Potential of drought impact propagation patterns for early warning

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with contributions from
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Drought Impacts 2018 in Central Europe

Lid.ch (2018)

Naturschutz.ch (2018)

Stern.de (2018)

hessenschau.de
Drought propagation – impact or monitored indicator?

Of interest for monitoring and early warning: the time lag to impact

Δt?

No grass to feed, no/lower crop yield
Terrestrial ecology, Cattle sales, recreation....

Δt?

Energy production, industrial cooling, navigation, tourisms, conflicts, public water supply

Δt?
Impact perspective: questions for monitoring and warning

- Indicator or impact?
- Are there typical impact patterns for flash droughts?
- Can impacts be linked to indices that are monitored/forecasted?
Indicator and measurable impact: vegetation

Indicator showing the highest correlation with VCI – few very short-term

Bachmair et al. 2018 ERL
Indicator and measurable impact: hydrology

- Hydrological models are rainfall-runoff models
- Role of storage-outflow rarely priority during development
Other impact data: The European Drought Impact Report Inventory

Old version at: www.geo.uio.no/edc/droughtdb/

New version coming soon to EDO, see report at https://drmkc.jrc.ec.europa.eu/innovation/SupportSystem
Reported impacts of large scale droughts in Europe

Were 2003, 2015 and 2018 Flash Droughts?

→ Can we see it in the abrupt onset of impact reports?

Stahl et al. 2016 NHESS
Impact report patterns during a drought event

Reported impacts in SE England 2011–2012

Reported impacts in Bavaria in 2015

→ Which is typical for a flash drought?

- Public water supply
  - Mar 2012: In some regions in the east and south east of England several domestic wells dried up.
  - Apr 2012: 7 water companies in the south and east of England imposed temporary water use bans on 20 million customers.

- Freshwater ecosystems
  - Jan/Feb 2012: Fish deaths and distress in River Meon and a lake in Hampshire. 30 mature sea trout and 6 salmon reported dead.
Impact perspective: questions for monitoring and warning

• Are there typical impact patterns for flash droughts?

• Can impacts be linked to indices that are monitored/forecasted?
Indicator values concurrent with impact onset in the state of Baden-Württemberg, DE

Abnormally dry
Moderate drought
Severe drought
Extreme drought
Exceptional drought

SPI or SPEI

Accumulation period

n = 116

BACHMAIR ET AL. 2015 (NHESS)
Rank correlation coefficients between drought indicators (SPI, SPEI) and number of impact occurrences in category

Large spread of index values!

Flash Drought/S2S: → Few categories with short lag relations except agriculture
Drought impact modelling (data-driven)

'Damage functions' typically used in risk assessments

Example 'drought impact function' (binary effect)

BACHMAIR ET AL. 2017 (NHESS)  
STAGGE ET AL. 2015 (J. Hydrol)
Example: best indices (predictors) in model

→ Best predictor combinations: short & long memory + season or trend

Stagge et al. 2015 (J. Hydrol)
Example: best indices (predictors) in model

Fig. 6. Agricultural drought impacts: SPI2/SPEI2 interaction term for Slovenia. Predicted impact likelihood is shown in color, with red corresponding to high likelihood (≈100%) and blue corresponding to low likelihood (≈0%). Percent likelihood is also shown as contour labels. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

STAGGE ET AL. 2015 (J. Hydrol)
Prediction with quantitative drought impact functions

Example

Predictor interactions SPI and SPEI

→ amplification role of E, but at long-term ????
Conclusions and ways forward - impact perspective

• Indicator or impact?
  – Invest into knowledge on impact models incl. specific regional sensitivities and time lags

• Are there typical impact patterns for flash droughts?
  – Explore potential in reported impact patterns (sequences) for impact to impact prediction during flash droughts?

• Can impacts be linked to indices that are monitored/forecasted?
  – Test S2S scale meteo forecasts for impact prediction; what can be achieved with combined short-long-info?
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Drought Impacts and Vulnerability thresholds in monitoring and Early warning Research
At the waterworks “Ebnet” well site, groundwater level has dropped below the threshold for abstraction (…) therefore water is now pumped from the “Hausen” wells to Freiburg (…)

→ assigned to category "Water Supply"

(…) Failure of the third cut of grass; emergency cattle sales necessary for some farmers (…)

→ assigned to category "Agriculture & Livestock Farming", subtype "...

(…) corn crops are most heavily affected. On many fields plants have not produced cobs (…)

→ assigned to category "Agriculture", subtype "...

(…) forest growth reduction expected (…)

→ expectation only and not (yet) ‘drought impacts’ in the category ‘forestry’ acc. to EDII definition

(…) trees shed leaves (…)

→ assigned to category "Terrestrial Ecosystems"
What we compile in the EDII

Reported drought impacts across Europe

- **negative environmental, economic, or social effects** experienced under drought conditions
- as reported in various **text information sources**
Current contents of the EDII

- Agriculture & livestock farming
- Forestry
- Aquacultures & fisheries
- Energy & industry
- Waterborne transportation
- Tourism & recreation
- Public water supply
- Water quality
- Freshwater ecosystems
- Terrestrial ecosystems
- Soil systems
- Wildfires
- Air quality
- Human health & public safety
- Conflicts