

# Supplementary Material

5 **Table S1:** Mass fractions of iron-containing minerals (Journet et al., 2008) and their apportionment to readily released, medium soluble, and slow soluble iron.

	<b>FE<sub>Total</sub></b>	<b>FE<sub>RR</sub></b>	<b>FE<sub>Med</sub></b>	<b>FE<sub>Slow</sub></b>
Hematite	57.50%			57.50%
Smectite	11.00%	0.55%	10.45%	
Illite	4.00%	0.11%	3.90%	
Feldspar	0.34%	0.01%		0.33%
Kaolinite	0.24%	0.01%		0.23%

10

15

20

**Table S2a:** Global annually-averaged atmospheric loading for REF and SS1-6.

Load	REF	SS1	SS2	SS3	SS4	SS5	SS6
Dust (Tg/yr)	16.1	16.1	16.1	16.1	16.1	16.1	16.1
Fe <sub>total</sub> (Tg/yr)	0.6	0.6	0.6	0.6	0.5	0.6	0.6
Fes <sub>med</sub> (Gg/yr)	15.1	6.7	14.5	1.7	11.1	15.8	15.2
Fes <sub>slow</sub> (Gg/yr)	0.2	0.1	0.2	n/a	0.2	0.3	0.3
Fet <sub>comb</sub> (Gg/yr)	14.5	14.5	14.5	14.5	14.5	14.5	14.5
Fes <sub>comb</sub> (Gg/yr)	1.2	0.8	1.0	1.0	1.2	1.4	1.3

**Table S2b:** Global annually-averaged wet deposition for REF and SS1-6

Wet Dep.	REF	SS1	SS2	SS3	SS4	SS5	SS6
Dust (Tg/yr)	637.9	637.9	637.9	638.6	637.9	637.9	637.9
Fe <sub>total</sub> (Tg/yr)	23.8	23.8	23.8	22.4	20.5	23.8	23.8
Fes <sub>med</sub> (Gg/yr)	912.4	269.6	887.3	181.1	693.9	954.8	929.9
Fes <sub>slow</sub> (Gg/yr)	13.4	2.8	12.8	n/a	12.8	19.2	18.6
Fet <sub>comb</sub> (Gg/yr)	1142.7	1142.7	1142.7	1142.7	1142.7	1142.7	1142.7
Fes <sub>comb</sub> (Gg/yr)	90.8	55.6	84.4	97.7	90.7	103.6	97.5

5 **Table S2c:** Global annually averaged dry deposition for REF, SS1-6.

Dry Dep.	REF	SS1	SS2	SS3	SS4	SS5	SS6
Dust (Tg/yr)	1143.4	1143.3	1143.3	1146.1	1143.4	1143.4	1143.4
Fe <sub>total</sub> (Tg/yr)	33.5	33.5	33.5	40.1	36.8	33.5	33.5
Fes <sub>med</sub> (Gg/yr)	351.9	284.3	358.9	25.2	402.5	359.8	366.8
Fes <sub>slow</sub> (Gg/yr)	2.2	0.8	2.3	n/a	2.2	3.8	3.8
Fet <sub>comb</sub> (Gg/yr)	756.1	756.1	756.1	756.1	756.1	756.1	756.1
Fes <sub>comb</sub> (Gg/yr)	37.6	32.6	36.6	36.8	37.6	40.9	39.9

**Table S2d:** Global annually-averaged emissions for REF, SS1-6.

Emission	REF	SS1	SS2	SS3	SS4	SS5	SS6
Dust (Tg/yr)	1767.8	1767.7	1767.6	1771.1	1767.7	1767.8	1767.8
Fe <sub>total</sub> (Tg/yr)	56.9	56.9	56.9	62.0	56.9	56.9	56.9
Fes <sub>med</sub> (Gg/yr)	506.9	506.9	506.9	0.0	506.9	506.9	506.9
Fet <sub>comb</sub> (Gg/yr)	1878.9	1878.9	1878.9	1878.9	1878.9	1878.9	1878.9
Fes <sub>comb</sub> (Gg/yr)	75.2	75.2	75.2	75.2	75.2	75.2	75.2

**Table S2e:** Total deposition (Gg/yr) for ocean regions defined as Western North Pacific (WNP) (40-60°N, 140-185°E) and Eastern North Pacific (ENP) (40-60°N, 185-230°E) for SS1 to compare to Table 6 from (Ito and Xu, 2014).

<b>Dep</b>	<b>WNP</b>	<b>ENP</b>
<b>Dust (Gg/yr)</b>	6162.0	2747.6
<b>Fe<sub>total</sub> (Gg/yr)</b>	237.9	108.8
<b>Fes<sub>med</sub> (Gg/yr)</b>	3.3	1.7
<b>Fes<sub>slow</sub> (Gg/yr)</b>	0.05	0.03
<b>Fet<sub>comb</sub> (Gg/yr)</b>	30.7	6.3
<b>Fes<sub>comb</sub> (Gg/yr)</b>	1.4	0.3

5

10

15

20

25

30

35

**Table S3a:** Global annually-averaged atmospheric loading for preindustrial (PI) cases 1-4.

<b>Load</b>	<b>PI1</b>	<b>PI2</b>	<b>PI3</b>	<b>PI4</b>
<b>Dust</b> (Tg/yr)	16.1	10.0	10.0	10.0
<b>Fe<sub>total</sub></b> (Tg/yr)	0.6	0.4	0.4	0.4
<b>Fes<sub>med</sub></b> (Gg/yr)	13.1	8.1	8.1	7.8
<b>Fes<sub>slow</sub></b> (Gg/yr)	0.12	0.08	0.08	0.07
<b>Fet<sub>comb</sub></b> (Gg/yr)	14.5	14.5	8.5	8.5
<b>Fes<sub>comb</sub></b> (Gg/yr)	1.0	1.0	0.6	0.6

**Table S3b:** Global annually-averaged wet deposition for PI1-4.

<b>Wet Dep.</b>	<b>PI1</b>	<b>PI2</b>	<b>PI3</b>	<b>PI4</b>
<b>Dust</b> (Tg/yr)	637.9	406.7	406.7	406.7
<b>Fe<sub>total</sub></b> (Tg/yr)	23.8	15.1	15.1	15.1
<b>Fes<sub>med</sub></b> (Gg/yr)	772.1	486.5	486.5	474.0
<b>Fes<sub>slow</sub></b> (Gg/yr)	9.8	6.3	6.3	6.1
<b>Fet<sub>comb</sub></b> (Gg/yr)	1142.7	1142.6	601.8	601.8
<b>Fes<sub>comb</sub></b> (Gg/yr)	79.1	79.5	43.1	41.5

5 **Table S3c:** Global annually-averaged dry deposition for PI1-4.

<b>Dry Dep.</b>	<b>PI1</b>	<b>PI2</b>	<b>PI3</b>	<b>PI4</b>
<b>Dust</b> (Tg/yr)	1143.4	705.3	705.2	705.2
<b>Fe<sub>total</sub></b> (Tg/yr)	33.5	20.7	20.7	20.7
<b>Fes<sub>med</sub></b> (Gg/yr)	337.9	210.7	210.7	211.5
<b>Fes<sub>slow</sub></b> (Gg/yr)	1.5	1.0	1.0	1.0
<b>Fet<sub>comb</sub></b> (Gg/yr)	756.1	756.2	410.1	410.1
<b>Fes<sub>comb</sub></b> (Gg/yr)	35.5	35.6	19.3	19.0

10

15

**Table S3d:** Global annually-averaged emissions for PI1-4.

<b>Emission</b>	<b>PI1</b>	<b>PI2</b>	<b>PI3</b>	<b>PI4</b>
<b>Dust</b> (Tg/yr)	1767.7	1103.6	1103.6	1103.5
<b>Fe<sub>total</sub></b> (Tg/yr)	56.9	35.5	35.5	35.5
<b>Fes<sub>med</sub></b> (Gg/yr)	506.9	316.8	316.8	316.8
<b>Fes<sub>slow</sub></b> (Gg/yr)	0.0	0.0	0.0	0.0
<b>Fet<sub>comb</sub></b> (Gg/yr)	1878.9	1878.9	1001.7	1001.7
<b>Fes<sub>comb</sub></b> (Gg/yr)	75.2	75.2	40.1	40.1

5

10

15

20

25

30

35

**Table S4:** Latitude and longitude of 12 ocean basins as defined by Gregg et al., 2003.

	<b>Latitude</b>	<b>Longitude</b>
<b>N.Atlantic</b>	lat>=30	lon<=75   lon>270
<b>N.Pacific</b>	lat>=30	lon>75 & lon<=270
<b>N.Cen.Atl.</b>	lat>=10 & lat<30	lon>270
<b>N.Cen.Pac.</b>	lat>=10 & lat<30	lon>120 & lon<=270
<b>N.Indian.Ocn</b>	lat>=10 & lat<30	lon>30 & lon<=120
<b>Equat.Atl.</b>	lat>=-10 & lat<10	lon<=30   lon>300
<b>Equat.Pac.</b>	lat>=-10 & lat<10	lon>120 & lon<300
<b>Equat.In.Ocn.</b>	lat>=-10 & lat<10	lon>30 & lon<120
<b>S.Atlantic</b>	lat>=-30 & lat<10	lon<=30   lon>300
<b>S.Pacific</b>	lat>=-30 & lat<-10	lon>120 & lon<=300
<b>S.Indian.Ocn</b>	lat>=-30 & lat<-10	lon>30 & lon<=120
<b>Antarctic</b>	lat<-30	lon>0 & lon<=360

5

10

15

20

25

30

**Table S5a:** Global ocean and regional ocean basin total fractional iron solubility (dust + combustion) for REF, SS1-6.

	<b>Ref</b>	<b>SS1</b>	<b>SS2</b>	<b>SS3</b>	<b>SS4</b>	<b>SS5</b>	<b>SS6</b>
<b>Global</b>	3.26	1.20	3.14	0.86	2.82	3.49	3.37
<b>N.Atlantic</b>	2.06	1.03	2.30	0.43	1.80	2.15	2.39
<b>N.Pacific</b>	4.92	1.83	5.39	2.48	4.46	5.49	5.95
<b>N.Cen.Atl.</b>	2.96	1.07	3.07	0.72	2.48	3.08	3.19
<b>N.Cen.Pac.</b>	6.49	2.35	6.93	2.61	5.70	7.83	8.26
<b>N.Indian.Ocn</b>	1.98	0.99	2.17	0.44	1.87	2.12	2.32
<b>Equat.Atl.</b>	7.06	1.36	5.05	1.66	6.53	7.35	5.34
<b>Equat.Pac.</b>	9.37	2.93	8.63	4.29	8.56	11.08	10.37
<b>Equat.In.Ocn.</b>	3.79	1.59	4.06	1.20	3.24	4.30	4.57
<b>S.Atlantic</b>	5.62	2.47	4.53	2.86	5.01	6.56	5.50
<b>S.Pacific</b>	5.40	3.11	5.10	4.07	5.44	6.67	6.39
<b>S.Indian.Ocn</b>	7.23	3.44	6.31	4.58	6.95	8.70	7.79
<b>Antarctic</b>	2.92	1.57	2.75	1.68	2.91	3.39	3.22

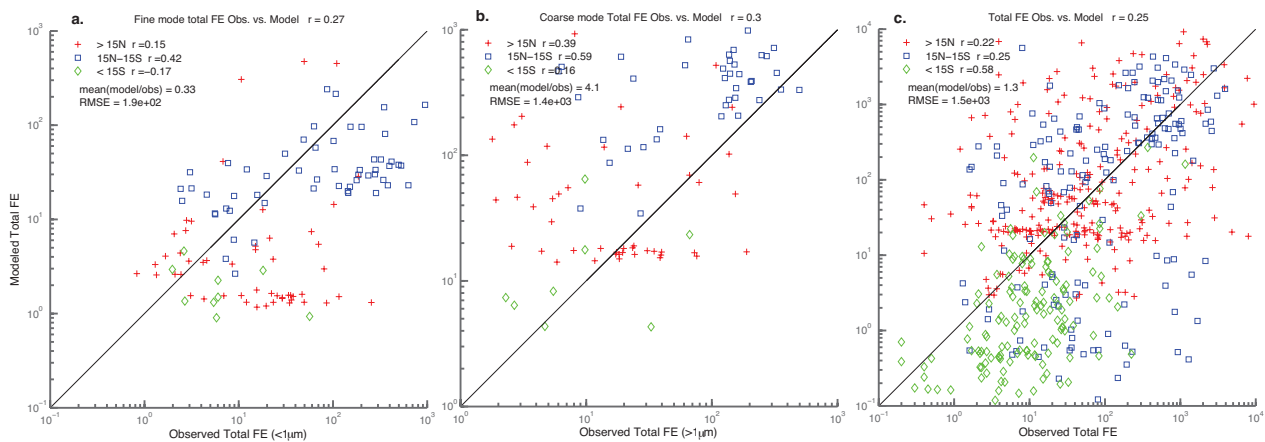
**Table S5b:** Global ocean and regional ocean basin total fractional iron solubility for preindustrial simulations.

	<b>PI1</b>	<b>PI2</b>	<b>PI3</b>	<b>PI4</b>
<b>Global</b>	2.80	2.87	2.77	2.72
<b>N.Atlantic</b>	1.93	1.97	1.92	2.01
<b>N.Pacific</b>	4.26	4.14	3.95	3.92
<b>N.Cen.Atl.</b>	2.75	2.81	2.80	2.86
<b>N.Cen.Pac.</b>	5.62	5.17	5.02	5.15
<b>N.Indian.Ocn</b>	1.78	1.81	1.76	1.77
<b>Equat.Atl.</b>	5.22	5.40	5.26	4.59
<b>Equat.Pac.</b>	8.05	8.25	7.95	7.85
<b>Equat.In.Ocn.</b>	3.30	3.37	3.10	3.10
<b>S.Atlantic</b>	4.50	4.26	3.98	3.79
<b>S.Pacific</b>	4.88	5.21	5.07	5.01
<b>S.Indian.Ocn</b>	6.05	6.07	6.13	5.88
<b>Antarctic</b>	2.66	3.02	3.02	3.00

5

10

**Figure S1:** Scatter plots of model total iron vs. observed total iron for fine mode, coarse mode and for fine + coarse mode.



5

10

15

20

25

30

35



**Figure S2:** Scatter plots of model labile iron vs. observed labile iron for fine mode, coarse mode and for fine + coarse mode.

