Anatomy of a Snowstorm

Large-Scale Data Visualization
Computational Meteorology
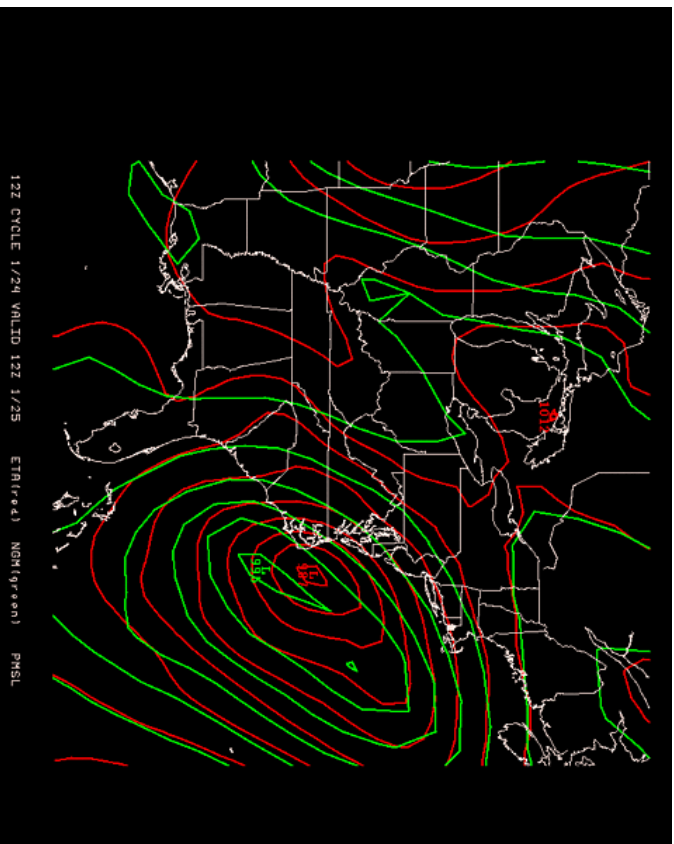

The Big Carolina Snowstorm
NOAA-14 HRPT
Multi-spectral False Color Image
January 25, 2000 @ 2025 UTC
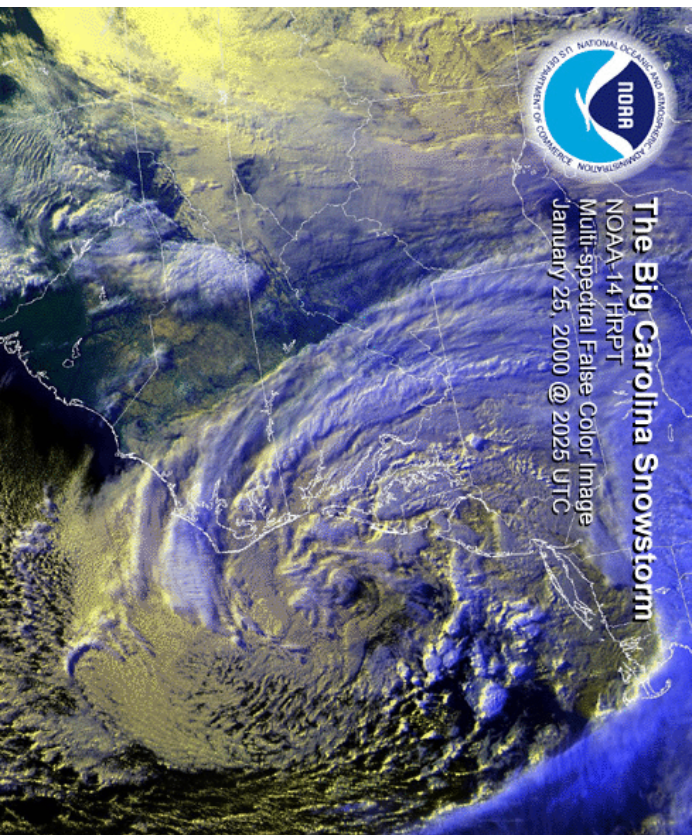
▽ Torsten Möller & Dave Muraki

▽ Fuqing Zhang (NCAR, Boulder)

www.emc.ncep.noaa.gov/mmb/research/blizz2000

North Carolina, 24-25 January, 2000

A Forecasting Disaster

▷ Rayleigh/Durham: 20+" of snow (a Jan monthly record!)
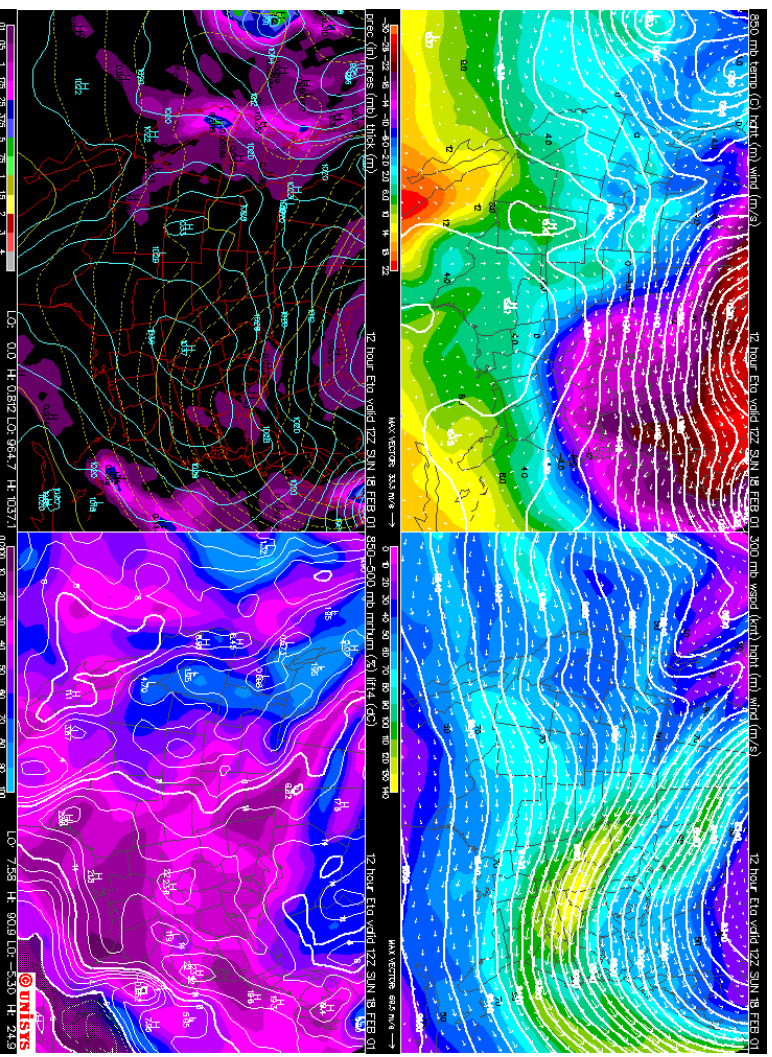
▷ forecasts tracked storm too far east

www.emc.ncep.noaa.gov/mmb/research/blizz2000

▷ NCAR: why did the forecast models go wrong?

Weather Forecasting Models

Supercomputing & Supersized Data

▽ 3 space dimensions (x, y, z on sphere) & time (t)

▽ many physical quantities (winds, temperature, humidity . . .)
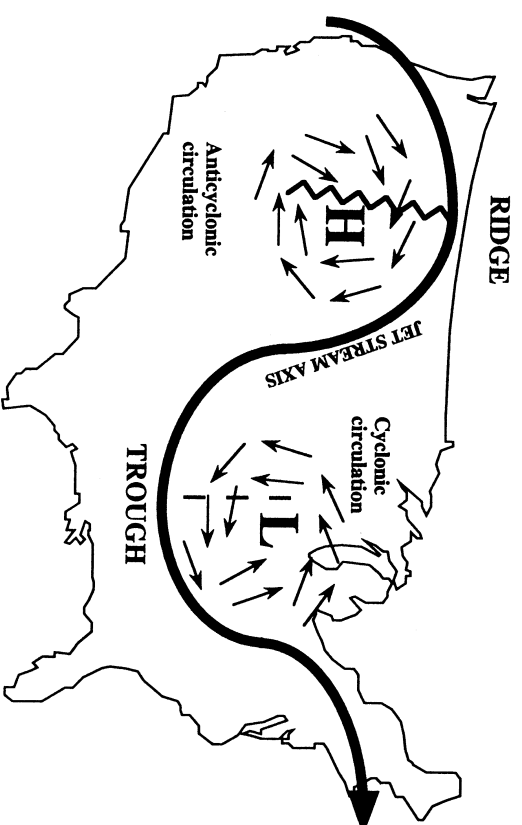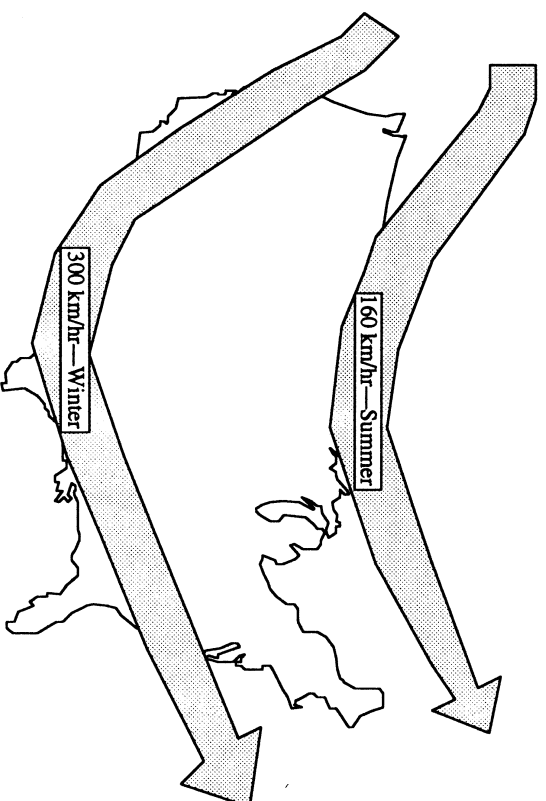
▽ many physical processes → complex interactions

weather.unisys.com

Midlatitude Meteorology 101

The Jetstream, Ridges & Troughs

▽ strong west-to-east flow at ≈ 10km

▽ primary mechanism of weather movement

▽ ridges = high pressure, troughs = low pressure

300 km/hr—Winter

160 km/hr—Summer

RIDGE

Anticyclonic circulation

H

JET STREAM AXIS

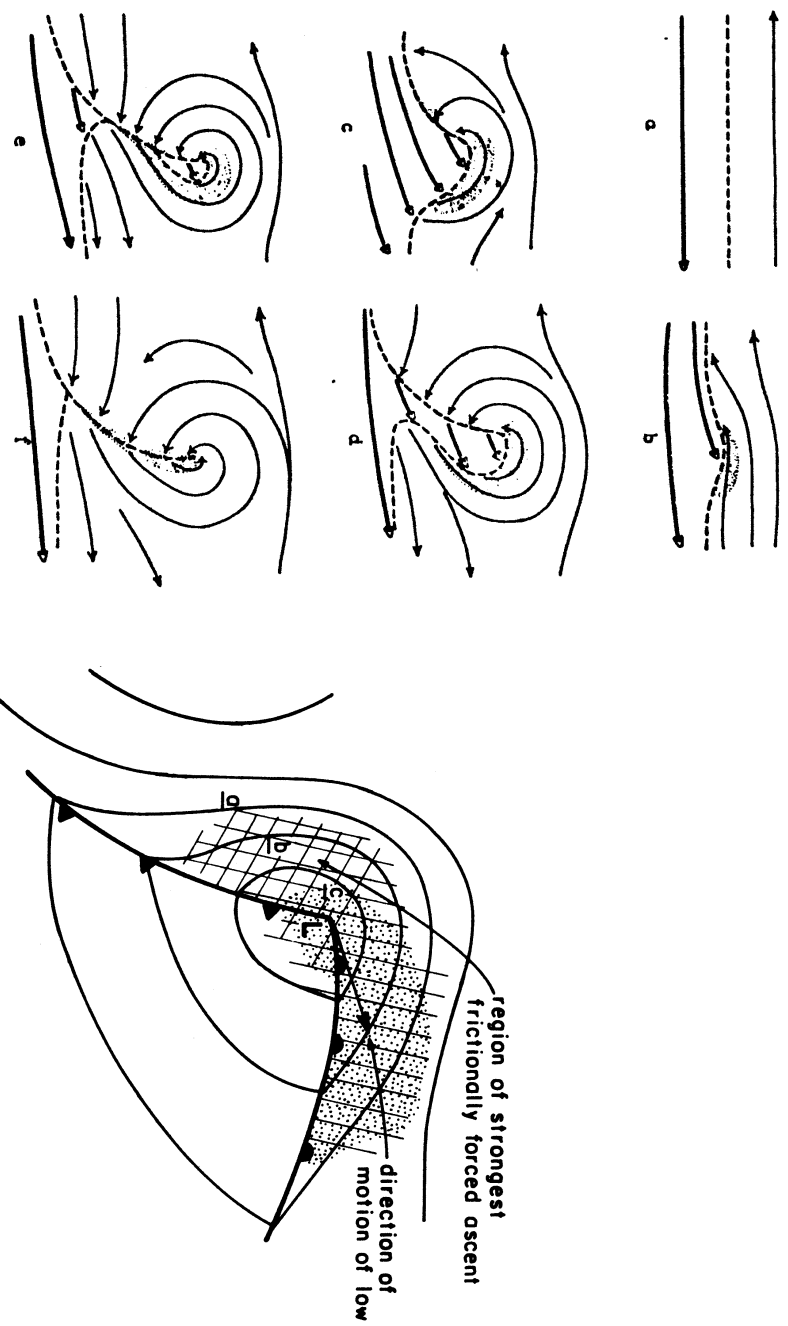Cyclonic circulation

L

TROUGH

conway

Midlatitude Meteorology 101

Norwegian Cyclone Model

▽ Bjerknes & Solberg (1926)

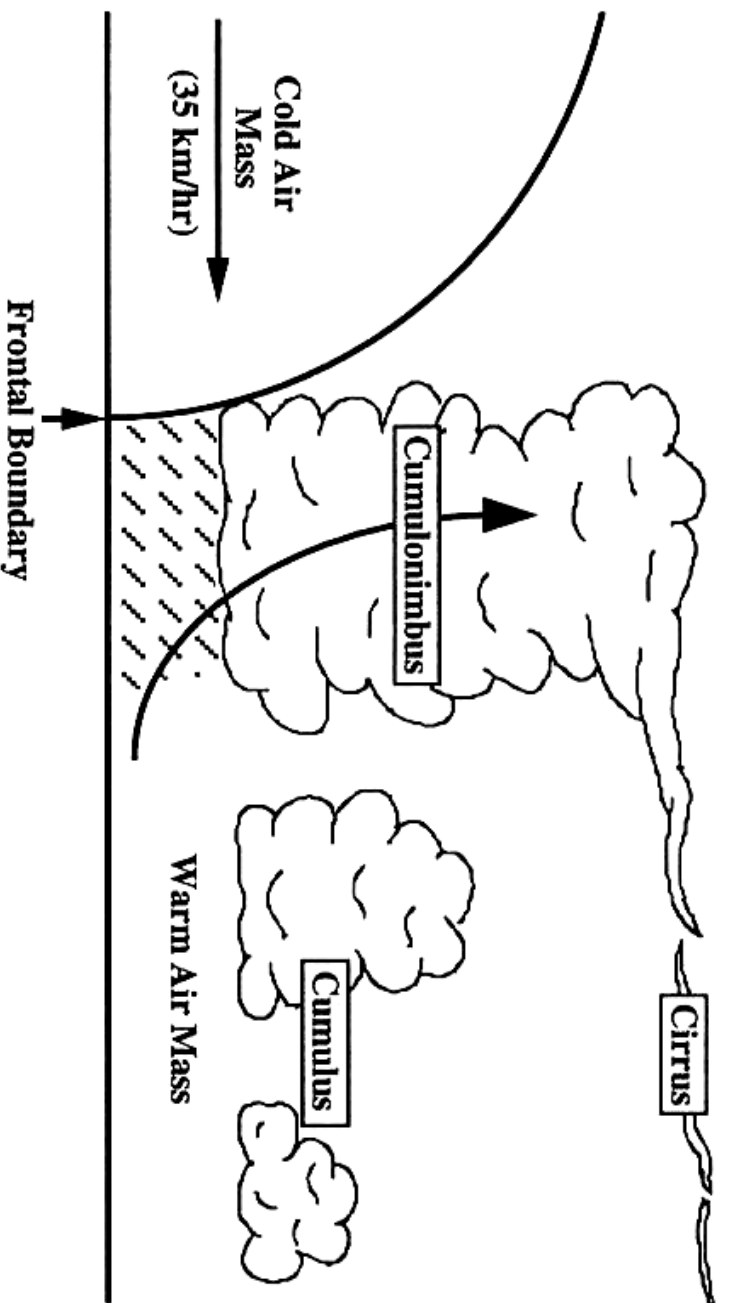▽ low pressure cells & counter-clockwise (cyclonic) flow

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Fronts

▽ cold, dry Arctic air meets warm, moist tropical air

▽ warm air rises, moisture condenses → precipitation

Cold Air Mass
(35 km/hr)

Frontal Boundary

Cumulonimbus

Cirrus

Cumulus

Warm Air Mass
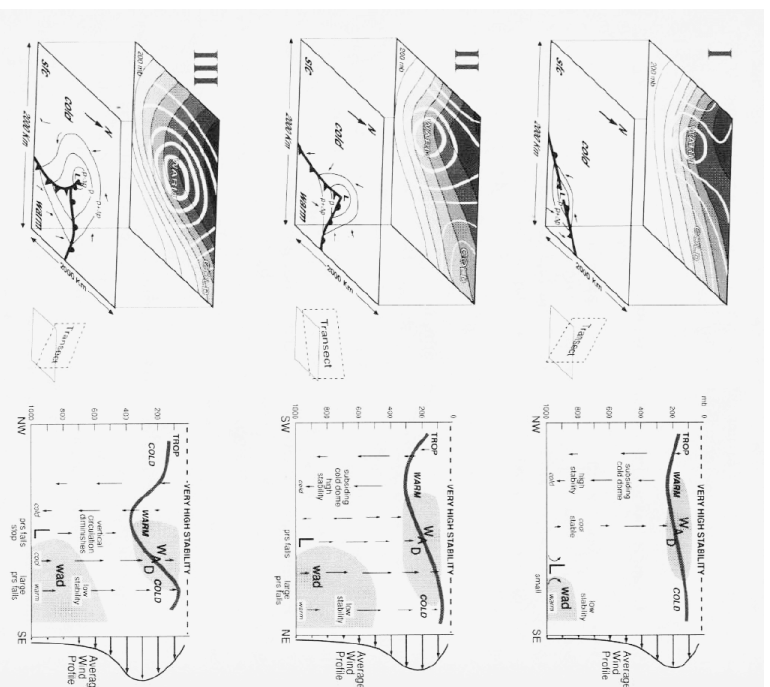
Conway

Graphical Visualation

Storm as a 3D Event

▽ vis5d: specialized meteorological graphics tool

▽ matlab: computing & graphical environment

▽ vtk: visualization API

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Your Mission . . .

Graphical Storm Chasing

▽ observe & identify basic atmospheric processes

▽ sequence the events of the storm development

▽ develop new graphical tools for analyzing data