MODULE 3.1B

DIAGNOSIS

Synoptic Scale Processes

Table of Contents

Introduction

On the synoptic scale the formation of cloud and precipitation is related to the large scale vertical motions in the atmosphere. At analysis time, therefore, we try to correlate those parameters and variables which produce vertical motions with the structure, extent and type of cloud and precipitation being observed.

Synoptic features usually have a consistent history from previous analyses. These features can be acquired from both surface and upper air charts and could include a front, trough, ridge, deformation zone, jet stream or any other relevant synoptic features from the analyses.

Synoptic Predictors

A synoptic predictor or diagnostic tool must have two (2) important characteristics.

1. It must have some physical relevance to the formation of cloud and precipitation. In order to produce cloud and precipitation it is necessary to have a good moisture source and a mechanism to produce condensation. In the mid-troposphere, on a synoptic scale, adiabatic cooling is the main mechanism for producing condensation due to vertical motion produced by some forcing mechanism (predictor). The forcing mechanism for vertical motion must move and maintain continuity with the synoptic cloud and precipitation to be considered a good predictor.

2. The predictor must be useful and readily available (useful in the sense that it can be predicted with some accuracy).

Forcing Mechanisms

The following forcing mechanisms are responsible for the formation and maintenance of mid-tropospheric cloud and precipitation.

1. Large scale vertical motion
2. Orographic lift
3. Lee waves
4. Radiational cooling of the cloud tops
5. Spreading out of convective cloud
6. Dissipation of cumulonimbus

Table 1 gives a number of synoptic features that are often used as predictors and the parameters with which they can be correlated.

TABLE 1

CORRELATION BETWEEN SYNOPTIC FEATURES AND ASSOCIATED DIAGNOSTIC VARIABLES AND TOOLS

SYNOPTIC FEATURES/PREDICTORS	MAY CORRELATE WITH THESE VARIABLES
500 mb trough	Trailing edge of synoptic cloud or precipitation
500 mb ridge	Leading edges of cloud or precipitation -Cirrus spills beyond ridge
700 mb trough	Trailing edge weather systems
700 mb ridge	Leading edge-cloud or precipitation
Surface features troughs/fronts/ridges	Orientation and pattern of cloud and precipitation
500 mb short waves ridge/trough	Trailing and leading edges cloud and or precipitation
500 mb vorticity centres	Comma shape
500 mb vorticity advection	PVA with BKN to OVC cloud and/or precipitation -Added to PTA gives area of precipitation
500 mb thickness advection	as for vorticity advection
700 mb $T-T_d$	BKN to OVC cloud
Deformation zones	Edge of cloud/precipitation - Cirrus thick along zone - Dry slots
Jet Streams	Edge of cloud/precipitation - Dry slots - Cirrus edges

Diagnosis of Cloud Areas

The table below gives a general indication of expected cloud cover based on the mean relative humidity of the lowest layers, (1000 through 500 mb).

Average Relative Humidity	Dew Point Depression	Sky Coverage
65% or lower	4°C or higher	0/8
66% to 75%	3 to 4°C	1/8 to 3/8
76% to 90%	2 to 3°C	4/8 to 7/8
91% or higher	1°C or lower	8/8

Moisture Content

When working with tephigrams, use the following rules of thumb to identify locations of significant cloud.

A) At temperatures around -10°C, the dew point depression should be 4°C or less.

B) At temperatures around -20°C, the dew point depression should be 5°C or less.

C) At temperatures around -30°C, the dew point depression can be as much as 6°C.

Limitations of Observations

Upstream observation stations should always be examined for cloud cover. However, cloud observations regularly available to forecasters in synoptic reports leave much to be desired if used as a basis for diagnosis. A number of points need to be considered when using these observations.

Middle and high cloud are only observed and reported when visible from the ground.

1. At night reports of mid and high cloud are less reliable.
2. Cloud bases are usually estimated.
3. Cloud tops are usually obtained from pireps, radar observations and satellite data.
4. Radar echoes do not indicate the extent of the visible cloud.
5. At night precipitation can only be reported at the station.
6. Local effects contaminate the large scale synoptic weather elements.
7. Each station exhibits its own climatological character.