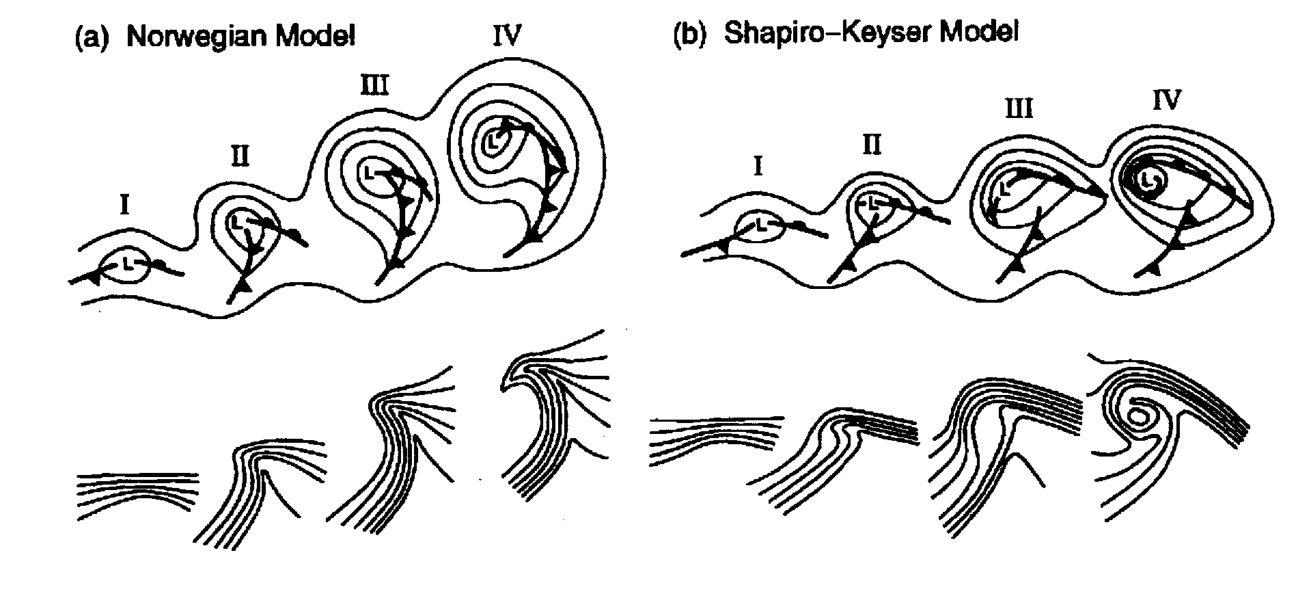
Schultz and Wernli
Determining Midlatitude Cyclone Structure and Evolution From the Upper-Level Flow

The conclusion from this paper does a nice job summarizing the author's thoughts. Cyclones that are embedded in a diffluent large scale flow develop strong cold fronts, weak warm fronts, and have a narrowing warm sector.
This model resembles the Norwegian Cyclone Model.

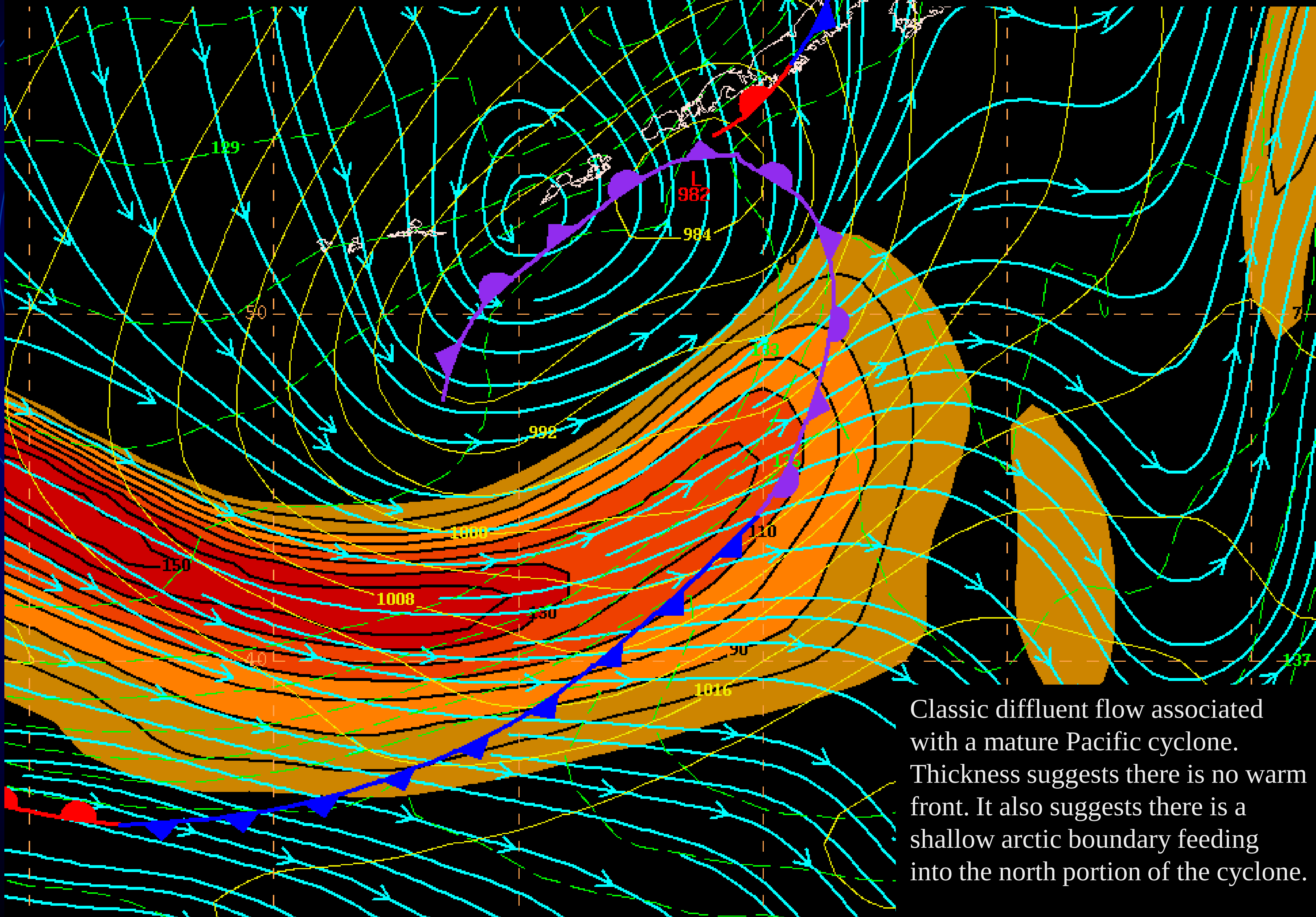
Cyclones embedded in large scale confluent flow have strong warm fronts, weak or a fractured cold front, and a T-bone type frontal structure similar to the Shapiro-Keyser Cyclone.

So…the flow determines the frontal structure and evolution.



300 mb isotachs, streamlines
SFC isobars, 1000-850 thickness

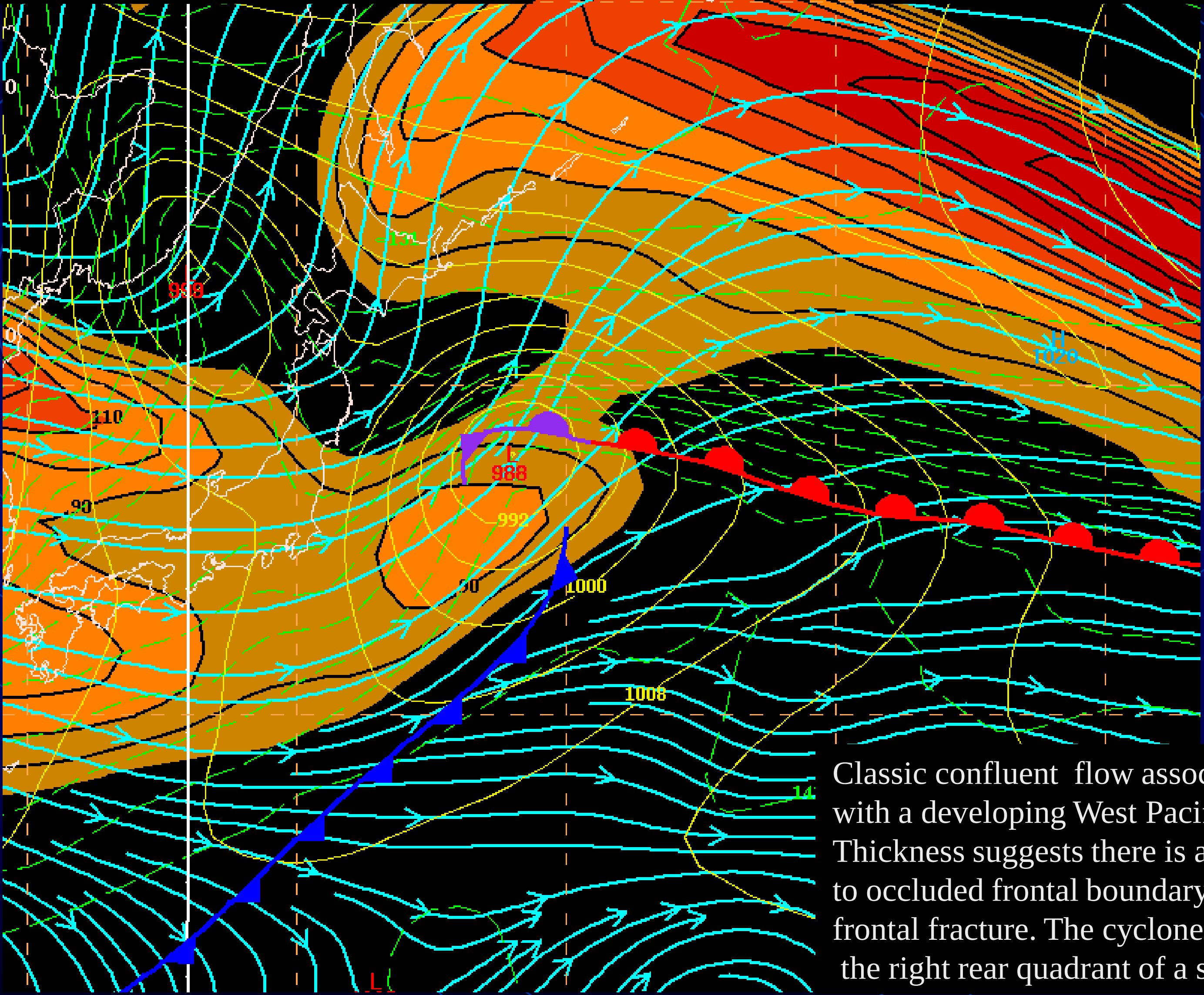
Diffluent flow
Norwegian Cyclone



Classic diffluent flow associated with a mature Pacific cyclone. Thickness suggests there is no warm front. It also suggests there is a shallow arctic boundary feeding into the north portion of the cyclone.

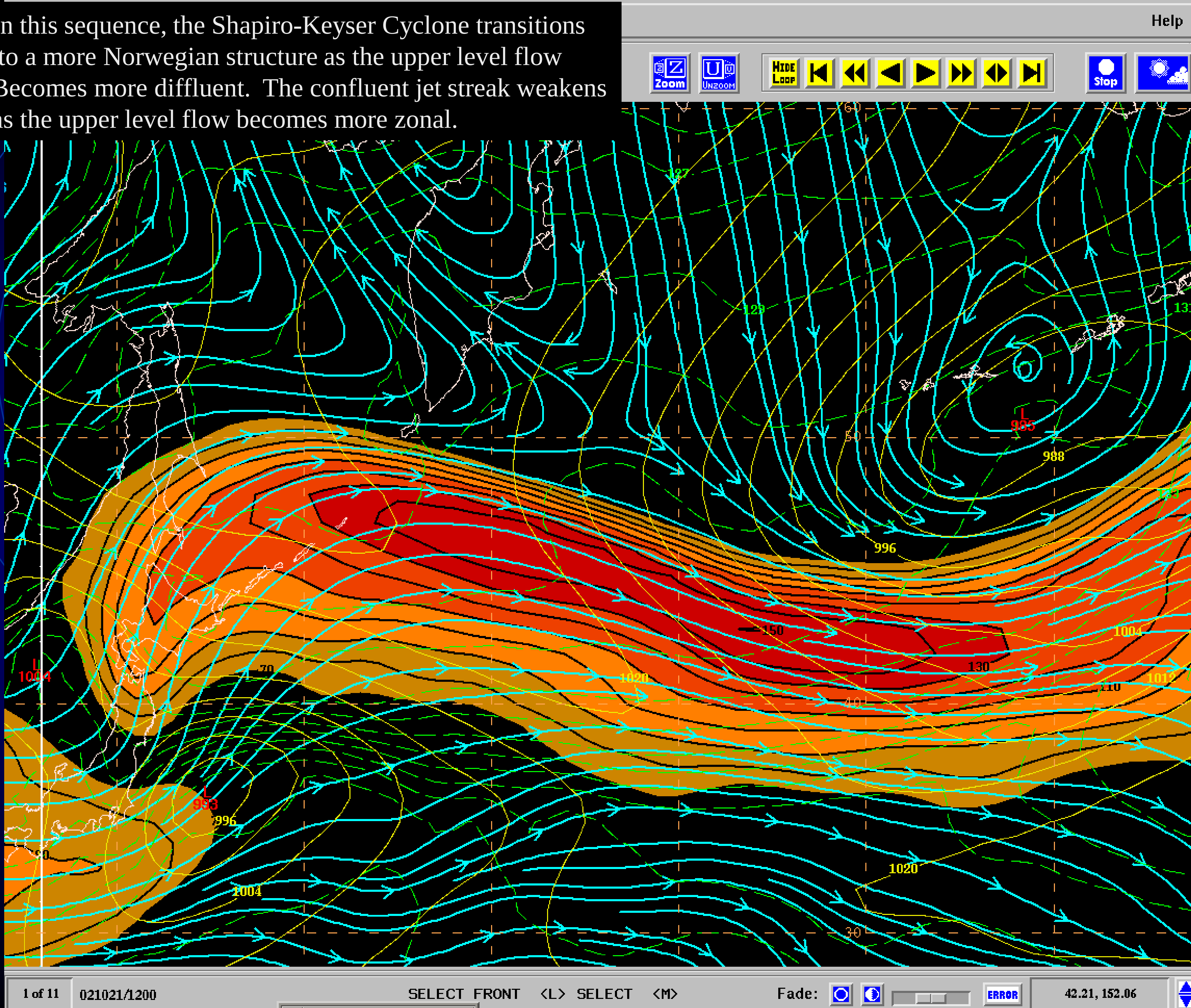
300 mb isotachs, streamlines SFC isobars, 1000-850 thickness

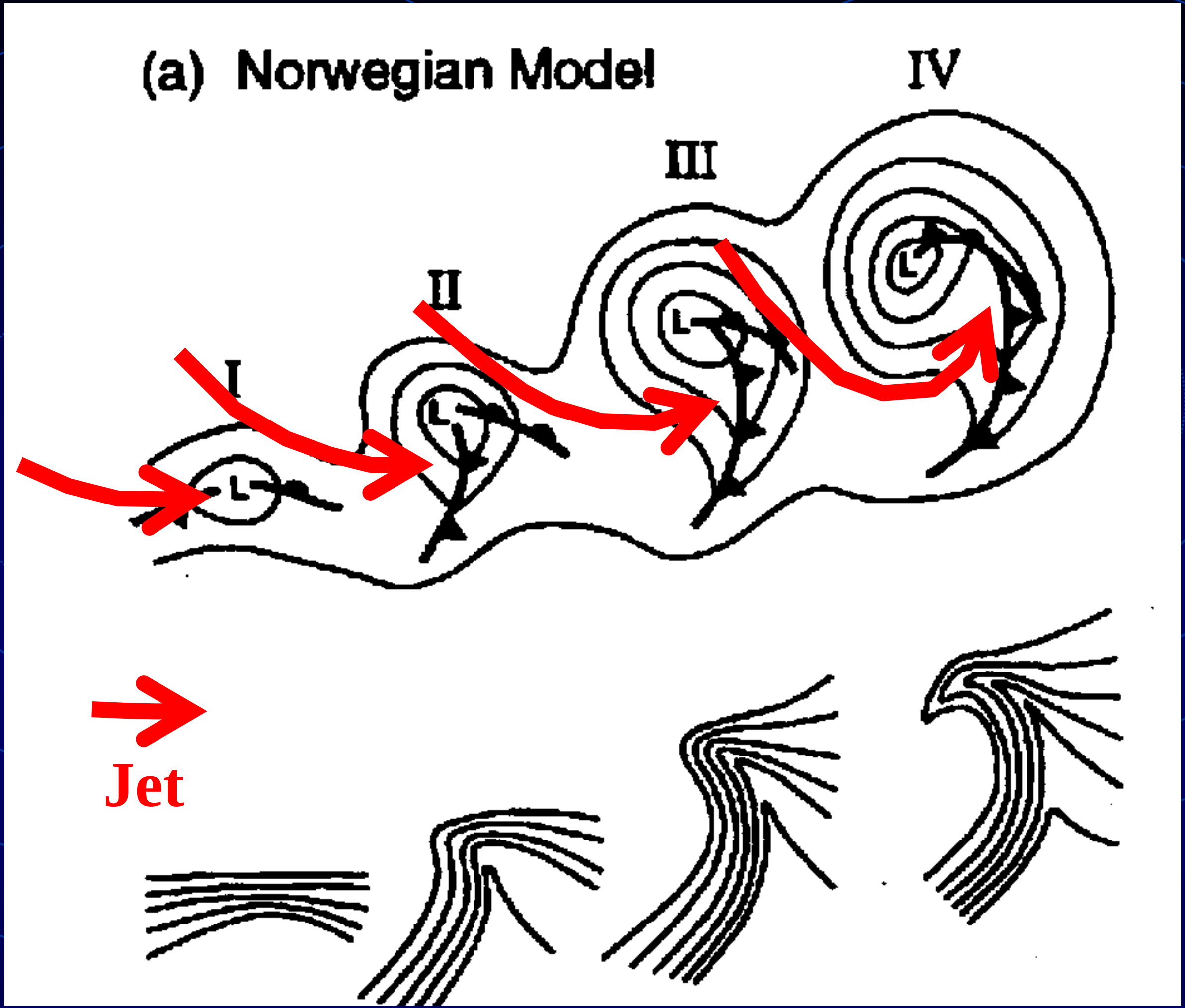
Confluent flow Shapiro-Keyser Cyclone



Classic confluent flow associated with a developing West Pacific cyclone. Thickness suggests there is a strong warm to occluded frontal boundary and a cold frontal fracture. The cyclone is developing in the right rear quadrant of a strong jet.

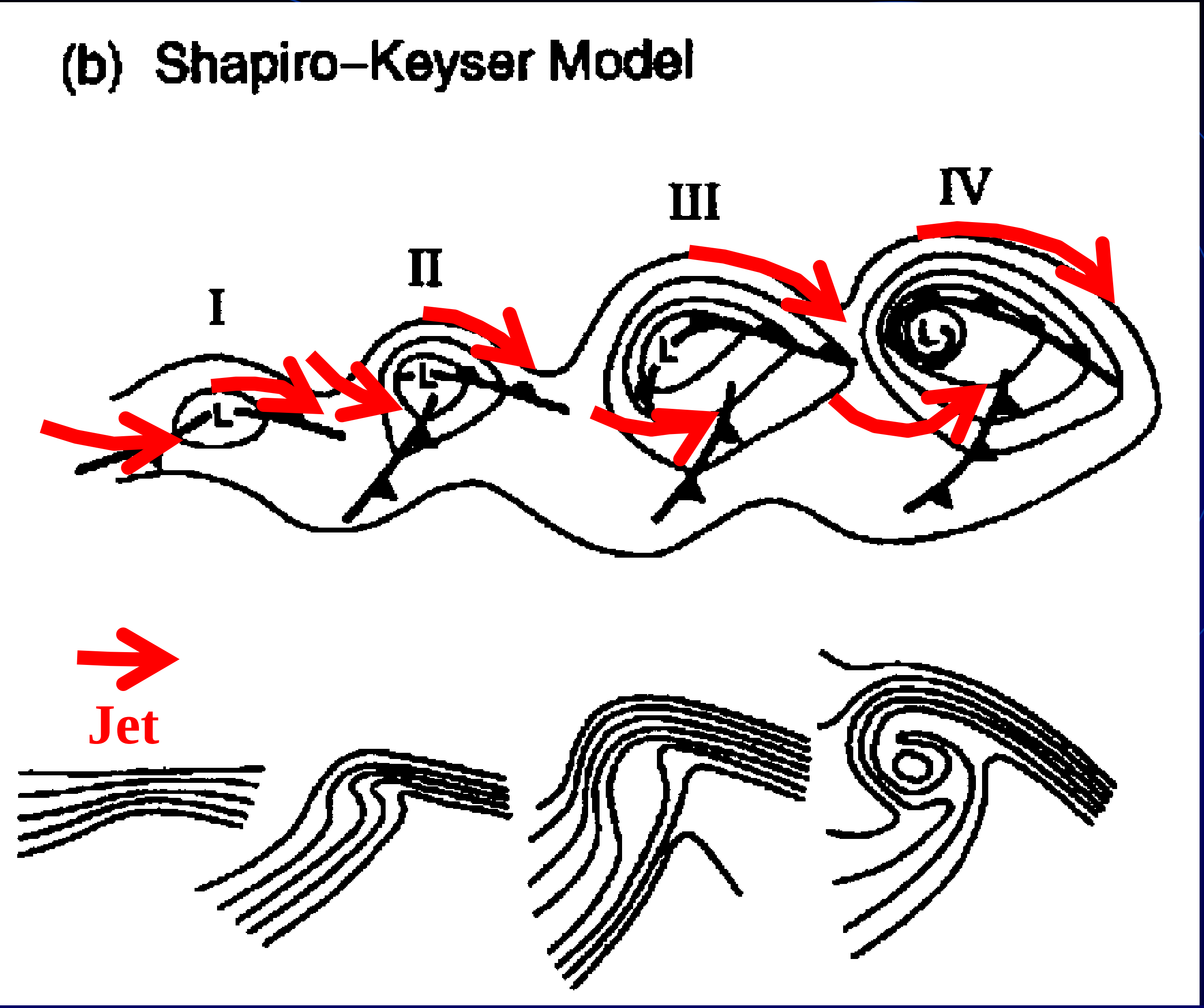
In this sequence, the Shapiro-Keyser Cyclone transitions to a more Norwegian structure as the upper level flow Becomes more diffluent. The confluent jet streak weakens as the upper level flow becomes more zonal.





Diffluent Flow – Divergence aloft is provided by the left front quadrant of a jet exit region.

To define the model jet exit region in NMAP you can look under: **avn_QPF_300mb_AGEO_DIV_ISOTACHS**
eta_QPF_300mb_AGEO_DIV_ISOTACHS
nogaps_standard/300mb_DIV_ISOTACH
cmc/streamlines/250mb_STREAMLINES
ukmet_QPF_300mb_AGEO_DIV_ISOTACHS
avn (or eta)_streamlines_250mb



Confluent Flow – Divergence aloft is provided by both the right rear quadrant of a jet entrance and left front quadrant of a jet exit region. This structure seems to favor coupled jets.

To summarize this short paper:

The upper-level flow determines the low-level frontal structure.

Confluent flow – Shapiro-Keyser

T-bone, cold frontal fracture, strong warm to occluded boundary

Diffluent flow – Norwegian Cyclone Model

Strong occluded to cold front, weak or no warm front

A cyclone can transition from one to the other as the associated Upper-level flow evolves (see the loop in slide 4).