

Automatische web-basierte Bereitstellung und Analyse von Fernerkundungsprodukten

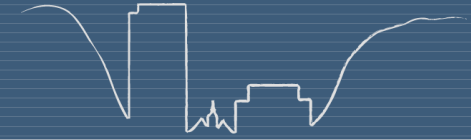
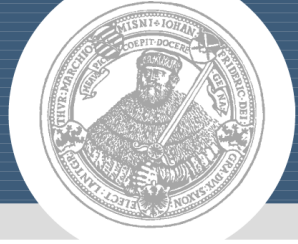
Jonas Eberle, PD Dr. Soeren Hese, Prof. Dr. Christiane Schmullius

Department for Earth Observation

Institute of Geography

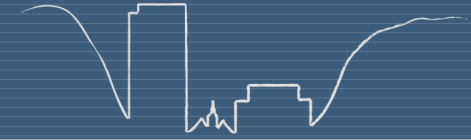
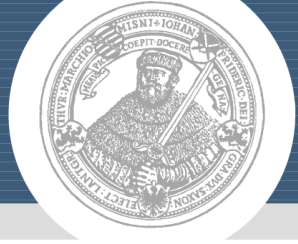
University of Jena

Germany



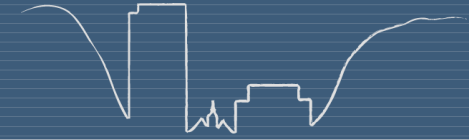
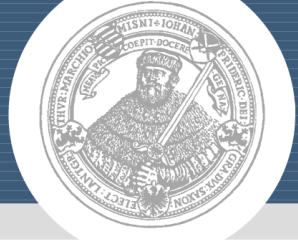
Über mich

- Jonas Eberle
 - Doktorand an der Friedrich-Schiller-Universität Jena
 - Institut für Geographie: Abteilung Erdbeobachtung
 - Informatiker mit Fokus auf Webentwicklung
- Mein Fokus in der Erdbeobachtung
 - Anwendung und Automatisierung entwickelter Algorithmen
 - Standardkonforme Datenbereitstellung
 - Analyse / Überwachen von Zeitreihendaten
- „Von der wissenschaftlichen Entwicklung zur Praxisreife“
 - Automatische Ableitung von Informationen
 - Bereitstellung der neuen Informationen



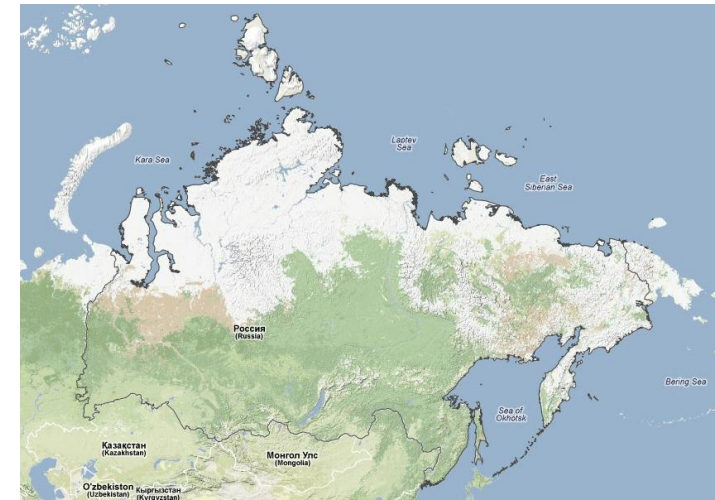
Automatische web-basierte Bereitstellung und Analyse von Fernerkundungsprodukten

- Automatische Bereitstellung
 - Regelmäßige Abfrage und Verarbeitung neuer Daten
 - Vom Download bis zum bereitgestellten Produkt bzw. Information
- Web-basierte Bereitstellung
 - Zugriff auf Daten über Dienste und Geoportal
 - OGC-konforme Bereitstellung der Daten
(OGC = Open Geospatial Consortium)

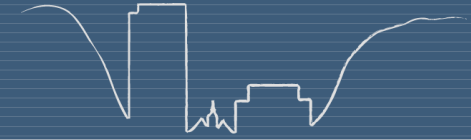
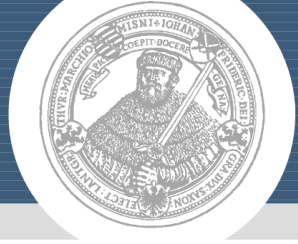


Projekt: Siberian Earth System Science Cluster

- Siberian
 - Testgebiet: Sibirien
 - Entwickelte Infrastruktur / Techniken lassen sich global anwenden!
- Earth System Science
 - Kein “spezieller” thematischer Fokus
 - Interdisziplinäre Informationsprodukte
- Cluster
 - Geodateninfrastruktur
 - Datenverarbeitung und –bereitstellung mit freien Standards

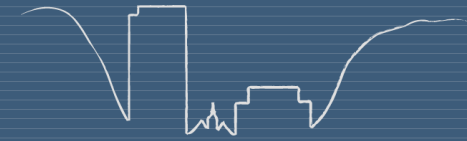


Testgebiet Sibirien

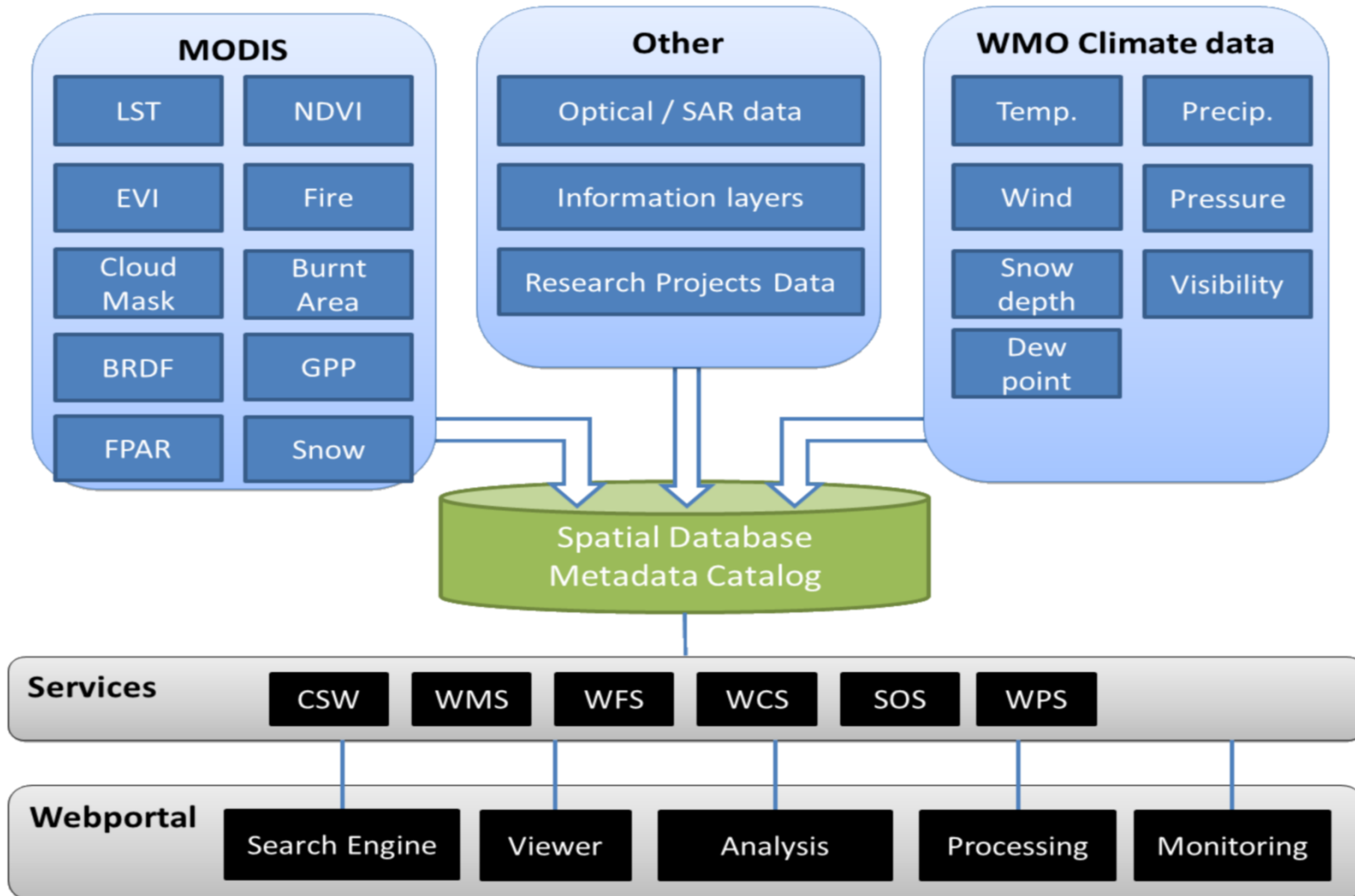


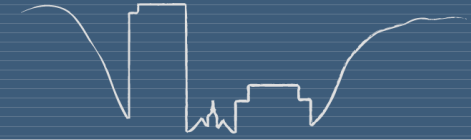
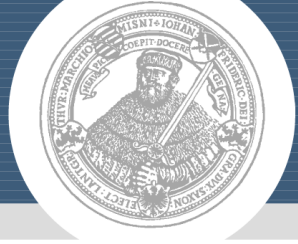
Verwendete Daten

- Voraussetzungen für automatische Bereitstellung
 - Daten mit automatisch abgeleiteten Produkten
 - Download der Daten / Produkte muss „script-bar“ sein
 - Aktuelle Zeitreihendaten
 - Kostenlose Daten
- Datensätze
 - MODIS Produkte
 - Global mit unterschiedlichen zeitlichen und räumlichen Auflösungen
 - Regelmäßig aktualisiert (von täglich bis jährlich)
 - Klimadaten der WMO / NOAA
 - Klimadaten von über 30.000 Stationen weltweit
 - Tägliche „Zusammenfassung“



SIB-ESS-C: Datenverarbeitung und -bereitstellung





Datenbank

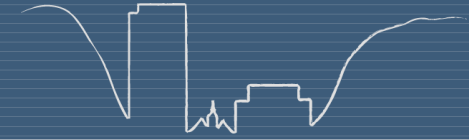
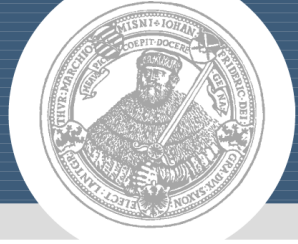
- MODIS Übersichtstabelle
 - Siehe nächste Folie
 - Beschreibung der integrierten MODIS-Produkte
 - Zum Konfigurieren der Geodienste und Erstellung der Metadaten
- Datentabellen

MODIS-Produkte

Spalte	Typ	Beschreibung
Location	Text	Link GeoTIFF-Datei
Geom	MultiPolygon	Bounding Box
Date	Date	Datum
Raster	Rast	Integrierte GeoTiff-Datei

Klimastationsdaten

Spalte	Typ	Beschreibung
Name	Text	Stationsname
Geom	Point	Georeferenz
Begin	Date	Start der Zeitserie
End	Date	Ende der Zeitserie
Location	Text	Link zur CSV-Datei
Metadata ID	Text	Metadaten ID
...		



Datenbank: MODIS Übersichtstabelle

Produkt	
Shortname	MOD11C3
Platform	Terra
Dataset	MODIS_MONTHLY_0.05DE G_CMG_LST:LST_Day_CMG
Raster Type	CMG

Quelle	
FTP Host	e4ftl01.cr.usgs.gov
FTP Directory	/Modis_Composites/MOLT

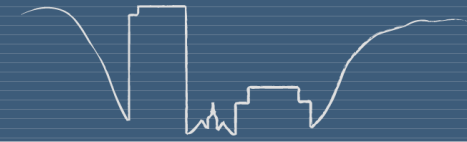
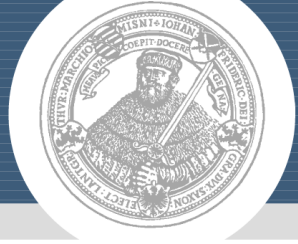
Metadaten	
FileIdentifier	MODIS_MOD11_C3_LST_D ay_Series
Title	Monthly Daytime Land Surface Temperature from MODIS Terra
Abstract	...
Keywords	MODIS,Terra,Siberia,Tempe rature,Global,Monthly,Seri es,Daytime
Lineage	...

Daten	
Description	Land Surface Temperature
Data Type	RASTER
ImageType	Physical Measurement
SRS	EPSG:4326
BBOX	57.1301270 81.2734985 179.8292847 42.2901001
Columns	2454
Rows	780
Resolution	0.05
ScaleFactor	0.02
NoDataValue	0
Time Begin	2000-03-01
Time End	2012-09-01
Time Interval	P1M
Dates	...

Layer	
Layername	mod11c3_lst_day
Tileitem	Location
Timeitem	Date
Templates	header_lst.html
SRS	EPSG:900913 EPSG:4326

Services	
URL	http://artemis.geogr.uni- jena.de/sibessc/modis
Protocol	WebCoverageService:1.0. 0:HTTP
Description	MODIS Terra LST Day Monthly

- Metadata and Processing Information for each dataset
- Used for Metadata Records, MapServer & MapCache-Configuration



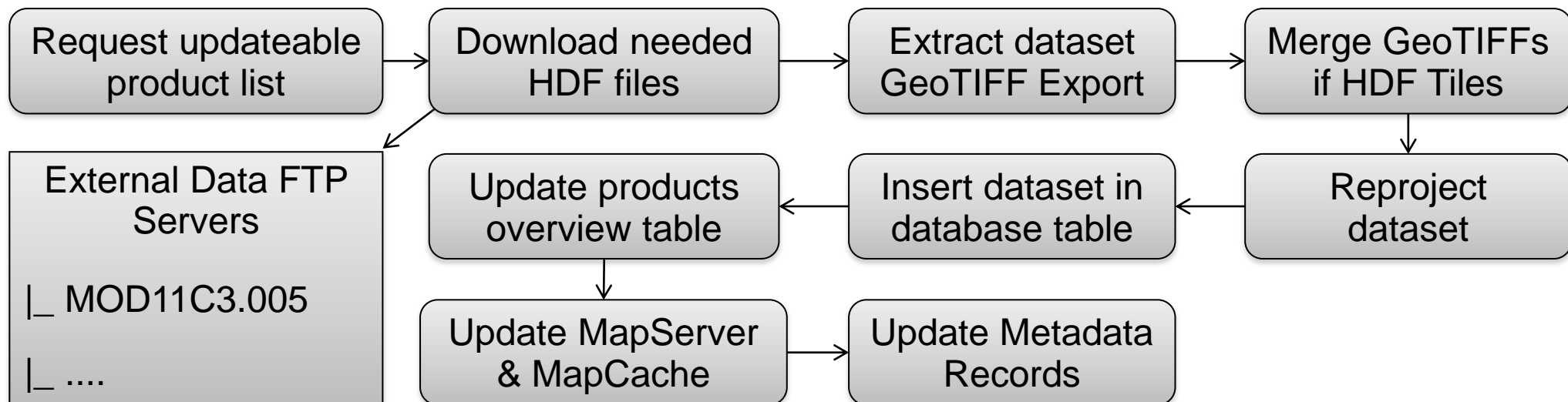
Automatische Datenbereitstellung: MODIS

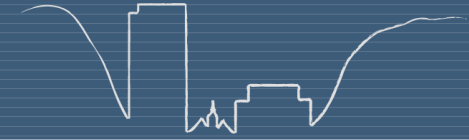
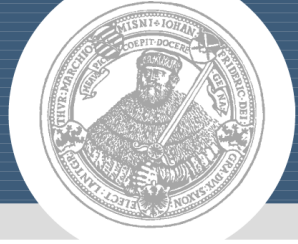
Produkte: LST, NDVI, EVI, Snow Cover, Burnt Area

Zeitliche Auflösung: Täglich, 8-Tages, 16-Tages, Monatlich

Räumliche Auflösung: 0.05 Grad, 1km, 500m

Workflow:

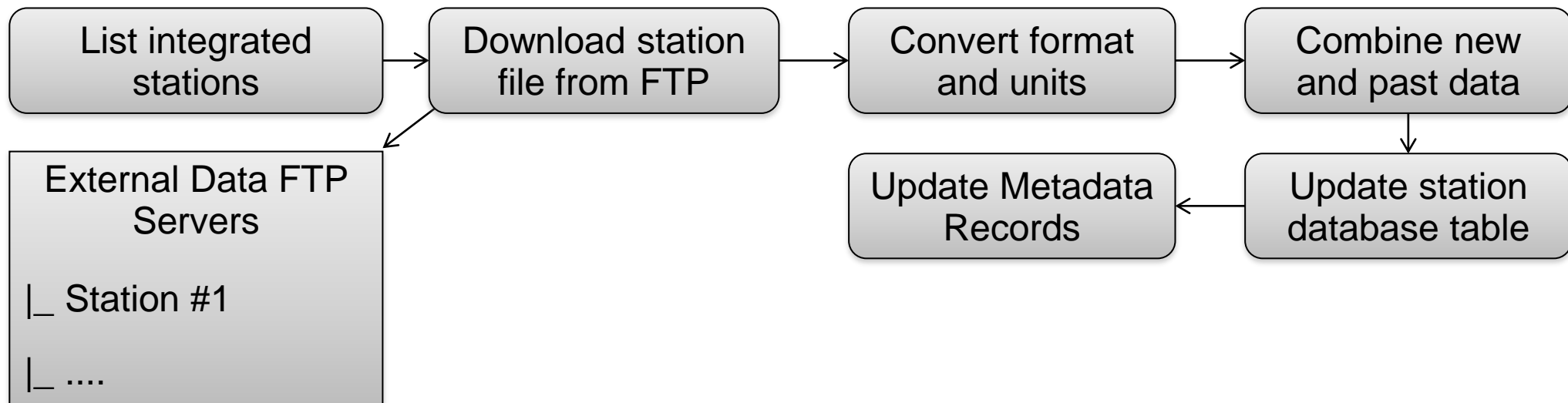


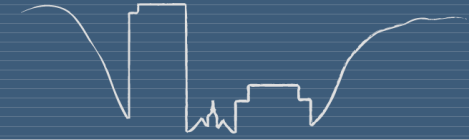
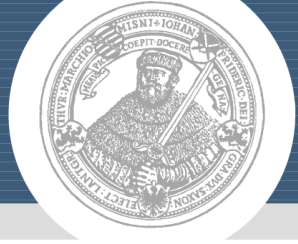


Automatische Datenbereitstellung: Klimadaten

Datensatz: Global Surface Summary of the Day (GSOD)
Daten-Provider: WMO-Stationen, vertrieben von NOAA
Parameter: Temp., Niederschlag, Schneetiefe, Windgeschw.
Zeitliche Auflösung: Täglich

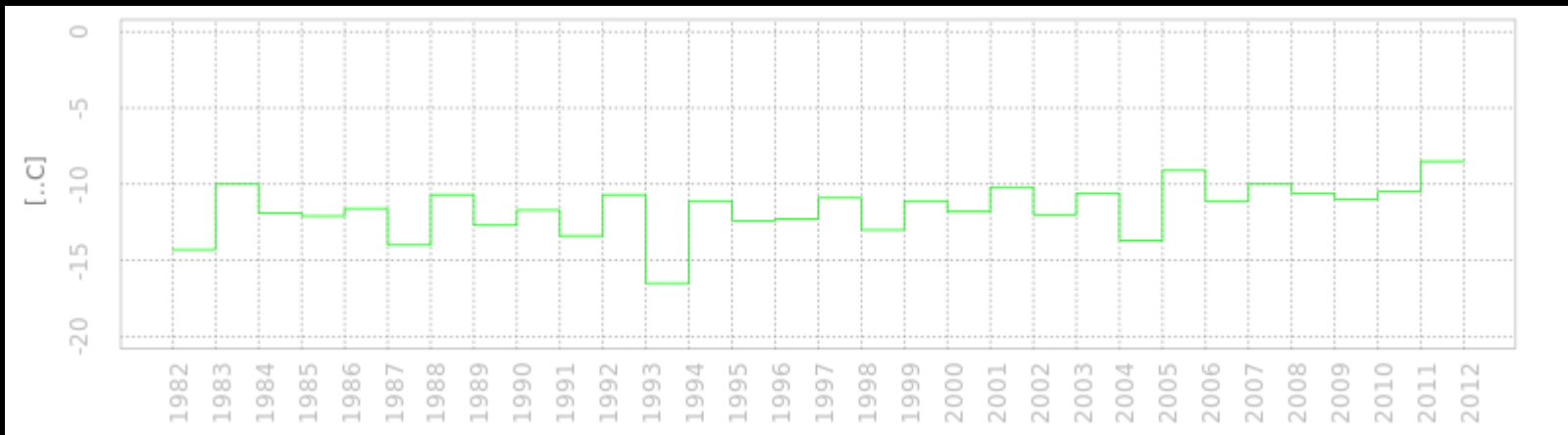
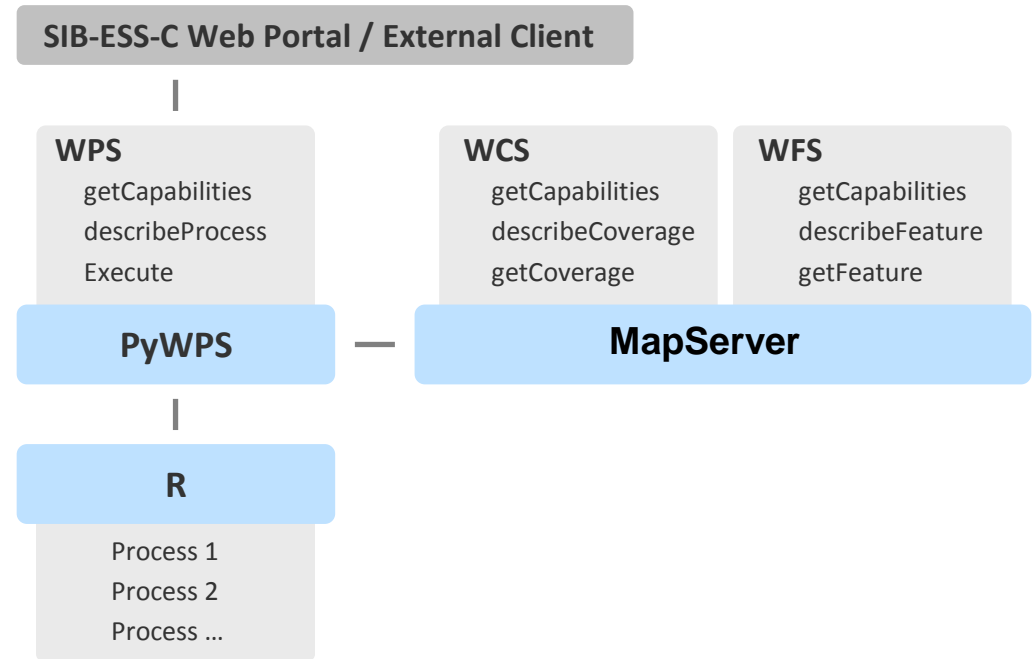
Workflow:

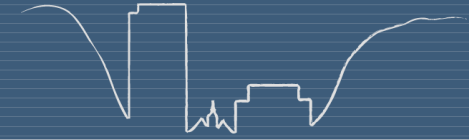
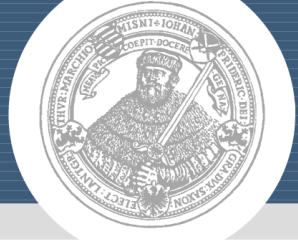




Datenanalyse

- **Verfügbare Funktionen:**
 - Single Time-series plot
 - Dual Time-series (difference) plot
 - Difference of 2 images
 - Scatter plot of 2 images
 - Histogram of an image





Geodienste

- Data Visualization and Access (OGC WMS, WFS, WCS)

- MapServer 6
- MapCache
- PostGIS 2



- Metadata (OGC CSW)

- pyCSW

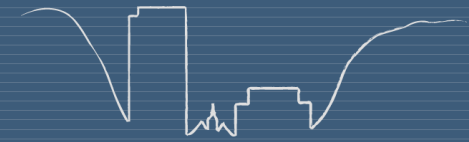


- Data Analysis (OGC WPS)

- pyWPS
- R

PyWPS

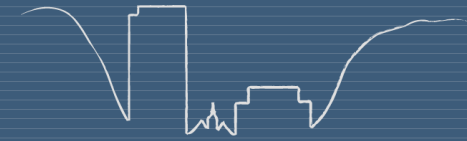




Webportal

The screenshot displays a web portal interface for land surface temperature data. The main map shows a geographical area with a color-coded temperature scale. Several panels are visible:

- Current layers:** A panel on the left showing the selected layer "Daily Daytime Land Surface Temperature from MODIS Terra" with a description, transparency slider, and date selection (Sep 2012).
- Metadata Panel:** A central panel with tabs for METADATA, ANALYSIS, and DOWNLOAD. It contains detailed information:
 - IDENTIFIER:** MODIS_MOD11_A1_LST_Day_Series
 - RESOURCE TITLE:** Daily Daytime Land Surface Temperature from MODIS Terra
 - RESOURCE OVERVIEW:** Time-series of dail Terra MODIS daytime land surface temperature in Kelvin at 1 km spatial resolution. To retrieve actual values in Kelvin a scale factor of 0.02 has to be applied. The unscaled nodata value is encoded as 0. Original MODIS data retrieved from the Land Processes Distributed Active Archive Center (ftp://e4ftl01.cr.usgs.gov/MOLT/).
 - CATEGORY:** Umwelt
 - KEYWORDS:** MODIS,Terra,Siberia,Temperature,Global,Daily,Series,Daytim
 - BOUNDING BOX (UL,LR):** 81.2734985 57.130127,42.2901004 87.130127
 - TEMPORAL EXTENT:** 2010-01-01 until 2012-09-27
 - LINEAGE:** Original MODIS data retrieved from the Land Processes Distributed Active Archive Center (ftp://e4ftl01.cr.usgs.gov/MOLT/) and processed with
- Data Catalog:** A panel on the right showing a tree view of data categories: MODIS, CLIMATE, ADDITIONAL, and PROJECTS. Under "Land Surface Temperature", there are sub-categories for "Daytime Land Surface Temperature" (Terra - 1km - Daily (MOD11A1)) and "Nighttime Land Surface Temperature" (Terra - 0.05deg - Monthly (MOD11C3)).
- Legend:** A color scale legend at the bottom left of the map panel, ranging from 200 to 325 Kelvin.



Webportal – Map Animator

SIB-ESS-C Geoportal

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Search Data

16-daily Normalized Difference Vegetation Index from MODIS Terra

IDENTIFIER
MODIS_MOD13_A1_NDVI_Series

RESOURCE TITLE
16-daily Normalized Difference Vegetation Index from MODIS Terra

RESOURCE OVERVIEW
Time-series of 16-daily Terra MODIS Normalized Difference Vegetation Index (NDVI) at 500 m spatial resolution. To retrieve actual values a scale factor of 0.0001 has to be applied. The unscaled nodata value is encoded as 0. Original MODIS data retrieved from the Land Processes Distributed Active Archive Center (<http://e4ftl01.cr.usgs.gov/MOLT/>).

KEYWORDS
MODIS,Terra,Siberia,NDVI,Normalized Difference Vegetation Index,Vegetation,Index,Global,16-daily,Series

BOUNDING BOX (UL,LR)
81.2734985 57.130127,42.2801004 57.130127

TEMPORAL EXTENT
2010-01-01 until 2012-07-27

LINEAGE
Original MODIS data retrieved from the Land Processes Distributed Active Archive Center (<http://e4ftl01.cr.usgs.gov/MOLT/>) and processed with GDAL 1.9.0.

RESOLUTION
500.0m

POINT OF CONTACT
Friedrich-Schiller-University Jena
Loebdergraben 32
07743 Jena
Contact: Jonas Eberle
Email: jonas.eberle@uni-jena.de

DATA DISTRIBUTOR
Friedrich-Schiller-University Jena

16-daily Normalized Difference Vegetation Index from MODIS Terra
2011-09-14

Current layers
16-daily Normalized Difference Vegetation Index from MODIS Terra

DESCRIPTION
Time-series of 16-daily Terra MODIS Normalized Difference Vegetation Index (NDVI) at 500 m spatial resolution. To retrieve actual values a scale factor of 0.0001 has to be applied. The unscaled nodata value is encoded as 0. Original MODIS data retrieved from the Land Processes Distributed Active Archive Center (<http://e4ftl01.cr.usgs.gov/MOLT/>).

CHANGE DATE OF LAYER
Sep 2011

SHOW LEGEND
-0.0001 0.23 0.23 0.33 0.43 0.53 0.63 0.73 0.83 0.93 0.99

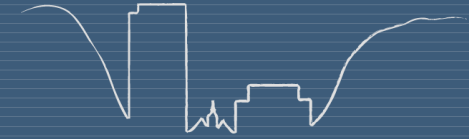
Data Catalog
MODIS CLIMATE ADDITIONAL PROJECTS

Land Surface Temperature

Vegetation Indices
Normalized Difference Vegetation Index (NDVI)
Terra - 500m - 16 Days (MOD13A1)
Time-series of MODIS Normalized Difference Vegetation Index (NDVI). To retrieve actual values a scale factor of 0.0001 has to be applied. The unscaled nodata value is encoded as 0. Original MODIS data retrieved from the Land Processes Distributed Active Archive Center (<http://e4ftl01.cr.usgs.gov/>).

Enhanced Vegetation Index (EVI)
Terra - 0.05deg - Monthly (MOD13C2)
Time-series of MODIS Enhanced Vegetation Index (EVI). To retrieve actual values a scale factor of 0.0001 has to be applied. The unscaled nodata value is encoded as 0.

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Webportal – Map Analysis

SIB-ESS-C Geoportal

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2011-09-14

Username: admin Password: ***** LOGIN

Register as new user

16-daily Normalized Difference Vegetation Index from MODIS Terra

METADATA ANALYSIS DOWNLOAD

SIB-ESS-C WPS 1010: Single Time-series

Description of process

1st Timeseries Input (WCS)

Data Selection: Selected dataset

Start Date: 2011-01-01

End Date: 2012-01-01

Bounding Box

56.3

92.64 Compass 93.37

56.07

Entire Dataset Selection

Current View Manual

Start analysis

Current layers

16-daily Normalized Difference Vegetation Index from MODIS Terra

DESCRIPTION

Time-series of 16-daily Terra MODIS Normalized Difference Vegetation Index (NDVI) at 500 m spatial resolution. To retrieve actual values a scale factor of 0.0001 has to be applied. The unscaled nodata value is encoded as 0. Original MODIS data retrieved from the Land Processes Distributed Active Archive Center (ftp://e4ft01.cr.usgs.gov/MOLT).

CHANGE LAYER TRANSPARENCY

CHANGE DATE OF LAYER

May 2010

Su Mo Tu We Th Fr Sa

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

SHOW LEGEND

0.05 0.01 0.25 0.29 0.33 0.40 0.46 0.52 0.58 0.64 0.70 0.80 0.85

Data Catalog

MODIS CLIMATE ADDITIONAL PROJECTS

Land Surface Temperature

Vegetation Indices

Normalized Difference Vegetation Index (NDVI)

Terra - 500m - 16 Days (MOD13A1)

Time-series of MODIS Normalized Difference Vegetation Index (NDVI). To retrieve actual values a scale factor of 0.0001 has to be applied. The unscaled nodata value is encoded as 0. Original MODIS data retrieved from the Land Processes Distributed Active Archive Center (ftp://e4ft01.cr.usgs.gov).

Enhanced Vegetation Index (EVI)

Terra - 0.05deg - Monthly (MOD13C2)

Time-series of MODIS Enhanced Vegetation Index (EVI). To retrieve actual values a scale factor of 0.0001 has to be applied. The unscaled nodata value is encoded as 0.

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Department of Earth Observation

Process Info

Process Time: 2012-08-28T10:01:29Z

Process Name: SIB-ESS-C WPS 1010: Single Time-series plot

Status: Succeeded

PyWPS Process 1010_single_ts_plot successfully calculated

Process Inputs

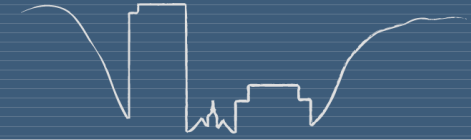
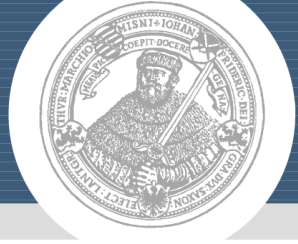
Process Results

Plot file in PNG format:

16-daily NDVI from MODIS Terra in the year 2011
Averaged over region (Lat/Long): 56.1 - 56.3 / 92.6 - 93.4

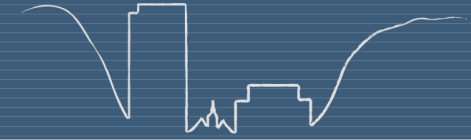
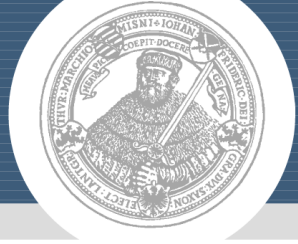
Processing time: 7.25996780396

Search Plot 1 Plot 2 *



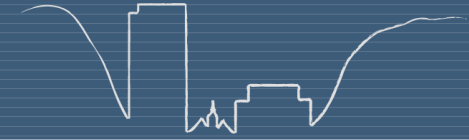
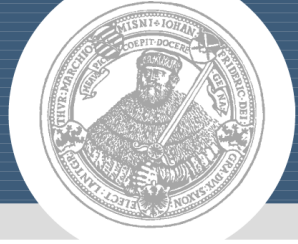
Zusammenfassung

- Entwicklung von automatischen ablaufenden Prozessketten zur **Datenintegration** mit Open Source Software
 - Automatisch ablaufenden Algorithmen notwendig!
 - Datenzugriff muss über Schnittstellen verfügbar sein!
- **Konvertierung** der Daten für mehr Benutzerfreundlichkeit
 - GeoTIFF anstatt HDF
 - CSV anstatt zeichen-getrenntes Format
 - Einheitenkonvertierung (° Fahrenheit → ° Celsius, Meilen → km)
- Entwicklung eines **Geoportals** zur Visualisierung, Download und Analyse der integrierten Zeitreihendaten und einzelnen Datensätzen
 - Wissenschaftlicher / Interessierte können leicht auf Daten zugreifen



Ausblick

- Integration von Time Series Analysis Tools
 - TimeSat, Bfast, ...
- On Demand Verarbeitung
 - Klimadaten mit zeitlich höher aufgelösten Daten
 - Weitere MODIS-Produkte
- Webportal
 - Datenupload
 - Speichern von Kartenansichten und erstellten Plots
- Data Monitoring
 - Veränderungsanalysen und Überwachung von Veränderungen
 - Überwachung von Trends



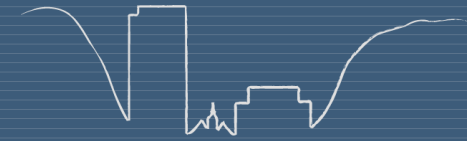
Vielen Dank für Eure Aufmerksamkeit!

Kontaktinformationen:

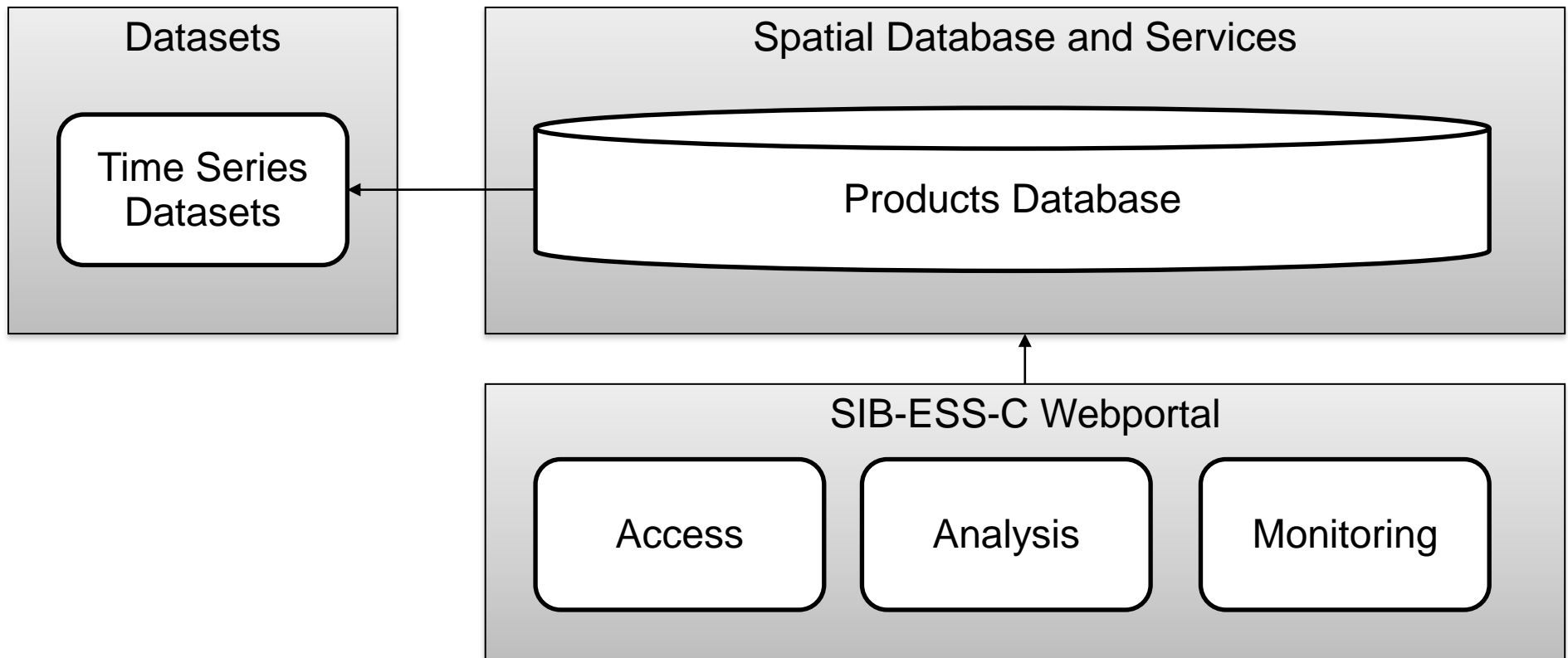
Jonas Eberle
Friedrich-Schiller-University
Institute of Geography
Department for Earth Observation
Loebdergraben 32
07743 Jena, Germany

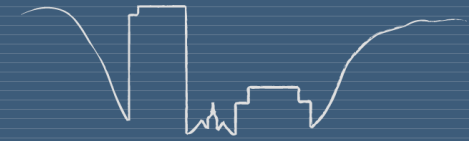
SIB-ESS-C Geoportal:
www.sibessc.uni-jena.de

phone: +49 3641 94 88 89
email: jonas.eberle@uni-jena.de
<http://www.eo.uni-jena.de/7020.0.html>



Main objectives

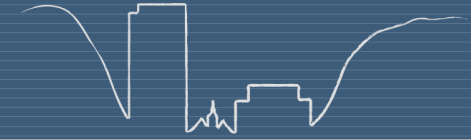
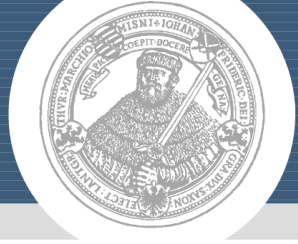




Integrated MODIS products

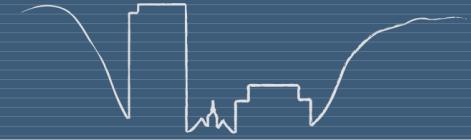
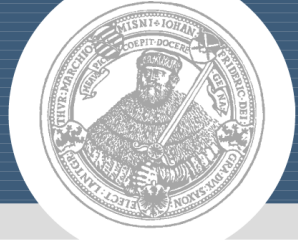
Shortname	Platform	Res. (m)	Temporal Cov.	Data Period	Collection No.
Snow Cover					
MOD10CM	Terra	5600	2000-2012	Monthly	005
MYD10CM	Aqua	5600	2002-2012	Monthly	005
MOD10C2	Terra	5600	2000-2012	8-day	005
MYD10C2	Aqua	5600	2002-2012	8-day	005
Land Surface Temperature					
MOD11C3	Terra	5600	2000-2012	Monthly	005
MYD11C3	Aqua	5600	2002-2012	Monthly	005
MOD11A1	Terra	1000	2010-2012	Daily	005
Vegetation Indices (NDVI, EVI)					
MOD13C2	Terra	5600	2000-2012	Monthly	005
MYD13C2	Aqua	5600	2002-2012	Monthly	005
MOD13C1	Terra	5600	2000-2012	16-day	005
MYD13C1	Aqua	5600	2002-2012	16-day	005
MOD13A1	Terra	500	2010-2012	16-day	005
Cloud Mask					
MOD35_L2	Terra	250	2012	5-min / Daily	-
Burned Area					
MCD45A1	Terra+Aqua	500	2000-2012	Monthly	005

Available products from NASA MODIS sensor. The shortname provides the internal product key.



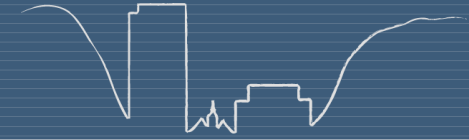
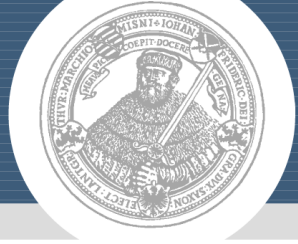
Questions

- How can I get daily climate data from a specific station?
 - Getting data
 - Finding out where to get the data and which stations are available
 - Nice WebGIS available: <http://gis.ncdc.noaa.gov/map/cdo/?thm=themeDaily>
 - Data can further by year and station download via FTP
 - Converting data
 - GSOD data comes in degree Fahrenheit, Inches, Knots
 - But we need degree Celsius, Meter and m/s
 - Further requirement:
 - We need continual data where data gaps are filled with no data values



Services – Standards and Specifications

- Standards:
 - Open Geospatial Consortium (OGC)
 - International Standardization of Organization (ISO)
- Data Visualization and Access
 - Web Map Service with Time support (WMS)
 - Web Feature Service (WFS)
 - Web Coverage Service (WCS)
 - Sensor Observation Service for climate data (SOS) [planned]
 - Catalogue Service for Web (CSW)
- Data Analysis
 - Web Processing Service (WPS)



Webportal – Used Software

- Backend:
 - Drupal Content Management System
 - User Authentication
 - Metadata Proxy
 - WPS client
 - XML to JSON conversion
- Frontend:
 - jQuery + a lot of extensions
 - OpenLayers
 - MapQuery

