

In-service Aircraft for a Global Observing System

In-Service Aircraft for the Global Observing System European Research Infrastructure

Andreas Volz-Thomas and the IAGOS Team

IAGOS-ERI Kickoff Meeting, Maastricht, 14.-16.9.2008

Outline

- **Scientific Background**
- **Objectives for the new ERI**
- **The way towards ERI**
 - Technical developments (IAGOS-DS)
 - Preparatory Phase
- **Status and Outlook**



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Scientific Issues

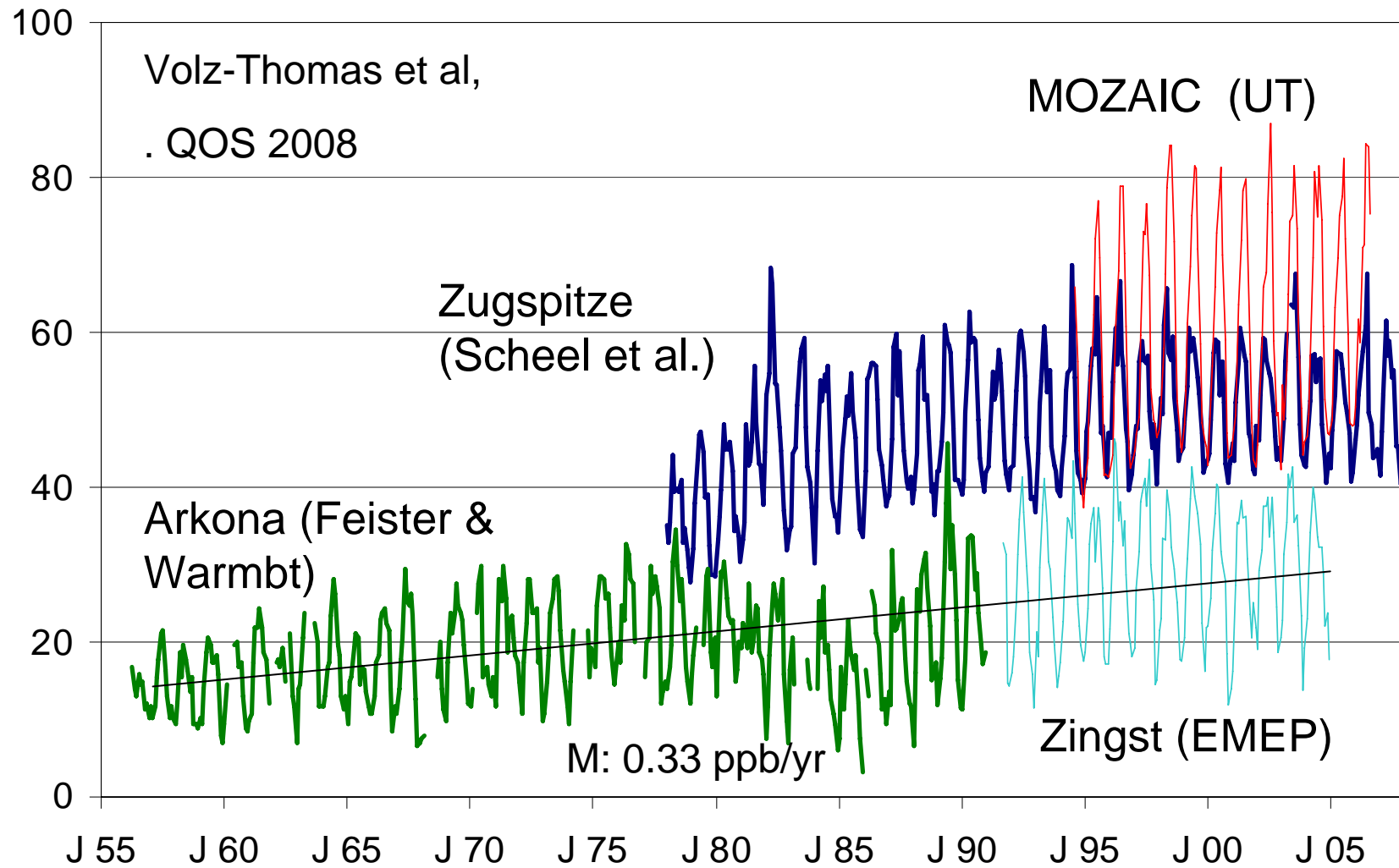
- **Ozone Trend and Budget**
- **Regional Air Quality**
 - vertical profiles of CO, NO_x, particles
- **Longrange Transport of Air Pollution**
 - Ozone precursors, particles
- **Climate Change (GHGs, UTLS, Clouds)**
 - CO₂ and CH₄ budgets, particles,
 - Transport processes in the UTLS
 - Ice super-saturation and cloud formation
 - Secondary aerosol effect
- **Numerical Weather Prediction**
 - collaboration with AMDAR for H₂O



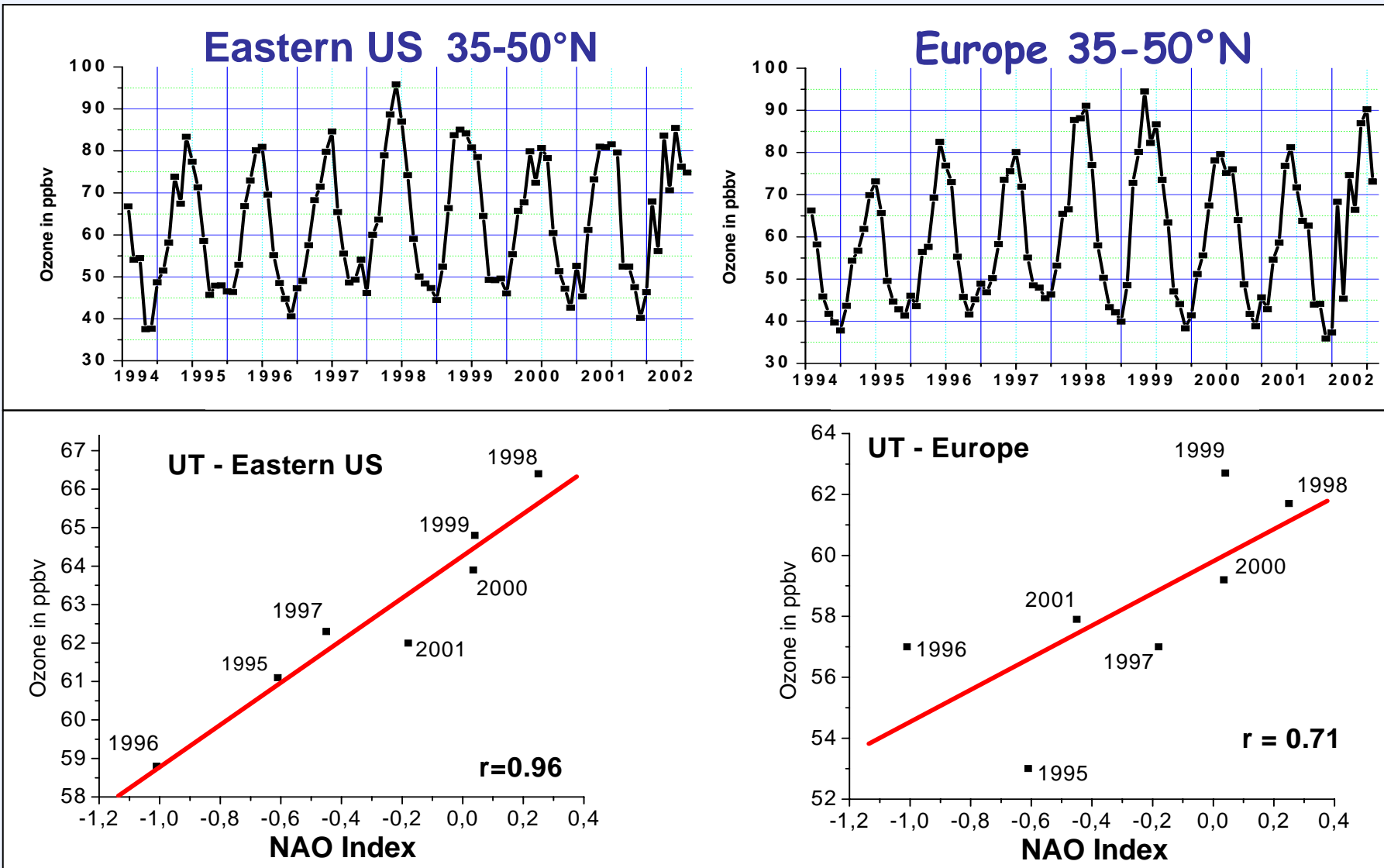
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Do we understand ozone trends?

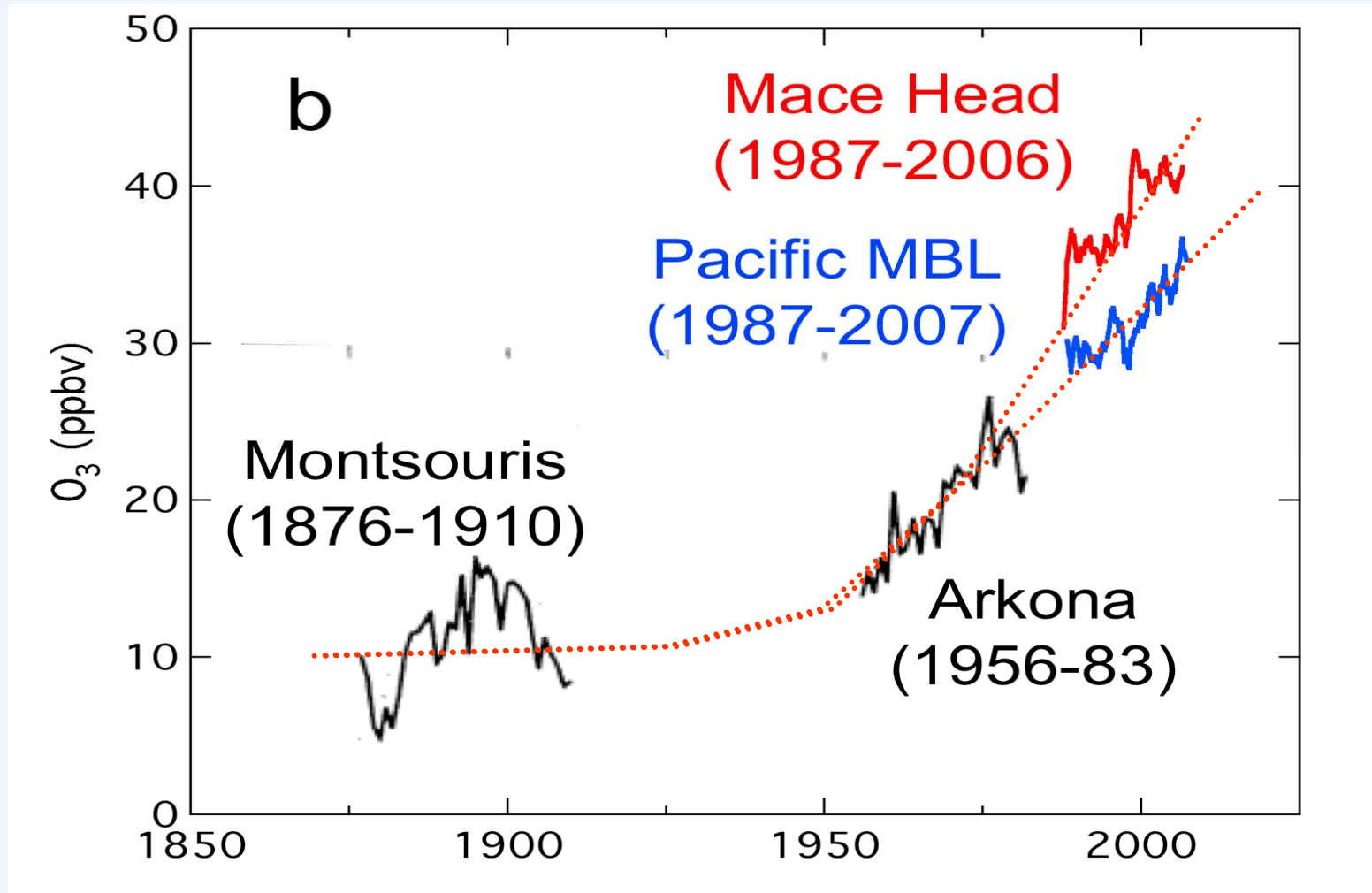


Interannual Variability of UT Ozone



Ozone Background Increase

Parrish et al., 2008, ACPD



The Value of Regular In-situ Aircraft Data

- **Trends in the UT and LS**
 - Good spatial and temporal resolution
 - Regular quality assurance
 - Good comparability (same systems/QA everywhere)
- **Validation of CTMs/GCMs**
 - Tropospheric profiles of CO, CO₂, NO_x, aerosol, ..
- **Validation of satellite retrievals**
- **Air Quality over developing regions**
- **Reasonable price (500 €/flight with 2 profiles)**



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Objectives for Infrastructure

- Equip 10-20 longrange aircraft with scientific instruments for chemical composition (H₂O, O₃, CO, CO₂, NO_x, NO_y) and particles (aerosol and cloud)
- Improved CARIBIC container
- Longterm deployment (>10 years)
- Global coverage (Pacific, SH)
- Open data policy (improved data base)
- Near-realtime data provision (GMES-GAS)



Routine Aircraft Projects

Project	period	a/c	fl/yr	species measured	Future
GASP	1975-1979	5	1500	H ₂ O, O ₃ , CO, aerosol	terminated
MOZAIC	1994-2007	5	2500	H ₂ O, O ₃ , CO, NO _y	=> IAGOS + CO ₂ , NO _x , aerosol, cloud part.
NOXAR	1995-1996	1	500	NO, NO _x , O ₃	terminated
JAL	Since 1993	1	26	CH ₄ , CO, CO ₂ (12 grab samples/flight)	=> CONTRAIL 5 aircraft, in situ CO ₂
CARIBIC	Since 1997	1	15	H ₂ O, O ₃ , CO, aerosol, grab samples for VOC, N ₂ O CFCs, isotopes,	=> IAGOS

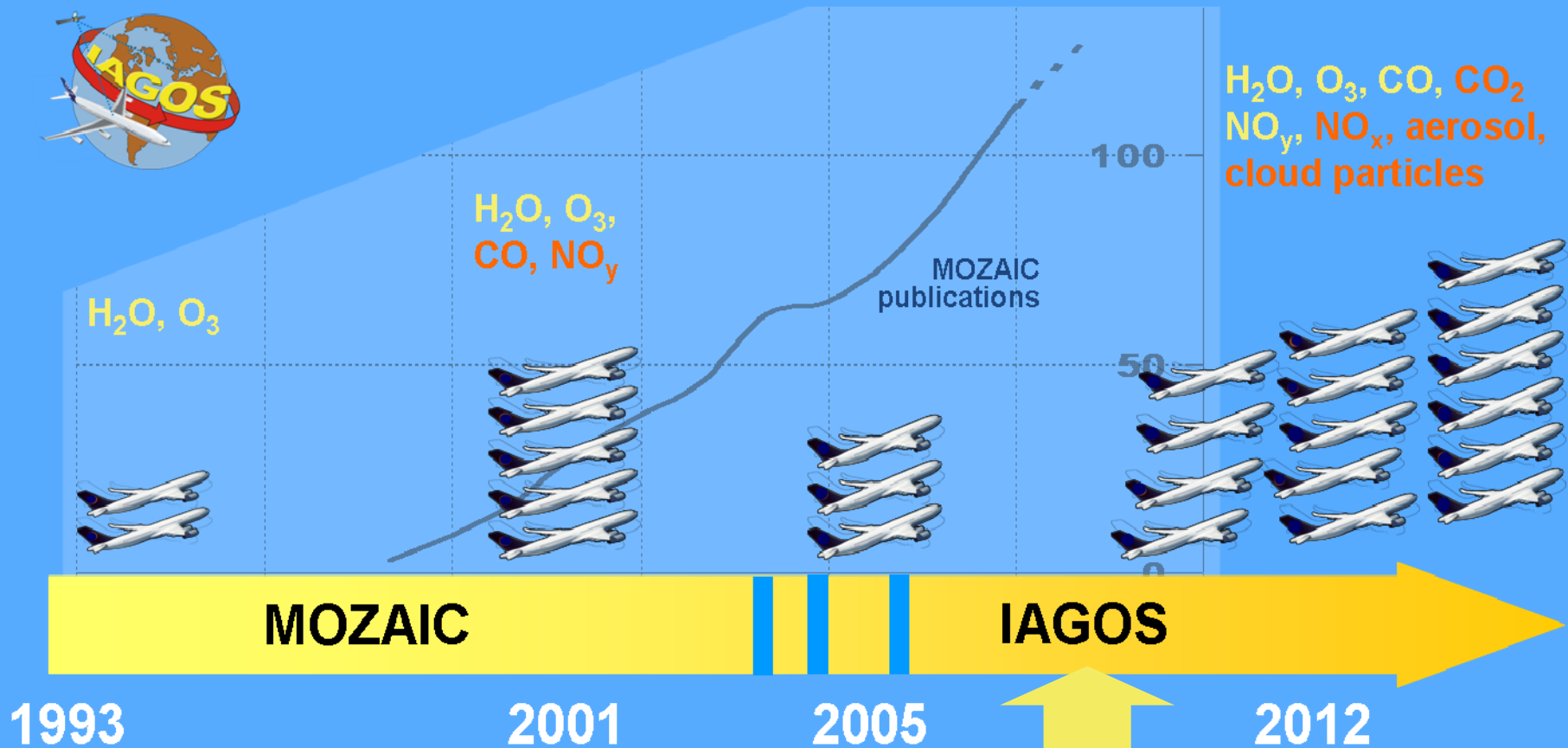


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In-Service Aircraft for a Global Observing System

A new European Research Infrastructure (ESFRI Roadmap 2006)



CARIBIC



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The Way Towards ERI

- **IAGOS Design Study (2005-2009)**
 - Redesign of MOZAIC Instruments
 - Package I (O3, CO, H2O, BCP) CNRS (FZJ, UMAN)
 - Package II (NOx or NOy) FZJ
 - STC for A340-300 CNRS, FZJ
 - Development of new instruments
 - Aerosol (OPC and CPC) DLR
 - CO2 and CH4 (CRD) MPG
 - Cloud particles (BCP) UMAN
 - Small package UCAM
 - Near-realtime data transmission MF-CNRM
- **ESFRI Roadmap 2006**
- **Preparatory Phase (2008-2012)**



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MOZAIC-Rack (left)

=> IAGOS Package 1



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MOZAIC NO_y-Instrument



Inlet Plate

Lufthansa unterstützt das EU-Forschungsprogramm MOZAIC. Im Reiseflug werden kontinuierlich alle klimarelevanten Spurengase gemessen.

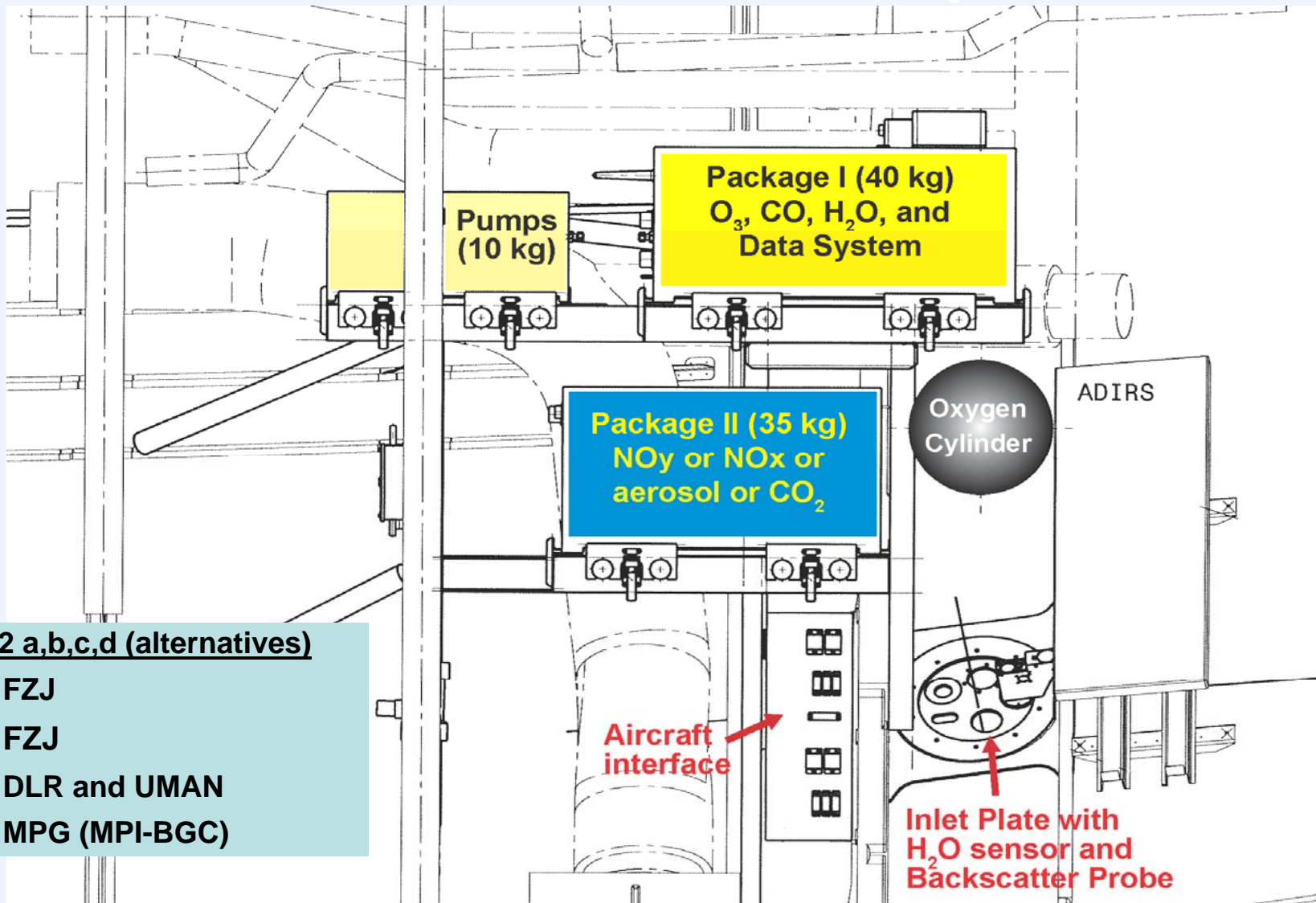
Foto: Udo Kröner / Lufthansa D53-49-6
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Technical Concept



Packages 2 a,b,c,d (alternatives)

NO_y: FZJ

NO_x: FZJ

Aerosol: DLR and UMAN

CO₂: MPG (MPI-BGC)



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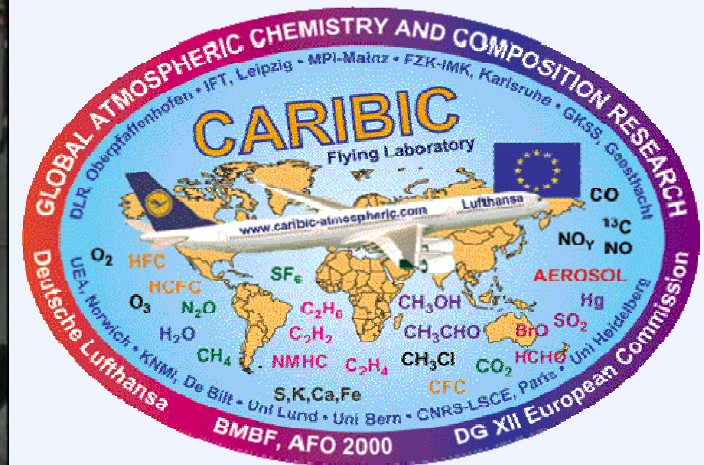
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CARIBIC

Cargo Container as flying laboratory

O₃, H₂O, NO_y, CO, CO₂, CH₄, aerosol,
VOC, CFC, etc., MAX-DOAS

4 flights per month



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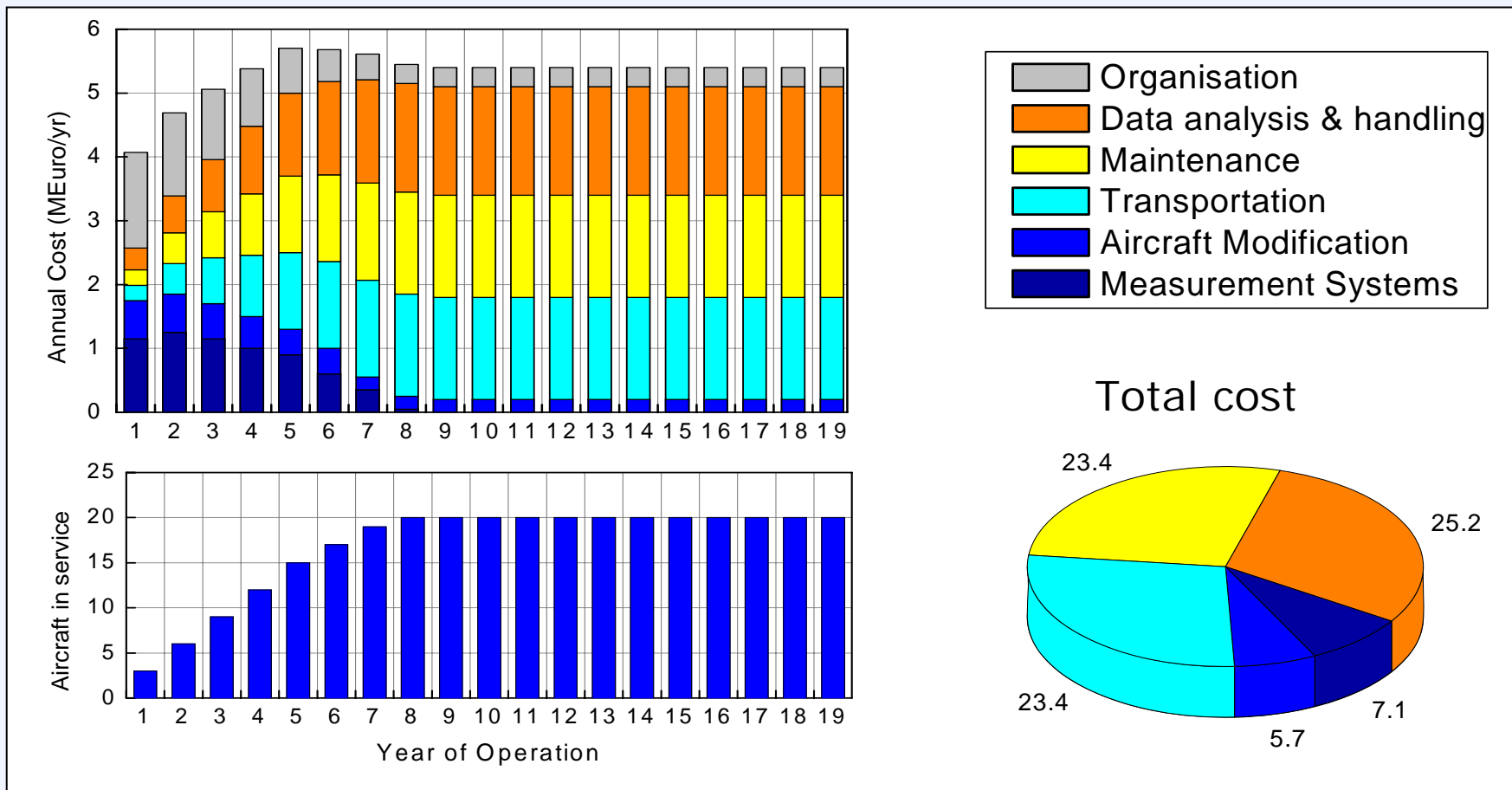
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Estimated Development and Cost

(from ESFRI Proposal)

5 MEuro/a => 100 MEuro over 20 years

50 % committed by partner institutions



Success of IAGOS-ERI

- **Extension of MOZAIC operation beyond 2004**
 - Still 3 aircraft in operation
- **Advances in instrument development**
 - Existing equipment improved
 - Development of new instruments
 - Technical spin-off to, e.g., EUFAR
- **Shaping the European Research Area**
- **Establishing routine aircraft in GMES**
- **Chances for truly global operation**
 - Thanks to the large support by Airlines !!
- **Visibility of European Research**



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Status and Outlook

2008	<ul style="list-style-type: none">- MoU with CA and NCU signed- FZJ/HGF Funding for ca. 3 a/c- Preparatory Phase started- CNRS Proposal for 1 a/c	
2009	<p>Package I and IIa,b certified</p> <p>First A340 equipped</p>	DLH (IAGOS-DS)
2010	<p>Second A340 equipped</p>	CA
2011	<p>2 more a/c equipped</p> <p>CO2 and aerosol package certified</p>	AF, CA, ??
2012	<p>Infrastructure established</p> <p>5-6 IAGOS aircraft in operation</p>	



Preparatory Phase for IAGOS-ERI

- **Preparatory work for**
 - Legal form of the new RI, including the relation with Airlines
 - Sustainable funding scheme
- **Coordination with**
 - AMDAR and GMES for realtime data provision
 - Scientific user community (data base)
 - European and Global Observation Strategies (GMES and GEOSS)
- **Legal preconditions for operation**
 - Realtime data transmission,
 - Aeronautical certification of CO2 and aerosol instruments,
 - Maintenance procedures
 - Extension of STC to A330 aircraft
- **Technical Work related to**
 - very small instrument package
 - very large instrument package (Caribic Container)



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Partnership

Project Partners

- FZJ
- CNRS (LA and INSU)
- Meteo France
- Univ. Cambridge
- Univ. Manchester
- DLR
- Lufthansa
- Airbus UK
- British Airways
- MPG
- enviscope GmbH
- IfT
- WMO
- NERC
- CNES

Associated and potential partners

- ECMWF (non-signatory partner)
- NCU Taiwan MoU signed
- China Airlines MoU signed
- Air France MoU in prep.
- Iberia interested
- Cathay Pacific interested
- South African Airlines interested
- Air Namibia MoU for MOZAIC



Thanks for Support !!

- **To the Airlines**
- **To the European Commission**
- **To the Partners and their Institutions**
- **To the Scientific Community**

Thank you all for coming to our kickoff meeting!!!



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