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Using the Adaptive Cycle in Climate-Risk Insurances to Design Resilient Futures

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Standfirst: Assessing the dynamics of resilience could help insurers and governments to reduce the costs of climate-risk insurance schemes and to secure future insurability under a rising trend in extreme hydro-meteorological events related to climate change.

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Since 1980 loss-relevant floods display the steepest and costliest global increase amongst weather-related extreme events (*1*). The burden of flood losses is usually born by home-owners or businesses, often supported by government pay-outs. In several OECD countries insurance is available to address the financial implications of floods, but demand and uptake differs significantly across countries. With growing exposure, increasing vulnerability and a changing climate this financial tool is coming under increasing stress, triggering concerns about affordability and availability of insurance (*2*).

After extreme hydro-meteorological events (EHMEs), insurers tend to critically reassess their risks if payouts were higher than estimated. This reassessment could result in decreased affordability and availability of insurance. For example, after the 2002 German floods, which costed €9 billion in public funds, some observers noticed that the risk reassessment by insurance companies led to an increase in premiums of up to 50%, and a reduction in areas where flood insurance was offered of 10% to 20% (*3*). In the USA, insured losses of over $100 billion caused by hurricane Katrina and others during 2004 and 2005 resulted in a decrease in the availability of insurance (*4*). In the UK, the end of “universally available” flood insurance coverage was mostly motivated by damages over £1 billion during the Autumn 2000 floods (*5*), while in Ireland a series of recent floods have left businesses and homeowners in certain areas struggling to secure flood insurance (*6*).

Rising climate-related risks such as from floods and windstorms threaten affordability and coverage availability for society at large (*7,8*), and recent experiences show that developing new solutions for these is far from straightforward even when there is public support, which raises concerns about the role of climate-risk insurances in the future.

Climate change is among the current and future challenges that the insurance industry is facing. The physical risks derived from climate change can affect insurance payouts directly—for example, through an EHME— and indirectly, for example, through disruption of electricity provision or supply chains after a catastrophe. Climate change can also modify the correlation of different physical risks, thus making uncertain the level of diversification necessary and the requirements of regulatory capital of insurance firms. Last but not least, the value of assets supporting the solvency of the industry can also be affected by the impacts of climate change and derived real-economy effects (*9*).

With globally distributed risks and underwriting policies on an annual basis, the solvency of the insurance industry as a whole seems not threatened by climate change. However, the above challenges might compromise the ability of insurance companies to deal with climate impacts and increase the costs of doing business in the insurance sector. This could result in companies exiting the market or certain segments becoming uninsurable. In turn this could lead to a readjustment of the existing financial compensation mechanisms, leaving households, businesses and the public sector—as the ultimate paymaster for uninsured losses—more and more exposed.

Efforts to reduce risks and adapt to future risk levels are essential—from a societal as well as company perspective. Important to this end are efforts within insurance companies, as well as by those in charge of managing climate risks through public policy.

Climate-Risk Insurances and the Adaptive Cycle

Increasing frequency of EHMEs in some regions, uncertainty about their occurrence (*10*), and decreasing affordability of insurance (*9*) are major societal concerns, and call for new tools of analysis to support policy making on societal resilience. Resilience is a widely used idea, but some of its key concepts—like the adaptive cycle (ACY) (*11*)—are rarely used in the realm of the financial sector.

Text Box 1: Climate-risk insurances through the lens of the adaptive cycle.

We describe for the first time the dynamic evolution of climate-risk insurances through the four phases of an ACY (*11*). In our model of the ACY, the cycle is triggered by a combination of climatic and socio-economic factors, often after an EHME causes payouts higher than expected. In the first phase insurers revisit their loss calculations and their underwriting and pricing models. The second phase is characterized by the insurance industry learning and seeking new ways of enhancing its performance and resilience under increased levels of risk. This includes activities aimed at improving risk understanding and mathematical model development (*7*). Considering innovative insurance products or schemes may also occur during this phase (*12*). This may also involve engagement through multi-sector partnerships (MSPs) (*13*) , which link the insurance industry with key governmental and societal actors, aiming to improve affordability (*14*) and the continuation of coverage (*8*) through efforts to reduce exposure and vulnerability. In the third phase, the insurance industry acts and adjusts its business practices—either by deploying innovative insurance arrangements in the market, or by implementing other changes such as increases on price (*4*), decreases in coverage (*7*) or existing a market (*4*,*5*). Resilience is higher in the third phase due to the new arrangements. However, if risk transfer opportunities decrease, there could be an unsuccessful evolution of the interaction between the insurance industry, policyholders and public decision makers, implying the creation of a low resilience “no-insurance trap” with progressive exclusion of some locations in the face of rising risks. Risk could no longer be transferred and become intolerable, compromising business survival and the continuation of human settlements, and thus creating limits to adaptation to climate change. The fourth phase of the ACY is characterized by the stability of a renewed operational routine of the insurance industry as it ‘rests’ on the new arrangements, thus putting less emphasis on innovation. This makes the fourth phase less resilient, due to a higher vulnerability to unexpected events after a “rigidity trap” is created by routine and lower innovation. The length of the fourth phase depends amongst other aspects on the occurrence of another EHME—which would eventually lead to phase 1. Our ACY model captures two aspects playing a central role for climate risks that go beyond the annual business cycle: the dynamic evolution of societal resilience over time, and the role of innovation under increased risks and its influence on the reorganization of insurance structures.

The ACY (see Fig. 1 and Text Box 1) illustrates how complex systems respond to shocks and recombine its components over time with different degrees of stability. This suggests the ACY can analyse how the insurance industry responds to climate-related shocks, and innovates to continue doing business and contributing to societal resilience. For instance, the ACY can be used to explain the developments in the flood insurance industry, as shown in Table 1.

Table 1. Examples of the adaptive cycle applied to the evolution of the insurance industry

Case Period)	**First phase**: Reassessing risk after EHME	**Second phase**: Learning about innovations	**Third Phase**: Deploying innovations	**Fourth Phase**: Enhanced business as usual (BAU)
UK (2000-2007)	Losses of the autumn 2000 floods	"Statement of Principles" between insurance industry and Government (2002-2008) (*6*)	The property's exposure is considered on each premium; "universal cover" stopped	New BAU until summer floods of 2007
UK (2007-2017)	Summer floods of 2007	Insurance industry accepts to renew the "Statement of Principles" but declines to extend it beyond 2013, proposing Flood RE in 2011	Exclusion of houses built after 2008; Flood RE is a multi-sector partnership aiming to provide affordable insurance	"Flood RE" is finally implemented in 2016 and a new BAU is ongoing to date
France (1964-2010)	Repeated droughts	Creation of an agricultural public indemnity fund	Coverage for all non-insured natural disasters	New BAU until low damage payments to losses ratio built social pressure against the fund (*15*)
USA (2012-2017)	Hurricane Sandy	First ever catastrophe bond for public transportation infrastructure	Damages after future EHMEs covered through capital markets	New BAU ongoing to date

Furthermore, the ACY model can be used to explore how insurance industry actions and those of other stakeholders can help to address rising climate risk and contribute to the design of positive long-term outcomes that could address the limits to adaptation to climate change. Insurance availability and affordability could be challenged under a rising trend in EHMEs related to climate change (*10*), threatening societal resilience, especially low-income population in exposed areas. The ACY offers a dynamic model to understand the response of the insurance system to external shocks, and to design positive long-term outcomes that avoid low-resilience traps and limits to adaptation, and is driven by an interaction between forces increasing organization and forces creating disruption (see Text Box 2).

Under an increased frequency of EHMEs, a successful evolution towards resilience of the interaction between the insurance industry, policyholders and public decision makers through the ACY is an insurance market with a higher organizational and economic complexity allowing these stakeholders to deal with higher levels of risk, thus helping to avoid the limits to adaptation.

Text Box 2: What drives the adaptive cycle of climate-risk insurances?

The ACY is driven by the interaction between forces increasing organization, i.e. improving how elements are connected and embedded in larger systems, and forces creating disruption. These forces in the case of climate-risk insurances correspond to the main stakeholders involved: the insurance industry, policyholders and public decision makers, and to EHMEs and/or socio-political pressure.

The interaction between stakeholders is driven by insurance innovations, by (re)insurance companies' profitability concerns, by limited scientific knowledge about future EHMEs, by policyholders' decisions on risk mitigation, and by public policy makers worried about affordability and simultaneously making crucial decisions about land-use planning, flood defences, subsidies and post-disaster compensations.

The interactions between the insurance industry and policy makers are particularly strong and reflect competing pressures, with both sides reassessing their options after a major event, the government and the insurance regulator because of public pressure, and the insurance industry because of internal and competitive pressure. The forces increasing organization are backed by an additional factor providing stability: flood insurance is often bundled and therefore only a relatively small component within the home policy. The impact of EHMEs in the industry is regulated by the interplays between the above factors.

Designing Resilient Futures

We next analyze each phase of the ACY model to show how greater resilience to future risks could be achieved, and explore the ACY's implications for the insurance industry, policyholders and public decision makers.

The insurance industry is improving the reassessment of business models and risks (1st phase), for example mapping flood-risk at the building level, and factoring in solvency requirements, market conditions and risk trends, although major scientific challenges remain for predicting the frequency of EHMEs under climate change. In the second phase, the process of learning about innovations to keep availability and affordability of insurance needs to take into account climate change (*10*), and consider that adjustments that consist only on limitations of affordability and availability of insurance are maladaptive solutions. Learning may include collaboration with governments and communities to identify resilience needs and to examine innovative approaches to flood risk insurance. To design innovations that improve risk transfer is important to establish durable forms of dialog between key stakeholders. These facilitate information exchange, and the formation of coalitions that lead to innovative MSPs (*16*).

According to recent reports, the insurance industry finds considerable barriers against implementing innovative products (3rd phase): it has been suggested that insurers perceive that regulators create the greatest barriers to innovation, but there is reluctance amongst insurers to be the first actor bringing innovative products to the market (*13*). These innovative arrangements need to aim both at market position and at addressing underlying risks, thus potentially creating business opportunities for the industry, securing affordable risk transfer opportunities for policyholders, and protecting public budgets. However, unless risk levels are reduced there are likely to be increased costs for public budgets, directly or via cross-subsidies, which implies that higher emphasis is needed on risk mitigation incentives for policyholders, although no effective incentives appear in leading policy formulations such as Flood RE (*17*).

The ACY model suggests that the "rigidity trap" of the 4th phase needs to be avoided by continuous learning and applying innovative products without the need for a shock, improving risk management with a faster pace than the anticipated increase in climate-related risks. Just the opposite is happening in the UK: although scientific evidence shows that climate change will contribute to rising flood risks and their impacts in the UK, Flood RE is creating such a 'rigidity trap', offering a false sense of security to all involved, while the real costs of flood risk continue to increase (*17*).

In general terms, the insurance industry is well adapted and can cope with rising risks because its annual nature allows the option of adjusting practices (*9*). But as our examples show, this creates challenges for society, government and ultimately industry if the only response taken is to exit a market. The ACY model underlines the importance of continuous efforts to address underlying risks, monitor trends and seek innovative solutions to prevent EHMEs triggering sudden withdrawals or steep price hikes. This needs to include broader measures, often not under direct control of the insurance industry, such as adjustments to building standards, stringent land-use planning, and policyholders investing in risk mitigation measures, which would all contribute to minimize the scope of a risk reassessment after an EHME and would secure affordability and availability of future cover. Most importantly, this is a continuous process that requires monitoring, learning and innovating. This comes at a cost to the industry, but it is a necessary investment to secure future markets.

A dynamic vision capturing how societal resilience evolves over time is absent in current international risk reduction frameworks (*18*). Considering the dynamics of resilience along the phases of the adaptive cycle could help insurers and governments to design effective MSPs, reducing the costs of existing and future insurance schemes and securing future insurability.

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Author contributions:

R.C., S.S., M.M.C., and P.H. conceived the application of the adaptive cycle to climate-risk insurances. S.S., P.H., P.S. and J.G. analysed and discussed the implications for climate-risk insurances. R.C., S.S., M.M.C. and P.H. outlined and drafted the manuscript. All authors substantially reflected upon the manuscript and greatly commented on it.

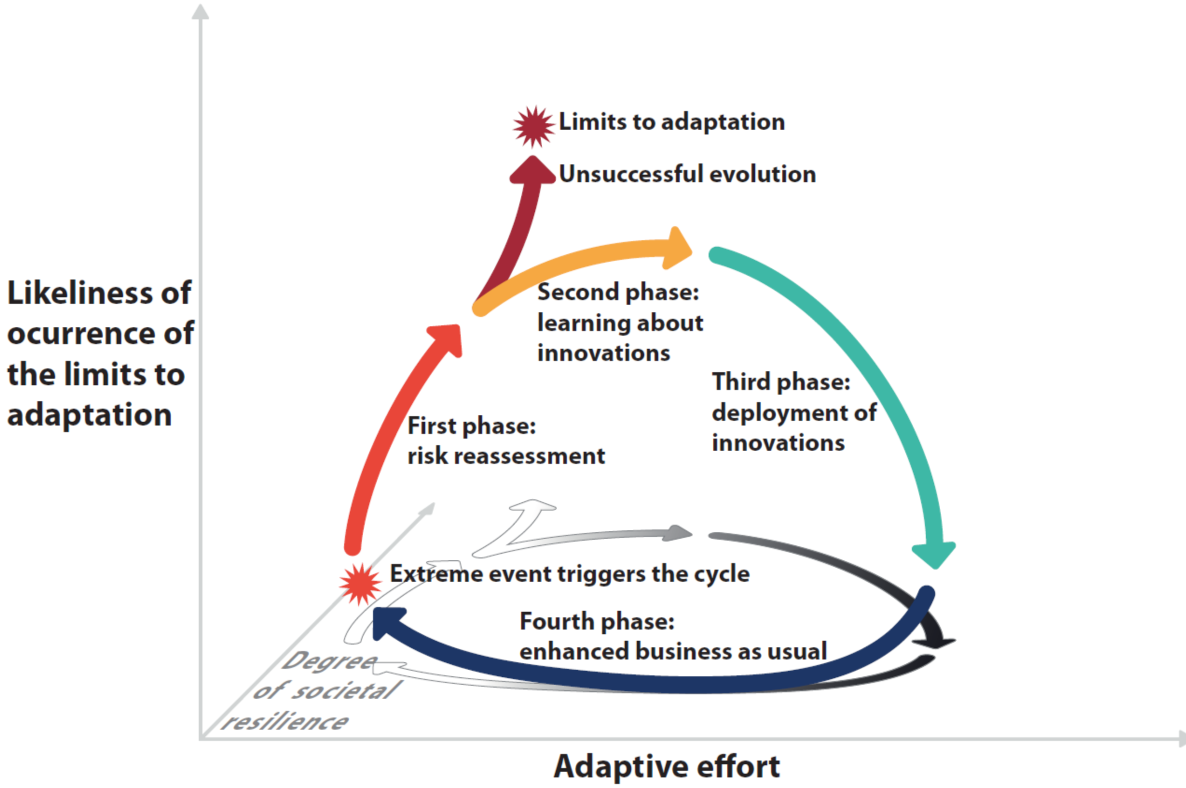

Figure 1. The adaptive cycle (ACY) applied to climate-risk insurances, and a projection of the cycle in the horizontal plane indicating the degree of societal resilience in a greyscale. The ACY illustrates how complex systems reorganize after shocks, hence it can analyze how, after a climate-related shock, the climate-risk insurance industry responds and continues contributing to societal resilience. After an extreme hydro-meteorological event triggers a risk reassessment that might compromise the availability and affordability of insurance and thus societal resilience—first phase, the insurance industry and its stakeholders learn about innovations—second phase. These innovations are later deployed in the market in a third phase. However, a reduction of risk-transfer opportunities could create limits to adaptation to climate change. If innovations improving risk transfer opportunities are successfully deployed, societal resilience would improve and an enhanced business as usual fourth phase would follow, but the stability of the fourth phase could create difficulties for innovators introducing new schemes in the insurance market, which again would decrease societal resilience. The ACY suggests taking measures to minimize the scope of risk reassessments, continuously innovating without the need for a shock, and improving risk management with a higher speed than the foreseen increase in climate-related risks.