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Materials Science & Technology

Global Atmosphere Watch Activities at Empa

Jörg Klausen¹
GAW QA/SAC Switzerland

C. Zellweger¹, S. Henne¹, A.F. Ilahi², C. Siregar², Herizal², M. Mimouni³,
M.S. Ferroudj³, J. M. Kariuki⁴, J.O. Aseyo⁴ and B. Buchmann¹

¹Empa, Laboratory for Air Pollution/Environmental Technology, CH-8600
Dübendorf, Switzerland

²Meteorological and Geophysical Agency, Global GAW Station Bukit
Koto Tabang, Bukittinggi, Sumatera Barat, Indonesia

³Office National de la Météorologie, Tamanrasset, Algeria

⁴Kenya Meteorological Department, Dagoretti Corner, Ngong Road,
Nairobi 00100, Kenya

NOAA ESRL Annual Meeting, Boulder (CO), 14-15 May 2008

Outline

- GAW at Your Fingertips
 - *The GAW Station Information System*
- It's the Quality, Stupid!
 - *WCC-Empa*
- Researching High
 - *The Global GAW Station Jungfraujoch*
- Mind the Gap, Please!
 - *Twinning with Algeria, Indonesia, Kenya*



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GAW at Your Fingertips

The GAW Station Information System (GAW SIS)

Scope of GAWSIS

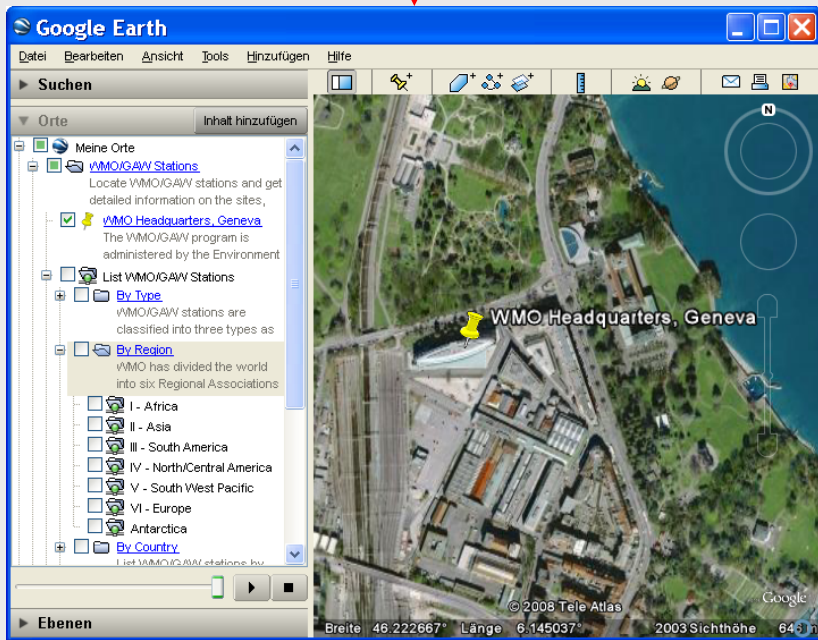
- Integration of information across all (GAW) variables
- Search and discovery across all variables
- 'Clearing house' for identification of GAW stations
- Direct link to data across WDCs
- Increased visibility of GAW and partner programmes
- 1-stop shop for information about the ground-based GAW network(s)

➡ GAWSIS 'defines' the GAW ground-based observational network

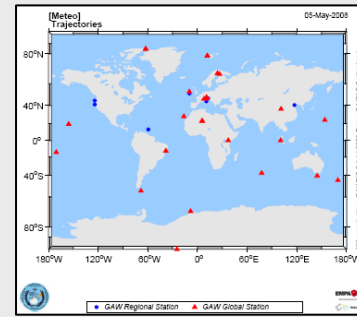
➡ GAWSIS is a precursor for a *GAW DATA Portal*

New in GAWSIS (1/2)

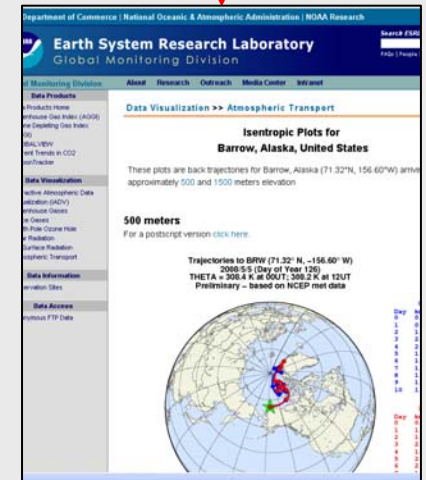
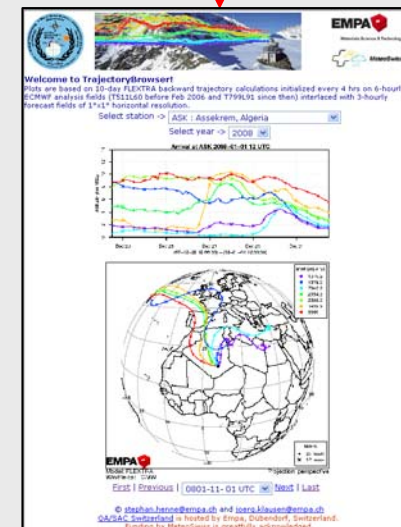
■ Google Earth Port



■ Links to Trajectories



Year	Parameter	Method	Start	End
Atmosol	Light absorption coefficient	Filter + light attenuation (aethalometer)	1995-08-01	
	Light scattering coefficient	nephelometry	1995-08-01	
	Major inorganic cations (coarse)	Ion Chromatography (IC) (Sawyer)	1999-06-17	
	Mass concentration (total aerosol) or Filter sampling + gravimetry		1973-01-01	
Mass TSP	Multianalytical optical depth	Sun-tracking photometry	2000-01-01	2005-12-30
	Multiwavelength optical depth	Sun-tracking photometry	1999-04-01	
Greenhouse Gas	Number concentration	Condensation particle counter (CPC)	2000-01-01	
	CO ₂	GC-MS	2000-01-01	
	CO ₂	GC-MS	2000-01-01	



New in GAWSIS (2/2)

■ Manage GAW IDs

[Home](#) [Extended Search](#) [Edit/Add Information](#) [Feedback](#)

[About](#) [Logout](#) [GAW IDs](#)

Table of Contents
 1. [Introduction](#)
 2. [Query status of station identifiers](#)
 3. [Request station identifier for a registered station](#)
 4. [Register a new station and request identifier](#)
 5. [Questions and comments](#)
 6. [Why 3-letter codes?](#)
 7. [Initial assignment of codes](#)
 8. [Tables of used station identifiers](#)

Introduction
 This web site is a managed list of unique station identifiers to also serves as the clearing house for registering such identifiers for ground-based fixed stations. The goal is to assign a unique 3-letter monitoring purpose. This process should be based on consensus because we would like these codes to find acceptance. Your help is appreciated. Please share this web address with anyone you know might be interested.

Enter Station Identifier

Request Station Identifier for a Registered Station

Register a New Station and Request Identifier

Station Characteristics
GAW ID JFJ
station status Full-time station
time zone UTC+1
climate zone xx (High Alpine)
description
 The high alpine research station Jungfraujoch two mountains Jungfrau (4158m) and Mönch (4099m) in the Swiss Alps, Europe and is surrounded by highly industrialized areas.

■ Archive Bibliographic Information

GAWSIS
 STATION INFORMATION SYSTEM
[Extended Search](#) [Edit/Add Information](#) [Feedback](#)

Welcome! You are logged on as GAWSIS administrator.
 You have permission to edit information relating to all stations known to GAWSIS.

Edit and/or amend station information
Station name Jungfraujoch
Type of information Bibliographic Reference(s)

Jungfraujoch (Switzerland) Global fixed station in WMO RA VI - Europe
References
 Zollweger, Christoph, et al. (2006), Systems and Performance Audit of Surface Ozone Carbon Monoxide and Methane at the Global GAW Station Jungfraujoch, July 2006, WCC-Empa Report 06/4, www.empa.ch/gaw/audits/EJ2006.pdf
 Romann, S., et al. (2005), Low European methyl chloroform emissions inferred from long-term atmospheric measurements, *Nature*, 433, 506-508
 Collaud Coen, M., et al. (2004), Saharan dust events at the Jungfraujoch: detection by wavelength dependence of the single scattering albedo and first climatology analysis, *Atmospheric Chemistry and Physics*, 4, 2465-2480, www.atmos-chem-phys.net/4/2465/2004/, ISSN:1680-7316
 Geropoulos, E., et al. (2001), A climatology of Be-7 at four high-altitude stations at the Alps and the Northern Apennines, *Atmospheric Environment*, 35, 6347-6360
 Bonasoni, P., et al. (1999), Stratosphere-troposphere exchanges: case studies recorded at Mt. Cimone during VOTALP project, *Physics and Chemistry of the Earth Part C-Solar-Terrestrial Energy*, 24, 443-446

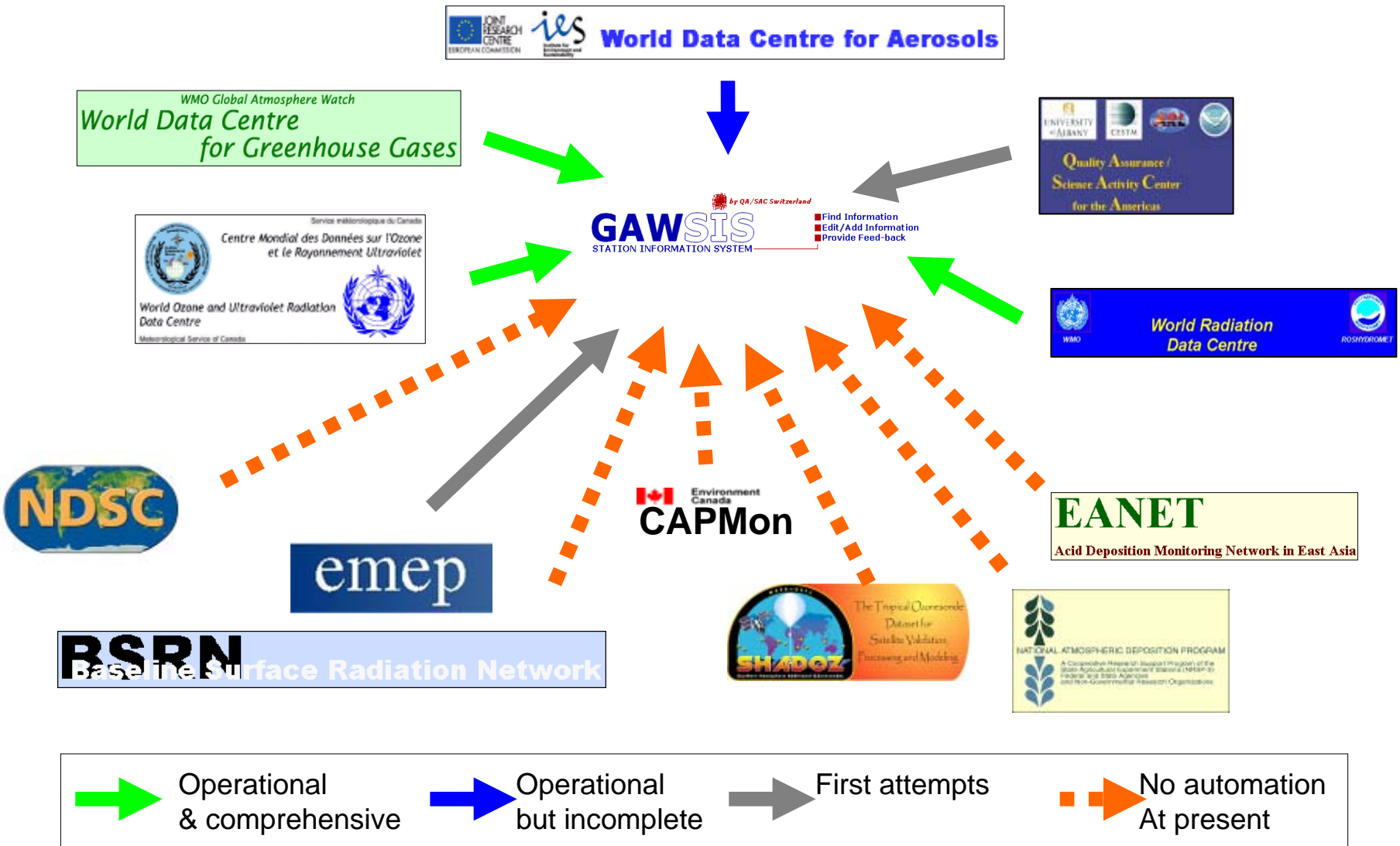
Add Bibliographic References
 Please only submit reference(s) that are properly formatted in BibTex. You can obtain references from various sources, e.g. [EnuBib](#) or [SciF](#). The following is an example:

```

@Article{emp-4-2465-2004,
  AUTHOR = {Collaud Coen, M. and Weingartner, E. and Schaub, D. and Hueglin, C. and Carrigan, C. and Henning, S. and Schirnikowski, M. and Baltensperger, U.},
  TITLE = {Saharan dust events at the Jungfraujoch: detection by wavelength dependence of the single scattering albedo and first climatology analysis},
  JOURNAL = {Atmospheric Chemistry and Physics},
  VOLUME = {4},
  YEAR = {2004},
  NUMBER = {11/12},
  PAGES = {2465-2480},
  URL = {http://www.atmos-chem-phys.net/4/2465/2004/},
  ISSN = {1680-7316}
}
  
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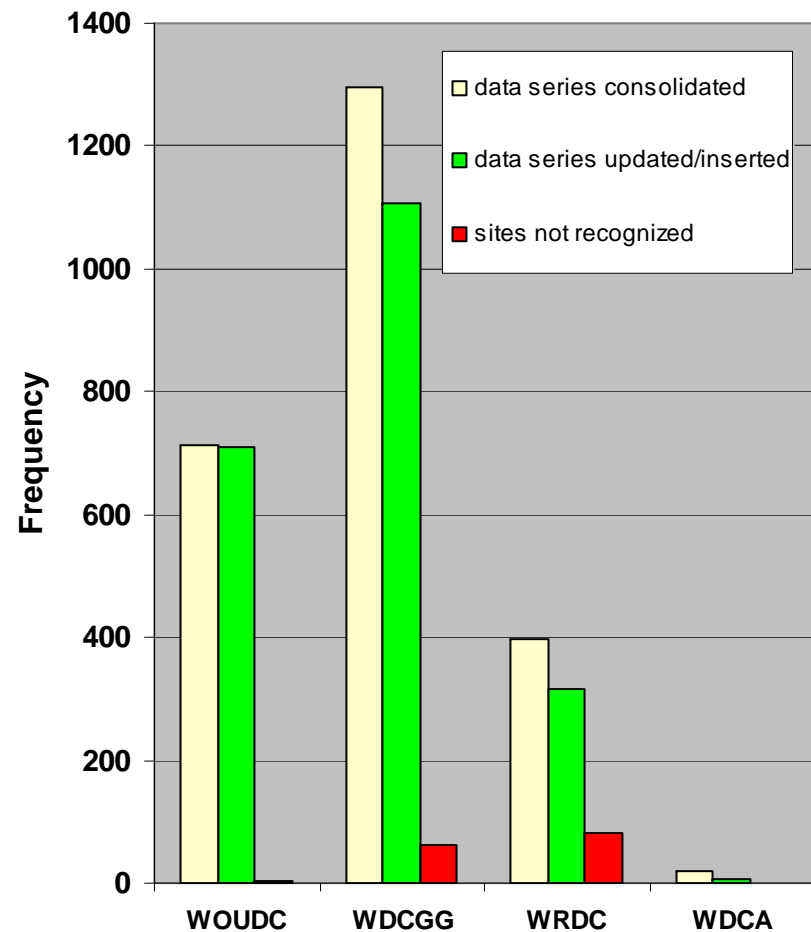
For more information, please visit [BibTex](#).

Linking (W)DCs with GAWSIS



GAWSIS-WDC Integration: Status May 2008

- **WOUDC**
 - *Metadata intake fully operational*
- **WDCGG**
 - *Metadata intake operational*
 - *Almost complete*
- **WRDC**
 - *Status of some sites unclear*
 - *Data not easily accessible*
- **WDCA**
 - *Metadata intake operational*
 - *very few parameters covered*
- **WDCPC**
 - *Not quite operational*
 - *Integrate Regional DCs?*





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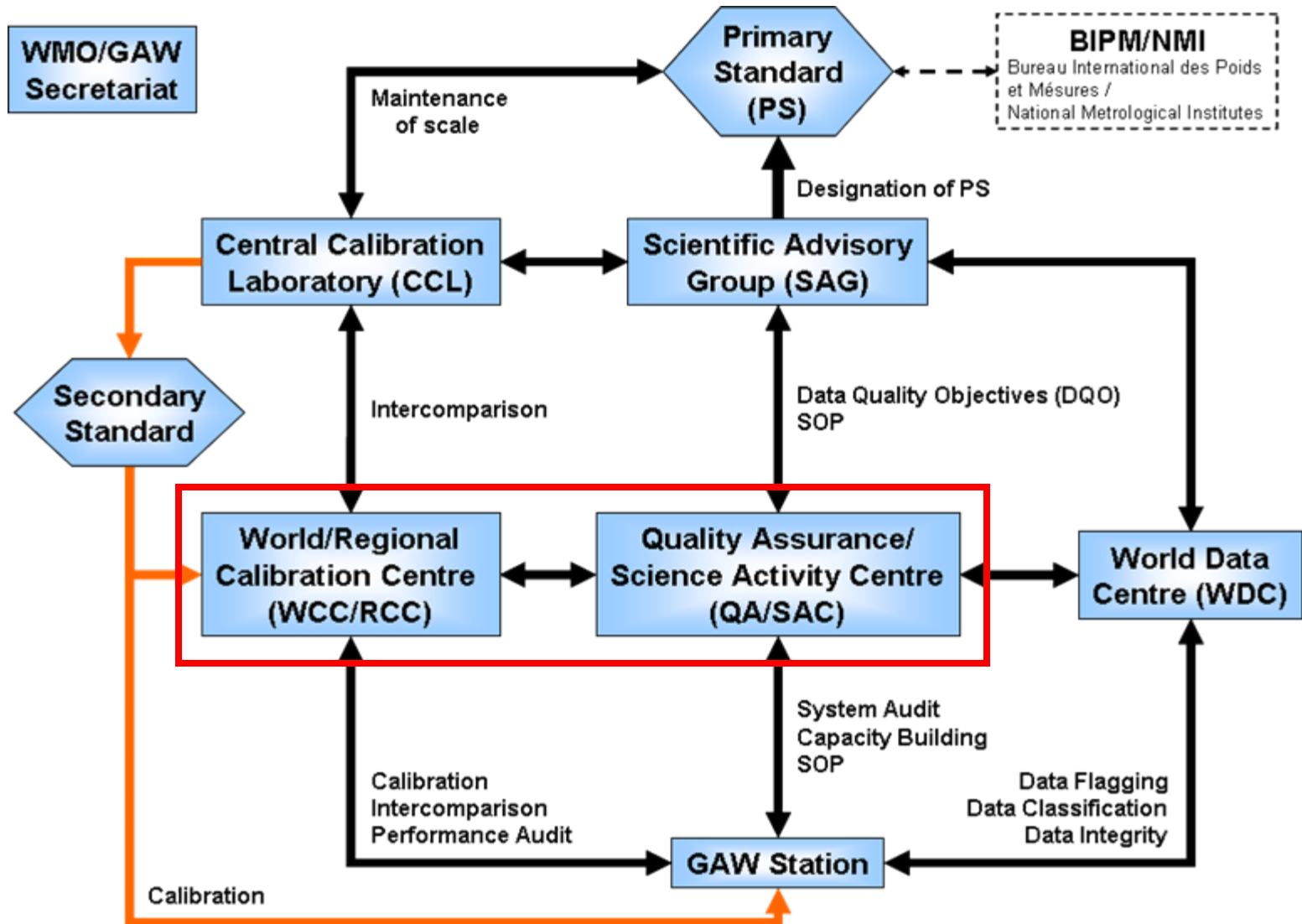


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It's the Quality, Stupid!

World Calibration Centre for Surface Ozone, Carbon
Monoxide and Methane

GAW Quality System



Surface Ozone

Upgrade of SRP Ensemble

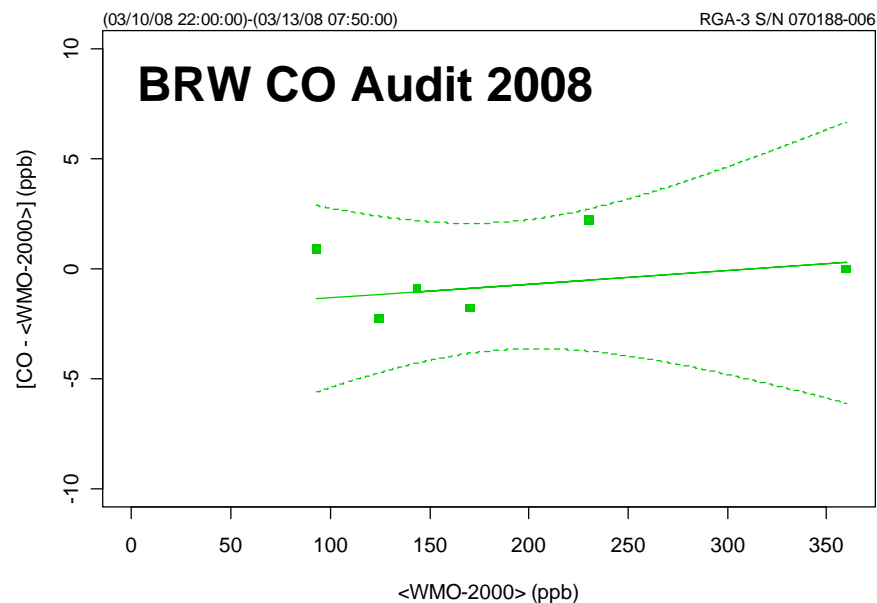
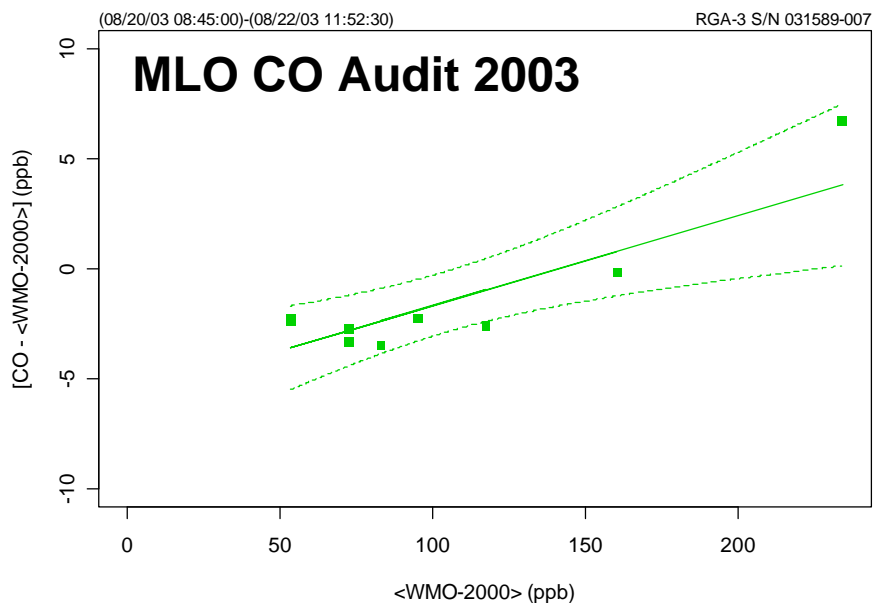
- Original SRP design
 - *biases due to temperature gradients and multiple reflections in the absorption cells (Viallon et al., Metrologia **43** (2006) 441–450)*
- Improved design
 - *new lamp block*
 - *absorption cells with optically sealed windows at 3 degree angles (@METAS together with NIST, and SRP#14, #18, #26)*
- Activities
 - *Upgrade of SRP#15 and #23*
 - *Re-certification against GAW (NIST) and Swiss (METAS) ozone reference*
- Result
 - *small changes (0.1-0.2 ‰) of SRPs*
 - *reduced uncertainty*



Carbon Monoxide

Resolving Scale Issues

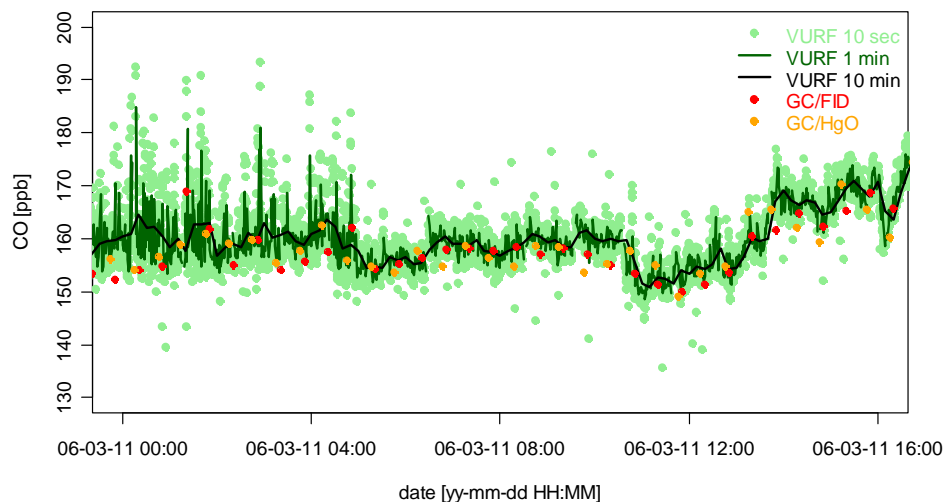
- Internal inconsistency / non-linearity of CO scale no longer a problem
- Status of transfer of scale to stations somewhat unclear
- Documentation / legacy data at WDCGG is an issue that will be addressed next



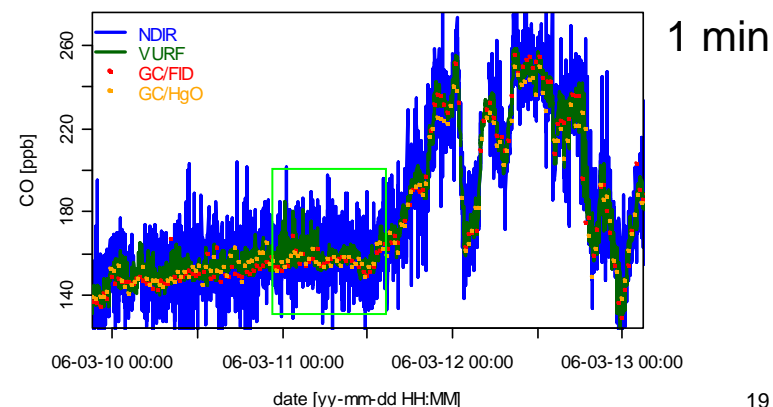
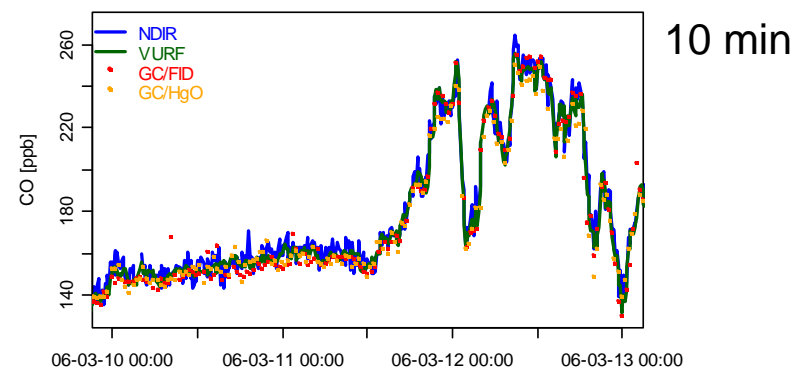
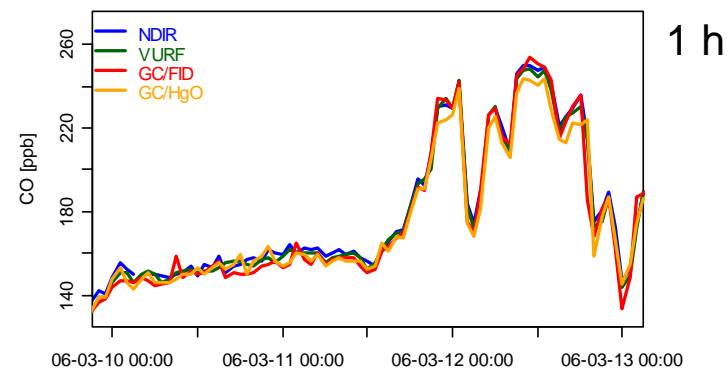
Empa	2006	VURF	WMO-2000	38.1 (0.5)	61.6 (0.3)	107.9 (0.3)	203.9 (0.5)	352.6 (0.3)
NOAA	2007	VURF	WMO-2000	37.6 (0.1)	61.3 (0.2)	106.9 (0.3)	202.9 (0.3)	349.7 (0.5)
NOAA	2007	VURF	WMO-2000 (2006 grav std)	37.8 (0.5)	61.6 (0.4)	107.5 (0.5)	204.0 (0.8)	352.2 (1.8)

CO Field Instrument Inter-Comparison at JFJ

- Comparison of NDIR, GC, and VURF techniques
- Good agreement between techniques
- All instruments are able to detect fast changes in mixing ratios
- NDIR (Horiba instrument) performs well at averaging intervals > 10 minutes



C. Zellweger et al. (in preparation)



Audit Barrow

WCC-Empa (9 – 12 March 2008)



- General Remarks
 - *Situated 8 km east of Barrow (small town / community with complete infrastructure)*
 - *Large number of ongoing measurements and cooperative programs*
 - *New station building planned (2009)*
 - *Both permanent positions vacant (station manager Dan Endres will leave in summer, operator Teresa Winter left in February)*
 - *First audit by WCC-Empa (2nd audit at a NOAA site)*
- O₃
 - *Instrument in calibration*
 - *Inlet could be improved*
- CO
 - *Instrument in calibration (bias < 2%)*
- CH₄
 - *Instrument in calibration (bias ~0.1%)*





Global Atmosphere Watch
QA/SAC Switzerland



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Bundesamt für Umwelt BAFU



































Materials Science & Technology
Air Pollution / Environmental Technology

Researching High

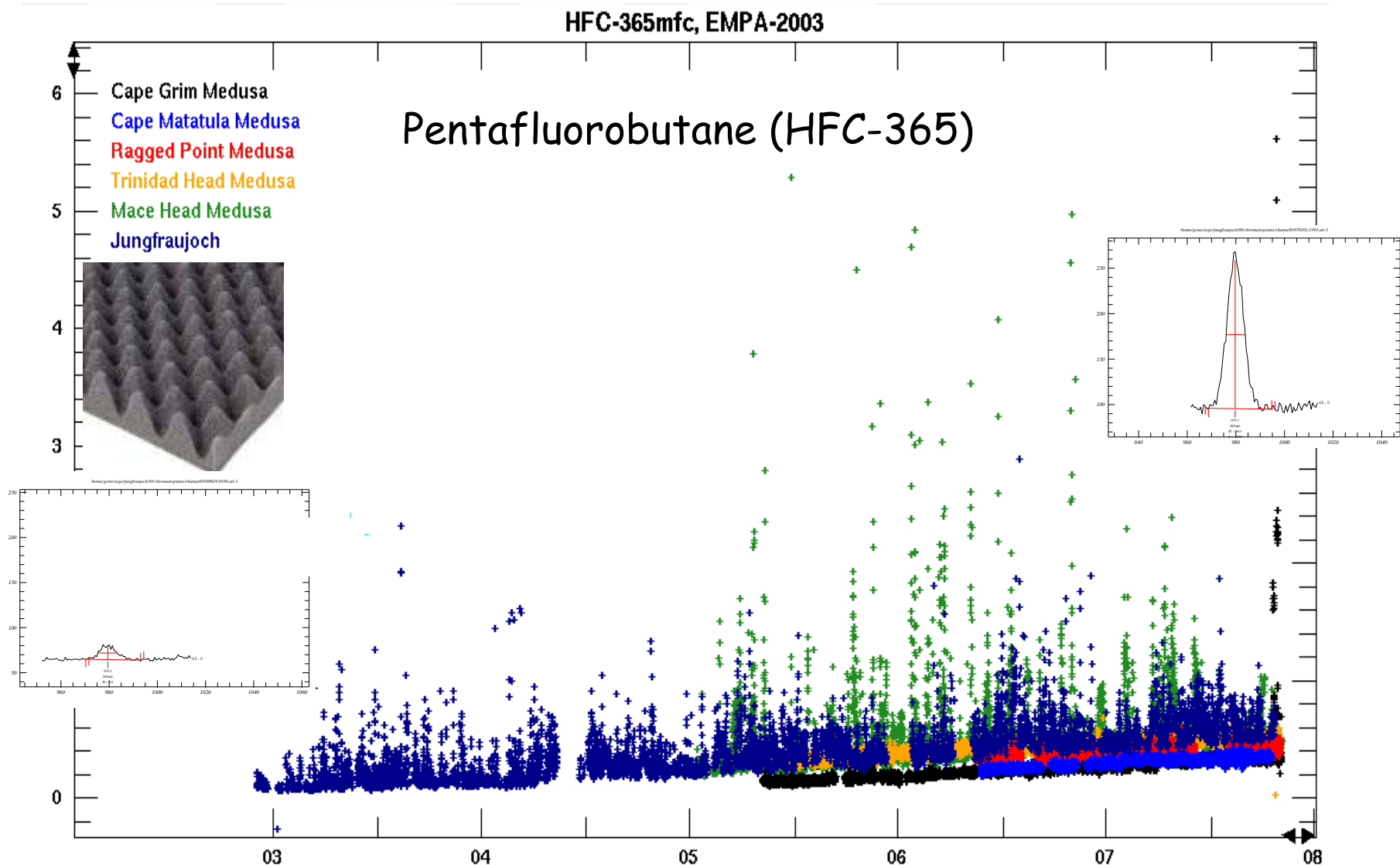
Jungfrauoch – The Swiss Global GAW Station

Contacts: S. Reimann, C. Hüglin, M. Steinbacher, ...

Gas Observations at Jungfraujoch

		Recommended for GAW	Jungfraujoch	funding
Greenhouse gases	CH₄			NABEL (BAFU, Empa)
	N₂O			NABEL (BAFU, Empa)
	CFC			SOGE (Empa, BAFU)
	HCFC, HFC		 , 	SOGE (Empa, BAFU)
	SF₆			NABEL (BAFU, Empa)
	CO₂			University of Berne
Reactive gases	O₃			NABEL (BAFU, Empa)
	CO			NABEL (BAFU, Empa)
	SO₂			NABEL (BAFU, Empa)
	NO, NO₂, NO_y	 ,  , 	 ,  , 	NABEL (BAFU, Empa)
	VOC			NABEL (BAFU, Empa)
	PAN, HNO₃ OVOC, H₂	 ,  ,  ,  ,	campaigns campaigns 	Empa, IACETH NABEL (BAFU, Empa) Empa

World-first measurements of 'Kyoto' gas HFC-365mfc at Jungfrauoch



S. Reimann, M. Steinbacher, M. Vollmer

VOCs and OVOCs at Jungfrauoch

Ethane new 2008
 Propane new 2008
 Acetylene new 2008

Isoprene
 Terpenes
 DMS

Formaldehyde campaign

Acetonitrile

Methanol campaign

Ethanol campaign

Acetone campaign

Benzene continuous

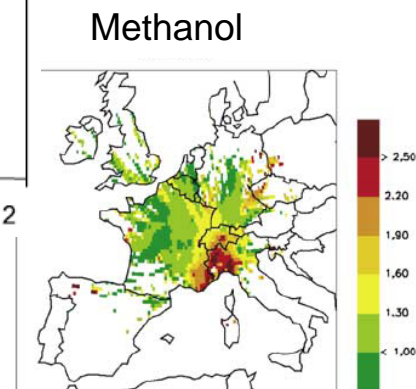
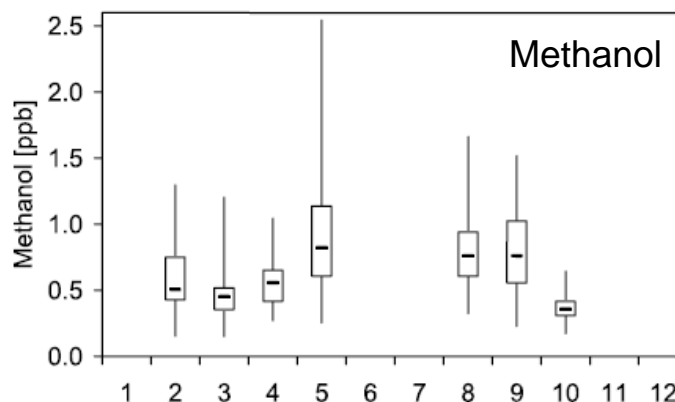
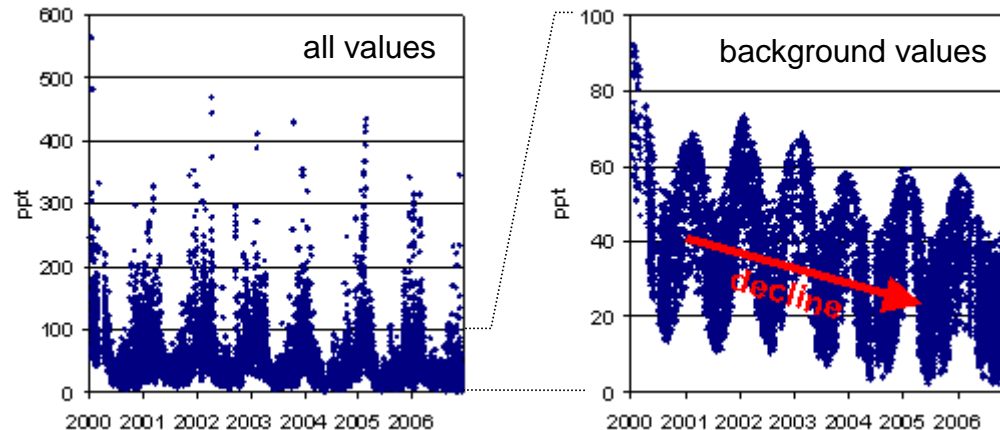
Toluene continuous

Iso-/n-Butane continuous

Iso-/n-Pentane continuous

Acetaldehyde campaign

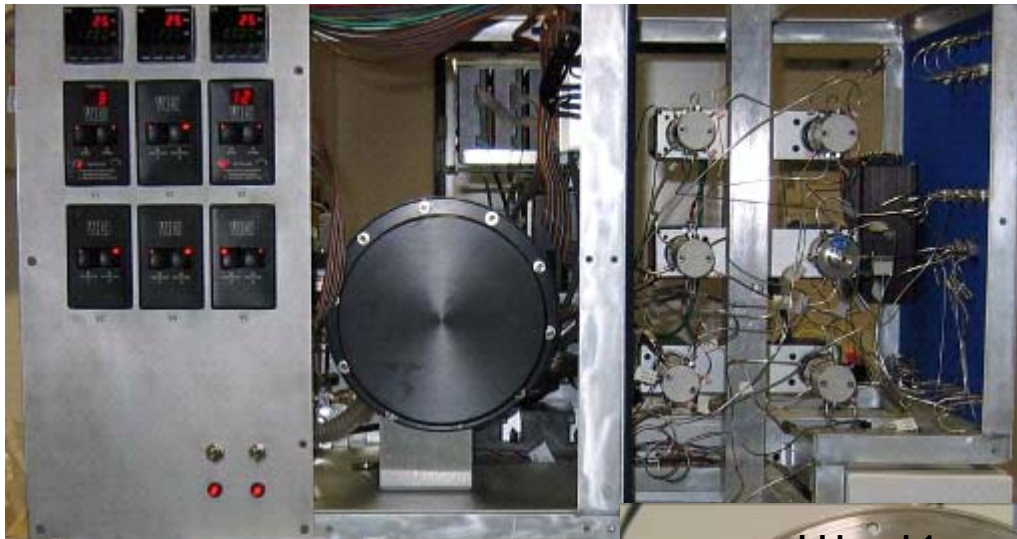
Benzene



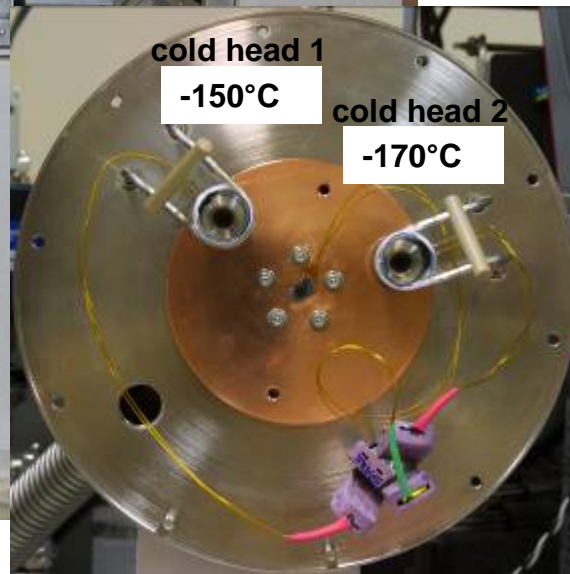
Legreid, G. et al., JGR 113, 2008

95% of VOCs in summer / 83% in winter

MEDUSA, launched at Jungfraujoch in February 2008



GC/MS



cold head 1
HFCs
CFCs
SF₆
C₂F₆
VOC

cold head 2
CF₄

In cooperation with AGAGE, SCRIPPS, University Bristol



Air Pollution/Environmental Technology Laboratory



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Mind the gap, please!

Twinning partnerships with
Algeria, Indonesia, Kenya

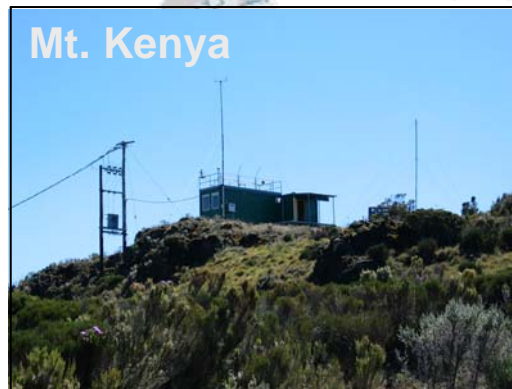
Three Partners in three Developing Countries



23.267°N 5.633°E
2710 m a.s.l.
Arid plateau



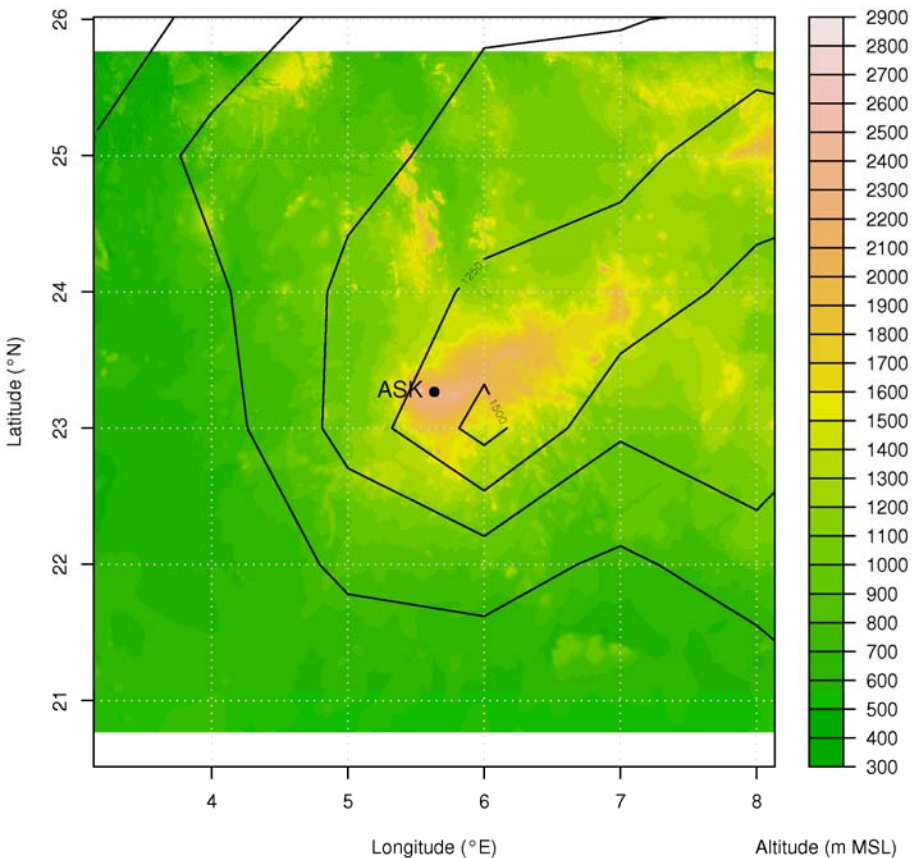
0.202°S 100.318°E
864 m a.s.l.
Elevated rain forest



0.062°S 37.297°E
3678 m a.s.l.
High mountain slope

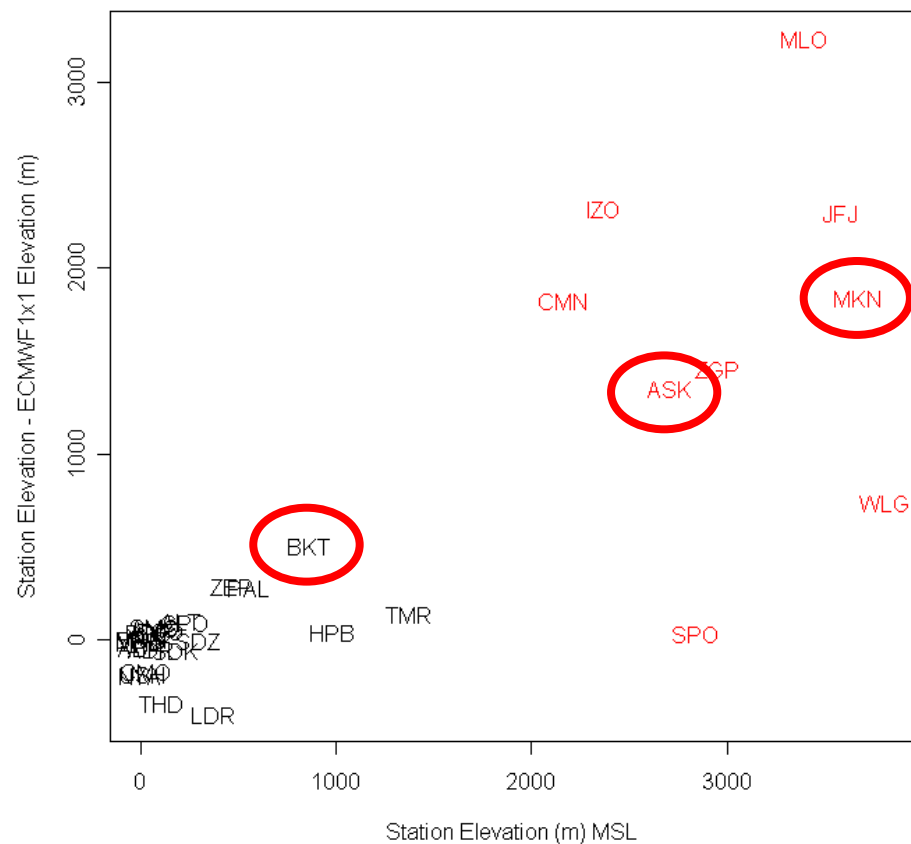
Topography

Assekrem, 2710 m a.s.l., 1355 m a.m.g.



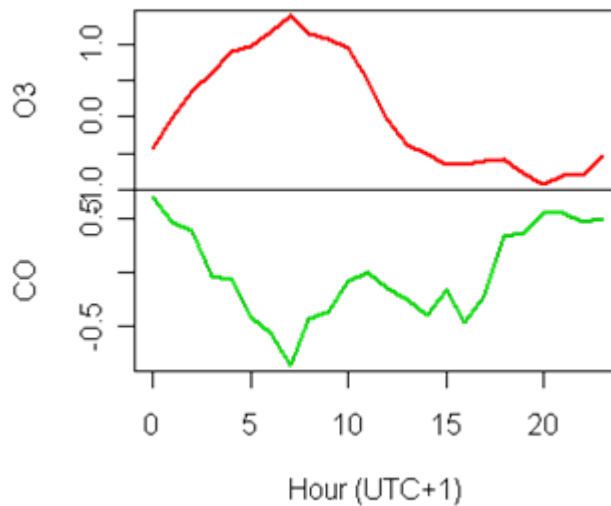
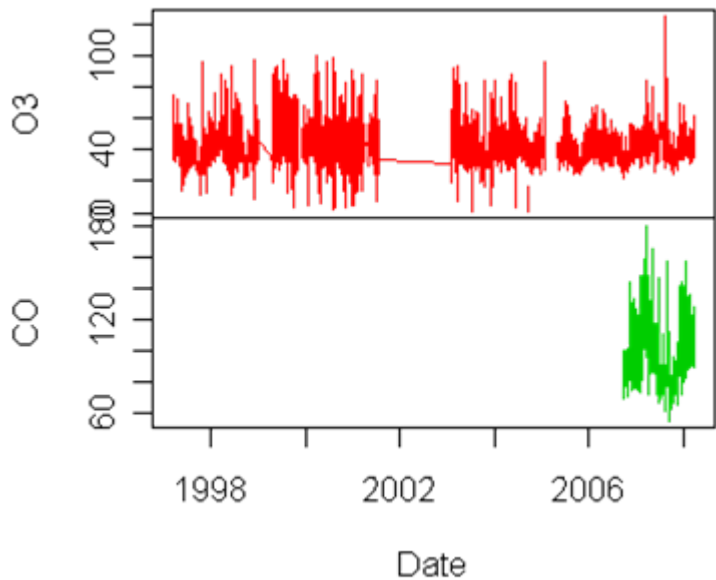
Colorscale: 1 km x 1 km
Contour: 1 ° x 1 °, ECMWF

**Difference between
 'real' and 'model' station elevation**

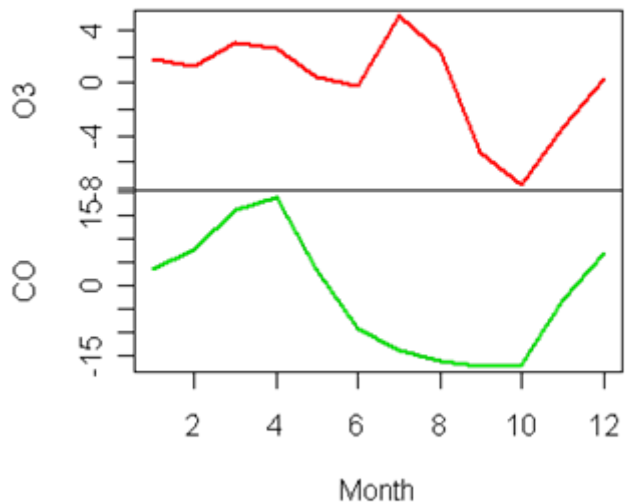
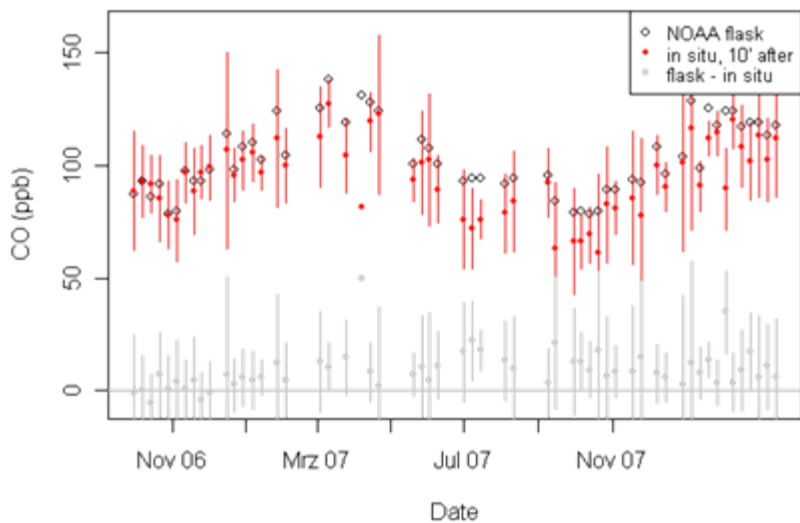


Global GAW stations

Assekrem

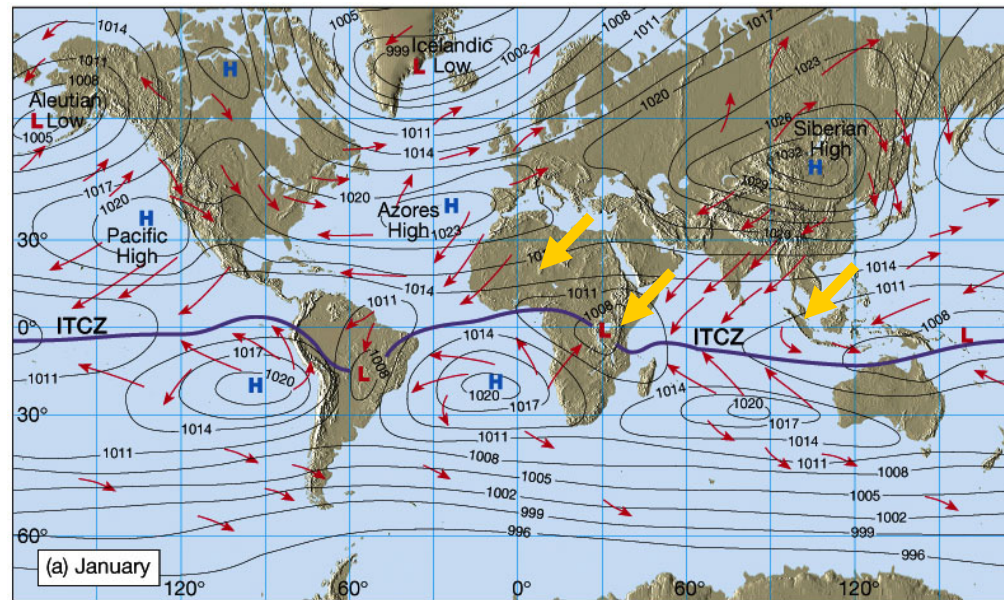


ASK: NOAA flask and in situ

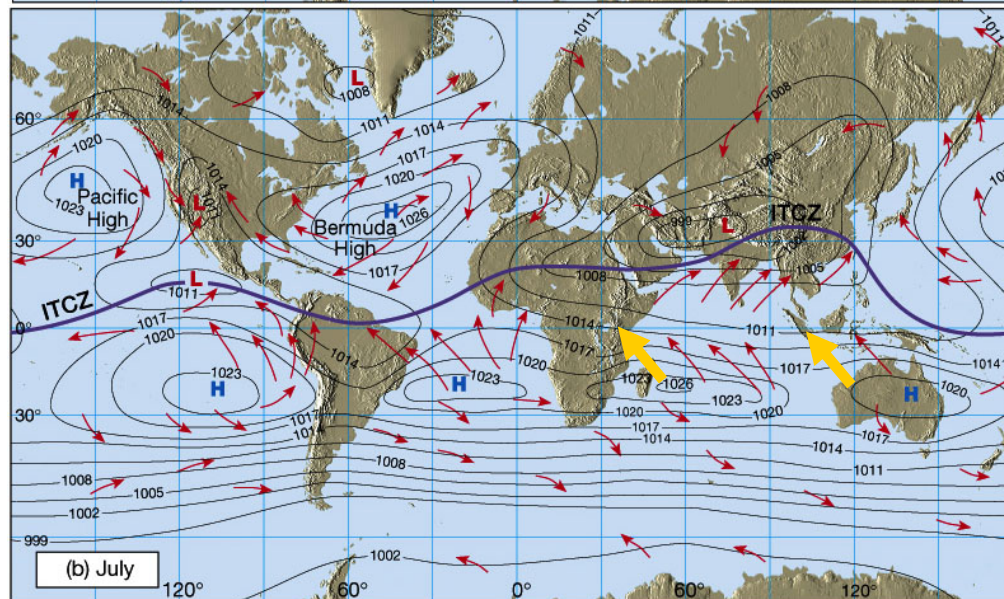


Global Atmospheric Circulation & ITCZ

January



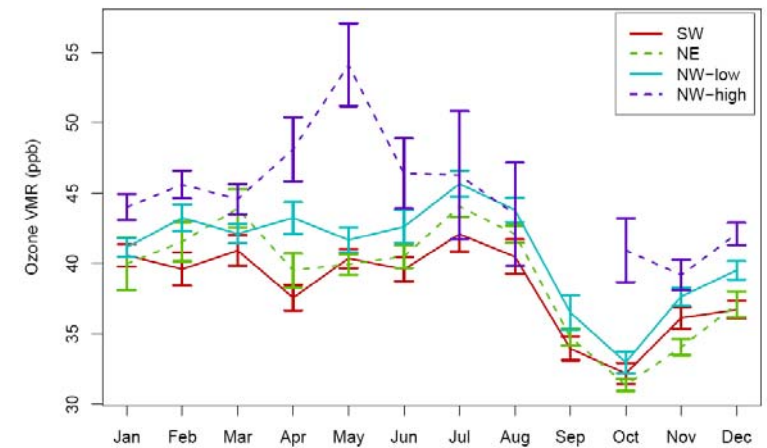
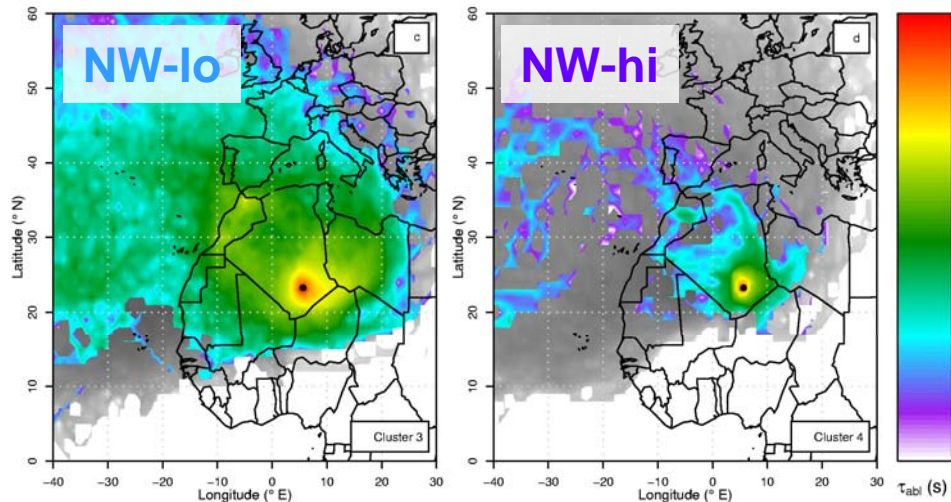
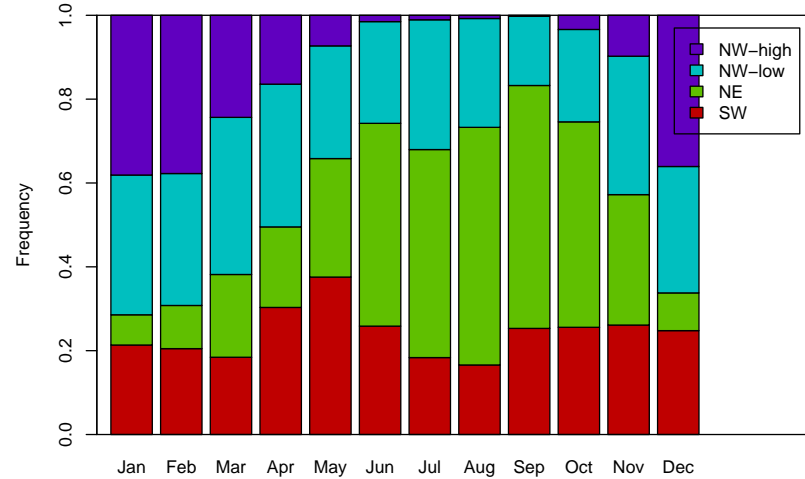
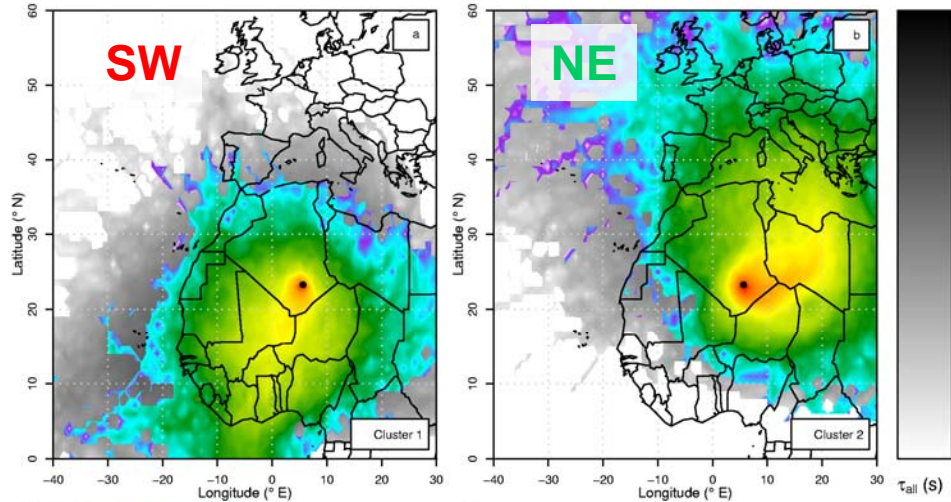
July



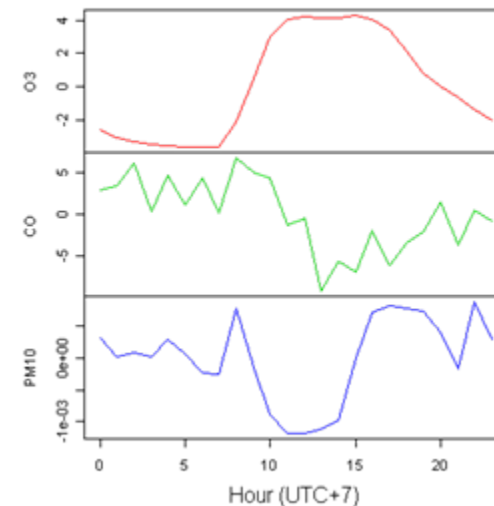
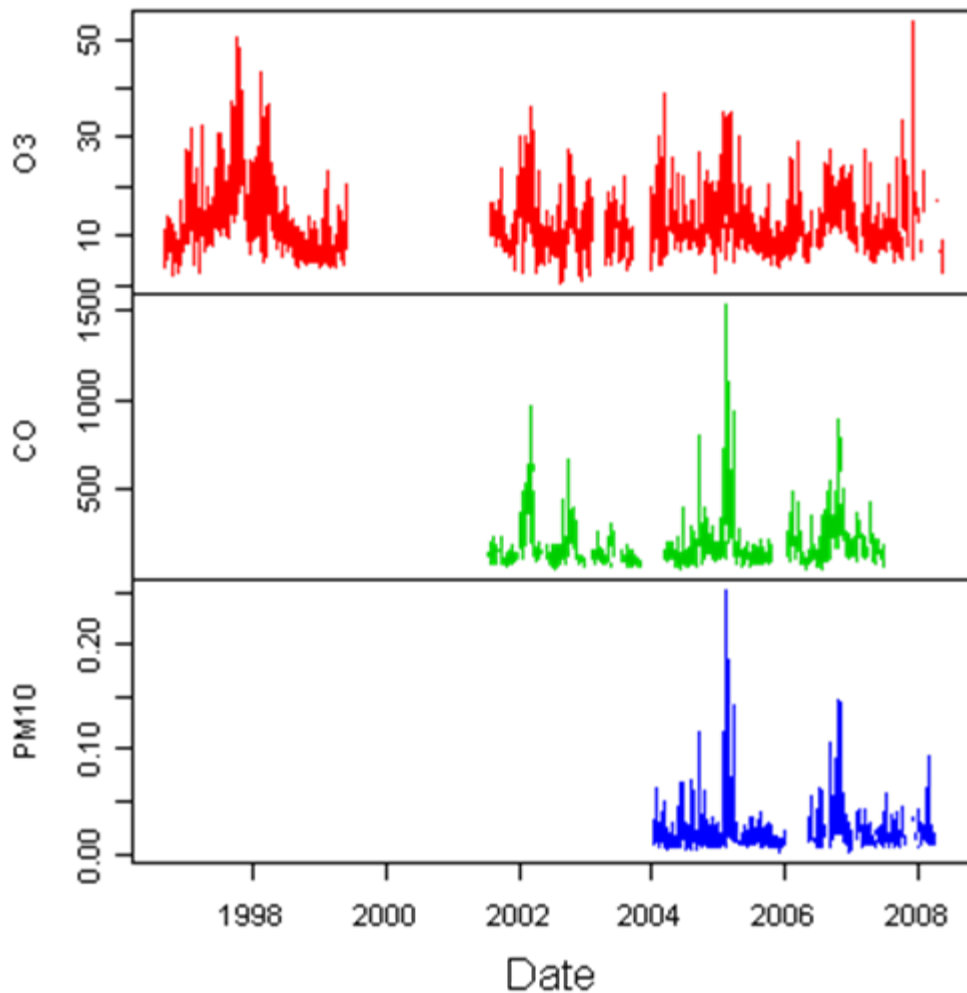
Assekrem: Trajectory Clustering

FLEXTRA, 10-day backward, 4 hourly start, Period: 2001 – 2006

Residence times: Grayscale: all altitudes, Colored: below 2000 m AGL



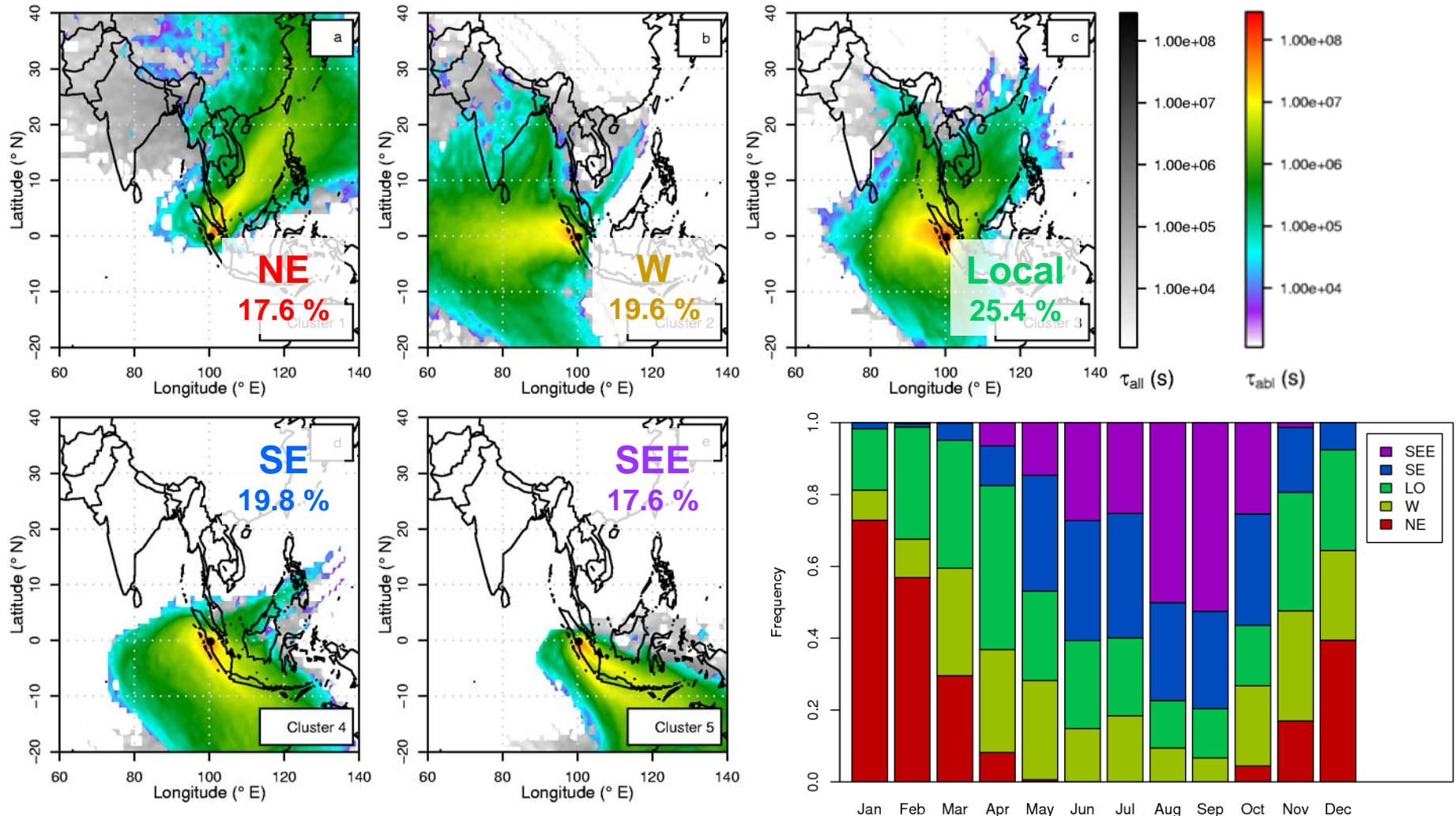
Bukit Koto Tabang



- O₃
 - *Deposition dominant during night*
 - *Mixing in from troposphere during day*
- CO
 - *Dilution with free tropospheric air during day*

Bukit Koto Tabang: Trajectory Clustering

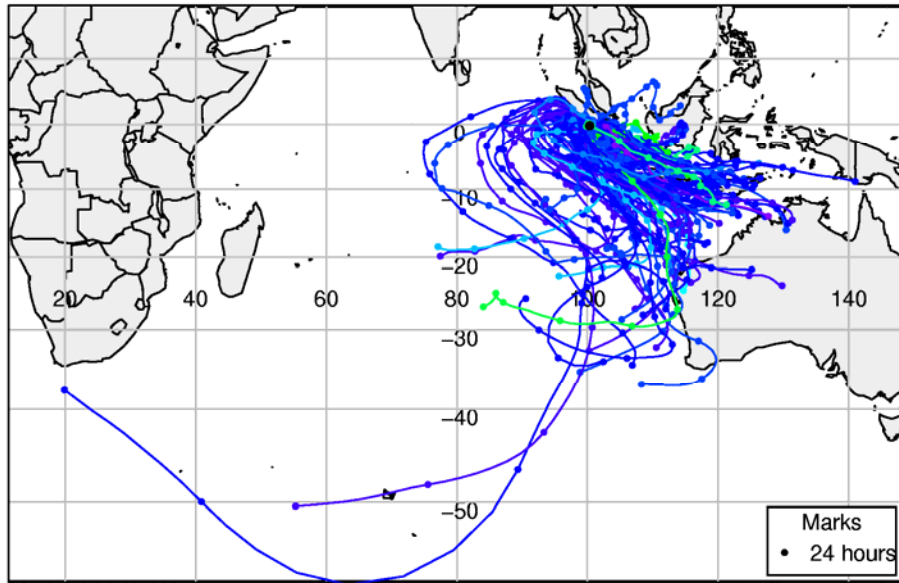
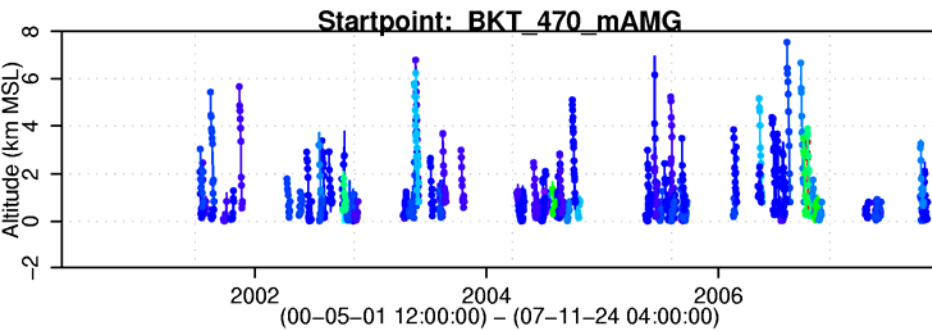
FLEXTRA, 10-day backward, 4 hourly start, Period: 2000-01 – 2007-12
 Residence times: Grayscale: all altitudes, Colored: below 2000 m AGL



Trajectories in SEE and SE Cluster

Representative sample

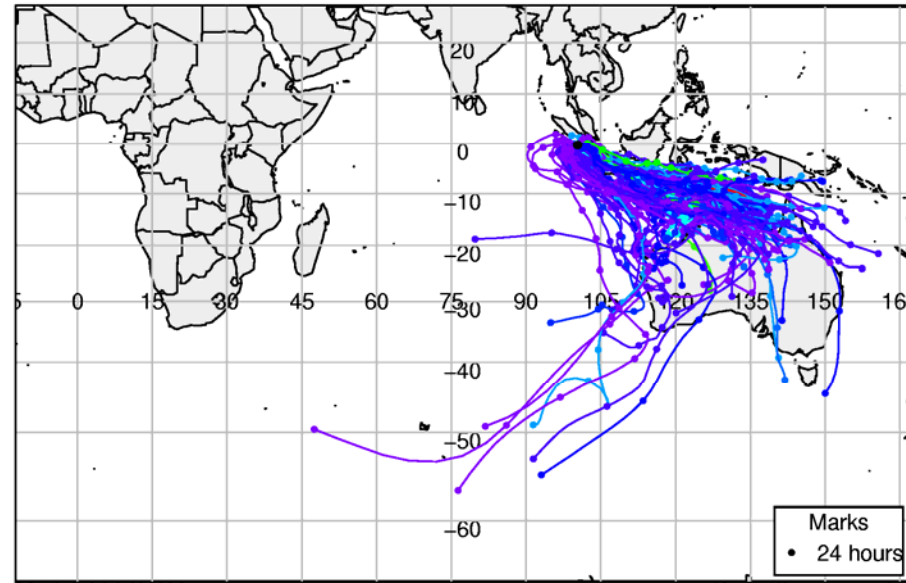
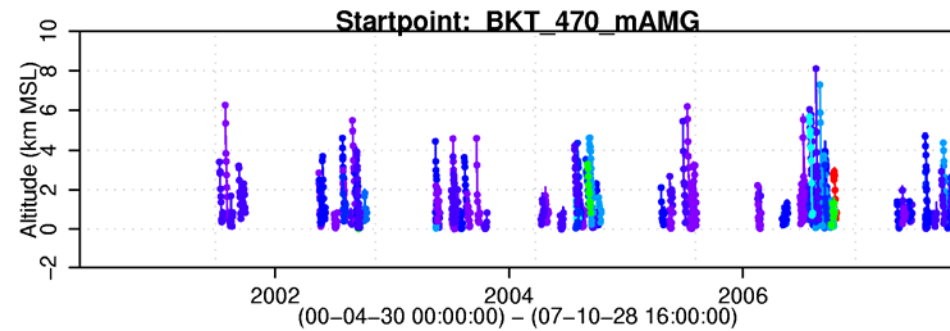
Cluster 4: SE



Model: FLEXTRA
Windfields: ECMWF

Projection: mercator

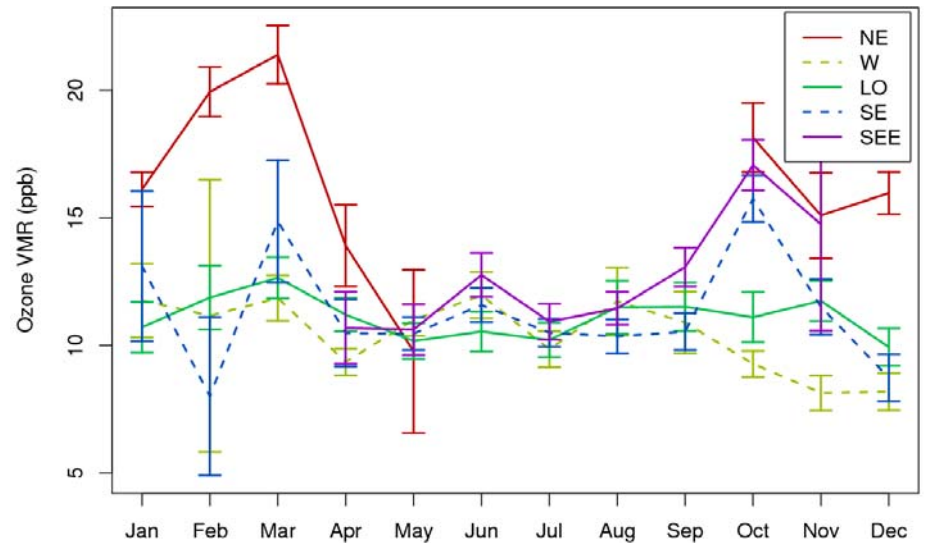
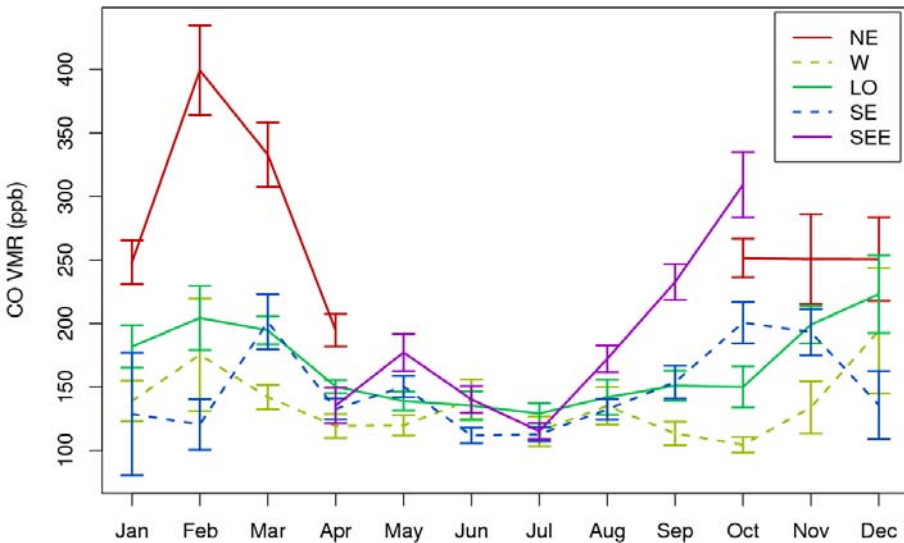
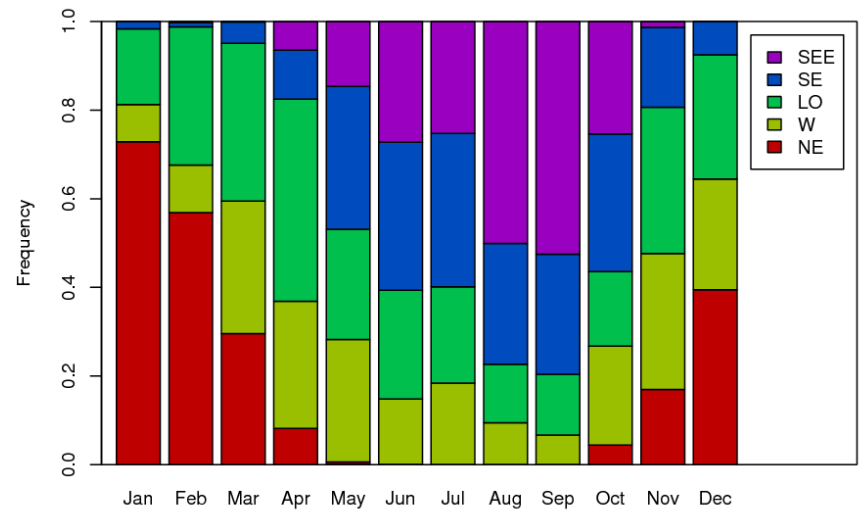
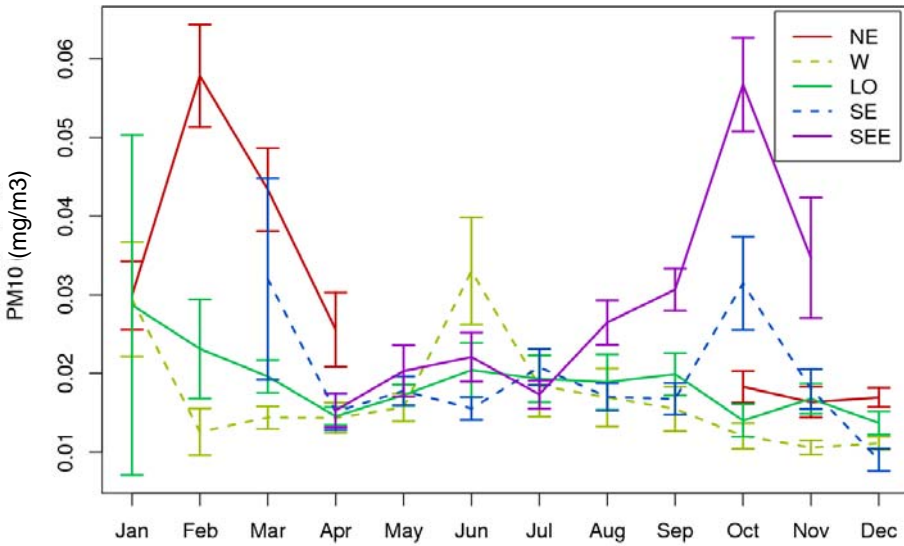
Cluster 5: SEE



Model: FLEXTRA
Windfields: ECMWF

Projection: mercator

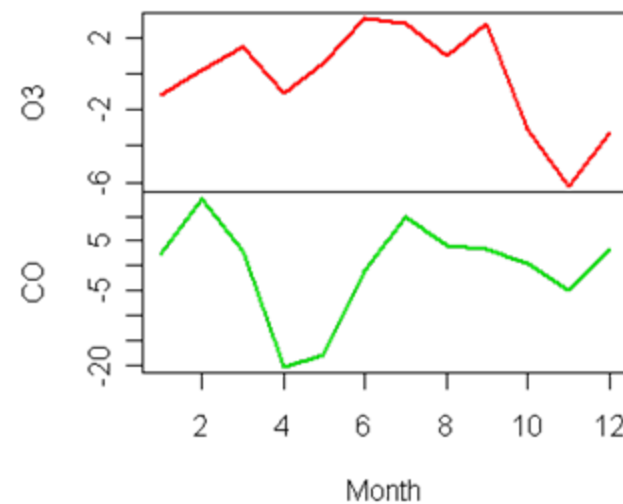
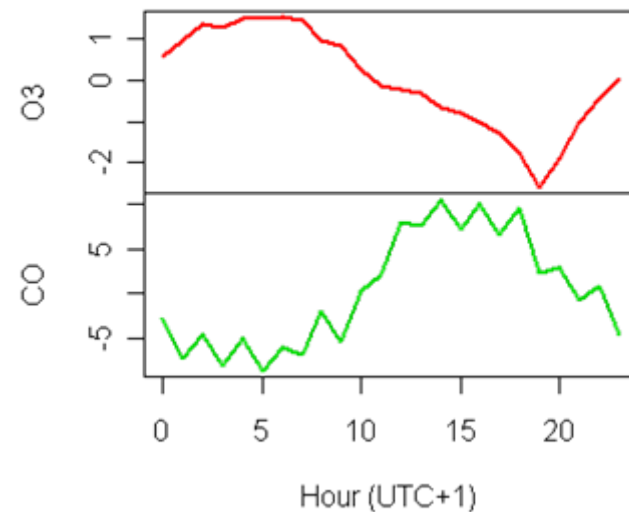
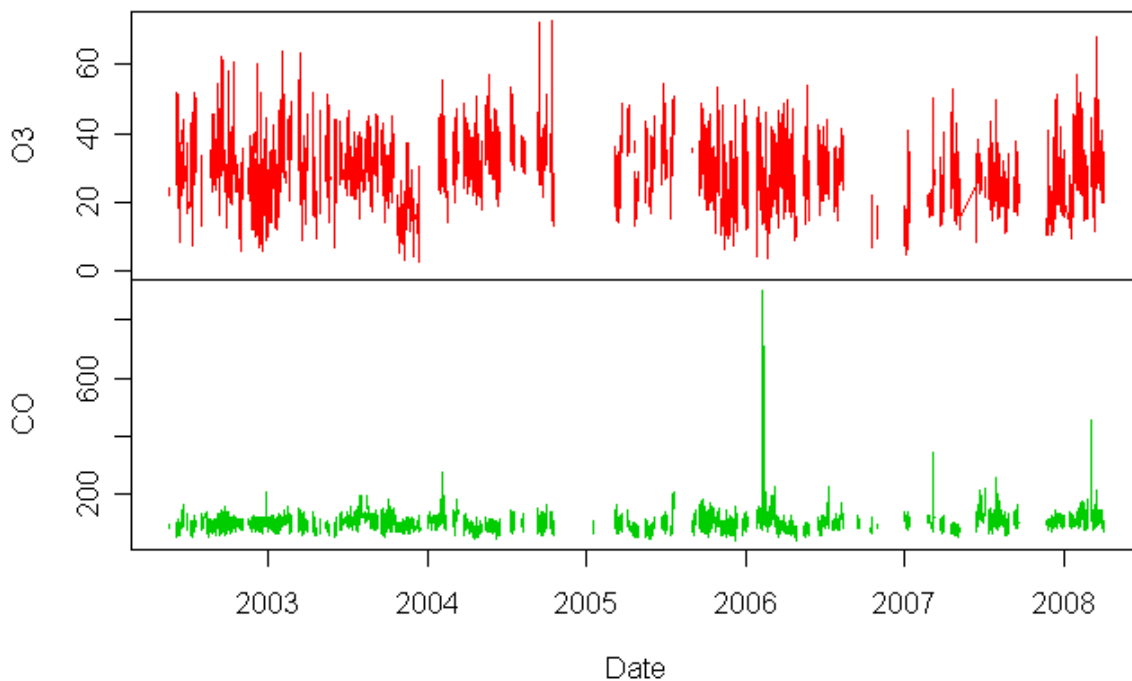
Bukit Koto Tabang: Trajectory Clustering



Mt. Kenya



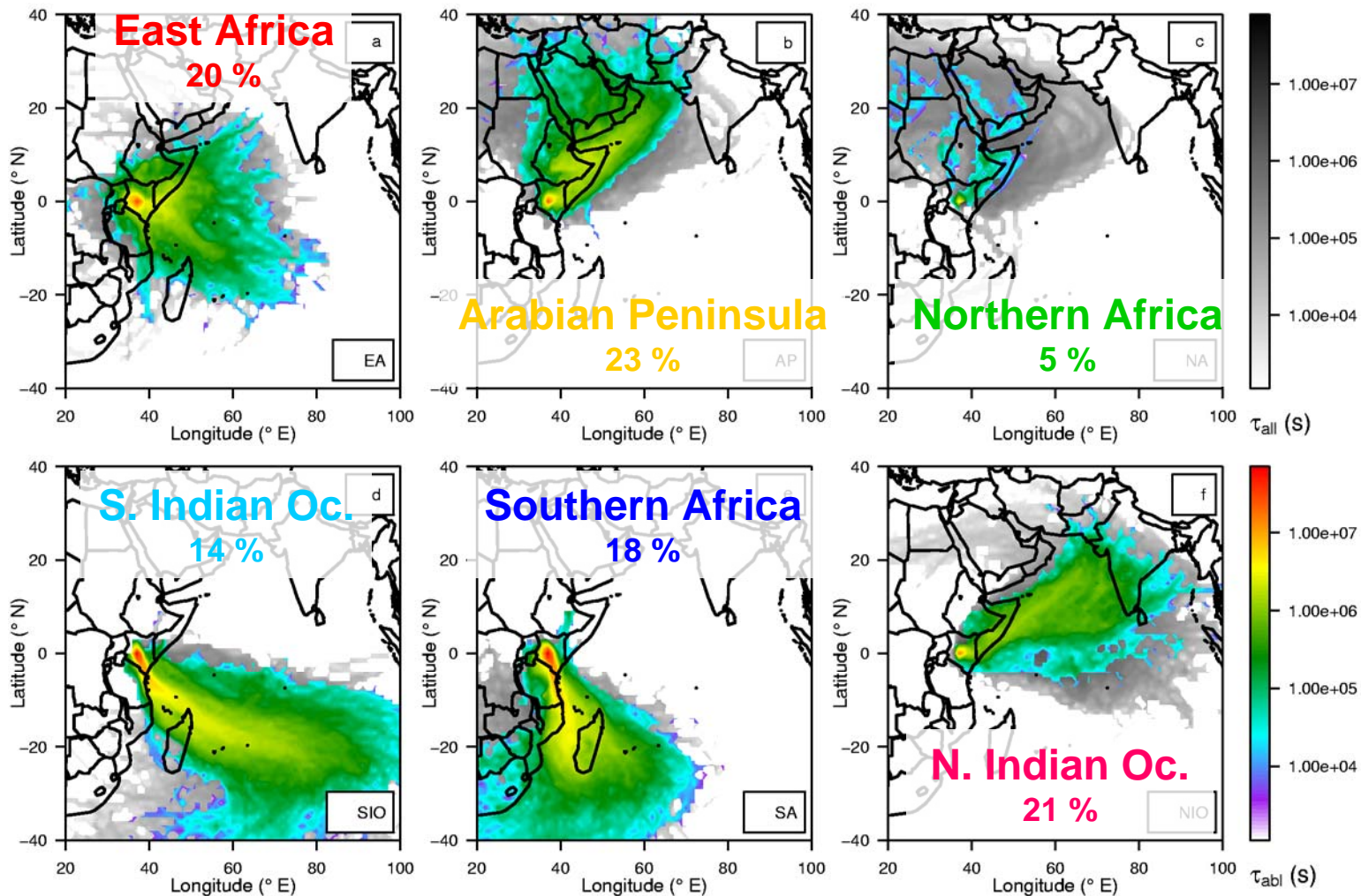
MKN (hourly aggregates)



Trajectory Clustering: Mt. Kenya

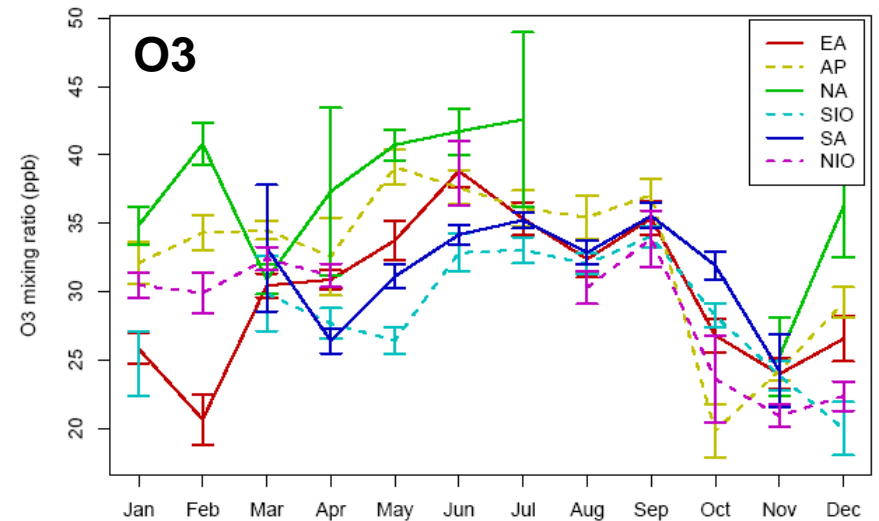
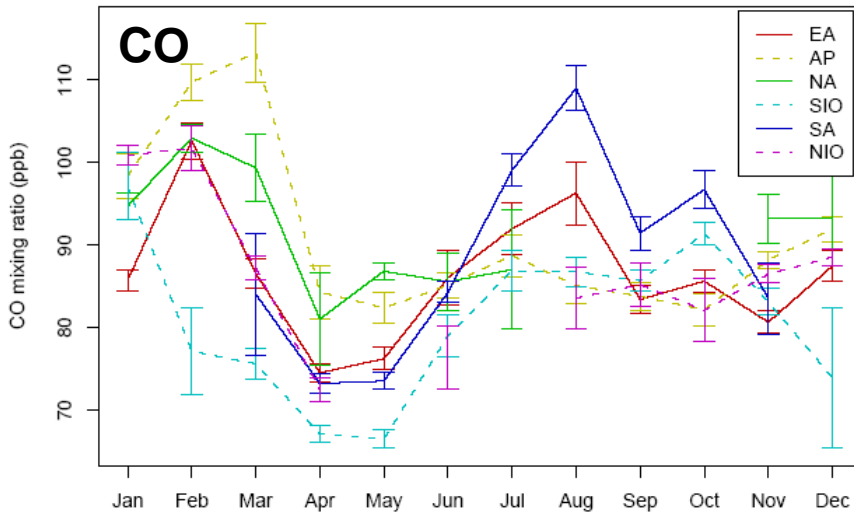
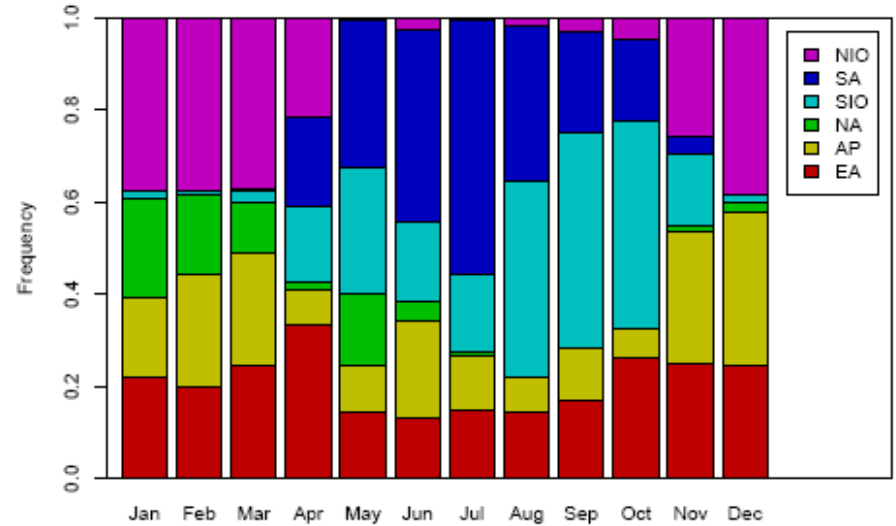
FLEXTRA, 10-day backward, 4 hourly start, Period: 2002-06 – 2006-06

Residence times: Grayscale: all altitudes, Colored: below 2000 m AGL



Trajectory Clustering: Mt. Kenya

- Clear monsoon pattern
 - *NIO, NA in winter*
 - *SA, SIO in summer*
- EA all year
- High CO
 - *from northerly clusters (winter)*
 - *biomass burning (summer)*
- Low O3 in Oct/Nov
 - *Passage of the ITCZ*



(Henne et al., 2007, ACPD)

Conclusions

- GAW SIS exerts a ‚structuring‘ influence on GAW, defining the ground-based network and unifying the WDCs.
- CO scale issues largely resolved, but work remains to (re)establish traceability of legacy and current observations.
- Improvements of SRP have reduced the uncertainty of ensemble realization of ozone reference.
- Jungfraujoch (JFJ) helps to identify European emission sources as well as global trends.
- Empa (and others) are working on narrowing remaining gaps in the global ground-based network with some success.
- Maintaining basic operations, capacity building and sustainable knowledge transfer remain a huge challenge.



Thank you for your attention