DISTENDER

Biophysical and economic models to calculate risk and vulnerability
14 June 2023
Workshop in Sustainable Places (SP2023)

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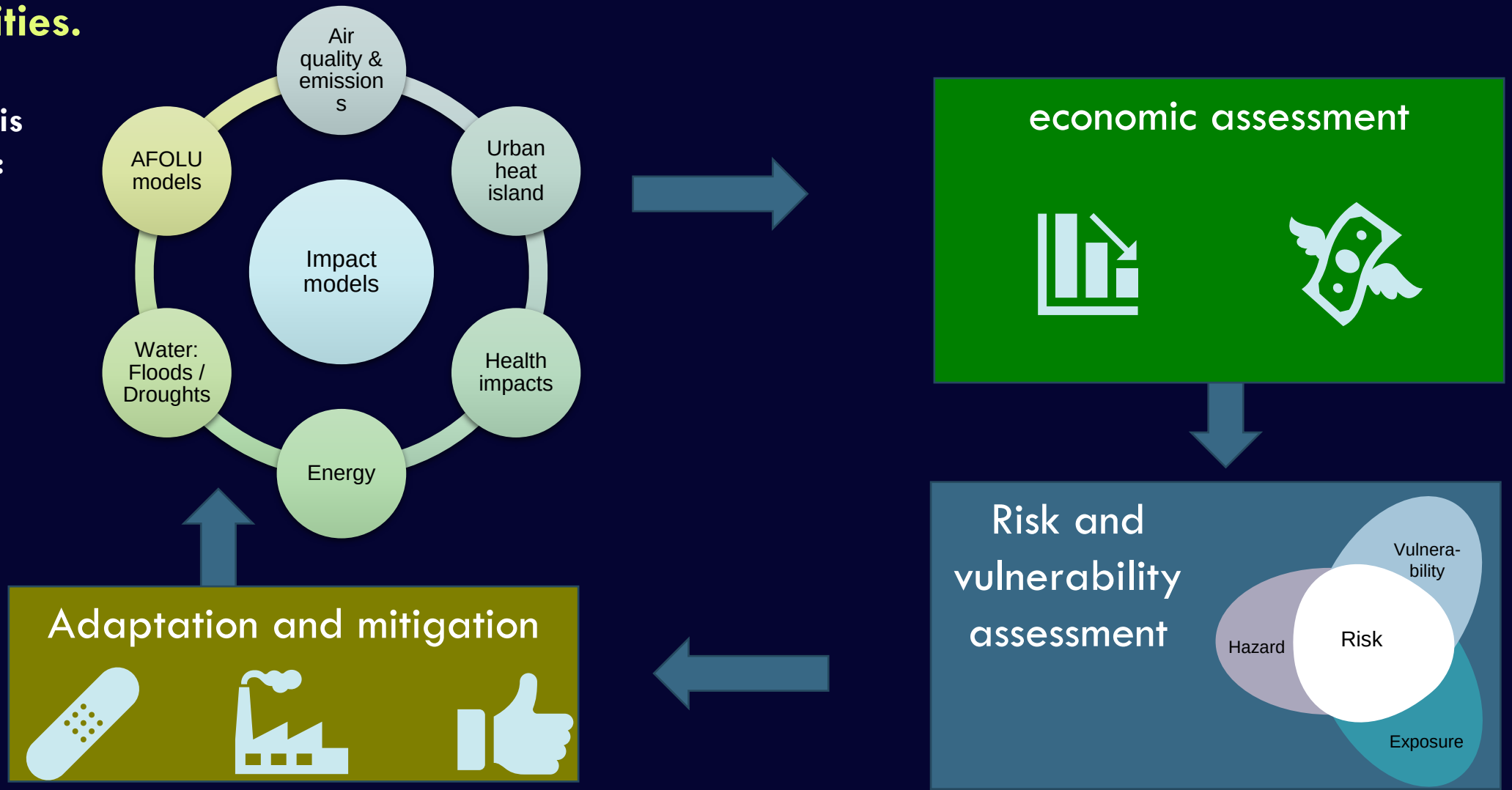
This presentation aims at providing an overview about the DISTENDER approach for impact modelling of biophysical and economic processes, and how to assess risks and vulnerabilities.

Outline of this presentation:



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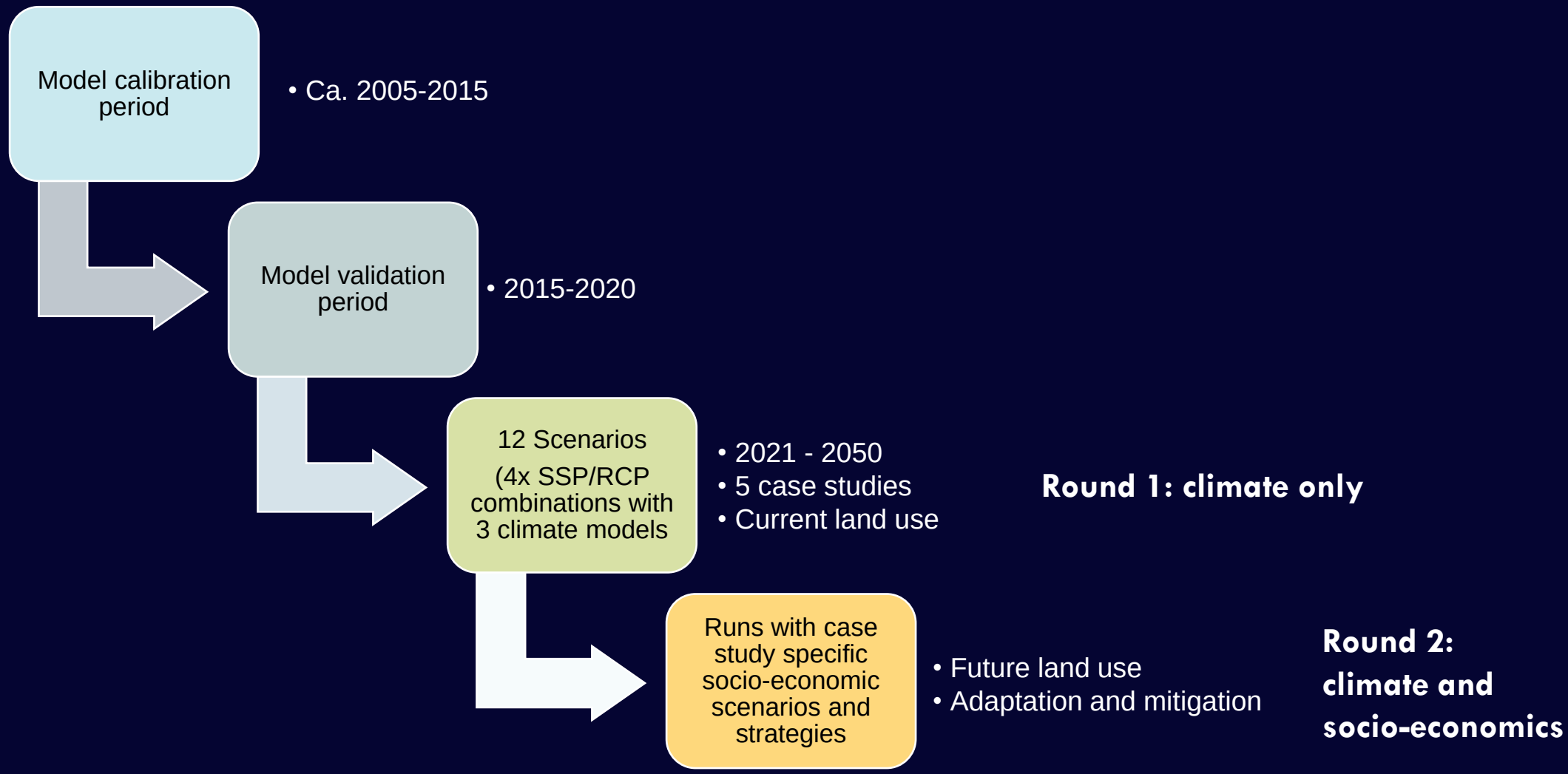
A large number on impact model runs is needed to address different case studies and SSP/RCP scenarios. Thus the impact models must be fast and robust.



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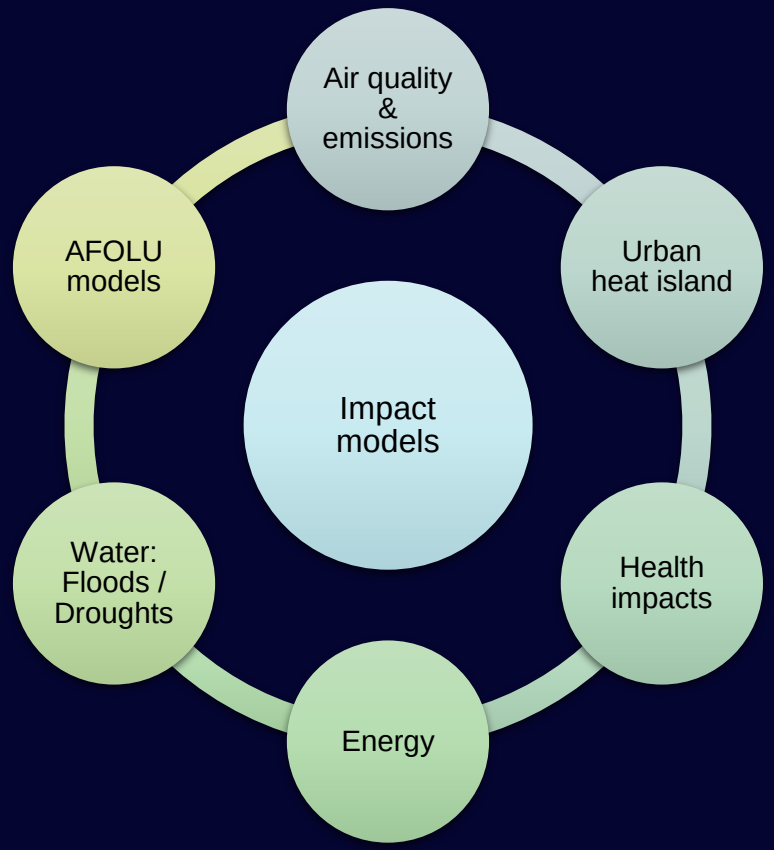
Six different models address a range of different impacts using sectoral modelling approaches.



- Models are physically based (Air quality & emissions (URBAIR), Urban Heat Island (SUEFS), Water (SWAT / MIKE-SHE), AFOLU (YIELD-SAFE) or empirical / statistical models (Health impacts and Energy).
- Models are driven with meteorological input from different sources (statistical downscaling / dynamical downscaling and station measurements for calibration).
- Interactions and feedbacks of the different impact models are not addressed.
- Spatial scales range from km to sub-catchment scales and depend upon model type and case study
- temporal scales range typically from daily to annual and depend on model type

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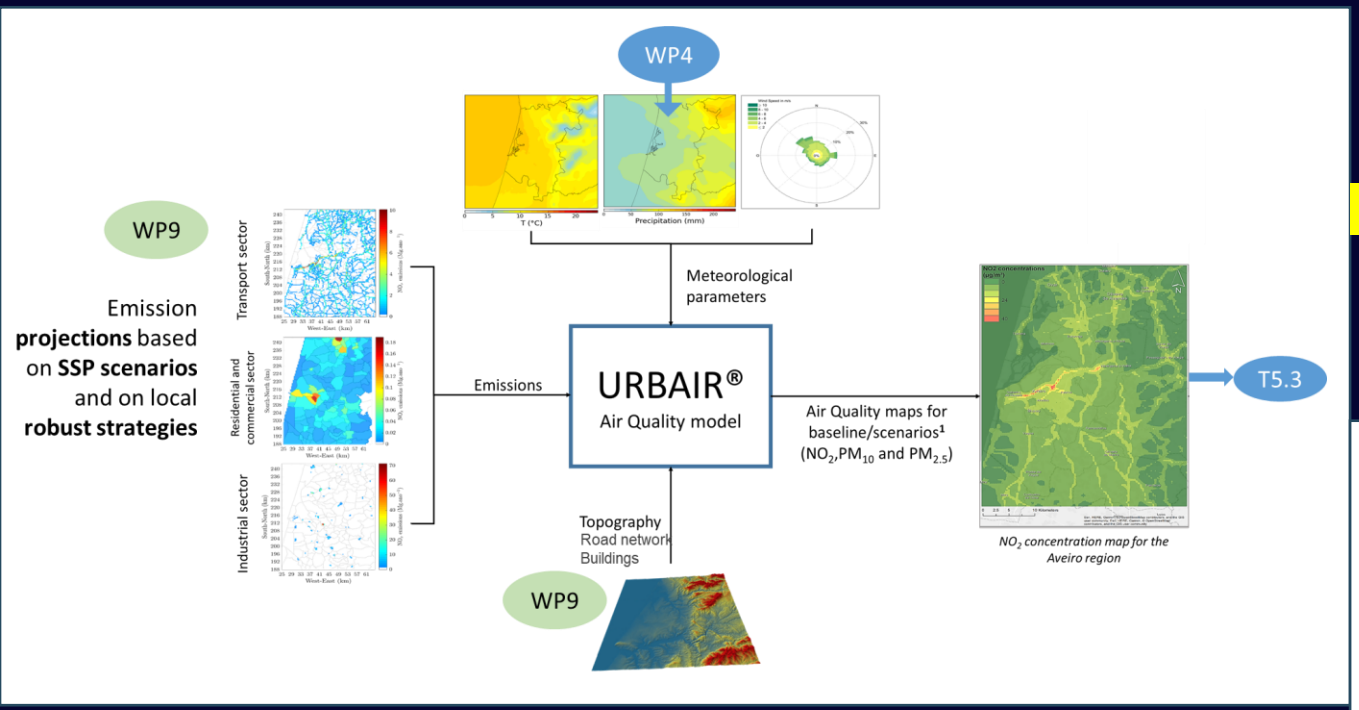
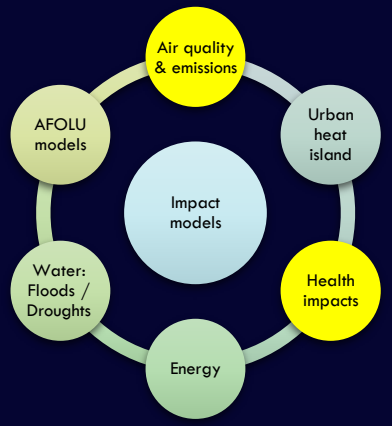
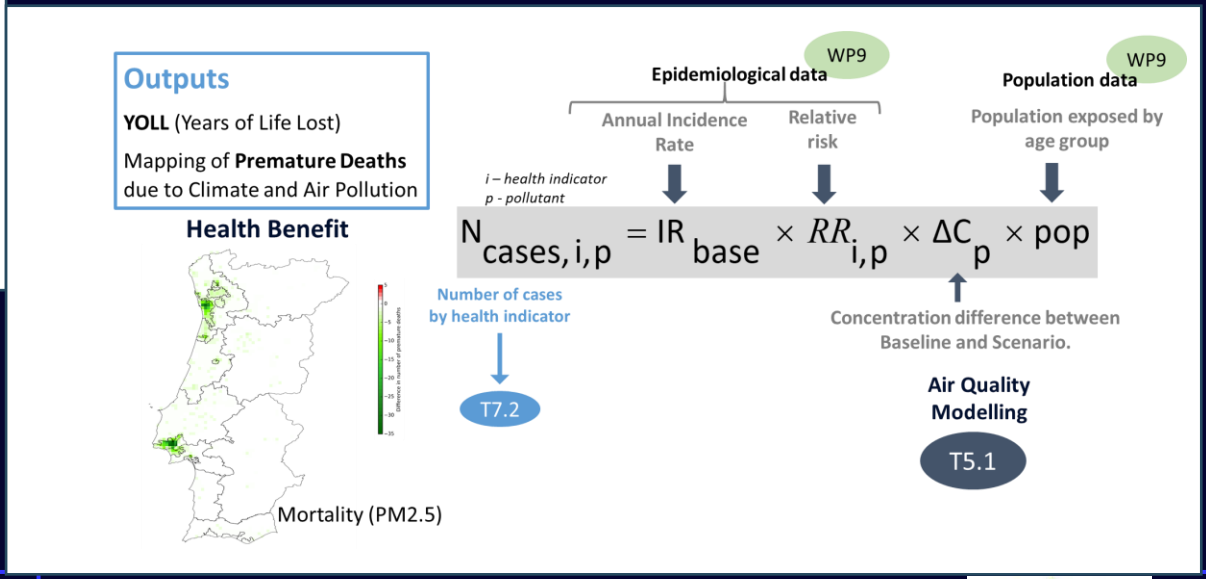
Air quality and health impact modelling are closely coupled by addressing emissions (esp. NO_x, CO, SO_2, VOC, NH_3, CO_2, N_2O, CH_4) and air quality (PM10, PM2.5, NO_2, O_3) and the impact on human health (esp. mortality and morbidity).







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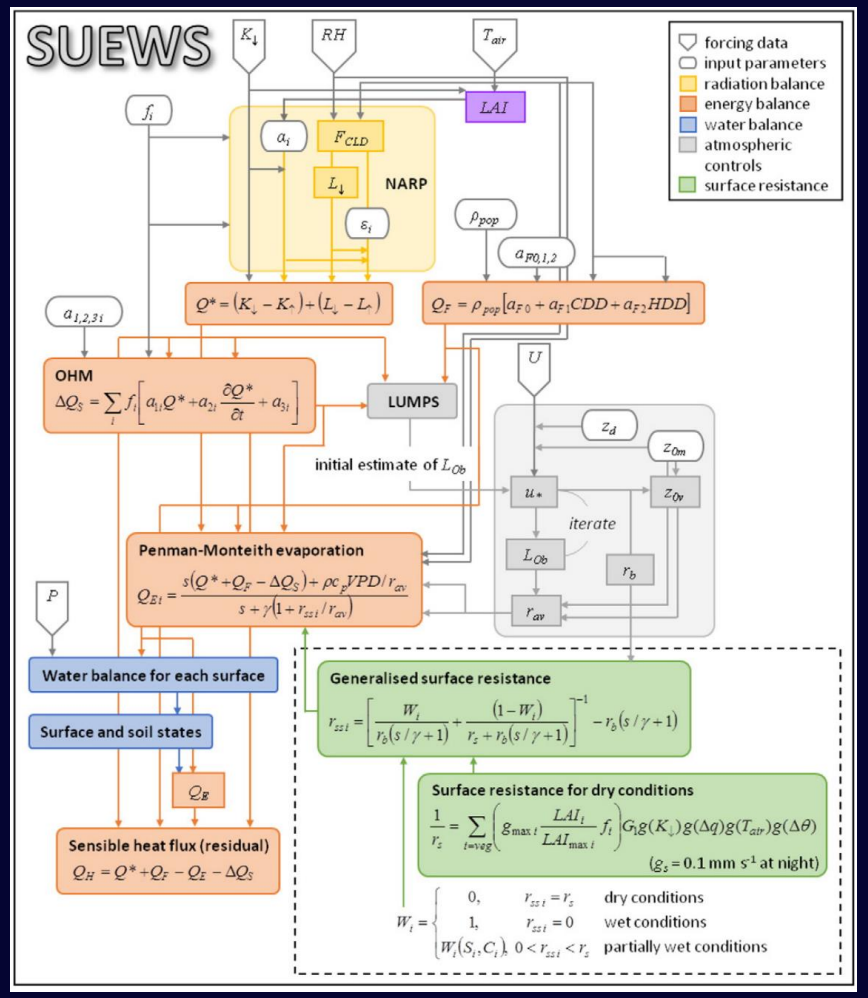
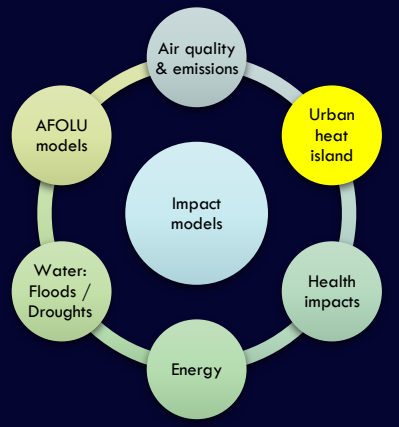
universidade de aveiro

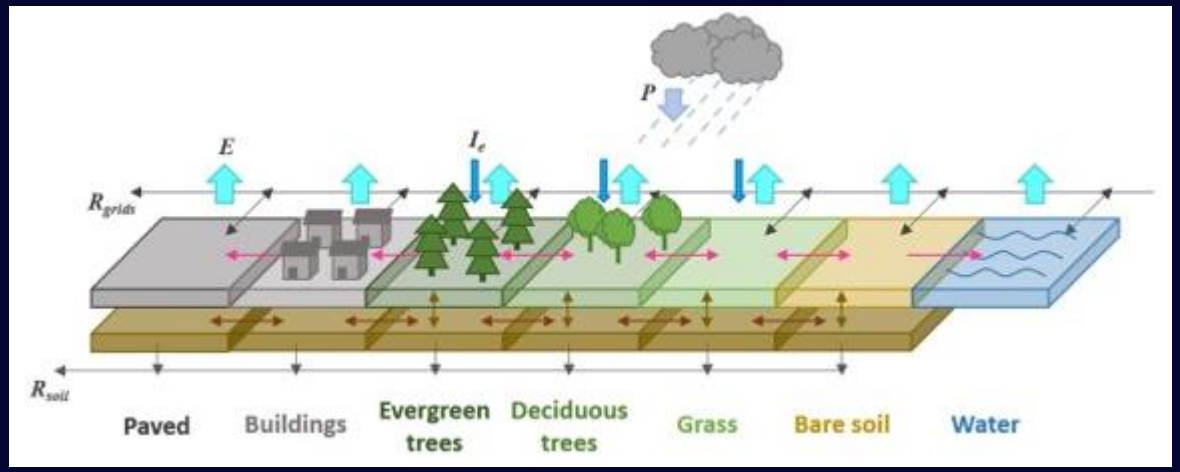
To model the urban heat island effects the SUEWS is used, esp. to model temperature and heat parameters as well as cooling / heating degree days.



From the SUEWS kernel



To its spatial representation



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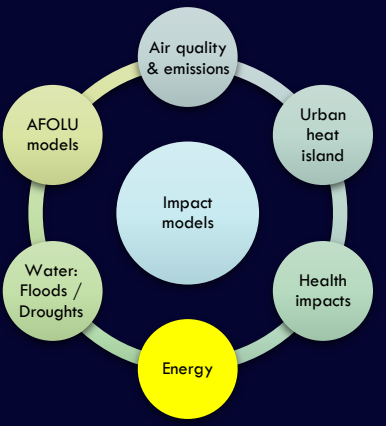
HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

Effects of climate change on the energy sector are represented by a regression-based model, which is sensitive to energy demand and adapted to the geographical scale of each case study.



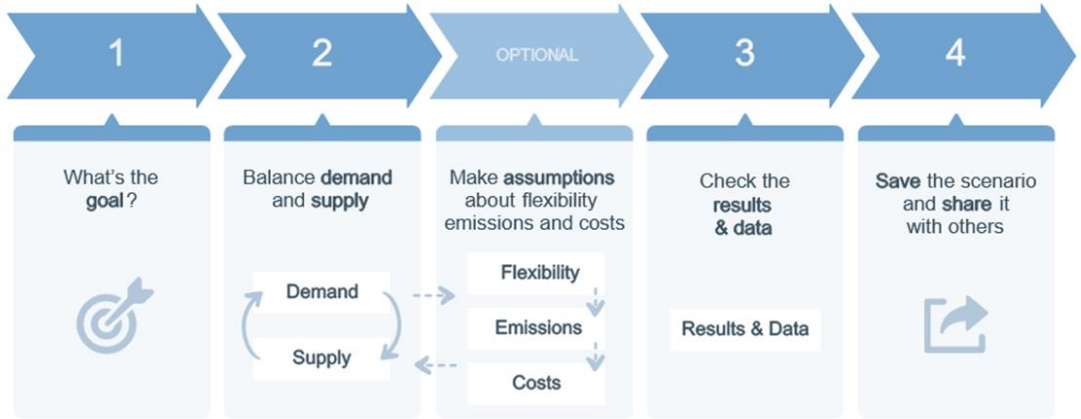
CURB Tool: Climate Action for Urban Sustainability | City level

Interactive scenario planning tool that helps cities take action on climate change.

WORLD BANK GROUP · C40 CITIES · GLOBAL COVENANT of MAYORS for CLIMATE & ENERGY · AECOM

Energy Transition Model | National level

Independent, comprehensive and fact-based energy model that is used in various countries.



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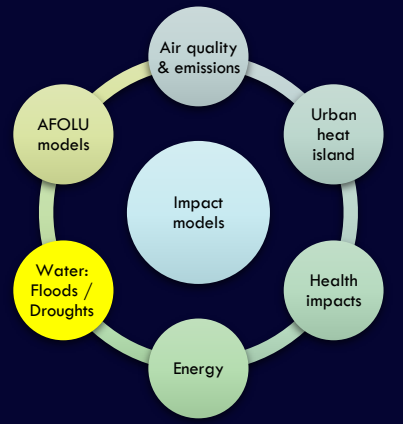
RdA CLIMATE SOLUTIONS

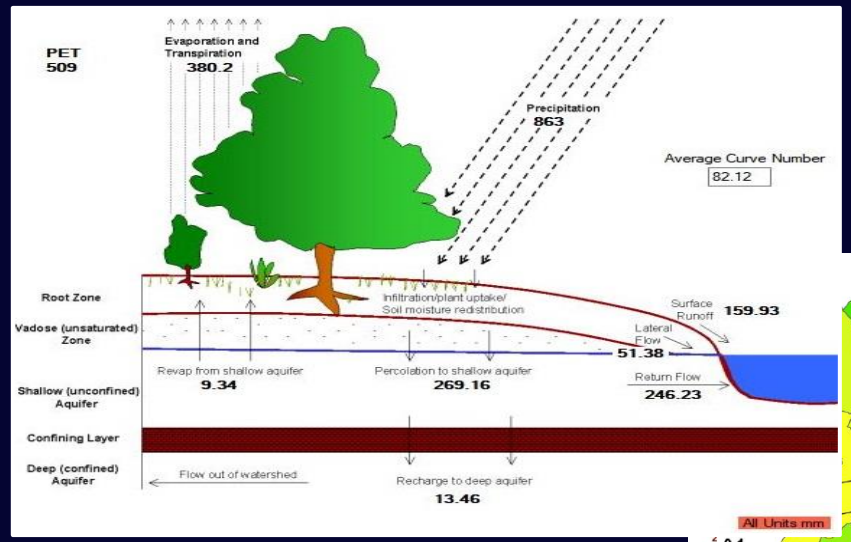
Climate change impact on water resources, particularly on floods and droughts are addressed on selected watersheds using a robust model (SWAT) and a sophisticated model (MIKE-SHE).

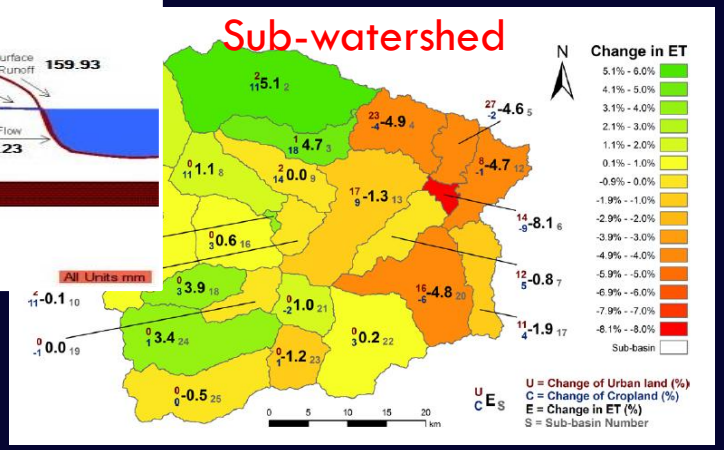


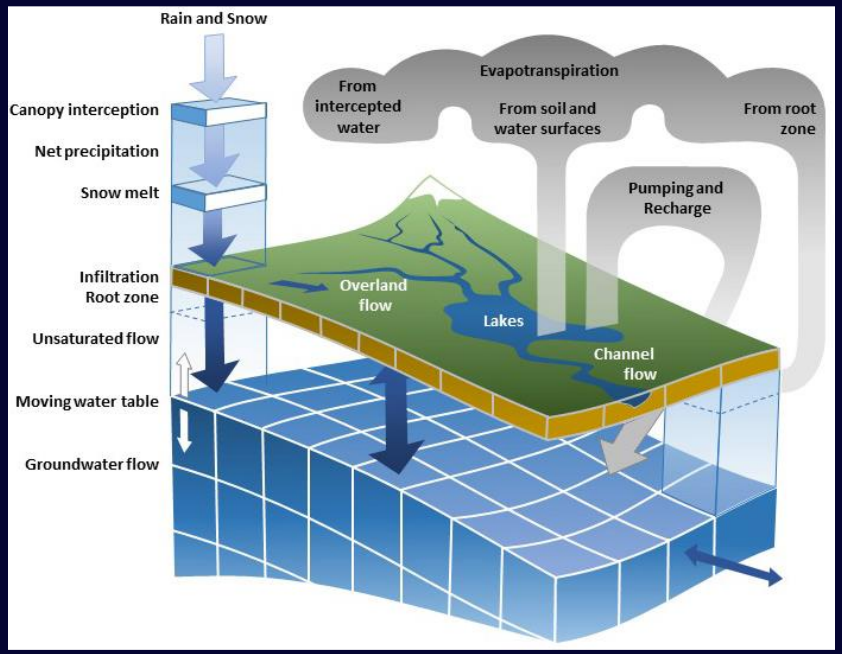
Two models are used:

a) SWAT
   a) Simplified model using hydrological response using and sub-watersheds

b) MIKE-SHE
   a) Raster based model (sophisticated model)







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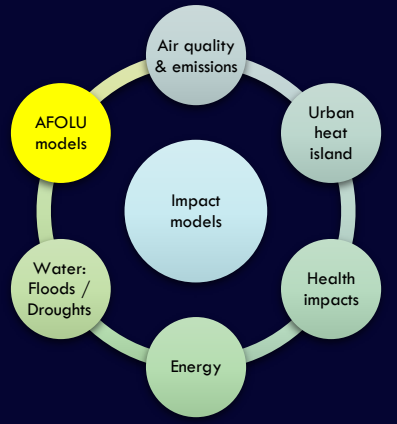
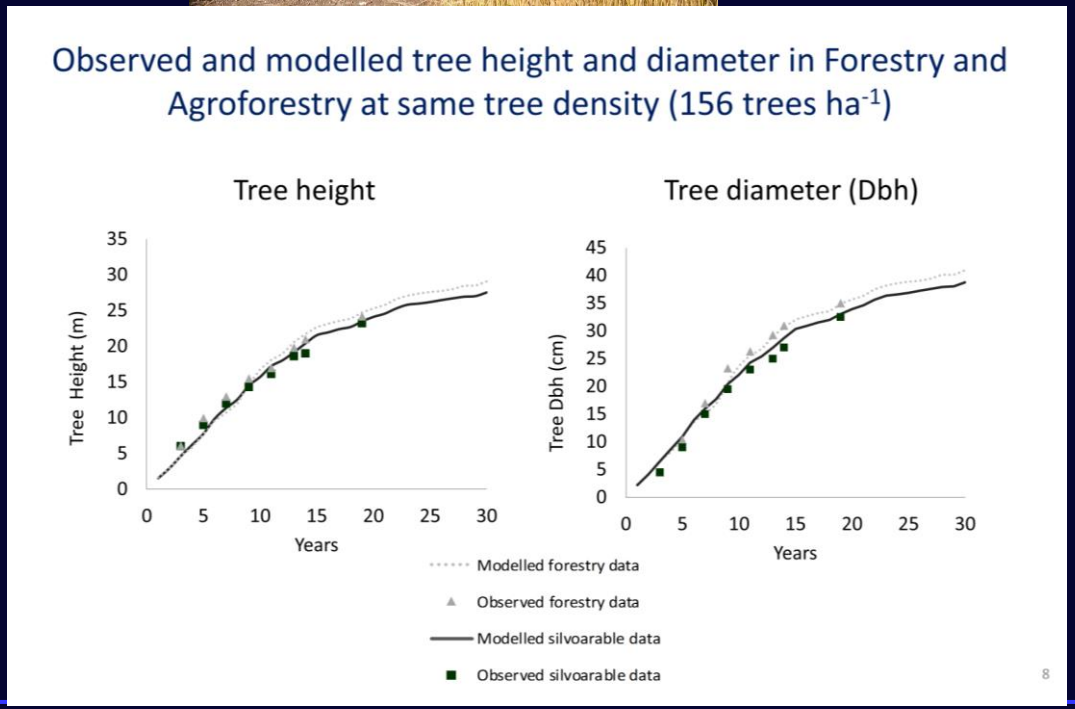
The response of Agriculture, Forestry, and Other Land Use (AFOLU) systems to climate change is modelled using YIELD-SAFE, which simulates among others yields of crops and trees.

Silvoarable agroforestry in Silsoe 2002 by Paul Burgess





Change of biomass over time is calculated with a radiation efficiency approach and limiting factors (e.g. soil water availability)

$$\frac{dB_t}{dt} = \frac{I f_t \varepsilon_t}{\rho}$$

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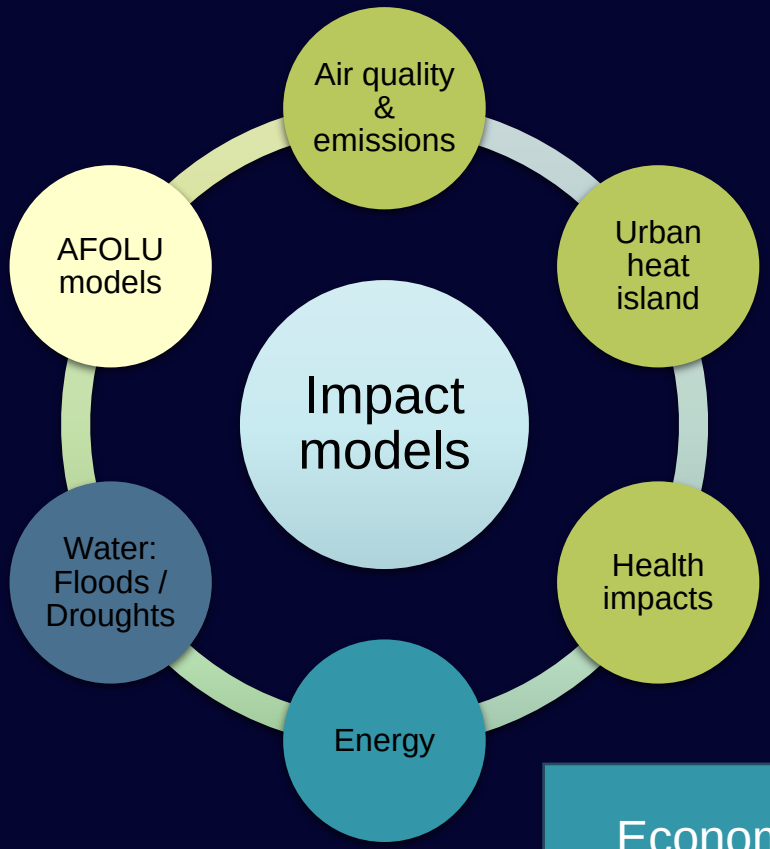
The economic assessment of the modelled climate impacts covers the direct sectoral effects as well as economy-wide effects for the large-scale case studies.

Sectoral



Economic assessment of AFOLU impacts

Economic assessment of heat and air quality impacts

Economic assessment of water impacts

Economic assessment of energy impacts

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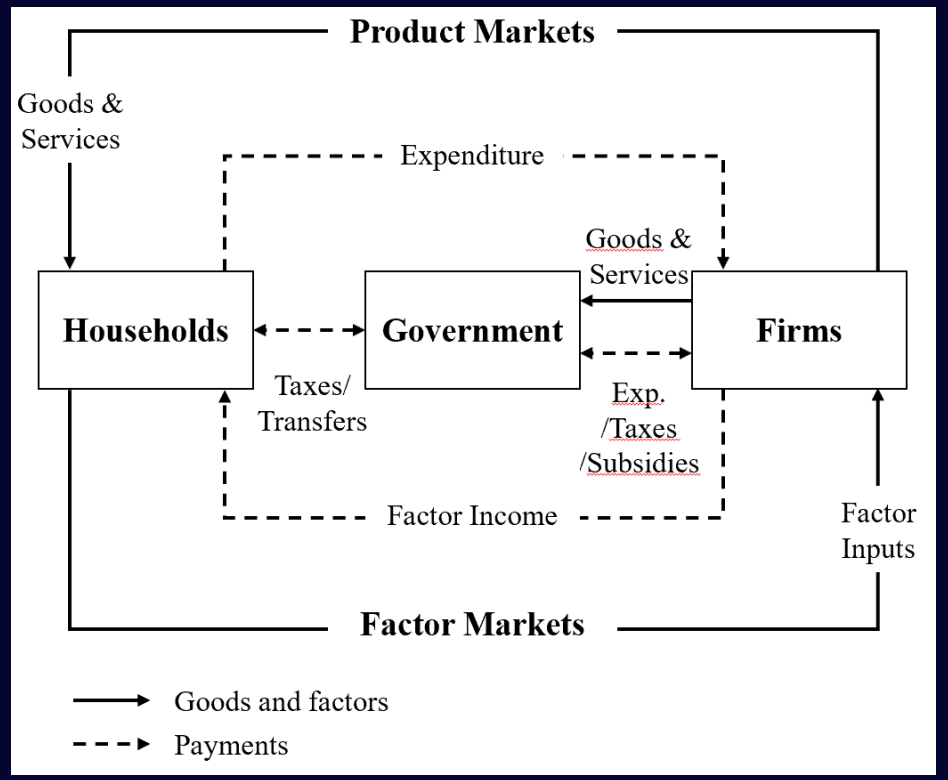
The economic assessment of the modelled climate impacts covers the direct sectoral effects as well as economy-wide effects for the large-scale case studies.

Sectoral

- Economic assessment of heat and air quality impacts
- Economic assessment of energy impacts
- Economic assessment of AFOLU impacts
- Economic assessment of water impacts

Computable General Equilibrium (CGE) model



Economy-wide

- GDP, welfare, employment
- Distributional effects
- Implications for public budgets
- Sectoral winners/losers

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The economic assessment considers case study specific socioeconomic scenarios and investigates consequences of adaptation and mitigation strategies across scenarios.

Case study

SSPs

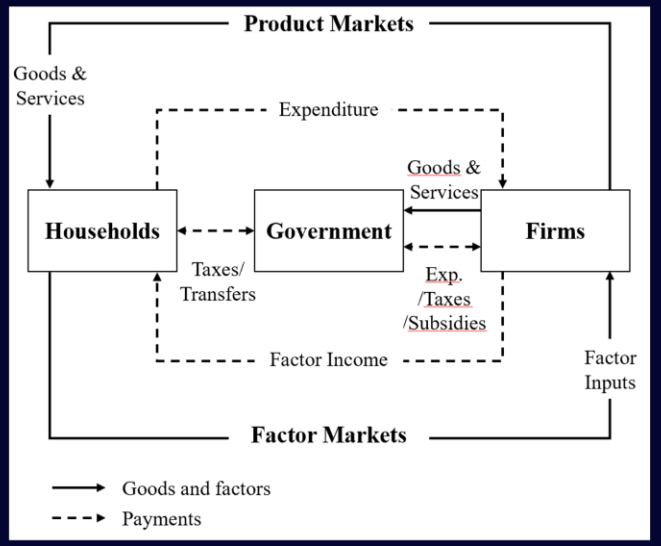
Adaptation

Mitigation

Sectoral

- Economic assessment of heat and air quality impacts
- Economic assessment of energy impacts
- Economic assessment of AFOLU impacts
- Economic assessment of water impacts

Computable General Equilibrium (CGE) model



Economy-wide

GDP, welfare, employment

Distributional effects

Implications for public budgets

Sectoral winners/losers

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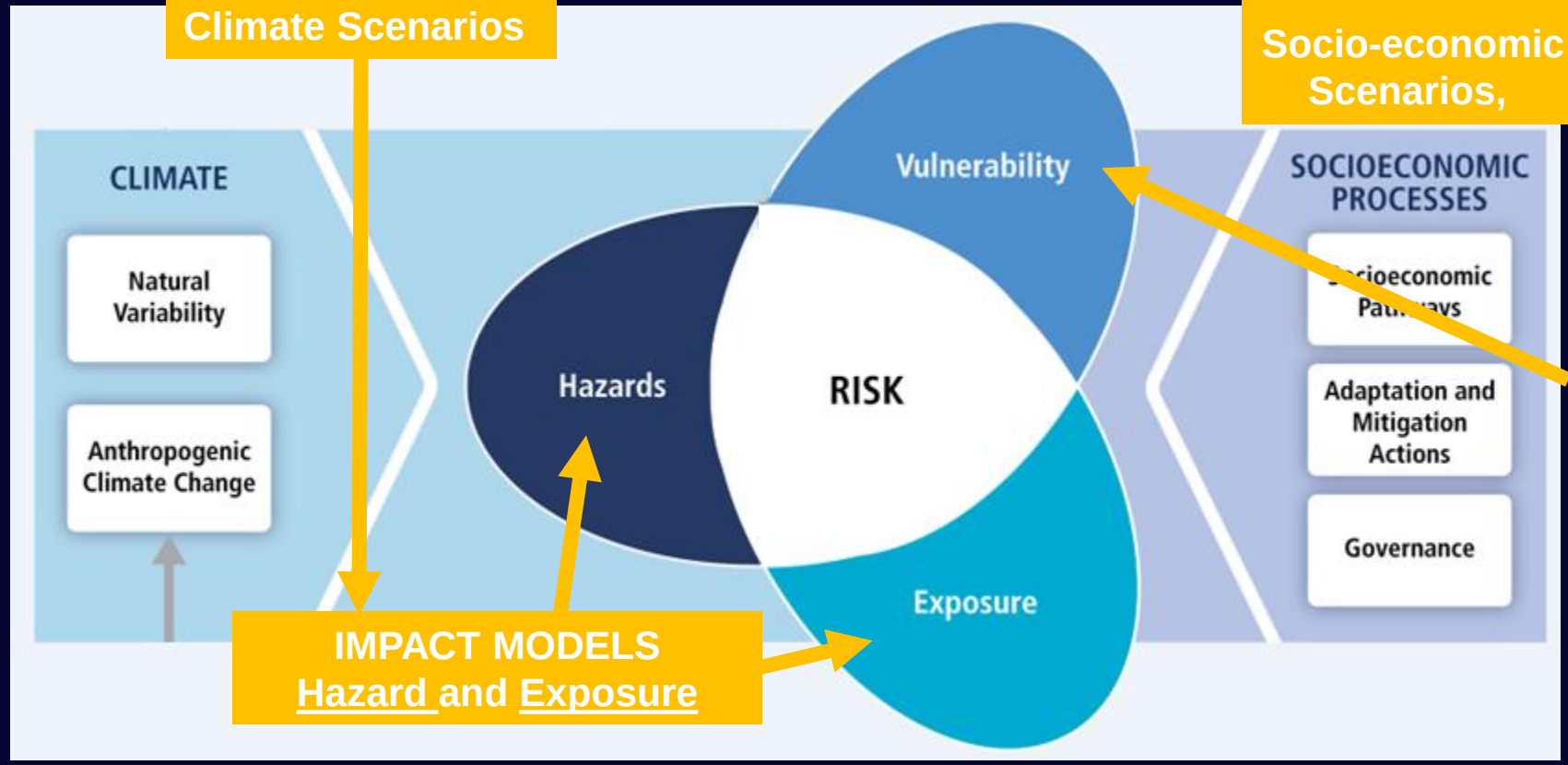
Assessment of risks and vulnerabilities follows the IPCC approach. Impact models provide data on hazard and exposure. Vulnerability is assessed using stakeholder workshops.

CLIMATE MODELS
Climate Scenarios

DISTENDER WORKSHOPS

Socio-economic Scenarios,



VULNERABILITY ASSESSMENT

Capital availability
Coping Capacity
Vulnerability

IMPACT MODELS
Hazard and Exposure

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Vulnerability is identified where society has the least resources with which to cope with the impacts of climate change. In DISTENDER we consider four resources: human, social and manufactured and financial capitals derived from indicator datasets.

FOUR CAPITALS

Human capital: e.g. Life expectancy; Tertiary Education.

Social capital: e.g. Income inequality; Help when threatened.

Financial capital: e.g. Household income; Net household savings rate.

Manufactured capital: e.g. Transport and Produced capital.

COPING CAPACITY

(See Dunford et al., 2014)

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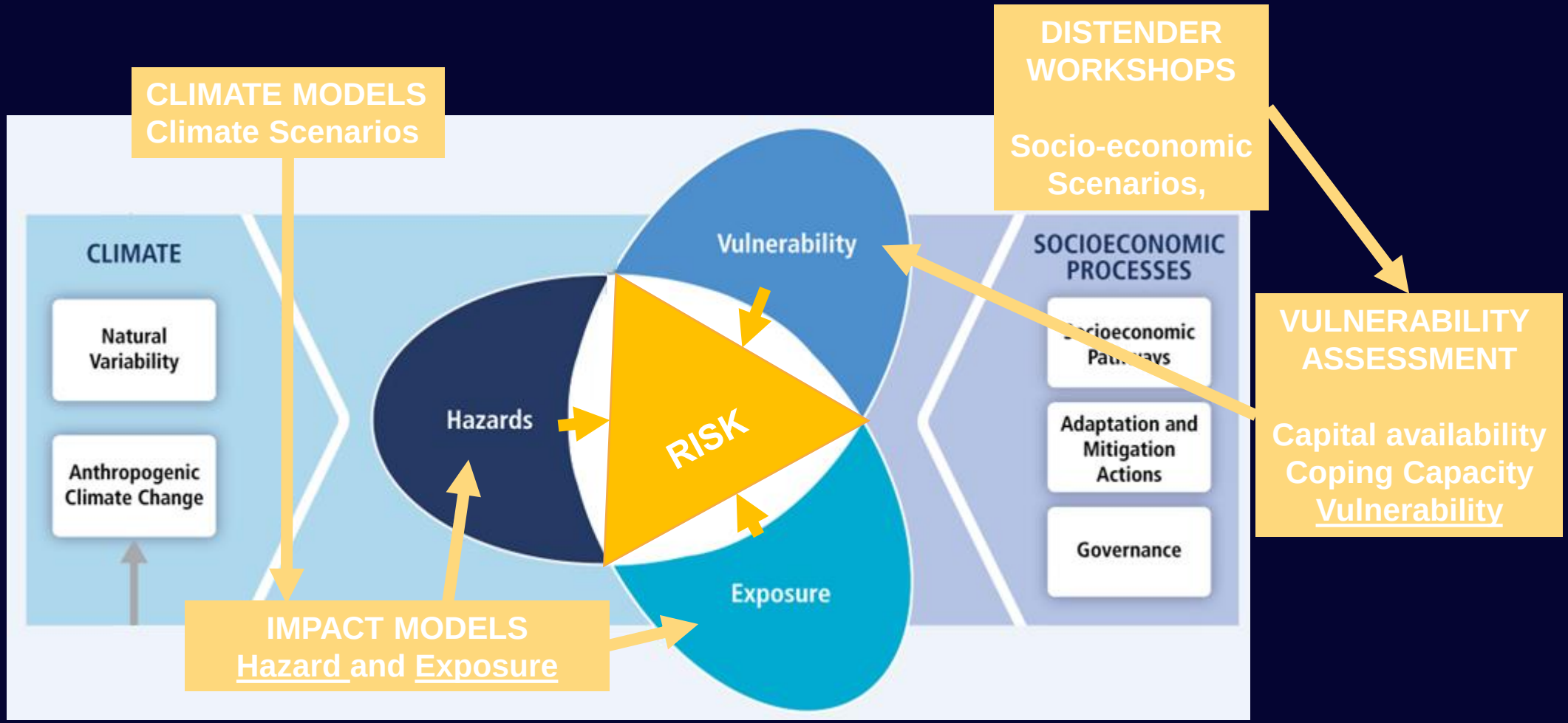
By combining impact model outputs with the DISTENDER vulnerability assessment, maps of risk can be created that consider both the level of impact of the hazard, and society's ability to cope with that impact.



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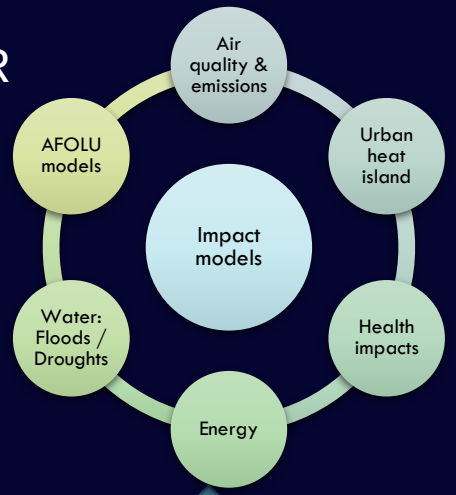
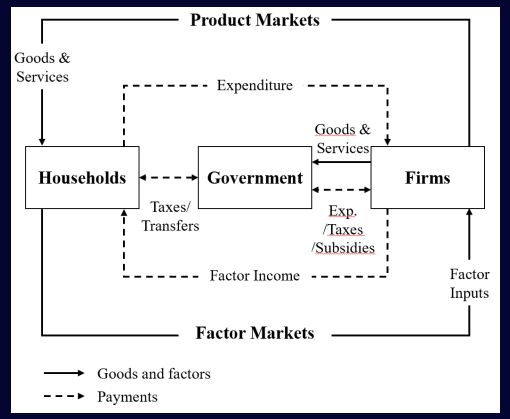
Adaptation and mitigation measures are identified through a co-creation process involving stakeholders from the core cases. These measures are assessed in round 2 of the model runs.

Round 2 of DISTENDER model runs

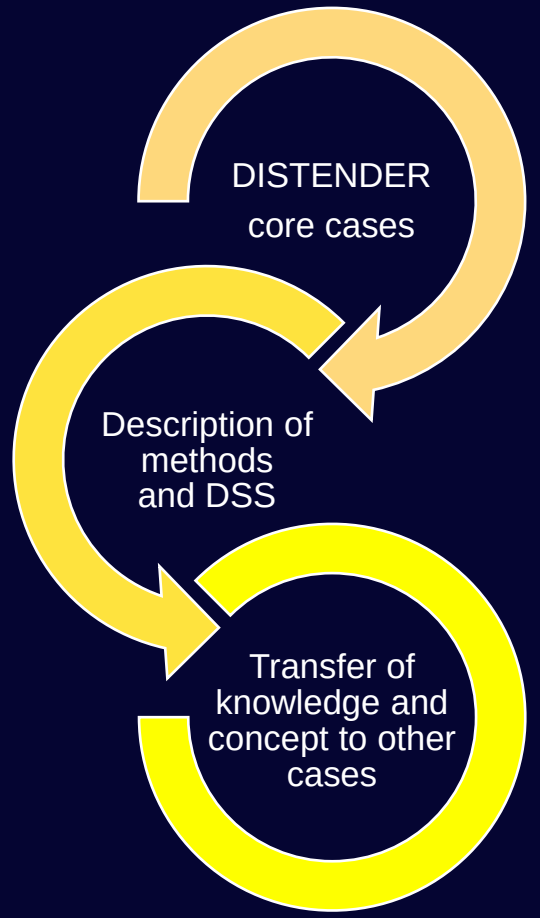




Stakeholder process and Co-Creation

Adaptation and mitigation

Vision and perspective



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Thank you!

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