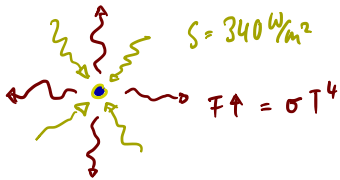
Climate Models

low complexity → high complexity

idealized climate models



zero-dimensional model

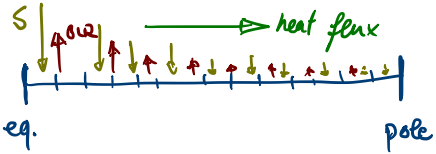
$F\downarrow = F\uparrow$

$\alpha S = \sigma T_s^4$

$\Downarrow$

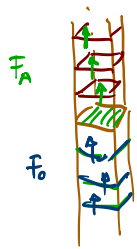
$T_s = \left(\frac{\alpha S}{\sigma}\right)^{1/4}$

(horizontal) diffusive energy balance model



one-dimensional models → (2-d model)

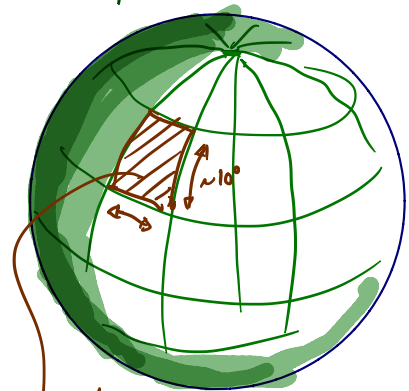
single column model (vertical)



comprehensive global climate models

EMICs

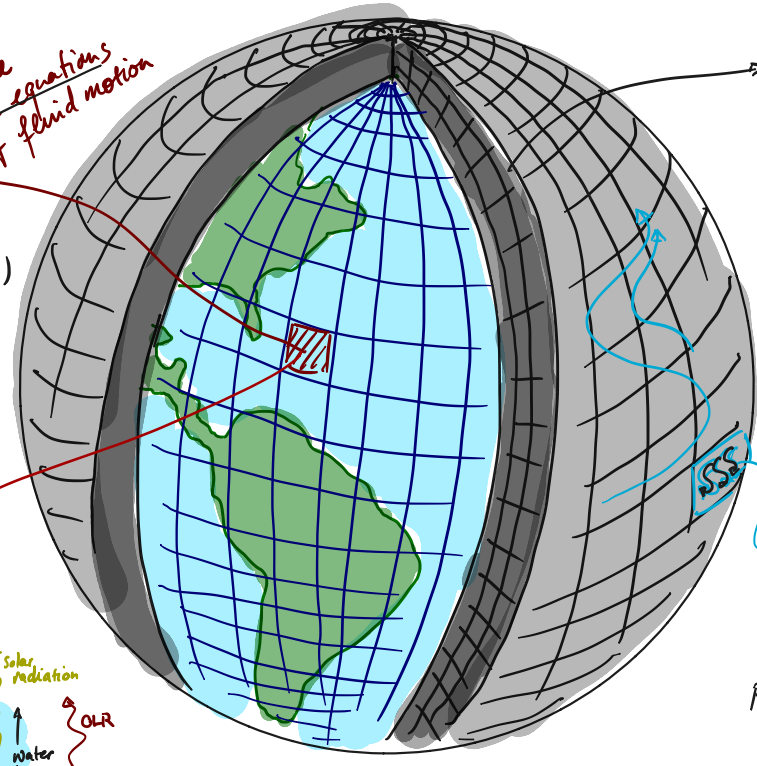
Earth-System Model of Intermediate complexity



- boundary conditions
- mtm eqns. atmos or ocean
- cons. of mass, cons. of energy

GCMs → (Generalized Circulation Model)

(comprehensive) Global Climate Models



Solve the primitive equations of fluid motion

1. continuity eq. (conservation of mass)
2. Conservation of momentum
3. thermal energy equation

~50 layers in Atmos. & Ocean

1070 cells (0.2°)

1440 cells (0.25°)

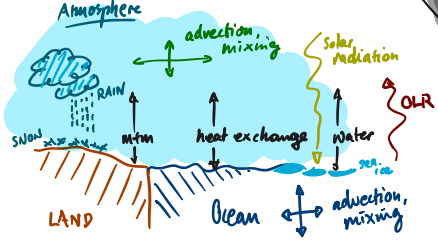
SSS

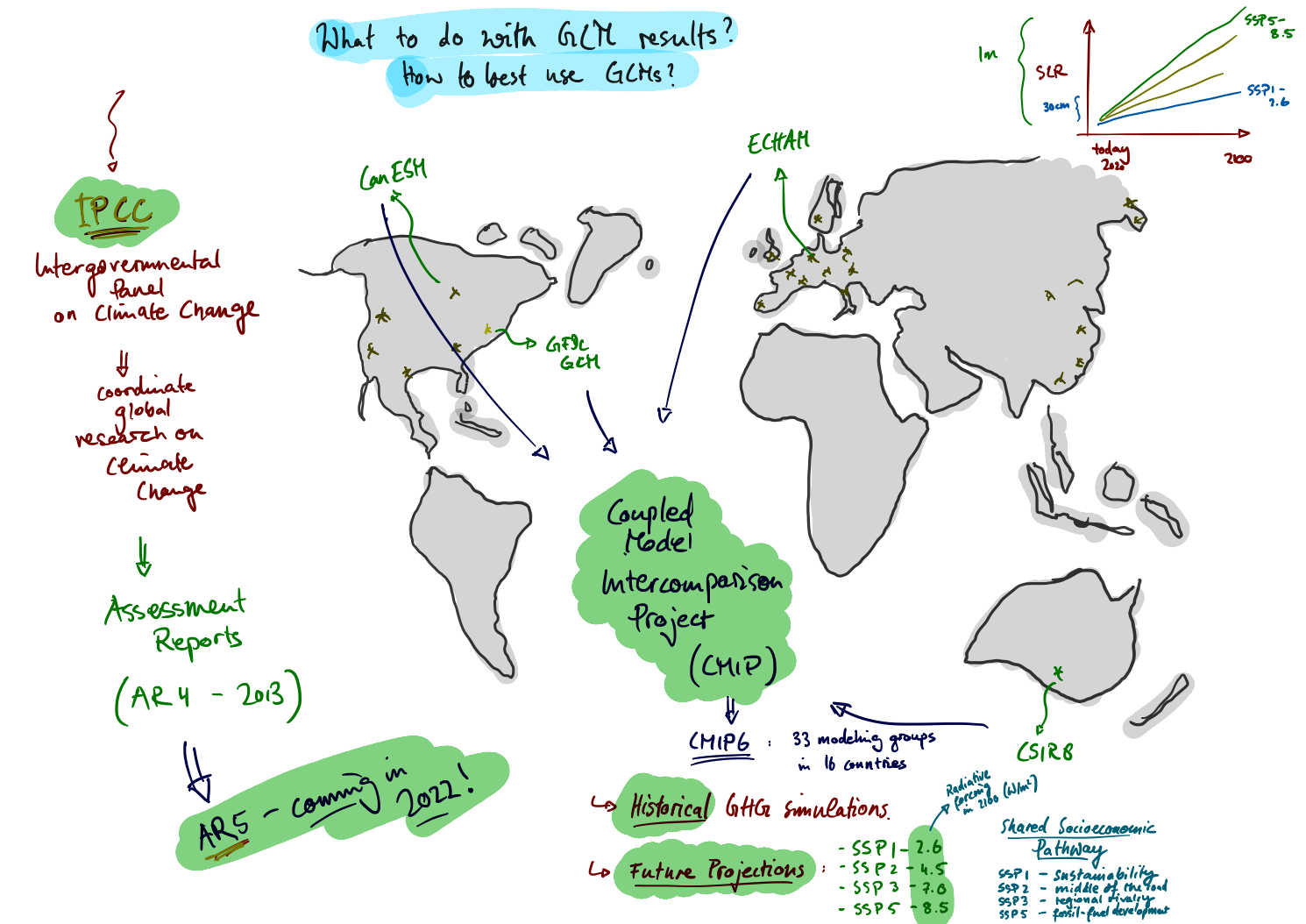
Subgrid-scale processes

included using parameterizations.

- convection
- albedo
- hydrology
- clouds

Physical Processes:




What to do with GCM results?
How to best use GCMs?
1m
SLR
30cm
SSP5-8.5
SSP1-2.6
today 2022
2100
IPCC
Intergovernmental Panel on Climate Change
coordinate global research on Climate Change
Assessment Reports
(AR4 - 2013)
AR5 - coming in 2022!
CanESM
ECHAM
GFDL GCM
Coupled Model Intercomparison Project (CMIP)
CMIP6 : 33 modeling groups in 16 countries
CSIRO
Historical GHG simulations
Future Projections :
- SSP1 - 2.6
- SSP2 - 4.5
- SSP3 - 7.0
- SSP5 - 8.5
Radiative forcing in 2100 (W/m²)
Shared Socioeconomic Pathway
SSP1 - sustainability
SSP2 - middle of the road
SSP3 - regional rivalry
SSP5 - fossil-fuel development