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Supplement of

Validation of the TROPOspheric Monitoring Instrument (TROPOMI) surface UV radiation product

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1 Spectral irradiance

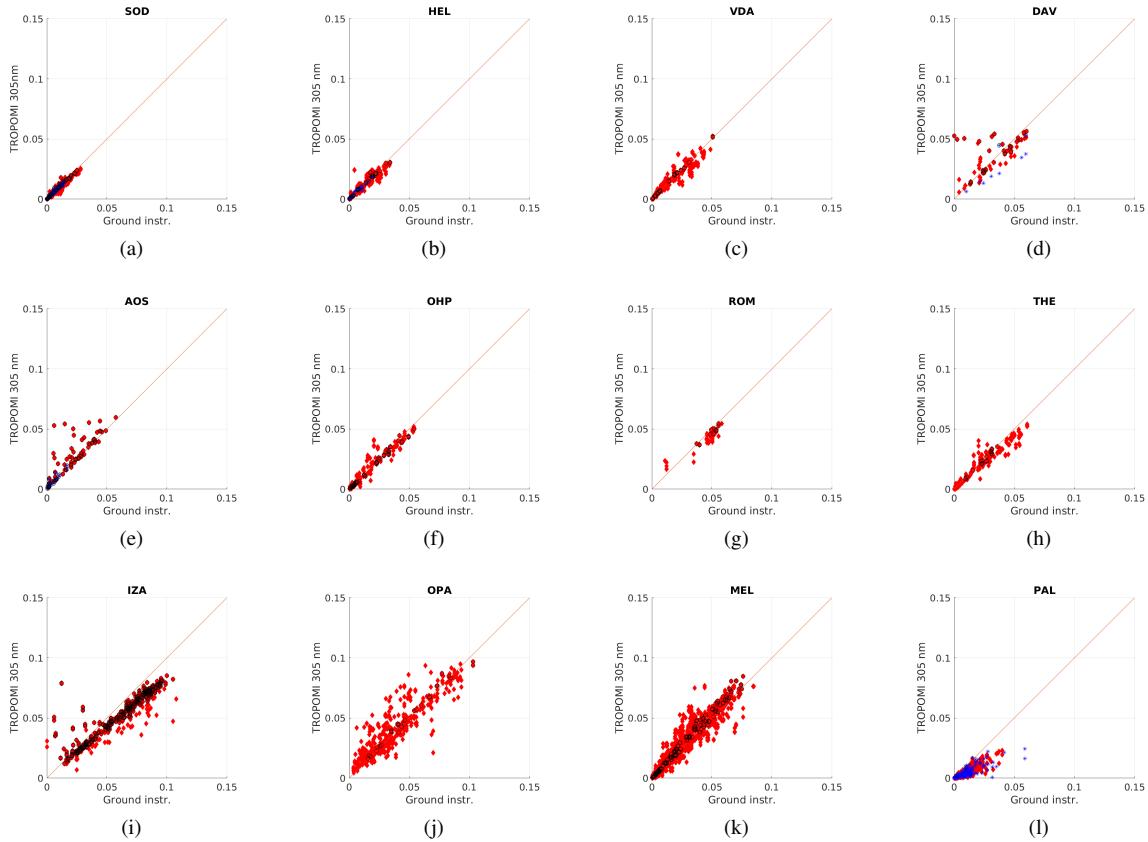


Figure S1. TROPOMI overpass Irradiance at 305 nm and spectroradiometer measurements at a) Sodankylä (SOD), b) Helsinki (HEL), c) Villeneuve-d'Ascq (VDA), d) Davos (DAV), e) Aosta (AOS), f) Haute-Provence (OHP), g) Rome (ROM), h) Thessaloniki, i) Izanña (IZA), j) Saint-Denis (OPA), k) Melbourne (MEL) and l) Palmer (PAL). Red diamond denotes snow free surface, blue star snow cover and black circle cloudfree.

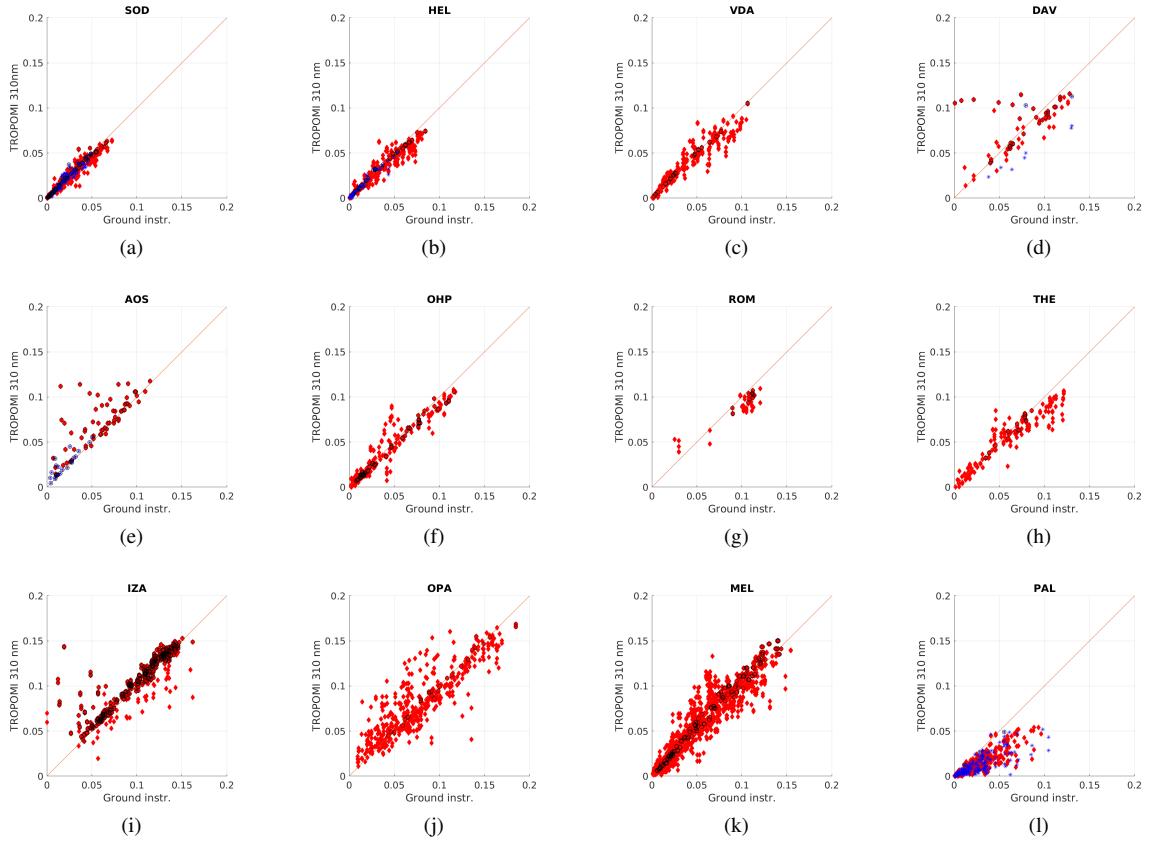


Figure S2. TROPOMI overpass Irradiance at 310 nm and spectroradiometer measurements at a) Sodankylä (SOD), b) Helsinki (HEL), c) Villeneuve-d'Ascq (VDA), d) Davos (DAV), e) Aosta (AOS), f) Haute-Provence (OHP), g) Rome (ROM), h) Thessaloniki, i) Izanña (IZA), j) Saint-Denis (OPA), k) Melbourne (MEL) and l) Palmer (PAL). Red diamond denotes snow free surface, blue star snow cover and black circle cloudfree.

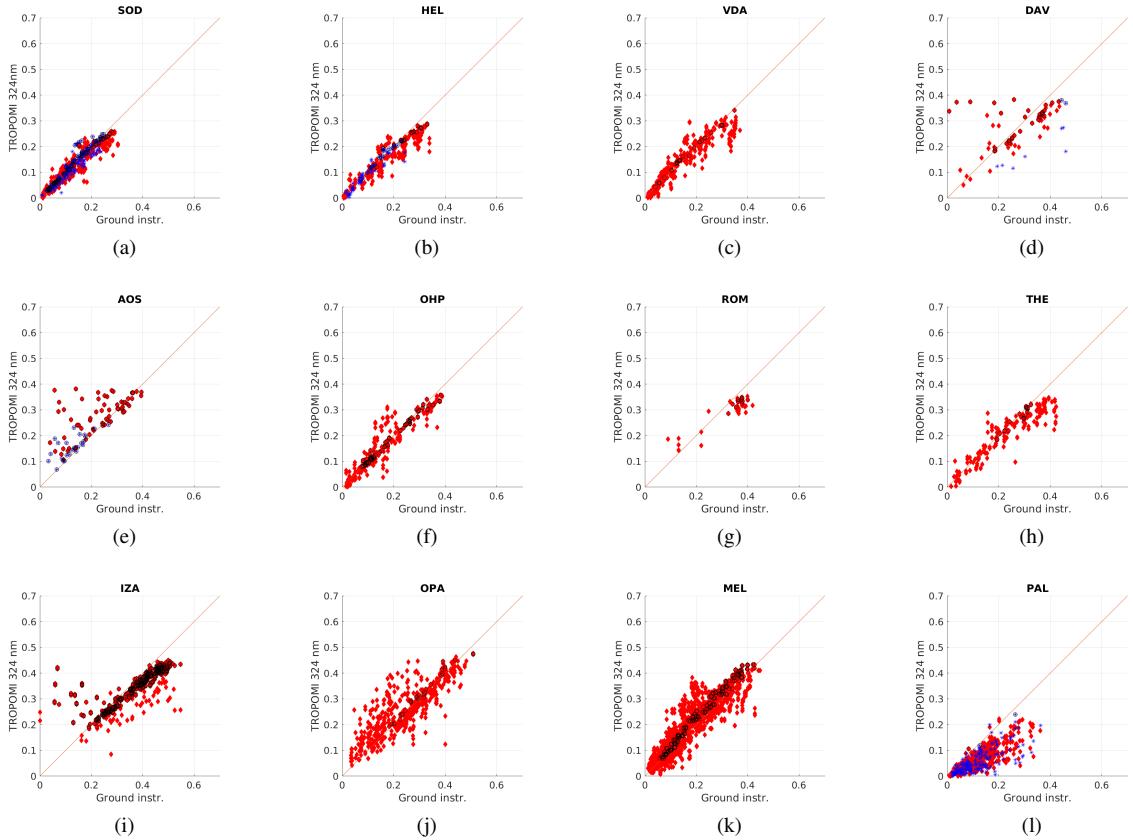


Figure S3. TROPOMI overpass Irradiance at 324 nm and spectroradiometer measurements at a) Sodankylä (SOD), b) Helsinki (HEL), c) Villeneuve-d'Ascq (VDA), d) Davos (DAV), e) Aosta (AOS), f) Haute-Provence (OHP), g) Rome (ROM), h) Thessaloniki, i) Izanña (IZA), j) Saint-Denis (OPA), k) Melbourne (MEL) and l) Palmer (PAL). Red diamond denotes snow free surface, blue star snow cover and black circle cloudfree.

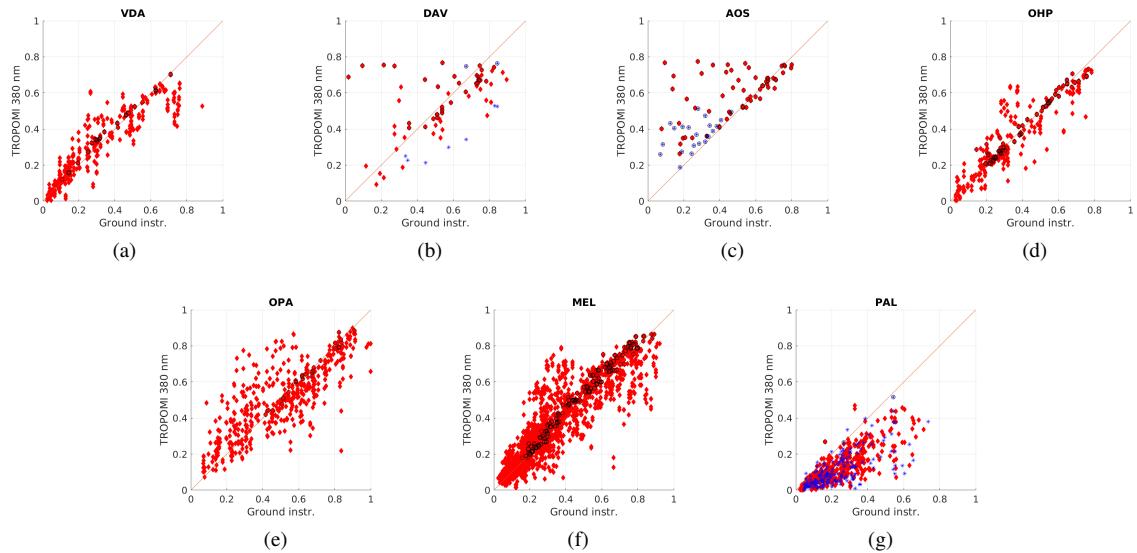


Figure S4. TROPOMI overpass Irradiance at 380 nm and spectroradiometer measurements at a) Villeneuve-d'Ascq (VDA), b) Davos (DAV), c) Aosta (AOS) d)Haute-Provence (OHP), e) Saint-Denis (OPA), f) Melbourne (MEL) and g) PALMER (PAL). Red diamond denotes snow free surface, blue star snow cover and black circle cloudfree.

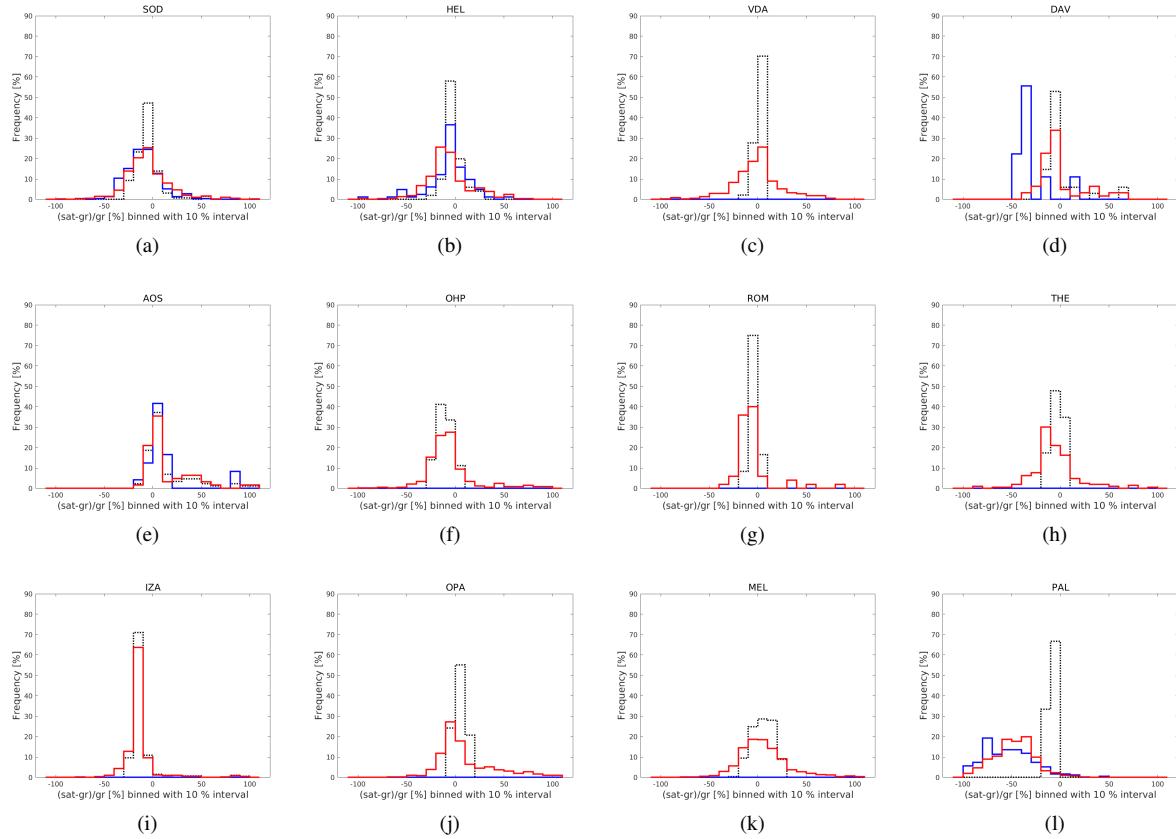


Figure S5. Histograms of relative difference between TROPOMI overpass irradiance at 305 nm and spectroradiometer measurement at a) Sodankylä (SOD), b) Helsinki (HEL), c) Villeneuve-d'Ascq (VDA), d) Davos (DAV), e) Aosta (AOS), f) Haute-Provence (OHP), g) Rome (ROM), h) Thessaloniki, i) Izanña (IZA), j) Saint-Denis (OPA), k) Melbourne (MEL) and l) Palmer (PAL). Black dotted line denotes cloudfree, red snow free surface and blue snow cover on the ground.

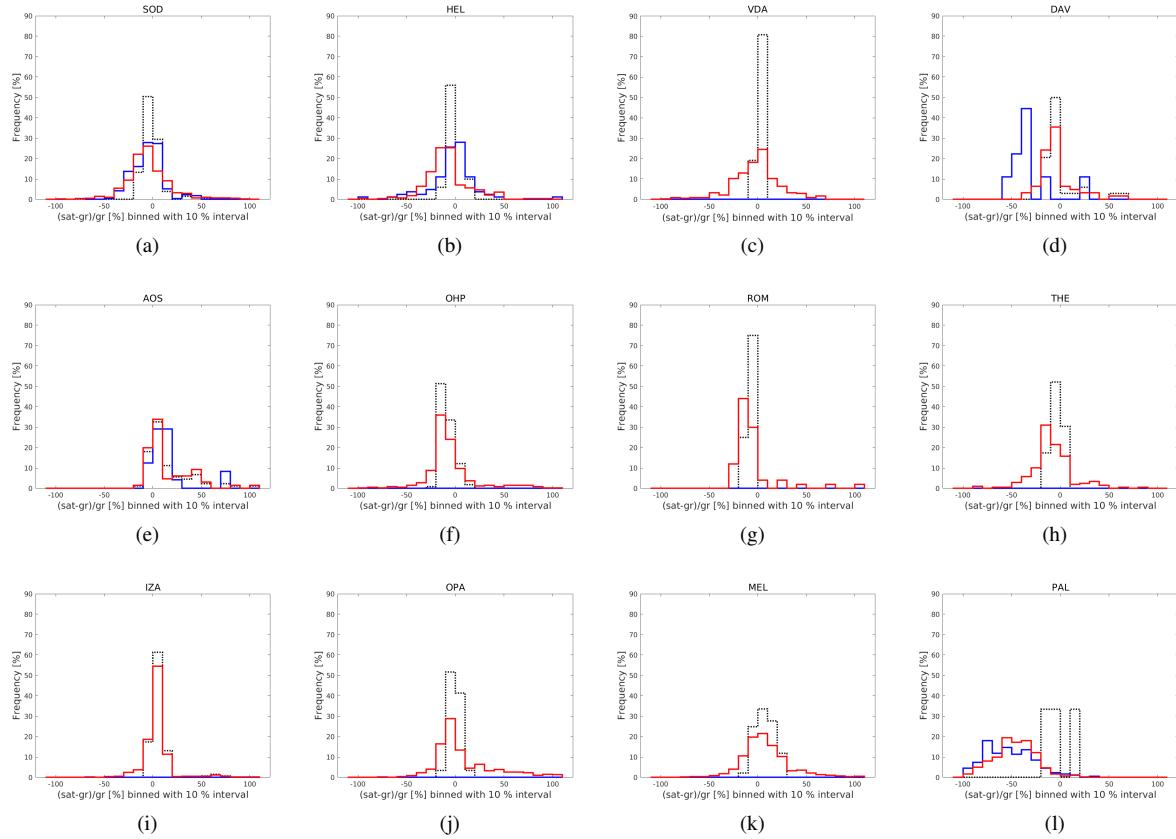


Figure S6. Histograms of relative difference between TROPOMI overpass irradiance at 310 nm and spectroradiometer measurement at a) Sodankylä (SOD), b) Helsinki (HEL), c) Villeneuve-d'Ascq (VDA), d) Davos (DAV), e) Aosta (AOS), f) Haute-Provence (OHP), g) Rome (ROM), h) Thessaloniki, i) Izanña (IZA), j) Saint-Denis (OPA), k) Melbourne (MEL) and l) Palmer (PAL). Black dotted line denotes cloudfree, red snow free surface and blue snow cover on the ground.

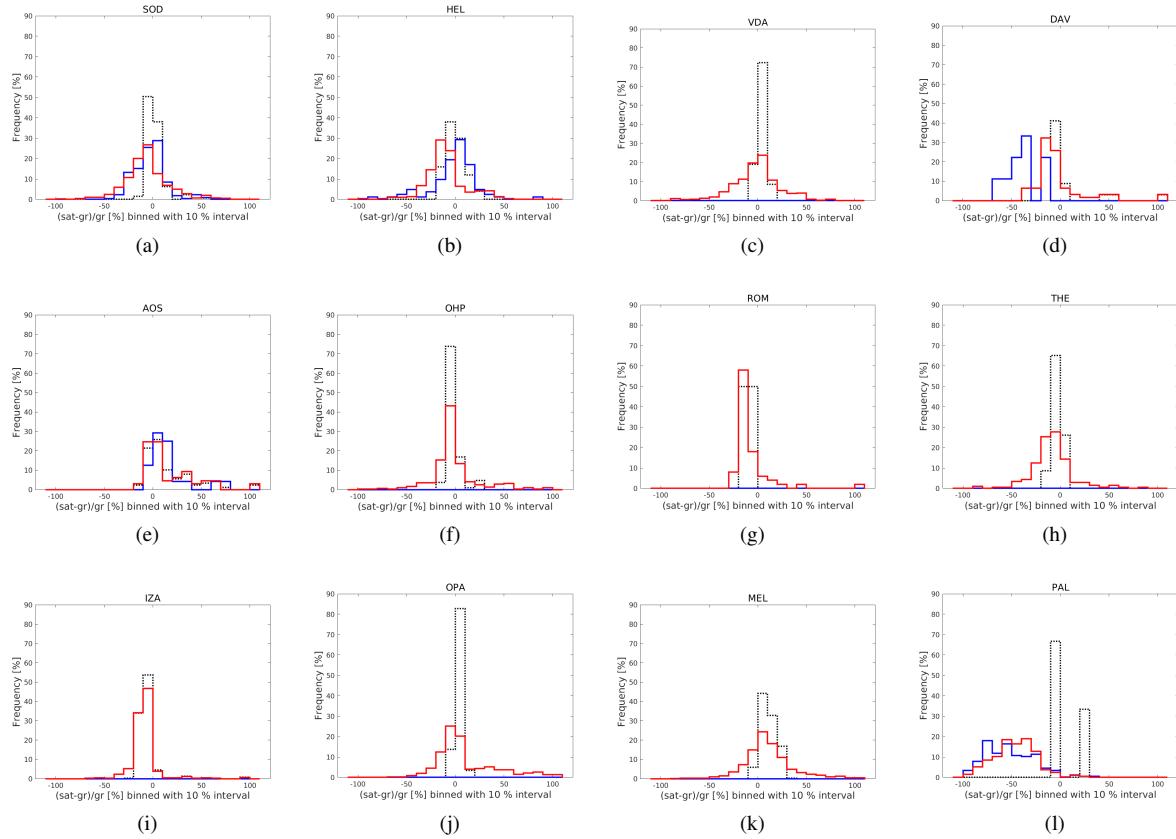


Figure S7. Histograms of relative difference between TROPOMI overpass irradiance at 324 nm and spectroradiometer measurement at a) Sodankylä (SOD), b) Helsinki (HEL), c) Villeneuve-d'Ascq (VDA), d) Davos (DAV), e) Aosta (AOS), f) Haute-Provence (OHP), g) Rome (ROM), h) Thessaloniki, i) Izanña (IZA), j) Saint-Denis (OPA), k) Melbourne (MEL) and l) Palmer (PAL). Black dotted line denotes cloudfree, red snow free surface and blue snow cover on the ground.

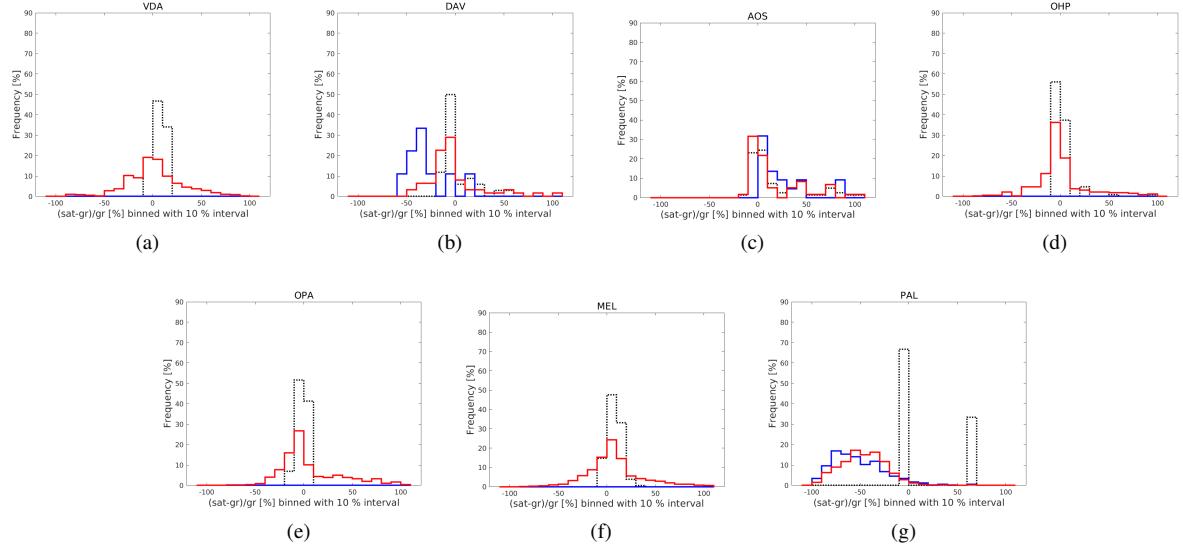


Figure S8. Histograms of relative difference between TROPOMI overpass irradiance at 380 nm and spectroradiometer measurement a) Villeneuve-d'Ascq (VDA), b) Davos (DAV), c) Aosta (AOS) d) Haute-Provence (OHP), e) Saint-Denis (OPA), f) Melbourne (MEL) and g) PALMER (PAL). Black dotted line denotes cloudfree, red snow free surface and blue snow cover on the ground.

Table S1. TROPOMI overpass irradiances at 305 nm compared to ground based measurements. The percentage relative differences 100%*(TROPOMI-ground)/ground, their medians (median) and 25th (p25) and 75th (p75) percentiles were calculated. N is the number of measurement days included in the study. W₁₀ and W₂₀ are percentage of satellite data which are within 10% and 20% from ground measurements. CF=Cloudfree, SCAS= Snow cover at ground, all sky, SFAS= Snow free ground, all sky.

| Station | Conditions | N | median [%] | p25 [%] | p75 [%] | W ₁₀ | W ₂₀ |
|---------|------------|------|------------|---------|---------|-----------------|-----------------|
| SOD | CF | 129 | -4.66 | -14.70 | -1.26 | 61.24 | 87.60 |
| SOD | SCAS | 212 | -11.38 | -21.97 | -0.85 | 37.26 | 66.98 |
| SOD | SFAS | 403 | -7.11 | -18.28 | 4.85 | 37.72 | 66.00 |
| HEL | CF | 50 | -2.51 | -7.06 | 2.74 | 78.00 | 94.00 |
| HEL | SCAS | 82 | -4.29 | -14.68 | 6.94 | 52.44 | 74.39 |
| HEL | SFAS | 281 | -9.56 | -19.35 | 2.68 | 32.03 | 61.92 |
| VDA | CF | 47 | 1.54 | -0.80 | 5.28 | 97.87 | 100.00 |
| VDA | SFAS | 370 | -0.10 | -13.96 | 9.32 | 44.32 | 67.03 |
| DBR | CF | 41 | -10.94 | -15.71 | 23.47 | 12.20 | 58.54 |
| DBR | SCAS | 80 | -49.89 | -65.52 | -15.84 | 1.25 | 16.25 |
| DBR | SFAS | 34 | -7.46 | -14.22 | 19.00 | 20.59 | 64.71 |
| DAV | CF | 34 | -5.21 | -8.59 | 13.68 | 58.82 | 79.41 |
| DAV | SCAS | 9 | -38.33 | -39.52 | -27.39 | 0.00 | 22.22 |
| DAV | SFAS | 62 | -6.26 | -12.10 | 23.25 | 38.71 | 62.90 |
| AOS | CF | 86 | 8.23 | 1.93 | 42.93 | 55.81 | 65.12 |
| AOS | SCAS | 24 | 8.92 | 5.14 | 49.21 | 54.17 | 75.00 |
| AOS | SFAS | 62 | 5.70 | 1.15 | 42.93 | 56.45 | 61.29 |
| OHP | CF | 107 | -11.58 | -17.93 | -3.52 | 44.86 | 85.98 |
| OHP | SFAS | 320 | -9.88 | -19.44 | -0.57 | 36.88 | 66.25 |
| ROM | CF | 12 | -6.46 | -8.59 | -2.73 | 91.67 | 100.00 |
| ROM | SFAS | 50 | -9.11 | -14.92 | -3.60 | 46.00 | 82.00 |
| THE | CF | 23 | -3.82 | -8.61 | 0.75 | 82.61 | 100.00 |
| THE | SFAS | 209 | -8.97 | -17.12 | 2.34 | 37.32 | 72.25 |
| IZA | CF | 398 | -14.66 | -17.18 | -11.43 | 12.31 | 84.42 |
| IZA | SFAS | 477 | -15.34 | -18.74 | -12.02 | 10.90 | 75.47 |
| OPA | CF | 29 | 2.59 | -0.06 | 9.43 | 79.31 | 100.00 |
| OPA | SFAS | 464 | 1.60 | -7.07 | 31.01 | 45.04 | 63.36 |
| MEL | CF | 286 | 5.65 | -3.90 | 14.49 | 53.50 | 90.91 |
| MEL | SFAS | 2194 | 3.16 | -10.17 | 18.77 | 37.06 | 65.86 |
| PAL | CF | 3 | -6.55 | -12.17 | -2.49 | 66.67 | 100.00 |
| PAL | SCAS | 177 | -55.97 | -74.44 | -35.28 | 3.39 | 9.60 |
| PAL | SFAS | 401 | -46.10 | -60.96 | -33.83 | 3.24 | 7.23 |

Table S2. TROPOMI overpass irradiances at 310 nm compared to ground based measurements. The percentage relative differences 100%*(TROPOMI-ground)/ground, their medians (median) and 25th (p25) and 75th (p75) percentiles were calculated. N is the number of measurement days included in the study. W₁₀ and W₂₀ are percentage of satellite data which are within 10% and 20% from ground measurements. CF=Cloudfree, SCAS= Snow cover at ground, all sky, SFAS= Snow free ground, all sky.

| Station | Conditions | N | median [%] | p25 [%] | p75 [%] | W ₁₀ | W ₂₀ |
|---------|------------|------|------------|---------|---------|-----------------|-----------------|
| SOD | CF | 129 | -2.52 | -6.70 | 2.15 | 79.84 | 96.90 |
| SOD | SCAS | 212 | -4.18 | -15.40 | 4.03 | 55.19 | 76.42 |
| SOD | SFAS | 403 | -6.67 | -15.97 | 6.25 | 39.95 | 71.22 |
| HEL | CF | 50 | -2.44 | -6.57 | 3.42 | 84.00 | 100.00 |
| HEL | SCAS | 82 | -0.45 | -10.57 | 6.18 | 53.66 | 75.61 |
| HEL | SFAS | 281 | -9.93 | -19.41 | 0.10 | 32.38 | 63.35 |
| VDA | CF | 47 | 3.16 | 0.55 | 4.74 | 100.00 | 100.00 |
| VDA | SFAS | 370 | -0.05 | -15.62 | 10.20 | 42.70 | 65.95 |
| DBR | CF | 41 | -10.28 | -15.32 | 24.67 | 12.20 | 60.98 |
| DBR | SCAS | 80 | -52.11 | -64.25 | -15.33 | 5.00 | 21.25 |
| DBR | SFAS | 34 | -10.32 | -16.28 | 35.54 | 11.76 | 58.82 |
| DAV | CF | 34 | -7.09 | -9.61 | 12.93 | 52.94 | 76.47 |
| DAV | SCAS | 9 | -38.45 | -40.79 | -29.40 | 0.00 | 11.11 |
| DAV | SFAS | 62 | -7.50 | -11.79 | 10.00 | 41.94 | 70.97 |
| AOS | CF | 89 | 7.89 | 1.57 | 41.83 | 50.56 | 62.92 |
| AOS | SCAS | 24 | 11.27 | 4.68 | 47.16 | 41.67 | 70.83 |
| AOS | SFAS | 65 | 7.50 | 1.27 | 41.83 | 53.85 | 60.00 |
| OHP | CF | 107 | -11.27 | -13.82 | -3.53 | 45.79 | 99.07 |
| OHP | SFAS | 320 | -10.47 | -16.63 | -0.86 | 33.75 | 73.44 |
| ROM | CF | 12 | -9.28 | -10.33 | -5.32 | 75.00 | 100.00 |
| ROM | SFAS | 50 | -10.98 | -14.16 | -5.60 | 34.00 | 78.00 |
| THE | CF | 23 | -3.08 | -8.40 | 0.47 | 82.61 | 100.00 |
| THE | SFAS | 209 | -10.19 | -16.71 | 0.55 | 37.32 | 70.33 |
| IZA | CF | 398 | 4.65 | 1.66 | 9.10 | 78.64 | 91.71 |
| IZA | SFAS | 477 | 3.91 | -0.23 | 8.49 | 73.17 | 88.26 |
| OPA | CF | 29 | -0.40 | -2.19 | 4.02 | 93.10 | 100.00 |
| OPA | SFAS | 464 | -1.29 | -9.62 | 25.86 | 42.24 | 63.15 |
| MEL | CF | 286 | 7.13 | -0.40 | 15.33 | 58.39 | 88.11 |
| MEL | SFAS | 2194 | 5.36 | -6.45 | 19.72 | 41.20 | 67.37 |
| PAL | CF | 3 | -6.84 | -10.30 | 7.47 | 33.33 | 100.00 |
| PAL | SCAS | 177 | -56.21 | -72.86 | -34.31 | 3.95 | 9.60 |
| PAL | SFAS | 401 | -45.46 | -59.96 | -31.88 | 2.49 | 8.23 |

Table S3. TROPOMI overpass irradiances at 324 nm compared to ground based measurements. The percentage relative differences 100%*(TROPOMI-ground)/ground, their medians (median) and 25th (p25) and 75th (p75) percentiles were calculated. N is the number of measurement days included in the study. W₁₀ and W₂₀ are percentage of satellite data which are within 10% and 20% from ground measurements. CF=Cloudfree, SCAS= Snow cover at ground, all sky, SFAS= Snow free ground, all sky.

| Station | Conditions | N | median [%] | p25 [%] | p75 [%] | W ₁₀ | W ₂₀ |
|---------|------------|------|------------|---------|---------|-----------------|-----------------|
| SOD | CF | 129 | -0.24 | -5.49 | 3.37 | 88.37 | 96.12 |
| SOD | SCAS | 212 | -1.52 | -14.67 | 4.00 | 54.25 | 77.83 |
| SOD | SFAS | 403 | -7.08 | -18.08 | 5.14 | 39.45 | 66.50 |
| HEL | CF | 50 | -0.83 | -6.78 | 4.62 | 68.00 | 96.00 |
| HEL | SCAS | 82 | 1.13 | -9.62 | 11.10 | 48.78 | 75.61 |
| HEL | SFAS | 281 | -11.61 | -20.51 | -2.45 | 30.25 | 62.99 |
| VDA | CF | 47 | 5.42 | 1.17 | 8.19 | 91.49 | 100.00 |
| VDA | SFAS | 370 | -0.39 | -14.41 | 11.35 | 43.51 | 65.68 |
| DBR | CF | 41 | -8.17 | -16.00 | 16.50 | 26.83 | 68.29 |
| DBR | SCAS | 80 | -52.02 | -63.98 | -17.27 | 7.50 | 23.75 |
| DBR | SFAS | 34 | -2.24 | -14.11 | 25.33 | 23.53 | 61.76 |
| DAV | CF | 34 | -8.15 | -11.47 | 3.75 | 50.00 | 82.35 |
| DAV | SCAS | 9 | -39.44 | -48.48 | -32.27 | 0.00 | 22.22 |
| DAV | SFAS | 62 | -9.42 | -15.87 | 8.00 | 32.26 | 67.74 |
| AOS | CF | 89 | 10.11 | 0.32 | 43.30 | 47.19 | 59.55 |
| AOS | SCAS | 24 | 12.60 | 4.95 | 48.12 | 41.67 | 66.67 |
| AOS | SFAS | 65 | 9.31 | -0.71 | 43.30 | 49.23 | 56.92 |
| OHP | CF | 107 | -2.52 | -6.75 | -0.06 | 90.65 | 95.33 |
| OHP | SFAS | 320 | -4.60 | -10.40 | 2.26 | 56.56 | 75.94 |
| ROM | CF | 12 | -10.55 | -12.30 | -8.11 | 50.00 | 100.00 |
| ROM | SFAS | 50 | -12.14 | -15.98 | -6.28 | 24.00 | 86.00 |
| THE | CF | 23 | -2.82 | -7.52 | 0.29 | 91.30 | 100.00 |
| THE | SFAS | 209 | -9.23 | -18.58 | -0.47 | 42.11 | 70.33 |
| IZA | CF | 398 | -7.80 | -11.13 | -3.81 | 58.29 | 92.46 |
| IZA | SFAS | 477 | -8.86 | -12.96 | -4.43 | 50.52 | 85.12 |
| OPA | CF | 29 | 3.83 | 1.39 | 5.82 | 96.55 | 100.00 |
| OPA | SFAS | 464 | 1.38 | -7.80 | 30.94 | 45.47 | 62.07 |
| MEL | CF | 287 | 9.92 | 5.07 | 16.75 | 50.17 | 82.93 |
| MEL | SFAS | 2201 | 8.36 | -2.61 | 22.35 | 39.25 | 64.61 |
| PAL | CF | 3 | -5.48 | -8.70 | 19.30 | 66.67 | 66.67 |
| PAL | SCAS | 177 | -57.11 | -72.83 | -34.09 | 3.39 | 9.04 |
| PAL | SFAS | 401 | -45.98 | -60.41 | -31.55 | 2.74 | 7.48 |

Table S4. TROPOMI overpass irradiances at 380 nm compared to ground based measurements. The percentage relative differences 100%*(TROPOMI-ground)/ground, their medians (median) and 25th (p25) and 75th (p75) percentiles were calculated. N is the number of measurement days included in the study. W₁₀ and W₂₀ are percentage of satellite data which are within 10% and 20% from ground measurements. CF=Cloudfree, SCAS= Snow cover at ground, all sky, SFAS= Snow free ground, all sky.

| Station | Conditions | N | median [%] | p25 [%] | p75 [%] | W ₁₀ | W ₂₀ |
|---------|------------|------|------------|---------|---------|-----------------|-----------------|
| VDA | CF | 47 | 8.43 | 2.78 | 11.91 | 65.96 | 100.00 |
| VDA | SFAS | 370 | 1.06 | -15.28 | 18.22 | 37.30 | 56.49 |
| DAV | CF | 34 | -5.73 | -9.23 | 14.41 | 55.88 | 76.47 |
| DAV | SCAS | 9 | -36.18 | -48.15 | -21.42 | 11.11 | 22.22 |
| DAV | SFAS | 62 | -7.35 | -16.11 | 7.33 | 37.10 | 62.90 |
| AOS | CF | 82 | 10.22 | 0.27 | 70.12 | 47.56 | 56.10 |
| AOS | SCAS | 22 | 21.01 | 7.71 | 83.07 | 31.82 | 45.45 |
| AOS | SFAS | 60 | 4.24 | -1.56 | 60.30 | 53.33 | 60.00 |
| OHP | CF | 107 | -0.36 | -5.16 | 2.52 | 93.46 | 93.46 |
| OHP | SFAS | 320 | -2.86 | -9.88 | 6.09 | 55.00 | 70.00 |
| OPA | CF | 29 | -0.44 | -2.93 | 1.74 | 93.10 | 100.00 |
| OPA | SFAS | 464 | -2.48 | -12.31 | 32.05 | 36.85 | 57.11 |
| MEL | CF | 286 | 7.31 | 2.23 | 13.06 | 62.24 | 95.45 |
| MEL | SFAS | 2190 | 5.24 | -6.58 | 19.84 | 39.59 | 63.06 |
| PAL | CF | 3 | -0.47 | -3.52 | 48.59 | 66.67 | 66.67 |
| PAL | SCAS | 177 | -58.80 | -73.61 | -34.67 | 5.08 | 10.73 |
| PAL | SFAS | 401 | -46.40 | -63.31 | -31.63 | 3.99 | 10.47 |

2 Erythemally weighted daily dose

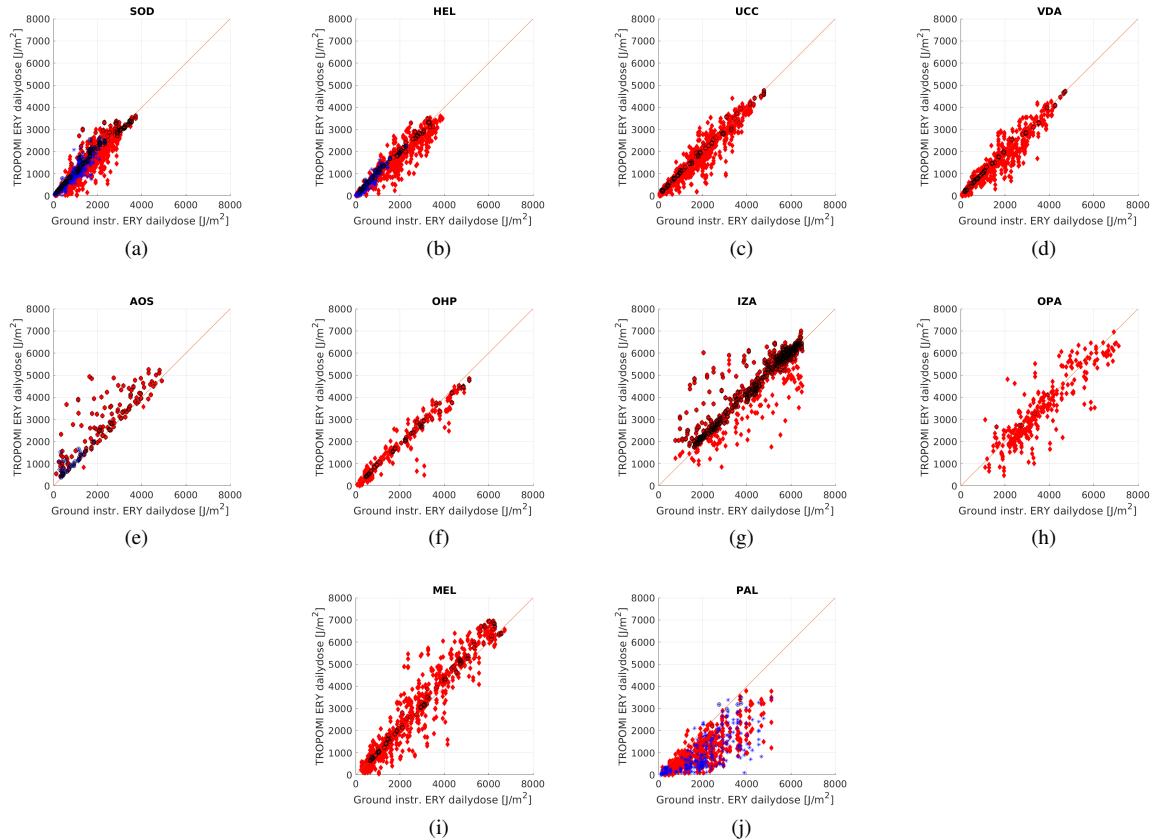


Figure S9. TROPOMI erythemally weighted daily doses and spectroradiometer measurements at a) Sodankylä, b) Helsinki, c) Uccle, d) Villeneuve d'Ascq, e) Aosta, f) Haute-Provence, g) Izaña, h) Saint-Denis, i) Melbourne and j) Palmer. Red diamond denotes snow free surface, blue star snow cover and black circle cloudfree.

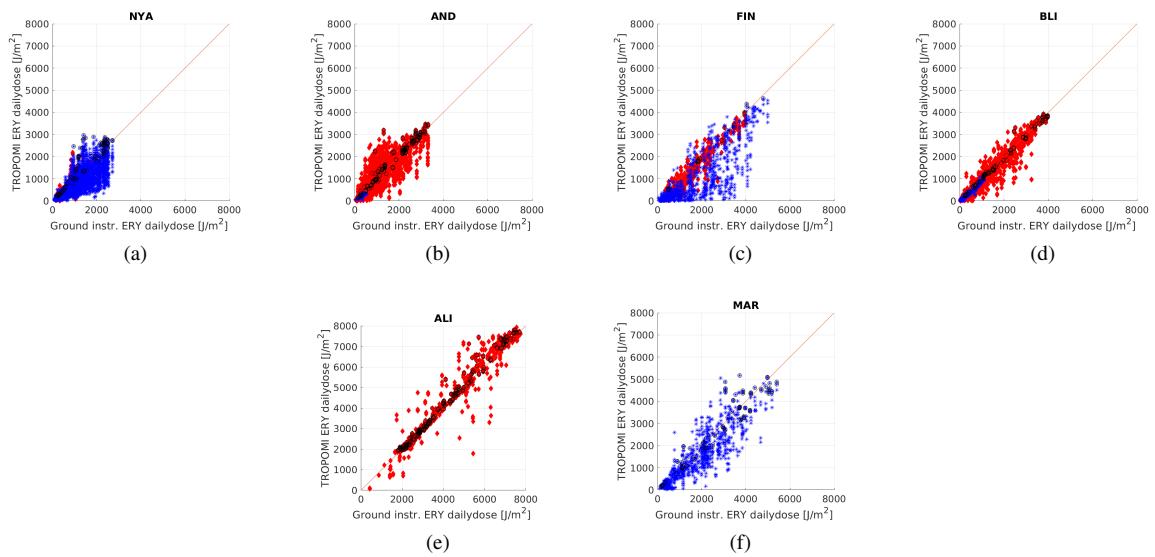


Figure S10. TROPOMI erythemally weighted daily doses and broadband/multichannel radiometer measurements at a) Ny-Ålesund, b) Andøya, c) Finse, d) Blindern, e) Alice Springs and f) Marambio. Red diamond denotes snow free surface, blue star snow cover and black circle cloudfree.

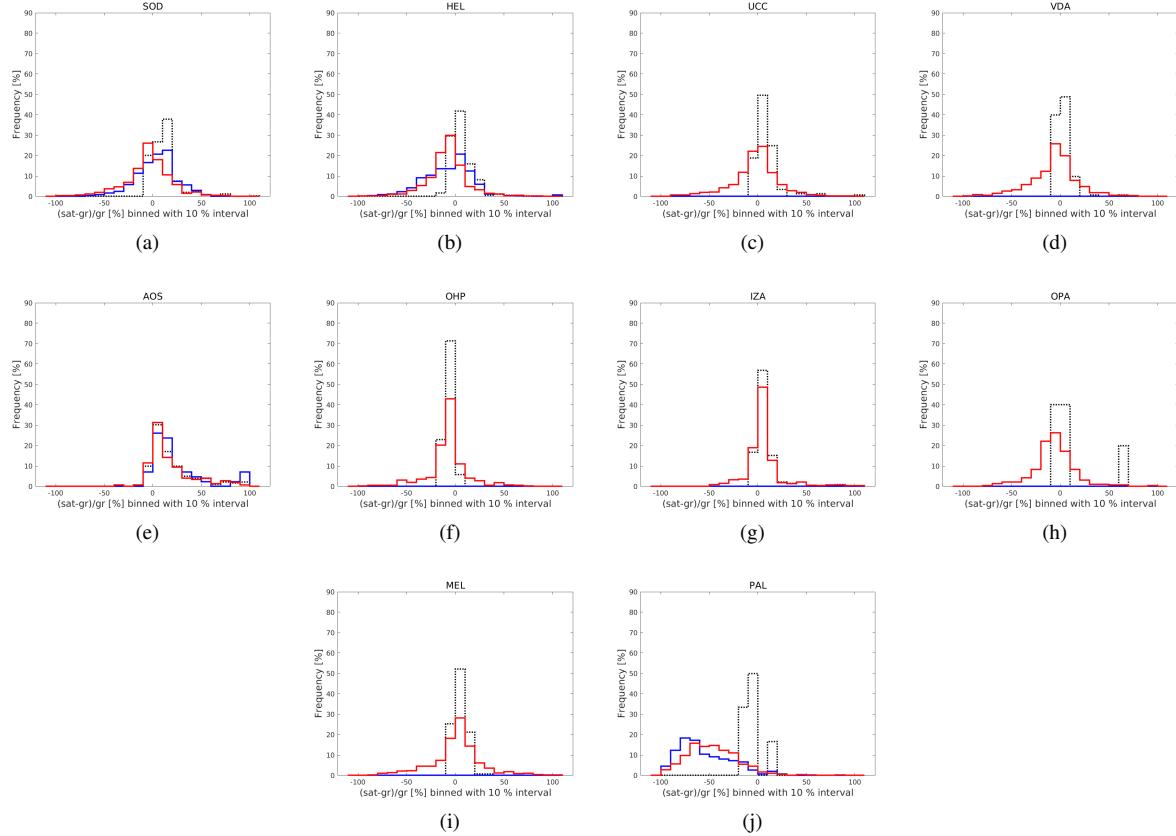


Figure S11. Histograms of relative difference between TROPOMI erythemally weighted daily doses and spectroradiometer measurements at a) Sodankylä, b) Helsinki, c) Uccle, d) Villeneuve d'Ascq, e) Aosta, f) Haute-Provence, g) Izaña, h) Saint-Denis, i) Melbourne and j) Palmer. Black dotted line denotes cloudfree, red snow free surface and blue snow cover on the ground.

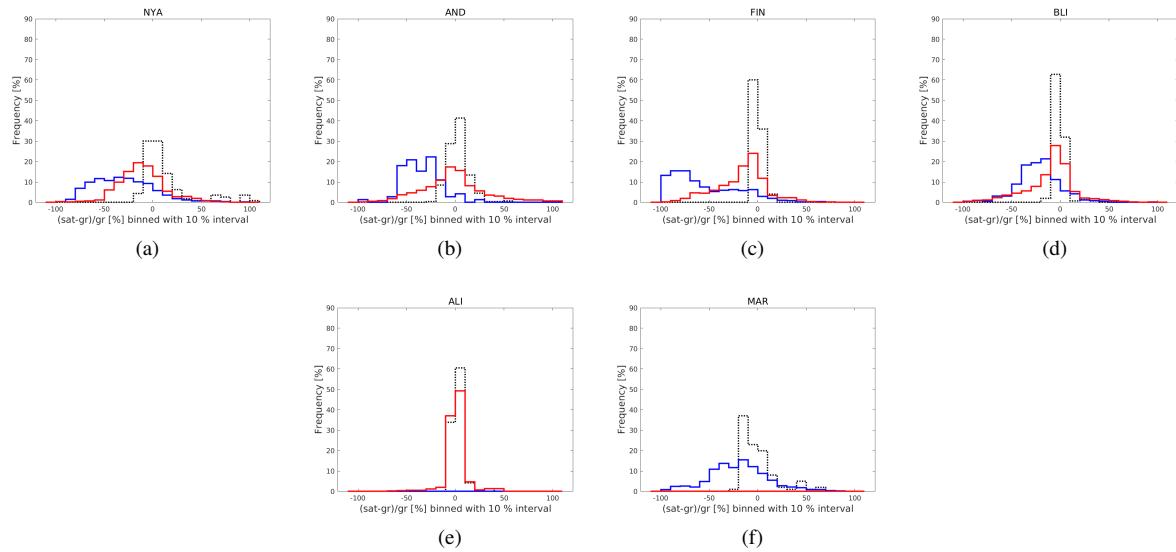


Figure S12. Histograms of relative difference between TROPOMI erythemally weighted daily doses and broadband/multichannel radiometer measurements at a) Ny-Ålesund, b) Andøya, c) Finse, d) Blindern, e) Alice Springs and f) Marambio. Black dotted line denotes cloudfree, red snow free surface and blue snow cover on the ground.

Table S5. Erythemally weighted daily doses compared to ground based measurements. The percentage relative differences 100%*(TROPOMI-ground)/ground, their medians (median) and 25th (p25) and 75th (p75) percentiles were calculated. N is the number of measurement days included in the study. W₁₀ and W₂₀ are percentage of satellite data which are within 10% and 20% from ground measurements. CF=Cloudfree, SCAS= Snow cover at ground, all sky, SFAS= Snow free ground, all sky.

| Station | Conditions | N | median [%] | p25 [%] | p75 [%] | W ₁₀ | W ₂₀ |
|---------|------------|------|------------|---------|---------|-----------------|-----------------|
| NYA | CF | 113 | 5.77 | -4.21 | 17.37 | 60.18 | 78.76 |
| NYA | SCAS | 3421 | -32.97 | -54.40 | -10.30 | 15.08 | 28.73 |
| NYA | SFAS | 840 | -12.17 | -26.07 | 2.15 | 30.60 | 55.60 |
| AND | CF | 261 | 1.80 | -2.42 | 7.63 | 70.11 | 91.95 |
| AND | SCAS | 72 | -36.19 | -48.19 | -23.45 | 6.94 | 18.06 |
| AND | SFAS | 2787 | -1.91 | -20.55 | 16.67 | 32.97 | 52.03 |
| SOD | CF | 348 | 10.71 | 2.85 | 16.30 | 46.84 | 84.77 |
| SOD | SCAS | 656 | 6.08 | -8.23 | 16.00 | 37.35 | 71.19 |
| SOD | SFAS | 1302 | -3.37 | -15.92 | 7.77 | 44.09 | 68.28 |
| FIN | CF | 25 | -0.99 | -3.47 | 3.28 | 96.00 | 100.00 |
| FIN | SCAS | 1095 | -65.52 | -82.22 | -27.11 | 9.13 | 16.99 |
| FIN | SFAS | 448 | -11.72 | -32.87 | -1.71 | 35.94 | 57.14 |
| HEL | CF | 182 | 5.96 | -1.81 | 10.60 | 71.43 | 89.01 |
| HEL | SCAS | 425 | -4.43 | -23.88 | 9.40 | 34.35 | 60.47 |
| HEL | SFAS | 1192 | -7.43 | -17.22 | 1.09 | 45.22 | 71.48 |
| BLI | CF | 153 | -2.33 | -5.47 | 1.91 | 94.77 | 97.39 |
| BLI | SCAS | 355 | -22.25 | -35.68 | -10.58 | 16.90 | 42.54 |
| BLI | SFAS | 1341 | -5.56 | -21.88 | 2.86 | 46.91 | 65.92 |
| UCC | CF | 149 | 5.99 | 1.58 | 13.45 | 68.46 | 93.29 |
| UCC | SFAS | 1181 | -0.21 | -12.61 | 9.89 | 46.66 | 70.03 |
| VDA | CF | 133 | 1.73 | -1.36 | 4.66 | 88.72 | 98.50 |
| VDA | SFAS | 986 | -3.44 | -18.76 | 4.70 | 45.74 | 66.13 |
| AOS | CF | 182 | 14.88 | 5.36 | 43.99 | 40.11 | 57.14 |
| AOS | SCAS | 42 | 14.19 | 8.00 | 43.99 | 33.33 | 57.14 |
| AOS | SFAS | 147 | 14.52 | 3.34 | 43.19 | 42.86 | 57.82 |
| OHP | CF | 122 | -6.97 | -9.86 | -3.61 | 77.05 | 100.00 |
| OHP | SFAS | 389 | -7.16 | -12.24 | -1.33 | 53.98 | 78.41 |
| IZA | CF | 693 | 4.82 | 1.27 | 10.42 | 73.59 | 88.74 |
| IZA | SFAS | 846 | 3.25 | -0.72 | 9.28 | 67.49 | 83.81 |
| OPA | CF | 43 | 4.25 | 1.22 | 8.09 | 83.72 | 97.67 |
| OPA | SFAS | 571 | -2.95 | -13.69 | 5.10 | 51.84 | 76.53 |
| ALI | CF | 286 | 1.29 | -0.74 | 5.14 | 94.41 | 98.60 |
| ALI | SFAS | 898 | 0.74 | -2.03 | 5.00 | 86.30 | 92.98 |
| MEL | CF | 142 | 4.35 | -0.42 | 9.35 | 77.46 | 98.59 |
| MEL | SFAS | 1074 | 2.98 | -8.50 | 11.99 | 46.37 | 68.25 |
| MAR | CF | 100 | -6.27 | -13.66 | 3.70 | 43.00 | 88.00 |
| MAR | SCAS | 879 | -19.20 | -38.42 | -2.19 | 20.93 | 41.87 |
| PAL | CF | 6 | -8.16 | -11.31 | -4.45 | 50.00 | 100.00 |
| PAL | SCAS | 261 | -61.57 | -76.66 | -34.47 | 3.45 | 11.88 |
| PAL | SFAS | 584 | -48.90 | -65.38 | -30.55 | 6.16 | 12.67 |

3 Pixel test

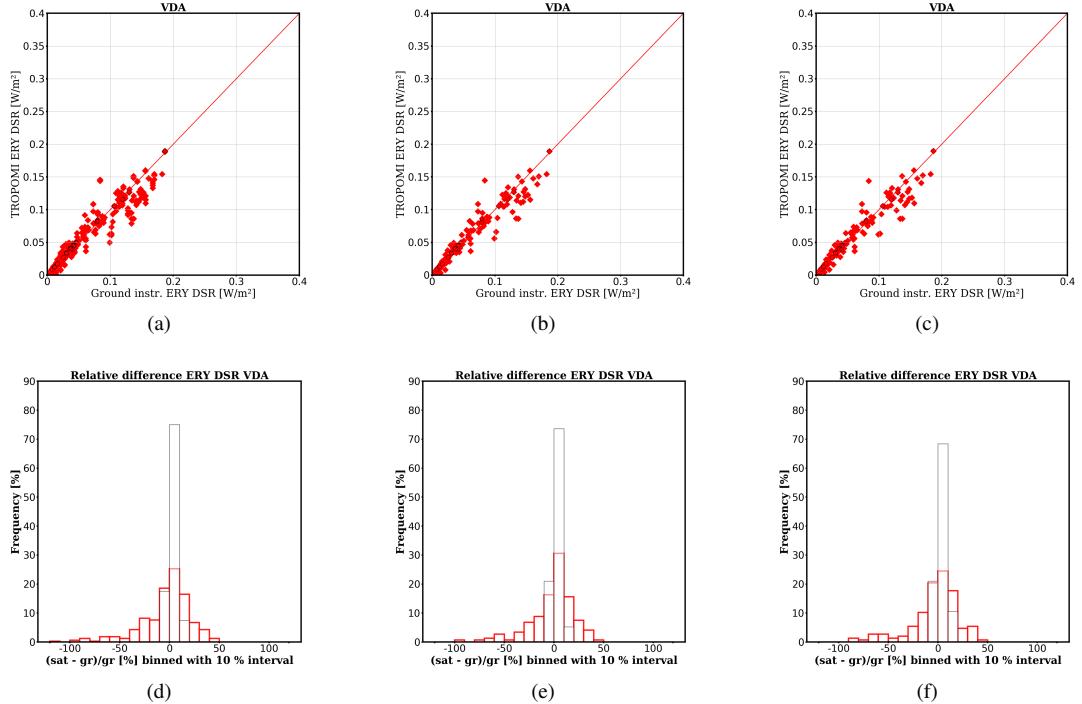


Figure S13. Erythemally weighted dose rates measured by the spectroradiometer (gr) and retrieved by TROPOMI (sat). A and d) each TROPOMI pixel was treated as individual measurement, b and e) the average of the TROPOMI pixels fulfilling the chosen limitations (time difference, SZA, altitude, distance) was used, and c) and f) the pixel nearest of the site was chosen. In scatter plots, black circle denotes cloudfree. In histograms, black dotted line denotes cloudfree.

Table S6. The statistics of the pixel test. TROPOMI overpass erythemally weighted dose rates compared to spectroradiometer measurements. The percentage relative differences $100\% \cdot (\text{sat}-\text{gr})/\text{gr}$, their medians (median) and 25th (p25) and 75th (p75) percentiles were calculated. N is the number of measurement days included in the study. W₁₀ and W₂₀ are percentage of satellite data which are within 10% and 20% from ground measurements. CF=Cloudfree and SFAS=Snow free ground, all sky.

| Station | Conditions | N | median [%] | p25 [%] | p75 [%] | W ₁₀ | W ₂₀ |
|-----------------------|------------|-----|------------|---------|---------|-----------------|-----------------|
| VDA all pixel | CF | 40 | 6.65 | 3.60 | 7.83 | 87.50 | 100.00 |
| VDA all pixel | SFAS | 337 | 1.63 | -13.17 | 14.14 | 41.84 | 64.39 |
| VDA average of pixels | CF | 19 | 6.68 | 1.60 | 8.23 | 84.21 | 100.00 |
| VDA average of pixels | SFAS | 151 | 2.12 | -10.85 | 12.56 | 42.38 | 67.55 |
| VDA nearest pixel | CF | 19 | 6.62 | 2.03 | 7.83 | 84.21 | 100.00 |
| VDA nearest pixel | SFAS | 151 | 1.20 | -10.70 | 13.78 | 42.38 | 68.21 |

5 4 UVQAV test

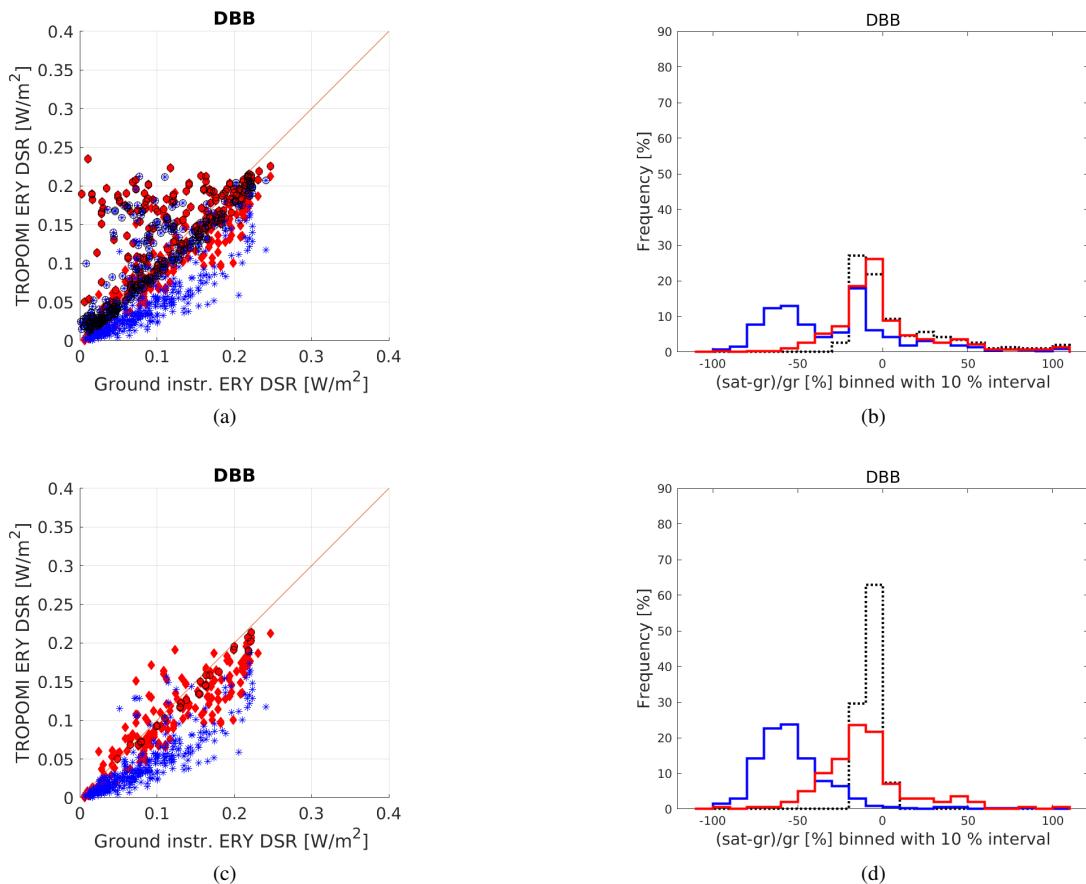


Figure S14. Erythemally weighted UV dose rates calculated from the average of broadband measurements (DBB, ground) and from the TROPOMI retrievals (sat) at Davos. TROPOMI data from pixels within 5 km from the site have been used. A) and b) all TROPOMI data are used, c) and d) TROPOMI data which UVQAV value is less than 0.5 have been excluded. In scatter plots, red diamond denotes snow free surface, blue star snow cover and black circle cloudfree. In histograms, black dotted line denotes cloudfree, red snow free surface and blue snow cover on the ground.

Table S7. The statistics of the UV quality flag test for Davos broadband data. Erythemally weighted UV dose rates calculated from the average of broadband measurements (DBB) and from the TROPOMI retrievals at Davos. TROPOMI data from pixels within 5 km from the site have been used. A) all TROPOMI data are used, B) TROPOMI data which UVQAV value is less than 0.5 have been excluded. The percentage relative differences $100\% * (\text{sat-gr})/\text{gr}$, their medians (median) and 25th (p25) and 75th (p75) percentiles were calculated. N is the number of measurement days included in the study. W_{10} and W_{20} are percentage of satellite data which are within 10% and 20% from ground measurements. CF=Cloudfree, SCAS= Snow cover at ground, all sky, SFAS= Snow free ground, all sky.

| Station | Conditions | N | median [%] | p25 [%] | p75 [%] | W₁₀ | W₂₀ |
|----------------|-------------------|----------|-------------------|----------------|----------------|-----------------------|-----------------------|
| A) DBB | CF | 503 | -1.96 | -10.98 | 39.56 | 31.21 | 62.82 |
| A) DBB | SCAS | 637 | -24.02 | -58.23 | -4.30 | 10.36 | 30.14 |
| A) DBB | SFAS | 384 | -5.70 | -13.85 | 19.92 | 34.90 | 58.07 |
| B) DBB | CF | 27 | -8.39 | -10.04 | -4.22 | 70.37 | 100.00 |
| B) DBB | SCAS | 346 | -56.44 | -67.39 | -44.46 | 1.45 | 4.62 |
| B) DBB | SFAS | 199 | -12.89 | -23.66 | -3.84 | 28.64 | 55.28 |