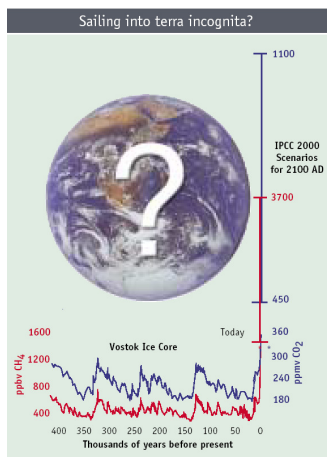


SENSE/KvK Autumn School 'Dealing with uncertainties in research for climate adaptation', Bunnik, 9-10 Oct 2012

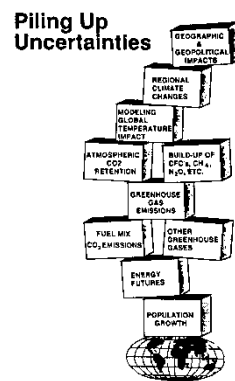
Framework for visualisation of uncertainties

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GLOBAL CLIMATE CHANGE



Copernicus Institute of Sustainable Development
Utrecht University



Various types of visualisation

- (Metaphors)
- Qualitative descriptors
- Ranges
- Comparisons
- Dedicated uncertainty graphs



Qualitative descriptors

Tabel 1 Trends in de milieudruk en -kwaliteit, het halen van doelen (2010), en milieukosten (in miljoenen euro per jaar, prijspeil 2004).

Milieuprobleem	Trend 1985-2004	Beleidsdoel bereikt? ²⁾	Milieukosten samenleving ¹⁾ 2004	w.v. Rijksbegroting gem. per jaar (2005-2009)
Klimaat: binnenlands	Yellow	Green	1.130	924
Klimaat: 'Kyoto-instrumenten'	-	EU Yellow		
Energie-efficiëntie	Yellow	Red		
Duurzame energie	Green	Red		
Duurzame elektriciteit	Yellow	Green		
Emissies NO ₂ , SO ₂	Green	EU Red	1.769	34
Emissies VOS, NH ₃	Green	EU Yellow		
Emissies fijn stof	Green	Red		
Depositie N / zuur op natuur	Green	Red		
Luchtkwaliteit ozon	Green	EU Green		
Luchtkwaliteit fijn stof, NO ₂	Green	EU Red		
Nutriëntenverlies landbouw	Green	EU Yellow	2.602	102
Nitraat in grondwater	Green	EU Red		
Gebruik dierlijke mest	Green	EU Yellow		
Fosfaatverzadiging in bodem	Red	Yellow		
Bestrijdingsmiddelen	Green	Yellow		
Oppervlaktewaterkwaliteit	Green	Red		
Biologische landbouw	Yellow	Red	Niet bekend	9
Verdroging	Yellow	Red	Niet bekend	Niet bekend
Geluid	Yellow	Red	505	481
Externe veiligheid ³⁾	Red	Red	Niet bekend	Niet bekend
Bodemsanering	Yellow	Red	614	278
Afvalbeheer	Green	Green	3.577	24

MNP (2005)

Color codes

- Is policy goal achieved? (col.3)
 - Green: likely, red: likely not.
 - Yellow: chance of about 50% OR cannot be determined.
- Policymakers: good, quick overview. Heavily used.
- However:
 - Chance 50% and unknown are very different; don't combine.
 - Not much information



Qualitative descriptors

Color codes

Tabel 4.2.1 Emissies van SO_2 , NO_x , NH_3 , VOS en PM_{10} in kiloton per jaar. [028t-mb05]

Stof	Emissies			Raming 2010 ²⁾	NEC plafond	Gothenburg Protocol
	1990 ¹⁾	2000 ¹⁾	2003 ¹⁾			
SO_2	191	75	65	67 (62-71)	50	50
NO_x	576	414	393	288 (242-334)	260	266
NH_3 ³⁾	249	152	130	126 (104-146)	128	128
VOS	493	269	224	176 (140-213)	185	191
PM_{10}	78	49	42	44 (38-49)	geen	Geen

1) Onzekerheden van gerealiseerde emissies zijn vermeld in tabel B1.2c van bijlage 1.

2) Betekenis kleuren: zie bijlage 3.

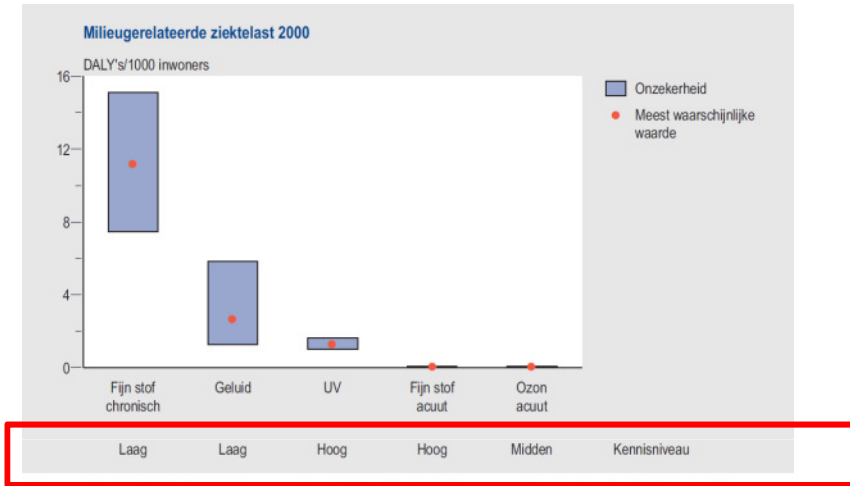
3) Zie hoofdstuk 3.

MNP (2005)

- Adding colors to tables with more detailed information
- Appreciated by both policymakers and advisors
- Higher information density
 - Does the location of the table warrant this?



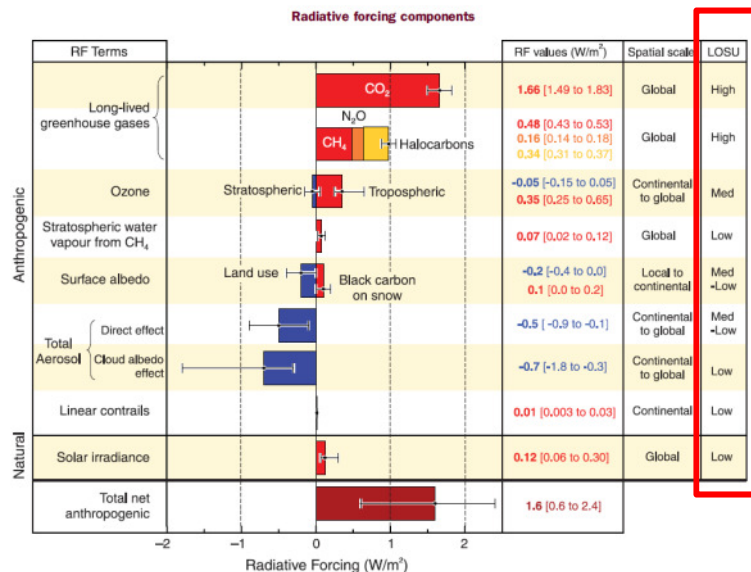
Qualitative descriptors



Figuur 4.1.1 DALY's in 2000 voor chronische blootstelling aan fijn stof, geluid, UV-straling en acute blootstelling aan fijn stof en ozon (Knol et al., 2005).

Verbal codes

- E.g. 'Level of scientific knowledge' (LOSU)
- Both policymakers and policy advisors liked such qualifiers
 - Quick and good overview



Sources:
Knol et al. (2005) (top)
IPCC (2007) (bottom)

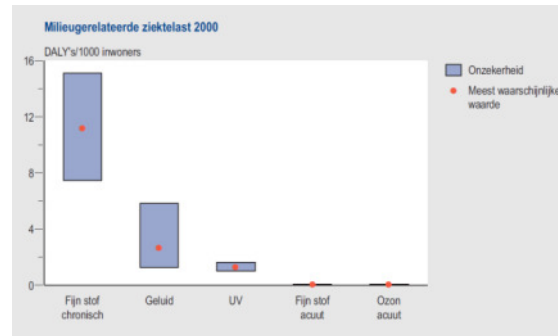
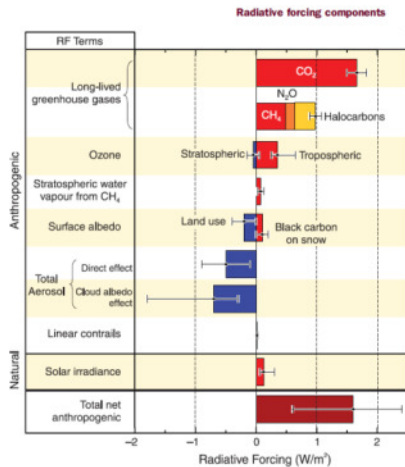


Qualitative descriptors

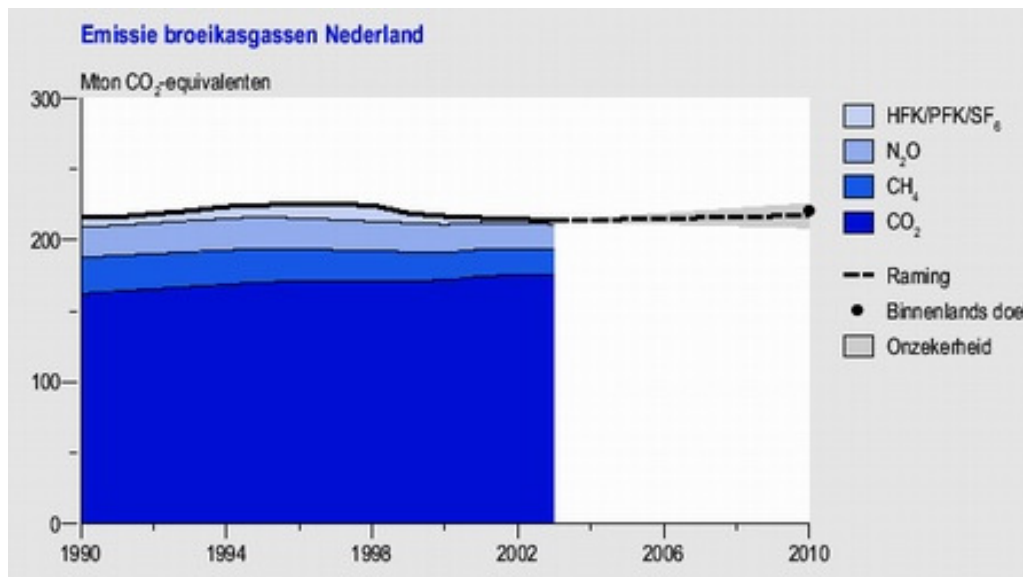
- Useful for quick overview
- Don't offer much information
 - Is this a problem for your target audience?
- Useful for audiences who work on high conceptual level ('grote lijnen'); e.g.
 - Politicians, strategic policymakers
 - Broad interest groups, press?
- For other audiences useful:
 - In summaries/overviews: quick comparison across topics/fields
 - As extra qualifier, added to more detailed information.



Uncertainty ranges



- Indication of range, magnitude of uncertainty
- 'Uncertainty awareness'
- Easy to link to policy goal

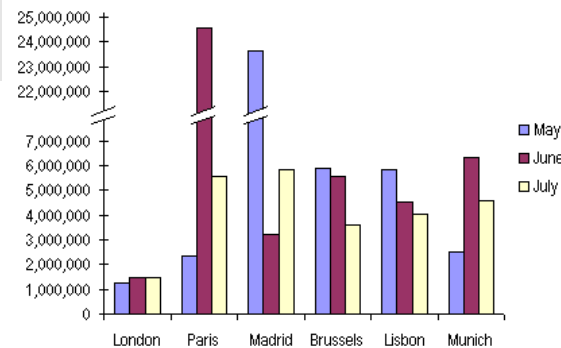
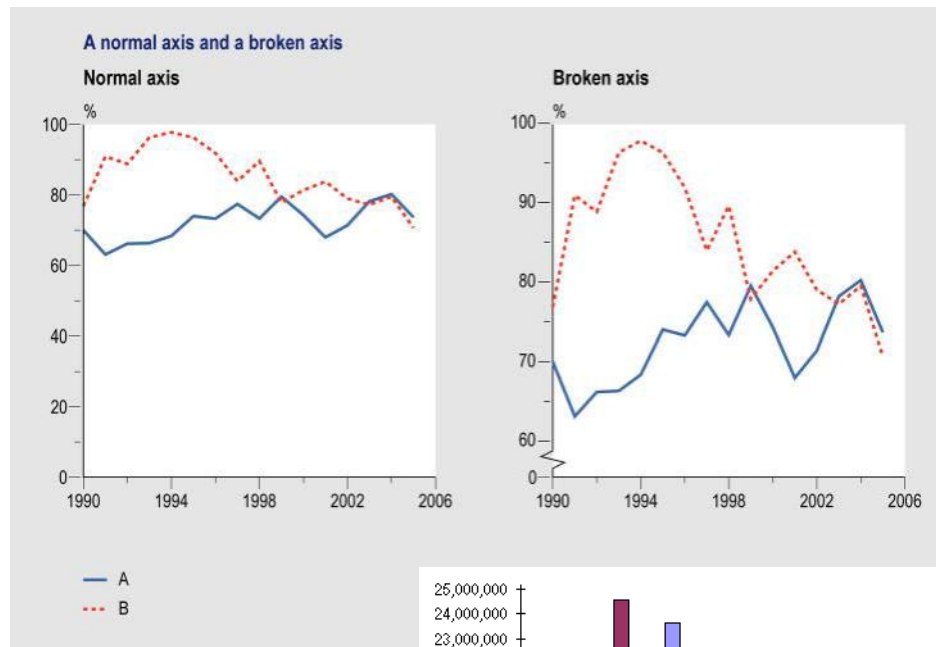


Reactions:

- Policymakers: range is very small, what is exact amount?
- Advisors: probability density for target year?



Uncertainty ranges



- Option: 'broken axis' or 'offset'
 - Zooms in on relevant part of graph

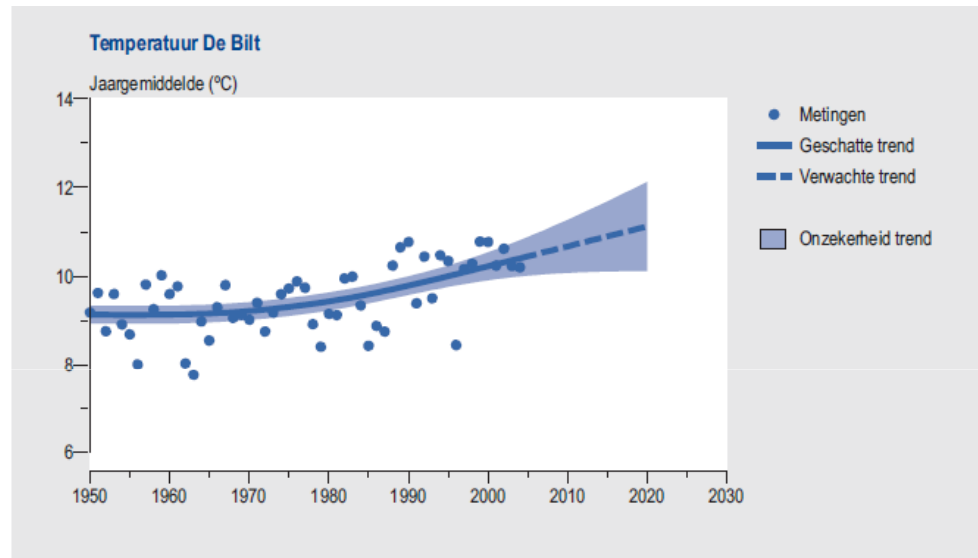
However:

- Scale effect
 - Uncertainty seems huge or tiny, regardless of actual size
- Obscuring proportions, rates of change, etc.



Uncertainty ranges

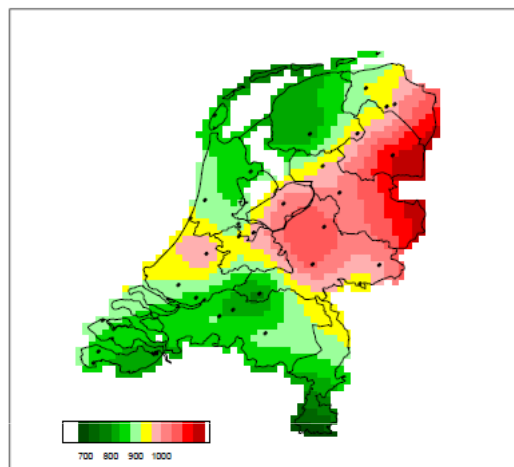
Scatterplot



- Effective for showing variability
 - (Lipkus & Hollands, 1999)



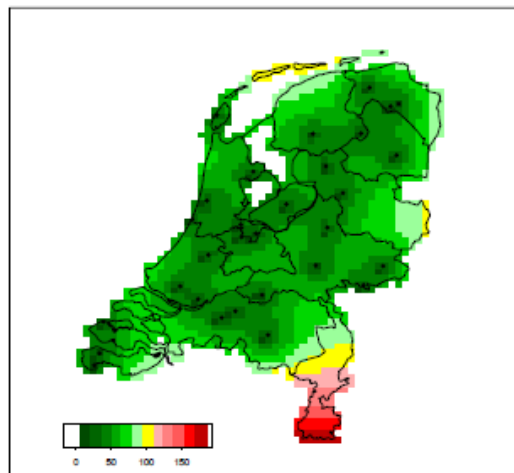
Uncertainty ranges



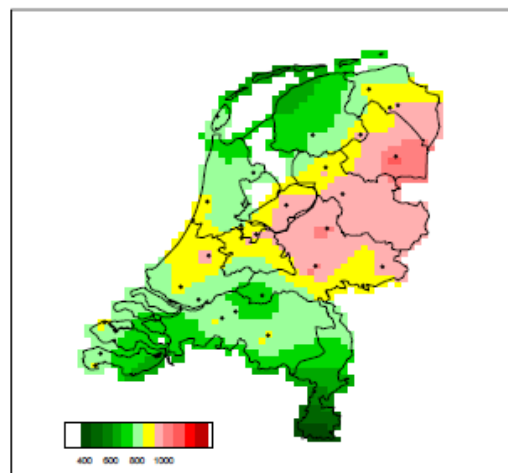
**Mean
(precipitation, mm/yr)**

Grid uncertainty maps

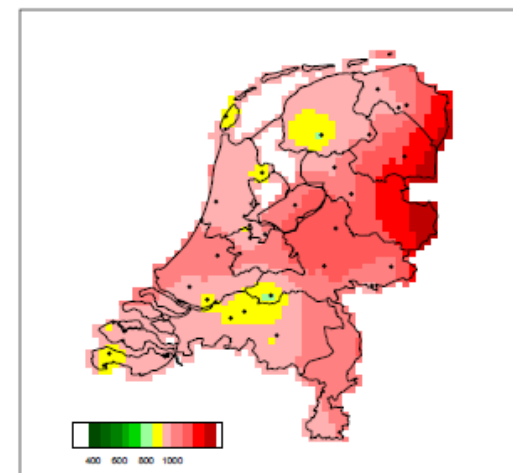
- Uncertainty map (e.g. σ or 2σ)
 - Percentile maps
- Don't plot uncertainty in map showing the mean



Standard deviation

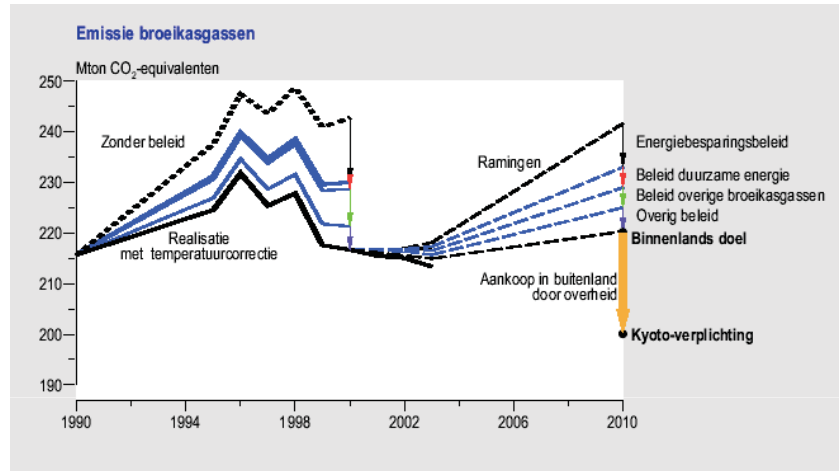


5% and 95% percentiles



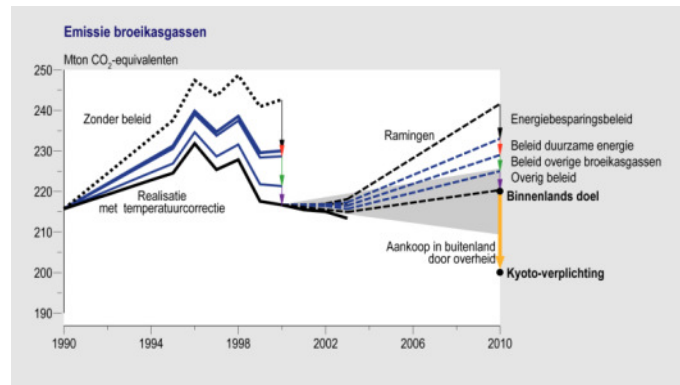
Uncertainty ranges

Original

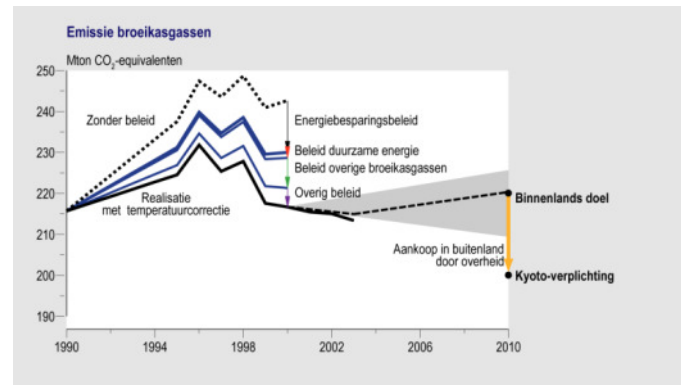


- Adding range not always practical
 - Does it clarify what you want to say?
 - Not too much info in one graph!
- Interesting: comparison uncertainty & past policy performance

Alternative A



Alternative B

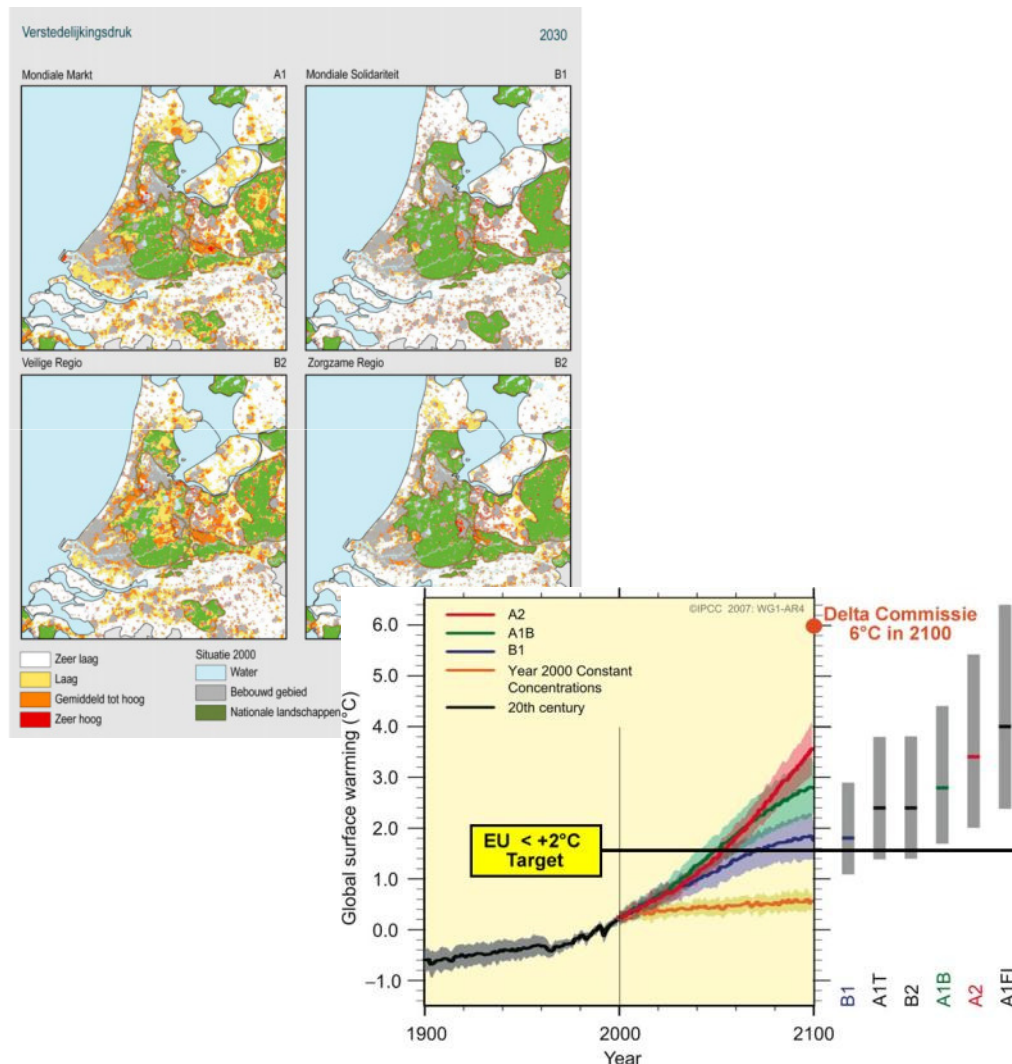


Uncertainty ranges

- Indication of range/magnitude of uncertainty
- Not sufficient if exact number is needed
 - Is this a problem for your target audience?
- Useful for most audiences; e.g.
 - Policymakers, societal actors: 'uncertainty awareness', robustness of results, range of outcomes?
 - Scientists: 'good practice' reporting, intercomparison



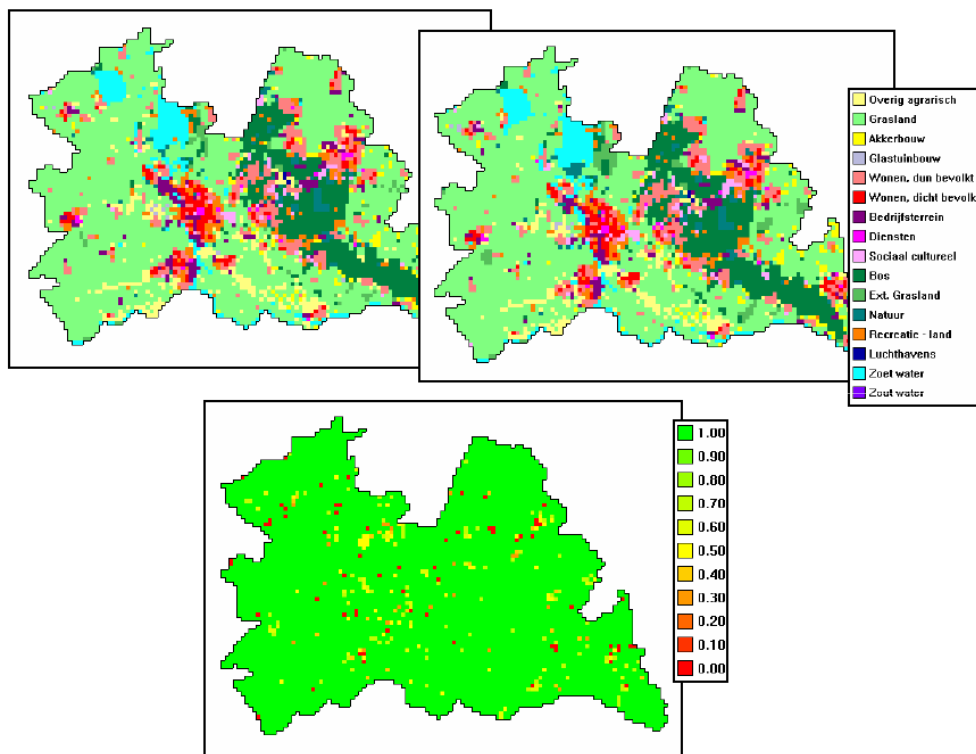
Comparisons



- Showing multiple realisations, futures, alternatives
- Concept of scenarios is familiar to policymakers
- Key things to make clear:
 - Key differences in basis and results
 - Implications



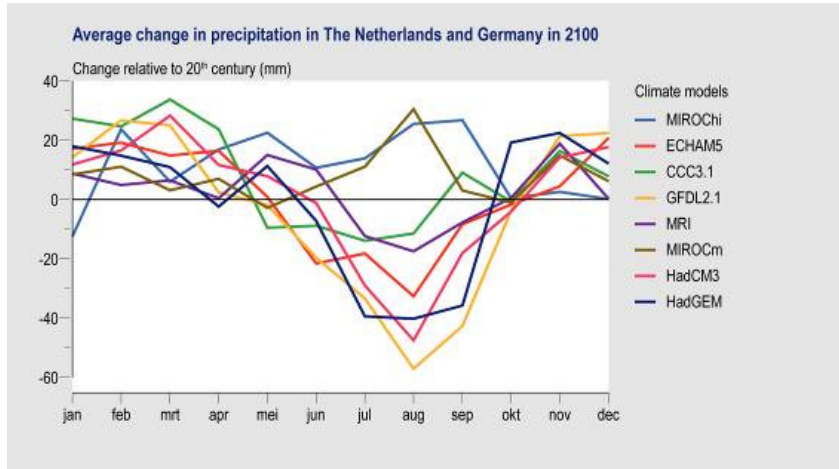
Comparisons



Difference map

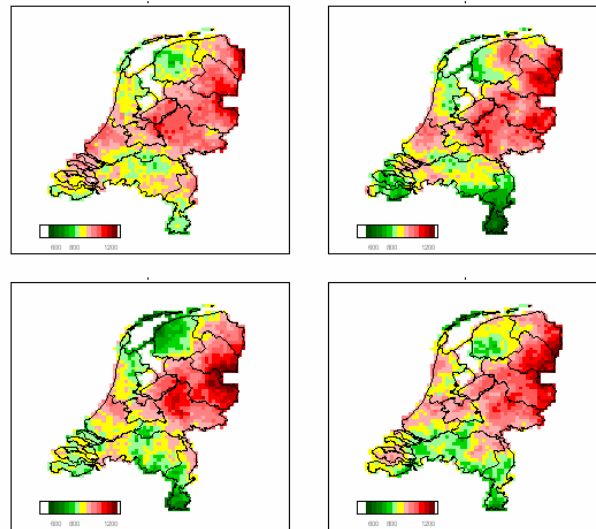
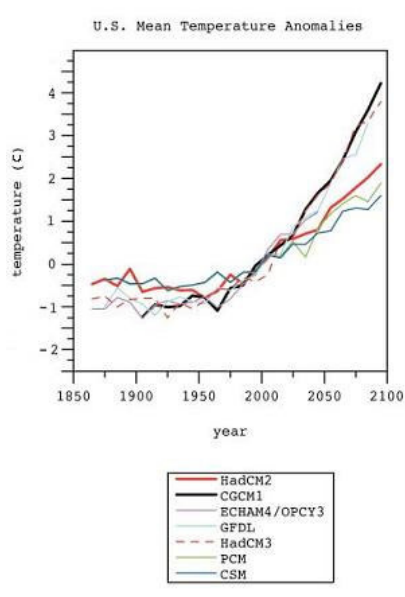
- Land use in Utrecht, 1993
- Left: Statistics Netherlands (CBS) map
- Right: PBL 'Environment Explorer' map.
- Bottom: differences, high (green) to poor (red) similarity

Comparisons



Ensembles

- Different outcomes of one or more models
- Set of experiments
- Comparing models, measurements, etc.



- Useful for discussing:
 - Methodological issues and reliability
 - Unusual/rare outcomes
- Difficult to interpret for non-experts

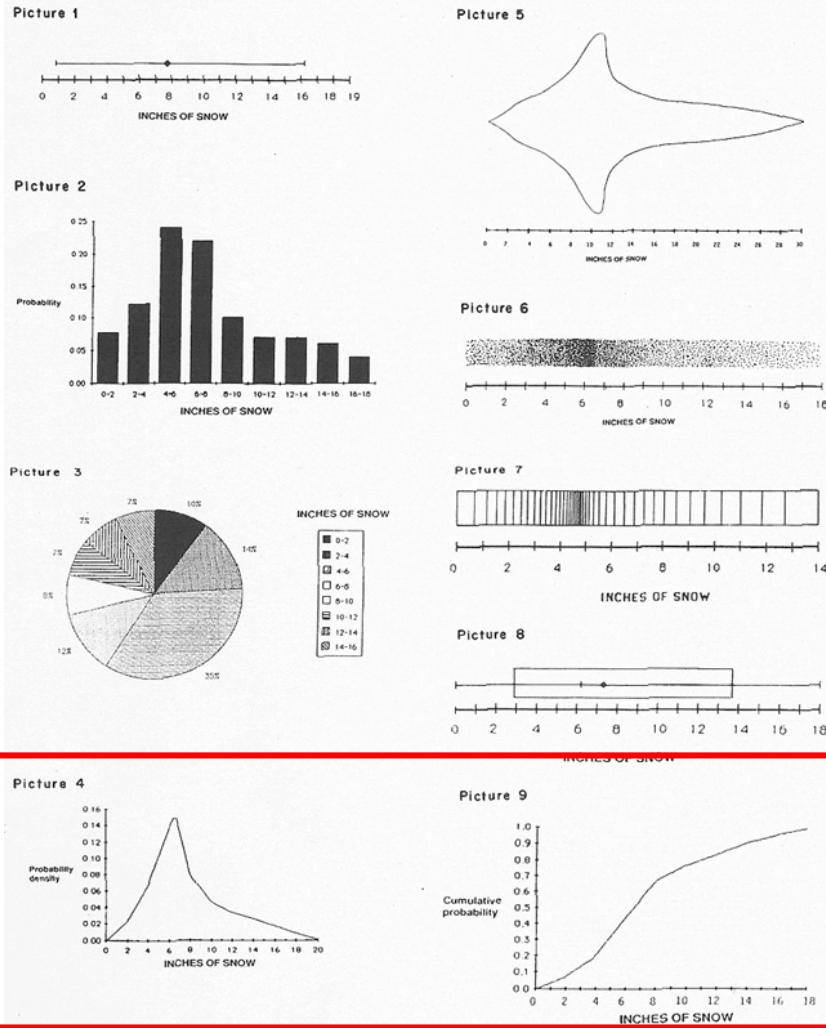


Comparisons

- Exploring different possibilities, futures
- Are the implications clear?
- Useful if well-explained for:
 - Policymakers: range of futures, policy scenarios
 - Policy advisors: robustness of options/developments, uncovering policy risks & opportunities
- Always a treat for:
 - Scientists: exploring potential futures, methodological issues, uncertainty analyses (e.g. sensitivity analyses).



Dedicated graphs

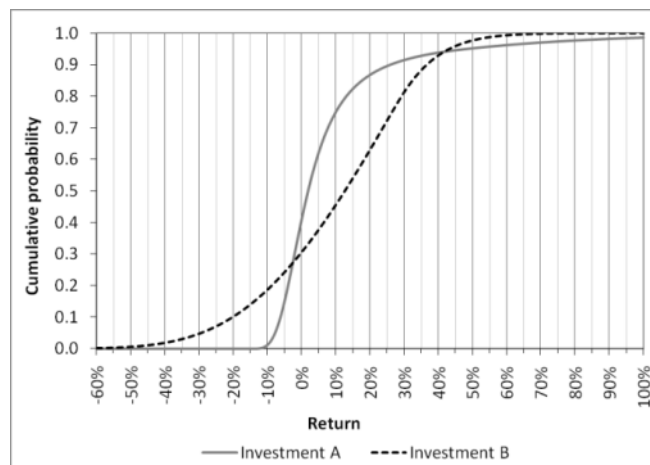
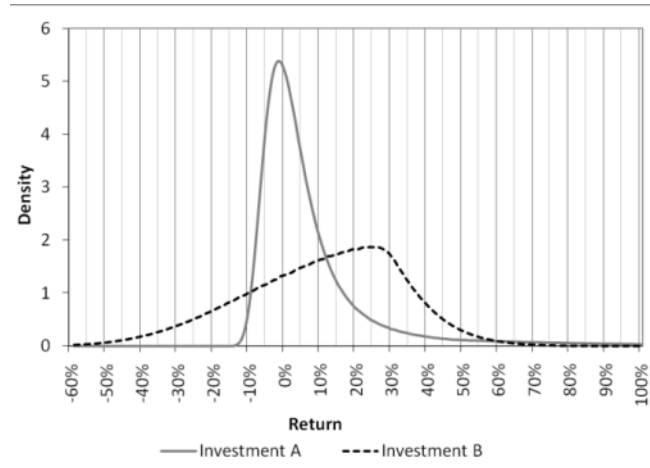


Ibrekk & Morgan, 1987

- Probability density function (PDF):
 - peak (mode) 'stands out'
 - people assume peak is the most likely value
- Cumulative density function (CDF):
 - CDF alone can also mislead in estimating the mean
- Clearly indicate key info
 - I&M (1987): PDF + CDF with mean clearly indicated



Dedicated graphs

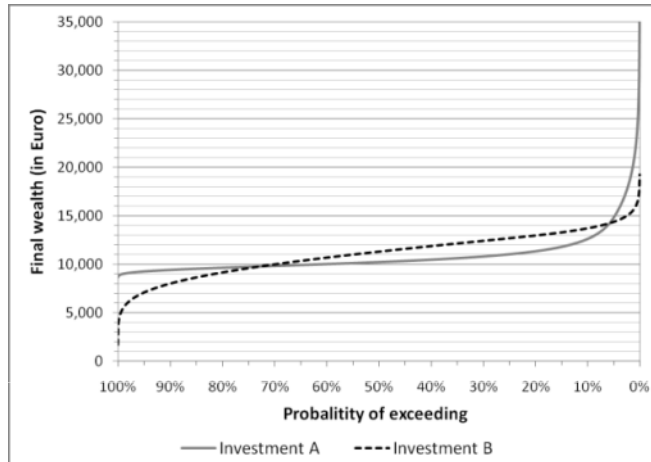


- PDF: people preferred left-skewed investments (B) to right-skewed ones
- CDF: preferences are reversed

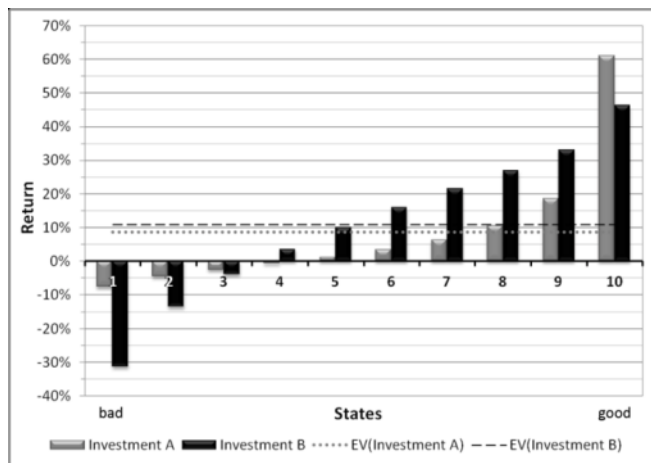
Vrecko et al., 2009



Dedicated graphs



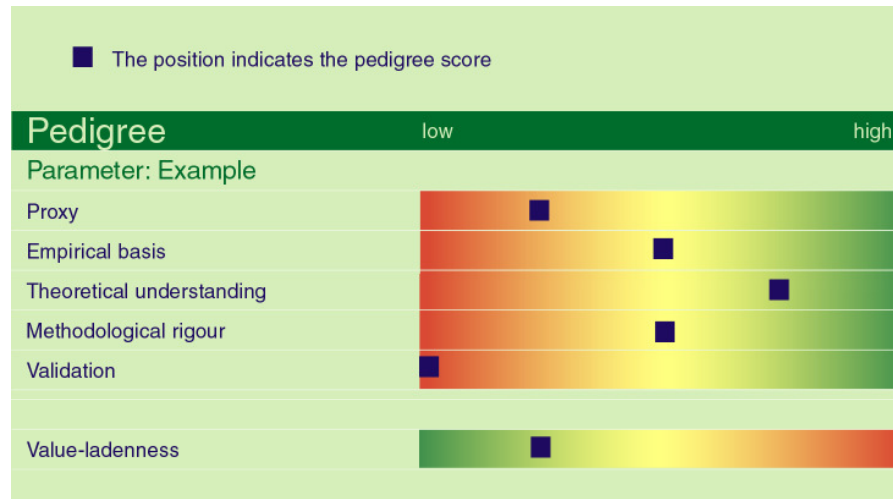
- Bias reduced for:
 - Rotated CDF (RCDF)
 - 10-state-chart



Vrecko et al., 2009



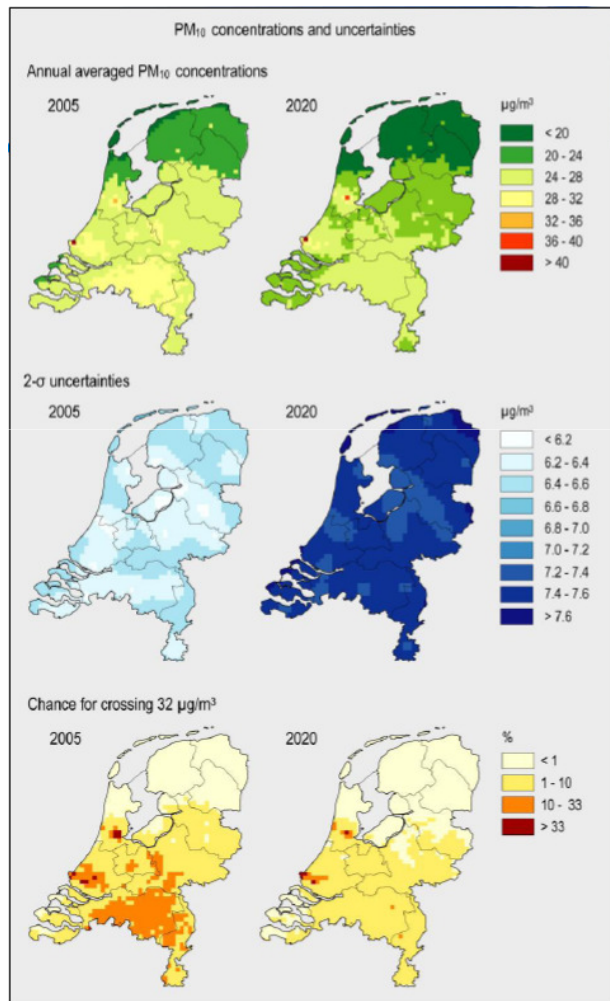
Dedicated graphs



- Pedigree chart
- Some policymakers:
 - Information perhaps a bit detailed?
- Policy advisors:
 - Useful: relating numbers
 - Opponents also know these things (be prepared)
 - Terms need explanation
- Traffic light analogy is easy to interpret



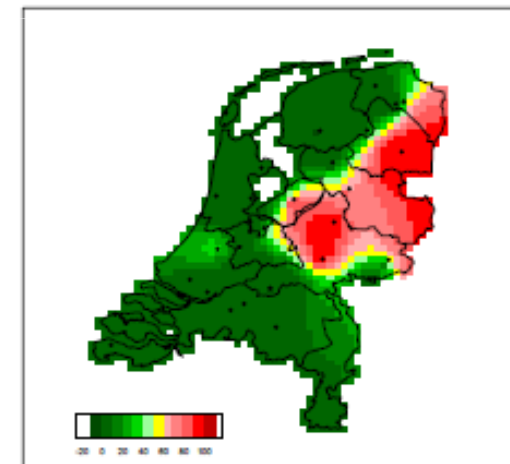
Dedicated graphs



PBL good practice example (Visser & Petersen, 2010)

Risk maps

- Useful to discuss risk:
 - ...of reaching dangerous or undesirable values
 - ...of not meeting policy targets/norms



Probability of >1000 mm/yr



Dedicated graphs

- Detailed representation of uncertainties
- Can be difficult to interpret
- Generally useful for:
 - Policy advisors: robustness of research results, specific details that might reveal policy risks & opportunities
 - Scientists: detailed analysis of magnitude, type, shape, relevance of various uncertainties and risks
- Use with some caution:
 - Policymakers: useful to make/support a specific point



Some general lessons

- Graphs/maps are good at showing proportions
 - but watch out for issues that distort these.
- Don't put too much info in a single graph/map.
- Keep in mind: what message am I trying to send?
 - Clearly indicate key info you're trying to communicate.
- Linking to implications relevant for target audience is helpful.
 - e.g. policy goals, risks, good/bad outcomes
- Best visualisation depends on target audience and its information needs
- Multiple types of visualisation & communication needed?
 - Multiple target groups and 'ways of learning'
 - Changing information needs over time



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