

# Program Evaluation with Remotely Sensed Outcomes

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## *Abstract :*

Economists often estimate treatment effects in experiments using remotely sensed variables (RSVs), e.g. satellite images or mobile phone activity, in place of directly measured economic outcomes. A common practice is to use an observational sample to train a predictor of the economic outcome from the RSV, and then to use its predictions as the outcomes in the experiment. We show that this method is biased whenever the RSV is post-outcome, i.e. if variation in the economic outcome causes variation in the RSV. In program evaluation, changes in poverty or environmental quality cause changes in satellite images, but not vice versa. As our main result, we nonparametrically identify the treatment effect by formalizing the intuition that underlies common practice: the conditional distribution of the RSV given the outcome and treatment is stable across the this [http URL](#) on our identifying formula, we find that the efficient representation of RSVs for causal inference requires three predictions rather than one. Valid inference does not require any rate conditions on RSV predictions, justifying the use of complex deep learning algorithms with unknown statistical properties. We re-analyze the effect of an anti-poverty program in India using satellite images.