skyguide SPECIFICATION

beyond horizons

subject **Swiss Obstacle Data Set**

title Data Product Specification

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abstract Specification of a series of datasets (AIXM format, KML format) for the provision of daily updated air navigation obstacle data for Switzerland and the Principality of Liechtenstein.

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1 Overview

Name	Swiss Obstacle Data Set
Version	1.0.1
Date of issue	23.05.2025
Language	eng
Contact	skyguide swiss air navigation services ltd Aeronautical Information Services CH-8602 Wangen bei Dübendorf Phone +41 (0) 43 931 61 68 Email dataproduction@skyguide.ch
Informal description	This DPS specifies a series of datasets (AIXM format, KML format) for the provision of daily updated air navigation obstacle data for Switzerland and the Principality of Liechtenstein. This encompasses the types of air navigation obstacles defined in Article 2 letter k of the Ordinance of 23 November 1994 on Aviation Infrastructure (VIL, SR 748.131.1). This DPS respects the ICAO SARPs referred to in VIL Article 3 paragraphs (2) and (3). Nevertheless, the AIXM format of the Swiss Obstacle Data Set is not considered the Obstacle Data Set as it is required by ICAO Annex 15 chapter 5.3. It is rather a lightweight AIXM representation of air navigation obstacle data, supporting existing clients in a transition from the former CSV format to the use of AIXM, but with improved data quality.
Terms and definitions	active/inactive obstacle - Indicates for an obstacle recorded in a (temporal) database or included in a dataset whether the obstacle exists in the real-world at specific instants or periods of time. aeronautical database of skyguide - The temporal database of the skyguide AIM, used to store and maintain changes on collected data items. built-up area - In Swiss civil aviation legislation, the term refers to the definition of areas with respect to aviation criteria that is applied in VIL Articles 63 and 65a. Federal Geoportal - geo.admin.ch is the geographical information platform of the Swiss Confederation within the Federal Administration. vicinity of an aerodrome - When something is located fully or partially within the outer boundary of an aerodrome's ICAO area 2 obstacle limitation surface. Obstacle limitation surfaces are described in ICAO Annex 15 chapter 5.3.3. In Switzerland, the aerodrome obstacle limitation surfaces are published on the Federal Geoportal as a Cadastre of obstacle limitation surfaces.
Abbreviations	AGL Above Ground Level AIXM Aeronautical Information eXchange Model AMSL Above Mean Sea Level DCS Data Collection Service DPS Data Product Specification EPSG European Petroleum Survey Group FIR Flight Information Region FSDI Federal Spatial Data Infrastructure GML Geography Markup Language KML Keyhole Markup Language OGC Open Geospatial Consortium OLS Obstacle Limitation Surface SARPs Standards And Recommended Practices (ICAO) UML Unified Modelling Language UTC Coordinated Universal Time WGS World Geodetic System XML eXtended Markup Language XSD XML Schema Definition

2 Specification scopes

General scope	
Scope identification	General
Level	series
Level description	The "General scope" is the root level of the scope level hierarchy. It includes the specifications applicable to all datasets of the dataset series.
Extent	Switzerland and the Principality of Liechtenstein (defined by the State borders).
AIXM scope	
Scope identification	AIXM
Level	dataset
Level description	The "AIXM scope" includes the specifications which are dedicated to the provision of a dataset in the AIXM format.
Extent	Switzerland and the Principality of Liechtenstein (defined by the State borders).
KML scope	
Scope identification	KML
Level	dataset
Level description	The "KML scope" includes the specifications which are dedicated to the provision of a dataset in the KML format.
Extent	Switzerland and the Principality of Liechtenstein (defined by the State borders).
Aerodrome obstacle scope	
Scope identification	Aerodrome obstacle
Level	feature
Level description	The "Aerodrome obstacle scope" includes the specifications which are dedicated to obstacles that are in the vicinity of an aerodrome.
Extent	Aerodrome obstacle limitation surfaces within Switzerland and the Principality of Liechtenstein.

3 Data product identification

General scope	
Title	Air Navigation Obstacles of Switzerland and the Principality of Liechtenstein
Abstract	Permanent and temporary air navigation obstacles within Switzerland and the Principality of Liechtenstein. Air navigation obstacles are man-made structures and installations (such as antennas, buildings, cables, cranes, cableways, power lines, wind turbines) and vegetation (trees) that can hamper, endanger or prevent the operation of aircraft or of air navigation systems. Criteria for an obstacle are: ▪ Obstacle has an AGL height of 25 meters or more (or 40 meters or more in the case of mobile cranes) when outside built-up areas; or ▪ Obstacle has an AGL height of 60 meters or more when in built-up areas; or ▪ Obstacle penetrates an OLS; or ▪ Obstacle is in the vicinity of an aerodrome and is particularly safety relevant (can also be below 25 / 60m).
Topic category	Transportation
Keywords	Obstacle, Aviation
Spatial representation	Vector
Extent	Air navigation obstacles collected by the DCS Provider and located within the State borders of Switzerland and the Principality of Liechtenstein.
AIXM scope	
Purpose	The Swiss Obstacle Data Set in AIXM format includes data of air navigation obstacles for the use with the following or similar types of applications: ▪ Ground proximity warning system with forward looking terrain avoidance function and minimum safe altitude warning (MSAW) system. ▪ Determination of contingency procedures for use in the event of an emergency during a missed approach or take-off. ▪ Aircraft operating limitations analysis. ▪ Instrument procedure design. ▪ Determination of enroute “drift-down” procedure and enroute emergency landing location. ▪ Advanced surface movement guidance and control system (A-SMGCS). ▪ Aeronautical chart production and on-board databases. ▪ Training/flight simulator and synthetic vision systems.
Restrictions	For aviation use only.
KML scope	
Purpose	The Swiss Obstacle Data Set in KML format includes data of air navigation obstacles for the use with the following or similar types of applications: ▪ Portrayal of active air navigation obstacles on the Federal Geoportal. ▪ Visualization and browsing of active air navigation obstacles in Google Earth.
Restrictions	For aviation use only. Do not use with real-world operation and reality-based testing applications.

4 Data content and structure

AIXM scope	
Narrative description	The Swiss Obstacle Data Set in AIXM format includes air navigation obstacles as described in "Data product identification / Abstract" and meet the following criteria: ▪ Man-made structures and installations that are active or inactive during the time of validity of the dataset; or ▪ Vegetation that exists during the time of validity of the dataset.
Application schema	Ref. UML model in "Appendix A: AIXM content and structure".
Feature catalogue	Ref. description of features in "Appendix A: AIXM content and structure".
KML scope	

Narrative description	The Swiss Obstacle Data Set in KML format includes air navigation obstacles as described in "Data product identification / Abstract" and meet the following criteria:
	▪ Man-made structures and installations that are active during the time of validity of the dataset; or
	▪ Vegetation that
	  ▪ Exists during the time of validity of the dataset; and
	  ▪ Is in the vicinity of an aerodrome; and
	  ▪ Is published on the Visual Approach Chart (VAC) or in the AD-INFO section (aerodrome chart) of the VFR Manual.

Application schema	Ref. UML model in "Appendix B: KML content and structure".
Feature catalogue	Ref. description of features in "Appendix B: KML content and structure".

5 Reference systems

General scope	
Temporal reference system	UTC, Gregorian Calendar
AIXM scope	
Spatial reference system	Horizontal reference system: WGS84 (longitude/latitude, EPSG:4326) Vertical reference system: LN02 (height, EPSG:5728)
KML scope	
Spatial reference system	Horizontal reference system: WGS84 (longitude/latitude, EPSG:4326) Vertical reference system: LN02 (height, EPSG:5728) ⚠ Elevation values in KML geometry are assumed relative to the EGM96 (EPSG:5773) vertical reference system. The elevation values included with the KML Swiss Obstacle Data Set are relative to the LN02 vertical reference system. The maximum difference between a true EGM96 elevation value and a LN02 elevation value is +/-15 meters, which is considered sufficiently accurate with respect to the intended use of the dataset.

6 Data quality

General scope	
Traceability	All actions on an obstacle are traced and saved. Trace information is not available to the public but only internally for skyguide data processing or for auditing and investigation purpose.
Timeliness	Timeliness is assured by providing the commissioning/decommissioning and activation/deactivation time of an obstacle.
Completeness	The completeness of obstacle data is checked by business rules, executed when storing the values to the aeronautical database of skyguide. The content of the Swiss Obstacle Data Set is checked for completeness as an integral part of the dataset production process.
Accuracy	The adherence of measured obstacle property values to the required accuracy is checked and assured at the time the values are stored to the aeronautical database of skyguide. The AIM Data Catalogue is the reference for the accuracy related data quality requirements.
Resolution	Whether the resolution of measured obstacle property values is commensurate with the stated accuracy of the value is checked and assured at the time the value is collected by the DCS Provider.
Integrity	The integrity of obstacle data is either protected or unintended alteration detected for data in transport (over a network) or at rest (in a database) by applying respective information security standards. The AIM Data Catalogue is the reference for the integrity related data quality requirements.
AIXM scope	
Completeness	Where properties of an obstacle were not collected, a NIL reason indicates the reason for an absent value.
KML scope	
Completeness	Where properties of an obstacle were not collected, the value of a concerned property is left empty.
Aerodrome obstacle scope	
Integrity	The integrity of horizontal and vertical position values is classified “essential”. The procedures for processing obstacles have been setup to meet the integrity requirements for such values.

7 Data capture

General scope	
Data capture statement	Obstacle data is collected as part of the authorization requirement under VIL Article 63 and the registration requirement under VIL Article 65a. The DCS Provider collects the obstacle data from Originators and once approved forwards it to skyguide for publication, in compliance with the applicable articles of regulation EU 2017/373.

8 Maintenance

General scope	
Maintenance and update frequency	The aeronautical database of skyguide is continuously updated with obstacle data changes received from the DCS Provider. The updated aeronautical database of skyguide is the single source of truth used for the creation of the Swiss Obstacle Data Set. An updated Swiss Obstacle Data Set is created daily after midnight (00:00UTC) from the data stored in the aeronautical database of skyguide and distributed to the Federal Geoportal. Further updates may be created and distributed to the Federal Geoportal during the day, if it is deemed necessary to correct reported or otherwise discovered errors. The updated Swiss Obstacle Data Set includes data of obstacles valid at 00:00UTC of its day of creation. The included data remains valid until 24:00UTC of its day of creation. Real-world changes made on obstacles during the stated period of validity of the dataset are announced by **NOTAM**, if necessary.

9 Portrayal

KML scope	
Portrayal catalogue	See the portrayal catalogue in "Appendix C: KML portrayal catalogue".

10 Data product delivery

AIXM scope	
Format name	AIXM
Format version	5.1
Format specification	Specification of the standard: AIXM 5.1 standard Specification of the transfer format: AIXM 5.1 XSD
File structure	**luftfahrthindernis_4326.aixm.zip** ZIP file with the following content: ▪ **Swiss_Obstacle_<YYYY-MM-DD_hhmmss>.aixm.xml** AIXM XML file containing the obstacle data, valid against the AIXM 5.1 XSD. ▪ **Swiss_Obstacle_<YYYY-MM-DD_hhmmss>.aixm.xml.sha512** Text file containing an SHA-512 checksum of the "Swiss_Obstacle_<YYYY-MM-DD_hhmmss>.aixm.xml" file. "<YYYY-MM-DD-hhmmss>" is the UTC date and time of the start of the production of a Swiss Obstacle Data Set.
Language	eng
Character set	UTF-8
Units of delivery	dataset
Transfer size	8 MB
Medium name	File download from the Federal Geoportal

KML scope	
Format name	KML/KMZ
Format version	2.2
Format specification	Specification of the standard: OGC KML 2.2 standard Specification of the transfer format: OGC KML 2.2 XSD
File structure	**luftfahrthindernis_4326.kmz** KMZ file with the following content: ▪ **Swiss_Obstacle_<YYYY-MM-DD_hhmmss>.kml** KML XML file containing the obstacle data, valid against the OGC KML 2.2 XSD. ▪ **Swiss_Obstacle_<YYYY-MM-DD_hhmmss>.kml.sha512** Text file containing an SHA-512 checksum of the "Swiss_Obstacle_<YYYY-MM-DD_hhmmss>.kml" file. ▪ **signature** Folder containing the .png icon files used with KML style definitions. "<YYYY-MM-DD-hhmmss>" is the UTC date and time of the start of the production of a Swiss Obstacle Data Set.
Language	eng
Character set	UTF-8
Units of delivery	dataset
Transfer size	2 MB
Medium name	File download from the Federal Geoportal

11 Metadata

General scope	
Specification	ISO 19115-1, Geographic information – Metadata. Date: 2014
Metadata elements	The dataset includes the minimum metadata described in ICAO Doc 10066 Chapter 5.3.2: ▪ Information about the organisation or entity providing the dataset. ▪ Date and time when the dataset was provided (publication date). ▪ Period of validity of the dataset data. ▪ Restrictions about the use of the dataset.
AIXM scope	
Encoding	The metadata is included on dataset level, using an ISO 19139 based encoding.
KML scope	
Encoding	The metadata is included on dataset level, encoded with a user-defined KML Schema.

12 Appendix A: AIXM content and structure

12.1 Application schema

This section describes the structure of the data as a model of features and objects with relations. It leverages a part of the AIXM 5.1 Obstacle model, including the AIXM VerticalStructure feature and related data types defined by AIXM.

The dataset is represented by an **AIXMBasicMessage** feature which includes for each obstacle a **VerticalStructure** feature. The AIXMBasicMessage has associated **DatasetMetadata**. The VerticalStructure feature is built from **VerticalStructureParts**. Each VerticalStructurePart contributes a piece to the shape of an obstacle. The shape of the part piece is described by an **ElevatedGeometry**.

The obstacle data collected by the DCS Provider covers only a subset of the properties modelled with the VerticalStructure feature. Properties not covered by DCS are omitted in the application schema and consequently also in the transfer file. Clients can assume an "unknown" NIL reason for such properties.

12.2 Feature catalogue

This section provides the feature catalogue in support to the application schema. It describes the semantics of the obstacle data.

Properties of AIXM features and objects can have a NIL reason. The following NIL reasons may appear with a property:

- unknown The property has not been collected and its value is therefore not known.
- inapplicable The property has not been collected because it does not apply to the specific instance of a feature or object.

The feature catalogue includes information about the mapping of the application schema elements to the XML elements of the AIXM 5.1 transfer format (specified by the AIXM 5.1 XSD). XML elements are prefixed with an abbreviated namespace name, using the following abbreviations:

- aixm-msg http://www.aixm.aero/schema/5.1/message
- aixm http://www.aixm.aero/schema/5.1
- gml http://www.opengis.net/gml/3.2
- gmd http://www.isotc211.org/2005/gmd
- gco http://www.isotc211.org/2005/gco

Although the GML profile for aviation data is generally applicable, only a subset of the GML geometry elements of the profile is used with the dataset. The used elements are identified in the following tables by the "Mapping to XML" information.

<<feature>> AIXMBasicMessage		
Description	The AIXMBasicMessage feature represents the Swiss Obstacle Data Set in AIXM format.	
Mapping to XML	AIXMBasicMessage => `aixm-msg:AIXMBasicMessage`	
Property name	**Description**	**Mapping to XML**

datasetMetadata	Metadata for the dataset.	`aixm-msg:AIXMBasicMessage`
		`  aixm:messageMetadata`
		`  gmd:MD_Metadata`

verticalStructure	1 or more AIXM VerticalStructure features, each representing an obstacle that is part of the dataset.	`aixm-msg:AIXMBasicMessage`
		`  aixm-msg:hasMember`
		`  aixm:VerticalStructure`

<<object>> DatasetMetadata		
Description	Metadata of the AIXM Swiss Obstacle Data Set.	

Mapping to XML	DatasetMetadata => `aixm-msg:AIXMBasicMessage`
	`aixm:messageMetadata`
	`gmd:MD_Metadata`	

Property name	**Description**	**Mapping to XML**

ownerName	Name of the organisation owning the dataset.
	Set to the value indicated with the first line of the "Overview / Contact".
		`gmd:MD_Metadata`
		`gmd:contact`
		`gmd:CI_ResponsibleParty`
		`gmd:organisationName`
		`gco:CharacterString`
		with `gmd:CI_ResponsibleParty`
		`gmd:role`
		`gmd:CI_RoleCode="owner"`

providerName	Name of the organisation or entity providing the dataset.
	Set to the value indicated with the second line of the "Overview / Contact".
		`gmd:MD_Metadata`
		`gmd:identificationInfo`
		`gmd:MD_DataIdentification`
		`gmd:pointOfContact`
		`gmd:CI_ResponsibleParty`
		`gmd:organisationName`
		`gco:CharacterString`
		with `gmd:CI_ResponsibleParty`
		`gmd:role`
		`gmd:CI_RoleCode="publisher"`

providerEmailAddress	Email address of the organisation or entity providing the dataset. This denotes the email address that can be used by users to contact the provider for information and feedback about the dataset.
	Set to the value indicated with the "Overview / Contact".
		`gmd:MD_Metadata`
		`gmd:identificationInfo`
		`gmd:MD_DataIdentification`
		`gmd:pointOfContact`
		`gmd:CI_ResponsiblePart`
		`gmd:contactInfo`
		`gmd:CI_Contact`
		`gmd:address`
		`gmd:CI_Address`
		`gmd:electronicMailAddress`
		`gco:CharacterString`

datasetName	Name of the obstacle dataset.
	Set to the value indicated with the DPS "Overview / Name".
		`gmd:MD_Metadata`
		`gmd:identificationInfo`
		`gmd:MD_DataIdentification`
		`gmd:citation`
		`gmd:CI_Citation`
		`gmd:title`
		`..` `gco:CharacterString`

datasetAbstract	A short description of the obstacle dataset.
	Set to the value indicated with the "Data product identification / Title".
		`gmd:MD_Metadata`
		`gmd:identificationInfo`
		`gmd:MD_DataIdentification`
		`gmd:abstract`
		`gco:CharacterString`

datasetPublishedAt	Date and time in UTC of dataset publication.
	The value is represented as an ISO 8601 UTC date/time string in the form "YYYY-MM-DDThh:mm:ssZ". This is the same date/time as also used in the AIXM file name indicated with the "Data product delivery / File structure".
		`gmd:MD_Metadata`
		`gmd:identificationInfo`
		`gmd:MD_DataIdentification`
		`gmd:citation`
		`gmd:CI_Citation`
		`gmd:date`
		`gmd:CI_Date`
		`gmd:date`
		`gco:DateTime`
		with `gmd:CI_Citation`
		`gmd:date`
		`gmd:CI_Date`
		`gmd:dateType`
		`gmd:CI_DateTypeCode=`
		`"publication"`

datasetValidityPeriod	Date and time in UTC of the begin and end of the period for which the obstacle data contained in the dataset is valid.
	The begin and end values are each represented as an ISO 8601 UTC date/time string in the form "YYYY-MM-DDThh:mm:ssZ".
		`gmd:MD_Metadata`
		`gmd:identificationInfo`
		`gmd:MD_DataIdentification`
		`gmd:extent`
		`gmd:EX_Extent`
		`gmd:temporalElement`
		`gmd:EX_TemporalExtent`
		`gmd:extent`
		`gml:TimePeriod`
		with `gmd:EX_Extent`
		`gmd:description`
		`gco:CharacterString=`
		`"period of validity of`
		`the data"`

<<object>> DatasetMetadata		

datasetUsageRestriction	Restrictions on the use of the dataset.
	Set to the value indicated with the AIXM scope of the "Data product identification / Restrictions".
		`gmd:MD_Metadata`
		`gmd:identificationInfo`
		`gmd:MD_DataIdentification`
		`gmd:resourceConstraints`
		`gmd:MD_Constraints`
		`gmd:useLimitation`
		`gco:CharacterString`

<<feature>> VerticalStructure		
Description	The VerticalStructure feature represents an obstacle. The feature is based on a temporal model of timeslices, explained in the AIXM Temporality Concept. Only the BASELINE timeslice active during the period of validity of the dataset is included. List of excluded AIXM core model VerticalStructure feature properties: hostedNavaidEquipment, hostedOrganisation, hostedPassengerService, hostedUnit, hostedSpecialNavStation, length, lightingAvailability, lightingICAOStandard, marker, markingICAOStandard, supportedGroundLight, supportedService, synchronisedLighting, width	

Mapping to XML	VerticalStructure => `aixm-msg:AIXMBasicMessage`
	`aixm-msg:hasMember`
	`aixm:VerticalStructure`	

Property name	**Description**	**Mapping to XML**

identifier	Globally unique, immutable identifier of the obstacle. The identifier is re-used across skyguide data products that refer to the same obstacle.
	See AIXM CodeUUIDType for general information about the data type.
		`aixm:VerticalStructure`
		`gml:identifier`
		with `aixm:VerticalStructure`
		`gml:identifier`
		`codeSpace="urn:uuid:"`

interpretation	Interpretation of the timeslice.
	Fixed to "BASELINE".
	See AIXM Temporality Concept for general information about interpretation.
		`aixm:VerticalStructure`
		`aixm:timeSlice`
		`aixm:VerticalStructureTimeSlice`
		`gml:interpretation`

sequenceNumber	Sequence number of the timeslice.
	A positive integer.
	See AIXM Temporality Concept for general information about sequenceNumber.
		`aixm:VerticalStructure`
		`aixm:timeSlice`
		`aixm:VerticalStructureTimeSlice`
		`aixm:sequenceNumber`

correctionNumber	Correction number of the timeslice.
	An integer equal to or greater than zero.
	See AIXM Temporality Concept for general information about correctionNumber.
		`aixm:VerticalStructure`
		`aixm:timeSlice`
		`aixm:VerticalStructureTimeSlice`
		`aixm:correctionNumber`

validTime	The period within which the obstacle's data is valid.
	The begin of the period is a UTC date/time value that is at or before the begin of the MessageMetadata.datasetValidityPeriod.
	The end of the period is not determined, implying that the obstacle's data is at least valid until the end of the MessageMetadata.datasetValidityPeriod, or until further notice by NOTAM.
	See AIXM Temporality Concept for general information about validTime.
		`aixm:VerticalStructure`
		`aixm:timeSlice`
		`aixm:VerticalStructureTimeSlice`
		`gml:validTime`
		`gml:TimePeriod`

<<feature>> VerticalStructure		

featureLifetime	The period from the obstacle commissioning to its decommissioning.
	The commissioning is a UTC date/time value that is at or before the begin of the VerticalStructure.validTime period.
	The decommissioning date/time is not set, implying that the obstacle exists at least until the end of the MessageMetadata.dataValidityPeriod, or until further notice by NOTAM.
	See AIXM Temporality Concept for general information about featureLifetime.
		`aixm:VerticalStructure`
		`  aixm:timeSlice`
		`  aixm:VerticalStructureTimeSlice`
		`  aixm:featureLifetime`
		`  gml:TimePeriod`

name	Name of the obstacle, if applicable.
	See AIXM TextNameType for general information about the data type.
		`aixm:VerticalStructure`
		`  aixm:timeSlice`
		`  aixm:VerticalStructureTimeSlice`
		`  aixm:name`

type	A code indicating the type of the obstacle. The following codes are in use:
	▪ BRIDGE bridge
	▪ BUILDING building
	▪ CABLE_CAR cable car
	▪ CATENARY wire
	▪ CRANE crane
	▪ POLE pole
	▪ STACK smoke, industrial
	▪ TRANSMISSION_LINE power line
	▪ VEGETATION tree, bush
	▪ WINDMILL windmill
	See the AIXM CodeVerticalStructureType for further information about the used codes.
		`aixm:VerticalStructure`
		`  aixm:timeSlice`
		`  aixm:VerticalStructureTimeSlice`
		`  aixm:type`

group	A flag indicating whether the obstacle consists of several closely situated similar objects.
	See AIXM CodeYesNoType for general information about the data type.
		`aixm:VerticalStructure`
		`  aixm:timeSlice`
		`  aixm:VerticalStructureTimeSlice`
		`  aixm:group`

radius	The overall radius of an obstacle that has a relatively circular shape.
	See AIXM ValDistanceType for general information about the data type.
		`aixm:VerticalStructure`
		`  aixm:timeSlice`
		`  aixm:VerticalStructureTimeSlice`
		`  aixm:radius`

lighted	A flag indicating whether the obstacle is lighted.
	See AIXM CodeYesNoType for general information about the data type.
		`aixm:VerticalStructure`
		`  aixm:timeSlice`
		`  aixm:VerticalStructureTimeSlice`
		`  aixm:lighted`

annotation_marked	A flag indicating whether the obstacle is marked.
	The information is provided as a VerticalStructure feature annotation with the note text set to:
	▪ YES the obstacle is marked
	▪ NO the obstacle is not marked
	See AIXM TextNoteType for general information about the data type.
		`aixm:VerticalStructure`
		`  aixm:timeSlice`
		`  aixm:annotation`
		`  aixm:Note`
		`  aixm:translatedNote`
		`  aixm:LinguisticNote`
		`  aixm:note`
		with `aixm:Note`
		`  aixm:purpose=`
		`  "OTHER:SG_MARKED"`
		and `aixm:LinguisticNote`
		`  aixm:note`
		`  lang="en"`

<<feature>> VerticalStructure		
annotation_estEndDate	UTC date and time of the estimated end of an obstacle. ⚠ The estimated end date is a hint and does not imply that the obstacle will be deactivated or decommissioned at the indicated date/time. The ISO 8601 "YYYY-MM-DDThh:mm:ssZ" formatted string is provided as a VerticalStructure feature annotation. See AIXM TextNoteType for general information about the data type.	aixm:VerticalStructure aixm:timeSlice aixm:annotation aixm:Note aixm:translatedNote aixm:LinguisticNote aixm:note *with* aixm:Note aixm:purpose= "OTHER:SG_ESTENDDATE" *and* aixm:LinguisticNote aixm:note lang="en"
annotation_publication	A flag indicating whether the obstacle must be shown on the Visual Approach Chart (VAC) or in the AD-INFO section (aerodrome chart) of the VFR Manual. ⚠ This property is a hint for charting applications and does not imply a guarantee that the concerned obstacle is shown on a chart. The information is provided as a VerticalStructure feature annotation with the note text set to: ▪ YES the obstacle must be shown on a chart See AIXM TextNoteType for general information about the data type.	aixm:VerticalStructure aixm:timeSlice aixm:annotation aixm:Note aixm:translatedNote aixm:LinguisticNote aixm:note *with* aixm:Note aixm:purpose= "OTHER:SG_PUBLICATION" *and* aixm:LinguisticNote aixm:note lang="en"
part	The parts of the obstacle. The rules for the parts that constitute an obstacle are: An inactive obstacle has zero parts. See "15.1.6 Representation of an inactive obstacle" for further explanations. An active obstacle with a point shape has 1 part with an ElevatedPointGeometry An active obstacle with a linear shape has N (N>=1) parts with an ElevatedCurveGeometry and N+1 parts with an ElevatedPointGeometry An active obstacle with a polygon shape has 1 part with an ElevatedSurfaceGeometry	aixm:VerticalStructure aixm:timeSlice aixm:VerticalStructureTimeSlice aixm:part aixm:VerticalStructurePart

<<object>> VerticalStructurePart		
Description	A part of an obstacle with a shape that is represented as either an ElevatedPointGeometry, ElevatedCurveGeometry, or ElevatedSurfaceGeometry, and a vertical extent. List of excluded AIXM core model VerticalStructurePart object properties: constructionStatus, designator, frangible, type, verticalExtentAccuracy, visibleMaterial	
Mapping to XML	VerticalStructurePart => aixm-msg:AIXMBasicMessage aixm-msg:hasMember aixm:VerticalStructure aixm:part aixm:VerticalStructurePart	
Property name	**Description**	**Mapping to XML**

<<object>> VerticalStructurePart		
verticalExtent	The vertical extent of the obstacle part, measured downward from the ElevatedGeometry set with the VerticalStructurePart.horizontalProjection property. Interpretation of the vertical extent: ▪ If the obstacle part has an ElevatedPointGeometry, then the VerticalStructurePart.verticalExtent property indicates the AGL height of the obstacle part structure's top. ▪ If the obstacle part has an ElevatedCurveGeometry or ElevatedSurfaceGeometry, then the VerticalStructurePart.verticalExtent property is NIL and further vertical extent information may exist with the VerticalStructurePart.verticalExtent_remark property. See "15.1.5 VerticalStructurePart vertical extent" for further explanations. See AIXM ValDistanceType for general information about the data type.	`aixm:VerticalStructurePart` `  aixm:verticalExtent`

verticalExtent_remark	This property is included with line parts of linear shape obstacles or parts of polygon shape obstacles only.
	The maximum vertical extent of the obstacle part. The value indicates the maximum erection of the structure from a position on the terrain (within the lateral extent of the part) to the top elevation of the structure at this position.
	Interpretation of the vertical extent remark:
	▪ If the obstacle part has an ElevatedPointGeometry, then no remark exists but the VerticalStructurePart.verticalExtent indicates the vertical extent of the obstacle part.
	▪ If the obstacle part has an ElevatedCurveGeometry or an ElevatedSurfaceGeometry, then the maximum vertical extent is provided as a VerticalStructurePart object annotation with the note text set to either one of the following values:
	  ▪ "Maximum height above ground level is <value> <unit>"
	  ▪ "Maximum height above ground level is unknown"
	<value> is a decimal number indicating the maximum extent and <uom> is an AIXM UomDistanceType. See "15.1.5 VerticalStructurePart vertical extent" for further explanations.
	See AIXM TextNoteType for general information about the data type.
		`aixm:VerticalStructurePart`
		`  aixm:annotation`
		`  aixm:Note`
		`  aixm:translatedNote`
		`  aixm:LinguisticNote`
		`  aixm:note`
		with `aixm:Note`
		`  aixm:purpose="REMARK"`
		and `aixm:LinguisticNote`
		`  aixm:note`
		`  lang="en"`
		and `aixm:LinguisticNote`
		`  aixm:note=`
		`  text-starts-with(`
		`  "Maximum height`
		`  above ground`
		`  level is")`

markingPattern	The general layout of the external paint of the obstacle part or another marking element, intended to increase the visibility of the obstacle. The following codes are in use: ▪ MARKERS markers attached to the obstacle structure ▪ OTHER:BANDS marking painted as horizontal or vertical bands ▪ OTHER:MARKED a not further specified marking See "15.1.3 VerticalStructurePart marking" for further explanations. See AIXM CodeVerticalStructureMarkingType for general information about the data type.	`aixm:VerticalStructurePart` `  aixm:markingPattern`
markingFirstColour	The principal colour of the obstacle part marking. The following codes are in use: ▪ RED ▪ ORANGE See "15.1.3 VerticalStructurePart marking" for further explanations. See AIXM CodeColourType for general information about the data type.	`aixm:VerticalStructurePart` `  aixm:markingFirstColour`

<<object>> VerticalStructurePart		
markingSecondColour	The secondary colour of the obstacle part marking. The following codes are in use: ▪ WHITE See "15.1.3 VerticalStructurePart marking" for further explanations. See AIXM CodeColourType for general information about the data type.	aixm:VerticalStructurePart aixm:markingSecondColour
mobile	A flag indicating whether the obstacle part is expected to move around its nominal location. See AIXM CodeYesNoType for general information about the data type.	aixm:VerticalStructurePart aixm:mobile
lighting	An element of the obstacle part lighting. See AIXM LightElement for general information about the data type.	aixm:VerticalStructurePart aixm:lighting aixm:LightElement
annotation_airport	This property is included with all obstacle parts except the line parts of linear shape obstacles. The location indicators of the aerodromes where the obstacle part is fully or partially in the vicinity of the aerodrome. The information is provided as a VerticalStructure object annotation with the note text set to a comma delimited list of the aerodrome location indicators. See "15.1.2 VerticalStructurePart "annotation_airport" property" for further explanations. See AIXM TextNoteType for general information about the data type.	aixm:VerticalStructurePart aixm:annotation aixm:Note aixm:translatedNote aixm:LinguisticNote aixm:note *with* aixm:Note aixm:purpose= "OTHER:SG_ADOLS" *and* aixm:LinguisticNote aixm:note lang="en"
annotation_inBuiltupArea	This property is included with all obstacle parts except the line parts of linear shape obstacles. Indicates whether the obstacle part is fully or partially within a built-up area. The information is provided as a VerticalStructure object annotation with the note text set to: ▪ YES the obstacle part is fully or partially within a built-up area ▪ NO the obstacle part is entirely outside built-up areas See AIXM TextNoteType for general information about the data type.	aixm:VerticalStructurePart aixm:annotation aixm:Note aixm:translatedNote aixm:LinguisticNote aixm:note *with* aixm:Note aixm:purpose= "OTHER:SG_INBUAREA" *and* aixm:LinguisticNote aixm:note lang="en"
annotation_partIdx	This property is included with line and point parts of linear shape obstacles only. An index for the obstacle part. The index is usable for the linear sorting of the point parts (those with an ElevatedPointGeometry) and line parts (those with an ElevatedCurveGeometry), so that the sorted parts are in a spatially sorted order. The index value is an integer number starting at 1 with the first part and incremented with each successive part. A separate index is used for the point parts and line parts of an obstacle. See "15.1.1 VerticalStructurePart "annotation_partIdx" property" for further explanations. The index is provided as a VerticalStructure object annotation with the note text representing the numeric value of the index. See AIXM TextNoteType for general information about the data type.	aixm:VerticalStructurePart aixm:annotation aixm:Note aixm:translatedNote aixm:LinguisticNote aixm:note *with* aixm:Note aixm:purpose= "OTHER:SG_PARTIDX" *and* aixm:LinguisticNote aixm:note lang="en"

<<object>> VerticalStructurePart		
horizontalProjection	The horizontal projection of the obstacle part shape and additionally information about the vertical extent of the shape. The horizontal projection is either a a) ElevatedPointGeometry representing an AIXM ElevatedPoint b) ElevatedCurveGeometry representing an AIXM ElevatedCurve c) ElevatedSurfaceGeometry representing an AIXM ElevatedSurface	a) `aixm:VerticalStructurePart aixm:horizontalProjection_ location aixm:ElevatedPoint` b) `aixm:VerticalStructurePart aixm:horizontalProjection_ linearExtent aixm:ElevatedCurve` c) `aixm:VerticalStructurePart aixm:horizontalProjection_ surfaceExtent aixm:ElevatedSurface`

<<object>> *ElevatedGeometry*		
Description	An abstract definition of a lateral geometry with an elevation, defining the top of an obstacle part. The description of the ElevatedGeometry properties is generic. There exist concrete ElevatedPointGeometry, ElevatedCurveGeometry, and ElevatedSurfaceGeometry sub-types of this abstract type. The concrete sub-types may include a more specific, sub-type dependent description.	
Mapping to XML	The mapping to an `<elevated-geometry>` XML element depends on the concrete sub-type of ElevatedGeometry. Ref. to the sub-type specific mapping to XML for more information.	
Property name	**Description**	**Mapping to XML**
geometry	The lateral (2D) geometry of the obstacle part, relative to the WGS84 horizontal reference system.	Ref. to the sub-type specific mapping to XML description.
horizontalAccuracy	The difference between a distinct lateral position of the lateral geometry and its true position expressed as a circular error at 90% probability (ref. ICAO Doc 10066, Appendix 1 Note (7)). See AIXM ValDistanceType for general information about the data type.	`<elevated-geometry> aixm:horizontalAccuracy`
elevation	The elevation of the lateral geometry, indicated as an AMSL elevation relative to the LN02 vertical reference system. See AIXM ValDistanceType for general information about the data type.	`<elevated-geometry> aixm:elevation`
verticalAccuracy	The difference between the value of the ElevatedGeometry.elevation property and its true value expressed as a linear error at 90% probability (ref. ICAO Doc 10066, Appendix 1 Note (7)). See AIXM ValDistanceType for general information about the data type.	`<elevated-geometry> aixm:verticalAccuracy`
geoidUndulation	The distance of the height reference surface (set by the ElevatedGeometry.verticalDatum property) above or below the mathematical reference ellipsoid at the location of the geometry. See AIXM ValDistanceSignedType for general information about the data type.	`<elevated-geometry> aixm:geoidUndulation`
verticalDatum	A reference (by name) to a geodetic datum with a definition of a height reference surface for AMSL heights. The geodetic datum may define the height reference surface as a geoid (as it is the case with the EGM96 vertical reference system) or as a set of reference points (as it is the case with LN02 vertical reference system). The following codes are in use: ▪ OTHER:LN02 See AIXM CodeVerticalDatumType for general information about the data type.	`<elevated-geometry> aixm:verticalDatum`

<<object>> ElevatedPointGeometry		
Description	A point defined by longitude/latitude coordinates and the elevation of the top of the obstacle part. Only type specific properties are described. For the other properties, ref. to the generic property description of ElevatedGeometry.	

Mapping to XML	ElevatedPointGeometry => `aixm-msg:AIXMBasicMessage`
	`aixm-msg:hasMember`
	`aixm:VerticalStructure`
	`aixm:part`
	`aixm:VerticalStructurePart`
	`aixm:horizontalProjection_location`
	`aixm:ElevatedPoint`	

Property name	**Description**	**Mapping to XML**

geometry	The lateral point geometry of the obstacle part as a pair of longitude/latitude coordinates.	`aixm:ElevatedPoint`
		`gml:pos`
		
		with `aixm:ElevatedPoint`
		`srsName=`
		`"urn:ogc:def:crs:OGC:1.3:CRS84"`

<<object>> ElevatedCurveGeometry		
Description	A geodesic curve defined by 2 pairs of longitude/latitude coordinates. The elevation is not set because the geometry is used with a part of a linear shape obstacle where the AMSL elevation may vary along the structure, which cannot be expressed by AIXM in the necessary detail. Only type specific properties are described. For the other properties, ref. to the generic property description of ElevatedGeometry.	

Mapping to XML	ElevatedCurveGeometry => `aixm-msg:AIXMBasicMessage`
	`aixm-msg:hasMember`
	`aixm:VerticalStructure`
	`aixm:part`
	`aixm:VerticalStructurePart`
	`aixm:horizontalProjection_linearExtent`
	`aixm:ElevatedCurve`	

Property name	**Description**	**Mapping to XML**

geometry	The lateral line geometry of the obstacle part as 2 vertices with longitude/latitude coordinates interpolated by a geodesic curve.
	See "15.1.4 VerticalStructurePart GML geometry" for further explanations.
		`aixm:ElevatedCurve`
		`gml:segments`
		`gml:GeodesicString`
		`gml:posList`
		
		with `aixm:ElevatedCurve`
		`srsName=`
		`"urn:ogc:def:crs:OGC:1.3:CRS84"`

elevation	The elevation is always NIL.	`aixm:ElevatedCurve`
		`aixm:elevation`
		`nilReason=<nil-reason>`

<<object>> ElevatedSurfaceGeometry		
Description	A polygon defined by a series of vertices with longitude/latitude coordinates and the elevation of the top of the obstacle part. The segment between 2 successive vertices is a geodesic curve. Only type specific properties are described. For the other properties, ref. to the generic property description of ElevatedGeometry.	

Mapping to XML	ElevatedSurfaceGeometry => `aixm-msg:AIXMBasicMessage`
	`aixm-msg:hasMember`
	`aixm:VerticalStructure`
	`aixm:part`
	`aixm:VerticalStructurePart`
	`aixm:horizontalProjection_surfaceExtent`
	`aixm:ElevatedSurface`	

Property name	**Description**	**Mapping to XML**

<<object>> ElevatedSurfaceGeometry		

geometry	The lateral polygon geometry of the obstacle part as a series of vertices with longitude/latitude coordinates interpolated by a geodesic curve.
	See "15.1.4 VerticalStructurePart GML geometry" for further explanations.
		`aixm:ElevatedSurface`
		`  gml:patches`
		`  gml:PolygonPatch`
		`  gml:exterior`
		`  gml:Ring`
		`  gml:curveMember`
		`  gml:Curve`
		`  gml:segments`
		`  gml:GeodesicString`
		`  gml:posList`
		
		with `aixm:ElevatedSurface`
		`  srsName=`
		`  "urn:ogc:def:crs:OGC:1.3:CRS84"`

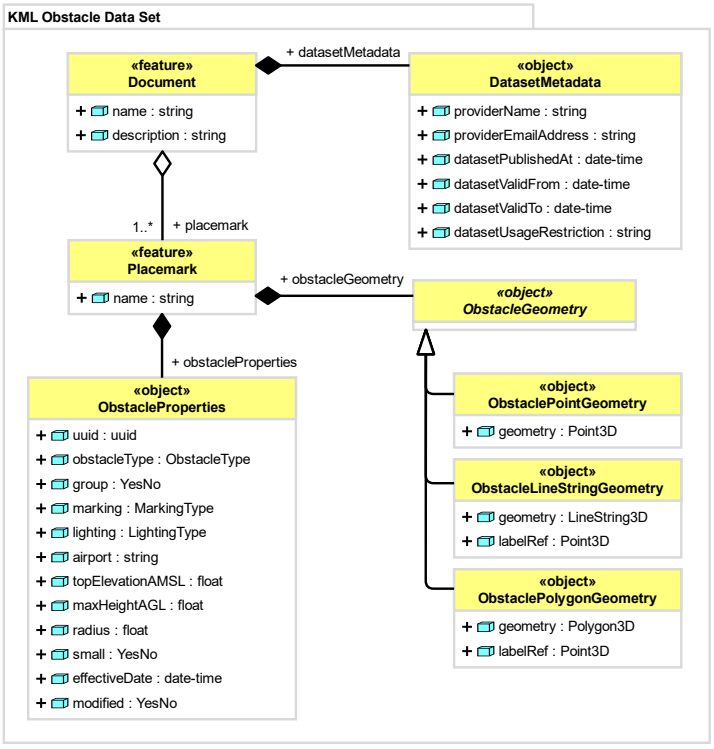
13 Appendix B: KML content and structure

13.1 Application schema

This section describes the structure of the data as a model of features and objects with relations. It leverages the OGC KML 2.2 standard.

The dataset in KML format is represented by a **Document** feature which includes for each obstacle a **Placemark** feature. The Document has associated **DatasetMetadata**. A Placemark feature includes **ObstacleProperties** with thematic information about an obstacle and an **ObstacleGeometry** that describes the shape of the obstacle.

The application schema uses data types not defined by the KML standard. These data types are used in the application schema for expressiveness reasons only. When represented in a KML XML document, the KML "string" data type will be used for those data types. The feature catalogue includes the information about the mapping/formatting to the KML "string" data type.



13.2 Feature catalogue

This section provides the feature catalogue in support to the application schema. It describes the semantics of the data.

The feature catalogue includes information about the mapping of the application schema elements to the XML elements of the KML 2.2 transfer format (specified by the OGC KML 2.2 XSD). XML elements are prefixed with an abbreviated namespace name, using the following abbreviation:

- kml http://www.opengis.net/kml/2.2

<<feature>> Document		
Description	The Document feature represents the Swiss Obstacle Data Set in KML format.	
Mapping to XML	Document => `kml:kml` `kml:Document`	
Property name	**Description**	**Mapping to XML**
name	Name of the obstacle dataset. Set to the value indicated with the "Overview / Name".	`kml:Document` `kml:name`
description	Description of the obstacle dataset. Set to the value indicated with the "Data product identification / Title".	`kml:Document` `kml:description`

<<feature>> Document		
datasetMetadata	Metadata for the dataset.	kml:Document kml:ExtendedData kml:SchemaData *with* kml:SchemaData schemaUrl="#datasetMetadataId"
placemark	1 or more Placemark features, each representing an obstacle that is part of the dataset.	kml:Document kml:Placemark

<<object>> DatasetMetadata		
Description	Metadata of the KML Swiss Obstacle Data Set.	

Mapping to XML	User-defined schema:
	The KML representation of the DatasetMetadata schema is defined by a KML Schema element. A KML SimpleField child element of the KML Schema exists for each DatasetMetadata property:
	`kml:kml`
	`kml:Document`
	`kml:Schema(name="Dataset",id="datasetMetadataId")`
	`kml:SimpleField(type="string",name="providerName")`
	`kml:displayName="Provider Name"`
	`kml:SimpleField(type="string",name="providerEmailAddress")`
	`kml:displayName="Provider Email Address"`
	`kml:SimpleField(type="string",name="datasetPublishedAt")`
	`kml:displayName="Publication Date [UTC]"`
	`kml:SimpleField(type="string",name="datasetValidFrom")`
	`kml:displayName="Dataset Valid From [UTC]"`
	`kml:SimpleField(type="string",name="datasetValidTo")`
	`kml:displayName="Dataset Valid To [UTC]"`
	`kml:SimpleField(type="string",name="datasetUsageRestriction")`
	`kml:displayName="Dataset Usage Restriction"`
	Data:
	DatasetMetadata => `kml:kml`
	`kml:Document`
	`kml:ExtendedData`
	`kml:SchemaData`
	with `kml:ExtendedData`
	`kml:SchemaData`
	`schemaUrl="#datasetMetadataId"`	

Property name	**Description**	**Mapping to XML**
providerName	Name of the organisation or entity providing the dataset. Set to the value indicated in the second line of the "Overview / Contact".	kml:SchemaData kml:SimpleData *with* kml:SimpleData name="providerName"
providerEmailAddress	Email address of the organisation or entity providing the dataset. This denotes the email address that can be used by users to contact the provider for information and feedback about the dataset. Set to the value indicated with the "Overview / Contact".	kml:SchemaData kml:SimpleData *with* kml:SimpleData name= "providerEmailAddress"
datasetPublishedAt	Date and time in UTC of dataset publication. The datasetPublishedAt value is represented as an ISO 8601 UTC date/time string in the form "YYYY-MM-DD hh:mm:ss". This is the same date/time as also used in the KML file name indicated with the "Data product delivery / File structure".	kml:SchemaData kml:SimpleData *with* kml:SimpleData name= "datasetPublishedAt"
datasetValidFrom	Date and time in UTC for which the obstacle data contained in the dataset is valid. The dataValidFrom value is represented as an ISO 8601 UTC date/time string in the form "YYYY-MM-DD hh:mm:ss".	kml:SchemaData kml:SimpleData *with* kml:SimpleData name= "datasetValidFrom"
datasetValidTo	Date and time in UTC until which the obstacle data contained in the dataset remains valid. The dataValidTo value is represented as an ISO 8601 UTC date/time string in the form "YYYY-MM-DD hh:mm:ss".	kml:SchemaData kml:SimpleData *with* kml:SimpleData name= "dadasetValidTo"

<<object>> DatasetMetadata		

datasetUsageRestriction	Restrictions on the use of the dataset.
	Set to the value indicated in the KML scope of the "Data product identification / Restrictions".
		`kml:SchemaData`
		`  kml:SimpleData`
		with `kml:SimpleData`
		`  name=`
		`  "datasetUsageRestriction"`

<<feature>> Placemark		
Description	The Placemark feature represents an obstacle.	

Mapping to XML	Placemark => `kml:kml`
	`  kml:Document`
	`  kml:Placemark`	

Property name	**Description**	**Mapping to XML**
name	Name of the obstacle. Name information may be empty.	`kml:Placemark` `  kml:name`

obstacleProperties	Properties of the obstacle.	`kml:Placemark`
		`  kml:ExtendedData`
		`  kml:SchemaData`
		with `kml:SchemaData`
		`  schemaUrl="# obstaclePropertiesId"`

obstacleGeometry	A 3D geometry describing the shape of the obstacle.
	The geometry is either a
	a) ObstaclePointGeometry
	b) ObstacleLineStringGeometry
	c) ObstaclePolygonGeometry
		a) `kml:Placemark`
		`  kml:Point`
		b) `kml:Placemark`
		`  kml:MultiGeometry`
		c) `kml:Placemark`
		`  kml:MultiGeometry`

<table>
<tr><th colspan="3"><<object>>
ObstacleProperties</th></tr>
<tr><td>Description</td><td colspan="2">Thematic properties of an obstacle.</td></tr>
<tr><td>Mapping to XML</td><td colspan="2">User-defined schema:
The KML representation of the ObstacleProperties schema is defined by a KML Schema element. A KML SimpleField child element of the KML Schema exists for each ObstacleProperties property:
<pre>kml:kml
  kml:Document
    kml:Schema(name="Obstacle",id="obstaclePropertiesId")
      kml:SimpleField(type="string",name="uuid")
        kml:displayName="UUID"
      kml:SimpleField(type="string",name="obstacleType")
        kml:displayName="Obstacle Type"
      kml:SimpleField(type="string",name="group")
        kml:displayName="Group"
      kml:SimpleField(type="string",name="marking")
        kml:displayName="Marking"
      kml:SimpleField(type="string",name="lighting")
        kml:displayName="Lighting"
      kml:SimpleField(type="string",name="airport")
        kml:displayName="Airport"
      kml:SimpleField(type="float",name="topElevationAMSL")
        kml:displayName="Top Elevation AMSL [m]"
      kml:SimpleField(type="float",name="maxHeightAGL")
        kml:displayName="Max Height AGL [m]"
      kml:SimpleField(type="float",name="radius")
        kml:displayName="Radius"
      kml:SimpleField(type="string",name="small")
        kml:displayName="Small"
      kml:SimpleField(type="string",name=" effectiveDate")
        kml:displayName="Effective Date"
      kml:SimpleField(type="string",name="modified")
        kml:displayName="Modified"</pre>
Data:
ObstacleProperties =>
<pre>kml:kml
  kml:Document
    kml:Placemark
      kml:ExtendedData
        kml:SchemaData
with kml:ExtendedData
        kml:SchemaData
          schemaUrl="#obstaclePropertiesId"</pre></td></tr>
<tr><th>Property name</th><th>Description</th><th>Mapping to XML</th></tr>
<tr><td>uuid</td><td>Globally unique, immutable identifier of the obstacle. The uuid is re-used across skyguide data products that refer to the same obstacle.
The uuid value is a type 4 UUID (ref. RFC 9562) represented as “xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx”.</td><td><pre>kml:SchemaData
  kml:SimpleData
with kml:SimpleData
       name="uuid"</pre></td></tr>
<tr><td>obstacleType</td><td>A code indicating the type of the obstacle:
▪ BRIDGE bridge
▪ BUILDING building
▪ CABLE_CAR cable car
▪ CATENARY wire
▪ CRANE crane
▪ POLE pole
▪ STACK smoke, industrial
▪ TRANSMISSION_LINE power line
▪ VEGETATION tree, bush
▪ WINDMILL windmill</td><td><pre>kml:SchemaData
  kml:SimpleData
with kml:SimpleData
        name="obstacleType"</pre></td></tr>
<tr><td>group</td><td>A flag indicating whether the obstacle consists of several closely situated similar objects:
▪ YES the obstacle represents several similar objects
▪ NO the obstacle is representing a single object
Group information may be empty.</td><td><pre>kml:SchemaData
  kml:SimpleData
with kml:SimpleData
        name="group"</pre></td></tr>
</table>

<<object>> ObstacleProperties		
marking	A code indicating the marking of the obstacle: ▪ NONE the obstacle is not marked ▪ MARKED the obstacle is marked ▪ RED_WHITE_RED the obstacle is marked with red-white-red band painted marks (horizontal or vertical) ▪ ORANGE_MARKS the obstacle is marked with orange marks (e.g. spheres on transmission line wires, canvas on crane, etc.) ▪ CABLE_WARNER the obstacle is marked with cable warners (e.g. on masts of transmission lines, catenary, etc.) See "15.2.1 ObstacleProperties "marking" property" for further explanations. Marking information may be empty.	kml:SchemaData kml:SimpleData *with* kml:SimpleData name="marking"
lighting	A code indicating the lighting of the obstacle: ▪ NONE the obstacle is not lighted ▪ LIGHTED the obstacle is lighted ▪ LOW the obstacle is lighted with low intensity lights ▪ MEDIUM the obstacle is lighted with medium intensity lights ▪ HIGH the obstacle is lighted with high intensity lights See "15.2.2 ObstacleProperties "lighting" property" for further explanations. Lighting information may be empty.	kml:SchemaData kml:SimpleData *with* kml:SimpleData name="lighting"
airport	A comma delimited list of location indicators of the aerodromes where the obstacle is fully or partially in the vicinity of the aerodrome. See "15.2.3 ObstacleProperties "airport" property" for further explanations. Airport information may be empty.	kml:SchemaData kml:SimpleData *with* kml:SimpleData name="airport"
topElevationAMSL	Highest elevation of the obstacle above mean sea level (AMSL). In meters relative to the LN02 vertical reference system. See "15.2.7 Vertical extent information" for further explanations. Highest elevation information may be empty.	kml:SchemaData kml:SimpleData *with* kml:SimpleData name="topElevationAMSL"
maxHeightAGL	Maximum AGL height of the obstacle, in meters. See "15.2.7 Vertical extent information" for further explanations. ⚠ Note that for obstacles with a point shape and a radius, the property value does not indicate the maximum AGL height but just the AGL height of the top at the point location. The maximum AGL height within the circular area covered by the obstacle may be larger. Maximum AGL height information may be empty.	kml:SchemaData kml:SimpleData *with* kml:SimpleData name="maxHeightAGL"
radius	Radius in meters of an obstacle that has a relatively circular shape. The decimal value is rounded to the meter. Radius information may be empty.	kml:SchemaData kml:SimpleData *with* kml:SimpleData name="radius"
small	A flag indicating for the obstacle whether it is a small obstacle in the vicinity of an aerodrome: ▪ YES the obstacle is in the vicinity of an aerodrome, and its maximum AGL height is either less than 60 m when inside a built-up area or less than 25 m when outside a built-up area ▪ NO otherwise See "15.2.4 ObstacleProperties "small" property" for further explanations.	kml:SchemaData kml:SimpleData *with* kml:SimpleData name="small"

<<object>> ObstacleProperties		

effectiveDate	Date in UTC since which the obstacle properties are in effect.
	The value is represented as an ISO 8601 UTC date string in the form "YYYY-MM-DD".
	The value is at or before the date set with the DatasetMetadata "dataValidFrom" property.
		`kml:SchemaData`
		`  kml:SimpleData`
		with `kml:SimpleData`
		`  name="effectiveDate"`

modified	A flag indicating whether the obstacle has been modified (ref. "effectiveDate" property) since the penultimate AIRAC date:
	▪ YES the obstacle has been modified since the penultimate AIRAC date
	▪ NO the obstacle has not been modified since the penultimate AIRAC date
	See "15.2.5 ObstacleProperties "modified" property" for further explanations.
		`kml:SchemaData`
		`  kml:SimpleData`
		with `kml:SimpleData`
		`  name="modified"`

<<object>> *ObstacleGeometry*	
Description	An abstract definition of a 3D geometry of an obstacle. There exist concrete ObstaclePointGeometry, ObstacleLineStringGeometry, and ObstaclePolygonGeometry sub-types of this abstract type.
Mapping to XML	Ref. to the sub-type specific mapping to XML.

<<object>> ObstaclePointGeometry		
Description	The 3D geometry of a point-obstacle, which is a single geographic position given its longitude/latitude/height coordinates.	

Mapping to XML	Placemark => `kml:kml`
	`  kml:Document`
	`  kml:Placemark`
	`  kml:Point`	

Property name	**Description**	**Mapping to XML**

geometry	The position of the obstacle, given its longitude/latitude/height coordinates.
	The height is the top elevation of the obstacle, indicated as an AMSL elevation in meters relative to the LN02 vertical reference system.
		`kml:Point`
		`  kml:coordinates`
		with `kml:Point`
		`  altitudeMode="absolute"`
		`  extrude="1"`

<<object>> ObstacleLineStringGeometry		
Description	The 3D geometry of a linear shape obstacle by a series of line vertices given their longitude/latitude/height coordinates.	

Mapping to XML	Placemark => `kml:kml`
	`  kml:Document`
	`  kml:Placemark`
	`  kml:MultiGeometry`	

Property name	**Description**	**Mapping to XML**

geometry	A line with 2 or more vertices. Each vertex is a geographical position of longitude/latitude/height coordinates. The vertex height is the top elevation of the obstacle at the vertex' longitude/latitude, indicated as an AMSL elevation in meters relative to the LN02 vertical reference system.
	The top elevation of the obstacle between 2 successive vertices is interpolated with a straight line between the top elevations of the 2 neighbour vertices.
		`kml:MultiGeometry`
		`  kml:LineString`
		`  kml:coordinates`
		with `kml:LineString`
		`  altitudeMode="absolute"`
		`  extrude="1"`
		`  tessellate="0"`

<<object>> ObstacleLineStringGeometry		

labelRef	A copy of the coordinates of the first vertex of the "geometry" property, used as a reference for the label placement in Google Earth.	`kml:Point`
		`  kml:coordinates`
		with `kml:Point`
		`  altitudeMode="absolute"`
		`  extrude="0"`

<<object>> ObstaclePolygonGeometry		
Description	The 3D geometry of a polygon shape obstacle by a series of polygon vertices given their longitude/latitude/height coordinates.	

Mapping to XML	Placemark => `kml:kml`
	`  kml:Document`
	`  kml:Placemark`
	`  kml:MultiGeometry`	

Property name	**Description**	**Mapping to XML**

geometry	A polygon with 4 or more vertices (first and last vertex coincident). Each vertex is a geographical position of longitude/latitude/height coordinates. All vertices have the same height.
	The height is the top elevation of the obstacle, indicated as an AMSL elevation in meters relative to the LN02 vertical reference system.
		`kml:MultiGeometry`
		`  kml:Polygon`
		`  kml: outerBoundaryIs`
		`  kml: LinearRing`
		`  kml:coordinates`
		with `kml:Polygon`
		`  altitudeMode="absolute"`
		`  extrude="1"`
		`  tessellate="0"`

labelRef	A point located within the polygon area, used as a reference for the label placement in Google Earth.
	The point height is a copy of the polygon height.
		`kml:Point`
		`  kml:coordinates`
		with `kml:Point`
		`  altitudeMode="absolute"`
		`  extrude="0"`

14 Appendix C: KML portrayal catalogue

14.1 Style maps

The KML Document includes style definitions which are referred to by the KML Placemarks via a style identifier. Each style has an assigned icon and geometry coloured in the icon colour.

Styles are built for groups of obstacles with a common characteristic. The characteristic is evaluated from the properties of an obstacle and conditions for their values. The following table is a priority list of styles. A Placemark gets assigned the first style where the obstacle properties meet the conditions.

Prio	Style identifier	Style description	Style icon	Obstacle properties and conditions					
				obstacle type	lighting	marking	max. height AGL	group	obstacle shape type
1	ms_high_pole_lighted	A lighted high pole		POLE, BUILDING, STACK, WINDMILL, CRANE	LIGHTED, LOW, MEDIUM, HIGH	n/a	height >= 150m	NO, empty	n/a
2	ms_high_pole_group_lighted	A group of lighted high poles		POLE, BUILDING, STACK, WINDMILL, CRANE	LIGHTED, LOW, MEDIUM, HIGH	n/a	height >= 150m	YES	n/a
3	ms_pole	A pole		POLE	NONE, empty	n/a	n/a	NO, empty	n/a
4	ms_pole_group	A group of poles		POLE	NONE, empty	n/a	n/a	YES	n/a
5	ms_pole_lighted	A lighted pole		POLE	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	NO, empty	n/a
6	ms_pole_group_lighted	A group of lighted poles		POLE	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	YES	n/a
7	ms_crane	A crane		CRANE	NONE, empty	n/a	n/a	NO, empty	n/a
8	ms_crane_group	A group of cranes		CRANE	NONE, empty	n/a	n/a	YES	n/a
9	ms_crane_lighted	A lighted crane		CRANE	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	NO, empty	n/a
10	ms_crane_group_lighted	A group of lighted cranes		CRANE	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	YES	n/a
11	ms_stack	A stack		STACK	NONE, empty	n/a	n/a	NO, empty	n/a
12	ms_stack_group	A group of stacks		STACK	NONE, empty	n/a	n/a	YES	n/a
13	ms_stack_lighted	A lighted stack		STACK	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	NO, empty	n/a
14	ms_stack_group_lighted	A group of lighted stacks		STACK	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	YES	n/a
15	ms_windmill	A windmill		WINDMILL	NONE, empty	n/a	n/a	NO, empty	n/a
16	ms_windmill_group	A group of windmills		WINDMILL	NONE, empty	n/a	n/a	YES	n/a

Prio	Style identifier	Style description	Style icon	Obstacle properties and conditions					
				obstacle type	lighting	marking	max. height AGL	group	obstacle shape type
17	ms_windmill_lighted	A lighted windmill		WINDMILL	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	NO, empty	n/a
18	ms_windmill_group_lighted	A group of lighted windmills		WINDMILL	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	YES	n/a
19	ms_building	A building		BUILDING	NONE, empty	n/a	n/a	NO, empty	n/a
20	ms_building_group	A group of buildings		BUILDING	NONE, empty	n/a	n/a	YES	n/a
21	ms_building_lighted	A lighted building		BUILDING	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	NO, empty	n/a
22	ms_building_group_lighted	A group of lighted buildings		BUILDING	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	YES	n/a
23	ms_bridge	A bridge		BRIDGE	NONE, empty	n/a	n/a	NO, empty	n/a
24	ms_bridge_lighted	A lighted bridge		BRIDGE	LIGHTED, LOW, MEDIUM, HIGH	n/a	n/a	YES	n/a
25	ms_tree	A tree		VEGETATION	n/a	n/a	n/a	NO, empty	n/a
26	ms_tree_group	A group of trees		VEGETATION	n/a	n/a	n/a	YES	n/a
27	ms_line	A transmission line		TRANSMISSION_LINE	n/a	NONE, empty	n/a	n/a	n/a
28	ms_line_marks	A transmission line with marking		TRANSMISSION_LINE	n/a	MARKED, ORANGE_MARKS, CABLE_WARNER, RED_WHITE_RED	n/a	n/a	n/a
29	ms_cable	A cable		CATENARY, CABLE_CAR	n/a	NONE, empty	n/a	n/a	n/a
30	ms_cable_marks	A cable with marking		CATENARY, CABLE_CAR	n/a	MARKED, ORANGE_MARKS, CABLE_WARNER, RED_WHITE_RED	n/a	n/a	n/a
31	ms_point	An obstacle with a point shape		n/a	n/a	n/a	n/a	n/a	point
32	ms_linear	An obstacle with a linear shape		n/a	n/a	n/a	n/a	n/a	linear
33	ms_polygon	An obstacle with a polygon shape		n/a	n/a	n/a	n/a	n/a	polygon
34	ms_other	Any other obstacle not covered by a more specific style		n/a	n/a	n/a	n/a	n/a	n/a

15 Appendix D: Additional information

15.1 About the Swiss Obstacle Data Set in AIXM format

15.1.1 VerticalStructurePart "annotation_partIdx" property

Obstacles with a linear shape are described with multiple point parts and multiple line parts. Each part contributes to the shape of the obstacle and the sum of all parts describe the total shape of the obstacle. The line parts of linear obstacles do together form a continuous line without gaps between lines, i.e. each line has a predecessor line that has an end-point matching the start-point of the line and a successor line that has a start-point matching the end-point of the line. The first line has no predecessor line, and the last line has no successor line unless the lines form together a closed loop. A point is situated at each junction of 2 lines and at the start-point of the first line and the end-point of the last line. In the case of the lines forming a closed loop, the first and last point are duplicated. Furthermore, the continuous line may be self-intersecting, and these intersections may be at the junction of 2 consecutive line parts. If so, each pair of line parts joining at the junction has its own point part.

Although the line and point parts form a continues line with vertices, these parts of an obstacle do in the general case not appear as an ordered sequence of XML elements and in the case of self-intersections at the junction of 2 consecutive line parts, the point parts at the junctions are not uniquely assignable to a consecutive pair of line parts. While this is sufficient from an aviation perspective, applications do sometimes wish to reconstruct the original continuous line. To do so, the point and line parts are indexed with an index number, to enable the sorting of the parts and the unique assignment of point parts to a pair of consecutive line parts:

- The point parts have an index starting with 1 at the first point and incremented by 1 with each consecutive point.
- The line parts have an index starting with 1 at the first line and incremented by 1 with each consecutive line.

The following relation exists between indices of point parts and line parts:

- The point with index N is at the start position of the line with index N.
- The point with index N+1 is at the end position of the line with index N.

Note:

- In the case of a closed loop, the first and last point parts do usually have identical property values.
- In the case of self-intersections at junctions of consecutive line parts, the point parts located at the junction do usually have identical property values.

15.1.2 VerticalStructurePart "annotation_airport" property

The VerticalStructurePart "annotation_airport" annotation-based property is a workaround to provide with an obstacle information about its vicinity to an aerodrome. The property was added on request of clients who need to filter obstacle data by aerodrome prior to loading it into their system.

For obstacles with a point shape, only the point location is used for the evaluation. The radius (circular area covered by the obstacle) is disregarded.

The workaround exists because AIXM ObstacleArea data is currently not collected by the skyguide AIM or the DCS Provider. Such data would from an AIXM perspective be required to maintain the associations between AIXM VerticalStructure features and AIXM AirportHeliport features. Future versions of the AIXM Swiss Obstacle Data Set may replace the VerticalStructurePart "annotation_airport" property with AIXM ObstacleArea and AIXM AirportHeliport features.

15.1.3 VerticalStructurePart marking

The VerticalStructurePart "markingPattern", "markingFirstColour", and "markingSecondColour" properties do together describe the marking of an obstacle part. Only a limited set of combinations of the 3 property values is used, describing common types of marking in use:

- MARKERS, ORANGE, NIL — Orange coloured markers, such as spheres or canvas.
- MARKERS, NIL, NIL — Markers with any colours.
- OTHER:BANDS, RED, WHITE — Red/white banded paintings.
- OTHER:MARKED, NIL, NIL — Any not further specified marking.

15.1.4 VerticalStructurePart GML geometry

All line and polygon geometries included in VerticalStructurePart GML geometry elements for the interpolation between vertices are coded according to the GML profile for aviation data section 5.2.1, using gml:GeodesicString with gml:posList. gml:posList is used for compactness, to keep the size of the dataset transfer size as small as possible.

15.1.5 VerticalStructurePart vertical extent

Obstacles with a linear or polygon shape have a lateral extent where the underlaying terrain is not necessarily flat. The "verticalExtent" property of an obstacle part is therefore not a constant value but varies on the position you take within the lateral extent of the obstacle. Consequently, the "verticalExtent" is set to a NIL reason and the maximum AGL height is indicated with a part "annotation" property of type "REMARK" and a text with the following pattern: "Maximum height above ground level is [<height-value> <unit-of-measurement>|unknown]". The approach for vertical extent adopts the principle explained in the Eurocontrol coding guidelines for the ICAO Obstacle Data Sets, Example 5,

15.1.6 Representation of an inactive obstacle

The DCS Provider collects information on whether an obstacle is active or inactive. The concept of inactive obstacles was transferred from the former obstacle management system (OMS) to the DCS Provider. Only temporary obstacles (those with an "annotation_estEndDate" property value) can become inactive.

AIXM does not have a notion of an inactive obstacle but a concept for a schedule on obstacle parts and a concept of TEMPDELTA timeslices. While these may be used in the future, skyguide has decided to initially have a simpler solution to lower the hurdles for AIXM newbies: An inactive obstacle is just published without its VerticalStructureParts. Logically, this indicates to the airspace user (or an application) that there is no obstacle part that can hamper, endanger or prevent the operation of aircraft or of air navigation systems.

15.1.7 Updating client databases

A VerticalStructure feature carries "identifier", "sequenceNumber", "correctionNumber", "effectiveDate", and "featureLifetime" AIXM system properties which can be used by a client to maintain an own (temporal) database of obstacles, updated from the BASELINE AIXM feature timeslices included with the dataset. With regard to the AIXM temporality concept, the dataset comes with the following limitation: If a feature was decommissioned during the validity period of the preceding dataset, there is no decommissioning information available in the dataset, neither in the current dataset nor in the preceding datasets. Respective information may eventually be available from a NOTAM.

In cases where the limitation is acceptable, it is possible for a client to implement a solution where feature decommissioning can be detected by a diff of feature identifiers between the preceding and the current dataset. Features with identifiers that exist in the preceding dataset but not in the current dataset can then be decommissioned with an effective date before the start of the validity period of the current dataset.

15.2 About the Swiss Obstacle Data Set in KML format

15.2.1 ObstacleProperties "marking" property

The marking property value is derived from the more detailed per-part marking information available with an obstacle (as described with the AIXM VerticalStructurePart marking information). The information contributed by each part is as follows:

1. ORANGE_MARKS — if VerticalStructurePart.markingPattern=MARKERS and VerticalStructurePart.markingFirstColour=ORANGE and VerticalStructurePart.markingSecondColour=NIL
2. CABLE_WARNER — if VerticalStructurePart.markingPattern=MARKERS and VerticalStructurePart.markingFirstColour=NIL and VerticalStructurePart.markingSecondColour=NIL
3. RED_WHITE_RED — if VerticalStructurePart.markingPattern=OTHER:BANDS and VerticalStructurePart.markingFirstColour=RED and VerticalStructurePart.markingSecondColour=WHITE
4. MARKED — if VerticalStructurePart.markingPattern=OTHER:MARKED and VerticalStructurePart.markingFirstColour=NIL and VerticalStructurePart.markingSecondColour=NIL
5. NONE — if VerticalStructurePart.markingPattern=NIL(inapplicable) and VerticalStructurePart.markingFirstColour=NIL(inapplicable) and VerticalStructurePart.markingSecondColour=NIL(inapplicable)
6. otherwise, no information is contributed by the part

The marking type used for the obstacle depends on the combination of the marking types of the parts and the setting of the VerticalStructure.annotation_marked property. The following priority list is used to determine the marking type of the obstacle:

1. If there is more than 1 of the ORANGE_MARKS, CABLE_WARNER, or RED_WHITE_RED types used, then MARKED is used.
2. If either one of the ORANGE_MARKS, CABLE_WARNER, or RED_WHITE_RED types is used, then use that type.
3. If at least 1 MARKED is used, use MARKED
4. if VerticalStructure.annotation_marked = "YES", then use MARKED
5. if VerticalStructure.annotation_marked = "NO", then use NONE
6. otherwise, marking information is empty

15.2.2 ObstacleProperties "lighting" property

The lighting property value is derived from the more detailed per-part lighting information available with an obstacle (from the AIXM VerticalStructurePart "lighting" property). The information contributed by each part is as follows:

1. HIGH — if VerticalStructurePart.lighting.LightElement.intensityLevel=LIH
2. MEDIUM — if VerticalStructurePart.lighting.LightElement.intensityLevel=LIM
3. LOW — if VerticalStructurePart.lighting.LightElement.intensityLevel=LIL
4. LIGHTED — if VerticalStructurePart.lighting.LightElement.intensityLevel=NIL
5. NONE — if VerticalStructurePart.lighting=NIL
6. otherwise, no information is contributed by the part

The lighting type used for the obstacle depends on the combination of the lighting types of the parts and the setting of the VerticalStructure.lighted property. The following priority list is used to determine the lighting type of the obstacle:

1. If there is more than 1 of the HIGH, MEDIUM, or LOW types used, then LIGHTED is used.
2. If either one of the HIGH, MEDIUM, or LOW types is used, then use that type.
3. If at least 1 LIGHTED is used, use LIGHTED
4. if VerticalStructure.lighted = "YES", then use LIGHTED
5. if VerticalStructure.lighted = "NO", then use NONE
6. otherwise, lighting information is empty

15.2.3 ObstacleProperties "airport" property

The airport property value is derived from the more detailed per-part airport information available with an obstacle (from the AIXM VerticalStructurePart "annotation_airport" property). The information contributed by each part is combined into a comma delimited list of unique values.

15.2.4 ObstacleProperties "small" property

The property is used for the filtering of obstacles for the FSDI "Small Obstacles in the vicinity of an aerodrome" layer (ch.bazl.luftfahrthindernis-klein). The property value is derived from the more detailed per-part information available with an obstacle (as described with the AIXM VerticalStructurePart marking information) and this rule:

An obstacle is small, if all obstacle parts are in the vicinity of an aerodrome, and the maximum AGL height of all parts is either less than 60 m when inside a built-up area or less than 25 m when outside a built-up area.

The VerticalStructurePart "annotation_airport", "verticalExtent", "verticalExtent_remark", and "annotation_inBuiltUpArea" property values are used to compute the "small" value according to the stated rule.

15.2.5 ObstacleProperties "modified" property

The property is used for the filtering of obstacles for the FSDI "Obstacle Changes" layer (ch.bazl.luftfahrthindernis-aenderungen). The penultimate AIRAC date is the second to the last AIRAC date (out of the AIRAC calendar) that precedes the date set with the DatasetMetadata "dataValidFrom" property. The "modified" value is "YES", if the "effectiveDate" of the obstacle is at or after the penultimate AIRAC date.

15.2.6 Height coordinates

Height coordinates are indicated as an "absolute" height, which is for KML an orthometric height (AMSL elevation) relative to the EGM96 vertical reference system. The AMSL elevation values from the aeronautical database of Switzerland are relative to the LN02 vertical reference system and are copied to the KML dataset without transformation. The maximum difference between a true EGM96 height and the used LN02 heights is +/-15 meters within the spatial extent of the KML dataset. Given the intended use of the dataset, this is acceptable, but you must be aware that earth browsers like Google Earth will interpret the height as an EGM96 height. This may lead to an inaccurate display of the obstacle geometry in relation to terrain.

15.2.7 Vertical extent information

An obstacle includes a "topElevationAMSL" and a "maxHeightAGL" property. While these properties are a useful information for obstacles with a point shape (because both apply to the same point position), the use of the information is of limited value for obstacles with a linear or polygon shape:

- linear shape: The "topElevationAMSL" and "maxHeightAGL" are anywhere along the line.
- polygon shape: The "topElevationAMSL" applies to the entire area (because the KML geometry is an abstraction with only the top AMSL elevation of the underlying structure indicated) and the "maxHeightAGL" is anywhere within the polygon area.

15.2.8 Google Earth performance

The KML file includes around 10'000 Placemarks which do bring the Google Earth client to its limits with a plain KML/KMZ file. To work around the limits, each Placemark of the KML dataset is complemented with a Region (3D bounding box) which allows you to add the KML datasets to Google Earth without sacrificing performance. The drawback of the performance improvement is reduced visibility of individual obstacles: An obstacle is only visible if its 3D bounding box occupies at least 4x4 pixels on the display. So, you need to be close enough to an obstacle until it becomes visible. The bounding box of small obstacles is respectively enlarged so that also small obstacles become visible early enough.

15.2.9 Google Earth Placemark labelling

Each Placemark which is based on a KML LineString or KML Polygon geometry includes an additional Point geometry. The point is added for legacy reasons and is used by Google Earth to set a label on the viewport.