

Meteorology 3110

Norwegian Cyclone Model

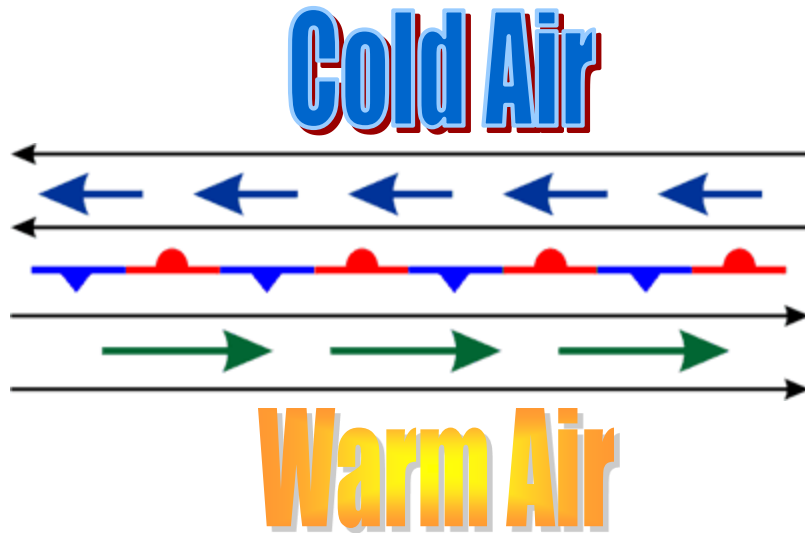
Mid-Latitude Cyclones

- What?
 - Low pressure located between 30° and 60° latitude.
- Impact?
 - Cause of most of the stormy weather in U.S., especially during the winter season.
- Why?
 - Crucial for predicting significant weather phenomena such as blizzards, flooding, rains, and severe weather.

Stages of Development

- Initial Setup
- Initiation*
- Development*
- Mature or Occluded*
- Dissipation

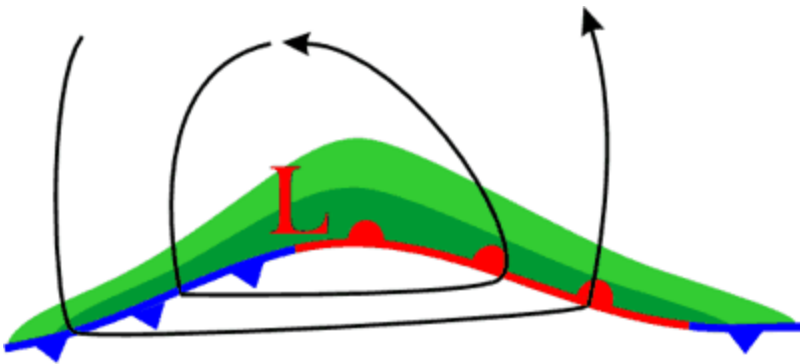
Initial Setup



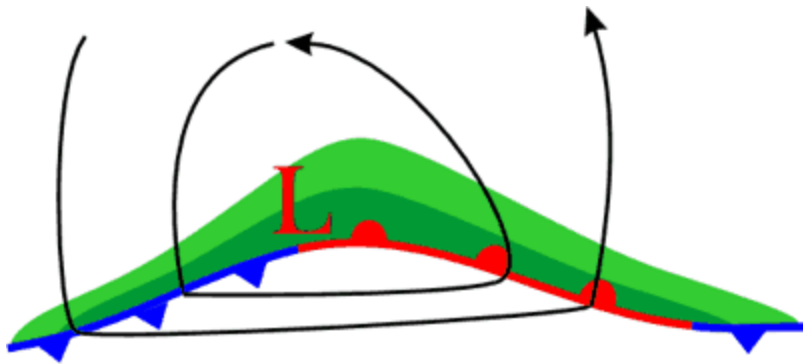
- Front exists separating warm air to south and cold air to north.
- The front is often stationary.
- Can be just about any boundary.
 - Differential heating

Initiation

- Weak surface wave develops.
- Usually the effect of some upper level forcing.
 - PVA from short-wave.
 - Jet streak

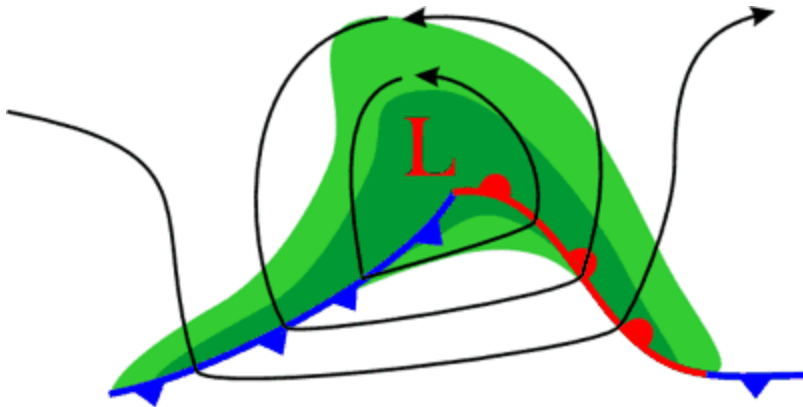


Initiation cont.



- Closed circulation around low is able to produce temperature advections.
- Precipitation begins to develop with the heaviest occurrence along the front.

Development



- Both warm and cold front become organized.
- Low pressure becomes stronger (surface pressures fall in the low).
- Winds intensify around the low.
- Temperature advections become large.

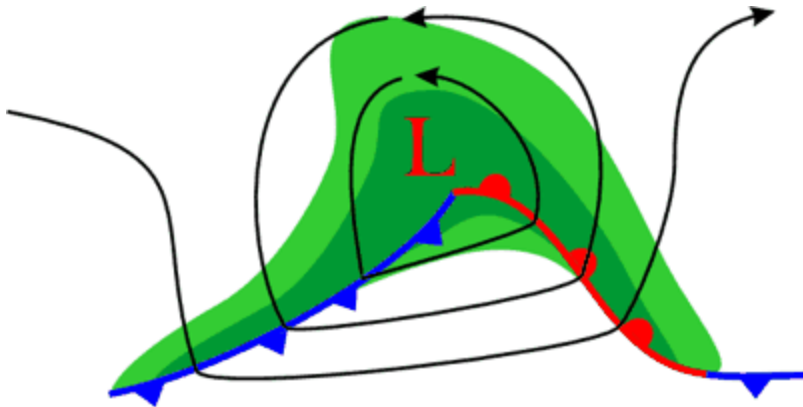
Temperature Advections

- Warm air advection: upward motion
 - Lowers surface pressure.
- Creates surface forcing in addition to the upper level forcing.
- Systems can intensify rapidly.

Temperature advections cont.

- Low-level temperature advections also alter the upper-level fields.
- Warm advection: Upper level heights increase.
- Cold advection: Upper level heights decrease.
- Advections intensify the upper level disturbance or trough that initially cause the disturbance.
- As trough deepens, forcing from PVA increases.
 - Positive feedback.

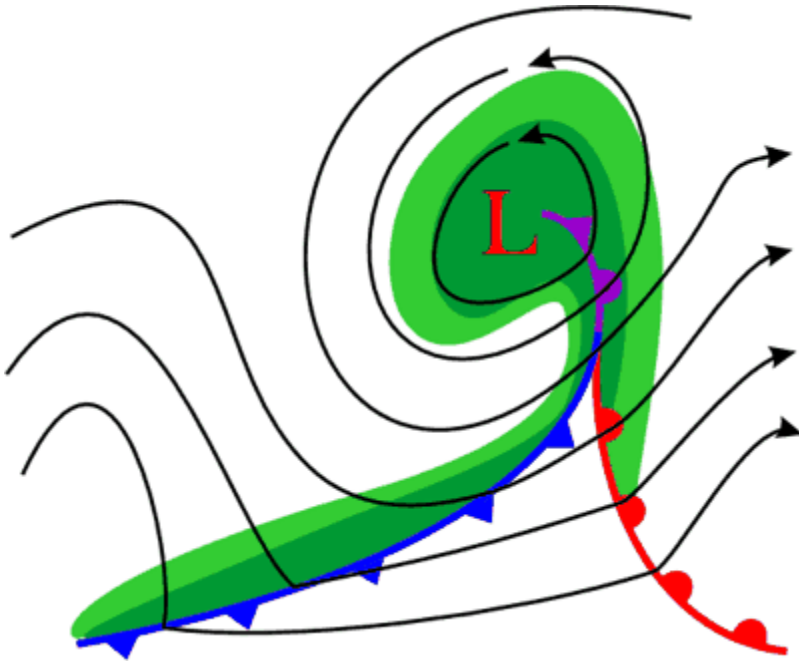
Development



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Mature or Occluded

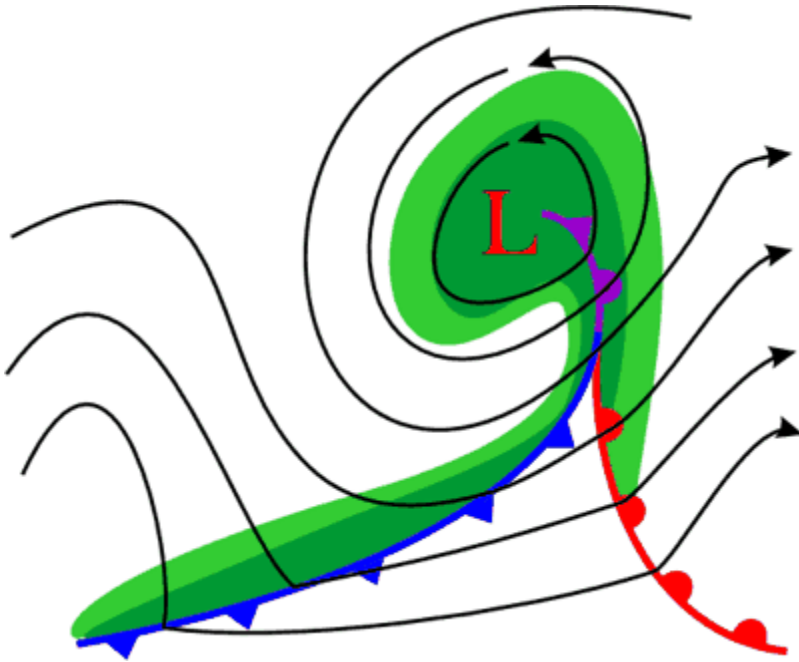
Surface



- Cold front “catches up” with warm front.
- Occlusion forms.
- Temperature advections are intense at low levels.

Mature cont.

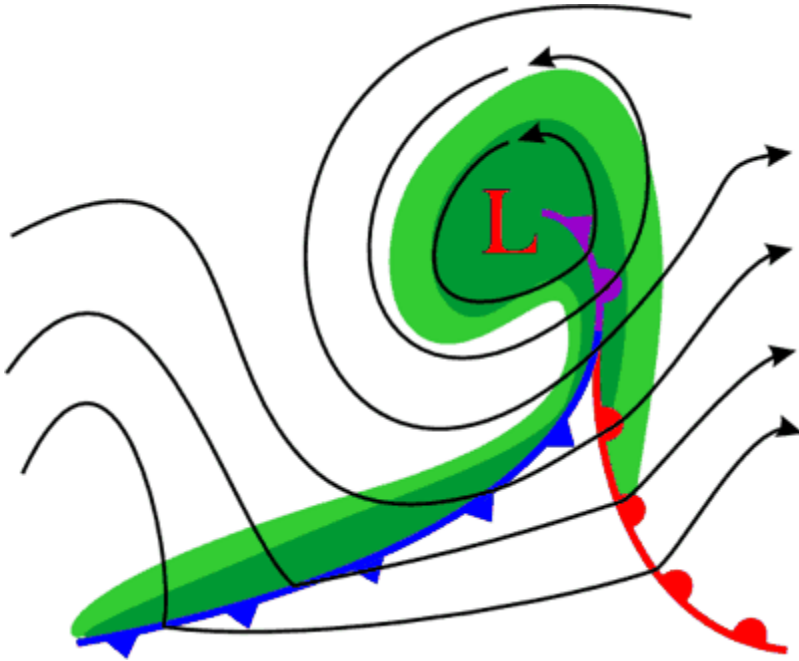
Surface



- Warm sector gets cut-off from the low.
- Low no longer has a supply of warm, moist air.
- Begins to dissipate.

Mature cont.

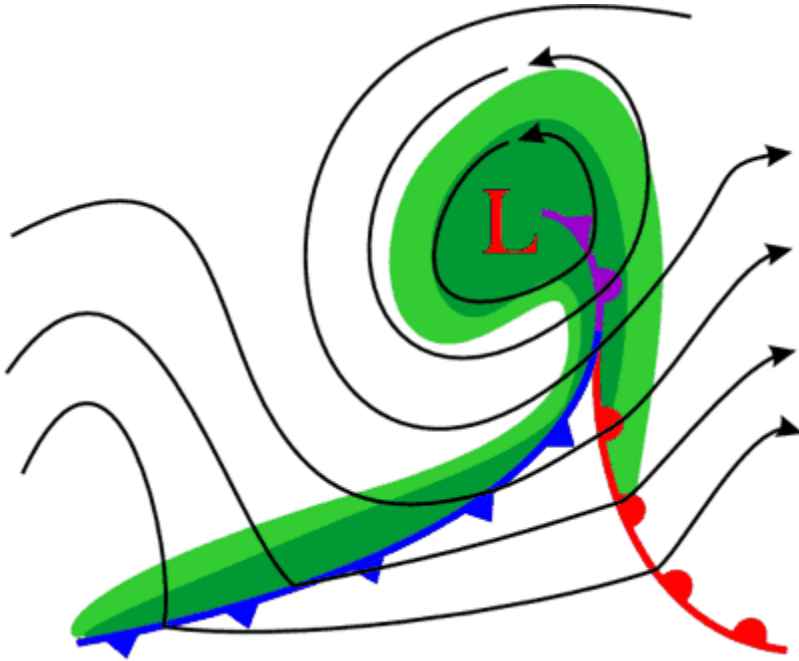
Aloft



- Heights fall so much aloft due to cold air advection that an upper-level low develops.
- Low becomes closed aloft (complete circulation around it).

Mature cont.

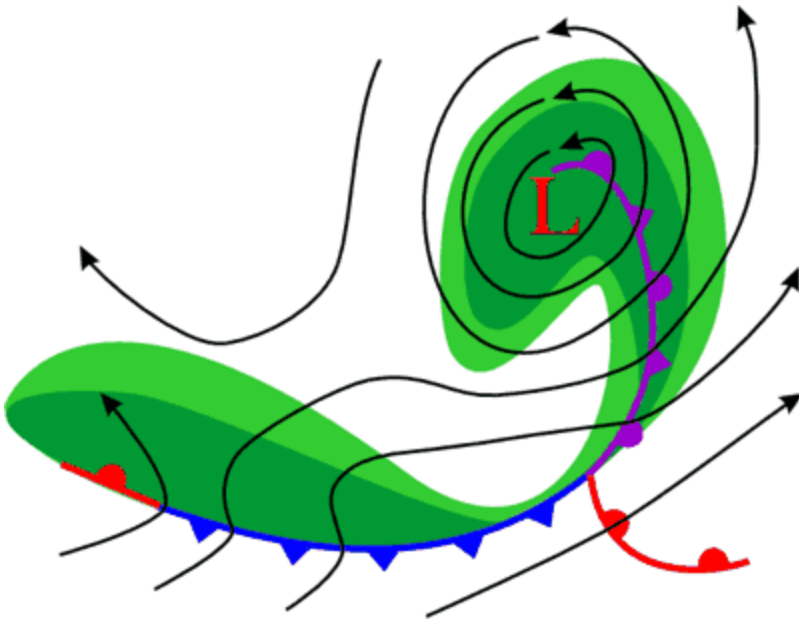
Aloft



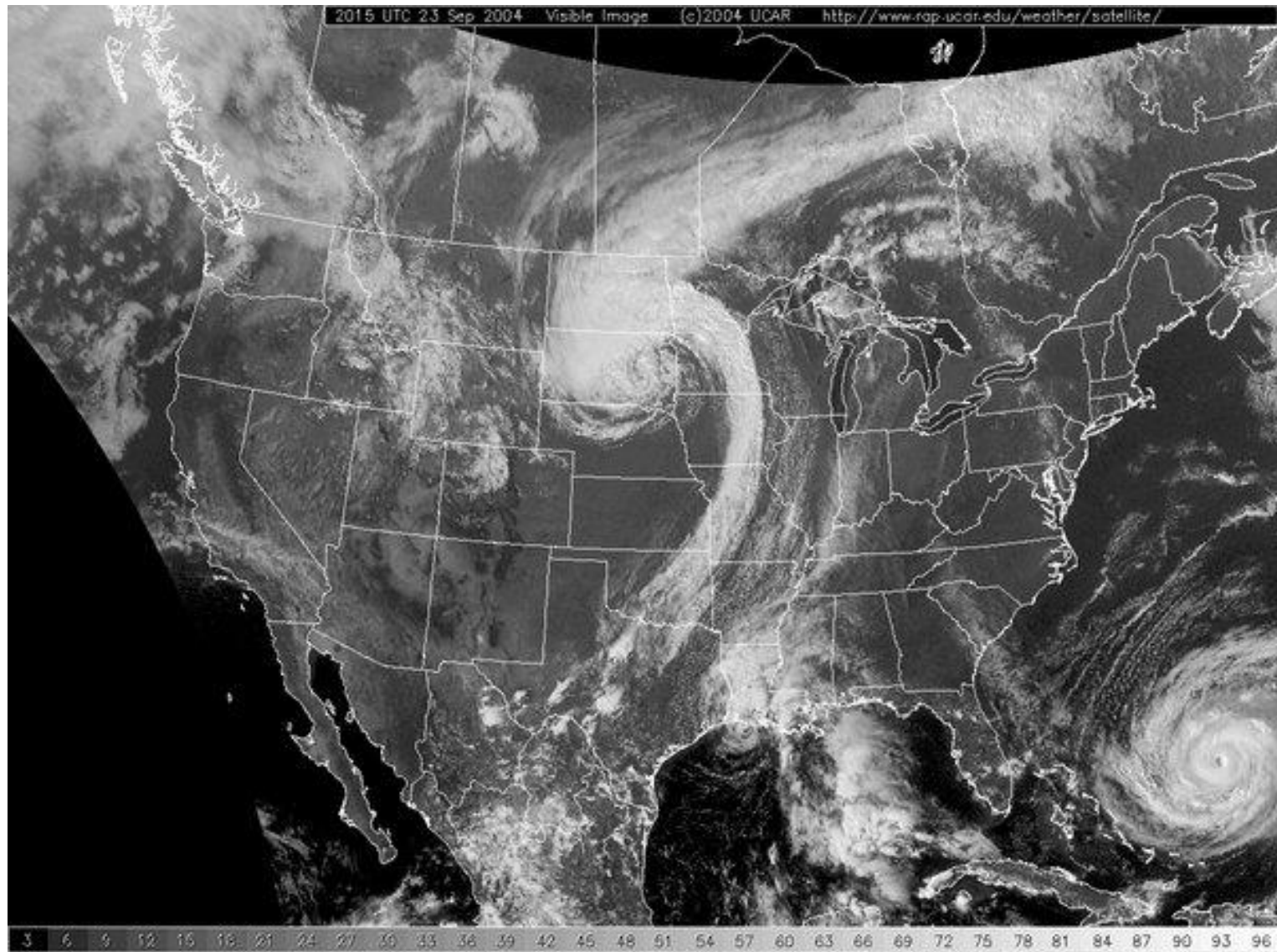
- Vorticity isopleths tend to become parallel to the flow (course notes).
- Upper level forcing weakens and eventually dissipates.
- Lows become “stacked”.
- System no longer intensifies.

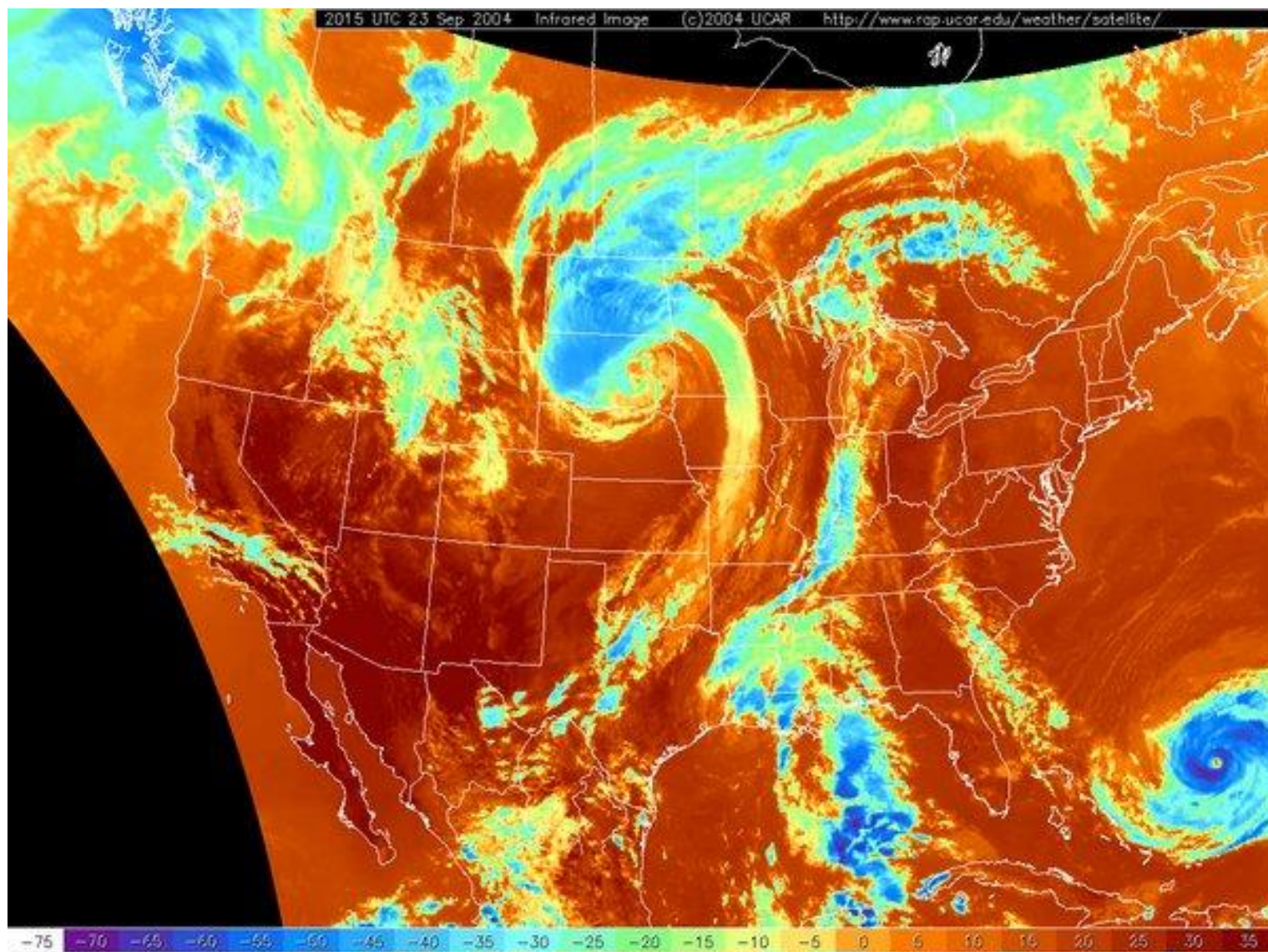
Dissipation

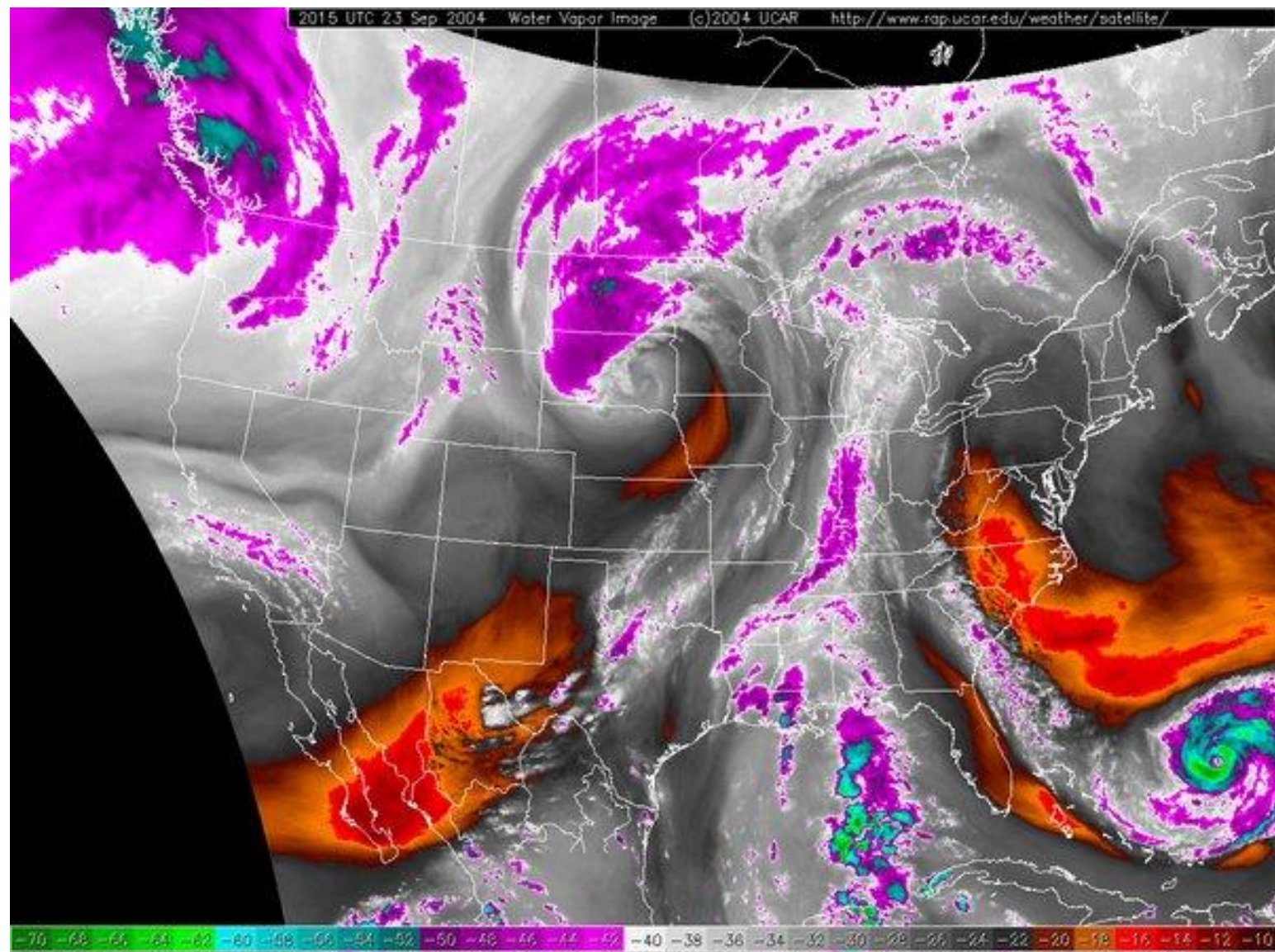
- System can no longer intensify and begins to dissipate.
- A new low may form at the triple point.
- Triple point: point where cold, warm, and occluded fronts come together.



“Textbook” case



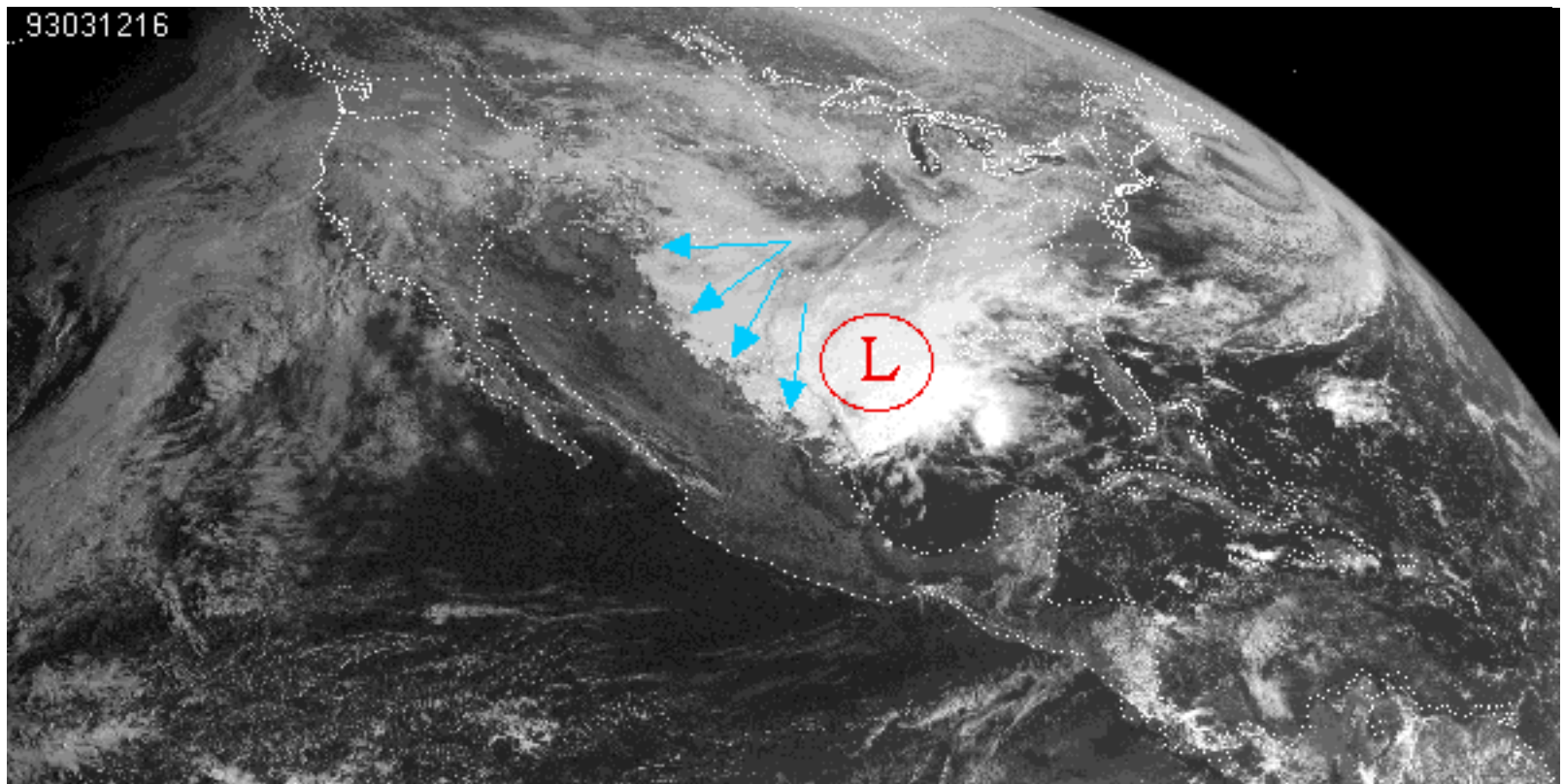




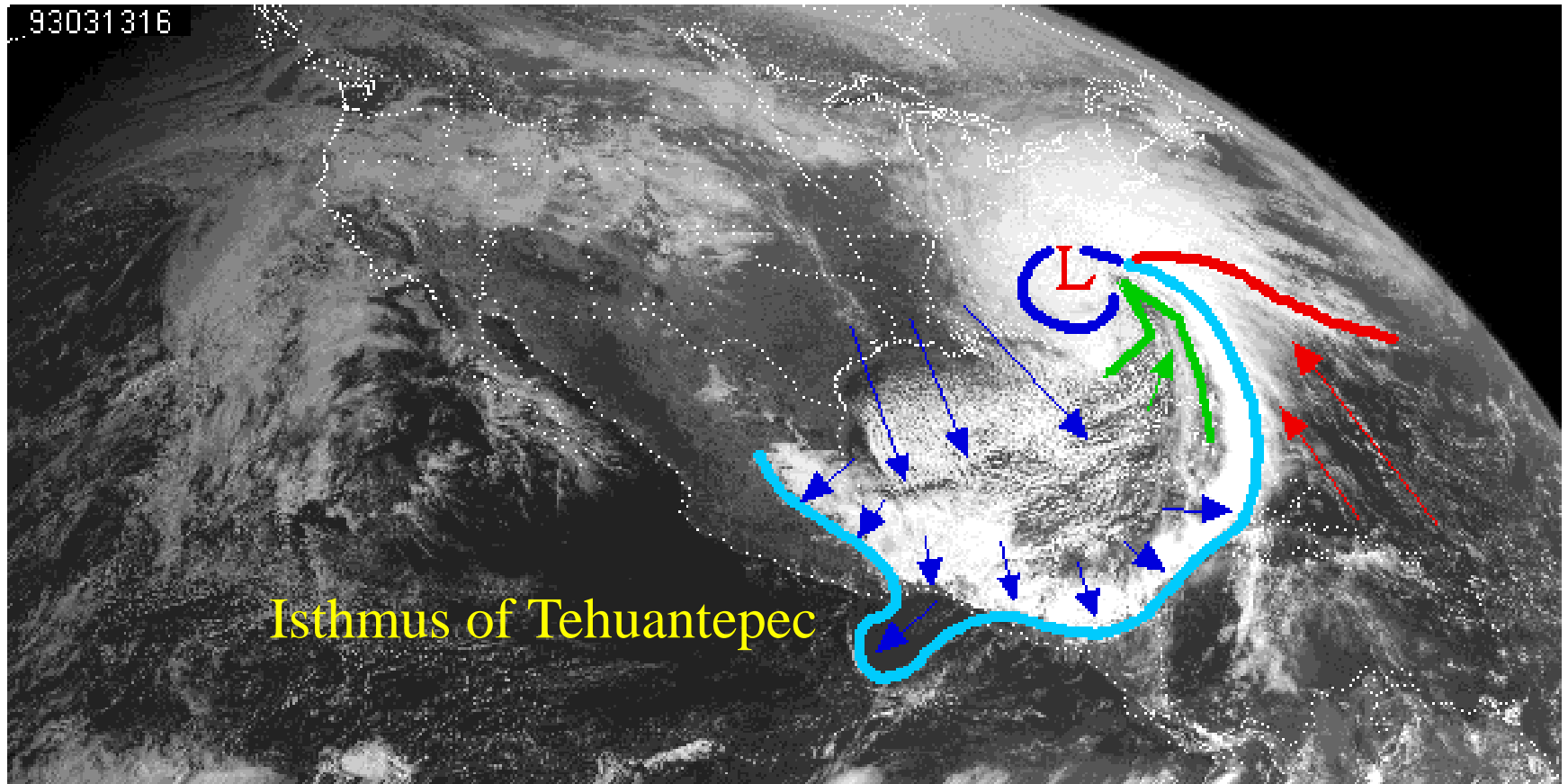
March “super-storm” of 1993

- More than a foot of snow from Alabama to Maine.
- Tornadoes ripped through Florida.
- Hurricane force winds and barometric pressure followed by record cold over eastern United States.

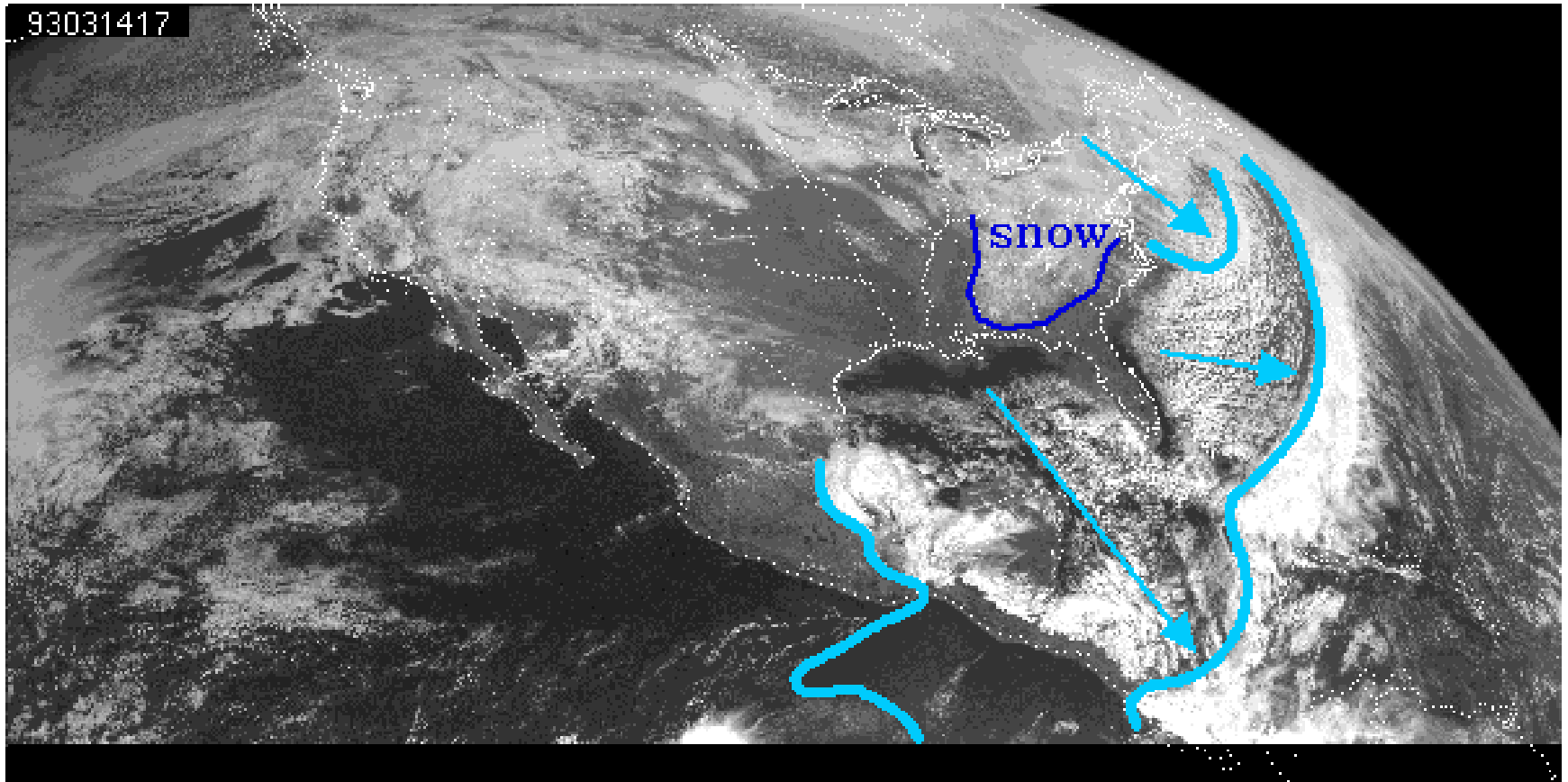
Storm of Century



Storm of the Century

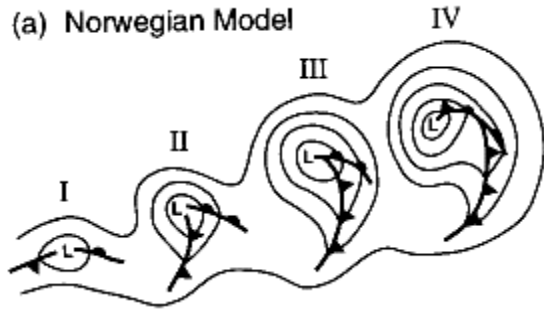


Storm of the Century



Other models

(a) Norwegian Model



(b) Shapiro-Keyser Model

