UEMF

الجامعة الأورومتوسطية بفاس

EURO-MEDITERRANEAN UNIVERSITY OF FES

UNIVERSITÉ EURO-MÉDITERRANÉENNE DE FÈS

Sustainability: Towards a New Paradigm of Development in the Euro-Mediterranean Region

November 26, 2019

Maintaining Global Warming Below 2˚C: A Systemic Challenge

Pr. Othmane Benmoussa, Ph.D, ACE, SE, Eng.

« It would be difficult to overstate the gravity of this moment. Without exaggeration, we can say: the future of our planet is at stake. People's lives, the health of global economy, the very survival of some nations. The science is clear… According to the International Energy Agency, we are nearing the ***point of no return***, and we must pull back from the abyss ».

Ban Ki Moon - COP17

Contents

LONDON

Source: Climate Central

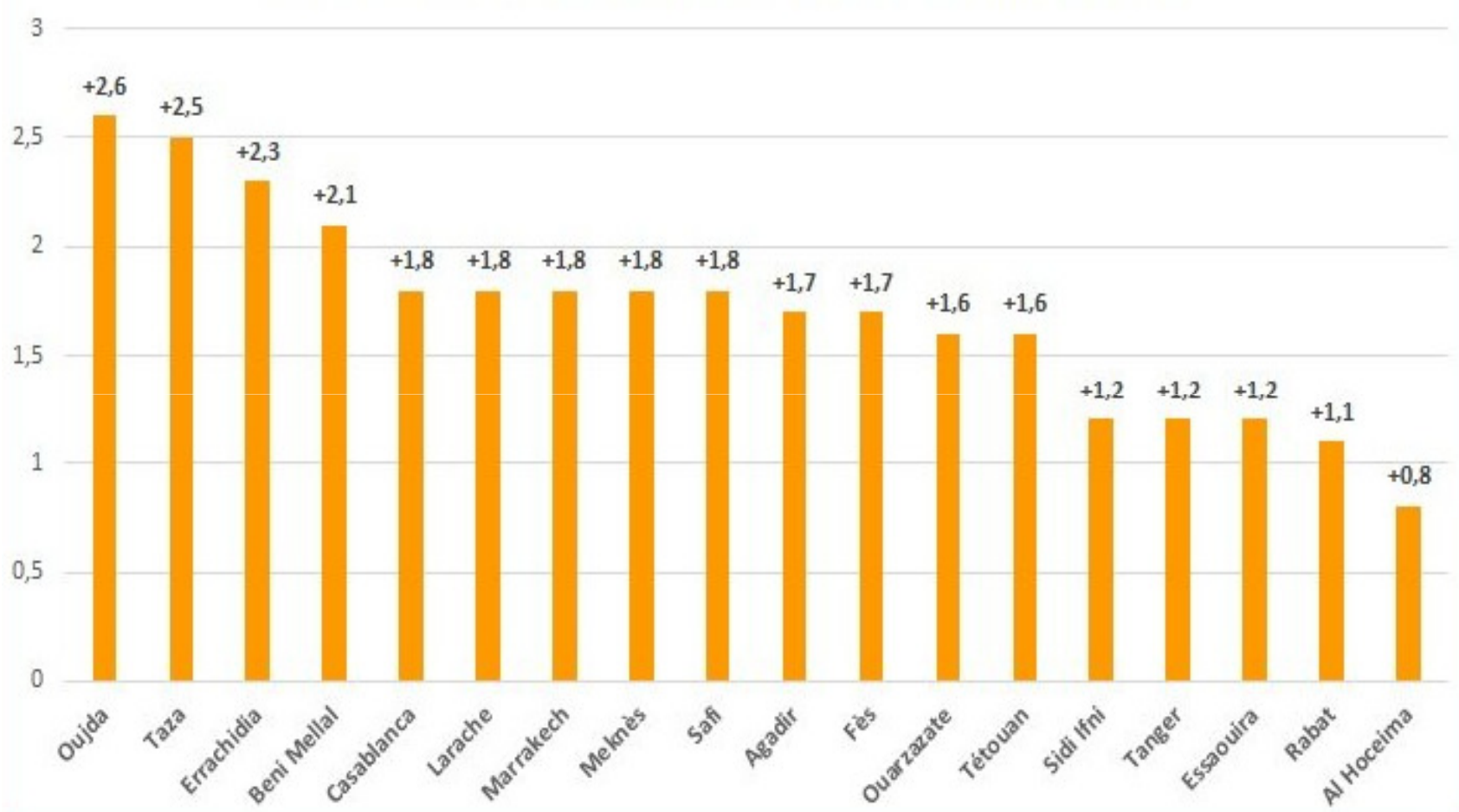
SHANGHAI

Effect of Climate Change in Morocco

Several Moroccan cities are threatened by the global warming.
By 2100, according to **Climate Central** and **National Geographic**, some of them will almost no longer exist in the new map and others will lose a lot of neighborhoods.

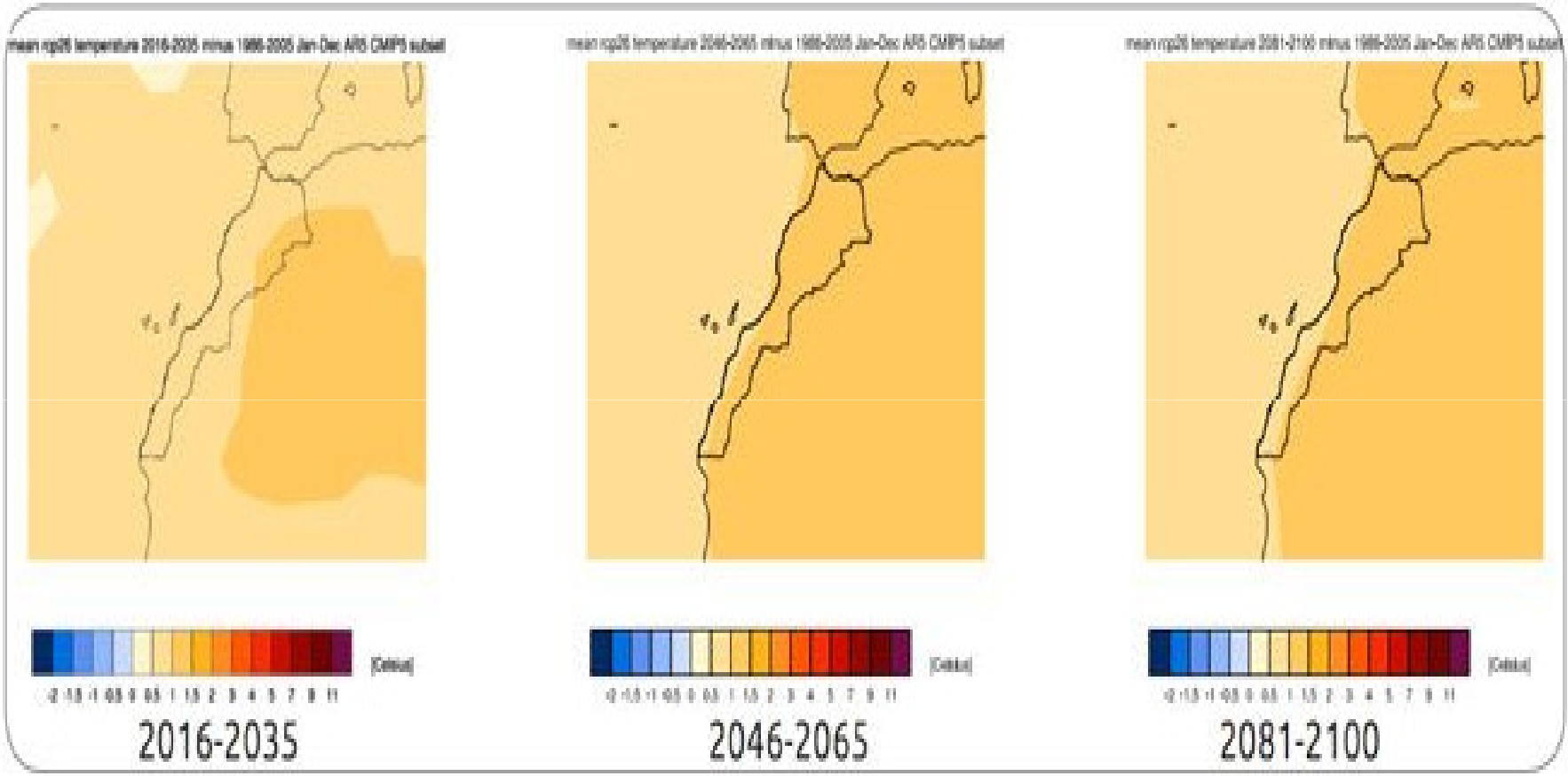
- **Dakhla, Tarfaya, Martil, Fnideq, and Mdiq** will be almost completely engulfed;
- **Laayoune, Agadir, Essaouira, El Jadida, Casablanca, Mohammedia, Rabat, Kenitra, Larache, Tangier, and Saidia** will lose a good part of their neighborhoods.

Effect of Climate Change in Morocco



Ranking of Moroccan cities by degree of global warming between **1971-1980 and 2009-2017** (variations in ˚C, Moroccan Meteorological Directorate data)

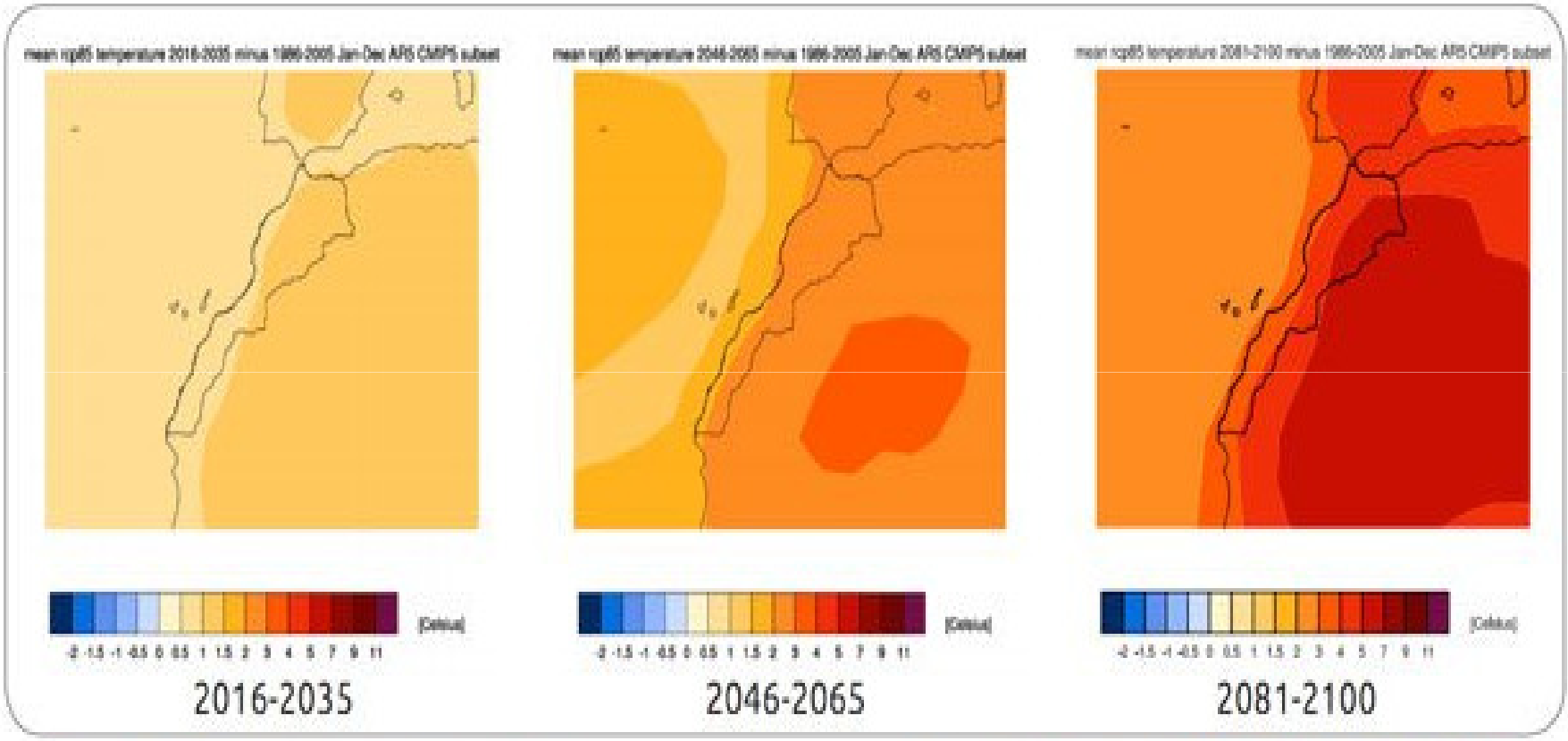
Effect of Climate Change in Morocco



Annual average temperature variations for the periods 2016-2035, 2046-2065, and 2081-2100 compared to the period 1986-2005 (**optimistic scenario RCP2.6**)

Source: *Intergovernmental Panel on Climate Change (IPCC)*

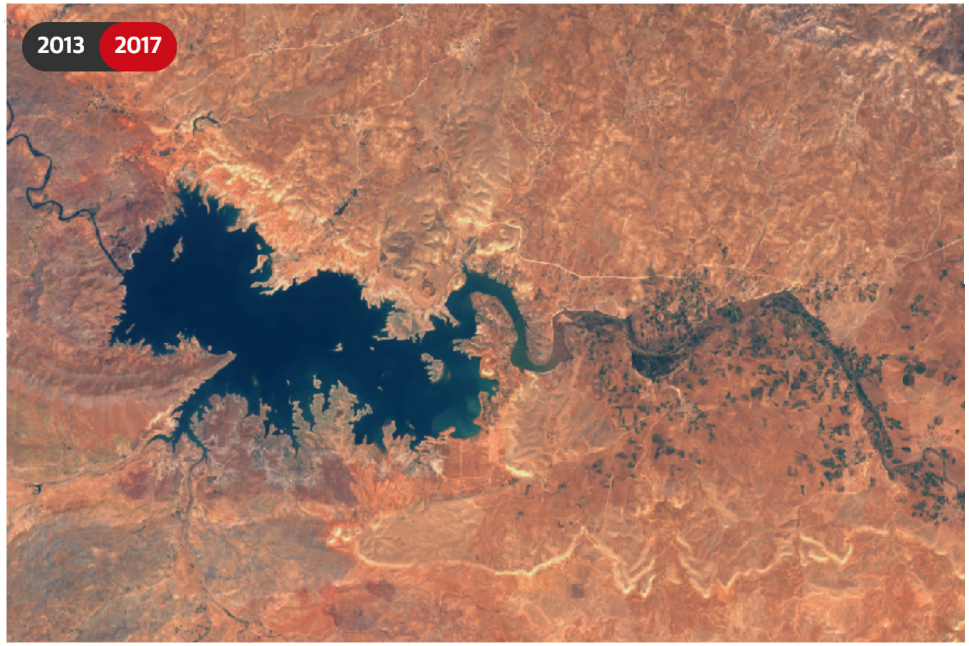
Effect of Climate Change in Morocco



Annual average temperature variations for the periods 2016-2035, 2046-2065, and 2081-2100 compared to the period 1986-2005 (**pessimistic scenario RCP8.5**)

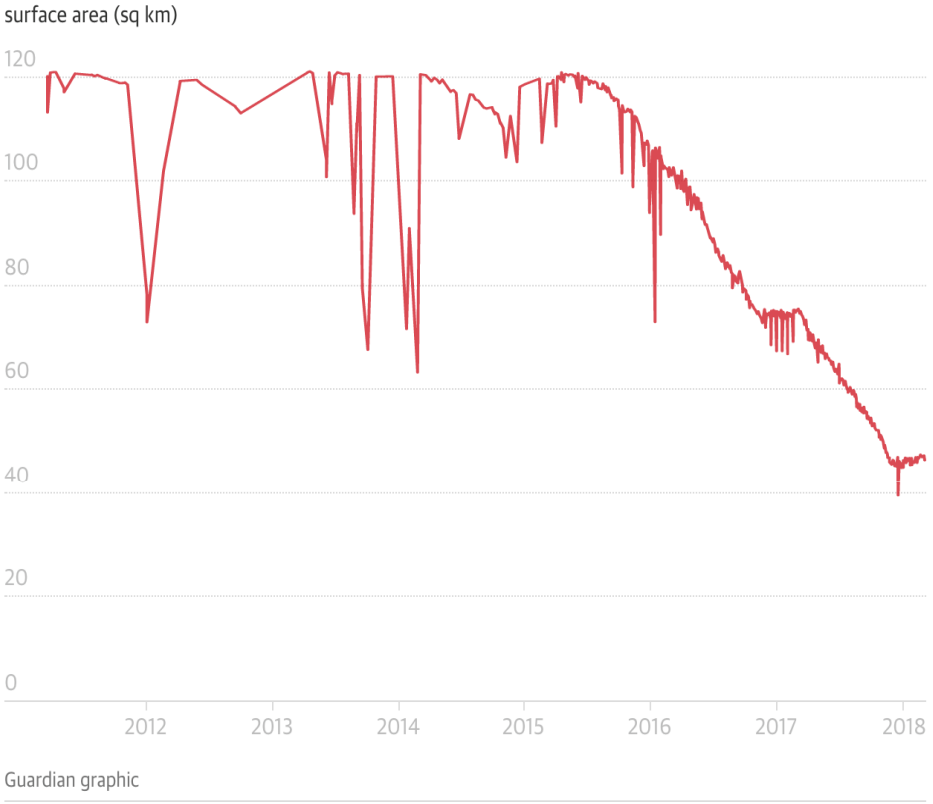
Source: *Intergovernmental Panel on Climate Change (IPCC)*

Effect of Climate Change in Morocco



Al Massira reservoir, Morocco | Source: NASA/Landsat

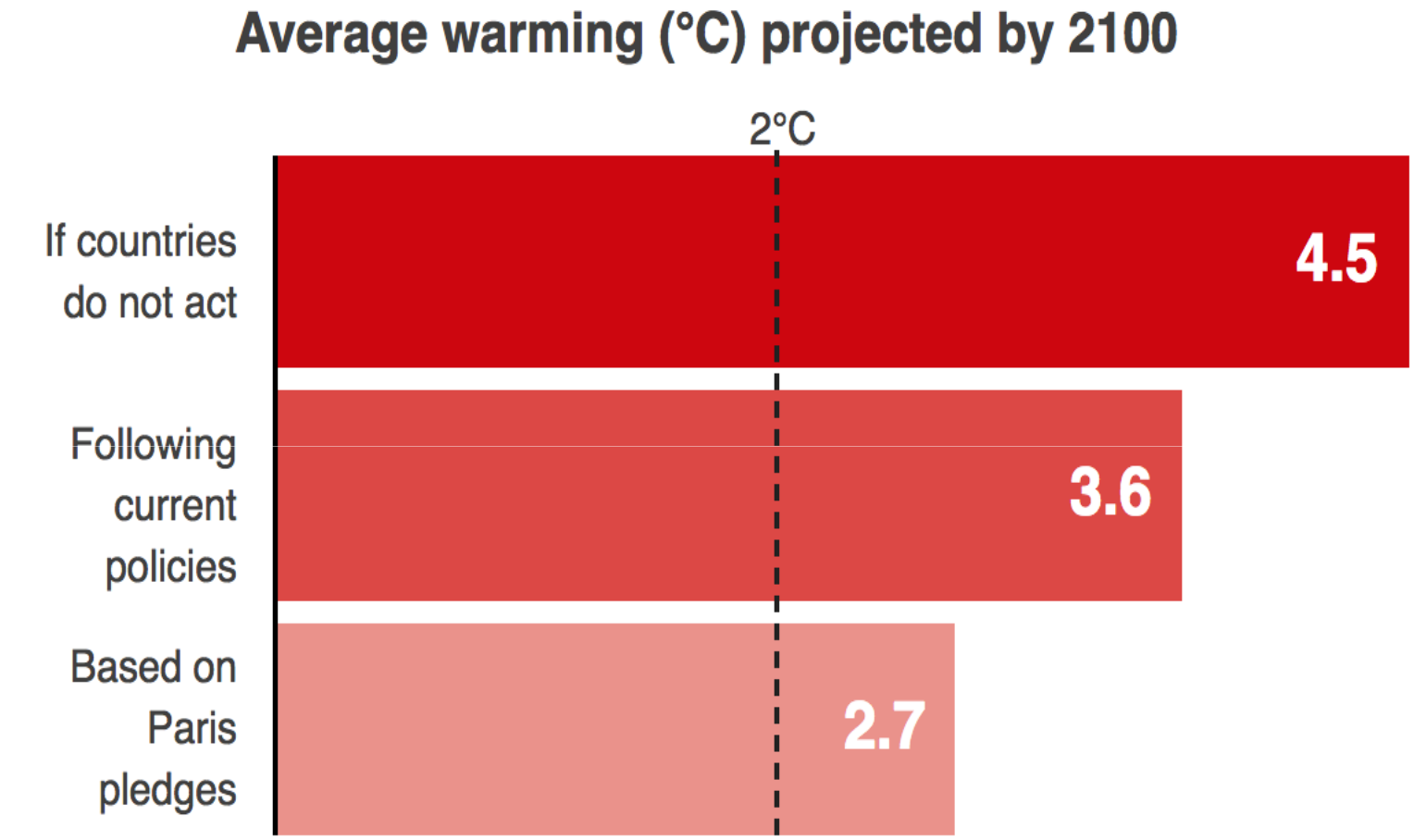
Water levels are historically low



‘Day Zero’ Water Crises – Al Massira Dam, Morocco

Source – Guardian 2018

Damage Limiting



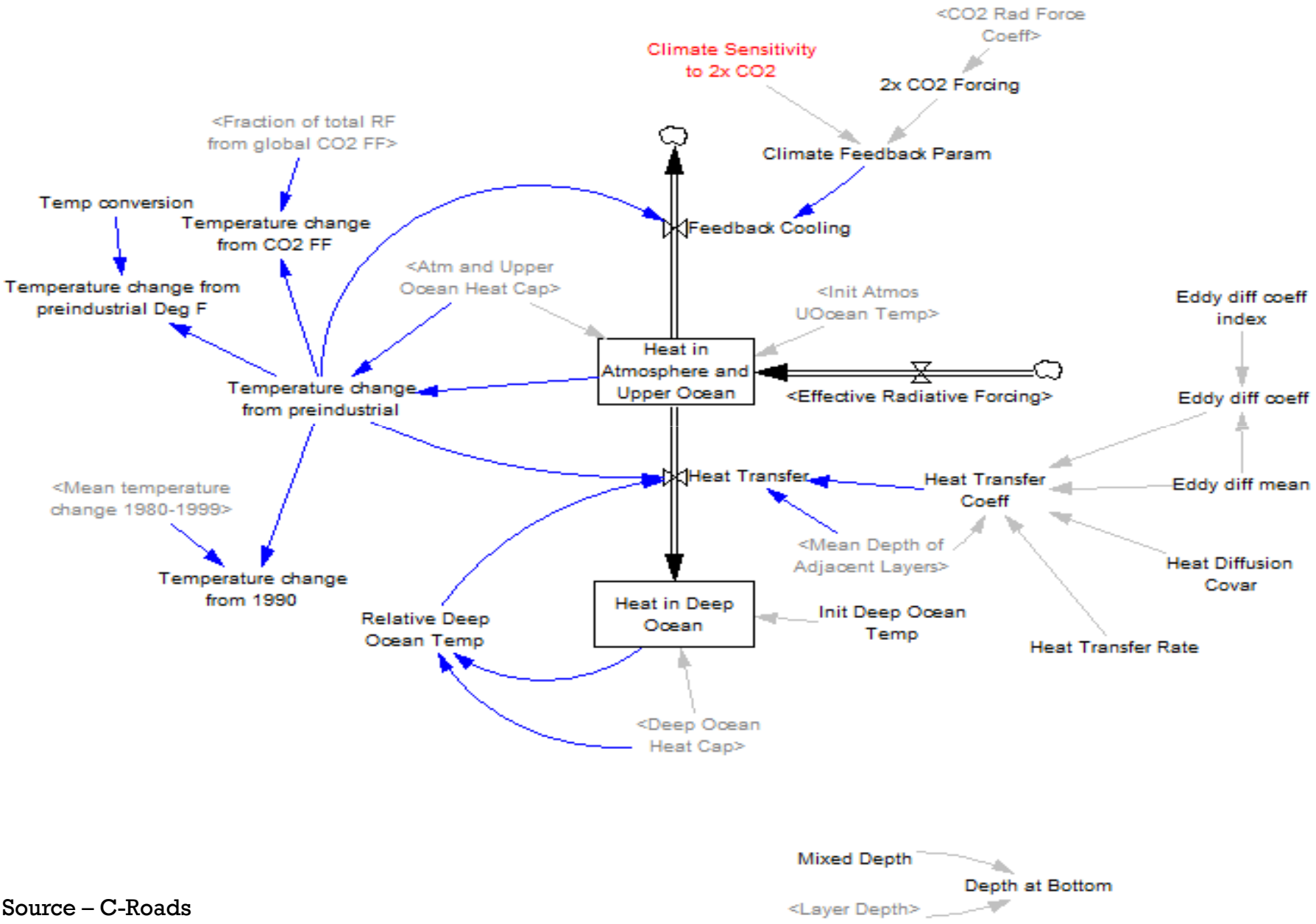
Source: Climate Action Tracker, data compiled by Climate Analytics, ECOFYS, New Climate Institute and Potsdam Institute for Climate Impact Research.

Climate Problem Statement

- The Earth's climate **SYSTEM** behaves in ways that make it challenging for people to fully anticipate and understand the long-term consequences of their decisions.

- An **advanced dynamic non-linear climate model** is needed to **help people understand, through interaction and exploration, what speed and scale of reductions in emissions will work to meet climate goals**, mainly **limiting temperature change between 1.5 and 2 degrees C of warming by 2100**.

Systemic Model of Global Warming



Source – C-Roads

C-Roads Simulator

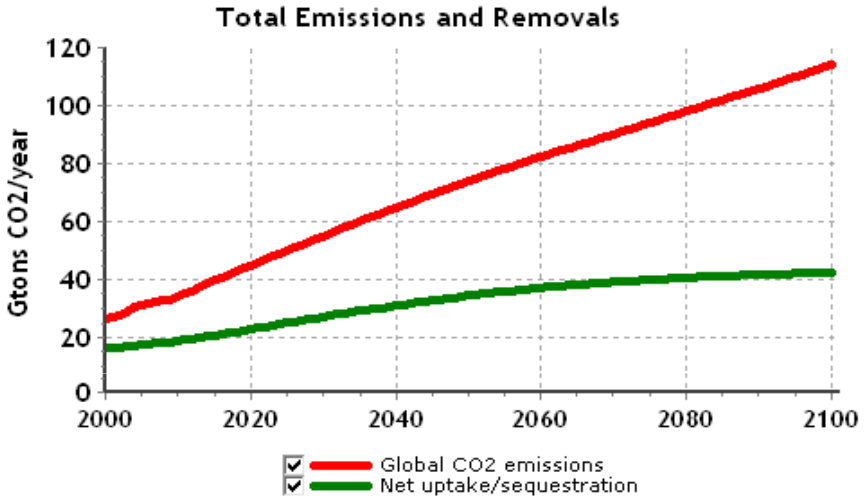
- The Climate Rapid Overview and Decision Support (**C-Roads**) policy simulation model, *developed by Ventana Systems*, helps to **explore the dynamics of the climate and impacts of proposed policies** using a model consistent with the **best available peer-reviewed science.**
- C-Roads simulations are based on the **RCP8.5/SSP3** (Representative Concentration Pathways and Shared Socioeconomic Pathways) **scenario.**

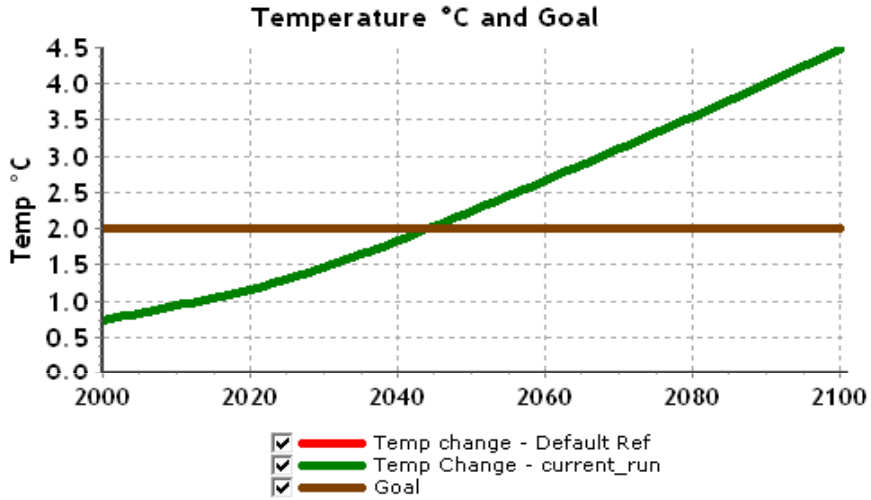
C-Roads Simulator

BAS Scenario

C-ROADS v5.001p.082e

8.0°F | 4.5°C | 2100 Data | Reset to Reference | Return to Main





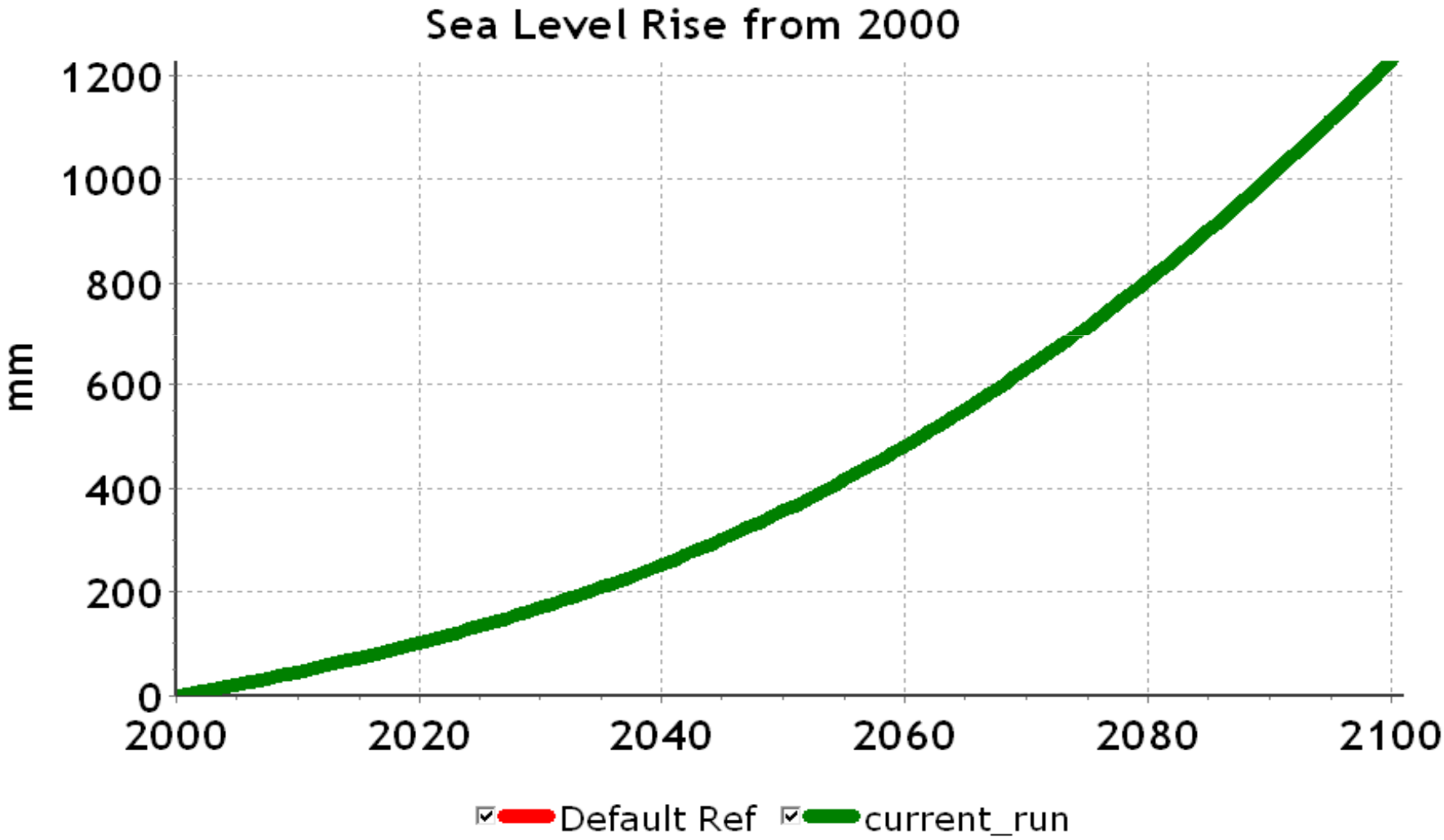
Large Graph | Graphs: Default Graphs | Bathtub Graphs | Atmospheric CO2 | Temp & Goal | Sea Level Rise | Ocean pH | Large Graph

Emissions Targets | Non-CO2 GHGs | Land-use Emissions | Non-CO2 Forcings | Population | Sensitivity | Settings | World Climate Exercise

	Emissions stop growing in year:	Begin reducing emissions in year:	Rate at which emissions are reduced (%/year)	Deforestation Effort	Afforestation Effort
US	2100	2100	0	0	0
EU	2100	2100	0	0	0
Other Developed	2100	2100	0	0	0
China	2100	2100	0	0	0
India	2100	2100	0	0	0
Other Developing	2100	2100	0	0	0

C-Roads Simulator

BAS Scenario



C-Roads Simulator

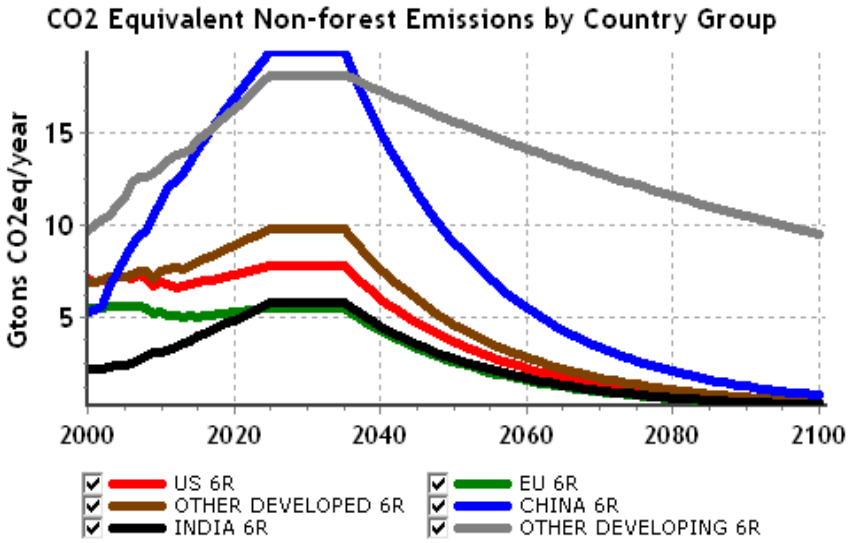
BAS Scenario *(Source: Climate Interactive & Climate Central)*

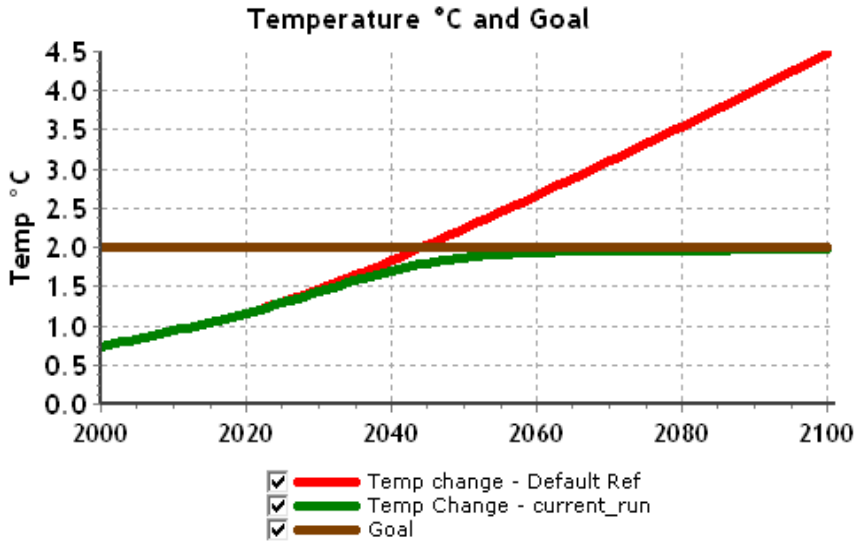
- **Multi-meter sea level rise** within 50-150 years possible.
- Widespread **increase in the frequency of drought** across the globe (**~60% increase**)
  - **Desertification of all the Mediterranean Region.**
- Intense and **frequent heat waves and floods** in many areas across globe impacting up to **640 million people** by 2100.
- Thawing of permafrost potentially releases CO2 and CH4.
- Committed warming (centuries to millennia): **+ >6˚C.**
- Long-term equilibrium sea level rise (millennia): **~13-15 m.**
- Irreversible change.

Simulations

C-ROADS v5.001p.082e

3.6°F | 2.0°C | 2100 Data | Reset to Reference | Return to Main



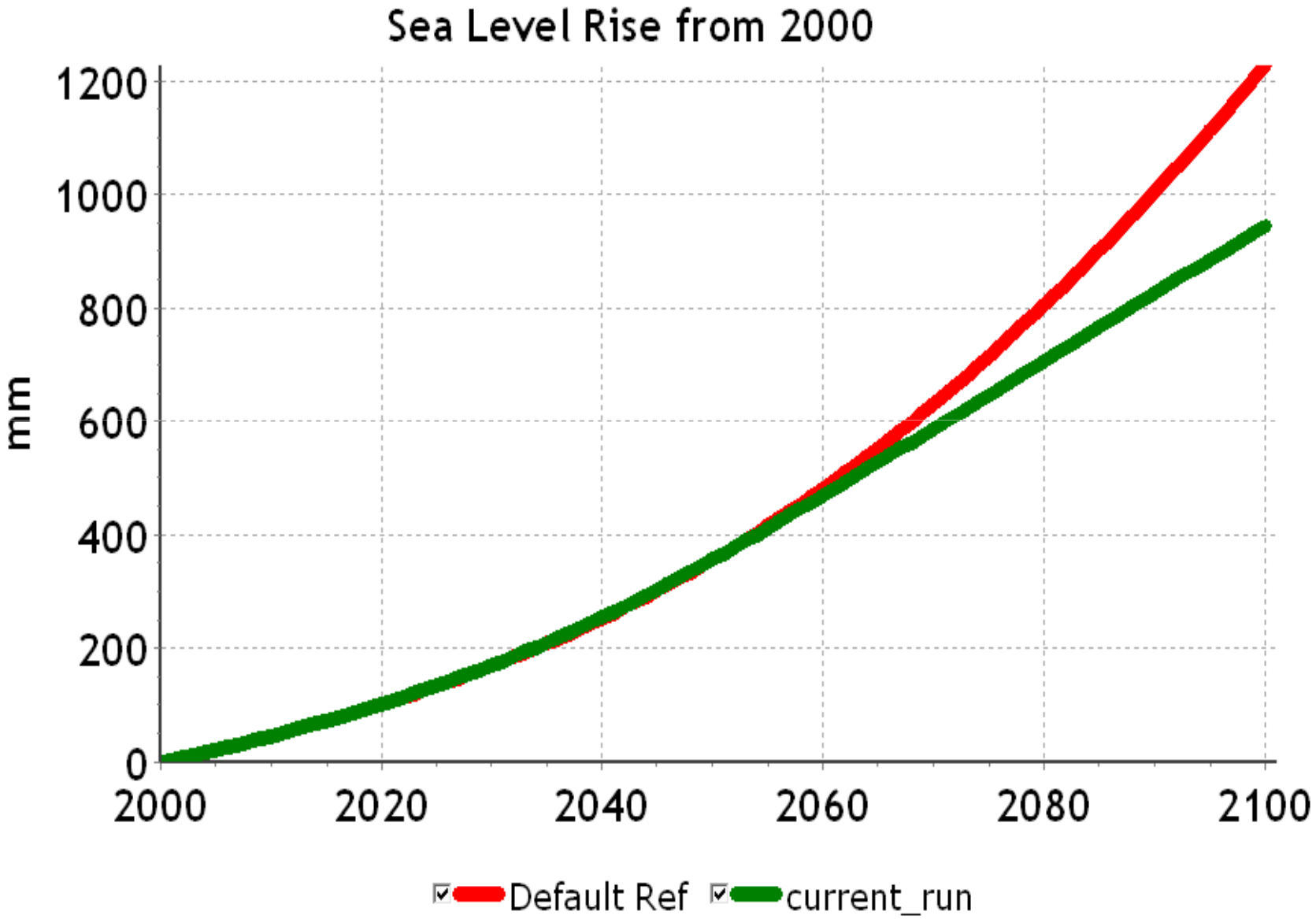


Large Graph | Graphs: Default Graphs | Bathtub Graphs | Atmospheric CO2 | Temp & Goal | Sea Level Rise | Ocean pH | Large Graph

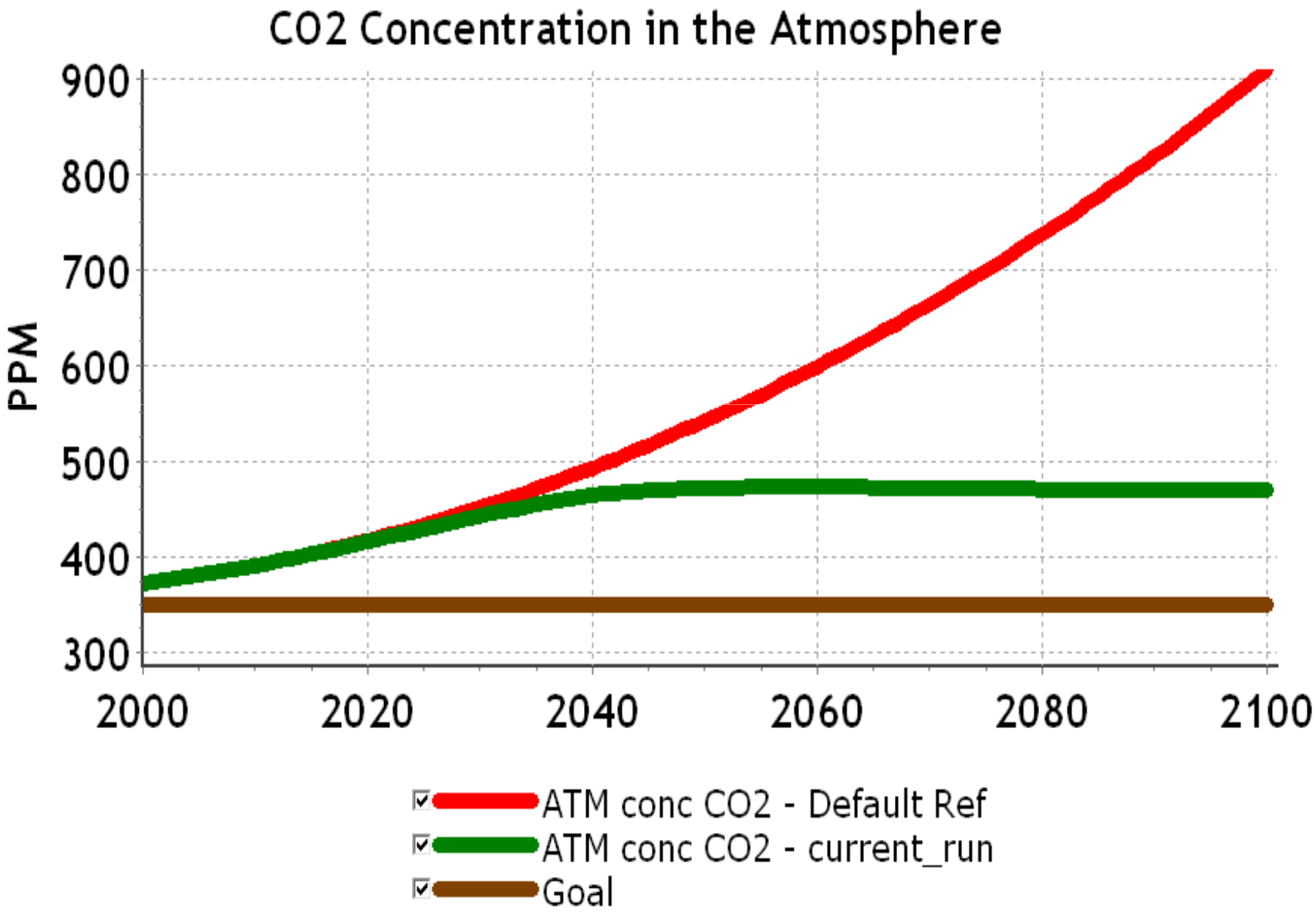
Emissions Targets | Non-CO2 GHGs | Land-use Emissions | Non-CO2 Forcings | Population | Sensitivity | Settings | World Climate Exercise

	Emissions stop growing in year:	Begin reducing emissions in year:	Rate at which emissions are reduced (%/year)	Deforestation Effort	Afforestation Effort
US	2025	2035	5.00	90.00	80.00
EU	2025	2035	5.00	100.00	90.00
Other Developed	2025	2035	5.00	80.00	90.00
China	2025	2035	5.00	70.00	50.00
India	2025	2035	5.00	25.00	35.00
Other Developing	2025	2035	1.00	25.00	35.00

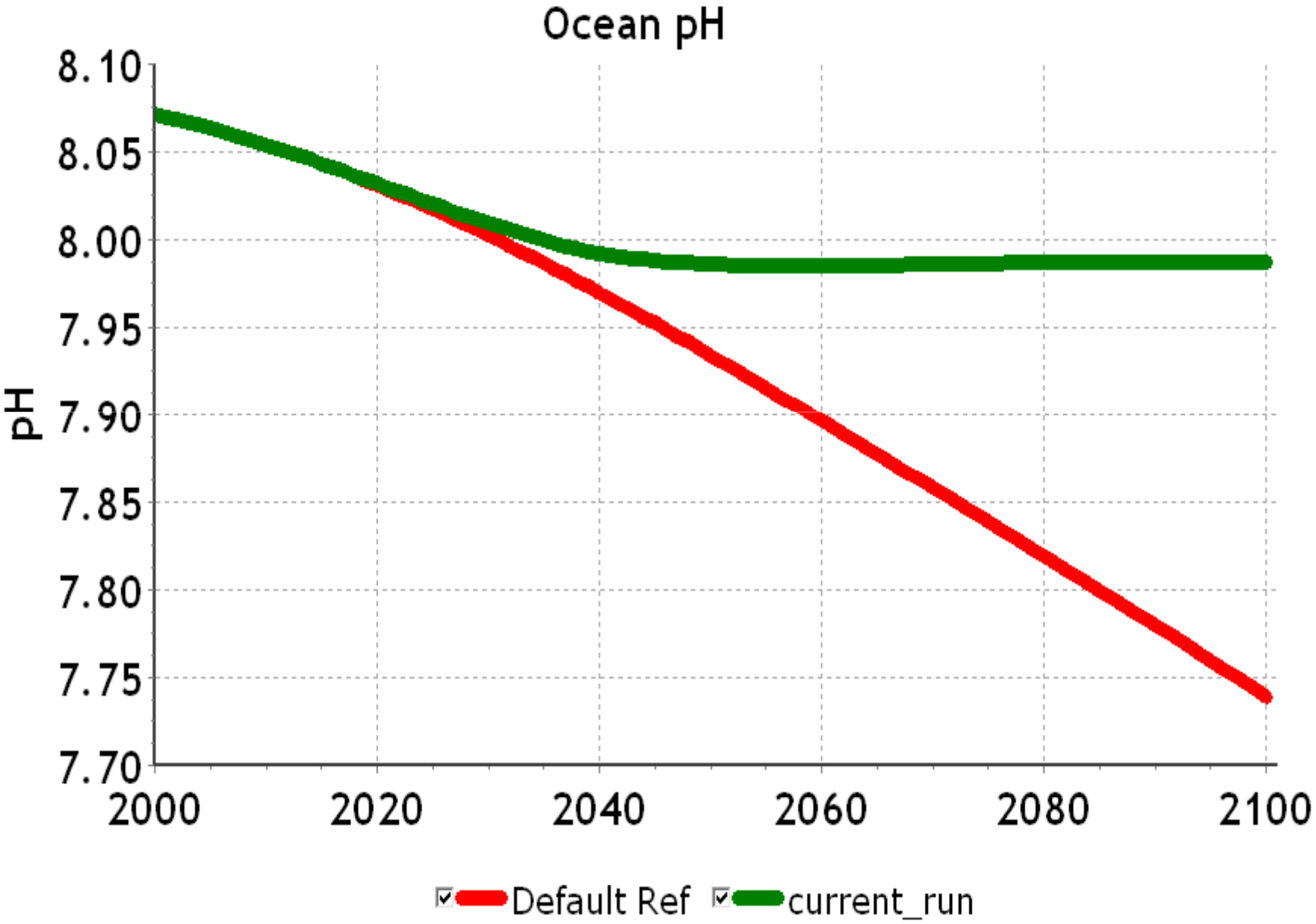
Simulations



Simulations



Simulations



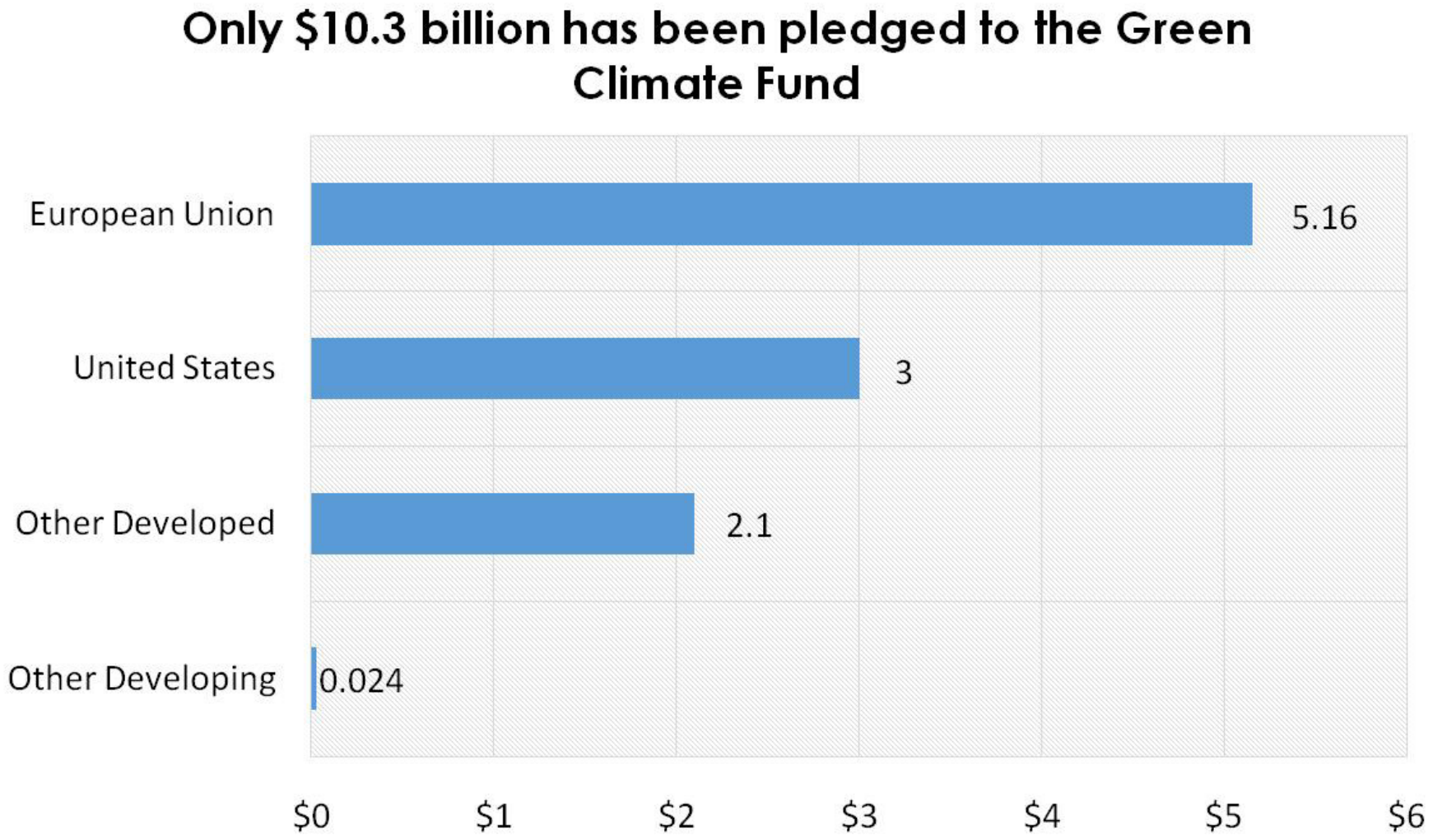
Simulations

~2ºC of warming by 2100 *(Source: Climate Interactive)*

- Sea level **rise** this century **~0.70 m**.
- **Decrease** in global production of staple crops:
  - Wheat 8-37%
  - Maize 6-38%.
- **Severe glacial melting**.
- **~8% reduction** of access to freshwater (compared to today).
- **~4% increase** in the global proportion of land under drought (compared to today).
- **9-31%** of plant and animal species will be committed to extinction.
- Committed warming (millennia) **+2 to +3.8℃**.
- Long-term equilibrium sea level rise (millennia) **~2-10 m**.
- **~90%** of coral reefs undergo coral bleaching.

Climate Finance

Target – US$100B annually



Source: The Green Climate Fund

Climate Finance

Target – US$100B annually

Goal: $100 Billion per year

The ***Green Climate Fund*** provides aid to countries for:

- Disaster relief;
- Regular food and water supply;
- Immigration and refugees “human management”;
- Emission reductions.

Bibliography

- Cronin, M., Gonzalez, C., and Sterman, J. (2009). Why Don't Well-Educated Adults Understand Accumulation? A Challenge to Researchers, Educators, and Citizens. *Organizational Behavior and Human Decision Processes*, *108*, 116-130.
- IPCC (2018). Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty [V. Masson-Delmotte, P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.
- Peters, G., Andrew, R., Boden, T., Canadell, J., Ciais, P., Le Quéré, C., and Wilson, C. (2013). The Challenge to Keep Global Warming Below 2°C. *Nature Climate Change*, *3*, 4-6.

Bibliography

- Schleussner, C.F., Lissner, T.K., Fischer, E.M., Wohland, J., Perrette, M., Golly, A.,Rogelj, J., Childers, K., Schewe, J., Frieler, K., Mengel, M., Hare, W., and Schaeffer, M. (2015). Differential Climate Impacts for Policy-relevant Limits to Global Warming: The Case of 1.5 ˚C and 2 ˚C. *Earth Syst. Dynam. Discuss. Earth System Dynamics Discussions 6.2*, 2447-2505.
- Solomon, S., Plattner, G.-K., Knutti, R., and Friedlingstein, P. (2009). Irreversible Climate Change Due to Carbon Dioxide Emissions. *Proceeding of the National Academy of Sciences*, *106*, 1704-1709.
- Sterman, J., Franck, T., Fiddaman, T., Jones, A., McCauley, S., Rice, P., Sawin, E., Siegel, L., and Rooney-Varga, J.N. (2014). World-Climate: A Role-Play Simulation of Climate Negotiations. *Simulation Gaming* (DOI: 10.1177/1046878113514935).
- Sterman, J., Fiddaman, T., Franck, T., Johns, A., McCauley, S., Rice, P., Sawin, E., and Siegel, L. (2013). Management Flight Simulators to Support Climate Negotiations, *Environmental Modelling & Software*, *44*, 122-135.
- Sterman, J. (2008). Risk Communication on Climate: Mental Models and Mass Balance. *Science*, *322*, 532-533.