

International Civil Aviation Day

The Greening of Flight

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Noise
dB

Key Environmental Issues

CO

HC

CO₂

NO_x

Aircraft Engine Emissions



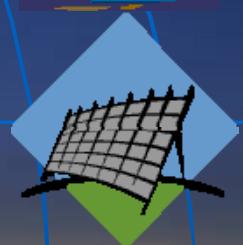
Context

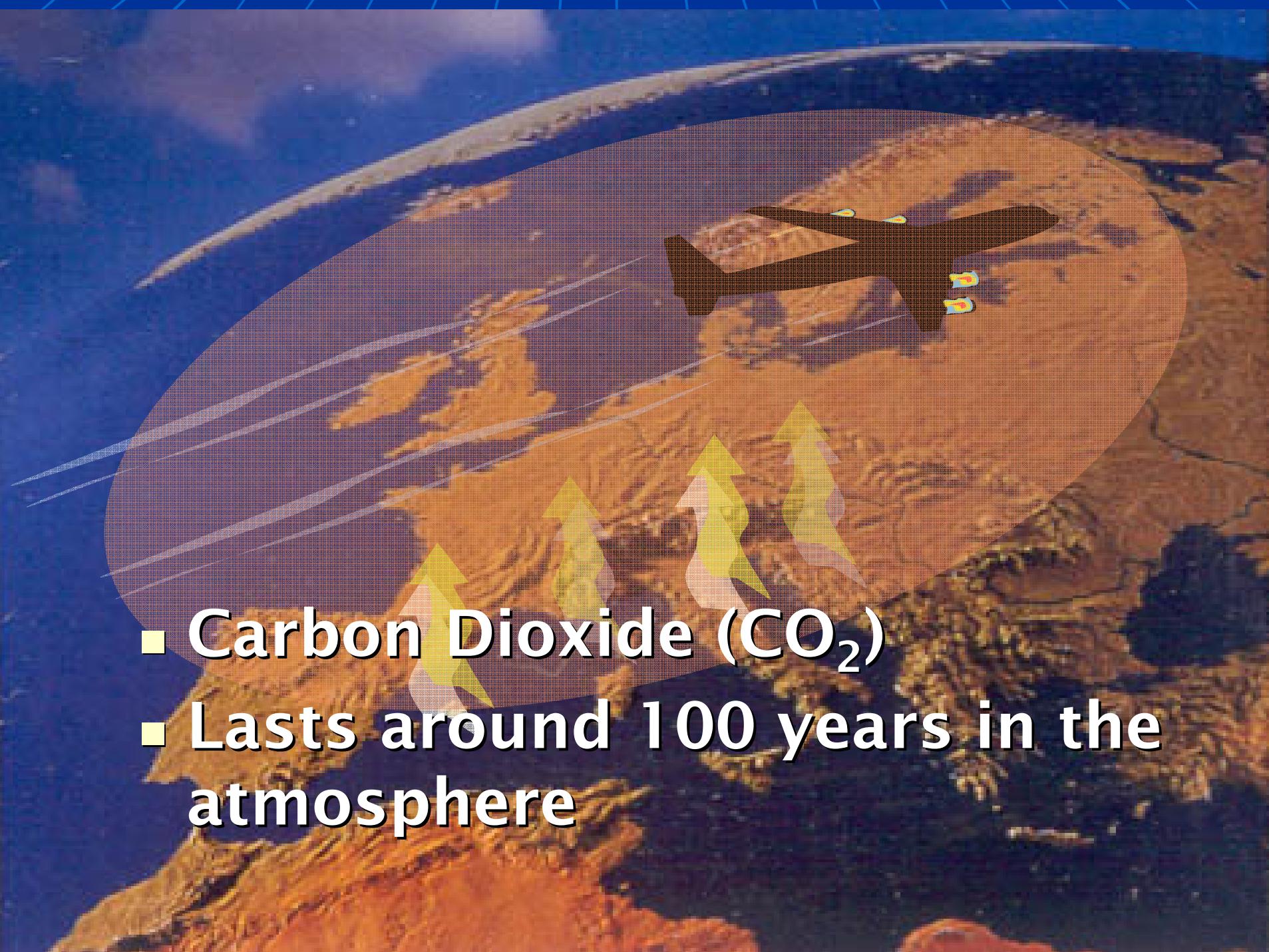
- Fuel / energy
- Emissions at high altitudes (8 to 13 km)
- Adverse meteorological conditions
- Past / future growth

Context



- Alternative aircraft fuels
- Fossil fuels
- Carbon Dioxide (CO_2)



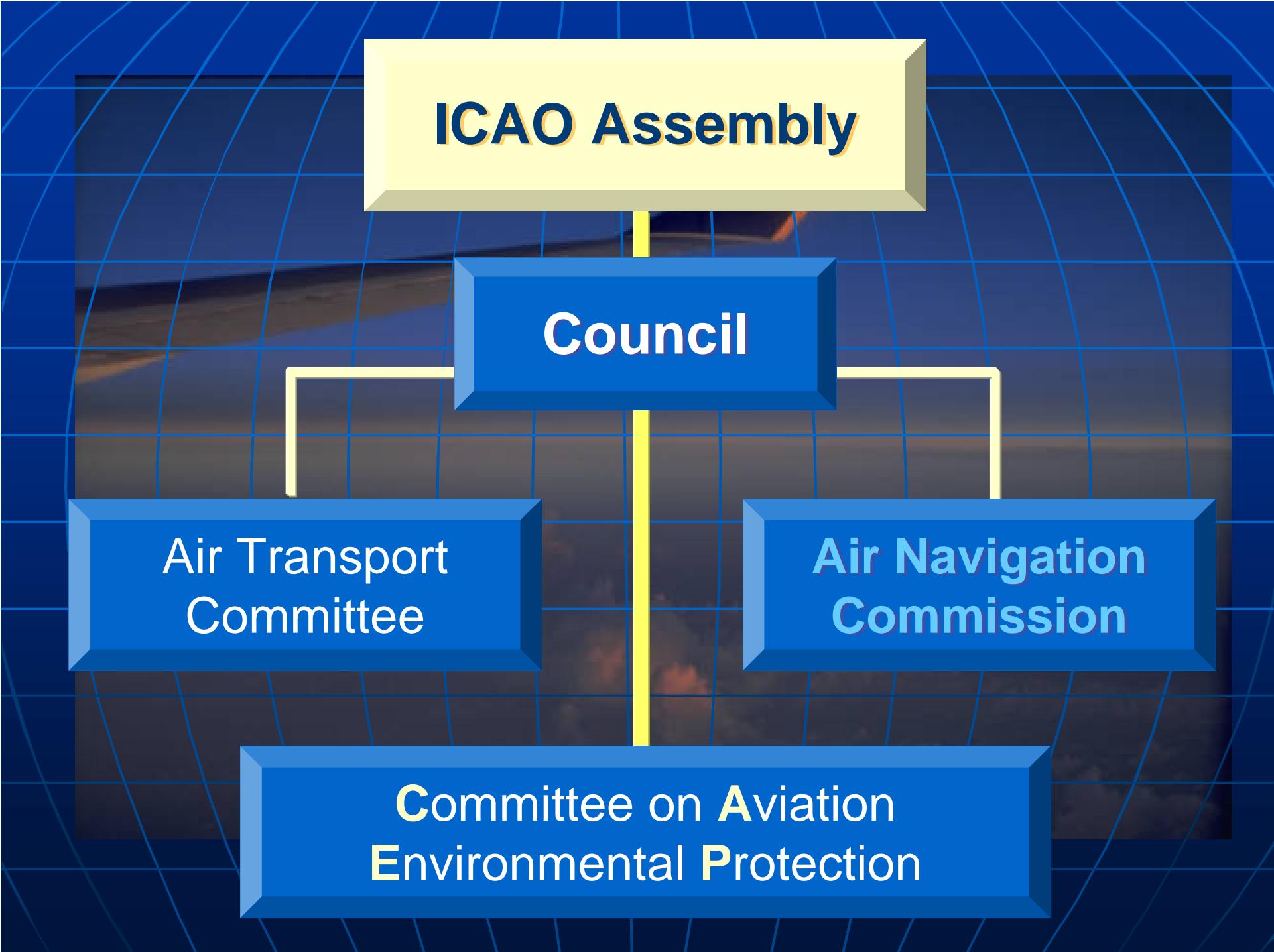
- 
- Carbon Dioxide (CO_2)
 - Lasts around 100 years in the atmosphere

Context

- Fuel / energy
- Emissions at high altitudes (8 to 13 km)
- Past / future growth
- Adverse meteorological conditions

Challenges for States and ICAO

- How to find an appropriate balance between future growth and environmental problems?
- How to accommodate States' very different views within a harmonized worldwide approach?



ICAO Assembly

Council

Air Transport
Committee

Air Navigation
Commission

**Committee on Aviation
Environmental Protection**

**1970
CAN
(Noise)**

**1977
CAEE
(Emissions)**

**1983
CAEP**

- Technical feasibility
- Environmental effectiveness
- Economic reasonableness
- Interdependencies of measures

CAEP Members and Observers

Argentina

Australia

Brazil

Canada

Egypt

France

Germany

India

Italy

Japan

Netherlands

Poland

Russian

Federation

Singapore

South Africa

Spain

Sweden

Switzerland

Tunisia

United

Kingdom

United States

CAEP Members and Observers

Greece

Norway

ACAC

ACI

EC

IATA

IBAC

ICCAIA

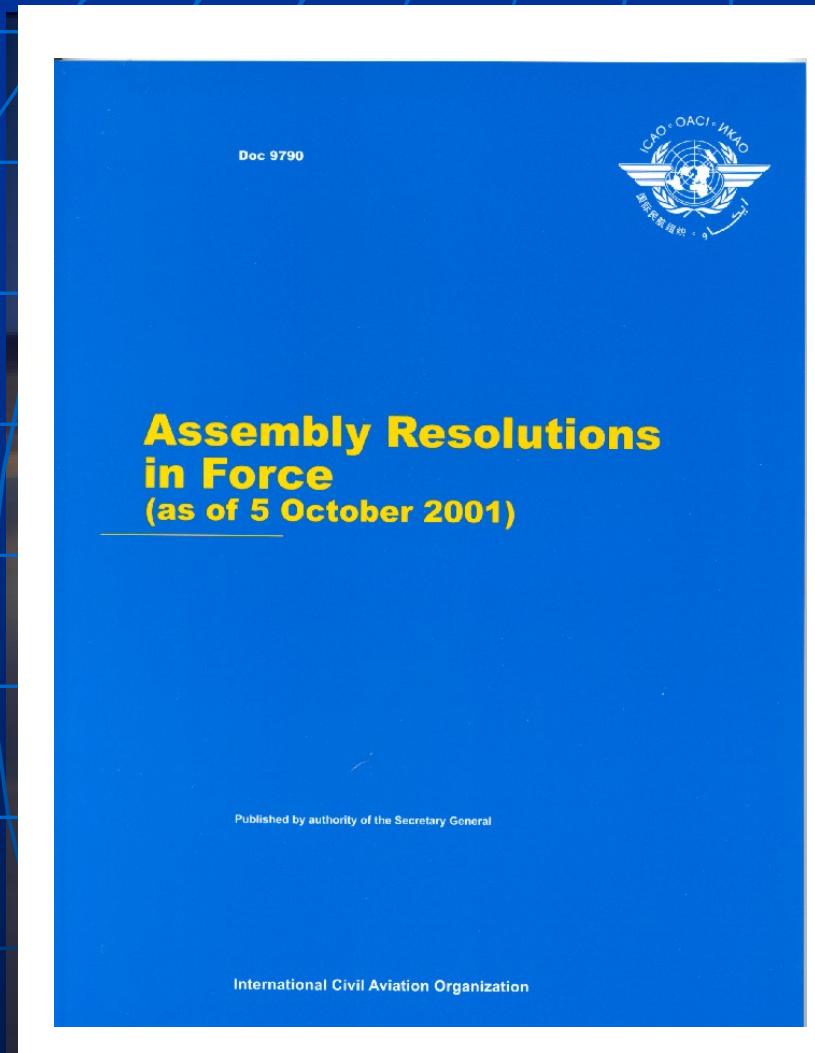
ICSA*

IFALPA

UNFCCC

WMO

*Environmental NGO umbrella group



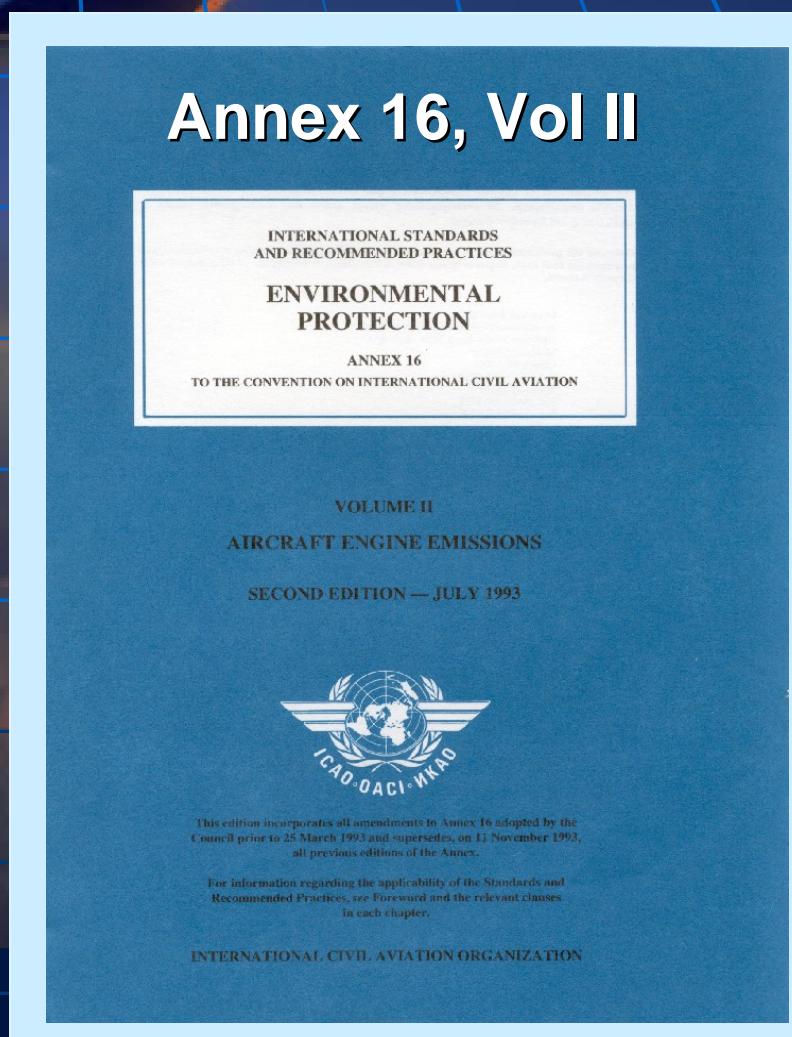
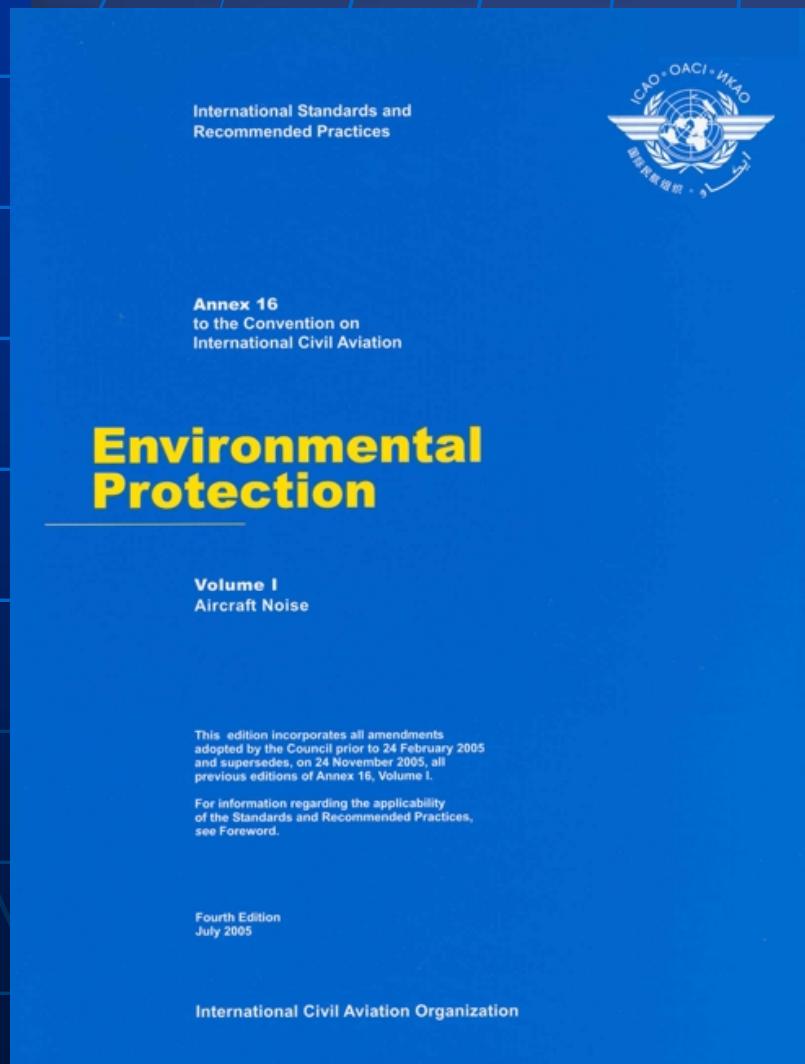
A35-5

Consolidated statement of continuing ICAO policies and practices related to environmental protection

A35

- Appendix H: Environmental impact of civil aviation on the atmosphere
- Appendix I: Market-based measures regarding aircraft engine emissions

Standards and Recommended Practices

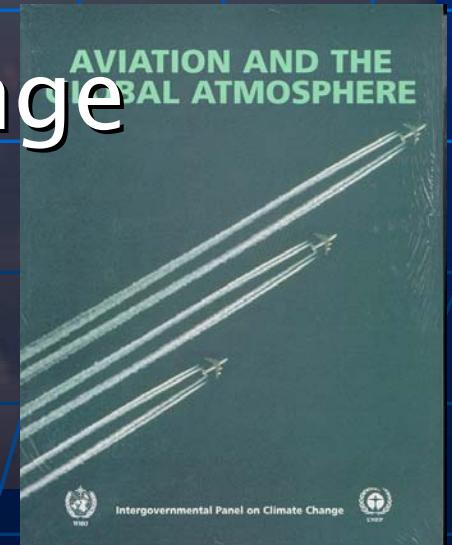




Intergovernmental
Panel on
Climate Change

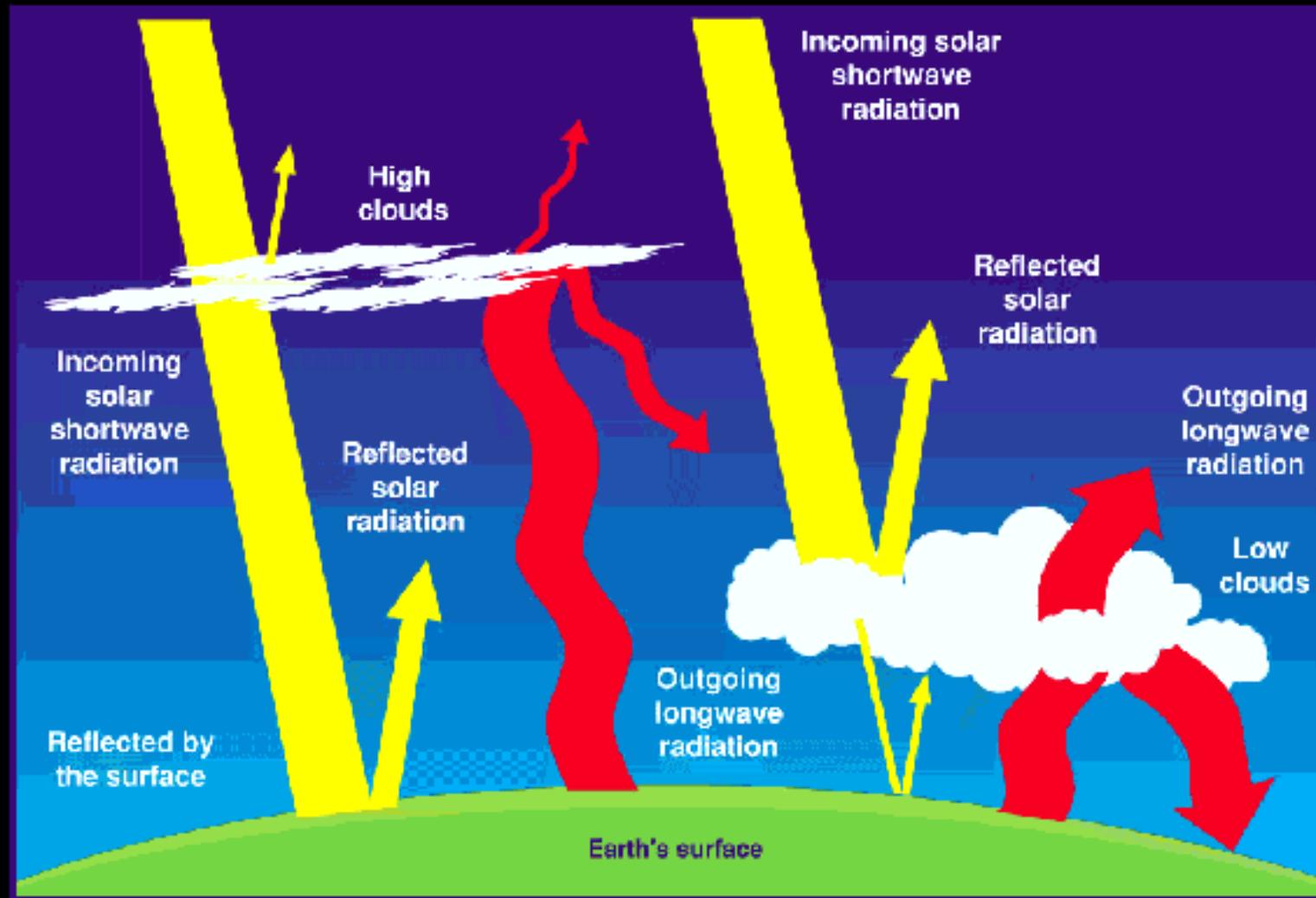
Special Report on *Aviation and the Global Atmosphere*

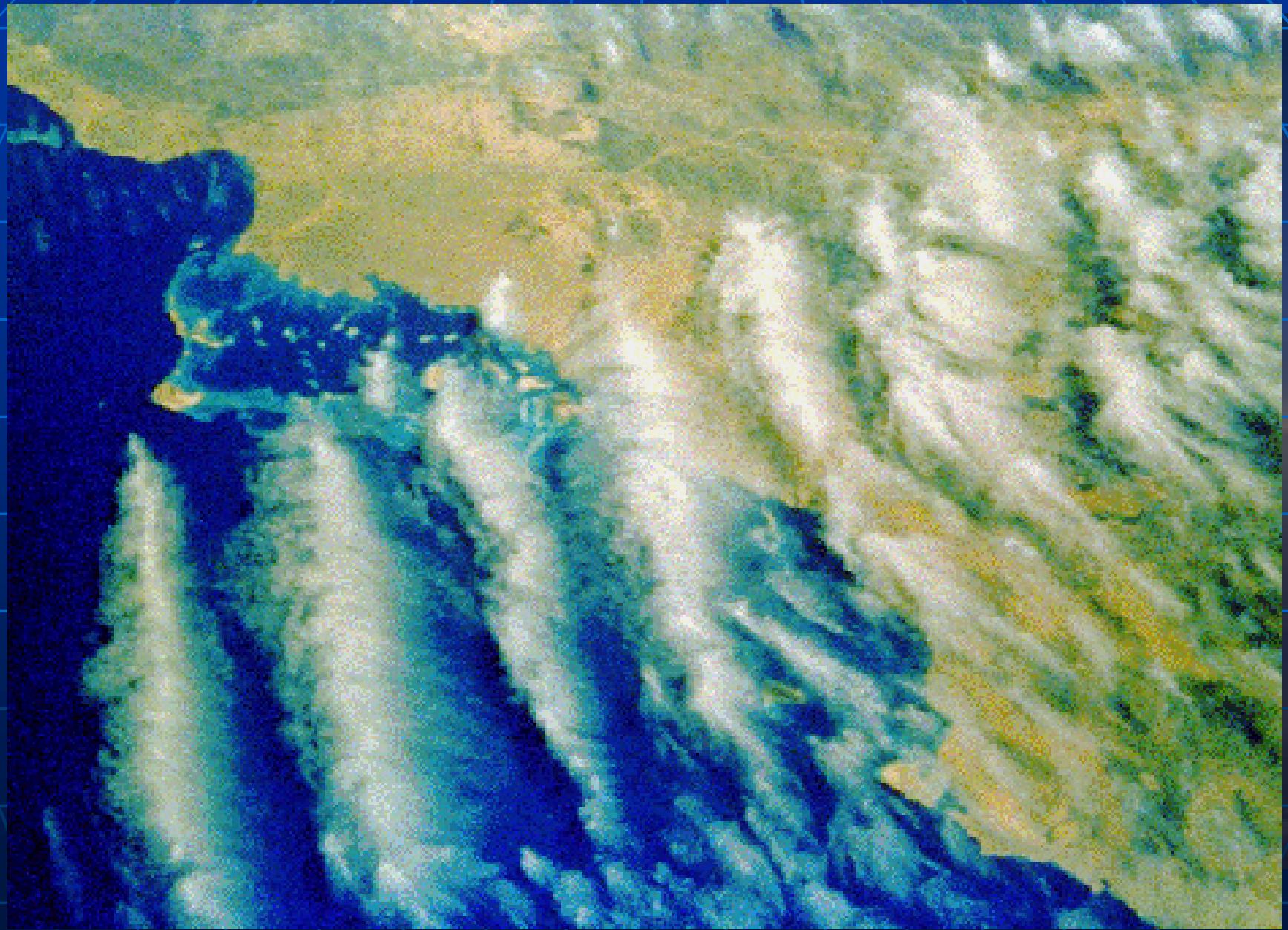
- Prepared at ICAO's request
- Completed April 1999
- Covered both climate change and ozone depletion



- 
- Nitrogen Oxides (NO_x)
- Produce ozone
 - Reduce the atmospheric concentration of methane

Cloud Effects On Earth's Radiation



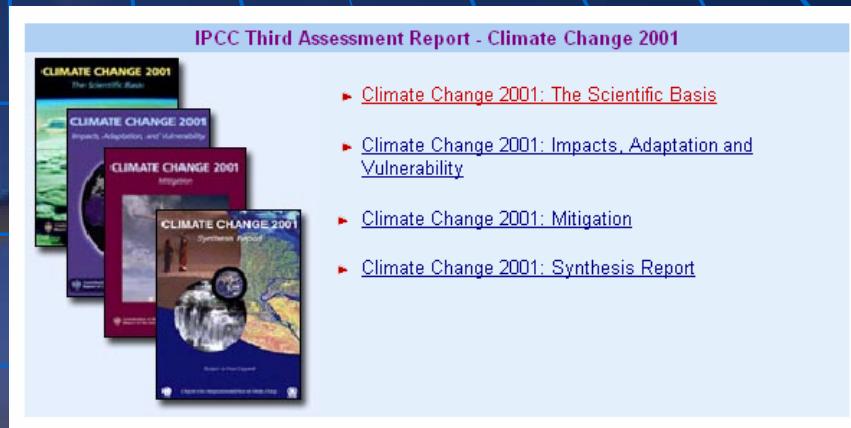


- Aircraft are estimated to contribute about 3.5% of the total radiative forcing of all human activity
- The Assembly urged States to promote scientific research ... and asked for cooperation with the IPCC and other organizations in this area

- IPCC to update information on aviation in 4th Assessment Report (AR4)

- Due 2007

- ICAO is involved in the revision process of 1996 IPPC Guidelines which includes an update of the aviation emissions factors and other parameters



Kyoto Protocol

- Adopted in 1997
- Commits Annex I Parties (developed Countries) to individual, legally-binding targets to limit or reduce greenhouse gas emissions from international aviation between 2008-2012 compared to 1990 levels, AND TO
- Pursue limitation or reduction of emissions of greenhouse gases from aviation bunker fuels, *working through ICAO*

ICAO and UNFCCC



- ALL parties have to report to the Convention on the emissions, including aviation emissions
- For Annex I - Domestic aviation emissions included in national totals
- International aviation emissions *reported*
- ICAO involved in a study on quality of aviation emissions data

Tracking Climate Change

- Aviation contributes to main scientific research projects
- In the framework of the CARIBIC and MOZAIC projects, sensitive measuring devices aboard long-haul aircraft collect data on the composition of the Earth's atmosphere. Scientists worldwide benefit from this research, which helps them better understand the causes and developments of climatic changes.



ICAO and UNFCCC



- A35, Appendix H - requested ICAO to continue to develop policy options to limit or reduce emissions and to develop proposals and provide advice to UNFCCC ; and

- to place special emphasis on the use of technical solutions while continuing consideration of market-based measures

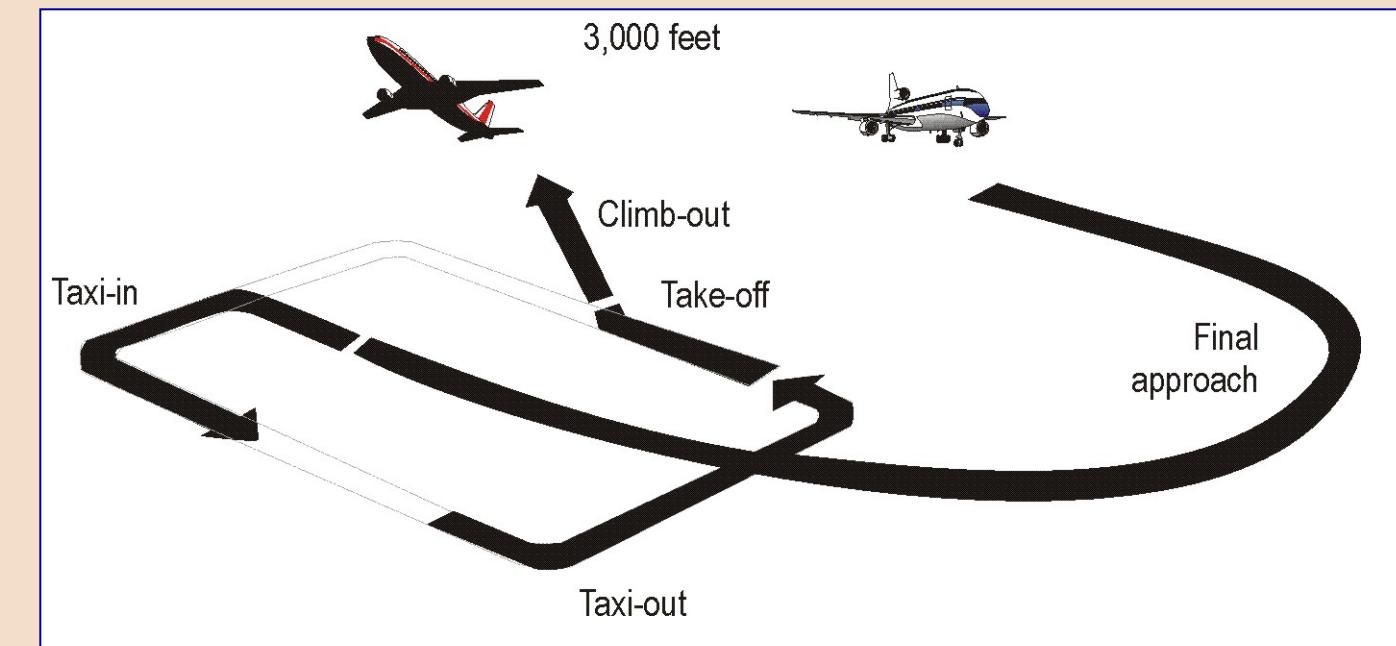
Policy Options to Reduce Emissions

- Technology and Standards
- Operational Measures
- Market-based Measures:
 - Emissions charges
 - Emissions trading
 - Voluntary measures

Technology and Standards

- Technology can help, through improved engine or airframe design, achieve reductions in emissions
- To achieve certification and to be “licensed” to operate, aircraft engines must meet standards defined in Annex 16

Technology and Standards

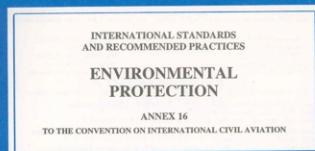


Technical Issues

- NO_x Standard was first adopted in 1981 then made more stringent in 1993, when ICAO reduced the permitted levels by 20% for newly certificated engines and again in 1998 by about 16%, on average for engines newly certificated from 31 December 2003

Technology and Standards

- Emissions database available from ICAO website
- Emissions standards (NO_x , HC, CO and smoke number)



VOLUME II
AIRCRAFT ENGINE EMISSIONS
SECOND EDITION — JULY 1997



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is available at the following address:

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Civil Aviation Authority

CAA Home Printer Version

Civil Aviation Authority

Aircraft Engine Emissions Home Page

Safety Regulation

Environmental

- FAQs
- Documents
- Contacts
- Airworthiness Approval Notes
- Certification of Products and Modifications

ICAO Engine Emissions Databank

- Introduction
- Individual Engine Datasheets
- Contacts
- Record of Changes

ICAO Aircraft Engine Emissions Databank

This DataBank contains information on exhaust emissions of only those aircraft engines that have entered production. The information was provided by engine manufacturers, who are solely responsible for its accuracy. It was collected in the course of the work carried out by the ICAO Committee on Aviation Environmental Protection (CAEP) but has not been independently verified unless indicated. The UK CAA is hosting this DataBank on behalf of ICAO and is not responsible for the contents.

Introduction

Background information for the ICAO Aircraft Engine Emissions Databank.

Aircraft Engine Emissions Individual Datasheets

The information was obtained from engine manufacturers by the ICAO Committee on Aviation Environmental Protection (CAEP).

ICAO Aircraft Engine Emissions Databank

Download the DataBank.

Search

Go

Operational Measures

- Emissions savings come from improvements in air traffic management (ATM) and other operational procedures
- CO₂ emissions are directly proportional to fuel burn
- Optimize fuel consumption = reduced emissions

Operational Measures

- Improvements in air traffic management (ATM) and other operational procedures could reduce aviation fuel burn by between 8 and 18%
- Most important fuel saving opportunities come from CNS/ATM systems that will permit more direct routings and the use of more efficient conditions such as optimum altitude and speed

Improvements in Flight Operations

- Opportunities for fuel conservation
 - Landing weight
 - Fuel reserves
 - Airplane loading
 - Route selection
 - Altitude selection
 - Speed selection
 - Flap selection

Reduce Weight



Catering

Reduce Weight

- Blanking off 1, out of 3 potable water tanks for “medium-haul” B777-200, prevents their use
- 100kg of water, per flight not loaded
- Annual savings estimated as
 - 380 tonnes fuel, 1 200 tonnes CO₂

Potable Water

Reduce Weight

- Using one route as an example
- Weight reductions (LHR-NY):
 - B747-400 - 32.60 kg
 - B777-200 - 34.40 kg

Plastic Cutlery

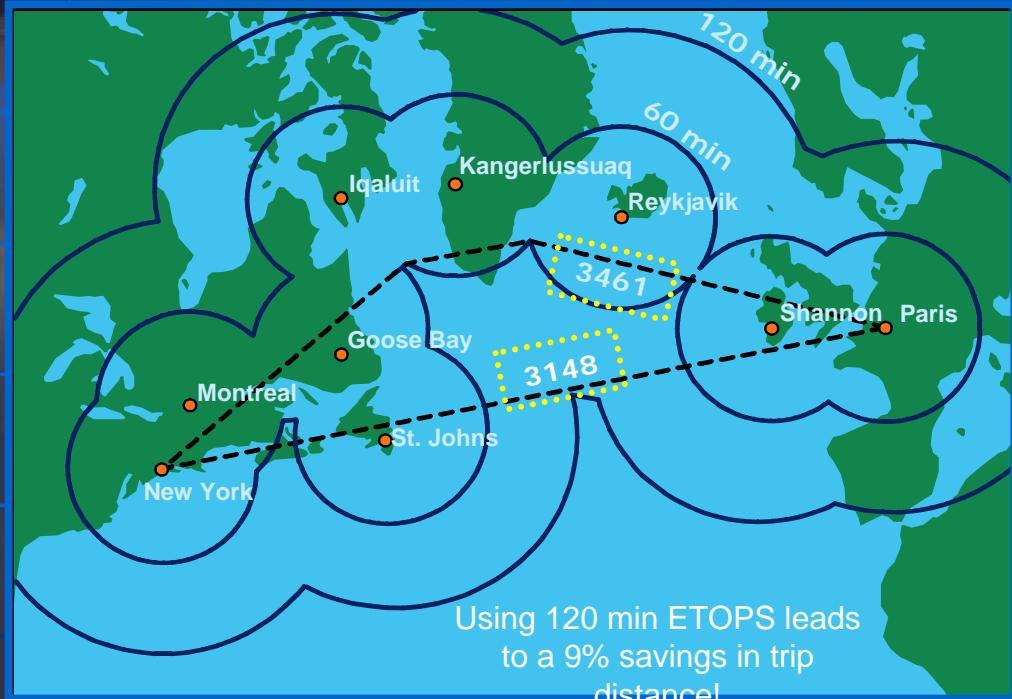
Route Improvements

- Choose the most direct route possible
- ‘Great Circle’ is the shortest distance between 2 points on the earth’s surface
- Great circle may not be the shortest air distance when winds are included



Route Improvements

ETOPS



- ETOPS allows for more direct routes
- Shorter routes = less fuel required

Altitude Selection

Optimum altitude:

Pressure altitude for a given weight and speed schedule that gives the maximum mileage per unit of fuel



Reduced Vertical Separation Minimum

- Taking advantage of operating closer to optimum levels
- Studies: conservative estimate: average 80kg fuel saving per flight in RVSM
- 10,000 flight daily in EUR RVSM
 - ⇒ yearly saving 290,000 tons
 - ⇒ yearly 913,500 tons less CO₂
 - ⇒ yearly 4,350 tons less NO_x

How Much is a 1% Reduction in Fuel Worth?

Airplane Type

Fuel Savings
(Gal/Year/Airplane)

737

15 000

727

30 000

757

25 000

767

30 000

777

70 000

747

100 000

(* Assumes typical airplane utilization rates)

- Circular 303

Operational Opportunities to Minimize Fuel Use and Reduce Emissions

Approved by the Secretary General
and published under his authority

February 2004

International Civil Aviation Organization



Doc 9750
AN/963

Doc 9750

Global Air Navigation Plan for CNS/ATM Systems

Approved by the Secretary General
and published under his authority

Second Edition — 2002

International Civil Aviation Organization



- ICAO promotes various workshops on operational opportunities
- For information, see the ICAO website

What Are Market-Based Measures?

- “*are policy tools that are designed to achieve environmental goals at a lower cost and in a more flexible manner than traditional command and control regulatory measures.*”
- ICAO has looked at three types:
 - voluntary mechanisms
 - emissions charges
 - emissions trading

Types of MBMs

- Voluntary Measures

- government and other entity agree to take specified actions or meet specified goals

- Emissions Charges

- a charge on the amount of emissions
 - revenues used to mitigate the environmental impact of engine emissions

- Emissions Trading

- the total amount of emissions would be capped
 - allowances in the form of permits could be bought and sold to meet emission reduction objectives
 - open trading allows trading across sectors

MBMs

- Open emissions trading system is cost effective solution for CO₂
- Voluntary measures advantageous for short-term implementation
- Further studies should be carried out on levies and further guidance developed
- More work needed on impact on developing countries

Voluntary Measures

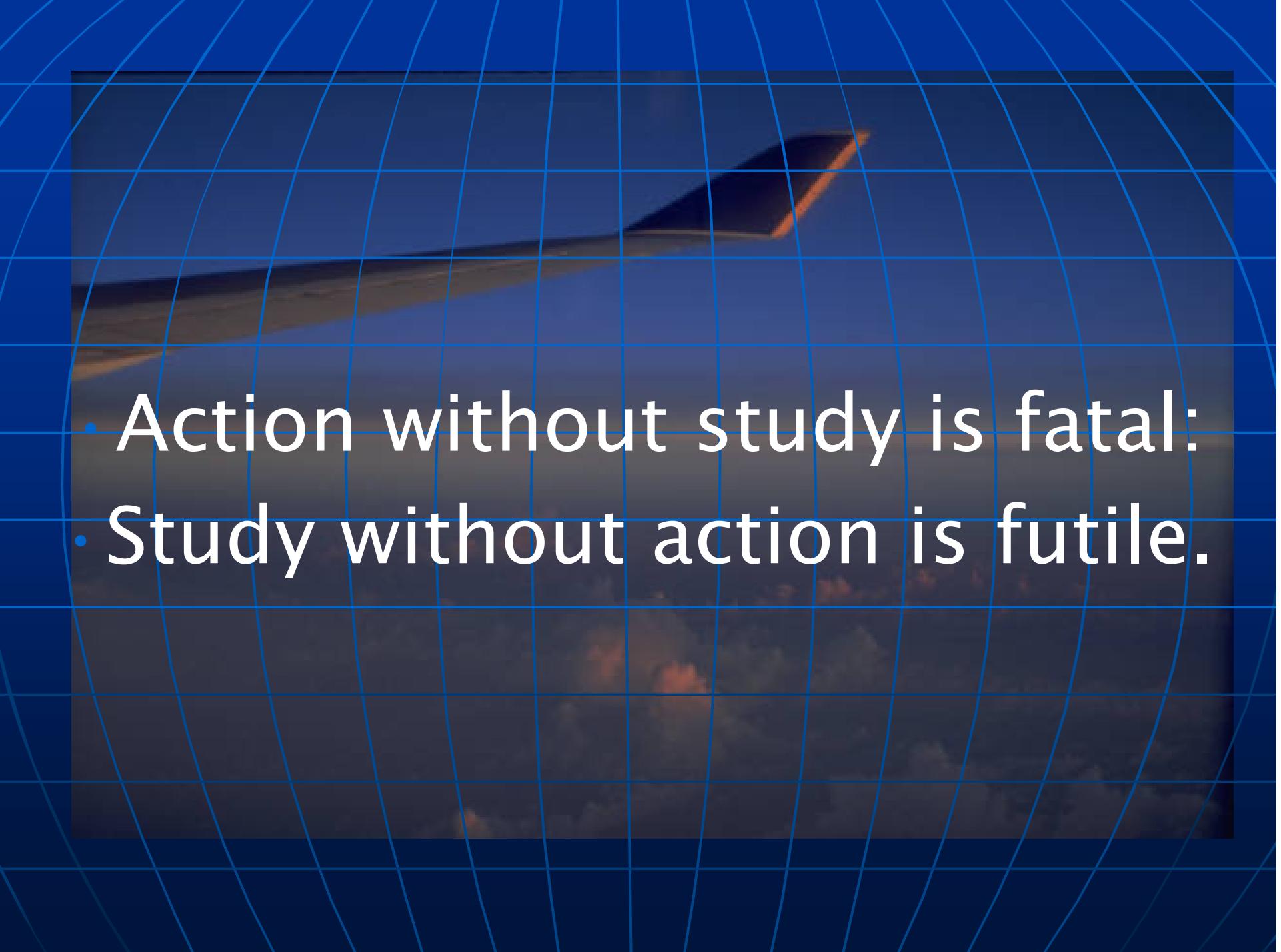
- Seen as a possible short-term measure
- A33 urged Council to facilitate actions by developing guidelines
- A template agreement and guidance on voluntary measures to reduce aviation emissions was developed and is available on the ICAO website
- CAEP will report on State's experiences

Local Air Quality Emission Charges

- Take account of past experience from States
- Take inspiration from concept of balanced approach
- Take account of CAEP Action Plan and
- Study cost effectiveness of the air quality charges

Emissions Trading

- ICAO commissioned a group of consultants to provide analytical basis for making recommendations on emissions trading system covering GHG emissions from civil aviation
- Guidance is currently under development in CAEP and expected by next Assembly
- Some emissions trading schemes are currently operating (eg EU trading scheme)

- 
- Action without study is fatal:
 - Study without action is futile.



• THE END