

Aerosol and Rainfall Sampling and Analysis for GEOTRACES

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There is wide acceptance that aerosol Fe input strongly affects primary productivity.

Recent evidence (Paytan et al., 2009) indicates that toxicity of soluble aerosol copper can influence phytoplankton community structure.

Atmospheric nitrate deposition affects $\delta^{15}\text{N}$ of nitrate in surface waters, confounding nitrogen fixation estimates.

Aerosol and rainfall sampling for trace elements and nutrients should therefore be part of GEOTRACES and SOLAS cruises.

The US equipment for collecting multiple types of aerosol samples, along with filtered and unfiltered rainfall, is available for GEOTRACES and SOLAS cruises.

GEOTRACES Hi-Vol Aerosol Samplers: Tisch-5170VBL (equipped with brushless motors) on RSMAS roof in September 2008 for 1st GEOTRACES Aerosol intercalibration experiment.

Shipboard deployment would be on 03 or 04 decks (as high as possible). Sampling (ON/OFF) is controlled by wind speed and sector.



1st and 2nd Aerosol samplers use 20cm x 25cm filters:
Whatman-41 (pre-cleaned) for inorganic TEIs and quartz
microfiber (pre-baked) for N isotopes and organics.

Flow rates are 1.2 m³/minute; 24-hour integrated sampling;
>1,700 m³ of filtered air.

Filters can be subsampled for many groups and TEIs;
Remaining filter will be archived (frozen).



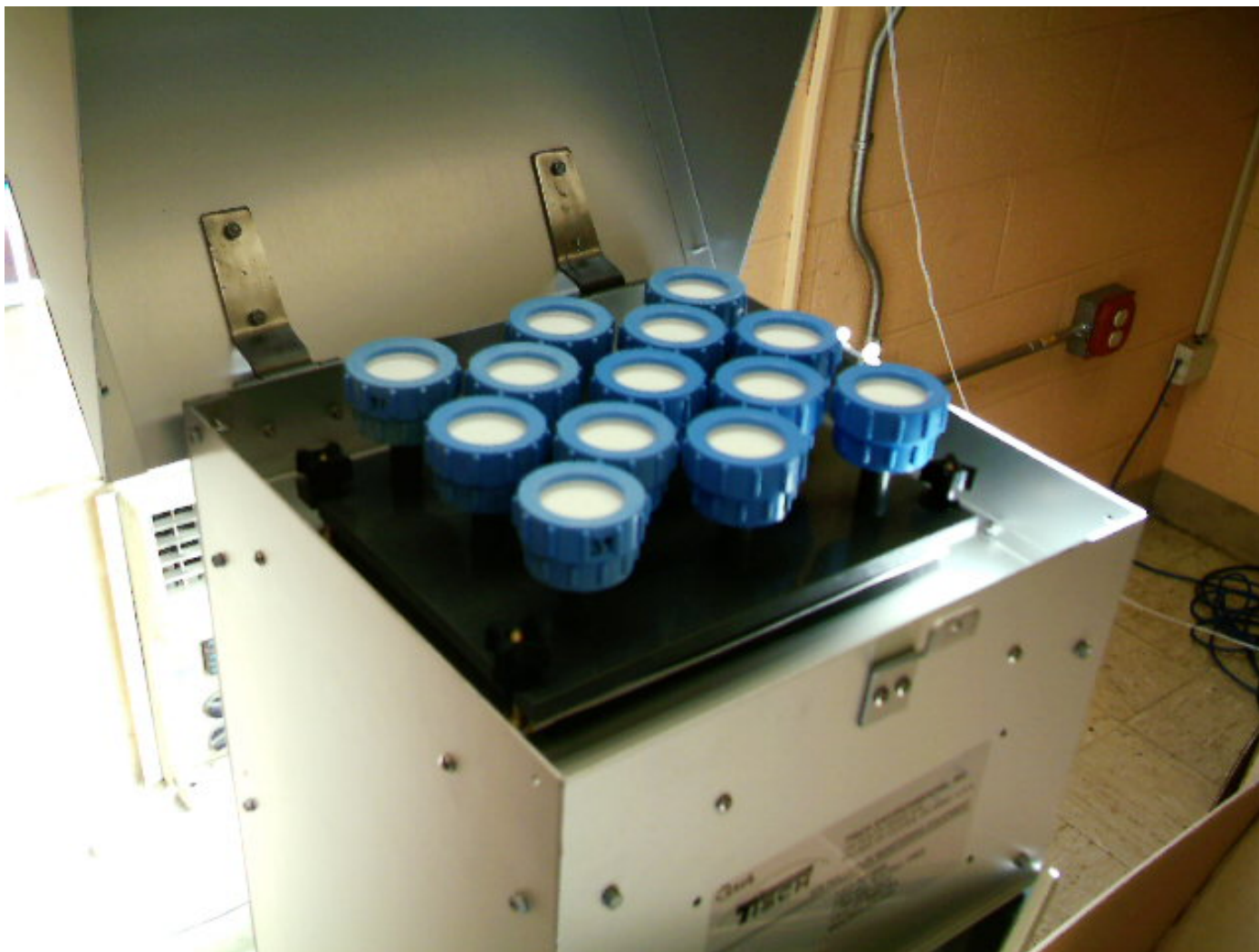
3rd Aerosol sampler accepts a “Sierra-style” slotted impactor for size-fractionation studies (needed for modeling dry deposition and studies of particle chemistry as a function of particle size).

>7.2, >3.0, >1.5, >0.95, >0.49, and <0.49 μm particle cut-offs.

Filters can be subsampled; archived.



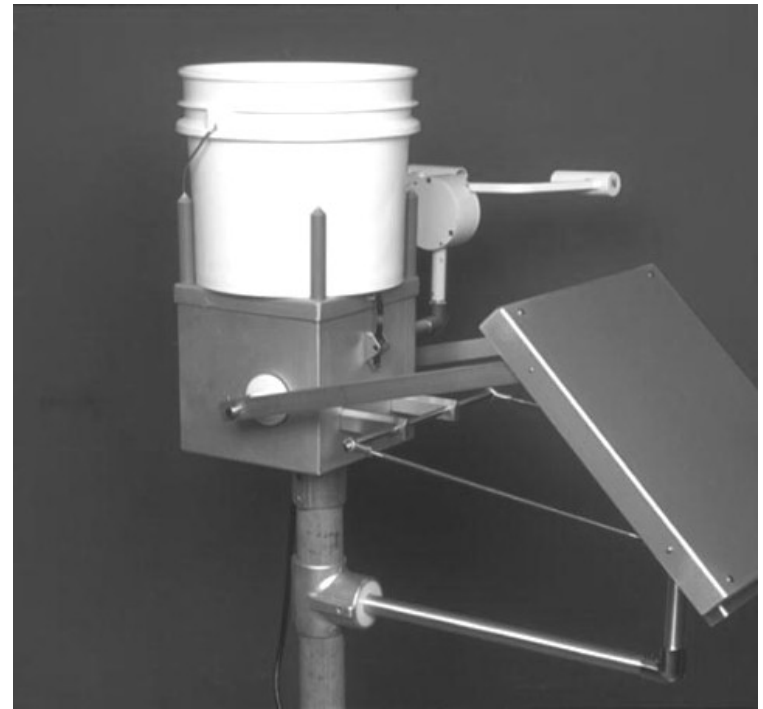
Modified sampler head to collect 12 replicate
47mm filters.



Event-based rainfall sampling with modified N-CON rain samplers. Lid design and movement minimizes splash into the bucket.

Pre-cleaned HD polyethylene funnels (attached to 500-1000mL receiving bottles) are inserted into the buckets.

25 cm funnel diameter (490cm^2); 1 cm rain yields 490 mL.



Digestion methods comparison

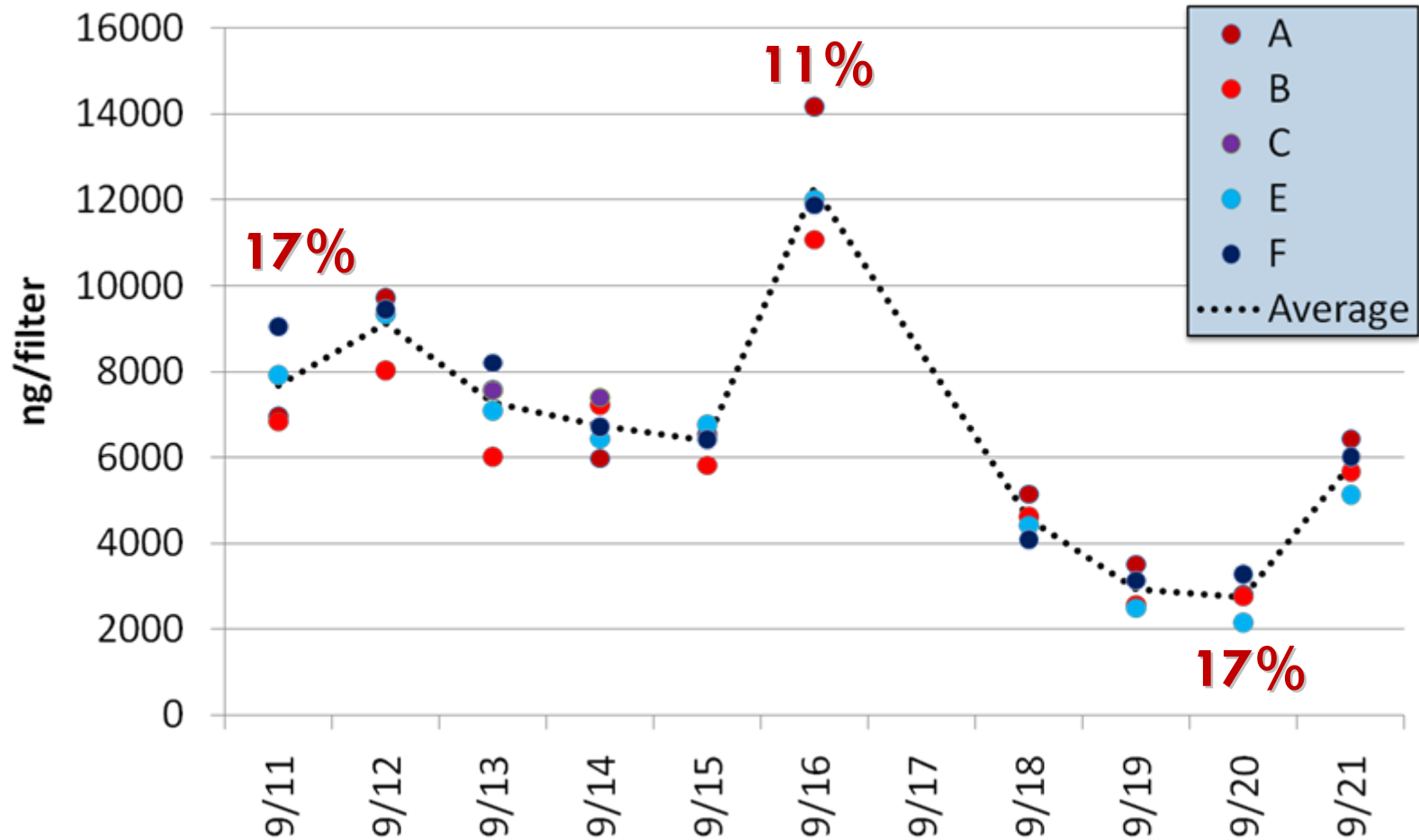
- Heating
 - Microwave
 - Oven
 - Hotplate
- Acid mixtures
 - HNO_3
 - H_2O_2
 - HF (some with H_3BO_3)

Filter blanks and detection limits

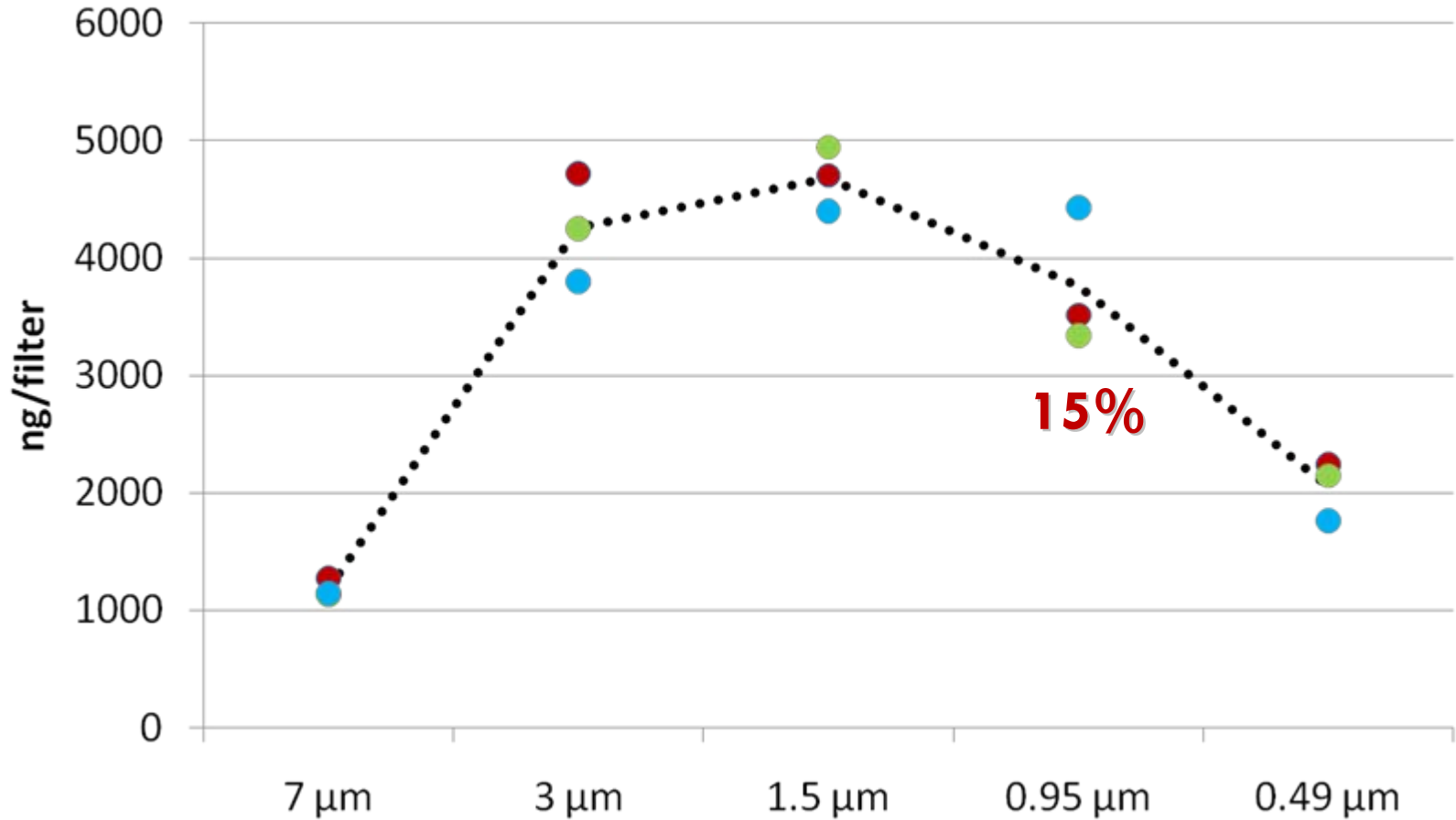
Sample blanks and detection limits are similar for all filter types, indicating that cutting and handling during subsampling can be performed without contaminating filters.

	Strips 28 strips per 8" x 10" sheet			Disks 13 discrete disks			Impactor 9 slotted impactor strips per stage, 5 stages per frame		
	Average ng/cm ²	StDev ng/cm ²	Detection Limit ng/cm ²	Average ng/cm ²	StDev ng/cm ²	Detection Limit ng/cm ²	Average ng/cm ²	StDev ng/cm ²	Detection Limit ng/cm ²
Al	21.1	9.1	27.4	13.8	3.8	11.4	4.8	0.8	2.27
Fe	4.22	0.53	1.58	3.55	0.41	1.24	4.12	0.65	1.95
Mn	0.052	0.006	0.019	0.042	0.009	0.027	0.056	0.011	0.034
V	0.015	0.002	0.005	0.014	0.001	0.004	0.007	0.000	0.000
Zn	1.21	0.55	1.64	1.23	0.47	1.42	1.38	0.71	2.12

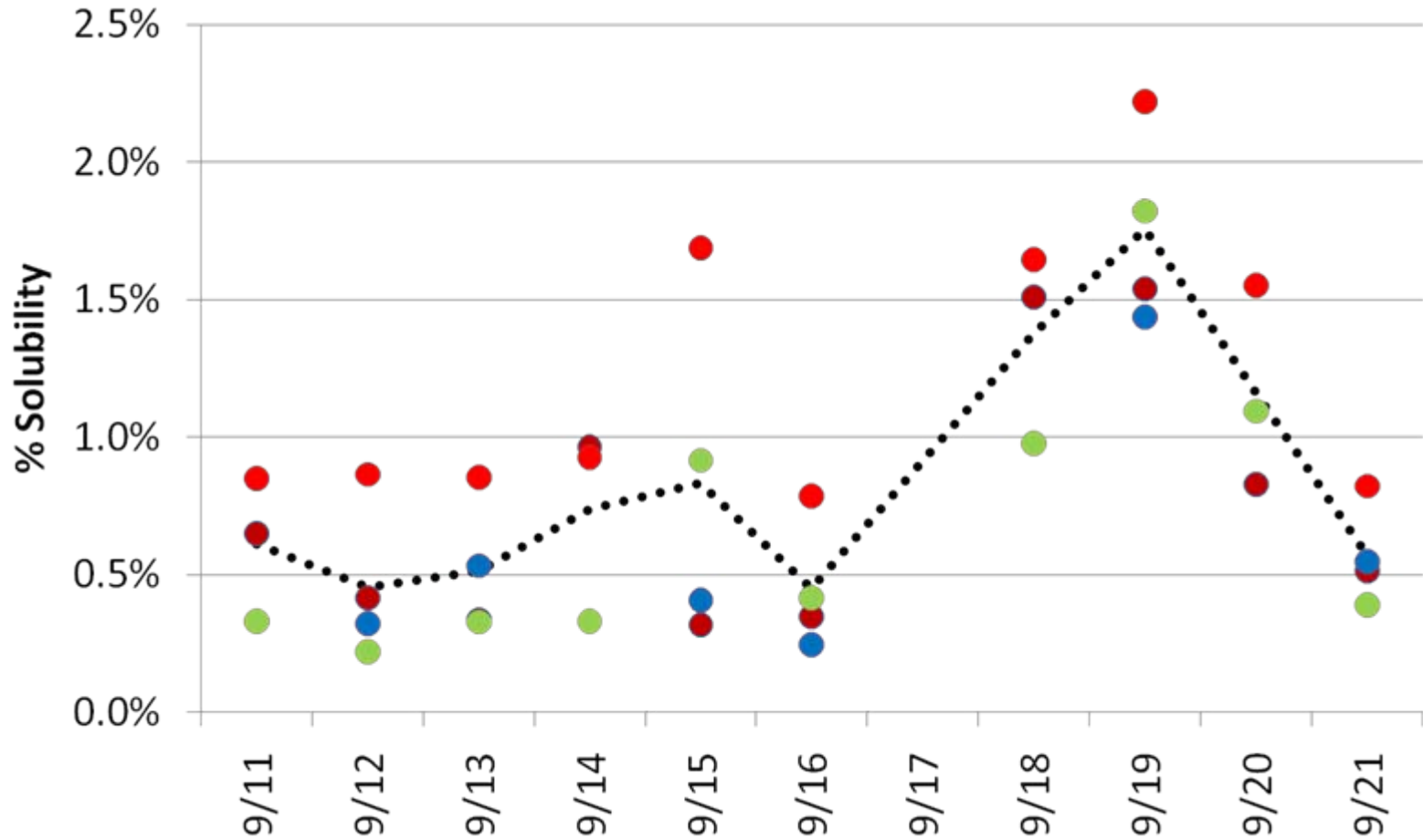
Total Fe (W41; n=5)



Total Fe (Impactor; n=3)



Soluble Fe (W41; n=4)



W41 Digests summary

- But within individual labs, similar imprecision

– Al	2% to 21%	<1% to 22%
– Fe	6% to 17%	<1% to 19%
– V	4% to 10%	<1% to 13%
– Cd	Worst (73%)	3% to 51%
– Co	Best	<1% to 28%
– Ni	6% to 25%	<1% to 52%
– Zn	~30%	<1% to 32%

Between labs

Within a lab

Results, to date

- Different digest methods = similar efficiencies

HF is essential for some elements

- Imprecision ***within*** lab group similar to imprecision observed ***between*** lab groups (W41)

Wait to draw conclusions until more labs report

- Some variability within soluble fraction results

Differences in extraction methods:

Bulk equilibration vs. Flow-through extraction

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