

1/25

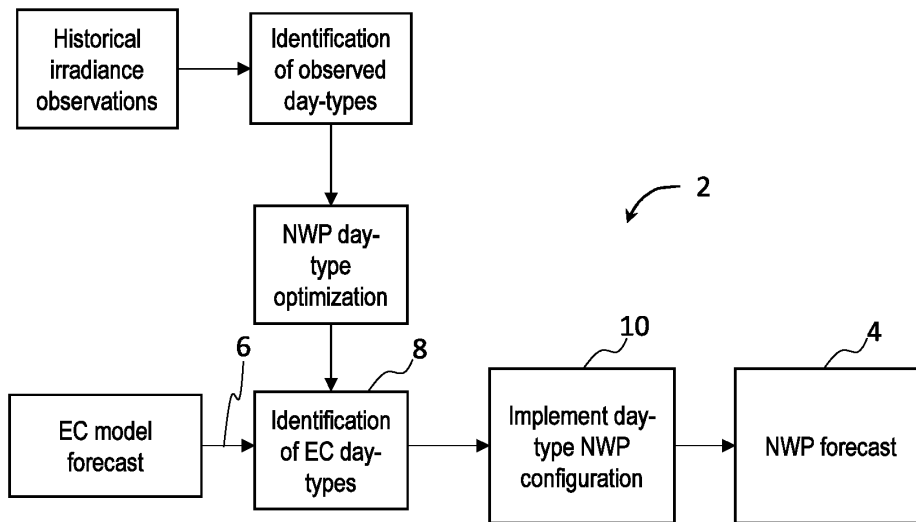


Fig. 1

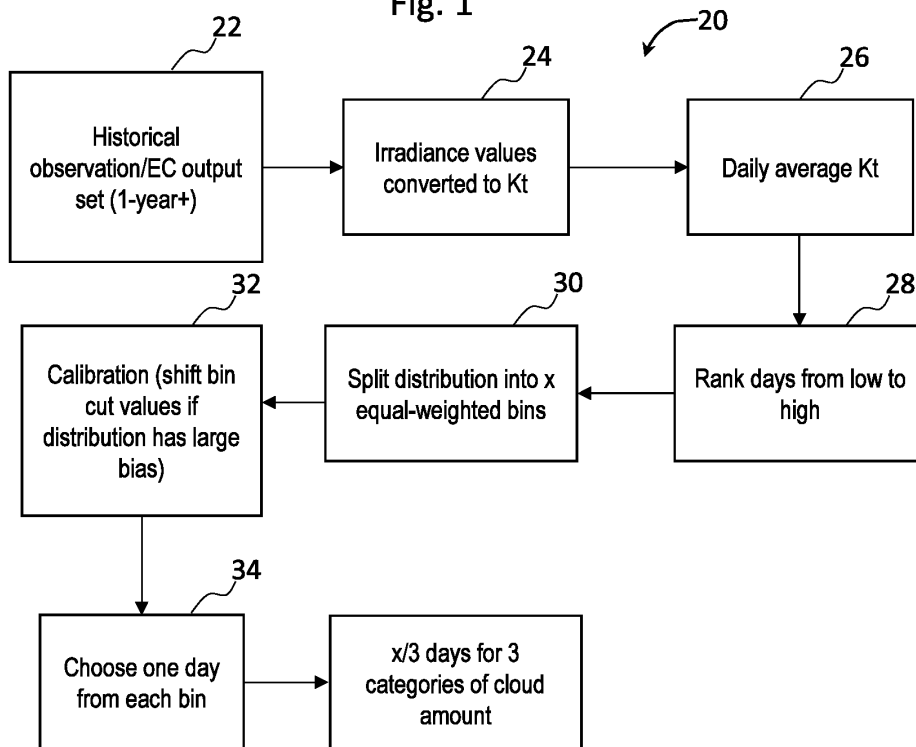


Fig. 2

Elm no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maximum k_c	0.32	0.44	0.53	0.59	0.66	0.69	0.73	0.76	0.82	0.85	0.88	0.93	0.96	0.99	1.09
Date chosen	2018-08-26	2018-03-05	2018-05-29	2018-08-11	2018-08-29	2018-11-03	2018-11-30	2018-04-30	2018-11-13	2018-10-17	2018-11-11	2018-08-23	2018-10-25	2018-11-12	2018-10-28
Date k_c	0.14	0.35	0.45	0.54	0.61	0.67	0.70	0.74	0.79	0.84	0.87	0.91	0.96	0.98	1.01

Fig. 3

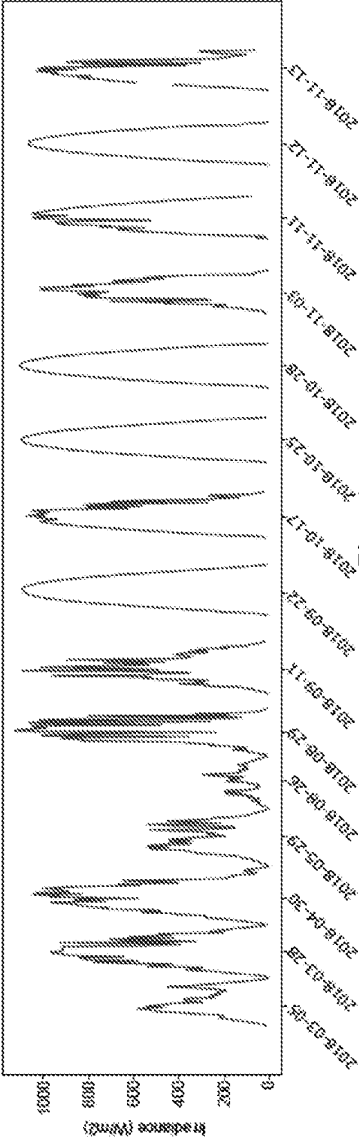


Fig. 4

3/25

Role of Scheme	WRF option	Scheme name
Surface Layer	1	Revised MM5 (Jiménez et al., 2012)
	2	Eta Similarity scheme (Janjic, 1994)
	3	NCEP Global Forecast System scheme
	4	Quasi-normal Scale Elimination (QNSE) scheme (Sukoriansky, Galperin and Perov, 2005)
	5	Mellor-Yamada Nakanishi and Niino (MYNN) surface layer scheme (Nakanishi and Niino, 2006)
	7	Pleim-Xiu scheme (Pleim, 2006)
	10	TEMF surface layer scheme (Angevine, Jiang and Mauritsen, 2010)
	91	MM5 similarity scheme (Beljaars, 1995)

Fig. 5

Role of Scheme	WRF option	Scheme name
Land-Surface Model	1	5-layer thermal diffusion (Dudhia, 1996)
	2	Noah Land Surface Model (Tewari et al., 2004)
	3	RUC Land Surface Model (Benjamin et al., 2004)
	4	Noah-MP (multi-physics) (Niu et al., 2011)
	7	Pleim-Xiu Land Surface Model (Xiu and Pleim, 2001)

Fig. 6

4/25

Role of Scheme	WRF option	Scheme name
Planetary Boundary Layer	1	Yonsei University scheme (Hong, Noh and Dudhia, 2006)
	2	Mellor-Yamada-Janjic scheme (Janjic, 1994)
	3	GFS scheme (Hong and Pan, 1996)
	4	Quasi-normal Scale Elimination (QNSE) Scheme (Sukoriansky, Galperin and Perov, 2005)
	5	MYNN 2.5 level TKE scheme (Nakanishi and Niino, 2006)
	6	Mellor-Yamada Nakanishi and Niino Level 3 (Nakanishi and Niino, 2006)
	7	ACM2 PBL scheme (Pleim, 2007)
	8	BouLac PBL scheme (Bougeault and Lacarrere, 1989)
	9	UW scheme (Park and Bretherton, 2009)
	10	Total Energy - Mass Flux (TEMF) scheme (Angevine, Jiang and Mauritsen, 2010)
	11	Shin-Hong scheme (Shin and Hong, 2015)
	12	Grenier-Bretherton-McCaa scheme (Grenier and Bretherton, 2001)
	99	MRF scheme (Hong and Pan, 1996)

Fig. 7

5/25

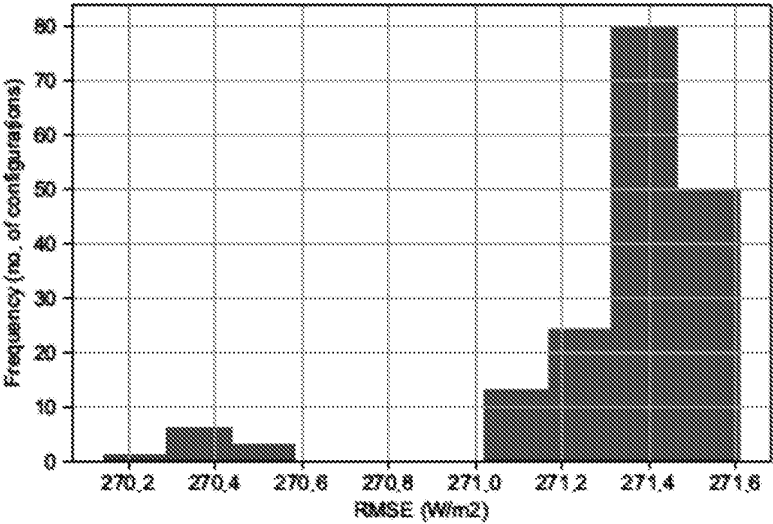


Fig. 8

Role of Scheme	WRF option	Scheme name
Microphysics	2	Purdue Lin scheme (Chen, Carlson and Del Genio, 2002)
	14	WRF Double-Moment 5-class scheme (Lim and Hong, 2010)
	16	WRF Double-Moment 6-class scheme (Lim and Hong, 2010)
	22	NSSL 2-moment scheme (Mansell, Ziegler and Bruning, 2010)
	28	Thompson aerosol-aware (Thompson and Eidhammer, 2014)

Fig. 9

6/25

Role of Scheme	WRF option	Scheme name
Cumulus parameterisation	0	No cumulus scheme
	0, shcu_physics=2	Park and Bretherton shallow cumulus (Park and Bretherton, 2009)
	0, shcu_physics=3	GRIMS shallow cumulus (Hong and Jang, 2018)
	1	Kain-Fritsch scheme (Kain and Kain, 2004)
	3	Grell-Freitas (GF) scheme (Grell and Freitas, 2013)
	5	Grell 3D (Grell and Dévényi, 2002)
	10	Kain-Fritsch-Cumulus Potential scheme (Berg et al., 2013)
	11	Multi-scale Kain-Fritsch scheme (Glotfelty et al., 2019)

Fig. 10

Role of Scheme	WRF option	Scheme name
Short-wave RTM	1	Dudhia scheme (Dudhia, 1989)
	3	CAM scheme (Collins et al., 2004)
	4	RRTMG shortwave (Iacono et al., 2008)
	7	Fu-Liou-Gu scheme (Gu et al., 2011)

Fig. 11

7/25

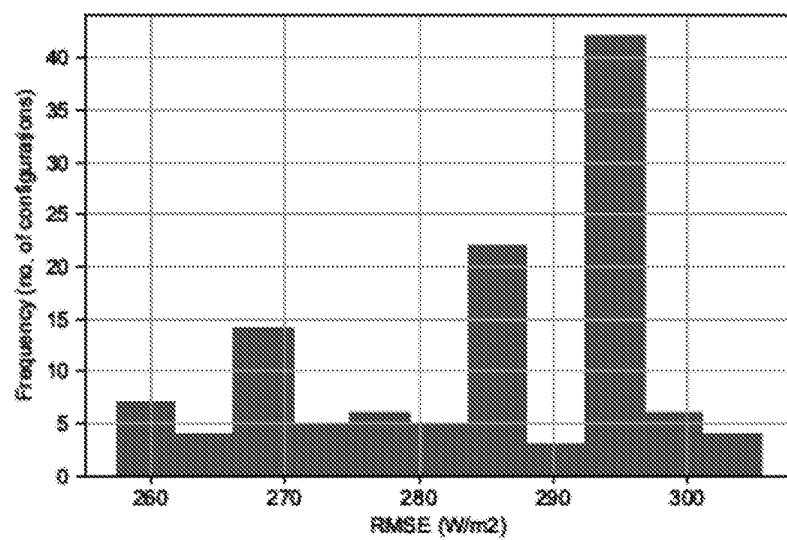


Fig. 12

8/25

Scheme	mp_ physics	cu_ physics	cutl	shcu_ physics	ra_lw_ physics	ra_sw_ physics	icloud	cu_rad_ feedback	shallow_ forced_ra	nbins	cu_ diag	ishallow
Overall Option	22	0	0	0	4	4	3	false	false	N/A	0	0
Sunny option	22	0	0	2	4	4	3	false	false	N/A	0	0
Partly cloudy option	14	10	5	0	4	1	3	true	true	21	0	0
Cloudy option	28	5	0	0	4	1	3	true	false	N/A	1	1

Fig. 13

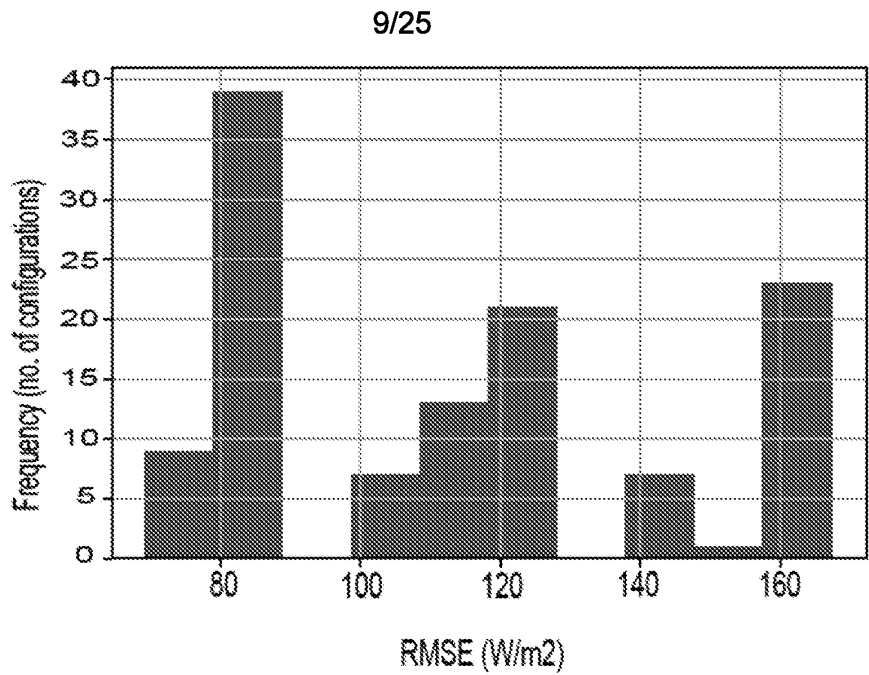


Fig. 14A

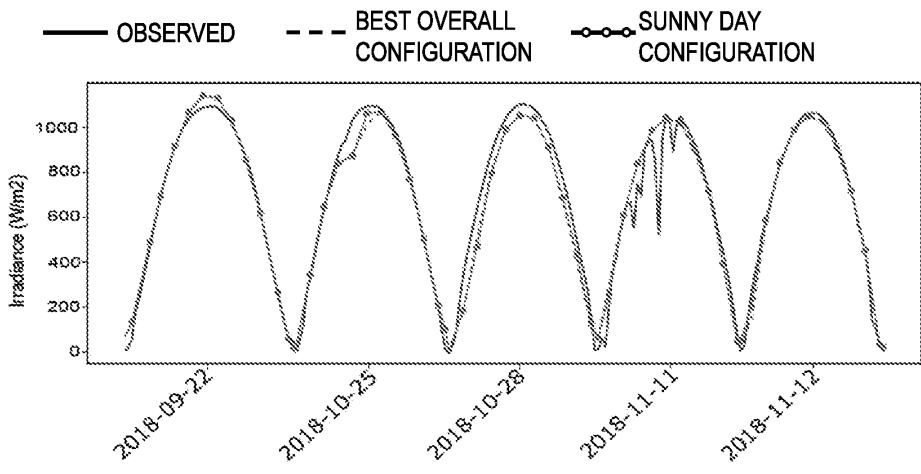


Fig. 14B

10/25

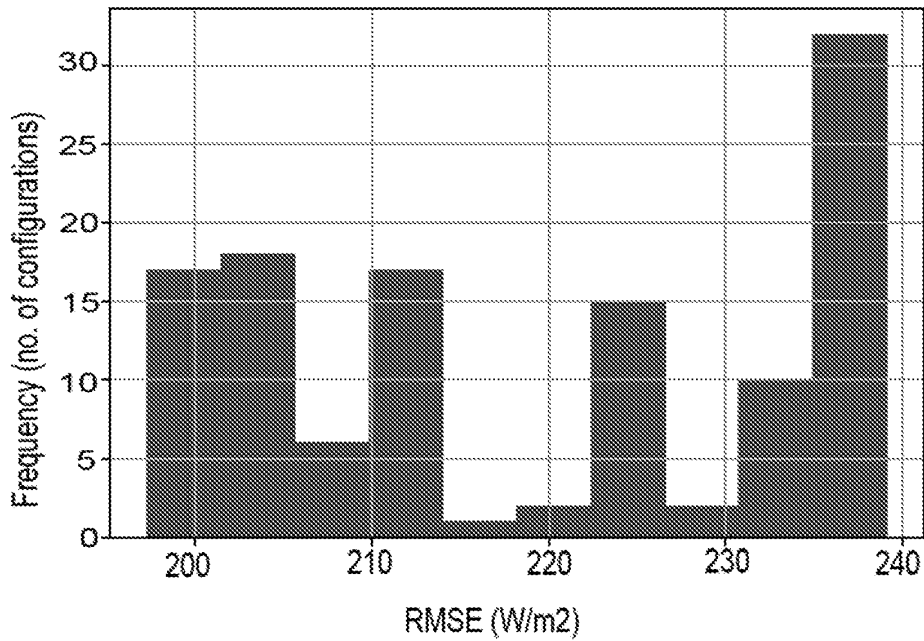


Fig. 15A

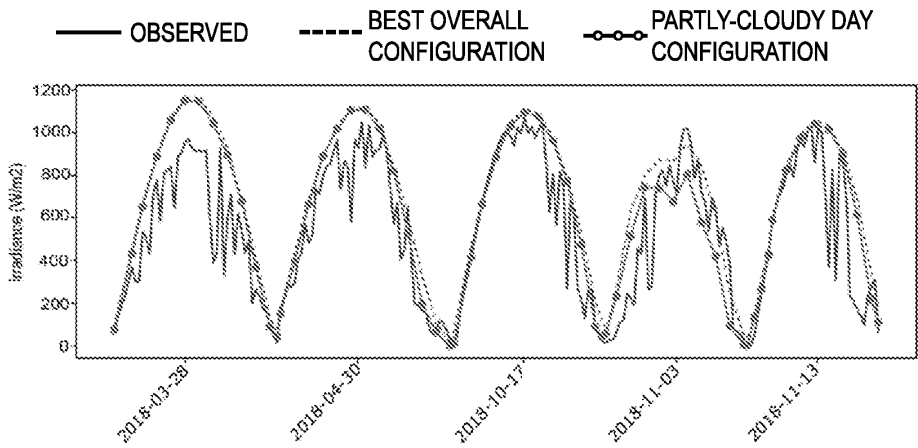


Fig. 15B

11/25

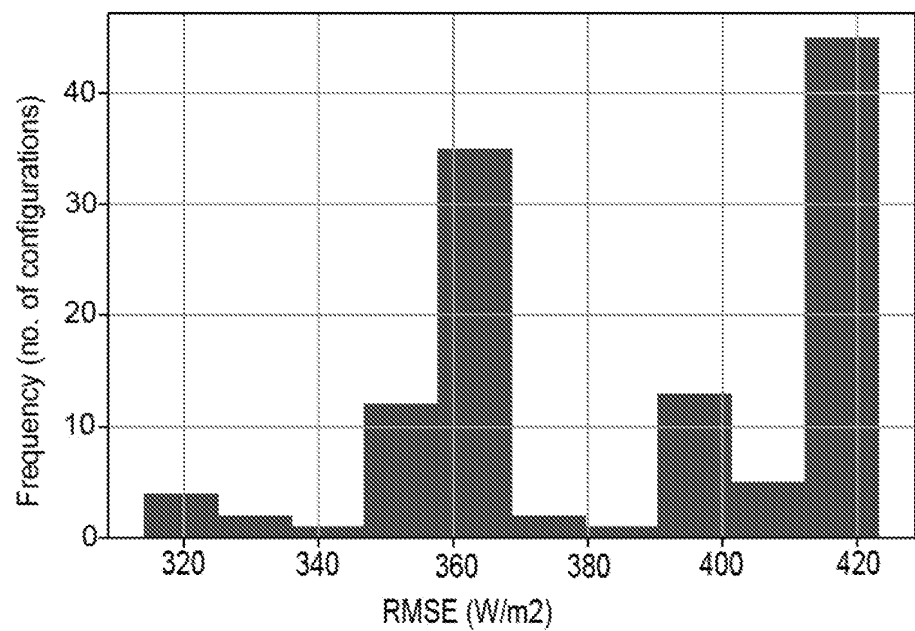


Fig. 16A

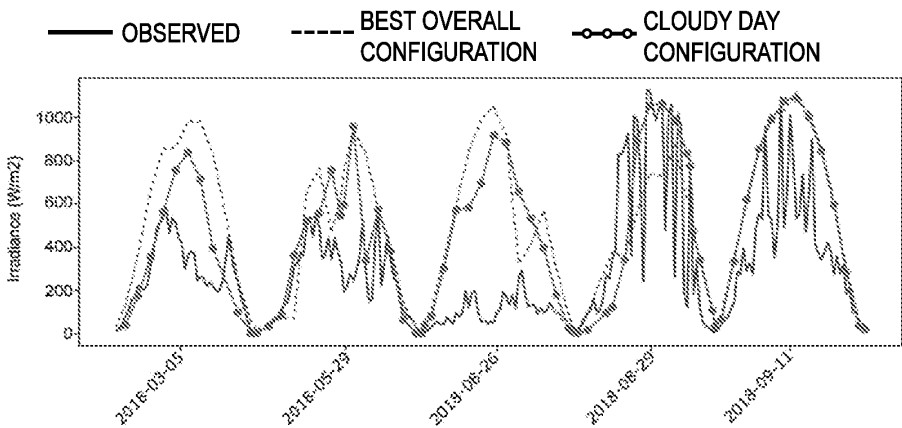


Fig. 16B

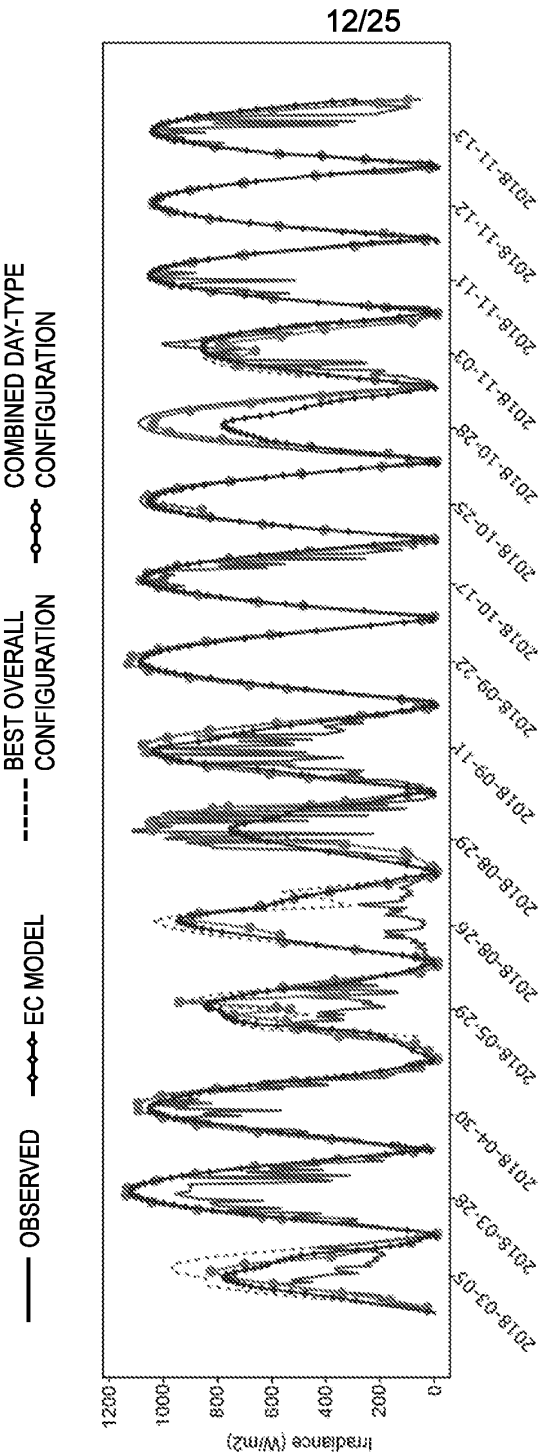


Fig. 17

Model	RMSE (W/m2)	Bias (W/m2)
Combined WRF	222.51	90.13
Overall WRF	257.46	124.19
EC model	231.77	81.75

Fig. 18

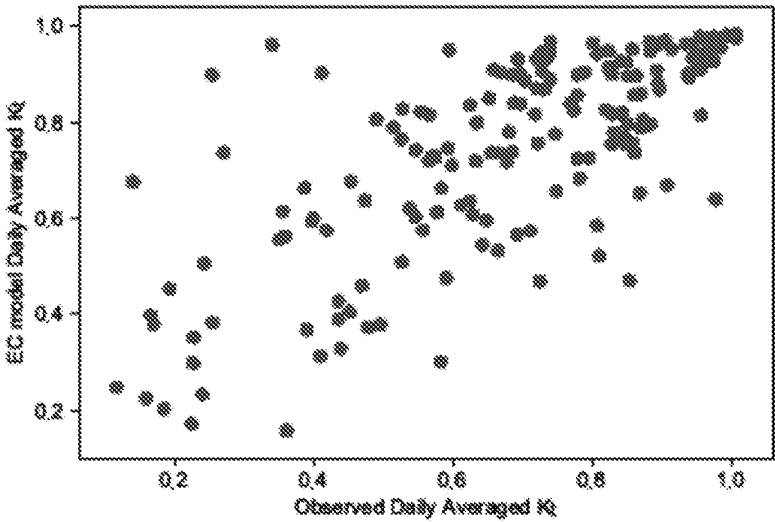


Fig. 19

14/25

Model	Overall RMSE (W/m2)	Overall Bias (W/m2)	Sunny RMSE (W/m2)	Sunny Bias (W/m2)	Partly cloudy RMSE (W/m2)	Partly cloudy Bias (W/m2)	Cloudy RMSE (W/m2)	Cloudy Bias (W/m2)
Combined WRF	232.36	-59.15	185.77	-66.80	261.68	-90.26	250.80	-6.69
Overall WRF	282.83	-111.53	228.34	-92.65	330.51	-156.88	284.04	-78.0
EC model	203.57	37.71	120.66	-12.93	213.41	20.77	277.67	132.68

Fig. 20

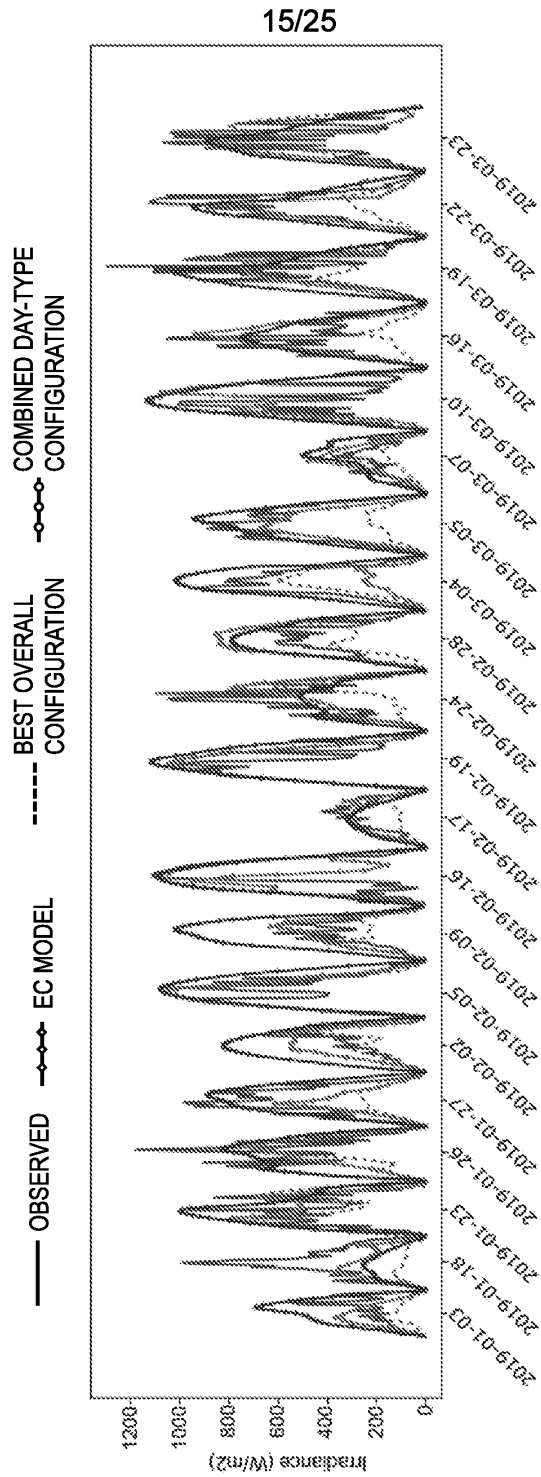


Fig. 21

16/25

Model	RMSE (W/m2)	Bias (W/m2)
Combined WRF	134.23	2.42
Overall WRF	144.94	21.15
EC model	130.69	2.33

Fig. 22

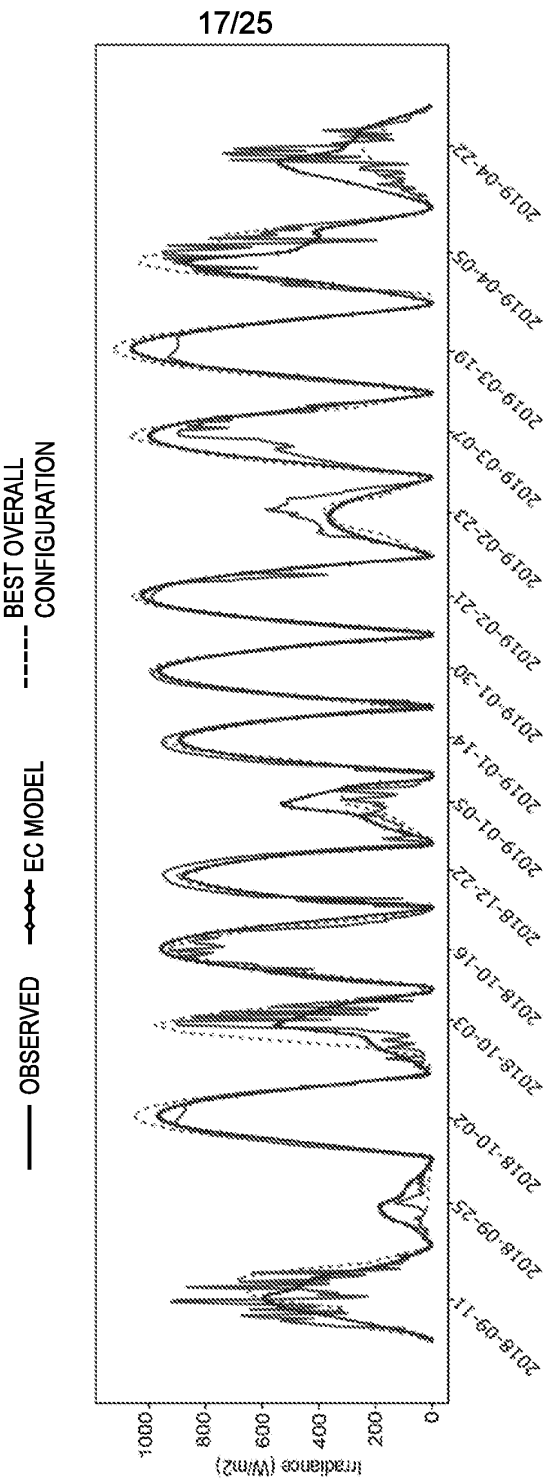


Fig. 23

18/25

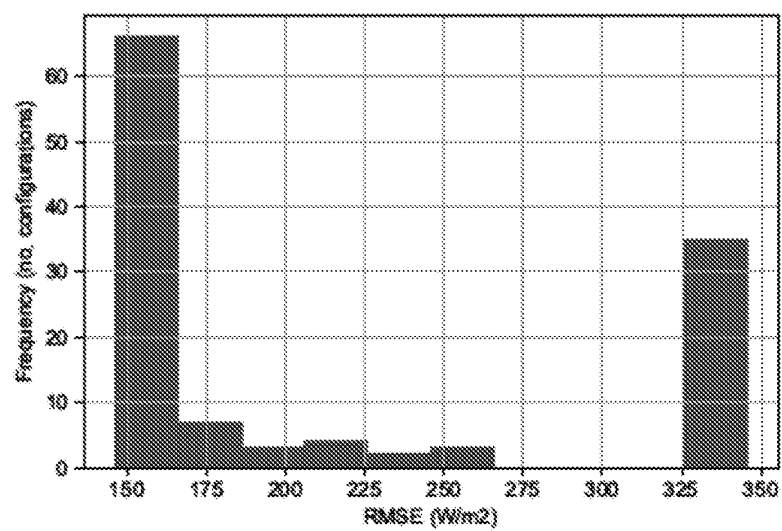


Fig. 24

Scheme	mp_ physics	cu_ physics	cutt	shcu_ physics	ra_lw_ physics	ra_sw_ physics	icloud	cu_rad_ feedback	shallow_ forced_ra	nbins	cu_ diag	ishallo w
Overall Option	16	0	0	2	4	4	3	false	false	N/A	0	0
Sunny option	22	1	5	0	4	4	3	false	false	N/A	0	0
Partly cloudy option	16	0	0	2	4	4	3	false	false	N/A	0	0
Cloudy option	2	0	0	0	4	1	3	false	false	N/A	0	0

Fig. 25

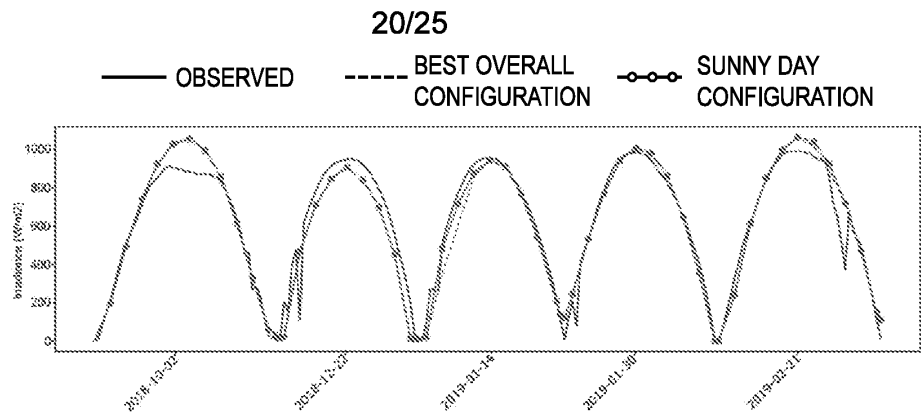


Fig. 26

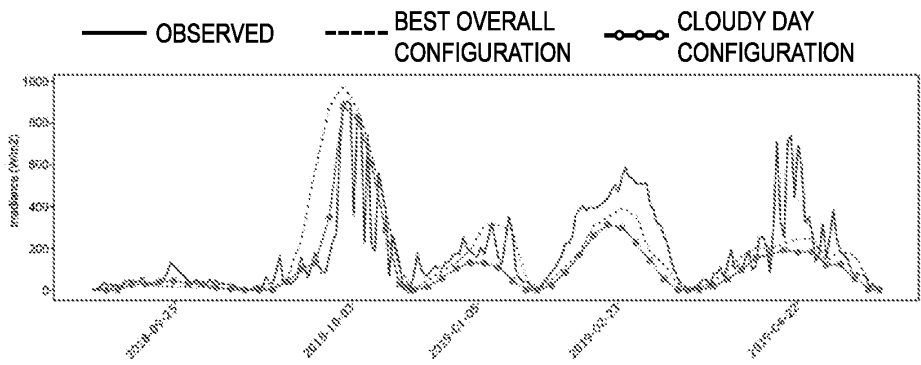


Fig. 27

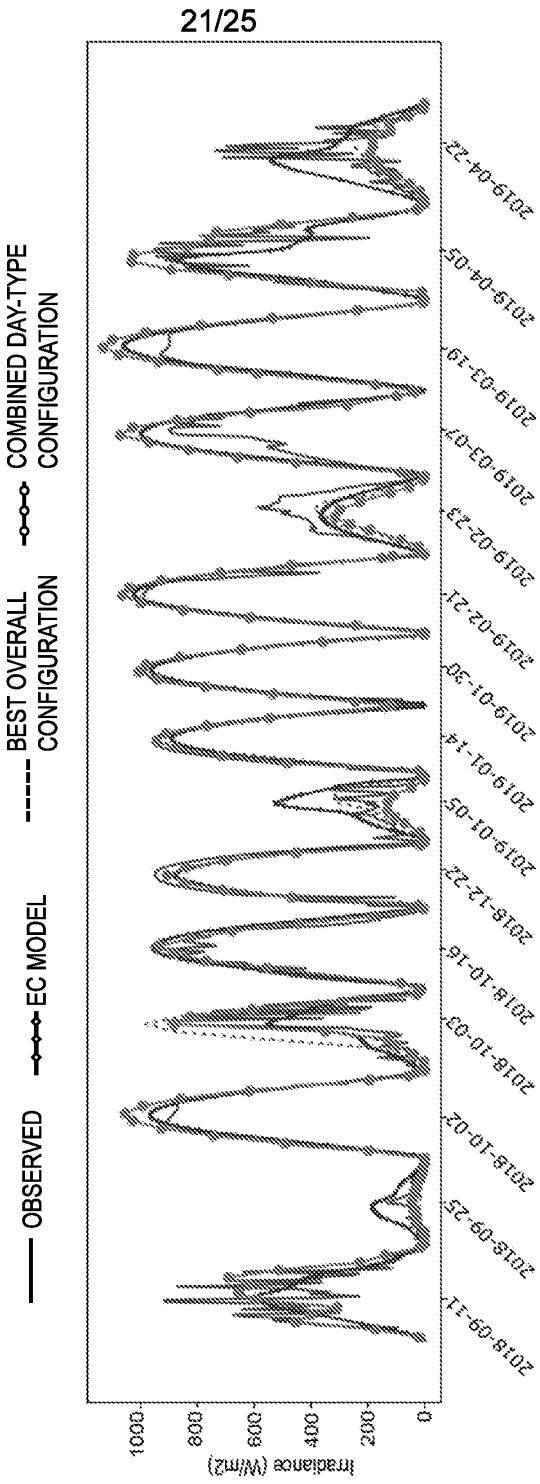


Fig. 28

22/25

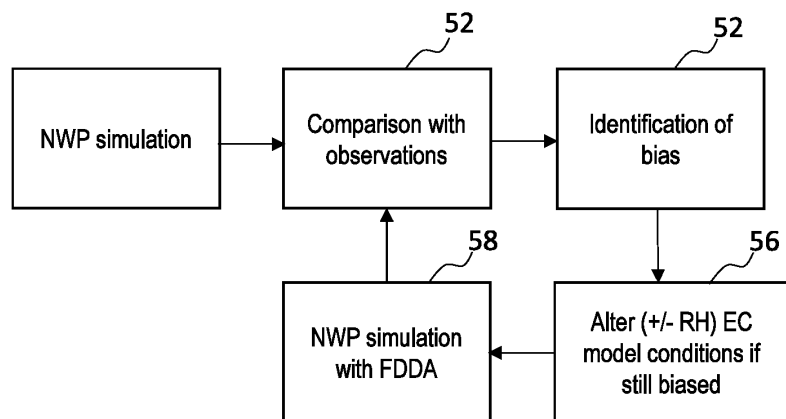


Fig. 29

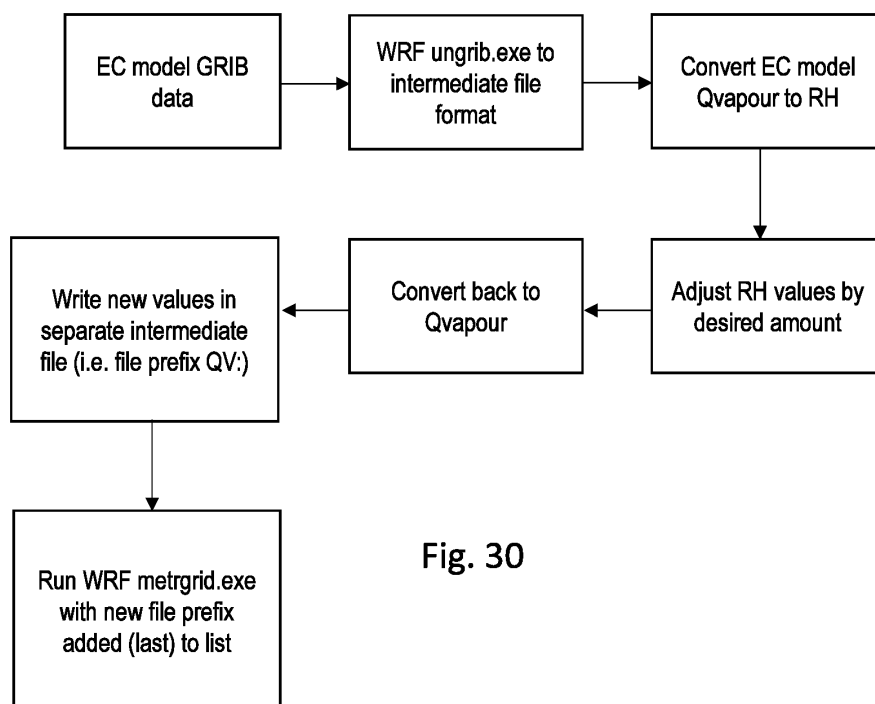


Fig. 30

23/25

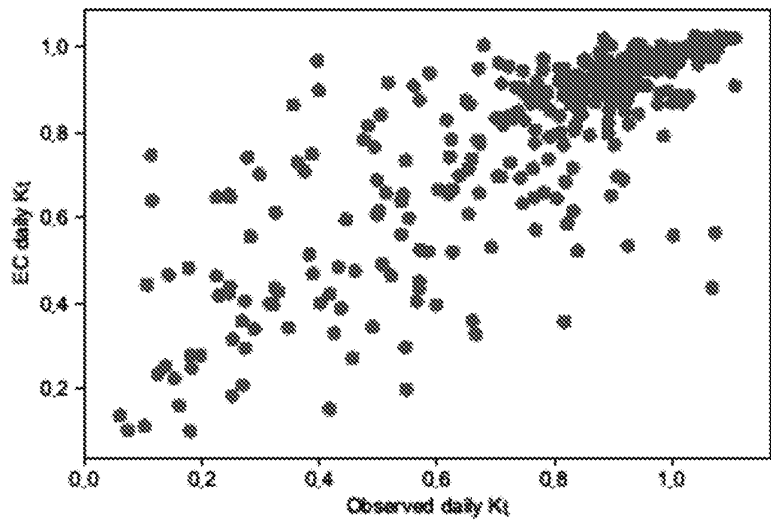


Fig. 31

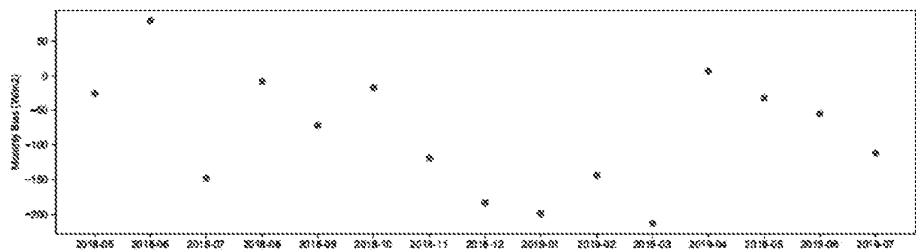


Fig. 32

24/25

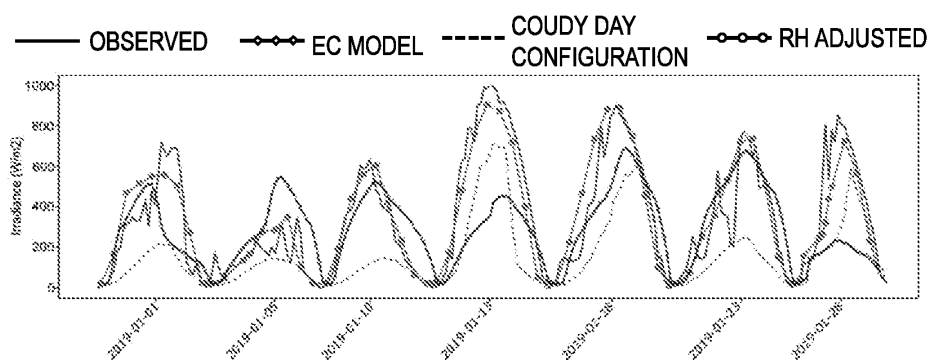


Fig. 33

Model	RMSE (W/m2)	Bias (W/m2)
Adjusted WRF	111.18	-18.94
Cloudy WRF	263.37	-198.5
EC model	239.49	-76.16

Fig. 34

25/25

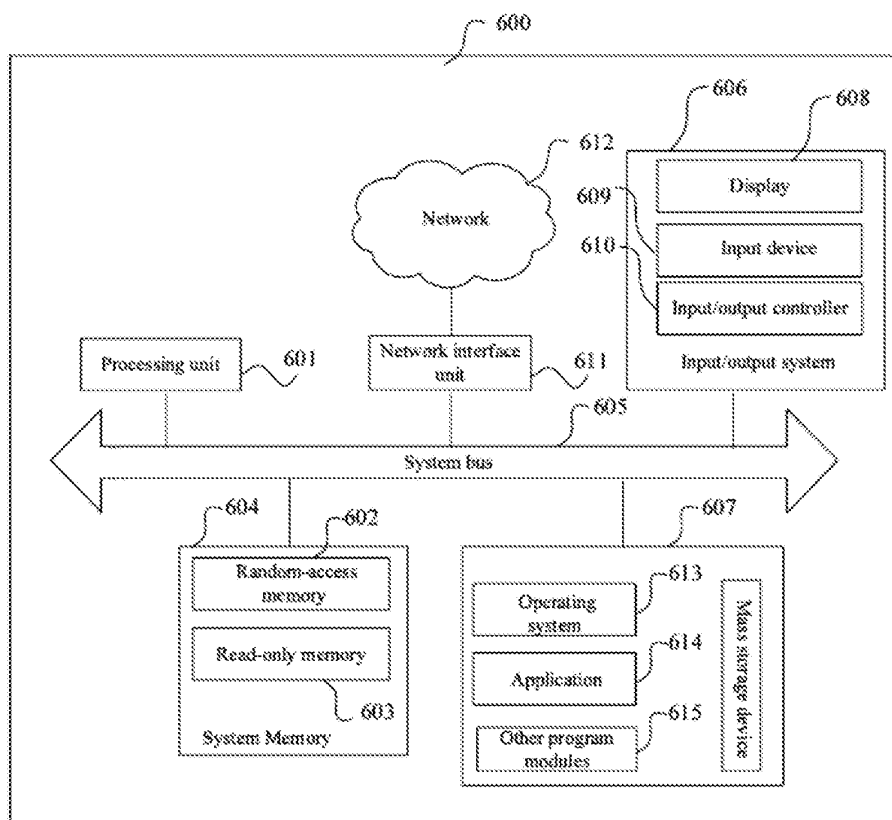


Fig. 35