Holländische Deiche und Finanzkrisen

Paul Embrechts

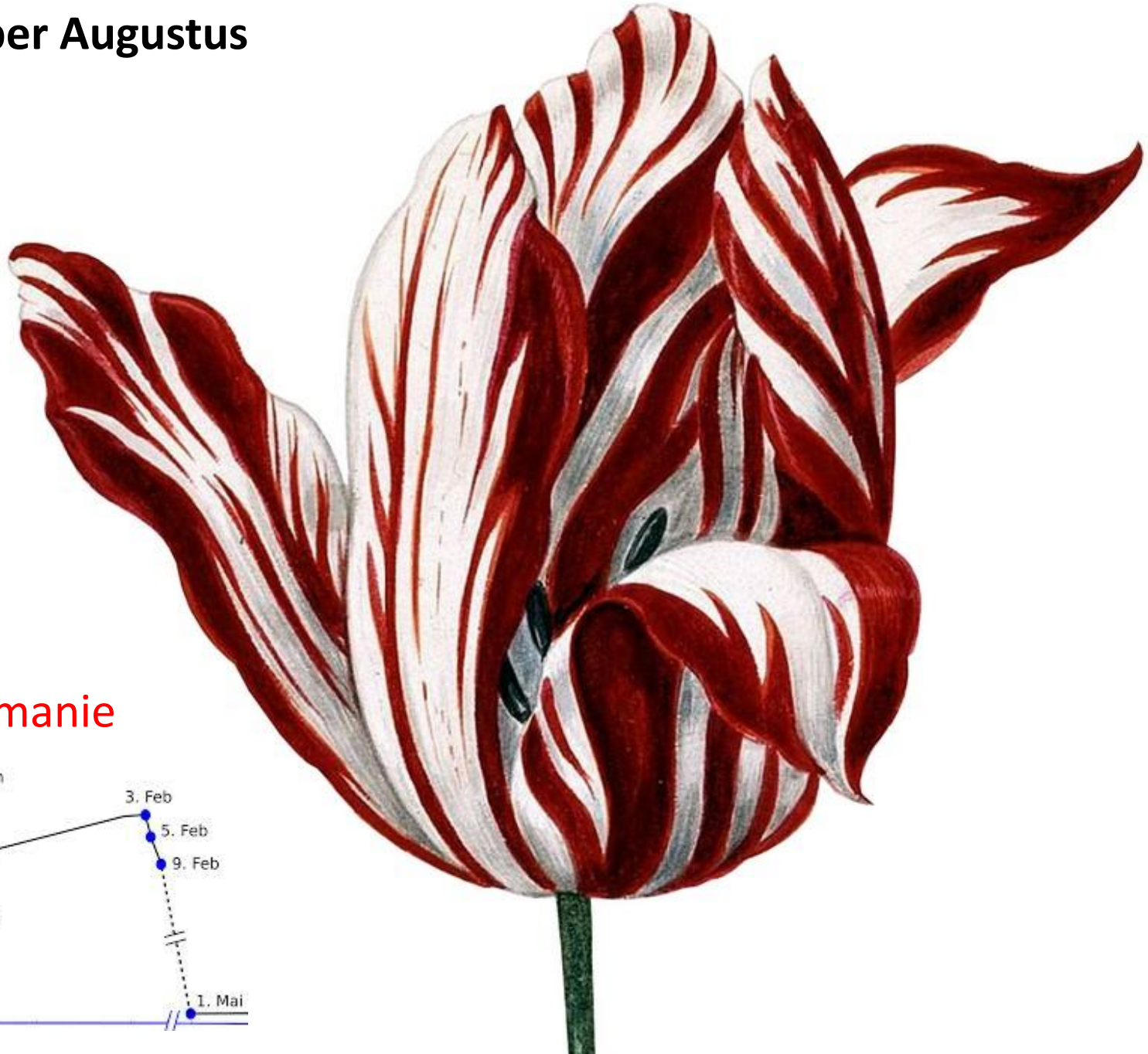
RiskLab, Departement Mathematik

und ETH Risk Center

Emeritenstamm, Winterthur, 27/1/2020

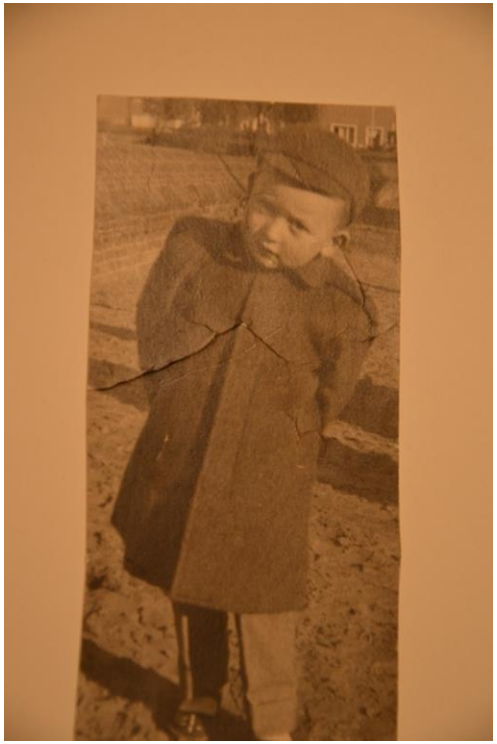
Semper Augustus

Semper Augustus



Tulpenmanie

Schoten (Antwerpen) in Belgien



Schoten (Antwerpen)
Geb. **3/2/1953**

Relevanz?

Hilversum Radio, Samstag **Januar 31, 1953**, in den Radio-Nachrichten von 18 Uhr wurde landesweit folgender Wortlaut ausgestrahlt:

- (**KNMI**): “Über dem nördlichen und westlichen Teil der Nordsee wütet ein schwerer Sturm von Nord-Nord-West. Das Sturmgebiet breitet sich weiter über die nördliche und östliche Nordsee aus.” …
- **Kurz nach Mitternacht**, um 00:44 Uhr des 1. Februar 1953, war Fluthochstand, drei Stunden später entwickelte sich eine Springflut.
- Um 03:24 Uhr wurde in Vlissingen der höchste Wasserstand mit 4.55 Metern über N.A.P. gemessen.
- Insgesamt brachen in dieser Nacht 89 Deiche auf einer Strecke von 187 Kilometern.

31/1 – 1/2/1953 Flutkatastrophe

Insgesamt kamen bei der Katastrophe
2408 Menschen ums Leben (…)

Nieuwekerk a/d IJssel (- 6.76 m unter N.A.P.)
Schielands Hoge Zeedijk

Schoten

1953: N.A.P. + 4.55 m

PE

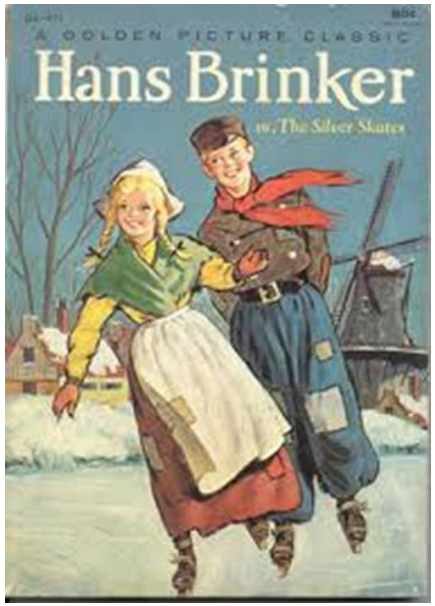
N.A.P. (*)

Guus Balkema

* Amsterdamer Normalnull

Aber wie ist eine solche Katastrophe in Zukunft zu vermeiden?

Fiktion versus Realität



Mary Mapes Dodge

1865

“Een dubbeltje op zijn kant”

1953

Mandate for the First Delta Committee:

"… which hydraulic engineering works should be undertaken in relation to those areas ravaged by the storm surge, (and) also to consider whether closure of the sea inlets should form one of these works …"

(**February 1953**, Dutch Minister of Transport and Public Works)

Abschlussdeich Zuiderzee (1918-1933)

Delta(1)werke (1953-1986)

H.A. Lorentz
(1853-1923)
Theoretischer Physiker
Nobel (1902)

David van Dantzig
(1900-1959)
Mathematiker
Statistiker

Jan Tinbergen
(1903-1994)
Mathematiker
Ökonom
Nobel (1969)

...

Die van Dantzig Formule:

David van Dantzig (1900 – 1959)

where

(12) $$C = \frac{100 p_0 V \alpha}{(\delta' - \beta)k} \cdot \frac{1 - e^{-(\delta' - \beta)T}}{1 - e^{-\delta' T}}$$

is always positive (with p_0, V, α, k, δ', β, T positive).

Differentiation with respect to X gives the condition for an extremum

(13) $$k - kCe^{-\alpha X} = 0$$

or

(14) $$X = \frac{1}{\alpha} \ln C.$$

(1) From **D. van Dantzig** (1956): Economic decision problems for flood prevention, **Econometrica** 24(3), 276 – 287 (p. 283)

(2) 1954 **Invited Lecture at the ICM** in Amsterdam on the topic: "Mathematical problems raised by the flood disaster 1953"

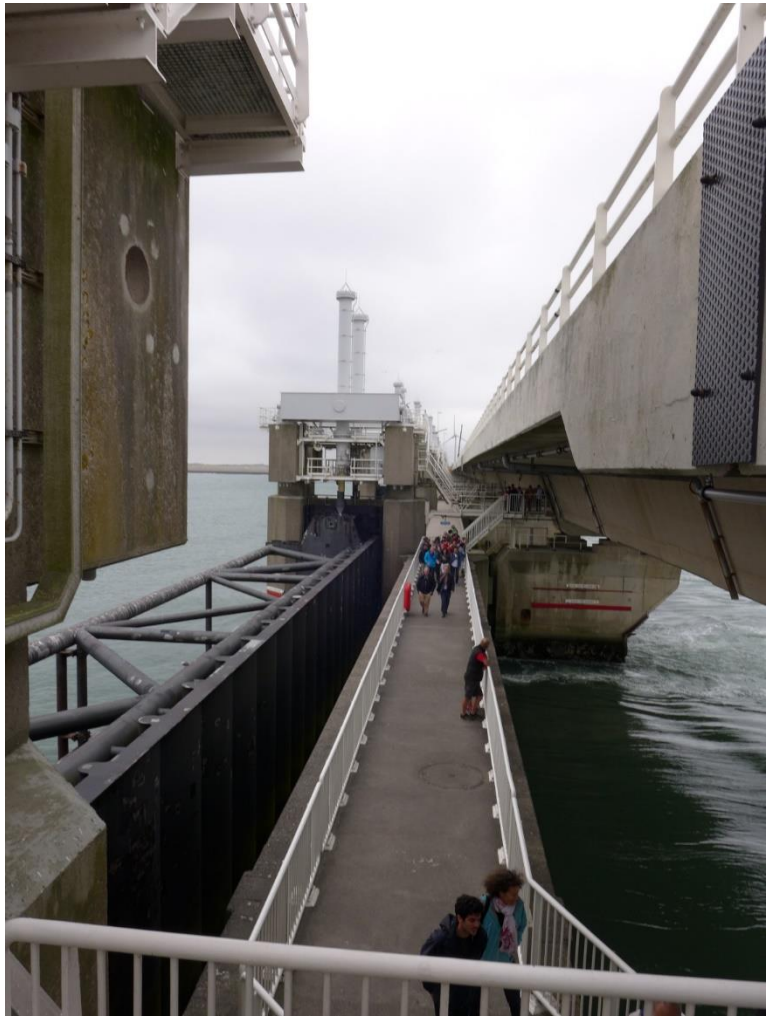
vD: +6:73m -> +6:00m -> **DC**: +5:00m (= "Erhöhung" von 1:15m)

Unsicherheit keine Unsicherheit!

Ein Beispiel: Der Oosterscheldewehr (*)

(*) In 1995 erstellte die American Society of Civil Engineers eine Liste der Sieben Wunder der modernen Welt:

#2 “Die Deltawerke und Zuiderzeewerke”



Der Oosterscheldewehr “Neeltje Jans”

19**60** bis 4/10/19**86**(!)

Der Oosterscheldewehr

Sturmflutwehr aber …

Ökologisch verantwortungsvoll

Königin Beatrix der Niederlande
am 4. Oktober 1986:

“De stormvloedkering is gesloten. De Deltawerken zijn voltooid. Zeeland is veilig.”

Die Deltawerke

Modellierung!

W'keit (MJHF > Deichhöhe) = (klein) 1/10'000

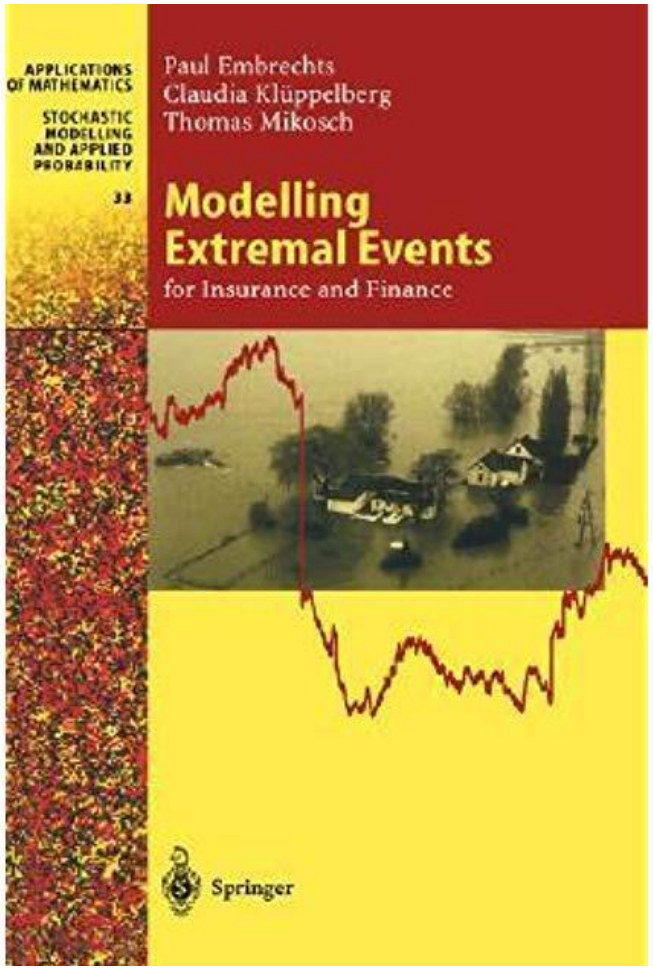
F = Flutwelle = «sea surge», also

gegeben «1/10'000», berechne «Deichhöhe»!

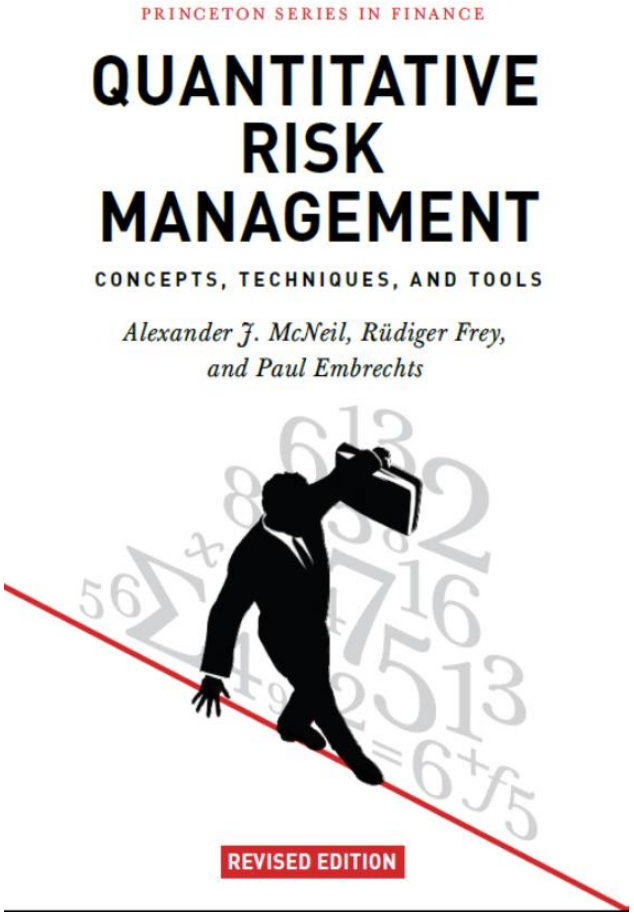
Risikomass → Absicherung

Mathematische Forschung:

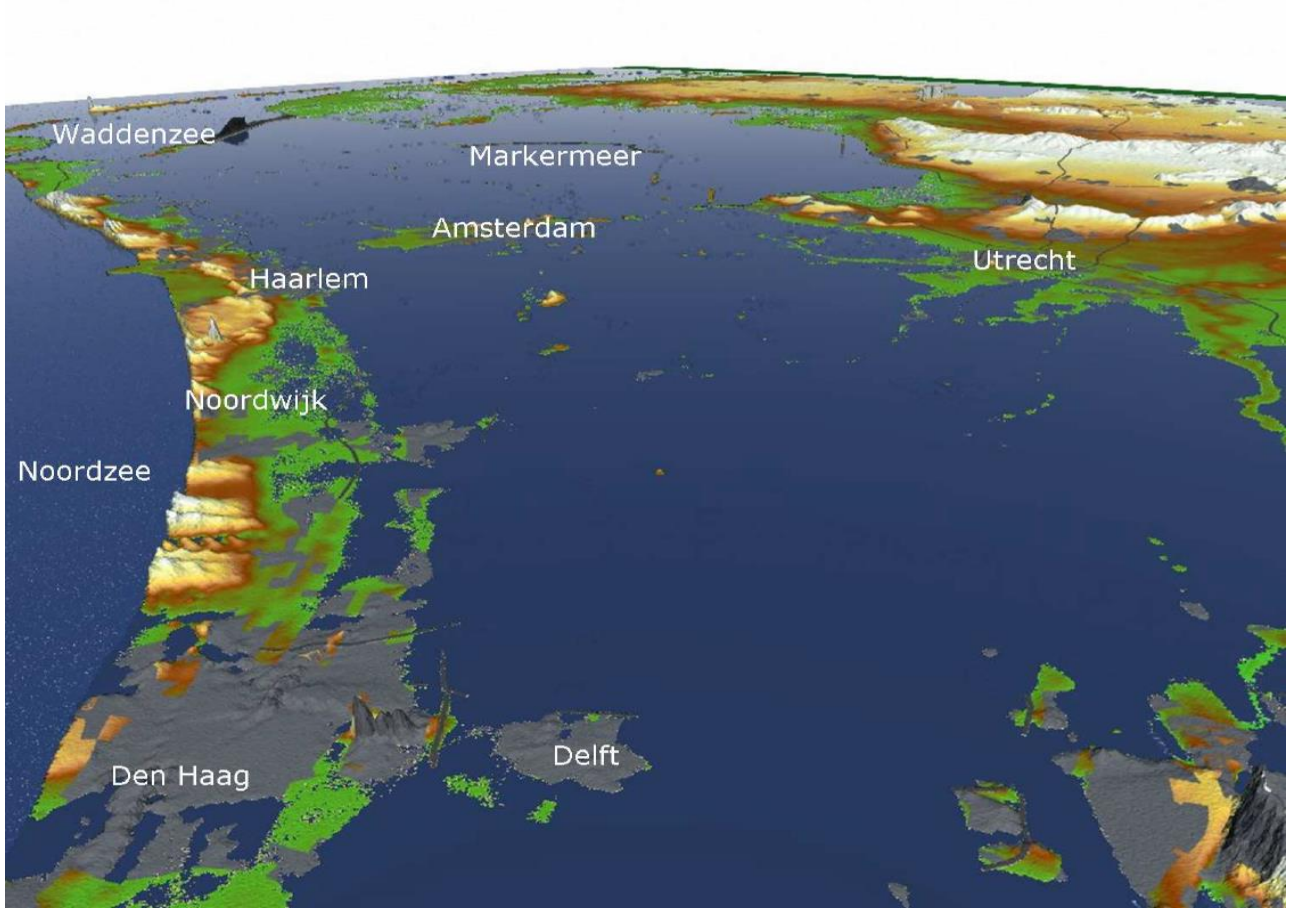
1997



2005 und 2015



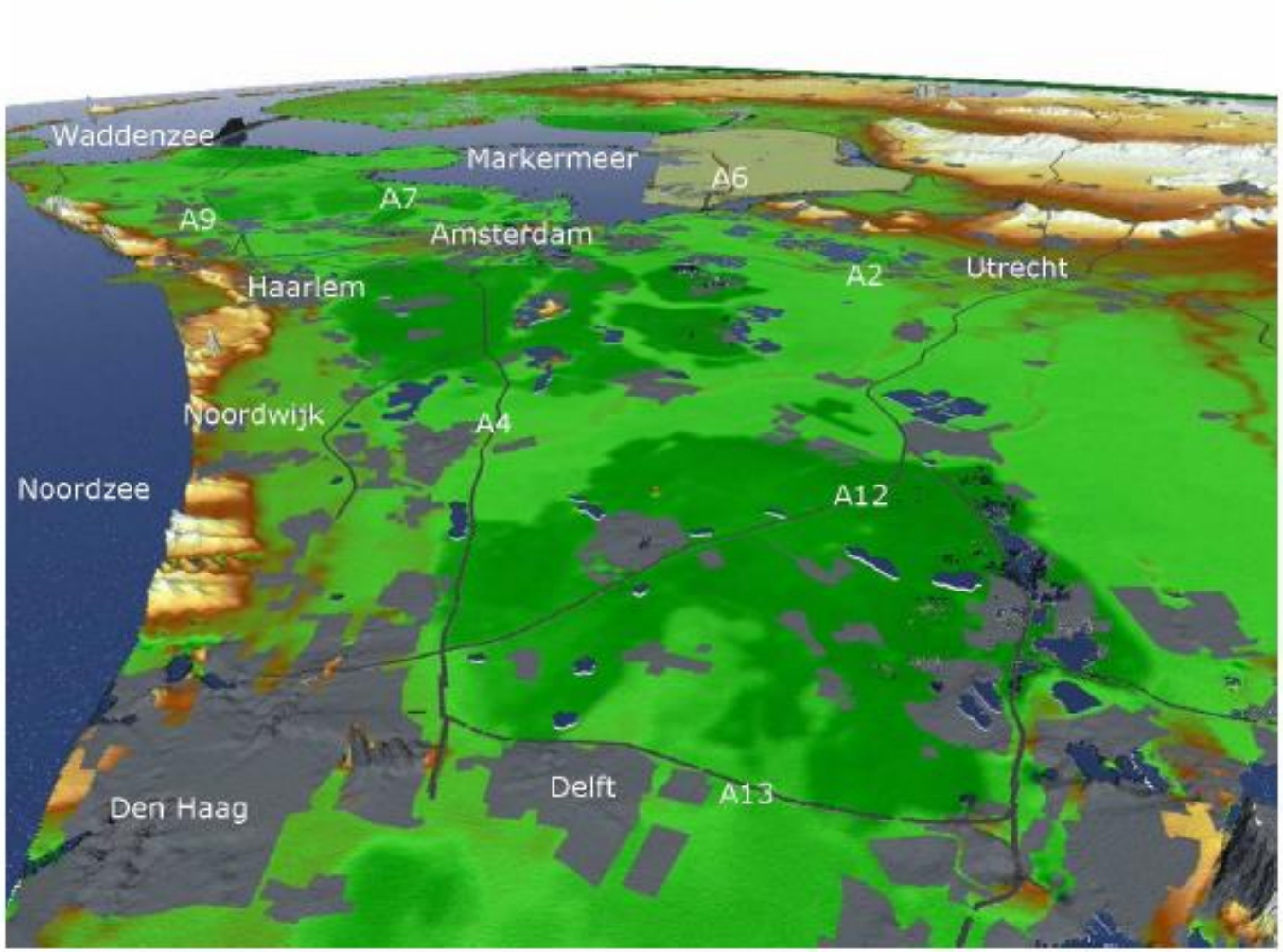
Die Niederlande ohne Deiche



21% Bevölkerung
26% Fläche

Henk van den Brink, KNMI, Fighting the arch-enemy with mathematics and climate models.

Die Niederlande mit Deiche



Wie weiter: 1/10 000 → 1/100 000 ?
Treibhausgase und Meereserwärmung!

(Henk van den Brink, KNMI)

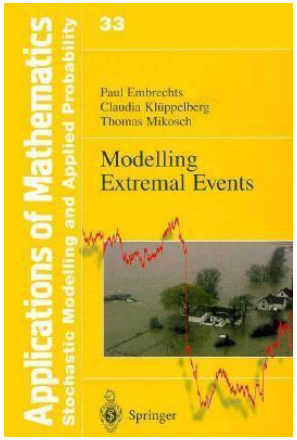
Mandate for the Second Delta Committee (2007):

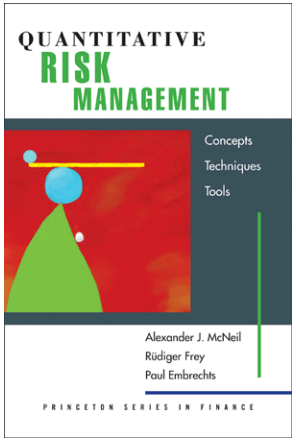
The government asked the Delta Committee to come up with recommendations on how to protect the Dutch coast and the low-lying hinterland against the consequences of **climate change**. The issue is how the Netherlands can be made climate proof over the very long term: safe against flooding, while still remaining an attractive place to live, to reside and work, for recreation and investment … also **cyber risk**!

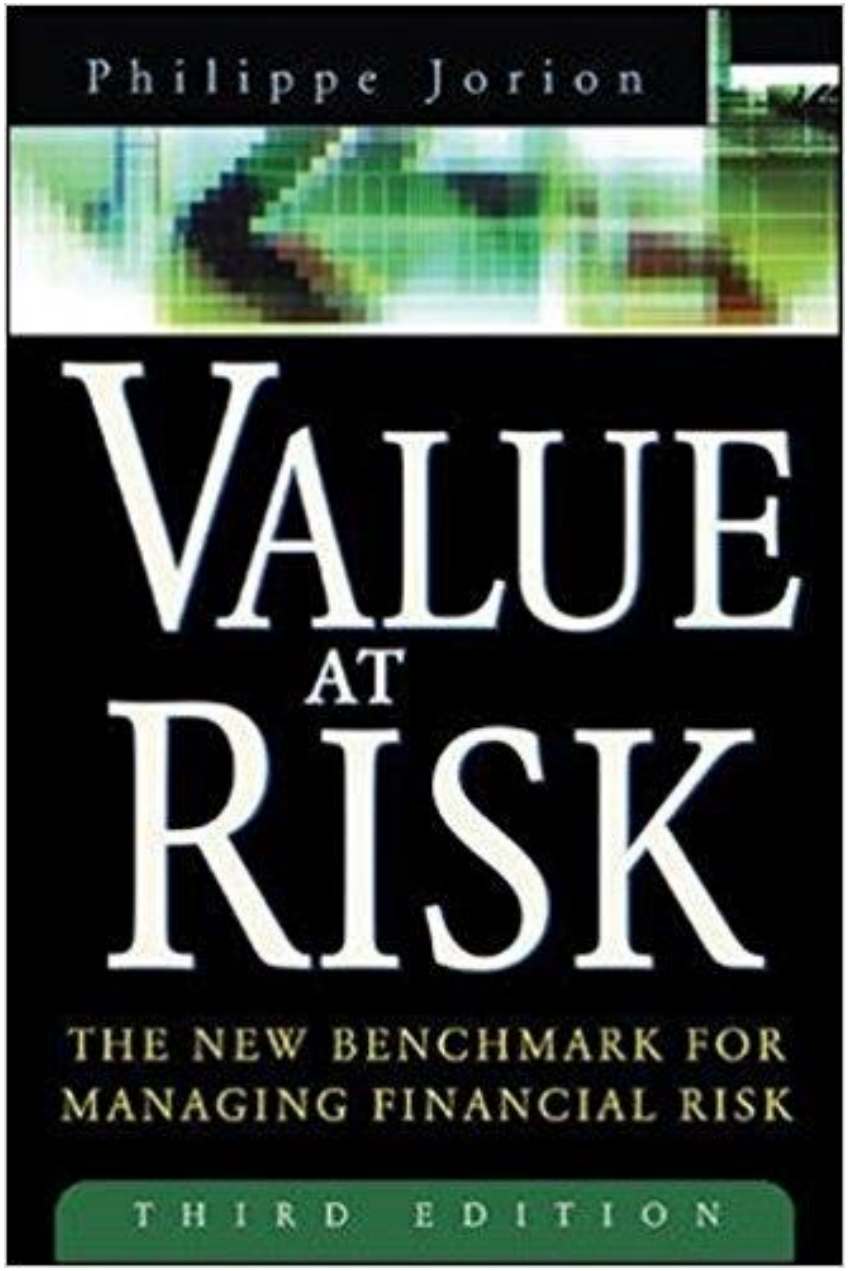
Von Amsterdam nach Basel:

Bank für Internationalen Zahlungsausgleich (BIZ/BIS)
mit dem *Basler* Ausschuss für Bankenaufsicht (BCBS)

Federal Reserve Bank of Boston course on “EVT & relevance for OpRisk” (2005)







VaR = Deichhöhe

(600 pages)

Value-at-Risk Risikomass

- Der Begriff **Wert-im-Risiko** oder englisch **Value-at-Risk** (VaR) bezeichnet ein Risikomass für eine Finanzposition, bspw. ein Portfolio von Wertpapieren #. Der Value-at-Risk gibt an, welche Verlusthöhe innerhalb eines gegebenen Zeitraums mit einer gegebenen Wahrscheinlichkeit nicht überschritten wird. *
- Ein **Value-at-Risk** von 10 Mio. EUR bei einer Haltedauer von 1 Tag und einem Konfidenzniveau von 99 % bedeutet, dass der potentielle Verlust der betrachteten Risikoposition von einem Tag auf den nächsten mit einer Wahrscheinlichkeit von 99 % den Betrag von 10 Mio. EUR nicht überschreiten wird. Aber mit 1% ... !?!?
- Das **Value-at-Risk** ist heute ein Standardrisikomass im Finanzsektor. * Mittlerweile wird das Konzept auch in Industrie- und Handelsunternehmen für die Quantifikation diverser, meist finanzwirtschaftlicher Risiken, eingesetzt.

* Deichhöhe

Banken, Finanzsektor

* FINMA

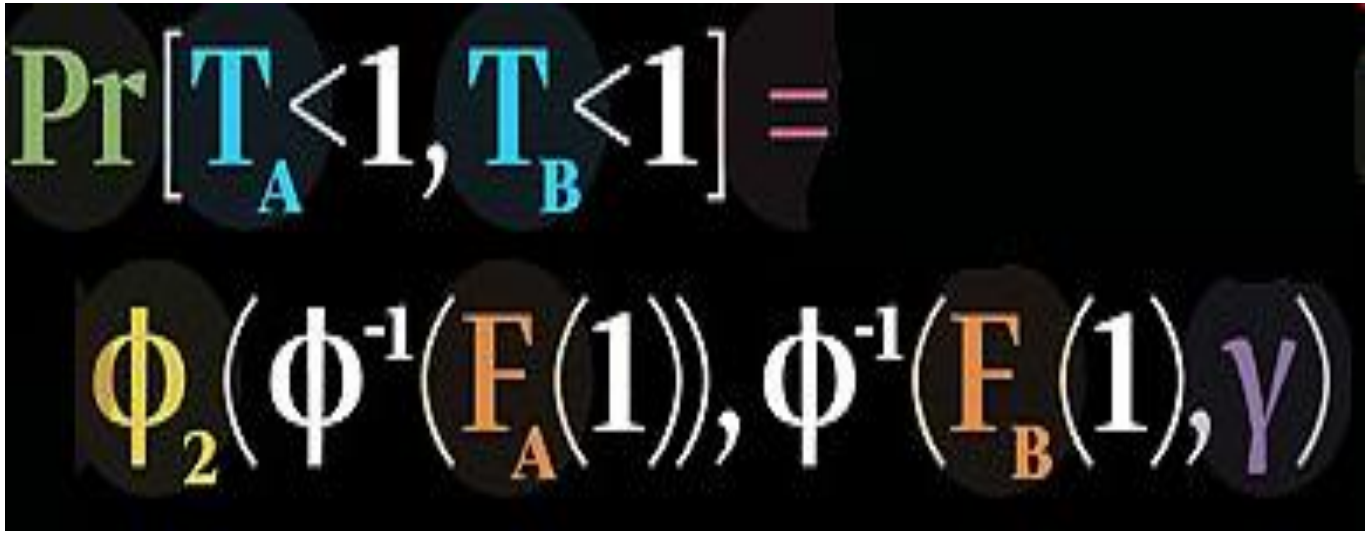
~ Wikepedia

Hat es funktioniert?
Die Finanzkrise 2006-2009!

Recipe for Disaster: The Formula That Killed Wall Street

Felix Salmon 23. Februar, 2009

Wired Magazine



J. Daníelsson et al. (2001): **An academic response to Basel II**
Financial Markets Group, London School of Economics.
(Mailed as an official response to the Basel Committee and published on its website as such) (17 pages)

→ PE website since 2001!

et al. = Paul Embrechts
Charles Goodhart
Con Keating
Felix Muennich
Olivier Renault
Hyun Song Shin

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

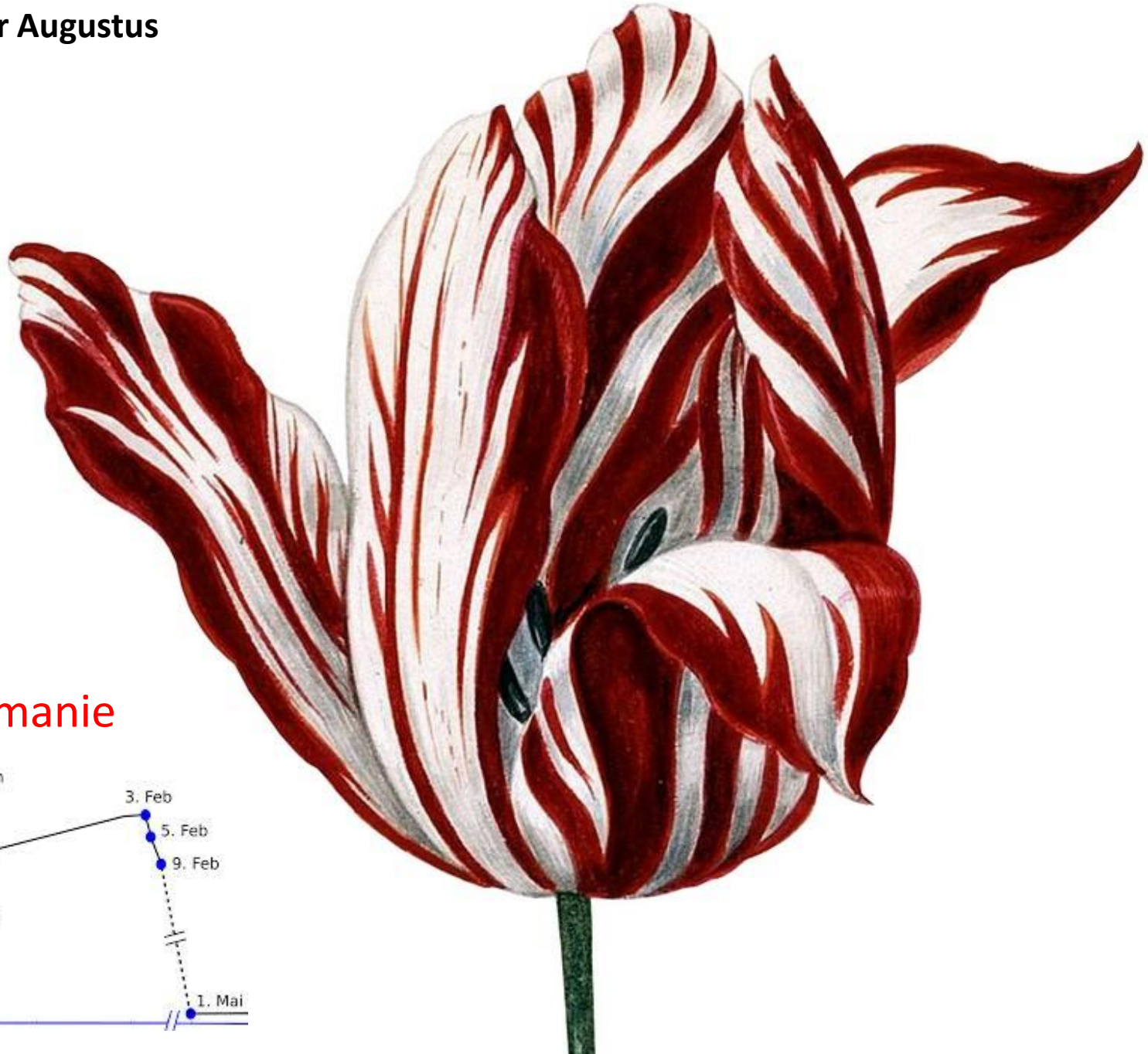
Wir hatten gewarnt!

Mai 2001 (!!): P. Embrechts et al. (LSE) → BCBS

«An academic response to Basel II»

S.5: «Perhaps our most serious concern is that these proposals ... will enhance ... the susceptibility of the financial system to systemic crises ... **Reconsider before it is too late!**»

Semper Augustus



Tulpenmanie

Die Zukunft? … Stichwörter:

- Bitcoin
- Cryptocurrencies (1000+)
- Stable coins
- Libra (Facebook)
- Blockchain, distributed ledger
- FinTech/InsurTech/RegTech
- P2P-credit/finance
- Social networks
- …

20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
USD
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

Die Zukunft?

“In (computer) code we trust”

ETH Zürich Kompetenzzentren für Risikoforschung

- …
- RiskLab (seit 7. Oktober 1994) D-MATH, PC-MW(2), hauptsächtlich für Banken, Versicherungen und Regulatoren (BCBS, FINMA, …)
- Risk Center (seit Juni 2011) 8 Departemente, 20(+) Professoren, **interdisziplinär**, breit gefasste Forschungsprojekte
- …

7/10/1994, die Gründung von

RiskLab®
Switzerland

zusammen mit

(Kompetenzzentrum)

Hans-Jakob Lüthi (IFOR)

FORSCHUNG Zusammenarbeitsvertrag der ETH mit den drei Grossbanken

Brückenschlag zum Finanzplatz Schweiz

Die ETH wird gemeinsam mit den drei Grossbanken im vorwettbewerblichen Bereich forschen, wobei Fragen des Risikomanagements im Vordergrund stehen. SBG, SKA und SBV haben den Zusammenarbeitsvertrag, der dem Departement Mathematik eine neue Quelle für Forschungsgelder eröffnet, im Oktober unterzeichnet.

!!!

ETH Intern, 3/94

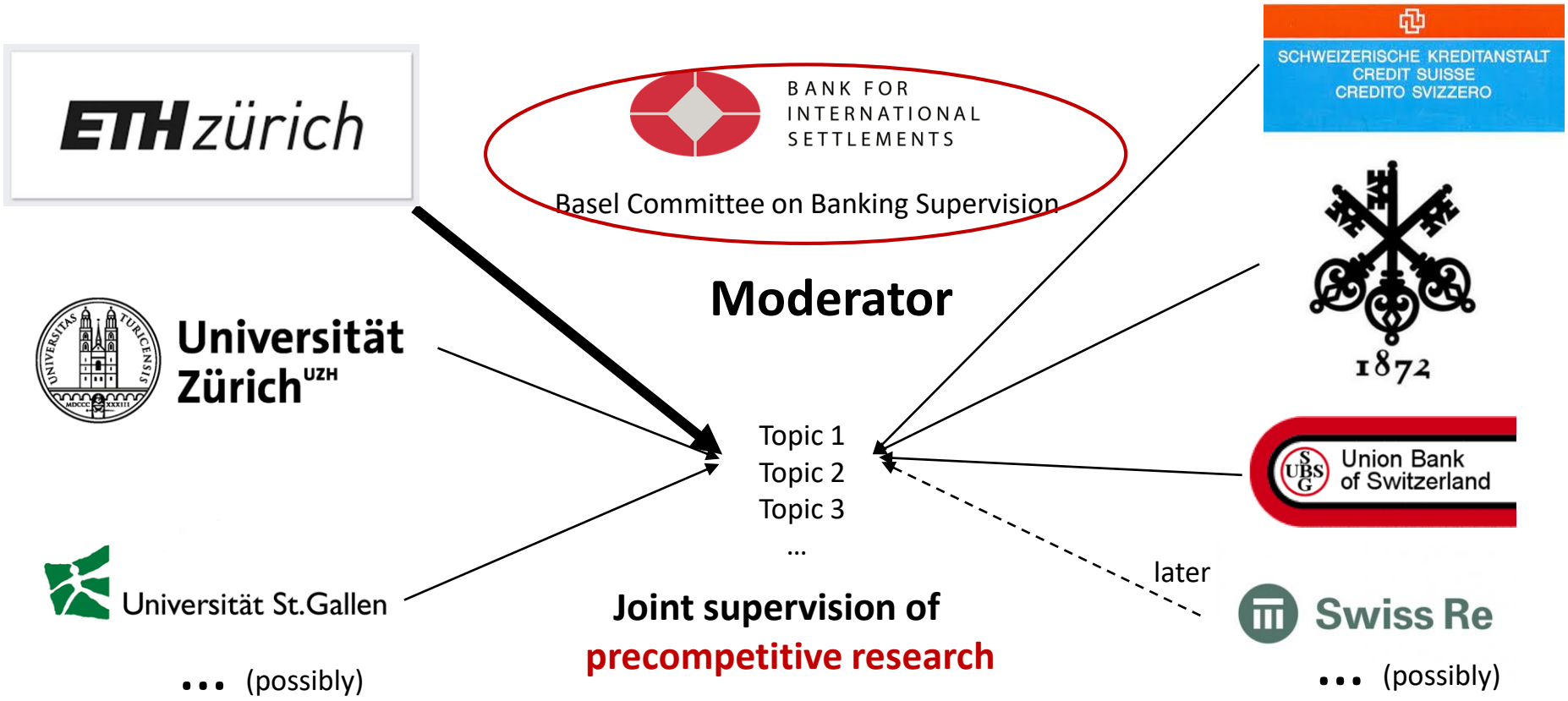
Versicherung, Banken und Regulierung

MIND THE GAP

Schulung & Forschung

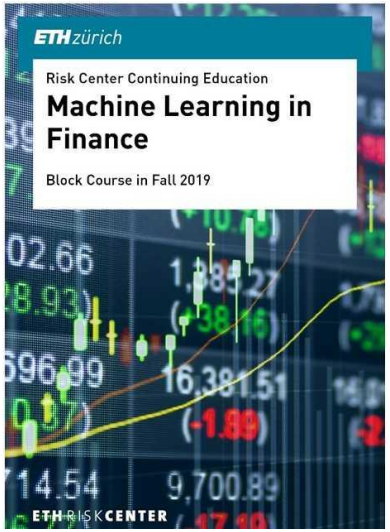
Wirtschaft, Gesellschaft, Politik & …

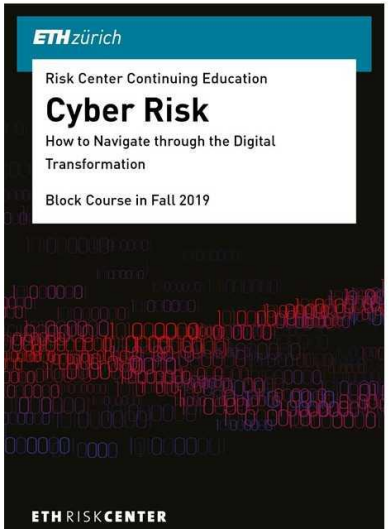
How did we achieve **RiskLab**'s success?

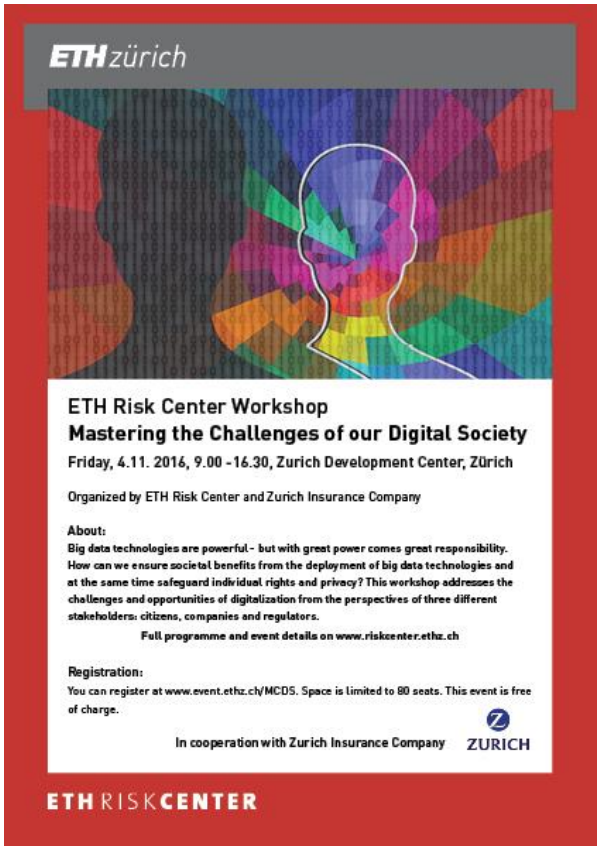


Keywords: **8** departments, **20** professors, **industry** support/topic discussions/joint workshops, (inter)national (**CREATE**-SG), **interdisciplinary** (support only when 2 professors from different departments jointly supervise); see **https://riskcenter.ethz.ch/**

«5G: Balancing Opportunities and Risks»: 13/3/20







Seminar series
Dialogue events
Risk courses
Workshops
Conferences
…

PE = Risk Center Ambassador

ETH zürich

Five steps to the MSc **Risk Studies Certificate** in cooperation with the **ETH Risk Center**

Answers to the most challenging risks of our society, like climate, energy, health, economic, and many more are rarely possible to give from within one discipline. The interdependence of these risks on each other make answers even more challenging. In addition, risks on the corporate level are also becoming more integrated in the future ranging from business interruption risk, cyber attacks, natural hazards, macro-economic shocks, and many more. People with a holistic and interdisciplinary mindset are necessary to understand the increasing complexity and dynamic interdependence of social and human-engineered systems.

Follow these five steps in order to obtain the MTEC MSc Risk Studies Certificate (Total of 60 ETCS):

1.Choose your MTEC tutor among Risk Center Professors at MTEC!

Prof. Dr. Antoine Bommier
Chair for Integrative Risk Management, D-MTEC

Antoine Bommier works on the economic analysis of interdependent risks and risks with long-term consequences. This involves the development of methods to analyze the cost of such risks and to initiate innovative strategies to mitigate them and develop efficient insurance schemes.

Prof. Dr. Hans Gersbach
Chair Macroeconomics: Innovation and Policy, D-MTEC

Hans Gersbach analyzes new designs for the financial architecture and for fiscal and monetary policy-making, to deal with systemic risks. For this purpose, he embeds models of banking, systemic risk, and politics into new macroeconomic models, to examine their possible consequences.

Prof. Dr. Wanda Mimra
Chair of Risk and Insurance Economics, D-MTEC

Wanda Mimra's research analyzes strategic interaction in markets with risk and asymmetric information with applications in insurance, health, and industrial organization.

Prof. Dr. Frank Schweitzer
Chair of System Design D-MTEC

Frank Schweitzer focuses in part on the emergence of systemic risk resulting from the collective interaction of economic or social agents. His work applies formal concepts to economic and financial networks, as well as to business companies, social organizations, and online communities in cyberspace.

Prof. Dr. Didier Sornette
Chair of Entrepreneurial Risks D-MTEC

Didier Sornette researches on the prediction of crises and extreme events in complex systems. Applications include the ex-ante diagnosis of financial bubbles and crashes, earthquake physics and geophysics, the failure of engineered structures, successes in social networks, etc.

2.Select your courses depending on your own risk-focus!

Choose from your core-courses, elective courses and non-MTEC courses a set of risk-related courses matching 24 ETCS.

Your tutor will help to choose eligible courses depending on your focus.

Select courses from other Risk Center Professors coming from other departments of ETH Zurich:

Prof. Dr. David Basin
Chair for Information Security D-INFK

Prof. Dr. Lars-Erik Cederman
Chair of International Conflict Research, D-GESS

Prof. Dr. Paul Embrechts
Professor of Mathematics D-MATH

Prof. Dr. Hans R. Heinimann
Chair of Land Use Engineering D-USYS

Prof. Dr. Hans J. Herrmann
Chair of Computational Physics D-BAUG

Prof. Dr. Giovanni Sansavini
Chair of Reliability and Risk Engineering D-MAVT

Prof. Dr. Bozidar Stojadinovic
Chair of Structural Dynamics and Earthquake Engineering D-BAUG

Prof. Dr. Bruno Sudret
Chair of Risk, Safety and Uncertainty Quantification D-BAUG

Prof. Dr. Ulrich Alois Weidmann
Chair of Traffic Planning and Transport Systems D-BAUG

Prof. Dr. Stefan Wiemer
Director of Swiss Seismological Service D-ERDW

3.Choose your internship in the area of risk management!

Experience a risk-related internship (6 ETCS). With a strong educational record in the area of risk you qualify for various positions in the risk modeling, risk management or risk analysis teams in the industry or governmental bodies.

4.Write your Master thesis on a risk-related topic!

Obain the remaining 30 ETCS by writing your thesis in the are of risk, supervised by your Tutor, coming from the Risk Center.

5.Obtain the Certificate and be selected to present your thesis to the Risk Center Partners.

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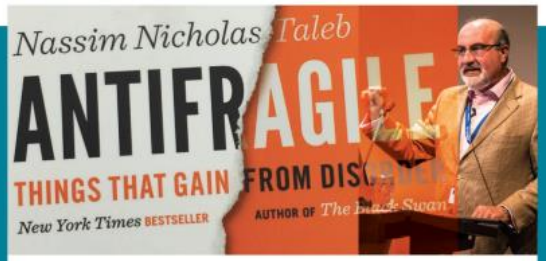
For more information please contact Bastian Bergmann, Executive Director, Risk Center, bbergmann@ethz.ch
ETH Risk Center - Scheuchzerstrasse 7 - 8092 Zurich - Switzerland - www.riskcenter.ethz.ch - info-riskcenter@ethz.ch

ETH RISK CENTER

ETH zürich



ETH Risk Center Seminar Series presents

Prof. Nassim Nicholas Taleb

NYU Polytechnic School of Engineering

How to Understand Fragility?

Tuesday | 27.10.2015 | HG F30

Time: 16.15 -17.30 | Apero

Please register for this event on www.riskcenter.ethz.ch

Audimax
ETH Main Campus

ETH Risk Center - Scheuchzerstrasse 7 - 8092 Zurich - Switzerland - www.riskcenter.ethz.ch - info-riskcenter@ethz.ch

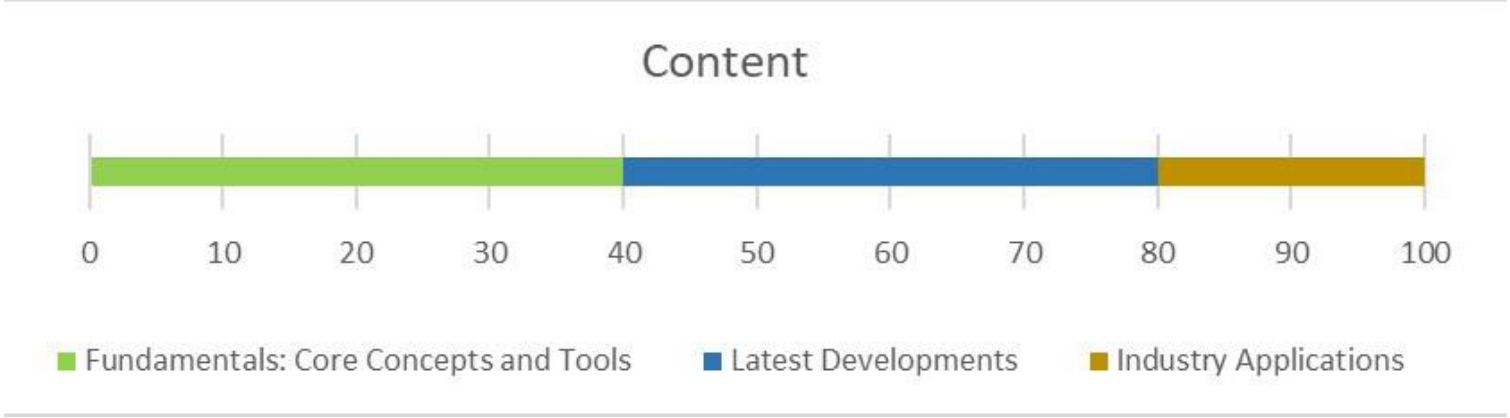
ETH RISK CENTER

Risk Center Continuing Education

Climate Risk and Decision Making under Deep Uncertainty

Block Course in Spring

2020



Interdisziplinarität

Danke!