

Köppen-Geiger classifications of paleoclimate model simulations

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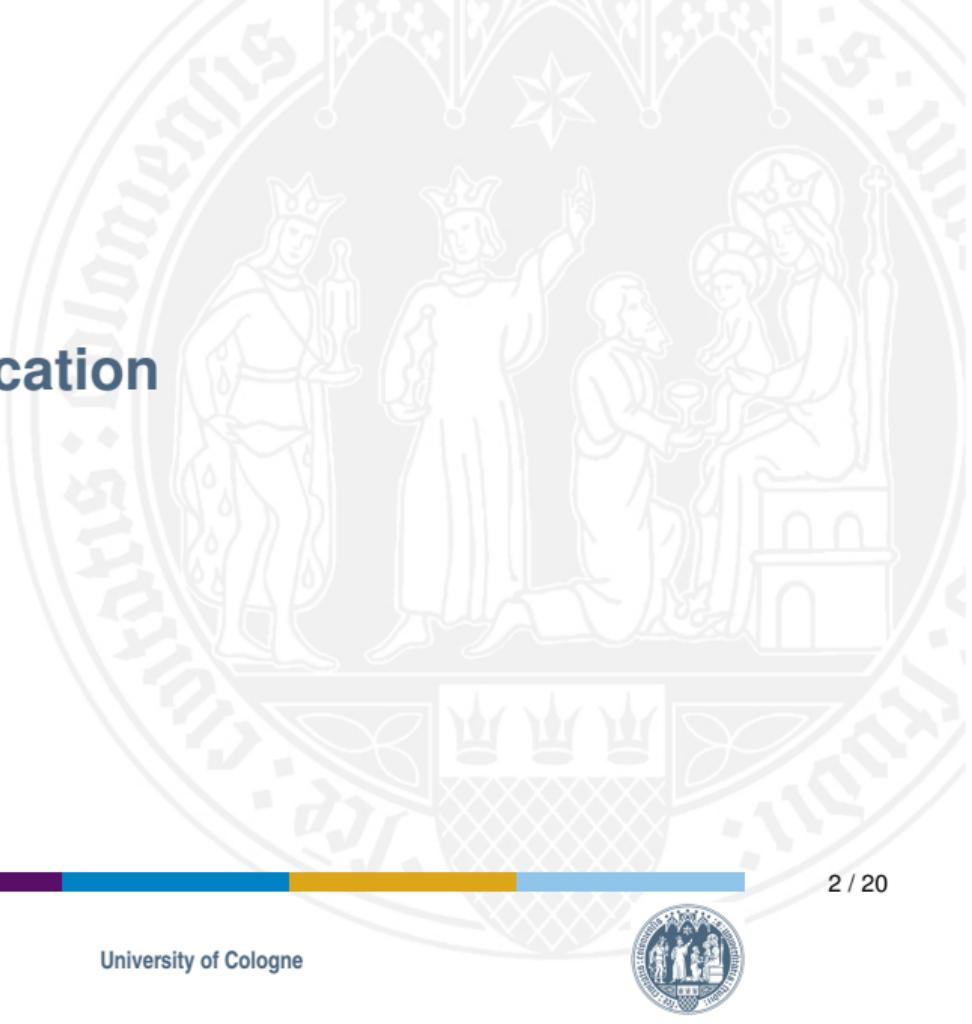
GIS & RS Group, Institute of Geography, University of Cologne

September 11th, 2014 FOSS4G - Portland, OR, USA.

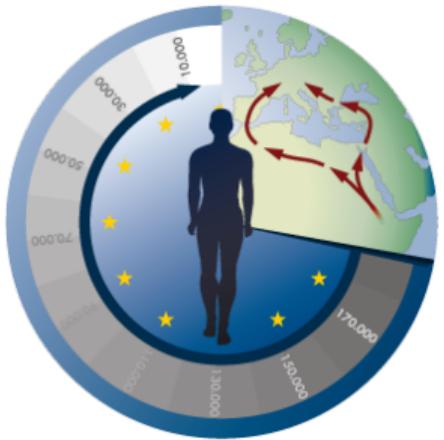
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- 1. Introduction**
- 2. Köppen-Geiger Classification**
- 3. Paleoclimate model**
- 4. Implementation**
- 5. Results**



Introduction



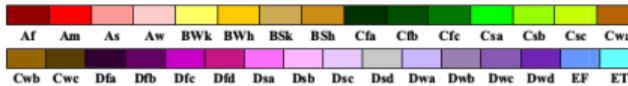
- This project was conducted within the frame of the DFG funded Collaborative Research Centre 806.
- The SFB/CRC 806 is an interdisciplinary research project concerning **Culture-Environment Interaction and Human Mobility in the Late Quaternary**
- www.sfb806.de



Köppen-Geiger Climate Classification

World Map of Köppen-Geiger Climate Classification

updated with CRU TS 2.1 temperature and VASclimO v1.1 precipitation data 1951 to 2000



Main climates

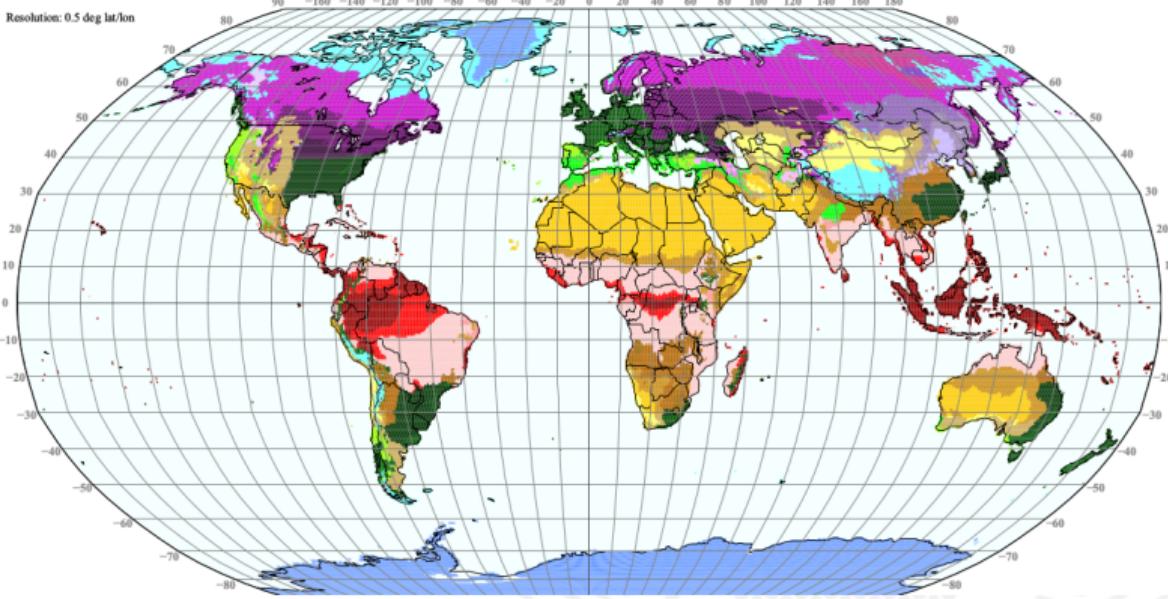
- A: equatorial
- B: arid
- C: warm temperate
- D: snow
- E: polar

Precipitation

- W: desert
- S: steppe
- f: fully humid
- s: summer dry
- w: winter dry
- m: monsoonal

Temperature

- h: hot arid
- k: cold arid
- a: hot summer
- b: warm summer
- c: cool summer
- d: extremely continental
- F: polar frost
- T: polar tundra



Kottek et al. (2006)



Köppen-Geiger Climate Classification

| Variable | Description |
|-----------------|--|
| T_{cold} | coldest month temperature |
| T_{hot} | hottest month temperature |
| P_{dry} | driest month precipitation |
| P_{ann} | mean annual precipitation |
| T_{ann} | mean annual temperature |
| P_{sdry} | precipitation of the driest month in summer |
| P_{swet} | precipitation of wettest month in summer |
| P_{wwet} | precipitation of wettest month in winter |
| P_{wdry} | precipitation of driest month in winter |
| T_{mon10} | count of month per year where temperature is above 10 °C |
| $P_{threshold}$ | If 70% of P_{ann} occurs in winter, $P_{threshold} = 2 * P_{ann}$ If 70% of P_{ann} occurs in summer, $P_{threshold} = 2 * T_{ann} + 28$ Else $P_{threshold} = 2 * T_{ann} + 14$ |



Köppen-Geiger Climate Classification

| 1st | 2nd | 3rd | Description | Criteria |
|-----|-----|-----|-------------|---|
| A | | | Tropics | $T_{cold} \geq 18^{\circ}\text{C}$ |
| | f | | -Rainforest | $P_{dry} \geq 60 \text{ mm}$ |
| | m | | -Monsoon | Not(Af) AND $P_{dry} \geq 100 - P_{ann}/25$ |
| | w | | -Savannah | Not(Af) AND $P_{dry} < 100 - P_{ann}/25$ |
| B | | | Arid | $P_{ann} < 10 \times P_{threshold}$ |
| | W | | -Desert | $P_{ann} < 5 \times P_{threshold}$ |
| | S | | -Steppe | $P_{ann} \geq 5 \times P_{threshold}$ |
| | h | | -Hot | $T_{ann} \geq 18$ |
| | k | | -Cold | $T_{ann} < 18$ |



Köppen-Geiger Climate Classification

| 1st | 2nd | 3rd | Description | Criteria |
|-----|-----|-----|----------------|--|
| C | | | Temperate | $T_{hot} > 10 \text{ AND } 0 < T_{cold} < 18$ |
| | s | | -Dry summer | $P_{sdry} < 40 \text{ AND } P_{sdry} < P_{wwet}$ |
| | w | | -Dry winter | $P_{wdry} < P_{swet} / 10$ |
| | f | | -No dry season | Not(Cs) OR Not(Cw) |
| | | a | -Hot summer | $T_{hot} \geq 22$ |
| | | b | -Warm summer | Not(a) AND $T_{mon10} \geq 4$ |
| | | c | -Cold summer | Not(a or b) AND $1 \leq T_{mon10} < 4$ |



Köppen-Geiger Climate Classification

| 1st | 2nd | 3rd | Description | Criteria |
|-----|-----|-----|-------------------|--|
| D | | | Cold | $T_{hot} > 10 \text{ AND } T_{cold} \leq 0$ |
| | s | | -Dry summer | $P_{sdry} < 40 \text{ AND } P_{sdry} < P_{wwet}/3$ |
| | w | | -Dry winter | $P_{wdry} < P_{swet}/10$ |
| | f | | -No dry season | Not(Ds) AND Not(Dw) |
| | a | | -Hot summer | $T_{hot} \geq 22$ |
| | b | | -Warm summer | Not(a) AND $T_{mon10} \geq 4$ |
| | c | | -Cold summer | Not(a OR b OR d) |
| | d | | -Very cold winter | Not(a OR b) AND $T_{cold} < -38$ |
| E | | | Polar | $T_{hot} < 10$ |
| | T | | -Tundra | $T_{hot} > 0$ |
| | F | | -Frost | $T_{hot} \leq 0$ |



Climate model data

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About WDCC/DKRZ

DKRZ, the German Climate Computing Centre, provides tools and the associated services which are needed to investigate the processes in the climate system. Computer power, data management and guidance to use these tools efficiently. As a national service provider, DKRZ operates a supercomputer center to enable climate simulation and provides the

Resources

Quick Links

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9 / 20



Climate model data

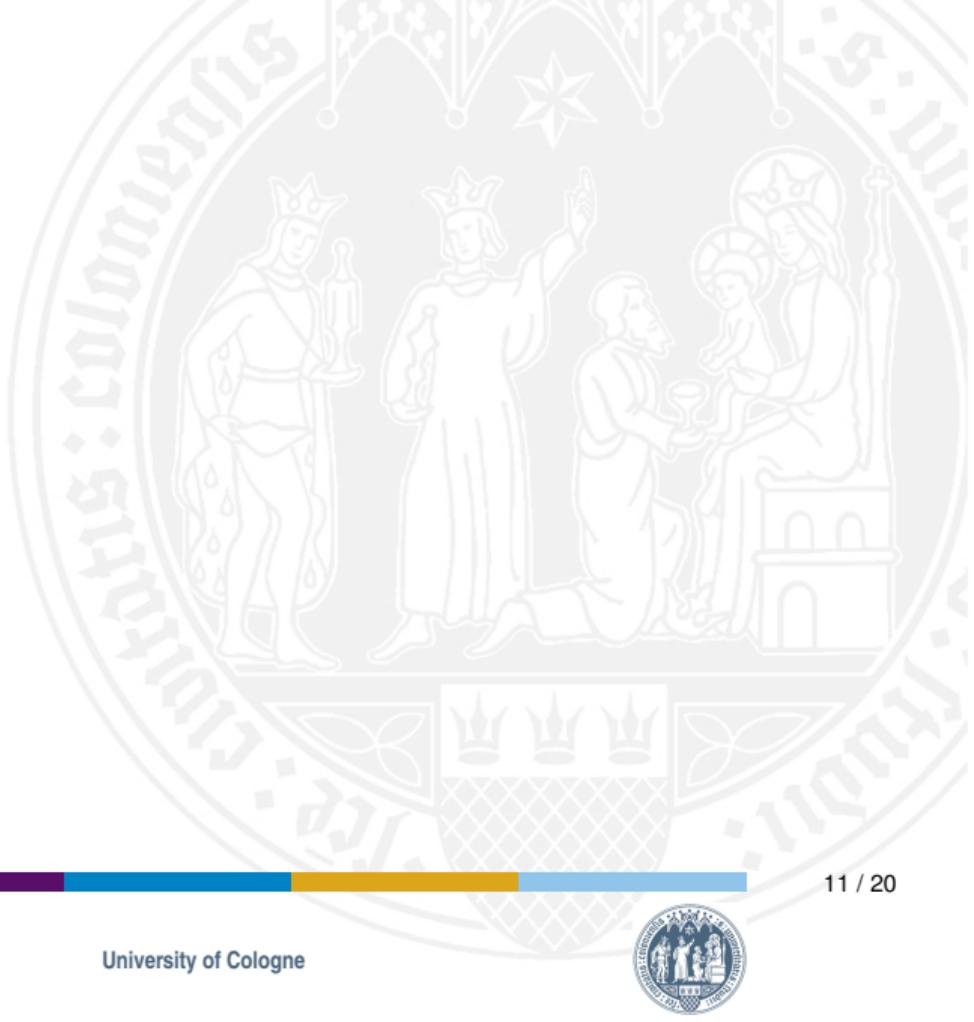
For this study, focus is on the three available experiments from PMIP III:

| Experiment | Var | Model | Realm | Temp. res | Spat. res | Version |
|--------------|-----|---------------------|-------|-----------------------|--|----------|
| PI Control | pr | MPI-ESM-P r1i1p1 | Amon | 150 yrs. (monthly) | 192 × 96 ($1.87^\circ \times 1.25^\circ$) | 20120602 |
| | tas | MPI-ESM-P r1i1p1 | Amon | 150 yrs. (monthly) | 192 × 96 ($1.87^\circ \times 1.25^\circ$) | 20120602 |
| Mid Holocene | pr | MPI-ESM-P r1i1p1 | Amon | 100 yrs. (monthly) | 192 × 96 ($1.87^\circ \times 1.25^\circ$) | 20120602 |
| | tas | MPI-ESM-P r1i1p1 | Amon | 100 yrs. (monthly) | 192 × 96 ($1.87^\circ \times 1.25^\circ$) | 20120602 |
| LGM | pr | MPI-ESM-P r1i1p1 | Amon | 100 yrs. (monthly) | 192 × 96 ($1.87^\circ \times 1.25^\circ$) | 20120602 |
| | tas | MPI-ESM-P r1i1p1 | Amon | 100 yrs. (monthly) | 192 × 96 ($1.87^\circ \times 1.25^\circ$) | 20120602 |

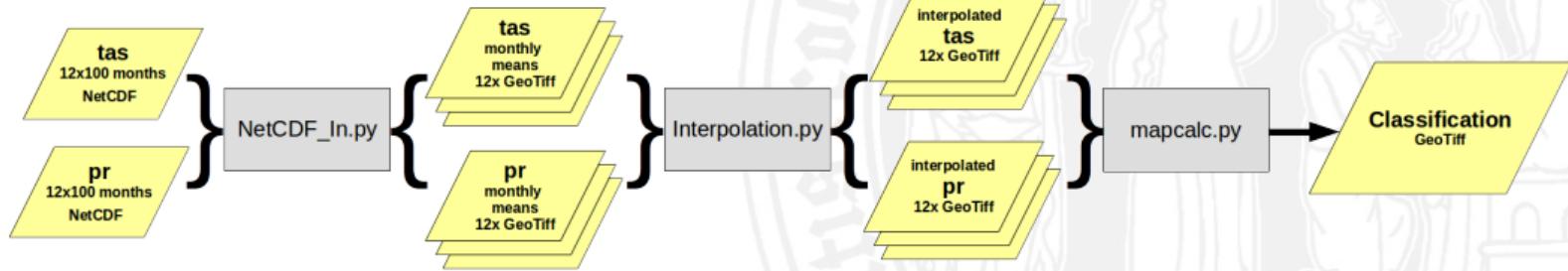


Model Parameters

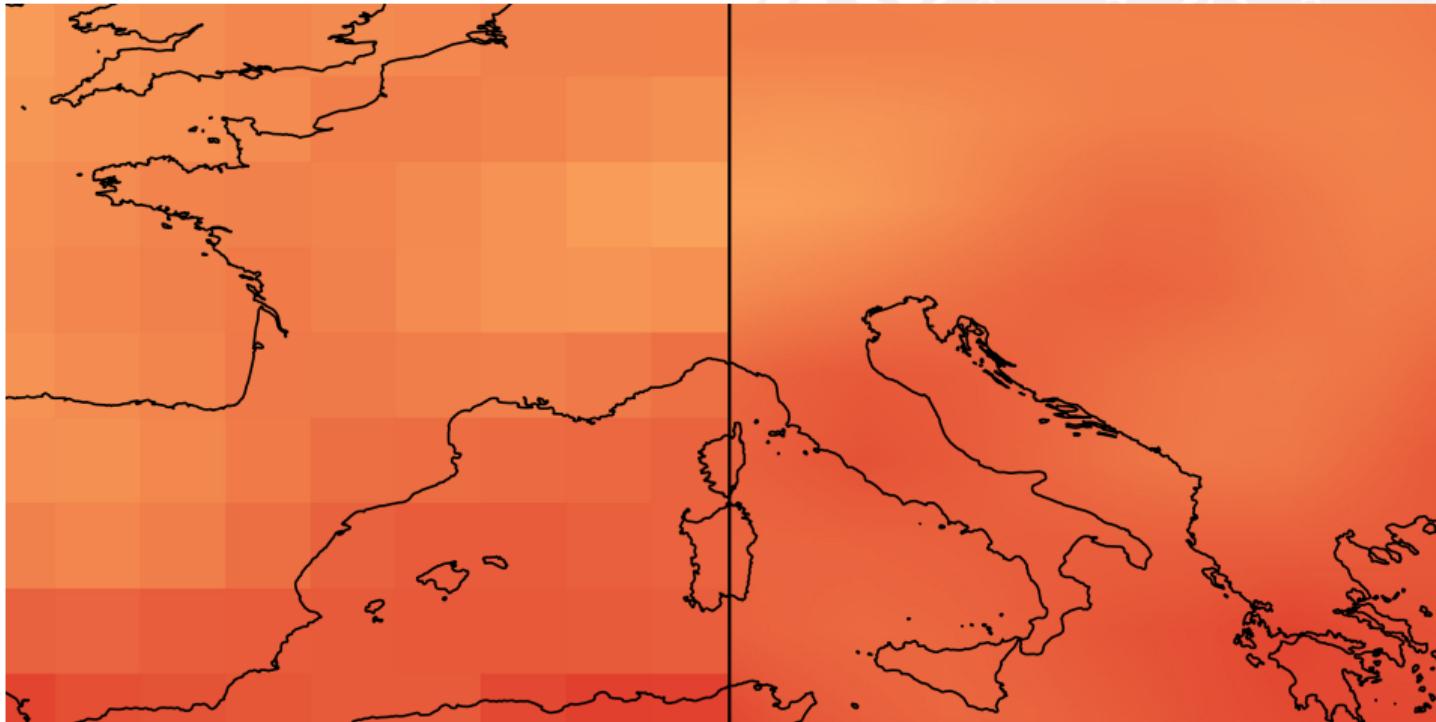
- Orbital parameters
- Date of vernal equinox
- Trace gas concentrations
- Aerosols / Dust forcing
- Solar constant
- Vegetation feedback
- Ice sheets
- Elevation, Bathymetry, Sea level
- ocean salinity
- atmospheric surface pressure



Data processing chain



Interpolation



Köppen-Geiger Mapcalc

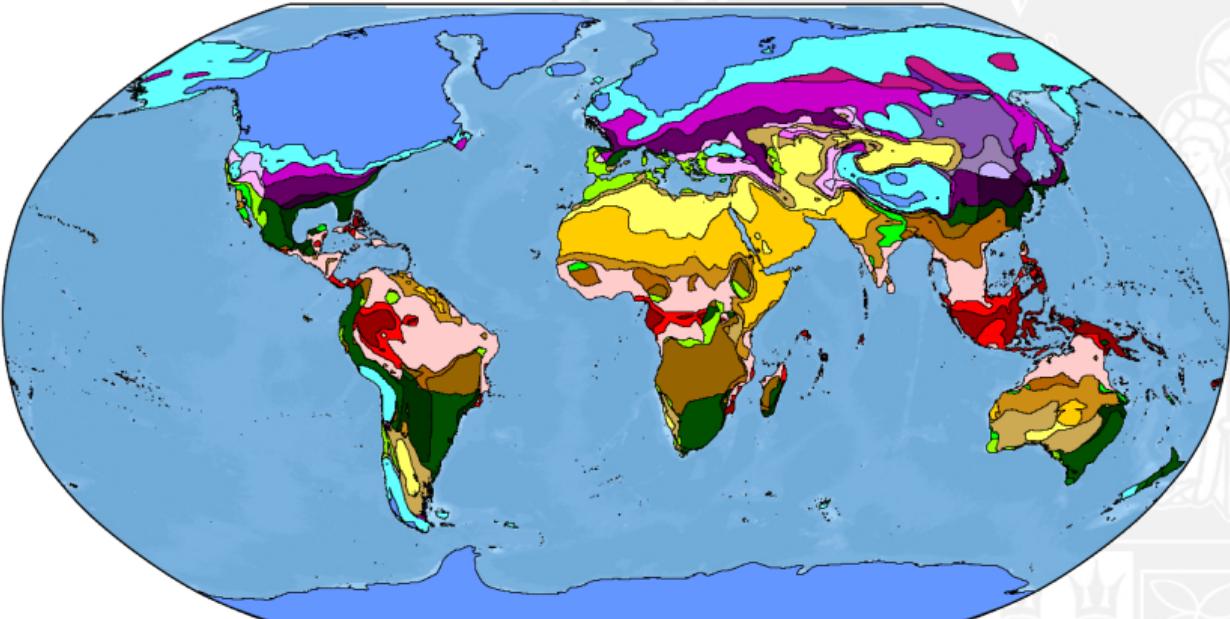
```
#Mean Annual Precipitation
print "Mean Annual Precipitation"
grass.mapcalc('pr_ann = (pr01 + pr02 + pr03 + pr04 + pr05 + pr06 + pr07 + pr08 + pr09 + pr10 + pr11 + pr12) / 12')
grass.mapcalc('pr_ann_mm = pr_ann * (86400 * 30)')
grass.mapcalc('pr_ann_sum = pr01 + pr02 + pr03 + pr04 + pr05 + pr06 + pr07 + pr08 + pr09 + pr10 + pr11 + pr12')
grass.mapcalc('pr_ann_sum_mm = pr_ann_sum * (86400 * 30)')
```

```
#Calculate Summer/Winter (Summer (winter) is defined as the warmer (cooler)
# six month period of ONDJFM and AMJJAS.)
print "Calculate Summer/Winter"
grass.mapcalc('ONDJFM = tas10 + tas11 + tas12 + tas01 + tas02 + tas03')
grass.mapcalc('AMJJAS = tas04 + tas05 + tas06 + tas07 + tas08 + tas09')
grass.mapcalc('nsummer = if(ONDJFM <= AMJJAS, 1, 0)')
```



Results: LGM Classification

- ET
- EF
- BSh
- BSk
- BWh
- BWk
- Af
- Am
- Aw
- Csa
- Csb
- Csc
- Cwa
- Cwb
- Cwc
- Cfa
- Cfb
- Cfc
- Dsa
- Dsb
- Dsc
- Dsd
- Dwa
- Dwb
- Dwc
- Dwd
- Dfa
- Dfb
- Dfc
- Dfd

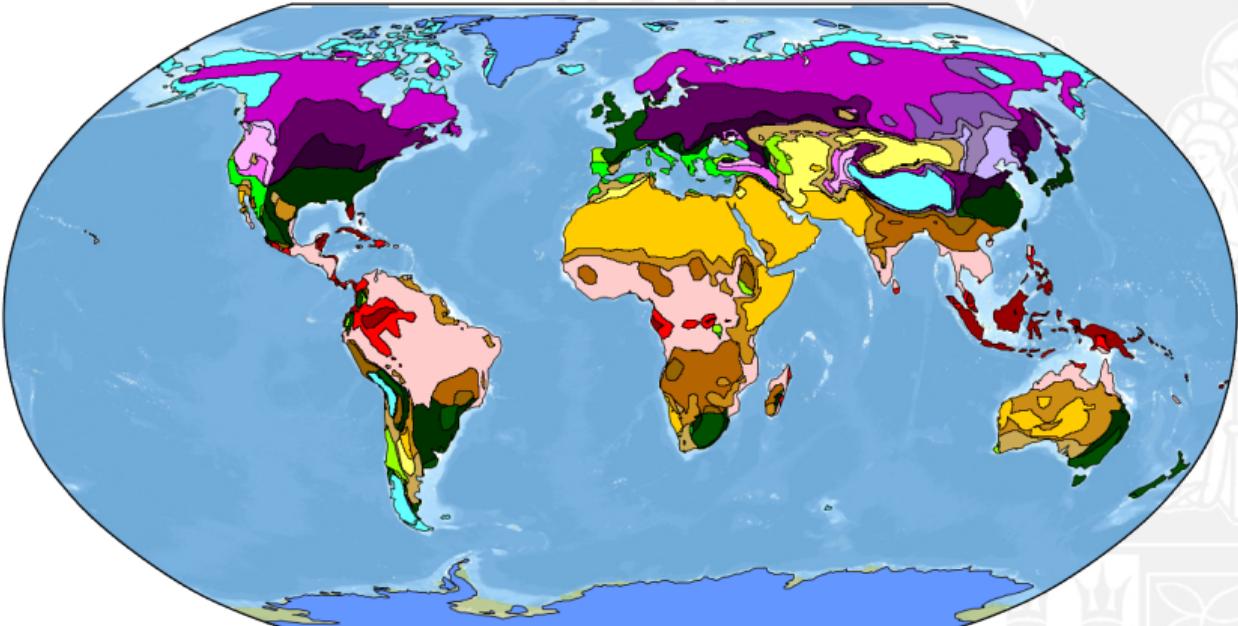


Data: <http://dx.doi.org/10.5880/SFB806.2>



Results: Mid-Holocene Classification

- ET
- EF
- BSh
- BSk
- BWh
- BWk
- Af
- Am
- Aw
- Csa
- Csb
- Csc
- Cwa
- Cwb
- Cwc
- Cfa
- Cfb
- Cfc
- Dsa
- Dsb
- Dsc
- Dsd
- Dwa
- Dwb
- Dwc
- Dwd
- Dfa
- Dfb
- Dfc
- Dfd

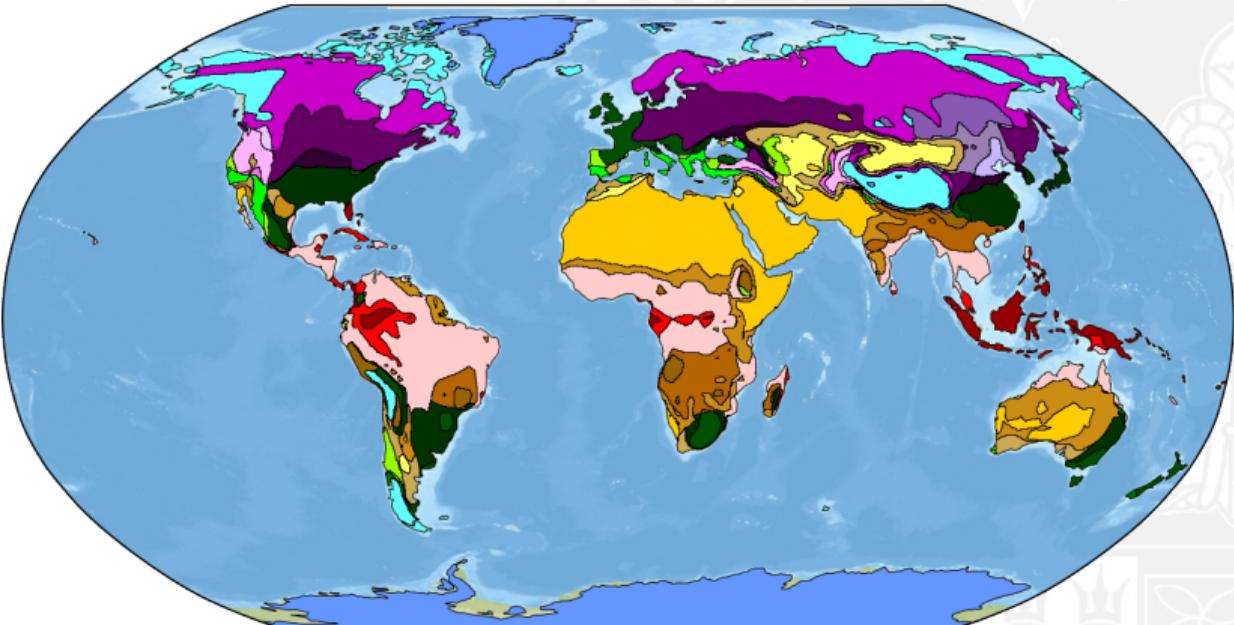


Data: <http://dx.doi.org/10.5880/SFB806.3>



Results: Pre-Industrial Classification

- ET
- EF
- BSh
- BSk
- BWh
- BWk
- Af
- Am
- Aw
- Csa
- Csb
- Csc
- Cwa
- Cwb
- Cwc
- Cfa
- Cfb
- Cfc
- Dsa
- Dsb
- Dsc
- Dsd
- Dwa
- Dwb
- Dwc
- Dwd
- Dfa
- Dfb
- Dfc
- Dfd



Data: <http://dx.doi.org/10.5880/SFB806.4>



Source Code and Data

GitLab:

<http://gitlab.crc806db.uni-koeln.de/public/projects>

Classification code repository:

<http://bit.ly/KGClassCode>

Documentation/Tutorial:

<http://bit.ly/KGClassDocumentation>

Classification Data:

<http://dx.doi.org/10.5880/SFB806.2>

<http://dx.doi.org/10.5880/SFB806.3>

<http://dx.doi.org/10.5880/SFB806.4>



2nd Data Management Workshop, Cologne 28th & 29th Nov.



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CRC 806: Our Way to Europe: Culture-Environment Interaction and Human Mobility in the Late Quaternary

Program - Friday, November 28th 2014

- 11:00 Registration
- 11:30 Coffee
- 11:50 Welcome address
Georg Barth, University of Cologne, Institute of Geography
- 12:00 Preliminary: The funder's perspective (LIS)
Stefan Winkler-Niem, German Research Foundation (DFG)
- 12:15 Preliminary: The funder's perspective (CRC)
Brit Reddin, German Research Foundation (DFG)
- 12:30 Preliminary: Research data management: What's happening & why should you care?
Kevin Ashley, Digital Curation Centre (DCC)
- 13:00 POSTERS & Lunch
- 14:30 Preliminary: Open Source and Open Data
Arnaud Cherd, Metaspacial, Bonn
- 15:00 The Role of Spatial Data for Linked Science
Tomi Kauppinen, Department of Media Technology, Aalto University School of Science
- 15:30 POSTERS & Coffee
- 17:00 The Dryad Data Repository: Metadata Workflows and Processes
Jane Greenberg and Erin Clary, Metadata Research Center, School of Information and Library Science, University of North Carolina at Chapel Hill
- 17:30 Preliminary: Data management in the PHENOME project
Pascal Neveu, French National Institute for Agricultural Research (INRA)
- from 18:00 POSTERS & Icebreaker

Program - Saturday, November 29th 2014

- 08:30 Coffee
- 09:00 NESPOS-Pleistocene sites and objects
Gerd-Christian Wenger, Neanderthal Museum, Mettmann
- 09:30 Digital data in archaeology: preservation, access and reuse
- the work of the Archaeology Data Service
Kate Green, Archaeology Data Service (ADS), Department of Archaeology, University of York
- 10:00 POSTERS & Coffee
- 11:00 Data in, data out: data management and publication at the British Atmospheric Data Centre
Sarah Callaghan, British Atmospheric Data Centre (BADC)
- 11:30 Data management planning in a federated landscape
Morgan Groves, Data Archiving and Networked Services (DANS)
- 12:00 POSTERS & Lunch
- 13:00 Data services in universities and journals
Wolfram Horstmann, State and University Library (SUB), Göttingen
- 13:30 Data Publishing - with a capital P
Hans-Peter Fewer, Alfred Wegener Institute (AWI), Earth System Science Data (ESSD)
- 14:00 Closing, POSTERS & Refreshment

- Workshop fee: 80 € (incl. printed workshop proceedings, snacks, coffee, & soft drinks)
- Deadline for full paper (6-12 pages) for workshop proceedings: September 26th, 2014
- Papers will be published in printed proceedings and online (open access) with DOI
- Selected, extended papers can be submitted for a Special Issue on Data Management in the ISPRS International Journal of Geo-Information
- Posters will be displayed during the whole workshop.
During the poster sessions, presenters are expected to be available for discussions.

Location

University of Cologne, Institute of Geography
Lecture Hall (Geosciences)
Zülpicher Straße 49 a
D-50674 Cologne

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Thank you very much!

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