Dealing with climate feedbacks in predicting human-caused global climate change

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To launch:

AtomSpheres;

Window Gallery
Opening May 26, 2008
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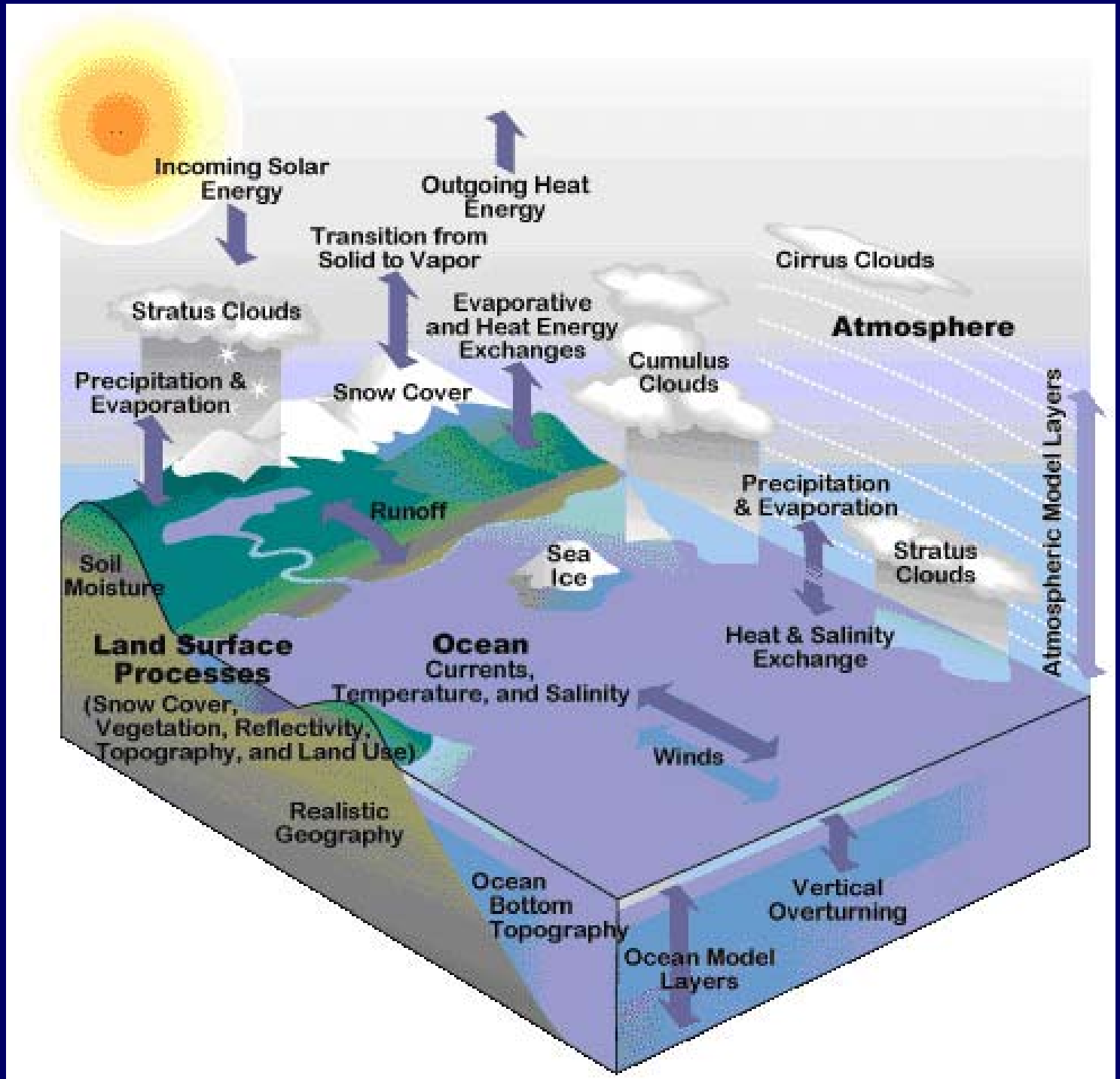
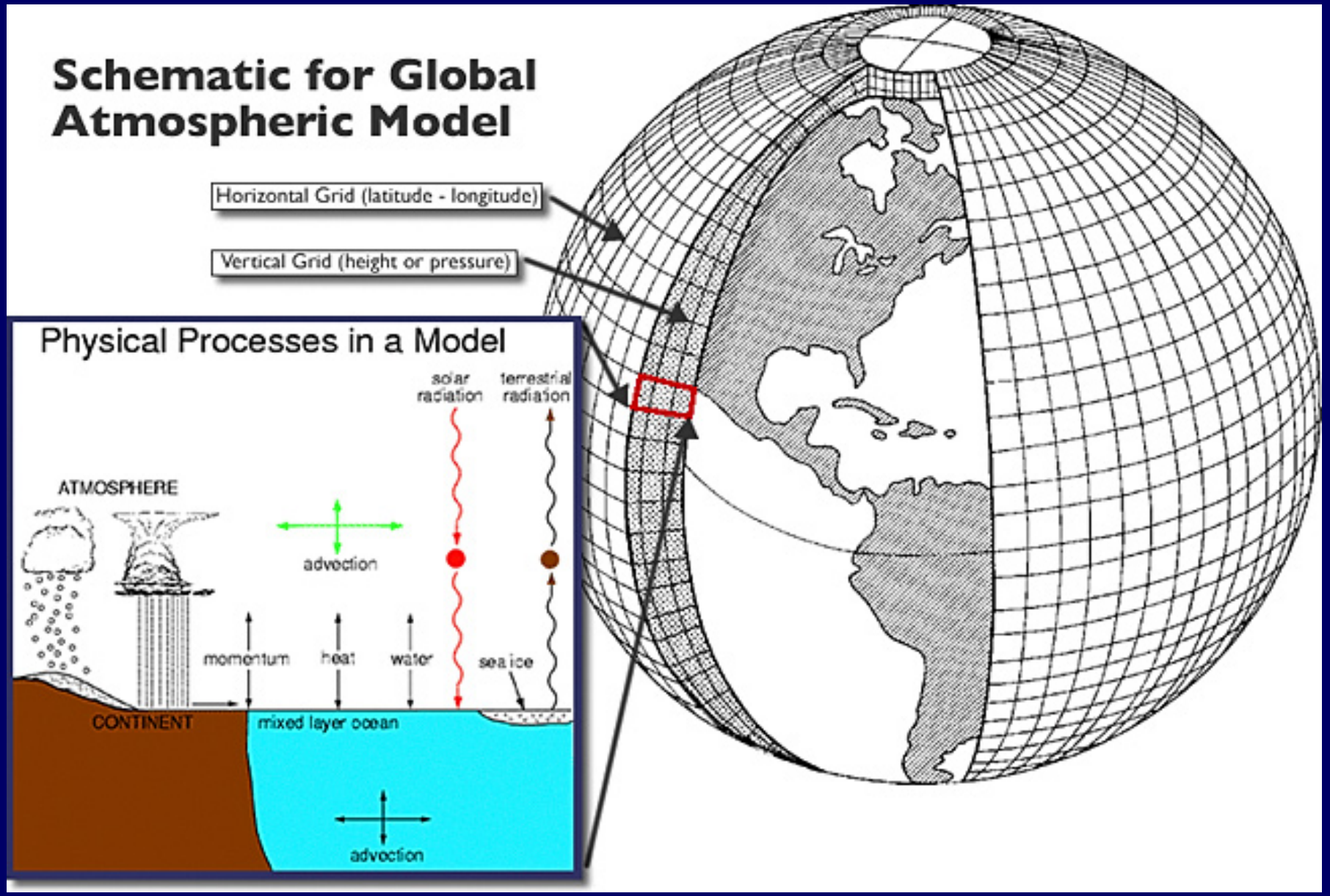
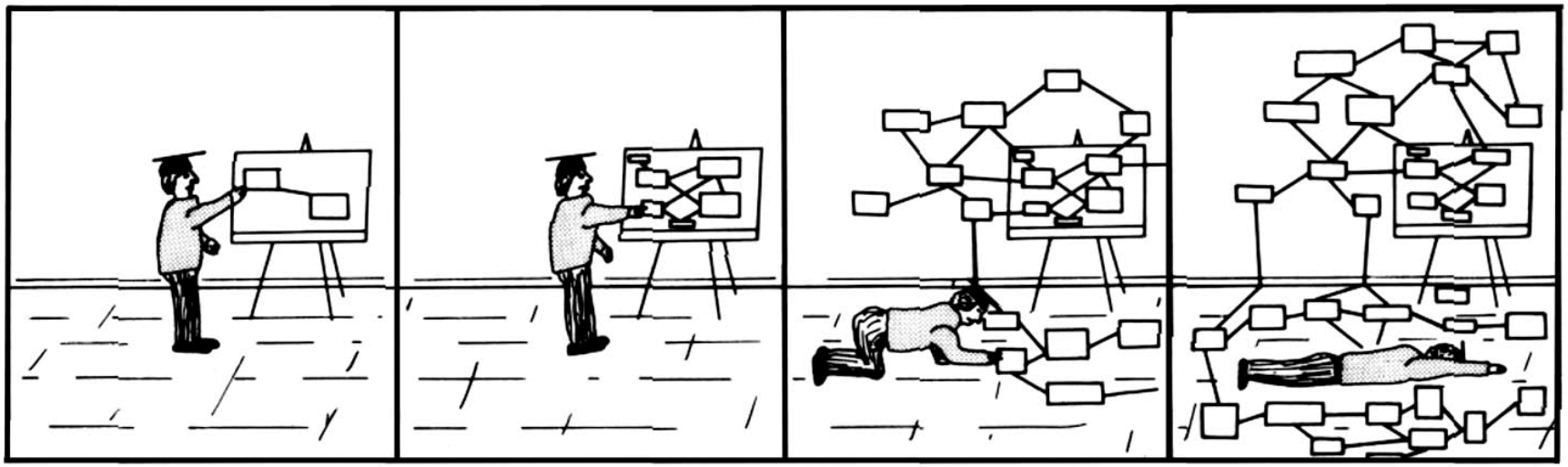
THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau


Incoming Solar Energy
Outgoing Heat Energy
Transition from Solid to Vapor
Cirrus Clouds
Stratus Clouds
Evaporative and Heat Energy Exchanges
Atmosphere
Cumulus Clouds
Precipitation & Evaporation
Snow Cover
Atmospheric Model Layers
Precipitation & Evaporation
Runoff
Stratus Clouds
Soil Moisture
Sea Ice
Land Surface Processes
(Snow Cover, Vegetation, Reflectivity, Topography, and Land Use)
Ocean
Currents, Temperature, and Salinity
Heat & Salinity Exchange
Winds
Realistic Geography
Ocean Bottom Topography
Vertical Overturning
Ocean Model Layers

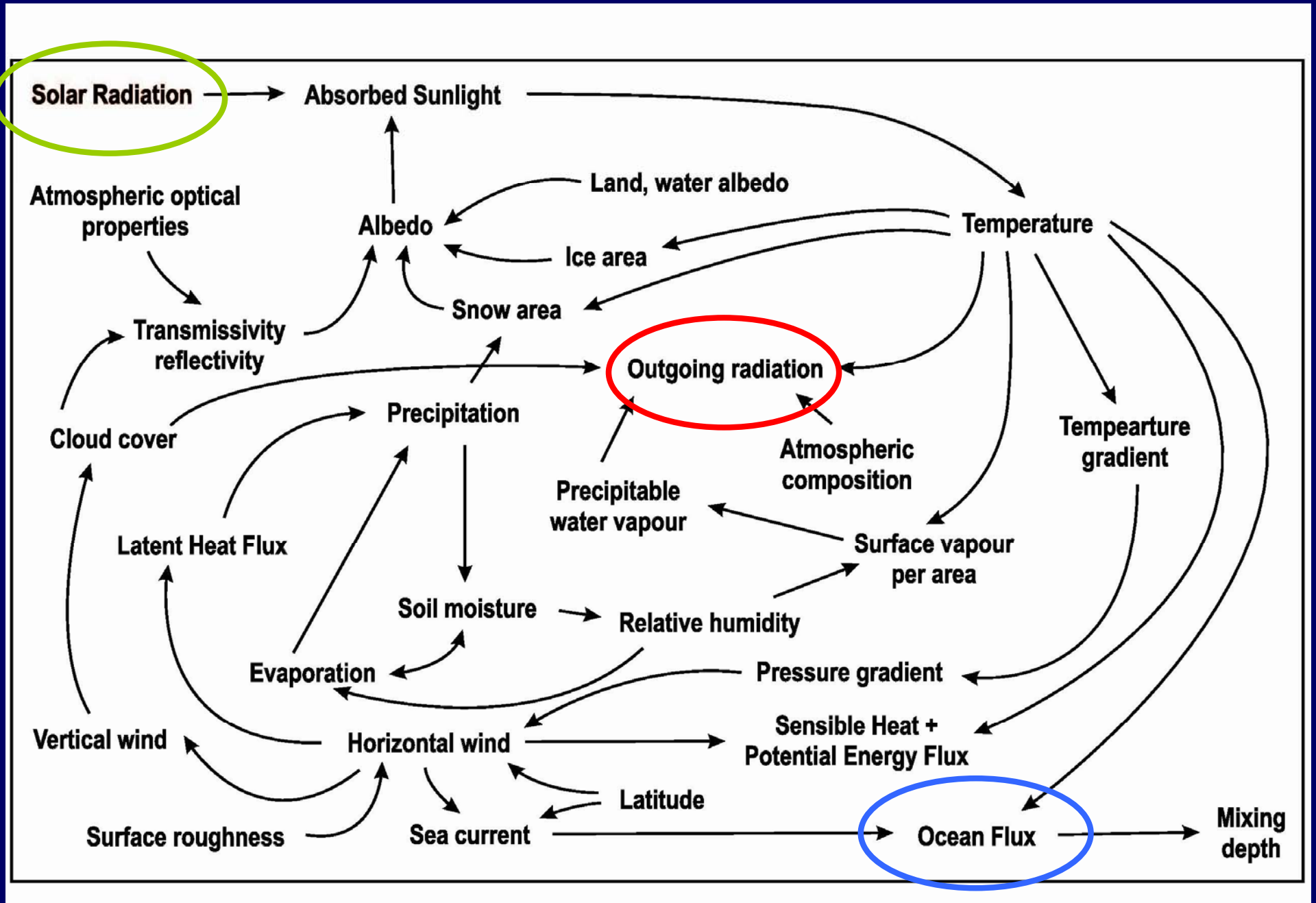
Schematic for Global Atmospheric Model



Climate Models



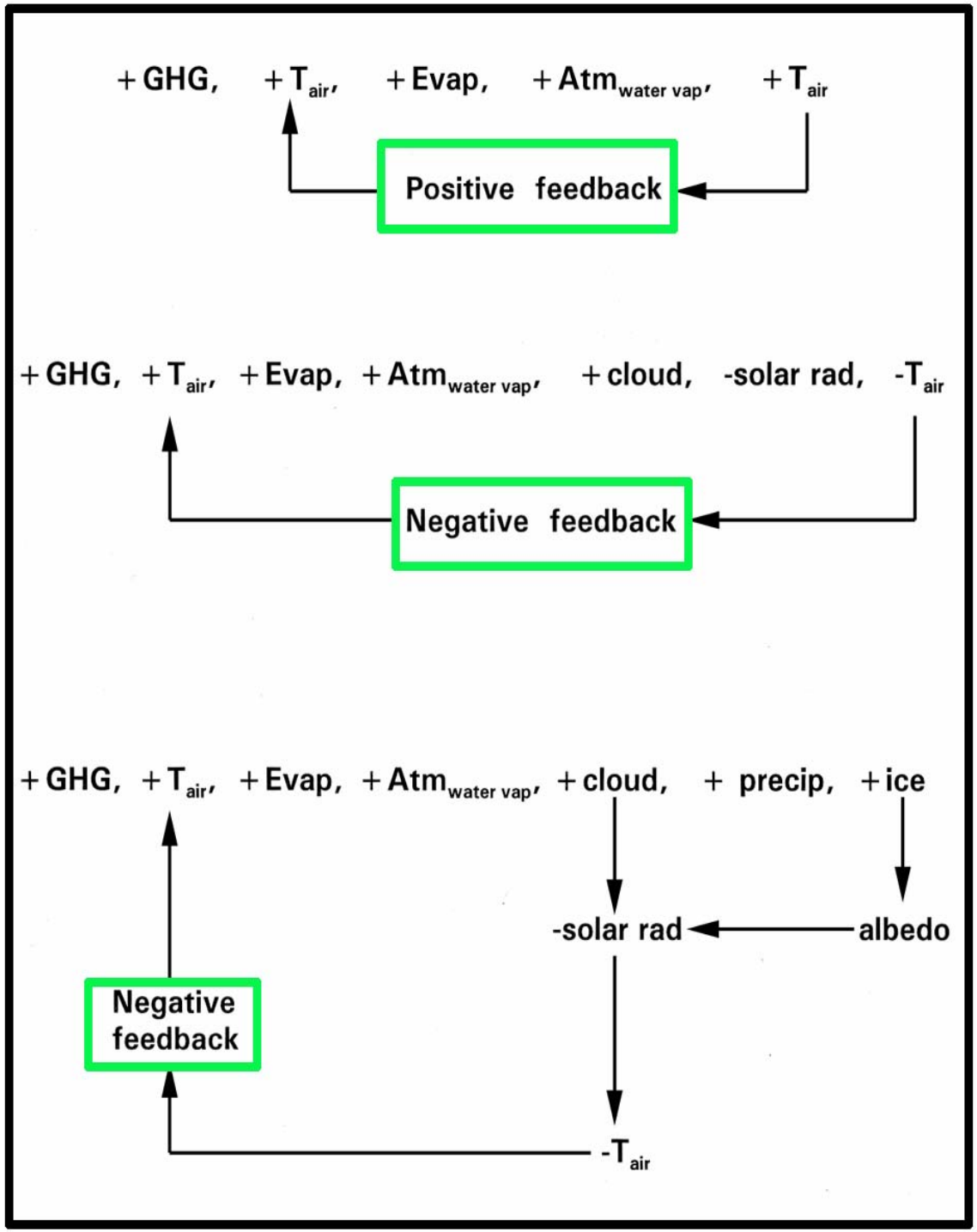
The dangers of modelling!


Solar Radiation
Absorbed Sunlight
Land, water albedo
Atmospheric optical properties
Albedo
Temperature
Ice area
Snow area
Transmissivity reflectivity
Outgoing radiation
Precipitation
Cloud cover
Tempearture gradient
Atmospheric composition
Precipitable water vapour
Surface vapour per area
Latent Heat Flux
Soil moisture
Relative humidity
Evaporation
Pressure gradient
Vertical wind
Horizontal wind
Sensible Heat + Potential Energy Flux
Latitude
Surface roughness
Sea current
Ocean Flux
Mixing depth

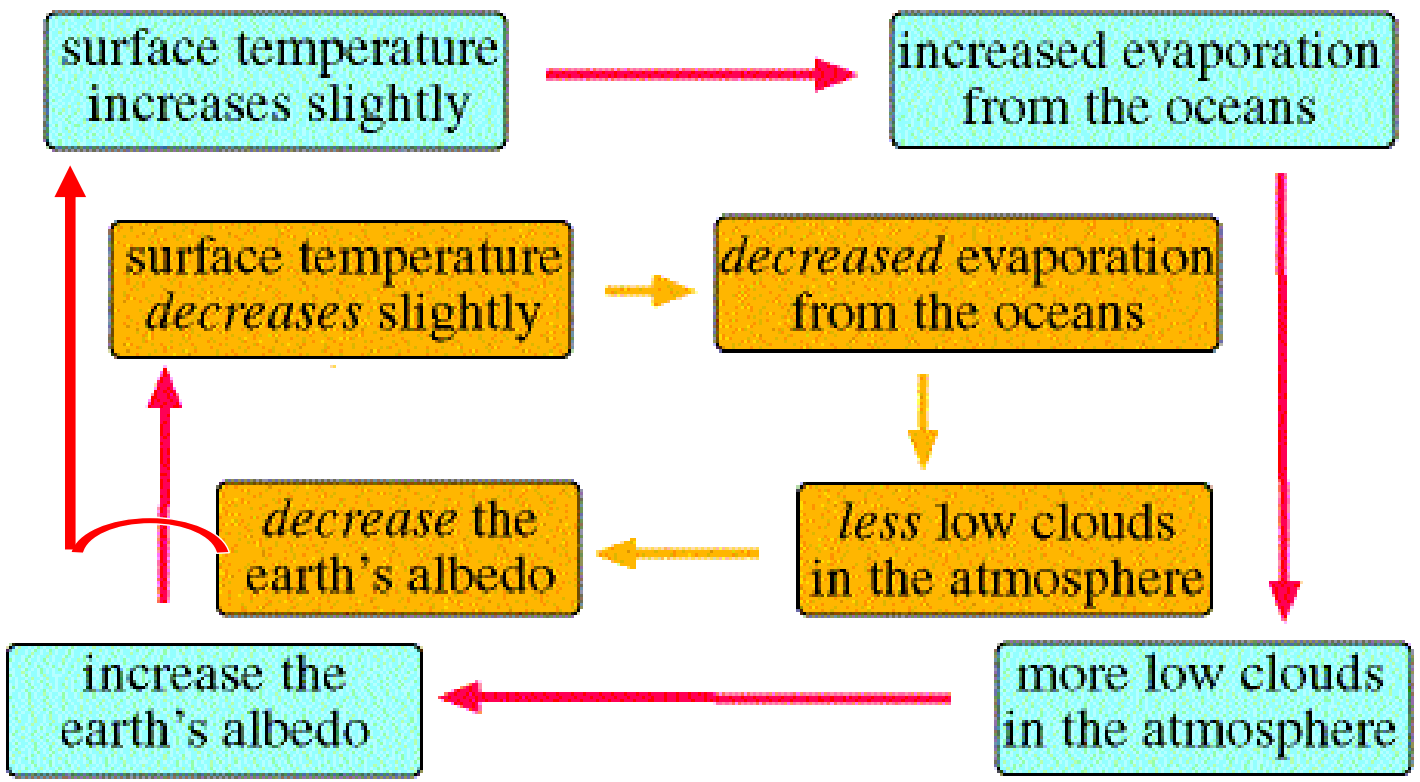
General circulation models (GCMs)

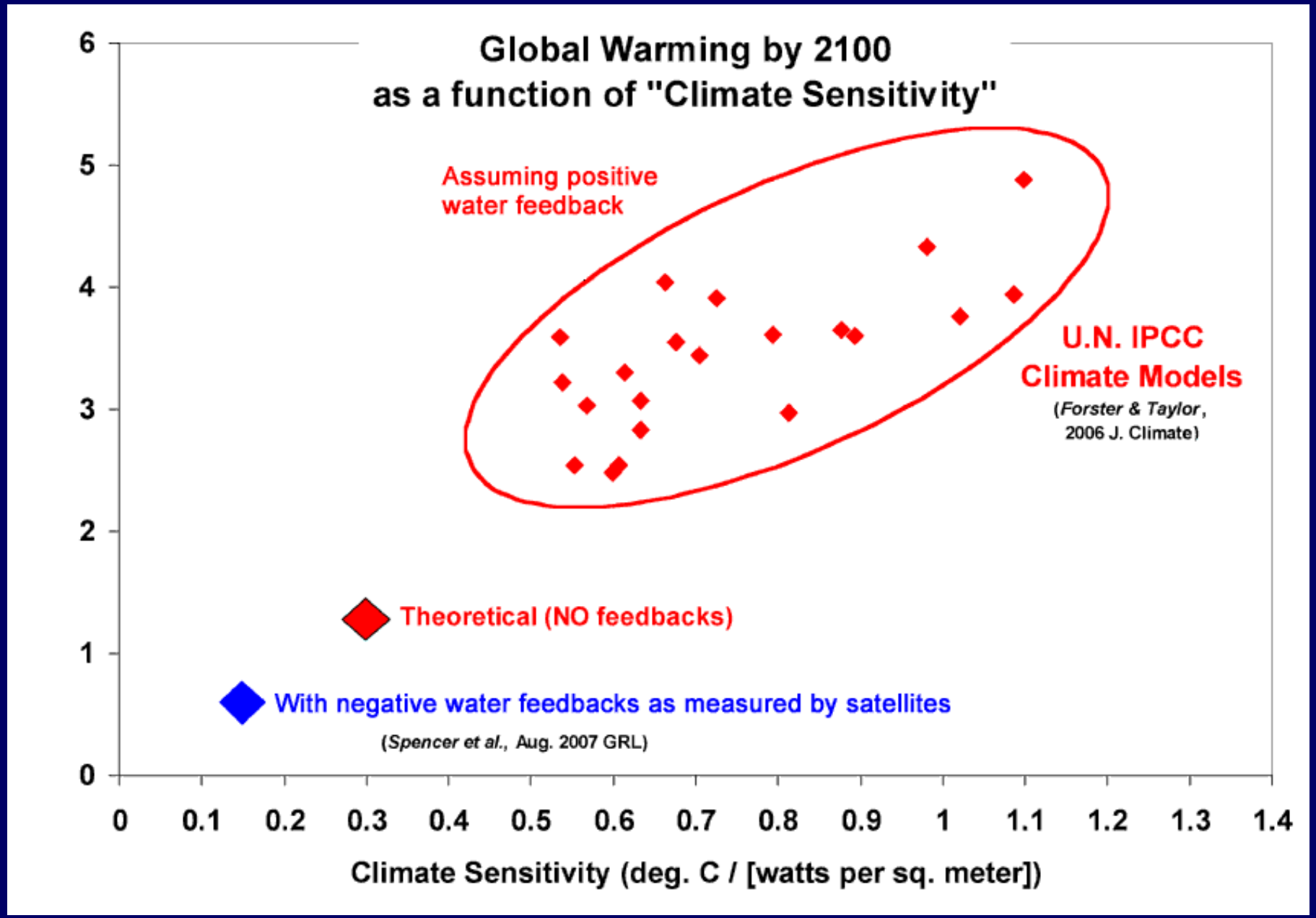
GCMs have many limitations, mainly due to unknown roles of:

- oceans
- clouds
- aerosols
- and especially feedbacks

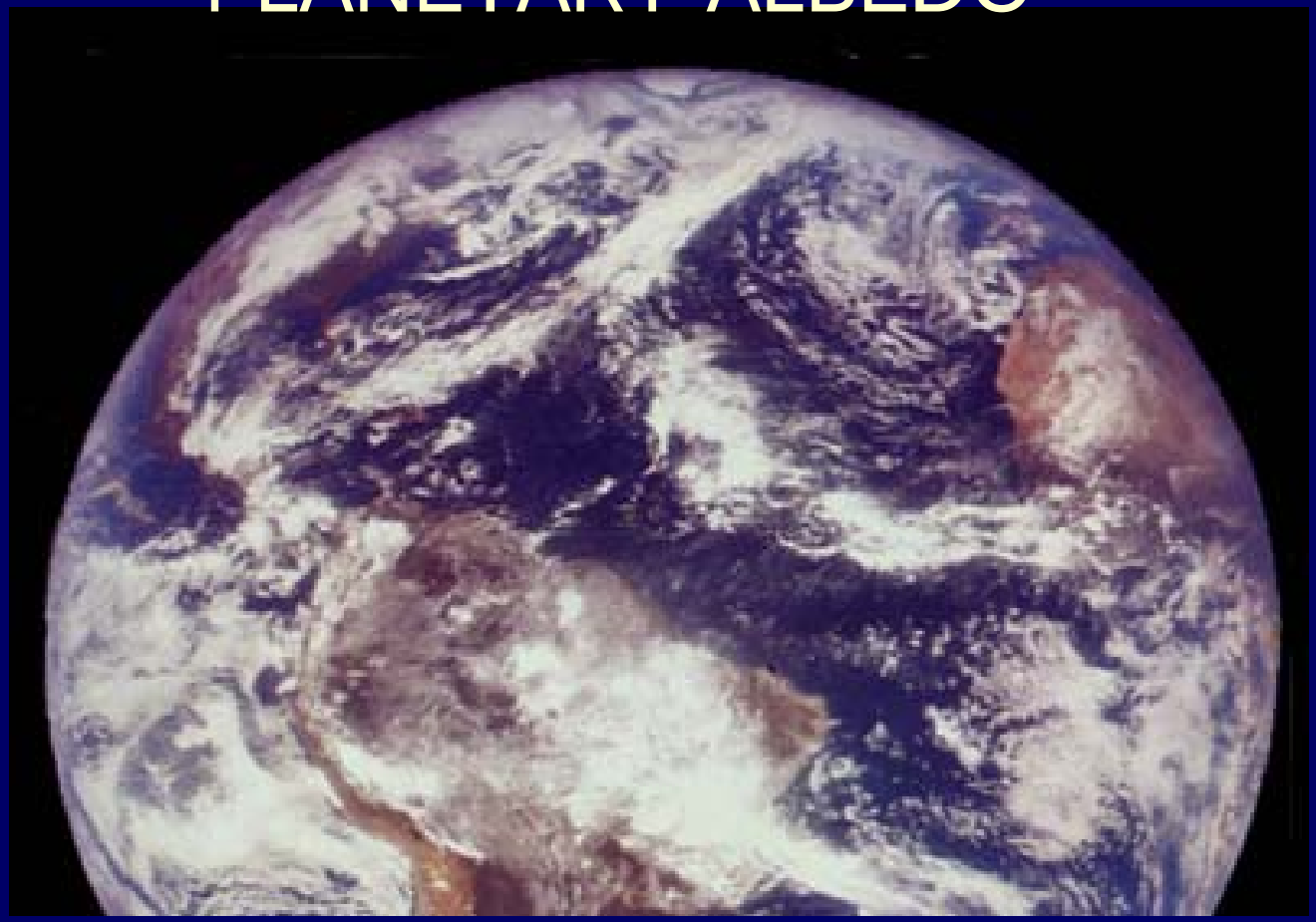

+GHG, +T_{air}, +Evap, +$Atm_{water\ vap}$, +T_{air}
Positive feedback
+GHG, +T_{air}, +Evap, +$Atm_{water\ vap}$, +cloud, -solar rad, -T_{air}
Negative feedback
+GHG, +T_{air}, +Evap, +$Atm_{water\ vap}$, +cloud, + precip, +ice
-solar rad
albedo
Negative feedback
-T_{air}

Dynamic Equilibrium




Global Warming by 2100
as a function of "Climate Sensitivity"
Assuming positive
water feedback
U.N. IPCC
Climate Models
(Forster & Taylor,
2006 J. Climate)
Theoretical (NO feedbacks)
With negative water feedbacks as measured by satellites
(Spencer et al., Aug. 2007 GRL)
6
5
4
3
2
1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
Climate Sensitivity (deg. C / [watts per sq. meter])

PLANETARY ALBEDO



A 1% reduction in Earth's albedo increases the solar radiation warming the surface by 1.3 W/m2. Radiative change due to increases in carbon dioxide is negligible compared to this change.

To conclude:

"In climate research and modeling, we should recognise that we are dealing with a coupled non-linear chaotic system, and therefore that the long-term prediction of future climate states is not possible."

IPCC (2001), TAR, Section 14.2.2.2.

“Predictions” of future climate are not predictions, but speculation. They come from global climate models that have not been verified, so their output is merely conjecture.

This is why the IPCC use terms such as “projections” “scenarios” and “story lines”

“*There is a social responsibility incurred when you present the models to the public as accurate portrayals of reality with valid predictions. Unfortunately, many people are not accepting [this] responsibility*”
(Tim Ball, 2007).