Project Report
ATC-449

CoSPA Data Product Description

D.L. Klingle-Wilson
J.M. Pelagatti

1 November 2021

Lincoln Laboratory
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LEXINGTON, MASSACHUSETTS

This material is based upon work supported by the Federal Aviation Administration under Air Force Contract No. FA8702-15-D-0001.

This material is based upon work supported by the Federal Aviation Administration under Air Force Contract No. FA8702-15-D-0001. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the U.S. Air Force.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
ATC-449		

4. Title and Subtitle	5. Report Date
CoSPA Data Product Description	1 November 2021
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
D.L. Klingle-Wilson, J.M. Pelagatti	ATC-449

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
MIT Lincoln Laboratory 244 Wood Street Lexington, MA 02421	11. Contract or Grant No. FA8702-15-D-0001

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Department of Transportation Federal Aviation Administration 800 Independence Ave., S.W. Washington, DC 20591	Project Report
	14. Sponsoring Agency Code

15. Supplementary Notes

This report is based on studies performed at Lincoln Laboratory, a federally funded research and development center operated by Massachusetts Institute of Technology, under Air Force Contract FA8702-15-D-0001.

16. Abstract

This document contains a description of Consolidated Storm Prediction for Aviation (CoSPA) data products that are packaged and distributed for external users. As described in Rappa and Troxel, 2013 [1] for Corridor Integrated Weather System (CIWS) data products, CoSPA products are categorized as gridded and non-gridded. Gridded products are typically expressed as rectangular arrays whose elements contain a data value coinciding with uniformly-spaced observations or computed results on a 2-D surface. Gridded data arrays map to the earth's surface through a map projection, for example, Lambert Conformal or Lambert Azimuthal Equal-Area. CoSPA generates only gridded products; there are no non-gridded data for CoSPA.

17. Key Words	18. Distribution Statement
	DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	28	

FORM DOT F 1700.7 (8-72) Reproduction of completed page authorized

This page intentionally left blank.

TABLE OF CONTENTS

		Page
	List of Illustrations	v
	List of Tables	vii
1.	INTRODUCTION	1
2.	COSPA GRIDDED PRODUCT FILES	3
	2.1 Forecast CONUS PRECIP (VIL) Dataset	3
	2.2 Forecast CONUS Echo Tops Dataset	5
APPENDIX A	GRIDDED PRODUCT DATASET FILE SUMMARIES	9
	Glossary	15
	References	17

This page intentionally left blank.

LIST OF ILLUSTRATIONS

Figure No.		Page
1	Example of 2:15- to 8-Hour VIL Forecast Grid.	4
2	Example of 2:15- to 8-Hour Echo Tops Forecast Grid.	6

This page intentionally left blank.

LIST OF TABLES

Table No.		Page
1	VIL Forecast Color Definitions	4
2	Echo Tops Forecast Color Definitions	6

This page intentionally left blank.

1. INTRODUCTION

This document contains a description of Consolidated Storm Prediction for Aviation (CoSPA) data products that are packaged and distributed for external users. As described in Rappa and Troxel, 2013 [1] for Corridor Integrated Weather System (CIWS) data products, CoSPA products are categorized as gridded and non-gridded. Gridded products are typically expressed as rectangular arrays whose elements contain a data value coinciding with uniformly-spaced observations or computed results on a 2-D surface. Gridded data arrays map to the earth's surface through a map projection, for example, Lambert Conformal or Lambert Azimuthal Equal-Area. CoSPA generates only gridded products; there are no non-gridded data for CoSPA.

The reader is referred to Rappa and Troxel, 2013 [1] for the details of the formatting of the data products. The same formatting is used for CoSPA products. This document serves as an addendum to Rappa and Troxel, 2013 [1] and describes only the CoSPA products, which are:

- 2-8 hour Forecast Continental United States (CONUS) Precipitation Vertically Integrated Liquid Water (VIL) Dataset
- 2-8 hour Forecast CONUS Echo Tops Dataset

This page intentionally left blank.

2. COSPA GRIDDED PRODUCT FILES

CoSPA gridded products consist of one or more rectangular arrays of uniformly spaced data values or flags. The files are formatted using University Data Interactive Computing and Communications Systems (Unidata) Network Common Data Format - Version 4 (NetCDF-4) which relies on NetCDF Application Programming Interface (API) software and Hierarchical Data Format - Version 5 (HDF5) file access software.

CoSPA product descriptions are summarized in the following sections. Appendix A includes more detailed product file summaries in "Network Common Data Form Language" (CDL), generated by the ncdump utility. The reader is referred to Rappa and Troxel, 2013 [1] for additional information.

2.1 FORECAST CONUS PRECIP (VIL) DATASET

The 2:15- to 8-hour VIL forecast dataset is a NetCDF-4 file containing two data variables, "VIL" and "VIL_FLAGS". The "VIL" variable is a two-byte data array containing forecast precipitation values (Figure 1). Table 1 describes the VIL ranges and color notations used for the data in Figure 1. The "VIL_FLAGS" variable is a data array of single-byte flags describing the forecast area of the VIL grid. Each data array consists of 3520 by 5120 cells, and each "VIL" cell represents the precipitation intensity for an area approximately one square kilometer in size.

An example of the Forecast CONUS Precip (VIL) Dataset is provided in APPENDIX A.

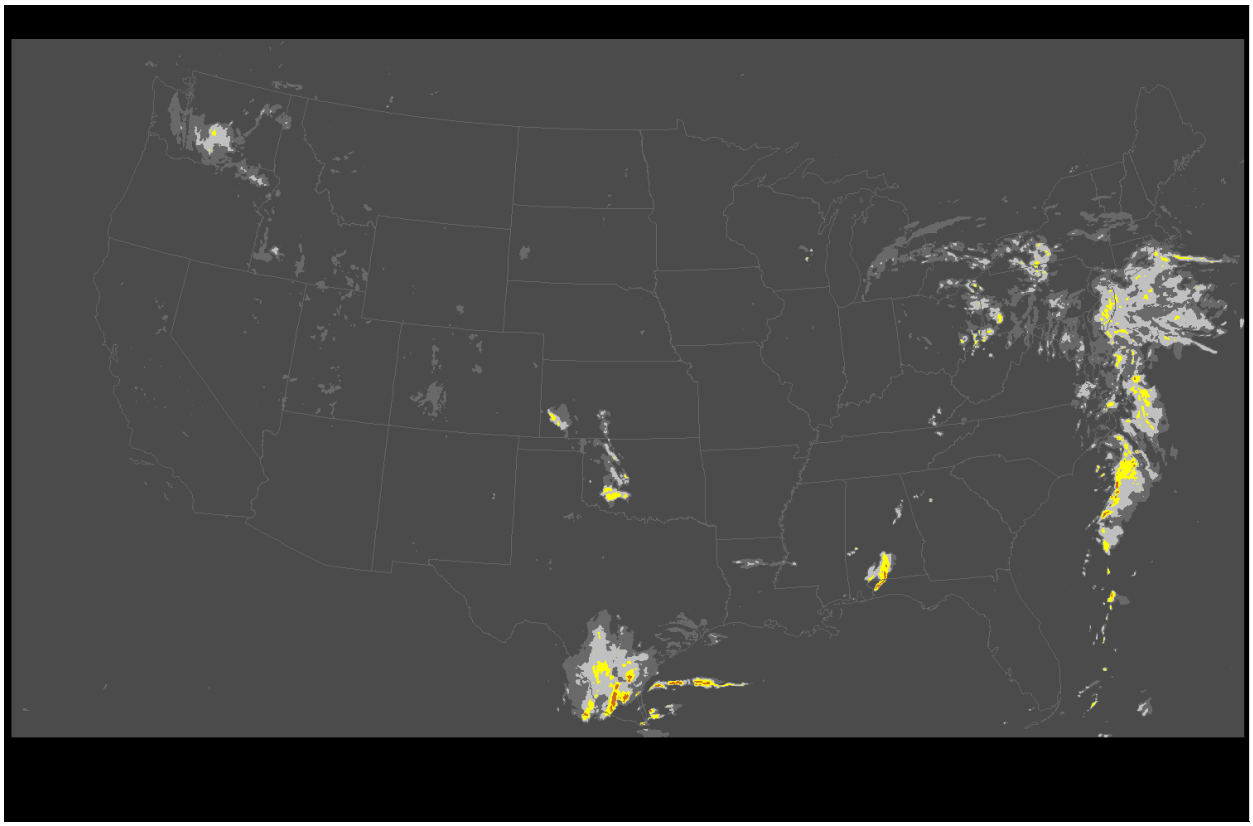

Figure 1. Example of 2:15- to 8-Hour VIL Forecast Grid.

Table 1

VIL Forecast Color Definitions

VIL Level	VIL Range (kg/m^2)	Color
0	VIL < 0.1544	
1	0.1544 ≤ VIL < 0.7757	
2	0.7757 ≤ VIL < 3.5384	
3-4	3.5384 ≤ VIL < 12.1629	
5-6	VIL ≥ 12.1629	

VIL forecast data has the following file name format:

edu.mit.ll.wx.CoSPA.Live.VILForecast.Netcdf4.1km.<date>T<time>Z.nc

where <date> is in the format: "YYYYMMDD", <time> is in the format "HHMMSS", and the "Z" refers to Coordinated Universal Time (UTC) time. These files are usually 40-50 MB in size and issued every five (5) minutes. The file size is dependent on the amount of weather in the domain.

The Forecast VIL dataset is a NetCDF-4 file containing two CONUS-extent variables:

- VIL(24,1,3520,5120). Forecast VIL represents a forecast of the amount of atmospheric liquid. Forecast VIL values are expressed with 16-bit digital codes whose scaled values span the full range of VIL: 0.0 to 80.0 kg/m^2. VIL variable attributes (scale_factor and add_offset) are included for the conversion of encoded VIL into floating point values according to NetCDF and Climate and Forecast (CF) convention. All 24 VIL forecasts are included in each NetCDF file by varying the time coordinate of the 4-D VIL variable from +2:15 to +8 hours at 15-minute intervals.
- VIL_FLAGS(1,1,3520,5120). VIL status flags indicate data quality with CF-compliant bit-mapped status flags. The same flag array may be applied to all forecast time horizons.
    - The **no coverage** status condition indicates that no radar coverage was available for the corresponding VIL data array element.
    - The **impaired** status condition indicates that the corresponding VIL data array element suffers some form of degradation, such as beam blockage.

2.2 FORECAST CONUS ECHO TOPS DATASET

The 2:15- to 8-hour Echo Tops forecast dataset is a NetCDF-4 file containing two data variables, "echoTops" and "echoTops_FLAGS". The "echoTops" variable is a data array of one-byte forecasted cloud height values (Figure 2). Table 2 describes the altitude levels and color notations used for the data in Figure 2. The "echoTops_FLAGS" variable is a data array of single-byte flags describing the forecast area of the grid in echoTops. Each data array consists of 3520 by 5120 single-byte cells and each cell in "echoTops" represents the cloud height for an area approximately one square kilometer in size.

An example of the Forecast CONUS Echo Tops Dataset is provided in APPENDIX A.

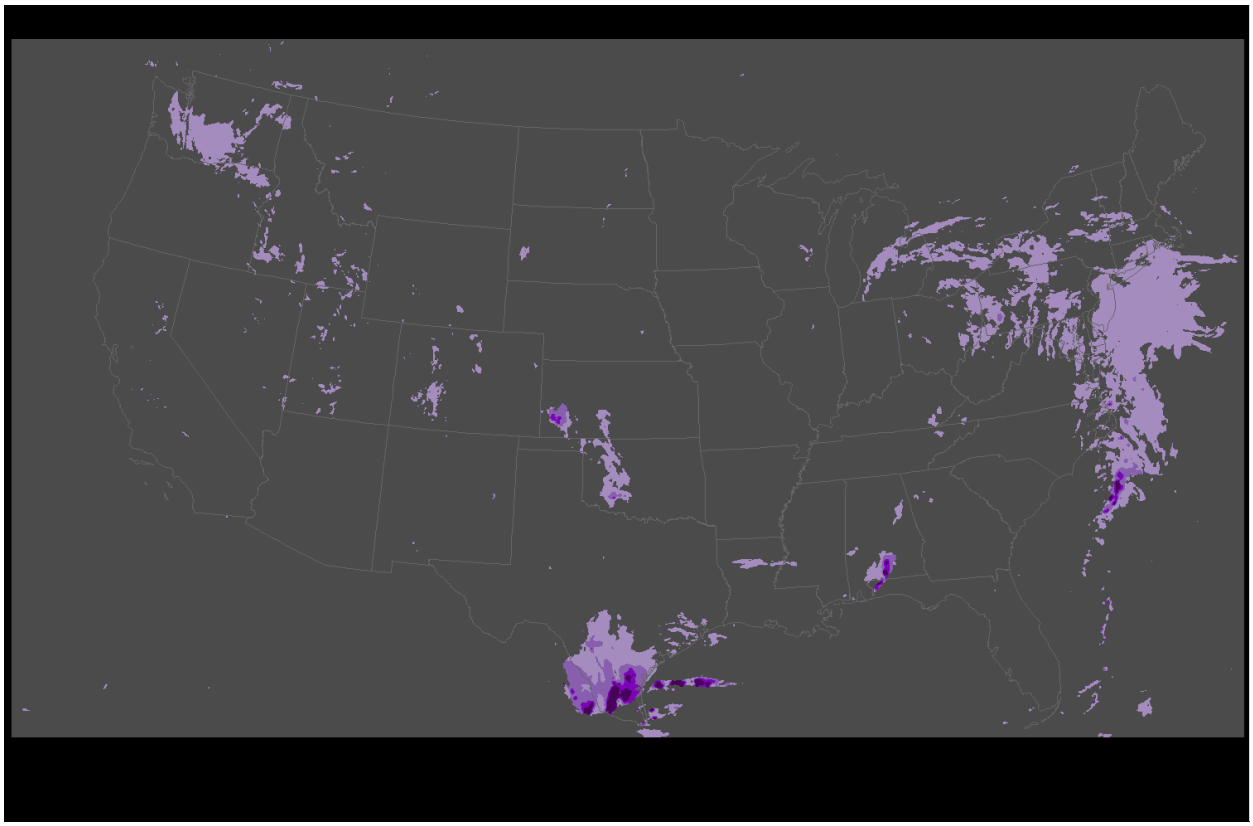

Figure 2. Example of 2:15- to 8-Hour Echo Tops Forecast Grid.

Table 2

Echo Tops Forecast Color Definitions

Altitude (kft)	Color
0	
0 < ET < 30	
30 ≤ ET < 35	
35 ≤ ET < 40	
ET ≥ 40	

Echo Tops forecast data has the following file name format:

edu.mit.ll.wx.CoSPA.Live.BlendedEchoTopsForecast.Netcdf4.1km.<date>T<time>Z.nc

where <date> is in the format: "YYYYMMDD", <time> is in the format "HHMMSS", and the "Z" refers to UTC time. These files are usually 20-25 MB in size and issued every five (5) minutes. The file size is dependent on the amount of weather in the truth domain.

The Forecast Echo Tops dataset is a NetCDF-4 file containing two CONUS-extent data variables:

- ECHO_TOP(24,1,3520,5120). Forecast Echo Tops indicates the maximum altitude of forecast precipitation. Echo Tops values are expressed with 8-bit digital codes whose scaled values span the full range of Echo Tops: 0 to 70,000 feet (1000-foot increments). Echo Tops variable attributes (scale_factor and add_offset) are included for the conversion of encoded Echo Tops into floating point values according to NetCDF and CF convention. All 24 Echo Tops forecasts are included in each NetCDF file by varying the time coordinate of the 4-D Echo Tops variable from +2:15 to +8 hours at 15-minute intervals.
- ECHO_TOP_FLAGS(1,1,3520,5120) Echo Tops status flags indicate data quality with CF-compliant bit-mapped status flags. The same flag array may be applied to all forecast time horizons.
    - The **no coverage** status condition indicates that no radar coverage was available for the corresponding Echo Tops data array element.
    - The **impaired** status condition indicates that the corresponding Echo Tops data array element suffers some form of degradation, such as beam blockage.

This page intentionally left blank.

APPENDIX A GRIDDED PRODUCT DATASET FILE SUMMARIES

The following summaries were produced with the ncdump utility, which comes with the NetCDF software library. It reads a NetCDF file and writes the CDL text equivalent. In the examples to follow, the lengthy y0 and x0 coordinate variable listings are abbreviated; a "…" indicates where data were removed. The filenames appearing in the CDL reflect the output of one particular NetCDF adapter and are not specific to the CoSPA information model. NetCDF filenames may vary among different product adapter implementations. The NetCDF files were produced in compliance with the CF convention, version 1.3 (7 November, 2008).

FORECAST CONUS PRECIP (VIL) DATASET CDL

```
netcdf edu.mit.ll.wx.CoSPA.Live.VILForecast.Netcdf4.1km.20191120T140000Z {
dimensions:
        times = 24 ;
        z0 = 1 ;
        y0 = 3520 ;
        x0 = 5120 ;
        time = 1 ;
        xml_metadata_len = 1387 ;
variables:
        double times(times) ;
                times:standard_name = "time" ;
                times:long_name = "Product forecast validity times" ;
                times:units = "seconds since 1970-01-01T00:00:00Z" ;
                times:calendar = "gregorian" ;
                times:string = "2019-11-20T16:15:00Z/2019-11-20T22:00:00Z" ;
        double z0(z0) ;
                z0:standard_name = "altitude" ;
                z0:long_name = "Product altitude" ;
                z0:units = "meters" ;
                z0:positive = "up" ;
        double y0(y0) ;
                y0:standard_name = "projection_y_coordinate" ;
                y0:long_name = "Distance from projection reference point latitude" ;
                y0:units = "meters" ;
        double x0(x0) ;
                x0:standard_name = "projection_x_coordinate" ;
                x0:long_name = "Distance from projection reference point longitude" ;
                x0:units = "meters" ;
        double start_time ;
                start_time:long_name = "Data observation start time" ;
                start_time:units = "seconds since 1970-01-01T00:00:00Z" ;
                start_time:calendar = "gregorian" ;
                start_time:string = "2019-11-20T13:45:00Z" ;
                start_time:comment = "Data observation start time is the time data collection
began" ;
        double stop_time ;
                stop_time:long_name = "Data observation stop time" ;
                stop_time:units = "seconds since 1970-01-01T00:00:00Z" ;
                stop_time:calendar = "gregorian" ;
                stop_time:string = "2019-11-20T14:00:00Z" ;
```

```
                stop_time:comment = "Data observation stop time is the time data collection ended"
;
        double forecast_reference_time ;
                forecast_reference_time:standard_name = "forecast_reference_time" ;
                forecast_reference_time:long_name = "Forecast reference time" ;
                forecast_reference_time:units = "seconds since 1970-01-01T00:00:00Z" ;
                forecast_reference_time:calendar = "gregorian" ;
                forecast_reference_time:string = "2019-11-20T14:00:00Z" ;
                forecast_reference_time:comment = "Forecast reference time is the time of the
analysis from which the forecast was made" ;
        int forecast_period(times) ;
                forecast_period:standard_name = "forecast_period" ;
                forecast_period:long_name = "Time interval between the forecast reference time and
the validity time" ;
                forecast_period:units = "seconds" ;
        double time(time) ;
                time:long_name = "Product flags validity time" ;
                time:units = "seconds since 1970-01-01T00:00:00Z" ;
                time:calendar = "gregorian" ;
                time:string = "2019-11-20T16:15:00Z" ;
        int grid_mapping0 ;
                grid_mapping0:grid_mapping_name = "lambert_azimuthal_equal_area" ;
                grid_mapping0:long_name = "Lambert Azimuthal Equal Area Projection" ;
                grid_mapping0:latitude_of_projection_origin = 38. ;
                grid_mapping0:longitude_of_projection_origin = -98. ;
                grid_mapping0:false_easting = 0. ;
                grid_mapping0:false_northing = 0. ;
                grid_mapping0:earth_radius = 6370997. ;
        char xml_metadata(xml_metadata_len) ;
                xml_metadata:long_name = "Product meta data" ;
                xml_metadata:comment = "Itemizes constituent mosaic tiles and radar sources" ;
        short VIL(times, z0, y0, x0) ;
                VIL:standard_name = "atmosphere_cloud_liquid_water_content" ;
                VIL:long_name = "Vertically integrated liquid water (VIL)" ;
                VIL:ancillary_variables = "VIL_FLAGS" ;
                VIL:units = "kg m-2" ;
                VIL:grid_mapping = "grid_mapping0" ;
                VIL:scale_factor = 0.00244148075807978 ;
                VIL:add_offset = 0. ;
                VIL:_FillValue = -1s ;
                VIL:valid_range = 0s, 32767s ;
        byte VIL_FLAGS(time, z0, y0, x0) ;
                VIL_FLAGS:standard_name = "atmosphere_cloud_liquid_water_content status_flag" ;
                VIL_FLAGS:long_name = "Vertically integrated liquid water (VIL) quality flags" ;
                VIL_FLAGS:class_name = "VIL_FLAGS" ;
                VIL_FLAGS:product_name = "VIL_FLAGS" ;
                VIL_FLAGS:grid_mapping = "grid_mapping0" ;
                VIL_FLAGS:_FillValue = -1b ;
                VIL_FLAGS:valid_range = 0b, 1b ;
                VIL_FLAGS:flag_values = 0b, 1b ;
                VIL_FLAGS:flag_meanings = "inside_forecast_area outside_forecast_area" ;

// global attributes:
                :Conventions = "CF-1.3" ;
                :history = "File created 2019-11-20T14:02:14Z on machine cospa006 by
ProductAdapterBlendedVILForecast 1.0.1" ;
                :institution = "Data produced by the MIT Lincoln Lab Weather Sensing Group" ;
                :references = "http://www.wx.ll.mit.edu" ;
                :source = "CoSPA Data Stream: Live:Cospa:CONUSBlendedVilForecast:MaskProc:Images"
;
                :title = "CoSPA Combine Final Forecast Product - 1 km @ 5 minutes" ;
```

```
                :comment = "Mosaic of CoSPA VIL Forecast product." ;
                :FileType = "NetCDF" ;
                :FileFormat = "Netcdf4" ;
data:

 times = 1574266500, 1574267400, 1574268300, 1574269200, 1574270100,
    1574271000, 1574271900, 1574272800, 1574273700, 1574274600, 1574275500,
    1574276400, 1574277300, 1574278200, 1574279100, 1574280000, 1574280900,
    1574281800, 1574282700, 1574283600, 1574284500, 1574285400, 1574286300,
    1574287200 ;

 z0 = 0 ;

 y0 = -1759500, -1758500, -1757500, -1756500, -1755500, -1754500, -1753500,
    -1752500, -1751500, -1750500, -1749500, -1748500, -1747500, -1746500,
    -1745500, -1744500, -1743500, -1742500, -1741500, -1740500, -1739500,
...
    1737500, 1738500, 1739500, 1740500, 1741500, 1742500, 1743500, 1744500,
    1745500, 1746500, 1747500, 1748500, 1749500, 1750500, 1751500, 1752500,
    1753500, 1754500, 1755500, 1756500, 1757500, 1758500, 1759500 ;

 x0 = -2559500, -2558500, -2557500, -2556500, -2555500, -2554500, -2553500,
    -2552500, -2551500, -2550500, -2549500, -2548500, -2547500, -2546500,
    -2545500, -2544500, -2543500, -2542500, -2541500, -2540500, -2539500,
...
    2542500, 2543500, 2544500, 2545500, 2546500, 2547500, 2548500, 2549500,
    2550500, 2551500, 2552500, 2553500, 2554500, 2555500, 2556500, 2557500,
    2558500, 2559500 ;
}
```

FORECAST CONUS ECHO TOPS DATASET CDL

```
netcdf edu.mit.ll.wx.CoSPA.Live.BlendedEchoTopsForecast.Netcdf4.1km.20191120T172000Z {
dimensions:
        times = 24 ;
        z0 = 1 ;
        y0 = 3520 ;
        x0 = 5120 ;
        time = 1 ;
        xml_metadata_len = 1387 ;
variables:
        double times(times) ;
                times:standard_name = "time" ;
                times:long_name = "Product forecast validity times" ;
                times:units = "seconds since 1970-01-01T00:00:00Z" ;
                times:calendar = "gregorian" ;
                times:string = "2019-11-20T19:35:00Z/2019-11-21T01:20:00Z" ;
        double z0(z0) ;
                z0:standard_name = "altitude" ;
                z0:long_name = "Product altitude" ;
                z0:units = "meters" ;
                z0:positive = "up" ;
        double y0(y0) ;
                y0:standard_name = "projection_y_coordinate" ;
                y0:long_name = "Distance from projection reference point latitude" ;
                y0:units = "meters" ;
        double x0(x0) ;
                x0:standard_name = "projection_x_coordinate" ;
                x0:long_name = "Distance from projection reference point longitude" ;
                x0:units = "meters" ;
        double start_time ;
                start_time:long_name = "Data observation start time" ;
                start_time:units = "seconds since 1970-01-01T00:00:00Z" ;
                start_time:calendar = "gregorian" ;
                start_time:string = "2019-11-20T17:00:00Z" ;
                start_time:comment = "Data observation start time is the time data collection
began" ;
        double stop_time ;
                stop_time:long_name = "Data observation stop time" ;
                stop_time:units = "seconds since 1970-01-01T00:00:00Z" ;
                stop_time:calendar = "gregorian" ;
                stop_time:string = "2019-11-20T17:20:00Z" ;
                stop_time:comment = "Data observation stop time is the time data collection
ended" ;
        double forecast_reference_time ;
                forecast_reference_time:standard_name = "forecast_reference_time" ;
                forecast_reference_time:long_name = "Forecast reference time" ;
                forecast_reference_time:units = "seconds since 1970-01-01T00:00:00Z" ;
                forecast_reference_time:calendar = "gregorian" ;
                forecast_reference_time:string = "2019-11-20T17:20:00Z" ;
                forecast_reference_time:comment = "Forecast reference time is the time of the
analysis from which the forecast was made" ;
        int forecast_period(times) ;
                forecast_period:standard_name = "forecast_period" ;
                forecast_period:long_name = "Time interval between the forecast reference time
and the validity time" ;
                forecast_period:units = "seconds" ;
        double time(time) ;
                time:long_name = "Product flags validity time" ;
                time:units = "seconds since 1970-01-01T00:00:00Z" ;
```

```
                time:calendar = "gregorian" ;
                time:string = "2019-11-20T19:35:00Z" ;
        int grid_mapping0 ;
                grid_mapping0:grid_mapping_name = "lambert_azimuthal_equal_area" ;
                grid_mapping0:long_name = "Lambert Azimuthal Equal Area Projection" ;
                grid_mapping0:latitude_of_projection_origin = 38. ;
                grid_mapping0:longitude_of_projection_origin = -98. ;
                grid_mapping0:false_easting = 0. ;
                grid_mapping0:false_northing = 0. ;
                grid_mapping0:earth_radius = 6370997. ;
        char xml_metadata(xml_metadata_len) ;
                xml_metadata:long_name = "Product meta data" ;
                xml_metadata:comment = "Itemizes constituent mosaic tiles and radar sources" ;
        byte echoTops(times, z0, y0, x0) ;
                echoTops:standard_name = "convective_cloud_top_altitude" ;
                echoTops:long_name = "Echo Tops (Echo Top)" ;
                echoTops:units = "international_feet" ;
                echoTops:grid_mapping = "grid_mapping0" ;
                echoTops:scale_factor = 1000. ;
                echoTops:add_offset = 0. ;
                echoTops:_FillValue = -1b ;
                echoTops:valid_range = 0b, 70b ;
        byte echoTops_FLAGS(time, z0, y0, x0) ;
                echoTops_FLAGS:standard_name = "convective_cloud_top_altitude status_flag" ;
                echoTops_FLAGS:long_name = "Echo Tops (Echo Top) quality flags" ;
                echoTops_FLAGS:class_name = "echoTops_FLAGS" ;
                echoTops_FLAGS:product_name = "echoTops_FLAGS" ;
                echoTops_FLAGS:grid_mapping = "grid_mapping0" ;
                echoTops_FLAGS:_FillValue = -1b ;
                echoTops_FLAGS:valid_range = 0b, 1b ;
                echoTops_FLAGS:flag_values = 0b, 1b ;
                echoTops_FLAGS:flag_meanings = "inside_forecast_area outside_forecast_area" ;

// global attributes:
                :Conventions = "CF-1.3" ;
                :history = "File created 2019-11-20T17:22:47Z on machine cospa013 by
ProductAdapterBlendedEchoTopsForecast 1.0.0" ;
                :institution = "Data produced by the MIT Lincoln Lab Weather Sensing Group" ;
                :references = "http://www.wx.ll.mit.edu" ;
                :source = "CoSPA Data Stream:
Live:Cospa:CONUSBlendedEchoTopsForecast:MaskProc:Images" ;
                :title = "CoSPA Blended Echo Tops Forecast Product - 1 km @ 5 minutes" ;
                :comment = "CoSPA Blended Echo Tops Forecast" ;
                :FileType = "NetCDF" ;
                :FileFormat = "Netcdf4" ;
data:

 times = 1574278500, 1574279400, 1574280300, 1574281200, 1574282100,
    1574283000, 1574283900, 1574284800, 1574285700, 1574286600, 1574287500,
    1574288400, 1574289300, 1574290200, 1574291100, 1574292000, 1574292900,
    1574293800, 1574294700, 1574295600, 1574296500, 1574297400, 1574298300,
    1574299200 ;

 z0 = 0 ;

y0 = -1759500, -1758500, -1757500, -1756500, -1755500, -1754500, -1753500,
    -1752500, -1751500, -1750500, -1749500, -1748500, -1747500, -1746500,
    -1745500, -1744500, -1743500, -1742500, -1741500, -1740500, -1739500,
...
    1737500, 1738500, 1739500, 1740500, 1741500, 1742500, 1743500, 1744500,
    1745500, 1746500, 1747500, 1748500, 1749500, 1750500, 1751500, 1752500,
```

```
    1753500, 1754500, 1755500, 1756500, 1757500, 1758500, 1759500 ;

 x0 = -2559500, -2558500, -2557500, -2556500, -2555500, -2554500, -2553500,
    -2552500, -2551500, -2550500, -2549500, -2548500, -2547500, -2546500,
    -2545500, -2544500, -2543500, -2542500, -2541500, -2540500, -2539500,
...
   2542500, 2543500, 2544500, 2545500, 2546500, 2547500, 2548500, 2549500,
    2550500, 2551500, 2552500, 2553500, 2554500, 2555500, 2556500, 2557500,
    2558500, 2559500 ;
}
```

GLOSSARY

API	Application Programming Interface
CDL	Network Common Data Form Language
CF	Climate and Forecast
CIWS	Corridor Integrated Weather System
CONUS	Continental United States
CoSPA	Consolidated Storm Prediction for Aviation
HDF5	Hierarchical Data Format – Version 5
MIT	Massachusetts Institute of Technology
NetCDF	Network Common Data Format
UTC	Coordinated Universal Time
Unidata	University Data Interactive Computing and Communications Systems
VIL	Vertically Integrated Liquid Water
XML	Extensible Markup Language

This page intentionally left blank.

REFERENCES

[1] Rappa, G. and S. Troxel, 2013: CIWS Product Description Revision 2.0, Project Report ATC-355 Revision 2.0, MIT Lincoln Laboratory.

This page intentionally left blank.