A new perspective on hydrological drought: a process-based classification into different drought types

Anne van Loon and Henny van Lanen

WAGENINGEN UR
For quality of life

Types of drought:

- Meteorological drought
- Soil moisture drought
- Hydrological drought (groundwater and discharge)

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011

Flood typology

Merz & Blöschl (2003): A process typology of regional floods, WRR

	P-control	T-control
long-rain floods	x	
short-rain floods	x	
flash floods	x	
rain-on-snow floods	x	x
snowmelt floods		x

WAGENINGEN UR
For quality of life

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011

Hydrological drought typology

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD

	P-control	T-control
classical rainfall deficit drought	x	
rain-to-snow-season drought	x	x
wet-to-dry-season drought	x	x
cold snow season drought		x
warm snow season drought	(x)	x
composite drought	x	x

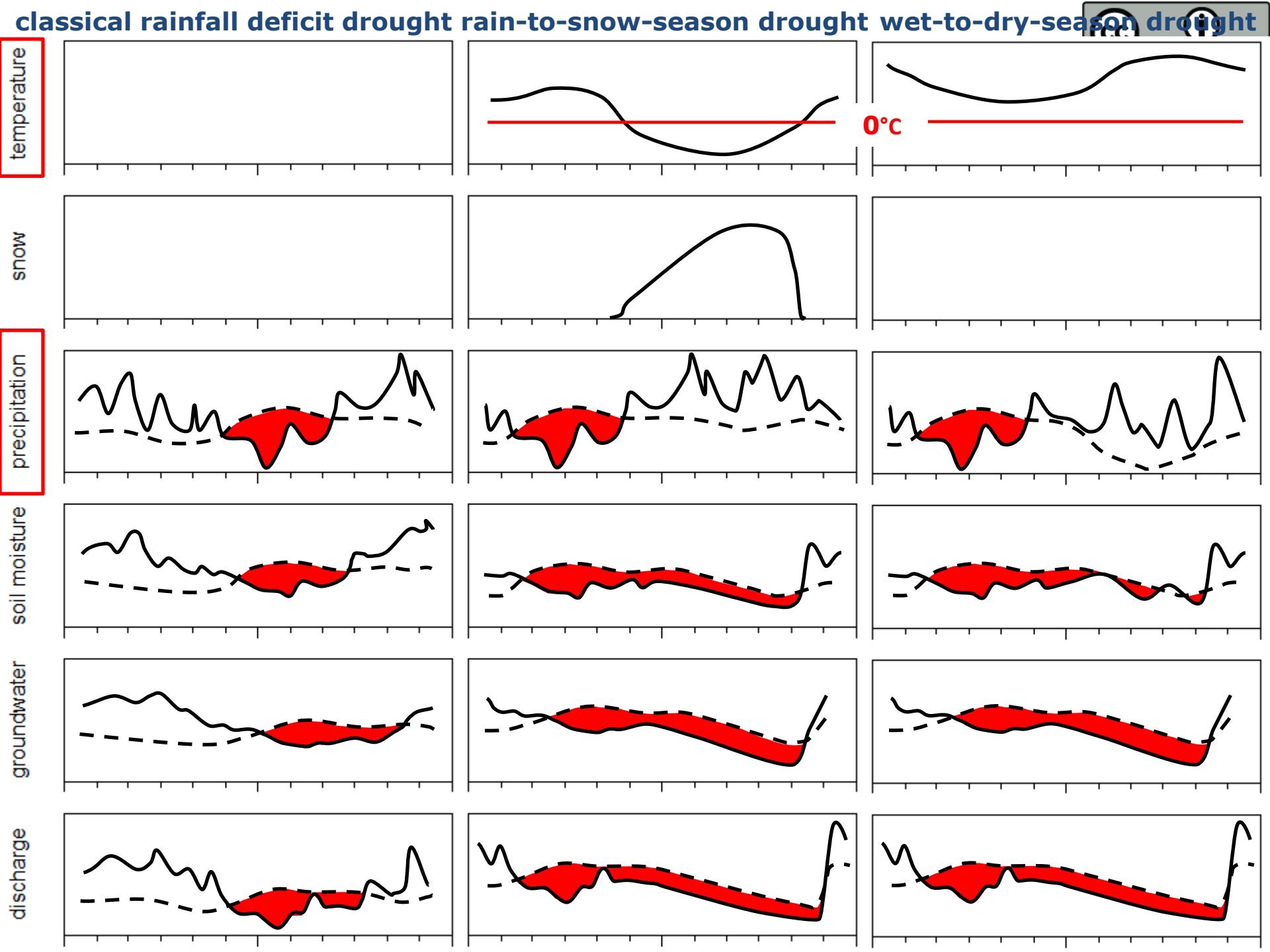
Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011

Hydrological drought typology

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD

	P-control	T-control
classical rainfall deficit drought	**x**	
rain-to-snow-season drought	**x**	**x**
wet-to-dry-season drought	**x**	**x**
cold snow season drought		x
warm snow season drought	(x)	x
composite drought	x	x

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011


classical rainfall deficit drought
rain-to-snow-season drought
wet-to-dry-season drought
temperature
0°C
snow
precipitation
soil moisture
groundwater
discharge

rain-to-snow-season drought wet-to-dry-season drought

Hovatn, drough

Reservoir for
(Bergens Tide

0°C

pr

soil moisture

groundwater

discharge

Strømmen er fortsatt dyrest i Midt- og Nord-Norge, der prisen er på over 4 kroner per kilowattime. I tillegg kommer moms, elavgift, nettleie og påslag fra kraftselskapene.

TERJE REITE
terje.reite@nrk.no

Publisert 22.02.2010 09:27.

Kulde og lite nedbør gjør at s
energibørsen Nord Pool Spot.
uka. I tillegg til sprengkulde, s
kraftanlegg i Europa.

Kaldt i hele Norden

Det er mindre vatn i kraftmagasine enn på lenge. I Midt-Noreg er kraftmaga meir enn halvtome.

ODD KRISTIAN DAHLE
odd.kristian.dahle@nrk.no

TERJE REITE
terje.reite@nrk.no

Publisert 01.02.2010 06:16. Oppdatert 01.02.2010 09:32.

Kraftverka opererer med omgrepet «fyllingsgrad» når dei skal fortelje om kor mykj
er i dammane som er bygde i vassdraga. Når eit vassmagasin er fylt heilt opp til ra
fyllingsgraden 100. I dag er fyllingsgraden i Midt-Noreg på 41,1 prosent. I fjor på
var fyllingsgraden på over 50 prosent.

- Lite behagelig

Dette er ein situasjon som får dei som overvakar straumsituasjonen til å følgje eks

Hydrological drought typology

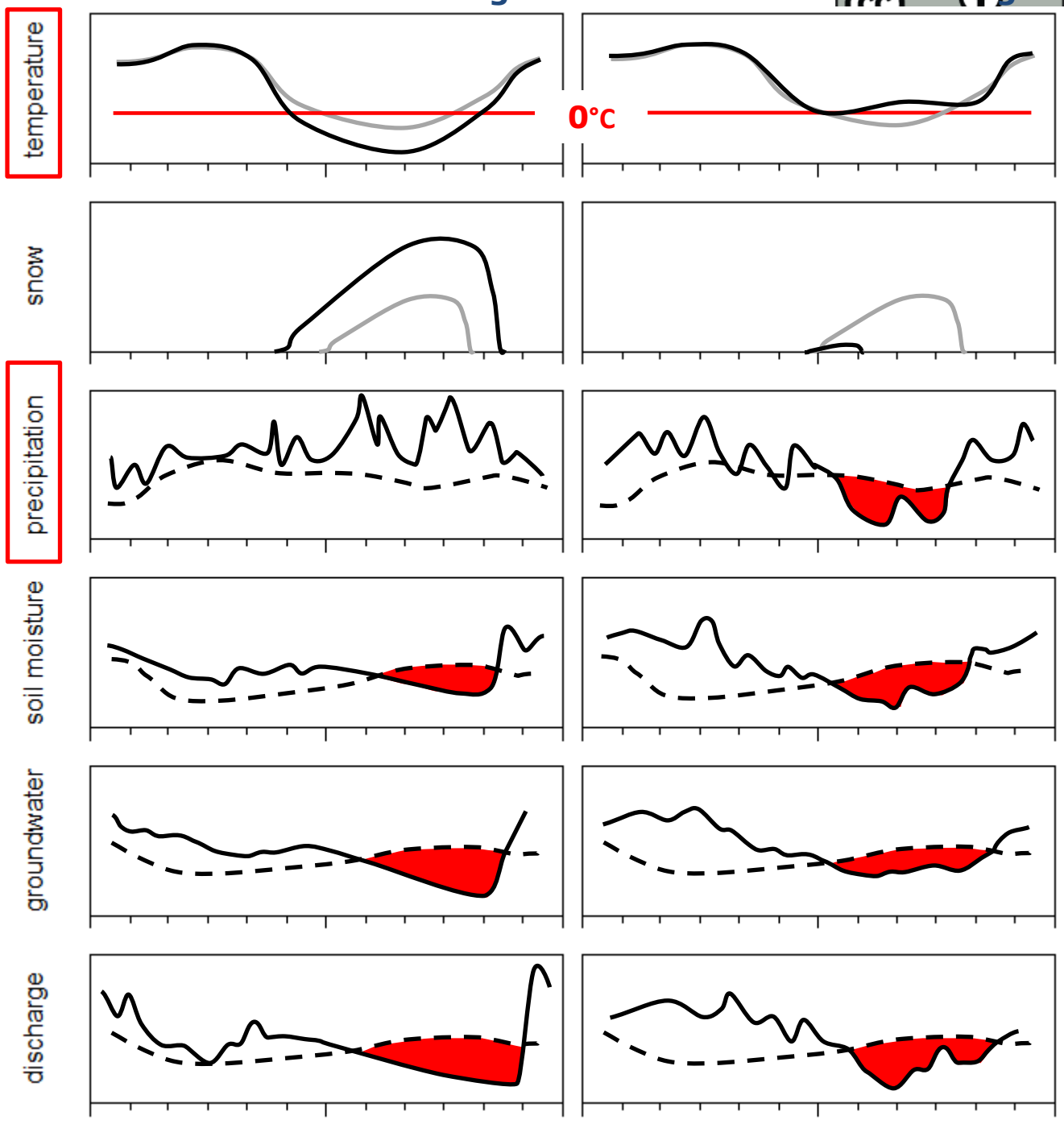
	P-control	T-control
classical rainfall deficit drought	**x**	
rain-to-snow-season drought	**x**	**x**
wet-to-dry-season drought	**x**	**x**
cold snow season drought		x
warm snow season drought	(x)	x
composite drought	x	x

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011

Hydrological drought typology

	P-control	T-control
classical rainfall deficit drought	x	
rain-to-snow-season drought	x	x
wet-to-dry-season drought	x	x
cold snow season drought		**x**
warm snow season drought	**(x)**	**x**
composite drought	x	x

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011



WAGENINGEN UR
For quality of life

Tallying the Statistics of a Warm, Dry Winter in the U.S.

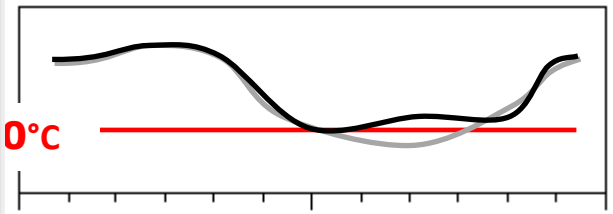
info@climatecentral.org - Wednesday, March 7, 2012, 14:24

Read More: Climate Central - Blogs, drought, national oceanic and atmospheric administration, tropical cyclones

The stats are in on the winter that wasn't, and the December through February period stacks up as the fourth-warmest winter on record for the Lower 48 states, according to newly released numbers from the National Oceanic and Atmospheric Administration (NOAA).

The average temperature for the Lower 48 states during the December through February period, the time span defined as meteorological winter, was 3.9 degrees Fahrenheit above the 1901-2000 long-term average, making it the warmest winter since 2000. The other winters that were warmer than this one occurred in 1992 and 1999.

warm snow season drought



SCIENTIFIC AMERICAN™

Winner of the 2011 National Magazine Award for General Excellence

Search ScientificAmerican.com

Subscribe | News & Features | Blogs | Multimedia | Education | Citizen Science | Topics

Home » News »

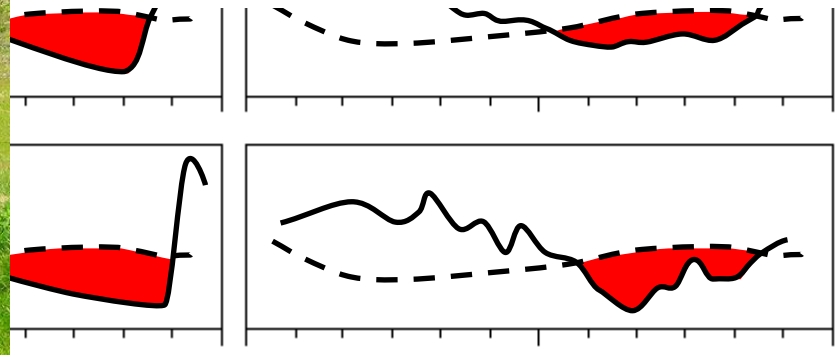
News | Energy & Sustainability

Tweet 181 Like

: What's Causing One of the Warmest Winters in History?

controls winter weather, but strange forces are controlling this season

anuary 12, 2012 | 198



Hydrological drought typology

	P-control	T-control
classical rainfall deficit drought	x	
rain-to-snow-season drought	x	x
wet-to-dry-season drought	x	x
cold snow season drought		**x**
warm snow season drought	**(x)**	**x**
composite drought	x	x

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011

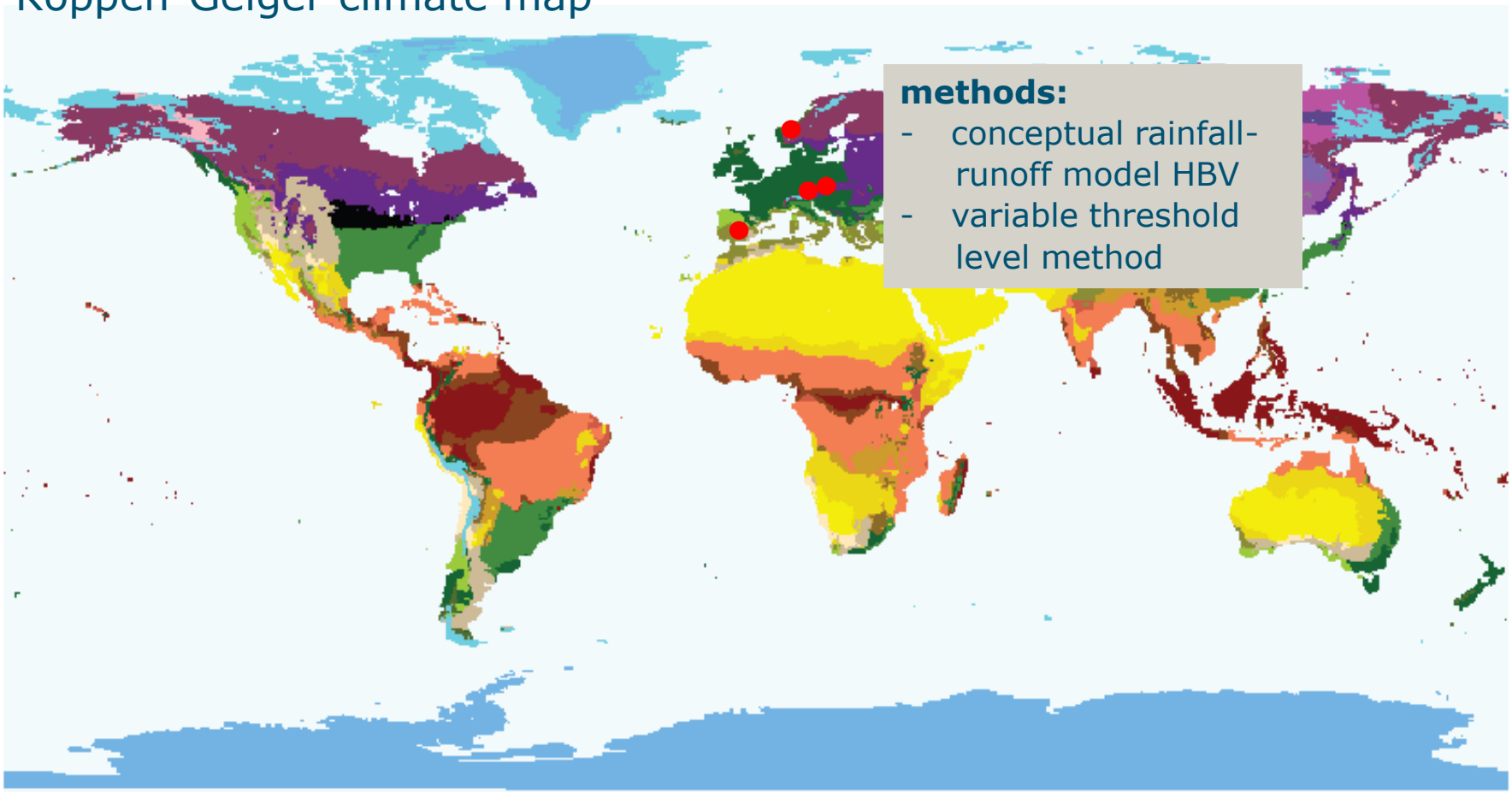
Hydrological drought typology

	P-control	T-control
classical rainfall deficit drought	x	
rain-to-snow-season drought	x	x
wet-to-dry-season drought	x	x
cold snow season drought		x
warm snow season drought	(x)	x
composite drought	**x**	**x**

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011

Global distribution

Köppen-Geiger climate map

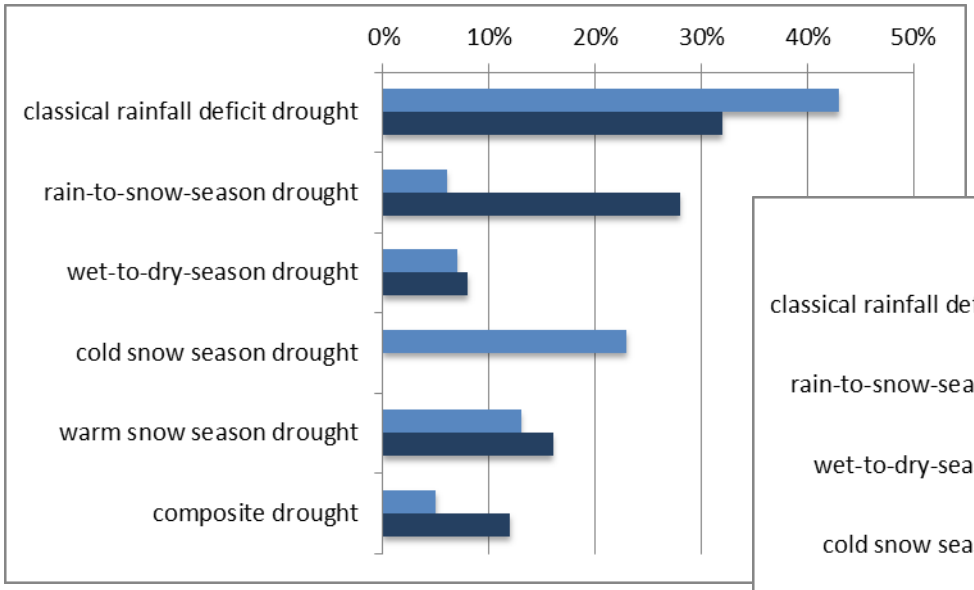


From: Wanders et al. 2010

Global distribution

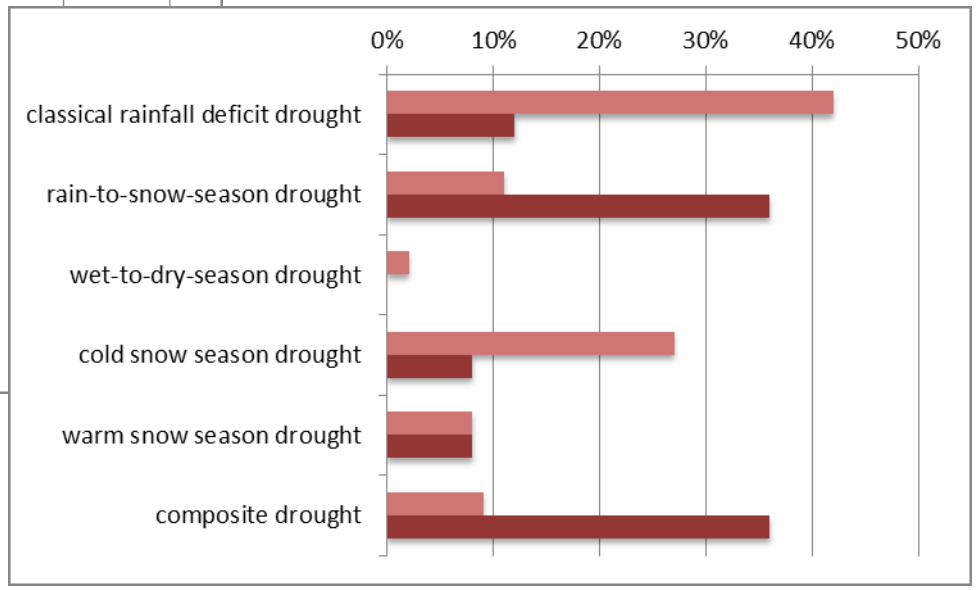
5 contrasting headwater catchments in Europe

discharge



5 most severe drought events

groundwater

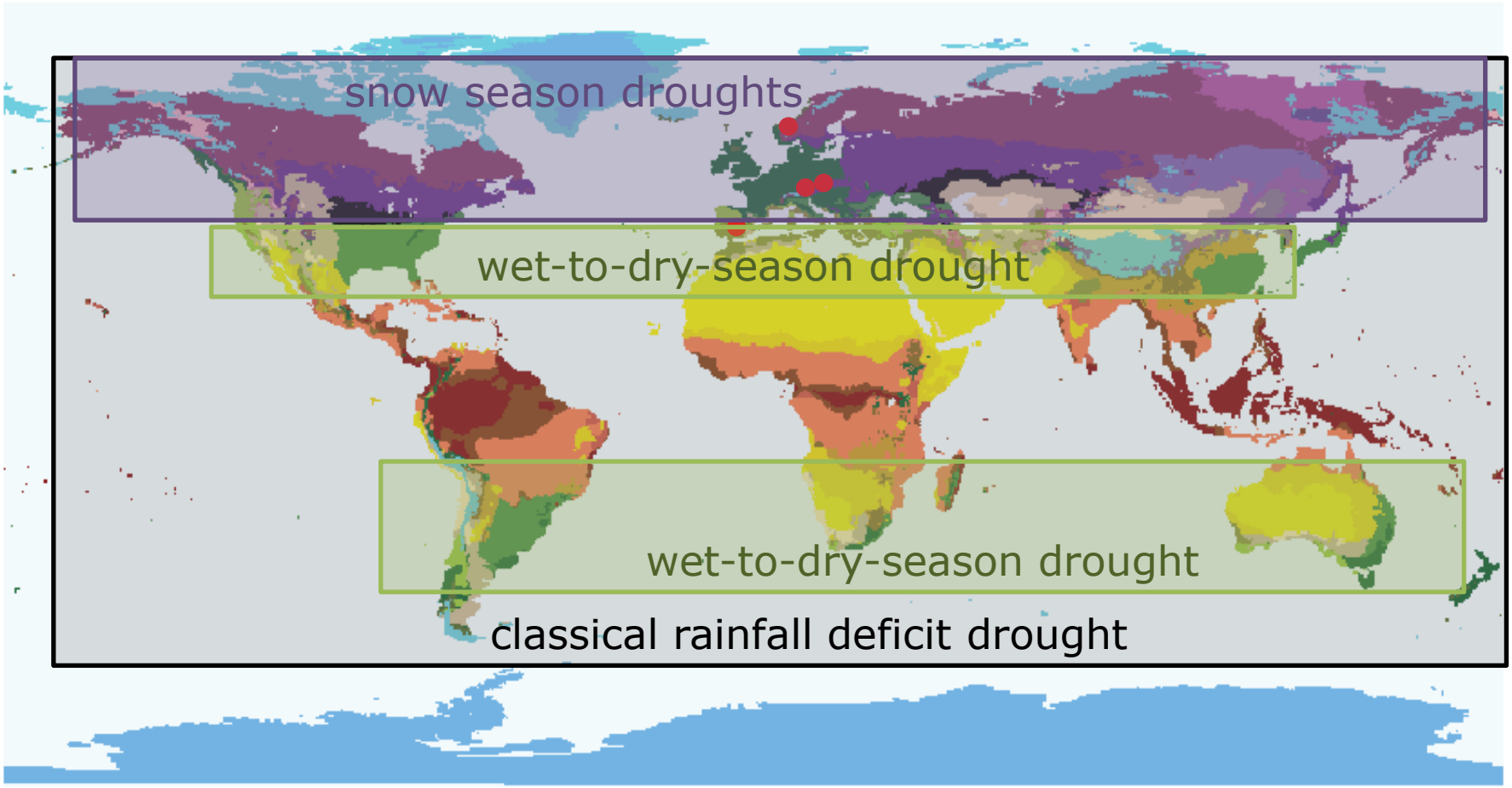


5 most severe drought events

WAGENINGEN UR
For quality of life

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011

Global distribution



From: Wanders et al. 2010

Look into the future of our research…

needed:

- **large-scale model > paper in preparation**
- **automatisation of typology > next research step**
- **global drought analysis method** v

A generic identification method for hydrological drought in different climates across the globe

Marjolein H. J. van Huijgevoort et al. >> Fri 10.30-12.00h poster **A53**

Thank you!

Van Loon, A. F. and Van Lanen, H. A. J.: A process-based typology of hydrological drought, Hydrology and Earth System Sciences Discussions, 8, 11 413–11 483, doi:10.5194/hessd-8-11413-2011, 2011.

WAGENINGEN UR
For quality of life

Hydrological drought typology

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD

	P-control	T-control
classical rainfall deficit drought	x	
rain-to-snow-season drought	x	x
wet-to-dry-season drought	x	x
cold snow season drought		x
warm snow season drought	(x)	x
composite drought	x	x

Van Loon & Van Lanen (2011): A process-based typology of hydrological drought, HESSD, doi:10.5194/hessd-8-11413-2011

rain-to-snow-season drought | **wet-to-dry-season drought** | **cold snow season drought** | **warm snow season drought**