



PERFLUOROOCTANOIC ACID (PFOA)  
AND PERFLUOROOCTANESULFONIC  
ACID (PFOS)

VOLUME 135

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TO HUMANS

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type           | Location and collection date                    | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L                                       | Median (IQR) ng/L          | Analytical method (LOD) ng/L                         | Comments   | Reference               |
|-----------------------|---|----------------|--|----------------------------|--|--|-------------------------|
| <i>Drinking-water</i> |   |                |  |                            |  |  |                         |
| <i>Well water</i>     |   |                |  |                            |  |  |                         |
| Well water            | Ohio, West Virginia, USA, 2001-2005             | ≥ 73           | PFOA 800 ± 1900 95% CI (< 6–13 300)  | PFOA, 200 (NR)             | HPLC LOQ 6   | PFOS was not analysed. The 62 private wells were located close to a fluoropolymer plant. 52 wells were sampled only once.  | Hoffman et al. (2011)   |
| Well water            | Osaka, Japan, 2015–2016                         | 22             | PFOA NR (45.2–7440)  | PFOA 240                   | GC-NCI-MS (2)  | PFOS was not analysed. The wells were located within 5 km from a fluoropolymer plant.  | Shiwaku et al. (2016)   |
| Drinking-water        | USA, NR   | NR             | PFOA (2.3–100 000)   | NR                         | HPLC-MS/MS (NR)                                      | At fluorochemical industrial facilities  | ATSDR (2021)            |
| Drinking-water        | USA, 2013–2015                                  | 4795           | PFOA [49.6] (20–349)<br>PFOS [174.9] (41–1800)                                       | PFOA [32.0]<br>PFOS [66.0] | PFOA (20)<br>PFOS (40)                               | PFOA DF [2.2%]<br>PFOS DF [1.9%]<br><br>Mean and median values were calculated for detected samples only.  | CDC (2023)              |
| Drinking-water        | 14 countries worldwide <sup>a</sup> , 2008–2016 | NR             | PFOA 0.16–778<br>PFOS < 0.04–97.5 (range of mean in different studies, see comments) | NR                         | LC-MS/MS except Shiwaku et al. (2016) GC-MS (0.01–2) | Includes Haug et al. (2010), Domingo et al. (2012), Schwanz et al. (2016), Eriksson et al. (2013), Heo et al. (2014), Llorca et al. (2012), Eschauzier et al. (2012, 2013), Kunacheva et al. (2010), Essumang et al. (2017), Qiu et al. (2010), Shiwaku et al. (2016). | Jian et al. (2017)      |
| Drinking-water        | Ruhr and Moehne area, Germany, 2006             | 28             | PFOA NR (ND–519)<br>PFOS NR (ND–22)  | NR                         | LC-MS<br>PFOA (2)                                    | Source: river Rhine and others   | Skutlarek et al. (2006) |

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|-----------------------|------------------------------|----------------|---|----------------------------|--|---|--------------------------|
| Tap water             | Italy, 2006                  | 6              | PFOA 2.4 (1.0–2.9)<br>PFOS 8.1 (ND–38.5)                        | NR                         | LC-MS/MS<br>PFOA (1)<br>PFOS (0.1)             | Tap was water from different towns with Lago Maggiore (lake) as source water.                           | Loos et al. (2007)       |
| Tap water             | Oslo, Norway, 2008           | 3              | PFOA [1.45] (0.65–2.5)<br>PFOS [0.20] (0.071–0.31)              | PFOA [1.20]<br>PFOS [0.23] | LC-MS/MS<br>(NR)                               | Samples were from households receiving water from different water works. Source: lake water.            | Haug et al. (2010)       |
| Public fountain water | Catalonia, Spain, 2009       | 10             | PFOA [2.42] (< 0.40–9.6)<br>PFOS [1.92] (< 0.05–6.2)            | PFOA [0.59]<br>PFOS [0.52] | LC-MS/MS<br>PFOA (0.4)<br>PFOS (0.05)          | Samples were from Barcelona, Tarragona, Girona, Lleida and Terres de l'Ebre. Source: mainly river water | Domingo et al. (2012)    |
| Tap water             | East China, 2009             | 4              | PFOA [18.4] (6.8–40)<br>PFOS [6.3] (< 2.4–14)                   | PFOA [13.4]<br>PFOS [5.0]  | HPLC-MS/MS<br>PFOA (0.5)<br>PFOS (1.0)         | Samples were from 4 restaurants around lake Taihu (source) near Shanghai                                | Qiu et al. (2010)        |
| Tap water             | Bangkok, Thailand, 2009      | 28             | PFOA 3.58 (1.43–16.54)<br>PFOS 0.17 (0.22–6.28)                 | NR                         | HPLC-ESI-MS/MS<br>PFOA (0.01)<br>PFOS (0.01)   | Samples were taken from 4 different WTPs and points of use. Source: river water.                        | Kunacheva et al. (2010)  |
| Tap water             | Amsterdam, Netherlands, 2011 | 4              | PFOA 3.7 (3.2–4.3)<br>PFOS < 0.30<br>br-PFOS 0.32 (< 0.43–0.50) | NR                         | ESI-MS/MS<br>LOQ<br>PFOA (3.07)<br>PFOS (0.43) | Method was validated for drinking-water. Source: River Rhine  | Eschauzier et al. (2013) |

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|----------------|--|----------------|--|----------------------|--|---|--------------------------|
| Drinking-water | Faroe islands, 2012                        | 2              | PFOA [0.24] (0.23–0.25)<br><i>n</i> -PFOS [0.39] (0.17–0.61) | NA                   | HPLC-MS/MS<br>PFOA (0.20)<br>PFOS (0.41) | Method ISO 25101:2009 last confirmed 2019.<br>Source: lake water. | Eriksson et al. (2013)   |
| Tap water      | Busan, Korea, 2011–2012                    | 34             | PFOA 12.9 (NR–20.7)<br>PFOS 2.62 (NR–10.1)                   | NR                   | LC-MS/MS<br>(NR)                         | PFOA DF 100%<br>PFOS DF 100%<br>Source: river water.              | Heo et al. (2014)        |
| Tap water      | Germany, 2010–2012                         | 5              | PFOA 1.3 (0.16–1.9)<br>PFOS 0.4 (0.04–0.4)                   | PFOA 1.3<br>PFOS NA  | LC-MS/MS<br>PFOA (0.83)<br>PFOS (0.39)   | The method was validated for tap water. Source: river Rhine       | Llorca et al. (2012)     |
| Tap water      | Spain, 2010–2012                           | 84             | PFOA 6.7 (0.16–35)<br>PFOS 46 (0.04–258)                     | PFOA 2.9<br>PFOS 7.0 | LC-MS/MS<br>PFOA (0.83)<br>PFOS (0.39)   | The method was validated for tap water.<br>Source: river water.   | Llorca et al. (2012)     |
| Tap water      | Amsterdam, Netherlands, 2010               | 1              | PFOA 5.7<br>PFOS 0.4   | NA                   | NR. LOQ<br>PFOA (0.75)<br>PFOS (0.23)    | Source: river Rhine.  | Eschauzier et al. (2012) |
| Tap water      | Daboase and Kakum, Ghana, 2015             | 10             | PFOA [105] (66–190)<br>PFOS [93.6] (16.2–168)                | NR                   | HPLC-MS/MS<br>PFOA (0.43)<br>PFOS (0.39) | Source: rivers  | Essumang et al. (2017)   |
| Tap water      | 34 cities and towns around Australia, 2010 | 62             | PFOA NR (0–9.7)<br>PFOS NR (0–16)                            | NR                   | HPLC-MS/MS<br>PFOA (0.13)<br>PFOS (0.13) | PFOA > LOQ 49%<br>PFOS > LOQ 44%                                  | Thompson et al. (2011)   |

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|-----------------------|---------------------------------------|----------------|---|---------------------------|---|--|------------------------|
| Tap water             | Germany, NR                           | 26             | PFOA NR (0–6.1)<br>PFOS NR (0–4.7)                | PFOA 2.6<br>PFOS 1.3      | LC-MS/MS<br>LOQ (1)                         | Sources: rivers, ground water, rainwater<br>PFOA > LOQ 19%<br>PFOS > LOQ 35%   | Gellrich et al. (2013) |
| Tap water             | Japan, 2002                           | 14             | PFOS [8.4] (0.1–50.9)                             | PFOS 2.8                  | HPLC-MS (NR)                                | PFOA was not measured.   | Harada et al. (2003)   |
| Potable tap water     | Osaka, Japan, 2006–2007               | 26             | PFOA [22.2] (2.3–84)<br>PFOS [2.9] (< 0.1–22)     | PFOA [16.5]<br>PFOS [1.9] | LC-MS/MS<br>PFOA LOQ 1<br>PFOS LOQ 0.1      |  | Takagi et al. (2008)   |
| Tap water             | Osaka, Kyoto, Japan, 2010, 2011, 2015 | NR             | PFOA Osaka (6.2–25.6)*<br>PFOA Kyoto (12.1–10.8)* | NR                        | GC-MS (2)                                   | PFOS was not analysed.<br>*range of annual mean values.<br>Source: river   | Shiwaku et al. (2016)  |
| Public drinking-water | California, USA, 2013–2015            | 83*            | PFOA [28 (20–53)]<br>PFOS [58] (41–156)]          | NR                        | HPLC-MS/MS<br>LOQ<br>PFOA (20)<br>PFOS (40) | Samples were taken from 452 public water sources.* Number of water samples in which the concentration $\geq$ LOQ<br>Source: Groundwater, river, rainwater, snow pack | Hurley et al. (2016)   |

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|------------------------|--|--|---|----------------------------------|--|--|-----------------------|
| Drinking-water         | USA nationwide, 2013–2015<br>UCMR3   | 36 972 samples from 4920 public water supplies | PFOA: NR (< 20–349)<br>PFOS: NR (< 40–1800).  | NR                               | EPA method 537. LC-MS/MS<br><br>MRL<br>PFOA (20)<br>PFOS (40)  | PFOA $\geq$ MRL in 0.09% samples, 0.3% PWS<br>PFOS $\geq$ MRL in 0.3% samples, 0.9% PWS. Source: finished drinking-water from river, lake, groundwater | US EPA (2017)         |
| Treated drinking-water | 24 US states, 2017   | 25   | PFOA NR (< LOQ to 104)<br>PFOS NR (ND–36.9)   | PFOA 4.15<br>PFOS 1.62           | LC-MS/MS<br>PFOA (0.56)<br>PFOS (0.13)                         | Samples from 25 DWTPs<br>PFOA DF 100%<br>PFOS DF 92% Source: river, lake, groundwater  | Boone et al. (2019)   |
| Drinking-water         | USA, nationwide, 2023<br>UCMR5 (2023–2025; Data shown is as of October 2023) | 10 020 samples from 3072 PWS                   | PFOA: Mean – NR; Range – < 4–235; GM – NR<br>PFOA: Mean-NR: Range – < 4–154; GM-NR                      | NR                               | US EPA method 533, LC-MS/MS<br><br>MRL<br>PFOA (4)<br>PFOS (4) | PFOA $\geq$ MRL in 6.1% samples; 9.5% PWS<br>PFOS $\geq$ MRL 6.4% samples; 9.5% PWS]<br>Source: finished drinking-water from river, lake, groundwater. | US EPA (2023)         |
| Drinking-water         | Indiana, USA, 2020   | 81   | PFOA NR (ND–3.6)<br>PFOS NR (ND–1.6)  | PFOA 0.46<br>PFOS 0.22           | HPLC-MS/MS<br>PFOA (0.01)<br>PFOS (0.01)                       | Samples: 90% tap water, 10% private wells.<br>PFOA DF 93%<br>PFOS DF 84%   | Zheng et al. (2023)   |
| Tap water              | France: 100 departments, 2009–2010   | 110  | PFOA 2–3* (< 0.2–9) ng/L; PFOS 3–6 (< 1.3–16) for 2009 (41 samples); max values from 2010 (69 samples): | PFOA 2–3 (NR); PFOS 2–5 (NR) for | LC-MS/MS PFOA (2); PFOS (1.3)                                  | Representative of 20% of the national water supply.<br>PFOS DF 27%<br>PFOA DF 11%  | Boiteux et al. (2012) |

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|                          |                                 |                | PFOA 12<br>PFOS 22                             | 2009 (41 samples)           |   | *mean values for treated water from surface water and ground water, respectively  |                             |
| Drinking-water           | France, 2013                    | NR             | PFOA NR (6–23)<br>PFOS NR (< 4–12)             | NR                          | LC-MS/MS<br>LOQ<br>PFOA (4)<br>PFOS (4)   | Source: river water 15 km downstream of two fluoropolymer-production sites  | Bach et al. (2017)          |
| Tap water                | Porto Alegre, Brazil, 2014      | 21             | PFOA [5.6] (ND–46)<br>PFOS [15.8] (4.58–43.8)  | PFOA ND<br>PFOS 5.79        | PFOA (0.89) PFOS (0.41)                   | PFOA DF 33%<br>PFOS DF 100%   | Schwanz et al. (2016)       |
| Tap water                | 8 cities, France, 2014          | 8              | PFOA [3.6] (ND–17.6);<br>PFOS [8.0] (ND–30)    | PFOA ND;<br>PFOS < LOQ      | PFOA (0.89) PFOS (0.41)                   | PFOA DF 25%<br>PFOS DF 38%<br>Toulouse, Montpellier, Nîmes, Avignon, Valence, Grenoble, Lyon, Perpignan                   | Schwanz et al. (2016)       |
| Tap water                | Barcelona, Spain, 2014          | 29             | PFOA [3.2] (ND–28);<br>PFOS [15.8] (ND–140)    | PFOA ND;<br>PFOS < LOQ (NR) | PFOA (0.89) PFOS (0.41)                   | PFOA DF 21%<br>PFOS DF 38%  | Schwanz et al. (2016)       |
| Municipal drinking-water | 33 provinces, Turkey, 2017–2018 | 94             | PFOA 0.40 (0.10–2.37)<br>PFOS 0.52 (0.09–2.04) | PFOA 0.19; PFOS 0.28 (NR)   | UHPLC-MS/MS<br>PFOA (0.10)<br>PFOS (0.09) | PFOA DF 55%, PFOS DF 55%. Only concentrations above the MDL were taken into account in calculating mean and median values | Ünlü Endirlik et al. (2019) |
| Tap water                | Hong Kong, China, 2017–2018     | 12             | PFOA 21.1 (5.67–39.7)<br>PFOS 3.91 (0.11–8.63) | PFOA 22.4 (NR–28.9)         | HPLC-MS/MS PFOA (0.02)                    | DR PFOA 100%  | Li et al. (2021)            |

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|-----------------------------|--|----------------|---|-------------------------------------|---|---|-------------------------|
| Drinking-water              | Beijing, China, NR   | 14             | PFOA 2.57 (0.4–10.2)<br>PFOS 0.3 (0.3)                      | PFOA 1.60;<br>PFOS 0.3              | LC-MS/MS (NR)                                 | DR PFOS 100% Sources: Hong Kong rainwater and Dongjiang river water<br>Samples from 14 DWTPs in Beijing<br>PFOA DF 93%<br>PFOS DF 14%<br>Source: mainly groundwater | Wu et al. (2023)        |
| Tap water                   | USA, Canada, Burkina Faso, Chile, China, France, Norway, Ivory Coast, Japan, 2015-2016 | 59             | PFOA 0.67 (< 0.070–4.9)<br>PFOS 1.0 (0.030–4.1)             | PFOA 0.31<br>PFOS 0.64              | UHPLC-MS<br>PFOA (0.070)<br>PFOS (0.030)      | PFOA DF 86%<br>PFOS DF 85%  | Kaboré et al. (2018)    |
| Drinking (tap) water        | 19 states, USA, NR   | 53             | PFOA (ND–213)<br>PFOS NR                                    | NR                                  | ICECLES-HPLC-MS/MS<br>PFOA (0.08) PFOS (0.10) | PFOA DF 96%;<br>PFOS DF 53%<br>Source: river, lake, groundwater, rainwater  | Skaggs and Logue (2021) |
| <b><i>Bottled water</i></b> |  |                |   |                                     |   |   |                         |
| Bottled water               | Bangkok, Thailand, 2009  | 20             | PFOA 10.55<br>PFOS 0.22                                     | NR                                  | HPLC-ESI-MS/MS<br>PFOA (0.01) PFOS (0.01)     | The sources of bottled water were in different places, not only in Bangkok.   | Kunacheva et al. (2010) |
| Commercial bottled water    | Bangkok and Khon Kaen, Thailand, NR  | 16             | Bangkok<br>PFOA [2.5] (2.19–2.75)<br>PFOS [0.2] (0.08–0.33) | Bangkok<br>PFOA [2.5]<br>PFOS [0.2] | LC-HRMS<br>PFOA (0.02)<br>PFOS (0.02)         | PFOA DF 100%<br>PFOS DF 100%  | Guardian et al. (2020)  |



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|                              |   |                               | Khon Kaen PFOA [4.98] (3.31–7.89) PFOS [0.25] (0.24–0.26) | Khon Kaen PFOA [3.74] PFOS [0.26] |  |  |                              |
| Local bottled drinking-water | Map Ta Phut, Thailand, 2019   | 5                             | PFOA (< 0.25–0.62); PFOS (< 0.125–0.45)                   | PFOA and PFOS: NR                 | LC-MS/MS PFOA LOQ 0.25; PFOS LOQ 0.125 | Map Ta Phut is an industrial estate area.<br>In Bangkok and Chantaburi, Thailand, bottled water PFOA and PFOS were < LOQ       | Lertassavakorn et al. (2021) |
| Mineral water                | Germany, Spain, 2010–2012   | 2 German, 4 Spanish           | PFOS Germany 1.0; Spain < LOQ                             | PFOS 1.0 Spain NA                 | LC-MS/MS PFOS LOQ 0.04                 | The method was validated for ultrapure water and tap water.  | Llorca et al. (2012)         |
| Spring water                 | Germany, Czech Republic, Switzerland, NR  | 18                            | PFOA NR (ND–7.4) PFOS < LOQ                               | PFOA 1.4 PFOS NA                  | LC-MS/MS LOQ 1                         | PFOA > LOQ 22%<br>PFOS > LOQ 0%  | Gellrich et al. (2013)       |
| Mineral water                | Germany, Italy, Malaysia, France, Slovenia, Turkey, Luxemburg, Serbia, Croatia, Netherlands, Greece, NR | 119                           | PFOA [1.7] (< LOQ–3.7) PFOS [2.1] (< LOQ–6.0)             | PFOA 1.6 PFOS 1.5 (NR)            | LC-MS/MS LOQ 1                         | PFOA > LOQ 26%<br>PFOS > LOQ 9%<br>Only concentrations above LOQ were taken into account in calculating mean and median values | Gellrich et al. (2013)       |
| Bottled water                | Korea, 2011–2012  | 8                             | PFOA 0.16 (ND–0.57) PFOS 0.06 (ND–0.35)                   | NR                                | LC-MS/MS (NR)                          | PFOA DF 27.5%<br>PFOS DF 25%   | Heo et al. (2014)            |
| Various brands of            | Various locations in Brazil, France and Spain. 2014   | 9 Brazil; 19 France; 10 Spain | Brazil: PFOA 7.6 (3.4–12).                                | Brazil: PFOA 7.6; PFOS ND.        | PFOA (0.89) PFOS (0.41)                | The study included bottled purified municipal waters, “generic brands”, and mineral, spring and artesian                       | Schwanz et al. (2016)        |

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|---|---|---|---|---|--|---|-----------------------------|
| bottled water – PET bottles               |   |   | PFOS ND<br>France:<br>PFOA 5.4 (3.9–7.4).<br>PFOS 5.2 (1.6–11).<br>Spain: PFOA 9.5 (8.3–11).<br>PFOS ND | France:<br>PFOA 4.8;<br>PFOS 4.2.<br>Spain<br>PFOA 9.5;<br>PFOS ND.<br>(NR) |  | bottled waters “gourmet brands”.<br>PFOS was only detected in France.<br><br>Mean and median values were calculated from positive samples.  |                             |
| Bottled waters                            | France, 2013  | 40 including 25 natural mineral waters and 15 bottled spring waters | PFOA 9.5 (9.5); PFOS 2.2 (0.6–3.7)  | PFOA 9.5; PFOS [2.3]  | LC-MS/MS PFOA LOQ 1; PFOS LOQ 0.5        | The sample represented 70% of the French bottled water market, PET and glass bottles.<br><br>PFOA > LOQ 2.5%<br><br>PFOS > LOQ 10% Mean and median values were calculated from positive samples only. | Le Coadou et al. (2017)     |
| Bottled water                             | Canada, Ivory Coast, China, Mexico, Burkina Faso, 2015–2016 | 38  | PFOA < 0.20 (< 0.070–3.02)<br>PFOS < 0.10 (< 0.030–0.67)  | PFOA < 0.070<br>PFOS < 0.030  | UHPLC-MS<br>PFOA (0.070)<br>PFOS (0.030) | PFOA DF 34%<br>PFOS DF 18%  | Kaboré et al. (2018)        |
| Spring water in glass and plastic bottles | Supermarkets, Turkey, 2017–2018                             | 26 (18 different brands)  | PFOA 0.10 (0.10)<br>PFOS ND   | PFOA 0.10 ng/L<br>PFOS ND<br>(NR)   | UHPLC-MS/MS PFOA (0.10) PFOS (0.09)      | PFOA DF was 4% (one sample, glass bottle). Only concentrations above the MDL were taken into account in calculating mean and median values  | Ünlü Endirlik et al. (2019) |
| Commercial bottled water                  | Manila, Philippines, NR                                     | 7   | Manila<br>PFOA [2.8] (2.60–3.01)  | Manila<br>PFOA [2.8]  | LC-HRMS PFOA (0.02) PFOS (0.02)          | Purified/distilled/natural waters. There was no significant difference in PFOA concentrations between   | Guardian et al. (2020)      |

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|----------------------|---|------------------------|---|--|--------------------------------------|---|-----------------------|
|                      |   |                        | PFOS [0.22] (0.11–0.39)                                 | PFOS [0.16]  |                                      | purified, distilled and natural waters. PFOS concentrations were higher in distilled than in purified waters. |                       |
| Bottled water        | Hong Kong, China, 2017–2018               | 3                      | PFOA 24.2 (8.27–32.6)<br>PFOS 4.90 (0.73–7.09)          | NR   | PFOA (0.02)<br>PFOS (0.02)           |   | Li et al. (2021)      |
| Local mineral water  | Qingdao, China, 2017                      | 3                      | PFOA < 0.1<br>PFOS < 0.5                                | PFOA < 0.1<br>PFOS < 0.5                           | HPLC-MS/MS LOQ<br>PFOA 0.1; PFOS 0.5 | PFOA DR 0%<br>PFOS DR 0%  | Lu et al. (2022)      |
| <b>Surface water</b> |   |                        |   |  |                                      |   |                       |
| Surface water        | > 30 countries and regions, 1998–2019     | > 1700 sampling sites  | PFOA Max (8.8–578 970)<br>PFOS Max (2.5–271 103)        | PFOA Max median 569<br>PFOS Max median 22          | NR                                   | Sites close to primary or secondary sources   | Johnson et al. (2022) |
| Surface water        | > 30 countries and regions, 1998–2019     | > 1700 sampling sites  | PFOA Max (0.4–1030)<br>PFOS Max (0.3–348)               | PFOA Max median 18<br>PFOS Max median 10           | NR                                   | Sites not located near an identified PFAS source  | Johnson et al. (2022) |
| Surface water        | Global, mainly Asia and Europe, 2000–2018 | PFOA 1289<br>PFOS 1285 | PFOA NR (< 0.03 to > 1493)<br>PFOS NR (< 0.02 to > 388) | PFOA 4.04–12 (1.04–59)<br>PFOS 2.28–4.66 (0.54–18) | LC-MS primarily                      | PFOA DF 90%<br>PFOS DF 81%<br>PFOS median (IQR) ↓   | Sims et al. (2022)    |
| Surface water        | Africa                                    | 35                     | (< 0.03 to > 264)                                       | 3.00 (0.82–11)                                     | (< 0.04 to > 238)                    | 0.32 (0.85–11)  | Sims et al. (2022)    |
|                      | Antarctica                                | 5                      | (ND to > 20)  |  | NR                                   | NR  |                       |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type | Location and collection date  | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L  | Median (IQR) ng/L | Analytical method (LOD) ng/L         | Comments  | Reference           |
|-------------|---|----------------|---|-------------------|--------------------------------------|---|---------------------|
|             | Asia  | 700            | (< 0.05 to > 2682)  | 0.13 (0.03–0.56)  | (< 0.04 to > 163)                    | 2.67 (0.81–8.79)  |                     |
|             | Europe  | 340            | (< 0.03 to > 740)   | 11 (2.24–54)      | (< 0.03 to > 705)                    | 4.34 (0.99–19)  |                     |
|             | North America   | 219            | (< 0.03 to > 374)   | 4.84 (1.13–21)    | (< 0.02 to > 1304)                   | 4.49 (0.87–23)  |                     |
|             | Oceania   | 14             | (< 0.07 to > 311)   | 3.61 (0.94–14)    | (< 0.13 to > 2623)                   | 19 (4.46–78)  |                     |
| River water | Rivers Kisat, Auji, Kibos and Saka draining into Lake Victoria, Kenya | 28             | PFOA [6.23] (0.4–96.4)<br>PFOS [1.63] < 0.4–13.23)  | NR                | HPLC-MS/MS PFOA (0.075) PFOS (0.040) | Values below the limit of detection were not included in the estimation of the mean   | Orata et al. (2009) |
| Lake water  | Lake Victoria Gulf, Kenya   | 32             | PFOA [1.58] (0.4–11.65)<br>PFOS [0.63] (< 0.4–2.53)   | NR                | PFOA (0.075)<br>PFOS (0.040)         | Values below the limit of detection were not included in the estimation of the mean   | Orata et al. (2009) |
| River water | Japan, all over the country, 2002                                     | 95             | PFOS 2.37 <sup>GM</sup> 4.13 <sup>GSD</sup> (0.3–135)   | PFOS 1.68         | LC-MS<br>PFOS LOQ 0.1                | PFOA was not measured   | Saito et al. (2003) |
| River water | Japan, all over, 2003   | 79             | PFOA 0.97 <sup>GM</sup> 3.06 <sup>GSD</sup> – 21.15 <sup>GM</sup> 6.16 <sup>GSD</sup> (0.10–456.41) | NR                | LC-MS<br>PFOA (0.06)<br>PFOS (0.04)  | Ranges of max and min geometric mean values among 6 regions (Hokkaido-Tohoku, Kanto, Chubu, Kinki, Chugoku, Kyushu-Shikoku) | Saito et al. (2004) |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type    | Location and collection date   | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L   | Median (IQR) ng/L       | Analytical method (LOD) ng/L                 | Comments  | Reference              |
|----------------|--|----------------|--|-------------------------|--|---|------------------------|
| Surface water  | USA, 2014  | 36             | PFOS 0.89 <sup>GM</sup> 3.09 <sup>GSD</sup> – 5.73 <sup>GM</sup> 3.61 <sup>GSD</sup><br>(0.24–37.32) | PFOA 0.382<br>PFOS 2.17 | LC-MS/MS                                     | US Air Force AFFF release sites other than fire-training areas                          | Anderson et al. (2016) |
| Surface waters | China, 2013<br>Japan, 2009–2012<br>South Korea,<br>Philippines,<br>Thailand<br>Mali, 2014<br>Kenya, 2014 | NR             | PFOS (ND–47)<br>(0.02–230)<br>(0.12–33)<br>(0.39–4.2)<br>(< 0.02–730)<br>4.70<br>4.6                 | NR                      | NR   | Only data for PFOS  | UNEP (2017)            |
| River water    | Dongguan and others, China, NR   | NR             | PFOA (0.32–1590)<br>PFOS (0.41–20.5)   | NR                      | NR   | Large industrial area. Highest values in Huangpu river. Lowest values in Songhua river. | Chen et al. (2009)     |
| Surface waters | Shanghai, Zhejiang, Jiangsu regions<br>China, 2011   | 39             | PFOA (0.47–256)<br>PFOS (< 0.07–5.0)   | NR                      | HPLC-ESI-MS/MS<br>PFOA (0.07)<br>PFOS (0.07) | Lakes and rivers, urban and rural areas.  | Lu et al. (2015)       |
| River water    | Songhua, Liaohe, Daling, Hunhe, Haihe, Huaihe, Huangpu, Hanjiang, Yangtze, Pearl and                     | NR             | PFOA 0.17–169<br>PFOS 0.32–51.8  | NR                      | NR   | Range of mean values.<br>Review of 11 publications                                      | Wang et al. (2015)     |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type          | Location and collection date   | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L      | Median (IQR) ng/L               | Analytical method (LOD) ng/L                   | Comments   | Reference               |
|----------------------|--|----------------|---|---------------------------------|--|--|-------------------------|
| River water          | Yellow rivers, China, 2007–2013<br>Uttarakhand, Uttar Pradesh, Bihar, West Bengal, India, 2014 | 14             | PFOA [0.40 (0.08–1.18)]<br>PFOS [0.44] (< MQL–1.73) | PFOA [0.38]<br>PFOS [0.19]      | LC-MS/MS<br>PFOA (0.028)<br>PFOS (0.010)       | Ganges river   | Sharma et al. (2016)    |
| Lake and river water | New York state, USA, 2004  | 51             | PFOA NR (10–173) PFOS NR (0.8–1090)                 | PFOA 14–49<br>PFOS 1.6–756      | LC-MS/MS<br>PFOA (10)                          | 9 main water bodies of New York State  | Sinclair et al. (2006)  |
| River water          | Germany, 2007  | 15             | PFOA (2.8–9.6)<br>PFOS (0.5–2.9)                    | NR                              | PFOA (0.08)<br>PFOS (0.17)                     | River Elbe, 15 locations, midstream, 1 m depth   | Ahrens et al. (2009)    |
| River water          | 41 cities in 15 Asian, North American and European countries <sup>b</sup> , 2004–2010          | 539            | PFOA < 100 (0.2–1630)*;<br>PFOS NR (ND–70.1)        | PFOA 7.7 (NR);<br>PFOS 1.9 (NR) | HPLC-ESI-MS/MS; LOQ PFOA (0.5); LOQ PFOS (0.2) | *Range of mean values by city.<br>PFOA > LOQ 89%; PFOS > LOQ 81%                             | Kunacheva et al. (2012) |
| River water          | Anoia, Cardener and Llobregat rivers, Spain, 2010  | 14             | PFOA 20.3 (0.07–146)<br>PFOS 234 (0.01–271 000)     | NR                              | LC-MS/MS                                       | PFOA DF 86%<br>PFOS DF 71%   | Campo et al. (2015)     |
| River water          | Jucar river, Spain, 2010   | 15             | PFOA 4.36 (0.07–52.2)<br>PFOS 11.29 (0.01–128)      |                                 | LC-MS/MS                                       | PFOA DF 53%;<br>PFOS DF 40%  | Campo et al. (2016)     |
| River water          | 22 countries <sup>c</sup> from Africa, Asia-Pacific, Latin America, Caribbean, 2017–2019       | 144            | PFOA NR (0.05–4.02)<br>PFOS NR (< 0.025–6.23)       | NR                              | HPLC-MS/MS<br>LOQ PFOA 0.05<br>PFOS 0.025      | DF PFOA 85%<br>DF PFOS 89%<br>Linear and branched PFOS were reported separately and as total | Baabish et al. (2021)   |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type            | Location and collection date            | No. of samples     | Mean (range), Geometric mean <sup>d</sup> ng/L   | Median (IQR) ng/L                         | Analytical method (LOD) ng/L  | Comments   | Reference             |
|------------------------|---|--------------------|--|---|---|--|-----------------------|
| Ice melting lake water | Larseman Hills, Antarctica, 2015–2016   | 21                 | <i>n</i> -PFOA 0.0557 (< 0.0159–0.458)<br><i>iso</i> -PFOA NR (0.0–0.0053)<br>PFOS 0.010 (0.0128–0.0214) | <i>n</i> -PFOA 0.0267<br>PFOS 0.0905      | HPLC-MS/MS<br><i>n</i> -PFOA (0.0159)<br><i>iso</i> -PFOA (0.0044)<br>PFOS (0.0128) | PFOA DF 90%<br>PFOS DF 24%   | Shan et al. (2021)    |
| <i>Groundwater</i>     |   |                    |  |   |   |  |                       |
| Groundwater            | Global, 1998–2019                       | 20729              | PFOA 15000 (<0.03–7 000 000)<br>PFOS 21 000 (0.01–5 000 000)   | NR  | LOQ PFOA (0.03–97.6)<br>LOQ PFOS (0.01–100)   | Primary source, secondary source and no known source -sites combined.                  | Johnson et al. (2022) |
| Groundwater            | Global 1998–2019                        | 8460               | PFOA 64 000 (NR–6 570 000)<br>PFOS 93 000 (NR–4 600 000)   |   | LOQ PFOA (0.5–97.6)<br>LOQ PFOS (0.05–100)  | Primary source sites e.g. PFAS production facilities, airports, military installations | Johnson et al. (2022) |
| Groundwater            | Global 1998–2019                        | 6279               | PFOA 325 (NR–70 000)<br>PFOS 42 (NR–8350)  |   | LOQ PFOA (0.05–5)<br>LOQ PFOS (0.21–40)   | Secondary sources e.g. landfills, waste water, biosolids                               | Johnson et al. (2022) |
| Groundwater            | Global 1998–2019                        | 5990               | PFOA 13 (NR–1800)<br>PFOS 46 (NR–20 000)   |   | LOQ PFOA (0.03–5)<br>LOQ PFOS (0.01–5)  | No known source sites  | Johnson et al. (2022) |
| Groundwater            | Global, 2000-2018. Review of 65 papers. | PFOA 98<br>PFOS 91 | PFOA NR<br>PFOS NR   | PFOA 9.47–257 (1.83–6117)<br>PFOS 7.24–97 |   | PFOA DF 57%<br>PFOS DF 66%   | Sims et al. (2022)    |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type | Location and collection date                               | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L        | Median (IQR) ng/L            | Analytical method (LOD) ng/L             | Comments   | Reference              |
|-------------|--|----------------|---|------------------------------|--|--|------------------------|
| Groundwater | All regions  | 98             | (< 0.01 to > 56 267)                                  | (0.79–3914)<br>23 (2.45–224) | (ND to > 215 318)                        | 16 (1.01–251)  | Sims et al. (2022)     |
| Groundwater | Asia   | 41             | (< 0.04 to > 2559)                                    | 9.51 (1.88–48)               | (< 0.02–312)                             | 2.58 (0.64–36)   | Sims et al. (2022)     |
| Groundwater | Europe   | 31             | (< 0.18 to > 227)                                     | 6.40 (2.27–18)               | (< 0.02–1035)                            | 4.58 (0.95–22)   | Sims et al. (2022)     |
| Groundwater | North America  | 21             | (< 0.03 to > 14 241 476)                              | 601 (32–11 145)              | (< 0.01 to > 64 904 184)                 | 704 (26–382 352)   | Sims et al. (2022)     |
| Groundwater | Oceania  | 5              | (< 0.01 to > 112 812)                                 | 149 (9.79–2255)              | (< 0.02 to > 180 494 704)                | 1752 (62–49 778)   | Sims et al. (2022)     |
| Groundwater | USA, 2014  | 149            | PFOA DF 90%, NR (ND–250)<br>PFOS DF 84%, NR (ND–4300) | PFOA 0.405<br>PFOS 4.22      | LC-MS/MS                                 | US Air Force AFFF release sites other than fire-training areas       | Anderson et al. (2016) |
| Groundwater | Uttrakhand, Uttar Pradesh, Bihar, West Bengal, India, 2014 | 14             | PFOA [0.46 (< MQL–0.76)]<br>PFOS [0.16] (< MQL–1.13)  | PFOA [0.52]<br>PFOS [0.05]   | LC-MS/MS<br>PFOA (0.028)<br>PFOS (0.010) | Ganges river basin. Untreated groundwater is used as drinking-water. | Sharma et al. (2016)   |
| Groundwater | Fuxin, China, 2009   | 4              | PFOA [249] (4.85–524)<br>PFOS [0.21] (ND–0.73)        | PFOA [233]<br>PFOS [0.05]    | HPLC-MS/MS<br>PFOA (0.05)<br>PFOS (0.03) | Private wells 5–7 m deep. Beneath fluorochemical industrial park.    | Bao et al. (2011)      |
| Groundwater | Fuxin, China, 2019   | 10             | PFOA 2470 (2470) PFOS 502 (500–503)                   | PFOA 2470                    | HPLC-MS/MS<br>(0.10) both                | Private well 7 m deep, multiple samples during 40 days               | Bao et al. (2020)      |



**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type       | Location and collection date       | No. of samples         | Mean (range), Geometric mean <sup>d</sup> ng/L         | Median (IQR) ng/L                          | Analytical method (LOD) ng/L                    | Comments  | Reference               |
|-------------------|------------------------------------|------------------------|--|--|---|---|-------------------------|
|                   |                                    |                        |  | PFOS [502]                                 |   |   |                         |
| Groundwater       | Beijing, China, NR                 | 50                     | PFOA 2.38–4.11 (0.08–12.30)<br>PFOS ND–9.11 (ND–0.23)  | NR   | HPLC-MS/MS PFOA (0.1)<br>PFOS (0.2)             | Reclaimed water irrigation of agricultural field area, next to landfill. Shallow (< 5 m) to deep (> 80 m) groundwater | Xingchun et al. (2023)  |
| Groundwater       | Melbourne, Australia, 2017-2018    | 28                     | PFOA 2.2 (< 0.09–6.9)<br>PFOS 11 (< 0.03–34)           | NR   | LC-MS/MS<br>PFOA (0.09)<br>PFOS (0.10)          | Agricultural area irrigated with recycled water from WWTP.<br>PFOA DF 82%<br>PFOS DF 96%                              | Szabo et al. (2018)     |
| Groundwater       | North China Plain, 2019            | 21                     | PFOA 177.33 (0.03–3540.9)<br>PFOS 2.33 (ND–9.31)       | PFOA 7.53<br>PFOS 0.5                      | PFOA (0.03)<br>PFOS (0.02)                      | Shallow (10–30 m) and deep (30–50 m) monitoring wells   | Li et al. (2022)        |
| <i>Sea water</i>  |                                    |                        |  |  |   |   |                         |
| Coastal waters    | Japan, China, Korea, 2002–2004     | 50                     | PFOA NR (0.137–192.000)<br>PFOS NR (0.023–57.700)      | NR   | HPLC-MS/MS                                      |   | Yamashita et al. (2005) |
| Coastal sea water | Japan, 2002                        | 16                     | PFOS 1.52 <sup>GM</sup> 4.14 <sup>GSD</sup> (0.2–25.2) | PFOS 1.21                                  | PFOS LOQ 0.1                                    | PFOA was not measured   | Saito et al. (2003)     |
| Sea water         | Red sea, Saudi Arabian coast, 2018 | 28                     | PFOA NR (ND–66.0)<br>PFOS NR (ND–34.5)                 | PFOA 0.776–10.9<br><i>n</i> -PFOS ND–0.434 | LC-MS/MS<br>PFOA (0.42)<br><i>n</i> -PFOS (1.5) | 4 sites with WWTP effluents<br>PFOA DF 95%<br>PFOS DF 57%   | Ali et al. (2021)       |
| Sea water         | Global, coastal waters 2000–2019   | PFOA 1072<br>PFOS 1245 | NR   | PFOA 0.05–1.63                             | LC-MS/MS<br>PFOA (0.0014)                       | Method ISO 25101:2009<br>Range of medians   | Muir and Miaz (2021)    |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type               | Location and collection date | No. of samples       | Mean (range), Geometric mean <sup>d</sup> ng/L               | Median (IQR) ng/L                 | Analytical method (LOD) ng/L               | Comments   | Reference               |
|---------------------------|------------------------------|----------------------|--|-----------------------------------|--|--|-------------------------|
| Sea water                 | Mediterranean Sea 2009–2018  | 88                   | PFOA 0.00–0.61 (0.00–2.51)<br>PFOS 0.01–0.79 (0.00–8.38)     | PFOA 0.00–0.39<br>PFOS 0.01–0.16  | LC-MS/MS<br>PFOA (0.0014)<br>PFOS (0.0035) | Method ISO 25101:2009<br>Ranges of means and medians | Muir and Miaz (2021)    |
| Sea water                 | Baltic Sea 2003–2017         | 169                  | PFOA 0.41–5.75 (0.00–7.82)<br>PFOS 0.18–4.75 (0.00–21.70)    | PFOA 0.27–5.40<br>PFOS 0.04–5.00  | LC-MS/MS<br>PFOA (0.0014)<br>PFOS (0.0035) | Method ISO 25101:2009<br>Ranges of means and medians | Muir and Miaz (2021)    |
| Sea water                 | Bohai, Yellow Sea, 2003–2018 | 180                  | PFOA 0.07–58.04 (0.00–844.88)<br>PFOS 0.15–5.21 (0.00–10.20) | PFOA 0.00–24.00<br>PFOS 0.00–5.31 | LC-MS/MS<br>PFOA (0.0014)<br>PFOS (0.0035) | Method ISO 25101:2009<br>Ranges of means and medians | Muir and Miaz (2021)    |
| Sea water                 | East China Sea, 2005–2019    | 40                   | PFOA 0.42–0.83 (0.00–1.84)<br>PFOS 0.00–0.15 (0.00–1.84)     | PFOA 0.26–0.76<br>PFOS 0.00–0.20  | LC-MS/MS<br>PFOA (0.0014)<br>PFOS (0.0035) | Ranges of means and medians                          | Muir and Miaz (2021)    |
| Sea water                 | South China Sea, 2000–2019   | PFOA 309<br>PFOS 332 | PFOA 0.48 (0.00–20.05)<br>PFOS 2.20 (0.01–320.50)            | PFOA 0.04–0.60<br>PFOS 0.00–1.00  | LC-MS/MS<br>PFOA (0.0014)<br>PFOS (0.0035) | Ranges of means and medians                          | Muir and Miaz (2021)    |
| <b><i>Ocean water</i></b> |                              |                      |  |                                   |  |  |                         |
| Ocean water               | Atlantic Ocean, 2002–2004    | 16                   | PFOA NR (0.10–0.439)<br>PFOS NR (0.0086–0.073)               | NR                                | HPLC-MS/MS                                 |  | Yamashita et al. (2005) |

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| Sample type | Location and collection date      | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L               | Median (IQR) ng/L                | Analytical method (LOD) ng/L                        | Comments   | Reference               |
|-------------|-----------------------------------|----------------|--|----------------------------------|---|--|-------------------------|
| Ocean water | Pacific Ocean, 2002–2004          | 16             | PFOA NR (0.015–0.142)<br>PFOS NR (0.0011–0.078)              | NR                               | HPLC-MS/MS  | No significant difference between surface and deep ( $\geq 4000$ m) PFOA levels  | Yamashita et al. (2005) |
| Ocean water | Atlantic Ocean, 2007, 2009        | 93             | PFOA NR (0.003–1.200)<br>PFOS NR (0.013–2.20)                | NR                               | HPLC-MS/MS PFOA (0.0057–0.0071) PFOS (0.0025–0.019) | Surface water mainly from 6m or 8m depth.  | Benskin et al. (2012)   |
| Ocean water | Canadian Arctic Ocean, 2005, 2008 | 27             | PFOA NR (0.0065–0.054)<br>PFOS NR (ND–0.039)                 | NR                               | HPLC-MS/MS PFOA (0.0026–0.0060)                     | Samples mainly from 8 m depth  | Benskin et al. (2012)   |
| Ocean water | North Atlantic Ocean, 2007–2010   | 62             | PFOA (< 0.004–0.209)<br>PFOS (< 0.010–0.116)                 | NR                               | HPLC-MS/MS  | Surface water (11 m below sea level).  | Zhao et al. (2012)      |
| Ocean water | Middle Atlantic Ocean, 2007–2010  | 20             | PFOA (< 0.004–0.087)<br>PFOS (< 0.010–0.077)                 | NR                               | HPLC-MS/MS  | Surface water (11 m below sea level).  | Zhao et al. (2012)      |
| Ocean water | South Atlantic Ocean, 2007–2010   | 39             | PFOA (< 0.004–0.062)<br>PFOS (< 0.010–0.072)                 | NR                               | HPLC-MS/MS  | Surface water (11 m below sea level).  | Zhao et al. (2012)      |
| Ocean water | Arctic ocean, 2012                | 65             | PFOA [0.029] (< 0.005–0.091)<br>PFOS [0.011] (< 0.005–0.041) | PFOA [0.029]<br>PFOS [0.008]     | HPLC-MS/MS LOQ PFOA 0.005<br>PFOS 0.005             | PFOA DF 54%<br>PFOS DF 48%<br>Samples from several depths between 1 m and 1000 m | Yeung et al. (2017)     |
| Ocean water | Arctic Ocean, 2003–2018           | 218            | PFOA 0.03–321 (0.00–7.24)<br>PFOS 0.01–0.41 (0.00–1.18)      | PFOA 0.03–3.62<br>PFOS 0.01–0.31 | LC-MS/MS PFOA (0.0014)<br>PFOS (0.0035)             | Ranges of means and medians  | Muir and Miaz (2021)    |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type             | Location and collection date         | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L                        | Median (IQR) ng/L                | Analytical method (LOD) ng/L                | Comments   | Reference   |
|-------------------------|--------------------------------------|----------------|---|----------------------------------|---|--|---|
| Ocean water             | North Atlantic, 2002–2014            | 172            | PFOA 0.04–0.33 (0.00–5.90)<br>PFOS 0.02–0.16 (0.00–3.13)              | PFOA 0.04–0.54<br>PFOS 0.00–0.33 | LC-MS/MS<br>PFOA (0.0014)<br>PFOS (0.0035)  | Ranges of means and medians                            | Muir and Miaz (2021)                              |
| Ocean water             | Western tropical Atlantic, 2017–2018 | 51             | PFOA 0.011<br><i>n</i> -PFOA NR<br>(0.009–0.030)<br><i>n</i> -PFOS ND | NR                               | HPLC-MS/MS PFOA (0.00298)<br>PFOS (0.00059) | Surface water (5–14 m) and deep (up to 5845 m) samples | Miranda et al. (2021)                             |
| <b><i>Rainwater</i></b> |                                      |                |   |                                  |   |  |   |
| Wet deposition          | Shandong, China, 2014                | 20             | PFOA (45–2752); PFOS (0.07–1.4)                                       | PFOA [615]<br>PFOS 0.35          | HPLC-MS/MS                                  | Fluoropolymer plant                                    | Liu et al. (2017)                                 |
| Wet deposition          | Mainland China, 2016                 | 39             | PFOA (0.3–100) PFOS (0.9–20)  | PFOA 3.4<br>PFOS 6.0             | HPLC-MS/MS                                  | Urban  | Chen et al. (2019)                                |
| Wet deposition          | Wuhan/Beijing, China, 2015           | 9              | PFOA (1.6–13)<br>PFOS (< 0.44–0.63)                                   | PFOA 6.8<br>PFOS <0.44           |   | Urban  | Cousins et al. (2022);<br>Johansson et al. (2018) |
| Wet deposition          | Stockholm, Sweden, 2015, 2016        | 14             | PFOA (0.17–1.4)<br>PFOS (0.047–0.60)                                  | PFOA 0.35<br>PFOS 0.16           |   | Urban  | Johansson et al. (2018)                           |
| Wet deposition          | Ohio-Indiana, USA, 2019              | 36             | PFOA 2.1 (0.03–30)<br>PFOS 4.9 (0.07–12)                              | NR<br>NR                         |   | Urban  | Pike et al. (2021)                                |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type    | Location and collection date   | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L | Median (IQR) ng/L        | Analytical method (LOD) ng/L | Comments | Reference               |
|----------------|--------------------------------|----------------|--|--------------------------|------------------------------|----------|-------------------------|
| Wet deposition | Malta, 2015                    | 8              | PFOA (< 0.03–0.68)<br>PFOS (< 0.03–0.27)       | PFOA 0.23<br>PFOS 0.06   |                              | Urban    | Sammut et al. (2017)    |
| Wet deposition | Northern China, 2013           | 19             | PFOA (9.1–107)<br>PFOS (3.5–54)                | PFOA 28<br>PFOS 10       |                              | Urban    | Shan et al. (2015)      |
| Wet deposition | Qingdao, China, 2017           | 9              | PFOA (0.4–42)<br>PFOS (< 0.5–7.0)              | PFOA 4.2<br>PFOS 0.4     |                              | Urban    | Han et al. (2020)       |
| Wet deposition | Xiamen, China, 2018, 2019      | 11             | PFOA (0.71–4.0)<br>PFOS (0.11–1.6)             | PFOA 1.4<br>PFOS 0.68    |                              | Urban    | Wang et al. (2022)      |
| Wet deposition | Krycklan, Sweden, 2011         | 11             | PFOA (0.354–1.088)<br>PFOS (0.037–0.126)       | PFOA 0.652<br>PFOS 0.077 |                              | Rural    | Filipovic et al. (2015) |
| Wet deposition | Great Lakes, Canada, 2010–2018 | 250            | PFOA (0.01–3.11)<br>PFOS (0.01–6.22)           | PFOA 0.36<br>PFOS 0.73   |                              | Rural    | Gewurtz et al. (2019)   |
| Wet deposition | Råö, Sweden, 2015              | 7              | PFOA (0.30–1.1)<br>PFOS (0.44–2.0)             | PFOA 0.72<br>PFOS 1.0    |                              | Rural    | Johansson et al. (2018) |
| Wet deposition | Azores, Portugal, 2016         | 5              | PFOA (0.24–1.7)<br>PFOS (0.20–1.3)             | PFOA 1.3<br>PFOS 0.8     |                              | Rural    | Johansson et al. (2018) |
| Wet deposition | Ohio-Indiana, USA, 2019        | 18             | PFOA 1 (0.2–3)<br>PFOS 5.4 (0.2–50)            | NR<br>NR                 |                              | Rural    | Pike et al. (2021)      |
| Wet deposition | Antarctica, 2017, 2018         | 20             | PFOA (0.02–0.557)<br>PFOS (0.005–0.31)         | PFOA [0.22]              |                              | Remote   | Casas et al. (2021)     |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type        | Location and collection date              | No. of samples       | Mean (range), Geometric mean <sup>d</sup> ng/L           | Median (IQR) ng/L                        | Analytical method (LOD) ng/L                     | Comments  | Reference                        |
|--------------------|---|----------------------|--|--|--|---|----------------------------------|
| Wet deposition     | Tibet, China, 2017                        | 178                  | PFOA (0.005–0.509)<br>PFOS (< 0.0006–0.682)              | PFOS [0.006]<br>PFOA 0.055<br>PFOS 0.005 | PFOA (0.4–1.3 pg/L);<br>PFOS (0.1–1.6 pg/L)      | Remote  | Chen et al. (2021)               |
| Rainwater          | Arizona, USA, 2017–2020                   | PFOA 192<br>PFOS 202 | PFOA 102.28 (1.48–1380.00)<br>PFOS 94.53 (1.68–741.00)   | PFOA 31.10<br>PFOS 36.80                 | LC-MS/MS<br>PFOA (1.5–33)<br>PFOS (1.5–2)        | Roof-harvested rainwater<br>PFOA DF 12%<br>PFOS DF 60%  | Villagómez-Márquez et al. (2023) |
| <b><i>Snow</i></b> |   |                      |  |  |  |   |                                  |
| Snow               | King George island, Antarctic, 2011       | 4                    | PFOA 0.196 (0.1067–0.383)<br>PFOS 0.0182 (0.0172–0.0199) | PFOA 0.148<br>PFOS 0.0179                | HPLC-ESI-MS/MS<br>PFOA (0.0059)<br>PFOS (0.0062) |   | Cai et al. (2012a)               |
| Snow               | North Pacific-Arctic ocean, 2010          | 3                    | PFOA 0.0577 (0.039–0.082)<br>PFOS < 0.021                | PFOA 0.052<br>PFOS < 0.021               | HPLC-MS/MS<br>PFOA (0.012)<br>PFOS (0.012)       |   | Cai et al. (2012b)               |
| Snow               | Cities in eastern and central China, 2010 | 18                   | < LOD  | < LOD                                    | HPLC-MS/MS<br>PFOA (0.19)<br>PFOS (0.10)         |   | Zhao et al. (2013)               |
| Fresh snow         | 19 cities, northern China, 2013           | 57                   | PFOA 34.1 (9.08–107)<br>PFOS 16.6 (3.52–54.3)            | PFOA 27.7<br>PFOS 9.96                   | HPLC-MS/MS                                       | <i>n</i> -PFOA, <i>iso</i> -PFOA, 4 <i>m</i> -PFOA, 5 <i>m</i> -PFOA, <i>n</i> -PFOS, <i>iso</i> -PFOS, 1 <i>m</i> -PFOS, 4 <i>m</i> -PFOS, 5 <i>m</i> -PFOS 3+5 <i>m</i> - | Shan et al. (2015)               |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type                        | Location and collection date               | No. of samples                           | Mean (range), Geometric mean <sup>d</sup> ng/L       | Median (IQR) ng/L            | Analytical method (LOD) ng/L                                      | Comments  | Reference                      |
|------------------------------------|--|--|--|------------------------------|---|---|--------------------------------|
|                                    |  |  |  |                              | <i>n</i> -PFOA dissolved phase (0.034) particulate matter (0.055) | PFOS and <i>m</i> <sub>2</sub> -PFOS reported separately and as total sum   |                                |
|                                    |  |  |  |                              | <i>n</i> -PFOS diss. (0.002) part. (0.0005)                       |   |                                |
| Fresh snow                         | Tianchi lake nature reserve, China, 2015   | 10                                       | PFOA [1.37] (0.098–10.43)<br>PFOS [0.105] (ND–1.041) | PFOA [0.439]<br>PFOS [0.000] | PFOA (0.05)<br>PFOS (0.03)  | PFOA DF 100%<br>PFOS DF 20%   | Wang et al. (2019)             |
| Fresh snow                         | Hangzhou, China, 2016                      | 11                                       | PFOA 10.5 (2.15–23.0)<br>PFOS 0.23 (0–0.46)          | PFOA [10.80]<br>PFOS [0.23]  | HPLC-MS/MS (NR)   | PFOA DF 100%<br>PFOS DF [82]%   | Zhang et al. (2017)            |
| Surface snow                       | Antarctic plateau, 2016                    | 11                                       | PFOA 0.358 (0.273–0.539)<br>PFOS 0.046 (0.036–0.062) | NR                           | LC-MS/MS<br>PFOA (0.041)<br>PFOS (0.027)                          |   | Xie et al. (2020)              |
| <b>Wastewater</b>                  |  |  |  |                              |   |   |                                |
|                                    |  | Influent ng/L                            | Sludge ng/g  |                              |   |   |                                |
| Influent wastewater, sewage sludge | North America, Europe, Asia, Australia, NR | PFOA NR (0.04–638)<br>PFOS NR (0.02–465) | PFOA NR (0.7–190)<br>PFOS NR                         | NR                           | LC-MS(/MS) Water<br>(0.07–9.4) Sludge                             | Data from 24 publications from 2005–2015. Min values estimated from figure. | Arvaniti and Stasinakis (2015) |

**Table S1.11 Occurrence of PFOA and PFOS in drinking-water, surface water, groundwater, snow, and ice**

| Sample type | Location and collection date | No. of samples | Mean (range), Geometric mean <sup>d</sup> ng/L | Median (IQR) ng/L | Analytical method (LOD) ng/L | Comments | Reference |
|-------------|------------------------------|----------------|--|-------------------|------------------------------|----------|-----------|
|             |                              |                | (0.6–7305)                                     |                   | (0.46–1.7)                   |          |           |

AFFF, aqueous film-forming foam; br-PFOS, branched isomers of perfluorooctanesulfonic acid; DF, detection frequency; DWTP, drinking-water treatment plant; GC-NCI-MS, gas chromatography-negative chemical ionization-mass spectrometry; GM, geometric mean; GSD, geometric standard deviation; HPLC, high-performance liquid chromatography; IQR, interquartile range; ISO, International Organization for Standardization; LC, liquid chromatography; LCMRL, lowest concentration minimum reporting level; LOQ, limit of quantification; MRL, minimum reporting level; MS, mass spectrometry; MS/MS, tandem mass spectrometry; NA, not applicable; ND, not detected; NR, not reported; PET, polyethylene terephthalate; PFOA, perfluorooctanoic acid; *iso*-PFOA, perfluoro-6-(trifluoromethyl)heptanoic acid, an isomer of PFOA; *n*-PFOA, linear perfluorooctanoic acid; PFOS, perfluorooctanesulfonic acid; *n*-PFOS, linear perfluorooctanesulfonic acid; PWS, public water systems; UCMR3, Third Unregulated Contaminant Monitoring Rule; UCMR5, Fifth Unregulated Contaminant Monitoring Rule; USA, United States of America; WWTP, wastewater treatment plant.

<sup>a</sup> Australia, Brazil, China, Faroe Islands, France, Germany, Ghana, Japan, Republic of Korea, Netherlands, Norway, Spain, Thailand, USA.

<sup>b</sup> Canada, China, England, Ireland, Japan, Laos, Malaysia, Nepal, Singapore, Sri Lanka, Sweden, Taiwan (China), Thailand, Turkey, Viet Nam.

<sup>c</sup> Egypt, Ghana, Kenya, Senegal, Tunisia, Zambia, Argentina, Brazil, Ecuador, Jamaica, Mexico, Mongolia, Viet Nam, Fiji, Kiribati, Palau, Samoa, Solomon Islands, Tuvalu, Vanuatu.

<sup>d</sup> Superscript “GM” and “GSD” indicate geometric mean and geometric standard deviation, respectively.

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