



*Supplement of*

## **Temperature and radiative responses to anthropogenic aerosols over the Mediterranean Basin based on CMIP6 Earth system models**

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**Table S1.** Annual mean values (in  $W\ m^{-2}$ ) of shortwave (SW) and longwave (LW) radiative flux change ( $\Delta F_{coupled}$ ) at the top-of-atmosphere (TOA) and at the surface (SURF) over the Mediterranean for the periods 1970–1979, 2005–2014 and their difference (2005–2014 minus 1970–1979).  $\Delta F_{coupled}$  was calculated from the difference *historical* minus *hist-piAer*. Values are presented for each model, along with the multi-model ensemble mean and inter-model variability (1 standard deviation; SD).

Model	1970–1979				2005–2014				Diff.			
	SW TOA	LW TOA	SW SURF	LW SURF	SW TOA	LW TOA	SW SURF	LW SURF	SW TOA	LW TOA	SW SURF	LW SURF
BCC-ESM1	-7.98	5.26	-8.01	1.67	-5.55	5.15	-5.87	1.14	2.43	-0.11	2.14	-0.54
CNRM-ESM2-1	-4.18	2.07	-5.02	1.55	-2.60	1.39	-3.61	1.33	1.59	-0.68	1.41	-0.22
EC-Earth3- AerChem	-8.60	8.00	-9.21	2.83	-5.44	6.21	-7.78	3.19	3.16	-1.80	1.43	0.36
GFDL-ESM4	-6.42	3.40	-8.06	2.78	-3.93	2.54	-6.06	1.82	2.49	-0.87	2.01	-0.96
MPI-ESM-1-2- HAM	-7.77	3.00	-8.16	2.37	-5.40	3.41	-6.57	2.56	2.37	0.41	1.59	0.19
MRI-ESM2-0	-9.73	3.56	-9.86	1.73	-3.86	1.93	-4.14	-0.50	5.87	-1.63	5.72	-2.23
NorESM2-LM	-5.25	4.07	-5.48	2.06	-2.88	2.31	-3.67	1.01	2.37	-1.76	1.81	-1.06
UKESM1-0-LL	-7.84	6.47	-8.31	3.20	-4.71	5.07	-6.48	3.07	3.12	-1.39	1.83	-0.14
Ensemble (Mean)	-7.22	4.48	-7.76	2.28	-4.30	3.50	-5.52	1.70	2.93	-0.98	2.24	-0.57
Ensemble (SD)	1.70	1.84	1.58	0.58	1.09	1.65	1.44	1.15	1.20	0.76	1.34	0.78

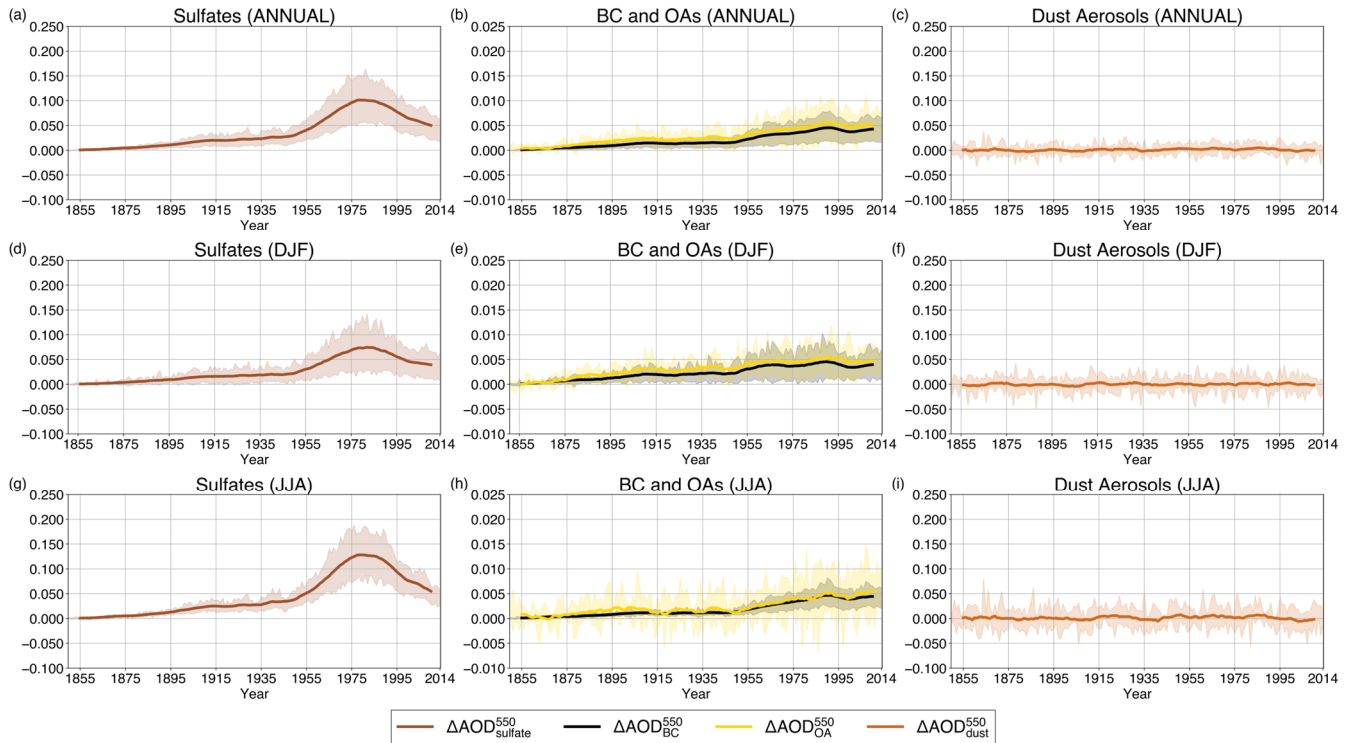
**Table S2.** As in Table S1, but for the boreal winter (DJF).

Model	1970–1979				2005–2014				Diff.			
	SW TOA	LW TOA	SW SURF	LW SURF	SW TOA	LW TOA	SW SURF	LW SURF	SW TOA	LW TOA	SW SURF	LW SURF
BCC-ESM1	-3.63	2.34	-3.48	1.08	-3.51	4.12	-3.51	1.92	0.12	1.78	-0.03	0.84
CNRM-ESM2-1	-2.49	1.65	-2.83	1.16	-1.38	0.52	-1.77	0.20	1.11	-1.13	1.06	-0.96
EC-Earth3- AerChem	-7.78	5.87	-8.26	2.87	-3.05	1.28	-3.96	1.78	4.73	-4.60	4.30	-1.09
GFDL-ESM4	-3.99	2.79	-5.04	3.43	-1.21	0.57	-2.53	1.50	2.78	-2.22	2.51	-1.92
MPI-ESM-1-2- HAM	-7.62	2.60	-8.17	4.04	-2.61	-1.23	-3.05	0.55	5.01	-3.83	5.12	-3.49
MRI-ESM2-0	-6.91	3.02	-6.72	3.40	-2.82	2.17	-3.04	1.39	4.09	-0.86	3.68	-2.02
NorESM2-LM	-3.42	2.55	-3.68	2.25	-3.81	2.79	-4.23	1.77	-0.39	0.24	-0.55	-0.47
UKESM1-0-LL	-4.88	4.64	-5.12	3.32	-4.32	5.01	-5.10	3.90	0.56	0.36	0.02	0.58
Ensemble (Mean)	-5.09	3.18	-5.41	2.69	-2.84	1.90	-3.40	1.63	2.25	-1.28	2.01	-1.07
Ensemble (SD)	1.93	1.29	1.97	1.03	1.03	1.91	0.97	1.03	2.03	2.03	2.05	1.33

**Table S3.** As in Table S1, but for the boreal summer (JJA).

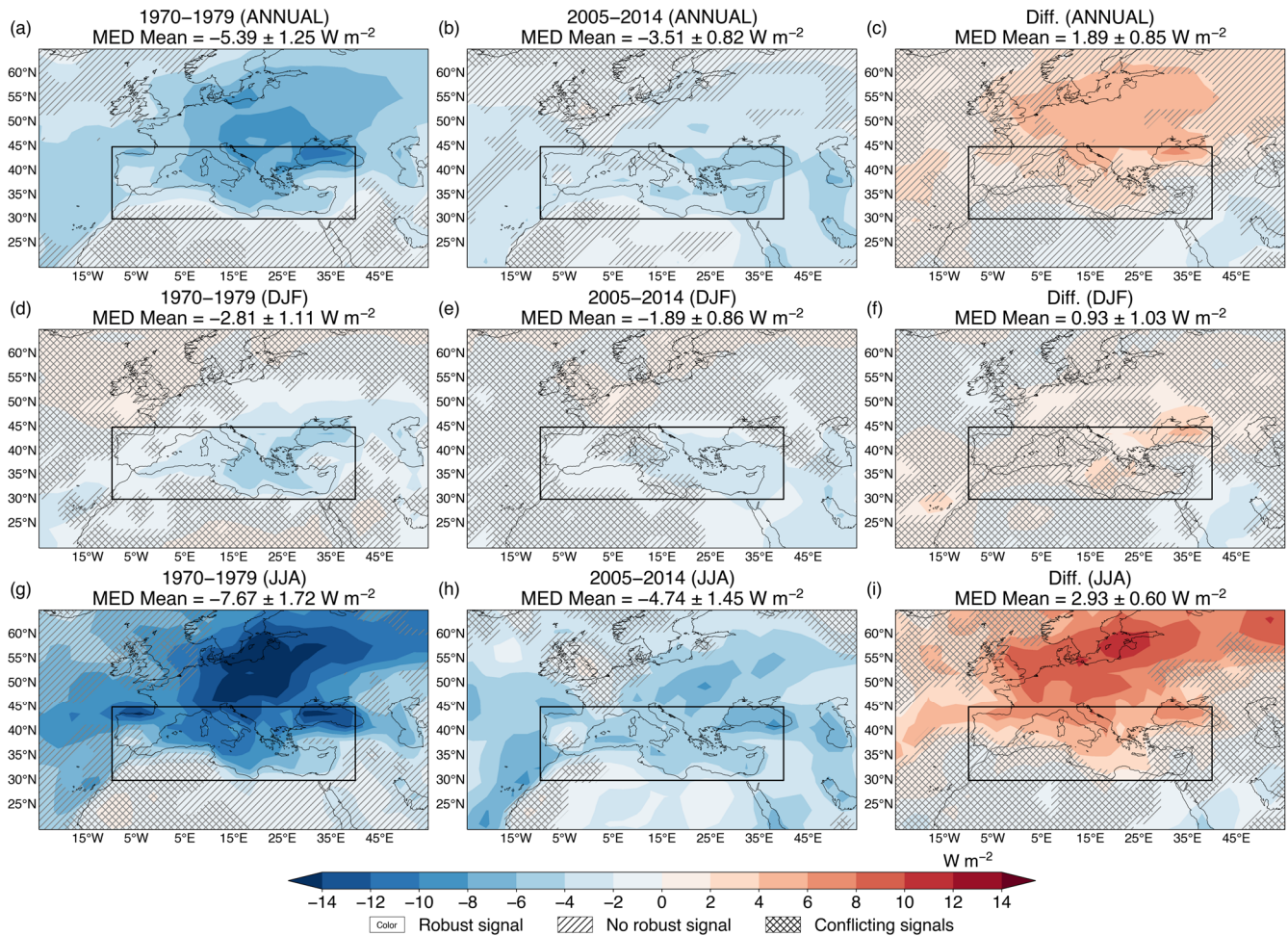
Model	1970–1979				2005–2014				Diff.			
	SW TOA	LW TOA	SW SURF	LW SURF	SW TOA	LW TOA	SW SURF	LW SURF	SW TOA	LW TOA	SW SURF	LW SURF
BCC-ESM1	-11.72	9.21	-12.18	2.65	-5.84	6.28	-6.42	1.14	5.89	-2.94	5.76	-1.52
CNRM-ESM2-1	-7.04	3.84	-8.79	2.87	-3.56	2.01	-5.32	2.11	3.48	-1.83	3.47	-0.76
EC-Earth3- AerChem	-9.85	12.09	-10.72	2.66	-7.27	11.75	-11.57	5.25	2.58	-0.34	-0.85	2.59
GFDL-ESM4	-8.98	5.66	-11.66	3.30	-5.19	4.19	-7.99	1.39	3.79	-1.47	3.67	-1.91
MPI-ESM-1-2- HAM	-8.24	6.12	-8.75	2.29	-4.79	5.30	-6.59	2.50	3.45	-0.82	2.16	0.21
MRI-ESM2-0	-11.75	5.36	-12.36	0.52	-5.12	2.85	-5.33	-1.48	6.63	-2.51	7.03	-2.00
NorESM2-LM	-5.67	5.33	-6.15	2.45	-2.41	2.46	-3.64	0.93	3.26	-2.87	2.51	-1.53
UKESM1-0-LL	-9.21	9.07	-10.09	3.18	-4.19	5.66	-6.82	2.78	5.02	-3.41	3.26	-0.40
Ensemble (Mean)	-9.06	7.09	-10.09	2.49	-4.80	5.06	-6.71	1.83	4.26	-2.03	3.38	-0.66
Ensemble (SD)	1.98	2.58	1.98	0.81	1.37	2.92	2.20	1.79	1.33	1.02	2.22	1.43

### Changes in AOD over MED (1850–2014)



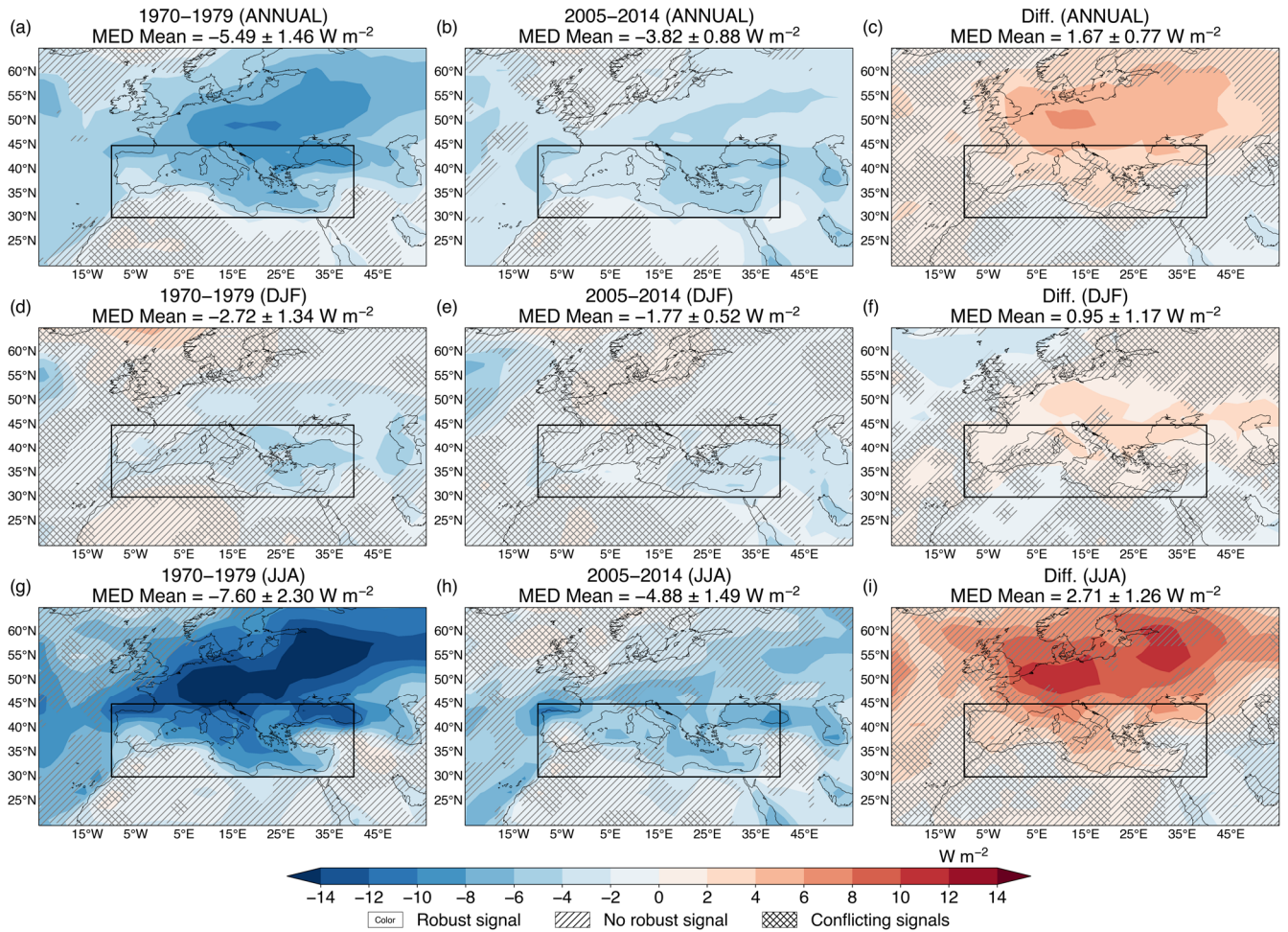
**Figure S1.** Timeseries of the AA-induced evolution of the aerosol optical depth ( $\Delta AOD$ ) of sulfate aerosols (left column) black carbon (BC) and organic aerosols (OA; middle column), and dust aerosols (right column) over the Mediterranean region ( $10^{\circ}\text{W}$ – $40^{\circ}\text{E}$ ,  $30^{\circ}\text{N}$ – $45^{\circ}\text{N}$ ) for the historical period (1850–2014) on an annual scale (top row) and in boreal winter (DJF; middle row) and summer (JJA; bottom row). Changes in AOD were calculated from the difference *historical* minus *hist-piAer*. The lines represent 10-year moving averages, while shading expresses the inter-model variability (one standard deviation).

ERF<sub>SURF</sub> Change (histSST – histSST-piAer)



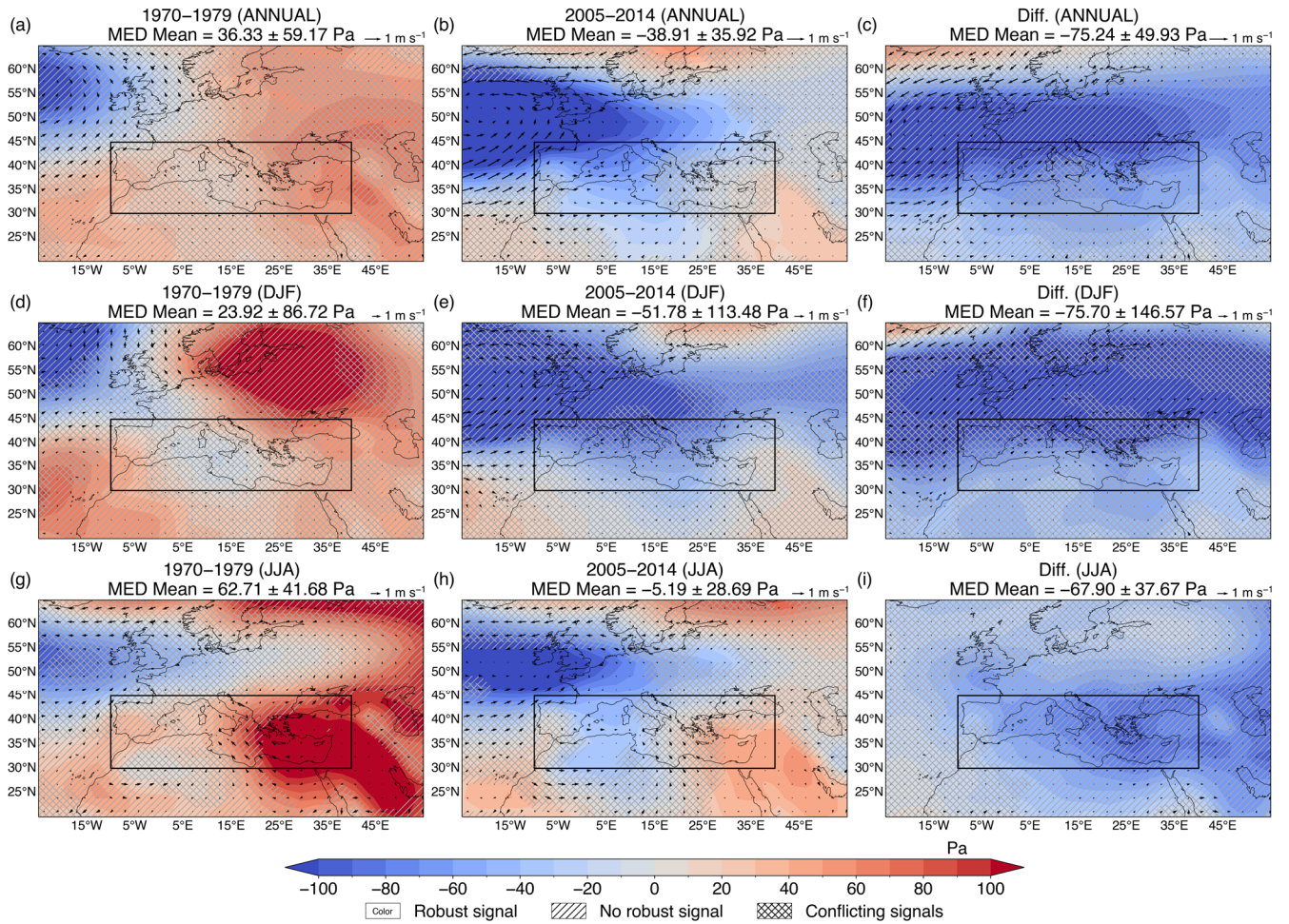
**Figure S2.** ERF<sub>SURF</sub> due to anthropogenic aerosols (calculated from the difference *histSST* minus *histSST-piAer*) over the Mediterranean (in  $W m^{-2}$ ). Spatial patterns are presented for the periods 1970–1979 (left column), 2005–2014 (middle column) and their difference (2005–2014 minus 1970–1979; right column) on an annual scale (top row) and in boreal winter (DJF; middle row) and summer (JJA; bottom row). The multi-model ensemble means over the Mediterranean region (shown as a box) are shown along with the inter-model variability (one standard deviation) at the top of each panel. Colored areas without markings indicate robust changes, while hatched (/) and cross-hatched (X) areas indicate non-robust changes and conflicting signals, respectively.

$\Delta F_{\text{SURF}}^{\text{coupled}}$  Change (historical – hist-piAer)



**Figure S3.**  $\Delta F_{\text{coupled}}$  at the surface due to anthropogenic aerosols over the Mediterranean (calculated from the difference *historical* minus *hist-piAer*). Spatial patterns are presented for the periods 1970–1979 (left column), 2005–2014 (middle column) and their difference (2005–2014 minus 1970–1979; right column) on an annual scale (top row) and in boreal winter (DJF; middle row) and summer (JJA; bottom row). The multi-model ensemble means over the Mediterranean region (shown as a box) are shown along with the inter-model variability (one standard deviation) at the top of each panel. Colored areas without markings indicate robust changes, while hatched (/) and cross-hatched (X) areas indicate non-robust changes and conflicting signals, respectively.

## Changes in Sea-Level Pressure and Surface Winds (historical – hist-piAer)



**Figure S4.** Changes in sea-level pressure and near-surface winds due to anthropogenic aerosols over the Mediterranean (calculated from the difference *historical* minus *hist-piAer*). Spatial patterns are presented for the periods 1970–1979 (left column), 2005–2014 (middle column) and their difference (2005–2014 minus 1970–1979; right column) on an annual scale (top row) and in boreal winter (DJF; middle row) and summer (JJA; bottom row). The multi-model ensemble means over the Mediterranean region (shown as a box) are shown along with the inter-model variability (one standard deviation) at the top of each panel. Colored areas without markings indicate robust changes, while hatched (/) and cross-hatched (X) areas indicate non-robust changes and conflicting signals, respectively.