

Report as of FY2010 for 2009MN253B: "Urban Stormwater Inputs of Perfluorochemicals"

Publications

- Conference Proceedings:
 - ◆ Xiao, F. J. Gulliver, and M. Simcik (presented by Feng Xiao). Do Perfluorinated Compounds Act Like a Solid in Competitive Adsorption onto a Solid/Water Interface? Poster presentation at the Gordon Research Conference on Environmental Sciences: Water in Plymouth New Hampshire June 2010.

Report Follows

Urban Stormwater Inputs of Perfluorochemicals

Principal Investigators

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Funding Source: USGS-WRRI 104B/CAIWQ Grants Program

Project Duration: 3/1/09-2/28/11

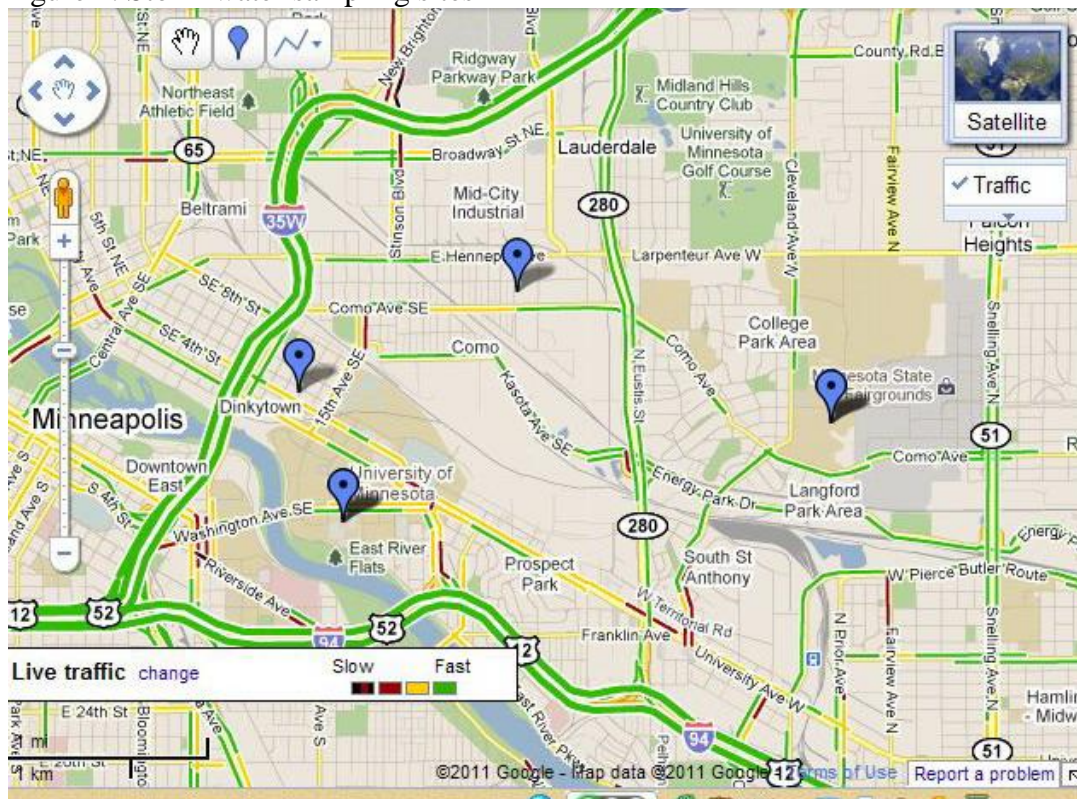
Reporting Period: 3/1/10-2/28/11

Title: Urban Stormwater Inputs of Perfluorochemicals

1) Research: A synopsis of your ongoing research project and of any research project completed during this reporting period. This includes projects funded under the base grant and the National Competitive Grants program. These reports are for a technical audience, and are posted and regularly accessed on the main USGS website. We do not do any editing of these, so please take care in their preparation. Somewhere between 5-10 pages including tables and figures is typical.

Six stormwater events were sampled in residential and University areas of Minneapolis and St. Paul, MN. Samples consisted of 4L grab samples taken by lowering 4L HDPE bottles into the storm water flow from street level into drainage ditches. A map of the sites is given in Figure 1.

Figure 1. Storm water sampling sites



Water samples were filtered to separate the dissolved phase from the particulate phase perfluorochemicals (PFCs). Filters were 47mm polypropylene (Millipore) filters with 2µm pore size. Several filters were required per water sample as the particles in the samples clogged the filters and head pressure increased (or flow decreased). The filtrate was then extracted using solid phase extraction cartridges packed in the laboratory with cleaned XAD-7 polymeric resin. The resin and filters were extracted separately with methanol (Optima grade, Fisher Scientific). Internal standards consisting of ¹³C labeled PFOS and PFOA were added to each extract and a suite of perfluorochemicals (Table 1) quantified by liquid chromatography/mass spectrometry (LC/MS) utilizing electrospray negative ionization (HP 1090 LC and Agilent 1100 MS).

PFC identification was performed by comparing retention times and m/z corresponding to native standards. The LC/MS was operated in the selective ion monitoring mode corresponding to the m/z for each analyte and standard.

Table 1. List of Analytes

Analyte	Abbreviation	CAS #
perfluorobutanoic acid	PFBA	375-22-4
perfluorobutane sulfonate	PFBS	375-73-5
perfluoropentanoic acid	PFPeA	2706-90-3
perfluorohexanoic acid	PFHxA	307-24-4
perfluorohexane sulfonate	PFHxS	355-46-4
perfluoroheptanoic acid	PFHpA	375-85-9
perfluorooctanoic acid	PFOA	335-67-1
perfluorooctane sulfonate	PFOS	1763-23-1
perfluorooctane sulfonamide	PFOSA	754-91-6
perfluorononanoic acid	PFNA	375-95-1
perfluorodecanoic acid	PFDA	335-76-2
perfluoroundecanoic acid	PFUnA	2058-94-8
perfluorododecanoic acid	PFDoA	307-55-1

Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid were the most frequently detected and highest concentration PFC contaminants measured in the six storm water events. Other PFCs were detected in less frequency (Figure 2).

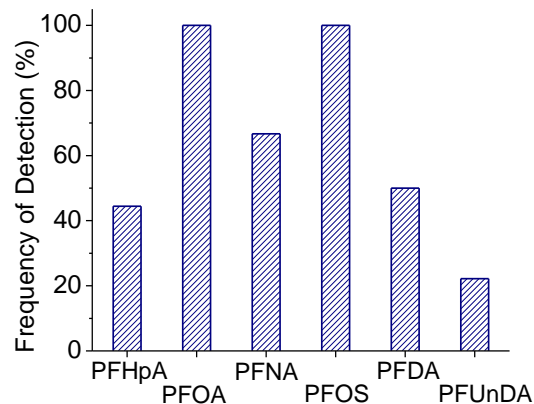


Figure 2. Frequency of detection: PFOS=PFOA>PFNA>PFHpA=PFDA>PFUnDA (based on the results of Chi-square test).

Concentrations of PFOS and PFOA are presented in Figure 3. For the six storm events in 2010-2011 the concentration of PFOS and PFOA were quite similar and statistically greater than the concentrations of perfluoroheptanoic acid (PFHpA), perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDA), which are statistically greater than the perfluorododecanoic acid (PFDoA) concentration.

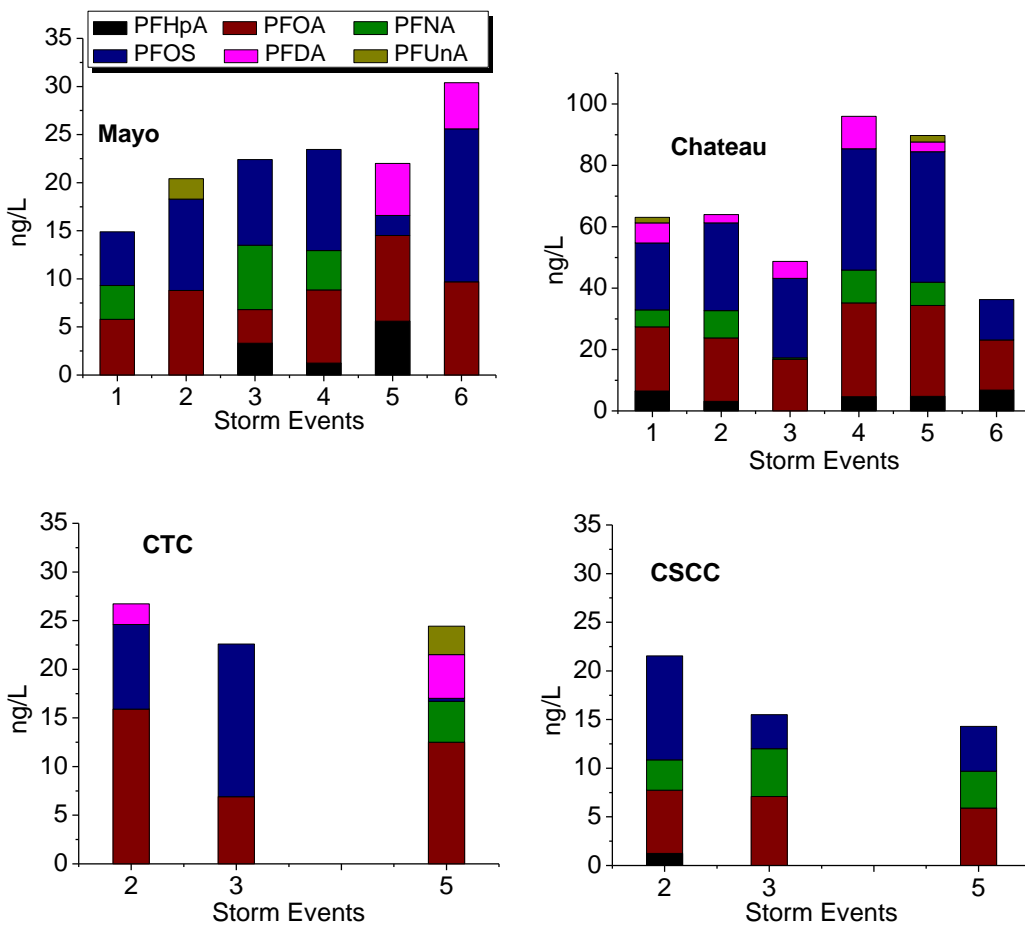


Fig. 3. PFAA concentrations in street runoff in different locations during six storm events. (Event 1: August 20 2010; Event 2: Sep 01 2010; Event 3: Sep 15 2010; Event 4: Sep 23 2010; Event 5: Oct 26 2010; Event 6: May 12 2011)

Only PFOS was detected in any of the particle phase samples. Three samples resulted in measurable PFOS ranging from 0.12 to 0.59 ng/mg of total suspended solids (TSS; Table 3).

Table 3. PFOS and PFOA on the total suspended solids (TSS) in stormwater runoff (2009, 9, 25)

PFAAs on particles in stormwater runoff, ng/gTSS						
	PFHpA	PFOA	PFNA	PFOS	PFDA	PFOA
36th and Brunswick ^a	ND	ND	ND	280.4	ND	ND
36th and Kenwood ^a	ND	ND	ND	120.5	ND	ND
351/2 ^a	ND	ND	ND	590	ND	ND
Chateau ^b	ND	ND	ND	19.8	ND	ND
CTC ^b	ND	ND	ND	ND	ND	ND
CSCC ^b	ND	ND	ND	ND	ND	ND
Mayo ^b	ND	ND	ND	ND	ND	ND
Chateau ^c	ND	ND	ND	45.9	ND	ND
CTC ^c	ND	ND	ND	ND	ND	ND
CSCC ^c	ND	ND	ND	ND	ND	ND
Mayo ^c	ND	ND	ND	ND	ND	ND
Chateau ^d	ND	ND	ND	ND	ND	ND
Mayo ^d	ND	ND	ND	ND	ND	ND

^a: Sep 25 2009; ^b: Sep 01 2010; ^c: Sep 15 2010; ^d: May 12 2011

2) Publications:

Xiao, F., Z. Xiangru, M. F. Simcik, and J. S. Gulliver. Effects of Monovalent Cations on the Competitive Adsorption of Perfluoroalkyl Acids on Kaolinite: Hydrophobic and Electrostatic Interactions. *Water Research* **in review**.

Xiao, F., M. F. Simcik, and J. S. Gulliver. Perfluorochemicals in Stormwater: Occurrence and Partitioning. **in preparation**.

3) Student Support: This project has supported one Ph.D. student, Feng Xiao, in Civil Engineering at the University of Minnesota.

4) Presentations:

Xiao, F. J. Gulliver, and M. Simcik (presented by Feng Xiao). Do Perfluorinated Compounds Act Like a Solid in Competitive Adsorption onto a Solid/Water Interface? Poster presentation at the Gordon Research Conference on Environmental Sciences: Water in Plymouth New Hampshire June 2010.

5) Awards: Civil Engineering travel award to Feng Xiao.

6) Related Funding: Proposal under review to MPCA/EPA 319 program.