An Arithmetical Language for Deep Uncertainty

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- How many significant digits do we use for the estimate of the damage from the next major flood?
- Our models would give us lots, but that is not accuracy but pseudo-precision.
- How many of our estimates do not have even one significant digit? (NEOSD)

- One of the most important physical constants today is the ‘climate sensitivity’.
- That is the global temperature rise resulting from a doubling of the CO2 concentration.
- It is roughly 3 ± 50%. Can we represent that in a digital language?
- No, it is NEOSD.

- Number is the language of science, but it has many dialects.
- There are ordinary numbers, negatives, fractions.
- There are ordinals, which have no zeroeth element, except in Oxford!
- And there is the dialect for Estimates, when there is significant uncertainty: lots of zeroes.

- Mixing dialects makes trouble. Here is a new version of the ‘fossils joke’, when the bone was discovered to be not so old as previously believed.
- We have the sum:
- 65,000,000
- -3
- 64,999, 997
- What is going on here? Where did all those 9’s come from?

- It’s a case of mismatched dialects!
- 65,000,000 Estimating
- -3 Counting
- 64,999, 997 Gibberish.
- But – how many of the numbers that we see around us are such gibberish?

- A more serious case is ‘the formula that killed Wall Street’, the infamous ‘Gaussian copula’.

$$\Pr[T_A<1, T_B<1] = \Phi_2(\Phi^{-1}(F_A(1)), \Phi^{-1}(F_B(1)), \gamma$$

- Here, the deep uncertainty in the financial ‘products’ was represented by a ‘Normal’ statistical distribution.
- The result of this mismatch was a catastrophe!
- Deeply Uncertain quantities are frequently NEOSD – Not Even One Significant Digit.
- We need to design an arithmetical language of NEOSD.

- For further information, there is a presentation I gave to Eurostat earlier this year.
- See: https://www.dropbox.com/s/q30ovlmt7mvxdkm/Eurostat%20slideshow%207404%3D7403%20copy.pptx?dl=0