

CMA's Capability & Effort to Serve the “Pilot Low-Carbon Action at 5 Provinces and 8 Cities in China” and the Global Network

Lingxi ZHOU & colleagues

**Chinese Academy of Meteorological Sciences (CAMS)
China Meteorological Administration (CMA)**

Ensuring Continuity and Reliability of Long Term Measurements,
2011 GMAC, Boulder, CO

Motivation

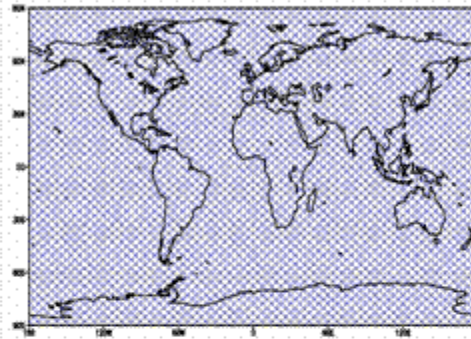
Ambient GHGs measurement (ground based site, tall tower, aircraft, etc) and inverse modeling techniques have been demonstrated they are currently not sufficiently developed to provide a comprehensive routine and verification at the desired accuracy, especially on a smaller scale, such as in regions and cities.

Atmospheric inversion estimation

Prior flux information



LMDZ transport model



Atmospheric observations

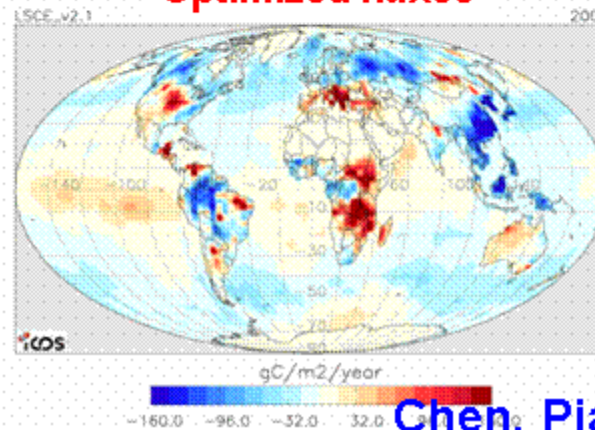


Inverse Procedure

Limitations 1:

sparse atmospheric measurement network (only a few sites in Asia), and uncertainty from transport model

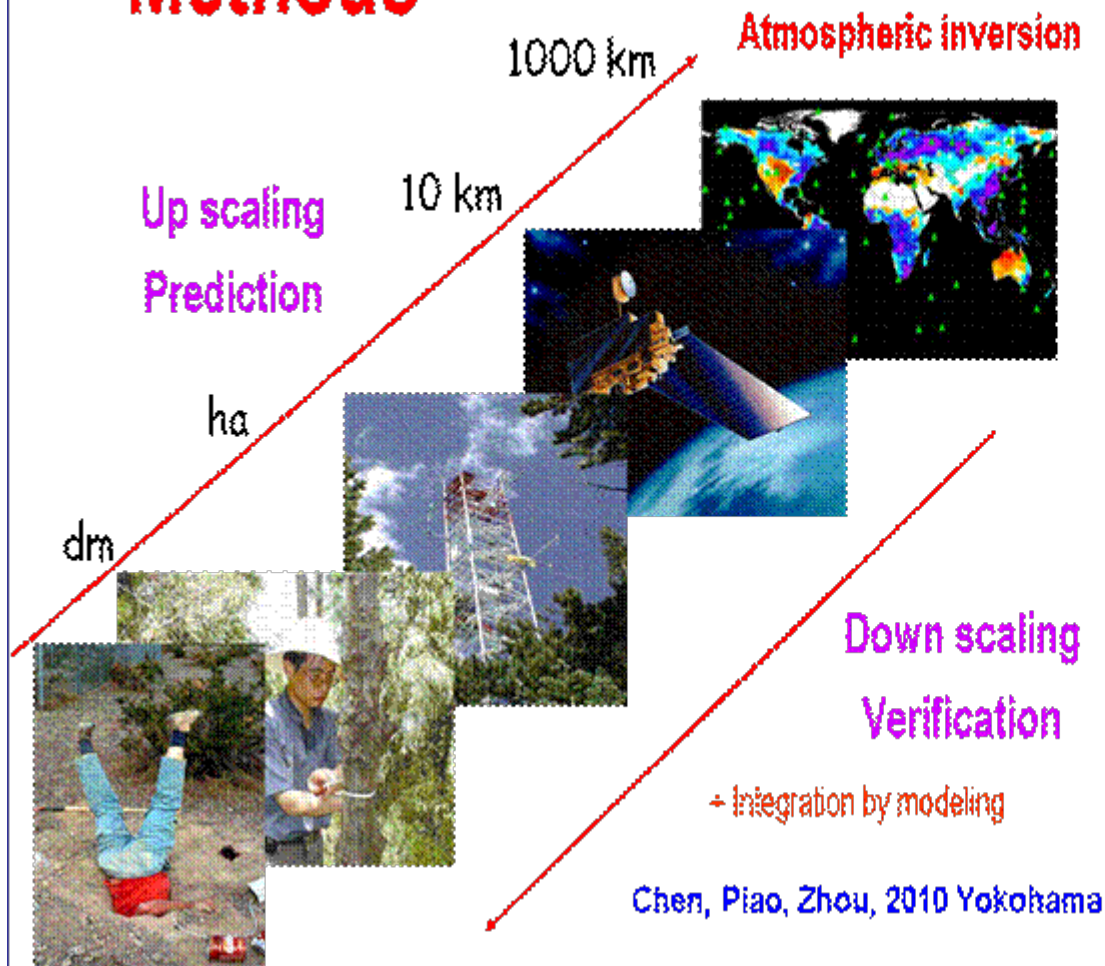
Optimized fluxes



Limitations 2:

Low spatial resolution, we can only estimate CO2 flux at regional scale, can not separate each ecosystem

Methods



Progress is to be gained from working together, to improve network coverage and verification techniques as well as to gain better understanding of inventory estimates.

The CMA leads operational monitoring network for GHGs & climate change in China and plays a key role in the IPCC activities.

To the end of 2010, CMA operate 2418 national climate/meteorological stations, and 30347 regional meteorological stations.





About IPCC

- Home
- About IPCC
- How the IPCC is organized
- IPCC Bureau and TFB
- IPCC Secretariat
- Working Group I
- Working Group II
- Working Group III
- Task Force on National Greenhouse Gas Inventories
- Other IPCC activities

THE IPCC BUREAU AND THE TASK FORCE BUREAU

Members of the IPCC Bureau are normally elected for the duration of the preparation of an IPCC Assessment Report (5-6 years). They should be experts in the field of climate change and all regions should be represented in the IPCC Bureau. The Bureau is chaired by the Chair of the IPCC and is composed of the Co-Chairs of the three IPCC Working Groups and the Task Force Bureau on National Greenhouse Gas Inventories, IPCC Vice-Chairs and Vice-Chairs of the Working Groups. Presently the IPCC Bureau is composed of 30 members.

The Bureau of the Task Force on National Greenhouse Gas Inventories (TFB) oversees the National Greenhouse Gas Inventories Programme. It is composed of two Co-chairs, which are also members of the IPCC Bureau, and 12 members.

The current composition of the IPCC Bureau and the TFB is shown below:

THE IPCC BUREAU (SEPT. 2008)

Chairman



Rajendra K. Pachauri

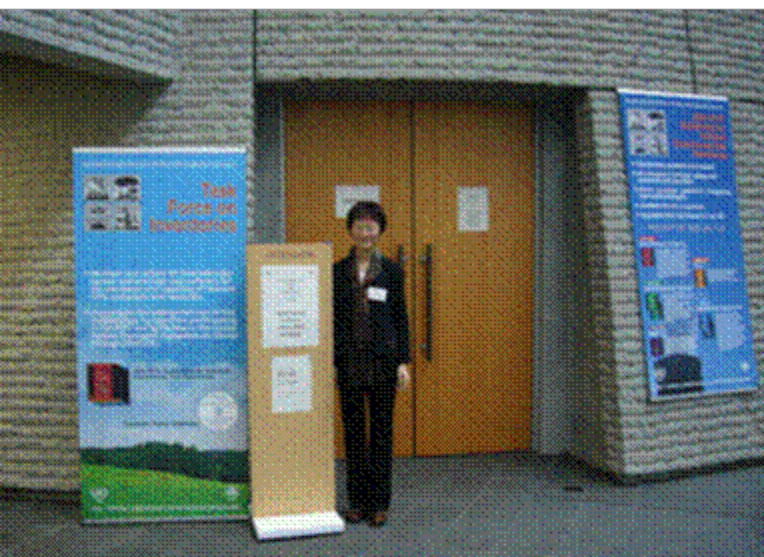
IPCC Vice - Chairs

		
<u>Ogunlade Davidson</u> (Sierra Leone)	<u>Jean-Pascal van Ypersele</u> (Belgium)	Hoesung Lee (Republic of Korea)

Working Group I The physical science basis	Working Group II Impacts, adaptation, vulnerability	Working Group III Mitigation	Task Force Bureau National Greenhouse Gas Inventories
Co-chairs	Co-chairs	Co-chairs	Co-chairs
 <u>Thomas Stocker</u> (Switzerland)	 Christopher Field (USA)	 <u>Ottmar Edenhofer</u> (Germany)	 <u>Taka Hiraishi</u> (Japan)
 <u>Dahe Qin</u> (China)	 <u>Vicente Barros</u> (Argentina)	 <u>Ramon Pichs-Madruga</u> (Cuba)	 Thelma Krug (Brazil)
		 <u>Youba Sokona</u> (Mali)	

**Dahe QIN
China**

IPCC, Bureau of the Task Force on National Greenhouse Gas Inventories (Sept. 2008 - 2014), together with IPCC AR5



Co-Chairs (2)

Taka Hiraishi (Japan)

Thelma Krug (Brazil)

Members (12)

Washington Zhakata (Zimbabwe)

Zhou Lingxi (China)

Leonidas O. Girardin (Argentina)

Art Jaques (Canada)

Robert Sturgiss (Australia)/

Leonard J. Brown (New Zealand) *

Detelina Petrova (Bulgaria)/

Sadeddin Kherfan (Syrian Arab Republic) **

Enmanuel Mpeta (United Republic of Tanzania)

Sirintornthep Towprayoon (Thailand)

Sergio Gonzalez Martineaux (Chile)

William N. Irving (USA)

Rizaldi Boer (Indonesia)

Jim Penman (UK)

Validation / verification capabilities of ambient mixing ratio measurements and inverse modeling

Lingxi ZHOU

**Chinese Academy of Meteorological Sciences (CAMS)
China Meteorological Administration (CMA)**

IPCC Expert Meeting on
Uncertainty and Validation of Emission Inventories
23-25 March 2010, Utrecht, The Netherlands

The CMA represents the WMO Commission for Atmospheric Sciences of China and is deeply involved in the Global Atmospheric Watch (GAW).

For example, Mt. Waliguan in remote western China (one of the 26 GAW baseline stations**) and the long greenhouse gas record we have there.**

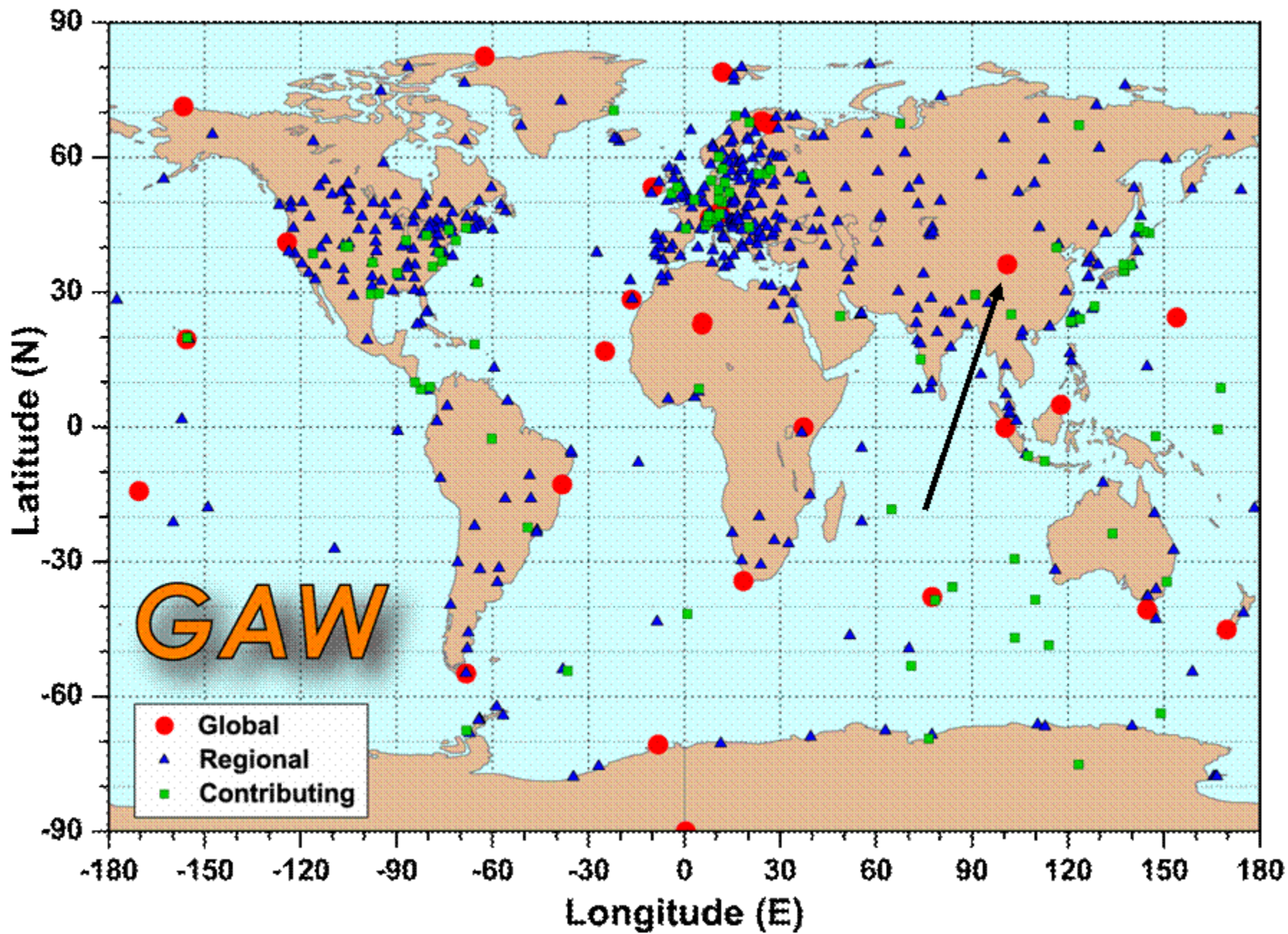
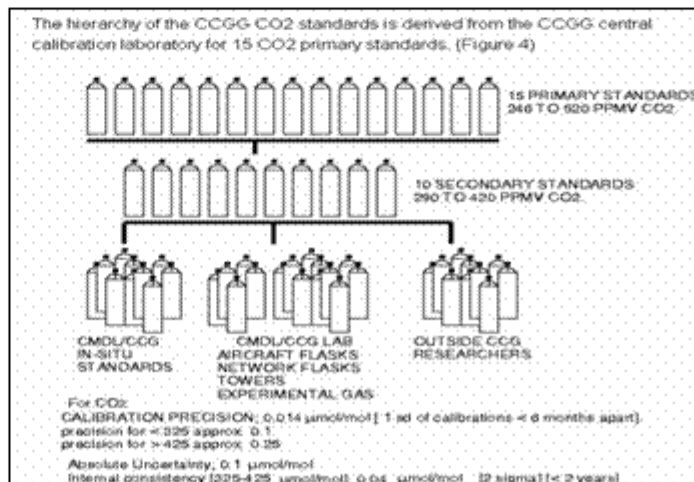
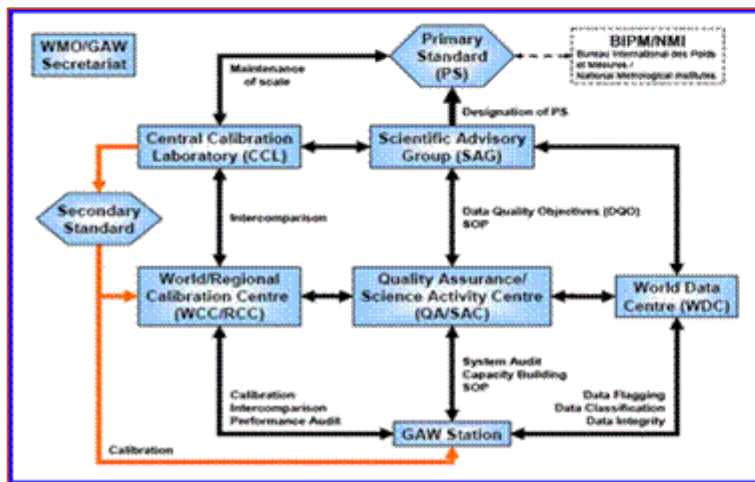


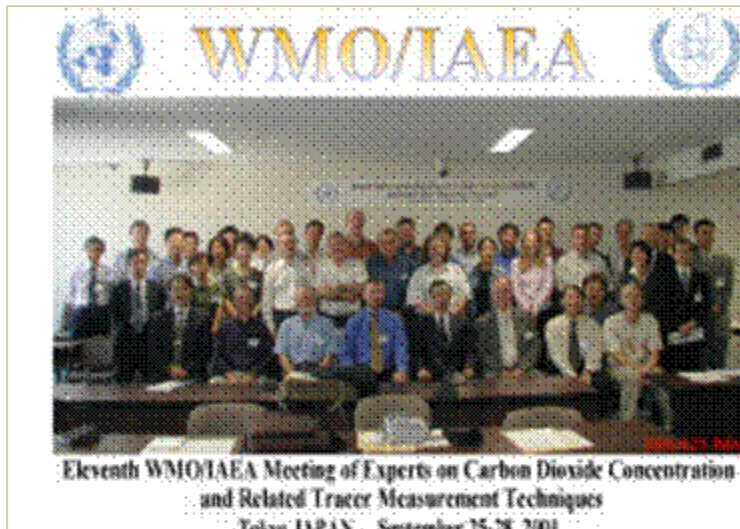
Table 1: Recommended inter-laboratory (network) comparability of components discussed.

Component	Inter-Laboratory comparability
CO ₂	± 0.1 ppm (± 0.05 ppm in the southern hemisphere)
δ ¹³ C-CO ₂	± 0.01 ‰
δ ¹⁸ O-CO ₂	± 0.05 ‰
Δ ¹⁴ C-CO ₂	± 1 ‰
O ₂ /N ₂	± 1 per meg
CH ₄	± 2 ppb
CO	± 2 ppb
N ₂ O	± 0.1 ppb
H ₂	± 2 ppb
SF ₆	± 0.02 ppt

WMO/GAW
recommendations
 14th WMO/IAEA expert meeting
 Sept. 2007, Helsinki
 15th WMO/IAEA expert meeting
 Sept. 2009, Jena



WMO/IAEA Meetings of Experts on CO₂ Concentration & Related Tracer Measurement Techniques

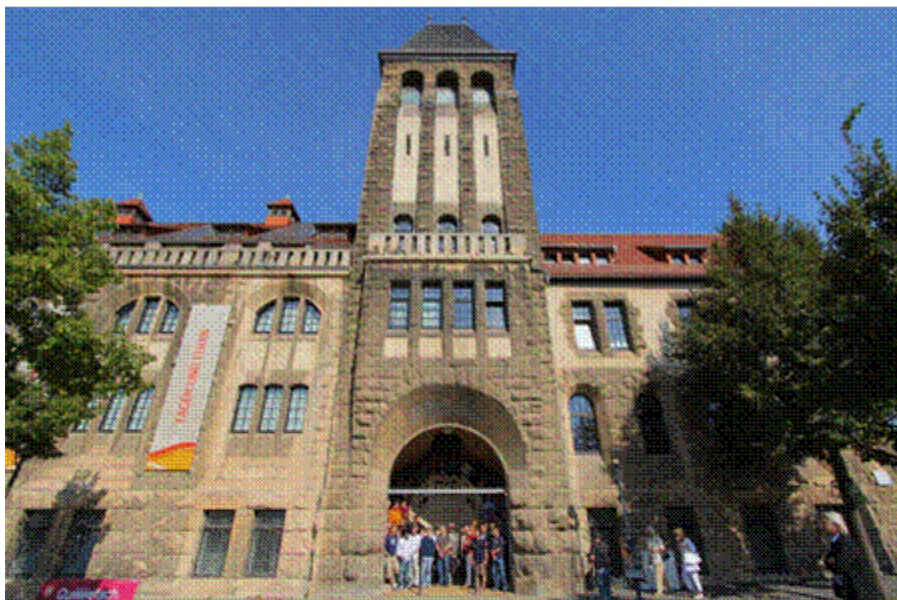


14th WMO/IAEA Meeting of Experts on Carbon Dioxide, Other Greenhouse Gases, and Related Tracers Measurement Techniques

10-13 September 2007, Helsinki, Finland



15th WMO/IAEA Meeting of Experts on Carbon Dioxide, Other Greenhouse Gases and Related Tracers Measurement Techniques, 7-10 Sept. 2009, Jena, Germany



WMO Round-robin Inter-comparison (GHGs)

2002 - 2006 WMO ROUND-ROBIN INTERCALIBRATION RESULTS CARBON DIOXIDE CONCENTRATIONS [Preliminary]

Laboratories	Analysis Date	Report Date	TANK # CO2 (ppm)			Other species measured (Reported in red)	Difference s(Lab - NOAA) CO2 (ppm)		
GROUP ONE (Tank #432, #449, #454)			432	449	454		432	449	454
US- NO AA	Feb-Mar 2001								
US- NO AA	Apr 2002		354.91	368.14	384.81				
US- NO AA	Feb 2005								
JP - Tohoku U.	Jan 2003	Mar 2004							
JP - NIES	Apr 2003	Mar 2004				CH4, N2O, SF6, CO, H2, d13C, d18O			
JP - MRI	July 2003	Mar 2004							
JP - AIST	Sept/Dec 2003	Mar 2004				CH4			
JP - JMA	Jan 2004	Mar 2004							
Korea - KMA (KGMV)	Mar/Jun 2004	July 2004							
CH - CMA (WLS)	July 2004	Nov 2004							
CH - CMA (BJ)	Aug 2004	Nov 2004							
US- SCRIPPS	June 2005	June 2005				(CMM) d13C, d18O			
FR - LSC E	Oct/Nov 2005	Dec 2005				(ECM II)			
GROUP TWO (Tank #442, #493, #499)			442	493	499		442	493	499
US- NO AA	Feb-Mar 2001								
US- NO AA	Apr-Mar 2002		355.85	368.35	384.68				
US- NO AA	Dec 2004								
IT - Monte Cimone	Oct 2002	Oct 2002							
IT - ENEC Lampedusa	Nov 2002	Mar 2003							
IT - Plateau Rosa/ESL/NR	Dec 2002	Dec 2002							
HU - HMS	Feb 2003	Sep 2003							
CA - MSC	May 2005	July 2005				CH4, N2O, SF6, CO, d13C, d18O			
CA - O SAP	not attend								
US - Perm State U.	Sep 2005	Sep 2005							

4th WMO Round-robin (15 countries)

25+1 Labs reported CO₂

11+1 Labs reported CH₄

7+1 Labs reported CO

5+1 Labs reported N₂O/SF₆

6+1 Labs reported d¹³C and d¹⁸O

1 Lab for O₂/N₂ and 1 Lab for H₂

Lingxi ZHOU, Referee since 2002

5th WMO RR started in 2009, 41 Labs from 19 countries registered

US- NOAA	Mar/Jun 2001								
US- NO AA	July 2001		353.68	366.25	383.31				
US- NO AA	Apr 2002								
US- NO AA	Dec 2004/Jan 2005								
DE - U. Heitberg	Sep 2002	Sep 2002				CH4, N2O, d13C, d18O			
DE - UBA	Oct 2002	Mar 2003				CH4			
FR - LSC E	Nov/Dec 2002	Dec 2005				CH4, N2O, SF6			
DE - FZK, formerly IfU	not attend								
FMI	Jan 2003	Mar 2004							
EMPA	July 2003	July 2003				CH4, CO (CO2 not measured)			
DE - MPI BG	Nov/Dec 2003	Oct 2004				CH4, N2O, SF6, CO, d13C, d18O			
HU - HMS	Mar 2004	Dec 2005							
NL - U. Groningen	Nov 2004	Sep 2005				CH4, CO, d13C, d18O			
NZ - NIWA	Mar 2005	Apr 2006							
AD - CSIRO	Sep 2005	Apr 2006				CH4, CO			
SA - CAEP T.	Dec 2005	Mar 2006				CH4, CO			
US - NCAR	May-June 2006	June 2006				CO2/N2			

CAMS/CMA joined 2nd, 3rd, 4th WMO

Round-robin inter-comparison organized by **WMO/CCL** hosted by **NOAA ESRL** for the periods of 1995-1997, 1999-2000 and 2002-2006.

WCC CH4 inter-comparision in Asia (2008-2009)



Table 2 Results of Methane Reference Gas Intercomparison for Asia

Laboratory and Location	Date of Measurement	Cylinder Number						instrument
		CPB13002			CPB13003			
		Concentration (ppb)	SD (ppb)	No	Concentration (ppb)	SD (ppb)	No	
JMA Tokyo, Japan	May. 1, 2008	1664.4	1.2	10	1848.4	1.8	10	SHIMADZU GC-14BPF
KRISS Daejeon, RP Korea	Sep. -Nov., 2008	1665.1	0.2	5	1851.2	0.2	5	HP-6890
KMA Anmyeon-do, RP Korea	Oct. -Nov., 2008	1665.6	1.2	12	1851.3	1.4	12	HP-6890
CMA Mt. Waliguan, China	Apr. 3-5, 2009	1661.1	0.9	14	1847.0	0.8	14	Agilent-6890N
	Apr. 13-14, 2009	1662.3	0.2	9	1847.2	0.3	9	Picarro G1301
	Apr. 14-16, 2009	1659.3	5.2	10	1846.1	1.9	10	HP-5890
CMA Beijing, China	Apr. 28-29, 2009	1661.9	2.0	10	1847.5	0.6	10	Agilent-6890N
	Apr. 29, 2009	1662.5	0.2	9	1847.3	0.1	9	Picarro G1301
	Apr. 30, 2009	1662.2	1.6	12	1847.2	1.8	12	Agilent-6890N
JMA Tokyo, Japan	Jul. 1, 2009	1664.3	1.1	10	1846.8	1.7	10	SHIMADZU GC-14BPF

Agreed
very well

SD: Standard deviation; No: Number of measurements

In recent years comparisons with CIPM-related institutions
(International Committee for Weights and Measures)

April 2010: CIPM Mutual Recognition Arrangement

The World Meteorological Organization (WMO) has become the second intergovernmental organization to join the [CIPM MRA](#).

→ Climate change - WMO signed the CIPM MRA!

The "[WMO-BIPM Workshop on Measurement Challenges for Global Observation Systems for Climate Change Monitoring: Traceability, Stability and Uncertainty](#)" was held from 30 March to 1 April 2010, at the WMO headquarters in Geneva, Switzerland, under the chairmanship of Prof. Andrew Wallard (BIPM) and Dr Wenjian Zhang (WMO).

At the occasion of the Workshop, the [World Meteorological Organization \(WMO\)](#) joined the CIPM MRA. The signing ceremony took place on 1 April 2010, when Michel Jarraud, Secretary General of the WMO, signed the Arrangement on behalf of the WMO.

WMO与CIPM 温室气体观测标准互认协议

WMO-BIPM Workshop on Measurement Challenges for Global Observation
Systems for Climate Change Monitoring: Traceability, Stability and Uncertainty
30 March-1 April 2010



Source of
information:
[http://www.
bipm.org/en
/cipm-mra/](http://www.bipm.org/en/cipm-mra/)

Network Observation of Greenhouse Gases & tracers in China and Propagation of Reference Gas Standards

Lingxi ZHOU, and colleagues

zhoulx@cma.gov.cn, zhoulx2007@gmail.com

**Chinese Academy of Meteorological Sciences (CAMS)
China Meteorological Administration (CMA)**

RM 2010, Beijing, Oct. 26-29

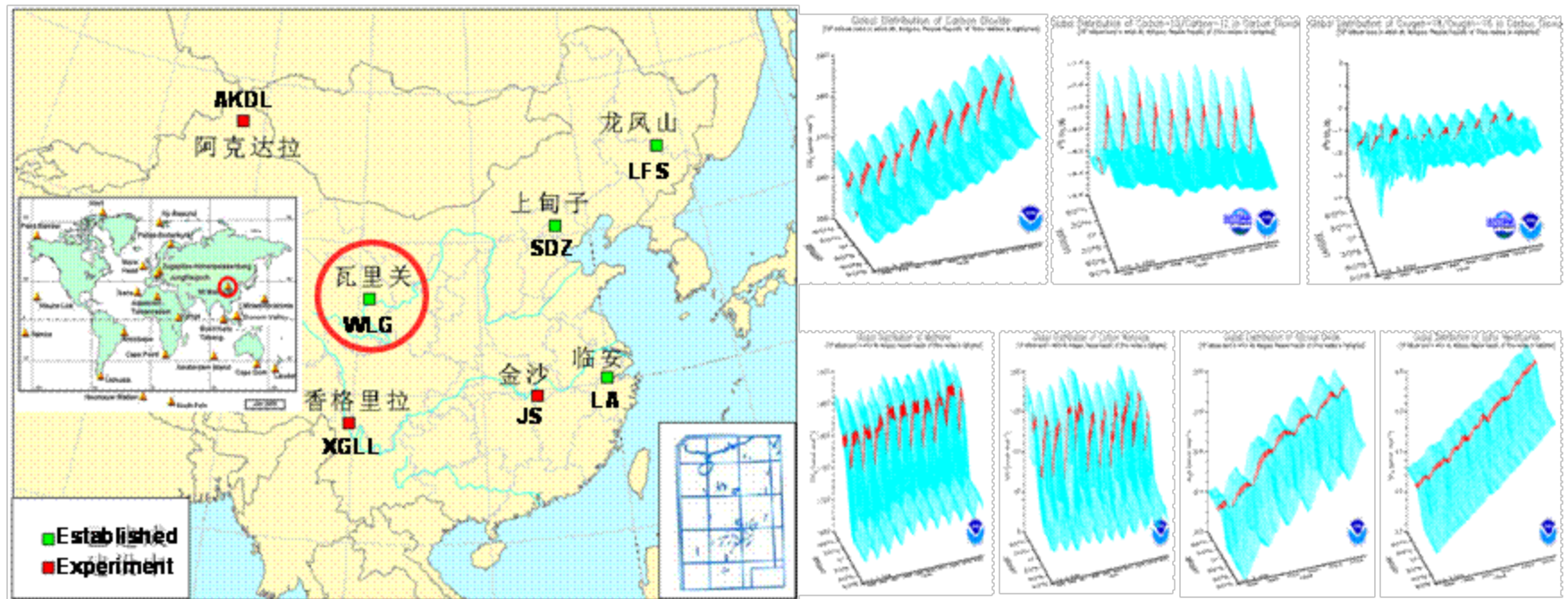
The CMA and the NOAA have strong working relationship and renew bilateral agreements every two years

⇒ joint exchanges of scientists, calibration gases, flask air sharing

⇒ especially the recent 10-day workshop in Boulder on high accuracy Greenhouse Gases measurements in Sept. 2010

Cooperative China-U.S. Greenhouse Gases and Related Tracers Measurements Program

L.X. Zhou, L.X. Liu, S.X. Fang, F. Zhang, B. Yao, M. Wen, L. Xu, S. Gu, K.P. Zang, L.J. Xia, X.C. Zhang, Y.L. Chen, P. Zhao, Y.P. Wen, X.J. Zhou, and Waliguan staff
P.P. Tans, R.C. Schnell, E. Dlugokencky, J.W.C. White, T. Conway, A. Crotwell, S.A. Montzka, C.L. Zhao, K. Masarie, A. Andrews, and C. Sweeney



The 7 GAW stations in China and the 3D annual global carbon cycle greenhouse gases pictures showing atmospheric CO₂, $\delta^{13}\text{C}$ & $\delta^{18}\text{O}$ in CO₂, CH₄, CO, N₂O, SF₆.

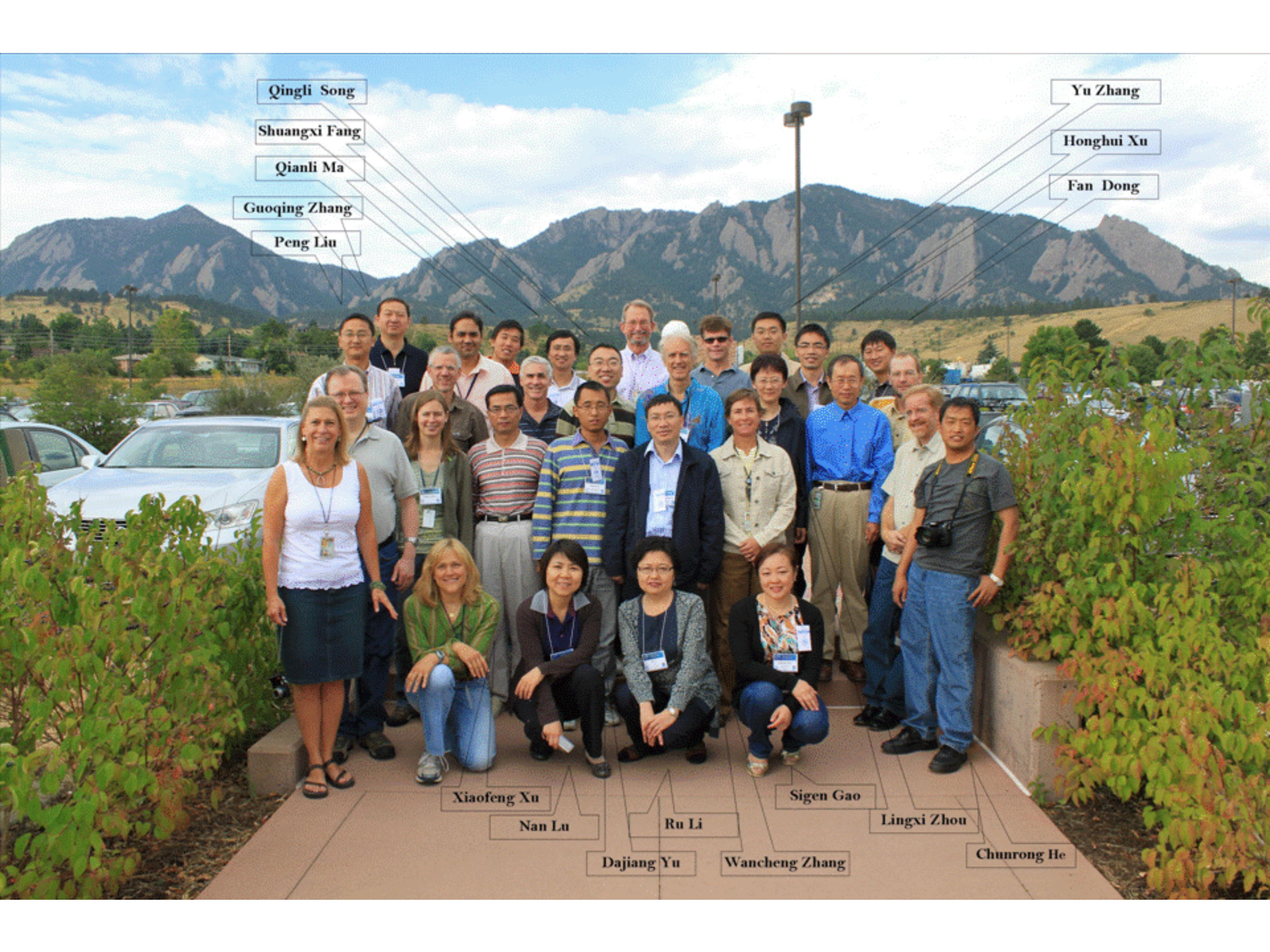
Red lines indicate measurement data from Mt. Waliguan (36°17'N, 100°54'E, 3816m asl), China.



Workshop on High-Accuracy Greenhouse Gas Measurements



Mary M. Glackin with the CMA GHGs delegation, Sept. 2010



Qingli Song

Shuangxi Fang

Qianli Ma

Guoqing Zhang

Peng Liu

Yu Zhang

Honghui Xu

Fan Dong

Xiaofeng Xu

Nan Lu

Dajiang Yu

Ru Li

Wancheng Zhang

Sigen Gao

Lingxi Zhou

Chunrong He





The 17th Joint Working Group Session on Cooperation in the Field of Atmospheric Science and Technology between NOAA and CMA (Sept. 2010)

Pilot Low-Carbon Action at 5 Provinces and 8 Cities in China

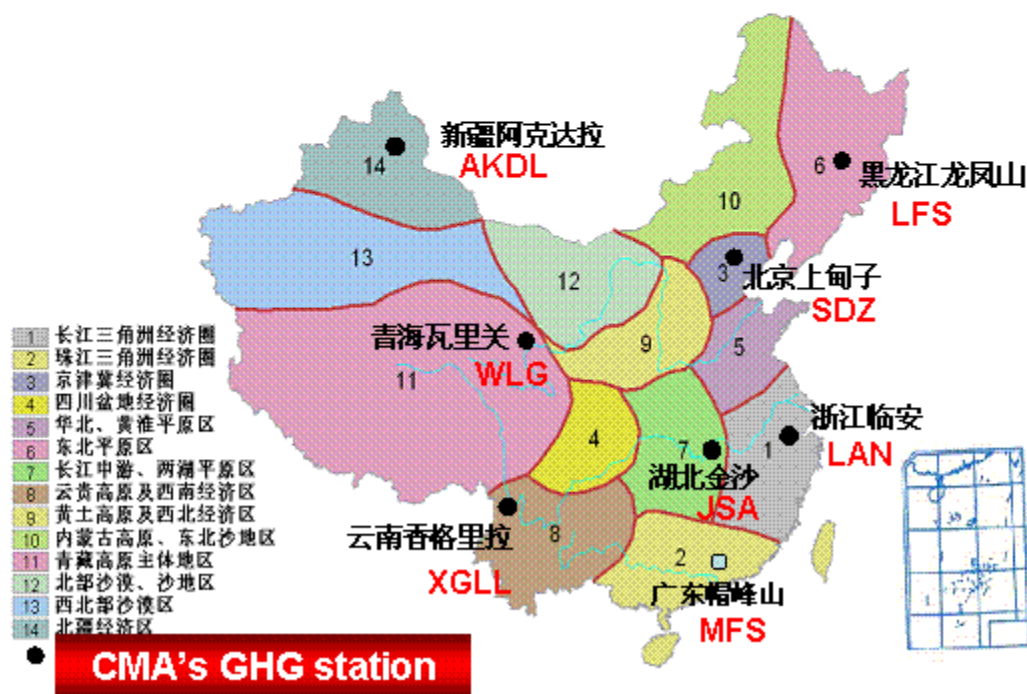
**It is the Chinese Governmental action
supervised by the National Development
and Reform Commission**

(NDRC <http://en.ndrc.gov.cn/>)

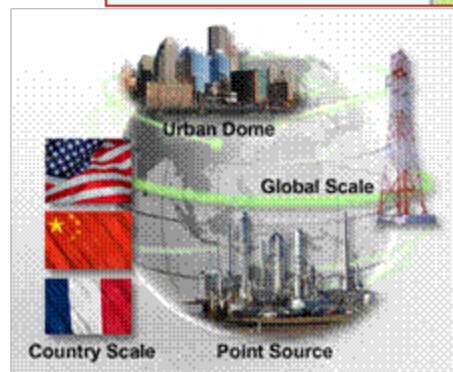
CMA's Capability and Effort to Serve the "Pilot Low-Carbon Action at 5 Provinces and 8 Cities in China" and the Global Network

统筹考虑各地方的工作基础和试点布局的代表性，首批试点包括广东、辽宁、湖北、陕西、云南五省和天津、重庆、深圳、厦门、杭州、南昌、贵阳、保定八市。国家低碳省区和低碳城市

国家大气成分本底野外研究站网络布局分区图



5 Provinces & 8 Cities



★ Picarro CO₂/CH₄/CO

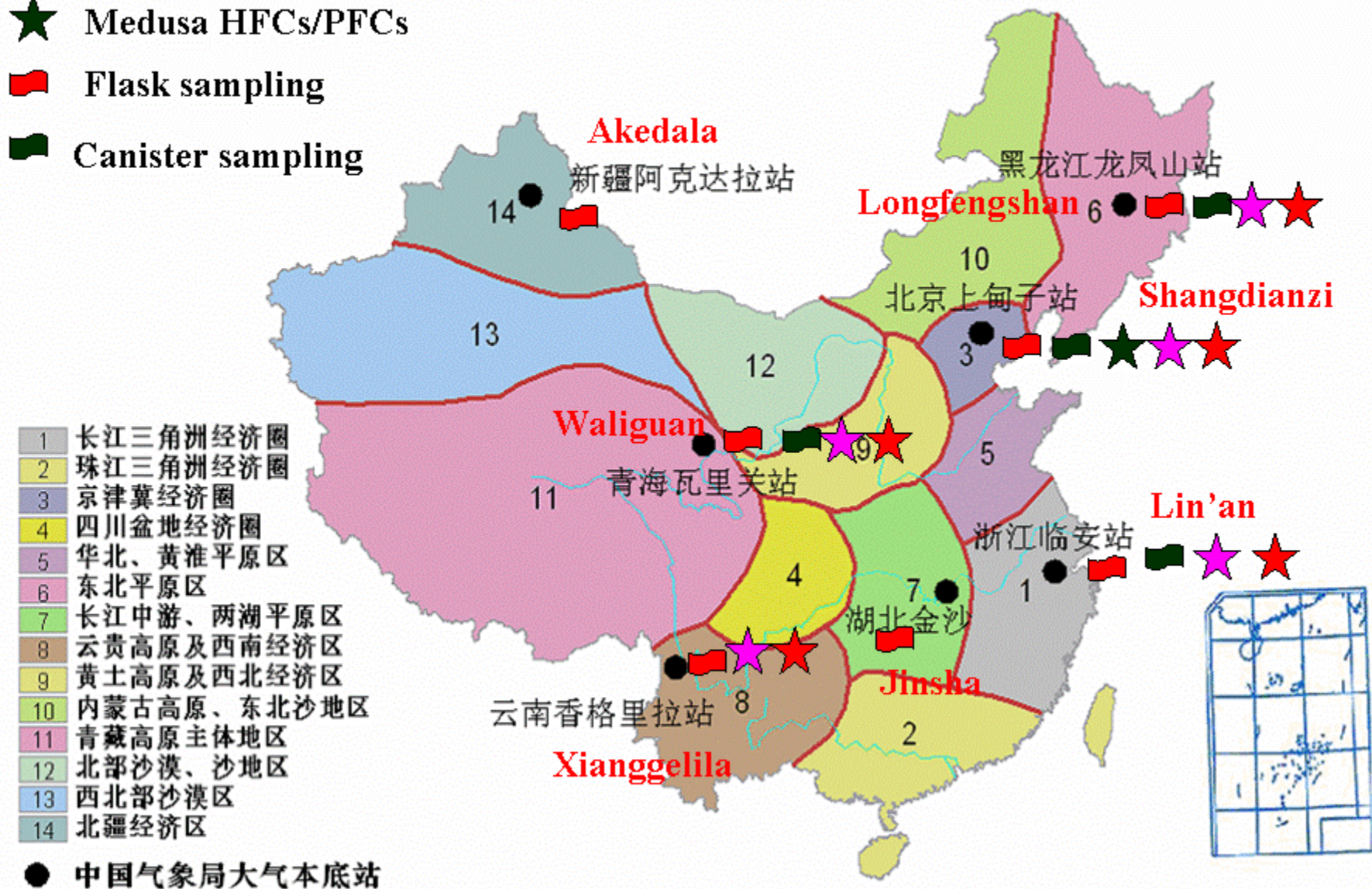
★ GC CH₄/CO/N₂O/SF₆

★ Medusa HFCs/PFCs

🚩 Flask sampling

📦 Canister sampling

中国气象局大气本底站网



“我国温室气体监测分析系统建设(一期)”

—青海瓦里关站



瓦里关CO₂/CH₄浓度甚高分辨率在线观测系统 (2010.4)



瓦里关大气N₂O/SF₆/CO浓度高精度在线观测系统



瓦里关梯度进气系统 (2010.5)



瓦里关采样塔及气象要素 (2010.5)



高压配气系统 (2010.11)

“我国温室气体监测分析系统建设(一期)”

—北京上甸子站



上甸子大气 $N_2O/SF_6/CO$ 浓度高精度在线观测系统1
(2009.12)



上甸子大气 $N_2O/SF_6/CO$ 浓度高精度在线观测系统1
(2010.11)



上甸子卤代类温室气体高压配气系统
(2010.11)

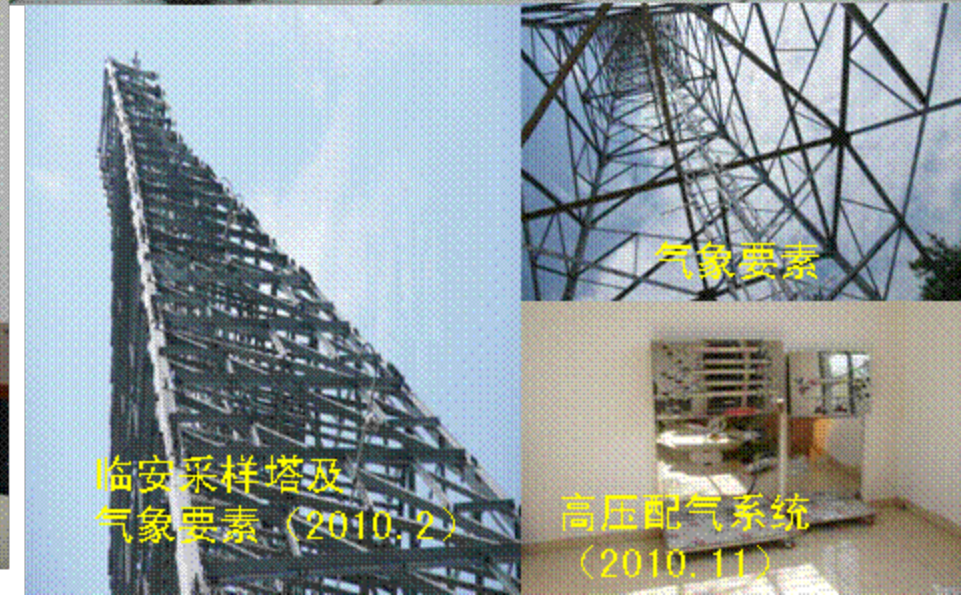
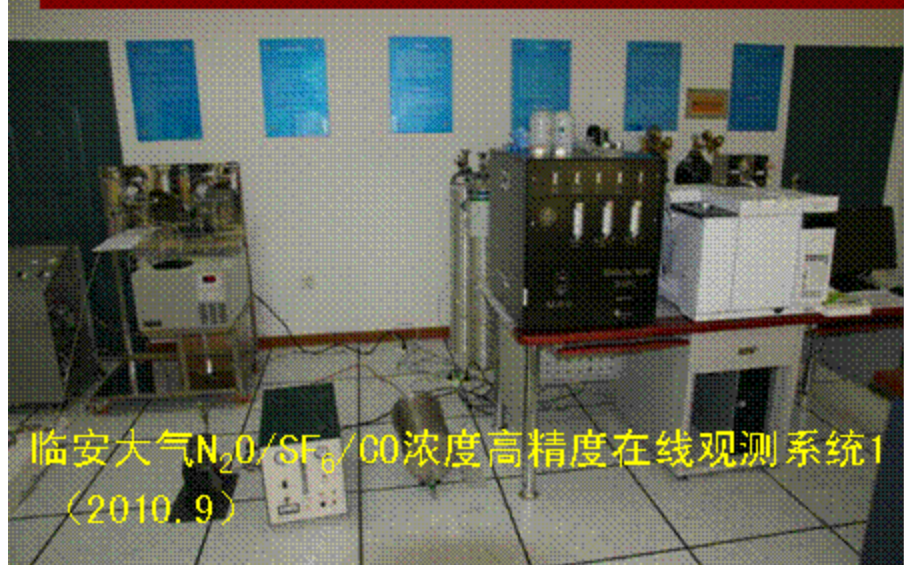


上甸子采样塔及
气象要素 (2010.12)



梯度进气系统
(2010.5)

“我国温室气体监测分析系统建设(一期)” —浙江临安站



“我国温室气体监测分析系统建设(一期)”

—黑龙江龙凤山站



梯度进气系统 (2010.5)



多种卤代温室气体
罐采样系统



龙凤上配套梯度采样塔
及气象要素 (2010.5)

“我国温室气体监测分析系统建设(一期)”

—云南香格里拉站



香格里拉CO₂/CH₄浓度甚高分辨率在线观测系统
(2010.7)

2010/07/03



香格里拉大气N₂O/SF₆/CO浓度高精度在线观测系统1 (2010.11)

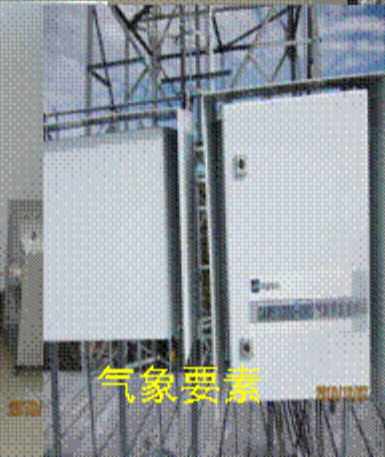
2010/12/07



梯度采样塔



梯度进气系统
(2010.5)



气象要素



香格里拉大气N₂O/SF₆/CO浓度高精度在线观测系统2 (2010.11)

2010/12/07

“我国温室气体监测分析系统建设(一期)”

—气科院温室气体实验室



光腔衰荡高精度多路标校-质控比对系统



实验室多级标气



Flask样品分析标校及质控比对、预处理和后处理系统



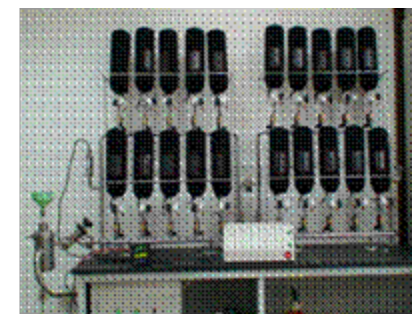
高精密空调



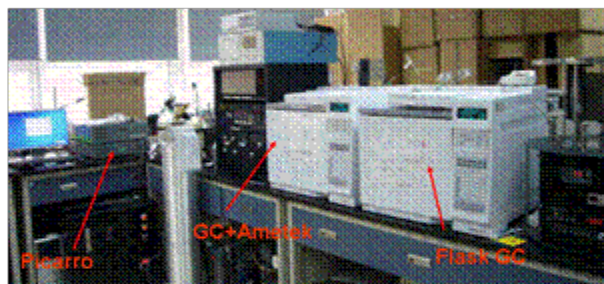
Flask样品处理系统



稳定同位素质控比对系统



CMA/SST/Picarro group in the lab at CMA
2008年11月



CAMS Lab in Beijing (GHGs & tracers)



Joint AGAGE, SOGE and affiliated Networks



Advanced Global Atmospheric Gases Experiment

Sponsored by NASA's Atmospheric Composition Focus Area in Earth Science

- Home
- Brochure
- Mission
- Research Highlights
- Stations
- Instruments
- Data
- Publications
- Related Links
- PI and Co-PIs
- Science Team Only

AGAGE Stations

Mace Head Trinidad Head Barbados Samoa Cape Grim

Affiliated Stations

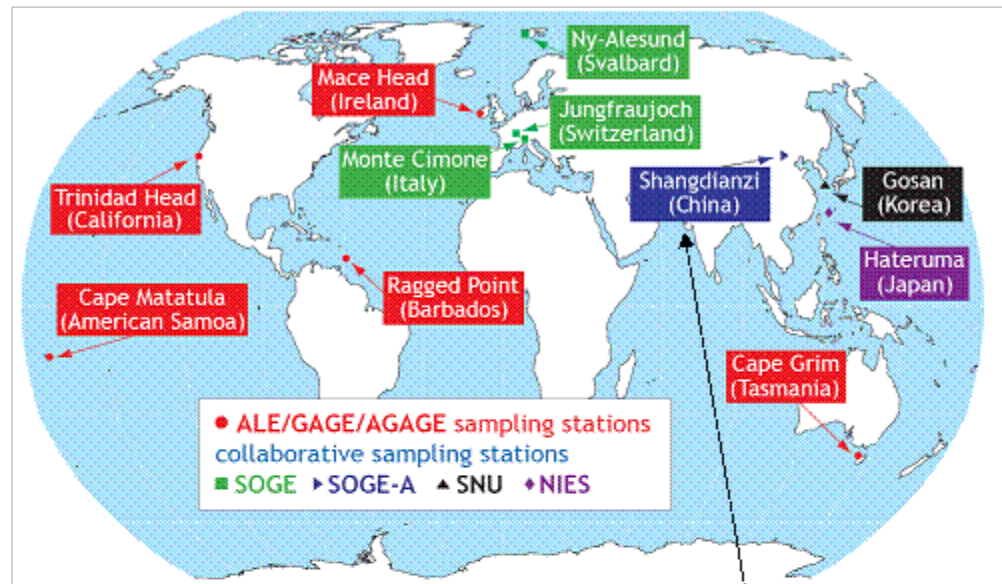
Ny-Alesund Jungfraujoch Mt. Cimone **ShangDianZi** Gosan Hateruma



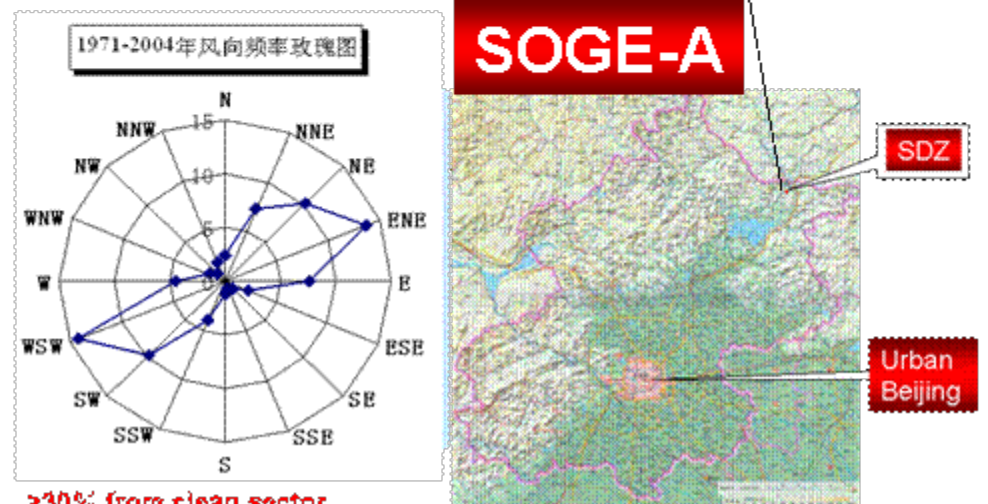
The Shangdianzi GAW Regional Station (Global Atmosphere Watch programme of the World Meteorological Organization) 150km northeast of urban Beijing is part of the domain of the China Meteorological Administration (CMA). It is jointly operated by the Beijing Meteorological Bureau (BMB) and the Chinese Academy of Meteorological Sciences (CAMS). The first in-situ measurement of ODSs and solvents in China has been performed by GC-ECDs at the Shangdianzi since 2006. As one of the partners of SOGE-A, Shangdianzi measurement is attached to the SOGE and linked to the AGAGE network. Furthermore, in-situ atmospheric CO₂/CH₄ measurements by Picarro CRDS and in-situ CH₄/CO/N₂O/SF₆ by GC-FID+ECD and enhanced in-situ measurements of halocarbon by the Medusa GC-MS will be implemented at the Shangdianzi in 2009.

Station Information (Shangdianzi, China)

Latitude:	40° 39' N
Longitude:	117° 7' E
Time Zone:	GMT+8
air sample Intake:	301.3 m (station is 293.3 m above sea level)
Station PIs:	Lingxi Zhou, zhoulx@cams.cma.gov.cn
Station manager:	



Wind Rose (1971-2004) Shangdianzi GAW Regional Station



>30% from clean sector
Ca 22% from Urban Beijing sector

Compounds measured at SDZ

Oct. 2006 – Apr. 2010

Ozone-depleting Gases

- CFCs: chlorofluorocarbons (C, Cl, F):
CFC-12, CFC-11, CFC-113, CFC-115, CFC-114
- HCFCs: hydrochlorofluorocarbons (C, Cl, F, H):
HCFC-22, HCFC-141b, HCFC-142b, HCFC-124
- Halons: (C, Br, Cl, F):
H-1301, H-1211
- Trichloroethane = methyl chloroform = CH_3CCl_3
- Carbon tetrachloride (CCl_4)
- Chloroform (CHCl_3)
- TCE (C_2HCl_3) and PCE (C_2Cl_3)
- Methyl bromide (CH_3Br)

Greenhouse Gases

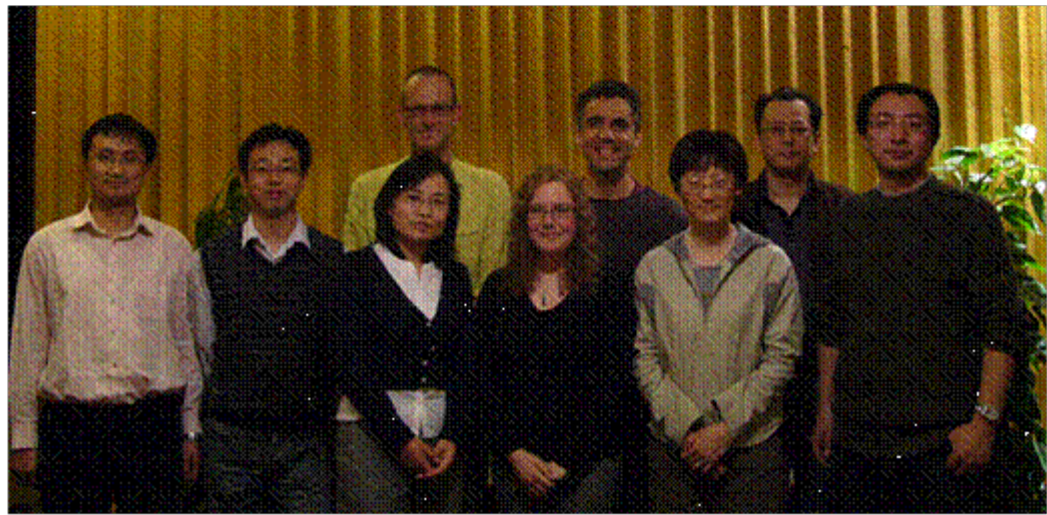
- CO_2 , CH_4 , N_2O
- HFCs: hydrofluorocarbons (C, H, F):
HFC-134, HFC-152a, HFC-125, HFC-23, HFC-143, HFC-227ea, HFC-161, HFC-365mfc, HFC-245fa, HFC-236fa, and many more
- PFCs: Perfluorated Hydrocarbons (C, F):
 CF_4 C_2F_6 C_4F_8
- SF_6
- CO

Species in red:
In-situ GC-uECDs, Horiba-CO
Species in blue:
Flask & in-situ G1301

Medusa-16 Installation at CAMS lab

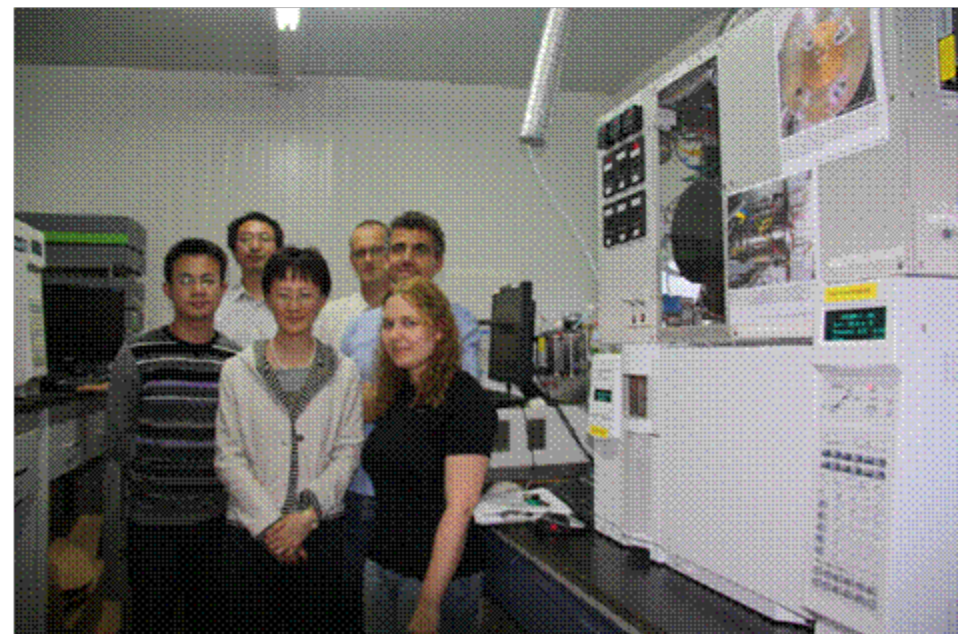
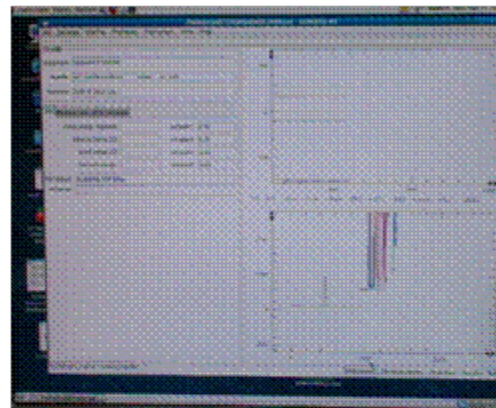


April-May 2010

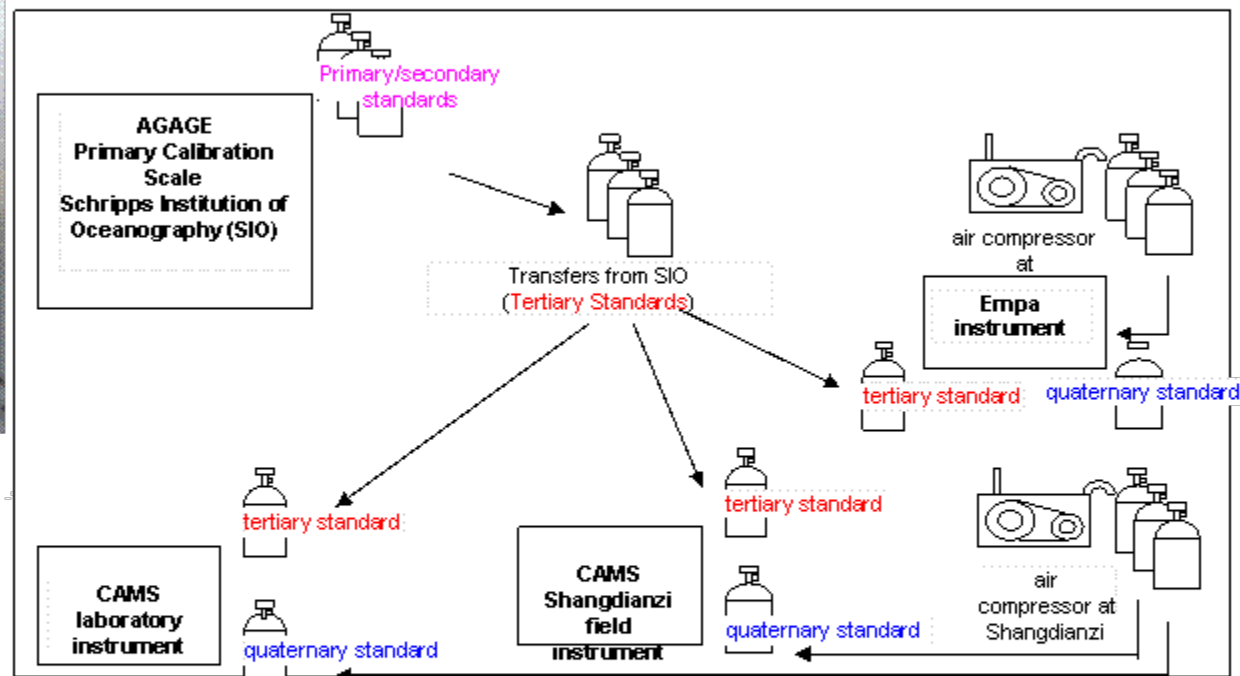


Medusa-17 Installation at SDZ

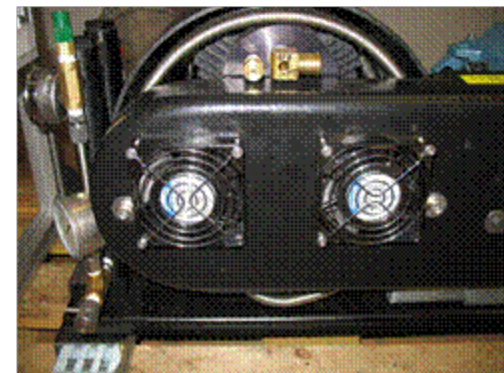
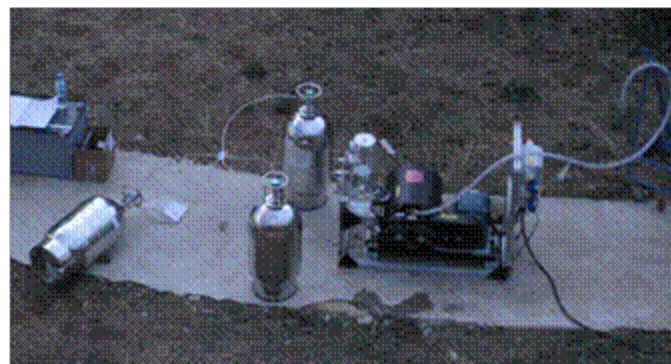
April-May 2010



New Rix-pump system at SDZ



Modified at EMPA



AGAGE41 in Beijing, June 2010



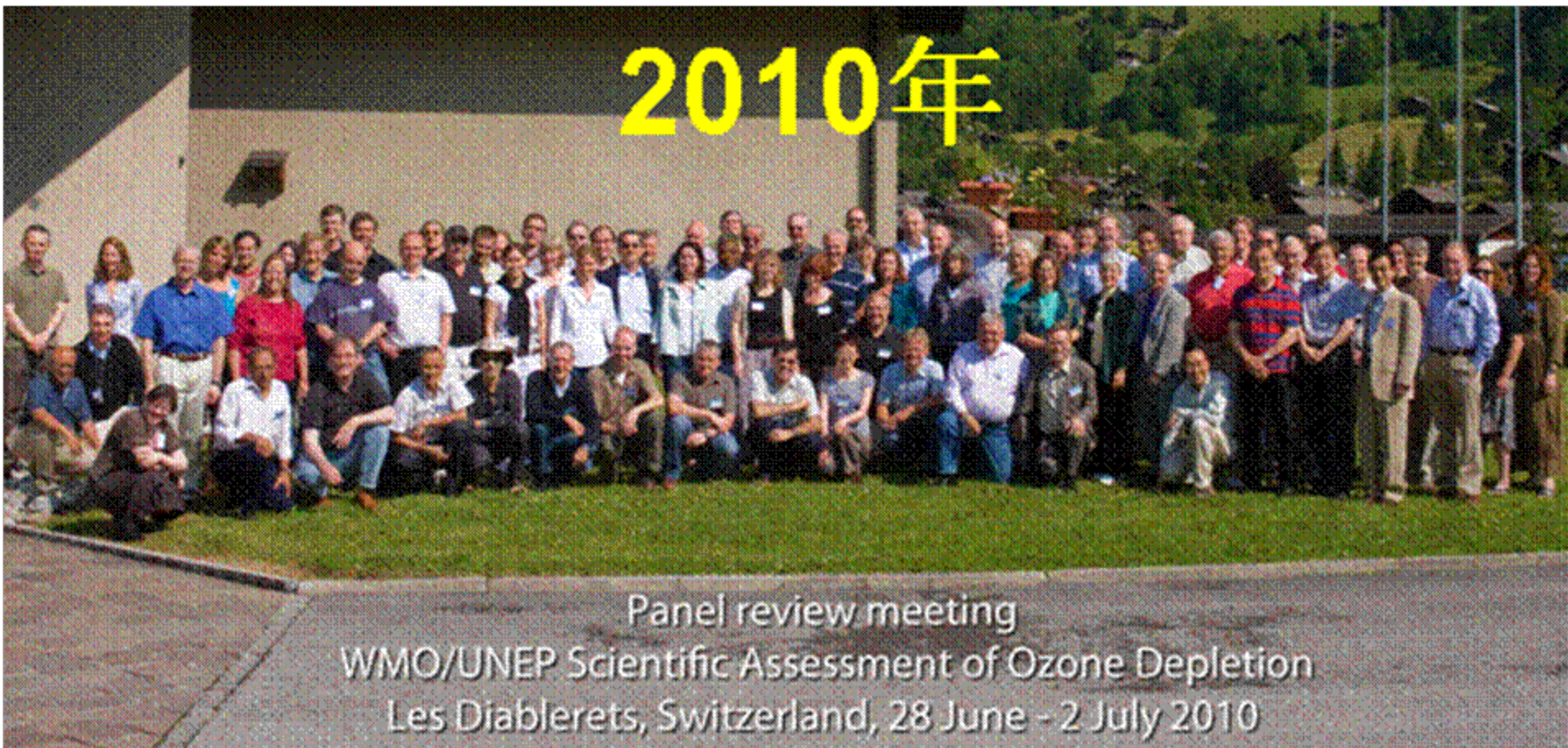
AGAGE41 in Beijing, June 2010



Panel Review Meeting

WMO/UNEP *Scientific Assessment of Ozone Depletion: 2010*

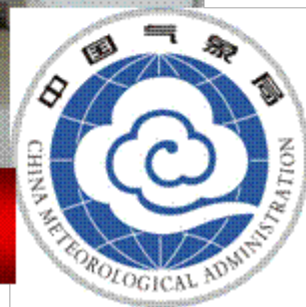
2010年



Panel review meeting
WMO/UNEP *Scientific Assessment of Ozone Depletion*
Les Diablerets, Switzerland, 28 June - 2 July 2010



GHGs new Lab, Shangdianzi, May 2011





GHGs Lab

SDZ Lab + 80m tower



Air intake →

Rix-pump & Tank storage

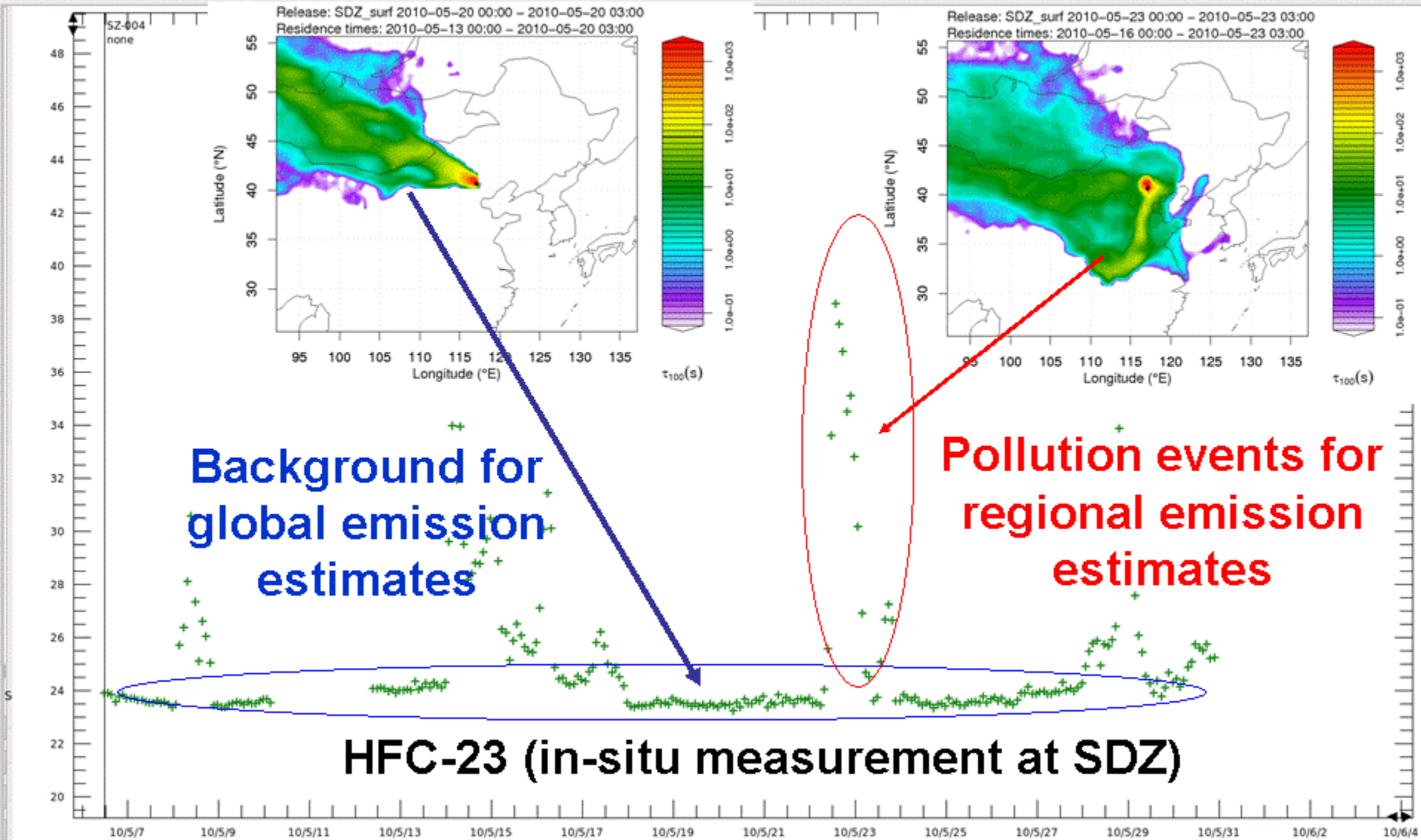


New building

Global vs Regional emission estimate

File Options View Update Help

Gas: HFC-23 Runtype: air Xaxis: Time Yaxis: C (reported)



For Regional Scale Resolution & Lower Uncertainty . . .

- **More Observations (x 10?)**

- Atmosphere
- Ocean
- Terrestrial
- Satellites
- Improved Instrumentation

**QA/QC, Data
Management**

- **Improved Modeling to Serve Smaller Footprints**

- Transport (10km global?)
- Boundary Layer Understanding
- Assimilation, Inversion, Diagnosis
- Prediction

- **Enhanced Computing Capacity**

The CMA's capability and effort

Expanding a number of ambient GHGs and tracers monitoring stations;

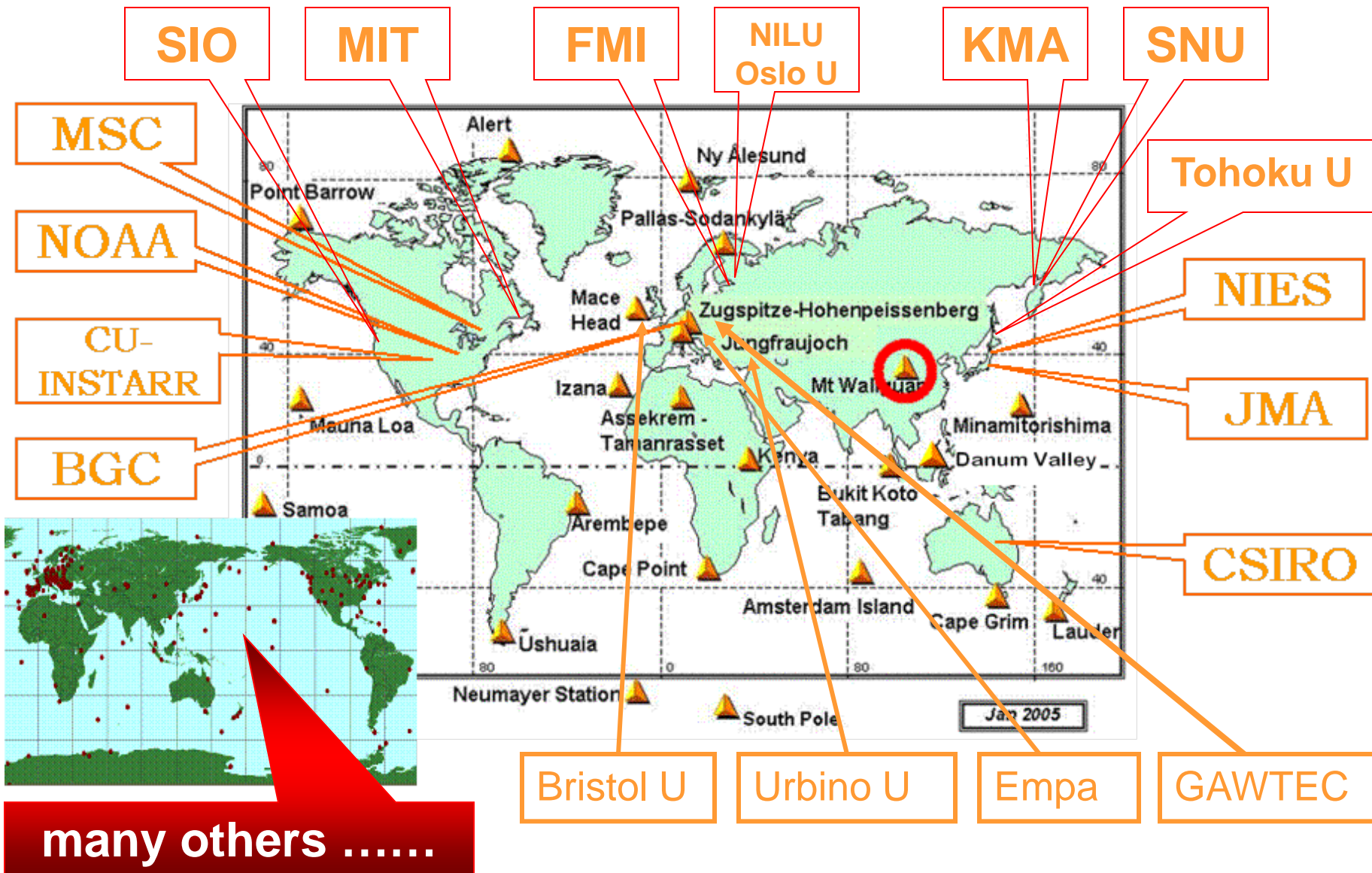
To develop a National Calibration Lab link to the WMO Central Calibration Labs (CCLs);

So that China can evaluate its own atmosphere-climate change-low carbon system and contribute to the global network.



加强中美两国有关气候变化、能源和环境合作（2011.5.10）
加强CMA与NOAA在《中美科技协定》框架下的联合研究，开发双方准确、可靠观测和理解大气温室气体活动的能力。

International Cooperation



Monitoring & Data-base of GHGs

Atmospheric GHGs & Tracers

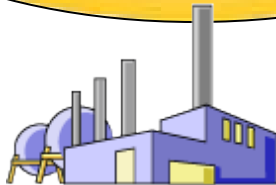
QA/QC
Standard Gases

- Land Surface Stations
 - Tall towers
- Over Pacific Ocean
 - Aircraft
 - Satellite



Emission of GHGs

- Emission Inventory
- Emission Scenario
- Change of Forest Cover
- Biomass Material Flow



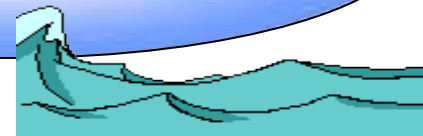
Carbon Storage in Forest

- Carbon Flux over Forest
- Remote Sensing of Biomass



Carbon Sink to the Ocean

ΔPCO_2



Acknowledgement

- **WLG, SDZ, LA, LFS, and CAMS colleagues**
- **CMA, MOST, NSFC, MOP..... of China**
- **Environment Division, AREP, WMO**
- **NOAA ESRL GMD & CU-INSTAAR, USA**
- **MSC Canada**
- **BoM & CSIRO-MAR, Australia**
- **Empa, Switzerland and SOGE-A members**
- **NIES & JMA, Japan**
- **MPI-BGC & GAWTEC, Germany**
- **FMI, Finland**
- **GAW SAG, QA/SAC, CCL, WCC, WDC,**

**and many
others**



**And all the people who give concern &
support to China GAW**