AI 4 Science - “Deep Extremes”

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Multi -Hazards, Compounds and Cascade Events

esa

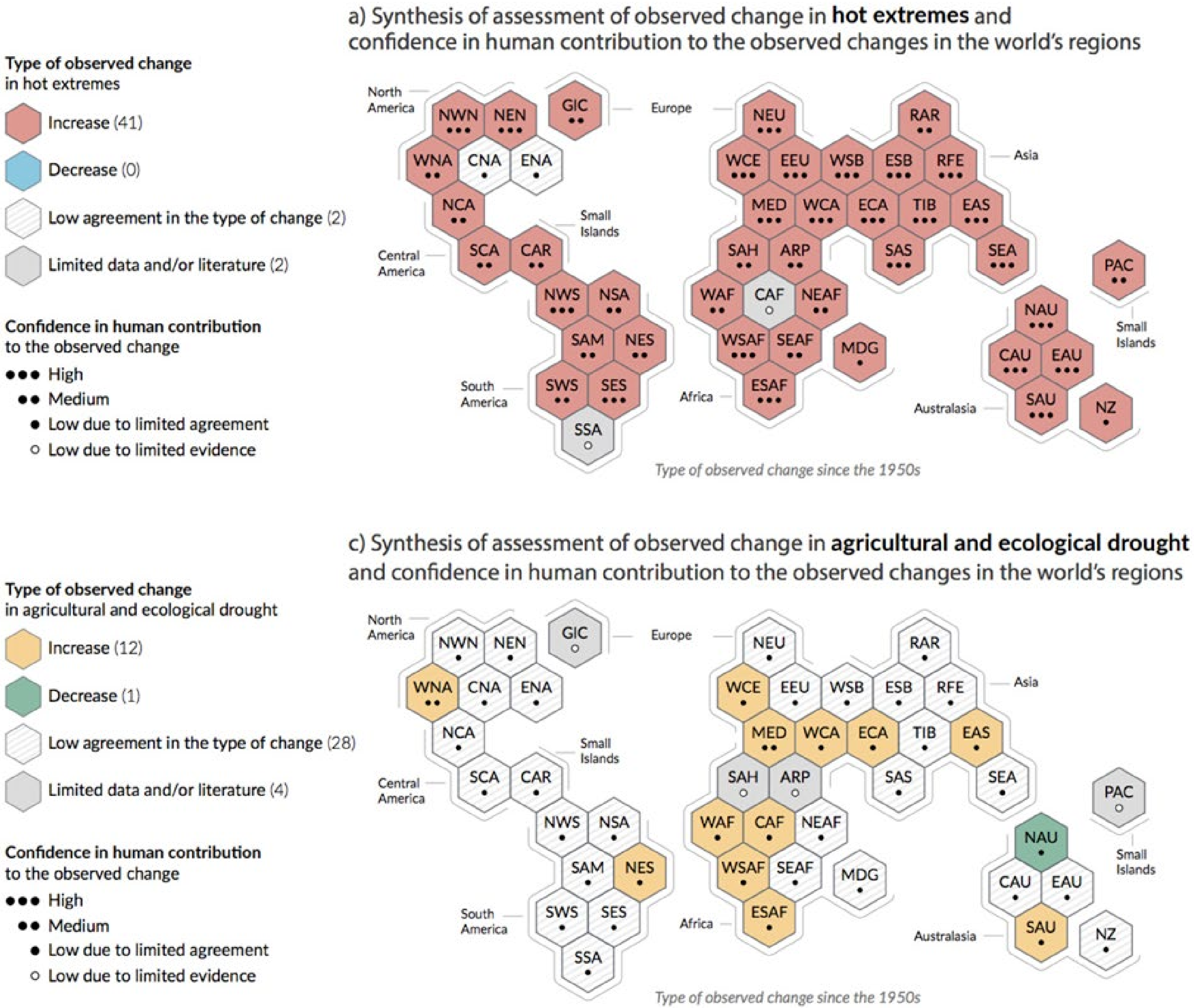
UNIVERSITÄT LEIPZIG

BROCKMANN CONSULT GMBH

VNIVERSITAT DE VALÈNCIA

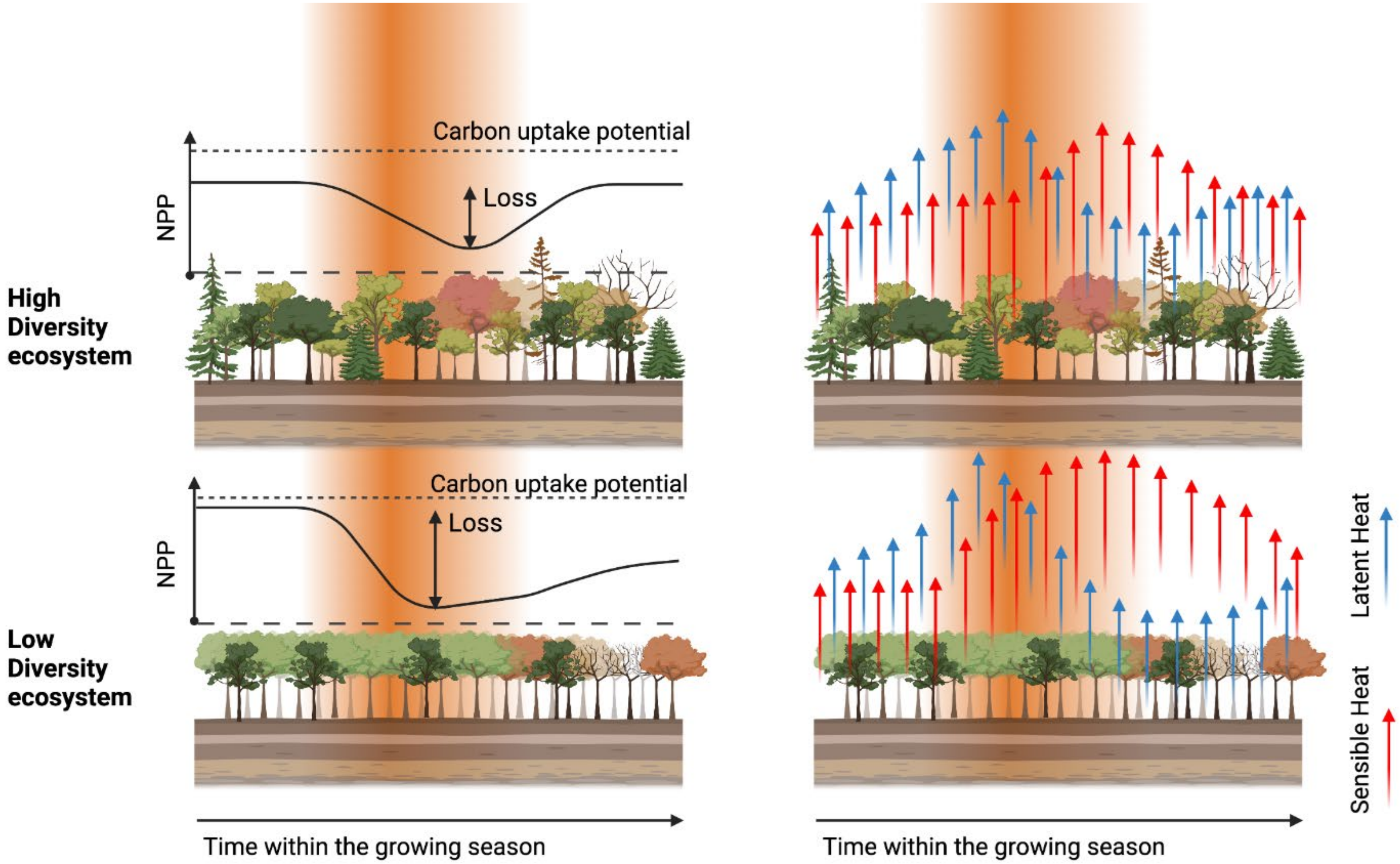
MAX PLANCK INSTITUTE FOR BIOGEOCHEMISTRY

Scientific Relevance: Climate extremes are on the rise



IPCC AR6 WGI reference regions: North America: NWN (North-Western North America, NEN (North-Eastern North America), WNA (Western North America), CNA (Central North America), ENA (Eastern North America), Central America: NCA (Northern Central America), SCA (Southern Central America), CAR (Caribbean), South America: NWS (North-Western South America), NSA (Northern South America), NES (North-Eastern South America), SAM (South American Monsoon), SWS (South-Western South America), SES (South-Eastern South America), SSA (Southern South America), Europe: GIC (Greenland/Iceland), NEU (Northern Europe), WCE (Western and Central Europe), EEU (Eastern Europe), MED (Mediterranean), Africa: MED (Mediterranean), SAH (Sahara), WAF (Western Africa), CAF (Central Africa), NEAF (North Eastern Africa), SEAF (South Eastern Africa), WSAF (West Southern Africa), ESAF (East Southern Africa), MDG (Madagascar), Asia: RAR (Russian Arctic), WSB (West Siberia), ESB (East Siberia), RFE (Russian Far East), WCA (West Central Asia), ECA (East Central Asia), TIB (Tibetan Plateau), EAS (East Asia), ARP (Arabian Peninsula), SAS (South Asia), SEA (South East Asia), Australasia: NAU (Northern Australia), CAU (Central Australia), EAU (Eastern Australia), SAU (Southern Australia), NZ (New Zealand), Small Islands: CAR (Caribbean), PAC (Pacific Small Islands)Figure SPM.3a from AR6 WGI Summary of Policymakers, IPCC.

Scientific Relevance: Land-surface structure controls impacts



- Climate extremes can lead to **multiple responses** depending on ecosystem structure

Mahecha et al. (submitted)

Scientific Relevance: Compounding event → *n*-dimensional impacts

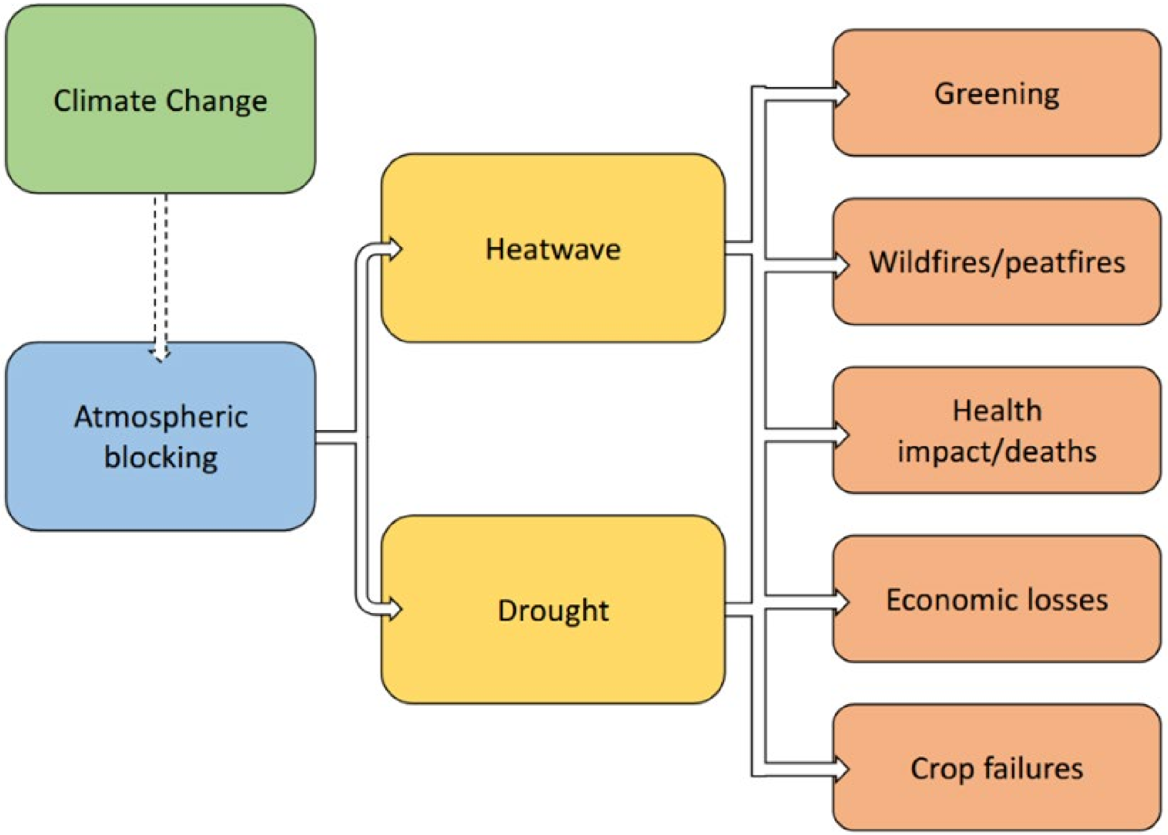
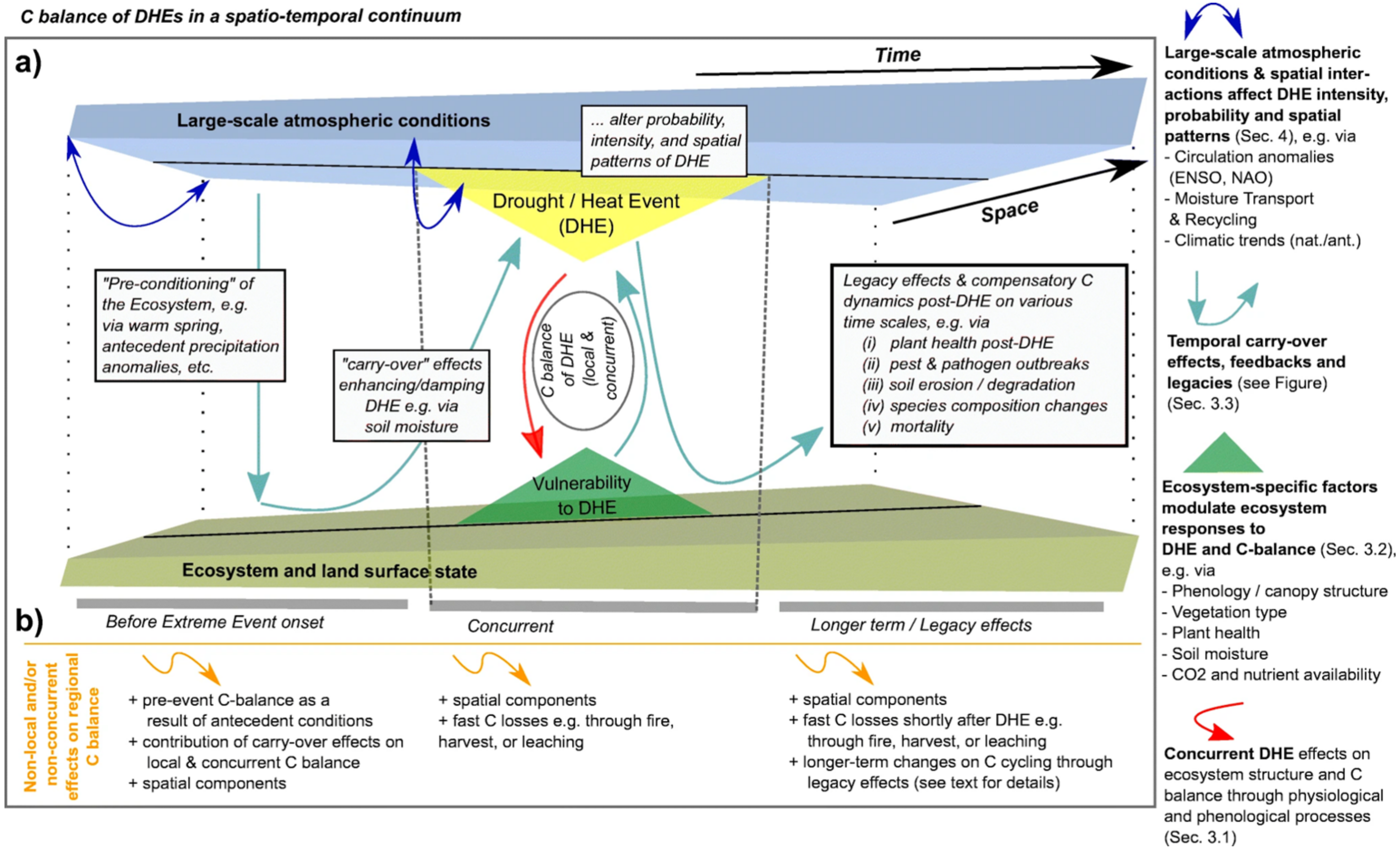


Fig. curtsey Karin Mora based on concept presented in
Zscheischler et al. (2020) Nature Reviews Earth & Environment 1, 333–347

- Climate extremes can lead to **multiple responses** depending on ecosystem structure
- **Compound events** max exacerbate the impacts on multiple sectors

Scientific Relevance: Timing of extremes is crucial



- Climate extremes can lead to **multiple responses** depending on ecosystem structure
- **Compound events** max exacerbate the impacts on multiple sectors
- **Timing matters** and can change impact dynamics

Sippel et al. (2018) *Current Climate Change Reports* 4, 266-286

Detecting large-scale *n*-dimensional extremes

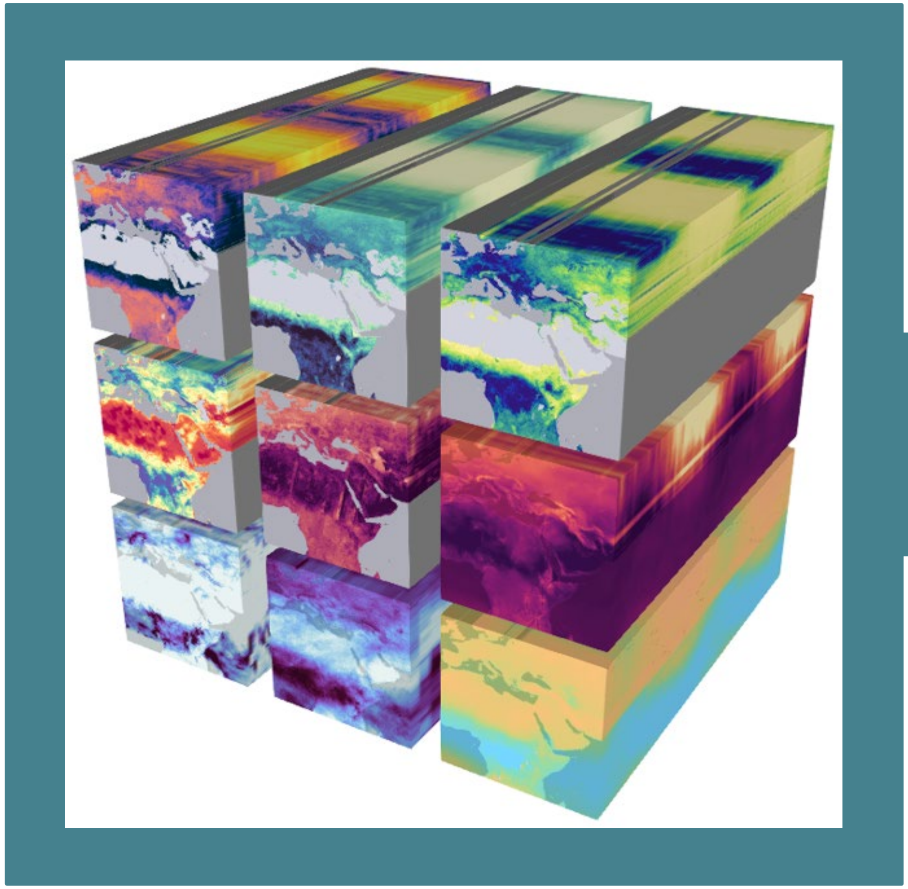


Fig. Mahecha, Gans et al. (2020) *Earth System Dynamics*, 11, 201-234

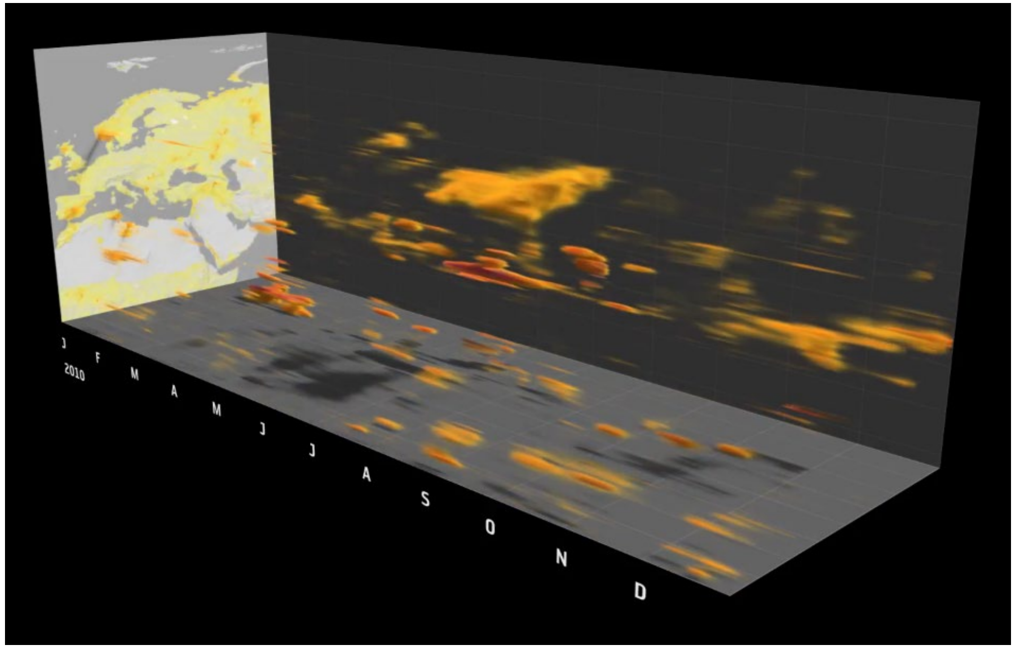


Fig. https://www.earthsystemdatalab.net/ movie from Planetary Vision based on the analysis in Flach et al. (2018) *Biogeosciences*, 15, 6067-6085

The devil is in the details! Can optical remote sensing data save us?

- Sentinel-2 data bring us the required detail and information

- But event detection is not enough, **impact prediction** capacity is what matters.

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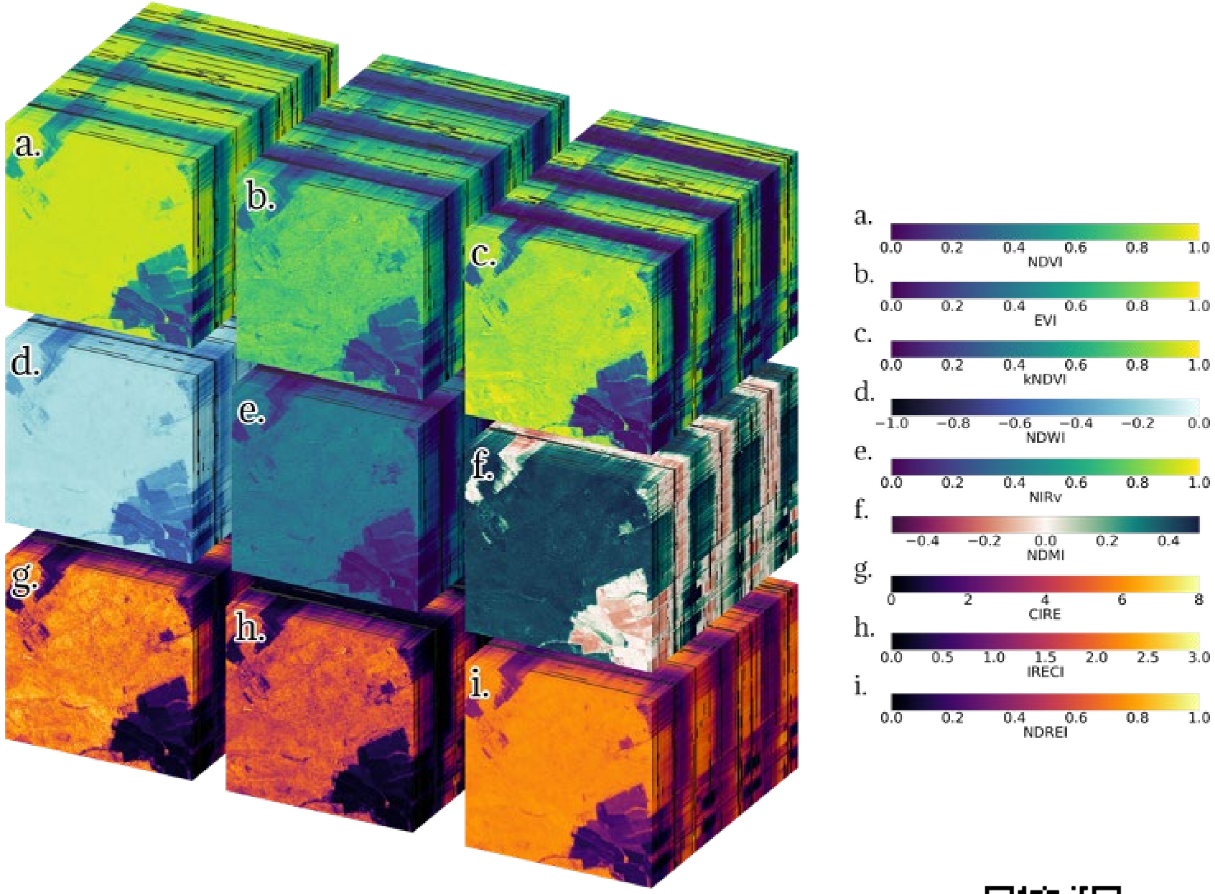


Montero et al. (in prep)
Poster C1.07 on Thursday

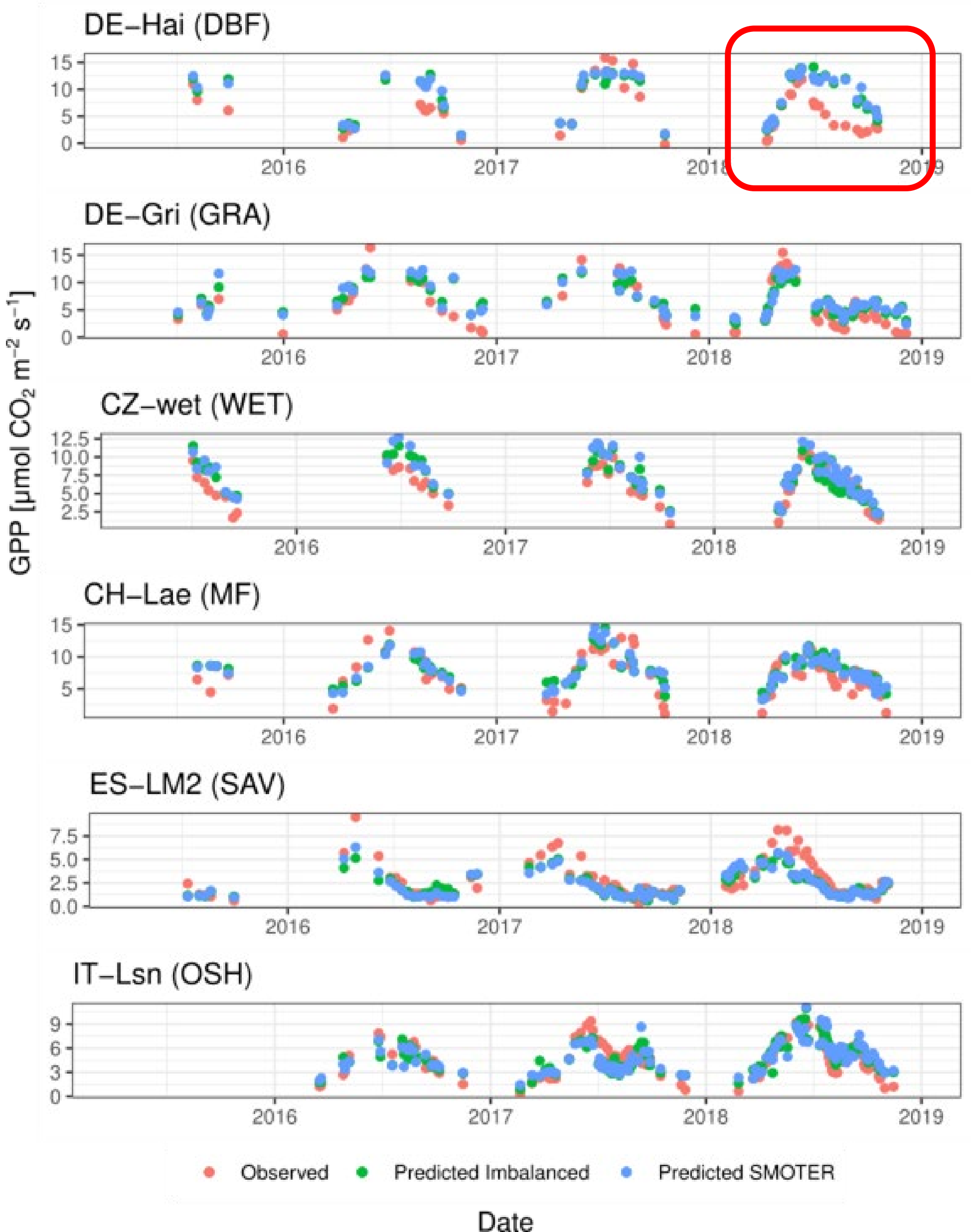
Poster: C1.07
ML4Earth

The devil is in the details, so can optical remote sensing save us?

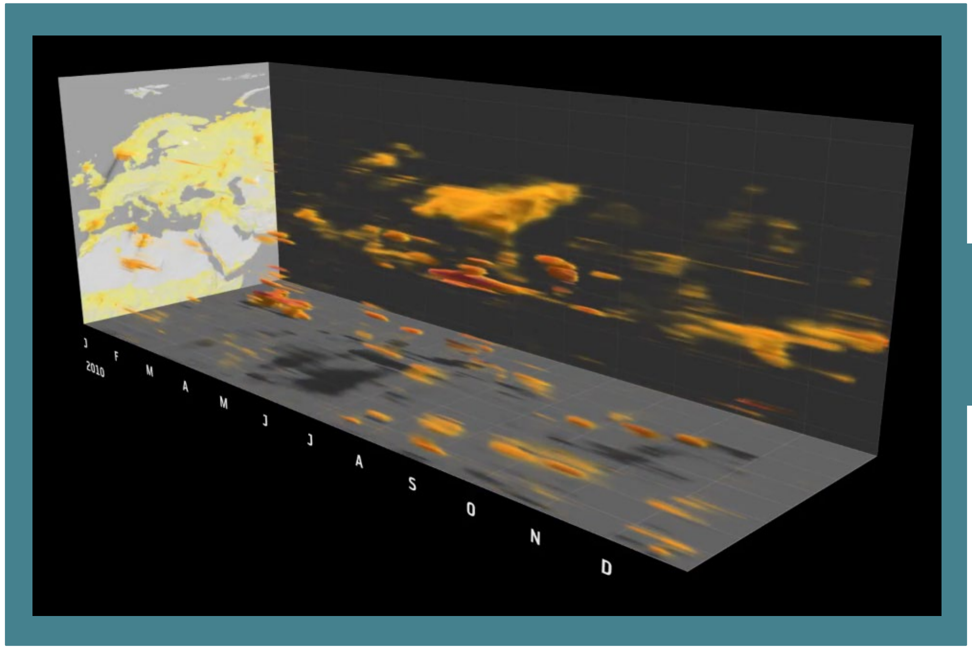
- Sentinel-2 data bring us the required detail and information

- But event detection is not enough, **impact prediction** capacity is what matters.

Pabon et al. (2022) *IEEE Transactions on Geoscience and Remote Sensing*→



Project idea: Subsampling



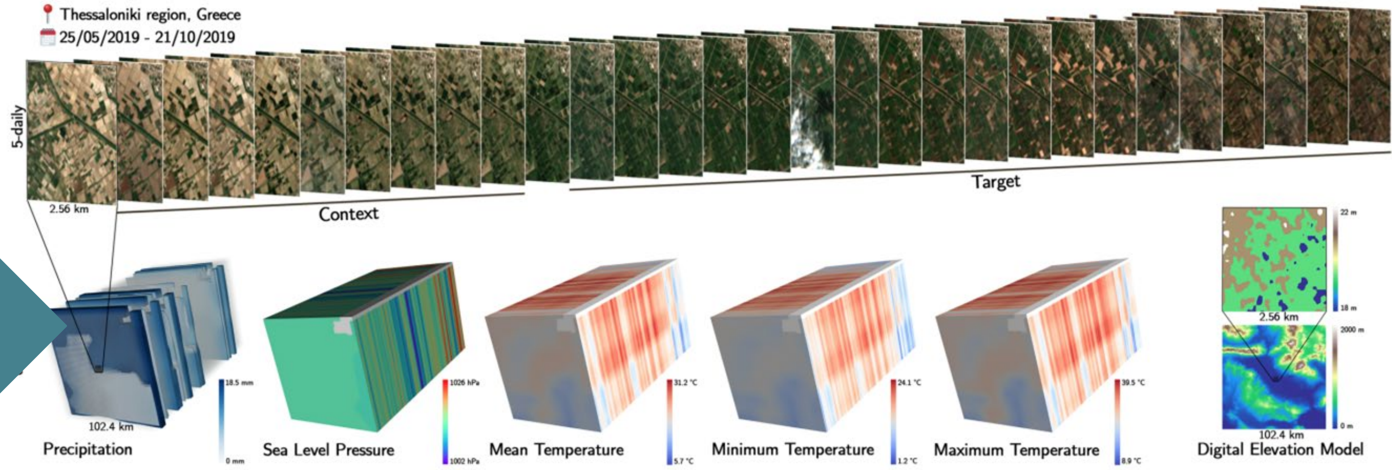
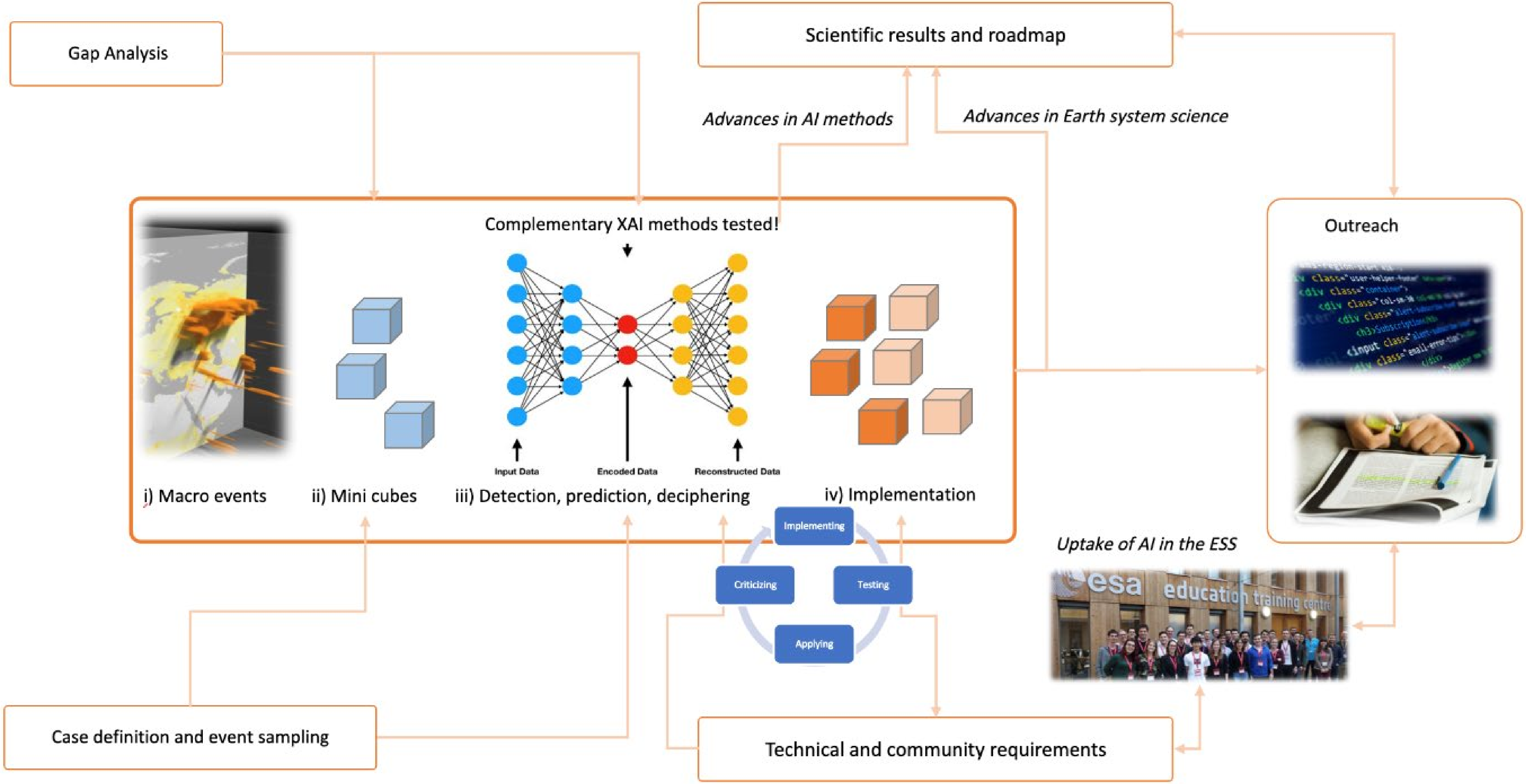
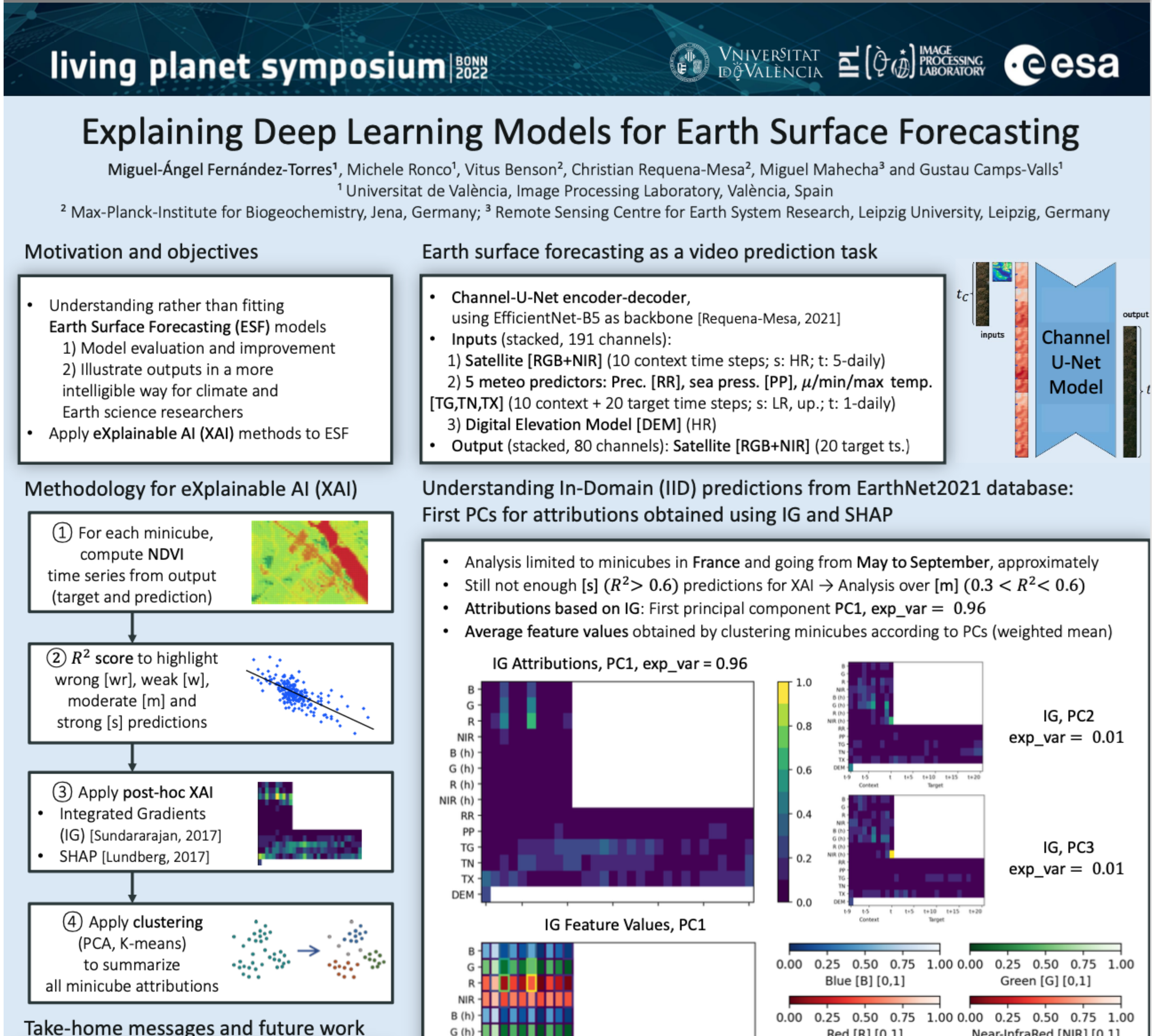


Fig. top
Requena-Mesa et al. (2021) EarthNet21: A novel large-scale dataset and challenge for forecasting localized climate imatcs. arXiv:2012.06246

DeepExtremes in a nutshell

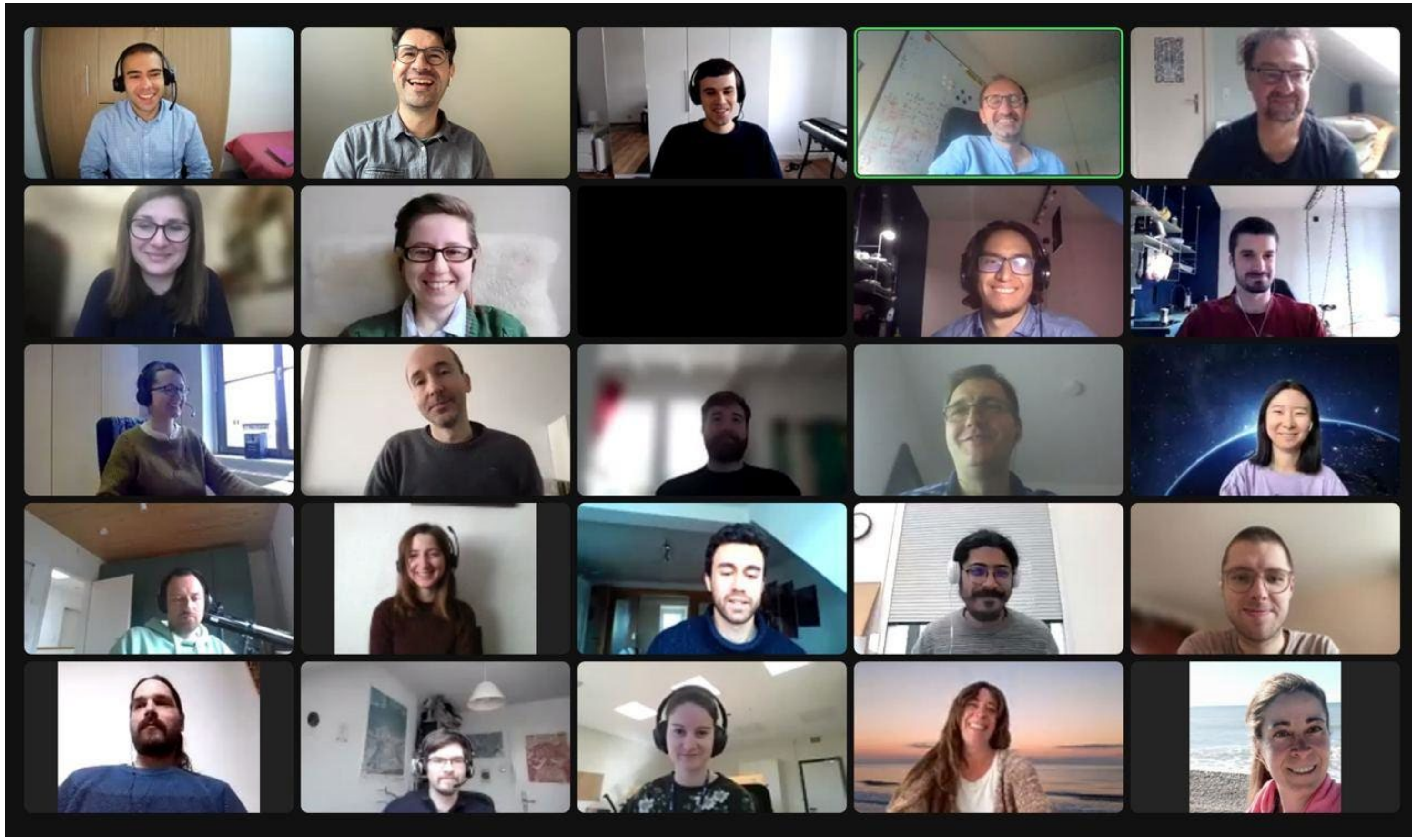


A nice example of the work in the consortium



“Deep Extremes” → MultiHazards, Compounds, Cascade Events

Thank you for your attention



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Valencia University

Thank you! Some preliminary information is here; rsc4earth.de/project/deepextremes/ …

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