

Investigation of Monthly Emission Variations using TROPOMI SO₂ Retrievals for Lignite-Fired Power Plants with Temporary Shutdowns

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🕒 The EGU General Assembly 2022, 23-27 May

AS3.19-EGU22-12258



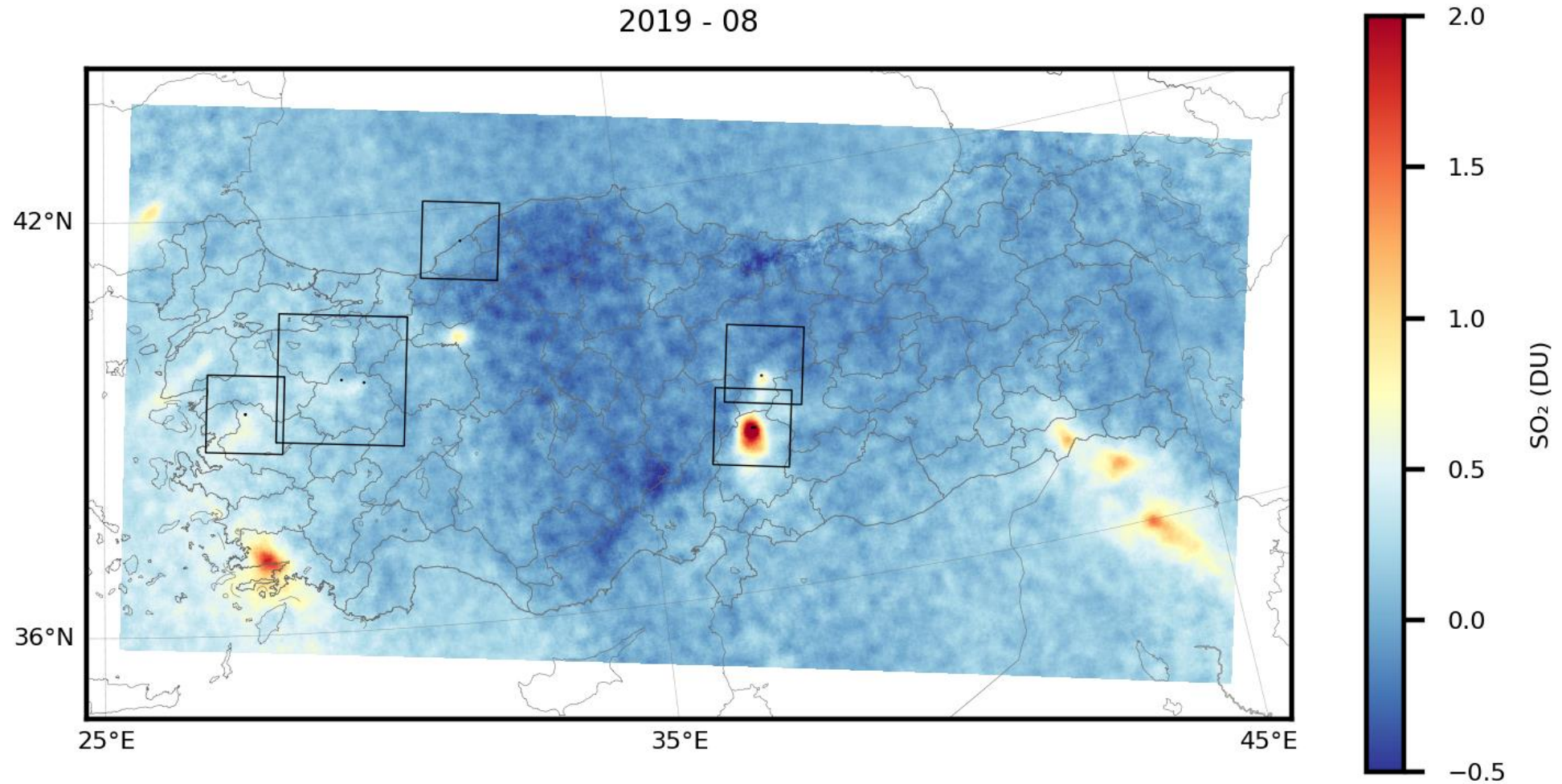
Aim and Scope

- Observe effect of lignite-fired power plants with temporary shutdowns on SO₂ pollution
- Estimate emissions using TROPOMI SO₂ retrievals

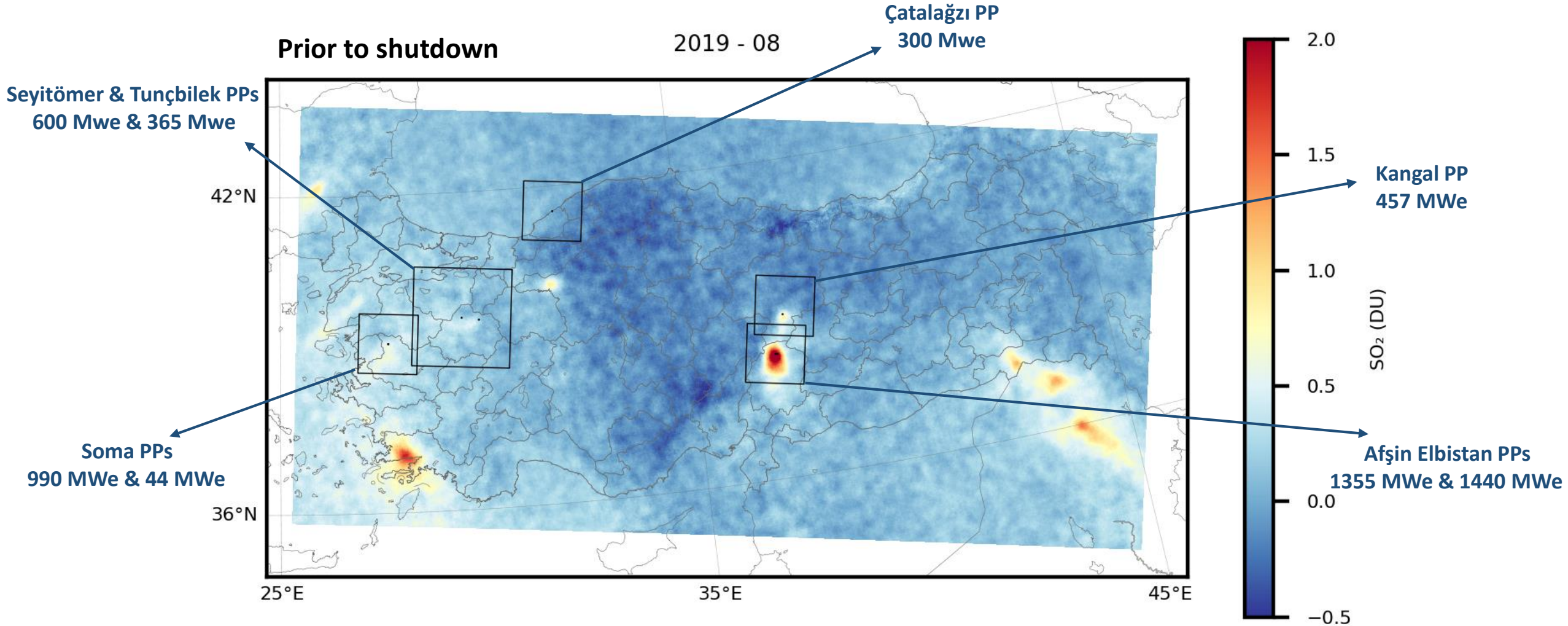


Afşin Elbistan Power Plant – May 2022

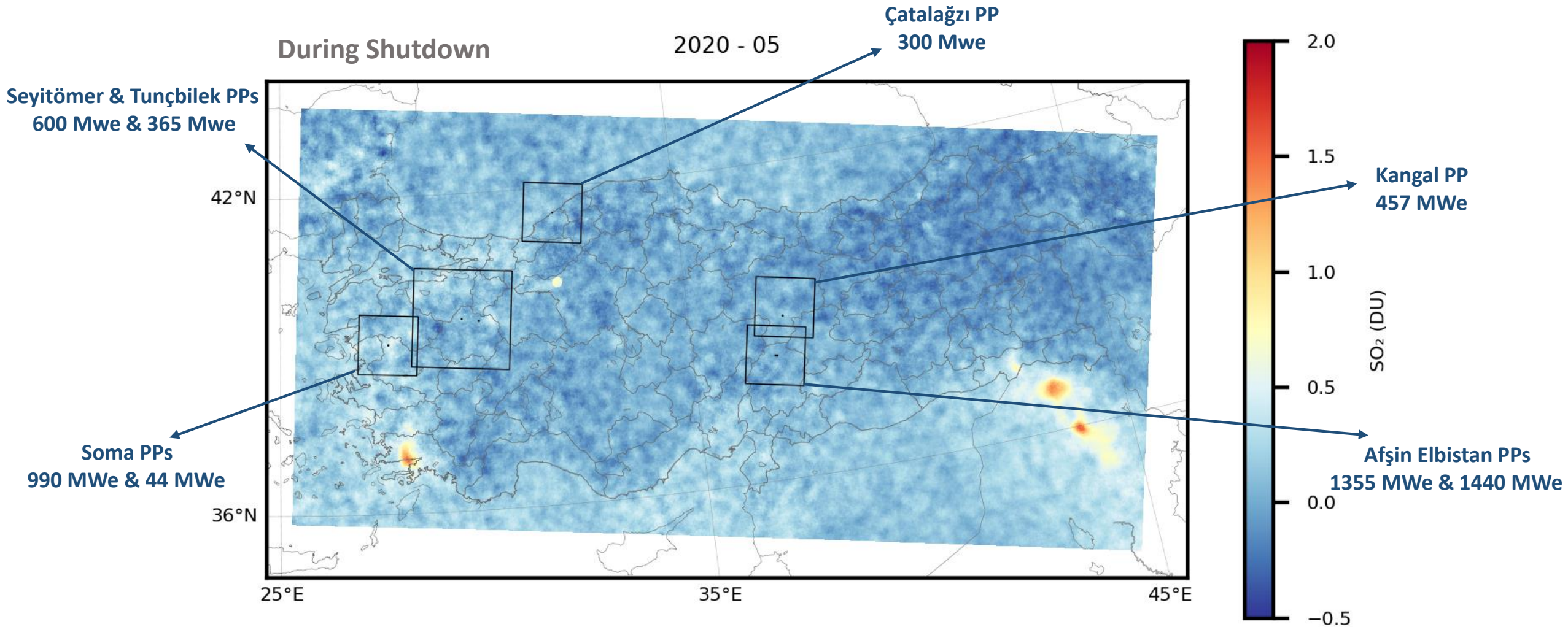
Study Area – Power Plants



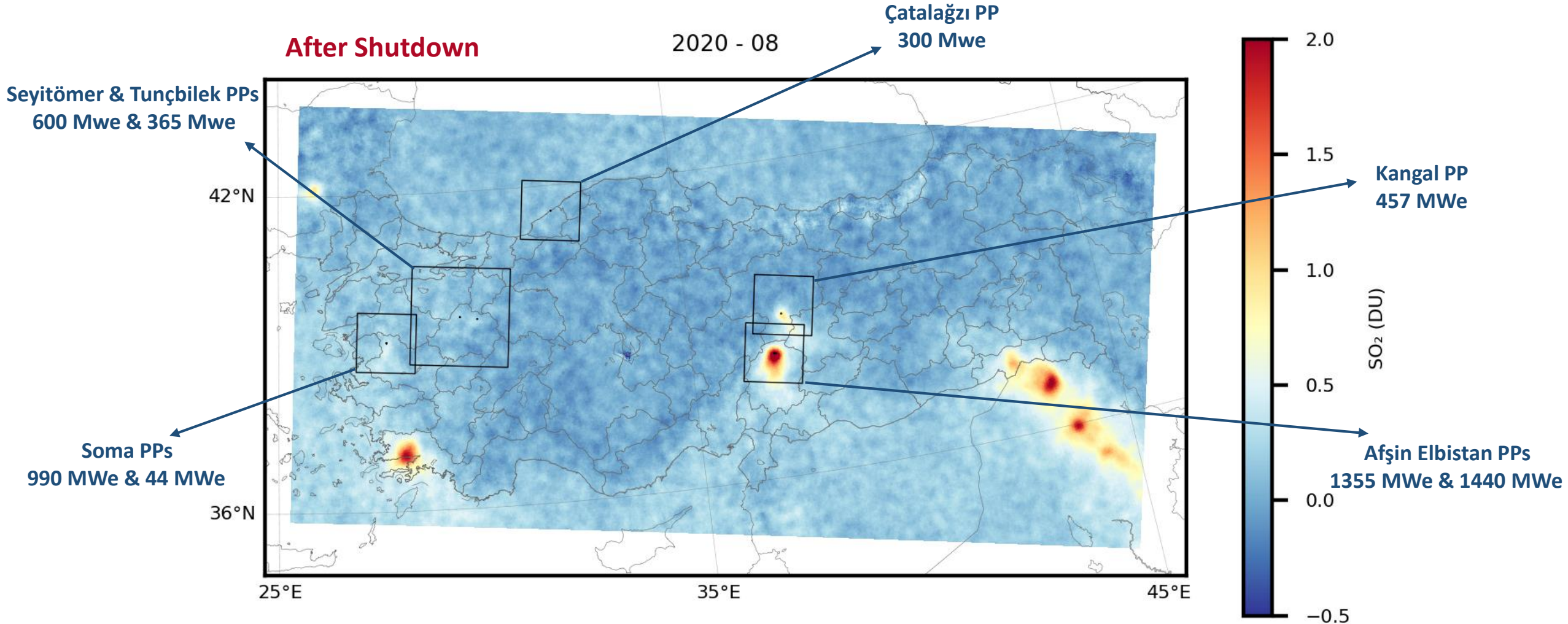
Study Area – Power Plants



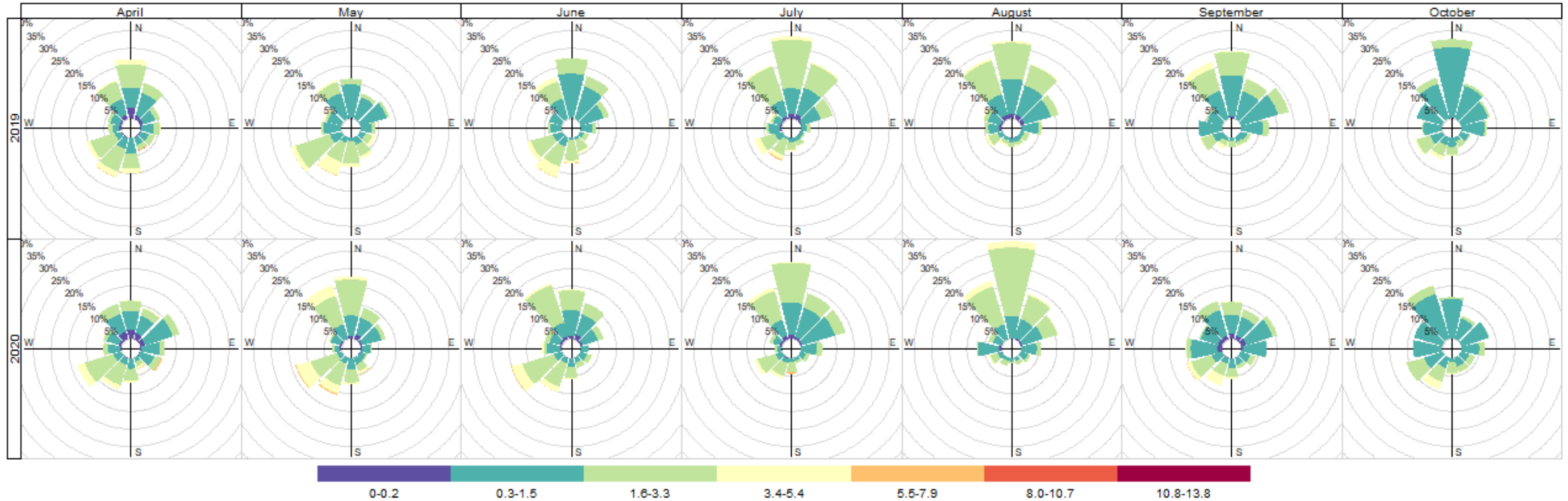
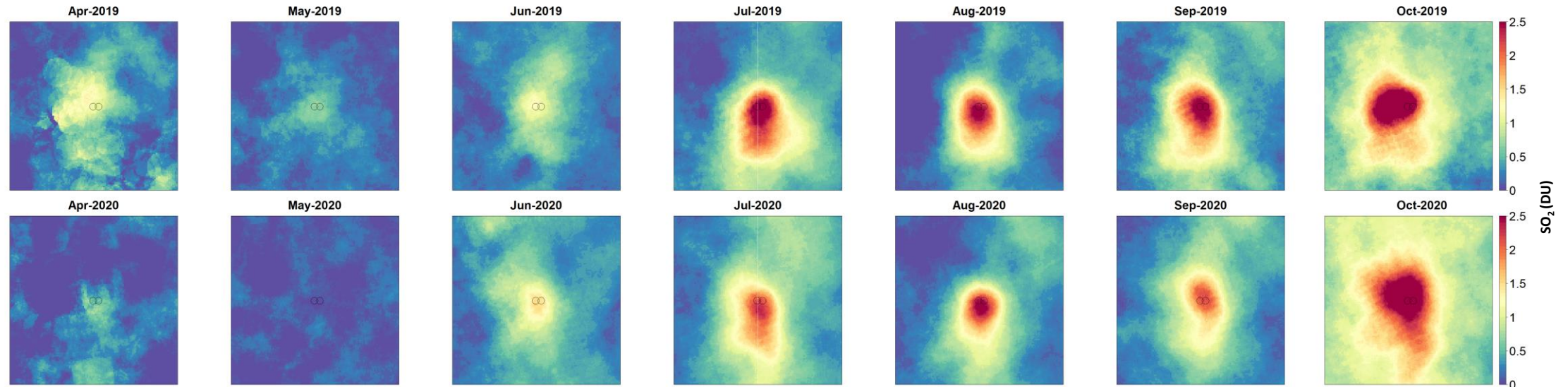
Study Area – Power Plants



Study Area – Power Plants



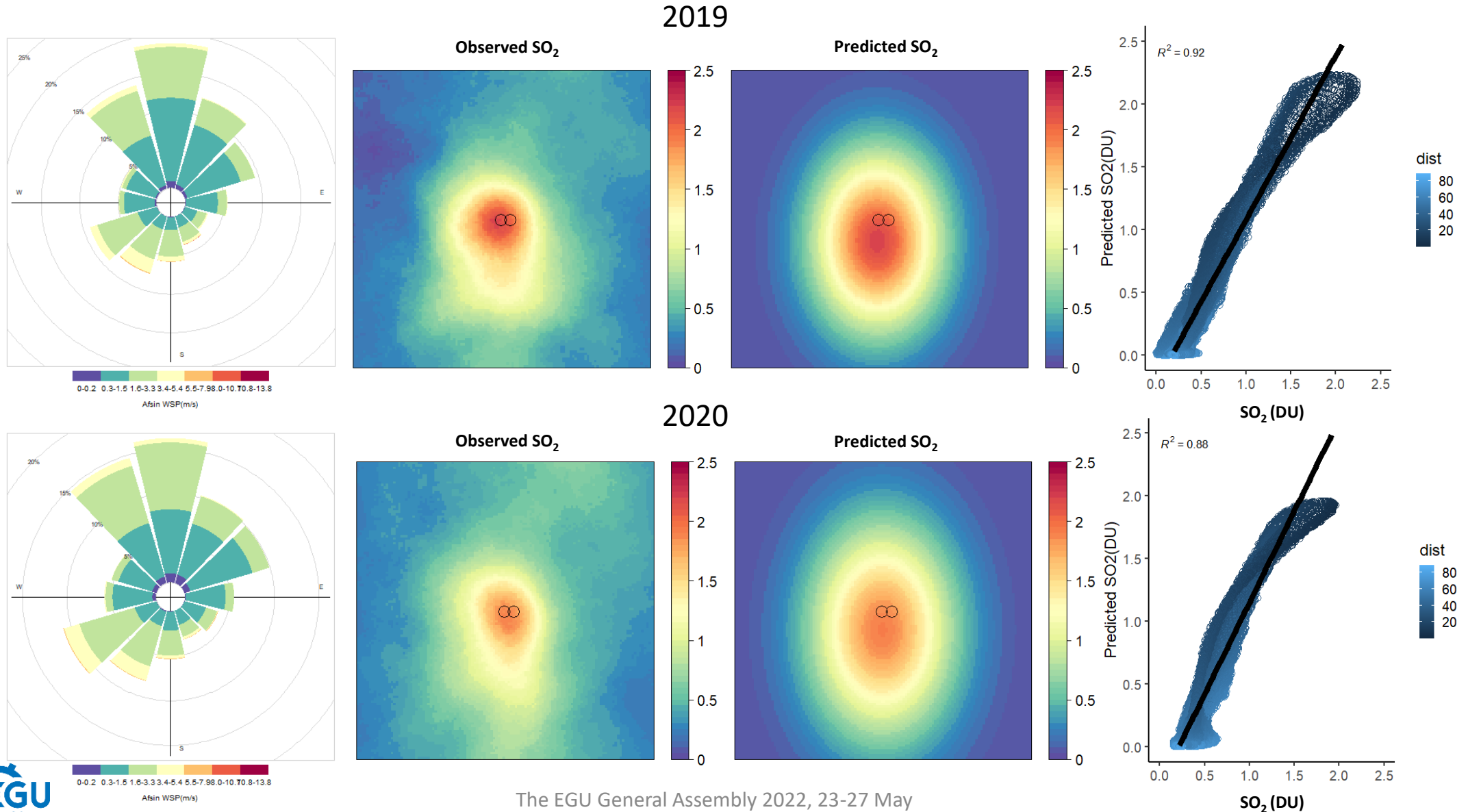
Afşin Elbistan Power Plant



Gaussian Fit example AEPP

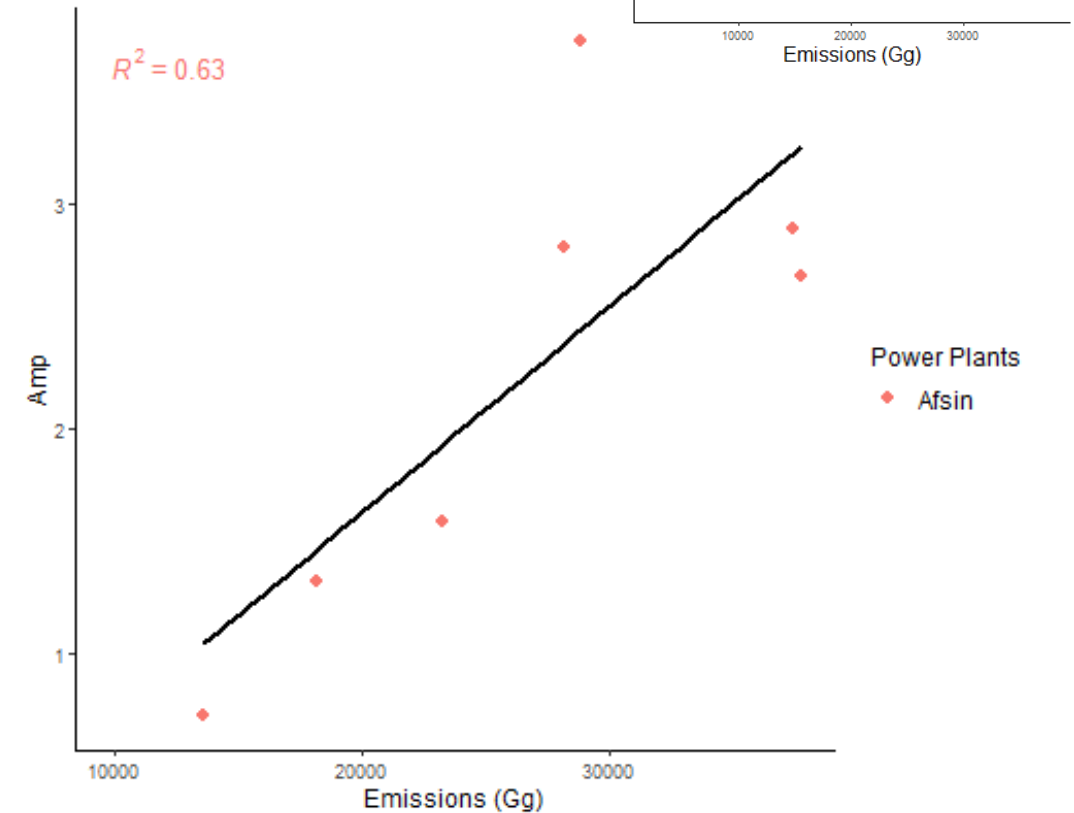
$$G(x, y) = A * e^{(-(((x-x_0)^2/2\sigma_x^2)+((y-y_0)^2/2\sigma_y^2)))}$$

*Fioletov ,2011; Fioletov 2015

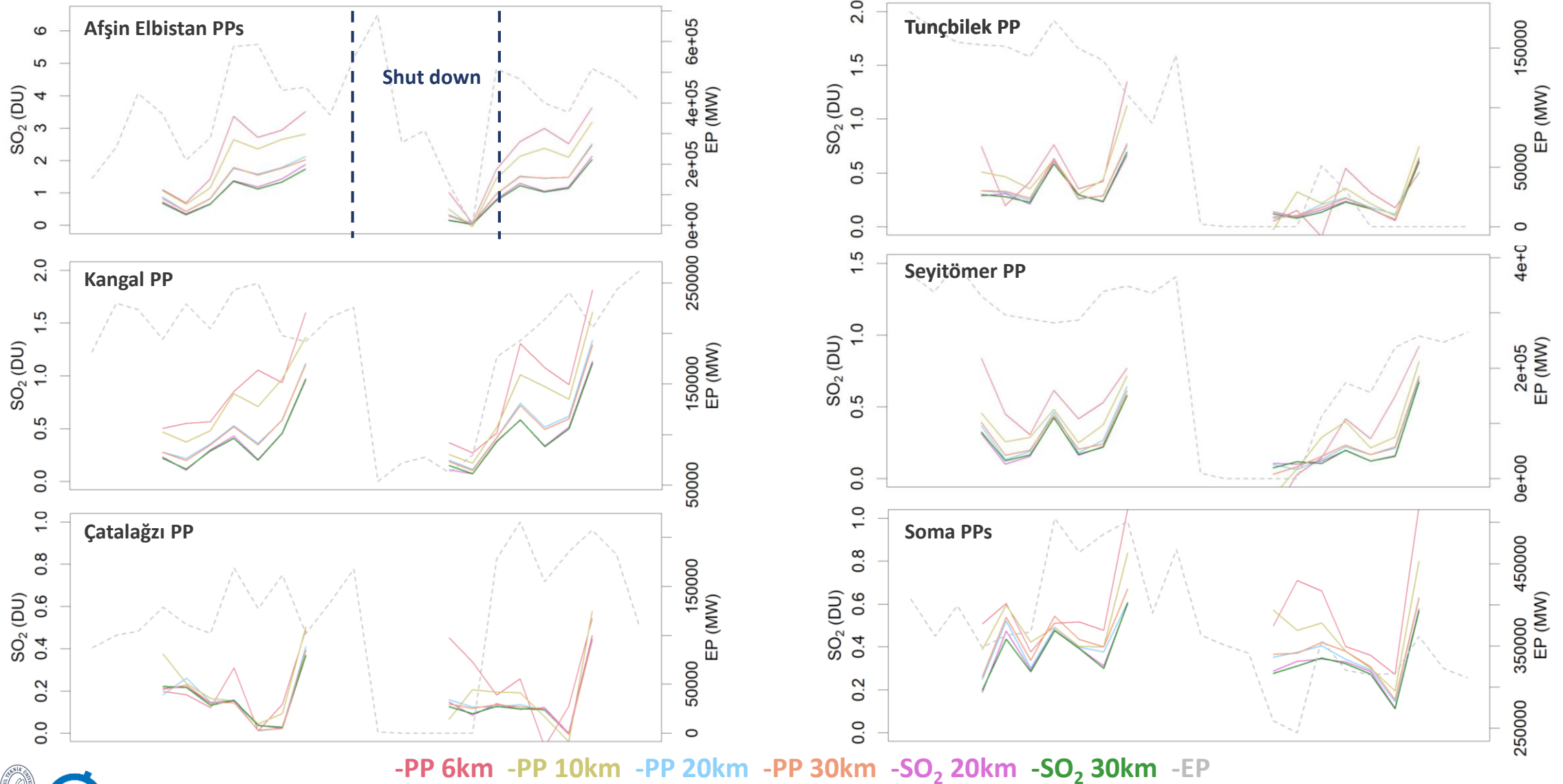


Fit parameters example AEPP

Date		Fit Parameters				R ²	SO ₂ (DU)	Electricity (GWh)	EMEP SO _x (Gg)
Year	Month	Amp	σ_x	σ_y	RMSE				
2019	Jan	-	-	-	-	-	-	153	9.80
	Feb	-	-	-	-	-	-	255	16.29
	Mar	-	-	-	-	-	-	431	27.58
	Apr	1.59	15.29	24.65	0.23	0.63	1.11	364	23.26
	May	0.72	20.04	22.73	0.12	0.57	0.70	213	13.63
	June	1.32	17.23	29.17	0.16	0.82	1.43	285	18.21
	July	2.89	16.6	20.91	0.22	0.88	3.36	584	37.38
	Aug	2.68	13.67	21.54	0.2	0.89	2.72	591	37.77
	Sep	2.81	16.63	26.29	0.28	0.89	2.94	440	28.18
	Oct	3.72	20.98	25.44	0.46	0.88	3.51	451	28.85
	Nov	-	-	-	-	-	-	361	23.07
	Dec	-	-	-	-	-	-	544	34.81
2019 overall		2.24	18.24	25.37	0.21	0.92	2.25	4,671	342.83
2020	Jan	-	-	-	-	-	-	688	43.99
	Feb	-	-	-	-	-	-	270	17.27
	Mar	-	-	-	-	-	-	310	19.81
	Apr	0.79	10.62	24.44	0.18	0.31	1.02	136	8.68
	May	-	-	-	-	-	0.08	0	0.00
	June	1.58	19.67	28.88	0.24	0.74	1.73	511	32.67
	July	2.41	18.98	30.64	0.3	0.84	2.59	478	30.59
	Aug	2.74	14.05	20.35	0.29	0.82	2.99	399	25.54
	Sep	2.23	17.53	29.44	0.24	0.88	2.52	369	23.60
	Oct	3.51	26.22	33.09	0.48	0.83	3.64	511	32.70
	Nov	-	-	-	-	-	-	473	30.28
	Dec	-	-	-	-	-	-	408	26.09
2020 overall		1.96	20.25	29.8	0.24	0.88	2.08	4,552	291.22



Comparison of before and after shutdown periods



Conclusions and Future Works

- Correlations between observed and estimated SO₂ concentrations for 2019 and 2020 are R²=0.92-0.88 for Afşin, R²=0.79-0.75 for Kangal, R²=0.37 for Soma, and R²=0.63-0.47 for Seyitömer-Tunçbilek
- SO₂ decreased during shutdown and increased rapidly after reopening for Afşin and Kangal PPs
- Lower SO₂ values observed after reopening for Seyitömer, Tunçbilek and Soma PPs indicating implementation of control technologies

Future Works

- The impact of wind direction can be eliminated for estimating better fit parameters
- The emissions can be estimated using power plant specific activity data

References

- Fioletov, V. E., McLinden, C. A., Krotkov, N., Li, C., (2015). Lifetimes and emissions of SO₂ from point sources estimated from OMI. *Geophysical Research Letters*, 42(6), doi: [10.1002/2015GL063148](https://doi.org/10.1002/2015GL063148).
- Fioletov, V. E., McLinden, C. A., Krotkov, N., Moran, M. D., Yang, K., (2011). Estimation of SO₂ emissions using OMI retrievals. *Geophysical Research Letters*, 38, doi:[10.1029/2011GL049402](https://doi.org/10.1029/2011GL049402).



Thanks For Listening