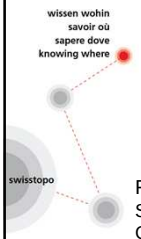
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Office of Topography swisstopo
Geodesy / National Survey



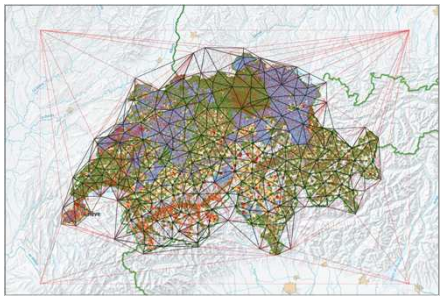


FIG Working Week 2015 Sofia
Session TS05D –
GIS, 3D Data and Cadastre

Towards a Distortion Free National Spatial Data Infrastructure SDI in Switzerland: Approach, Developed Tools and Internet Services for the Change of the Reference Frame

Swiss Federal Office of Topography swisstopo

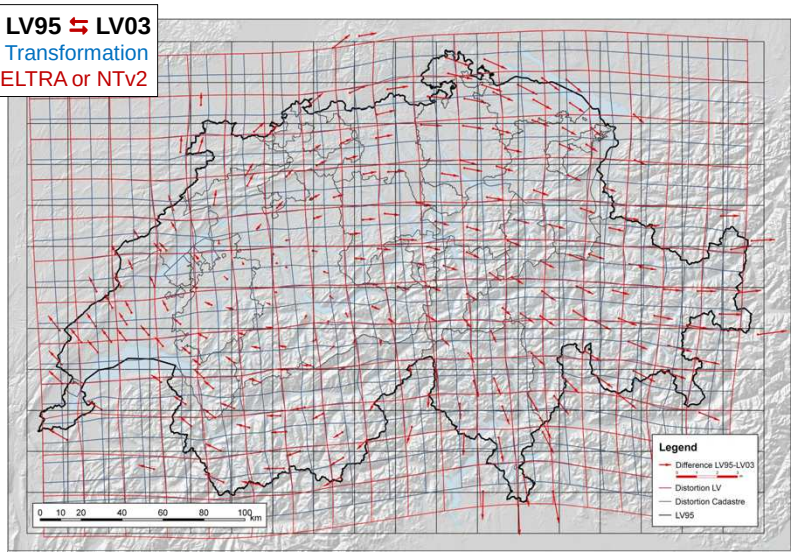
Matthias Kistler, Urs Marti, Jérôme Ray, Christian Baumann and Adrian Wiget

Agenda

1. **Starting Position in Switzerland**
   - Distortions in the historic reference frame LV03
   - Transformation algorithms to get to the new reference frame LV95: FINELTRA and NTv2-grid
2. **Developed Software Tools, Libraries and Plug-In's**
   - GeoSuite software package
   - Swiss transformation library DLL
   - FME Plug-In
3. **Transformation and Interpolation Services**
4. **Visualisation Services**
   - Transformation parameters like accuracy, coordinate change, ..
   - Geodetic control points
5. **Download Services**
6. **Conclusions**

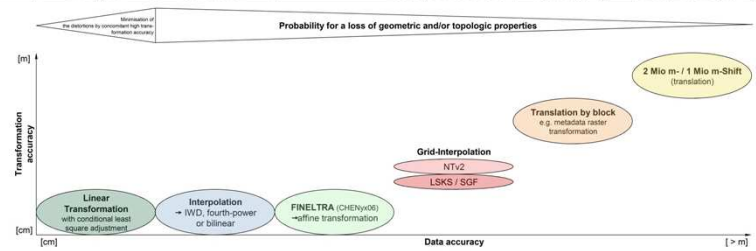
1. Distortions of the historic Reference Frame LV03

ETRF93 ⇆ LV95 ⇆ LV03
3 Parameter Transformation
FINELTRA or NTv2



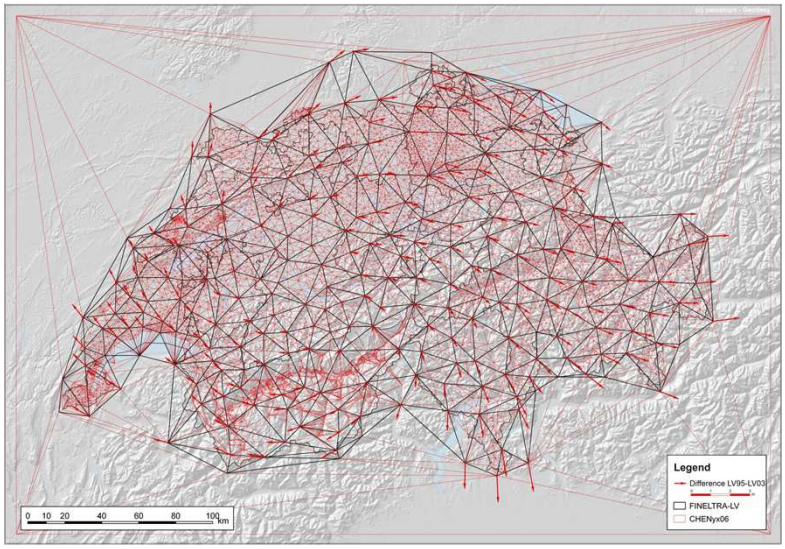
1. Transformation and Interpolation Methods according Data Accuracy and Properties with available Tools

	Transformation and Interpolation	Individual Interpolation	Transformation	Interpolation	Translation	One translation for all Switzerland
Character	Semi-automatic "data migration"	"Data migration with local rectification"	"Data migration"	"On the Fly" directly on the GIS system / GNSS sensor	Transformation per object (centre of gravity)	Change of projection directly in the GIS system



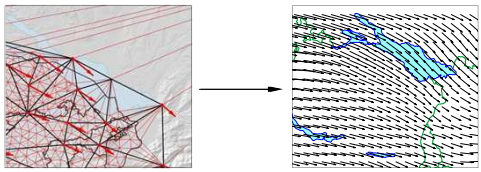
Application	GIS datasets with network structure and important geometric properties as well as high accuracy	Reference datasets with very high (neighborhood) accuracy demands, e.g. in cadastral survey	Cadastre survey "High accurate" GIS datasets	GIS datasets more accurate than 1 dm GNSS sensors	GIS datasets in the range of dm Raster datasets with a pixel size in the range of dm	GIS datasets in the range of m Raster datasets with a pixel size in the range of m
Software / Tools	SwissRailTra95 - SBB Swiss Federal Railways	GeoSuite-TRANSINT TRANSINT for FME	GeoSuite-REFRAME REFRAME for FME	swipos-GIS/GEO® Positionierungsdienst	REFRAME (metadata raster transformation)	Projection engine in the GIS system
Services	-	Transformation accuracy on > map.geo.admin.ch	Transformations service REFRAME Transformation accuracy	Positioning services with realtime-FINELTRA Transformation accuracy	-	-
Program libraries DLL	In house development SBB + REFRAME DLL	TRANSINT-DLL	REFRAME-DLL	Based on REFRAME-DLL	-	-

1. Transformation Algorithms: FINELTRA



1. Transformation Algorithms: NTv2

- **FINELTRA** **NTv2**

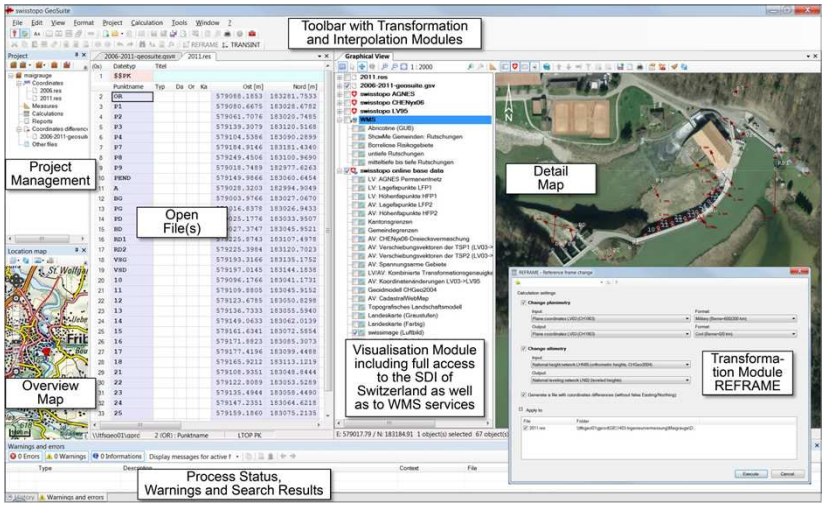


- **1 km grid in projection coordinates for GNSS-receivers**
  - CSCS Leica Geosystems
  - SGF Trimble
- **30" grid for GIS-Software in the format NTv2**

2. Developed Tools

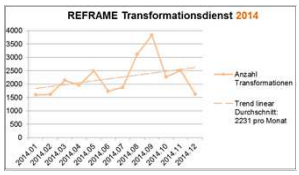
- **GeoSuite Software Package**
  - Pre-defined transformations with **REFRAME** module
  - Individually transformations and interpolations with **TRANSINT** module
  - Powerful visualisation module with access to all datasets of the SDI of Switzerland and an open Web Map Service WMS interface
- **Swiss Transformation Library DLL**
  - Supports transformations in **position** as well as in **altitude**
  - Transforms coordinates from global reference frames to the Swiss local ones and vice versa
  - Has to be **platform independent**
  - The DLL has been integrated in many **GIS extensions** (i.e. for cadastral survey) as well as in the **Swiss Positioning Service swipos:** users can measure with GNSS in real-time in the old reference frame LV03 or the new one LV95 and gets the appropriate correction values
- **Plug-In's**
  - REFRAME and TRANSINT transformers for FME: the former is distributed with the FME standard package by Safe Software so that the official Swiss reference frames (LV03 and LV95) are available worldwide

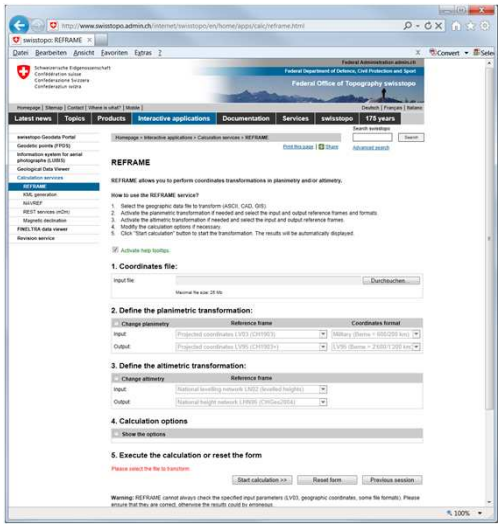
2. GeoSuite Software Package



3. Transformations Services > Machine2Human

- Supports beside text all the (quasi) standard formats from the GIS and CAD world
- Available as transformation- [REFRAME] and interpolation-service [TRANSINT]
- File size limited to 25MB due performance reasons
- Free of charge
- Used for more than 2000 transformations per month (state end 2014)





1. Starting Position
2. Developed Tools
3. **Transformation Services**
4. Visualisation Services
5. Download Services
6. Conclusions

3. Transformations Services > Machine2Machine

- Swiss SDI visualisation service > http://map.geo.admin.ch provides coordinates in 5 reference frames in real time
- The **Swiss Positioning Service swipos** offers real-time GNSS corrections and transformations in 3 different data streams

Real-time services

Pay per use

New access without flat rate contract by GPRS/NTRIP charged CHF 0.50 per minute (communication costs exklusive).

Communication type:	GPRS (General Packet Radio Service, Internet mobile)
Data format (input):	NMEA: approximate position of the GPS receiver required for t computation of a virtual reference station
Data format (output):	RTCM 3.1
Server:	www.swipos.ch, Port: 2101
Protocol:	NTRIP

Data stream	Position	Height	Remark
VRS-LV95-LHN95	LV95	LHN95	no transformation
VRS-LV03-LN02	LV03*	LN02**	real-time FINELTRA and HTRANS
VRS-LV95-LN02	LV95	LN02**	real-time HTRANS

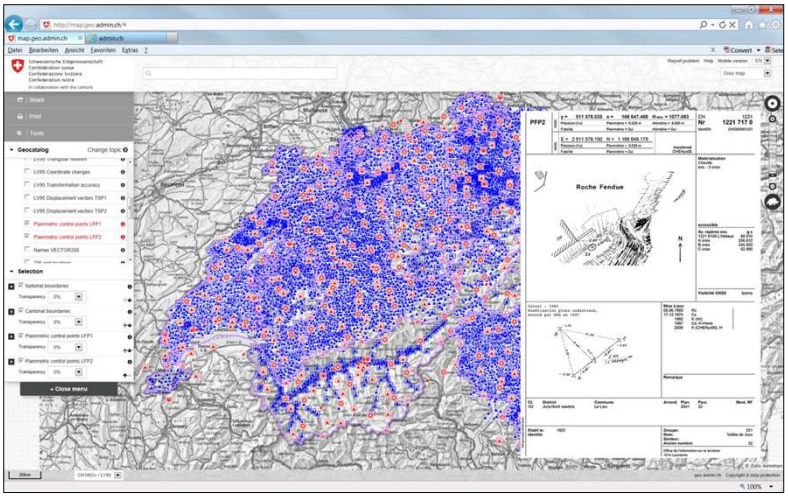
1. Starting Position
2. Developed Tools
3. **Transformation Services**
4. Visualisation Services
5. Download Services
6. Conclusions

- GNSS corrections only
- GNSS corrections plus position distortions
- GNSS corrections plus height distortions

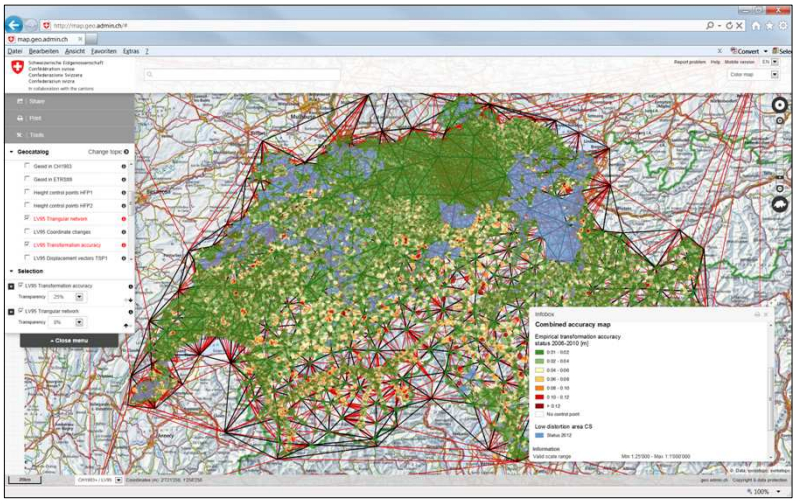
4. Visualisation Services

- Free access to almost 200 data sets of the SDI of Switzerland over the visualisation Service > http://map.geo.admin.ch
- Works on desktop computers as well as on mobile devices or tablets
- Supports KML and WMS import
- All the transformations parameters can be visualized, for example:
  - Triangular network for affine transformation by finite elements (FINELTRA) with pass points
  - Transformation accuracy
  - "GNSS ready zones" for cadastral survey (no local adaptation necessary)
  - Coordinate changes
  - Geodetic control points on national and cantonal / state level

4. Visualisation Services: Geodetic Control Points



4. Visualisation Services: Transformation Parameters



1. Starting Position
2. Developed Tools
3. Transformation Services
4. **Visualisation Services**
5. Download Services
6. Conclusions

5. Download Services

- Swiss transformation Library DLL
- Transformation data set CHENyx06
- FME Plug-In
- Protocol of the geodetic control points

1. Starting Position
2. Developed Tools
3. Transformation Services
4. Visualisation Services
5. **Download Services**
6. Conclusions

6. Conclusions

- When the tools are ready to transform a SDI from a historic reference frame to a new one, it will take quite a while until the last data set is migrated. Timeline for Switzerland:
  90ties: Definition and realisation of the new Swiss reference frame LV95
  2006: High accurate transformation data set CHENyx06 realised
  2007 More and more software tools available (until 2010)
  Positioning service swipos supports 2 reference frames
  2016: Last reference data set should be transformed
  2020: Last base data set should be transformed
- The most convenient way to transform complete SDI's is to change the coordinates directly in the database (without export and/or import).
- Smaller SDI's can be transformed with FME or transformations services.
- After the transformation the geometric and topologic properties have to be restored and the data quality has to be tested.
- The more user friendly the software tools are, the faster the stakeholders change their SDI's.

Thank you for your attention!

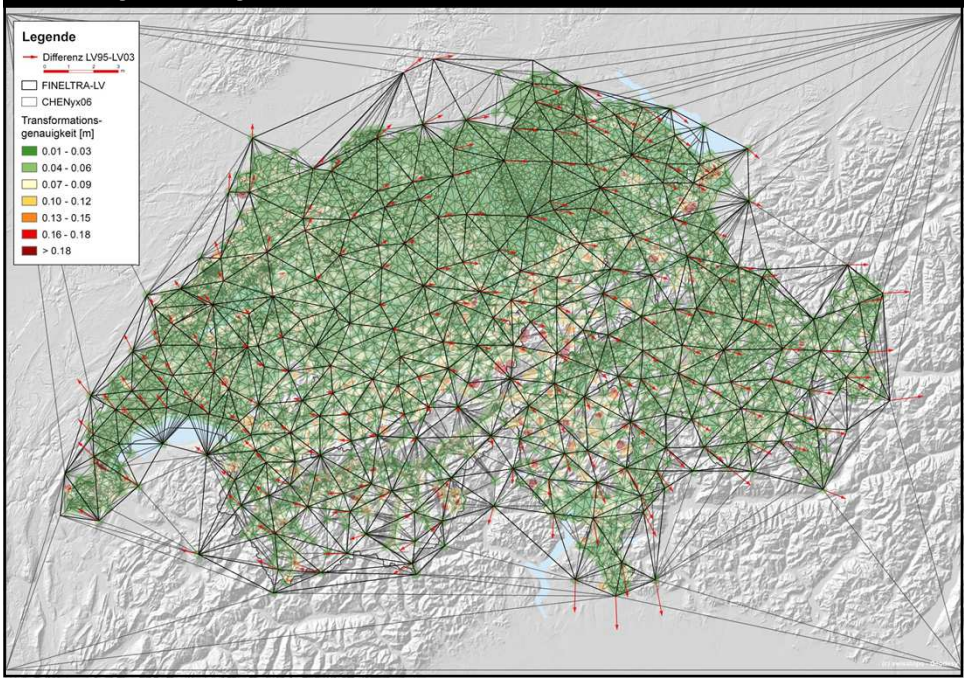
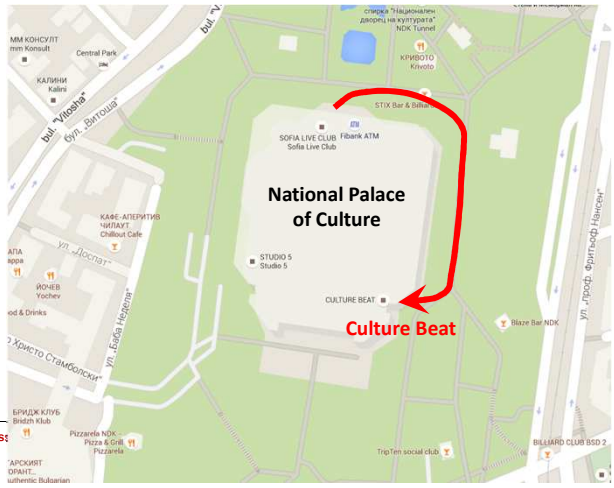


FIG Working Week Switzerland 2019

Get to know us

Come along, have a drink, and get surprised!!!

Wednesday, 20 May, 17h30-18h30 at "Culture Beat"



Federal Office of Topography swiss