

# Realizing the 2015 Paris Agreement

## Pathways to and benefits of limiting global warming to 1.5°C

## Realizing the Paris Agreement

- 195 countries have agreed a plan to limit global warming to well below 2°C above pre-industrial values and to work towards limiting long-term warming to 1.5°C.
- Based on recent emissions the Earth is on course to exceed 1.5°C global warming in the next 10-30 years.
- To limit global warming to 1.5°C requires large and rapid reductions in carbon emissions, combined with extensive use of carbon capture and significant increases in forest cover.
- If global warming is limited to 1.5°C compared to 2°C the risk of major changes in climate extremes, such as drought, heat waves and flooding will be significantly reduced over land areas such as Southern Europe and North Africa.
- These are some of the science and policy insights from the EU Horizon 2020 project CRESCENDO pertinent to realizing the Paris Agreement.



*Limiting global warming to 1.5°C instead of 2°C decreases the risk of increased flooding, heatwaves and droughts in Europe.*

## Using Earth System Models to understand interactions between society and climate

Colin Jones, University of Leeds

Earth System Models represent both the global climate system and the carbon cycle, this is necessary for developing realistic future projections of the Earth's response to human emissions of carbon.

Approximately, only 50% of the CO<sub>2</sub> emitted by human activities stays in the atmosphere, warming the planet. The other 50% is absorbed by 'carbon sinks' such as the oceans, soil and vegetation.

The future effectiveness of these sinks is sensitive to increasing carbon concentrations and to the degree of climate change caused. If their efficiency decreases in the future, more emitted CO<sub>2</sub> will remain in the atmosphere, further amplifying warming.

The converse is also true: if the efficiency of these sinks increases, future warming will be reduced.

## Improved estimates of carbon budgets

Chris Jones, UK Met Office

There is a direct link between the cumulative amount of CO<sub>2</sub> emissions and global temperature rise.

This results in a 'carbon budget' available for any given global warming level, for example approximately 1 trillion tonnes of emitted carbon causes 2°C of warming.

Over the last two centuries more than half of the 2°C carbon budget has been used up. When we account for other greenhouse gases, or consider the 1.5°C limit, a very limited carbon budget remains. Precisely what size budget is uncertain.

CRESCENDO is developing new methods to reduce this uncertainty and improve projections of the actual carbon budget available to realize the Paris Agreement.



*Future warming could be reduced if the planting of forests and fuel crops was massively increased alongside carbon capture and storage.*



*Carbon emission reductions required to meet the Paris Agreement will require a significant increase in renewable energy production to meet future electricity demand.*

## Exploring emission pathways and policy choices

**Detlef van Vuuren, PBL Netherlands**

The carbon budget available to stay below 1.5°C global warming equates to roughly 10-30 years of present-day emissions.

In developing emission scenarios for these low warming targets, models assume extensive use of CO<sub>2</sub> removal technologies, such as bio-energy crops with carbon capture and storage and massive afforestation. These 'negative emissions', on the long-term, should theoretically compensate for near term emissions exceeding the available carbon budget.

Such stringent scenarios raise important questions around societal and policy changes needed to achieve them, as well as risks associated with overshooting a given warming target before returning to it later.

CRESCENDO scientists have developed such scenarios for the Paris Agreement that are actively being applied in state-of-the-art Earth System Models to investigate these risks.

## Benefits of limiting global warming to 1.5°C

**Sonia Seneviratne, ETH Zurich**

Limiting global warming to 1.5°C compared to 2°C will have significant positive benefits with respect to the risk of future changes in heat waves, droughts and extreme rainfall over land.

The impact of such a reduction in global warming is much larger over land because land temperatures, in particular extreme warm events, increase more rapidly than do ocean temperatures.

Hence, even a 0.5°C reduction in global warming offers major potential benefits across a range of regional impacts. This is particularly true for the Mediterranean region of Southern Europe and North Africa.

Land temperatures and rainfall are substantially impacted by biophysical changes arising from urbanization, agriculture, irrigation, and other land use changes. CRESCENDO is working to better quantify these effects given the radical land use changes assumed in future scenarios that limit long-term global warming to 1.5 or 2°C.

## CRESCENDO in numbers:

---

25

Research  
Organisations

10

European  
Countries

7

European Earth  
System Models

3

European Integrated  
Assessment Models

139

Scientists

# Together, assessing interactions between the environment, society and climate



For more information contact the Project Office

---

By email: [alberto.munoz@metoffice.gov.uk](mailto:alberto.munoz@metoffice.gov.uk)

By Phone: (+44) (0) 7827 251527

By Post: Alberto Muñoz  
Project Manager in CRESCENDO  
Met Office Hadley Centre  
FitzRoy Road  
Exeter EX1 3PB  
United Kingdom



*CRESCENDO is a European Union Horizon 2020 Project funded under the programme SC5-01-2014: Advanced Earth-system models under grant agreement No. 641816.*