Appendix A. Supporting Figures for Section 3.2.2 (Model Results)

These animations (Figures A-1 through A-9) provide context for the still images shown in Section 3.2.2.

Figure A-1. RAQMS-modeled ozone at the 300 K isentrope-level from May 3 at 12:00 UTC to May 8 at 12:00 UTC. The model was initialized at 12:00 UTC on May 3.

Figure A-2. RAQMS-modeled ozone at the 300 K isentrope-level from May 6 at 12:00 UTC to May 11 at 12:00 UTC. The model was initialized at 12:00 UTC on May 6.

Figure A-3. RAQMS-modeled ozone at the 310 K isentrope-level from May 3 at 12:00 UTC to May 8 at 12:00 UTC. The model was initialized at 12:00 UTC on May 3.

Figure A-4. RAQMS-modeled cross-section of ozone from May 3 at 12:00 UTC to May 8 at 12:00 UTC. The model was initialized at 12:00 UTC on May 3. The red box represents the approximate area of stratospheric intrusion.

Figure A-5. RAQMS-modeled CO at the 310 K isentrope-level from May 3 at 12:00 UTC to May 8 at 12:00 UTC. The model was initialized at 12:00 UTC on May 3.

Figure A-6. RAQMS-modeled cross-section of CO from May 3 at 12:00 UTC to May 8 at 12:00 UTC. The model was initialized at 12:00 UTC on May 3.

Figure A-7. RAQMS-modeled cross-section of CO from May 6 at 12:00 UTC to May 11 at 12:00 UTC. The model was initialized at 12:00 UTC on May 6.

Figure A-8. Stratospheric ozone from May 3 at 00:00 UTC to May 4 at 18:00 UTC.

Figure A-9. WACCM-modeled ozone at the 500 mb level with a minimum contour of 60 ppb and a maximum contour of 140 ppb on May 4 at 0:00 UTC to May 7 at 06:00 UTC.

Figures A-10 through A-14 depict the stratospheric ozone (O3S) tracer time series and correspond to the WACCM latitudinal cross sections of total ozone concentrations in Figures 3-24 through 3-28 in Section 3.2.2. The modeled O3S cross section profiles indicate a persistent feature along the transport path to Clark County. Due to the expected chemical and dry deposition losses of a stratospheric ozone contribution during multi-day transport, the O3S values decrease over time leading up to the event day. This positive detection of stratospheric influence is within the range of SOI episodes detected previously. Chouza et al. 2020 report comparable values for the stratospheric ozone tracer in the WACCM model near Clark County (15-20 ppb in the boundary layer during the May 6 event), with a typical interquartile range including exceptional SOI event days during late spring 2019 and 2020. Furthermore, the total ozone bias in WACCM is typically +20% or less near the surface (Chouza et al., 2020). Overall, the WACCM model results provide evidence for a detectable stratospheric ozone influence on May 6, 2020, in Clark County.

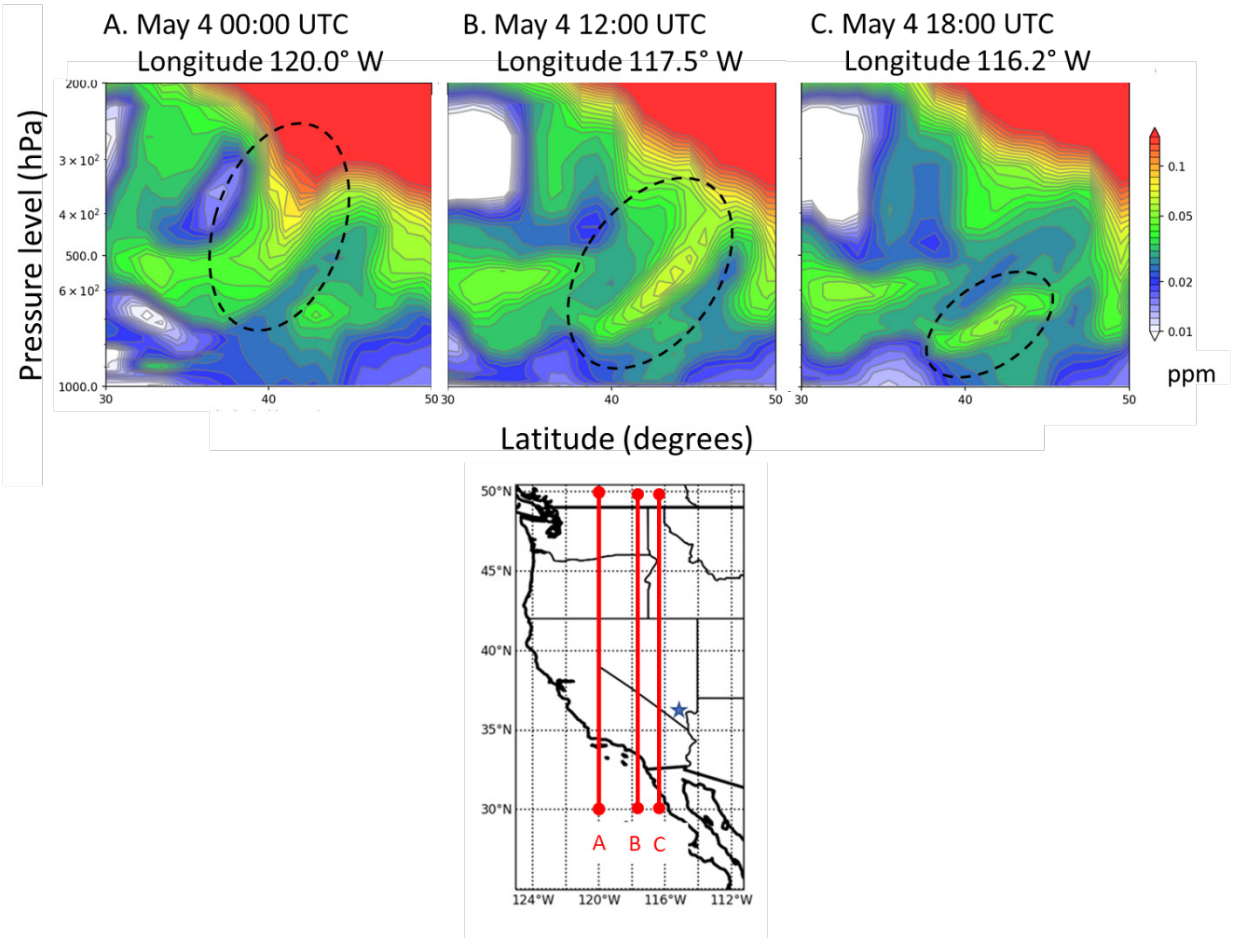

Figure A-10. WACCM-modelled cross-section of the stratospheric ozone tracer along the (A) 120-degrees W longitude line on May 4 at 00:00 UTC, (B) 117.5-degrees W longitude line on May 4 at 12:00 UTC, and (C) 116.2-degrees W longitude line on May 4 at 18:00 UTC. Ozone injected from the proposed source of stratospheric ozone on May 4, 00:00 UTC is circled in black in each plot. The extent of the cross-section is represented by the red line on the map (bottom). Las Vegas is represented by a blue star.

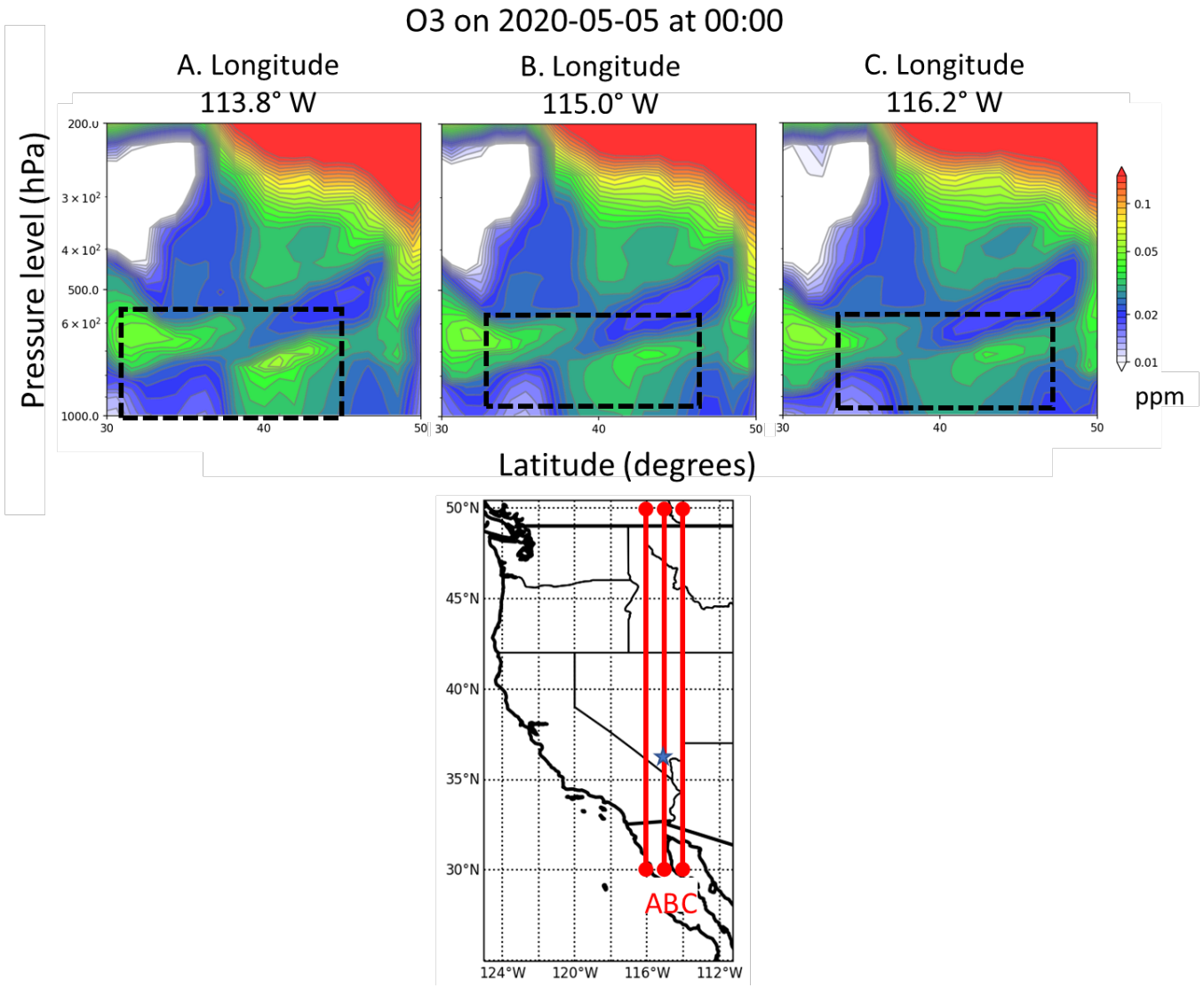

Figure A-11. WACCM-modelled cross-section of the stratospheric ozone tracer along the (A) 113.8-, (B) 115.0, and (C) 116.2-degrees W longitude line on May 5 at 00:00 UTC. The layer of ozone injected from the stratosphere is boxed in black. The extent of each cross-section is represented by the red lines (labelled by letter) on the map (bottom). Las Vegas is represented by a blue star.

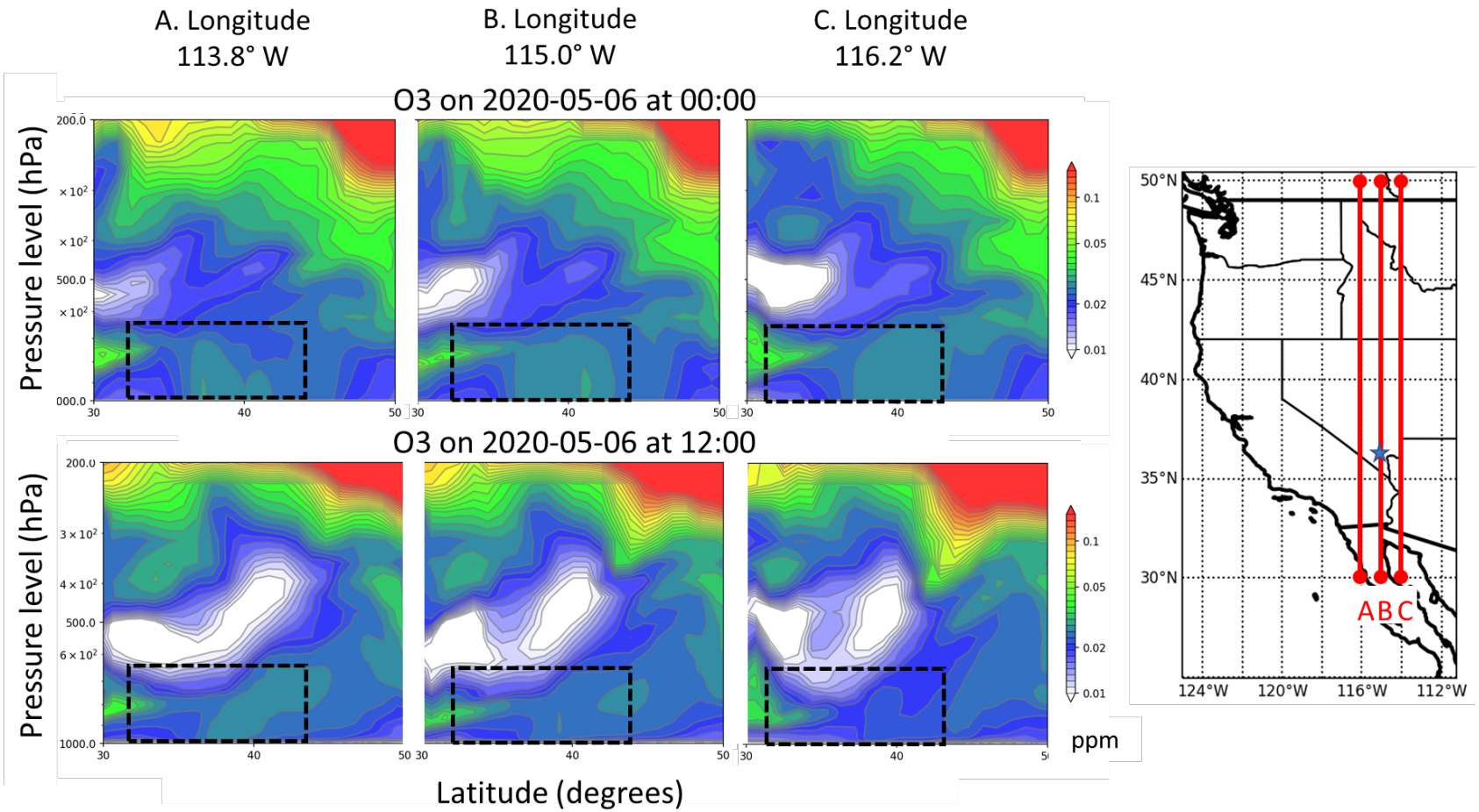

Figure A-12. WACCM-modelled cross-section of the stratospheric ozone tracer along the (A) 113.8-, (B) 115.0, and (C) 116.2-degrees W longitude line on May 6 at 00:00 UTC (top panel) and May 6 at 12:00 UTC (bottom panel). The layer of ozone injected from the stratosphere is boxed in black. The extent of each cross-section is represented by the red lines (labelled by letter) on the map (right). Las Vegas is represented by a blue star.

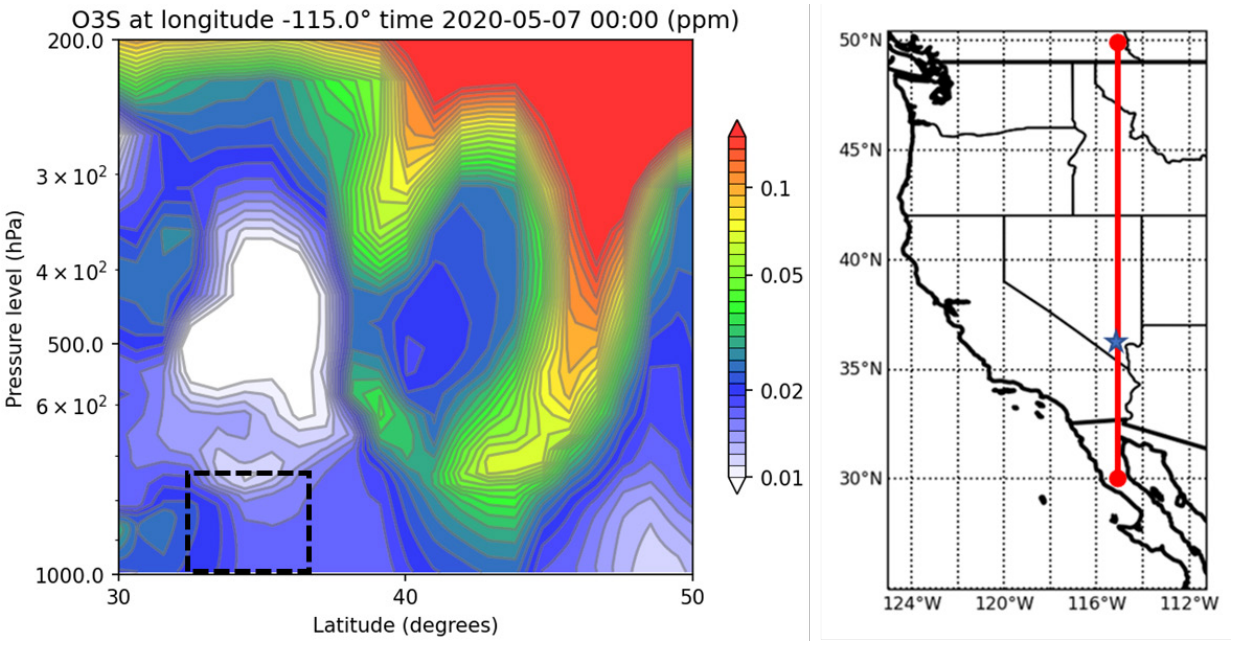

Figure A-13. WACCM-modelled cross-section of the stratospheric ozone tracer along the 115-degrees W longitude line on May 7 at 00:00 UTC, the exceedance event date (May 6, 16:00 local time). The extent of the cross-section is represented by the red line on the map (right). Las Vegas is represented by a blue star.

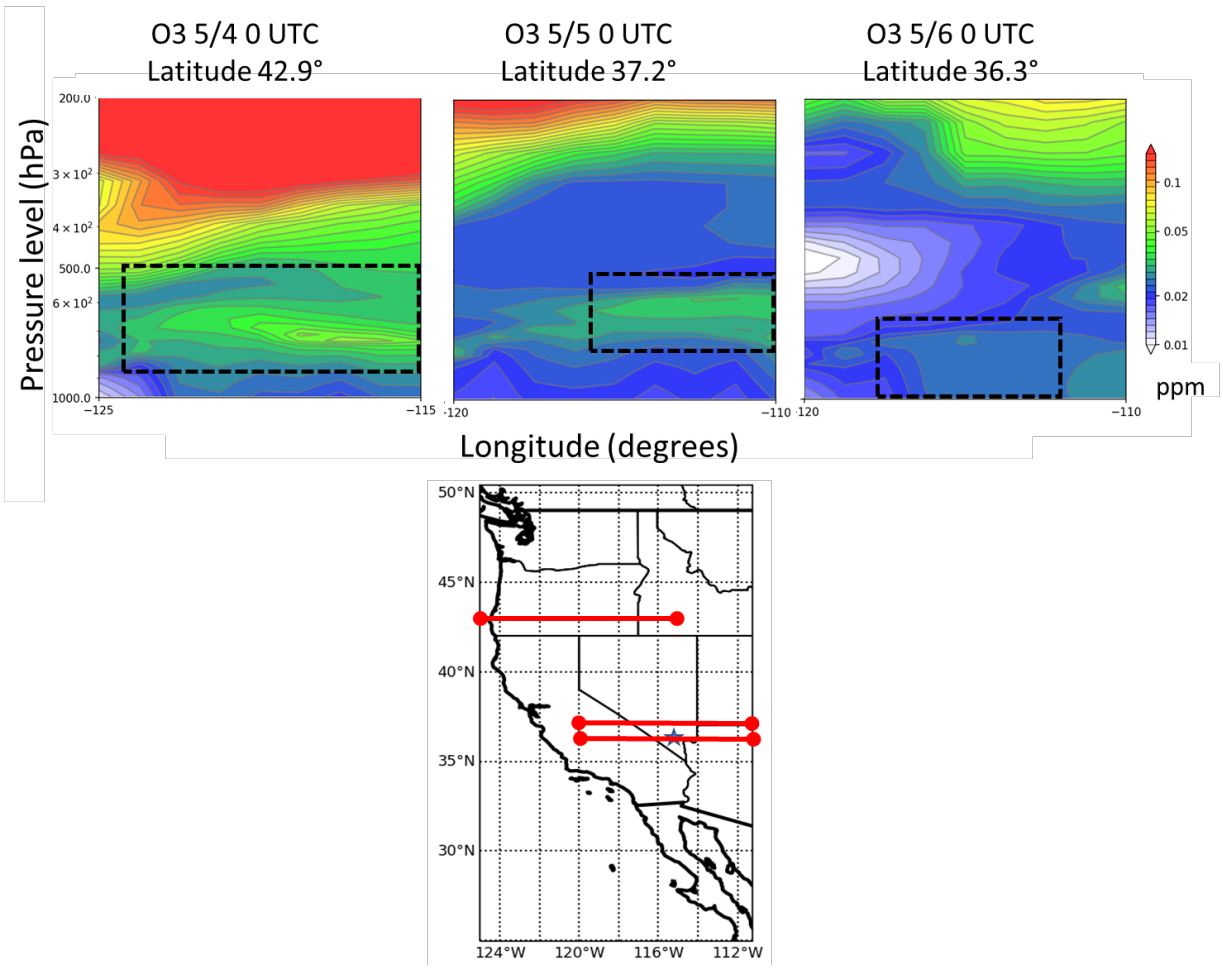

Figure A-14. WACCM-modelled cross-section of the stratospheric ozone tracer along the (A) 42.9-, (B) 37.2, and (C) 36.3-degrees N latitude lines on May 4, 5, and 6 respectively at 00:00 UTC. The extent of each cross-section is represented by the red lines (labelled by letter) on the map (right). Las Vegas is represented by a blue star. The boxed layer in A shows a tropospheric fold and elevated ozone in the mid-troposphere over the source region. The boxed layer in B shows elevated mid-tropospheric ozone in the transport path between the source region and Clark County. The boxed area in C shows a deep layer of elevated ozone between the surface and 600 mb.

References

Chouza F., Leblanc T., Brewer M., Wang P., Piazzolla S., Pfister G., Kumar R., Drews C., Tilmes S., and Emmons L. (2020) The impact of Los Angeles basin pollution and stratospheric intrusions on the surrounding San Gabriel Mountains as seen by surface measurements, lidar, and numerical models. *Atmos. Chem. Phys. Discuss.*, 2020, 1-29. Available at https://acp.copernicus.org/preprints/acp-2020-1208/.

Appendix B. Figures and Tables Supporting Section 3.5.1 (Matching Day Analysis)

Identification of matching (meteorologically similar) days includes a comparison of meteorology maps between May 6 and each date subset from candidate matching days. Surface maps for May 6, 2020, and each date listed in Table 3-15 show highly consistent conditions, with a surface low pressure system over Clark County. Surface maps for May 6, 2020, and each date in Table 3-15 in Section 3.5.1 of the report are shown in **Figure B-1 through Figure B-10**. Each upper-level map shows a ridge to the north and upper-level high pressure to the south. 500-mb maps for May 9, 2020, and each date in Table 3-15 are shown in **Figure B-11 through Figure B-20**.

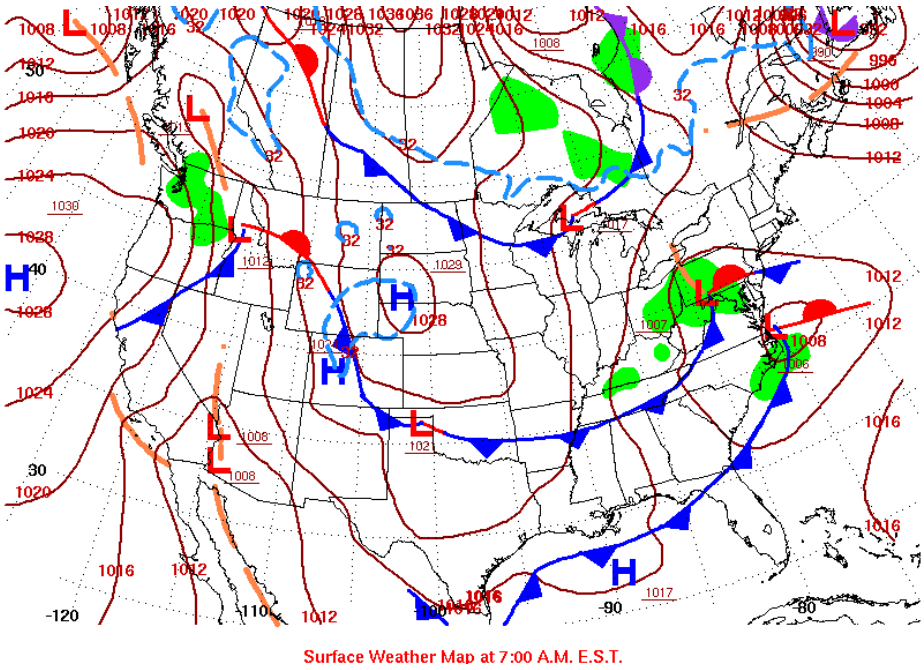

Figure B-1. Surface meteorology map on May 6, 2020 (the event date).

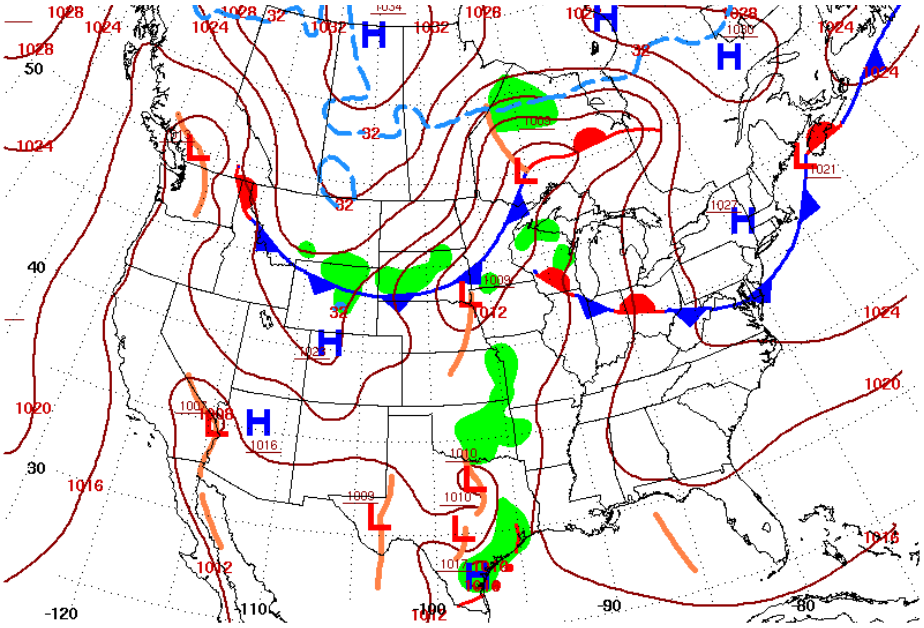

Figure B-2. Surface meteorology map on May 29, 2015.

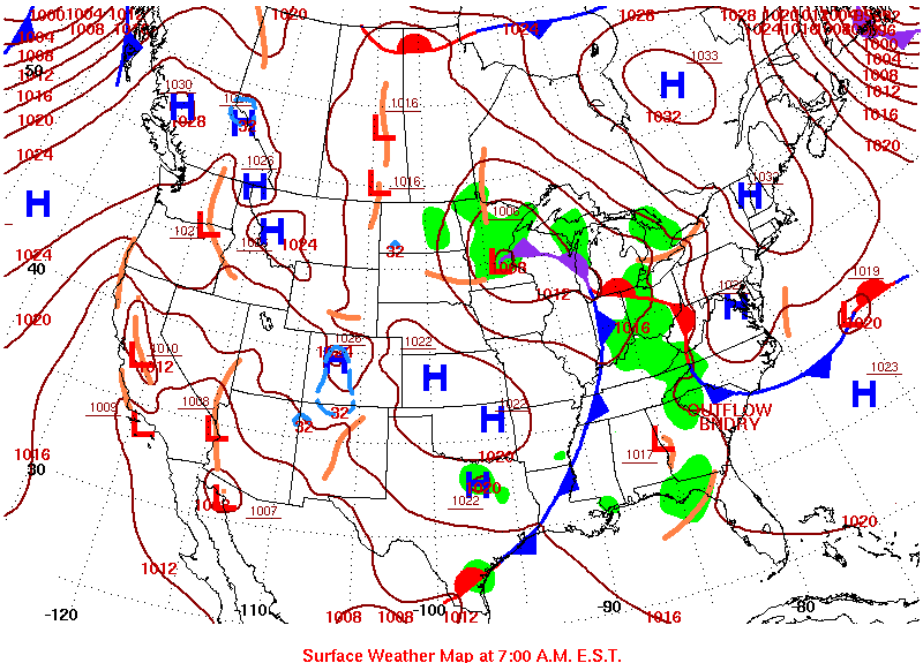

Figure B-3. Surface meteorology map on May 21, 2017.

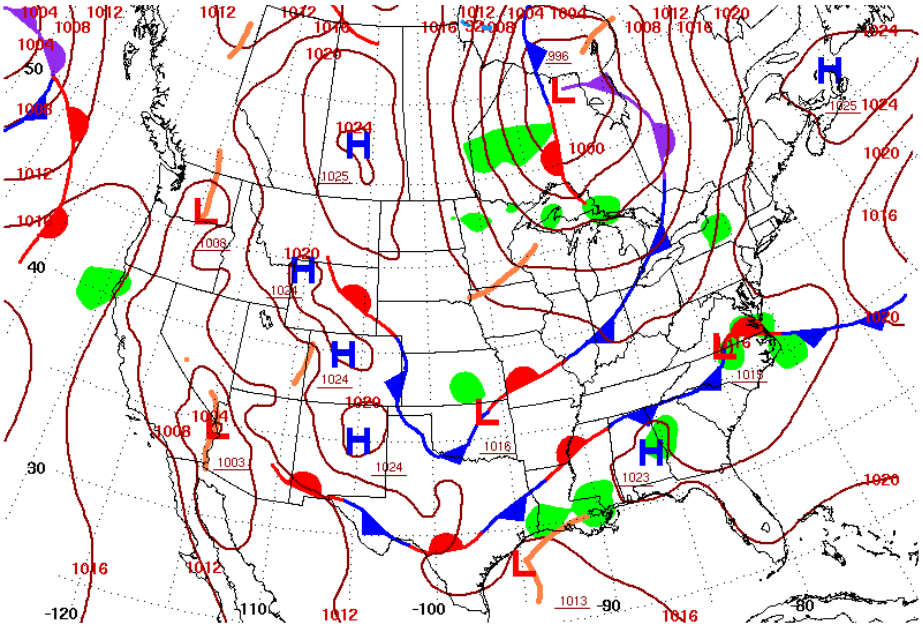

Figure B-4. Surface meteorology map on May 30, 2017.

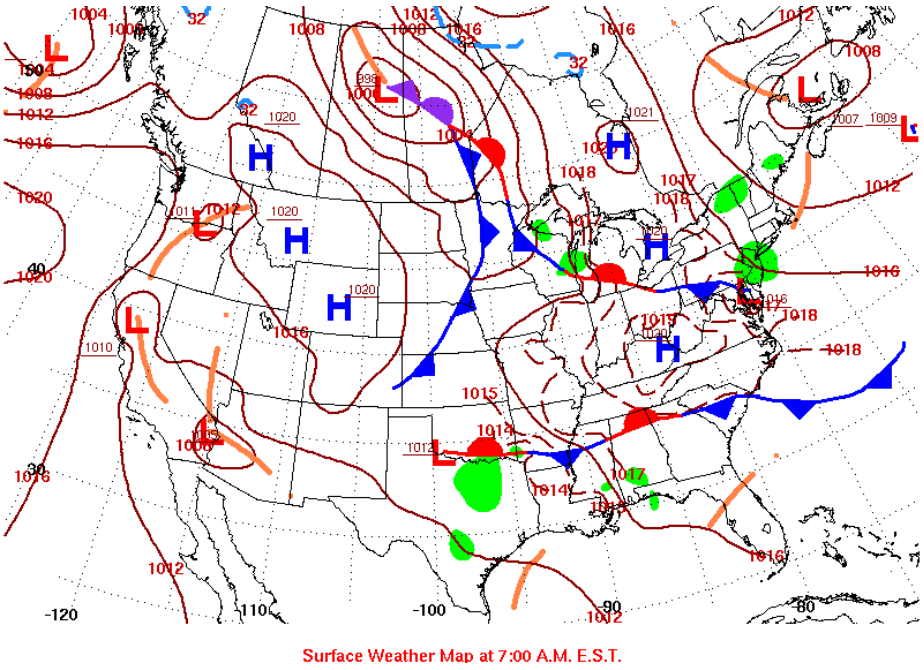

Figure B-5. Surface meteorology map on June 3, 2017.

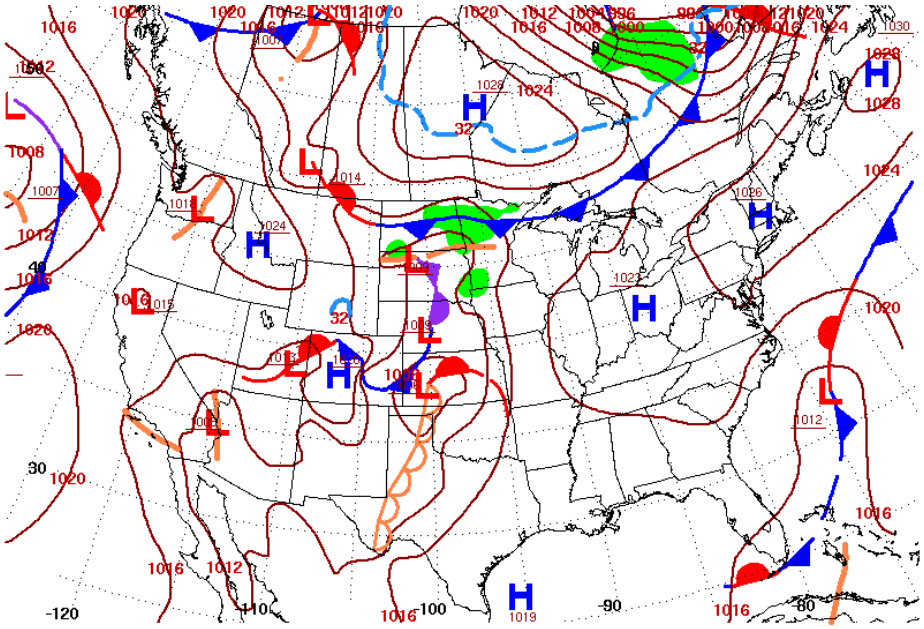

Figure B-6. Surface meteorology map on May 8, 2018.

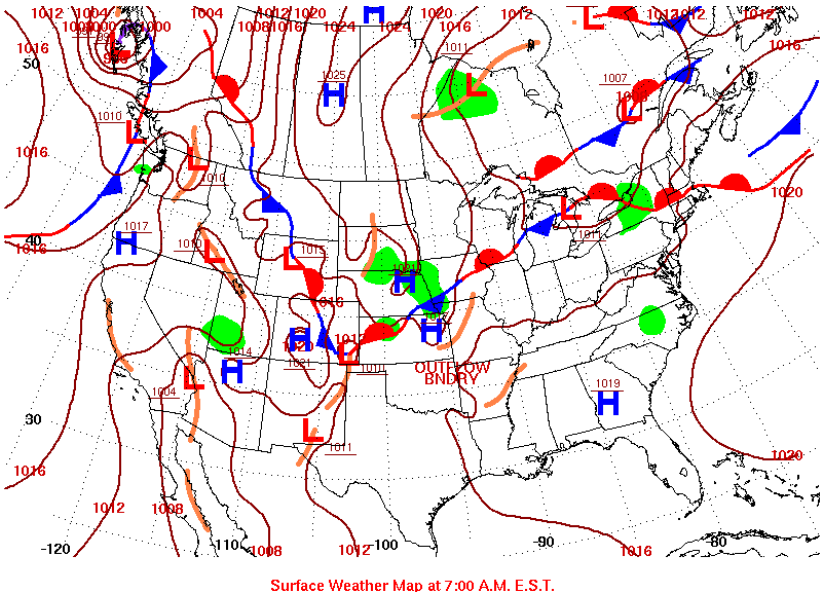

Figure B-7. Surface meteorology map on August 21, 2019.

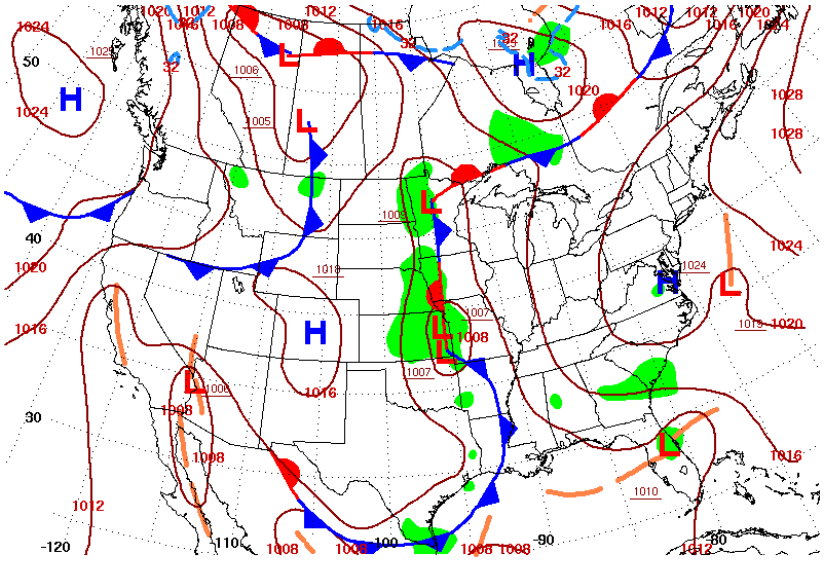

Figure B-8. Surface meteorology map on May 26, 2020.

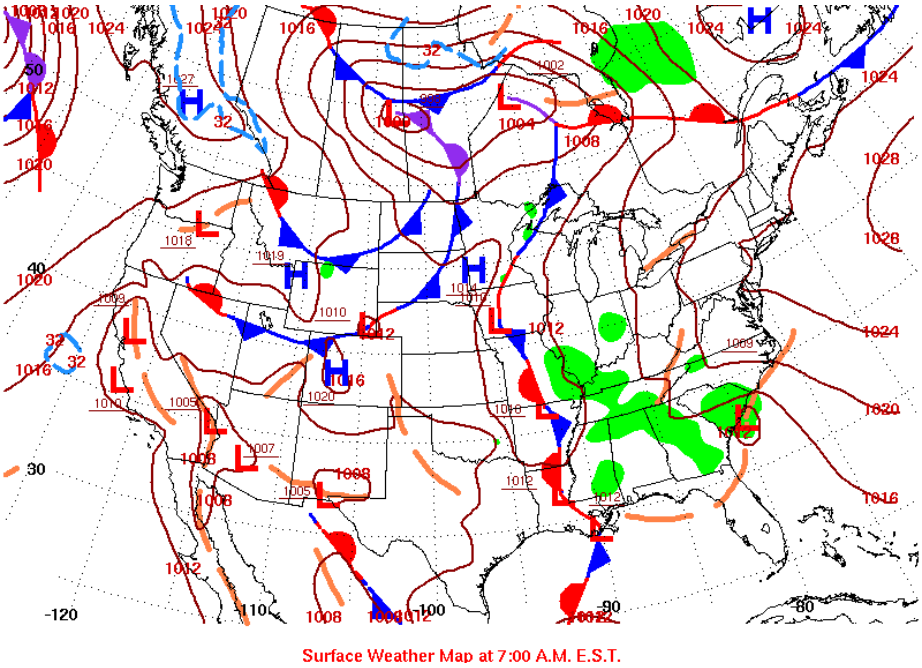

Figure B-9. Surface meteorology map on May 27, 2020

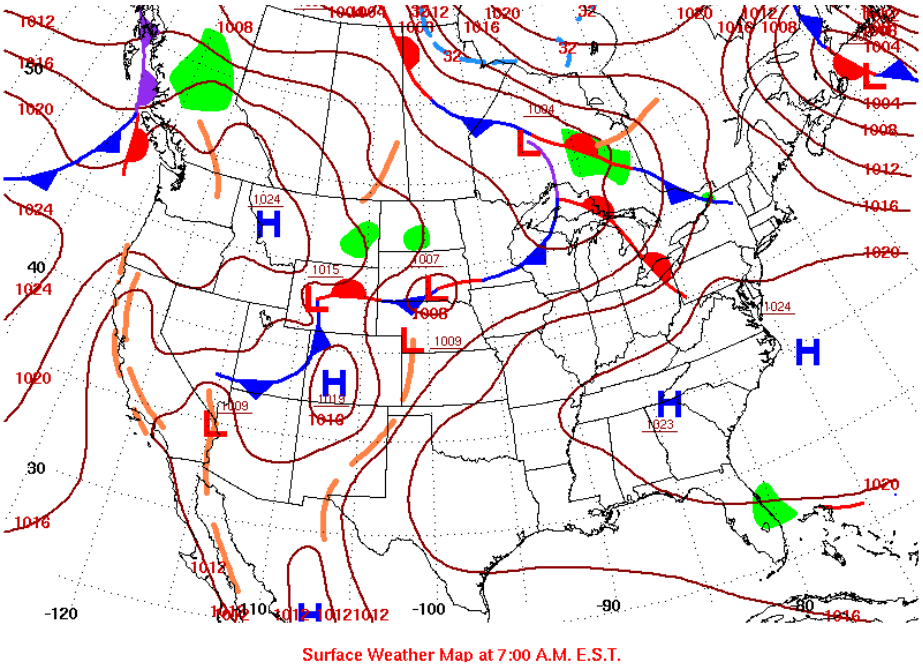

Figure B-10. Surface meteorology map on June 2, 2020.

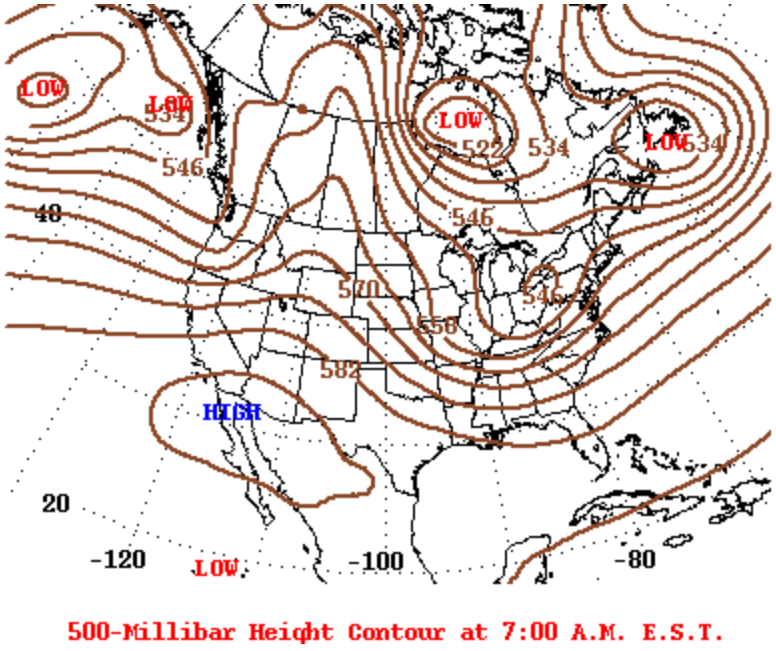

Figure B-11. 500 mb meteorology map on May 6, 2020 (the event date).

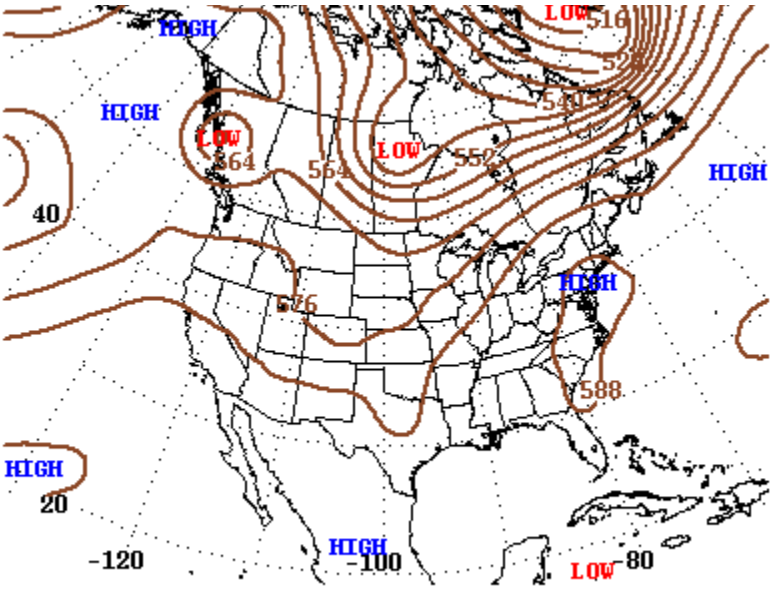

Figure B-12. 500-mb meteorology map on May 29, 2015.

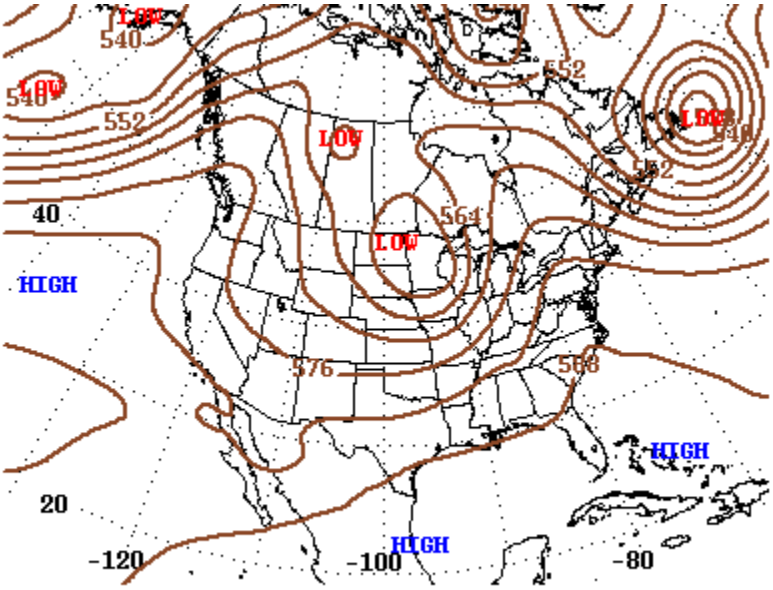

Figure B-13. 500-mb meteorology map on May 21, 2017.

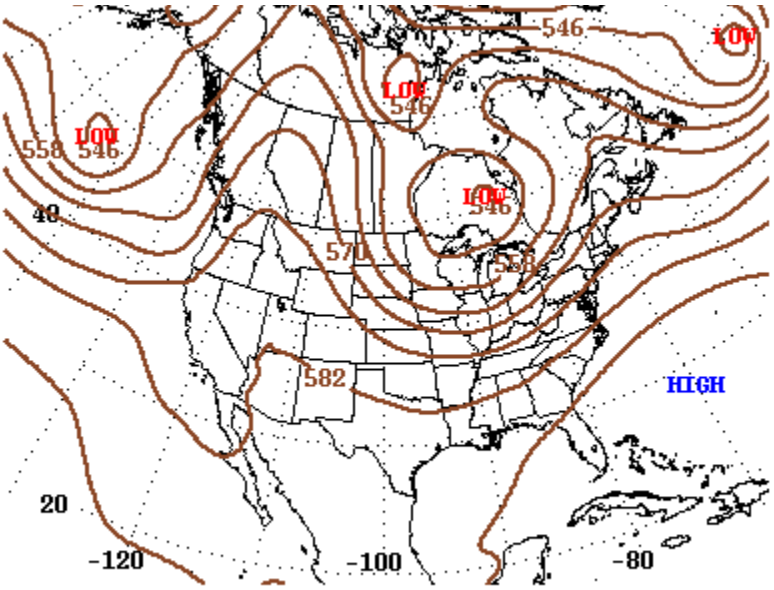

Figure B-14. 500-mb meteorology map on May 30, 2017.

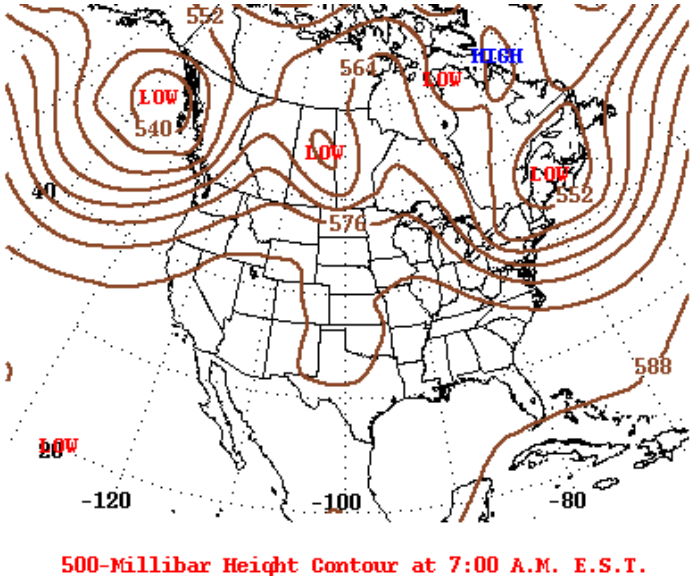

Figure B-15. 500-mb meteorology map on June 3, 2017.

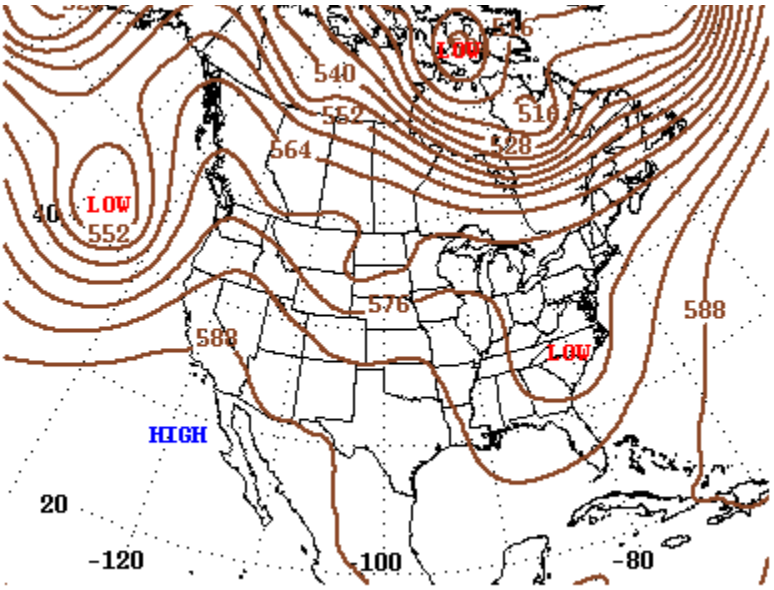

Figure B-16. 500-mb meteorology map on May 8, 2018.

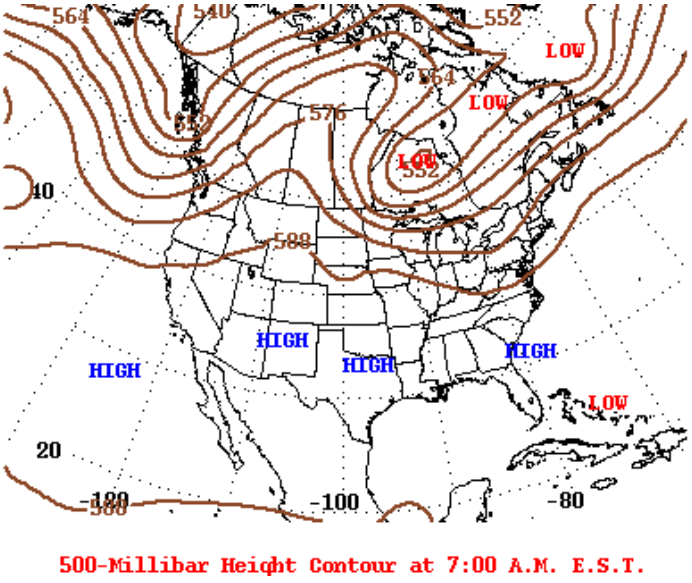

Figure B-17. 500-mb meteorology map on August 21, 2019.

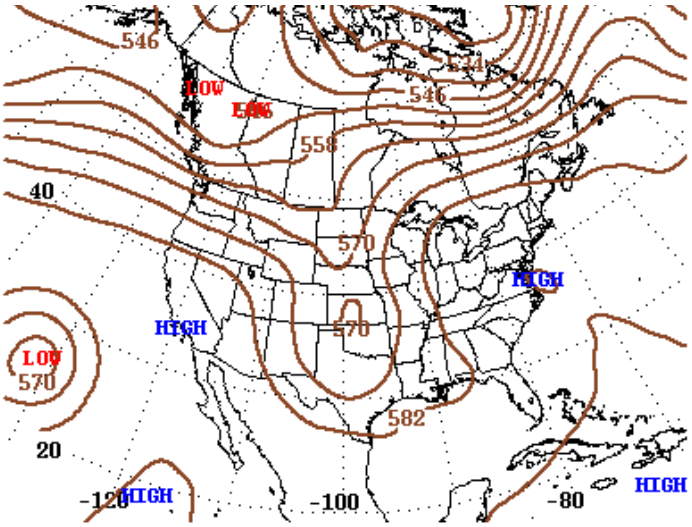

Figure B-18. 500-mb meteorology map on May 26, 2020.

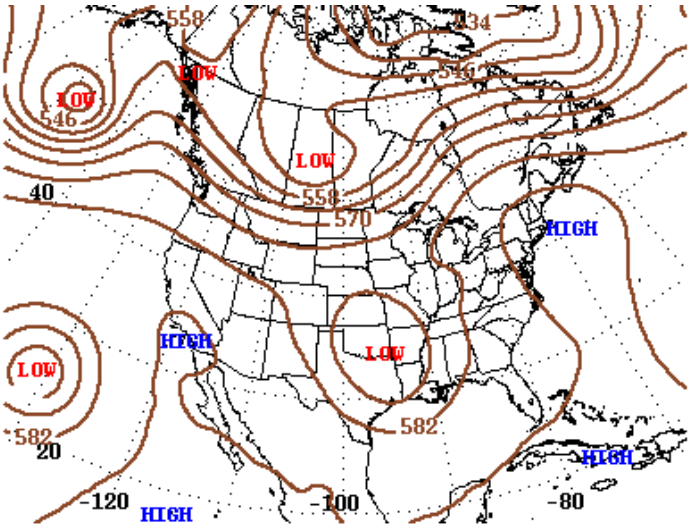

Figure B-19. 500-mb meteorology map on May 27, 2020.

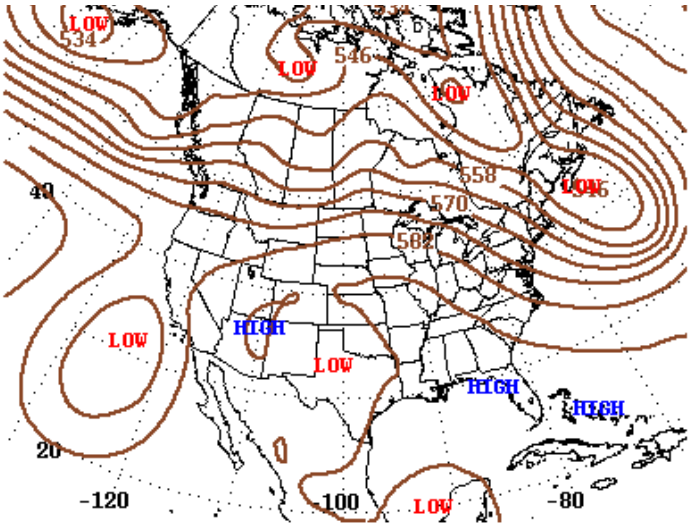

Figure B-20. 500-mb meteorology map on June 2, 2020.

Appendix C. GAM Residual Histograms and Scatter Plots from Concurred Exceptional Event Demonstrations

The following are GAM residual histograms and scatter plots from the concurred Arizona Department of Environmental Quality demonstration (Arizona Department of Environmental Quality 2016) and the submitted Texas Commission on Environmental Quality demonstration (Texas Commission on Environmental Quality 2021) for comparison with our GAM residual analysis. The figures in this Appendix show the good residual results from concurred and currently submitted exceptional events demonstrations to which we compared our results. Based on this comparison, we suggest that our GAM results show a well-fit, unbiased model. A well-fit GAM model should show a normal distribution of residuals at all sites modeled (ADEQ example in **Figure C-1**) and show no pattern or bias between GAM residuals and predicted values (TCEQ example in **Figure C-2**). These figures compare well with our GAM results in Section 3.5.2 of the main report.

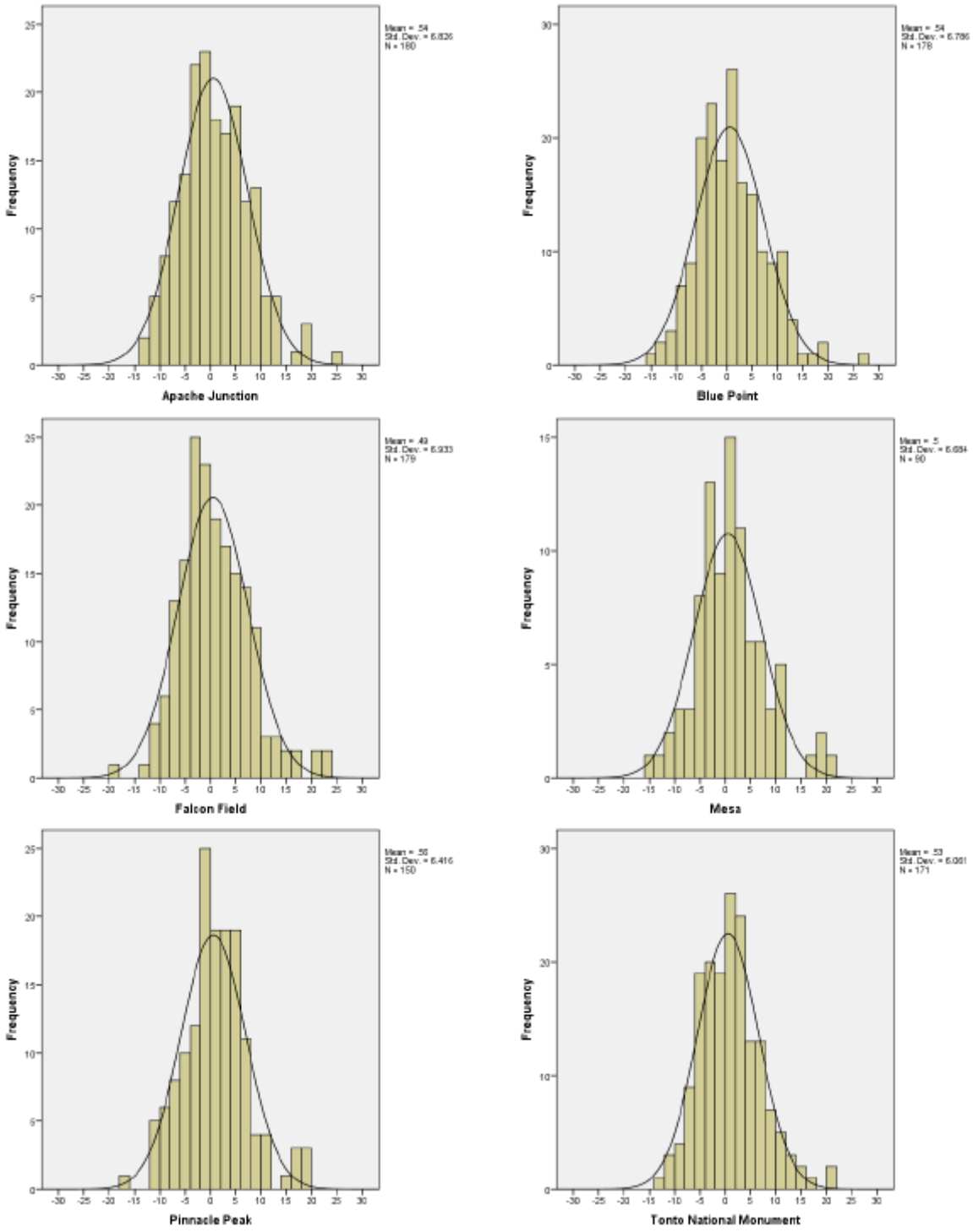

Figure C-1. Histograms of residuals results at each monitoring site from the Arizona DEQ GAM Analysis (Arizona Department of Environmental Quality 2016).

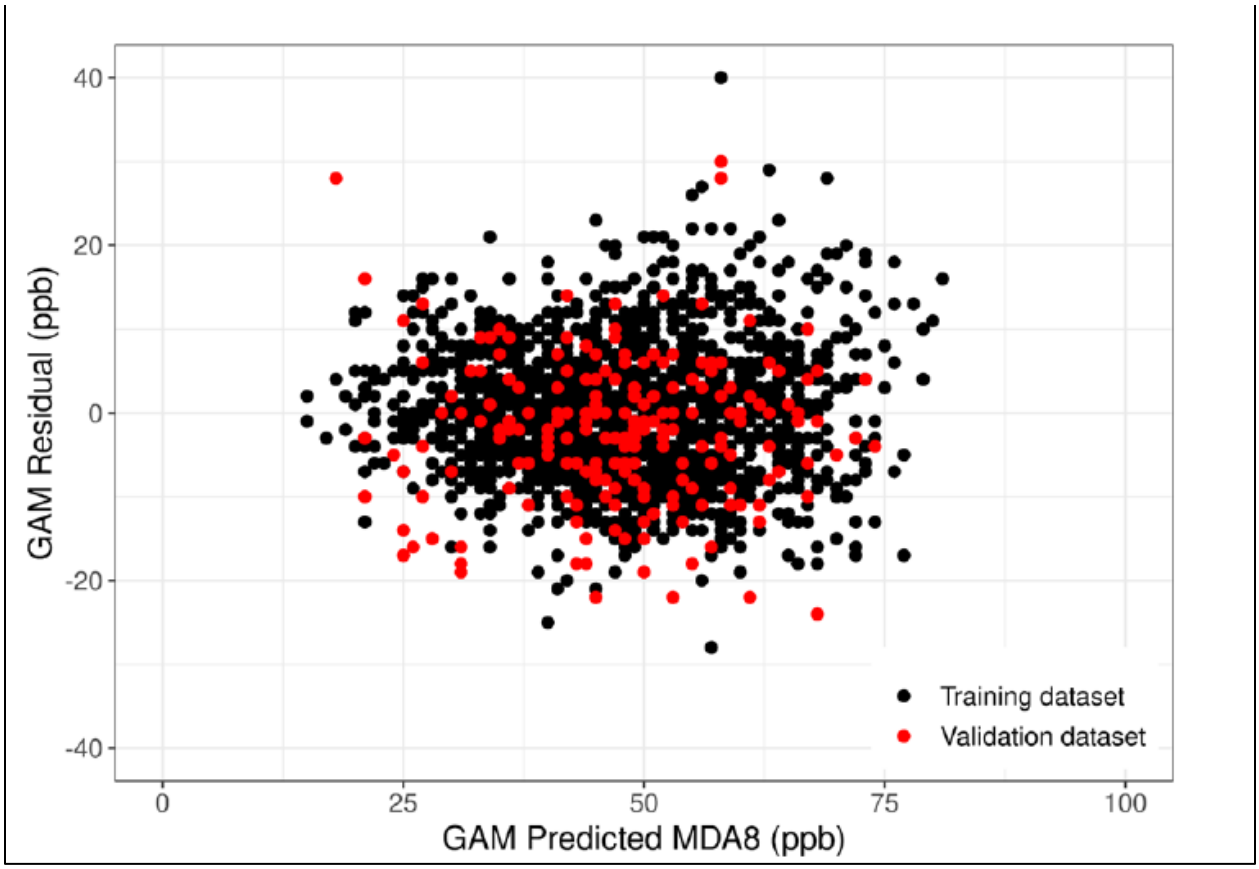

Figure C-2. Scatter plot of GAM residuals (observed – GAM predicted MDA8 ozone) vs. GAM predicted MDA8 ozone from the TCEQ submitted GAM analysis. Training data is shown in black, and validation data is shown in red (Texas Commission on Environmental Quality 2021).

References

Arizona Department of Environmental Quality (2016) State of Arizona exceptional event documentation for wildfire-caused ozone exceedances on June 20, 2015 in the Maricopa nonattainment area. Final report, September. Available at https://static.azdeq.gov/pn/1609_ee_report.pdf.

Texas Commission on Environmental Quality (2021) Dallas-Fort Worth area exceptional event demonstration for ozone on August 16, 17, and 21, 2020. April. Available at https://www.tceq.texas.gov/assets/public/airquality/airmod/docs/ozoneExceptionalEvent/2020-DFW-EE-Ozone.pdf.

Appendix D. Documentation of the Public Comment Process

May 6, 2020 Demonstration

Notice of Public Comment

NOTICE OF PUBLIC COMMENT PERIOD ON
FINAL EXCEPTIONAL EVENT DEMONSTRATIONS

NOTICE IS HEREBY GIVEN of a public comment period on the final exceptional event demonstrations identified below. The Exceptional Events Rule (EER), codified at 40 CFR 50.1, 50.14, and 51.930, allows air agencies to petition the U.S. Environmental Protection Agency (EPA) to exclude air quality monitoring data influenced by exceptional events from applicable regulatory determinations. Between 2018 and 2020, Clark County recorded several exceedances of the 2015 8-hour ozone National Ambient Air Quality Standard (NAAQS) due to impacts from wildfire smoke or stratospheric intrusions. The following table details these exceedances. The Clark County Department of Environment and Sustainability (DES) developed these demonstrations to show that exceedances would not have occurred without wildfire or stratospheric intrusion impacts and requests exclusion of event-related data from use in regulatory determinations in accordance with the EER.

NOTICE IS FURTHER GIVEN that a 30-day public comment period will begin on July 1, 2021, and end at 4:00 PM on August 2, 2021, in accordance with the requirements of 40 CFR 50.14(c)(3)(v). The public may review and provide written comments on these demonstrations during this period. Copies of the demonstrations are available for review on the DES website at: https://www.clarkcountynv.gov/government/departments/environment_and_sustainability/public_communications/public_notices.php and may also be obtained by contacting Araceli Pruett at (702) 455-3206.

Any written comments must be received by DES at 4701 W. Russell Road, Suite 200, Las Vegas, Nevada 89118, by 4:00 PM on August 2, 2021. Comments should be addressed to Araceli Pruett at the same mailing address, emailed to araceli.pruett@clarkcountynv.gov, or faxed to (702) 383-9994. All comments will be considered and forwarded to EPA.

Published: June 30, 2021

Marci D. Henson, Director

Final 2018 and 2020 Exceptional Events

Date of Event	Type of Event	Site Name	Exceedance Concentration (ppb)
06/19/2018	Wildfire	Green Valley Paul Meyer Walter Johnson	77 72 72
06/20/2018	Wildfire	Joe Neal Paul Meyer Walter Johnson	72 71 74
05/06/2020	Stratospheric Intrusion	Green Valley Joe Neal Paul Meyer Walter Johnson	72 76 77 78
05/09/2020	Stratospheric Intrusion	Paul Meyer Walter Johnson	74 71
05/28/2020	Stratospheric Intrusion	Paul Meyer Walter Johnson	76 71
06/22/2020	Wildfire	Joe Neal Paul Meyer Walter Johnson	78 74 73
06/26/2020	Wildfire	Paul Meyer	73
09/02/2020	Wildfire	Paul Meyer Walter Johnson	73 75

DES Website Notices

AIR QUALITY PLANNING NOTICES

Wed., June 30, 2021 - Public Notice for Final 2018 and 2020 Exceptional Event Demonstrations

DES welcomes comments on the final exceptional event demonstrations identified in the table below. Under the Exceptional Events Rule (EER), codified at 40 CFR 50.1, 50.14, and 51.930, air agencies are allowed to petition the U.S. Environmental Protection Agency (EPA) to exclude air quality monitoring data influenced by exceptional events from applicable regulatory determinations. Between 2018 and 2020, Clark County recorded several exceedances of the 2015 8-hour ozone National Ambient Air Quality Standard due to impacts from wildfire smoke or stratospheric intrusions. The purpose of these demonstrations is to show that the exceedances would not have occurred without wildfire or stratospheric intrusion impacts and request exclusion of event-related data from use in regulatory determinations in accordance with the EER. All comments will be considered and forwarded to EPA.

Public Comment Period:
July 1 through August 2, 2021

Submit comments in writing to:
Araceli Pruett, Senior Planner
Clark County Department of Environment and Sustainability
4701 West Russell Road, Suite 200
Las Vegas, NV 89118
Phone: (702) 455-3206
Email: araceli.pruett@clarkcountynv.gov

Review Documents
View Public Notice

Event Dates(s)	Event Type
June 19-20, 2018 Demonstration Appendices	Wildfire
May 6, 2020 Demonstration Appendices	Stratospheric Intrusion
May 9, 2020 Demonstration Appendices	Stratospheric Intrusion
May 28, 2020 Demonstration Appendices	Stratospheric Intrusion
June 22, 2020 Demonstration Appendices	Wildfire
June 26, 2020 Demonstration Appendices	Wildfire
September 2, 2020 Demonstration Appendices	Wildfire

Declaration of DES Website Posting

DECLARATION OF WEBSITE POSTING OF PUBLIC NOTICE

STATE OF NEVADA)
) ss.
COUNTY OF CLARK)

I, Araceli Pruett, declare that I am over 18 years of age and a Senior Planner with the Clark County Department of Environment and Sustainability (DES). I declare that the *Exceptional Event Demonstration for Ozone Exceedances in Clark County, Nevada – May 6, 2020* was posted on the DES website from June 30 through August 2, 2021. Below is a screenshot of the posting on the DES website at:
https://www.clarkcountynv.gov/government/departments/environment_and_sustainability/public_communications/public_notices.php

I declare under penalty of perjury that the foregoing is true and correct and that this declaration was executed in Las Vegas, NV, on August 2, 2021.

Araceli Pruett

Araceli Pruett
DES Senior Planner

DES Facebook Posting

DES Twitter Posting

E-Notice

Araceli Pruett

From: Araceli Pruett
Sent: Thursday, July 1, 2021 7:59 AM
Subject: NOTICE OF PUBLIC COMMENT PERIOD ON FINAL EXCEPTIONAL EVENT DEMONSTRATIONS

NOTICE IS HEREBY GIVEN of a public comment period on the final exceptional event demonstrations identified below. The Exceptional Events Rule (EER), codified at 40 CFR 50.1, 50.14, and 51.930, allows air agencies to petition the U.S. Environmental Protection Agency (EPA) to exclude air quality monitoring data influenced by exceptional events from applicable regulatory determinations. Between 2018 and 2020, Clark County recorded several exceedances of the 2015 8-hour ozone National Ambient Air Quality Standard (NAAQS) due to impacts from wildfire smoke or stratospheric intrusions. The following table details these exceedances. The Clark County Department of Environment and Sustainability (DES) developed these demonstrations to show that exceedances would not have occurred without wildfire or stratospheric intrusion impacts and requests exclusion of event-related data from use in regulatory determinations in accordance with the EER.

NOTICE IS FURTHER GIVEN that a 30-day public comment period will begin on July 1, 2021, and end at 4:00 PM on August 2, 2021, in accordance with the requirements of 40 CFR 50.14(c)(3)(v). The public may review and provide written comments on these demonstrations during this period. Copies of the demonstrations are available for review on the DES website at: https://www.clarkcountynv.gov/government/departments/environment_and_sustainability/public_communications/public_notices.php and may also be obtained by contacting Araceli Pruett at (702) 455-3206.

Any written comments must be received by DES at 4701 W. Russell Road, Suite 200, Las Vegas, Nevada 89118, by 4:00 PM on August 2, 2021. Comments should be addressed to Araceli Pruett at the same mailing address, emailed to araceli.pruett@clarkcountynv.gov, or faxed to (702) 383-9994. All comments will be considered and forwarded to EPA.

Published: June 30, 2021

1

E-Notice Distribution List

PLANNING E-NOTICE DISTRIBUTION LIST	
Organization	**Contact**
Air & Waste Management Association	Paul Fransioli
American Lung Association Nevada	James Martinez
Bureau of Land Management	Lisa Christianson
City of Boulder City	Michael Mays
City of Henderson	Sean Robertson
City of Las Vegas	Marco Velotta
City of Las Vegas	Milagros (Miles) Escuin
City of Las Vegas	Robert Summerfield
City of North Las Vegas	Alfredo Melesio
City of North Las Vegas	Johanna Murphy
Clark County	Daniel Kezar
Clark County	Mario Bermudez
Clark County School District	Chris Dingell
Clark County School District	Dimitrios Karapanagiotis
Las Vegas Valley Water District	Brian Bowler
Nellis Air Force Base	Shimi Mathew
Nevada Department of Environmental Protection	Sheryl Fontaine
Nevada Department of Environmental Protection	Sig Jaunarajs
Nevada Resort Association	Sabrina Santiago
Nevada Resort Association	Virginia Valentine
Regional Flood Control	Steve Parrish
Regional Transportation Commission	Beth Xie
Regional Transportation Commission	Craig Raborn
Sierra Club Toiyabe Chapter	Brian Beffort
Southern Nevada Health District	Nicole Bungum
Southern Nevada Off Road Enthusiasts	Ken Thatcher
Southern Nevada Water Authority	Ayoub Ayoub
Southern Nevada Water Authority	Keiba Crear
Southern Nevada Water Authority	Thomas Maher
Southern Nevada Home Builders	Amanda Moss
Southern Nevada Home Builders	Nat Hodgson
The Nature Conservancy	Jaina Moan
University of Nevada Las Vegas	Dave James, PhD.
Washoe County Health District	Francisco Vega
Washoe County Health District	Daniel Inouye

Public Comment Report

Public Notice:	DES Website: June 30 through August 2, 2021
Public Comment Period	July 1 through August 2, 2021
Formal Comments Received:	None
DES Responses:	None