

Global and Regional Sea Level Projections for the 21st century

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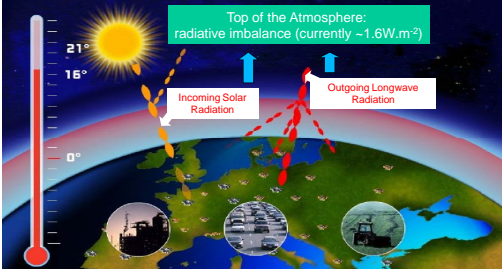
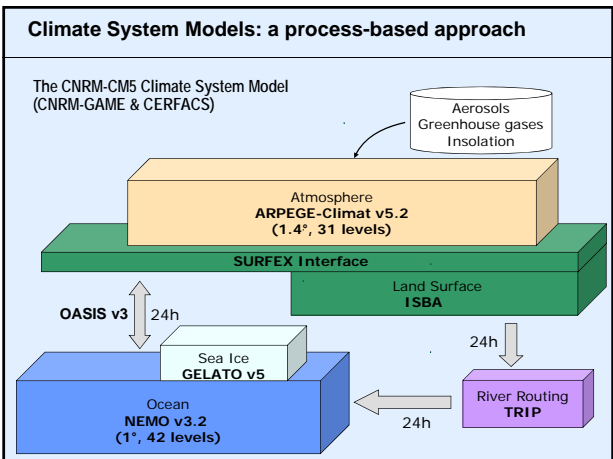
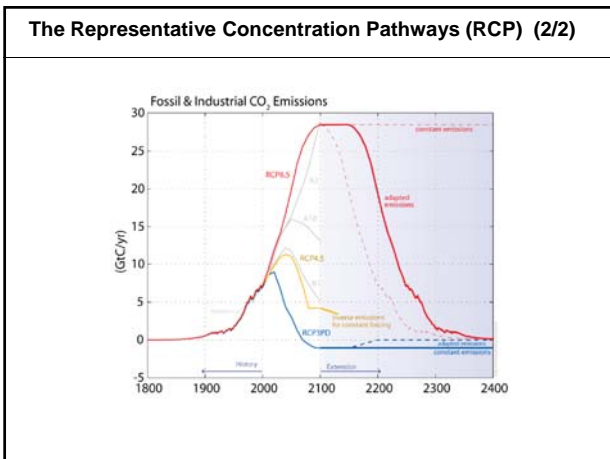
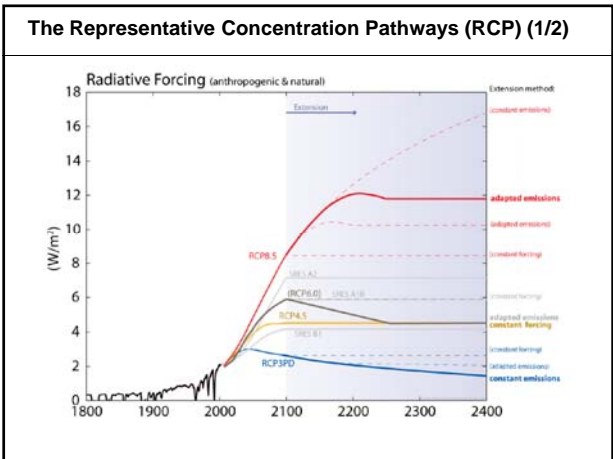
Collège de France, 10-11/06/2013

Contributions to global and regional sea level rise

- Ocean processes : steric effects, (ocean density changes due to temperature and salinity changes), dynamic effects
- Small ice sheets and glaciers: process-based and/or extrapolations (particularly beyond 2100)
- Greenland and Antarctic Ice sheets: Surface Mass Balance changes + dynamic processes
- Land water storage changes
- Gravitational effects due to land ice and land water mass changes

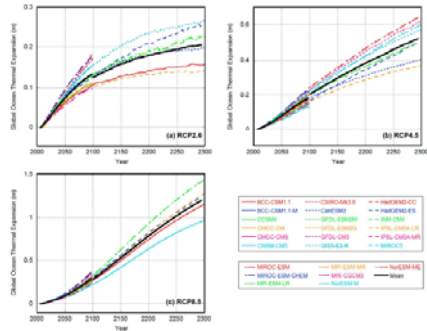
➔ Modelling (part of) the future sea level changes can be seen as a « by-product » of future climate change modelling

Climate Change: a matter of radiative imbalance

Future scenarios : dynamic sea level changes

Model uncertainty (CMIP5 simulations)



2100:
RCP2.6: 13 cm
RCP4.5: 18 cm
RCP8.5: 28 cm

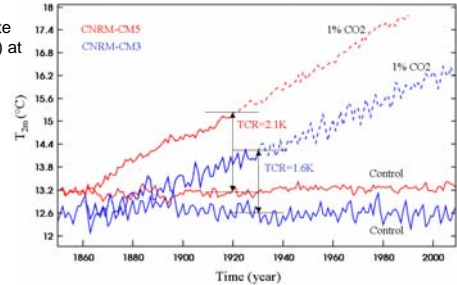
2300:
RCP2.6: 21 cm
RCP4.5: 52 cm
RCP8.5: 119 cm

Yin et al, GRL (2012)

How to interpret model uncertainty ? (1/2)

- Models respond to greenhouse gases changes by radiative forcing changes
- Climate response (temperature, precipitation, ocean heat uptake)
- ➔ Models have different climate sensitivities (clouds, lapse rate, surface albedo, water vapour feedback), different ocean heat uptake efficiencies !

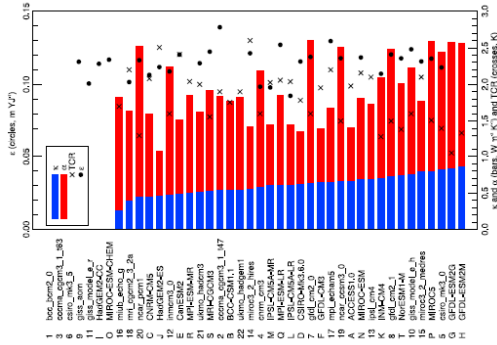
Transient climate response (TCR) at 2xCO2 level in 1% CO2/yr experiments



How to interpret model uncertainty ? (2/2)

TCR: transient climate response 2xCO2 (K) = F / (α+k)

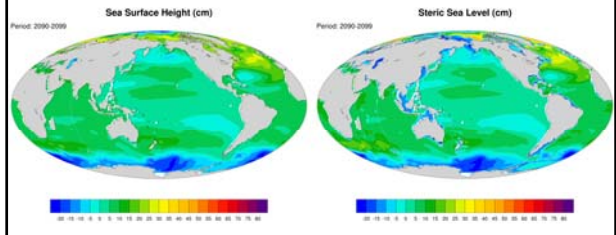
- F : radiative forcing
- α: climate feedback parameter
- k: ocean heat uptake efficiency



Kuhlbrodt and Gregory, GRL (2012)

Regional structures (1/4)

CNRM-CM5.1 RCP8.5 2090-2099 (global mean removed)

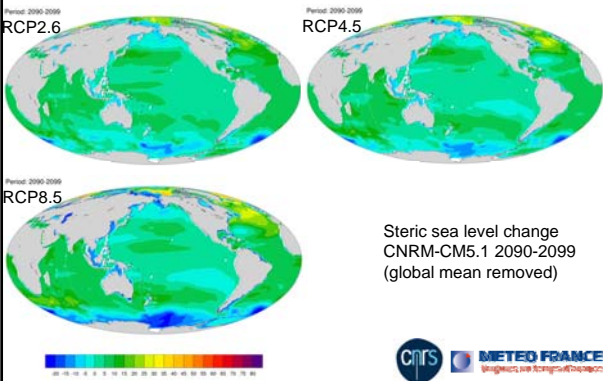


Includes: steric + dynamic effects

Steric effects



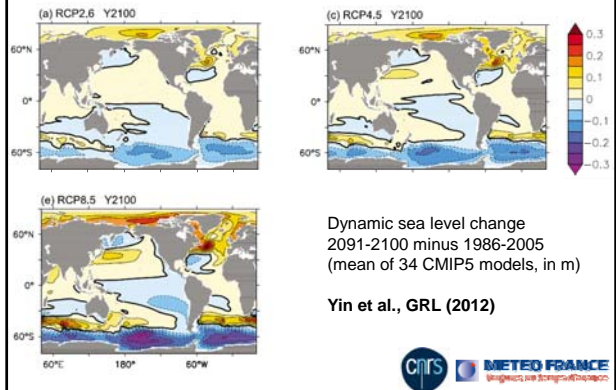
Regional structures (2/4)



Steric sea level change
CNRM-CM5.1 2090-2099
(global mean removed)



Regional structures (3/4)

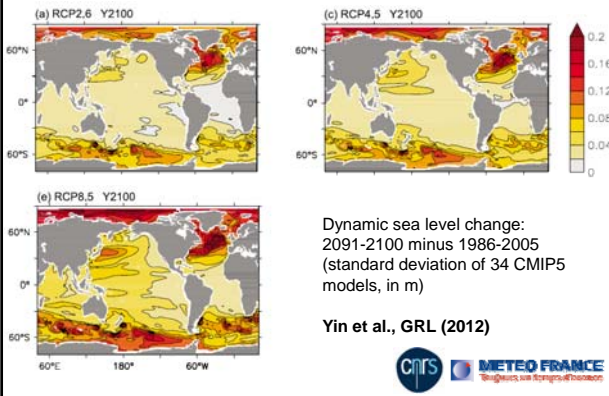


Dynamic sea level change
2091-2100 minus 1986-2005
(mean of 34 CMIP5 models, in m)

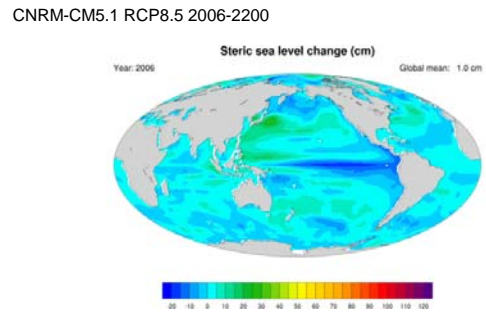
Yin et al., GRL (2012)



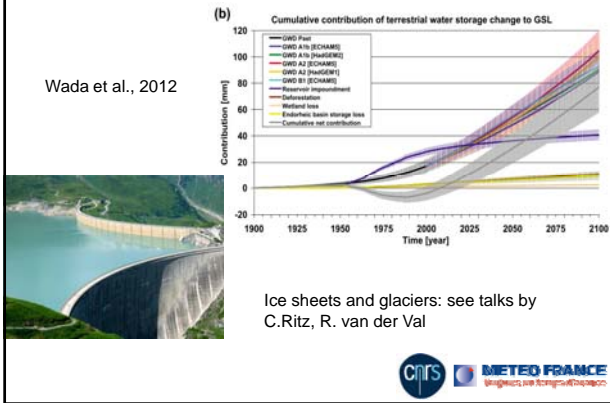
Regional structures (3/4)



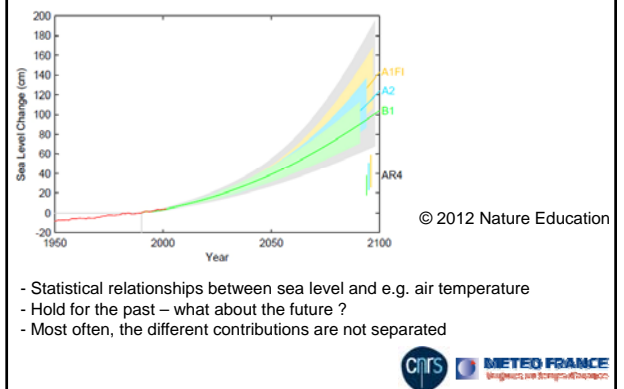
Regional structures (4/4)



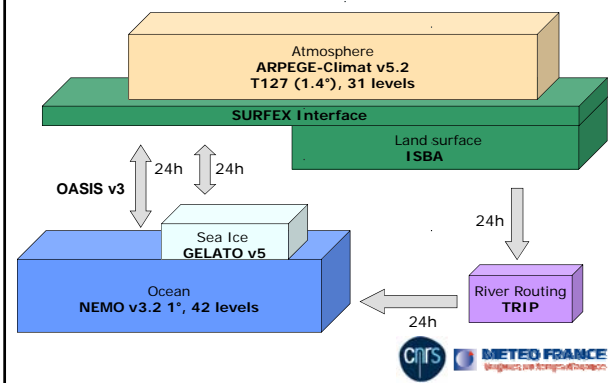
Contribution of land water storage changes



Semi-empirical methods: an alternative way ?



A perspective for future model development (CNRM-CM and others)



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