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3 **The 2019 Methane Budget And Uncertainties At 1 Degree Resolution And Each Country**
4 **Through Bayesian Integration Of GOSAT Total Column Methane Data And A Priori**
5 **Inventory Estimates**
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20 **Abstract:** We use Optimal Estimation (OE) to quantify methane fluxes based on total column
21 CH₄ data from the Greenhouse Gases Observing Satellite (GOSAT) and the GEOS-Chem global
22 chemistry transport model. We then project these fluxes to emissions by sector at 1 degree
23 resolution and then to each country using a new Bayesian algorithm that accounts for prior and
24 posterior uncertainties in the methane emissions. These estimates are intended as a pilot dataset
25 for the Global Stock Take in support of the Paris Agreement. However, differences between the
26 emissions reported here and widely-used bottom-up inventories should be used as a starting point
27 for further research because of potential systematic errors of these satellite based emissions
28 estimates. We find that agricultural and waste emissions are ~263 +/- 24 Tg CH₄/yr,
29 anthropogenic fossil emissions are 82 +/- 12 Tg CH₄/yr, and natural wetland/aquatic emissions
30 are 180 +/- 10 Tg CH₄/yr. These estimates are consistent with previous inversions based on
31 GOSAT data and the GEOS-Chem model. In addition, anthropogenic fossil estimates are

32 consistent with those reported to the United Nations Framework Convention on Climate Change
33 [80.4 Tg CH₄/yr for 2019]. Alternative priors can be easily tested with our new Bayesian
34 approach (also known as prior swapping) to determine their impact on posterior emissions
35 estimates. We use this approach by swapping to priors that include much larger aquatic emissions
36 and fossil emissions (based on isotopic evidence) and find little impact on our posterior fluxes.
37 This indicates that these alternative inventories are inconsistent with our remote-sensing
38 estimates and also that the posteriors reported here are due to the observing and flux inversion
39 system and not uncertainties in the prior inventories. We find that total emissions for
40 approximately 57 countries can be resolved with this observing system based on the degrees-of-
41 freedom for signal metric (DOFS > 1.0) that can be calculated with our Bayesian flux estimation
42 approach. Below DOFS of 0.5, estimates for a countries total emissions are more weighted to our
43 choice of prior inventories. The top five emitting countries (Brazil, China, India, Russia, USA)
44 emit about half of the global anthropogenic budget, similar to our choice of prior emissions but
45 with the posterior emissions shifted towards the agricultural sector and less towards fossil
46 emissions, consistent with our global posterior results. Our results suggest remote sensing based
47 estimates of methane emissions can be substantially different (although within uncertainty) than
48 bottom-up inventories, isotopic evidence, or estimates based on sparse in situ data, indicating a
49 need for further studies reconciling these different approaches for quantifying the methane
50 budget. Higher resolution fluxes calculated from upcoming satellite or aircraft data such as the
51 Tropospheric Monitoring Instrument (TROPOMI) and those in formulation such as the
52 Copernicus CO₂M, MethaneSat, or Carbon Mapper can be incorporated in our Bayesian
53 estimation framework for the purpose of reducing uncertainty and improving the spatial
54 resolution and sectoral attribution of subsequent methane emissions estimates.
55

56

57 1.0 Introduction

58 1.1 Atmospheric Methane Background

59

60 Atmospheric methane (CH₄) is the second most important anthropogenic greenhouse gas
 61 behind carbon dioxide (CO₂) and a contributor to poor surface air quality as it is an ozone
 62 precursor. Atmospheric methane has increased by nearly a factor 3 over its pre-industrial values
 63 largely due to anthropogenic emissions (e.g. Dlugokencky *et al.* 2011; Ciais *et al.* 2013, and refs
 64 therein). Over the last two decades, methane has been increasing but for reasons that are still
 65 being assessed, although recent studies provide evidence that it is due to a combination of fossil
 66 and agricultural emissions with some role due to variations in the atmospheric sink of methane
 67 (e.g. Schaefer *et al.* 2016; Worden *et al.* 2017; Turner *et al.* 2019; Zhang *et al.* 2021). However,
 68 it is unclear which regions and which sectors are the cause of changes in atmospheric methane
 69 over the last twenty years because of substantial uncertainties in all components of the methane
 70 budget (Kirchke *et al.* 2013, Janssens *et al.* 2019; Sanuois *et al.* 2020) from the global (Table 1)
 71 to local scale (Section 2). Methane has a relatively short lifetime of approximately 9 years
 72 making it an attractive target for emissions reduction as a decline in emissions will have a rapid
 73 impact on net radiative forcing and corresponding atmospheric heating (e.g. Shindell *et al.* 2009;

Sector	Prior (Tg CH ₄ /yr)	Posterior (Tg CH ₄ /yr)
Wetlands / Aquatic	199.8+/-52.8	179.8+/-10.0
Seeps	32.0+/-6.2	22.5+/-3.8
Livestock	87.6+/-17.2	146.1 +/-10.3
Rice	36.9+/-12.9	67.6 +/-6.8
Fires	15.1+/-2.5	13.3+/-2.2
Waste	57.7+/-11.9	49.6+/-7.1
Oil	41.6+/-9.7	28.8 +/-4.7
Gas	24.5+/-4.7	28.0 +/-3.6
Coal	31.4+/-9.8	25.3 +/-3.9
Total	526+/-128	561 +/-52

Table 1: Prior emissions and uncertainties are generated from various inventories or models (Section 2.3). Posterior emissions represent projection of satellite based fluxes back to emissions while accounting for the prior emissions distribution and covariances (Section 2.2). We conservatively assume uncertainties are 100% correlated so that the total reported prior and posterior uncertainties are the sum of the individual uncertainties.

74 Ganeson *et al.* 2019; Turner *et al.* 2019). Hence there is significant interest in accurately
75 quantifying methane emissions for identifying those emissions that can be efficiently reduced.

76

77 ***1.2 Global Stock Take***

78

79 As part of the effort to reduce methane emissions and corresponding risk related to
80 changes in climate, the Paris Agreement resulted in a framework by which countries provide an
81 accounting of their emissions. A “Global Stock Take” (GST) to track progress in emission
82 reductions is conducted at five-year intervals, beginning 2023. To support the first GST, Parties
83 to the Paris Agreement are compiling inventories of GHG emissions and removals to inform
84 their progress. Inventories are generally estimated using “bottom-up” approaches, in which
85 emission estimates are generally based on activity data and emission factors. These bottom-up
86 methods can provide precise and accurate emission estimates when the activity data are well
87 quantified and emission factors are well understood. However, substantial uncertainties exist for
88 emissions in many parts of the globe where these measurements are not rigorously made or
89 tested across multiple sites. Even regions and emissions that are thought to be well measured can
90 have significant differences between independent assessments and official reports; for example,
91 Alvarez *et al.* (2018) demonstrates that 2015 oil and gas emissions are under estimated by the
92 United States Environmental Protection Agency by about 60%. These differences, if they are
93 representative for emissions across the globe indicate a need for an independent assessment of
94 emissions and their uncertainties to better evaluate if reported changes in emissions are in fact
95 occurring or if changes in the natural carbon cycle through wetlands and the methane sink are
96 substantively affecting atmospheric methane burden. Top down estimates of methane emissions
97 using atmospheric measurements provide an independent way of testing these inventories as
98 observed methane concentrations are compared against expected concentrations that result from
99 reported inventories. The objective of this paper is to demonstrate the use of satellite
100 observations for testing and updating emissions by sector for use with the Global Stock Take.
101 While these top-down atmospheric methane budgets cannot replace the detailed activity reports
102 used to generate bottom-up inventories, they can be combined with those bottom-up products to
103 produce a more complete and transparent assessment of progress toward greenhouse gas
104 emission reduction targets. They can also help determine if the natural part of the methane
105 budget is becoming a strong component of atmospheric methane increases. As discussed next, an

106 important component of this assessment is the evaluation of uncertainties from both bottom-up
107 inventories and in top-down approaches.

108
109

110 *1.3 Overview of Bottom-Up Emissions And Uncertainties*

111
112 Bottom-up uncertainties are calculated for the methane budget by comparison between
113 independent methods or sources, evaluating multiple estimates from a single source, comparison
114 between models and remote sensing data, and expert opinion. For example, Sauniois *et al.*
115 (2020) uses a range of results from different studies to quantify uncertainty in the different
116 sectors of the methane budget. However, these uncertainties are likely underestimated as they
117 suggest that total anthropogenic agricultural emissions, for example, are known to 10% or
118 better, whereas comparisons between different global inventories (e.g., Janssens-Maenhout *et al.*
119 2019) suggest a much larger range of estimates for the global totals (e.g., 129 to 219 Tg CH₄/yr
120 for agriculture, and 129 to 164 Tg CH₄/yr for fossil emissions). Uncertainties in national or
121 regional total emissions are even more challenging to estimate such that expert opinion is used:
122 Janssens-Maenhout *et al.* (2019) suggests that Annex 1 (developed) countries have
123 approximately 15% uncertainty in reported fossil emissions whereas Annex 2 countries have
124 ~30% uncertainties, essentially asserting that less informed inventories have double the
125 uncertainty of better informed emissions. Wetland emissions, which comprise ~30-45 % of the
126 methane budget also show significant differences of up to 40% across wetland models (e.g.
127 Melton *et al.* 2013; Poulter *et al.* 2017, Ma *et al.* 2021), depending on region. An example of
128 how these uncertainties are projected to the total methane budget for each of the main sectors is
129 presented in Table 1 using the prior emissions and their uncertainties for the analysis discussed
130 in this paper (Section 2.3).

131 However, recent studies challenge even these estimates of emission uncertainties;
132 emissions for lakes and rivers could be as large or larger than wetlands, with correspondingly
133 larger uncertainties of 50% or more (Sauniois *et al.* 2020; Rosentreter *et al.* 2021). Primarily
134 because of this extra term from lakes and rivers, the total budget from bottom-up inventories
135 discussed in Sauniois *et al.* (2020) ranges from 583 – 861 Tg CH₄/yr. Contrasting with this much
136 larger than expected biogenic source is isotopic evidence that suggests fossil emissions are also
137 much larger than expected, 160 +/- 40 Tg CH₄/yr (Schweitzke *et al.* 2017). These larger than

138 expected values from aquatic and fossil sources are challenging to reconcile with existing bottom
139 up estimates and with global estimates from the top down which are primarily constrained by the
140 methane sink. For example, the methane sink must approximately balance total methane
141 emissions, leading to total emissions of 560 +/- 60 Tg CH₄/yr (e.g., Prather *et al.* 2012).
142 Consequently much larger values in either aquatic emissions or fossil emissions must be
143 balanced by much lower emissions in other sectors indicating that either our knowledge of the
144 processes controlling different components of the methane sink are fundamentally wrong or one
145 or both of these inflated emissions is incorrect, that is, well outside calculated uncertainties.

146

147 *1.4 Use of Remote Sensing For Quantifying Emissions and Uncertainties*

148

149 Top-down approaches using in situ or remote sensing measurements of atmospheric
150 methane can be used to evaluate and update bottom-up emissions (or inventories) by first
151 projecting bottom up emissions through a chemical transport model to atmospheric
152 concentrations and then comparing these modeled concentrations to observations (e.g.

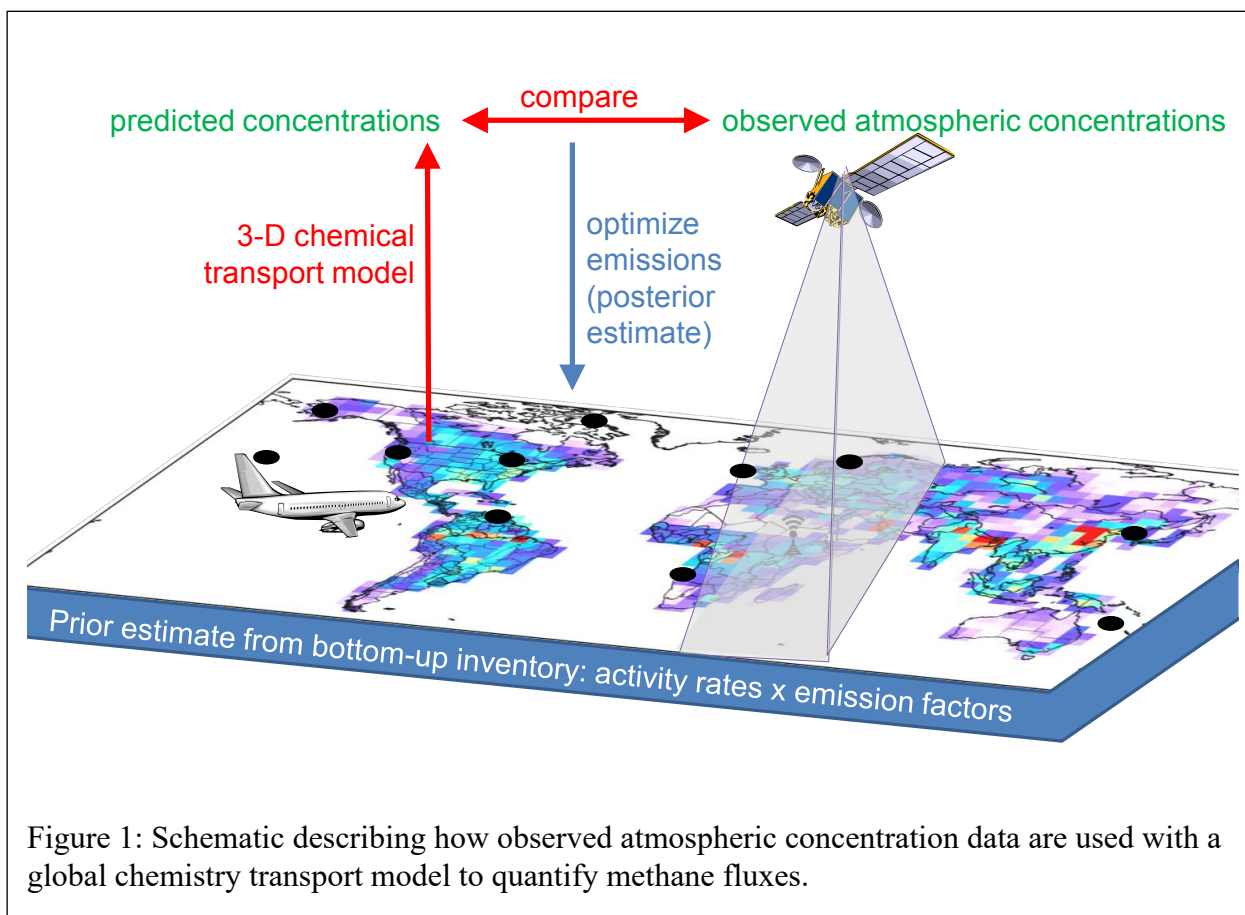


Figure 1: Schematic describing how observed atmospheric concentration data are used with a global chemistry transport model to quantify methane fluxes.

153 Frankenberg *et al.* 2005; Bergamaschi *et al.* 2013, Qu *et al.* 2021 and refs therein). An inverse
154 method is utilized to update the net flux (or total emissions and surface sinks) within a chosen
155 grid scale based on the mismatch between modeled and observed concentrations (Figure 1).
156 When the top-down quantified flux can be uniquely associated with a single source, these tests of
157 bottom-up inventories provide information about biases in the reported emission (e.g, Duren *et*
158 *al.* 2019, Varon *et al.* 2019, Pandey *et al.* 2019) which can be used to either update the emissions
159 or provide evidence that additional research is needed to improve the process knowledge used to
160 construct the emissions. However, top-down fluxes have other uncertainties that must be
161 accounted for when comparing to bottom-up inventories, these include 1) systematic and random
162 uncertainties in the data, 2) systematic errors in the model that relates observed methane
163 concentrations to fluxes, and 3) smoothing error related to uncertainty in the prior emissions
164 combined with the spatial resolution of the top-down estimate.

165 Top-down approaches can typically quantify the precision of the fluxes as it is directly
166 related to the uncertainties of the observations and the prior knowledge of the flux distribution.
167 However, the accuracy of the top-down fluxes related to data and model is more challenging to
168 quantify and recent results suggest that these errors can be substantive. For example, Qu *et al.*
169 (2021) demonstrates that systematic differences between total column CH₄ concentrations from
170 TROPOMI and GOSAT satellite data, likely related to poorly characterized surface albedo, can
171 lead to substantial differences when used to constrain top-down fluxes. For example, there is
172 almost a 100% difference between estimated livestock emissions in Brazil when comparing
173 TROPOMI versus GOSAT based fluxes, which Qu *et al.* (2021) attributes to biases in the
174 TROPOMI total column data due to surface albedo variations over Brazil.

175 Errors in model transport and chemistry are another significant uncertainty when
176 inverting concentration data to fluxes. For example, Mcnorton *et al.* (2020) finds that model
177 errors in atmospheric concentrations that result from atmospheric transport can be as large or
178 larger as uncertainties in the data, leading to almost a doubling of the uncertainty in top-down
179 fluxes. Schuh *et al.* (2019) demonstrates that transport errors can result in biases of up to 1.7
180 Petagrams of carbon in top-down CO₂ fluxes, about the same as the global net yearly carbon
181 sink. Jiang *et al.* (2013) also demonstrates that errors in convection can affect surface emissions
182 estimates of CO by up to 40% in regions of strong convection such as S.E. Asia. Unfortunately,
183 challenges remain in quantifying how model uncertainties project to flux uncertainty. One

184 approach is to use an ensemble of models for the inversion in which the same data and
185 constraints are used for the inverse model; a challenge here is to ensure that the inversion
186 approach used with each model is consistent. For example, the Global Carbon Project (Sauniois *et*
187 *al.* 2020) uses an ensemble of model inversions using different data sets to evaluate flux
188 inversion errors; however, as shown in Section 2.2, this approach does not attempt to attribute
189 differences in results to either the model, data, or spatial resolution and hence it can be
190 challenging to identify approaches to reduce overall uncertainty. Another approach is to use
191 different data sets but the same model and inversion setup to quantify emissions, as different
192 sensitivities of the model to the different observed concentrations are affected by model error
193 (Jiang *et al.* 2015; Yin *et al.* 2021). A third approach is to mitigate model and transport error. For
194 example, Jiang *et al.* (2015) assimilates observed CO concentrations over ocean regions before
195 inverting for continental source emissions to ensure that model/data mismatch over the ocean
196 does not affect the emissions estimates. As discussed in the next section our flux inversion
197 jointly estimates OH (the primary methane sink) with methane emissions to mitigate the impact
198 of OH variability on CH₄ emissions estimates. A latitudinal correction is also applied to both
199 data and model to ensure that errors in stratospheric chemistry and transport have less of an
200 impact on the estimated fluxes. However, the residual systematic errors from model transport
201 and chemistry are not characterized although there is no evidence to suspect significant
202 systematic errors based on comparing posterior concentrations with independent data as
203 discussed in the next section. Nonetheless, as stated in the abstract, differences between top-
204 down emissions reported in this manuscript with those from bottom-up efforts should be
205 considered as a starting point for new investigation as opposed to confirmation or falsification of
206 the top-down or bottom up estimate.

207 Smoothing error is also a significant but challenging component of the emissions error
208 budget to quantify for top-down estimates. This uncertainty depends on the spatial and temporal
209 resolution of the top-down estimate combined with the prior uncertainty of the emissions
210 (Rodgers 2000). The spatial resolution of the estimate in turn depends on the sampling, pixel
211 size, measurement uncertainty, and lifetime of the gas. As typical top-down estimates do not
212 quantify the terms needed to quantify smoothing error, smoothing error is not usually represented
213 in top-down error budgets. However, this term can be the largest of the error sources, as
214 discussed further in Section 2.1, especially if the *a priori* uncertainties for emissions are poorly

215 characterized. Our Bayesian, optimal estimation approach (Rodgers 2000) described here allows
216 us to quantify smoothing error for the sectoral emissions presented here (Sections 2.2. and 2.3).
217 Furthermore, by reporting the averaging kernel matrices and fluxes we can remove smoothing
218 error in comparisons between top-down fluxes and bottom-up models (Ma *et al.* 2021) or greatly
219 reduce the smoothing error component in comparisons between two different instruments (e.g.
220 Cusworth *et al.* 2021).

221 Related to the problem of calculating smoothing error is that many top-down fluxes are
222 projected back to emissions by assuming that all emissions within a grid can be uniformly scaled
223 by the ratio of posterior to prior flux (e.g., Maasakkers *et al.* 2019 and references therein). This
224 method, while computationally expedient, diverts from the Bayesian assumptions used with top-
225 down inversions, potentially adding poorly characterized uncertainty and potentially unphysical
226 biases (Cusworth *et al.* 2021) to the emissions estimates, because it does not account for the
227 structure of the errors or their correlations and instead assumes that different types of emissions
228 within a grid cell (e.g. fires, fossil, livestock, wetlands) are 100% correlated. Shen *et al.* (2021)
229 addresses this problem by weighting the posterior emissions estimate by their prior uncertainty.
230 Our approach used here is derived in Cusworth *et al.* (2021) and summarized in Section 2.2,
231 addresses this problem by accounting for the structure of the errors, following a Bayesian
232 methodology from the start of the problem (calculation of fluxes using observations) to the end
233 (calculation of emissions from fluxes).

234

235 **2.0 Approach for Quantifying “Top Down” Emissions Using Satellite Data**

236 Our emission quantification approach is described in this section. First optimal estimation
237 is used (Section 2.1) to quantify methane fluxes on a 2x2.5 grid using the GEOS-Chem global
238 chemistry transport model with GOSAT satellite data for the year 2019. For our purposes of
239 emissions attribution, this first inverse step must report the prior as well as the posterior flux
240 error covariance (or Hessian) matrices (Zhang *et al.* 2021, Qu *et al.* 2021). The posterior error
241 covariance (or Hessian) can be computationally challenging to calculate so is typically not
242 reported with variational or adjoint based top-down estimates and instead ensemble approaches
243 are used to approximate flux uncertainties (e.g. Janadarnan *et al.* 2020). However in our
244 approach, this first step uses analytic Jacobians derived from the GEOS-Chem model that relate
245 emissions to concentrations and hence has been traditionally computationally expensive as

246 compared to ensemble or adjoint based inversion methods, but does allow for a straightforward
247 calculation of the Hessian. The second step (Section 2.2) uses the prior fluxes, the corresponding
248 constraint and Hessian covariance matrices, and priors and prior covariances for emissions by
249 sector, to linearly project the fluxes to emissions by sector at 1 degree resolution while
250 accounting for the prior uncertainty distributions, correlations in the posterior covariance, and
251 varying spatial resolution. This step can use different prior emissions and prior covariances from
252 that of the flux inversion as the information from the flux inversion is preserved (Rodgers and
253 Connor 2003). Critical to this second step is that prior uncertainties and their correlations are
254 provided for the emissions for the desired sector and spatial resolution (Section 2.3).

255 ***2.1 Top Down Flux Estimates***

256 We estimate top-down fluxes based on the approach and results described in Maasackers *et*
257 *al.* (2021), Zhang *et al.* (2021) and Qu *et al.* (2021) and the reader is referred to these papers for
258 a more extensive description of the approach and validation of these methane fluxes. To
259 summarize, we optimize a state vector that consists of (1) 2019 methane emissions from all
260 sectors on a global 2°×2.5° grid (4020 elements); and (2) tropospheric OH concentrations in
261 northern and southern hemispheres (2 elements). We assume the seasonal variations of methane
262 emissions to be correct in the prior inventory and apply posterior/prior ratio equally to all months
263 in each grid cell. The optimization of annual hemispheric OH concentrations avoids propagating
264 biases in the simulated interhemispheric OH gradient to the solution for methane emissions
265 (Zhang *et al.*, 2018). We solve this Bayesian problem analytically, which yields a best posterior
266 estimate for the state vector, the posterior error covariance matrix, and the averaging kernel
267 matrix. Unlike in Zhang *et al.* (2021) and Qu *et al.* (2021), wetland fluxes are not treated as
268 separate elements in the state vector as we found that introduced uncertainties into the sectoral
269 attribution because the wetland flux areas used in Qu *et al.* (2021) could overlap the different
270 regions (Table 2) used in our approach to mitigate computational complexity.

271 The inverse problem is regularized by prior estimates for the state vector, which are compiled
272 from multiple bottom-up studies. The EDGAR v4.3.2 global emission inventory for 2012
273 (Janssens-Maenhout *et al.*, 2017) is used as default for anthropogenic emissions, superseded in
274 the U.S. by Maasackers *et al.* (2016) and for the fossil fuel exploitation sector by Scarpelli *et al.*
275 (2020). Seasonalities of emissions from manure management and rice cultivation are specified
276

278 following Maasakkers et al. (2016) and B. Zhang et al. (2016), respectively. Monthly wetland
 279 emissions in 2019 are from the WetCHARTS v1.3.1 18-member ensemble mean (Bloom et al.,
 280 2017). Note that in Zhang *et al.* (2021) and Qu *et al.* (2021), wetland fluxes are not included in
 281 the gridded fluxes but instead estimated separately so as to better compare to bottom-up models
 282 (Ma *et al.* 2021). In the top-down flux inversion used here, wetland fluxes are included with the
 283 other emissions in each grid as we found that partitioning fluxes back to their sectoral
 284 contribution (next section) was challenging due to gridding errors when wetland fluxes are
 285 separately considered in the cost function. Daily global emissions from open fires are taken from
 286 GFEDv4s (van der Werf et al., 2017). Global geological emissions for the flux inversion are set
 287 to be 2 Tg a⁻¹ based on Hmiel et al. (2020) with the spatial distribution from Etiope et al. (2019).
 288 Termite emissions are from Fung et al. (1991). The prior estimates for the hemispheric
 289 tropospheric OH concentrations are based on a GEOS-Chem full chemistry simulation (Wecht et
 290 al., 2014).

291 The GEOS-Chem CTM v12.5.0 (10.5281/zenodo.3403111) is used as forward model for
 292 the inversion. The simulation is driven by MERRA-2 meteorological fields (Gelaro et al., 2017)
 293 from the NASA Global Modeling and Assimilation Office (GMAO) with 2°×2.5°
 294 horizontal resolution and 47 vertical layers (~ 30 layers in the troposphere). We excluded
 295 observations poleward of 60°, where low Sun angles and extensive cloud cover make the
 296 retrieval more difficult, and stratospheric CTM bias can affect the inversion (Turner *et al.*, 2015).
 297

298 The posterior estimate as defined by Bayesian inference assuming Gaussian error
 299 statistics is obtained by minimizing the cost function $J(x)$:

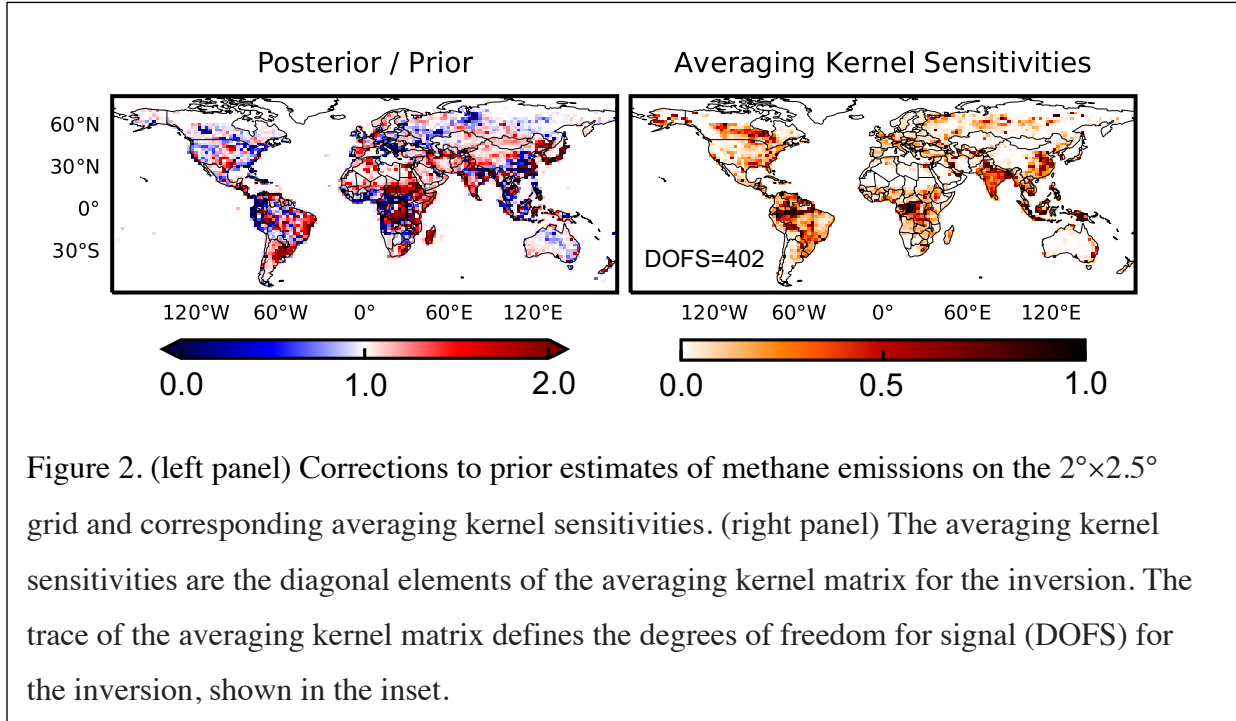
300

$$301 J(x) = (\mathbf{x} - \mathbf{x}_A)^T \mathbf{S}_A^{-1} (\mathbf{x} - \mathbf{x}_A) + \gamma (\mathbf{y} - \mathbf{Kx})^T \mathbf{S}_y^{-1} (\mathbf{y} - \mathbf{Kx}), \quad (1)$$

302

303

304 where \mathbf{K} is the Jacobian matrix describing the sensitivity of the observations to the state vector as
 305 simulated by GEOS-Chem. The vector \mathbf{x}_A is the prior flux estimate. \mathbf{S}_A is the *a priori*
 306 covariance matrix for this inversion and is a diagonal matrix that is constructed by assuming
 307 50% prior error standard deviation for emissions on the 2°×2.5° grid and 10% prior error
 308 standard deviation for hemispheric annual mean OH concentrations. \mathbf{S}_y is the observational error



309 covariance matrix. Diagonal elements of \mathbf{S}_y are calculated using the residual error method (Heald
 310 et al., 2004) as the variance of the residual difference between observations and the GEOS-Chem
 311 prior simulation on the $2^\circ \times 2.5^\circ$ grid after subtracting the mean difference. We use a
 312 regularization parameter γ (Hansen et al., 1999; Y. Zhang et al., 2018, 2020; Maasakkers et al.,
 313 2019; Lu et al., 2021) to account for the off-diagonal structure missing in \mathbf{S}_y . Based on the corner
 314 of the L-curve (Hansen et al., 1999) and the expected chi-square distribution of the cost function
 315 (Lu et al., 2021), we choose $\gamma = 0.5$ (Qu et al., 2021).

316 Assuming that the problem for quantifying methane fluxes from observed concentrations
 317 is linear, or only moderately non-linear, then the fluxes, $\hat{\mathbf{x}}$, can be related to observed methane
 318 concentrations using the following equation: (Rodgers 2000):

$$319 \hat{\mathbf{x}} = \mathbf{x}_A + \hat{\mathbf{S}}\mathbf{K}^T\mathbf{S}_y^{-1}(\mathbf{y} - \mathbf{K}\mathbf{x}_A) \quad (2)$$

320
 321
 322 The posterior error covariance matrix $\hat{\mathbf{S}}$ is given by:

$$323 \hat{\mathbf{S}} = (\mathbf{K}^T\mathbf{S}_y^{-1}\mathbf{K} + \mathbf{S}_A^{-1})^{-1}. \quad (3)$$

324
 325
 326

327 This top-down flux inversion also provides the spatial resolution matrix or Averaging Kernel
 328 Matrix \mathbf{A} , which defines the sensitivity of the solution to the true state:

$$329$$

$$330$$

$$331 \mathbf{A} = \mathbf{I} - \hat{\mathbf{S}}\mathbf{S}_A^{-1}, \quad (4)$$

$$332$$

333 Summing the diagonal elements of the averaging kernel for a given region provides the
 334 Degrees of Freedom for Signal (or DOFS), a useful metric for the sensitivity of the observing
 335 system to the underlying fluxes as it describes the sensitivity of the estimated fluxes to the actual
 336 distribution of fluxes (Rodgers 2000). Figure 2 (right panel) shows the averaging kernel
 337 sensitivities (or diagonal elements of the averaging kernel matrix) of the inversions. The
 338 averaging kernel sensitivities are highest over major anthropogenic source regions, where the
 339 methane emissions are the largest and the observations have a good ability to determine the
 340 posterior solution independently of the prior estimate. The inversion has ~402 DOFS for
 341 methane emissions, meaning that it contains 402 independent pieces of information on the
 342 distribution of methane emissions. Although our flux inversion is based on the top-down setup
 343 described in Qu *et al.* (2021), this value is larger than the DOFS reported in Qu *et al.* (2021)
 344 because that estimate separates wetlands from non-wetlands in the inversion scheme whereas the
 345 flux estimate used here does not. The posterior / prior ratios for the 2019 inversion in Figure 2
 346 (left panel) show consistent upward adjustments in the south-central US, Venezuela, and the
 347 Middle East and downward adjustments in the western US and North China Plain, consistent
 348 with Qu *et al.* (2021) and Zhang *et al.* (2021).

349 If the matrix \mathbf{S}_A in equations 1 and 3 represents the actual *a priori* uncertainty
 350 corresponding to the *a priori* \mathbf{x}_A , then the posterior error covariance describes the total error for
 351 the estimate (Rodgers 2000). In practice, the matrix \mathbf{S}_A represents a “constraint matrix” that is
 352 either a best guess for uncertainties of fluxes (e.g., assumed here to be 50%) within a grid and/or
 353 it is constructed to ensure the inversion converges, typically because systematic errors in the data
 354 and/or the model or numerical instabilities make it challenging to find a global minimum in the
 355 cost function as shown in Equation 1 (Bowman *et al.* 2006). In the case where \mathbf{S}_A represents a
 356 constraint matrix, the total posterior error becomes:

$$357$$

$$358 \mathbf{S}_{\text{tot}} = (\mathbf{I} - \mathbf{A})\mathbf{S}_A^{\text{true}}(\mathbf{I} - \mathbf{A})^T + \hat{\mathbf{S}}\mathbf{K}^T\mathbf{S}_y^{-1}\mathbf{K}\hat{\mathbf{S}} \quad (5)$$

359

360 Where the $\mathbf{S}_A^{\text{true}}$ is the *a priori* uncertainties for the estimate. In practice, $\mathbf{S}_A^{\text{true}}$ can be
361 challenging to calculate due to lack of information about the emissions or fluxes and may not
362 even be invertible because of correlations within the matrix. However, we use a set of informed
363 inventories and models to generate a prior covariance for methane emissions as described in the
364 next section. As discussed Worden *et al.* (2004), the smoothing error in the estimate is the first
365 term on the right side and the error due to measurement uncertainty is the second/middle term.
366 While the variables in Equation 5 are representative here of the top-down flux estimate, the
367 formulation can be generalized for any estimate to support interpretation of the results. For
368 example, in a system with perfect resolution the averaging kernel matrix becomes the identity
369 matrix and the smoothing error becomes zero, hence the reason that improving the spatial
370 resolution reduces the smoothing error, an important goal which can be realized with the
371 increased observation density of up-coming satellites such as CO2M, methane-sat, and Carbon
372 Mapper. Equation 5 also demonstrates that poorly characterized prior uncertainties in one region
373 affect an estimate in another regions because of cross-terms in the averaging kernel matrix \mathbf{A} .
374 This aspect of top-down inversions must therefore be accounted for when interpreting the
375 seasonality and magnitude of top-down fluxes (e.g. Ma *et al.* 2021).

376 Systematic errors can be included by adding the following term: $\hat{\mathbf{S}}\mathbf{K}_{\text{sys}}^T\mathbf{S}_{\text{sys}}^{-1}\mathbf{K}_{\text{sys}}^T\hat{\mathbf{S}}$,
377 where \mathbf{K}_{sys} is the Jacobian that describes the sensitivity of the modeled concentrations to different
378 parameters in the model that relate emissions to concentrations and \mathbf{S}_{sys} is a matrix containing
379 uncertainties for the model or data parameters. In this manuscript we do not explicitly calculate
380 systematic errors for the fluxes. We are currently studying how to empirically evaluate
381 systematic errors in the flux estimate, following the approach in Jiang *et al.* (2015) for use in
382 quantifying uncertainties in methane fluxes and emissions.

383

384 **Evaluation of Top-Down Flux Estimates:** The combination of model (GEOS-chem)
385 and data (GOSAT) used to quantify methane fluxes have been evaluated previously by
386 comparing prior and posterior model concentrations to independent data. Maasakkers et al
387 (2019) finds that posterior methane concentrations have correlations (R^2) of 0.76, 0.81, and 0.91
388 with data from surface sites, aircraft, and total column data respectively. These correlations are
389 essentially the same as those for the GEOS-chem prior concentrations, likely because these

390 measurements are taken in background regions away from sources. These comparisons between
 391 posterior concentrations with independent data sets demonstrate that the GEOS-Chem model
 392 with GOSAT data has skill in quantifying atmospheric methane concentrations and that
 393 assimilating GOSAT data into GEOS-Chem for the purpose of quantifying fluxes is at least as
 394 skillful as using prior information when looking at background regions away from emissions
 395 sources. Changes in fluxes based on GOSAT data are therefore driven entirely by differences in
 396 satellite observed concentrations over source regions.

397
 398

399 *2.2 Projecting Fluxes To Emissions And Their Uncertainties*

400

401 The derivation that describes how to project top-down fluxes back to emissions by sector
 402 at arbitrary resolution is described in Cusworth *et al.* (2021) and summarized in this section.

403 For policy-relevance and CH₄ budget quantification, we wish to optimize emissions (\mathbf{z}) using
 404 atmospheric observations, i.e., we want to compute the explicit posterior representation without
 405 re-simulation of an atmospheric transport model. The relationship we use between emissions \mathbf{z} and
 406 fluxes \mathbf{x} is simple aggregation (the total flux within a grid box is the sum of emissions), and can
 407 be represented by matrix \mathbf{M} :

408

$$409 \mathbf{x} = \mathbf{Mz}. \quad (6)$$

410

411 The solution for projecting fluxes back to emissions takes the form (Cusworth *et al.* 2021):

412

$$413 \hat{\mathbf{z}} = \mathbf{z}_A + \hat{\mathbf{Z}}\mathbf{M}^T\hat{\mathbf{S}}^{-1}[(\mathbf{I} - \hat{\mathbf{S}}\mathbf{S}_A^{-1})(\mathbf{x}_A - \mathbf{Mz}_A) + (\hat{\mathbf{x}} - \mathbf{x}_A)] \quad (7)$$

414

415 where the ($\hat{\mathbf{z}}$) is the posterior emissions vector with error covariance ($\hat{\mathbf{Z}}$) and \mathbf{I} is the identity matrix,

416 The posterior emission error covariance matrix $\hat{\mathbf{Z}}$ is calculated explicitly given \mathbf{M} , \mathbf{S}_A , $\hat{\mathbf{S}}$, and prior
 417 emissions error covariance matrix \mathbf{Z}_A :

418

$$419 \hat{\mathbf{Z}} = (\mathbf{M}^T(\hat{\mathbf{S}}^{-1} - \mathbf{S}_A^{-1})\mathbf{M} + \mathbf{Z}_A^{-1})^{-1} = (\mathbf{M}^T(\mathbf{K}^T\mathbf{S}_v^{-1}\mathbf{K})\mathbf{M} + \mathbf{Z}_A^{-1})^{-1} \quad (8)$$

420

421 This solution depends on the top-down flux inversion providing the inversion characterization
422 products (i.e., the flux prior \mathbf{x}_A and flux constraint matrix \mathbf{S}_A and the flux Hessian $\hat{\mathbf{S}}$). Note that
423 here we must use the Hessian as described in Equation 3, not the total posterior covariance as
424 described by Equation 5 (Cusworth *et al.* 2021). To quantify the set of sectoral emissions $\hat{\mathbf{z}}$, a
425 corresponding prior emissions \mathbf{z}_A , and covariance matrix \mathbf{Z}_A , must be provided at the desired
426 spatial grid; in this study we choose a 1 degree lon/lat grid. Note that the emissions and their
427 prior uncertainties used to generate prior fluxes for the top-down flux inversion (\mathbf{x}_A) can be
428 different from those used to project the top-down fluxes back to sectoral emissions for linear or
429 moderately non-linear problems (e.g. Rodgers and Connor 2003; Bowman *et al.* 2006) as the
430 information from the measurement is preserved in the $\mathbf{K}^T \mathbf{S}_y^{-1} \mathbf{K}$ term which is contained in
431 $\hat{\mathbf{S}}^{-1} - \mathbf{S}_A^{-1}$ as shown in Equation 8. This means that \mathbf{Mz}_A can be different from \mathbf{x}_A , and their
432 corresponding covariances, as long as the inversion problem is linear or only moderately
433 nonlinear (Bowman *et al.* 2006; Cusworth *et al.* 2021). However, the interpretation of fluxes will
434 be different if these matrices (\mathbf{S}_A and \mathbf{Z}_A) are inconsistent (e.g. Shen *et al.* 2021), that is $\mathbf{S}_A \neq$
435 $\mathbf{MZ}_A \mathbf{M}^T$.

436 The uncertainty for any given element of the state vector \mathbf{z} is generally given by the
437 square root of the diagonal element of the total error covariance and includes the effects of the
438 limited spatial resolution of the top-down flux and how this projects uncertainties from one grid
439 box and sector into another grid box and sector as discussed in the previous section. For
440 example, the estimate for the emissions for some emissions sector “ i ” at some lon/lat grid box “ j ”
441 is given by (Rodgers and Connor 2003; Worden *et al.* 2004):

442

$$443 \hat{z}_{ij} = z_a^{ij} + A_{ij,ij}(z_{ij} - z_a^{ij}) + \mathbf{A}_{ij,xy}(\mathbf{z}_{xy} - \mathbf{z}_a^{xy}) + \delta_{ij} \quad (9)$$

444

445 Where the italicized variables in Equation 9 are scalar representations of the variables in
446 Equations 7 and 8, the index “ x ” represents all sectors and the index “ y ” represents all other
447 lat/lon elements and matrices and vectors are boldfaced. Note that the paired indices x and y
448 exclude the paired indices i and j . The variable “ z_{xy} ” represents the “true” value corresponding
449 to the estimate “ \hat{z}_{ij} ” and the variable δ_{ij} represents the error due to random noise (we exclude
450 systematic error here to simplify the math but Equation 9 can be expanded to include this term).

451 Of course we do not actually know the true value and its errors but Equation 9 allows us to
 452 represent them in a manner than allows us to calculate their statistics. The total error for \hat{z}_{ij} ,
 453 equivalent to an element of the total error in Equation 8, is:

454

$$455 \quad E \left\| \hat{z}_{ij} - z_{xy} \right\|^2 = (1 - A_{ij}) Z_a^{ij} (1 - A_{ij})^T + \mathbf{A}_{ij,xy} \mathbf{Z}_a^{xy} \mathbf{A}_{ij,xy}^T + S_{ij}^n \quad (10)$$

456

457 Where the $E \left\| \right\|^2$ term describes the expectation operator for calculating the statistics of the
 458 quantity of interest (Bowman *et al.* 2006). The diagonal elements of the total error covariance
 459 therefore include the effect of the limited spatial resolution through the second term on the right
 460 hand side of Equation 10, which projects prior uncertainties from one region and sector (x,y) into
 461 the region and sector of interest (i,j). The last term is the covariance due to measurement noise.
 462 As the spatial resolution increases, the averaging kernel matrix converges towards the identity
 463 matrix; in this limit the first and second terms on the right side converge to zero such that the
 464 total error is due to noise (last term in Equation 10) and any residual systematic errors (not
 465 shown in Equation 10 but discussed in the previous section). Improving the spatial resolution of
 466 the methane emissions estimate therefore improves the accuracy.

467

468 In order to calculate the uncertainty for an aggregation of the elements of the state vector
 469 \mathbf{z} (e.g. the coal sector for a country), instead of an individual element, we must sum the desired
 470 set of elements $[z_i]$ that represent this sector and region. The uncertainty for this sum (squared) is
 471 then:

472

$$473 \quad \sigma_{ij}^2 = \mathbf{h} \hat{\mathbf{Z}}_{ij} \mathbf{h}^T \quad (11)$$

474

475 where \mathbf{h} is a vector that is the same length as $[z_{ij}]$, with values of one in each element and $\hat{\mathbf{Z}}_{ij}$ is
 476 the square sub-matrix of the covariance matrix \mathbf{Z} corresponding $[z_{ij}]$ (e.g. the country and
 477 emission sector of interest).

478

479 **2.3 Generation of Prior Emissions, Covariances, and Uncertainties**

480

481 In order to project fluxes from a top-down inversion back to emissions using the
482 approach described in Section 2.2, sectoral emissions and their covariances, or \mathbf{z}_A and \mathbf{Z}_A , at the
483 desired spatial resolution are required. One challenge with the flux to emissions projection is that
484 the *a priori* covariance matrix \mathbf{Z}_A must be inverted (Equation 8), which can be computationally
485 expensive because this matrix can be quite large as the number of sectors and spatial resolution
486 of the emissions increases and because correlations within the matrix (next section) make it
487 challenging to invert. In order to reduce computational expense for our chosen spatial resolution
488 of 1 degree resolution (prior to calculating country wide emissions), we dis-aggregate global
489 emissions into eight regions (Table 2) chosen by regions with peaks in the inversion sensitivity
490 to the underlying fluxes as shown by the averaging kernel diagonals in Figure 2. The different
491 categories are shown in Table 2 for each region and by sector along with the provenance (or
492 manuscript reference) in the second column. Cross-terms in the averaging kernel (Equations 5,
493 9, and 10) matrix demonstrate that the change in emissions in one region affect the estimated
494 emissions in another. Subdividing the fluxes into these eight regions therefore introduces an
495 extra error term in the total error covariance for each region; however this extra error is
496 automatically included in the total error covariance for each region as demonstrated by Equation
497 10.

498 Table 2: *A priori* emissions by source and region used with sectoral attribution

Source Tg CH ₄ /yr	Ref	N. America (15%)	S. America (30%)	Africa (30%)	Europe W. Russia N. Africa Mid-East (15%)	E. Russia (30%)	India Eurasia (30%)	Asia (30%)	Indonesia Australia (20%)	Total
Lon / Lat		175W-40W 25N-80N	130W-30W 65S-25N	24W-60E 40S-20N	24W-60E 20N-80N	60E-179E 50N-90N	60E-90E 5N-50N	90E-179E 5N-50N	90E-179E 45S-5N	
Livestock	1,2	7.7 +/-1.2	21.6 +/-3.9	10.7 +/- 2.1	12.4 +/-1.8	0.6 +/-0.1	19.1 +/- 5.0	11.7 +/-2.4	3.9 +/- 0.8	87.6 +/- 7.4-17.2
Rice	2	0.4 +/-0.1	1.2 +/- 0.3	1.8 +/-0.6	0.6 +/-0.1	0.04 +/- 0.01	8.7 +/- 2.4	32.8 +/-8.5	4.4 +/- 0.9	36.9 +/- 8.9-12.9
Waste	2	7.4 +/-1.1	4.1 +/-1.3	7.1 +/-2.0	23.9 +/-3.6	0.9 +/-0.3	4.4 +/-1.3	6.8 +/-1.6	3.1 +/- 0.7	57.7 +/- 5.0 – 11.9
Oil	3	2.7 +/-0.4	4.5 +/-1.4	2.8 +/-0.8	17.7 +/- 2.9	10.6 +/-3.3	0.6 +/-0.2	2.0 +/-0.6	0.7 +/- 0.1	41.6 +/- 4.7-9.7
Coal	3	3.2 +/-0.5	0.4 +/-0.1	0.78 +/- 0.22	2.3 +/-0.3	2.8 +/-0.9	1.6 +/-0.5	19.2 +/-5.9	1.2 +/- 0.3	31.4 +/- 6.1-9.8
Gas	3	7.5 +/-1.1	0.4 +/-0.1	0.7 +/-0.2	8.9 +/-1.3	0.4 +/-0.1	3.7 +/-1.2	0.9 +/-0.3	1.1 +/- 0.2	24.5 +/- 2.1-4.7
Fires	4	1.4 +/-0.3	2.3 +/-0.4	4.9 +/-0.8	0.3 +/-0.03	1.5 +/-0.2	0.1 +/- 0.02	1.1 +/-0.2	3.6 +/- 0.6	15.1 +/- 1.1 – 2.5
Wetlands Aquatic	5,6	37.1 +/-7.2	72.8 +/-16.2	42.4 +/- 16.3	7.5 +/-1.5	8.6 +/-2.0	3.7 +/-1.1	8.6 +/-1.9	19.0 +/- 6.5	199.8 +/- 25.2 - 52.8
Seeps	7	7.8 +/-1.1	2.0 +/-0.6	0.4 +/-0.1	14.1 +/-2.5	2.8 +/-0.8	0.8 +/-0.2	2.7 +/-0.7	1.3 +/- 0.2	32.0 +/- 3.0 – 6.2
Total Tg CH ₄ /yr		75.2 +/- 7.6 – 12.9	109.3 +/- 16.8-24.4	71 +/- 16.6–23.1	87.8 +/- 5.9-14.1	28.9 +/- 4.0 – 7.8	42.7 +/- 5.9 – 11.9	85.8 +/- 11.0-22.1	38.3 +/- 6.7-10.4	526 +/- 29.5 – 127.7

499
500 Table 2: Prior emissions by source and regions. Single values for uncertainties are calculated by projecting the
501 corresponding covariance to a single number for the indicated lon/lat region and taking the square root. Total values
502 show a range of uncertainty with the lower bound being the sum (squared) of the individual region or sector
503 (assumes errors are un-correlated) and the upper bound being the sum of the errors (assumes errors are completely
504 correlated). The following references indicate the source for each emission type: 1) NASA CMS V1.0 (Wolf *et al.*
505 2017), 2) EDGAR 6.0 (Crippa *et al.* 2020), 3) NASA GFEI V1 (Scarpelli *et al.* 2020), 4) GFED 4.1 (van der Werf *et al.*
506 2017), 5) WETCHARTS 1.3.1 (Bloom *et al.* 2017), 6) GCP (Poulter *et al.* 2017), 7) Etiope *et al.* (2019). The
507 target uncertainty for each region and sector is given in brackets underneath each region.
508

509 Our prior emission distribution and magnitude represents, by necessity, a set of ad hoc
510 choices that are informed by the scientific literature and experience of the co-authors of this
511 paper with developing top-down flux estimates. For example, our chosen resolution for
512 reporting sectoral emissions is 1 degree, which represents a compromise between computational
513 expense while minimizing representation errors when quantifying emissions for each country,
514 which in turn is needed for these estimates to inform the global stock take. Future research will
515 evaluate if higher-resolution emissions estimates by sector can be quantified given the
516 computational expense of inverting Equation 8; our motivation for reporting top-down estimates
517 at a higher resolution are because many of the inventories are at these scales (e.g. 0.1 degree) and
518 also to better utilize high-resolution emissions estimates now available by aircraft data (e.g.
519 Duren *et al.* 2019) and from upcoming satellites such as Carbon Mapper (e.g. Cusworth *et al.*
520 2019; 2021).

521 We make the following choices for which sectoral emission type is represented: wastewater
522 is not explicitly estimated as these emissions are spatially correlated with landfill emissions
523 based on inspection of EDGAR inventories when projected to 1 degree resolution. The waste
524 category should therefore be interpreted as a combination of landfill and wastewater. We also did
525 not consider biofuels or termites for this estimate as they represent a small component of the
526 budget. For these reasons, the biofuel and termite components of the methane budget will
527 slightly bias our other sectoral estimates by 15-30 Tg CH₄/yr based on bottom up estimates
528 reported in (Saunio *et al.* 2020). On the other hand, emissions for seeps are included as bottom-
529 up inventories suggest these could be as large as 30 Tg CH₄/yr; however given the co-location of
530 seep emissions with oil and coal (Figure 3), care must be taken in interpreting our results for
531 Seep emissions estimates. Our prior emissions for livestock are from a NASA Carbon
532 Monitoring System product (Wolf *et al.* 2017) and is found from post-processing to be too low
533 by ~25% due to not including a scaling factor in the overall emissions. Nonetheless we keep the
534 current set of (low) prior livestock emissions of ~89 Tg CH₄/yr as they demonstrate (along with
535 the analysis in Section 3.3, Figure 6) that our total results are largely independent of the choice
536 of priors because of the sensitivity of the fluxes to the underlying emissions as shown in the right
537 panel of Figure 2. A future version of these estimates will have an updated prior for livestock
538 emissions and will include termites, wastewater, and biofuels. Although there can be many

539 emissions within a single grid box, uncertainty can still decrease for each emission type as shown
540 in Equation 8, which shows that these correlations are quantified in the posterior covariance.
541 Uncertainty reduction of a particular emission therefore depends on the magnitude of the
542 emission and its uncertainty, its correlations with nearby emissions of the same type (next
543 section) and the magnitude and uncertainty of emissions within the same grid box.

544 Prior wetland emissions are based on an ensemble of process models from the
545 WETCHARTS system and the Global Carbon Project (Bloom *et al.* 2017; Poulter *et al.* 2017;
546 Ma *et al.* 2021) and include the effects of lakes and rivers. A future version of this system will
547 separately estimate these other sectors of the methane budget if further analysis using other
548 satellite data (e.g. TROPOMI) shows that they can be distinguished from these other sectors.

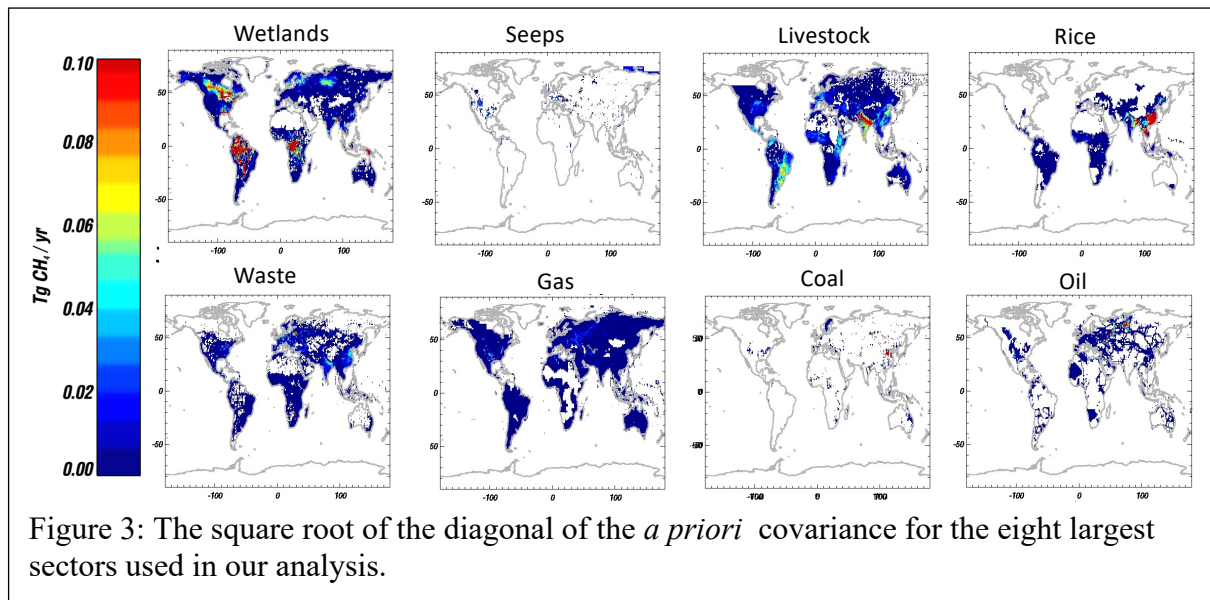
549 **Covariance Generation:** Generating representative prior covariances is challenging as there
550 are few global studies that allow for accurate representation of uncertainties for emissions across
551 the globe and their correlations that are based on data and/or well calibrated models. This
552 problem exists not just for methane emissions but with other inverse problems where there is
553 little data representative of the quantities of interest (e.g. with remote sensing; Worden *et al.*
554 2004). For this reason we need to make another set of ad-hoc choices that is based on prior
555 research in order to generate the covariances for each sector. We therefore use the following
556 approach: first we assume that the total anthropogenic emissions (by sector) in “Annex 1”
557 countries have an uncertainty of 15%. For example, we assume the total error for the N.
558 American Coal sector is ~15%, and so on for each anthropogenic sector. Similarly, the total error
559 for Annex 2 regions is 30%. These targeted uncertainties are listed underneath the label for each
560 region in Table 2. These uncertainties are reported in Janssens *et al.* (2019) and are based on
561 “expert opinion” as quantifying uncertainties over a country or region using bottom up-
562 approaches can be challenging. Total regional uncertainty for a specific sector is calculated using
563 Equation 11. In order for sectoral emissions at 1 degree resolution to project to a total regional
564 uncertainty of 15%, there must be significant uncertainty of any given emission within that 1
565 degree grid cell. However, even assuming very large uncertainties for an emission within a 1
566 degree grid cell (e.g. 100%), the regional total uncertainty can be much smaller than 15% once
567 projected over a large enough number of grid cells if the emission errors are assumed to be
568 uncorrelated. To address this issue we also add correlations between nearby emissions; we start
569 the diagonal values at 0.7 (squared) of the prior emissions, or 70% uncertainty, and with a

570 correlation of 0.7 between neighboring emissions of the same type that are within 400 km (or
571 four grid cells). The diagonal values and correlations are then adjusted until the projected
572 uncertainty reaches 15% (for Annex 1) or 30% (Annex 2). Final values typically range from 0.6
573 (squared) to 1.0 for the diagonal and 0.7 to 0.9 for the off-diagonal values with variations in
574 these numbers because of the different spatial distributions of the emissions. These numbers for
575 the correlation and length scale are based on regional studies for N. America which also indicate
576 that uncertainties for nearby emissions should be correlated (e.g. Maasakkers *et al.* 2016, 2019).

577 For wetlands, we use a slightly different approach for generating covariances. Here we
578 calculate the root mean square (RMS) of an ensemble of different wetland process models
579 (Bloom *et al.* 2017; Poulter *et al.* 2017; Ma *et al.* 2021) for a given region. We then follow a
580 similar covariance generation approach as used for the anthropogenic emissions, iterating with
581 different diagonal and off-diagonal values until the projected uncertainty for a region is
582 approximately the same as the corresponding variance of the models.

583 While generating representative prior covariances is challenging, Equations 7 and 8 from
584 the previous section allow us to swap in better priors and prior covariances as these become
585 available. For example, if a researcher finds that the uncertainties expressed in \mathbf{Z}_A over a given
586 region for a given sector should be 10% instead of the value used (approximately 70%), then it is
587 straightforward to update the covariance matrix to reflect this improved knowledge so that the
588 attribution to each sector is improved. Of course this improved information could also be used to
589 improve the \mathbf{S}_A constraint matrix in Equation 1 to improve convergence of the top-down flux
590 estimate. Furthermore the updated posterior covariances can be used for the next flux inversion
591 based on other independent data and at some point these covariances, because they are based on
592 observations, will best reflect our knowledge of the methane emission. Covariances and prior
593 emissions are all publicly available, as well as python code that demonstrates how to use these
594 files, so that a researcher can determine how other priors and changes to their uncertainty
595 structure affects this top-down result or to use them for their own top-down inversions. Links to
596 these data and codes are in the Data Repository section (Section 5).

597 **Uncertainty Calculation Approach:** The uncertainties shown in the Tables 1 and 2 are
598 calculated in the following manner. First the prior uncertainties for each sector and for each
599 region shown in Table 2 are calculated by projecting the regional (e.g. N. America, S. America)
600 posterior error covariance to a single number corresponding to the mean emissions for that



601 region using Equation 11. One approach is to then assume that these uncertainties are
 602 independent of each other in which case they are added in quadrature to get the total value; this is
 603 the smaller uncertainty shown in the **Total** column in Table 2. However, another method is to
 604 assume that the uncertainties are 100% correlated such that they should be added linearly; these
 605 are the values shown as the larger value in Table 2. We expect that the actual uncertainty is
 606 somewhere between these values. However, to be conservative we only report the larger value in
 607 Table 1 and for the remainder of the paper.

608 The prior uncertainties generated using the method described here are consistent with
 609 those reported in the literature even though the methodology differs. For example the values
 610 shown in the “prior” column of Table 1 are consistent (within reported ranges or uncertainties) of
 611 the equivalent sectors discussed in Sauniois *et al.* (2020) and with the regional EDGAR v4.3.2
 612 inventories as discussed in Janssens-Maenhout *et al.* (2019). A caveat is that Janssens-
 613 Maenhout *et al.* (2019) also reports global totals for each sector, from a range of inventories and
 614 models, that are 2-3 times larger for each sector than those shown here. Another caveat is that
 615 Sauniois *et al.* (2020) includes a freshwater category with a 120 +/- 60 Tg CH₄/yr uncertainty
 616 whereas this category is subsumed into our Wetlands / Aquatic sector.

617 Figure 3 shows the (square root) diagonal of the covariance for each sector; as discussed
 618 previously, these are generally correlated with the magnitude of the emissions but also the
 619 chosen value for the regional total error (Table 2). Most of the sectors have enhancements and
 620 corresponding uncertainties that are spatially distinct. For example, the largest uncertainties for

621 oil are located in Eastern Europe and Russia; the largest uncertainties for coal are in China, and
622 the largest uncertainties for gas are in N. America and Central Asia. In turn, these fossil
623 emissions are spatially distinct from wetlands and livestock. However, the largest uncertainties
624 for rice and waste can spatially overlap those of livestock, especially in India and Asia, which
625 indicates that remote sensing will be challenged to distinguish these emissions.

626

627 **3.0 Results**

628

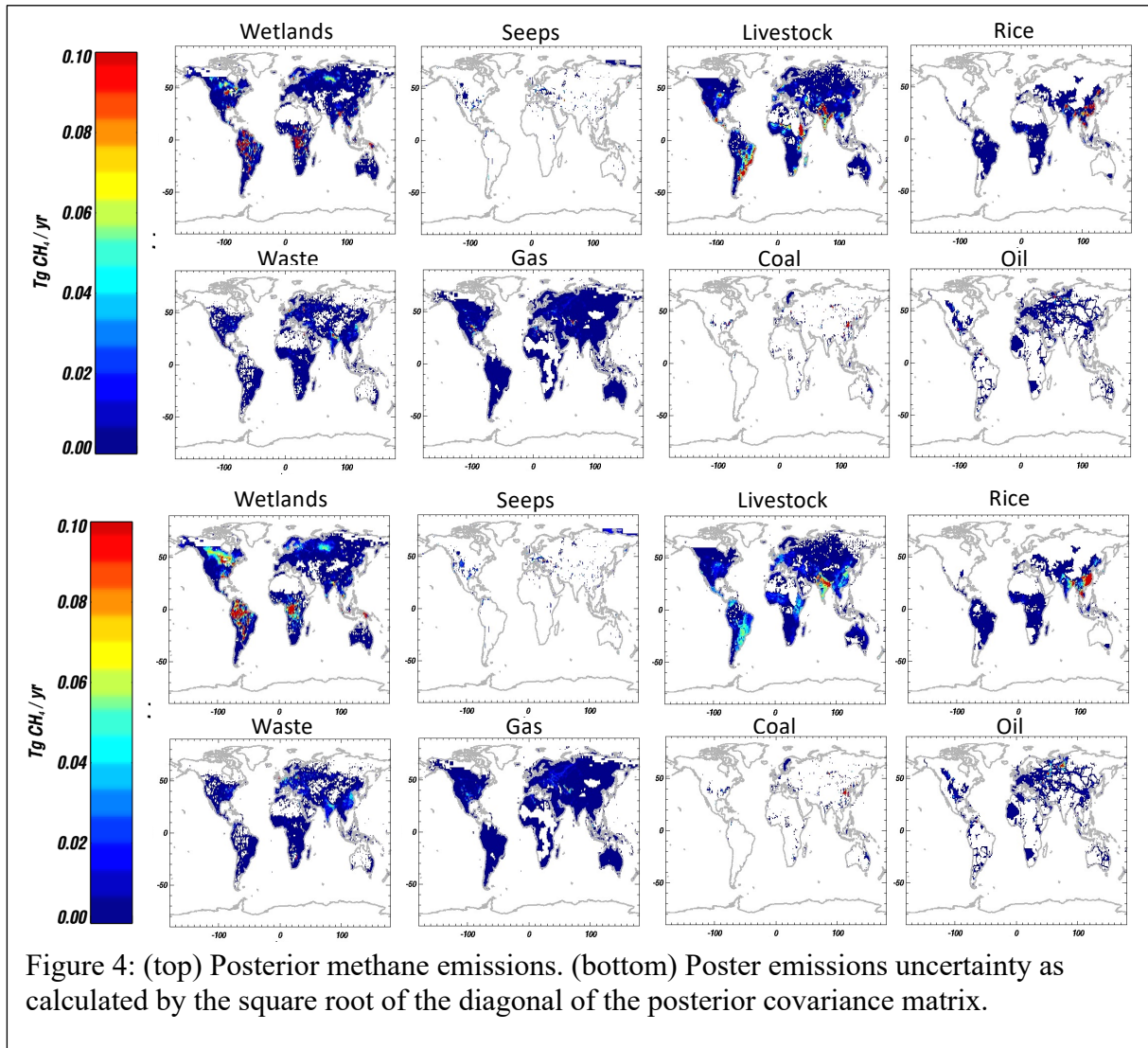
629 In this next section we first present global estimates, followed by a discussion of the
630 sectoral emissions for the top-10 emitting countries, then emissions for all countries. Finally we
631 test if different assumptions about bottom-up emissions as discussed in recent literature, i.e.
632 larger wetland/aquatic emissions (Rosentreter *et al.* 2021), and larger fossil emissions
633 (Schweitzke *et al.* 2017) affect our conclusions about the top-down results presented here.

634

635

636

637



638

3.1 Global Methane Budget By Sector

639

Emissions by sector and their uncertainty at 1 degree resolution are shown in Figure 4

640

with the top set of panels showing the posterior emissions and the bottom showing the

641

uncertainties. As in Figure 3, the uncertainty at each longitude/latitude grid element is given by

642

the square root of the diagonal of the total error covariance. Uncertainty can decrease for

643

emissions even when there is more than one type of emission in a grid box. As shown in

644

Equation 8, this uncertainty reduction depends on the magnitude of the emission and its

645

uncertainty, its correlations with nearby emissions of the same type (Section 2.3) and the

646

magnitude and uncertainty of emissions within the same grid box.

647

Inspection of Figure 4 (bottom panel) and Figure 3 shows reduction of uncertainty in

648

many parts of the world relate to the prior such as the larger wetlands and agricultural regions in

649 India and Asia. The right panel of Table 1 shows the global total posterior emissions by sector.
650 The increase in sectoral emissions relative to the prior for the agriculture sector and reduction in
651 fossil emissions reflect the top-down flux estimates (Figure 2) which show a lower posterior flux
652 relative to the prior in fossil emitting regions such as Russia and N. America (with the exception
653 of Southern USA) and increases in regions where livestock and rice emissions are expected to be
654 the largest source relative to other emissions such as in India, Brazil, Argentina, and East Africa.

655 **Comparisons to Previous Top-Down Inversions Using GOSAT and GEOS-Chem:** Our
656 results are consistent with previous top-down estimates based on the satellite GOSAT data. For
657 example, the results here are based on the inversion framework from Zhang *et al.* (2021) and Qu
658 *et al.* (2021), and are therefore generally consistent for the larger emissions such as wetlands, and
659 livestock, or the emissions which are spatially distinct from other sources and therefore easier to
660 resolve with remote sensing such as oil and coal. However, our estimates for rice, waste, seeps
661 are very different and this is likely because our choice of priors for these sectors are different and
662 because Qu *et al.* (2021) uses a uniform scaling approach to project fluxes to emissions whereas
663 we account for the prior uncertainties. Similarly, our results for wetlands, livestock, and fossil
664 emissions are consistent with previous GOSAT based inversions (e.g. Maasackers *et al.* 2019;
665 Zhang *et al.*, 2021) with the caveat that these estimates are for earlier time periods and changes
666 in emissions can affect interpretation of any differences. Ma *et al.* (2021) uses GOSAT based
667 wetland estimates to show that wetland emissions for the years 2010-2018 are likely even lower
668 than our results. As with results presented here they take into account the spatial resolution and
669 prior of the top-down fluxes but use a different approach to quantify emissions; they select
670 “high” performing wetland models based on comparison of an ensemble of models with mean
671 wetland emissions and temporal variability. The total emissions for these highest performing
672 models 117 – 189 Tg CH₄/yr is lower, but within the uncertainty of the results here. These
673 difference in results, even when using similar models and data, highlight the importance of the
674 choice of priors as well as the methodology by which fluxes are projected back to emissions as
675 estimates for sectoral emissions can be very different from one estimate to the other depending
676 on these choices.

677 **Comparisons to Top-Down Inversions from GCP:** Emissions in Table 4 can be compared
678 to top-down inversions from the Global Carbon Project (GCP) when aggregated into combined
679 categories (Saunois *et al.* 2020). For example our agriculture and waste emissions are ~263 +/-

680 24 Tg CH₄/yr, anthropogenic fossil emissions are 82 +/- 12 Tg CH₄/yr, and natural
681 wetland/aquatic emissions are 180 +/- 10 Tg CH₄/yr. These are within the reported uncertainties
682 of top-down inversions in GCP which are [205-246 Tg CH₄/yr], [91-121 Tg CH₄/yr], and [155-
683 217 Tg CH₄/yr] respectively, but on the high side for agriculture and waste and on the low side
684 for fossil emissions. These differences between GCP and emissions reported here likely
685 represent the differences in information content and sampling from satellite versus ground-based
686 data as most of top-down ensembles reported in Sauniois *et al.* (2020) are based on in situ
687 measurements which are typically in background regions and which are therefore not as sensitive
688 to the spatial distribution of emissions as the satellite based estimates (e.g. Figure 6 from Yin *et*
689 *al.* 2021). However, one set of results included with the top-down GCP results that is based on
690 GOSAT data (i.e. Tsuruta *et al.* 2017) is consistent with our results as they report biospheric
691 emissions of ~172 +/- 29 Tg CH₄/yr. Note the other paper citations in the GCP methane paper
692 that indicate use GOSAT data describe the model setup and results for CO emissions or for
693 regional results so we cannot explicitly compare to their results.

694 **Fossil Emissions:** Our posterior results for anthropogenic fossil emissions (82 +/- 12 Tg
695 CH₄/yr) and natural (22.5 +/- 3.8) are lower than our prior and in general do not reflect recent
696 papers that suggest much higher fossil emissions using measurements of δ¹³CH₄ (e.g.
697 Schwietzke *et al.* 2016 indicates 211 +/- 33 Tg CH₄/yr for anthro + natural fossil emission) or
698 upscaled from aircraft measurements over USA basins (e.g. Alvarez *et al.* 2018). However, as
699 discussed in Turner *et al.* (2019), care must be taken in using isotope measurements to infer the
700 partitioning of methane sources because of large uncertainties in the emission factors of different
701 sources at different latitudes. Upscaling also can have large uncertainties as emission factors that
702 relate activity data to emissions can vary significantly from region to region. Our global
703 posterior fossil emissions are consistent with more recent reports of fossil emissions, ~84 Tg
704 CH₄/yr, to the UNFCCC (Scarpelli *et al.* 2022) for 2019, suggesting that our lower posterior
705 estimates of fossil emissions are not unreasonable.

706 Onshore geological seeps represent another largely uncertain source of fossil emissions
707 with values ranging from 2 to 30 Tg CH₄/yr. For example, the top-down flux estimate, used as a
708 basis for the sectoral emissions attribution, assumes a prior of ~2 Tg CH₄/yr. However, our
709 choice of prior (part of the **z_A** vector, Equation 7) is based on Etiope *et al.* (2019) with a value of
710 32.0 +/- 6.2, resulting in a posterior of 22.5 +/- 3.8 Tg CH₄/yr. This reduction in uncertainty is

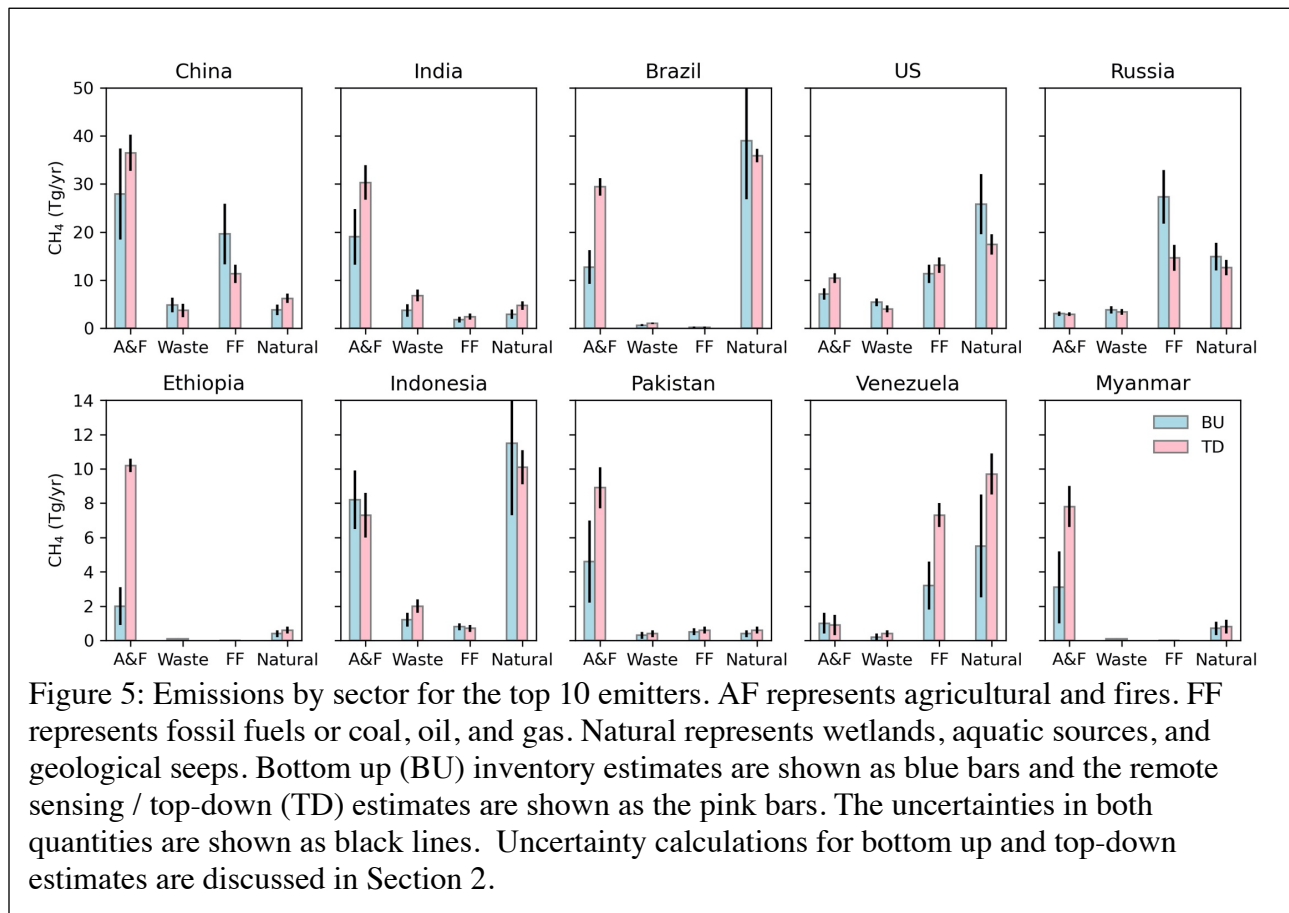
711 substantial suggesting that remote sensing is providing good information about this source. A
 712 caveat is that seep emissions tend to overlap those from coal and oil (Figure 4) suggesting a
 713 potential equifinality between these emissions estimates. Combining fossil emissions from the
 714 seep category with anthropogenic fossil emissions increases the overall fossil total and would
 715 make the total fossil emissions (natural + anthropogenic) consistent with top-down results from
 716 GC. Based on these results, we suggest this category attention deserves measurements, especially
 717 from the up and coming high-resolution greenhouse gas measurements such as Carbon Mapper.

718

719 *3.2 Top 10 Emitting Countries*

720

721



722

723

724 Figure 5 lists the top 10 emitting Countries ranked by total anthropogenic emissions as
 725 calculated using this remote sensing system. Sectoral attribution is based on the nine categories

726 in Table 3; here we combine categories so that they are similar to what is being reported for the
727 CO₂ based carbon inventories. The different categories are AF, which includes the sectors for
728 agriculture (livestock and rice) and fires. This category is similar to the Agriculture, Forestry,
729 and Land Use category or “AFOLU” a used in CO₂ based carbon inventories. W is the waste
730 category, FF is the fossil category, which includes extraction, transport and use of coal, oil, and
731 natural gas (Scarpelli *et al.* 2020; 2021). The Natural category, includes wetlands and geological
732 seeps. The top five emitting countries are essentially the same from the bottom-up and top-down.
733 However, top emitting countries with most emissions from the agriculture sector, likely due to
734 livestock (see table in Section 4). While top-down and inventory emissions for China, USA, and
735 Indonesia are consistent; there are major differences between our top-down results and
736 inventories for the other countries. We next compare these results to those of previous studies;
737 however, as stated earlier, these results should be treated cautiously and as a starting point for
738 future research as differences can also be due to unquantified uncertainties in either the remote
739 sensing data or the transport model used to relate concentrations to fluxes.

740 Our results are consistent with those from Maasakkers *et al.* (2019), Zhang *et al.* (2021)
741 and Qu *et al.* (2021); however this is not too surprising as emissions that are reported here are
742 based on the flux inversion system from these studies. A notable difference in methodology is
743 that Qu *et al.* (2021) who also derives fluxes based on total column data from the Tropospheric
744 Monitoring Instrument (TROPOMI). However, Qu *et al.* (2021) finds that country totals for the
745 top-5 are essentially the same based on GOSAT and TROPOMI except for Brazil, but attributed
746 large differences between TROPOMI and GOSAT to systematic errors in the TROPOMI total
747 column data related to low surface albedo over Brazil; consequently, the TROPOMI based
748 estimates in this region should be treated more cautiously.

749 Comparisons of these results to other estimates discussed in the literature can show
750 substantial differences in either total emissions or attribution or both. For example Ganesan *et al.*
751 (2017), using in situ and satellite atmospheric methane data, finds much lower total Indian
752 emissions of 22 +/- 2.3 Tg CH₄/yr for the 2010-2015 time period as compared to 39.5 +/- 5.4 for
753 our study (and the Qu *et al.* 2021, Zhang *et al.* 2021 studies) and 36.5 +/-5.3 from Janardanan *et*
754 *al.* (2020). Miller *et al.* (2019) provides similar total emissions for China of 61.5 +/- 2.7 Tg
755 CH₄/yr but different partitioning; for example they find that Coal is the largest source of
756 emissions based on comparison of top-down fluxes to EDGAR emissions and using a relative

757 weighting attribution flux to emissions attribution approach, whereas we find that agriculture
758 (primarily Rice, Table 3 Section 4) is the largest sector. A major caveat is that attribution of
759 emissions from total fluxes is challenging for China because many of the strongest emissions
760 (e.g. coal, livestock, and rice as shown in Figures 3 and 4) overlap within the spatial resolution of
761 the top-down estimate which is less than 2.5 degrees based on gridding used for the flux
762 inversion and the variable sensitivity of the averaging kernel. While in principal these
763 uncertainties due to limited spatial resolution are quantified based on our assumed prior
764 covariance for each sector, it is quite possible that both our choice of the location of the
765 emissions and corresponding prior covariance are incorrect due to less confidence in the
766 emissions characterization in this region (Janssens-Maenhout *et al.* 2019). Our results are
767 consistent (within uncertainties) for recent results by Deng *et al.* (2021); total anthropogenic
768 emissions from Table 3 are within uncertainty of reported bottom-up and top-down total
769 anthropogenic emissions shown in Figure 4 of Deng *et al.* (2021), even if the attribution of
770 emissions may differ. Similarly, top-down based country level anthropogenic emissions from
771 Stavert *et al.* (2022) are consistent, when we are able to directly compare emissions country to
772 country, although many of their emissions only agree at the outer edge of the reported
773 uncertainties.

774 We find that Myanmar has anomalously large agricultural emissions (primarily from
775 livestock, Table 3 Section 4) relative to prior assumptions. Given that the DOFS reported for
776 Myanmar is 2.7, we expect that the fluxes here are well resolved such that it is possible that
777 poorly characterized prior emissions drive this difference between prior and posterior. For
778 example, Janardanan *et al.* (2020) also reports similar top-down emissions of 6.1 +/- 0.8 Tg
779 using a higher resolution satellite based flux inversion. However, an alternative explanation
780 could be that errors in model transport could project to larger than expected fluxes (Equation 9)
781 in this region as Jiang *et al.* (2013) finds that regions with substantial atmospheric convection
782 can have large biases in top-down surface emission estimates.

783 Ethiopia also has larger than expected agricultural (livestock emissions) as compared to
784 the prior. As with Myanmar, the prior emissions could be too low. For example, the amount of
785 cattle and other livestock, between 80 and 90 million in 2015 and growing (Bachewe *et al.* 2018,
786 statista.com) is not that different in size than USA livestock, ~93 million in 2021 (statista.com),
787 suggesting that they could also have comparable livestock emissions. An alternative explanation

788 for this discrepancy are very low prior emissions in neighboring Sudan despite possible large
789 numbers of cattle in this region as well (knoema.com) suggesting that livestock inventories in the
790 E. African regions need to be re-examined.

791 Russian posterior fossil emissions are substantially lower than those initially reported in
792 Scarpelli *et al.* (2020), which are based on reports to the UNFCCC in 2017. However, more recent
793 reporting to the UNFCCC also suggest a much smaller bottom-up fossil estimate of ~ 7 Tg CH₄/yr
794 (Scarpelli *et al.* 2021). Table 3 (next section) indicates that remote sensing provides the best
795 information about Russian oil and to some extent coal emissions as the reduction of uncertainty
796 is largest for these sectors but has little change for gas emissions. Total emissions for oil and coal
797 are 11.2 +/- 1.9 indicating that total fossil emissions are likely larger than expected for the latest
798 reports to the UNFCCC but smaller than previous. As discussed previously, these top-down
799 estimates should be treated cautiously and only as a starting point for future studies due to the
800 limited sensitivity and potential uncertainties in both top down and bottom up.

801 **3.3 Results for all Countries**

802 This section presents the complete table (Table 3, Appendix 1) of emissions by sector and
803 country. As discussed previously in Section 2.1, we project the sectoral emissions in each 1
804 degree grid to each country using a country map to quantify the emissions and their uncertainties
805 for each country. The table is ordered by Degrees of Freedom for Signal (DOFS), which is a
806 metric of sensitivity for inversion problems. As discussed in Section 2.1, the DOFS is a metric
807 for the sensitivity of the flux estimate. For example, a DOFS of 1 means that this remote sensing
808 system (GOSAT plus GEOS-Chem) can generally resolve the countries total emissions,
809 assuming the sensitivity is evenly distributed across the country. More DOFS means that more
810 emissions can be spatially resolved. However, even a DOFS of 0.5 means that half of the
811 estimate is weighted by the measurement, with the estimate increasingly weighted by the *a priori*
812 as the DOFS approaches zero. For these reasons we report estimates for all countries, even if the
813 DOFS are effectively zero as information about the *a priori* inventories from the measurement
814 might be useful even if not well informed by the satellite data. To distinguish these different
815 levels of sensitivity, we color countries with corresponding DOFS greater than 1.0 as green,
816 between 0.5 and 1.0 as yellow, and below 0.5 as red.

819 The DOFS are calculated from the Averaging Kernel matrix provided by the GEOS-
820 Chem based inversion (Section 2.1). To calculate the DOFS for a given country we project the
821 diagonal of the Averaging Kernel (Figure 2) to 1-degree resolution and then add up these values
822 based on the 1-degree country map used in this study. Note that the total DOFS between the
823 reduced resolution flux inversion and the 1-degree map is preserved. Table 3 indicates that the
824 GOSAT based top-down estimate can quantify total emissions (i.e. reduce uncertainty) for
825 approximately 57 countries as the DOFS for the 57th country is more than 1 and less than 1 for
826 the 58th country. As discussed previously, As DOFS approaches zero there is less reduction in
827 uncertainty using the top-down system discussed here. Furthermore, inspection of Table 3 shows
828 that even countries where DOFS are between 1 and 2 show little reduction of uncertainty; this
829 happens because of cross-terms in the sensitivity project uncertainty from one sector or region
830 into another as shown in Equation 10.

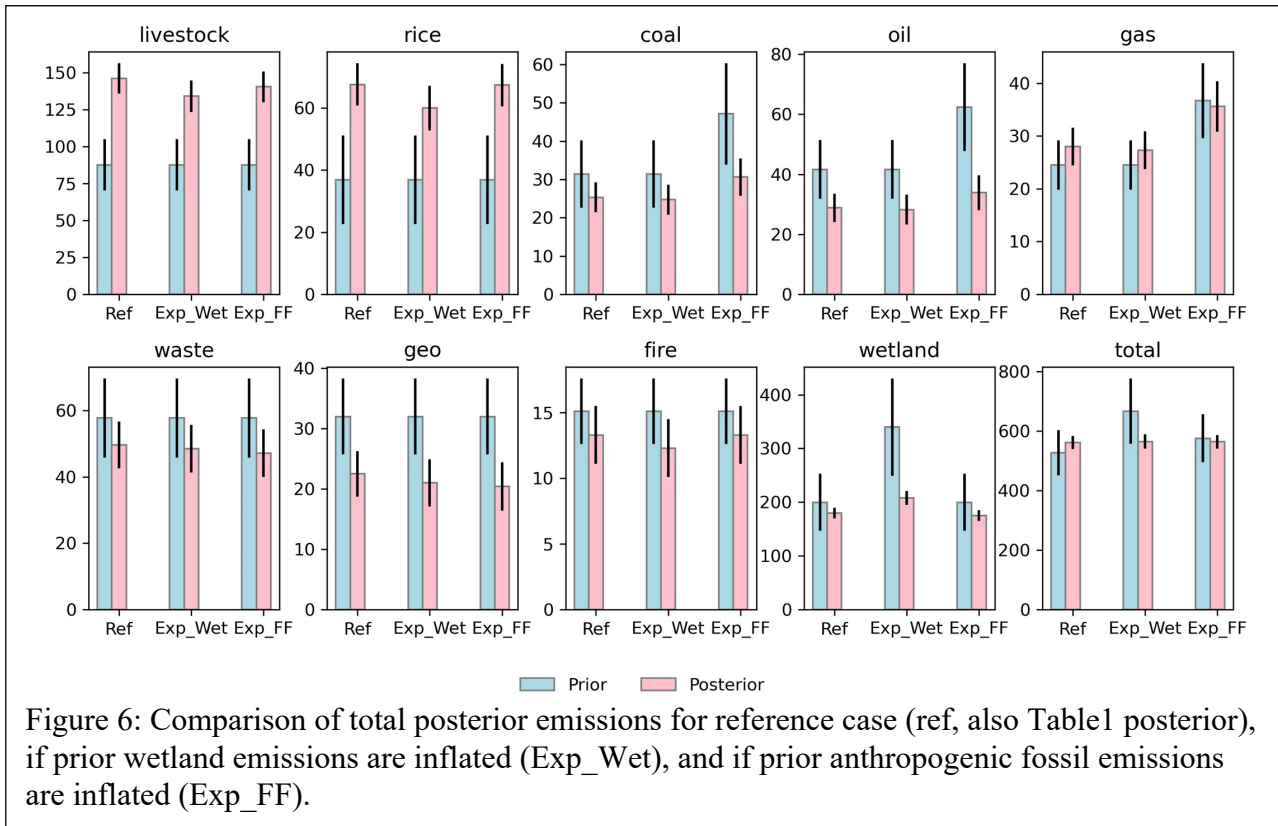
831 The astute reader will notice negative emissions in some countries in Table 3. Negative
832 emissions are a possible solution for inverse problems using linear updates, such as used here,
833 even if they are not physically possible. Typically negative emissions occur when there are
834 limited constraints on emissions in one region with large values in the state vector in a
835 neighboring region; this is also known as “jack-knifing” in the inverse community. For example,
836 livestock emissions for Peru are shown to be negative in Table 3, likely because Peru is near the
837 Amazon basin which has substantive wetland emissions and the cross-correlations between these
838 regions result in negative values in Peru livestock. In this case we would assume there is no
839 information from this remote sensing system on this category and ignore these results.

840

841 ***3.4 What Happens to (Top Down) Methane Budget if Priors for Wetland/Aquatic and*** 842 ***Fossil Emissions are Substantially Increased?***

843

844 Equations 7 and 8 also allow us to test other prior emission inventories to determine if
845 they are consistent with top-down fluxes. This approach is similar to the “prior swapping”
846 approach described in Rodgers and Connor (2003) but can also include “prior covariance
847 swapping” as discussed in Cusworth *et al.* (2021). This approach involves replacing the \mathbf{z}_A and
848 \mathbf{Z}_A shown in Section 2.2 with different formulations. In this section we test what happens if we
849 inflate the prior emissions for the wetland or fossil fuel categories such that they are consistent
850 with other studies indicating much higher values than expected from top-down estimates, e.g.



851 Rosentreter *et al.* (2021) for wetland/aquatic emissions and Schwietzke *et al.* (2017) for fossil
 852 emissions. Figure 6 shows the results of these two studies. The bars labeled “Ref” indicate the
 853 prior used for the results reported in this manuscript. The bars labeled “Wet” indicated the
 854 increased wetland study (which also includes increases to lake and river emissions as the wetland
 855 models include these categories, Bloom *et al.* 2017) and the bars labeled “FF” indicate the study
 856 where anthropogenic fossil fuels are increased by 50%. We find that even with a very large prior
 857 emissions for wetland/aquatic sources, the posterior gives an estimate of 208 +/- 12.8 Tg CH₄/yr
 858 as compared to 179.8 +/-10 for the reference values. This decrease from the inflated prior of
 859 ~340 Tg CH₄/ yr to 208 Tg CH₄/yr happens because the global total is constrained to ~560 Tg
 860 CH₄/yr through knowledge of the methane sink and because wetland emissions tend to be
 861 spatially distinct from other sources. For the same reasons, fossil emissions, especially coal,
 862 and geological seeps show a substantial decrease in uncertainty. Consequently, the posterior
 863 emissions difference between the reference and inflated fossil studies are consistent within
 864 uncertainty and generally these emissions are much less than either the reference or inflated
 865 priors. For these reasons, it is challenging to reconcile these inflated aquatic emissions or inflated
 866 fossil emissions with top-down results. As noted previously, these comparisons should still be

867 treated cautiously and as a starting point for further research because of poorly characterized
868 systematic errors in the chemistry transport model used to related observed concentrations to
869 fluxes and because sources that are not included in the prior state vector but co-located with
870 other sectors cannot be distinguished. For example, if there are significant (unspecified) aquatic
871 emissions that are co-located with livestock emissions then the corresponding livestock
872 emissions estimate would be biased high.

873

874 **4.0 Summary and Future Directions**

875 In this paper we demonstrate, using a new Bayesian algorithm, estimates of emissions by
876 sector at 1 degree resolution and by country, by using a combination of prior information of the
877 emissions, satellite data, and a global chemistry transport model. Uncertainties are provided for
878 representation (or smoothing) error and data precision but not for systematic errors in the
879 transport model or data. Using a metric called the degrees-of-freedom for signal (DOFS), we
880 show that the combination of GOSAT based satellite data with the GEOS-Chem model and prior
881 uncertainties can estimate total emissions for about 57 of the 242 countries, with only partial
882 information for the remaining countries. Our results can be used for comparison to country
883 level, bottom-up inventories by sector that might be, for example, provided by the global stock
884 take. However, any discrepancies between these top-down and inventory based estimates should
885 be considered as a starting point for future investigations given the potential for systematic errors
886 affecting the top-down results such as from accuracy limitations in the data or in the chemistry
887 transport model used to estimate fluxes from the data (e.g. Buchwitz *et al.* 2015; Jiang *et al.*
888 2015; McNorton *et al.* 2020; Schuh *et al.* 2019. Alternatively, countries with little capability for
889 quantifying bottom-up emissions could use these results, along with other published top-down
890 estimates (e.g. Deng *et al.* 2021; Stavert *et al.* 2022) for their contribution to the global stock
891 take.

892 In the absence of systematic errors, we find robust estimates for livestock, coal, oil, seeps,
893 fires, and wetlands as these can (on average) be distinguished from other sources using remote
894 sensing given their distinct locations. Our results are consistent (within uncertainty) with
895 previous top-down estimates such as the 2017 Global Carbon Project that are primarily based on
896 in situ data. However, these remote sensing estimates are on the high side for agricultural and
897 waste emissions and the low side for fossil and wetland emissions. On the other hand, total fossil

898 emissions reported here are consistent with recent reports of fossil emissions to the UNFCCC
899 (Scarpelli *et al.* 2022).

900 The new Bayesian algorithm we demonstrate can be used to test if different prior emissions
901 are consistent with our posterior emissions estimates. For example, we find that inflating the
902 priors for wetland/aquatic fluxes, or alternatively fossil emissions do not fundamentally alter our
903 estimates for these sectors. Consequently, the remote sensing estimates reported here show much
904 lower wetland and fossil emissions than these studies based on bottom-up models and isotope
905 data, and much larger agricultural and waste emissions. The largest differences between remote
906 sensing and these other estimates occur in Brazil and India (primarily related to livestock),
907 Russia (fossil emissions), and Central and E. Africa (livestock). These contrasting differences
908 between the remote sensing based results and bottom-up models suggest that additional research
909 is needed in these geographical areas to reconcile global methane budget estimates.

910 **Future Directions:** We are evaluating how to characterize systematic errors related to the
911 atmospheric chemistry transport model (e.g. Schuh *et al.* 2019) and in the satellite data to our
912 error analysis and we expect the next version of these estimates to contain these uncertainties We
913 also expect to add isotopic information through new flux estimates based on the surface network
914 and the GEOS-Chem model; these independent data can be used to test the partitioning of
915 biogenic, fossil, and pyrogenic emissions (e.g. Worden *et al.* 2017). We are also examining how
916 to combine high-resolution emissions estimates based on aircraft data and imaging spectrometers
917 such as GHG-Sat or Carbon Mapper to the top-down fluxes to improve inventory estimates at
918 finer spatial scales than reported here. Finally, the posterior emissions and covariances
919 demonstrated in this manuscript can be used as priors in subsequent emissions estimates using
920 data from other measurements such as from the upcoming CO2M, Methane-Sat, and Carbon
921 Mapper instruments.

922

923

924 **5.0 Data Repositories**

925

926 The prior and posterior emissions and covariances are stored on <https://cmsflux.jpl.nasa.gov/>.

927

928 Please refer to Qu *et al.* (2021) for data related to the top-down flux inversion.

929

930 The provenance of individual inventories that are used to generate the emissions and inventories
931 are shown in Table 2.

932

933 **6.0 Author Contributions**

934

935 JW led the integration of results and writing and developed the prior covariances. DC provided
936 the emissions attribution with JW and AB and co-wrote Section 2.2. ZQ and YZ provided the
937 flux estimates and co-wrote section 2.1. YY SM and AB supported the attribution derivation and
938 analysis. BB and DC helped link results to the global stock take. TS and JM supported the
939 inventory description and analysis. RD and DJ helped design the overall flux inversion and
940 emissions attribution system described in the paper. All co-authors have read the paper and
941 provided feedback.

942

943 **Competing Interests:** To our knowledge there are no competing interests

944

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946

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953

954

955

956 **8.0 Appendix table of emissions for each country ordered by DOFS**

957

958 Table 3: Table of Emissions for Each Country.

959 This table provides the top-down and bottom up estimates for each sector based on the
 960 methodology described in this paper. The table is ordered by DOFS which is the metric for
 961 sensitivity for the remote sensing system described in this paper. The first row for each country
 962 provides the top-down result and the second row is the bottom-up. Prior inventories are shown in
 963 Table 2. Green are for results where DOFS > 1. Yellow corresponds to 0.5 < DOFS < 1. Red
 964 corresponds to DOFS < 0.5

Sector	Livestock Tg CH ₄ /yr	Rice Tg CH ₄ /yr	Waste Tg CH ₄ /yr	Fire Tg CH ₄ /yr	Oil Tg CH ₄ /yr	Coal Tg CH ₄ /yr	Gas Tg CH ₄ /yr	Seeps Tg CH ₄ /yr	Wetland/ Aquatic Tg CH ₄ /yr	DOFS	Total Anthro
1) Brazil	27.5+/- 1.3	0.20+/- 0.10	1.0+/- 0.2	1.7+/- 0.4	0.18+/- 0.05	0.05+/- 0.02	0.00+/- 0.00	0.05+/- 0.02	35.9+/- 1.4	46	30.6+/- (1.4- 2.0)
Inventory	11.0+/- 3.0	0.26+/- 0.09	0.55+/- 0.20	1.5+/- 0.4	0.16+/- 0.05	0.05+/- 0.02	0.00+/- 0.00	0.06+/- 0.02	39.0+/- 12.2		13.5+/- (3.0- 3.7)
2) Russian Federation	1.3+/-0.2	0.07+/- 0.02	3.4+/- 0.6	1.5+/- 0.2	7.6+/- 1.4	3.6+/- 0.5	3.3+/- 0.7	1.4+/- 0.4	11.3+/- 1.2	35.8	20.9+/- (1.8- 3.7)
Inventory	1.3+/-0.3	0.09+/- 0.02	3.8+/- 0.8	1.6+/- 0.2	20.4+/- 3.9	2.5+/- 0.9	4.4+/- 0.8	2.6+/- 0.6	12.3+/- 2.3		34.1+/- (4.2- 6.8)
3) United States of America	9.9+/-0.9	0.27+/- 0.07	4.0+/- 0.7	0.22+/- 0.04	2.4+/- 0.3	2.8+/- 0.4	7.9+/- 0.9	2.7+/- 0.8	14.6+/- 1.3	32.2	27.6+/- (1.5- 3.3)
Inventory	6.4+/-1.1	0.38+/- 0.06	5.4+/- 0.8	0.26+/- 0.06	1.7+/- 0.3	3.0+/- 0.5	6.5+/- 1.1	6.7+/- 1.1	19.0+/- 5.3		23.8+/- (1.9- 3.9)
4) Canada	0.90+/- 0.15	0.00+/- 0.00	0.43+/- 0.37	0.76+/- 0.20	0.74+/- 0.26	0.05+/- 0.01	0.82+/- 0.17	1.1+/- 0.2	9.2+/- 0.7	31.5	3.7+/- (0.5- 1.2)
Inventory	0.91+/- 0.15	0.00+/- 0.00	1.2+/- 0.4	1.1+/- 0.3	0.88+/- 0.27	0.05+/- 0.01	0.80+/- 0.18	1.1+/- 0.2	18.0+/- 4.6		5.0+/- (0.6- 1.3)
5) China	6.6+/-1.7	29.6+/- 2.1	3.7+/- 1.4	0.23+/- 0.03	1.1+/- 0.3	10.1+/- 1.6	0.11+/- 0.03	1.2+/- 0.3	5.0+/- 0.8	26.5	51.5+/- (3.4- 7.1)
Inventory	8.6+/-2.1	19.1+/- 7.4	4.8+/- 1.5	0.23+/- 0.03	0.99+/- 0.28	18.5+/- 5.9	0.12+/- 0.03	1.0+/- 0.3	2.8+/- 0.8		52.3+/- (9.8- 17.3)
6) India	23.9+/- 2.0	6.3+/- 1.6	6.8+/- 1.2	0.09+/- 0.02	0.03+/- 0.01	0.91+/- 0.37	1.5+/- 0.2	0.12+/- 0.06	4.6+/- 0.8	20.8	39.5+/- (2.8- 5.4)
Inventory	13.0+/- 4.1	5.9+/- 1.7	3.7+/- 1.3	0.09+/- 0.02	0.03+/- 0.01	0.84+/- 0.38	0.90+/- 0.24	0.13+/- 0.06	2.8+/- 0.9		24.5+/- (4.6- 7.7)

7) Democratic Republic of the Congo	0.05+/-0.02	0.06+/-0.03	0.22+/-0.05	1.5+/-0.3	-0.07+/-0.04	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	17.6+/-1.0	16.9	1.8+/- (0.4-0.5)
Inventory	0.06+/-0.02	0.07+/-0.03	0.24+/-0.05	1.1+/-0.4	0.07+/-0.05	0.00+/-0.00	0.01+/-0.00	0.04+/-0.01	21.2+/-11.1		1.6+/- (0.4-0.5)
8) Indonesia	0.95+/-0.23	4.2+/-0.6	2.0+/-0.4	2.1+/-0.5	0.48+/-0.14	0.13+/-0.05	0.08+/-0.01	0.65+/-0.17	9.4+/-0.8	16.1	10.0+/- (0.9-1.9)
Inventory	0.83+/-0.23	4.3+/-0.9	1.2+/-0.4	3.0+/-0.6	0.54+/-0.14	0.14+/-0.05	0.09+/-0.01	0.62+/-0.17	10.9+/-4.0		10.1+/- (1.2-2.4)
9) Peru	-0.52+/-0.20	-0.11+/-0.10	0.04+/-0.07	0.02+/-0.01	0.07+/-0.05	0.00+/-0.00	0.02+/-0.01	0.05+/-0.02	7.8+/-0.5	6.9	-0.48+/- (0.24-0.43)
Inventory	0.48+/-0.26	0.15+/-0.09	0.14+/-0.08	0.02+/-0.01	0.07+/-0.05	0.00+/-0.00	0.02+/-0.01	0.06+/-0.02	10.9+/-8.1		0.88+/- (0.29-0.49)
10) Australia	1.3+/-0.3	0.02+/-0.00	3.0+/-0.3	0.48+/-0.05	0.02+/-0.00	1.7+/-0.2	0.38+/-0.06	0.22+/-0.07	1.0+/-0.2	6.9	6.9+/- (0.5-0.9)
Inventory	2.2+/-0.5	0.03+/-0.00	1.4+/-0.5	0.48+/-0.05	0.02+/-0.00	1.0+/-0.3	0.37+/-0.06	0.27+/-0.08	1.1+/-0.2		5.5+/- (0.8-1.4)
11) Venezuela (Bolivarian Republic of)	0.77+/-0.52	0.02+/-0.03	0.41+/-0.17	0.08+/-0.03	7.3+/-0.7	0.00+/-0.00	0.01+/-0.00	1.3+/-0.4	8.4+/-0.9	5	8.6+/- (0.9-1.5)
Inventory	0.85+/-0.55	0.03+/-0.02	0.25+/-0.18	0.08+/-0.03	3.2+/-1.4	0.00+/-0.00	0.00+/-0.00	0.66+/-0.37	4.8+/-2.6		4.4+/- (1.5-2.1)
12) Colombia	-1.97+/-0.64	0.05+/-0.14	0.18+/-0.31	0.03+/-0.01	0.33+/-0.10	0.32+/-0.14	0.01+/-0.00	0.37+/-0.23	-0.79+/-0.73	5	-1.05+/- (0.74-1.34)
Inventory	1.3+/-0.8	0.16+/-0.12	0.46+/-0.33	0.03+/-0.01	0.26+/-0.11	0.37+/-0.14	0.01+/-0.00	0.40+/-0.24	3.7+/-2.0		2.6+/- (0.9-1.5)
13) Argentina	6.6+/-0.6	0.03+/-0.04	0.22+/-0.07	0.09+/-0.03	0.29+/-0.10	0.00+/-0.00	0.06+/-0.02	0.26+/-0.08	5.2+/-0.6	4.6	7.3+/- (0.6-0.9)
Inventory	2.6+/-1.2	0.04+/-0.03	0.15+/-0.07	0.08+/-0.03	0.31+/-0.10	0.00+/-0.00	0.06+/-0.02	0.18+/-0.09	2.4+/-1.3		3.2+/- (1.2-1.4)
14) Papua New Guinea	0.04+/-0.02	0.00+/-0.00	0.02+/-0.00	0.08+/-0.02	0.03+/-0.02	0.01+/-0.00	0.01+/-0.00	0.13+/-0.05	2.8+/-0.4	4.4	0.19+/- (0.03-0.06)
Inventory	0.04+/-0.02	0.00+/-0.00	0.02+/-0.00	0.08+/-0.02	0.04+/-0.02	0.01+/-0.00	0.01+/-0.00	0.15+/-0.05	6.0+/-4.4		0.19+/- (0.03-0.06)
15) Iran (Islamic Republic of)	2.2+/-0.2	0.18+/-0.06	0.69+/-0.12	0.00+/-0.00	3.0+/-0.4	0.02+/-0.00	0.73+/-0.16	0.26+/-0.07	0.46+/-0.13	4.3	6.8+/- (0.5-1.0)
Inventory	0.74+/-0.36	0.15+/-0.05	0.41+/-0.12	0.00+/-0.00	3.4+/-1.6	0.02+/-0.00	0.47+/-0.17	0.26+/-0.07	0.19+/-0.14		5.2+/- (1.7-2.3)
16) Bolivia (Plurinational State of)	0.60+/-0.28	0.02+/-0.02	0.03+/-0.02	0.31+/-0.16	0.05+/-0.02	0.00+/-0.00	0.02+/-0.01	0.18+/-0.08	2.2+/-0.5	4.3	1.0+/- (0.3-0.5)

Inventory	0.61+/- 0.32	0.03+/- 0.02	0.03+/- 0.02	0.34+/- 0.16	0.05+/- 0.02	0.00+/- 0.00	0.02+/- 0.01	0.19+/- 0.08	3.4+/- 2.4		1.1+/- (0.4- 0.5)
17) Mexico	4.1+/-0.5	0.00+/- 0.00	1.2+/- 0.5	0.12+/- 0.04	0.07+/- 0.03	0.12+/- 0.04	0.55+/- 0.12	0.19+/- 0.07	1.1+/- 0.3	3.7	6.1+/- (0.7- 1.2)
Inventory	2.0+/-0.9	0.01+/- 0.00	2.4+/- 1.3	0.12+/- 0.04	0.07+/- 0.03	0.09+/- 0.04	0.34+/- 0.12	0.19+/- 0.07	0.81+/- 0.32		5.0+/- (1.5- 2.3)
18) Pakistan	6.7+/-0.6	2.2+/- 0.5	0.39+/- 0.16	0.01+/- 0.00	0.26+/- 0.09	0.06+/- 0.04	0.29+/- 0.11	0.53+/- 0.16	0.08+/- 0.03	3.6	9.9+/- (0.9- 1.6)
Inventory	3.4+/-1.9	1.2+/- 0.5	0.28+/- 0.16	0.01+/- 0.00	0.19+/- 0.09	0.06+/- 0.04	0.25+/- 0.11	0.35+/- 0.18	0.08+/- 0.03		5.4+/- (2.0- 2.8)
19) Congo	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.06+/- 0.04	- 0.26+/- 0.11	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	7.5+/- 0.9	3.4	- 0.18+/- (0.12- 0.16)
Inventory	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.07+/- 0.04	0.21+/- 0.14	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	8.0+/- 6.4		0.30+/- (0.15- 0.19)
20) United Republic of Tanzania	2.8+/-0.4	0.18+/- 0.13	0.13+/- 0.04	0.34+/- 0.10	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.03	0.06+/- 0.02	1.9+/- 0.4	3	3.5+/- (0.4- 0.7)
Inventory	0.96+/- 0.59	0.20+/- 0.14	0.12+/- 0.04	0.23+/- 0.10	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.03	0.06+/- 0.02	1.5+/- 0.8		1.6+/- (0.6- 0.9)
21) South Africa	1.9+/-0.2	0.00+/- 0.00	0.72+/- 0.15	0.05+/- 0.01	0.00+/- 0.00	0.71+/- 0.13	0.00+/- 0.00	0.04+/- 0.01	0.21+/- 0.07	3	3.4+/- (0.3- 0.5)
Inventory	0.52+/- 0.30	0.00+/- 0.00	0.65+/- 0.25	0.05+/- 0.01	0.00+/- 0.00	0.43+/- 0.19	0.00+/- 0.00	0.04+/- 0.01	0.16+/- 0.07		1.6+/- (0.4- 0.7)
22) Ethiopia	10.1+/- 0.4	0.01+/- 0.00	0.12+/- 0.04	0.09+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.14+/- 0.04	0.43+/- 0.11	2.9	10.3+/- (0.4- 0.5)
Inventory	1.9+/-1.1	0.01+/- 0.00	0.10+/- 0.04	0.08+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.12+/- 0.05	0.27+/- 0.12		2.1+/- (1.1- 1.2)
23) Angola	0.13+/- 0.03	0.00+/- 0.00	0.08+/- 0.05	0.75+/- 0.22	- 1.38+/- 0.21	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.4+/- 0.1	2.8	- 0.41+/- (0.31- 0.51)
Inventory	0.15+/- 0.03	0.01+/- 0.00	0.14+/- 0.05	0.74+/- 0.31	0.63+/- 0.36	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.41+/- 0.16		1.7+/- (0.5- 0.8)
24) Myanmar	0.67+/- 0.47	6.9+/- 0.6	0.05+/- 0.01	0.23+/- 0.06	0.00+/- 0.00	0.01+/- 0.00	0.01+/- 0.00	0.08+/- 0.04	0.72+/- 0.31	2.7	7.8+/- (0.8- 1.2)
Inventory	0.83+/- 0.56	2.0+/- 1.4	0.05+/- 0.01	0.24+/- 0.06	0.00+/- 0.00	0.01+/- 0.00	0.01+/- 0.00	0.09+/- 0.04	0.64+/- 0.33		3.2+/- (1.5- 2.1)
25) Thailand	0.21+/- 0.18	2.7+/- 0.8	0.27+/- 0.16	0.10+/- 0.03	0.10+/- 0.16	0.02+/- 0.01	0.07+/- 0.06	0.06+/- 0.02	0.18+/- 0.35	2.4	3.5+/- (0.8- 1.4)
Inventory	0.31+/- 0.18	2.9+/- 2.2	0.26+/- 0.16	0.10+/- 0.03	0.21+/- 0.16	0.02+/- 0.01	0.09+/- 0.06	0.06+/- 0.02	0.62+/- 0.39		3.8+/- (2.2- 2.8)
26) Nigeria	1.4+/-0.4	1.2+/- 0.3	0.53+/- 0.15	0.12+/- 0.05	0.13+/- 0.08	0.38+/- 0.12	0.25+/- 0.13	0.04+/- 0.01	1.6+/- 0.3	2.3	4.0+/- (0.6- 1.2)

Inventory	0.87+/- 0.52	0.49+/- 0.40	0.47+/- 0.15	0.12+/- 0.05	0.15+/- 0.08	0.25+/- 0.12	0.20+/- 0.13	0.04+/- 0.01	0.84+/- 0.49		2.5+/- (0.7- 1.5)
27) Malaysia	0.04+/- 0.02	0.10+/- 0.07	0.26+/- 0.20	0.04+/- 0.01	0.11+/- 0.03	0.00+/- 0.00	0.11+/- 0.08	0.27+/- 0.13	0.68+/- 0.27	2.2	0.66+/- (0.23- 0.41)
Inventory	0.05+/- 0.02	0.19+/- 0.06	0.47+/- 0.22	0.04+/- 0.01	0.11+/- 0.03	0.00+/- 0.00	0.30+/- 0.08	0.27+/- 0.13	1.1+/- 0.5		1.2+/- (0.2- 0.4)
28) Sudan	0.32+/- 0.03	0.00+/- 0.00	0.08+/- 0.02	0.02+/- 0.02	0.14+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.17+/- 0.03	2.1	0.57+/- (0.05- 0.10)
Inventory	0.04+/- 0.04	0.00+/- 0.00	0.07+/- 0.02	0.03+/- 0.02	0.06+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.11+/- 0.03		0.21+/- (0.06- 0.11)
29) Zambia	0.13+/- 0.05	0.00+/- 0.00	0.07+/- 0.03	0.81+/- 0.16	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.91+/- 0.24	2.1	1.0+/- (0.2- 0.2)
Inventory	0.13+/- 0.05	0.00+/- 0.00	0.08+/- 0.04	0.42+/- 0.19	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.87+/- 0.43		0.64+/- (0.20- 0.27)
30) South Sudan	0.05+/- 0.03	0.00+/- 0.00	0.02+/- 0.00	- 0.07+/- 0.16	0.26+/- 0.06	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	3.1+/- 0.4	2.1	0.25+/- (0.17- 0.25)
Inventory	0.03+/- 0.03	0.00+/- 0.00	0.02+/- 0.00	0.34+/- 0.16	0.11+/- 0.06	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.8+/- 1.3		0.50+/- (0.18- 0.26)
31) Turkey	0.89+/- 0.28	0.04+/- 0.02	1.8+/- 0.5	0.01+/- 0.00	0.02+/- 0.01	0.23+/- 0.04	0.10+/- 0.03	0.33+/- 0.15	0.10+/- 0.05	2	3.1+/- (0.6- 0.9)
Inventory	0.70+/- 0.33	0.05+/- 0.02	2.0+/- 0.8	0.01+/- 0.00	0.02+/- 0.01	0.22+/- 0.04	0.10+/- 0.03	0.47+/- 0.17	0.10+/- 0.05		3.1+/- (0.9- 1.2)
32) Saudi Arabia	0.16+/- 0.05	0.00+/- 0.00	0.29+/- 0.07	0.00+/- 0.00	0.12+/- 0.09	0.00+/- 0.00	0.65+/- 0.21	0.09+/- 0.03	0.00+/- 0.00	1.9	1.2+/- (0.2- 0.4)
Inventory	0.10+/- 0.06	0.00+/- 0.00	0.23+/- 0.07	0.00+/- 0.00	0.29+/- 0.11	0.00+/- 0.00	0.53+/- 0.26	0.10+/- 0.03	0.00+/- 0.00		1.2+/- (0.3- 0.5)
33) Kazakhstan	0.58+/- 0.08	0.02+/- 0.01	0.15+/- 0.03	0.05+/- 0.01	0.12+/- 0.06	1.2+/- 0.3	0.15+/- 0.05	0.25+/- 0.07	0.39+/- 0.09	1.9	2.3+/- (0.4- 0.6)
Inventory	0.54+/- 0.08	0.03+/- 0.01	0.13+/- 0.04	0.05+/- 0.01	0.20+/- 0.07	0.90+/- 0.38	0.17+/- 0.06	0.21+/- 0.07	0.36+/- 0.10		2.0+/- (0.4- 0.6)
34) Central African Republic	0.04+/- 0.07	0.00+/- 0.00	0.02+/- 0.00	- 0.79+/- 0.17	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.04+/- 0.01	-1.00+/- 0.19	1.8	- 0.73+/- (0.18- 0.25)
Inventory	0.13+/- 0.07	0.00+/- 0.00	0.02+/- 0.00	0.40+/- 0.19	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.04+/- 0.01	0.52+/- 0.32		0.55+/- (0.20- 0.27)
35) Viet Nam	0.58+/- 0.21	3.6+/- 0.9	0.20+/- 0.10	0.08+/- 0.02	0.02+/- 0.04	0.09+/- 0.03	0.04+/- 0.03	0.08+/- 0.02	0.61+/- 0.50	1.7	4.6+/- (0.9- 1.3)
Inventory	0.35+/- 0.22	2.7+/- 1.6	0.19+/- 0.10	0.07+/- 0.02	0.12+/- 0.10	0.09+/- 0.03	0.04+/- 0.03	0.08+/- 0.02	1.0+/- 0.6		3.6+/- (1.7- 2.1)
36) France	2.2+/-0.4	0.00+/- 0.00	0.86+/- 0.28	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.01	0.20+/- 0.06	0.09+/- 0.05	1.7	3.1+/- (0.5- 0.7)
Inventory	1.2+/-0.6	0.00+/- 0.00	0.70+/- 0.33	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.01	0.19+/- 0.06	0.08+/- 0.05		2.0+/- (0.7- 1.0)

37) Uzbekistan	0.79+/- 0.23	0.02+/- 0.01	0.10+/- 0.04	0.00+/- 0.00	0.04+/- 0.02	0.01+/- 0.00	2.9+/- 0.4	0.04+/- 0.01	0.04+/- 0.02	1.6	3.9+/- (0.5- 0.8)
Inventory	0.56+/- 0.26	0.03+/- 0.01	0.08+/- 0.04	0.00+/- 0.00	0.03+/- 0.02	0.01+/- 0.00	2.3+/- 1.0	0.04+/- 0.01	0.04+/- 0.02		3.0+/- (1.1- 1.4)
38) Turkmenistan	0.35+/- 0.11	0.04+/- 0.01	0.02+/- 0.01	0.00+/- 0.00	1.5+/- 0.3	0.00+/- 0.00	1.1+/- 0.2	1.2+/- 0.2	0.01+/- 0.00	1.6	3.0+/- (0.4- 0.6)
Inventory	0.22+/- 0.11	0.05+/- 0.01	0.02+/- 0.01	0.00+/- 0.00	0.85+/- 0.33	0.00+/- 0.00	0.58+/- 0.26	0.58+/- 0.30	0.01+/- 0.00		1.7+/- (0.4- 0.7)
39) Philippines	0.25+/- 0.14	- 0.20+/- 0.52	0.84+/- 0.31	0.01+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.01+/- 0.00	0.29+/- 0.15	0.45+/- 0.15	1.5	0.96+/- (0.62- 0.99)
Inventory	0.26+/- 0.14	1.6+/- 0.9	0.52+/- 0.33	0.01+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.01+/- 0.00	0.32+/- 0.15	0.25+/- 0.16		2.4+/- (1.0- 1.4)
40) Paraguay	0.64+/- 0.40	0.01+/- 0.02	0.03+/- 0.03	0.05+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.4+/- 0.6	1.5	0.74+/- (0.40- 0.47)
Inventory	0.59+/- 0.48	0.02+/- 0.02	0.03+/- 0.03	0.05+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.5+/- 1.1		0.69+/- (0.49- 0.56)
41) Guyana	0.01+/- 0.01	0.07+/- 0.07	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.5+/- 0.3	1.5	0.09+/- (0.08- 0.09)
Inventory	0.01+/- 0.01	0.08+/- 0.07	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.4+/- 1.3		0.10+/- (0.07- 0.08)
42) Mozambique	0.09+/- 0.02	0.04+/- 0.03	0.08+/- 0.02	0.64+/- 0.14	0.00+/- 0.00	0.02+/- 0.01	0.01+/- 0.01	0.04+/- 0.01	1.2+/- 0.2	1.4	0.87+/- (0.15- 0.22)
Inventory	0.10+/- 0.03	0.04+/- 0.03	0.08+/- 0.02	0.35+/- 0.15	0.00+/- 0.00	0.02+/- 0.01	0.01+/- 0.01	0.04+/- 0.01	0.62+/- 0.25		0.60+/- (0.16- 0.24)
43) Egypt	1.1+/-0.3	0.23+/- 0.13	2.0+/- 0.3	0.00+/- 0.00	0.43+/- 0.11	0.00+/- 0.00	0.09+/- 0.04	0.04+/- 0.01	0.06+/- 0.02	1.4	3.9+/- (0.4- 0.8)
Inventory	0.44+/- 0.29	0.22+/- 0.12	0.66+/- 0.41	0.00+/- 0.00	0.33+/- 0.12	0.00+/- 0.00	0.07+/- 0.04	0.04+/- 0.01	0.04+/- 0.02		1.7+/- (0.5- 1.0)
44) Cameroon	0.42+/- 0.15	0.05+/- 0.04	0.13+/- 0.10	0.08+/- 0.05	0.01+/- 0.02	0.00+/- 0.00	0.04+/- 0.03	0.04+/- 0.01	-0.69+/- 0.30	1.3	0.71+/- (0.20- 0.39)
Inventory	0.23+/- 0.18	0.04+/- 0.04	0.24+/- 0.10	0.09+/- 0.05	0.03+/- 0.02	0.00+/- 0.00	0.03+/- 0.03	0.04+/- 0.01	0.72+/- 0.47		0.67+/- (0.22- 0.42)
45) Algeria	0.25+/- 0.11	0.00+/- 0.00	0.16+/- 0.08	0.00+/- 0.00	0.05+/- 0.01	0.00+/- 0.00	3.2+/- 0.3	0.12+/- 0.02	0.04+/- 0.03	1.3	3.7+/- (0.3- 0.5)
Inventory	0.22+/- 0.12	0.00+/- 0.00	0.19+/- 0.09	0.00+/- 0.00	0.05+/- 0.01	0.00+/- 0.00	1.2+/- 0.6	0.11+/- 0.02	0.05+/- 0.03		1.6+/- (0.6- 0.8)
46) Bangladesh	1.0+/-0.5	1.2+/- 1.3	0.15+/- 0.08	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.03	0.04+/- 0.01	1.4+/- 0.6	1.3	2.4+/- (1.4- 2.0)
Inventory	0.92+/- 0.60	2.6+/- 1.5	0.12+/- 0.08	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.03	0.04+/- 0.01	0.98+/- 0.60		3.7+/- (1.6- 2.2)
47) Ukraine	0.44+/- 0.16	0.00+/- 0.00	0.48+/- 0.16	0.05+/- 0.01	0.07+/- 0.02	0.57+/- 0.19	0.99+/- 0.39	- 0.05+/- 0.24	0.33+/- 0.17	1.3	2.6+/- (0.5- 0.9)

Inventory	0.36+/- 0.16	0.01+/- 0.00	0.50+/- 0.17	0.05+/- 0.01	0.07+/- 0.02	0.66+/- 0.20	1.0+/- 0.5	0.67+/- 0.31	0.31+/- 0.18		2.7+/- (0.6- 1.0)
48) Germany	1.7+/-0.5	0.00+/- 0.00	2.0+/- 0.6	0.00+/- 0.00	0.01+/- 0.00	0.10+/- 0.03	0.18+/- 0.10	0.22+/- 0.09	0.09+/- 0.06	1.3	4.0+/- (0.8- 1.2)
Inventory	1.0+/-0.6	0.00+/- 0.00	1.6+/- 0.8	0.00+/- 0.00	0.01+/- 0.00	0.10+/- 0.03	0.18+/- 0.10	0.21+/- 0.09	0.08+/- 0.06		2.9+/- (1.0- 1.5)
49) Madagascar	1.3+/-0.2	0.56+/- 0.13	0.02+/- 0.00	0.12+/- 0.04	0.01+/- 0.00	0.00+/- 0.00	0.05+/- 0.02	0.04+/- 0.01	1.1+/- 0.2	1.3	2.1+/- (0.2- 0.4)
Inventory	0.32+/- 0.21	0.18+/- 0.15	0.02+/- 0.00	0.09+/- 0.04	0.01+/- 0.00	0.00+/- 0.00	0.04+/- 0.02	0.04+/- 0.01	0.34+/- 0.20		0.66+/- (0.26- 0.42)
50) Spain	1.1+/-0.2	0.02+/- 0.01	0.94+/- 0.27	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.03+/- 0.01	0.09+/- 0.02	0.09+/- 0.05	1.2	2.1+/- (0.4- 0.5)
Inventory	0.57+/- 0.31	0.03+/- 0.01	0.81+/- 0.37	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.03+/- 0.01	0.09+/- 0.02	0.08+/- 0.05		1.4+/- (0.5- 0.7)
51) Gabon	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.55+/- 0.21	1.2	0.02+/- (0.01- 0.01)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.01+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.69+/- 0.60		0.03+/- (0.01- 0.01)
52) Kenya	1.5+/-0.4	0.01+/- 0.01	0.08+/- 0.03	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.10+/- 0.04	0.48+/- 0.15	1.2	1.6+/- (0.4- 0.4)
Inventory	0.92+/- 0.67	0.01+/- 0.01	0.07+/- 0.03	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.10+/- 0.04	0.34+/- 0.17		1.0+/- (0.7- 0.7)
53) Suriname	0.01+/- 0.00	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	2.3+/- 0.3	1.1	0.04+/- (0.02- 0.03)
Inventory	0.01+/- 0.00	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.7+/- 1.5		0.04+/- (0.02- 0.03)
54) Chad	1.9+/-0.2	0.00+/- 0.03	0.03+/- 0.01	- 0.02+/- 0.05	0.02+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.7+/- 0.3	1.1	2.0+/- (0.2- 0.3)
Inventory	0.32+/- 0.22	0.03+/- 0.03	0.03+/- 0.01	0.09+/- 0.05	0.07+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.67+/- 0.40		0.55+/- (0.23- 0.36)
55) Ecuador	-0.31+/- 0.21	0.01+/- 0.12	0.01+/- 0.01	0.00+/- 0.00	0.03+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.02	-0.32+/- 0.34	1	- 0.26+/- (0.24- 0.36)
Inventory	0.30+/- 0.24	0.13+/- 0.11	0.01+/- 0.01	0.00+/- 0.00	0.04+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.06+/- 0.02	0.72+/- 0.79		0.48+/- (0.27- 0.38)
56) Uganda	0.17+/- 0.34	0.01+/- 0.01	0.01+/- 0.00	0.05+/- 0.04	0.01+/- 0.00	0.00+/- 0.00	0.05+/- 0.05	0.04+/- 0.01	0.23+/- 0.37	1	0.31+/- (0.35- 0.45)
Inventory	0.47+/- 0.41	0.01+/- 0.01	0.01+/- 0.00	0.07+/- 0.04	0.01+/- 0.00	0.00+/- 0.00	0.06+/- 0.05	0.04+/- 0.01	0.82+/- 0.68		0.63+/- (0.41- 0.51)
57) Japan	0.42+/- 0.10	3.0+/- 0.4	0.51+/- 0.17	0.01+/- 0.00	0.00+/- 0.00	0.02+/- 0.00	0.01+/- 0.01	5.7+/- 0.4	1.2+/- 0.2	1	4.0+/- (0.4- 0.7)
Inventory	0.22+/- 0.10	0.89+/- 0.46	0.28+/- 0.18	0.01+/- 0.00	0.00+/- 0.00	0.02+/- 0.00	0.01+/- 0.01	0.96+/- 0.58	0.44+/- 0.21		1.4+/- (0.5- 0.8)

58) Cambodia	0.13+/- 0.11	1.4+/- 0.4	0.02+/- 0.01	0.21+/- 0.08	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.05+/- 0.02	0.86+/- 0.57	0.95	1.8+/- (0.4- 0.7)
Inventory	0.12+/- 0.11	0.66+/- 0.66	0.02+/- 0.01	0.21+/- 0.08	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.05+/- 0.02	0.87+/- 0.72		1.0+/- (0.7- 0.9)
59) Poland	0.31+/- 0.23	0.00+/- 0.00	0.19+/- 0.40	0.00+/- 0.00	0.05+/- 0.01	0.42+/- 0.16	0.07+/- 0.04	0.22+/- 0.12	0.08+/- 0.06	0.95	1.0+/- (0.5- 0.8)
Inventory	0.42+/- 0.24	0.00+/- 0.00	0.95+/- 0.48	0.00+/- 0.00	0.05+/- 0.01	0.52+/- 0.17	0.08+/- 0.04	0.28+/- 0.12	0.10+/- 0.06		2.0+/- (0.6- 0.9)
60) Italy	0.30+/- 0.22	0.06+/- 0.04	0.66+/- 0.41	0.01+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.16+/- 0.09	- 0.61+/- 0.55	0.13+/- 0.08	0.93	1.2+/- (0.5- 0.8)
Inventory	0.55+/- 0.24	0.07+/- 0.03	0.88+/- 0.45	0.01+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.17+/- 0.09	2.9+/- 1.1	0.13+/- 0.08		1.7+/- (0.5- 0.8)
61) Uruguay	1.8+/-0.3	0.05+/- 0.07	0.04+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.18+/- 0.09	0.89	1.9+/- (0.3- 0.4)
Inventory	0.62+/- 0.55	0.08+/- 0.07	0.03+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.17+/- 0.09		0.73+/- (0.56- 0.64)
62) Iraq	0.27+/- 0.08	0.01+/- 0.00	0.23+/- 0.08	0.00+/- 0.00	0.13+/- 0.05	0.00+/- 0.00	0.01+/- 0.00	0.16+/- 0.06	0.02+/- 0.01	0.88	0.65+/- (0.12- 0.22)
Inventory	0.13+/- 0.09	0.01+/- 0.00	0.15+/- 0.09	0.00+/- 0.00	0.13+/- 0.06	0.00+/- 0.00	0.01+/- 0.00	0.13+/- 0.07	0.02+/- 0.01		0.43+/- (0.14- 0.24)
63) Mali	1.2+/-0.2	0.19+/- 0.10	0.04+/- 0.01	0.05+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.22+/- 0.07	0.86	1.5+/- (0.2- 0.3)
Inventory	0.52+/- 0.33	0.13+/- 0.12	0.04+/- 0.01	0.05+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.18+/- 0.07		0.75+/- (0.35- 0.49)
64) Chile	0.43+/- 0.12	0.00+/- 0.00	0.49+/- 0.11	0.01+/- 0.01	0.01+/- 0.01	0.01+/- 0.00	0.02+/- 0.01	0.15+/- 0.05	0.28+/- 0.07	0.85	0.97+/- (0.16- 0.26)
Inventory	0.24+/- 0.14	0.00+/- 0.00	0.18+/- 0.12	0.01+/- 0.01	0.01+/- 0.01	0.01+/- 0.00	0.02+/- 0.01	0.13+/- 0.05	0.27+/- 0.08		0.48+/- (0.18- 0.29)
65) United Kingdom of Great Britain and Northern Ireland	0.61+/- 0.41	0.00+/- 0.00	0.55+/- 0.74	0.00+/- 0.00	0.01+/- 0.00	0.02+/- 0.01	0.16+/- 0.10	0.55+/- 0.21	0.12+/- 0.08	0.78	1.3+/- (0.8- 1.3)
Inventory	0.75+/- 0.44	0.00+/- 0.00	3.8+/- 2.3	0.00+/- 0.00	0.01+/- 0.00	0.02+/- 0.01	0.16+/- 0.10	0.55+/- 0.22	0.12+/- 0.08		4.8+/- (2.3- 2.8)
66) Republic of Korea	0.30+/- 0.12	1.5+/- 0.2	0.08+/- 0.05	0.00+/- 0.00	0.14+/- 0.09	0.02+/- 0.01	0.12+/- 0.08	0.04+/- 0.01	0.06+/- 0.04	0.78	2.2+/- (0.3- 0.6)
Inventory	0.15+/- 0.13	0.35+/- 0.29	0.06+/- 0.05	0.00+/- 0.00	0.10+/- 0.09	0.02+/- 0.01	0.08+/- 0.08	0.04+/- 0.01	0.05+/- 0.04		0.77+/- (0.34- 0.64)
67) New Zealand	1.5+/-0.2	0.00+/- 0.00	0.26+/- 0.11	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.01+/- 0.00	0.18+/- 0.07	0.43+/- 0.12	0.77	1.8+/- (0.3- 0.4)
Inventory	0.70+/- 0.41	0.00+/- 0.00	0.21+/- 0.12	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.01+/- 0.00	0.17+/- 0.07	0.27+/- 0.12		0.93+/- (0.43- 0.53)

68) Afghanistan	0.70+/- 0.19	0.04+/- 0.01	0.03+/- 0.01	0.00+/- 0.00	0.01+/- 0.01	0.13+/- 0.05	0.01+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.74	0.92+/- (0.20- 0.28)
Inventory	0.40+/- 0.27	0.05+/- 0.01	0.03+/- 0.01	0.00+/- 0.00	0.01+/- 0.01	0.11+/- 0.05	0.01+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.60+/- (0.28- 0.35)
69) Niger	1.5+/-0.2	0.01+/- 0.01	0.13+/- 0.05	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.08+/- 0.02	0.72	1.6+/- (0.2- 0.3)
Inventory	0.50+/- 0.34	0.01+/- 0.01	0.12+/- 0.05	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.04+/- 0.02		0.65+/- (0.35- 0.41)
70) Cote d'Ivoire	0.04+/- 0.05	0.02+/- 0.04	0.03+/- 0.02	0.05+/- 0.03	0.78+/- 0.31	0.00+/- 0.00	0.11+/- 0.09	0.04+/- 0.01	-0.03+/- 0.29	0.72	1.0+/- (0.3- 0.5)
Inventory	0.06+/- 0.05	0.04+/- 0.04	0.04+/- 0.02	0.05+/- 0.03	0.65+/- 0.41	0.00+/- 0.00	0.11+/- 0.09	0.04+/- 0.01	0.46+/- 0.35		0.94+/- (0.43- 0.64)
71) Sweden	0.12+/- 0.04	0.00+/- 0.00	0.12+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	1.8+/- 0.4	0.71	0.25+/- (0.07- 0.09)
Inventory	0.11+/- 0.04	0.00+/- 0.00	0.11+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.86+/- 0.56		0.22+/- (0.07- 0.10)
72) Zimbabwe	0.01+/- 0.11	0.00+/- 0.00	0.01+/- 0.05	0.04+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.03+/- 0.03	0.71	0.05+/- (0.12- 0.18)
Inventory	0.16+/- 0.13	0.00+/- 0.00	0.14+/- 0.07	0.03+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.06+/- 0.04		0.33+/- (0.15- 0.22)
73) United Arab Emirates	0.04+/- 0.02	0.00+/- 0.00	0.37+/- 0.18	0.00+/- 0.00	0.72+/- 0.21	0.00+/- 0.00	0.05+/- 0.05	0.04+/- 0.01	0.01+/- 0.01	0.71	1.2+/- (0.3- 0.5)
Inventory	0.03+/- 0.02	0.00+/- 0.00	0.27+/- 0.20	0.00+/- 0.00	1.3+/- 0.7	0.00+/- 0.00	0.07+/- 0.05	0.04+/- 0.01	0.01+/- 0.01		1.6+/- (0.7- 1.0)
74) Romania	0.14+/- 0.15	0.00+/- 0.00	0.09+/- 0.18	0.01+/- 0.00	0.14+/- 0.04	0.19+/- 0.10	0.18+/- 0.15	0.79+/- 0.45	0.02+/- 0.05	0.7	0.75+/- (0.29- 0.62)
Inventory	0.22+/- 0.16	0.00+/- 0.00	0.30+/- 0.19	0.01+/- 0.00	0.13+/- 0.05	0.24+/- 0.10	0.22+/- 0.15	2.1+/- 1.0	0.06+/- 0.05		1.1+/- (0.3- 0.6)
75) Nepal	-1.08+/- 0.29	- 0.04+/- 0.24	0.09+/- 0.05	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.02	0.06+/- 0.03	0.19+/- 0.08	0.69	- 0.98+/- (0.38- 0.60)
Inventory	0.54+/- 0.45	0.40+/- 0.25	0.06+/- 0.05	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.02	0.07+/- 0.03	0.10+/- 0.09		1.0+/- (0.5- 0.8)
76) Botswana	0.08+/- 0.04	0.00+/- 0.00	0.40+/- 0.24	0.03+/- 0.01	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.04+/- 0.01	0.16+/- 0.11	0.66	0.52+/- (0.24- 0.29)
Inventory	0.09+/- 0.04	0.00+/- 0.00	3.9+/- 1.8	0.03+/- 0.01	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.04+/- 0.01	0.20+/- 0.13		4.0+/- (1.8- 1.9)
77) Finland	0.07+/- 0.03	0.00+/- 0.00	0.11+/- 0.29	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.17+/- 0.32	0.63	0.18+/- (0.29- 0.32)
Inventory	0.07+/- 0.03	0.00+/- 0.00	0.60+/- 0.36	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.68+/- 0.49		0.67+/- (0.36- 0.38)
78) Ghana	0.02+/- 0.08	0.01+/- 0.04	0.08+/- 0.04	0.06+/- 0.05	0.04+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	-0.10+/- 0.29	0.63	0.21+/- (0.12- 0.25)

Inventory	0.10+/- 0.09	0.05+/- 0.05	0.09+/- 0.04	0.09+/- 0.05	0.05+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.49+/- 0.39		0.37+/- (0.12- 0.26)
79) Lao People's Democratic Republic	0.09+/- 0.10	- 0.27+/- 0.18	0.01+/- 0.01	0.10+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.05+/- 0.01	0.07+/- 0.14	0.59	- 0.06+/- (0.21- 0.32)
Inventory	0.12+/- 0.10	0.25+/- 0.21	0.01+/- 0.01	0.10+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.05+/- 0.01	0.21+/- 0.15		0.49+/- (0.23- 0.35)
80) Democratic People's Republic of Korea	0.06+/- 0.03	0.34+/- 0.09	0.15+/- 0.08	0.00+/- 0.00	0.00+/- 0.00	0.63+/- 0.22	0.00+/- 0.00	0.05+/- 0.01	0.10+/- 0.04	0.55	1.2+/- (0.3- 0.4)
Inventory	0.05+/- 0.03	0.15+/- 0.08	0.10+/- 0.08	0.00+/- 0.00	0.00+/- 0.00	0.48+/- 0.27	0.00+/- 0.00	0.05+/- 0.01	0.07+/- 0.05		0.78+/- (0.29- 0.47)
81) French Guiana	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.37+/- 0.17	0.48	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.30+/- 0.36		0.00+/- (0.00- 0.00)
82) Tajikistan	0.27+/- 0.13	0.00+/- 0.00	0.06+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.16+/- 0.08	0.05+/- 0.01	0.01+/- 0.01	0.47	0.50+/- (0.16- 0.26)
Inventory	0.18+/- 0.16	0.01+/- 0.00	0.04+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.13+/- 0.10	0.05+/- 0.01	0.01+/- 0.01		0.37+/- (0.19- 0.30)
83) Honduras	0.54+/- 0.11	0.00+/- 0.00	0.08+/- 0.04	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.08+/- 0.03	0.80+/- 0.24	0.46	0.65+/- (0.12- 0.17)
Inventory	0.15+/- 0.14	0.00+/- 0.00	0.05+/- 0.04	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.07+/- 0.03	0.55+/- 0.48		0.22+/- (0.15- 0.20)
84) Burkina Faso	0.36+/- 0.17	0.02+/- 0.02	0.02+/- 0.01	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.02	0.04+/- 0.01	0.02+/- 0.01	0.45	0.44+/- (0.17- 0.23)
Inventory	0.32+/- 0.26	0.02+/- 0.02	0.02+/- 0.01	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.02	0.04+/- 0.01	0.02+/- 0.01		0.41+/- (0.26- 0.32)
85) Syrian Arab Republic	0.15+/- 0.08	0.00+/- 0.00	0.15+/- 0.06	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.09+/- 0.02	0.00+/- 0.00	0.41	0.33+/- (0.10- 0.15)
Inventory	0.12+/- 0.09	0.00+/- 0.00	0.13+/- 0.08	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.09+/- 0.02	0.00+/- 0.00		0.28+/- (0.12- 0.18)
86) Azerbaijan	0.46+/- 0.14	0.00+/- 0.00	0.06+/- 0.03	0.00+/- 0.00	0.36+/- 0.25	0.00+/- 0.00	0.03+/- 0.02	- 0.35+/- 0.51	0.03+/- 0.02	0.41	0.92+/- (0.29- 0.44)
Inventory	0.20+/- 0.16	0.00+/- 0.00	0.05+/- 0.03	0.00+/- 0.00	0.48+/- 0.25	0.00+/- 0.00	0.03+/- 0.02	2.8+/- 1.7	0.02+/- 0.02		0.76+/- (0.30- 0.46)
87) Morocco	0.31+/- 0.12	0.00+/- 0.00	0.11+/- 0.09	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.02	0.08+/- 0.02	0.00+/- 0.00	0.4	0.48+/- (0.16- 0.24)
Inventory	0.25+/- 0.15	0.00+/- 0.00	0.21+/- 0.10	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.02	0.09+/- 0.02	0.00+/- 0.00		0.51+/- (0.18- 0.28)
88) Somalia	1.4+/-0.2	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.04+/- 0.01	0.21+/- 0.06	0.39	1.4+/- (0.2- 0.3)

Inventory	0.52+/- 0.41	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.04+/- 0.01	0.13+/- 0.06		0.58+/- (0.41- 0.43)
89) Kyrgyzstan	0.15+/- 0.03	0.00+/- 0.00	0.12+/- 0.05	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.15+/- 0.06	0.05+/- 0.01	0.07+/- 0.06	0.39	0.44+/- (0.08- 0.15)
Inventory	0.14+/- 0.04	0.00+/- 0.00	0.07+/- 0.05	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.09+/- 0.06	0.04+/- 0.01	0.08+/- 0.06		0.32+/- (0.09- 0.16)
90) Libya	0.04+/- 0.02	0.00+/- 0.00	0.04+/- 0.02	0.00+/- 0.00	0.43+/- 0.10	0.00+/- 0.00	0.01+/- 0.00	0.17+/- 0.05	0.01+/- 0.01	0.38	0.53+/- (0.11- 0.15)
Inventory	0.05+/- 0.02	0.00+/- 0.00	0.05+/- 0.02	0.00+/- 0.00	0.32+/- 0.12	0.00+/- 0.00	0.01+/- 0.00	0.15+/- 0.05	0.02+/- 0.01		0.44+/- (0.12- 0.17)
91) Oman	0.04+/- 0.02	0.00+/- 0.00	0.03+/- 0.01	0.00+/- 0.00	0.12+/- 0.03	0.00+/- 0.00	0.01+/- 0.00	0.04+/- 0.01	0.03+/- 0.02	0.38	0.19+/- (0.04- 0.07)
Inventory	0.03+/- 0.02	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.12+/- 0.04	0.00+/- 0.00	0.01+/- 0.00	0.04+/- 0.01	0.03+/- 0.02		0.18+/- (0.04- 0.07)
92) Bulgaria	0.01+/- 0.05	0.00+/- 0.00	- 0.21+/- 0.16	0.01+/- 0.00	0.00+/- 0.00	0.03+/- 0.01	0.01+/- 0.00	- 0.04+/- 0.16	0.02+/- 0.05	0.38	- 0.14+/- (0.17- 0.23)
Inventory	0.07+/- 0.05	0.00+/- 0.00	0.31+/- 0.20	0.01+/- 0.00	0.00+/- 0.00	0.03+/- 0.01	0.01+/- 0.00	0.31+/- 0.17	0.06+/- 0.05		0.43+/- (0.21- 0.27)
93) Nicaragua	0.56+/- 0.17	0.01+/- 0.01	0.03+/- 0.03	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.16+/- 0.08	0.52+/- 0.16	0.37	0.61+/- (0.17- 0.21)
Inventory	0.23+/- 0.21	0.01+/- 0.01	0.03+/- 0.03	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.14+/- 0.09	0.23+/- 0.22		0.28+/- (0.21- 0.25)
94) Namibia	0.04+/- 0.04	0.00+/- 0.00	0.01+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	-0.01+/- 0.03	0.34	0.07+/- (0.04- 0.06)
Inventory	0.08+/- 0.04	0.00+/- 0.00	0.01+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.05+/- 0.04		0.11+/- (0.04- 0.06)
95) Austria	0.06+/- 0.11	0.00+/- 0.00	0.02+/- 0.08	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.19+/- 0.10	0.03+/- 0.02	0.33	0.10+/- (0.14- 0.21)
Inventory	0.18+/- 0.14	0.00+/- 0.00	0.13+/- 0.09	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.25+/- 0.11	0.03+/- 0.02		0.33+/- (0.17- 0.25)
96) Guinea	0.06+/- 0.11	0.37+/- 0.14	0.02+/- 0.01	0.09+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.04+/- 0.01	0.03+/- 0.01	0.32	0.56+/- (0.18- 0.32)
Inventory	0.15+/- 0.13	0.19+/- 0.18	0.02+/- 0.01	0.08+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.04+/- 0.01	0.03+/- 0.01		0.46+/- (0.22- 0.37)
97) Sri Lanka	0.07+/- 0.04	0.41+/- 0.23	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.72+/- 0.18	0.3	0.49+/- (0.23- 0.27)
Inventory	0.06+/- 0.04	0.37+/- 0.25	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.25+/- 0.23		0.44+/- (0.25- 0.30)
98) Greece	0.04+/- 0.06	0.00+/- 0.00	- 0.04+/- 0.15	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.01	0.00+/- 0.00	0.17+/- 0.06	0.03+/- 0.06	0.3	0.04+/- (0.16- 0.23)
Inventory	0.10+/- 0.07	0.01+/- 0.00	0.24+/- 0.17	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.01	0.00+/- 0.00	0.18+/- 0.06	0.06+/- 0.06		0.39+/- (0.19- 0.25)

99) Malawi	0.15+/- 0.05	0.01+/- 0.01	0.02+/- 0.01	0.07+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.58+/- 0.12	0.29	0.25+/- (0.05- 0.08)
Inventory	0.06+/- 0.05	0.01+/- 0.01	0.02+/- 0.01	0.03+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.21+/- 0.15		0.12+/- (0.05- 0.09)
100) Guatemala	0.60+/- 0.17	0.00+/- 0.00	0.11+/- 0.06	0.02+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.08+/- 0.04	0.13+/- 0.05	0.29	0.73+/- (0.18- 0.25)
Inventory	0.23+/- 0.21	0.00+/- 0.00	0.07+/- 0.06	0.02+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.08+/- 0.04	0.10+/- 0.06		0.33+/- (0.22- 0.30)
101) Mongolia	0.55+/- 0.08	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.02+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.11+/- 0.04	0.14+/- 0.03	0.28	0.64+/- (0.09- 0.12)
Inventory	0.37+/- 0.09	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.02+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.09+/- 0.04	0.13+/- 0.03		0.45+/- (0.09- 0.12)
102) Czech Republic	0.01+/- 0.07	0.00+/- 0.00	0.00+/- 0.13	0.00+/- 0.00	0.00+/- 0.00	0.23+/- 0.11	0.02+/- 0.02	0.09+/- 0.05	0.01+/- 0.01	0.27	0.26+/- (0.19- 0.33)
Inventory	0.09+/- 0.08	0.00+/- 0.00	0.23+/- 0.16	0.00+/- 0.00	0.00+/- 0.00	0.29+/- 0.12	0.02+/- 0.02	0.11+/- 0.05	0.01+/- 0.01		0.63+/- (0.21- 0.37)
103) Eritrea	0.67+/- 0.06	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.10+/- 0.03	0.02+/- 0.01	0.27	0.68+/- (0.06- 0.07)
Inventory	0.08+/- 0.08	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.08+/- 0.03	0.02+/- 0.01		0.10+/- (0.08- 0.08)
104) Norway	0.07+/- 0.01	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.41+/- 0.15	0.26	0.11+/- (0.02- 0.04)
Inventory	0.06+/- 0.01	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.26+/- 0.17		0.11+/- (0.02- 0.04)
105) Belarus	0.28+/- 0.17	0.00+/- 0.00	1.2+/- 0.5	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.01	0.04+/- 0.01	0.07+/- 0.10	0.26	1.6+/- (0.5- 0.7)
Inventory	0.24+/- 0.17	0.00+/- 0.00	2.3+/- 1.5	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.01	0.04+/- 0.01	0.11+/- 0.10		2.6+/- (1.5- 1.7)
106) Switzerland	0.25+/- 0.13	0.00+/- 0.00	0.04+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.16+/- 0.06	0.06+/- 0.05	0.24	0.30+/- (0.13- 0.18)
Inventory	0.17+/- 0.15	0.00+/- 0.00	0.05+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.15+/- 0.07	0.05+/- 0.05		0.23+/- (0.16- 0.21)
107) Hungary	0.03+/- 0.05	0.00+/- 0.00	0.17+/- 0.16	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.05+/- 0.02	0.03+/- 0.02	0.24	0.23+/- (0.16- 0.23)
Inventory	0.05+/- 0.05	0.00+/- 0.00	0.28+/- 0.20	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.06+/- 0.02	0.03+/- 0.02		0.36+/- (0.20- 0.27)
108) Senegal	0.03+/- 0.12	0.05+/- 0.05	0.04+/- 0.02	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.02+/- 0.02	0.23	0.15+/- (0.14- 0.21)
Inventory	0.18+/- 0.15	0.05+/- 0.06	0.04+/- 0.02	0.03+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.03+/- 0.02		0.30+/- (0.17- 0.25)
109) Netherlands	1.2+/-0.3	0.00+/- 0.00	0.36+/- 0.13	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.03+/- 0.02	0.05+/- 0.01	0.03+/- 0.03	0.23	1.6+/- (0.3- 0.4)

Inventory	0.37+/- 0.30	0.00+/- 0.00	0.20+/- 0.15	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.05+/- 0.01	0.03+/- 0.03		0.60+/- (0.33- 0.47)
110) Serbia	-0.02+/- 0.05	0.00+/- 0.00	0.01+/- 0.07	0.00+/- 0.00	0.02+/- 0.01	0.03+/- 0.01	0.01+/- 0.01	0.04+/- 0.02	0.01+/- 0.02	0.23	0.05+/- (0.09- 0.15)
Inventory	0.06+/- 0.06	0.00+/- 0.00	0.11+/- 0.08	0.00+/- 0.00	0.02+/- 0.01	0.03+/- 0.01	0.01+/- 0.01	0.05+/- 0.02	0.01+/- 0.02		0.23+/- (0.10- 0.16)
111) Panama	0.09+/- 0.07	0.01+/- 0.01	0.03+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.02	0.85+/- 0.18	0.23	0.13+/- (0.08- 0.11)
Inventory	0.09+/- 0.07	0.01+/- 0.01	0.04+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.02	0.30+/- 0.25		0.15+/- (0.08- 0.11)
112) Georgia	0.10+/- 0.06	0.00+/- 0.00	0.07+/- 0.05	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.07+/- 0.05	0.47+/- 0.17	0.01+/- 0.01	0.23	0.25+/- (0.10- 0.17)
Inventory	0.07+/- 0.07	0.00+/- 0.00	0.07+/- 0.05	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.07+/- 0.06	0.41+/- 0.19	0.01+/- 0.01		0.22+/- (0.10- 0.18)
113) Tunisia	-0.01+/- 0.06	0.00+/- 0.00	0.03+/- 0.03	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.02+/- 0.01	0.05+/- 0.02	0.01+/- 0.02	0.23	0.06+/- (0.07- 0.12)
Inventory	0.09+/- 0.06	0.00+/- 0.00	0.07+/- 0.04	0.00+/- 0.00	0.03+/- 0.01	0.00+/- 0.00	0.02+/- 0.01	0.07+/- 0.02	0.02+/- 0.02		0.20+/- (0.08- 0.12)
114) Mauritania	0.49+/- 0.10	0.01+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.01+/- 0.00	0.22	0.51+/- (0.10- 0.12)
Inventory	0.19+/- 0.15	0.01+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.01+/- 0.00		0.22+/- (0.15- 0.17)
115) Yemen	0.16+/- 0.10	0.00+/- 0.00	0.07+/- 0.03	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.09+/- 0.02	0.02+/- 0.01	0.22	0.24+/- (0.11- 0.14)
Inventory	0.14+/- 0.11	0.00+/- 0.00	0.06+/- 0.03	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.08+/- 0.02	0.01+/- 0.01		0.22+/- (0.12- 0.15)
116) Cuba	0.12+/- 0.15	0.03+/- 0.04	0.13+/- 0.15	0.02+/- 0.01	0.10+/- 0.06	0.00+/- 0.00	0.01+/- 0.00	0.08+/- 0.04	0.07+/- 0.17	0.22	0.40+/- (0.23- 0.42)
Inventory	0.24+/- 0.16	0.05+/- 0.04	0.24+/- 0.16	0.02+/- 0.01	0.11+/- 0.06	0.00+/- 0.00	0.01+/- 0.00	0.08+/- 0.04	0.26+/- 0.19		0.66+/- (0.24- 0.44)
117) Portugal	0.12+/- 0.08	0.01+/- 0.01	- 0.29+/- 0.22	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.01+/- 0.01	0.2	- 0.16+/- (0.24- 0.31)
Inventory	0.11+/- 0.09	0.01+/- 0.00	0.42+/- 0.28	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.01+/- 0.01		0.55+/- (0.30- 0.38)
118) Jordan	0.03+/- 0.02	0.00+/- 0.00	0.14+/- 0.08	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.02	0.04+/- 0.01	0.00+/- 0.00	0.2	0.22+/- (0.09- 0.13)
Inventory	0.02+/- 0.02	0.00+/- 0.00	0.14+/- 0.12	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.02	0.04+/- 0.01	0.00+/- 0.00		0.20+/- (0.12- 0.16)
119) Bahamas	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.2	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)

120) Benin	-0.08+/- 0.08	0.00+/- 0.01	0.03+/- 0.01	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.04+/- 0.01	0.02+/- 0.03	0.19	- 0.01+/- (0.09- 0.14)
Inventory	0.09+/- 0.10	0.01+/- 0.01	0.03+/- 0.01	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.03+/- 0.03		0.17+/- (0.10- 0.16)
121) Rwanda	-0.02+/- 0.05	0.00+/- 0.01	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.04+/- 0.01	0.19+/- 0.09	0.17	0.03+/- (0.06- 0.10)
Inventory	0.05+/- 0.06	0.01+/- 0.01	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.04+/- 0.01	0.10+/- 0.12		0.10+/- (0.06- 0.10)
122) Slovakia	0.02+/- 0.02	0.00+/- 0.00	0.05+/- 0.06	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.04+/- 0.04	0.07+/- 0.02	0.00+/- 0.00	0.17	0.12+/- (0.07- 0.12)
Inventory	0.02+/- 0.02	0.00+/- 0.00	0.09+/- 0.07	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.05+/- 0.04	0.08+/- 0.02	0.00+/- 0.00		0.17+/- (0.08- 0.13)
123) Croatia	0.00+/- 0.04	0.00+/- 0.00	0.02+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.01	0.01+/- 0.00	0.06+/- 0.05	0.01+/- 0.01	0.16	0.06+/- (0.06- 0.10)
Inventory	0.05+/- 0.04	0.00+/- 0.00	0.06+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.01	0.01+/- 0.00	0.11+/- 0.05	0.01+/- 0.01		0.15+/- (0.06- 0.10)
124) Israel	0.03+/- 0.02	0.00+/- 0.00	0.33+/- 0.11	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.02	0.04+/- 0.01	0.00+/- 0.00	0.16	0.40+/- (0.12- 0.16)
Inventory	0.02+/- 0.02	0.00+/- 0.00	0.23+/- 0.18	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.02	0.04+/- 0.01	0.00+/- 0.00		0.29+/- (0.18- 0.23)
125) Belize	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.22+/- 0.09	0.16	0.02+/- (0.01- 0.01)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.14+/- 0.14		0.02+/- (0.01- 0.01)
126) Bhutan	0.01+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.14	0.02+/- (0.02- 0.02)
Inventory	0.01+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.02+/- (0.02- 0.02)
127) Dominican Republic	-0.09+/- 0.15	0.02+/- 0.07	0.02+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.01	-0.02+/- 0.06	0.14	- 0.05+/- (0.17- 0.26)
Inventory	0.19+/- 0.17	0.07+/- 0.06	0.05+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.01	0.09+/- 0.07		0.31+/- (0.19- 0.28)
128) Burundi	0.01+/- 0.03	0.00+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.13+/- 0.04	0.14	0.04+/- (0.04- 0.06)
Inventory	0.03+/- 0.04	0.00+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.03+/- 0.05		0.05+/- (0.04- 0.06)
129) Sierra Leone	0.02+/- 0.03	0.16+/- 0.07	0.02+/- 0.01	0.04+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.10+/- 0.09	0.14	0.25+/- (0.08- 0.14)
Inventory	0.03+/- 0.03	0.07+/- 0.09	0.02+/- 0.01	0.03+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.11+/- 0.09		0.16+/- (0.10- 0.16)

130) Costa Rica	0.17+/- 0.08	0.01+/- 0.01	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.11+/- 0.05	0.64+/- 0.12	0.13	0.18+/- (0.08- 0.10)
Inventory	0.09+/- 0.09	0.01+/- 0.01	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.10+/- 0.06	0.16+/- 0.16		0.11+/- (0.09- 0.11)
131) Liberia	0.00+/- 0.00	0.01+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.05+/- 0.06	0.12	0.04+/- (0.01- 0.03)
Inventory	0.00+/- 0.00	0.01+/- 0.01	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.08+/- 0.06		0.04+/- (0.01- 0.03)
132) Belgium	0.29+/- 0.10	0.00+/- 0.00	0.15+/- 0.07	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.00+/- 0.00	0.12	0.45+/- (0.12- 0.18)
Inventory	0.12+/- 0.11	0.00+/- 0.00	0.10+/- 0.09	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.00+/- 0.00		0.24+/- (0.14- 0.21)
133) Togo	-0.02+/- 0.04	0.00+/- 0.01	0.02+/- 0.01	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.03+/- 0.04	0.12	0.03+/- (0.05- 0.09)
Inventory	0.03+/- 0.04	0.01+/- 0.01	0.02+/- 0.01	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.05+/- 0.04		0.09+/- (0.05- 0.09)
134) Taiwan	0.00+/- 0.00	0.01+/- 0.08	- 0.11+/- 0.12	0.00+/- 0.00	0.01+/- 0.02	0.00+/- 0.00	0.02+/- 0.02	- 0.21+/- 0.15	0.02+/- 0.03	0.11	- 0.07+/- (0.15- 0.25)
Inventory	0.00+/- 0.00	0.08+/- 0.08	0.14+/- 0.13	0.00+/- 0.00	0.02+/- 0.02	0.00+/- 0.00	0.03+/- 0.02	0.20+/- 0.16	0.03+/- 0.03		0.27+/- (0.15- 0.25)
135) Equatorial Guinea	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	- 0.12+/- 0.09	0.01+/- 0.00	0.01+/- 0.01	0.05+/- 0.02	-0.15+/- 0.06	0.11	- 0.11+/- (0.09- 0.10)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.15+/- 0.09	0.01+/- 0.00	0.01+/- 0.01	0.05+/- 0.02	0.05+/- 0.07		0.16+/- (0.09- 0.10)
136) Cyprus	0.01+/- 0.01	0.00+/- 0.00	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.1	0.03+/- (0.02- 0.03)
Inventory	0.01+/- 0.01	0.00+/- 0.00	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.03+/- (0.02- 0.03)
137) Kuwait	0.00+/- 0.00	0.00+/- 0.00	0.35+/- 0.30	0.00+/- 0.00	0.05+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.09+/- 0.04	0.00+/- 0.00	0.1	0.40+/- (0.30- 0.33)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.53+/- 0.41	0.00+/- 0.00	0.06+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.09+/- 0.04	0.00+/- 0.00		0.59+/- (0.41- 0.45)
138) Trinidad and Tobago	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.11+/- 0.04	0.00+/- 0.00	0.07+/- 0.04	0.22+/- 0.06	0.00+/- 0.00	0.1	0.19+/- (0.05- 0.09)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.06+/- 0.04	0.00+/- 0.00	0.05+/- 0.04	0.10+/- 0.07	0.00+/- 0.00		0.12+/- (0.06- 0.09)
139) Ireland	0.19+/- 0.28	0.00+/- 0.00	0.06+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.05+/- 0.06	0.09	0.26+/- (0.28- 0.33)
Inventory	0.39+/- 0.30	0.00+/- 0.00	0.07+/- 0.05	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.06+/- 0.06		0.47+/- (0.31- 0.36)

140) Haiti	-0.03+/- 0.07	0.00+/- 0.01	0.03+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.04+/- 0.01	0.00+/- 0.00	0.09	0.02+/- (0.08- 0.13)
Inventory	0.09+/- 0.08	0.01+/- 0.01	0.04+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.01	0.04+/- 0.01	0.00+/- 0.00		0.15+/- (0.09- 0.14)
141) Denmark	0.57+/- 0.14	0.00+/- 0.00	0.25+/- 0.09	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.03+/- 0.02	0.09	0.82+/- (0.16- 0.23)
Inventory	0.18+/- 0.14	0.00+/- 0.00	0.13+/- 0.10	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.02+/- 0.02		0.32+/- (0.17- 0.24)
142) Lesotho	0.14+/- 0.02	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.09	0.15+/- (0.02- 0.03)
Inventory	0.02+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.03+/- (0.03- 0.03)
143) Estonia	0.01+/- 0.01	0.00+/- 0.00	- 0.01+/- 0.07	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	-0.06+/- 0.07	0.08	0.01+/- (0.07- 0.08)
Inventory	0.02+/- 0.01	0.00+/- 0.00	0.11+/- 0.08	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.07+/- 0.08		0.13+/- (0.08- 0.09)
144) Qatar	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.01	0.04+/- 0.01	0.00+/- 0.00	0.08	0.03+/- (0.02- 0.03)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.00+/- 0.00		0.03+/- (0.02- 0.03)
145) Latvia	0.03+/- 0.03	0.00+/- 0.00	0.01+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.04+/- 0.01	0.00+/- 0.05	0.08	0.05+/- (0.04- 0.06)
Inventory	0.03+/- 0.03	0.00+/- 0.00	0.05+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.04+/- 0.01	0.05+/- 0.05		0.09+/- (0.04- 0.07)
146) Guinea-Bissau	0.00+/- 0.03	0.05+/- 0.04	0.01+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.02+/- 0.06	0.08	0.07+/- (0.05- 0.09)
Inventory	0.03+/- 0.03	0.04+/- 0.05	0.01+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.08+/- 0.07		0.09+/- (0.06- 0.10)
147) Bosnia and Herzegovina	-0.02+/- 0.04	0.00+/- 0.00	0.00+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.02	0.00+/- 0.00	0.07	- 0.02+/- (0.05- 0.07)
Inventory	0.04+/- 0.04	0.00+/- 0.00	0.04+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.05+/- 0.02	0.00+/- 0.00		0.08+/- (0.05- 0.08)
148) Albania	-0.03+/- 0.05	0.00+/- 0.00	- 0.01+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.07+/- 0.04	0.00+/- 0.01	0.06	- 0.04+/- (0.06- 0.08)
Inventory	0.05+/- 0.05	0.00+/- 0.00	0.04+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.10+/- 0.04	0.01+/- 0.01		0.10+/- (0.06- 0.09)
149) Lithuania	0.05+/- 0.04	0.00+/- 0.00	- 0.02+/- 0.06	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.01+/- 0.03	0.06	0.04+/- (0.08- 0.12)
Inventory	0.06+/- 0.04	0.00+/- 0.00	0.09+/- 0.08	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.04+/- 0.01	0.02+/- 0.03		0.17+/- (0.09- 0.13)

150) Armenia	0.06+/- 0.03	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.02	0.08+/- 0.03	0.01+/- 0.02	0.06	0.10+/- (0.04- 0.07)
Inventory	0.03+/- 0.03	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.03	0.08+/- 0.04	0.01+/- 0.02		0.07+/- (0.04- 0.07)
151) Lebanon	0.01+/- 0.01	0.00+/- 0.00	0.07+/- 0.06	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.06	0.09+/- (0.06- 0.08)
Inventory	0.01+/- 0.01	0.00+/- 0.00	0.10+/- 0.09	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.11+/- (0.09- 0.10)
152) El Salvador	0.16+/- 0.05	0.00+/- 0.00	0.02+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.16+/- 0.07	0.05	0.18+/- (0.05- 0.06)
Inventory	0.04+/- 0.05	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.06+/- 0.08		0.05+/- (0.05- 0.07)
153) Kosovo	-0.01+/- 0.03	0.00+/- 0.00	- 0.02+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.05	- 0.03+/- (0.05- 0.07)
Inventory	0.03+/- 0.03	0.00+/- 0.00	0.04+/- 0.04	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.08+/- (0.05- 0.07)
154) Swaziland	0.04+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.05	0.05+/- (0.02- 0.02)
Inventory	0.01+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.02+/- (0.02- 0.02)
155) The former Yugoslav Republic of Macedonia	0.00+/- 0.02	0.00+/- 0.00	- 0.01+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.05	0.00+/- (0.03- 0.04)
Inventory	0.02+/- 0.02	0.00+/- 0.00	0.02+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.05+/- (0.03- 0.04)
156) Brunei Darussalam	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.02+/- 0.03	0.00+/- 0.00	- 0.01+/- 0.04	0.04+/- 0.01	0.00+/- 0.00	0.04	0.01+/- (0.05- 0.07)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.03+/- 0.03	0.00+/- 0.00	0.04+/- 0.04	0.04+/- 0.01	0.00+/- 0.00		0.07+/- (0.05- 0.07)
157) Grenada	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.04	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
158) Slovenia	0.01+/- 0.02	0.00+/- 0.00	0.00+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.02+/- 0.02	0.03	0.02+/- (0.03- 0.04)
Inventory	0.02+/- 0.02	0.00+/- 0.00	0.01+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.01+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.02+/- 0.02		0.04+/- (0.03- 0.04)
159) Montenegro	-0.01+/- 0.02	0.00+/- 0.00	0.00+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.01+/- 0.01	0.03	- 0.01+/- (0.02- 0.03)
Inventory	0.02+/- 0.02	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.01+/- 0.01		0.03+/- (0.02- 0.03)

160) Svalbard and Jan Mayen Islands	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.01+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00	0.03	0.02+/- (0.00-0.01)
Inventory	0.01+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.01+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00		0.02+/- (0.00-0.01)
161) Western Sahara	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00	0.03	0.01+/- (0.00-0.00)
Inventory	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00		0.01+/- (0.00-0.00)
162) Puerto Rico	0.00+/-0.00	0.00+/-0.00	0.05+/-0.06	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00	0.02	0.06+/- (0.06-0.06)
Inventory	0.00+/-0.00	0.00+/-0.00	0.06+/-0.06	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00		0.06+/- (0.06-0.06)
163) Djibouti	0.02+/-0.02	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.01+/-0.01	0.00+/-0.00	0.00+/-0.00	0.05+/-0.01	0.01+/-0.01	0.02	0.04+/- (0.02-0.03)
Inventory	0.01+/-0.02	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.01+/-0.01	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.01+/-0.01		0.02+/- (0.02-0.03)
164) Republic of Moldova	0.01+/-0.01	0.00+/-0.00	0.05+/-0.06	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.01+/-0.01	0.13+/-0.09	0.00+/-0.00	0.02	0.07+/- (0.06-0.08)
Inventory	0.01+/-0.01	0.00+/-0.00	0.07+/-0.06	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.01+/-0.01	0.17+/-0.10	0.00+/-0.00		0.09+/- (0.06-0.08)
165) Jamaica	0.01+/-0.01	0.00+/-0.00	0.07+/-0.06	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.07+/-0.03	0.00+/-0.00	0.02	0.08+/- (0.06-0.07)
Inventory	0.01+/-0.01	0.00+/-0.00	0.07+/-0.06	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.06+/-0.03	0.00+/-0.00		0.08+/- (0.07-0.08)
166) Sao Tome and Principe	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00	0.02	0.00+/- (0.00-0.00)
Inventory	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00		0.00+/- (0.00-0.00)
167) Turks and Caicos Islands	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00	0.02	0.00+/- (0.00-0.00)
Inventory	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00		0.00+/- (0.00-0.00)
168) Jersey	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00	0.01	0.00+/- (0.00-0.00)
Inventory	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.00+/-0.00	0.04+/-0.01	0.00+/-0.00		0.00+/- (0.00-0.00)
169) Timor-Leste	0.02+/-0.01	0.01+/-0.00	0.01+/-0.01	0.00+/-0.00	0.03+/-0.01	0.01+/-0.00	0.00+/-0.00	0.09+/-0.04	0.00+/-0.00	0.01	0.08+/- (0.02-0.04)
Inventory	0.01+/-0.01	0.01+/-0.00	0.01+/-0.01	0.00+/-0.00	0.03+/-0.01	0.01+/-0.00	0.00+/-0.00	0.08+/-0.04	0.00+/-0.00		0.08+/- (0.02-0.04)

170) Bonaire Saint Eustatius and Saba	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.01	0.01+/- (0.00- 0.01)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.01+/- (0.00- 0.01)
171) Cayman Islands	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.01	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
172) Fiji	0.01+/- 0.01	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.01	0.01+/- (0.02- 0.02)
Inventory	0.02+/- 0.01	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.03+/- (0.02- 0.02)
173) Saint Vincent and the Grenadines	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.01	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
174) Saint Pierre and Miquelon	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.01	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
175) United States Minor Outlying Islands	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0.01	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
176) Iceland	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.02+/- 0.02	0.01	0.02+/- (0.01- 0.01)
Inventory	0.01+/- 0.00	0.00+/- 0.00	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.02+/- 0.02		0.02+/- (0.01- 0.01)
177) Aland Islands	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
178) Mayotte	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
179) Solomon Islands	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.01+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.01+/- (0.00- 0.00)

180) French Southern Territories	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
181) Comoros	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.01+/- (0.01- 0.01)
Inventory	0.00+/- 0.00	0.00+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.01+/- (0.01- 0.01)
182) New Caledonia	-0.01+/- 0.02	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.02- 0.03)
Inventory	0.04+/- 0.03	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.04+/- (0.03- 0.03)
183) Vanuatu	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.01+/- (0.01- 0.01)
Inventory	0.01+/- 0.01	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.01+/- (0.01- 0.01)
184) United States Virgin Islands	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
185) British Virgin Islands	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
186) Anguilla	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
187) Montserrat	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
188) Seychelles	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
189) Saint Lucia	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)

Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
222) Bouvet Island	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
223) Tokelau	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
224) South Georgia and the South Sandwich Islands	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
225) Niue	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
226) Norfolk Island	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
227) British Indian Ocean Territory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)
228) Heard Island and McDonald Islands	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00	0	0.00+/- (0.00- 0.00)
Inventory	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.00+/- 0.00	0.04+/- 0.01	0.00+/- 0.00		0.00+/- (0.00- 0.00)

966 **9.0References**

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