

# Dissemination of SLR data-related products through a Virtual Observatory

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# GRGS on-line tools to compare time series provided by GRGS ACs

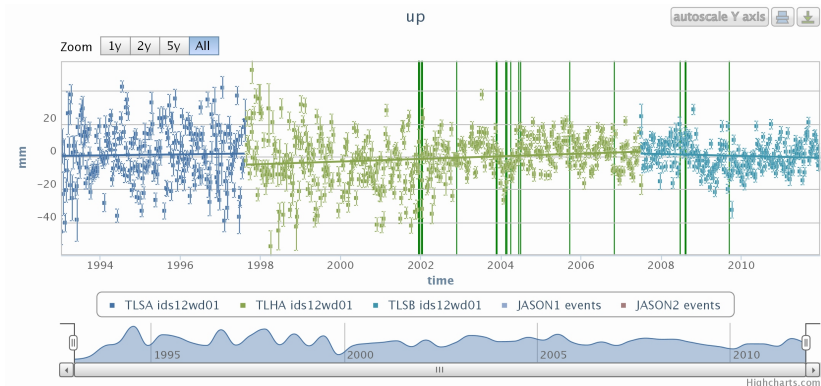
- time series derived from DORIS, GNSS, SLR, VLBI data
  - Network selection: *Mapshup*
  - Time series analysis: *Plottool*
  - GRGS ILRS AC: IGS, ILRS, IDS, IVS
  - <http://vo.imcce.fr/slr-ac/>
- main goal:
  - comparisons and bias estimation in time series derived from the techniques
  - a step/tool to combine time series (CC COL/ IERS WG)
- something similar to what is provided on other ACs websites:
  - JCET, ASI, ...
  - but with a V.O. approach



# Station and network selection with *Mapshup*



# Visualization through dedicated libraries: highcharts.com



Example of a coordinate time series provided by IDS @ CLS, containing additional information (here: satellite events):

<http://ids-doris.org/plottool/stcd/stcdtool.php>

# Superimposition of time series, and additional information



## STATISTICS:

north :

Station	mean	wrms	Fitted slope	Period
THUB ids12wd01	9.13mm	6.08mm	3.02+/-0.1mm/year	2002/10/06-2012/09/25
THU3 igs13wd01	13.19mm	0.87mm	4.98+/-0.01mm/year	2002/12/18-2012/08/12

east :

Station	mean	wrms	Fitted slope	Period
THUB ids12wd01	-191.75mm	5.3mm	-22.79+/-0.09mm/year	2002/10/06-2012/09/25
THU3 igs13wd01	-211.88mm	0.69mm	-22.33+/-0.01mm/year	2002/12/18-2012/08/12

up :

Station	mean	wrms	Fitted slope	Period
THUB ids12wd01	93.83mm	7.64mm	6.11+/-0.12mm/year	2002/10/06-2012/09/25
THU3 igs13wd01	99.9mm	4.96mm	7.33+/-0.08mm/year	2002/12/18-2012/08/12

# The Astronomical Virtual Observatory

- Virtual Observatory (VO) is an ambitious international proposal to:
  - provide **uniform, convenient** access
  - to **disparate, geographically dispersed archives of astronomical data** ...
  - ... using s/w which runs on the computer on the astronomer's desktop.
- The VO could be of interest for the geodetic community
- Existing self descriptive format based on these standards and XML: the VO-Table.
- Astronomers using that Virtual Observatory are now organized within an international association called the **International Virtual Observatory Alliance (IVOA)**: <http://www.ivoa.net/>.
- Mission: "Facilitate the international coordination and collaboration necessary for the development and deployment of the tools, systems and organizational structures necessary to enable the international utilization of astronomical archives as an integrated and interoperating virtual observatory."



# The VOTable Data Exchange Format

- VOTable is a **XML-based format** for representing astronomical catalogs (properties of celestial objects: celestial coordinates, brightness etc.)
- The VOTable has been defined in terms of XML in order to
  - take advantage of computer-industry standards
  - **utilize standard software and tools**
  - Successful project in Astronomy. Why not in geodesy ?
- Concerning time series:
  - geodetic tables are rich in metadata
  - annotation, interpretable by either computers or humans, both the tables and the individual columns that they contain
  - metadata to be preserved along with the table, features to permit this with .vot
- VOTable is designed to describe a wide variety of physical parameters.
- Description through **Unified Content Descriptors (UCD)**
- for an accurate description of complex data: to be used jointly with an **external data model**, such as the STC.



## UCD relevant to geodesy time series approved by IVOA

Description	UCD	Commentaire	UCD existant (oui ou non)
<b>UCD fréquemment utilisés en géodésie</b>			
<b>Généraux</b>			
Epoque	time.epoch		oui
<b>Système de Référence Céleste</b>			
Ascension droite	pos.eq.ra		oui
Déclinaison	pos.eq.de		oui
Ecart-type ascension droite	stat.stdev.pos.eq.ra		oui
Ecart-type déclinaison	stat.stdev.pos.eq.de		oui
Corrélation	stat.correlation		oui
<b>Orientation de la Terre</b>			
Coordonnée X du CIP dans le repère Terrestre	pos.eop.xp		oui (accepté sur recommandation OVI(GAFF))
Coordonnée Y du CIP dans le repère Terrestre	pos.eop.yp		oui (accepté sur recommandation OVI(GAFF))
Vitesse X du CIP dans le repère Terrestre	arith.rate.pos.eop.xp		oui
Vitesse Y du CIP dans le repère Terrestre	arith.rate.pos.eop.yp		oui
UT1-UTC	pos.eop.UT1mUTC		oui (accepté sur recommandation OVI(GAFF))
Longueur du jour		Ajouter une description dans le VOTABLE: <DESCRIPTION>Length of day (k times UT1 rate, where k = ...)</DESCRIPTION>.	oui
Position X du CIP dans le repère céleste	arith.rate.pos.eop.UT1mUTC		oui (accepté sur recommandation OVI(GAFF))
Position Y du CIP dans le repère céleste	pos.eop.dX		oui (accepté sur recommandation OVI(GAFF))
Ecart-type Coordonnée X du CIP dans le repère Terrestre	pos.eop.dY		oui
Ecart-type Coordonnée Y du CIP dans le repère Terrestre	stat.stdev.pos.eop.xp		oui
Ecart-type Coordonnée Y du CIP dans le repère Terrestre	stat.stdev.pos.eop.yp		oui
Ecart-type Vitesse X du CIP dans le repère Terrestre	stat.stdev.arith.rate.pos.eop.xp		oui
Ecart-type Vitesse Y du CIP dans le repère Terrestre	stat.stdev.arith.rate.pos.eop.yp		oui
Ecart-type UT1-UTC	stat.stdev.pos.eop.UT1mUTC		oui
Ecart-type Longueur du jour	stat.stdev.arith.rate.pos.eop.UT1mUTC		oui
<b>Système de Référence Terrestre</b>			
Coordonnées X	pos.cartesian.x	coordonnées cartésiennes géocentriques	oui
Coordonnées Y	pos.cartesian.x	coordonnées cartésiennes géocentriques	oui
Coordonnées Z	pos.cartesian.x	coordonnées cartésiennes géocentriques	oui
Vitesse en X	arith.rate.pos.cartesian.x	coordonnées cartésiennes géocentriques	oui
Vitesse en Y	arith.rate.pos.cartesian.y	coordonnées cartésiennes géocentriques	oui
Vitesse en Z	arith.rate.pos.cartesian.z	coordonnées cartésiennes géocentriques	oui
Ecart-type position en X	stat.stdev.pos.cartesian.x	coordonnées cartésiennes géocentriques	oui
Ecart-type position en Y	stat.stdev.pos.cartesian.y		oui
Ecart-type position en Z	stat.stdev.pos.cartesian.z		oui
Ecart-type vitesse en X	stat.stdev.arith.rate.pos.cartesian.x		oui
Ecart-type vitesse en Y	stat.stdev.arith.rate.pos.cartesian.y		oui
Ecart-type vitesse en Z	stat.stdev.arith.rate.pos.cartesian.z		oui
Vitesse en Est	arith.rate.pos.topocentric.east	repère centré sur le point (repère topocentrique)	oui (accepté sur recommandation OVI(GAFF))
Vitesse en Nord	arith.rate.pos.topocentric.north	repère centré sur le point (repère topocentrique)	oui
Vitesse verticale	arith.rate.pos.topocentric.up	repère centré sur le point (repère topocentrique)	oui
Ecart-type Vitesse en Est	stat.stdev.arith.rate.pos.topocentric.east		oui
Ecart-type Vitesse en Nord	stat.stdev.arith.rate.pos.topocentric.north		oui
Ecart-type Vitesse verticale	stat.stdev.arith.rate.pos.topocentric.up		oui



# Example of a VOTable file : ICRF-2

```

<?xml version="1.0" encoding="UTF-8" ?>
- <VOTABLE version="1.1" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://www.ivoa.net/xml/VOTable/v1.1" xsi:schemaLoca
  http://www.ivoa.net/xml/VOTable/v1.1">
  <DESCRIPTION>VizieR Astronomical Server: vizier.cfa.harvard.edu 2008-02-20T13:12:48</DESCRIPTION>
- <DEFINITIONS>
  <COOSYS ID="J2000" system="eq_FK5" equinox="J2000" />
</DEFINITIONS>
<INFO ID="Ref" name="-ref" value="VOTx12474" />
<INFO ID="MaxTuples" name="-out.max" value="50000" />
- <RESOURCE ID="yCat_51273587" name="J/AJ/127/3587">
  <DESCRIPTION>VLBI ICRF. II (Fey+, 2004)</DESCRIPTION>
- <TABLE ID="J_AJ_127_3587_icrf" name="J/AJ/127/3587/icrf">
  <DESCRIPTION>All ICRF positions (tables 1, 2 and 3 of the paper)</DESCRIPTION>
  <!-- Now comes the definition of each field -->
- <FIELD name="RAJ2000" ucd="pos.eq.ra;meta.main" ref="J2000" datatype="double" width="13" precision="9" unit="deg">
  <DESCRIPTION>Right ascension (FK5) Equinox=J2000. (computed by VizieR, not part of the original data)</DESCRIPTION>
  <!-- ucd="POS_EQ_RA_MAIN" -->
</FIELD>
- <FIELD name="DEJ2000" ucd="pos.eq.dec;meta.main" ref="J2000" datatype="double" width="13" precision="9" unit="deg">
  <DESCRIPTION>Declination (FK5) Equinox=J2000. (computed by VizieR, not part of the original data)</DESCRIPTION>
  <!-- ucd="POS_EQ_DEC_MAIN" -->
</FIELD>
- <FIELD name="ICRF" ucd="ID_MAIN" datatype="char" arraysize="16">
  <DESCRIPTION>ICRF designation (1)</DESCRIPTION>
  <!-- ucd="(unassigned)" -->
</FIELD>
- <FIELD name="n_ICRF" ucd="NOTE" datatype="char">
  <DESCRIPTION>{\bf n} for new sources (table1), {\bf c} for candidate sources (table2), and {\bf r} for revised positions (table3)</DESCRIP
  <!-- ucd="(unassigned)" -->
</FIELD>
- <FIELD name="RAJ2000" ucd="POS_EQ_RA_MAIN" ref="J2000" datatype="char" arraysize="15" unit="h:m:s">
  <DESCRIPTION>Hour of Right Ascension (J2000)</DESCRIPTION>
  <!-- ucd="(unassigned)" -->
</FIELD>
- <FIELD name="DEJ2000" ucd="POS_EQ_DEC_MAIN" ref="J2000" datatype="char" arraysize="15" unit="d:m:s">
  <DESCRIPTION>Degree of Declination (J2000)</DESCRIPTION>

```

## Example of a VOTable file: ILRS station coordinate time series

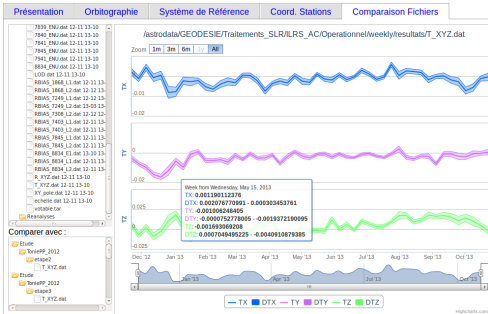
```

▼<VOTABLE xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://www.ivoa.net/xml/VOTable/v1.1"
  xsi:schemaLocation="http://www.ivoa.net/xml/VOTable/v1.1 http://www.ivoa.net/xml/VOTable/v1.1"
  ▼<!--
      ! VOTable written by STIL version 2.9-2x (uk.ac.starlink.votable.VOTableWriter)
      ! at 2013-11-05T13:17:34
      !
  -->
  ▼<RESOURCE>
    ▼<TABLE name="7810_ENU.dat" nrows="34">
      ▼<DESCRIPTION>
        /Users/fde/Downloads/7810_ENU.vot Serie temporelle de la station 7810 Nom station
        position stations : m
      </DESCRIPTION>
      ▼<FIELD datatype="double" name="DATE" ucd="time.epoch;obs" unit="TBD">
        <DESCRIPTION>Description</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="double" name="E" ucd="pos.topocentric.east" unit="m">
        <DESCRIPTION>Description</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="double" name="DE" ucd="stat.stdev;pos.topocentric.east" unit="m">
        <DESCRIPTION>Description</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="double" name="N" ucd="pos.topocentric.north" unit="m">
        <DESCRIPTION>Description</DESCRIPTION>
      </FIELD>
    </TABLE>
  </RESOURCE>
</VOTABLE>

```

# What is available on <http://vo.imcce.fr/slr-ac/>

- GRGS AC Time series projected into a homogeneous reference frame: weekly Helmert transformations w.r.t. ITRF2008
- ASCII and .vot files
- Status of the operational solutions, and reanalyses
  - Stations: SSCs, and biases
  - Additional info: global transformation parameters: translations, rotations, scale
- Comparison tools between different time series



## Conclusions and prospects

- Prototype written in French: comments welcome
- All the framework already well defined
  - Archiving and exploring geodetic products time series very efficient through VO tools
  - additional information can be managed with "VO-event"
- Many tools available and well-documented on the web
  - Visualization tools: "**TOPcat**"
  - UCD finder
  - VOTable: automatic transformation script from and to each common data formats
  - Current up-to-date version: 1.3
- Such files can easily and **automatically be built** from common **ASCII files** using dedicated tools, such as "**stilts**".



Thank you for your attention

