

European Commission

# Record-breaking and unprecedented compound hot and dry summers in Europe under different emission scenarios

A. Dosio, J. Spinoni, M. Migliavacca

## Methodology:

Daily summer (JJA) precipitation and temperature data from E-OBS (1950-2022) and EURO-CORDEX (1981-2100)

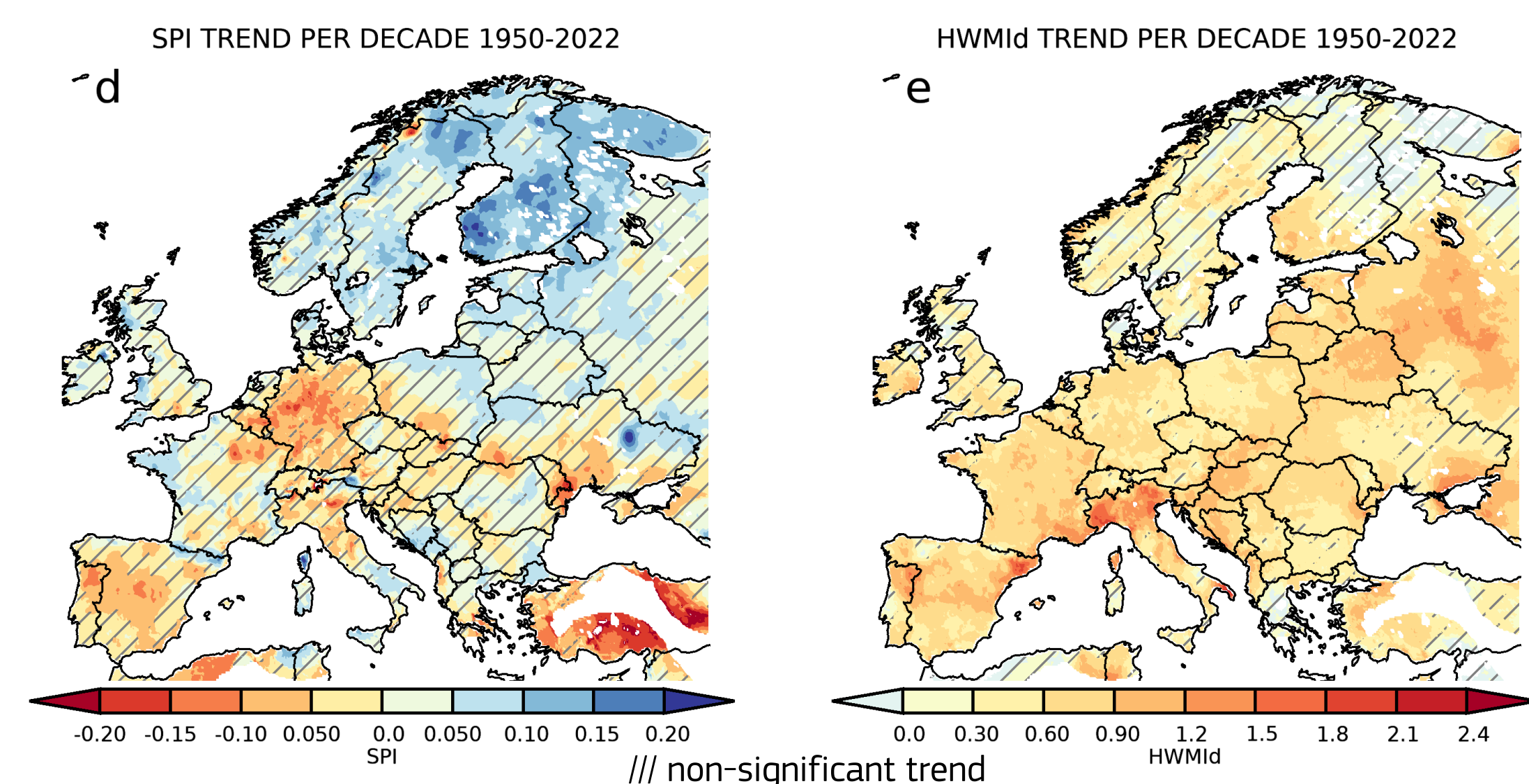
**Heatwave** event defined when the HeatWave Magnitude Index Daily (HWMId, Russo et al 2015) >10

**Drought** event defined when SPI-3 (JJA) < -1

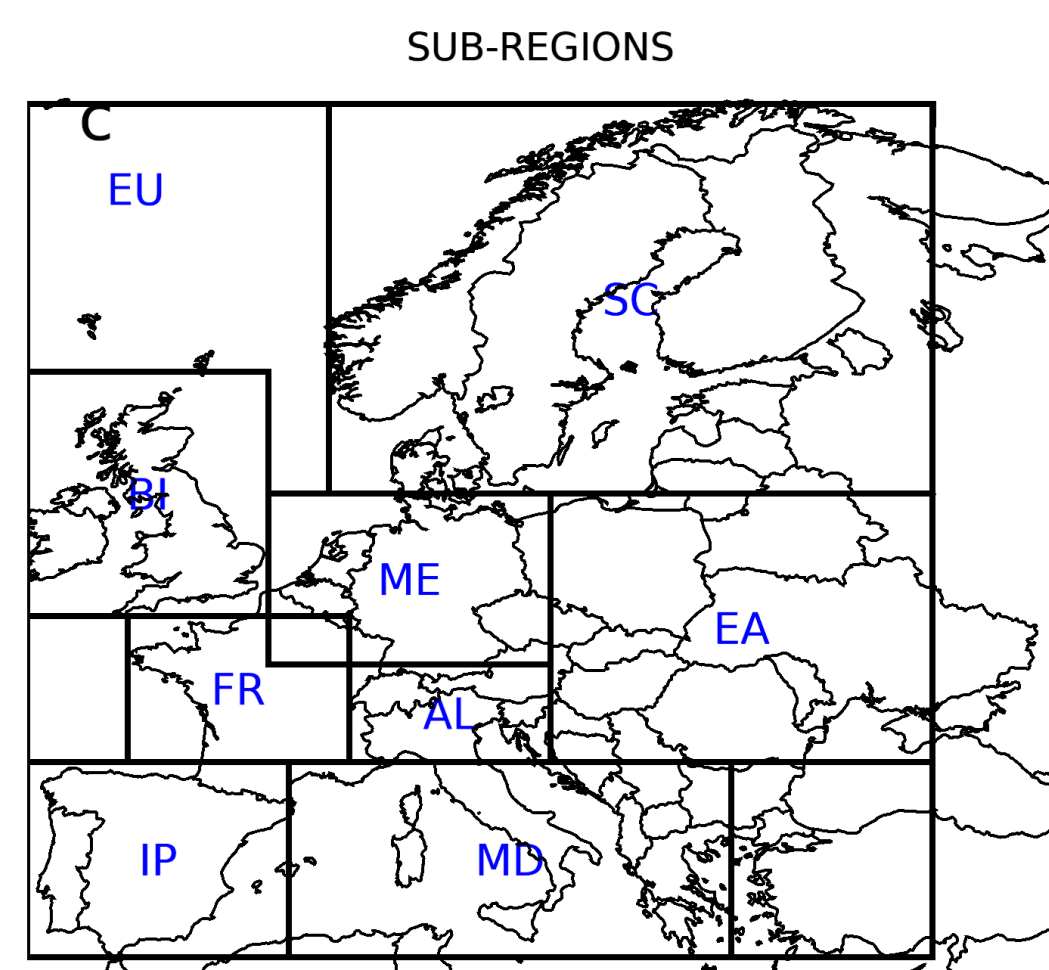
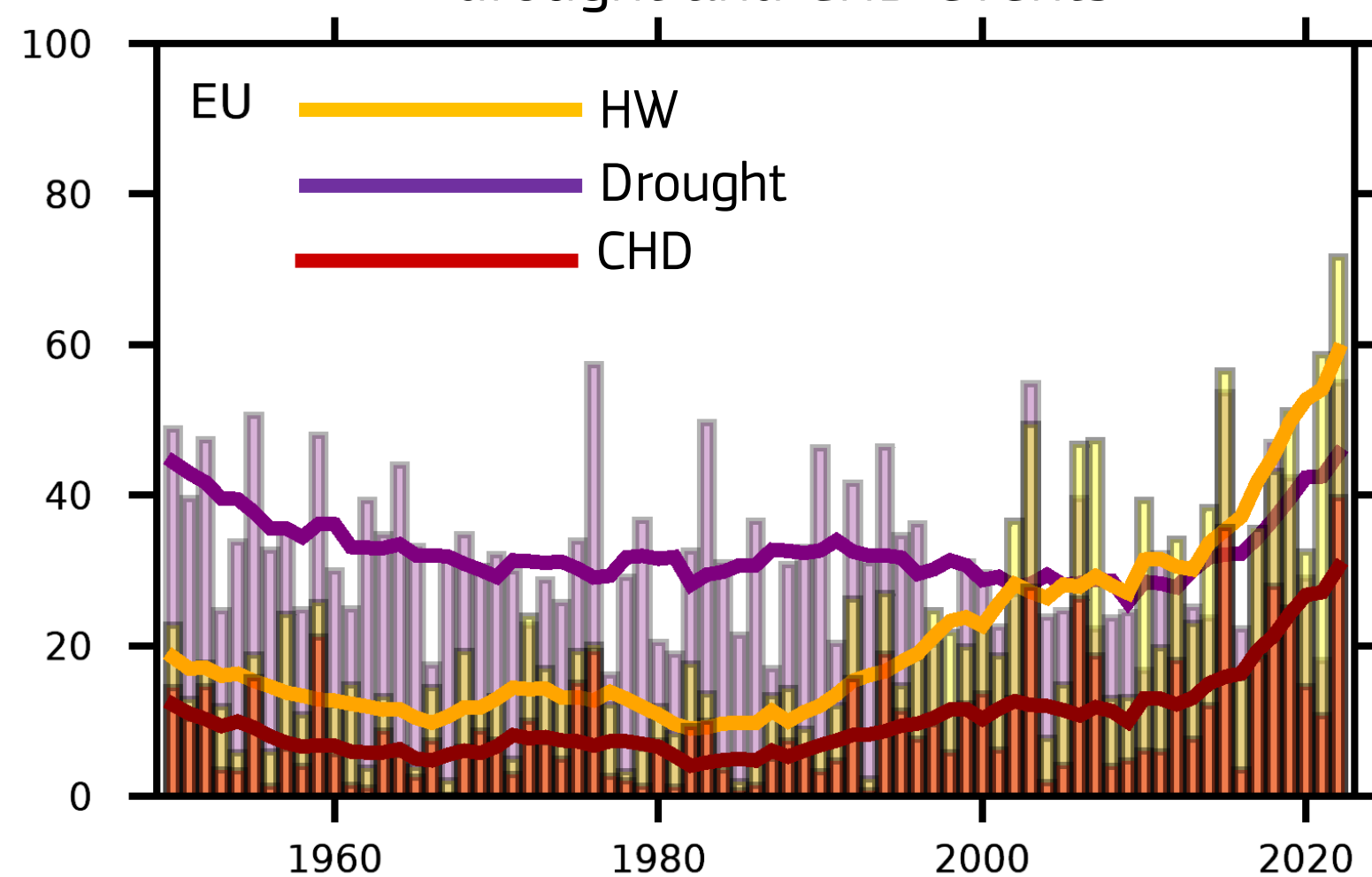
**Compound Hot and Dry event (CHD)** if both the above conditions occur in the same year (summer).

## Observations: E-OBS 1950-2022

European summers have become hotter and, for some sub-regions, drier

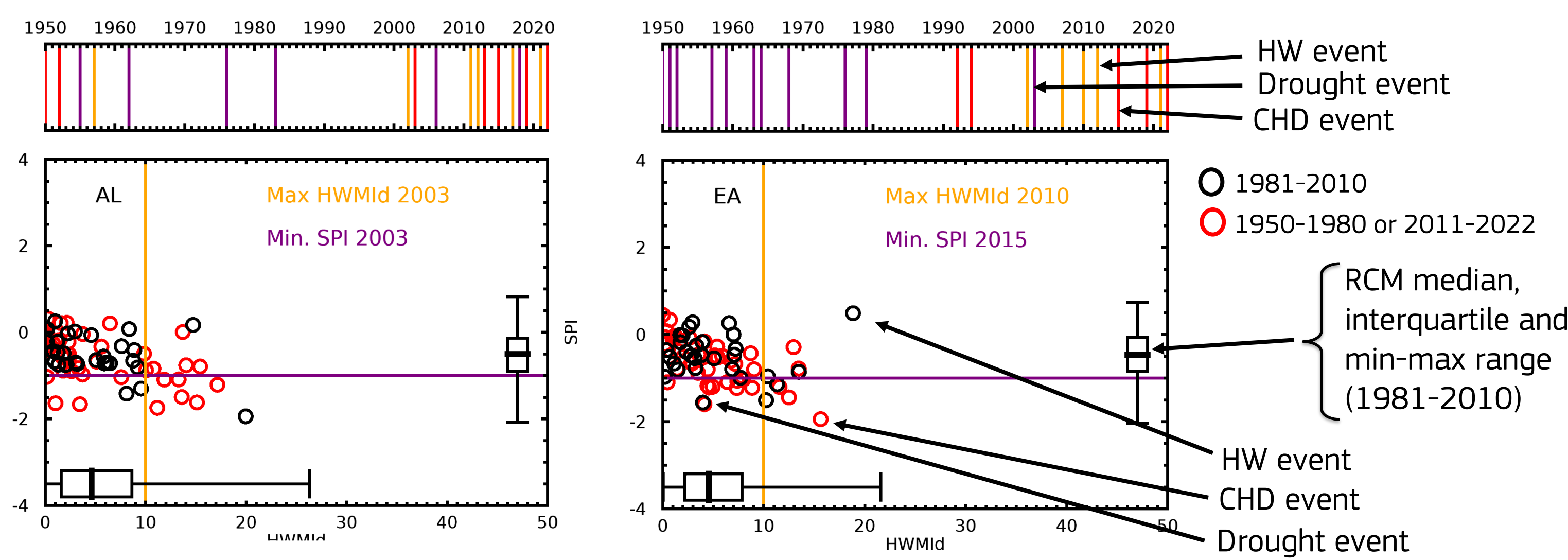


Percentage of land area affected by HW, drought and CHD events



At European level (EU) there is no clear tendency in drought frequency and extension. However, as the frequency and extension of HW events increase steadily over all regions of Europe this results in CHD events clustering usually in the last decade or so.

Sub-regionally averaged, annual HWMId and SPI values and HW, drought and CHD events:



## Record-breaking and unprecedented events

Assume SPI<sub>m</sub> and HWMId<sub>M</sub> are the minimum and maximum observed (1950-2022) values. If SPI<sub>m</sub> and HWMId<sub>M</sub> occurred in the same year (e.g. over AL), then any future event when, at the same time, both SPI and HWMId are equal or worse than SPI<sub>m</sub> and HWMId<sub>M</sub> will be defined as a **record-breaking** CHD event.

If SPI<sub>m</sub> and HWMId<sub>M</sub> occurred in different years (e.g., EA), any event with SPI and HWMId that are, at the same time, equal or worse than SPI<sub>m</sub> and HWMId<sub>M</sub> will be defined as **unprecedented** CHD event as this particular SPI/HWMId combination has never happened in the observed period.

## Future projections 2071-2100

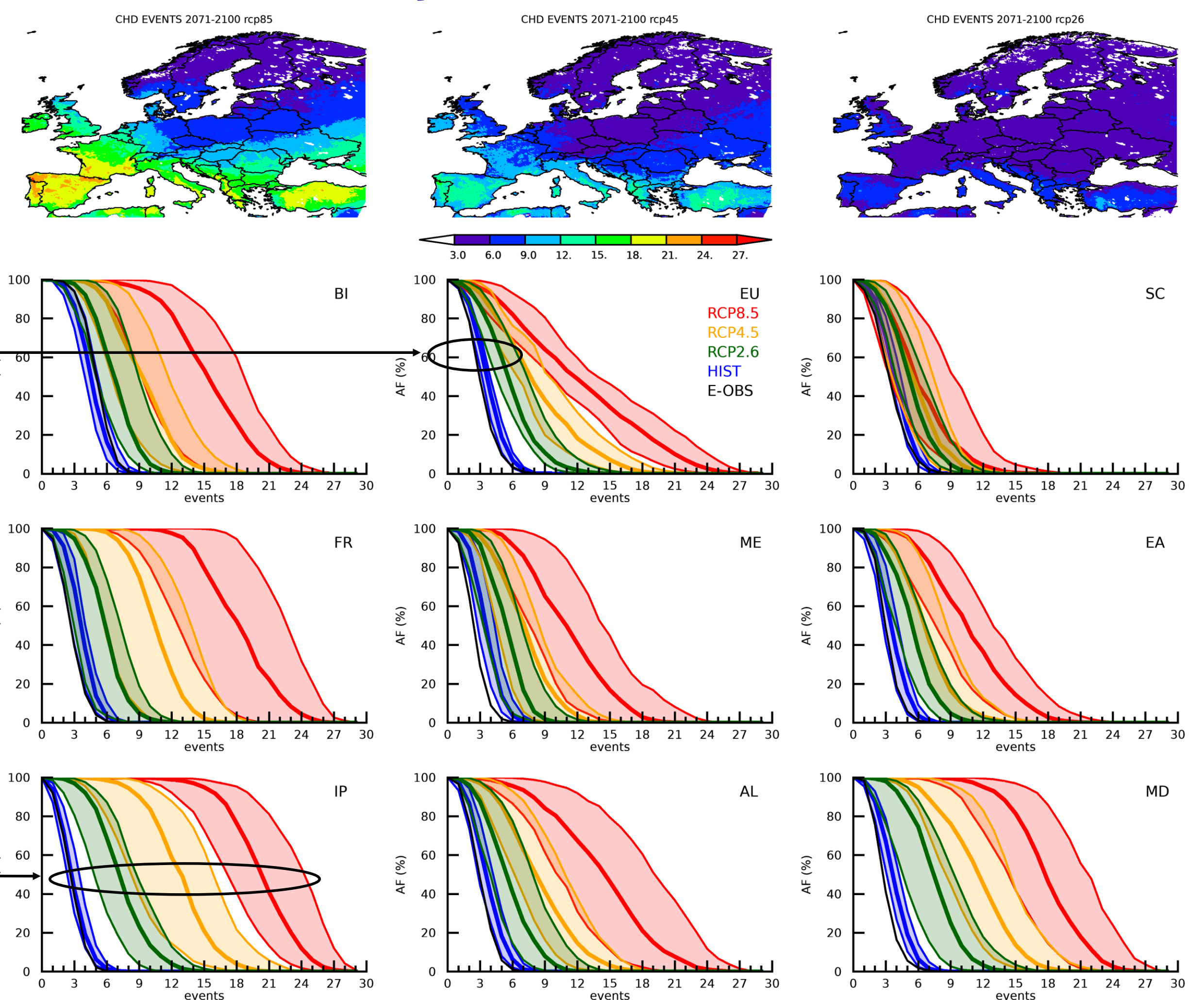
Bias-adjusted EURO-CORDEX (0.11°) RCM simulations

- 27 simulations (RCM-GCM combinations) for RCP2.6,

- 21 for RCP4.5

- 61 for RCP8.5.

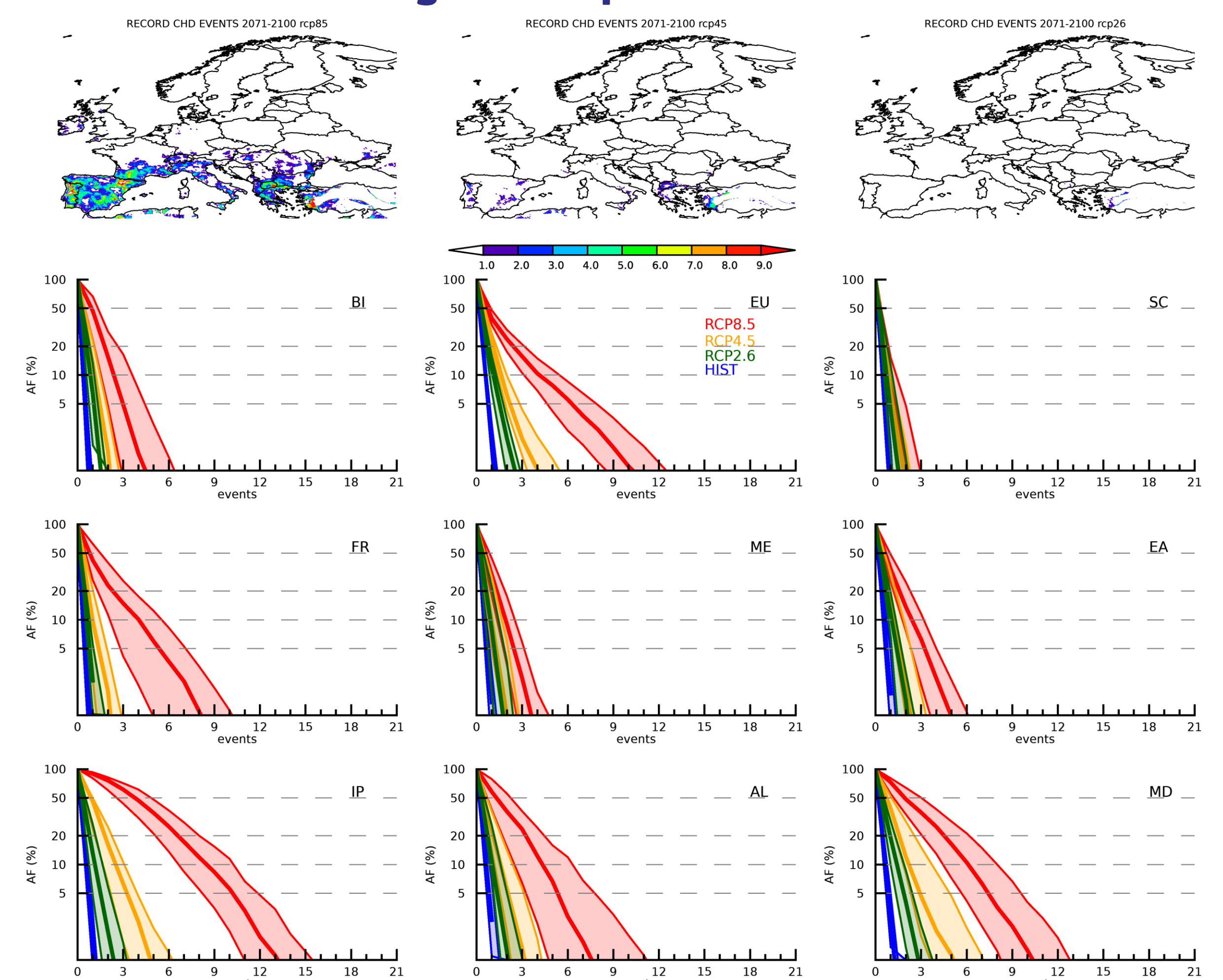
## Projected CHD events



By the end of the century, even under a low-emission scenario there is a likely (model median +/- 1 standard deviation) increase in the frequency of CHD events over most (60%) of Europe compared to the reference (1981-2010) period.

Under a high-emission scenario, 50% of the Iberian Peninsula (IP) is projected to be hit at least twice every three years, compared to 1 in ten years in the historical period, 7.1 times in 30 years under RCP2.6, and 12.8 times under RCP4.5, whereas 50% of the British Islands (BI), France (FR), and the Mediterranean (MD) more than once every two years under RCP8.5.

## Record-breaking and unprecedented CHD events



With increasing warming Europe will face CHD events whose intensity has equaled or even surpassed that of the historical observed record (1950-2022), with the number of record-breaking or unprecedented CHD events hitting 10% of land projected to increase from at least 1.2 (0.9-1.5) under RCP2.6 to 1.7 (1.5-1.9) under RCP4.5 and 4.2 (3.2-5.6) under RCP8.5. In addition, 20% of IP land will be hit at least once every 5 years and 10% once every 10 years under RCP8.5.

## For more info:

Dosio et al: Record-breaking and unprecedented compound hot and dry summers in Europe under different emission scenarios, *Environmental Research: Climate*, under review

Bias-adjusted EURO-CORDEX simulations available upon request. [Alessandro.dosio@ec.europa.eu](mailto:Alessandro.dosio@ec.europa.eu)

EU Science Hub  
joint-research-centre.ec.europa.eu

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