Dimensions of ignorance and uncertainty management in the IPCC

Minh HA-DUONG

haduong@centre-cired.fr

Friday, June 4th 2010, Giens

NICE Spring School

Dimensions of ignorance

- Error
  - Probability (risk)
  - Imprecision (uncertainty)
  - Incompleteness (unknown unknowns)
- Human dimensions
  - Psychologic and social
  - Strategic

Degrees of error

- The probabilistic model starts with an exhaustive partition of the future into mutually exclusive states, and assign each state a specific weight
- Uncertainty: states are known, weights are imprecise
- Incompleteness: unknown unknowns

Imprecision

Intervalls of probability : $[p^-, p^+]$

- Ellsberg's urn
- Coherent bets (De Finetti)

- Belief/plausibility

Ellsberg's urn

What is the probability of drawing a red ball from a box ?

We know the box contains:

- 3 colored balls
- 1 is yellow
- The other 2 are red or black

The probability is between 0 and 2/3.

Mental experiment

An investor accepted a project paying:

- 4 utility units in the good case (probability *p*)
- -4 utility units in the bad case

Assume that this is a rational investor.

What do we know about *p* ?

Bets and information

$4\,p + (-4)\,(1-p) > 0$ that is $\boldsymbol{p > ½}$

Market choices reveal the information of economic agents.

Application: capitalism, prediction markets, foundations of belief/plausibility theory

Special cases [0, p^+] or [p^- , 1]

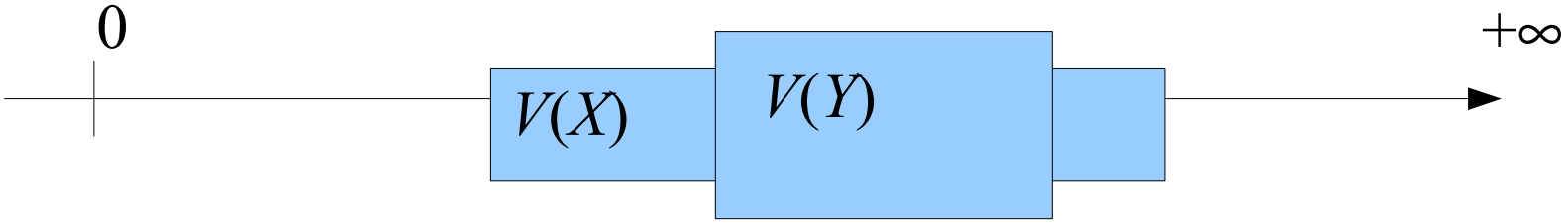
Plausibility level is 0.6 means that
p is lower than 0.6

Scenarios are plausible, not probable.

Imprecision and decision

Expected value is an intervall too

$$V(X)=[\underline{P}(X),\overline{P}(X)]$$



We may not always compare options

Human dimensions of ignorance

Error: missing information, a desire to get it right

1. Active ignorance
2. Strategic

1. Active ignorance

Elements excluded from the discourse for psychologic or social reasons

- Surprises
- Metaphysics
- Taboos

Surprise

Unexpected event

Mismatch between a stimulus and pre-established knowledge networks

Surprise ≠ abrupt change

Scenarios can help !

Metaphysics

- Cannot be verified: Faith, values, belief systems
- Parameters of the decision model utility, risk and time preferences, equity

- Warnings
  - Diversity is a source of resilience
  - Dialogue has a role

Taboos

- What the members of a social group must not know or even question
- Essential to the identity of any group, IPCC too
- Plenty of opportunity for interference with Scientific Truth
- Fixes must come from outside

2. Strategic Ignorance

- Conflicts
- Trust and et coordination

- Example:
  - Free riding
  - Information asymmetries

Individual vs. collective rationality

ex: Prisonner's dilemna

Payoff to blue

	D	C
D	1	3
C	0	2

Payoff to red

	D	C
D	1	0
C	3	2

Critical assumptions
(why there is hope for the climate)

The Nash equilibrium is stable when:

- Independent decisions
- Players know the game
- Non repeated

Conclusions

Please use probability intervalls or bounds.

Scenarios are useful tools to analyze the human dimensions of ignorance.

Uncertainty management in IPCC

Minh Ha-Duong

Centre International de Recherche sur l'Environnement et le Développement (CIRED), UMR CNRS/EHESS/ENPC/CIRAD/AgroParisTech/Météo France

Outline

1. IPCC
2. History: increasing coordination of uncertainty management
3. Cases: cost and potentials, plausibility of scenarios, climate sensitivity
4. Conclusion: Agreeding to disagree

Method: participative observation and corpus analysis.

Référence: Swart, Bernstein, Ha-Duong, Petersen (2007) Agreeing to disagree: Uncertainty management in assessing climate change, impacts and responses by the IPCC.

1. IPCC

OMM

GROUPE D'EXPERTS INTERGOUVERNEMENTAL SUR L'ÉVOLUTION DU CLIMAT

PNUE

- Reports to UNFCCC the state of scientific knowledge
- Based on peer review
- Intergouvernemental group

IPCC Organization

Permanent Bureau

For assessment reports

- WG I: Past, present and future climates
- WG II: Impacts and adaptation
- WG III: Mitigation
- Synthesis reports
- Secretaries

Special reports writing groups

2. History of uncertainty management

Four AR: 1990, 1996, 2001, 2007

- Increasing coordination
- But persistent differences between the working groups

First report: starting up

Question 1: Is it a real problem ? $\rightarrow$ WG I's place

- Political pressure on WG I to adress uncertainties rigorously, with peer review.
- Subjective perspective: certainties, degrees of confidence. Predictions (!).
- No central inter-WG coordination
- Review and formulation of uncertainties less systematic in WG II and III.

Second Report

- WG I: No specific vocabulary. An “uncertainties“ section. Projection instead of prediction.
- WG II: Vocabulary for degrees of confidence.
- WG III: Reports intervalls, conditional cost scenarios

Need for coordination is recognized

Reports 3 (and 4)

- Directive note common to the 3 WG
- Based on the state of the art, but pragmatic (practical limits)
- Offers a common approach and vocabulary

WG III harmonizes at AR4 only, but...

Uncertainty vocabulary used by WG III

Table 2 considers both the amount of evidence available in support of findings and the degree of consensus among experts on its interpretation. The terms defined here are intended to be used in a relative sense to summarize judgments of the scientific understanding relevant to an issue, or to express uncertainty in a finding where there is no basis for making more quantitative statements. A finer scale for describing either the amount of evidence (columns) or degree of consensus (rows) may be introduced where appropriate, however, if a mid-range category is used authors should avoid over-using that as a 'safe' option that communicates little information to the reader. Where the level of confidence is '*high agreement much evidence*', or where otherwise appropriate, describe uncertainties using Table 3 or 4.

Table 2. Qualitatively defined levels of understanding

Level of agreement or consensus →			
	High agreement limited evidence	…	*High agreement much evidence*
	…	…	…
	Low agreement limited evidence	…	*Low agreement much evidence*

Amount of evidence (theory, observations, models) →

2005 Guidance notes (page 3)

Uncertainty vocabulary used by WG I and II

Terminology	Likelihood of the occurrence/ outcome
Virtually certain	$>$ 99% probability of occurrence
Very likely	$>$ 90% probability
Likely	$>$ 66% probability
About as likely as not	33 to 66% probability
Unlikely	$<$ 33% probability
Very unlikely	$<$ 10% probability
Exceptionally unlikely	$<$ 1% probability

2005 Guidance 2005 (page 4)

3. Examples

1. Cost and potentials
2. Scenarios
3. Climate sensitivity

3.1 Costs and potential

In each sector of the economy, what are the potentials of GHG reduction and at what costs ?

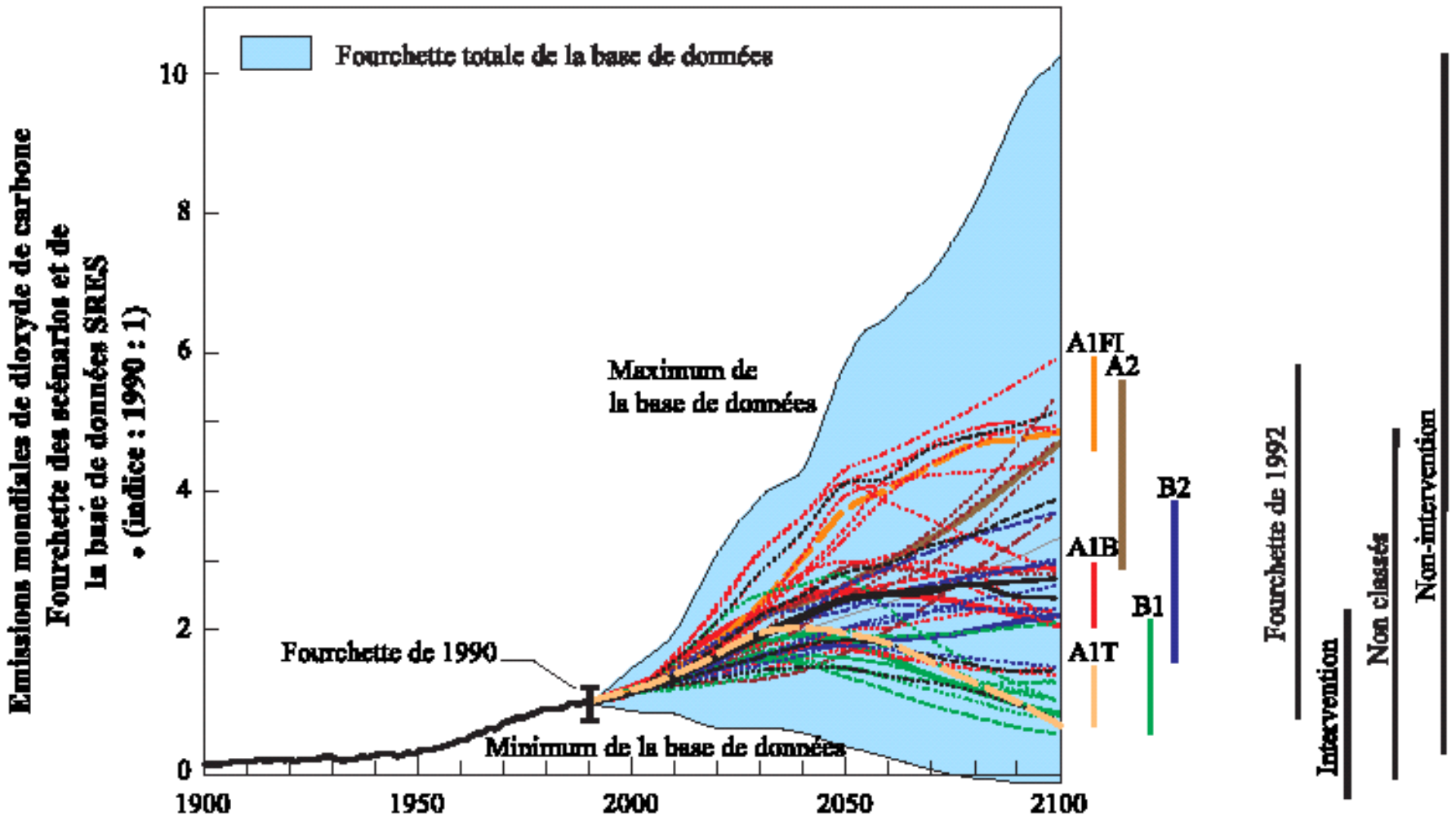
Uncertainty sources:

1. Reference context scenario
2. Fuzzy defintion of terms
3. Decline of the technical costs in the medium run
4. Demand and usages changs

$\Rightarrow$ Qualitative judgements on the number of studies and their degree of convergence.

3.2 Scenarios

SRES: Special Report on Emissions Scenarios (of GHGs at 2100).



Plausibility of scenarios

Usual tension; not all futures are equally plausible. Give us probabilities.

1. Uses: climatology but also policymaking
2. Specific issue: high emissions, high climate sensitivity?

Arguments: IPCC does not predicts, infeasible, counterfactual scenarios, free will of agents is poorly represented, non-linearities

$\Rightarrow$ Gave a familly of trajectories without probabilities

3.3 Climate sensitivity

$\Delta T_{2\times}$: average long term global warming at double atmospheric CO_2 concentration.
Communication anchor, an "urgency" measure
$\Rightarrow$ negociated litteral jugdements, with a correspondance table using probability bounds

- Probably ($p > 66\%$): between 2°Cand 4.5°C
- Most probable value: 3°C
- Very little probability: ($p < 10\%$): below 1.5°C
- Not excluded: substancially ¿ 4.5°C

Today: PDFs and imprecise approaches are available

Comparing today with expert opinion in 1995

- Above 4.5 already plausible in 1995
- Below 1.5 less plausible today

Conclusion: Agreeing to disagree

No to unify in a single (quantified) framework, but to organize the rigorous application of a diversity of methods. Recognize that disciplinary traditions are generally good to deal with the kind of ignorance in their domain. Take care of the key dimensions:

1. Objective fact / subjective belief
2. Precise / imprecise evidence
3. Causal / intentionnal systems

Describe the pedigree of important results: the nature of uncertainties, sources of evidence.