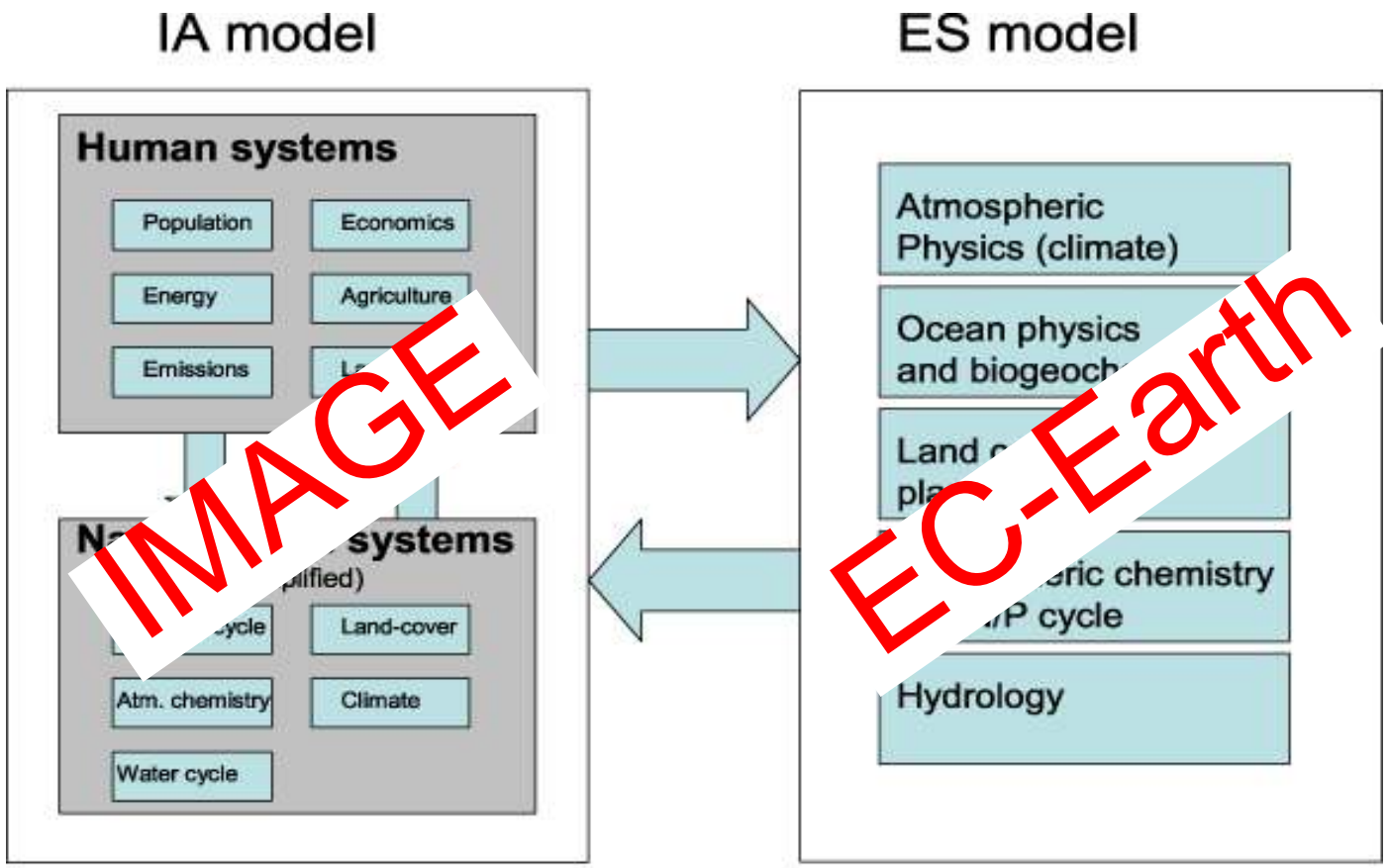
WAGENINGEN UR
For quality of life

Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu

EC-Earth – and integrated assessment modelling

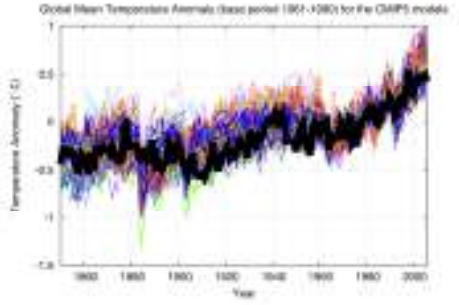
Bart van den Hurk
Wilco Hazeleger



van Vuuren et al 2012

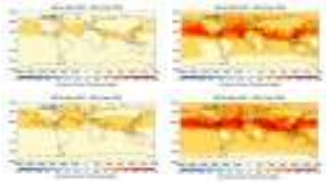
Contents

- EC-Earth

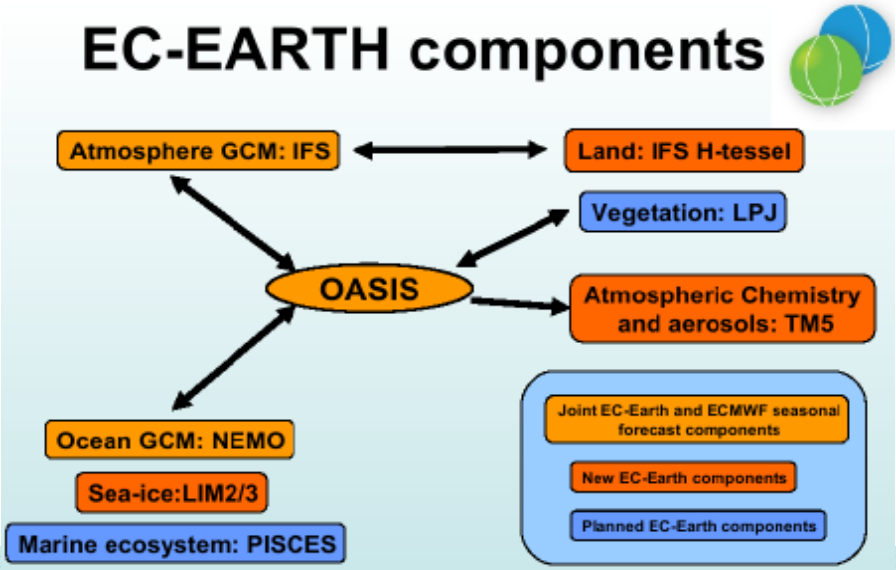


- CMIP5 results so far

- Examples of integrated studies
  - Land use – climate
  - Air pollution policies



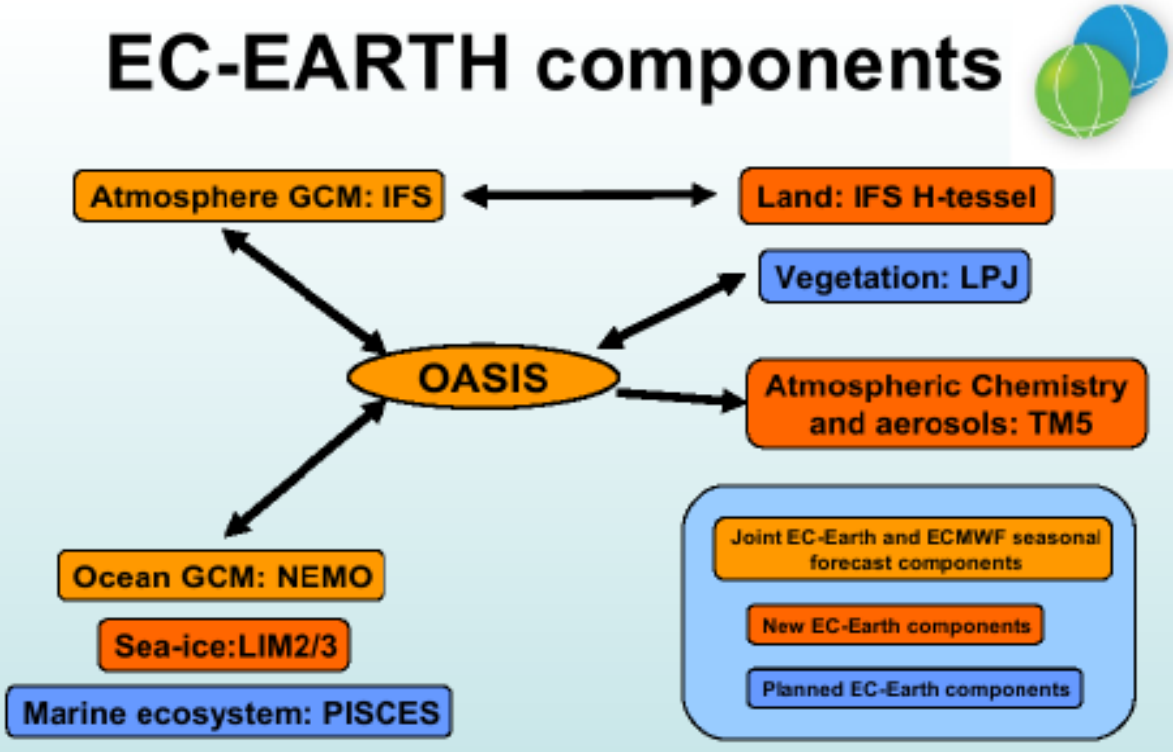
- Based on and in collaboration with best *weather* prediction model (ECMWF)
  - Continuous updates
  - Consortium effort
- Seamless approach: from seasonal to decadal to century
- Extension to Earth System Model ongoing



Hazeleger et al BAMS 2010, Clim Dyn 2012

EC-Earth consortium

Steering group: W. Hazeleger (KNMI, chair), C. Jones (SMHI), J. Hesselbjerg, Christensen (DMI), R. McGrath (Met Eireann), P. Viterbo (IM), E. C. Rodriguez (AEMET) observer E. Kallen (ECMWF), NEMO-representative



ECMWFs atmosphere model (from 150 km to 20 km global

NEMO ocean model (120 km to 25 km global)

TM5: chemistry transport Model

LPJ-GUESS vegetation

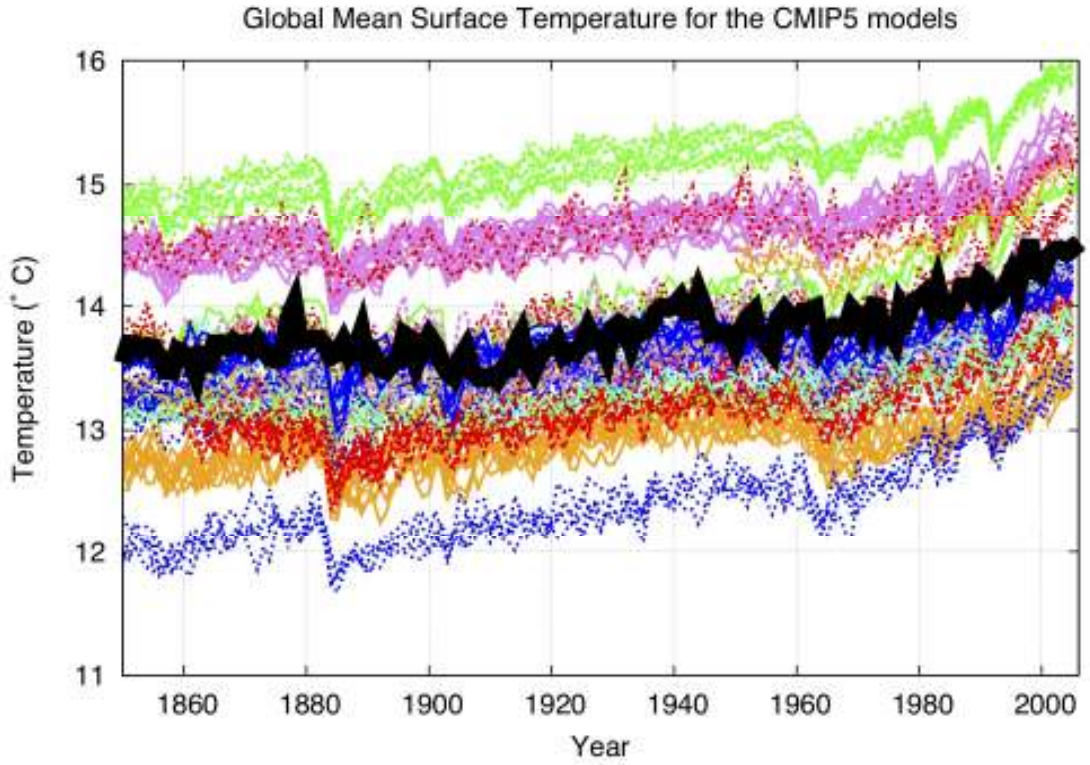
Off-line coupled to IMAGE

Hazeleger et al BAMS, October, 2010

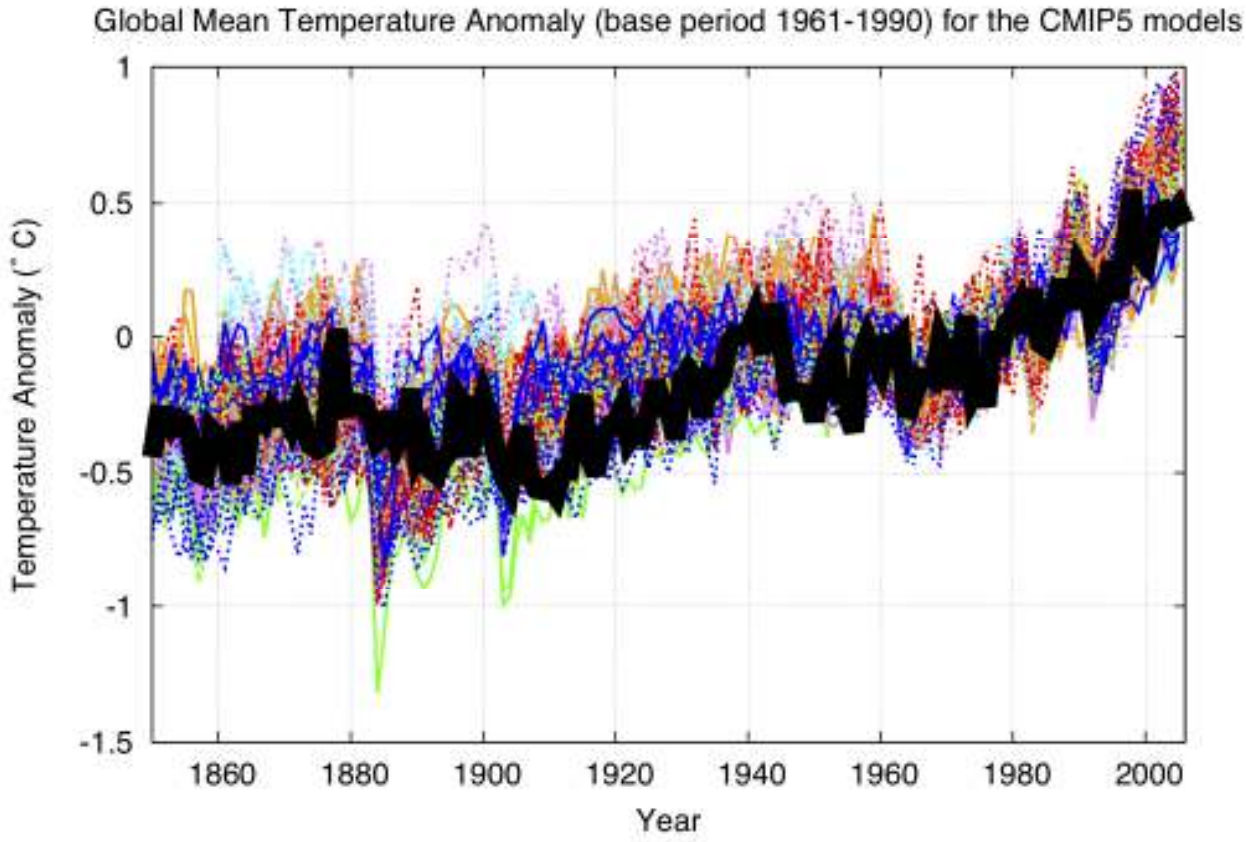
Some CMIP5 results

- In general: comparable results to CMIP3/4
- Similar climate sensitivity
- Uncertainties still large in clouds and indirect aerosol effect (relevant to RCP 2.6 in particular → strong warming in some models in the first few decades)
- No abrupt changes in Atlantic Meridional Overturning Circulation except for one model (FIO ESM)
- More models with online (biogeo)chemistry modules

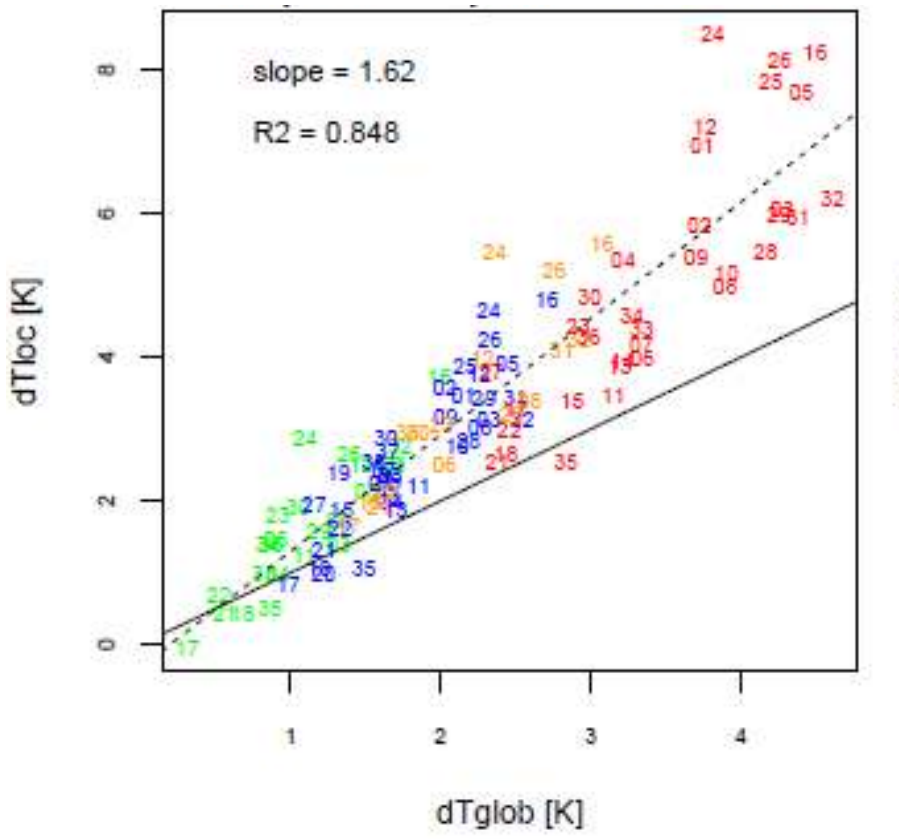
CMIP5 model uncertainty still large

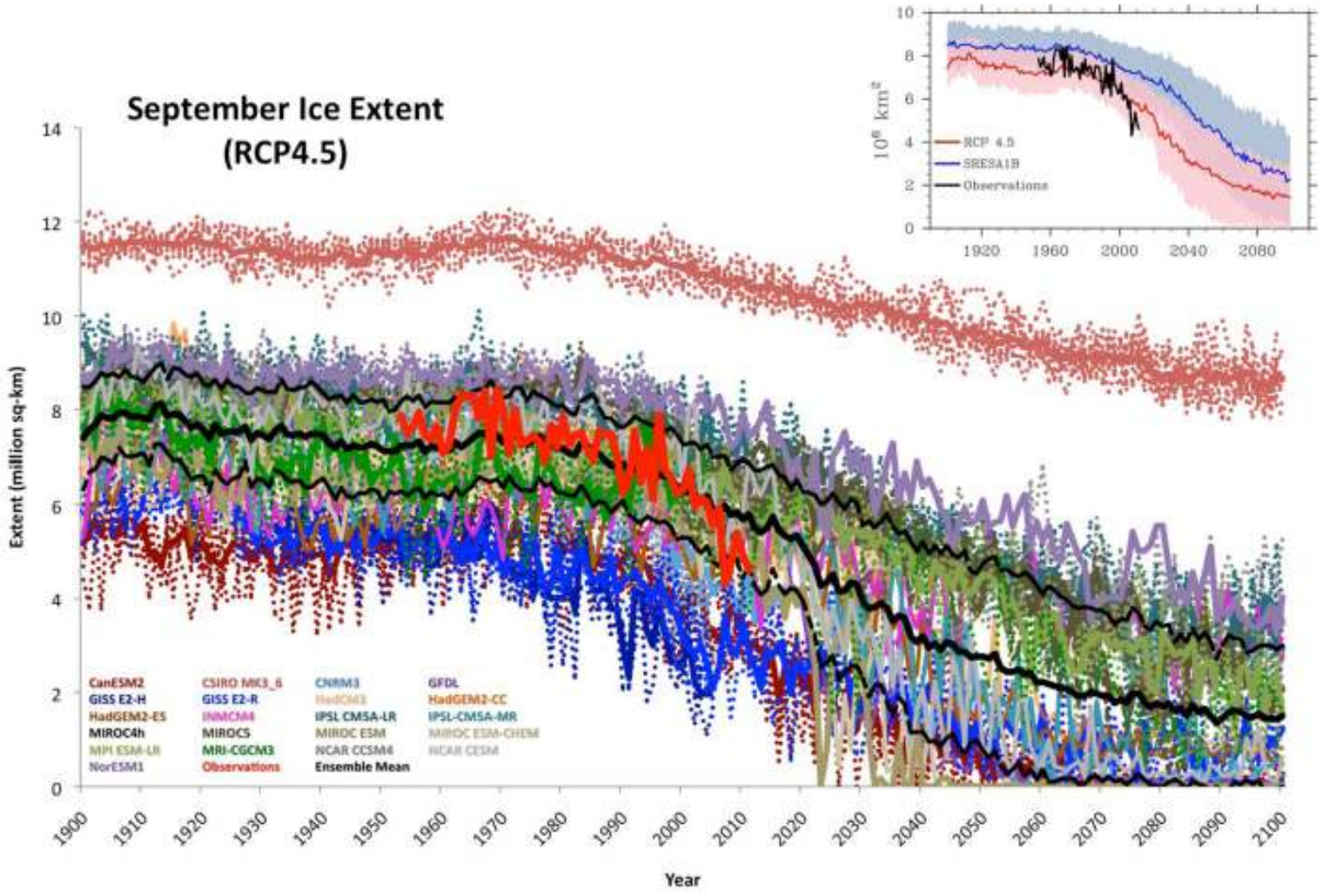


CMIP5: Coupled Model Intercomparison project #5
http://cmip-pcmdi.llnl.gov/cmip5/


Global Mean Temperature Anomaly (base period 1961-1990) for the CMIP5 models
Temperature Anomaly (°C)
1
0.5
0
-0.5
-1
-1.5
1860
1880
1900
1920
1940
1960
1980
2000
Year

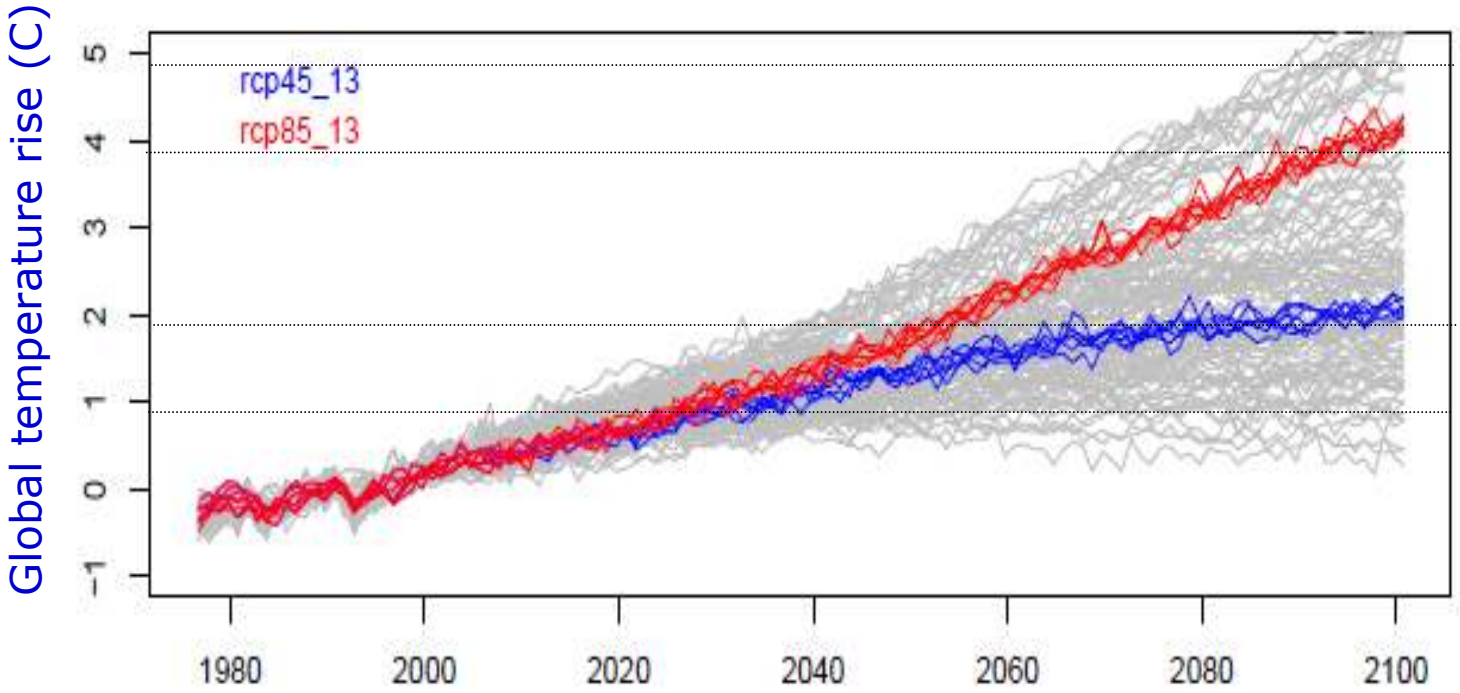
Response in Western Europe wrt global mean (JJA)



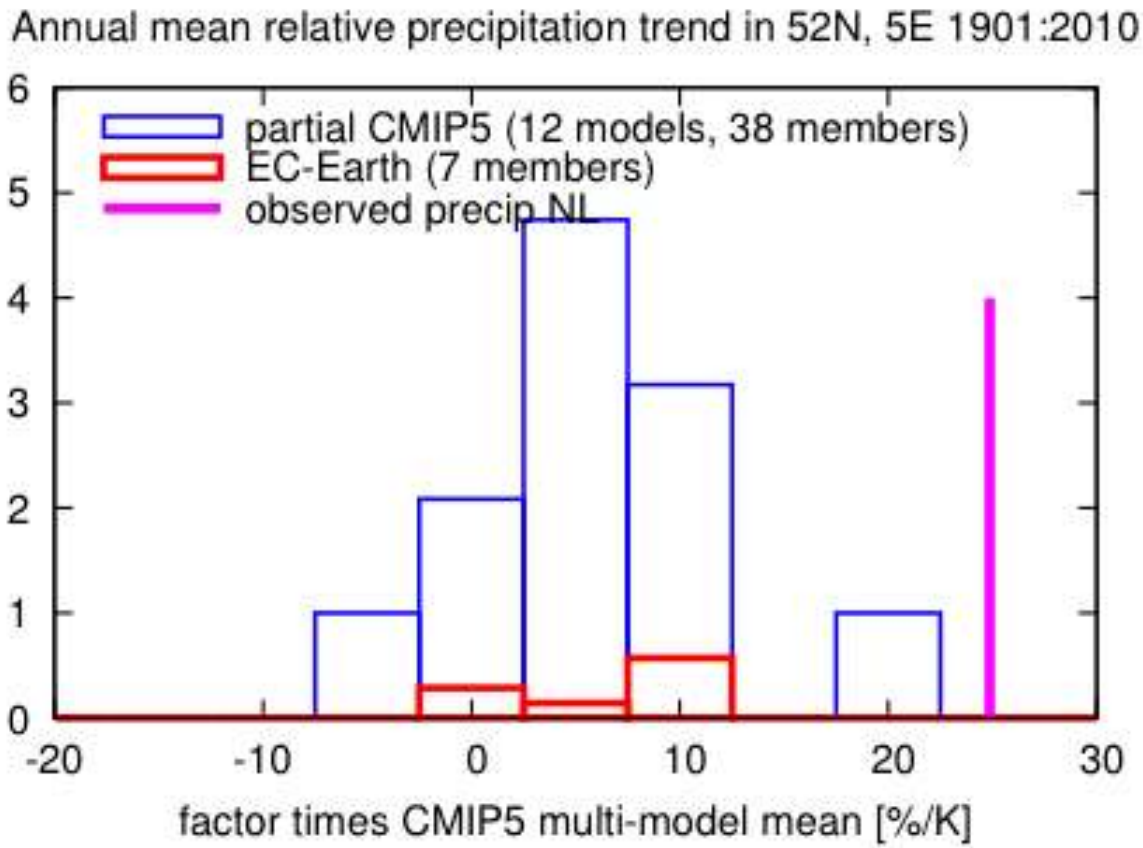


Serreze et al 2012

EC-Earth results in CMIP5 'plume'

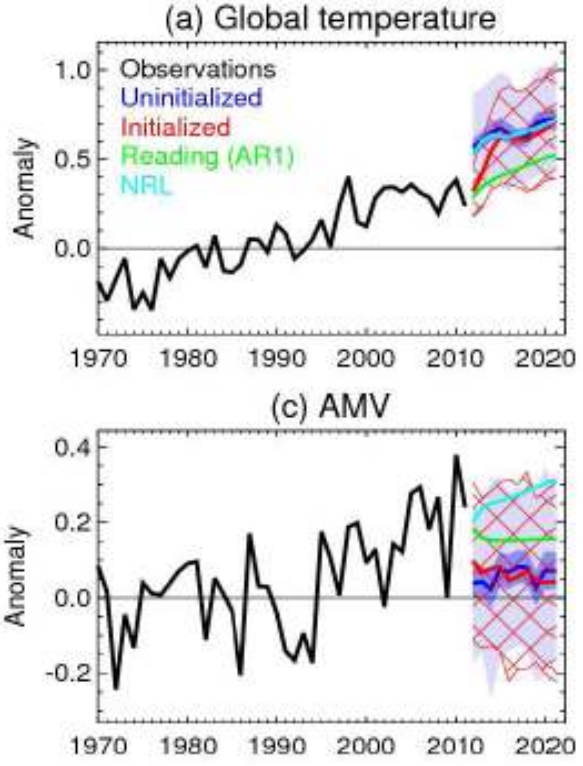


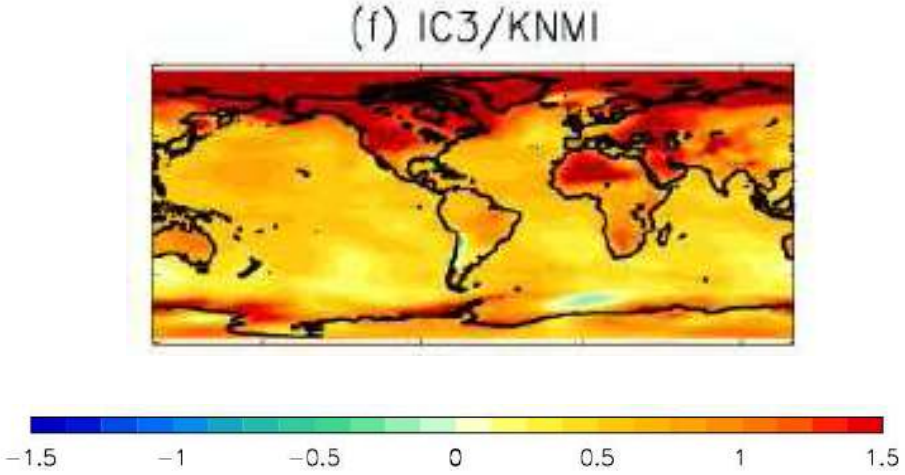
Regional trends still challenging for CMIP5



New decadal initialized predictions

Initialized from observations instead of preindustrial spin up run.
Allows for forecasts, including phase and amplitude of natural variability

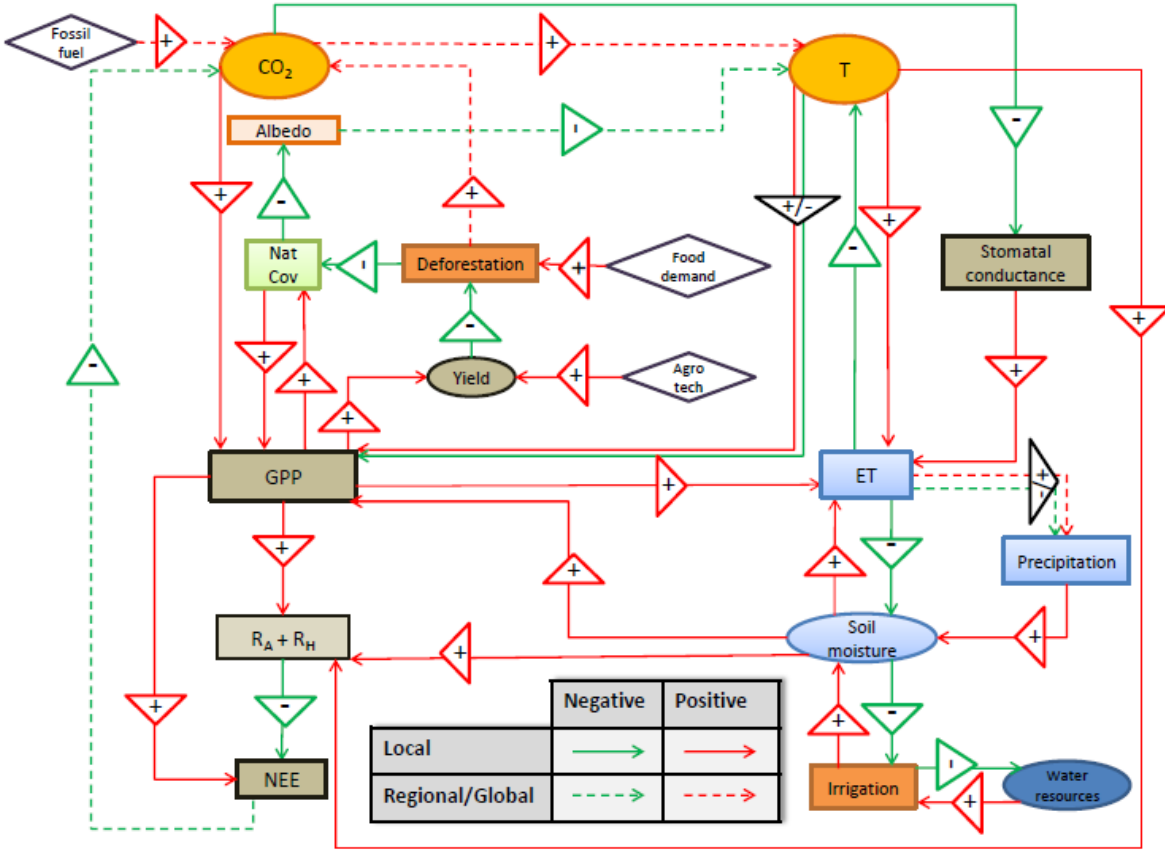




2 meter temperature, 2016-2020
wrt 1971-2000

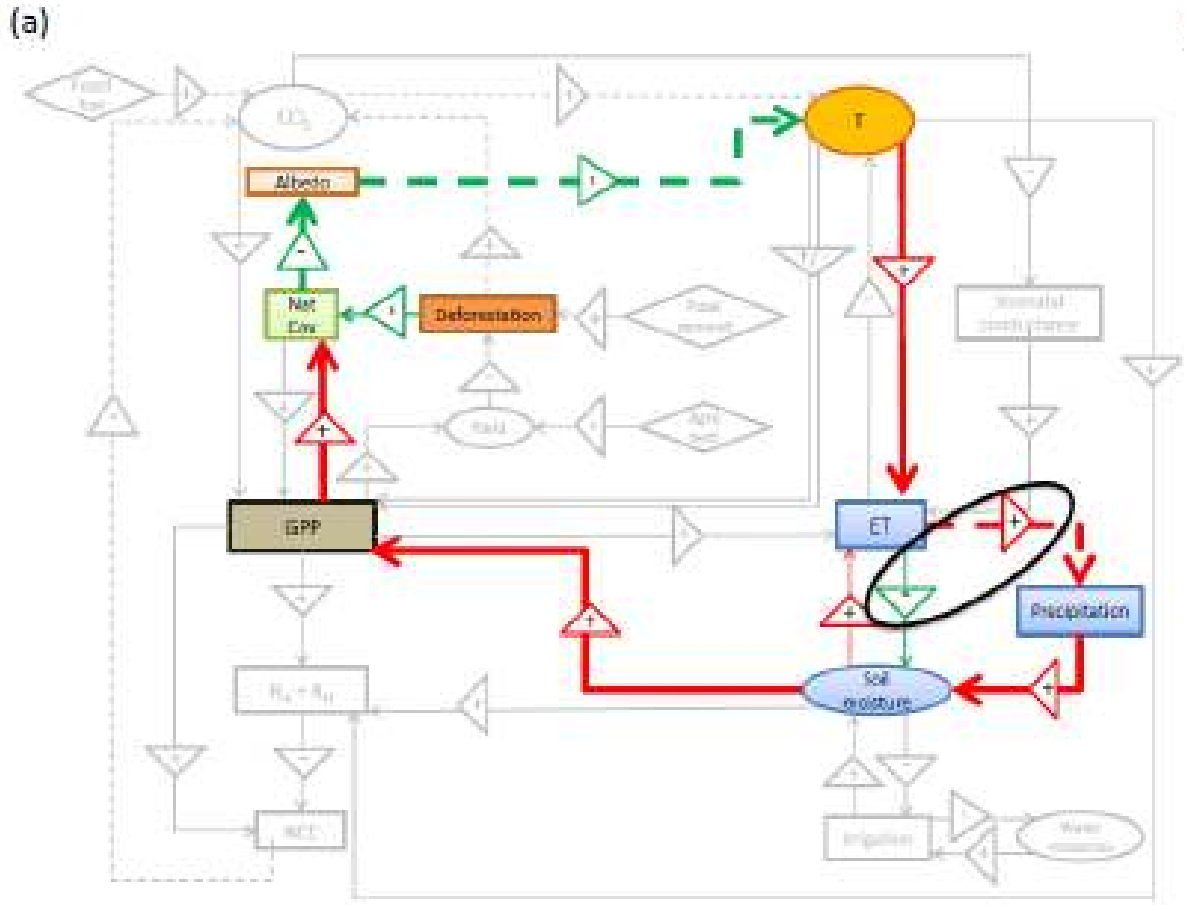
Smith et al 2012, submitted

Coupled models to study feedbacks



Literature review by Batlle-Bayer et al

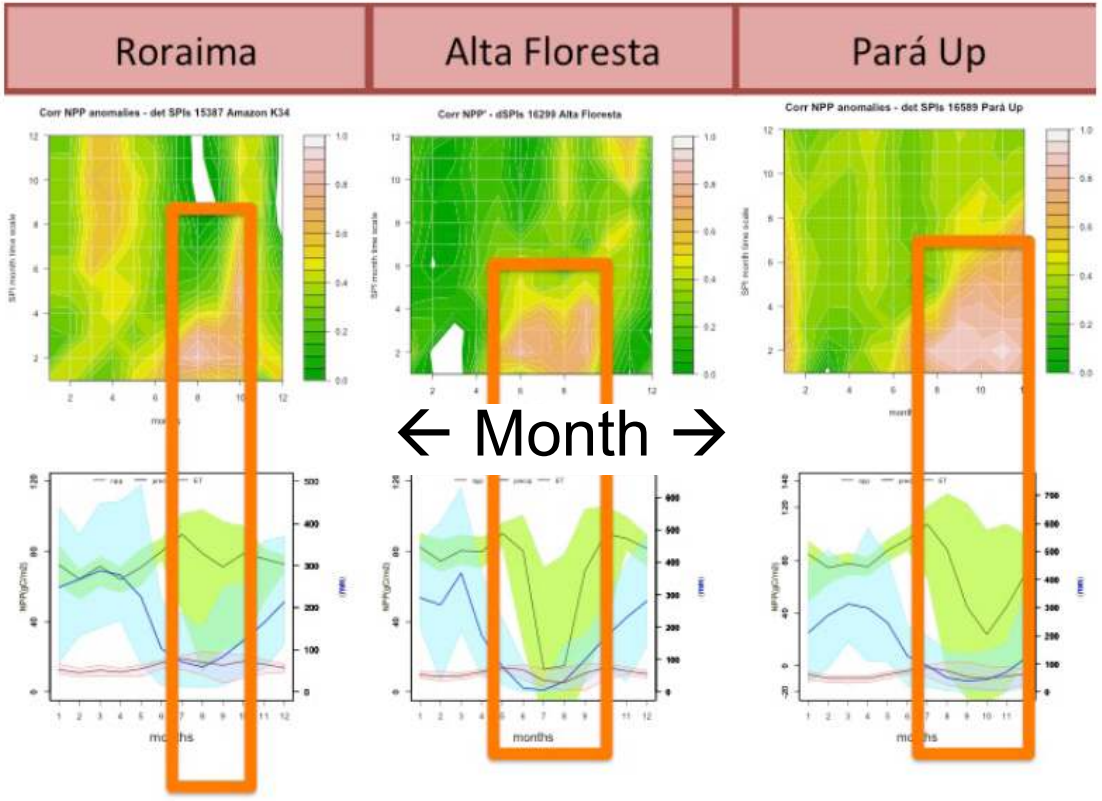
Vegetation/albedo feedbacks in Amazon



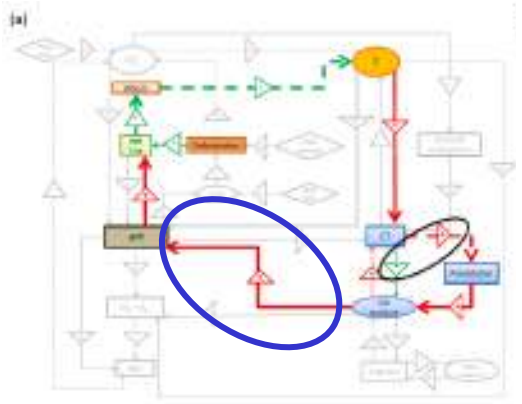
Literature review by Batlle-Bayer et al

NPP – precipitation correlations in Amazon

3 Amazonian locations



← Time scale →

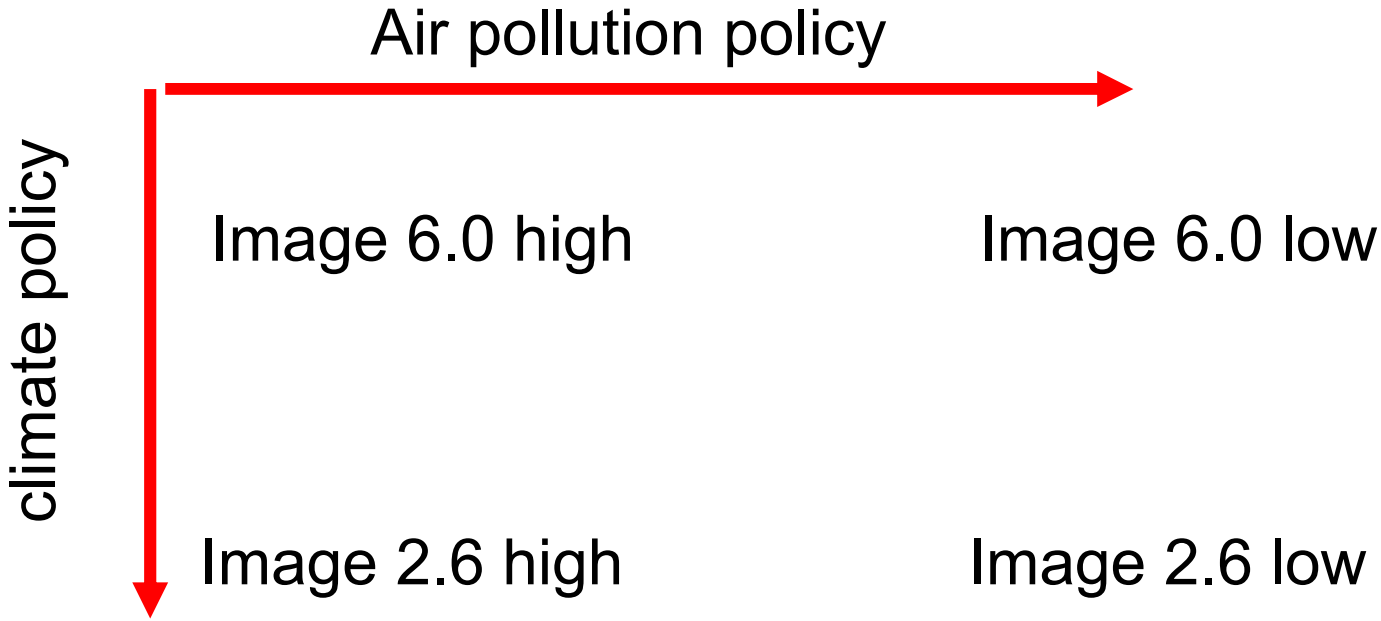


Literature review by Batlle-Bayer et al

Emissions and concentrations with alternative air quality policies (IMAGE/TM5)

Low: emission factors of air pollutants decline up to 2030 (implementation of current and planned air quality policies). After 2030, further abatement measures are a function of the increasing income levels

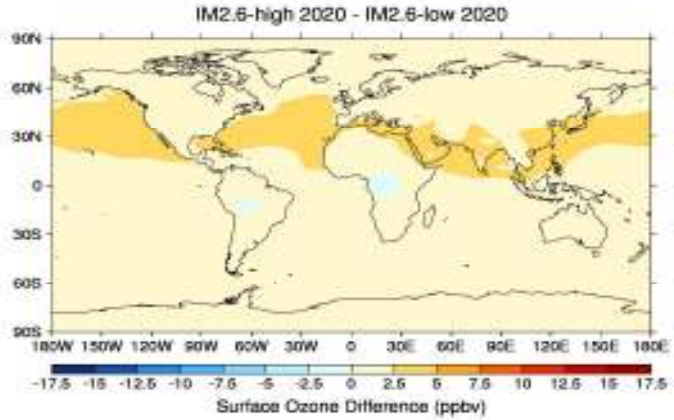
High: constant emission factors from 2010 onward

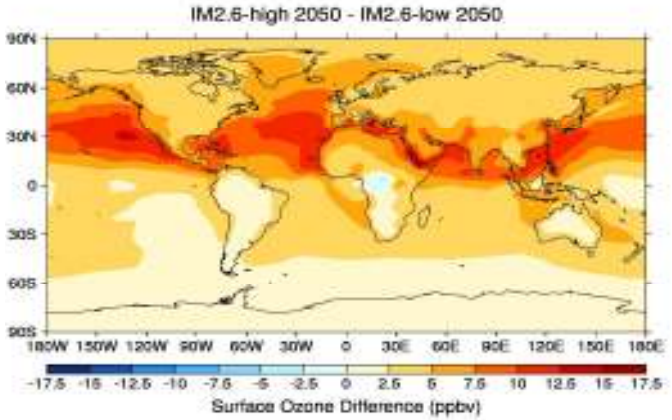


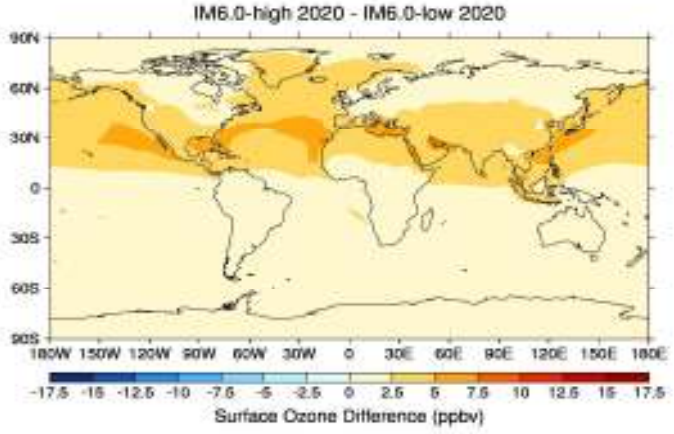
Dia 18

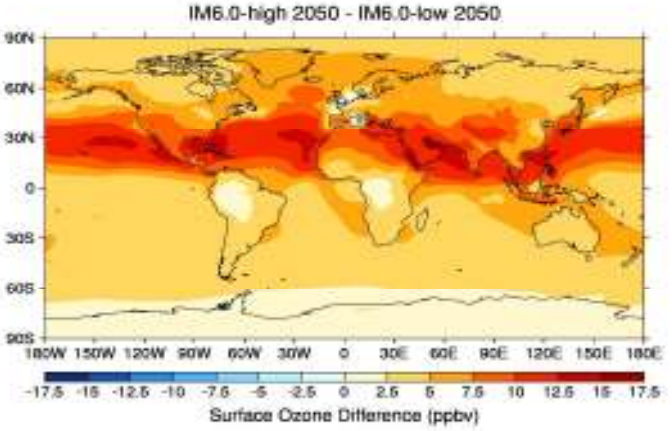
h2 hazelege; 12-11-2012

Impact on surface ozone (high minus low)

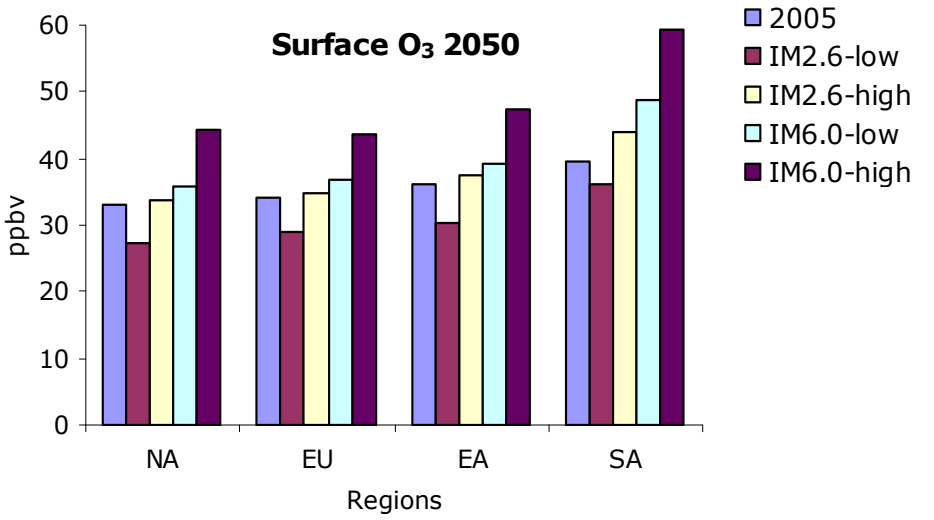


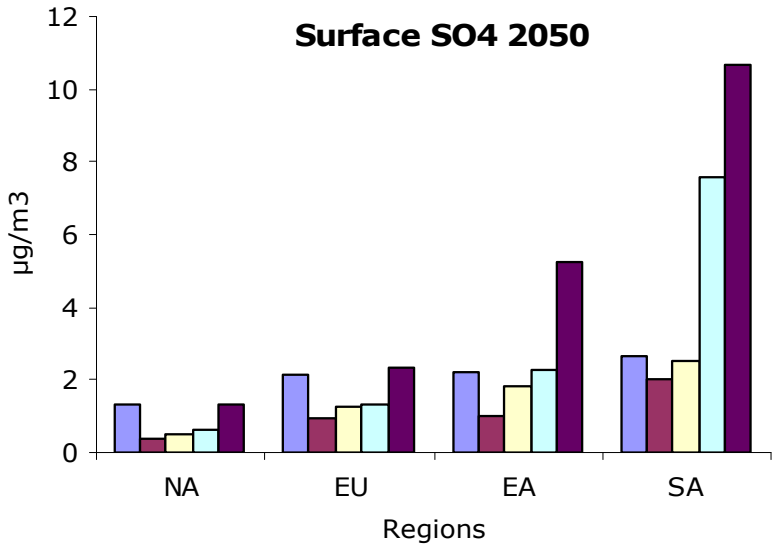






Result from IMAGE emissions into TM5 CTM (Chuwah et al in prep)





North America (NA) (60°W-125°W × 15°N-55°N), Europe (EU) (10°W-50°E × 25°N-65°N), East Asia (EA) (95°E-160°E × 15°N-50°N) and South Asia (SA) (50°E-95°E × 5°N-35°N)

Impact on climate

Impact on direct radiative forcing is small

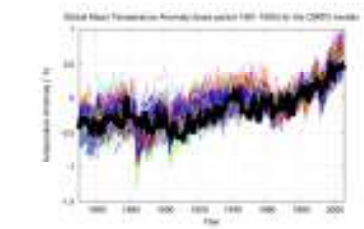
	IM2.6 Low 2020	IM2.6 High 2020	IM6.0 Low 2020	IM6.0 High 2020	IM2.6 Low 2050	IM2.6 High 2050	IM6.0 Low 2050	IM6.0 High 2050
Total RF	0.07	0.07	0.10	0.11	-0.07	0.09	0.06	-0.03

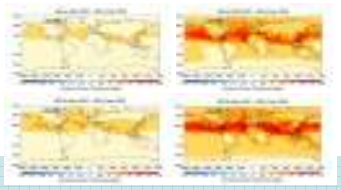
To do:

Full coupling with EC-Earth to identify regional feedbacks to climate

Sensitivity to indirect aerosol effect

Final remarks





- new seamless prediction earth system model: regular updates from Numerical Weather Prediction, can run at very high resolution (synoptic weather scales)
- CMIP5: similar results to CMIP3. EC-Earth not that different from other GCMs.
- Opportunities in coupling ESMs to IAMs:
  - Exploring feedbacks
  - Exploring consistent socio-economic and physical scenarios at regional scales