GoNEXUS
Tools and solutions for governing the nexus

Deliverable D2.1: Global and continental climate and land use scenarios

WP2

Version 3.0, November 2022

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D2.1: Global and continental climate and land use scenarios

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Abstract

This deliverable describes the process followed to generate climate change, landuse and socioeconomic change scenarios at the global and continental level, including the data and information sources, data acquisition protocols, and data post-processing stages; as well as a summary of the information and narratives shown by them.

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Version History

Version	Date	Authors	Description
V0.1	23/11/2021	Hector Macian-Sorribes (UPV)	Preliminary information on the scenarios
V0.2	20/05/2022	Daniele Peano (CMCC), Rens van Beek (UU), Berny Bisselink (JRC)	Update for MS2
V1.0	17/10/2022	Daniele Peano (CMCC), Rens van Beek (UU), Berny Bisselink (JRC)	First version of D2.1
V1.1	07/11/2022	Amparo Martinez-Domingo (UPV), Hector Macian-Sorribes (UPV), Daniele Peano (CMCC)	First internal review
V2.0	25/11/2022	Daniele Peano (CMCC), Rens van Beek (UU), Berny Bisselink (JRC)	Second version of D2.1
V2.1	29/11/2022	Kudakwashe Kayirasora (ZAMCOM), Jean-Daniel Rinaudo (BRGM)	Second internal review
V3.0	30/11/2022	Daniele Peano (CMCC), Rens van Beek (UU), Berny Bisselink (JRC), Hector Macian-Sorribes (UPV)	Final version

Table of contents

List of figures

List of tables

1.Introduction

GoNEXUS aims to develop a framework for designing and assessing innovative solutions for an efficient and sustainable coordinated governance of the water-energy-food-ecosystems (WEFE) nexus. Solutions will combine policy changes and soft path options with technical and infrastructure measures for a more resilient future. GoNEXUS, through its model toolbox, will explore these solutions under global climate and land-use scenarios obtained under different governance and socioeconomic pathways. The present deliverable illustrates the selected global and continental climate and land-use scenarios (red square in Fig. 1).

This deliverable is divided into two sections: Section 2 describes the selected climate scenarios and the projected climate variability during the 21st century; Section 3 presents land-use and socio-economic pathways for the 21st century.

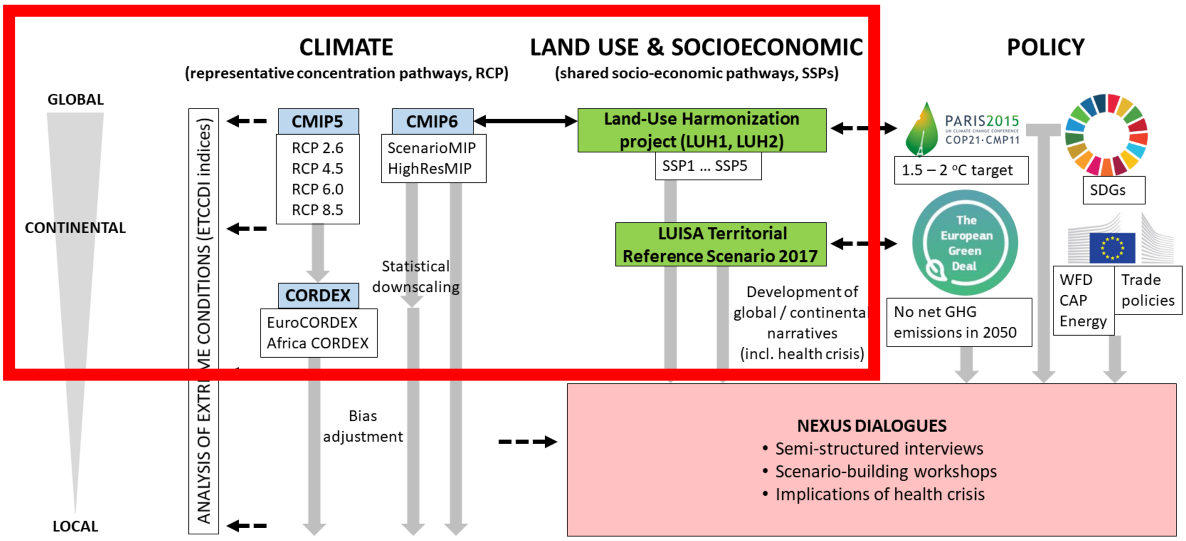

Fig 1: Overview of GoNEXUS scenarios

2. Global and continental climate change scenarios

2.1. Summary of scenarios

The climate change scenarios analysed by GoNEXUS have been obtained from the Coupled Model Intercomparison Project (CMIP), which is the most established information source for climate change projections in response to the scenarios developed by the IPCC. Two phases of the CMIP have been considered in GoNEXUS: CMIP5 and CMIP6. CMIP5 is the established family of scenarios used so far, while CMIP6 is the most recent family of scenarios developed, and it has been used to inform the last IPCC report (AR6). Both phases are not mutually exclusive: they are comparable with each other and can be used to expand the current set of scenarios analysed taking advantages of their complementary features. Furthermore, keeping both experiments can exploit both the existence of dynamically downscaled experiments, the experience in the use of CMIP5, and the explicit link with Shared Socioeconomic Pathways -SSPs- together with the scientific advance posed by CMIP6. Fig 2, from O'Neill et al. (2016) illustrates the link between RCPs and SSPs established by CMIP6, and how CMIP5 and CMIP6 scenarios can be compared. It is noteworthy that the novel CMIP6 scenarios have been grouped into two tiers of priority, where tier 1 pathways are prioritized compared to tier 2 ones (O'Neill et al., 2016).

The CMIP5 data are already available among GoNEXUS partners or are retrievable through Earth System Grid Federation (ESGF) nodes (https://esgf-data.dkrz.de/search/cmip6-dkrz/) and the Copernicus Climate Change Service (C3S, https://cds.climate.copernicus.eu/cdsapp#!/home) at their original resolution (spanning between ~100 and ~250km).

At the continental scale, climate change scenarios have come from Europe and Africa domains of the Coordinated Regional Climate Downscaling Experiment (CORDEX), which developed climate change scenarios for the continental level using dynamical downscaling (using global climate model from CMIP5 RCPs 2.6, 4.5 and 8.5 scenarios to force regional climate models). In case of Europe (EU case study), bias-adjusted datasets are already available through the CORDEX nodes (https://cordex.org/data-access/esgf/). The Euro-CORDEX data are available at a nominal horizontal resolution of about 11km, while the Africa-CORDEX ones at a nominal horizontal resolution of 22km.

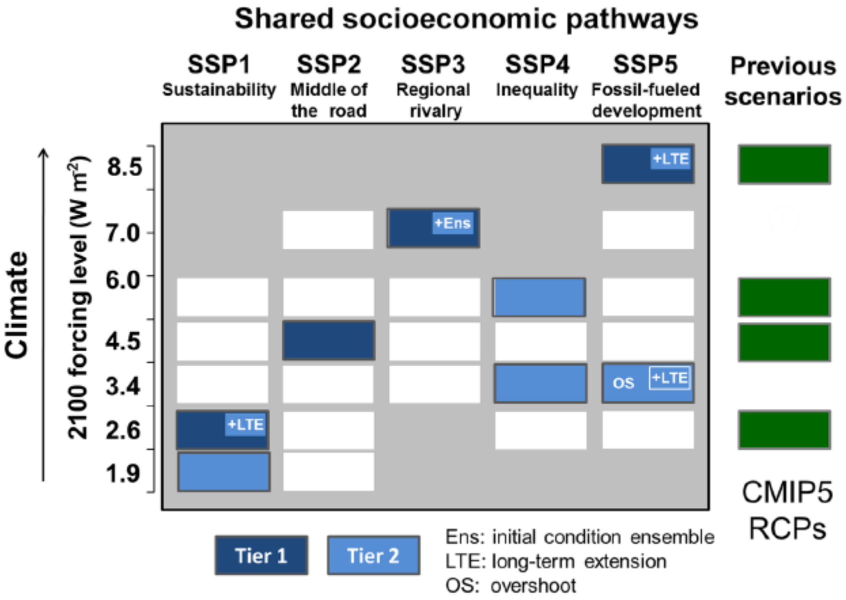

Fig 2: Linkages between RCPs and SSPs implemented by CMIP6, and how they relate to CMIP5
Source : O'Neil et al. (2016)

CMIP6 scenarios include two activities: the ScenarioMIP (standard resolution from ~100 to ~250km) and the ISIMIP3b (Inter-Sectoral Impact Model Intercomparison Project, high resolution data, ~50km). From the combinations between RCPs and SSPs shown in Fig 2, GoNEXUS will select the ones referring to RCP1.9 and RCP 2.6 (related to achieving the goal of not surpassing 1.5 and 2 degrees of global warming as indicated in the Paris Agreement), RCP 7.0 (business as usual scenario considering the ongoing energy transition) and RCP 8.5 (worst case scenario). Note that among these scenarios, only the SSP119 one falls within the set of tier 2 pathways.

CMIP6 datasets have been downloaded from the ISIMIP repository (https://data.isimip.org/) and the ESGF nodes (https://esgf-node.llnl.gov/projects/cmip6/).

The requested variables (Table 1) have been retrieved from five CMIP6 models, namely GFDL-ESM4, IPSL-CM6A-LR, MPI-ESM1-2-HR, MRI-ESM2-0, and UKESM1-0-LL, for historical and future scenarios in the ISIMIP framework. These five models have been selected as primary models in ISIMIP due to their data availability, process representation, structural independence, climate sensitivity, and performance in the historical period, as described in the ISIMIP3b fact sheet (Section 6, https://www.isimip.org/documents/413/ISIMIP3b_bias_adjustment_fact_sheet_Gnsz7CO.pdf). The ISIMIP data are derived from the CMIP6 simulations on which the ISIMIP3BASD (Lange 2019, 2021) bias adjustment and statistical downscaling method has been applied. The datasets used in GoNEXUS and derived from ISIMIP have a nominal resolution of about 50km. Besides, the computed multi-model-mean of these five models, which delineates a case that balances the variability of the ISIMIP models, is provided (Figure 3). The variables for the SSP1-RCP1.9 pathway are extracted from four models of the ScenarioMIP (namely GFDL-ESM4, IPSL-CM6A-LR, MRI-ESM2-0, and UKESM1-0-LL) at their original horizontal resolution (from ~100km to ~250km).

Variable long name	**CMOR name**
Total precipitation	pr
Surface air pressure	ps
Near-surface relative humidity	hurs
Near-surface wind speed	sfcWind
Near-surface air temperature	tas
Minimum near-surface air temperature	tasmin
Maximum near-surface air temperature	tasmax
Surface downwelling shortwave radiation	rsds
Surface downwelling longwave radiation	rlds

Table 1: climate variables requested to force the WEFE nexus

For all scenarios generated by GoNEXUS, the historical period will be 1979-2014. GoNEXUS future assessments will be based on 4 deadlines: 2030 (according to the UN SDGs), 2040 (intermediate between 2030 and 2050), 2050 (deadline foreseen by the EU Green Deal) and beyond (until 2070 or 2100 depending on the scenario and particular purpose).

2.2. Climate scenarios variability

The selected climate scenarios identify various possible future pathways from Paris agreement compliant (RCP1.9 and RCP2.6) to business-as-usual (RCP7.0 and RCP8.5). This variety of scenarios describes different trajectories in projected climate evolution during the 21st century (Figure 3).

In the low-end scenarios, i.e. SSP119 and SSP126, global average mean increases in near-surface air temperature are below the thresholds indicated in the Paris Agreement (Figure 3A) of 1.5 and 2.0°C respectively. On the contrary, the two business-as-usual scenarios reach a mean increase in mean global temperature of about 4-5°C by 2100 compared to the end of the 20th century (1981-2000).

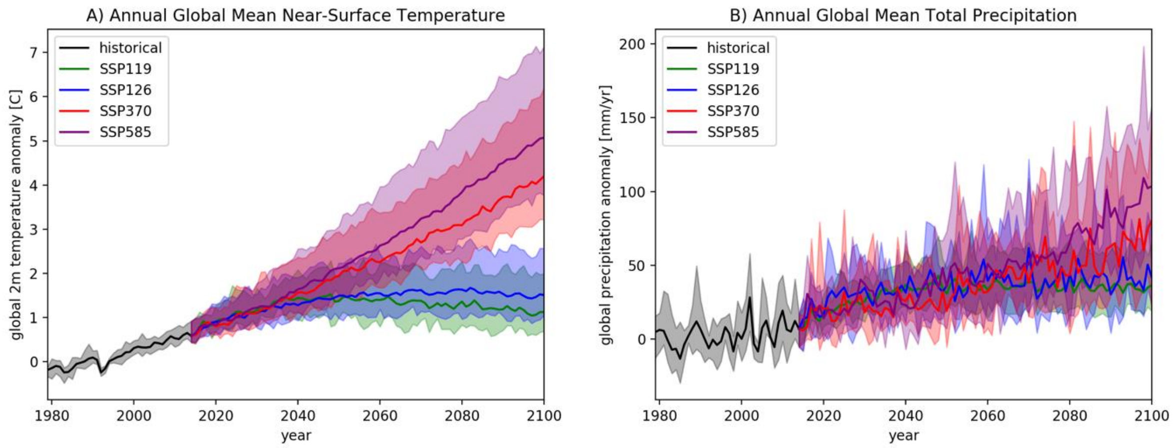

Fig 3: Time evolution of global near-surface air temperature and precipitation anomaly compared to the end of the 20th century (1981-2000) for the five (four in SSP119) ISIMIP models spread (shaded area) and the Multi-model mean (solid lines).

The intermodel variability has been characterized considering a set of five climate models for each future emission pathway but for the SSP119, in which only four models were included. From the total number of possible future climate trajectories (all models with the four emissions pathways) an increase of global-average temperature between 0.5 °C and 7°C is projected (Figure 3A). Regardless the future scenario, the mean global total precipitation is simulated to increase during the 21st century with a clear distinction among pathways only in the last decades of the century (Figure 3B).

The spread among scenarios is minor in the near future (2026-2035, Figure 4a,d,g,j), and all scenarios agree with a general increase in temperature all around the globe with peaks in the mid- and high-latitude of the Northern Hemisphere. By the mid-century (2046-2055), the differences among scenarios are much more visible. The two SSP1 scenarios still show a peak increase of about 3°C over the Arctic regions. They mainly differ in the projected temperature increase of the Southern Hemisphere (Figure 4b,e). On the contrary, SSP370 and SSP585 show a general increase in temperature over the entire globe with higher values over land in the Northern Hemisphere (Figure 4h,k). At the end of the century (2086-2095), the scenarios show clear distinctions: SSP119 has anomalies smaller than the ones reached in the mid-century, especially over the north Atlantic ocean and south Pacific ocean (Figure 4c); SSP126 shows anomalies similar to the ones reached by mid-century (Figure 4f); SSP370 displays anomalies above 2°C and 3°C over ocean and land, respectively (Figure 4i); and SSP585 exhibits the largest increase with anomalies above 3°C and 5°C over ocean and land, respectively (Figure 4l).

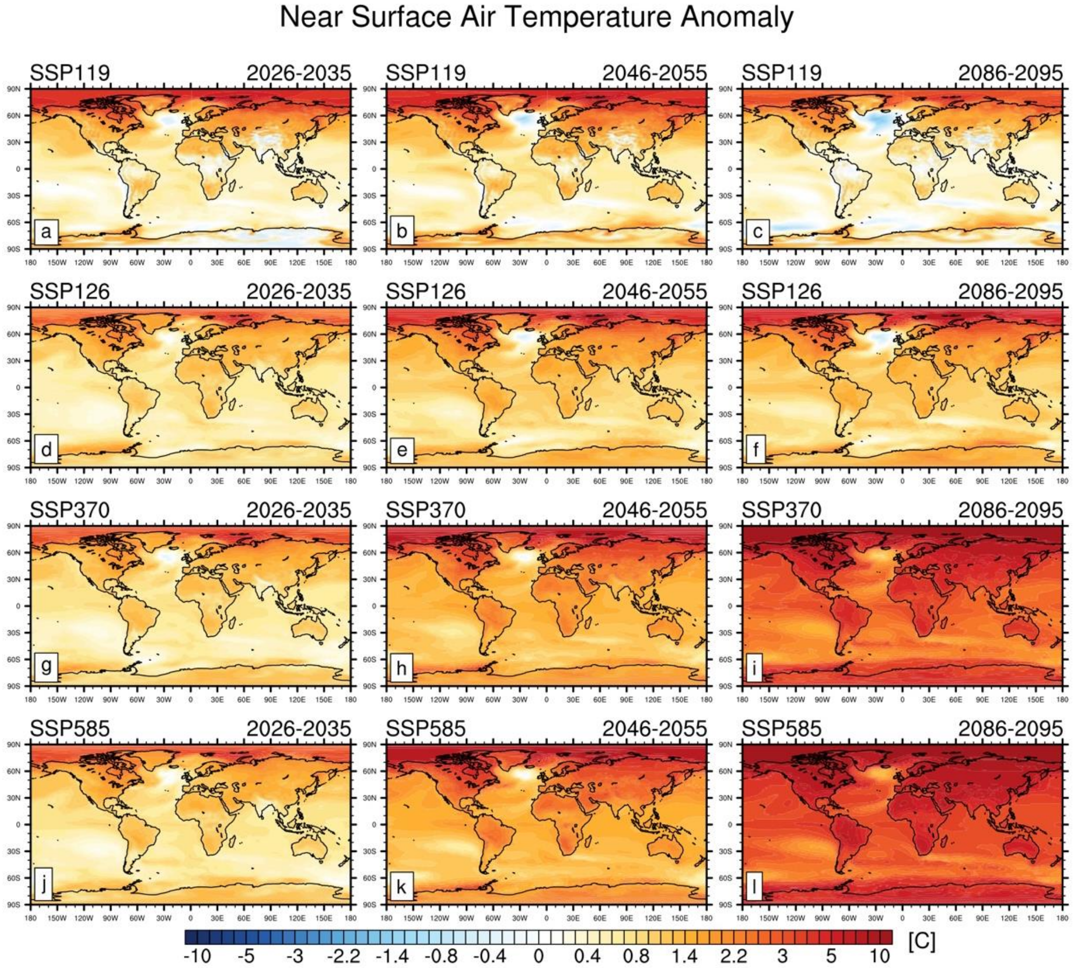

Fig 4: The multi-model ensemble mean global's near surface air temperature anomaly compared to 1996-2005 for the near future (2026-2035), mid-21st century (2046-2055), and end of 21st century (2086-2095) under four scenarios (i.e. SSP1-RCP1.9, SSP1-RCP2.6, SSP3-RCP7.0, and SSP5-RCP8.5).

Despite a global mean increase in total precipitation throughout the 21st century (Figure 3B), the total precipitation anomalies exhibit substantial spatial variability (Figure 5). The SSP119 scenario shows a similar pattern in total precipitation anomaly compared to historical values (1996-2005) during the entire 21st century, characterized by wetter conditions in the equatorial band and over land in Northern Hemisphere; and drier conditions over oceans, South America and South Africa (Figure 5a,b,c). The SSP126 scenario displays a principal precipitation increase over the equatorial region in the near future (Figure 5d). By the mid-century, it displays wetter conditions in the equatorial belt, and drier conditions emerge over South America and the Indian Ocean (Figure 5e). However, the dry conditions over South America disappear by the end of the century (Figure 5f). SSP370 and SSP585 scenarios show similar patterns in precipitation anomalies, which intensify during the 21st century (Figure 5g,h,i and Figure 5j,k,l). Both scenarios exhibit wetter conditions over the equatorial belt and drier conditions over South Pacific Ocean, North Atlantic Ocean, the Amazon basin, and the Indian Ocean.

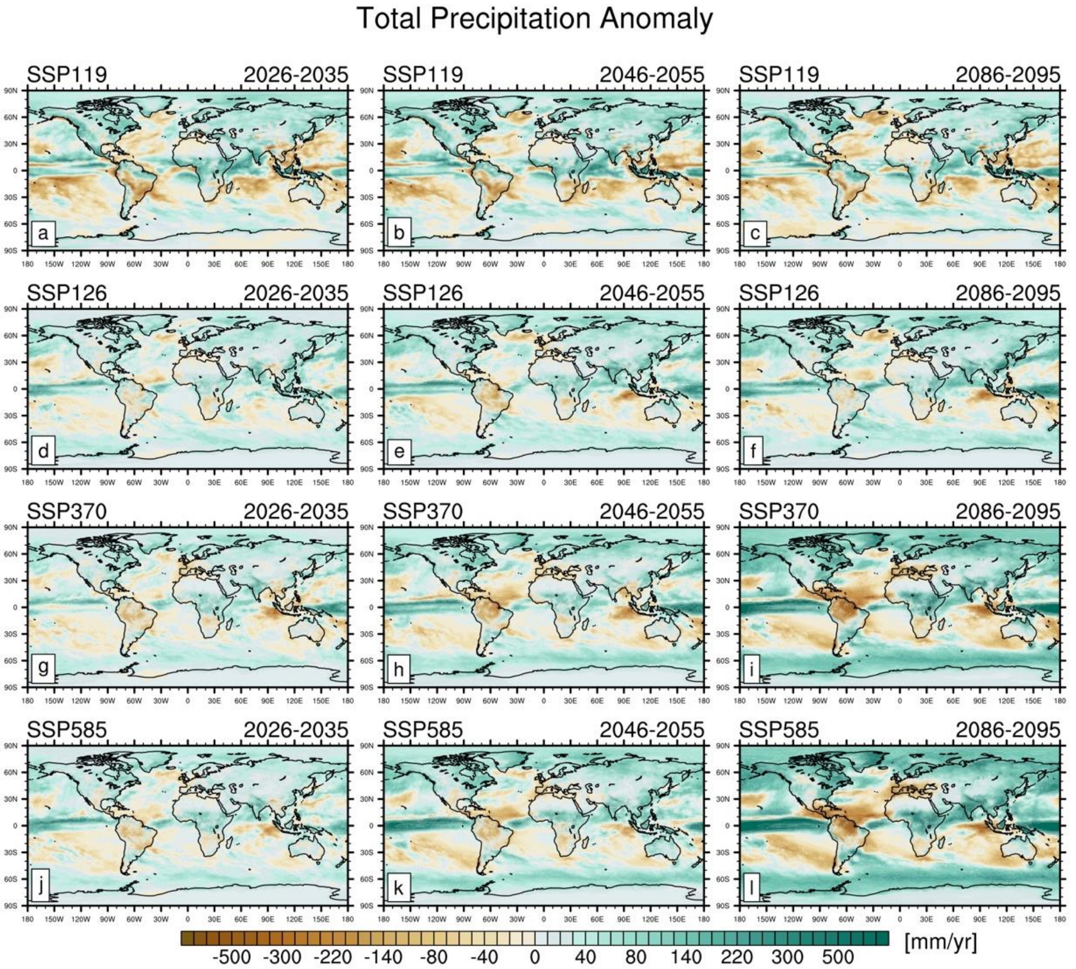

Fig 5: The multi-model ensemble mean global's total precipitation anomaly compared to 1996-2005 for the near future (2026-2035), mid-21st century (2046-2055), and end of 21st century (2086-2095) under four scenarios (i.e. SSP1-RCP1.9, SSP1-RCP2.6, SSP3-RCP7.0, and SSP5-RCP8.5).

Focusing on Europe, the pattern of anomalies varies among scenarios (Figure 6). In the near future (2026-2035), all scenarios exhibit an increase in temperature over land with peaks of about 2°C in the northeastern part of the domain and a slight decrease (or no change) over the North Atlantic Ocean (Figure 6a,d,g,j). By the mid-century (2046-2055), the differences among scenarios start to increase. SSP119 scenario shows anomalies over land similar to the ones of the near future, but the reduction in temperature over the North Atlantic Ocean increases, reaching anomalies of about -1 °C compared to the historical values (Figure 6b). The SSP126 scenario displays an increase in temperature anomalies over land reaching values of about 3°C in the northeastern part of the domain while the temperature anomaly decreases over the North Atlantic Ocean (Figure 6e). On the contrary, the SSP370 and SSP585 scenarios show a uniform increase in temperature anomalies over the entire domain with values of about 3-4°C (Figure 6h,k). At the end of the 21st century, the temperature anomalies are reduced over the entire domain in the SSP119 scenario compared to the mid-century, with negative anomalies compared to the historical period in the North Atlantic Ocean and positive anomalies of about 1-1.5°C over land (Figure 6c). The SSP126 scenario exhibits anomalies similar to the mid-century ones (Figure 6f). Conversely, SSP370 and SSP585 scenarios show a continuous increase in temperature with anomalies of about 5°C and 7° over land, respectively (Figure 6i and Figure 6l).

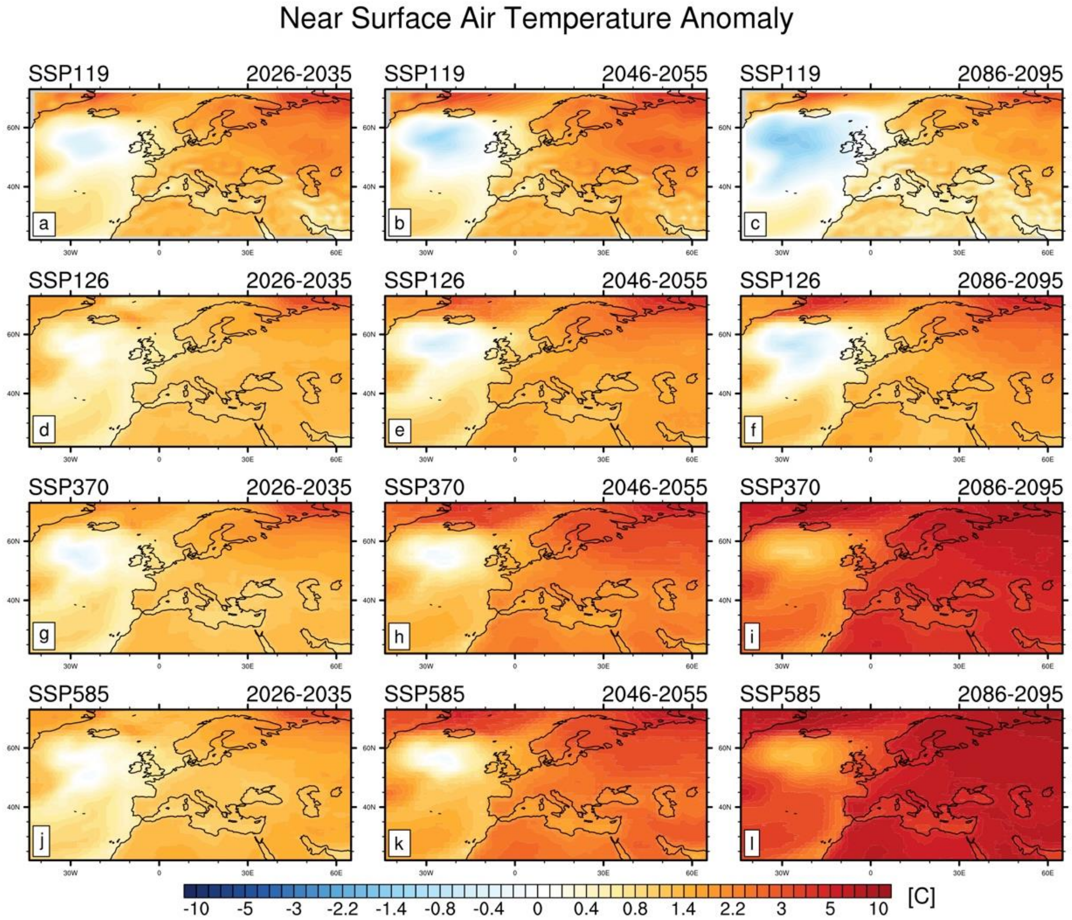

Fig 6: The multi-model ensemble mean Europe's near surface air temperature anomaly compared to 1996-2005 for the near future (2026-2035), mid-21st century (2046-2055), and end of 21st century (2086-2095) under four scenarios (i.e. SSP1-RCP1.9, SSP1-RCP2.6, SSP3-RCP7.0, and SSP5-RCP8.5).

The anomalies in precipitation over Europe present various patterns depending on the scenario. The SSP119 scenario displays drier conditions compared to the historical period over the north Atlantic Ocean which tends to intensify during the 21st century, while wetter conditions are found over land, especially in the Alpine and Anatolia regions in all the timeframes (Figure 7a,b,c). At the end of the 21st century, dry conditions are also found in the Mediterranean Sea (Figure 7c). The SSP126 scenario differs from the SSP119 in the absence of wetter conditions over the Alpine and Anatolia regions (Figure 7d,e,f).

The SSP370 scenario exhibits wetter conditions in northern Europe and drier conditions in western Europe in the near future (Figure 7g). A similar behaviour remains in the mid-century (Figure 7h) but, at the end of the century, the drier conditions intensify in western Europe and extend to southern Europe and the Mediterranean Sea (Figure 7i). The same pattern is simulated for the SPP585 scenario (Figure 7j,k,l).

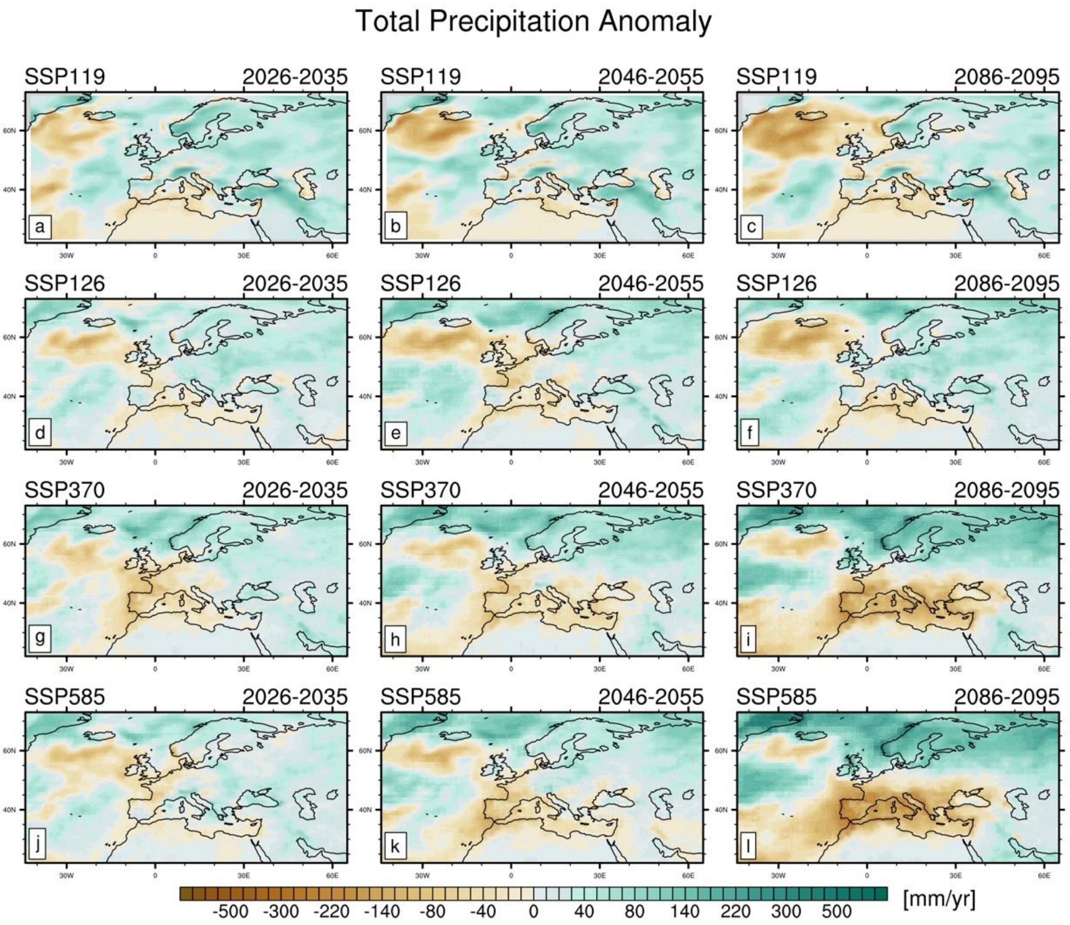

Fig 7: The multi-model ensemble mean Europe's total precipitation anomaly compared to 1996-2005 for the near future (2026-2035), mid-21st century (2046-2055), and end of 21st century (2086-2095) under four scenarios (i.e. SSP1-RCP1.9, SSP1-RCP2.6, SSP3-RCP7.0, and SSP5-RCP8.5).

The set of CMIP6 scenarios covers a wide range of climate trajectories that the GoNEXUS consortium needs to take into account when assessing the stakeholders on the range of possible upcoming changes.

3. Global and continental land use and socioeconomic scenarios

3.1. Summary of scenarios

Land use and socioeconomic scenarios (associated to socioeconomic drivers) refer to the Shared Socioeconomic Pathways (SSPs), as shown in Fig 8 (obtained from O'Neill et al. 2014). These SSPs represent alternative visions of the future on the evolution of society and ecosystems. Similarly to climate change scenarios, there are projections on land use and socioeconomic variables based on the SSPs. For CMIP6, a direct association between SSPs and RCPs is made, while this link was absent in CMIP5 (although not all RCPs in CMIP5 could be considered coherent with all SSPs).

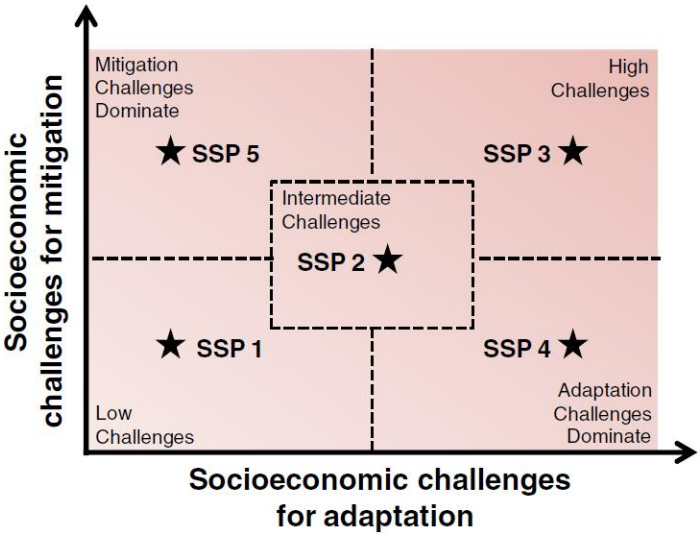

Fig 8 : Shared Socioeconomic Pathways (SSPs)
Source : O'Neil et al. (2014)

At the global scale, land use and socioeconomic scenarios have been obtained from the Land-Use Harmonization (LUH2) project (https://luh.umd.edu/index.shtml), which is part of CMIP6. It includes datasets for all the SSPs from different Integrated Assessment Models (IAMs). Detailed information on these scenarios can be found in Hurtt et (al. 2020). GoNEXUS focus in particular in the land use scenarios derived from the IAM IMAGE 3[1], which is currently being used by the GoNEXUS partners. The IAM IMAGE 3 has been developed by the Netherlands Environmental Assessment Agency (PBL, Stehfest et al., 2014). As a general rule, the association between RCPs and SSPs for CMIP5 scenarios used by GoNEXUS, in case they are employed, will follow the one of CMIP6, as shown in Fig 2.

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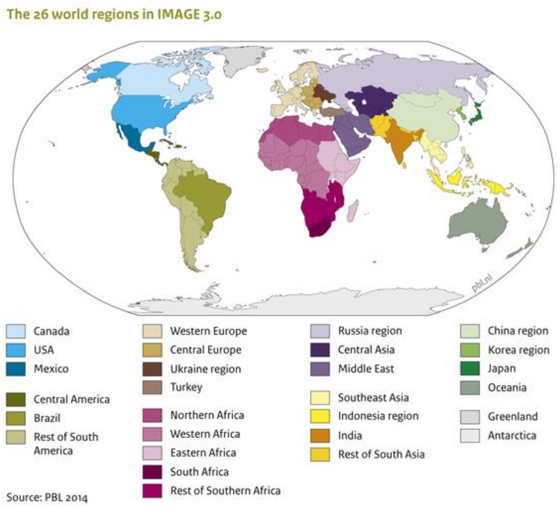
[1] https://models.pbl.nl/image/index.php/Welcome_to_IMAGE_3.0_Documentation


The 26 world regions in IMAGE 3.0

Source: PBL 2014

Fig 9 : IMAGE 3 world regions

All SSPs have been processed by IMAGE 3, and projections covering SSPs 1, 3, and 5 have been selected to be used in GoNEXUS. Global developments over the 21st century are projected by IMAGE 3 following a historical period starting in 1970. IMAGE 3 links different modules[2] that operate with different spatial and temporal resolutions and that are conditioned by the narratives of the SSP scenarios. In order to exchange information between modules and to harmonize the output, information is aggregated within the IMAGE 3 IAM over 26 socio-economic regions over the world (Fig. 9[3]), and generally reported every 5 years. The temporal extent of the projections varies per IMAGE 3 simulation but generally extend to 2070.

IMAGE 3 reports a large number of variables from one consistent projection per SSP that are relevant for the GoNEXUS project. Some of these variables are drivers, meaning they condition the projections by IMAGE 3 based on the policies outlined in the SSP narratives; some others are output of the different modules or derived in post-processing to assess impacts. Generally, the information is aggregated at the level of the regions, but for a limited number of variables gridded spatial output is available at resolutions of 5 arc minutes or 30 arc minutes (0.5°) every five years.

Relevant variables comprise (*D* denotes drivers, *S* denotes spatial, i.e, gridded information, and * identifies post-processing, meaning the information is derived from the output of IMAGE 3 but not used by the coupled modules of the IAM):

• GDP	(*D*)
• Population	(*D*, *S**)
• Energy consumption	
• Electricity production	
• Water demand and consumption	(S)
• Land use and land cover	(S)
• Access to water	(*)
• Fraction of population served by piped water (in major cities)	(*)

Output from IMAGE 3 can be obtained directly from the User Support System[4] and spatial output via the KNMI Climate Explorer[5].

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[2] https://models.pbl.nl/image/index.php/Framework_overview
[3] https://models.pbl.nl/image/index.php/Region_classification_map
[4] https://models.pbl.nl/image/index.php/USS_manual
[5] https://data.knmi.nl/datasets?q=PBL

The scenario information for the SSPs relevant for the GoNEXUS project is provided on the basis of the parameterization derived for UU's hydrological model PCR-GLOBWB (Sutanudjaja et al., 2018), in which relevant variables of IMAGE 3 have been converted into specific model input.
Regarding the projected changes in land use and land cover, post-processing is based on the methodology described by Bosman et al. (2017), who originally used the precursor of the Land Use Data Harmonization (LUH2) of Hurtt et al. (2020). Here, the processing is based on the following output (Doelman et al., 2018):

- Area under rainfed and irrigated under cultivation, each considering up to 32 crop types, and under pasture (at 5 arc minutes);
- Land cover area for urban, forest, other natural land, crop area, and pasture (30 arc minutes).

Parameterizations directly linked to the land use and land cover patterns are the annual fractions of the land cover types used by PCR-GLOBWB (rainfed crop cover, irrigated paddy, irrigated non-paddy, pasture, short natural and tall natural cf. Bosman et al. 2017 and urban; Fig. 10) and, indirectly, the associated parameterization.

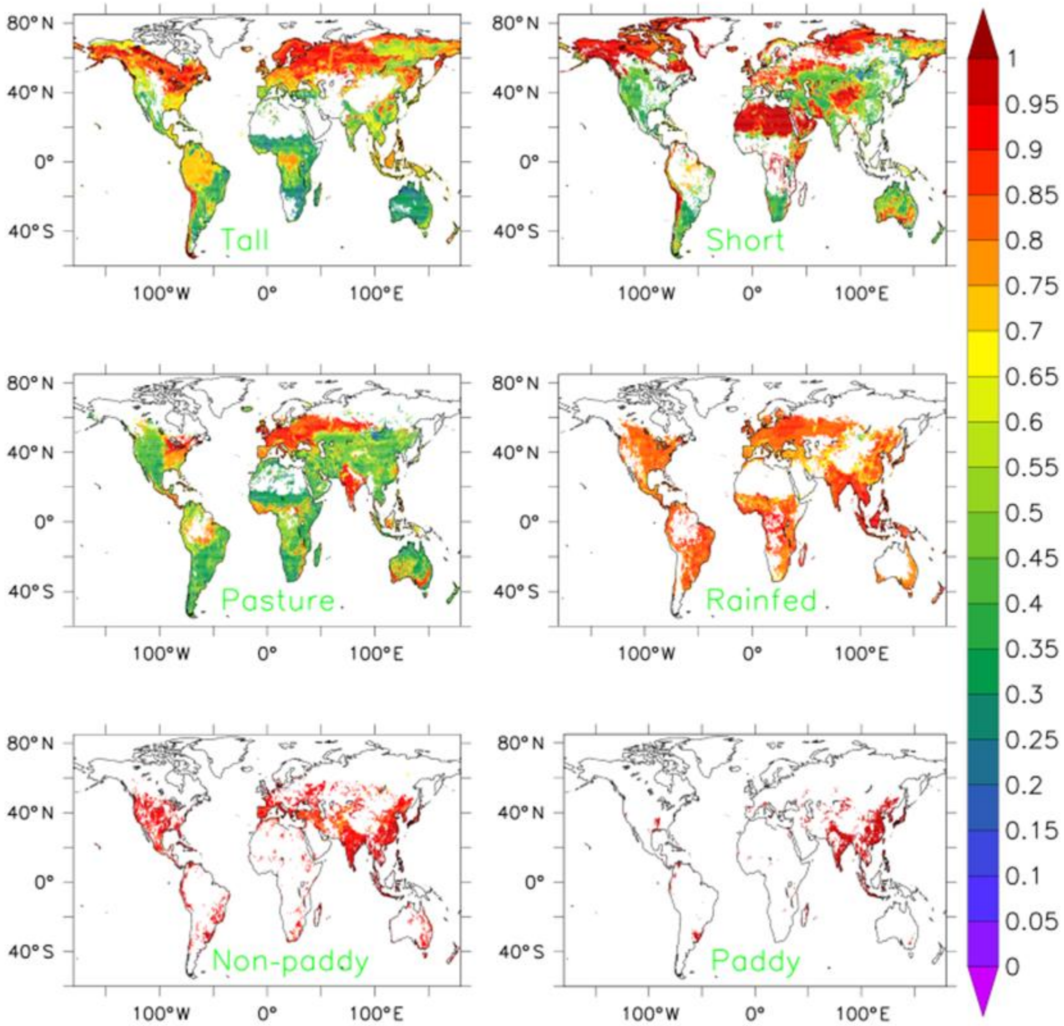

Fig 10 : Land cover fractions used in PCR-GLOBWB and their global distribution for year 2000
Source : Bosman et al. (2018)

Provided within the GoNEXUS project are the PCR-GLOBWB land cover fractions at 5 arc minutes for SSP1, 3 and 5. The next figure shows an example of the evolution of land cover and socioeconomic variables over the 21st century (Fig. 11).

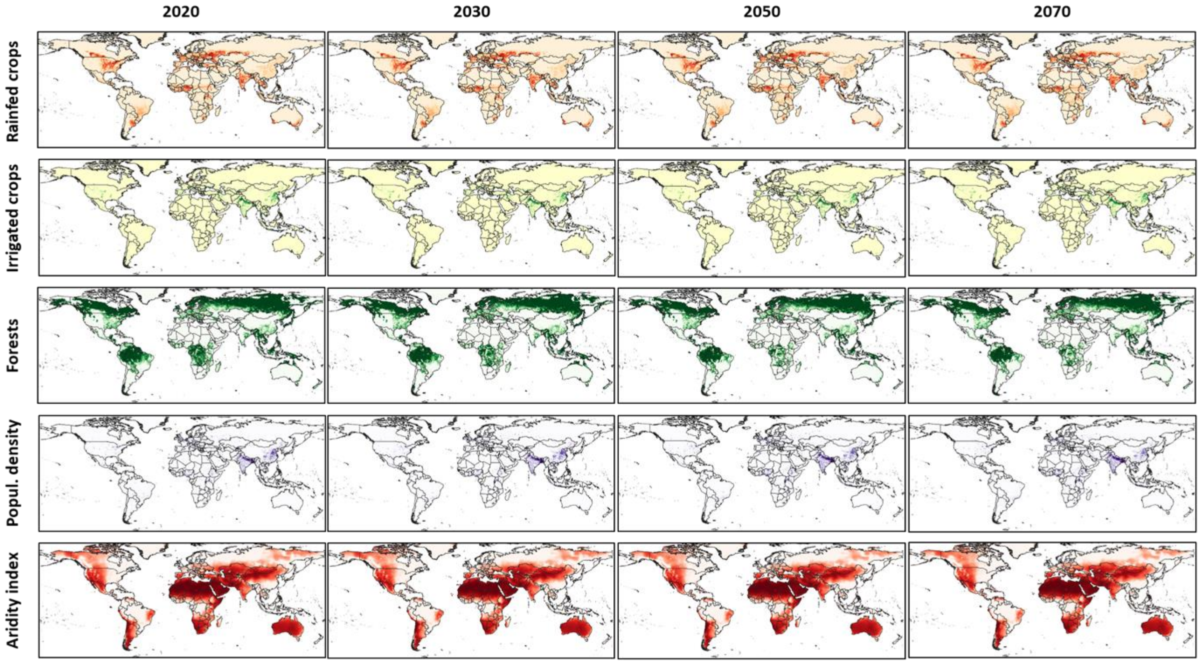

Fig 11 : Example of evolution of rainfed crop land cover %, irrigated crop land cover %, forest %, population density (in h/km2) and aridity index (P/ET) over the 21st century according to IMAGE3
Source :KNMI Climate Explorer

In addition, the water demand is provided based on the IMAGE 3 output for water demand and consumption (Bijl et al., 2016). Again, 5-year values have been interpolated to annual values for domestic, industrial and cooling water demand for energy specifying the gross and net water demand (i.e., potential withdrawal and potential consumption) at 5 arc minutes. Yearly values are converted into monthly values for the domestic water demand following the approach of Wada et al. (2011). These secondary products derived from the IMAGE 3 SSP scenarios are projections of the groundwater pumping capacity and the irrigation water efficiency per country. Also, potential locations for dams and in-stream turbines for hydropower generation have been identified at 15 arc seconds (0.25°) resolution, but these are not explicitly linked to the SSPs (Gernaat et al., 2017). At the moment, only the gross and net demand are provided at a 5′ resolution for SSP1, 3 and 5.

At the continental scale (EU), GoNEXUS will use the land use and socioeconomic scenarios obtained from the Land-Use based Integrated Sustainability Assessment modelling platform (LUISA, https://data.jrc.ec.europa.eu/collection/luisa), developed by the Joint Research Centre (JRC) of the European Commission. The JRC has implemented the LUISA Territorial Modelling Platform for EU-wide scenarios of territorial development in order to understand the direct and indirect impacts of EU policies, measures and initiatives.

Among other things, LUISA allocates (in space and time) population, economic activities and land use patterns which are constrained by biophysical suitability, policy targets, economic criteria and many other factors. Except from the constraints, LUISA incorporates historical trends, current state and future projections in order to capture the complex interactions between human activities and their determinants. The mechanisms to obtain land-use demands are described in Baranzelli et al. (2014) and Jacobs-Crisioni et al. (2017).

Key LUISA outputs are fine resolution maps on a 100mx100m spatial raster covering a wide range of themes, from economy to demography, to accessibility and transport, population densities and land-use patterns. LUISA covers all EU member states and the UK, Serbia, Bosnia Herzegovina and Montenegro until 2050. For a complete description of the LUISA modelling platform and its underlying mechanics we refer to Batista e Silva et al., 2013 and Lavalle et al., 2011.

The land use scenario available for the GoNEXUS project and already used in the LISFLOOD-EPIC model is the so-called Territorial Reference Scenario 2017. This scenario projects the most likely changes in the spatial distribution of activities across the European territory, given business-as-usual location choice preferences, official EU projections, and EU policies that are in act and have territorial relevance (Jacobs-Crisioni et al., 2017).

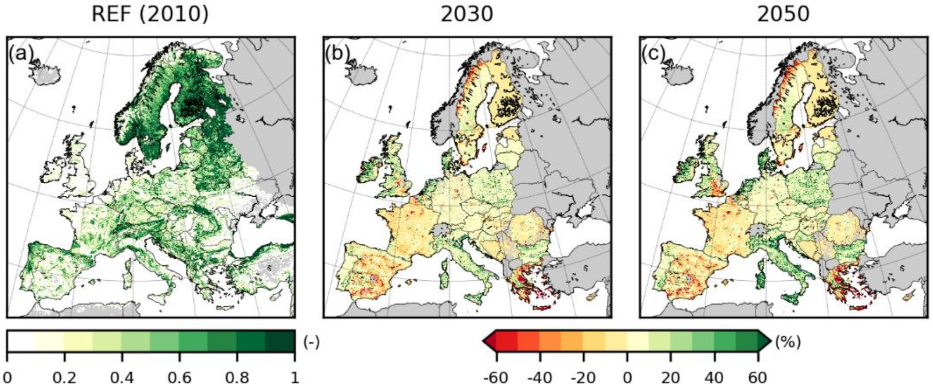

Fig. 12: Fraction in 2010 (a) and percentage of changes in forest between (b) 2010 and 2030, and (c) 2010 and 2050.

In the next few figures we show examples of projected changes of the land use classes based on the LUISA platform and used as input for LISFLOOD-EPIC. Fig 12 provides the fraction and the projected changes of land occupied by forest between the years 2010, 2030 and 2050. From the total surface of the EU, one third is occupied by forest in 2010. Forest areas are widely presented in less populated, mountainous and/or cold climate zones, where other land cover is less suitable. Forest is particularly dominant in Finland (63% forest share in the country), Sweden (60%) and Slovenia (60%) in 2010. By 2050 forest areas will hardly change with a slight increase (3%) within the EU. At a country scale, forest is significantly projected to expand in Italy (19%) and Poland (10%) within 2010-2050. The deepest relative decrease is expected in Finland (-2%).

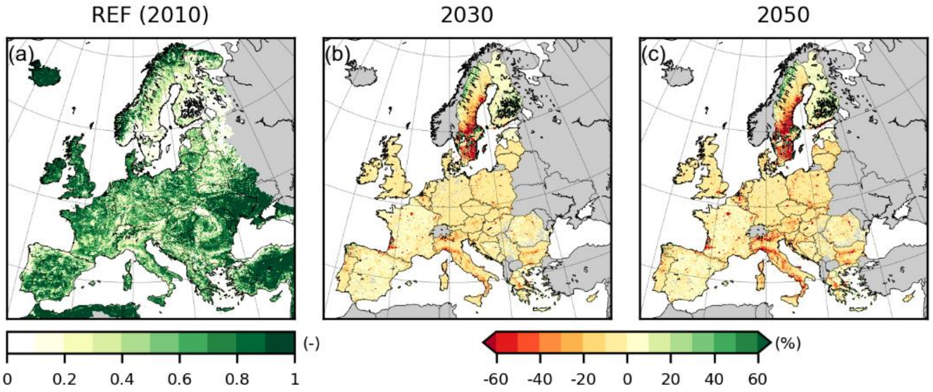

Fig. 13: Fraction in 2010 (a) and percentage of changes in the sum of the land use classes pasture, arable, permanent crop, semi-natural vegetation and other nature between (b) 2010 and 2030, and (c) 2010 and 2050.

As input for LISFLOOD-EPIC, a sum of the land use classes pasture, arable, permanent crop, semi natural vegetation and other nature, is used (Fig. 13). The analysis of these classes indicates that they cover 51% of the EU surface in 2010 with the largest contribution from France, Spain, Germany, Poland, Italy, Romania and the United Kingdom. Slight increases are projected for Finland (3%) and Estonia (1%), while all other EU countries show a decrease until 2050 resulting in a slight decrease (3%) for the EU. The largest absolute decreases are projected for Italy, Poland and France.

The classes urban, industry and infrastructure or the so-called sealed areas (Fig. 14) cover 5% of the EU surface in 2010 with the largest contribution of 16% by Germany, followed by France (15%). In relative terms (urban, industry and infrastructure share in the country), the densely populated Belgium, (21%), the Netherlands (16%) and Malta (15%) top the list. Urban, industry and infrastructure land use classes are projected to continue expanding in and around most capitals and other major cities, albeit at different extents. By 2050, the sealed areas will expand across the EU (12%). France will see the largest absolute increase, followed by the United Kingdom and Italy. The highest relative growth of around 79% is expected for Luxembourg followed by Belgium (38%).

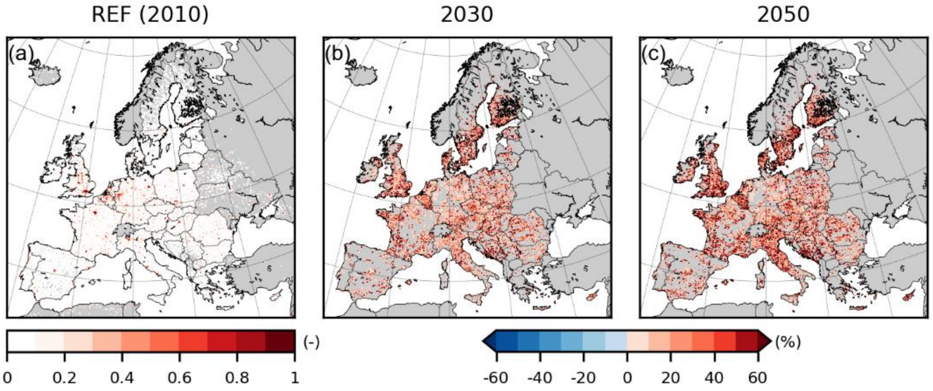

Fig. 14: Fraction in 2010 (a) and percentage of changes of the sum of the land use classes urban, industry and infrastructure between (b) 2010 and 2030, and (c) 2010 and 2050.

Although the Territorial Reference Scenario 2017 from LUISA is not in full agreement with the trajectories derived from SSPs, it is taken as the baseline reference for the EU policies and scenarios.

On top of the SSPs, the impact of NextGenerationEU (https://europa.eu/next-generation-eu/index_en) on socioeconomic projections for the EU will be explored, updating the projections of the SSPs, in line with the relevant EU policies.

The LUISA projections thus are detailed and reflect EU policy but are basically incongruent with the SSP scenarios and these differences will be quantified.

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