Chattanooga-Hamilton County Air Pollution Control Bureau

November 4, 2004

Mr. Doug Neeley
Chief
Air Toxics and Monitoring Branch
Air, Pesticides, and Toxics Management Division
USEPA Region 4
Atlanta Federal Center
61 Forsyth Street
Atlanta, Georgia 30303-8960

Dear Mr. Neeley:

I am responding to your letter of March 2 where you indicated that the three incidents for which I have applied for exceptional event status in 2003 may be reconsidered by EPA with submittal of additional information, especially speciation data. I believe that these ozone 8-hour exceedances: April 14, 2003; June 24 and 25, 2003; and August 26, 2003, are each during exceptional events that affected both ozone and $PM_{2.5}$ data in Hamilton County and the region. I am supplying you with additional significant information, including graphs of speciation data. This additional information proves that these events are exceptional.

At my request, Dave Larko, Webmaster and image producer of TOMS (Total Ozone Mapping Spectometry) satellite imagery, of Science Systems Applications, Inc., SESDA Program at NASA Goddard Space Flight Center, has prepared special TOMS imagery movies of each incident. I have sent you an e-mail from Dave Larko about how to access copies of the April and August movies on FTP. The FTP file is located at ftp://toms.gsfc.nasa.gov/pub/tmp/kjones. The slide movie of the June event has been placed on the TOMS website, http://jwocky.gsfc.nasa.gov, under TOMS News -scroll down to June 2003. Please view both the Quicktime and the MPEG formats for each incident because the faster MPEG movie sometimes shows the aerosol cloud movement from the fire area better than the slower Quicktime movie. I have requested that Mr. Larko place the other two movies on the web site, and they should be on the web under TOMS News as soon as Mr. Larko can free up disk space.

We are requesting an immediate response to our requests from EPA because both Hamilton County and Meigs County ozone and Hamilton County and Walker County $PM_{2.5}$ design values are affected by these events. $PM_{2.5}$ attainment/nonattainment designation is imminent, thus we (and the State of Georgia) are interested in recalculating our design values for $PM_{2.5}$ designation if

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EPA concurs with flagging this data. EPA is excluding exceptional event data from the design value calculations for 2001-2003 that are flagged with an EPA concurrent flag.

I have provided graphs of speciation data for you for April through September 2003. I have altered the magnitude of some of the components of the graphs by multiplying or adding increments of 20, 100, or 1000 in order to graph the components using different units or magnitudes. The purpose of graphing them on the same graph is to show that the peaks synchronize during the events. I have graphed known biomass burning markers: potassium, calcium, organic carbon, elevated $PM_{2.5}$, nitrates, and silicon. I am adding aluminum because of the unusual spike in calcium, potassium, and silicon for the July 8, 2003, speciation sample. Previous testing on PM_{10} filters has shown in Hamilton County that aluminum levels spike dramatically during known African Sahara Desert Sands transport incidents. TOMS satellite pictures from that time period indicate that transport of Sahara Sands probably affected the July 8 sampling date.

Graphs of ozone versus organic carbon and ozone versus potassium are provided for each ozone site, including Meigs County. The speciation data is from the downtown University of Tennessee at Chattanooga site. To facilitate graphing against daily ozone data, the same organic carbon (OC) or potassium data (K) has been assigned to the ozone day before and after the speciation date. Since ozone data has been graphed in three day increments, all daily ozone data is not represented.

Graphing was done with organic carbon rather than elemental carbon or total carbon as a marker because according to the ***Development of Emissions Inventory Methods for Wildland Fire*** Report of February 2002 prepared by EC/R, Incorporated, for EPA, organic carbon appears to correlate well with total $PM_{2.5}$ over the full range of combustion efficiencies (both flaming and smoltering conditions). This document indicates that the correlation is less true for elemental carbon, although the correlation coefficient is still quite high.

Special Request for Meigs Ozone Site on Behalf of State of Tennessee

I am making the same exceptional event requests for ozone for Meigs County on behalf of the State of Tennessee that we are making for Hamilton County because if the ozone exceedances are granted for Hamilton and not Meigs, the effort is an exercise in futility. Since the data represents the same air mass we must include Meigs in our request. I received permission to make this request from Jackie Waynick, Chief of Technical Services, of the State of Tennessee. We are expanding our original request to include elevated data, not just exceedances, because our data and Meigs' data were affected on most all the days of the events.

Special Request for Walker County Suggs Street $PM_{2.5}$ Site on Behalf of the State of Georgia

Because the Walker County $PM_{2.5}$ site at the Rossville Health Center, 1430 Suggs Street, is also in our metropolitan statistical area, we have received permission from Susan Zimmer-Dauphinee, Program Manager over Ambient Monitoring of the State of Georgia, to make an exceptional event request on behalf of this site for the same dates that we are requesting for our own sites for $PM_{2.5}$. Our East Ridge Site is about two blocks from the Georgia Border. The Walker County Site is roughly 1.75 miles south of the border. Thus, the sites are within three miles of each other. **Again, it is useless for us to request exceptional event status without including the similar and equally affected data from the sites in our common air mass.**

The three incidents are as follows (max numbers are ranked for 2003 in the graphs):

Event 1- Kansas Agricultural Fires April 12-15, 2003

First, I am requesting exceptional event status for the elevated $PM_{2.5}$ data and elevated ozone, including an ozone exceedance for Hamilton County, for the Kansas Agricultural Fire incident in April of 2003. Since the exceptional event has been granted to Missouri by Region 7 without a Smoke Management Plan, it is unreasonable for Region 4 to deny our request based upon Tennessee's lack of a Smoke Management Plan. Even if Tennessee had a Smoke Management Plan, it would not have prevented intrusion from significant agricultural burning in another state. The State of Tennessee has no legal authority in Kansas. States should not be penalized for exceptional events in another state over which that state has no control.

Exceedances in different parts of Tennessee on each day of the April Kansas fire event provide supporting evidence for an exceptional event. Our agency researched at least ten (10) years back and could find only one other April exceedance in Hamilton County that occurred in 1998 during the Mexican Fires. The April exceedance in 2003 was so extraordinary for Hamilton County that it prompted our agency to scrutinize fire activity.

	Soddy-Daisy Ozone 470651011	VAAP Ozone 470650028	Meigs Ozone 471210104	Soddy $PM_{2.5}$ 470651011	East Ridge $PM_{2.5}$ 470650031	UTC Col CORE $PM_{2.5}$ 470654002	Walker Co, Georgia $PM_{2.5}$ 132950002
April 12	80 (4th Max)	79 (6th Max)	73			13.6 VD	
April 13	66	67	65				
April 14	88 (2nd Max)	83 (4th Max)	79 (6th Max)				
April 15	79 (5th Max)	78 (8th Max)	78 (7th Max)	24.5 (6th Max)	32.5 (6th Max)	31.0 30.5 (6th Max)	30.7 (5th Max)

This event was unusual in that weather conditions forced the local farmers in Kansas to compact their yearly April agricultural burning. This burning is normally spread out over a several week time period and is to rid 10,000 acre farms of scrub brush and eastern red cedars. More than 2 million acres burned in roughly 3 days. I am sending you numerous graphs of speciation data that indicate that this is an exceptional fire event. The graphs indicate that ozone, total organic carbon, $PM_{2.5}$, potassium, calcium, silicon, and nitrates (known fire indicators) all had synchronizing peaks on April 15, the speciation monitoring day, a day after the exceedance.

TOMS specially prepared imagery indicates heavy aerosols over Hamilton County on April 13 and 15. If the aerosols are indicated on those two dates, they were there also on the April 14, but below the height of 10,000 feet for aerosol detection on TOMS. NOAA Local Climitological Data for Chattanooga for April 14 indicates that the maximum temperature was 83 degrees, higher than the temperature on April 13 or 15, which would be more favorable than lower temperatures for ozone production.

There are those that believe that exceptional event data should not be flagged unless there are exceedances. This viewpoint seems especially true in reference to ozone data since it is now generally recognized that daily $PM_{2.5}$ data can be dramatically elevated and still under the daily standard. We maintain, however, that all elevated data in the same general air mass during an established exceptional event merits flagging, especially those affected but under the standard as in ozone data from April 12, 14, and 15. Whether the data exceeds or not is irrelevant if there is no doubt the data was significantly affected by the event.

Exceptional Event status is evident in studying the one hour maximum data for April 12, 14, and 15. A study was done about 1997 to look at the earliest high one hour ozone data in Hamilton County. The earliest in the year that one hour data reached the low 90s was about May 23 every year. These one hour ozone numbers in April 2003 are quite high in comparison to historical data for April.

	Soddy-Daisy Ozone One Hour Max 470651011	VAAP Ozone One Hour Max 470650028	Meigs Ozone One Hour Max 471210104
April 12	83	82	80
April 13	71	71	68
April 14	99	101	96
April 15	89	91	89

One can see from the one-hour evening ozone data (chart below) that both VAAP and Meigs would have exceeded on April 14 if their ozone had not dropped to much lower levels two hours before the ozone decreased at Soddy. The one hour at Meigs dropped far below Soddy and VAAP starting at the 1800 hour implying that weather conditions changed there to bring the levels down rapidly.

Comparison of Ozone Levels in ppb for Evening Hours on April 14, 2003

Site	1700	1800	1800	2000	2100	2200	2300
Soddy	99	96	81	66	63	59	58
VAAP	93	83	64	58	47	52	19
Meigs	96	64	44	22	25	34	BD

According to the ***Development of Emissions Inventory Methods for Wildland Fire*** Report of February 2002 prepared by EC/R, Incorporated, for EPA (page 40), grassland fires produce about twice the magnitude of NOx emissions factors than forest fires. The Kansas agricultural fires can be classified as grassland fires for emissions purposes. If this report is correct, it is not surprising that ozone levels in nearby states appear to have been affected by the emissions from these fires.

Request to Flag: Ozone data from April 12, 14, and 15;
$PM_{2.5}$ data from April 15

Event 2- Canadian Fires from Western Ontario June 23-29, 2003

	Soddy-Daisy Ozone 470651011	VAAP Ozone 470650028	Meigs Ozone 471210104	Soddy $PM_{2.5}$ 470651011	East Ridge $PM_{2.5}$ 470650031	UTC Col CORE $PM_{2.5}$ 470654002	Walker Co. GA $PM_{2.5}$ 132950002
June 23	63	75 (9th Max)	64			VD 19.2	
June 24	85 (3rd Max)	98 (2nd Max)	84 (1st Max)				
June 25	97 (1st Max)	103 (1st Max)	83 (2nd Max)				
June 26	73 (9th Max)	71	82 (4th Max)	38.1 (1st Max)	44.3 (1st Max)	41.4 40.2 (1st Max)	46.9 (1st Max)
June 29	60	**61**	**59**	**Void**	38.0 (2nd Max)	39.3 37.8 (2nd Max)	

This particular event is notable in that the Fire Hazard Maps indicate smoke moving into East Tennessee from wildfires in Canada on June 23. They show East Tennessee completely covered with fire emissions on the map produced on June 25. The Fire Hazard Map is a contrived map using fire algorithm information from a number of satellite pictures. Again, the graphed speciation data indicates spikes in ozone, organic carbon, $PM_{2.5}$, potassium, calcium, silicon, and nitrates that synchronize for June 26, the speciation date one day after the exceedance. Graphically, the event appears to be an exceptional fire event.

Dave Larko of TOMS imagery has prepared a slide movie of this fire event that he has placed on the TOMS website at http://jwocky.gsfc.nasa.gov **under** TOMS news in the left menu. Scroll down to June 2003. His specially prepared TOMS pictures indicate aerosols over Hamilton County on each of the still pictures of June 19, 20, 21, 22, 23, 24, and 26. Regular TOMS imagery indicates aerosols roughly over Hamilton County on the 27, 28, and 30. TOMS imagery cannot show aerosols from ground level to approximately 10,000 feet. Therefore, if fire emissions dropped to the surface on June 25 and June 29, they would not be indicated on TOMS imagery, but possibly on other imagery that shows ground level. If the aerosols are shown on TOMS imagery for June 24th and 26th, they were likely there also on the 25th as the Fire Hazard Map for that date indicates using other satellite imagery. If the aerosols are shown on June 28 and 30, they were likely there on the June 29 but at ground level, thus not detectible by TOMS, as indicated by the second highest $PM_{2.5}$ recorded for the year at the East Ridge and UTC sites (unfortunately I did not keep a copy of the Fire Hazard Map for June 29. They are not archived on the website for more than a few months).

Again, we maintain that all elevated data in the same general air mass during an established exceptional event merits flagging, especially those obviously affected but just

under the standard as in ozone data from Meigs County for June 24, 25, and 26. Whether the data exceeds or not is irrelevant if there is no doubt the data was significantly affected by the event.

Some consideration should be given in terms of flagging an elevated nonexceedance to the fact that there is an additional variable in comparison of data between the Meigs site and Hamilton County sites because they have different operator technicians. At 85 ppb, a 2% variation in operation between the operators (which is a reasonable variability) can be 1.7 ppb. For example, on June 24, the Soddy and Meigs sites, closest together of the three ozone sites, are 1 ppb apart, Soddy exceeding and Meigs not exceeding. In 2002 the Meigs site had ten (10) more exceedances of the 8-hour standard than Soddy did, but in 2003 Meigs had no exceedances of the standard where Soddy, nearby, had three (3).

My observation from studying all three of these events is that the heavy aerosol cloud shows up on TOMS about every other day on days of heavy aerosol. It shows up lightly on the "off" day. This "every other day" phenomenon may be related to the way TOMS pictures are gathered and processed. TOMS is limited in that each picture in the composite is an individual picture, each taken at a different time of day and pieced together. Therefore, an event for a specific location on a specific day can easily be missed.

A residence time graph Figure 2.1.2, page 2-3, (Hinds, 1982) published in EPA's ***Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}*** indicates that $PM_{2.5}$ can remain in the air for a minimum of about 6 days and up to 30 days depending upon whether it is still or stirred.

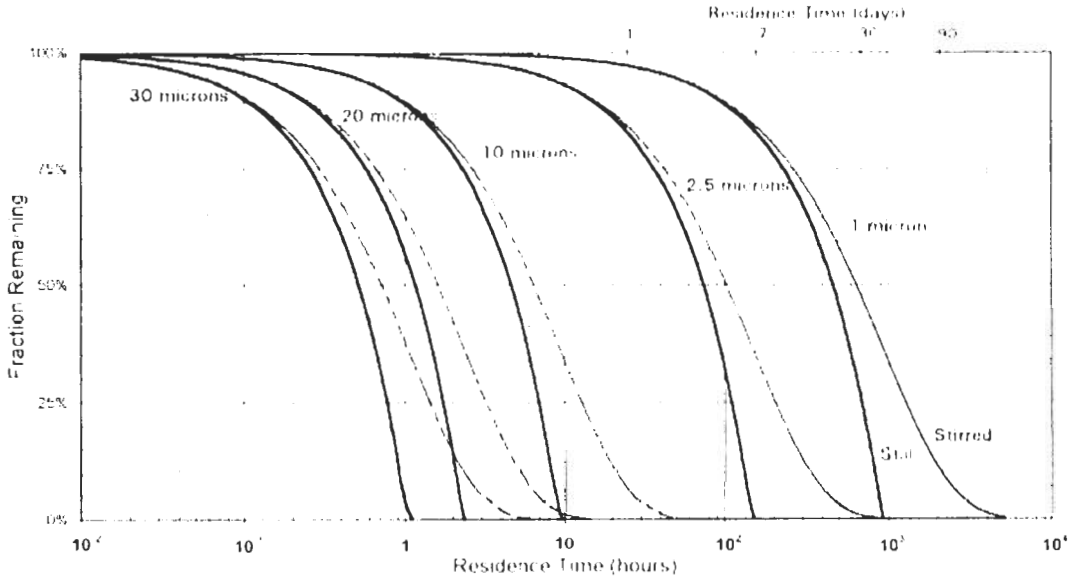


Figure 2.1.2. Residence times for homogeneously distributed particles of different aerodynamic diameters in a 100 m deep mixed layer. Gravitational settling is assumed for both still and stirred chamber models (Hinds, 1982).

As you are well aware, ozone production is site specific even on exceptional event days because it is dependent on dry conditions, wind, sunlight, and mixing height- just to name a few of the variables. Fire precursors from an event can be at or over every ozone site and only affect one or two sites, depending upon the variables at the site itself. In fact, it can be raining or cloudy at one site and have bright sunshine at a site two miles away. Aerosols can be so heavy during an event that they block the sun at a site and prevent ozone production entirely. This was known to have happened in 1998 during the Mexican Fire event at some sites in the US.

In the June incident, June 24 and 25 should be flagged, at a minimum, for ozone at all sites. We believe that weather conditions favored ozone formation at the Meigs' site on June 26 as part of the same event (see special TOMS imagery). We support flagging all the ozone data on June 26. All $PM_{2.5}$ from June 26 and 29 should be flagged regardless of whether there were exceedances because of imagery proof of an extended aerosol event. The June 26 data was the **highest of the year on all $PM_{2.5}$ sites** including the Walker County site. June 29 provided the **second highest values of the year** for the East Ridge and UTC sites, the only sites that were scheduled that day.

We have not requested to flag ozone data on days of this event where none of the sites appeared more than slightly elevated even though $PM_{2.5}$ was significantly elevated. We believe that on those days weather conditions were not conducive to ozone formation at any site even if exceptional event fire emissions were present.

Request to Flag: Ozone data from June 24, 25, 26
$PM_{2.5}$ data from June 26 and 29

Event 3- Canadian Fires
August 19-28, 2003

	Soddy-Daisy Ozone 470651011	VAAP Ozone 470650028	Meigs Ozone 471210104	Soddy $PM_{2.5}$ 470651011	East Ridge $PM_{2.5}$ 470650031	UTC Col CORE $PM_{2.5}$ 470654002	Walker Co. Georgia $PM_{2.5}$ 132950002
August 19	52	60	61	27.2 (4th Max)	33.3 (5th Max)	Void (36.2, 34.8 -flow out of spec)	34.1 (3rd Max)
August 22	60	75 (10th Max)	74		35.8 (3rd Max)	Void	
August 23	50	54	60				
August 24	61	56	62				
August 25	67	74	70	34.8 (2nd Max)	Void	37.2 37.1 (4th Max)	34.1 (4th Max)
August 26	73 (10th Max)	91 (3rd Max)	75 (8th Max)				
August 27	57	65	68				
August 28	61	63	68		24.2 (not in top 10)	26.2 25.5 (8th and 10th Max)	

The third event is smoke from wildfires in Canada shown on the Fire Hazard Maps with emissions covering Hamilton County on the pictures dated August 23, 24, and 25. The TOMS pictures indicate aerosols close to Hamilton County on August 19 and August 21, and roughly over the county on August 23, 25, and 27. Again, if the fire emissions as aerosols are indicated on August 25 and 27 on TOMS, they were there, but at ground level below detection, on August 26. The aerosol cloud trajectory can be followed and is particularly evident on the MPEG movie. Even if the cloud is not at a height where it can appear on TOMS, the trajectory shows that it was there at some point on that day. The elevated $PM_{2.5}$ data from August 19th through the 28th indicates that the smoke particulate remained in the area for days. Ozone mapping indicates that during this incident ozone seemed to be at the highest magnitude on August 26 in our region. There seems to be some correlation between the ozone mapping maps indicating high ozone and the TOMS aerosol pictures for the same days. Numerous satellite pictures show rivers of smoke moving into the US from Manitoba and Ontario.

We have, again, not requested to flag ozone data on days of this event where none of the sites appeared more than slightly elevated even though $PM_{2.5}$ was significantly elevated. We believe that on those days weather conditions were not conducive to ozone formation at any site even if exceptional event fire emissions were present.

Request to Flag: Ozone data from August 26;
$PM_{2.5}$ data from August 19, 22, 25, 28

Summary

These events provide the highest four ozone 8-hour values for the Hamilton County Soddy and VAAP ozone sites for 2003. The June event alone, imaged by Dave Larko of TOMS, provides two out of the top four on each of the Soddy and VAAP sites and three of the top four on the State of Tennessee's Meigs County site for 2003.

In 2003 for $PM_{2.5}$, five out of the top six values for East Ridge Maxwell Road, four out of the top six for UTC, four out of the top six for Soddy-Daisy, and four out of the top five for Walker County, Georgia, Suggs Street, appear to be related to the exceptional events. These data values affect the data summaries in two different quarters, consequently affecting the yearly $PM_{2.5}$ average for 2003.

We believe that the graphed $PM_{2.5}$ speciation data indicating synchronizing peaks for all three incidents and specially prepared TOMS slide movies of unusual aerosols for all three incidents authenticate that these incidents were exceptional fire events.

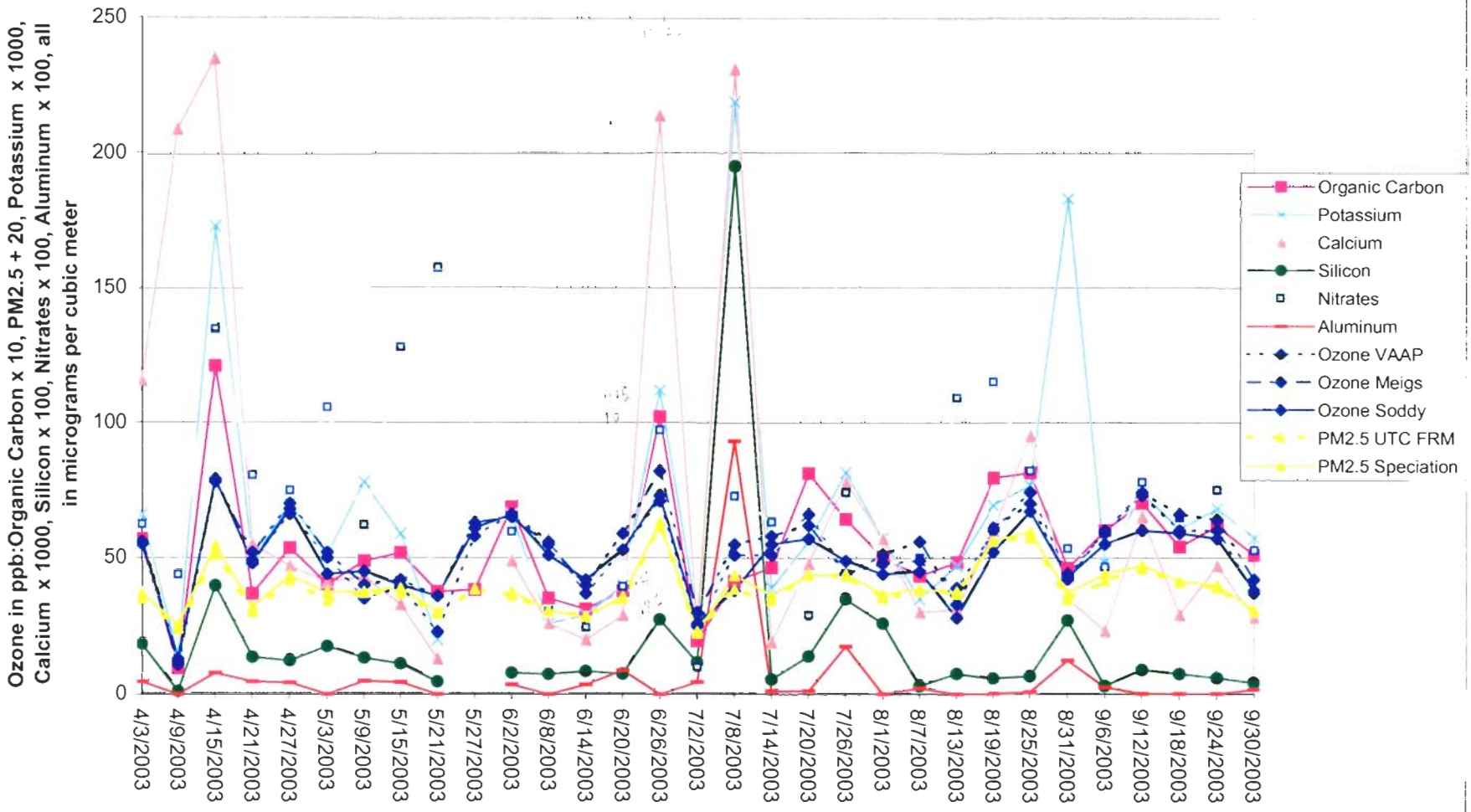
If you should need any further information, call me at (423) 643-5980. If this new phone number does not work, call me at my old phone number of (423) 668-2561.

Sincerely,

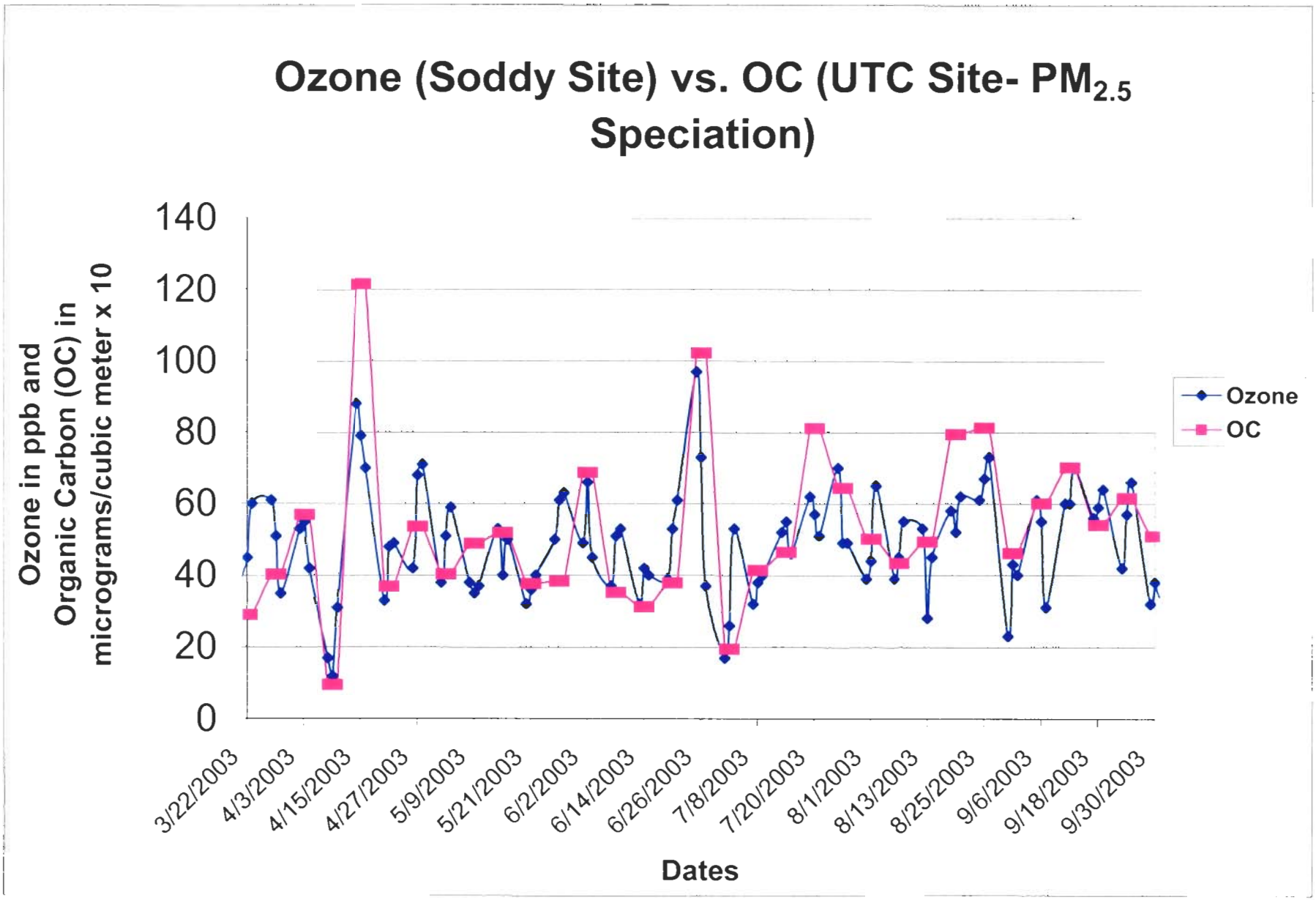
Kathy S. Jones
Air Monitoring Manager

C: Mr. Jackie Waynick, State of Tennessee (entire package)
Ms. Susan Zimmer-Dauphinee, State of Georgia (letter only)
Ms. Beverly Banister, EPA (letter only)
Mr. Fred Dimmick, EPA (package)
Mr. Richard Guillot, EPA (letter only)

Ozone (All Sites) vs $PM_{2.5}$ FRM vs $PM_{2.5}$ Speciation vs OC vs Potassium vs Calcium vs Silicon vs Nitrates vs Aluminum (all from UTC Site-Speciation Data)



Dates-**Note 6- day schedule to make ozone data match speciation data: does not reflect ozone variations between run days. Aluminum and Silicon indicate possible Sahara Sands transport for unusual spikes. Silicon can be a biomass burning marker.


Ozone (Soddy Site) vs. OC (UTC Site- PM2.5 Speciation)
Ozone in ppb and Organic Carbon (OC) in micrograms/cubic meter x 10
140
120
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60
40
20
0
3/22/2003
4/3/2003
4/15/2003
4/27/2003
5/9/2003
5/21/2003
6/2/2003
6/14/2003
6/26/2003
7/8/2003
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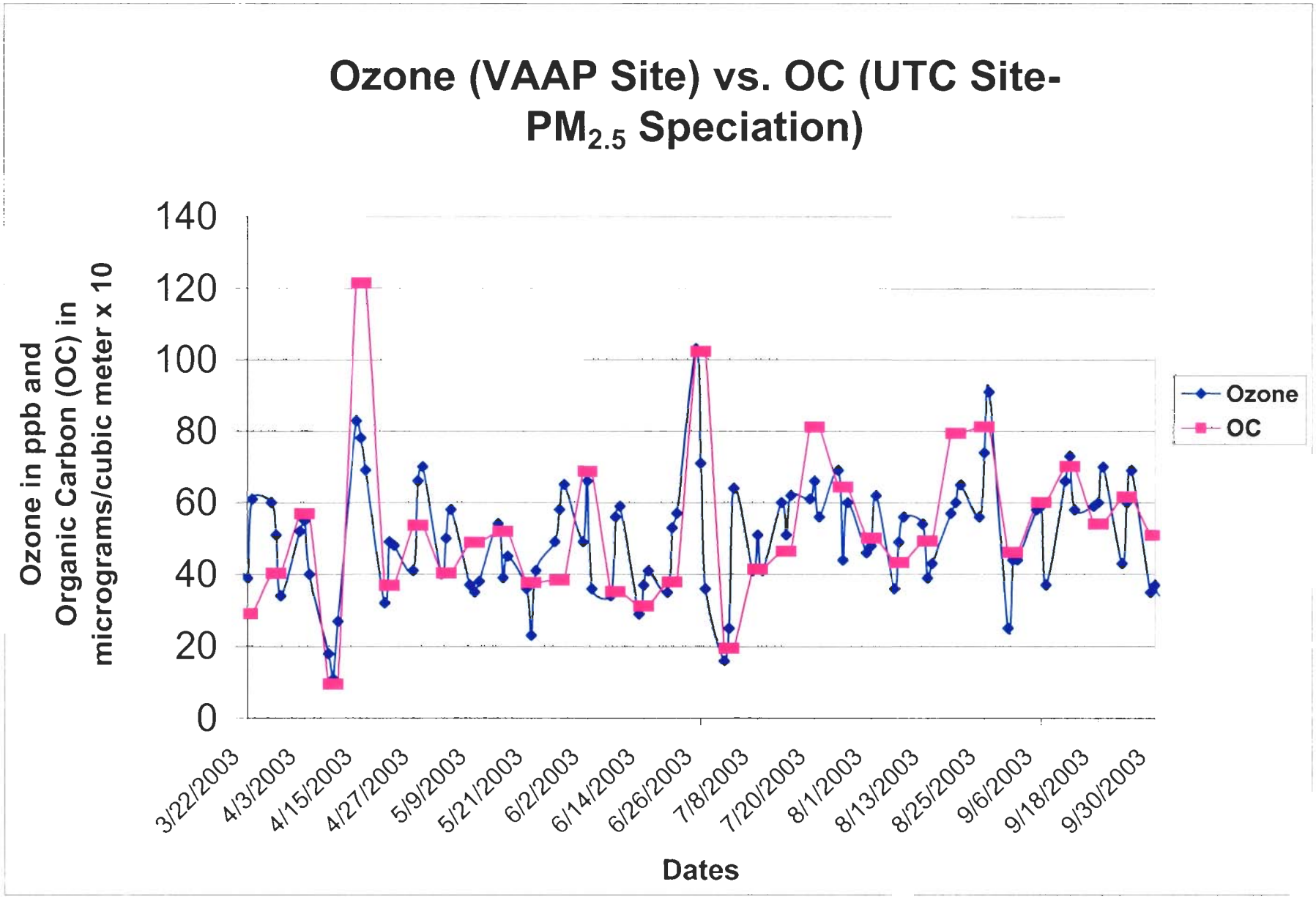
9/30/2003
Dates
Ozone
OC


Ozone (VAAP Site) vs. OC (UTC Site- PM2.5 Speciation)
Ozone in ppb and Organic Carbon (OC) in micrograms/cubic meter x 10
140
120
100
80
60
40
20
0
3/22/2003
4/3/2003
4/15/2003
4/27/2003
5/9/2003
5/21/2003
6/2/2003
6/14/2003
6/26/2003
7/8/2003
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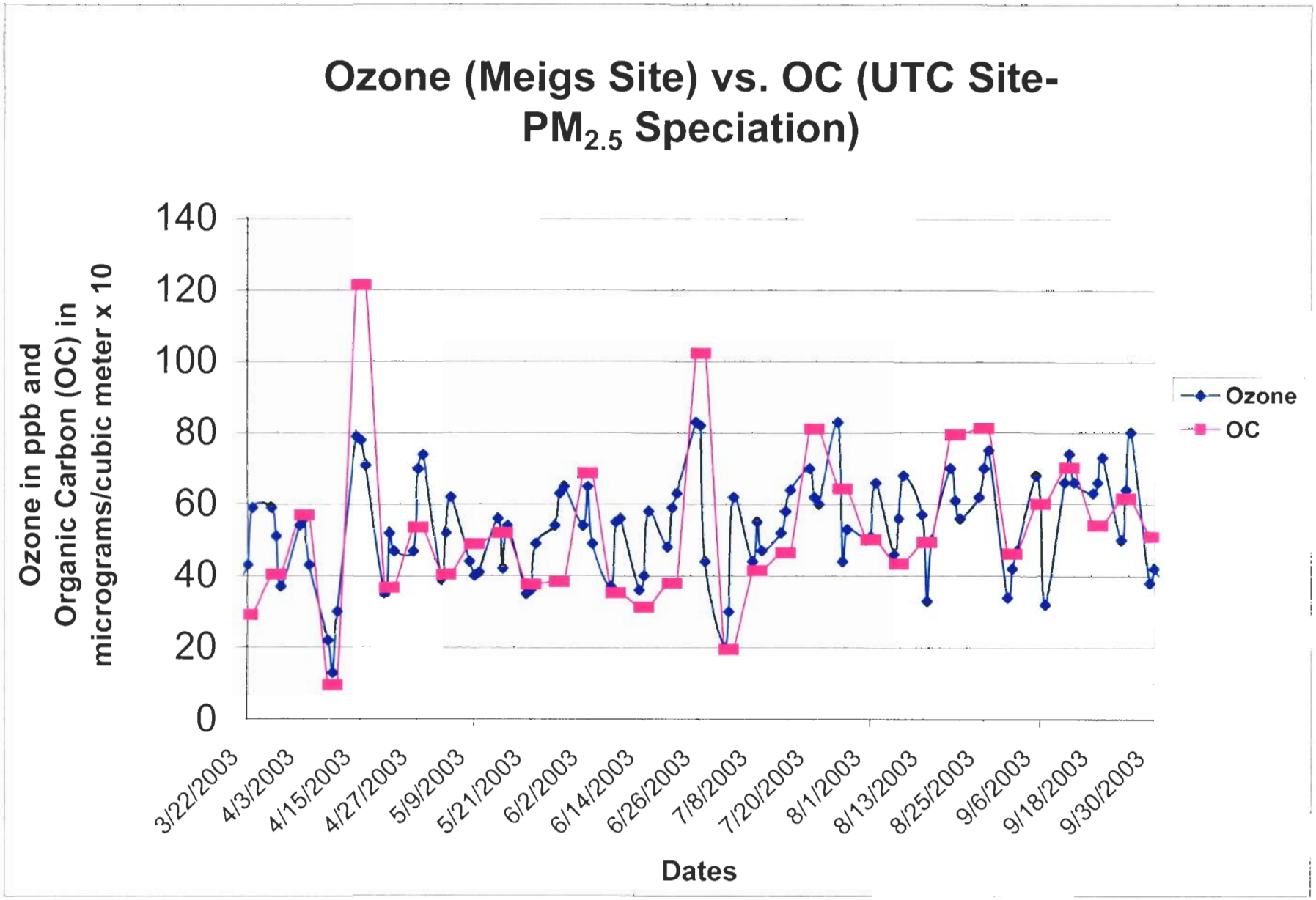
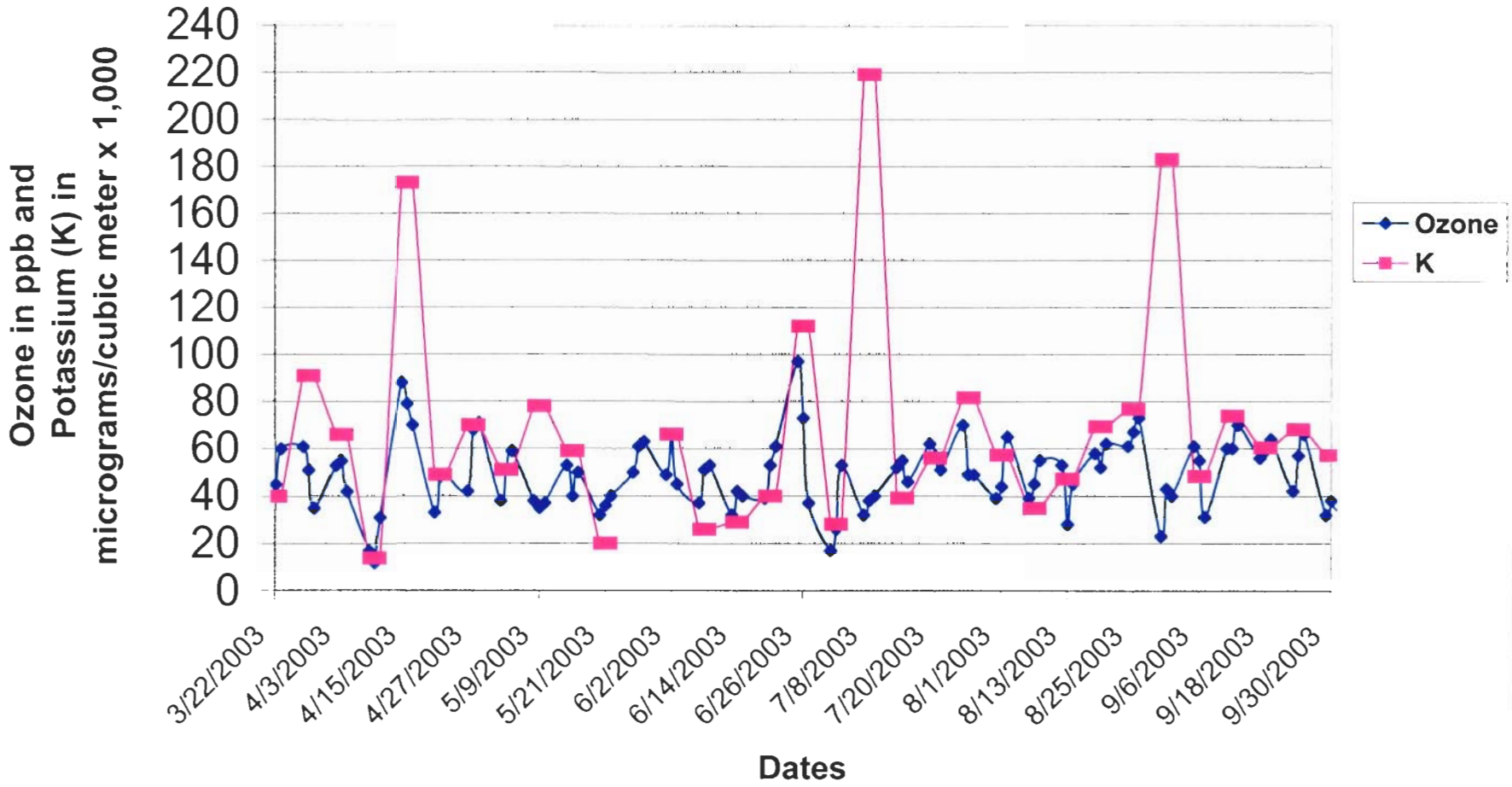
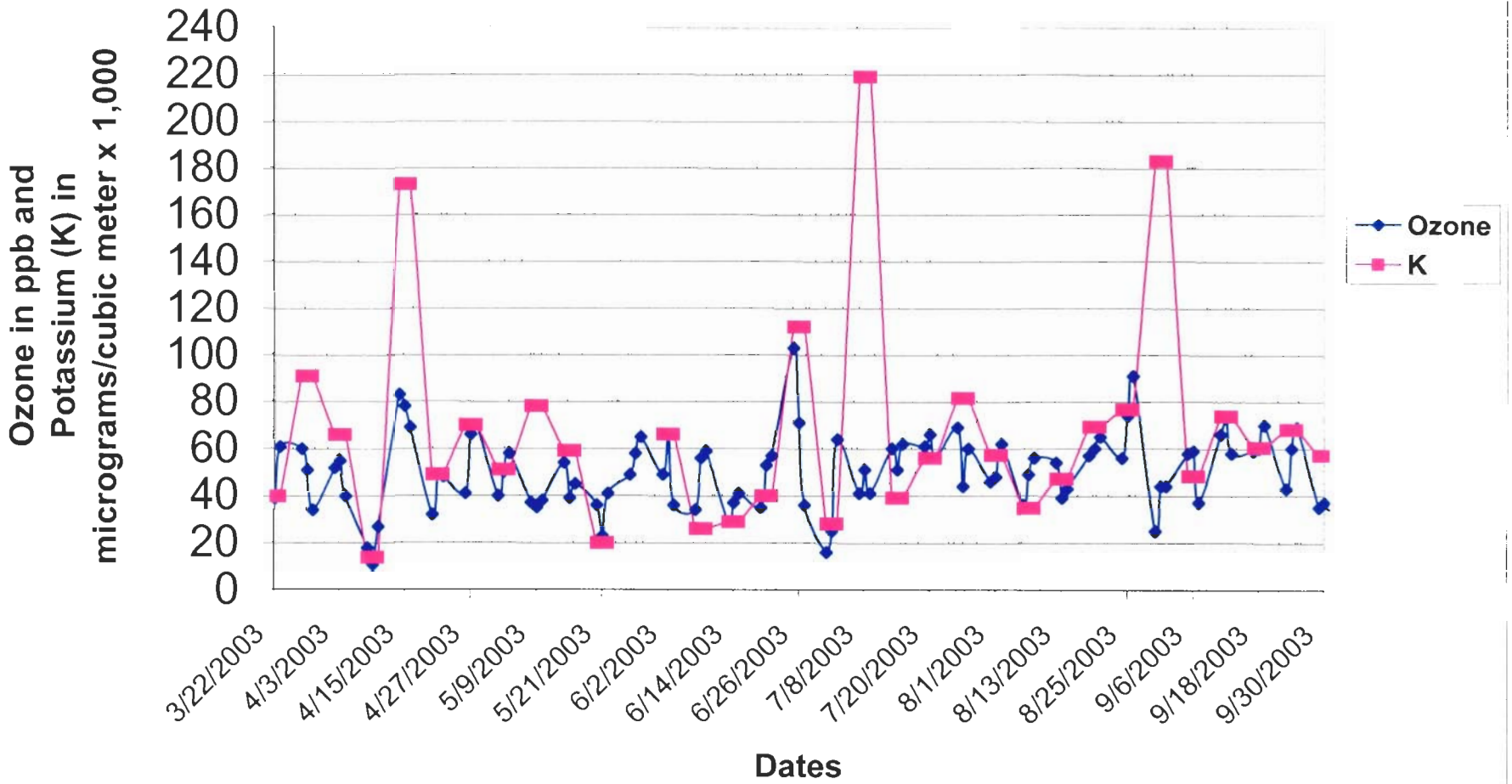
9/6/2003
9/18/2003
9/30/2003
Dates
Ozone
OC

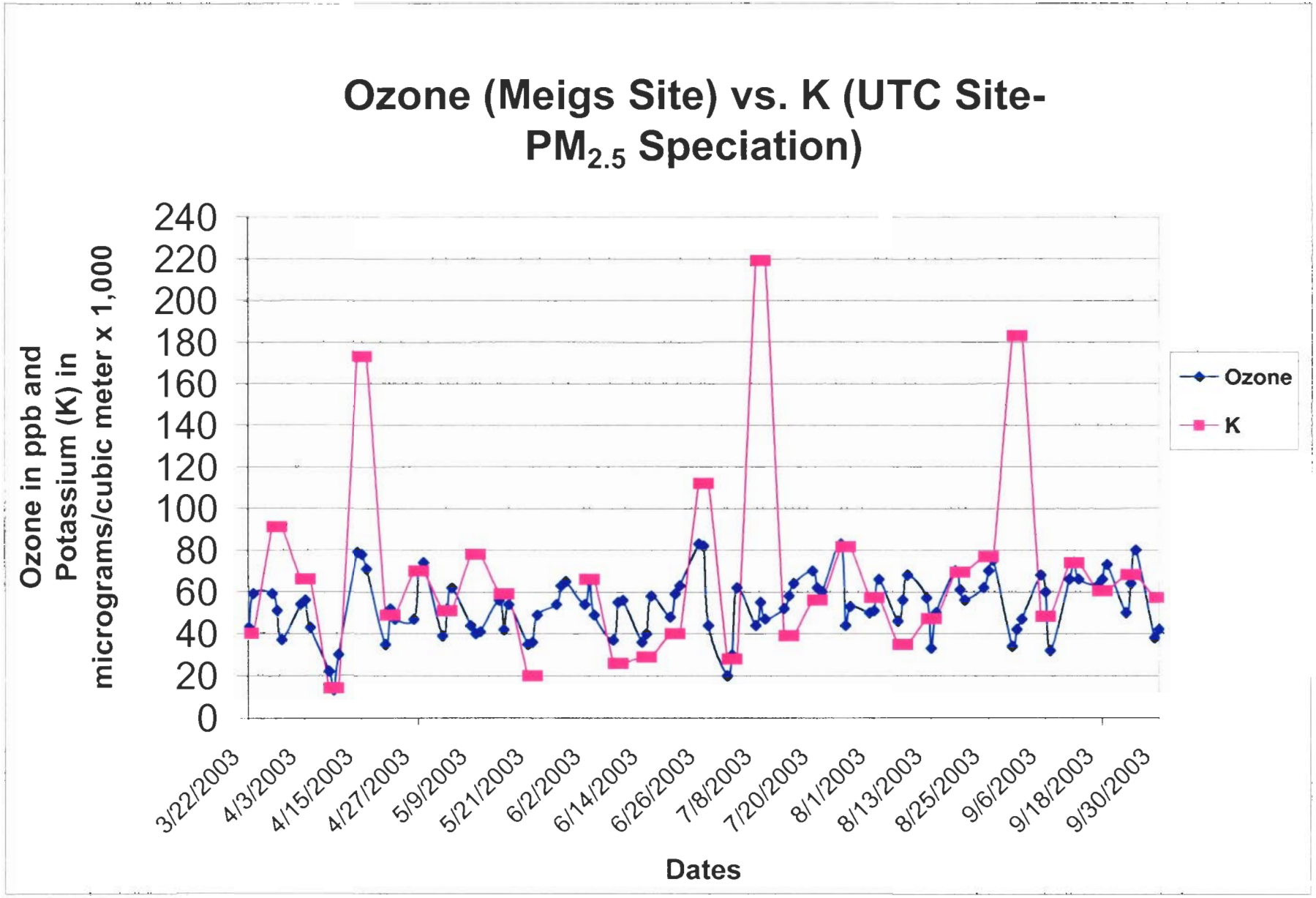

Ozone (Meigs Site) vs. OC (UTC Site- PM2.5 Speciation)
Ozone in ppb and Organic Carbon (OC) in micrograms/cubic meter x 10
140
120
100
80
60
40
20
0
3/22/2003
4/3/2003
4/15/2003
4/27/2003
5/9/2003
5/21/2003
6/2/2003
6/14/2003
6/26/2003
7/8/2003
7/20/2003
8/1/2003
8/13/2003
8/25/2003
9/6/2003
9/18/2003
9/30/2003
Dates
Ozone
OC

Ozone (Soddy Site) vs. K (UTC Site- $PM_{2.5}$ Speciation)

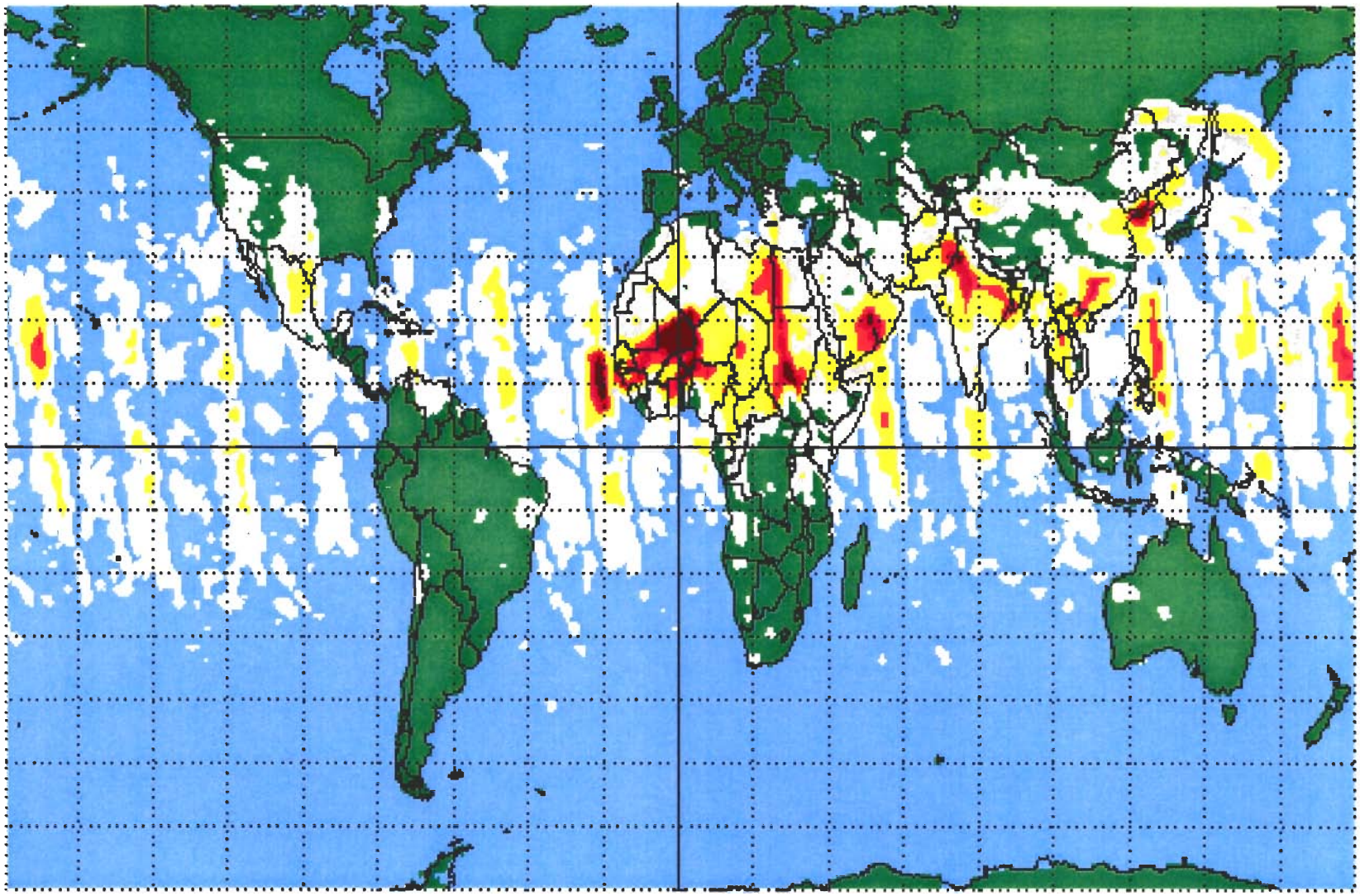


Ozone (VAAP Site) vs. K (UTC Site- $PM_{2.5}$ Speciation)




Ozone (Meigs Site) vs. K (UTC Site- PM2.5 Speciation)
Ozone in ppb and Potassium (K) in micrograms/cubic meter x 1,000
240
220
200
180
160
140
120
100
80
60
40
20
0
3/22/2003
4/3/2003
4/15/2003
4/27/2003
5/9/2003
5/21/2003
6/2/2003
6/14/2003
6/26/2003
7/8/2003
7/20/2003
8/1/2003
8/13/2003
8/25/2003
9/6/2003
9/18/2003
9/30/2003
Dates
Ozone
K

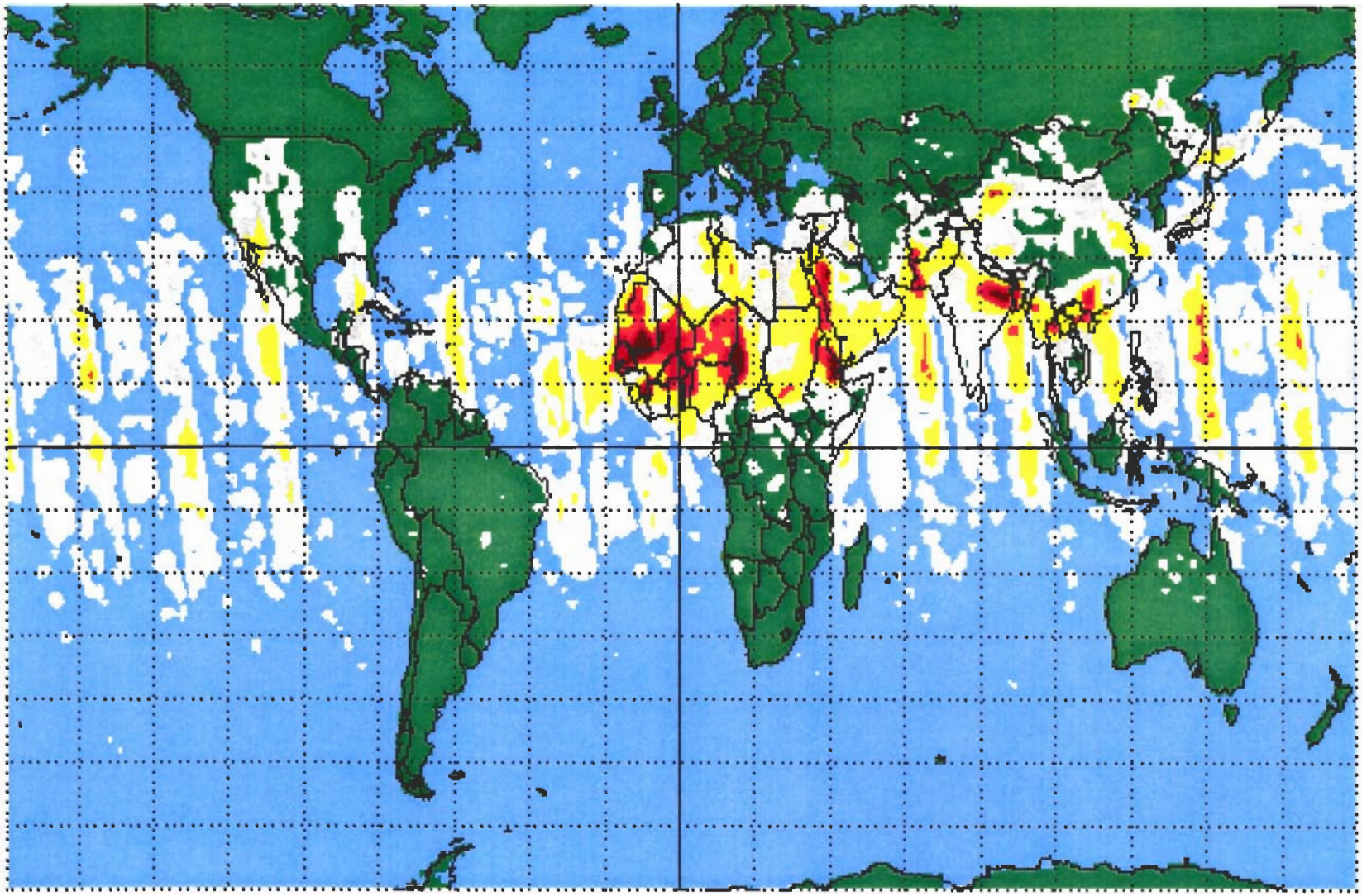
Earth Probe TOMS Version 8 Aerosol Index on April 12, 2003



Aerosol Index

Goddard Space Flight Center

Earth Probe TOMS Version 8 Aerosol Index on April 13, 2003



1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5>

Aerosol Index

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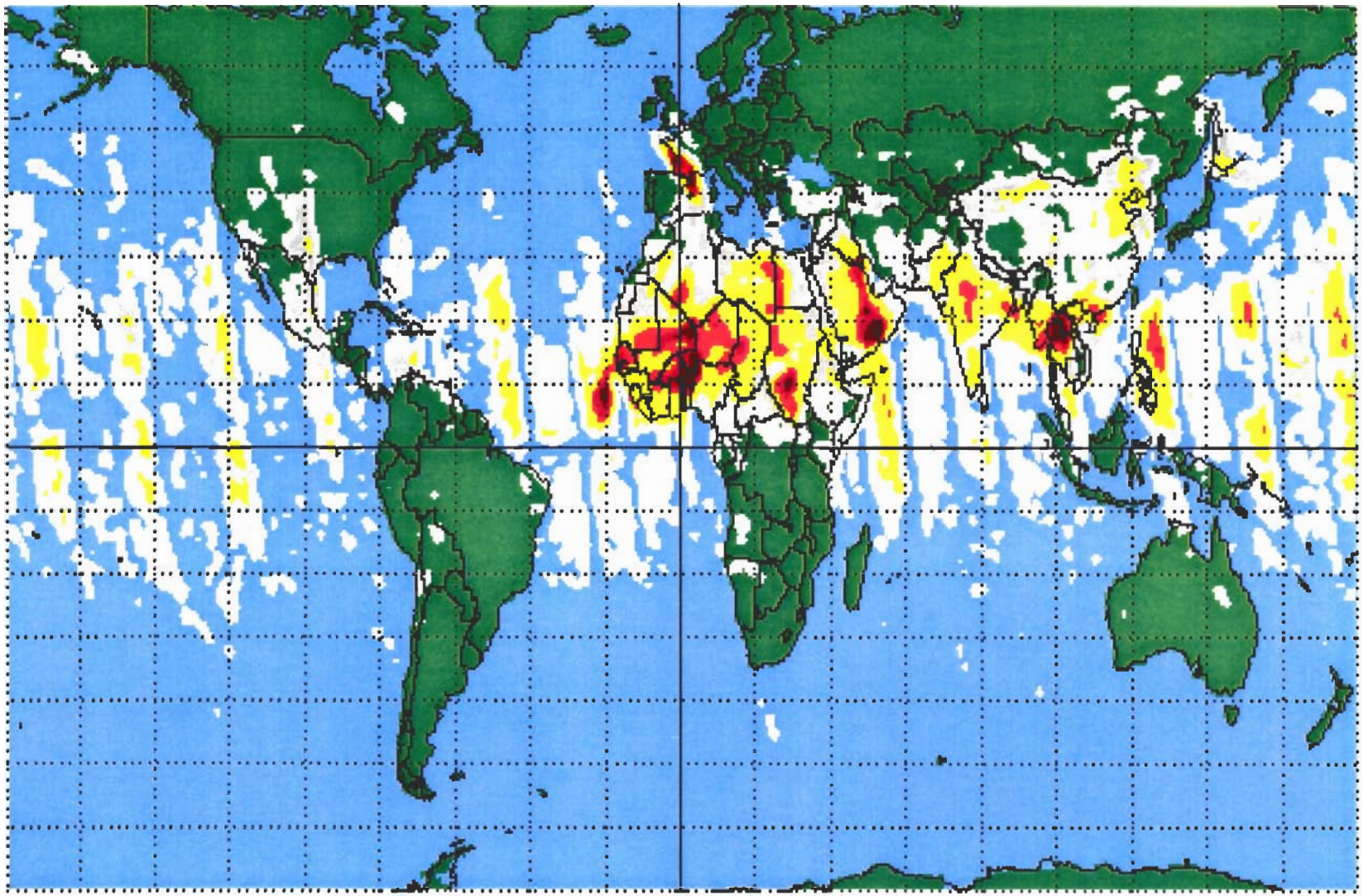
Earth Probe TOMS Version 8 Aerosol Index on April 14, 2003



Aerosol Index

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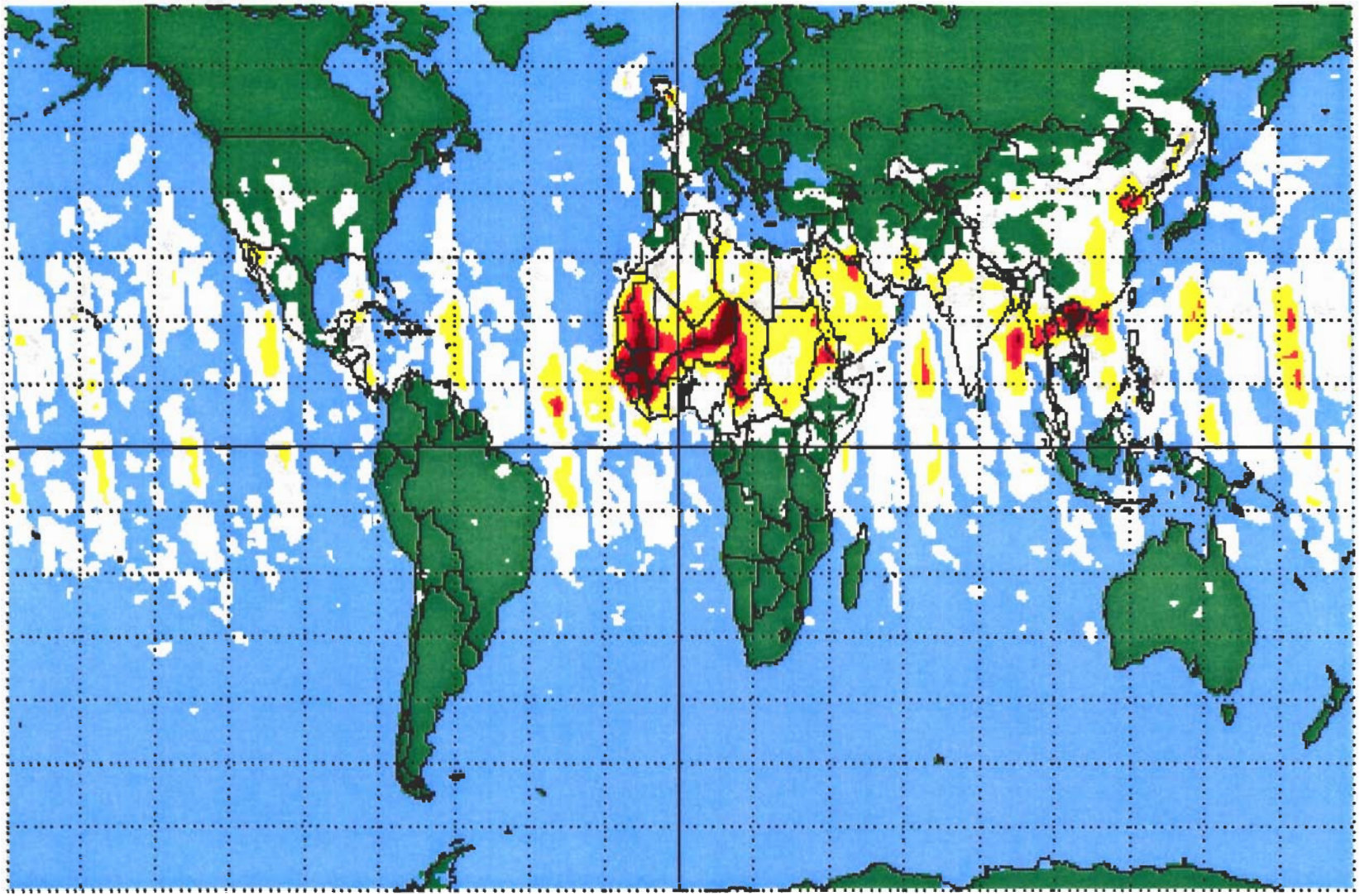
Earth Probe TOMS Version 8 Aerosol Index on April 15, 2003



1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5>

Aerosol Index

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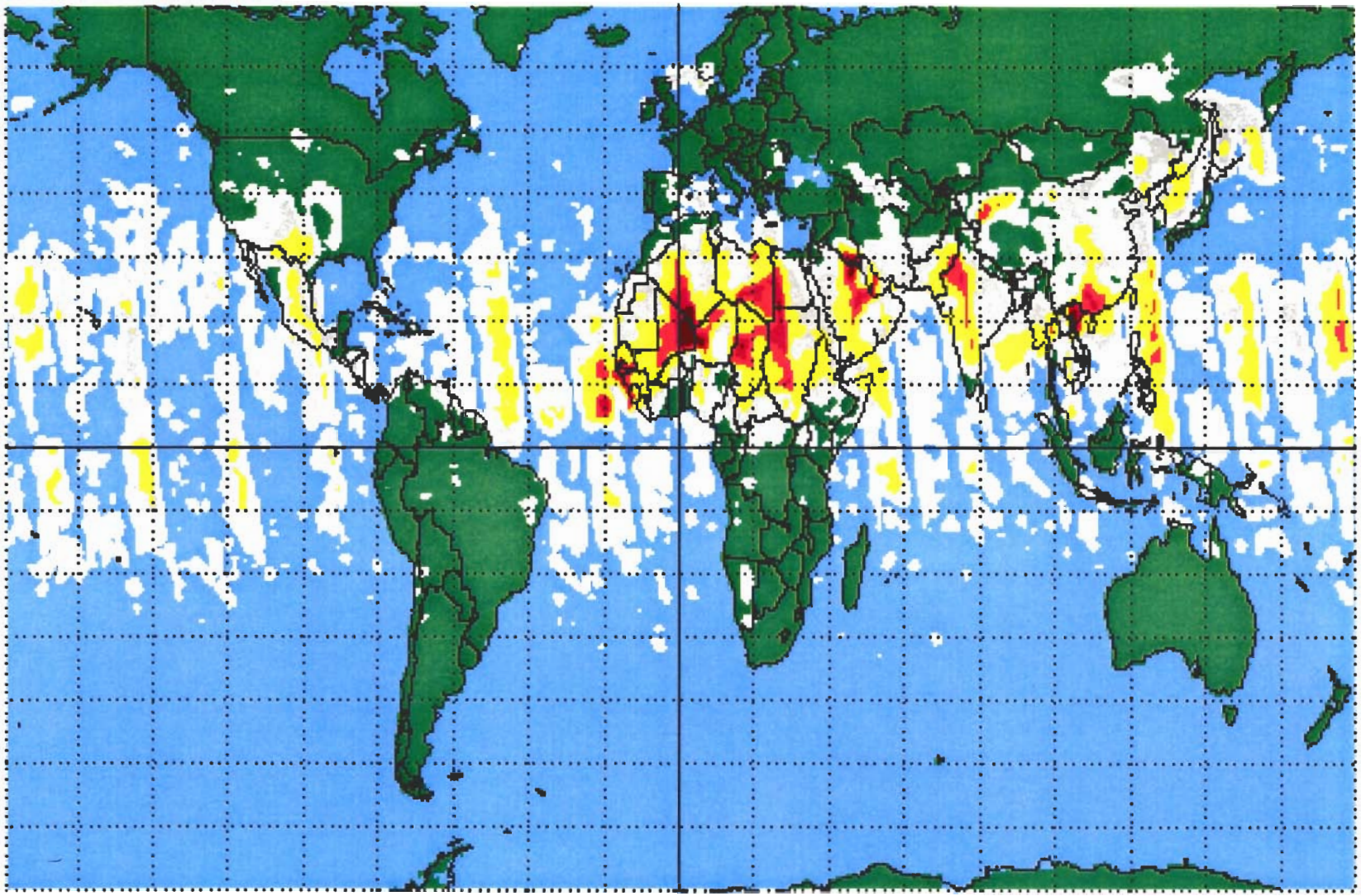
Earth Probe TOMS Version 8 Aerosol Index on April 16, 2003



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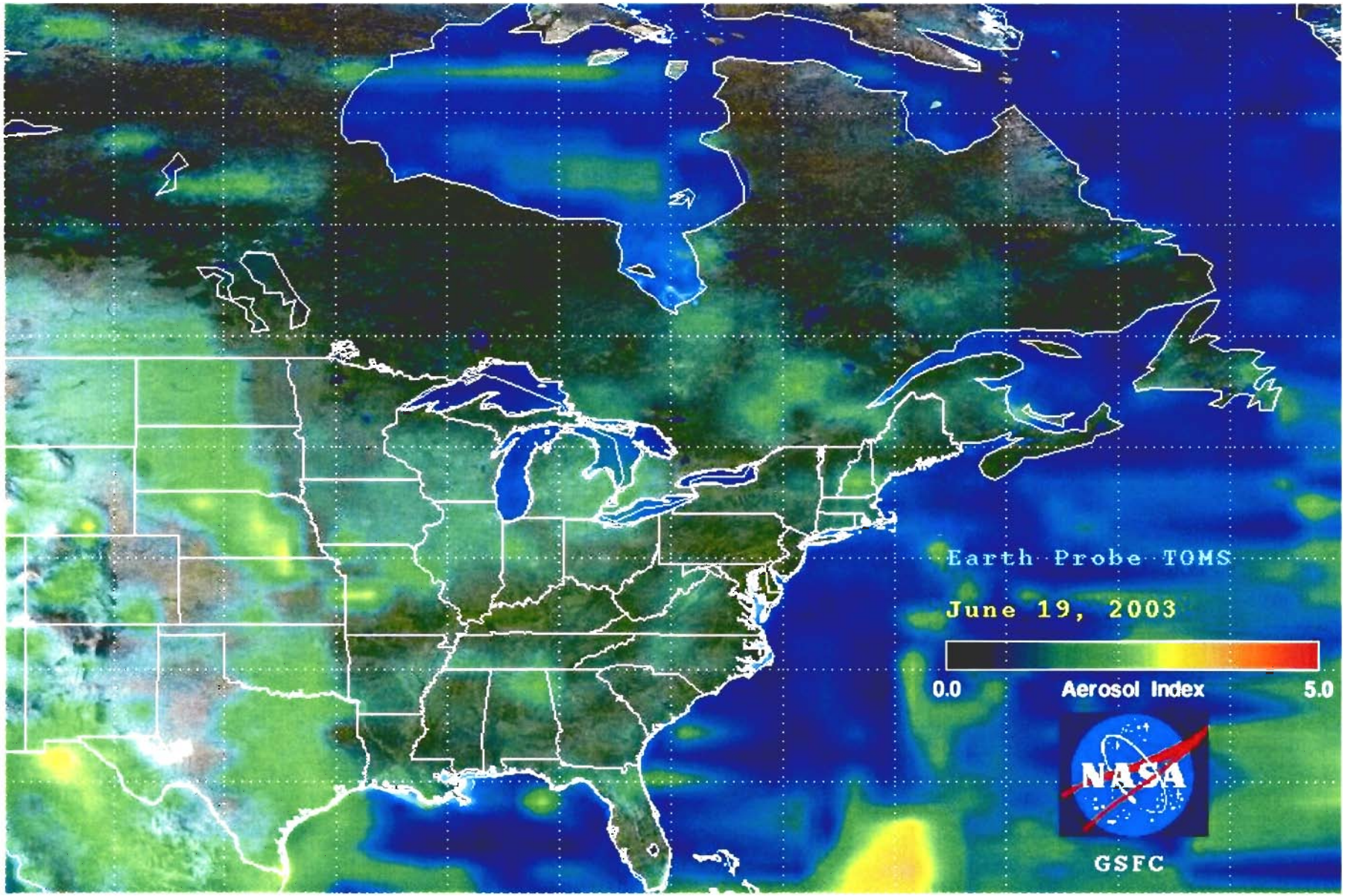
Earth Probe TOMS
June 19, 2003
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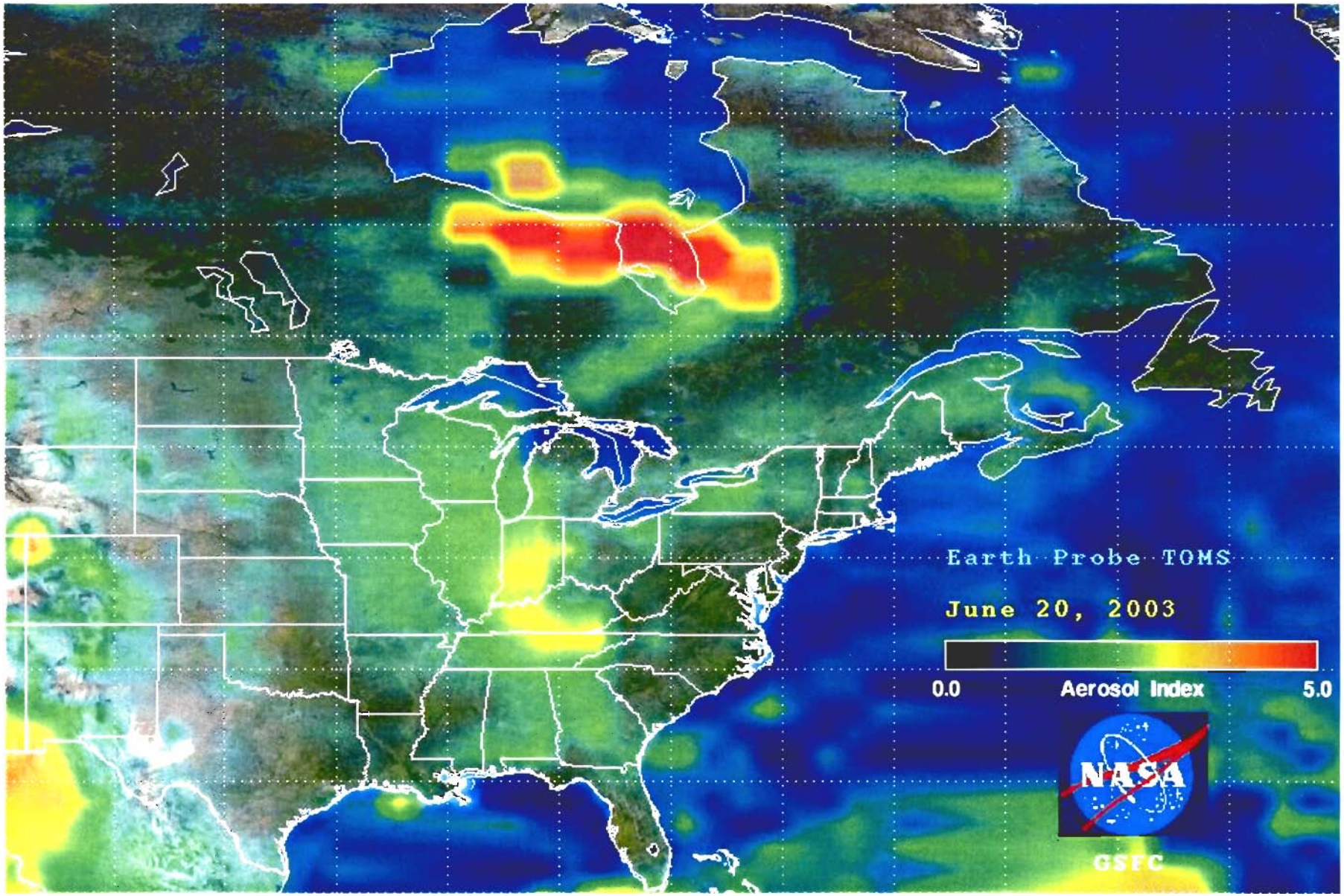
Aerosol Index
5.0
NASA
GSFC


Earth Probe TOMS
June 20, 2003
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Aerosol Index
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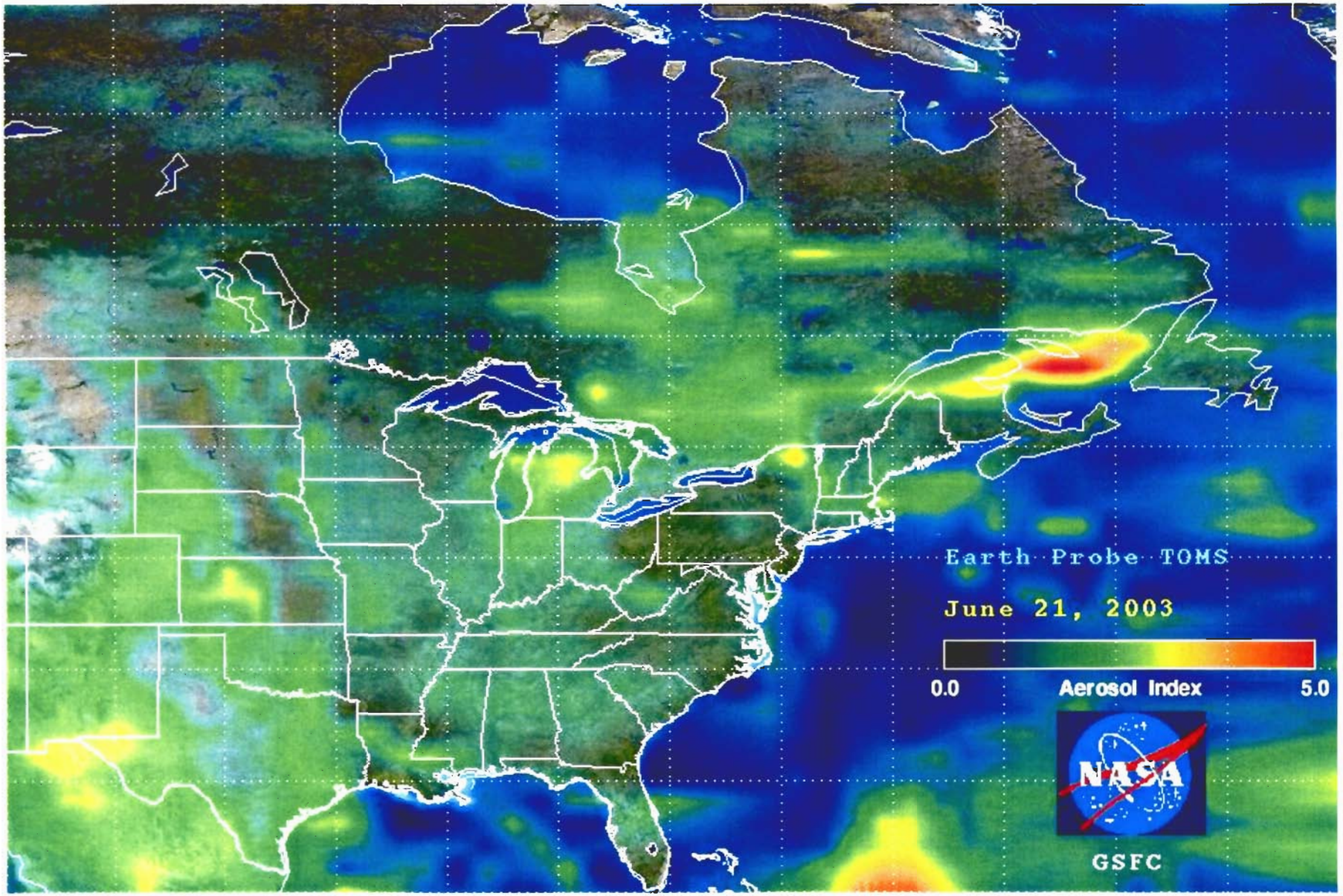
NASA
GSFC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June 21, 2003
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Aerosol Index
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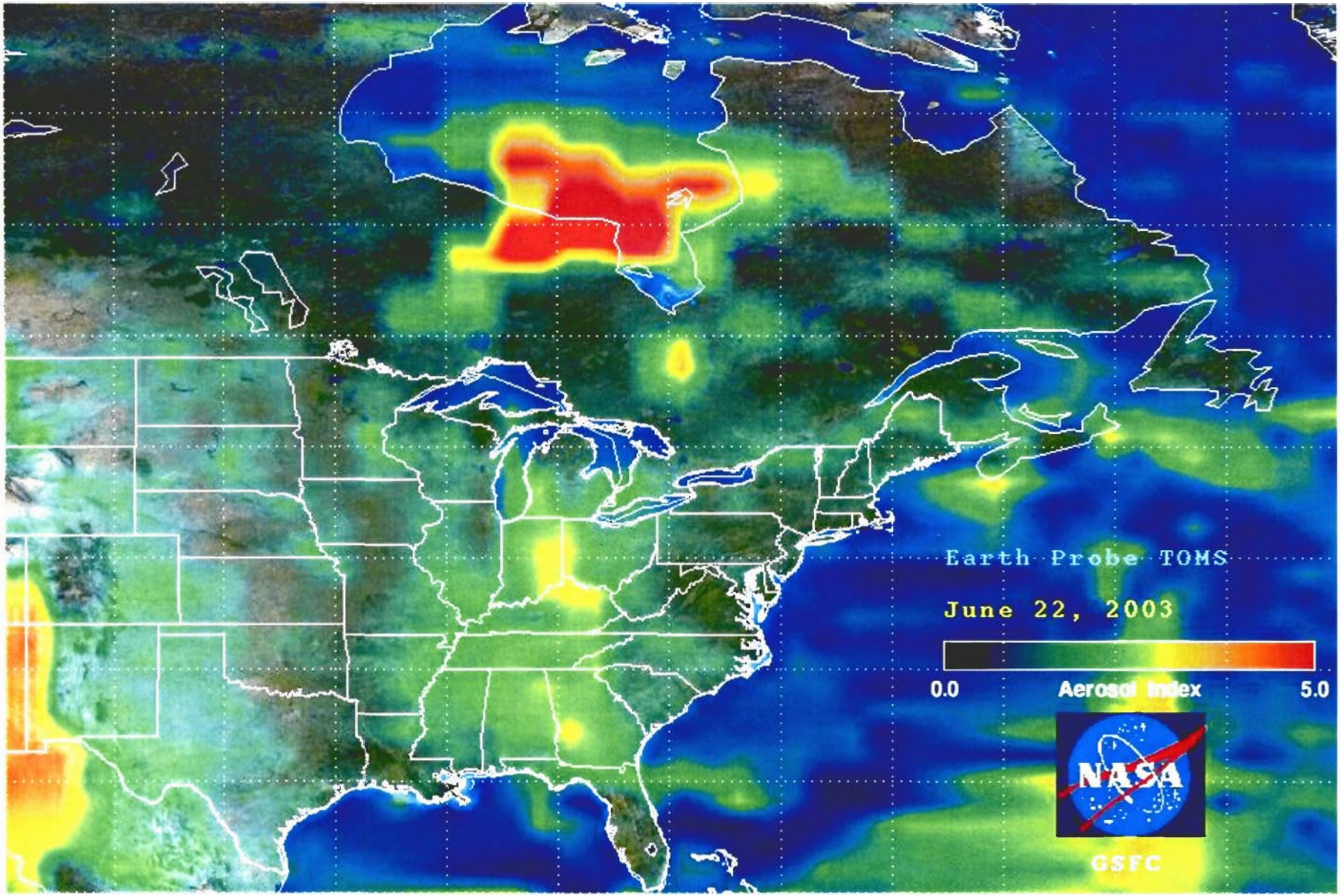
NASA
GSFC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June 22, 2003
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Aerosol Index
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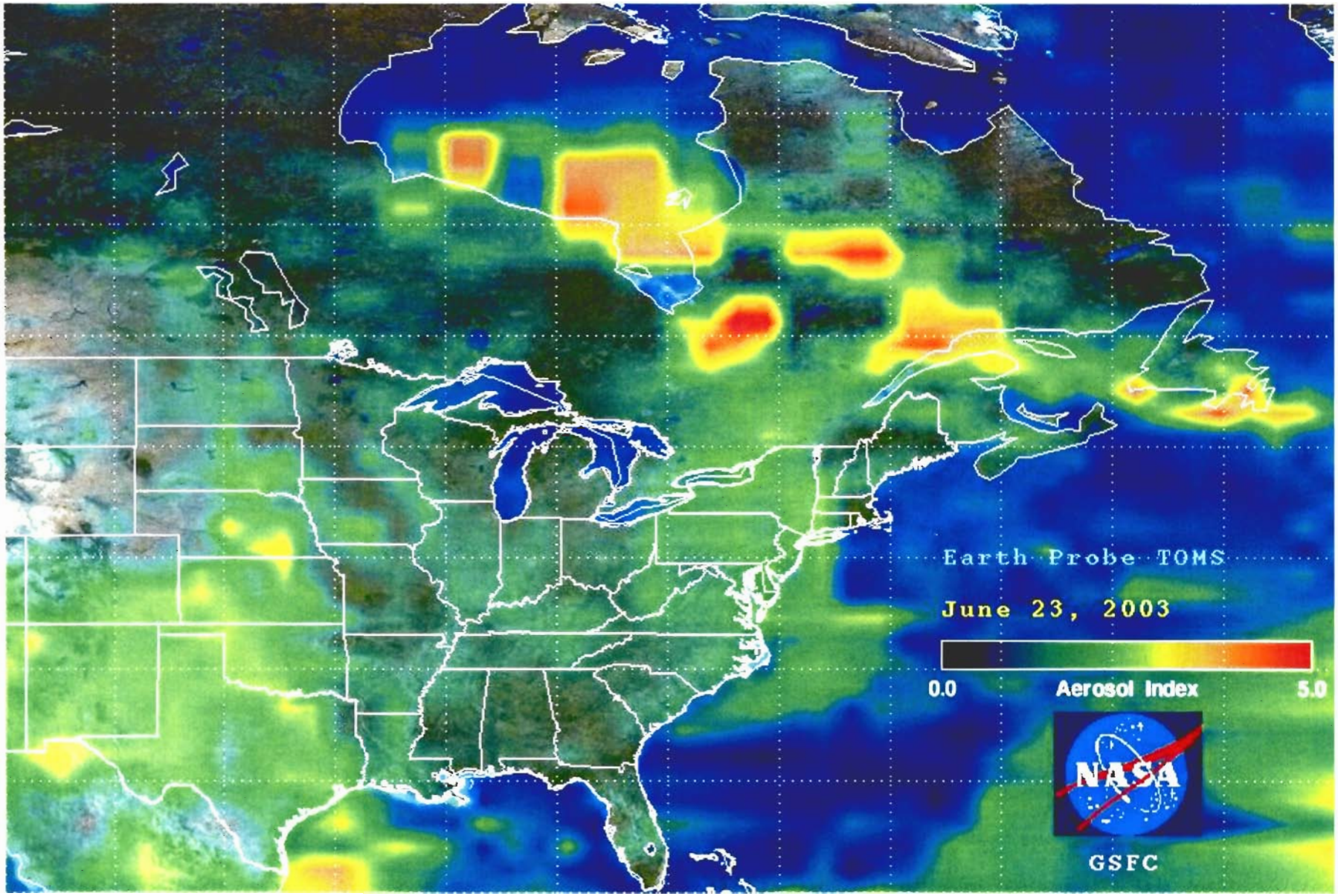
NASA
GSFC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June 23, 2003
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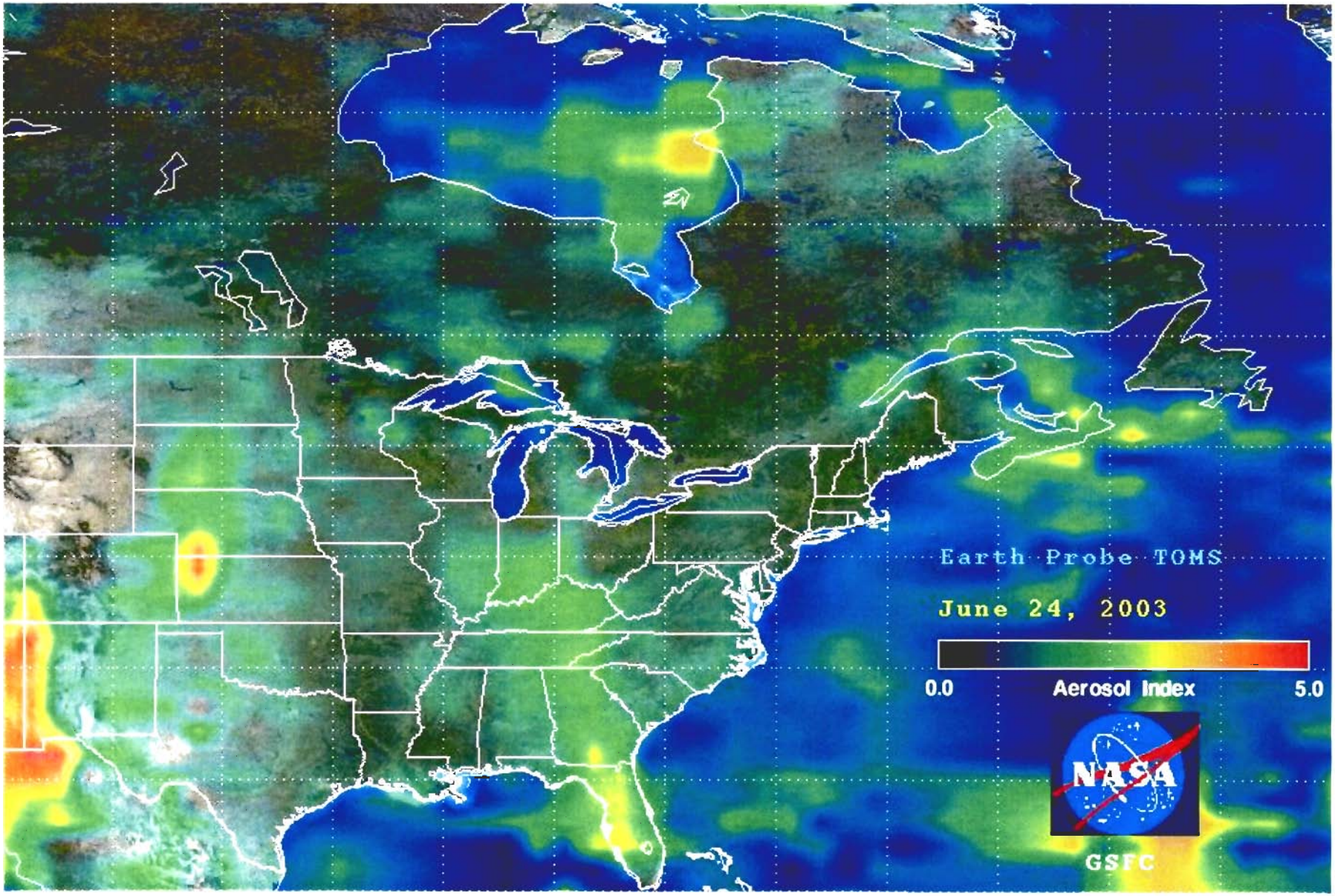
NASA
GSFC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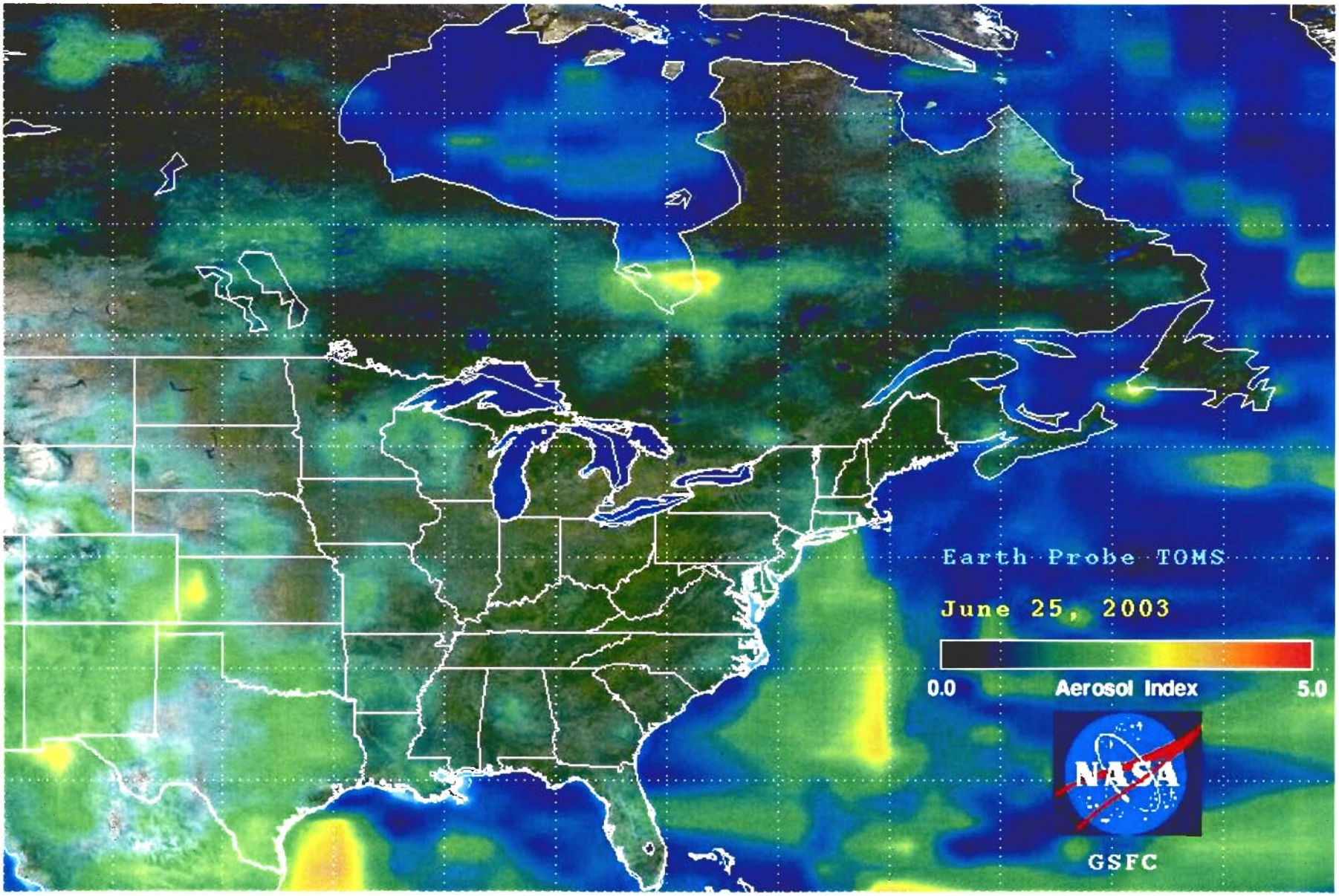
NASA
GSFC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Aerosol Index
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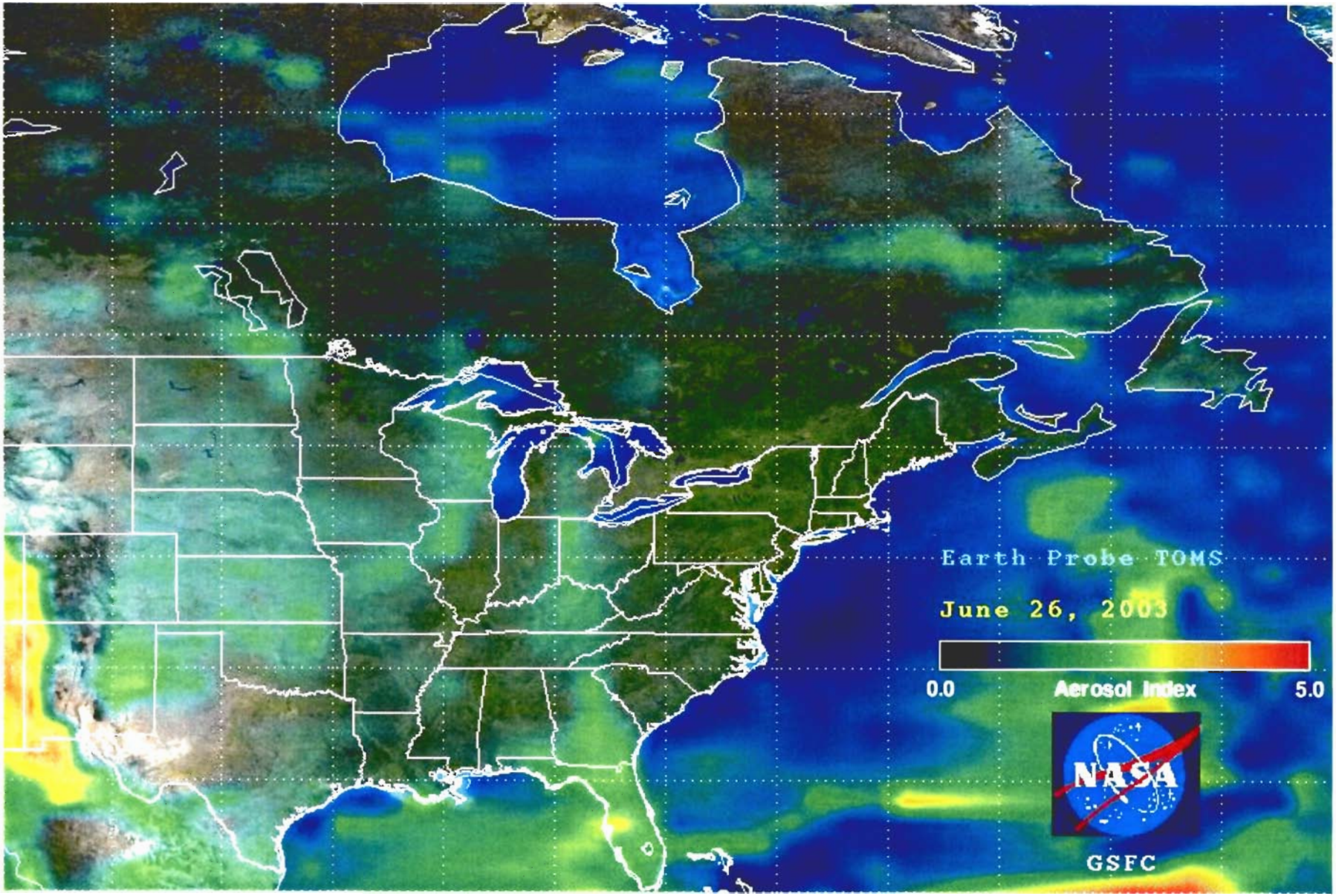
NASA
GSFC


Earth Probe TOMS
June 26, 2003
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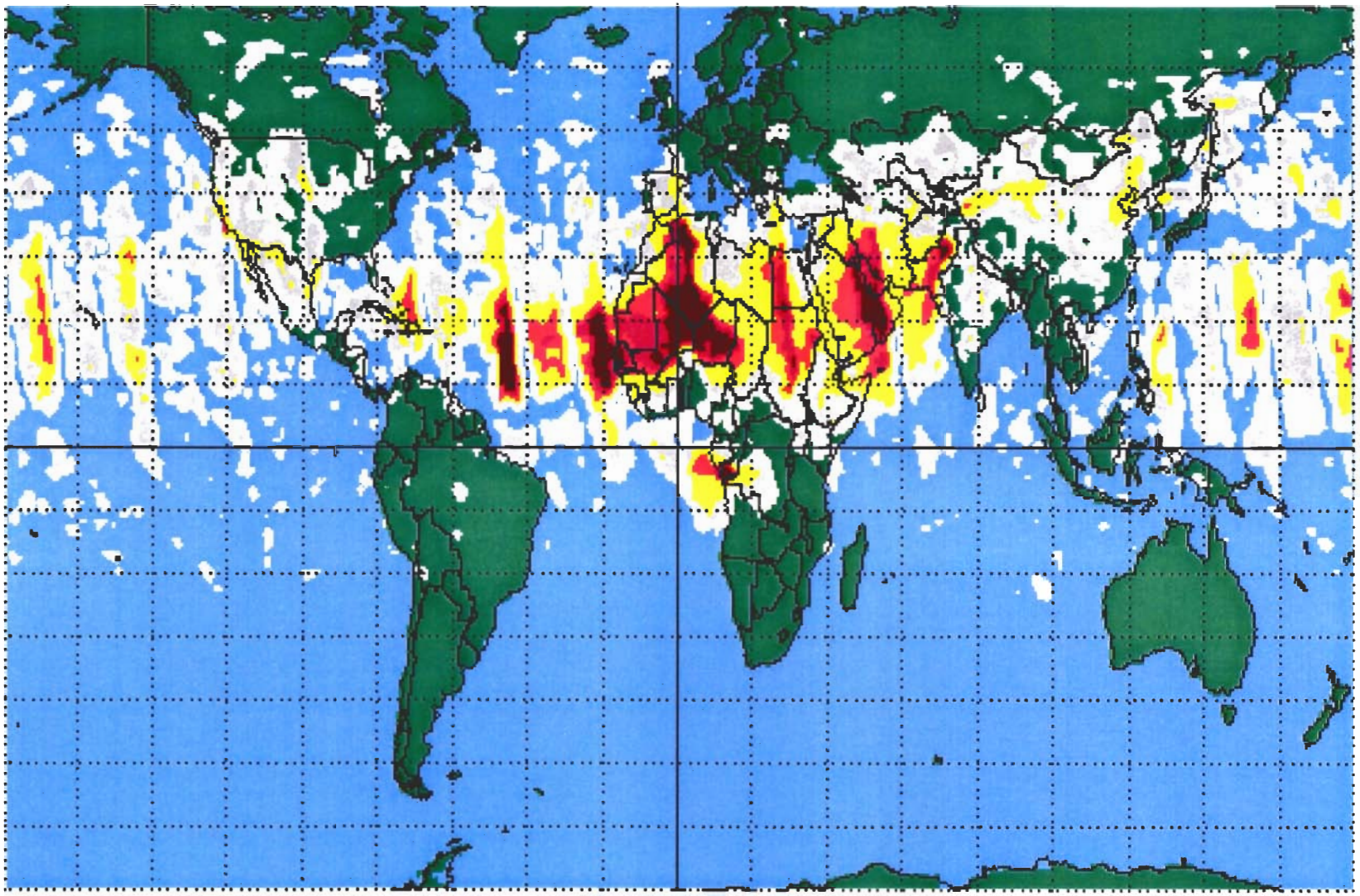
Aerosol Index
5.0
NASA
GSFC

Earth Probe TOMS Version 8 Aerosol Index on June 19, 2003



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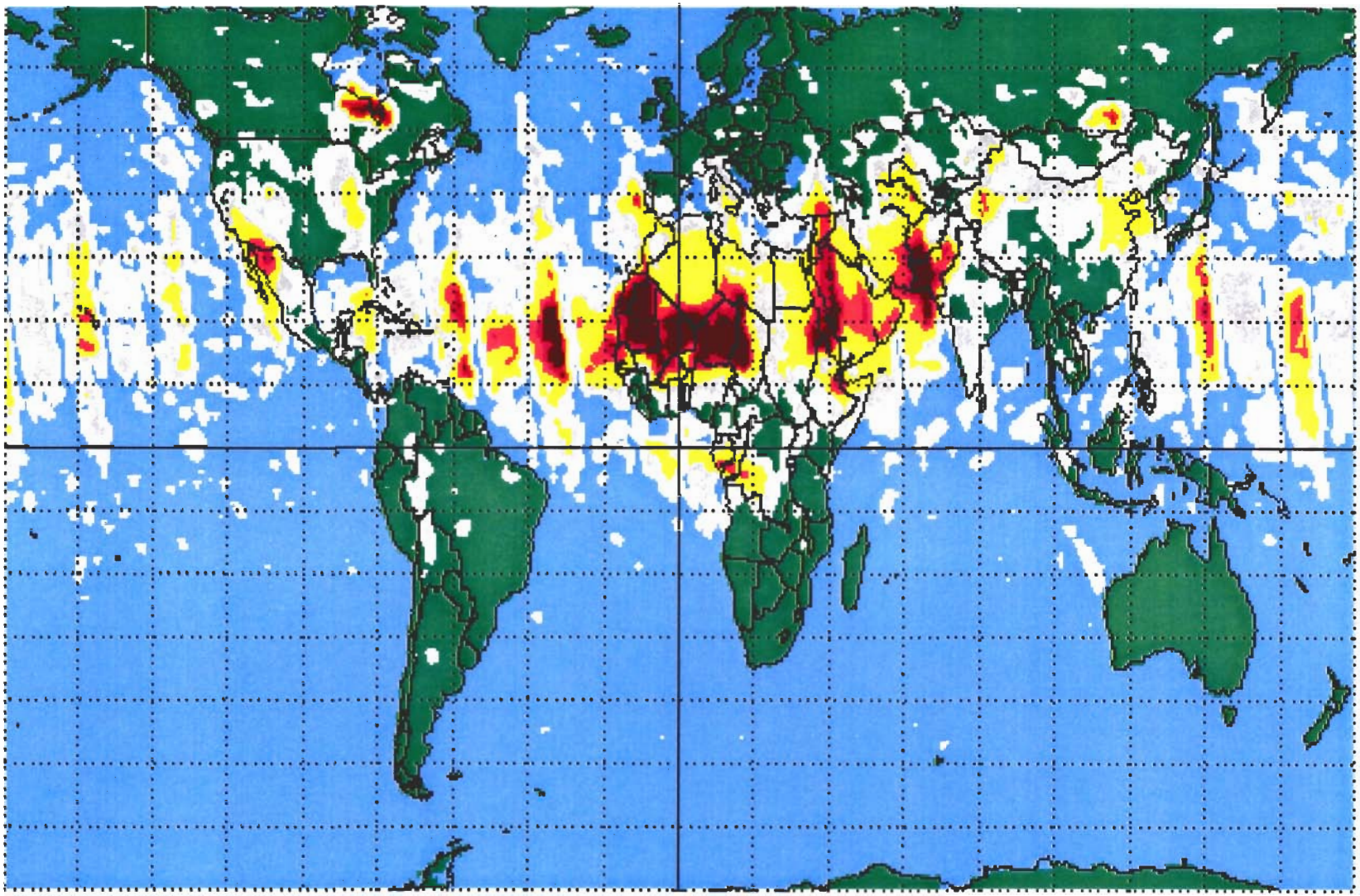
Earth Probe TOMS Version 8 Aerosol Index on June 20, 2003



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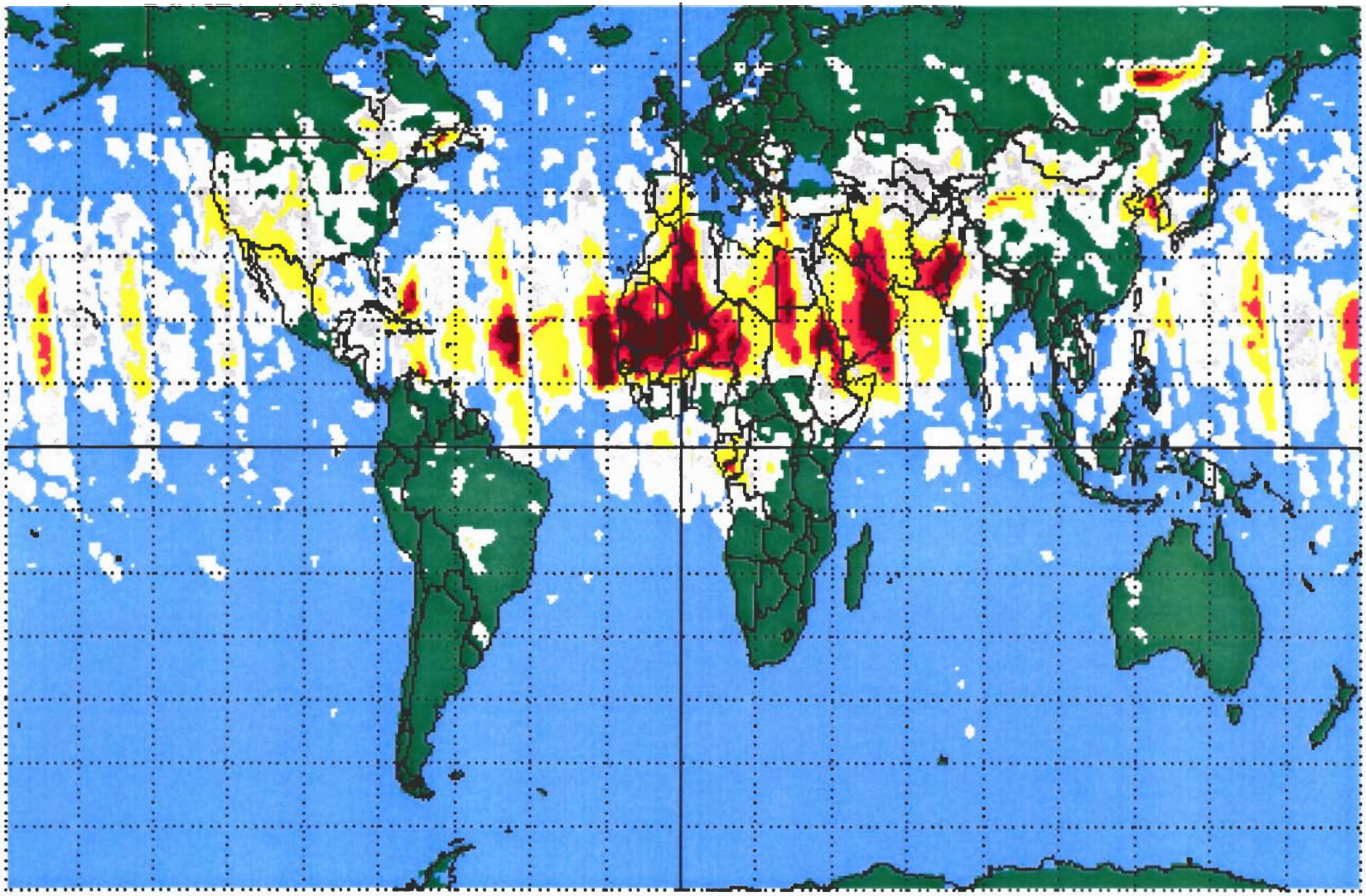
Earth Probe TOMS Version 8 Aerosol Index on June 21, 2003



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Aerosol Index

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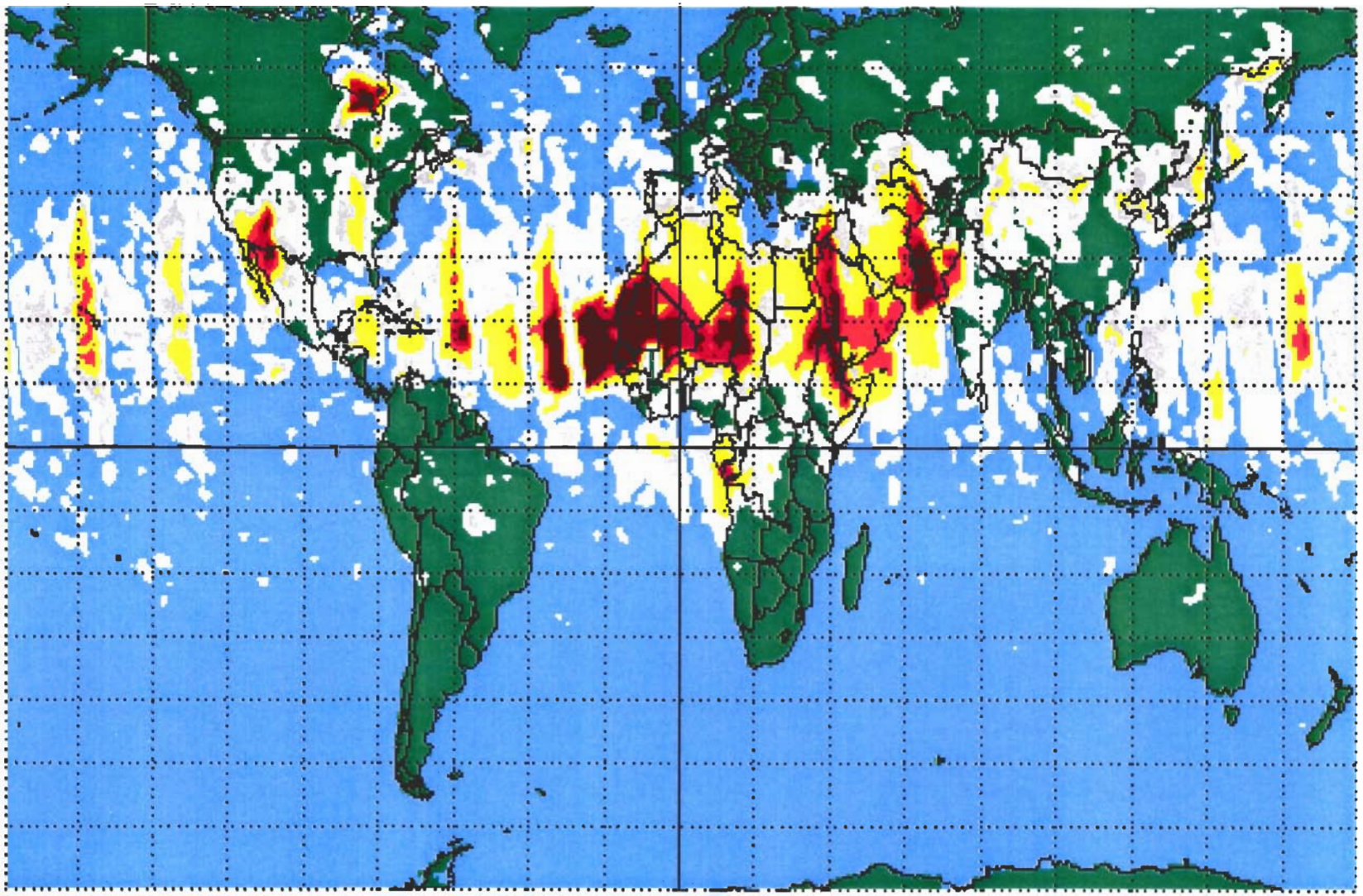
Earth Probe TOMS Version 8 Aerosol Index on June 22, 2003



Aerosol Index

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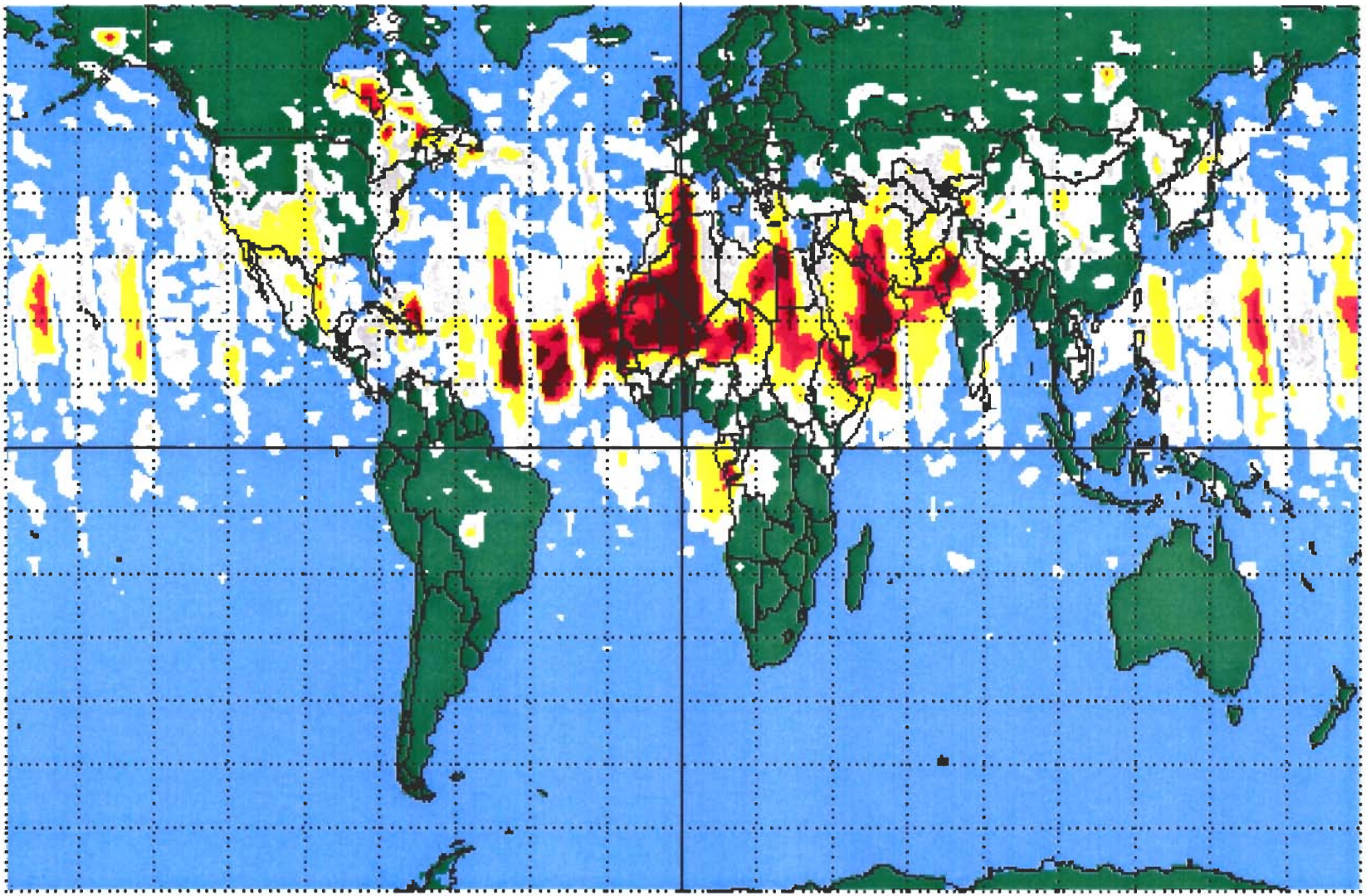
Earth Probe TOMS Version 8 Aerosol Index on June 23, 2003



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Aerosol Index

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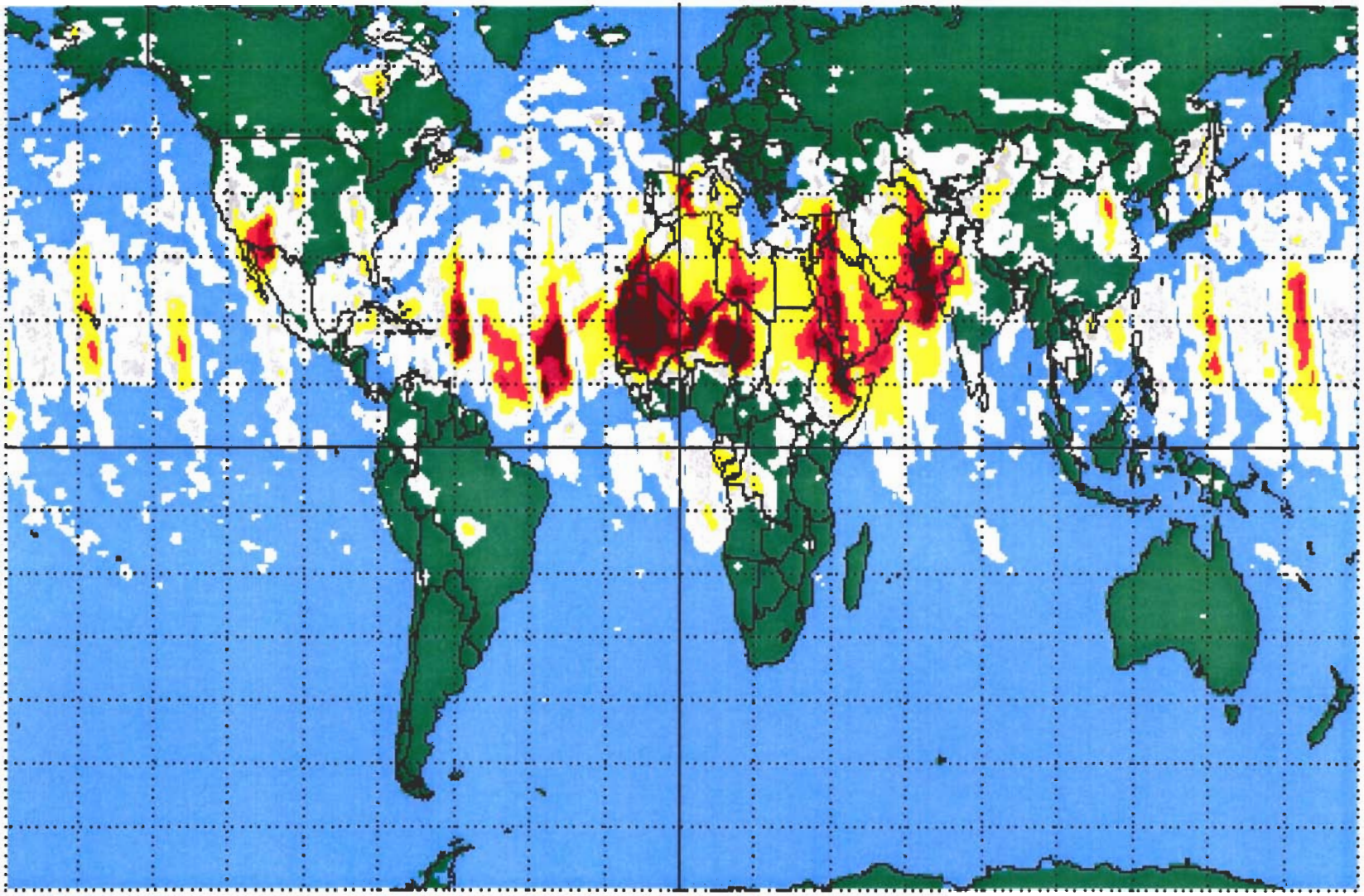
Earth Probe TOMS Version 8 Aerosol Index on June 24, 2003



Aerosol Index

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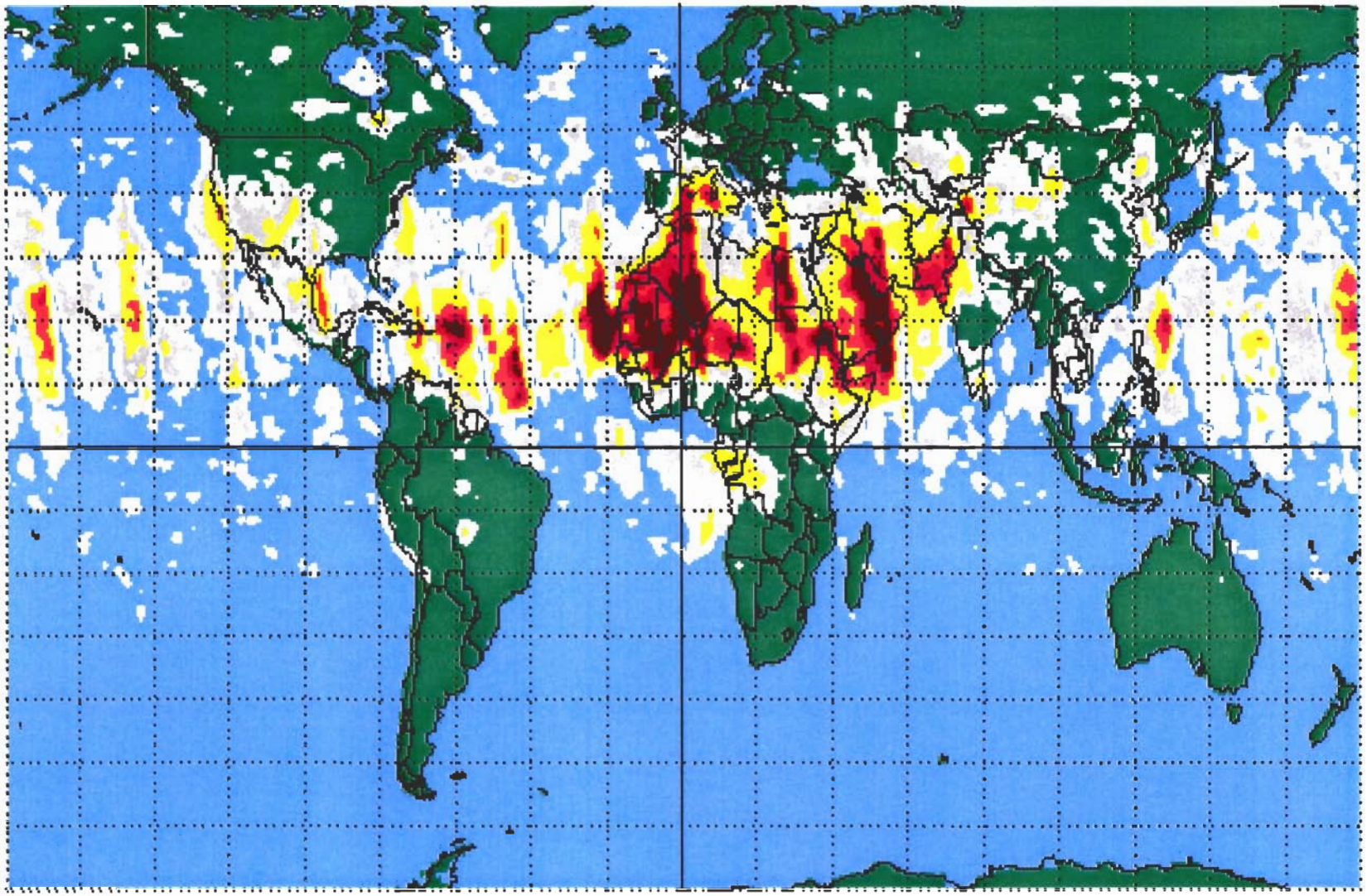
Earth Probe TOMS Version 8 Aerosol Index on June 25, 2003



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Aerosol Index

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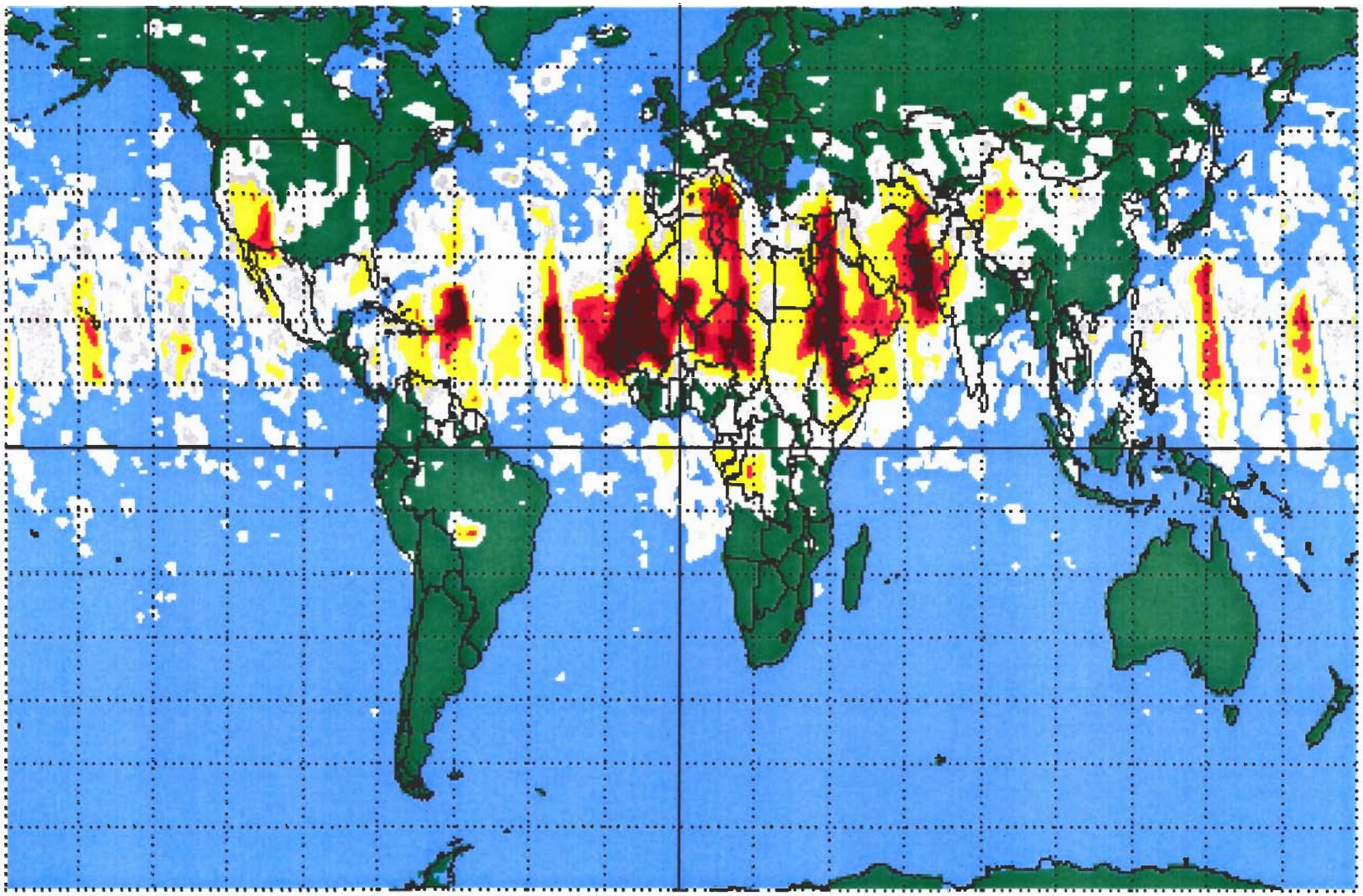
Earth Probe TOMS Version 8 Aerosol Index on June 26, 2003



Aerosol Index

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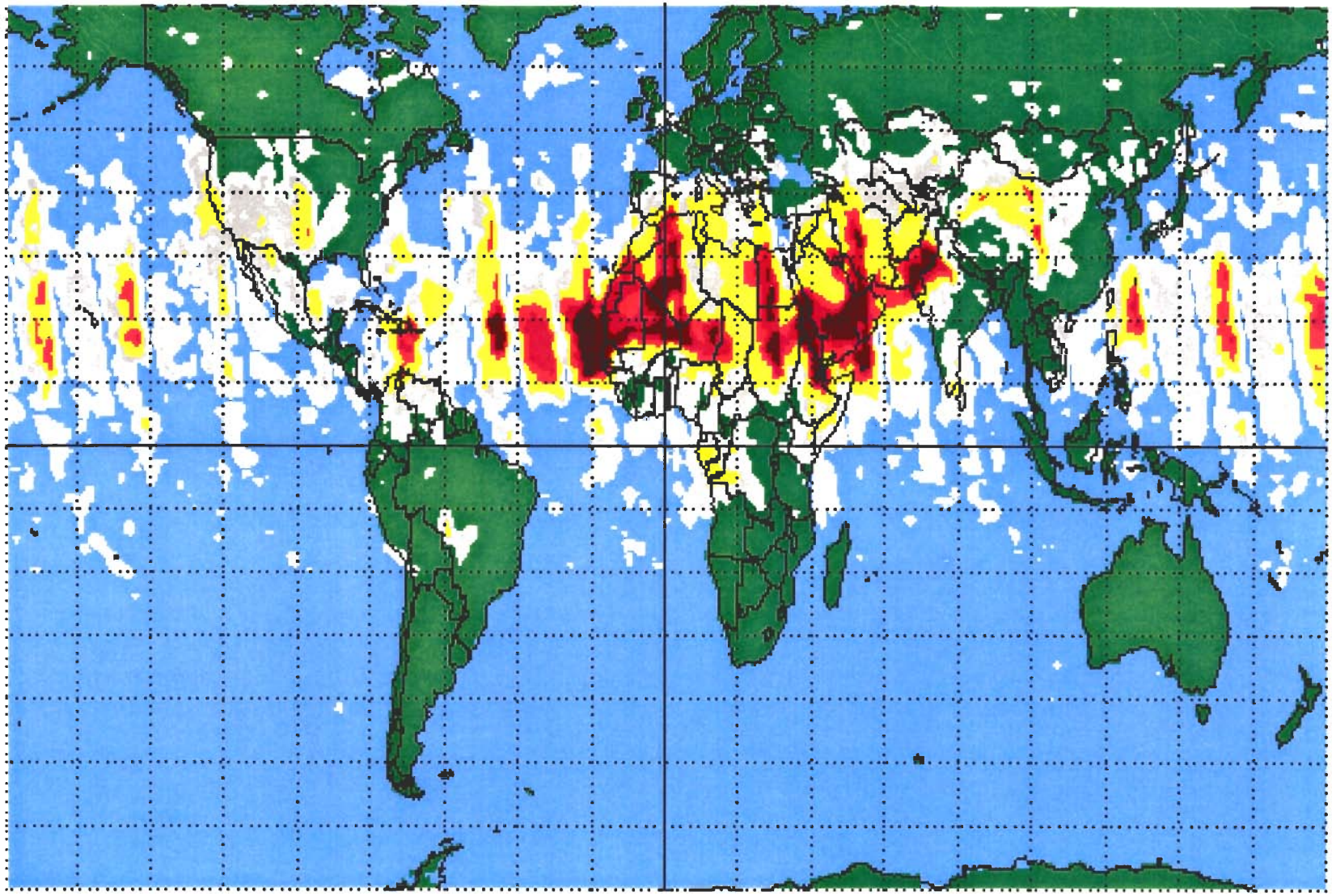
Earth Probe TOMS Version 8 Aerosol Index on June 27, 2003



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Aerosol Index

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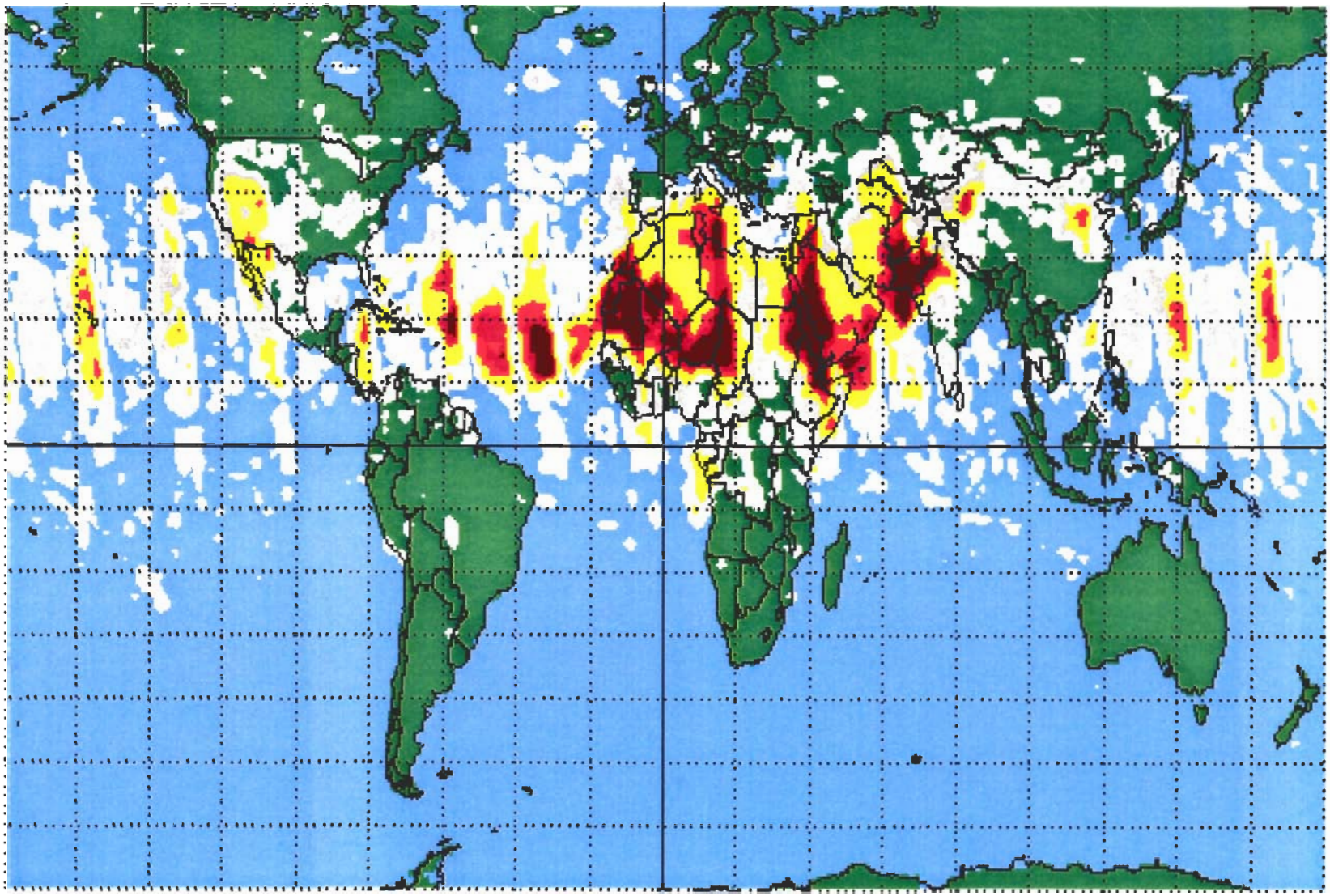
Earth Probe TOMS V.sion 8 Aerosol Index on June 28, 2003



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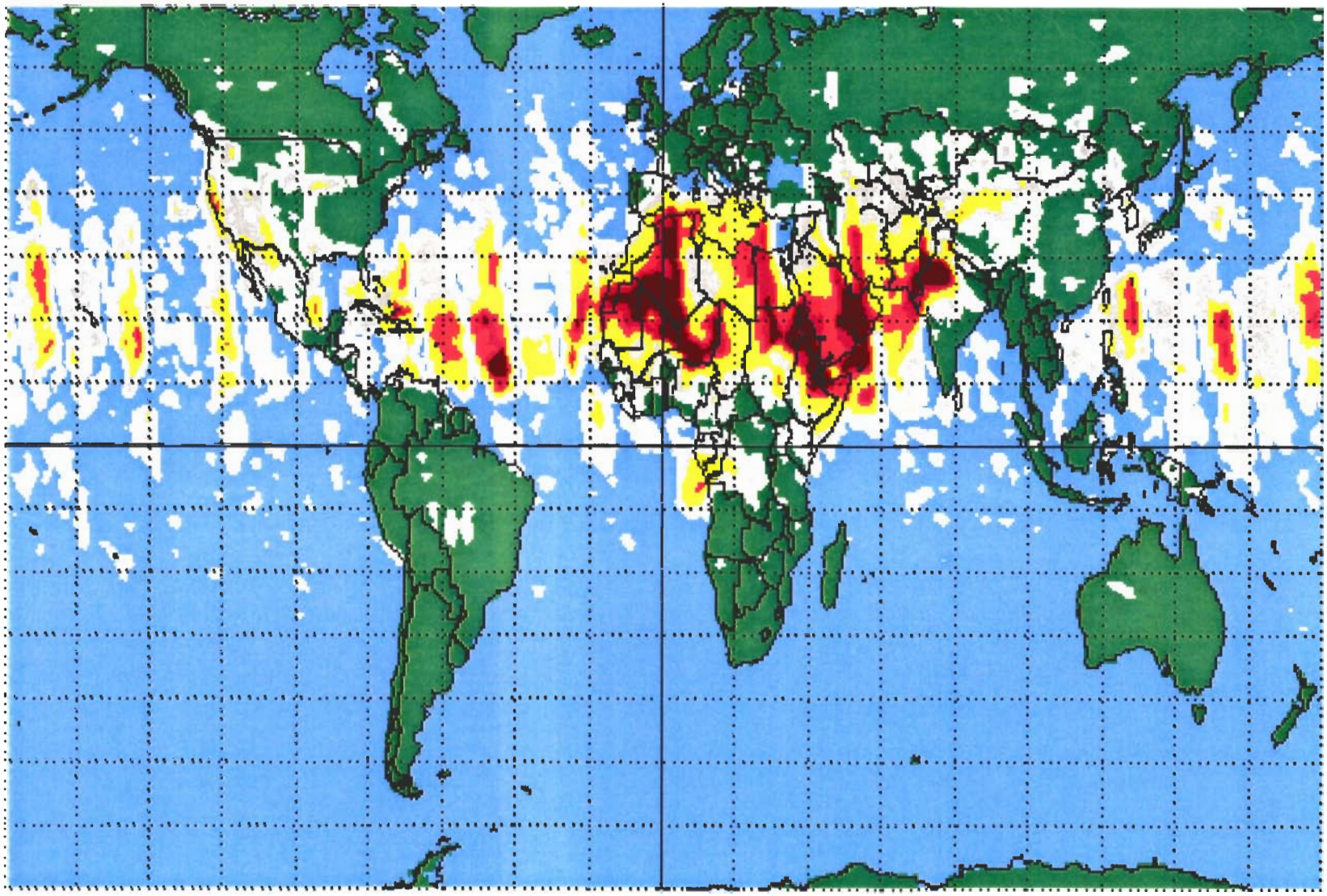
Aerosol Index

Goddard Space Flight Center

Earth Probe TOMS V. sion 8 Aerosol Index on June 29, 2003



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Aerosol Index

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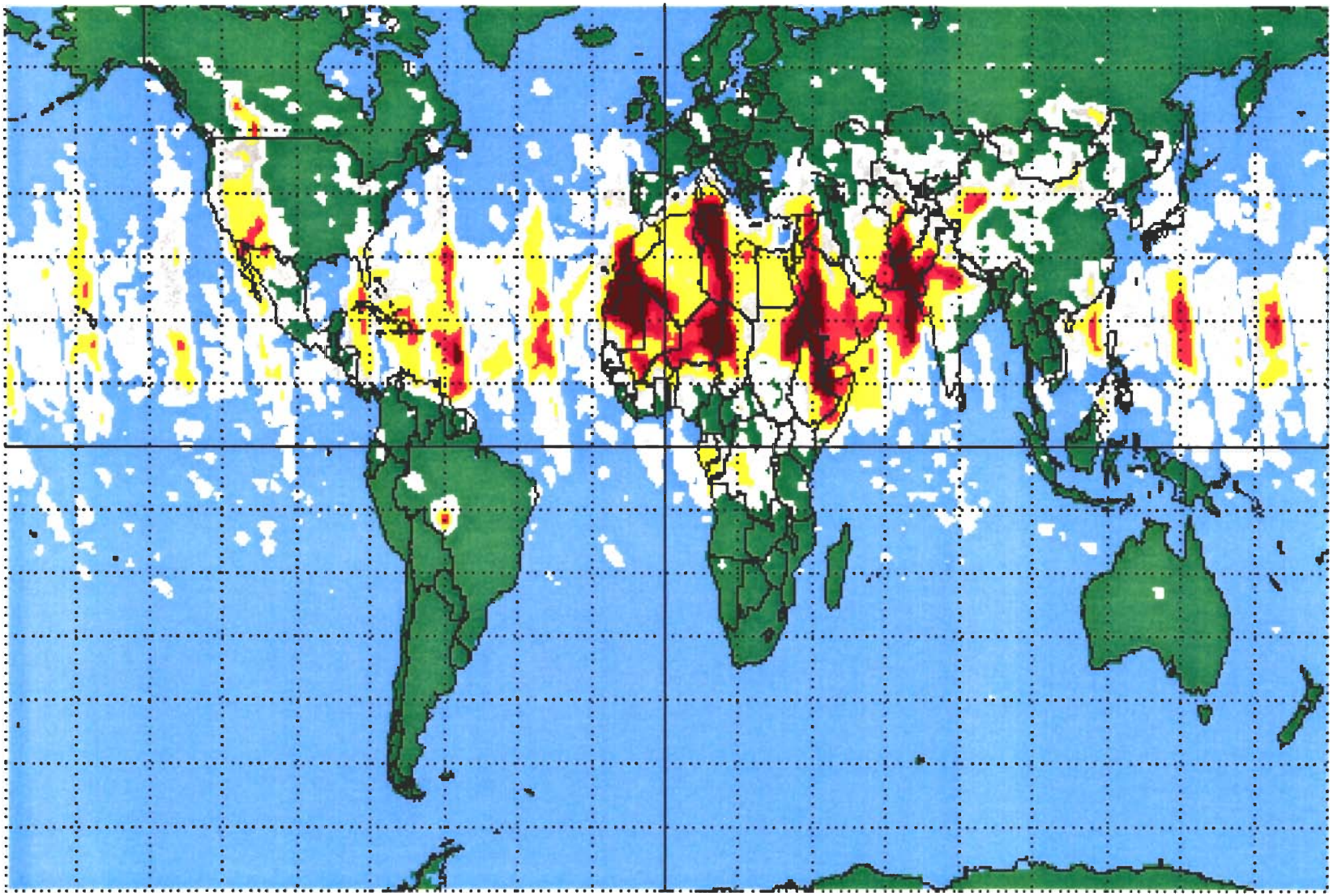
Earth Probe TOMS V. sion 8 Aerosol Index on June 30, 2003



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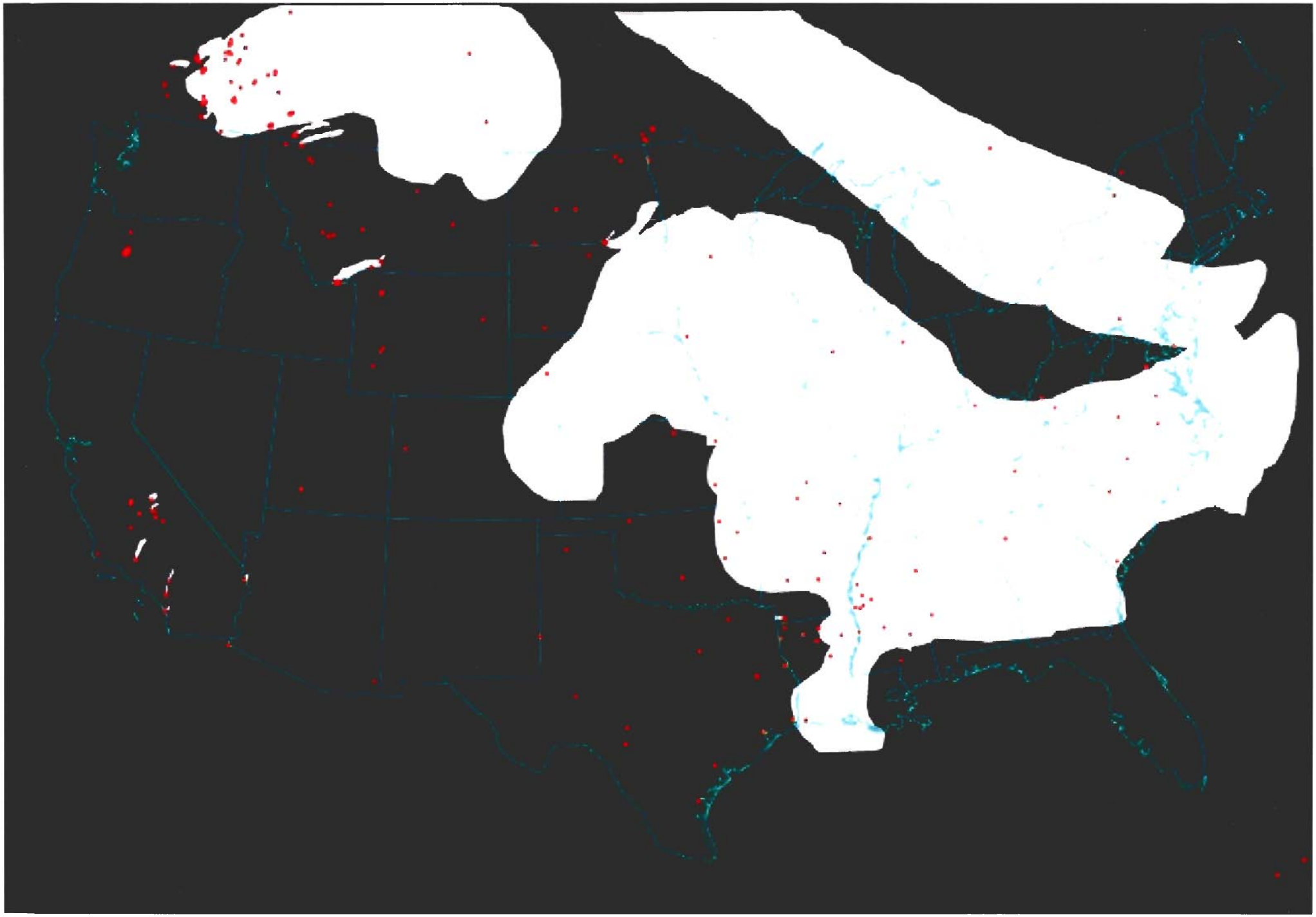
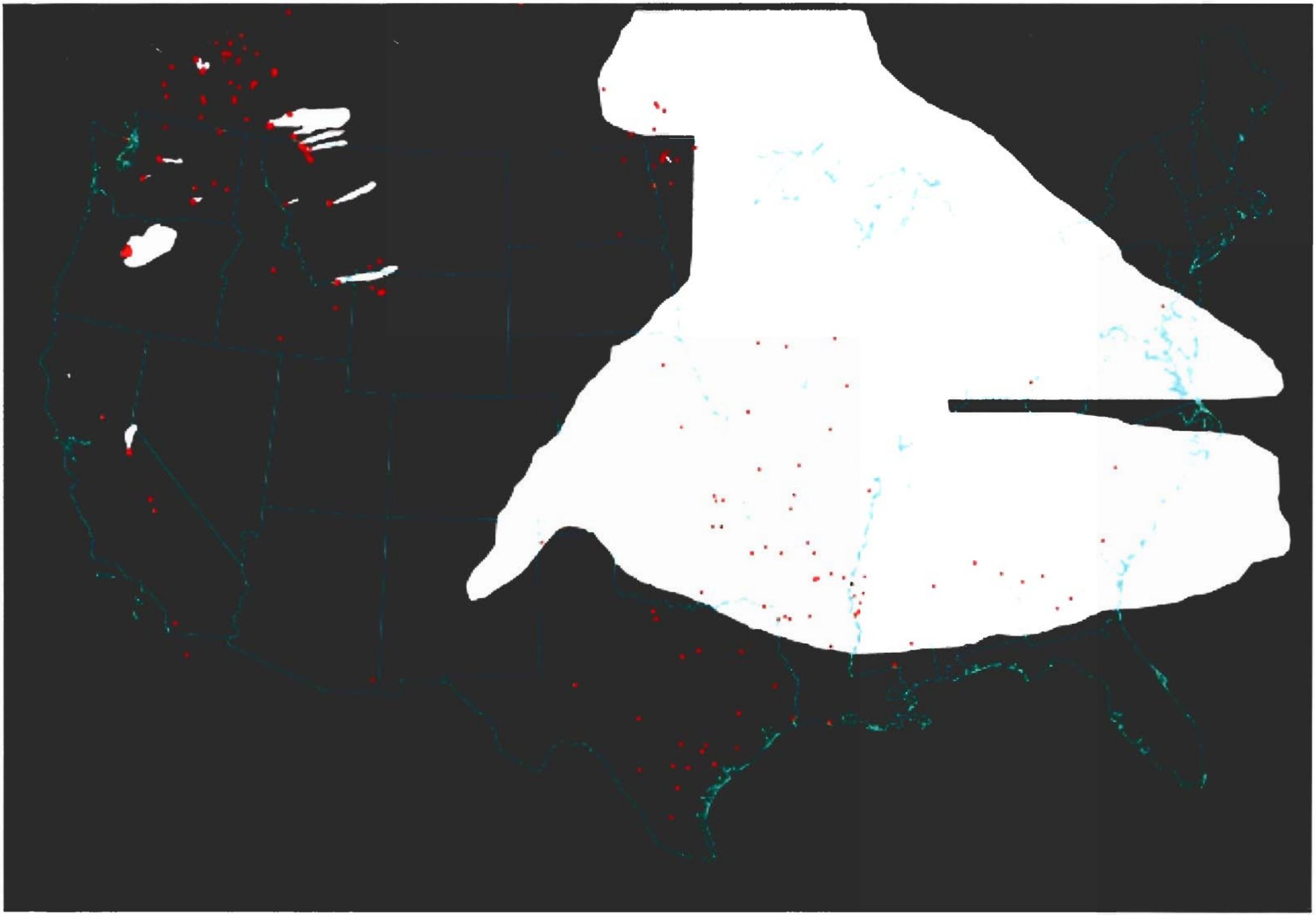
Aerosol Index

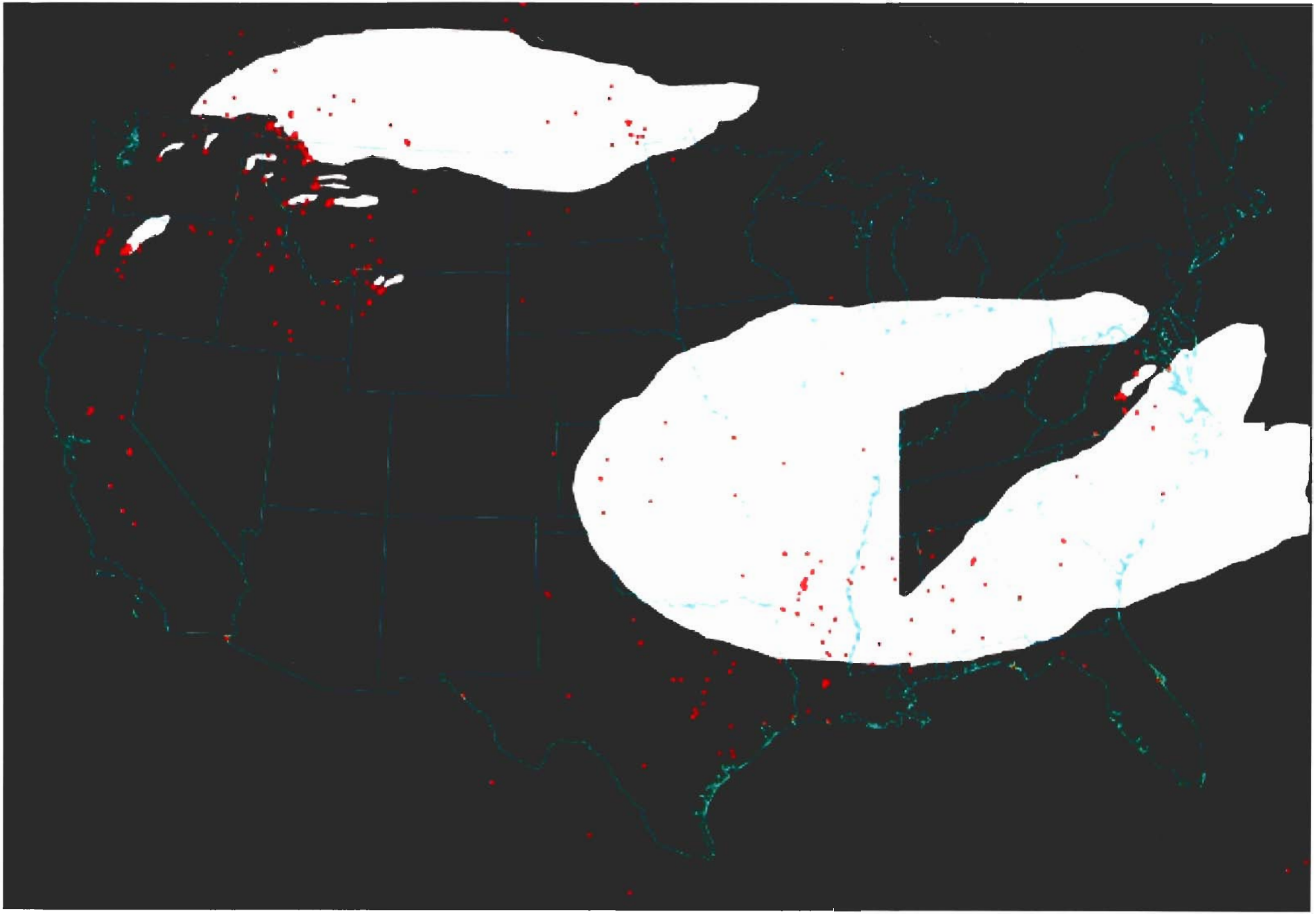
Goddard Space Flight Center



August 23, 2003 Fire Hazard Map

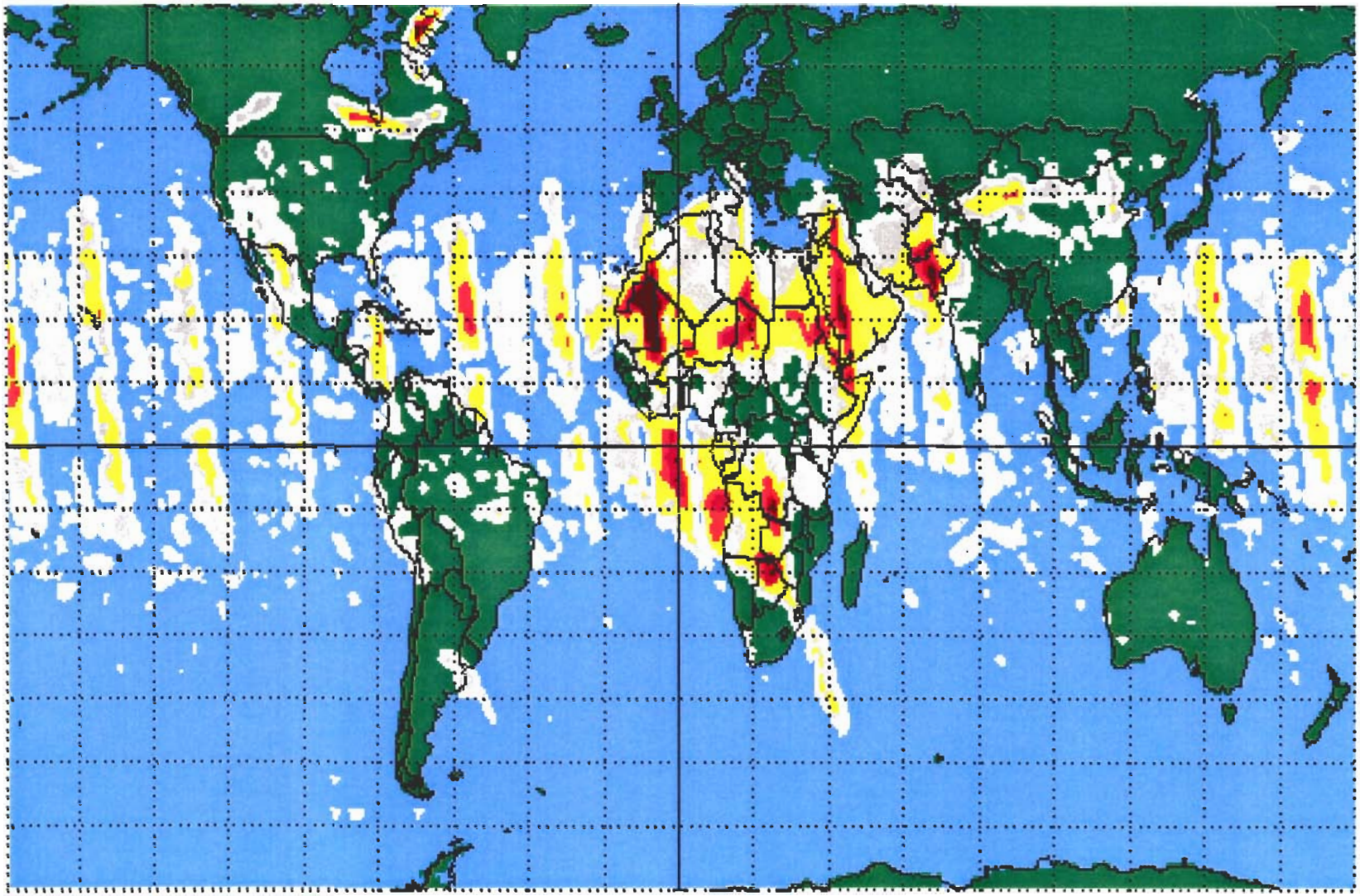


August 24, 2003 Fire Hazard Map



August 25, 2003 Fire Hazard Map

Earth Probe TOMS Version 8 Aerosol Index on August 19, 2003



Aerosol Index

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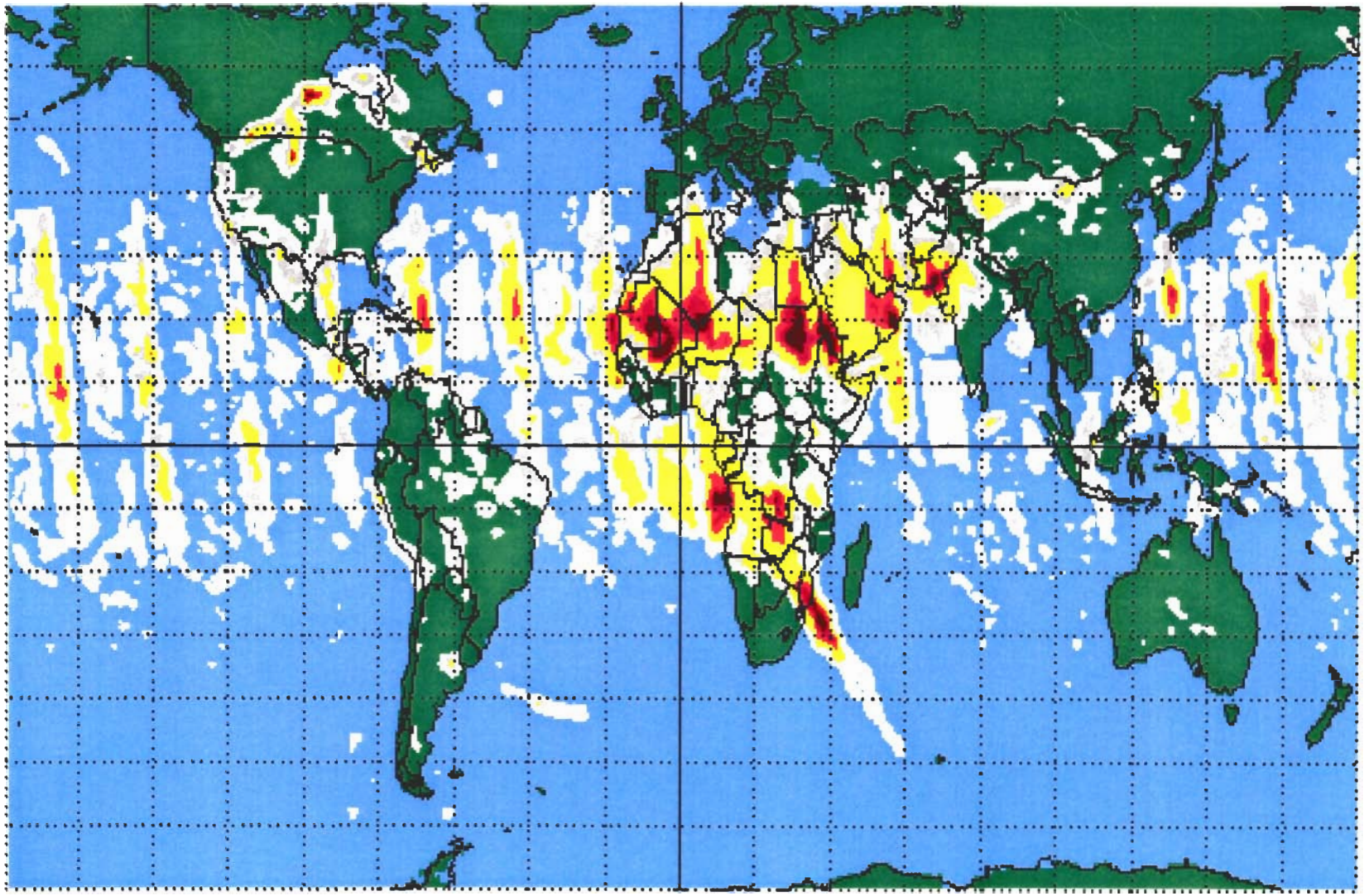
Earth Probe TOMS Version 8 Aerosol Index on August 20, 2003



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Aerosol Index

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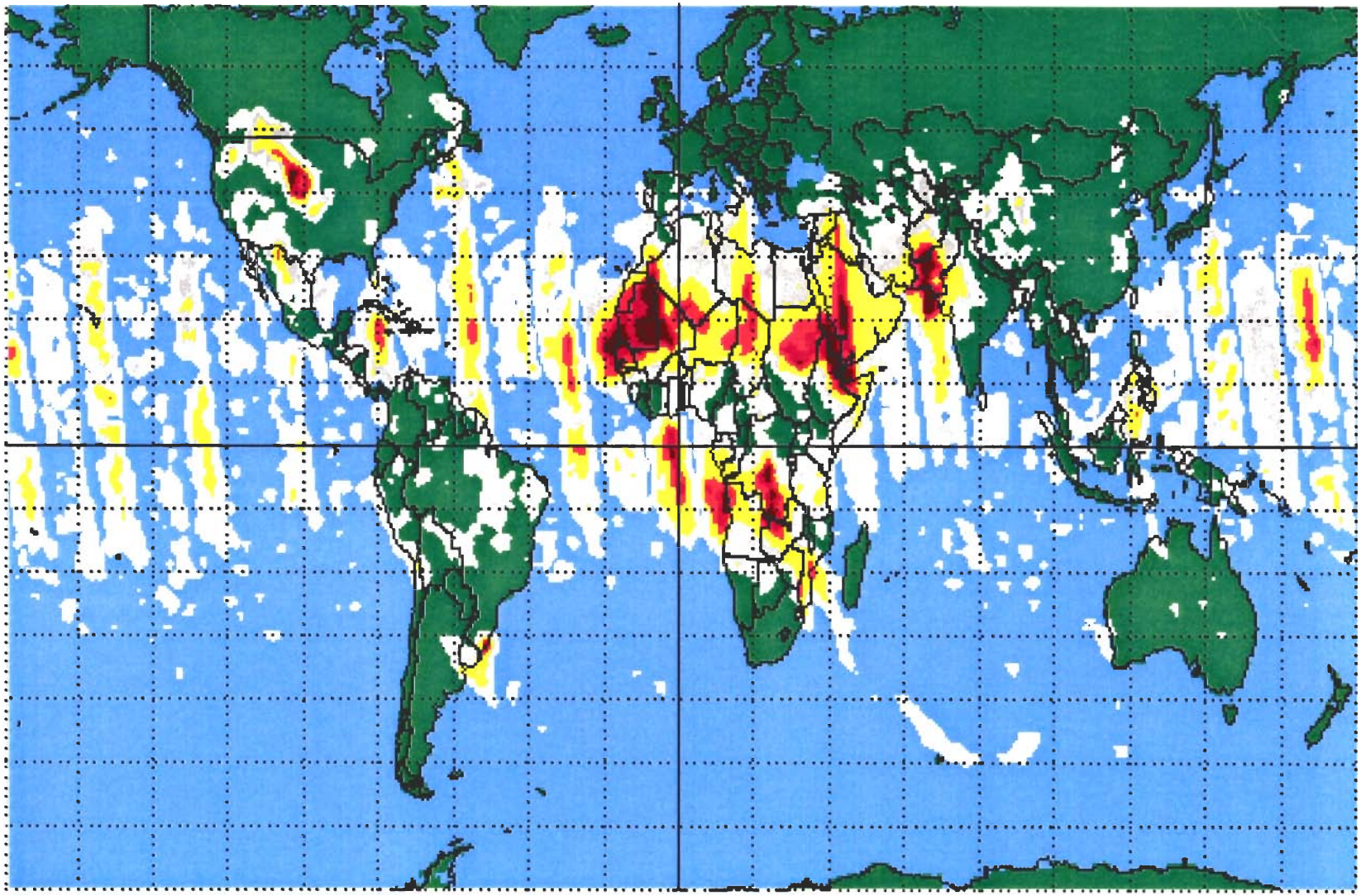
Earth Probe TOMS Version 8 Aerosol Index on August 21, 2003



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Aerosol Index

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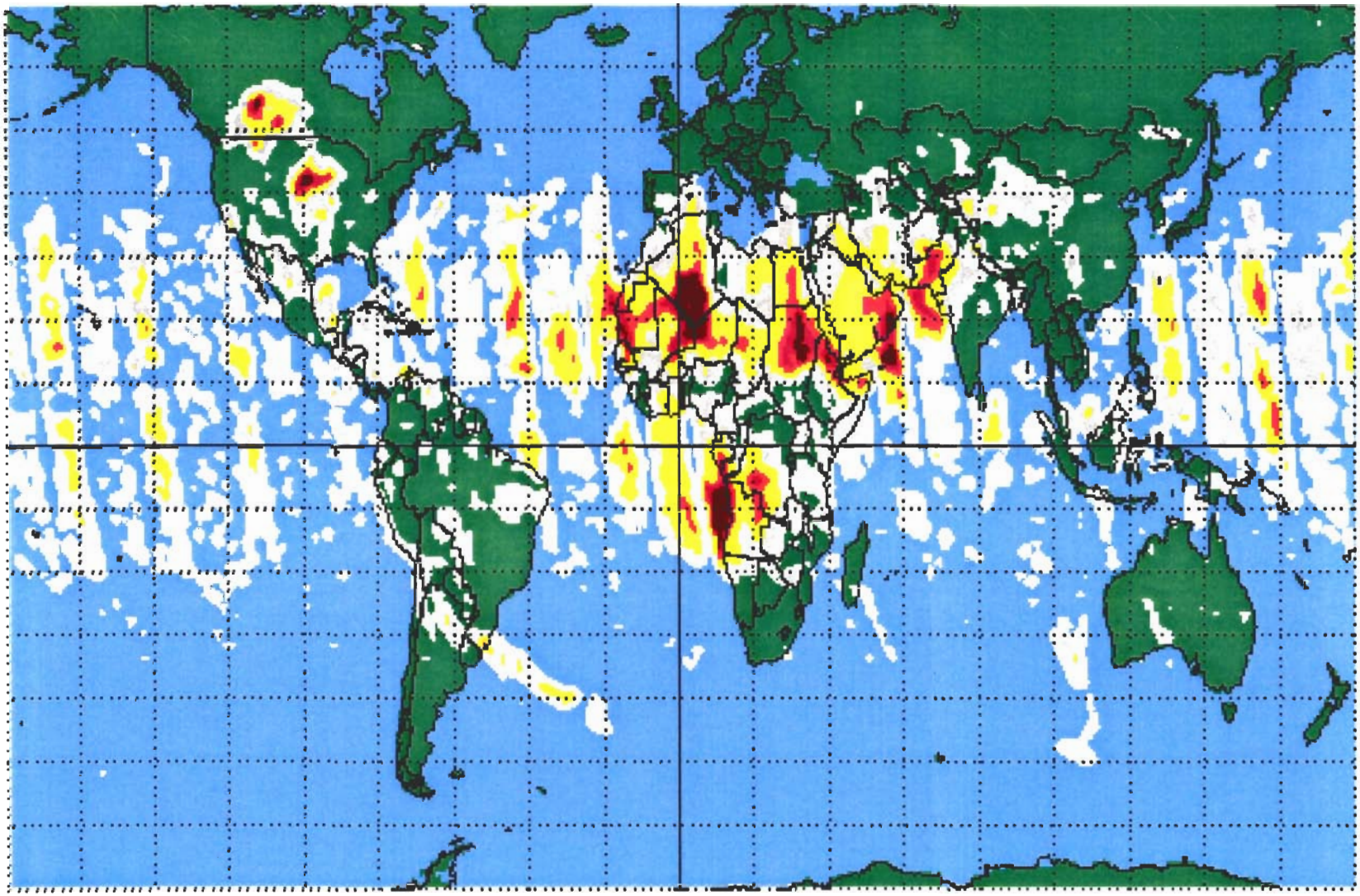
Earth Probe TOMS Version 8 Aerosol Index on August 22, 2003



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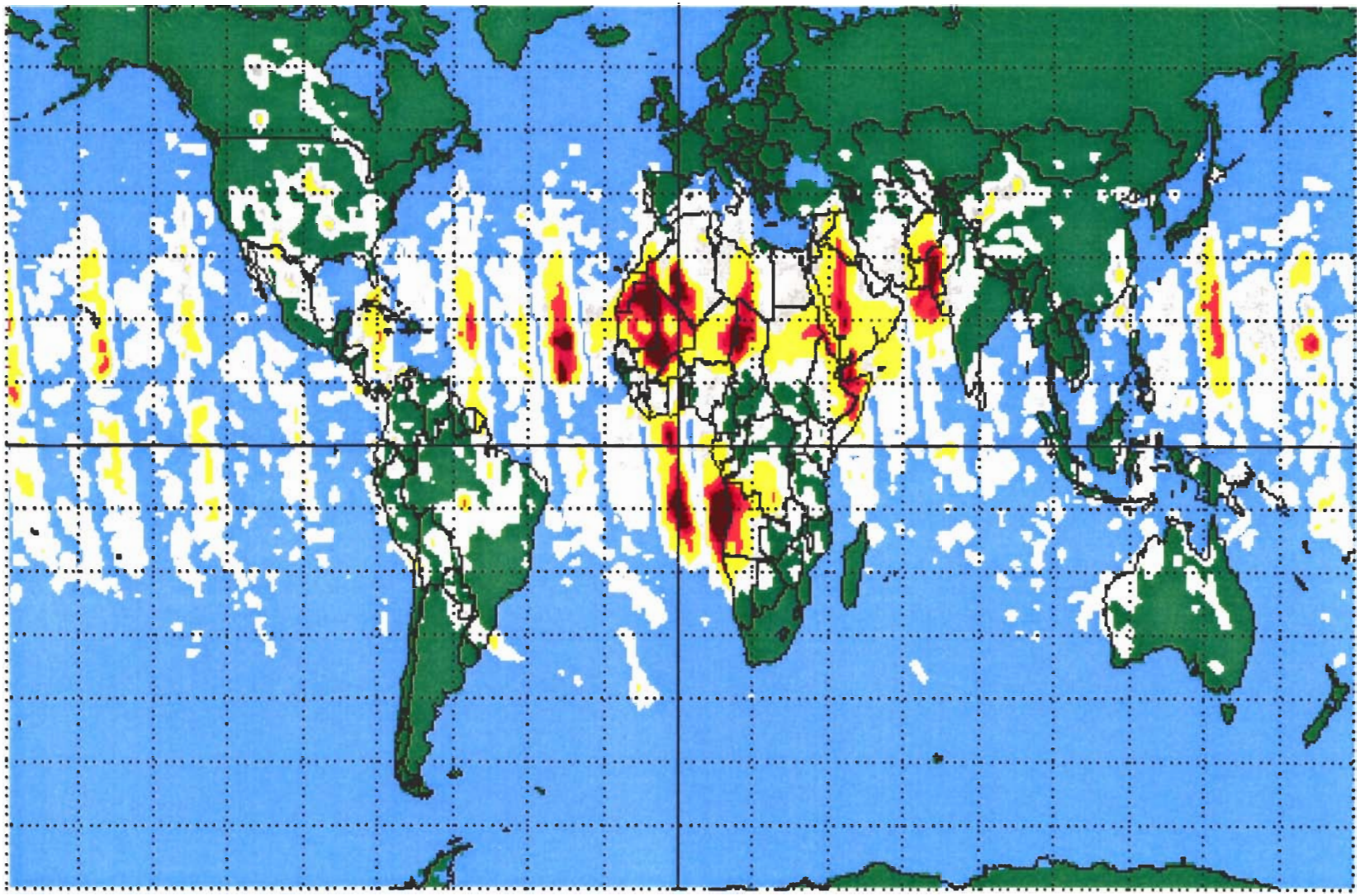
Earth Probe TOMS Version 8 Aerosol Index on August 23, 2003



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Aerosol Index

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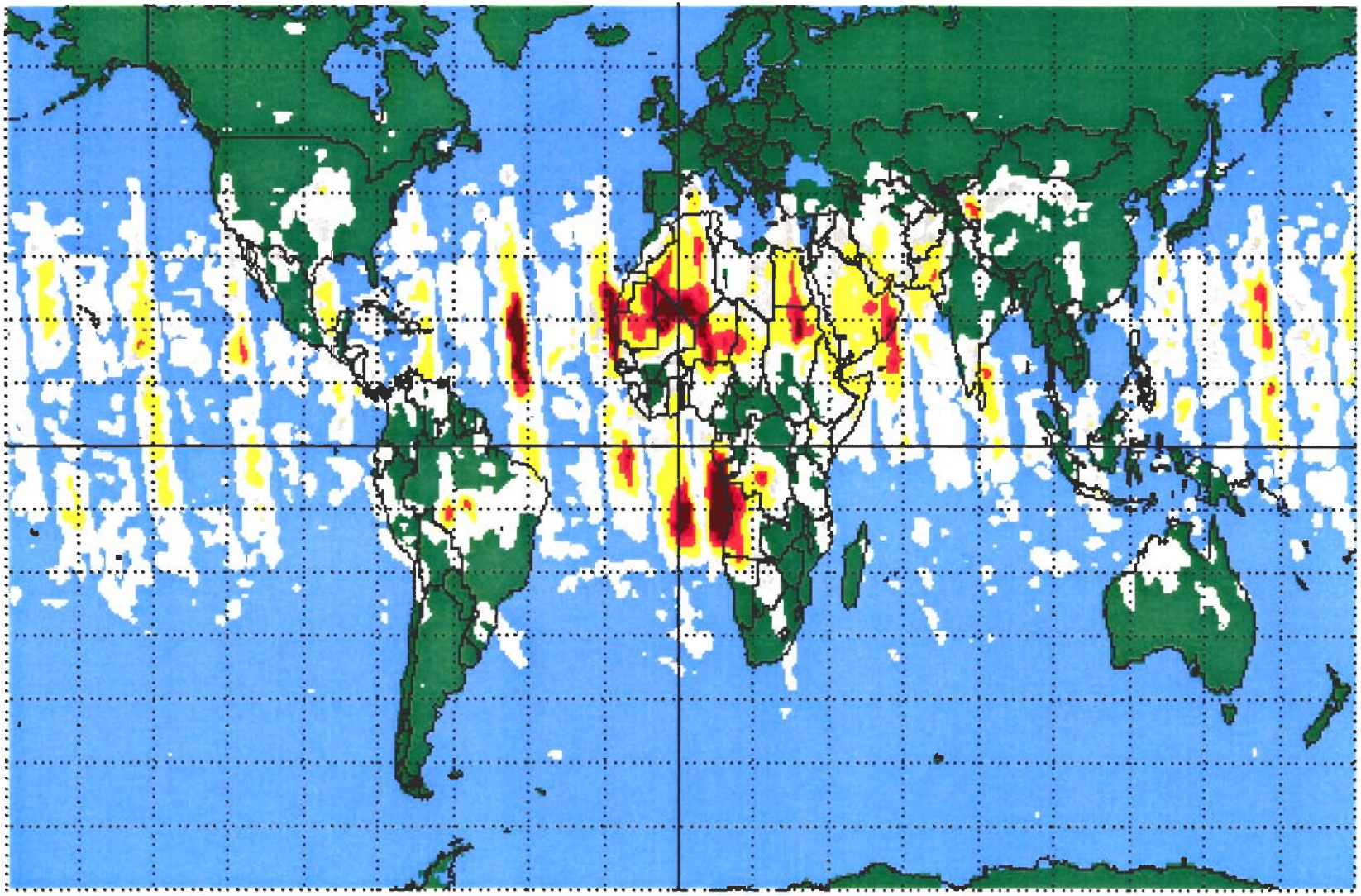
Earth Probe TOMS Version 8 Aerosol Index on August 24, 2003



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Aerosol Index

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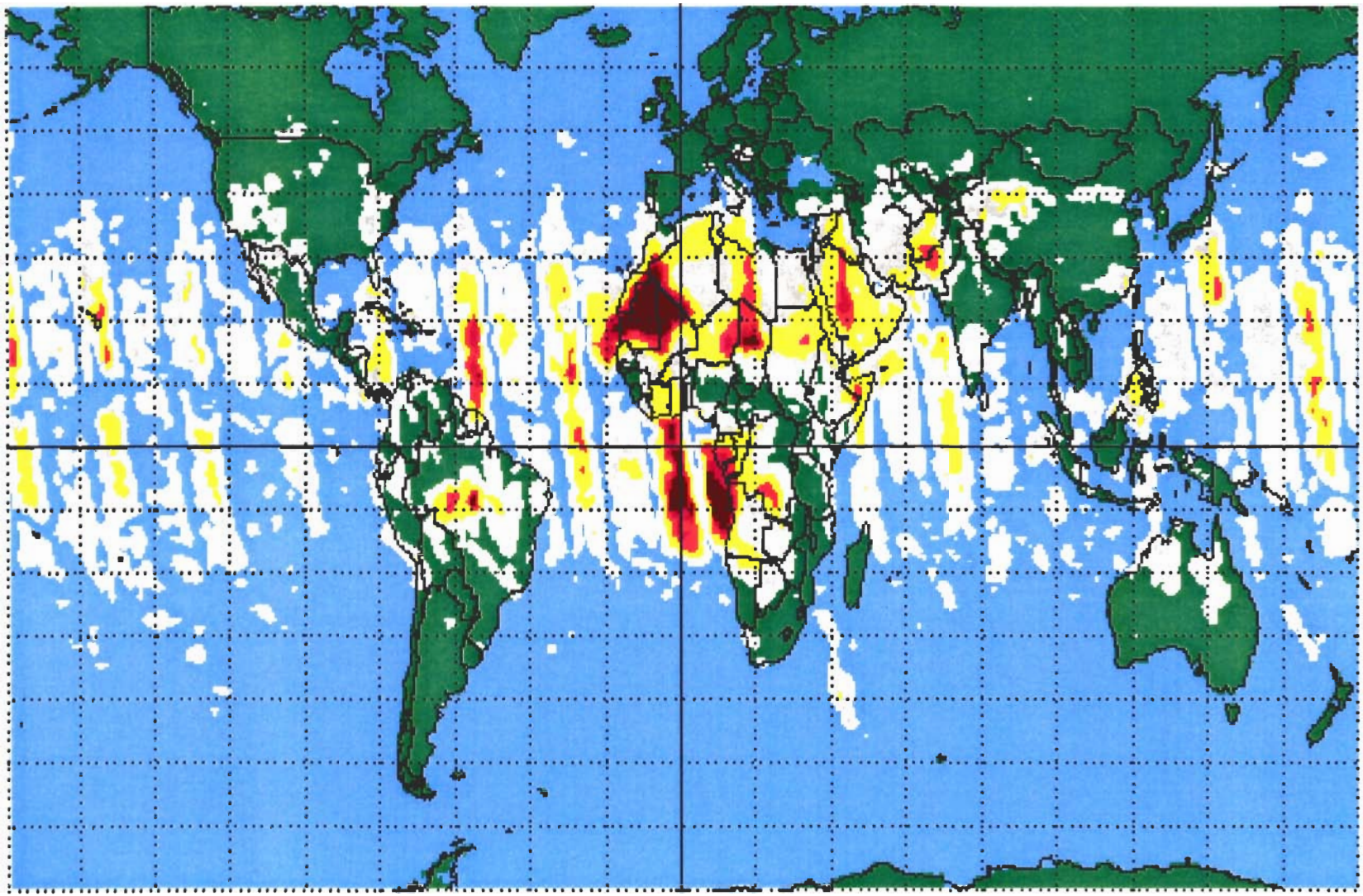
Earth Probe TOMS Version 8 Aerosol Index on August 25, 2003



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Aerosol Index

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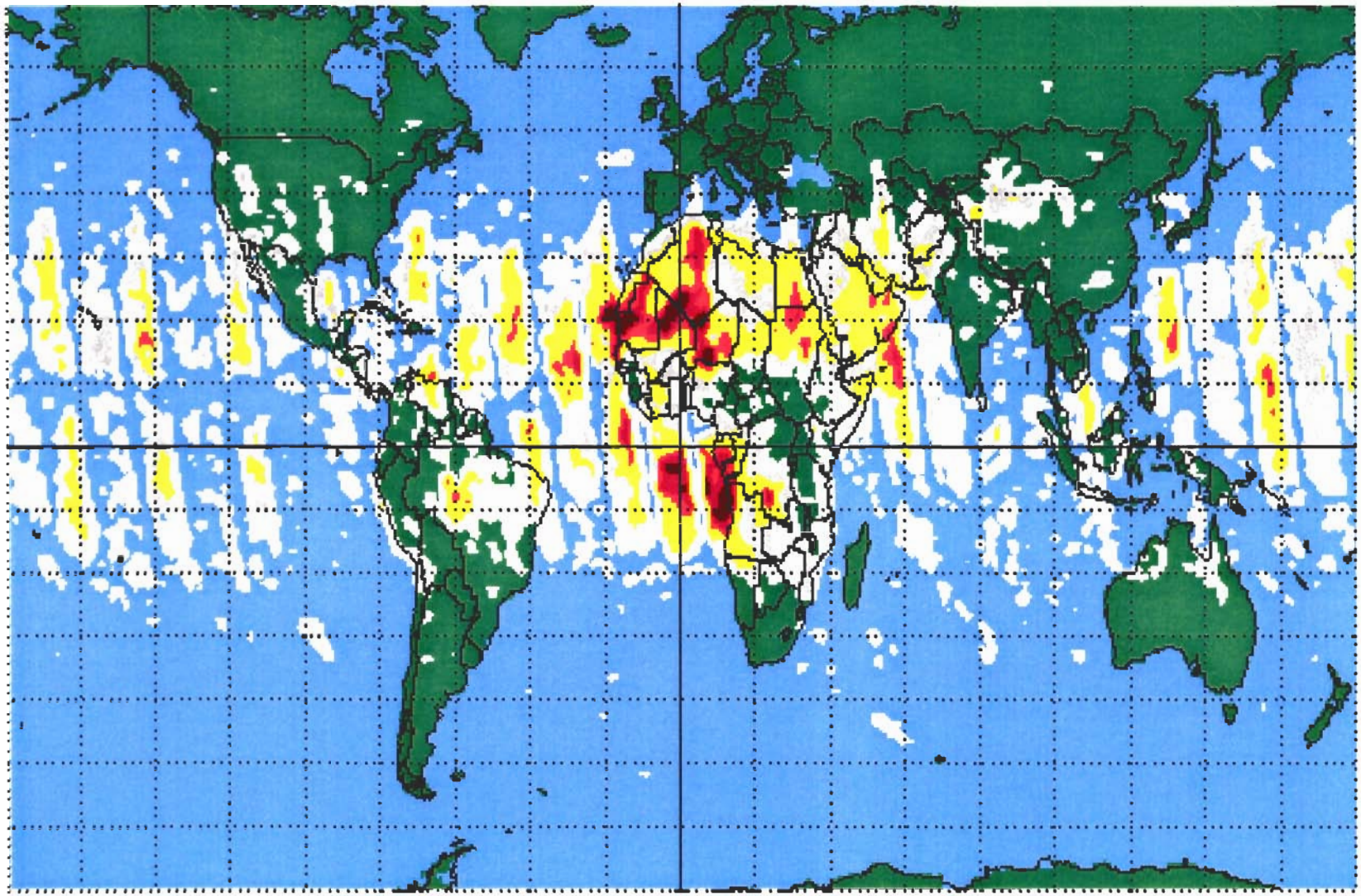
Earth Probe TOMS Version 8 Aerosol Index on August 26, 2003



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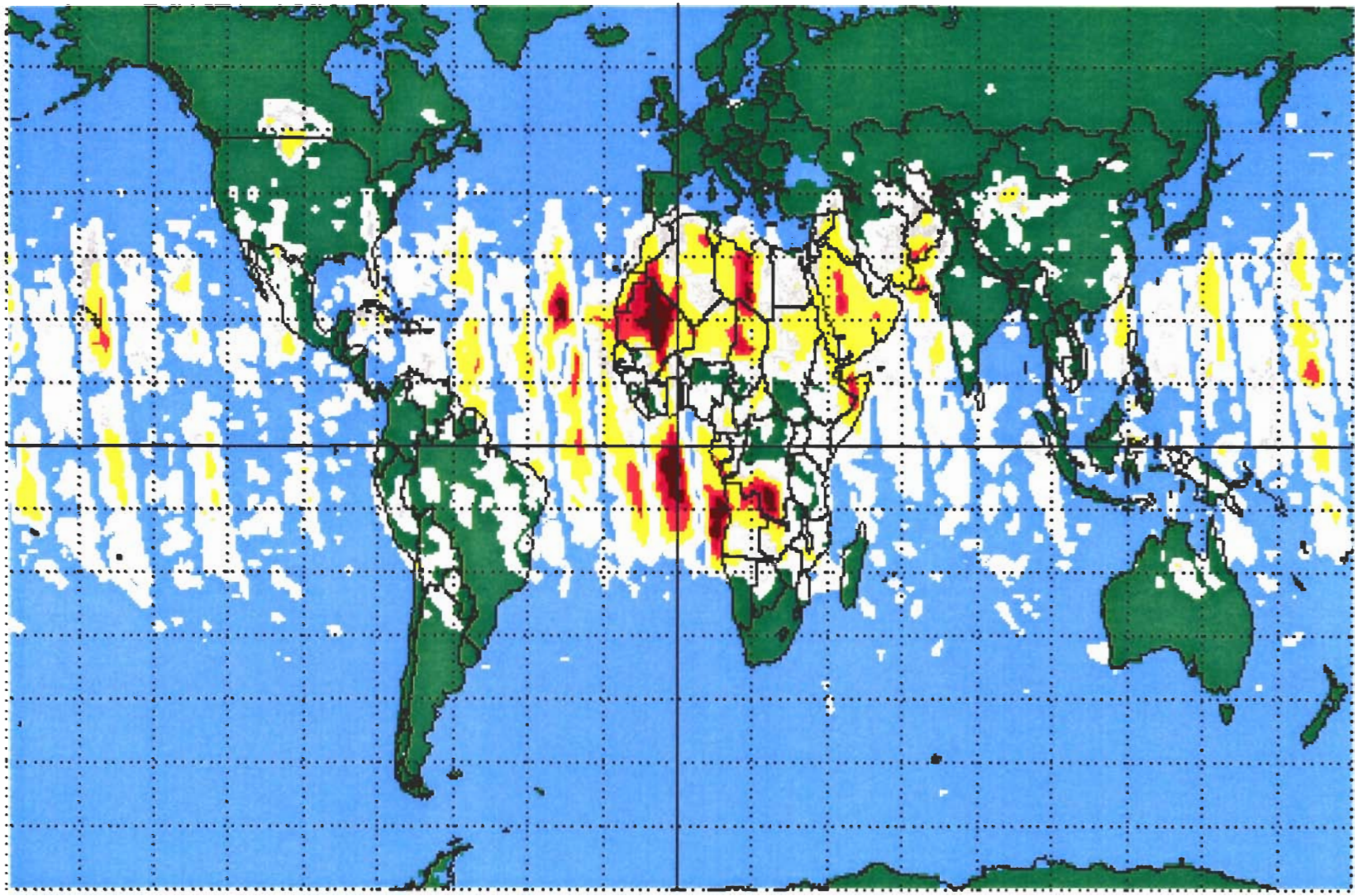
Earth Probe TOMS Version 8 Aerosol Index on August 27, 2003



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Aerosol Index

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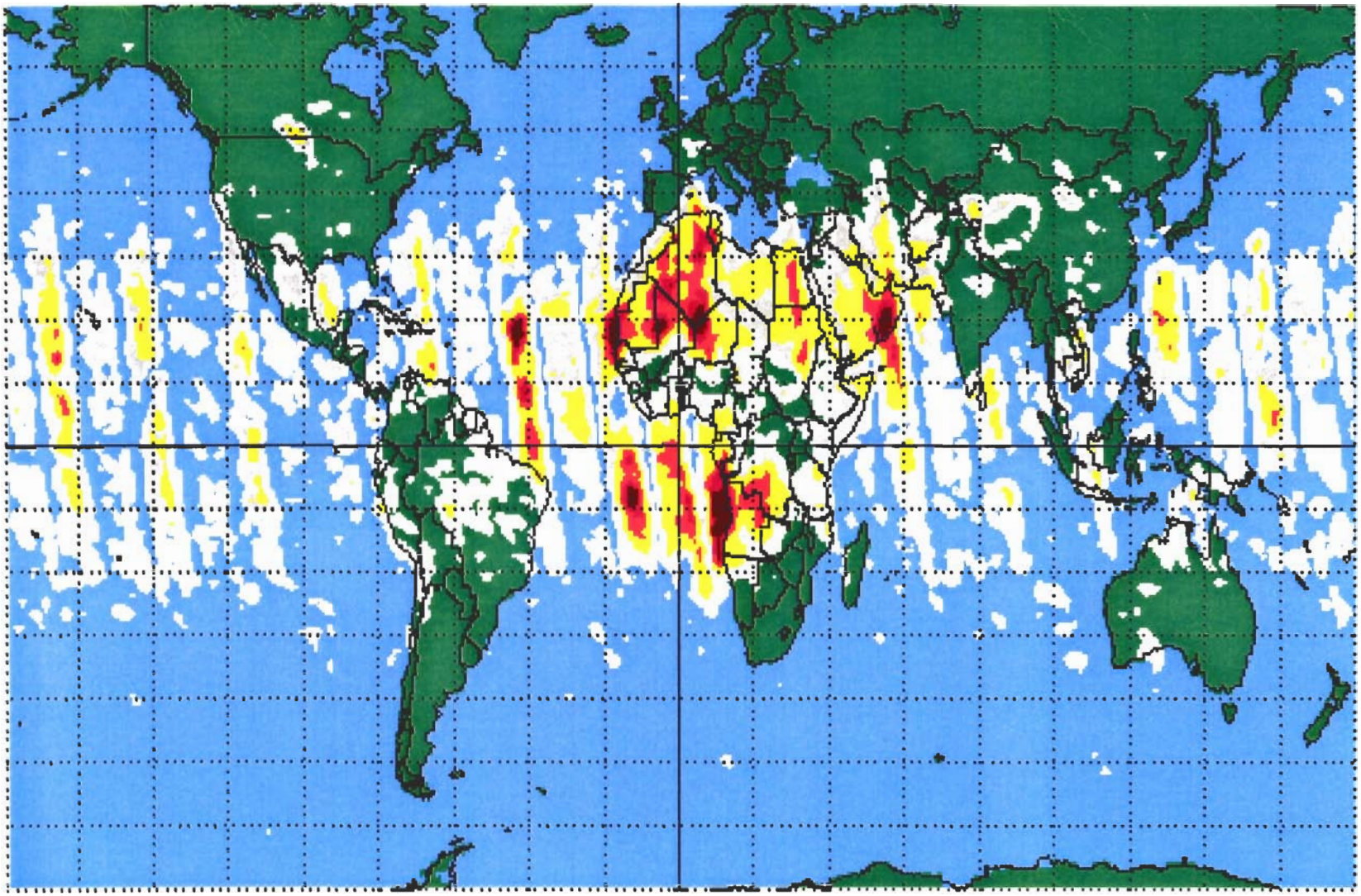
Earth Probe TOMS Version 8 Aerosol Index on August 28, 2003



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