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Supplementary Material

Evaluation and comparison of simple empirical models for dead fuel moisture content

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1. Nonparametric significance tests

The nonparametric permutation test was used to assess the statistical significance of the difference in mean performance statistics of different model pairings. The difference in the means of two original distributions was first calculated, then two new distributions were randomly generated by permuting the samples from the two original distributions and recalculating the difference in the means of these distributions. This process was reiterated 10,000 times to get a distribution of the mean difference values. The difference in the means of two original distributions is deemed significantly different, at the 0.05 significance level, if it is higher (lower) than the 95th (5th) percentile of the randomly generated distribution of the mean difference values (Good 2013; Singh *et al*. 2021). Significance was also assessed at 0.1 significance level, for which the 90th and 10th percentiles were used.

		FMI_{rel}	FMI_{gen}	m_D	m_{gen}
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
FMI		0.99	0.89	0.61	0.57
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
			0.87	0.00**	0.26
			0.95	0.00**	0.82
		FMI_{rel}	0.89	0.61	0.57
			0.45	0.00**	0.30
			0.85	0.00**	0.16
				0.00**	0.33
				0.01**	0.86
			FMI_{gen}	0.70	0.66
				0.00**	0.80
				0.00**	0.23
Legend	MAE				0.00**
	RMSE				0.00**
	R^2			m_D	0.95
	AIC				0.00**
	D_r				0.00**

Table S1. p-values arising from the permutation test to determine the statistical significance of mean differences of the respective error statistics (MAE, RMSE, R^2, AIC, and D_r) between different models using dataset D_1. The p-values for each model pairing are listed for each error statistic according to the legend in the bottom left corner of the table. A single asterisk * indicates a significant difference at the 0.1 level, while a double asterisk ** indicates a significant difference at the 0.05 level.

		FMI_{rel}	FMI_{gen}	m_D	m_{gen}
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
FMI		0.99	0.89	0.02**	0.11
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
			0.64	0.00**	0.06*
			0.93	0.00**	0.22
		FMI_{rel}	0.89	0.02**	0.11
			0.15	0.00**	0.01**
			0.60	0.00**	0.03**
				0.00**	0.14
				0.01**	0.25
			FMI_{gen}	0.03**	0.14
				0.00**	0.25
				0.00**	0.10
Legend	MAE				0.00**
	RMSE				0.00**
	R^2			m_D	0.54
	AIC				0.06*
	D_r				0.00**

Table S2. Same as Table S1, but for dataset D_2 ($FMC < 20\%$).

		FMI_{rel}	FMI_{gen}	m_D	m_{gen}
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
FMI		0.99	0.70	0.62	0.71
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
			0.82	0.68	0.96
			0.75	0.78	0.77
		FMI_{rel}	0.70	0.62	0.71
			0.07*	0.07*	0.08*
			0.82	0.72	0.95
				0.84	0.78
				0.56	0.98
			FMI_{gen}	0.90	0.98
				0.00**	0.99
				0.88	0.78
Legend	MAE				0.65
	RMSE				0.58
	R^2			m_D	0.88
	AIC				0.00**
	D_r				0.70

Table S3. Same as Table S1, but for dataset D_3 ($10\% \leq FMC < 20\%$).

		FMI_{rel}	FMI_{gen}	m_D	m_{gen}
FMI		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
		0.99	0.35	0.20	0.55
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
	FMI_{rel}		0.93	0.06*	0.79
			0.89	0.00**	0.89
			0.35	0.20	0.55
			0.03**	0.17	0.03**
			0.88	0.00**	0.61
	FMI_{gen}			0.05*	0.73
				0.00**	0.89
				0.03**	0.11
				0.56	0.93
				0.00**	0.51
Legend	MAE				0.10
	RMSE			m_D	0.00**
	R^2				0.39
	AIC				0.61
	D_r				0.00**

Table S4. Same as Table S1, but for dataset D_4 ($FMC < 10\%$).

2. Analyses of the data of Resco de Dios et al. (2015)

Separate analyses were conducted based on the dataset of Resco de Dios et al. (2015) described in Table 1. To facilitate comparison with the analyses of the combined datasets, the following datasets were analysed:

1. The set of all fuel moisture sensor data and associated weather variables used by Resco de Dios et al. (2015), consisting of $N_5 = 311$ observations, and denoted D_5.
2. The subset of D_5 consisting of the $N_6 = 286$ elements with fuel moisture content values below 20%, and denoted D_6.
3. The subset of D_5 consisting of the $N_7 = 184$ elements with fuel moisture content values above or equal to 10% and below 20%, and denoted D_7
4. The subset of D_5 consisting of $N_8 = 102$ elements with fuel moisture content values below 10%, and denoted D_8.

The following Figures and Tables summarise the results of these analyses.

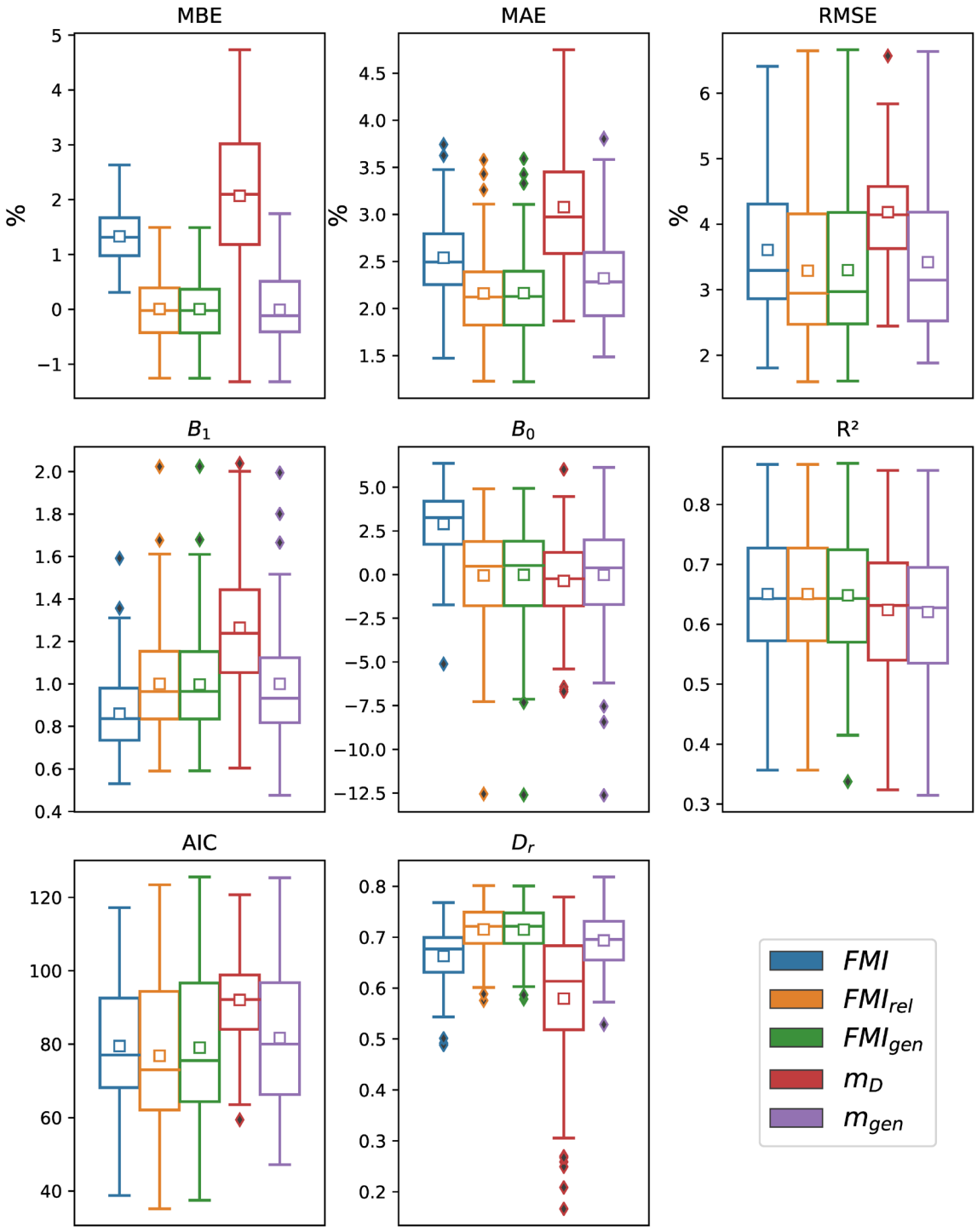

Figure S1. Box and whisker plot of the performance statistics of all five models (blue = FMI, orange = FMI_{rel}, green = FMI_{gen}, red = m_D, and violet = m_{gen}) obtained using 10-fold cross-validation with dataset D_5. The lower end and upper end of each box represents the 25th and 75th percentile values, respectively. The whiskers represent 1.5 times the respective interquartile (25th and 75th) range. The small boxes and lines represent the mean and median, respectively. Solid diamonds represent outliers.

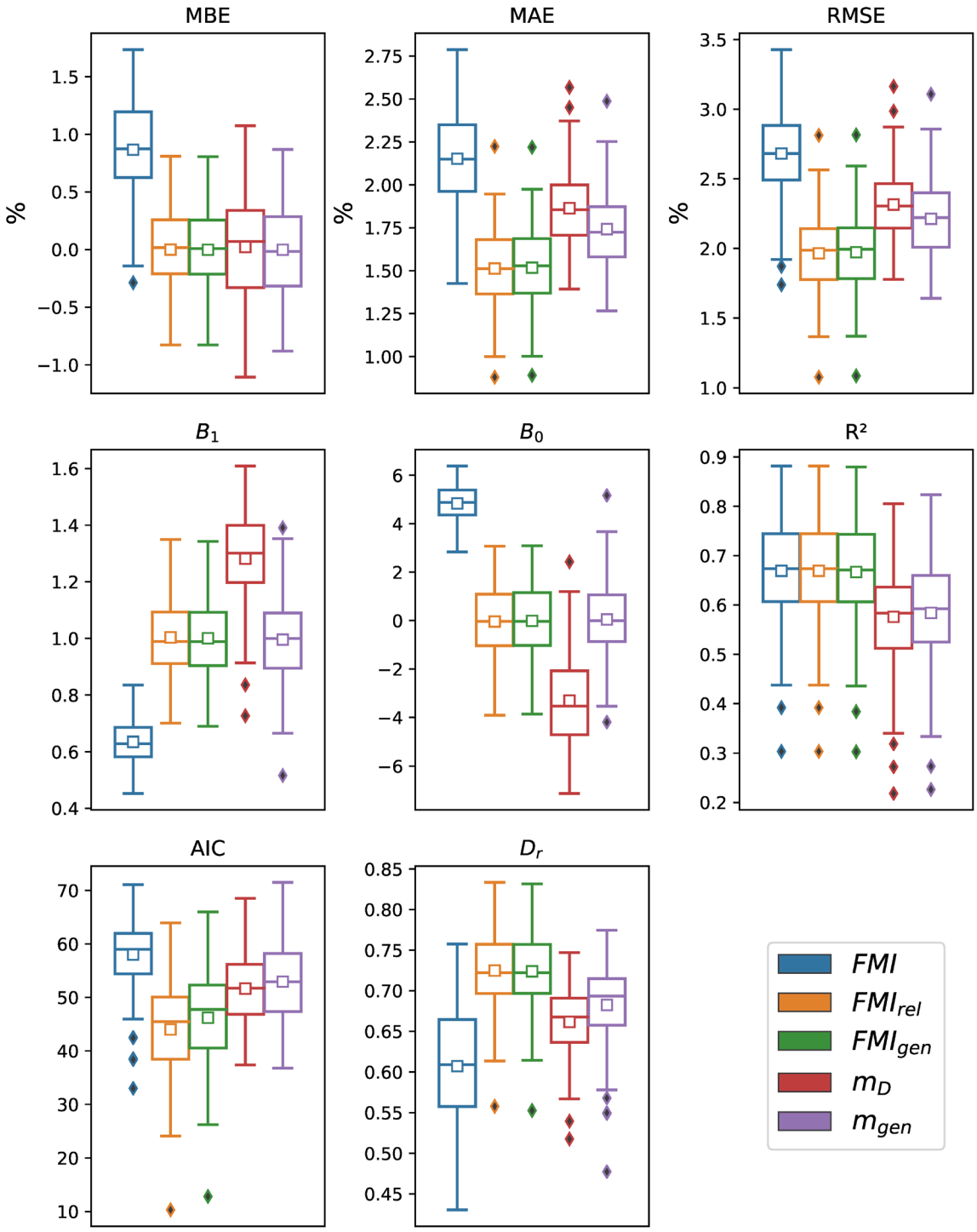

Figure S2. Same as Fig. S1, but for dataset D_6 ($FMC < 20\%$).

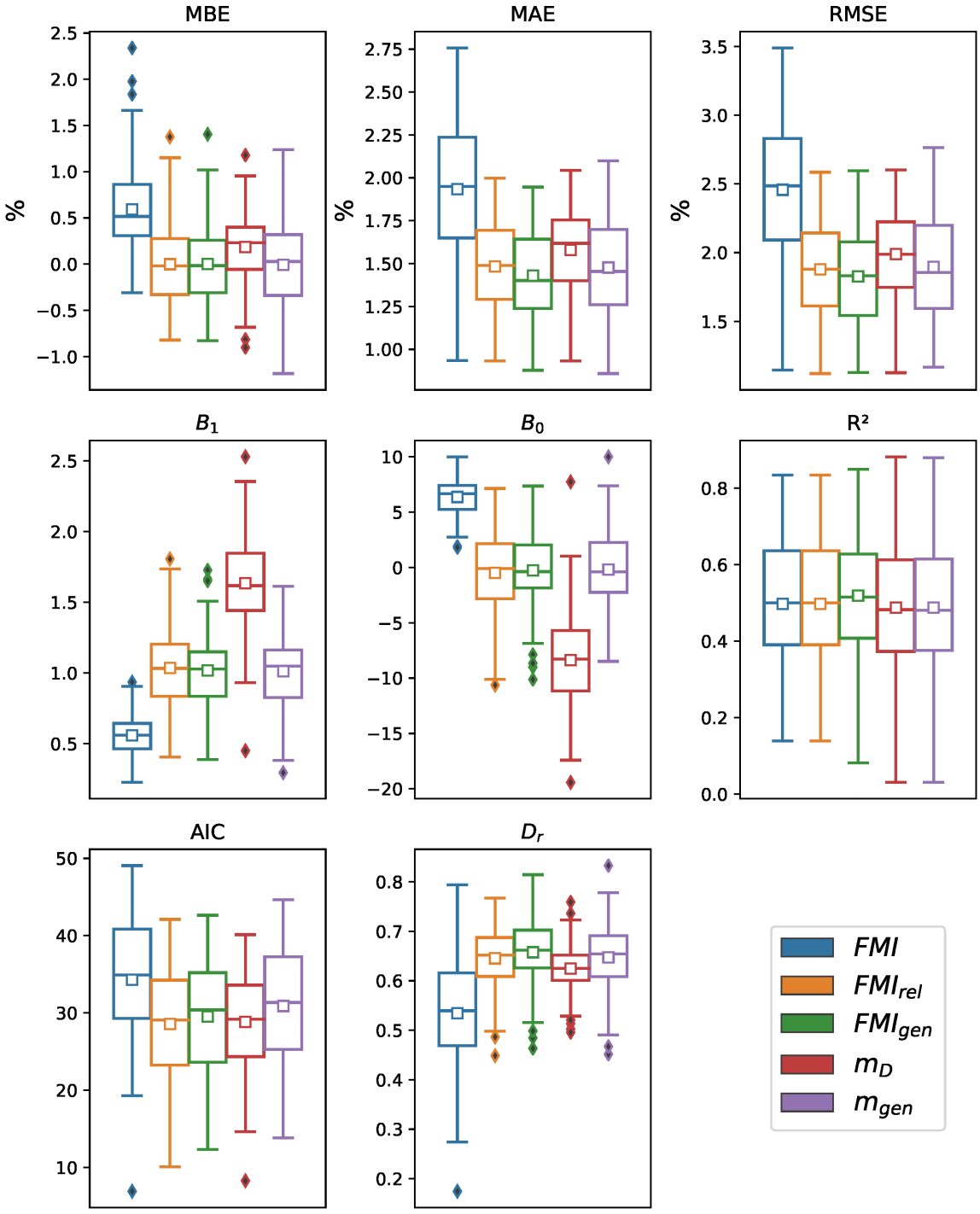

Figure S3. Same as Fig. S1, but for dataset D_7 ($10\% \leq FMC < 20\%$).

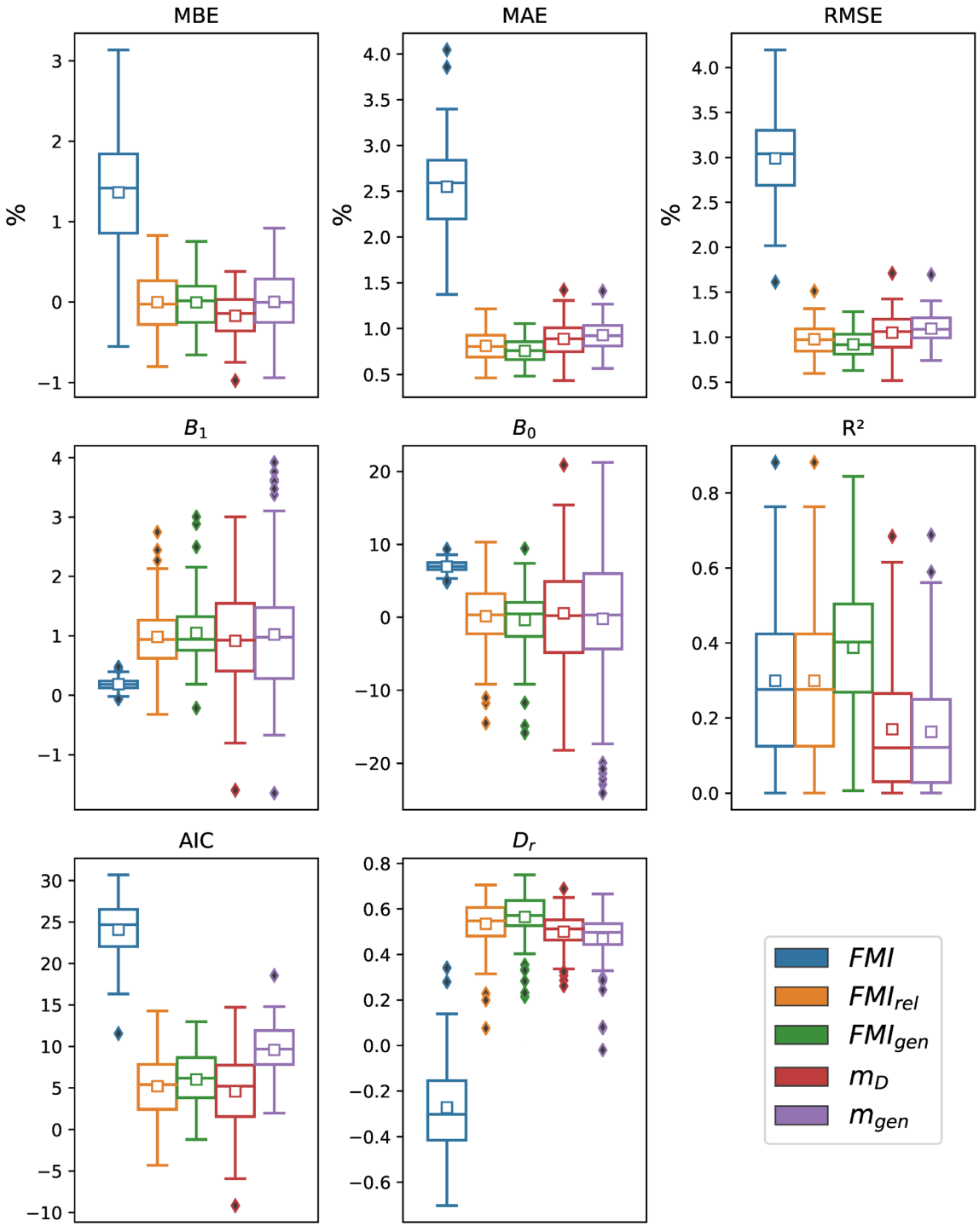

Figure S4. Same as Fig. S1, but for dataset D_8 ($FMC < 10\%$).

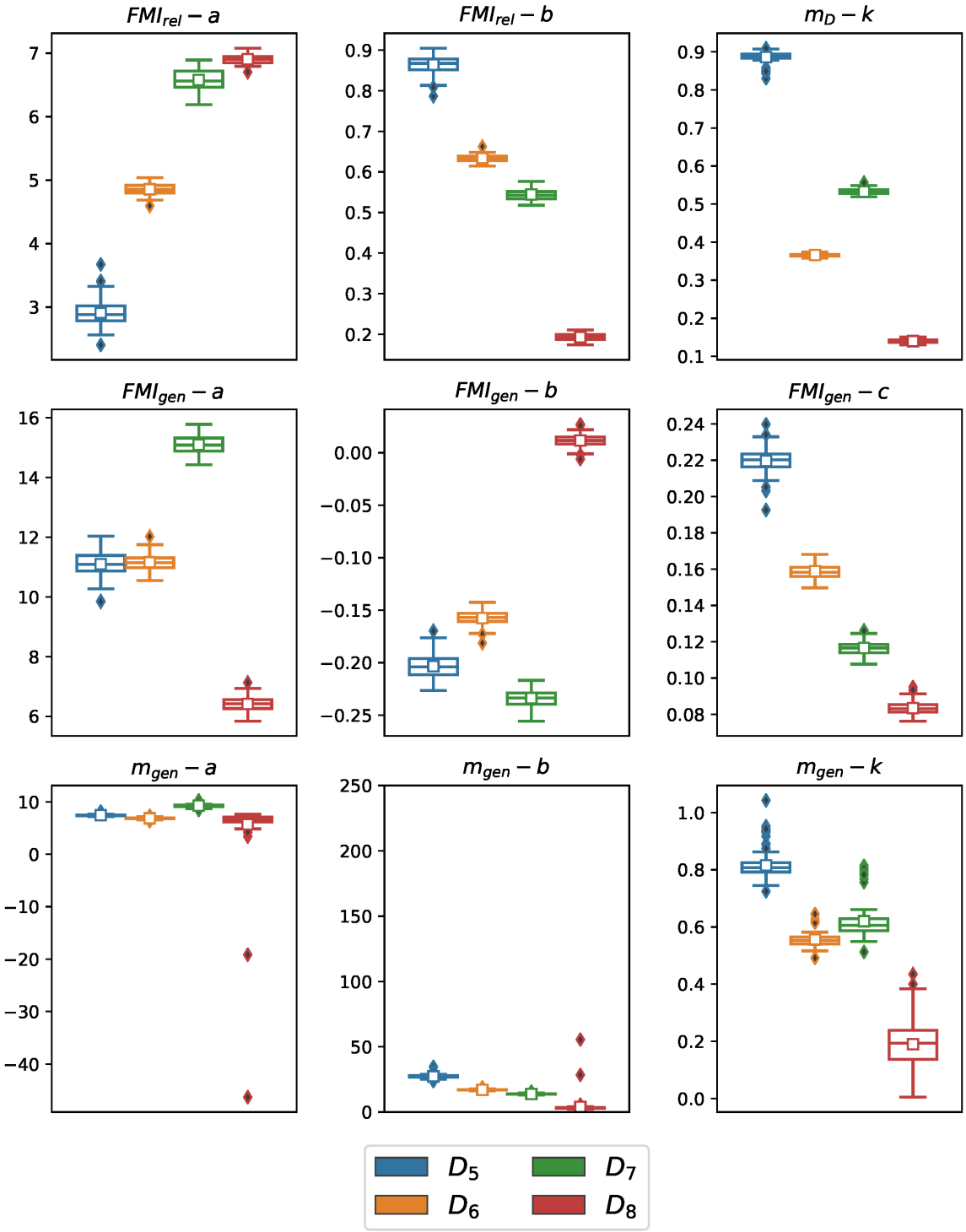

Figure S5. Box and whisker plots for the estimated parameters of the respective models obtained using 10-fold cross-validation with each of the datasets (blue = D_5 (all data), orange = D_6 ($FMC < 20\%$), green = D_7 ($10\% \leq FMC < 20\%$), red = D_8 ($FMC < 10\%$)). The lower end and upper end of each box represents the 25th and 75th percentile values, respectively. The whiskers represent 1.5 times the respective interquartile (25th and 75th) range. The small boxes and lines represent the mean and median, respectively. Solid diamonds represent outliers.

		FMI_{rel}	FMI_{gen}	m_D	m_{gen}
		0.00**	0.00**	0.00**	0.00**
		0.03**	0.03**	0.00**	0.21
FMI		0.99	0.88	0.08	0.05*
		0.31	0.85	0.00**	0.38
		0.00**	0.00**	0.00**	0.00**
			0.96	0.00**	0.02**
			0.95	0.00**	0.38
	FMI_{rel}		0.87	0.08*	0.05*
			0.43	0.00**	0.08
			0.96	0.00**	0.00**
				0.00**	0.02**
				0.00**	0.42
			FMI_{gen}	0.11	0.06*
				0.00**	0.33
				0.00**	0.00**
Legend	MAE				0.01**
	RMSE				0.00**
	R^2			m_D	0.82
	AIC				0.00**
	D_r				0.00**

Table S5. Same as Table S1, but for dataset D_5 (all data, Resco de Dios et al. (2015)).

		FMI_{rel}	FMI_{gen}	m_D	m_{gen}
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
FMI		0.99	0.87	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
			0.87	0.00**	0.00**
			0.85	0.00**	0.00**
		FMI_{rel}	0.87	0.00**	0.00**
			0.07*	0.00**	0.00**
			0.88	0.00**	0.00**
				0.00**	0.00**
				0.00**	0.00**
			FMI_{gen}	0.00**	0.00**
				0.00**	0.00**
				0.00**	0.00**
Legend	MAE				0.00**
	RMSE				0.00**
	R^2			m_D	0.61
	AIC				0.19
	D_r				0.00**

Table S6. Same as Table S1, but for dataset D_6 ($FMC < 20\%$, Resco de Dios et al. (2015)).

		FMI_{rel}	FMI_{gen}	m_D	m_{gen}
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
FMI		1.00	0.37	0.68	0.67
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
			0.14	0.00**	0.85
			0.29	0.02**	0.07*
		FMI_{rel}	0.37	0.68	0.66
			0.34	0.78	0.02**
			0.17	0.01**	0.83
				0.00**	0.22
				0.00**	0.16
			FMI_{gen}	0.19	0.18
				0.47	0.17
				0.00**	0.26
Legend	MAE				0.00**
	RMSE				0.05*
	R^2			m_D	0.98
	AIC				0.03**
	D_r				0.00**

Table S7. Same as Table S1, but for dataset D_7 ($10\% \leq FMC < 20\%$, Resco de Dios et al. (2015)).

		FMI_{rel}	FMI_{gen}	m_D	m_{gen}
		0.00**	0.00**	0.00**	0.00**
		0.00**	0.00**	0.00**	0.00**
FMI		0.99	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**
			0.00**	0.00**	0.00**
		FMI_{rel}	0.00**	0.00**	0.00**
			0.26	0.00**	0.00**
			0.00**	0.00**	0.00**
				0.00**	0.00**
				0.00**	0.00**
			FMI_{gen}	0.00**	0.00**
				0.00**	0.00**
				0.00**	0.00**
Legend	MAE				0.27
	RMSE				0.34
	R^2			m_D	0.34
	AIC				0.00**
	D_r				0.18

Table S8. Same as Table S1, but for dataset D_8 ($FMC < 10\%$, Resco de Dios et al. (2015)).

References

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