Table S1. Ensemble member perturbations

member	emission	IC and BC	us_{th}	bin_1	bin_2	bin_3	bin_4	bin_5	bin_6	bin_7	bin_8
1	MB95	ERA-interim	0.839108	1.106343	1.098947	1.097245	1.165611	1.116009	1.080891	1.126951	0.548321
2	G01	ERA-interim	1.064186	1.000612	0.998531	0.987129	0.948493	0.935082	0.776795	0.882573	1.006390
3	K14	ERA-interim	0.994903	1.082477	1.074797	1.093450	1.082074	1.101794	1.287324	1.407303	0.88648
4	MB95	ERA-interim	1.128865	1.475536	1.472015	1.487424	1.426227	1.365402	1.364965	0.662187	1.102514
5	G01	ERA-interim	0.939841	0.843028	0.850205	0.828624	0.866220	0.785977	0.912424	0.865147	1.394948
6	K14	ERA-interim	1.077895	1.42372	1.430319	1.437714	1.381353	1.493562	1.331407	0.802836	1.286722
7	MB95	MERRA2+ERA5	0.978513	1.309229	1.299753	1.325002	1.371184	1.390100	1.327775	1.357229	1.174099
8	G01	MERRA2+ERA5	0.904003	0.811747	0.828486	0.8390127	0.793838	0.629129	0.962559	1.397023	1.009974
9	K14	MERRA2+ERA5	1.119007	0.995270	1.002254	1.009480	1.048545	1.101997	0.923016	0.811385	0.945916
10	MB95	MERRA2+ERA5	0.907066	1.524607	1.524329	1.547502	1.510950	1.638613	1.219089	0.815051	0.930637
11	G01	MERRA2+ERA5	1.133456	0.823556	0.830391	0.882344	0.816682	0.739484	0.897321	1.133981	1.395042
12	K14	MERRA2+ERA5	0.838777	0.475334	0.479323	0.468367	0.387790	0.426551	0.764757	1.124143	1.018455

Table S2. Calibration factors for the total emitted dust vertical flux varying with the emission scheme used (MB95, G01 or K14) and the meteorological initial and boundary conditions (IC and BC) used (ERA-interim or MERRA2 with ERA5 soil information).

emission scheme	IC and BC	calibration factor
MB95	ERA-interim	2.65
G01	ERA-interim	0.61
K14	ERA-interim	0.004
MB95	MERRA2 / ERA5 soil	3.4
G01	MERRA2 / ERA5 soil	0.7
K14	MERRA2 / ERA5 soil	0.004

Table S3. Description of the selected AERONET stations in the Northwestern Africa sub-region. First and last measurement date is reported together with the station coordinates and the number of available 3-hourly observations during the study period (NDATA).

AERONET site	Longitude	Latitude	NDATA	Fist date	Last date
Northwestern Africa					
Agoufou	-1.48	15.35	1959	01/01/2007	28/04/2011
Bambey-ISRA	-16.48	14.71	470	07/12/2010	10/09/2011
Banizoumbou	2.66	13.54	6349	01/01/2007	30/12/2016
Bordj-Badji-Mokhtar	0.92	21.38	92	08/06/2011	28/06/2012
Calhau	-24.87	16.86	864	07/02/2012	02/12/2014
Capo-Verde	-22.94	16.73	4254	01/01/2007	30/12/2016
CATUC-Bamenda	10.16	5.95	40	10/12/2016	30/12/2016
Dakar	-16.96	14.39	6830	01/01/2007	30/12/2016
Djougou	1.60	9.76	189	05/01/2007	06/05/2007
DMN-Maine-Soroa	12.02	13.22	1596	01/01/2007	15/07/2010
IER-Cinzana	-5.93	13.28	6629	01/01/2007	30/12/2016
Ilorin	4.34	8.32	2297	01/01/2007	30/12/2016
KITcube-Save	2.43	8.00	22	08/06/2016	29/07/2016
Koforidua-ANUC	-0.30	6.11	369	15/12/2015	22/11/2016
La-Laguna	-16.32	28.48	2518	10/01/2007	29/12/2016
Las-Galletas	-16.65	28.02	16	12/06/2012	17/06/2012
Niamey	2.17	13.48	8	01/01/2007	07/01/2007
Ouagadougou	-1.40	12.20	23	01/01/2007	08/09/2007
Ouarzazate	-6.91	30.93	2580	11/02/2012	28/06/2015
Oukaimeden	-7.88	31.21	346	21/02/2009	14/09/2009
Praia	-23.48	14.95	71	23/01/2008	20/08/2015
Ras-El-Ain	-7.60	31.67	363	08/01/2007	31/07/2007
Saada	-8.16	31.63	4818	14/04/2007	06/12/2016
Santa-Cruz-Tenerife	-16.25	28.47	5606	01/01/2007	29/12/2016
Tamanrasset-INM	5.53	22.79	6902	01/01/2007	30/12/2016
Zinder-Airport	8.99	13.78	4004	19/05/2009	30/12/2016
Zinder-DMN	8.98	13.78	399	24/03/2008	06/10/2008

Table S4. Same as Table S3 but for the Middle East sub-region.

AERONET site	Longitude	Latitude	NDATA	Fist date	Last date
Middle East					
Abu-Al-Bukhoosh	53.15	25.50	1286	02/01/2007	16/09/2008
Cairo-EMA-2	31.29	30.08	3277	26/04/2010	29/12/2016
Dhabi	54.38	24.48	573	01/01/2007	03/08/2008
Dhadnah	56.32	25.51	1094	02/01/2007	06/06/2010
Eilat	34.92	29.50	3242	27/11/2007	28/12/2016
El-Farafra	27.99	27.06	2187	04/03/2014	28/12/2016
Hada-El-Sham	39.73	21.80	753	08/10/2012	11/06/2014
Hamim	54.30	22.97	405	02/01/2007	07/08/2007
IASBS	48.51	36.71	1827	10/12/2009	29/12/2016
KAUST-Campus	39.10	22.30	3595	24/02/2012	30/12/2016
KITcube-Masada	35.37	31.32	71	23/07/2014	03/12/2014
Kuwait-Airport	47.97	29.24	51	25/04/2009	21/05/2009
Kuwait-Inst-Sci-Res	47.91	29.34	4	18/08/2015	19/08/2015
Kuwait-University	47.97	29.33	1139	09/11/2007	12/06/2010
Masdar-Institute	54.62	24.44	2071	08/06/2012	28/12/2016
Mezaira	53.78	23.15	3887	11/08/2007	29/12/2016
Mussafa	54.47	24.37	838	20/01/2009	24/09/2010
Nes-Ziona	34.79	31.92	2650	01/01/2007	13/11/2015
SEDE-BOKER	34.78	30.86	6267	03/01/2007	30/12/2016
Shagaya-Park	47.06	29.21	624	23/08/2015	23/07/2016
Solar-Village	46.40	24.91	4581	01/01/2007	16/05/2013
Technion-Haifa-IL	35.02	32.78	204	27/07/2016	11/12/2016
Weizmann-Institute	34.81	31.91	489	22/11/2015	30/12/2016

Table S5. Same as Table S3 but for the Mediterranean sub-region. The list of stations for this sub-region is completed in Table S6.

AERONET site	Longitude	Latitude	NDATA	Fist date	Last date
Mediterranean					
AgiaMarina-Xyliatou	33.06	35.04	897	14/05/2015	20/12/2016
Alboran	-3.04	35.95	299	20/06/2011	23/01/2012
ATHENS-NOA	23.78	37.99	3518	12/05/2008	27/12/2016
Barcelona	2.12	41.39	4652	04/01/2007	30/12/2016
Bari-University	16.88	41.11	926	07/10/2010	21/05/2012
Ben-Salem	9.91	35.55	1246	20/03/2013	14/12/2016
Blida	2.88	36.51	1458	01/01/2007	07/03/2012
Burjassot	-0.42	39.51	4456	16/04/2007	30/12/2016
Cagliari	9.05	39.28	63	13/06/2013	03/07/2013
Cap-d-En-Font	4.21	39.83	63	12/06/2013	03/07/2013
Carloforte	8.31	39.14	524	05/07/2013	26/11/2014
CUT-TEPAK	33.04	34.67	2055	13/04/2010	28/12/2016
Epanomi	22.98	40.38	53	28/09/2007	25/10/2007
Ersa	9.36	43.00	4135	09/06/2008	30/12/2016
ETNA	15.02	37.61	1834	01/06/2007	26/10/2016
FORTH-CRETE	25.28	35.33	2821	01/01/2007	28/12/2016
Frioul	5.29	43.27	2649	07/07/2010	30/12/2016
Gozo	14.26	36.03	537	19/08/2014	30/12/2016
Granada	-3.61	37.16	4154	01/01/2007	30/12/2016
IMAA-Potenza	15.72	40.60	2834	27/01/2007	28/12/2016
IMS-METU-ERDEMLI	34.26	36.57	3506	01/01/2007	26/12/2016
Lamezia-Terme	16.23	38.88	464	25/05/2016	30/12/2016
Lampedusa	12.63	35.52	2199	16/03/2010	24/12/2016
LAQUILA-Coppito	13.35	42.37	813	02/04/2015	30/12/2016
Lecce-University	18.11	40.34	4154	10/05/2007	30/12/2016
Malaga	-4.48	36.72	3022	06/11/2008	03/07/2016
Marbella-San-Pedro	-4.99	36.49	53	17/06/2011	23/08/2011
Medenine-IRA	10.64	33.50	1550	29/07/2014	18/12/2016
Messina	15.57	38.20	2634	06/01/2007	27/12/2016
Montesoro-Bastia	9.44	42.67	411	26/07/2012	10/07/2013
Murcia	-1.17	38.00	2565	25/09/2012	30/12/2016
Napoli-CeSMA	14.31	40.84	162	09/05/2016	30/12/2016
Nicosia	33.38	35.14	98	04/03/2015	27/04/2016
Oujda	-1.90	34.65	1712	27/10/2010	03/05/2016

Table S6. Continuation of Table S5 for the description of the stations for the Mediterranean sub-region.

AERONET site	Longitude	Latitude	NDATA	Fist date	Last date
Mediterranean					
Palma-de-Mallorca	2.63	39.55	2634	04/08/2011	30/12/2016
Porquerolles	6.16	43.00	1211	08/12/2010	08/11/2014
Rome-ESA-ESRIN	12.67	41.83	322	09/01/2016	30/12/2016
Rome-Tor-Vergata	12.65	41.84	4304	26/03/2007	30/12/2016
Saint-Mandrier	5.94	43.07	12	21/05/2008	10/06/2008
San-Giuliano	9.52	42.29	86	24/06/2012	25/07/2012
Tabernas-PSA-DLR	-2.36	37.09	1585	20/02/2011	30/12/2016
Thessaloniki	22.96	40.63	4820	01/01/2007	28/12/2016
Tizi-Ouzou	4.06	36.70	1300	27/04/2012	30/12/2016
Toulon	6.01	43.14	3163	02/01/2007	30/12/2016
Tremiti	15.49	42.12	116	05/08/2007	17/03/2008
Tunis-Carthage	10.20	36.84	1971	11/06/2013	29/12/2016
Villefranche	7.33	43.68	3054	10/01/2007	15/10/2016
Xanthi	24.92	41.15	1166	28/01/2008	16/01/2015

Table S7. Same as Table S3 but for the Southern Europe sub-region (excluding the stations included in the Mediterranean sub-region). The list of stations for this sub-region is completed in Table S8.

AERONET site	Longitude	Latitude	NDATA	Fist date	Last date
Southern Europe					
Aras-de-los-Olmos	-1.10	39.95	313	15/10/2015	30/12/2016
Arcachon	-1.16	44.66	1694	23/12/2008	28/12/2016
Autilla	-4.60	42.00	2910	03/09/2007	12/11/2015
Avignon	4.88	43.93	3126	22/03/2007	29/10/2012
Badajoz	-7.01	38.88	991	22/12/2014	30/12/2016
Baneasa	26.08	44.51	217	31/07/2008	15/01/2009
Bucharest-Inoe	26.03	44.35	2576	09/07/2007	24/05/2016
Cabo-da-Roca	-9.50	38.78	1974	06/01/2007	28/12/2016
Cabo-Raso	-9.49	38.71	277	26/01/2008	01/04/2009
Caceres	-6.34	39.48	2617	18/01/2007	04/06/2012
Calern-OCA	6.93	43.75	1013	28/06/2011	22/07/2014
Carpentras	5.06	44.08	6228	02/01/2007	29/12/2016
CENER	-1.60	42.82	1616	05/06/2013	30/12/2016
Coruna	-8.42	43.36	1521	24/01/2012	30/12/2016
Eforie	28.63	44.08	1912	14/09/2009	26/12/2016
El-Arenosillo	-6.73	37.11	836	01/01/2007	30/12/2016
Evora	-7.91	38.57	4692	01/01/2007	30/12/2016
Galata-Platform	28.19	43.04	1480	12/04/2014	28/12/2016
Gloria	29.36	44.60	3025	22/11/2010	26/12/2016
Huelva	-6.57	37.02	2705	18/03/2010	09/05/2016
La-Crau	4.82	43.58	11	04/07/2013	19/08/2015
Le-Fauga	1.28	43.38	316	03/01/2007	24/09/2013
Madrid	-3.72	40.45	3138	29/03/2012	30/12/2016
Magurele-Inoe	26.03	44.35	875	22/05/2015	24/12/2016
Modena	10.95	44.63	3309	13/03/2007	22/06/2016
Montsec	0.73	42.05	2091	07/04/2011	30/12/2016

Table S8. Continuation of Table S7 for the description of the stations for the Southern Europe sub-region.

AERONET site	Longitude	Latitude	NDATA	Fist date	Last date
Southern Europe					
OHP-OBSERVATOIRE	5.71	43.94	4855	19/02/2007	30/12/2016
Palencia	-4.52	41.99	3690	01/01/2007	30/12/2016
SAGRES	-8.87	37.05	655	29/01/2010	13/11/2012
Salon-de-Provence	5.12	43.61	138	08/12/2009	14/06/2010
Sevastopol	33.52	44.62	2904	01/01/2007	17/01/2014
Seysses	1.26	43.50	1100	11/01/2010	04/01/2014
Toulouse	1.37	43.57	131	29/04/2012	06/09/2012
TOULOUSE	1.48	43.56	6	21/07/2009	26/07/2009
Toulouse-MF	1.37	43.57	995	15/12/2013	29/12/2016
TUBITAK-UZAY-Ankara	32.78	39.89	949	02/12/2009	13/04/2012
Tuz-Golu	33.34	38.75	10	25/08/2009	28/08/2009
Tuz-Golu-2	33.45	38.84	36	19/08/2011	21/09/2011
Valladolid	-4.71	41.66	2062	31/07/2012	30/12/2016
Valladolid-Sci	-4.71	41.66	135	25/06/2008	21/05/2012
Zaragoza	-0.88	41.63	1158	17/07/2014	23/12/2016

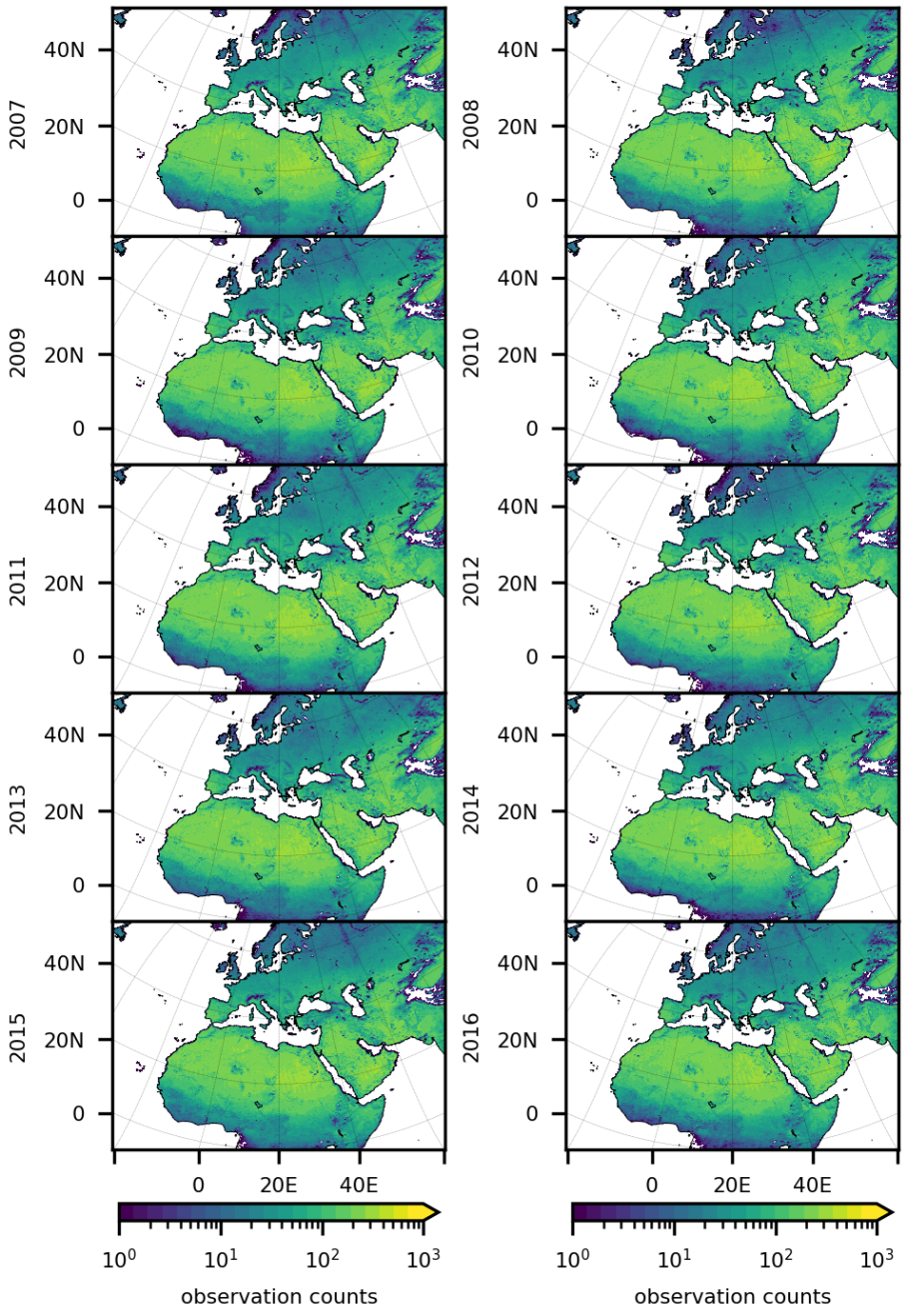

Figure S1. Same as top row of Fig. 2 but for individual years: odd years (left) and even years (right).

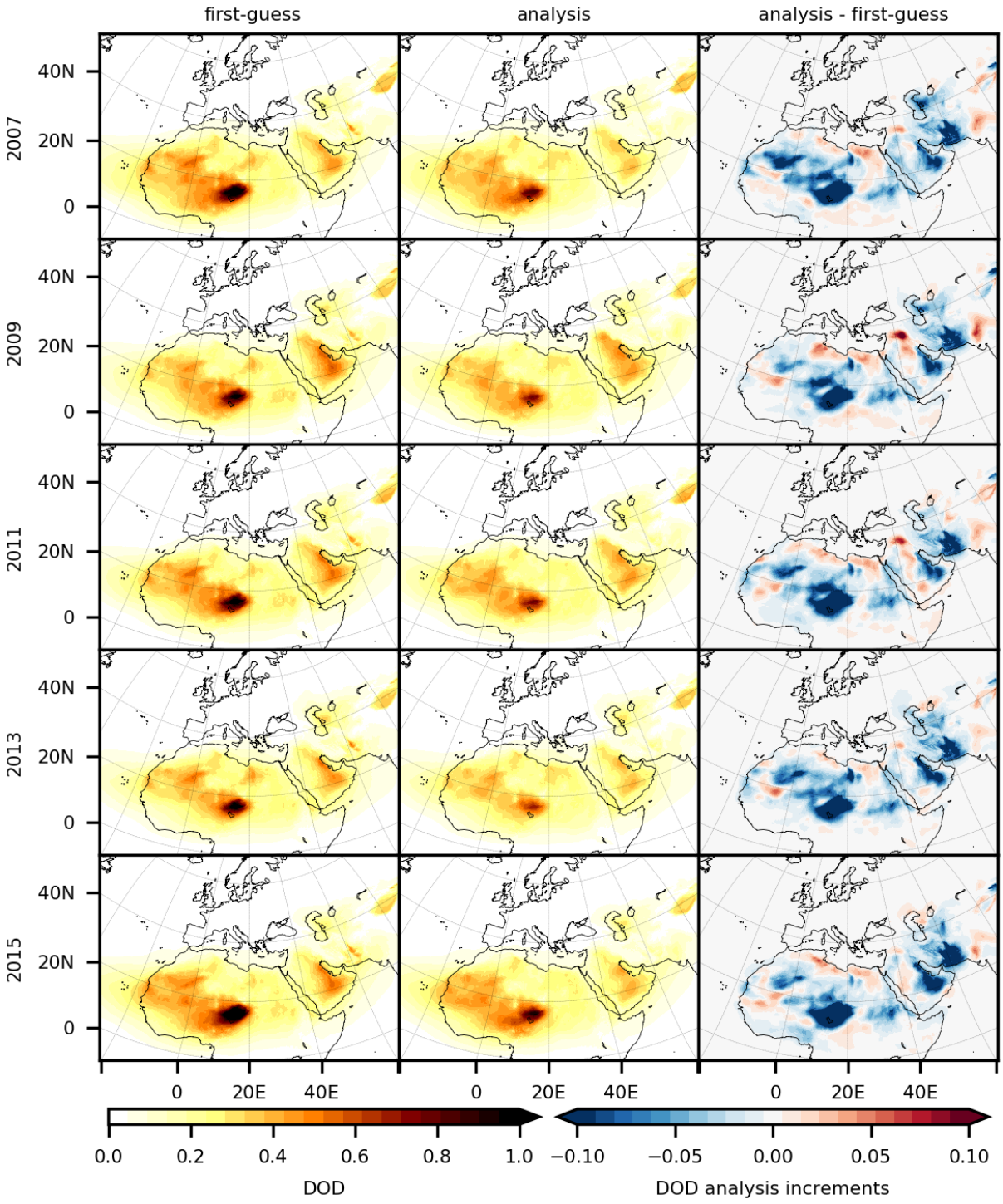

Figure S2. Same as top row of Fig. 6 but for individual (odd) years.

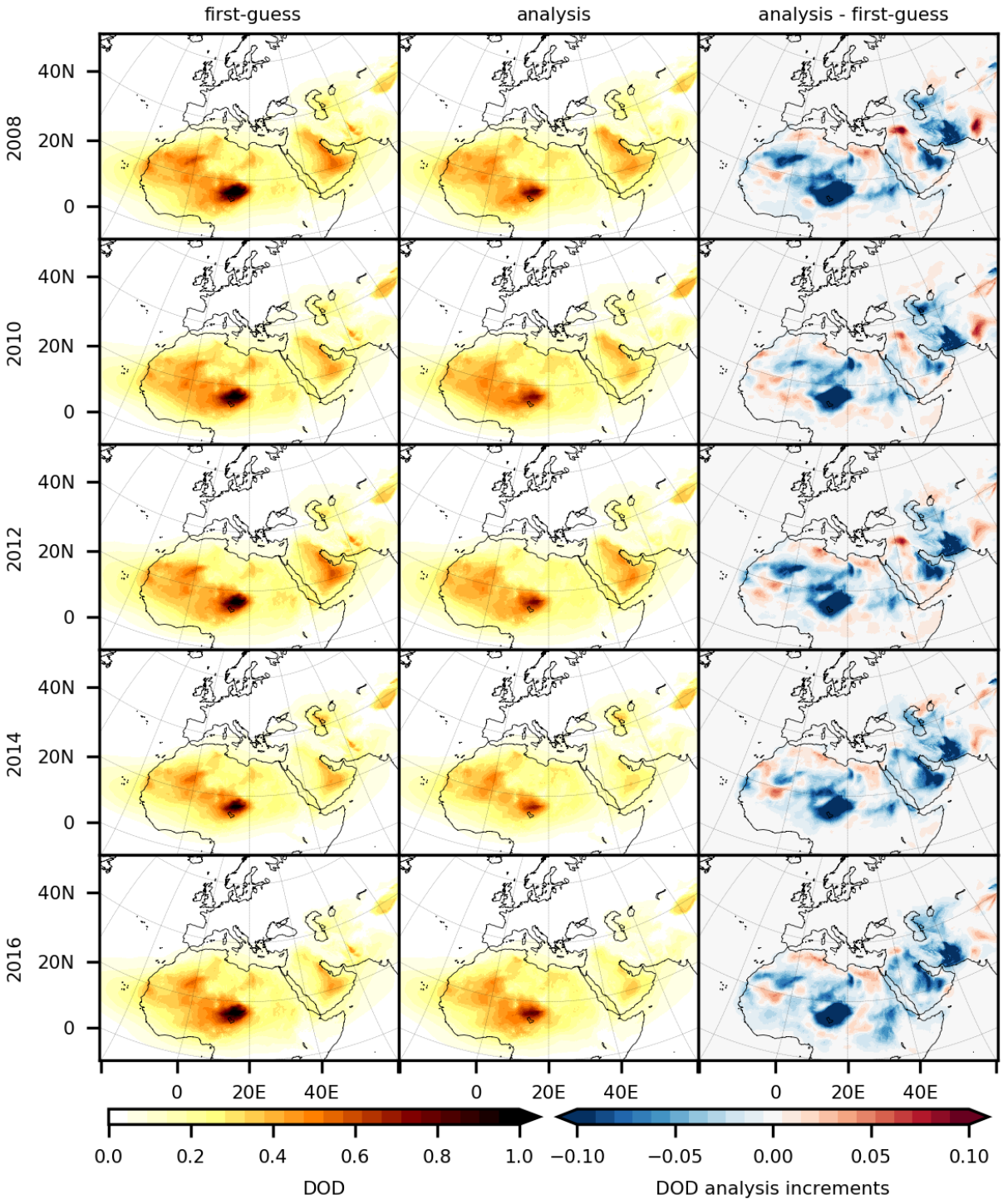

Figure S3. Same as Fig. 6 but for individual (even) years.

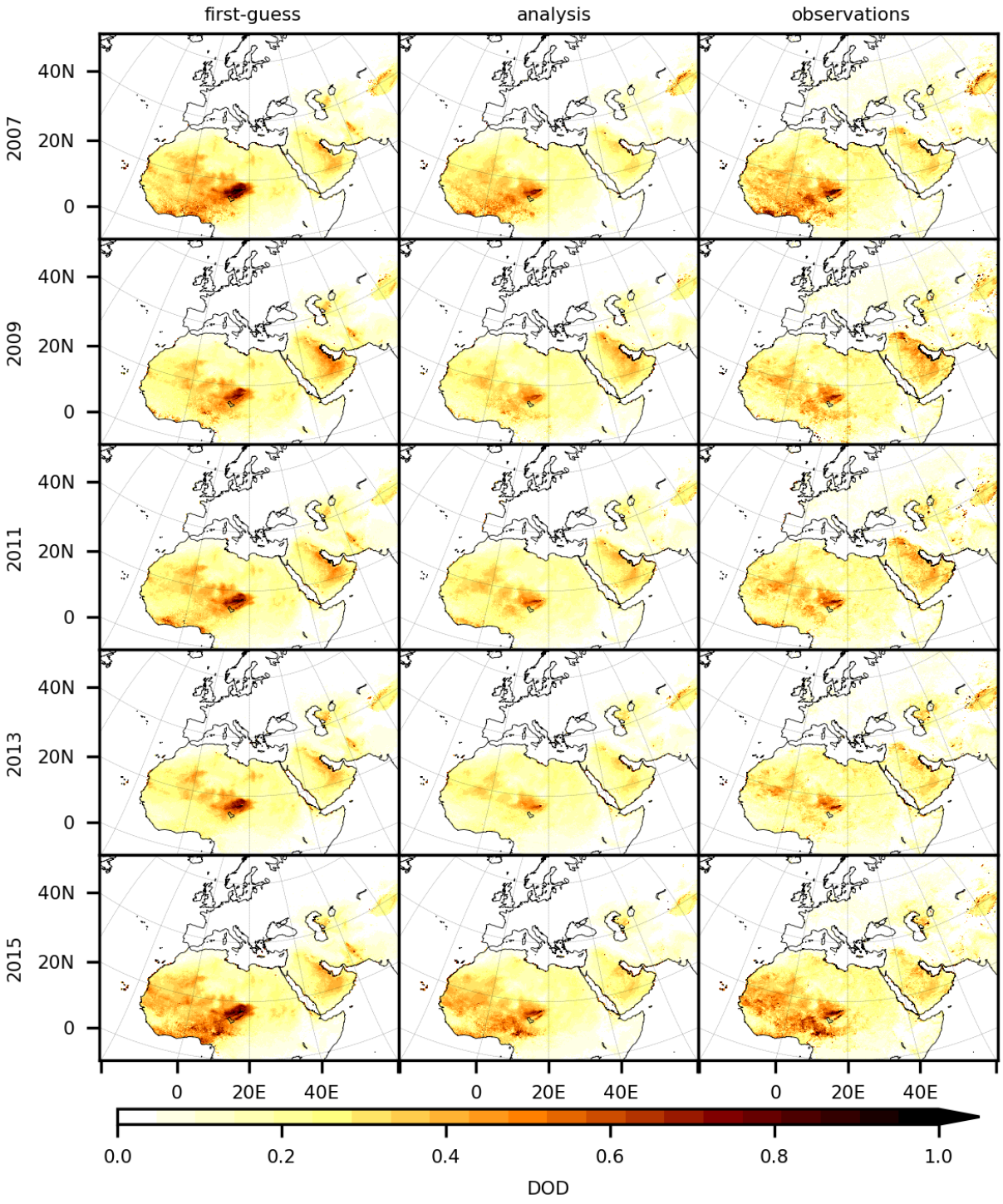

Figure S4. Same as top row of Fig. 7 but for individual (odd) years.

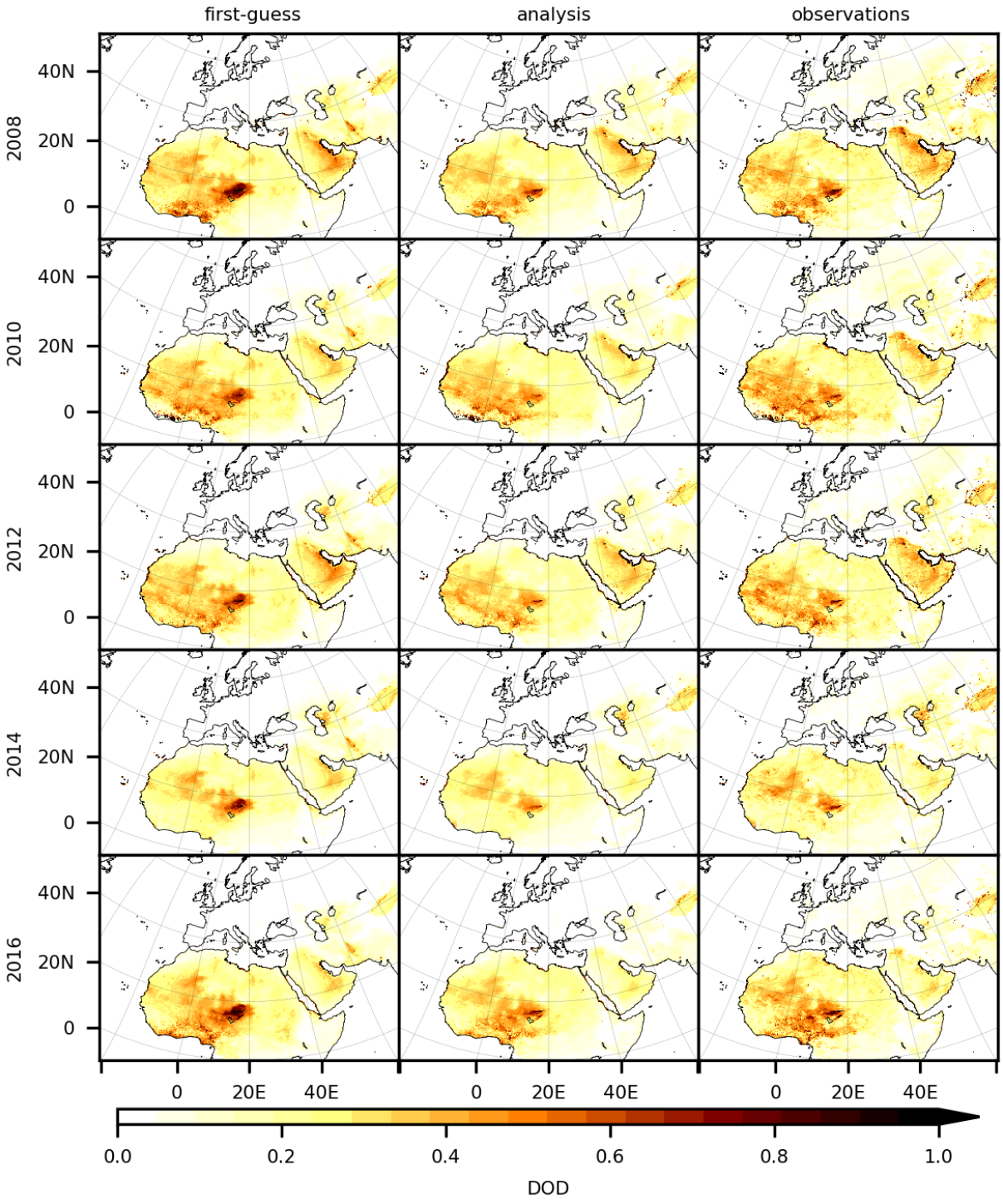

Figure S5. Same as Fig. 7 but for individual (even) years.

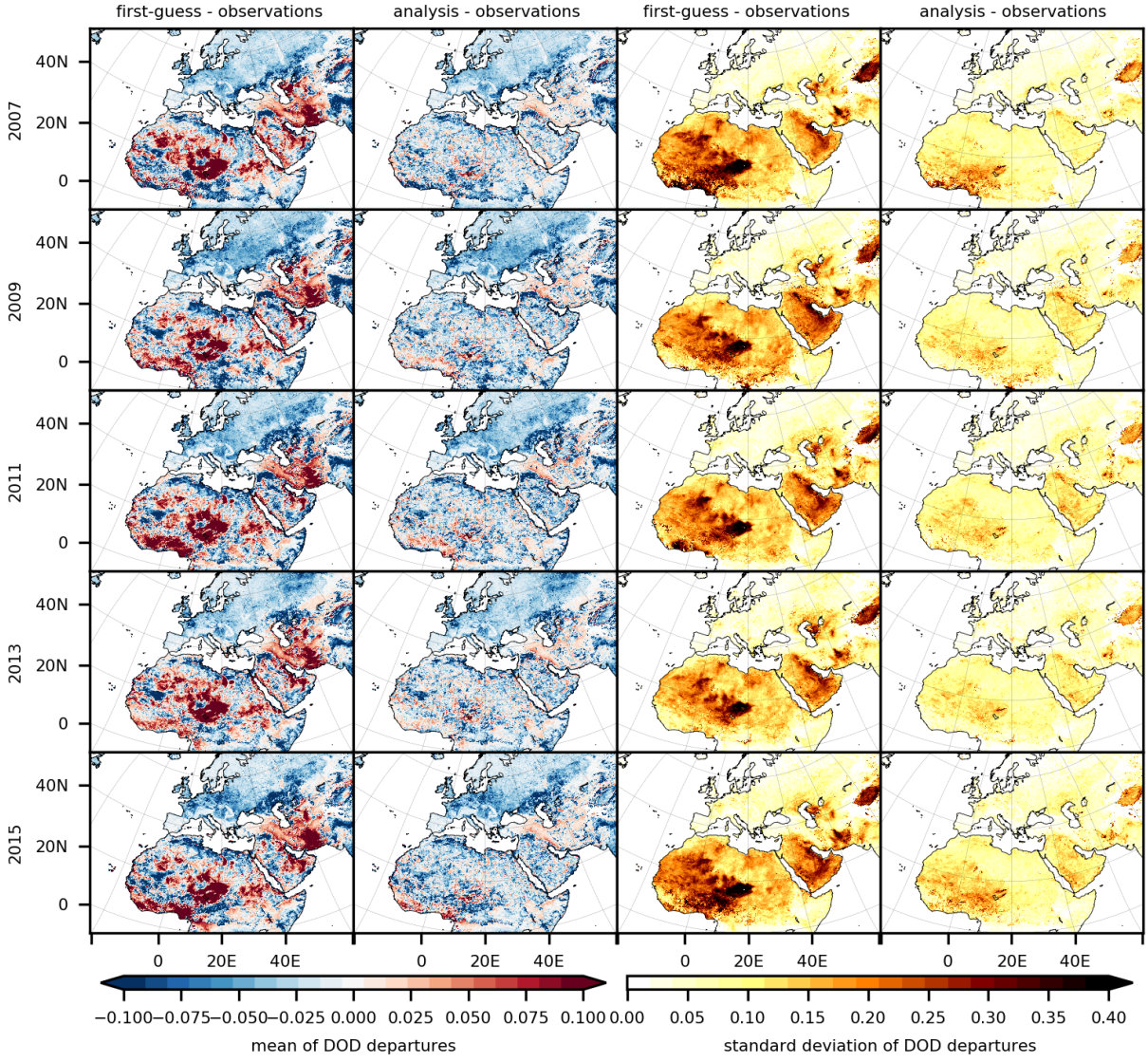

Figure S6. Same as top row of Fig. 8 but for individual (odd) years.

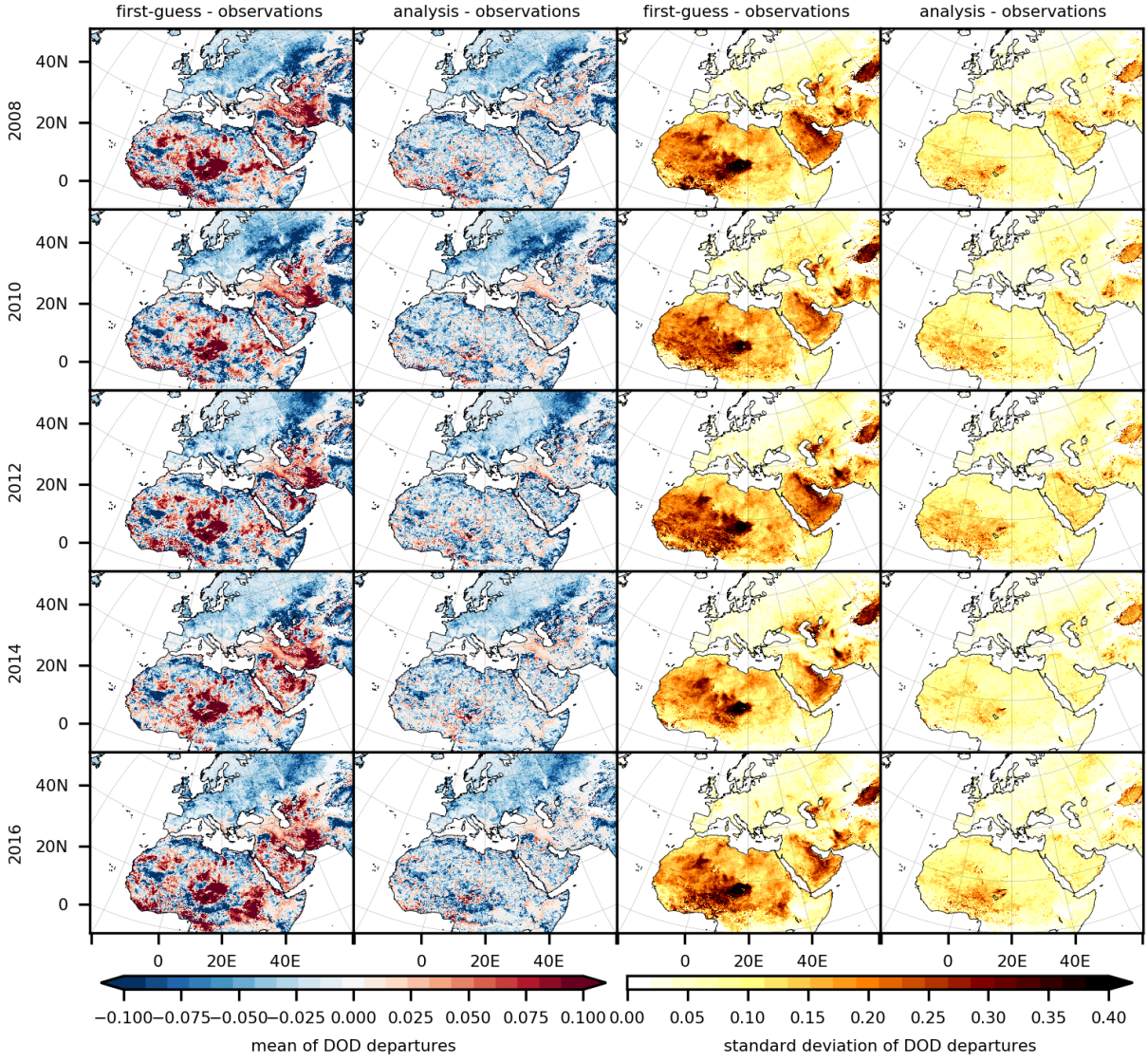

Figure S7. Same as Fig. 8 but for individual (even) years.