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Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

Operational Drought Monitoring in Switzerland

Anke Tetzlaff, Vincent Humphrey, Annkatrin Rassi, Simon Scherrer, Christian Grams

Motivation

Rekord-Dürre im Sommer 2015 in Mitteleuropa

02.09.2016 | Zukunftsblog

Von: Dr. René Orth, ETH Zürich | 1 Kommentar

Während das Wetter in der Schweiz in diesem Sommer eher durch heftige Unwetter von sich reden macht, war der Sommer letzten Jahres von einer markanten Dürre geprägt. Das schleichend wachsende Niederschlagsdefizit brachte der Schweiz 2015 beinahe mediterranes Klima, aber auch wirtschaftliche Schäden.



Flussbett in den bayerischen Alpen, Deutschland. (Bild: Colourbox)

Hitze und Trockenheit im Sommer 2018

Auswirkungen auf Mensch und Umwelt



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Eidgenössisches Departement des Innern EDI
Bundesamt für Meteorologie und Klimatologie MeteoSchweiz

MeteoSchweiz

Fachbericht MeteoSchweiz Nr. 272

**Hitze und Trockenheit im Sommerhalbjahr 2018 –
eine klimatologische Übersicht**

MeteoSchweiz



Neue Zürcher Zeitung

Ein Ende der Dürre ist nicht absehbar

In weiten Teilen Mitteleuropas herrscht nach wie vor ein ausgeprägtes Niederschlagsdefizit. Wie lange solche Trockenperioden im Extremfall dauern können, lässt sich mit den heutigen Wettermodellen noch nicht treffsicher vorhersagen.

Sven Titz

24.11.2018, 05:30 Uhr





Summer Droughts in Switzerland

TOP 5 since 1981

2018

2003

2020

2015

2011

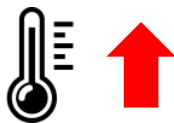
Changes 1981-2020

Precipitation



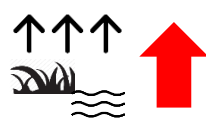
−66 mm
(−11 %)

Temperature



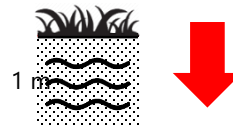
+2,2 °C

Evapotranspiration



≈ +60 mm
(+11 %)

Soil Moisture



≈ −20 mm
(−5 %)

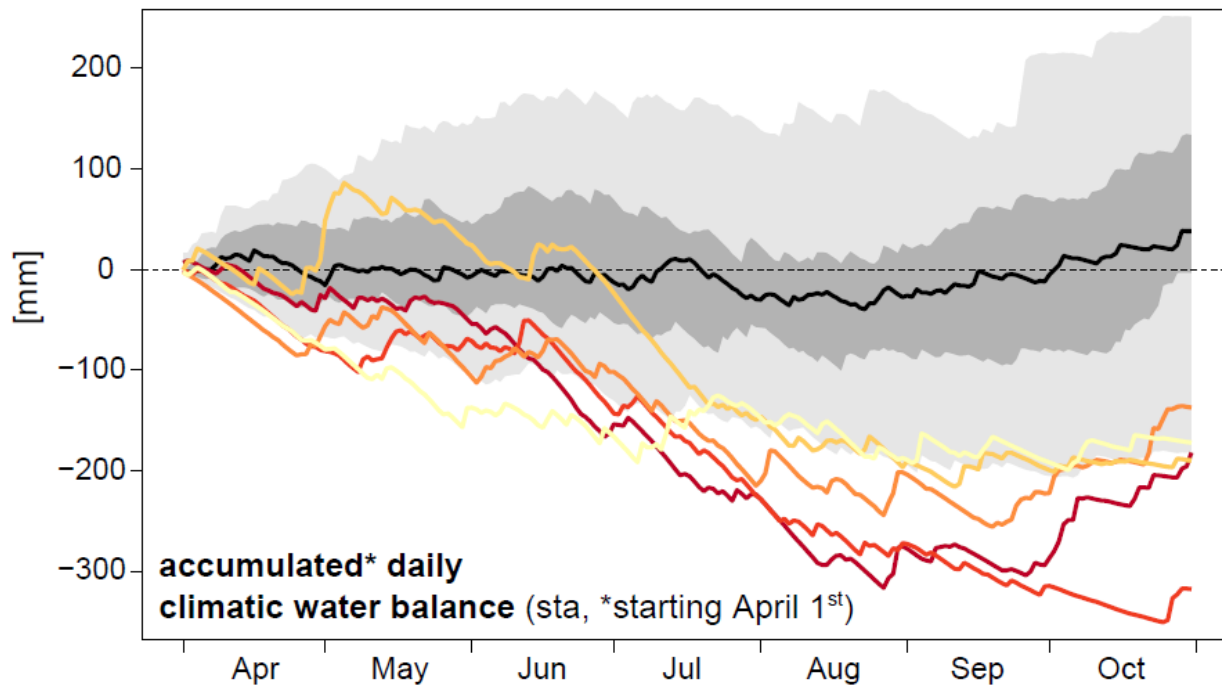
Scherrer et al. (2022)

<https://doi.org/10.1088/2515-7620/ac4fb9>

Summer Droughts in Switzerland since 1981

drought
summers

— 2003
— 2018
— 2020
— 2015
— 2011



MeteoSwiss



Swiss Drought Program



The Federal Office of Meteorology and Climatology MeteoSwiss, the Federal Office for the Environment FOEN and the Federal Office of Topography swisstopo are jointly developing a **national drought monitoring and warning platform** until 2027.



CM SAF & LSA SAF Products for Drought Monitoring



Land Flux CDR 1983-2020



EUMETSAT

CM SAF

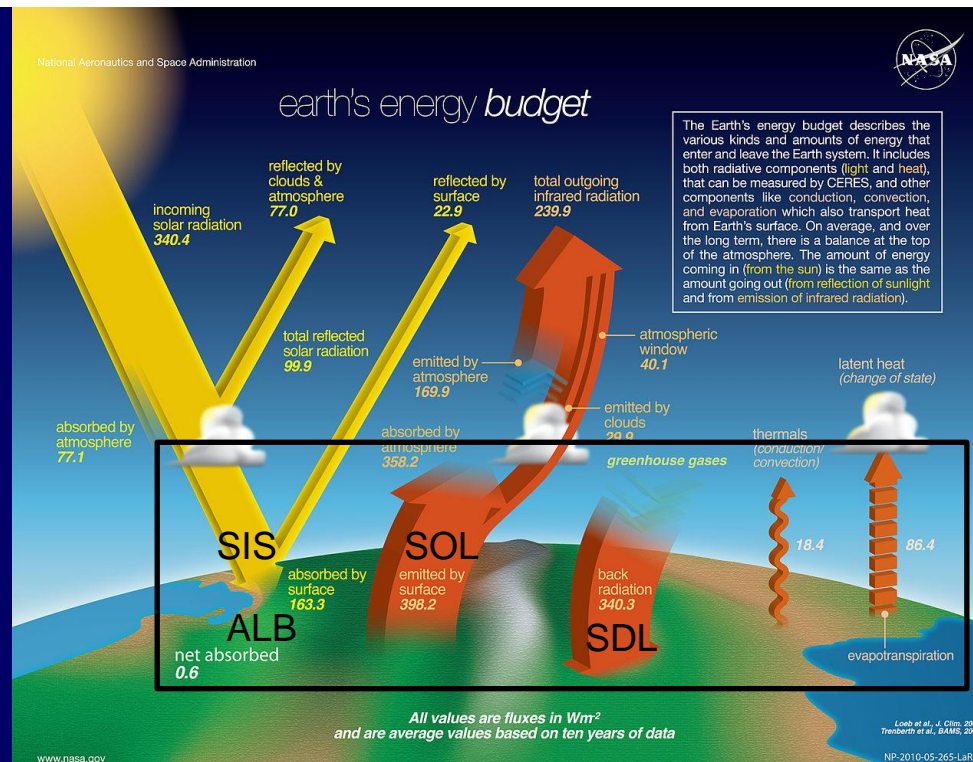


EUMETSAT

LSA SAF

Joint retrieval of the entire Surface Radiation Budget and Surface Fluxes:

- Cloud Fraction
- Surface Radiation Budget including single components
- Land Surface Temperature
- Latent and sensible heat

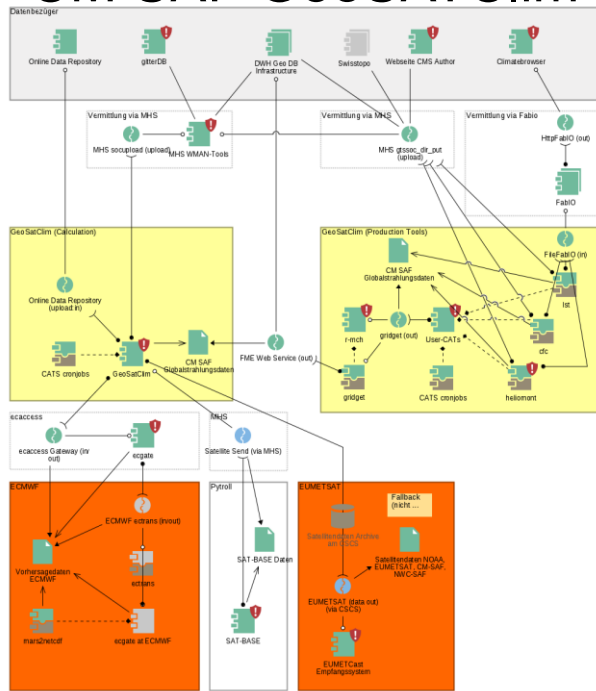


Extention of LSA SAF real-time products into the past.



MeteoSwiss Operational Processing

CM SAF GeoSatClim

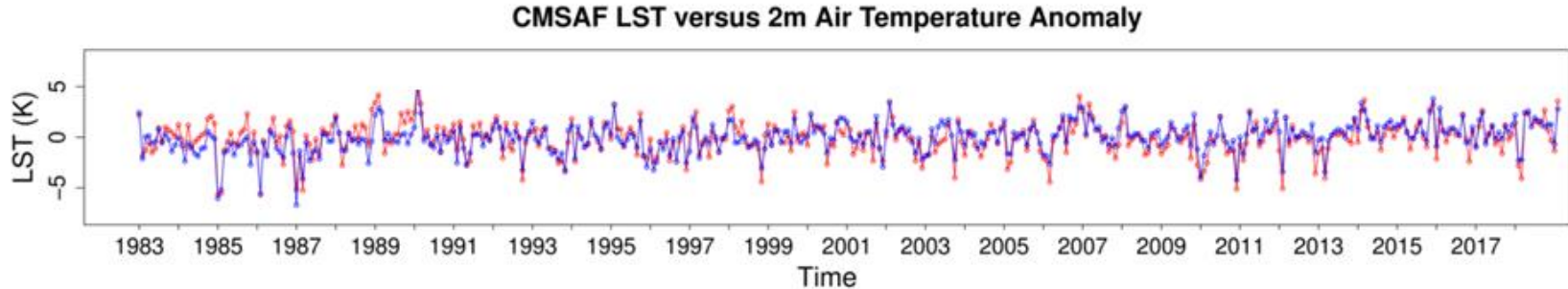
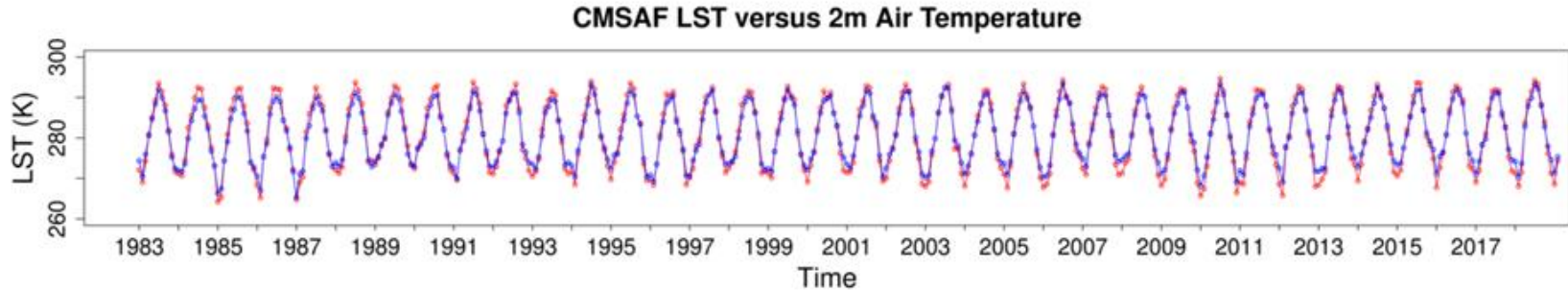


Every day at 6:00 am we generate hourly data for the previous day for Switzerland using the CM SAF software GeoSatClim «ICDR».

GeoSatClim was also used to calculate hourly, daily and monthly climatologies covering the period 1991 to 2020 «CDR».

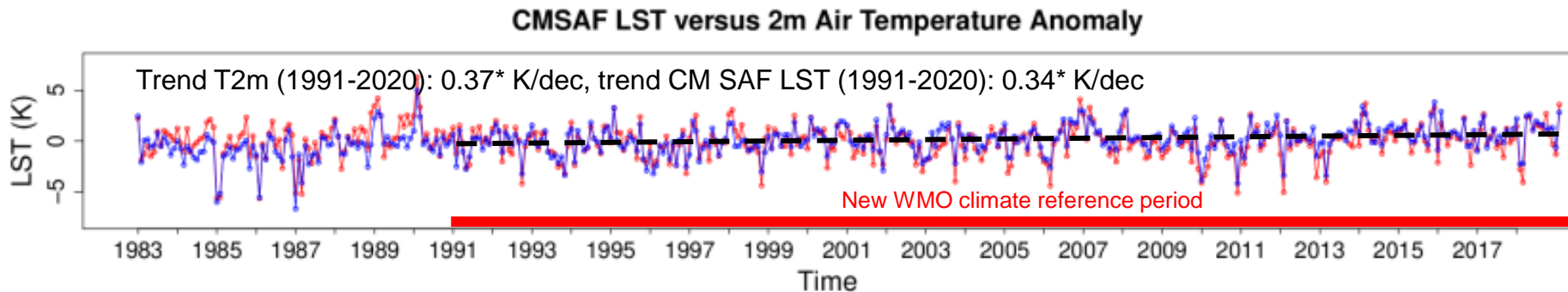
For our climate services we need both CDR and ICDR.

Land Surface Temperature since 1983





LST trends versus air temperature

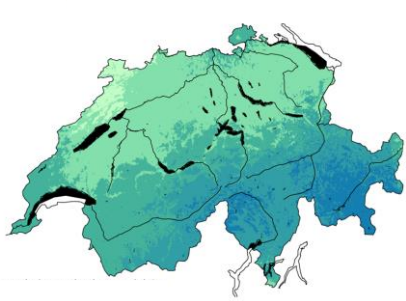


Temperature trends calculated from CM SAF LSTs for Europe are with $0.34^{\circ}\text{K/decade}$ almost identical to trends obtained from homogenized air temperature data.

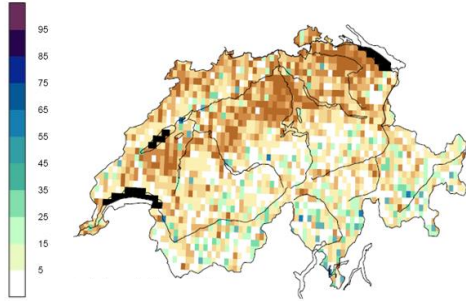
How to integrate satellite data for
the national drought monitoring?



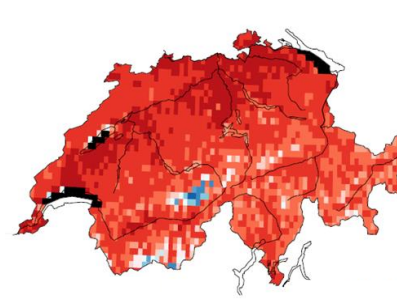
Satellite-Based Drought Indices



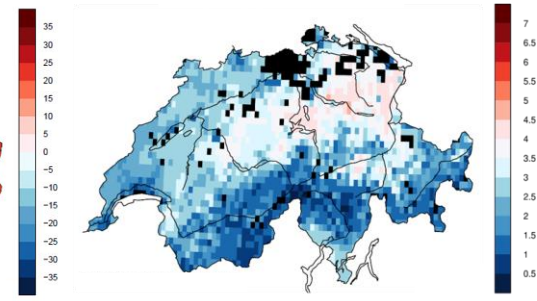
H SAF ASCAT
surface **soil**
moisture product



NOAA AVHRR
vegetation
products



CM SAF **land**
surface
temperature





LSA SAF Meteosat
evapotranspiration
products

Open Access

Article

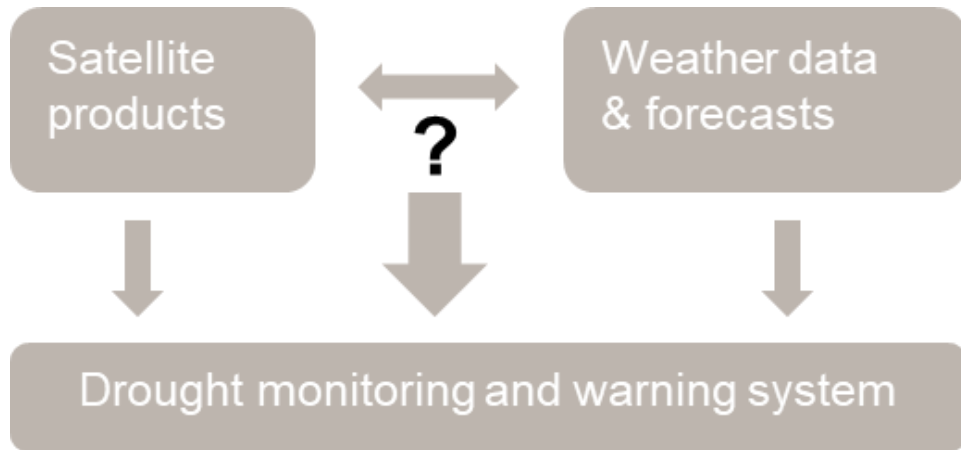
Climatological Drought Monitoring in Switzerland Using EUMETSAT SAF Satellite Data

by Annkatrin Rassel ¹, Dominik Michel ², Martin Hirschi ² , Anke Duguay-Tetzlaff ^{1,*}  and Sonia I. Seneviratne ² 

Climate Monitoring, November 2023



Integration of satellite products



Government

Agriculture

Energy

MeteoSwiss

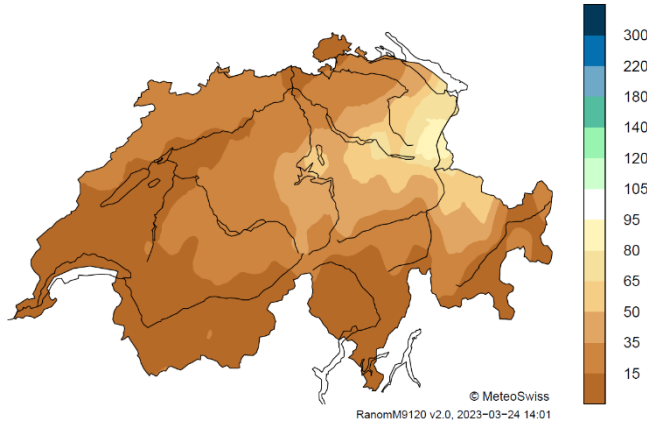


Synergies: Seamless prediction

Historical weather data

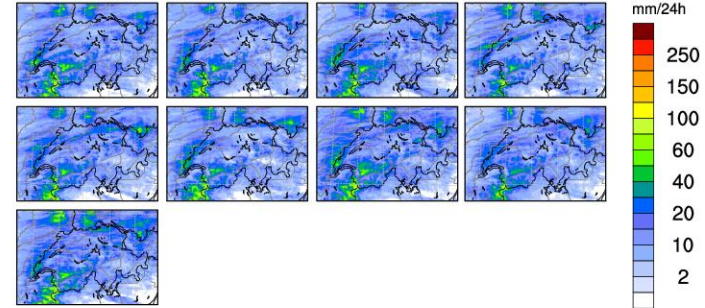
Weather forecast

Monthly Precipitation Anomaly (%) Feb 2023 (Ref. 1991–2020)



COSMO-1E ENSEMBLE_FORECAST
24h Sum of Total Precipitation

Sat 01 Apr 2023 03UTC
31.03.2023 03UTC +24h



MeteoSwiss



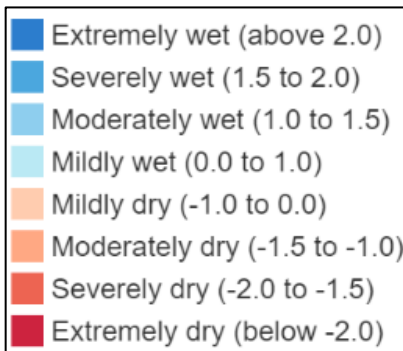
Synergies

Historical weather data

Weather forecast

Drought indices (e.g. SPI, SPEI, ...)

Warning?



MeteoSwiss

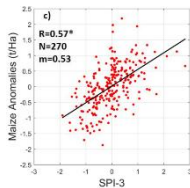


User Requirements

Historical weather data

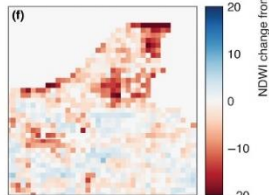
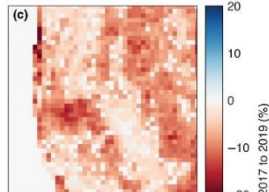
Weather forecast

Drought indices (e.g. SPI, SPEI, ...)



Historical drought impacts

Impact forecast



- Impact mapping
- High resolution
- Climate signal back to 1991

MeteoSwiss

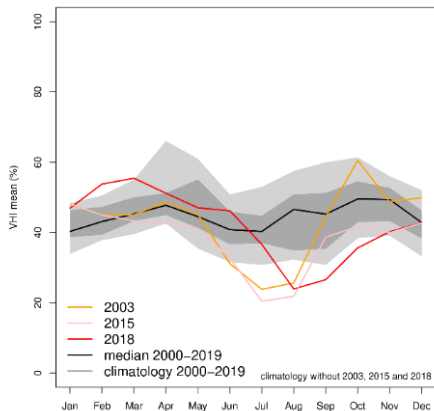
Czech drought monitor
intersucho.cz

- no drought impact
- drought affected crops, yield loss up to 10%
- moderate drought damage, yield loss 10 - 30 %
- severe drought damage, yield loss 30 - 40 %
- extreme drought damage, yield loss above 40%

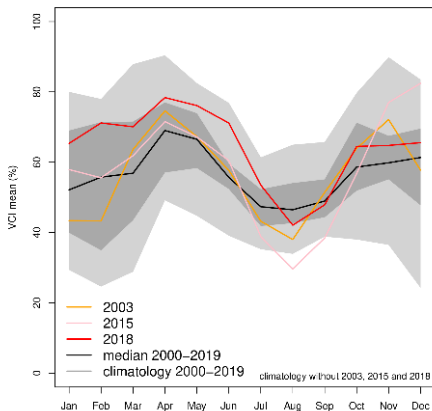


Vegetation Heat Index

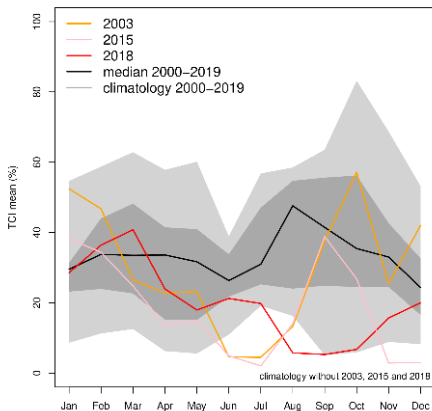
VHI



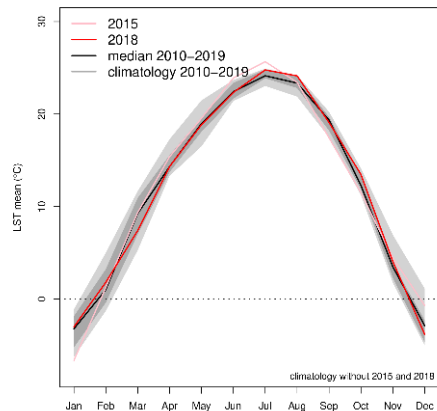
VCI



TCI



LST

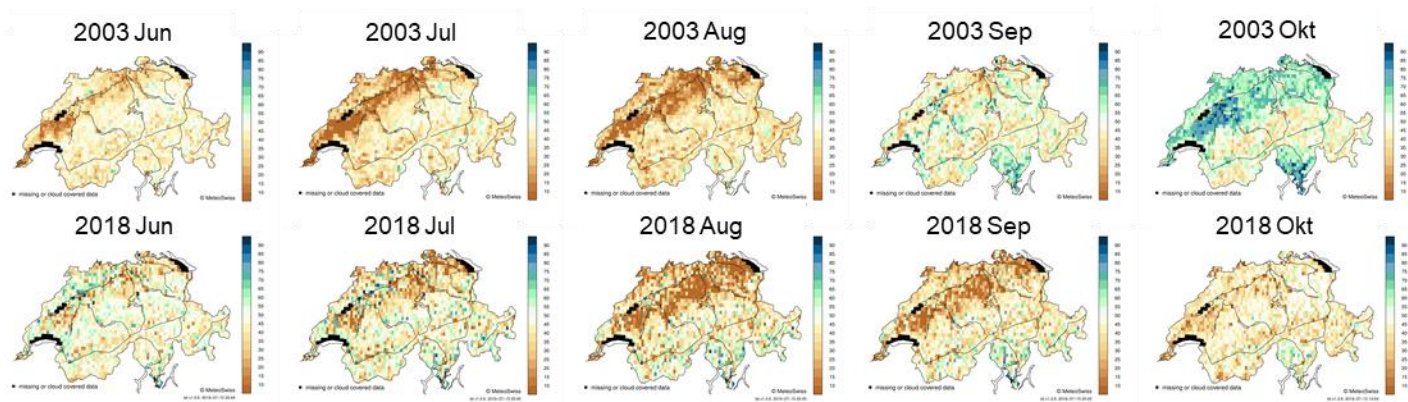


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Climatological Drought Monitoring in Switzerland Using EUMETSAT SAF Satellite Data

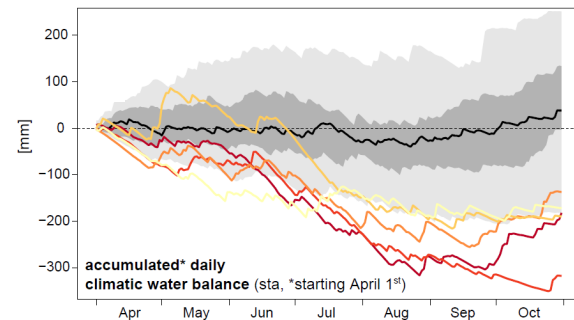
by Annkatrin Rassel¹, Dominik Michel², Martin Hirschi² , Anke Duguay-Tetzlaff^{1,*} and Sonia I. Seneviratne²

Vegetation Heat Index 2003 + 2018



drought
summers

- 2003
- 2018
- 2020
- 2015
- 2011



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Climatological Drought Monitoring in Switzerland Using EUMETSAT SAF Satellite Data

by Annkatrin Rassel¹, Dominik Michel², Martin Hirschi² , Anke Duguay-Tetzlaff^{1,*} and
Sonia I. Seneviratne²

© ANKE TETZLAFF SAFOLL, NOVEMBER 2024



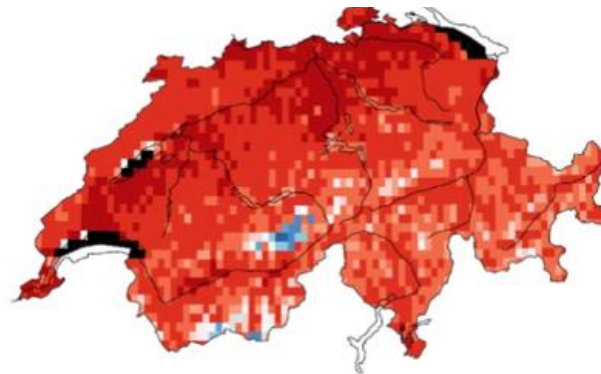
New Climate Service on Drought using the CM SAF Land Surface Temperature CDR

High Resolution

Climate Data back to 1991

Sentinel-2 Vegetation NDVI

Meteosat Land Surface Temperature



$$VCI = \frac{NDVI_{current} - NDVI_{Ref,min}}{NDVI_{Ref,max} - NDVI_{Ref,min}} \times 100\%$$

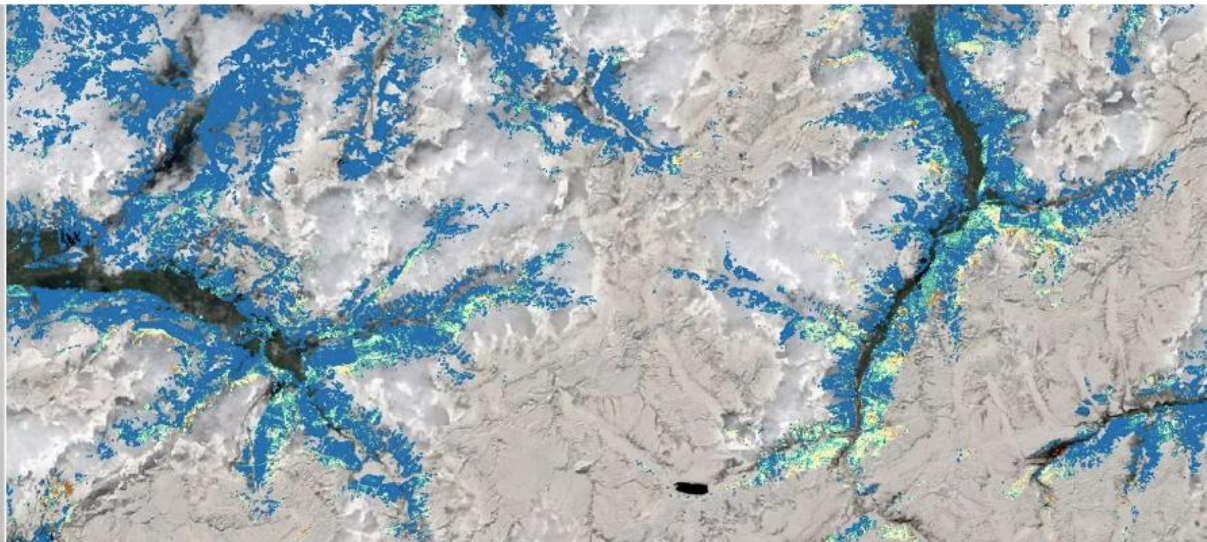
$$TCI = \frac{T_{Ref,max} - T_{current}}{T_{Ref,max} - T_{Ref,min}} \times 100\%$$

MeteoSwiss «CM SAF» ICDR
CM SAF CDR

$$VHI = \alpha VCI + (1 - \alpha) TCI, \text{ where } \alpha = 0.5$$



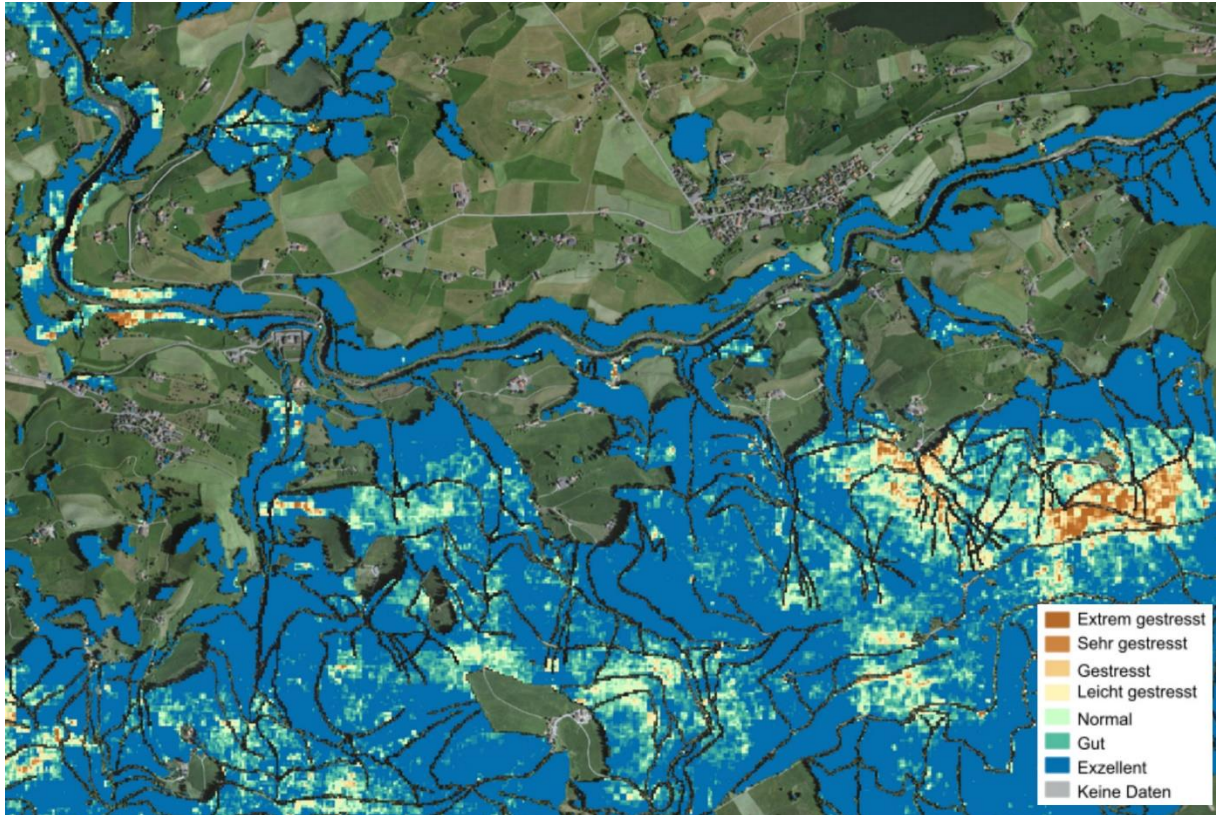
New Climate Service on Drought using Land Surface Temperature CDR



Combining the SAF Land Surface Temperature with high resolution Sentinel vegetation data



Example: Forest Canton Zug





Example 21.09.2024



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Confédération suisse
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Confederaziun svizra
In Zusammenarbeit mit den Kantonen

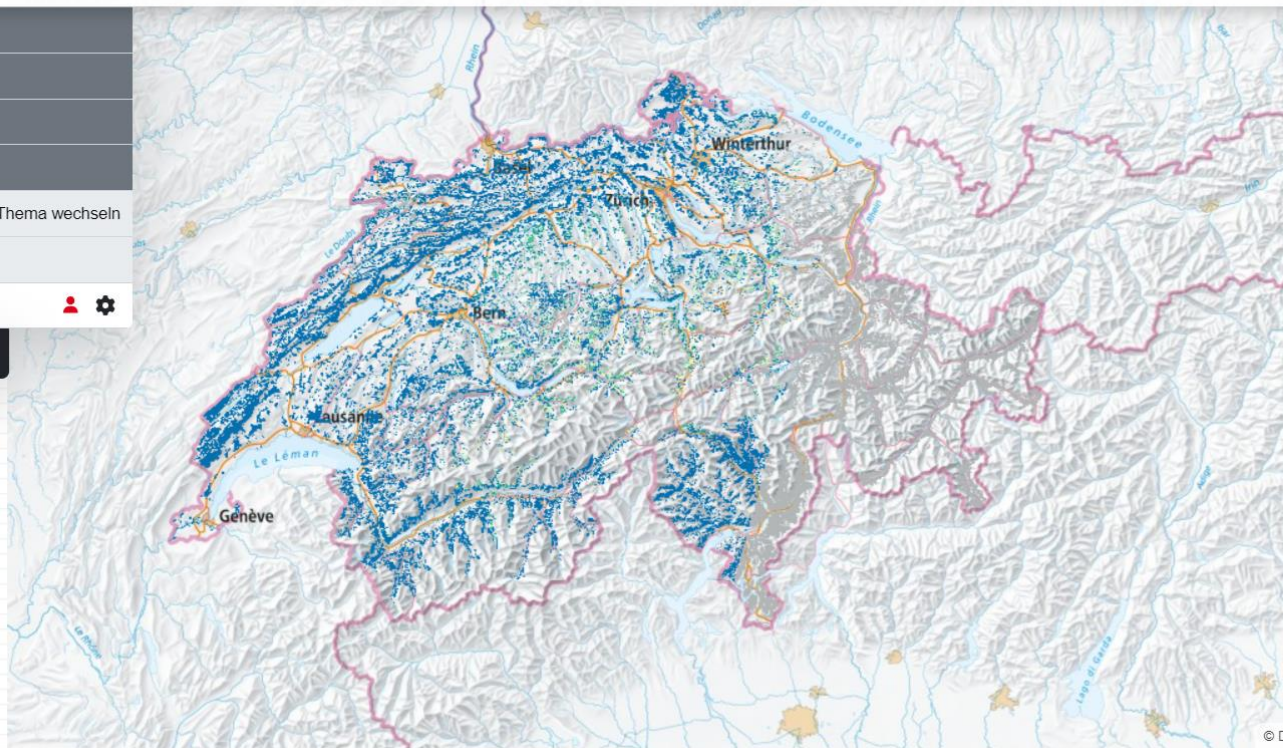
[Problem melden](#) [Mehr Informationen](#) [Hilfe](#) [DE](#) [FR](#) [IT](#) [EN](#) [RM](#)



- ▶ Teilen
- ▶ Drucken
- ▶ Zeichnen & Messen auf der Karte
- ▶ Erweiterte Werkzeuge
- ▶ Geokatalog Thema wechseln
- ▼ Dargestellte Karten

☒ swissEO VHI  

▲ Menü schliessen



© Daten: swisstopo, Das Geoportal des Bundes

50 km

CH1903+ / LV95

Koordinaten (m) 2'502'800.00, 1'293'542.00

v1.47.1 [geo.admin.ch](#) [Nutzungsbedingungen](#) [Impressum](#)



Summery

Historical weather data

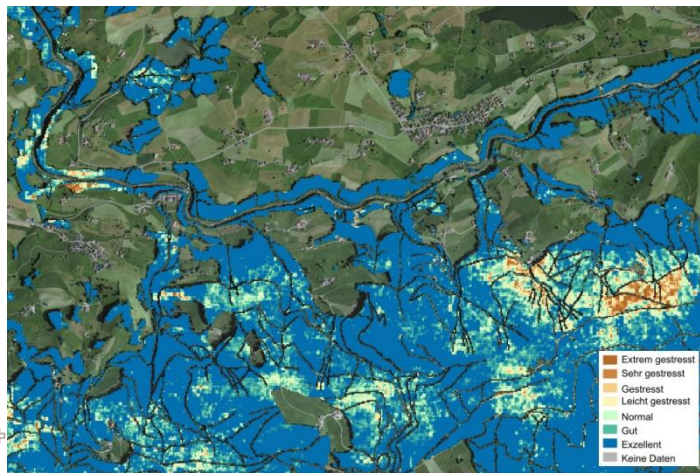
Weather forecast

Drought indices (e.g. SPI, SPEI, ...)



Historical drought impacts

- Impact mapping
- High resolution
- Climate signal back to 1991



MeteoSwiss

Summary

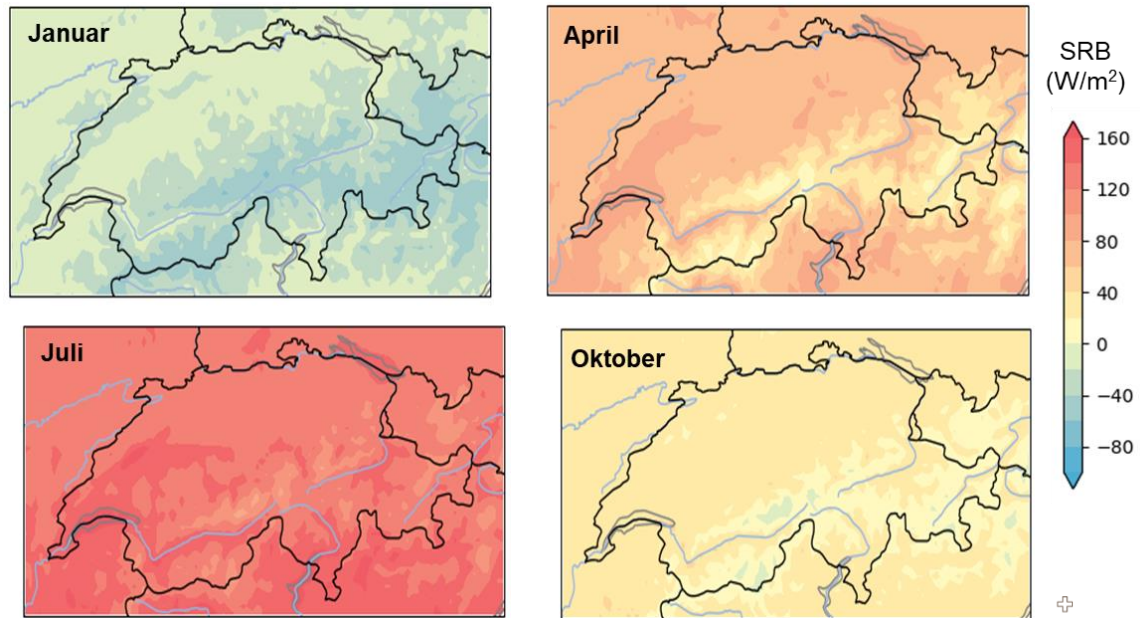
- Drought events are well depicted in combined **CM SAF & LSA SAF land surface temperature** and Sentinel **vegetation products**
- Combining satellites and weather models for drought monitoring:
 - Satellite observations: high-resolution monitoring & closer to the impacts
 - Weather models: generic & low-resolution but ability to make forecasts
- New climate service for drought monitoring:
<https://www.swisstopo.admin.ch/de/satellitenbilder-swisseo-vhi>

SAF satellite products can well complement the station-based indicators for drought monitoring in Switzerland with spatial information.



Outlook

CM SAF Land Flux Energy Balance 1991-2020



Energy Balance and
Evapotranspiration
for Swiss Drought
Monitoring



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Thank you.

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