Revolutions during the past 50 years

1) transition to the digital age
   computation
   storage
2) development of satellite-based remote sensing
3) advent of numerical weather prediction
4) recognition of nonlinear dynamical systems
   limitations to predictability
   sensitivity to initial conditions
5) emergence of climate dynamics
  past and future climates
  recognition of internal climate variability

1900-1940	growth of aviation, polar front theory, jet stream
	archival of upper air data, hand-drawn surface maps
	teleconnections (AO, SO, NAO), index cycle
	Rossby waves, zonal index cycle
1940s	quasi-geostrophic scaling, baroclinic instability
	balance requirements in general circulation, role of eddies
	discovery of ITCZ
1950s	dynamics of a zonally symmetric vortex
	discovery of Brewer-Dobson circulation
	use of electronic computers
	first GCM
	kinetic energy cycle
	IGY (1957-58); discovery of stratospheric sudden warmings
	founding of GFDL

1960s	
	satellite imagery based on visible imagery
	beginning of GARP
	nuclear bomb tests; long-lived stratospheric debris
	studies of nonlinear systems, predictability
	advent of numerical weather prediction
	first comprehensive GCM experiments
	recognition of importance of moist convection
	discovery of equatorial stratospheric waves
	theory of QBO
	dynamic of stratospheric sudden warmings
	objective analysis of weather maps
1970s	discovery of MJO
	discovery of ENSO
	infrared satellite imagery and soundings
	archived global gridded data (operational NWP)
	GARP Global Weather Experiment (1979)
	studies of zonally varying general circulation: jet streams, storm tracks
	advances in data assimilation
	applications of turbulence theory
	founding of ECMWF
	growing interest in atmospheres of other planets

1980s	coupled atmosphere-ocean dynamics
	recognition of the importance of boundary forcing
	growing interest in paleoclimate
	discovery and attribution of the ozone hole
	systematic studies of teleconnection patterns; PNA pattern
	global response to tropical SST anomalies
	widespread use of regression, EOF and factor analysis
	interest in possibility of multiple equilibria
	introduction of EP flux as a diagnostic
	major expansion of gridded, global data sets
1990s	advent of global reanalyses products
	increasing emphasis on global warming, climate change; IPCC
	recognition if the 1976-77 ENSO-related “regime shift”
	discovery of annular modes
	growing interest in troposphere-stratosphere exchange
	major advances in NWP, data assimilation
	TRMM (rainfall) and COSMIC (high resolution temperature) monitoring
	Improved geochemical measurements
2000-2013	ARGO floats; CALIPSO, Cloudsat; WWLLN
	hiatus in global warming; summer melting of Arctic pack ice
	reversal of trend in NAM index prevalence of La Niña state in equatorial Pacific
	2003 European and 2001 summer droughts
	increasing focus on “extreme events”

	progress in understanding dynamical controls on BDC and interactions between baroclinic waves and the background flow
	recognition of the importance of equatorially asymmetric modes of variability
	discovery of a ~3 week vacillation cycle in eddy kinetic energy
2014–	understanding the MJO
	attribution of i climate trends: external vs. internal
	atmospheric internal variability
	interactions between clouds and dynamics
	concerns about continuity of key satellite measurements