

Global radiative forcing of land use and land cover change activities

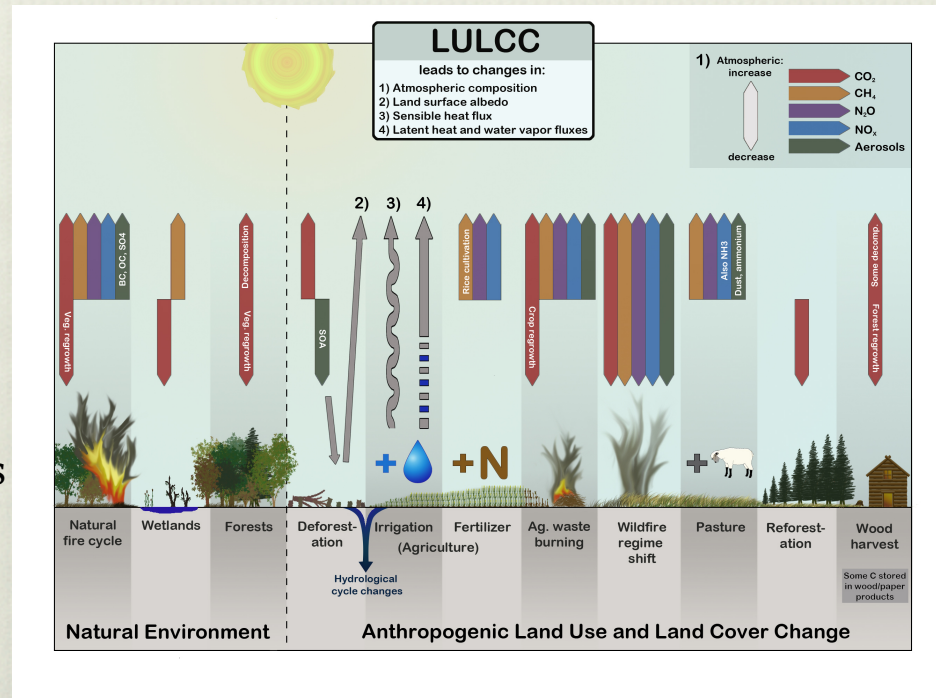
Dan Ward, Natalie Mahowald, Silvia Kloster

LUMIP 8.5.14

1. What are the relative contributions to global radiative forcing (RF) of: *Land Use and Land Cover Change (LULCC)* and *Fossil Fuel burning (FF+)*?

Including:

- land cover changes
- deforestation fires
- wood harvesting
- fertilizer emissions
- livestock emissions
- waste burning
- wildfire regime changes



Not Including:

- BGP effects (except alb.)
- irrigation
- water vapor forcing
- fluvial C flux
- natural emiss changes of ch₄, n₂o
- direct human impacts on wildfires

2. How is the contribution of LULCC likely to change in the future?

3. Can we place an upper bound on the future contribution of LULCC to global RF?

On the use of the radiative forcing metric for addressing these questions:

Advantages

Defined the same way for long and short-lived forcing agents

Can be used to approximate a global temperature response

Has been used in many studies to compute the total anthropogenic contribution to climate change

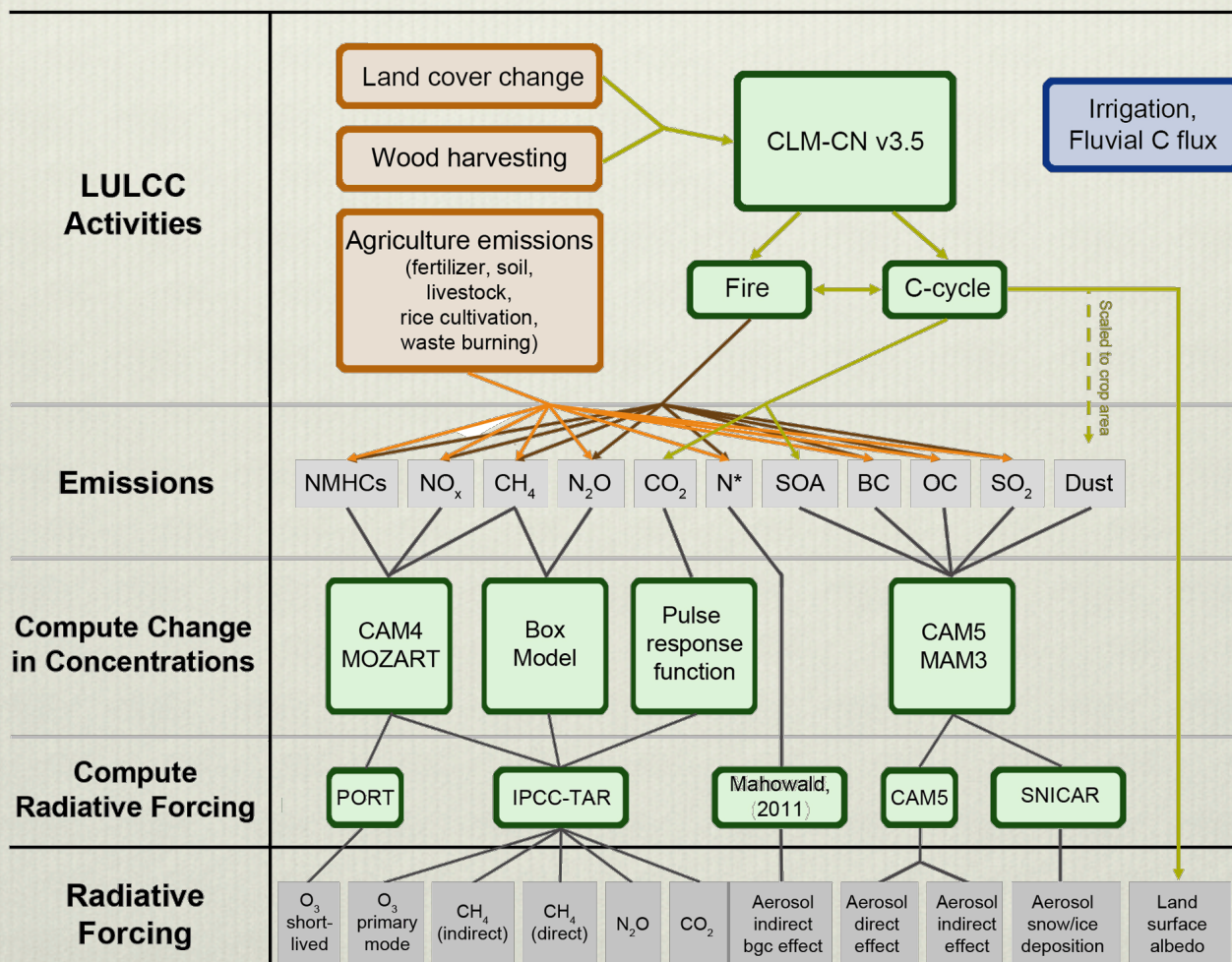
Disadvantages

Global mean RF does not represent the impacts of regional forcings (bgs)

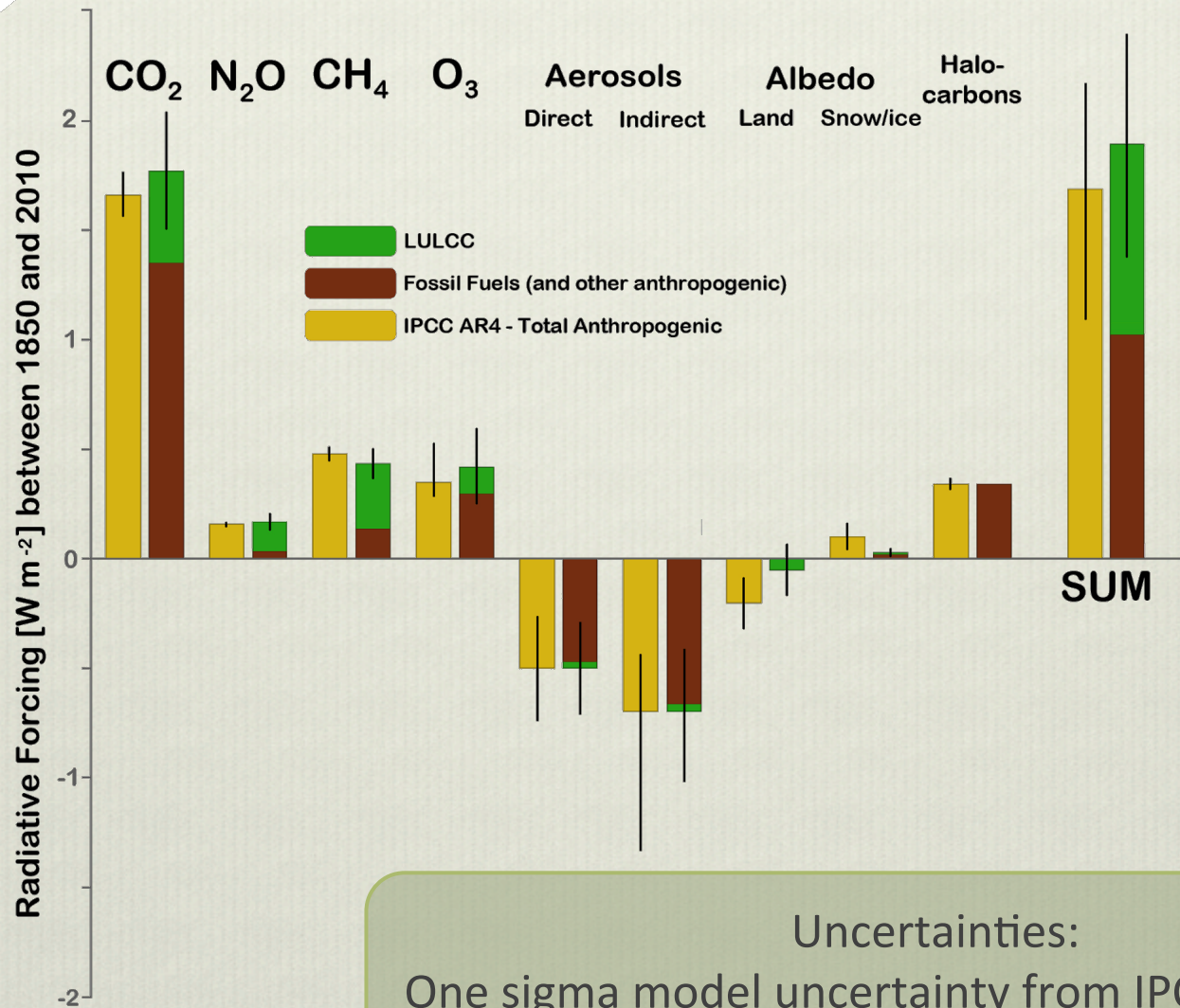
Temperature response to BGC and BGP forcings is not strictly additive (e.g. Jones et al., 2013)

Multiple methods are required to compute RFs from diverse forcing agents

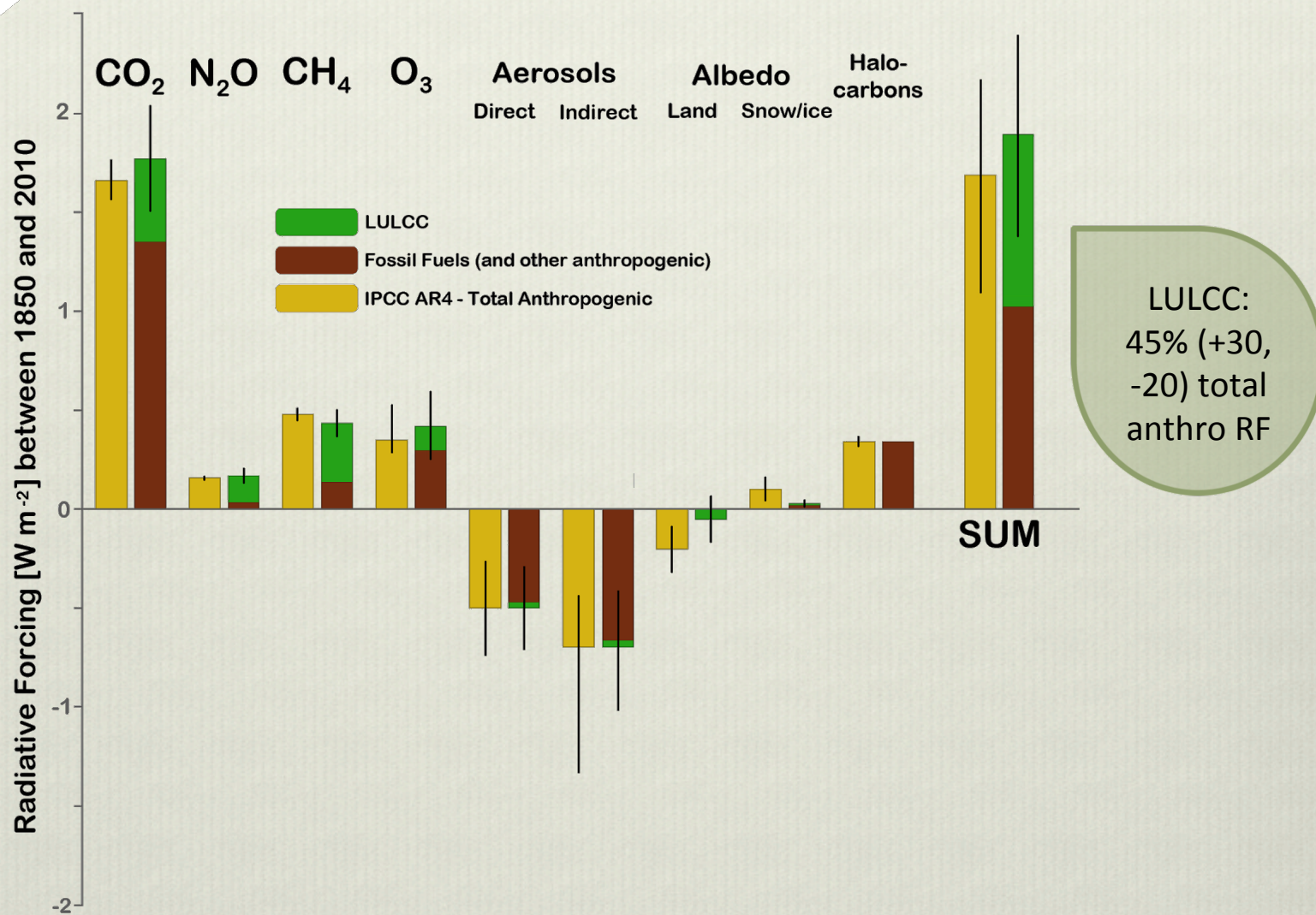
Methods to go from LULCC activities -> emissions of relevant species -> changes in atmospheric concentrations -> radiative forcing



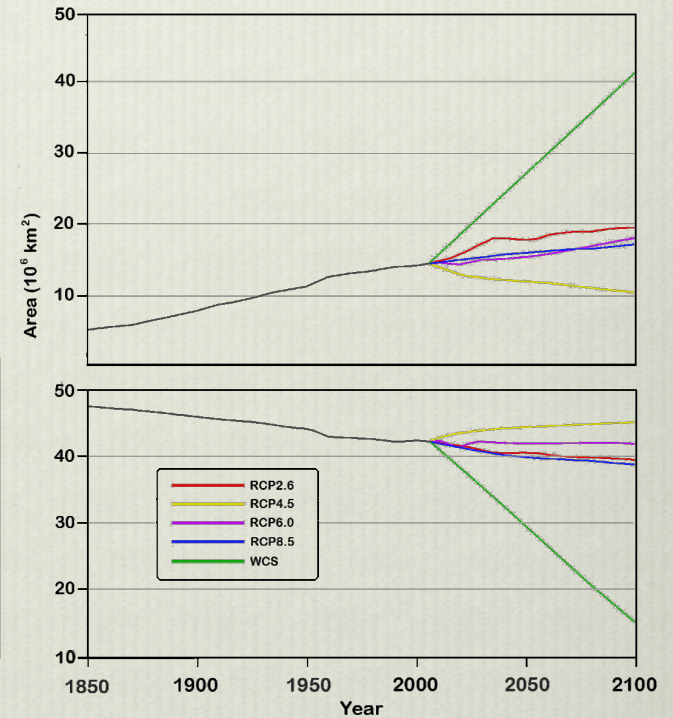
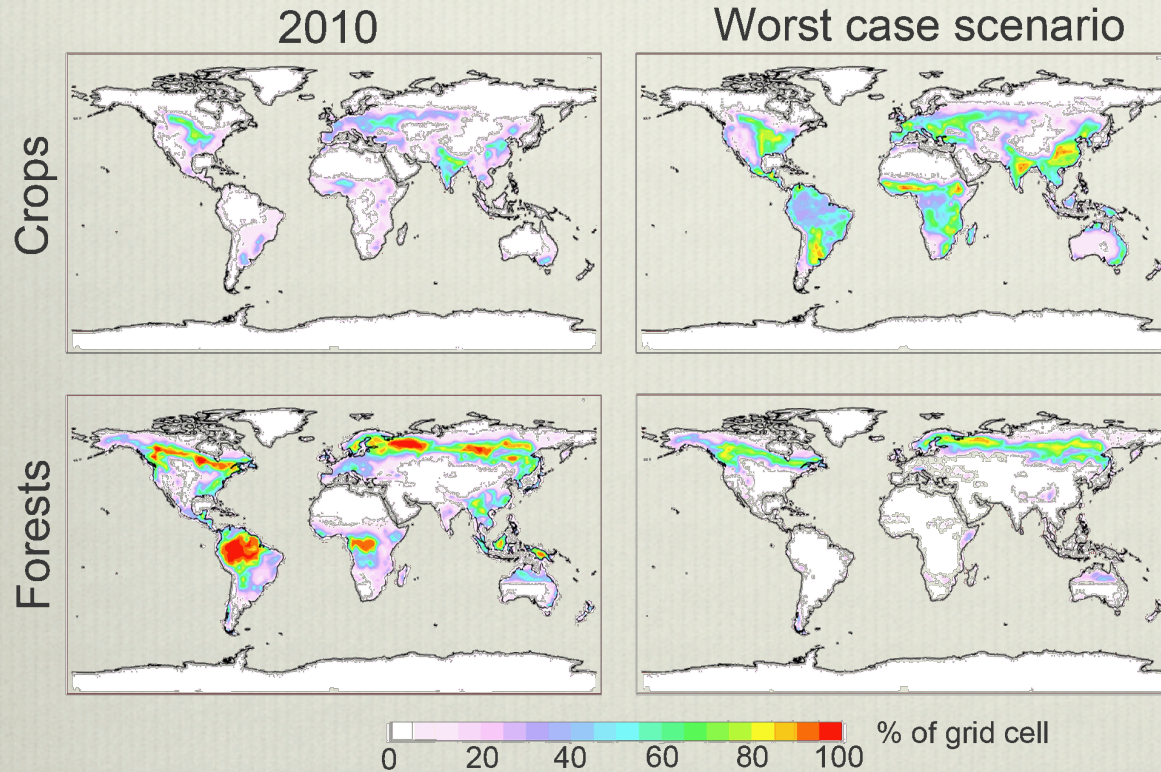
2010 radiative forcing (relative to 1850)



2010 radiative forcing (relative to 1850)



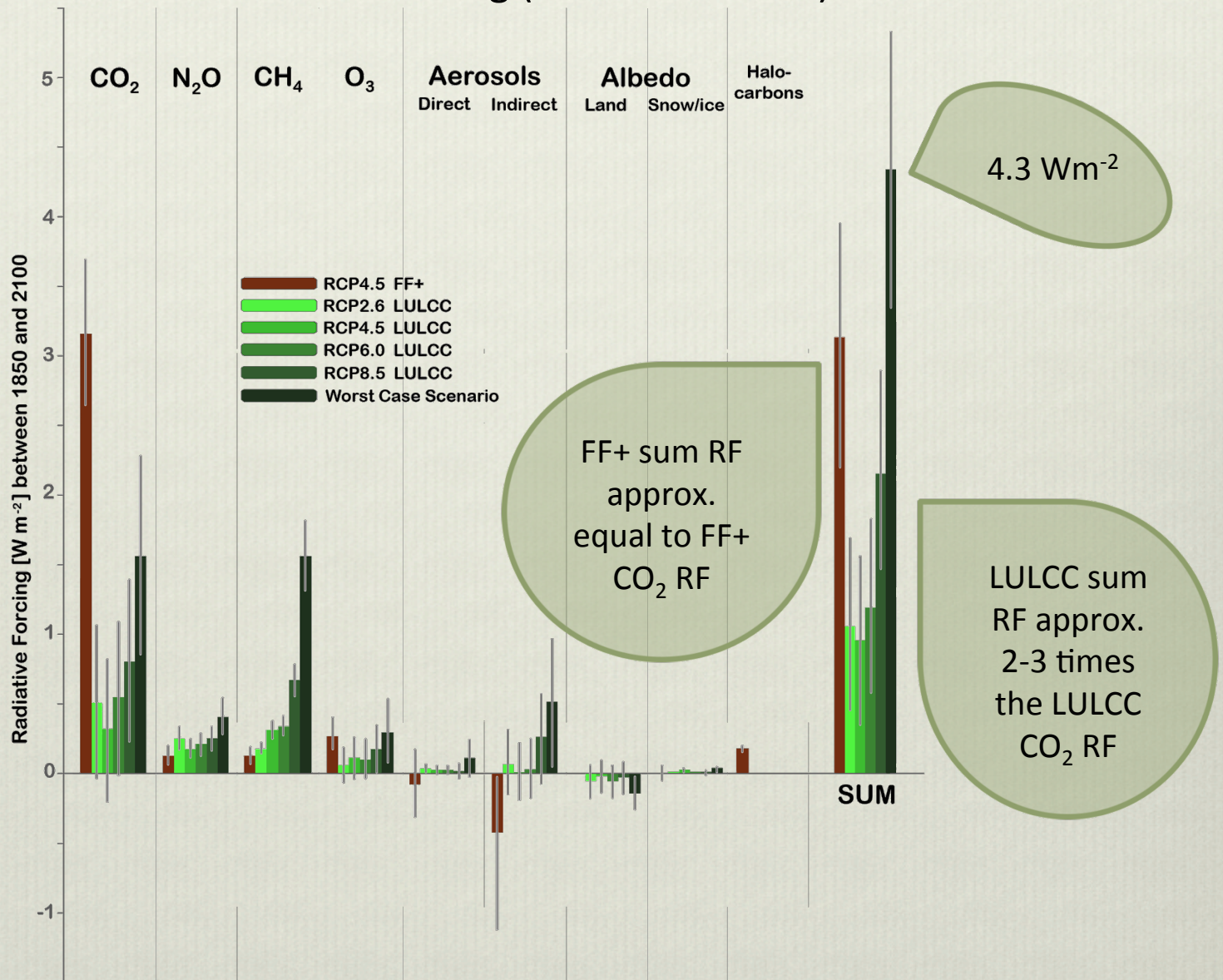
What would the world look like if all arable land was cultivated and all pasturable land was converted to pasture?

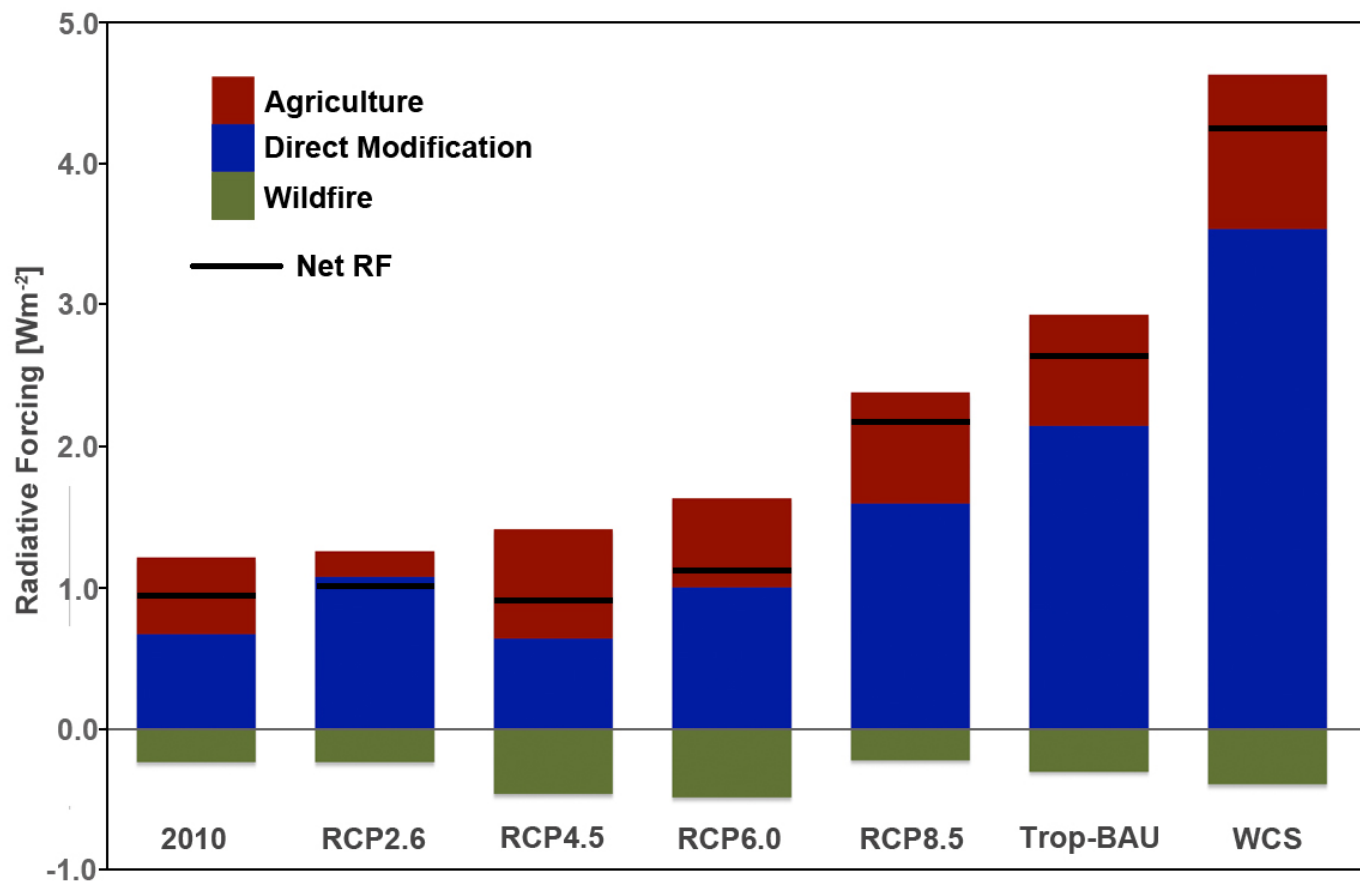


Arable: Climate and soil suitable

Pasturable: Only soil suitable

2100 radiative forcing (relative to 1850)





Takeaways

1. The present day RF of LULCC activities could be comparable to RF of FF+ activities, although there is substantial uncertainty
2. In the future: LULCC RF is likely to increase, but highly dependent on the scenario used
3. Carefully constructed land use policy is needed *in addition to energy policy* for mitigation of global warming