

A. What short-lived halocarbons do you measure?

		1-Elliott Atlas	2-Don Blake	3-Lucy Carpenter	4-Brad Hall	5-Claire Hughes	6-Karlsson/Abrahamsson	7-Laubel/Engel	8-Michalea Malone	9-Manuela Martino	10-Bob Moore	11-Phil Nightingale	13-Dave Oram	14-Birgit Quack	15-Raimund Morin	17-Barkley Smith	18-Spr	20-J. Williams	21-Yo
Bromochloromethane	CH ₂ BrCl	LF	LF		L		Y	Y		SW		A	Y		Y	LF			Y
Dibromomethane	CH ₂ Br ₂	Y	A	Y	S+L	SW	Y	Y		SW	SW	A	Y	Y	Y			Y	Y
Bromodichloromethane	CHBrCl ₂	LF	LF				Y					A		Y	Y				Y
Dibromochloromethane	CHBr ₂ Cl	Y	LF	Y	L		Y			SW		A	Y	Y	Y	LF			Y
1,2-Dibromoethane (ethylene dibromide)	CH ₂ BrCH ₂ Br											A							
Bromoethane (ethyl bromide)	C ₂ H ₅ Br	Y						Y		SW									
Tribromomethane (bromoform)	CHBr ₃	Y	A	Y	S+L	SW	Y	Y		SW	SW	A	Y	Y	Y		Y	Y	Y
Bromomethane (methyl bromide)	CH₃Br	Y	A		Y			Y	Y	SW		A				Y	Y	Y	Y
1-Bromopropane (n-propyl bromide)	n-C ₃ H ₇ Br	Y																	
Phosphorous tribromide (NPhostrExO)	PBr ₃																		
Iodomethane (methyl iodide)	CH ₃ I	Y	A	Y	S+L+A	SW	Y	Y	Y	SW	SW	SW	A	Y		Y	Y	Y	Y
Trifluoroiodomethane	CF ₃ I																		
Iodoethane (ethyl iodide)	C ₂ H ₅ I	LF	LF	Y		SW	Y	Y		SW	SW	SW	A		Y	LF			Y
2-Iodopropane (isopropyl iodide)	i-C ₃ H ₇ I			Y		SW	Y			SW	SW	SW							
1-Iodopropane (n-propyl iodide)	n-C ₃ H ₇ I			Y			Y			SW									
2-iodobutane	CH₃ICHCH₂CH₃						Y												
1-iodobutane	CH₂ICH₂CH₂CH₃						Y												
Chloriodomethane	CH ₂ ClI	LF		Y		SW	Y			SW	SW	SW	A	Y		Y	LF		Y
chlorodiiodomethane	CHClI₂									NC									
Bromoiodomethane	CH ₂ BrI	LF		Y		SW	Y			SW	SW	SW			Y				
Bromodiiodomethane	CHBrI₂									NC									
Diiodomethane	CH ₂ I ₂	LF		Y		SW	Y				SW	SW	Y						Y
Triiodomethane	CHI₃									NC									
Trichloromethane (chloroform)	CHCl ₃	Y	A	Y	S+L		Y	Y				A				LF	Y	Y	Y
Dichloromethane (methylene chloride)	CH ₂ Cl ₂	Y	A		L		Y	Y				A				LF	Y	Y	Y
Tetrachloroethene (perchloroethylene)	C ₂ Cl ₄	Y	A				Y	Y				A					Y		Y
1,2-Dichloroethane	CH ₂ ClCH ₂ Cl	Y	A					Y											
Chloroethane (ethyl chloride)	C ₂ H ₅ Cl							Y											
Trichloroethene (trichloroethylene)	C ₂ HCl ₃	Y	A				Y	Y				A			Y				Y
Chlorobenzene	C₆H₅Cl							Y											
2-bromo-2-chloro-1,1,1-trifluoro-ethane (halothane)	C₂HBrClF₃	LF																	
chlorotrifluoroethene (HCFC-1113)	C₂F₃Cl							Y											
3-chloropentafluoropropene	CF₂CF₂CF₂Cl							Y											

Y= Yes

LF = Less Frequently

S = At Sea, L=Lab, A=Aircraft

A = in Air only

SW = in seawater only

NC = Not Calibrated

- The gases most commonly routinely measured are CH₃I, CHBr₃ and CH₂Br₂
- Many labs also measure longer-lived halocarbons, especially CH₃Cl
- The gases in **bold** were not included as VSL compounds in the 20006 WMO report

B. What are your analytical methods in general?

	1-Elliott Atlas	2-Don Blake	3-Lucy Carpenter	4-Brad Hall	5-Claire Hughes	6-Karlsson/Abrahamsson	7-Laube/Engel	8-Michalea Malone	9-Manuela Martino	10-Bob Moore	11-Phil Nightingale	13-Dave Oram	14-Birgit Quack	15-Raimund Morin	17-Barkley Siv	18-Sm	20-J. Williams	21-Yokouchi
Air:																		
Preconcentration?	Y	Y	Y	Y		Y							Y		Y		Y	Y
GC-ECD?		Y				Y							Y	Y	Y			
GC-MS?	Y	Y	Y	Y		Y	Y				Y	Y		Y	Y		Y	Y
MS-Selective Ion?	Y	Y	Y															
MS-EI?	Y	Y	Y											Y				
MS-NICI?	S									Y			Y					
Water:																		
Purge and trap?	Y		Y	Y	Y	Y		Y	Y			Y	Y		Y			Y
GC-ECD?						Y				Y			Y		Y			
GC-MS?	Y		Y		Y	Y		Y	Y	Y		Y			Y			Y
MS-Selective Ion?				Y														
MS-EI?																		
MS-NICI?																		

Y = Yes

S = sometimes

- Most labs use Mass Spec Detection.
- Many also use ECD.

C. What Standards do you use?

How are they prepared and
who prepares them?

Air

Primary Standards:

	1-Elliott Atlas	2-Don Blake	3-Lucy Carpenter	4-Brad Hall	5-Claire Hughes	6-Karlsson/Abrahamsson	7-Laubel/Engel	8-Michalea Malone	9-Manuela Martino	10-Bob Moore	11-Phil Nightingale	13-Dave Oram	14-Birgit Quack	15-Raimund Morin	17-Barkley Sr	18-Sr	20-J. Williams	21-Yokouchi
In-house gravimetric w. static dilution		Y	Y		Y					Y	Y				S	S		
In-house Perm tube system		Y								D	D							
Scott Marrin (ppb with dynamic dilution)	Y	Y																
NOAA ESRL					Y													
NOAA -CMDL										Y	Y			Y				
Don Blake/UCI	I												Y					
Apel-Riemer Inc (gravimetric w. static dilution) & dynamic dilution													Y			Y		
Elliott Atlas/NCAR		I								I						I		
Happell & Wallace 1997(Gravimetric Gas)							Y											
Scripps/AGAGE					I	Y							Y	Y				
UEA Scale					I					Y								
Taiyo Nippon Sanso w. dynamic dilution																	Y	

Working Standard:

High Pressure Whole Air	Y	Y	Y		Y								Y					
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Water

Primary Standards:

Stock Solution in Pentane											Y							
In house Liquid gravimetric in methanol	Y			Y	Y		Y		Y		Y	Y						
Perm tube - in house			Y						Y								Y	
Perm tube - (KinTec)									Y					Y				

Working standard:

Diluted primary in water																	Y	
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Y = Yes

D = In Development

S = Sometimes

I = Intercalibrated with this lab

- Many different standards!
- Often made “in house” - especially liquid stds for water analysis - but also gas stds
- Many use multiple standards
- Many standards are “related” to a parent standard

D. How do you calibrate your measurements? (Field Approach)

Air

Primary Standards:

	1-Elliott Atlas	2-Don Blake	3-Lucy Carpenter	4-Brad Hall	5-Claire Hughes	6-Karlsson/Abrahamsson	7-Laube/Engel	8-Michalea Malone	9-Manuela Martino	10-Bob Moore	11-Phil Nightingale	13-Dave Oram	14-Birgit Quack	15-Raimund/Morin	17-Barkley Smith	18-Sr	20-J. Willi
Calibrate directly from primary in field	S	S	Y		Y								Y		Y	Y	S
Dynamic dilution of primary in field?					Y								Y				
Use Internal standard technique					Y												
Use working standards in field?	Y	Y	Y	Y	Y	Y	Y		Y		Y		Y		Y	Y	Y
Run Working standard: per # of samples/Daily (D)	4	4	2+D		5	1			Y		1	Y	Y		1	3-4	
Calibrate secondary to primary before / after field	Y	Y	Y	Y					Y			Y	Y	Y		Y	
Run regular blanks?															Y	Y	

Water

Calibrate directly from primary in field	Y				Y	Y	Y	Y	Y		Y						S
Calibrate from Perm tubes in field									Y								
Inject liquid standards & analyze as sample				Y			Y				Y						Y
Inject gas standards into purge gas								Y									
Make calibration curves in water						Y	Y										Y
Use Internal standard technique	Y						Y										
Use working standards in field?	Y																
Run Working standard: per # of samples/Daily (D)					5		D				2/D						
Calibrate secondary to primary before/after field															Y		
Compare instruments as cal check					Y												
Run regular blanks?												Y					

Y = Yes
D = Daily
S = Sometimes

- Many different techniques!
- Most gas measurements use working standards in the field
- Water calibrations tend to be done from primary standards

E. Accuracy and Precision?

	1-Elliott Atlas	2-Don Blake	3-Lucy Carpenter	4-Brad Hall	5-Claire Hughes	6-Karlsson/Abrahamsson	7-Laube/Engel	8-Michalea Malone	9-Manuela Marino	10-Bob Moore	11-Phil Nightingale	13-Dave Oram	14-Birgit Quack	15-Raimund Morin	17-Barkley Sive	18-Smythe-Wright	20-J. William
Air																	
Analytical Precision																	
- typical		2-5%	±3-5%				2.5%				1-10%				5-10%		6.7% (O) 5%
- min		few%		0.05 ppt			0.2%									0.10%	2.1% (O) 1%
- max		15%		0.3 ppt			6.7%									2%	25% (O) 15%
Sampling Precision (replicates)																	
- typical		~1%	±5%				2.5%				5-15%				~1%	N	
Accuracy of Stds																	
- typical	<10%	<10%	±12%	5%			0.03-0.1pptv								5-10%		0.05-0.6% 1%
- overall				10-15%													1-2%
Water																	
Analytical Precision																	
- typical			±3-5%	5%			0.9%	4-8%				2-5%	3-9 ng ml-1	5-20%		±1.2 pmol l-1	
- min							3%	<1.6%	1%		5%						
- max								<4%	5.2%		15%						
Sampling Precision (replicates)																	
- typical		±11%	3-15%	±2%	N			<1%		5%		2%	1.9-4.2%	~10-15%?			
Accuracy of Stds																	
- typical		±12%		±2%	few%		0.4%-4%	2-3%	±0.01 ppb (0.01%) gas std	10-20%		3-10% (liquid stds)	±0.5%	5-10%			

N = Negligible
O = Overall Uncertainty

- Wide range of precision/accuracy estimates!
- Need to define sampling precision