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# The emergence of numerical weather prediction and climate modelling

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Numerical simulation of an ever-increasing range of geophysical phenomena is adding enormously to our understanding of complex processes in the Earth system. The consequences for mankind of ongoing climate change will be far-reaching. Earth System Models are capable of replicating climate regimes of past millennia and are the best means we have of predicting the future of our climate.

The basic ideas of numerical forecasting and climate modelling were developed by Lewis Fry Richardson about a century ago, long before the first electronic computer was constructed. Since he was not aware of the dominant role of dynamics in the short-term, Richardson gave as much weight to small-scale physical processes as to large-scale dynamics. As a result, the algorithm he produced amounts, in effect, to a general circulation model of the atmosphere, capable of describing both weather and climate.

There were several major practical obstacles to be overcome before numerical prediction could be put into practice. A fuller understanding of atmospheric dynamics allowed the development of simplified systems of equations; regular radiosonde observations of the free atmosphere and, later, satellite data, provided the initial conditions; stable finite difference schemes were developed; and powerful electronic computers provided a practical means of carrying out the prodigious calculations required to predict the changes in the weather.

Progress in weather forecasting and in climate modelling over the past fifty years has been dramatic. In this presentation, we will trace the history of computer forecasting through the ENIAC integrations to the present day. The useful range of deterministic prediction is increasing by about one day each decade; seasonal forecasting skill is expected to increase significantly in the near future; and our understanding of climate

change is growing rapidly as Earth System Models of ever-increasing sophistication are developed.