SPARC/IGACO-O_3/IOC Initiative on Understanding Past Changes in the Vertical Distribution of Ozone

Workshop Geneva January 25th-27th 2011

Neil Harris

(modified by Johannes Staehelin for presentation at SPARC Scientific Steering Group Meeting in Pune, 2011)

Outline

1. **1998 SPARC/IOC/GAW Ozone Profile Assessment**
2. **Where do we stand now, 15 years on? New Challenges**
3. **Workshop**
4. **Action Plan**

1. Assessment of Trends in Vertical Distribution of Ozone (1998)

SPARC/IOC/GAW
Assessment of Trends in the Vertical Distribution of Ozone
May 1998

Edited by N. Harris, R. Hudson and C. Phillips

SPARC Report No. 1,
and
WMO Ozone Research and Monitoring Project Report No. 43

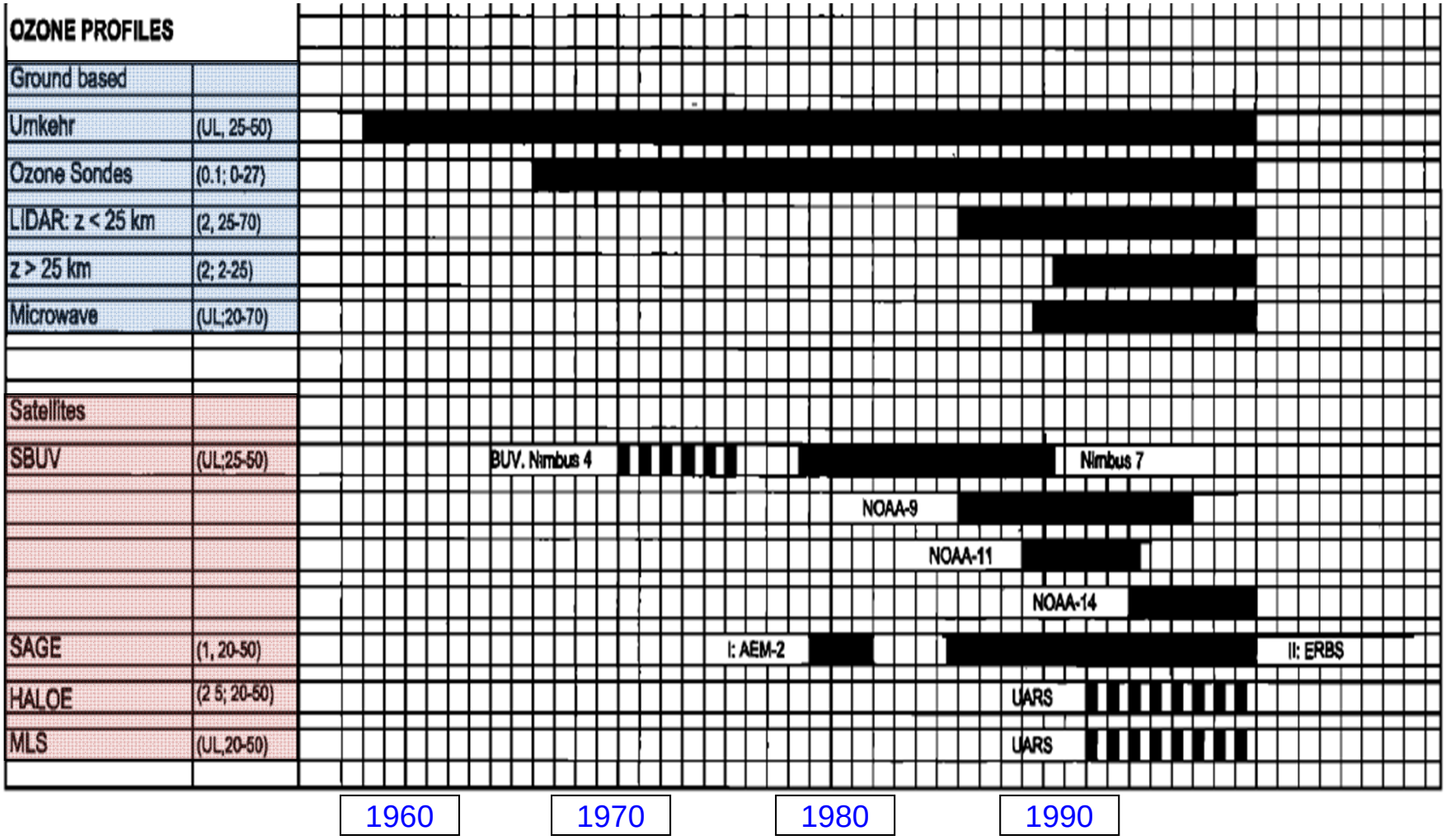
Motivation

- Difficulties to derive consistent (global) profile ozone trends, esp. ≤ 20 km

- Disagreements between satellite series SAGE (I and II) and SBUV

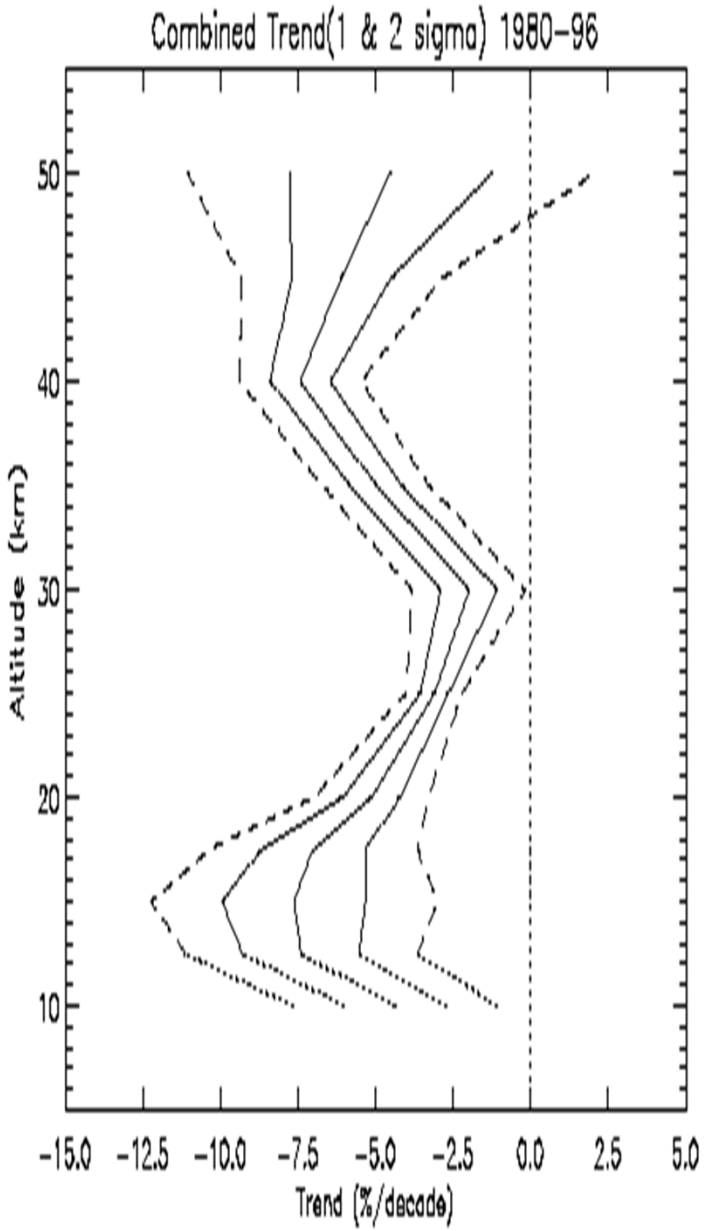
- Large uncertainties, variable coverage

Ozone Profile Measurements available for 1998 Assessment



Ground-based largely northern mid-lats satellite largely global

Figure 2 from 1998 summary



Key results:

Combined estimate of the mean trend in vertical distribution of ozone over **northern mid-latitudes** from 1980-1996 (heavy solid line) calculated using the trends derived from SAGE I/II, ozonesondes, SBUV and Umkehr measurements. Combined uncertainties are shown as 1σ (light solid lines) and 2σ (dashed lines).

The combined trends and uncertainties are extended down to 10 km as shown by the light dotted lines. The results below 15 km are a mixture of stratospheric and tropospheric trends and the exact numbers should be viewed with caution.

Combined trends have **not** been extended lower into the troposphere because there are concerns regarding the representativeness of any mean trends derived from the small sample of sonde stations.

But much, much more in there…..

Assessment of
Trends in Vertical Distribution of Ozone (1998)

Lessons learnt (nearly all positive)

Committed team of authors and contributors

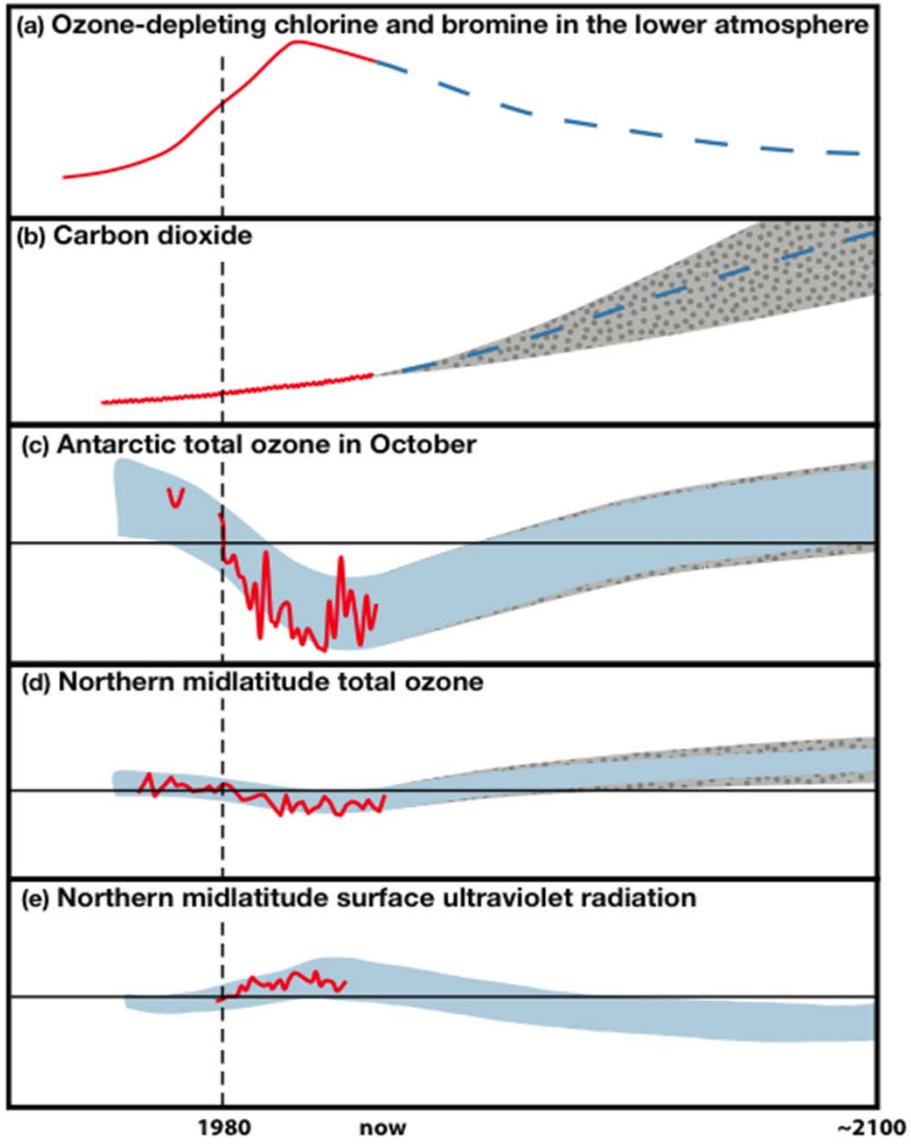
- mix of neutrals and experts (latter on instrument teams)
- wanting to improve overall understanding of measurements
- not overly concerned with 'defending' their own instruments
- able to commit real time and effort
- supported by agencies or institutions

Assessment provided (for the first time)

- the chance to spend enough combined time to sort the problem out
- the appropriate expert forum
- a tangible end product (an assessment produced in time for the 1998 UNEP/WMO Assessment)

2. Where do we stand now? New challenges

How does the ozone profile recover as ODS decrease?



Recent measurements of the vertical ozone distribution did not say much at all about

- ODS recovery
- Effect of climate change

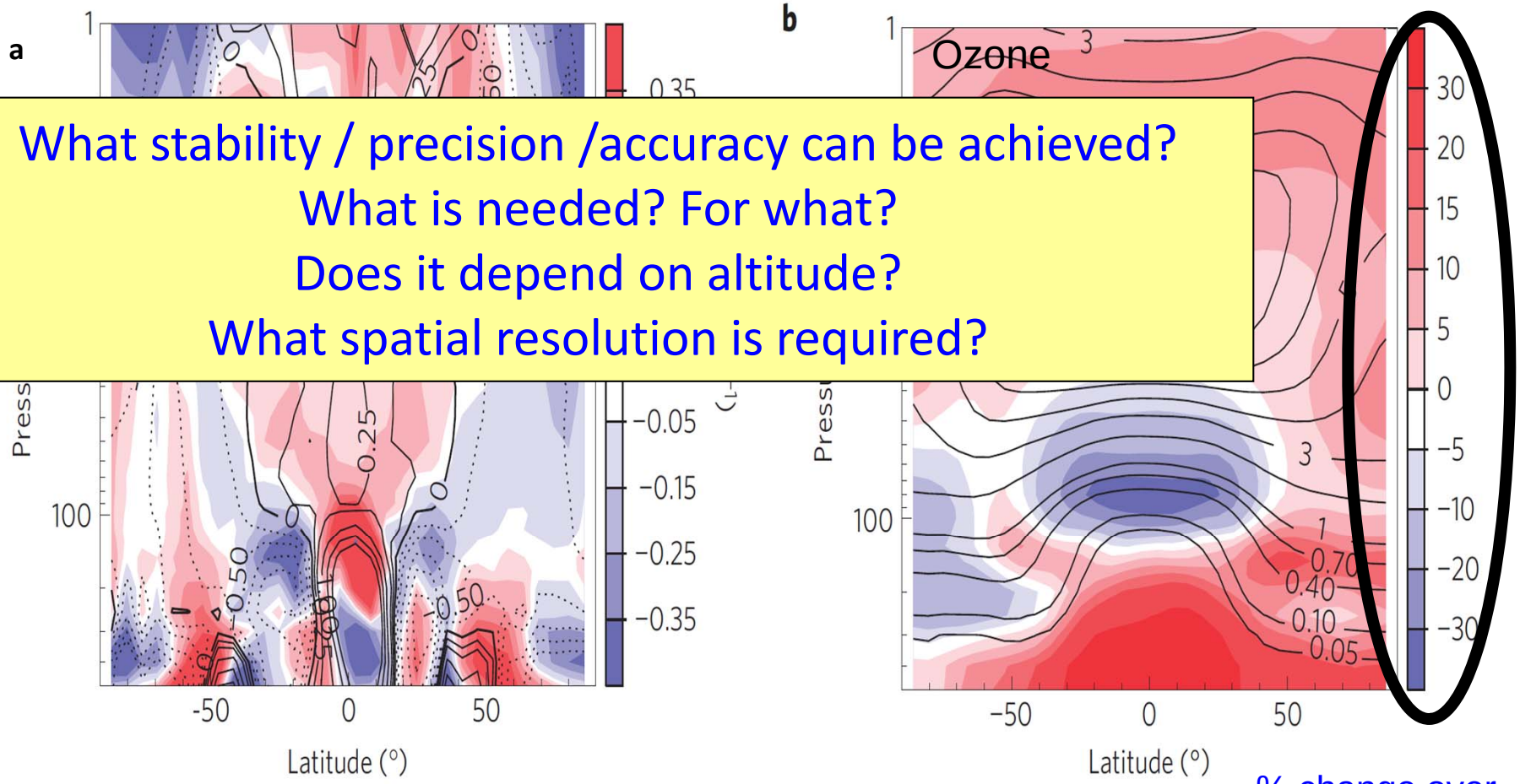
Why?

No consistent global view of ozone profile measurements after 2005

- SAGE (workhorse for 1984-2005) turned off; as was HALOE (1991-2005)
- Many satellites making profile measurements since 2005, but they have not been well enough assessed to know what has been happening to trends in ozone profile

Changes in distribution of ozone as climate changes

Vertical-latitudinal cross-sections of past values (1960–1970, black contours) and long-term changes (differences between 1960–1970 and 2090–2100, colour shading) for
(a) annual mean vertical residual velocity; and
(b) ozone using an ensemble mean of three simulations from the CMAM. For ozone, the past values are in units of ppmv and the long-term changes as relative changes.

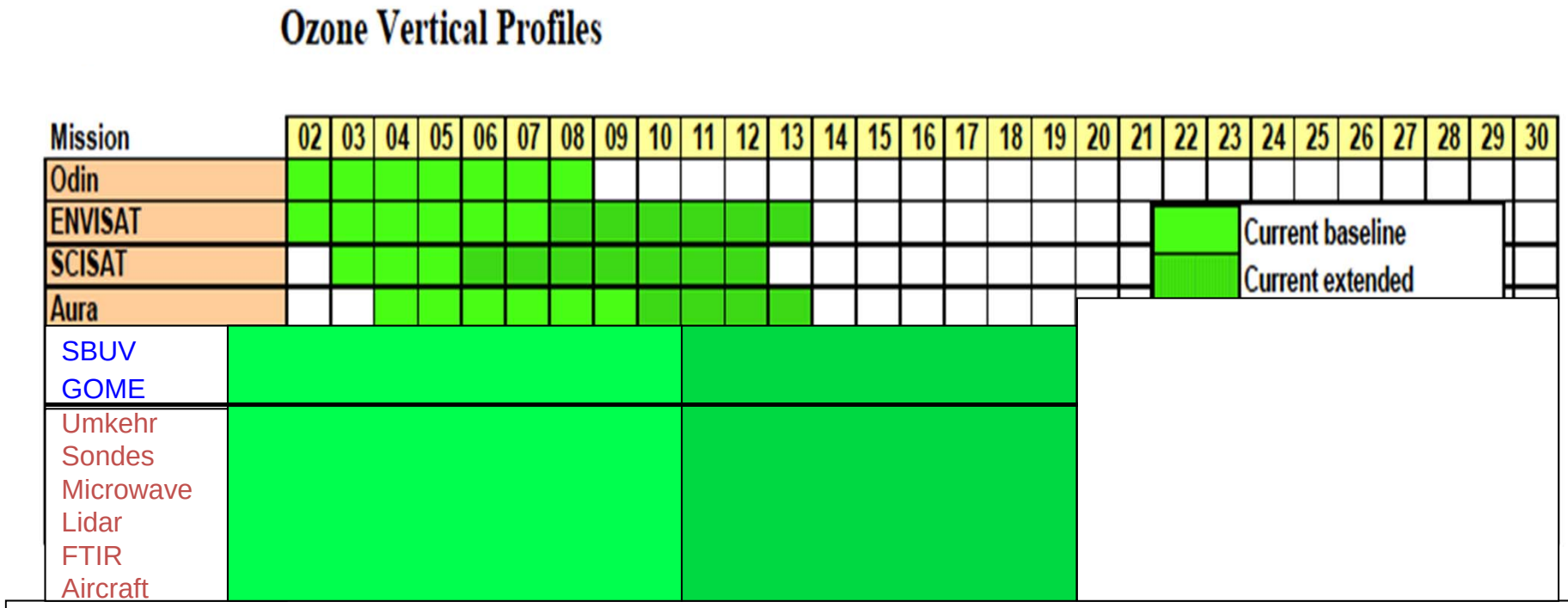


What stability / precision /accuracy can be achieved?
What is needed? For what?
Does it depend on altitude?
What spatial resolution is required?

Hegglin and Shepherd, Nat. Geo., 2010

% change over 130 yrs

Current O_3 profile measurements



SAGE, HALOE finished in 2005

SBUV record 1978-now, but different instruments - low vertical resolution below 25 km

What to use for validation? What for their own trends?

Much better geographical spread of ground-based networks in last 10 years

3. Workshop in Geneva

January 25th-27th 2011

Aims: Define issues

Discuss (a) what is being done and *

(b) what could be done

(c) how best to coordinate globally?

including

will there be a core measurement again?

is it best to have multiple core measurements?

what should be used for validation, what for trends?

what are good ways to merge time series?

how can this be assessed?

Decide how this initiative should be organised

leaders, work plan, communication, end product

* *ESA, NASA, CSA, SSC already have relevant programmes / projects and other groups working on it*

Goals of new Ozone profile activities

Overall goal: reliable knowledge of longterm (stratospheric) ozone profile evolution:

involves

a) satellite data retrieval, quality and records
b) ground-based measurements (ozonesonde, lidars, Umkehr ...) retrieval, quality and records
c) procedures for homogenizing existing vertically resolved ozone measurements from different sources
d) creating databases in different coordinate systems (for different users)

Should be used as input for UNEP/WMO O_3 Assessment in 2014, i.e. ready in 2013

Program: Tuesday 25 January

GENERAL Chair: Geir Braathen

The SPARC/IOC/GAW Initiative ***Neil Harris***
Issues from the WMO 2010 Assessment ***Chris McLinden***
Ozone trends and variability in the tropical lower stratosphere ***Bill Randel***

SATELLITE Chairs: Claus Zehner and Larry Flynn

Progress in the NASA GOZCARDS project ***Lucien Froidevaux***
Plans for the ESA Ozone-cci project ***M. van Roozendael***
The SAGE record ***Joe Zawodny***
The SBUV Ozone record- the Good, the Bad, and the Ugly ***P.K. Bhartia***
Envisat/GOMOS stellar occultation and ODIN/OSIRIS limb scatter *Johanna Tamminen*
Merging total ozone data from different uv-vis satellite sensors ***M. Coldewey-Egbers***
SCIAMACHY limb scatter ozone pofiles since 2002 ***Christian von Savigny***
The Odin/OSIRIS time series from 2001 to now ***Doug Degenstein***
Combining height resolved ozone time-series from satellite instruments ***Jo Urban***
Ozone profiles measured by the Atmospheric Chemistry Experiment ***Tom McElroy***
The MIPAS ozone record since 2002 ***Th. von Clarmann***
Discussion on using satellite measurements to provide a long-term record and for validation

GROUND Chair: Mike Kurylo

Umkehr data: comparisons with sondes, microwave and satellite ***Irina Petropavlovskikh***
NDACC microwave O3 measurements at Mauna Loa since 1995 ***Alan Parrish***
Time series and quality assessment of O3 data from ground-based FTIR ***Sabine Barthlott***
What are ozone lidars telling us about satellite data? ***S. Godin-Beekman***
Stratospheric ozone interannual variability measured by lidar at MLO ***Stuart McDermid***

Wednesday 26 January, 2011

GROUND, cont. Chair: Wolfgang Steinbrecht

Overview of the performance of ozone sondes and their uncertainties ***Herman Smit***
NOAA ozonesonde records (South Pole, Hilo, Boulder, and Samoa) ***Sam Oltmans***
Ozonesonde data from high-latitude stations ***Rigel Kivi***
Canadian ozonesonde network *David Tarasick*
Analysis of the long-term ozone measurements of MeteoSwiss ***R. Stübi / E. Maillard***
Long term observations with sondes ***Andy Delcloo***
Ozonesondes, MLS, and their comparison *by* ***Jennifer Logan*** *(*presented by J. Staehelin)
MOZAIC-IAGOS and its role in satellite validation ***Valerie Thouret***
Discussion on using ground-based measurements as long -term records and for validation

DATASETS Chair: Bill Randel

Long-term stratospheric ozone and temperature changes ***Klairie Tourpali***
Database to determine changes in vertically resolved stratospheric O_3 ***Birgit Hassler***
Retrospective analysis of ozone at ECMWF ***Rossana Dragani***
Thirty year record of assimilated ozone ***Roland van der A***
Homogenizing existing vertically resolved ozone measurements ***Ray Wang***
The experience gained from merging TOMS and SBUV records ***Richard Stolarski***
NOAA CPC work on merging SBUV/2 ***Craig Long***
Discussion on strategies on producing internally consistent, long-term datasets

PLANNING

1700 Break-out groups

Thursday 27 January

Plenary: reports of break-out groups and discussion of plans
1045 Break-out groups
1330 Plenary: discussion and agreement of an action plan
1500 Close

Timetable

1. Provide input to WMO 2014
2. Need a plan of work to provide reviewed material by 2013

   => *2 years*
3. Presentations here have made it clear that there are real opportunities for progress using satellite and ground-based data - but they have not made timescales particularly clear

   plans should be ambitious, but realistic
4. Varying degrees of readiness in different groups
5. Build on existing plans (whether ESA / NASA .. projects or NDACC/WMO based)

4. Action Plan

Short Assessment (description of (ground-based) instrumental records and their stabilities are expected to provide important scientific papers and/or reports but should not be integral part of the assessment)

Coordination: Neil Harris, Johannes Staehelin, Rich Stolarski

1. **Long-term satellite data quality (1970 - now):** *Ray Wang, Johanna Tamminen*

Longterm Change

   1. SBUV consolidation
   2. Better SAGE I (extension backwards)
   3. SAGE II re-processing (T link)
   4. SAGE II extension forwards - use occultation for stability (GOMOS, OSIRIS)
   5. Validation

2. **The last decade (satellite):** *Michel van Roozendael, Lucien Froidevaux*

Climate Variability

   1. ODIN / ACE / ENVISAT / AURA
   2. Work in ESA Ozone-CCI & NASA GOZCARD projects
   3. Start with SPARC Data Initiative products - then move further

Action plan, cont. I

3. **Ozonesondes:** *Herman Smit, Sam Oltmans*

    1. Produce homogenised data set (>10 year)
    2. Improvements based on known sonde differences (“transfer function”)
    3. Clear documentation

    (Next meeting: NDACC, fall 2011)

4. **Umkehr (Dobson and Brewer):** *Tom McElroy, Irina Petropavlovskikh*

    1. Dobson in good shape
    2. Brewer not in good shape

        (a) data collection; (b) retrieval improvement; (c) processing

Action plan, cont. II

5. Other ground-based measurements (lidar, FTIR, and micro wave): *through NDACC working groups* (S. Godin Beekman, T. Leblanc, N. Kämpfer, G. Neduloha, J. Hannigan, M. De Maziere)

1. Measurements fundamentals & principle
2. Algorithms & coordinate system
3. Spectroscopic parameters
4. Ancillary data (T, p) profiles
5. Summary of (past) validations
6. Precision & accuracy (especially for trends)
7. Effects of trends in external data

(Next meeting: NDACC, fall 2011, work planned to start in NDACC Working Group meetings in June 2011)

***6.* Approaches to producing multi-instrument ozone data:** *Neil Harris, Greg Bodeker*

Phase 2: Summary/Assessment topics

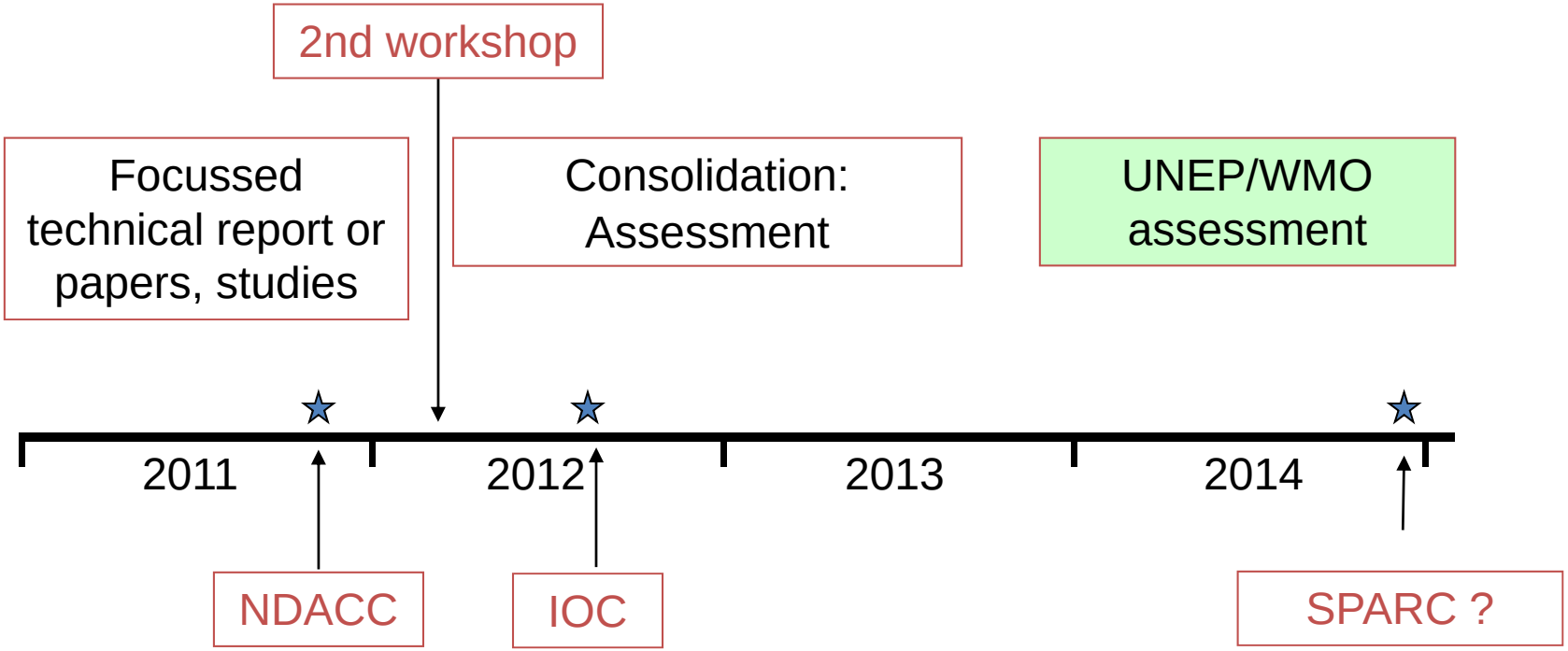
1. Long term changes
   - How well are they known? - stability important
   - What are they?
   - What implications?

2. Climate - ozone links in the shorter-term
   - How well are they known? - precision important
   - What do the new records show?

3. New science
   - Not necessarily relevant for UNEP/WMO

Measurement driven, but would include interpretative work

Time plan and website



IGACO - O3/UV website: **http://www.igaco-o3.fi/en/index.html**

- general information (and links); workshop's presentations
- basic information for the on-going work : instrumental record details, working group, timetables