A Structured Server Architecture To Stock And Share Ice Core Data

From Database To Webgis Application


Geomatic Laboratory – Earth & Environmental Sciences Dept., University of Milano Bicocca
INTRODUCTION

NEXTDATA Project

WP2.3

Retrieval, storage, access and diffusion of environmental and climate data from mountain and marine areas

Mountain regions, in particular, respond more rapidly, and more intensely, to the climatic and environmental changes in progress

Archive of non polar ice core extracted from tropical, subtropical and mid-latitude glaciers
INTRODUCTION

Why non polar ice cores?

- Offer unique information with high temporal resolution of recent climate variability;
- Supply information on the evolution of anthropogenic pollution processes and natural climate-altering processes in specific continental region;
- Thanks to their high-altitude locations (4000 to 6000 m) non polar ice cores provide information on the middle troposphere in relation to large-scale climate change.
ICE CORE DATA DATABASE CHARACTERIZATION

Which informations are need to describe ice cores from database point of view?

ICE CORE

METADATA

SHARE GEONETWORK

CHEMICAL & PHYSICAL PARAMETERS

ATTRIBUTE INFORMATIONS

GEOGRAPHIC INFORMATIONS

DATABASE

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ICE CORE DATABASE CHARACTERIZATION

More than 200 chemical and physical parameters

- N2o concentration (Ossido di azoto in ppbv)
- Uncertainty ppbv (1 sigma)
- Microparticles concentration
- Vector Variables
- Delta 18/o
- Delta deuterium
- CH4, CO2
- Dielectric Profiling Data
- 14C Data
- Dust Flux Data at 25yr Resolution

CHEMICAL & PHYSICAL PARAMETERS

Phisical analysis
Chemical analysis
Isotopic analysis

AVERAGE LENGTH (Reference time)
NUMBER OF SAMPLES (In function of analysis type)
DIAMETER (10x10)
175 NON POLAR ICE CORE

ICE CORE DATABASE CHARACTERIZATION

GEOGRAPHIC INFORMATIONS

15.5% Ice core (27)
Canada, Alaska, U.S.A.

16% Ice core (28)
Peru, Bolivia

27% Ice core (47)
Europe

37% Ice core (65)
Himalaya, Asia

4.5% Ice core (8)
Africa

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ICE CORE DATABASE CHARACTERIZATION

Principal attribute informations

• DATAPROVIDER
• ICE CORE NAME
• GEOGRAPHIC COORDINATE
• TOP AND BOTTOM OF THE ICE CORE
• REFERENCE TIME (I.E.: 1400-1800 YEARS BC)
WHICH DATABASE?

WDB - Weather and Water Database

- Developed by Norwegian Meteorological Institute (met.no)
- Created for stock meteorological, hydrological and oceanographic data
- Database management server PostgreSQL / PostGIS structure
- A set of functions for loading, maintenance, and retrieving data
- GNU General Public License
WDB – meteorological and ice core data

Stations at high altitude for meteorological data

(Elena Glacier, Uganda)

Non polar Ice cores

(Lys glacier, ice core drilling)

Geometry → Point

Meteorological parameters

Reference time → 1400 AC

Geometry → Point

Ice core parameters

Reference time → ?

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WDB DATABASE (Principal Structure)

DATAPROVIDER

DB USERS

PLACEPOINT

PARAMETERS

VALUE
**ADD DATAPROVIDER**

The appropriate function in order to add a new data provider to the database is the `wci.add dataprovider` function.

```sql
SELECT wci.begin('nextdata');
SELECT wci.add dataprovider('Anja Eichler','person','point','0','Principal investigator of Belukha IceCore 1');
```

**ADD PLACEPOINT**

The `wci.add placepoint` function is used in order to add point data.

```sql
SELECT wci.begin('nextdata');
SELECT wci.add or update placepoint('AR 94-14', ST_GeomFromText('Point(-121.830000 48.370000)', 4326), '-infinity','infinity');
```

**ADD PARAMETERS**

In order to add a parameter to the database, the `wci.add value parameter` function is used.

```sql
SELECT wci.begin('nextdata');
SELECT wci.add parameter('oxygen isotope',null,null,null,null,null,null,'d18O (per mil)');
```
## Example of meteorological data

<table>
<thead>
<tr>
<th>Data Provider</th>
<th>Place name</th>
<th>Valid from</th>
<th>Valid to</th>
<th>Parameter name</th>
<th>Level parameter name</th>
<th>Level from</th>
<th>Level to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>forecast</td>
<td>2011-01-01T00:00:00Z</td>
<td>2011-01-01T00:09:00Z</td>
<td>air temperature</td>
<td>height above ground</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16.6</td>
<td>3190</td>
<td>2011-01-01T00:05:00Z</td>
<td>2011-01-01T00:09:00Z</td>
<td>air temperature</td>
<td>height above ground</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16.7</td>
<td>3190</td>
<td>2011-01-01T00:15:00Z</td>
<td>2011-01-01T00:19:00Z</td>
<td>air temperature</td>
<td>height above ground</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16.7</td>
<td>3190</td>
<td>2011-01-01T00:25:00Z</td>
<td>2011-01-01T00:29:00Z</td>
<td>air temperature</td>
<td>height above ground</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16.8</td>
<td>3190</td>
<td>2011-01-01T00:35:00Z</td>
<td>2011-01-01T00:39:00Z</td>
<td>air temperature</td>
<td>height above ground</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16.9</td>
<td>3190</td>
<td>2011-01-01T00:45:00Z</td>
<td>2011-01-01T00:49:00Z</td>
<td>air temperature</td>
<td>height above ground</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16.9</td>
<td>3190</td>
<td>2011-01-01T00:55:00Z</td>
<td>2011-01-01T00:59:00Z</td>
<td>air temperature</td>
<td>height above ground</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
SELECT wci.write(
  <double precision>,
  <text>,
  <timestamp with time zone>,
  <timestamp with time zone>,
  <timestamp with time zone>,
  <text>,
  <text>,
  <real>,
  <real>
);

UPDATE wdb_int.floatvalueitem
SET referencetime = referencetime - interval '4000 years';

Fastload library boost can't insert dates below 1400

Add 4000 years to every date
WDB – Problem to load data

Another problem: restriction on time data field

<table>
<thead>
<tr>
<th>Name</th>
<th>Storage Size</th>
<th>Description</th>
<th>Low Value</th>
<th>High Value</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>timestamp [ (p) ] [ without time zone ]</td>
<td>8 bytes</td>
<td>both date and time</td>
<td>4713 BC</td>
<td>5874897 AD</td>
<td>1 microsecond / 14 digits</td>
</tr>
<tr>
<td>timestamp [ (p) ] with time zone</td>
<td>8 bytes</td>
<td>both date and time, with time zone</td>
<td>4713 BC</td>
<td>5874897 AD</td>
<td>1 microsecond / 14 digits</td>
</tr>
<tr>
<td>interval [ (p) ]</td>
<td>12 bytes</td>
<td>time intervals</td>
<td>-1780000000 years</td>
<td>1780000000 years</td>
<td>1 microsecond / 14 digits</td>
</tr>
<tr>
<td>date</td>
<td>4 bytes</td>
<td>dates only</td>
<td>4713 BC</td>
<td>5874897 AD</td>
<td>1 day</td>
</tr>
<tr>
<td>time [ (p) ] [ without time zone ]</td>
<td>8 bytes</td>
<td>times of day only</td>
<td>00:00:00</td>
<td>24:00:00</td>
<td>1 microsecond / 14 digits</td>
</tr>
<tr>
<td>time [ (p) ] with time zone</td>
<td>12 bytes</td>
<td>times of day only, with time zone</td>
<td>00:00:00+1459</td>
<td>24:00:00-1459</td>
<td>1 microsecond / 14 digits</td>
</tr>
</tbody>
</table>

We modified WDB source code in order to change the type field from: “timestamp without time zone” to “real”

```sql
SELECT wci.writepaleo( <double precision>,<text>,<text>,<real>,<real>,<real>,<text>,<text>, <real>,<real>,<integer>,<integer>);
```
WDB – Load data

```bash
#!/bin/bash

echo " digitsi lo user per la funzione wcl.begin:" read user

echo "Digitare la path in cui è presente il file csv(es.:/home/user/path/to.csv):" read pathimport

echo "Database username:" read userdb

echo "Database password:" read passwd

echo "Indirizzo server del database:" read hostdb

echo "Porta dell'indirizzo server:" read portdb

echo "Nome del database:" read dbname

dataversion_="0
setconfidencecode_="0

while IFS=, read value_dataprovname_placename_referencetime_validfrom_validto_valueparametername_levelparametername_levelfrom_levelto

do
  for l in $dbname
    do
      echo "SELECT wcl.begin('$user');
          SELECT wcl.writepaldeo(
              '$value_'
              '$dataprovname_'
              '$placename_'
              '$referencetime_'
              '$validfrom_'
              '$validto_'
              '$valueparametername_'
              '$levelparametername_'
            );"
```
4 different levels of work
These levels will be integrated with each other
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SHARING DATA
FUTURE DEVELOPMENTS

Ice Core data (WDB)

Drilling

Project

References

Ice Core

Glaciers ?

Level parameter (depth)

IceCore name

Data provider

Ice Core ID

Accurature of Replacement Set

Source

Principal Investigator

Drilling Tab

ID

Drilling Year + Site code

Geographic region

Location

Place Name of Drilling Site

Year of drilling

Driller

Ice Core

Ice Core Tab

IC

Name

Lat/Long

Altitude

Bottom of Core

Accessories parameters

Accuracy of Replacement Set

Source

Principal Investigator

Ice Core data (WDB)

Parameter

Value

Reference

Time parameter (depth)

IceCore name

Data provider

Ice Core ID

Drilling Tab

ID

Drilling Year + Site code

Geographic region

Location

Place Name of Drilling Site

Year of drilling

Driller

??

Project

ID

Project Name

Years of reference

P.I. or Institution

Complete Citation

DOI

References

ID

Paper

Years of publication

Principal Authors

Complete Citation

DOI

Drilling

ID

Drilling Year + Site code

Geographic region

Location

Place Name of Drilling Site

Year of drilling

Driller

??

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