



Generative Modelling Challenge

Competition kick-off

2022, November 17th



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INTERNATIONAL



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The bank for a changing world



Chair Stress Test, Risk Management and Financial Steering

Inauguration : 2018, October 18th

Partners:



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FONDATION
ÉCOLE POLYTECHNIQUE



Organising committee



Michaël Allouche
Senior Quant-Product
Manager



Emmanuel Gobet
Professor



David Métivier
Research manager



Marine Saux
Project Manager

+ many people involved



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Experts



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Yann Drillet
Deputy
scientific director



Marie Drevillon
Head of evaluation of
analysis and
forecasting systems



Jean-Michel Lellouche
Oceanographer,
specialized in data
assimilation



Elisabeth Remy
Head of observations
for analysis and
forecasting systems



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Antoine Bezat
Head of Risk, STFS



Dorinel Bastide
Senior analyst Quantitatif



Jeremy Goh
Data scientist



Thibaut Malafosse
Data scientist



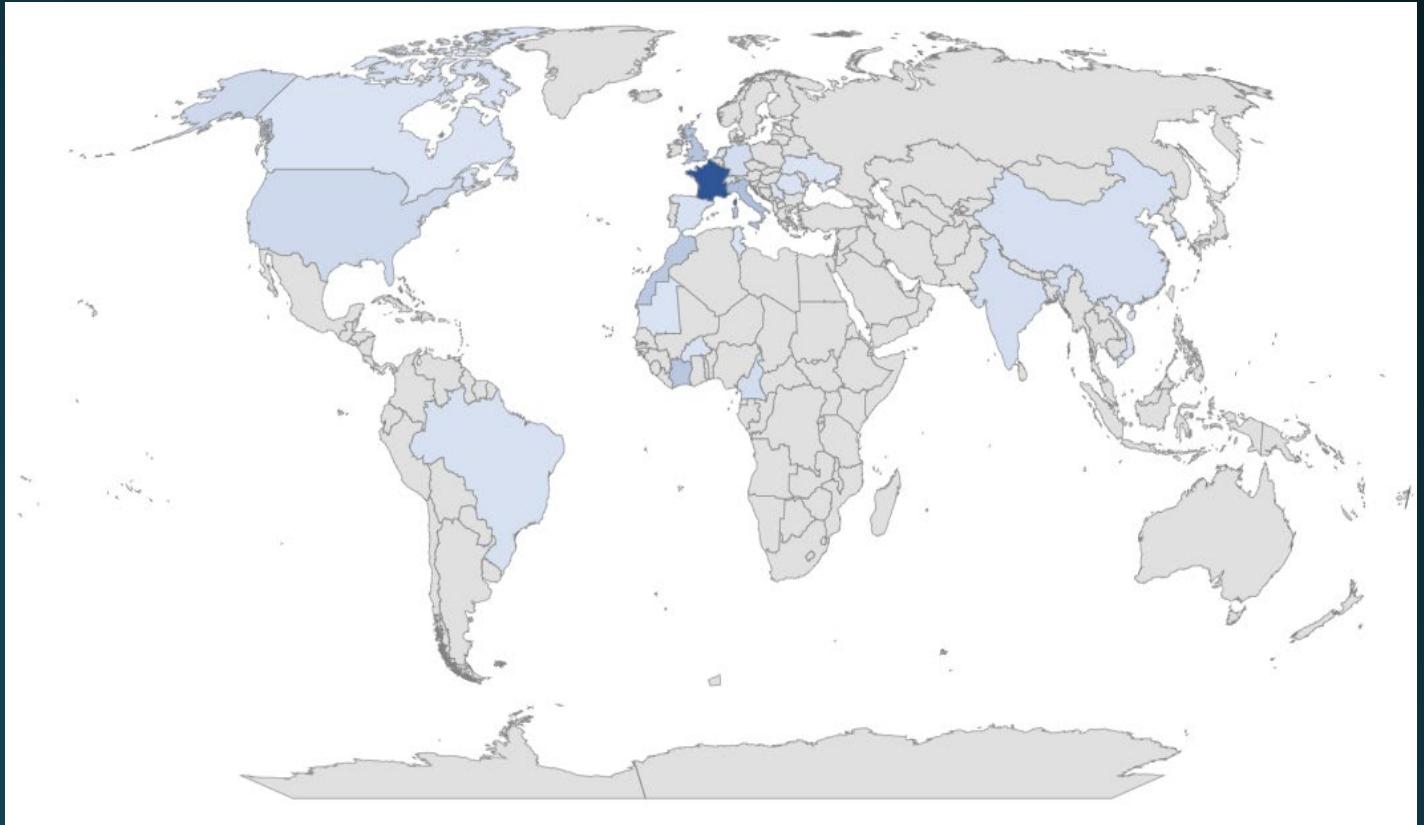
Goncalo Ribeiro Matos
Quantitative stress-testing analyst

Welcome to the Genhack Competition!

- 292 participants ! 

- 27 countries 

- 53 universities 





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Imene BEN REJEB-MZAH

Head of Climate Analytics and
Alignment Data Analytics

Physical Risk Modelisation



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Karina VON SCHUCKMANN

- Oceanographer specialised in ocean climate monitoring
- Lead Author of the Working Group 1 (Physical Risk) IPCC



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Lorena Moreira Mendez

- Project scientist



The Ocean & Climate

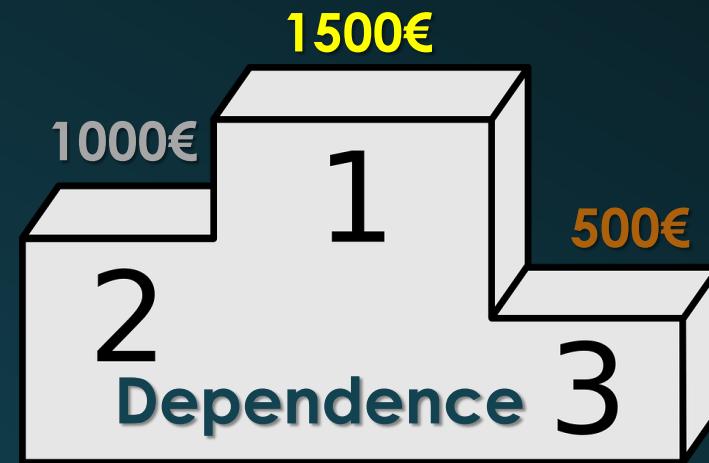


Competition Agenda

- **Thursday, November 17th** : Start of the competition
- First submission
 - not included in final ranking
 - **November 26th**, 11:59pm (Paris Time)
- Second submission
 - 1/3 of final ranking
 - **December 3rd**, 11:59pm (Paris Time)
- Third submission
 - 2/3 of final ranking
 - **December 17th**, 11:59pm (Paris Time)

Final ranking and prizes

A scoreboard for the 2 metrics : Marginal and Dependence



A team could win the monetary prize for both rankings!

All winning guilds will be invited to an exclusive event!
A participating certificate for all participants!

Generative Modelling Challenge

Kickoff: Modelisation

Michaël Allouche

2022, November 17th



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Modelisation

Motivations. Collecting temperatures with ocean sensors (*stations*) on a fine mesh is too expansive and enriching the possible scenarios in the context of global warming is of major importance.

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Data. Daily Sea Surface Temperature (SST) in Kelvin at [6 stations](#):

- Train: 1981-09-01 to 2007-12-31 ([9618 days](#))
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(drawn at random during the year) with **spatial dependence** between stations.

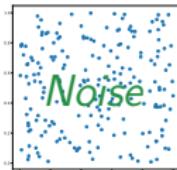
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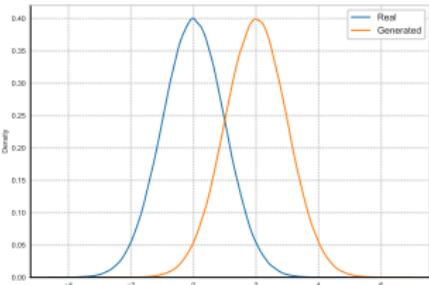
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Generator





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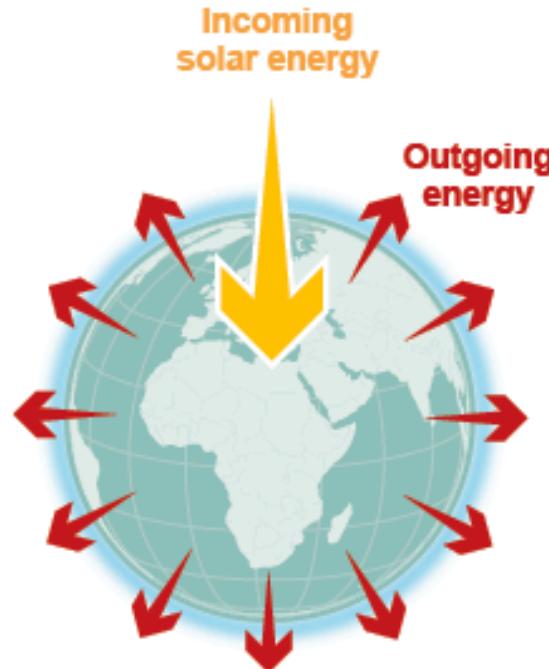
The ocean in climate change

Lorena Moreira, Karina von Schuckmann, Muriel Lux
Kickoff GenHack2 data challenge

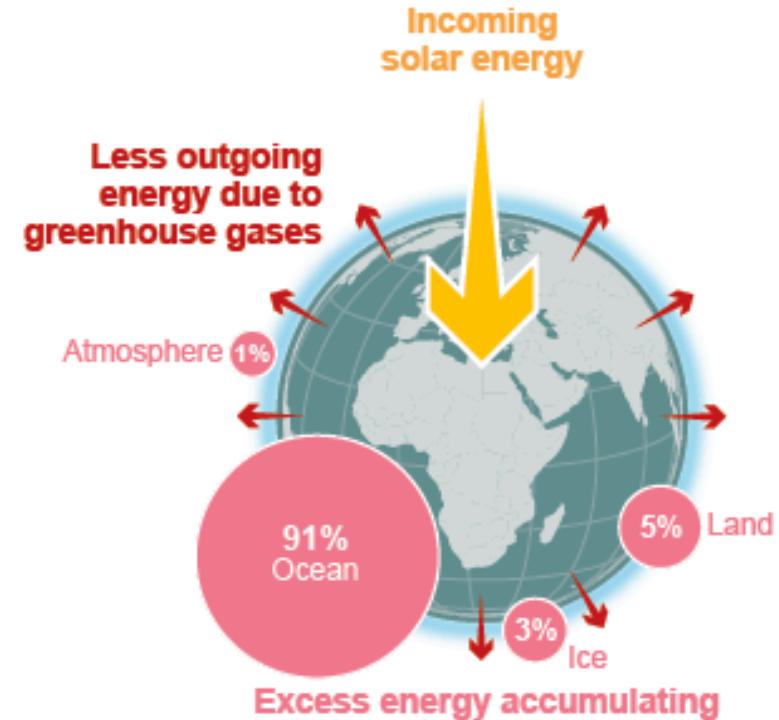
Ocean warming

Due to anthropogenic GHG emission, the Earth is out of energy balance, and the Earth climate system is gaining heat

Stable climate: in balance



Today: imbalanced

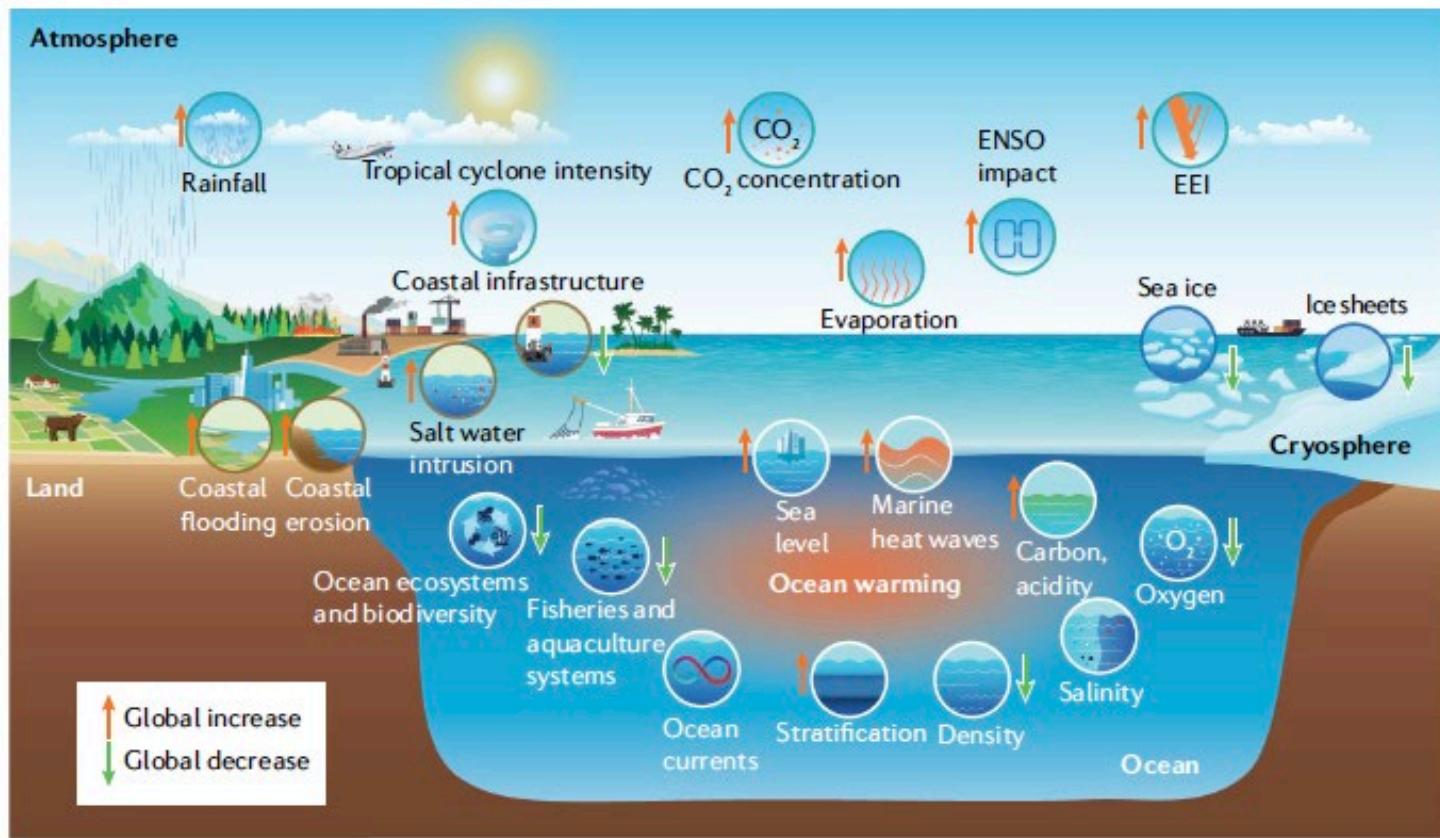


As a consequence, the global ocean is warming

IPCC, AR6, Chapter 7, FAQ1

Implications of ocean warming

Wide-reaching impacts of surface to subsurface ocean warming for the environment, society and economy – the three pillars of sustainable development

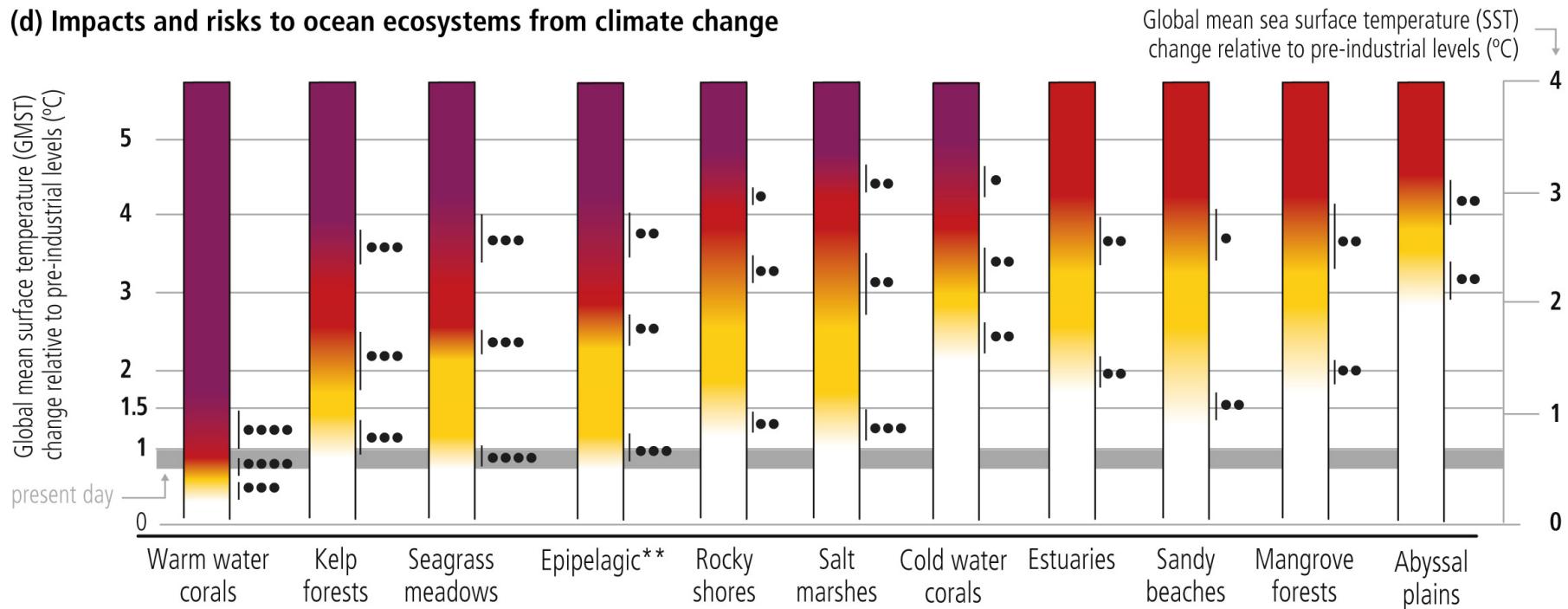


Cheng, von Schuckmann et al., 2022

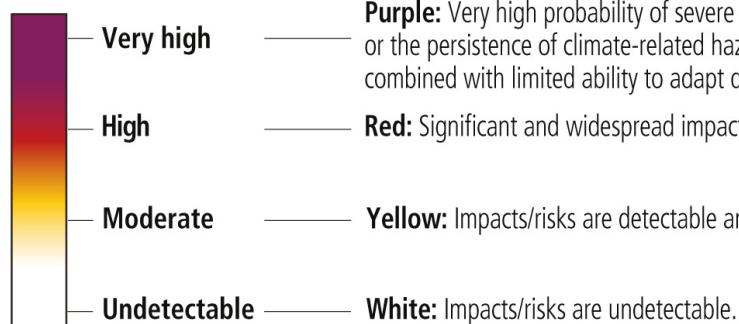
→ need to continuously improve our capabilities to monitor, understand and predict the ocean

Risk & impacts to the ocean from climate change

(d) Impacts and risks to ocean ecosystems from climate change



Level of added impacts/risks



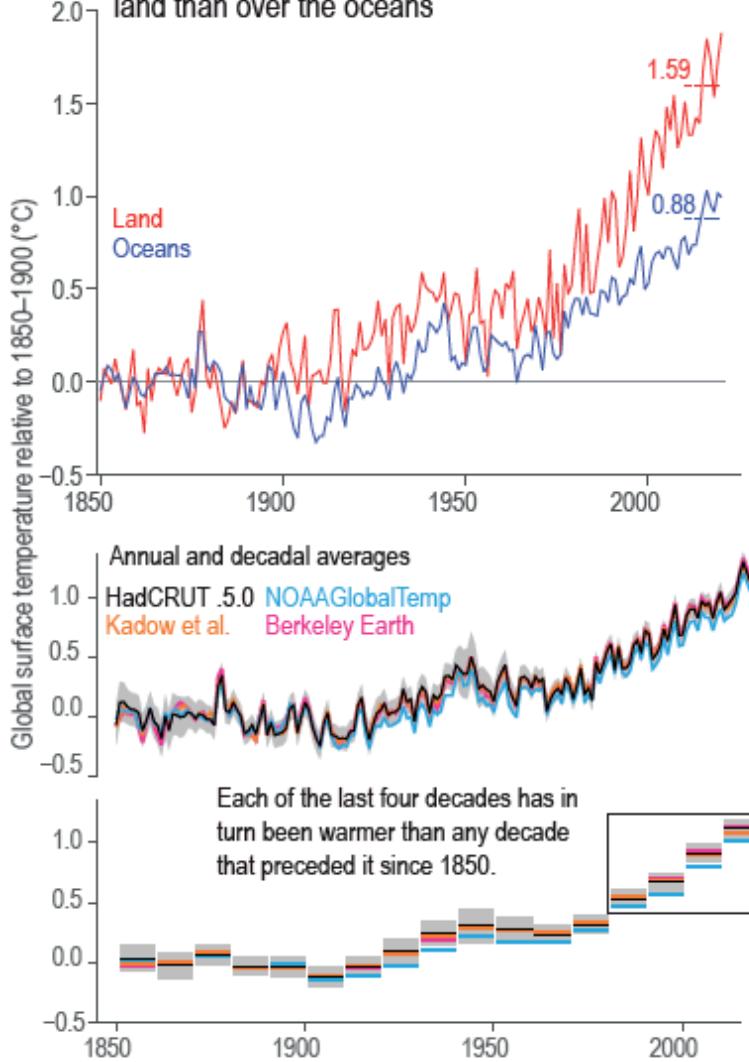
Confidence level for transition

- = Very high
- = High
- = Medium
- | = Transition range

**see figure caption for definition

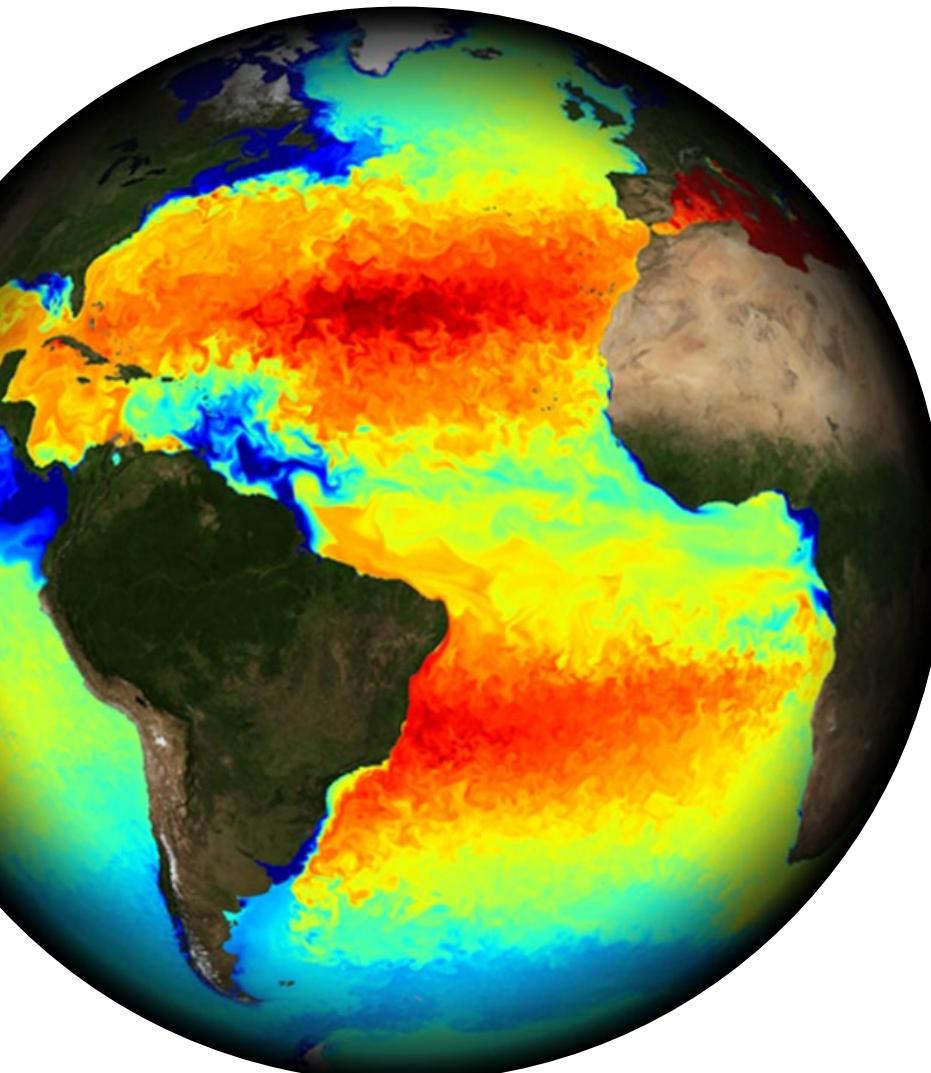
The role of ocean temperature

(c) Temperatures have increased faster over land than over the oceans



Global Mean Surface Temperature (GMSL) – a key indicator for global warming

- As by 2019, global warming has reached 1.1°C
- Ocean's Sea Surface Temperature: a major contributor for assessing the state and evolution of global warming - 71% of Earth's surface is covered by the ocean
- Indicator provides insight into the role of the global ocean mitigating global warming



A Global Ocean Prediction Centre

Marine modelling scientists and operational forecasters
Toulouse, France

A non-profit service organization born 25 years ago owned by public institutions

CMCC – CNR – CNRS – IFREMER – IRD – Météo-France – Met Office – NERSC – Puertos del Estado – SHOM



With bilateral partnerships

ECCC, **DFO** / Canada; NMEFC, China



With strong European Union mandates

EU Operations: Copernicus

EU Blue Diplomacy: G7 and GEO



Contributing to UN initiatives

UNESCO-IOC, UNEP, IPCC

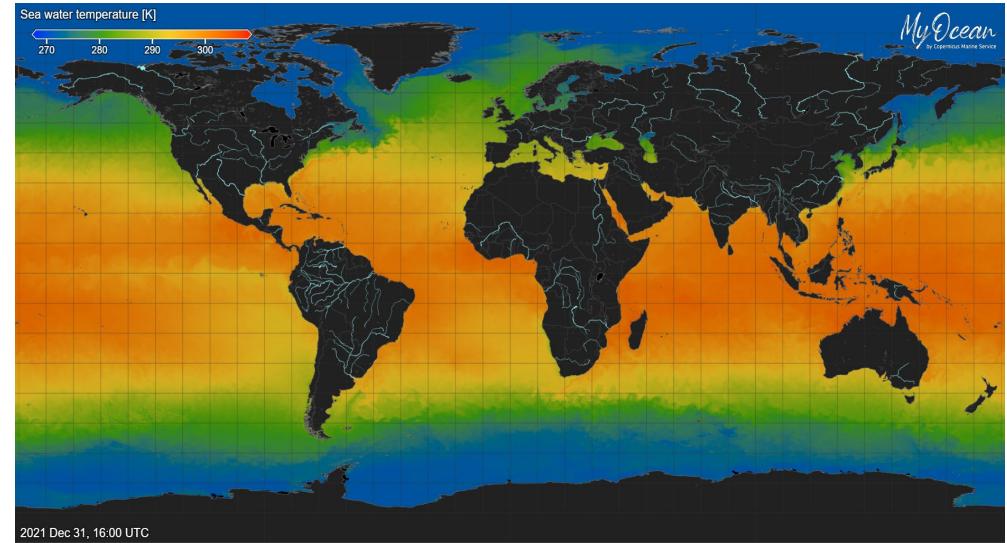
now under transformation into an intergovernmental organisation focused on digital oceanography

Mercator Ocean International is increasingly mobilised on the development of capacity-building actions through sharing scientific & technical expertise across different channels



- The GENHACK 2 – Hackathon for generative modelling will be based on Copernicus Marine data provided by Mercator Ocean International in order to test AI methods which are of particular interest in the context of the Digital Ocean Mercator Ocean is building.
- The involvement of worldwide teams of students as new users of the Copernicus Marine data is also part of the Mercator Ocean objectives.

- Sea surface temperature (SST) is an essential climate variable defined by GCOS
- SST has been measured in situ for over 150 years, and in recent decades derived from Earth-orbiting satellites which complement the in situ network, providing finer and more complete spatio-temporal sampling
- Target applications of the SST data record include:
 - climate and ocean model testing and development;
 - quantification of marine change and variability (including marine heatwaves);
 - climate and ocean-atmosphere processes;
 - and specific applications in ocean ecology, oceanography and geophysics



source: [ESA SST CCI and C3S reprocessed sea surface temperature analyses | Copernicus Marine MyOcean Viewer](#)

SST data for the GENHACK 2 - HACKATHON FOR GENERATIVE MODELLING:

- Copernicus Marine global SST reprocessed product is created using data from OSTIA (Operational SST and Sea Ice Analysis) system from re-processed satellite data as part of the ESA SST CCI and C3S projects
- Daily average SST at 20 cm depth from 1 September 1981 to 31 December 2021
- Global regular grid at 0.05° (approx. 5 km) resolution
- Data can be openly accessed through Copernicus Marine Service implemented by Mercator Ocean international

PHYSICAL CLIMATE RISK

HARNESSING GEO-SPATIAL ANALYSIS TO THE SERVICE OF
CLIMATE RISK ASSESSMENT

IMÈNE BEN REJEB-MZAH

GROUP CSR

PARIS, 17 November 2022



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EXTREME WEATHER EVENTS BECOME MORE FREQUENT AND/OR MORE ACUTE DUE TO CLIMATE CHANGE

CLIMATE

The New York Times

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INEQUALITY AT THE BOILING POINT

A Quarter of Bangladesh Is Flooded. Millions Have Lost Everything.

The country's latest calamity illustrates a striking inequity of our time: The people least responsible for climate change are among those most hurt by its consequences.

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FRANCE 24

EN DIRECT

ELECTIONS DE MI MANDAT #UKRAINE #ISRAEL FRANCE AFRIQUE REPORTAGES EMISSIONS STOP L'INFO

Inondations dans le Sud-Est : le bilan s'alourdit en appui des secours

20:20 Modifié le : 05/10/2020 - 20:24



Sur les rues de Breil-sur-Roya, le 5 octobre 2020. AFP - VALERY HACHE

WFP SAVING LIVES CHANGING LIVES

WHO WE ARE OUR WORK WHERE WE WORK GET INVOLVED MEDIA & RESOURCES DONATE

Horn of Africa drought: Late rains in Ethiopia, Kenya and Somalia are inflaming hunger, warns WFP

Horn of Africa drought: Late rains in Ethiopia, Kenya and Somalia are inflaming hunger, warns WFP

The World Food Programme urgently needs US\$437 million to respond and save lives in the region over the next six months

19 April 2022, Gemma Snowdon

Somalia Kenya Ethiopia



Agnes, a farmer, inspects a canal installed as part of a WFP-backed irrigation project in Kalemriyang, Turkana County. Photo: WFP/Arete/Fredrik Lerneryd



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PHYSICAL CLIMATE RISK IS THE RISK DUE TO PHYSICAL EFFECTS OF CLIMATE CHANGE.

risk =

f (hazard, exposure, vulnerability)

adverse
consequence
hitting the
asset

June 2013: 5,700
casualties, 10 hydroelectric
dams destroyed
(Uttarakhand, India)

f(magnitude,
likelihood)

~3.75
monsoons in
3 days

f(asset geolocation)
supply chain

dams along the
Gange & other rivers
that burst their banks

f(sensitivity,
resilience)

vulnerable
infrastructure, built in
fragilized catchment
areas.
unprepared to floods of
this magnitude



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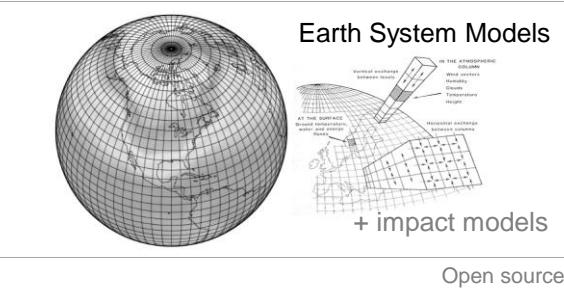
PHYSICAL RISKS ASSESSMENT POC ON THE POWER GENERATION PORTFOLIO

Project aim:

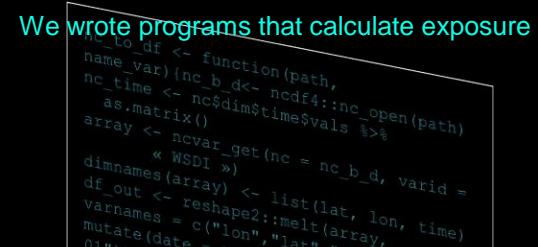
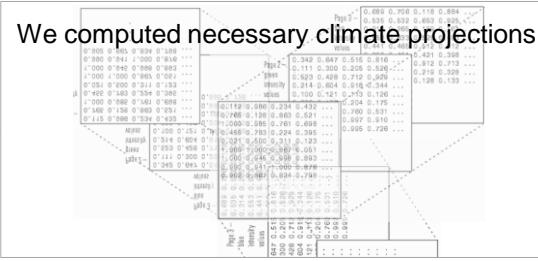
to perform a transparent & auditable study of the **exposure of every single power asset** owned by a BNP client **to the extreme weather events worsened by climate change**

COMPUTATION

Where we got data from



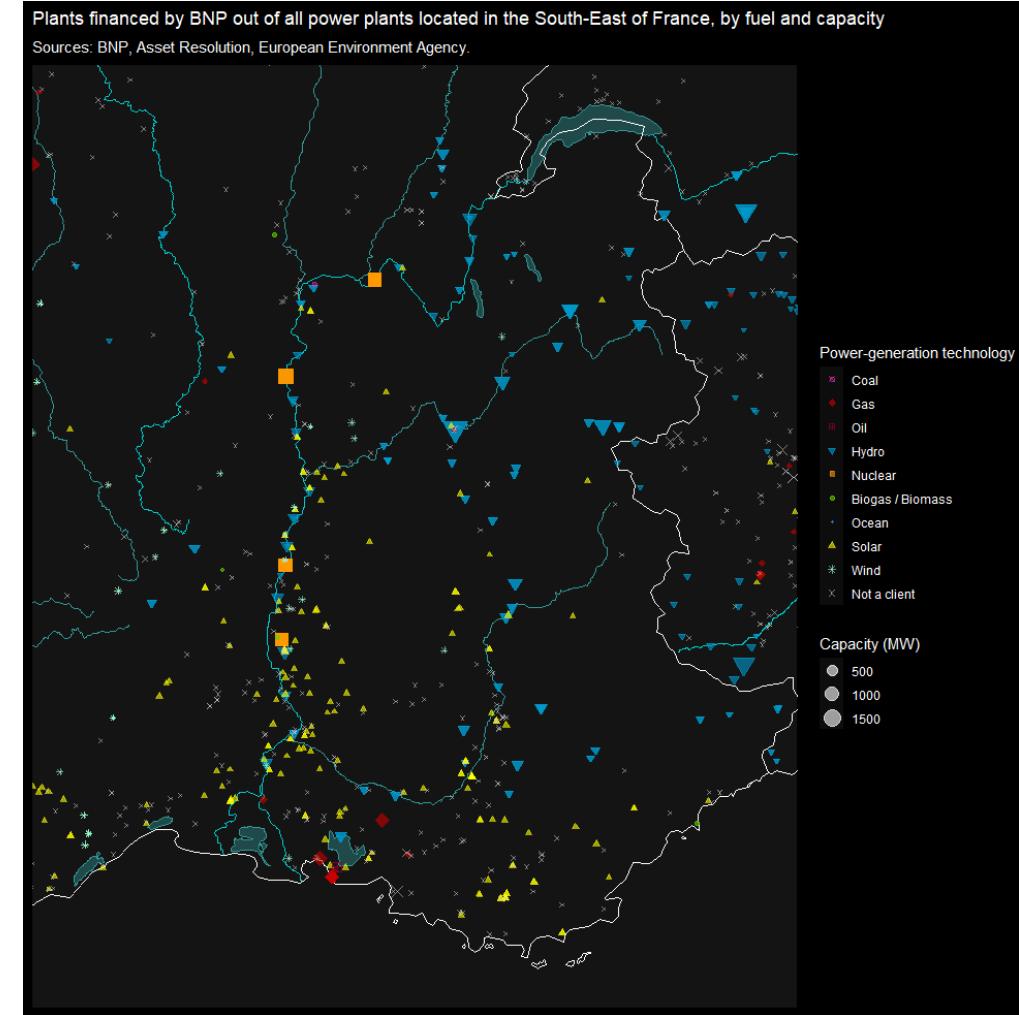
What we did with it



POWER ASSETS DATASET

Scope

- worldwide power-generation capacity: 110k plants
 - of which: XX financed by BNP Paribas



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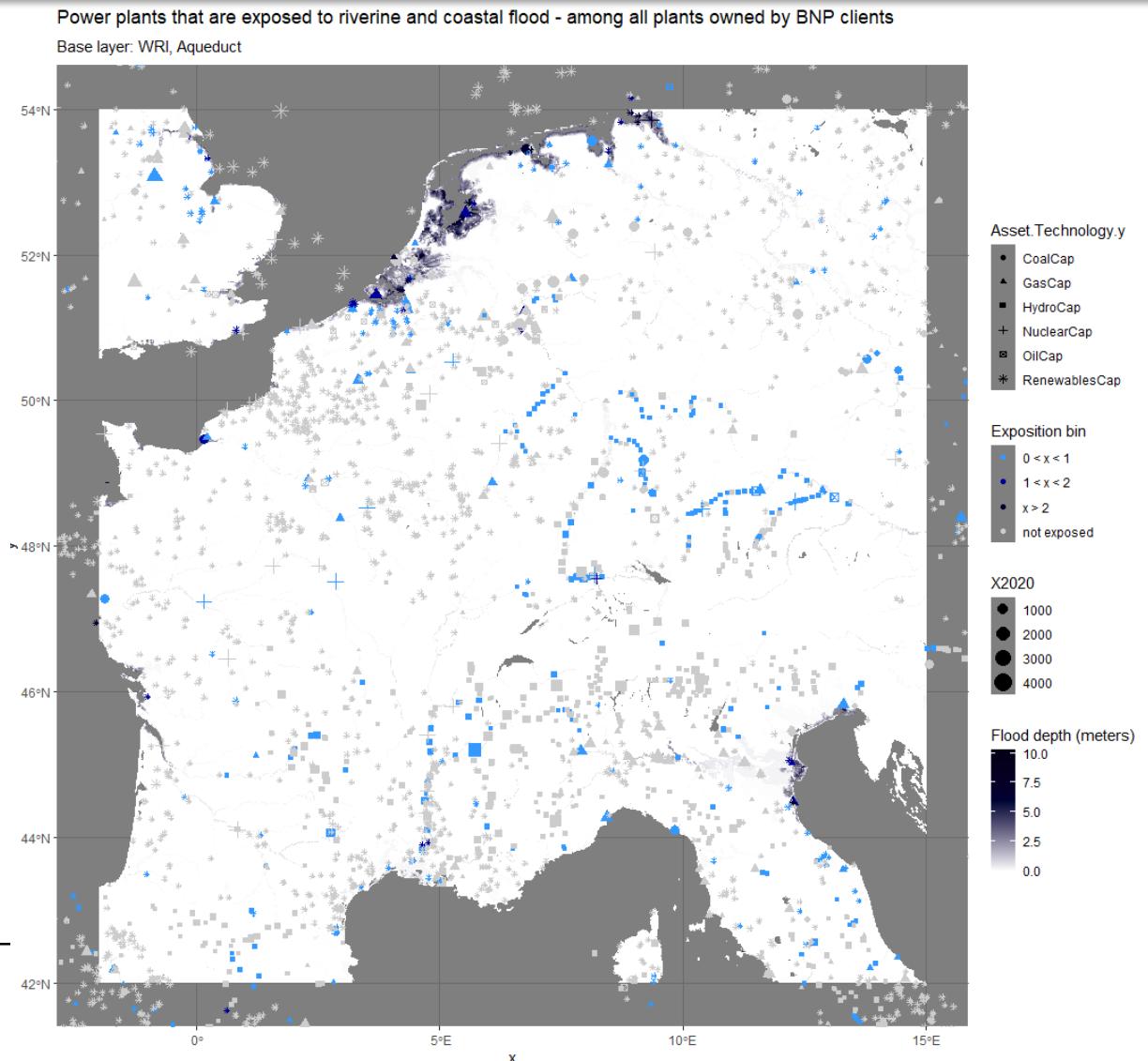
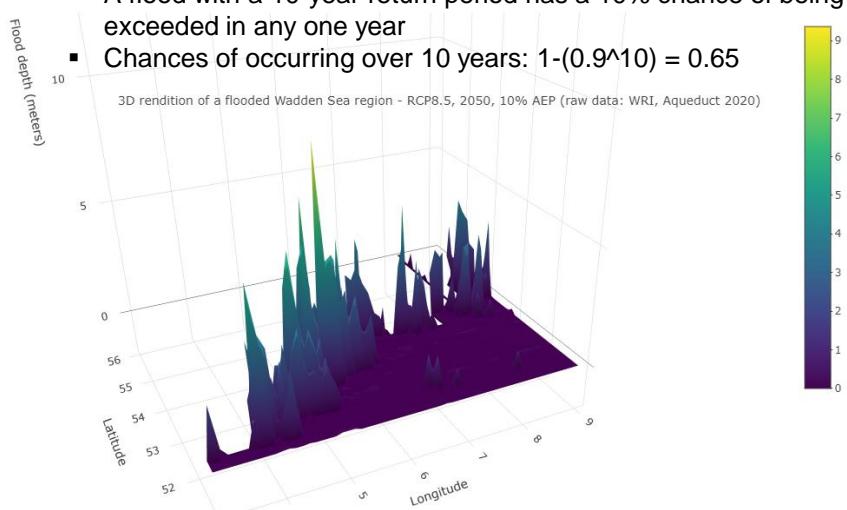
15 November 2022

6

WRI'S AQUEDUCT: 880 ITERATIONS ACROSS 5 DIMENSIONS, EACH ~1BN CELLS

A consortium led by WRI, bolstered by Dutch research labs and funded by the Dutch administration and the World Bank undertook the most ambitious effort to date to coastal & riverine flood globally

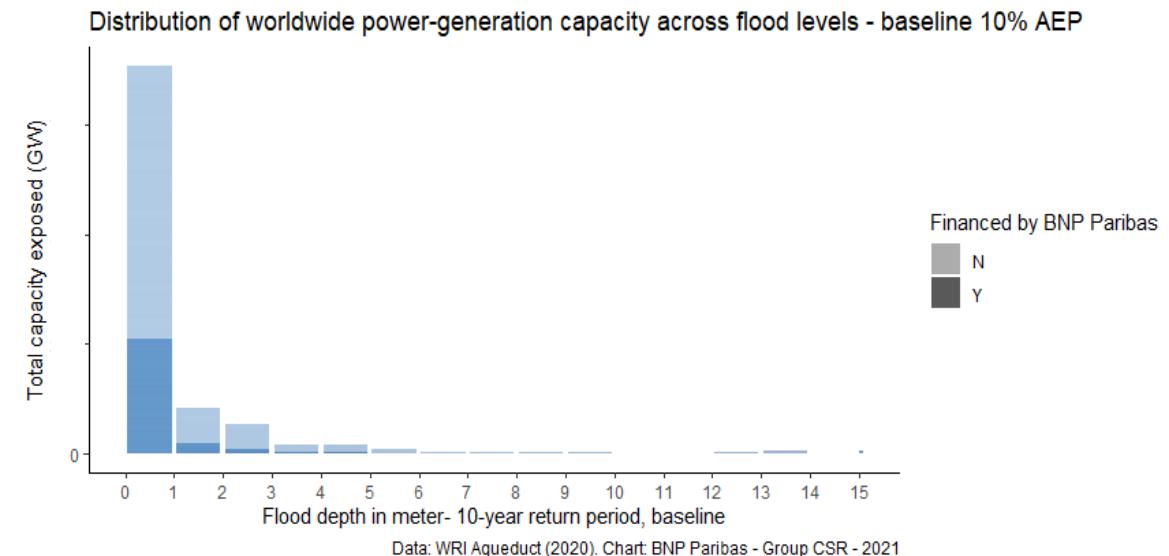
- WRI Aqueduct Floods: a global flood map to render the “influence of natural climate variability and climate change on flood risk”
 - Research consortium: WRI, Utrecht University, PBL (Netherlands Environmental Assessment Agency, and more
 - Used (among others) **C-MIP projections**, weather models, and a global hydrological model with a **river and floodplain routing scheme** to make long-term simulations of flood levels for several climate conditions
 - 2 scenarios: RCP 4.5, RCP 8.5
 - Spatial resolution: 30 arc-seconds \approx 900 meters (\sim 1bn cells/map)
 - 4 horizons: baseline, 2030, 2050, 2080
 - Coastal & riverine flood
 - 10 return periods: we used 10-year (10% AEP) and 250-year (0.4% AEP)
 - A flood with a 10-year return period has a 10% chance of being exceeded in any one year
 - Chances of occurring over 10 years: $1 - (0.9^{10}) = 0.65$



BNPP-FINANCED CAPACITY FLOOD RISK -BASELINE

Under the baseline computed using historical observations, 18.5% of worldwide power-generating capacity has a 10% chance of being flooded each year – at the levels shown below:

- YY of BNP-financed capacity is exposed to 10% AEP flood risk
 - corresponding (when spreading a client's loan across its assets based on capacity) to ZZ % of total € exposure



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TAKEAWAYS

- Multi-dimensional climate projections and data from impact models (e.g. flood maps) are freely available and will remain so
- Using those, we can calculate the change in exposure of physical assets worldwide to climate hazards, across space, time, scenarios, etc.
- Physical-units results centered on the climate part of the equation tackle generic risk ahead of financial-risk assessments
- Future research on vulnerability & the financial impact on each asset will have to heed past learnings on the underestimation of the economic impact of climate change



Thanks for your time.
If you have any questions or remarks, please do [get in touch](#).



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