# 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 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-2.** RAQMS-modeled ozone at the 300 K isentrope-level from May 9 at 12:00 UTC to May 14 at 12:00 UTC. The model was initialized at 12:00 UTC on May 9.

**Figure A-3.** RAQMS-modeled ozone at the 310 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-4.** RAQMS-modeled cross-section of ozone 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-5.** RAQMS-modeled CO at the 310 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-6.** 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-7.** RAQMS-modeled cross-section of CO from May 9 at 12:00 UTC to May 14 at 12:00 UTC. The model was initialized at 12:00 UTC on May 9.

**Figure A-8.** WACCM-modeled stratospheric ozone from May 7 at 00:00 UTC to May 10 at 00:00 UTC.

**Figure A-9.** Ozone mass mixing ratio, Instantaneous from the MERRA-2 model on May 7 at 0:00 UTC to May 9 at 23:59 UTC.

Figures A-10 through A-12 depict the stratospheric ozone (O3S) tracer time series and correspond to the WACCM latitudinal cross sections of total ozone concentration in Figure 3-16 and Figures 3-19 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 9, 2020, in Clark County.

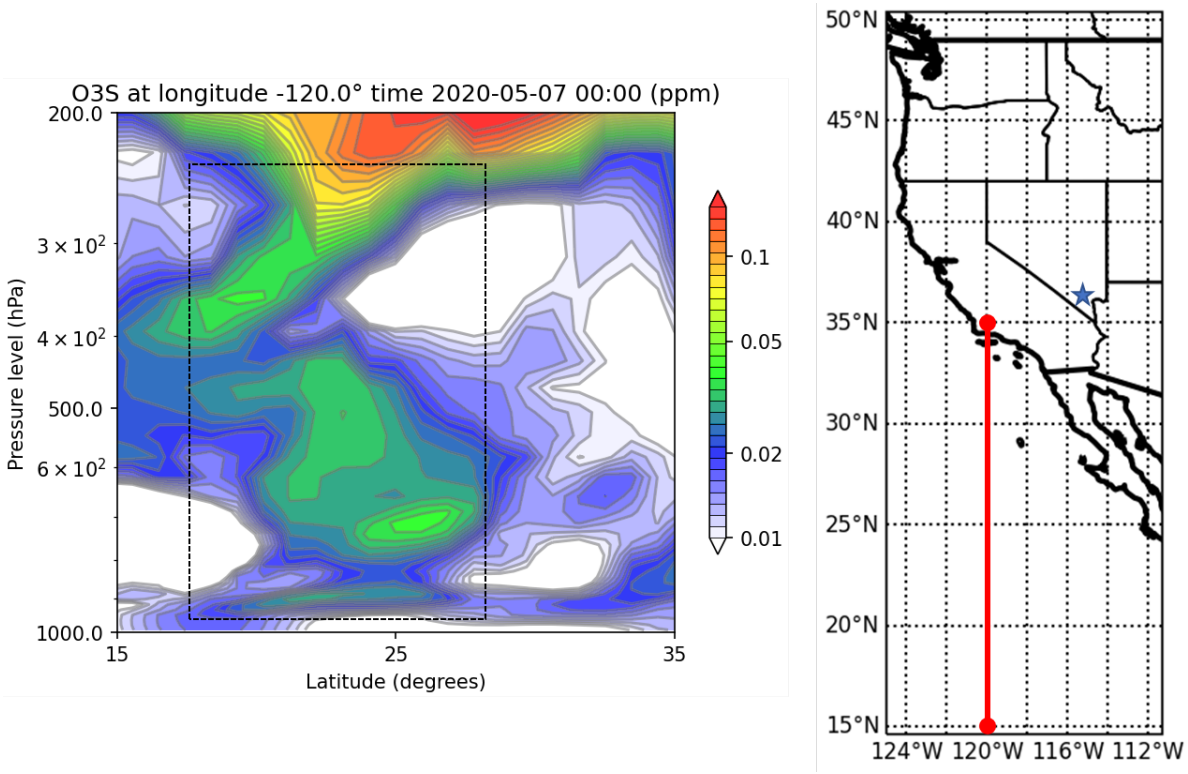


**Figure A-10.** WACCM-modeled cross-section of the stratospheric ozone tracer along the 120 degrees west longitude line on May 7 at 0:00 UTC. The "tongue" of elevated ozone extending from the stratosphere into the mid-to-lower troposphere is boxed in black. The map to the right shows the extent of the cross section. Las Vegas is marked with a blue star.

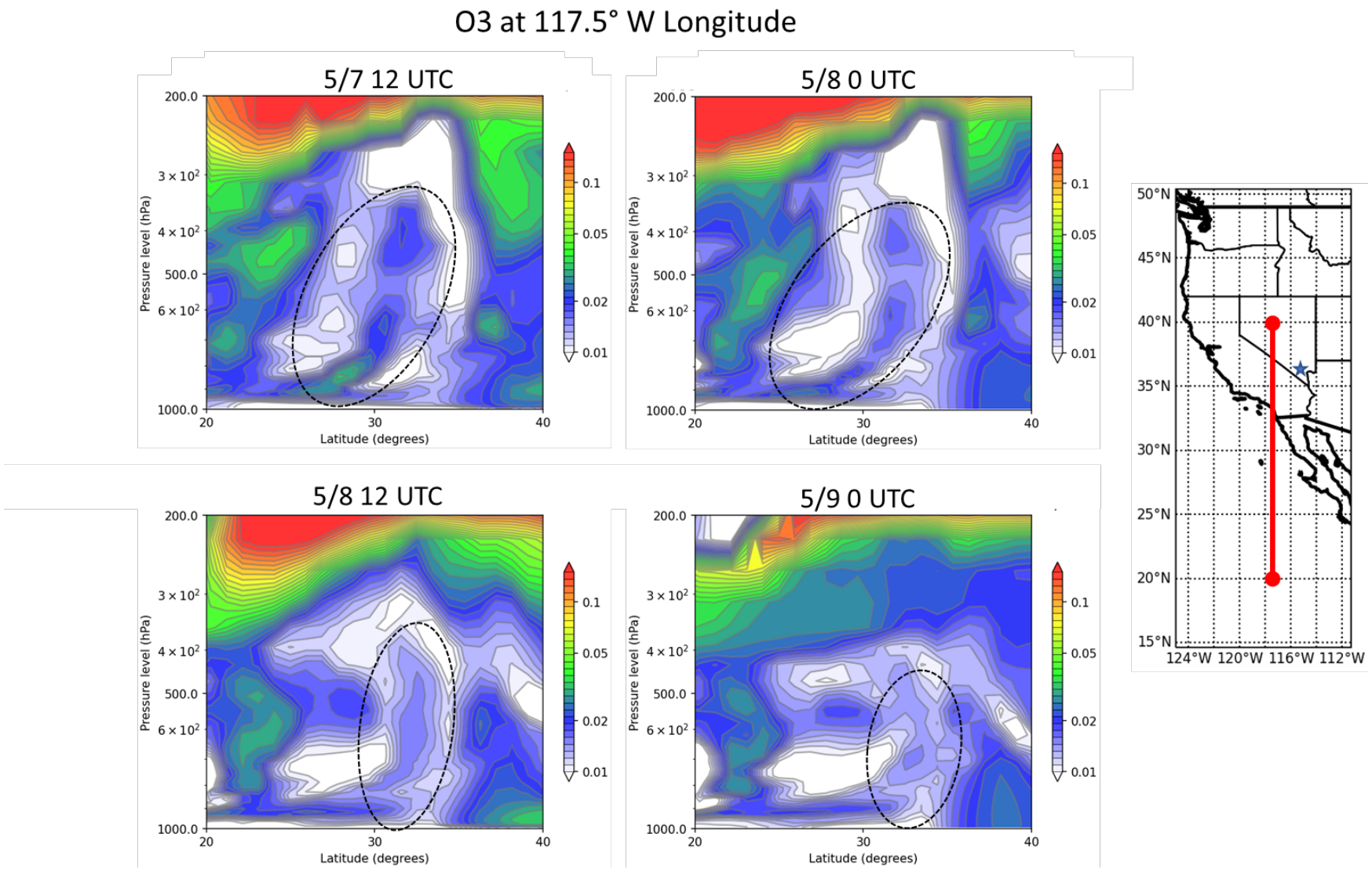


**Figure A-11.** Progression of WACCM-modeled cross-sections of the stratospheric ozone tracer along the 117.5-degrees west longitude line between May 7 at 12:00 UTC and May 9 at 0:00 UTC. The map to the right shows the extent of the cross section. Las Vegas is marked with a blue star.

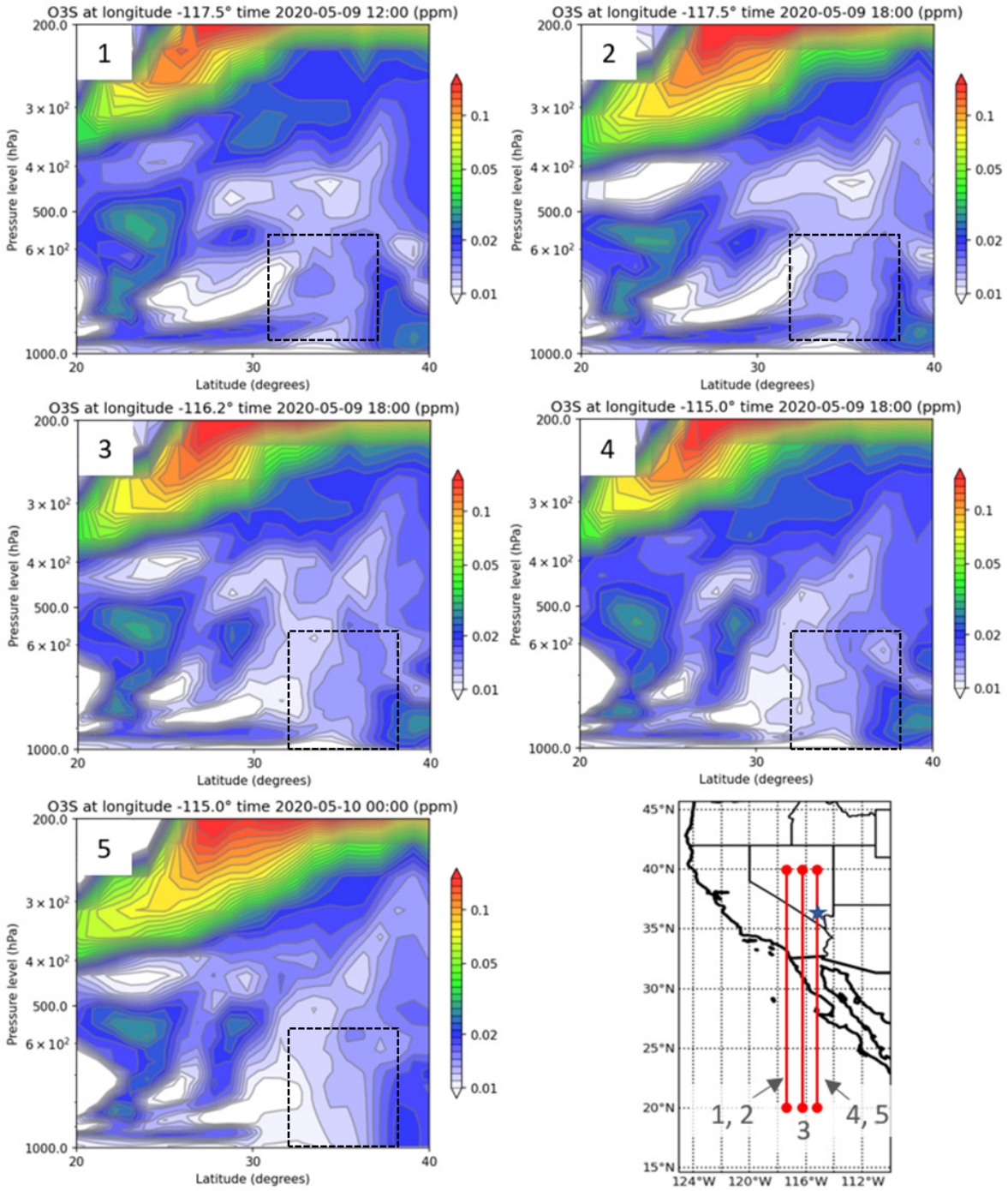


**Figure A-12.** WACCM-modeled cross-sections of the stratospheric ozone tracer on the event date, between 12:00 UTC (04:00 PST) on May 9 and 0:00 UTC on May 10 (16:00 PST on May 10). Cross sections along the 117.5-, 116.2- and 115.0-degrees west longitude lines are shown, and the number at the top left of each plot aligns with the labeled cross-section extents shown on the map. Vertical mixing in the mid-to-lower troposphere is indicated by the black boxes. Las Vegas is marked with a blue star on the map.

## 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 9, 2020, and each date subset from candidate matching days. Surface and upper-level maps for May 9, and each date listed in Table 3-10 in Section 3.5.1 of the report show highly consistent conditions. At the surface, all dates show a low pressure system over Clark County, and most dates show a region of high pressure at the surface directly to the east of the surface low. Surface maps for May 9 and each date in Table 3-10 are shown in Figure B-1 through Figure B-9. Each upper-level map shows an upper-level ridge over Clark County. 500 mb maps for May 9 and each date in Table 3-10 are shown in Figure B-10 through Figure B-18.

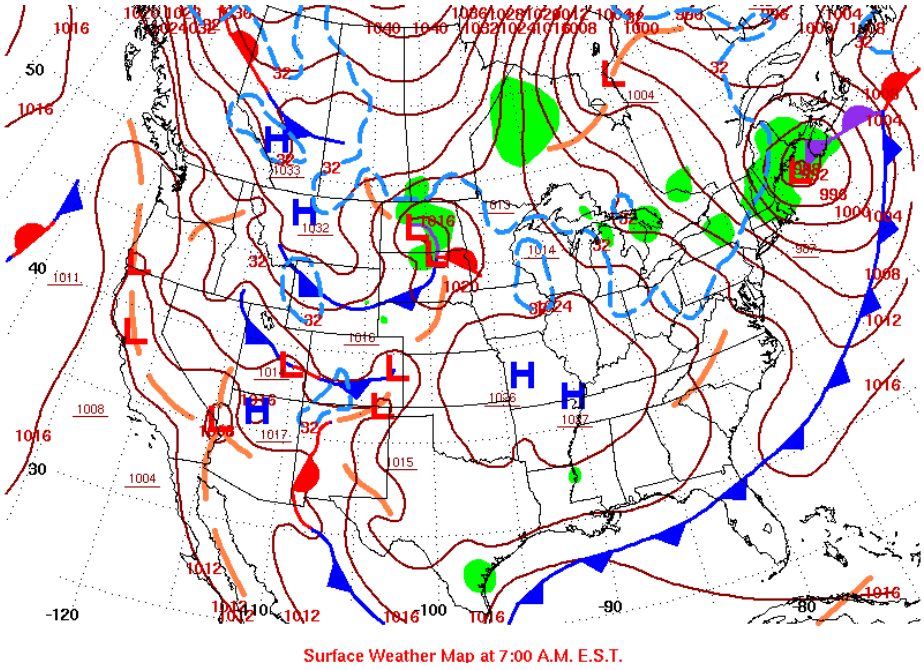


**Figure B-1.** Surface meteorology map on May 9, 2020 (the event date).

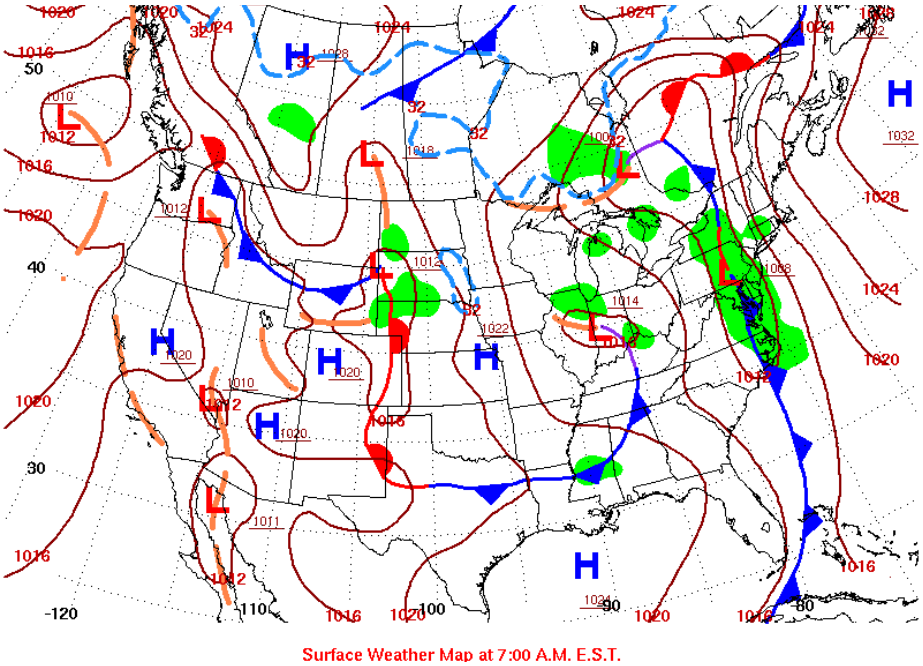


**Figure B-2.** Surface meteorology map on May 16, 2014.

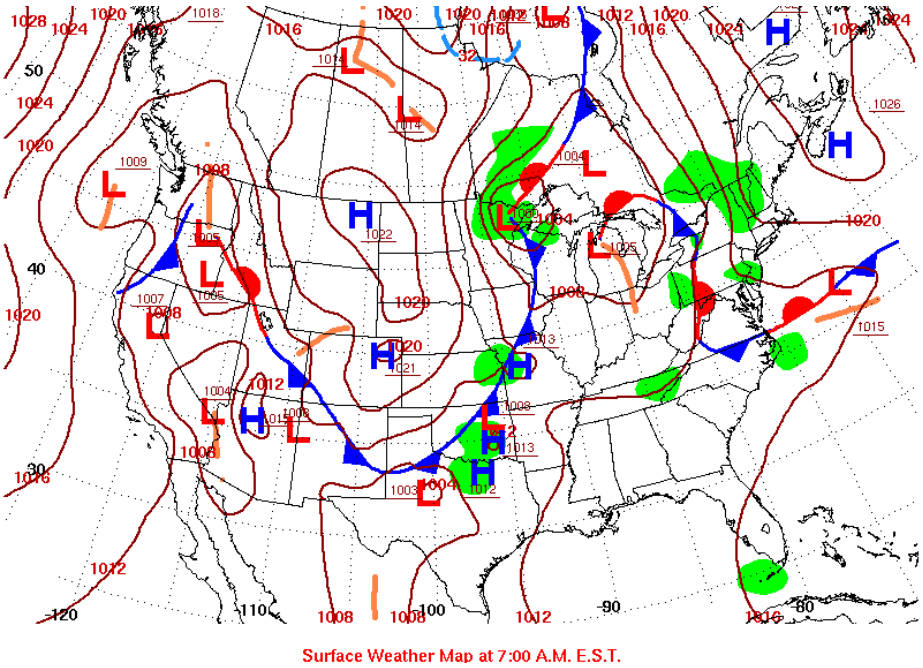


**Figure B-3.** Surface meteorology map on June 12, 2014.

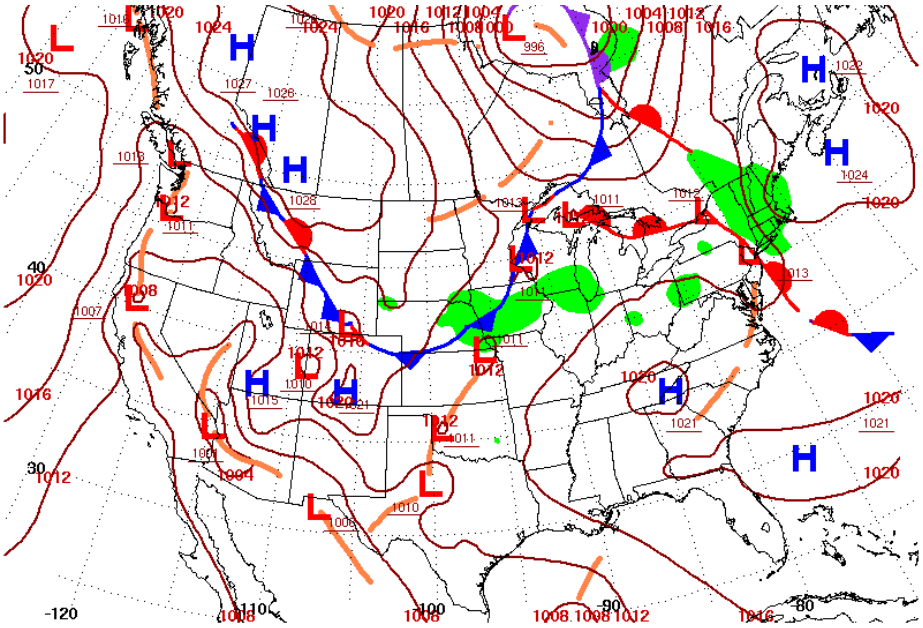


**Figure B-4.** Surface meteorology map on June 15, 2015.

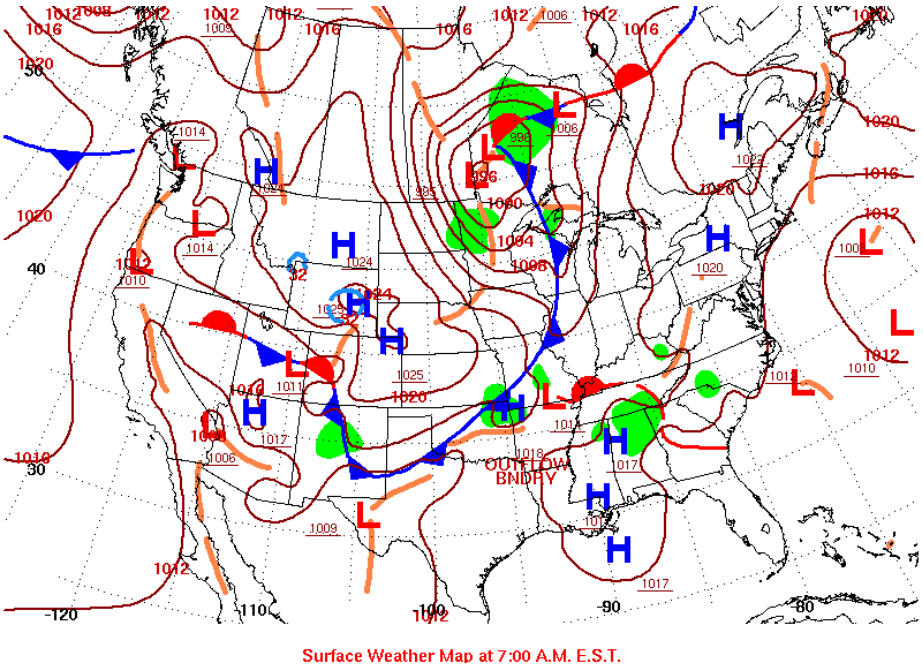


**Figure B-5.** Surface meteorology map on August 23, 2015.

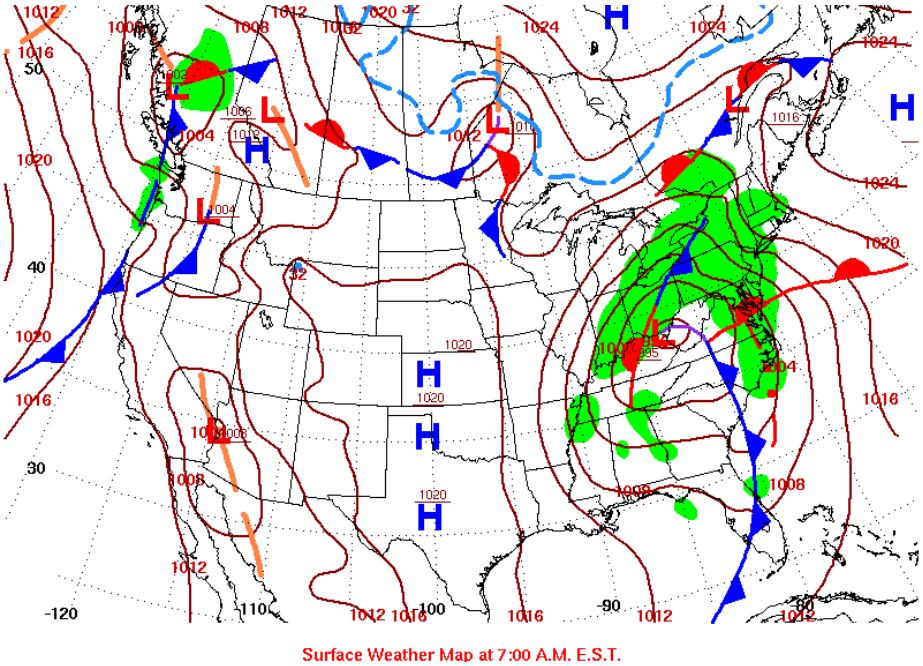


**Figure B-6.** Surface meteorology map on May 5, 2017.

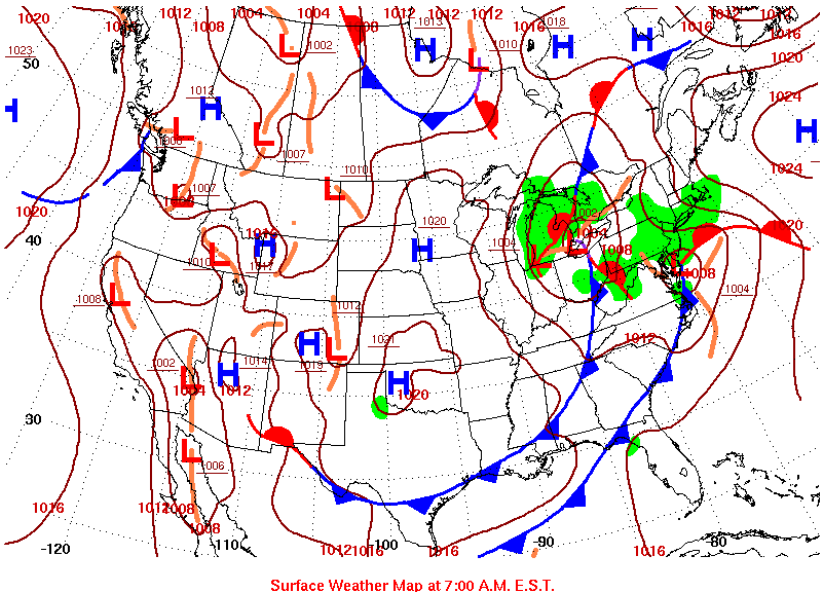


**Figure B-7.** Surface meteorology map on June 13, 2019.

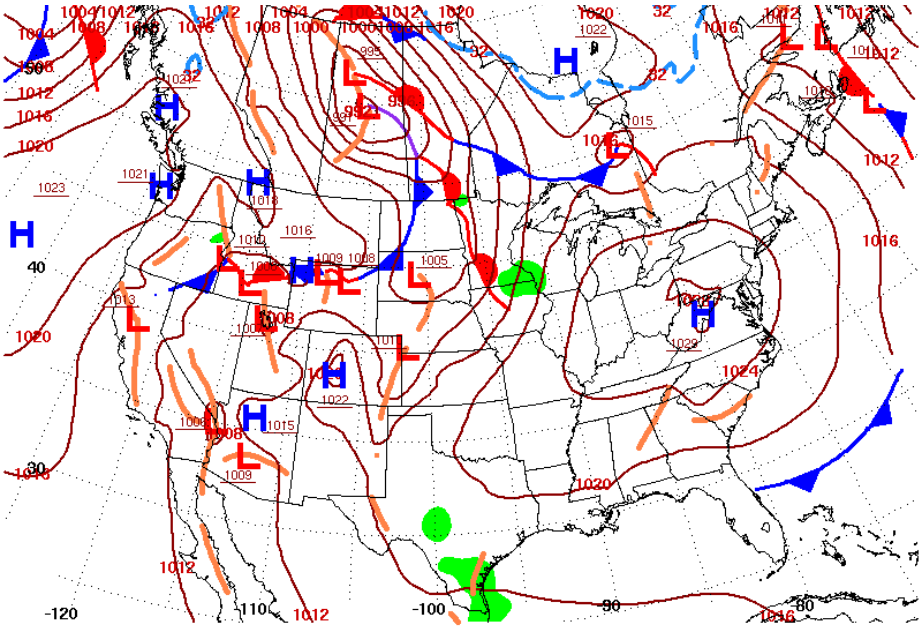


**Figure B-8.** Surface meteorology map on June 1, 2020.

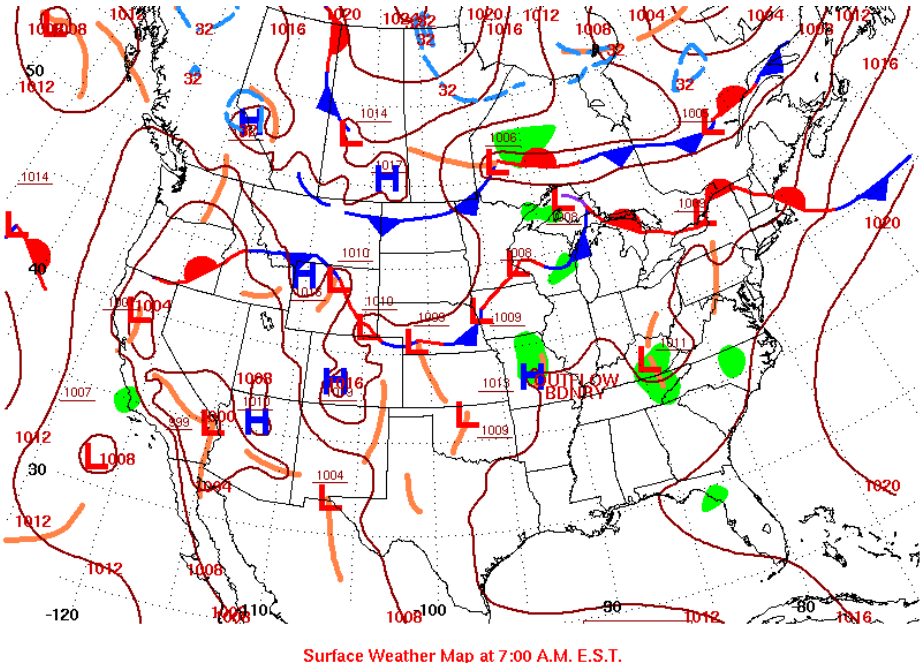


**Figure B-9.** Surface meteorology map on June 5, 2020

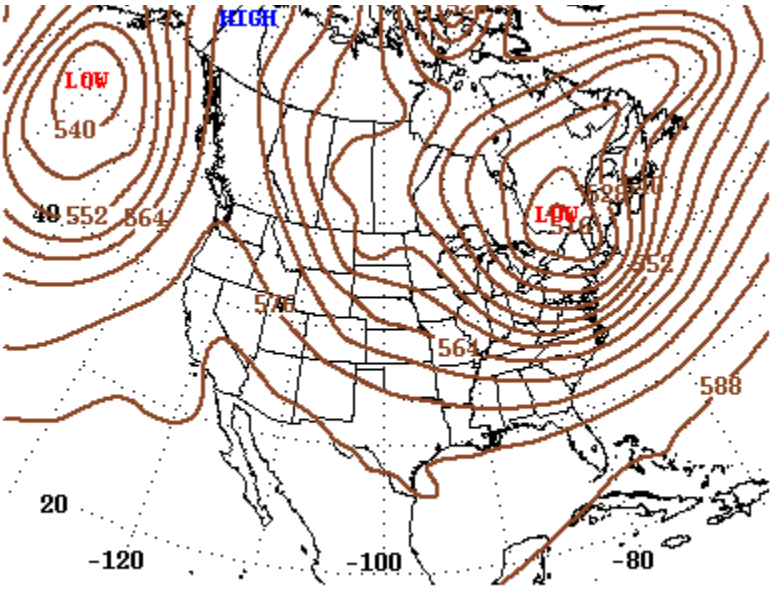


**Figure B-10.** 500 mb meteorology map on May 9, 2020 (the event date).

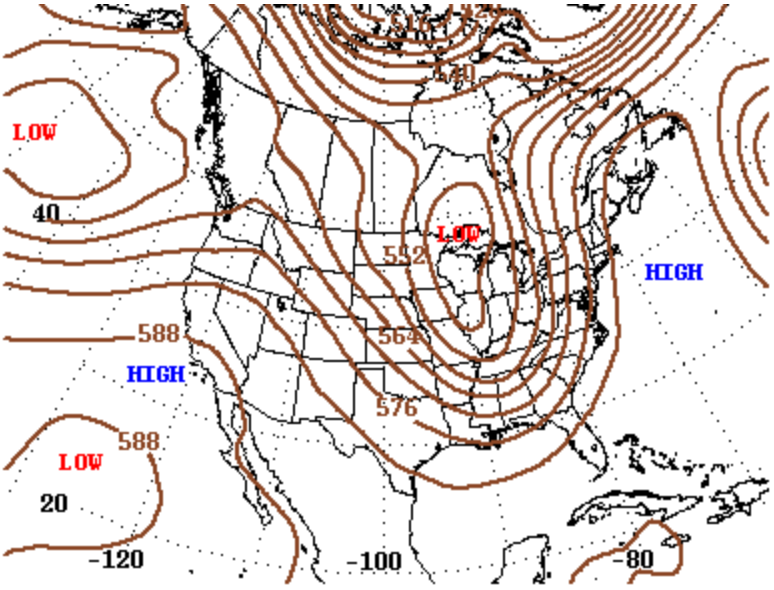


**Figure B-11.** 500 mb meteorology map on May 16, 2014.

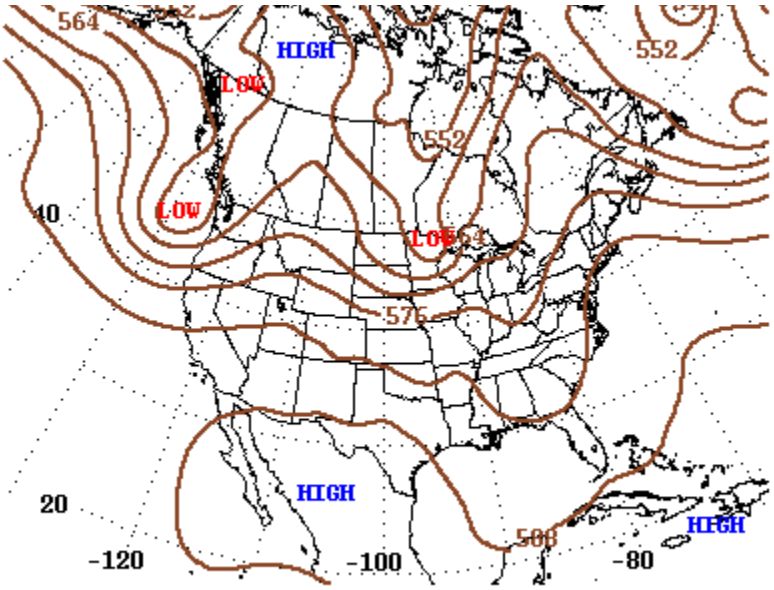


**Figure B-12.** 500 mb meteorology map on June 12, 2014.

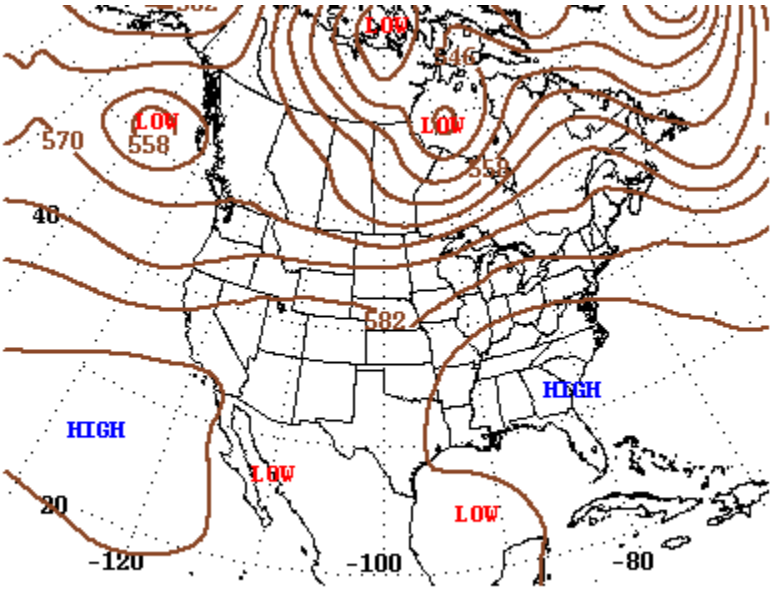


**Figure B-13.** 500 mb meteorology map on June 15, 2015.

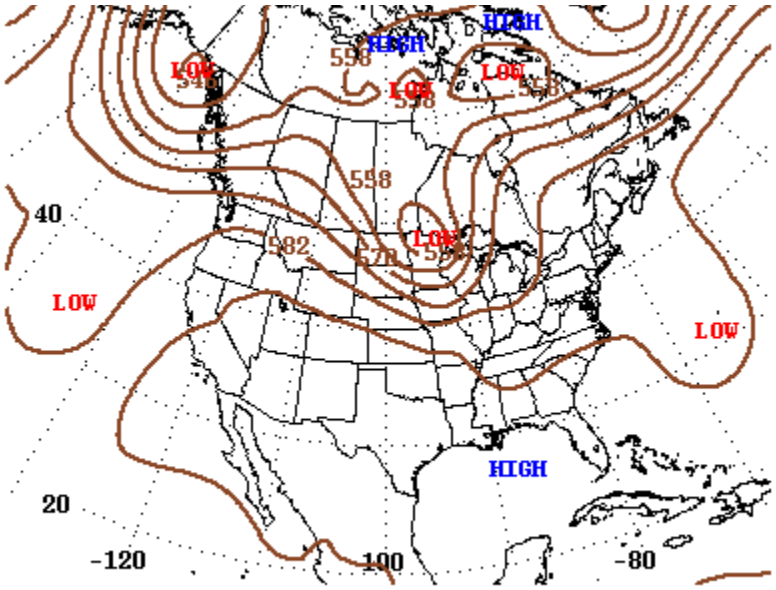


**Figure B-14.** 500 mb meteorology map on August 23, 2015.

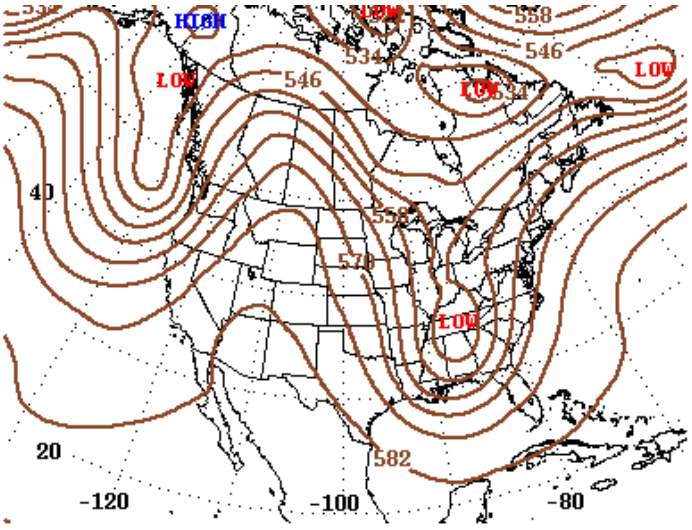


**Figure B-15.** 500 mb meteorology map on May 5, 2017.

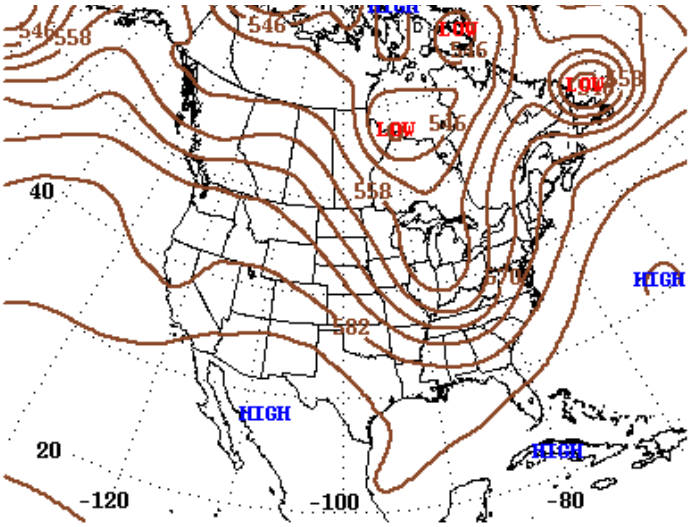


**Figure B-16.** 500 mb meteorology map on June 13, 2019.

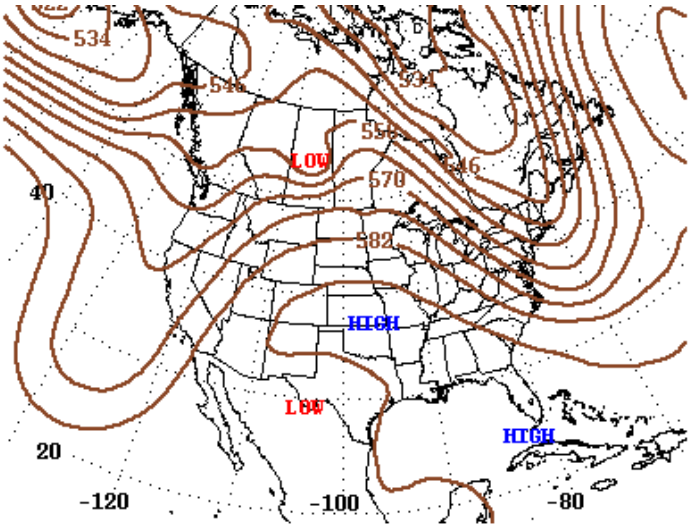


**Figure B-17.** 500 mb meteorology map on June 1, 2020.

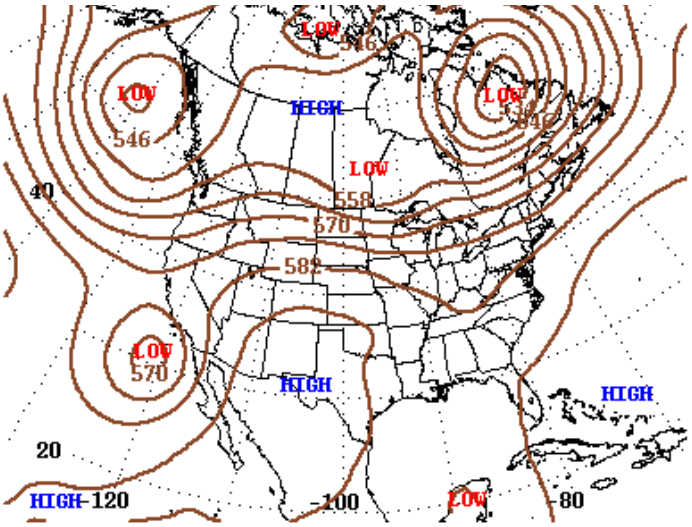


**Figure B-18.** 500 mb meteorology map on June 5, 2020.

# 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.

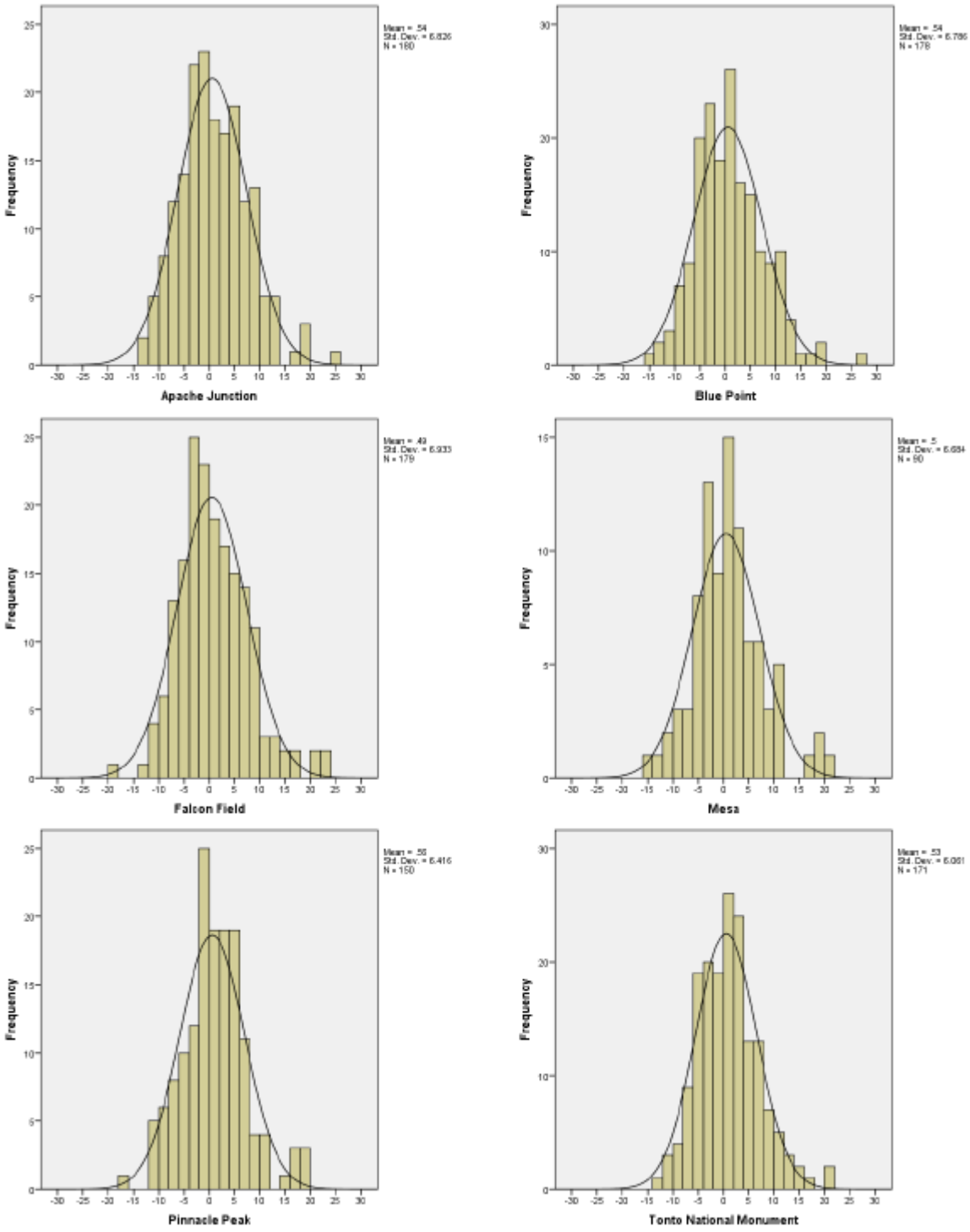


**Figure C-1.** Histograms of residuals results at each monitoring site from the Arizona DEQ GAM Analysis (Arizona Department of Environmental Quality 2016).

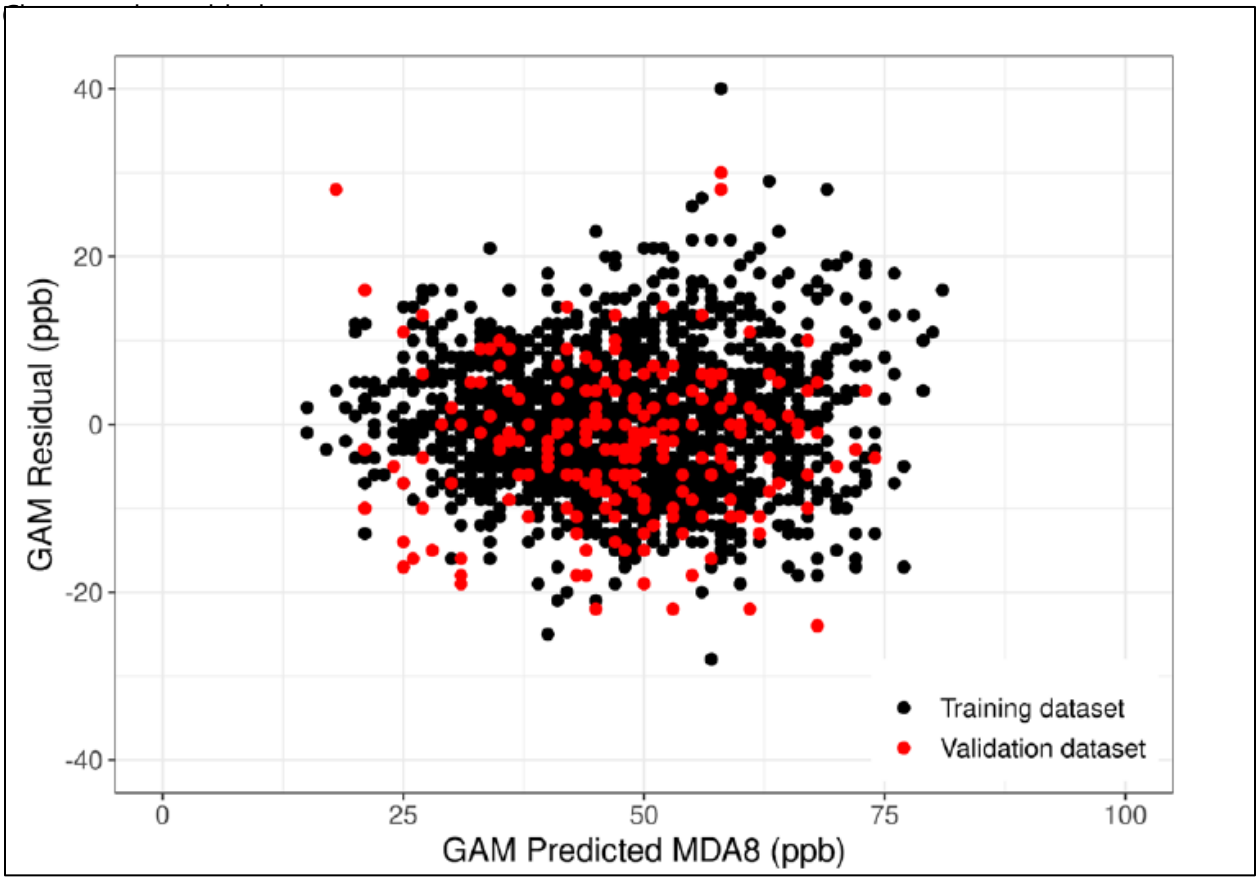


**Figure C-2.** Scatter plot of GAM residuals (observed – GAM predicted MDA8 ozone) vs. GAM predicted MDA8 ozone from the TCEQ submitted GAM analysis. Training data is shown in black and validation data is shown in red (Texas Commission on Environmental Quality 2021).

## 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 9, 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<br>Paul Meyer<br>Walter Johnson | 77<br>72<br>72 |
| 06/20/2018 | Wildfire | Joe Neal<br>Paul Meyer<br>Walter Johnson | 72<br>71<br>74 |
| 05/06/2020 | Stratospheric Intrusion | Green Valley<br>Joe Neal<br>Paul Meyer<br>Walter Johnson | 72<br>76<br>77<br>78 |
| 05/09/2020 | Stratospheric Intrusion | Paul Meyer<br>Walter Johnson | 74<br>71 |
| 05/28/2020 | Stratospheric Intrusion | Paul Meyer<br>Walter Johnson | 76<br>71 |
| 06/22/2020 | Wildfire | Joe Neal<br>Paul Meyer<br>Walter Johnson | 78<br>74<br>73 |
| 06/26/2020 | Wildfire | Paul Meyer | 73 |
| 09/02/2020 | Wildfire | Paul Meyer<br>Walter Johnson | 73<br>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<br>Appendices | Wildfire |
| May 6, 2020 Demonstration<br>Appendices | Stratospheric Intrusion |
| May 9, 2020 Demonstration<br>Appendices | Stratospheric Intrusion |
| May 28, 2020 Demonstration<br>Appendices | Stratospheric Intrusion |
| June 22, 2020 Demonstration<br>Appendices | Wildfire |
| June 26, 2020 Demonstration<br>Appendices | Wildfire |
| September 2, 2020 Demonstration<br>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 9, 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 |