Supplement of Intercomparison of Sentinel-5P TROPOMI cloud products for tropospheric trace gas retrievals

Miriam Latsch et al.

S1 Additional plots of the comparison between version 1 and version 2 cloud fractions and cloud heights for Europe and Africa

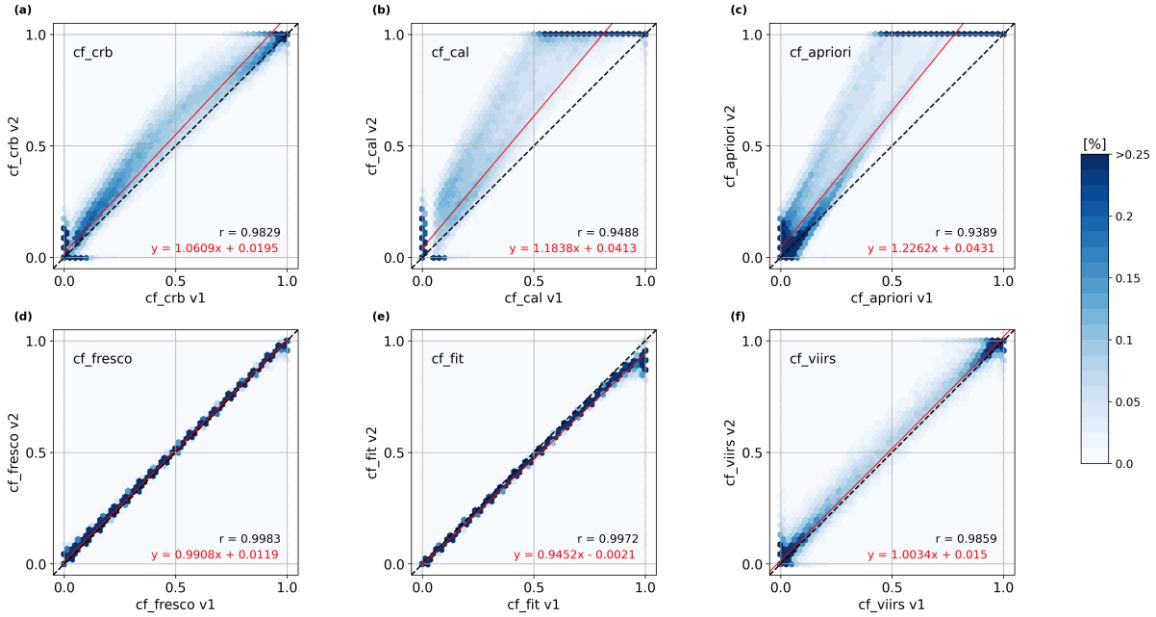
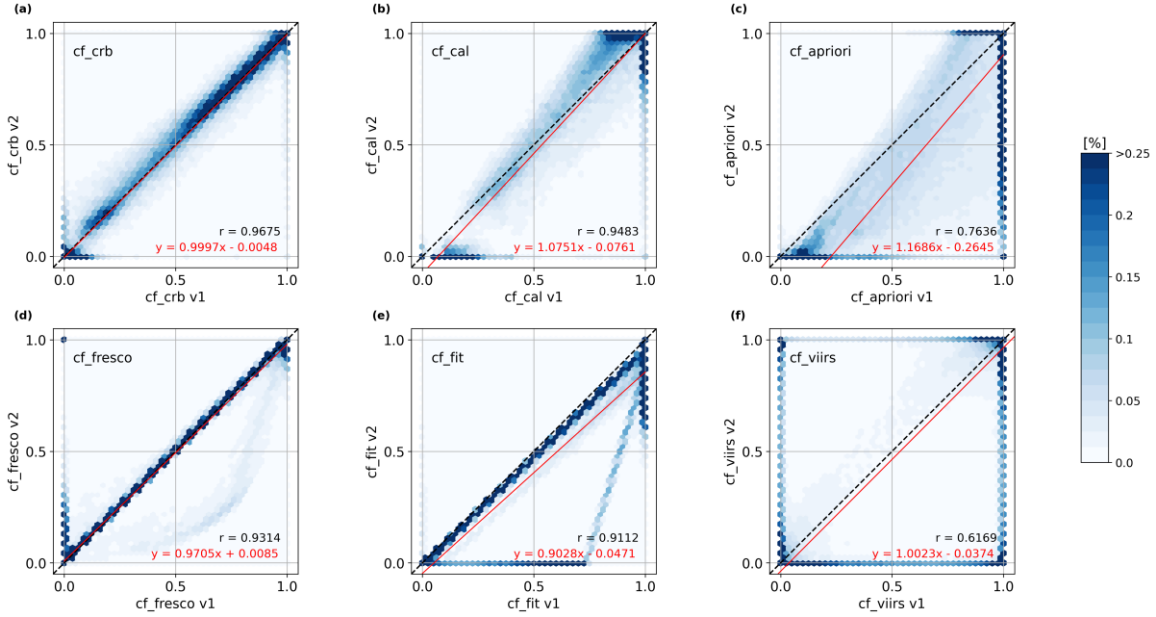


Figure S1: Scatter plots between the version 1 and version 2 cloud fractions from (a) ROCINN CRB, (b) ROCINN CAL, (c) OCRA a priori, (d) FRESCO, (e) the NO_2 fitting window, and (f) VIIRS for Europe and the summer day (30 June 2018).



10 **Figure S2: As Figure S1 but for the winter day (5 January 2019).**

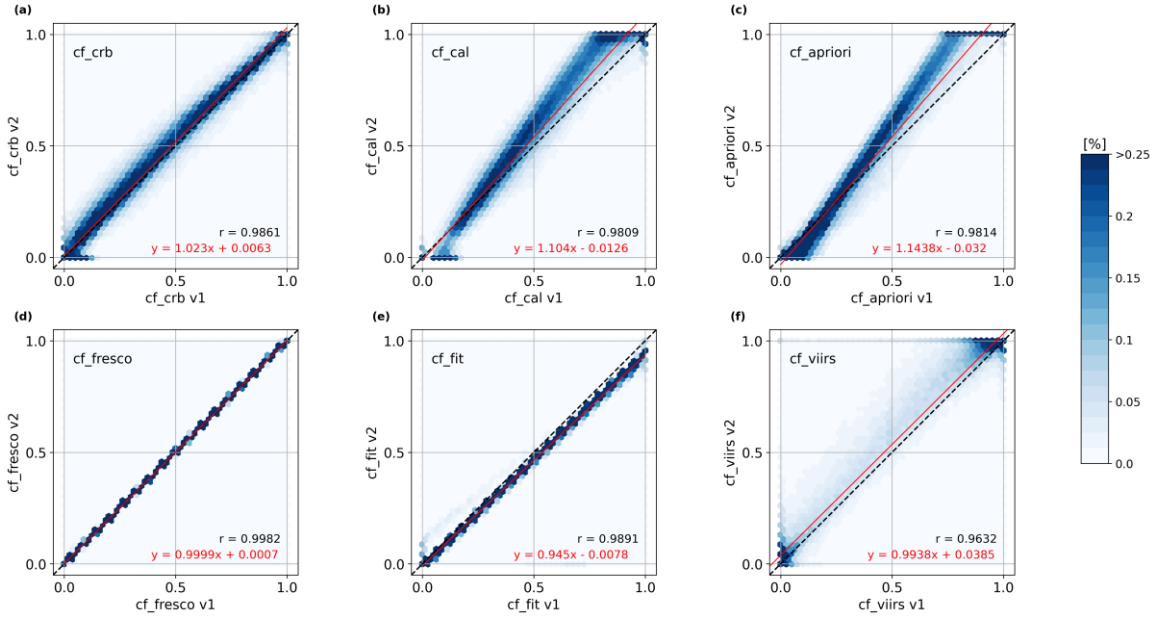


Figure S3: As Figure S1 but for the fall day (20 September 2019).

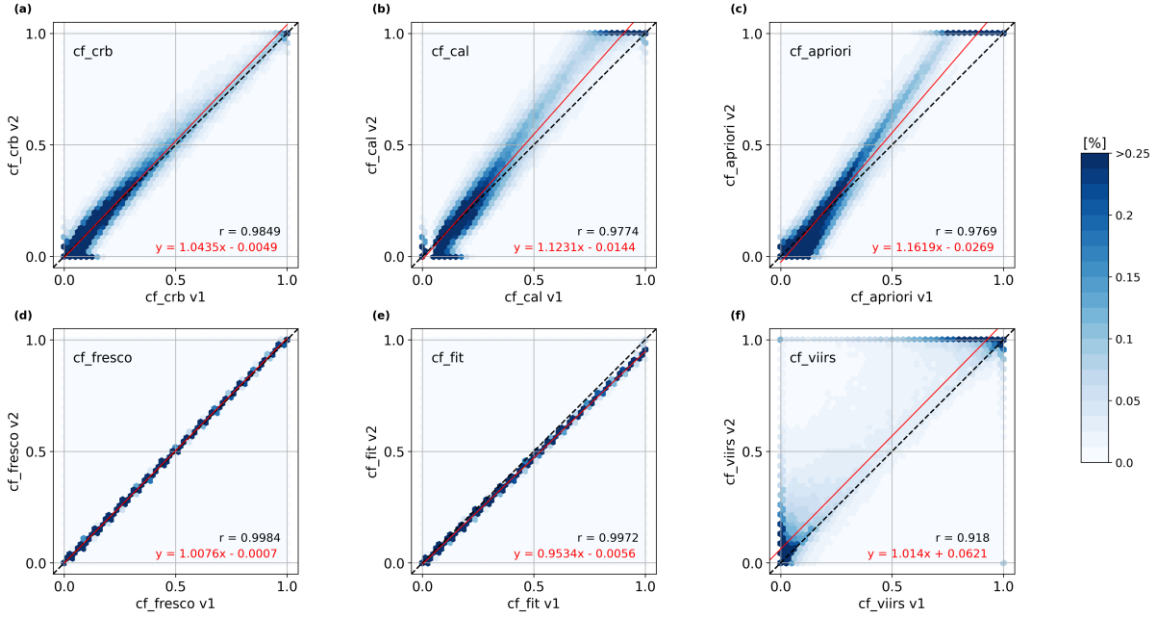


Figure S4: Scatter plots between the version 1 and version 2 cloud fractions from (a) ROCINN CRB, (b) ROCINN CAL, (c) OCRA a priori, (d) FRESCO, (e) the NO_2 fitting window, and (f) VIIRS for Africa and the spring day (4 April 2019).

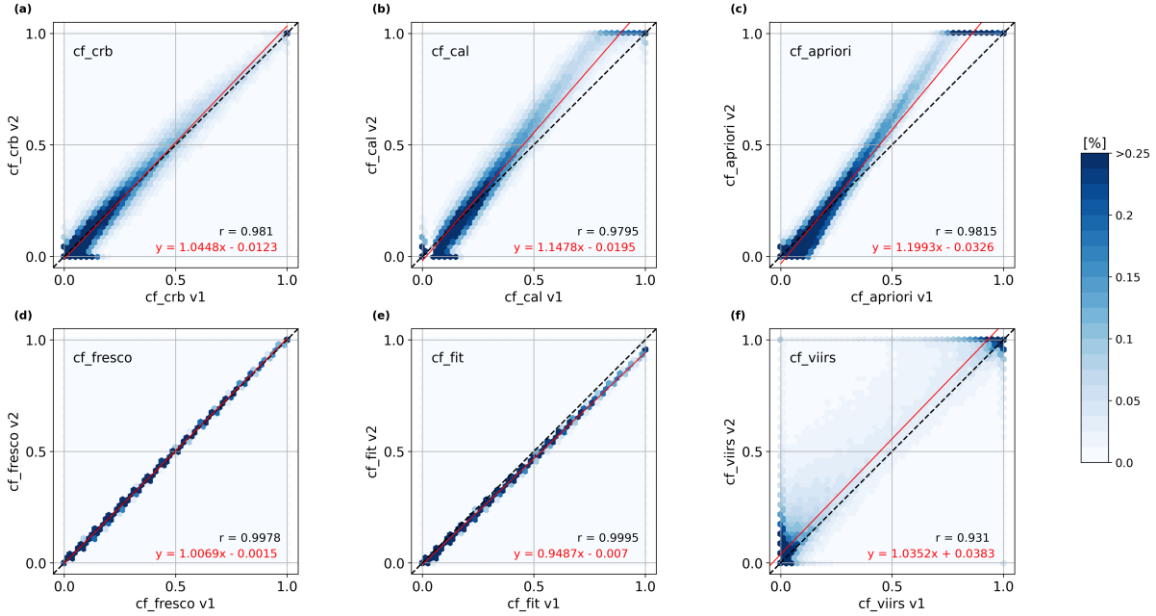


Figure S5: As Figure S4 but for the fall day (20 September 2019).

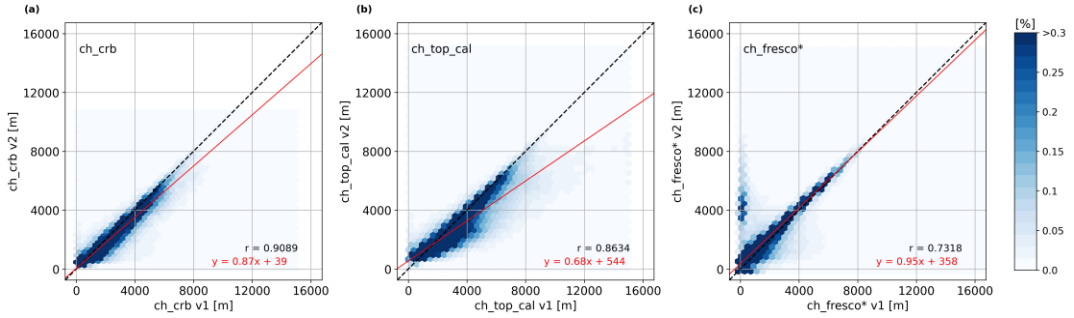


Figure S6: Scatter plots between the version 1 and version 2 cloud heights from (a) ROCINN CRB, (b) ROCINN CAL top, and (c) FRESCO from the TROPOMI NO_2 product (ch_fresco*) for Europe and the summer day (30 June 2018).

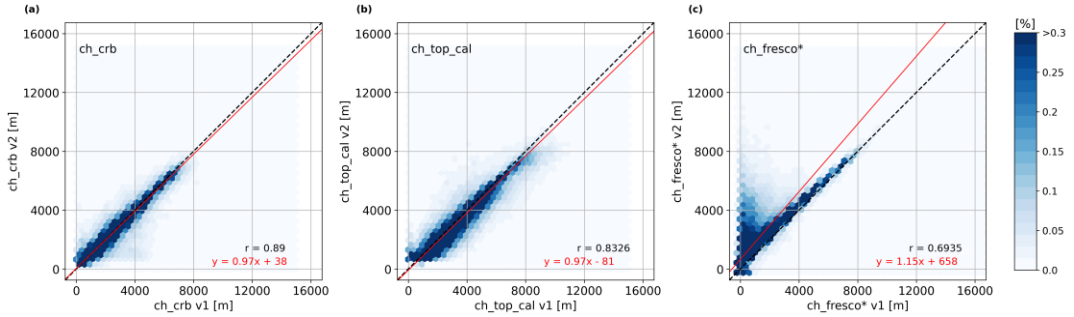


Figure S7: As Figure S6 but for the winter day (5 January 2019).

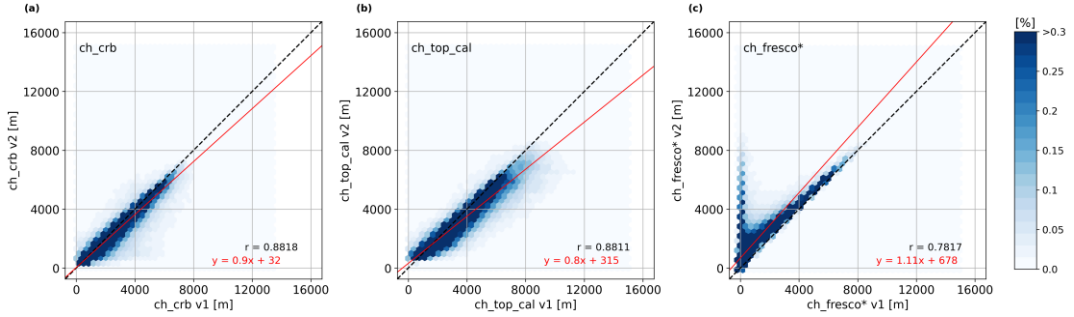


Figure S8: As Figure S6 but for the spring day (4 April 2019).

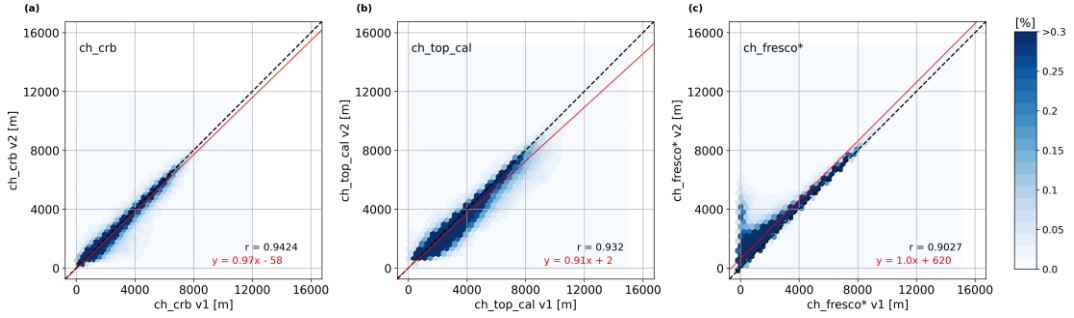


Figure S9: As Figure S6 but for the fall day (20 September 2019).

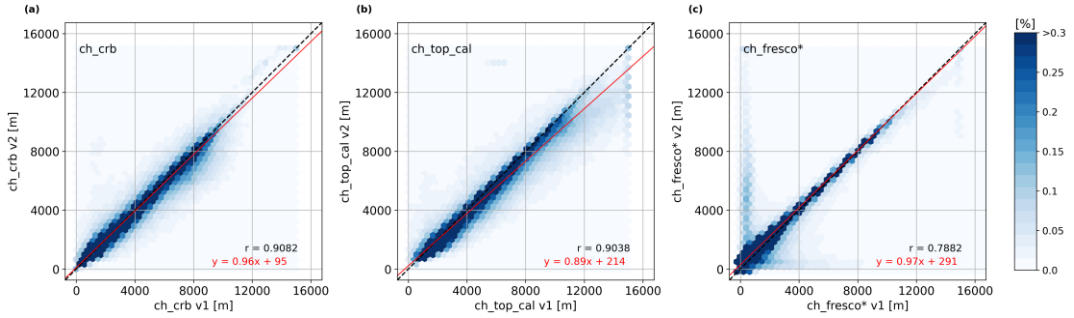


Figure S10: Scatter plots between the version 1 and version 2 cloud heights from (a) ROCINN CRB, (b) ROCINN CAL top, and (c) FRESCO from the TROPOMI NO_2 product (ch_fresco*) for Africa and the winter day (5 January 2019).

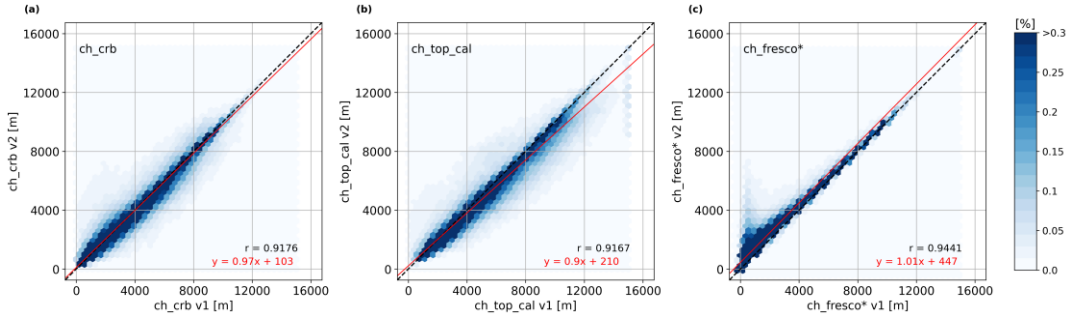


Figure S11: As Figure S10 but for the spring day (4 April 2019).

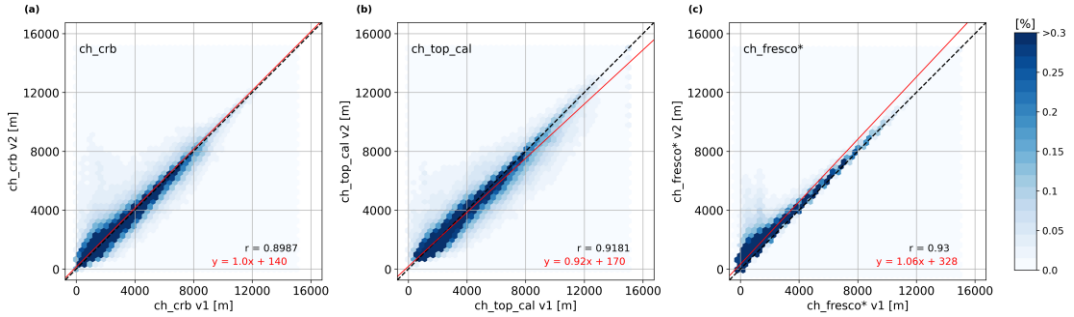


Figure S12: As Figure S10 but for the fall day (20 September 2019).

S2 Tabular intercomparison of the statistics between the version 2 cloud fractions for China

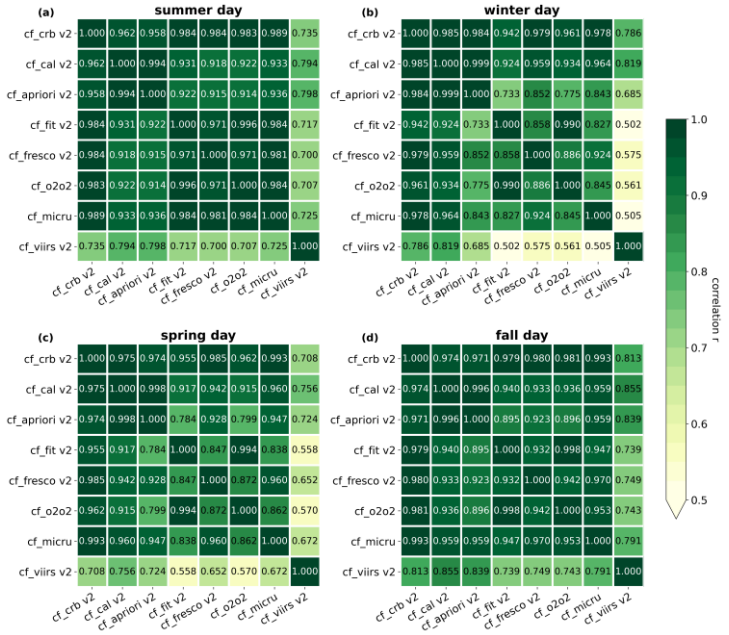


Figure S13: Tabular intercomparison of the correlations between the version 2 cloud fractions from ROCINN CRB, ROCINN CAL, OCRA a priori, the NO_2 fitting window (cf_fit), FRESCO, O2-O2, MICRU, and VIIRS for China and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

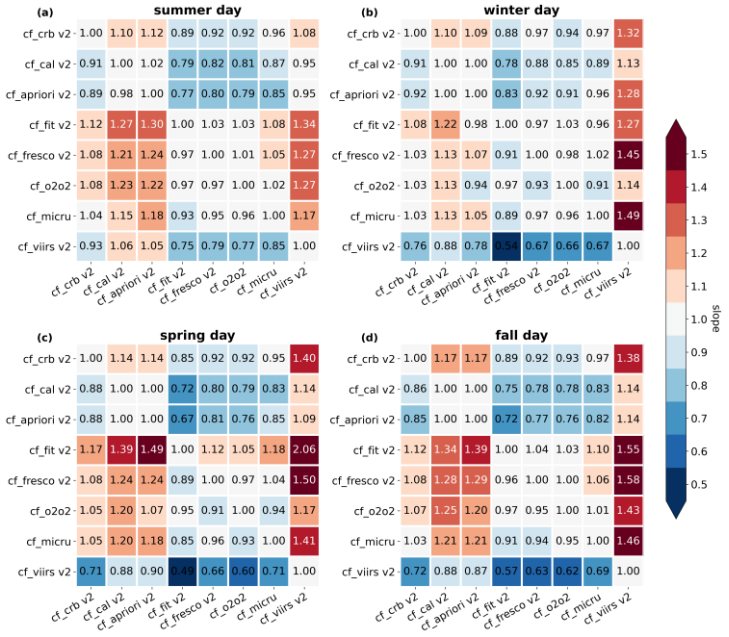


Figure S14: Tabular intercomparison of the slopes of the scatter plots between the version 2 cloud fractions from ROCINN CRB, ROCINN CAL, OCRA a priori, the NO_2 fitting window (cf_fit), FRESCO, O2-O2, MICRU, and VIIRS for China and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

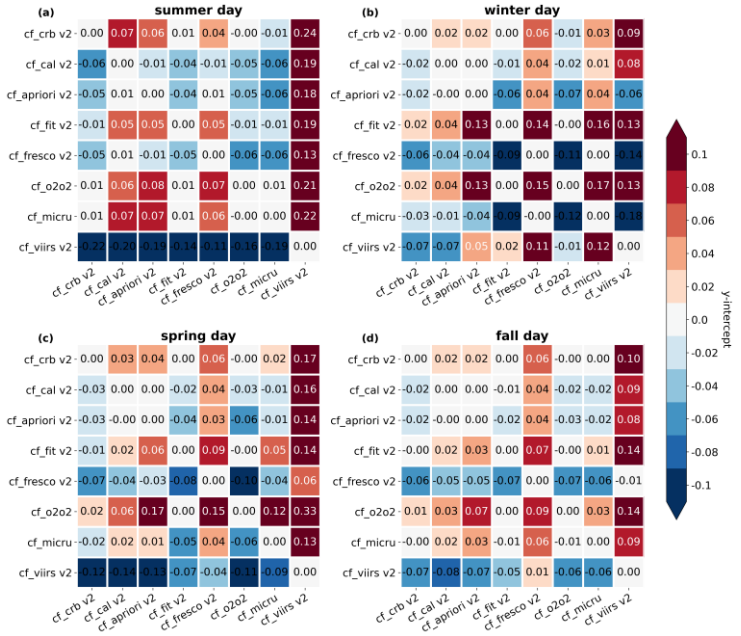


Figure S15: Tabular intercomparison of the y-intercepts of the scatter plots between the version 2 cloud fractions from ROCINN CRB, ROCINN CAL, OCRA a priori, the NO_2 fitting window (cf_fit), FRESCO, O2-O2, MICRU, and VIIRS for China and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

S3 Tabular intercomparison of the statistics between the version 1 cloud fractions for Europe, Africa, and China

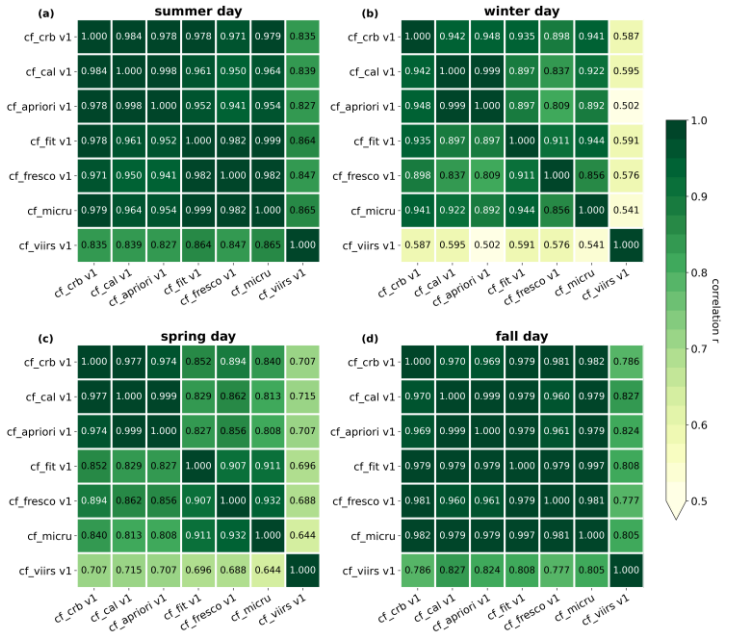


Figure S16: Tabular intercomparison of the correlations between the version 1 cloud fractions from ROCINN CRB, ROCINN CAL, OCRA a priori, the NO_2 fitting window (cf_fit), FRESCO, MICRU, and VIIRS for Europe and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

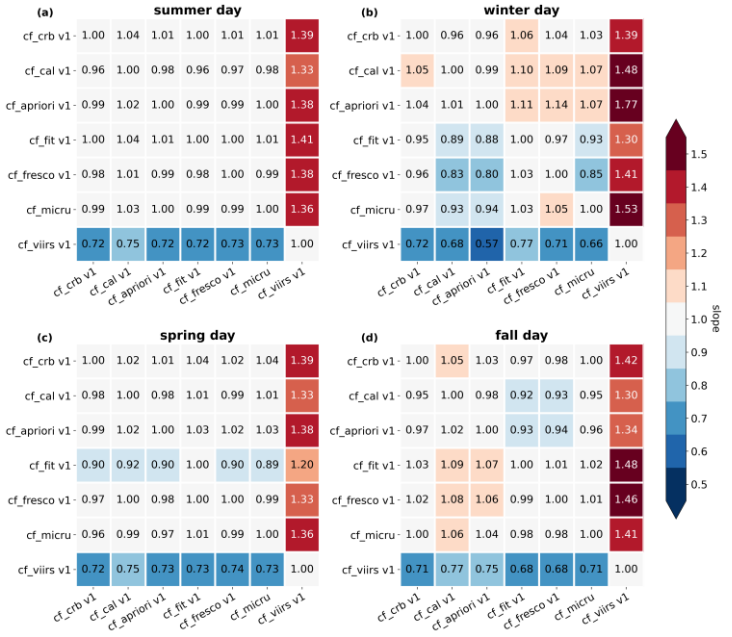


Figure S17: Tabular intercomparison of the slopes of the scatter plots between the version 1 cloud fractions from ROCINN CRB, ROCINN CAL, OCRA a priori, the NO_2 fitting window (cf_fit), FRESCO, MICRU, and VIIRS for Europe and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

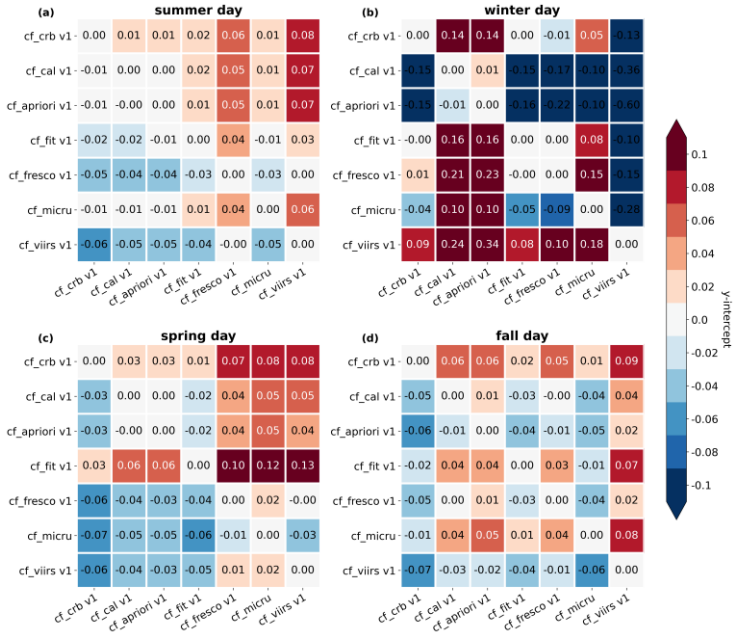


Figure S18: Tabular intercomparison of the y-intercepts of the scatter plots between the version 1 cloud fractions from ROCINN CRB, ROCINN CAL, OCRA a priori, the NO_2 fitting window (cf_fit), FRESCO, MICRU, and VIIRS for Europe and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

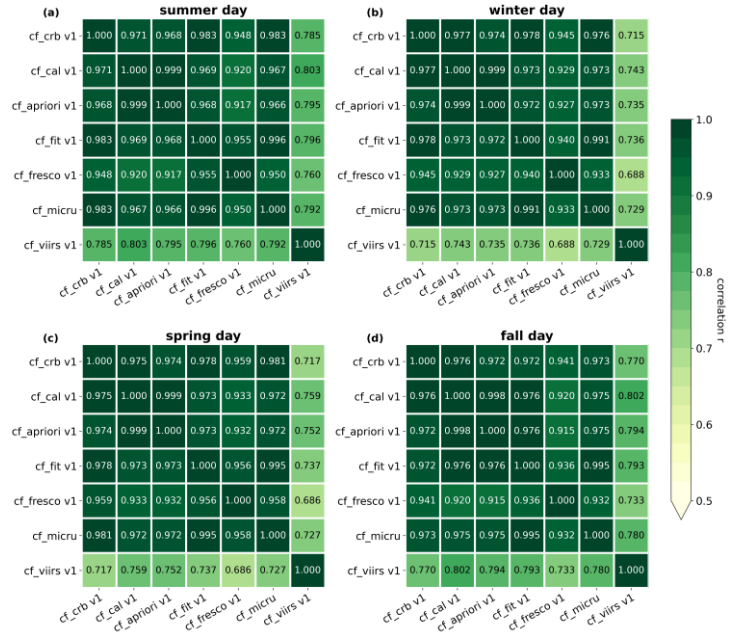


Figure S19: As Figure S16 but for Africa.

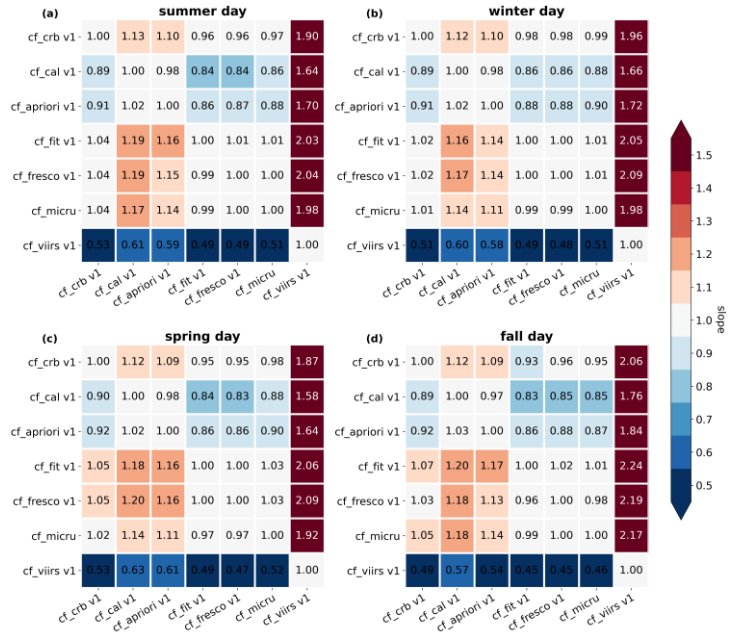


Figure S20: As Figure S17 but for Africa.

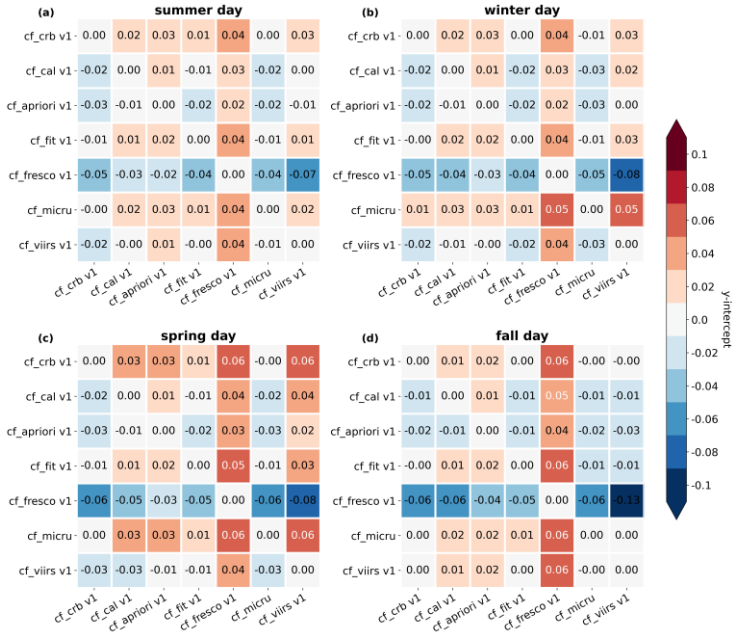


Figure S21: As Figure S18 but for Africa.

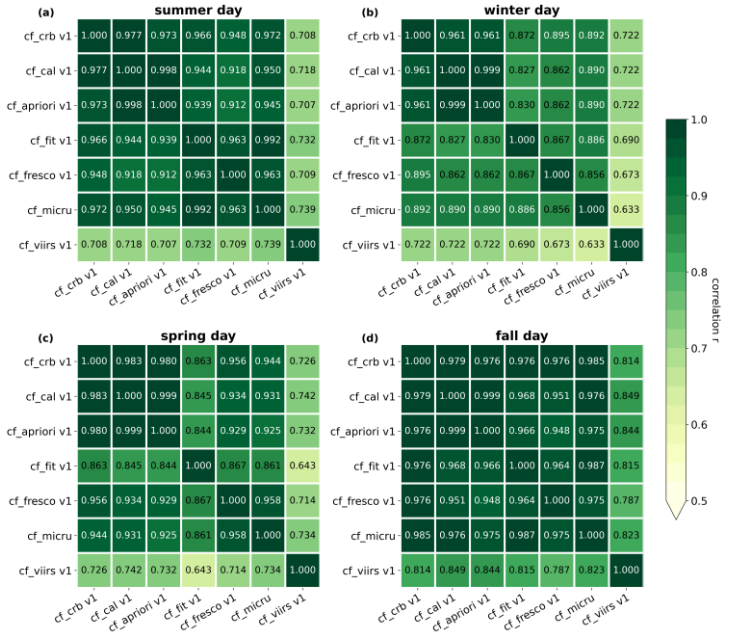


Figure S22: As Figure S16 but for China.

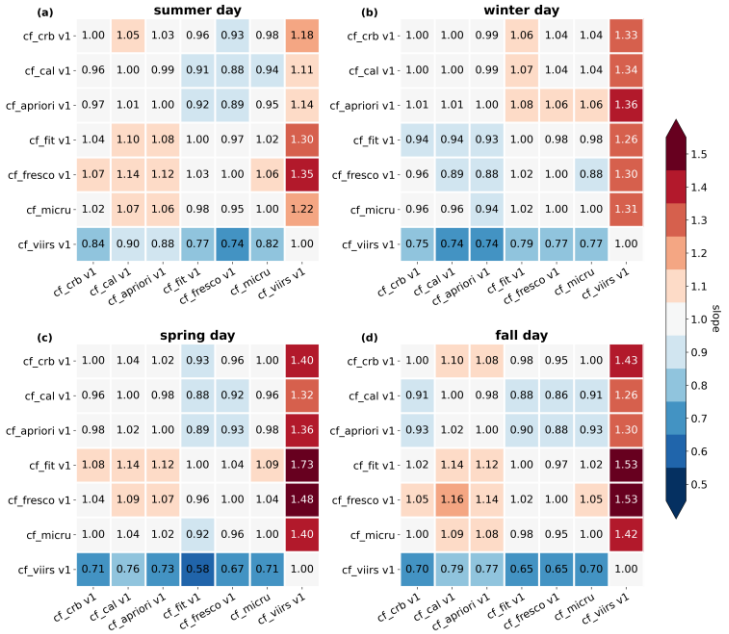


Figure S23: As Figure S17 but for China.

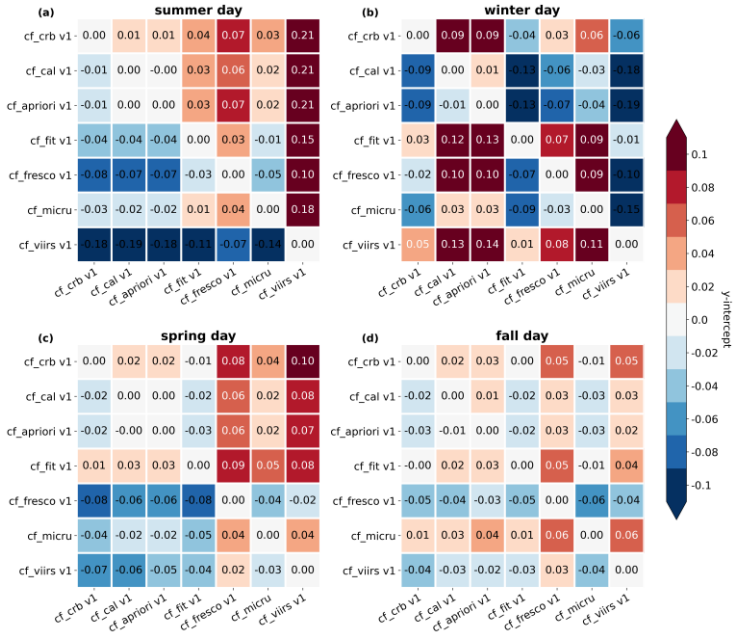


Figure S24: As Figure S18 but for China.

S4 Tabular intercomparison of the statistics between the version 2 cloud heights for Europe and Africa

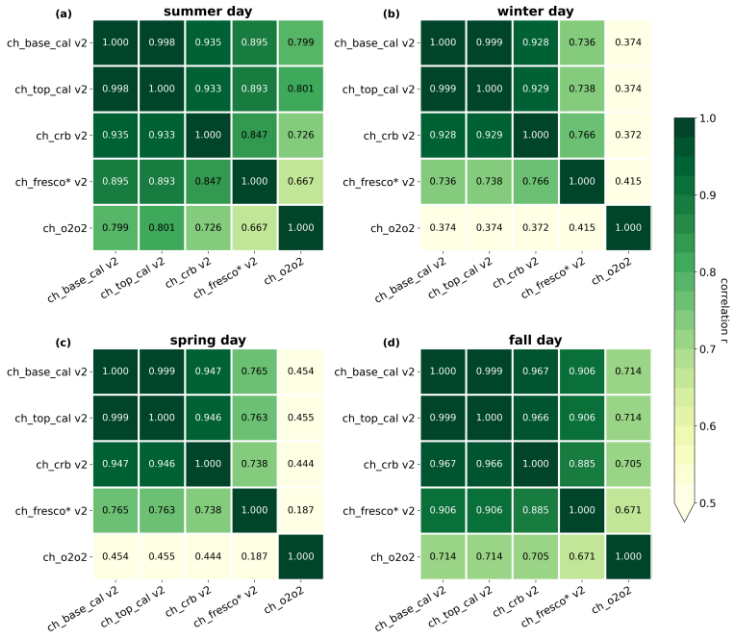


Figure S25: Tabular intercomparison of the correlations between the version 2 cloud heights from ROCINN CAL base and top, ROCINN CRB, FRESCO from the TROPOMI NO_2 product (ch_fresco*), and O2-O2 for Europe and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

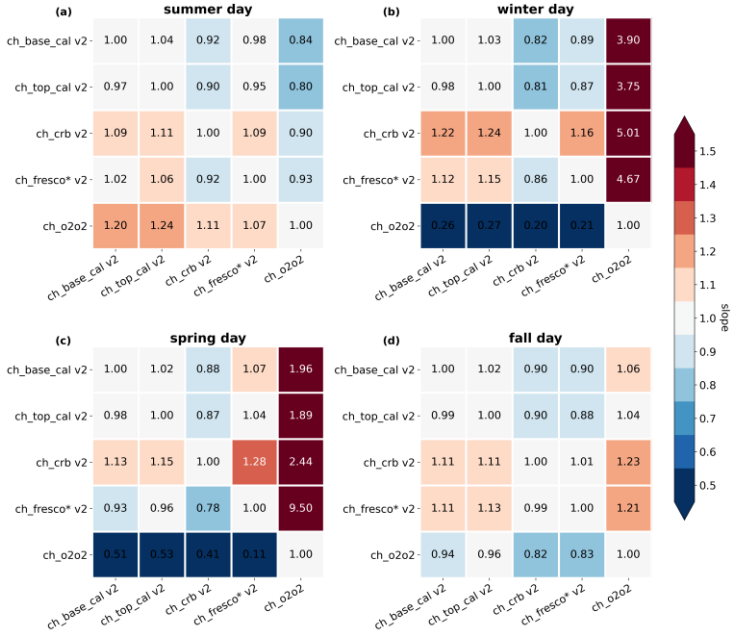


Figure S26: Tabular intercomparison of the slopes of the scatter plots between the version 2 cloud heights from ROCINN CAL base and top, ROCINN CRB, FRESCO from the TROPOMI NO_2 product (ch_fresco*), and O2-O2 for Europe and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

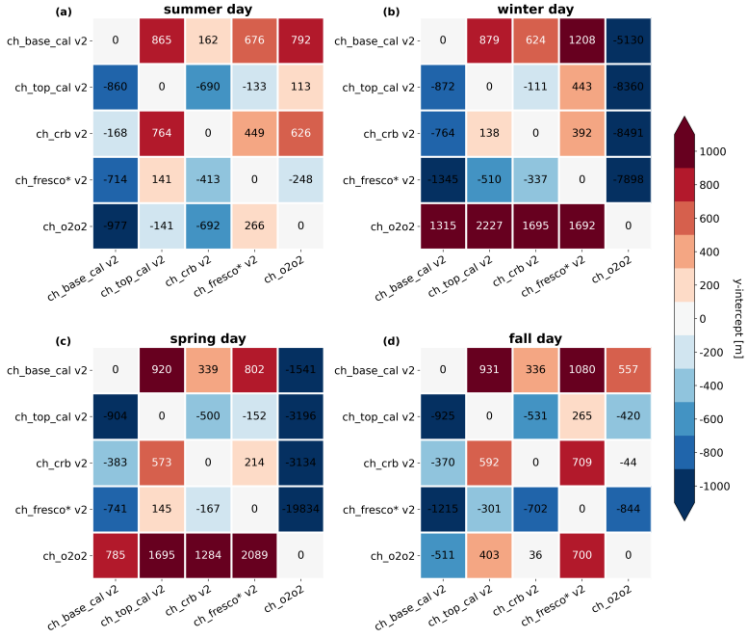


Figure S27: Tabular intercomparison of the y-intercepts of the scatter plots between the version 2 cloud heights from ROCINN CAL base and top, ROCINN CRB, FRESCO from the TROPOMI NO_2 product (ch_fresco*), and O2-O2 for Europe and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

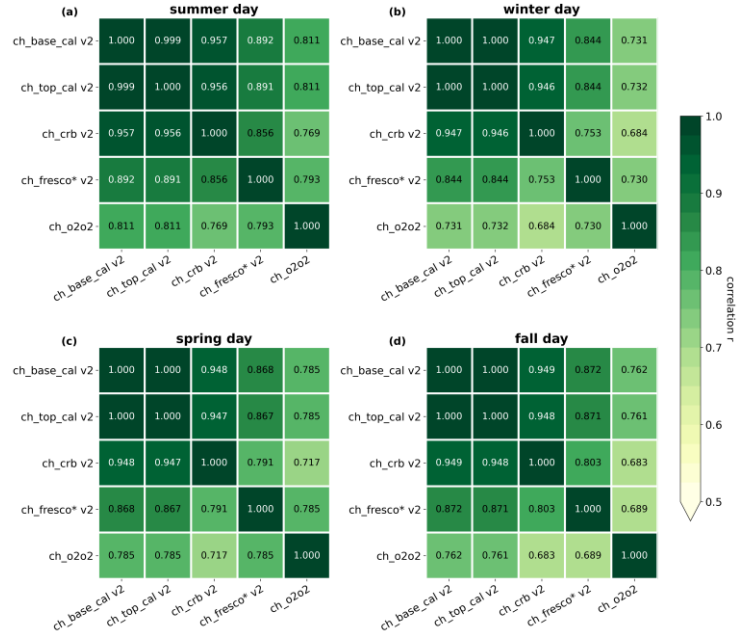


Figure S28: As Figure S25 but for Africa.

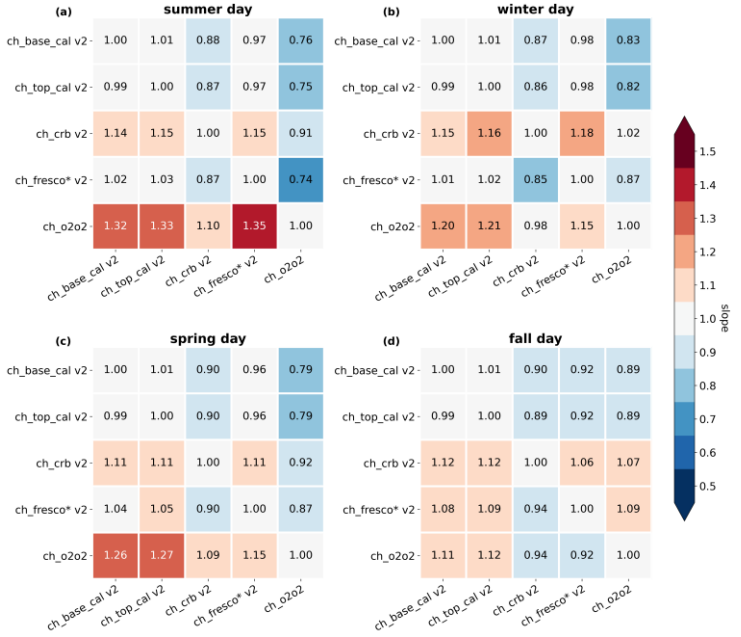


Figure S29: As Figure S26 but for Africa.

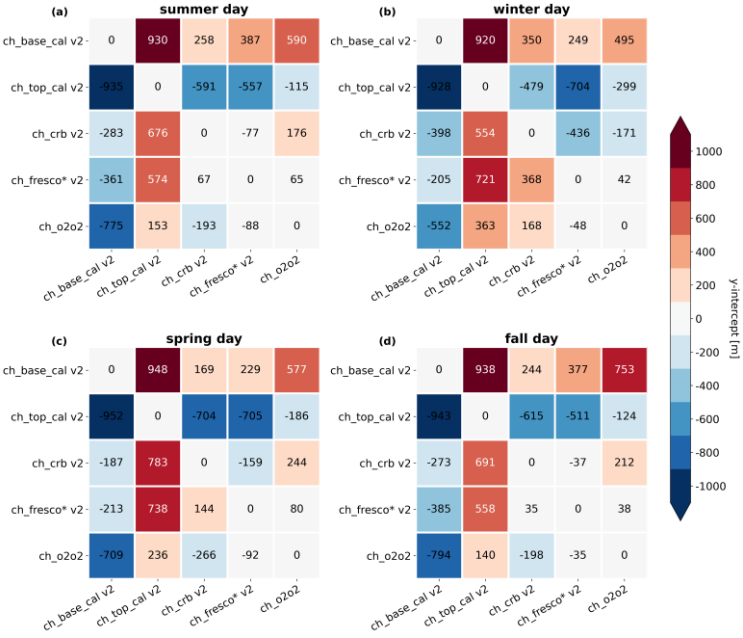


Figure S30: As Figure S27 but for Africa.

S5 Tabular intercomparison of the statistics between the version 1 cloud heights for China, Europe, and Africa

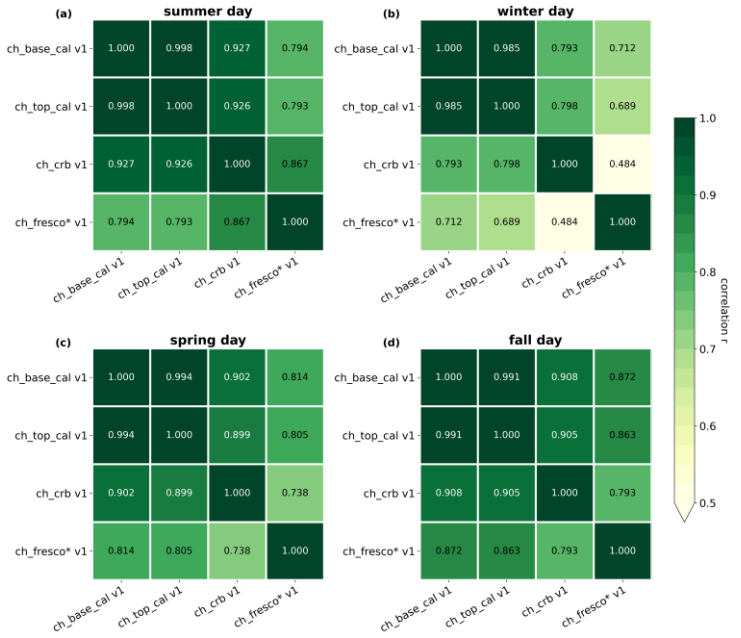


Figure S31: Tabular intercomparison of the correlations between the version 1 cloud heights from ROCINN CAL base and top, ROCINN CRB, and FRESCO from the TROPOMI NO_2 product (ch_fresco*) for China and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

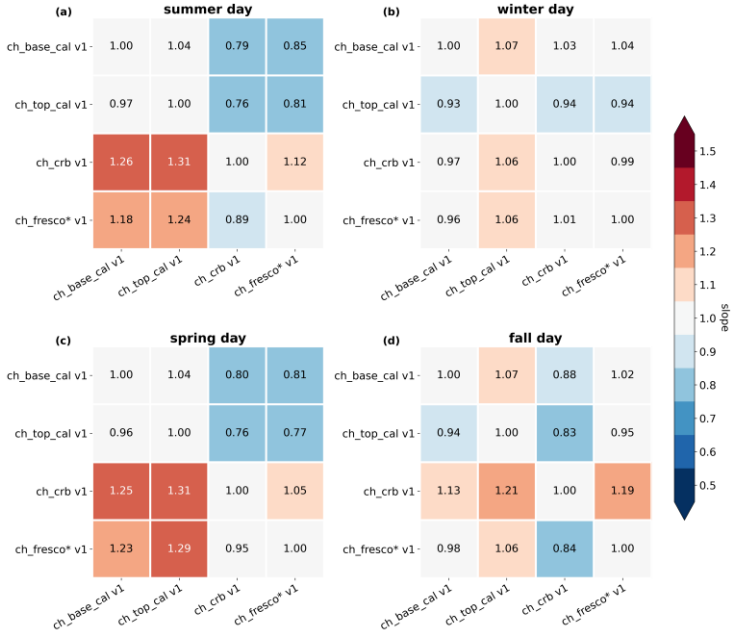


Figure S32: Tabular intercomparison of the slopes of the scatter plots between the version 1 cloud heights from ROCINN CAL base and top, ROCINN CRB, and FRESCO from the TROPOMI NO_2 product (ch_fresco*) for China and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

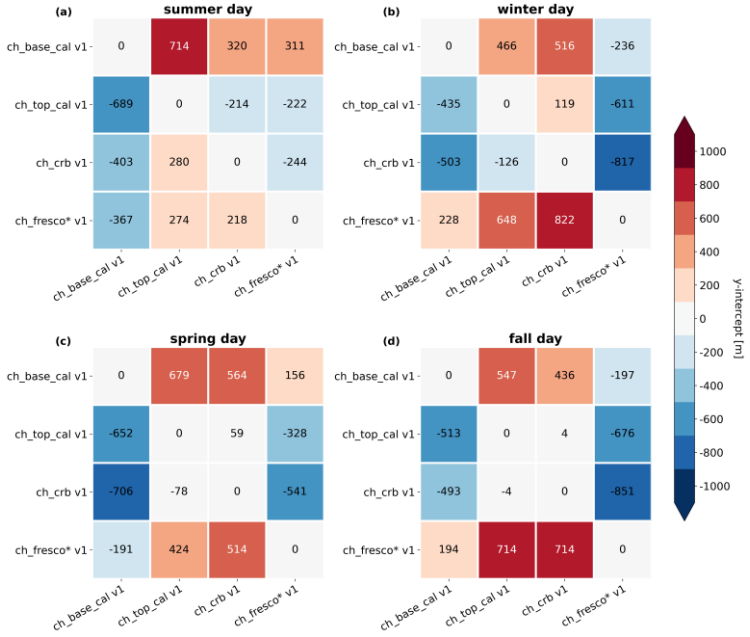


Figure S33: Tabular intercomparison of the y-intercepts of the scatter plots between the version 1 cloud heights from ROCINN CAL base and top, ROCINN CRB, and FRESCO from the TROPOMI NO_2 product (ch_fresco*) for China and (a) the summer day, (b) the winter day, (c) the spring day, (d) the fall day.

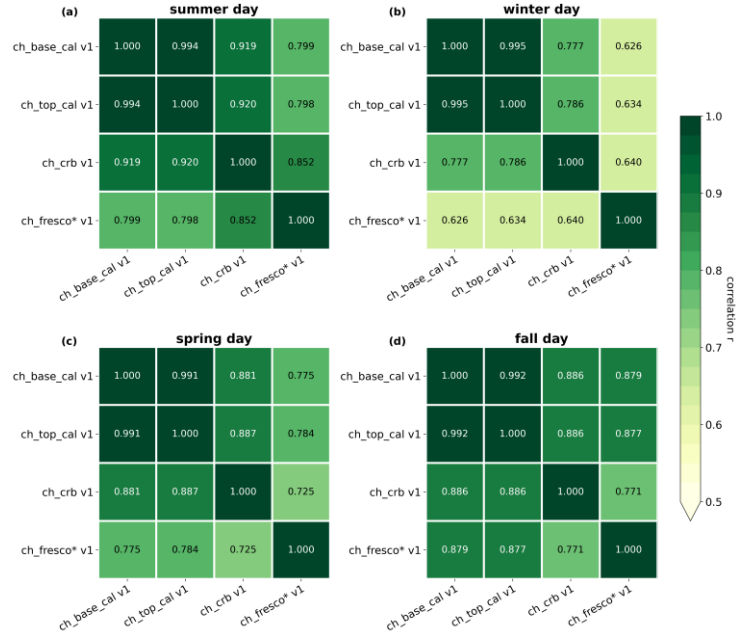


Figure S34: As Figure S31 but for Europe.

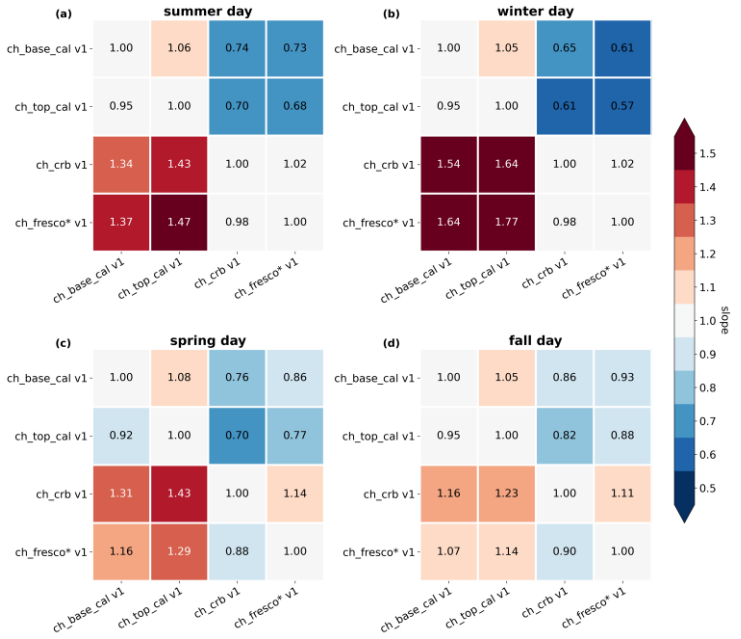


Figure S35: As Figure S32 but for Europe.

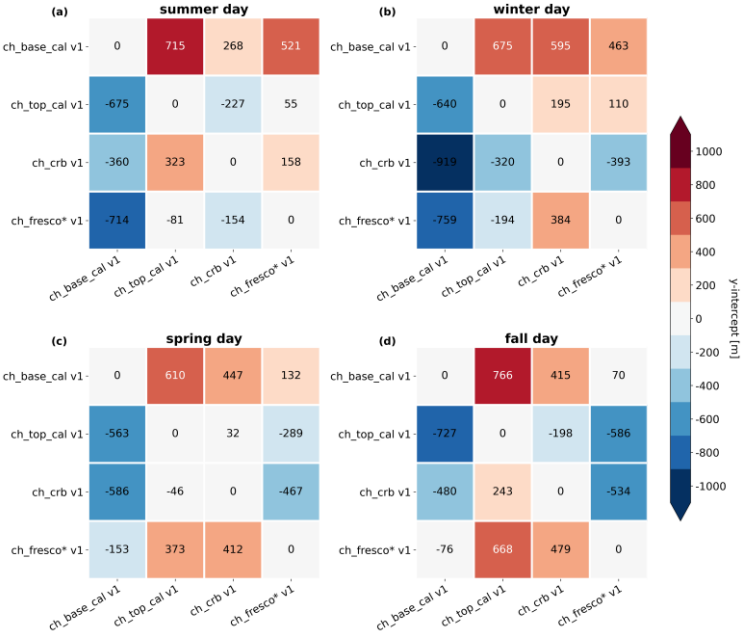


Figure S36: As Figure S33 but for Europe.

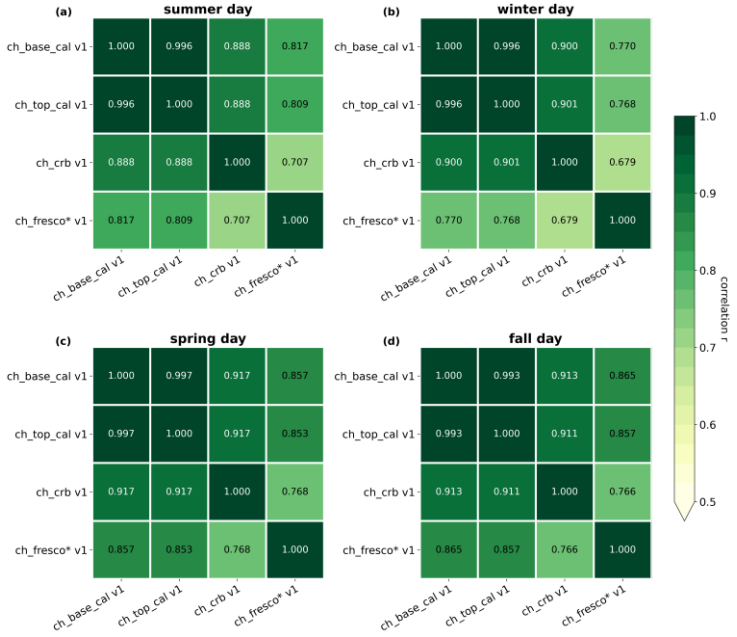


Figure S37: As Figure S31 but for Africa.

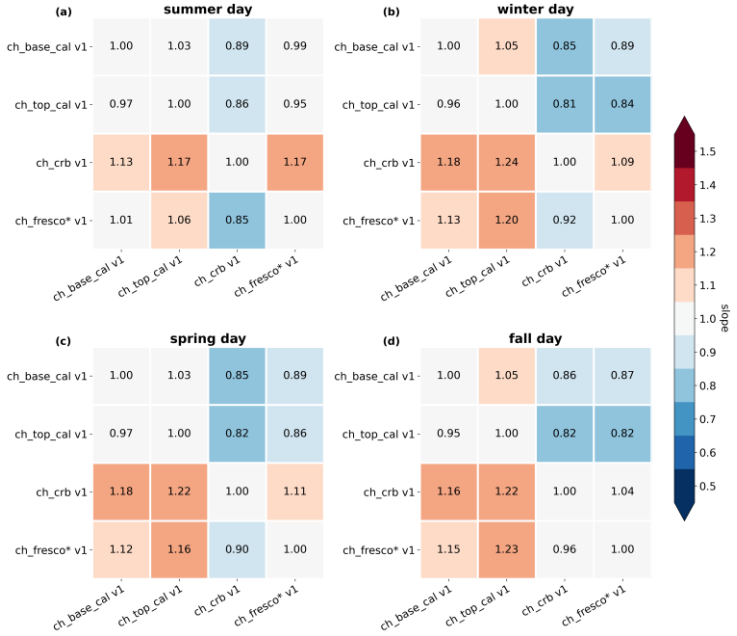


Figure S38: As Figure S32 but for Africa.

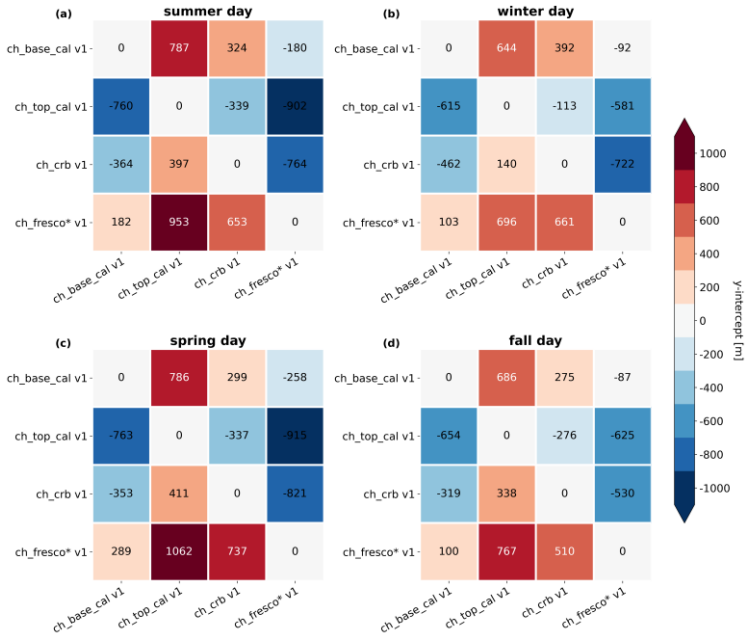


Figure S39: As Figure S33 but for Africa.

S6: Additional plots of the intercomparison between the version 2 cloud fractions for Europe and Africa

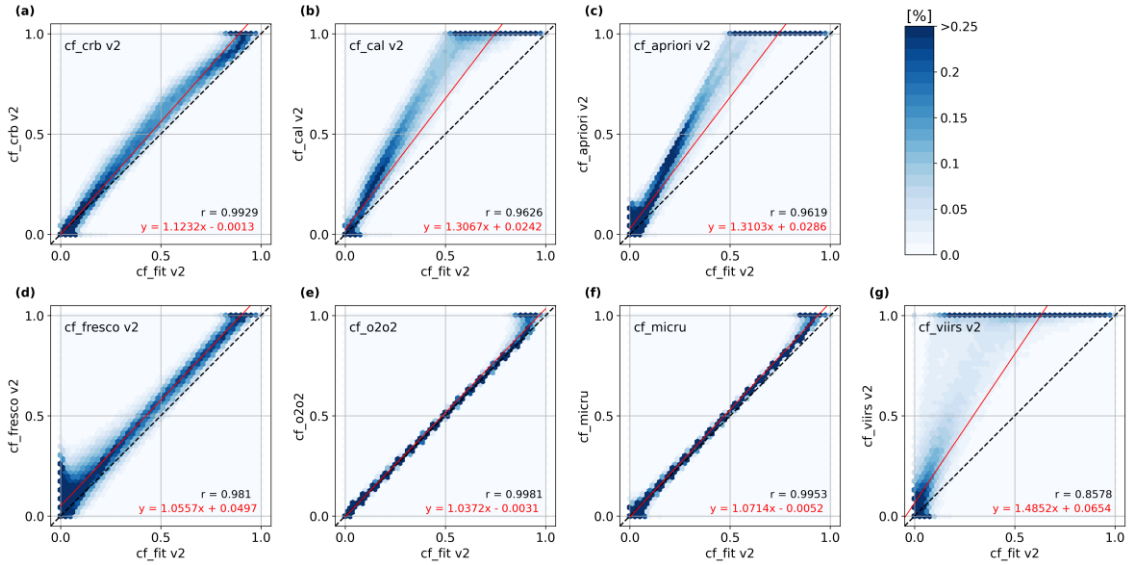


Figure S40: Scatter plots between the version 2 cloud fractions from (a) ROCINN CRB, (b) ROCINN CAL, (c) OCRA a priori, (d) FRESCO, (e) O2-O2, (f) MICRU, and (g) VIIRS and the cloud fraction from the NO_2 fitting window (cf_fit) for Europe and the summer day (30 June 2018).

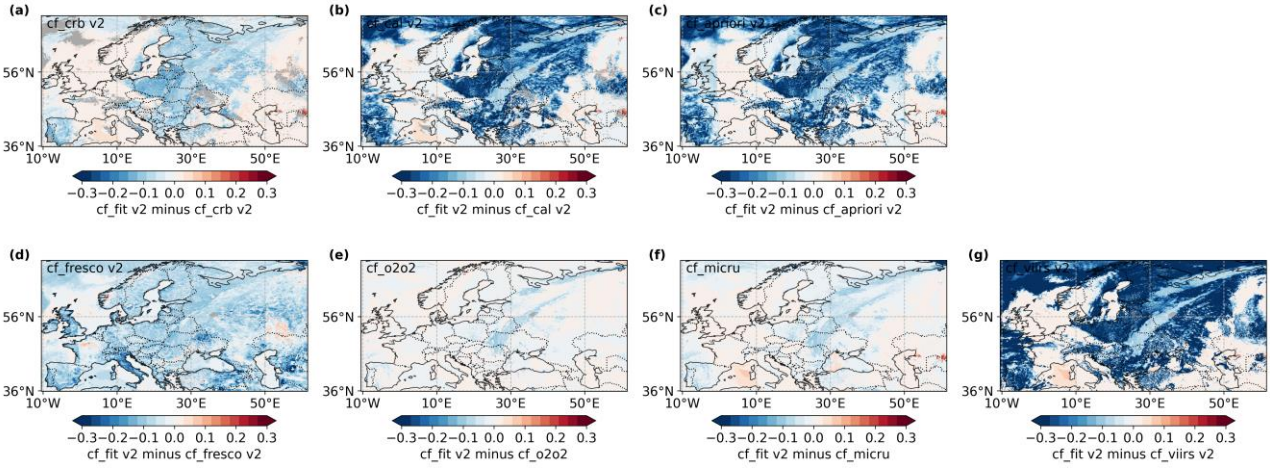


Figure S41: Differences between the version 2 cloud fractions from (a) ROCINN CRB, (b) ROCINN CAL, (c) OCRA a priori, (d) FRESCO, (e) O2-O2, (f) MICRU, and (g) VIIRS and the cloud fraction from the NO_2 fitting window (cf_fit) for Europe and the summer day (30 June 2018).

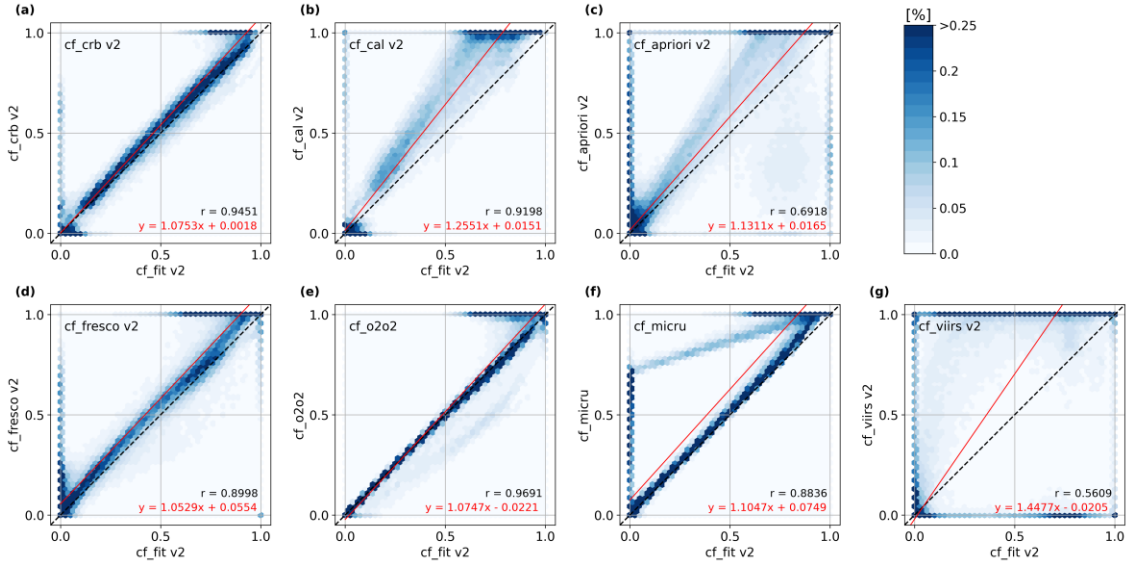
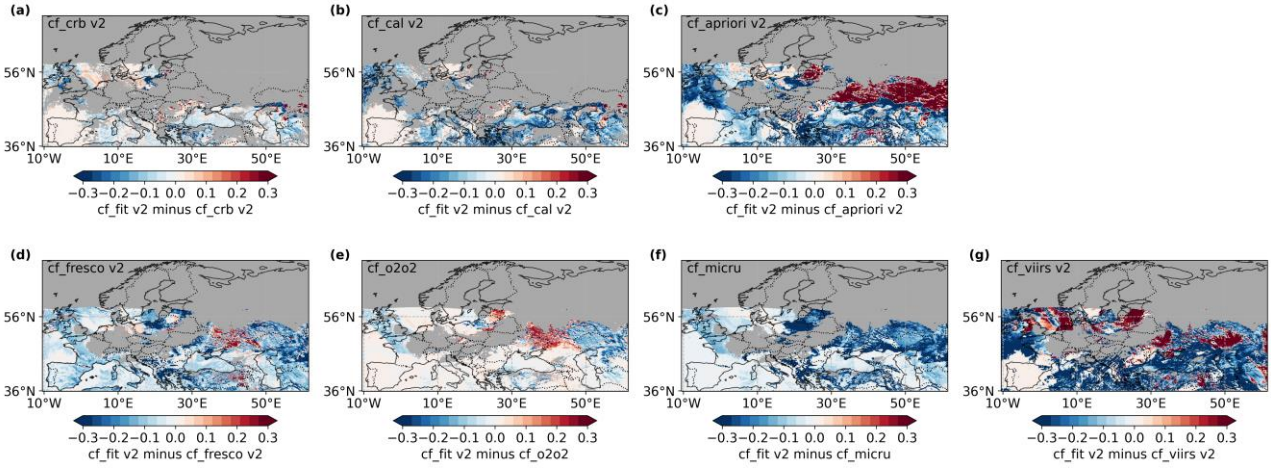


Figure S42: As Figure S40 but for the winter day (5 January 2019).



130

Figure S43: As Figure S41 but for the winter day (5 January 2019).

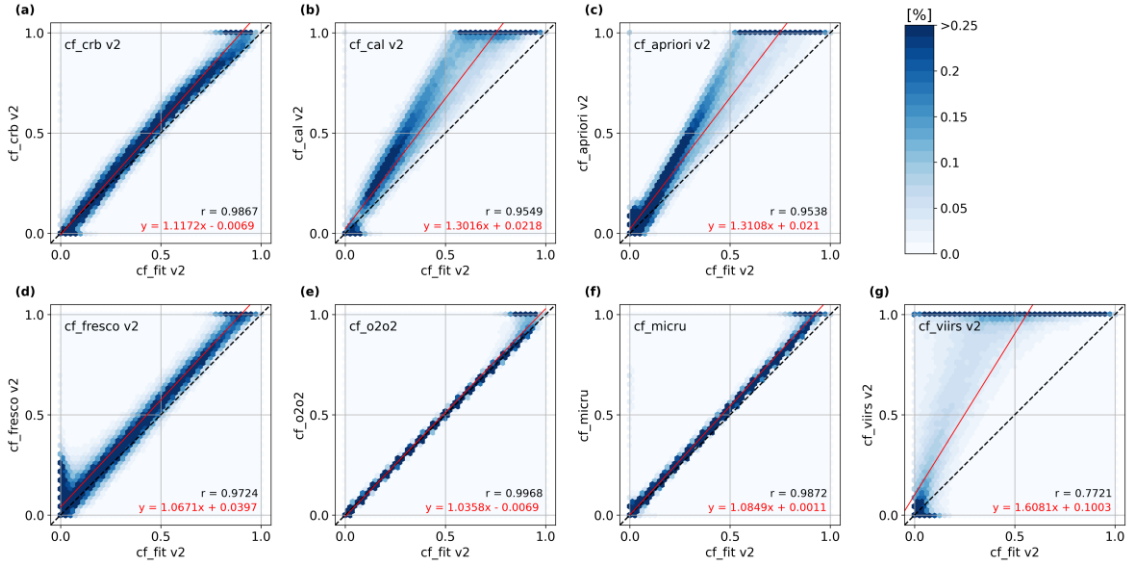


Figure S44: As Figure S40 but for the fall day (20 September 2019).

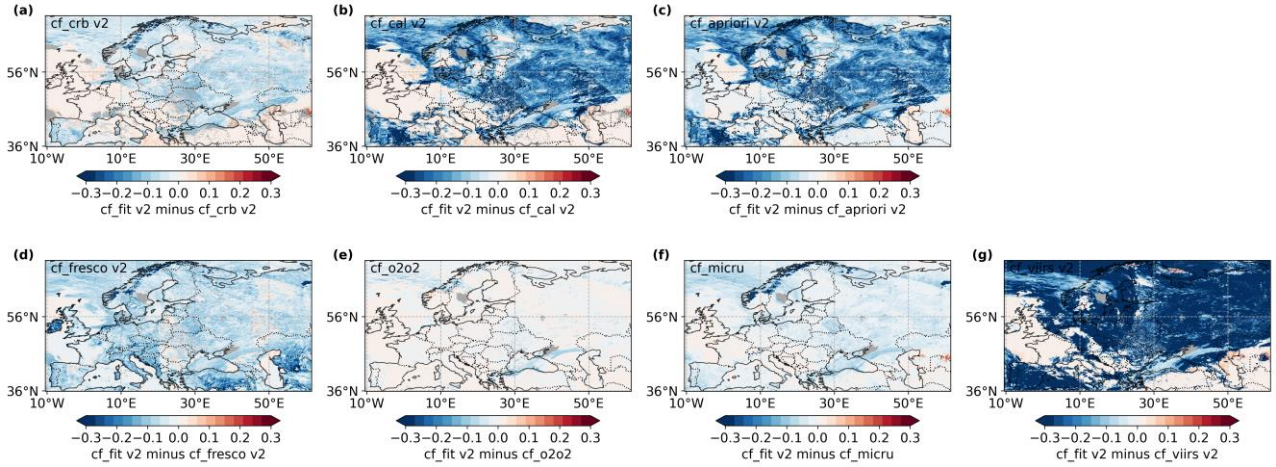


Figure S45: As Figure S41 but for the fall day (20 September 2019).

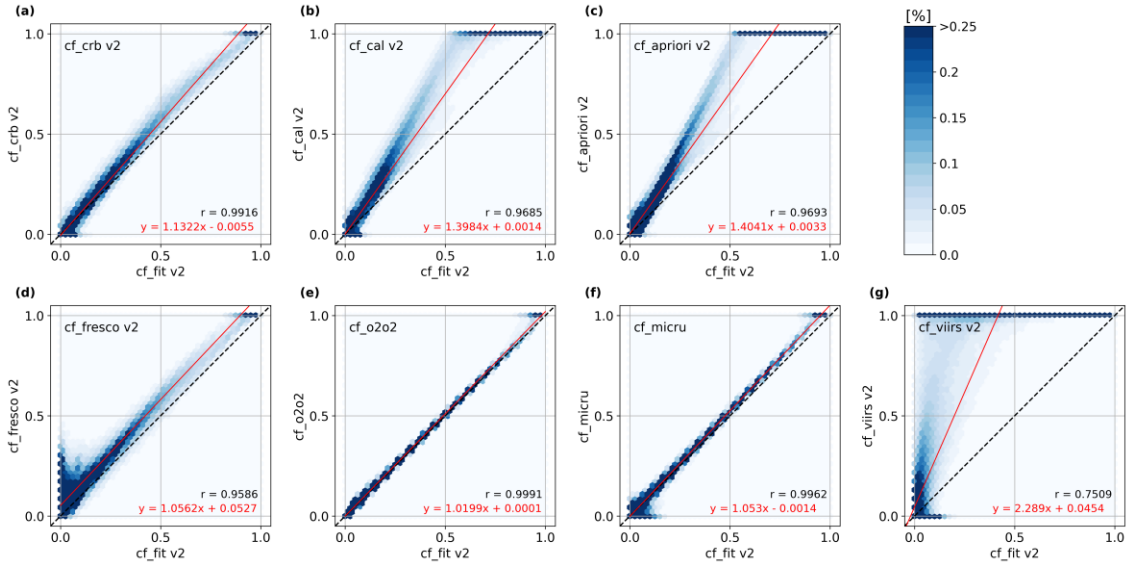


Figure S46: Scatter plots between the version 2 cloud fractions from (a) ROCINN CRB, (b) ROCINN CAL, (c) OCRA a priori, (d) FRESCO, (e) O2-O2, (f) MICRU, and (g) VIIRS and the cloud fraction from the NO_2 fitting window (cf_fit) for Africa and the summer day (30 June 2018).

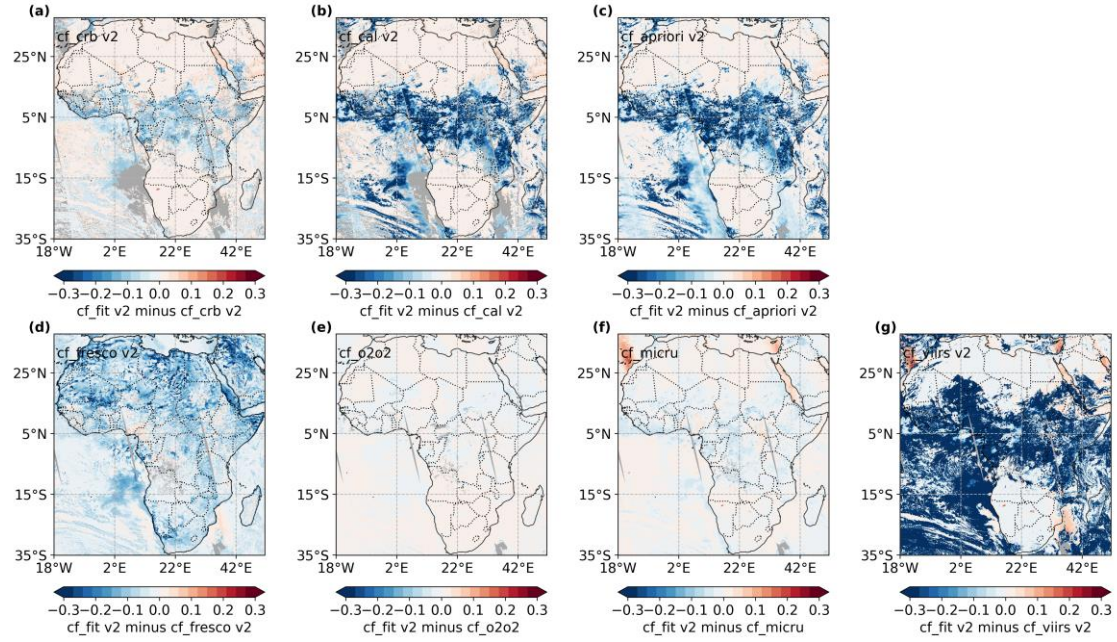
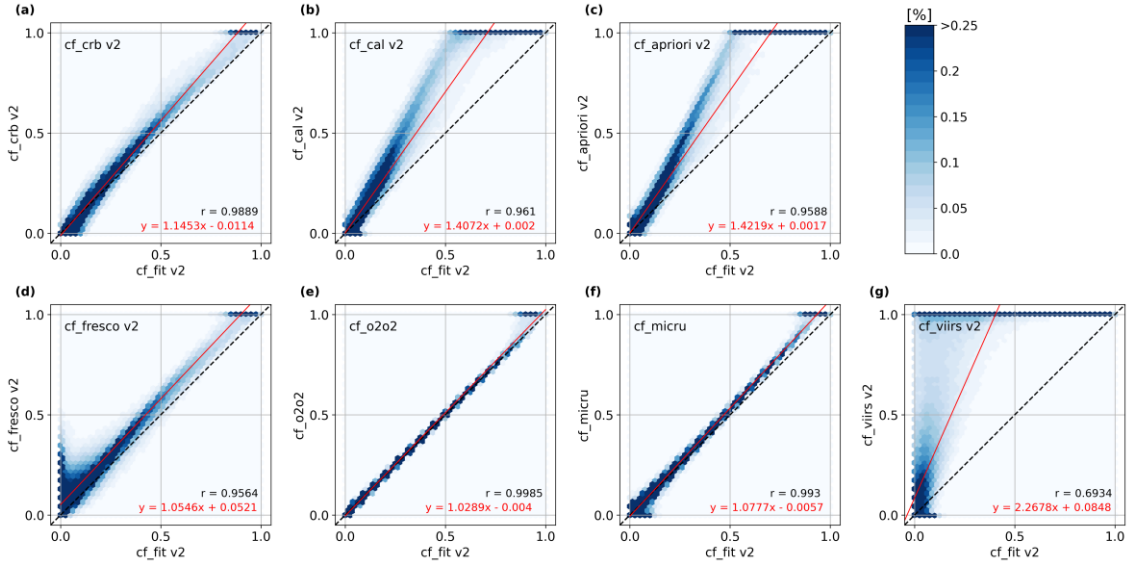


Figure S47: Differences between the version 2 cloud fractions from (a) ROCINN CRB, (b) ROCINN CAL, (c) OCRA a priori, (d) FRESCO, (e) O2-O2, (f) MICRU, and (g) VIIRS and the cloud fraction from the NO_2 fitting window (cf_fit) for Africa and the summer day (30 June 2018).



145 **Figure S48: As Figure S46 but for the spring day (4 April 2019).**

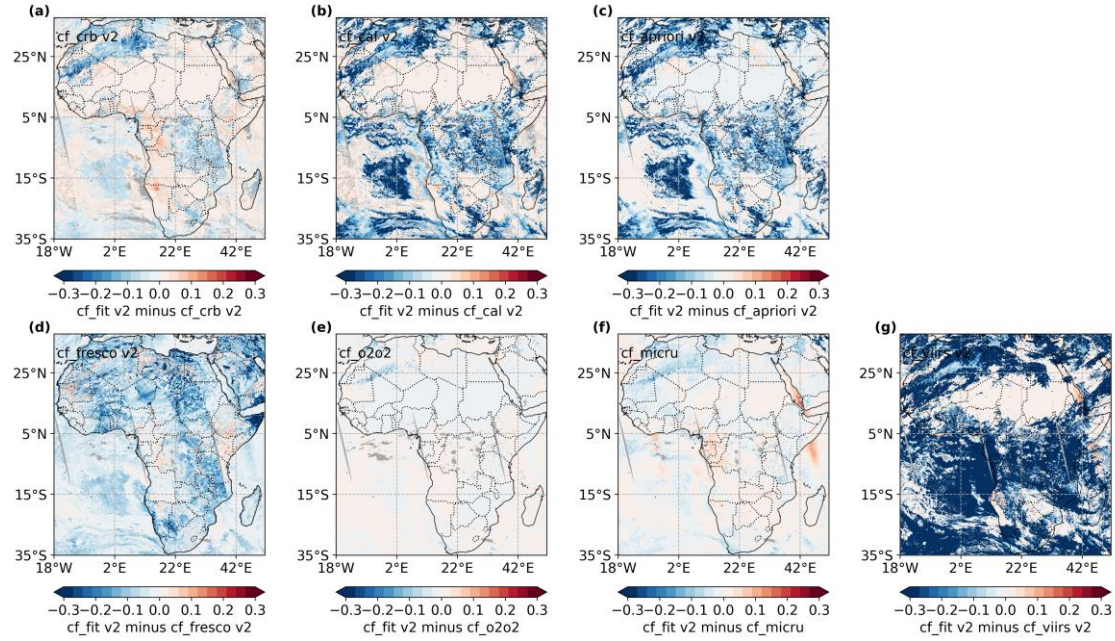


Figure S49: As Figure S47 but for the spring day (4 April 2019).

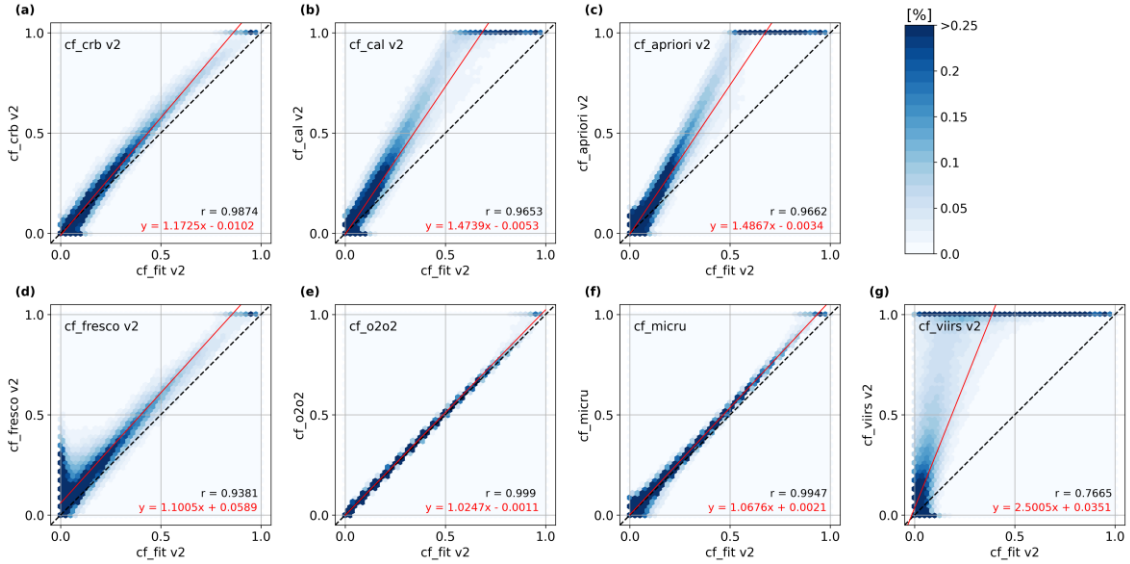


Figure S50: As Figure S46 but for the fall day (20 September 2019).

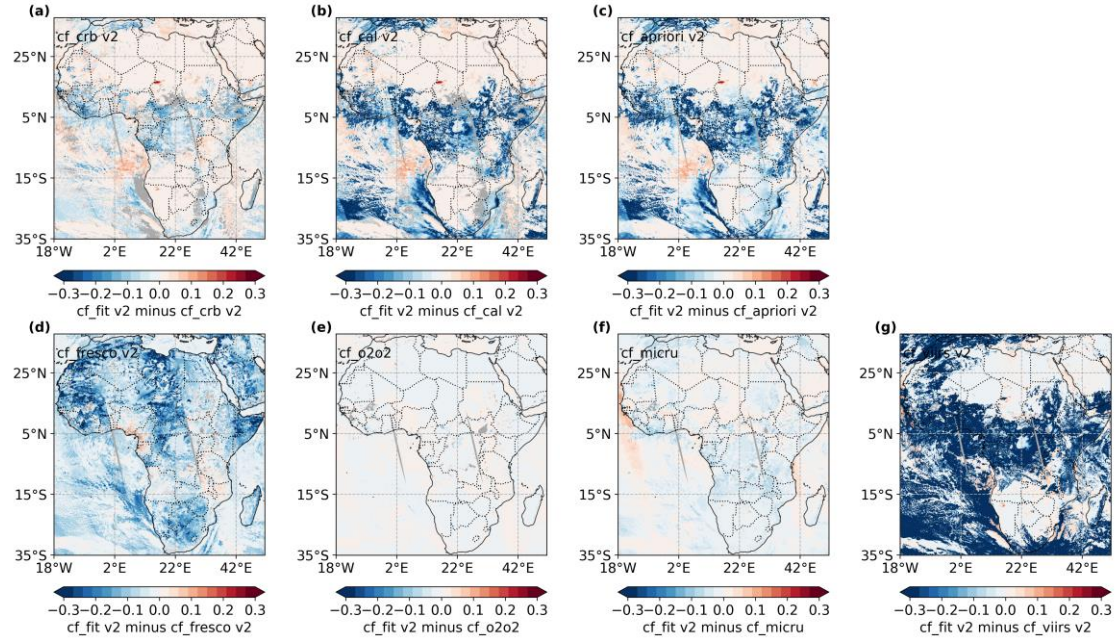


Figure S51: As Figure S47 but for the fall day (20 September 2019).

S7: Additional scatter plots of the intercomparison between the version 2 cloud heights for China

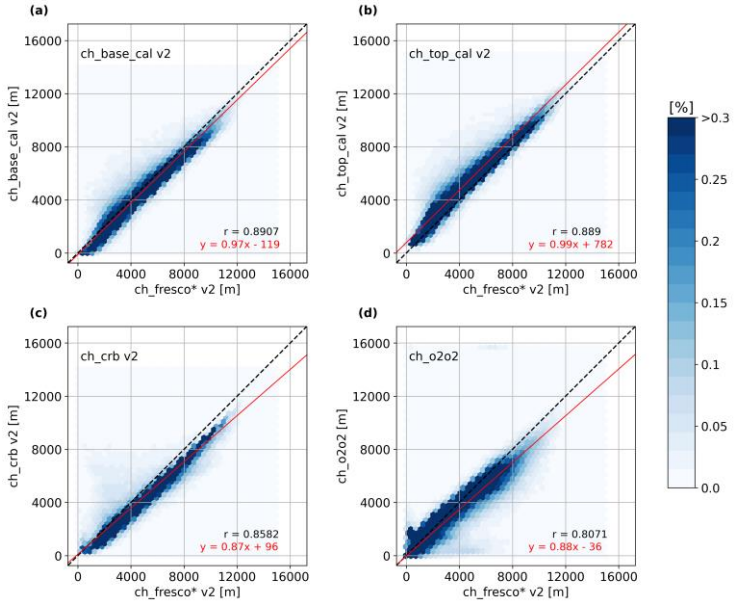


Figure S52: Scatter plots between the version 2 (a) ROCINN CAL CBH, (b) ROCINN CAL CTH, (c) ROCINN CRB CH, and (d) O2-O2 CH and the FRESCO CH from the TROPOMI NO_2 product (ch_fresco*) for China and the summer day (30 June 2018).

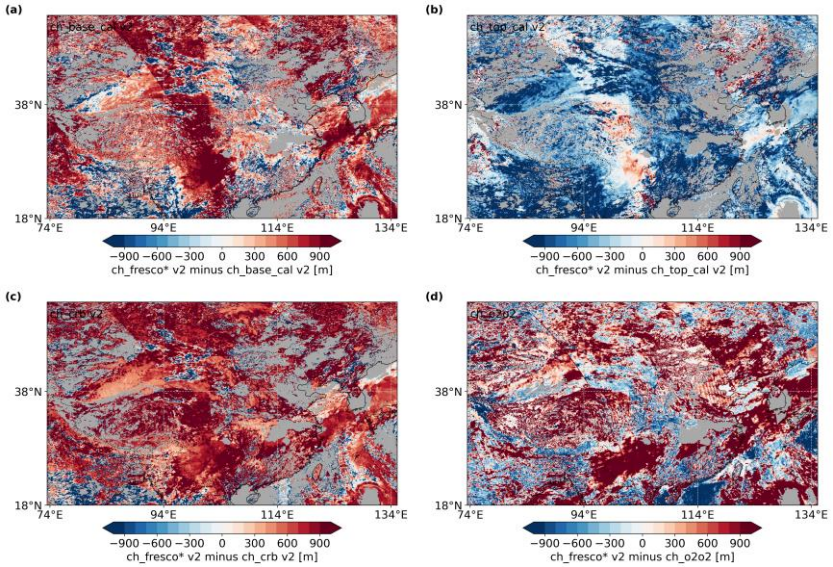
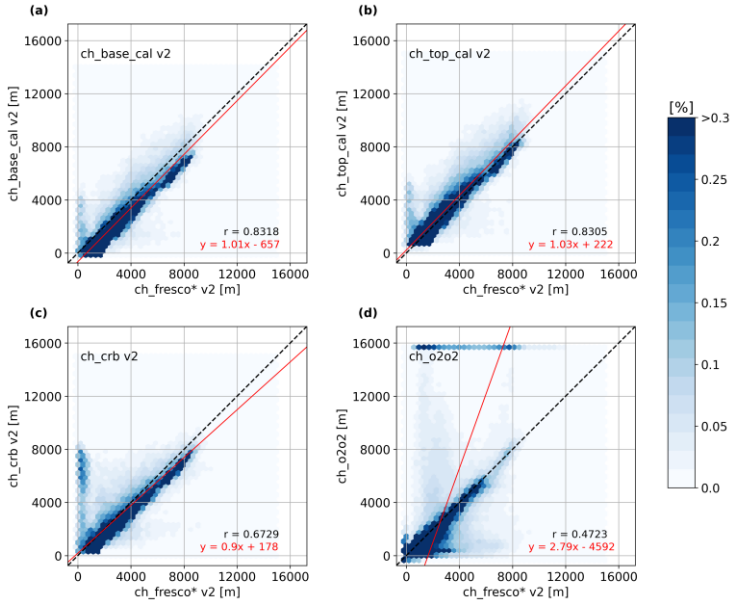


Figure S53: Differences between the version 2 (a) ROCINN CAL CBH, (b) ROCINN CAL CTH, (c) ROCINN CRB CH, and (d) O2-O2 CH and the FRESCO CH from the TROPOMI NO_2 product (ch_fresco*) for China and the summer day (30 June 2018).



160 **Figure S54: As Figure S52 but for the winter day (5 January 2019).**

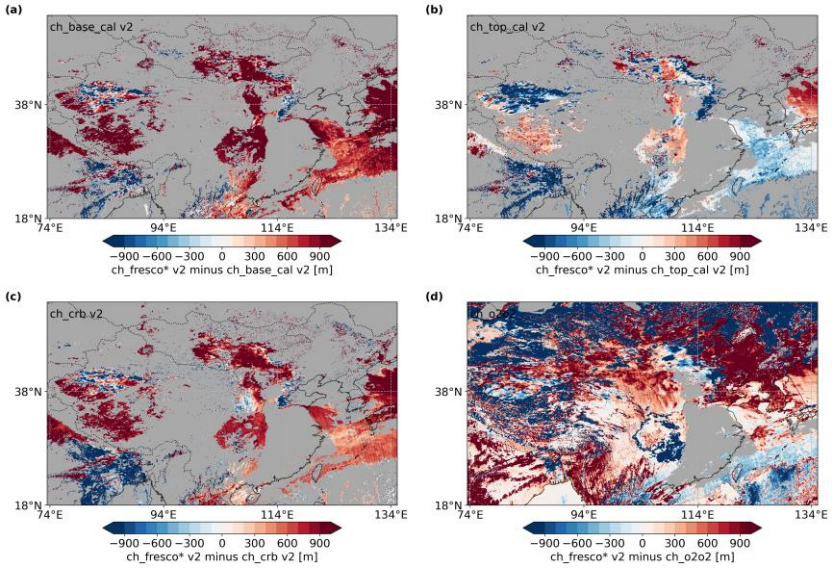


Figure S55: As Figure S53 but for the winter day (5 January 2019).

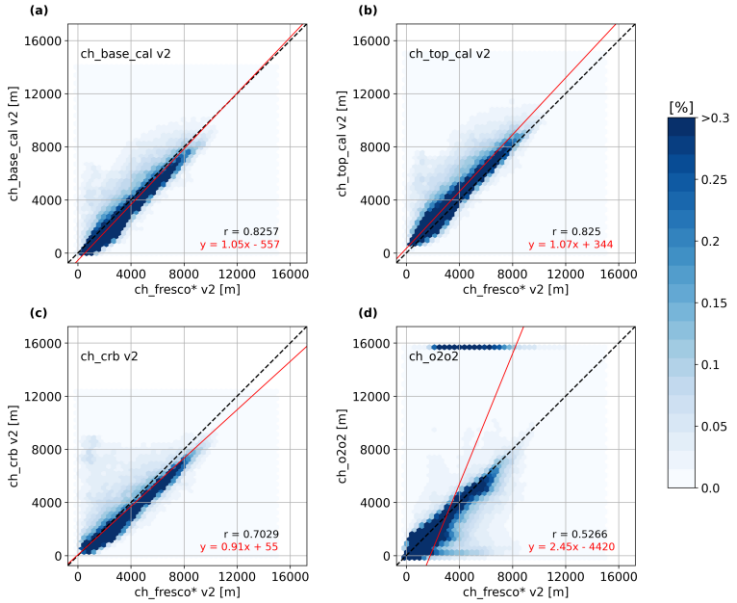


Figure S56: As Figure S52 but for the spring day (4 April 2019).

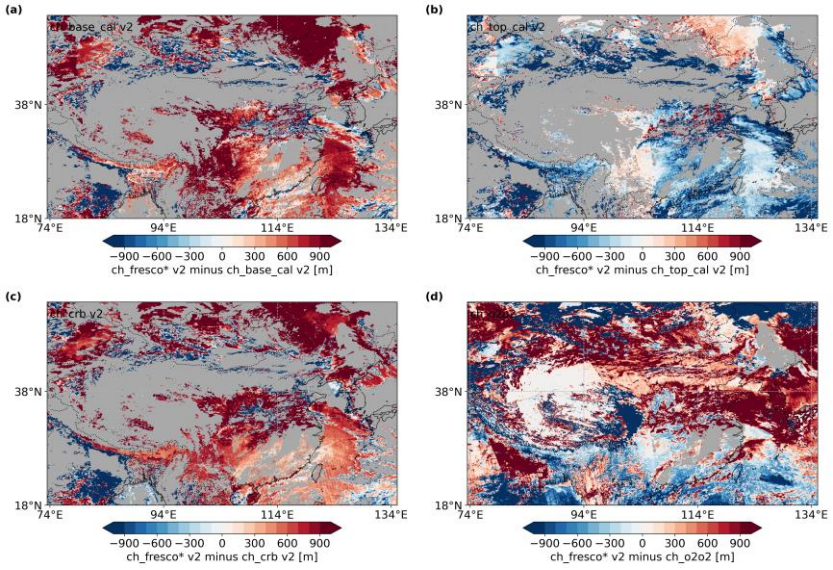


Figure S57: As Figure S53 but for the spring day (4 April 2019).

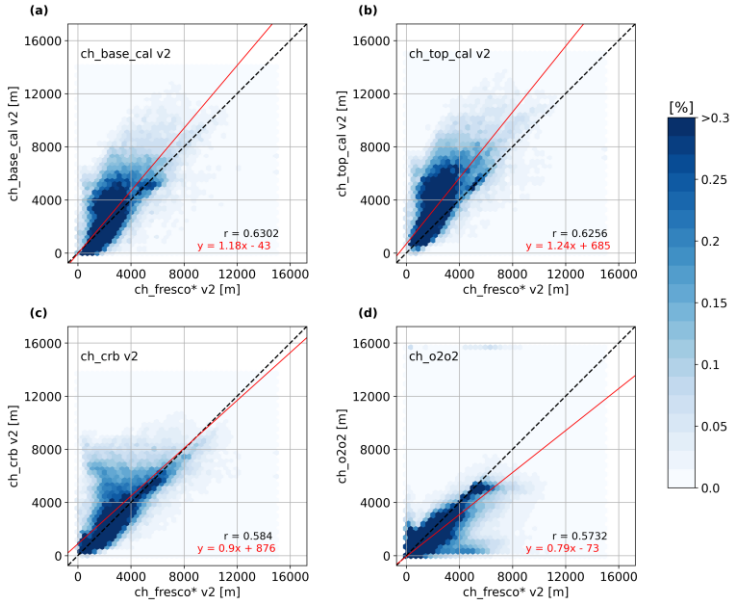


Figure S58: Scatter plots between the version 2 (a) ROCINN CAL CBH, (b) ROCINN CAL CTH, (c) ROCINN CRB CH, and (d) O2-O2 CH and the FRESCO CH from the TROPOMI NO_2 product (ch_fresco*) for China and the summer day (30 June 2018) with a cloud fraction threshold of 0.2 (only CH for scenes with cloud fractions ≤ 0.2).

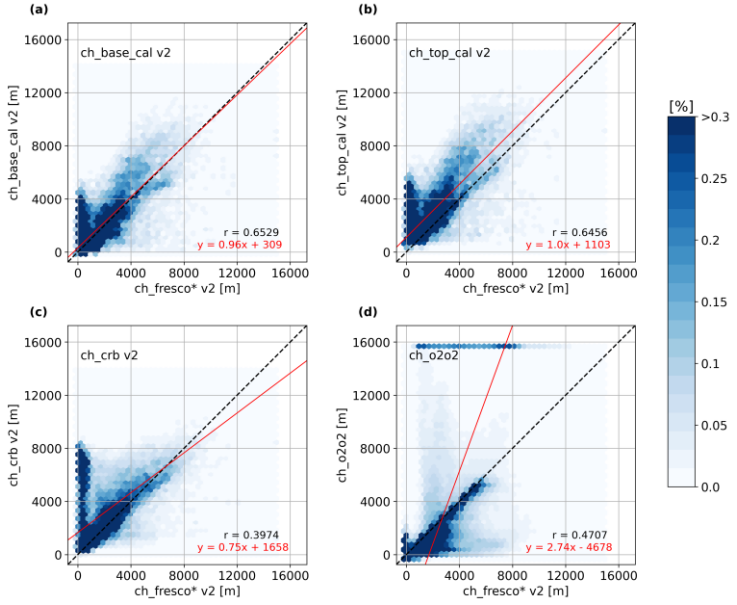


Figure S59: As Figure S58 but for the winter day (5 January 2019).

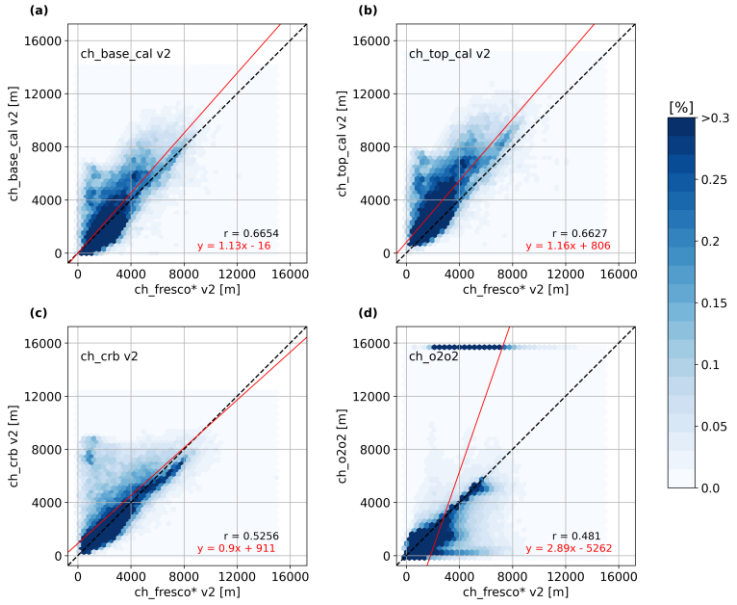
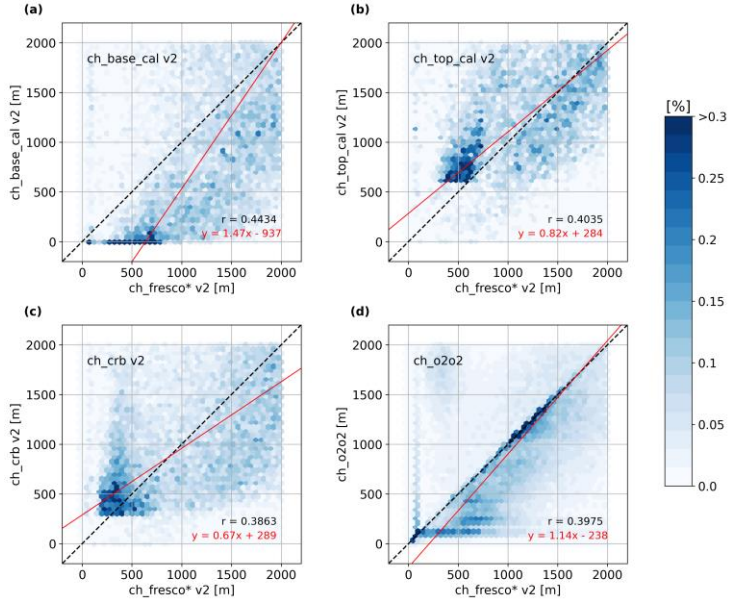
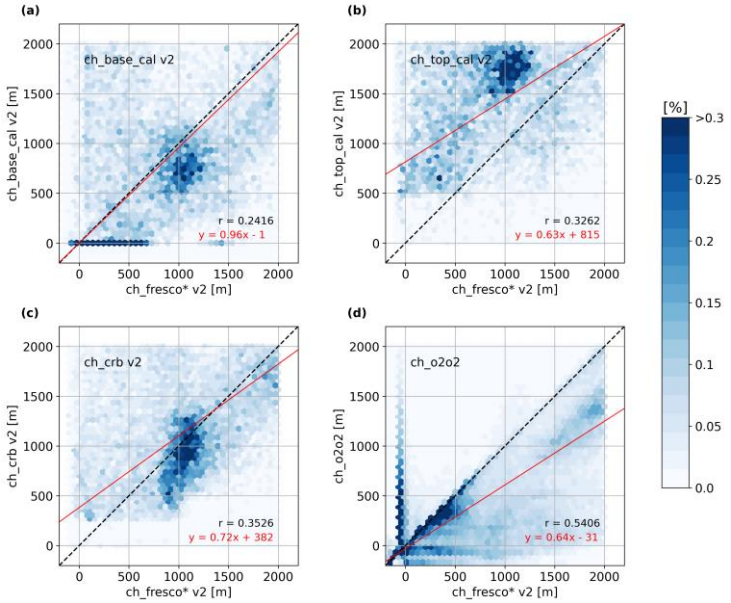


Figure S60: As Figure S58 but for the spring day (4 April 2019).



175

Figure S61: Scatter plots between the version 2 (a) ROCINN CAL CBH, (b) ROCINN CAL CTH, (c) ROCINN CRB CH, and (d) O2-O2 CH and the FRESCO CH from the TROPOMI NO_2 product (ch_fresco*) for China and the summer day (30 June 2018) with a cloud fraction threshold of 0.2 for cloud heights lower than or equal 2 km (only CH ≤ 2 km for scenes with cloud fractions ≤ 0.2).



180 **Figure S62: As Figure S61 but for the winter day (5 January 2019).**

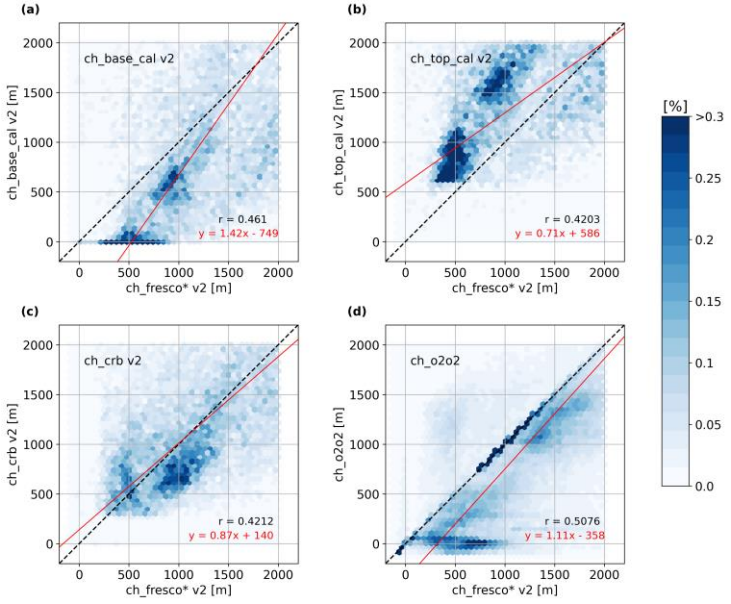


Figure S63: As Figure S61 but for the spring day (4 April 2019).

S8 Across-track dependency plots of the version 1 cloud fractions and cloud heights for the globe, Africa, Europe, and China

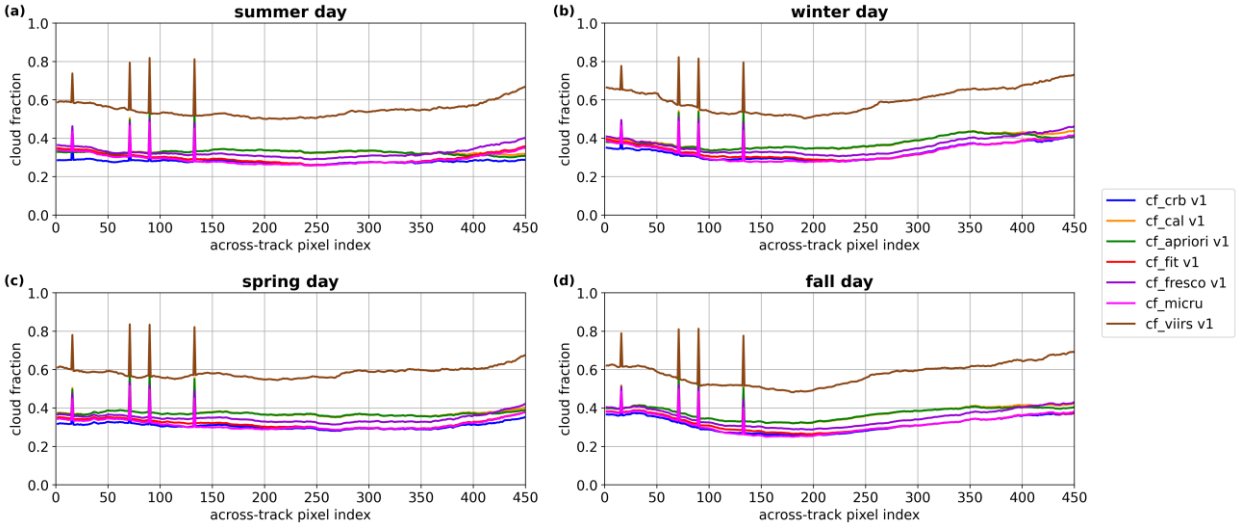


Figure S64: Mean values of version 1 cloud fractions, as a function of the across-track index, from ROCINN CRB, ROCINN CAL, OCRA a priori, the NO_2 fitting window (cf_fit), FRESCO, MICRU, and VIIRS for the globe and (a) the summer day, (b) the winter day, (c) the spring day, and (d) the fall day with quality- and snow-/ice-flagging, and including only pixels having valid values for all products.

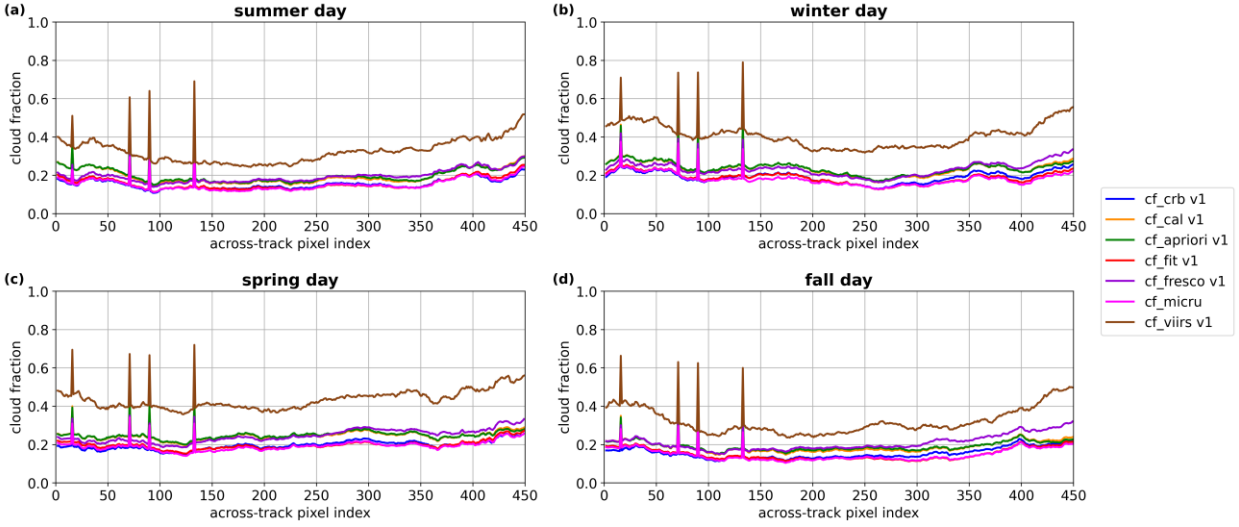


Figure S65: As Figure S64 but for Africa.

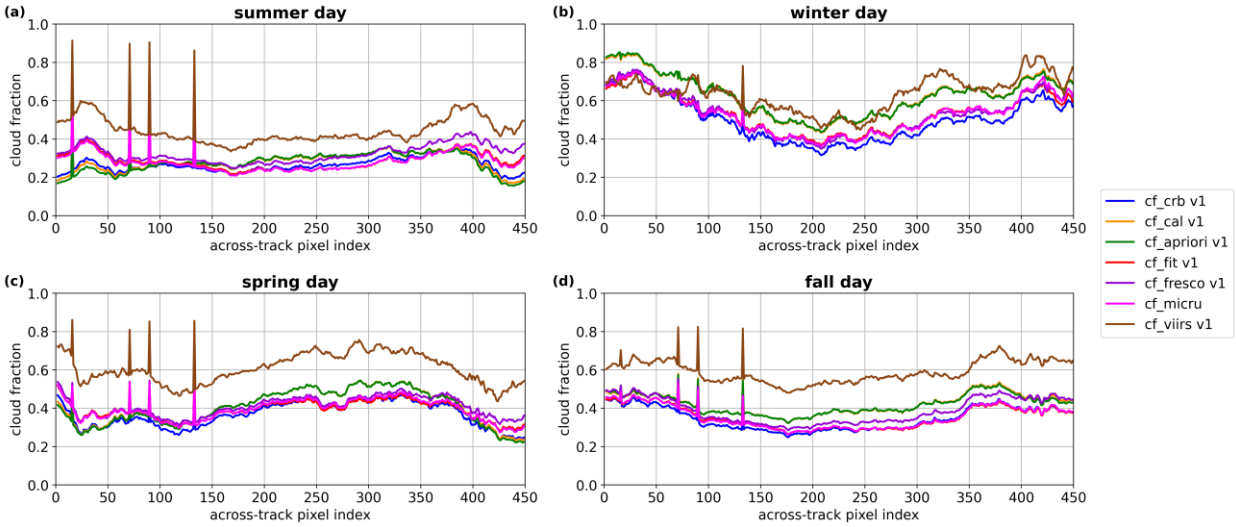


Figure S66: As Figure S64 but for Europe.

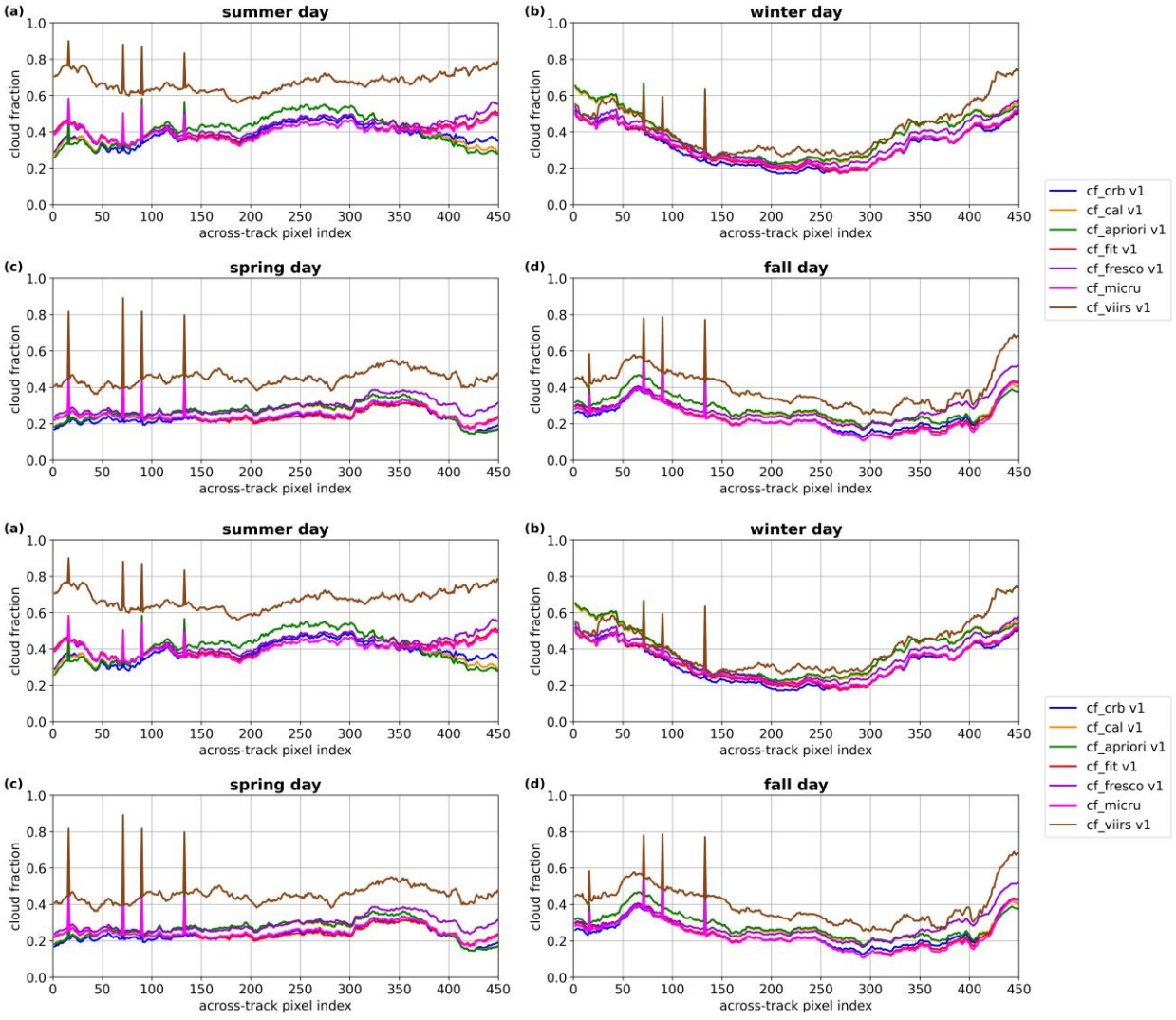


Figure S67: As Figure S64 but for China.

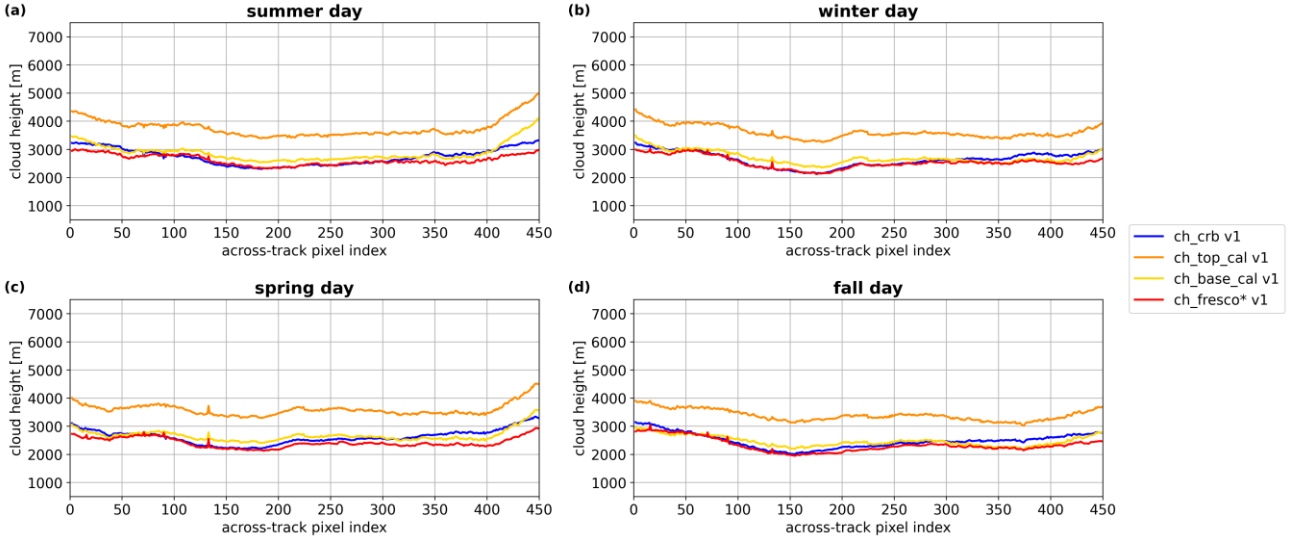


Figure S68: Mean values of version 1 cloud heights, as a function of the across-track index, from ROCINN CRB, ROCINN CAL top and base, and FRESCO from the TROPOMI NO_2 product (ch_fresco*) for the globe and (a) the summer day, (b) the winter day, (c) the spring day, and (d) the fall day with quality- and snow-/ice-flagging, and including only pixels having valid values for all products.

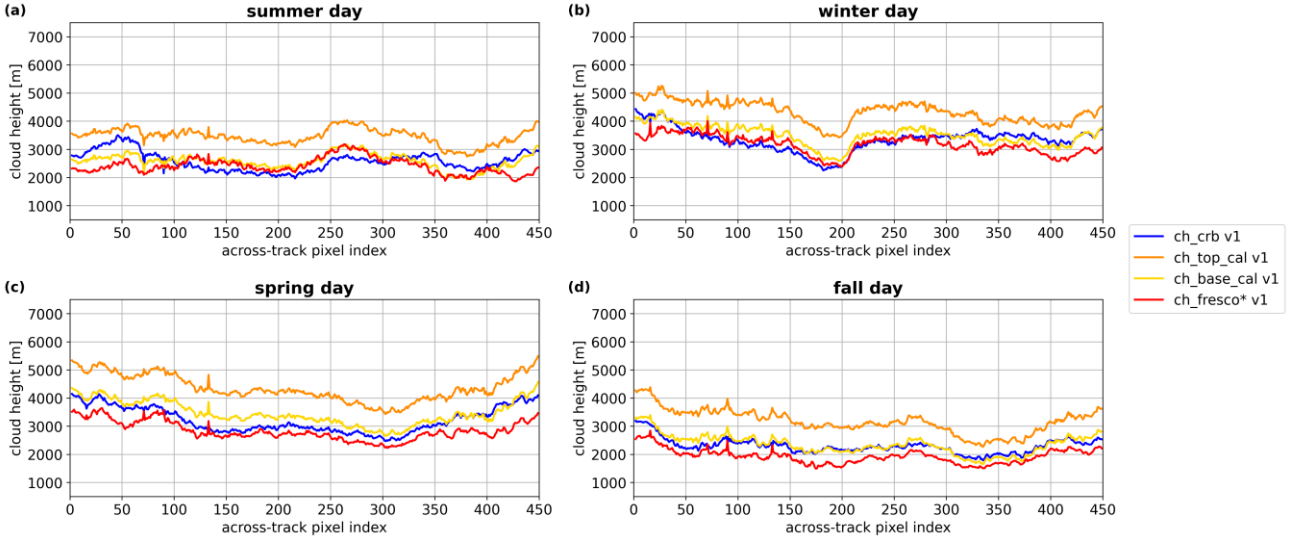


Figure S69: As Figure S68 but for Africa.

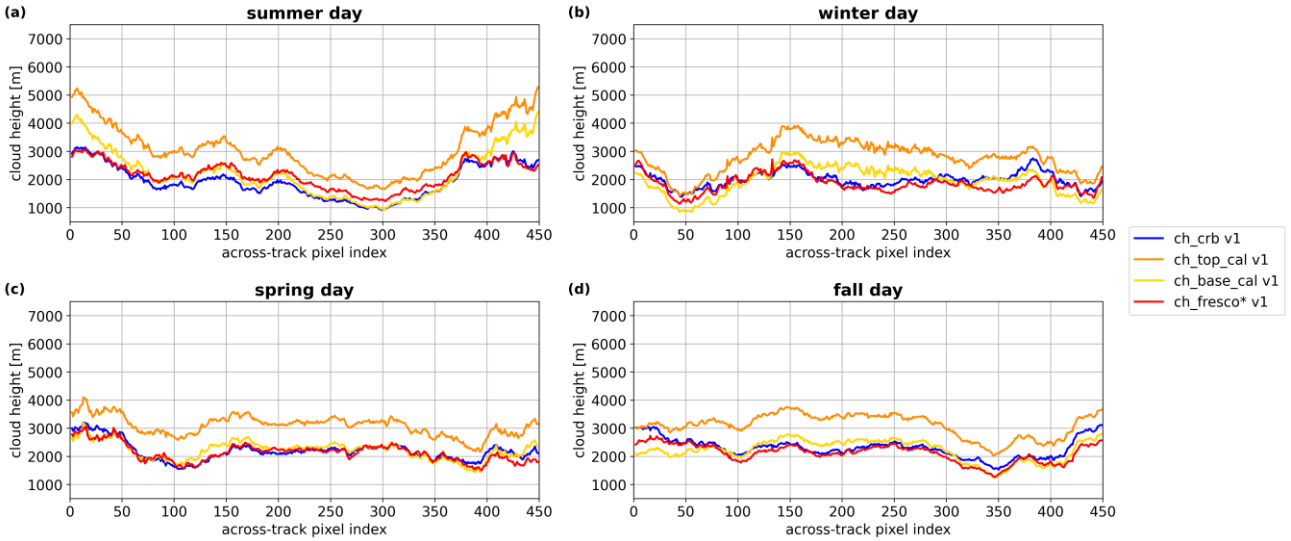


Figure S70: As Figure S68 but for Europe.

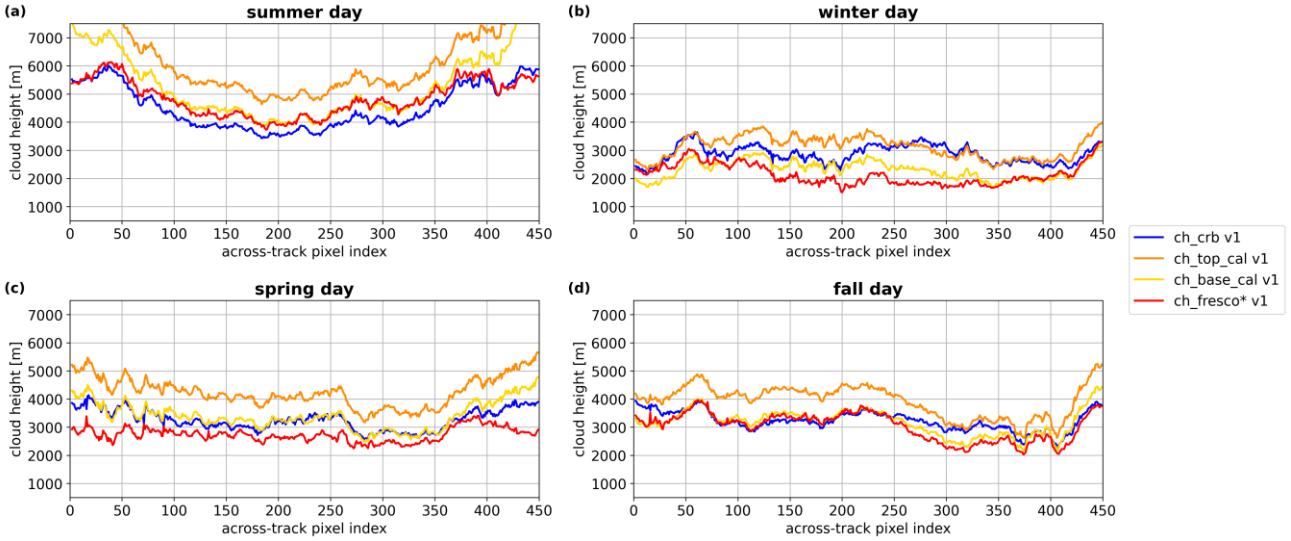


Figure S71: As Figure S68 but for China.