

WMO Global Energy Resilience Atlas

Climate Risk Indices for Hydropower

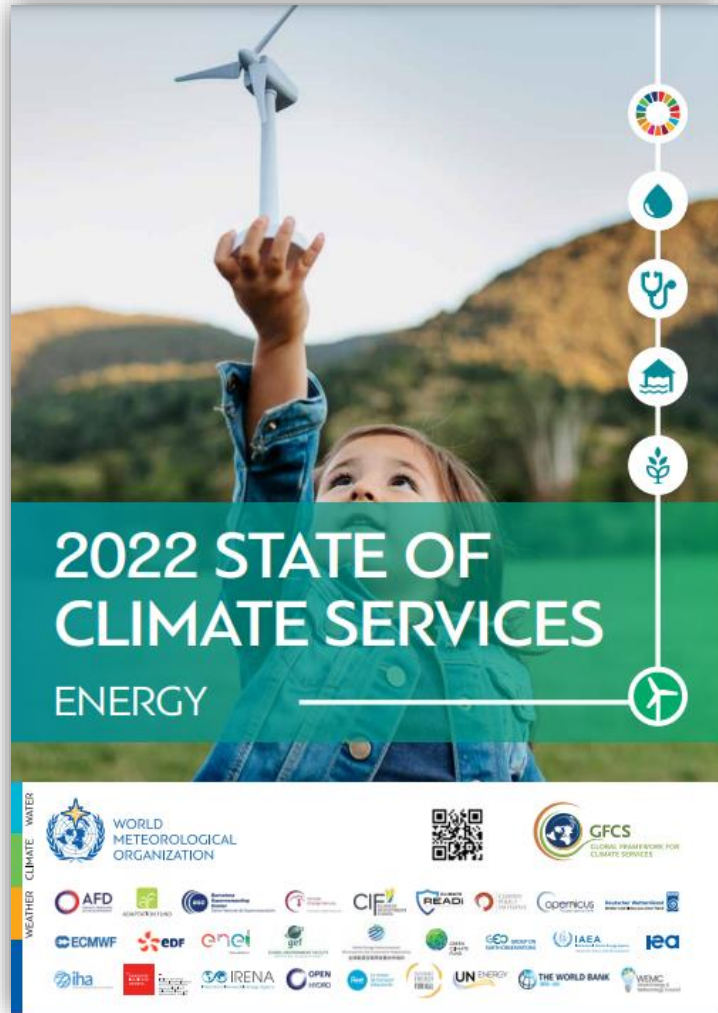
Wurichaihu

Climate and Energy

World Meteorological Organization (WMO)

2023.6.29

BACKGROUND



The supply of electricity from clean energy sources must double to limit global temperature increase by 2030.



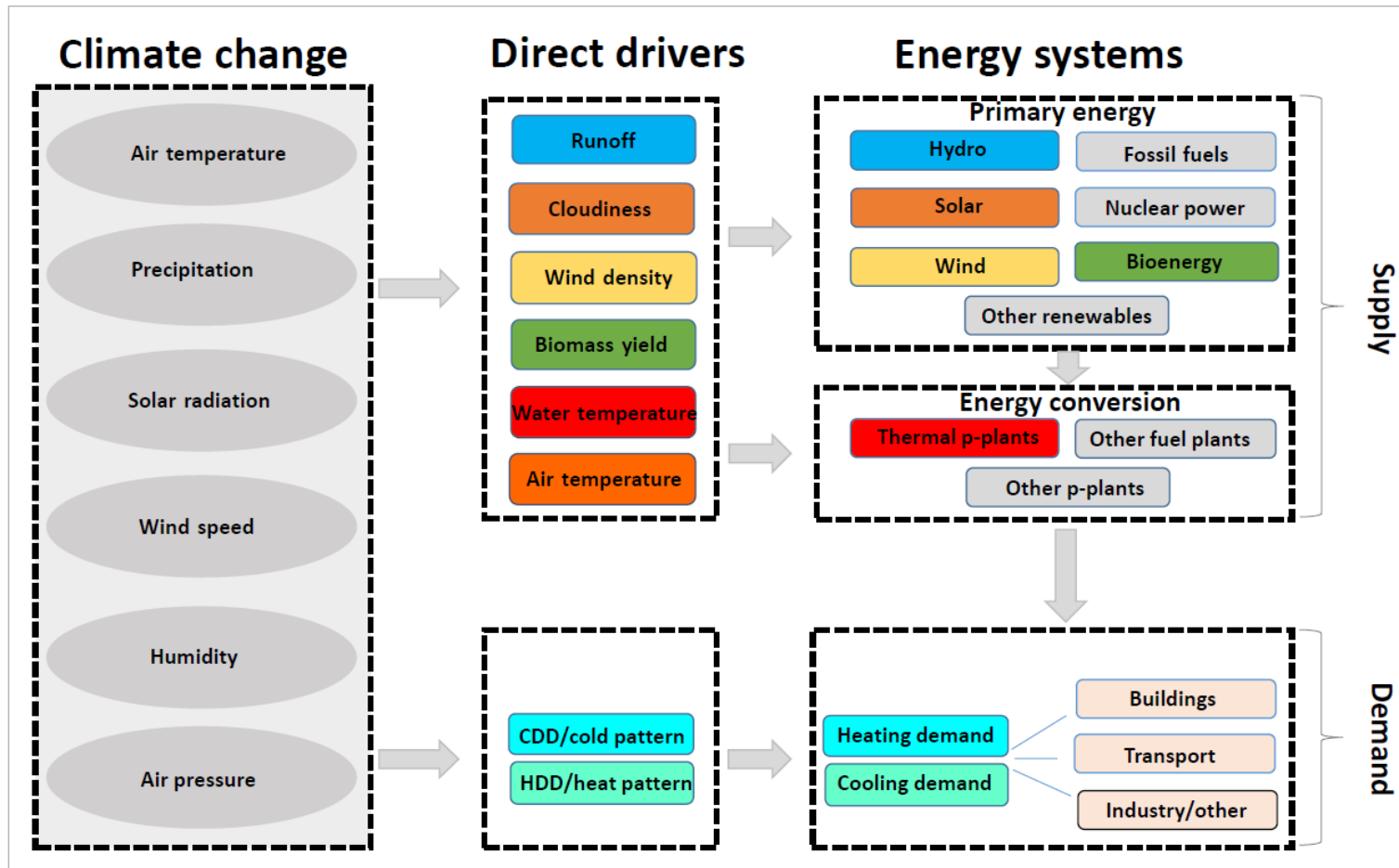
Climate change is putting energy security at risk globally



Water resources are scarce. 11% of hydroelectric capacity is also located in highly water-stressed areas

BACKGROUND

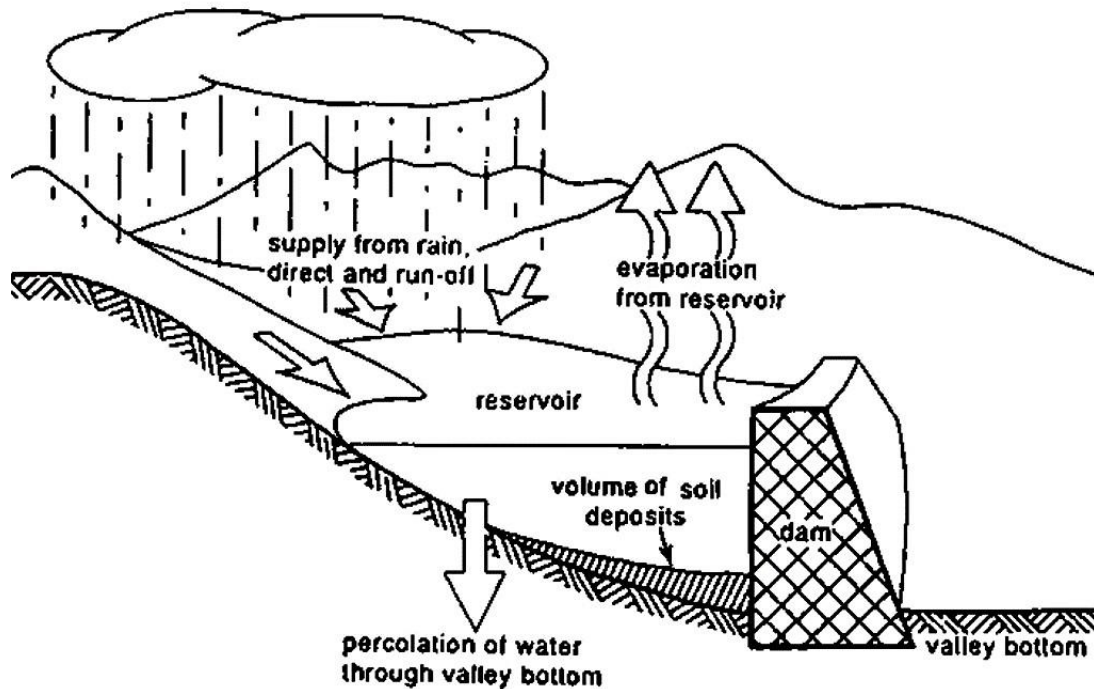
Conceptual framework of climate impacts on the energy sector



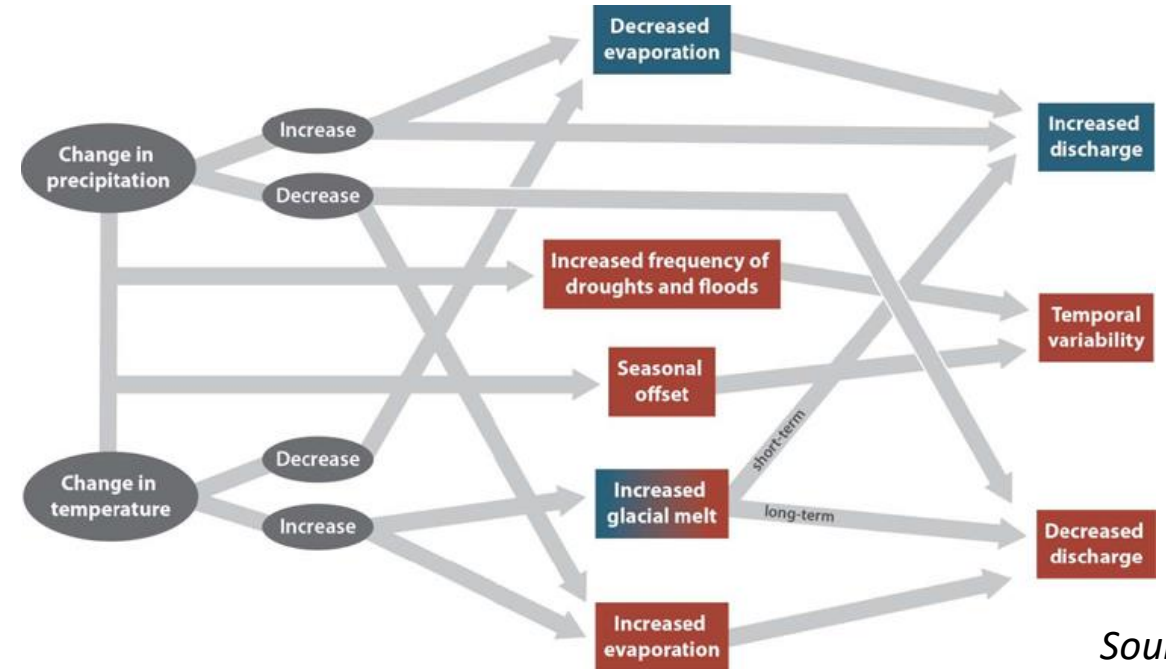
- Increasing the climate-dependent sources of energy means more **vulnerability** to potential climate changes.
- **WMO and WEMC** are developing a Global Energy Resilience Atlas to provide **early indications of the risk of climate change on renewable energy systems.**

Source: *Impacts of Climate Change on Energy Systems in Global and Regional Scenarios*

METHOD



Source: FAO



Source:
<https://sites.google.com/a/marence.at/climate-change-and-hydropower/>

- Follow a similar approach to **Hamududu and Kilingtveit (2012)** based on the fact that the current hydropower generation system may only be limited by water availability.
- The key resource for hydropower generation is runoff, which is dependent on **precipitation**.

METHOD

Risk (Climate Risk index) = H (Climate Hazard) * E(Climate Exposure) * V(Climate Vulnerability)

From: IPCC AR5 climate change

(HRI) Hydropower Risk Index

(NIC) Normalised Installed Capacity

- Mean Annual Precipitation
- Precipitation Variability
- Standardized Precipitation Index_wet
- Standardized Precipitation Index_dry

(Hyp) Proportion of Hydropower
Generation of the Country Energy Mix

HRI = Climate Hazard Indicator (CHI) * NIC * Hyp

DATA

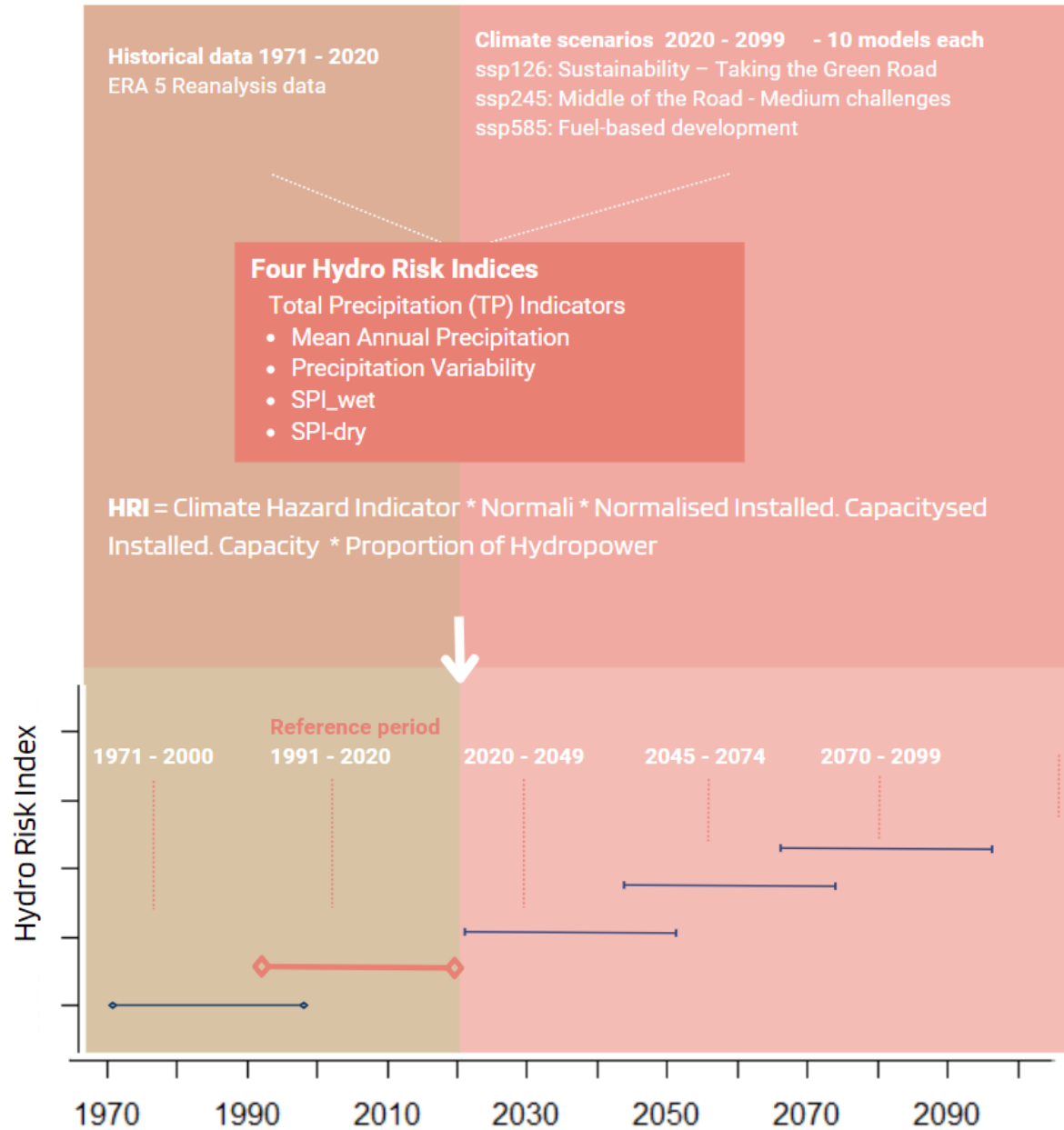
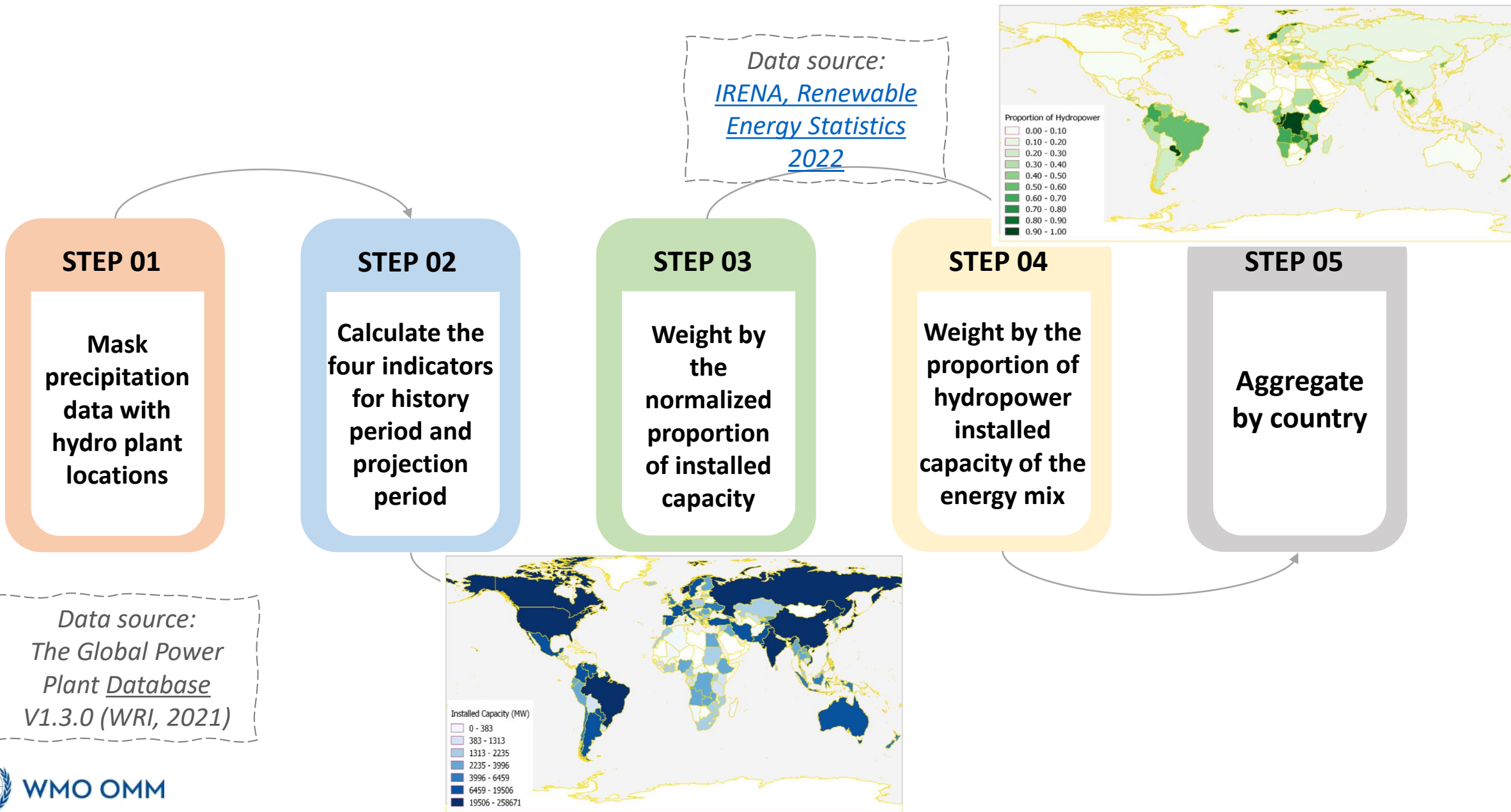
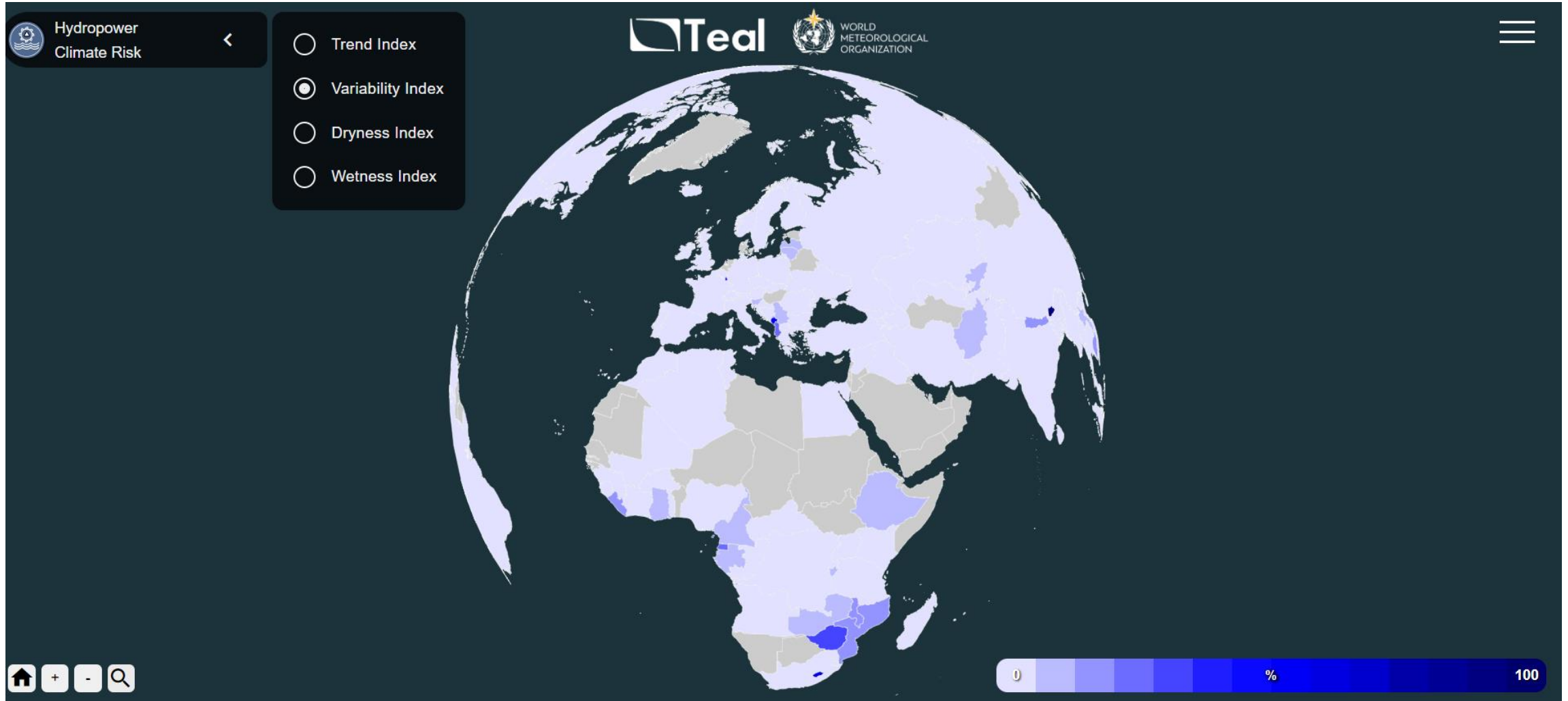


Fig: summary of the method used to calculate the four Hydro Risk Indices

WORKFLOW

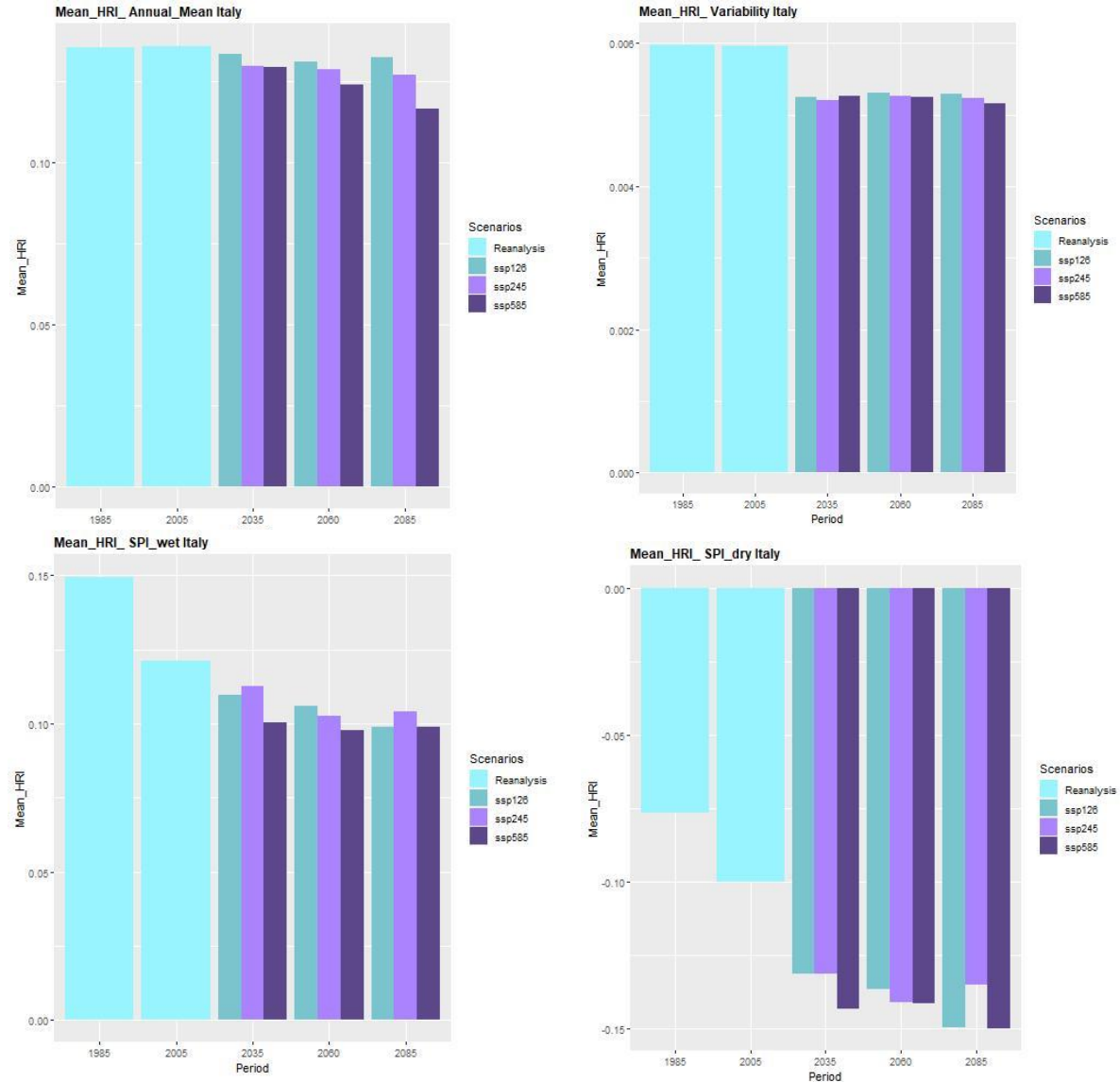


RESULT



RESULT

ITALY: With future decreased river run-off trend, based on 12 GCMs under A1B scenario (Hamududu and Killingtveit, 2012)



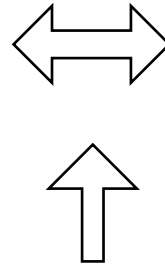
Hydro Risk Indices (HRI)

Mean Annual Precipitation

Precipitation Variability

SPI_wet

SPI_dry



Expected changes

Receive the same amount of rain in a shorter period of time or prolonged dry periods followed by persistent rain.

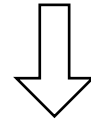
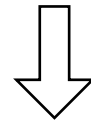
Hydro Risk Indices (HRI)

Mean Annual Precipitation

Precipitation Variability

SPI_wet

SPI_dry



Expected changes

Expect to have an established drought

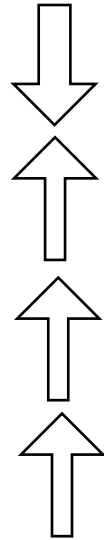
Hydro Risk Indices (HRI)

Mean Annual Precipitation

Precipitation Variability

SPI_wet

SPI_dry

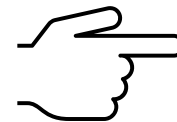


Expected changes

Expect mostly dry conditions but some flash floods

CONCLUSION

- This climate risk index for hydropower tool is designed to **inform decision-making at a country level**, by providing insight into the expected changes in precipitation patterns, and how this will impact each country according to their installed capacity and its reliance on hydropower generation.
- The ultimate product will be globally available as an open-access interactive map covering **solar, wind, and hydro**.
- Find out more about **WMO Climate and Energy Activities**.



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Thank you!

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