

HIGH IMPACT WEATHER EVENTS IN A CHANGING CLIMATE IN DIFFERENT REGIONS OF THE WORLD

Prof. Nicole van Lipzig

Department Earth and Environmental Sciences

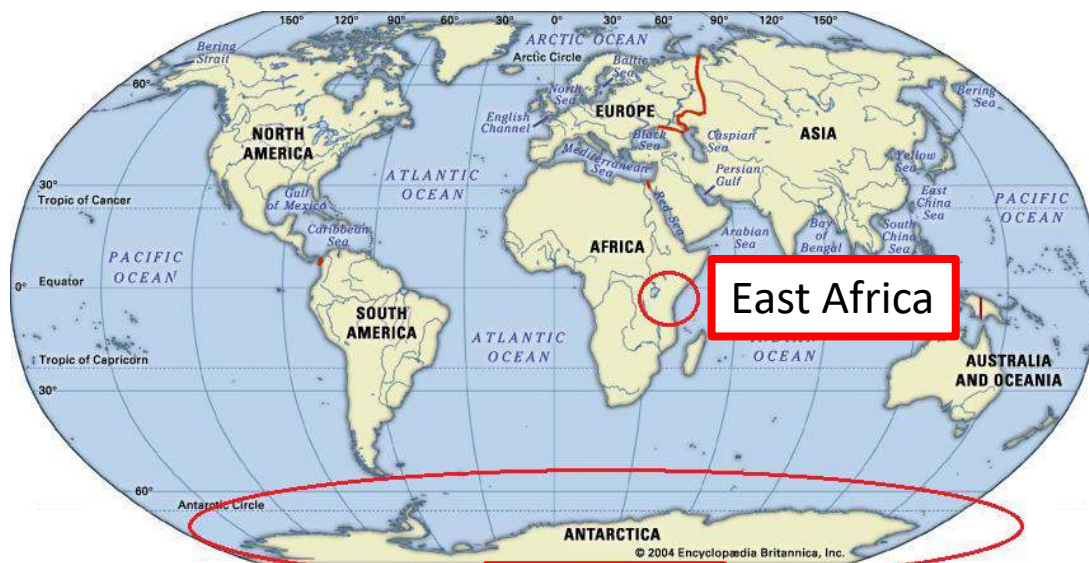
KU Leuven, Belgium

The logo of KU Leuven, featuring the text "KU LEUVEN" in white, bold, uppercase letters on a dark blue rectangular background. A light blue border is visible on the left and top edges of the logo.

KU LEUVEN

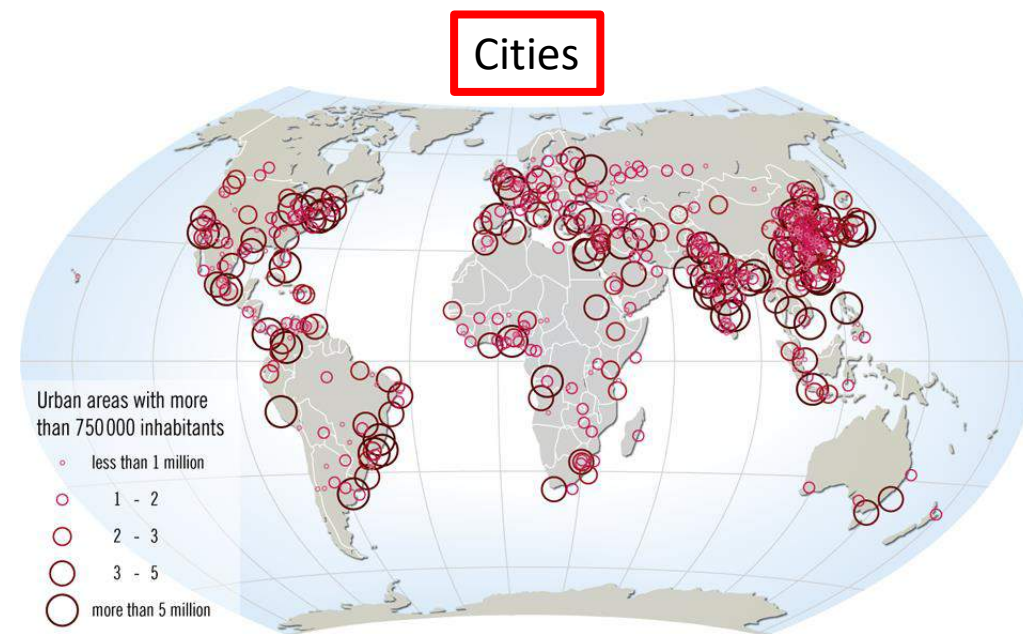


Today, I take you on a journey ...



Antarctica

Irina Gorodetskaya

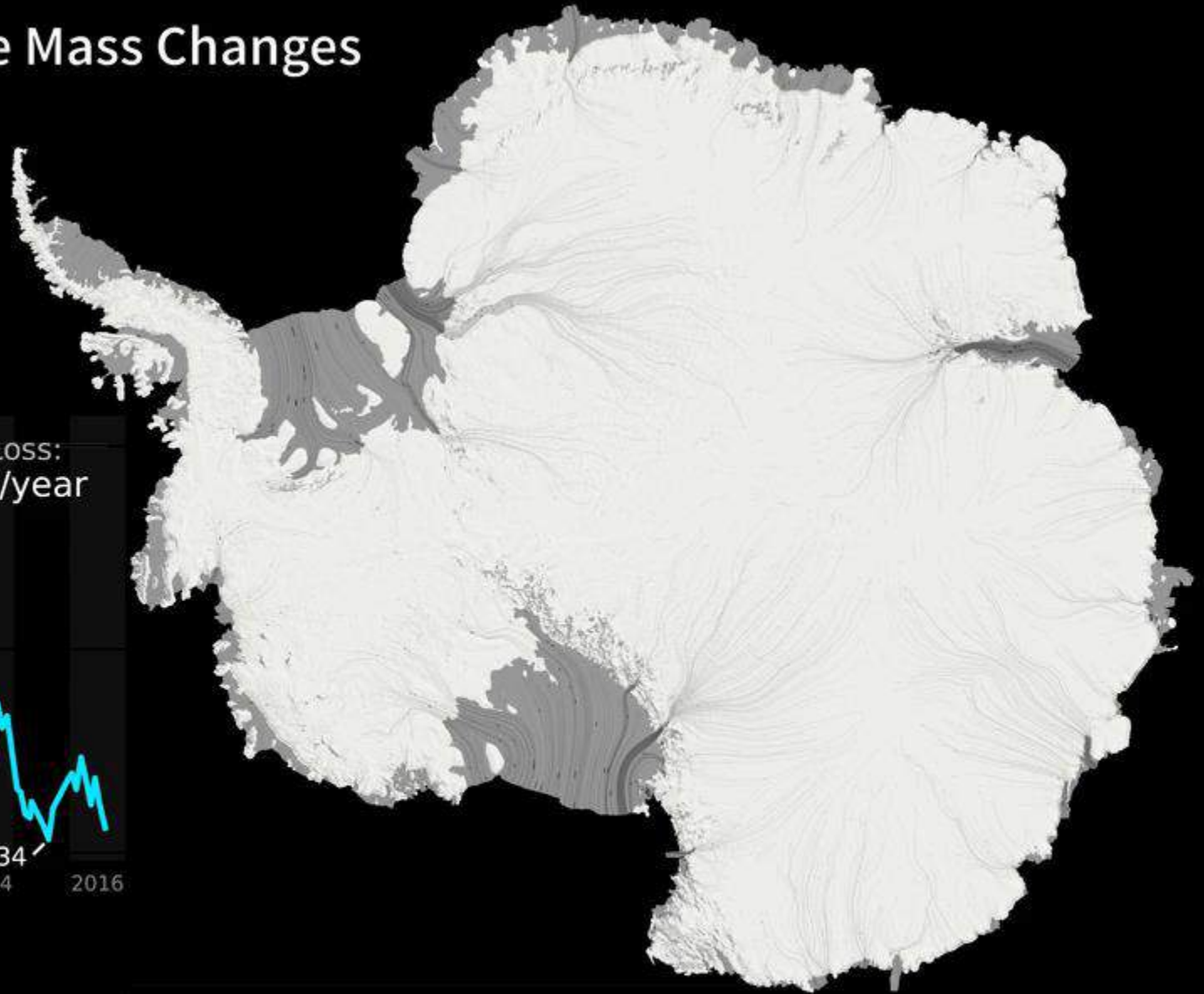
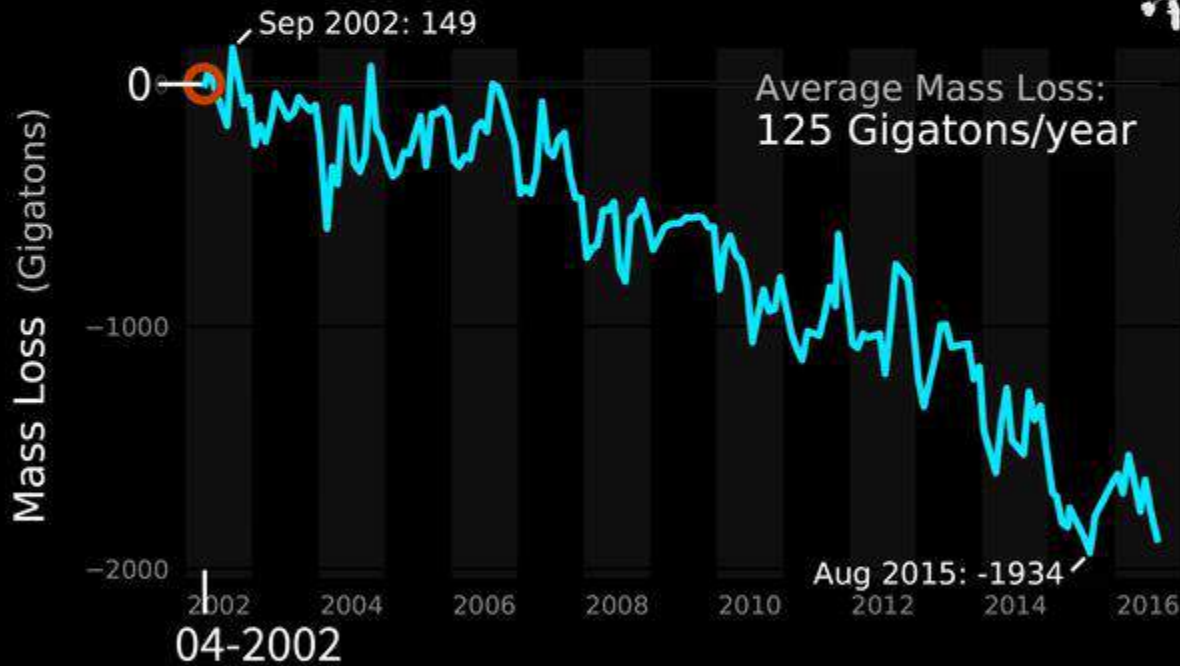


GRACE Observations of Antarctic Ice Mass Changes

1.5 times area of Europe

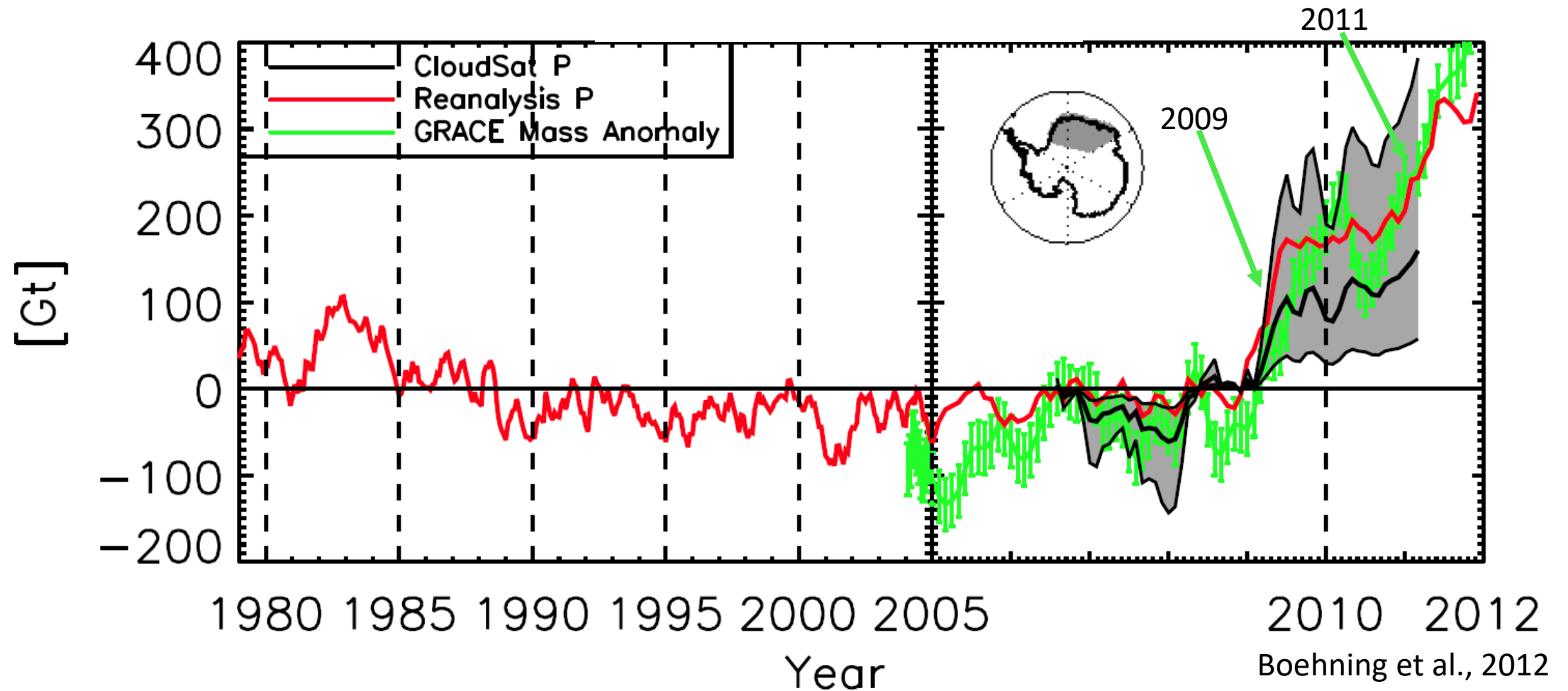
61% percent of all fresh water

equivalent to about 58 m of sea-level rise



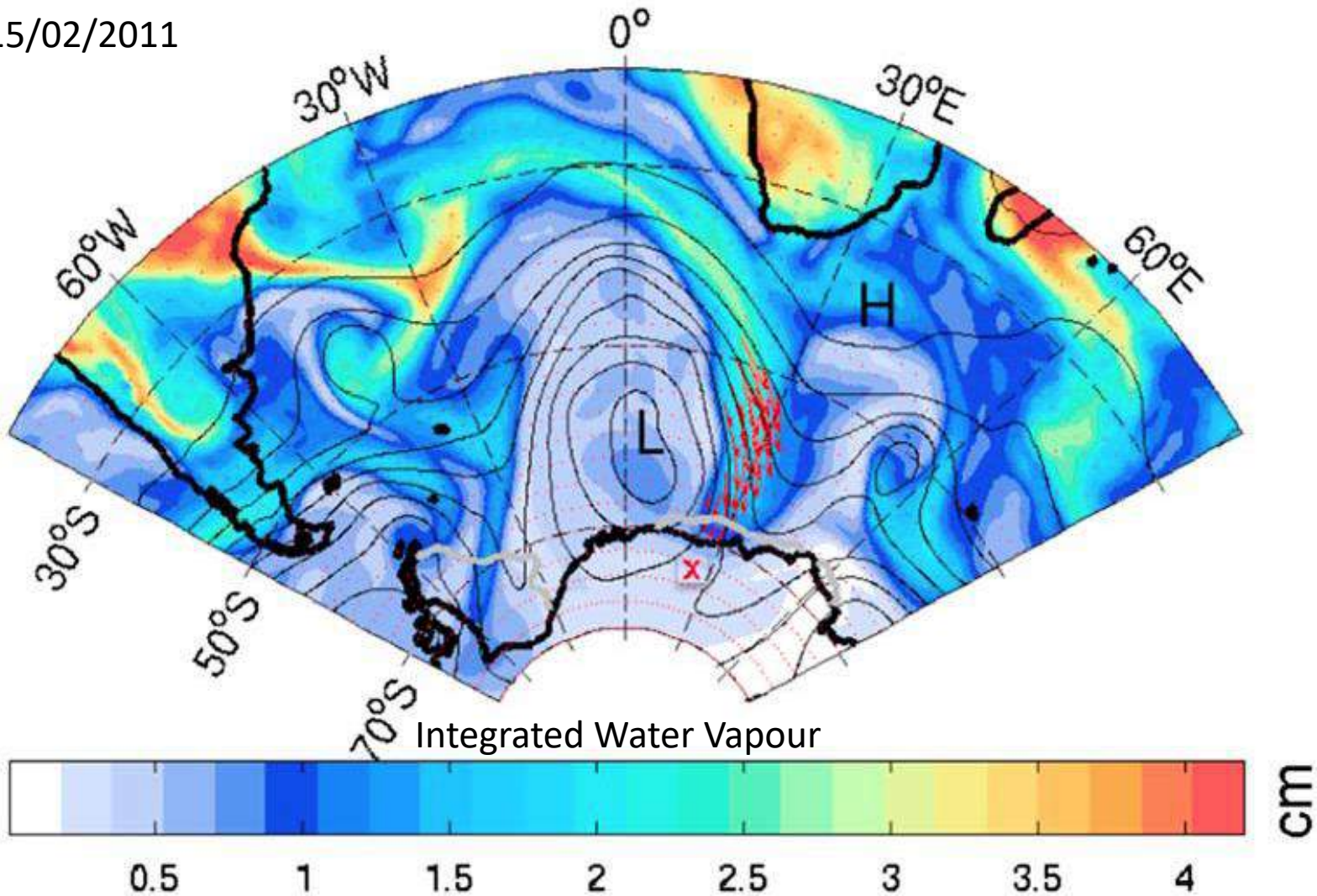
Zoom in into Dronning Maud Land

Accumulation in Dronning Maud Land



Mass increase in Dronning Maud Land is due to snowfall
Anomalous snowfall in DML in 2009 → Offset 15% of 20-year ice sheet loss
Research question: What is the role of atmospheric rivers? (**extreme events**)

Extended definition of atmospheric rivers
Example of an atmospheric river 15/02/2011

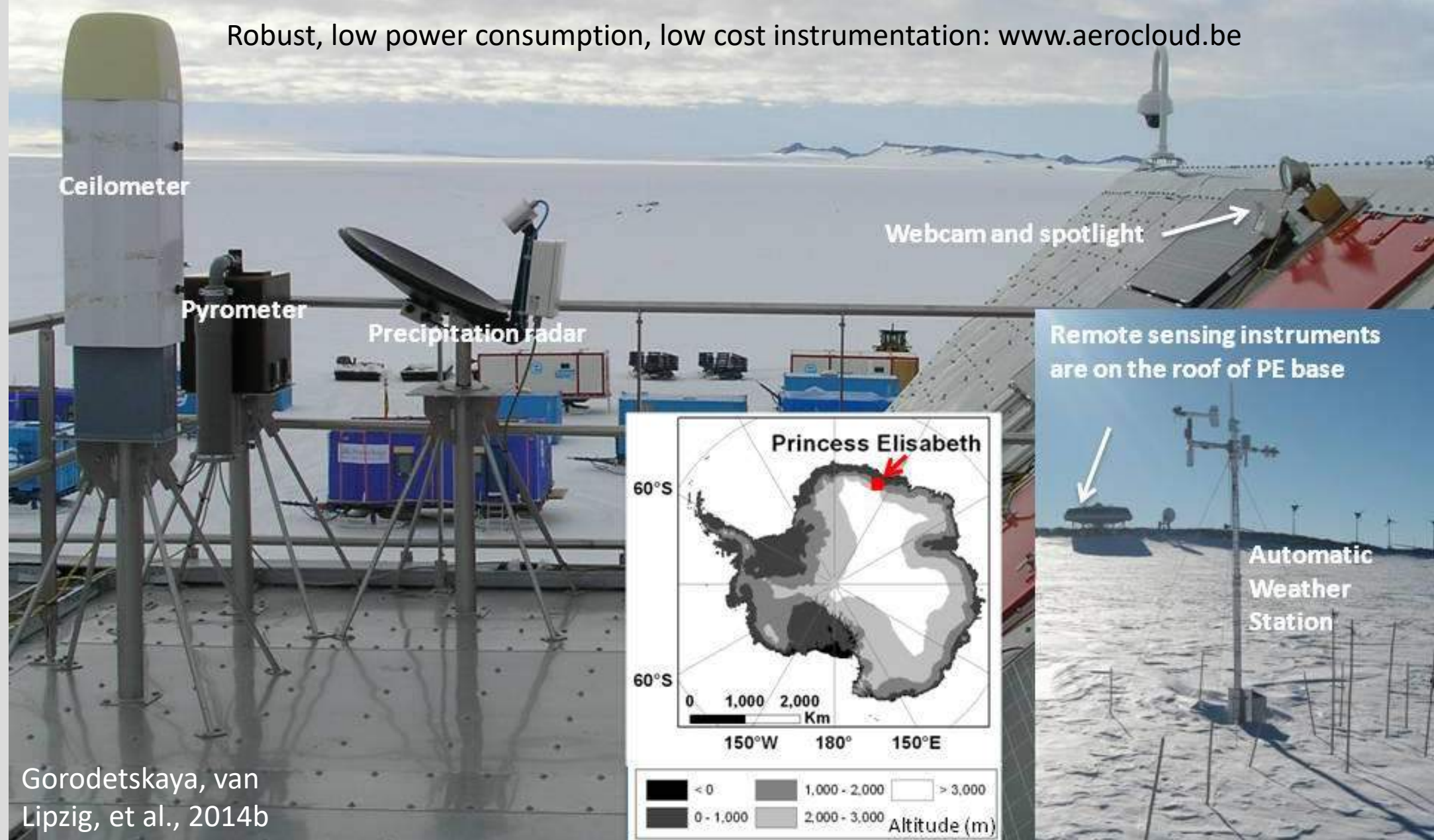


Mass gain in 2009 and 2011
75% due to atmospheric rivers

Gorodetskaya, van
Lipzig, et al., 2014a

..... what about snowfall?

Robust, low power consumption, low cost instrumentation: www.aerocloud.be



Gorodetskaya, van
Lipzig, et al., 2014b

Relation with AR is stronger for accumulation than for precipitation

Size of the precipitation event matters (Souverijns, Gorodetskaya, van Lipzig, 2018)

Implications: Extreme snowfall events do affect Antarctic mass: increasingly probable toward the end of the 21st century. (Lenaerts et al., 2013)

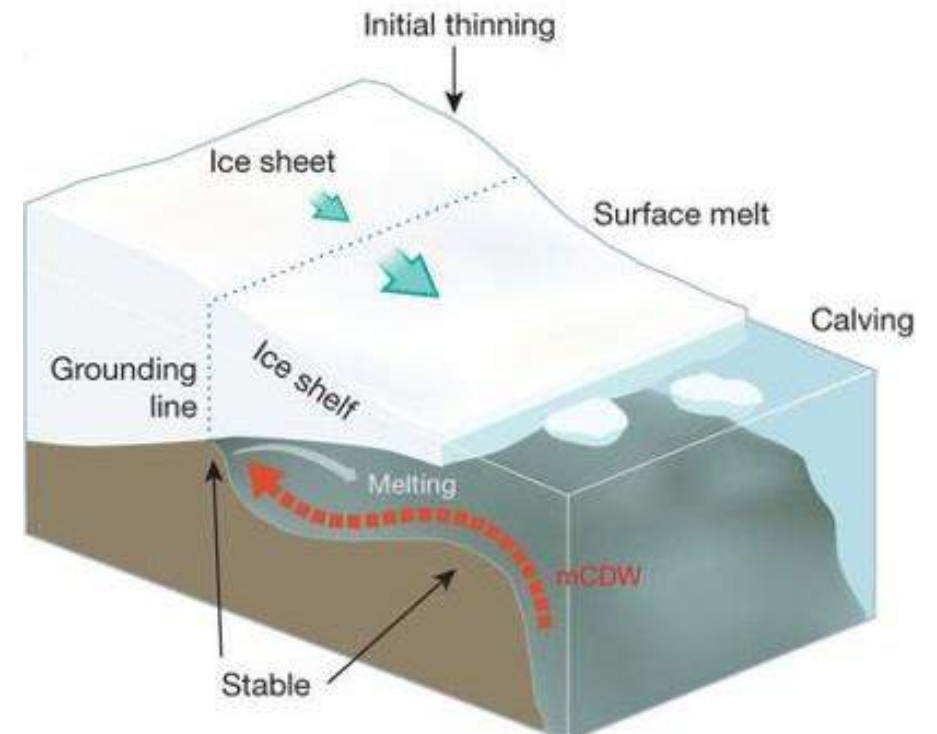
Future research priorities: Role of the ice shelves (buttressing effect) increased melt in a warming climate, feedbacks ocean dynamics

Development: Two-way coupled regional atmosphere, ocean, ice dynamical models

PARAMOUR project

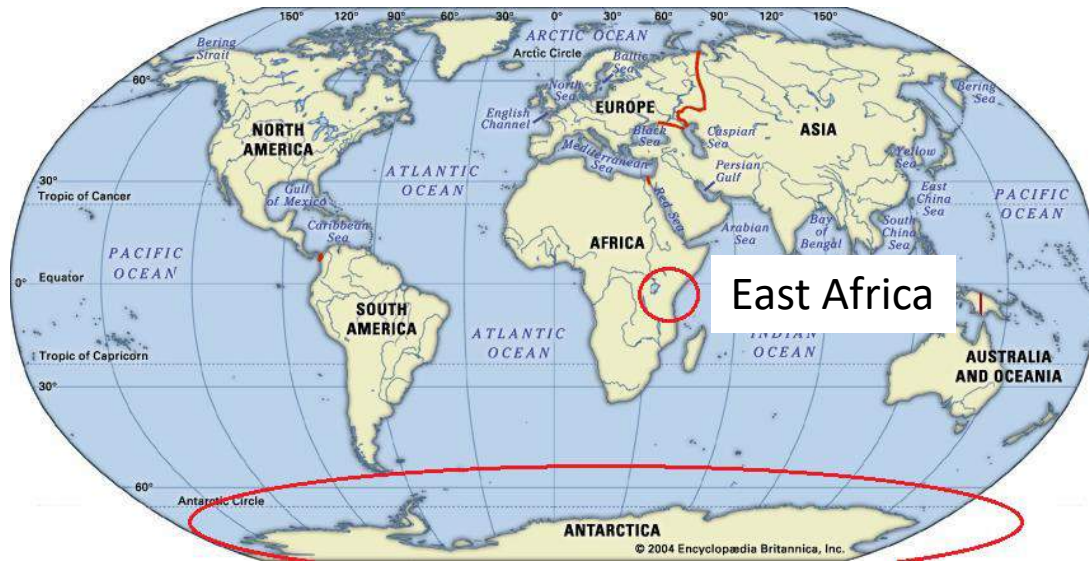


Brucide: Predictability and viscosity of polar climate: the loss of Antarctica - Ocean cryosphere
multiscale interactions - PARAMOUR



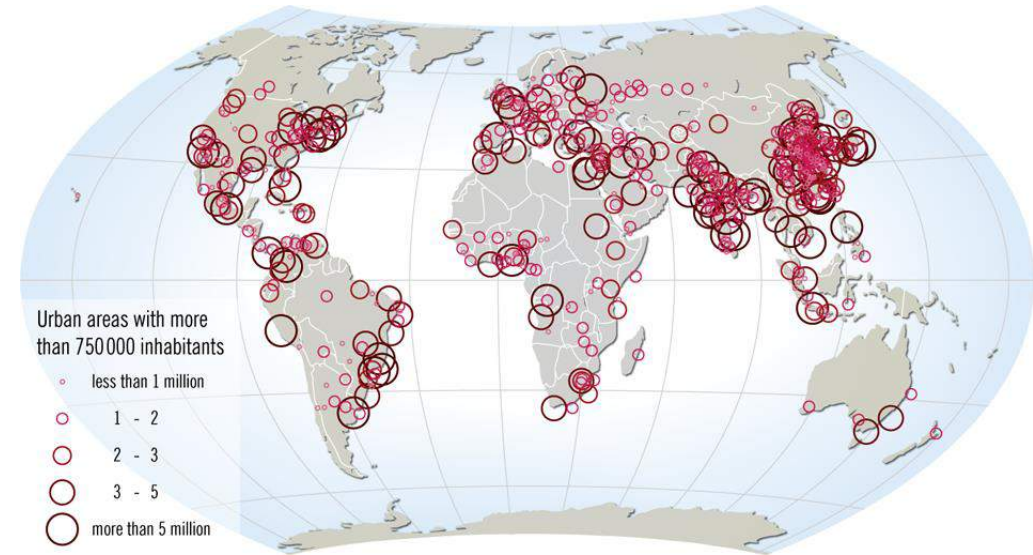


East Africa – Lake Victoria Basin; Wim Thiery



Antarctica

Cities



Lake Victoria



Ecosystem services: Drinking water; Electricity; Fishing (200 000 fishermen; sustains livelihood of 30 million people)

Risks: thunderstorms at night: estimated 3000-5000 loss of life per year

Research question: How are these extremes affected by a changing climate

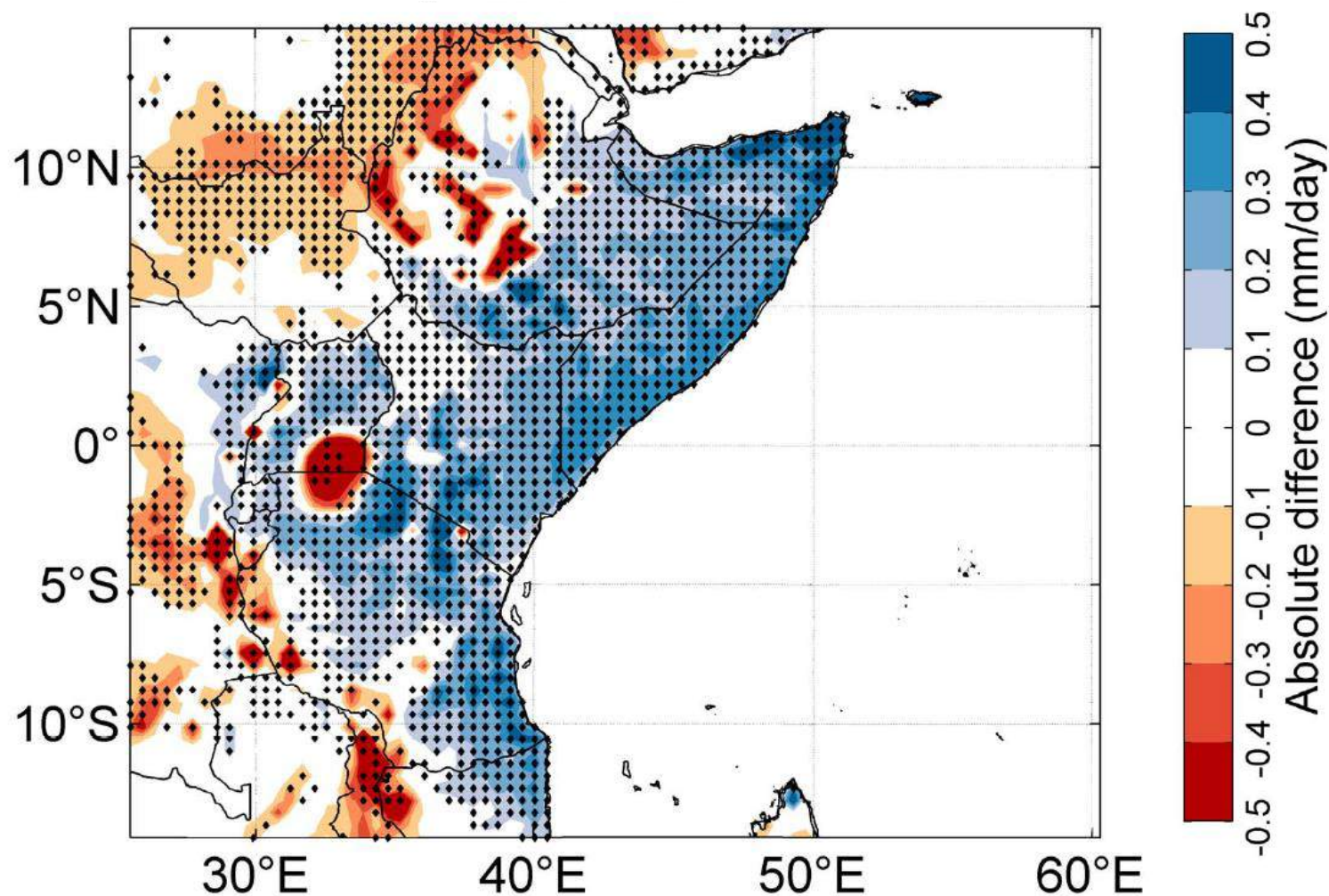


(Lake Victoria, © Yann Arthus-Bertrand)

Let's first look what CORDEX-Africa says about

Absolute precipitation changes

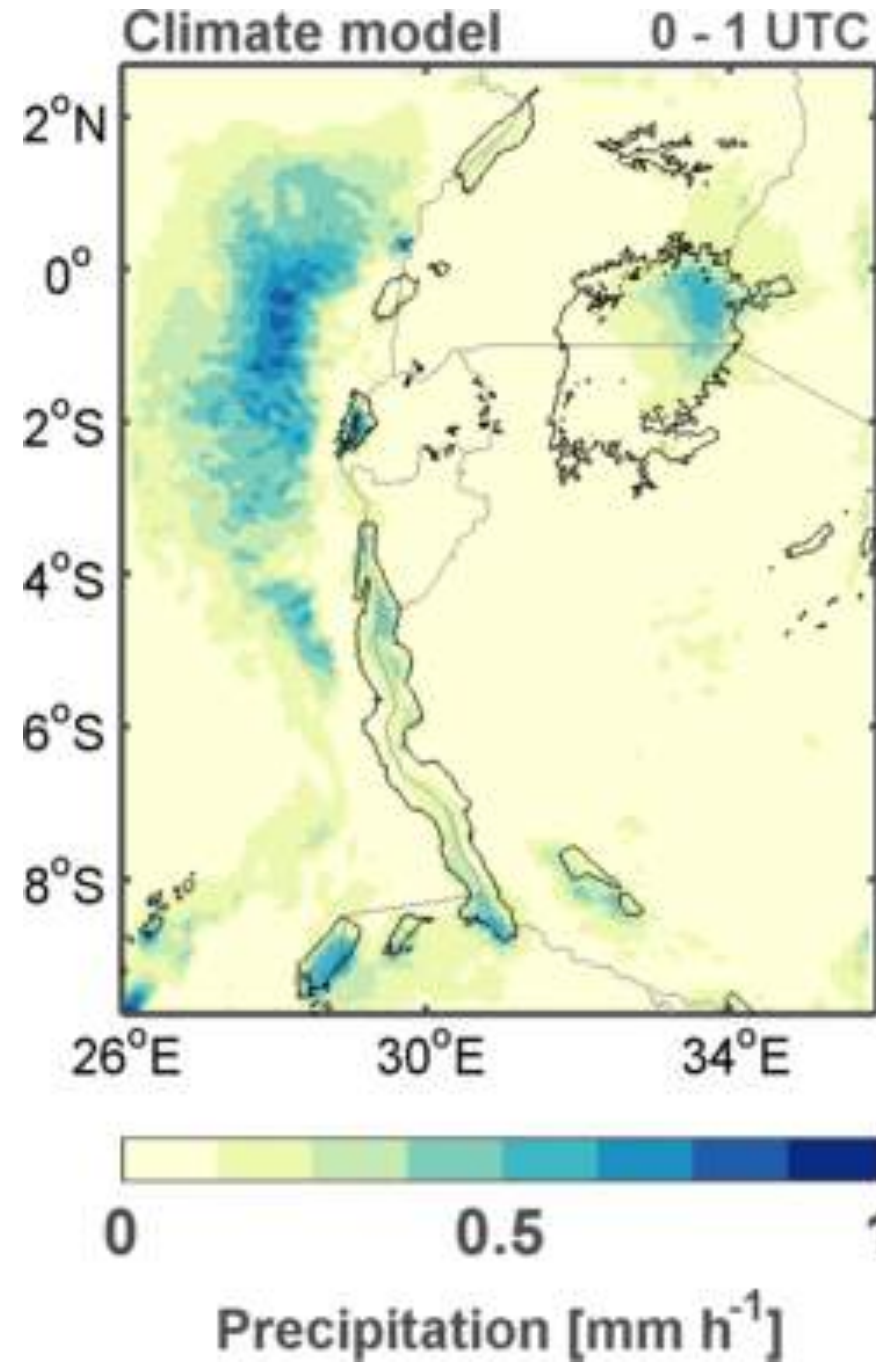
between 1981–2010 and 2071–2100 (RCP8.5) for 15 RCM members



Souverijns, Thiery,
Demuzere, van Lipzig,
2016

... to get better insight in extremes we used a high-resolution model coupled to 1D lake model

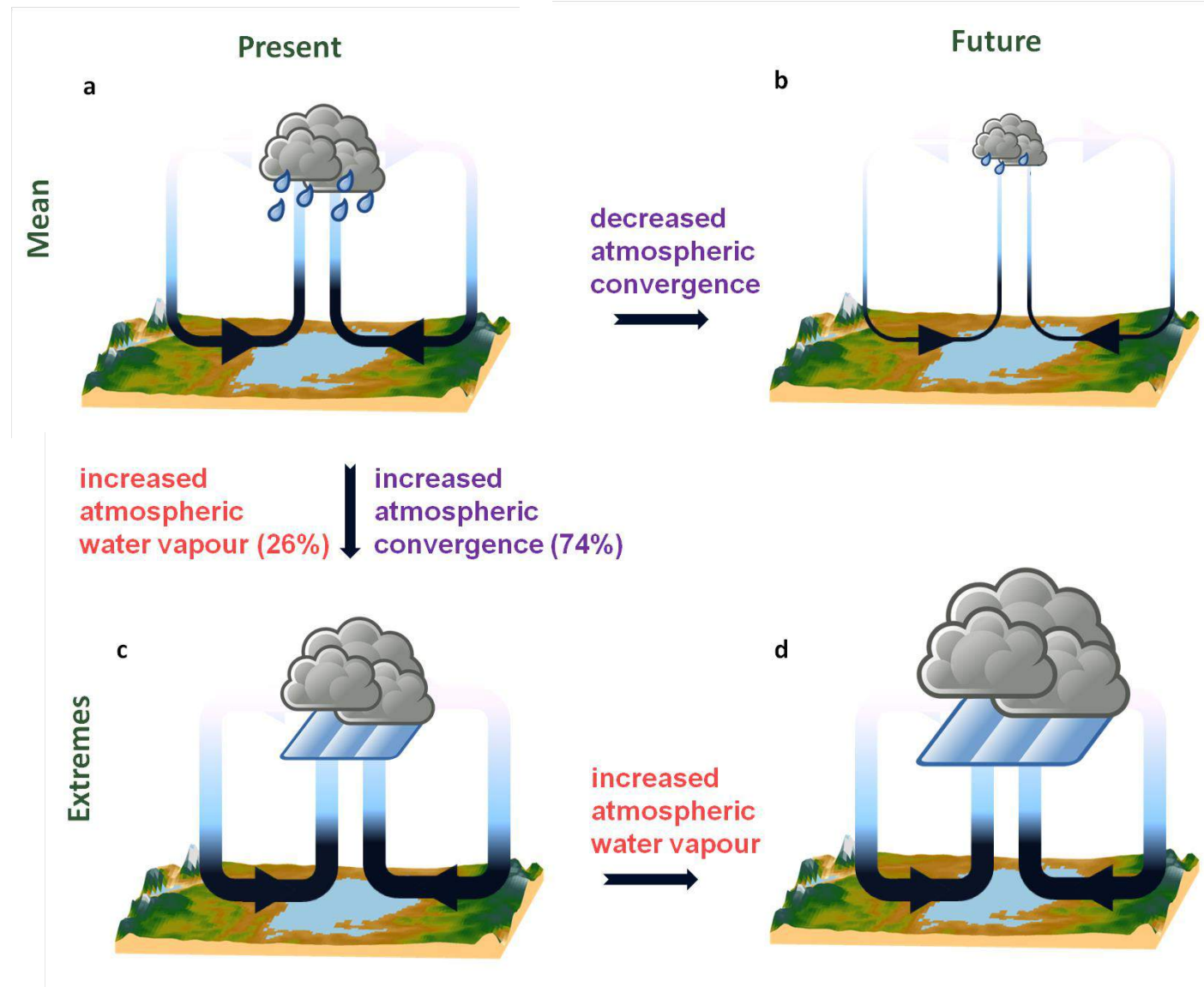
- Regional climate model
COSMO-CLM² coupled to
Flake
- 7 km grid spacing
- CTL:1999-2008 (ERA-Interim)
- HIST: 1981-2010 (CORDEX-Africa -
MPI-ESM-LR)
- RCP8.5: 2071-2100 (CORDEX-
Africa - MPI-ESM-LR)
- Evaluated using remote sensing and
in-situ data (Thiery, van Lipzig et al.,
2015)



Thiery, van Lipzig et al., 2016

Climate change: average versus extreme precipitation

- Future increase in extremes over lake about twice as large relative to surrounding land
- A 1-in-15-year precipitation event over the lake becomes a 1-in-1.5-year event (end of the century; RCP8.5)



Implications: High resolution modelling needed for projections of extremes

Future research priorities: international collaboration for improved climate modelling of extremes and for actionable climate information especially where **vulnerability** of population is high

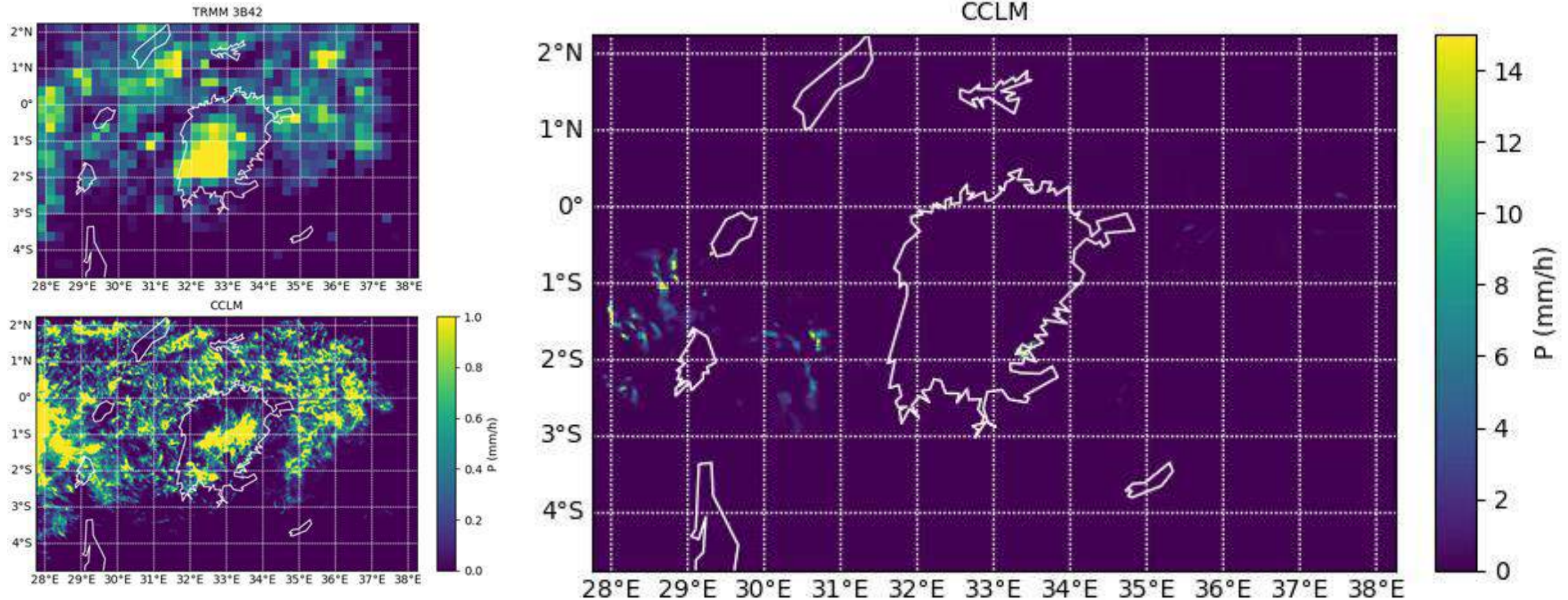


PROPOSED STUDY SUMMARY

PROPOSED STUDY SUMMARY	
Title	“ELVIC - Climate Extremes in the Lake Victoria Basin” a CORDEX-Africa & GEWEX initiative

- Are moist convective systems better represented by Convection Permitting Models?
- How can we best combine information of CMIP and CORDEX-Africa with CPM integrations?
- How will extreme weather events evolve in the future?
- How can improved probabilistic information be used by the impact community?

Convection Permitting Model simulations

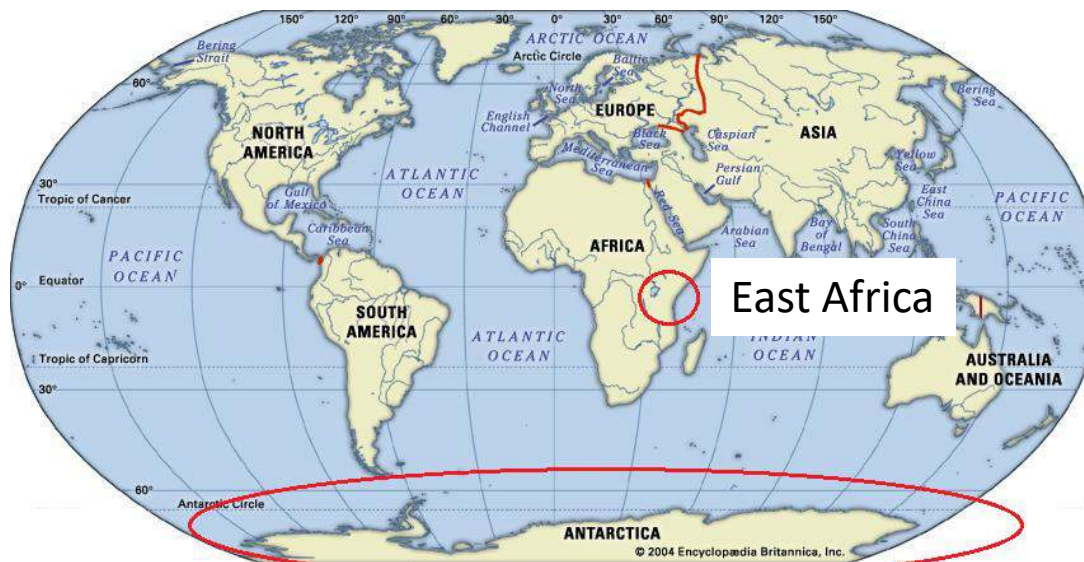


4/5 September 2011; CCLM at (2.8 km)² driven by ERA5; ©Van de Walle

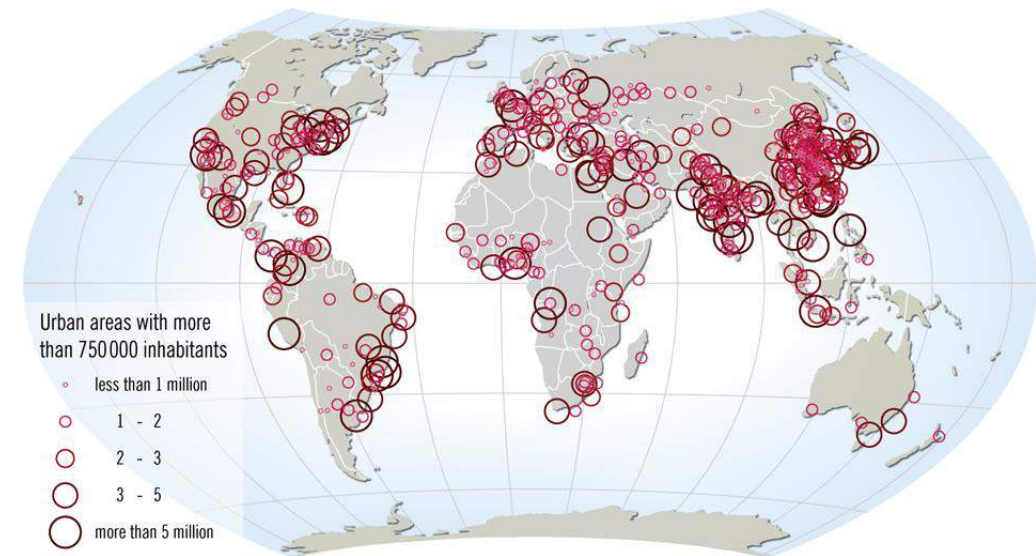


Cities – Brussels; Hendrik Wouters

Cities



Antarctica

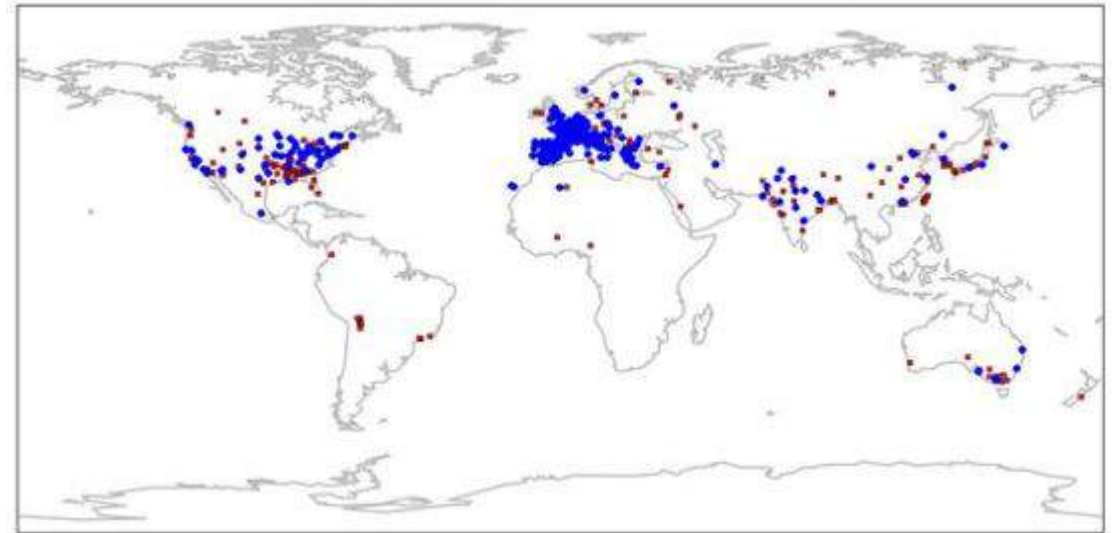


Extreme heat leading weather-related cause of death

A few examples (Lopez, 2018):

- 1980 Southern Plains (1,700 fatalities)
- 1995 event in Chicago, Illinois (1,021 fatalities)
- 2003 European heat wave (52,452 fatalities)
- 2010 Russian event (55,736 fatalities)
- 2011 event over the US Great Plains (206 fatalities)

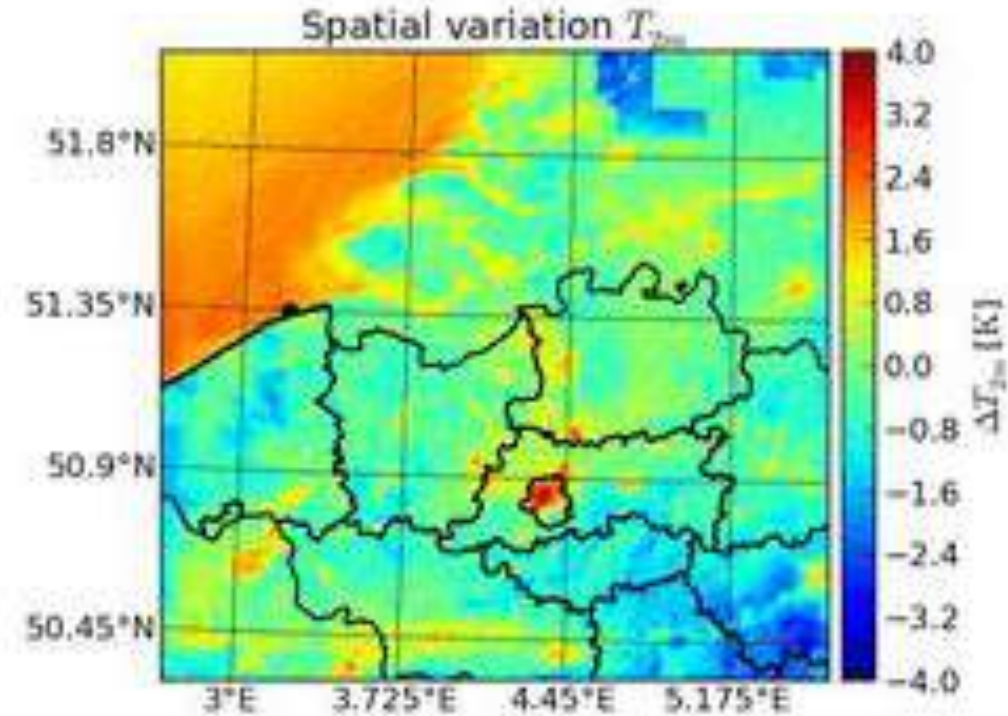
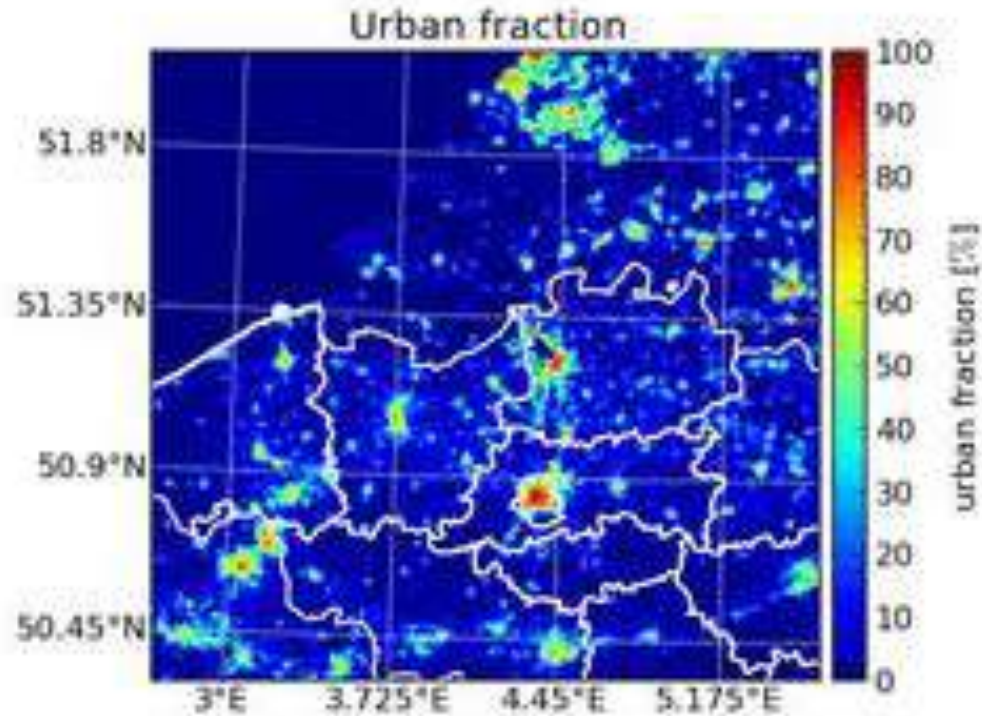
Places where relationships between heat and mortality have been documented (Mora et al., 2017)



... cities are hot!

2012-08-10 23:00:00UTC

Anomaly in T2m compared to domain average



Wouters, van Lipzig,
Demuzere et al., 2017

Research question: How is heat stress in cities evolving compared to the countryside?

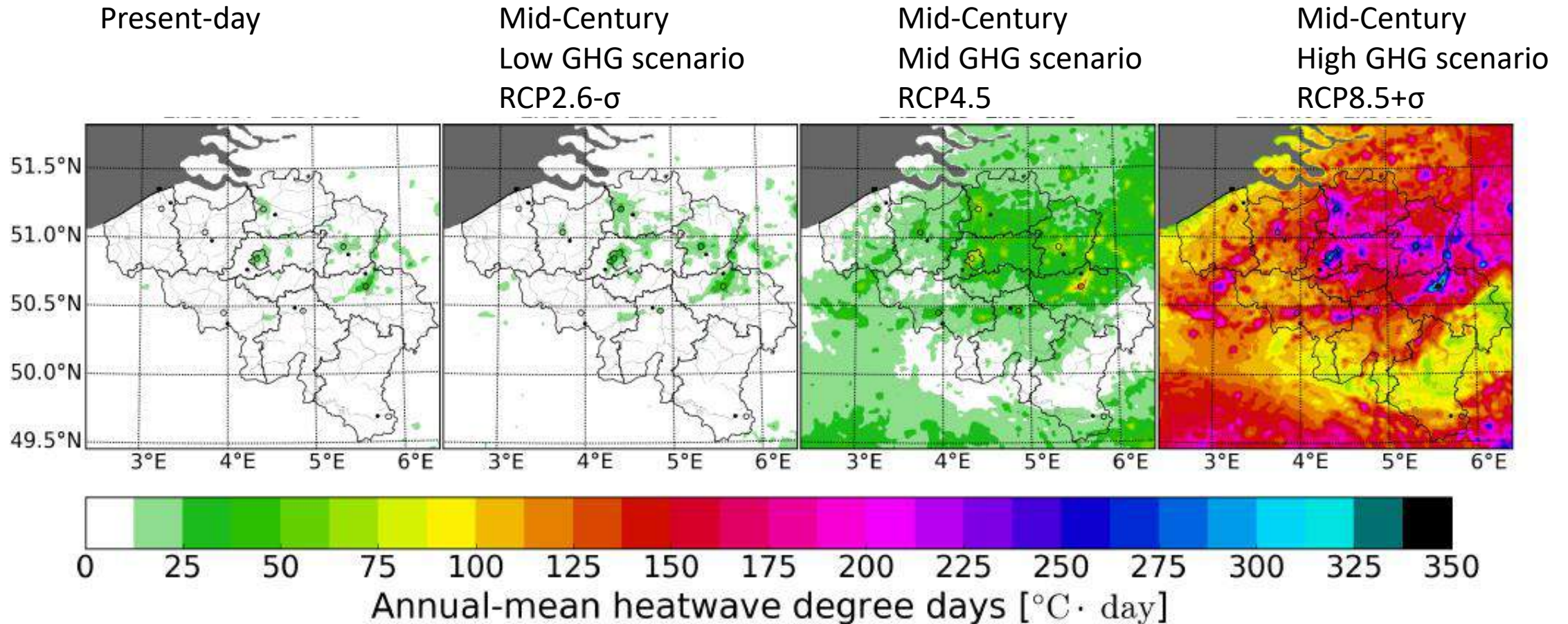
- Regional climate model CCLM coupled to TERRA_URB
- 2.8 km grid spacing
- CTL: 1980–2014 (CCLM 12 km driven by ERA-Interim)
- Present-day urbanization

Design of the study

- Regional climate model CCLM coupled to TERRA_URB
- 2.8 km grid spacing
- CTL: 1980–2014 (CCLM 12 km driven by ERA-Interim)
- Present-day urbanization and 2060 business-as-usual urbanization
- 42 members from 11 CMIP5 GCMs for 1980–2014 and 2040–2074
- Heat stress indicator - health authorities in Belgium

$$\sum_i \left[(T_{\min,i} - 18.2^\circ\text{C})^+ + (T_{\max,i} - 29.6^\circ\text{C})^+ \right] h_i$$

Mid-century heat stress



- Mid GHG scenario: increase in heatwave days from 7 to 16
- Heat stress in the urban centers is multiplied by a factor up to 15 depending on the emission scenario
- The heat-stress increase is about twice as large for the city centers as for the natural surroundings

Implications: Should we move out of the city? No – cities hold the key to solutions, but are priority areas for climate adaptation

“Cities are where change is happening the fastest and we must seize the opportunities we have been presented with to make that change significant and permanent.”

DAVID MILLER
Mayor of Toronto (2007)

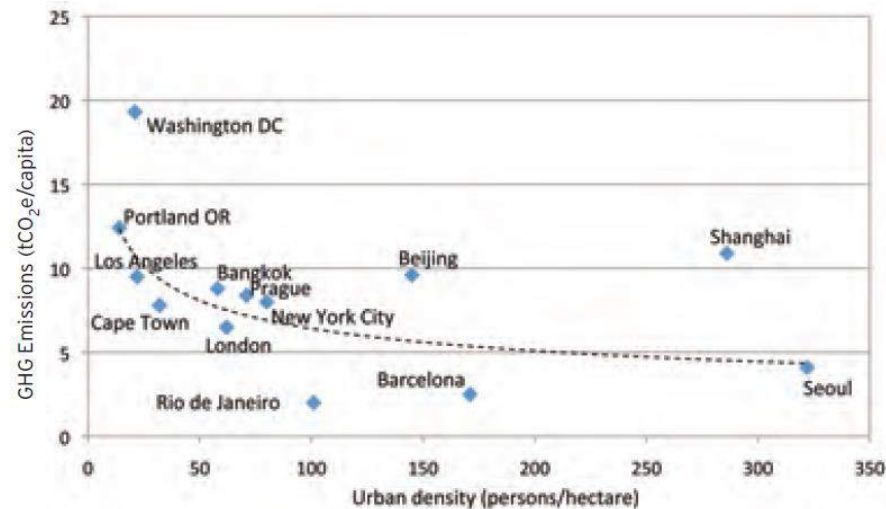


Stadsplan Vlaanderen
Midden- en Zuidoost-Vlaanderen 2017-2020

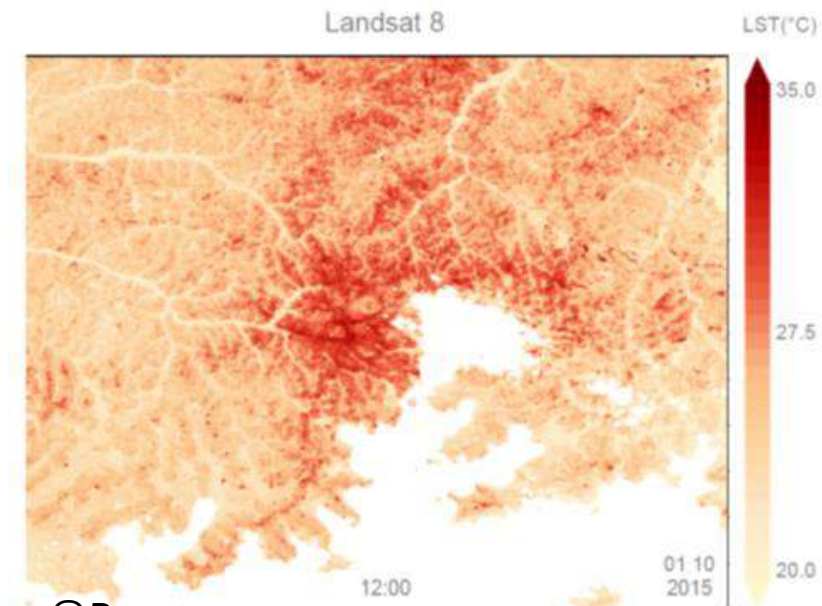


BWMSTR
2017–2020
Ruimte maken
voor mens
en natuur

City Densities and their Greenhouse Gas Emissions per Capita



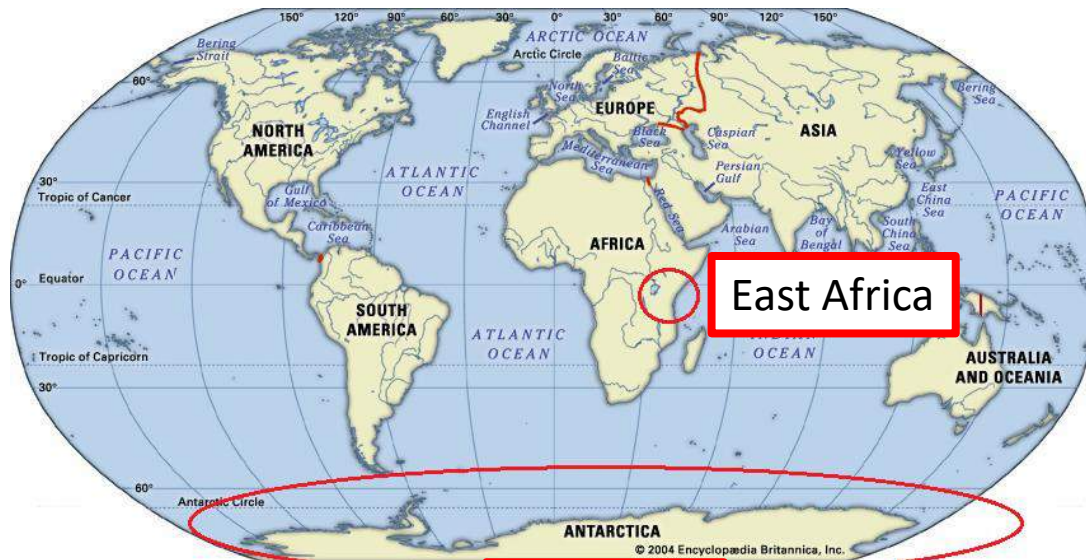
Future research priorities:
Heat stress in tropical regions



©Brousse



I hope you enjoyed the journey ...



Antarctica

