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Can we measure Earth's energy imbalance directly from space?

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The direct measurement of Earth's energy imbalance (EEI) is one of the greatest challenges in climate research. The global mean EEI represents the integrated value of global warming; its spatial and temporal variability reflect the nature of heat transports through the climate system and internal climate modes such as ENSO. These heat transports control atmospheric and oceanic circulations, and henceforth the water cycle and habitability of our planet. Current space-born systems measure the individual radiative components of the energy balance with unprecedented accuracy and stability, but the error bounds are too coarse to determine the absolute magnitude of global mean EEI as the components' residual. Best estimates of long-term EEI are currently derived from changes in ocean heat content as measured in situ, and from remote sensing of changes in steric sea level height. Both approaches have their strengths but are afflicted with sampling and retrieval errors. Alternative methods are needed to avoid the imprecision of radiometric calibration and the incomplete in-situ sampling of the ocean. To monitor the integrated value of EEI from space, we propose an approach based on accelerometry that measures non-gravitational forces, such as radiation pressure, acting on Earth orbiting spacecrafts. The concept of deriving EEI from radiation pressure and associated accelerations has proven feasible in the past. Today's capabilities have further improved and may provide sufficient accuracy to answer the question: At what rate is our planet warming? This mission concept would complement existing concepts and improve upon our understanding of the climatic changes our planet is subjected to.