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AI vs. mathematical modeling for climate and weather analysis

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With the rise in the availability and importance of big data, machine learning approaches in the field of meteorology, including specifically in the alpine regions, have become rapidly more prevalent in the scientific literature. Artificial intelligence is a fast-changing field, with deep learning techniques (with important applications in computer vision) popularized in the last decade. Weather and climate forecasting using machine learning approaches has been shown to enhance conventional statistical techniques. Methods break down into a few major categories, including now-casting, short-range weather prediction, medium-range prediction, subseasonal forecasting, seasonal forecasting, and climate-change prediction. In this session, we raise the questions, will artificial intelligence totally replace numerical models? How can they supplement or enhance the performance and results of traditional mathematical models? In this scope, the answer to these questions can be different for the subareas of study within meteorological modeling. For instance, "Hard AI"refers to applications in which predictions on the corresponding timescales can be largely or completely replaced by artificial intelligence; in this case, physical constraints like conservation laws, are able to be ignored as marginal errors that do not accumulate to a significant level over time. Mobile phone data is an excellent source of data for this purpose, as it provides a large database of information to work with, which is necessary for machine learning. In general, a wide range of machine learning algorithms and models have use cases in alpine meteorology, from linear regression, to random forest ensembles (RFs), to convolutional neural networks (CNNs), to generative adversarial networks (GANs).

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