The number of observations of our atmosphere has increased at an incredible pace since the early days of meteorology. Today, the number of atmospheric observations (including from satellites) available to numerical weather prediction centers exceeds 100 million per day. These diverse and heterogeneously-distributed observations are collected, pre-processed, transmitted across the globe, received, processed, and assimilated into numerical weather prediction models within a few hours after collection time. This formidable chain stands as one of the best examples of constructive human collaboration, transcending political borders and crises. These developments have been helped and mirrored by increases in computing power that have enabled breakthroughs in prediction capability. Quite naturally, re-analyzing all this mass of observations has emerged as a powerful approach to enhance our understanding of our environment. Global reanalyses generate coherent, global datasets of our atmosphere, though challenges remain. In this talk we will review the atmospheric observing system (with its evolutions and the challenges this represents for data assimilation into reanalysis), present the integration of observations into global reanalysis data assimilation, discuss applications of real-time reanalysis (e.g. to quickly put today’s weather events into the climate context), and explore the opportunities that lie ahead for atmospheric reanalysis to converge with similar activities in the other Earth sciences.