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The Earth energy imbalance – new advances and remaining challenges

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Human-induced atmospheric composition changes cause a radiative imbalance at the top of the atmosphere which is driving global warming. This simple number, the Earth energy imbalance (EEI), is the most fundamental metric that the scientific community and public must be aware of as the measure of how well the world is doing in the task of bringing climate change under control. Combining multiple measurements and approaches in an optimal way holds considerable promise for estimating EEI and continued quantification and reduced uncertainties can be best achieved through the maintenance of the current global climate observing system, its extension into areas of gaps in the sampling, advance on instrumental limitations, and the establishment of an international framework for concerted multidisciplinary research effort. This talk will provide an overview on the different approaches and their challenges for estimating the EEI. A particular emphasis will be drawn on the heat gain of the Earth system over the past half of a century – and particularly how much and where the heat is distributed – which is fundamental to understanding how this affects warming ocean, atmosphere and land; rising surface temperature; sea level; and loss of grounded and floating ice, which are critical concerns for society.