IPCC AR6 report “Physical science basis”: Status update and relevance for EO research

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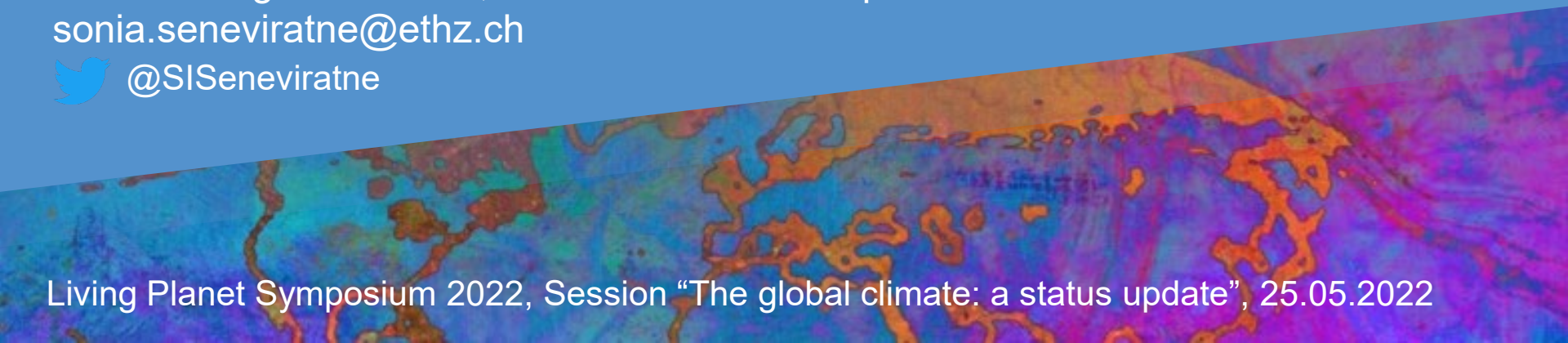
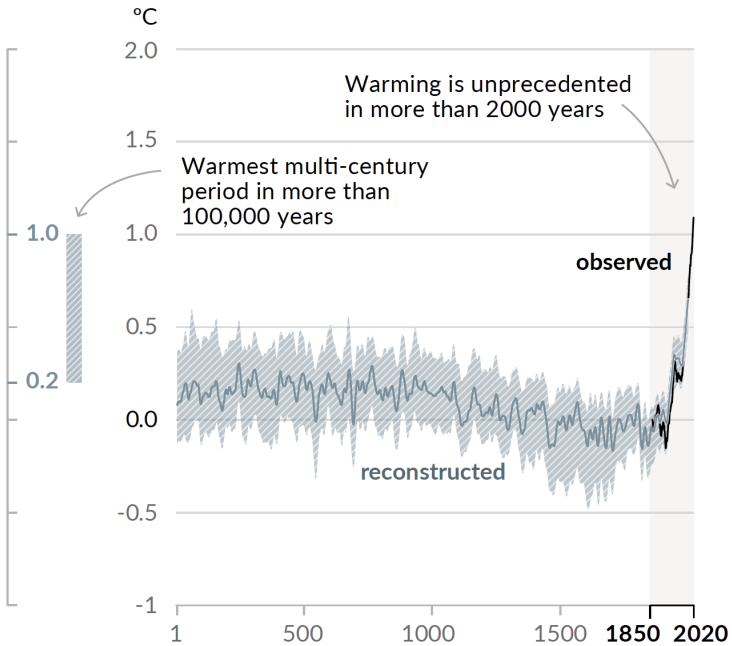


Living Planet Symposium 2022, Session “The global climate: a status update”, 25.05.2022

Observed global warming

Changes in global surface temperature relative to 1850-1900

Change in global surface temperature (decadal average) as reconstructed (1-2000) and **observed** (1850-2020)



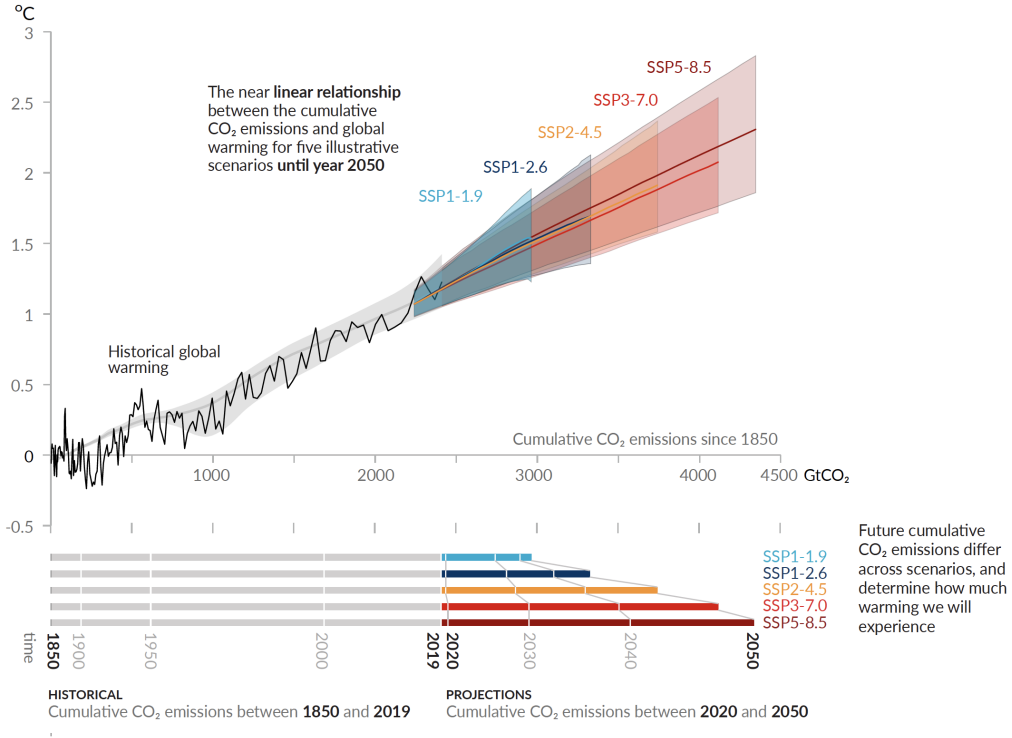
- We already had 1.1°C of global warming in 2011-2020 compared to 1850-1900
- This temperature level is unprecedented in more than 100'000 years
- Human contribution to observed global warming is unequivocal and is responsible for all of observed warming
- The largest part of this warming is irreversible for several generations

(IPCC AR6, Fig. SPM.1)

Cumulative CO_2 emissions vs global warming

Every tonne of CO_2 emissions adds to global warming

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO_2 emissions ($GtCO_2$)



Direct relationship between cumulative CO_2 emissions and global warming

Every additional emissions of CO_2 lead to additional long-term global warming

(IPCC AR6, Fig. SPM.10)

Observed changes in extremes

- Evidence of observed changes in extremes has strengthened
- Human-induced climate change is already affecting many weather and climate extremes in every region across the globe
- Some recent hot extreme events would have been *extremely unlikely* to occur without human influence on the climate system

(IPCC AR6, Chapter 11; https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter11.pdf)

Temperature extremes

Heavy precipitation

Floods

Droughts

Storms

Compound events

Observed changes in extremes

Human emissions have contributed to several recent outstanding events

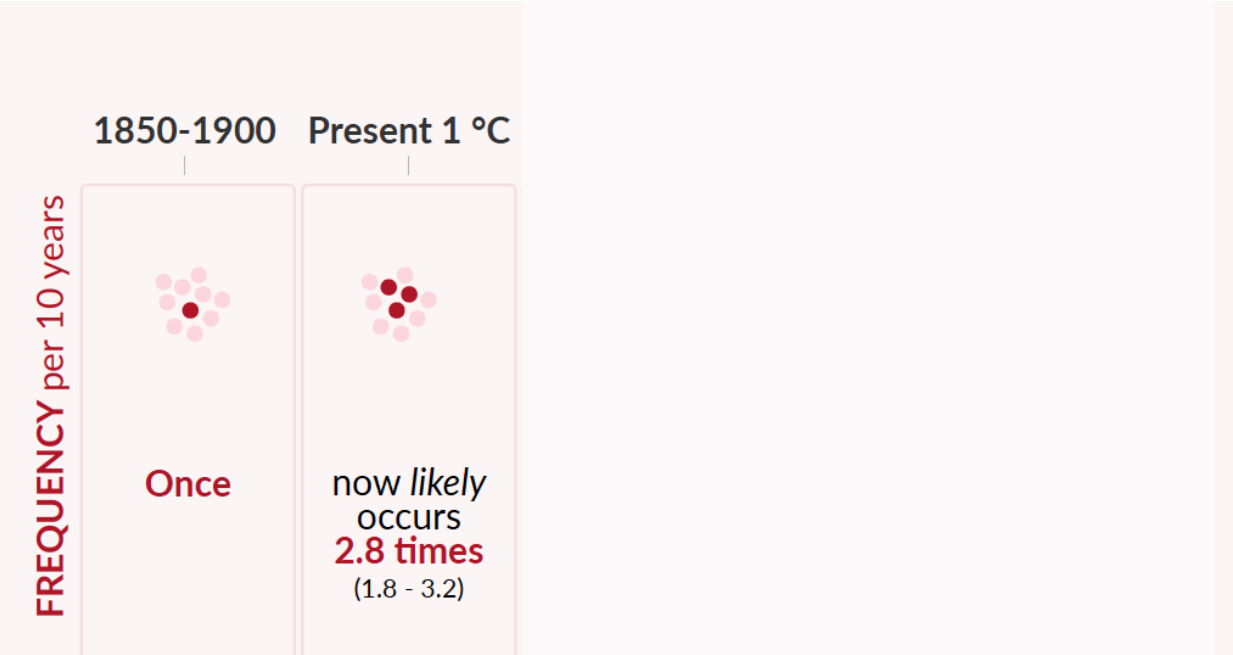
Canada, 2021

Germany, 2021

India, 2022

Changes in extremes as function of global warming

- Many changes in the **frequency and intensity of climate extremes become larger with increasing global warming**



Change in probability of extreme temperature events

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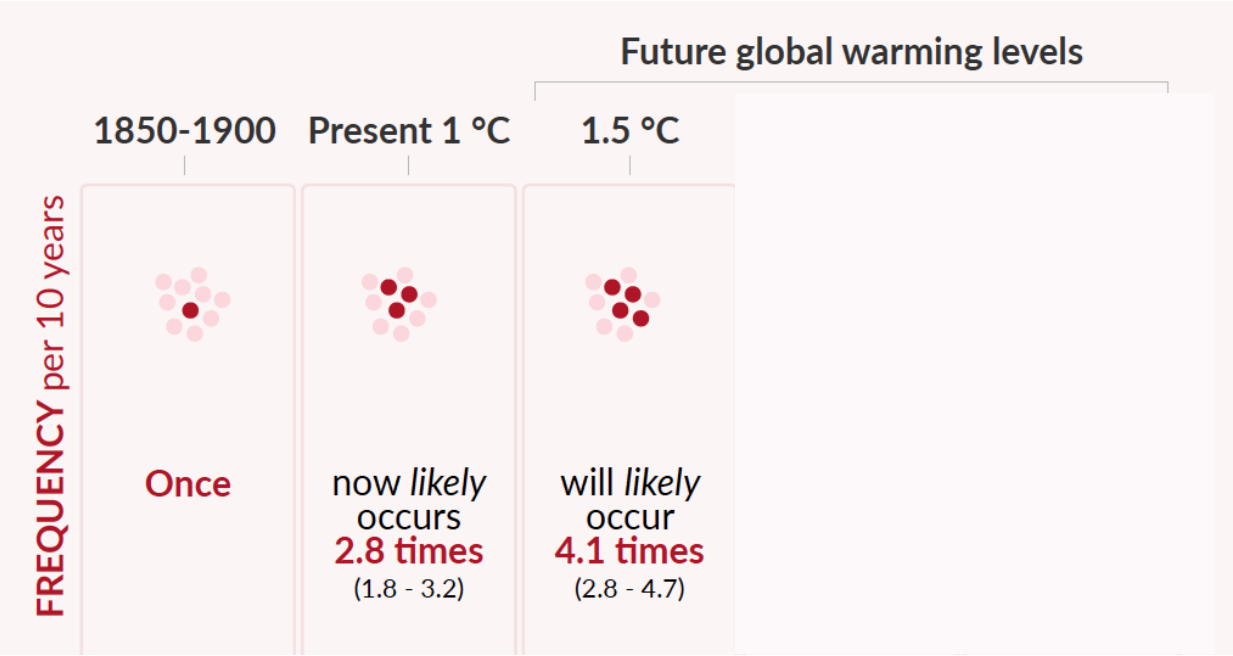

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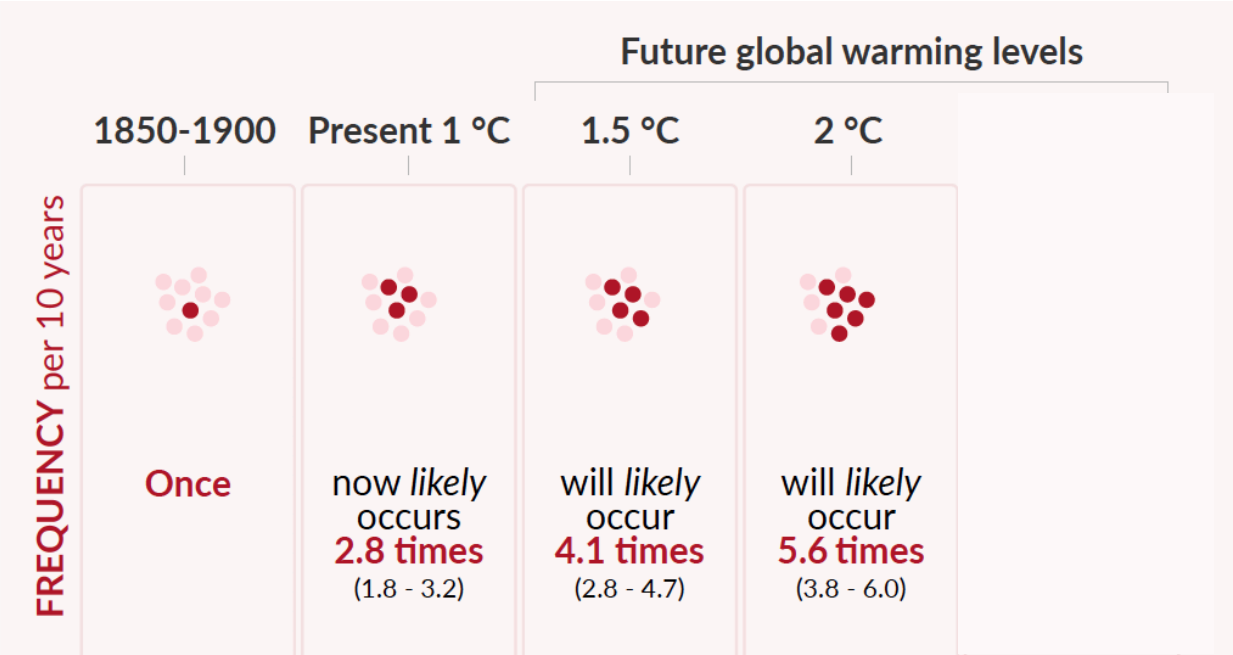

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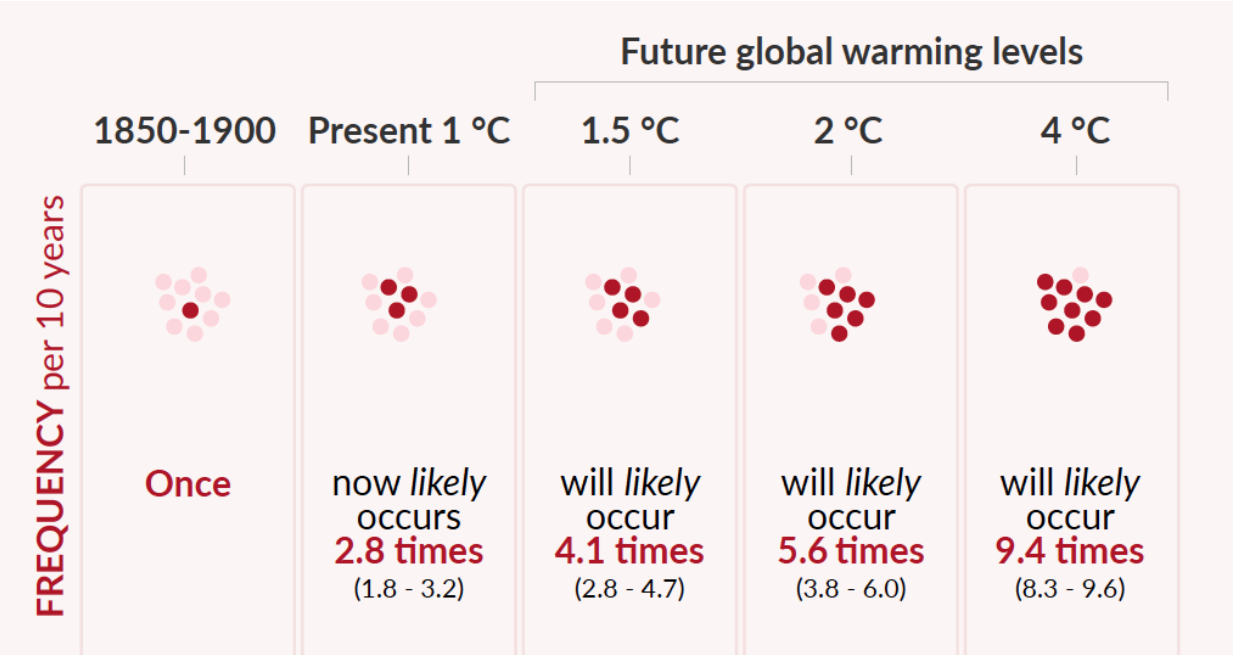
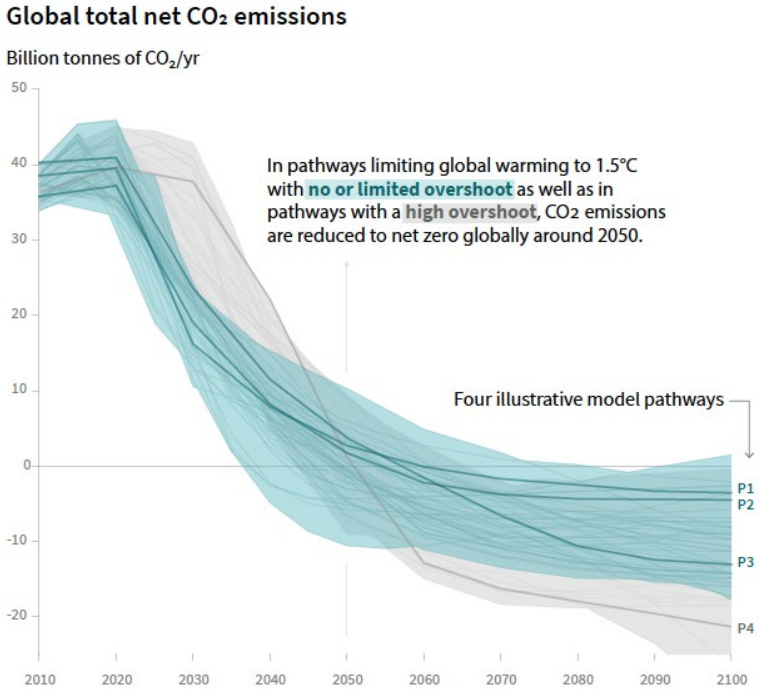


Change in probability of extreme temperature events

Changes in extremes as function of global warming

- **Concurrent extremes at multiple locations** become more frequent with increasing global warming, including in **crop-producing areas**, at 2°C and above compared to 1.5°C global warming (*high confidence*)

Scenarios for stabilization at ~1.5°C



(IPCC SR15)

Stabilization to ~1.5ºC requires changes which are unprecedented in terms of scale:

- **Immediate reduction of CO_2 emissions on global scale** (until 2030: 50% of 2010)
- **Net-zero CO_2 emissions at the latest in 2040** (66% probability) **– 2050** (50% probability)
- **"Negative emissions"** after reaching net-zero CO_2: **At most 10%** of present-day emissions

Relevance of satellite research and observations

How can satellite data contribute to climate research & IPCC reports?

- Process understanding (e.g. drought effects on vegetation and CO_2)
- Constraints for climate models
- Early warning and monitoring of climate extremes
- New integrated datasets (digital twin Earth)
- Verification of emissions (fires, methane, CO_2, deforestation)

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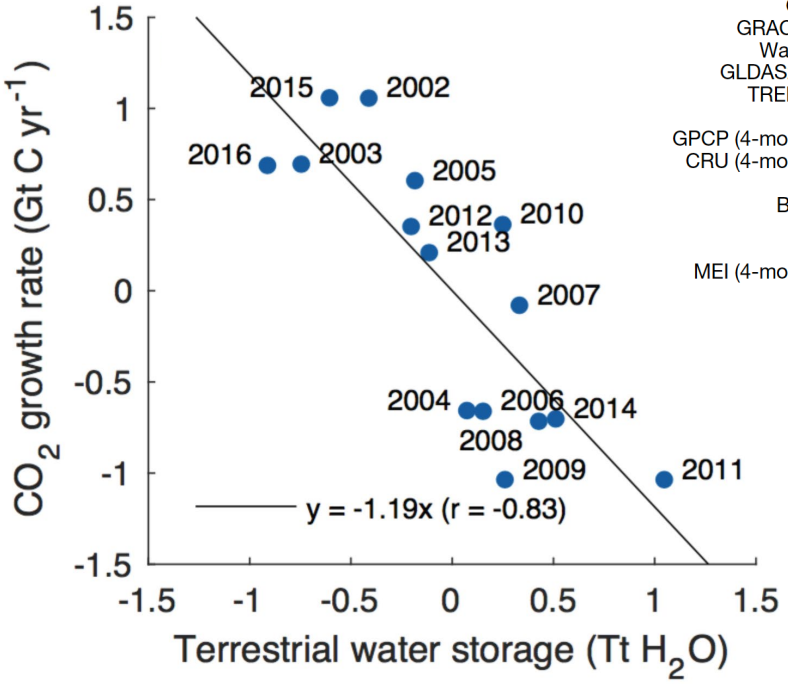
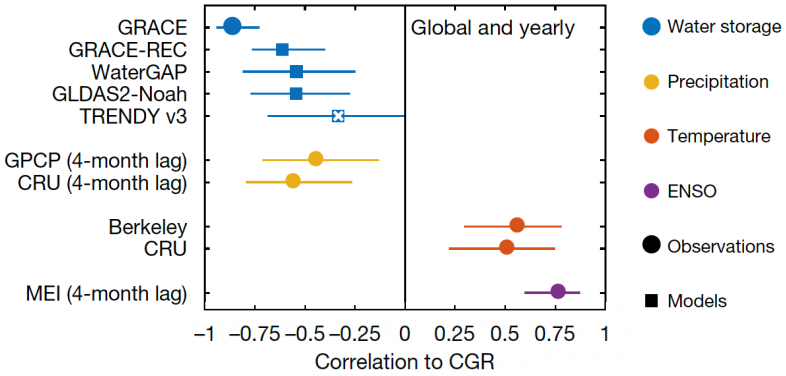
Essential consideration:

- General lack of long-term consistent datasets; e.g. for climate extremes: observed trends assessed from 1950 to present, only limited consideration of shorter trends (e.g. 1990 to present)
- Ensuring continuity of EO measurements is key for climate data records

Effects of soil moisture/droughts on global carbon cycle

Possible enhancing feedback: Underestimated in current climate models...





(Humphrey et al. 2018, Nature)

Conclusions

We are in a climate crisis:

- We need both to mitigate and adapt, there is no choice anymore

Satellite data play an essential role for for a) monitoring and verification, b) early warning, c) process understanding, model validation and model constraints

Long records (>30years) are essential. ESA CCI is an important initiative helping progress, but continuous measurements are key.

More exchange between climate and satellite research communities is essential: Joint projects, digital twin Earth


ipcc
INTERGOVERNMENTAL PANEL ON
climate change
WMO
UNEP
EVERY ACTION MATTERS
EVERY BIT OF WARMING MATTERS
EVERY YEAR MATTERS
EVERY CHOICE MATTERS

Thank you!