

Uncertainty and Limitations

1. **Measurement uncertainties:**

- Exact position of the instruments
- Representativity of a point
- Long term variability

2. **Regional model**

- Parameterization schemes
- Resolution
- Model core
- Surface classifications

3. **Microscale model**

- Roughness map data availability and errors
- Simplification of calculations

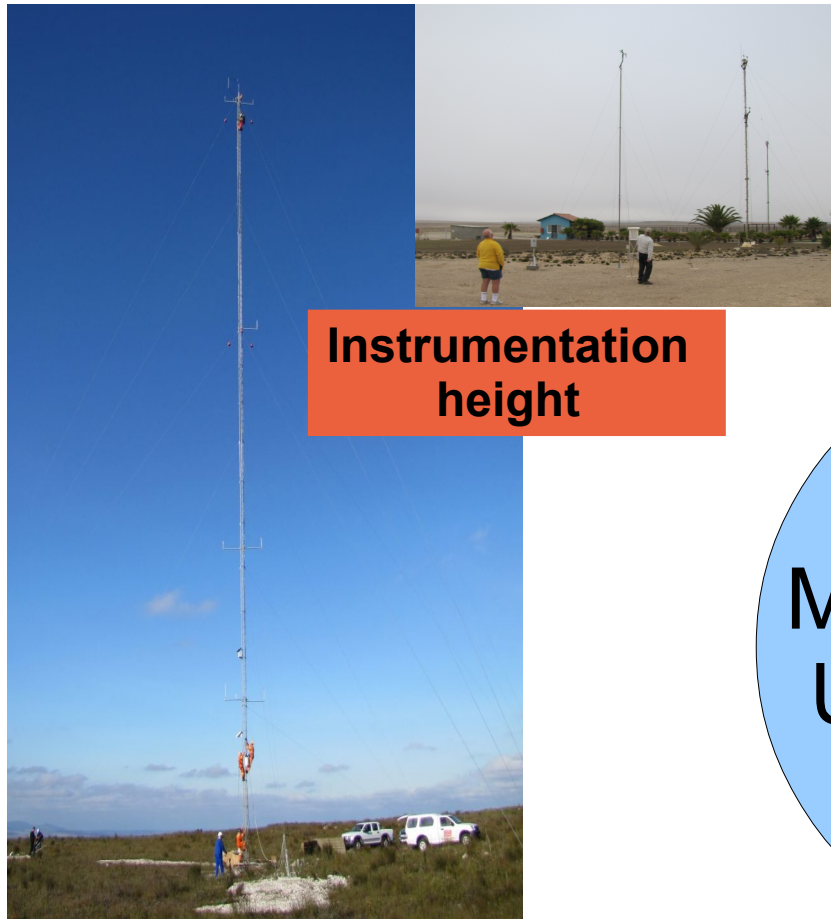
4. **Large scale, natural and human**

5. **Climate Change**

6. **Uncertainty Cascade**



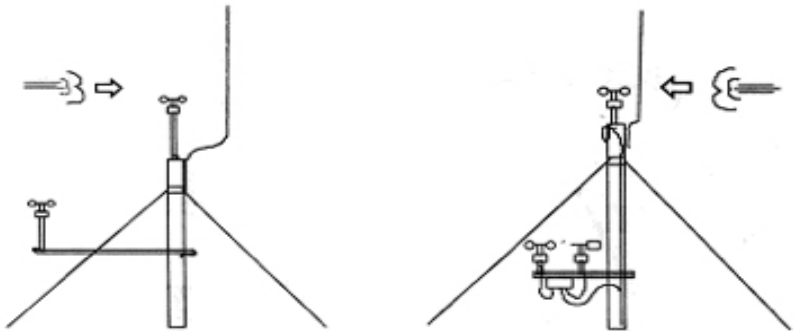
Sources of Uncertainty...



Instrumentation height

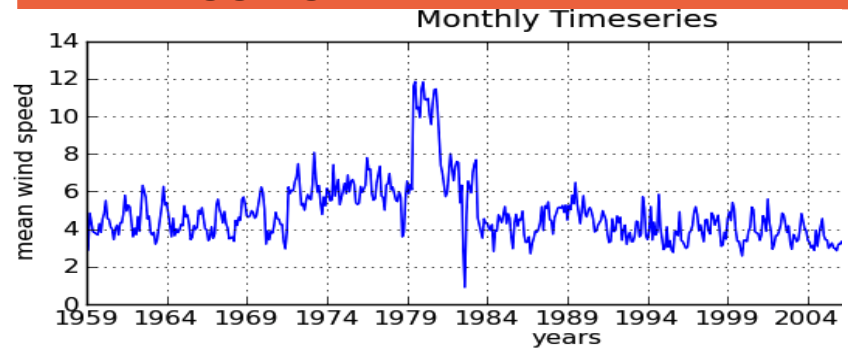
Measurement Uncertainties

Anemometer placement



Source: Garrad Hassan

Data logging, transmission and QC



Record Length

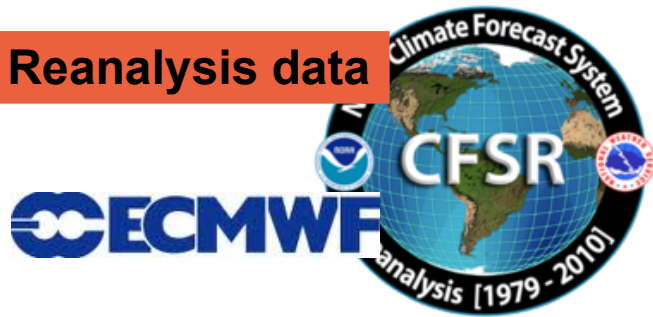


Mast placement and number

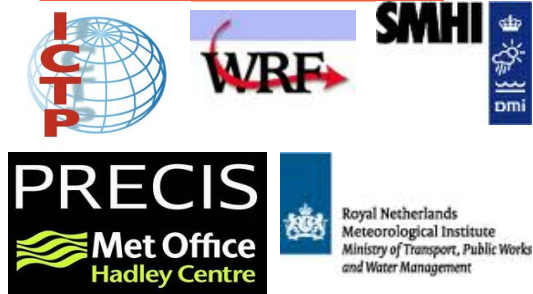


Sources of Uncertainty...

Reanalysis data

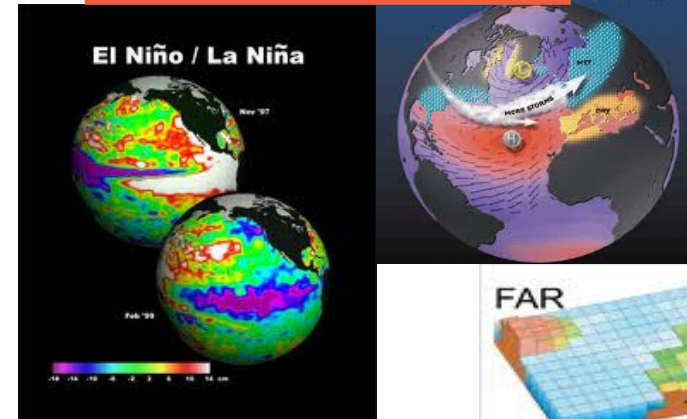


Regional model



Regional Model Uncertainties

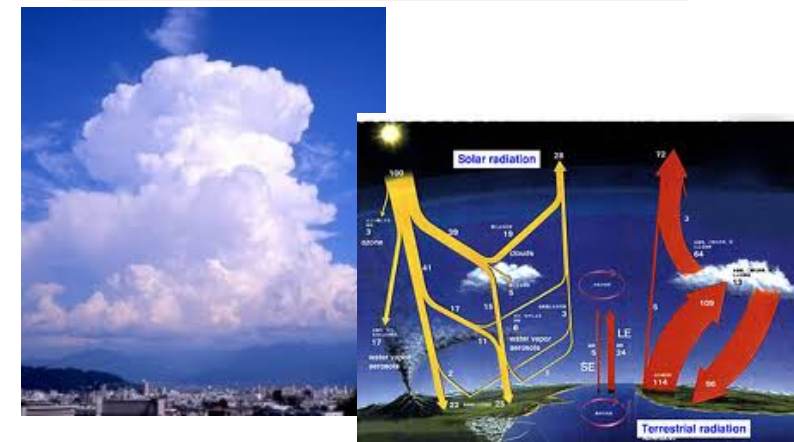
Modes of variability



Grid resolution and coastlines



Parametrization schemes



Multiple simulations



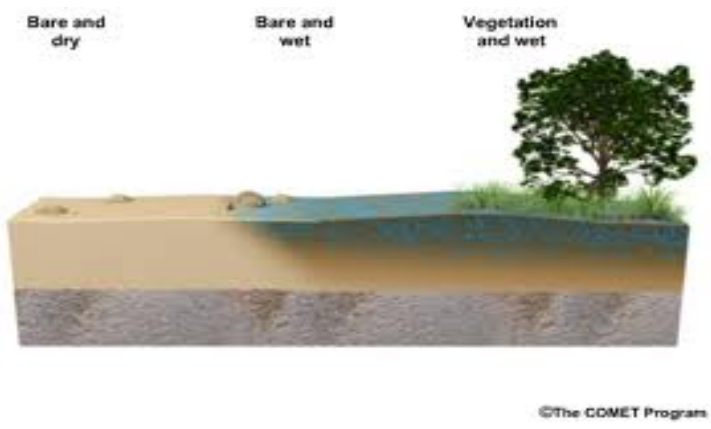
Boundary layer representation & land use change



Sources of Uncertainty...

Linearized equations

Surface Roughness



$$\frac{D}{Dt} \left(-\frac{v_y}{p_y} \right) - \frac{\omega}{p_y} \cdot \nabla u - f \frac{u_y}{p_y} = -\alpha_y + \frac{\alpha_y}{p_y} p_y - \frac{F_{2y}}{p_y} \quad (4.5)$$

$$\frac{D}{Dt} \left(\frac{u_y}{p_y} \right) - \frac{\omega}{p_y} \cdot \nabla v - f \frac{v_y}{p_y} = \alpha_x - \frac{\alpha_x}{p_y} p_x + \frac{F_{1y}}{p_y} \quad (4.6)$$

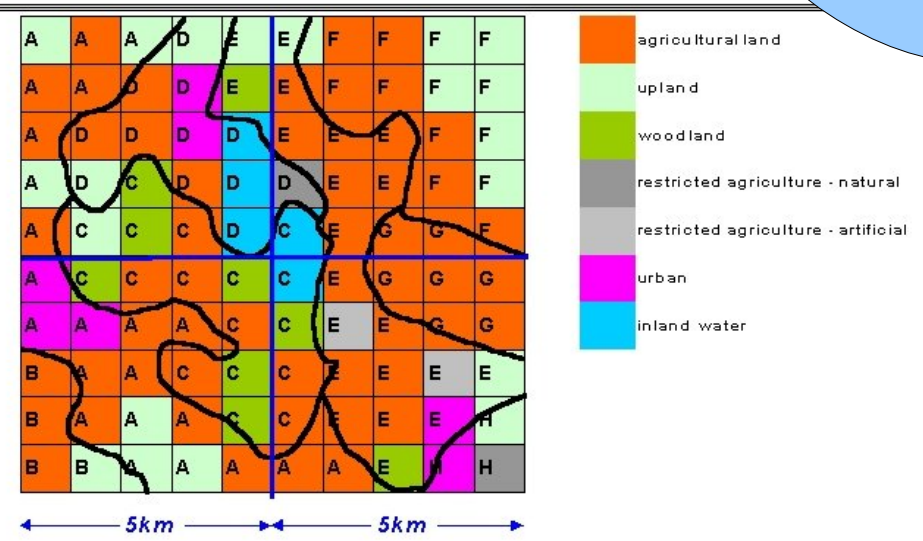
$$\begin{aligned} \frac{D}{Dt} \left(\frac{f + v_x - u_y}{p_y} \right) &= \frac{fk + \omega}{p_y} \cdot \nabla \gamma \\ &+ \frac{-\alpha_x p_y + \alpha_y p_x}{p_y} \\ &+ \frac{F_{2x} - F_{1y}}{p_y} \end{aligned} \quad (4.7)$$

Microscale Model Uncertainties

Heat flux and air density

Land use classification

Agricultural Census - parish to grid square

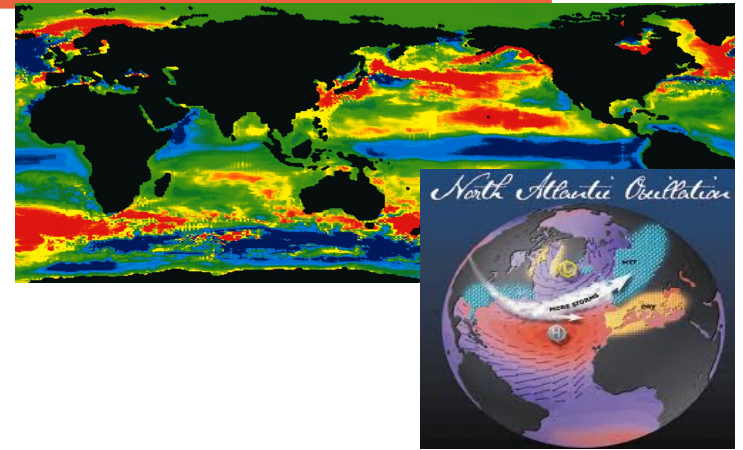


Land use change over time

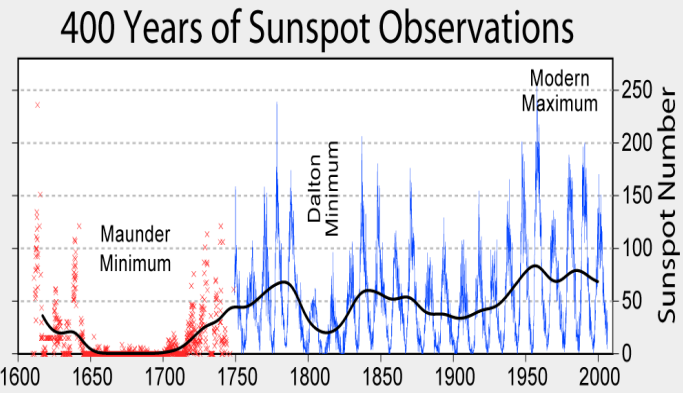


Sources of Uncertainty...

Imperfect knowledge of a Non-linear climate system

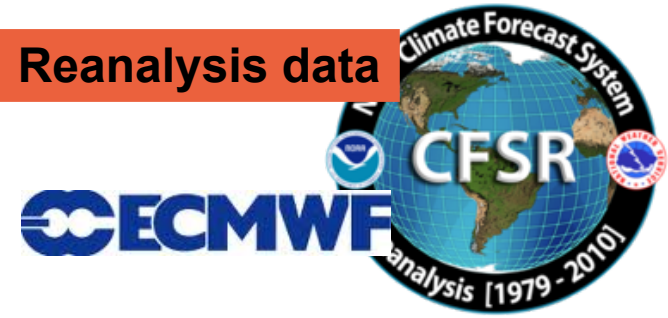


Natural forcing

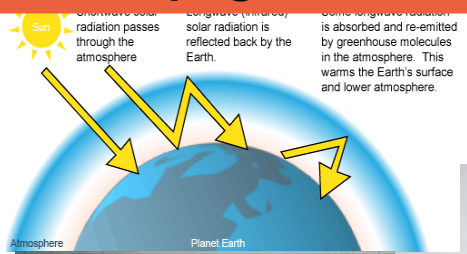


Large Scale Sources

Reanalysis data



Anthropogenic forcing



Human factor



Measurements

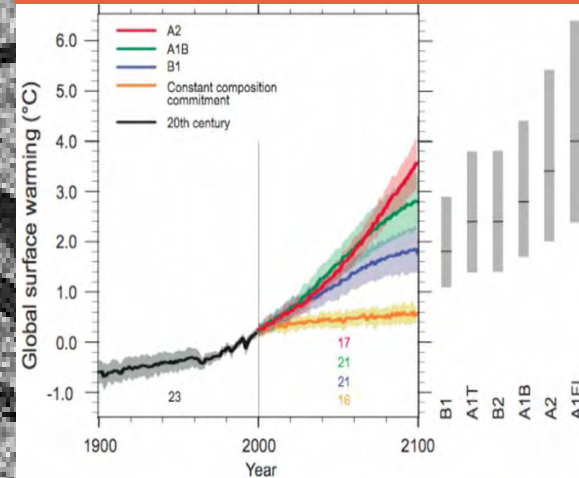
Regional Model

Total
Uncertainty

Microscale Model

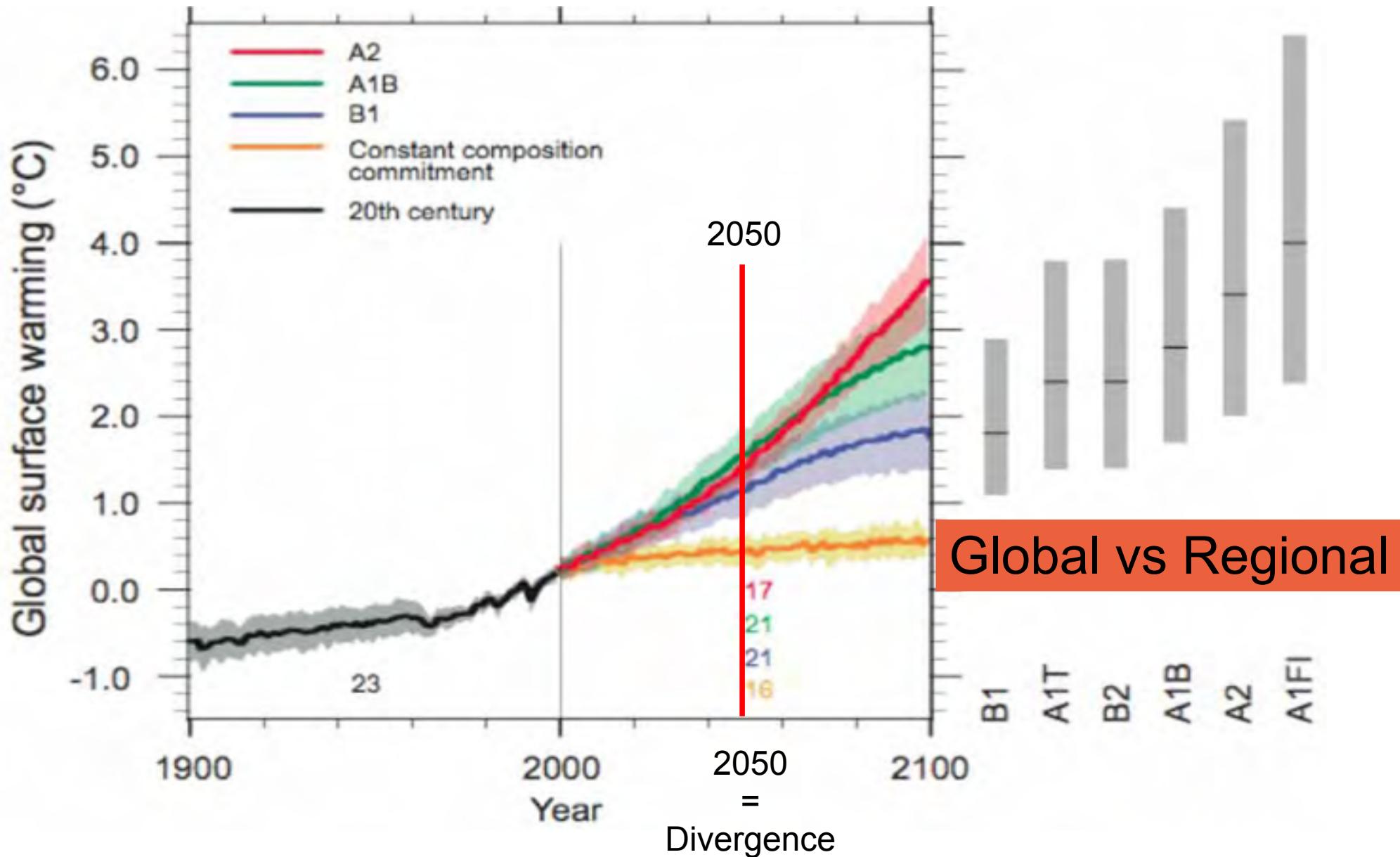
Society and Nature

Climate Change

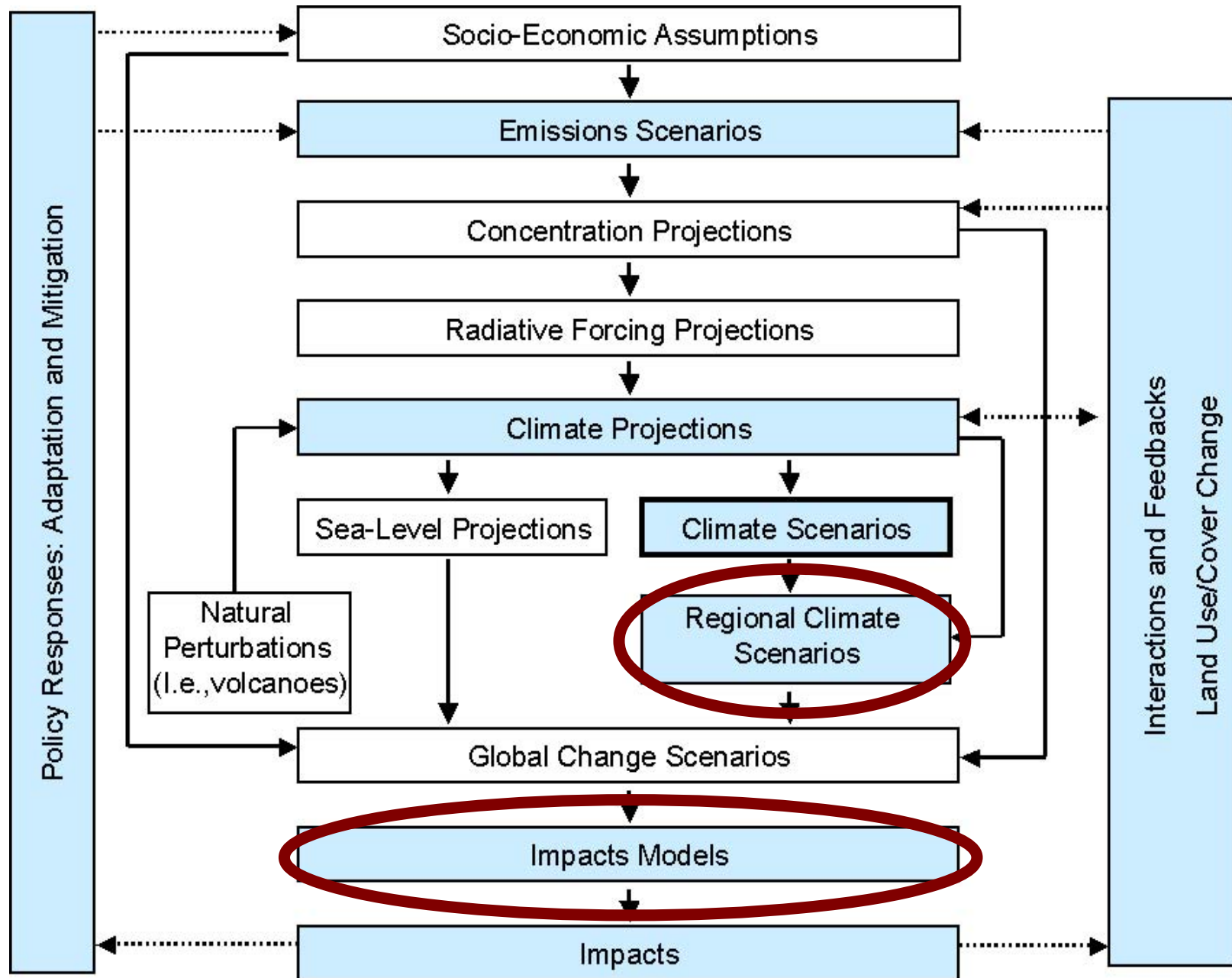


Summary...

Climate Change



Uncertainty Cascade...



Measurements

Regional Model

Minimizing
Uncertainty

Climate Change

Microscale Model

Society and Nature

Propagation in the cascade

Uncertainty Atlas

LOST

CONFUSED

UNSURE

UNCLEAR

PERPLEXED

Validation against obs

Uncertainty Budget

DISORIENTED

BEWILDERED

