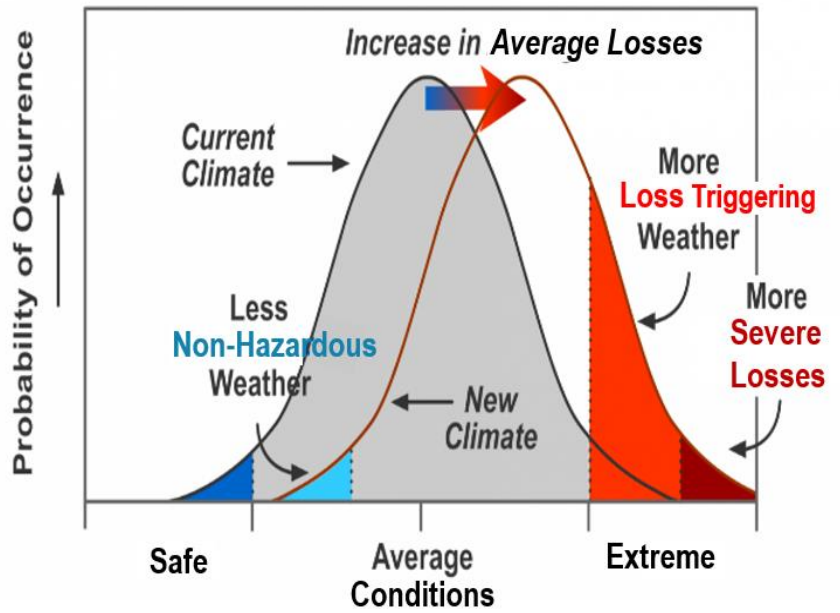
INDUSTRY AND SCIENCE PULLING TOGETHER FOR A SUSTAINABLE PROTECTION OF YOUR COMPANY UNDER AGGRAVATED HAZARDS FORCED BY CLIMATE CHANGE – CAN WE ACHIEVE THAT?



Christoph Matulla, Katharina Enigl, Audrey Macnab, Philip Evans, Gavin Rosner

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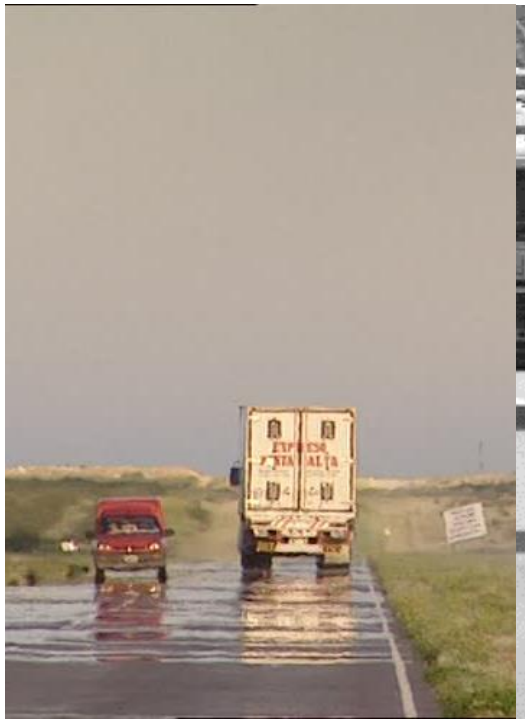
ROAD TRANSPORT

ROAD TRANSPORT

High temperatures



ROAD TRANSPORT

- Snowfall and low temperatures
- High temperatures

ROAD TRANSPORT

- Snowfall and low temperatures
- High temperatures
- Storm/Wind gusts

ROAD TRANSPORT

Snowfall and low temperatures

Heavy precipitation - Floodings

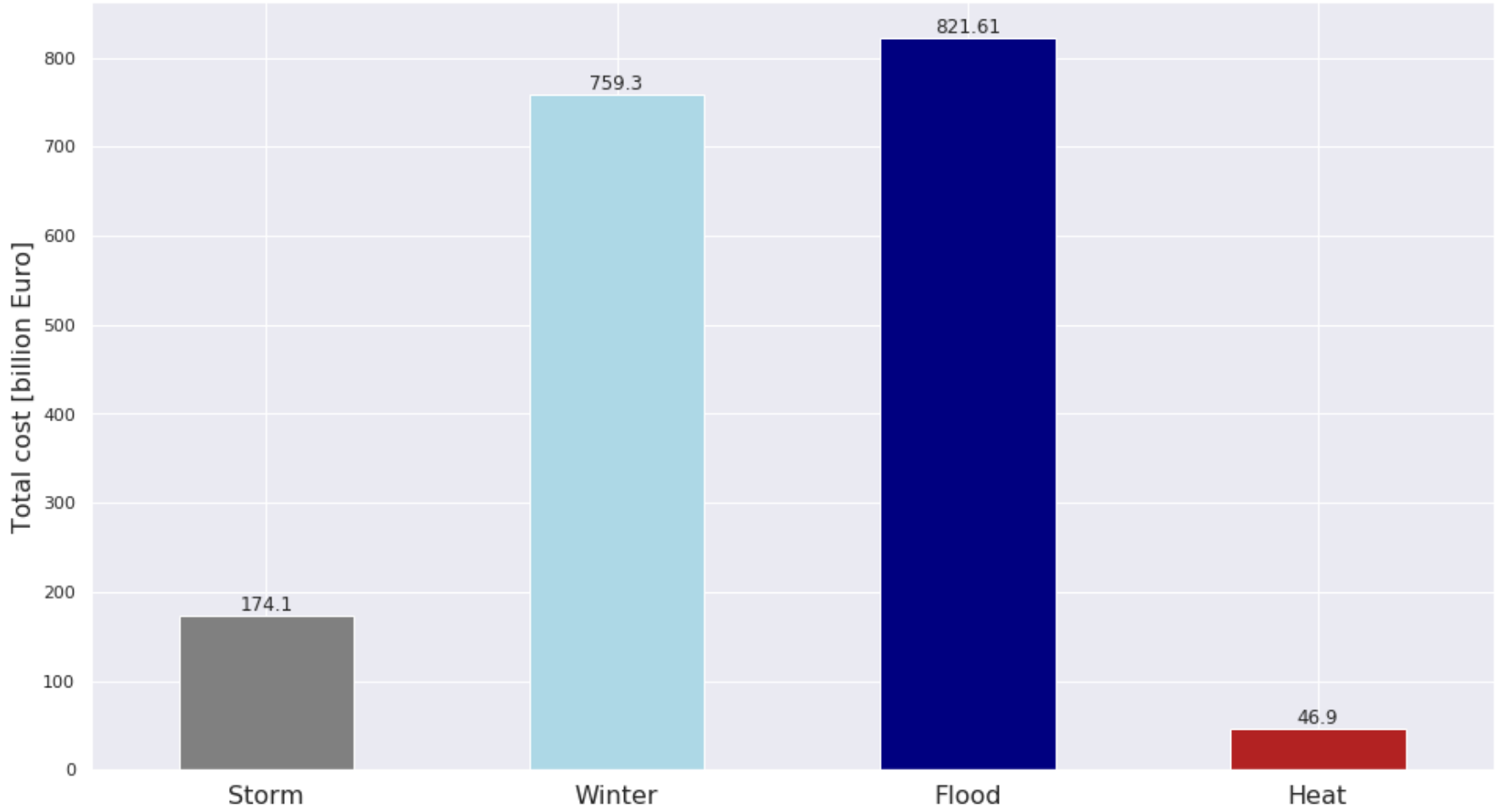
High temperatures

Storm/Wind gusts

ROAD TRANSPORT

- Snowfall and low temperatures
- Heavy precipitation - Floodings
- High temperatures
- Storm/Wind gusts
- Bad visibility - fog

ROAD TRANSPORT – AVERAGE ANNUAL COSTS 2000 - 2010 CAUSED BY EXTREME EVENTS



Enei et al, 2010

INLAND SHIPPING

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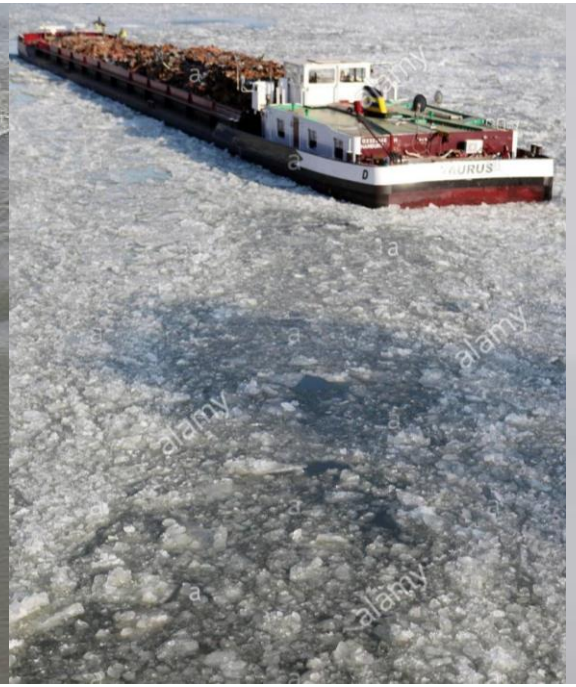
Heavy precipitation – high water

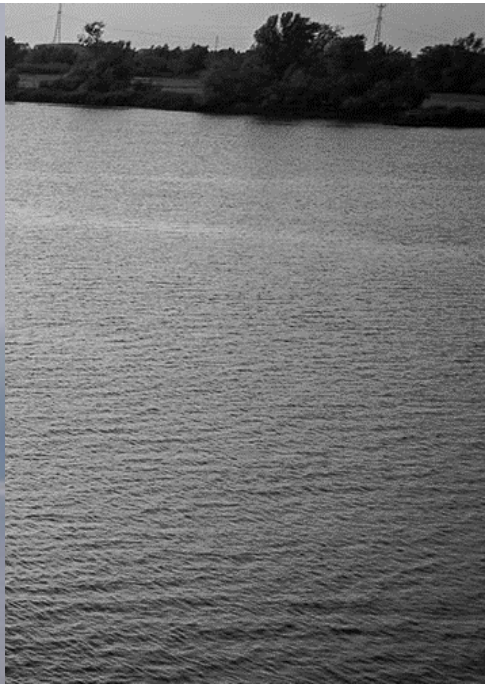
INLAND SHIPPING

- Heavy precipitation – high water
  - Temperatures below 0°C

INLAND SHIPPING

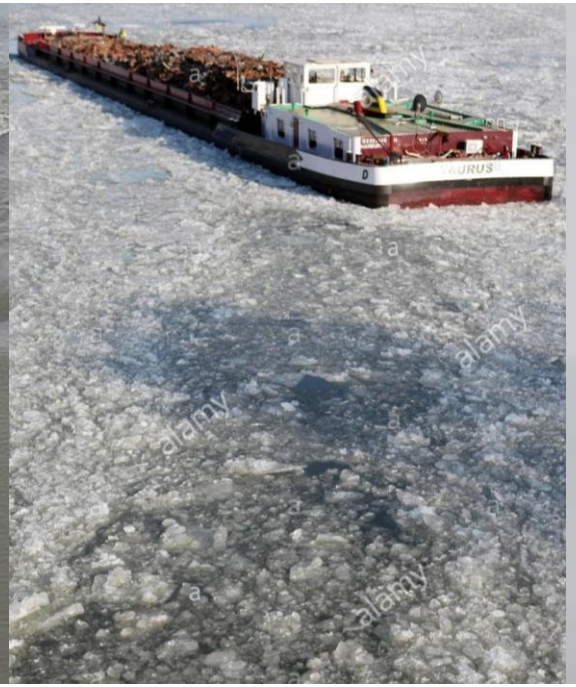
- Heavy precipitation – high water
- Fog
- Snow and temperatures below 0°C

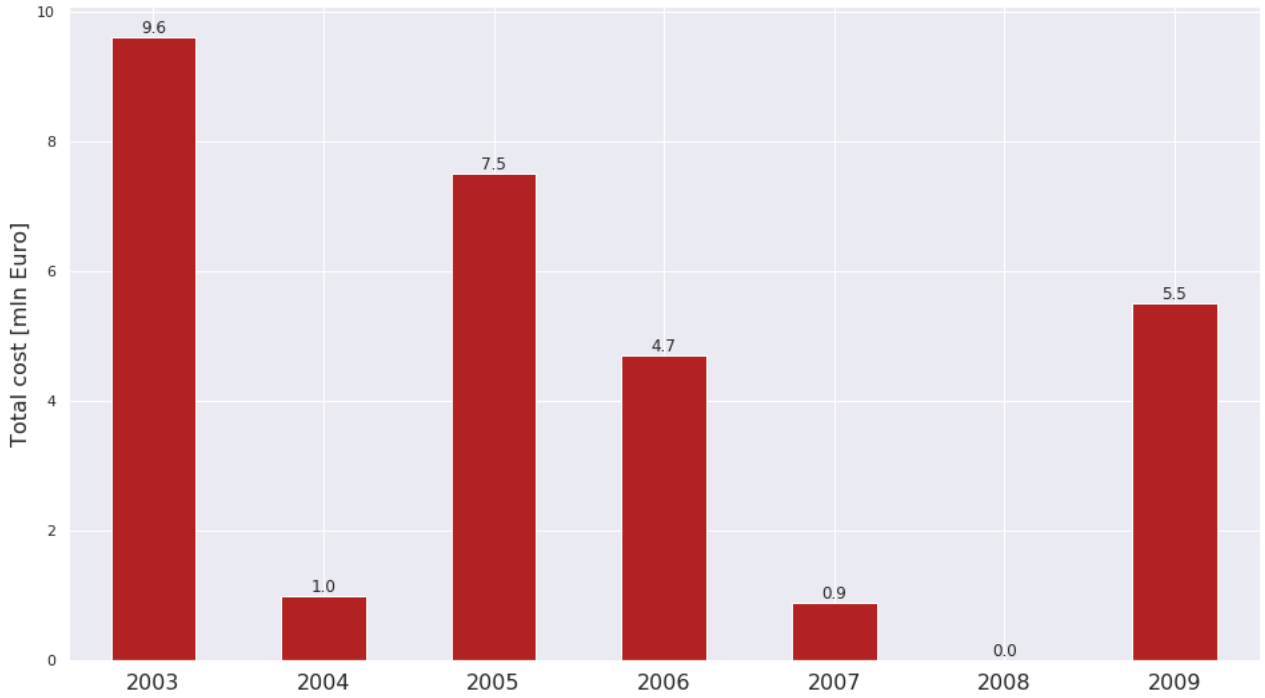


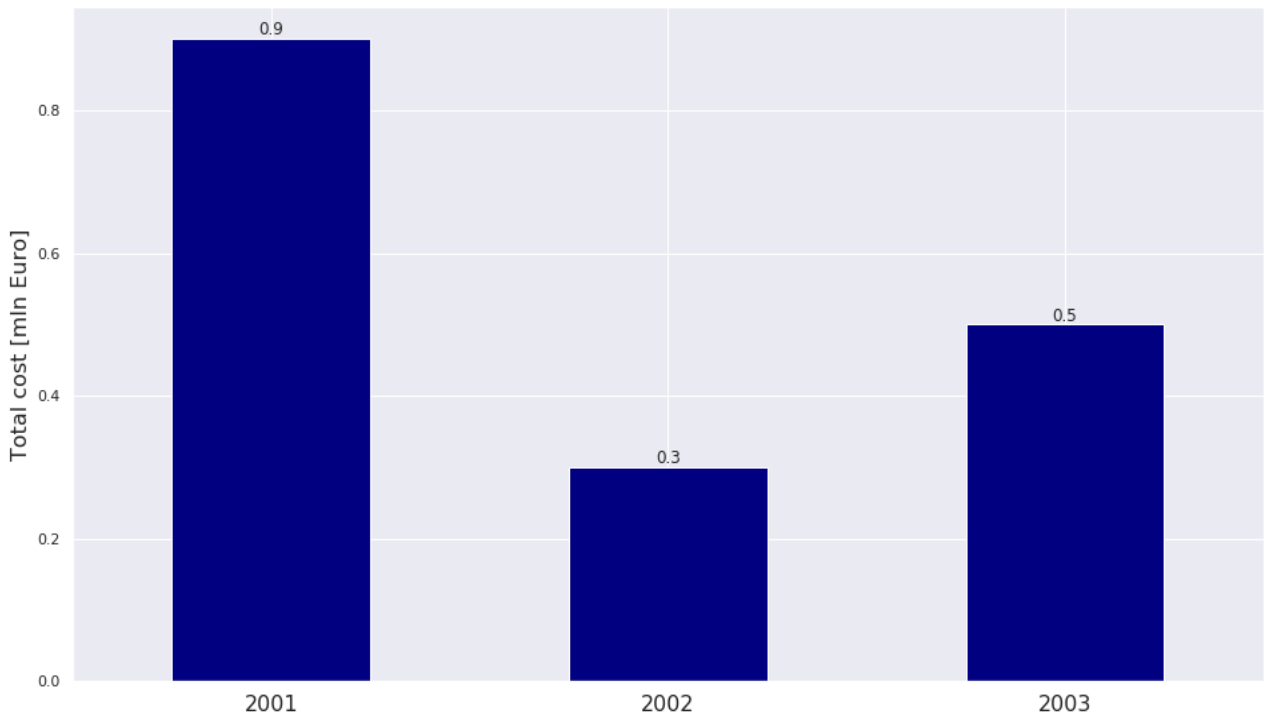
INLAND SHIPPING

- Heavy precipitation – high water
- Fog
- Snow and temperatures below 0°C
- Heat / drought

INLAND SHIPPING – TOTAL COSTS DUE TO DROUGHTS AND FLOODS IN KAUB AREA





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RAIL TRANSPORT

RAIL TRANSPORT

- Snowfall and low temperatures

RAIL TRANSPORT

- Snowfall and low temperatures
  - Heavy precipitation – Floods and landslides

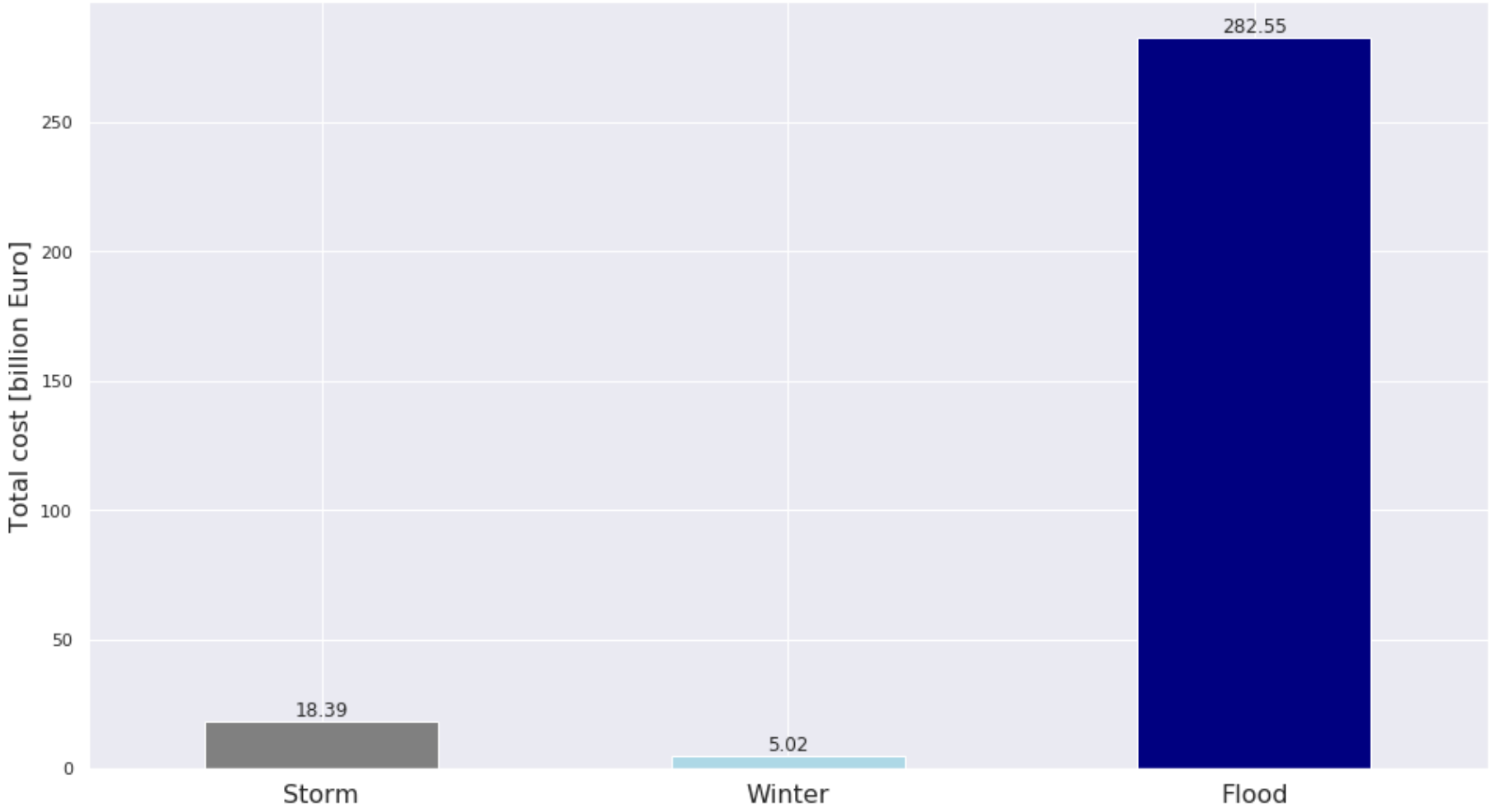
RAIL TRANSPORT

- Snowfall and low temperatures
- Storm / Wind gusts
- Heavy precipitation – Floods and landslides

RAIL TRANSPORT

- Snowfall and low temperatures
- Storm / Wind gusts
- Heavy precipitation – Floods and landslides
- Heat

RAIL TRANSPORTS – ANNUAL COSTS 1998 – 2010 CAUSED BY EXTREME EVENTS



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MARITIME SHIPPING

MARITIME SHIPPING

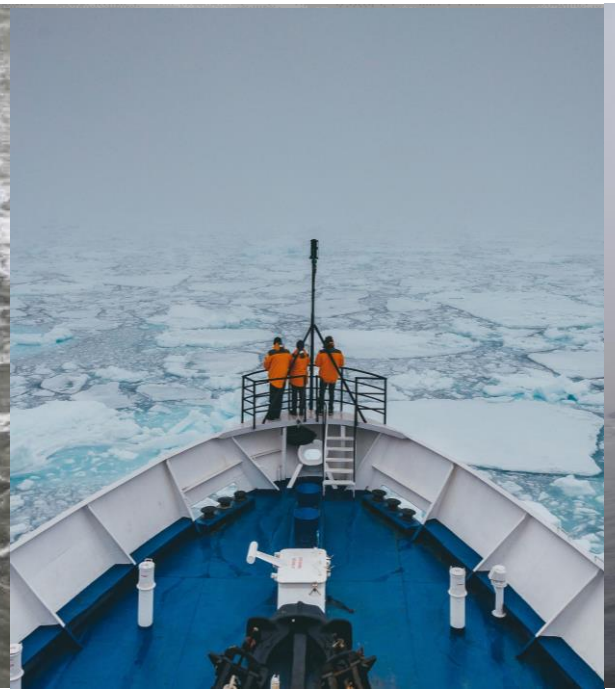
Storm and waves

MARITIME SHIPPING

- Storm and waves
  - Low temperatures

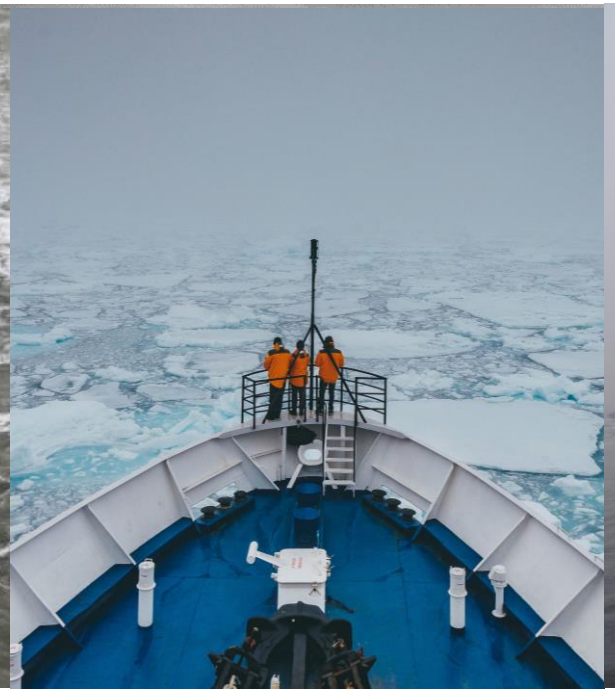
MARITIME SHIPPING

- Storm and waves
- Fog
- Low temperatures

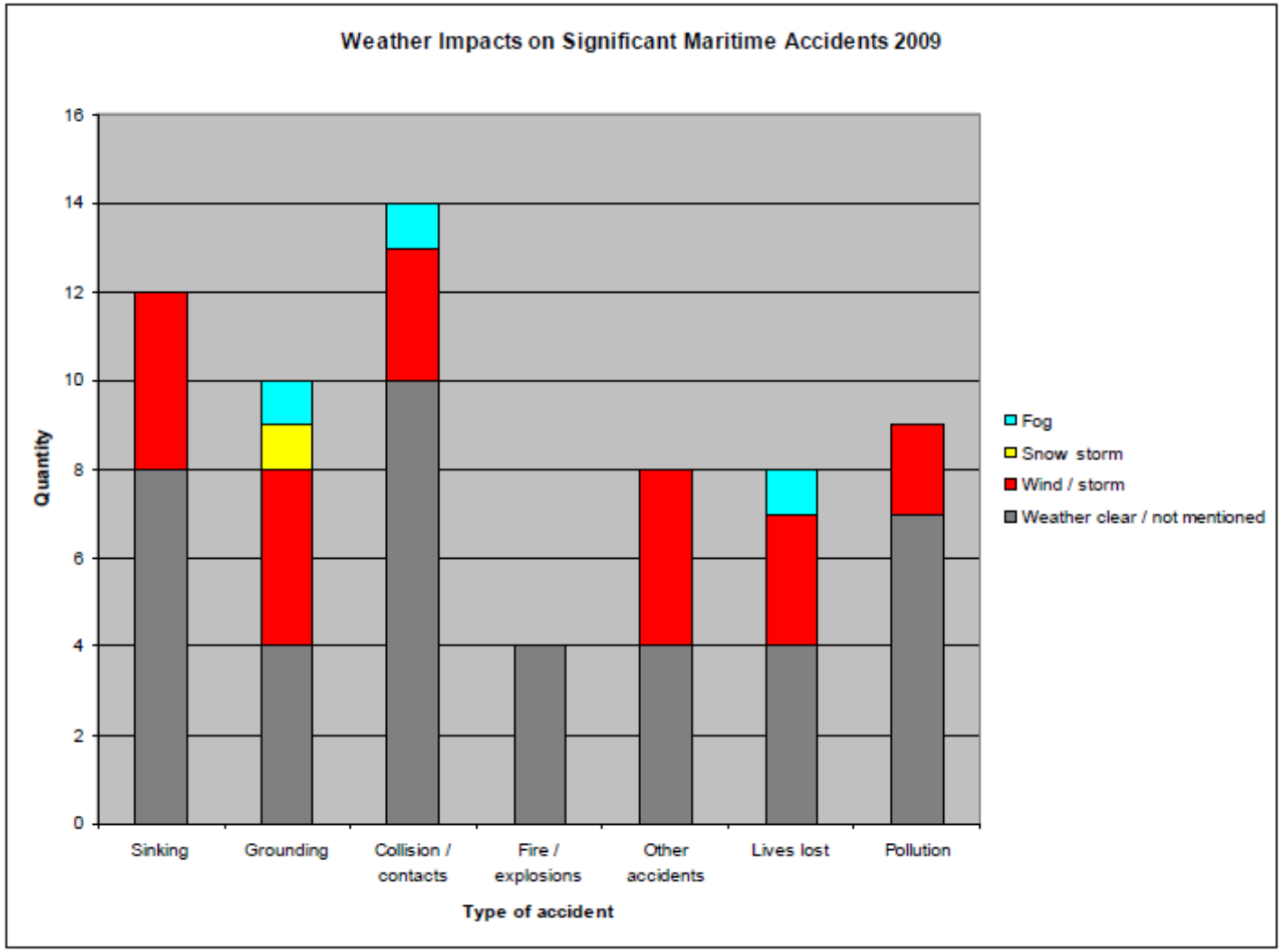


MARITIME SHIPPING

- Storm and waves
- Low temperatures
- Fog
- Snow storms



MARITIME SHIPPING – SOME NUMBERS



European Maritime Safety Agency (EMSA), 2010,

PORTS

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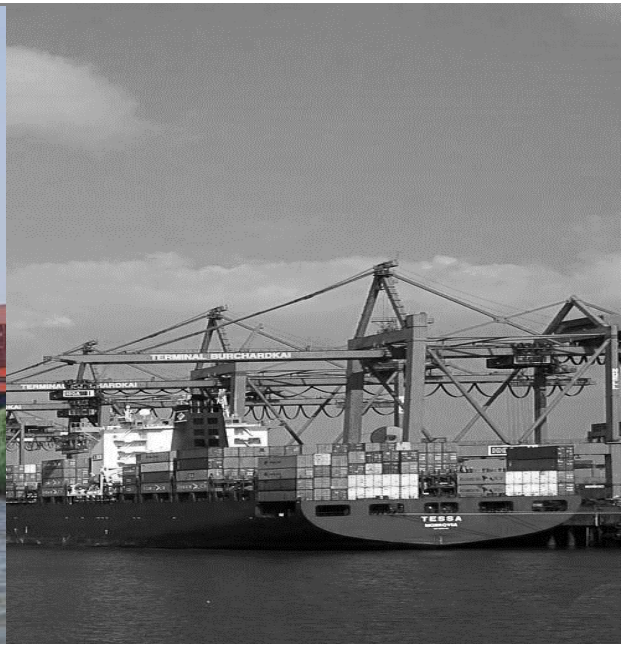
PORTS

Fog

PORTS

- Fog
- Storms

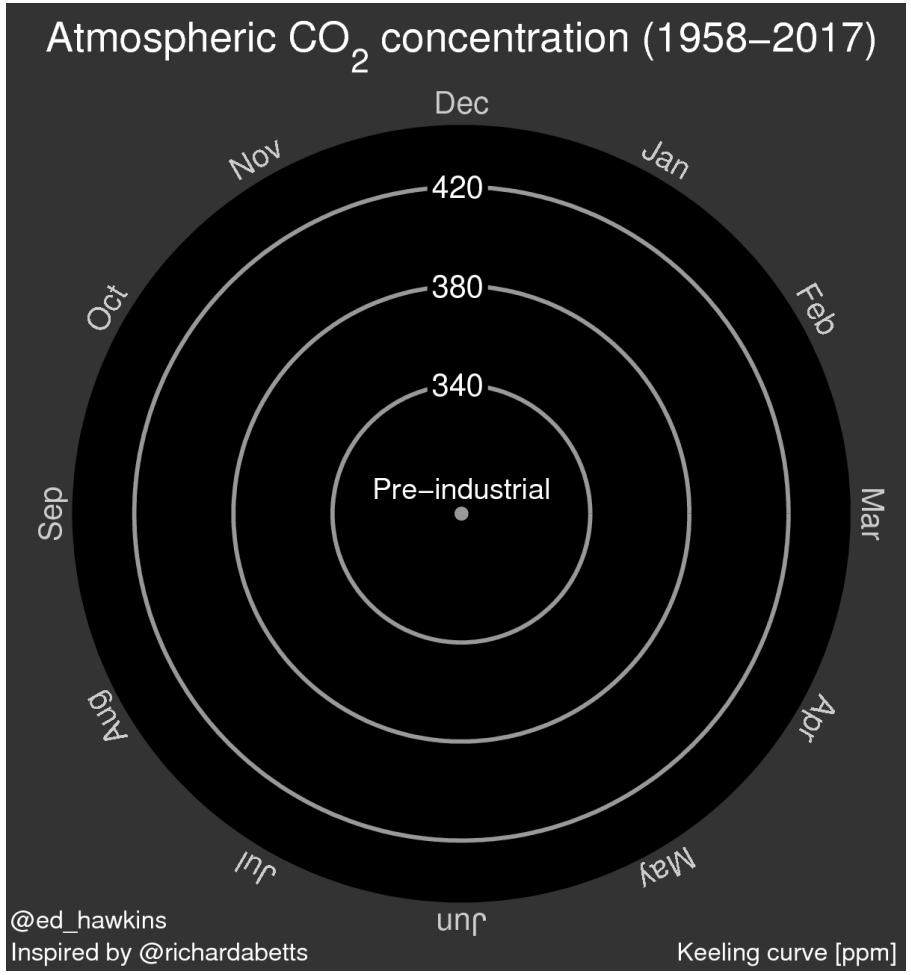


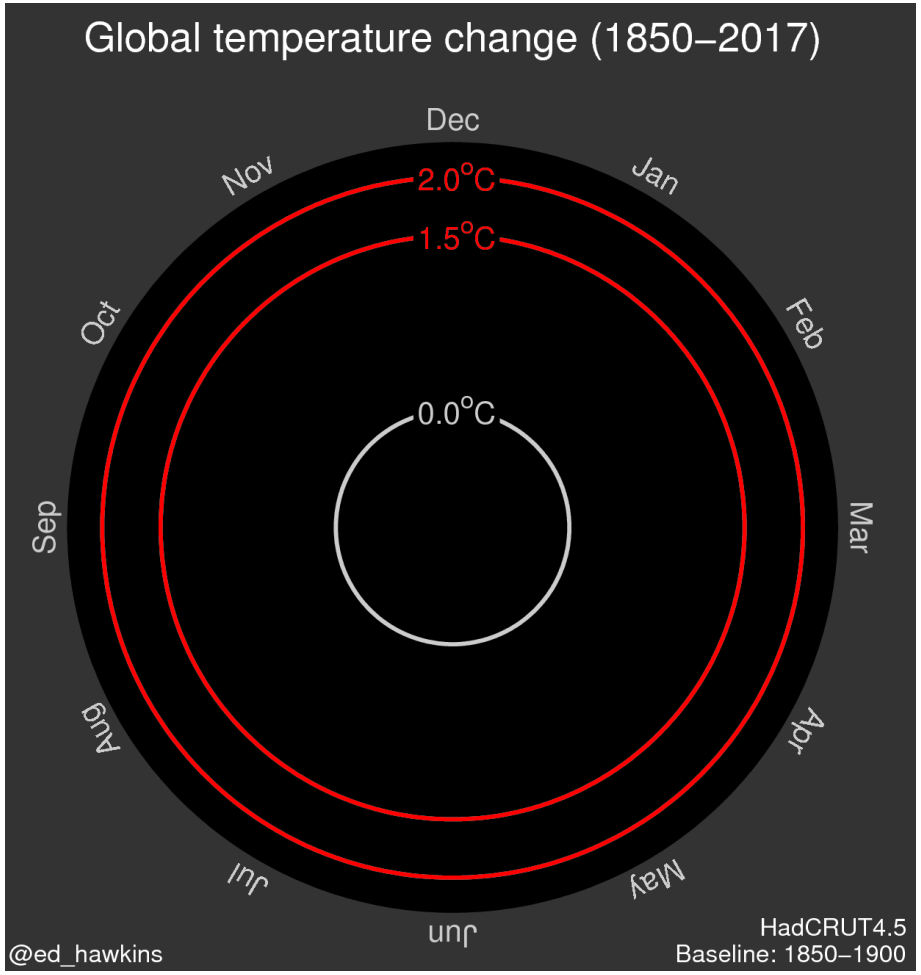
PORTS

- Fog
- Heavy precipitation
- Storms
- Sea level rise

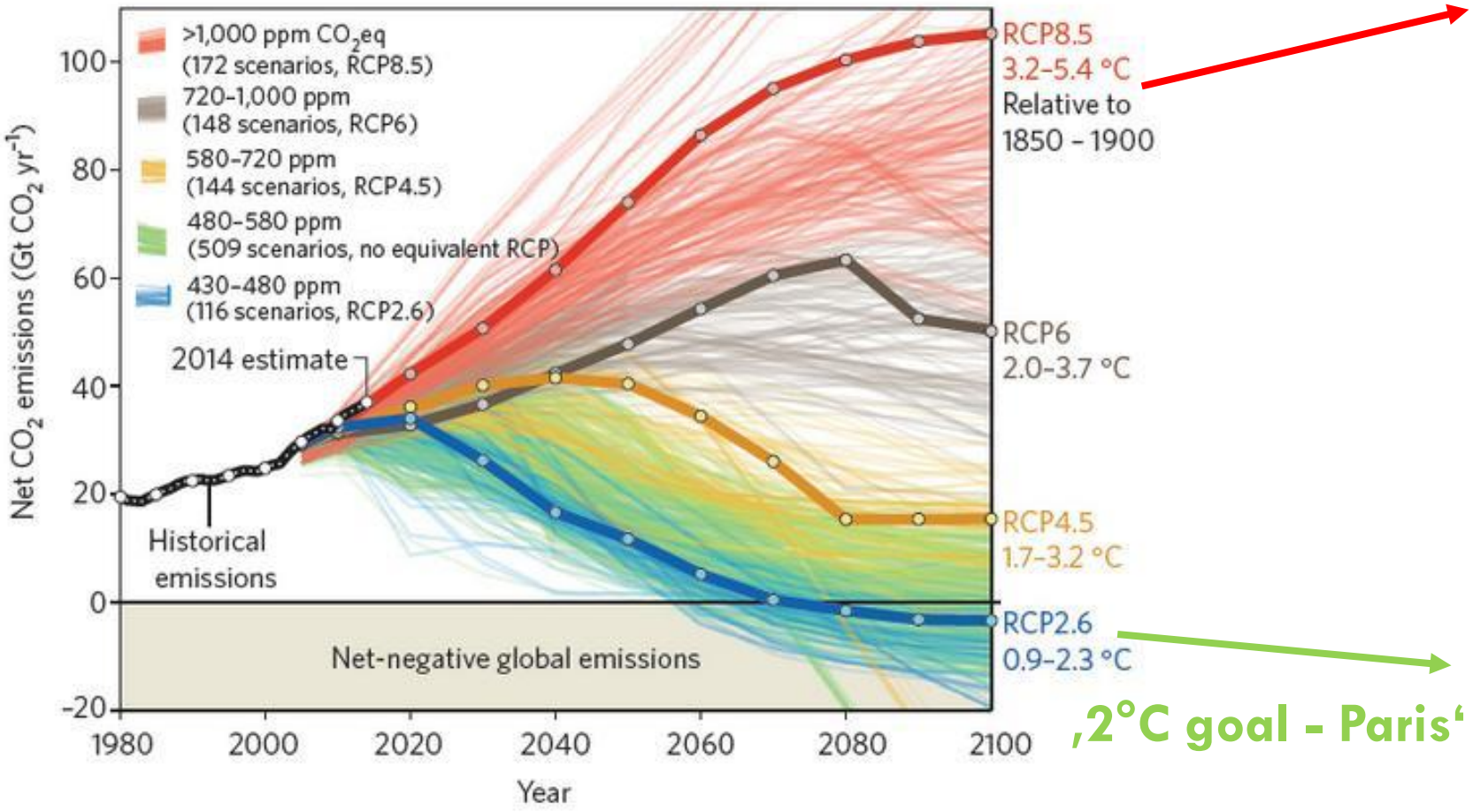
BUT THAT‘S JUST WHAT HAPPENED IN THE PAST…

CO2 CONCENTRATION AND GLOBAL TEMPERATURE DEVELOPMENT

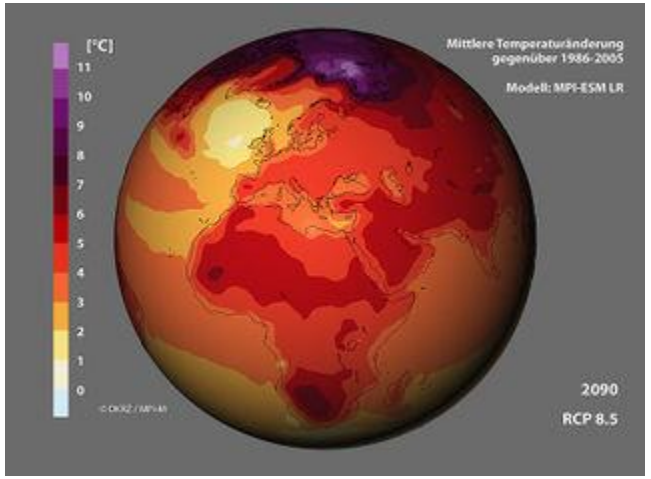


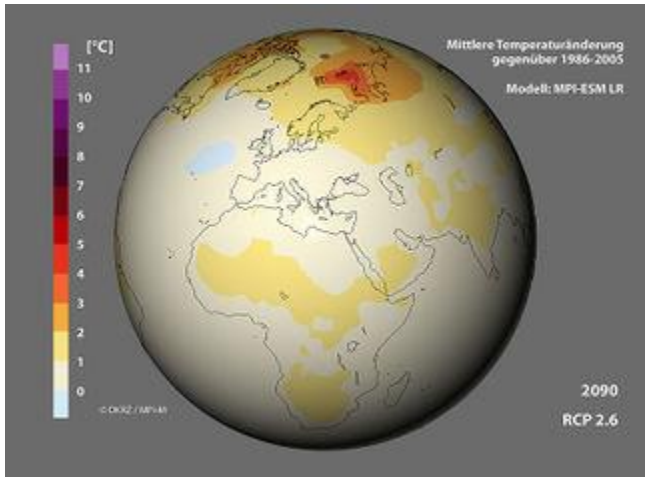


SO WHAT WILL THE FUTURE LOOK LIKE?



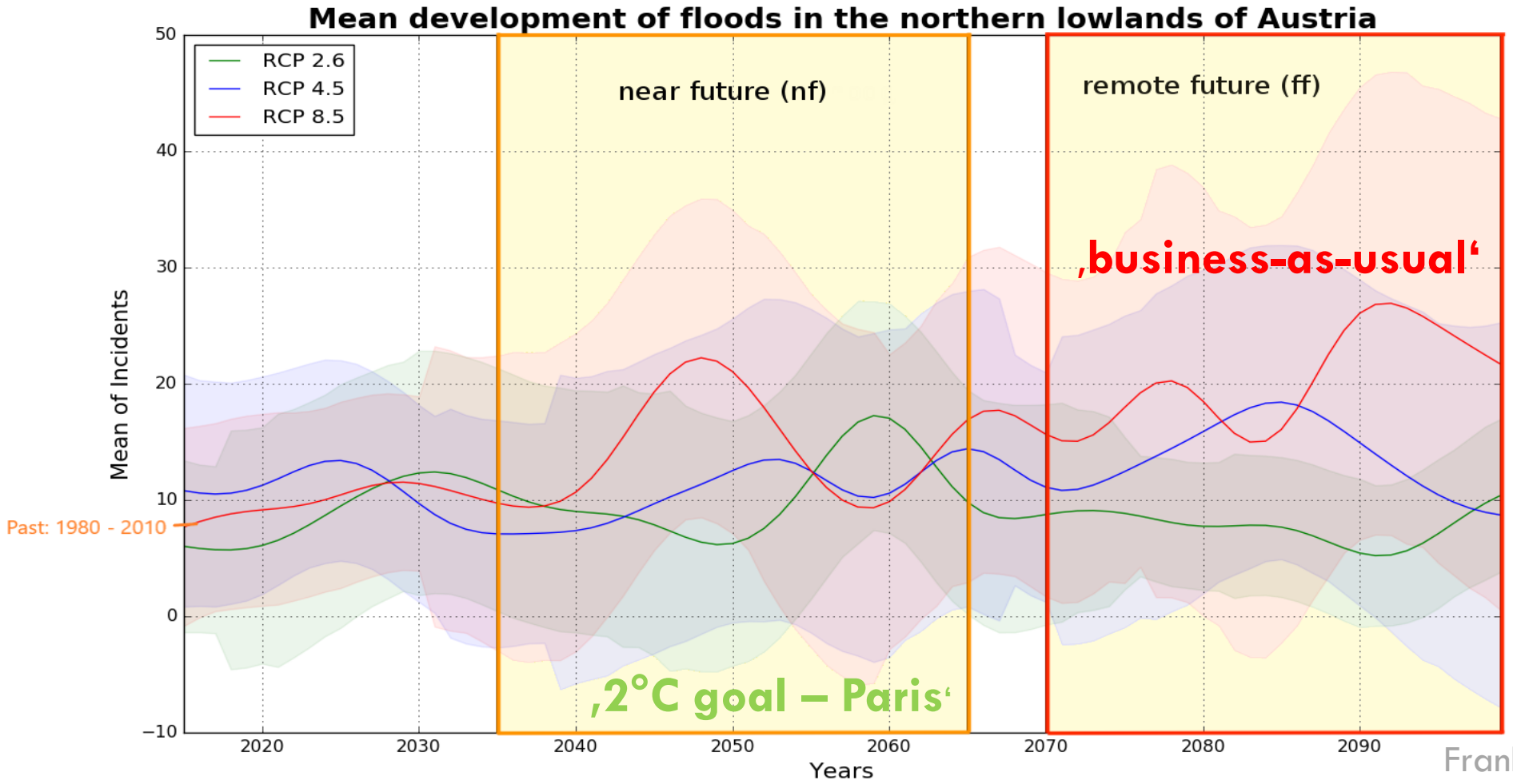
‚business-as-usual'





‚2°C goal - Paris'

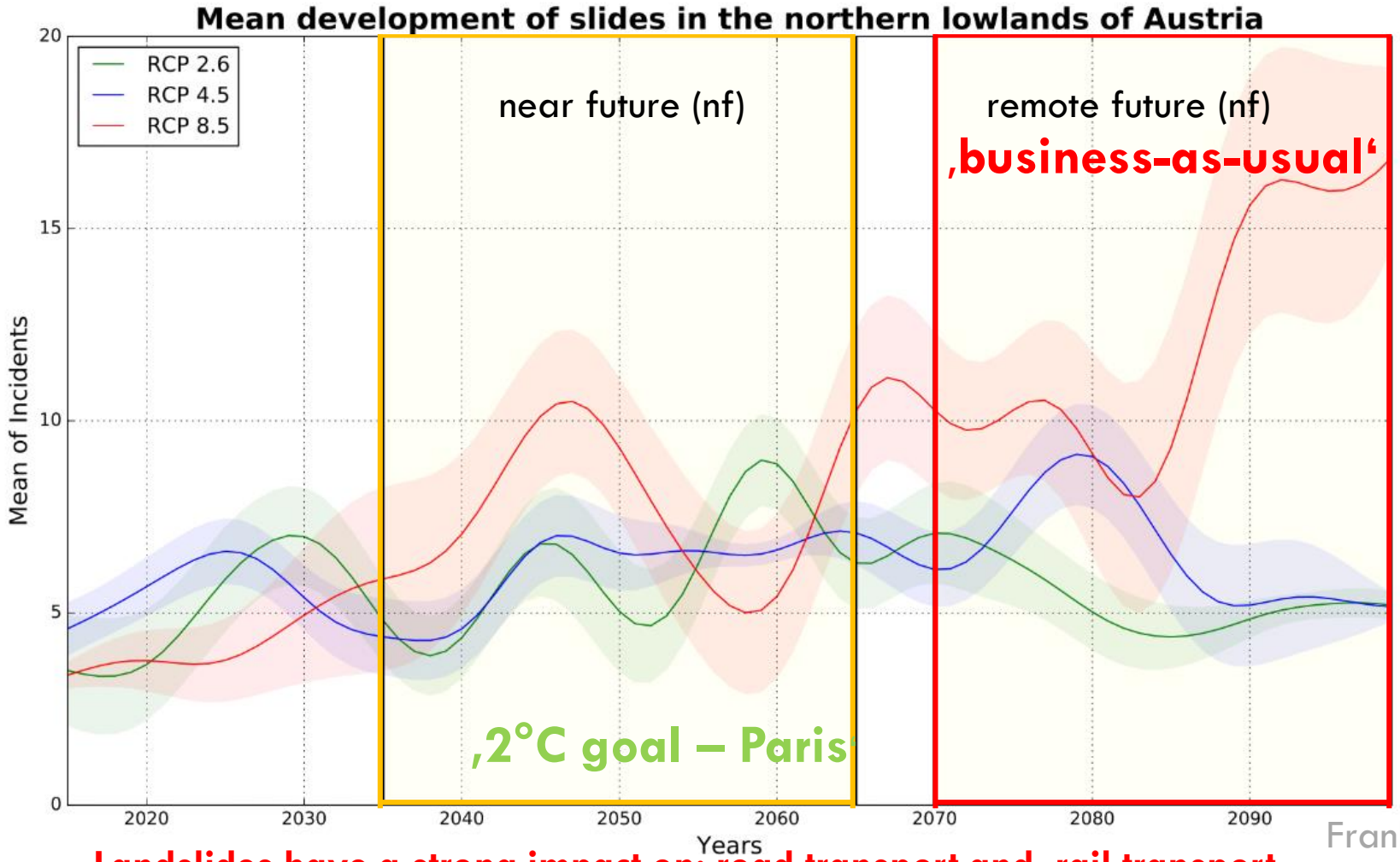
AND THAT MEANS FOR FLOODINGS: HAZARD CORRIDORS IN THE ALPINE FOOTHILLS



Frank et al, under review

Floodings have a strong impact on: road transport, rail transport, inland shipping

HAZARD CORRIDORS FOR *LANDSLIDES* IN CENTRAL EUROPE

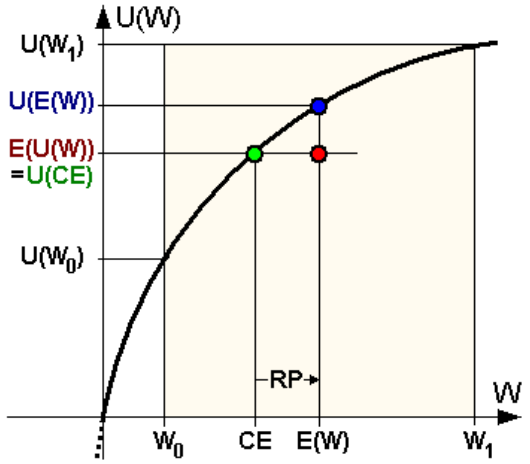


Frank et al, under review

Landslides have a strong impact on: road transport and rail transport

DESIGN OF A (DECISION & PROBABILITY THEORY BASED) PROCEDURE SUPPORTING KEY EXECUTIVES

…using the example of Austria's most extensive project in civil protection since WWII



	near future			more remote future		
	RCP2.6	RCP4.5	RCP8.5	RCP2.6	RCP4.5	RCP8.5
Expected probability	8%	30%	62%	30%	60%	10%
relocation	$u(e_{11})$	$u(e_{12})$	$u(e_{13})$	$u(e_{14})$	$u(e_{15})$	$u(e_{16})$
retention	$u(e_{21})$	$u(e_{22})$	$u(e_{23})$	$u(e_{24})$	$u(e_{25})$	$u(e_{26})$
linear	$u(e_{31})$	$u(e_{32})$	$u(e_{33})$	$u(e_{34})$	$u(e_{35})$	$u(e_{36})$

left: procedure's flexibility in risk perception and further applicability by employing concept of 'utility'

right: rows – possible protection strategies A (relocation), R (retention), L (linear);
columns: refer to **'business as usual'**, 'first measures', **'2°C goal – COP21, Paris'**

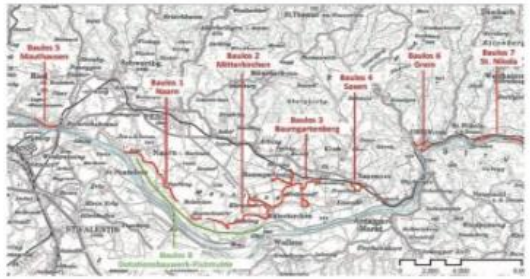
GUIDELINE FOR INVESTMENT PROTECTION

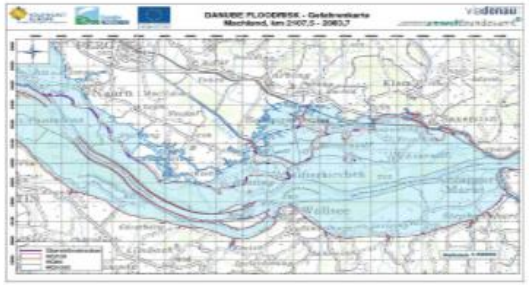
Application to Austria's most extensive project in public protection since WWII

civil protection project 'Machland (Nord)'

Machland region - prone to flooding; seven communities 35 km along the Danube affected.

1991: heavy flood, start of programme: 33 residences re-located.
2002: historic flooding in Austria, current flood defences no longer sufficient. Initiation of the project of the century 'Machland Nord'.
2008-2015: Participation of all 7 municipalities. Implementation of flood protection measures of several classes (HQ30, HQ100). Reference: 2002





About € 265 million invested in flood protection.
Implementation of 3 protection measures:
linear **L**, retention **R**, relocation **A**

- **A** 220 objects, aprox. 85 Mio. €
- **R** 8.7 km, aprox. 15 Mio. €
- **L** 36 km, aprox. 165 Mio. €

Strategies	von Neumann	Hurwicz	Savage-Niehans	Ranking
A	43.55	10.50 (19.78)	0.14	**2.**
R	43.57	10.52 (19.79)	0.12	**1.**
L	43.46	10.51 (19.86)	0.18	**3.**
A	87.86	10.76 (19.83)	0.14	**1.**
R	87.48	10.69 (19.73)	0.28	**2.**
L	87.04	10.68 (19.71)	0.46	**3.**

OUTCOME? While in the near future implementing retention measures is slightly more advisable than relocation, this changes when taking into account longer periods of time. Towards the end of this century relocation clearly outperforms both other alternatives.
short: here is a brand-new, successfully evaluated, and published procedure helping us to base our decisions on knowledge.

Frank et al, under review

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Tackling challenges caused by extremes, securing businesses and providing sustainability require profound expertise

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Climate Change is upsetting existing rules, and induced losses can only be controllable by science and business pulling together. Can we do that?

BUT HOW?

The design of anticipatory strategies efficiently implementing protection measures sustainably safeguarding investments in supply-chain operations relies on decision theory, derived hazard development-corridors and most effective countermeasures known from business practice. Thus, their success in keeping the supply-chain operational under accelerated aggravating future risks, depends crucially on the performance of the cooperation between F&L and CIT (Climate Impact Team, KLFOR/ZAMG).

Necessary steps comprise:

- the compilation of F&L members' damage records, which is kindly taken over by F&L
- mutual sharing their expertise (e.g. survey)
- intense, focused cooperation

Successful decision-making and asset protection requires interlinking F&L members' expertise in dealing with extreme weather and natural hazards with climate impact research.

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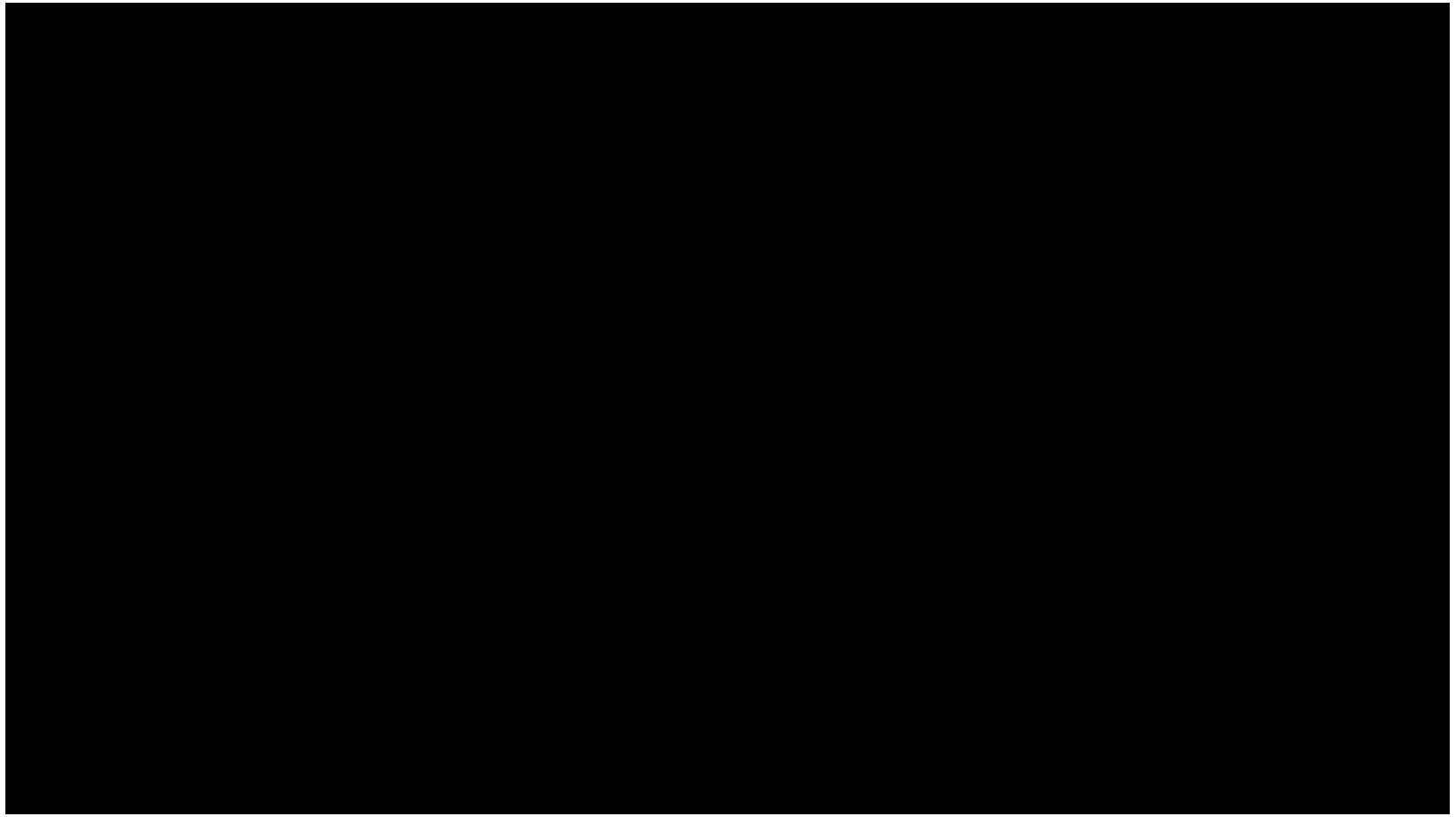
SEA-ICE CONCENTRATION UNDER ‚2°C-PARIS' AND ‚BUSINESS-AT-USUAL'



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MEAN TEMPERATURE CHANGE UNDER UNDER ‚2°C-PARIS' AND ‚BUSINESS-AT-USUAL'