

Status and benefits of IAGOS for air quality monitoring within the United States

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On behalf of the IAGOS in the US working group

Presentation amended from IAGOS in the US presentation to Office of Federal Coordination for Meteorology and developed by:

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Vertical profiling of multiple species is expensive, but one cost effective method is to use commercial aircraft.

IAGOS (In-Service Aircraft for the Global Observing System) is a new European initiative to measure tropospheric and lower stratospheric air quality and greenhouse gases with instruments based on commercial aircraft. IAGOS is based on the proven operational demonstrated by MOZAIC (Measurement of Ozone, Water Vapor, Carbon Monoxide and Nitrogen Oxides Aboard Airbus In-Service Aircraft) .

Goal of IAGOS: Over the next decade install monitoring equipment on 10-20 commercial aircraft, based around the world.

At present IAGOS (and its forerunner, MOZAIC) has no facilities in the United States and has no funding connections to the United States. Regardless, IAGOS will monitor trace gases in US air space when its aircraft fly to the US, and the program will make the data freely available to US researchers.



IAGOS is eager to install its monitoring equipment on US based aircraft (Airbus A330), greatly increasing the profiling frequency within the USA.



IAGOS aircraft measurements

- Package I, on all aircraft, measures ozone, carbon monoxide, temperature, water vapor, cloud droplets**
- Package II, optional, measures one of the following:**

NO_x or NO_y or CO_2/CH_4 or aerosols

- Data will be available in near real-time, so it can support local air quality forecast.**

IAGOS Measurements

Package 1: (on each aircraft)

Ozone UV absorption (CNRS, Thermo Instruments)

CO NDIR with enhanced sensitivity (CNRS, TE)

H₂O Humicap (FZJ, Vaisala)

Cloud particles Backscatter Probe (UNIMAN, DMT)

Data acquisition (CNRS)

Realtime data provision (Meteo-France)

Package 2: (only one of the following 4 options per aircraft)

NO_x Chemiluminescence, Photolytic converter (FZJ)

NO_y Chemiluminescence, Catalytic converter (FZJ)

Aerosol 1 OPC, 2 CPC, Themrodenuder (DLR, Grimm)

CO₂/CH₄ Cavity Ringdown (MPI-Jena, Picarro)

To bring IAGOS to the USA, a group of scientists has recently formed the “IAGOS in the USA” working group and written a white paper listing the benefits of the program for operational air quality monitoring and for climate research.



Formed in August, 2010, the IAGOS in the USA Working Group has representation from a broad range of US government agencies and universities

NOAA / U. of Colorado: Owen Cooper (US lead) & Colm Sweeney

FAA: Mohan Gupta, Rangasayi Halhore & S. Daniel Jacob

EPA: Terry Keating, Darrell Winner, Richard Scheffe, S.T. Rao & Jim Szykman

NASA: Jay Al-Saadi

Harvard University: Jennifer Logan

University of Alabama: Mike Newchurch,

National Center for Atmospheric Research: Bill Randel

Department of Energy: Jared S. Dreicer

European-based IAGOS members: Andreas Volz-Thomas, Jean-Pierre Cammas, Philippe Nédélec,

Initial Goal of the Working Group:

- Install IAGOS Package I & II on a single U.S.-based A330 by the end of 2012.

Current Status:

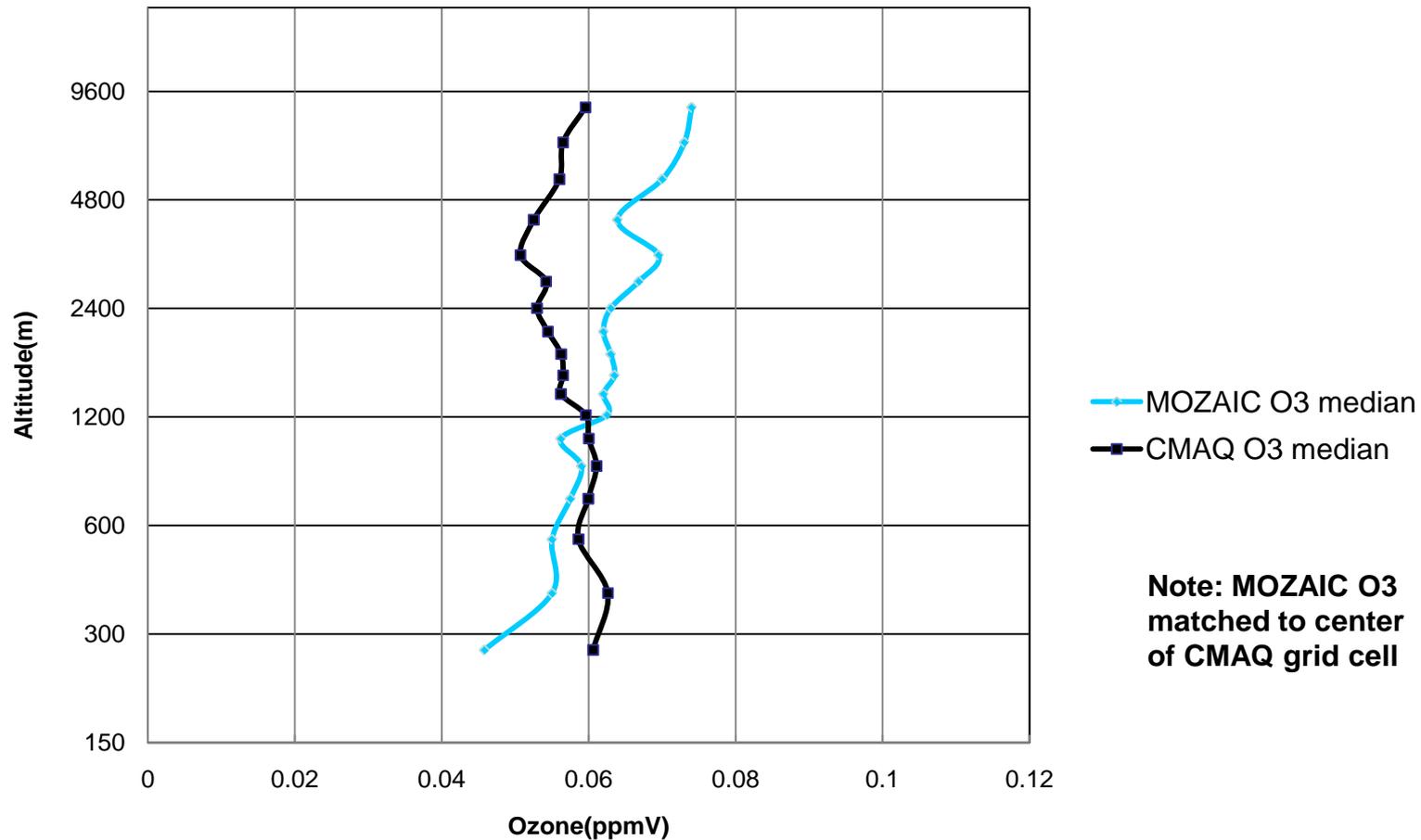
- Initiated discussions with Delta Airlines as potential carrier airlines.
- Awaiting approval of IAGOS instruments on A330 airframe in Europe to be followed by process for FAA approval of IAGOS instruments on US aircraft. Preliminary discussions with the FAA have begun.
- EPA is currently working to demonstrate value of IAGOS data through use of MOZAIC data for CMAQ model evaluation and development coincident with EPA's participation in the Air Quality Model Evaluation International Initiative (AQMEII). EPA is prototyping web access to available observations of air pollution aloft from MOZAIC/IAGOS .
- NOAA efforts on-going to demonstrate the value of near-real-time IAGOS data for assimilation into air quality forecast models using current MOZAIC data.
- Seeking funding sources for initial instrument package on 1st A330 and maintenance cost with a focus on leveraging across US agencies.

Benefits of bringing IAGOS measurements to a US carrier for Air Quality monitoring related to Photochemical Assessment Monitoring Station (PAMS) program

- IAGOS provides a cost effective way to obtain multiple profiles per day from the surface to 12 km of **ozone, CO water vapor, and cloud properties** (package 1), plus options for **NO_x, NO_y, aerosols**, or CO₂ and CH₄ (package 2).
- Participation by a US airline such as Delta would likely mean initial aircraft would be based in Atlanta, GA; complementary to the existing Atlanta PAMS network. Strong geographical link between major US airports and location of monitors in PAMS network
- IAGOS data can be applied to the monitoring of air quality in the boundary layer and free troposphere at very high resolution. Profiles can be used to:
 - Model evaluation in the SIP process
 - Reveal any trends in trace gases
 - Help assess inter-urban and inter-state transport of pollution.
 - Improve AQI and model based air quality forecast , since IAGOS data will be available in near real-time .

Initial Plot of MOZIAC and CMAQ Ozone Profiles July 2006, Outbound Flights (ATL)

Hartsfield-Jackson Atlanta International Airport (ATL)
July 2006 MOZIAC Outbound Profile Flights (n =12)
Median Ozone (ppmV)



IAGOS in the US offers tremendous potential for expansion following completion of initial goal of one instrument package on US based A330.

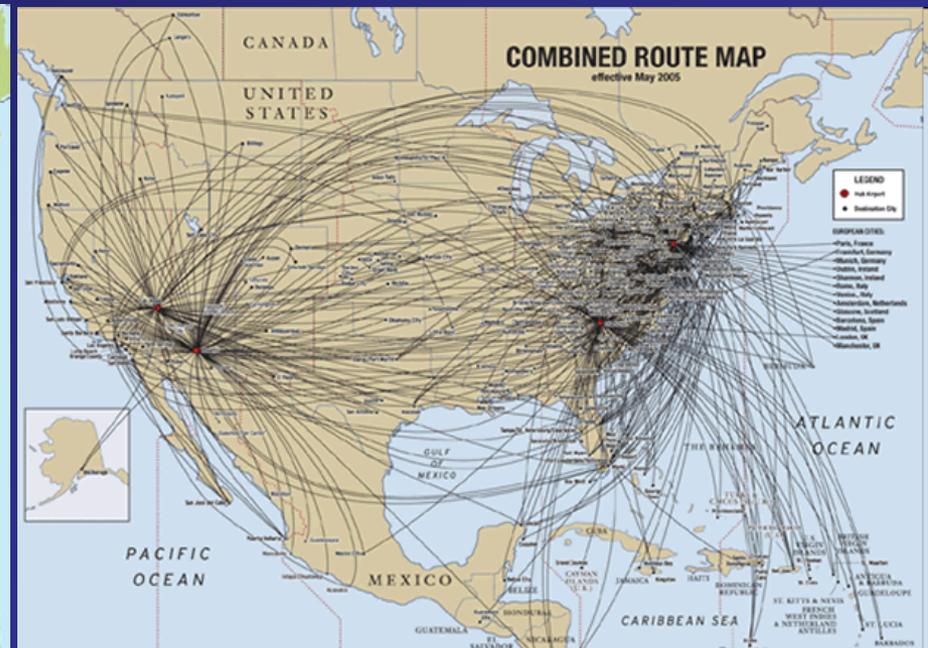
At present there are two large US airlines with A330s in their fleets.

- Delta Airlines has 32 A330's, currently the largest A330 fleet in the USA.
- USAirways will soon have 35 A330s.

Delta flight routes



USAirways flight routes



The Bottom Line

Cost per flight is ~ \$900, includes two profiles and UTLS measurements. Air sampled at 4-second resolution, yielding 6,300 measurements for a 7-hour flight.

In comparison ozonesondes costs ~\$1000 each and provide just a single vertical profile of ozone.

A typical A330 is in service 340 days a year, equating to a yearly maintenance cost of ~ \$300,000.

The cost for purchasing and installing Package 1 is ~ \$340,000.

The cost for purchasing and installing Package 2 is ~ \$180,000.

Concluding remarks:

Through MOZAIC, IAGOS has a proven track record on providing operational trace gas and aerosol profile measurements.

IAGOS in the USA can be a reality by 2012, providing increased near real-time trace gas and aerosols profiles measurements via a US airline.

The IAGOS measurements can help fill an existing data gap in geographic areas relevant to PAMS.

However, funding sources need to be identified:

Given that the IAGOS data are relevant to the operational monitoring and research needs of many US agencies and research institutions, US-based IAGOS aircraft could be funded by a consortium of agencies and institutions.

If several agencies each contribute ~\$100K to \$300K/year, IAGOS in the USA can be sustained.