

ESA Ozone Climate Change Initiative: towards combined use of satellite ozone profile measurements

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[5] University of York, UK

[6] Chalmers University, Sweden

[7] LATMOS, France

[8] BISA, Belgium

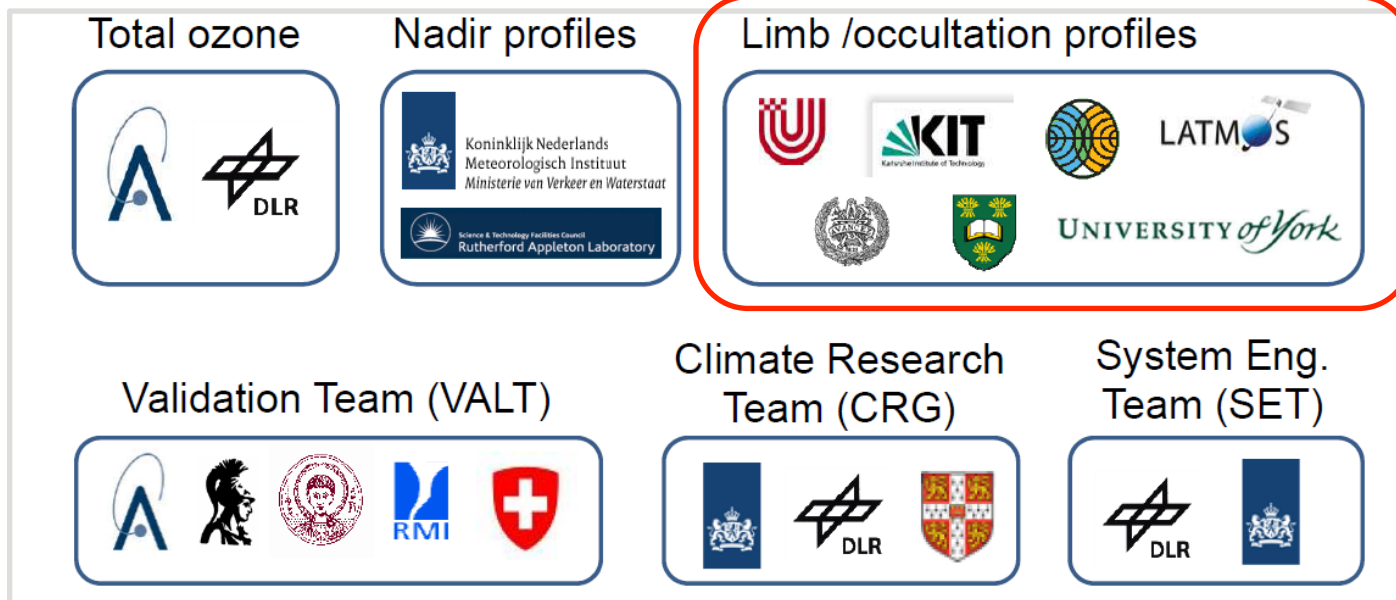
[9] ESA/ESRIN, Italy



The ESA Climate Change Initiative (CCI)



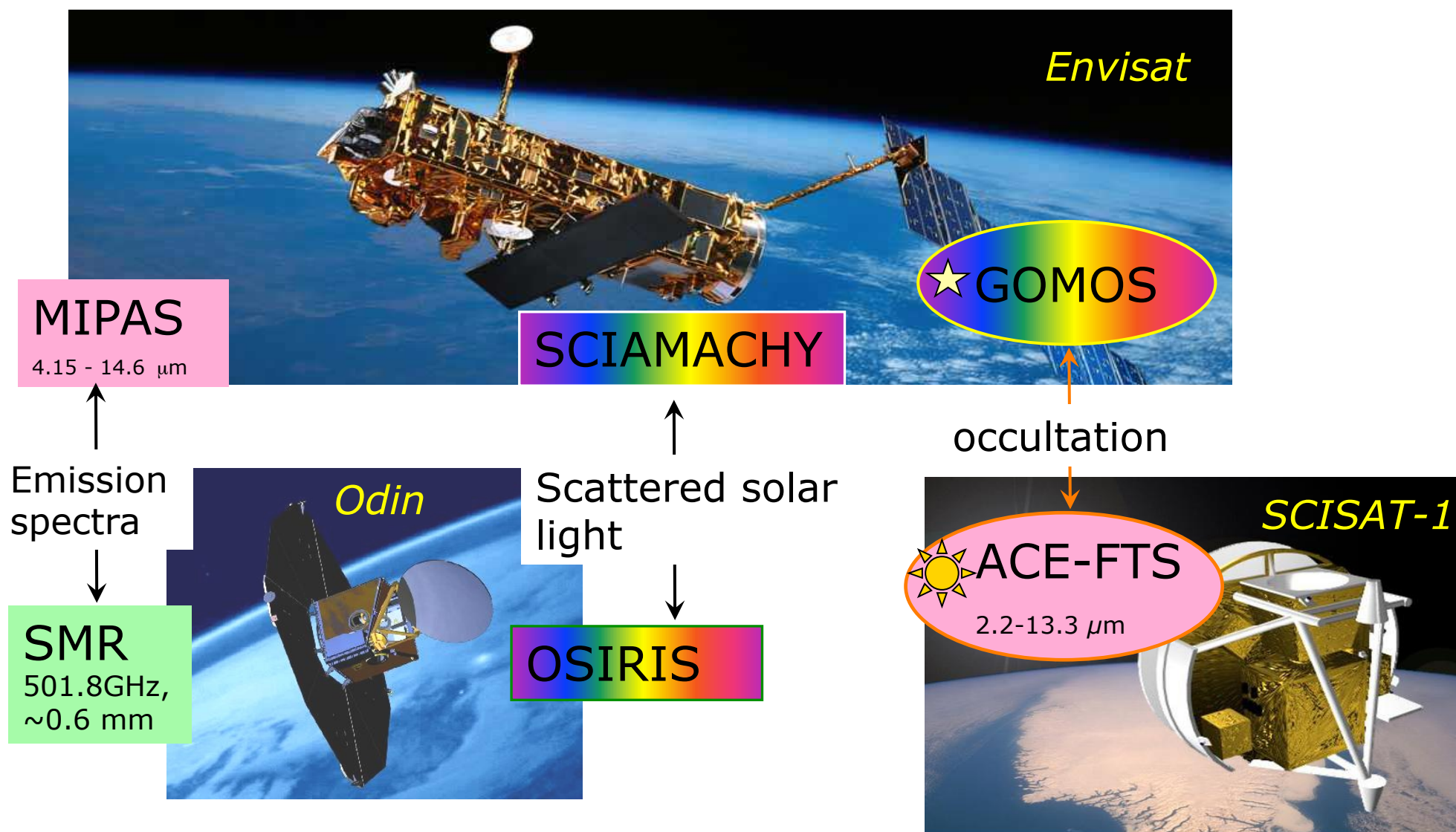
- A coordinated program to provide stable, long-term, satellite-based essential climate variable data (ECV)
- Time frame
 - 2010-2013 – 1st phase
 - 2014-2016 – 2nd phase
- 14 projects
 - 13 ECVs + climate modelling group
- Ozone_cci team (16 institutes from 10 countries)



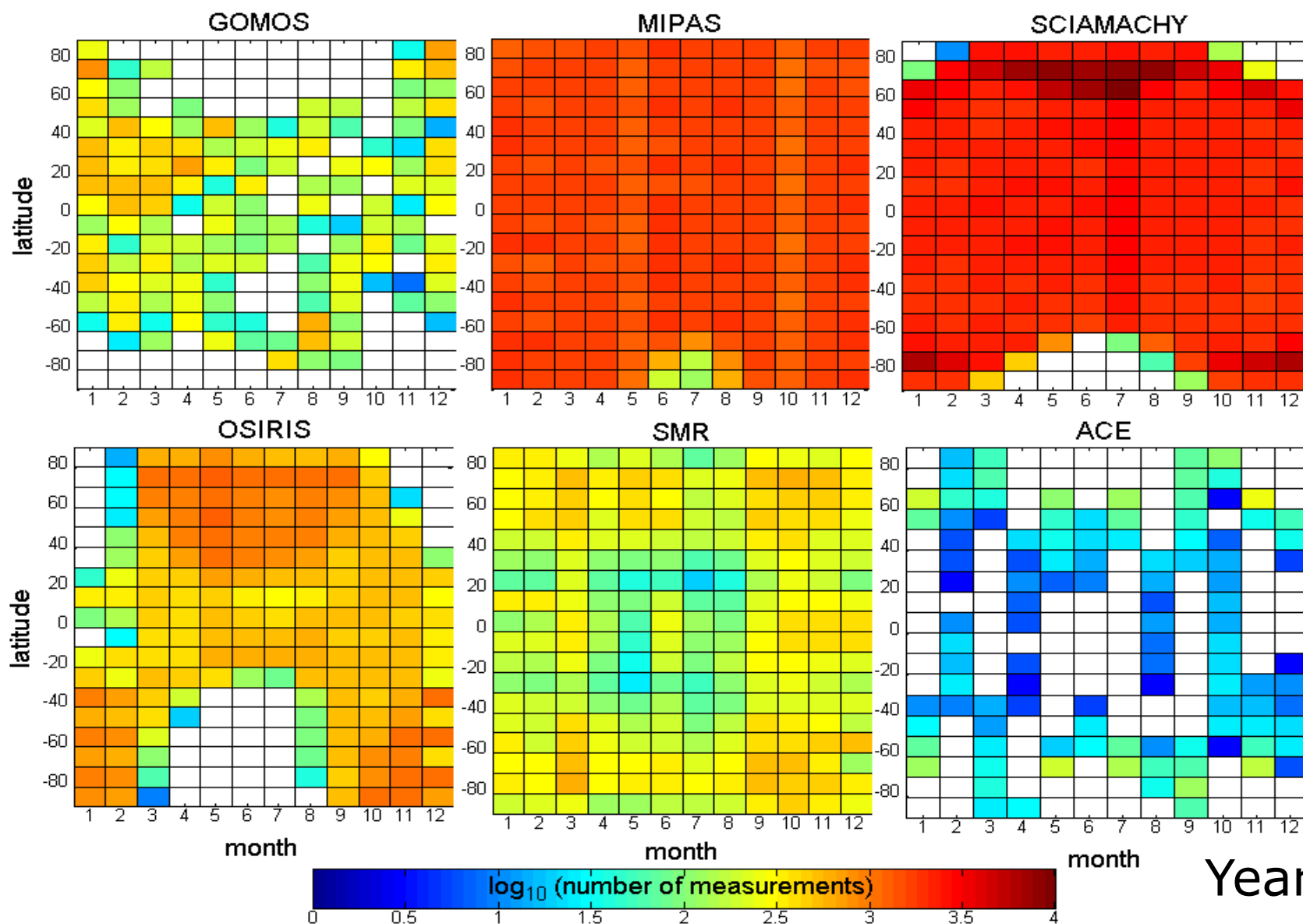
Ozone_cci limb profile instruments



Create state-of-the-art homogenized and combined datasets of ozone profiles



Coverage by the datasets



Year 2008

Outlines of the presentation

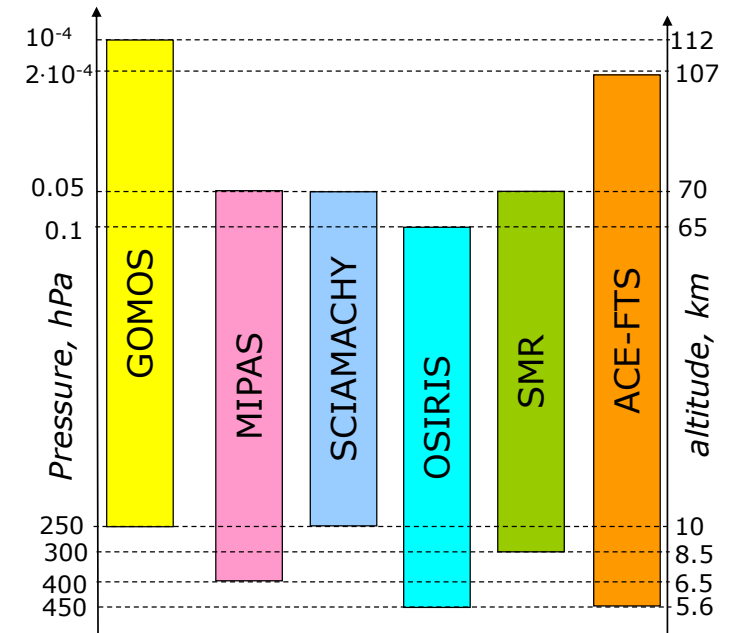


- **Datasets created in Phase 1:**
 - Harmonized datasets of ozone profiles (HARMOZ)
 - Monthly zonal mean ozone profiles
 - from individual instruments and merged
 - Semi-monthly mean ozone profiles with resolved longitudinal structure
 - from individual instruments and merged
- **Plans for Phase 2**

Harmonized dataset (HARMOZ)



- **Level 2 ozone profiles in the same vertical grid**
 - screened for invalid data by the instrument teams
 - Extended SPARC-DI pressure grid
- **Data are in the same netcdf format**
- **Mandatory parameters**
 - Coordinates/dimensions
 - Air pressure
 - Time (to index the profiles)
 - Geolocation: latitude and longitude
 - Ozone data
 - Profiles of mole concentrations
 - Profiles of ozone uncertainties
 - Profiles of vertical resolution
 - Parameters for different ozone representations (vmr/concentrations on altitude/pressure)
 - Profiles of altitude as a function of pressure
 - Profiles of temperature
- **Optional parameters**
 - Specific for each instrument
 - Related to data quality and its characterization



Bias tables



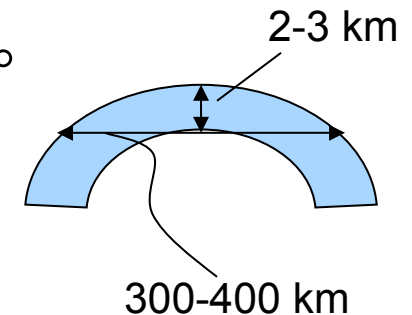
- For each pair of instruments
- For each month
- 2 types of collocation criteria
 - Standard: $|\Delta t| \leq 24 \text{ h}$ $|\Delta d| \leq 1000 \text{ km}$ $|\Delta lat| \leq 2^\circ$
 - Tight (for pairs including MIPAS and SCIAMACHY)
 $|\Delta t| \leq 4 \text{ h}$ $|\Delta d| \leq 400 \text{ km}$ $|\Delta lat| \leq 2^\circ$

- Parameters

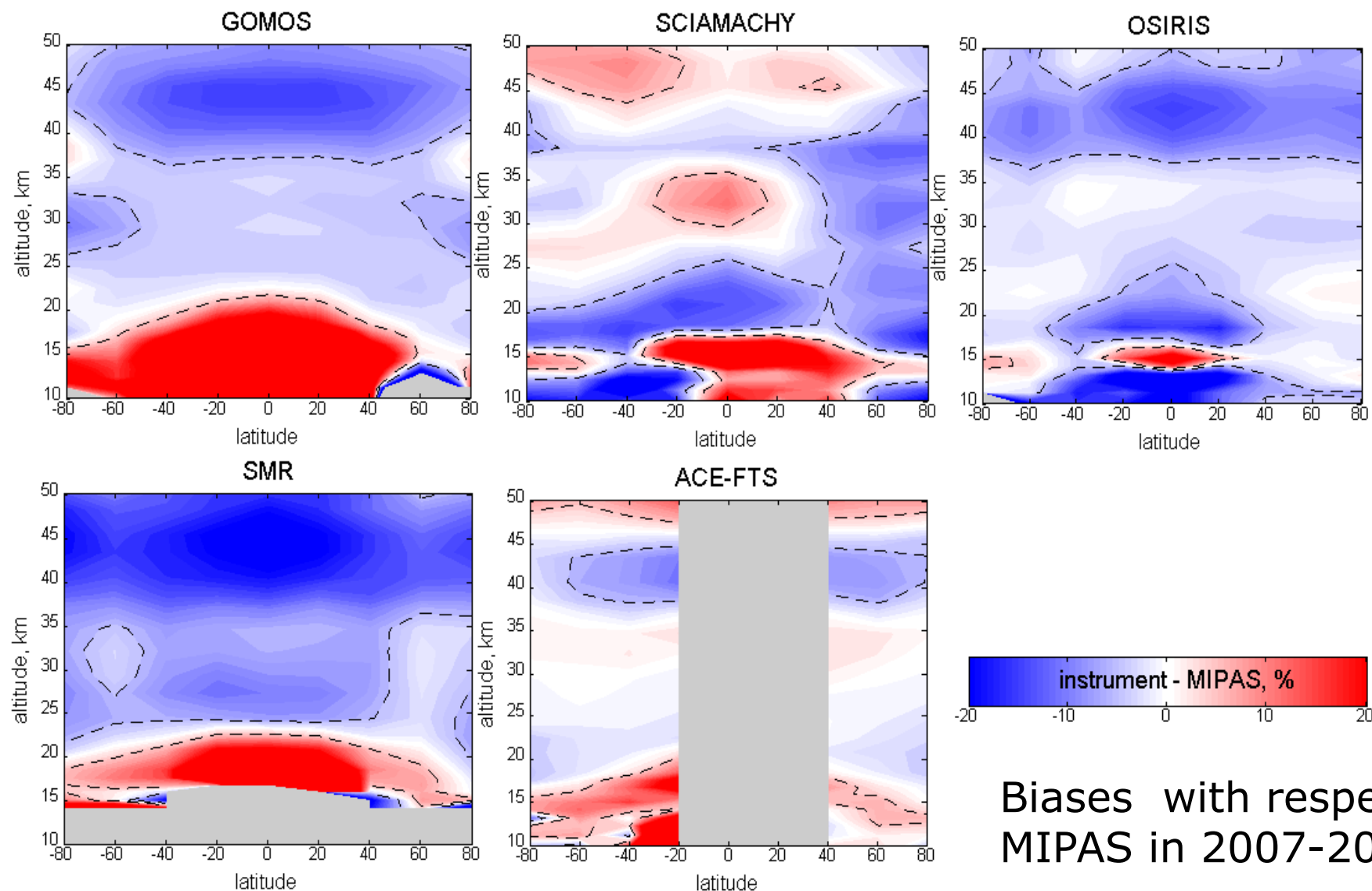
- Bias $b = 2 \frac{\langle x_1 - x_2 \rangle}{\langle x_1 \rangle + \langle x_2 \rangle}$
- Uncertainty of bias $\sigma_b = \frac{\sigma}{\sqrt{N}}$

- Estimates based on mean/rms and median/inter-percentile range are provided

- Format: netcdf



Example of a higher level analyses of data consistency using the bias tables



Level 3: monthly zonal mean from individual instruments

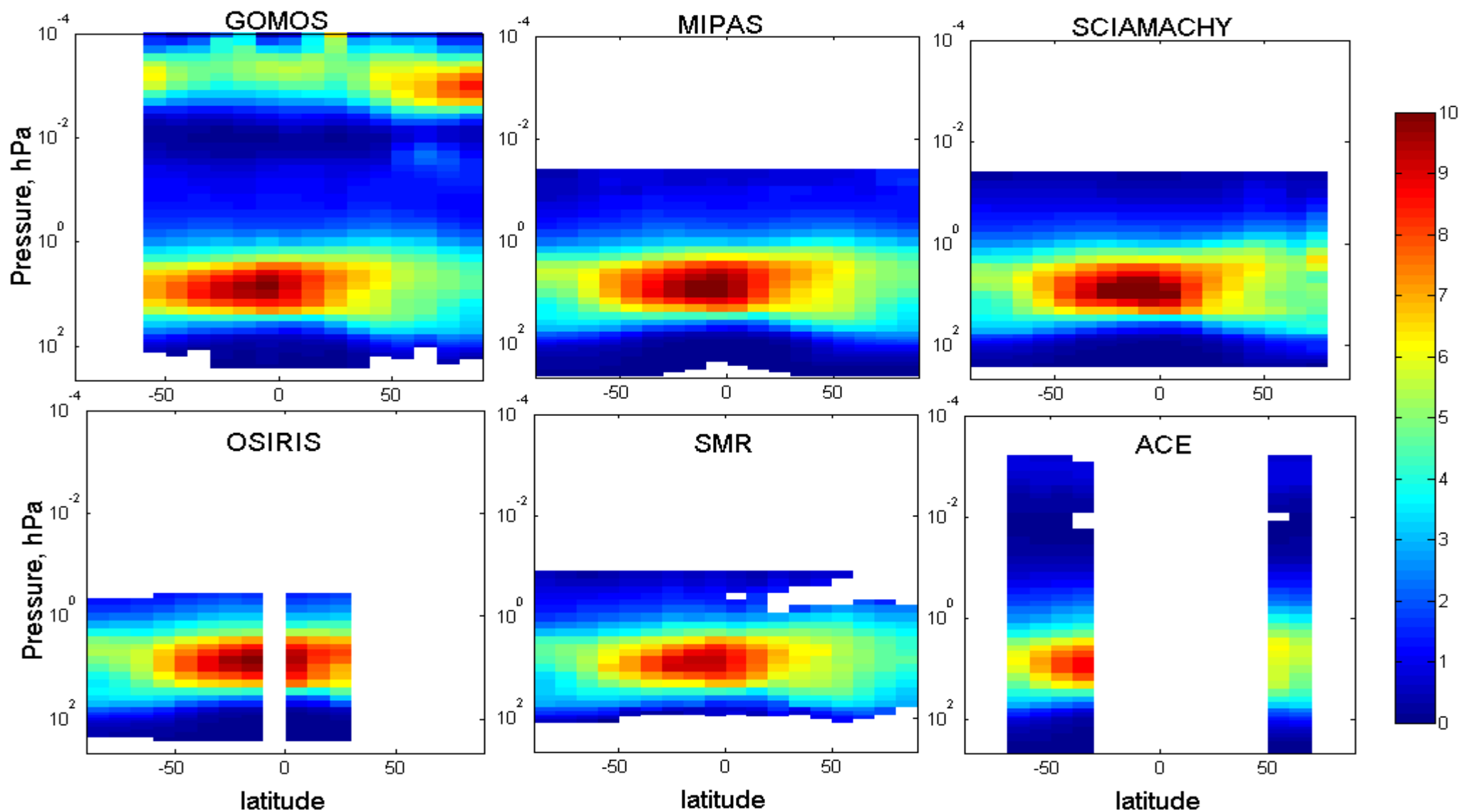


- **Targeted for:**
 - climate modelling, climate research
- **Included (6 separate datasets, all years):**
 - Monthly mean in 10° latitude bins ozone $\bar{x} = \frac{1}{N} \sum x_k$
 - Uncertainty of the mean $\sigma_{mean}^2 = \frac{s^2}{N}$ $s^2 = \langle (x_k - \bar{x})^2 \rangle$
 - The mean of individual error estimates $\bar{e} = \frac{1}{N} \sum e_k$
 - Parameters characterizing uniformity of data sampling (inhomogeneity measures in latitude and in time)

$$H = \frac{1}{2} (A + (1 - E)) \quad A - \text{asymmetry}, E - \text{entropy}$$

- **Altitude range and grid**
 - Pressure levels as in harmonized dataset
- **Netcdf format**

Monthly zonal mean profiles of ozone mixing ratio (ppmv) January 2008.



Merged monthly zonal mean ozone profiles



- **Merging: weighted mean according to total uncertainty**

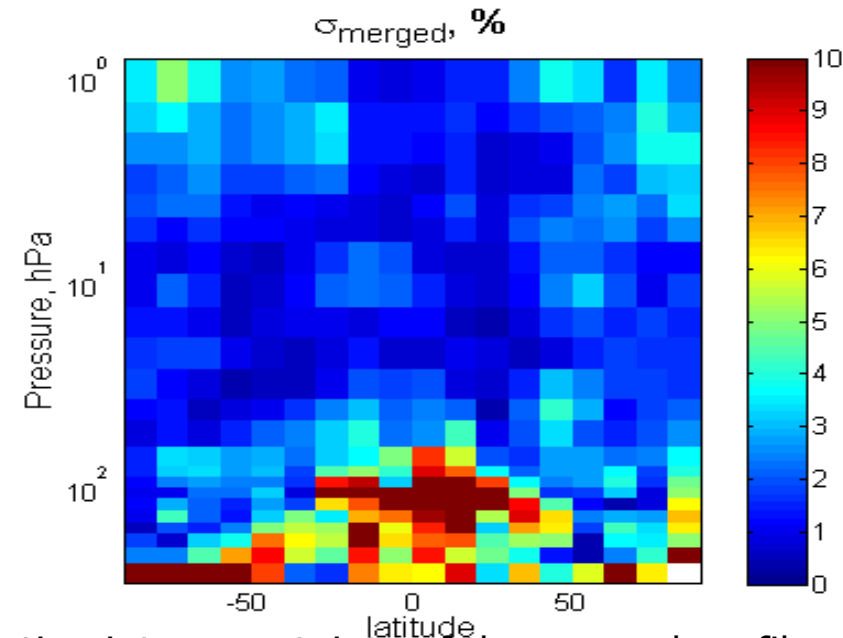
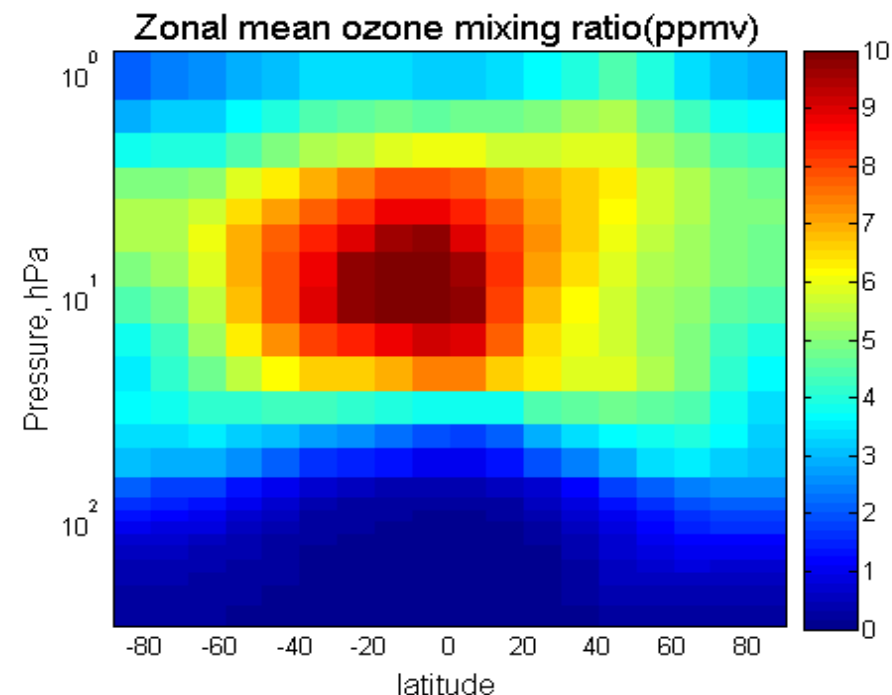
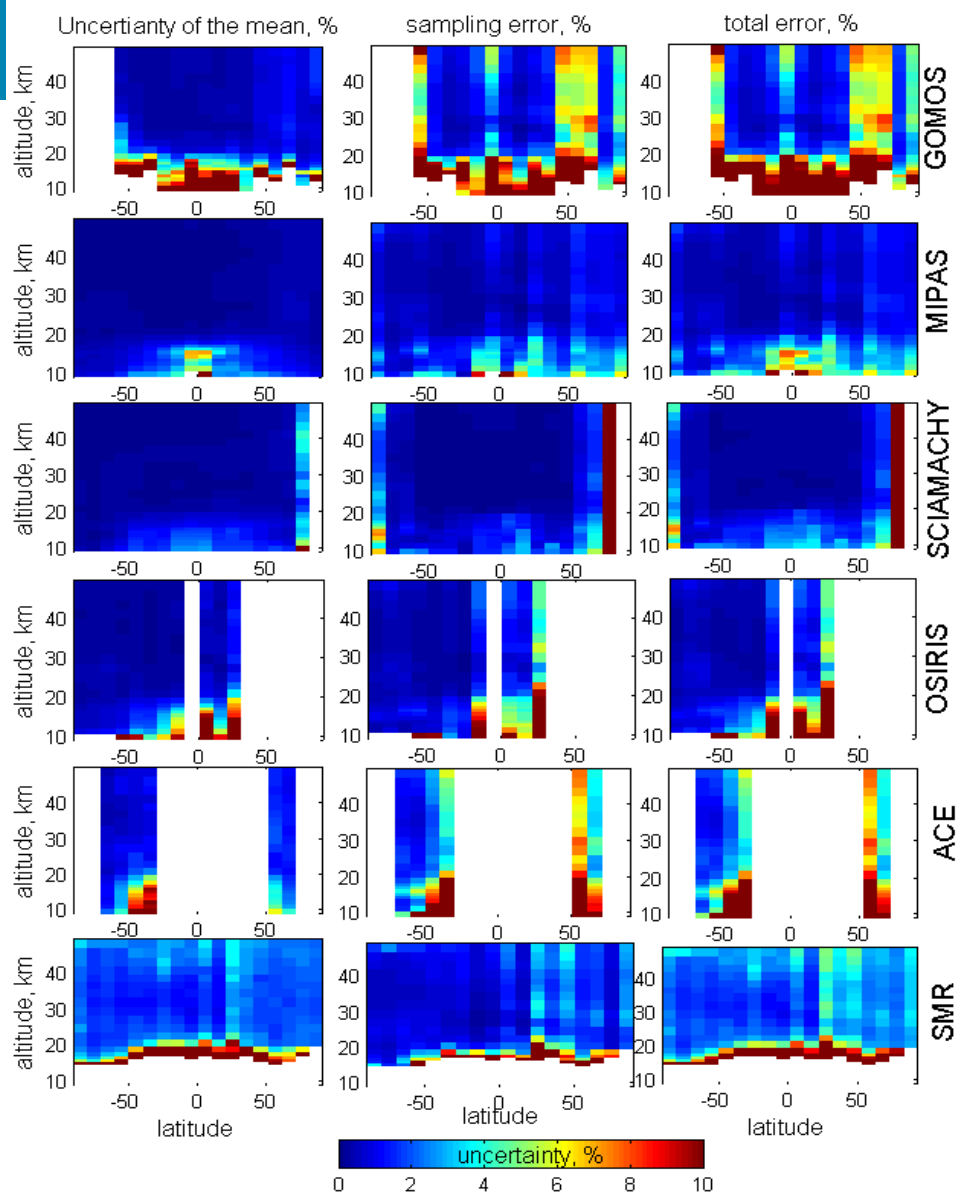
$$\sigma^2 = \sigma_{mean}^2 + \sigma_{sampling}^2$$

$$\sigma_{mean}^2 = \frac{s^2}{N}$$

$$\sigma_{sampling} = \frac{1}{2} (H_{lat} + H_{time}) \cdot \sigma_{nat}$$

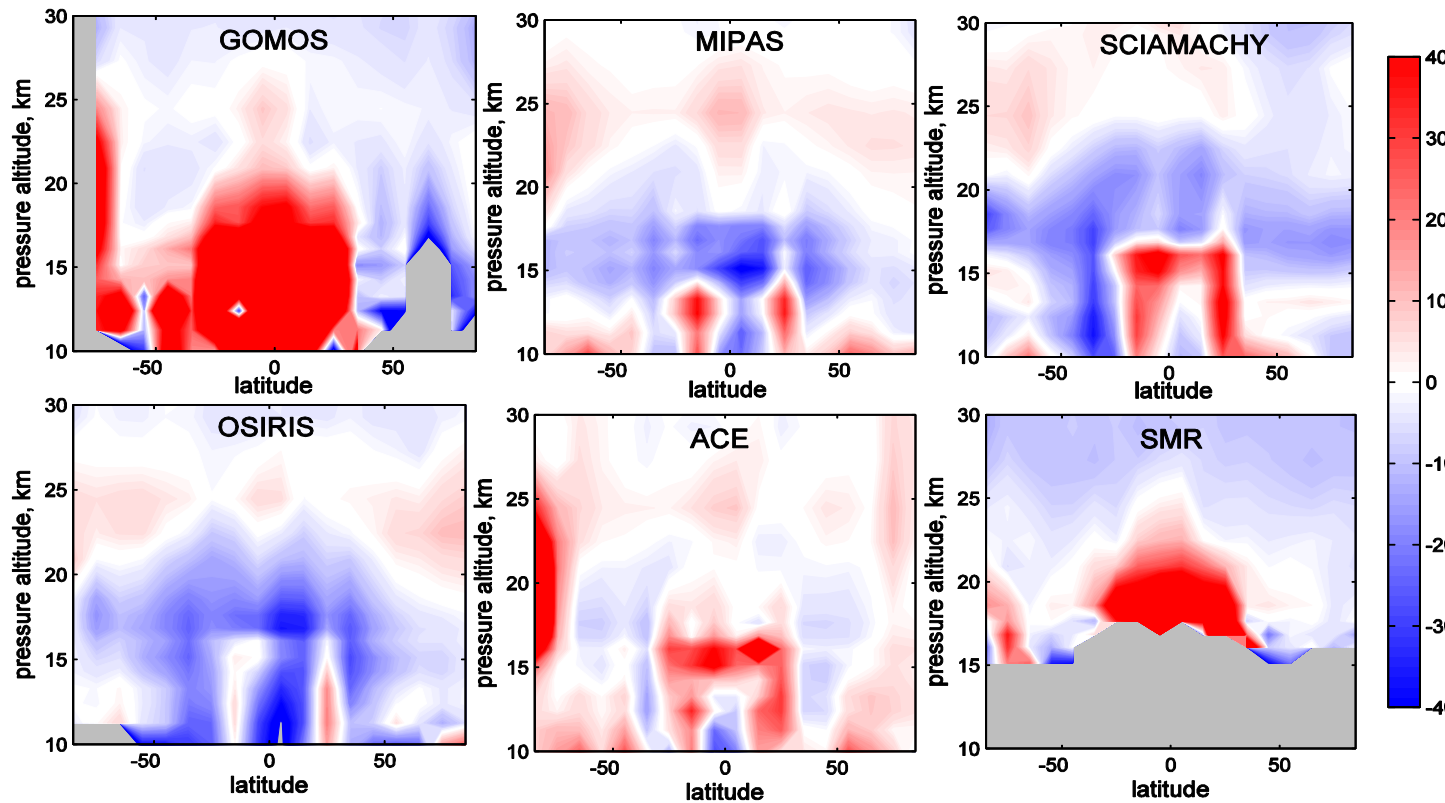
- **Latitude bins of 10°**
- **Latitude range: 250hPa – 1 hPa (~10-50 km)**
- **The merged dataset does not represent exactly “day and night mean”**
- **Years 2007-2008 (Phase 1), full dataset in Phase 2**

Data examples



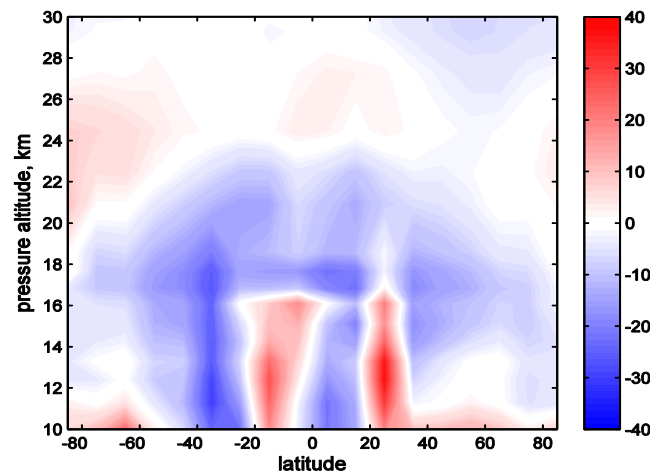
the variability between the datasets has a dominating contribution into uncertainty of the merged profiles

Preliminary evaluation (1) : UTLs

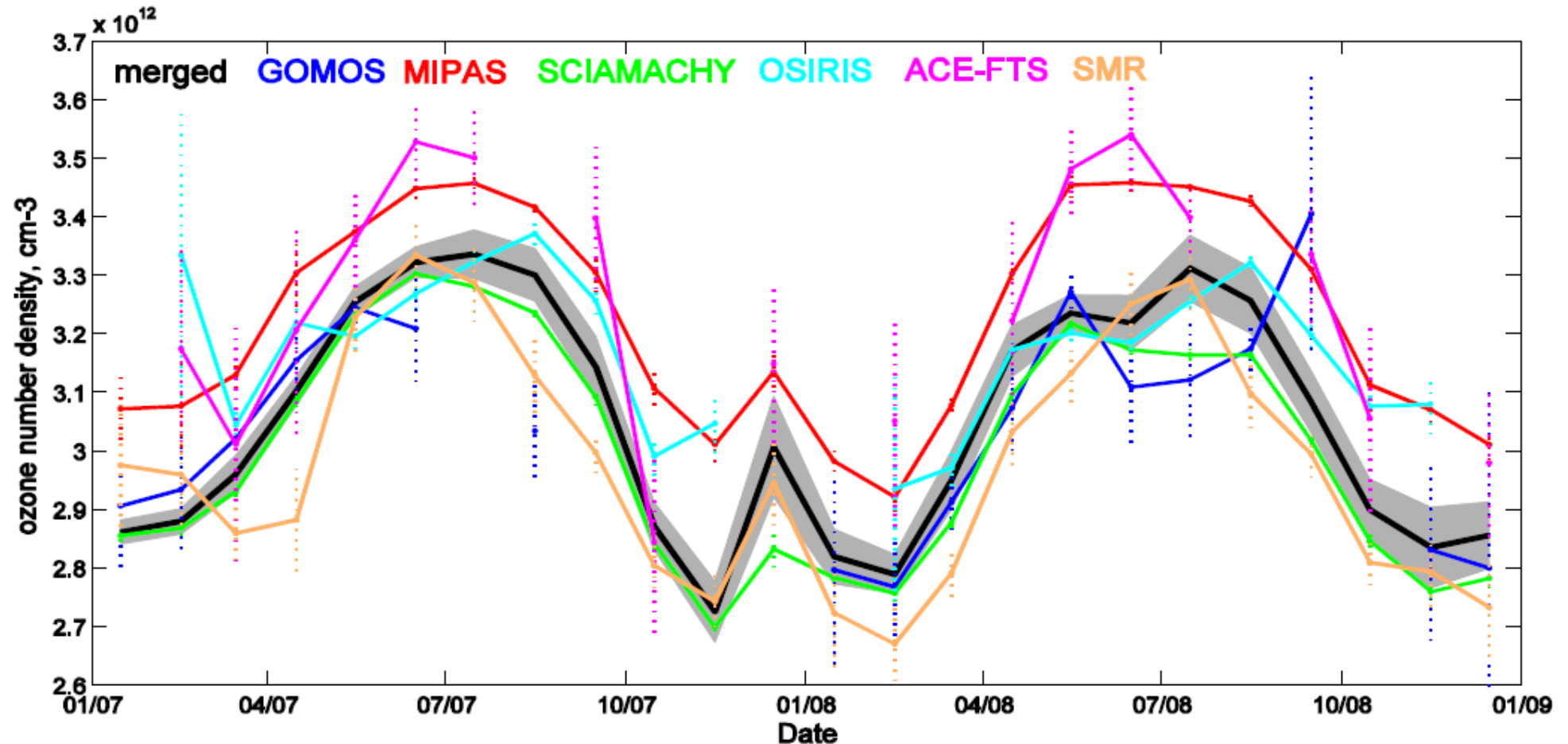


Mean deviations
from McPeters-
Labov climatology
(expressed in %)
for year 2008

merged



Preliminary evaluation (2): Improved data characterization



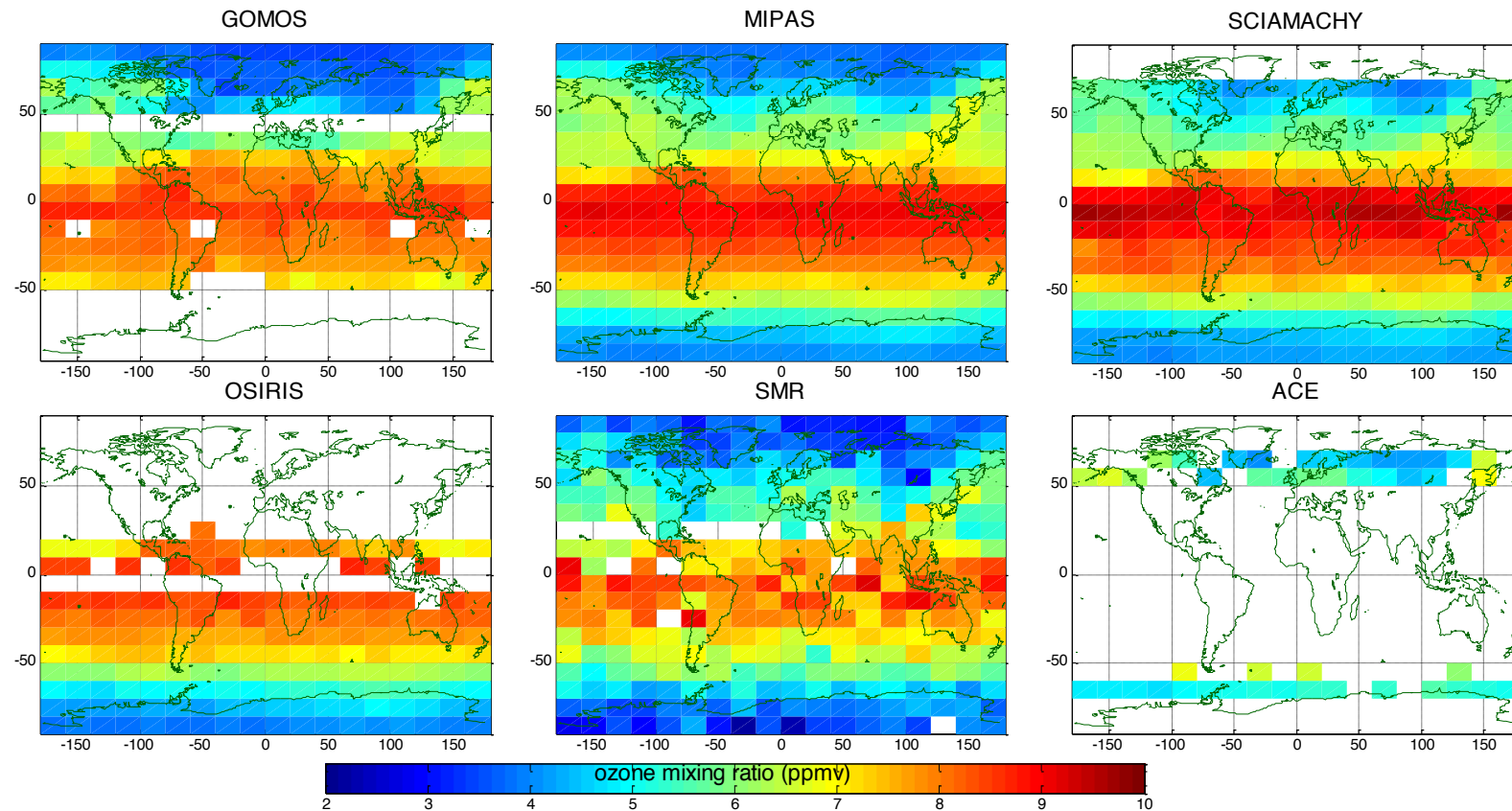
Ozone MZM number density at 15 hPa (~30 km) at latitudes 40°N-50°N in 2007-2008 for individual datasets and the MMZM dataset.

Semi-monthly mean ozone profiles with resolved longitudinal structure

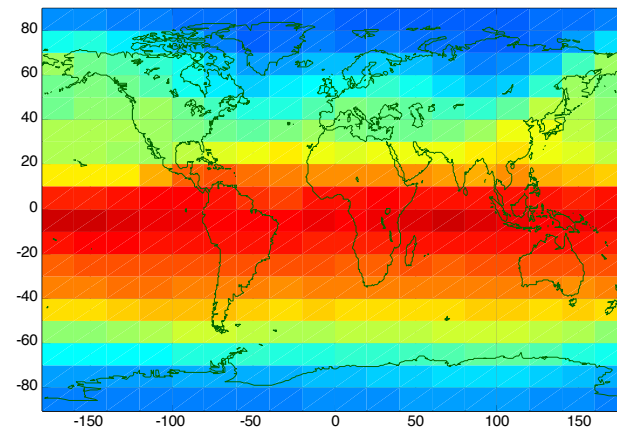


- **10° × 20° latitude-longitude bins**
- **Latitude range: 250hPa – 1 hPa (~10-50 km)**
- **The data construction is fully analogous to that used for monthly zonal mean**
 - Datasets from individual instruments are first created
 - Merging of averaged data according to the total error estimates

Examples of data: 15 hPa (~30 km), 1- 16 January 2008



merged



Data availability:

<http://www.esa-ozone-cci.org>



www.esa-ozone-cci.org/?q=node/100

software FMI Data my Publications



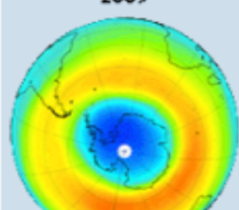
Ozone



Navigation

- About OZONE CCI
- Project Plan
- Project Content
- Support
- CRDP
- Private Area

Total Ozone Columns (DU)
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Home

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Open access:

No password
No registration

LP_L2_SCIA	SCIAMACHY	Individual profiles with a common pressure grid and concentration unit, auxiliary information for converting into mixing ratio and/or	IUP	
HARMonized dataset of OZone profiles (HARMOZ)	LP_L2_GOMOS	GOMOS	FMI	
	LP_L2_MIPAS	MIPAS	KIT	
	LP_L2_OSIRIS	ODIN/OSIRIS	USask	Data screened for outliers (filtered data)
			CUT	
			UoY	
			IUP	
			FMI	
			KIT	Lifetime, MIPAS: RR mode only (>2005)
			USask	
			CUT	
			UoY	
LP_L3_SMK	ODIN/SMK			
LP_L3_ACE	SciSAT/ACE			
Merged Monthly Zonal Mean (MMZM)	LP_L3_MRG-MMZM	combined	FMI	2007-2008
Level 3		Same as MZM but a composite of all limb data; associated uncertainties		
Merged Semi-Monthly Mean (MSMM)	LP_L3_MRG-MSMM	combined	FMI	2007-2008
Level 3		Bimonthly merged data set (20° longitude, 10° latitude, bimonthly)		



consortium



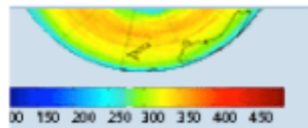
alendar

« September 2013 »

Mon	Tue	Wed	Thu	Fri	Sat	Sun
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

coming Events

- Living Planet Symposium 2013 (1 Day)



Website Hosted By
BIRA-IASB



Belgian Institute For Space
Aeronomy

Recent Updates

- Project Team
4 Weeks 3 Days
Ago
- Validation
21 Weeks 2 Days
Ago
- ESA Climate
Change Initiative
23 Weeks 3 Days
Ago



The harmonized dataset is

- screened for invalid data
- presented on the same
- written in the same ne

For convenience of users, ta
are provided.

DOWNLOAD the harmonized

For more details:

- README
- Algorithm Theoretical
- Sofieva, V. F., Rahpoe,
Lossow, S., Degenstei
Murtagh, D., Hauchecorne, A., van Roozendael, M., Kalb, N., and Zenner, C.: Harmonized dataset of ozone profiles from satellite limb and occultation measurements, Earth Syst. Sci. Data Discuss., 6, 189-222, doi:10.5194/essdd-6-189-2013, 2013, <http://www.earth-syst-sci-data-discuss.net/6/189/2013/>.
- Presentation at Atmospheric Chemistry Validation and Evolution 2013 conference

Examples of reading the main parameters in [MATLAB](#) and [IDL](#)

In publications using the harmonized dataset, please include the reference to the paper above.

Earth Syst. Sci. Data Discuss., 6, 189–222, 2013
www.earth-syst-sci-data-discuss.net/6/189/2013/
doi:10.5194/essdd-6-189-2013
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Earth System
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Discussions

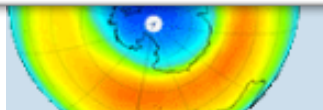
This discussion paper is/has been under review for the journal Earth System Science Data (ESSD). Please refer to the corresponding final paper in ESSD if available.

Harmonized dataset of ozone profiles from satellite limb and occultation measurements

V. F. Sofieva¹, N. Rahpoe², J. Tamminen¹, E. Kyrölä¹, N. Kalakoski¹, M. Weber², A. Laeng³, T. von Clarmann³, G. Stiller³, S. Lossow³, D. Degenstein⁴, A. Bourassa⁴, C. Adams⁴, C. Roth⁴, N. Lloyd⁴, P. Bernath^{5,6}, R. J. Hargreaves⁵, J. Urban⁷, D. Murtagh⁷, A. Hauchecorne⁸, M. Van Roozendael⁹, N. Kalb⁹, and C. Zehner¹⁰

Murtagh, D., Hauchecorne, A., van Roozendael, M., Kalb, N., and Zenner, C.: Harmonized dataset of ozone profiles from satellite limb and occultation measurements, Earth Syst. Sci. Data Discuss., 6, 189-222, doi:10.5194/essdd-6-189-2013, 2013, <http://www.earth-syst-sci-data-discuss.net/6/189/2013/>.

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Ambitious plans for Phase 2



- **Extension of altitude to lower altitudes (UTLS) and upper altitudes (mesosphere)**
- **Long-term ozone profile climate data record**
- **Ozone natural variability (climatological and small-scale)**
- **Advanced climate parameters**
- **Ozone trends (evaluation with the historical data)**