Colorado and Great Basin Maximum Mean Areal Precipitation Values

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INTRODUCTION:

The generally arid characteristics of the Colorado and Great Basin river systems lends itself to different evaluative techniques for quantitative precipitation forecasts than would be applied in basins receiving more precipitation. Flash flood threshold values in particular should reflect values consistent with values that have produced flash floods within this basin. This analysis will establish historical maximum values for precipitation. These values will be useful in evaluating future high precipitation forecasts as well as evaluating the realism of other forecast products such as flash flood guidance numbers.

DATA:

Each area used by the Colorado Basin River Forecast Center (CBRFC) will be considered as a separate instance. Areas are typically defined to include basins upstream of a particular river gauge. Mean Areal Precipitation (MAP) values are calculated for each area by a weighted average of nearby precipitation gauges. Typically areas are divided into two or three subareas to reflect elevation differences within the area important for distinguishing precipitation type in the winter months. These nuances, however, are outside the scope of this analysis.

Cumulative six hourly values are used. An hour value of “1” indicates the six hour period 6Z through 12Z on the date indicated. The hour values increment through “4” which is the period 0Z through 6Z on the following date.

Each area has a different period of record. The beginning of the record is reflective of the beginning of the record for the precipitation gauges that define the record. The ending date is the result of the most recent averaging done by the CBRFC that is largely the same within a larger region. These dates vary between areas. Beginning dates are between 1948 and 1960 with most around 1950. End dates are 1993 for the Gila and between 1997 and 1999 for other regions.

Input data was taken from flat files at: /awips/hydroapps/rfc/nwsrfs/calb/data/area_ts/. Each region is contained in a subdirectory and each area is contained within next level subdirectories. Subareas, in turn, are in flat files in these subdirectories. For example, the file
“/awips/hydroapps/rfc/nwsrfs/calb/data/area_ts/gn_f/acju1l_f/acju1llf.p”
Contains MAP data for the lower the lower subarea of the acju1 area which is in the gn_f region.

PROCEDURE:

The maximum MAP for each area was computed by taking the maximum of the maximum MAPs for each subarea. These values are plotted in Figure 2 through Figure 4. The date of maximum occurrence is labeled on each area.

Values were calculated with the program /pc1/home/kvw/maxmap/mapmast.tcl.

Various case studies may be analyzed to determine the meteorological conditions that produce maximum MAP events. Unfortunately the data available is weighted to more recent events. For example, GOES satellite pictures are available from 1992 onwards although higher resolution pictures are available only from 1996 onwards. Other historical data is only available through the mid 1990s. These discrepancies make a consistent case study analysis difficult. Nevertheless, to illustrate some of the resources available for a case study, one is presented here. A recent case, 13 January 1997, was chosen to illustrate the potential for case studies. This case produced the maximum 6-hour MAP event for the Salt River in south central Arizona. NCEP reanalysis data is displayed in Figure 5 and Figure 6. GOES satellite imagery is displayed in Figure 7.

NCEP reanalysis is from NCEP Reanalysis data provided by the NOAA-CIRES Climate Diagnostics Center, Boulder, Colorado, USA, from their Web site at http://www.cdc.noaa.gov/. GOES data is from the GOES browser at http://lwf.ncdc.noaa.gov/servlets/GoesBrowser.

Monthly maximum MAP values were calculated. These are presented in the attached spreadsheet. Each area shows the monthly maximum for each month as well as the date of occurrence. These values were drawn from the TCL programs contained in /pc1/home/kvw/maxmap/seasonal and converted into a Correl Quatra Pro spreadsheet. These spreadsheets are easily converted to database format, which may be read into ArcMap. Minimum, maximum, and mean values are computed for each column (month).

RESULTS AND CONCLUSIONS:

The mean maximum MAP for all subareas is 1.94 inches. The mean maximum for all areas is 2.4 inches.

These values should prove useful when evaluating the realism of 6-hour precipitation accumulation forecasts. Obviously when amounts are forecast in excess of the historical maximum amounts presented here discretion should be used.

The meteorological situation depicted in Figure 5 to Figure 7 shows a strong frontal system moving across the western USA. The 500 mb heights show an upper level trough initially tilted eastward with latitude. The southern portion of this trough stalls out while the northern portion continues its eastward march across North America. At the surface the situation shows a classic cold front in surface temperatures. A high precipitation rate, due to the southern portion of the storm stalling out, is depicted in the southwestern USA. The satellite imagery a large area of the southwestern USA covered by clouds. The system is not particularly organized in the satellite picture.

POSSIBLE FUTURE WORK:

1) CASE STUDIES could be done to cover a wide variety of areas, meteorological events, and seasons. Unfortunately there will not necessarily be consistency in the data provided for each case due to the different availabilities.
2) SEASONAL ANALYSIS could be done to analysis the maximum events during each season or month. This may be useful to the forecaster in determining realistic bounds for forecasted MAPs or flash flood numbers during a particular season.
3) Analysis could be broken into SUBAREAS (i.e. upper, middle, and lower) areas.
4) Different TIME FRAME analysis (i.e. 24 hour MAP values instead of 6 hour).
5) ???

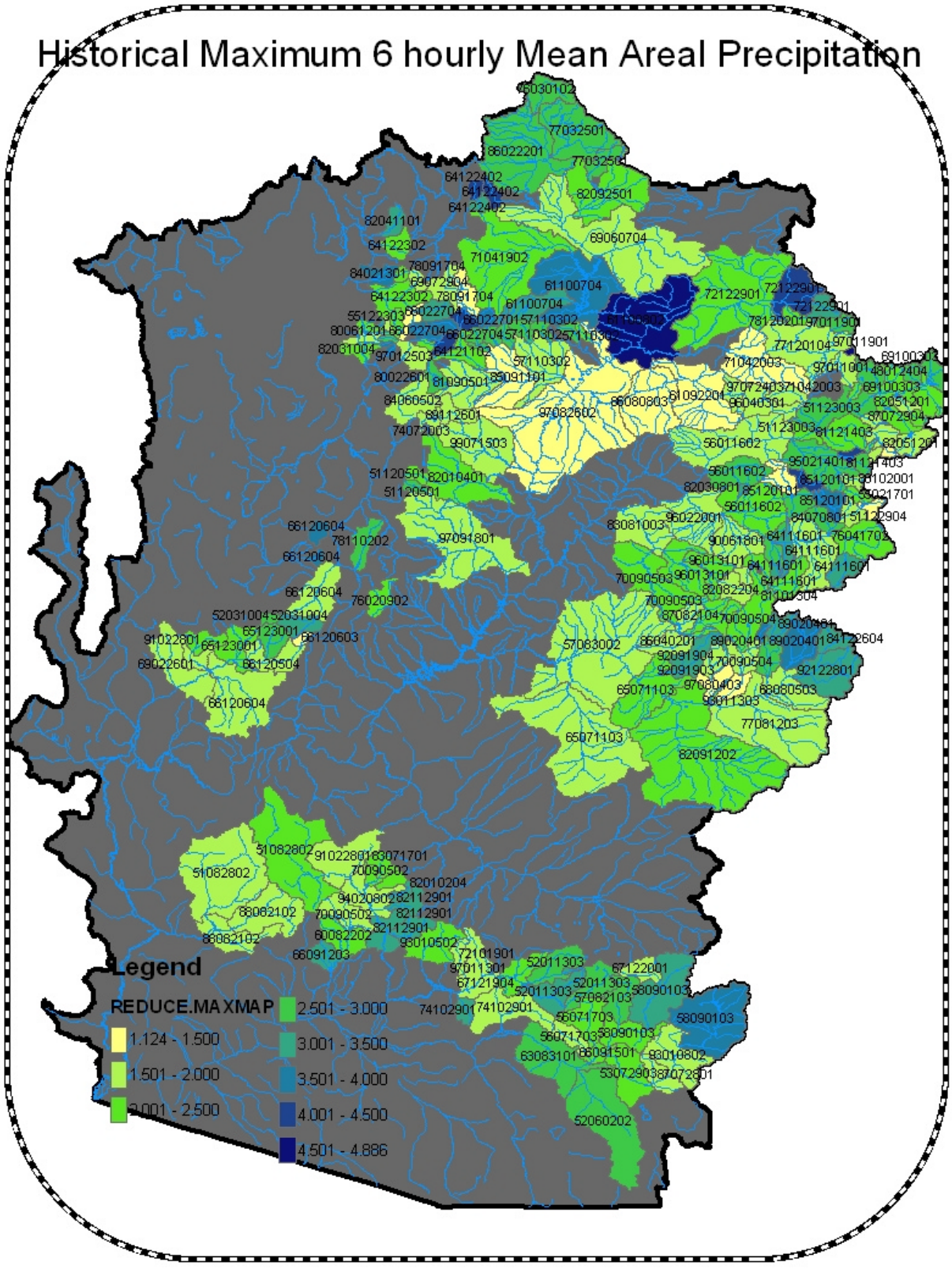


Figure 1: Maximum recorded 6 hourly Mean Areal Precipitation values. Dates o f occurrence are labeled.

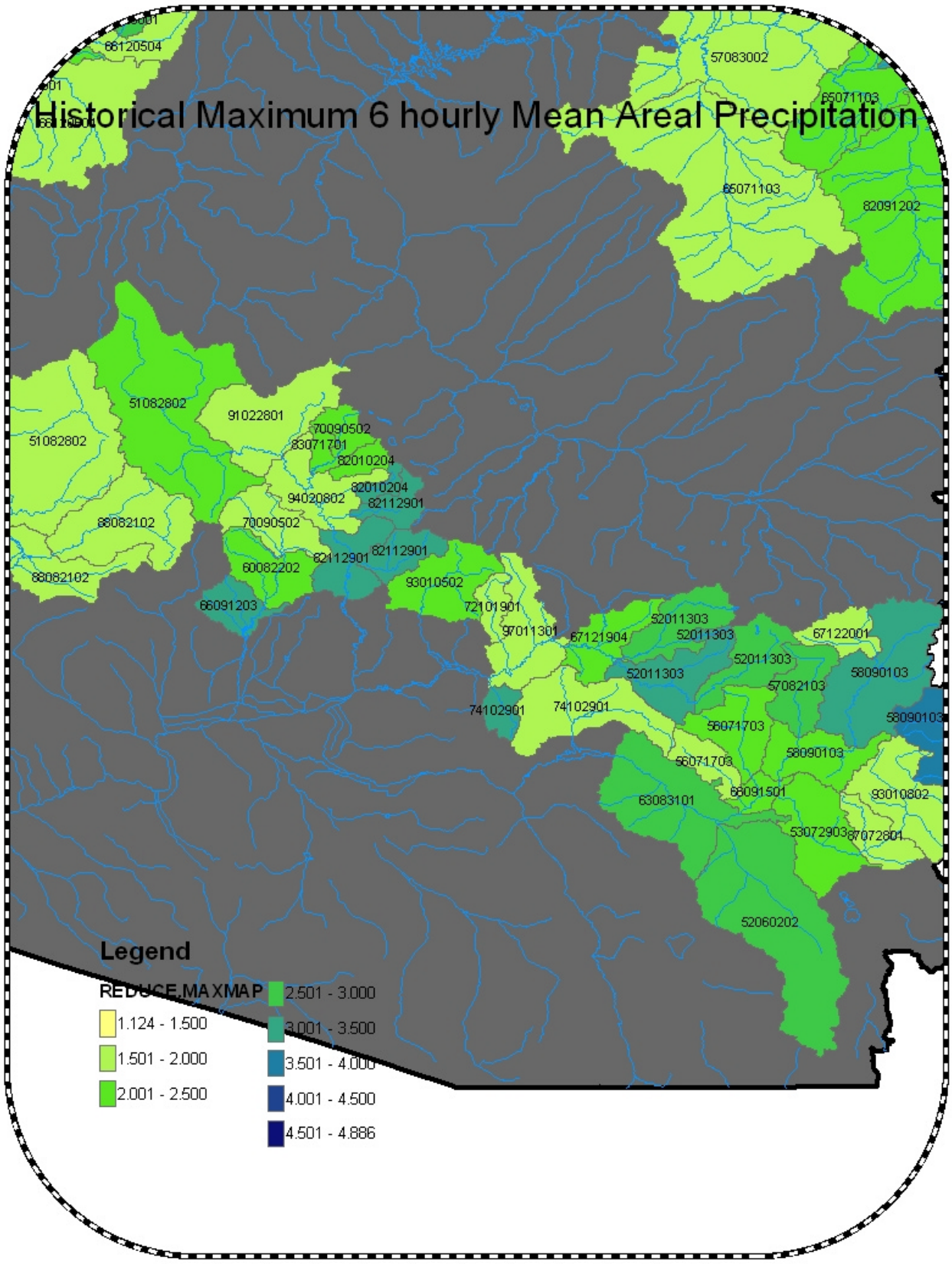


Figure 2: Maximum MAPs for southern portion of CBRFC area

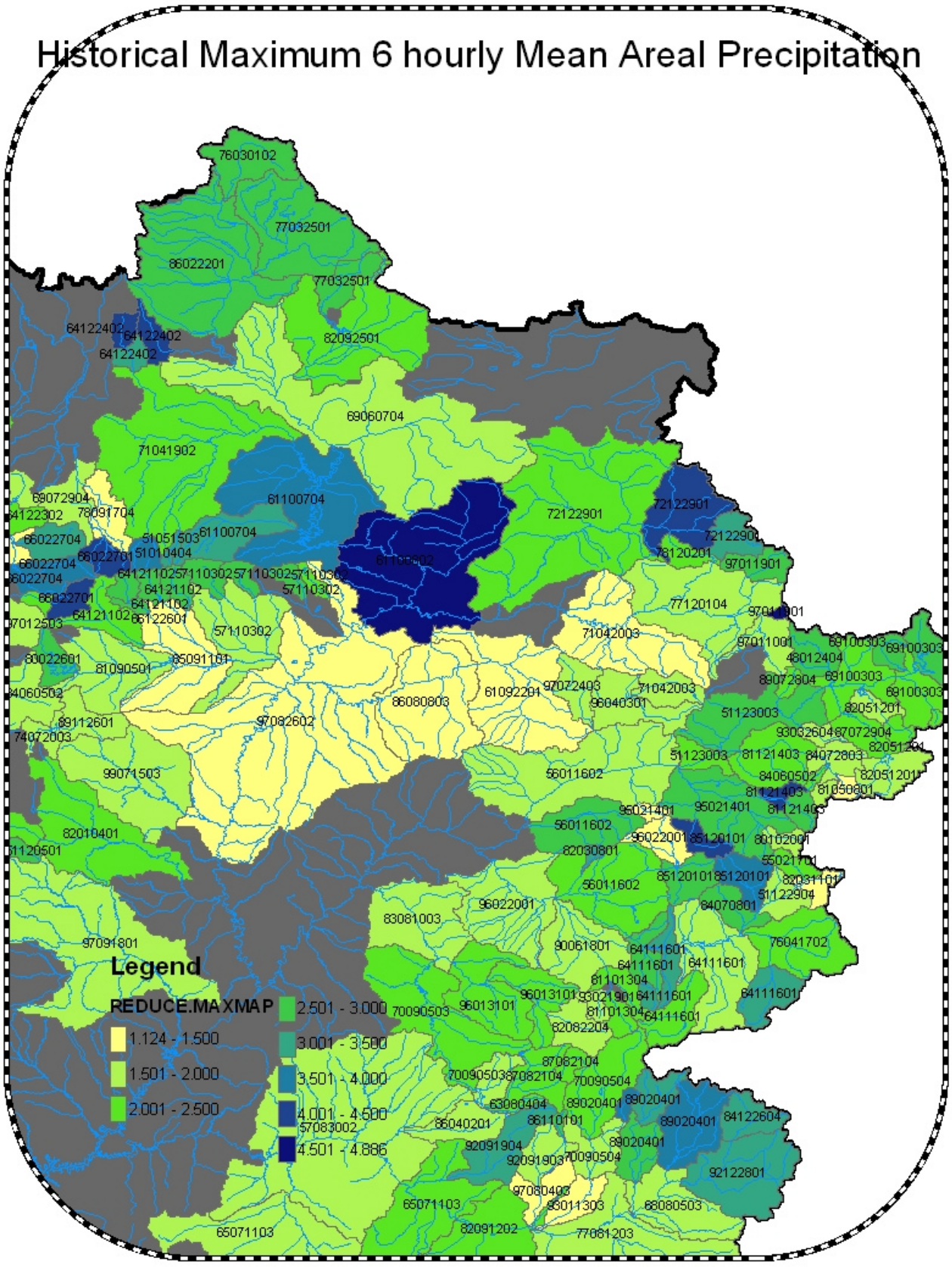


Figure 3: Maximum MAPs for north eastern CBRFC region

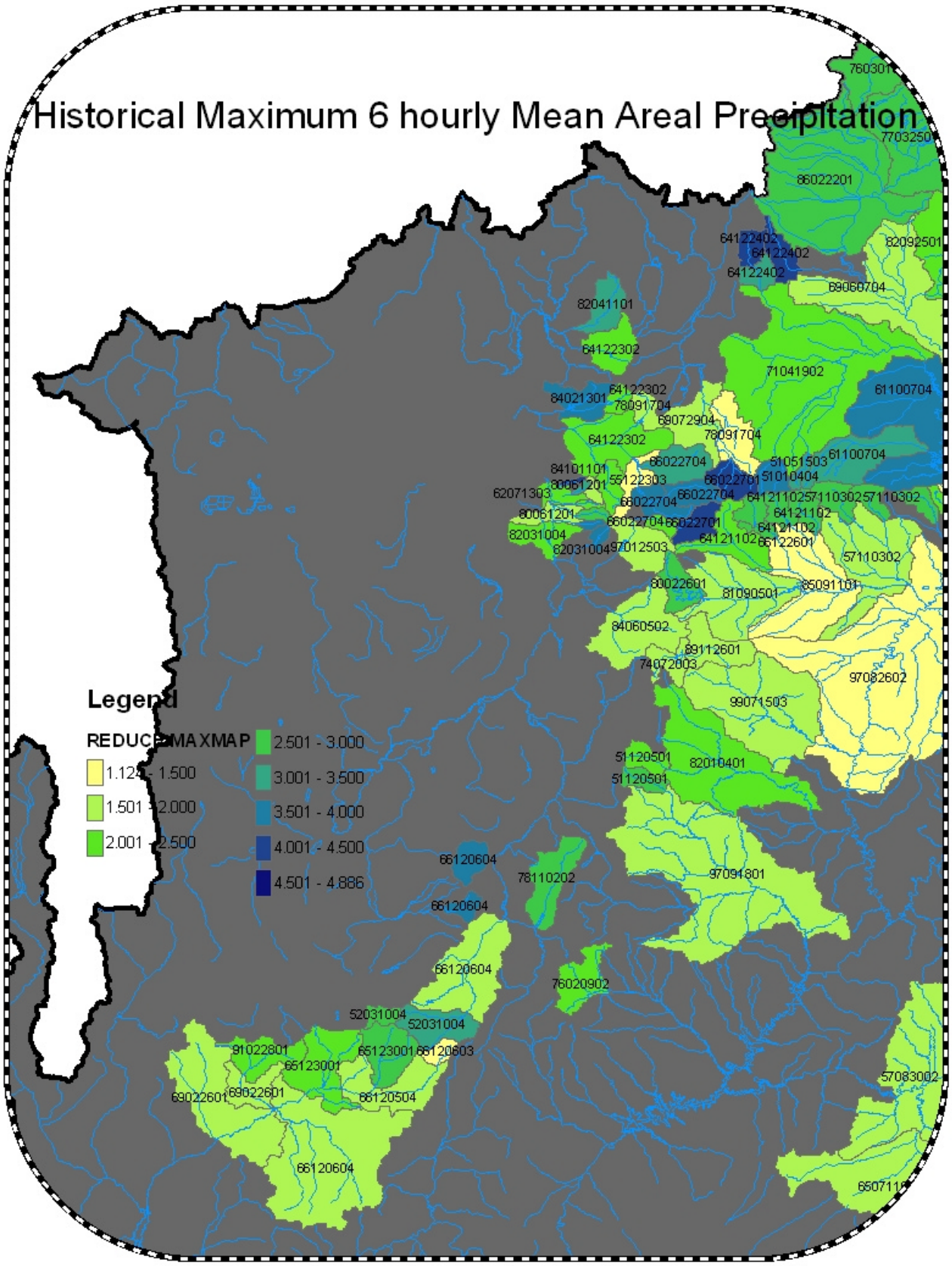


Figure 4: For northwest area

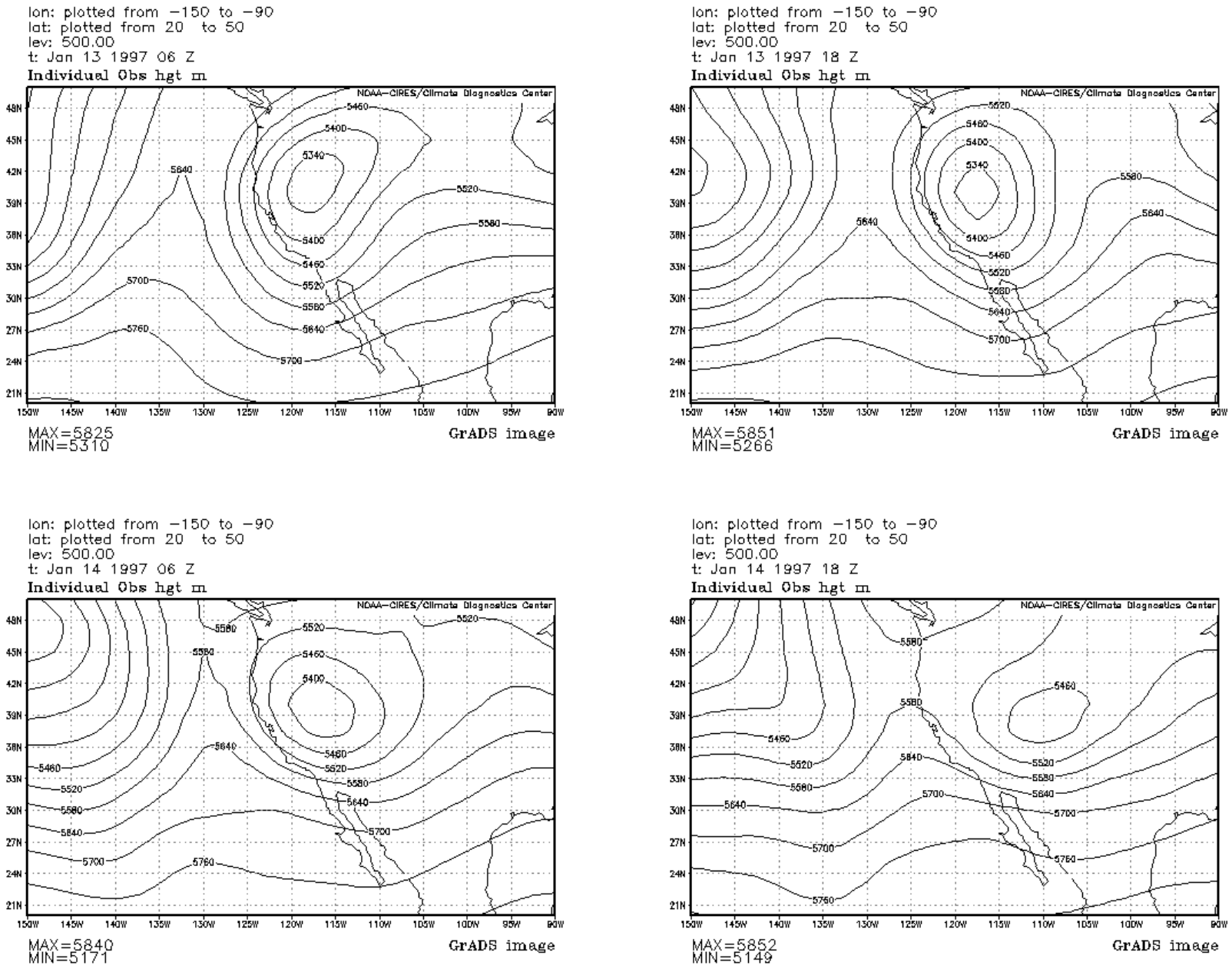
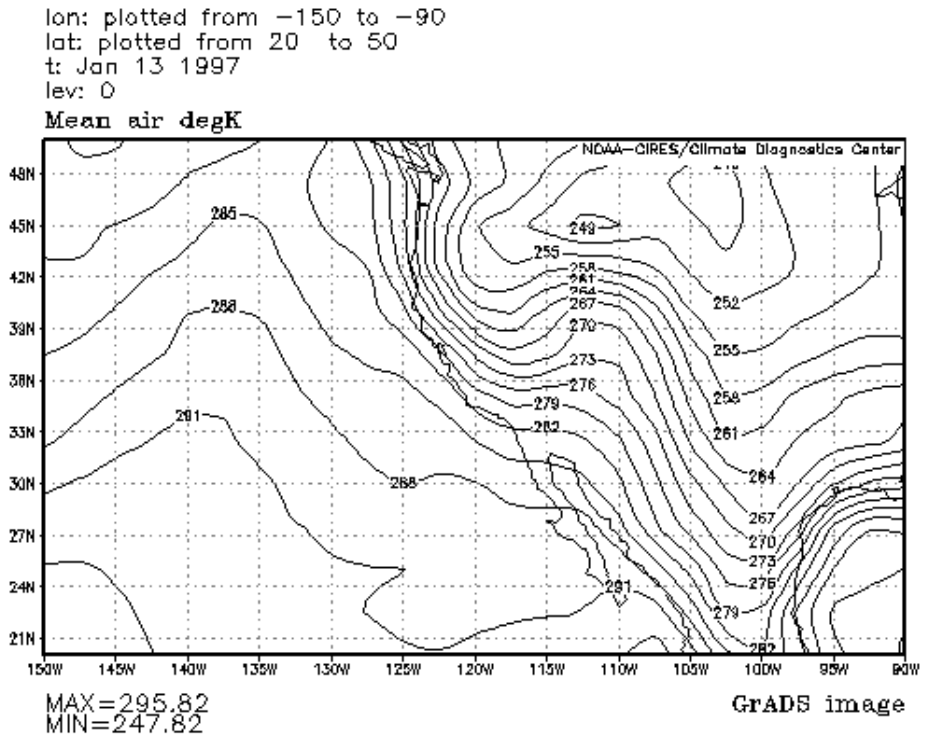


Figure 5: 500 mb heights for 1/13/97 event from NCEP reanalysis (from NCEP Reanalysis data provided by the NOAA-CIRES Climate Diagnostics Center, Boulder, Colorado, USA, from their Web site at http://www.cdc.noaa.gov/



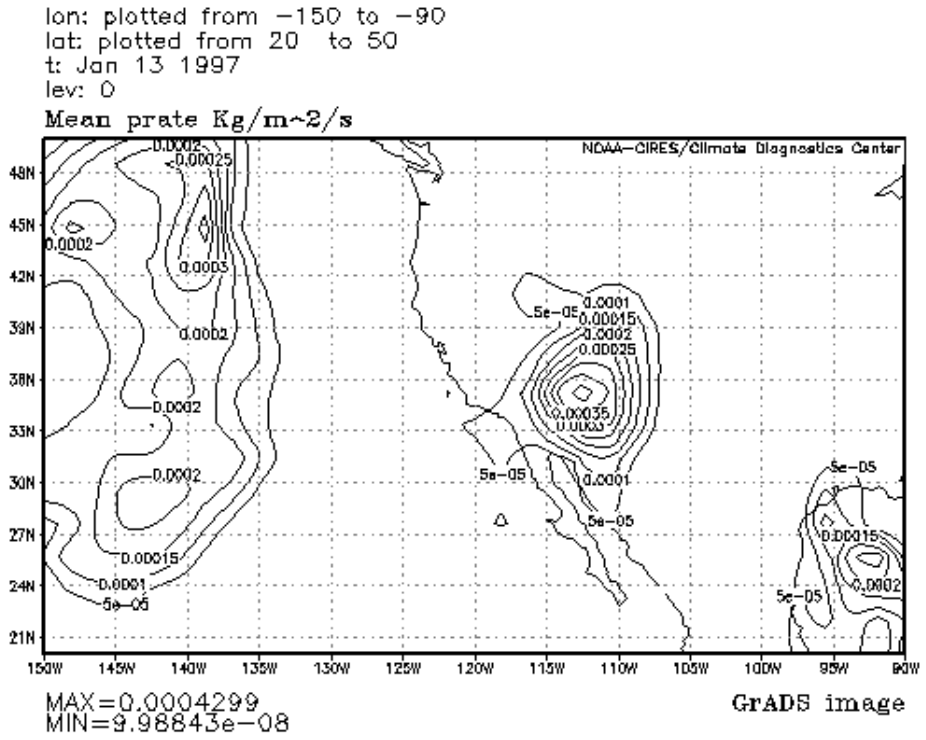


Figure 6: Daily mean temperature and precipitation rate for 1/13/97 event from NCEP reanalysis (from NCEP Reanalysis data provided by the NOAA-CIRES Climate Diagnostics Center, Boulder, Colorado, USA, from their Web site at http://www.cdc.noaa.gov/

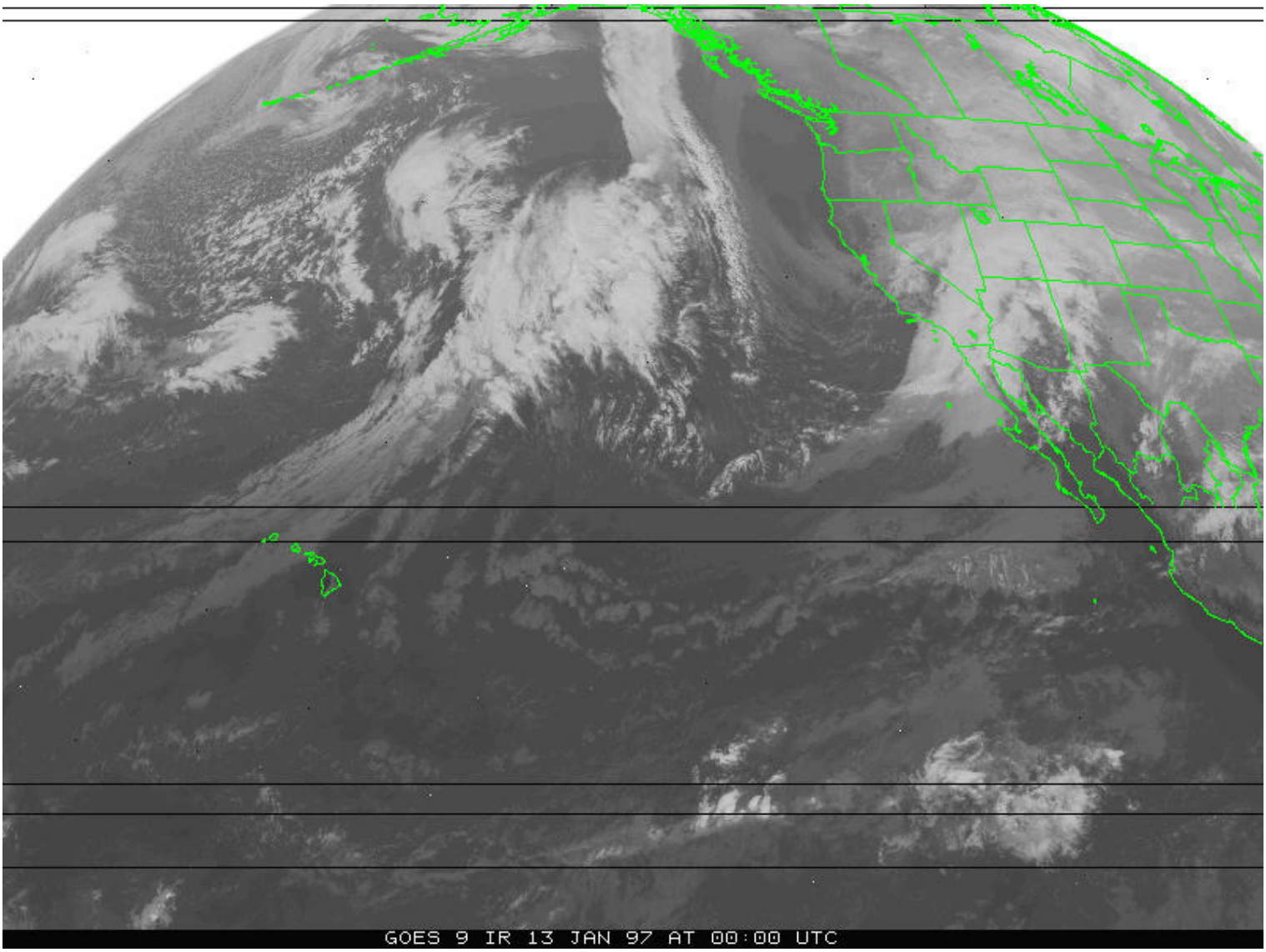


Figure 7: GOES West infrared satellite imagery for 1/13/97 event from http://lwf.ncdc.noaa.gov/servlets/GoesBrowser