

## Supplementary Material

### **Provenance tracing of mid-tropospheric transported dust over the Northeastern Arabian Sea during southwest monsoon**

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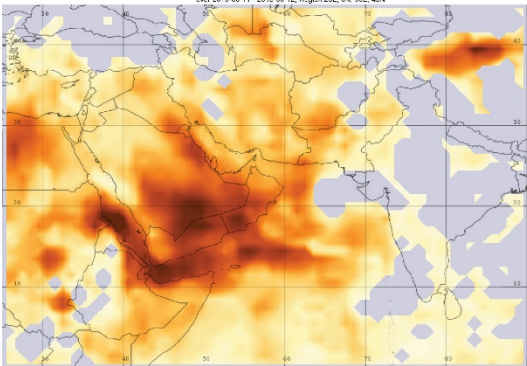
#### **Supplementary material S1**

##### **Identification of dust source using Aerosol Index, Back trajectories and CALIPSO profiles**

Aerosol Index (AI) of Ozone Monitoring Instrument of NASA were used for tracking the dust sources. Time averaged map of UV-AI for the study area (<https://giovanni.gsfc.nasa.gov/giovanni/>) were used to monitor the dust activity and transport from the source region towards the AS. To find the possible source of the mineral dust, HYBRID Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) (Draxler and Rolph, 2003) with the GDAS meteorological dataset from the National Oceanic and Atmospheric Administration (NOAA) Air Research Laboratory (<http://www.arl.noaa.gov/ready/hysplit4.html>) was used. Backward trajectories were run for the day of sampling for 168 hours at different altitude (500-1500m, 1500-2500m and 2500-4000m) levels above ground level during sampling days, to show the origin of dust laden air mass at different altitudes from different regions. CALIPSO vertical profile pass available the sampling period near source or receptor region is also shown to assess the evolution and transport of dust over Arabian Sea.

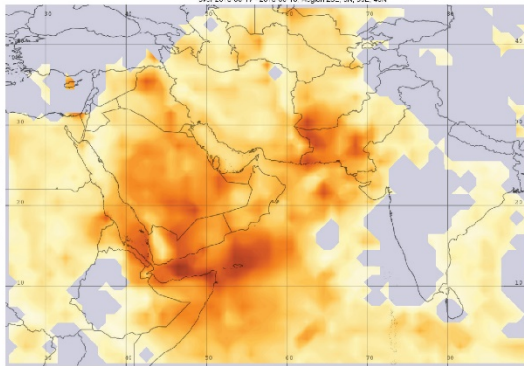
### WD-2

Time Averaged Map of UV Aerosol Index daily 1 deg [OMI QMTC03-v002]  
over 2013 06 11 2013 06 12, Region 25E, 0N, 90E, 45N



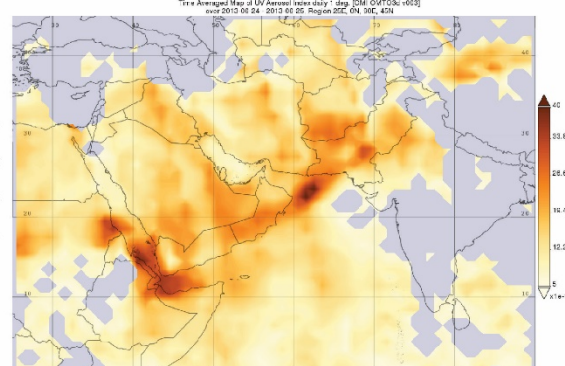
### WD-3

Time Averaged Map of UV Aerosol Index daily 1 deg [OMI QMTC03-v002]  
over 2013 06 17 2013 06 18, Region 25E, 0N, 90E, 45N

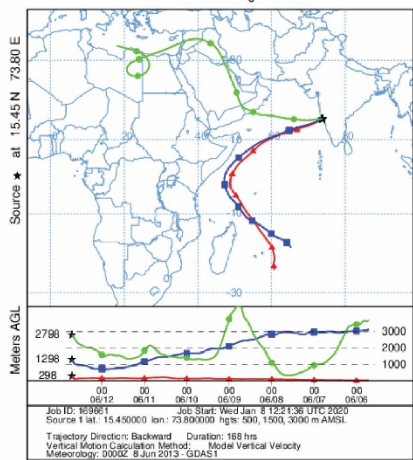


### WD-4

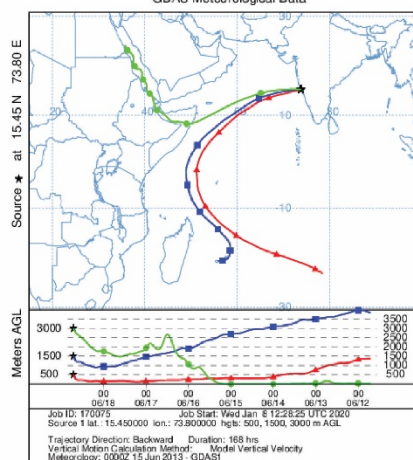
Time Averaged Map of UV Aerosol Index daily 1 deg [OMI QMTC03-v002]  
over 2013 06 24 2013 06 25, Region 25E, 0N, 90E, 45N



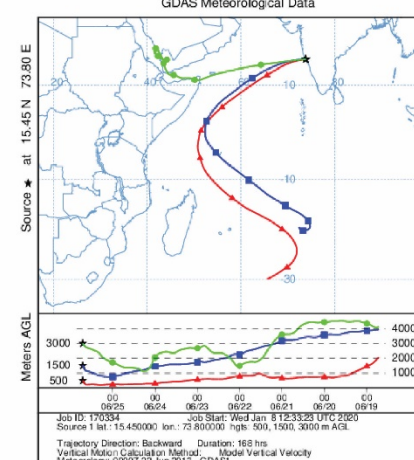
NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 12 Jun 13  
GDAS Meteorological Data



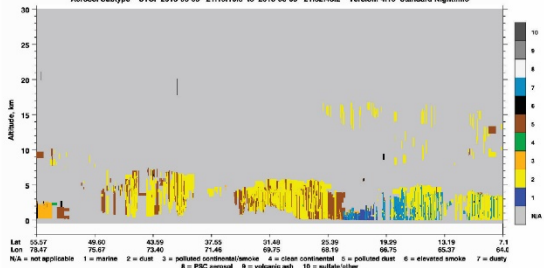
NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 18 Jun 13  
GDAS Meteorological Data



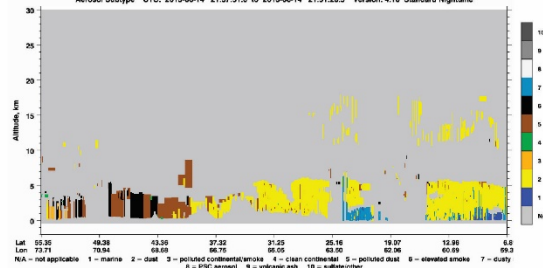
NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 25 Jun 13  
GDAS Meteorological Data



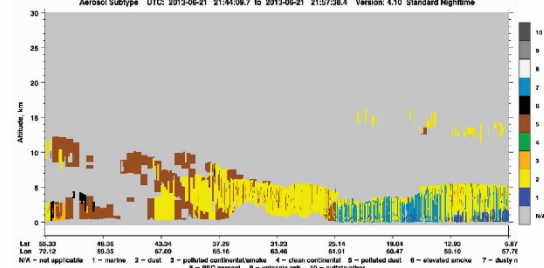
Aerosol Subtype UTC: 2013-06-09 21:19:16.5 to 2013-06-09 21:32:45.2 Version: 4.10 Standard Nighttime



Aerosol Subtype UTC: 2013-06-14 21:37:51.8 to 2013-06-14 21:51:25.8 Version: 4.10 Standard Nighttime

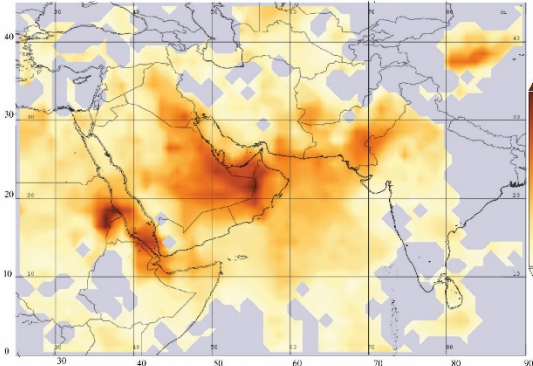


Aerosol Subtype UTC: 2013-06-21 21:41:06.7 to 2013-06-21 21:57:28.4 Version: 4.10 Standard Nighttime

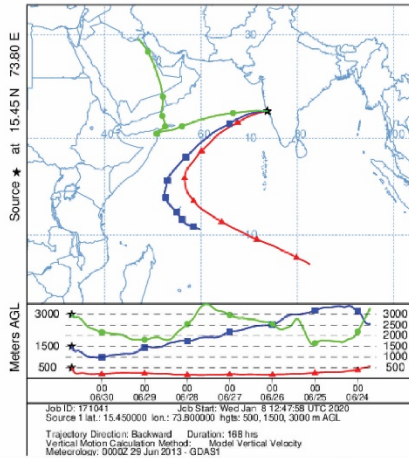


### WD-5

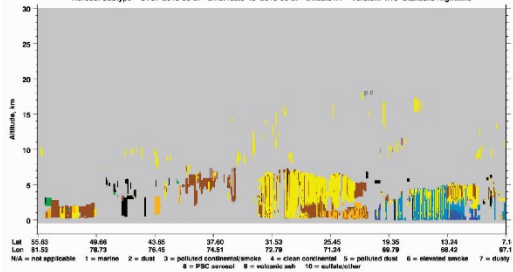
Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMI O3d v003 over 2013-06-29 - 2013-06-30, Region 25E, 0N, 90E, 45N



NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 30 Jun 13  
GDAS Meteorological Data



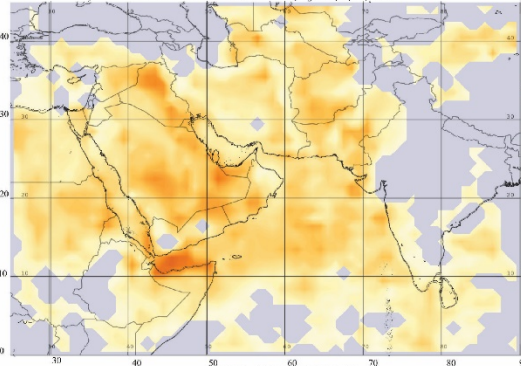
Aerosol SubType UTC: 2013-06-27 21:07:02.5 to 2013-06-27 21:20:31.1 Version: 4.10 Standard Nighttime



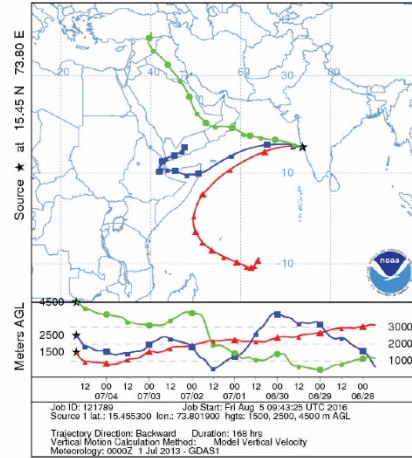
Lat 81.53 80.66 78.73 78.45 74.81 72.79 71.24 69.79 68.42 87.1  
Lon 81.53 80.66 78.73 78.45 74.81 72.79 71.24 69.79 68.42 87.1  
NA = not applicable 1 = marine 2 = dust 3 = polluted continental/smoke 4 = clean continental 5 = polluted dust 6 = elevated smoke 7 = dusty  
8 = PSC aerosol 9 = volcanic ash 10 = sulfate/other

### WD-6

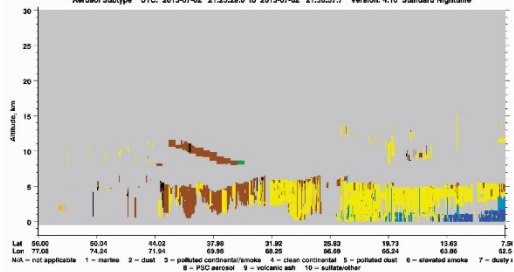
Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMI O3d v003 over 2013-07-03 - 2013-07-04, Region 25E, 0N, 90E, 45N



NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 04 Jul 13  
GDAS Meteorological Data



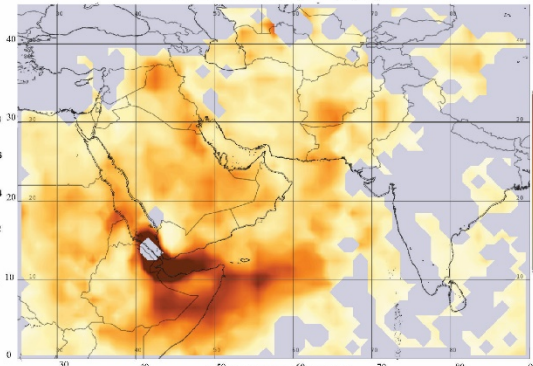
Aerosol SubType UTC: 2013-07-02 21:25:29.0 to 2013-07-02 21:38:27.7 Version: 4.10 Standard Nighttime



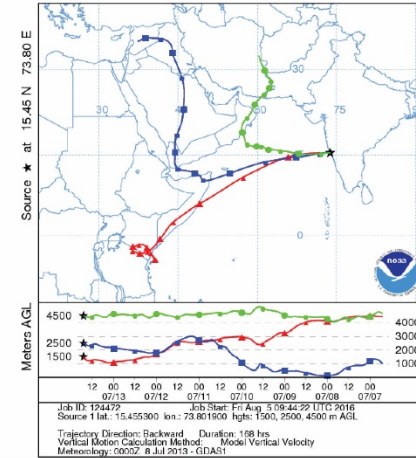
Lat 77.08 74.24 71.04 69.90 66.25 66.09 65.34 63.96 63.5  
Lon 77.08 74.24 71.04 69.90 66.25 66.09 65.34 63.96 63.5  
NA = not applicable 1 = marine 2 = dust 3 = polluted continental/smoke 4 = clean continental 5 = polluted dust 6 = elevated smoke 7 = dusty  
8 = PSC aerosol 9 = volcanic ash 10 = sulfate/other

### WD-7

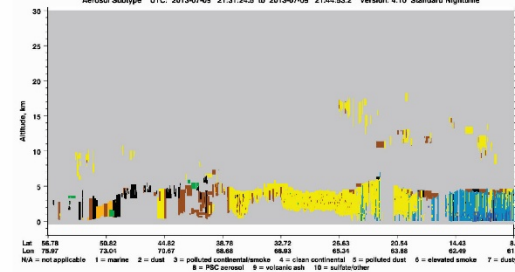
Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMI O3d v003 over 2013-07-12 - 2013-07-13, Region 25E, 0N, 90E, 45N



NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 13 Jul 13  
GDAS Meteorological Data



Aerosol SubType UTC: 2013-07-09 21:31:24.8 to 2013-07-09 21:44:53.2 Version: 4.10 Standard Nighttime

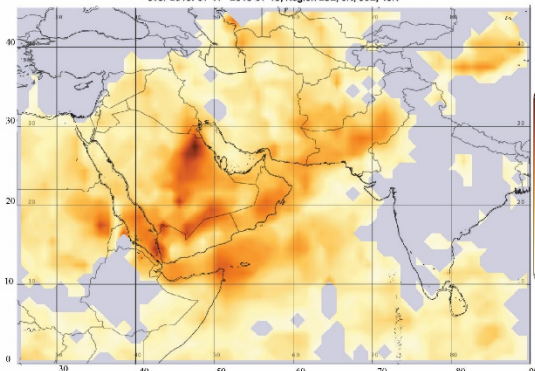


Lat 80.29 78.73 73.01 72.87 68.68 68.63 65.31 63.88 62.49 61.71  
Lon 78.97 73.01 72.87 68.68 68.63 65.31 63.88 62.49 61.71  
NA = not applicable 1 = marine 2 = dust 3 = polluted continental/smoke 4 = clean continental 5 = polluted dust 6 = elevated smoke 7 = dusty  
8 = PSC aerosol 9 = volcanic ash 10 = sulfate/other

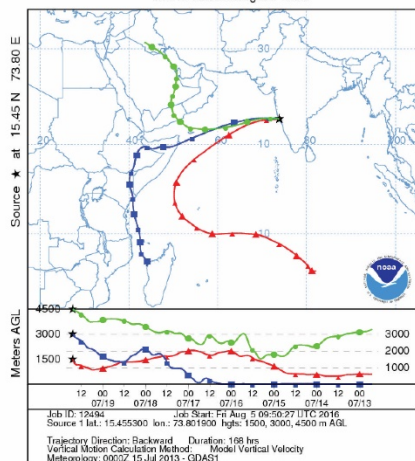


### WD-8

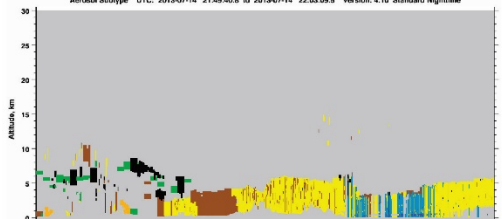
Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMT Q3d v003 over 2013-07-17 - 2013-07-18, Region 25E, 0N, 90E, 45N



NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 19 Jul 13  
GDAS Meteorological Data

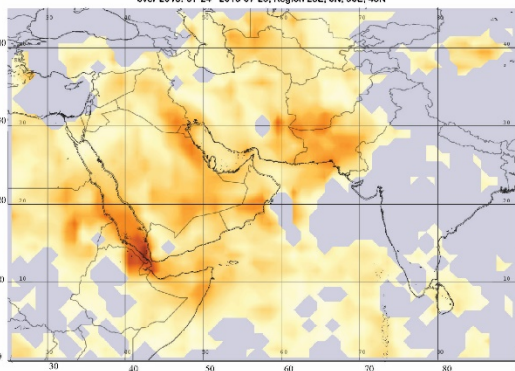


Aerosol Subtype UTC: 2013-07-14 21:49:00.6 to 2013-07-14 22:03:09.8 Version: 4.10 Standard Nighttime

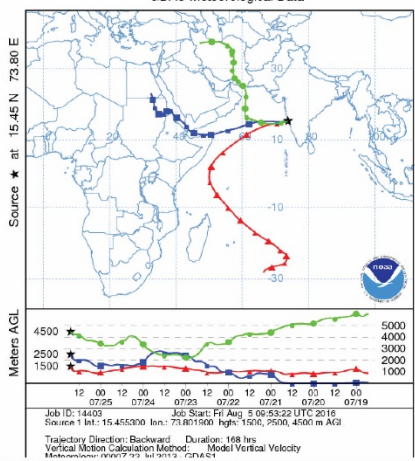


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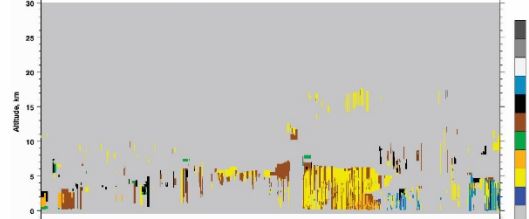
Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMT Q3d v003 over 2013-07-24 - 2013-07-25, Region 25E, 0N, 90E, 45N



NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 25 Jul 13  
GDAS Meteorological Data

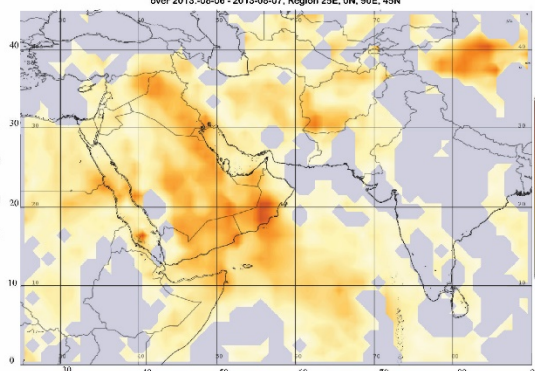


Aerosol Subtype UTC: 2013-07-20 21:12:11.3 to 2013-07-20 21:26:40.0 Version: 4.10 Standard Nighttime

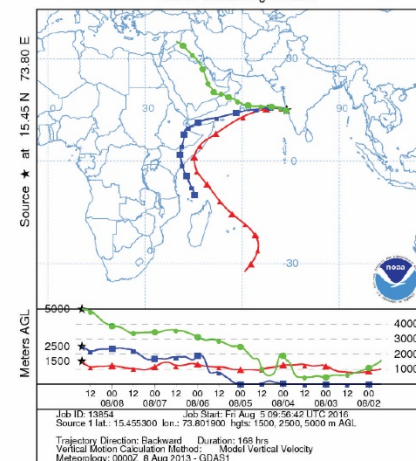


### WD-11

Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMT Q3d v003 over 2013-08-06 - 2013-08-07, Region 25E, 0N, 90E, 45N



NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 08 Aug 13  
GDAS Meteorological Data

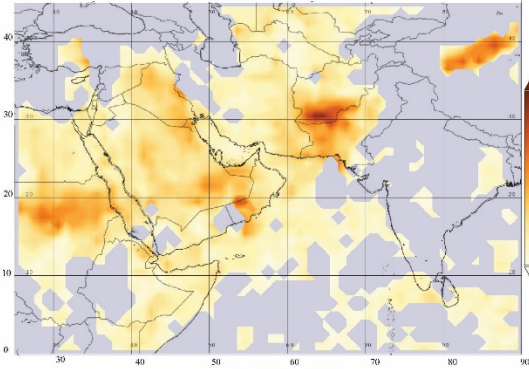


Aerosol Subtype UTC: 2013-08-03 21:23:29.7 to 2013-08-03 21:38:58.4 Version: 4.10 Standard Nighttime

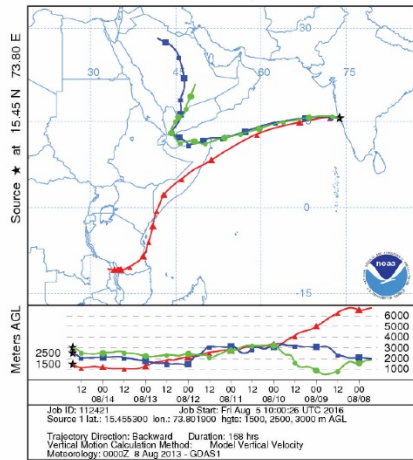


### WD-12

Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMT O3d v003 over 2013-08-13 - 2013-08-14, Region 25E, 0N, 30E, 45N

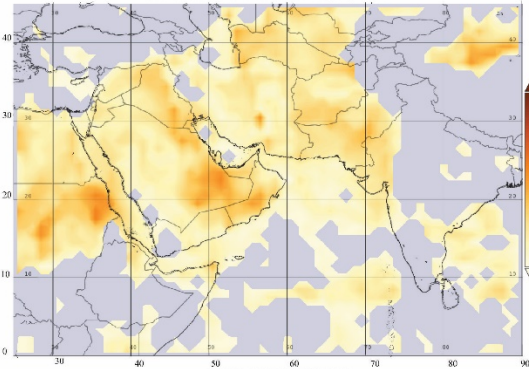


NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 14 Aug 13  
GDAS Meteorological Data

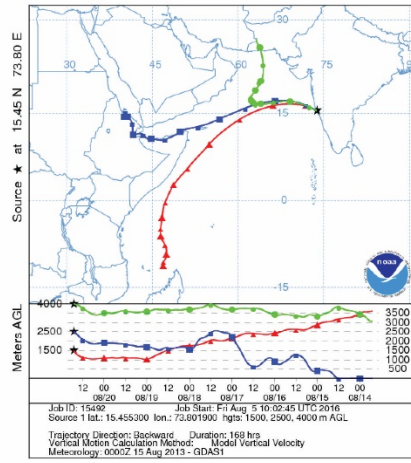


### WD-13

Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMT O3d v003 over 2013-08-19 - 2013-08-20, Region 25E, 0N, 30E, 45N

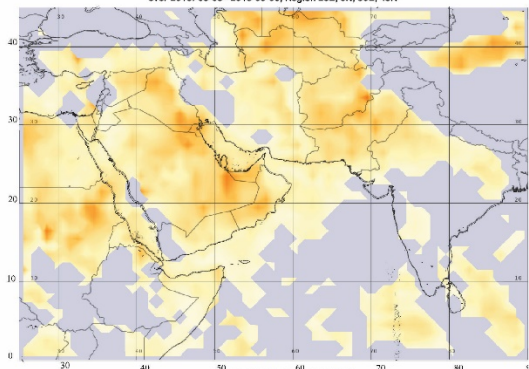


NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 20 Aug 13  
GDAS Meteorological Data

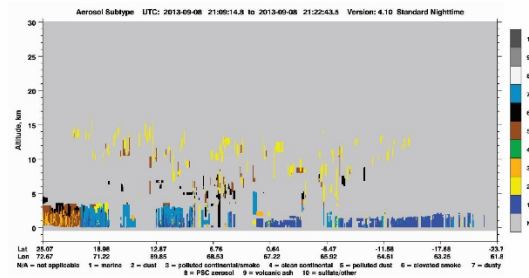
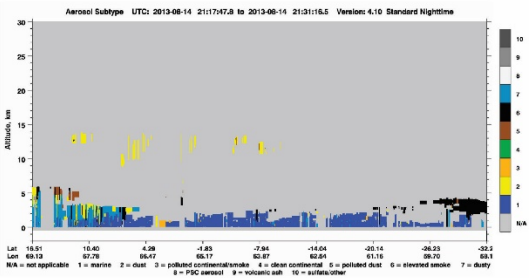
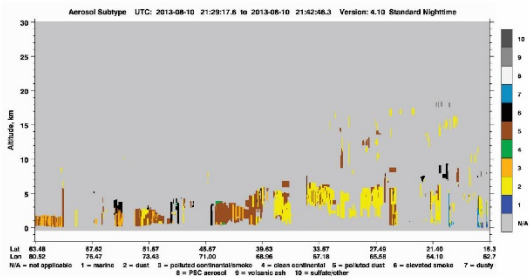
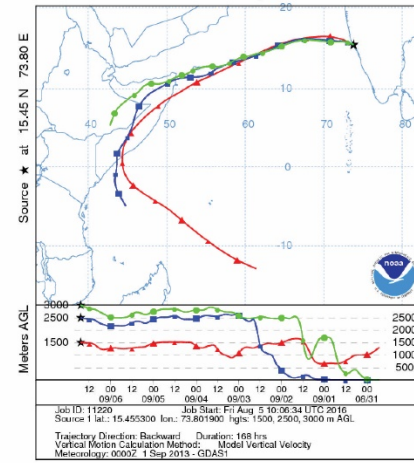


### WD-14

Time Averaged Map of UV Aerosol Index Daily 1 deg. [OMI OMT O3d v003 over 2013-09-05 - 2013-09-06, Region 25E, 0N, 30E, 45N



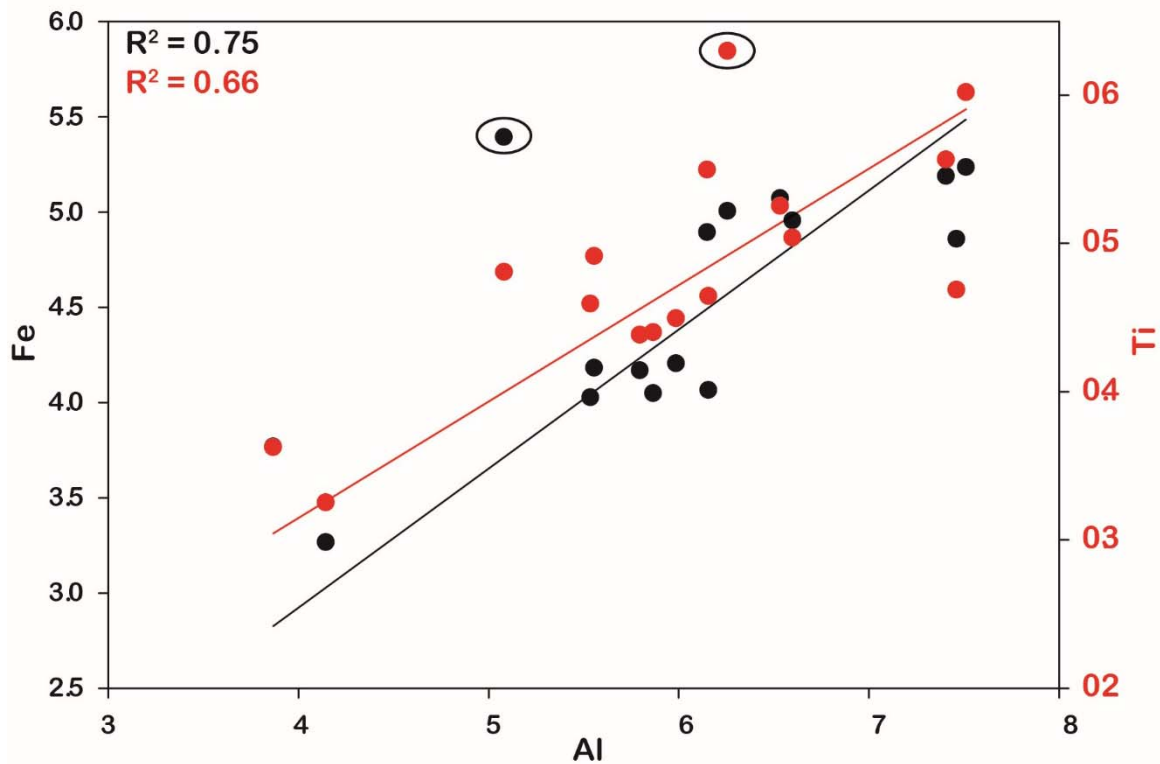
NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 06 Sep 13  
GDAS Meteorological Data







Supplementary material S2



The scatter plot between Fe vs Al and Ti Vs Al for WDP samples collected during the SW monsoon of 2013. The data points circled are not considered while calculating correlation coefficient ( $R^2$ ).

**Table-ST-1**

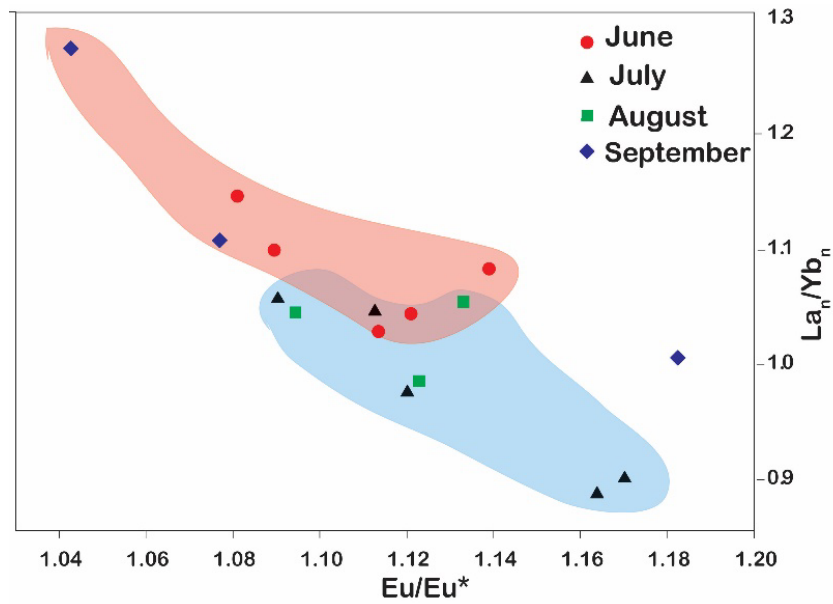
Sample name, date of collection, major elements ratios and clay mineral ratios are given.

Illite (I), chlorite (C), Palygorskite (P) and kaolinite (K)

	<b>Sample name</b>	<b>Date of collection</b>	<b>Fe/Al</b>	<b>Ca/Al</b>	<b>Mg/Al</b>	<b>Ti/Al</b>	<b>I/K</b>	<b>K/C</b>	<b>P/I</b>
BM	WD-1	7-10 June 2013	0.70	0.09	0.45	0.08	1.5	NA	1.3
	WD-2	11-12 June 2013	0.97	1.40	0.84	0.09	1.3	1.2	1.6
	WD-3	18-19 June 2013	0.72	0.10	0.43	0.08	0.8	1.6	2.4
	WD-4	25-26 June 2013	0.80	0.27	0.50	0.10	1.3	1.2	1.7
MM	WD-5	29-30 June 2013	0.75	0.16	0.41	0.08	2.2	0.8	0.8
	WD-6	3-4 July 2013	0.70	0.13	0.40	0.08	1.8	1.0	1.2
	WD-7	12-13 July 2013	0.70	0.13	0.36	0.08	1.2	1.1	1.4
	WD-8	18-19 July 2013	0.78	0.14	0.31	0.08	0.8	1.5	0.7
	WD-9	23-24 July 2013	0.73	0.13	0.36	0.08	1.4	1.1	1.1
	WD-10	31 july-1 Aug 2013	0.80	0.33	0.49	0.09	1.0	1.2	1.4
	WD-11	6-7 Aug 2013	0.75	0.17	0.39	0.09	1.4	1.2	0.9
	WD-12	12-13 Aug 2013	0.79	0.10	0.44	0.08	2.1	0.8	0.6
	WD-13	17-18 Aug 2013	0.66	0.09	0.33	0.08	1.1	0.6	1.3
EM	WD-14	10-11 Sep 2013	1.08	0.06	0.27	0.09	4.5	0.6	0.3
	WD-15	19-20 Sep 2013	0.65	0.09	0.30	0.06	2.2	0.8	NA
	WD-16	28-30 Sep 2013	0.69	0.14	0.43	0.08	2.9	0.6	NA



*Supplementary material S3*



The scatter plot between  $Eu/Eu^*$  and  $La_n/Yb_n$  to illustrate temporal variability of source region impacting at the NEAS during SW monsoon. Two different cluster having July and August sample (Mod of monsoon) in one and June and September in other (Beginning and end of monsoon). This shows the enrichment of HREE in the mid-monsoon samples due to the contribution from the NE African sources.