

4th VALUE Training School

Validation of Regional Climate Change Projections

A View on Uncertainties

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Wrap up

Uncertainty cascade revisited

How to present ensembles

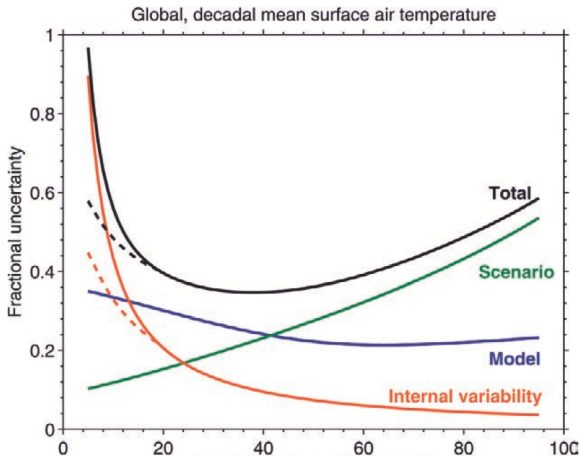
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Fractional uncertainty

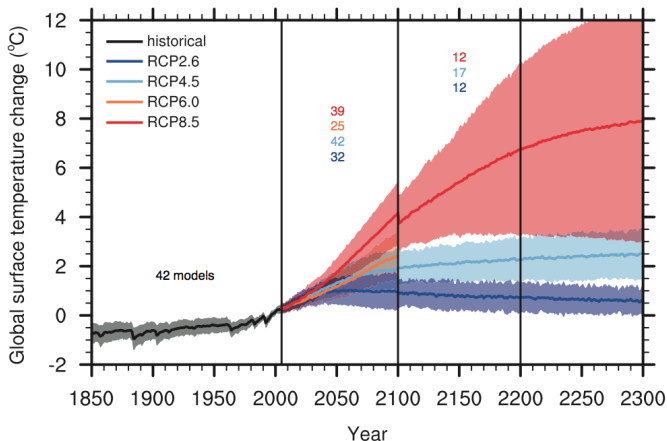
How large are the uncertainties relative to the climate change signal?



Hawkins & Sutton, B.A.M.S., 2009

Scenario uncertainty

is inherently different because of human reflexive uncertainty

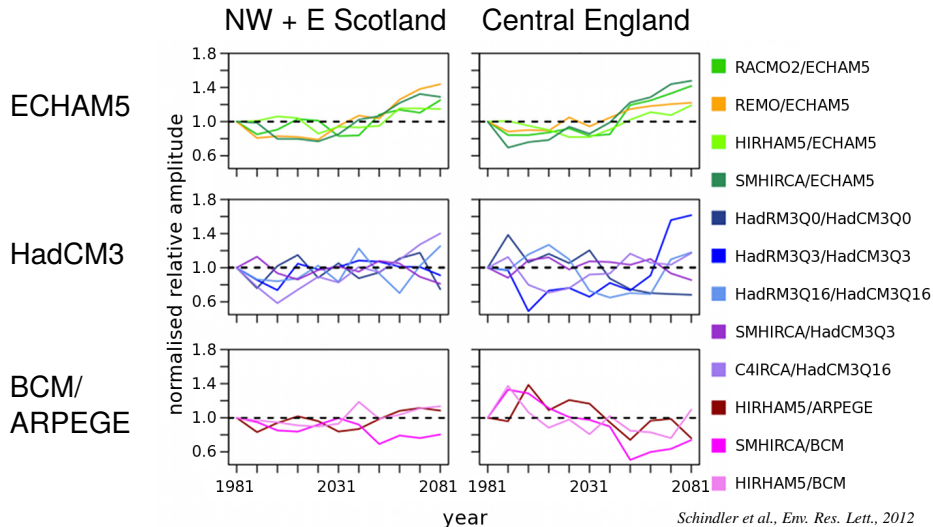


Probabilistic statements can only be done conditional on a scenario!

IPCC 2013

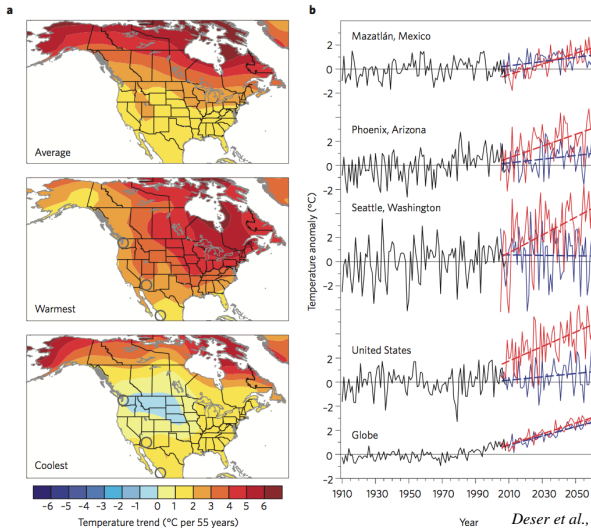
Model uncertainty

E.g.: Amplitude of seasonal cycle in extreme precipitation in UK



Internal climate variability

Potential temperature changes in the US



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Sources of model imperfection

Model imperfections arise from

Model inadequacy

- ▶ Key processes might be misrepresented or missing

Model uncertainty

- ▶ Processes might be implemented differently (different parameterisation, resolution, numerical schemes,...)

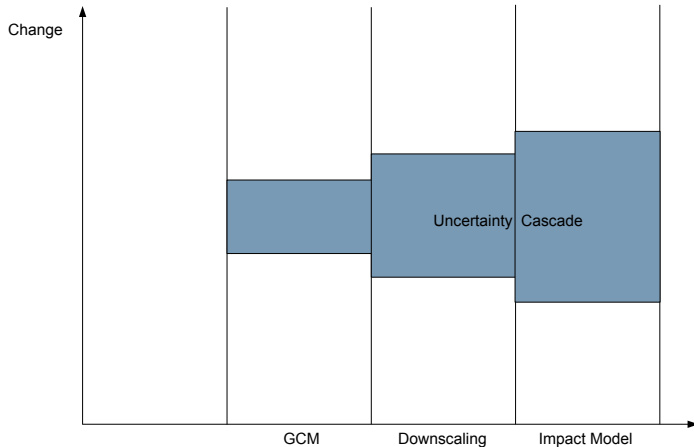
Stainforth et al., 2007

Prominent statements

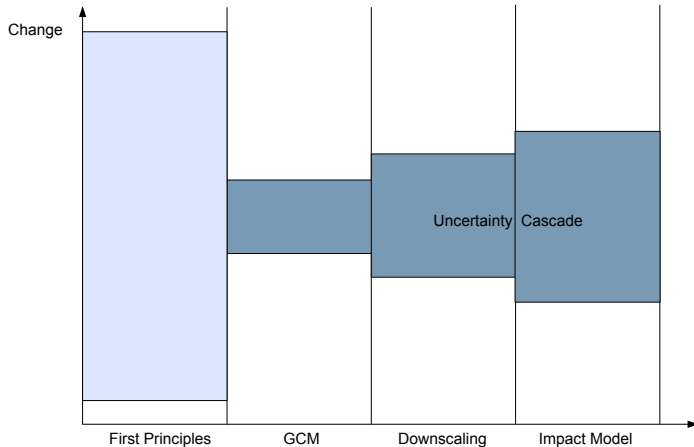
- ▶ *I don't trust climate models, because they are wrong. I rather rely on first principles.*
- ▶ *I don't use downscaling because it increases uncertainties ("it adds another layer of uncertainty")*

I believe that these statements arise from a fundamental misconception of what uncertainties are.

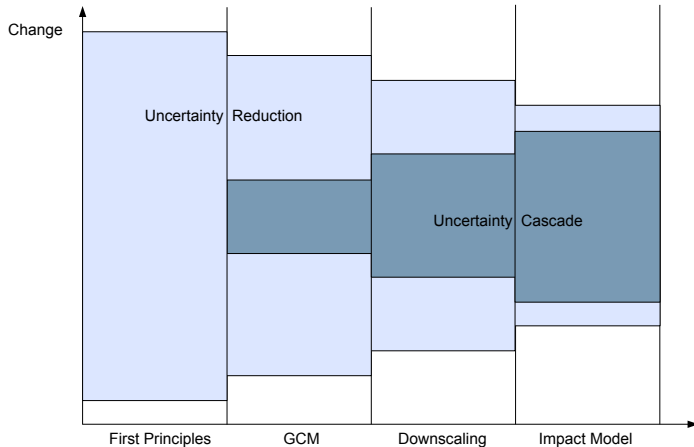
Rethinking the uncertainty cascade



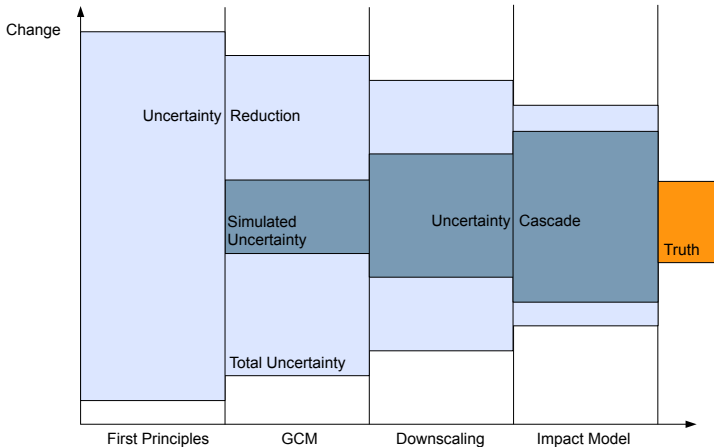
Rethinking the uncertainty cascade



Rethinking the uncertainty cascade



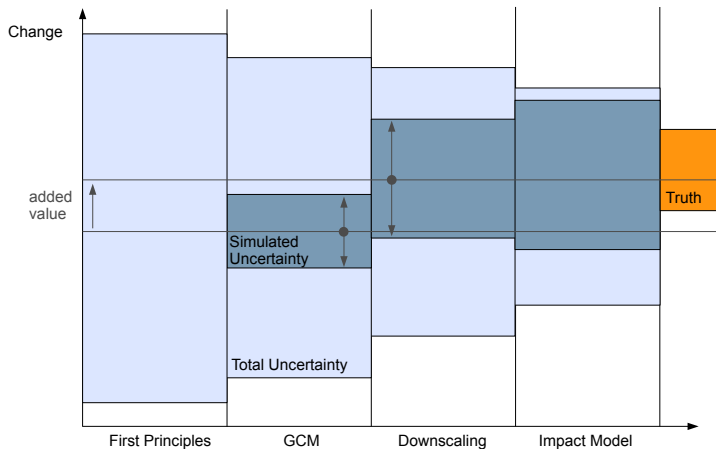
Rethinking the uncertainty cascade



- holds only after proper validation (whatever this means here);
- uncertainty reduction is added value (but hardly measureable).

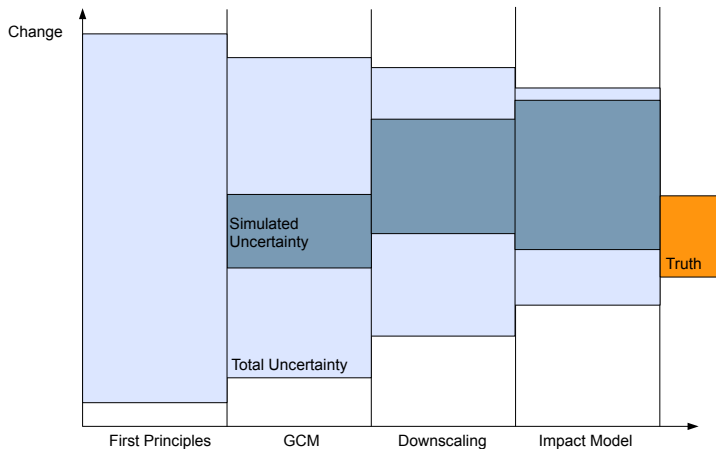
Case 1: downscaling adds value

Example: summer precipitation in Europe



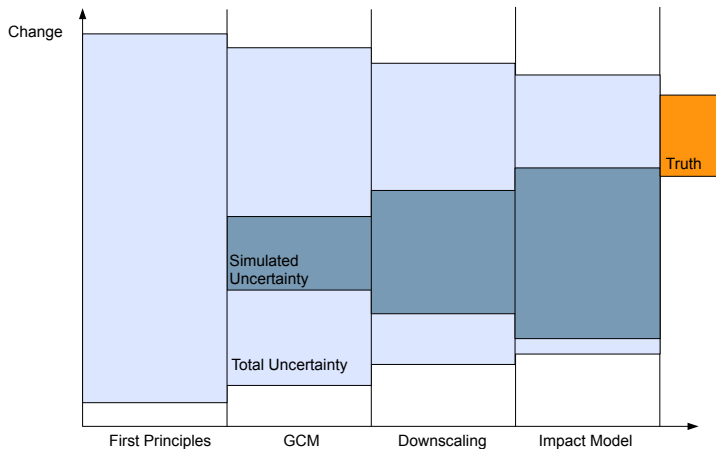
Case 2: downscaling deteriorates value

Example: RCM summer temperatures in Europe



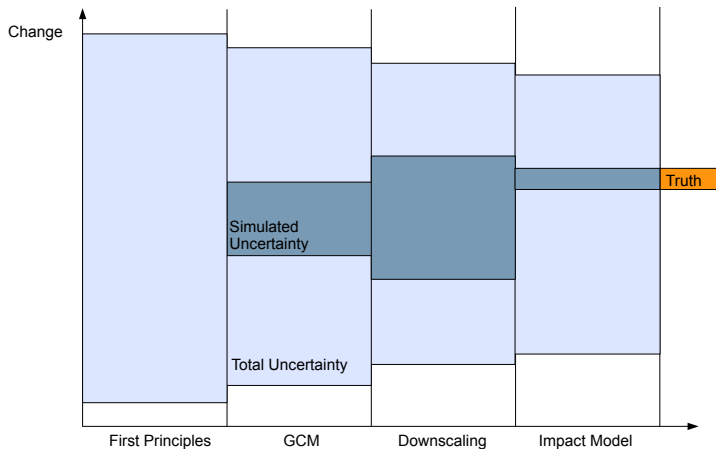
Case 3: current projections are wrong

Example: subdaily summer extreme precipitation



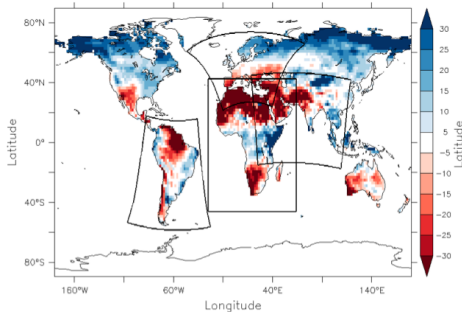
Case 4: impact collapses

Example: growth of specific species

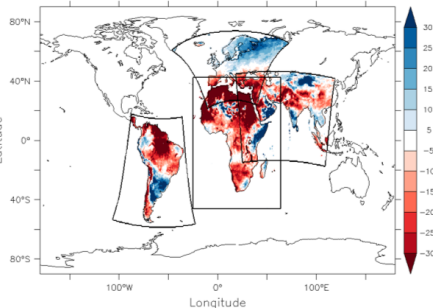


Downscaling might change change

RCP 8.5, precipitation change (%)
MPI-ESM-LR, (2071–2100)–(1971–2000)



RCP 8.5, precipitation change (%)
REMO, (2071–2100)–(1971–2000)

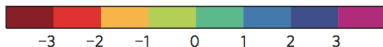
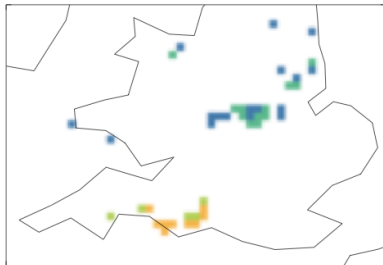


Teichmann et al., 2013

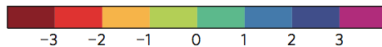
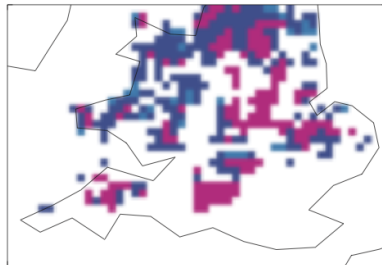
State-of-the-art might be not good enough

e.g., for hourly precipitation extremes

d 12 km future change (2100 – present-day), JJA



e 1.5 km future change (2100 – present-day), JJA



Kendon, 2013

What is added value?

Different - not necessarily independent - aspects:

- ▶ **Added detail**

Small scale processes are represented.

- ▶ **Added value at coarse scale**

Skill of output aggregated to the scale of the driving model is improved.

- ▶ **Added value to climate change**

The climate change signal is improved.

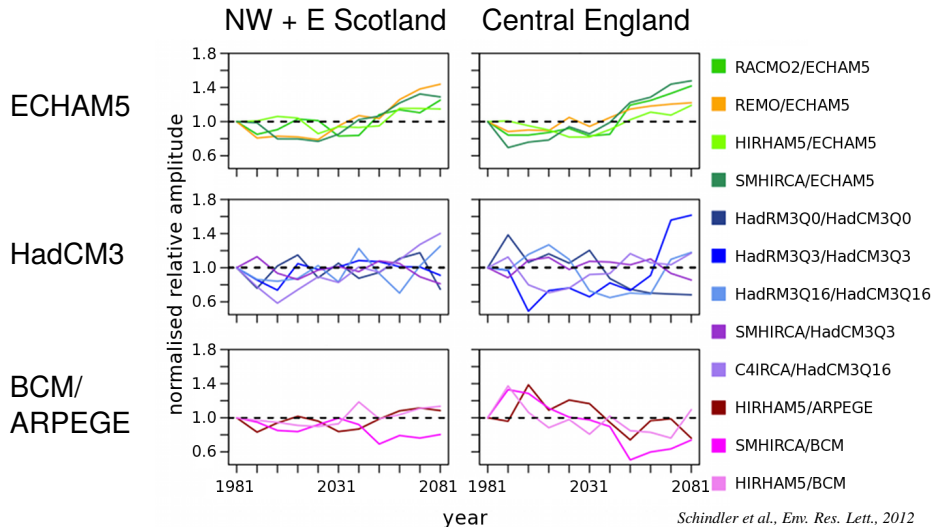
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Grouping for uncertainty attribution

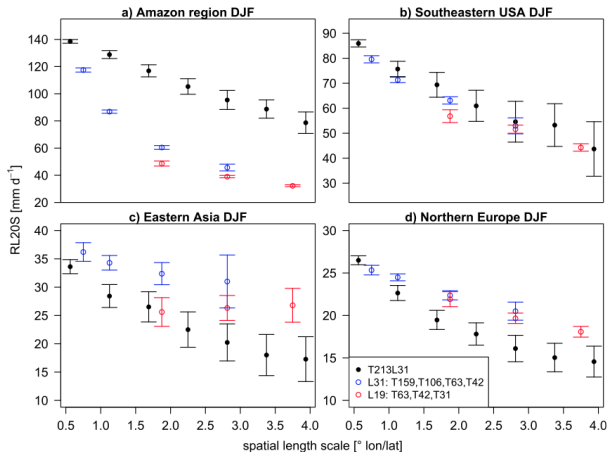
E.g.: Amplitude of seasonal cycle in extreme precipitation in UK



Comparing like with like

20 winter return level,
simulated with ECHAM5,
at different resolutions.

black: averaged T214
blue/red: different model
resolutions



- ▶ comparison at same resolution
- ▶ NB: be careful whether to use interpolation or aggregation!
(sometimes they are not the same)

Volosciuc et al., J Climate, 2015

Communicating ensemble results

- ▶ Never combine different scenarios!
- ▶ Combine different models and approaches!
- ▶ Show only comparable output in one plot (e.g. at the same scale)!
- ▶ Show what is robust!
- ▶ Be clear about what is not robust!