

Geobeyond
31 maggio 2012
A Spatial Data
Infrastructure for
Avalanche
Awareness
Warning
GEOAVALANCHE

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Agenda

- Snow avalanche risk management
- What is **Geoavalanche**?
- CAAML application profile
- **Geoavalanche** server
- Benefits
- Challenges

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Mountain Risk Management

- AVALANCHES dramatically:
 - kill backcountry practitioners
 - damage villages, settlements, infrastructures
- SNOWCOVER frequently:
 - affects hydropower generation
 - is a source of water for drinkable and irrigation use

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Actors

- AVALANCHE WARNING SERVICES
 - distributed offices collect avalanche and meteorological data often locally
 - issue nationwide nowcasting and forecasting bulletin centrally
- Governments
 - has to mitigate natural hazard and regulate land use
 - deal with the management of resources
 - are approaching to [Inspire](#) where Avalanches are issued in the Natural Risk Zones theme of Annex III

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Users

- Tourists
 - attempt in the wilderness with a number as much as increased in the latest years
 - claim innovative early warning alert systems and more avalanche awareness for safer activities
- Mountain professionals
 - plan their activities more often via mobile devices
 - promote and make their business on the safety of outdoor activities
 - are actively involved to report snowdrift risk and snowslide prone areas as the situation evolves

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Geoavalanche

- Open Source project born from [Geebeyond](#) and released under the GNU GPL v3 terms
- Development of a web architecture to deal with snow avalanche datasets over the Internet
- Overcome the lack of shared knowledge on snow avalanche information
- Core component of data infrastructure spatially and semantically focused
- Web 2.0 oriented

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Goals

*“Exchange of snow avalanche information in a common standard for building **Spatial Data Infrastructure** to cross-border interoperability”*

“Leverage of more avalanche awareness to mountaineers by using user-oriented services on Web channels”

“Make avalanche bulletin mostly available and hence mountain experience safe-effective”

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Key Concepts

- Geographical nature of snow avalanche data (spatial component)
- Geospatial standards
- Cross-boarder cooperation and harmonisation of data (Regional – National – European)
- Interoperability in mind

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Technologies

- Canadian Avalanche Association Markup Language [CAAML](#)
- Geographic Markup Language [GML](#)
- OGC Web Feature Service [WFS](#)
- OGC Web Map Service [WMS](#)
- [GeoServer](#) and the GML application schema extension
- [PostGIS](#) spatial database

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Implications

- Accessing datasets by using WFS services for exchanging data on R/W operations
- Providing maps avalanche bulletins and snow cover by using WMS services
- Enabling 3th-party internet sites and mobile devices for snow avalanche geolocalisation services

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CAAML

- XML grammar language initially developed and still maintained by the Canadian Avalanche Association CAA
- Common encoding structure based on top of GML
- Currently supports the following avalanche types:
 - incident information
 - activity comments
 - observations
 - bulletins
 - closure
 - observations on the field
 - snowpack structure comments
 - snow profile observations
 - weather observations

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CAAML architecture

- Latest version 5.0 developed by CAA

```

    graph TD
      caaml_xsd[caaml.xsd] --> caaml_ObjectsAndObservations_xsd[caaml_ObjectsAndObservations.xsd]
      caaml_ObjectsAndObservations_xsd --> caaml_ValuesComposite_xsd[caaml_ValuesComposite.xsd]
      caaml_ObjectsAndObservations_xsd --> caaml_ObjectsBase_xsd[caaml_ObjectsBase.xsd]
      caaml_ObjectsAndObservations_xsd --> caaml_ObjectsGeometry_xsd[caaml_ObjectsGeometry.xsd]
      caaml_ValuesComposite_xsd --> caaml_ValuesList_xsd[caaml_ValuesList.xsd]
      caaml_ValuesList_xsd --> caaml_ValuesScalar_xsd[caaml_ValuesScalar.xsd]
      caaml_ObjectsBase_xsd --> gml32Profile_xsd[gml3.2Profile.xsd]
      gml32Profile_xsd --> xlinks_xsd[xlinks.xsd]
  
```

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Similar features

- o Object-Property-Value model pattern of GML
- o Same flexibility in mind
- o Borrows the concept of profile which permits:
 - o express logical limitation of elements relevant for a specific application
 - o maintain the ability to be validated against the overall CAAML standard
 - o design a common schema which raises the needs among AWS in the neighborhood of European mountains

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EAWS CAAML profile

- o **EAWS** European Avalanche Warning Service maintains standards across the Alps
- o Proposed **schema** profile for the Alps
- o Geoavalanche uses EAWS CAAML-scoped avalanche bulletins

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Bulletin element type

Courtesy of CAA






```

<element name="Bulletin" type="caaml:BulletinType"/>
<complexType name="BulletinType" final="#all">
  <sequence>
    <element name="metaDataProperty">
      <complexType>
        <sequence>
          <element name="MetaData" type="caaml:ObsMetaDataType"/>
        </sequence>
      </complexType>
    </element>
    <element ref="caaml:validTime"/>
    <element name="bulletinResultsOf">
      <complexType>
        <sequence>
          <element ref="caaml:BulletinMeasurements"/>
        </sequence>
      </complexType>
    </element>
    <element ref="caaml:locRef"/>
  </sequence>
  <attribute ref="gml:id" use="required"/>
</complexType>
  
```

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European avalanche danger scale

European Danger Scale with Recommendations

Danger level	Snowpack stability	Avalanche triggering probability	Consequences for transportation routes and settlements / recommendations	Consequences for persons outside secured zones / recommendations
5 	The snowpack is poorly bonded and largely unstable in general.	Many large and multiple very large natural avalanches are expected, even in moderately steep terrain.	Acute danger. Comprehensive safety measures.	Highly unfavourable conditions. Avoid open terrain.
4 	The snowpack is poorly bonded on most steep slopes*.	Triggering is likely even from low additional loads** on many steep slopes. In some cases, numerous medium-sized and often large-sized natural avalanches can be expected.	Many exposed sectors are endangered. Safety measures recommended in those places.	Unfavourable conditions. Extensive experience in the assessment of avalanche danger is required. Remain in moderately steep terrain / heed avalanche run out zones.
3 	The snowpack is moderately to poorly bonded on many steep slopes*.	Triggering is possible, even from low additional loads** particularly on those steep slopes indicated in the bulletin. In some cases medium-sized, in isolated cases large-sized natural avalanches are possible.	Isolated exposed sectors are endangered. Some safety measures recommended in those places.	Partially unfavourable conditions. Experience in the assessment of avalanche danger is required. Steep slopes of indicated aspects and altitude zones should be avoided if possible.
2 	The snowpack is only moderately well bonded on some steep slopes*, otherwise well bonded in general.	Triggering is possible primarily from high additional loads**, particularly on those steep slopes indicated in the bulletin. Large-sized natural avalanches are unlikely.	Low danger of natural avalanches.	Mostly favourable conditions. Careful route selection, especially on steep slopes of indicated aspect and altitude zones.
1 	The snowpack is well bonded and stable in general.	Triggering is generally possible only from high additional loads** in isolated areas of very steep, extreme terrain. Only sluffs and small sized natural avalanches are possible.	No danger	Generally safe conditions

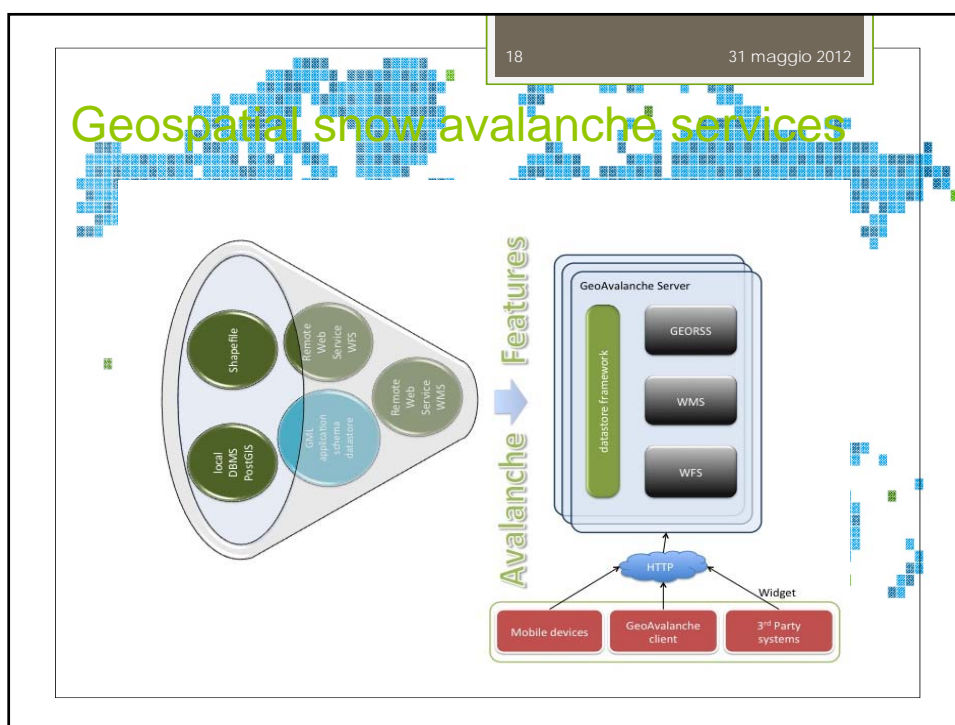
Explanations: ** Additional load: - high (e.g. group of skiers without spacing, snowmobile/zoomer, avalanche blasting) - natural: without human assistance
 - low (e.g. single skier, snowboarder, snowshoe hiker) - aspect: the compass direction in which a downward slope faces
 * generally explained in greater detail in Avalanche Bulletin (e.g. altitude zone, aspect, type of terrain) - exposed: especially exposed to danger
 → moderately steep terrain: slopes flatter than about 30 degrees
 → steep slopes: slopes with an angle of more than about 30 degrees
 → steep extreme terrain: those which are particularly unfavourable as regards slope angle (usually steeper than about 40°), terrain profile, proximity to ridge, roughness of underlying ground

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Geoavalanche Server

- Uses [GeoServer](#) to aggregate different datastores centrally.
- Includes GML application schema extension for supporting 3rd-party like CAAML.
- Allows direct querying of complex snow avalanche features CAAML-encoded.
- Enables data fusion between remote and local sources.
- Achieves web mapping services for avalanche bulletin.
- is **Inspire-ready** because of the abilities passed-down by Geoserver.

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CAAML schema mapping

- Single `caaml:Bulletin`
 - is observed at several distinct locations on the Earth's surface
 - has a multivalued `caaml:bulletinResultsOf` property of `caaml:BulletinMeasurements` type

CAAML Schema mapping

```

graph LR
    subgraph Complex_Feature [Complex Feature]
        C1["<caaml:Bulletin>"]
        C2["<caaml:bulletinResultsOf>"]
        C3["<caaml:BulletinMeasurements>"]
    end
    subgraph app_schema [app-schema]
        AS(( ))
    end
    subgraph Simple_Features [Simple Feature]
        S1["type:bulletin"]
        S2["type:bulletinmeasurements"]
    end
    subgraph Database [Database]
        D1["TABLE bulletin"]
        D2["TABLE bulletinmeasurements"]
    end
    C1 --- AS
    C2 --- AS
    C3 --- AS
    AS --- S1
    AS --- S2
    S1 --- D1
    S2 --- D2
  
```

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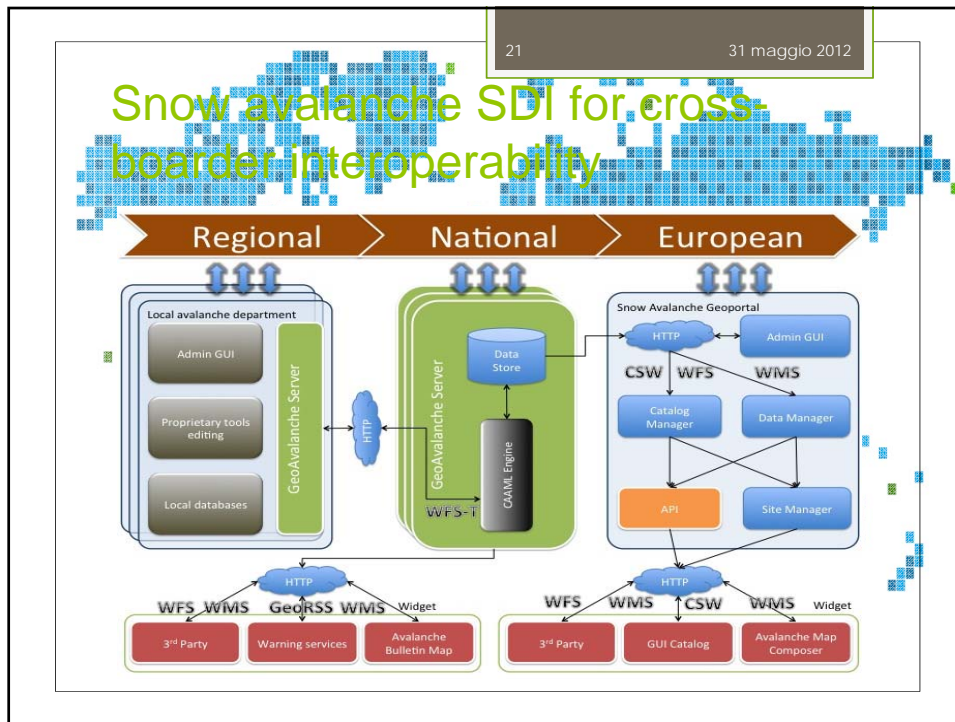
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Key effects

“A CAAML Spatial Data Infrastructure would exploit Geoavalanche Server which assumes a key role since it manages both of R/W operations regardless of the database schema used to store data”

“When performing WFS filter queries it can also act accordingly to OGC WFS-T transactional specification because each single service has been conformed to the same CAAML schema”

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Benefits

- Interoperability at largest scale for stakeholders, actors, and users
- EUROPEAN – Snow avalanche Geoportal for EU, which would represent the application of Natural Risk Zones
- NATIONAL – Geospatial product which provides avalanche bulletin maps, warning LBS to mobile users and a complement for Resource Management (Snow water equivalent)
- REGIONAL – A bridge to connect distributed observation centers to national agencies AWS in an easily common format

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Challenges


- Schema transformation for CAAML datasets to comply with the "Natural Risk Zones" data theme
- Robustness and scalability of snow avalanche database for CAAML
- Catalogue Service for the Web (CSW)
- Implementation of map visualization services INSPIRE conformed (WMS 1.3)
- Develop of mobile LBS client (iOS, Android)

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More on Geoavalanche

- [Source code on github](#)
- Read more on the project site geoavalanche.org
- Follow me [@francbartoli](#) on Twitter



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Questions?

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Making Geospatial Happen
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