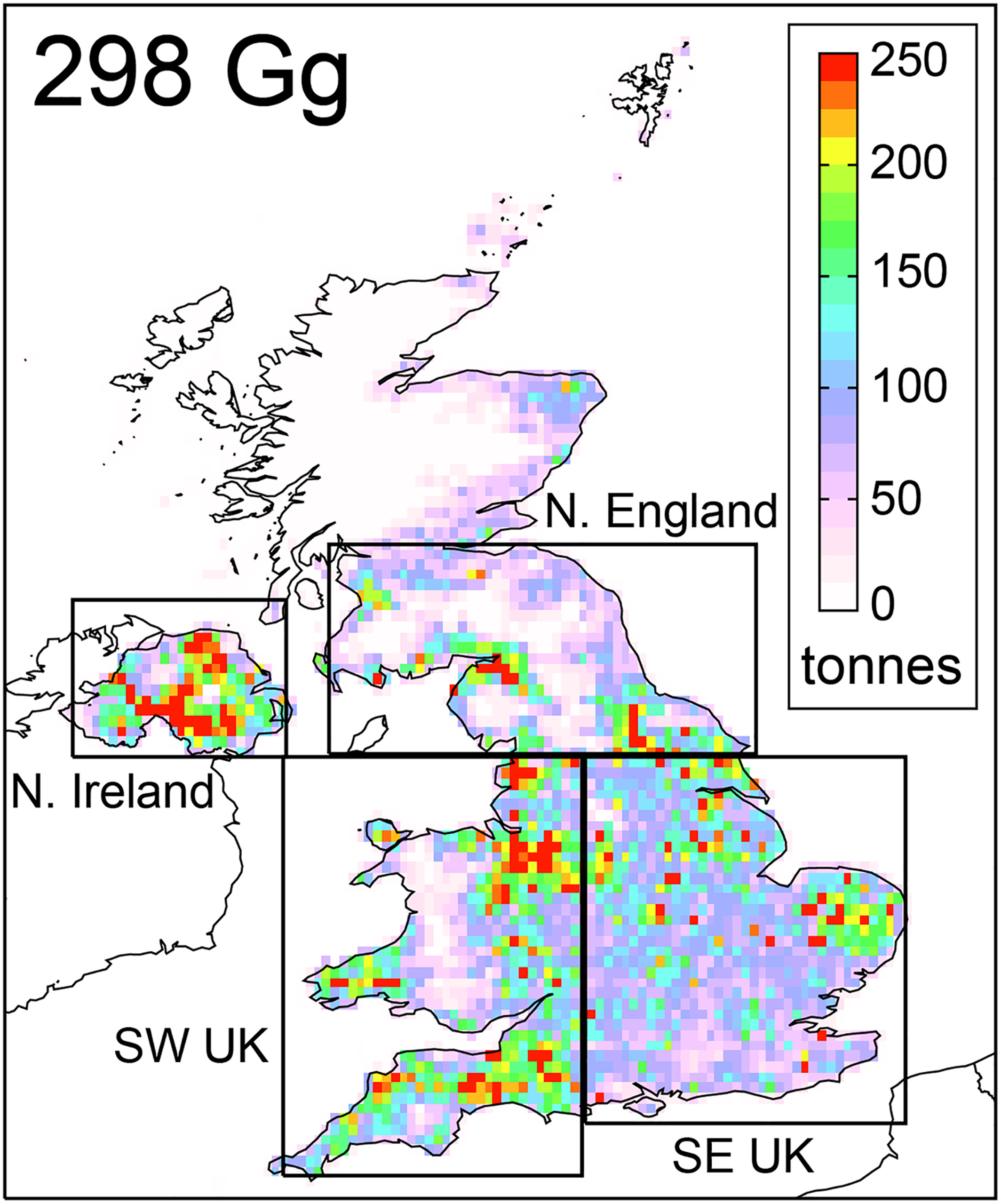
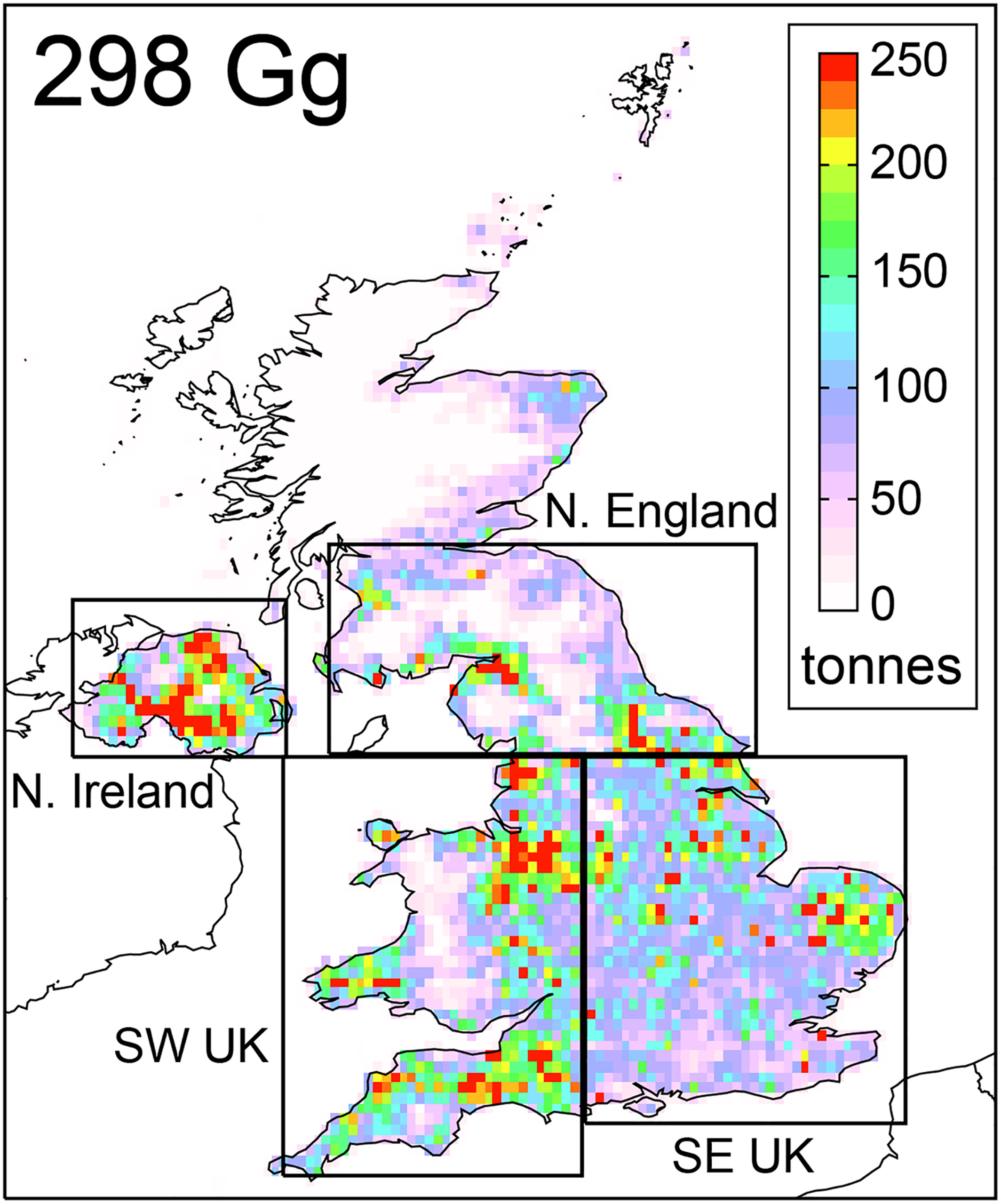
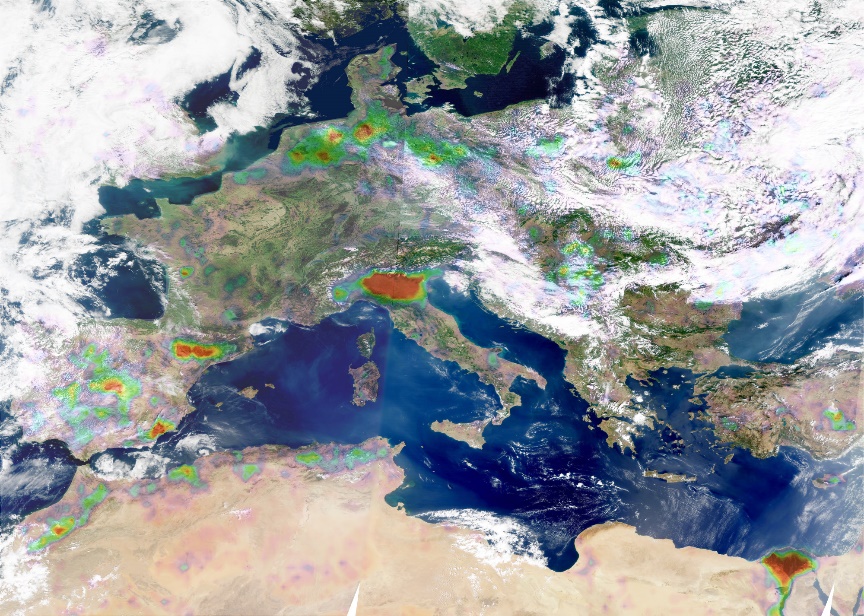
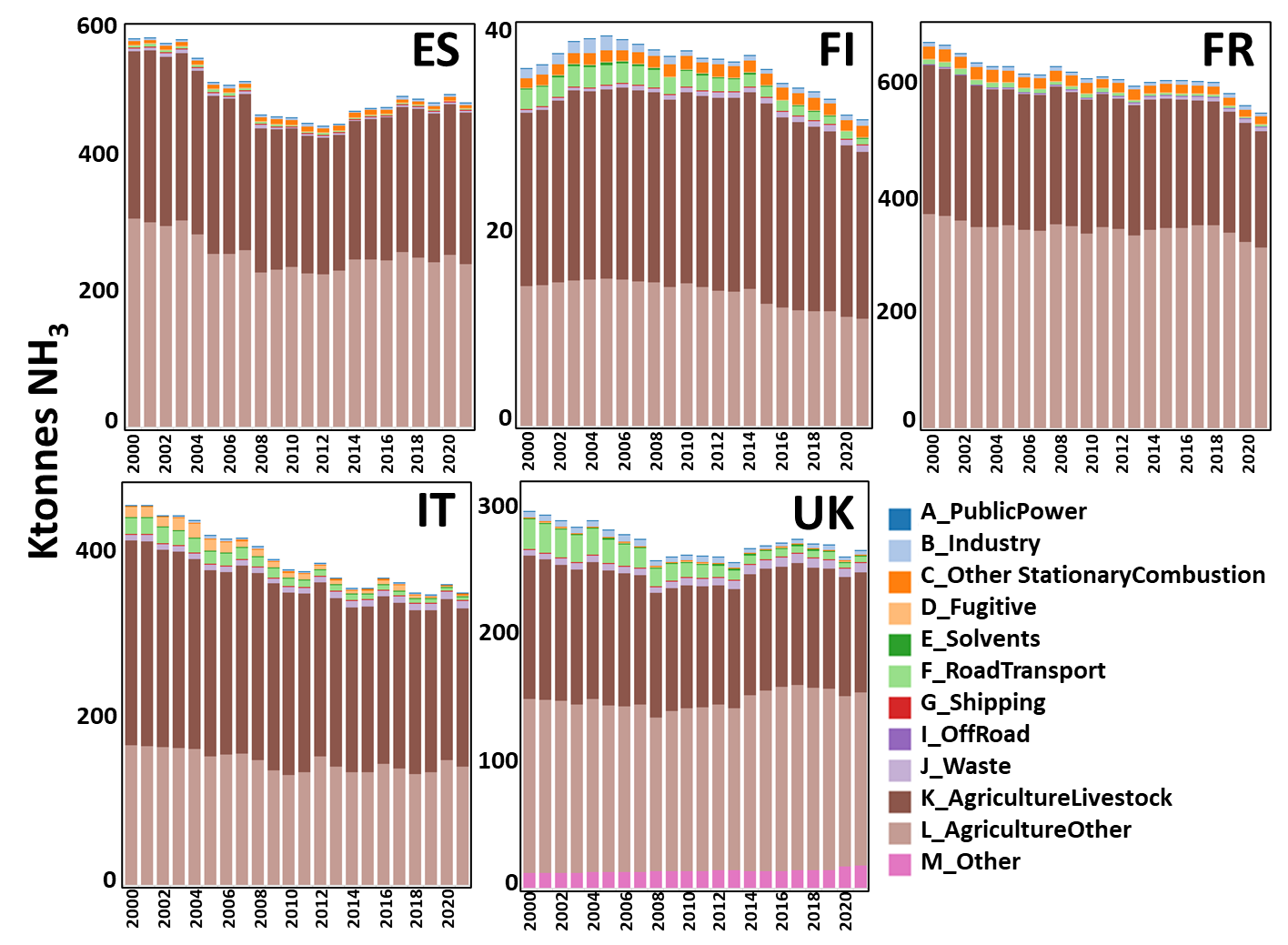
*Supporting information*

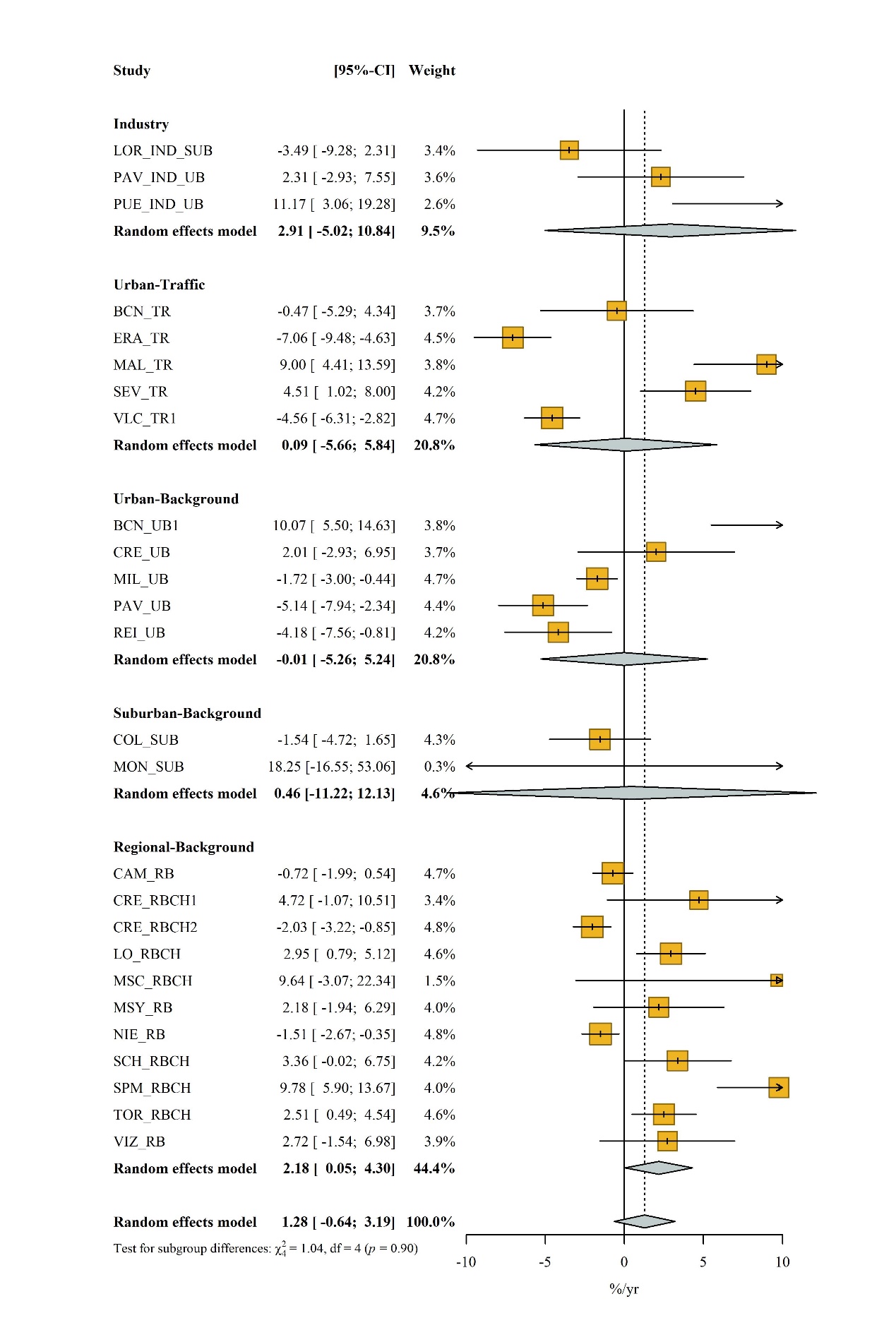
***Variability of ambient atmospheric ammonia in urban Europe (Finland, France, Italy, Spain, and the UK)***

**

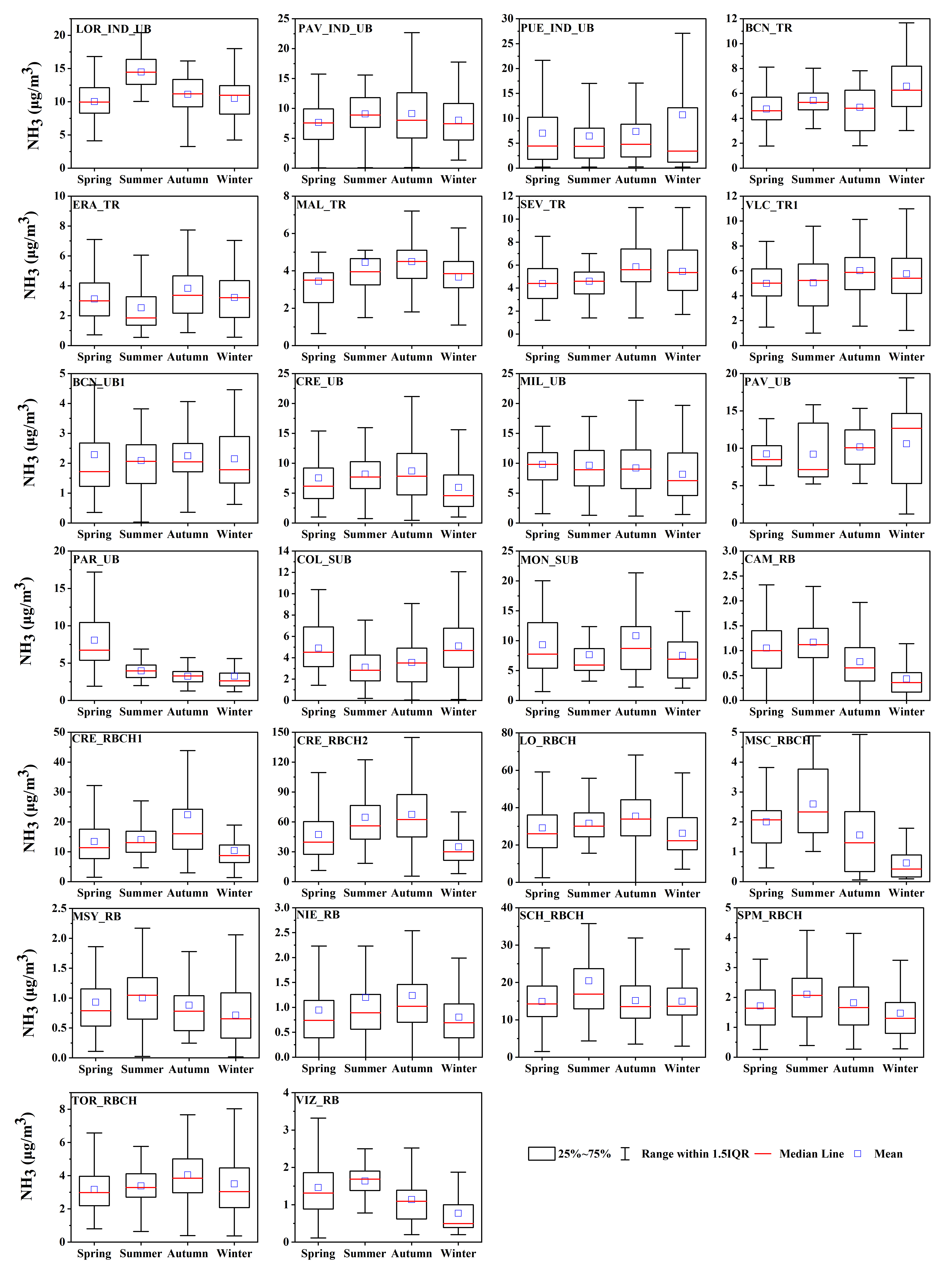
*Figure S1. The identifiable hotspots using remote data in France, Italy, Spain, and the UK. (Citation: Van Damme, et al. (2022).* [*https://www.nature.com/articles/s41598-022-15836-w*](https://www.nature.com/articles/s41598-022-15836-w)*; Marais, Eloise A., et al. (2021).*[*https://doi.org/10.1029/2021JD035237*](https://doi.org/10.1029/2021JD035237)*).*

**

*Figure S2: Trends emission of NH3 in the five countries of Europe (ES, Spain; FI, Finland; FR, France; IT, Italy; and UK, United Kingdom) during 2000-2021 (https://www.ceip.at/data-viewer-2).*



*Figure S3. Meta-analysis results for all long-term monitoring sites.*



*Figure S4. Seasonal variations of NH3 concentrations for 26 out of the 69 studied sites.*

*Table S1. List of air quality sites supplying NH3 datasets to this study with location and type of environment. IND, industry; UB, Urban Background; TR, Traffic; SUB, Suburban Background; RB, Regional Background.**RBCH, Regional Background closed hotspot.* ***Bold, farming/agricultural hotspots (FAHs).***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| City (Country) | Station type | Acronym | Latitude | Longitude | Altitude （m） |
| **Sannazzaro de' Burgondi (IT)** | **Urban-Industry** | **PAV\_IND\_UB** | **45.10** | **8.90** | **86** |
| **Puertollano (ES)** | **Urban-Industry** | **PUE\_IND\_UB** | **38.70** | **-4.09** | **708** |
| Coruña (A) (ES) | Suburban-Industry | COR\_IND\_SUB | 43.14 | -8.03 | 498 |
| Castellón (ES) | Suburban-industry | CS\_IND\_SUB | 39.97 | 0.01 | 0 |
| Lorca (ES) | Urban-Industry | LOR\_IND\_SUB | 37.68 | -1.69 | 327 |
| Barcelona (ES) | Urban-Traffic | BCN\_TR | 41.39 | 2.15 | 70 |
| Bordeaux Gautier (FR) | Urban-Traffic | BOR\_TR | 44.82 | -0.55 | 7 |
| **Valladolid (ES)** | **Urban-Traffic** | **EMB\_TR** | **41.63** | **-4.72** | **691** |
| Erandio (ES) | Urban-Traffic | ERA\_TR | 43.30 | -2.97 | 19 |
| Madrid (ES) | Urban-Traffic | MAD\_TR | 40.42 | -3.71 | 637 |
| Málaga (ES) | Urban-Traffic | MAL\_TR | 36.71 | -4.45 | 380 |
| **Murcia (región de) (ES)** | **Suburban-Traffic** | **MUR\_TR\_SUB** | **37.99** | **-1.14** | **40** |
| Paris (FR) | Urban-Traffic | PAR\_TR | 48.84 | 2.41 | 44 |
| Poitiers-le nain (FR) | Urban-Traffic | POI\_TR | 46.59 | 0.34 | 71 |
| Sevilla (ES) | Urban-Traffic | SEV\_TR | 37.38 | -5.96 | 29 |
| Valencia (ES) | Urban-Traffic | VLC\_TR1 | 39.47 | -0.38 | 8 |
| Valencia (ES) | Urban-Traffic | VLC\_TR2 | 39.97 | 0.01 | 3 |
| **Argales (ES)** | **Urban-Background** | **ARG\_UB** | **41.63** | **-4.23** | **741** |
| Barcelona (ES) | Urban-Background | BCN\_UB1 | 41.39 | 2.11 | 64 |
| Barcelona (ES) | Urban-Background | BCN\_UB2 | 41.39 | 2.12 | 68 |
| Barcelona (ES) | Urban-Background | BCN\_UB3 | 41.37 | 2.17 | 30 |
| **Bergamo (IT)** | **Urban-Background** | **BER\_UB** | **45.69** | **9.64** | **242** |
| Birmingham Tyburn (UK) | Urban-Background | BIR\_UB | 52.51 | -1.83 | 92 |
| **Valladolid (ES** | **Urban-Background** | **CAB\_UB** | **41.67** | **-4.72** | **691** |
| **Cremona (IT)** | **Urban-Background** | **CRE\_UB** | **45.14** | **10.04** | **40** |
| Gonfreville l'Orcher (FR) | Urban-Background | GOR\_UB | 49.50 | 0.23 | 72 |
| Helsinki (FI) | Urban-Background | HEL\_UB | 60.12 | 24.58 | 26 |
| **Valladolid (ES)** | **Urban-Background** | **LAG\_UB** | **41.59** | **-4.73** | **702** |
| London (Honor oak park) (UK) | Urban-Background | LND\_UB | 51.45 | -0.04 | 31 |
| Málaga (ES) | Urban-Background | MAL\_UB | 36.72 | -4.45 | 36 |
| Manchester (UK) | Urban-Background | MAN\_UB | 53.4 | -2.24 | 36 |
| **Manlleu (ES)** | **Urban-Background** | **MANL\_UB** | **42.01** | **2.28** | **460** |
| **Milano (IT)** | **Urban-Background** | **MIL\_UB** | **45.48** | **9.24** | **116** |
| Niort Venise (FR) | Urban-Background | NIO\_UB | 46.32 | -0.46 | 29 |
| **Valladolid (ES)** | **Urban-Background** | **OBR\_UB** | **41.67** | **-4.73** | **691** |
| Paris (FR) | Urban-Background | PAR\_UB | 48.86 | 2.34 | 35 |
| **Pavia (IT)** | **Urban-Background** | **PAV\_UB** | **45.19** | **9.16** | **89** |
| **Valladolid (ES)** | **Urban-Background** | **PDR\_UB** | **41.64** | **-4.76** | **747** |
| Rouen Petit Queuvilly (FR) | Urban-Background | PQUE\_UB | 46.43 | 1.07 | 10 |
| Rouen, Quai de Paris (FR) | Urban-Background | QDP\_UB | 49.44 | 1.10 | 4 |
| Reims (FR) | Urban-Background | REI\_UB | 49.22 | 4.02 | 97 |
| Strasbourg (FR) | Urban-Background | STR\_UB | 48.57 | 7.77 | 140 |
| Colico (IT) | Suburban-Background | COL\_SUB | 46.14 | 9.38 | 229 |
| **Cremona (Piadena) (IT)** | **Suburban-Background** | **CRE\_SUB** | **45.13** | **10.38** | **30** |
| **Valladolid (ES)** | **Suburban-Background** | **JAR\_SUB** | **41.67** | **-4.72** | **692** |
| Málaga (ES) | Suburban-Background | MAL\_SUB | 36.73 | -4.47 | 86 |
| **Milano (IT)** | **Suburban-Background** | **MIL\_SUB** | **45.28** | **8.99** | **101** |
| **Monza (IT)** | **Suburban-Background** | **MON\_SUB** | **45.60** | **9.28** | **237** |
| Paris (FR) | Suburban-Background | PAR\_SUB1 | 48.71 | 2.21 | 156 |
| Paris (FR) | Suburban-Background | PAR\_SUB2 | 48.71 | 2.21 | 156 |
| Paris (FR) | Suburban-Background | PAR\_SUB3 | 48.71 | 2.21 | 156 |
| Poses (FR) | Suburban-Background | POSE\_SUB | 49.30 | 1.24 | 10 |
| **Vic (ES)** | **Suburban-Background** | **VIC\_SUB1** | **41.90** | **2.24** | **478** |
| **Vic (ES)** | **Suburban-Background** | **VIC\_SUB2** | **41.90** | **2.24** | **478** |
| Auchencorth Moss (UK) | Rural-Background | ACTH\_RB | 55.79 | -3.24 | 270 |
| Barcarrota (ES) | Rural-Background | BAR\_RB | 38.47 | -6.92 | 377 |
| **Bujaraloz (ES)** | **Regional-Background** | **BUJ\_RBCH** | **41.50** | **-0.15** | **327** |
| Campisábalos (ES) | Regional-Background | CAM\_RB | 41.27 | -3.14 | 1368 |
| **Chilbolton (UK)** | **Regional-Background** | **CHIL\_RBCH** | **51.10** | **1.44** | **90** |
| **Cremona (IT)** | **Regional-Background** | **CRE\_RBCH1** | **45.11** | **10.07** | **35** |
| **Cremona (IT)** | **Regional-Background** | **CRE\_RBCH2** | **45.28** | **10.01** | **60** |
| **Bertonico (IT)** | **Regional-Background** | **LO\_RBCH** | **45.23** | **9.67** | **64** |
| **Montsec (ES)** | **Regional-Background** | **MSC\_RBCH** | **42.00** | **0.73** | **1571** |
| **Montseny (ES)** | **Regional-Background** | **MSY\_RB** | **41.70** | **2.36** | **720** |
| Niembro (ES) | Regional-Background | NIE\_RB | 43.44 | -4.85 | 132 |
| **Schivenoglia (IT)** | **Regional-Background** | **SCH\_RBCH** | **45.02** | **11.08** | **12** |
| San Pablo de los Montes (ES) | Regional-Background | SPM\_RB | 39.55 | -4.35 | 923 |
| **Els Torms (ES)** | **Regional-Background** | **TOR\_RBCH** | **41.39** | **0.73** | **488** |
| Víznar (ES) | Regional-Background | VIZ\_RB | 37.24 | -3.55 | 1258 |

*Table S2. Summary of atmospheric NH3 monitoring results in various cities of the world.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| City (Country) | Season | Types | Method | NH3 | Reference |
| Nanjing (CN) | 07/2013-08/2014 | Urban Traffic | portable ammonia gas detector | 6.7±1.1 | (Wang et al., 2016) |
| Shanghai (CN) | 04/2014-04/2015 | Urban | MARGA | 5.5±3.9 | (Chang *et al.*, 2016) |
| Beijing (CN) | 01/2019-06/2020 | Urban | Los Gatos Research | 15.7±8.9 | (Zhang *et al.*, 2021) |
| Seoul (ROK) | 03/2020-03/2021 | Urban Traffic | Radiello passive ammonia sampler | 18.2±4.6 | (Singh et al., 2021) |
| Toronto (CAN) | 07/2003-07/2014 | Urban | a PartisolModel 2300 | 1.8±0.8 | (Yao and Zhang, 2016) |
| 05/2006-04/2014 | 1.7±0.4 |
| 11/2007-10/2014 | 1.3±0.6 |
| 09/2003-08/2014 | 1.1±0.4 |
| Rochester (US) | 04/2016-10/2017 | Urban | chemiluminescence | 2.3±1.6 | (Zhou et al., 2019) |
| New York (US) | 06/2016-10/2017 | Urban | chemiluminescence | 2.0±1.3 |
| Delhi (IND) | 01/2011-12/2015 | Urban | chemiluminescence | 13.5±3.1 | (Saraswati et al., 2018) |

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