side-long term)

- Tourism: Some popular destinations may suffer from extreme droughts,sand-and dust storms, wild fires – less attractive
- Winter tourism (skiing) could suffer from highly variable snow cover
- Tropical destinations challenged by stronger cyclones, storm surges, sea level rise
- Cost to national economies of mitigating and compensating for climate change will reduce free disposable income – «short breaks » to go from family budgets?

Effects on Aviation Operations

- Hot extremes: performance limitations on flights near max endurance
- Tropical Cyclones: Damages to infrastructure, disruption of schedules, evacuation?
- Intensity of storms and convection: severe disruption of apch/dept corridors / cornerposts, blocking of flight levels, runway flooding, ground side transportation,sand-and dust storms


Note:Aviation induced Cirrus!
THANK YOUR FOR YOUR ATTENTION!