Climate Data Crash Course

What is climate?

Climate is a measure of the average pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time. Climate is different from weather, in that weather only describes the short-term conditions of these variables in a given region.

– Wikipedia

Source: https://en.wikipedia.org/wiki/Climate (as of October 15th 2014)

Why is climate important for VBD?

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On large spatio-temporal scales, climate is one of the primary factors governing species' distributions.

Pictures: Polar Bear by Arturo de Frias Marques, license: CC BY-SA 4.0
Dromedary by Bjørn Christian Tørrissen, license: CC BY-SA 3.0

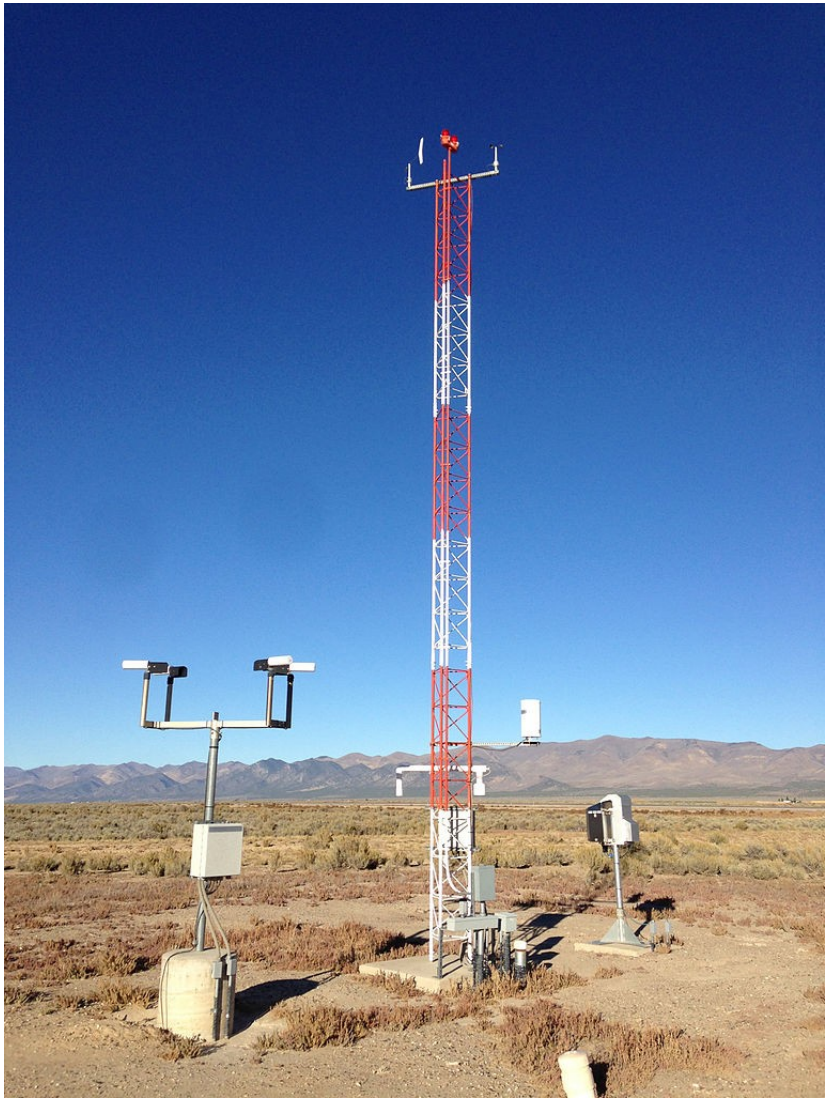
Why is climate important for VBD?

On large spatio-temporal scales, climate is one of the primary factors governing species' distributions.

That's true for many vectors as well!

Pictures: Aedes albopictus by James Gathany, CDC
Ixodes Ricinus by Hubert Berberich, license: CC BY-SA 3.0

Climate data: where does it come from?



Pictures: Weather station: Famartin, license: CC BY-SA 4.0

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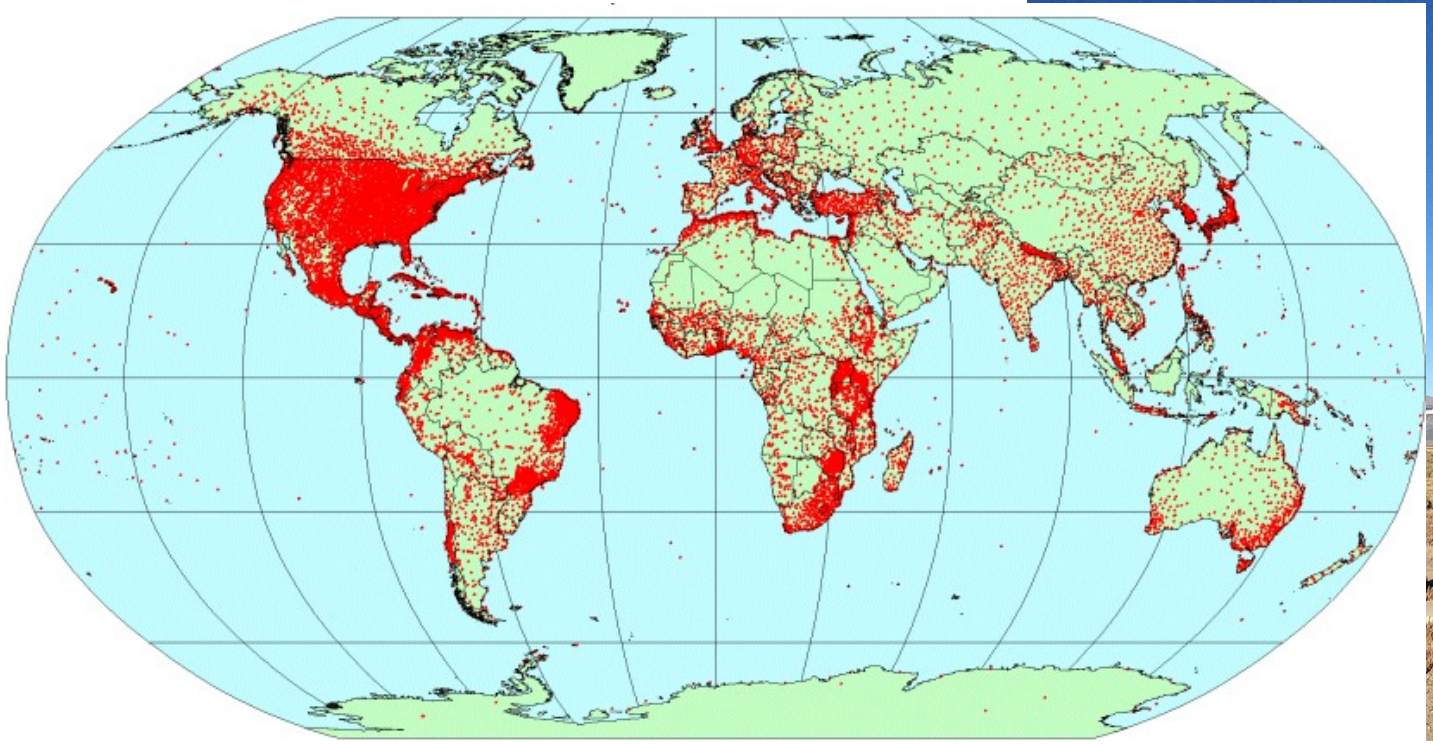
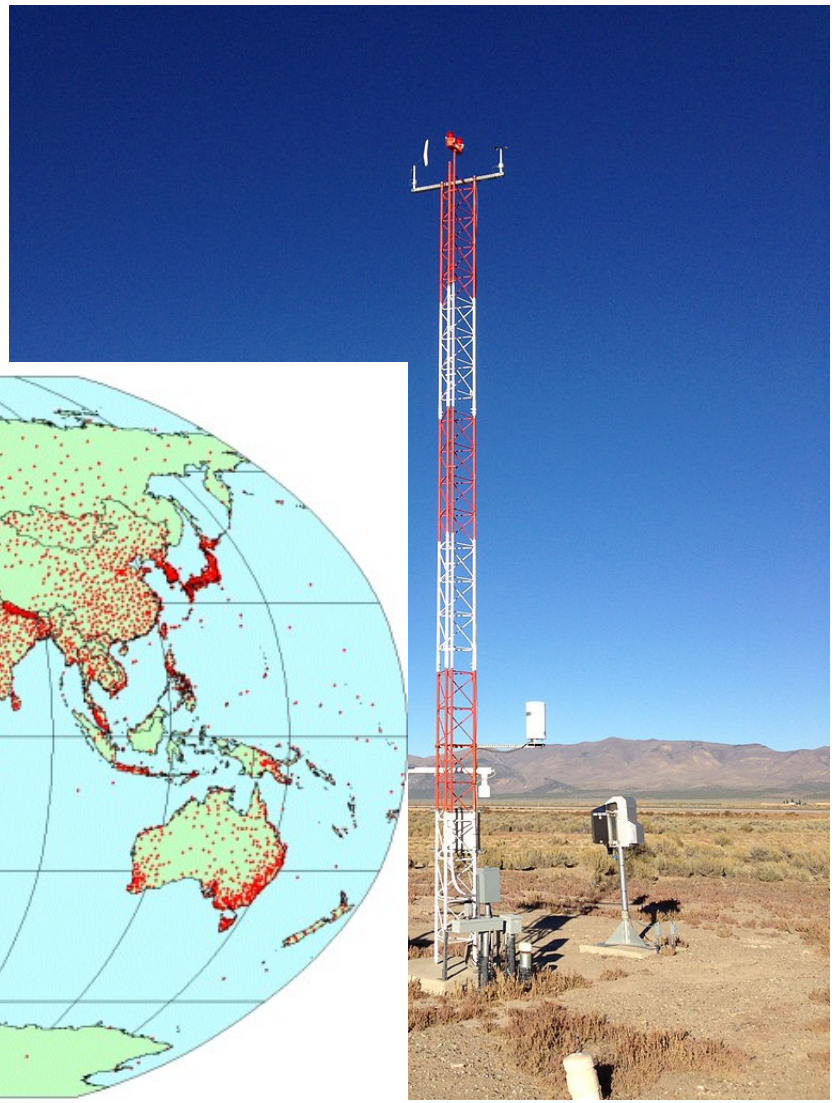
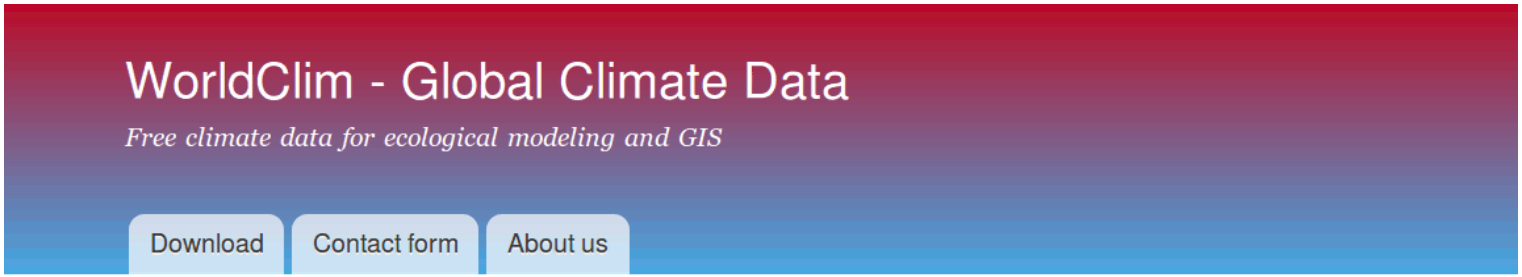




Pictures: Weather station: Famartin, license: CC BY-SA 4.0
Weather station map: Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. Int. J.Climatol. 25: 1965-1978.

Sources for global, gridded climate data



WorldClim

WorldClim is a set of global climate layers (climate grids) with a spatial resolution of about 1 square kilometer. The data can be used for mapping and spatial modeling in a GIS or with other computer programs. If you are not familiar with such programs, you can try DIVA-GIS or the *R* raster package.

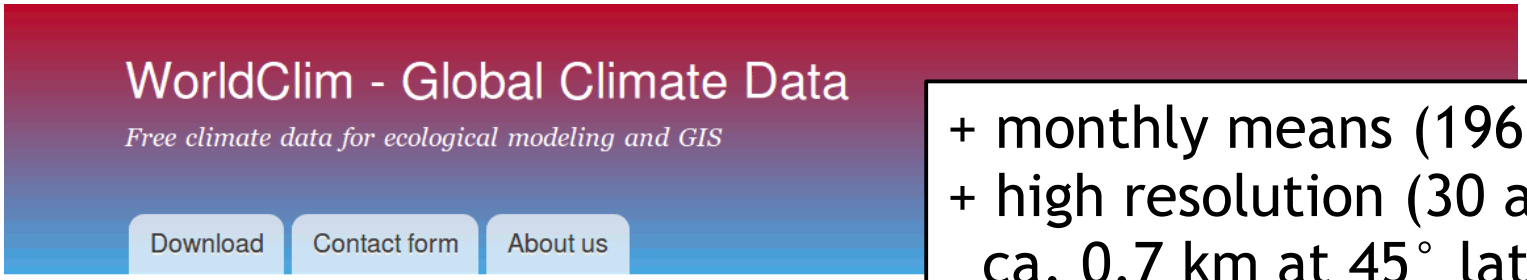
The current version is Version 1.4 (release 3). Please write us if you find any problems.

---> **Download data**

Information about the methods used to generate the climate layers, and the units and formats of the data. You can find more info in the **preferred citation**:
Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978.

Home: http://www.worldclim.org
data download: http://www.worldclim.org/current

Sources for global, gridded climate data



+ monthly means (1961-90)
+ high resolution (30 arcsec, ca. 0.7 km at 45° latitude)
- temperature & precipitation only
+ bioclimatic variables

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Sources for global, gridded climate data

UEA University of East Anglia

Climatic Research Unit

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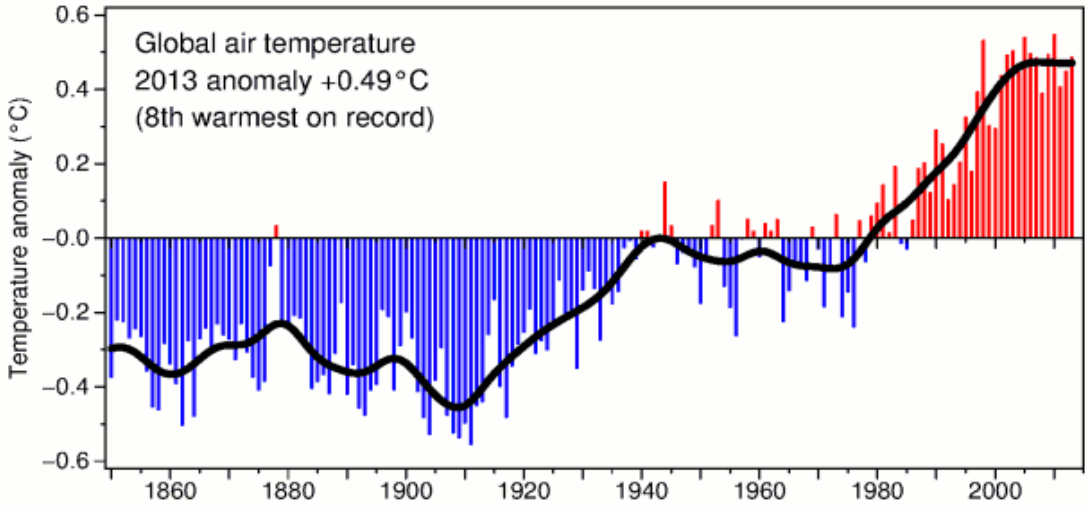
Home

The aim of the Climatic Research Unit (CRU) is to improve scientific understanding in

- past climate history and its impact on humanity
- the course and causes of climate change during the present century
- prospects for the future



Home: http://www.cru.uea.ac.uk/
data download: http://www.cru.uea.ac.uk/cru/data/hrg/tmc/

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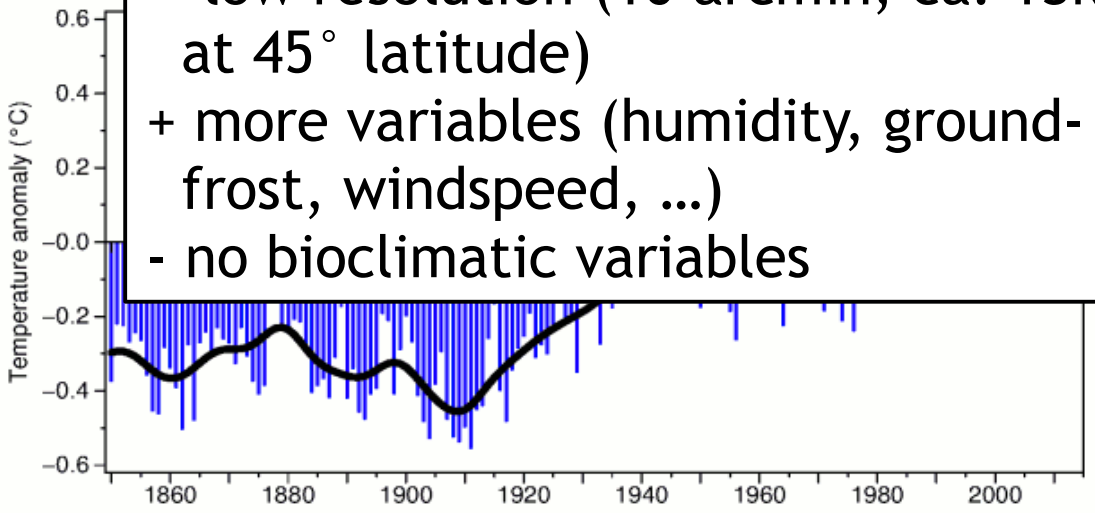


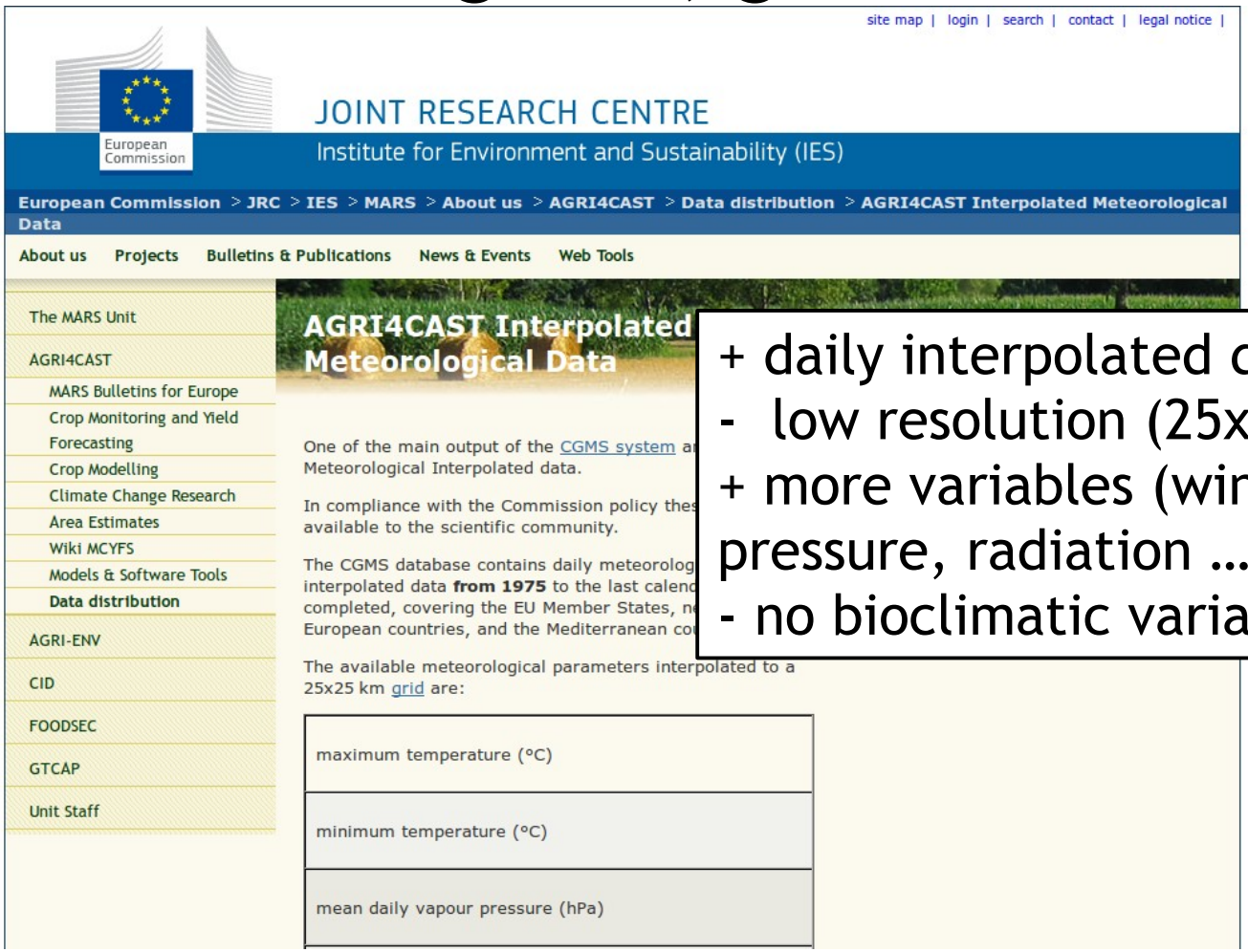
+ monthly means (1960-90)
- low resolution (10 arcmin, ca. 13km at 45° latitude)
+ more variables (humidity, ground-frost, windspeed, …)
- no bioclimatic variables

Home: http://www.cru.uea.ac.uk/
data download: http://www.cru.uea.ac.uk/cru/data/hrg/tmc/

Sources for global, gridded climate data

Home: http://mars.jrc.ec.europa.eu/
data download: DataPortal

Sources for global, gridded climate data



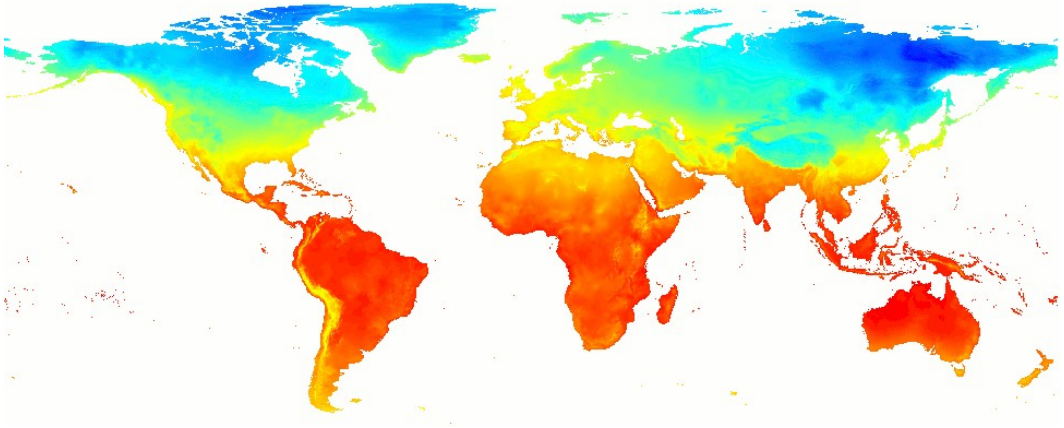
+ daily interpolated data starting 1975
- low resolution (25x25 km)
+ more variables (windspeed, vapour pressure, radiation …)
- no bioclimatic variables

Home: http://mars.jrc.ec.europa.eu/
data download: DataPortal

Interlude: Bioclimatic data

Problem with monthly climate data:

"January" is winter in Stockholm but summer in South Africa



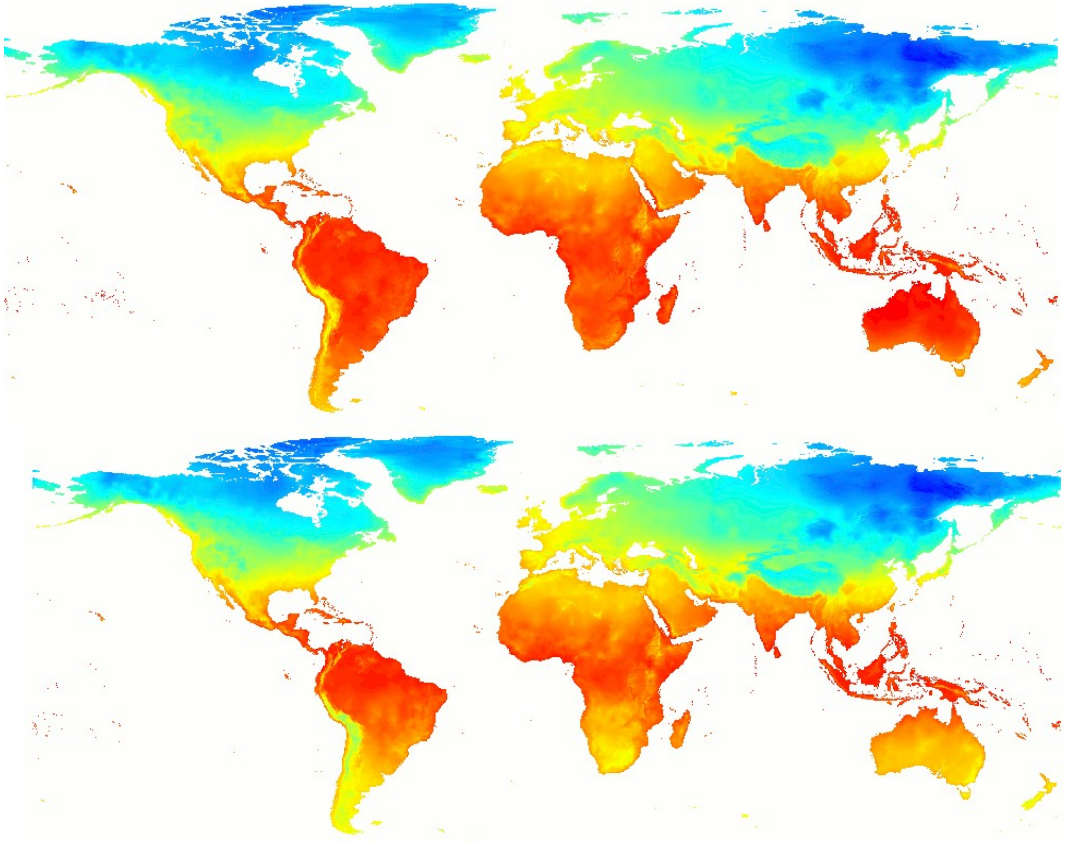
Top: Minimum temperature in January (Worldclim.org)

Interlude: Bioclimatic data

Problem with monthly climate data:

"January" is winter in Stockholm but summer in South Africa

Solution: Use ecologically more meaningful variables



Top: Minimum temperature in January (Worldclim.org)
Bottom: Minimum Temperature of the coldest month (Worldclim.org)

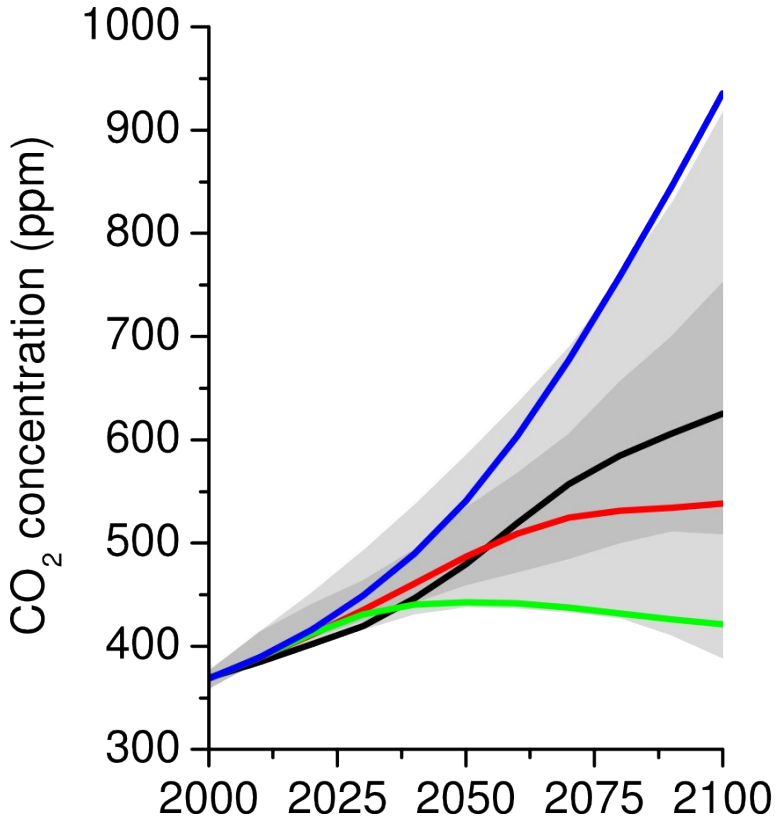
Interlude: Bioclimatic data

BIO1 = Annual Mean Temperature
BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp))
BIO3 = Isothermality (BIO2/BIO7) (* 100)
BIO4 = Temperature Seasonality (standard deviation *100)
BIO5 = Max Temperature of Warmest Month
BIO6 = Min Temperature of Coldest Month
BIO7 = Temperature Annual Range (BIO5-BIO6)
BIO8 = Mean Temperature of Wettest Quarter
BIO9 = Mean Temperature of Driest Quarter
BIO10 = Mean Temperature of Warmest Quarter
BIO11 = Mean Temperature of Coldest Quarter
BIO12 = Annual Precipitation
BIO13 = Precipitation of Wettest Month
BIO14 = Precipitation of Driest Month
BIO15 = Precipitation Seasonality (Coefficient of Variation)
BIO16 = Precipitation of Wettest Quarter
BIO17 = Precipitation of Driest Quarter
BIO18 = Precipitation of Warmest Quarter
BIO19 = Precipitation of Coldest Quarter

source: http://www.worldclim.com/bioclim

Future climate: IPCC 5 scenarios

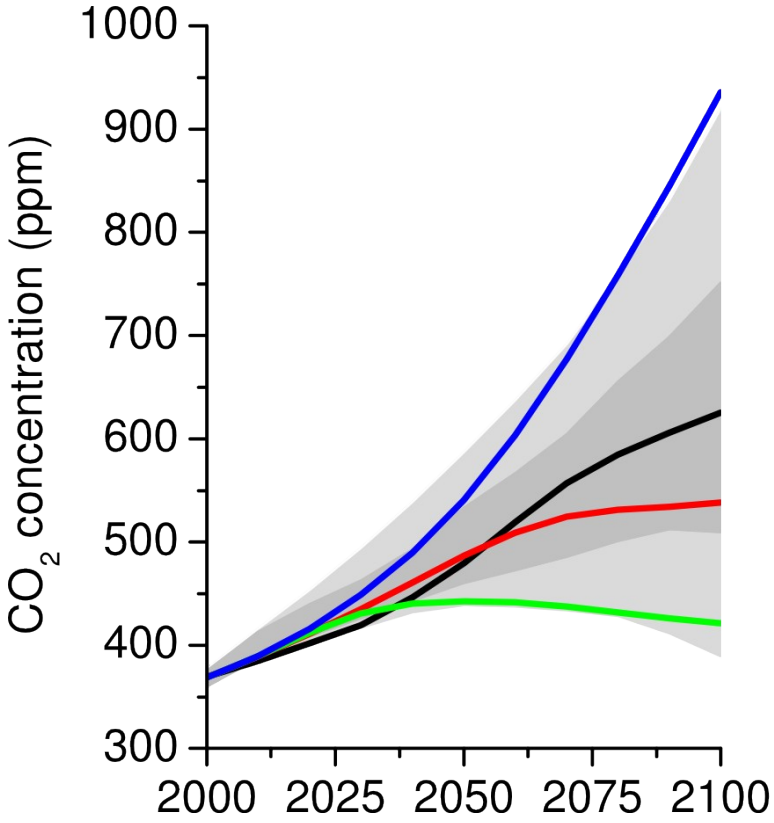
Future climate: IPCC 5 scenarios



Representative
Concentration
Pathway

van Vuuren et al. (2011). Representative concentration pathways: An overview. Climatic Change, Volume 109, Issue 1-2, pp 5-31, . doi:10.1007/s10584-011-0148-z

Future climate: IPCC 5 scenarios



Representative
Concentration
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Further reading:

- van Vuuren 2011 (see below)
- IPCC: Summary for Policymakers
- see Wikipedia article on RCPs (sections “References” and “External links”)

van Vuuren et al. (2011). Representative concentration pathways: An overview. Climatic Change, Volume 109, Issue 1-2, pp 5-31, . doi:10.1007/s10584-011-0148-z

Future climate: CMIP5

- models are not reality
- there is not a single “right” model
- different models give different results
- different models are good/bad at different things

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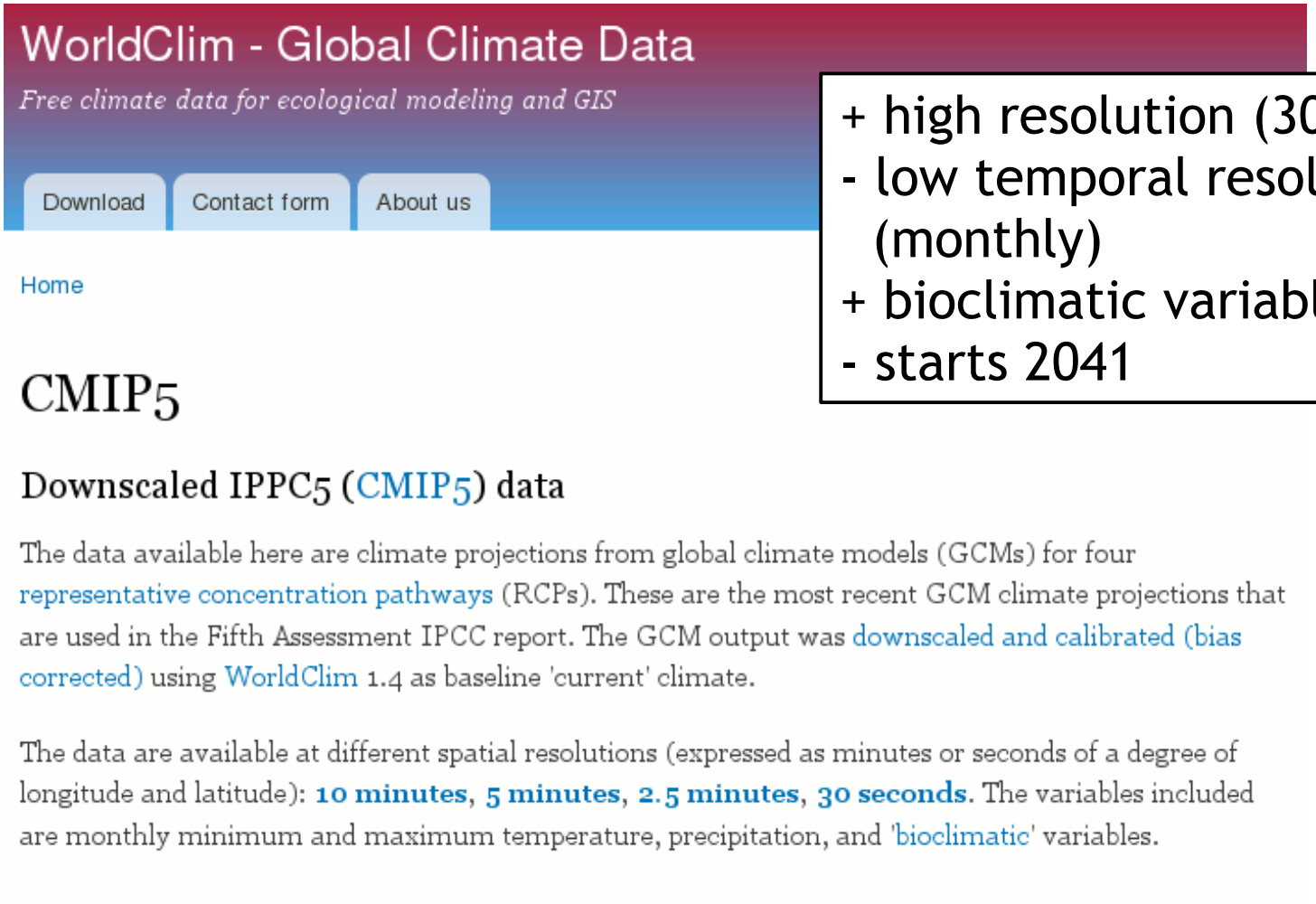
Coupled Model Intercomparison Project:
Many different institutions are building different models after common conventions, and compare them to see where they (dis-) agree

Future climate: CMIP 5

Modeling Center (or Group)	Institute ID	Model Name
Commonwealth Scientific and Industrial Research Organization (CSIRO) and Bureau of Meteorology (BOM), Australia	CSIRO-BOM	ACCESS1.0 ACCESS1.3
Beijing Climate Center, China Meteorological Administration	BCC	BCC-CSM1.1 BCC-CSM1.1(m)
Instituto Nacional de Pesquisas Espaciais (National Institute for Space Research)	INPE	BESM OA 2.3*
College of Global Change and Earth System Science, Beijing Normal University	GCESS	BNU-ESM
Canadian Centre for Climate Modelling and Analysis	CCCMA	CanESM2 CanCM4 CanAM4
University of Miami - RSMAS	RSMAS	CCSM4(RSMAS)*
National Center for Atmospheric Research	NCAR	CCSM4

http://cmip-pcmdi.llnl.gov/cmip5/docs/CMIP5_modeling_groups.pdf

Data sources - future climate: pre-processed



+ high resolution (30 arcsec)
- low temporal resolution (monthly)
+ bioclimatic variables
- starts 2041

Home: http://www.worldclim.org
data download: http://www.worldclim.org/CMIP5

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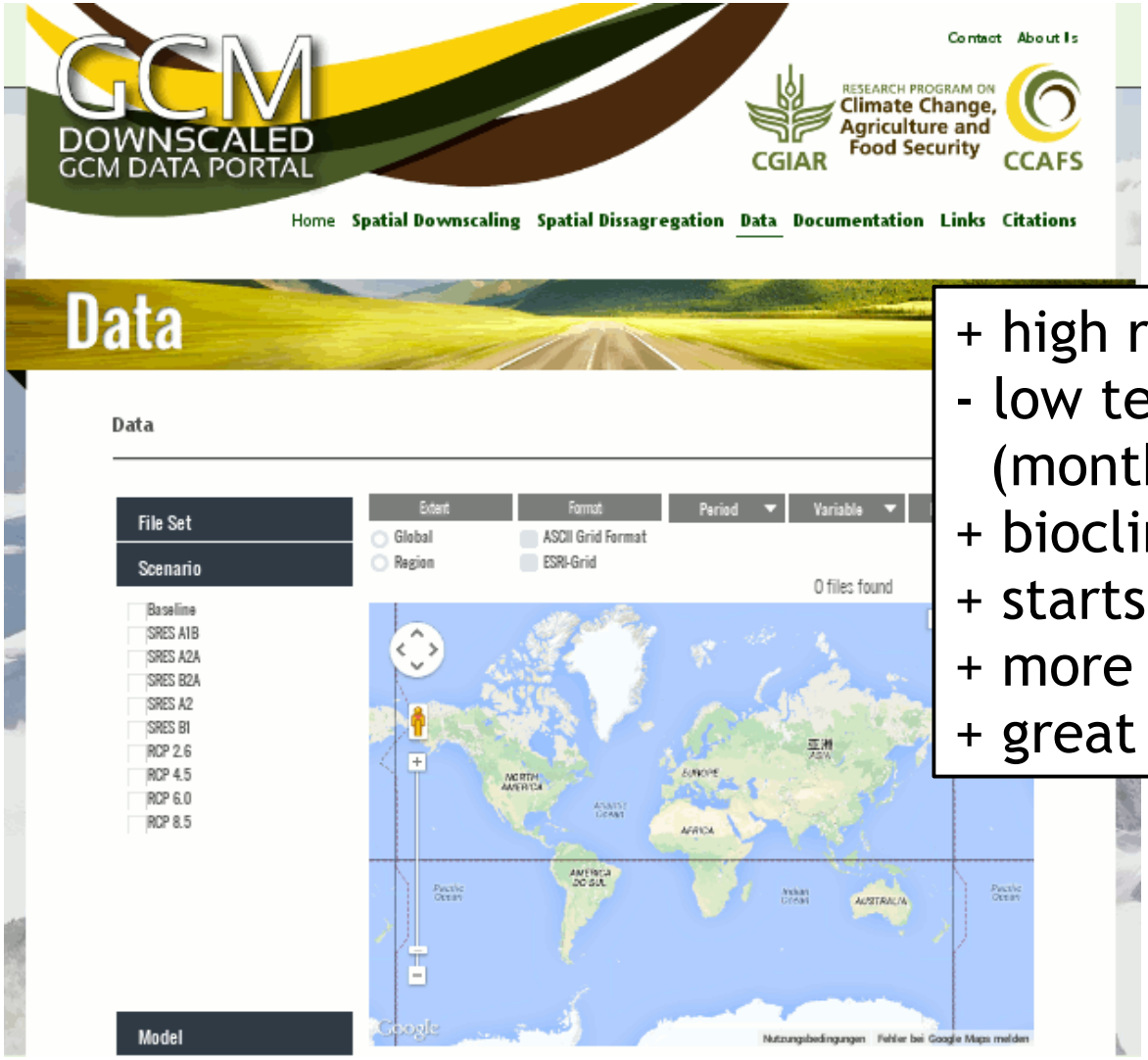

+ high resolution (30 arcsec)
- low temporal resolution (monthly)
+ bioclimatic variables
+ starts ~ 2000
+ more choices available
+ great support

Home: ccafs-climate.org
data download: ccafs-climate.org/data

Data sources - future climate: pre-processed

+ GCM data output dowscaled to high spatial resolution

+ pre-processed into bioclimatic variables

+ data formats (ESRI-grid, ASCII-grid) relatively easy to handle for non-climatologists

- monthly resolution

Data sources - future climate: “raw” data

Data sources - future climate: “raw” data

Pros:

- full output from most climate models
- many paramaters
- up to daily resolution

Cons:

- native spatial resolution of most GCMs: >1°
- easy to get lost in the data base unless you know exactly what you want
- data format NetCDF can be hard to handle
- pre-processing downloaded data can take weeks

Data sources - future climate: “raw” data

Where to get help/more information:

- Paola Petrelli: CMIP5 and other climate data survival guide
- CMIP-homepage: http://cmip-pcmdi.llnl.gov/index.html
  - Taylor et al.: CMIP5 Data Reference Syntax
  - Taylor et al.: CMIP5 Model Output Requirements
  - overview of variables: standard_output.xls

- Higher resolution data :
  - CORDEX initiative (regional downscaling)
    - Christensen: CORDEX Archive Design
    - EURO-CORDEX (data available from ESGF-hubs)

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