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Illustrative list of data providers and tools / methodologies

- Compiled on a best efforts basis and is not exhaustive
- Inclusion on the list does not indicate use of or endorsement by the CFRF Risk Management Working Group members
- Information within the excel is as at June 2020
- Note there are different use cases for each tool; they differ in how they deal with uncertainty and in their assumptions on the underlying scenarios. Outputs vary from qualitative to quantitative.

Name	Overview	Data Type	Tool Type	Transition Risk	Physical Risk	Risks	Data Source	Scenario used	Scope	Access and delivery	Macro-economic impact assessment tools	Asset or company specific impact assessment tools	Outputs	Source
2 Degrees of Separation - Carbon Tracker and the PRI	In-depth sector and company-level analysis of oil and gas companies' upstream exposure to climate transition risks. Uses asset-level data to examine whether the supply options of the largest publicly-traded oil and gas producers are aligned with demand levels consistent with a staying "well below" 2 degrees on the basis of project economics, and quantifies exposure in terms of potential capital expenditure.	Company capex	Estimate of potential capex outside a given low-carbon scenario (as a % of a "business as usual" scenario)	Y	N	Transition: market, whether driven by policy/technology/other factors	Own approach, Rystad Energy	Most recently 1.6 degrees, 1.7-1.8 degrees	Primarily listed companies	High level numbers available for free on Carbon Tracker website (report). Various other detailed indicators available in Bloomberg app and website available to PRI signatories.	Sector level, other (e.g. type of oil/gas development)	Asset level, company level	Analytical reports, online resources for PRI signatories, Bloomberg app	https://2degreeseparation.com/ https://carbontracker.org/reports/breaking-the-habit/
Acclimatise for UNEP FI banking pilot- PHASE I [Phase II due out in Summer / Autumn 2020]	In 2017-2018, UNEP FI worked with 16 commercial banks on a Phase 1 pilot project to develop and test a widely applicable scenario-based approach for estimating the impacts of climate change on bank's lending portfolios, as recommended by the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD). Acclimatise supported UNEP FI and the banks on the Phase 1 pilot project. The pilot covered physical climate risks and opportunities, and transition risks and opportunities. The outcomes of the Phase 1 pilot for physical climate risk and opportunities were published in a report by UNEP FI and Acclimatise, 'Navigating a New Climate: Assessing Credit Risk and Opportunity in a Changing Climate'. The methodologies allow banks to evaluate the impacts of climate change scenarios on borrowers' revenues, costs and property values, and how this could affect the Probability of Default (PD) and Loan-to-Value (LTV) ratios at a borrower and portfolio level. Two Excel-based methodologies were developed for three pilot sectors. One methodology enables banks to analyse credit risk for borrowers in the agriculture and energy sectors. A second methodology, for real estate, enables banks to assess potential changes in property values and LTV ratios due to extreme weather events.	It is a set of methodologies, rather than data.	Excel-based methodology	N	Y	Acute and chronic	Counterparty datasets are not embedded in the methodologies; users must input this data. Some steps rely on global datasets, , for which there is guidance on how to access and use, and other steps use regional, country-specific or even more granular datasets (e.g. local-level analysis of agricultural yield).	2 and 4 degrees	The pilot study focused on the energy, real estate and agriculture sectors but the methodologies can be applied to a wide range of sectors, provided research exists to link changes in climate parameters with production characteristics of the sectors. The methodologies allow for both portfolio and asset level assessments. A portfolio level assessment is either based on the assessment of a sample of borrowers with findings extrapolated to the whole portfolio; or an assessment of the whole sector portfolio, using online risk assessment platforms (such as Bloomberg MAPS, which was used in a pilot for the energy sector or Swiss RE CatNet, used in the real estate pilot). The methodologies are primarily top-down: The methodologies for agriculture and energy rely on country and sub-sector-specific information; they draw upon published climate change impact assessments relating incremental climate changes to future changes in sub-sector productivity, for world regions and countries. These sub-sector impacts are assumed to apply to all counterparties within that sector and region / country. The impacts are combined with counterparty-level data held by the bank, (e.g. actual revenues, costs and credit risk rating) to generate counterparty-specific assessments of changes in PD. A representative sample of counterparties can be selected, and findings can be extrapolated to whole portfolios.	Banks participating in the UNEP FI Phase 1 and 2 TCFD pilot have full access; a truncated version is available in the Navigating a New Climate report	Sector level	Company level	For agriculture and energy, the methodology analyses how incremental change and extreme events impact on sub-sector productivity. It then translates climate change related impacts on future sub-sector productivity into adjustments to borrowers' revenues and cost of goods sold (COGS). Estimates of changes in revenues and COGS are used to evaluate changes in credit risk for individual borrowers and sector portfolios. This process involves stressing factors/ratios in the bank's rating models that have revenue and cost components and calculating revised risk grades across the portfolio. This is done for each time period (2020s and 2040s) and climate scenario (2°C and 4°C). For real estate, the methodology provides high-level estimates of changes in property values due to extreme events based on empirical evidence. Data on future return periods for extreme events under both scenarios are converted into 'encounter probabilities' – the chances of properties experiencing extreme events over the average remaining mortgage term for the portfolio. The encounter probabilities for each extreme event are multiplied by the high-level estimates of changes in property values, and the results are aggregated, to calculate the 'risk to property value' for each climate scenario and time period, across all relevant extreme events. Finally, the original property value is adjusted by the 'risk to property value', to arrive at revised LTV ratios.	https://www.unepfi.org/publications/banking-publications/navigating-a-new-climate-assessing-credit-risk-and-opportunity-in-a-changing-climate/
Acclimatise Aware for Projects	Aware for Projects uses the latest climate model outputs and other climate-related and geological hazard data. The tool combines this data with information about the sensitivity of your project to the hazards, and determines risk ratings for each individual hazard your project may face.	Global chronic and acute hazard indices derived from post-processed multi-model climate projections data for temperature and precipitation and a wide ranging suite of observed and modelled natural hazards data.	High level risk screening for infrastructure investments	N	Y	Acute and chronic	Include IPPC CMIPS, WRI Aqueduct, UNEP Global Risk Data Platform, Global Assessment Report 15.	4 degrees	Multi-sector, global application. Rapid natural hazard risk screening and evidence base at early stages of investment project cycle / initiation.	Cloud-based. Commercial basis organisation-level account setup. Unlimited number of organisational users.	N/A	Physical asset level (investment sub-sector)	Report (save as PDF): risk screening results with supporting narrative, questions to ask of project sponsors / designers, links to useful data sources and publications.	https://www.acclimatise.uk.com/analytics/applications/
Acclimatise Physical Risk Heatmapping Analytics	Acclimatise's Physical Risk Heatmapping Analytics provides an early indication of where higher risks may lie within a portfolio. Comprehensive in scope, the heatmapping covers whole investment portfolios. Based on an in-house analytics platform, it can be configured to the needs of individual clients. The analysis can be undertaken quickly and efficiently, and in line with general best practice, provides the first step in a tiered risk management approach.	Global chronic and acute hazard indices derived from over 30 hazard data sets and linked to eight value chain Vulnerability Indicators. The hazards indices derived from post-processed multi-model climate projections data and a wide ranging suite of observed and modelled natural hazards data.	High-level climate risk vulnerability heatmapping for investment portfolios	N	Y	Acute and chronic	Include IPCC CMIPS, US National Oceanic and Atmospheric Administration (NOAA), US National Aeronautics and Space Administration (NASA), the European Centre for Medium-Range Weather Forecast (ECMWF)	1.5, 2 and 4 degrees	Multi-sector, global application. Rapid physical risk heatmapping of diverse investment portfolios, helping to identify hotspots for deep-dive analysis. Results can be returned based on clients' own sector / subsector descriptors. The heatmapping can be run for any required time horizon between 'Present day' and end-of-century.	In-house toolkit	N/A	Portfolio-wide, asset or counterparty level.	Excel-based, colour-coded physical risk heatmapping matrix of investments versus geographies. Supporting 'white-box' report on the Heatmapping methodology and client-customised reporting on key outcomes. Additional narrative, analysis and support with disclosure reporting can be provided upon request.	Acclimatisehttps://www.acclimatise.uk.com/analytics/applications/
AIR	BoE physical risk assessment for insurers	Methodology	Catastrophe Model	N	Y	Acute risks	Science based	Various scenarios by region/peril including US hurricane, UK flood, UK windstorm etc.	(Re)insurance portfolios, mortgage portfolios, real estate portfolios	Licensed through vendor and delivered through software, consulting reports etc.		Flexible resolutions e.g. Asset level or portfolio level	Detailed output from AIR models is the basis for understanding and quantifying catastrophe risk. It is the "currency" by which risk is priced, transferred, and traded, and applications today go far beyond those within the insurance industry. Critical metrics produced by AIR models include - average annual loss - exceedance probability - probable maximum loss - tail VaR	https://www.air-worldwide.com/Models/About-Catastrophe-Modeling/
Ambiental	BoE physical risk assessment for insurers	High resolution (5m) 2-d flood hazard mapping for full GB showing current and future flood depths through time.	Hazard maps	N	Y	Physical: acute and chronic	5m LiDAR/photogrammetry, local best practice national hydrological data (CEH), UKCP09/18 and prevailing EA/SEPA/NRW guidance.	Low Emissions (RCP 2.6/RCP 4.5), Medium Emissions (RCP 6.0) and High Emissions (RCP 8.5).	This product can be tailored for use with any type of asset/portfolio within the coverage of GB.	Annual licence for either complete dataset, or portfolio-run (e.g. quarterly, bi-annual, etc.)	Impact assessment available from individual asset-level to postcode, regional or national aggregation.	Property-level assessment.	Flood Hazard Mapping (GIS); Property-Level/Postcode-Level or Portfolio-Level flood hazard data and £AAL for now and into the future (2020s, 2050s and 2080s)	https://www.ambientalrisk.com/floodfutures/
Baringa Partners LLP Baringa Climate Change Scenario Model	Baringa's Climate Change Scenario Model enables financial institutions to run integrated physical and transition scenarios on their portfolios; and to assess the temperature alignment of their portfolios. The model enables the assessment of a comprehensive range of asset classes including loans, equities, bonds, mortgages and direct holdings of property. The model is fully configurable, providing full visibility of climate impacts at portfolio down to individual asset level. It provides both Baringa standard scenarios aligned with the NGFS and Bank of England scenarios, and bespoke scenario development to reflect firms' internal views. Baringa's unique Climate Change Scenario Model is built on our 20 years of experience in advising governments, energy and financial services clients on the energy transition and climate change and has been selected for use by some of the world's largest financial services institutions, including a number of the BES7 banks	Transition and physical risk on equities, bonds, loans, mortgages and physical assets. Temperature alignment.	Scenario and temperature alignment model	Y	Y	Physical: acute, chronic Transition: Policy, legal, technology, market, reputational	Multiple data sources, curated by Baringa. Over 500,000 data points on transition. Physical risk analysis 70 million physical assets owned by 4 million companies. Support for incorporation of 'in-house' views on sector and region transition, and company level mitigation plans.	Baringa standard scenario for 4°C, orderly 2°C and disorderly 2°C. Scenario expansions for any external (e.g. regulatory) scenario. Fully configurable, customisable firm-specific scenarios to support what-if analysis.	The model has full multi-sector, global coverage capable of full coverage of listed and unlisted companies along with exposures to real assets: - Equity (listed and unlisted) - Bonds (corporate and sovereign) - Loans - Mortgages - Real assets (e.g. direct holdings of property, private placed corporate debt & infrastructure assets) - Vehicle Finance	External paid for vendor - Model access typically as a license - Extensive accompanying advisory support available Ability to deliver by: - standard flat files or SQL database, with a visualisation layer to support detailed drilldown (analytics as a service) - Integrated in house or cloud based hosting system (software as a service)	Impacts on sector- and region-level fundamentals	Outputs a multiple levels: - Sector- and region-level - Portfolio level - Company / counterparty level - Instrument-level / loan-level - Physical asset-level	Scenario impacts: Value change; impairment. Current and projected financed emissions. Temperature alignment based on sector and region transition pathways. Drilldown to individual companies, positions and physical assets. Corporate level metrics including impacts on profit, balance sheet, credit rating, and probability of default. Instrument (bond and equity) value impacts. Loan impairment impacts (unsecured loans and mortgages).	https://www.baringa.com/en/climatechangescenariomodel/
Carbon4 Finance	Transition risk: Carbon Impact Analytics (CIA) is a methodology for assessing the climate impact of portfolios through the measurement of GHG emissions directly and indirectly induced and saved by companies. CIA also asses the alignment of investor and lender portfolios with the Paris 2° objective. Carbon4 finance also provides Physical risk evaluation of these issuers with Climate Risk Impact Screening (CRIS). The CRIS method allows asset managers and investors to know the level of risk in their portfolios so that they can manage this risk, track it over time and engage in dialogue with the underlying companies about their vulnerability to climate change.	Methodology Bottom-up Analysis	Framework Sectoral calculation modules	Y	Y	Physical: acute and chronic. Transition: policy and technology	Reported information, emissions recalculated by analyst team based on sectoral modules.	Physical: >3, 4, 6 degrees. Transition: 2, 4, 6 degrees	Global Equities, Corporate, Sovereign and Green bonds Real assets (Private equity, Real Estate, Infrastructure)	External paid for vendor Annual licence fee to database. Data and analysis available on web platform API / datafeed can be developed on demand	Sector and country levels	Asset and Company levels	Identify corporates and sovereigns which have a high transition and/or physical risk. Identify best-in-class corporates or companies which strongly contribute to decarbonisation and will create value. CIA and CRIS results can be used to : - support strategic decision of investors in portfolio construction; - develop thematic or sector-specific investment strategies; - measure climate-related risks in loan books or investment portfolios; and - create indices or benchmarks based on climate performance.	https://www.unpri.org/climate-change/directory-of-climate-scenario-tools/3606.article http://www.carbon4finance.com/
ClimateWise	ClimateWise Transition Risk framework. Purpose: framework to assess the impact of transition risk and opportunity on the financial performance of investments in infrastructure at the portfolio and asset level. Coverage: includes a step-by-step guide and case studies for investors to: - assess the breadth of asset types exposed to transition risk and opportunity; - define potential impact of transition risk at the asset level; and - incorporate transition impacts into an asset financial model.	Methodology	Framework	Y	N	Policy and technology	CISL website	2 and 4 degrees	N/A	External paid for vendor	Sector and country levels	Asset level	Navigating the Transition open-source framework step-by-step guide to: - inform investors and regulators on the future allocation of funds and diversification of investment portfolios; - indicate investment options for asset managers and owners to help improve asset resilience; and - enable quantification of potential impact on asset returns, investment options or exit strategies.	https://www.unpri.org/climate-change/directory-of-climate-scenario-tools/3606.article
ClimateWise Transition risk framework	ClimateWise Transition risk framework. Purpose: framework to assess the impact of transition risk and opportunity on the financial performance of investments in infrastructure at the portfolio and asset level. Coverage: includes a step-by-step guide and case studies for investors to: - assess the breadth of asset types exposed to transition risk and opportunity; - define potential impact of transition risk at the asset level; and - incorporate transition impacts into an asset financial model.	Methodology	Framework	Y	N	Market, policy and technology	CISL website	Business as Usual, Paris Agreement Scenario and 2 Degree Scenario	N/A	Original delivery external paid for vendor, ongoing access by CISL	Sector and country levels	Asset level	ClimateWise Transition Risk Exposure Matrix to: - inform investors and regulators on the future allocation of funds and diversification of investment portfolios; - indicate investment options for asset managers and owners to help improve asset resilience; and - enable quantification of potential impact on asset returns, investment options or exit strategies.	www.cisl.cam.ac.uk/transitionrisk

ClimateWise Physical risk framework	ClimateWise Physical risk framework. Purpose: framework demonstrates how investors and lenders can make use of insurance industry catastrophe modelling tools and metrics to improve their management of the physical risks of climate change, especially by encouraging adaptation measures in targeted areas. Coverage: includes a step-by-step guide for real estate investors and lenders to understand and measure the potential physical risks of climate change on their portfolios.	Methodology	Framework	N	Y	Acute and chronic	CISL website	2° and 4° degrees	N/A	External paid for vendor	Country level	Asset level	ClimateWise Physical risk approach quantified the increase in physical risks from floods on UK assets, European winter wind storms and tropical cyclones in North America and the Pacific Rim. The physical risk is quantified as: - number of properties at 'considerable' risk - expected average annual losses - geographic clustering of expected losses - implied value impairment of property - impact of adaptation in reduction of loss	https://www.cisl.cam.ac.uk/resources/sustainable-finance-publications/physical-risk-framework-understanding-the-impact-of-climate-change-on-real-estate-lending-and-investment-portfolios
ERM	Climate Risk and Opportunity Portfolio Screen - Scenario identification and development - Scenario indicator mapping to portfolio - Prioritisation of risk and opportunity exposure in portfolios, including through heat maps	Methodology	Framework	Y	Y	Physical: acute and chronic. Transition: policy, legal, market, reputation and technology	Various. The methodology is designed to leverage publicly available scenario data sets. Transition analysis typically leverages IEA with additional data from other sources, where relevant to the sector(s) / counterpart(ies) under study. Physical analysis leverages IPCC with additional data from other sources depending on the location of assets under study.	Typically transition: - Base case (BAU, no progress to decarbonisation, e.g. IEA Current Policies Scenario) - Transition case (2C or 1.5C scenario, e.g. IEA Sustainable Development) Physical: - Base case (e.g. RCP 8.5) - Low carbon case (e.g. RCP 2.6 or RCP 4.5)	Flexible to all investment asset classes and credit portfolios	External paid for vendor	Sector level	Undertaken at sector or company level across the portfolio	Key outputs include: - Scenario indicator data, with guidance to relevance, and including baseline climate data for physical risks and opportunities - Sector or company exposure ratings - Risks and opportunities reviews - Heat maps - Climate indicator dashboards	Energy & Climate Change - www.erm.com/service/capabilities/Energy-Climate-Change/ Low Carbon Economy Transition - www.erm.com/service/Low-Carbon-Economy-Transition/
ERM	Climate Financial Driver and Impact Assessment - Sector segment through to counterparty level assessment granularity - Scenario-based approach - Quantification of climate financial risk and opportunity (i.e. impact of transition and physical climate risks and opportunities on CAPEX, OPEX, Revenue) - Integration of analysis into risk management processes and tools (e.g. credit)	Methodology	Framework	Y	Y	Physical: acute and chronic. Transition: policy, legal, market, reputation and technology	Various. The methodology is designed to leverage publicly available scenario data sets. Transition analysis typically leverages IEA with additional data from other sources, where relevant to the sector(s) / counterpart(ies) under study. Physical analysis leverages IPCC with additional data from other sources depending on the location of assets under study.	Transition: - Base case (BAU, no progress to decarbonisation, e.g. IEA Current Policies Scenario) - Transition case (2C or 1.5C scenario, e.g. IEA Sustainable Development) Physical: - Base case (e.g. RCP 8.5) - Low carbon case (e.g. RCP 2.6 or RCP 4.5)	Flexible to all investment asset classes and credit portfolios	External paid for vendor	N/A	The tool is adaptable and has been used for sector-level, sub-sector level, and counterparty level assessment	Excel-based tool, supporting analysis & insight	Energy & Climate Change - www.erm.com/service/capabilities/Energy-Climate-Change/ Low Carbon Economy Transition - www.erm.com/service/Low-Carbon-Economy-Transition/
ERM	Programme / Framework Development - Capacity building / training - Gap analysis / benchmarking - Assessment tools - e.g. scorecards - for first / second line - Implementation planning - Strategy integration - Risk framework integration - Disclosure planning and preparation	Advisory support	Programmatic	Y	Y	Physical: acute and chronic. Transition: policy, legal, market, reputation and technology	ERM has a number of tools and methodologies for supporting clients in building and implementing their climate financial risk and opportunity programs including: - TCFD Readiness Assessment - TCFD Disclosure Benchmarking Tool - Climate Executive Training Program - Climate Relationship / Investment and Risk Managers Training Program - Climate Risk and Opportunity Assessment Workshops	Transition: - Base case (BAU, no progress to decarbonisation, e.g. IEA Current Policies Scenario) - Transition case (2C or 1.5C scenario, e.g. IEA Sustainable Development) Physical: - Base case (e.g. RCP 8.5) - Low carbon case (e.g. RCP 2.6 or RCP 4.5)	Flexible to all investment asset classes and credit portfolios	External paid for vendor	N/A	N/A	Overall programme development building capacity, strategy, implementation plans, risk frameworks, disclosure, etc.	Energy & Climate Change - www.erm.com/service/capabilities/Energy-Climate-Change/ Low Carbon Economy Transition - www.erm.com/service/Low-Carbon-Economy-Transition/
Four Twenty Seven (427)	Four Twenty Seven's tool helps investors identify climate risk exposure in their portfolios and design new investment strategies. This model measures exposure and sensitivity to climate impacts (storms, droughts, floods, heat waves, wildfires, sea level rises) at the facility-level for publicly-listed companies and real asset portfolios. Focuses on exposure to tail risks and change from current conditions against a 2020-2040 timeframe.	Location and hazard data	Web-based application for on-demand scoring of single or portfolio of assets. API delivery for equities/FI, bonds and other listed instruments scores.	N	Y	Physical: Acute and chronic (floods, sea level rise, heat stress, water stress, cyclones, wildfires)	Global Climate Models (IPCC), NASA, NOAA, Environmental Space Agency, World Meteorological Organization, WRI, Fathom.	4 degrees	Global Equities, fixed income, Sovereign bonds, munis, and real assets.	External paid for vendor	Sector and country levels	Asset and Company levels	Identify assets, sectors and geographies most vulnerable to physical impacts of climate change. Build a risk mitigation strategy and resilience plan based on granular assessment. Perform due diligence for new asset acquisition. Inform quantification of financial impacts on firm.	http://427mt.com/our-solutions/
JBA Risk Management	BoE physical risk assessment for insurers Aiming to provide a realistic view, the model reflects warming consistent with a 2°C increase in global temperatures by 2100, in line with the Paris Agreement's long-term temperature goals set at COP21 in 2015, for the time slice 2010 – 2039 (2020s). To develop this model, climate change allowances available from the UK Climate Change Risk Assessment 2017 and UK Climate Projections 2009 (UKCP09) are applied to the JBA UK Flood Event Set to adjust the hazard intensity of events. Each event in the stochastic event set is defined in terms of the return period of the hazard intensity (of river flow, rainfall or sea level) at all affected gauges. The allowances denote the expected change in river flow, rainfall and sea level under the chosen scenario and are used to adjust the return period of river, surface water and coastal flooding, respectively. The impact on events varies geographically – 200-year events are up to five times more severe by 2040 than 2018 across most of the UK, but up to two times less severe in the south-east.	Climate change catastrophe loss data	Catastrophe Model	N	Y	Physical: acute and chronic	Uses climate projections from UKCP09 and the UK Climate Change Risk Assessment 2017. Physical hazard based upon JBA's market-leading UK 5m Flood Maps and UK Flood Event Set.	2°C warming by 2100.	Portfolio management and diversification.	Accessed via portfolio analysis services provided by JBA Risk Management, or our catastrophe modelling platform, JCalF®. The models can also be accessed via Oasis and Nasdaq Risk Modelling.	Losses are available at resolutions from country-level through to postcode-unit level for the UK.	Asset and company-level available.	Working with the insurance and property industries, governments and financial institutions, we help our clients to understand, manage and quantify flood risk across the world. Our UK Climate Change Flood Model enables users to understand, and quantify, the magnitude of change in flood risk associated with a realistic climate change scenario and identify areas which may be more or less susceptible to flooding under a warmer climate. Losses from the climate change model will aid proactive management of portfolios most susceptible to climate change-induced flood risk, allowing for the future planning of portfolio diversification to less susceptible areas.	https://www.jbarisk.com/flood-services/catastrophe-models/ https://www.jbarisk.com/flood-services/catastrophe-models/flood-models/uk-flood-and-uk-climate-change-flood-models/ https://www.jbarisk.com/media/1710/uk-flood-model-executive-briefing-august-19-v12.pdf
KatRisk SoloKat Flood Maps	Inland Flood Risk under current and future climate	Simulation data, flood hazard maps and associated loss	Location-level Risk calculation	N	Y	Physical: acute and chronic. Transition: policy, market, reputation and technology	Global Precipitation and atmospheric data, Digital Terrain Models, River Gauge Data	Current Risk, Warming 0.25 Kelvin C, 0.5 K, 1K and 2K	Global real estate	Online Tool or API call	-	Portfolio bulk lookup of Location Risk	Average Annual Loss, Probable Maximum Loss at user-supplied return periods (e.g. 10, 20, 50, 100, 500 year)	http://www.katrisk.com
KatRisk SoloKat Nuisance Flooding	Sunny day flooding of coastal areas due to high tides, sea level rise and subsidence	Simulation Data, tide levels and associated financial loss	Location-level Risk calculation	N	Y	Physical: acute and chronic. Transition: policy, market, reputation and technology	Sea level rise scenarios, current and historic gauge data, subsidence datasets	NOAA SLR scenarios for North America, IPCC for rest of world	Real estate	Online Tool or API call	-	Portfolio bulk lookup of Location Risk	Flood Frequency and depth by scenario and decade (2010 – 2100)	http://www.katrisk.com
KatRisk SpatialKat North America Probabilistic Model	US and Canada Inland Flood, Tropical Cyclone Wind and Storm Surge Model	Simulation Data, Probabilistic Event Set, loss calculation	Portfolio Level Risk	N	Y	Physical: acute and chronic. Transition: policy, market, reputation and technology	Meteorological, Hydrological and Topographic data, loss and vulnerability	Current Risk, user-chosen scenarios for increased precipitation, sea level rise and changes in TC frequency	US and Canada real estate	In-house or cloud based hosting	-	Portfolio and location level loss CDFs	Loss by event on various output levels, EP curves and loss statistics	http://www.katrisk.com
KatRisk SpatialKat European FloodModel	Europe-wide inland flood model with climate perturbations	Simulation Data, Probabilistic Event Set, loss calculation	Portfolio Level Risk	N	Y	Physical: acute and chronic. Transition: policy, market, reputation and technology	Meteorological, Hydrological and Topographic data, loss and vulnerability	Current Risk, user-chosen scenarios for increased precipitation	Europe excluding Russia and Turkey real estate	In-house or cloud based hosting	-	Portfolio and location level loss CDFs	Loss by event on various output levels, EP curves and loss statistics	http://www.katrisk.com
Moody's	Moody's leverages data from its affiliates 427 and VE to provide climate-adjusted PDs/LGDs and quantify the financial impacts of transition risk and physical risk on asset valuation, cash flow, volatility, credit risk, spread.	Financial data	Delivery via Excel or API. Web-based application under development.	Y	Y	Physical: acute and chronic; Transition: regulatory, market, consumer	Four Twenty Seven and Vigeo-Eiris	Orderly transition (2 degrees), late and disorderly transition (~2 degrees), hot house (4 degrees), accelerated meltdown (4+ degrees)	Equities/FI, sovereigns	External paid for vendor	Sector/region. Macroeconomic models including climate scenarios are also available.	Company level. Asset level (real estate)	climate-adjusted PDs, LGDs, spreads, as well as portfolio risk metrics for each scenarios	http://esg.moodys.io
MSCI	MSCI offers climate risk data through MSCI ESG Research LLC. The data is available on its proprietary platform, ESG Manager. Analytics clients can also integrate MSCI climate data and MSCI Indexes into their security selection and portfolio construction processes, stress testing, and risk and performance attribution analysis.	Climate data both bottom up (emissions, management assessment, asset level information) and top down (from climate models)	Carbon emission footprints, climate value-at-risk, low carbon transition assessment all feeding into analytics platform for risk management and portfolio construction / reporting purposes.	Y	Y	Acute and chronic physical risks, broken down by hazards. Transition: policy risks and technology opportunities.	Reported information and own approach	1.5, 2 and 3 degrees	Global Equity, corporate bonds, sovereign bonds, real estate assets	External paid for vendor	N/A	Asset level, Company level, portfolio level	Over 700 climate change metrics including Climate Value-at-Risk, carbon management assessment, carbon and clean tech metrics and fossil fuel screens. Scalable client reporting and automated report generation on the climate risk and opportunities exposure of portfolio. Range of indexes for institutional investors who seek to incorporate climate risks and opportunities into their investment process.	https://www.msci.com/climate-solutions
Oliver Wyman for UNEP FI Banking Pilot,	This report synthesizes the efforts of a Working Group of sixteen international banks convened by the UN Environment Finance Initiative (UNEP FI) and supported by Oliver Wyman to develop a methodology for assessing the risks and opportunities associated with the transition to a low-carbon economy (the "transition-related" impacts associated with climate change). As such the methodology addresses the Strategy element of the TCFD recommendations around the use of scenario analysis for forward-looking assessments of transition-related impacts. A Working Group of 39 financial institutions is now piloting this methodology (Phase 2 of UNEP FI TCFD banking pilot).	Scenario data Company financial statements Sector characteristics Emissions	Transition Assessment	Y	N	Transition risk (policy, technology, market sentiment…)	Reported information PIK/IIASA	1.5 degree 2 degree Delayed 1.5 degree Delayed 2 degree Low CDR 1.5 degree Low CDR 2 degree Npi NDC	Corporate loans and bonds	Report: public Tool: UNEP FI members	Sector and country level	Company level	The methodology identifies how a low-carbon policy and technology transition to mitigate climate change could impact the credit risk of a bank's corporate loan portfolio, as well as its commercial strategy: it helps build awareness of climate risks and opportunities. The outputs include name-level scenario-adjusted rating, probability of default, and expected loss for banks' counterparties.	https://www.unepfi.org/wordpress/wp-content/uploads/2018/04/EXTENDING-OUR-HORIZONS.pdf https://www.oliverwyman.com/our-expertise/insights/2018/apr/extending-our-horizons.html

Ortec Finance ClimateMAPS: systemic climate risk-aware economic & financial scenarios	Climate MAPS quantifies the systemic impacts of climate change, including both transition risk and physical risk, on the real economy and financial markets. The tool equips investors with knowledge and quantified data of what their systemic climate-related risks/opportunities are, where they are, and what trends they can anticipate over time and across multiple scenarios. This enables consistent integration of climate risk into investment decision-making. ClimateMAPS provides Economic & Financial Climate Risk Scenario Analytics for Pension Funds, Insurance Companies, Sovereign Wealth Funds, Personal wealth advisors, and Asset Managers. ClimateMAPS enables: - Climate-aware risk management for SAA/ALM and/or ORSA/stress-testing; - Exploring quantified impacts on strategic asset allocation from a holistic balance sheet framework; - Insights into resilience of portfolio's risk budget under different climate scenarios; - Assessing financial impact and materiality of climate change across all asset classes within portfolio; - Insights on how to increase resilience through asset-, regional-, and sector- reallocation; - Provide retail or high-net-worth clients with climate risk-aware personal wealth management services; - Develop systemic climate risk-aware investment products; - Fulfil climate scenario analysis for TCFD disclosure.	Delivered in clients' preferred data format, e.g. Excel, csv, JSON, etc.	Flat file data delivery (or reporting service)	Y	Y	Physical: gradual physical risks and climate attributable extreme weather risks. Transition: Policy and Technology drivers Market sentiment risk: pricing-in effects of both transition and physical risks	The model combines complex climate science (e.g. from IPCC reports, the GENIE climate model, and scientific literature) with the macro-econometric model E3ME of Cambridge Econometrics, as well as the stochastic financial model of Ortec Finance. Each of these methodological steps is based on a multitude of input sources. All clients receive a detailed technical methodology document which references all relevant sources across these modelling steps.	1) Paris orderly transition -> average global temperatures below 2ºC by 2100 (IPCC RCP 2.6) 2) Paris disorderly transition ->average global temperatures below 2ºC by 2100 (IPCC RCP 2.6) and 3) Failed transition –> average global temperatures rising to around 4ºC by 2100 (IPCC RCP 6.0) Additionally, clients have the option to define their own bespoke climate scenario, changing any of the underlying input assumptions/data (e.g. carbon price levels) and/or how these are implemented (e.g. timing of disorderly sentiment shock).	Available scope per climate scenario: Transition Risks & Opportunities: Policy Drivers (carbon pricing, energy efficiency, subsidies, phaseouts, etc.) and Technology Drivers (low-carbon technologies across sectors; technology uptake curves). Physical Risks: Gradual Physical Risks (agricultural productivity; worker productivity; sea level rise) and Climate-attributable extreme weather risks (climatological, meteorological, hydrological event frequency & loss impacts) Per scenario (climate pathway), covering transition and physical risks, the year by year impact (i.e. climate-adjusted growth expectations & pricing in dynamics) of climate change up to 2060 is available for economic variables (GDP, interest rates, inflation), all asset classes (Fixed Income; Corporate credits; Equities; Real Assets; Alternatives; Commodities; Currencies) for 28 countries. For GDP and equity returns, the sector level detail is also available.	The web-based Climate Scenario Pathway Narratives portal combines all the underlying data and assumptions used in our Climate MAPS solution and enables users to understand and interpret the climate scenarios. It then shows how these pathways translate into resulting effects on key macro-economic drivers and different asset classes. The ClimateMAPS economic and (non-)financial climate informed scenarios are provided by means of an annual dataset license. Investors can apply these systemic climate risk-aware scenarios as input in their internal SAA or ALM/ORSA tooling to test the robustness of the asset portfolio and/or solvency position for climate change. Delivered in clients' preferred data format, e.g. Excel, csv, JSON, etc. Alternatively, if clients do not want to run analytics themselves, we also offer a reporting service, where we run the analysis and deliver a Climate Risk Portfolio Scan Report containing the	ClimateMAPS is a tool that delivers output variables for assessing macro-economic impact. In addition GDP, interest rate, inflation data for each climate scenario, it is also possible to deliver other direct output data from Cambridge Econometrics' E3ME model, including variables such as: - Components of GDP (household expenditure, investment, government expenditure, international trade volumes) - Sectoral output and GVA, prices, investment, trade and competitiveness effects - Sectoral employment, unemployment, labour supply - Fuel mix (4 fuel types) - Power generation mix (9 technologies) - Wholesale energy prices - Commodity prices - CO2 emissions by sector and by fuel; other airborne emissions This data is available across 61 global regions (incl. all G20 and EU Member States), as well as	N/A	Systemic climate risk-aware economic & financial scenarios. Per scenario (climate pathway), covering both transition and physical risks, the year by year impact of climate change for all asset classes and economic variables for 28 countries up to 2060 is available as quantified datasets in the user's preferred format. The dataset provides quantified climate-adjusted growth expectations & pricing-in dynamics in annual timesteps and enables the user to analyse not only the total climate impact, but also the disaggregation to each of the climate risk factors (transition risk, gradual physical risk, climate-attributable extreme weather risk, pricing-in dynamics, sentiment shock) for each of the 600+ variables contained in the dataset. In addition, forward-looking year-by-year non-financial climate informed scenarios (file service) from the Cambridge Econometrics E3ME model is available. Per climate pathway and region, this includes for example the required fuel-mix, power generation-mix, vehicle technology-mix, wholesale energy prices.	Ortec Finance, ClimateMAPS, last update: June 2020. More info available: www.climatemaps.app
Ortec Finance ClimatePREDICT: climate-attributable extreme weather risk and impact model	ClimatePREDICT enables financial institutions to quantify future climate change related physical risks per climate pathway based on the client's specific geographical exposure to these risks. For any given climate pathway, PAL predicts event frequency by location - we cover over 1800 cities worldwide - and by type of event – storm, extreme rainfall and extreme temperatures – and the extent to which these events can be linked to climate change. This is relevant for financial institutions such as Banks, Real Estate Managers, Pension and Insurance companies. ClimatePREDICT enables financial institutions to map their physical exposure to these catastrophe risks and quantify the impacts, e.g. on: - Mortgage risk - Real estate valuation - Property and Casualty underwriting risks - Capital Market return assumptions	Delivered in clients' preferred data format, e.g. Excel, csv, JSON, etc.	Flat file data delivery	N	Y	Climate attributable extreme weather risks - disaggregated per peril type: - climatological (drought, wildfire), - hydrological (flood, extreme rainfall, hail), - meteorological (storms)	ClimatePREDICT is using our unique in-house extreme weather risk and impact model, PALgamma. PALgamma uses a statistical algorithm to identify at-risk locations and total number of loss events per year based on hazard loss data. This is then combined with global event attribution modelling that determines the extent to which each event can be linked to climate change. We provide the user with full documentation of the PALgamma model and all its underlying data sources, including, for example, NOAA data on temperature anomality, UN urbanisation projections, as well as historic natural disaster event databases for calibration purposes.	1) Paris transition -> average global temperatures below 2ºC by 2100 (IPCC RCP 2.6) 2) Failed transition –> average global temperatures rising to around 4ºC by 2100 (IPCC RCP 6.0) It should be noted that the PALgamma model can deliver outputs for any chosen temperature pathway, using TCRE.	Quantified year-on-year (up-to 2100) and geographical exposure to physical climate risk. E.g., the expected increase in number of storms, floods, drought and wildfires, as well as the related expected direct losses, at any given year and location (incl. the differences across climate scenarios).	Annual dataset license. Investors can apply this data as input in their internal tooling. - For example, the impact of an increased number of storms on the expected costs and value of a property. Or enhance insurance companies in-house Property and Causality catastrophe models with the impact climate change may bring on insurance claims. Delivered in clients' preferred data format, e.g. Excel, csv, JSON, etc.	ClimatePREDICT can also translate the expected changes to event frequency and direct losses into GDP impacts per country and year and thus highlight differences in expected climate-attributable extreme weather impacts on future GDP growth across countries worldwide.	N/A	Delivered in clients' preferred data format, e.g. Excel, csv, JSON, etc. Dataset includes # of extreme weather events and associated direct losses (US$) in annual timesteps up to 2100 per type of extreme weather peril for each location (1800 cities and/or country level). This dataset is available for both climate scenarios as well as a climate-uninformed baseline. On a bespoke basis, the dataset can also be delivered for specific locations (GIS coordinates) of interest to the user.	Ortec Finance, ClimatePREDICT, last update: June 2020 More info available: https://www.ortecfinance.com/en/solutions/application/climate-esg-solutions
PCAF	PCAF is a global partnership of financial institutions that work together to develop and implement a harmonized approach to assess and disclose the greenhouse gas (GHG) emissions financed by their loans and investments, in line with the GHG Protocol. The harmonized accounting approach provides financial institutions with the starting point required to set science-based targets and align their portfolio with the Paris Climate Agreement.	Methodology	Measuring financed emissions	Y	N		Various (publicly available) data sources	N/A	PCAF standard covers methodologies for measuring financed emissions of mortgages, commercial real estate, business loans, listed equity and bonds, project finance and motor vehicle loans.	No cost	N/A	Financed emissions are measured at client-level, and afterwards aggregated at asset-class and portfolio level	Absolute GHG emissions financed by loans and investments (in line with GHG Protocol Scope 3 Cat. 15 Investments)	www.carbonaccountingfinancials.com
RMS	For over 30 years, RMS has shaped the world's view of risk. RMS leads the catastrophe risk industry that we helped to pioneer. We marry data and advanced model science with leading-edge technology to create the most comprehensive catastrophe risk models, applications, and APIs. Leaders across multiple industries can address the risks of tomorrow with RMS Risk Intelligence™, our open, unified cloud platform for global risk. Insurers, reinsurers, financial services organizations, and the public sector trust RMS to help them better manage and navigate the risks of natural and man-made catastrophes.	Hazard, Impact, Loss and Disruption modelling and data	Risk analytics models; hazard and risk scoring data sets; a big data exposure and loss analytics platform; consulting services	N	Y	Physical Climate Risk: flood, wildfire, windstorm (tropical cyclone [hurricane, typhoon], extratropical cyclone, severe convective storm, hail, winterstorm). Other risks: pandemic, earthquake/tsunami, terrorism, life mortality and morbidity.	Models are based on peer reviewed science, third-party data, and proprietary in-house developed data. Exposure data can be provided by the client or build from proprietary database.	*Client specified* *[Adjustable based on client requirements]*	A global catalogue of climate risk models that assess insurance instruments and portfolios, physical asset portfolios and investments, location-based risk assessments, and infrastructure risk.	Analytics can be delivered via either a client-run SaaS platform or consulting services.	Global exposure databases can be used to assess macro impacts.	Probabilistic (VaR) analysis available at the client's location, regional, or portfolio level. Metrics can include net loss probability, uncertainty statistics, risk scores, and loss of use estimates in highly configurable reports.	Value-at-Risk based output at any resolution along with uncertainty statistics. Risk scores, hazard information and scores. Exposure summaries and statistics. Data quality scores. Enhanced exposure data sets.	https://www.rms.com/products/models
South Pole	South Pole's Sustainable Finance services enable the assessment of transition and physical climate risks, as well as forward-looking scenario analysis. Our services have been designed in line with TCFD and regulatory frameworks. This work supports sustainable investment and lending strategies at banks, asset managers and asset owners. Our services offer a quick and flexible screening using environmental data combined with advisory from our consultants, who include climate scientists and financial sector experts. Assessments can be completed at portfolio, sector or holding level with global sectoral and geographical coverage. IPCC, OECD and ND-GAIN data is modelled for major physical risks, defined by hazard, vulnerability and exposure. Transition risks are calculated by integrating OECD and IEA data which assess the risk for IEA and SSP scenarios.	CO2 data, scientific inputs	Footprints (Co2, land and water), Paris alignment, Climate risk assessments	Y	Y	Physical: acute and chronic. Transition: policy	IPCC, OECD and ND-GAIN	IEA and SSP	Equity and fixed income investment portfolios, Loan portfolios	External paid for vendor - Available on commercial terms depending on portfolio size and the level of analysis required.	Sector and Country level	Company level	The South Pole tools and services categorise and plot the major climate risk 'hotspots' through business activities, operations and along the supply chain, identifying areas for attention. South Pole's analysis enables financial services to understand vulnerabilities to the impacts of physical and transition risks resulting from climate change. Our services include: - Measurement of portfolios' global climate risk exposure (transition & physical risks) - Scenario analysis - which compares climate risk exposure of underlying holdings across different climate change mitigation scenarios - Comparison of holdings' risk exposure across sectors and geographic portfolios	https://www.southpole.com/sustainability-solutions/measure-impacts-and-assess-sustainability-risks
Sustainalytics	Next generation ESG research and ratings, are designed to help investors identify and understand financially material ESG risks at the security and portfolio level.	Carbon Risk Rating	ESG Scoring	Y	N	Transition Risk policy, legal, technology, market and reputational risk	Company reporting	N/A	Global Equities	External paid for vendor	Sector level	Company level	Report insights: - Company ratings are categorized across five risk levels: negligible, low, medium, high and severe. - A company's risk is measured against its industry peers and against the global universe. - Companies are exposed to different ESG issues to different degrees. Exposure assessment is driven by sub-industry and company-specific factors - The magnitude to which a company is exposed to ESG and how well the company is managing that risk is measured and explained. - Material ESG Issues (MEIs) are identified and brought into focus.	https://www.sustainalytics.com/esg-ratings-for-companies/#1530569101275-ef381f7e-5014
TCFD	The Task Force on Climate-related Financial Disclosures (TCFD) have developed voluntary, consistent climate-related financial risk disclosure recommendations for use by companies in providing information to investors, lenders, insurers, and other stakeholders.	Methodology	Framework	Y	Y	Physical: acute and chronic. Transition: policy, market, reputation and technology		<2, 2 degree			Sector level		The work and recommendations of the Task Force will help firms understand what financial markets want from disclosure in order to measure and respond to climate change risks, and encourage firms to align their disclosures with investors' needs.	https://www.fsb-tcfd.org/
The Transition Pathway Initiative (of which PRI is secretariat) (TPI)	Sector-level analysis of companies' management of carbon emissions and alignment with the Paris Agreement. TPI uses company-disclosed data. Evaluates and tracks the quality of companies' management of their GHG emissions and of risks and opportunities related to the low-carbon transition. Evaluates how companies' future carbon performance would compare to the international targets and national pledges made as part of the Paris Agreement.	CO2 data	Alignment with Paris Agreement	Y	N	Policy and technology	Reported information - FTSE Russell	B2DS, 2 degrees	Global Equities	Limited/no cost	Sector level	Company level	In-depth sector analysis of industrial sectors (including steel, mining and automotive).	http://www.lse.ac.uk/GranthamInstitute/tpi/about/how-investors-can-use-tpi/
Vigeo Eiris	Vigeo Eiris Climate Risk Assessment products have been designed to provide investors with a comprehensive set of tools that can be used to effectively identify risks and opportunities associated with climate change and the transition to a low carbon economy. Alignment with the TCFD: Our solutions are in line with the Task Force on Climate-Related Financial Disclosures (TCFD) recommendations Back History: VE's Carbon Footprint and Energy Transition product provides investors with up to 10 years of back history making the data suited to back testing for fund and index development as well as trend analysis.	Carbon Footprint Energy Transition Assessment Physical Riks Management Assessment TCFD Climate Change Strategy Assessment Green Share Assessment Brown Share Assessment Climate Controversies	Access to data provided though web-based platform or xl delivery. Company Profiles / Reports accessed through the web platform. Portfolio reports can be delivered by VE's team.	Y	Y	Transition: Management of Market, Technology, Policy and Legal, Reputational Risks Physical: Management of physical risk (acute and chronic)	Company Reported data + own approach for estimations of GHG emissions, science based	For the Energy Transition Scores no particular scenario is used. The scoring methodology is built based on a "best in class" approach and a responsibility respective thus enabling the assessment of all sectors.	Global Equities / Sovereign Bonds / fixed income	External paid for vendor	Sector level	Company level	Identify most/least emitting issuers. Identify investable universe based on best performers in terms of decarbonisation strategy and most exposed to transition risks. Identify best performers in terms of TCFD alignment and disclosure. Disclose in alignment with TCFD. Built own strategy using web based interactive platform.	http://vigeo-eiris.com/solutions-for-investors/climate-risk-assessments/

Vivid Economics Climate Risk Toolkit	Vivid's Climate Risk Toolkit uses a scenario-driven approach to assess the impact of climate risks on financial assets. Asset class, subclass and asset-level impacts are estimated using a financial impacts estimation module. The Toolkit covers all major asset classes, including listed and private equity, corporate and sovereign debt, and real estate, and both physical and transition risks. The toolkit covers over 20,000 listed companies, and associated corporate bonds, as well as real estate and sovereign bonds for major economies.	Value impairment estimates (% of current asset value) Breakdown of value impairment by key drivers	Quantitative climate risk assessment tool (either physical risk only, transition risk only, or combined physical and transition risk assessment)	Y	Y	Transition risks (including policy timing, policy coordination, and technology), physical risks Tail risks from extreme climate system response to anthropogenic emissions Impacts of adaptation, emissions abatement, cost pass through	Multiple proprietary and publicly available data sources	The toolkit provides access to a range of predetermined scenarios, including Early and delayed action 1.5 degrees-compatible policy scenarios 2 degrees early and delayed NDCs Reference and No Policy Extreme warming Bespoke scenarios designed to reflect client beliefs on technology, policy and climate system developments	Corporates are modelled at the business unit level, with each business unit being part of one of over 300 markets in 16 global regions Major sovereign debt issuers are modelled using macroeconomic modelling tools at the country-level, with resulting changes in sovereign risk and monetary policy variables being used to estimate bond price changes Real estate is modelled at the real asset-level, although this relies on the client sharing data on the underlying properties (for instance, geolocation).	Outputs for inclusion in regulatory and voluntary disclosures, e.g. TCFD. Bespoke advisory support around integrating climate risk into asset management and investment practices Tool for automated results delivery as part of TCFD offering is under development	The Climate Risk Toolkit uses a bottom-up approach to estimate the impacts of transition and physical risks on corporate bonds and equities. Macroeconomic modelling is used to estimate impacts on sovereign debt.	Company level Listed equity level Real asset level Sovereign or corporate bond level	Asset price value impairment based on the Climate Risk Toolkit's modelling of cost, price, and quantity impacts under climate scenarios. These impacts can further be broken down into different impact channels, including transition-related demand destruction, demand creation, direct physical impacts, carbon taxes, abatement opportunities, adaptations to physical risk, and cost-pass through. Vivid also provides carbon intensity and temperature alignment analysis.	https://www.vivideconomics.com/net-zero-toolkit/ https://www.unpri.org/download?ac=9857 https://www.assetmanagement.hsbc.co.uk/en/intermediary/news-and-insights/investing-in-the-low-carbon-transition