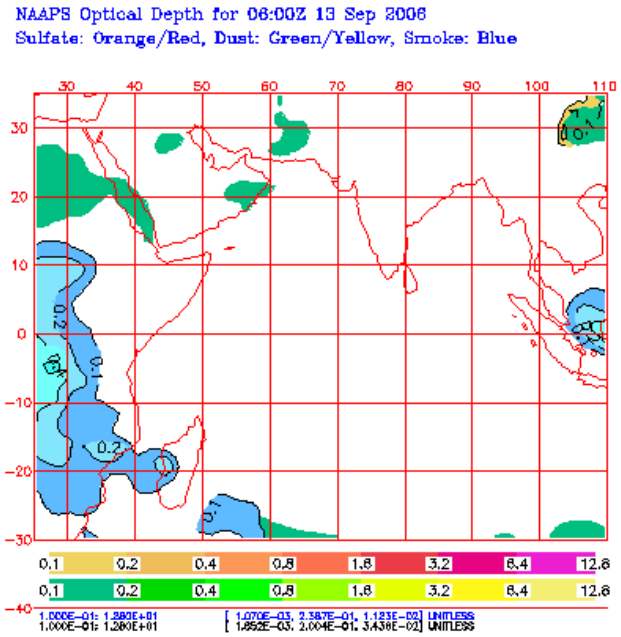
Malé Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia

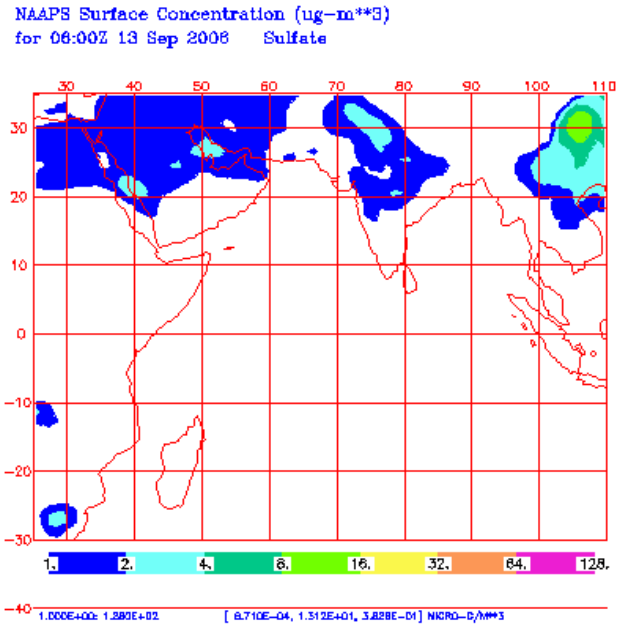
Monitoring Data Report: Strengths and Weaknesses

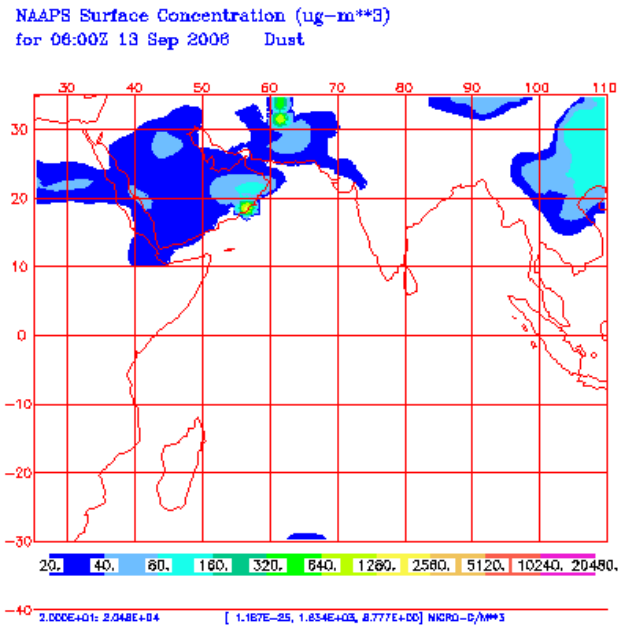
The Eighth Session of the Intergovernmental Meetingon Malé Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia; 13 September 2006, Thimpu, Bhutan

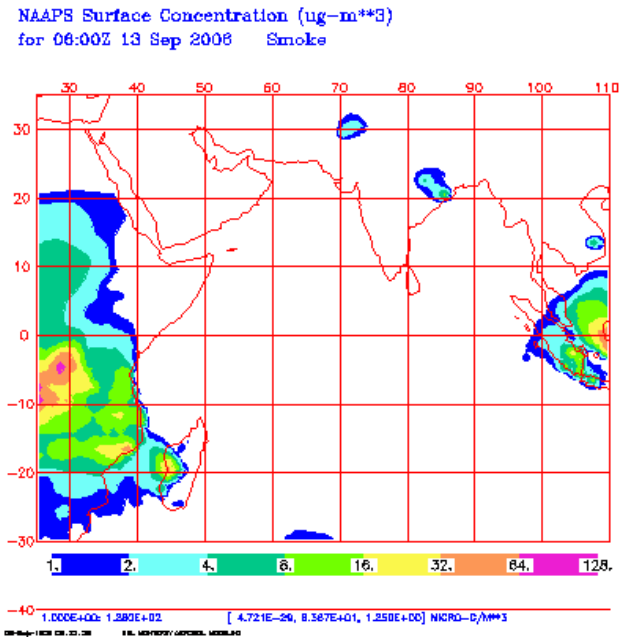
Picture of the day

Chemical Weather Forecast





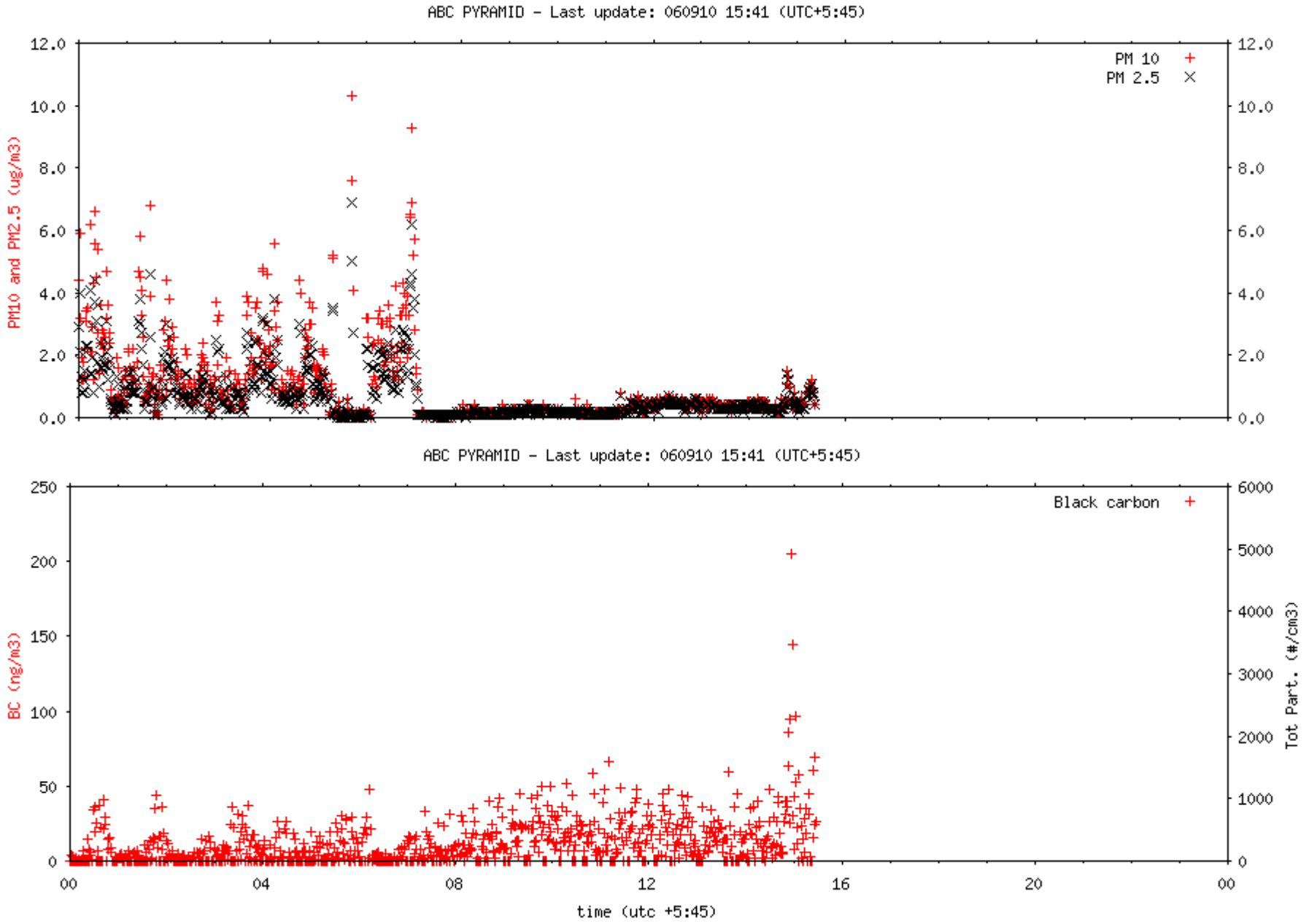




http://www.nrlmry.navy.mil/aerosol/globaer_india_loop.html

Picture of the day

Real-time data



http://evk2.isac.cnr.it/realtime.html

Data

- **Data is the foundation, say backbone if you will, of air pollution management**
- **Data provides information on current status, trends, better insights into science of air pollution.**
- **Data is crucial in impact assessment, devising science-based policy options, and assessment of the effects of various mitigation measures.**

Thus,

We need credible data.

Bangladesh

Station	Start time	Stop time	Temp C	SO_2 µg/m^3 STP	*	NO_2 µg/m^3 STP	*	Remarks
Bangladesh, Stn 7	7/19/2004 16:50	9/17/2004 16:12	29.4	1.2		0.7		
Bangladesh, Stn 7	9/17/2004 16:16	10/16/2004 15:40	29.6	0.8		0.7		
Bangladesh, Stn 7	10/16/2004 15:45	12/14/2004 8:20	27.4	3.3		4.4		
Bangladesh, Stn 7	12/14/2004 8:25	2/11/2005 16:13	20.0	5.5		3.9		Samplers old (prepared March 2004), station name changed from "field blank"
Bangladesh, Stn 7	2/11/2005 16:15	4/11/2005 11:03	24.0	1.7		1.7		
Bangladesh, Stn 7	4/11/2005 11:05	6/9/2005 16:20	28.6	0.6		0.6		
Bangladesh, Stn 7	6/12/2005 16:35	7/11/2005 16:35	31.0	0.6		0.7		Stop date in May 050609 16:20. SO2 samplers damaged, value might be uncertain
Bangladesh, Stn 7	7/11/2005 16:35	8/9/2005 16:35	29.9	0.7		0.7		
Bangladesh, Stn 7	8/13/2005 6:00	9/11/2005 6:00	27.5	0.7		0.7		
Bangladesh, Stn 7	9/11/2005 6:00	12/30/2005 6:00	15.5	1.0		1.5		
Bangladesh, Stn 7	3/1/2006 6:00	4/1/2006 6:00	21.9	4.9		3.6		Duplicate samplers?
Bangladesh, Stn 7	3/1/2006 6:00	4/1/2006 6:00	21.9	5.4		3.6		Duplicate samplers?
Bangladesh, Stn 7	4/1/2006 6:00	5/1/2006 6:00	26.2	1.7		3.0		
Bangladesh, Field blank	7/19/2004 16:50	8/17/2004 17:23	29.2	0.6		0.7		
Bangladesh, Field blank	8/17/2004 17:25	9/17/2004 16:15	29.6	0.8		1.0		
Bangladesh, Field blank	6/12/2005 16:35	8/10/2005 16:35	30.5	0.7		0.7		
Bangladesh, Field blank	11/1/2005 6:00	11/30/2005 6:00	18.9	1.9		4.9		Field blanks ??
Bangladesh, Field blank	1/1/2006 6:00	1/30/2006 6:00	13.6	5.4		7.0		Field blanks ??
Bangladesh, Field blank	1/30/2006 6:00	2/27/2006 6:00	19.0	13.0		2.1		Field blanks? SO2: Start time 2006-01-29 06:00 due to protocol. Does not match with stop time for the previous sampler.

- **Inconsistent Sampling intervals**
- **No mention of Detection Limits**

Bangladesh

Form (Wet A) No.3

Site Name: Kaikhali Forest station, Shamnagar,Satkhira.

Name of Laboratory :

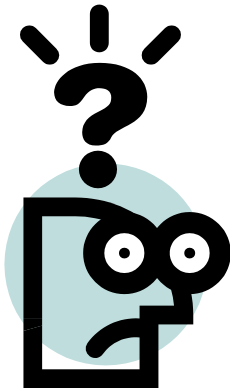
Method code 1:Rain Gause 2:Calculation by sample amount 3: Other

Sample No	Sampling Period				EC mS/m	EC mS/m	pH	pH	Amount of Sample(g)	Amount of Sample (ml)
	Start		End							
	Date	Time	Date	Time						
1	30.9.4	9:00	1.10.4	9:00		0.0		6.909		150ml
2	1.10.4	9:00	2.10.4	9:00		0.0		6.136		120ml
3	2.10.4	9:00	3.10.4	9:00	4.78	0.0	5.95	5.901	520	240ml
4	3.10.4	9:00	4.10.4	9:00	0.48	0.0	6.10	5.702	2050	630ml
5	4.10.4	9:00	5.10.4	9:00		0.0	6.34	6.931	1560	250ml
6	5.10.4	9:00	6.10.4	9:00			6.58		970	
7	6.10.4	9:00	7.10.4	9:00	0.77		5.26		2100	
8	7.10.4	9:00	8.10.4	9:00	1		4.6		1580	
9	8.10.4	9:00	9.10.4	9:00						
10	9.10.4	9:00	10.10.4	9:00						

Note: The EC meter was not functioning properly due to low bettery from September last.

Bhutan

Bhutan, Fieldblank	3/18/2004 12:15	4/14/2004 9:30
Bhutan, Stn 2	4/14/2004 9:30	5/18/2004 9:45
Bhutan, Fieldblank	5/18/2004 9:48	6/17/2004 11:12
Bhutan, Stn 2	6/17/2004 11:12	7/16/2004 11:58
Bhutan, Stn 2	7/16/2004 11:58	8/23/2004 11:00
Bhutan, Stn 2	8/23/2004 11:00	10/5/2004 10:55
Bhutan, Stn 2	10/5/2004 10:55	11/15/2004 15:05



Stop time	Temp C
9/25/2003 10:00	20.0
1/25/2003 10:00	20.0
2/25/2003 10:00	20.0
1/25/2004 10:00	20.0
3/4/2004 9:30	20.0
4/25/2004 9:30	20.0
5/25/2004 9:30	20.0
6/25/2004 9:30	20.0
7/25/2004 9:30	20.0
8/25/2004 9:30	20.0
9/25/2004 9:30	28.0
4/12/2005 9:30	20.0
6/12/2005 9:30	20.0
8/12/2005 9:30	20.0
4/14/2004 9:30	10.0
5/18/2004 9:45	10.0
6/17/2004 11:12	15.0
7/16/2004 11:58	22.0

EC mS/m	flg1	flg2	flg3	pH
0.87				6.16
0.58				6.54
0.33				7.56
0.43				6.23
0.77				6.85
0.23				6.66
0.39				7.35
0				0
0.68				6.13

SO_2 $\mu g/m^3$ STP *
<0.2 b
0.1 b

		EC mS/m	pH	Amount of sample ml
27-Dec-04	9:30	10.9	6.8	Nill
6-Jan-05	9:30	11.1	6.2	Nill
10-Jan-05	9:30	12.1	5.9	14
17-Jan-05	9:30	11.3	6	Nill

IVL's remarks are very useful. Please put remarks if there is something to be noted

India

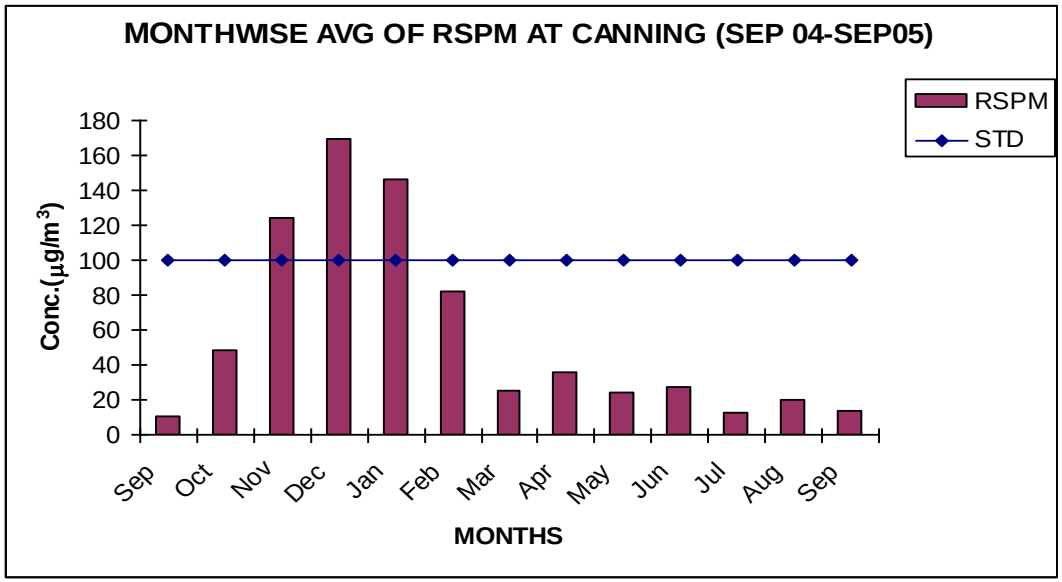
Stop time	Temp C	SO_2 µg/m^3 STP	*
12/21/2004 13:45	20.0	5.4	
12/21/2004 13:45	20.0	5.6	
2/27/2005 14:00	20.0	9.3	
3/31/2005 14:00	20.0	2.5	
7/5/2005 14:00	20.0	0.7	
8/2/2005 14:00	20.0	1.0	
8/23/2005 14:00	20.0	2.3	
9/21/2005 14:00	20.0	1.1	
10/26/2005 14:00	20.0	2.2	
11/23/2005 14:00	20.0	4.5	
12/21/2005 14:00	25.0	9.8	
2/27/2006 14:00	25.0	9.1	
3/22/2006 14:00	20.0	9.4	
4/24/2006 14:00	20.0	3.0	
12/21/2004 13:45	20.0	<0.2	b
3/31/2005 14:00	20.0	<0.1	b
7/5/2005 14:00	20.0	<0.2	b
2/27/2006 14:00	25.0	<0.2	b

DL = 0.2 ug/m^3

Date	RSPM (ug/m^3)	SO_2 (ug/m^3)	NO_2 (ug/m^3)
13.04.04 14.04.04	23	BDL*	BDL
14.04.04 15.04.04	17	BDL	35
15.04.04 16.04.04	14	BDL	BDL

*Below Detection Limit

What are BDL values?



There are graphs for monthly RSPM, but no data are presented.

Iran

Stop time	Temp C
12/31/2004 12:00	20.0
5/2/2005 12:00	20.0
6/10/2005 12:00	20.0
6/10/2005 12:00	20.0
8/10/2005 12:00	20.0
8/10/2005 12:00	20.0
8/10/2005 12:00	20.0

Start		End	
Date	Time	Date	Time
2004/07/02	10:30	2004/07/02	7:30
2004/08/06			
2004/08/21			
2004/09/16			
2004/10/12			
2004/11/25			
2005/02/07			
2005/03/15			
2005/07/20			
2005/09/28			

Concentration (mg/m^3)		
PM_{10}	NRSPM	TSPM
22	22	44
20.3	30.29	50.6
45.4	24.08	69.45
26.5	34.6	61.13
20.5	19.8	40.3
19	17.5	36.5
19.8	18.9	39.7

Concentration (mg/m^3)		
SO2	NOx	?
12	17	
12	17	
10.4	14.9	
10.15	18	
21	26	
20	23	

Units?

Start		End		Anion			
Date	Time	Date	Time	SO_4^{2-}	NO_3^-	HCO_3^-	CL^-
2005/12/22				55.67		42.7	17.75
2006/01/14	8:00	2006/01/21	11:00	15.76	…	12.2	7.1
2006/02/05	9:00	2006/02/12	12:00	42.29	…	30.5	14.2

DL??

Maldives

Stop time	Temp C	SO_2 $\mu g/m^3$ STP *	NO_2 $\mu g/m^3$ STP *
8/30/2003 10:15	20.0	<0.2 b	1.2
9/30/2003 12:00	20.0	0.2	0.3
11/1/2003 12:00	20.0	<0.2 b	0.3
11/30/2003 12:00	20.0	1.0	1.8
1/31/2004 12:00	20.0	0.6	0.9
2/29/2004 12:00	20.0	0.5	1.4
3/31/2004 10:00	20.0	0.4	0.6
5/31/2004 10:00	30.4	<0.2 b	0.3
6/30/2004 10:00	29.0	0.2	<0.1 b
9/30/2004 10:00	29.0	<0.2 b	0.5

Nepal

Start time	Stop time	Temp C
3/25/2003 12:00	6/7/2003 12:00	20.0
3/25/2003 12:00	6/7/2003 12:00	20.0
6/7/2003 12:00	7/31/2003 12:00	20.0
7/31/2003 12:00	9/15/2003 12:00	20.0
9/10/2003 12:00	10/12/2003 12:00	20.0
10/12/2003 12:00	11/9/2003 12:00	20.0
11/9/2003 12:00	12/9/2003 12:00	20.0
12/9/2003 12:00	1/11/2004 12:00	20.0
3/1/2004 9:00	4/1/2004 8:45	20.0
4/1/2004 8:45	5/1/2004 8:45	20.0
5/1/2004 8:45	6/1/2004 9:45	20.0
1/13/2005 12:15	2/1/2005 14:15	20.0
2/1/2005 14:15	3/1/2005 12:15	20.0
3/1/2005 12:15	4/1/2005 12:15	20.0
4/1/2005 13:30	5/1/2005 12:15	20.0
5/1/2005 12:15	6/1/2005 12:15	20.0
6/1/2005 12:15	7/1/2005 12:15	20.0
7/1/2005 12:15	8/1/2005 12:15	20.0

Start		End	
Date	Time	Date	Time
10/4/2005	9:00	11/4/2005	9:00
11/4/2005	9:15	12/4/2005	9:15
12/4/2005	9:25	13/4/2005	9:25
15/4/2005	9:00	16/4/2005	9:00
16/4/2005	9:10	17/4/2005	9:10
20/4/2005	8:50	21/4/2005	8:50
21/4/2005	9:00	22/4/2005	9:00
22/4/2005	9:10	23/4/2005	9:10

Concentration (mg/m^3)	
SO2	NOx
2	1
3	1
2	1
2	1
2	1

Concentration (mg/m^3)		
PM_{10}	NRSPM	TSPM
79	94	17
73	121	19
80	107	18
51	86	13
82	114	19
69	93	16
123	102	22

- Inconsistent sampling intervals
- Incorrect units

Pakistan

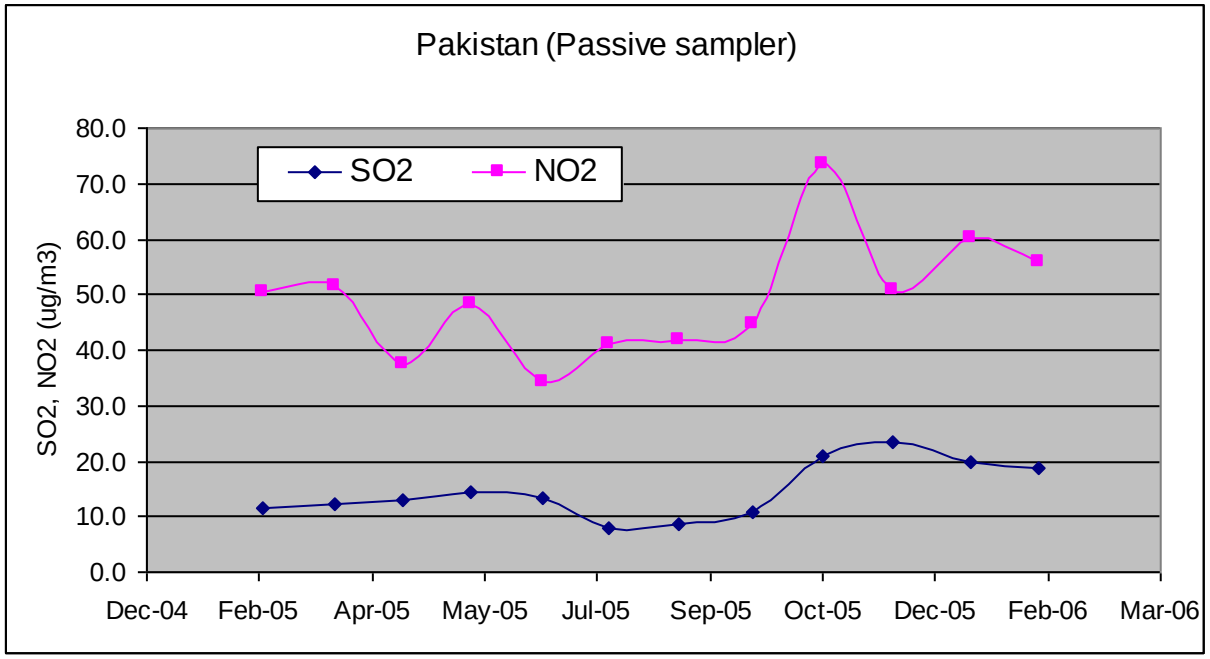
Start time	Stop time
1/18/2005 12:45	2/18/2005 9:58
2/18/2005 9:07	3/22/2005 9:35
3/22/2005 9:36	4/21/2005 9:10
4/21/2005 9:14	5/21/2005 9:25
5/21/2005 9:30	6/22/2005 13:10
6/22/2005 13:14	7/22/2005 9:28
7/22/2005 9:32	8/22/2005 10:10
8/22/2005 10:14	9/24/2005 9:03
9/24/2005 9:10	10/25/2005 9:35
10/25/2005 9:38	11/25/2005 9:10
11/25/2005 9:10	12/29/2005 14:15
12/29/2005 14:15	1/28/2006 11:55

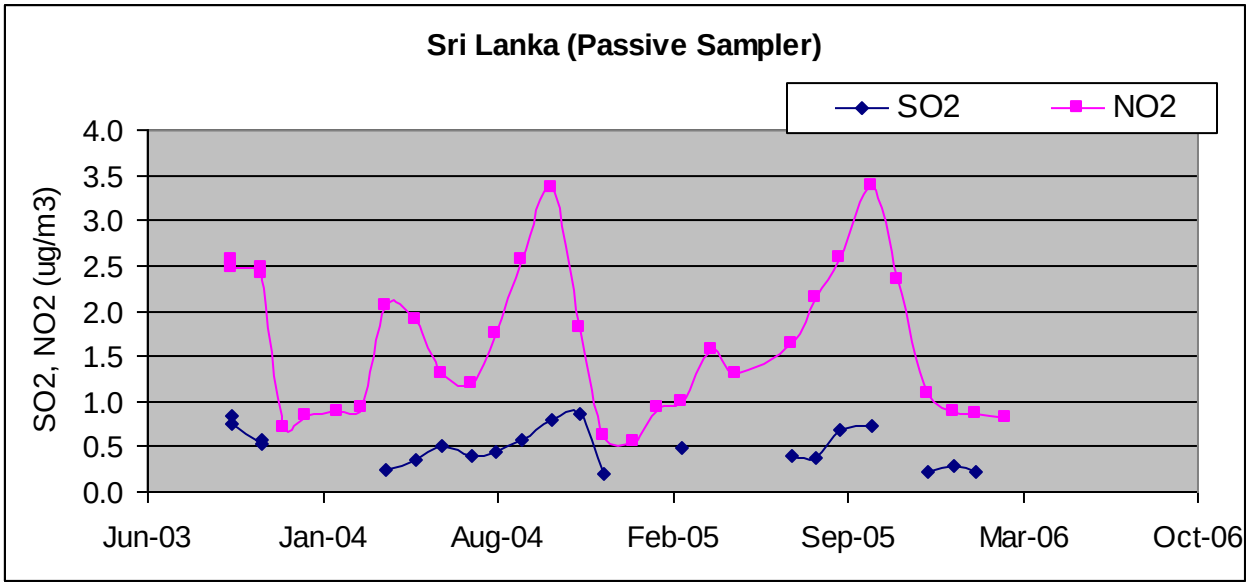
- Inconsistent sampling intervals

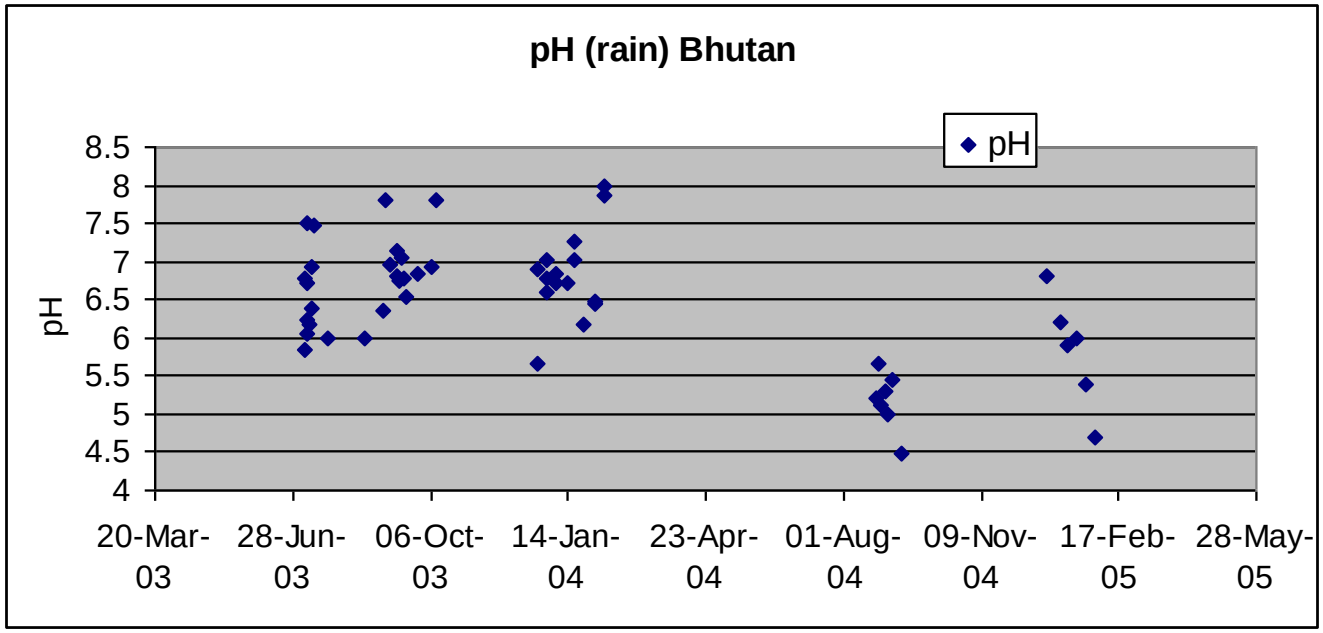
Sri Lanka

Start time	Stop time	SO_2 $\mu g/m^3$ STP	*	NO_2 $\mu g/m^3$ STP	*
8/15/2003 13:15	10/2/2003 17:15	<0.2	b	<0.1	b
8/15/2003 13:15	10/2/2003 17:15	<0.2	b	<0.1	b
10/2/2003 17:15	11/5/2003 15:15	<0.2	b	0.2	
10/2/2003 17:15	11/5/2003 15:15	<0.2	b	0.2	
11/5/2003 15:20	11/29/2003 11:00	<0.2	b	0.1	
11/29/2003 11:05	12/26/2003 15:45	<0.1	b	0.1	
12/26/2003 15:45	1/31/2004 14:55	<0.1	b	0.1	
1/31/2004 15:00	2/27/2004 10:00	<0.1	b	0.1	
2/27/2004 10:05	3/26/2004 9:35				
3/26/2004 9:40	4/30/2004 9:00				
5/14/2004 11:00	5/29/2004 15:00				
5/29/2004 15:00	7/1/2004 16:30				
7/1/2004 16:45	7/29/2004 9:00				
7/29/2004 9:00	8/27/2004 15:40				
8/27/2004 15:40	10/1/2004 15:40				
10/1/2004 15:45	11/1/2004 13:55				
11/1/2004 14:00	11/30/2004 7:30				
11/30/2004 7:30	1/2/2005 15:50				

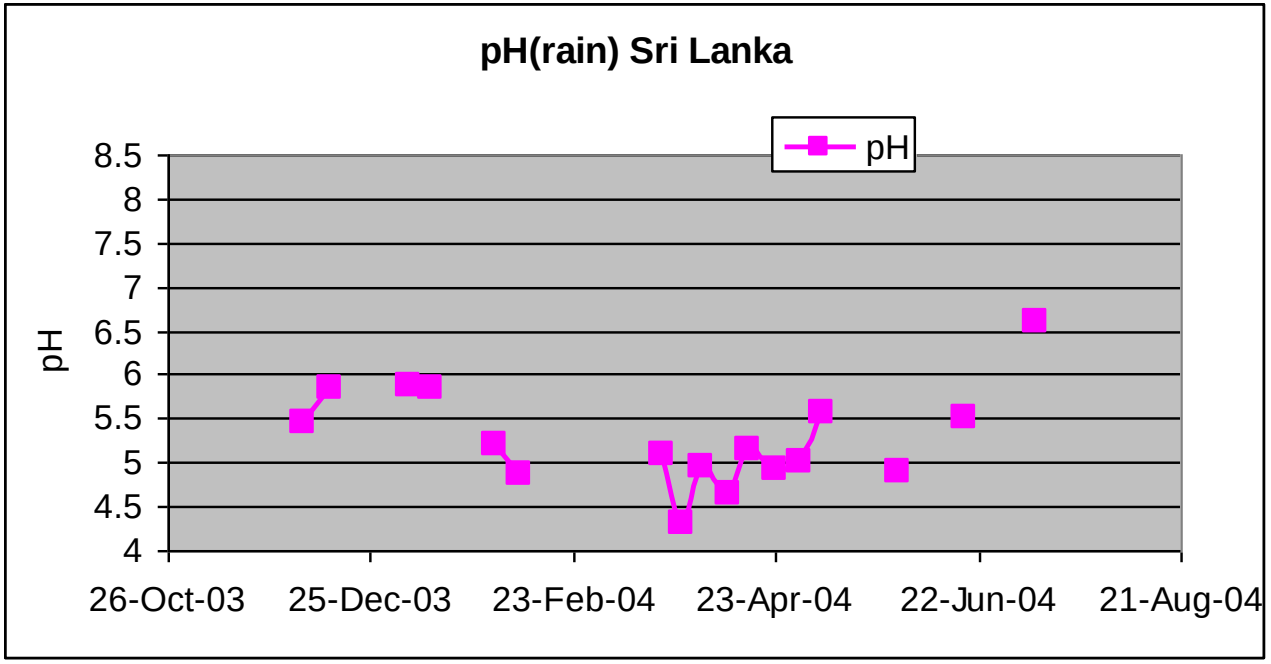
Some Preliminary Results







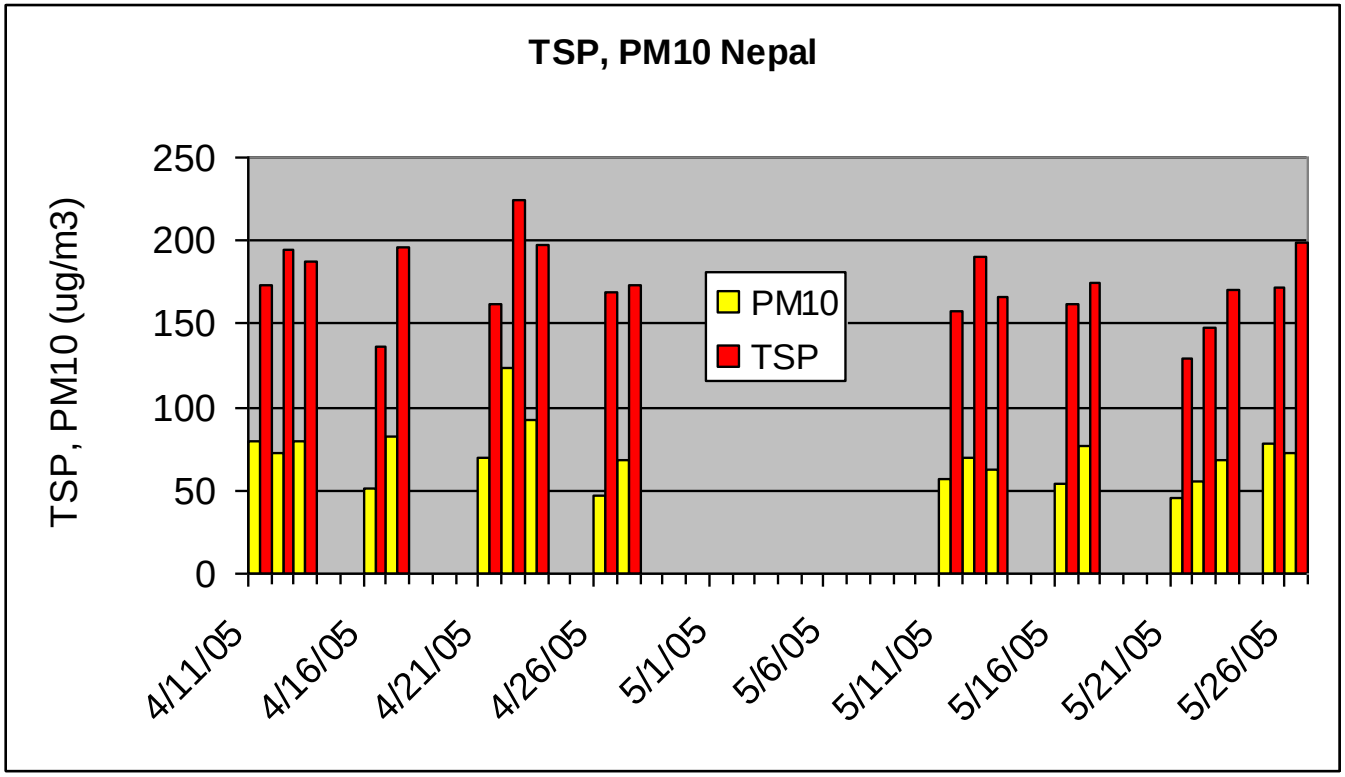
pH is lower in Sri Lanka



Conclusions

- **Minor mistakes are consistently repeated.**
- **Sampling intervals are inconsistent**
- **None of the countries has mentioned about the computation methods (i.e. calculation). The data report should mention the computation formulas.**

- **A little extra care must be paid in data reporting (Detection limited of instruments, precession of instrument, units …)**
- **Go through the IVL's comments. This will help minimize such mistakes, and improve data quality**
- **Keep record of anything that is worth nothing i.e. any remarks, flags etc.**


TSP, PM10 Nepal
TSP, PM10 (ug/m3)
250
200
150
100
50
0
PM10
TSP
4/11/05
4/16/05
4/21/05
4/26/05
5/1/05
5/6/05
5/11/05
5/16/05
5/21/05
5/26/05

Further Analysis of data : Wet Collector

- **QA/QC (data completeness: insufficient sample volume, precipitation coverage etc.)**
- **Calculation of Wet Deposition**
- **Calculation of Ion balance (R1) and Conductivity Agreement (R2)**

Requirements:

1. **Chemical analysis of rain sample: anions and cations**
2. **Electrical Conductivity (EC) and pH**
3. **Total amount of sample, total amount of precipitation**
4. **Number of days with/without precipitations**

Calculation of R1

$$R_1 = \frac{(C - A)}{(C + A)} 100\%$$

where C : total cation conc. ($\mu eq / L$)

A : total anion conc. ($\mu eq / L$)

$$C = \frac{10^{(6-pH)}}{1.008} + \sum C_{Ci}\, V_i$$

where C_{Ci} : the conc of ith cation ($\mu eq / L$)

V_i : the valence of the given ion

$$A = \sum C_{Ai}\, V_i$$

where C_{Ai} : the conc. of the ith anion ($\mu eq / L$)

Calculation of R2

$$R_2 = \frac{(\Lambda_{cal} - \Lambda_{meas})}{(\Lambda_{cal} - \Lambda_{meas})} 100\%$$

where Λ_{cal} : the calculated electrical conductivity (mS / m)

Λ_{measl} : the measured measured condctivity (mS / m)

$$\Lambda_{cal} = \sum C_i\, \Lambda_i^0\, 10^{-4}$$

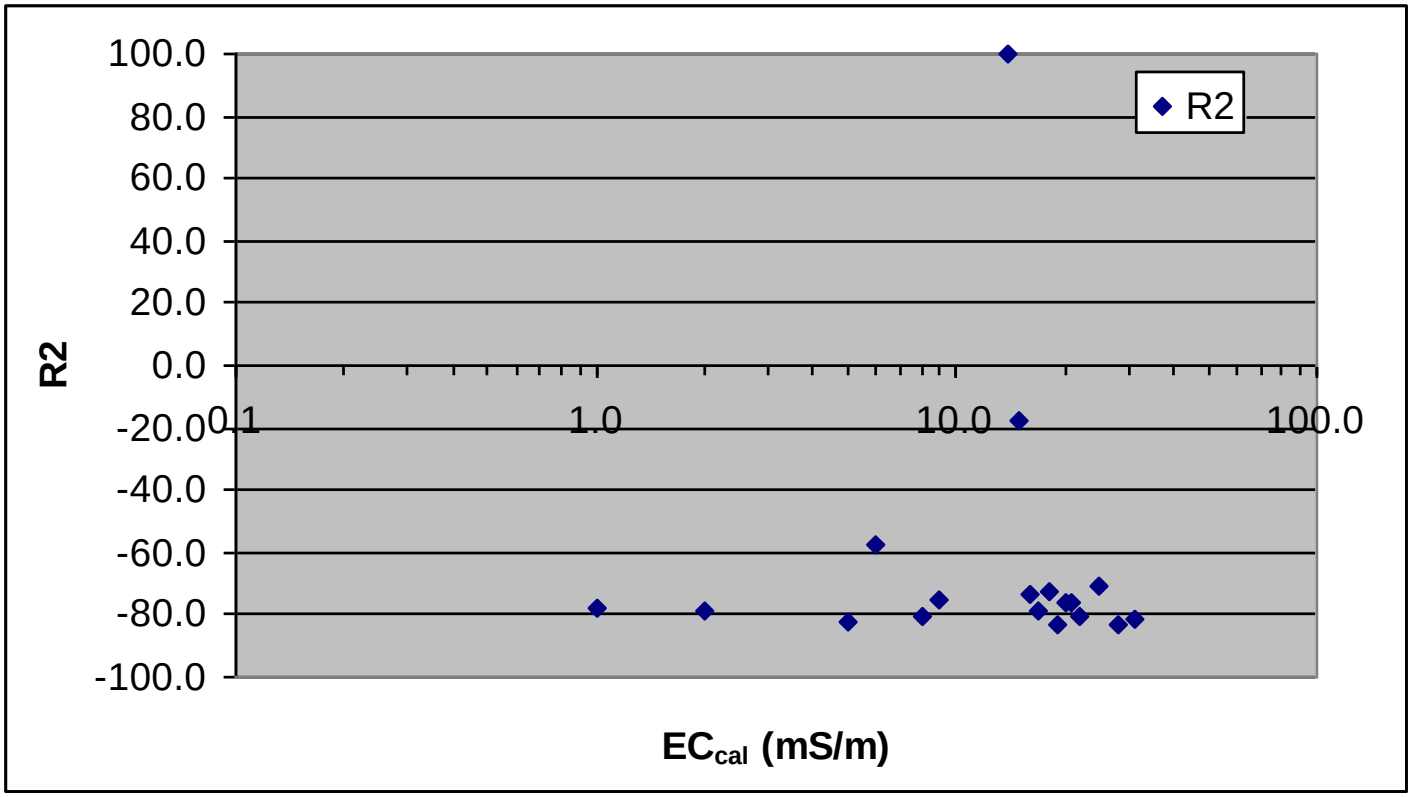
where C_i : ionic conc. of the ith ion ($\mu mol / L$)

Λ_i^0 : molar conductivity at inf inite dilution at $25^0 C$ ($S cm^2 / mol$)

$$\Lambda_{calc} : [349.7 x 10^{(6-pH)} + 80 * 2 * SO_4^{=} + 71.5\, NO_3^{-} + 76.3\, Cl^{-}$$
$$+ 73.5\, NH_4^{+} + 50.1\, Na^{+} + 73.5\, K^{+} + 59.8 * 2 * Ca^{++} + 53.3 * 2 * Mg^{++}] / 10000$$

Criteria for R2

Λ_{meas}	R_2 (%)
< 0.5	±20
0.5-3	±13
>3	±9



R2 for Sri Lanka

Thank You

Monitoring Data Report

NO = 21, YES = 28

Parameters	TSP	PM10	SO_2, NO_2 (passive)	SO_2, NO_2 (active)	pH (rain)	pH (sfc water)	EC (rain)
Bangladesh	**NO**	**NO**	**YES** (13 months)	**NO**	**YES** (3 months)		**YES** (2 months)
Bhutan	**YES**	**NO**	**YES** (15 months)	**YES** (1 month)	**YES** (9 months)		**YES** (9 months)
India	**YES** (13 months)	**YES**	**YES** (12 months)	**YES**	**NO**	**YES**	**NO**
Iran	**YES** (9 months)	**YES** (9 months)	**YES** (4 months)	**YES** (9 months)	**YES** (6 months)		**YES** (6 months)
Maldives	**NO**	**NO**	**YES** (10 months)	**NO**	**NO**		**NO**
Nepal	**YES** (03&05)	**YES** (03&05)	**YES** (19 months)	**YES** (03 &05)	**NO**		**NO**
Pakistan	**NO**	**NO**	**YES** (12 months)	**NO**	**NO**		**NO**
Sri Lanka	**NO**	**NO**	**YES** (29 months)	**NO**	**YES**		**YES**

Bangladesh: Solar radiation, Temperature, Relative humidity, Wind Speed and Direction, Precipitation

Iran and Sri Lakka: Chemical analysis of Wet only collector and bulk collector