Lecture 11 (10-21-83)
21 October 1983

USES OF SATELLITE DATA: WEATHER PHENOMENA FROM CLOUD PATTERNS — ICE AND SNOW.

I. POLAR IMAGES

- Figure 11-1 (slide): Lest we forget how far we've progressed in cloud imaging!
  - TIROS images of Typhoon Karen, 14 Nov. 1962 & nephanalysis.
- Unrectified examples of HRPT from early NOAA satellites.
  - Figure 11-2 (slide) = Hurricane Ava — VIS. } 1km. res.
  - Figure 11-3 (slide) = " " — IR }
  - Figure 11-4 (slide) = TWIN HURRICANES IONE & KIRSTEN } NOAA 3 VHRR VIS 24 AUG 1974
- ~~AVHRR 4-C~~
- FIGURE 11-5 (SLIDE): 4 CHANNELS OF TIROS-N AVHRR FOR COMPARISON. (L-R)
  - VIS = 0.55 – 0.9 (now 0.58 – 0.68)
  - NR IR = 0.725 – 1.1
  - window = 3.55 – 3.93
  - window = 10.5 – 11.5.

  24 May 1979
  - Point out effect of background on contrast.
  - Diff. btwn 2 vis, nr. IR channels & thermal IR re Cirrus from storm on right edge of picture.

II. GOES IMAGES.

- Sequence of simultaneous pics., 8 AUGUST 1980 with
  - Hurricane Allen in Gulf of Mexico and Howard in Pacific.
  - Occluded storm off W. Coast of southern South America.
- Figure 11-6 (slide): Full disk vis (here, res. ≐ 7 km.)
- Figure 11-7 (slide): Full disk IR " 8 km
  (Note differentiation of low & high cloud W. of S. America & N. America.)
- Figure 11-8 (slide): "Electronic enlargement", VIS ~ 4km Res.
- Figure 11-9 (slide): " " , VIS ~ 2km "
  - Note eye & rain bands.
- Figure 11-10 (slide): GOES VIS. (LOW SUN ANGLE!) THUNDERSTORMS ALONG A COLD FRONT. (23 July 1978)

Fig. 11-1 TIROS Images of Typhoon Karen, Nov. 11, 1962 & Nephanalysis

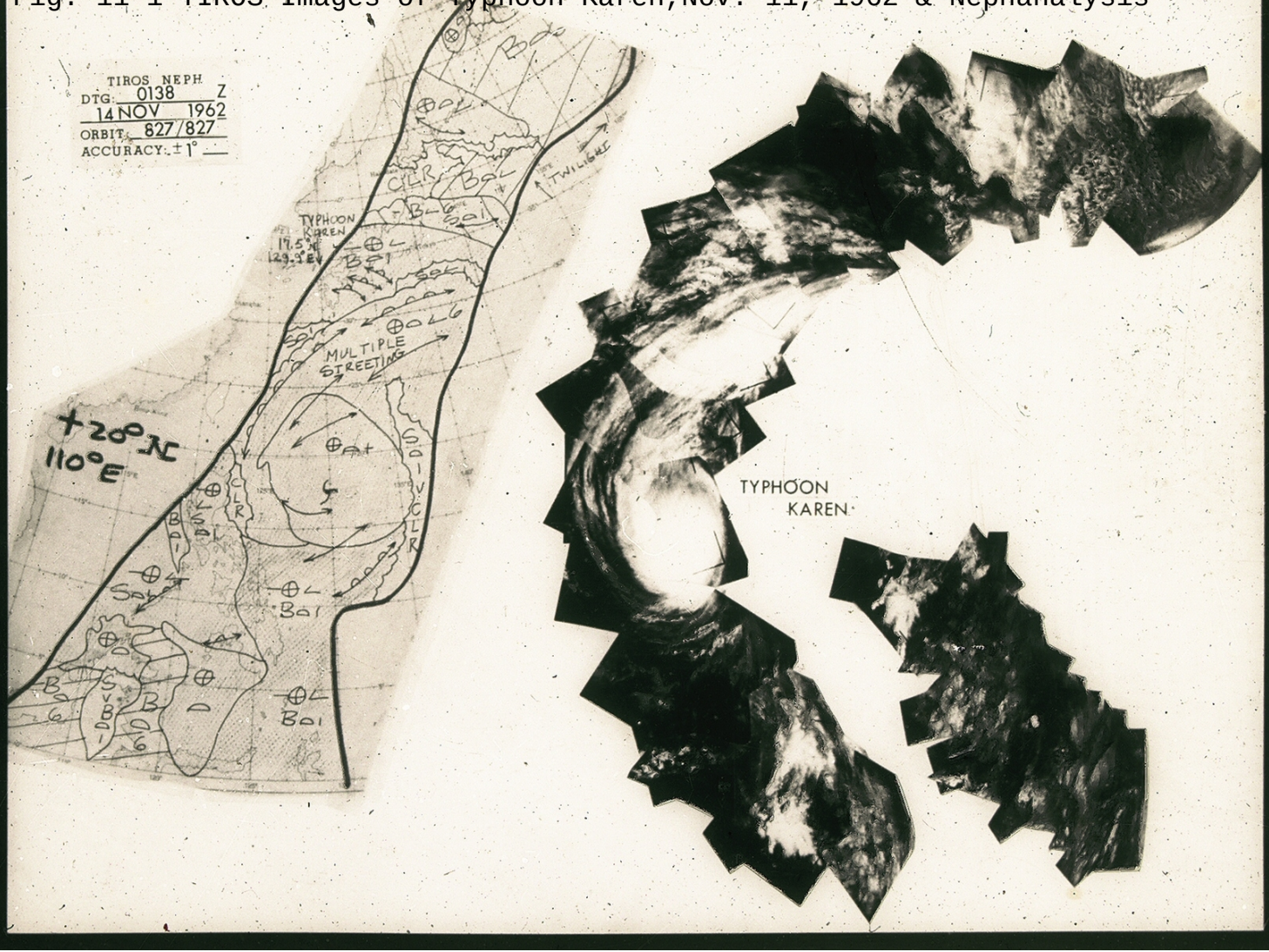


Fig. 11-2 Hurricane Ava - VIS.

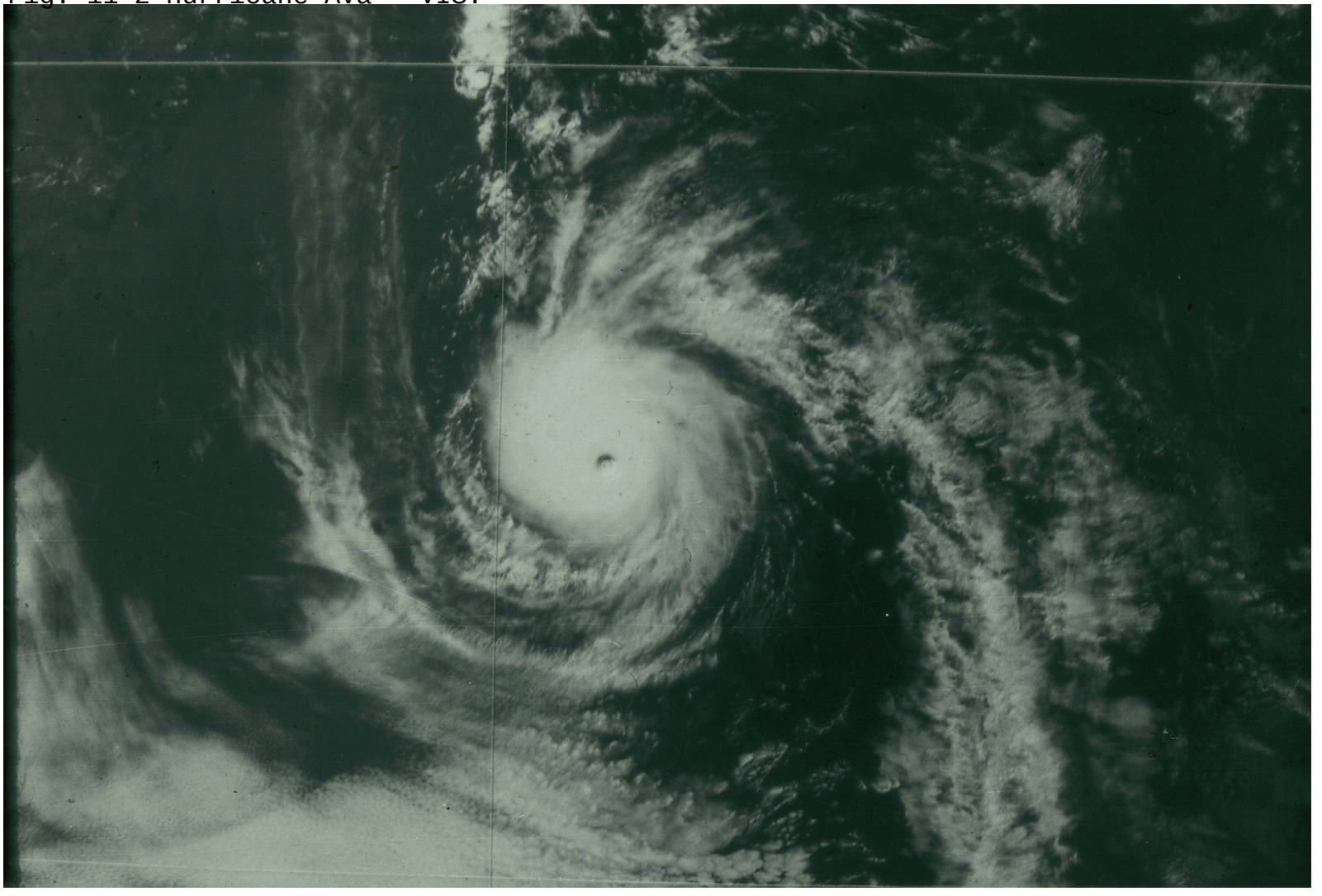


Fig. 11-3 Hurricane Ava - IR

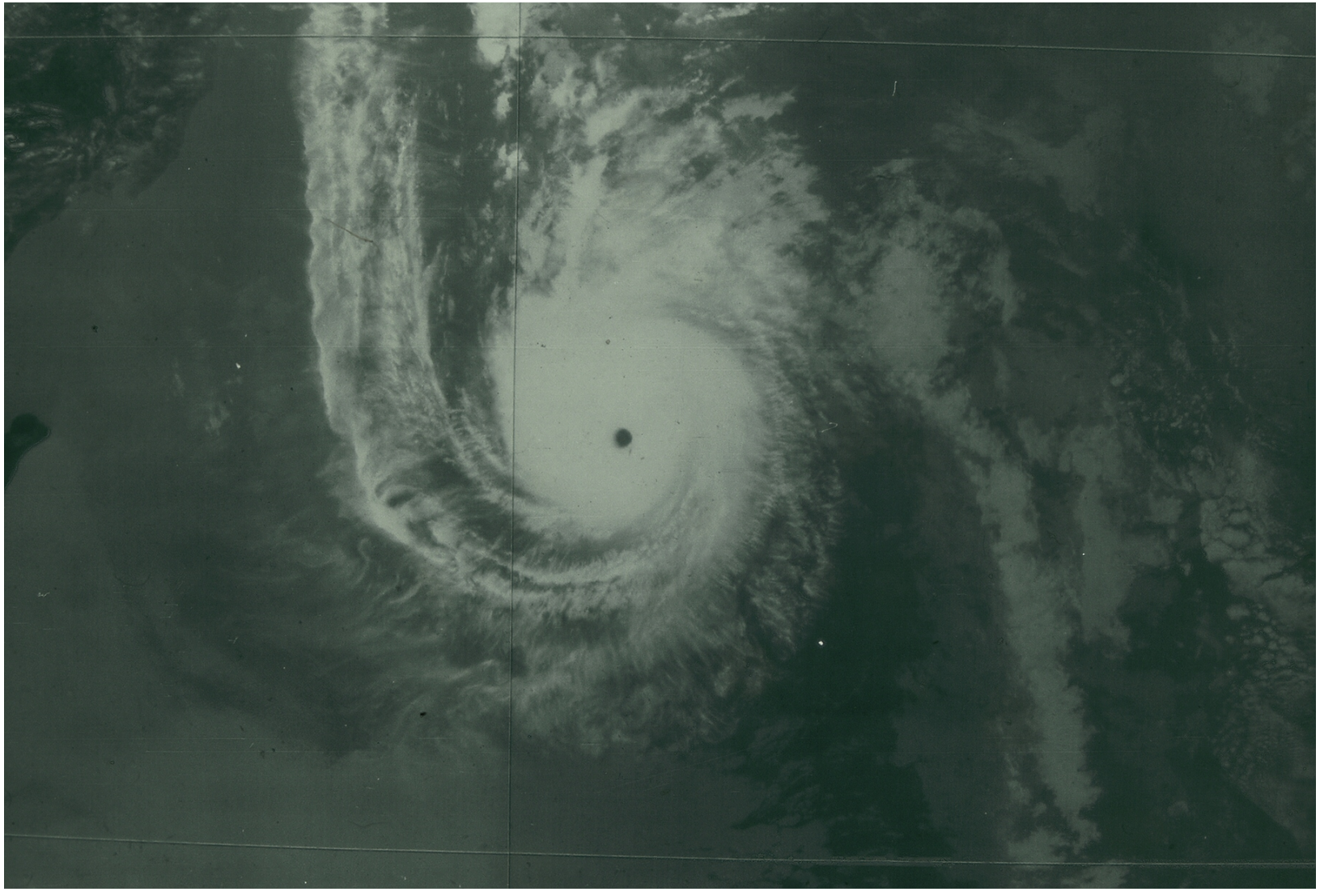


Fig. 11-4 Twin Hurricanes Ione and Kirsten - Aug. 24, 1974 - NOAA 3, VHRR VIS

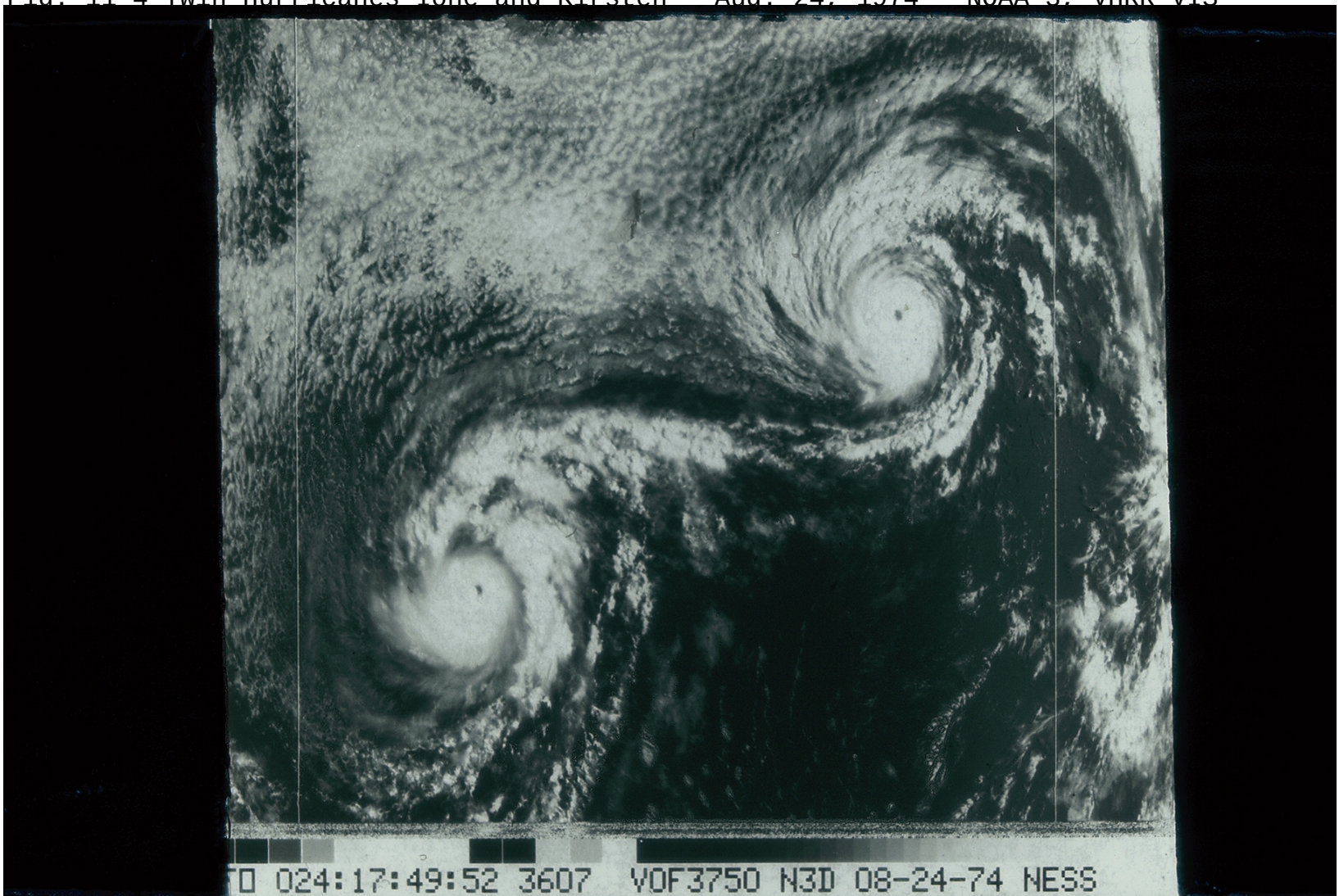


Fig. 11-5 Four Channels of TIROS-N AVHRR for Comparison - May 24, 1979

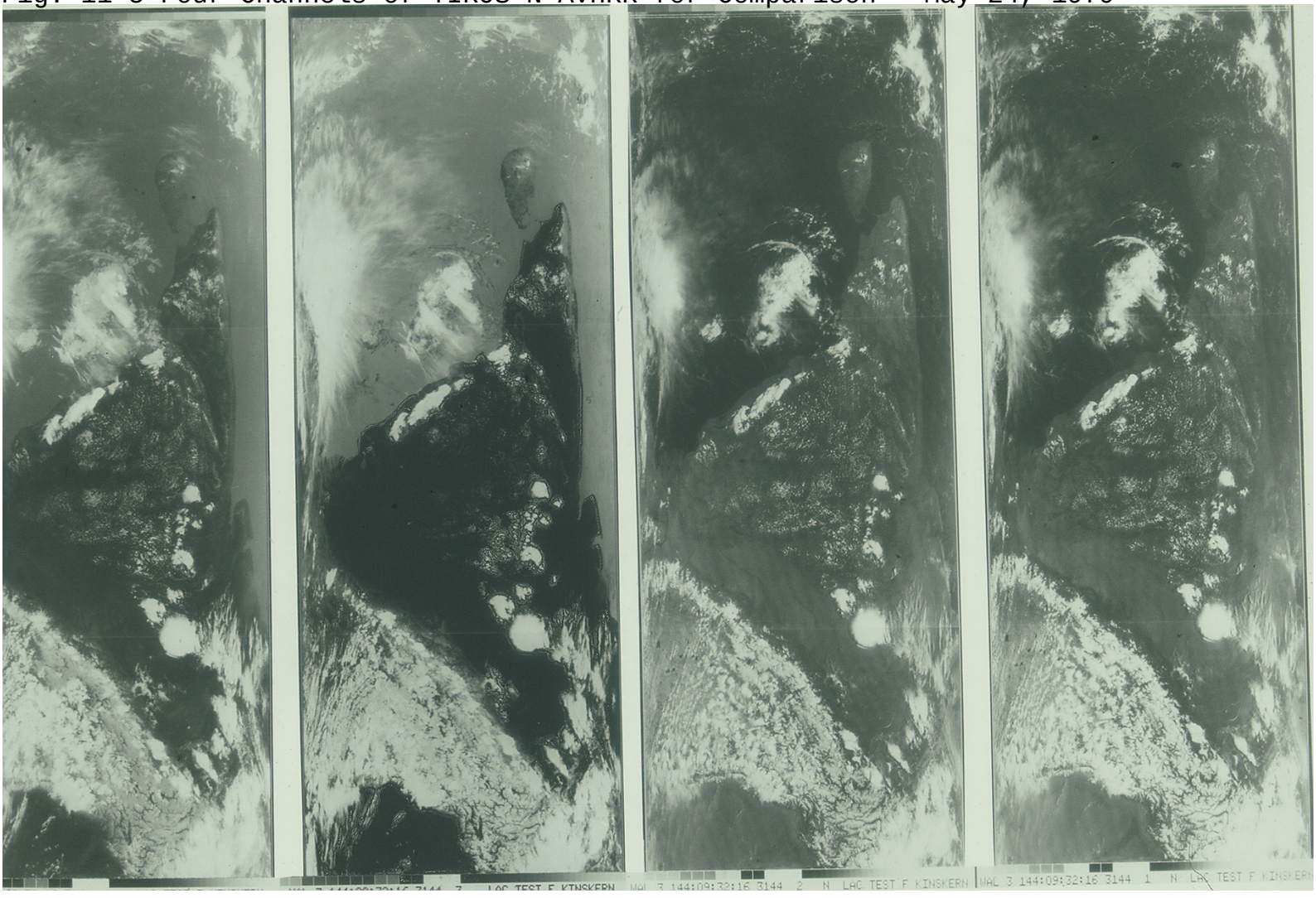


Fig. 11-6 GOES Full Disk VIS - Hurricane Allen

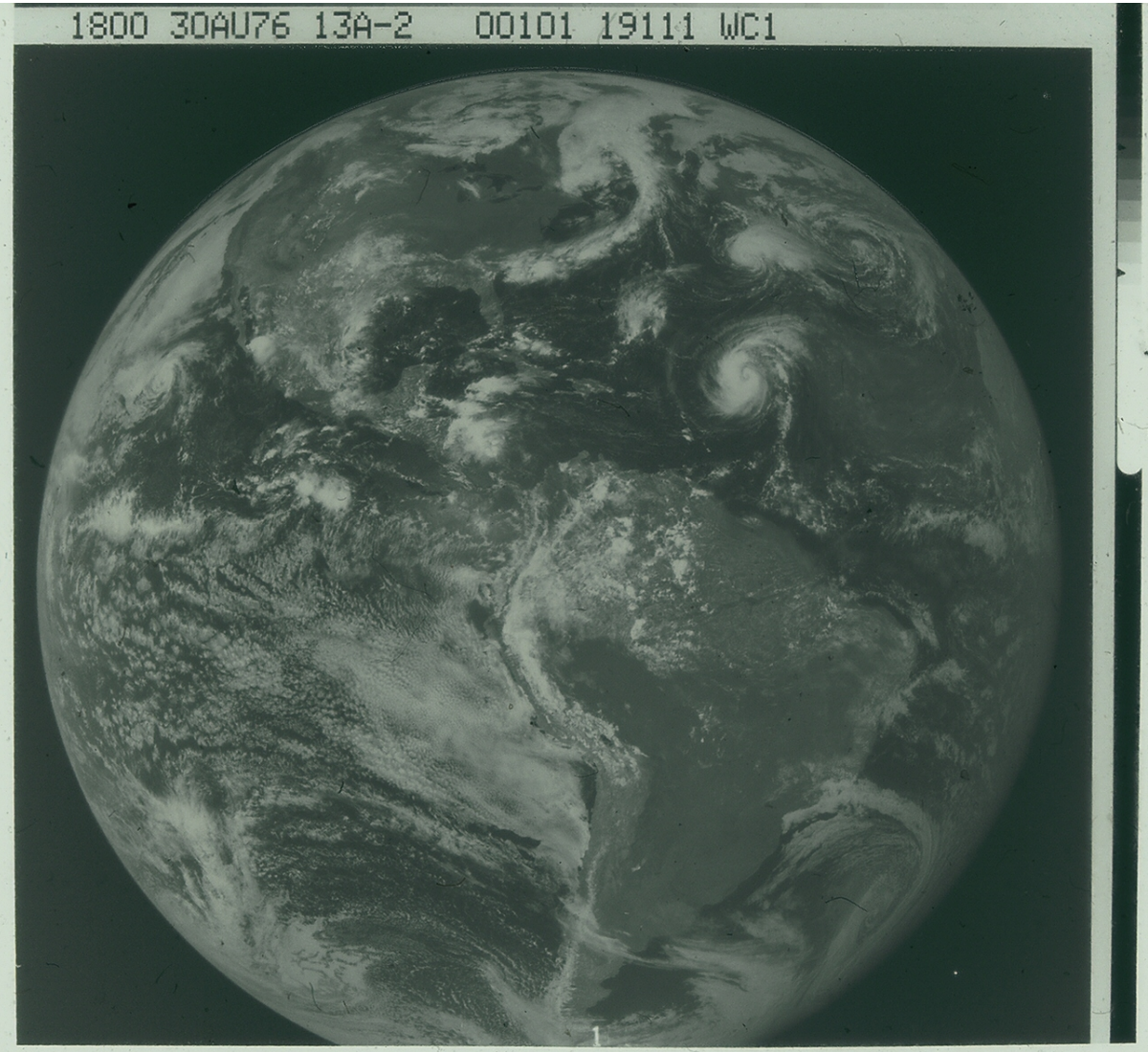


Fig. 11-7 GOES Full Disk IR - Hurricane Howard in Pacific, August 8, 1980

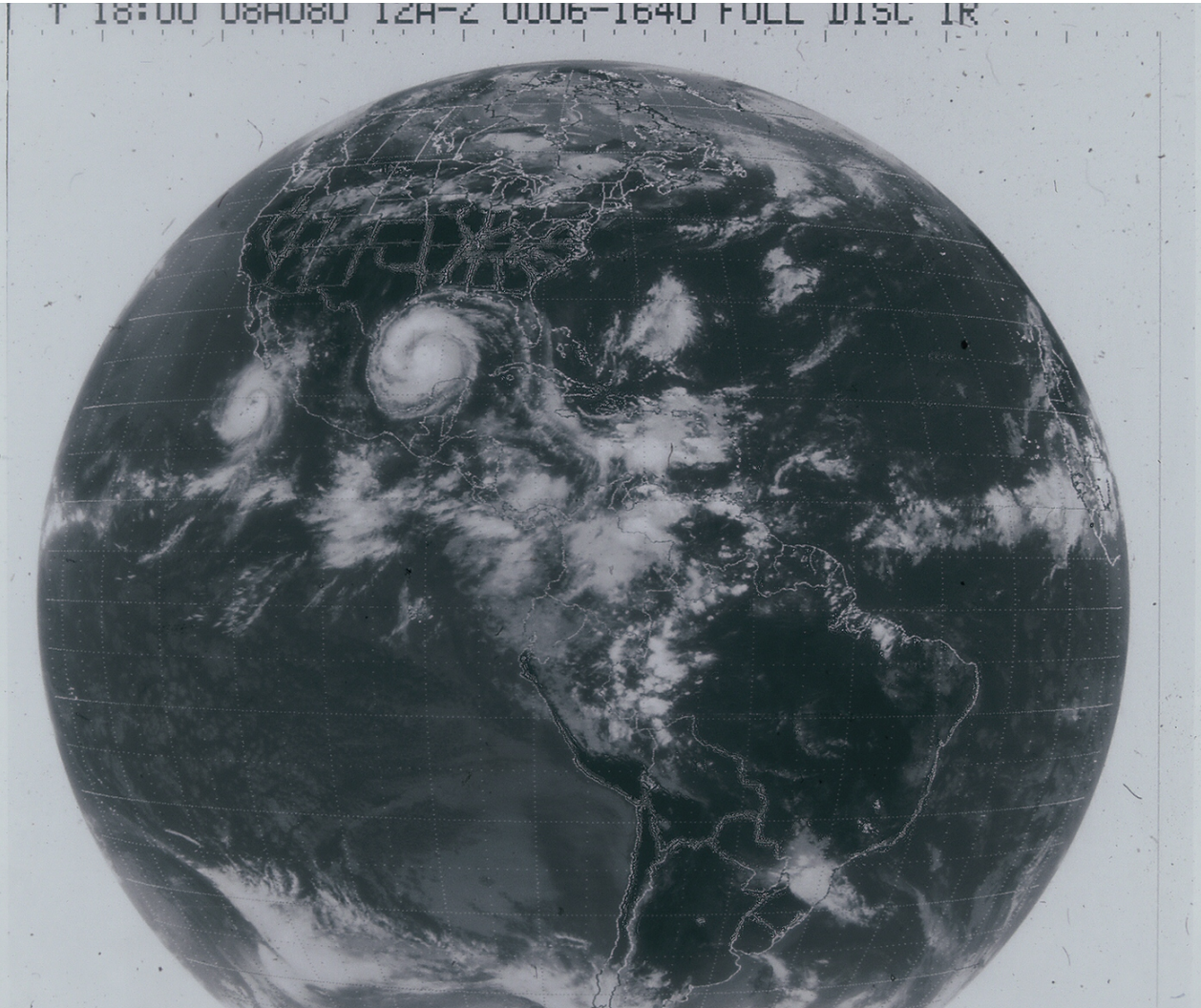


Fig. 11-8 GOES Electronic Enlargement, VIS ~ 4km res. Aug. 8, 1980

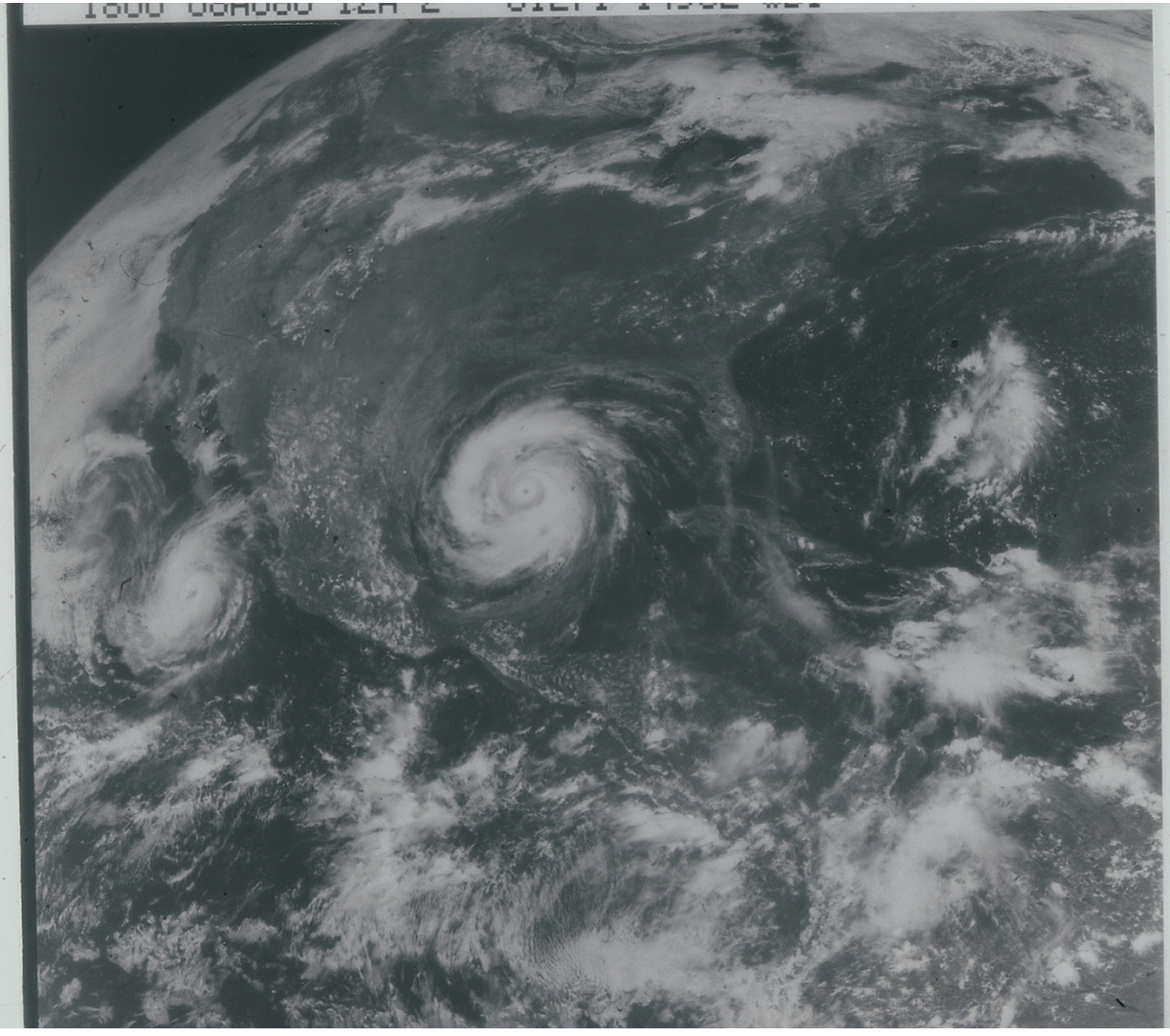


Fig. 11-9 GOES Electronic Enlargement, VIS ~2 km res., 8-8-80

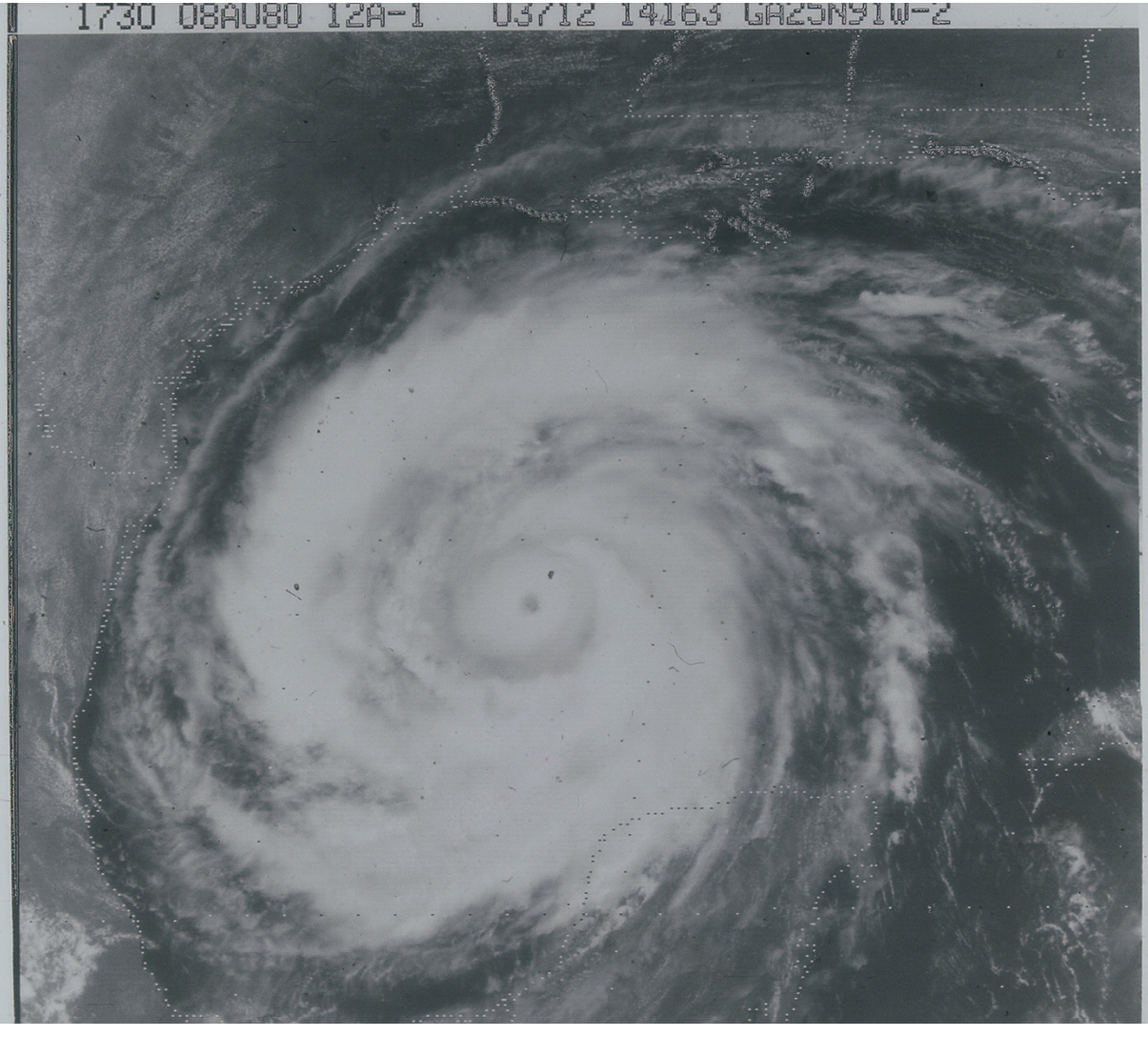
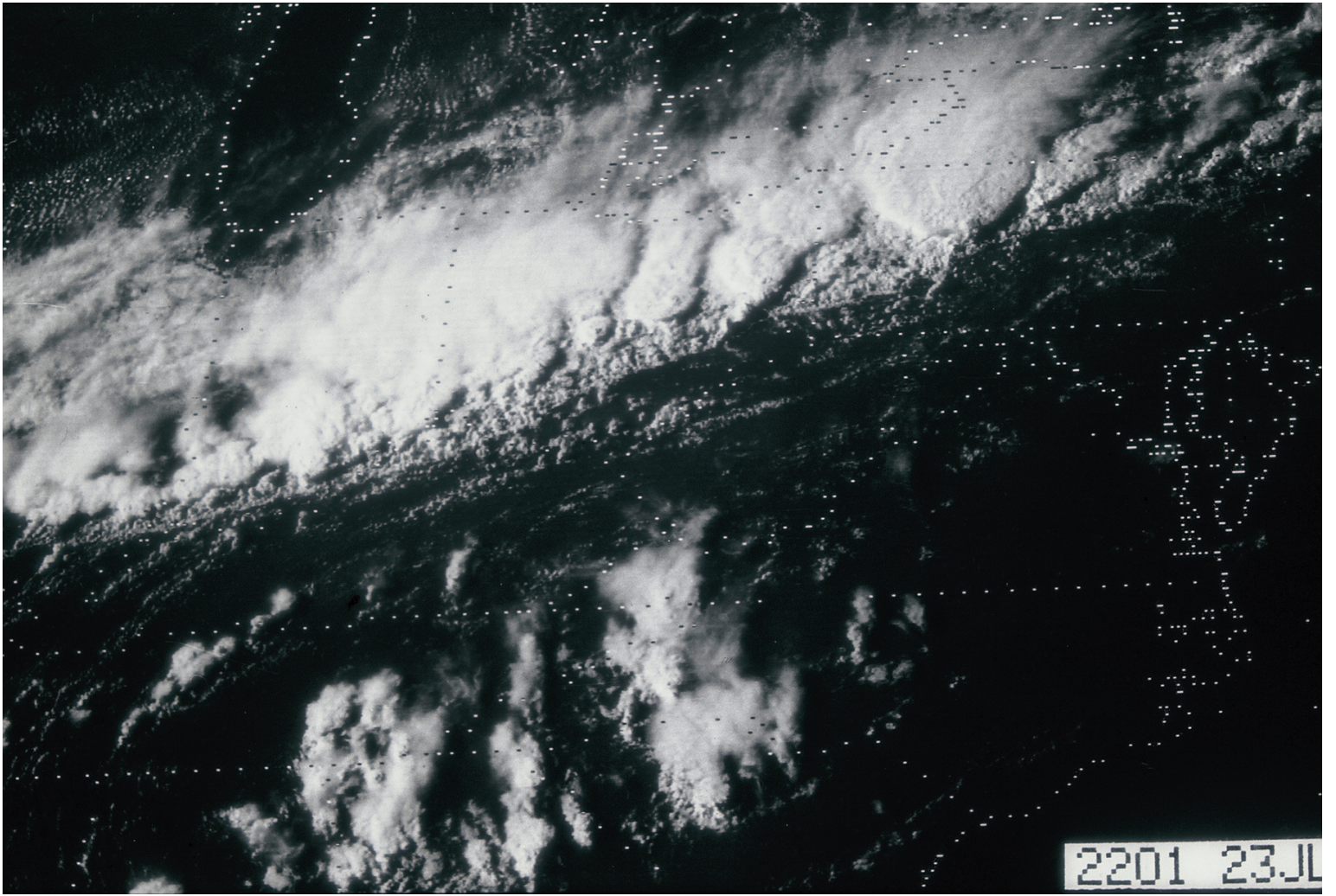


Fig. 11-10 GOES VIS. Thunderstorms Along a Cold Front, July 23, 1978



- Figure 11-11 (slide): GOES VIS, 1km Res. Thunderstorms with overshooting tops. — Point out cores. (31 May 1976) ~~(23 July 1978)~~
- Figure 11-12 (slide) [Shown also in FIGURE 8-1 lecture 8]: Evolution of major thunderstorm viewed at ½ hour intervals. IR images enhanced to show coldest part of storm as white. (Total time period shown = 12 hours.)

III. MOVIE OF GOES IMAGES (4 min at 16 fps)

(Translate what will be seen before showing film)

- Hurricane Gladys, Altantic ocean, Five days of images — 29 September to 3 October 1975.

  Visible images — Continuous daytime coverage at 30 minute intervals, resolution ~ 4 km.
  - Overlay shows track of Gladys during the five days.
  - Eight-hour time lapse only, 1330–2130 GMT, 29 SEPT. Full area of ~~the storm~~ coverage, then zoom in on the storm.

  Infrared images — Same 5 days, but 24 hr./day coverages.
  - Complete cycle over the Atlantic Ocean.
  - Enlarged view of the storm, with camera moving with the storm.

- Tornadic Thunderstorms — 24 April 1975, visible images, all at 5 minute intervals.
  - 7 hours, 1300 to 1940
    - Six cycles over full area; last 3 point out location of tornadoes.
  - 3 hours, 1630 to 1940, enlargement of Joplin-Neosho area.
    - One cycle in slow motion, overlay shows paths of tornadoes.

Fig. 11-11 GOES VIS, 1 km res.-Thunderstorms with Overshooting Tops - May 31, 1976

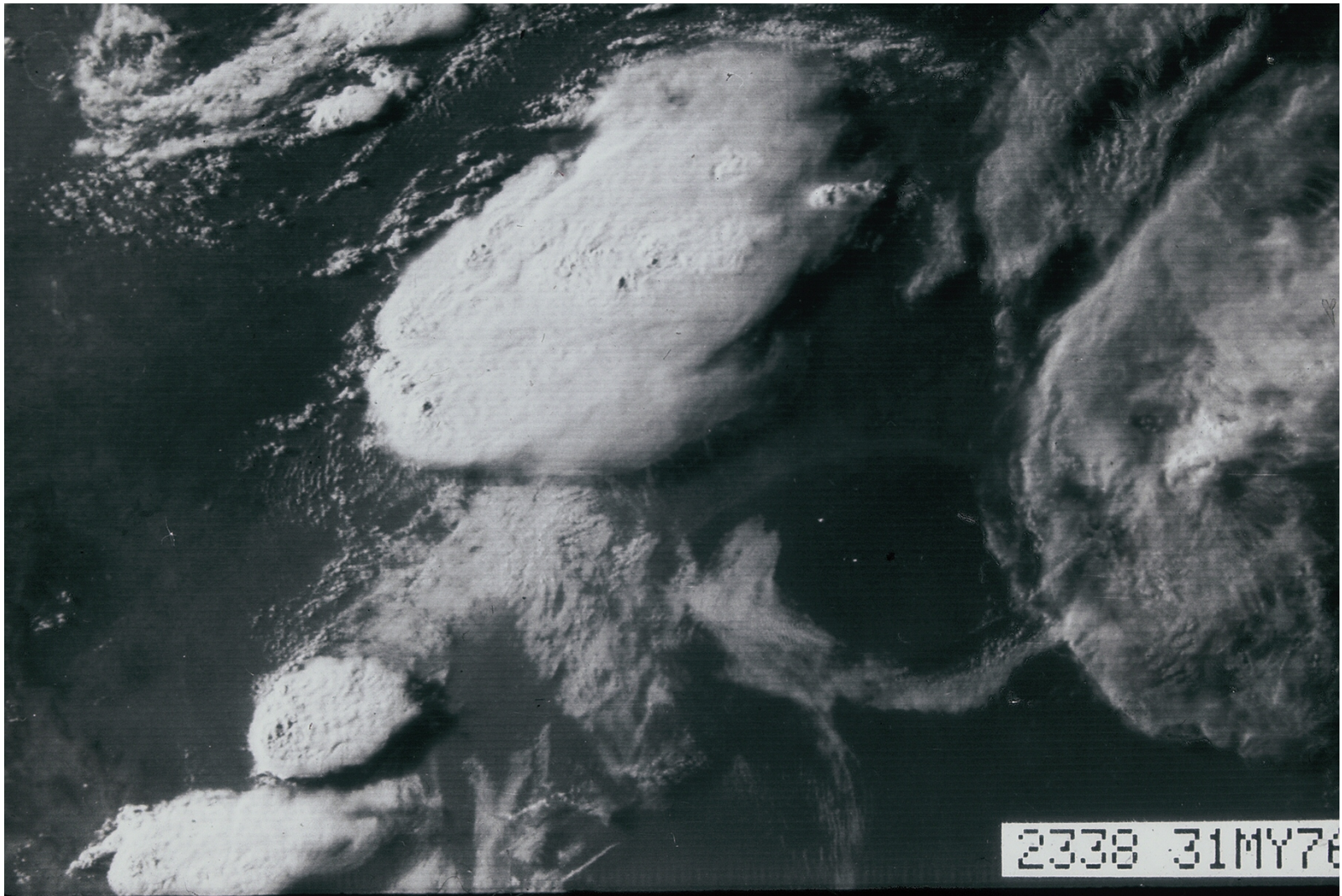


Fig. 11-12 Slide [also shown as Fig. 8-1]

Evolution of major thunderstorm viewed at ½ hour intervals.

MISSING

- Figure 11-13 (Vu-graph) - Apparent effect of use of an interactive processor with GOES data by the NSSFC on the forecasting of severe storm and tornado watch areas. Also has been a reduction in the size of the watch boxes.

IV. USE OF MSU CHANNEL 3 FOR HURRICANES

(From W.L. Smith and C.S. Velden - NESS + U. Wisc., Nov. 20, 1981)

MSU Channel 3 weighting function (temperature) peaks at about 250 mb. Images from this channel show the darkest area (warmest temperatures) near the center of a hurricane.

Objective analysis done by calculating the Laplacian of the temperature field based on the MSU channel 3: $\nabla^2 T_{250mb.}$ (10^{-5} °K/M²)

- Figure 11-14 (Vu-graph) - Comparison of the MSU Channel 3 estimate of the center of Hurricane Harvey and the best knowledge of the National Hurricane Center.

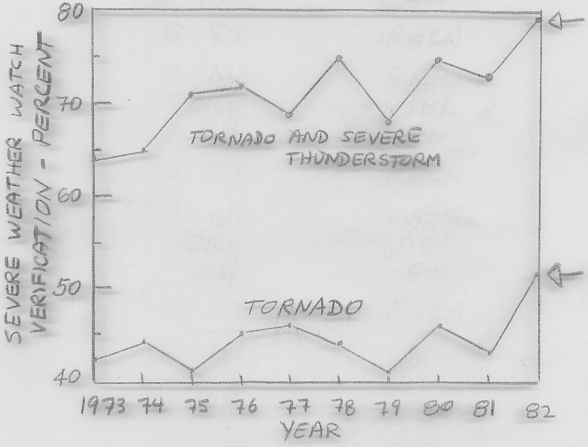
  Agreement well within one degree of lat/long

- Figure 11-15 (Vu-graph)

  Relation between the Laplacian and maximum wind speed for Harvey used to produce regression line shown here. Line then used to predict maximum winds for Hurricane Irene. "X's" give observed values from formation of Irene to its peak intensity.

(~~August~~ ~~May~~ May 1983 (I) Journ. of Climate + Applied Meteorology.

IMPACT OF USE OF GOES INTERACTIVE PROCESSOR ON THE SEVERE STORM FORECASTING BY THE NATIONAL SEVERE STORM FORECAST CENTER



"... the trend since installation (late '81) of (interactive processor) is encouraging. .... watches which were verified reached an all-time high in 1982 ..... statistics ... for the first half of 1983 .... indicate that .... watch verification has remained near the record 1982 level".

Fred Ostby, NWS-NSSFC

Figure 11-13.

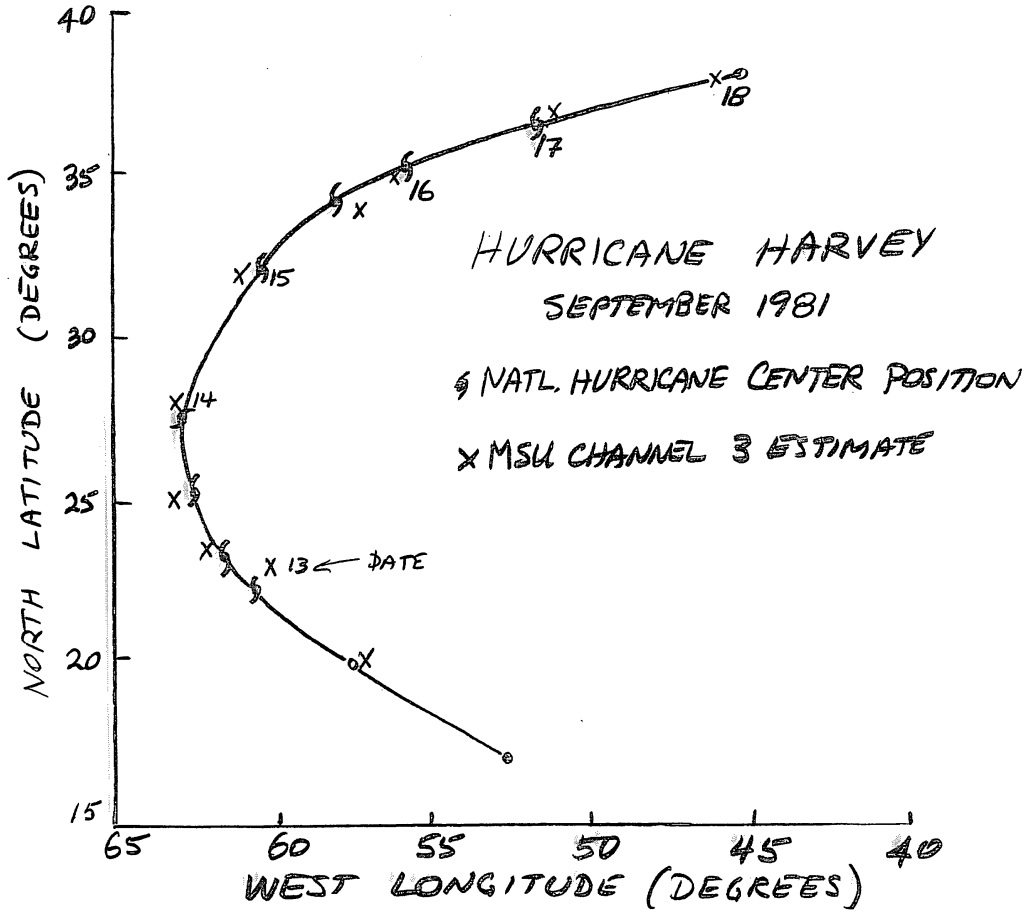


Figure 11-14

Figure 11-14

RELATIONSHIP BETWEEN THE MSU CHANNEL 3 TEMPERATURE (LAPLACIAN) AND MAXIMUM WIND SPEED OF HURRICANE 'IRENE'.

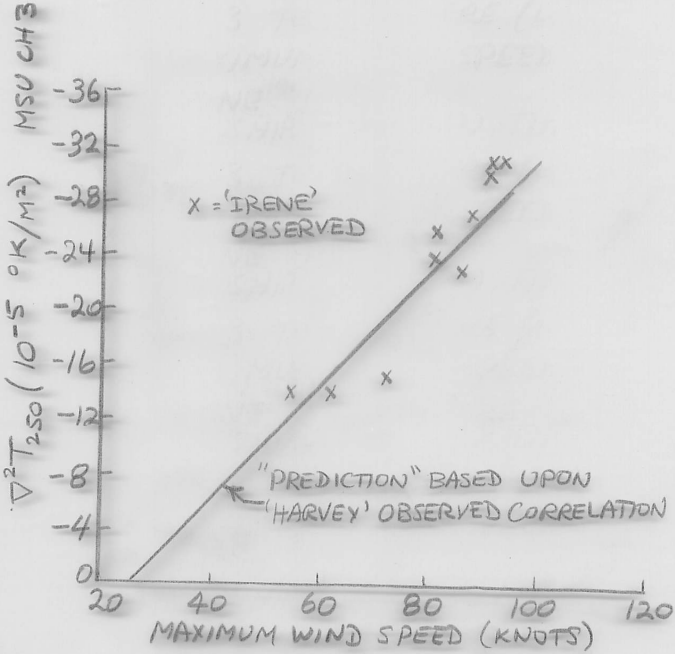


Figure 11-15

- Figure 11-16 (slide):
  Full disk view in 6.7 μm water vapor channel.
  (upper troposphere H_2O).
  Subsidence over Baja California.
  Circulation in High over South Pacific.
  Moisture associated with convective zones.
- Figure 11-17 (slide): 6.7 μm VAS + 300MB R/S winds.
  Dry, subsiding air typically in the left rear quadrant of the jet stream.

V. ICE AND SNOW.

- Figure 11-18 (slide): Hi res vis, 25 March 1975
  Shows ice in Bering Sea area.
- Figure 11-19 (slide): Resulting ice analysis based on images for 22-26 March
- Figure 11-20 (slide): Ice in Beaufort Sea from SEASAT synthetic Aperture ~~Resolution~~ radar. Area is ~~18 x 75 MB~~ ≐ 30 x 120 KM. (11 JULY 1978)
  Right to Left: (1) Banks Island
  (2) Black area: Shore-fast ice, 1 to 2 M. thick, Mostly 1st year
  (3) Light grey: open water
  (4) Mixed open water/multi-year ice floes 2-3M thick
  (5) Dark grey: Main icepack; floes up to 20km. dia.
- Figure 11-21 (slide): Snow on the Sierra-Nevada Mountains.
  (Point out California coast, Lake Tahoe)
  American River Basin is just W. of Tahoe
- Figure 11-22 (slide): Plot of snow-covered area in American River Basin.
  Information used in water management and flood forecasting;
  Over 20 river basins. (Also Scandinavia)

Fig. 11-16 GOES VAS Full Disk View - water vapor channel (upper troposphere)

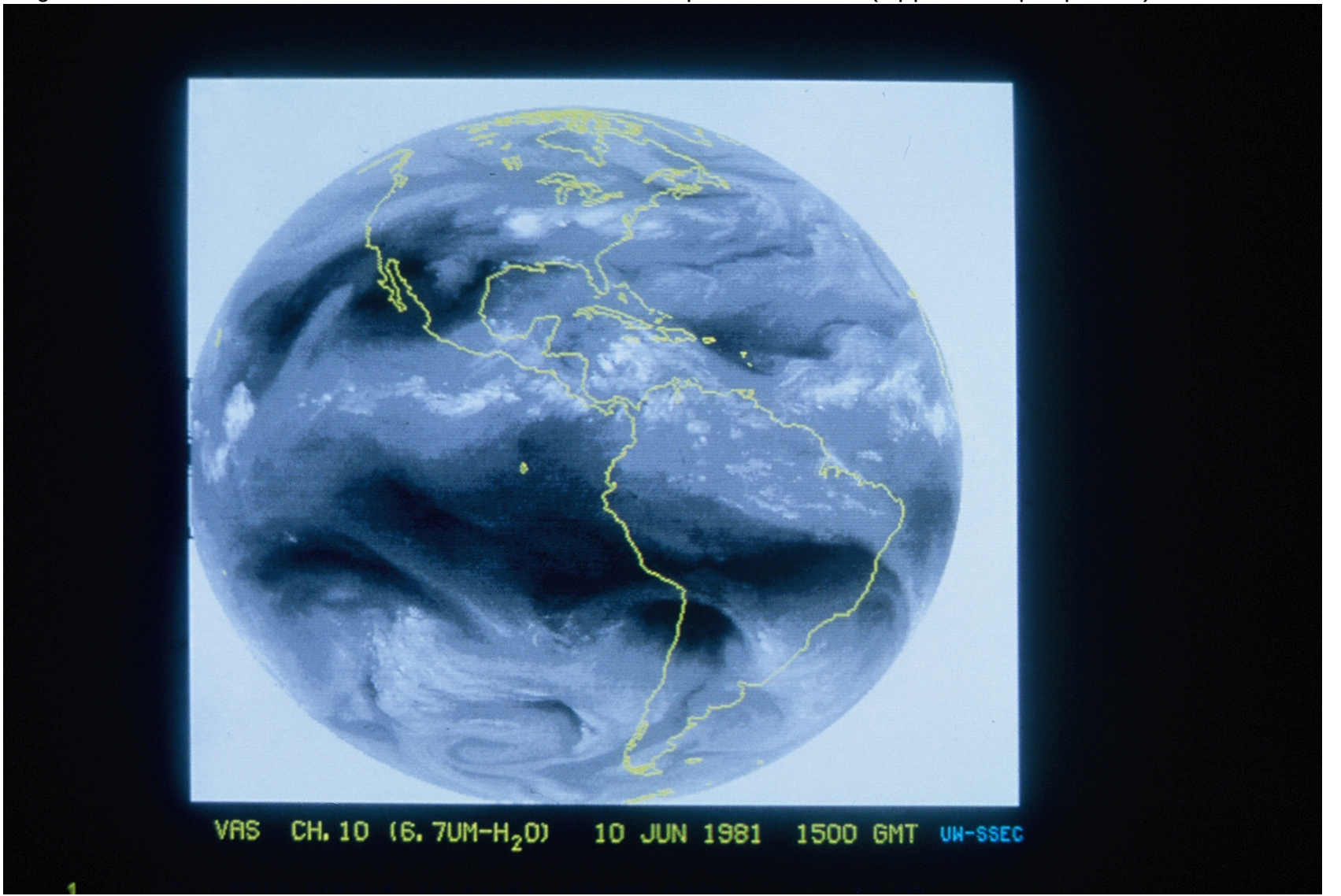


Fig. 11-17 GOES VAS Water Vapor Plus R/S Winds

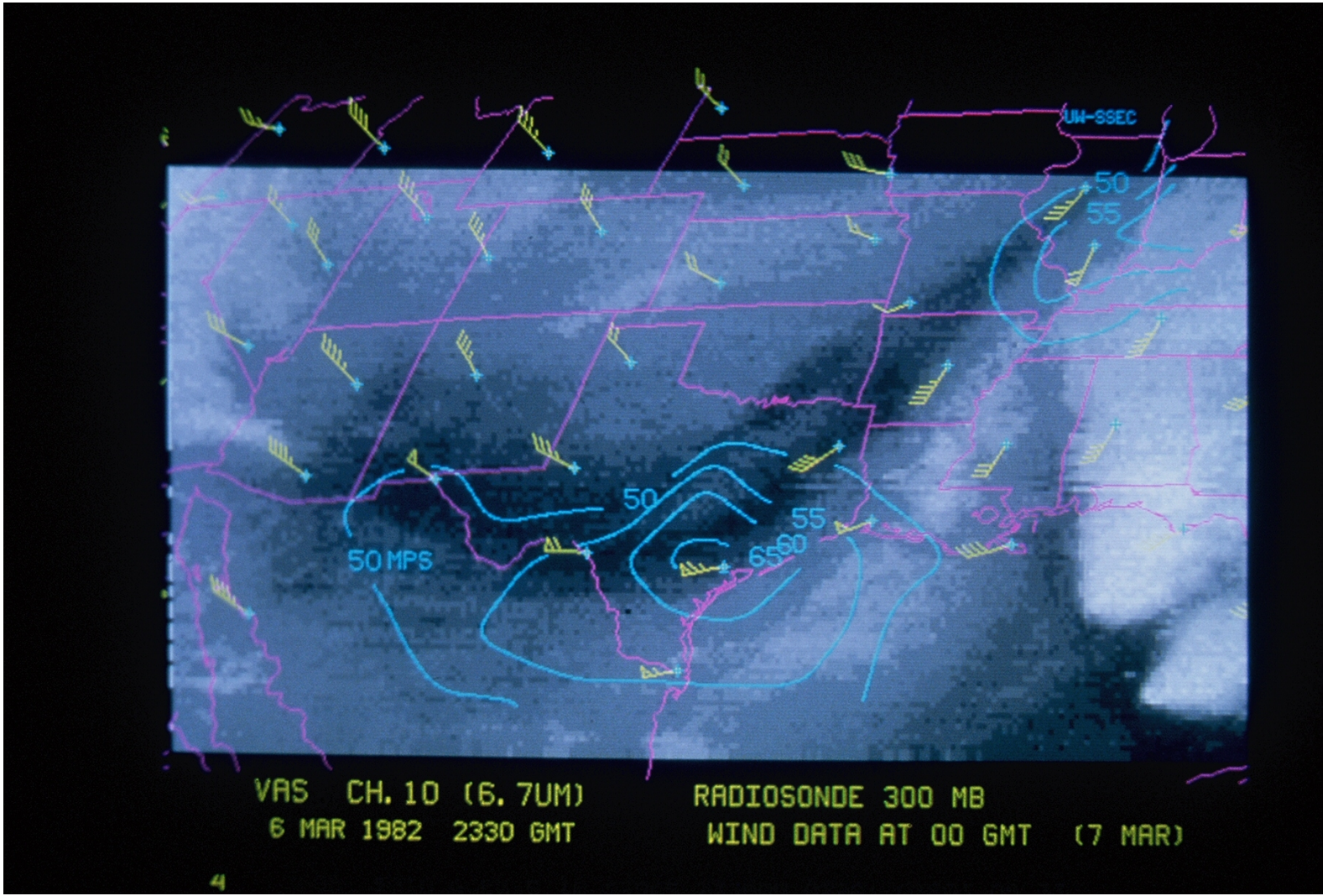


Fig. 11-18 Ice & Snow - hi res, Bering Sea

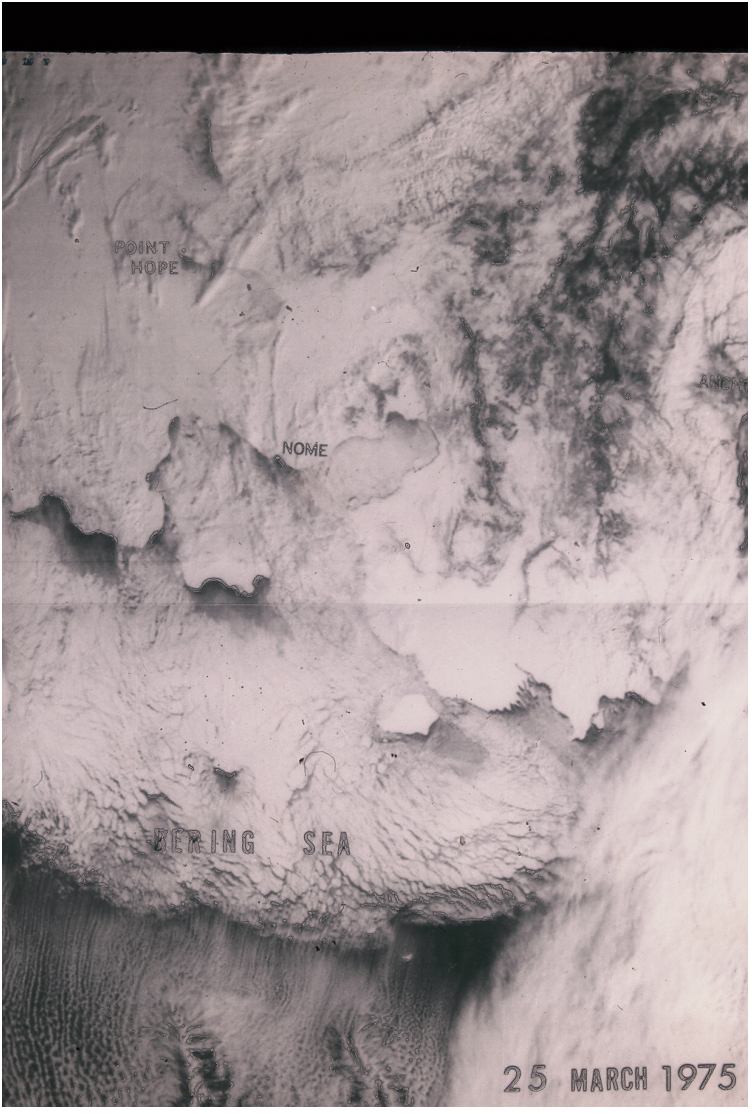


Fig. 11-19 Resulting Ice Analysis, March 22-26, 1975

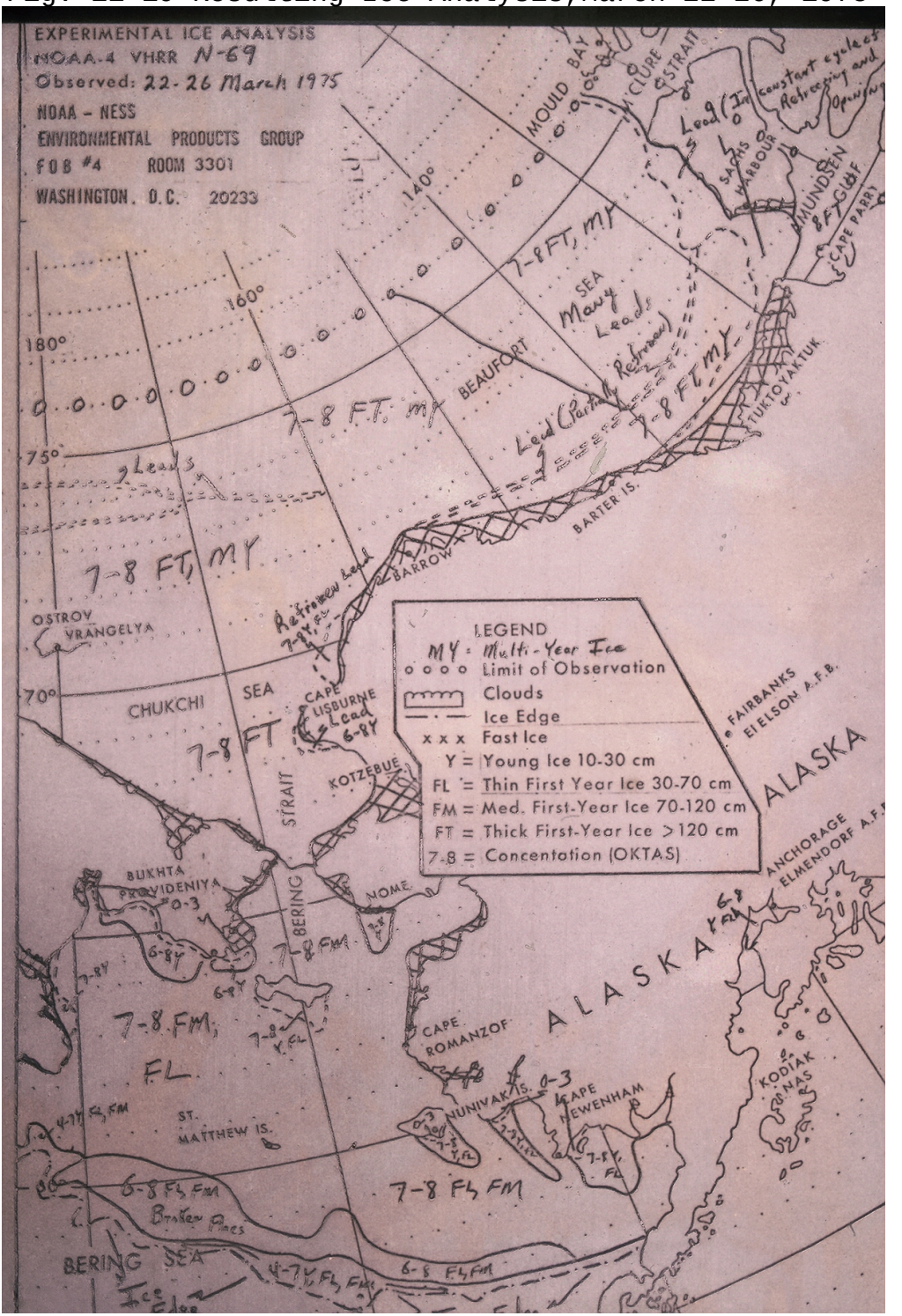


Fig. 11-20 Beaufort Sea Ice Pack , July 11, 1978

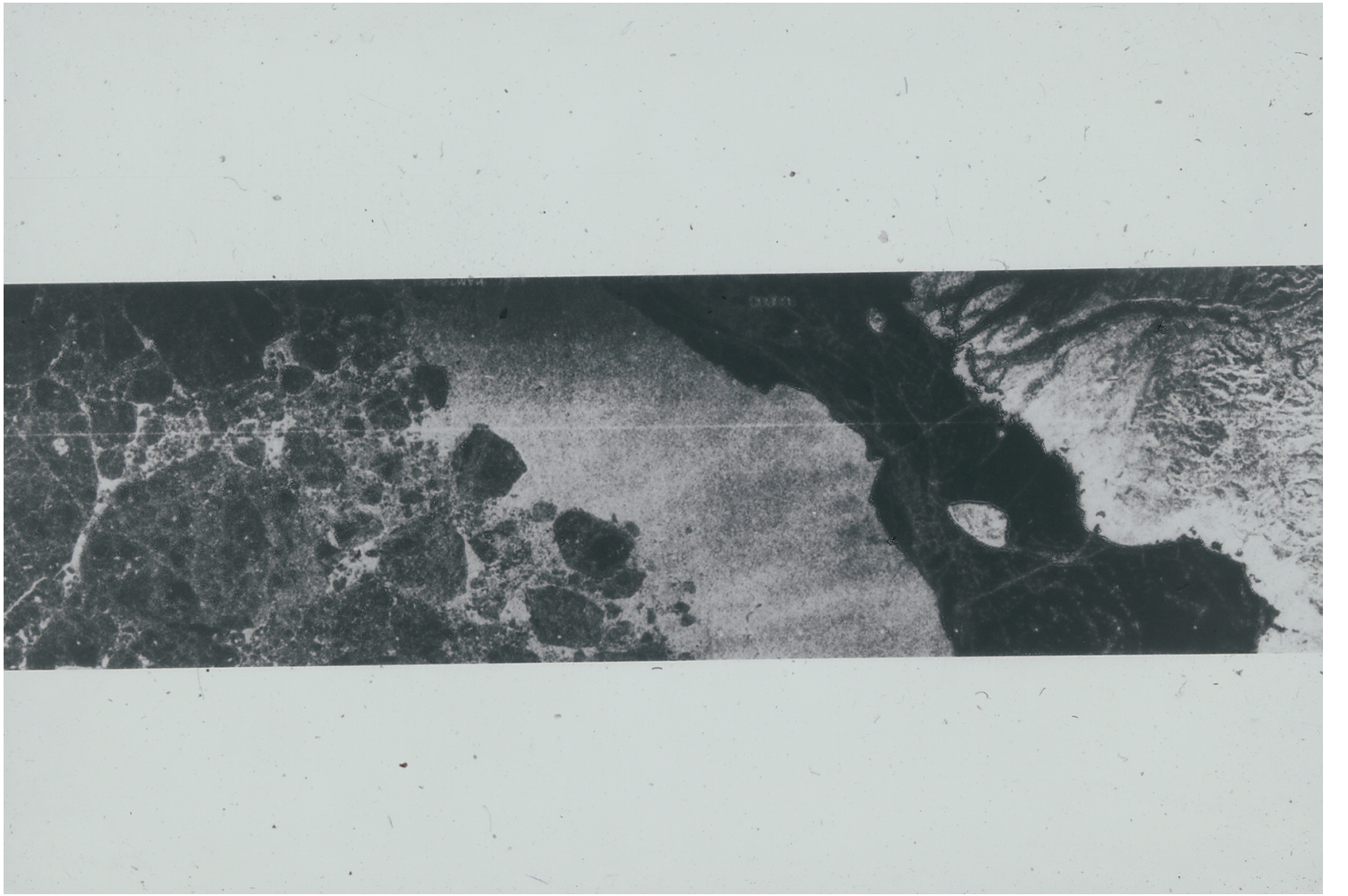


Fig. 11-21 Snow on the Sierra-Nevada Mountains, April 28, 1975

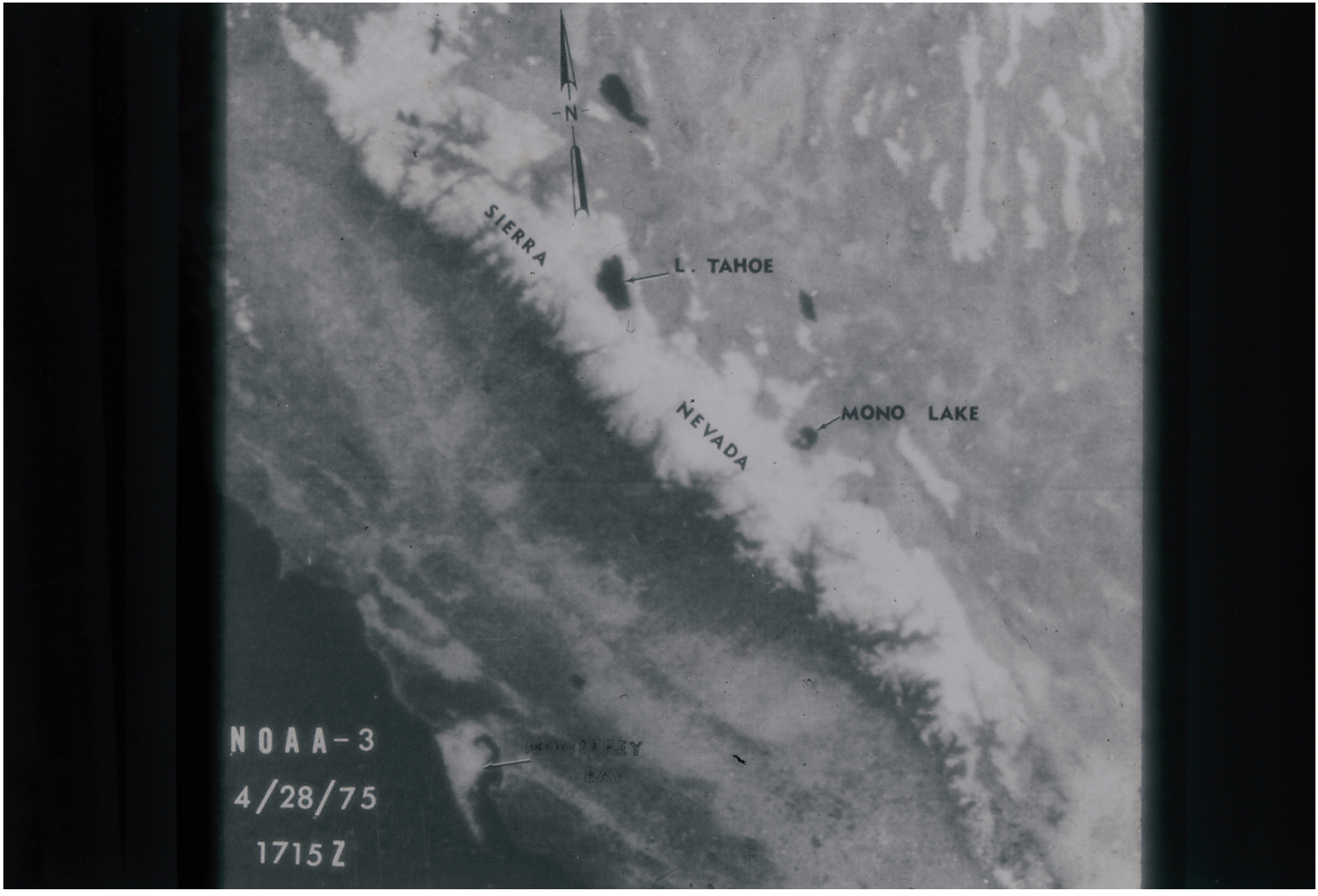
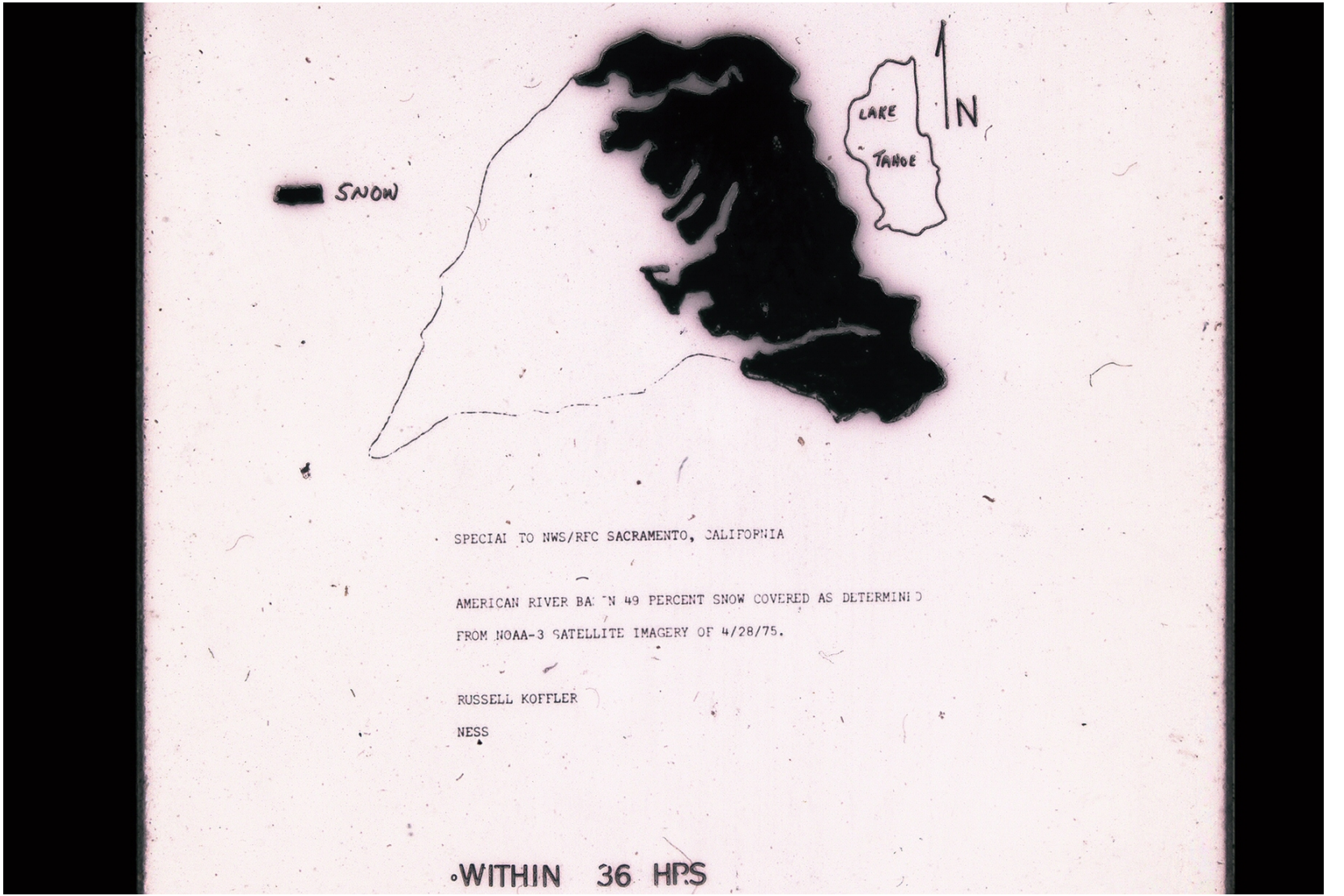


Fig. 11-22 Snow Analysis from VHRR 4/28/75 - Plot of Snow-Covered Area in American River Basin



- ✓ (slide) Figure 11-23: Climatology of global snow cover since 1967. Here is N.H. mean snow cover for January 1981.
- ✓ (slide) Figure 11-24: Departure of ~~the~~ January 1981 from the 14 year average (1967-81)
- ✓ (slide) Figure 11-25: Variation in the December-February seasonal average snow cover for Eurasia 1967-1982

Fig. 11-23 Northern Hemisphere Mean Snow Cover for January 1981

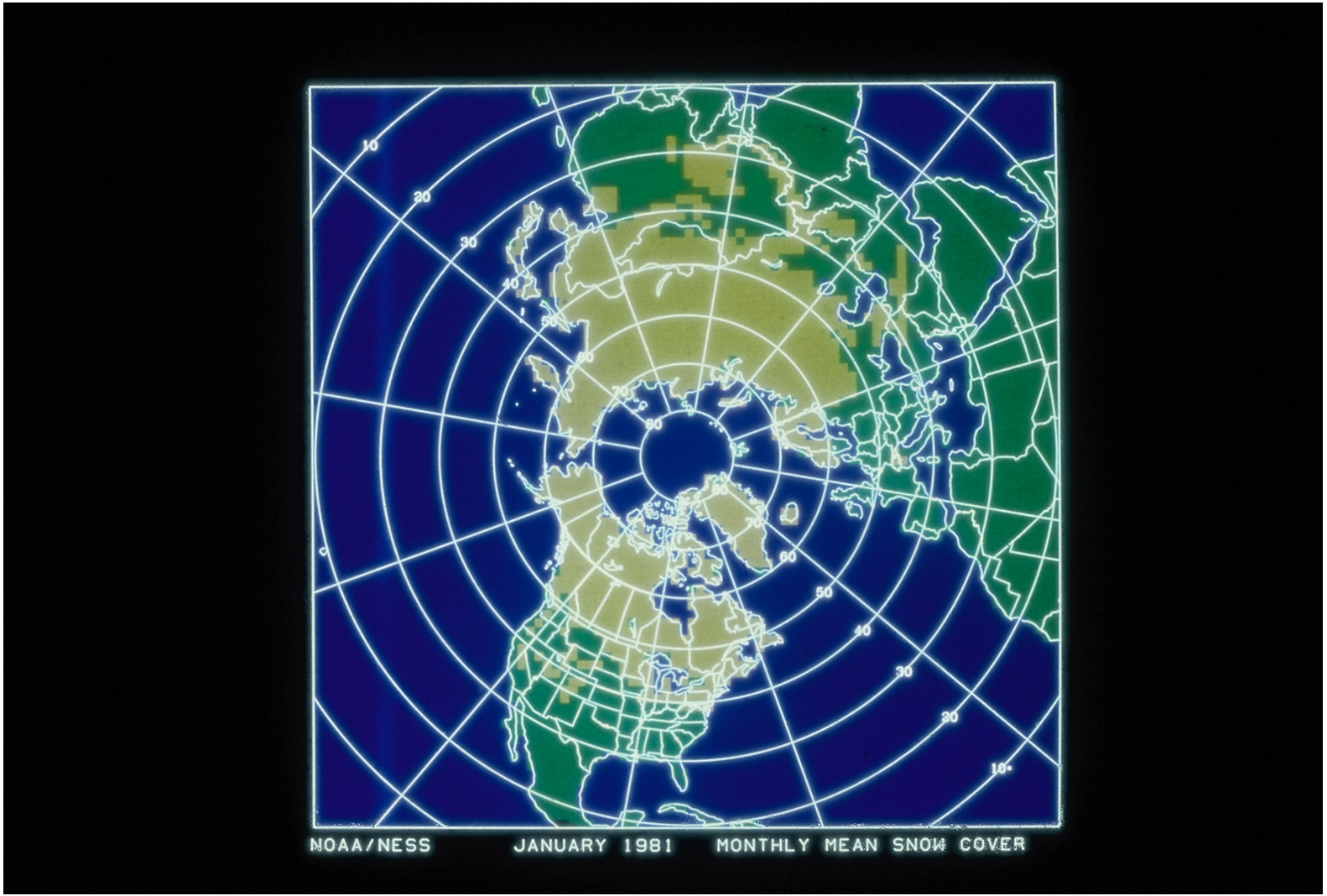
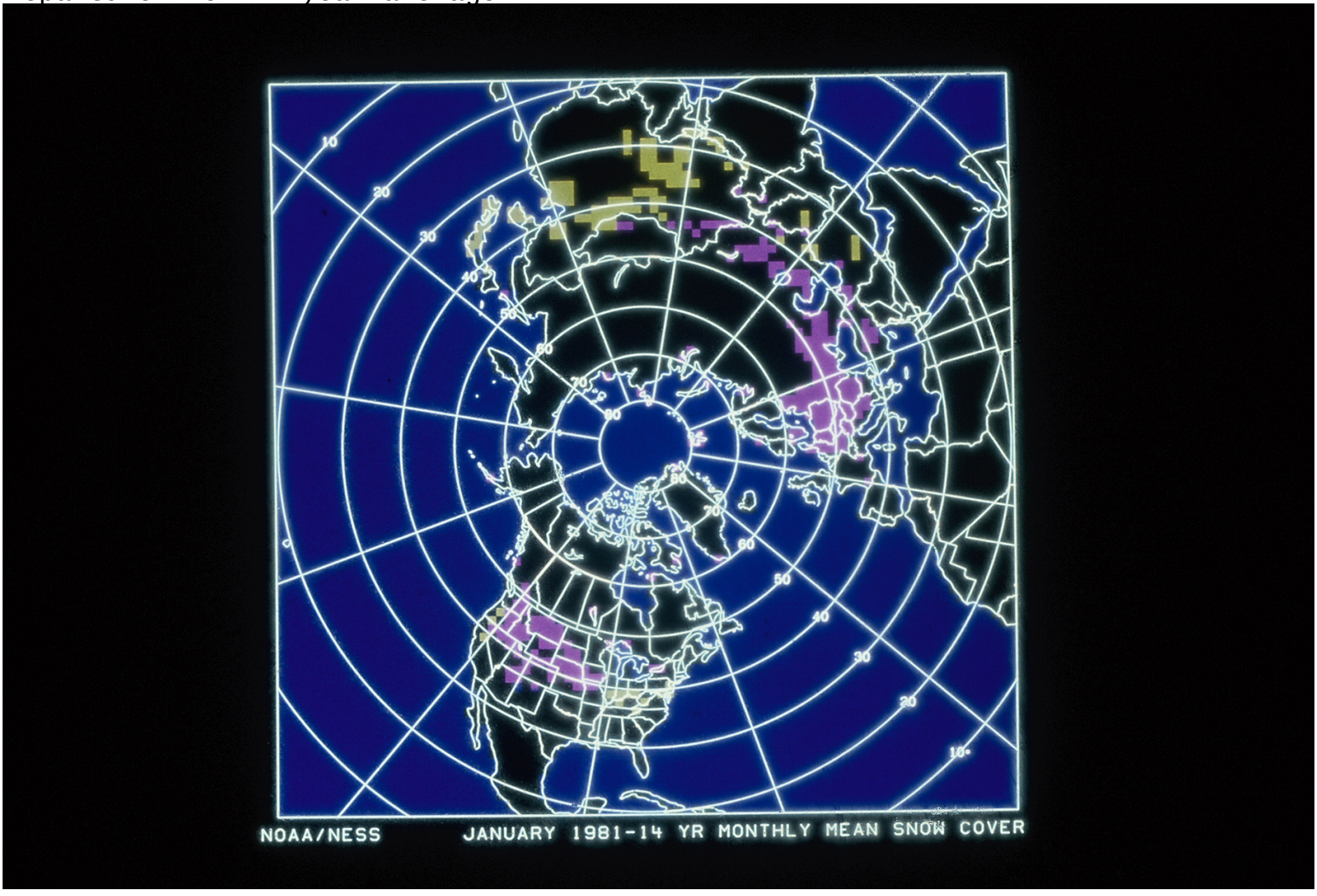
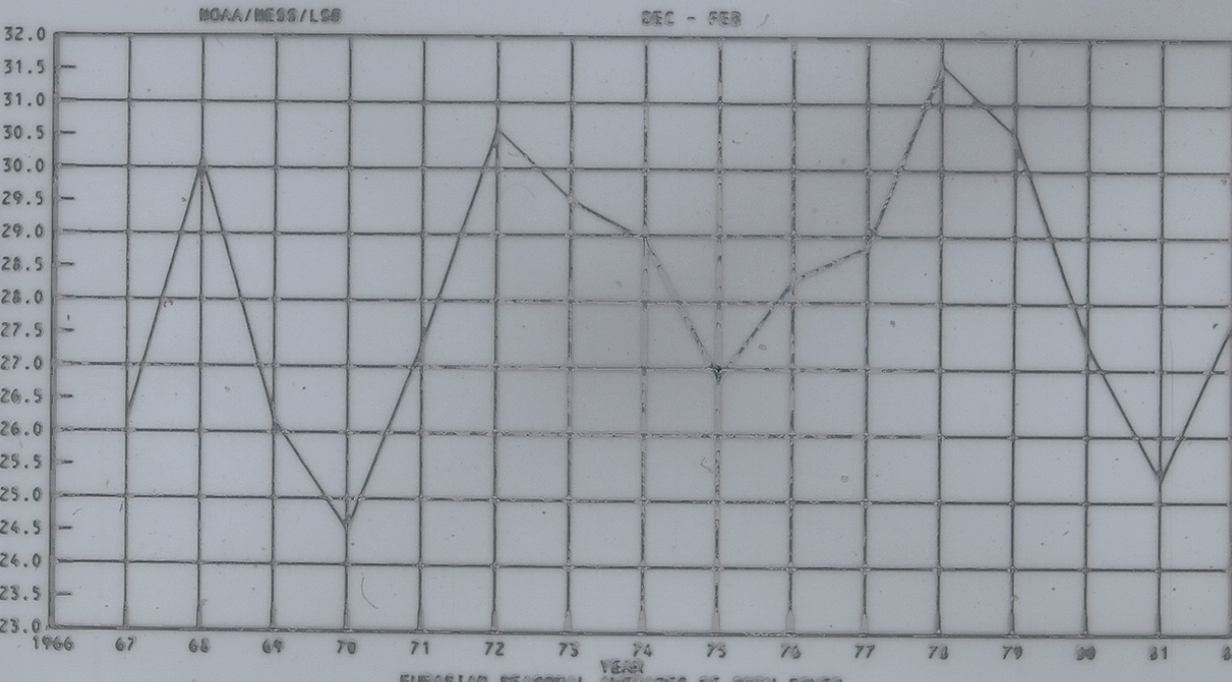


Fig. 11-24 Northern Hemisphere Mean Snow Cover, January 1981

Departure from 14 year average





EURASIAN SEASONAL AVERAGES OF SNOW COVER