Using Synoptic Climatology and the PRISM Model to Improve Precipitation Assessment and Prediction

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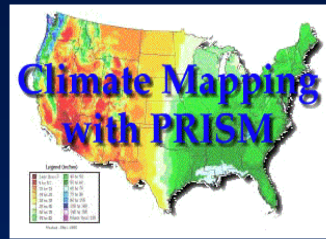
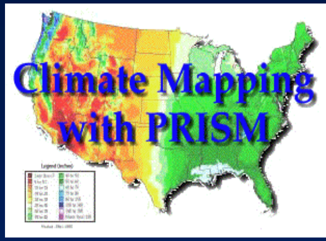


PRISM

Parameter-elevation Regressions on Independent Slopes Model

- Generates gridded estimates of climatic parameters
- Moving-window regression of climate vs. elevation for each grid cell
  - Uses nearby station observations
- Spatial climate knowledge base (KBS) weights stations in the regression function by their climatological similarity to the target grid cell



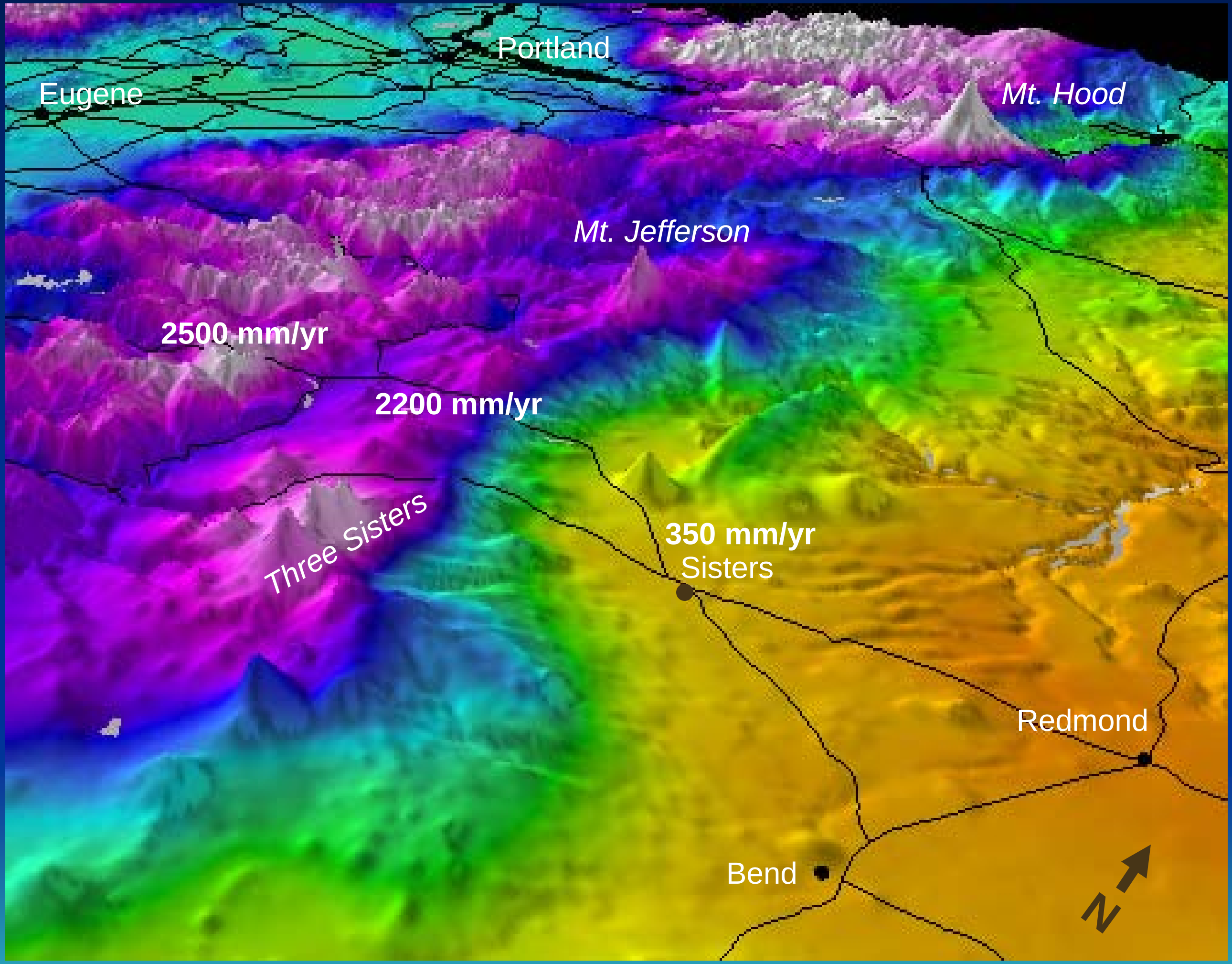
PRISM

Parameter-elevation Regressions on Independent Slopes Model

PRISM Knowledge Base accounts for spatial variations in climate due to:

- Distance – closer is better
- Elevation – similar elevation is better
- Terrain orientation – same side of mountain is better
- Terrain steepness - same slope steepness is better
- Coastal proximity – similar exposure to coastal effects is better
- Inversion layer – same side (above or below) of inversion is better

Rain Shadows: 1961-90 Mean Annual Precipitation Oregon Cascades

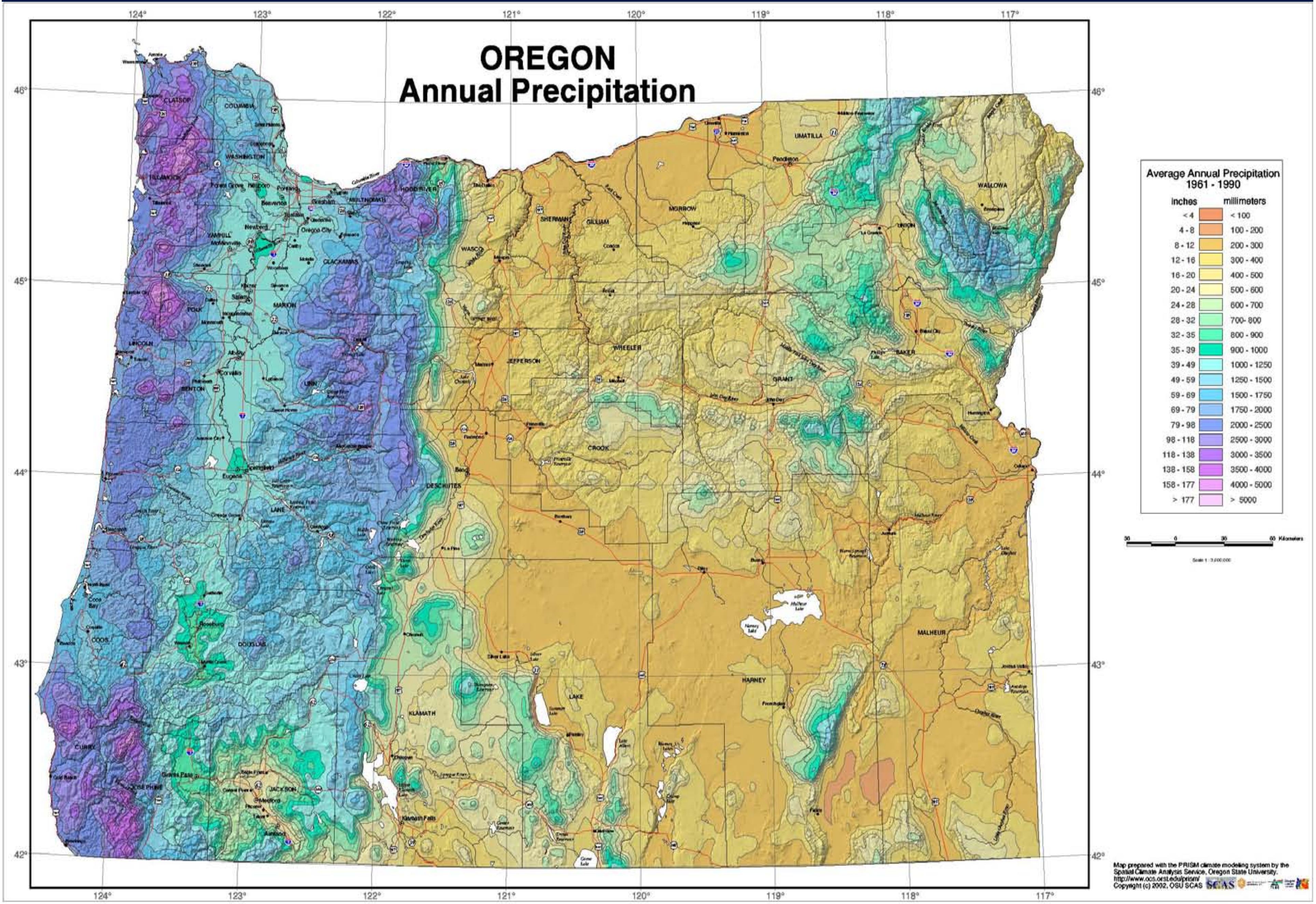


Dominant PRISM KBS Components

Elevation

Terrain orientation

Terrain steepness


OREGON
Annual Precipitation
CLATSOP
COLUMBIA
TILLAMOOK
WASHINGTON
MULTNOMAH
HOOD RIVER
UMATILLA
MORROW
SHERMAN
GILLIAM
WASCO
UNION
WALLOWA
YAMHILL
CLACKAMAS
MARION
POLK
LINCOLN
BENTON
LINN
JEFFERSON
WHEELER
GRANT
BAKER
CROOK
DESCHUTES
LANE
DOUGLAS
COOS
CURRY
JOSEPHINE
JACKSON
KLAMATH
LAKE
HARNEY
MALHEUR
Average Annual Precipitation
1961 - 1990
inches | millimeters
< 4 | < 100
4 - 8 | 100 - 200
8 - 12 | 200 - 300
12 - 16 | 300 - 400
16 - 20 | 400 - 500
20 - 24 | 500 - 600
24 - 28 | 600 - 700
28 - 32 | 700 - 800
32 - 35 | 800 - 900
35 - 39 | 900 - 1000
39 - 49 | 1000 - 1250
49 - 59 | 1250 - 1500
59 - 69 | 1500 - 1750
69 - 79 | 1750 - 2000
79 - 98 | 2000 - 2500
98 - 118 | 2500 - 3000
118 - 138 | 3000 - 3500
138 - 158 | 3500 - 4000
158 - 177 | 4000 - 5000
> 177 | > 5000
Map prepared with the PRISM climate modeling system by the Spatial Climate Analysis Service, Oregon State University.
http://www.ocs.orst.edu/prism/
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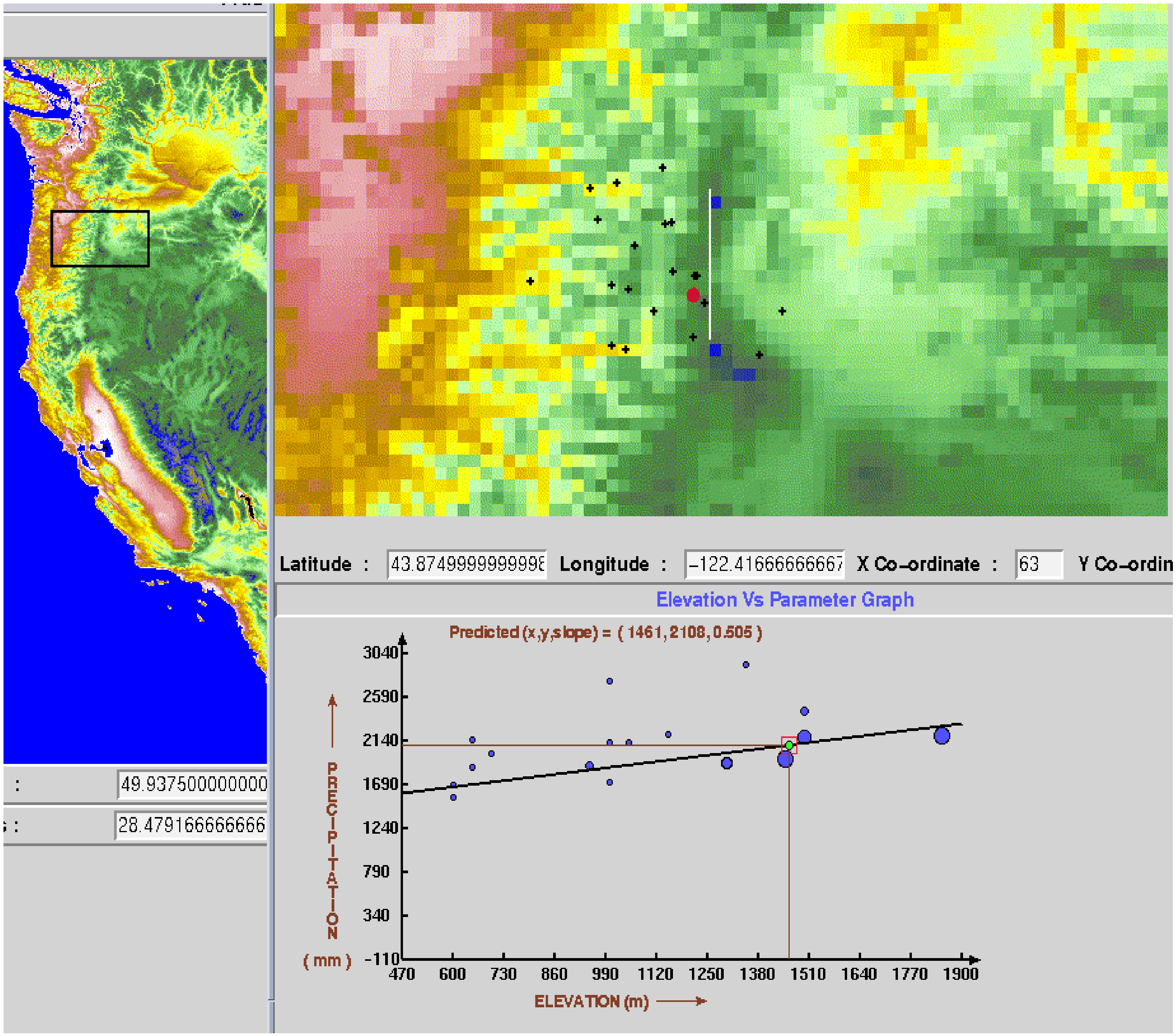
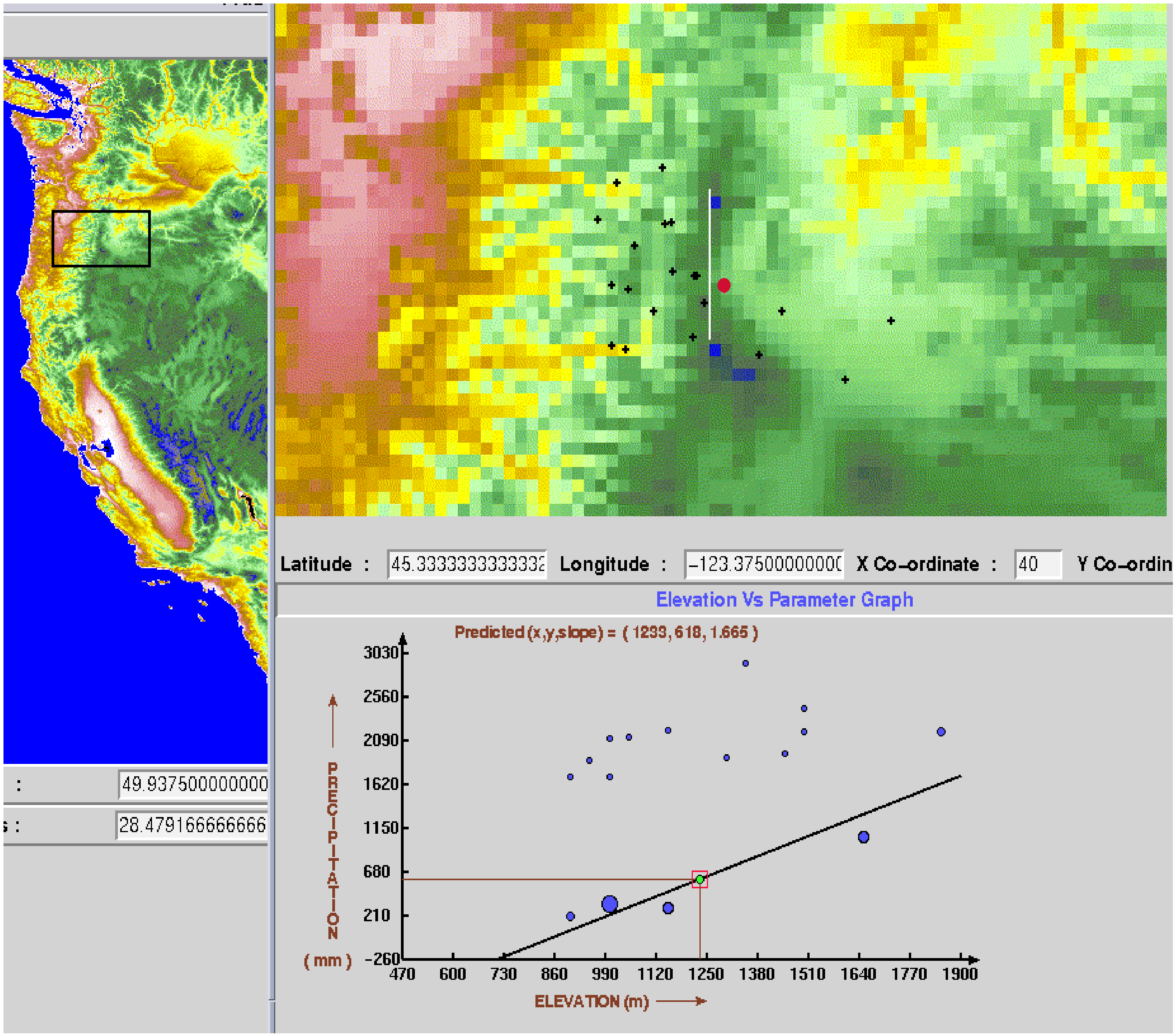
1961-90 Mean Annual Precipitation, Cascade Mtns, OR, USA

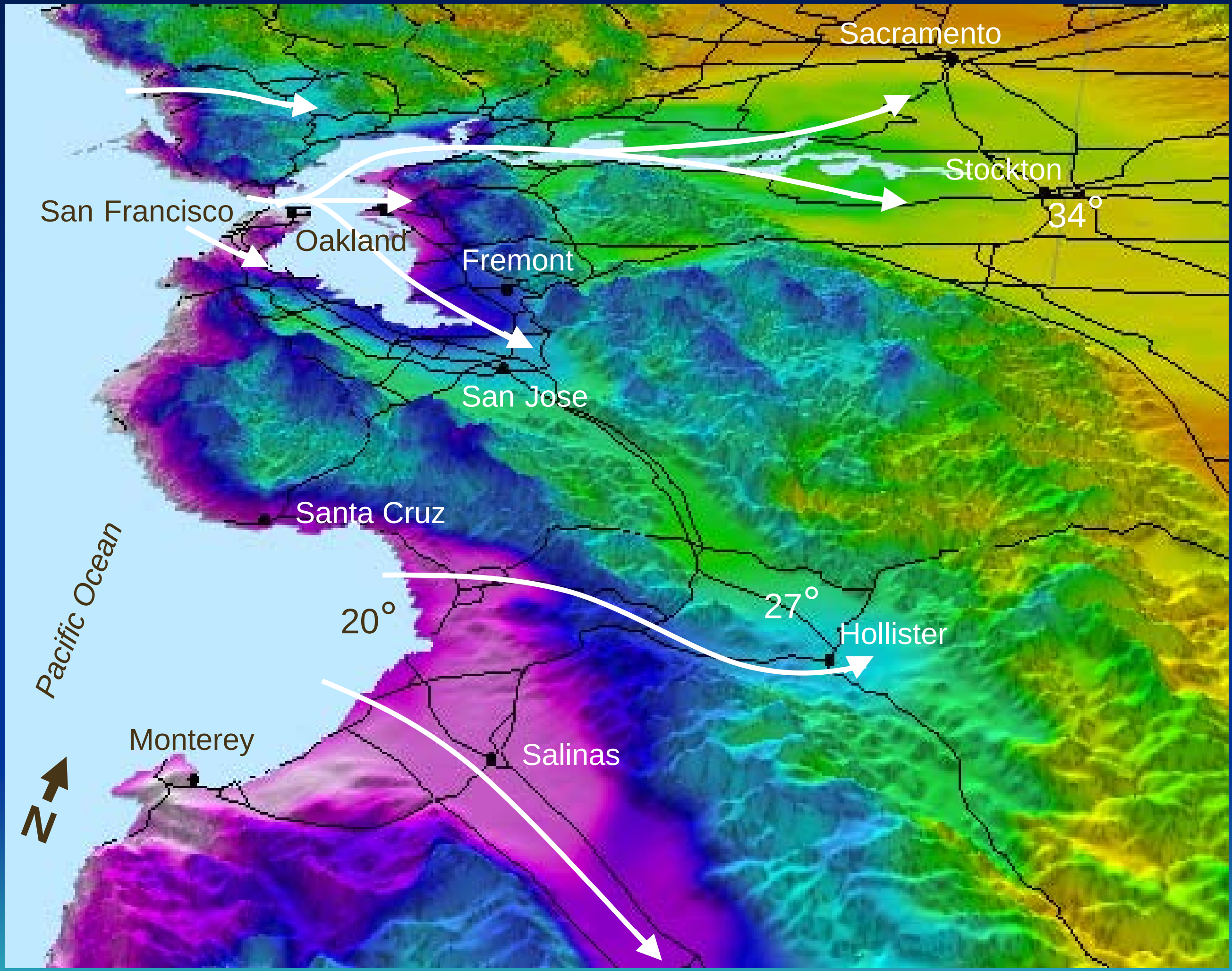


1961-90 Mean Annual Precipitation, Cascade Mtns, OR, USA



Coastal Effects: 1971-00 July Maximum Temperature
Central California Coast

Preferred Trajectories →



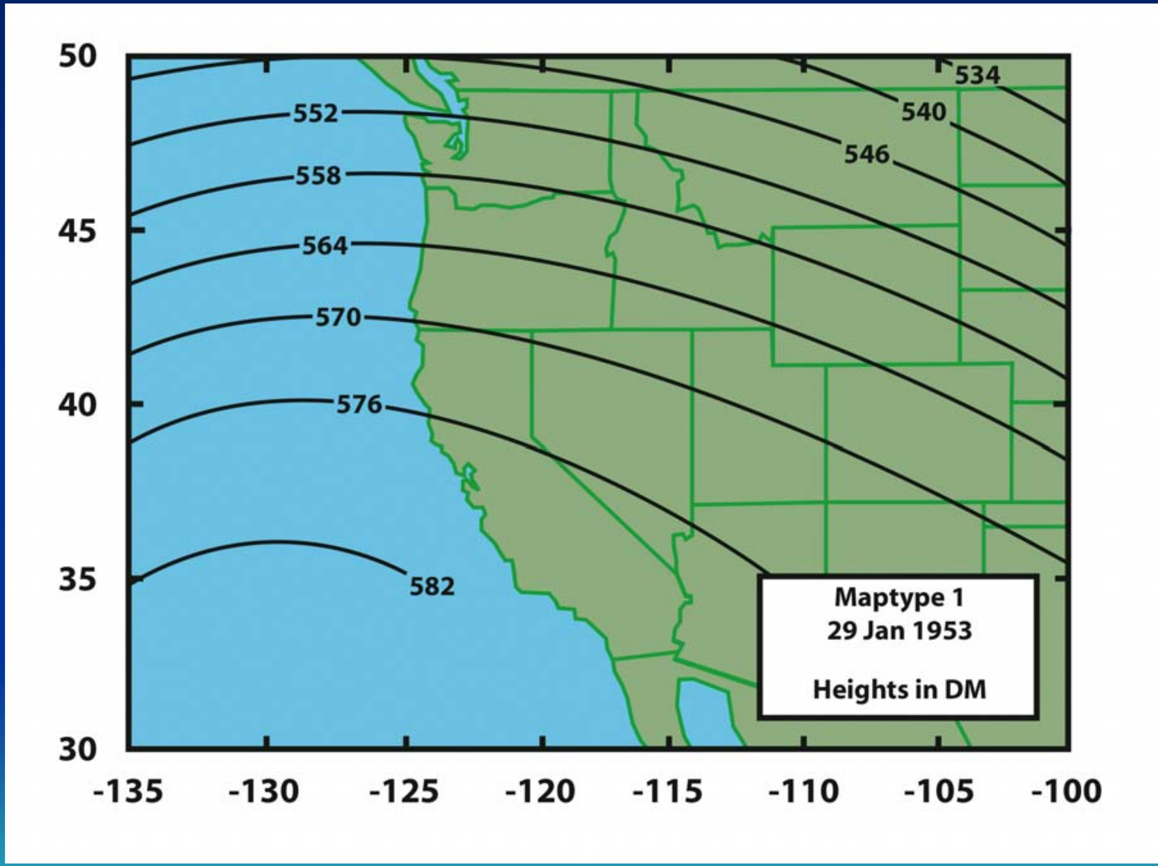
Dominant PRISM KBS Components

Elevation

Coastal Proximity

Inversion Layer

Map-type Climatology



Weaver, 1962 (HMR-37)

METEOROLOGY OF HYDROLOGICALLY CRITICAL STORMS IN CALIFORNIA

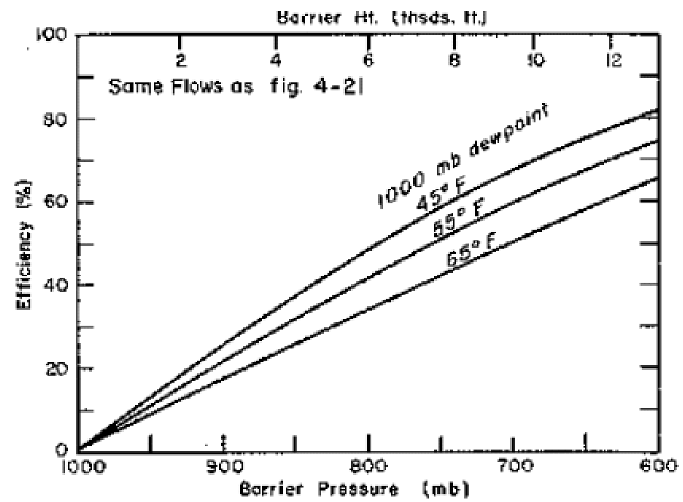


Fig. 4-23. EFFICIENCY OF OROGRAPHIC PRECIPITATION MECHANISM

Weaver "Map Types"

Low-latitude type. Blocking in, mid-Pacific between longitude 160W and 180W, or about the longitude of the eastern Aleutians. This is primarily a type for precipitation in the northern half of California.

High-latitude type. Blocking in the eastern Pacific east of longitude 160W. This is mainly a storm type for the southern half of California.

Mid-latitude type. Low pressure in the central and eastern Pacific, with varying degrees of blocking over western North America.

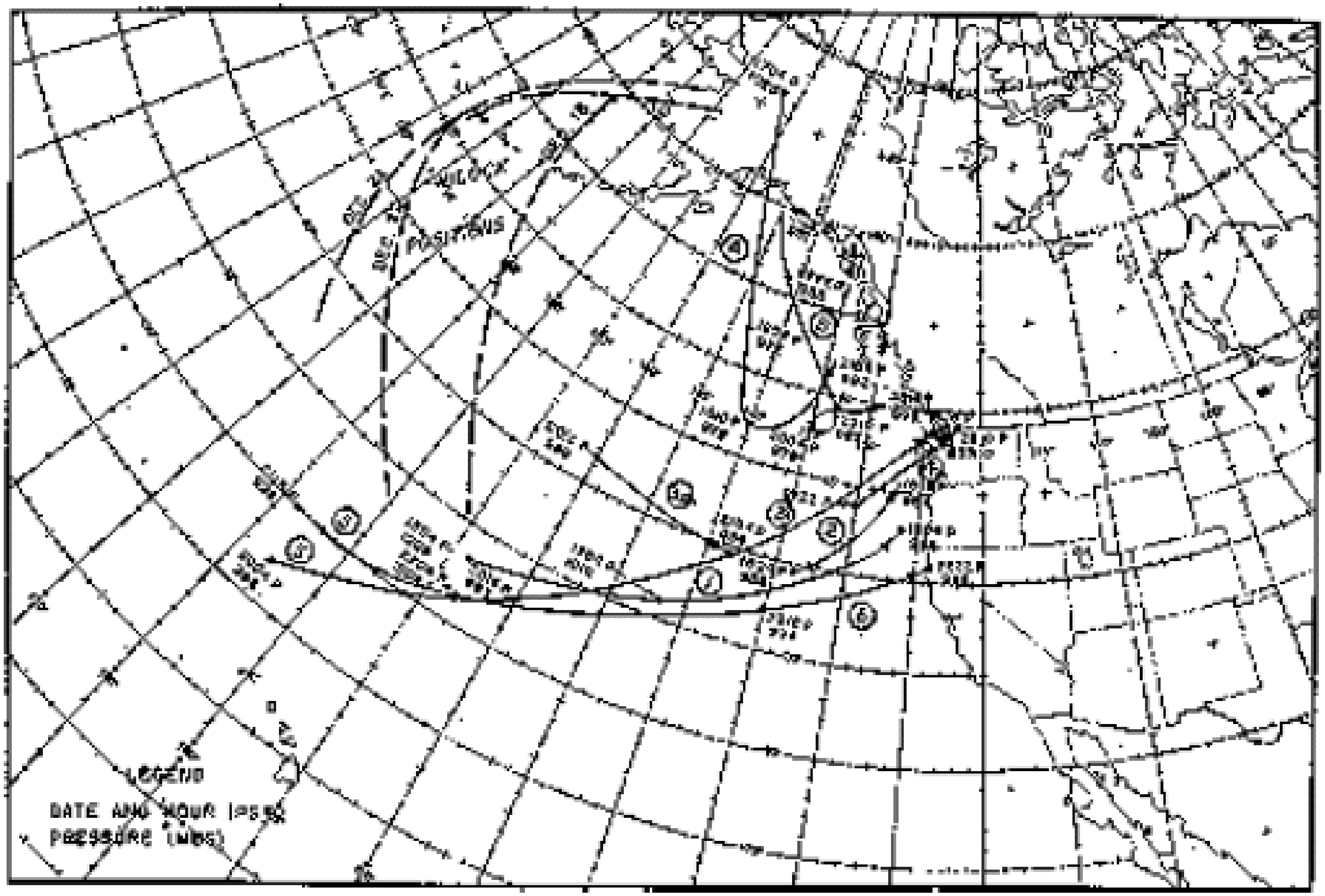
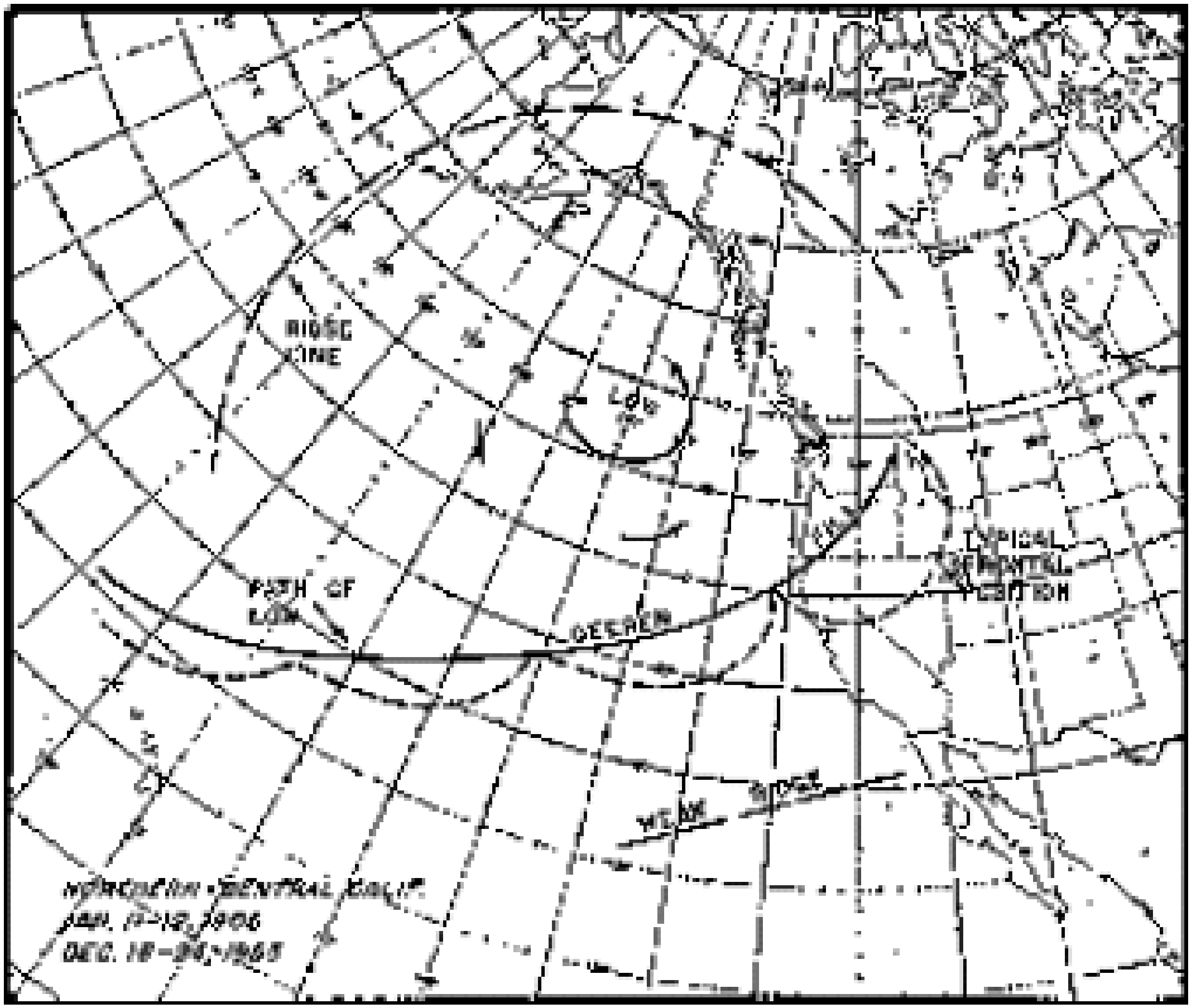


Fig. 2-12. TRACKS OF SURFACE LOWS IN THE DECEMBER 1955 STORM


RIDGE LINE
LOW
PATH OF LOW
DEEPEN
TYPICAL FRONTAL POSITION
WEAK RIDGE
NORTHERN-CENTRAL CALIF.

OSU Map-type Procedure

a. Use the gridded reanalysis data, which begins in 1946. Most of the period has twice-daily maps. Large-scale patterns are probably best captured using the 700 or 500 mb grids.

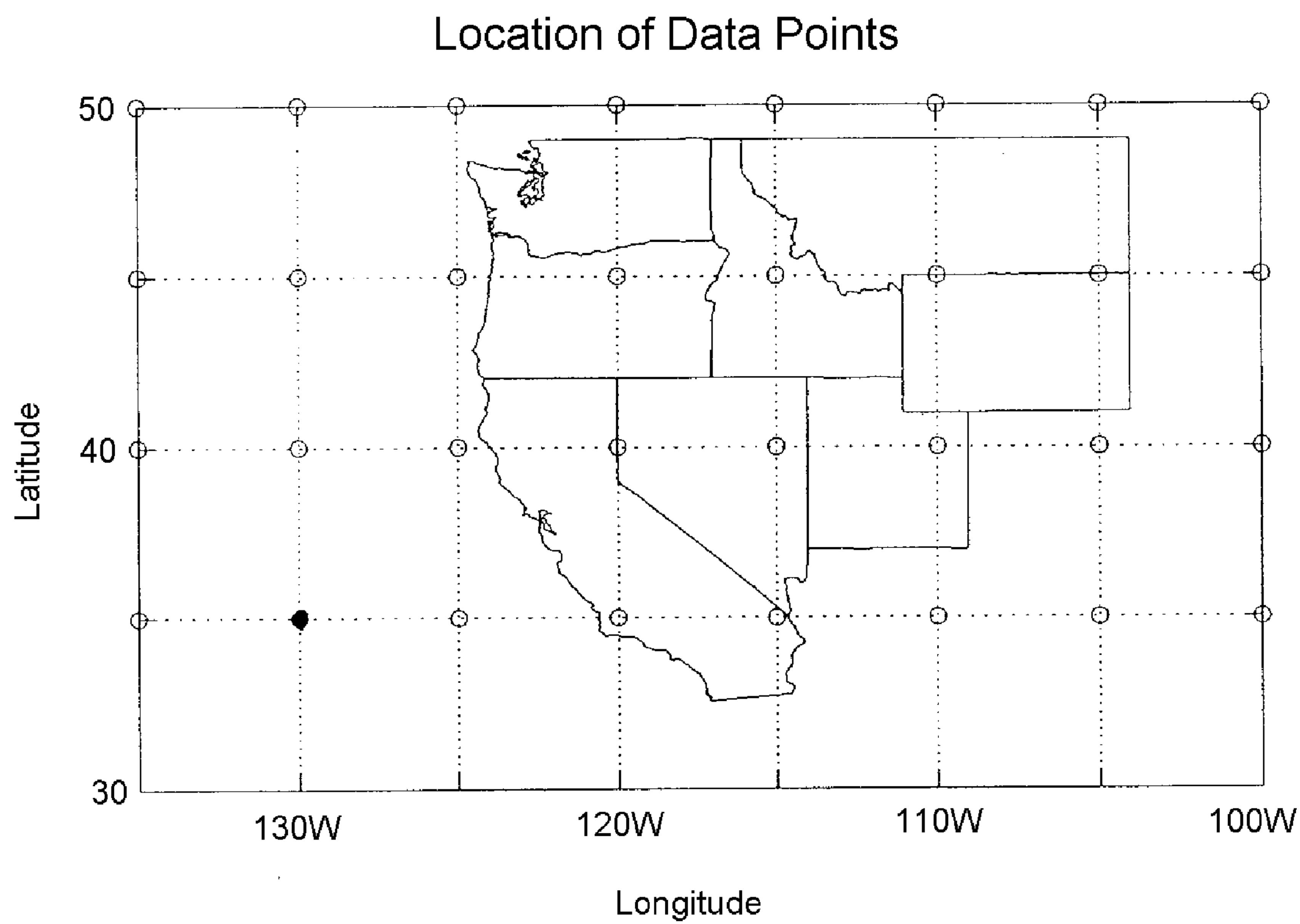
b. Compute the correlations between individual maps of pressure or height; comparisons are restricted to certain ranges of dates (in the current system, calendar days up to 30 days before or after the given date were used for comparison).

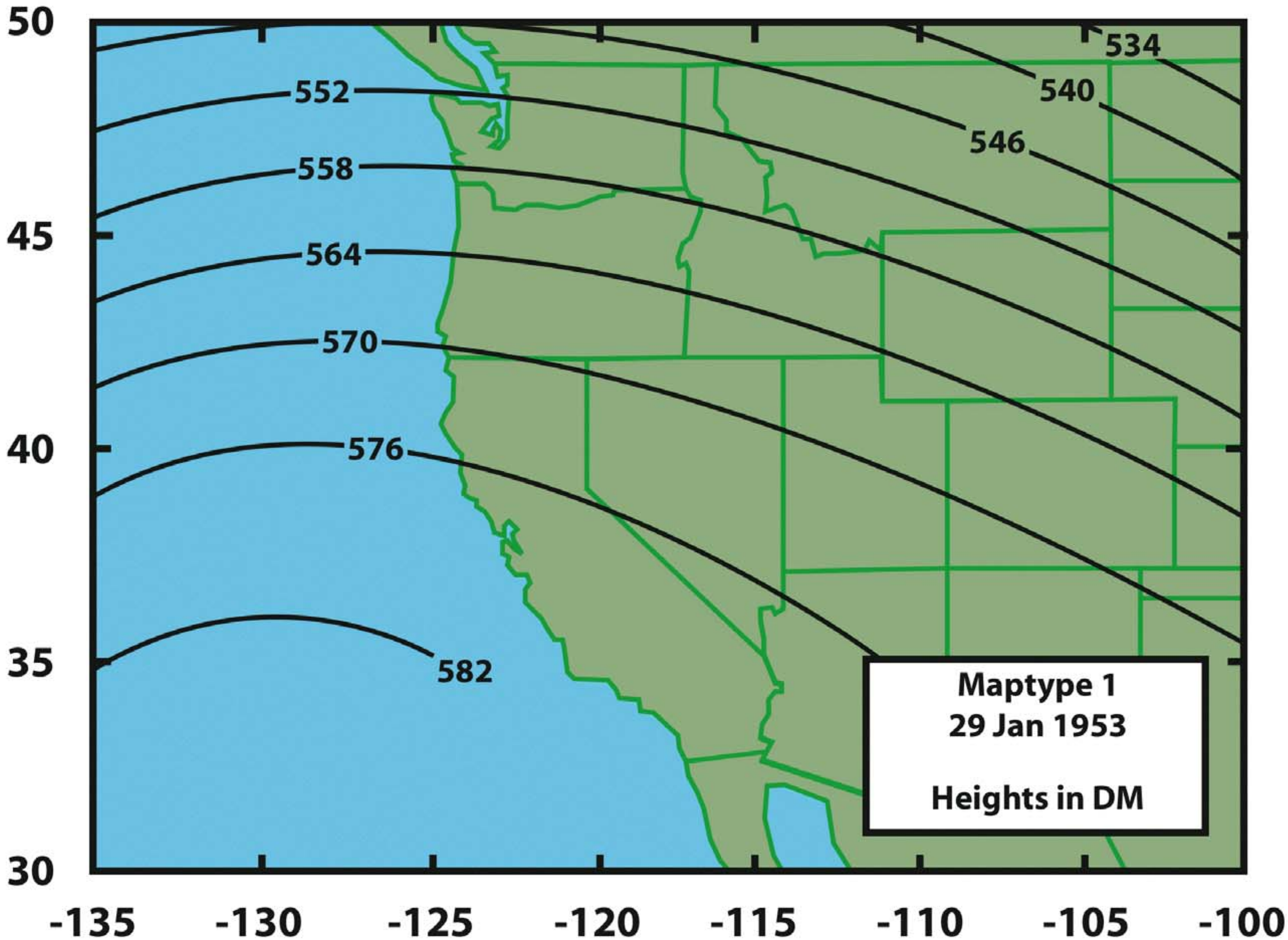
c. Select an “acceptable” correlation coefficient representing the minimum value for establishing similarity between maps. In this case, 0.80 was used.

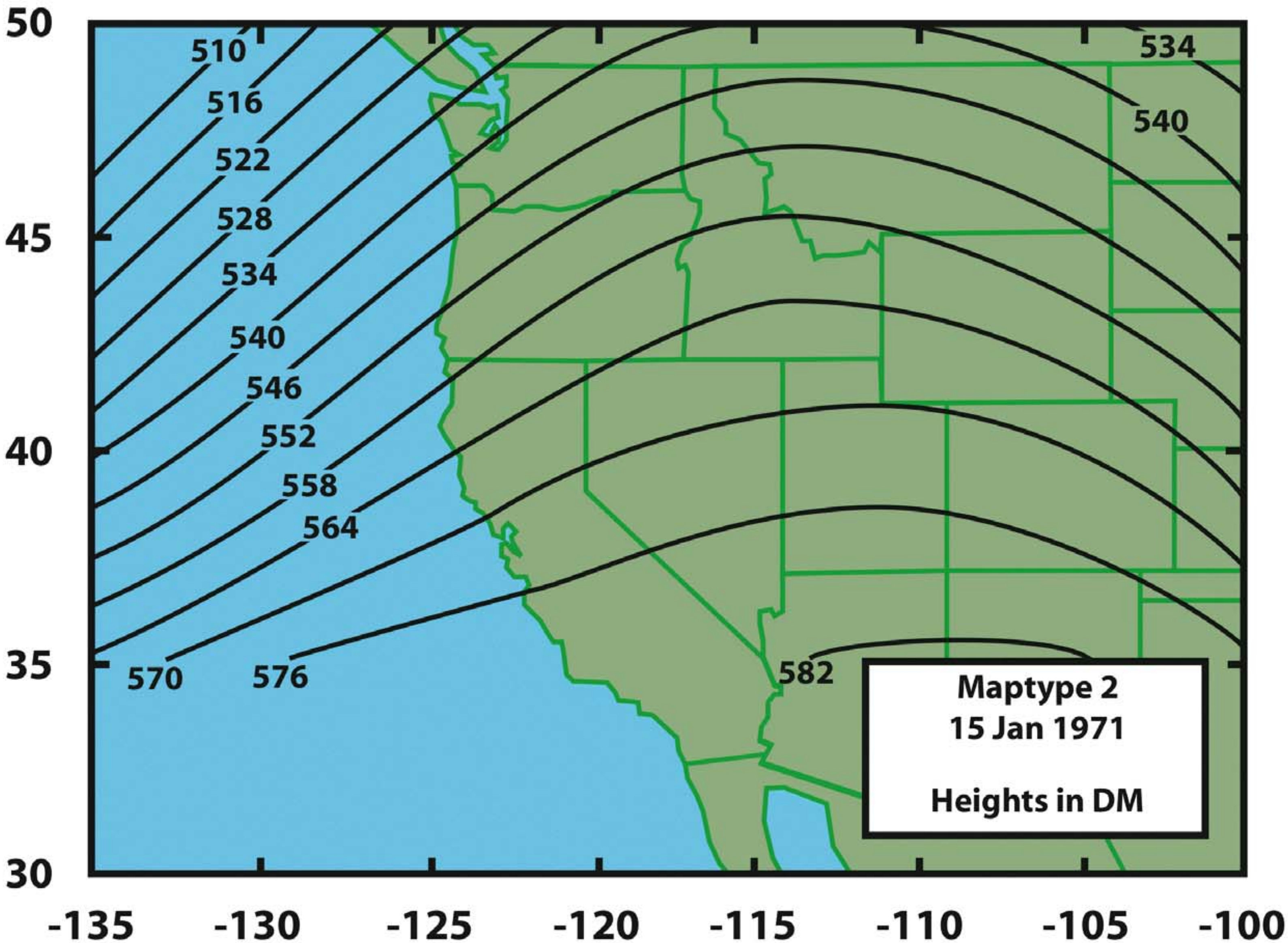
d. Find the map with the largest number of 0.80 correlations with other maps. This will be identified as “Type 1,” and the map selected called the “Key Day” map.

e. Remove the Type 1 maps from the data set and repeat steps c. and d. until some maximum number of types have been identified (typically 12-20 types).

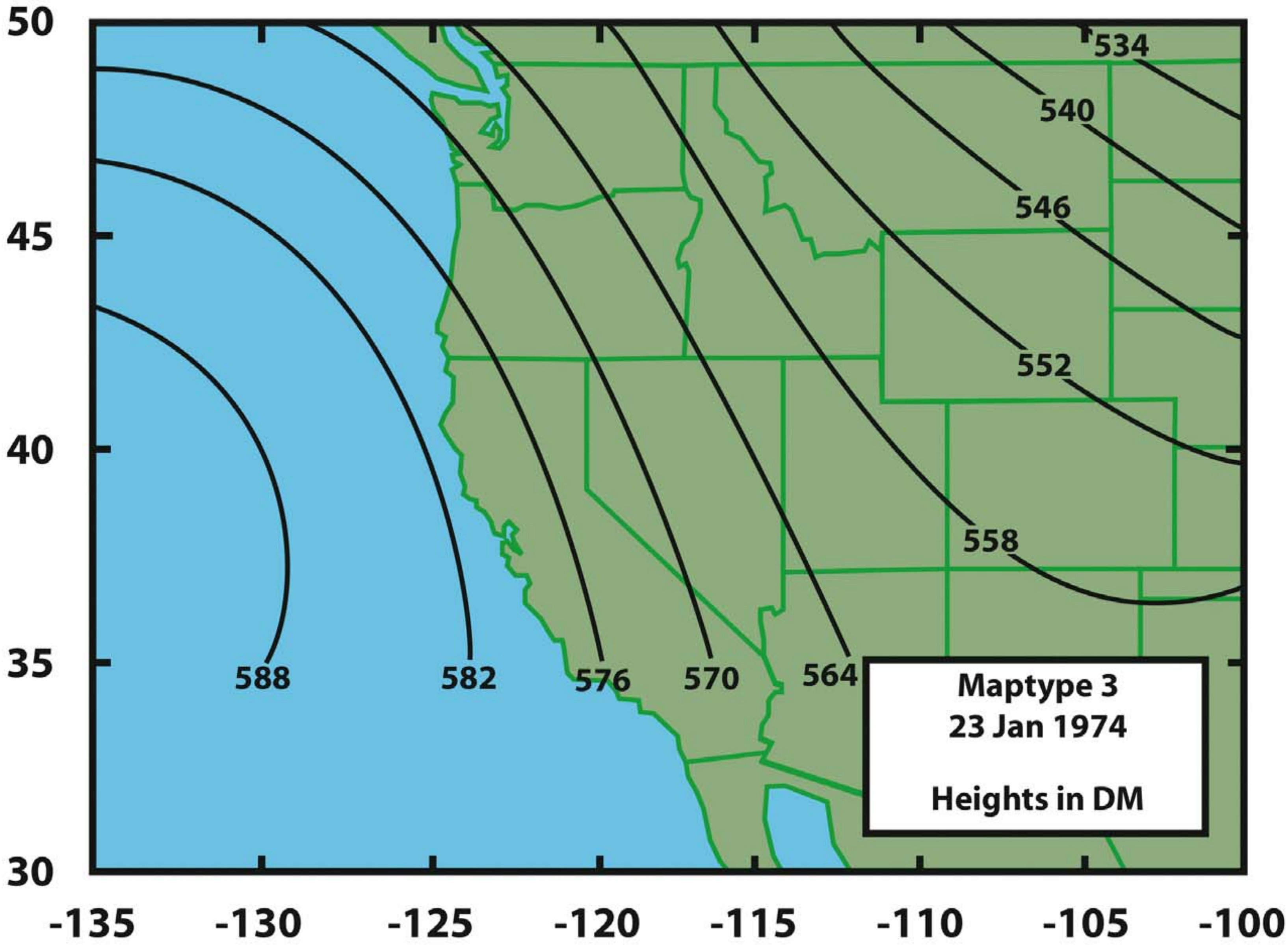
f. Compare the selected maps with the Key Day map for later map types; if the correlation coefficient with another map type is higher, move the selected map to the other map type group. For example, if a map is selected for Type 1, it will be removed from the data set prior to creation of the Type 2, Type 3, etc. data sets. If it fits better with Type 3, it should be moved.

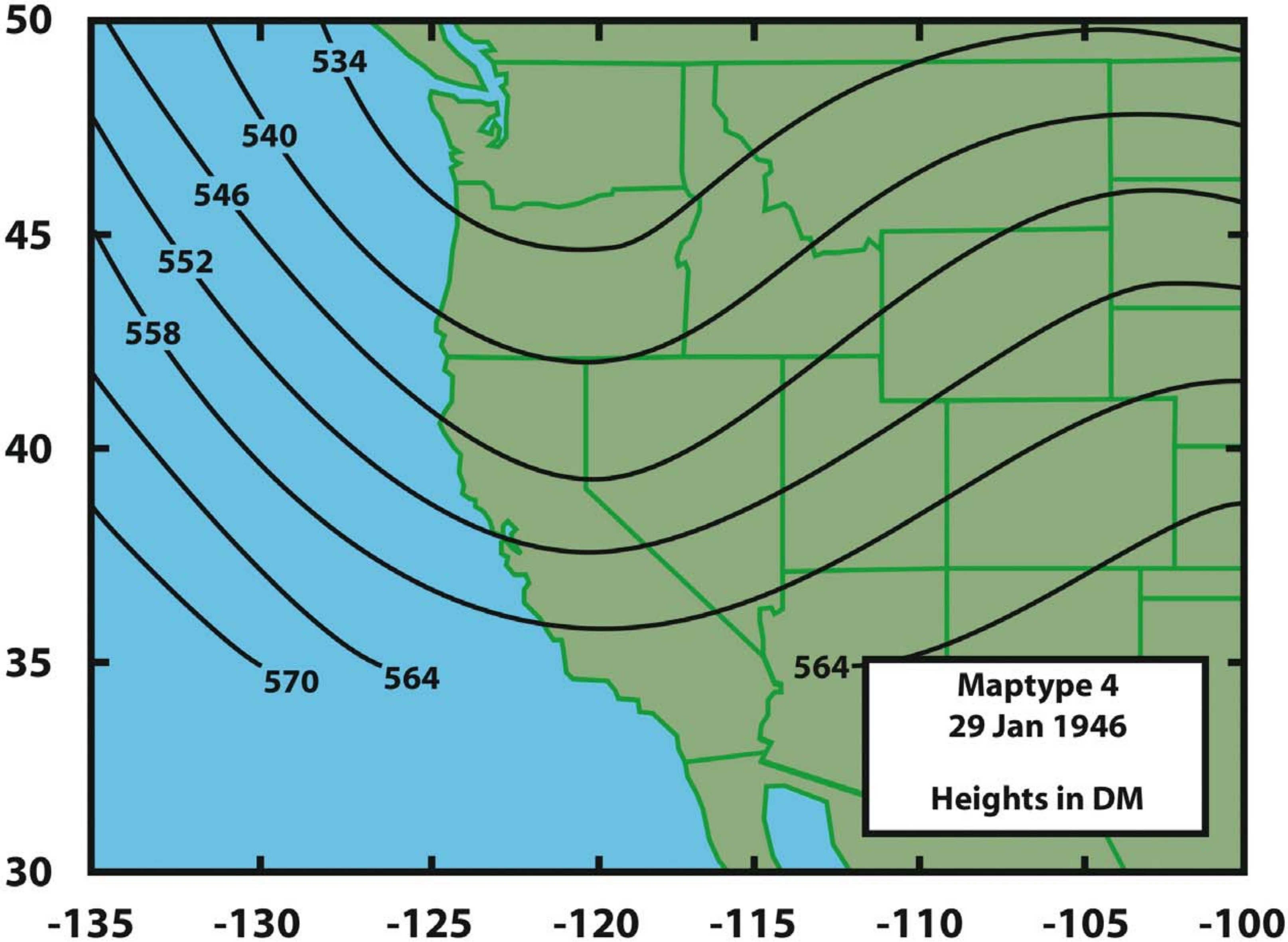

Location of Data Points
50
40
30
Latitude
130W
120W
110W
100W
Longitude


50
45
40
35
30
-135
-130
-125
-120
-115
-110
-105
-100
534
540
546
552
558
564
570
576
582
Maptype 1
29 Jan 1953
Heights in DM



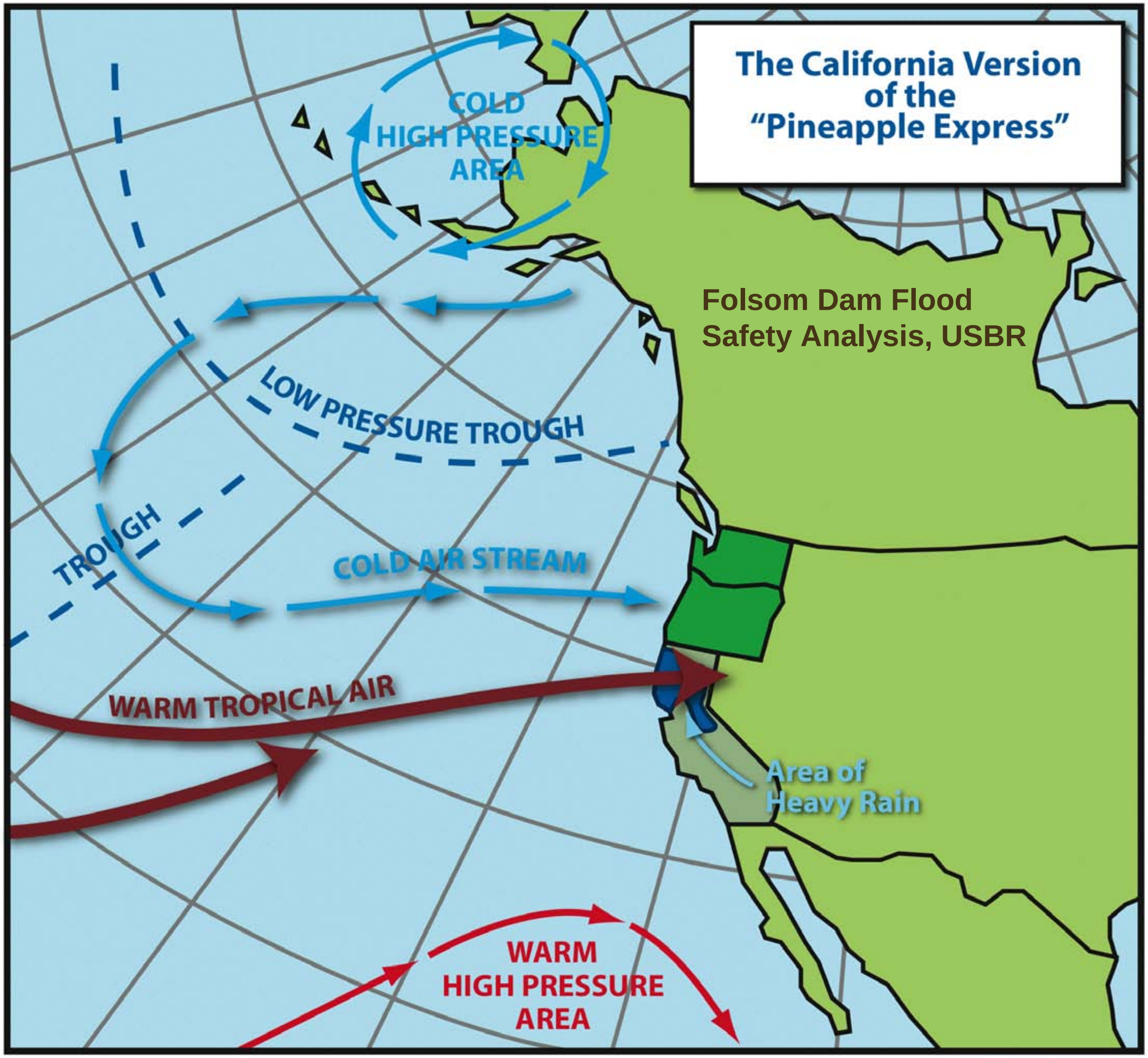
50
45
40
35
30
-135
-130
-125
-120
-115
-110
-105
-100
510
516
522
528
534
540
546
552
558
564
570
576
582
534
540
Maptype 2
15 Jan 1971
Heights in DM


50
45
40
35
30
-135
-130
-125
-120
-115
-110
-105
-100
534
540
546
552
558
564
570
576
582
588
Maptype 3
23 Jan 1974
Heights in DM



50
45
40
35
30
-135
-130
-125
-120
-115
-110
-105
-100
534
540
546
552
558
570
564
564
Maptype 4
29 Jan 1946
Heights in DM

Comparing Extreme Storms in The Pacific Northwest and California



Folsom Dam Flood Safety Analysis, USBR

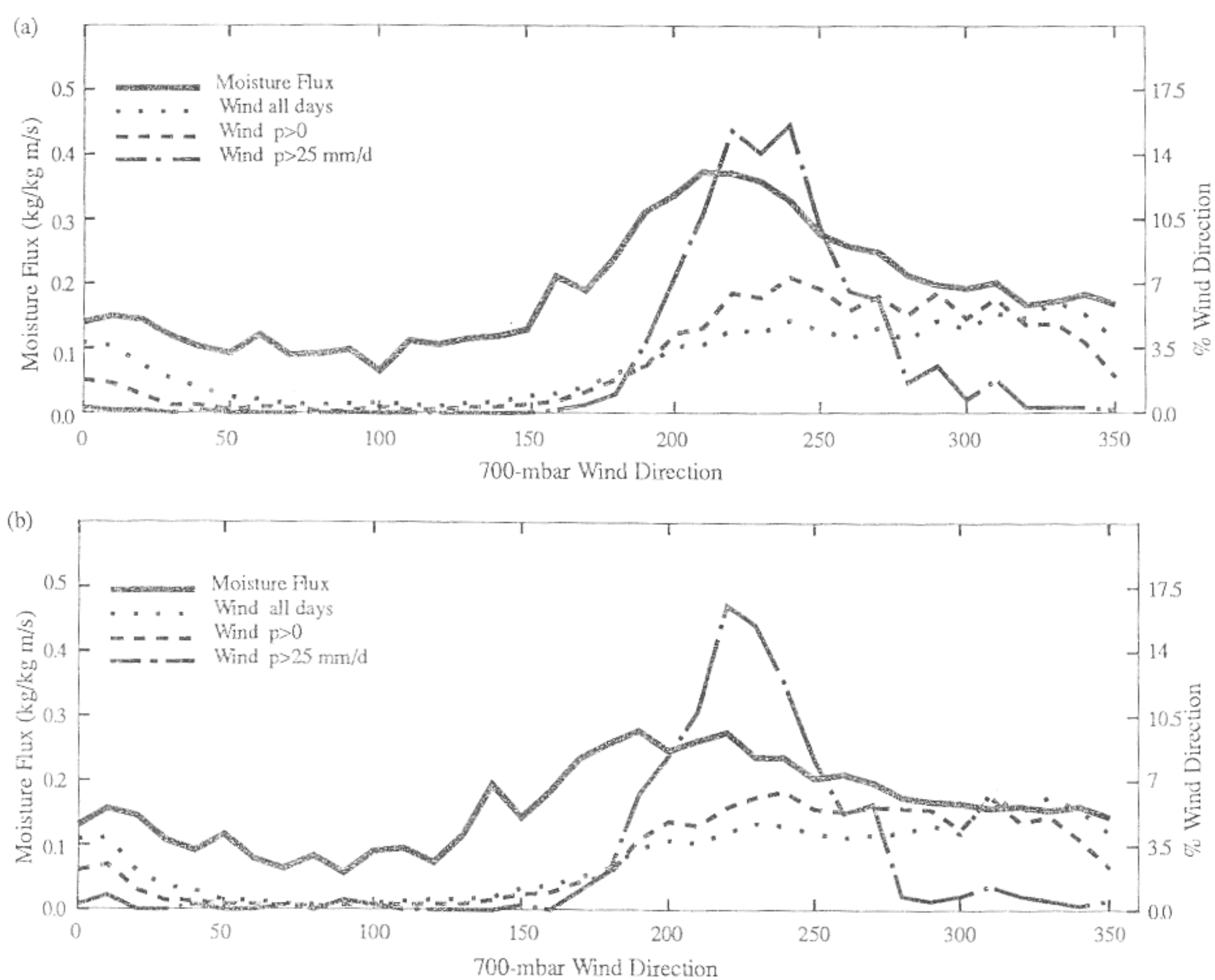
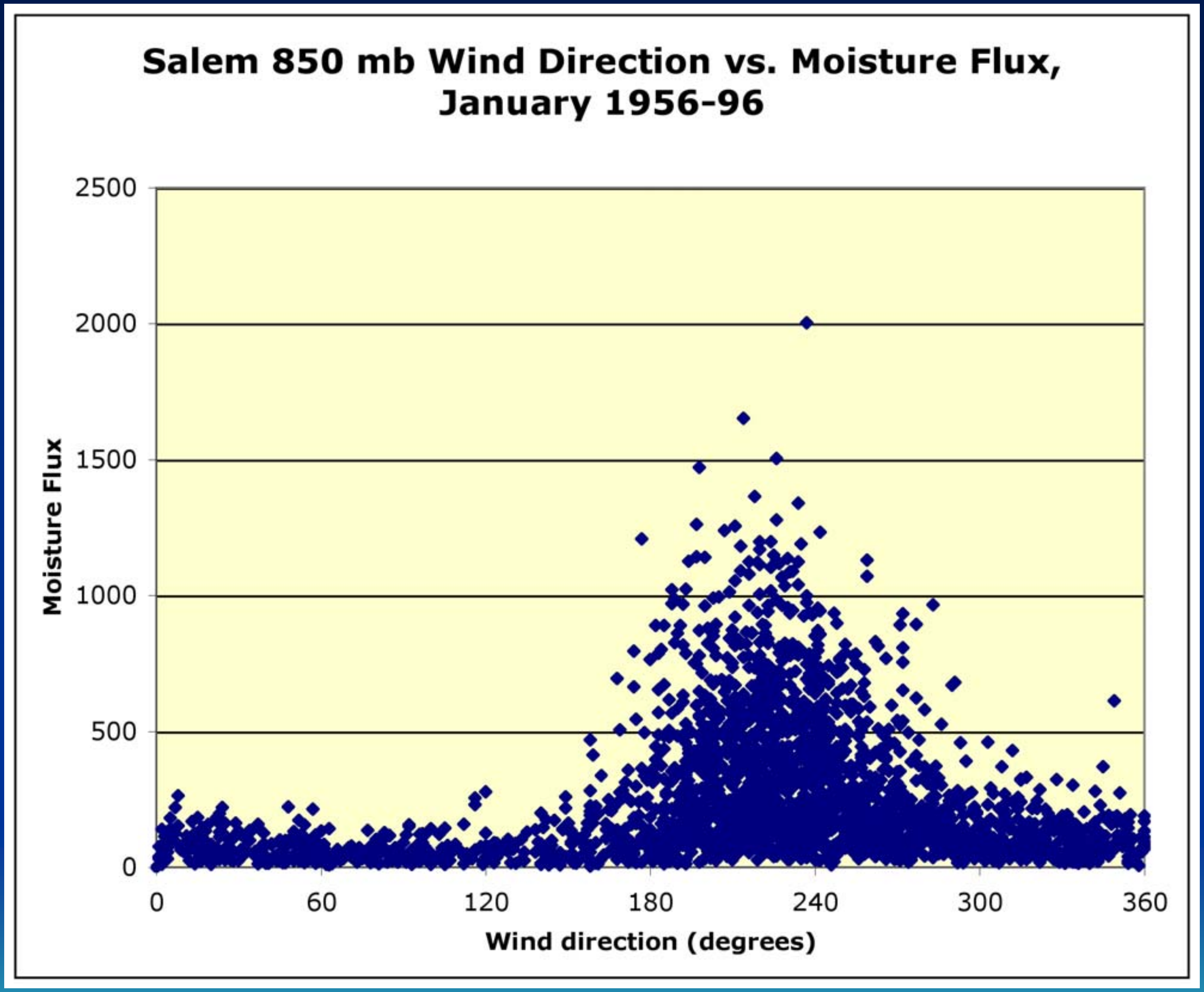
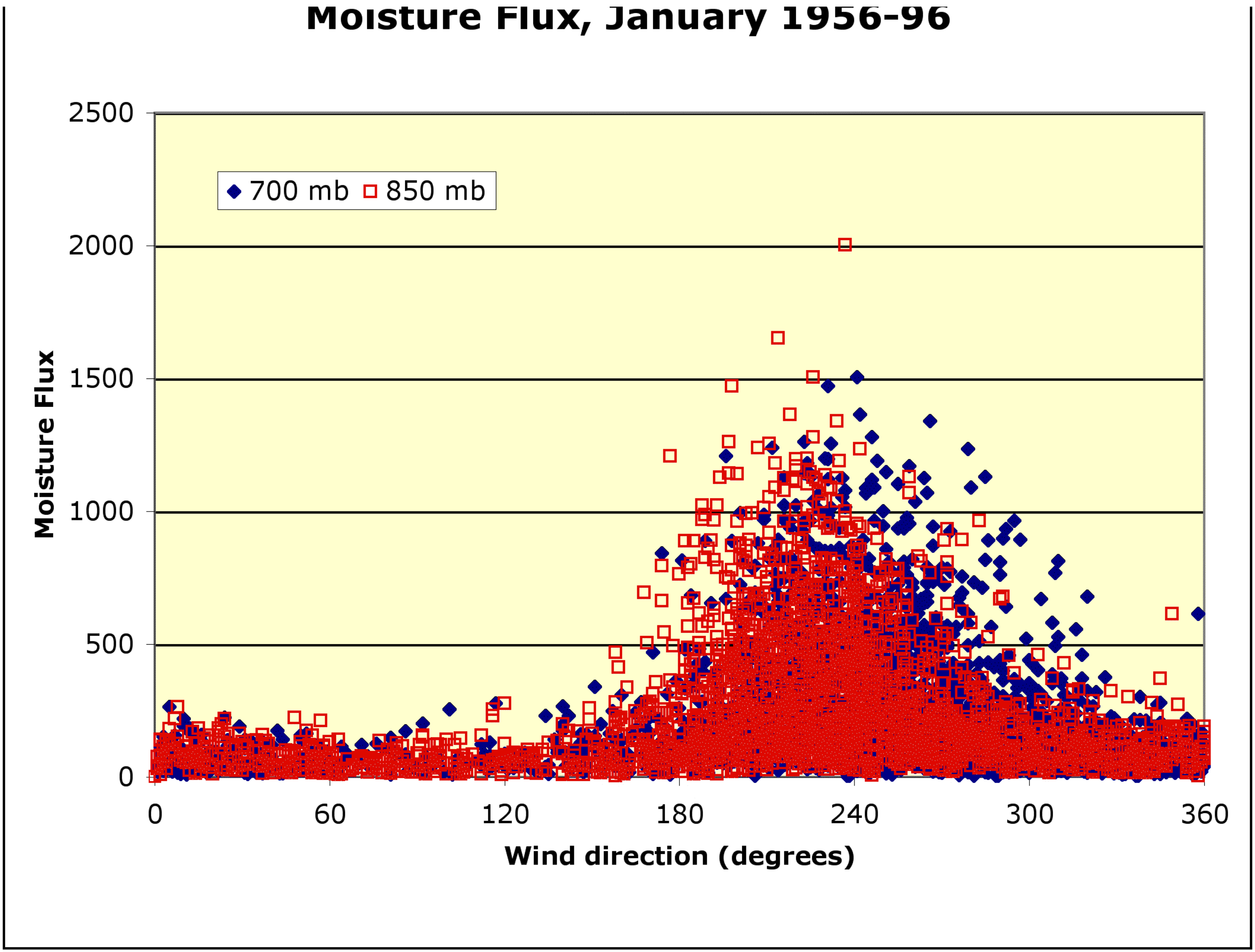
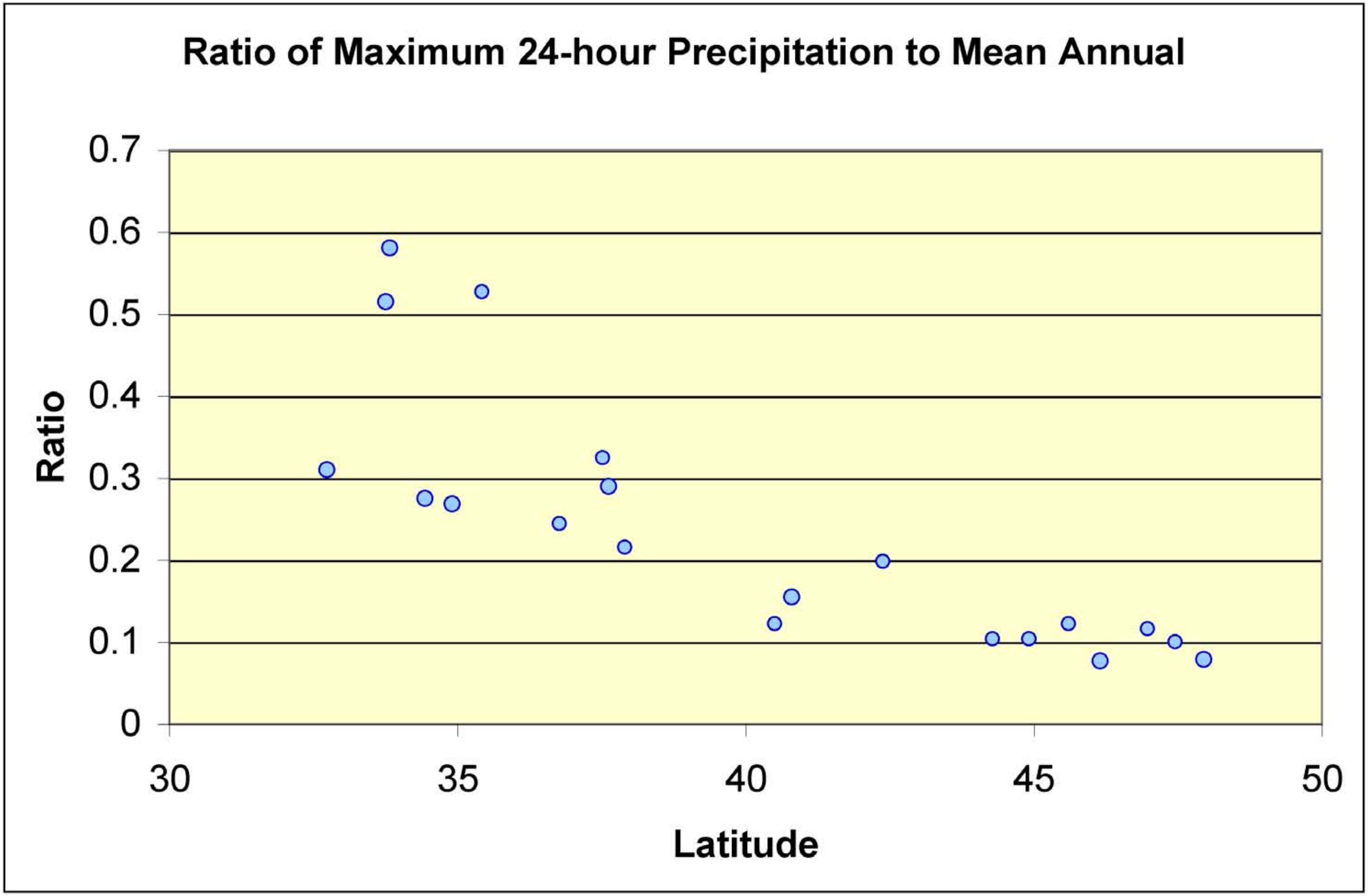


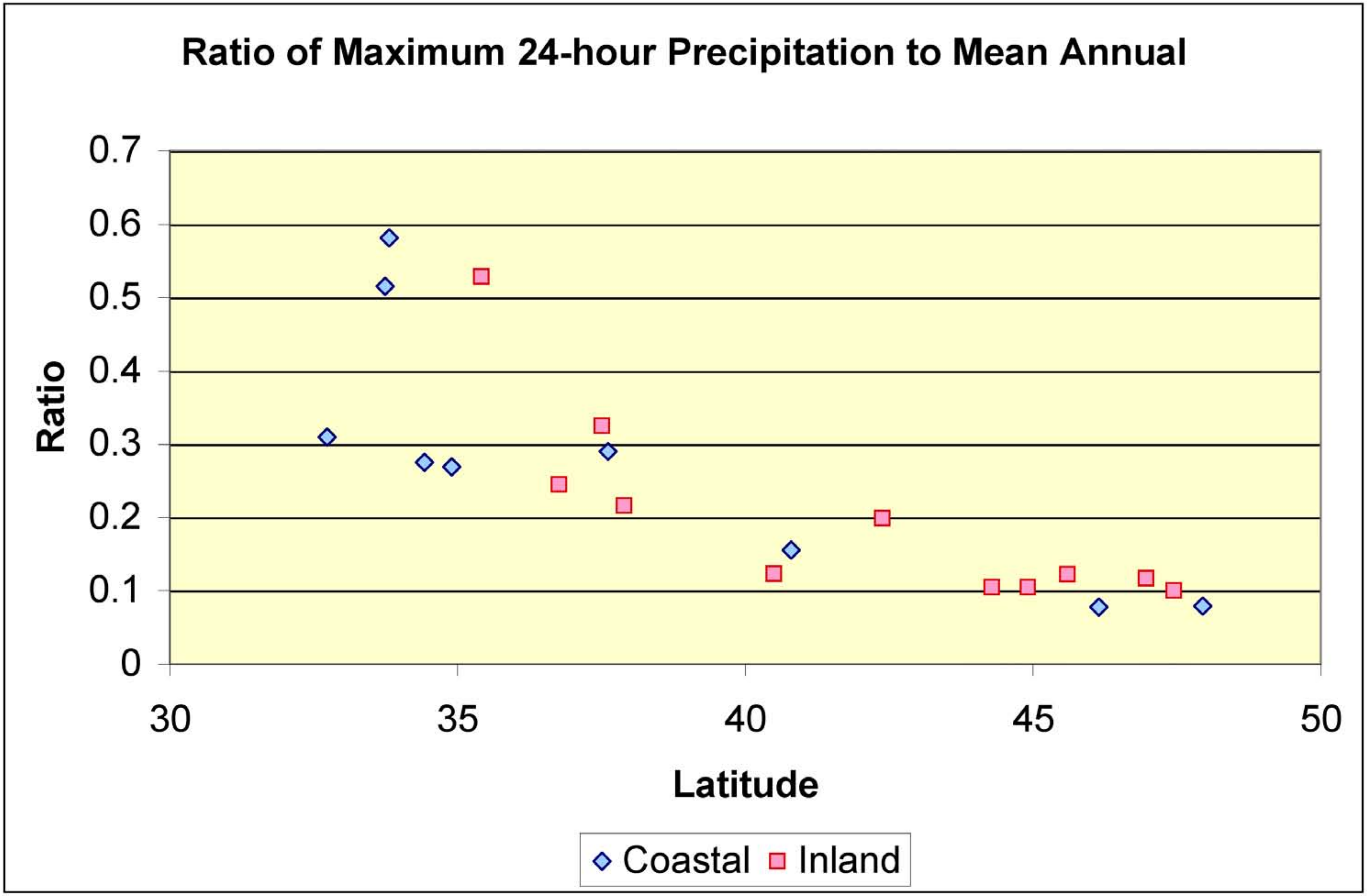
Figure 5. Climatological distribution of incoming moisture flux as a function of wind direction and fraction of time the wind is blowing from each direction at Oakland in (a) early winter (NDJ) and (b) late winter (FMA). The incoming moisture fluxes (solid line) are marked on the left *y* axis. The distributions of winds are marked on the right *y* axis and are shown for all days (dotted line), for days with any measurable precipitation (p>0, dashed line), and for days when precipitation exceeds 25 mm/d (dashed-dotted line).


Salem 850 mb Wind Direction vs. Moisture Flux,
January 1956-96
Moisture Flux
2500
2000
1500
1000
500
0
0
60
120
180
240
300
360
Wind direction (degrees)

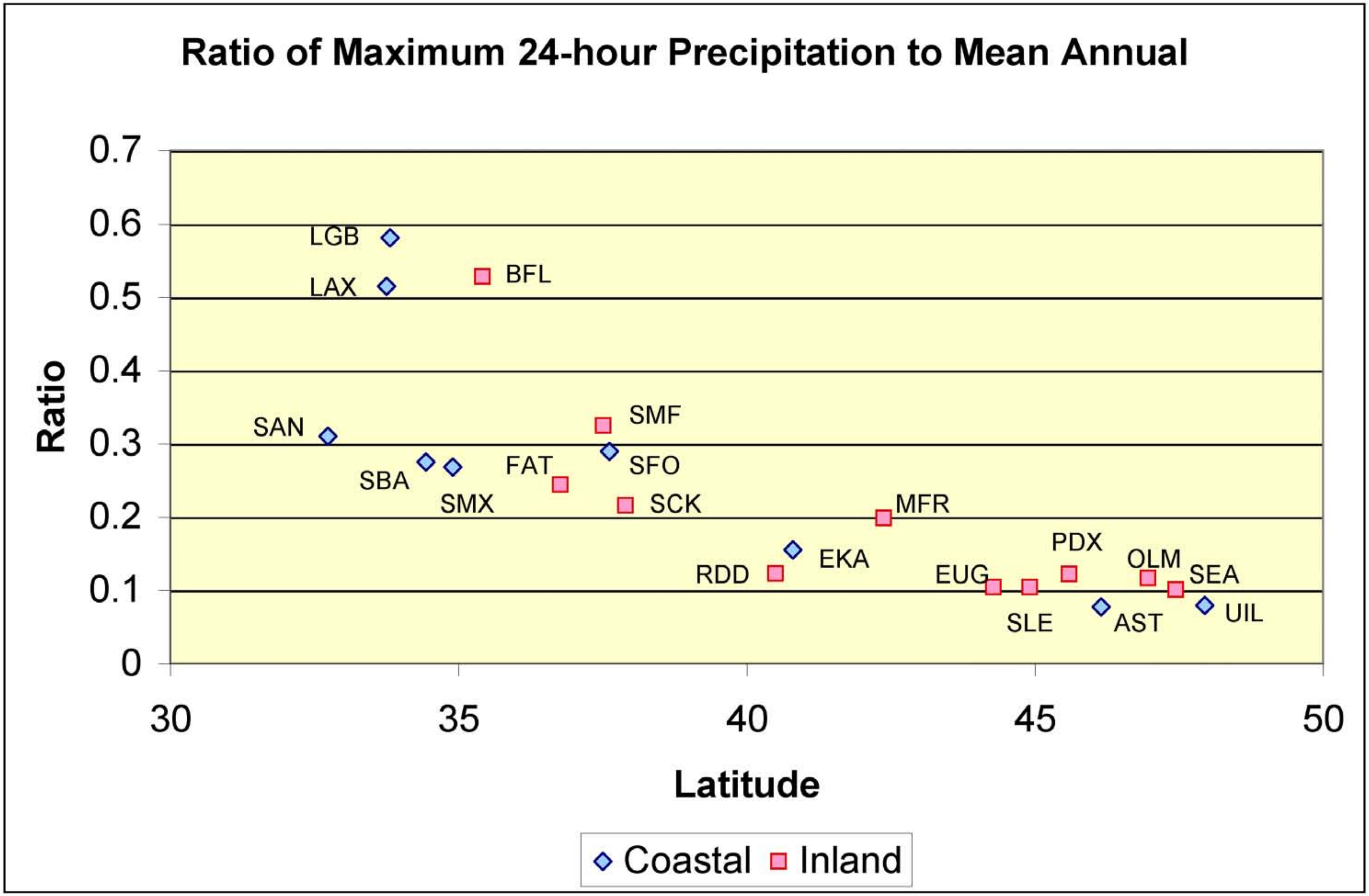

Moisture Flux, January 1956-96
700 mb
850 mb
Moisture Flux
Wind direction (degrees)
0
500
1000
1500
2000
2500
0
60
120
180
240
300
360

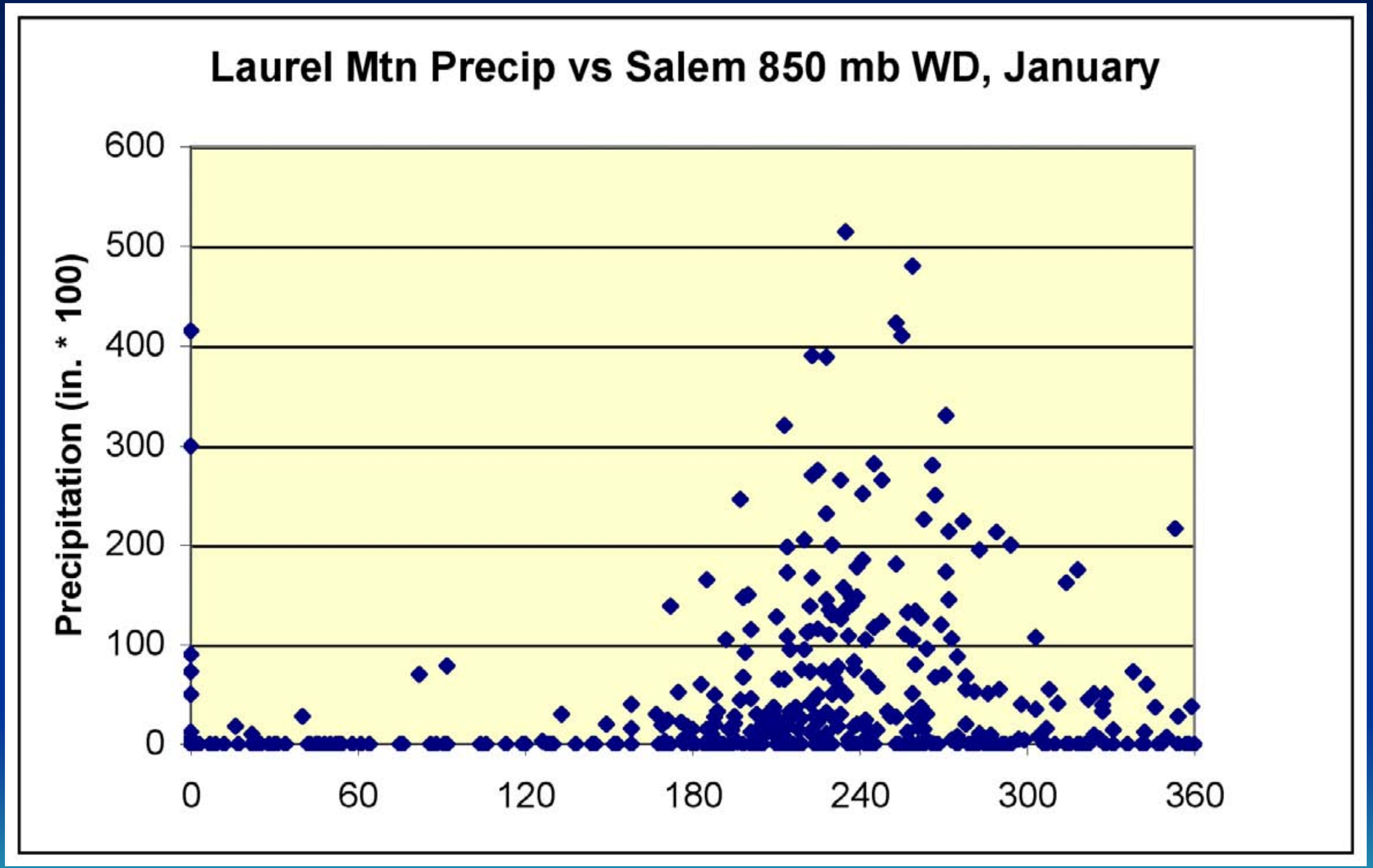


Ratio of Maximum 24-hour Precipitation to Mean Annual
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Ratio
30
35
40
45
50
Latitude



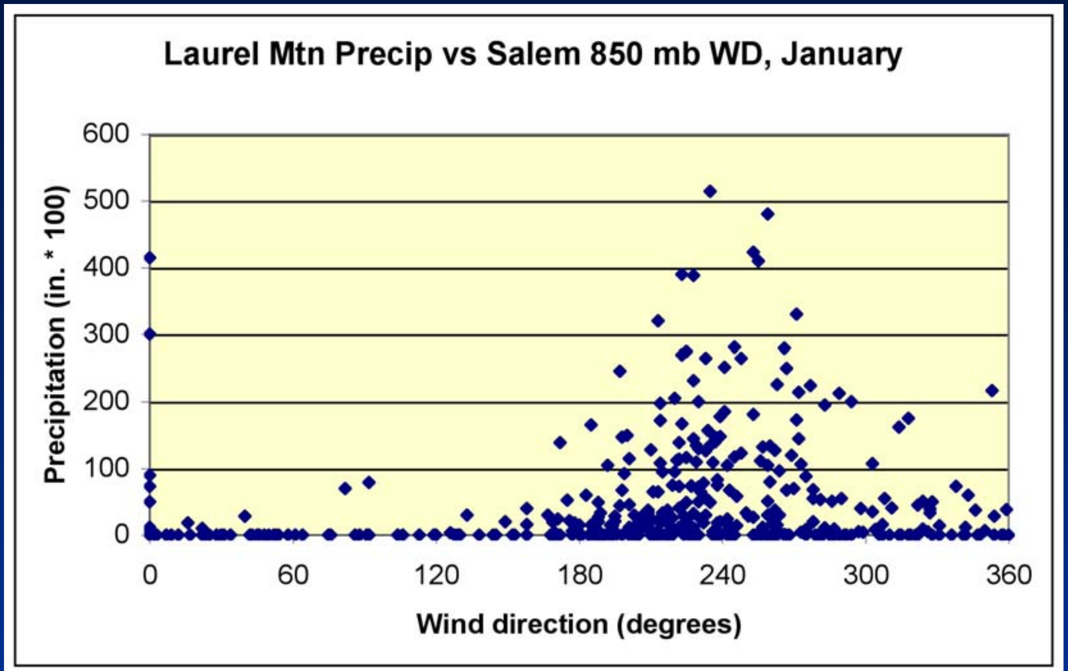
Ratio of Maximum 24-hour Precipitation to Mean Annual
Ratio
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
30
35
40
45
50
Latitude
Coastal
Inland

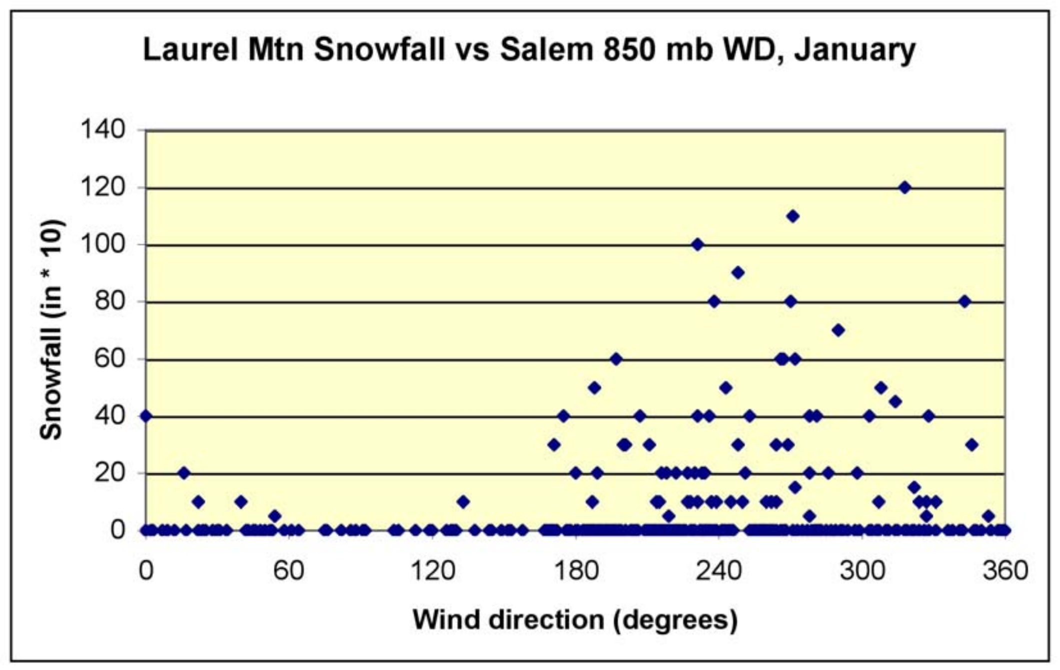

Ratio of Maximum 24-hour Precipitation to Mean Annual
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Ratio
LGB
LAX
BFL
SAN
SMF
SFO
SBA
SMX
FAT
SCK
MFR
EKA
RDD
PDX
OLM
SEA
EUG
SLE
AST
UIL
30
35
40
45
50
Latitude
Coastal
Inland

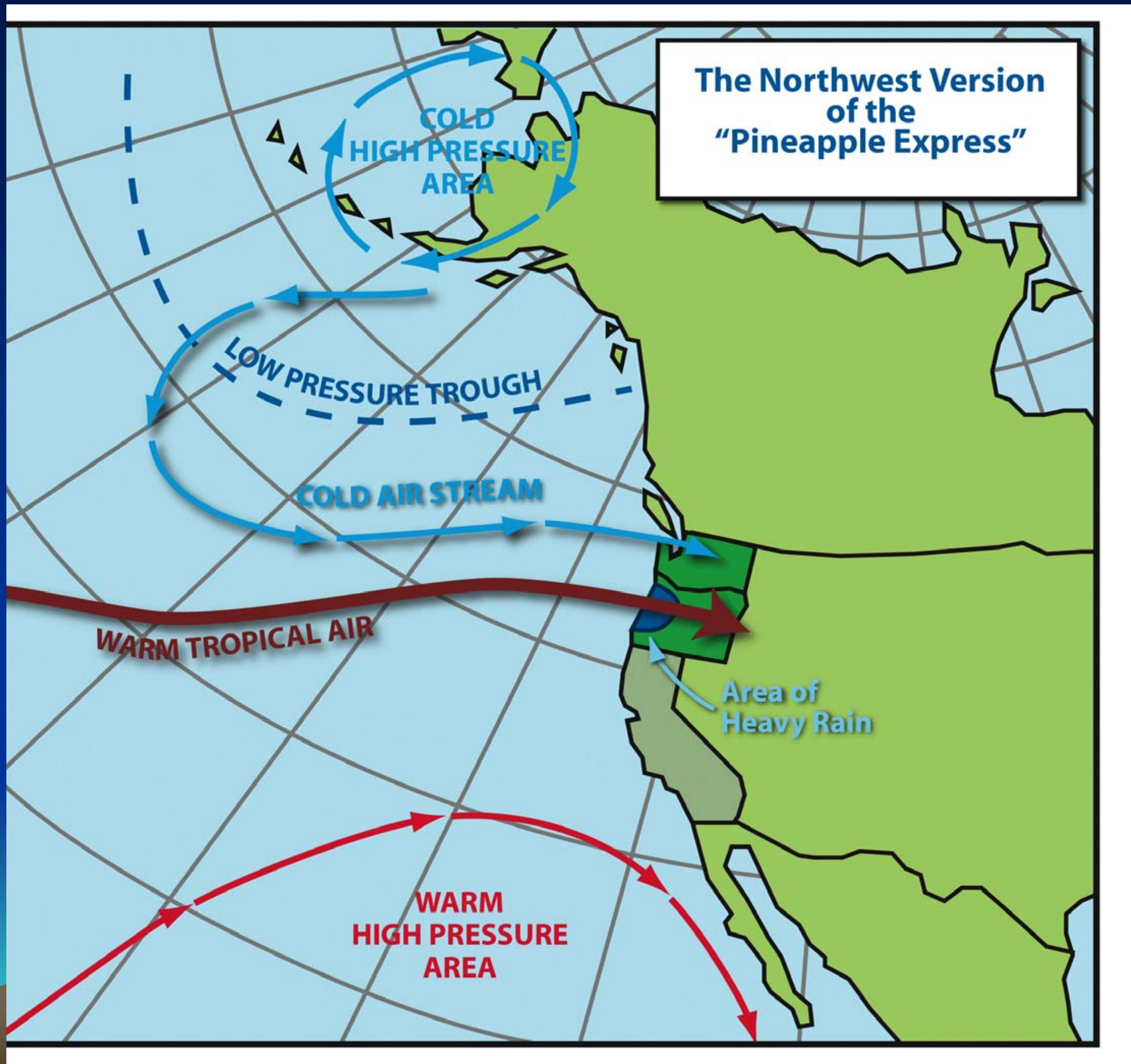


Laurel Mtn Precip vs Salem 850 mb WD, January
Precipitation (in. * 100)
600
500
400
300
200
100
0
0
60
120
180
240
300
360

Coast Range Precip and snowfall as functions of WD






The Northwest Version
of the
"Pineapple Express"
COLD
HIGH PRESSURE
AREA
LOW PRESSURE TROUGH
COLD AIR STREAM
WARM TROPICAL AIR
Area of
Heavy Rain
WARM
HIGH PRESSURE
AREA