Measuring is knowing……or is it?

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It is a conventional wisdom that *Measuring is Knowing*. In fact it is one of the oldest dicta of the engineer. In general it is not true. Of course it seems straightforward, when you measure an object with a flexible steel ruler; the number on the ruler is a quantitative indication of for example its length. Then one forgets that a person's mind is needed to interpret the reading as the length of the object. Hence the reading is always correct; the interpretation can be wrong. To state it in a formal way: you need a theory to convert your measurement into knowing. That is also the message of our most famous football player Johan Cruijff: You only see it when you understand it.

In seismic exploration for instance you need the wave theory of elastic waves and the knowledge of your sound source to convert the tera-bytes of recorded data into an image of the subsurface of the Earth. This is the active mode. You record the reflected sound waves after the shot was fired. Can we use the same technique when we listen to the ambient noise of the Earth? The surprising answer is that we indeed can. It has always been thought that noise doesn't carry any information. Think of the noise on your old gramophone records: it is a nuisance that masks the information (the music). You would rather be able to suppress it than having to listen to it. This has also always been the attitude in seismic exploration: first try to suppress the noise in the seismic data as much as possible and only then use your most advanced wave theory-based imaging methods to image the Earth's interior. However, since the turn of the century new theories have emerged that overhaul the traditional views on noise and diffuse wave fields. Contrary to their definition, diffuse wave fields appear not to be fully disorganized and without any information. It has been shown theoretically and experimentally that the geology of the Earth leaves an imprint on ambient seismic noise which is characteristic for the geology, just as a fingerprint identifies its owner. What was even more surprising was the fact that this imprint can be unraveled and turned into an image of the subsurface without knowing the ambient noise sources.

The last example illustrates how we can obtain an image of the subsurface from listening to the interior sounds of the Earth, albeit at the expense of a more complicated theory.

The Earth sends out more signals and we monitor them from all sides: on land, sea, in the air and from space. They are important as the dashboard readings on how mother Earth is doing. The last years we got alarming messages: Global temperature rise, CO_2 level and sea-level rise, to name a few. The numbers are differently interpreted depending on the case where they are used; even in some cases contradictorily. Although observations are interpreted in their own right that does not mean that they can be understood together in an extended context. What we need is an encompassing theory that hosts the complementary input of the different observations as different aspects of the same "reality". This would be helpful in accessing the realistic state of our vulnerable Earth.
Do you get the picture?