GRASS GIS 7:
A theoretical and practical course

Session 1 – Integrated Raster/Vector analysis: Zonal statistics

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Session Objectives

- Integrated Raster/Vector analysis: Zonal statistics
  - Raster-vector statistics: DEM stats per watershed
  - ECA&D climatic data
    - Country-wise statistics of aggregated precipitation ECA&D data: 1951-1980 versus 1981-2010
    - Calculating a differences map for the two 30ys periods

Exercise – GRASS GIS 7 startup with NC data

Raster-vector statistics: DEM stats per watershed

1) Watershed calculation (basin parameter) – Wake County, NC

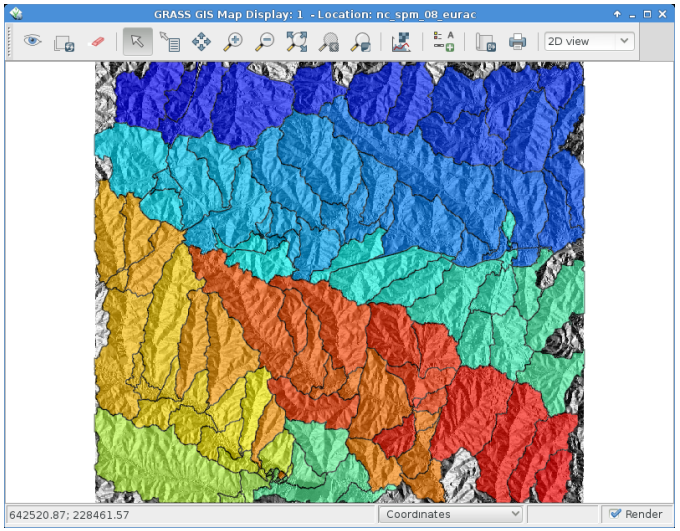
```
# Set computational region to elevation model
g.region raster=elevation -p

# calculate watershed basins (threshold in cell units)
r.watershed elevation=elevation basin=basins_10k \
    threshold=10000
```

2) Vectorization of watersheds (wxGUI: File → Map type conversions)

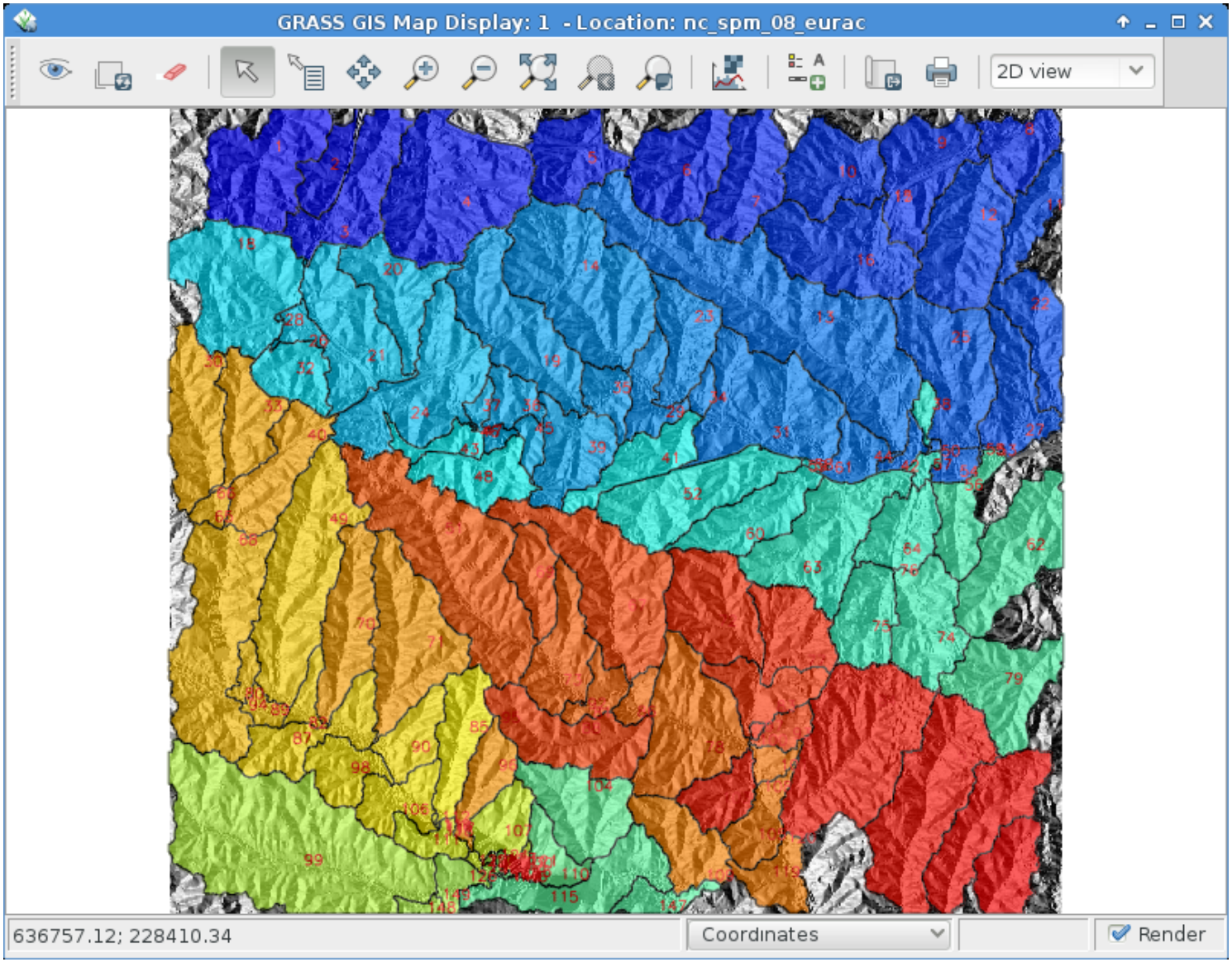
```
r.to.vect input=basins_10k output=basins_10k type=area \
    column=basin_num

# colorize by basin number
v.colors map=basins_10k use=attr \
    column=basin_num color=bcyr
```

3) Show vector watersheds (shaded)

- Map “elevation.shaded”
- Watershed map with transparency



Raster-vector statistics: DEM stats per watershed



With **v.rast.stats** we will calculate univariate statistics per polygon based on a raster map.

Results are added as new columns to the attribute table of the watershed map.

Raster-vector statistics: DEM stats per watershed

3) Zonal statistics of elevation data per watershed basin

```
v.rast.stats map=basins_10k raster=elevation \
    column_prefix=elev
v.db.select basins_10k separator=comma
```

Statistics per watershed ID ...

GRASS GIS Attribute Table Manager - <basin_10k@user1>

1 / Table basin_10k

Attribute data - right-click to edit/manage records

cat	basin_num	label	elev_n	elev_min	elev_max	elev_range	elev_mean	elev_stddev	elev_variance	elev_cf_var	elev_sum
1	2		30346	111.7435...	155.73408...	43.990562...	137.80064...	9.27004685...	85.93376870...	6.72714311...	4181698.48722...
2	4		9220	118.4454...	152.26892...	33.823493...	134.87729...	8.14500692...	66.34113775...	6.03882748...	1243568.62303...
3	6		22504	102.3183...	156.09910...	53.780746...	134.18460...	12.1913137...	148.6281301...	9.08547887...	3019690.29414...
4	8		45764	102.8480...	155.17250...	52.324432...	133.37537...	10.5128660...	110.5203522...	7.88216405...	6103790.76357...
5	10		17748	100.6119...	155.16319...	54.551208...	132.90083...	11.2063305...	125.5818443...	8.43209973...	2358723.93410...
6	12		23611	90.14228...	144.26728...	54.125	120.50823...	11.2829864...	127.3057822...	9.36283435...	2845319.93252...
7	14		20817	80.41838...	133.44969...	53.031311...	113.94928...	11.1785386...	124.9597255...	9.81010003...	2372082.21596...
8	16		13383	55.99602...	90.988014...	34.991989...	71.039377...	9.09764033...	82.76705959...	12.8064753...	950719.985893...
9	18		23600	61.72412...	106.42794...	44.703815...	84.402294...	9.29577272...	86.41139048...	11.0136492...	1991894.16147...
10	20		20129	74.98153...	128.39311...	53.411575...	102.35722...	11.7841064...	138.8651646...	11.5127257...	2060348.56206...
11	26		10951	57.97982...	108.12604...	50.146217...	86.146171...	10.4951096...	110.1473270...	12.1829089...	943386.728965...
12	24		28814	61.66728...	109.61430...	47.947013...	89.160832...	10.2329887...	104.7140597...	11.4770000...	2569080.22002...

SQL Query

Simple | Advanced

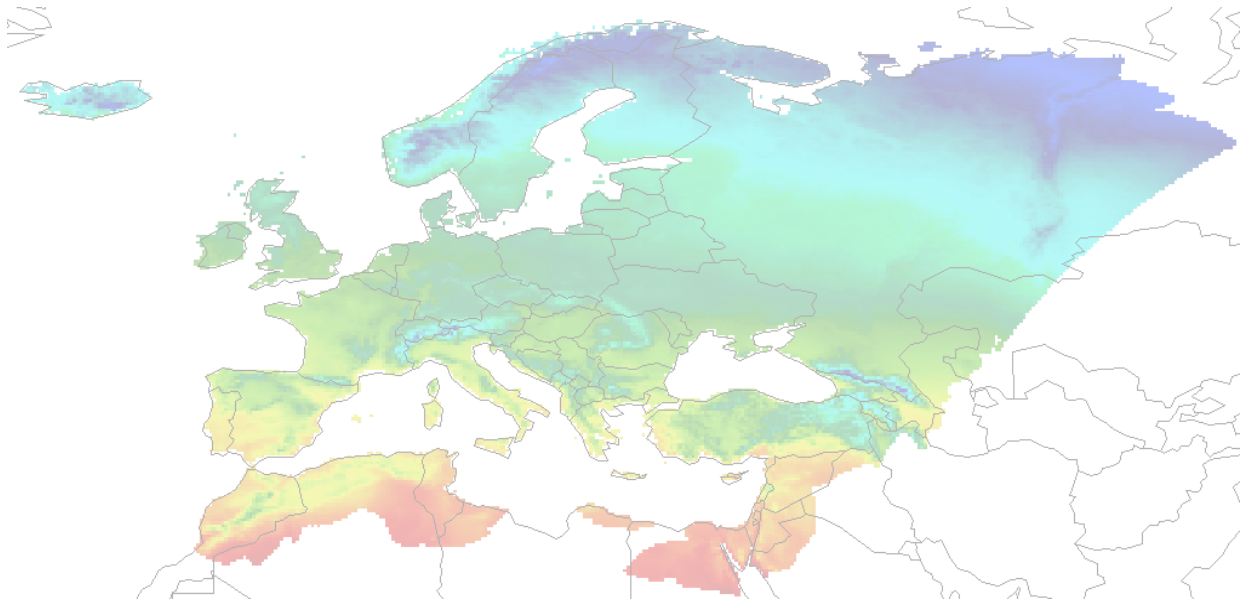
SELECT * FROM basin_10k WHERE cat = Apply

Browse data | Manage tables | Manage layers

Refresh Close

Number of loaded records: 149

Zonal statistics in GRASS GIS with the ECA&D climate data



Overview

Course data download address:

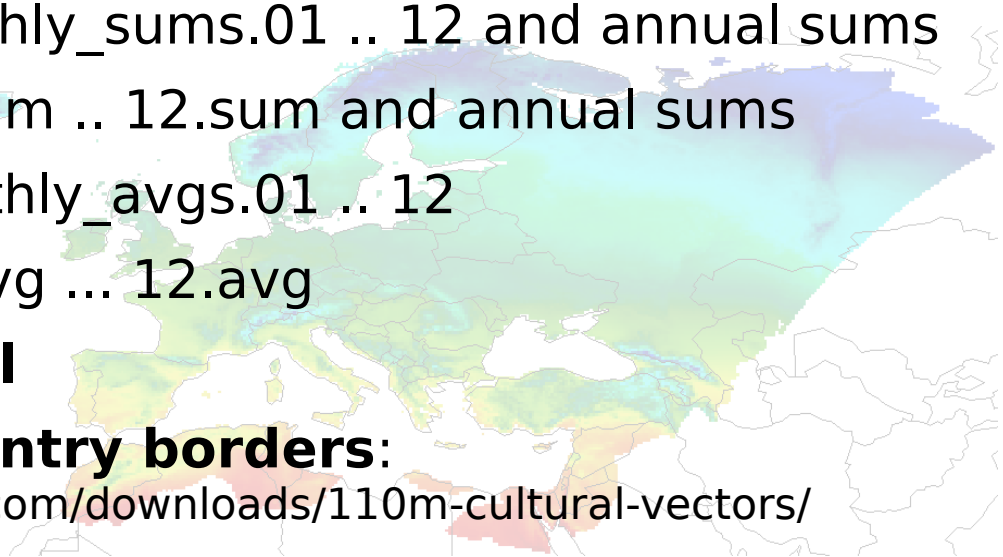
http://www.mundialis.de/workshops/nina2016/ecad5_grassdata/

- `ecad5_grassdata_ll.zip|.tar.gz  6.3MB`

Get the package and save it on your computer.
Unpack the GRASS GIS location into your $HOME/grassdata/

Content for exercises:

- Aggregated **ECA&D climatic data** (http://www.ecad.eu/): derived from daily data, 0.25° pixel resolution
  - precip.1951_1980.monthly_sums.01 .. 12 and annual sums
  - precip.1981_2010.01.sum .. 12.sum and annual sums
  - tmean.1951_1980.monthly_avgs.01 .. 12
  - tmean.1981_2010.01.avg ... 12.avg
- Related **elevation model**
- NaturalEarth Admin0 **country borders**: http://www.naturalearthdata.com/downloads/110m-cultural-vectors/

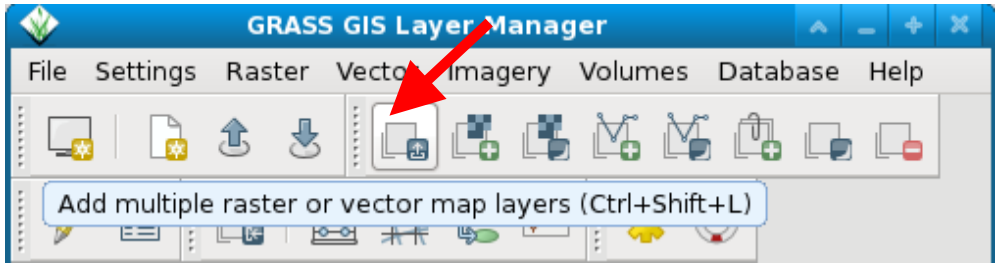


Exercise – GRASS GIS 7 startup with ECA&D data

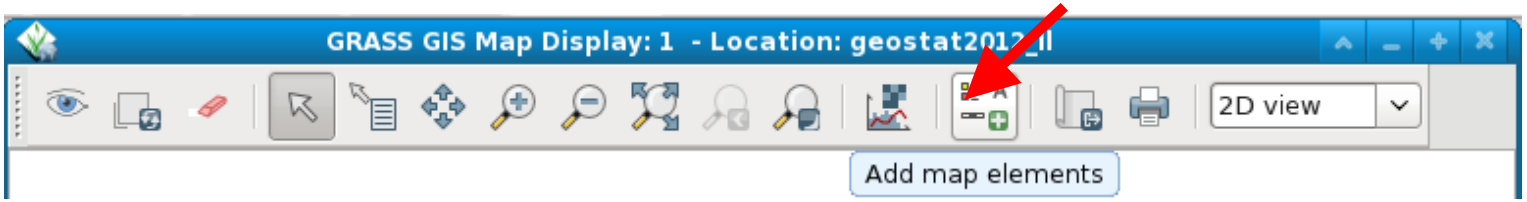
Exercise – ECA&D data

QUICK DATA ASSESSMENT:
Getting a feeling for the data

- use icon "Add multiple raster or vector map layers"



- assign appropriate color tables:
  "celsius" and "precipitation_monthly"
  - Use right mouse button in layer manager on map
  - Alternative: Menu Raster → Manage colors → r.colors for quicker workflow

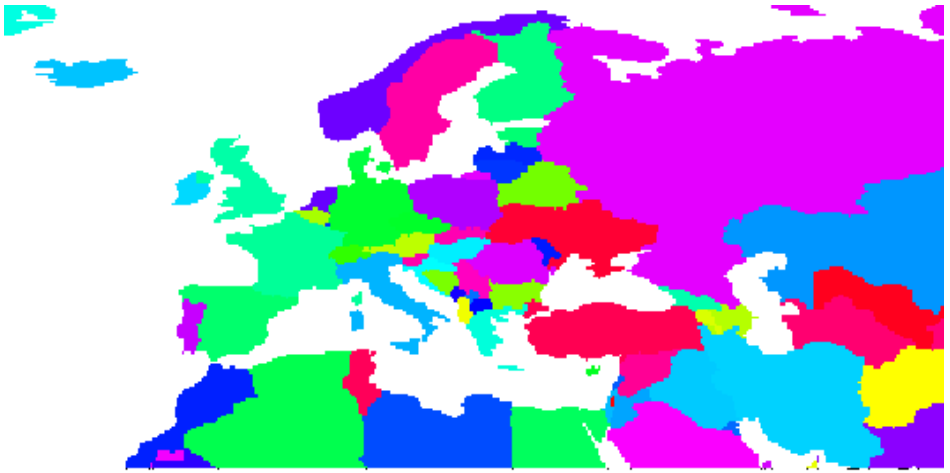


- add legend
- try "precipitation" color table instead of "precipitation_monthly", redisplay

ECA&D Zonal statistics I

Country-wise statistics of aggregated precipitation ECA&D data: 1951_1980 versus 1981_2010

```
# check the available column (or use wxGUI attribute manager)
v.info -c country_boundaries

# look at country names
v.db.select country_boundaries column="NAME_ENGLI"


# for zonal statistics, we convert the vector polyons to raster model
g.region rast=precip.1981_2010.sum -p
v.to.rast country_boundaries output=country_boundaries use=cat \
   labelcolumn="NAME_ENGLI"

# check raster polygons
r.category country_boundaries
```



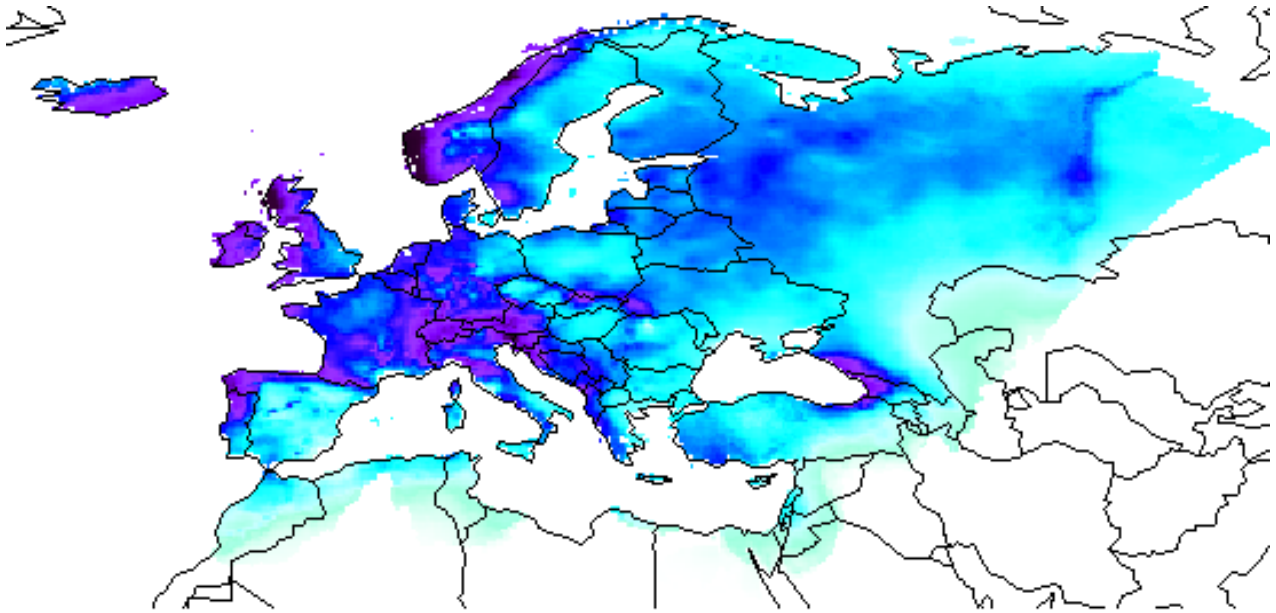
http://grass.osgeo.org/wiki/Zonal_statistics

(cont.)

ECA&D Zonal statistics II

Country-wise statistics of aggregated precipitation ECA&D data: 1951_1980 versus 1981_2010

```
# Now we generate univariate zonal statistics,
# writing the results to CSV file: for each zone univariate statistics
# are performed for all pixels falling into each zone

r.univar -t precip.1981_2010.sum zones=country_boundaries \
        sep=comma output=countries_precip.1981_2010.sum.csv
```



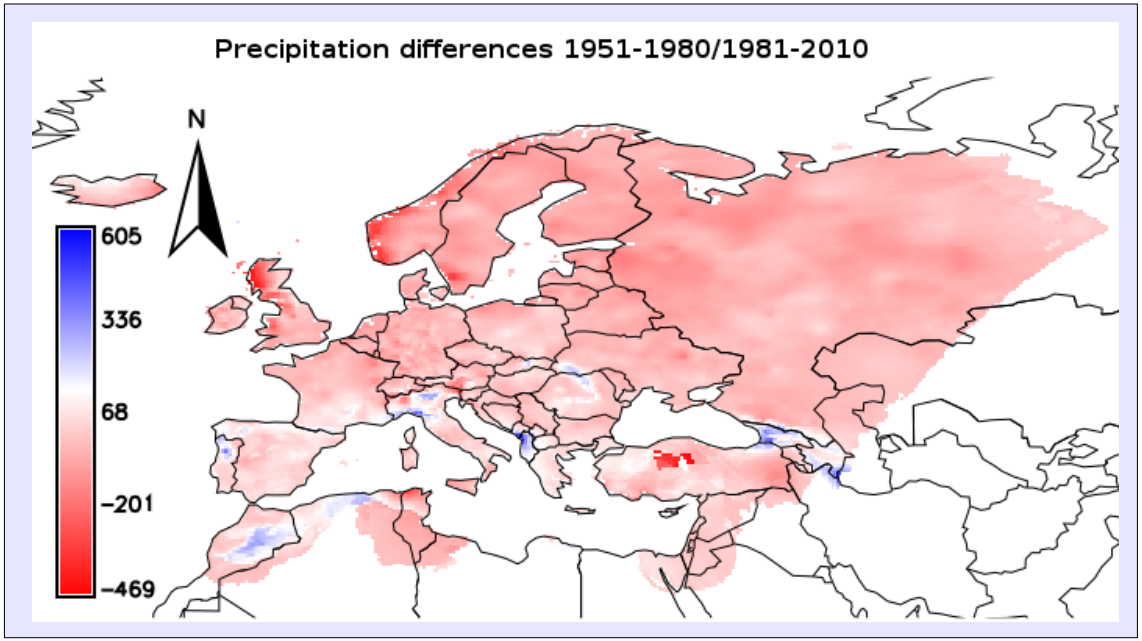
(cont.)

Exercise – Calculating new maps from time series

Calculating a differences map for the two 30ys periods

```
# we want to be sure to have the computational region set
   g.region rast=precip.1981_2010.06.sum -p
   r.mapcalc "precip_diff_1951_1981_2010 = \
      precip.1951_1980.sum - precip.1981_2010.sum"

# apply inverse “differences” color table
   r.colors -n precip_diff_1951_1981_2010 \
      color=differences
```

Now visualize in wxGUI along with “country_boundaries” as boundaries



If you think that precipitation should have become more, swap the maps in the differences calculation! Older – newer or newer – older...

Data: ECA&D V5

ECA&D Zonal statistics III

Country-wise statistics of aggregated ECA&D data (cont.)

```
# ... open CSV file in spreadsheet software or R
soffice countries_precip_1981_2010_sum.csv

# precipitation differences of 1951-1980 and 1981-2010
r.univar -t diff_1951_1981_2010 zones=country_boundaries \
  sep="," output=countries_precip_1951_1980_vs_1981_2010_sum.csv


# open also this file in a spreadsheet software
soffice countries_precip_1951_1980_vs_1981_2010_sum.csv
```

Sort data by "mean" column; then do column or net plot on country and “mean” precipitation