

DRAFT File Format Specifications for B08FDP, Version 2.3

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This document specifies the file formats to be used for nowcasts and forecasts produced during the Beijing 2008 Forecast Demonstration Project (B08FDP). It also provides definitions of the metadata and data that can be included in the files.

It is a working document, that is, new systems, products, and definitions can be added as required. This document can be downloaded from
http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/NowcastFormatSpecifications_v2.3.pdf
and
http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/NowcastFormatSpecifications_v2.3.doc.

Table of Contents

1. Common formats.....	1
2. File names	1
3. Name conventions for metadata and data	3
4. Description of netCDF files	14
5. Description of XML files	15
6. Adding new systems, products, and definitions.....	16
Appendix A. Sample nowcasts in netCDF format	17
Appendix B1: Data Model for WxML.....	25
Appendix B2. XML specifications for B08FDP.....	31
Appendix B3: Valid values for environmental parameters and weather data.....	44
Appendix C. Sample nowcasts in XML format	46
Appendix D. Additional variables not included in Table 4.....	59
Appendix E. Revision history	61

1. Common formats

Our goal is provide self-describing formats to enable display and verification of the nowcasts/forecasts in the Beijing 2008 Forecast Demonstration Project (B08FDP), and that are broadly applicable within other organizations including the Bureau of Meteorology.

Two formats were chosen based on their flexibility, ease of use, and free availability of supporting libraries and information.

Network Common Data Form (NetCDF) will be used for grid-based nowcasts and short-range forecasts. NetCDF is widely used in the weather and climate communities for array-oriented data access. More information on NetCDF, as well as the source library and installation, are freely available from UCAR. See <http://www.unidata.ucar.edu/software/netcdf/>.

EXtensible Markup Language (XML) format will be used for point-, cell-, line-, and area-based nowcasts and short-range forecasts. XML files are self-describing text files that are flexible in nature and allow easy interface to web display routines. XML is an internationally recognized format that is conceptually similar to the AXF format used in the Sydney 2000 FDP (S2K). For those new to XML a good tutorial can be found on the W3Schools web site, <http://www.w3schools.com/xml/default.asp>.

The format specifications for B08FDP are intentionally kept simple so as to be manageable for everyone participating in the project. We are aware of activity within WMO to develop XML standards for exchange of weather data (see http://www.wmo.int/web/www/WDM/Metadata/WMOCore_v0-2_040916/index.htm) but so far there do not appear to be standards for weather objects such as thunderstorm cells. Geographic Markup Language (GML) is overly complex for B08FDP. Instead we have modified and extended the Digital Weather XML (DWML) format used by the US National Weather Service to describe point-based products derived from the National Digital Forecast Database (see <http://www.weather.gov/xml/>).

Sample data in each of these formats are provided later in this document. Sample data files can also be downloaded from <ftp://ftp.bom.gov.au/anon/home/bmrc/eee/>.

2. File names

File names for output files should be descriptive and include information on the system producing the forecast, the nature of the product, and the base (start) date and time of the forecast. A new file should be generated whenever a new forecast or set of forecasts is produced. All of the forecast projections (e.g., 10 min, 20 min, etc.) originating at a given base date and time should be included in a single file. Probabilistic forecasts may produce a separate file for each occurrence thresholds, or may combine these forecasts into a single file (see example in Appendix A). Some nowcasts may contain diagnosed cell or boundary motion, in which case the forecasts need not be explicitly output since they can be easily produced from the diagnosed motion.

The template for file names is:

<system>_<product>_<YYYYMMDDhhmmss>.<extension>

Some examples are:

cards_storm_20060117055500.xml
 tifs_threat_20060124134500.xml
 steps_pop01_20060114091500.nc

Table 1 and 2 list the system names and products in the B08FDP project.

Table 1. Nowcast system names

system	Name	Provider
autotifs	automated TIFS	Bureau of Meteorology
banc	Beijing-ANC	Beijing Meteorological Bureau
cards	CARDS	Environment Canada
grapes	GRAPES	China Academy of Meteorological Research
niwot	NIWOT	National Center for Atmospheric Research
rainfields	rainfields ¹	Bureau of Meteorology
steps	STEPS	Bureau of Meteorology
swirls	SWIRLS	Hong Kong Observatory
tifs	TIFS	Bureau of Meteorology
titan	TITAN	Bureau of Meteorology (not in B08FDP but used as input to TIFS)
vdras	forecast VDRAS	National Center for Atmospheric Research
wdss	WDSS	Bureau of Meteorology (not in B08FDP but used as input to TIFS)

Table 2. Nowcast product descriptors (based on B08FDP Verification Plan)

Product	Description	Spatial type(s)
bdry	convective boundary (e.g., AutoNowcaster)	line
dewpt	dewpoint temperature	point, grid
ltng	lightning	area, grid
pop, pop<mm>	probability of precipitation exceeding specified threshold in mm hr ⁻¹ (ex. pop01)	point, grid
qpf	quantitative precipitation forecast	point, grid
sevwxx	downburst / damaging winds, hail, mesocyclone / tornado	point, track
storm	thunderstorm cells (e.g., WDSS, TIFS)	track
temp	temperature	point, grid
threat	threat area	area
wind	wind speed and direction	point, grid

¹ Although rainfields will be used as verification data for the precipitation nowcasts, we wish to verify the gridded radar rain accumulations against the gauge data.

<YYYYMMDDhhmmss> gives the year (YYYY), month (MM), day (DD), hour (hh, 00-24), minute (mm), and second (ss) in UTC of the start of the forecast (t=0). Use the format extension "xml" for XML files and "nc" for netCDF files. The most recent files should be copied to "latest" versions, e.g.,

```
cards_storm_latest.xml
tifs_threat_latest.xml
steps_pop01_latest.xml
```

Files should be delivered to:

```
<machine>:<path>/<system>/datefiles
```

(machine and path to be determined later in consultation with the Beijing Meteorological Bureau) and the latest version written to:

```
<machine>:<path>/<system>/loopfiles
```

3. Name conventions for metadata and data

Existing name conventions are used where possible. Many have been taken from the netCDF documentation and the CF Standard Name Table (http://www.cgd.ucar.edu/cms/eaton/cf-metadata/standard_name.html) which is recommended by UCAR for netCDF files. Others were adopted from the DWML specifications given by the National Weather Service. Most of the variables relevant for storm cells and threat areas were not in the list of CF standard names. Where possible we have borrowed or adapted name conventions from documented radar-based nowcast systems including WDSS and TIFS, as well as the S2K FDP.

In the interest of the downstream display and verification applications in B08FDP we ask that you please adhere to these name conventions and units when writing netCDF and XML output files, even if the same variable is called something else in your system. We apologize for the fact that some names use hyphens ("-") and some use underscores ("_"); the standards were set by other larger bodies, and in the interest of compatibility with those systems we prefer to follow them rather than try to change them. Some variables are redundant; please choose the variable that applies best to your data.

Table 3 lists the name conventions for the metadata (information about data) that are likely to be used in B08FDP systems. It includes information relevant both for netCDF files and XML files.

Table 4 lists the name conventions for the environmental and related data that are likely to be used in B08FDP systems. It includes variables relevant both for netCDF files and XML files. The nowcast display and verification will not be able to handle multi-level fields such as air temperature, so only variables defined either for the column or at surface level are included.

If your system predicts variables that are not listed in Table 4 but you consider important to include please give us the relevant details and we will add them to the list (see section 5). Appendix D lists variables used in the WDSS system but not included in Table 4 – this might be one place to check for relevant variable names.

Name conventions for attributes (units, valid range, etc.) associated with the data are given in Table 5. These apply mainly to netCDF files.

Table 3. Name conventions for metadata.

Name	Type or units	Definition	Required
concise-name	(string)	data type ²	netCDF, XML
operational-mode	(string)	status of the product ³	netCDF, XML
system	(string)	name of nowcast/forecast system ⁴	netCDF, XML
sub-system	(string)	name of sub-system	
title	(string)	title of product (e.g., for plotting)	
description	(string)	brief description of product	
category	(string)	category of this product ⁵	
creation-date	YYYY-MM-DDThh:mm:ss	date/time of product preparation	XML
refresh-frequency	string: PTnM or PTnH	n is the number of minutes or hours until next product generation	XML
type	(string)	type of radar or network	netCDF, XML
name	(string)	name of radar or network	netCDF, XML
latitude	degrees_N	location of radar	XML
longitude	degrees_E		
zr_a	decimal	a in $Z=aR^b$	
zr_b	decimal	b in $Z=aR^b$	
more-information	URL	web page giving more information about the product	XML
production-center	(string)	name of production center	
sub-center	(string)	name of production sub-center	
disclaimer	URL	web site giving disclaimer	
credit	URL	web site crediting product source	
credit-logo	URL	link to logo for credit source	
feedback	URL	web site for providing feedback	

² Valid values of concise-name (data types) are "point", "line", "area", "grid", or "track".

³ Valid values of operational-mode include "test", "developmental", "experimental", and "official".

⁴ See Table 1.

⁵ Valid values of category include "observation", "forecast", "analysis", and "statistic".

Table 4. Name conventions for environmental and supporting data.

Name	Preferred Units	Definition	Required
base_date	YYYYMMDD (UTC)	date corresponding to t=0	netCDF
base_time	hhmmss (UTC)	time corresponding to t=0	netCDF
forecast_date	YYYYMMDD (UTC)	date when forecast is valid	netCDF
forecast_time	hhmmss (UTC)	time when forecast is valid	netCDF
forecast_hours	h	forecast lead time	one of these variables required by netCDF
forecast_minutes	min	forecast lead time	
forecast_period	s	forecast lead time	
time-coordinate	(string)	time coordinate (local or UTC)	XML
layout-key	(string)	coded information on obs/forecast time	
start-valid-time	YYYY-MM-DDThh:mm:ss	start of period for which product is valid	XML
end-valid-time	YYYY-MM-DDThh:mm:ss	end of period for which product is valid	
timestamp	hh:mm:ss		XML (moving data)
location-key	(string)	ID of static location	
ID	(string)	ID of moving location (cell, line, etc)	XML (moving data)
latitude	degrees N	latitude	netCDF for grids in deg, XML
longitude	degrees E	longitude	
x_loc	km	distance east of westernmost gridpoint	netCDF for grids in km
y_loc	km	distance north of southernmost gridpoint	
city	(string)	name of city	XML (point data)
site	(string)	name of site	
zone	(string)	name of forecast zone	
state	(string)	2-letter abbreviation for state/province	
radius	km	radius of circular area	
major_axis	km	ellipse length dimension	
minor_axis	km	ellipse width dimension	

Name	Preferred Units	Definition	Required
orientation	degrees true	ellipse orientation	
summarization	(string)	spatial summarization (mean, max, etc)	
surface_altitude	m	surface altitude	
air_temperature	K	2m air temperature	
dew_point_temperature	K	dewpoint temperature	
precipitation	mm	precipitation accumulation (preferred over rainfall_amount)	
rain_rate	mm h-1	(preferred over rainfall_rate)	
rainfall_amount	kg m-2	rainfall flux	
rain_probability	percent	probability of precipitation exceeding a given threshold (see note 2)	
rainfall_rate	m s-1	rainfall rate	
probability_of_precipitation	percent	probability of measurable precipitation	
relative_humidity	percent	relative humidity	
surface_air_pressure	Pa	surface air pressure	
surface_specific_humidity	(range 0-1)	specific humidity at the surface	
surface_temperature	K	surface air temperature	
upward_air_velocity	m s-1	upward air velocity	
wind_direction	degrees true	direction from which wind blows	
wind_from_direction	degrees true	direction from which wind blows	
wind_speed, wind-speed	m s-1	wind speed	
wind_to_direction	degrees true	direction to which wind blows	
x_wind	m s-1	westerly wind speed	
y_wind	m s-1	southerly wind speed	
coverage	(string)	weather coverage ("scattered", etc.)	
intensity	(string)	weather intensity ("light", "heavy", etc)	
ID_parent	(string)	cell ID for cell that has split or merged (TITAN)	
ID_child	(string)	cell ID for split track (TITAN)	
area_threshold	km2	minimum cell area	

Name	Preferred Units	Definition	Required
height_threshold	km	cell threshold height	
reflectivity_threshold	dbz	reflectivity threshold for storm cell	
volume_threshold	km ³	minimum cell volume	
speed	km h ⁻¹	speed of storm cell	
direction_from	degrees true	direction cell is moving from	
direction_to	degrees true	direction cell is moving toward	
u_motion	m s ⁻¹	eastward speed	
v_motion	m s ⁻¹	northward speed	
w_motion	m s ⁻¹	upward motion	
original_speed	km h ⁻¹	original speed before forecaster modification (TIFS)	
original_direction	degrees true	original direction before forecaster modification (TIFS)	
cell_base	km	base altitude of storm cell	
cell_top	km	top of storm cell	
cell_volume	km ³	storm cell or core volume	
diameter	km	diameter of storm cell	
mean_area	km ²	mean horizontal area of cell	
projected_area	km ²	projected horizontal area	
height_max_dbz	km	height of max reflectivity	
reflectivity_mean	dbz	mean reflectivity of cell	
reflectivity_max, max_dbz	dbz	maximum reflectivity of cell	
storm_intensity	category	(see note 1)	
VIL	kg m ⁻²	maximum vertically integrated liquid water	
VIL_mean	kg m ⁻²	mean VIL for cell (CARDS)	
VIL_max	kg m ⁻²	maximum VIL for cell based on maximum reflectivity at each level	
visible	"true" or "false"	cell OKed by forecaster (TIFS)	
rain_reflectivity_threshold	dbz	reflectivity threshold for rain	

Name	Preferred Units	Definition	Required
rain_base	km	base altitude for rain volume	
rain_top	km	top altitude for rain volume	
rain_volume	km ³	volume with rain	
rain_mass	kg	mass of rain in the volume	
rain_type	category	(see note 1)	
rain_intensity	category	(see note 1)	
rain_rate_mean	mm h ⁻¹	mean rain rate	
rain_rate_max	mm h ⁻¹	maximum rain rate	
rain_probability	percent	probability of rain exceeding specified rain rate threshold (see note 2)	
hail_reflectivity_threshold	dbz	reflectivity threshold for hail	
hail_base	km	base altitude for hail volume	
hail_top	km	top altitude for hail volume	
hail_volume	km ³	volume with hail	
hail_mass	kg	mass of hail in the volume	
hail_type	category	(see note 1)	
hail_intensity	category	(see note 1)	
hail_size_mean	mm	mean hail size	
hail_size_max	mm	maximum hail size	
hail_probability	percent	probability of hail exceeding specified size threshold (see note 2)	
lightning_reflectivity_threshold	dbz	reflectivity threshold for lightning	
lightning_base	km	base altitude for lightning volume	
lightning_top	km	top altitude for lightning volume	
lightning_volume	km ³	volume with lightning	
lightning_type	category	(see note 1)	
lightning_intensity	category	(see note 1)	
lightning_flash_density_mean	km ⁻² h ⁻¹	mean lightning flash density	
lightning_flash_density_max	km ⁻² h ⁻¹	maximum lightning flash density	
lightning_probability	percent	probability of lightning exceeding	

Name	Preferred Units	Definition	Required
		specified flash density threshold (see note 2)	
meso_shear_threshold	s-1	horizontal shear threshold for mesocyclone	
meso_base	km	base altitude for mesocyclone volume	
meso_top	km	top altitude for mesocyclone volume	
meso_volume	km3	volume with hail	
meso_type	category	(see note 1)	
meso_intensity	category	(see note 1)	
meso_probability	percent	probability of mesocyclone exceeding specified shear threshold (see note 2)	
tornado_type	category	(see note 1)	
tornado_intensity	category	(see note 1)	
tornado_probability	percent	probability of tornado	
turbulence_shear_threshold	dbz	shear threshold for turbulence	
turbulence_base	km	base altitude for turbulence volume	
turbulence_top	km	top altitude for turbulence volume	
turbulence_volume	km3	volume with turbulence	
turbulence_type	category	(see note 1)	
turbulence_intensity	category	(see note 1)	
turbulence_shear_mean	mm	mean turbulence shear	
turbulence_shear_max	mm	maximum turbulence shear	
turbulence_probability	percent	probability of turbulence exceeding specified shear threshold (see note 2)	
The following variables support the CARDS system			
last_storm_number_used	dimensionless	last storm number used	
number_of_storms	dimensionless	number of storms	
storm_number	dimensionless	storm number	
track_status	dimensionless	track status	
number_of_pattern_vectors	dimensionless	number of pattern vectors	

Name	Preferred Units	Definition	Required
reflectivity_mean	dbz	mean reflectivity in cell	
reflectivity_max	dbz	maximum reflectivity in cell	
latitude_VIL_max	degrees	latitude of maximum VIL	
longitude_VIL_max	degrees	longitude of maximum VIL	
VIL_density_mean	kg km ⁻³	mean VIL density	
VIL_density_max	kg km ⁻³	maximum VIL density	
latitude_VIL_density_max	degrees	latitude of maximum VIL density	
longitude_VIL_density_max	degrees	longitude of maximum VIL density	
hail_mean	kg km ⁻²	mean hail flux	
hail_max	kg km ⁻²	maximum hail flux	
latitude_hail_max	degrees	latitude of maximum hail flux	
longitude_hail_max	degrees	longitude of maximum hail flux	
down_draft_mean	m s ⁻¹	mean downdraft	
down_draft_max	m s ⁻¹	maximum downdraft	
latitude_down_draft_max	degrees	latitude of maximum downdraft	
longitude_down_draft_max	degrees	longitude of maximum downdraft	
echo_top_mean	km	mean echo top	
echo_top_max	km	maximum echo top	
latitude_echo_top_max	degrees	latitude of maximum echo top	
longitude_echo_top_max	degrees	longitude of maximum echo top	
echo_top_45dbz_mean	km	mean top of 45 dbz echo	
echo_top_45dbz_max	km	maximum top of 45 dbz echo	
latitude_echo_top_45dbz_max	degrees	latitude of maximum top of 45 dbz echo	
longitude_echo_top_45dbz_max	degrees	longitude of maximum top of 45 dbz echo	
low_level_gradient_mean	dbz km ⁻¹	mean low level gradient	
low_level_gradient_max	dbz km ⁻¹	maximum low level gradient	
latitude_low_level_gradient_max	degrees	latitude of maximum low level gradient	
longitude_low_level_gradient_max	degrees	longitude of maximum low level	

Name	Preferred Units	Definition	Required
		gradient	
mid_level_gradient_mean	dbz km-1	mean mid level gradient	
mid_level_gradient_max	dbz km-1	maximum mid level gradient	
latitude_mid_level_gradient_max	degrees	latitude of maximum mid level gradient	
longitude_mid_level_gradient_max	degrees	longitude of maximum mid level gradient	
bwer_mean	km	mean bounded weak echo region	
bwer_max	km	maximum bounded weak echo region	
latitude_bwer_mean	degrees	latitude of mean bounded weak echo region	
longitude_bwer_mean	degrees	longitude of mean bounded weak echo region	
latitude_bwer_max	degrees	latitude of maximum bounded weak echo region	
longitude_bwer_max	degrees	longitude of maximum bounded weak echo region	
mesocyclone_shear_mean	ms-1 km-1	mean mesocyclone shear	
mesocyclone_shear_max	ms-1 km-1	maximum mesocyclone shear	
latitude_mesocyclone_mean	degrees	latitude of mean mesocyclone shear	
longitude_mesocyclone_mean	degrees	longitude of mean mesocyclone shear	
latitude_mesocyclone_max	degrees	latitude of maximum mesocyclone shear	
longitude_mesocyclone_max	degrees	longitude of maximum mesocyclone shear	
downburst_shear_mean	m s-1 km-1	mean downburst shear	
downburst_shear_max	m s-1 km-1	maximum downburst shear	
latitude_downburst_mean	degrees	latitude of mean downburst shear	
longitude_downburst_mean	degrees	longitude of mean downburst shear	
latitude_downburst_max	degrees	latitude of maximum downburst shear	
longitude_downburst_max	degrees	longitude of maximum downburst shear	

Name	Preferred Units	Definition	Required
gust_front_diameter	km	gust front diameter	
gust_front_velocity_differential	m s ⁻¹	gust front velocity differential	
gust_front_shear_mean	m s ⁻¹ km ⁻¹	mean gust front shear	
gust_front_shear_max	m s ⁻¹ km ⁻¹	maximum gust front shear	
latitude_gust_front_mean	degrees	latitude of mean hail flux	
longitude_gust_front_mean	degrees	longitude of mean hail flux	
latitude_gust_front_max	degrees	latitude of maximum hail flux	
longitude_gust_front_max	degrees	longitude of maximum hail flux	

Notes:

1. Categorical values are integers with values defined elsewhere.
2. All probabilities must be accompanied by information about the threshold in `threshold_value` and `threshold_units`.

Table 5. Attributes of data in netCDF files.

Req'd in netCDF	Name	Definition
X	long_name	long descriptive name
	spacing	scalar grid spacing
X	units	string specifying units (various uses)
	type	string descriptor (various uses)
X or X	valid_min	scalar specifying minimum valid value
	valid_max	scalar specifying maximum valid value
	valid_range	vector specifying minimum and maximum valid values
	scale_factor	multiply data by this factor (default=1)
	add_offset	added to (scaled) data (default=0)
	_FillValue	fill value used to pre-fill disk space allocated to the variable
	missing_value	missing data value (should be outside valid range)

4. Description of netCDF files

The *NetCDF User's Guide* (<http://www.unidata.ucar.edu/software/netcdf/docs/netcdf/>) gives a complete description of how netCDF files are structured. They recommend that users use the provided netCDF interfaces for Fortran 77/90, C, or C++ rather than attempting to write low level routines to read and write files⁶. Use a recent version of netCDF (3.0+) if possible.

Many operational centers have their own conventions for netCDF file structure, especially for NWP. For example, the Bureau of Meteorology structures its forecast files for single-level fields like precipitation so that each record contains a 2-dimensional grid of data corresponding to a particular lead time (or a 3-dimensional grid if more than one type of forecast data is included in the file). NetCDF allows the user to write data in whatever way seems most natural. We encourage you to consider using netCDF conventions that may already exist in your center. Having said that, the *Writing NetCDF Files: Best Practice* page (<http://www.unidata.ucar.edu/software/netcdf/docs/BestPractices.html>) notes that drilling through the data to get time series at a single gridpoint is more efficient if the forecast data are written as a single multi-dimensional array rather than as separate records.

For B08FDP please use a uniform grid, i.e., constant Δx and Δy , for all data. Most nowcast grids would be expected to use grid spacing in km, while most model grids would be expected to have grid spacing in degrees latitude/longitude. Both conventions are acceptable. The starting latitude and longitude must be specified and should refer to

⁶ Note that other languages and applications including Python, IDL, and MatLab also provide interfaces to netCDF.

the center of the first grid box in the southwest corner, with x- and y- (or latitude and longitude) coordinates increasing in the eastward and northward directions, respectively.

Use the name conventions for metadata, data, and attributes given in the tables above. If your system predicts a variable that is not found on the list in Table 4 please contact us with the necessary information so that we can add it to the list (see Section 6).

Two sample netCDF files are described in Appendix A.

5. Description of XML files

For B08FDP we had hoped to simply adapt an XML format used by an existing nowcast system. We found only one system (WDSS) that used XML, and its file structure was not considered optimal for use with TIFS and TITAN, two systems in wide usage in the Bureau. However, we found that the Digital Weather XML (DWML) format developed by the US National Weather Service for point-based products derived from the National Digital Forecast Database (see <http://www.weather.gov/xml/>), was quite suitable for point forecasts, and could be modified to include lines, areas, and tracks.

The original DWML specifications are available from http://www.weather.gov/mdl/XML/Design/MDL_XML_Design.pdf, with a schema defined by <http://www.weather.gov/forecasts/xml/DWMLgen/schema/DWML.xsd>. The modified DWML format for nowcasts is called WxML. Its specifications are described in Appendix B. The yellow boxes in the WxML Data Model (Appendix B1) indicate the modifications that have been made to DWML to include nowcasts.

Each file should contain only one spatial type ("point", "moving-point", "line", "area", or "track"). Files with static locations ("point" and "area") are structured slightly differently from files with moving spatial objects ("moving-point", "line" and "track"). The former use the <data> format while the latter use the <nowcast-data> format. String IDs are used to identify the spatial location of the forecast, while the time variables "start-valid-time" and "end-valid-time" indicate the time for which the forecast or analysis is valid.

Please use the name conventions for metadata, data, and attributes given in the Tables 3-5. If your system predicts a variable that is not found in those tables please provide us with the necessary information so that we can add it to the list (see Section 6).

Sample WxML files and schemas for several types of nowcast and forecast products are given in Appendix C. You may find it easier to look at the WxML files first before attempting to read the rather lengthy specifications in Appendix B. The XML examples and accompanying schemas are available online at <http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML>.

6. Adding new systems, products, and definitions

The use of self-describing files for nowcast/forecast output makes it relatively easy to add new systems, products, and variable definitions.

New systems and new products within existing systems should make use of existing name conventions for products, metadata, and variables to the extent possible. New metadata and variables should be given names in keeping with existing name conventions, i.e., they should be descriptive and use underscores to distinguish words and abbreviations.

Please send the relevant information to Beth Ebert (e.ebert@bom.gov.au) to add to the online format specifications document (http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/NowcastFormatSpecifications_v2.3.pdf). B08FDP participants will be notified whenever new information has been added.

Appendix A. Sample nowcasts in netCDF format

Example 1. SPROG precipitation nowcasts

The first file, `sprog_qpf_20001113220500.nc`, gives the data on a kilometer grid. The data was written as a single array `rain_rate(x,y,t)`. This file and the others in this appendix can be downloaded from the Bureau's FTP site at <ftp://ftp.bom.gov.au/anon/home/bmrc/eee/>.

Calling `ncdump` to view the file contents produces the listing below.

```
netcdf sprog_qpf_20001113220500 {
dimensions:
    x_loc = 256 ;
    y_loc = 256 ;
    forecast_minutes = 7 ;
variables:
    float x_loc(x_loc) ;
        x_loc:type = "uniform" ;
        x_loc:long_name = "x location" ;
        x_loc:units = "km" ;
        x_loc:spacing = "1" ;
        x_loc:valid_min = 0.f ;
        x_loc:valid_max = 255.f ;
    float y_loc(y_loc) ;
        y_loc:type = "uniform" ;
        y_loc:long_name = "y location" ;
        y_loc:units = "km" ;
        y_loc:spacing = "1" ;
        y_loc:valid_min = 0.f ;
        y_loc:valid_max = 255.f ;
    int forecast_minutes(forecast_minutes) ;
        forecast_minutes:long_name = "number of minutes forecast" ;
        forecast_minutes:units = "minutes" ;
        forecast_minutes:valid_min = 0s ;
        forecast_minutes:valid_max = 2880s ;
    int creation_date ;
        creation_date:long_name = "creation date of this forecast" ;
        creation_date:units = "yyyymmdd" ;
    int creation_time ;
        creation_time:long_name = "creation time of this forecast" ;
        creation_time:units = "hhmmss UTC" ;
    int base_date ;
        base_date:long_name = "base date of this forecast" ;
        base_date:units = "yyyymmdd" ;
    int base_time ;
        base_time:long_name = "base time of this forecast" ;
        base_time:units = "hhmmss UTC" ;
    int forecast_date(forecast_minutes) ;
        forecast_date:long_name = "valid date(s) of this forecast" ;
        forecast_date:units = "yyyymmdd" ;
    int forecast_time(forecast_minutes) ;
        forecast_time:long_name = "valid time(s) of this forecast" ;
        forecast_time:units = "hhmmss UTC" ;
    float rain_rate(forecast_minutes, y_loc, x_loc) ;
        rain_rate:long_name = "Rainfall rate" ;
        rain_rate:units = "mm/hr" ;
        rain_rate:valid_min = 0.f ;
        rain_rate:valid_max = 1000.f ;
        rain_rate:missing_value = "-999" ;

// global attributes:
    :concise-name = "grid" ;
    :system = "sprog" ;
    :operational-mode = "experimental" ;
    :description = "rain_rate" ;
    :production-center = "BMRC" ;
```



```

rain_rate:long_name = "precipitation" ;
rain_rate:units = "mm/hr" ;
rain_rate:valid_min = 0.f ;
rain_rate:valid_max = 1000.f ;
rain_rate:missing_value = "-999" ;

// global attributes:
:concise-name = "grid" ;
:system = "sprog" ;
:operational-mode = "experimental" ;
:description = "rain_rate" ;
:production-center = "BMRC" ;
:category = "forecast" ;
:type = "radar" ;
:name = "Kurnell" ;

data:

segments = 1, 2, 3, 4, 5, 6, 7 ;

seg_type =
"ANAL",
"FCST",
"FCST",
"FCST",
"FCST",
"FCST",
"FCST" ;

longitude = 149.8291, 149.84, 149.8509, 149.8618, 149.8726, 149.8835,
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latitude = -35.16315, -35.15414, -35.14513, -35.13612, -35.12711, -35.11811,
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-34.88387, -34.87486, -34.86585, -34.85685, -34.84784, -34.83883,
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```

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-32.91991, -32.9109, -32.90189, -32.89288, -32.88387, -32.87486, -32.86585 ;

forecast_minutes = 0, 10, 20, 30, 40, 50, 60 ;

creation_date = 20060427 ;

creation_time = 31948 ;

base_date = 20001103 ;

base_time = 131500 ;

forecast_date = 20001103, 20001103, 20001103, 20001103, 20001103, 20001103,
20001103 ;

forecast_time = 131500, 132500, 133500, 134500, 135500, 140500, 141500 ;

rain_rate =
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0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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0.3, 0.3, 2.9, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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(more records...)

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0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,

```



```

        pop5:units = "percent" ;
        pop5:valid_min = 0.f ;
        pop5:valid_max = 100.f ;
        pop5:missing_value = "-999" ;
float pop10(forecast_hours, y_loc, x_loc) ;
        pop10:long_name = "Probability of hourly rain accumulation
exceeding 10 mm" ;
        pop10:units = "percent" ;
        pop10:valid_min = 0.f ;
        pop10:valid_max = 100.f ;
        pop10:missing_value = "-999" ;
float pop20(forecast_hours, y_loc, x_loc) ;
        pop20:long_name = "Probability of hourly rain accumulation
exceeding 20 mm" ;
        pop20:units = "percent" ;
        pop20:valid_min = 0.f ;
        pop20:valid_max = 100.f ;
        pop20:missing_value = "-999" ;
float pop50(forecast_hours, y_loc, x_loc) ;
        pop50:long_name = "Probability of hourly rain accumulation
exceeding 50 mm" ;
        pop50:units = "percent" ;
        pop50:valid_min = 0.f ;
        pop50:valid_max = 100.f ;
        pop50:missing_value = "-999" ;

// global attributes:
        :concise-name = "grid" ;
        :system = "sprog" ;
        :operational-mode = "experimental" ;
        :description = "rain_probability" ;
        :production-center = "BMRC" ;
        :category = "forecast" ;
        :type = "radar" ;
        :name = "Kurnell" ;
        :latitude = -34.01f ;
        :longitude = 151.2203f ;

data:

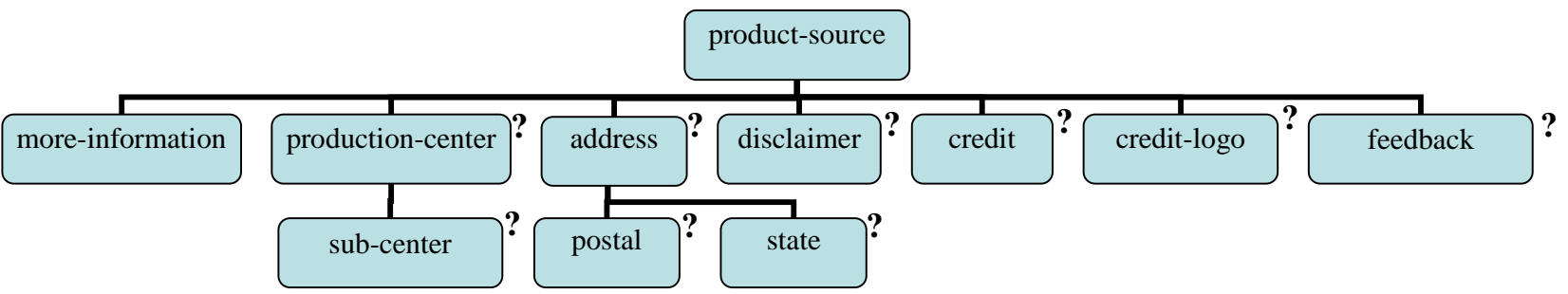
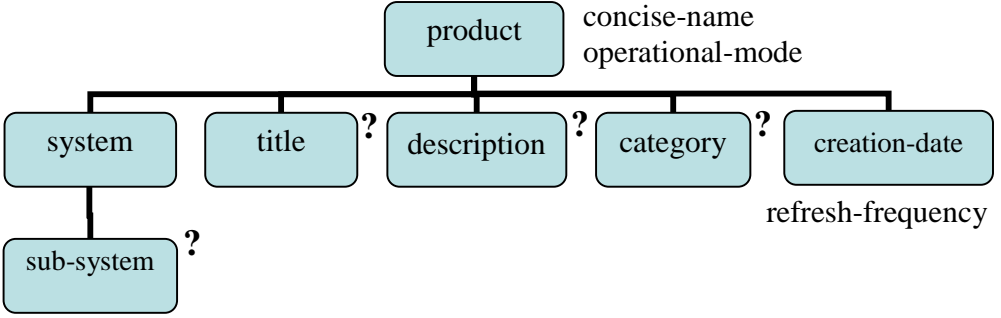
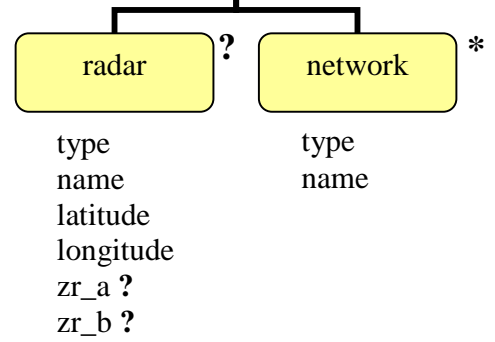
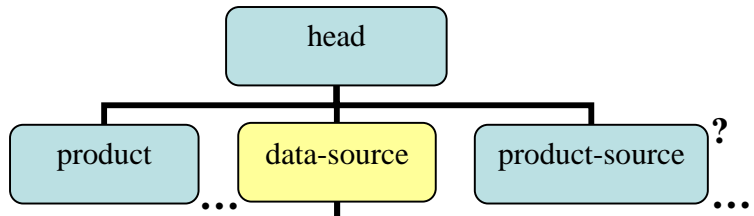
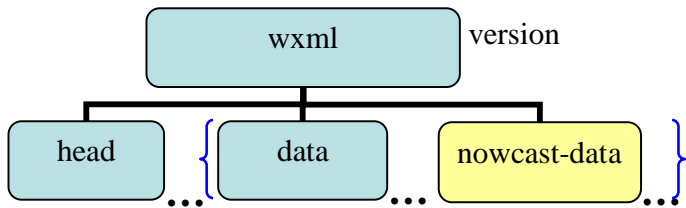
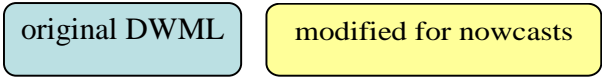
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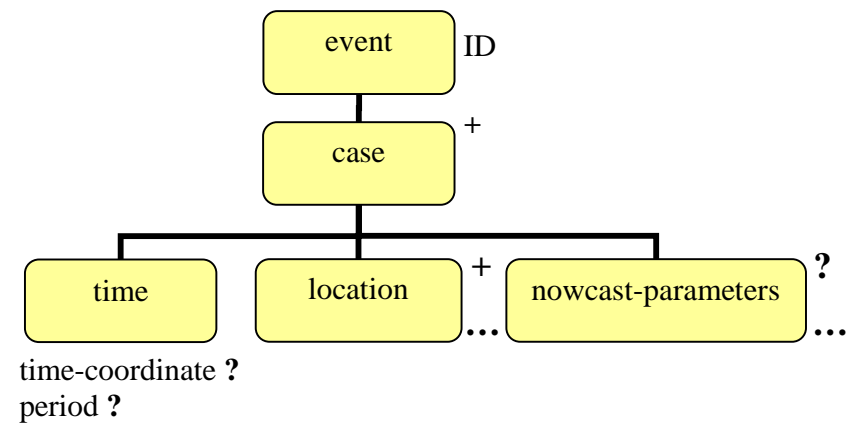
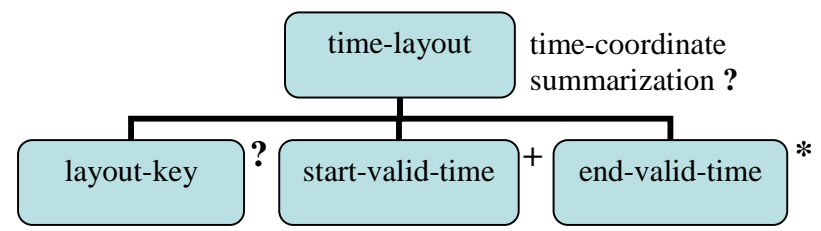
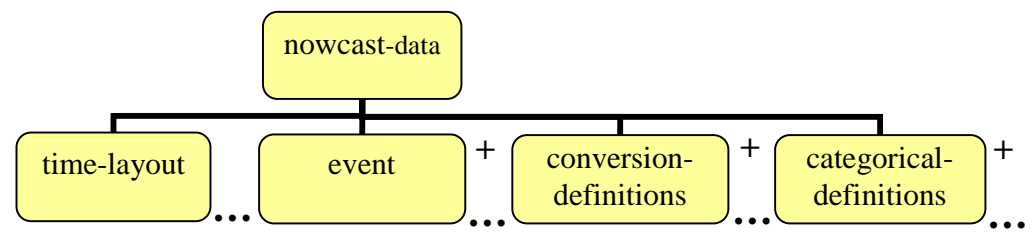
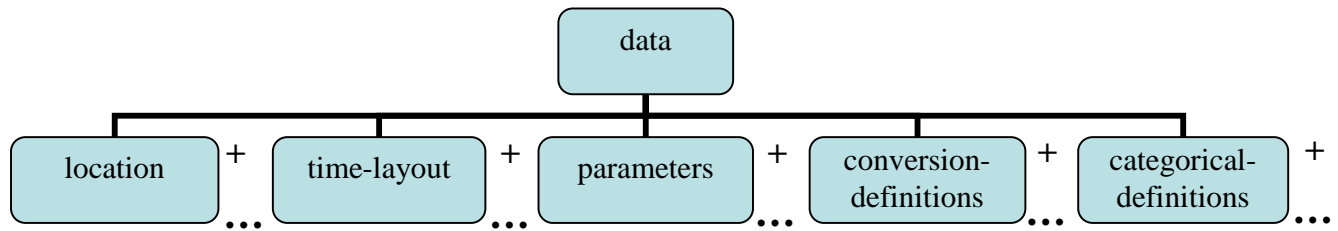
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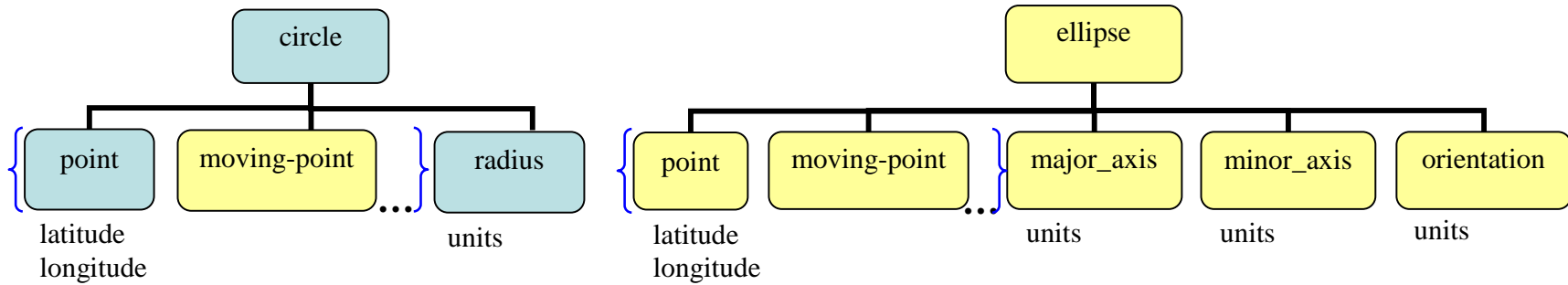
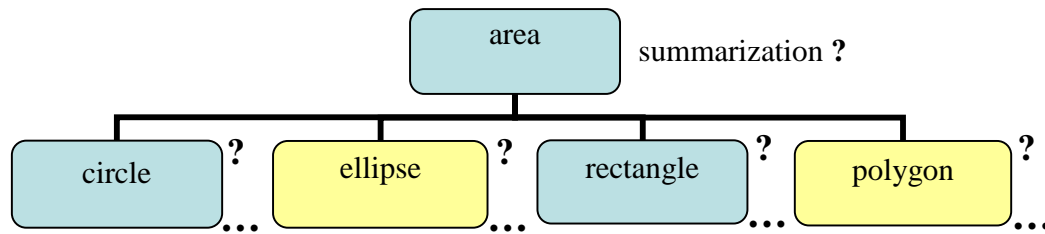
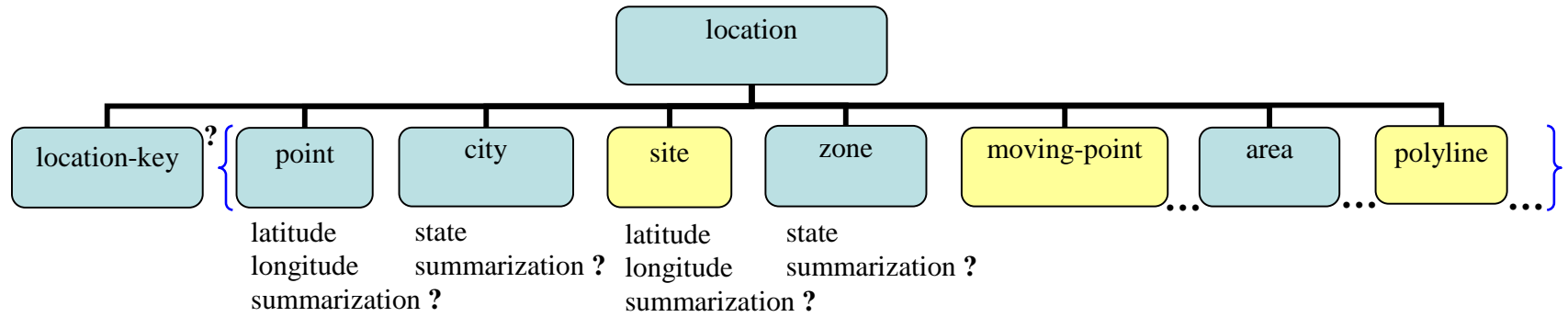
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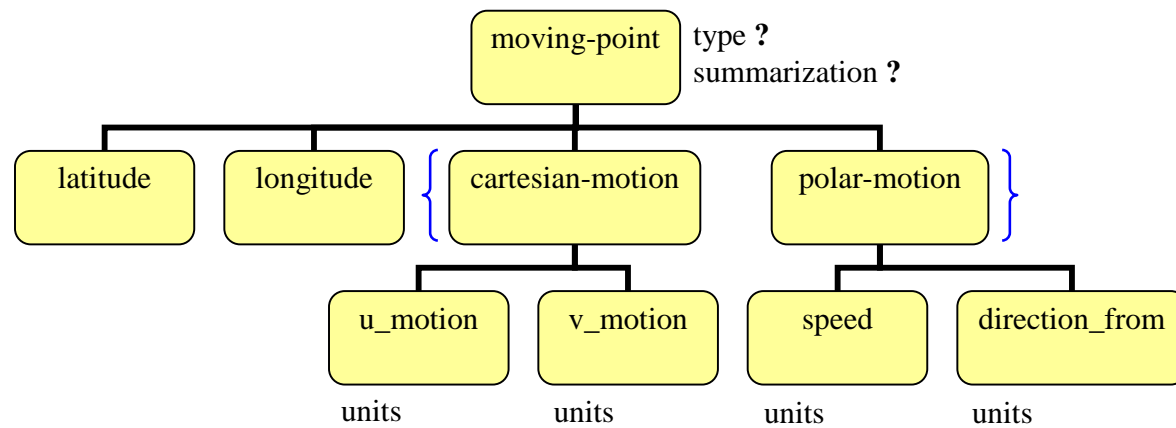
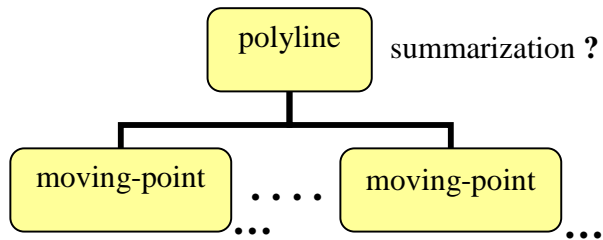
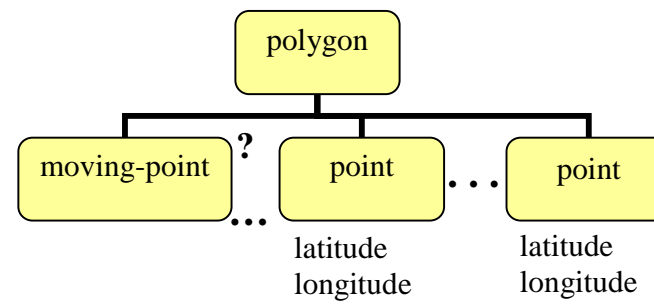
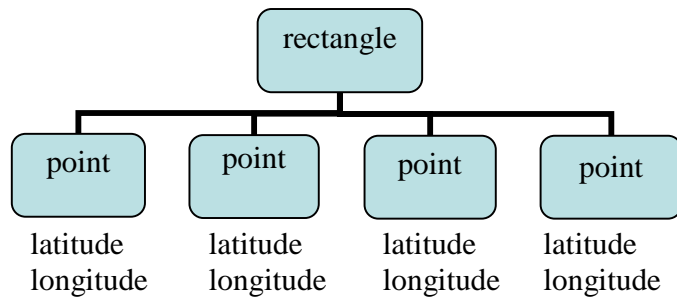

Appendix B1: Data Model for WxML

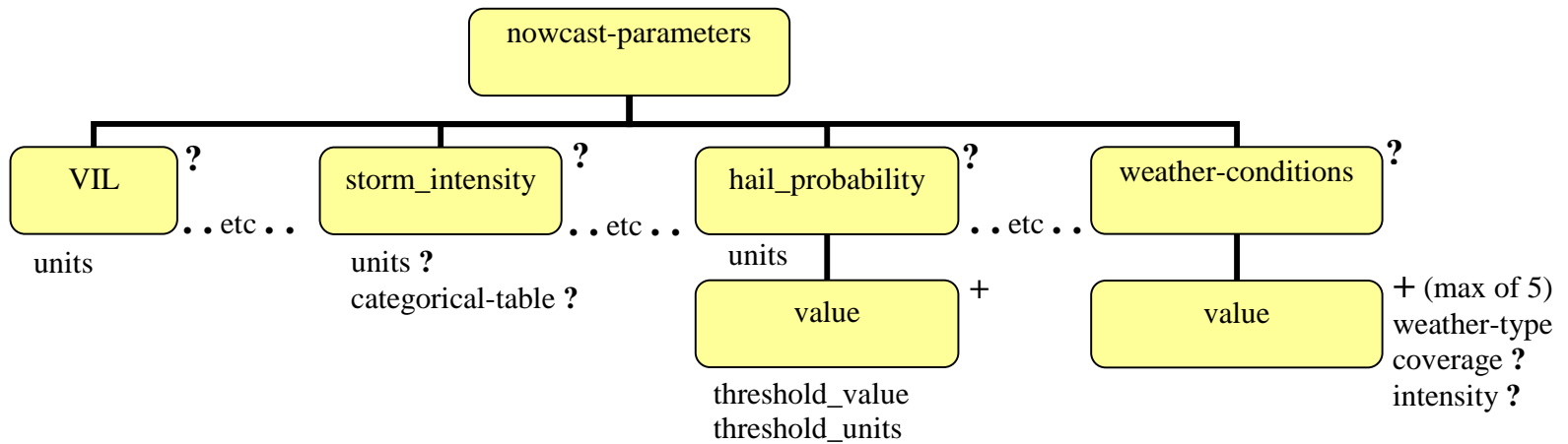
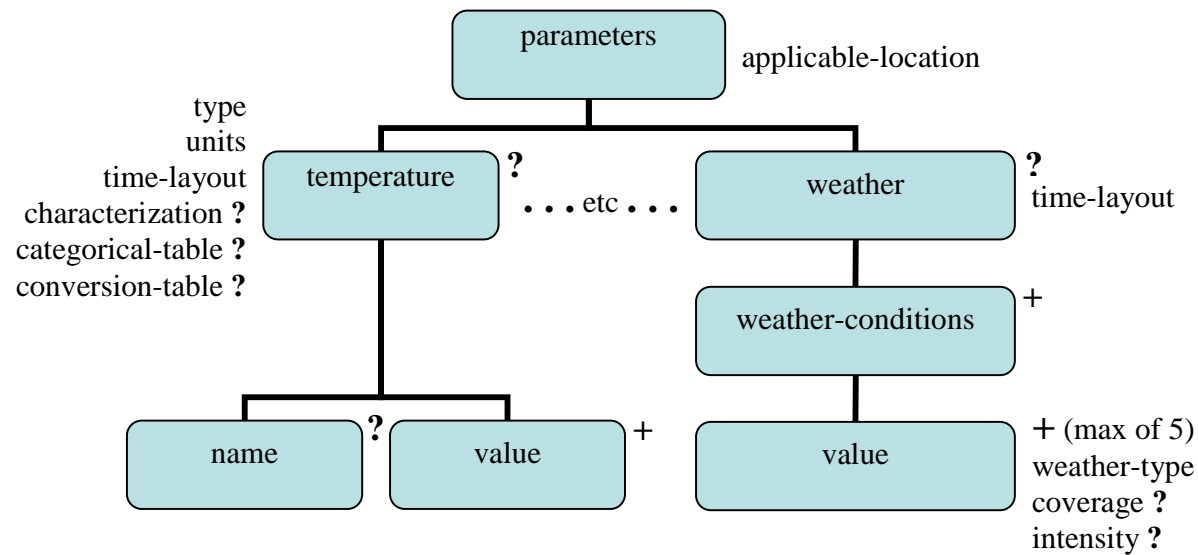
more follows = ... zero or one = ? zero or more = * one or more = + choose one = { }

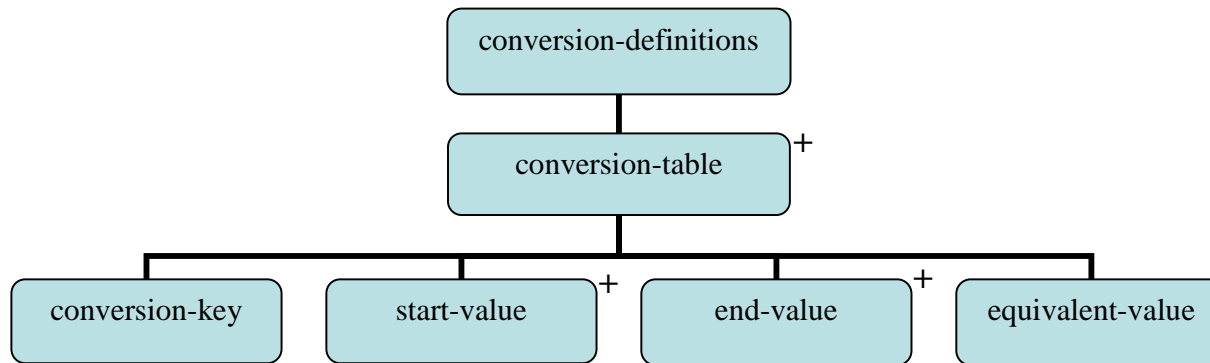
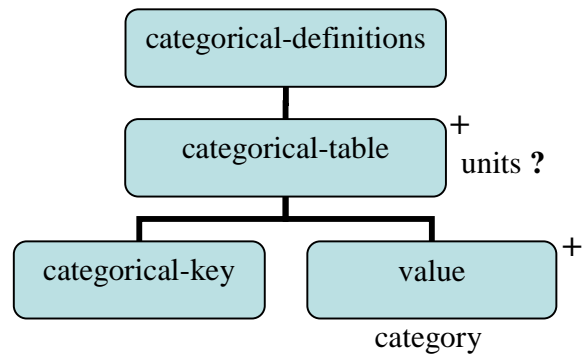












Appendix B2. XML specifications for B08FDP

These specifications were modified from the original NWS DWML specifications. The original document was modified with the permission of the NWS Meteorological Development Laboratory.

1. **Overview:** This document defines the XML format to be used for nowcasts and forecasts in B08FDP, called WxML. It combines the NWS Digital Weather Markup Language (DWML) version 1 with features of the AIFS Exchange Format (AXF) format used to represent nowcasts in the Sydney 2000 FDP. It is designed to efficiently represent nowcasts of lines, areas, storm tracks, and severe weather along with more traditional point-based forecasts.
 - 1.1. **WxML Structure:** First the WxML elements and attributes are described. → *Notes on WxML usage in B08FDP are printed in italics and marked with an arrow*. Tree diagrams in Appendix B1 provide a graphical representation of how WxML elements and attributes relate to each other. The elements shaded in yellow signify the enhancements made to DWML to accommodate nowcasts. These relationships in concert with the WxML type definitions in Appendix B2 form the basis for language validation.
 - 1.2. **Sample Documents:** Appendix C provides examples of WxML files for specific products of each type: point forecasts (generic), polylines (Autonowcaster boundaries), areas (TIFS threat areas), and storm tracks (TIFS cells, TITAN cells).
2. **WxML Data Element Nomenclature:** This specification uses the following approach to describing elements:
 - 2.1. Element and attribute names are all lower case.
 - 2.2. Many element and attribute names use a hyphen ("-") to separate multiple word names so as to improve readability (ex. <creation-date>). Element and attribute names for meteorological variables and forecast locations and times use an underscore ("_") to separate multiple word names (ex. <wind_speed>) to be consistent with the CF Standard used for netCDF files (see Section 3 of the B08FDP Format Specifications). Attribute and element names avoid the use of abbreviations to enhance readability.
 - 2.3. Within this document, child elements are nested in a sub-paragraph under their parents.
 - 2.4. Attributes are also nested but do not have the angle brackets ("<>") and are italicized bold.
 - 2.5. The element's and attribute's types, referred to by the schemas, are provided in braces ("{}").

- 2.6. If the element can occur zero or more times, an asterisk ("*") is placed after its name.
- 2.7. If the element occurs zero or one times, a question mark ("?") follows its name.
- 2.8. If the element must appear at least once, a plus sign ("+") follows its name.
- 2.9. Element names without a special trailing character must occur exactly once.
- 2.10. The order of element descriptions in the paragraphs below is not significant. Any required ordering of elements is specified in the tree diagrams found in Appendix B1 and type definitions in Appendix B2.

3. Framework Elements:

3.1. **<WxML>** {wxml:WxMLType}: The root element for WxML. It must contain the <head> element describing metadata, followed by either the <data> element describing data for fixed locations (closely following DWML conventions) or the <nowcast-data> element describing nowcast data.

3.1.1. **version** {xsd:string}: Indicates which version of WxML the instance contains.

→ For B08FDP the version number is 1.0.

3.1.2. **<head>** {wxml:headType}: Contains the metadata for the WxML instance. See section 4 for elements found in the <head> element.

3.1.3. **<data>** {wxml:dataType} [?]: Contains the environmental data when it refers to static locations. See section 5 for child elements of the <data> element. This is very similar to the <data> element used in DWML.

→ For B08FDP represent point forecasts and threat areas using <data>.

3.1.4. **<nowcast-data>** {wxml:nowcast-dataType} [?]: Contains the environmental data when it refers to moving locations. See section 5 for child elements of the <nowcast-data> element.

→ For B08FDP represent cells (storm tracks), lines, severe weather detections, and moving points by <nowcast-data>.

4. **WxML Metadata Elements:** WxML metadata provides information about the WxML product and the data it contains. These elements are children of the <head> element.

4.1. **<product>** {wxml:productType}: Holds meta information about the product.

4.1.1. **concise-name** {wxml:concise-nameType}: A name or code that describes this product.

→ For B08FDP use a data type of "point", "line", "area", or "track".

4.1.2. **operational-mode** {wxml:operational-modeType}: Defines the status of the product. Applications can review the content of this element to determine if they should perform further processing. Sample values include "test", "developmental", "experimental", and "official" product.

→ For B08FDP use "experimental".

4.1.3. **<system>** {xsd:systemType}: Name of the system producing the meteorological products. This is to identify the source of the forecasts, observations, etc.

→ For B08FDP refer to Table 1 of the B08FDP Format Specifications.

4.1.3.1. **<sub-system>** {xsd:string} [?]: Sub-system underlying the full system.

→ For example, TIFS storm tracks could be based on TITAN or WDSS storm tracks.

4.1.4. **<title>** {xsd:string} [?]: Provides a title of what this WxML product contains (e.g. for plotting).

4.1.5. **<description>** {xsd:string} [?]: Provides a concise summarization of what this WxML product contains (for convenience).

4.1.6. **<category>** {wxml:categoryType} [?]: Defines the specific category that the product belongs to. Example values include "observation", "forecast", "analysis", and "statistic".

→ For B08FDP storm tracks and boundaries should be specified as "analysis" unless future positions are included; threat areas should be specified as "forecast".

4.1.7. **<creation-date>** {wxml:creation-dateType}: The date and time that the product was prepared. The dateTime syntax is YYYY-MM-DDThh:mm:ss.

4.1.7.1. **refresh-frequency** {xsd:duration}: Used by the production center to help users know how often to return for updated data. The syntax is PTnH for hours, PTnM for minutes.

4.2. **<data-source>** {wxml:data-sourceType}: Holds information about the source(s) of data used to make the nowcast product. Multiple data types can be used.

4.2.1. **<radar>** {nml:radarType} [?]: Holds information about the input from a single radar. For radar networks use <network>.

4.2.1.1. **type** {xsd:string}: Type of radar data (e.g., NEXRAD)

- 4.2.1.2. **name** {xsd:string}: Name of the radar.
- 4.2.1.3. **latitude** {xsd:decimal}: Latitude of the radar.
- 4.2.1.4. **longitude** {xsd:decimal}: Longitude of the radar.
- 4.2.1.5. **zr_a**{xsd:decimal} [?]: *a* coefficient in $Z=aR^b$.
- 4.2.1.6. **zr_b**{xsd:decimal} [?]: *b* coefficient in $Z=aR^b$.
- 4.2.2. <**network**> {nml:networkType} [+]: Holds information about the input data from a surface network.
 - 4.2.2.1. **type** {wxml:networkTypeType}: Type of network data. Possible values include "radar", "lightning ", "AWS", "synop", "rain gauge".
 - 4.2.2.2. **name** {xsd:string}: Name of the network.
- 4.3. <**product-source**> {wxml:product-sourceType} [?]: Holds information about the product's source and links to credit and disclaimer information.
 - 4.3.1. <**more-information**> {xsd:anyURI}: A link to the web page of the forecast's source or a more complete forecast.
 - 4.3.2. <**production-center**> {wxml:production-centerType} [?]: Identifies which organization creates the product.
 - 4.3.2.1.<**sub-center**> {xsd:string} [?]: The part of the production center that prepared the product.
 - 4.3.3. <**address**> {wxml:addressType} [?]: Gives the address of the production center.
 - 4.3.3.1. <**postal**> {xsd:string} [?]: Street address.
 - 4.3.3.2. <**state**> {wxml:stateType}: The state that the address is in.
 - 4.3.4. <**disclaimer**> {xsd:anyURI} [?]: The URL containing a disclaimer regarding the data.
 - 4.3.5. <**credit**> {xsd:anyURI} [?]: The URL used to credit the source of the data.
 - 4.3.6. <**credit-logo**> {xsd:anyURI} [?]: The image link used with the credit URL to acknowledge the data source.
 - 4.3.7. <**feedback**> {xsd:anyURI} [?]: A URL to a web page used to provide the production center comments on the product.

5. **WxML Data Elements:** These elements hold the environmental data. They are children of the <data> and <nowcast-data> elements.

- 5.1. **<time-layout>** {wxml:time-layoutType } [+]: Contains the start and stop valid times and any associated period names for the data.

For <data>: Since different environmental parameters may have different time schemes (valid at different interval and available for different lengths of time into the future), there will be one <time-layout> element for each of these unique temporal configurations. Each environmental parameter will reference exactly one of these time layouts.

For <nowcast-data>:

- 5.1.1. **time-coordinate** {wxml:time-coordinateType}: The time coordinate can be either "local time" or "UTC".
- 5.1.2. **summarization** {wxml:summarizationType} [?]: Collections of values may be summarized into a single value. Example summarization types include "none", "mean", "median", "mode", "maximum", "minimum". A value of "none" (or no summarization) indicates that the values are valid at a single location.
- 5.1.3. **<layout-key>** {wxml:layout-keyType} [?]: Used for <data> but not for <nowcast-data>. The key (**k-p1h-n7-1**) is used to associated this time layout with a particular parameter element. The key is derived using the following convention:
- 5.1.3.1. "k" stands for key.
- 5.1.3.2. "p1h" implies a data period length of 1 hour. The end of this code should be "s" for seconds, "m" for minutes, "h" for hours, "d" for days, and "M" for months.
- 5.1.3.3. "n7" means that the number of data times is 7.
- 5.1.3.4. "1" is a sequential number used to keep the layout keys unique.
- The key **should not** be parsed to derive the period.
- 5.1.4. **<start-valid-time>** {wxml:start-valid-timeType} [+ for data, once for nowcast-data]: The start time of the period of time for which the data is valid.
- 5.1.5. **<end-valid-time>** {xsd:dateTime} [*]: The end time of the period of time for which the data is valid. The absence of this attribute indicates that the parameter is valid at a specific time given by <start-valid-time>.

- 5.2. **<location>** {wxml:locationType} [+]: Defines the location(s) of the data. Locations can be static (<point>, <city>, <site>, <zone>, or <area>) or moving (<moving-point>, <area>, or <polyline>). Exactly one of these child elements must be specified.
- 5.2.1. **<location-key>** {xsd:string} [?]: Holds the unique ID of the static location. If more than one location is represented in the <data> element, the location-key element is used to relate the location to its corresponding parameters.
- 5.2.2. **<point>** {wxml:pointType} [?]: Defines a point location.
- 5.2.2.1. **latitude** {xsd:decimal}: The latitude of the point where the data is valid.
- 5.2.2.2. **longitude** {xsd:decimal}: The longitude of the point where the data is valid.
- 5.2.2.3. **summarization** {wxml:summarizationType} [?]: Collections of values may be summarized into a single value. Example summarization types include "none", "mean", "median", "mode", "maximum", "minimum", "hourly", "12hourly", or "24hourly". A value of "none" (or no summarization) indicates that the values are valid at a single time.
- 5.2.3. **<city>** {wxml:cityType} [?]: Name of the city for which the data is valid.
- 5.2.3.1. **state** {wxml:stateType}: 2-letter abbreviation for the state that the city is in.
- 5.2.3.2. **summarization** [?]: See section 5.2.2.3.
- 5.2.4. **<site>** {wxml:siteType} [?]: Name of a site for which the data is valid. <site> is similar to <city> except that it contains latitude and longitude instead of state. Unlike <point> it specifies the name of the site.
- A B08FDP example is a MOS forecast for specific sites.
- 5.2.4.1. **latitude** {xsd:decimal}: The latitude of the site.
- 5.2.4.2. **longitude** {xsd:decimal}: The longitude of the site.
- 5.2.4.3. **summarization** [?]: See section 5.2.2.3.
- 5.2.5. **<zone>** {wxml:zoneType} [?]: Contains the zone for which the data is valid.
- 5.2.5.1. **state** {wxml:stateType}: 2-letter abbreviation for the state that the zone is in.

5.2.5.2. **summarization** [?]: See section 5.2.2.3.

5.2.6. **<moving-point>** {wxml:moving-pointType} [?]: Defines a moving point such as the centroid of a storm cell, a vertex along a moving line, or the motion of a severe weather element such as a tornado. The motion of the point must be defined by either the **<cartesian-motion>** or **<polar-motion>** element.

5.2.6.1. **type** {wxml:moving-point-typeType} [?]: Describes the nature of the moving point. Valid values include "centroid", "vertex", and certain severe weather elements (see Appendix B2, Table 3).

5.2.6.2. **<latitude>** {xsd:decimal}: The latitude of the moving point.

5.2.6.3. **<longitude>** {xsd:decimal}: The longitude of the moving point.

5.2.6.4. **<cartesian-motion>** {wxml:cartesian-motionType} [?]: Cartesian description of the motion.

5.2.6.4.1.1. **<u_motion>** {wxml:motionType}: Motion in the eastward direction.

5.2.6.4.1.1.1. **units** {wxml:motion-unitsType}: The units of speed. Possible values are "km h-1" "m s-1" "miles per hour".

5.2.6.4.1.2. **<v_motion>** {wxml:motionType}: Motion in the northward direction.

5.2.6.4.1.2.1. **units** {wxml:motion-unitsType}: (as above)

5.2.6.5. **<polar-motion>** {wxml:polar-motionType} [?]: Polar description of the motion.

5.2.6.5.1. **<speed>** {wxml:motionType}: Speed of the moving point.

5.2.6.5.1.1. **units** {wxml:motion-unitsType}: The units of speed. Possible values are "km h-1" "m s-1" "miles per hour".

5.2.6.5.2. **<direction_from>** {wxml:directionType}: Direction of motion.

5.2.6.5.2.1. **units** {wxml:direction-unitsType}: The units of the direction angle. Values include "degrees true".

5.2.7. **<area>** {wxml:areaType} [+]: Defines the spatial shape of the data. Must be at least one of the following: "circle", "ellipse", "rectangle" or "polygon".

→ *In B08FDP storm cells are represented as areas with motion. Normally only one shape is used to represent a cell; however, it is*

possible to describe a cell using more than one shape, for example, a polygon and an ellipse.

5.2.7.1. **summarization**: See section 5.2.2.3.

5.2.7.2. **<circle>** {wxml:circleType} [?]: A circular area about a central point described either by <point> if the circle is static or <moving-point> if the circle has motion.

5.2.7.2.1. **<point>** [?]: See section 5.2.2.

5.2.7.2.2. **<moving-point>** [?]: See 5.2.6. The appropriate type attribute is "centroid".

5.2.7.2.3. **<radius>** {wxml:distanceType}: The distance from the centroid to the edge of the circular area.

5.2.7.2.3.1. **units** {wxml:distance-unitsType}: The units of radius. Examples are "km", "m" and "statute miles"

5.2.7.3. **<ellipse>** {wxml:ellipseType} [?]: A elliptical area about a central point described either by <point> if the circle is static or <moving-point> if the circle has motion.

→ *A B08FDP example is a TIFS storm track with elliptical storm cells.*

5.2.7.3.1. **<point>** [?]: See section 5.2.2.

5.2.7.3.2. **<moving-point>** [?]: See section 5.2.6. The appropriate type attribute is "centroid".

5.2.7.3.3. **<major_axis>** {wxml:distanceType}: The distance from the center point of the ellipse to the long edge of the elliptical area.

5.2.7.3.3.1. **units**: See section 5.2.7.2.3.1.

5.2.7.3.4. **<minor_axis>** {wxml:distanceType}: The distance from the center point of the ellipse to the short edge of the elliptical area.

5.2.7.3.4.1. **units**: See section 5.2.7.2.3.1.

5.2.7.3.5. **<orientation>** {wxml:directionType}: Orientation angle of the ellipse.

5.2.7.3.5.1. **units** {xsd:direction-unitsType}: The units of the orientation angle. Possible values include "degrees true".

5.2.7.4. **<rectangle>** {wxml:rectangleType} [?]: A static rectangular area which is defined by four latitude and longitude pairs. (Normally this will not be required for nowcasts but is left in the specifications for compatibility with DWML.)

5.2.7.4.1. **<point>** {wxml:pointType} [+ (exactly 4)]: Describes the vertices of the rectangle. See section 5.2.2.

5.2.7.5. **<polygon>** {wxml:polygonType} [?]: A multi-sided polygon which is defined by at least three latitude and longitude pairs. The polygon may have motion, which is associated with its central point.

→ A B08FDP example is a TIFS threat area, which does not have motion.

5.2.7.5.1. **<moving-point>** [?]: Describes the centroid of the polygon, and is used only for polygons with motion. See section 5.2.6.

5.2.7.5.2. **<point>** {wxml:pointType} [+ (min of 3)]: Describes the vertices of the polygon. See section 5.2.2. (Note: Although the vertices are not static in a moving polygon, the motion of the polygon is associated with the **<moving-point>** element used to describe the centroid.) Following convention the first point in the polygon should be repeated as the last point.

5.2.8. **<polyline>**{wxml:polylineType} [?]: A set of at least two points defining a (multi-segment) line, which may not be straight. The polyline may have motion.

→ A B08FDP example is an Autonowcaster boundary, where each point has motion in the *u* and *v* directions.

5.2.8.1. **summarization**: See section 5.2.2.3.

5.2.8.2. **<moving-point>** {wxml:moving-pointType} [+ (min of 2)]: Defines a point on the polyline. See section 5.2.6.

5.3. **<event>** {wxml:eventType} [+]: Contains the nowcast event data, where an "event" is defined as a set of data for a *moving* point, polyline, or area location (tornado, storm cell, gust front, etc) identified by a unique ID.

5.3.1. **ID** {xsd:string}: ID number or code for the event.

5.3.2. **<case>** {wxml:caseType} [+]: Defines a realization of the event at a particular time. When multiple times are indicated in the time-layout, the absence of the event at a particular time is indicated by an empty case (see Appendix C, Example 3b).

5.3.2.1. **<time>** {xsd:dateTime}: Valid date and time of the case

5.3.2.1.1. **time-coordinate** { wxml:time-coordinateType } [?]: See 5.1.1.

5.3.2.1.2. **period** {xsd:duration}[?]: Time period of the data validity. The syntax is PTnH for hours, PTnM for minutes.

5.3.2.2. **<location>** { wxml:locationType } [+]: Defines the location(s) of the data. See 5.2. For nowcasts more than one of these child elements may be specified.

→ A B08FDP example is a TITAN cell, which can be represented both as an ellipse and a polygon.

5.3.2.3. **<nowcast-parameters>** [?]: See section 5.5. <nowcast-parameters> is used for all events except polylines.

5.4. **<parameters>** { wxml:parametersType } [+]: Holds the collected environmental data for static locations. Quantitative data are held in the appropriate child element for each variable type. Worded weather elements are described by the <weather-conditions> parameter – see section 5.4.3.

5.4.1. **applicable-location** {xsd:string}: Used to relate the <location-key> to the list of parameters (see section 5.2.1).

5.4.2. **<... parameter...>** { wxml:parameterType } [?]: Holds the individual types of environmental data. Possible values include <temperature>, <humidity>, <wind-speed>, <weather>, etc. Refer to Appendix B2, Table 1 for types of environmental data.

5.4.2.1. **type** { wxml:parameter-typeType }: Refines the meteorological parameter. For example, if <parameter> is "temperature" then <type> can have values of "air", "dewpoint", "surface", etc. Refer to Appendix B2, Table 1 for possible values.

5.4.2.2. **units** { wxml:parameter-unitsType }: Defines the units of the parameter. Refer to Appendix B2, Table 1 for possible values.

5.4.2.3. **time-layout** { wxml:time-layoutType }: Defines the key to the appropriate valid times (see section 5.1). Required for static forecasts if more than one time is given.

5.4.2.4. **characterization** { wxml:characterizationType } [?]: Temporal summarization of the data. Valid values are "maximum", "minimum", "mean", "average", and "median".

5.4.2.5. **categorical-table** { wxml:categorical-tableType } [?]: Foreign key to a list of categories that defines the meaning of the (categorical) value.

5.4.2.6. **conversion-table** {wxml:conversion-tableType} [?]: Foreign key to a list of conversion tables that provide an equivalent value for the data.

5.4.2.7. **<name>** {xsd:string} [?]: The name of this parameter. The name value can be used for display purposes.

5.4.2.8. **<value>** {xsd:decimal} [+]: The value(s) of the parameter. A missing value is represented by xsi:nil="true". No value is represented by an empty element. Not required for <weather> parameter – see 5.5.3.

5.4.3. **<weather-conditions>**: {wxml:weather-conditionsType} [?]: Container for up to five weather values. This is a special type of parameter used to represent worded weather data. It is a child of the <weather> parameter.

→ For B08FDP *weather_conditions* are used to describe severe weather elements such as mesocyclones, hail, downbursts, etc.

5.4.3.1. **<value>** {wxml:valueType} [* (max of 5)]: The sensible weather. Missing values are represented by an empty element, or an empty elements and xsi:nil="true".

5.4.3.1.1. **weather-type** {wxml:weather-typeType}: Weather description. Valid values are contained in Appendix B2, Table 4.

5.4.3.1.2. **coverage** {wxml:coverageType} [?]: The weather coverage value. Valid values are contained in Appendix B2, Table 2.

5.4.3.1.3. **intensity** {wxml:intensityType} [?]: The weather intensity. Valid values are contained in Appendix B2, Table 3.

5.5. **<nowcast-parameters>** {wxml:nowcast-parametersType} [?]: Holds the collected environmental data for moving locations. Quantitative data are held in the appropriate child element for each variable type. Worded weather elements are described by the <weather-conditions> parameter – see section 5.5.2. <nowcast-parameters> uses a briefer description of the data than <parameters>. Note that <nowcast-parameters> is not required for forecasts of lines which have no meteorological data associated with them.

5.5.1. **<... nowcast-parameter...>** {wxml:nowcast-parameterType} [?]: Holds the individual types of environmental data. Possible values include <temperature>, <wind_speed>, etc. A missing value is represented by xsi:nil="true". No value is represented by an empty element.

→ For B08FDP refer to Table 3 of the B08FDP Format Specification document for names and preferred units of parameters.

5.5.1.1. **units** {wxml:parameter-unitsType}: [?] Defines the units of the parameter. Must accompany all parameters except categorical and weather-conditions parameters.

5.5.1.2. **categorical-table** {wxml:categorical-tableType} [?]: Foreign key to a list of categories that define the meaning of the (categorical) value.

5.5.1.3. **threshold_value** {xsd:decimal} [?]: Must accompany probability forecasts to indicate the threshold exceedance value.

5.5.1.4. **threshold_units** { nml:parameter-unitsType } [?]: Must accompany probability forecasts to indicate the units of the threshold value.

5.5.2. <**weather-conditions**>: See section 5.4.3.

→ For B08FDP *weather_conditions* are used to describe severe weather elements such as mesocyclones, hail, downbursts, etc. Nest these data in <nowcast-parameters> if they have motion associated with them.

5.6. <**categorical-definitions**> {wxml:categorical-definitionsType} [?]: Contains the definitions of categories found in parameter values.

5.6.1. <**categorical-table**> {wxml:categorical-table-elementType} [+]: Contains the categorical data.

5.6.1.1. **units** {wxml:parameter-unitsType}: [?] The units of the data in the categories.

5.6.1.2. <**categorical-key**> {wxml:categorical-keyType}: The primary key relating the data in the parameter element to a particular categorical table.

5.6.1.3. <**value**> {xsd:string} [+]: The categorical value of the data.

5.6.1.3.1. **category** {xsd:string}: The description of the category.

5.7. <**conversion-definitions**> {wxml:conversion-definitionsType} [?]: Contains loop-up tables used to relate numerical data to an equivalent value.

5.7.1. <**conversion-table**> {wxml:conversion-table-elementType} [+]: Holds the range of data associated with each equivalent value.

5.7.1.1.<**conversion-key**> {wxml:conversion-keyType}: The primary key relating the data in the parameter element to a particular conversion table.

5.7.1.2.<**start-value**> {wxml:start-valueType} [+]: The starting value of the range of data for which the value is equivalent.

5.7.1.3.<**end-value**> {wxml:end-valueType} [+]: The ending value of the range of data for which the value is equivalent.

5.7.1.4.<**equivalent-value**> {xsd:string} [+]: The equivalent value of the data

6. XML Considerations

6.1. **Namespace:** WxML will use the namespace

<http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML>.

6.2. **Schema:** WxML will use XML Schema to perform validity checking.

Appendix B3: Valid values for environmental parameters and weather data.

Table 1. Valid values for parameters and their types and units.

Parameter	Types	Units
temperature	"air", "dew point", "dry bulb", "wet bulb", "heat index", "wind chill", "apparent", "sea surface", "soil"	"C", "K", "F", "Celsius", "Kelvin", "Fahrenheit"
precipitation	"rain", "snow", "liquid"	"mm h-1", "mm", "inches"
probability-of-precipitation	"12 hour", "floating"	"percent"
wind-speed	"sustained", "gust", "transport"	"m s-1", "km h-1", "knots"
wind_direction	"sustained", "gust", "transport"	"degrees true"
cloud-amount	"total"	"percent"
humidity	"relative", "specific", "absolute"	"percent"
weather		

Table 2. Valid values for weather coverage attribute.

Coverage Values (<i>coverage</i>)				
slight chance	occasional	scattered	areas	frequent
chance	definitely	numerous	widespread	intermittent
likely	isolated	patchy	periods of	none

Table 3. Valid values for weather intensity attribute.

Intensity Values (<i>intensity</i>)	
very light	mild
light	strong
moderate	severe
heavy	none

Table 4. Valid weather values.

Weather Values (<value>)
thunderstorms
lightning
hail
downburst
damaging winds
mesocyclone
rain
drizzle
snow
fog

Appendix C. Sample nowcasts in XML format

Sample XML files for nowcasts are printed below to show how point, line, track, severe weather, and area nowcasts can be represented in WxML format. The XML examples and schemas are available online at <http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML>.

Example 1: Point forecasts of temperature from MOS

File name: *MOS_temp_20060217120000.xml*

```
<?xml version="1.0"?>
<wxml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML"
  version="1.01"
  xsi:schemaLocation="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML
  http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML/wxml.1.01.xsd">
<head>
  <product concise-name="point" operational-mode="experimental">
    <system>MUF</system>
    <title>Made-Up Forecast</title>
    <description>B08FDP MOS</description>
    <category>forecast</category>
    <creation-date refresh-frequency="PT6H">2006-02-17T12:00:00</creation-date>
  </product>
  <data-source>
    <network type="AWS" name="AWS" />
  </data-source>
  <product-source>
    <more-information>
      http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/info.html
    </more-information>
    <production-center>Bureau of Meteorology
      <sub-center>Research Centre</sub-center>
    </production-center>
    <disclaimer>http://www.bom.gov.au/other/disclaimer.shtml</disclaimer>
    <credit>http://www.bom.gov.au</credit>
    <credit-logo>http://www.bom.gov.au/images/bom_logo.gif</credit-logo>
    <feedback>http://www.bom.gov.au/bmrc/wfhome.htm</feedback>
  </product-source>
</head>
<data>
  <location>
    <location-key>00001</location-key>
    <site latitude="40.1" longitude="116.4">Olympic Stadium</site>
  </location>
  <location>
    <location-key>00002</location-key>
    <site latitude="40.2" longitude="116.2">Beijing Intl Airport</site>
  </location>
  <location>
    <location-key>00003</location-key>
    <site latitude="39.7" longitude="116.5">Rowing venue</site>
  </location>
  <time-layout time-coordinate="UTC">
    <layout-key>k-plh-n6-1</layout-key>
    <start-valid-time>2006-02-13T13:00:00</start-valid-time>
    <start-valid-time>2006-02-13T14:00:00</start-valid-time>
    <start-valid-time>2006-02-13T15:00:00</start-valid-time>
    <start-valid-time>2006-02-13T16:00:00</start-valid-time>
    <start-valid-time>2006-02-13T17:00:00</start-valid-time>
    <start-valid-time>2006-02-13T18:00:00</start-valid-time>
  </time-layout>
  <parameters applicable-location="00001">
    <temperature type="air" units="C" time-layout="k-plh-n6-1">
      <name>Air temperature (C)</name>
      <value>26.7</value>
      <value>26.3</value>
      <value>25.6</value>
      <value>25.2</value>
      <value>24.2</value>
    </temperature>
  </parameters>
</data>
</wxml>
```

```
        <value>23.4</value>
    </temperature>
</parameters>
<parameters applicable-location="00002">
    <temperature type="air" units="C" time-layout="k-plh-n6-1">
        <name>Air temperature (C)</name>
        <value>26.6</value>
        <value xsi:nil="true"/>
        <value>25.2</value>
        <value>24.8</value>
        <value>24.3</value>
        <value>23.5</value>
    </temperature>
</parameters>
<parameters applicable-location="00003">
    <temperature type="air" units="C" time-layout="k-plh-n6-1">
        <name>Air temperature (C)</name>
        <value>26.2</value>
        <value>26.2</value>
        <value>25.1</value>
        <value>24.5</value>
        <value>24.0</value>
        <value>23.1</value>
    </temperature>
</parameters>
</data>
</wxml>
```

Example 2: Track forecast from TIFS

File name: *tifs_storm_20060217173000.xml*

```
<?xml version="1.0"?>
<wxml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML" version="1.01"
  xsi:schemaLocation="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML
  http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML/wxml.1.01.xsd">
<head>
  <product concise-name="track" operational-mode="experimental">
    <system>tifs
      <sub-system>TITAN</sub-system>
    </system>
    <title>Thunderstorm Interactive Forecast System Thunderstorm Track</title>
    <description>B08FDP TIFS track</description>
    <category>analysis</category>
    <creation-date refresh-frequency=" PT10M ">2006-02-17T17:35:00</creation-date>
  </product>
  <data-source>
    <radar name="Tianjin" type="NEXRAD" latitude="39.20" longitude="117.30" />
  </data-source>
  <product-source>
    <more-information>
      http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/info.html
    </more-information>
    <production-center>Bureau of Meteorology
      <sub-center>Research Centre</sub-center>
    </production-center>
    <disclaimer>http://www.bom.gov.au/other/disclaimer.shtml</disclaimer>
    <credit>http://www.bom.gov.au</credit>
    <credit-logo>http://www.bom.gov.au/images/bom_logo.gif</credit-logo>
  </product-source>
</head>
<nowcast-data>
  <time-layout time-coordinate="UTC">
    <start-valid-time>2006-02-17T17:30:00</start-valid-time>
    <end-valid-time>2006-02-17T17:30:00</end-valid-time>
  </time-layout>
  <event ID="00036">
    <case>
      <time time-coordinate="UTC" period="PT10M">2006-02-17T17:30:00</time>
      <location>
        <area>
          <ellipse>
            <moving-point type="centroid">
              <latitude>39.55</latitude>
              <longitude>116.67</longitude>
            </moving-point>
            <polar_motion>
              <speed units="km h-1">10.1</speed>
              <direction_from units="degrees true">94</direction_from>
            </polar_motion>
          </ellipse>
        </area>
      </location>
      <nowcast-parameters>
        <max_dbz units="dbz">52</max_dbz>
        <VIL units="kg m-2">3.4</VIL>
        <original_speed units="km h-1">9.8</original_speed>
        <original_direction units="degrees true">138</original_direction>
        <visible units="none">true</visible>
        <storm_intensity categorical-table="storm categories">
          4
        </storm_intensity>
      </nowcast-parameters>
    </case>
  </event>
  <event ID="00037">
    <case>
```

```

<time time-coordinate="UTC" period="PT10M">2006-02-17T17:30:00</time>
<location>
  <area>
    <ellipse>
      <moving-point type="centroid">
        <latitude>40.02</latitude>
        <longitude>116.89</longitude>
        <polar_motion>
          <speed units="km h-1">11.7</speed>
          <direction_from units="degrees true">98</direction_from>
        </polar_motion>
      </moving-point>
      <major_axis units="km">3.9</major_axis>
      <minor_axis units="km">2.2</minor_axis>
      <orientation units="degrees true">25</orientation>
    </ellipse>
  </area>
</location>
<nowcast-parameters>
  <max_dbz units="dbz">46</max_dbz>
  <VIL units="kg m-2">2.7</VIL>
  <original_speed units="km h-1">11.7</original_speed>
  <original_direction units="degrees true">98</original_direction>
  <visible units="none">true</visible>
  <storm_intensity categorical-table="storm categories">
    3
  </storm_intensity>
</nowcast-parameters>
</case>
</event>
<event ID="00038">
  <case>
    <time time-coordinate="UTC" period="PT10M">2006-02-17T17:30:00</time>
    <location>
      <area>
        <ellipse>
          <moving-point type="centroid">
            <latitude>40.21</latitude>
            <longitude>116.56</longitude>
            <polar_motion>
              <speed units="km h-1">9.8</speed>
              <direction_from units="degrees true">95</direction_from>
            </polar_motion>
          </moving-point>
          <major_axis units="km">8.7</major_axis>
          <minor_axis units="km">3.1</minor_axis>
          <orientation units="degrees true">24</orientation>
        </ellipse>
      </area>
    </location>
    <nowcast-parameters>
      <max_dbz units="dbz">43</max_dbz>
      <VIL units="kg m-2">2.9</VIL>
      <original_speed units="km h-1">9.8</original_speed>
      <original_direction units="degrees true">95</original_direction>
      <visible units="none">true</visible>
      <storm_intensity categorical-table="storm categories">
        2
      </storm_intensity>
    </nowcast-parameters>
  </case>
</event>
<categorical-definitions>
  <categorical-table>
    <categorical-key>storm categories</categorical-key>
    <value category="very mild">1</value>
    <value category="mild">2</value>
    <value category="moderate">3</value>
    <value category="strong">4</value>
    <value category="intense">5</value>
  </categorical-table>
</categorical-definitions>
</nowcast-data>
</wxml>

```

Example 3: TITAN track forecast with two shape representations and cell history (2 time steps)

File name: *titan_storm_20060217175000.xml*

```
<?xml version="1.0"?>
<wxml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML" version="1.01"
  xsi:schemaLocation="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML
  http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML/wxml.1.01.xsd">
<head>
  <product concise-name="track" operational-mode="experimental">
    <system>TITAN</system>
    <title>TITAN Thunderstorm Track</title>
    <description>B08FDP TITAN</description>
    <category>analysis</category>
    <creation-date refresh-frequency="PT10M">
      2006-02-17T17:55:00
    </creation-date>
  </product>
  <data-source>
    <radar name="Tianjin" type="NEXRAD" latitude="39.20" longitude="117.30" />
  </data-source>
  <product-source>
    <more-information>
      http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/info.html
    </more-information>
    <production-center>
      Bureau of Meteorology
      <sub-center>Research Centre</sub-center>
    </production-center>
    <disclaimer>http://www.bom.gov.au/other/disclaimer.shtml</disclaimer>
    <credit>http://www.bom.gov.au</credit>
    <credit-logo>http://www.bom.gov.au/images/bom_logo.gif</credit-logo>
  </product-source>
</head>
<nowcast-data>
  <time-layout time-coordinate="UTC">
    <start-valid-time>2006-02-17T17:40:00</start-valid-time>
    <end-valid-time>2006-02-17T17:50:00</end-valid-time>
  </time-layout>
  <event ID="254">
    <case>
      <time>2006-02-17T17:40:00</time>
      <location>
        <area>
          <ellipse>
            <moving-point type="centroid">
              <latitude>39.55</latitude>
              <longitude>116.67</longitude>
              <polar_motion>
                <speed units="km h-1">11.7</speed>
                <direction_from units="degrees true">
                  98
                </direction_from>
              </polar_motion>
            </moving-point>
            <major_axis units="km">4.2</major_axis>
            <minor_axis units="km">2.5</minor_axis>
            <orientation units="degrees true">22</orientation>
          </ellipse>
          <polygon>
            <moving-point type="centroid">
              <latitude>39.55</latitude>
              <longitude>116.67</longitude>
              <polar_motion>
                <speed units="km h-1">11.7</speed>
                <direction_from units="degrees true">
                  98
                </direction_from>
              </polar_motion>
            </moving-point>
            <point latitude="39.55" longitude="116.645" />
          </polygon>
        </area>
      </location>
    </case>
  </event>
</nowcast-data>
```

```

        <point latitude="39.565" longitude="116.659" />
        <point latitude="39.574" longitude="116.661" />
        <point latitude="39.577" longitude="116.675" />
        <point latitude="39.58" longitude="116.69" />
        <point latitude="39.571" longitude="116.70" />
        <point latitude="39.565" longitude="116.75" />
        <point latitude="39.551" longitude="116.70" />
        <point latitude="39.535" longitude="116.66" />
        <point latitude="39.537" longitude="116.67" />
        <point latitude="39.514" longitude="116.643" />
        <point latitude="39.521" longitude="116.64" />
        <point latitude="39.532" longitude="116.638" />
        <point latitude="39.55" longitude="116.645" />
    </polygon>
</area>
</location>
<nowcast-parameters>
  <ID_parent units="none">246</ID_parent>
  <ID_child units="none">270</ID_child>
  <reflectivity_threshold units="dbz">35</reflectivity_threshold>
  <height_threshold units="km">3</height_threshold>
  <volume_threshold units="km3">30</volume_threshold>
  <cell_top units="km">3.625</cell_top>
  <cell_volume units="km3">32.9</cell_volume>
  <mean_area units="km2">10.97</mean_area>
  <projected_area units="km2">18</projected_area>
  <max_dbz units="dbz">52</max_dbz>
  <height_max_dbz units="km">1.75</height_max_dbz>
  <VIL units="kg m-2">3.36</VIL>
  <storm_intensity units="category">0</storm_intensity>
  <hail_mass units="kg">0</hail_mass>
  <hail_probability units="percent">
    <value threshold_value="0" threshold_units="mm">20</value>
    <value threshold_value="10" threshold_units="mm">10</value>
    <value threshold_value="20" threshold_units="mm">10</value>
  </hail_probability>
</nowcast-parameters>
</case>
<case>
  <time>2006-02-17T17:50:00</time>
  <location>
    <area>
      <ellipse>
        <moving-point type="centroid">
          <latitude>39.54</latitude>
          <longitude>116.78</longitude>
          <polar_motion>
            <speed units="km h-1">11.9</speed>
            <direction_from units="degrees true">
              104
            </direction_from>
          </polar_motion>
        </moving-point>
        <major_axis units="km">4.3</major_axis>
        <minor_axis units="km">2.8</minor_axis>
        <orientation units="degrees true">25</orientation>
      </ellipse>
      <polygon>
        <moving-point type="centroid">
          <latitude>39.54</latitude>
          <longitude>116.78</longitude>
          <polar_motion>
            <speed units="km h-1">11.9</speed>
            <direction_from units="degrees true">
              104
            </direction_from>
          </polar_motion>
        </moving-point>
        <point latitude="39.54" longitude="116.755" />
        <point latitude="39.560" longitude="116.77" />
        <point latitude="39.571" longitude="116.785" />
        <point latitude="39.57" longitude="116.802" />
        <point latitude="39.56" longitude="116.811" />
        <point latitude="39.554" longitude="116.859" />
      </polygon>
    </area>
  </location>
</case>

```

```

        <point latitude="39.544" longitude="116.809" />
        <point latitude="39.525" longitude="116.77" />
        <point latitude="39.510" longitude="116.754" />
        <point latitude="39.512" longitude="116.751" />
        <point latitude="39.520" longitude="116.749" />
        <point latitude="39.54" longitude="116.755" />
    </polygon>
</area>
</location>
<nowcast-parameters>
    <ID_parent units="none">246</ID_parent>
    <reflectivity_threshold units="dbz">35</reflectivity_threshold>
    <height_threshold units="km">3</height_threshold>
    <volume_threshold units="km3">30</volume_threshold>
    <cell_top units="km">3.64</cell_top>
    <cell_volume units="km3">33.8</cell_volume>
    <mean_area units="km2">11.6</mean_area>
    <projected_area units="km2">18.3</projected_area>
    <max_dbz units="dbz">53</max_dbz>
    <height_max_dbz units="km">1.85</height_max_dbz>
    <VIL units="kg m-2">3.42</VIL>
    <storm_intensity units="category">0</storm_intensity>
    <hail_mass units="kg">0</hail_mass>
    <hail_probability units="percent">
        <value threshold_value="0" threshold_units="mm">30</value>
        <value threshold_value="10" threshold_units="mm">20</value>
        <value threshold_value="20" threshold_units="mm">10</value>
    </hail_probability>
</nowcast-parameters>
</case>
</event>
<event ID="255">
    <case">
        <time>2006-02-17T17:40:00</time>
        <location>
            <area>
                <ellipse>
                    <moving-point type="centroid">
                        <latitude>40.02</latitude>
                        <longitude>116.89</longitude>
                    <polar_motion>
                        <speed units="km h-1">11.9</speed>
                        <direction_from units="degrees true">
                            105
                        </direction_from>
                    </polar_motion>
                </moving-point>
                <major_axis units="km">3.9</major_axis>
                <minor_axis units="km">2.2</minor_axis>
                <orientation units="degrees true">25</orientation>
            </ellipse>
            <polygon>
                <moving-point type="centroid">
                    <latitude>40.02</latitude>
                    <longitude>116.89</longitude>
                <polar_motion>
                    <speed units="km h-1">11.9</speed>
                    <direction_from units="degrees true">
                        105
                    </direction_from>
                </polar_motion>
            </moving-point>
            <point latitude="40.0" longitude="116.88" />
            <point latitude="40.014" longitude="116.87" />
            <point latitude="40.021" longitude="116.887" />
            <point latitude="40.025" longitude="116.911" />
            <point latitude="40.018" longitude="116.917" />
            <point latitude="40.0" longitude="116.92" />
            <point latitude="39.981" longitude="116.904" />
            <point latitude="39.968" longitude="116.89" />
            <point latitude="39.962" longitude="116.869" />
            <point latitude="39.975" longitude="116.864" />
            <point latitude="40.0" longitude="116.88" />
        </polygon>
    </case>
</event>

```

```

    </area>
  </location>
  <nowcast-parameters>
    <ID_parent units="none">247</ID_parent>
    <ID_child units="none">271</ID_child>
    <reflectivity_threshold units="dbz">35</reflectivity_threshold>
    <height_threshold units="km">3</height_threshold>
    <volume_threshold units="km3">30</volume_threshold>
    <cell_top units="km">3.985</cell_top>
    <cell_volume units="km3">43.5</cell_volume>
    <mean_area units="km2">13.5</mean_area>
    <projected_area units="km2">24</projected_area>
    <max_dbz units="dbz">57</max_dbz>
    <height_max_dbz units="km">2.34</height_max_dbz>
    <VIL units="kg m-2">3.85</VIL>
    <storm_intensity units="category">0</storm_intensity>
    <hail_mass units="kg">0</hail_mass>
    <hail_probability units="percent">
      <value threshold_value="0" threshold_units="mm">20</value>
      <value threshold_value="10" threshold_units="mm">10</value>
      <value threshold_value="20" threshold_units="mm">10</value>
    </hail_probability>
  </nowcast-parameters>
</case>
</event>
<event ID="270">
  <case>
    <<time>2006-02-17T17:50:00</time>
    <location>
      <area>
        <ellipse>
          <moving-point type="centroid">
            <latitude>39.56</latitude>
            <longitude>116.83</longitude>
            <polar_motion>
              <speed units="km h-1">12.5</speed>
              <direction_from units="degrees true">
                85
              </direction_from>
            </polar_motion>
          </moving-point>
          <major_axis units="km">1.3</major_axis>
          <minor_axis units="km">1.0</minor_axis>
          <orientation units="degrees true">30</orientation>
        </ellipse>
        <polygon>
          <moving-point type="centroid">
            <latitude>39.56</latitude>
            <longitude>116.83</longitude>
            <polar_motion>
              <speed units="km h-1">12.5</speed>
              <direction_from units="degrees true">
                85
              </direction_from>
            </polar_motion>
          </moving-point>
          <point latitude="39.562" longitude="116.885" />
          <point latitude="39.576" longitude="116.895" />
          <point latitude="39.568" longitude="116.811" />
          <point latitude="39.554" longitude="116.809" />
          <point latitude="39.521" longitude="116.754" />
          <point latitude="39.538" longitude="116.749" />
          <point latitude="39.551" longitude="116.654" />
          <point latitude="39.562" longitude="116.885" />
        </polygon>
      </area>
    </location>
    <nowcast-parameters>
      <ID_parent units="none">254</ID_parent>
      <reflectivity_threshold units="dbz">35</reflectivity_threshold>
      <height_threshold units="km">3</height_threshold>
      <volume_threshold units="km3">30</volume_threshold>
      <cell_top units="km">2.45</cell_top>
    </nowcast-parameters>
  </case>
</event>

```

```

    <cell_volume units="km3">15.0</cell_volume>
    <mean_area units="km2">8.5</mean_area>
    <projected_area units="km2">9.1</projected_area>
    <max_dbz units="dbz">45</max_dbz>
    <height_max_dbz units="km">1.7</height_max_dbz>
    <VIL units="kg m-2">1.55</VIL>
    <storm_intensity units="category">0</storm_intensity>
    <hail_mass units="kg">0</hail_mass>
    <hail_probability units="percent">
      <value threshold_value="0" threshold_units="mm">0</value>
      <value threshold_value="10" threshold_units="mm">0</value>
      <value threshold_value="20" threshold_units="mm">0</value>
    </hail_probability>
  </nowcast-parameters>
</case>
</event>
</nowcast-data>
</wxml>

```

Example 4. TIFS threat area

File name: *tifs_threat_20060217165000.xml*

```
<?xml version="1.0"?>
<wxml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML" version="1.01"
  xsi:schemaLocation="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML
  http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML/wxml.1.01.xsd">
<head>
  <product concise-name="area" operational-mode="experimental">
    <system>tifs</system>
    <title>Thunderstorm Interactive Forecast System Threat Area</title>
    <description>B08FDP TIFS area</description>
    <category>forecast</category>
    <creation-date refresh-frequency="PT10M">2006-02-17T16:50:00</creation-date>
  </product>
  <data-source>
    <network type="radar" name="Beijing composite" />
    <network type="lightning" name="GPATS" />
  </data-source>
  <product-source>
    <more-information>
      http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/info.html
    </more-information>
    <production-center>Bureau of Meteorology
      <sub-center>Research Centre</sub-center>
    </production-center>
    <disclaimer>http://www.bom.gov.au/other/disclaimer.shtml</disclaimer>
    <credit>http://www.bom.gov.au</credit>
    <credit-logo>http://www.bom.gov.au/images/bom_logo.gif</credit-logo>
  </product-source>
</head>
<data>
  <location>
    <location-key>00001</location-key>
    <area>
      <polygon>
        <point latitude="39.42" longitude="115.88" />
        <point latitude="39.76" longitude="115.97" />
        <point latitude="40.03" longitude="116.10" />
        <point latitude="40.09" longitude="116.78" />
        <point latitude="39.82" longitude="117.07" />
        <point latitude="39.53" longitude="117.21" />
        <point latitude="39.22" longitude="116.89" />
        <point latitude="38.99" longitude="116.54" />
        <point latitude="38.34" longitude="116.29" />
        <point latitude="38.25" longitude="116.06" />
        <point latitude="38.74" longitude="115.94" />
        <point latitude="39.42" longitude="115.88" />
      </polygon>
    </area>
  </location>
  <time-layout time-coordinate="UTC">
    <layout-key>k-plh-n1-1</layout-key>
    <start-valid-time>2006-02-13T16:50:00</start-valid-time>
    <end-valid-time>2006-02-13T17:50:00</end-valid-time>
  </time-layout>
  <parameters applicable-location="00001">
    <weather time-layout="k-plh-n1-1">
      <weather-conditions>
        <value weather-type="thunderstorms" coverage="widespread"
intensity="strong"/>
        <value weather-type="damaging winds" coverage="chance"
intensity="strong"/>
      </weather-conditions>
    </weather>
  </parameters>
</data>
</wxml>
```

Example 5. Autonowcaster boundary

File name: *banc_bdry_20060217173000.xml*

```
<?xml version="1.0"?>
<wxml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML" version="1.01"
  xsi:schemaLocation="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML
  http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML/wxml.1.01.xsd">
<head>
  <product concise-name="line" operational-mode="experimental">
    <system>banc</system>
    <title>Autonowcaster Boundary</title>
    <description>B08FDP ANC boundary</description>
    <category>analysis</category>
    <creation-date refresh-frequency="PT10M">2006-02-17T17:35:00</creation-date>
  </product>
  <data-source>
    <radar name="Tianjin" type="NEXRAD" latitude="39.20" longitude="117.30" />
  </data-source>
  <product-source>
    <more-information>
      http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/info.html
    </more-information>
    <production-center>Bureau of Meteorology
      <sub-center>Research Centre</sub-center>
    </production-center>
    <disclaimer>http://www.bom.gov.au/other/disclaimer.shtml</disclaimer>
    <credit>http://www.bom.gov.au</credit>
    <credit-logo>http://www.bom.gov.au/images/bom_logo.gif</credit-logo>
  </product-source>
</head>
<nowcast-data>
  <time-layout time-coordinate="UTC">
    <start-valid-time>2006-02-17T17:30:00</start-valid-time>
    <end-valid-time>2006-02-17T17:30:00</end-valid-time>
  </time-layout>
  <event ID="00001">
    <case>
      <time>2006-02-17T17:30:00</time>
      <location>
        <polyline>
          <moving-point type="vertex">
            <latitude>39.67</latitude>
            <longitude>115.71</longitude>
            <cartesian_motion>
              <u_motion units="m s-1">-5.7</u_motion>
              <v_motion units="m s-1">2.1</v_motion>
            </cartesian_motion>
          </moving-point>
          <moving-point type="vertex">
            <latitude>39.49</latitude>
            <longitude>115.62</longitude>
            <cartesian_motion>
              <u_motion units="m s-1">-5.8</u_motion>
              <v_motion units="m s-1">1.9</v_motion>
            </cartesian_motion>
          </moving-point>
          <moving-point type="vertex">
            <latitude>39.29</latitude>
            <longitude>115.59</longitude>
            <cartesian_motion>
              <u_motion units="m s-1">-5.8</u_motion>
              <v_motion units="m s-1">1.7</v_motion>
            </cartesian_motion>
          </moving-point>
          <moving-point type="vertex">
            <latitude>39.10</latitude>
            <longitude>115.60</longitude>
            <cartesian_motion>
              <u_motion units="m s-1">-5.8</u_motion>
              <v_motion units="m s-1">1.5</v_motion>
            </cartesian_motion>
          </moving-point>
        </polyline>
      </location>
    </case>
  </event>
</nowcast-data>
```

```
</moving-point>
<moving-point type="vertex">
  <latitude>38.98</latitude>
  <longitude>115.62</longitude>
  <cartesian_motion>
    <u_motion units="m s-1">-5.7</u_motion>
    <v_motion units="m s-1">1.3</v_motion>
  </cartesian_motion>
</moving-point>
<moving-point type="vertex">
  <latitude>38.87</latitude>
  <longitude>115.64</longitude>
  <cartesian_motion>
    <u_motion units="m s-1">-5.7</u_motion>
    <v_motion units="m s-1">1.2</v_motion>
  </cartesian_motion>
</moving-point>
</polyline>
</location>
</case>
</event>
</nowcast-data>
</wxml>
```

Example 6. CARDS mesocyclone detection

File name: *cards_sevwx_20060217173000.xml*

```
<?xml version="1.0"?>
<wxml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML" version="1.01"
  xsi:schemaLocation="http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML
  http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/WxML/wxml.1.01.xsd">
<head>
  <product concise-name="point" operational-mode="experimental">
    <system>cards</system>
    <title>CARDS Mesocyclone Detection</title>
    <description>B08FDP CARDS meso</description>
    <category>analysis</category>
    <creation-date refresh-frequency="PT10M">2006-02-17T17:35:00</creation-date>
  </product>
  <data-source>
    <radar type="NEXRAD" name="Tianjin" latitude="39.20" longitude="117.30" />
  </data-source>
  <product-source>
    <more-information>
      http://www.bom.gov.au/bmrc/wefor/projects/b08fdp/info.html
    </more-information>
    <production-center>Bureau of Meteorology
      <sub-center>Research Centre</sub-center>
    </production-center>
  </product-source>
</head>
<nowcast-data>
  <time-layout time-coordinate="UTC">
    <start-valid-time>2006-02-17T17:30:00</start-valid-time>
    <end-valid-time>2006-02-17T17:30:00</end-valid-time>
  </time-layout>
  <event ID="00001">
    <case>
      <time>2006-02-17T17:30:00</time>
      <location>
        <moving-point type="mesocyclone">
          <latitude>39.67</latitude>
          <longitude>115.71</longitude>
          <polar_motion>
            <speed units="km h-1">32</speed>
            <direction_from units="degrees true">102</direction_from>
          </polar_motion>
        </moving-point>
      </location>
      <nowcast-parameters>
        <meso_type categorical-table="meso types">2</meso_type>
        <meso_intensity categorical-table="meso intensities">3</meso_intensity>
      </nowcast-parameters>
    </case>
  </event>
  <categorical-definitions>
    <categorical-table>
      <categorical-key>meso types</categorical-key>
      <value category="small mesocyclone">1</value>
      <value category="large mesocyclone">2</value>
    </categorical-table>
    <categorical-table>
      <categorical-key>meso intensities</categorical-key>
      <value category="very mild">1</value>
      <value category="mild">2</value>
      <value category="moderate">3</value>
      <value category="strong">4</value>
      <value category="intense">5</value>
    </categorical-table>
  </categorical-definitions>
</nowcast-data>
</wxml>
```

Appendix D. Additional variables not included in Table 4.

Variables from WDSS

Name	Units
3DAz	degrees
3DRa	km
3DXLoc	km
3DYLoc	km
6kmXloc	km
6kmYloc	km
Age	min
AgeHours	hr
AgeMin	min
AgeSec	s
AgeVS	(dimensionless)
AlgRank	(dimensionless)
AssocMesoID	(dimensionless)
AssocStormID	(dimensionless)
Azimuth	degrees
CellBase	km
CellID	(dimensionless)
CellMass	kg
CellTop	km
CellTop_COS	km
CellVolume	m ³
CircType	(dimensionless)
ConeOfSilence	(dimensionless)
ConvDepth	km
CoreAspectRatio	(dimensionless)
CoreBase	km
CoreDepth	km
CoreTop	km
DDPDASTrength	(dimensionless)
DDPDAType	(dimensionless)
DistToDetection	km
FcstError	km
HailSizeEstimate	mm
HailSizeEstimate_COS	mm
HeightMaxLevShear	km
HeightMaxLevV	km
HeightOfCenterOfMass	km
HeightOfMaxdBZ	km
HtMaxLevDia	km
HtMaxLevGtGdV	km
HtMaxLevRotV	km
HtMaxLevShear	km
LowLevAz	degrees
LowLevDia	km
LowLevGtGdV	m s ⁻¹
LowLevRan	km
LowLevRotV	m s ⁻¹
LowLevShear	m s ⁻¹ km ⁻¹
LowLevV	m s ⁻¹
LowLevelConv	m s ⁻¹
LowLevelXLoc	km
LowLevelYLoc	km
LowToppedMeso	(dimensionless)
MaxConvergence	m s ⁻¹
MaxLevDia	km
MaxLevGtGdVr	m s ⁻¹
MaxLevRotV	m s ⁻¹

MaxLevShear	m s-1 km-1
MaxLevdV	m s-1
MDAType	(dimensionless)
MesoBase	km
MesoDepth	km
MesoDetectionType	(dimensionless)
MesoDir	degrees
MesoSpeed	m s-1
MesoStrengthIndex	(dimensionless)
MesoTop	km
MidLevelConv	m s-1
MSIRank	(dimensionless)
NSSLBase	km
NSSLDepth	km
NSSLMeso	(dimensionless)
NSSLTop	km
OldEventID	(dimensionless)
ProbOfHail	%
ProbOfHail_COS	%
ProbOfSeverehail	%
ProbOfSeverehail_COS	%
ProbOfSvrWx	%
ProbOfTornado	%
Range	km
ReflectivityRatio	(dimensionless)
RowName	(dimensionless)
RowNameUsage	(dimensionless)
SevereHailIndex	(dimensionless)
StormCellID	(dimensionless)
StormDepth	km
StormDir	degrees
StormRelativeDepth	%
StormSpeed	m s-1
StormTopDiv	m s-1
StrengthRank	(dimensionless)
TableBase	km
TableBaseSign	(dimensionless)
TableDepth	km
TableTop	km
TimeAssocCode	(dimensionless)
TornadicMeso	(dimensionless)
TornadoStrengthIndex	(dimensionless)
TVSBase	km
TVSDepth	km
TVSDir	degrees
TVSID	(dimensionless)
TVSSpeed	m s-1
TVSTop	km
UMotion	m s-1
VertIntegratedGtGdV	(dimensionless)
VertIntegratedRotVel	(dimensionless)
VertIntegratedShear	(dimensionless)
VIL_COS	kg m-2
VMotion	m s-1
WeakLowtopBase	km
WeakLowtopDepth	km
WeakLowtopTop	km
XLoc	km
YLoc	km

Appendix E. Revision history

Version	Date	Revisions
1.0	14 March 2006	1 st draft of B08FDP file format specifications released for comment
2.0	27 April 2006	Specified variables required for display and verification applications Added <i>description</i> to product definition (XML) Clarified <i>base_date</i> and <i>base_time</i> for t=0, <i>forecast_date</i> and <i>forecast_time</i> for forecast valid time (netCDF)
2.1	7 July 2006	<i>n-points</i> removed from polygons and polylines, instructions added to repeat the first point as the last point in polygons (XML) <i>timestamp</i> attribute changed to optional string (XML) Clarified missing data to be represented by <code>xsi:nil="true"</code> and no value to be represented by empty element, for both parameters and nowcast_parameters (XML) Example 3b of TITAN storm with cell history added to illustrate file with more than one time step, when not all cells have data for all time steps. Handling of empty <i>case</i> (absent cell) clarified. (XML) XML files now refer to BOM web site for namespace and schema Sample probabilistic QPF file added (netCDF)
2.2	25 August 2006	<i>timestamp</i> attribute removed from <i>case</i> element, <i>time-layout</i> attribute removed from <i>event</i> element, and <i>time</i> element added to <i>case</i> . (XML) In <i>time-layout</i> under <i>nowcast-data</i> , the <i>start-valid-time</i> and <i>end-valid-time</i> now refer to the range of times in this file. Files with no cells have a time-layout but no events (XML) Empty cases no longer allowed. (XML) Latitude and longitude of lower left grid box now included in the global attributes of netCDF files that have grid increments in distance instead of latitude/longitude (netCDF) Some variable names added to Table 4 (name conventions for environmental and supporting data)