Deutscher Wetterdienst
Wetter und Klima aus einer Hand

ERA-20C and CERA-20C precipitation in comparison to GPCC daily and monthly analyses

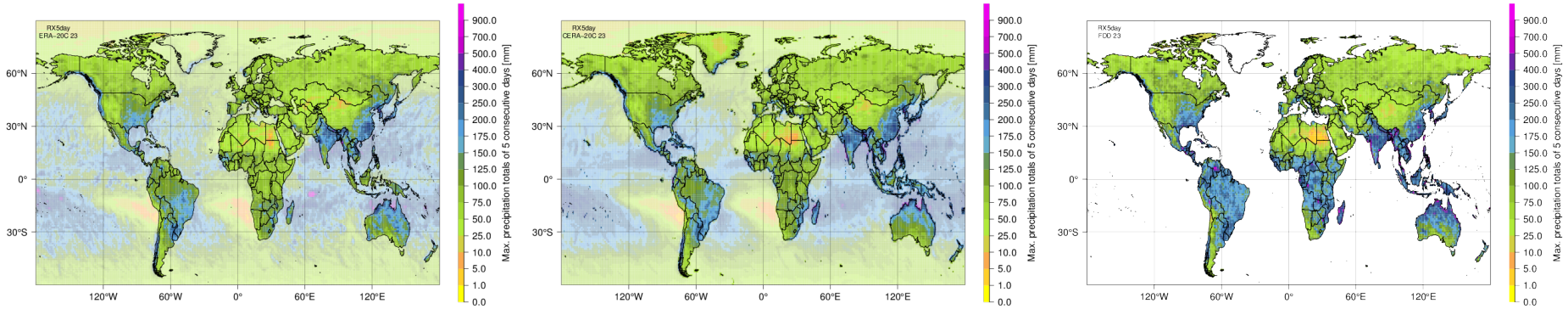
Elke Rustemeier, Markus Ziese, Andreas Becker
Global Precipitation Climatology Centre (GPCC)

Statistics on daily precipitation totals

- Applied to ERA-20C, CERA-20C and GPCC Full Data Daily (FDD)
- Overlapping time period: January 1988 to December 2010
- Utilized indices:
  - Highest daily precipitation total in a period (**RX1**).
  - Highest precipitation total of five consecutive days in a period (**RX5**).
  - Highest number of consecutive dry days (precipitation < 1 mm/day) in a period (**CDD**).
  - Highest number of consecutive wet days (precipitation >= 1 mm/day) in a period (**CWD**).
  - Number of days with a precipitation total above 10 mm in a period (**R10**).
  - 90%-Quantile of daily precipitation totals in a period (**R90p**).
  - Mean precipitation amount of heavy precipitation days (precipitation >= 10 mm/day) in a period (**SDII**).

Statistics on daily precipitation totals – RX5

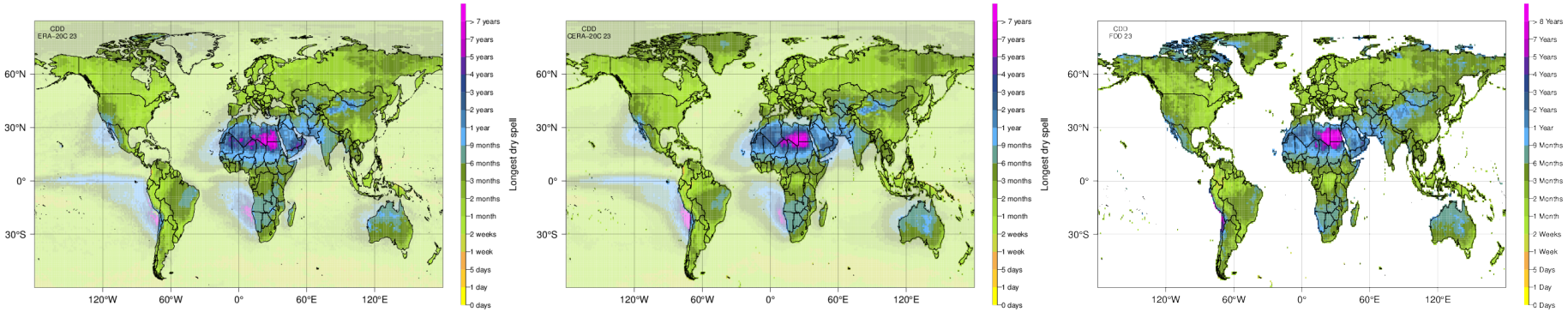
- Such precipitation events cause floods along rivers and streams as well as landslides



- Reanalyses do not reproduce patterns in Africa, Central and South America related to movement of ITCZ and African Monsoon
- RX5 values in reanalyses are much lower for these regions than FDD
- Reanalyses comparable, CERA-20C reproduces better Indian Monsoon than ERA-20C

Statistics on daily precipitation totals – CDD

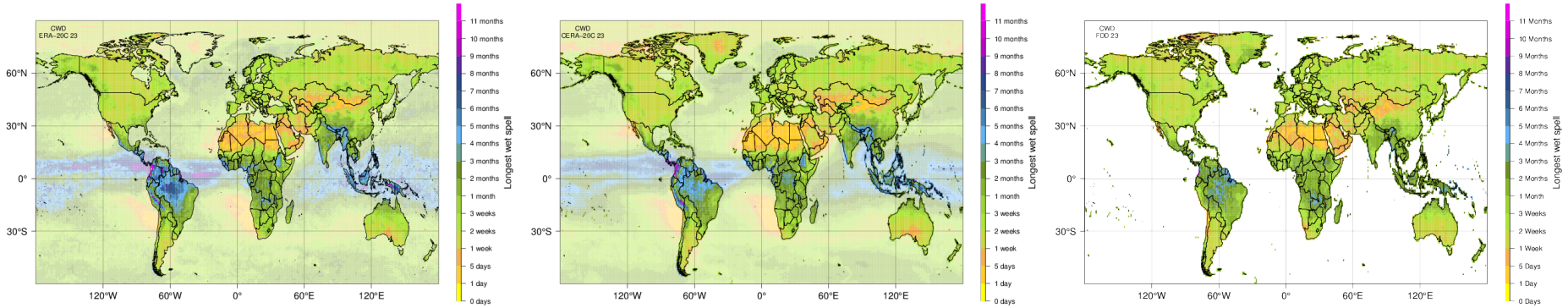
- A measure for aridity combined with droughts



- Main characteristics occur in all data sets
- Longest periods in deserts with multiple years without precipitation as well as in regions with distinct dry and wet seasons
- Impact of orographic induced precipitation in Congo Basin better captured in CERA-20C than in ERA-20C
- Different patterns in North America

Statistics on daily precipitation totals – CWD

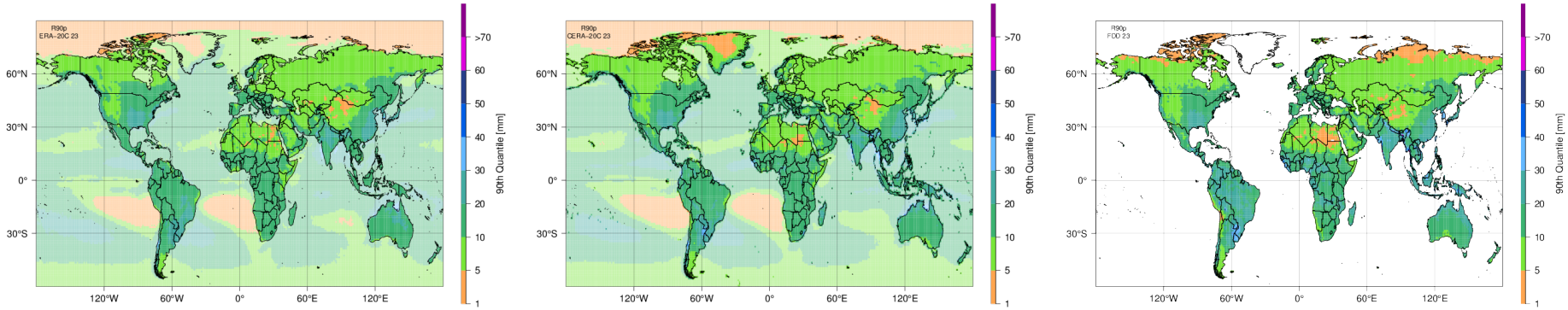
- A measure for climatic characteristic wet spells as well as persistent precipitation events



- General agreement of CWD-patterns in all data sets
- Both reanalyses overestimate the length of longest wet spell in tropics and Western Canada
- Long wet spells in Andes not in FDD
- Longest wet spell in Amazon Basin twice as long in ERA-20C than in CERA-20C

Statistics on daily precipitation totals – R90p

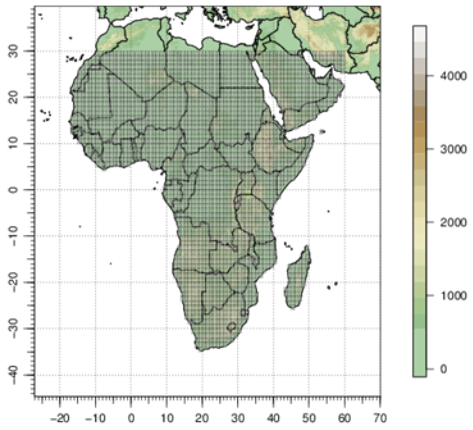
- A measure for climatological typically high precipitation totals and less sensitive to outliers than RX5

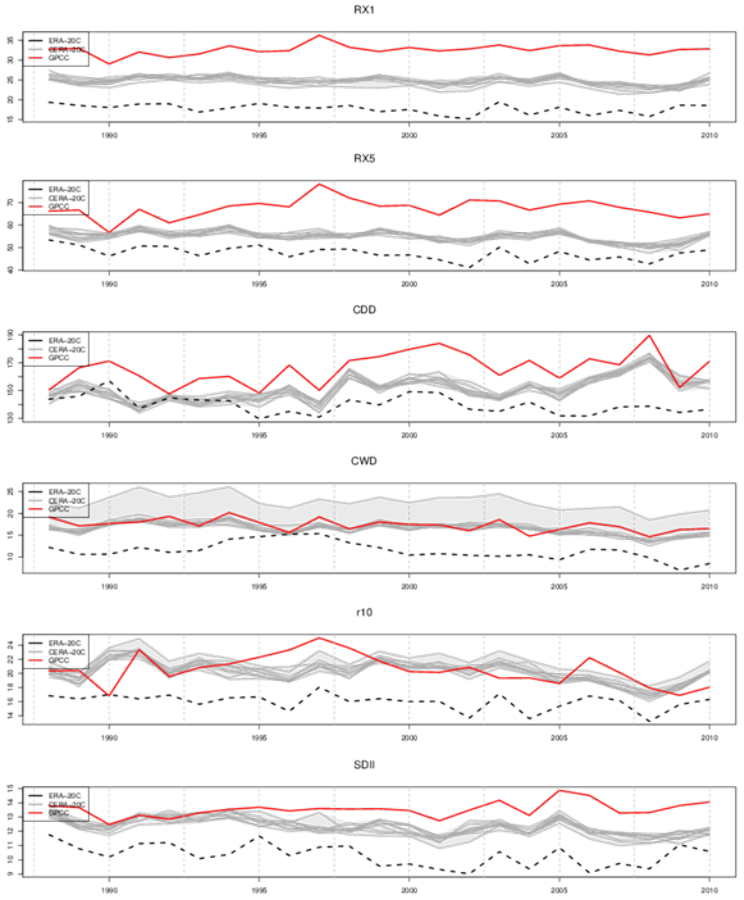


- General patterns comparable between all data sets
- Different location of lowest values in Sahara between Reanalyses and FDD
- Values around the lower stream of the Paranã River in South America are higher in FDD than in reanalyses
- Reanalyses have lower values than FDD in Indian Monsoon region

Statistics on daily precipitation totals – Africa

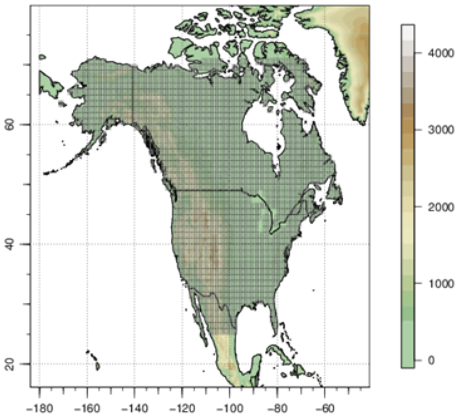
- **RX*** from FDD larger than reanalyses, CERA-20C higher than ERA-20C
- Reanalyses agree on **CDD** until 1994, FDD always higher
- FDD and CERA-20C agrees for **CWD**, but one ensemble member lies out
- Temporary overlap between FDD and CERA-20C for **R10**
- Indices from ERA-20C in general lower than from CERA-20C and FDD

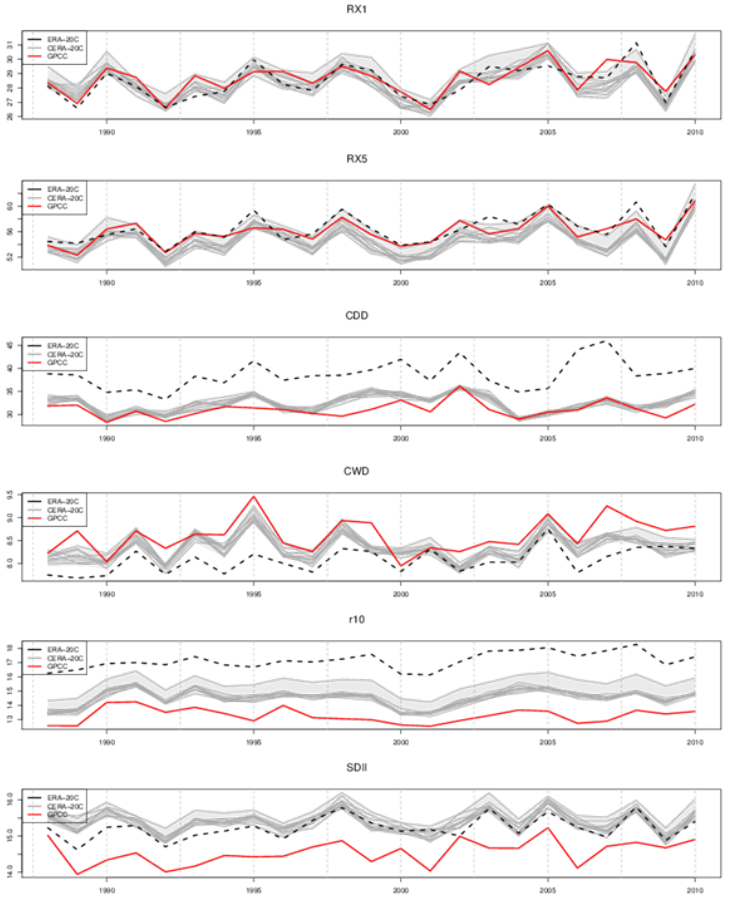




Statistics on daily precipitation totals – North America

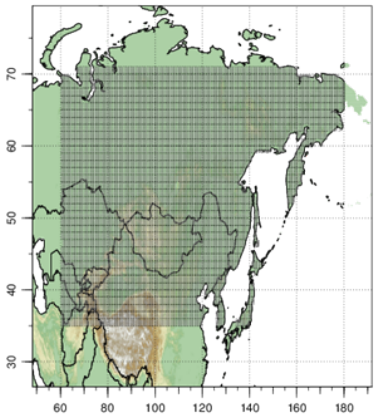
- Reanalyses and FDD agrees for **RX*** within spread
- Partial agreement between FDD and CERA-20C for **CDD**, ERA-20C has longer dry spells
- **CWD** from FDD equal or higher than CERA-20C, higher than ERA-20C
- Highest **R10**-values from ERA-20C, lowest from FDD, no overlap
- Reanalyses agree for **SDII**, but higher values than FDD

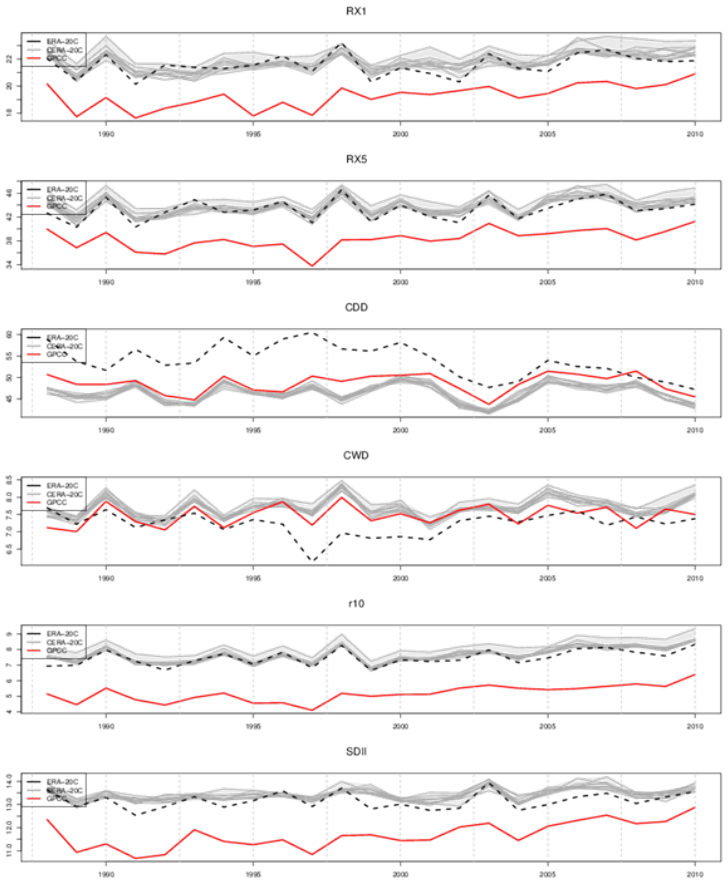




Statistics on daily precipitation totals – Northeast Asia

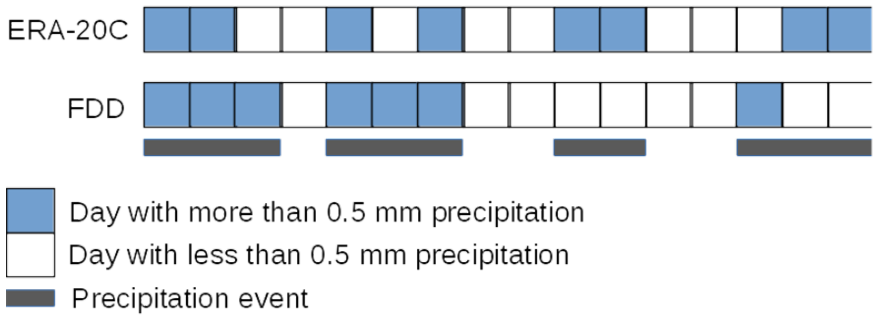
- Reanalyses agree for **RX***, FDD lower
- FDD slightly larger than CERA-20C for **CDD**, ERA-20C higher with decrease since 2001
- Data sets agree on **CWD**, but significant lower values between 1996 and 2001 in ERA-20C
- Reanalyses agree on **R10** and **SDII**, but FDD has significant lower values for both indices





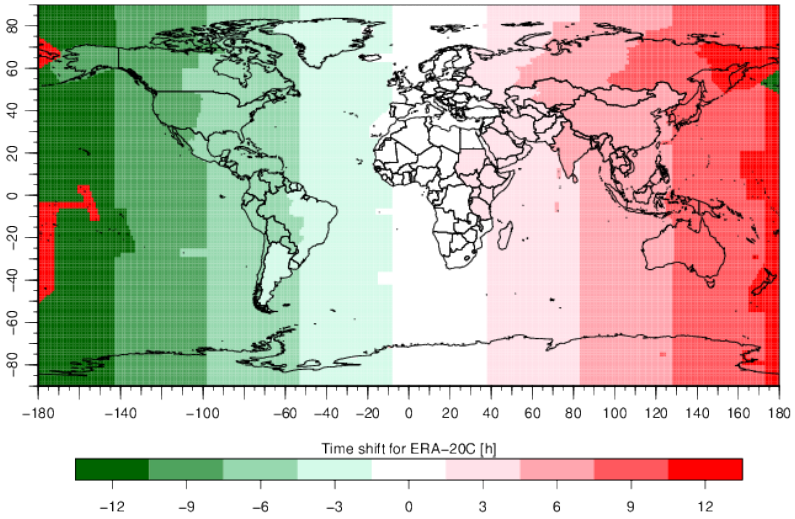
Statistics on events - definition

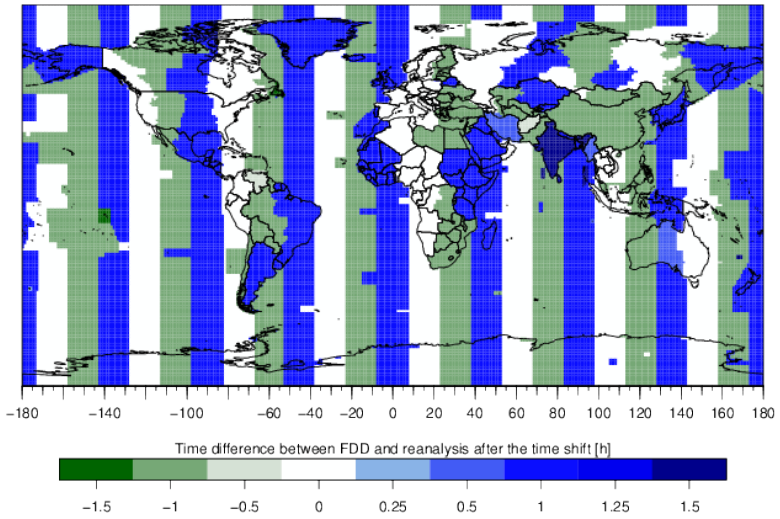
- Grid cells containing at least **one station** for at least **five years** from FDD are analyzed
- Period between days with a precipitation total below 0.5 mm in both data sets ERA-20C and FDD, also used for CERA-20C



Statistics on events - definition

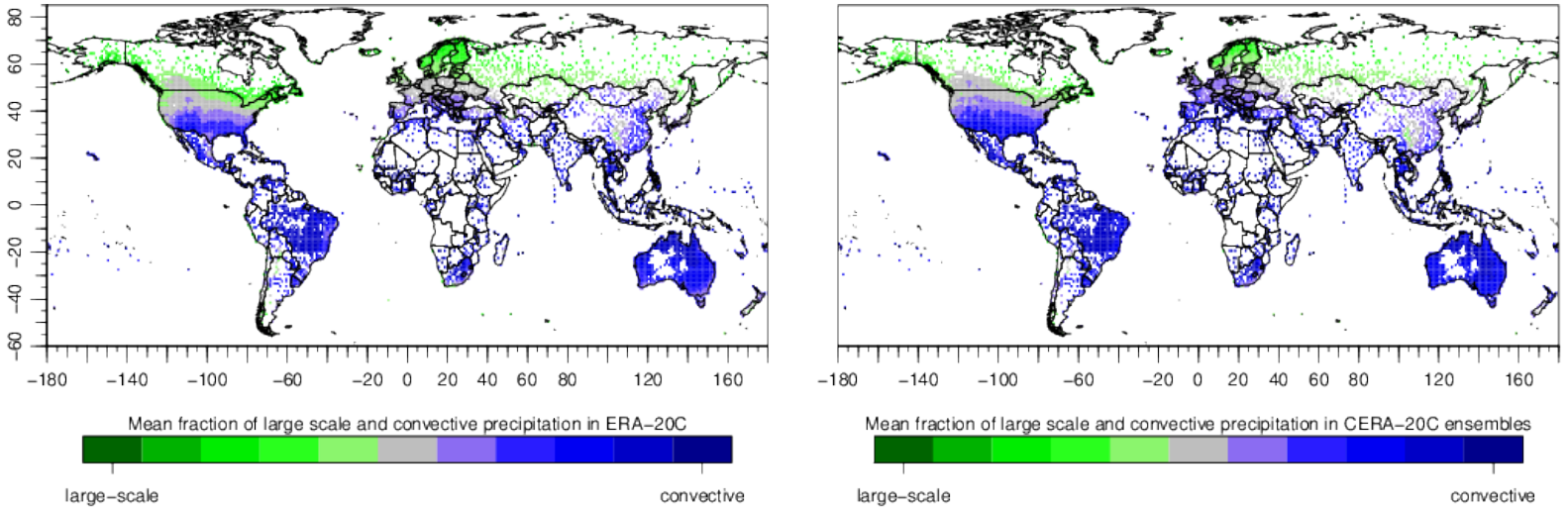
- Day-by-day comparison can cause wrong conclusions due to the possibility of incorrectly time referenced station data and remaining time shift between reanalyses and climatological day in FDD
- Length of events not examined
- Utilizing three hourly aggregated precipitation to compute the corresponding climatological total





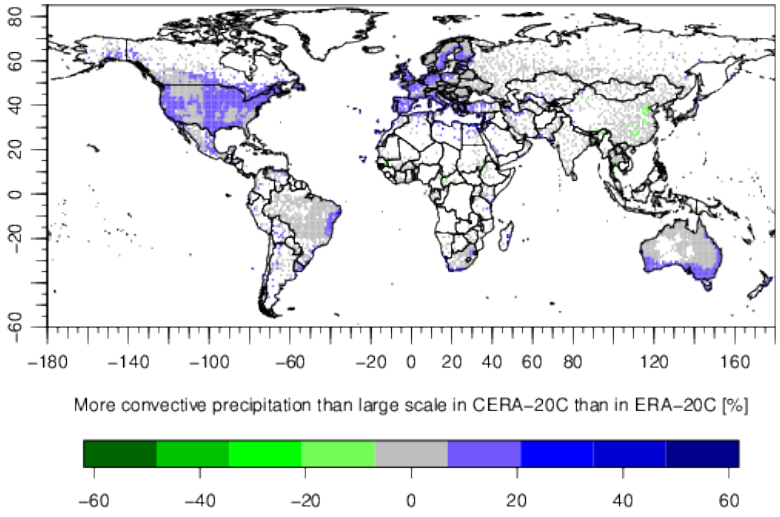
Statistics on events – precipitation type

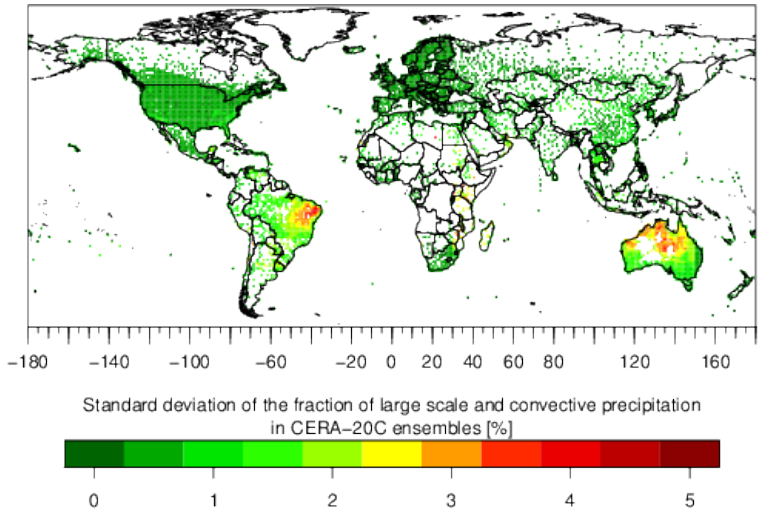
- Convective precipitation is prevailing type in tropics and subtropics
- More large-scale than convective precipitation in polar and subpolar regions



Statistics on events – precipitation type difference

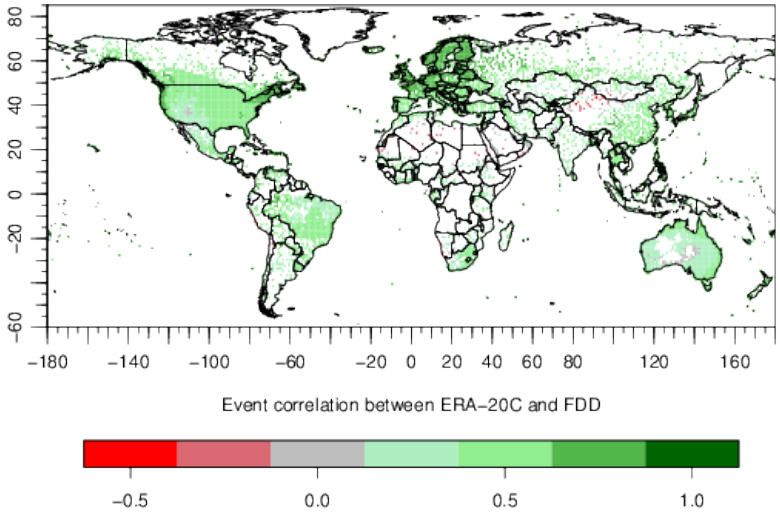
- CERA-20C has more convective precipitation than ERA-20C
- Some grids in China, Southeast Asia and Sahel region vice versa
- Highest spread in precipitation type within CERA-20C ensemble in arid regions and whole South America
- Monthly precipitation totals vary between zero and more than 300 mm/month in North and Central Australia due to wet and dry season

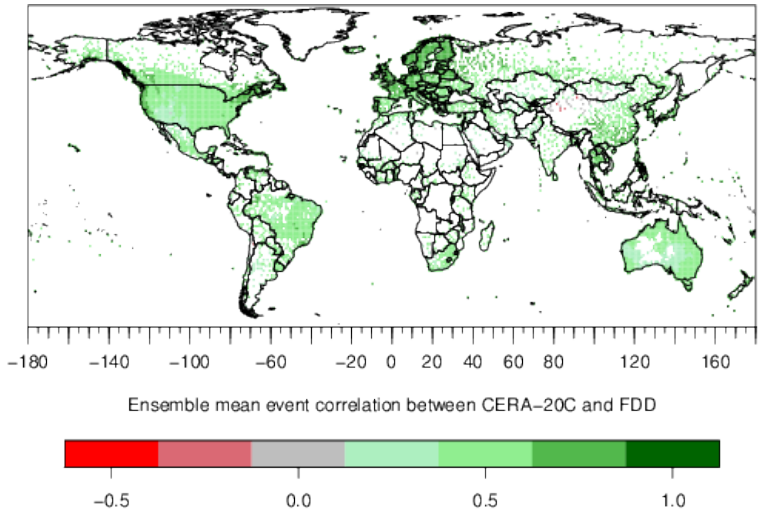




Statistics on events – correlation

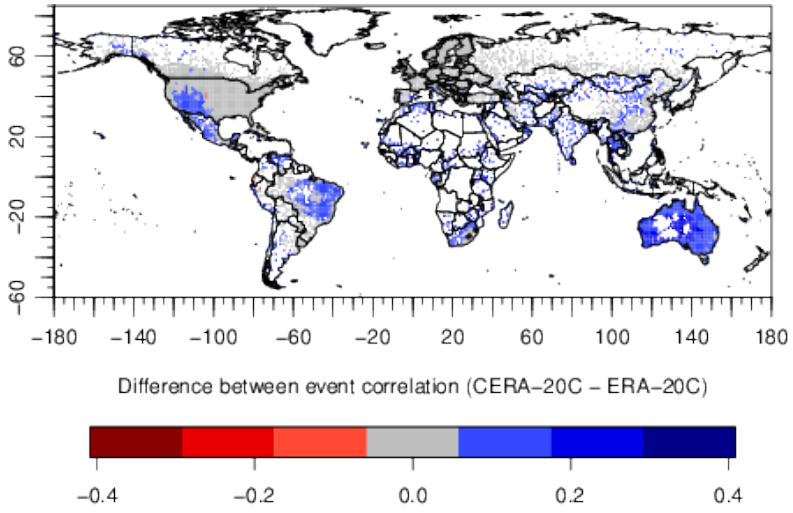
- Kendal correlation coefficient for precipitation sums of events
- Highest correlations in Central and Northern Europe, Northeast USA, Newfoundland and relief rain at Rocky Mountains
- Lower correlations in arid regions
- Negative correlations for some grids in Namibia, Peru, Central Asia and North African deserts (ERA-20C)

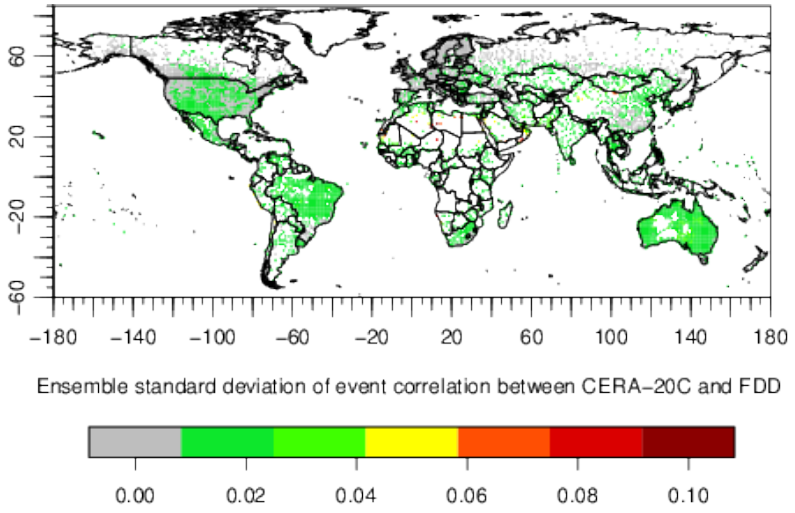




Statistics on events – correlation difference

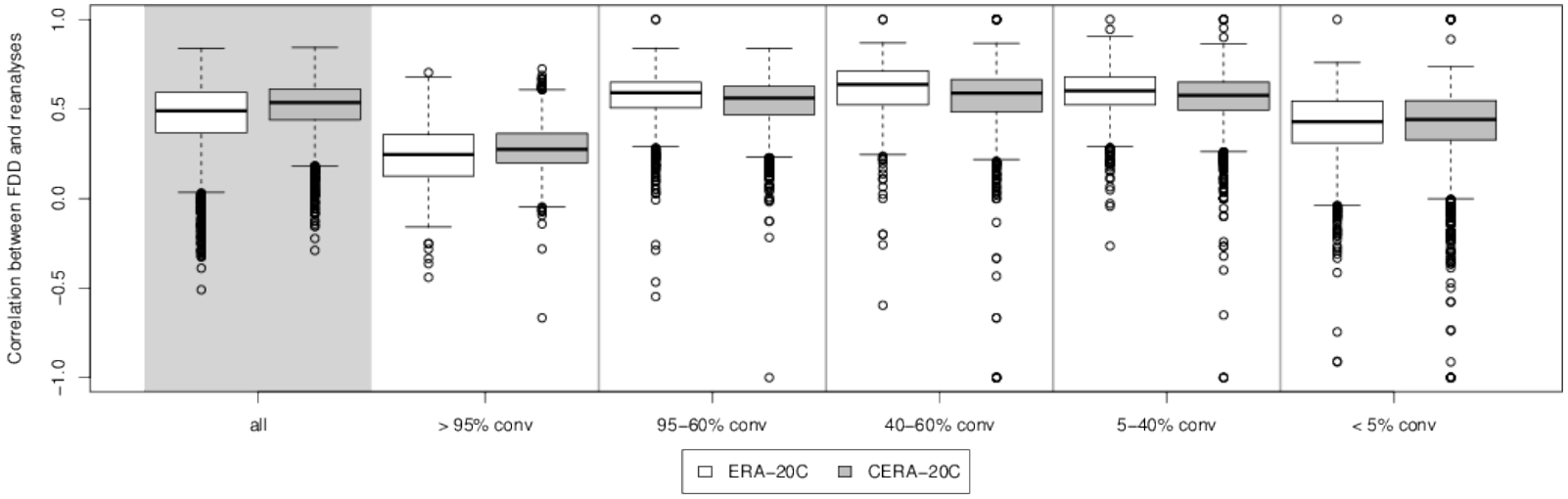
- Correlation between CERA-20C and FDD higher than ERA-20C and FDD
- CERA-20C less negative correlations than ERA-20C
- Higher correlations for Indian Monsoon in CERA-20C than ERA-20C
- Some grid in deserts have significant spread in correlations
- Moderate temperature grids have lowest spread in their correlations





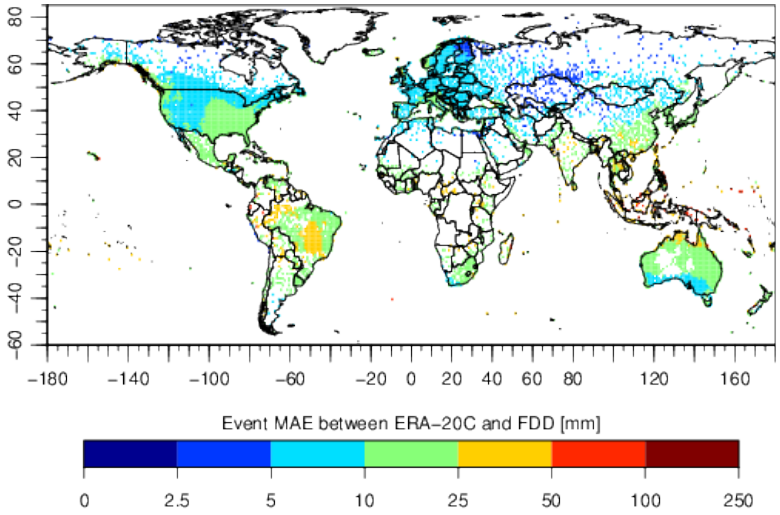
Statistics on events – correlation precipitation type

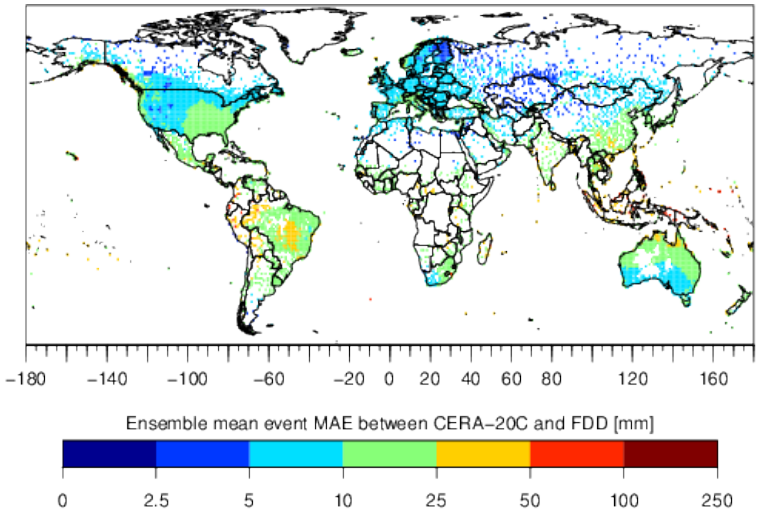
- CERA-20C correlates better with FDD than ERA-20C for all precipitation types
- Median of correlation is higher and interquartile range smaller for CERA-20C than ERA-20C
- Large-scale precipitation correlates better than convective precipitation for both reanalyses, but mixed precipitation type events correlates even better



Statistics on events – MAE (Mean Absolute Error)

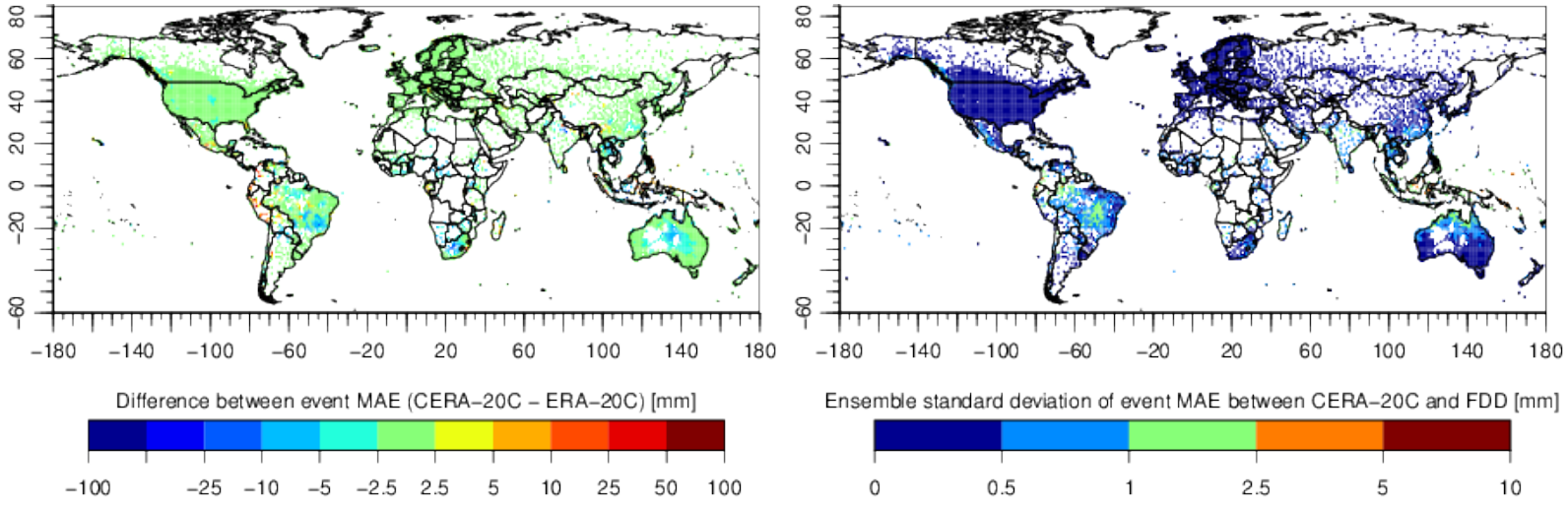
- MAE largest in tropics due to high precipitation totals
- Lower MAE in polar and temperate regions
- Same patterns for both reanalyses





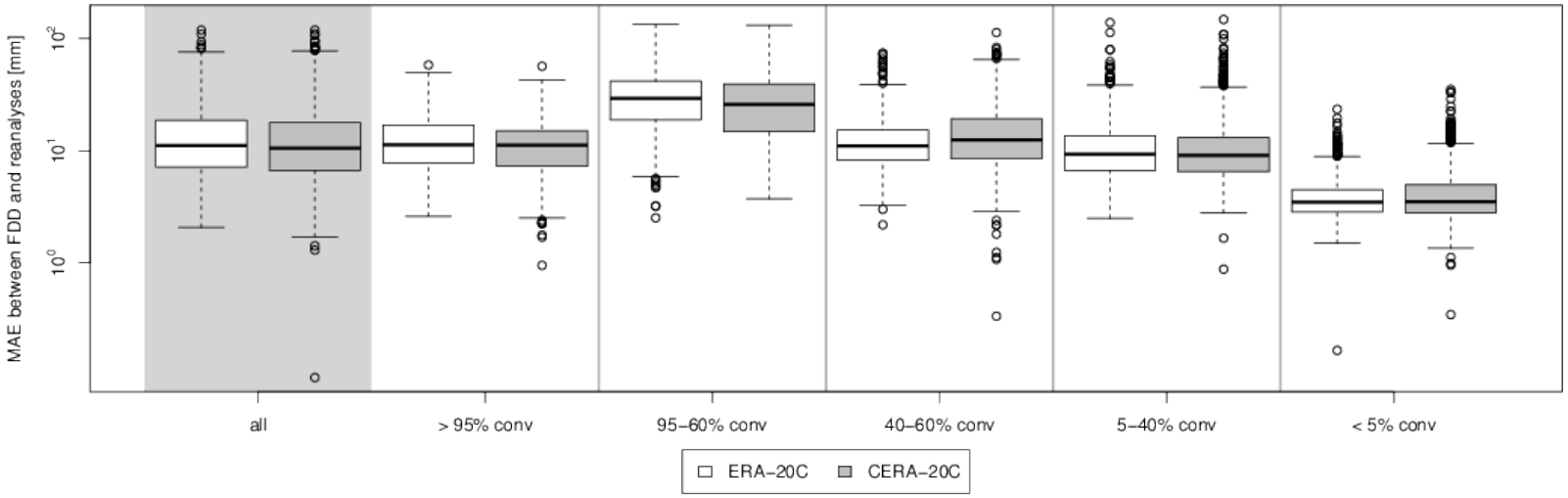
Statistics on events – MAE difference

- Lower MAE in CERA-20C than in ERA-20C in Brazil, Bolivia, Argentina, Southern and Central Africa, Centrals Australia, parts of India, Southeast Asia and Indonesia
- Larger MAE in CERA-20C than in ERA-20C in Andes and Mexico, some grids in Brazil, Argentina, Bolivia, China and at some coastal regions
- Ensemble spread MAE larger in tropics than in polar and temperate regions



Statistics on events – MAE precipitation type

- No differences in median and interquartile range, if precipitation type not taken into account
- Greater outliers found for CERA-20C
- Large scale precipitation has lower MAE than convective precipitation
- Mixed type events similar median, but interquartile range larger in CERA-20C than in ERA-20C

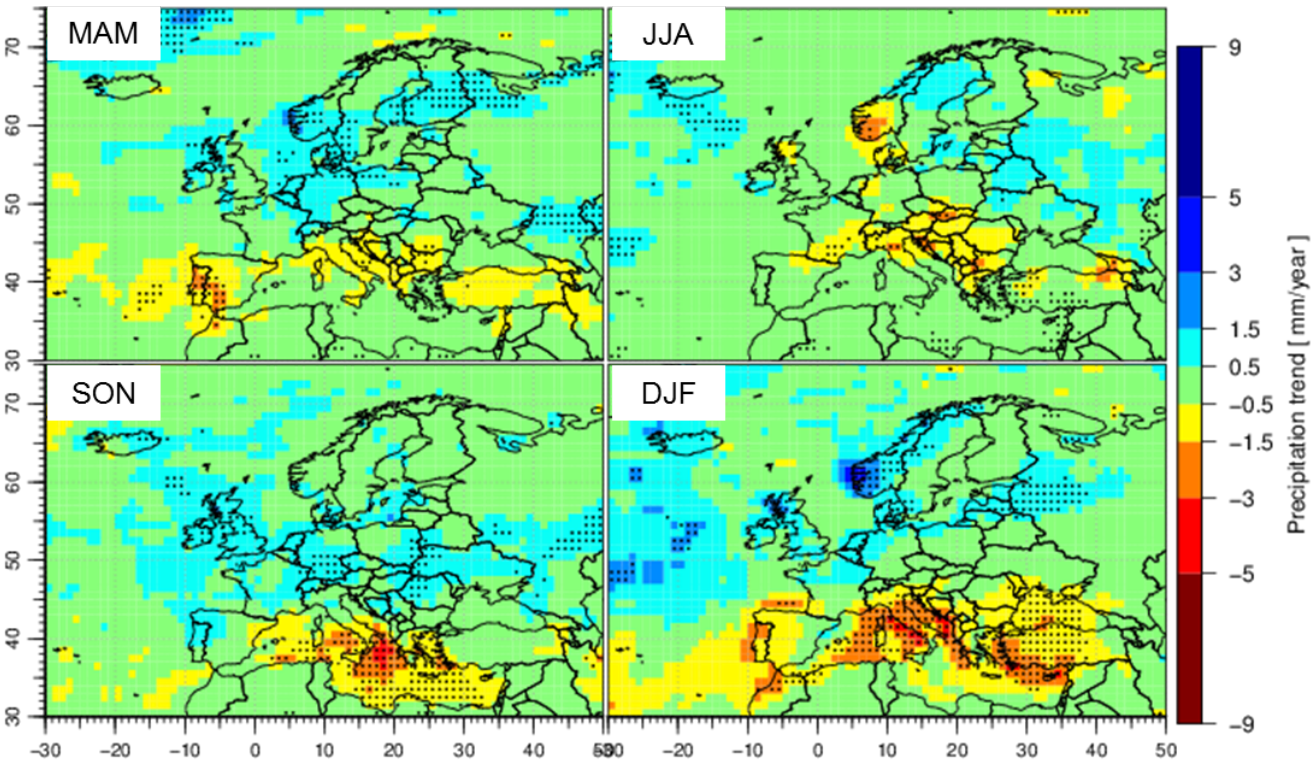


Trends in seasonal precipitation totals

- GPCC released homogenized monthly precipitation data set for Europe in spring 2017 – HOMPRA-Europe
- Starts in 1951 to 2005
- Stations with at least 90% coverage homogenized with automated scheme and interpolated to grids with 0.5°, 1° and 2.5° spatial resolution, ~5,340 stations
- ERA-20C and CERA-20C not homogenized

Trends in seasonal precipitation totals – ERA-20C

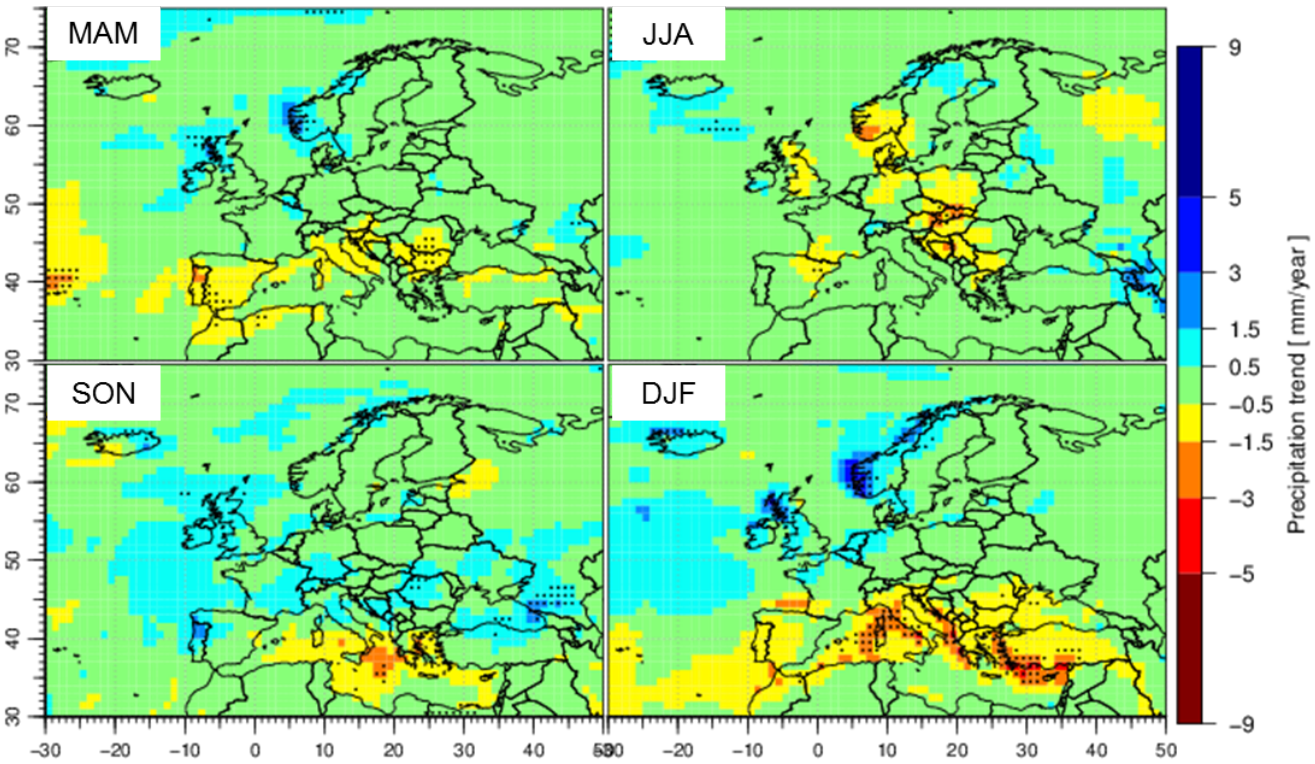
- Strongest trends in DJF, weakest trends in MAM and JJA
- Positive trends in northern part, negative trends in southern part of Europe
- In JJA also negative trends in Western Scandinavia
- Trends not significant in all seasons



Trends in seasonal precipitation totals – CERA-20C

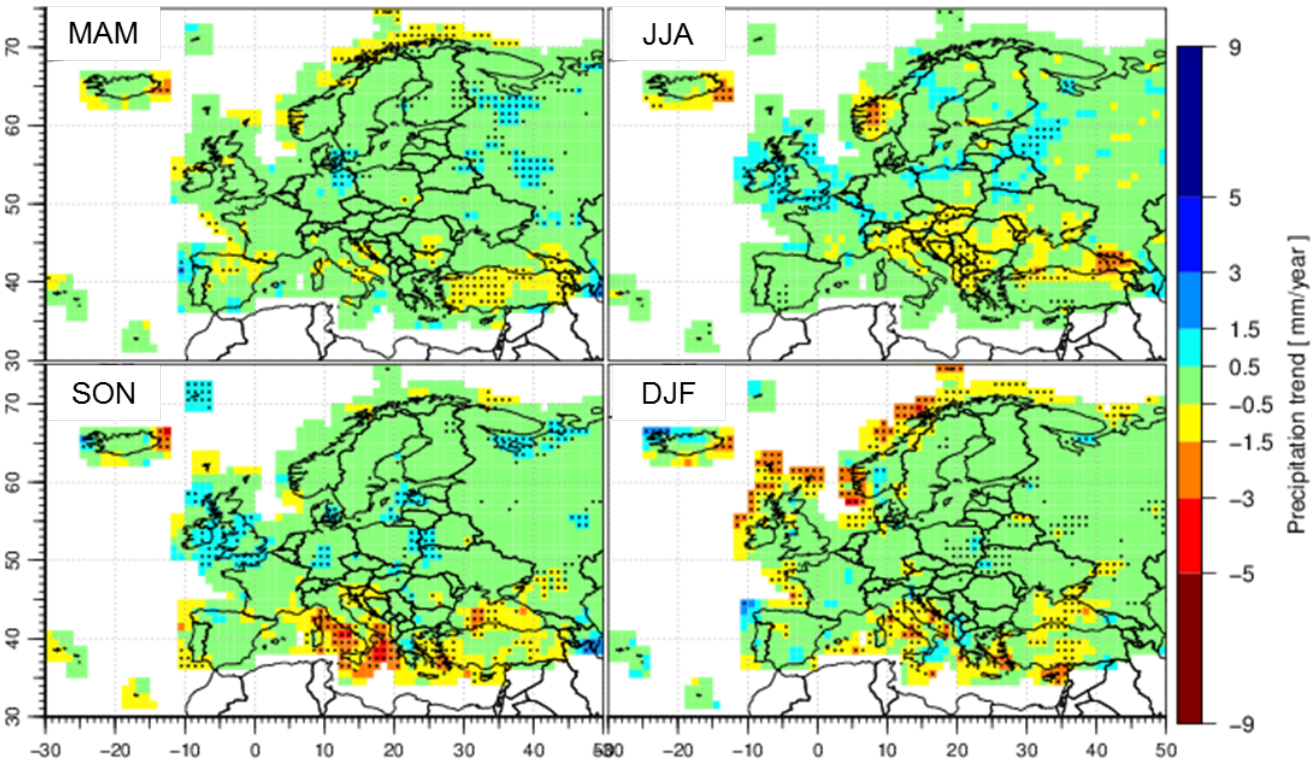
- General seasonal trend patterns in CERA-20C similar to ERA-20C, but areas with significant trends much smaller

- Strongest trends in DJF and weaker trends in MAM and JJA
- Northern part dominated by positive trends, southern part dominated by negative trends



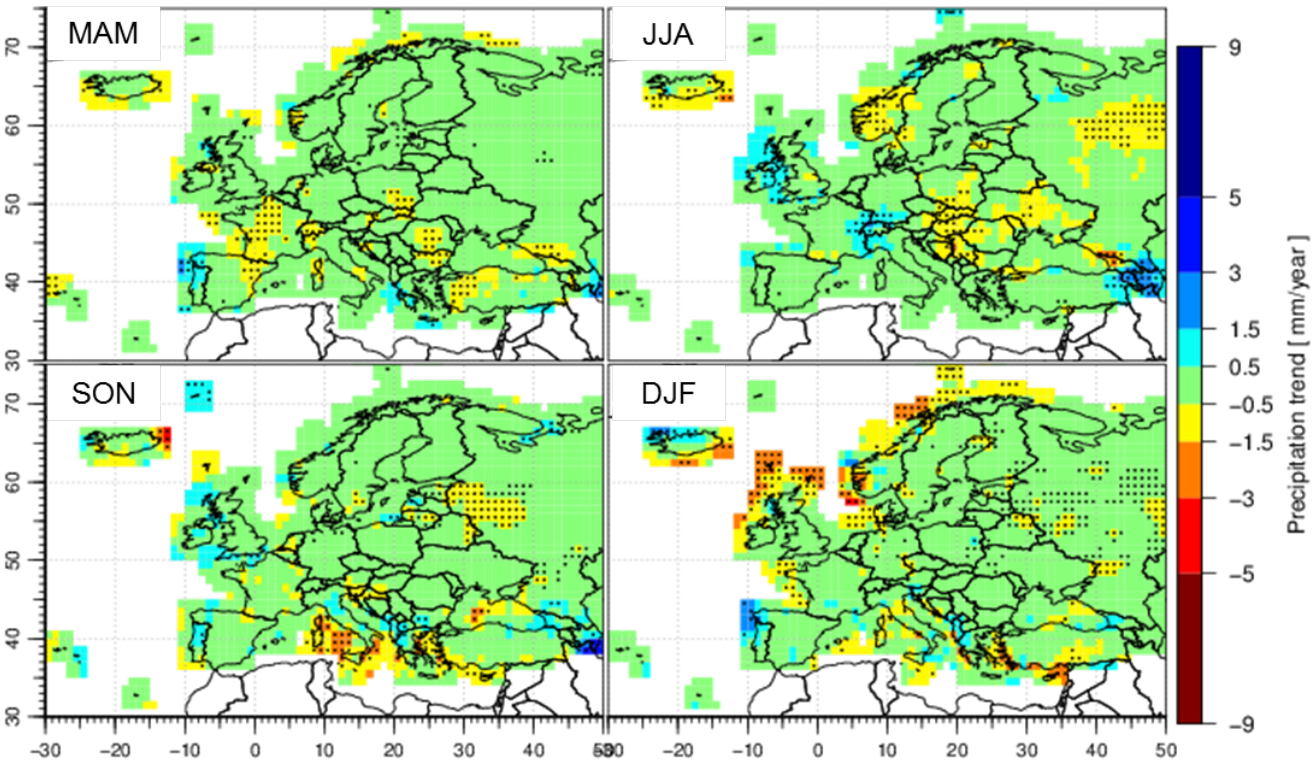
Trends in seasonal precipitation totals – difference

- Trends in the seasonal differences between ERA-20C and HOMPRA-Europe
- ERA-20C has stronger negative trends than HOMPRA-Europe
- Strongest differences at Atlantic coast in DJF and Mediterranean region in SON
- Most trends are significant



Trends in seasonal precipitation totals – difference

- Trends in the seasonal differences between CERA-20C and HOMPRA-Europe
- More negative than positive trends
- Strongest differences at Atlantic coast in JJA and in Mediterranean region in SON
- Trends in Russia in JJA and SON did not occurred in ERA-20C



Summary

- Reanalyses don’t reproduce ITCZ and African Monsoon
- CERA-20C reproduces Indian Monsoon better than ERA-20C
- More convective precipitation in CERA-20C than in ERA-20C
- Events in CERA-20C correlates better with FDD than ERA-20C, for all precipitation types
- Similar trends in seasonal precipitation sums in Europe in CERA-20C and ERA-20C, CERA-20C less significant trends than ERA-20C
- Reanalyses have stronger negative / weaker positive trends than HOMPRA