Comment le GIEC gère-t-il les incertitudes scientifiques ?

Prof. Jean-Pascal van Ypersele

IPCC Vice-Chair

Earth & Life Institute
Université catholique de Louvain
(Louvain-la-Neuve, Belgium)

www.ipcc.ch & www.climate.be
vanyp@climate.be

Colloque international « Controverses climatiques (sciences et politique) »
Bruxelles, 27-10-2010

Merci aux Services fédéraux de la Politique scientifique belge pour leur soutien

belspo

Claude Allègre: « Il faut supprimer le Giec »

(Slate.fr, 23-2-2010)

« La thèse développée [par le GIEC] est que le climat se réchauffe et que la cause en est les dégagements de CO_2 dus à l'activité humaine. Cette conclusion est présentée sans tenir compte des **énormes incertitudes qui pèsent sur cette interprétation** et ses conséquences. »

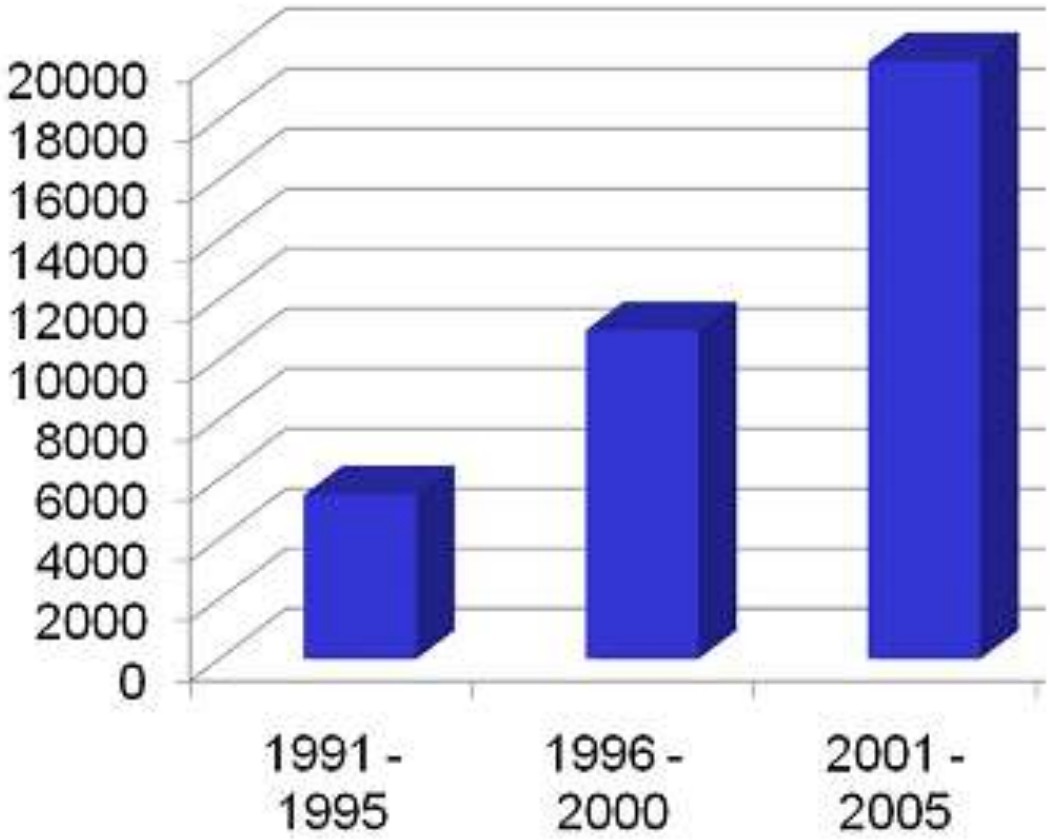
Why the IPCC ?

Established by WMO and UNEP in 1988

to provide policy-makers with an objective source of information about

- causes of climate change,
- potential environmental and socio-economic impacts,
- possible response options.

Number of papers published on climate change



Role of IPCC

"The IPCC does not carry out research nor does it monitor climate related data or other relevant parameters. It bases its assessment mainly on peer reviewed and published scientific/technical literature."

(source: www.ipcc.ch)

NB: IPCC Reports are policy-relevant, NOT policy-prescriptive

IPCC Structure

- **3 Working Groups, 1 Task Force**
- WG1: Physical basis for climate change
- WG2: Impacts, adaptation & vulnerability
- WG3: Mitigation (emission reductions)
- TF: Emission inventories (methodologies)

Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

IPCC writing cycle (4 years, 2500 scientists)

- Plenary decides table of content of reports
- Bureau appoints world-class scientists as authors, based on publication record
- Authors assess all scientific literature
- *Draft* – Expert review (+ Review editors)
- *Draft 2 (+ Draft 1 Summary for Policy Makers (SPM)* – Combined expert/government review
- *Draft 3 (+ Draft 2 SPM)*– Government review of SPM
- Approval Plenary (interaction authors – governments) – *SPM and full report*

Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

The IPCC Fourth Assessment Report (2007)

+130 countries

around 450 lead authors

around 800 contributing authors

+2500 scientific expert reviewers

+18000 peer-reviewed publications cited

+90000 comments from experts and Governments

Completed IPCC Reports

4 Assessment Reports *(1990,1995, 2001, 2007)*

1992 Supplementary Report and 1994 Special Report

7 Special Reports *(1997,1999, 2000, 2005)*

Guidelines for National GHG Inventories, Good Practice Guidance *(1995-2006)*

6 Technical Papers *(1996-2008)*

The assessments carried out by the IPCC have influenced global action on an unprecedented scale

1. First Assessment Report (1990) had a major impact in defining the content of the **UNFCCC**

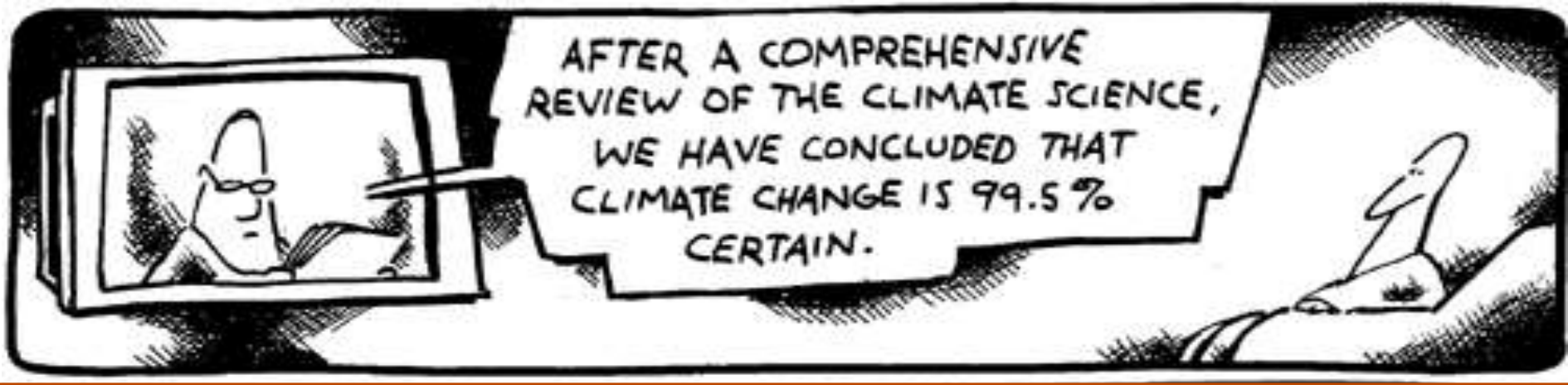
2. The Second Assessment Report (1996) was largely influential in defining the provisions of the **Kyoto Protocol**

3. The Third Assessment Report (2001) focused attention on the **impacts** of climate change and the need for **adaptation**

4. The Fourth Assessment Report (2007) is creating a strong basis for a **post-2012** agreement

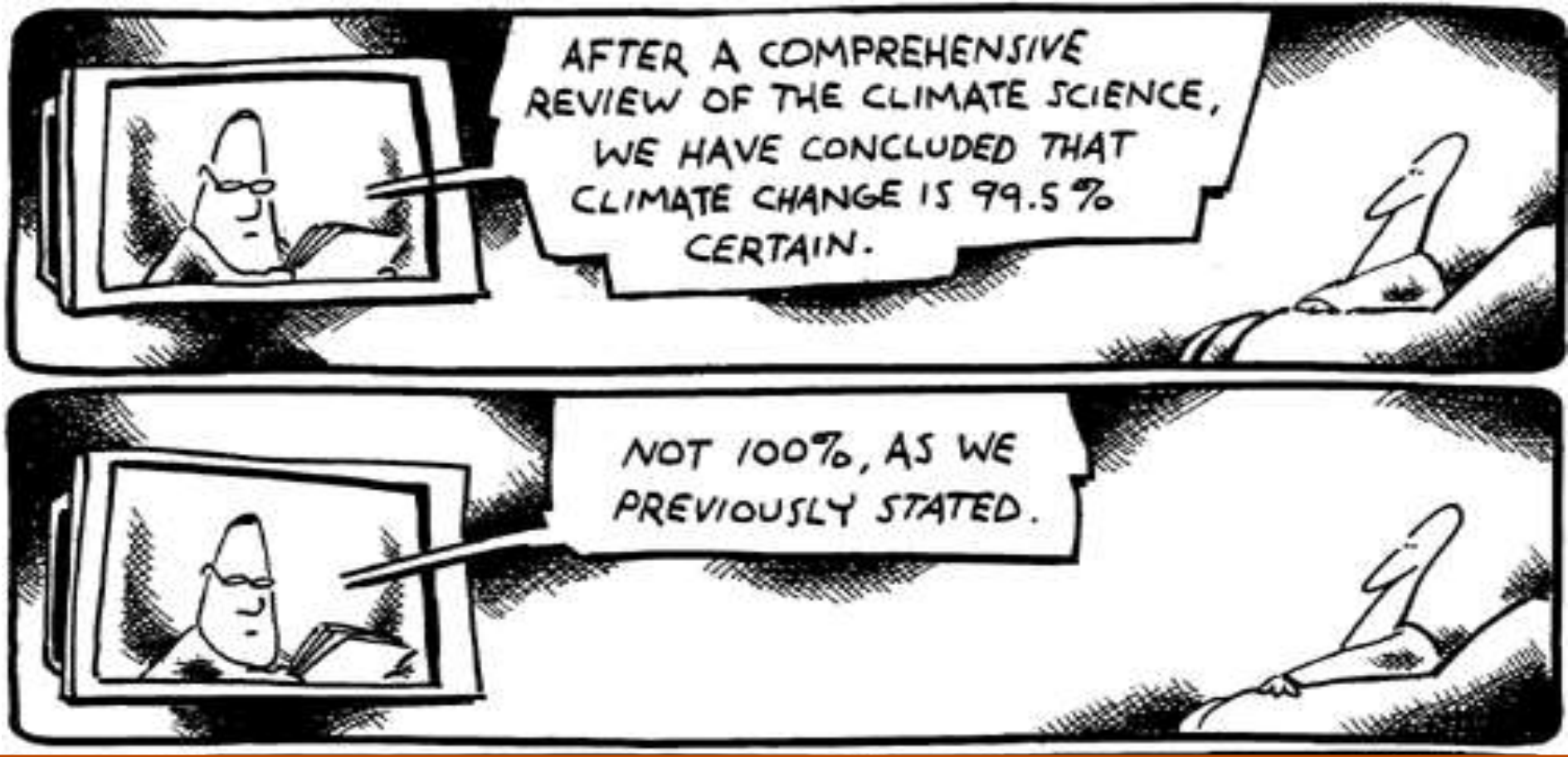
Nobel Peace Prize for 2007

- **Shared, in two equal parts, between the Intergovernmental Panel on Climate Change (IPCC) and Albert Arnold (Al) Gore Jr. for « *their efforts to build up and disseminate greater knowledge about manmade climate change, and to lay the foundations for the measures that are needed to counteract such change*. »**

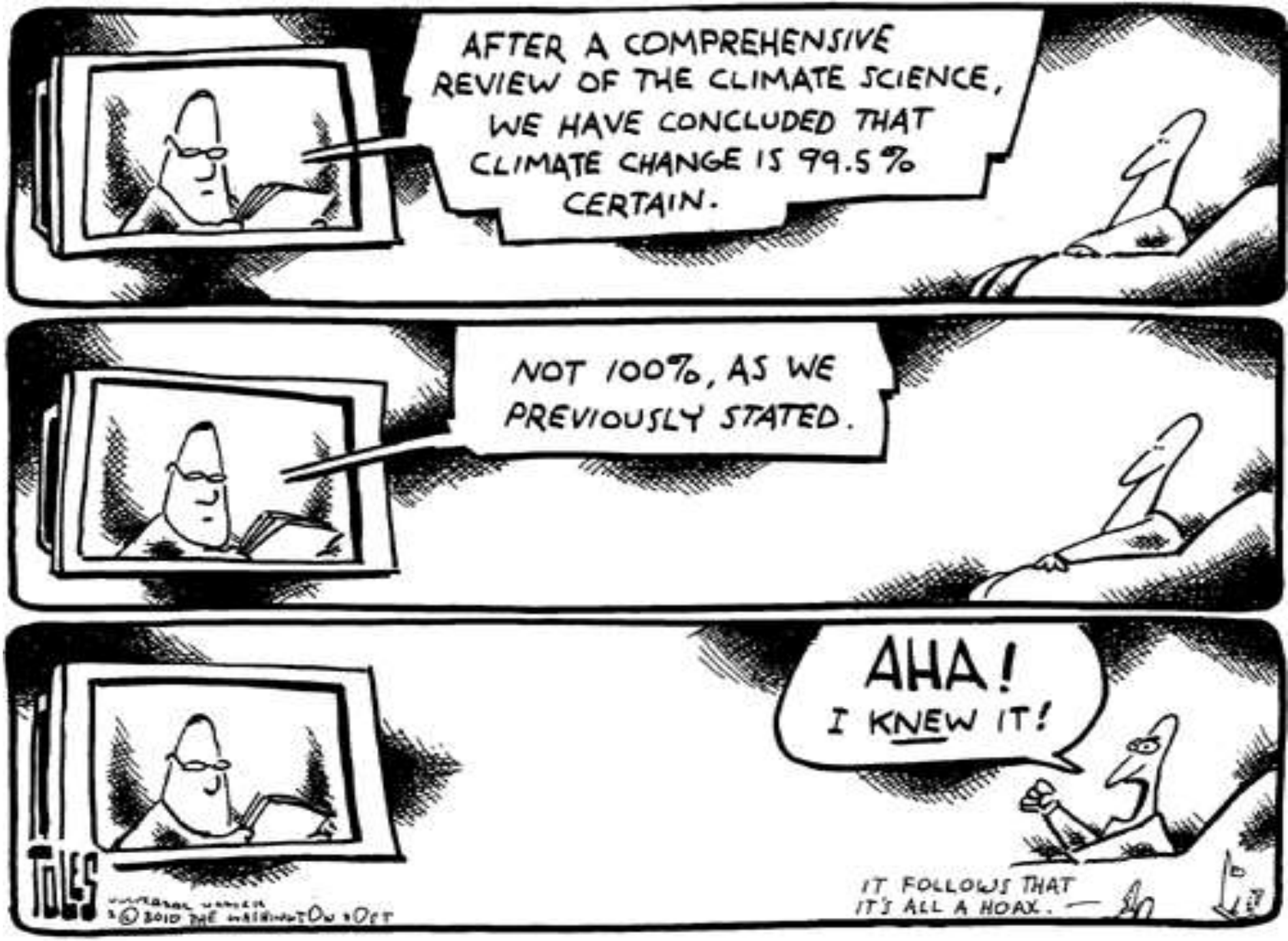


2-22-10

Tom Toles in The Washington Post



Tom Toles in The Washington Post



Tom Toles in The Washington Post

We are certain of the following: **(from IPCC WGI (1990))**

- there is a natural greenhouse effect which already keeps the Earth warmer than it would otherwise be

- emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases carbon dioxide, methane, chlorofluorocarbons (CFCs) and nitrous oxide. These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface. The main greenhouse gas, water vapour, will increase in response to global warming and further enhance it

1.0.4 *With regard to uncertainties, we note that:*

(from IPCC WGI (1990))

- There are many uncertainties in our predictions particularly with regard to the timing, magnitude and regional patterns of climate change, especially changes in precipitation.

  - These uncertainties are due to our incomplete understanding of sources and sinks of greenhouse gases and the responses of clouds, oceans and polar ice sheets to a change of the radiative forcing caused by increasing greenhouse gas concentrations.

  - These processes are already partially understood, and we are confident that the uncertainties can be reduced by further research. However, the complexity of the system means that we cannot rule out surprises.

The IPCC WG1 Sequence (1)……

IPCC (1990) “The size of this warming is broadly consistent with predictions of climate models, but it is also of the same magnitude as natural climate variability (…) The unequivocal detection of the enhanced greenhouse effect from observations is not likely for a decade or more”

IPCC (1995) “The balance of evidence suggests a discernible human influence on global climate”

The IPCC WG1 Sequence (2)……

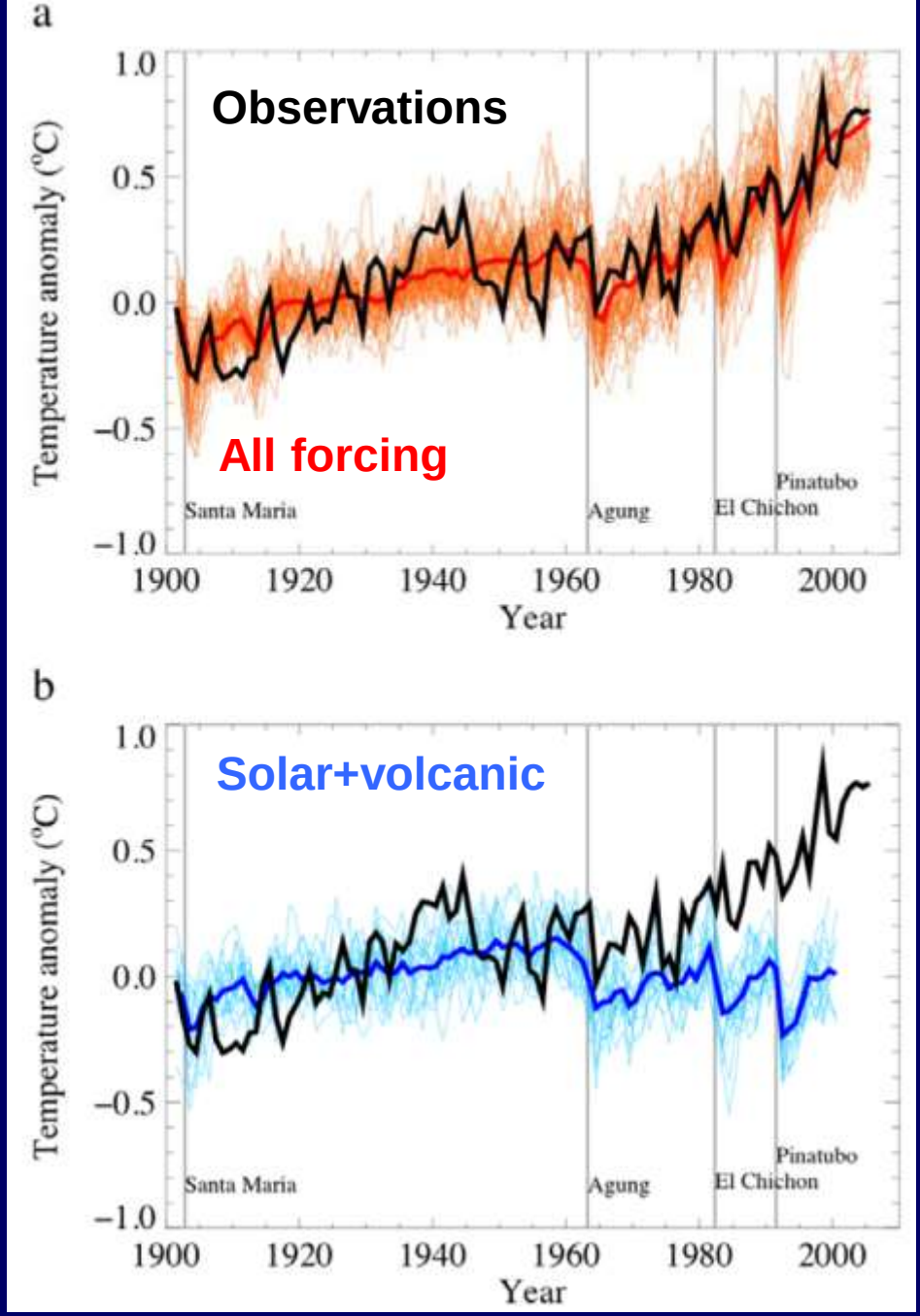
IPCC (2001) "Most of the observed warming over the last 50 years is likely (P>66%) to have been due to the increase in greenhouse gas concentrations."

IPCC (2007) "Warming is unequivocal, and most of the mid-20th century is very likely (P>90%) due to the observed increase in anthropogenic greenhouse gas concentrations"

Attribution

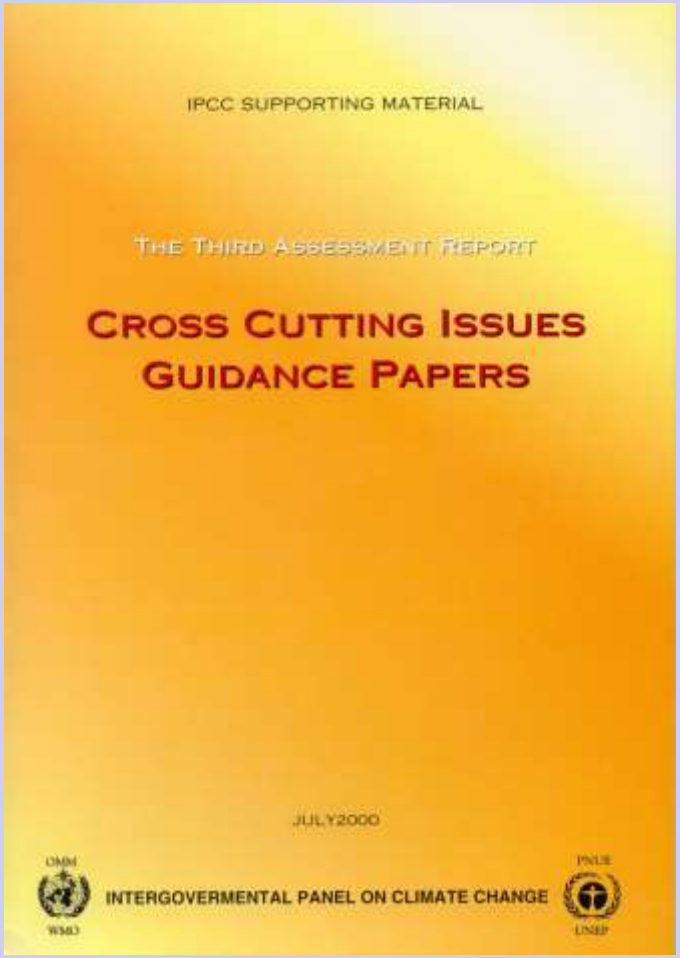
Are observed changes consistent with expected responses to natural forcings?

- IPCC (2007): "**Warming is unequivocal,** and m**ost of the observed increase in global average temperatures since the mid-20th century is *very likely*** (P>90%) **due to the observed increase in anthropogenic greenhouse gas concentrations**"



TAR Uncertainty Guidance

- Approximately 40 contributors & reviewers
- 2 rounds of drafting, review, and revision
- Based on evaluation of SAR at Aspen Global Change Institute Workshop
- Addressed both “internal” and “external” communications challenges
- Did not preclude more conventional statistical methods



(Slide from Stephen H. Schneider)

Two Key Challenges Addressed

1. For cases when an uncertain parameter is needed and limits in data or understanding preclude standard statistical approaches, provide advice on improving internal process of making "expert judgments"
2. To address challenge that words mean different things to different people, provide approach for calibrating and standardizing communication (both internal and external audiences)

(Slide from Stephen H. Schneider)

Guidance Notes for Lead Authors of the IPCC AR4 on Addressing Uncertainties

Simple typology of uncertainties

Type	Indicative examples	Typical approaches or considerations
Unpredictability	Difficult projections of human behaviour (eg. political systems); chaotic components of complex systems	Use scenarios spanning a plausible range, clearly stating assumptions, judgments and limits; ensembles of model runs
Structural uncertainty	Inadequate models, incomplete or competing conceptual frameworks, processes not considered…	Specify assumptions, compare with observations, assess maturity of underlying science & how understanding is based on fundamental tested concepts
Value uncertainty	Missing, inaccurate or non-representative data, poorly known model parameters	Analysis of statistical properties of sets of values (observations, model ensemble results…), model-observations comparisons

In this Summary for Policymakers, the following terms have been used to indicate the assessed likelihood, using expert judgement, of an outcome or a result: *Virtually certain* > 99% probability of occurrence, *Extremely likely* > 95%, *Very likely* > 90%, *Likely* > 66%, *More likely than not* > 50%, *Unlikely* < 33%, *Very unlikely* < 10%, *Extremely unlikely* < 5% (see Box TS.1 for more details).

In this Summary for Policymakers the following levels of confidence have been used to express expert judgements on the correctness of the underlying science: *very high confidence* represents at least a 9 out of 10 chance of being correct; *high confidence* represents about an 8 out of 10 chance of being correct (see Box TS.1)

(From IPCC AR4 WGI, 2007)

AR4 Guidance on Clarity

- Conclusion, outcome, or variable must be well specified for meaningful probability distribution to be assessed
- Avoid nearly indifferent statements based on speculative knowledge, e.g.,
  - "warming could alter biodiversity“ needs modifiers (rate/magnitude of change, location, etc.)
- Clear specification may require several iterations within the writing team to develop a set of well-posed questions or issues

(Slide from Stephen H. Schneider)

AR4 Guidance on Clarity

- Conclusion, outcome, or variable must be well specified for meaningful probability distribution to be assessed
- Avoid nearly indifferent statements based on speculative knowledge, e.g.,
  - "warming could alter biodiversity“ needs modifiers (rate/magnitude of change, location, etc.)
- Clear specification may require several iterations within the writing team to develop a set of well-posed questions or issues*

---

*Had this been done in Asia Regional Chapter of AR 4 the scientifically ridiculous Himalaya specific melt date would would have been uncovered (High Confidence).

(Slide from Stephen H. Schneider)

Evaluation of Evidence and Treatment of Uncertainty (InterAcademyCouncil report, 30-8-2010)

- Use qualitative level-of-understanding scale in SPM and TS (each WG)

- Traceable account of ratings for level of scientific understanding

- Quantitative probabilities : only if sufficient evidence

- Use confidence scale, not subjective probabilities
- Likelihood scale in terms of probabilities
- Formal expert elicitation procedures…

IAC, 2010, pp.39-41

Development of AR5 Guidance

July 2010:

IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties

Jasper Ridge Biological Preserve, Stanford, CA

WG II Technical Support Unit · c/o The Carnegie Institution
260 Panama Street · Stanford · California 94305 · USA
telephone +1 650 462 1047 · fax +1 650 462 5968 · email tsu@ipcc-wg2.gov · www.ipcc-wg2.gov

WMO UNEP

Development of AR5 Guidance

Decision:

- Update AR4 Guidance to improve distinction and transition between different metrics and consistent application across WGs

Result:

- Guidance Notes for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties

Degree of Certainty for Findings

Two metrics based on evaluation of evidence and agreement:

- Level of *confidence* in the validity of a finding
  - Qualitative
- *Quantified measures of uncertainty* in a finding
  - Expressed probabilistically

Evidence and Agreement

Evaluation

EVIDENCE and AGREEMENT

- Type
  - e.g., mechanistic understanding, theory, data, models, expert judgment
- Amount
- Quality
- Consistency

Provide a ***traceable account*** of evaluation of evidence and agreement in chapter text.

Evidence and Agreement

Summary Terms for Evaluation

- Evidence: “limited,” “medium,” “robust”
- Agreement: “low,” “medium,” “high”

Draft Guidance Note for Lead Authors of the AR5 on Consistent Treatment of Uncertainties

Source: IPCC-XXXII, Doc. INF. 9

1. *Basis of confidence in terms of level of evidence and degree of agreement*:

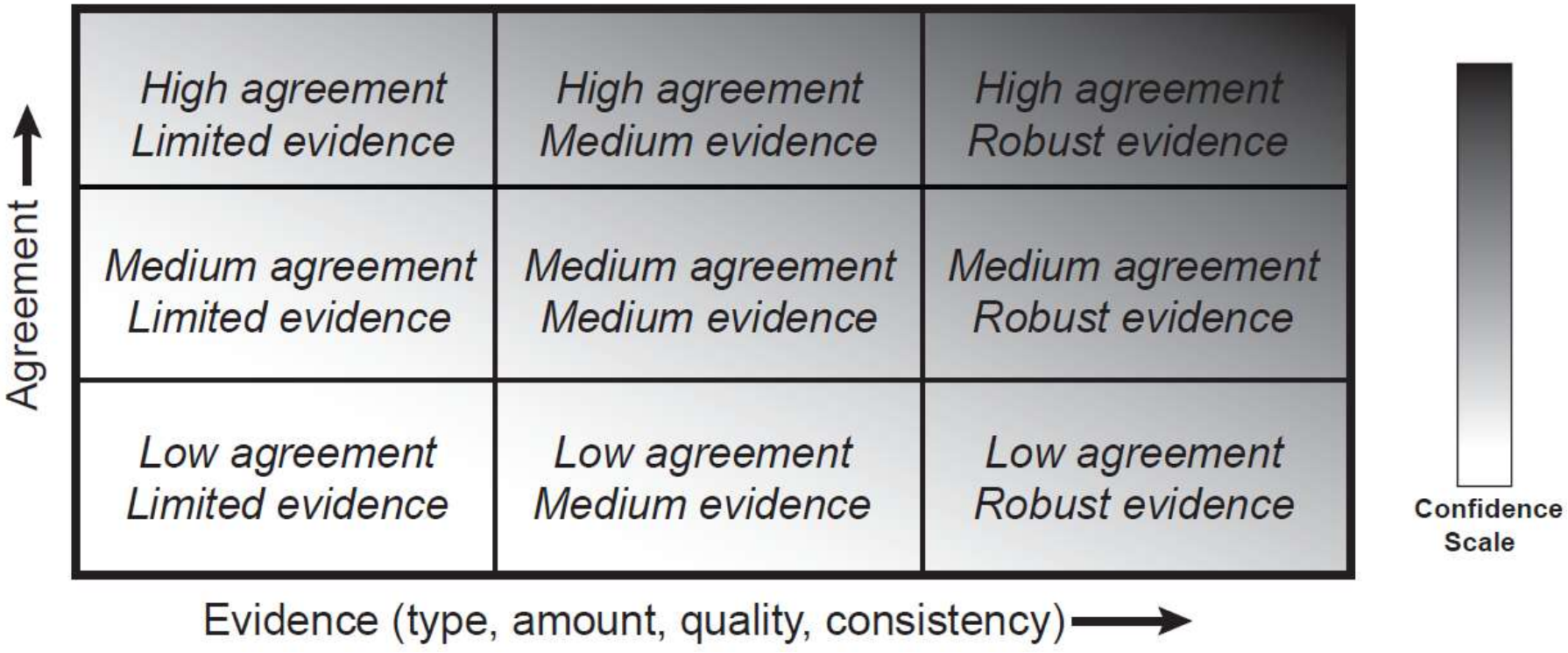
- high agreement + robust evidence → level of confidence/quantified measure of uncertainty
- high agreement *or* robust evidence → confidence/quantify uncertainty when possible
- *low* agreement + *limited* evidence → summary terms for evaluation of evidence

The degree of certainty in findings that are conditional on other findings should be evaluated and reported independently

Confidence

Validity of Finding

Confidence synthesizes evaluation of evidence and agreement into a judgment about the validity of a finding.



WG II Technical Support Unit · c/o The Carnegie Institution
260 Panama Street · Stanford · California 94305 · USA
telephone +1 650 462 1047 · fax +1 650 462 5968 · email tsu@ipcc-wg2.gov · **www.ipcc-wg2.gov**

WMO UNEP

Confidence

Levels of Confidence

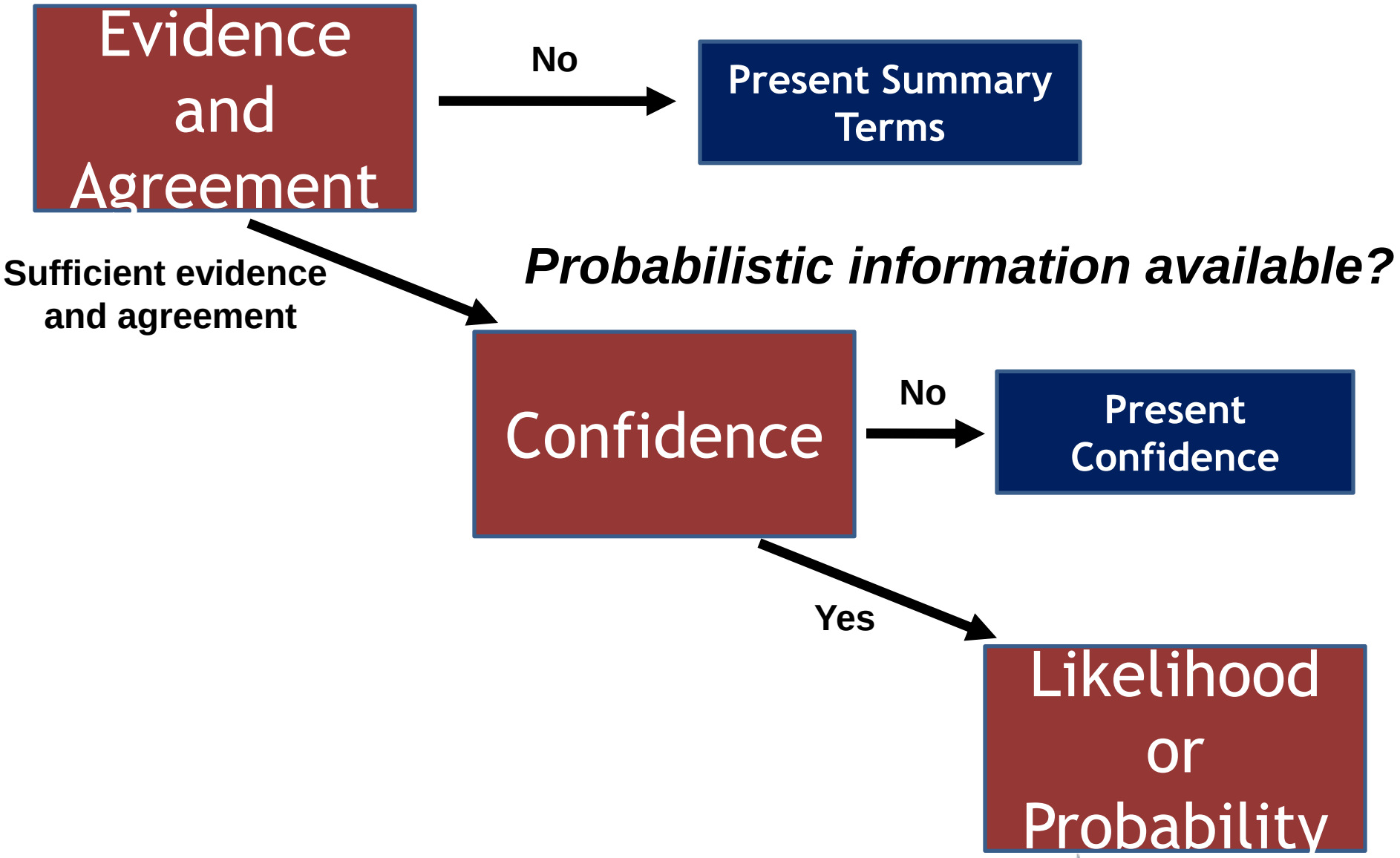
Confidence synthesizes evaluation of evidence and agreement into a judgment about the validity of a finding.

"Very high"
"High"
"Medium"
"Low"
"Very low"

WG II Technical Support Unit · c/o The Carnegie Institution
260 Panama Street · Stanford · California 94305 · USA
telephone +1 650 462 1047 · fax +1 650 462 5968 · email tsu@ipcc-wg2.gov · www.ipcc-wg2.gov

WMO UNEP

Degree of Certainty for Findings: Process



WG II Technical Support Unit · c/o The Carnegie Institution
260 Panama Street · Stanford · California 94305 · USA
telephone +1 650 462 1047 · fax +1 650 462 5968 · email tsu@ipcc-wg2.gov · www.ipcc-wg2.gov

Likelihood or Probability

Probabilistic estimate

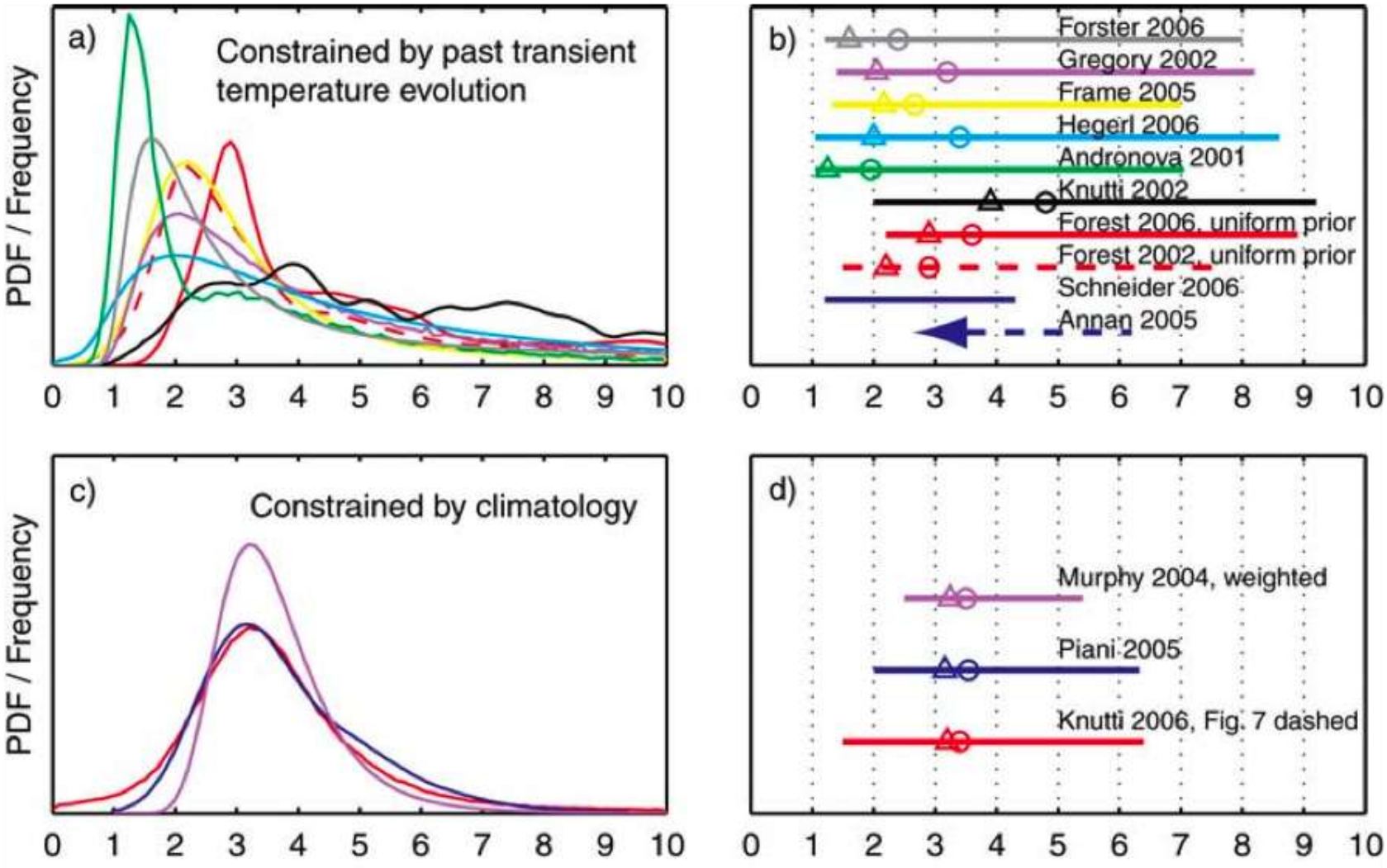
Likelihood expresses a probabilistic estimate of the occurrence of a single event or of an outcome lying in a given range.

Term	Likelihood of the outcome
Virtually certain	99-100% probability
Very likely	90-100% probability
Likely	66-100% probability
About as likely as not	33 to 66% probability
Unlikely	0-33% probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% probability

Use more precise probability ranges when appropriate.

Climate sensitivity PDFs

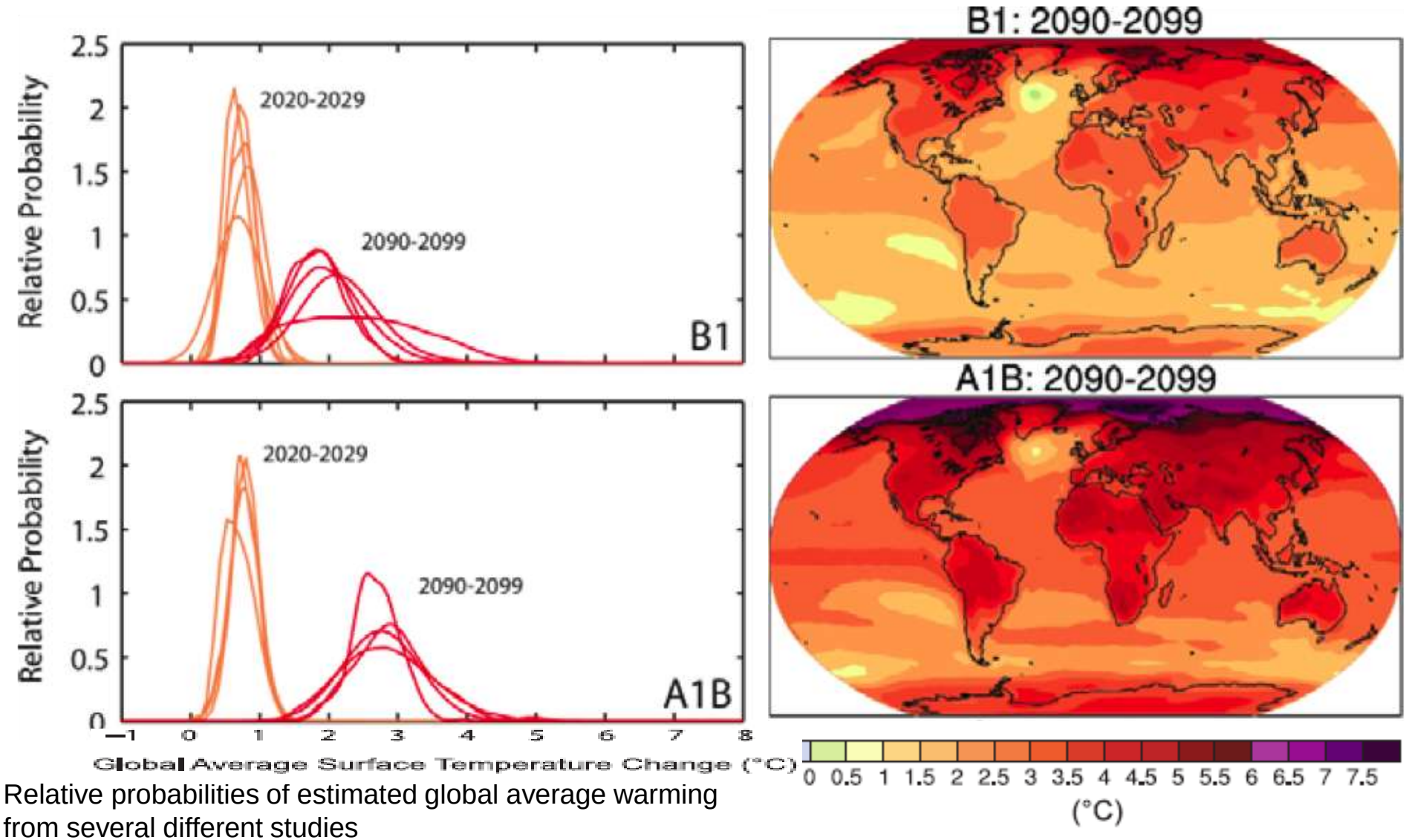
Extract from IPCC AR4 WGI, Ch. 10, Box 10.2, Figure 1.



Surface temperature projections

from AOGCMs for B1 & A1B (change relative to 1980-99)

Adapted from IPCC AR4 WGI SPM, Figure SPM 6



Relative probabilities of estimated global average warming from several different studies

Climate change and extremes (IPCC AR4 WG1)

	Post 1960		21th century
Phenomenon[a] and direction of trend	**Likelihood that trend occurred in late 20th century (typically post 1960)**	**Likelihood of a human contribution to observed trend [b]**	**Likelihood of future trends based on projections for 21st century using SRES scenarios**
Warmer and fewer cold days and nights over most land areas	*Very likely* [c]	*Likely* [d]	*Virtually certain* [d]
Warmer and more frequent hot days and nights over most land areas	*Very likely* [e]	*Likely (nights)* [d]	*Virtually certain* [d]
Warm spells / heat waves. Frequency increases over most land areas	*Likely*	*More likely than not* [f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	*Likely*	*More likely than not* [f]	*Very likely*
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not* [f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis) [g]	*Likely*	*More likely than not* [f, h]	*Likely* [i]

Virtually certain > 99%, very likely > 90%, likely > 66%, more likely than not > 50%

Draft Guidance Note for LA of the AR5 on Consistent Treatment of Uncertainties

« In summary, communicate uncertainty carefully, using calibrated language for key findings, and provide traceable accounts describing your evaluations of evidence and agreement in your chapter »

Claude Allègre: « Il faut supprimer le Giec »

(Slate.fr, 23-2-2010)

« La thèse développée [par le GIEC] est que le climat se réchauffe et que la cause en est les dégagements de CO_2 dus à l'activité humaine. Cette conclusion est présentée sans tenir compte des **énormes incertitudes qui pèsent sur cette interprétation** et ses conséquences. »

Savait-il ce dont il parlait ?

Useful links:

- www.ipcc.ch : IPCC
- www.climatechange.net : Steve Schneider (interdisciplinary) site
- www.climate.be/vanyp : my slides and other documents