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Supporting Information for

**Observing a Volatile Organic Compound from a Geostationary Infrared Sounder:
HCOOH from FengYun-4B/GIIRS**

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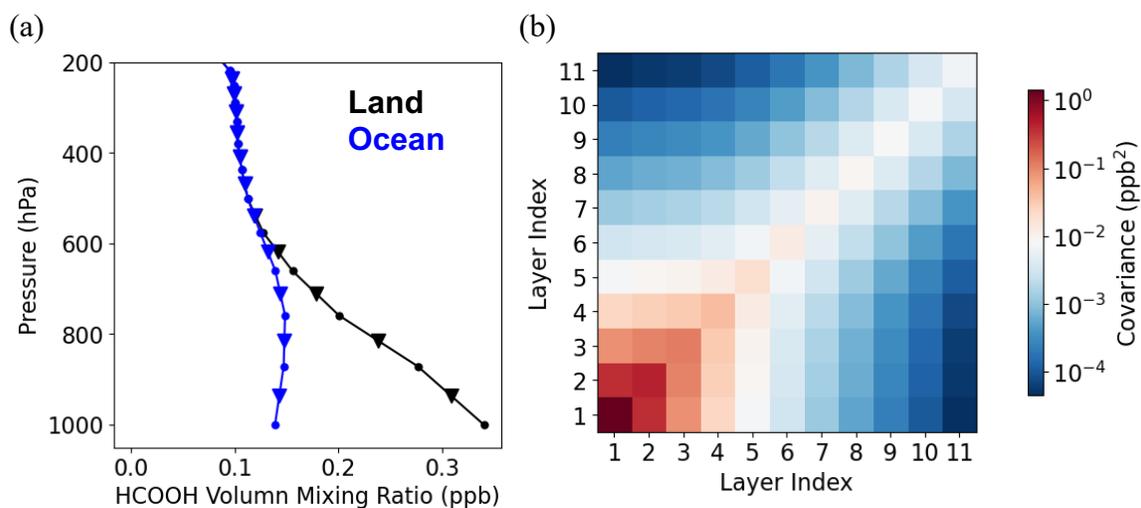


Figure S1. The a priori HCOOH profiles over land and ocean adopted from an updated version of the IASI a priori (Franco et al. 2018) in (a) and the a priori covariance matrix for land retrieval as an example in (b) from the surface to 200 hPa (i.e., layer #1 to #11). The one sigma variability of the a priori HCOOH profile derived from model simulations is about 70%, which is enlarged by a factor of 5 to relax the a priori constraint. The covariance matrix is constructed in the same way as in Zeng et al. (2023b).

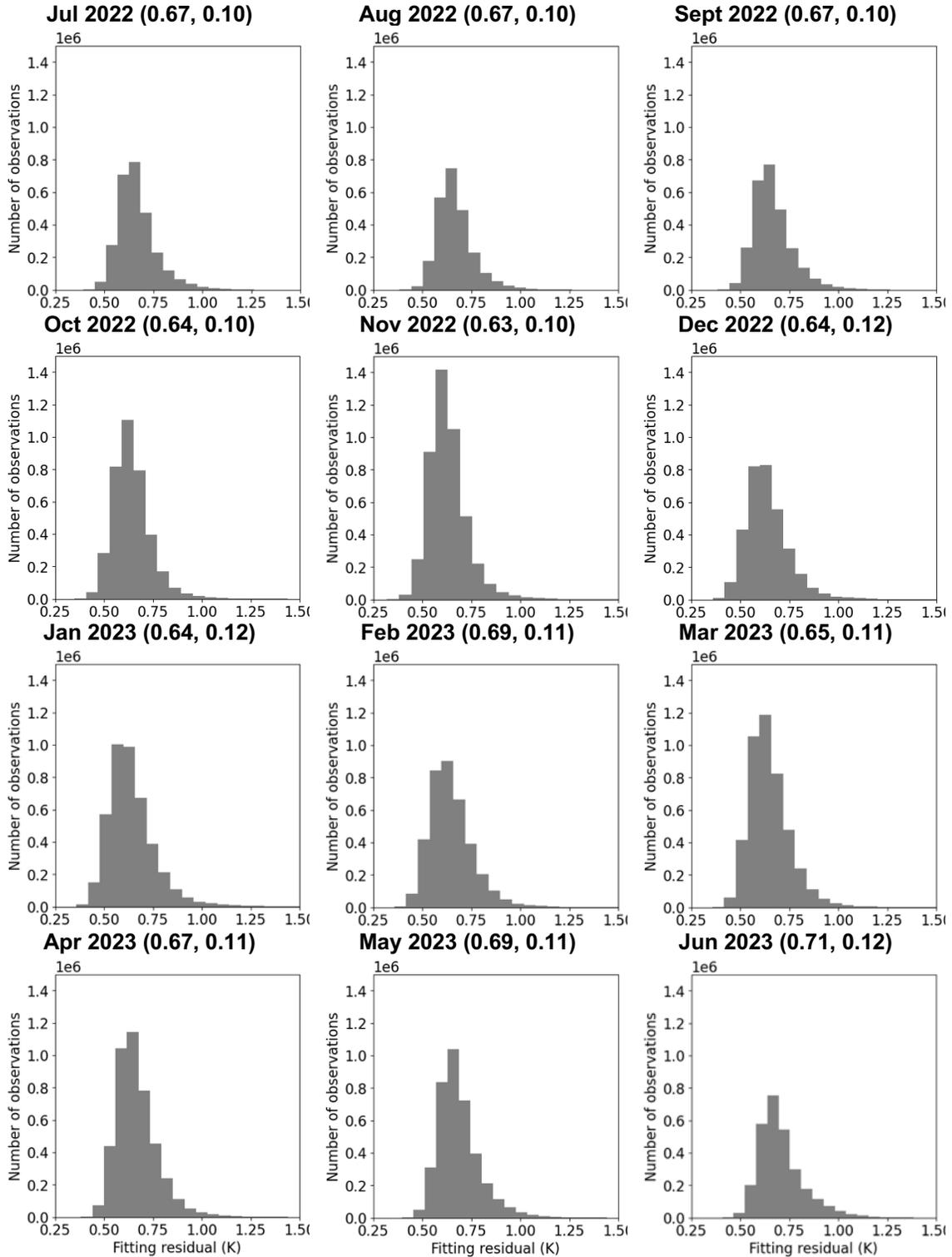


Figure S2. Histograms of the root-mean-square-error (RMSE) of fitting residuals in brightness temperature for every month from July 2022 to June 2023. The values in the parentheses are the monthly mean and standard deviation, respectively.

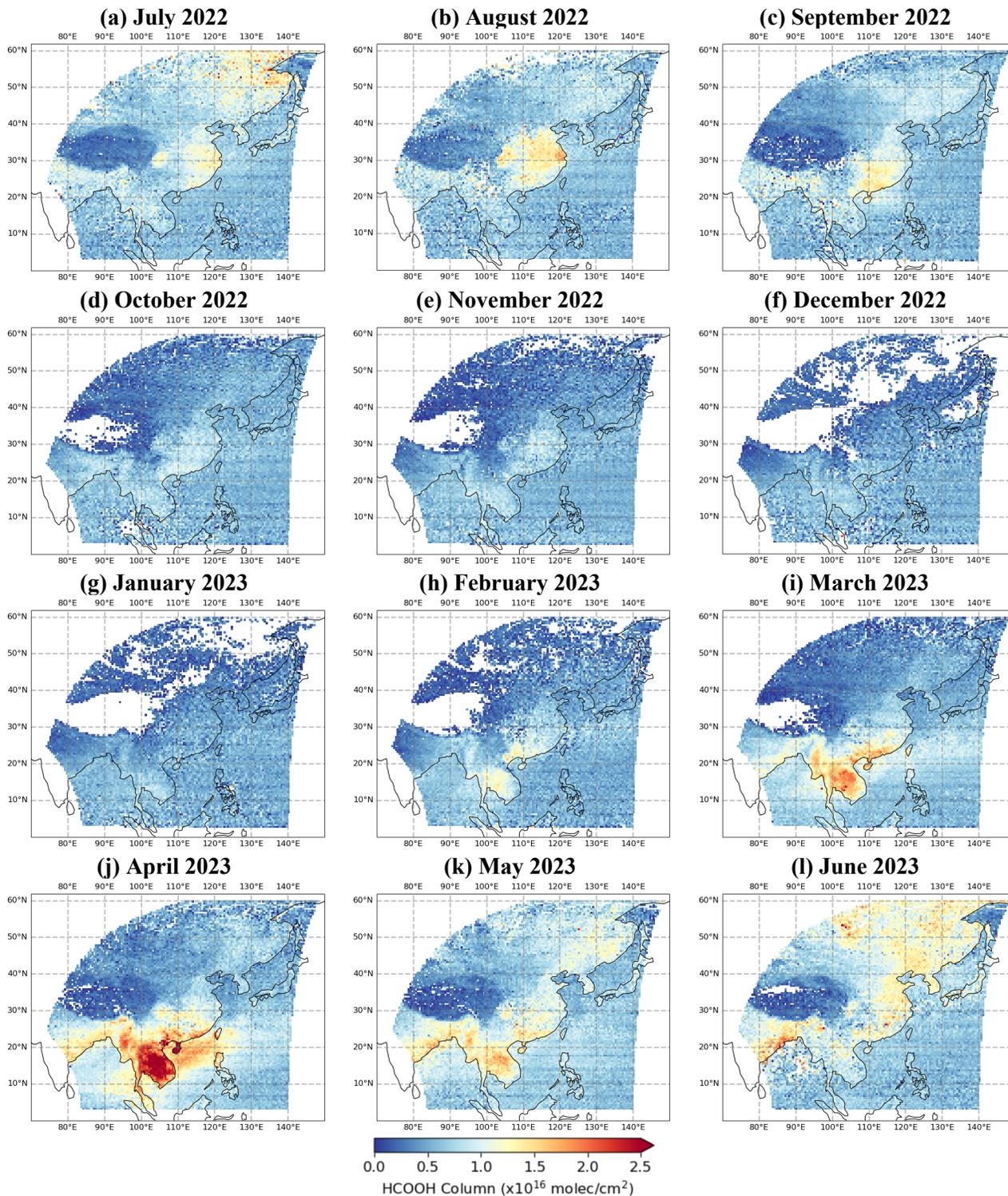


Figure S3. Monthly mean of HCOOH column retrievals at 09:00–11:00 Beijing Time. These HCOOH retrievals are filtered by DOFS > 0.3 and the fitting residual rmse less than the mean plus two sigma, and then gridded into 0.5° by 0.5°.

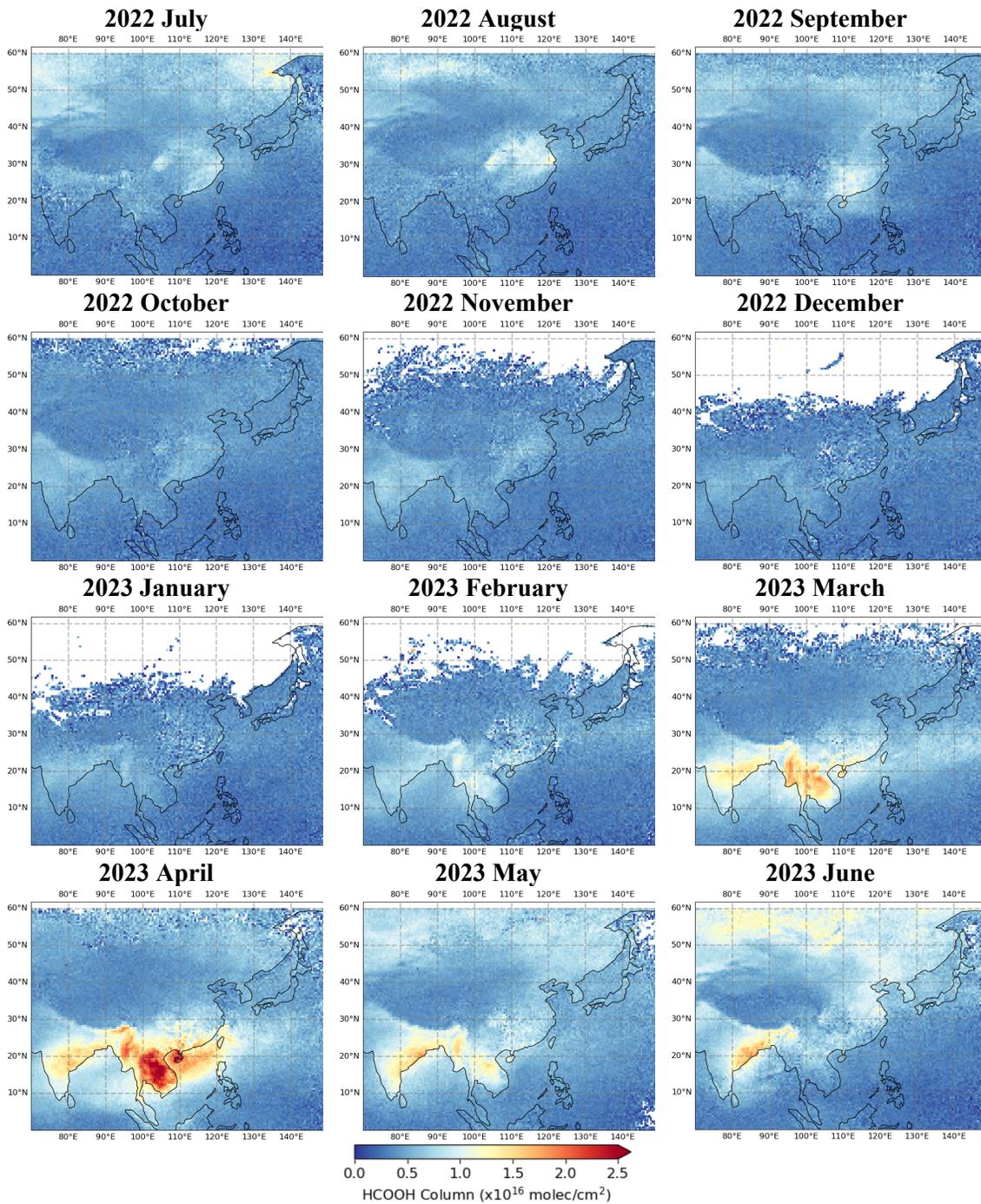


Figure S4. Monthly mean of IASI HCOOH in the daytime from July 2022 to June 2023. These IASI HCOOH retrievals are filtered by the “postfilter” variable in the data product and then re-gridded into 0.5° by 0.5°. IASI HCOOH data product comes from the Daily IASI/Metop-B ULB-LATMOS HCOOH L2 product (columns) - version 4 Reanalysis. The overpass local time crossing equator is about 09:30 am.

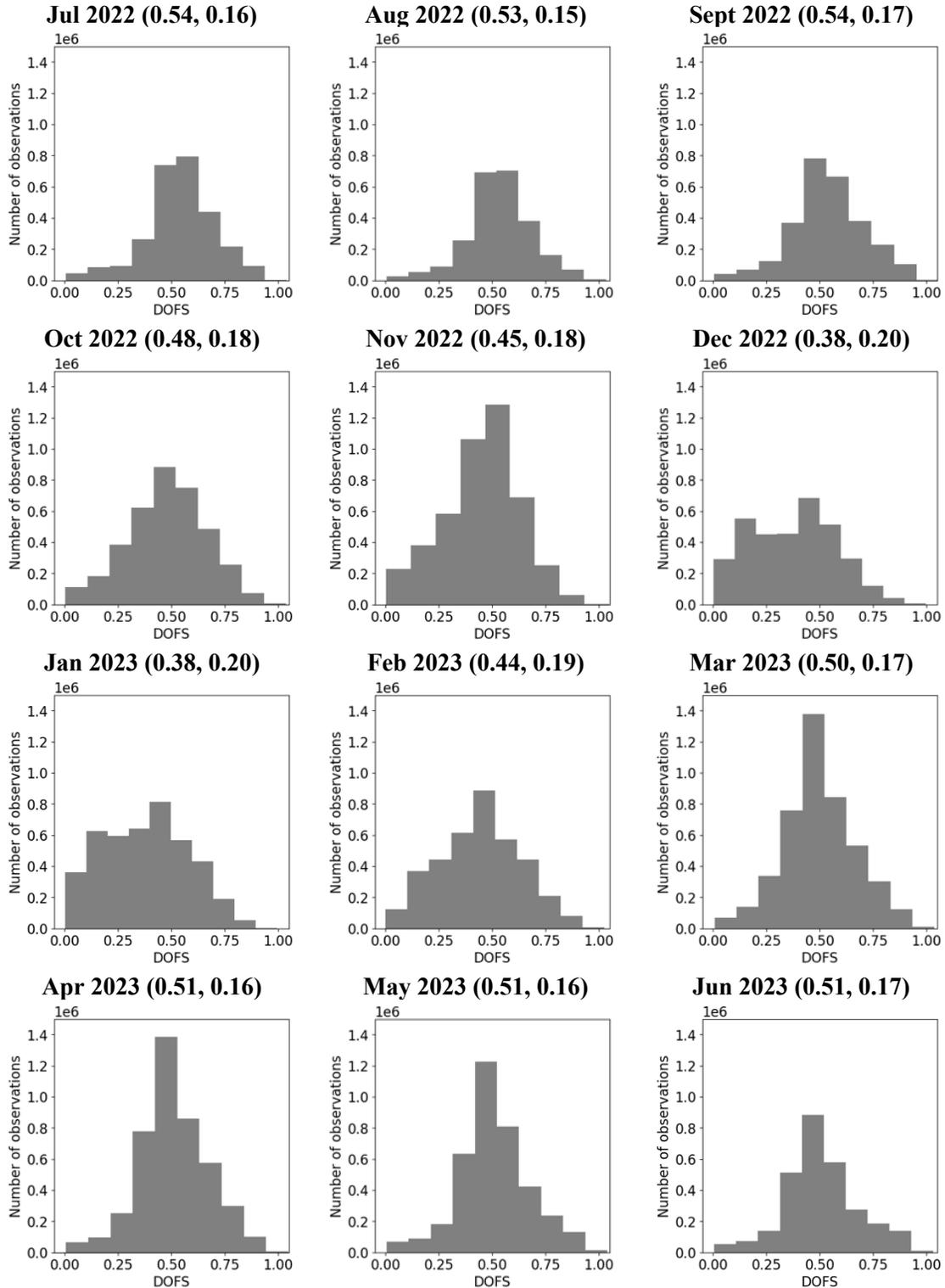


Figure S5. Histograms of the degree of freedom for signal (DOFS) from the retrieval algorithm for every month from July 2022 to June 2023. The values in the parentheses are the monthly mean and standard deviation, respectively.

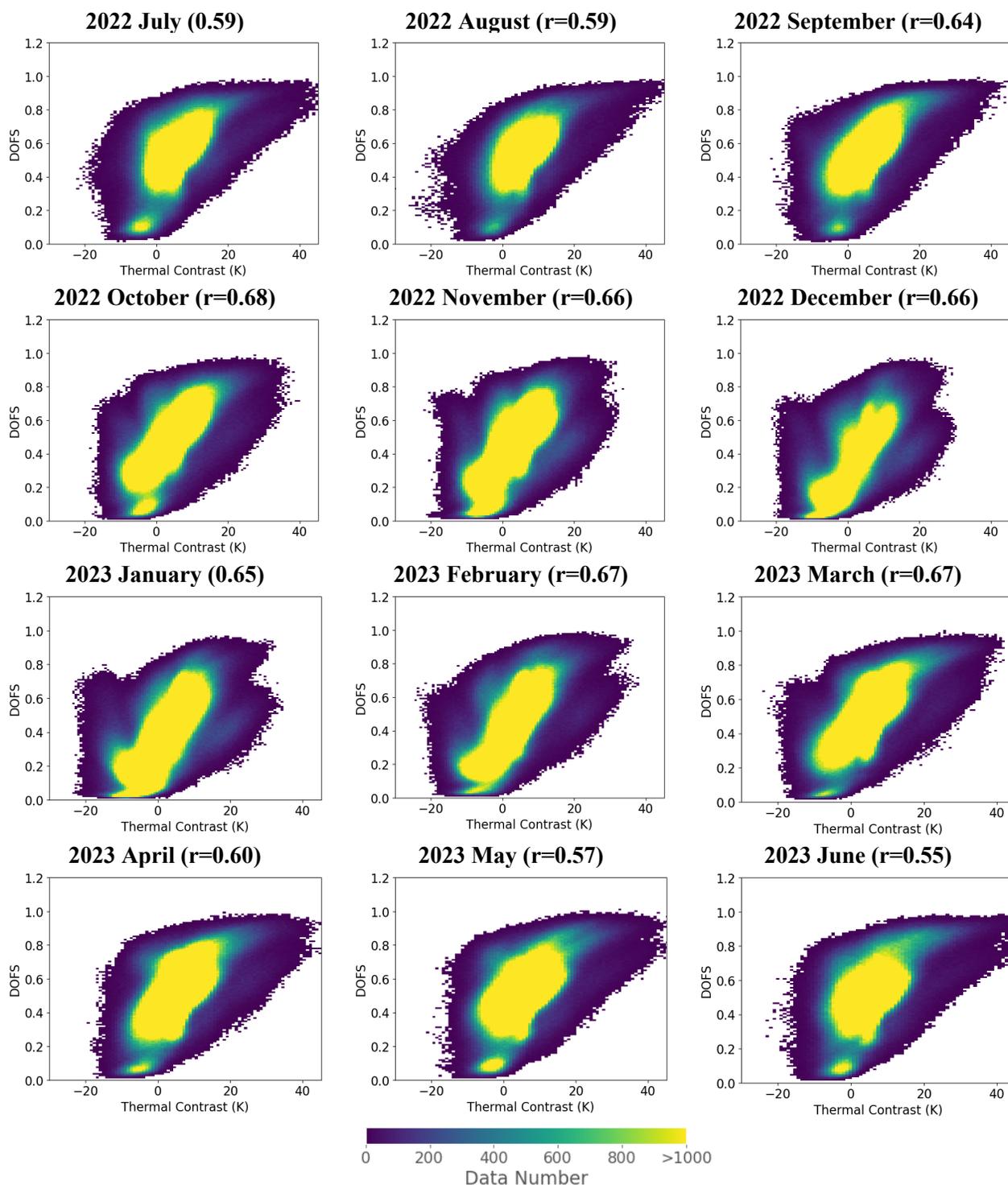


Figure S6. Monthly scatter plots between DOFS and TC from GIIRS HCOOH retrievals from July 2022 to June 2023. The data have been filtered by the fitting residual rmse less than the monthly mean plus two sigmas. The value in the parentheses is the correlation coefficient.

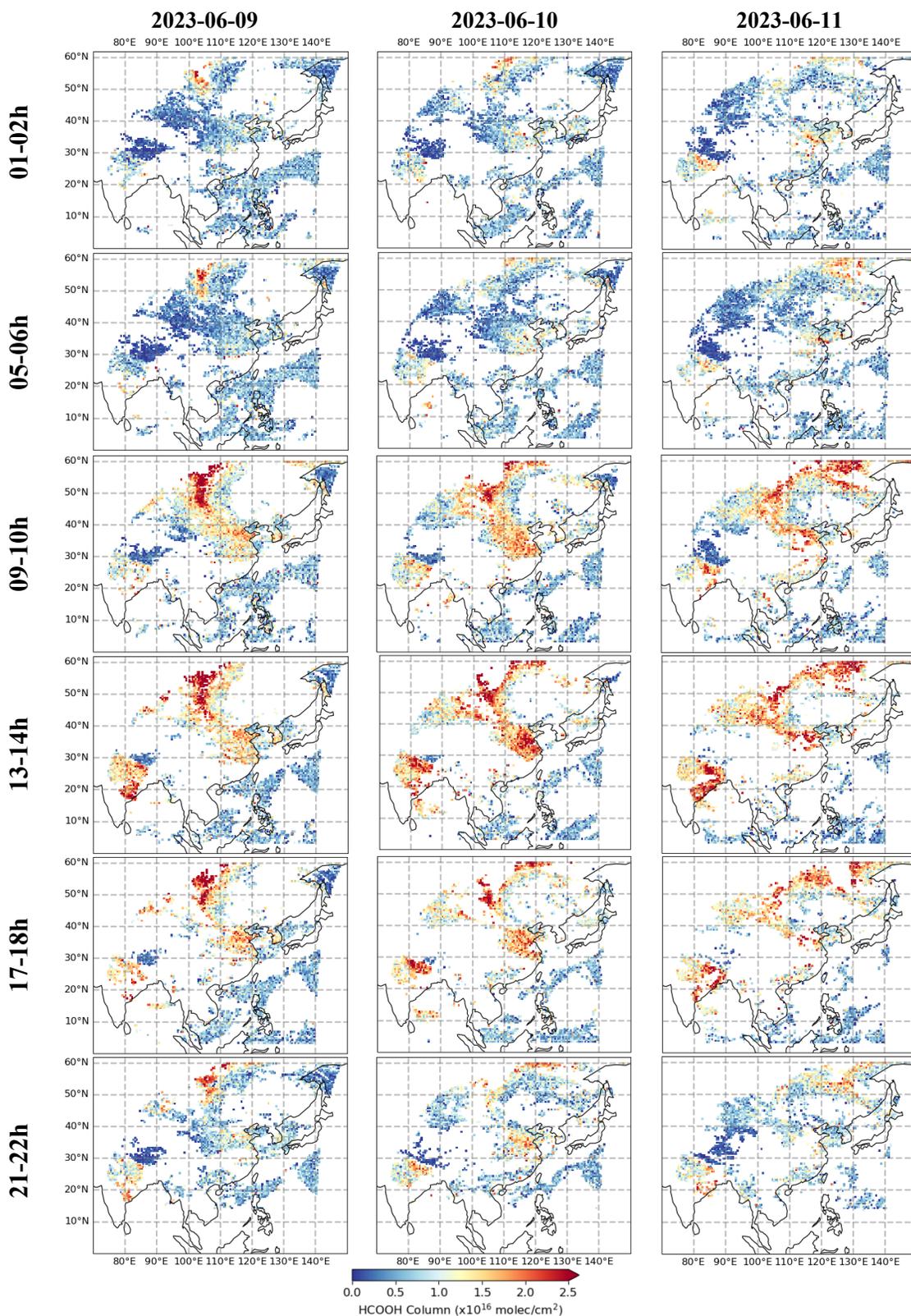


Figure S7. Example of HCOOH retrievals in each 2-hour measurement cycle from early morning to late evening on June 09-11 in 2023. Data have been filtered by DOFS and spectral fit as in Figure 2, and then gridded into 0.5° by 0.5°.

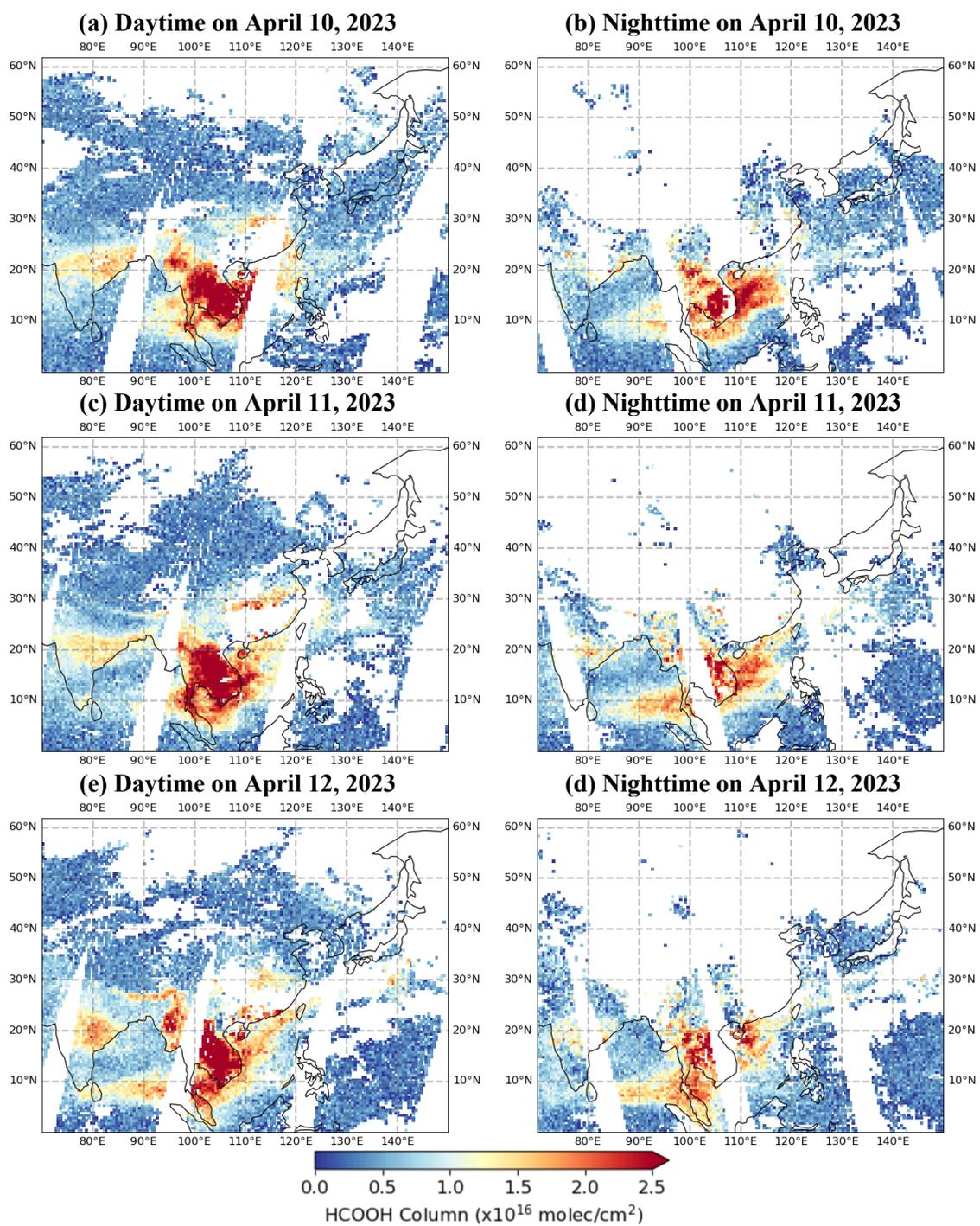


Figure S8. IASI maps of the HCOOH distribution over Asia on April 10, April 11, and April 12 in 2023. These IASI HCOOH retrievals are filtered by the “postfilter” variable in the data product and then re-gridded into 0.5° by 0.5°. IASI HCOOH data product comes from the ANNI HCOOH v4 product from IASI/Metop-B.

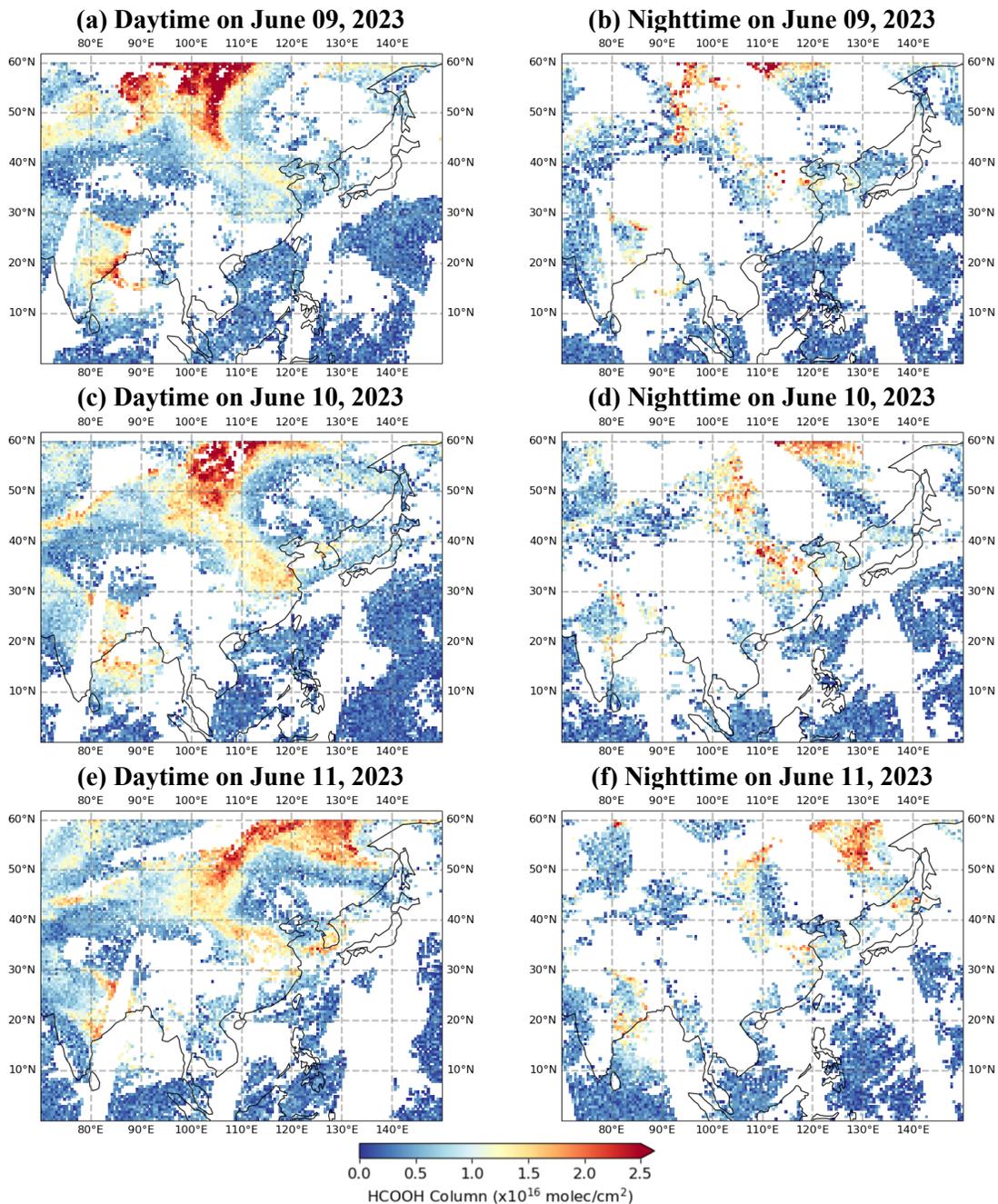


Figure S9. IASI maps of the HCOOH distribution over Asia on June 09, June 10, and June 11 in 2023. These IASI HCOOH retrievals are filtered by the “postfilter” variable in the data product and then re-gridded into 0.5° by 0.5°. IASI HCOOH data product comes from the ANNI HCOOH v4 product from IASI/Metop-B.

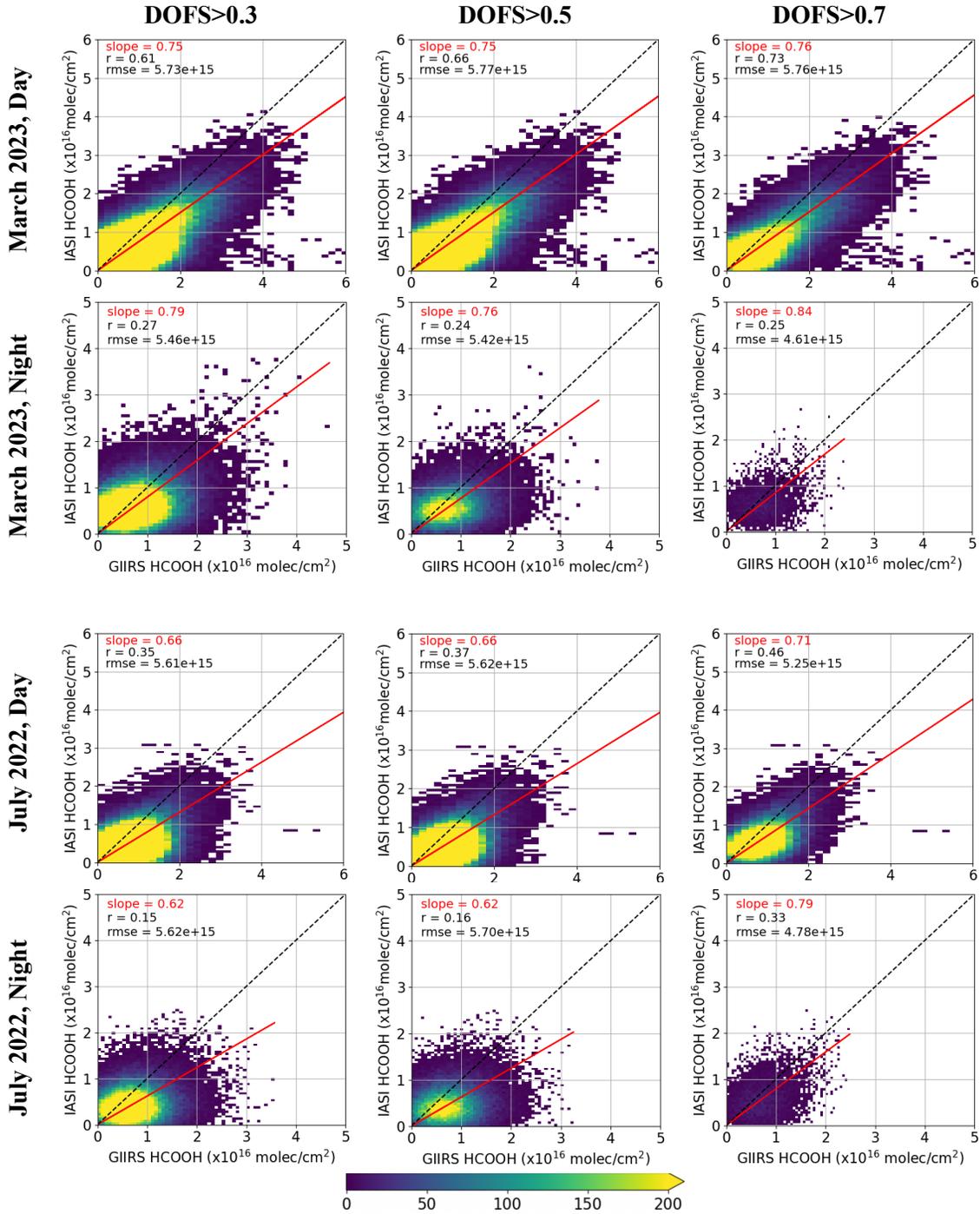


Figure S10. Comparison of HCOOH columns between GIIRS and IASI retrievals in the daytime and nighttime in March 2023 and July 2022. Collocated point pair between GIIRS and IASI is defined as observation footprints that are less than 20 km apart in space and differ by less than 1 hour in observation time. The dotted line in black is the 1:1 line while the red line is the linear fit crossing the origin. The slope, correlation coefficient (r), and root-mean-square-error (rmse) are also indicated. These IASI HCOOH retrievals are filtered by the “postfilter” variable in the data product. GIIRS HCOOH retrievals are filtered by DOFS > 0.3 and fitting residual less than the sum of mean and 2 sigma.

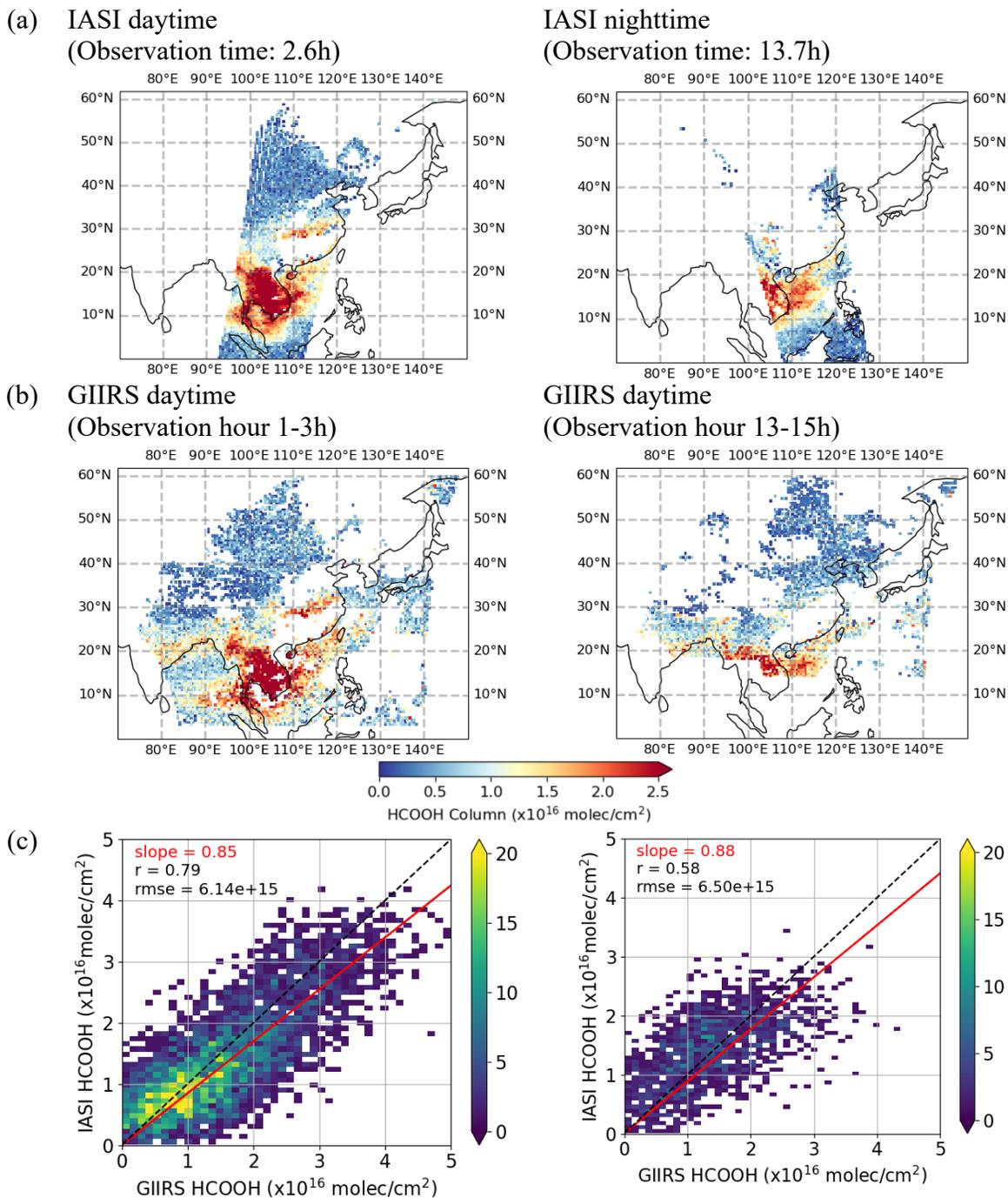


Figure S11. Comparison of IASI in (a) and GIIRS in (b) on 11 April 2023. The Collocated point pairs in (c) are defined as observation footprints that are less than 20 km apart in space and differ by less than 1 hour in observation time. The black dashed line is the 1:1 line while the red line is the linear fit through the origin. The slope, correlation coefficient (r), and root-mean-square-error ($rmse$) are also given. These IASI HCOOH retrievals are filtered by the “postfilter” variable in the data product. GIIRS HCOOH retrievals are filtered by $DOFS > 0.3$ and fitted residual $rmse$ less than the mean plus two sigma.

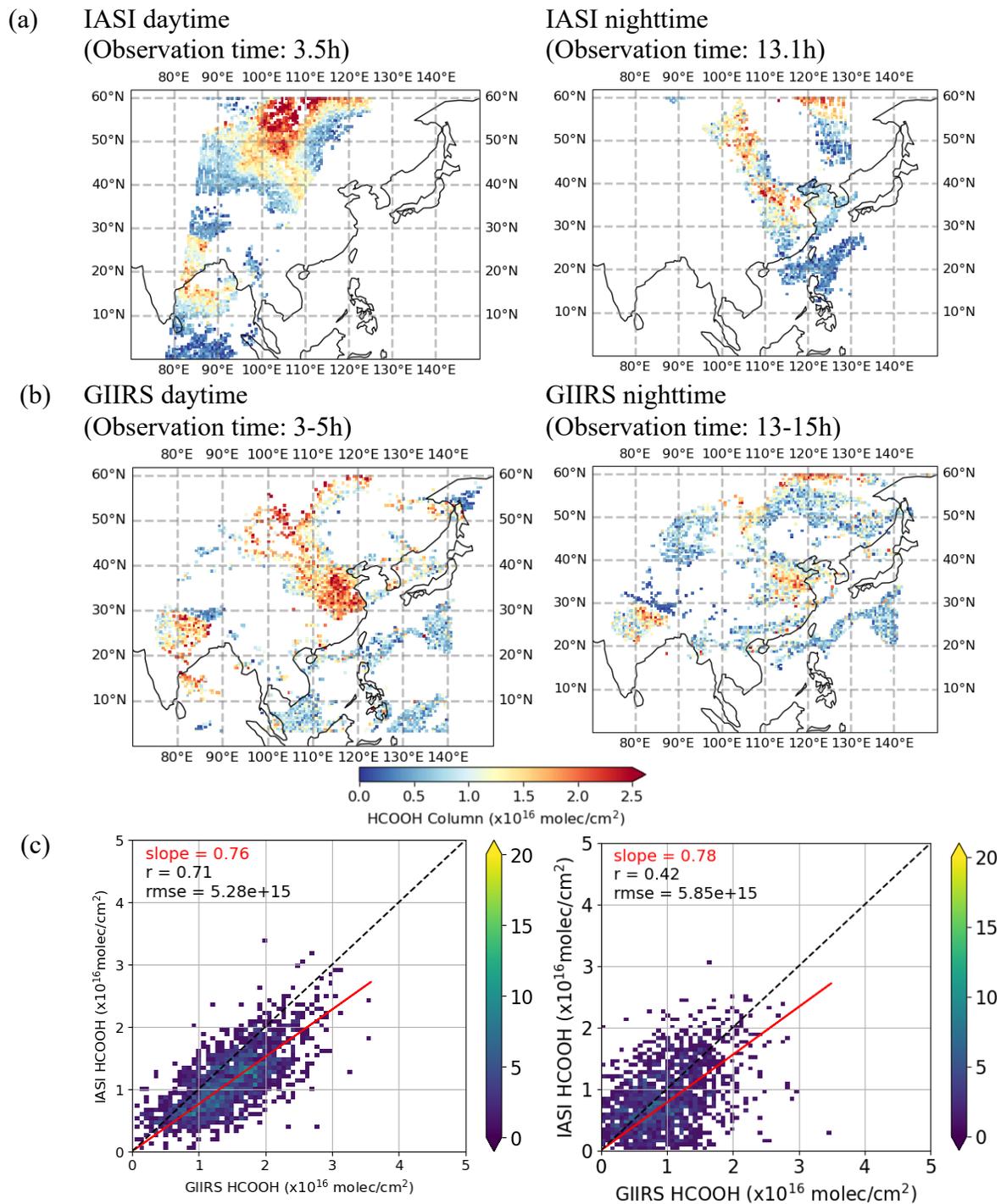


Figure S12. The same as Figure S12 but for 10 June 2023.