Shifts in climatic regions

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What are we doing?

• When and where are climates shifting?

• Use Köppen climate classifications to trace climate shifts
Köppen Climate Classification

World Map of Köppen–Geiger Climate Classification
updated with CRU TS 2.1 temperature and VASChimO 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
E: 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

Resolution: 0.5 deg lat/lon

Version of April 2006

Rubel and Kottek, 2010

http://gpcc.dwd.de
http://koenpen-geiger.va-wien.ac.at
Köppen Climate Classification

Dry and hot conditions

Wet and warm conditions
Köppen Climate Classification

Frost climates

Desert
Use of model data

Global Warming Predictions

Annual cycle of $T$ and $PR$ (1900-2098)

13 CMIP5 models: historical and RCP8.5
Climate variability

- Natural fluctuations in climates are taken into account
- Only if a climate is appearing that has never been experienced before at this grid cell
How much land area sees a shift?
How much land area sees a shift?
Increasing speed in shifts

- Models
- Multi model mean

Velocity of area change [%/C]

ase [°C]
Where is it changing?
Which one is the driving factor?

- Which changes are more important? Temperature or precipitation?

- Two approaches:

  Precipitation constant  Temperature constant
Precipitation constant
Temperature constant

![Graph showing temperature constant with models and multi-model mean.](image-url)
Why is it temperature driven?

• The way the Köppen scheme is defined ➔ Thresholds

• Models underestimate precipitation changes

• Precipitation is more noisy

• Precipitation changes make shifts ‘less linear’
Conclusions

- At two degrees nothing extraordinary happens.
- At 3°C temperature increase already 10-15% of all land area experiences a climate shift.
- Low latitude mountain regions change first.
- Changes are temperature driven.