Plans for the Ozone-cci

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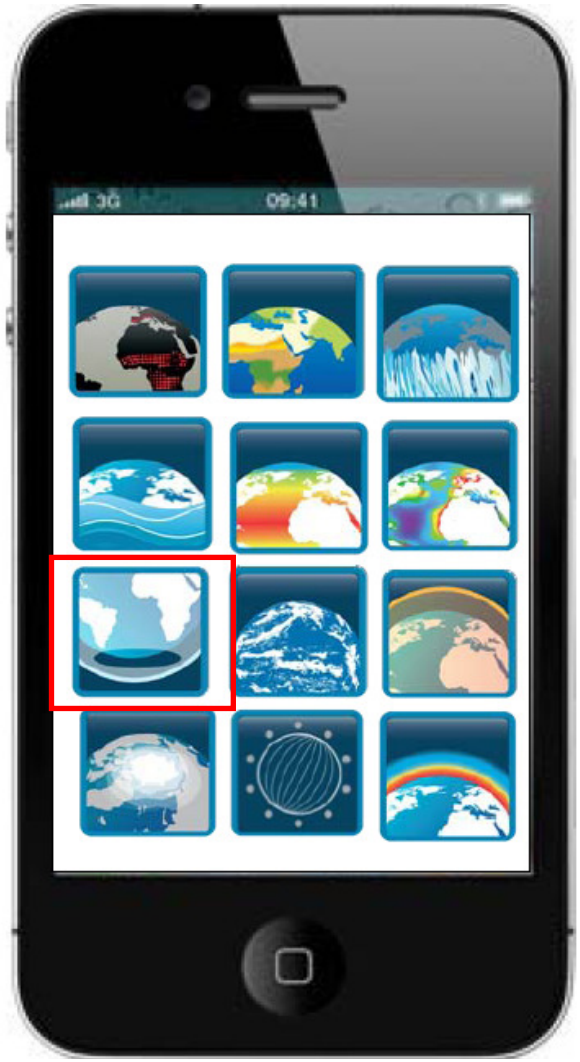
(on behalf of the Ozone_cci team)

The ESA Climate Change Initiative (CCI)

- **Overall aim: generate space based climate data record**
- **using an integrated and consistent approach**



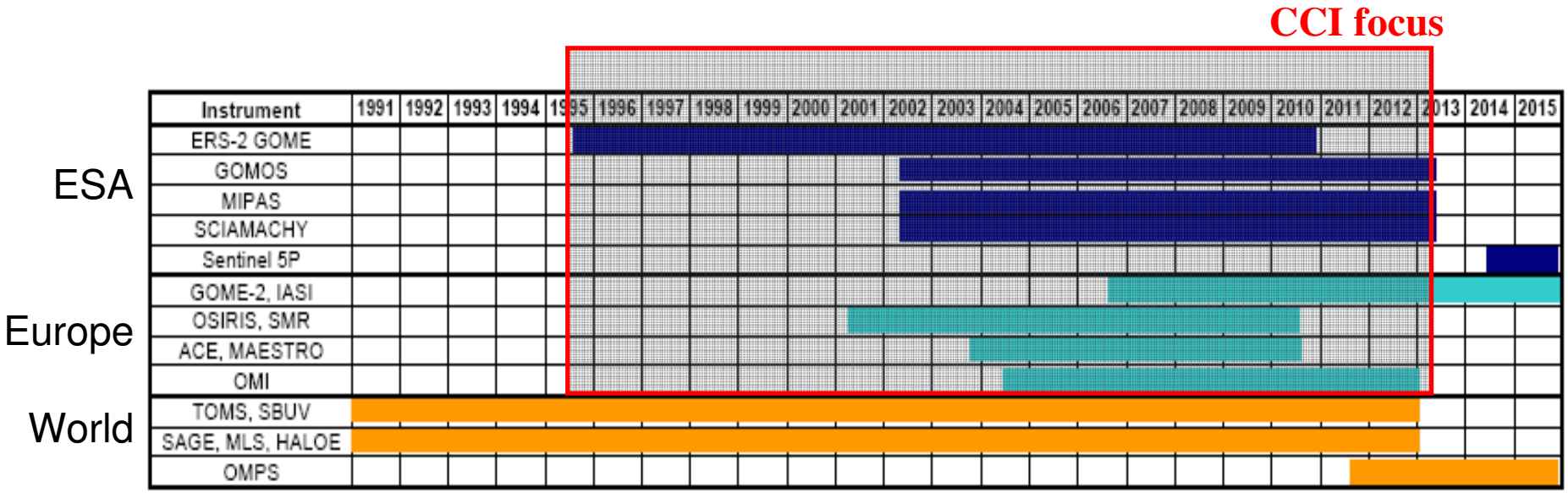
- **Time frame: 2010-2013 (first phase)**
- **12 projects**
  (11 ECVs + CMUG)

- **Ozone_cci → started on 1st Sep 2010**

Objectives

1) **To develop, produce and validate** long-term global ozone seeries derived from multiple satellite instruments
2) **To evaluate the impact** of the resulting improved Ozone ECV data products in a climate perspective
3) **To explore System Specifications** for ozone ECV production

Satellite instruments and data sets



- **Ozone ECV products** to be developed:
  - **Total ozone** from all ESA UV-Vis nadir sensors
  - **Nadir profiles** from all European UV-Vis sensors
  - **Limb and occultation profiles** from ENVISAT & TPM sensors

- CCI Focus → ESA and Third Party Mission (TPM) sensors
- Non-european sensors → validation and quality assessment

Main tasks

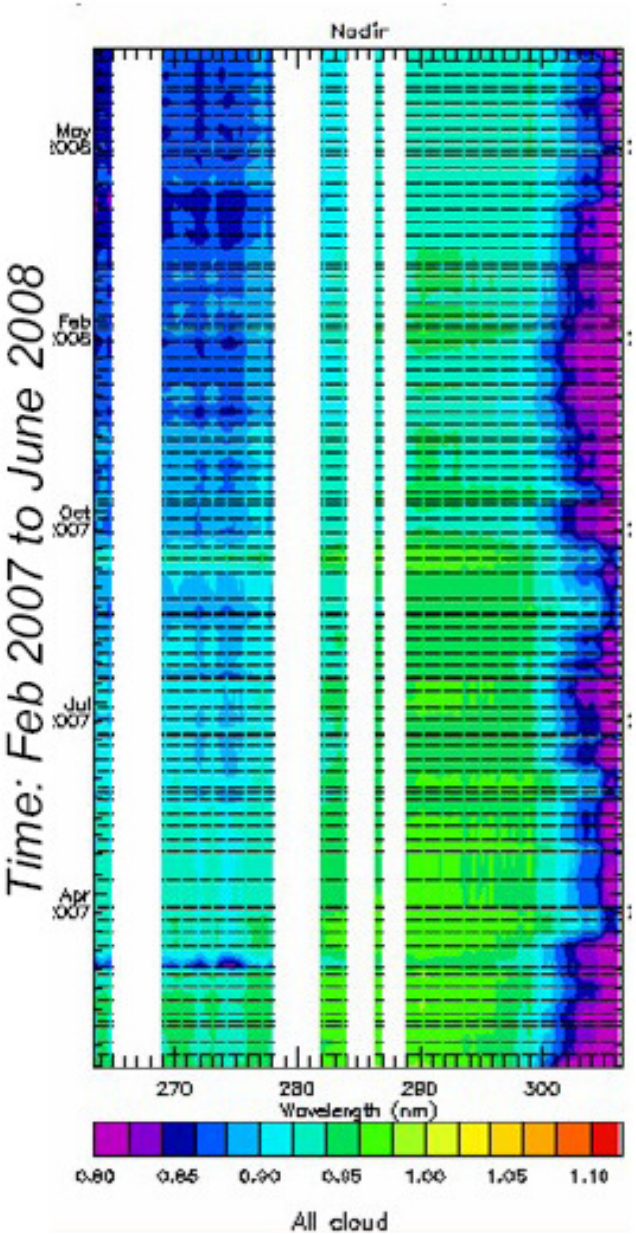
- **Level-1** → improved soft calibrations for UV radiances
- **Level-2** → retrieval algorithm improvements and standardisation, selection through round-robin exercises
- **Error analysis and data characterisation**
- **Data merging**
  - Total columns
  - Nadir profiles
  - Limb/occultation profiles
- **Prototyping, processing, validation and Climate User Assessment**
- **Documentation**

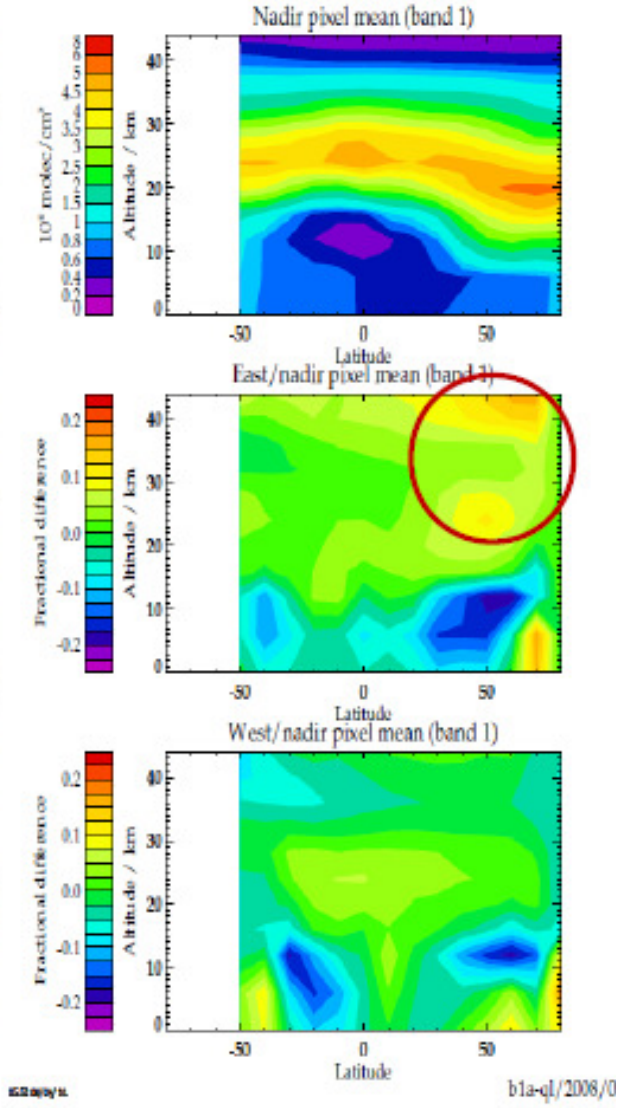
The team

13 partners

Improving the retrievals: Diagnosis of Hartley Band radiometric errors

- GOME-2 reflectance generally higher than model
  - Feb'07: by ~several % <280nm
  - Jun'08: by 10 – 15% <280nm
- Discrepancy depends on across-track position and leads to across-track bias in retrievals
- To be handled by fitting radiometric calibration correction as GOME-1

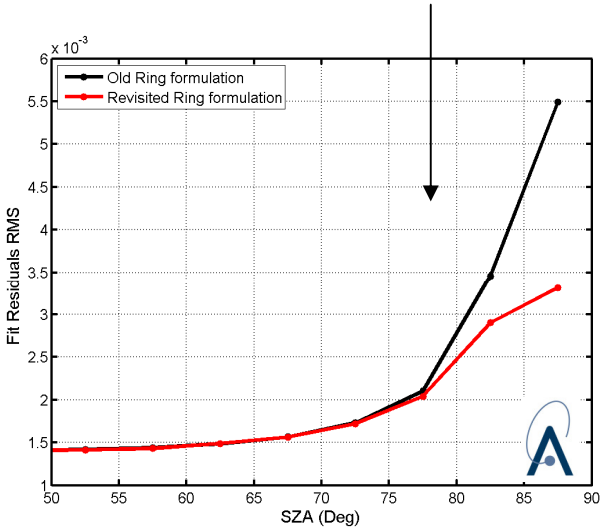




May 2008

Level-2 algorithms

- **Total columns (BIRA-DLR)**
  - **Baseline algorithm is GDP5 (direct-fitting approach)**
  - **Under development for CCI:**
    - **Improved cloud treatment**
    - **New Ring correction → improved O_3 fits at large SZA**
    - **Acceleration of RT calculations**
    - **Error budget**

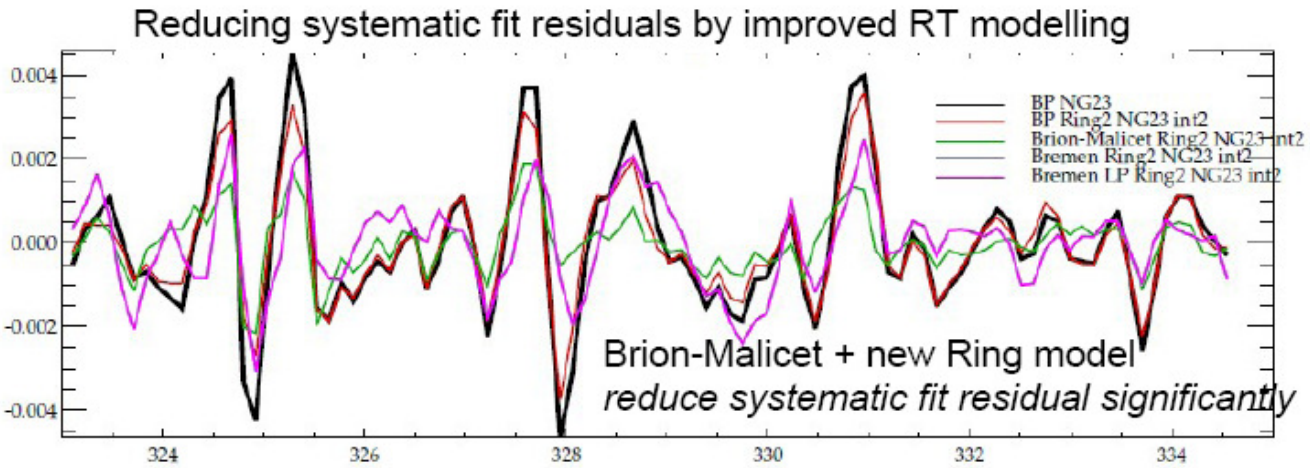


European UV-Vis Sensors:

GOME	1995-2003
SCIAMACHY	2002-2010
GOME-2	2007-2010

Level-2 algorithms

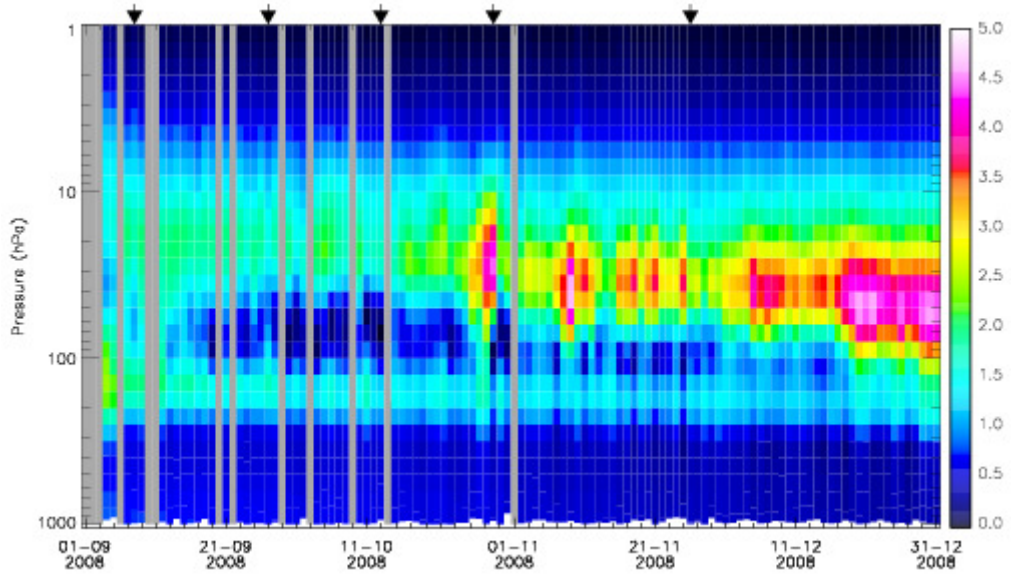
- **Nadir ozone profiles (KNMI, RAL)**
  - **Baseline algorithms are KNMI OPERA and RAL retrieval schemes**
  - **Merging of both algorithms through round-robin**
  - **Optimise retrievals for all altitudes from troposphere to stratosphere**



Science & Technology Facilities Council
Rutherford Appleton Laboratory

UV-VIS nadir satellite observations

• SBUV (not used)	1978-2010	NOAA
• GOME	1995-2000	ESA
• SCIAMACHY	2002-2010	ESA
• OMI	2004-2010	NASA/KNMI
• GOME-2	2007-2010	EUMETSAT



Timeseries of GOME-2 ozone profiles over Neumayer in 2008 (van Peet et al., GRL 2009)

Limb viewing type of sensors

- Main focus → the **characterization of individual data sets** (sampling, geographical coverage, horizontal and vertical resolution) and on the **error budget**

SCIAMACHY → IUP scientific algorithm (full altitude coverage)
See talk by C. von Savigny

GOMOS → operational product (IPF v. 6) **See talk by J. Tamminen**

MIPAS **See talk by T. von Clarman**

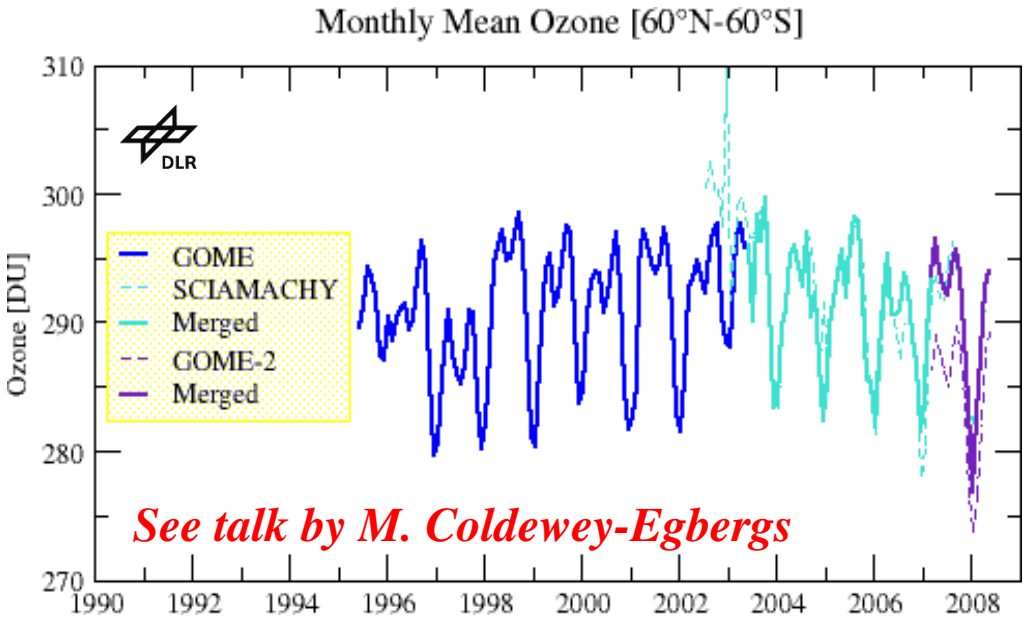
- Selection among 4 competing algorithms (Round-Robin)
- Full involvement of MIPAS QWG through consultancy mechanism

OSIRIS → Univ. Saskatchewan **See talk by D. Degenstein**

Data merging

The issue:

How to combine measurements from sensors having different sampling, resolution and bias ?



Different possible approaches to be reviewed:

1) Bias corrections from "a" satellite reference (e.g. GOME)
2) Bias corrections from constructed satellite reference (e.g. average from different sensors)
3) Bias corrections based on validation data sets
4) Assimilation in 3D-CTM for merging

Merging of limb viewing sensors

- Merging of ENVISAT & TPM limb & occultation sensors is a (big) challenge!
- Not attempted so far
- Key issues to be addressed:
  - How to use errors from individual data sets in the merging and propagating these errors in the final merged product?
  - Different merging strategies might be needed according to different requirements from data assimilation, CCMval, and trend assessments
- One expected key output of the ozone_cci project

Validation

- Independent experts on ground network ozone measurements (columns and profiles)
- Critical knowledge of quality and maintenance of correlative data sets.

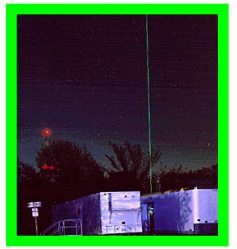
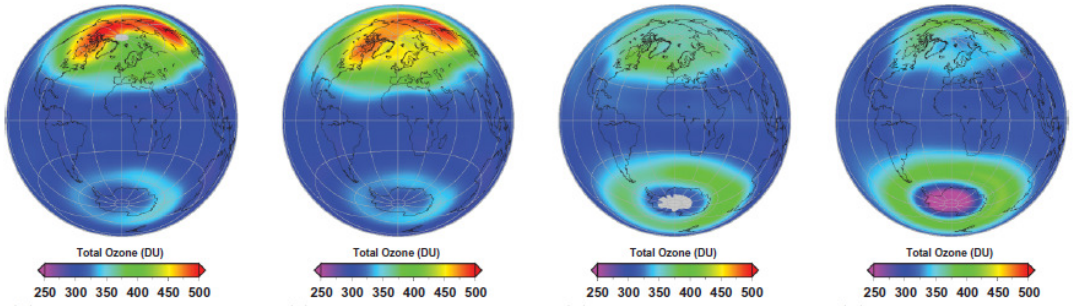



Table I: Ground-based data sets

Sensor	Data product type	Source of the data
Brewer UV spectrophotometer	Level 2, column	WOUDC, NDACC
Dobson UV spectrophotometer	Level 2, column	WOUDC, NDACC
DOAS UV-vis spectrometer	Level 2, column	NDACC
Baloon-borne ozonesonde	Level 2, profile	WOUDC, NDACC, SHADOZ
Lidar	Level 2, profile	NDACC
Microwave radiometer	Level 2, profile	NDACC

Climate modelling

- Climate Research Group (CRG → **DLR, UCAM, KNMI**)
- Specialized in climate research including stratosphere-troposphere responses and feedbacks
- Involved in SPARC CCMVal activity
- Participate to WMO/UNEP Assessment of Ozone Depletion and IPCC reports
- Several project partners involved in IO_3C



Comparison of data derived from satellite and a CCM

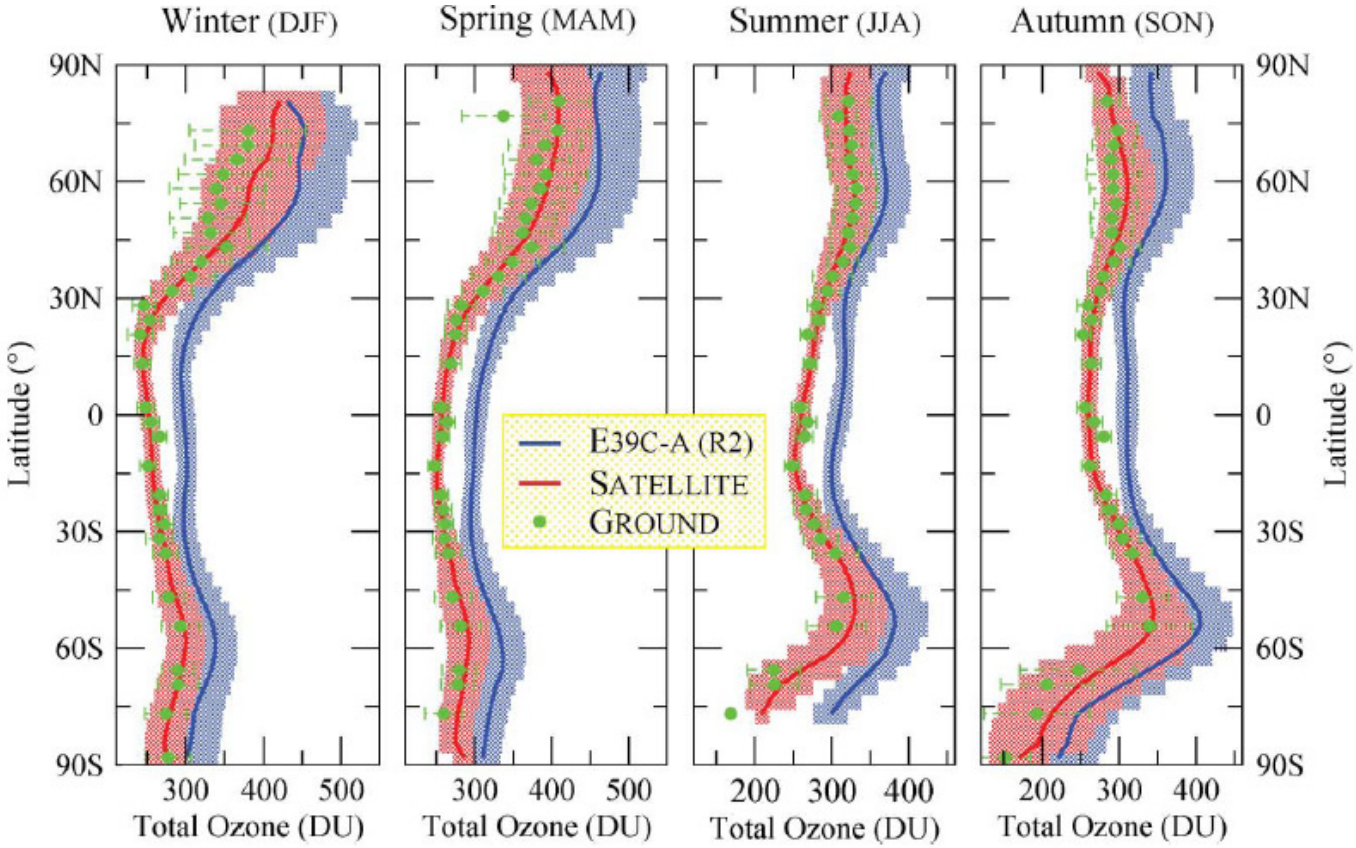


Figure 5. Zonal mean (June 1995 to May 2008) total ozone values for each season from satellite instruments (mean values in red with standard deviations as background surfaces), ground-based measurements (green points with mean values and standard deviations), and results from E39C-A (blue curves with mean and standard deviation).

from Loyola et al., 2009

User Requirements

- **User requirements are being defined for the three ozone ECV products:**
  - **Total ozone column**
  - **Nadir-based ozone profiles**
  - **Limb-based ozone profiles**

- **Following requirements set by GCOS and climate modellers (CMUG)**

- **Taking into account the WMO/IGACO vision of the integrated approach for ozone monitoring using satellite data, in-situ observations, and ground-based networks, in combination with model information**

User Requirements

- **The ozone data requirements consist of tables containing:**
  - **Horizontal resolution**
  - **Observation frequency**
  - **Time period**
  - **Accuracy**
  - **Stability**

Details → See poster by M. van Weele et al.

- **If applicable, distinction in ozone data requirements is made between driving research topics, geographical zone, and height range. A rationale is presented for the quantitative requirements, e.g. by reference to the contributing satellite instruments over the considered time period**

- **For each ozone product ancillary data requirements are defined including error characteristics, averaging kernels, a priori data, flags (e.g. detailed cloud and surface information), data format, conventions and basic visualization tools**

User Requirements

Example

O_3 data requirements
Nadir-based ozone profiles
***)**

Driving research topics e.g.

- **Regional differences in evolution ozone layer**
- **Regional differences in evolution of tropospheric O_3**
- **Seasonal cycle and interannual profile variability**
- **Short-term variability**

***) Numbers to be confirmed at the Ozone_cci progress meeting later this week**

Quantity	Height range		
	Troposphere	UT/LS	Middle Atmosphere
Horizontal resolution	200-400 km	~200 km	~100 km
Vertical resolution	Tropospheric column	3 km	10 km
Observation frequency	3 days	3 days	3 days
Time period	1980-2010	1980-2010	1980-2010
Accuracy for evolution	10 %	8 %	8 %
Accuracy for variability	20 %	15 %	15 %
Stability	..% / decade	..% / decade	..% / decade

In brief

Ozone_cci aims at:

- Consolidating the European ozone data sets, with focus on:
  - Improvement of retrieval algorithms
  - consistent data merging,
  - data characterization and error budget
- Produced the first merged limb/occultation data set based on ENVISAT and TPM missions
- Provide independent validation based on common standards
- Quantify status of ECV products against User Requirements
- Transparency → data sets and documentation will be freely available to the scientific community