FOREST FIRES AND GREENHOUSE GASSES EMISSION REDUCTION IN INDONESIA

BAMBANG HERO SAHARJO

FACULTY OF FORESTRY AND ENVIRONMENTS

IPB UNIVERSITY

- Tropical forests have a vital role in buffering the brunt of global environmental change. The forests act as a giant carbon sink, and well-preserved tropical forests can reduce global emission by at least 30% (Busch & Seymour, 2016; Turetsky et al., 2015).
- Unfortunately, tropical forest conservation efforts have faced a significant challenge from the occurrence of fires (Carmenta, Coudel, & Steward, 2018).
- Extensive fires have become more frequent and pervasive in tropical forests worldwide (Fernandes et al., 2017; Jolly et al., 2015).
- Indonesia has been identified as a hotspot of fires activities, a considerable proportion of which has come from within its peat landscape (Ordway, Asner, & Lambin, 2017; Luca Tacconi, 2016; Wijedasa et al., 2017).

- Fire is a significant source of gases and particulate to the atmosphere: environmentally important gases produce by fire includes carbon dioxide, carbon monoxide, methane, non-methane hydrocarbons and oxides of nitrogen.
- Fire also produces large amounts of small, solid particles or “particulate matter”, which absorb and scatter incoming solar radiation, and hence the impact of our planet as well as provoking a variety of human health problems (Levine 1996).
- The problem of forest fires cannot be observed merely from a single viewpoint. It must be seen expansively in various contexts.

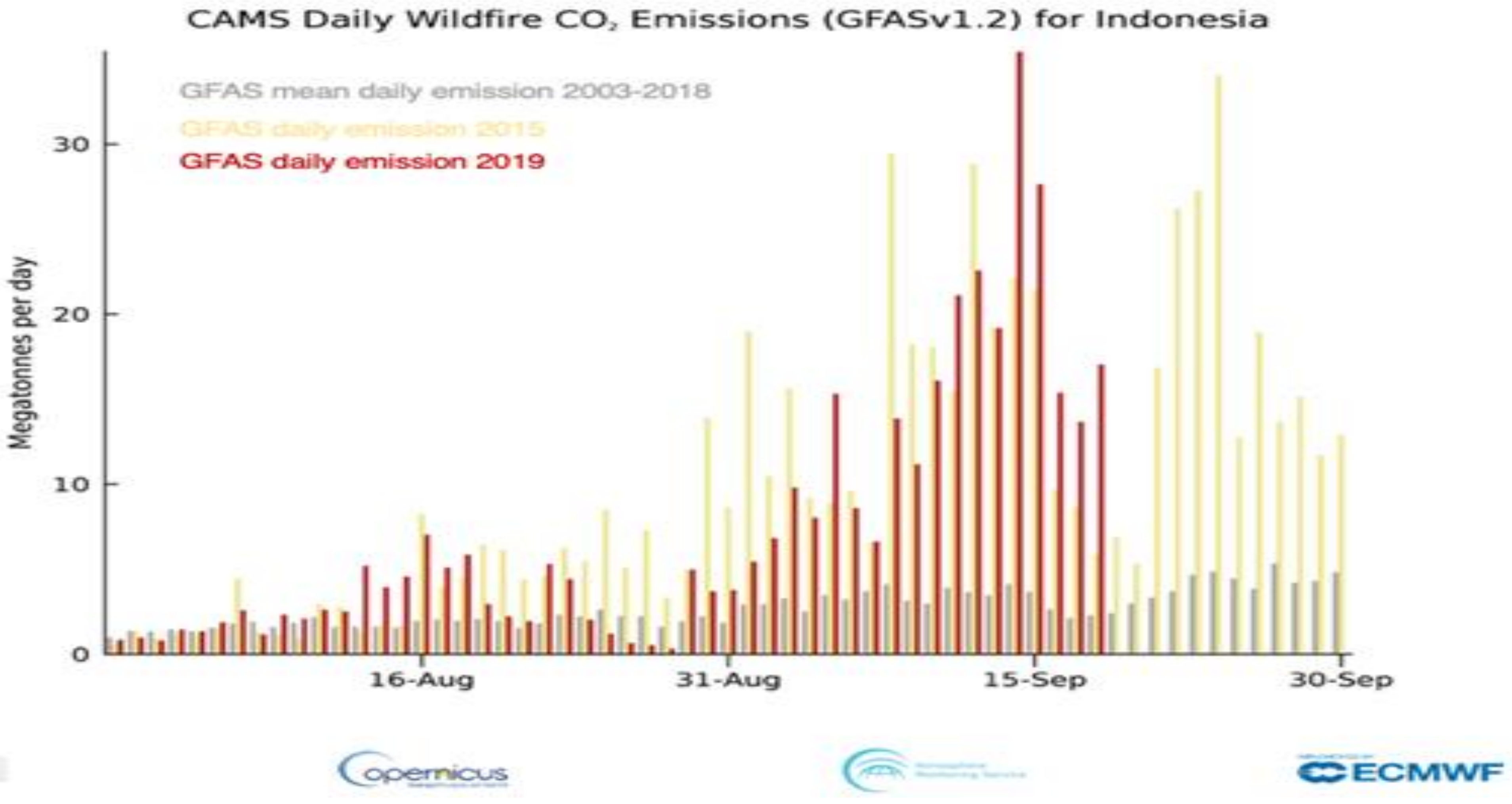

Network: 14 Sep 2019 15.58.20 WIB
Local: 14 Sep 2019 15.58.19 WIB
-3°12'44"S 104°39'40"E
Jalan Lingkar Citra
Kecamatan Indralaya Utara, Kabupaten Ogan Ilir 30862
Indonesia
Remark: IBNU. S _ SatGas BPBD OI
BADAN PENANGGULANGAN BENCANA DAERAH
BPBD
KABUPATEN OGAN ILIR

Provinces	2015	2016	2017	2018	2019
South Sumatra	646,298.80	8,784.91	3,625.66	16,226.60	336,798
Central Kalimantan	583,833.44	6,148.42	1,743.82	47,432.57	317,749
West Kalimantan	93,515.80	9,174.19	7,467.33	68,422.03	151,419
South Kalimantan	196,516.77	2,331.96	8,290.34	98,637.99	137,878
Riau	183,808.59	85,219.51	6,866.09	37,236.27	90,550
Jambi	115,634.34	8,281.25	109.17	1,577.75	56,593
Papua	350,005.30	185,571.60	28,767.38	88,626.84	108,110
7 Provinces Restoration target area	**2,169,613.04**	**305,511.84**	**56,869.79**	**358,160.05**	**1,199,097**
Total areal burnt (IND)	**2,611.411.44**	**438,363.19**	**165,483.92**	**529,266.64**	**1,649,258**
%	**83.08**	**69.70**	**34.36**	**67.70**	**72.70**

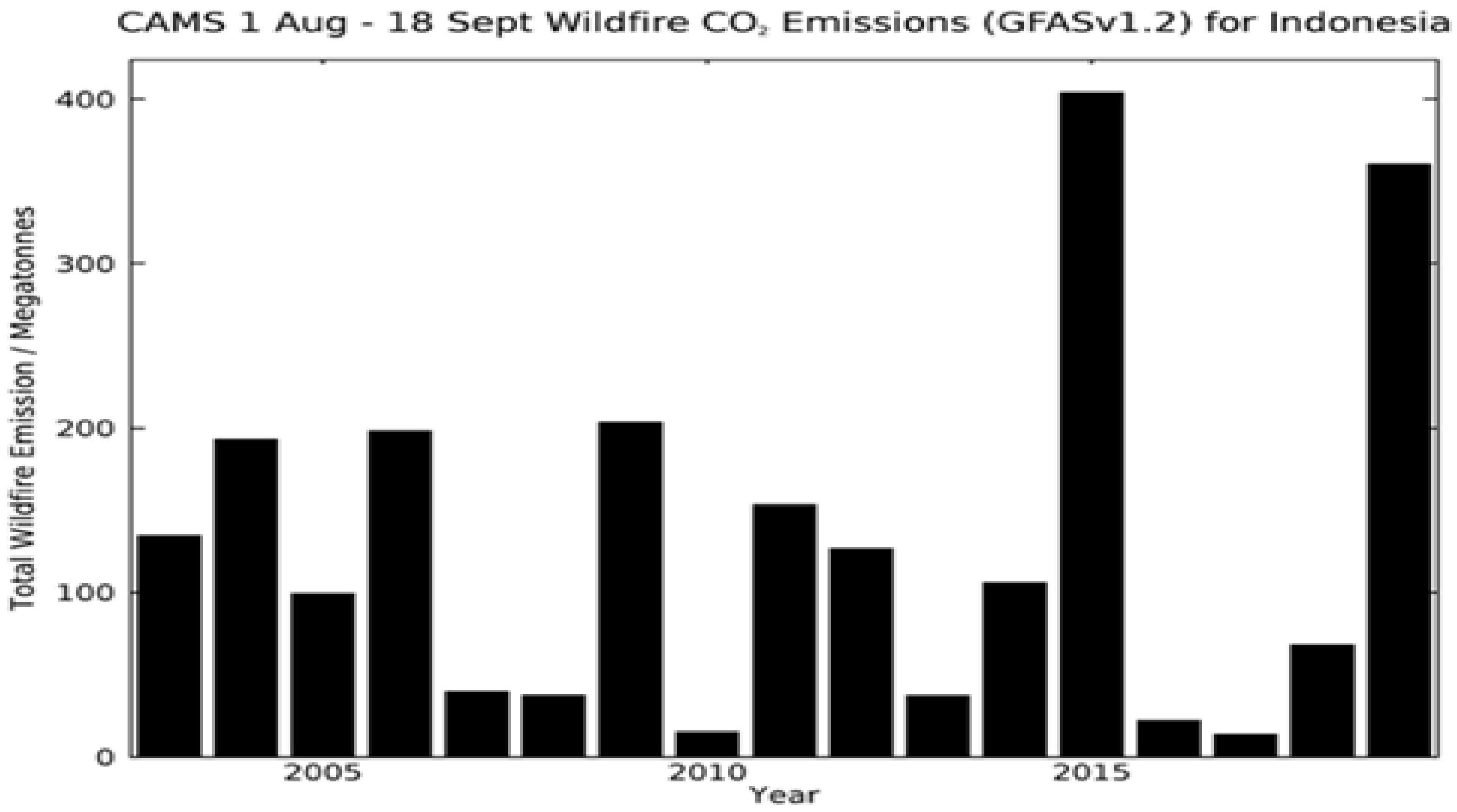
Burnt peat area in the year 2018 and 2019

Provinces	2018	2019	%
South Sumatra	2,071	136,875	6609
Central Kalimantan	27,516	183,836	668
West Kalimantan	39,573	60,487	153
South Kalimantan	9,902	11,950	121
Riau	33,867	63,282	187
Jambi	622	24,045	3866
Papua	2,372	2,199	-7.3
Burnt peat restoration target area	115,923	482,674	416
All burnt peat (Indonesia)	125,340	494,450	394

Daily total estimated CO_2 equivalent emissions, comparing 2019 (in red) with 2015 (in yellow) and the 2003-2018 mean (in grey), showing the comparability of recent emissions to the same days in 2015. Credit: CAMS/ECMWF



Total estimated CO_2 equivalent emissions calculated for Indonesia between 1 August and 18 September for all years between 2003 and 2019. Credit: CAMS/ECMWF



No	Province	Burnt area (Ha)								
		2019			2020			2021		
		Mineral	Peat	Total	Mineral	Peat	Total	Mineral	Peat	Total
1	Aceh	528	202	730	885	193	1.078	330	304	634
2	Bengkulu	11		11	221		221	49		49
3	Kepulauan Bangka Belitung	4.231	548	4.778	350	226	576	137	13	150
4	Kepulauan Riau	6.002	132	6.134	8.798	7	8.805	1.512	61	1.574
5	Jambi	32.549	24.045	56.593	994	7	1.002	64	3	67
6	Lampung	32.851	2.695	35.546	1.358		1.358	918		918
7	Riau	27.269	63.282	90.550	3.855	11.587	15.442	383	6.265	6.648
8	Sumatera Barat	1.274	858	2.133	1.101	473	1.573	124	235	238
9	Sumatera Selatan	199.923	136.875	336.798	433	517	950	1.095	121	1.215
10	Sumatera Utara	1.799	714	2.514	2.847	897	3.744	786	332	1.118
11	Bali	373		373	29		29	3		3
12	Banten	9		9	2		2			-
13	Jawa Barat	9.552		9.552	2.344		2.344	138		138
14	Jawa Tengah	4.782		4.782	7.516		7.516	7		7
15	Jawa Timur	23.655		23.655	19.148		19.148	5.485		5.485
16	DI Yogyakarta	23		23	181		181			-
17	Nusa Tenggara Barat	60.234		60.234	29.147		29.147	19.372		19.372
18	Nusa Tenggara Timur	136.920		136.920	114.719		114.719	41.818		41.818
19	Kalimantan Barat	91.433	60.487	151.919	6.234	1.413	7.646	3.670	11.639	15.309
20	Kalimantan Selatan	125.898	11.950	137.848	3.978	39	4.017	2.008	39	2.047
21	Kalimantan Tengah	133.913	183.836	317.749	6.135	1.546	7.681	653	545	1.197
22	Kalimantan Timur	62.851	5.673	68.524	5.084	137	5.221	414		414
23	Kalimantan Utara	8.555	5	8.559	1.721		1.721	294		294
24	Gorontalo	1.909		1.909	80		80	50		50
25	Sulawesi Barat	3.029		3.029	569		569	651		651
26	Sulawesi Selatan	15.697		15.697	1.902		1.902	79		79
27	Sulawesi Tengah	11.551		11.551	2.555		2.555	944		944
28	Sulawesi Tenggara	16.929		16.929	3.206		3.206	1.142		1.142
29	Sulawesi Utara	4.574		4.574	177		177	119		119
30	Maluku	27.211		27.211	20.270		20.270	2.223		2.223
31	Maluku Utara	2.781		2.781	59		59	41		41
32	Papua	105.911	2.199	108.110	27.853	424	28.277	1.684	1	1.685
33	Papua Barat	582	951	1.533	3.182	2.534	5.716	42		42
Total		**1.154.807**	**494.450**	**1.649.258**	**276.944**	**19.998**	**296.942**	**86.231**	**19.557**	**105.789**

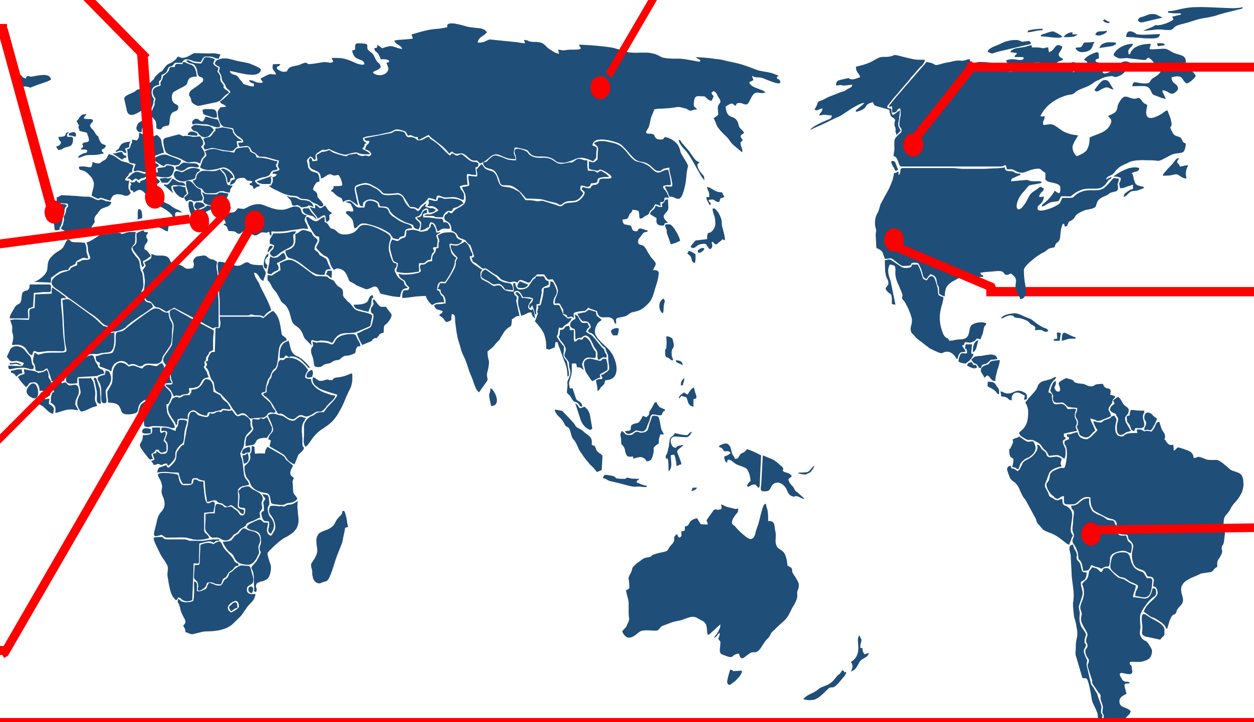
Note: 2021 data is at as July

No	Province	Emission (Ton CO2-e)		
		2019	2020	2021
1	Aceh	281.560	361.241	379.229
2	Sumatera Utara	885.018	1.425.416	475.476
3	Riau	72.081.698	12.422.996	6.754.421
4	Kepulauan Riau	651.434	602.348	161.327
5	Sumatera Barat	1.029.562	660.876	272.891
6	Jambi	29.884.752	138.961	13.561
7	Sumatera Selatan	158.329.629	612.278	226.415
8	Bengkulu	3.912	28.985	6.449
9	Bangka Belitung	839.454	253.108	45.918
10	Lampung	6.642.737	159.258	127.196
11	Kalimantan Barat	71.642.105	2.159.837	12.319.403
12	Kalimantan Tengah	195.824.662	2.313.223	595.078
13	Kalimantan Selatan	19.944.430	241.705	165.802
14	Kalimantan Timur	12.852.068	779.825	72.489
15	Kalimantan Utara	1.112.651	269.849	52.074
16	Sulawesi Barat	153.410	30.576	50.882
17	Sulawesi Tengah	871.489	239.088	32.479
18	Sulawesi Selatan	818.516	116.939	2.313
19	Gorontalo	189.475	5.612	1.427
20	Sulawesi Utara	340.325	6.645	3.241
21	Sulawesi Tenggara	1.621.348	216.246	31.302
22	Banten	2.134	423	-
23	Jawa Barat	743.929	348.260	10.932
24	DKI Jakarta	-	-	-
25	Jawa Tengah	491.617	85.750	51
26	DI Yogyakarta	5.297	246	-
27	Jawa Timur	3.872.440	2.212.151	648.656
28	Bali	41.410	2.408	-
29	Nusa Tenggara Barat	3.544.094	1.623.911	579.506
30	Nusa Tenggara Timur	8.810.217	6.546.923	1.076.971
31	Maluku	2.511.141	1.824.612	138.888
32	Maluku Utara	238.113	9.770	3.757
33	Papua Barat	898.894	2.701.410	1.372
34	Papua	6.646.052	1.803.978	124.206
Total		603.805.573	40.204.855	24.374.027

Note: 2021 data is at as July

COMPARE TO THE FOREST AND LAND FIRES IN OTHER COUNTRIES

Indonesia = 229.978 ha (Jan-Oct. 2021)



ITALY
20.000 ha

SPAIN
5.000 ha

GREECE
56.655 ha

CYPRUS
5.000 ha

TURKEY
95.000 ha

RUSSIA
1.500.000 ha

CANADA
580.000 ha

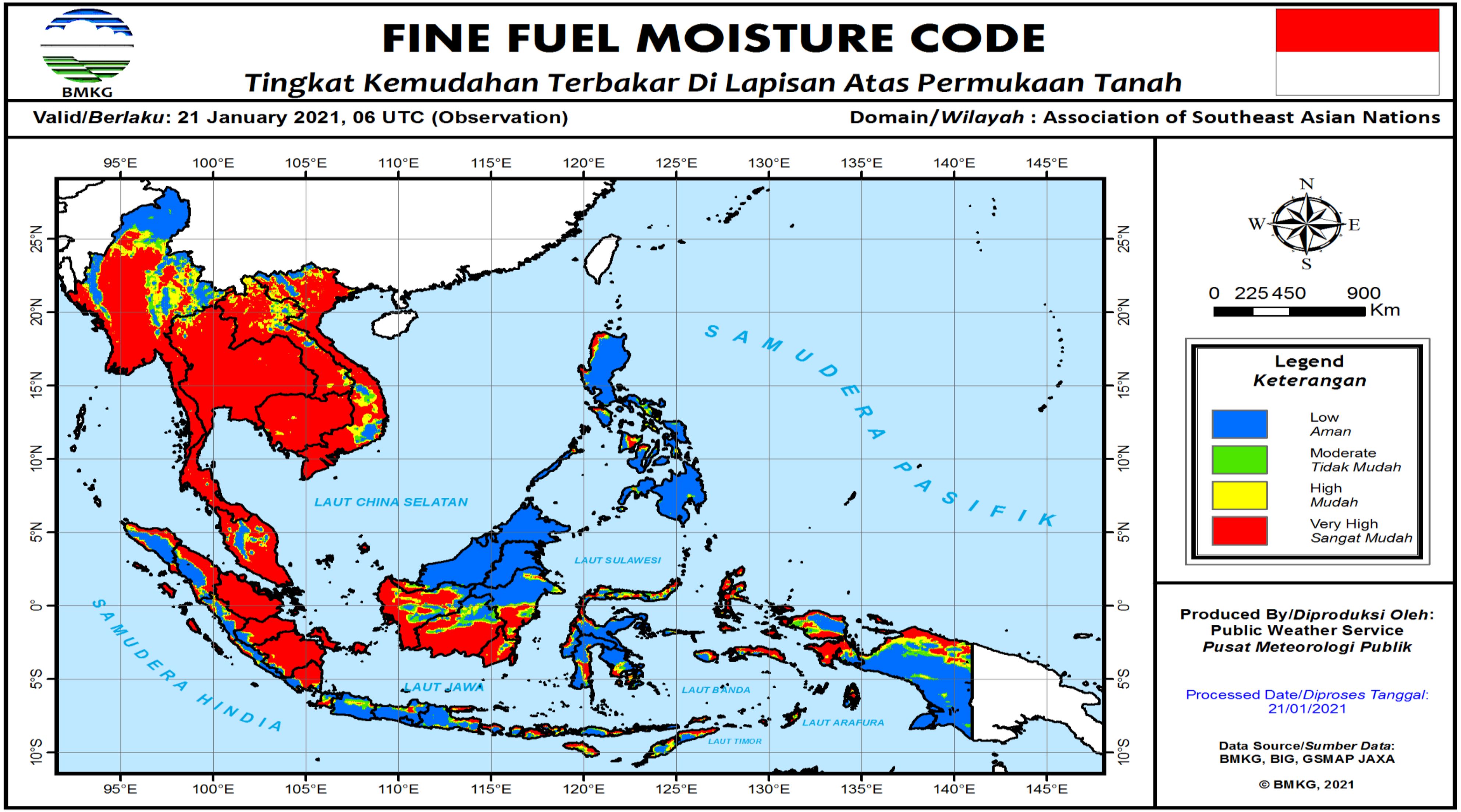
USA
3.500.000 ha

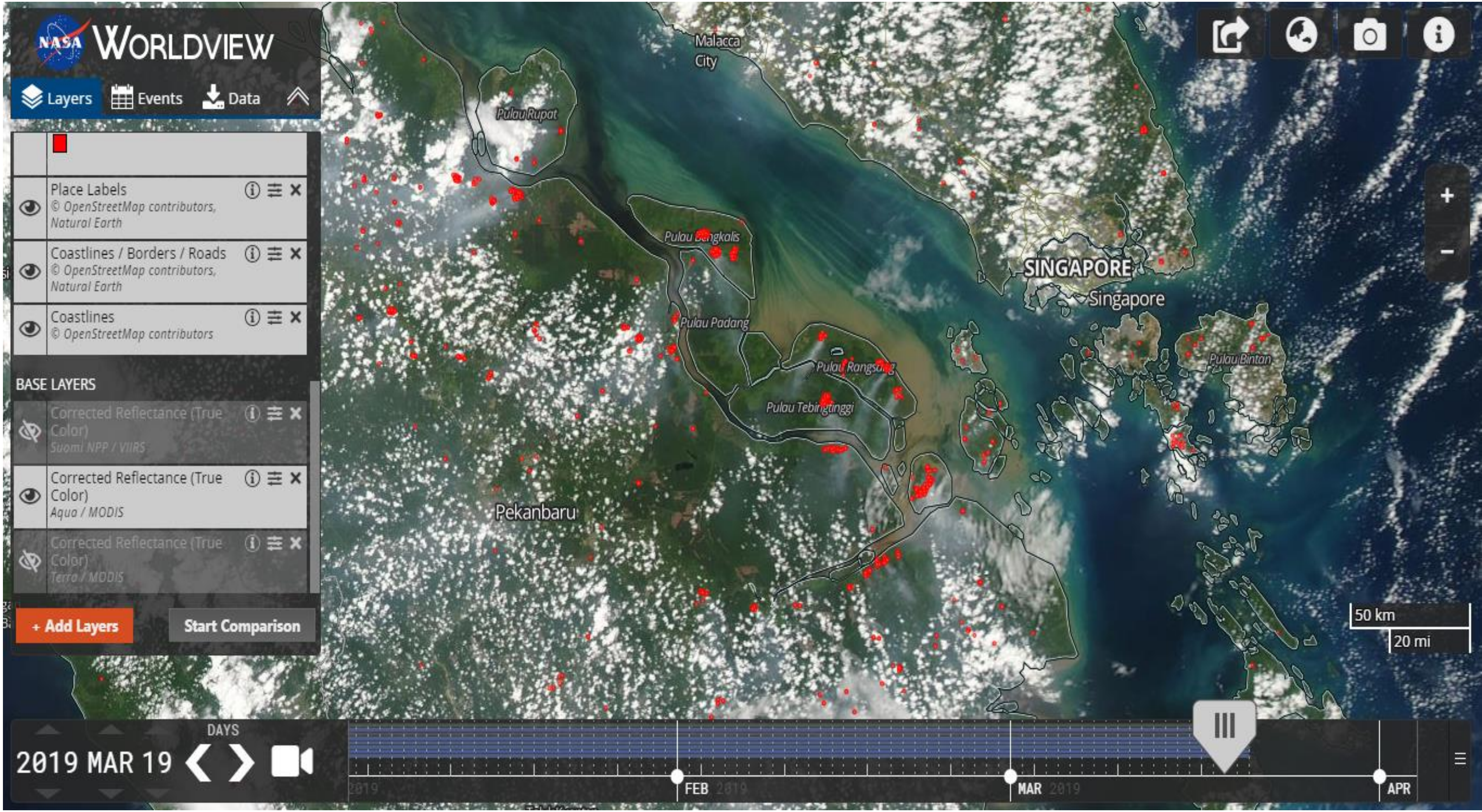
BOLIVIA
150.000 ha

***REFLECTION and ANTICIPATION*:** The forest and land fires disaster triggered by heat waves which occur in European and American countries throughout 2021. Indonesia has learned since 2015 (six years ago) continues to improve the management of forest and land fires management with prevention is priority among the government central, regional, military, police, local community and private sector.

**Data based on satelite wich is launching by Copernicus Atmosphere Monitoring Service (CAMS) Uni Eropa.*

Early warning system (before the fires occur)





WORLDVIEW
Layers
Events
Data
Place Labels
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Coastlines
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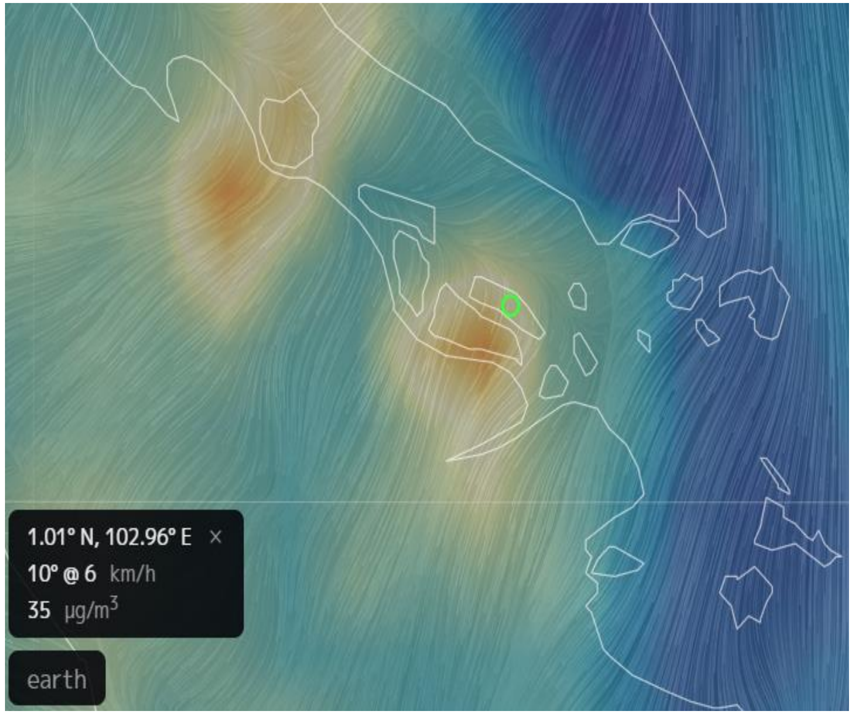
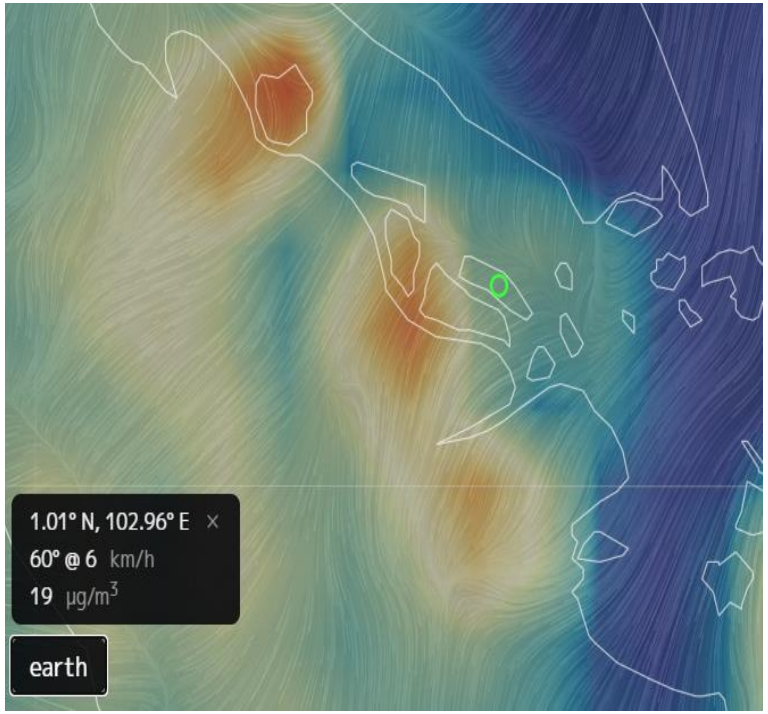
BASE LAYERS
Corrected Reflectance (True Color)
Suomi NPP / VIIRS
Corrected Reflectance (True Color)
Aqua / MODIS
Corrected Reflectance (True Color)
Terra / MODIS
+ Add Layers
Start Comparison
Malacca City
Pulau Rupat
Pulau Bengkalis
Pulau Padang
Pulau Rangsang
Pulau Tebingtinggi
SINGAPORE
Singapore
Pulau Bintan
Pekanbaru
50 km
20 mi
DAYS
2019 MAR 19
FEB 2019
MAR 2019
APR

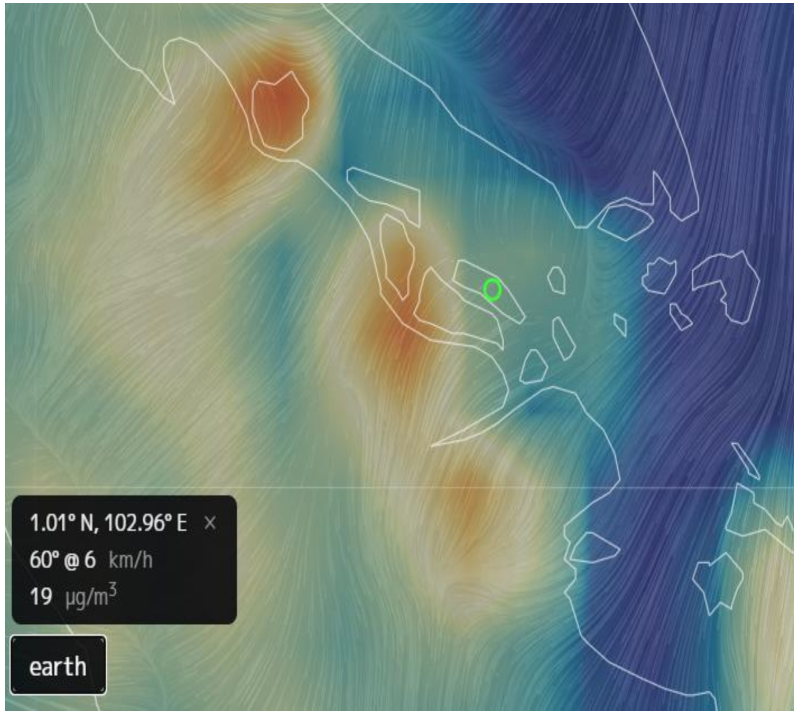
(Monitoring PM 2.5)



1 March 2020

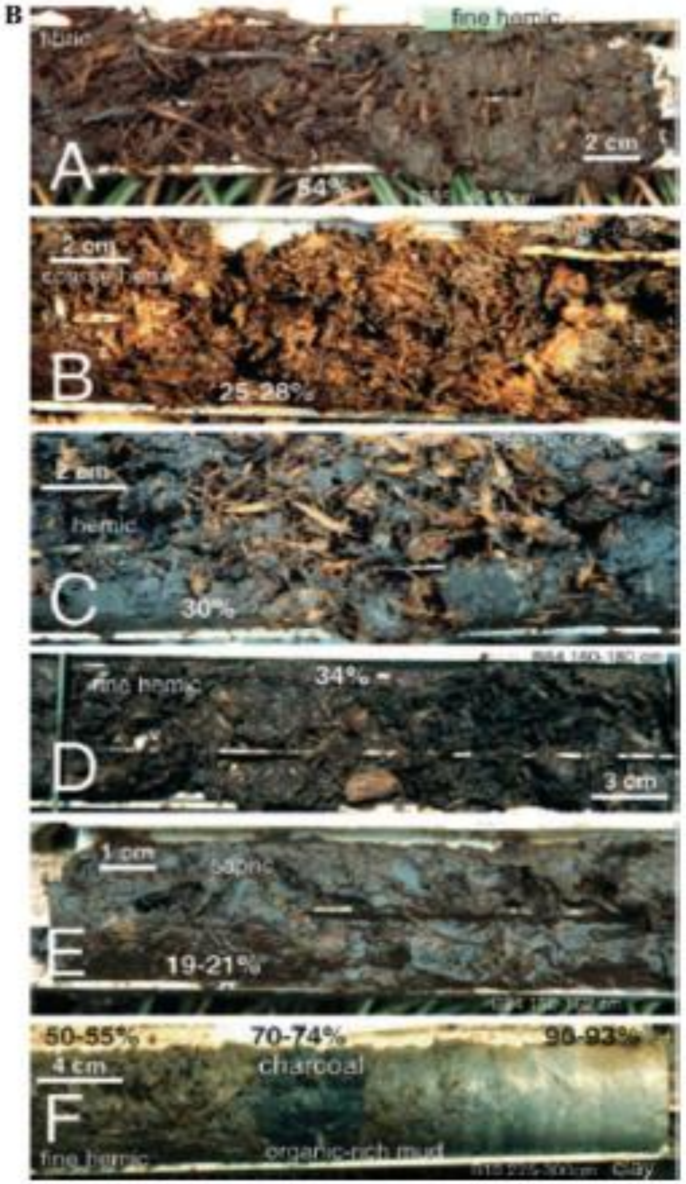


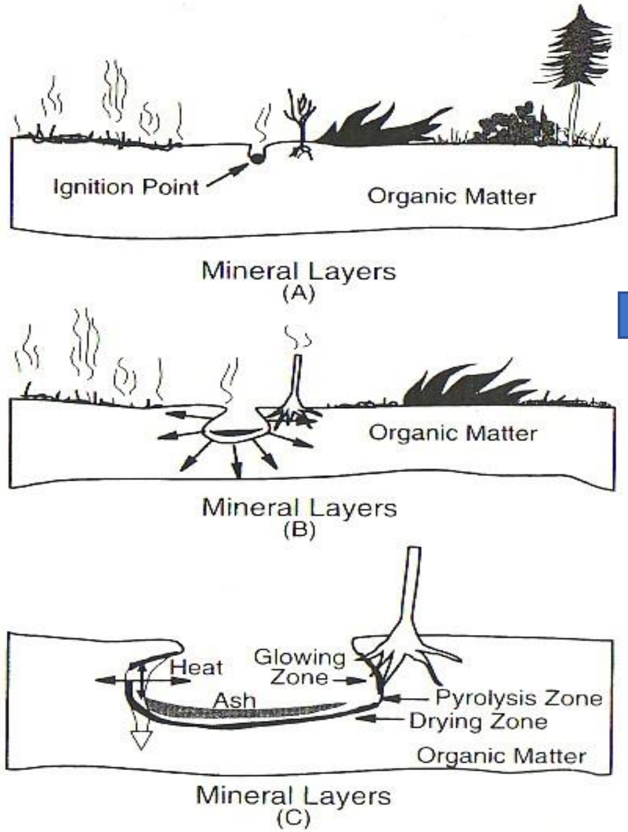
2 March 2020

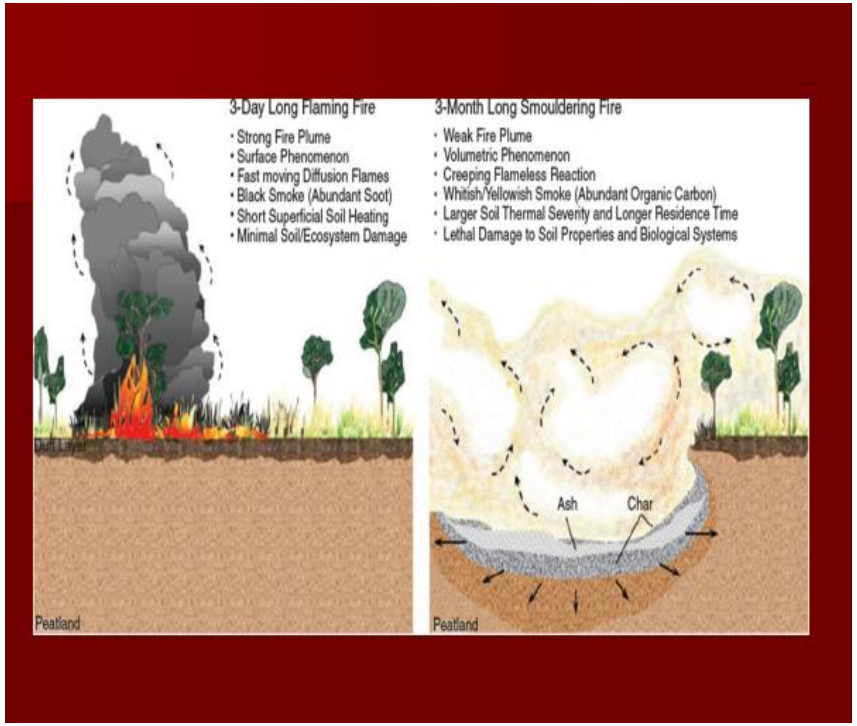


3 March 2020

Peatland







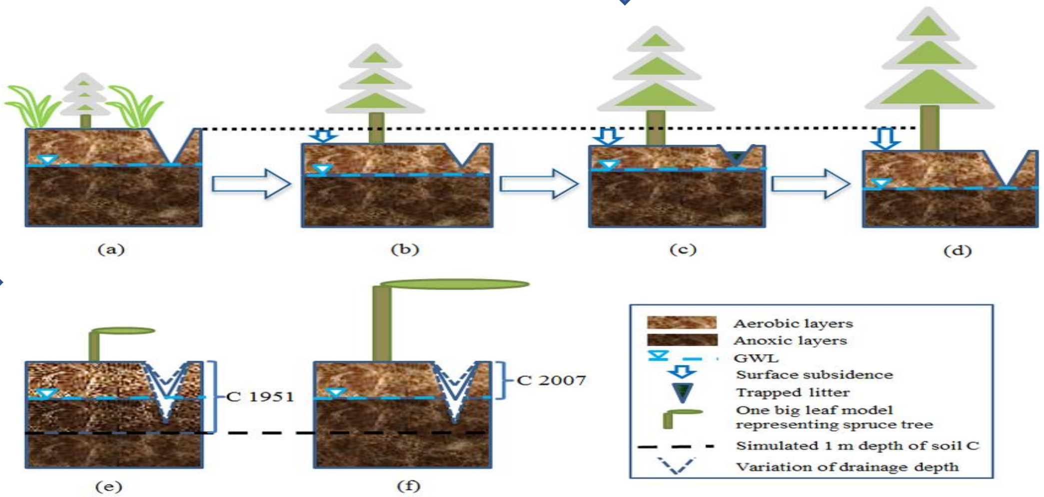
PP 4 THN 2001

PERMENLH 10 THN 2010

PP 71 THN.2014

PP 57 THN.2016

PERMENLHK 15 THN 2017



Mark Cochrane's NASA-funded research team sampled burning peat in Jambi, Sumatra, in 2019. The bottom photo, taken in infrared, reveals locations of smoldering peat fires. Credit: Prof. Yulianto Sulisto Nugroho

Depth to the water table is a prime determinant of the peat that can burn

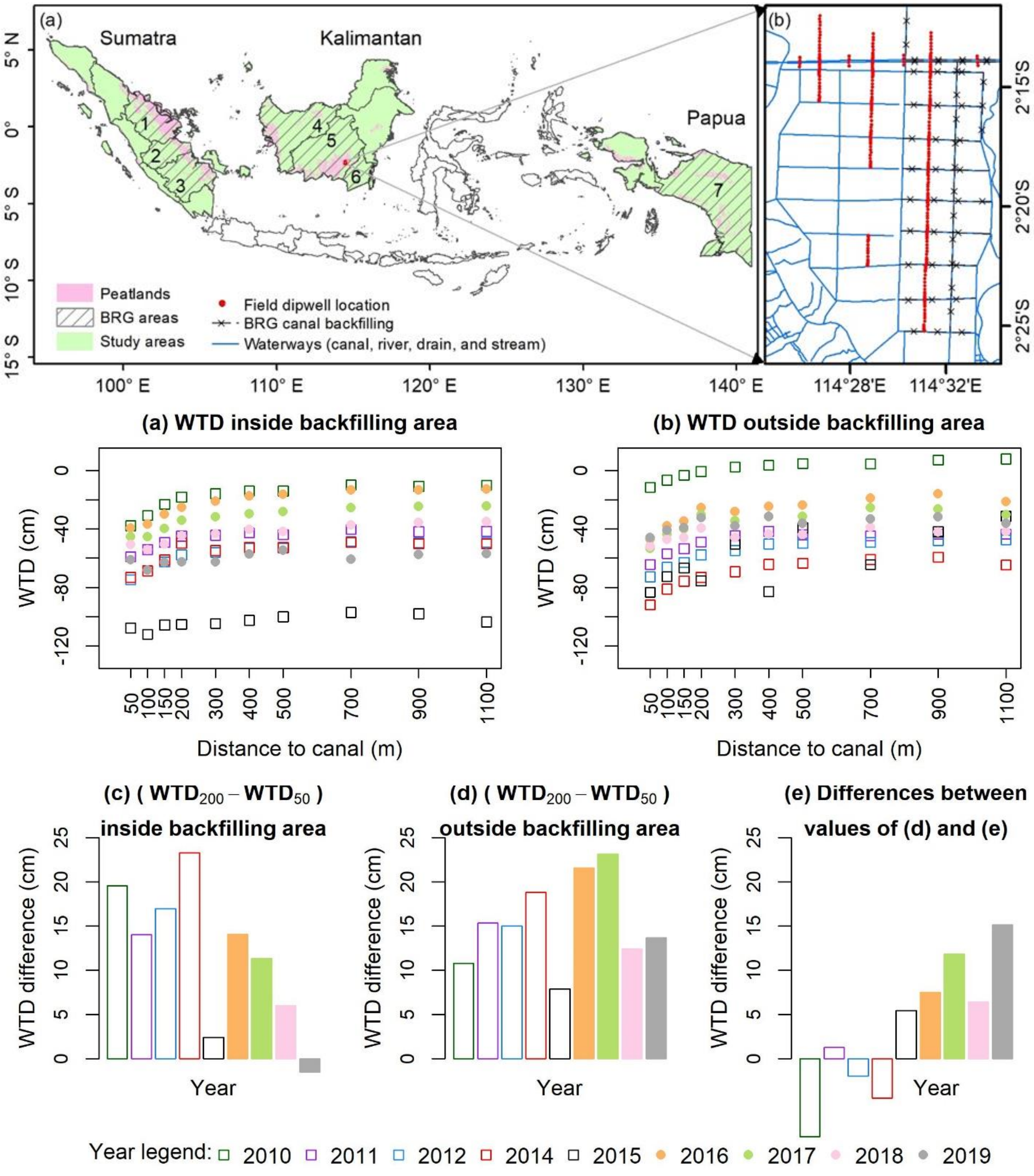
(COCHRANE, 2014)

Canal Blocking at the pulp and paper plantation

Mitigation Results (Cochrane,2021)

- Peatlands rewetted by BRG activities
  - Water table depths (WTD) have improved
  - Differences between WTDs near and far from canals have been reduced
  - Hydrologic differences have continued to improve over time as well as space
    - May reflect ongoing BRG activities
    - Could indicate restoration of normal hydrology

- Aerosol emissions for similar fires in peatlands have been shown to decrease under wetter conditions
- Early indications are that BRG's mitigation efforts show promise for reducing carbon emissions from rewetted peatland areas



(Lu et al. in press)

West Kalimantan-Land Preparation Without Fire

SIAK-Land Preparation Without Fire


ISUZU
GD


11 03 2013


Schneider Electric
PowerLogic
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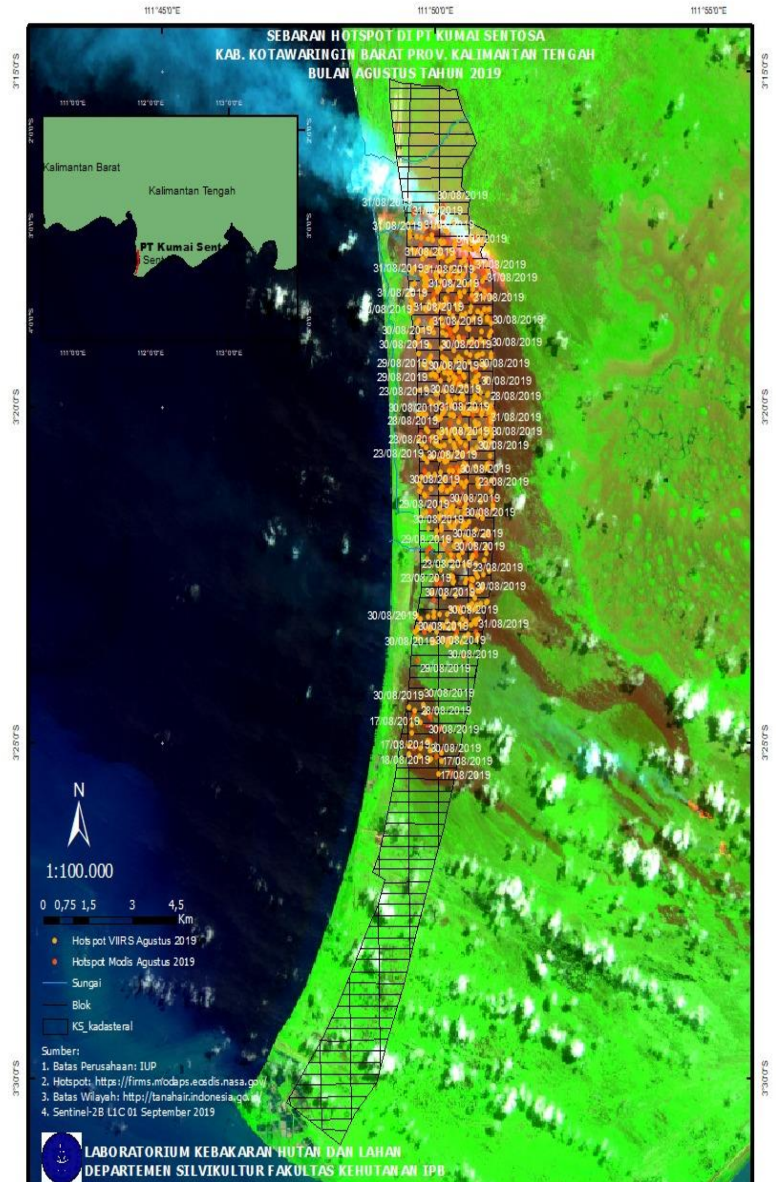
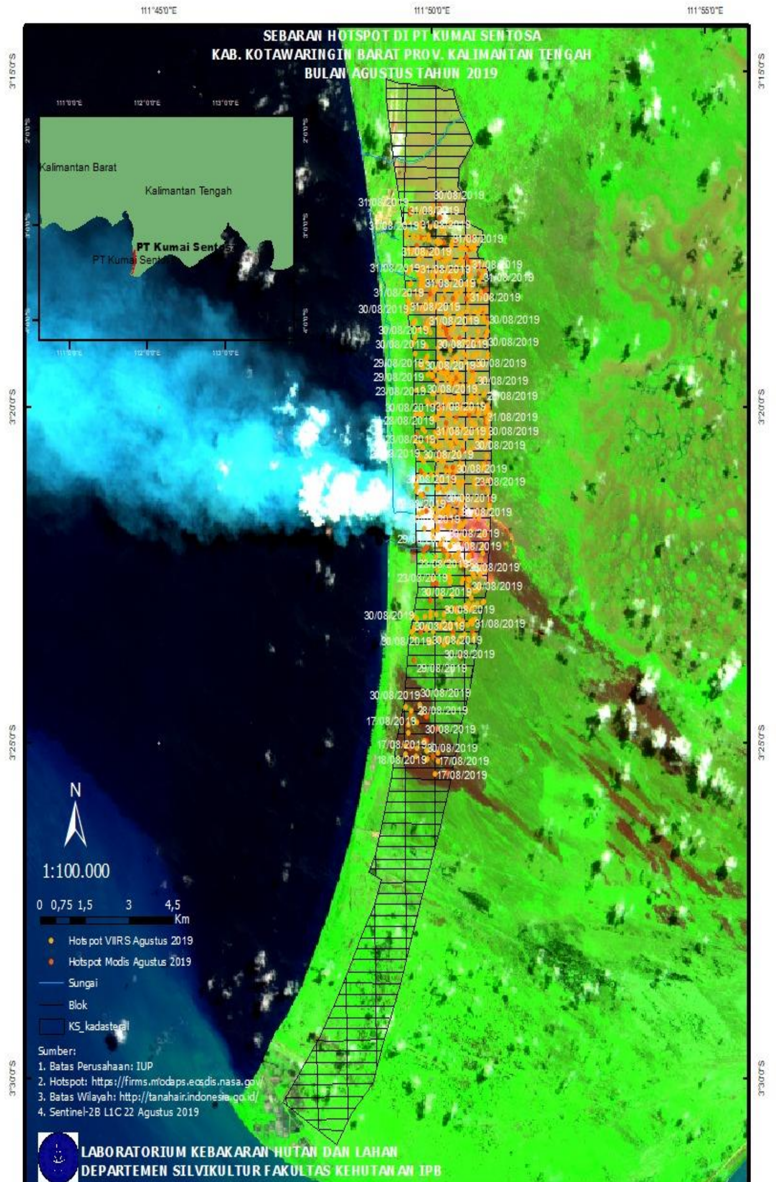
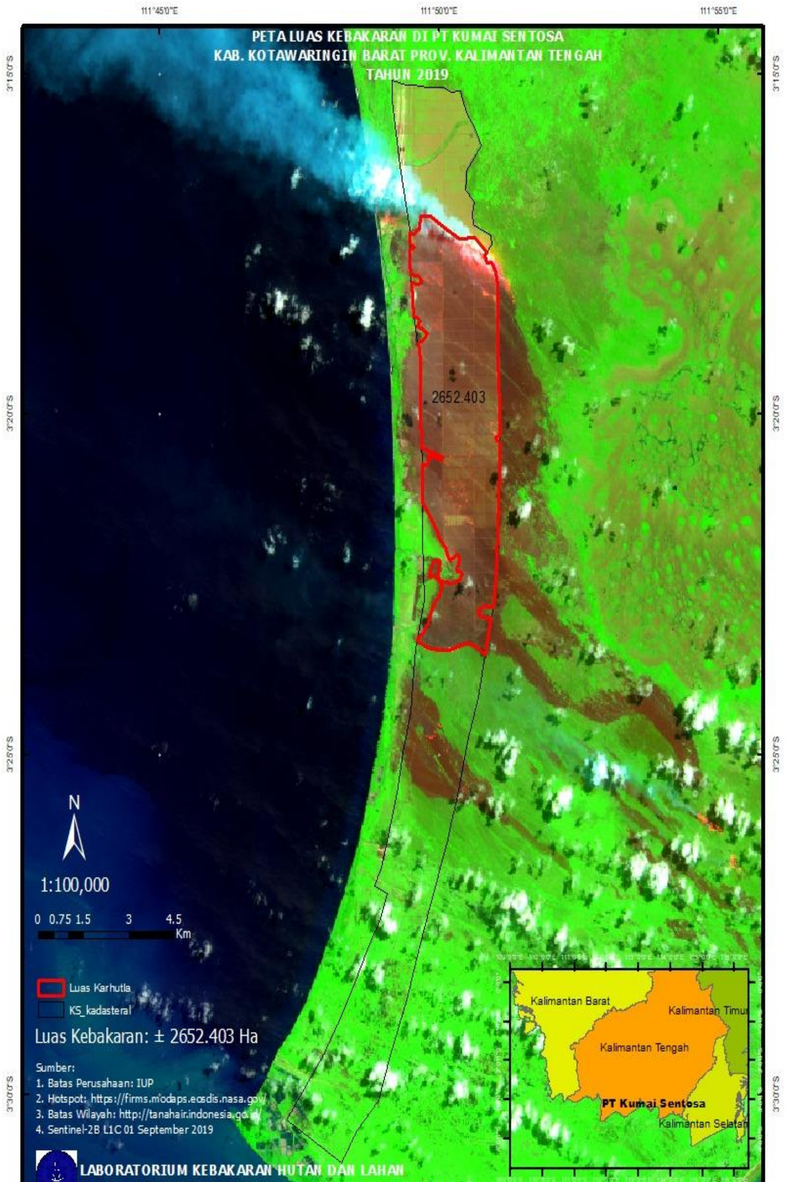
LAW ENFORCEMENT







To calculate annual CO_2-C and Non-CO_2 emissions from organic soil fire using this equations (Krisnawati, 2015):

Equation 2.8 (IPCC, 2014)

- Annual CO_{2-}C and Non CO_2 Emission from Organic Soil Fire

$$L_{fire} = A \text{ x } MB \text{ x } C_f \text{ x } G_{ef} \text{ x } 10^{-3}$$

Where : L fire = amount of CO_2 or non-CO_2 emissions, e.g. CH_4 from fire, tonnes

- A = total area burnt annually, ha
- MB = mass of fuel available for combustion, t ha^{-1}
- Cf = combustion factor, dimensionless
- Gef = emission factor for each gas, g kg^{-1} dry matter burnt

Mass of fuel available for combustion = burnt area (m^2) x burn depth (m) x bulk density (t m^{-3})

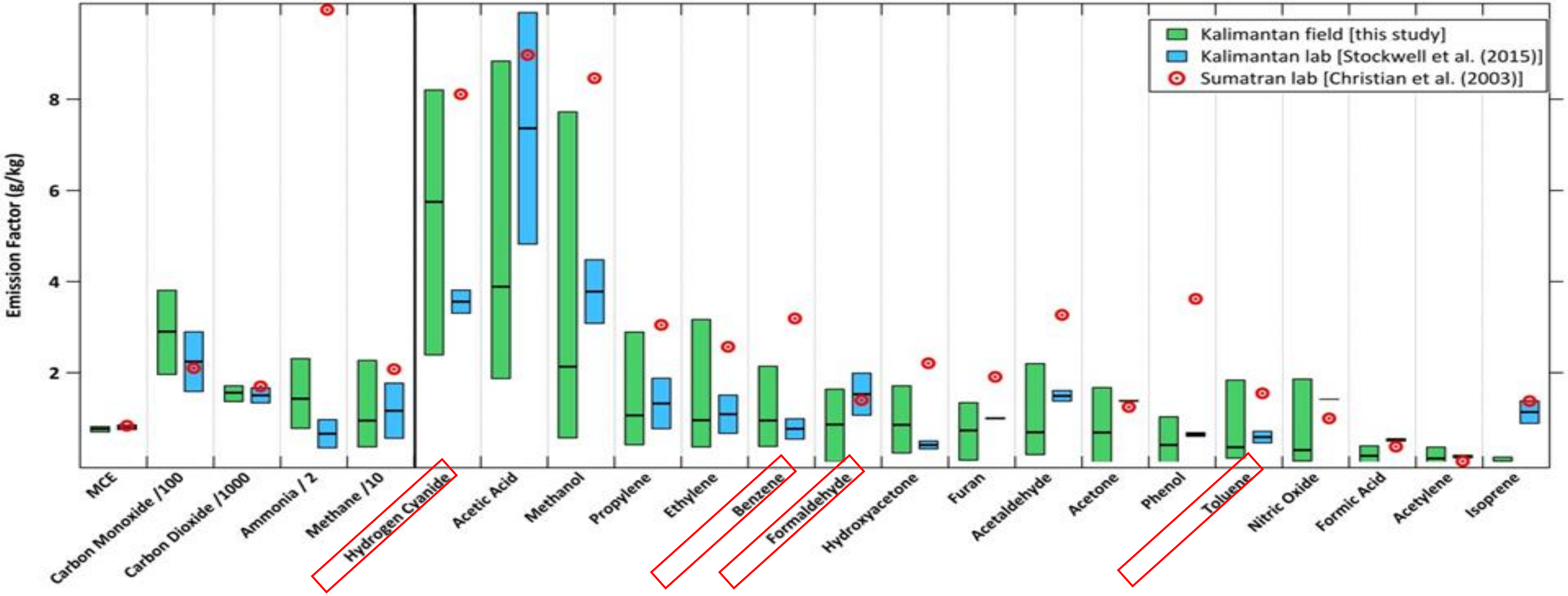
Paramaters input CO_2-C, CO dan CH_4 emissions ha^{-1} for fires in the organic soils (Krisnawati, 2015)

Peat fire EF calculation	First fire	Second fire	Third fire
Burned depth (m)	18	11	4
Area (ha)	1	1	1
Bulk density (gcm^{-3})	0.121	0.121	0.121
Combustion factor	1	1	1
FE CO_2-C (g kg^{-1})	464	464	464
FE CO (g kg^{-1})	210	210	210
FE CH_4 (g kg^{-1})	21	21	21
Mass of fuel available for combustion (t dm ha^{-1})	217.8	133.1	48.4
Emisi CO (t CO ha^{-1})	45.7	28.0	10.2
Emisi CH_4 (t CH_4 ha^{-1})	4.6	2.8	1.0
Emisi CO_2-C (t C ha^{-1})	101.1	61.8	22.5
Emisi CO-C (t C ha^{-1})	19.6	12.0	4.4
Emisi CH_4-C (t C ha^{-1})	3.4	2.1	0.8
Emisi C Total (t C ha^{-1})	124.1	75.8	27.6

Source of CO_2-C, CO, CH_4. emission using Tabel 2.7 IPCC (2013)

Source of burnt depth, buld density, and combustion factor is Page et al., (2014)

Note: Emissions factor for N2O dan Nox is not given by IPCC at Tier due to lack of data on of N_2O dan NOx fires emission in organic soils



Our field data strongly suggest revisions to previously recommended IPCC's EFs for most gases that were based on a limited amount of lab measurements:

CO_2 (-8%)

CH_4 (-55%)

NH_3 (-86%)

CO (+39%)

Emission from Indonesian peat fires will be improved by using these new EFs

Conclusion

- Reduce the fires then followed with decreasing of GHG emission is not a simple activities. It needs not just commitment but also the real actions.
- It must be well managed and control and accompany by law enforcement.
- GHG emission reduction only could be reached if and if every sectors and human individual working together with clear target and the way to run without any exception as policy only is not enough.
- Fire prevention should be realized as it should be applied