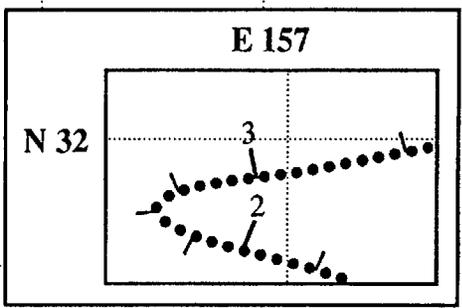


E 145 150 155 160 165 170 175 180

N 40

TROPICAL DEPRESSION 31W
 BEST TRACK TC-31W
 28 SEP-06 OCT 94
 MAX SFC WIND 30KT
 MINIMUM SLP 1000MB



LEGEND

- △/△ 6-IR BEST TRACK POSITION
- a SPEED OF MOVEMENT (KT)
- b INTENSITY (KT)
- c POSITION AT XX/0000Z
- ○ ○ ○ TROPICAL DISTURBANCE
- ● ● ● TROPICAL DEPRESSION
- TROPICAL STORM
- TYPHOON
- ◇ SUPER TYPHOON START
- ◇ SUPER TYPHOON END
- ◆ ◆ ◆ ◆ EXTRATROPICAL
- ◆ ◆ ◆ ◆ SUBTROPICAL
- *** DISSIPATING STAGE
- F FIRST WARNING ISSUED
- L LAST WARNING ISSUED

DTG (Z)	SPEED (KT)	INTENSITY (KT)
01/18	4	30
02/00	4	30
02/06	3	30
02/12	3	30
02/18	2	30
03/00	4	30
03/06	9	30

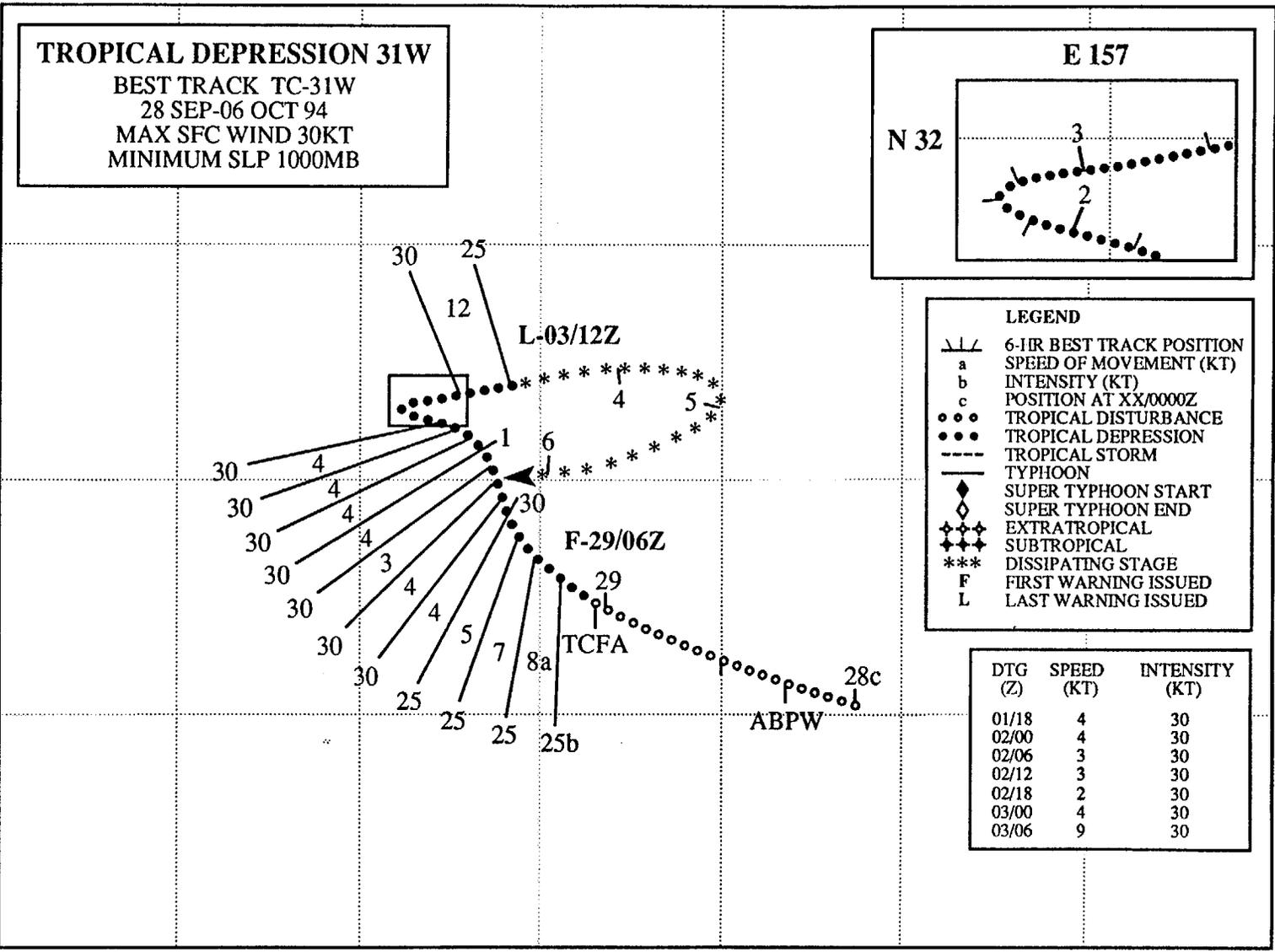
35

30

25

N 20

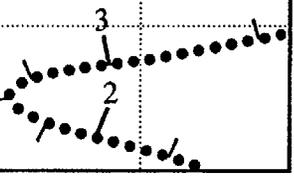
174



TROPICAL DEPRESSION 31W
 BEST TRACK TC-31W
 28 SEP-06 OCT 94
 MAX SFC WIND 30KT
 MINIMUM SLP 1000MB

E 157

N 32



LEGEND

- △/△ 6-IR BEST TRACK POSITION
- a SPEED OF MOVEMENT (KT)
- b INTENSITY (KT)
- c POSITION AT XX/0000Z
- ○ ○ ○ TROPICAL DISTURBANCE
- ● ● ● TROPICAL DEPRESSION
- TROPICAL STORM
- TYPHOON
- ◇ SUPER TYPHOON START
- ◇ SUPER TYPHOON END
- ◆ ◆ ◆ ◆ EXTRATROPICAL
- ◆ ◆ ◆ ◆ SUBTROPICAL
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DTG (Z)	SPEED (KT)	INTENSITY (KT)
01/18	4	30
02/00	4	30
02/06	3	30
02/12	3	30
02/18	2	30
03/00	4	30
03/06	9	30

30

25

L-03/12Z

4

5

1

F-29/06Z

8a

25b

7

25

25

5

4

4

4

4

30

ABPW

28c

29

TCFA

6

30

30

30

TROPICAL DEPRESSION 31W

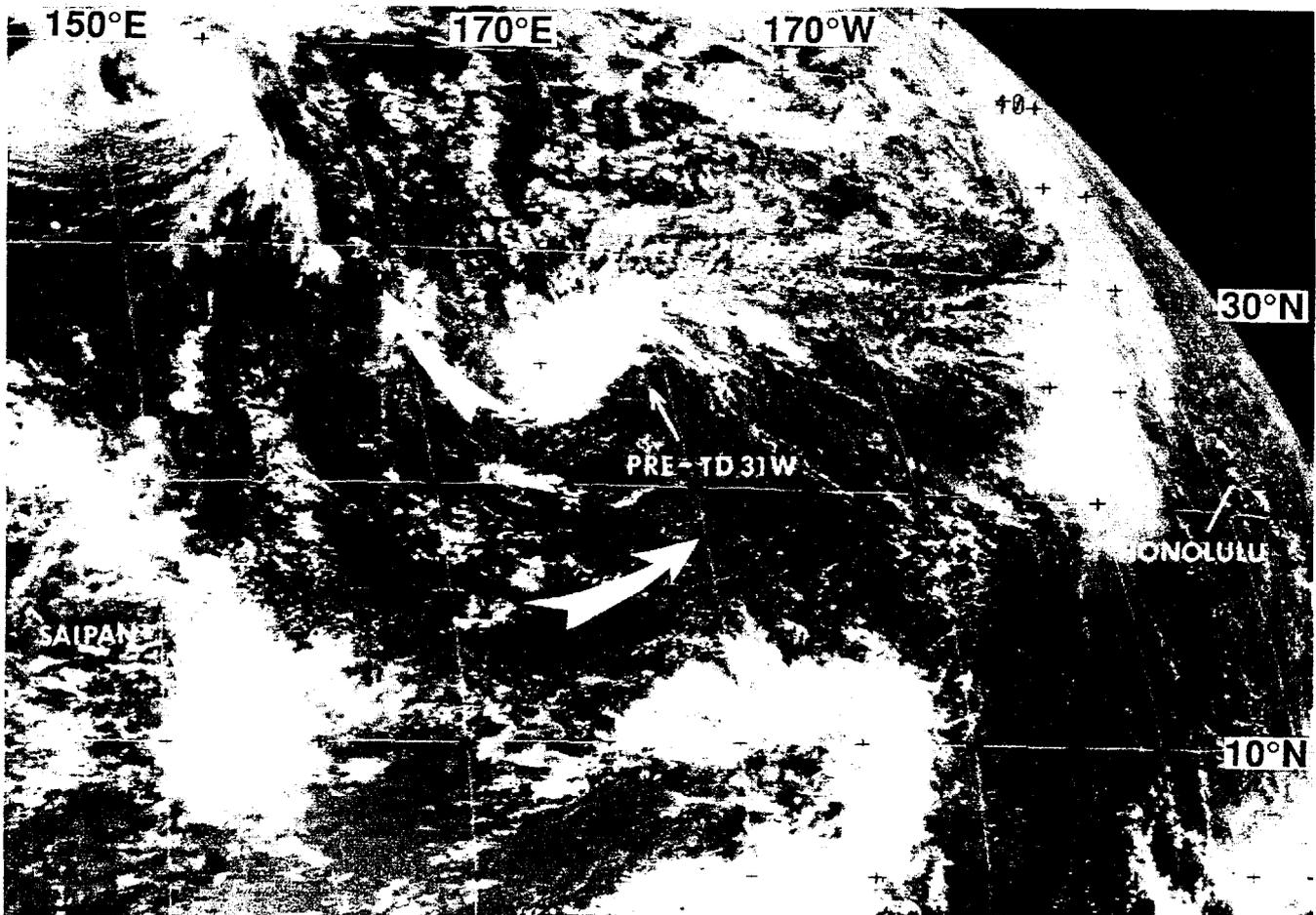


Figure 3-31-1 An area of deep convection located on the north side of an upper-level cold-core cyclonic vortex (i.e., a TUTT cell) precedes the formation of Tropical Depression 31W. Arrows indicate upper-tropospheric wind flow. (280031Z September GMS visible imagery.)

I. HIGHLIGHTS

Tropical Depression 31W was one of two tropical cyclones during 1994 — the other was Tropical Storm Yuri (36W) — that developed in direct association with a cyclonic vortex in the tropical upper tropospheric trough (TUTT) (i.e., a TUTT cell). TD 31W was a small tropical cyclone that developed at high latitude (25°N).

II. TRACK AND INTENSITY

During the last week of September, an area of persistent cloudiness associated with an upper-level trough was quasi-stationary northwest of the Hawaiian Islands. On 26 September, an upper-tropospheric cyclonic vortex detached from this trough and began to drift westward toward the international date line (i.e., it became a westward moving TUTT cell). Accompanying this TUTT cell was a small area of deep convection which was associated with some low-level cloud lines indicating the possibility of a low-level circulation. The TUTT cell moved rapidly westward, and crossed the international date line on 27 September. The small area of deep convection persisted on its north side (Figure 3-31-1), and it

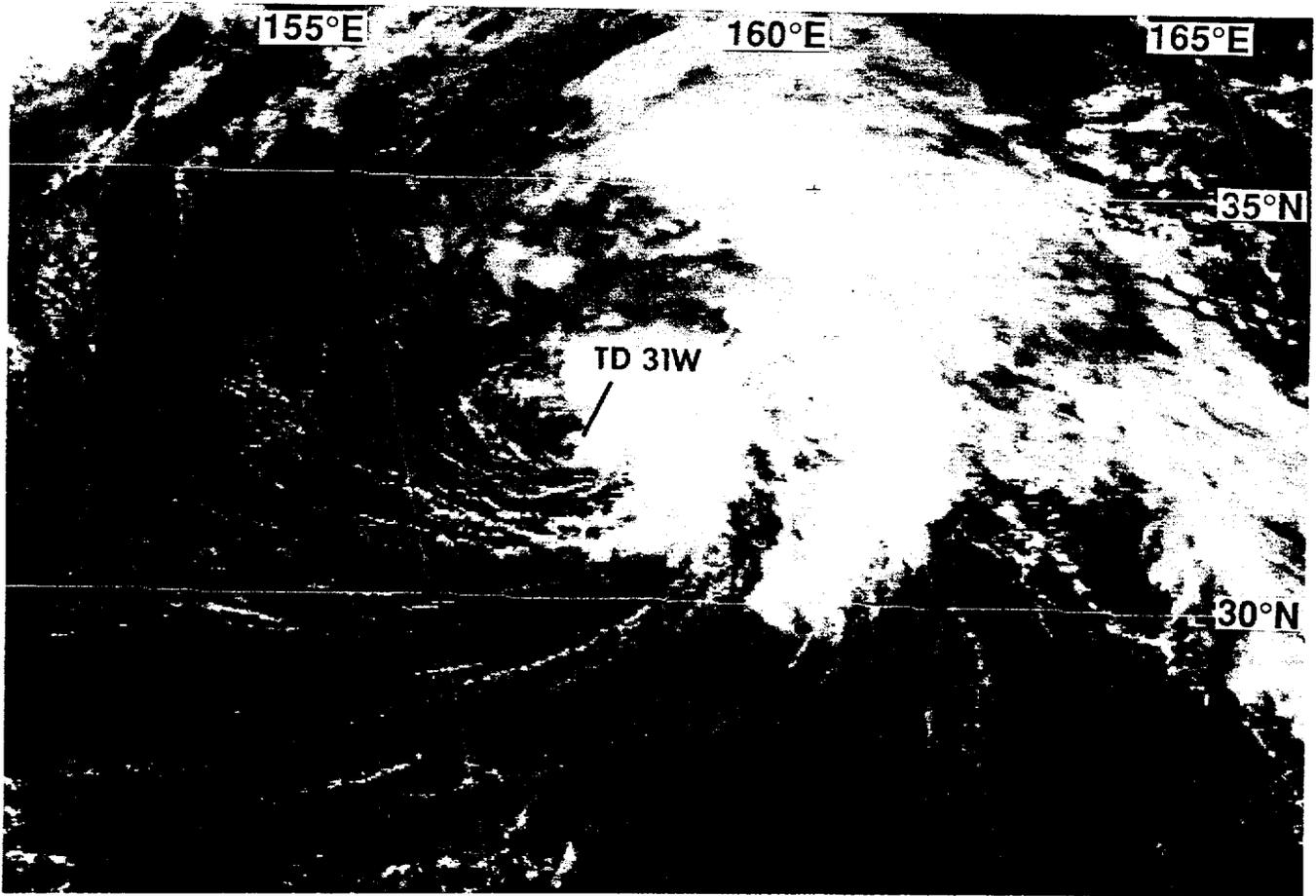


Figure 3-31-2 Well-organized low-level cloud lines accompany an area of deep convection as Tropical Depression 31W moves eastward and begins to dissipate (030031Z October visible GMS imagery).

was included on the 280600Z September Significant Tropical Weather Advisory. At 290600Z, the first warning was issued on Tropical Depression 31W. Remarks on this first warning included:

“ . . . The tropical disturbance east of Marcus island [WMO 47991] has intensified into Tropical Depression 31W, This system is well organized but lacks any significant deep convection. Some moderate convection has developed around the system center and numerous low-level cloud lines were noted spiraling into the tight circulation. . . .”

Tropical Depression 31W failed to become a tropical storm. For most of its life it lacked significant deep convection. Often, it was merely composed of tightly wound low-level cloud lines. After the system recurved at 021200Z October, it acquired significant deep convection and exhibited its most impressive satellite signature (Figure 3-31-2). The final warning was issued at 031200Z, as the system moved eastward and weakened.

III. DISCUSSION

The formation of Tropical Depression 31W in direct association with a cold low in the tropical upper tropospheric trough (i.e., a TUTT cell) is hypothesized to be a distinct mechanism of tropical cyclogenesis that has not been previously addressed (see also the discussion section in Yuri's (36W) summary). The closest description of this process is Sadler (1976). However, in Sadler's model, the

tropical cyclone forms about 1000 km to the southeast of a TUTT cell where diffluent upper-level southwesterly wind enhances deep convection (Figure 3-31-3a). The TUTT cell also acts to enhance upper-level outflow from the incipient tropical cyclone. In Sadler's model, the tropical cyclone may originate in the low-level monsoon trough, and as such, it is indirectly affected by the TUTT cell. Tropical cyclones like Tropical Depression 31W and Yuri (36W), form near the core of the TUTT cell, embedded in low-level tradewind flow at sub-tropical latitudes (i.e., north of 20°N) (Figure 3-31-3b). The cloud systems of such tropical cyclones tend to be isolated in the cloud-free zone between the cloudiness associated with the monsoon trough and the extensive cloudiness associated with the polar front.

IV. IMPACT

No reports of damage or injuries were received.

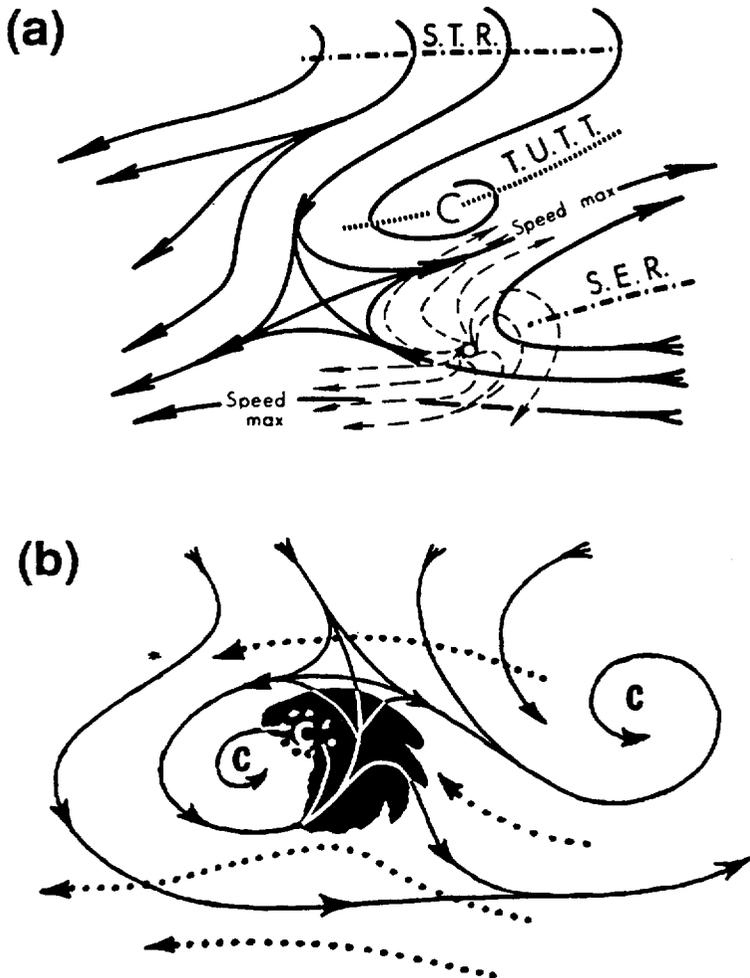


Figure 3-31-3 (a) Sadler's (1976) model of the indirect role of a TUTT cell in tropical cyclogenesis. S.T.R. = subtropical ridge, T.U.T.T. = tropical upper tropospheric trough, and S.E.R. = sub-equatorial ridge. (b) Schematic illustration of the direct role of a TUTT cell in the genesis of Tropical Depression 31W and of Tropical Storm Yuri (36W). Solid lines are 200 mb streamlines, dotted lines are low-level flow. Black-shaded area shows deep convection.