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Quality Scientific Data Collection and Analysis

Hydrology and Simulation of Flow and Land-Surface Subsidence in the Chicot, Evangeline, and Jasper Aquifers, Northern Gulf Coast, Texas

Mark C. Kasmarek, James L. Robinson, N.A. Houston, and Jennifer Lanning-Rush
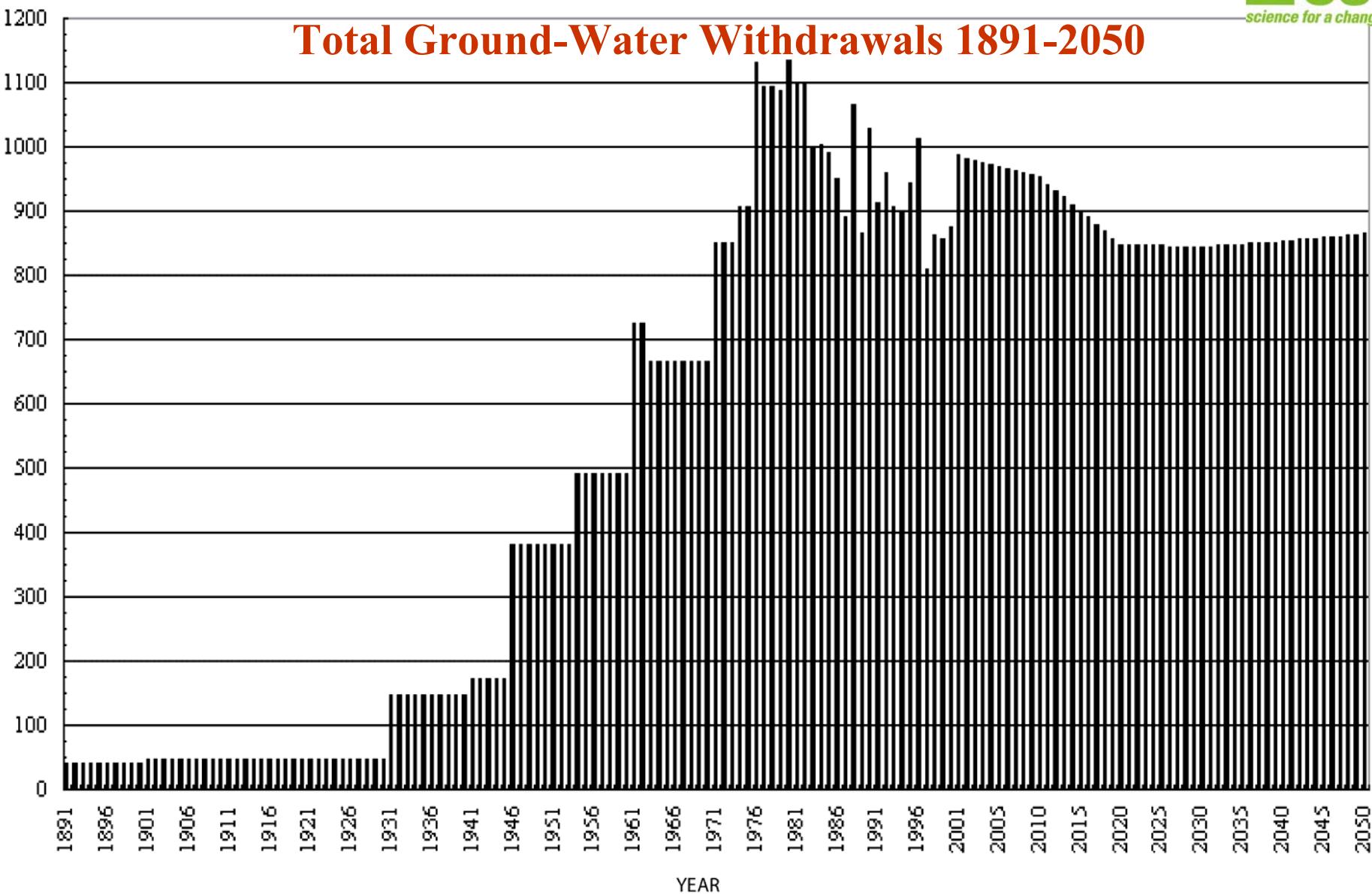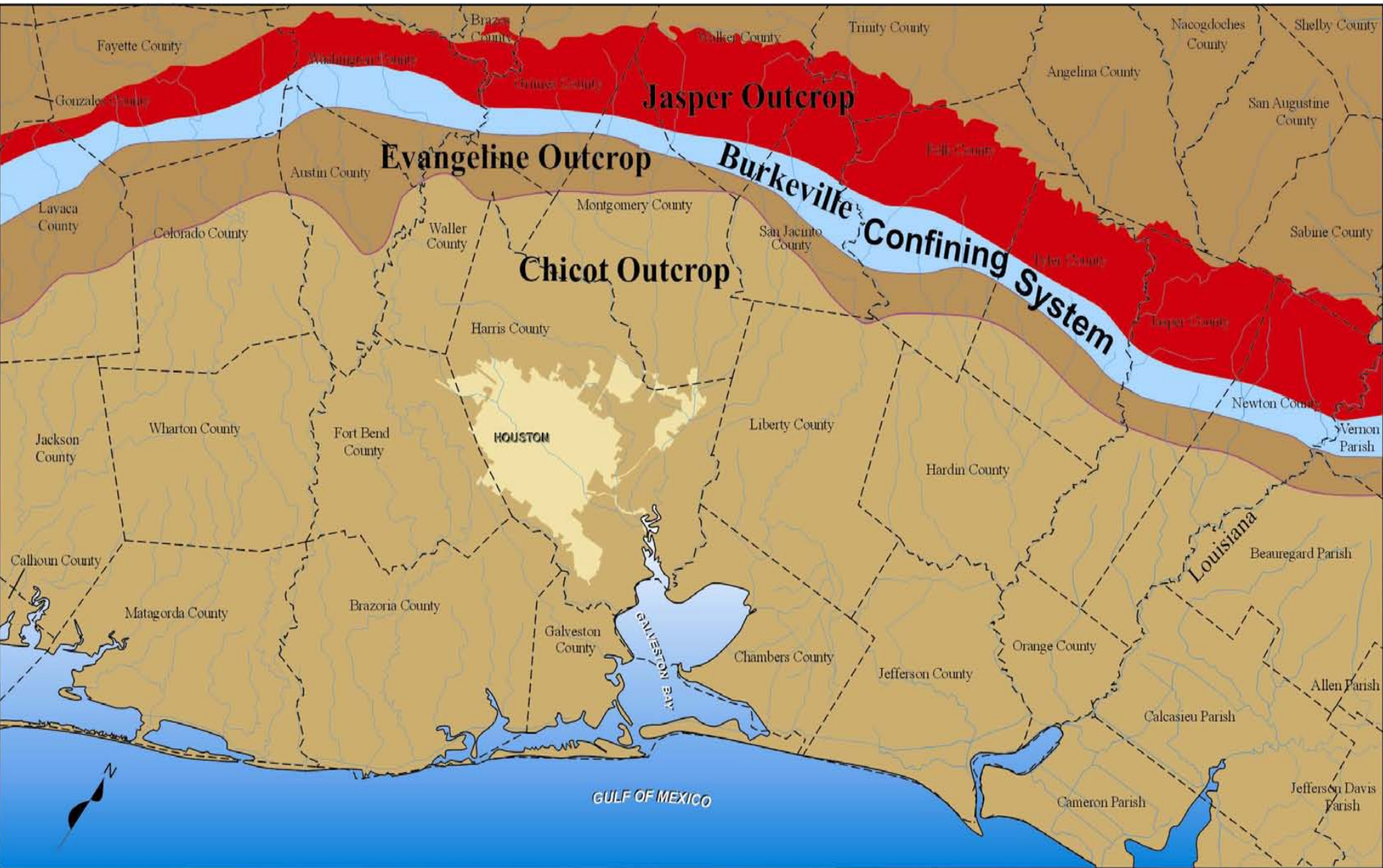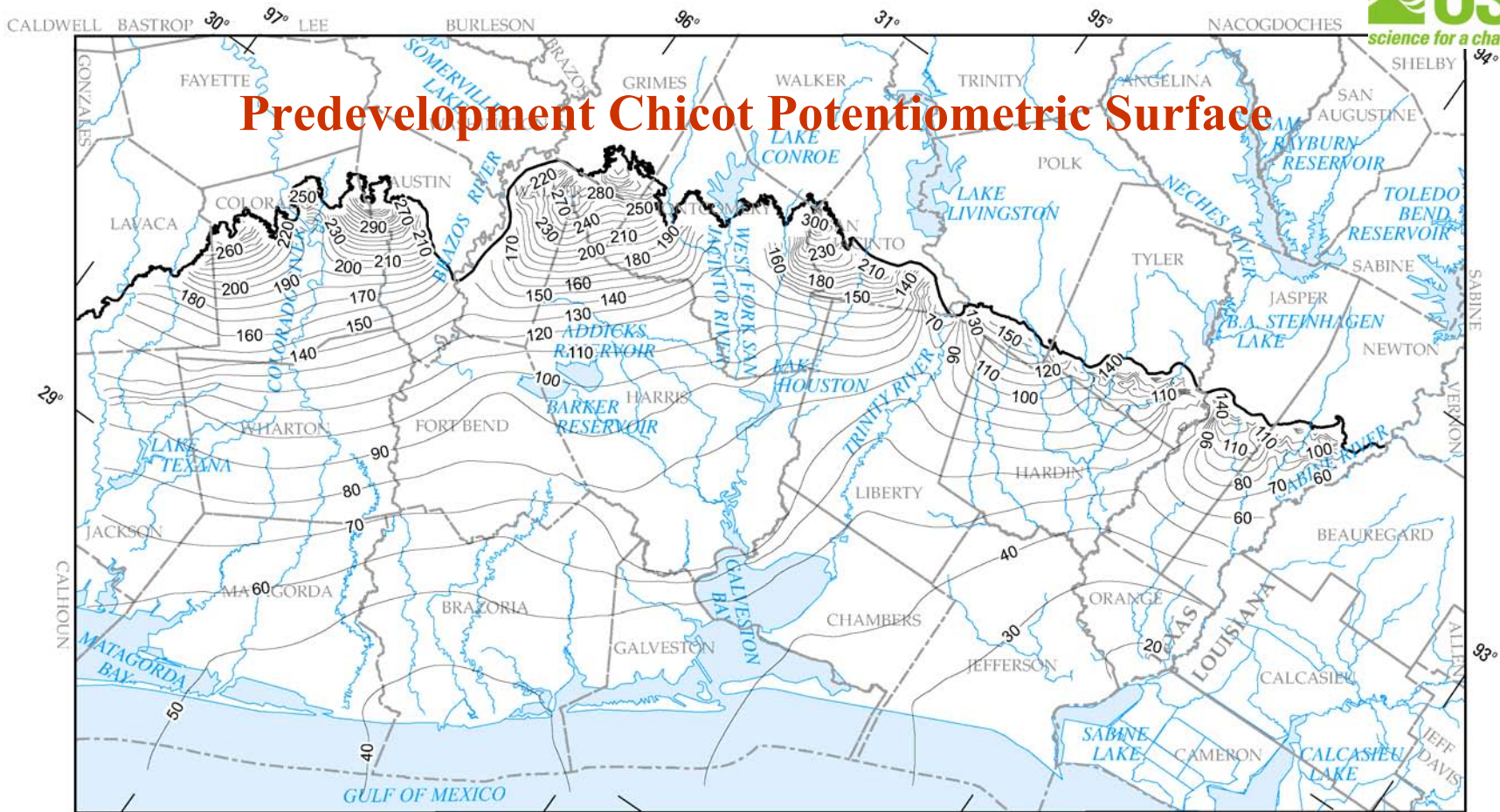
Total Ground-Water Withdrawals 1891-2050

Figure 34. Total ground-water withdrawals used in transient and predictive model simulations, 1891-2050.

Outcrops of the Gulf Coast Aquifer System Outcrops

Figure 53. Simulated predevelopment potentiometric surface of the Chicot aquifer in the Ground-Water Availability Model study area.

Figure 54. Simulated predevelopment potentiometric surface of the Evangeline aquifer in the Ground-Water Availability Model study area.

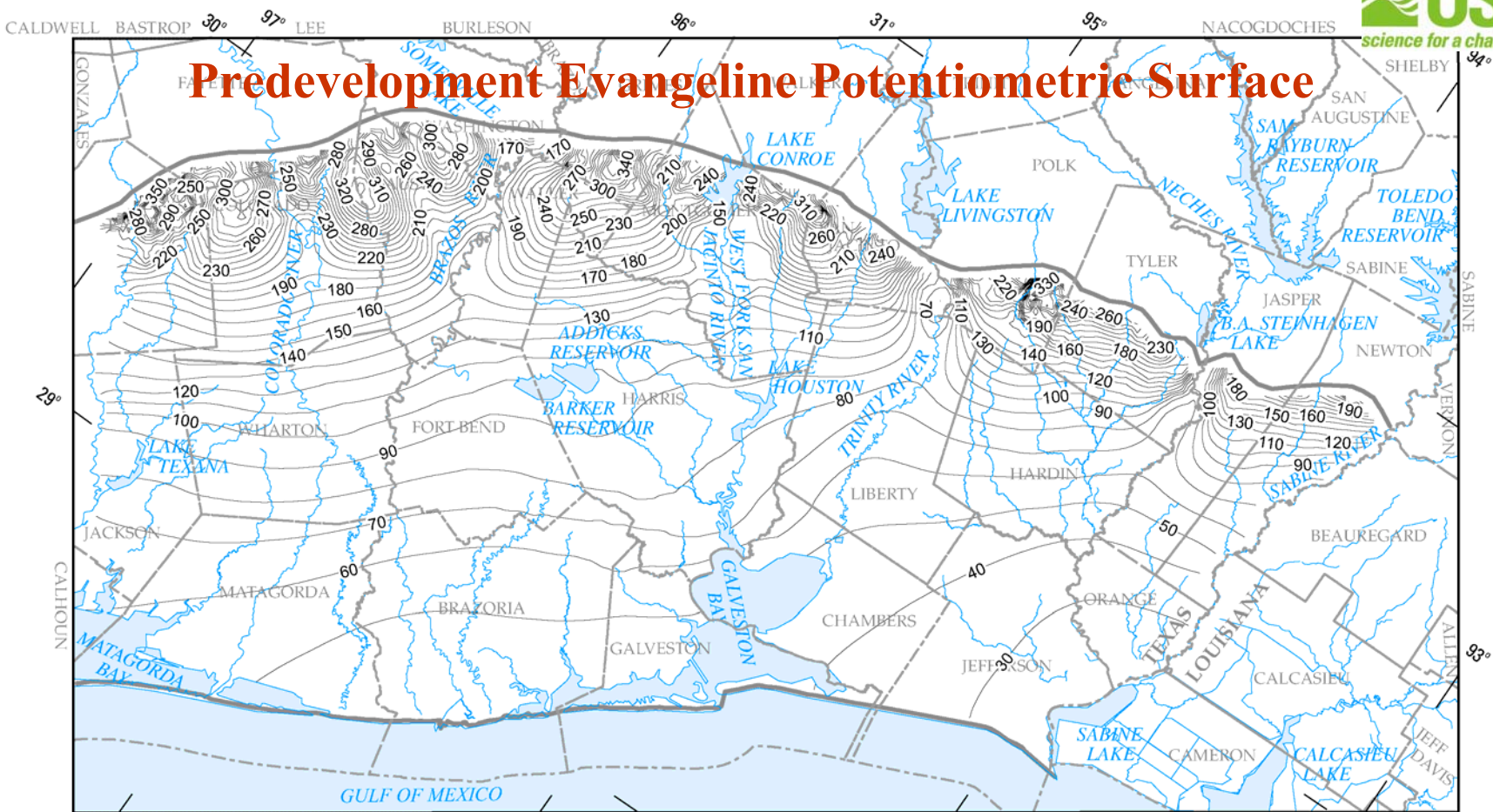# Predevelopment Jasper Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
Standard parallels 34°55' and 27°25', central meridian -100°
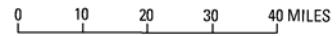
0   10   20   30   40 MILES

EXPLANATION

— Simulated potentiometric contour, Interval 10 feet
Datum is sea level

Figure 55. Simulated predevelopment potentiometric surface of the Jasper aquifer in the Ground-Water Availability Model study area.
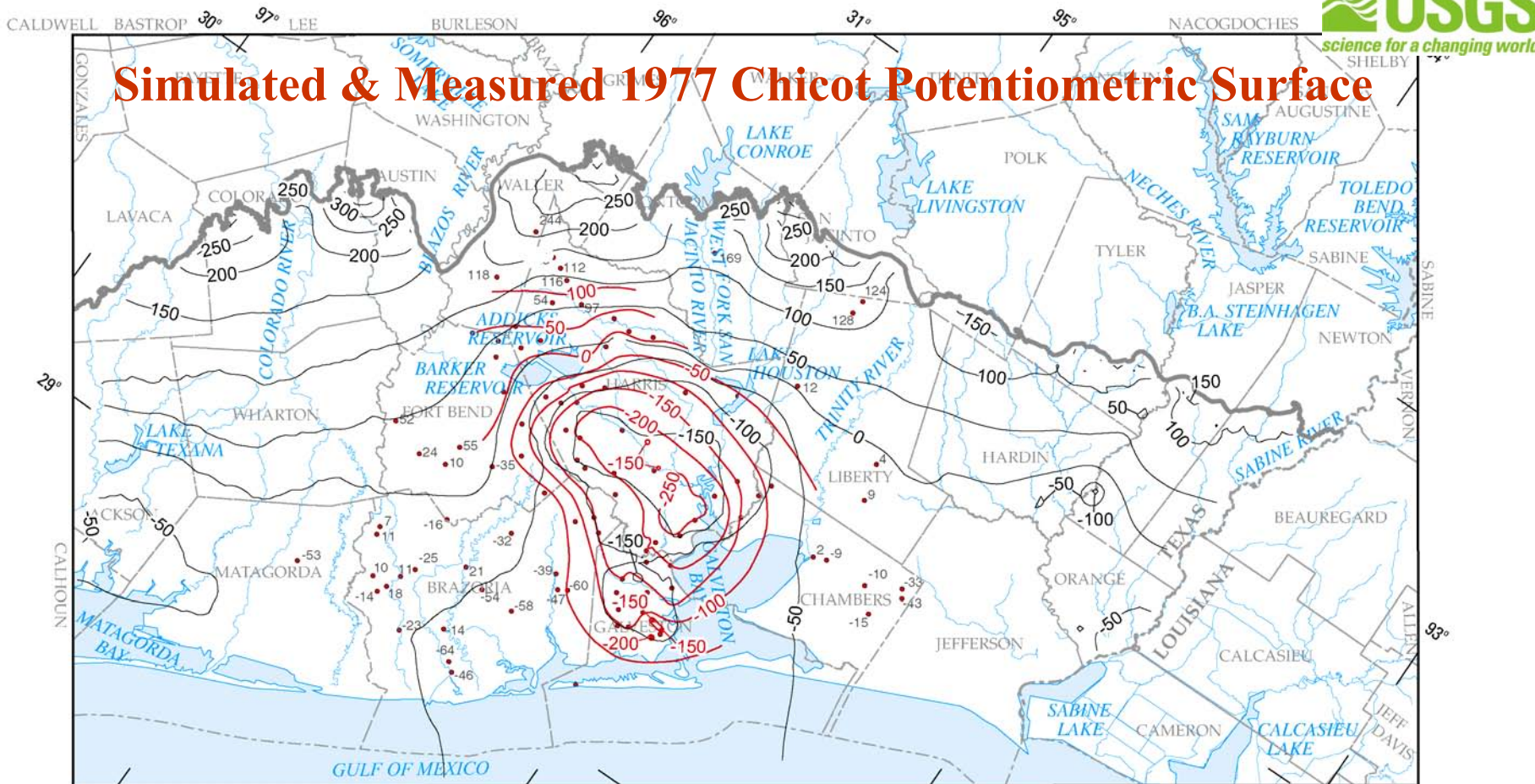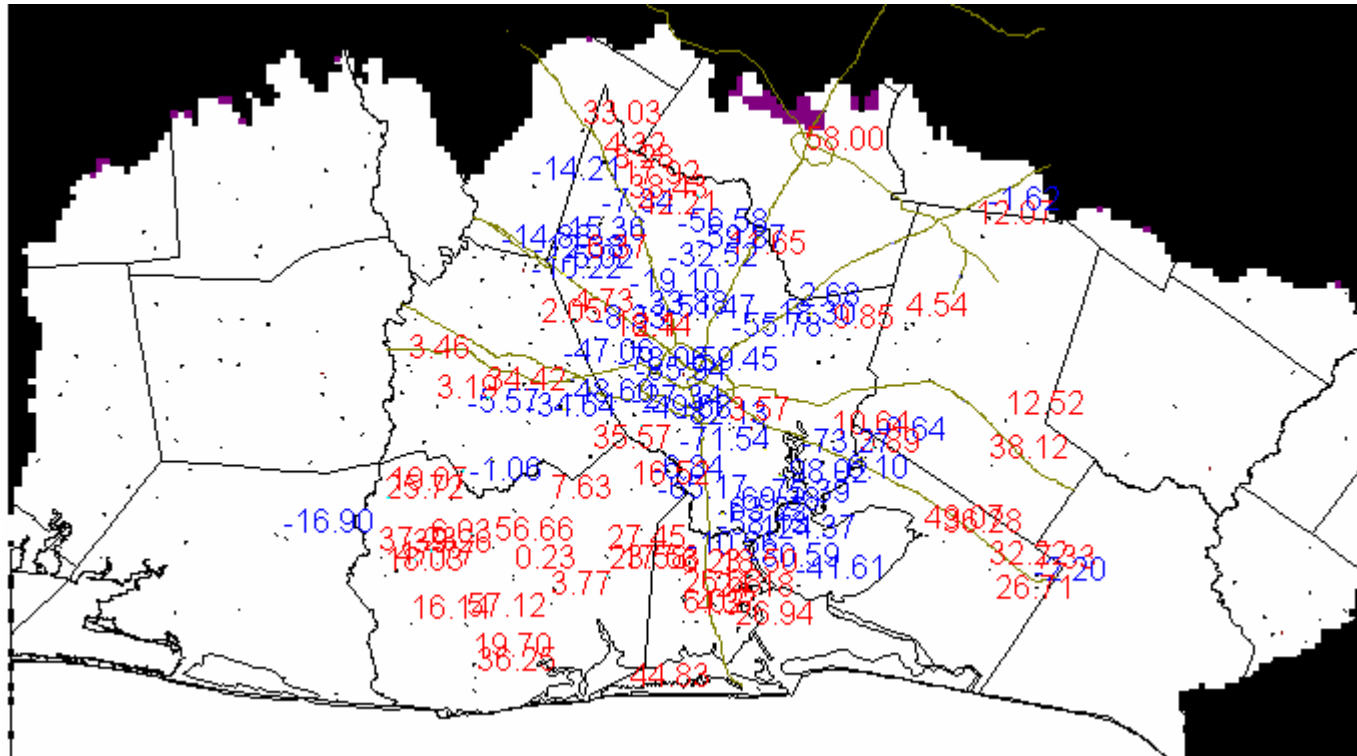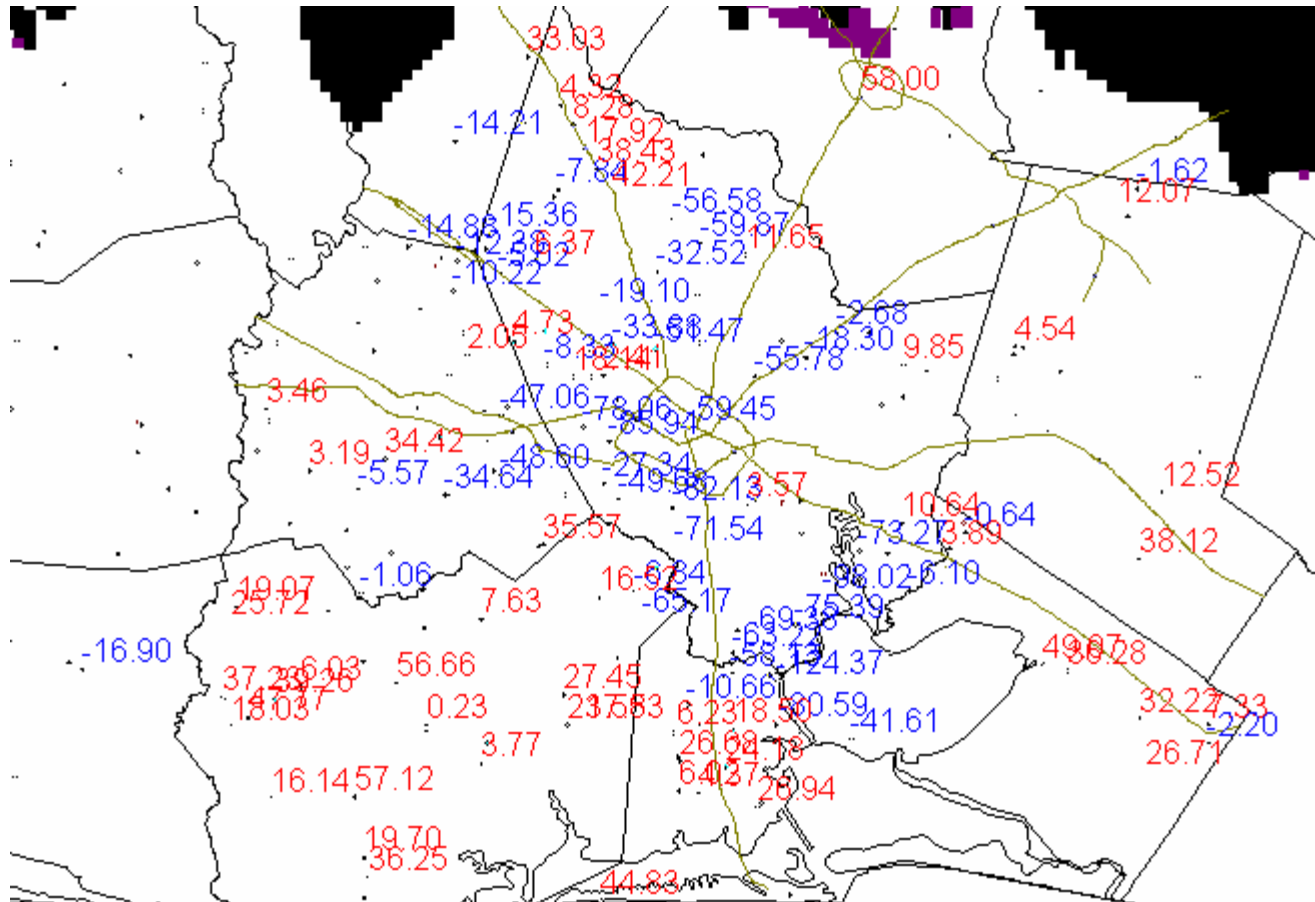
Figure 46. Simulated and measured 1977 potentiometric surfaces of the Chicot aquifer and 1977 water-level measurements from wells screened in the Chicot aquifer (modified from Gabrysch, 1979) in the Ground-Water Availability Model study area.
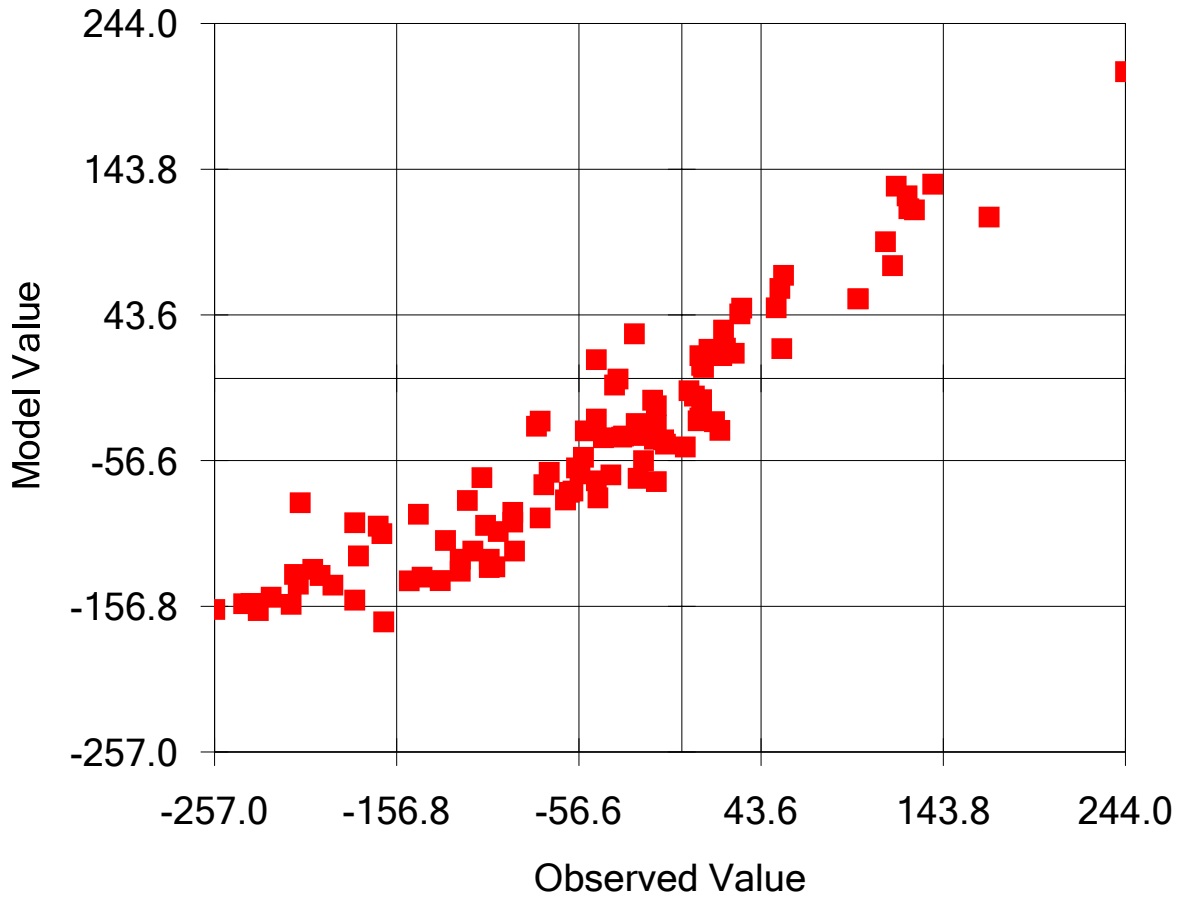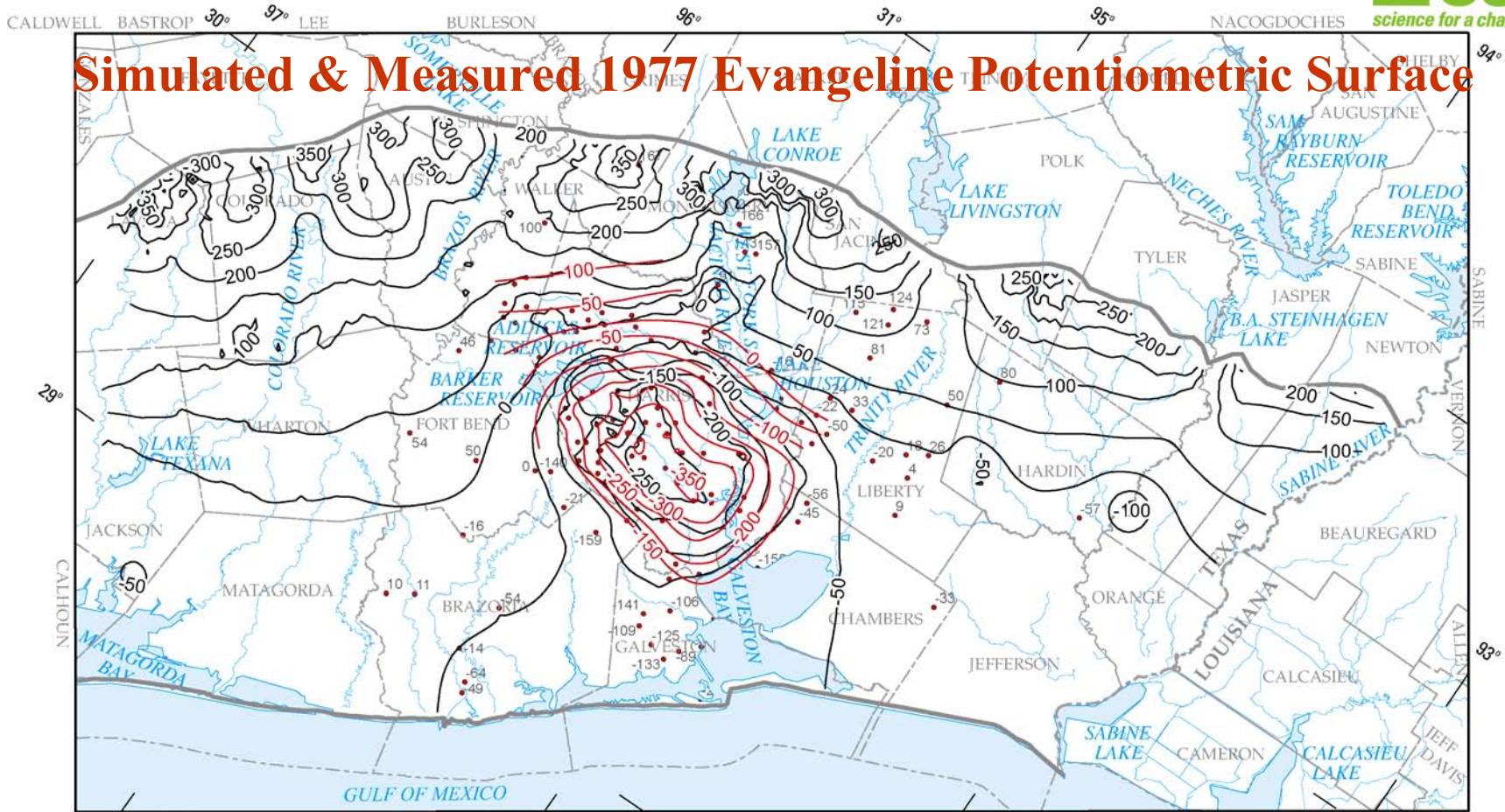
1977 Chicot Residuals

1977 Chicot Residuals Zoom

1977 Chicot Observed vs. Computed Values

Figure 47. Simulated and measured 1977 potentiometric surfaces of the Evangeline aquifer and 1977 water-level measurements from wells screened in the Evangeline aquifer (modified from Gabrysch, 1979) in the Ground-Water Availability Model study area.

1977 Evangeline Residuals

1977 Evangeline Residuals Zoom

1977 Evangeline Observed vs. Computed Values

Simulated 1977 Jasper Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
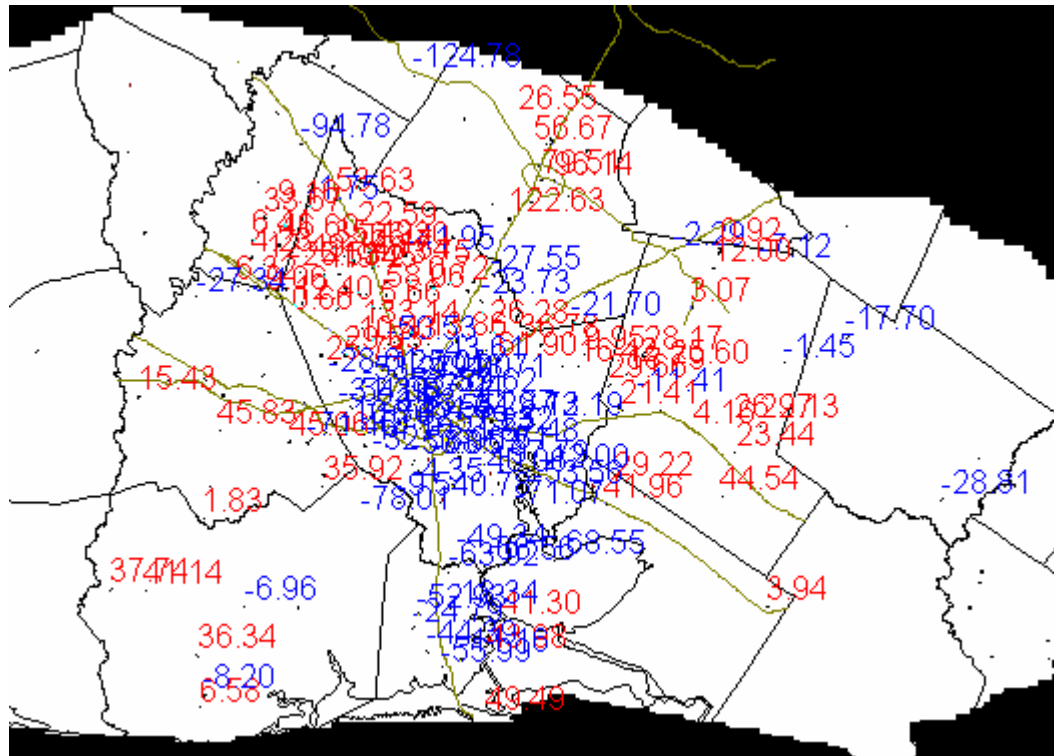Standard parallels 34°55′ and 27°25′, central meridian -100°
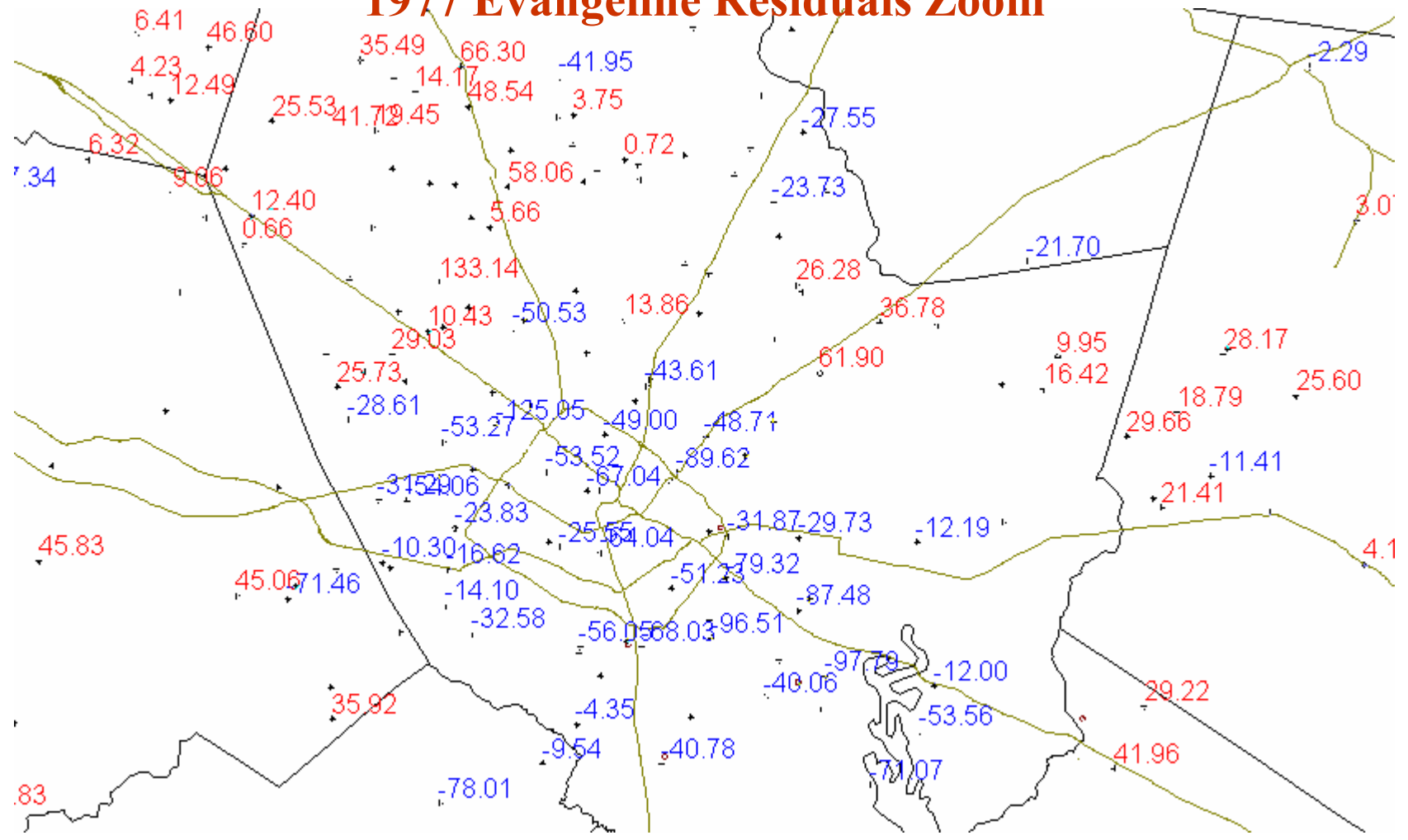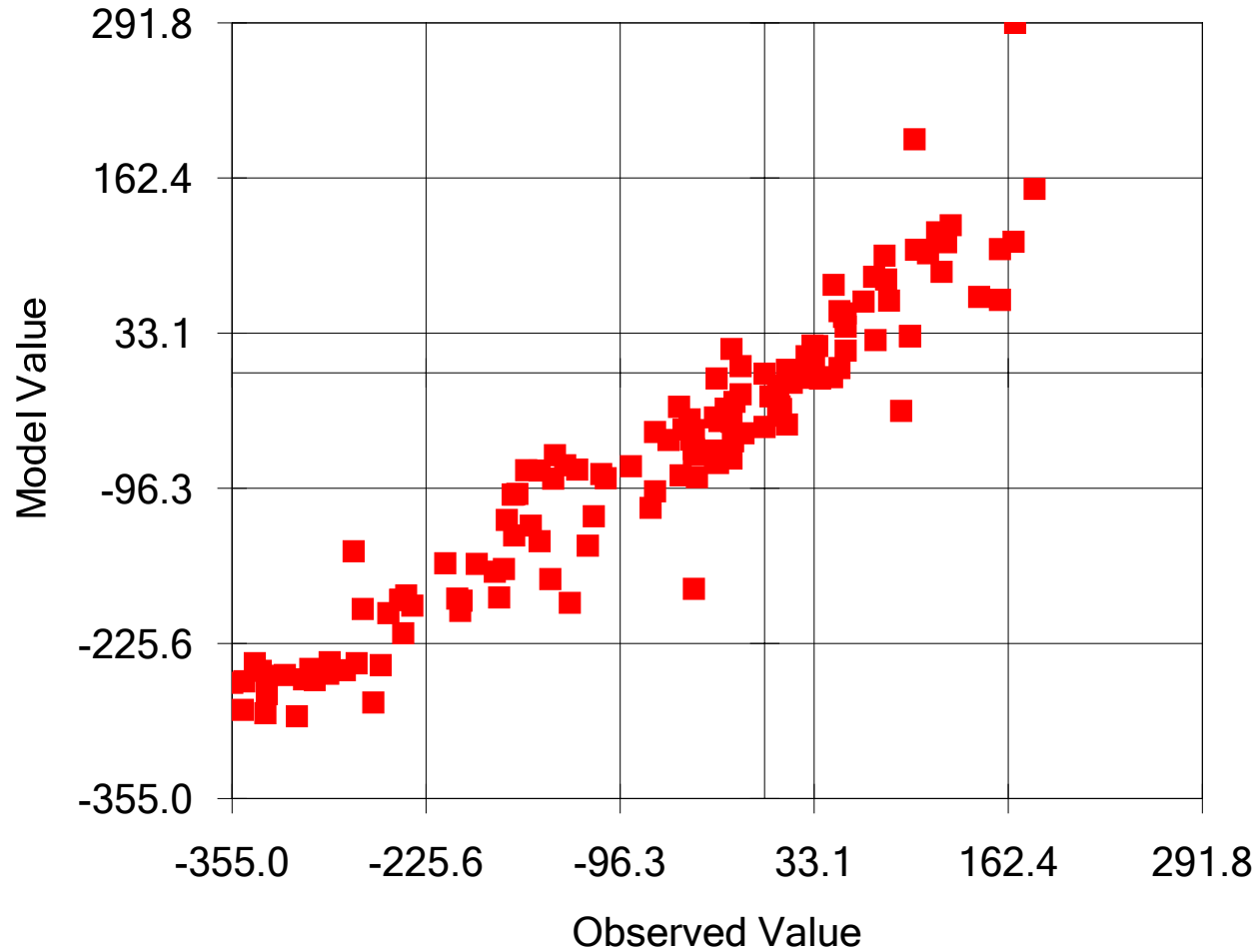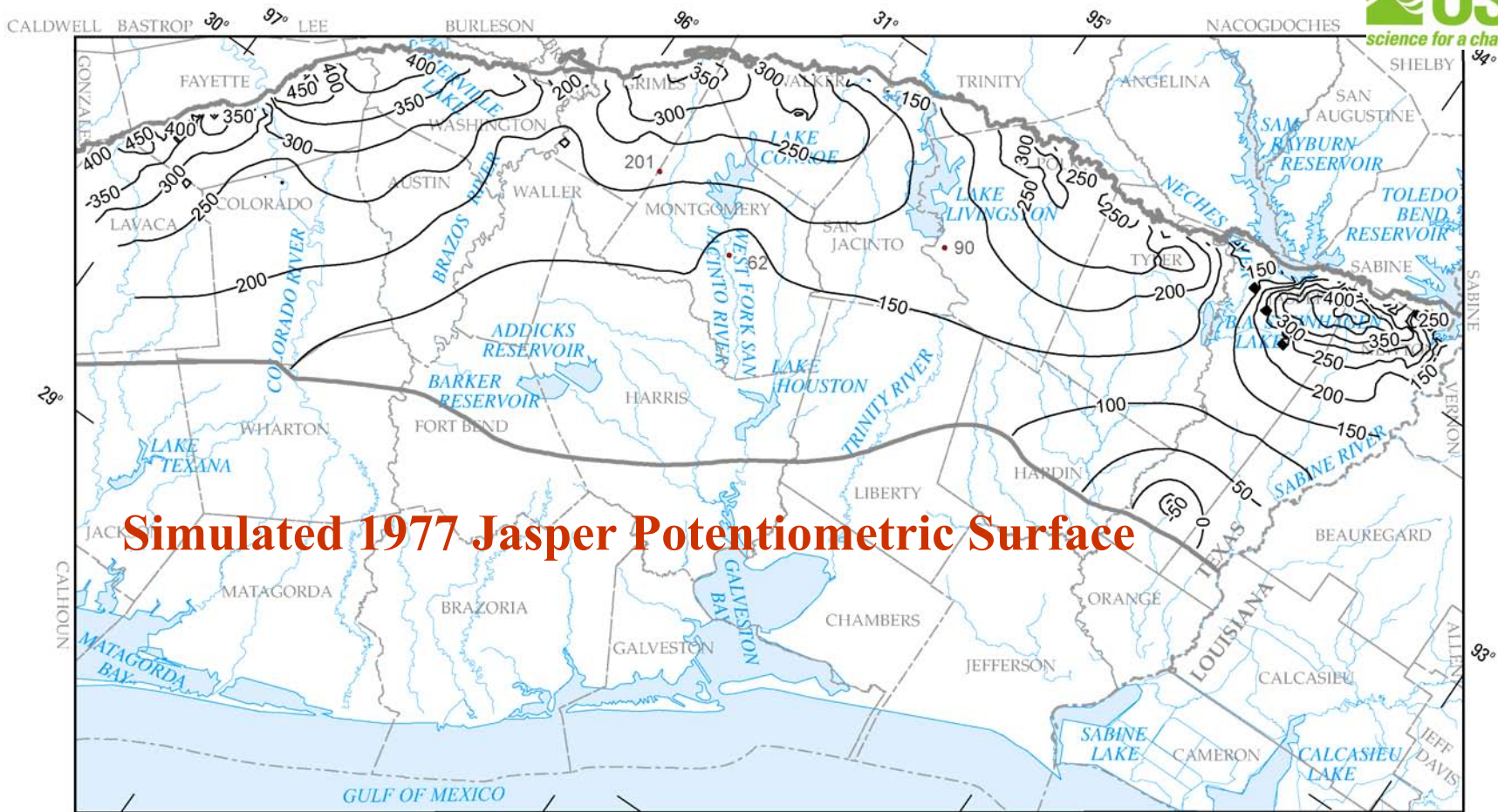
0   10   20   30   40 MILES

EXPLANATION

• Data Point—Well in which water-level measurement
was made. Number is water-level altitude (shown in
areas not having published contours).

━━━ Updip and downdip limit of the Jasper aquifer

━━━ 1977 Simulated, interval 50 feet

━━━ 1977 Measured, interval 50 feet. Datum is sea level

Figure 48. Simulated 1977 potentiometric surface of the Jasper aquifer and 1977 water-level measurements from wells screened in the Jasper aquifer in the Ground-Water Availability Model study area.
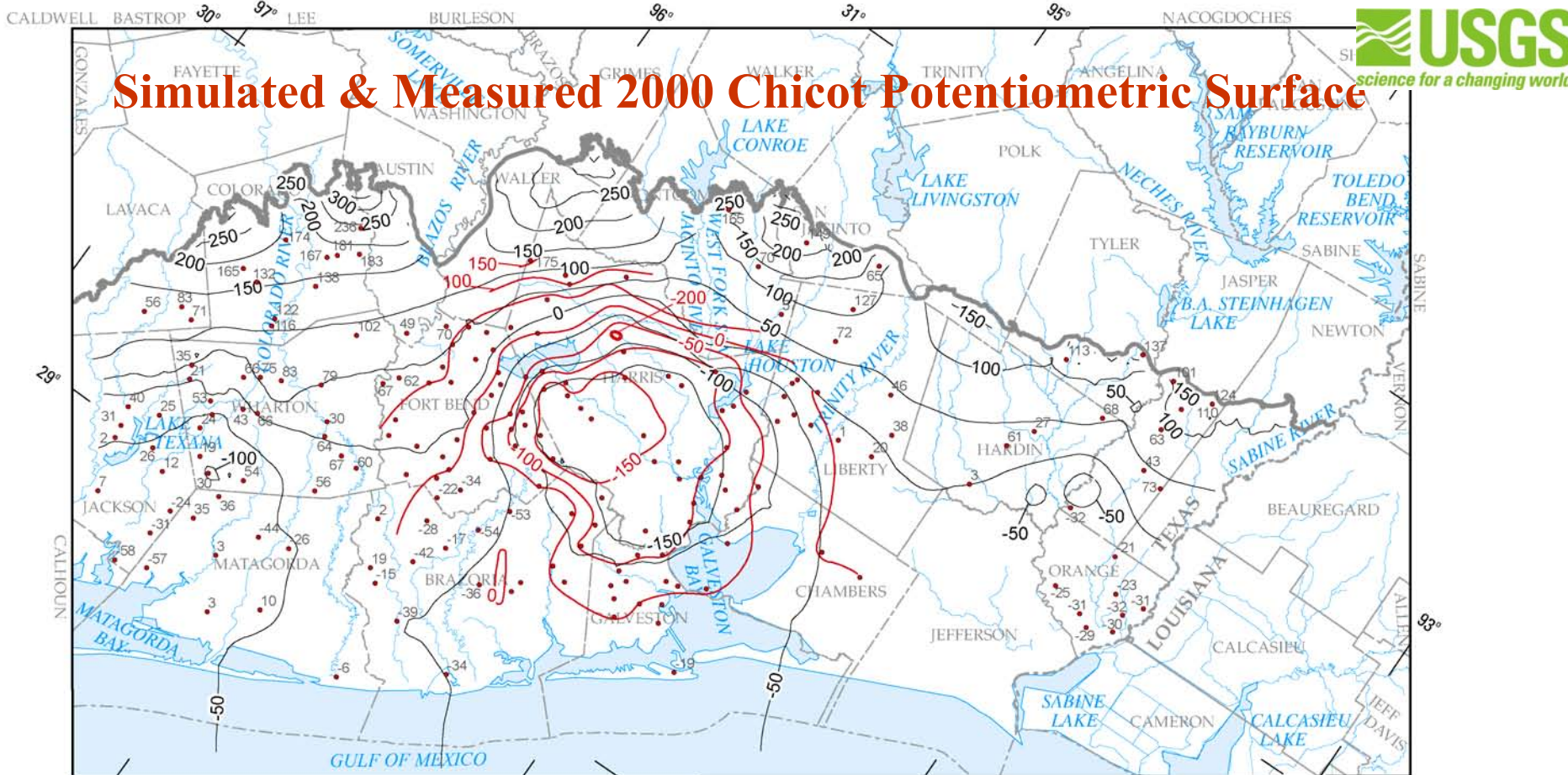
Figure 49. Simulated and measured 2000 potentiometric surfaces of the Chicot aquifer and 2000 water-level measurements from wells screened in the Chicot aquifer (modified from Coplin and Santos, 2000) in the Ground-Water Availability Model study area.

2000 Chicot Residuals

2000 Chicot Residuals Zoom

2000 Chicot Observed vs. Computed Values
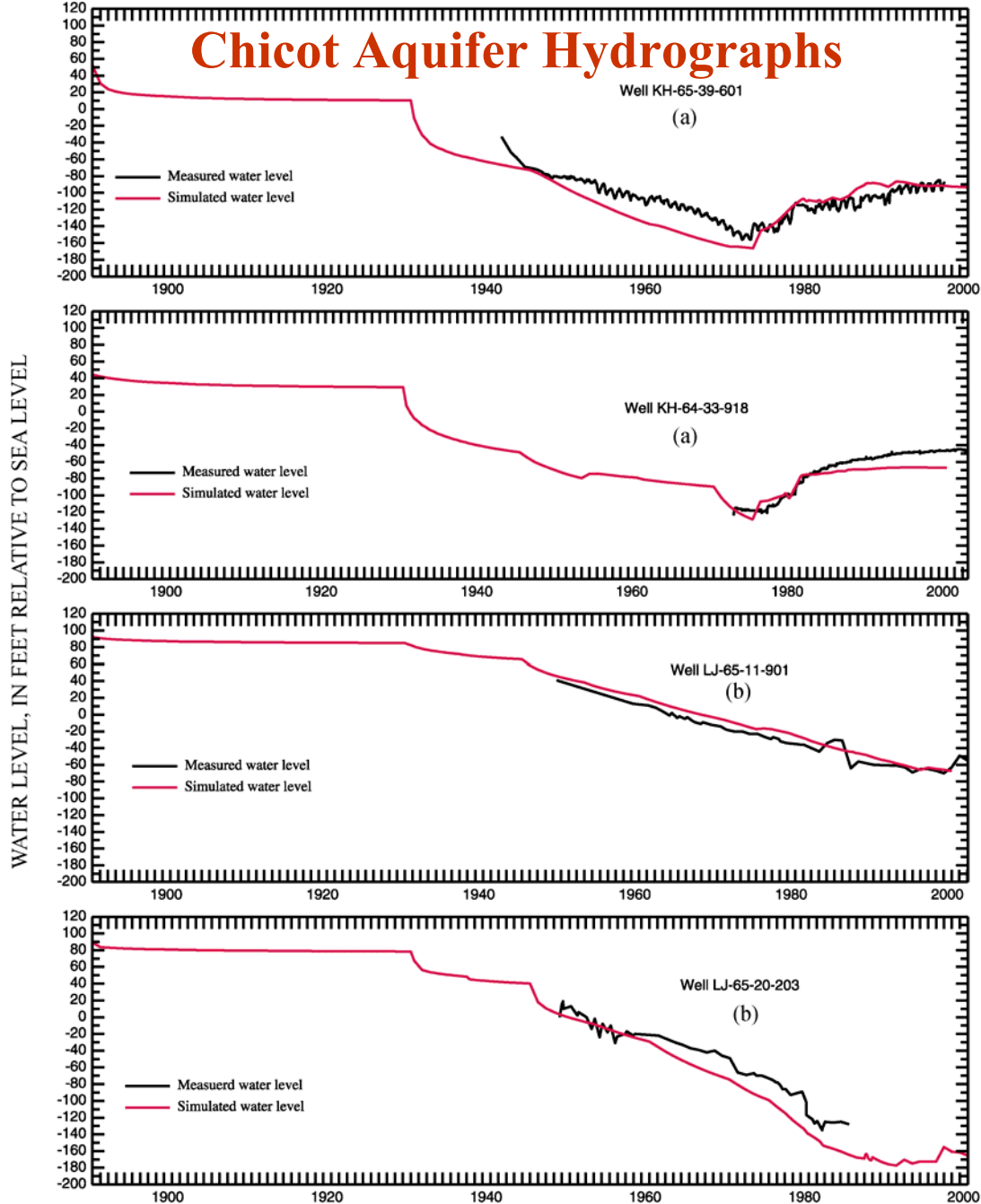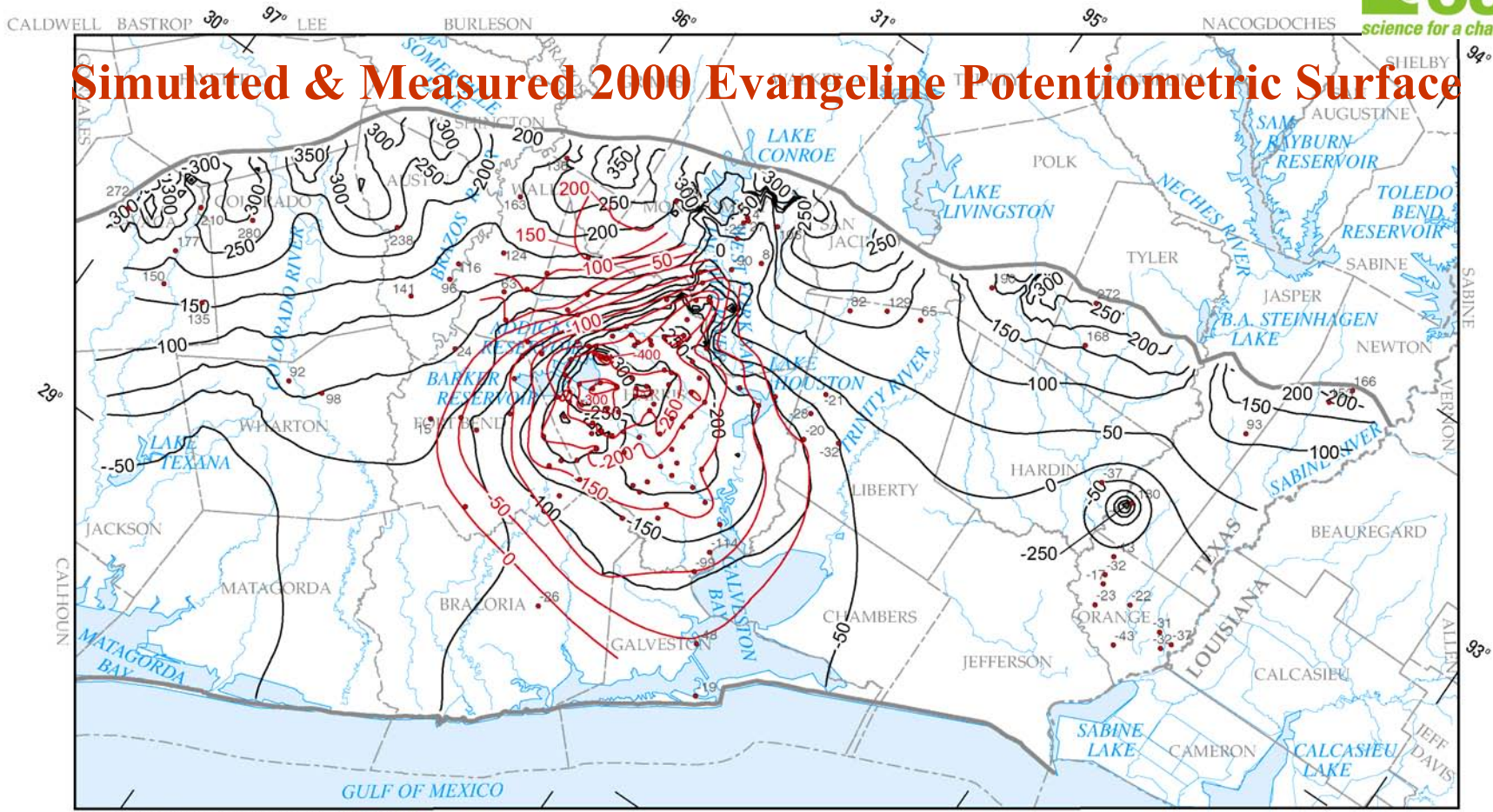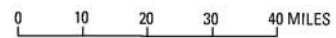
Chicot Aquifer Hydrographs
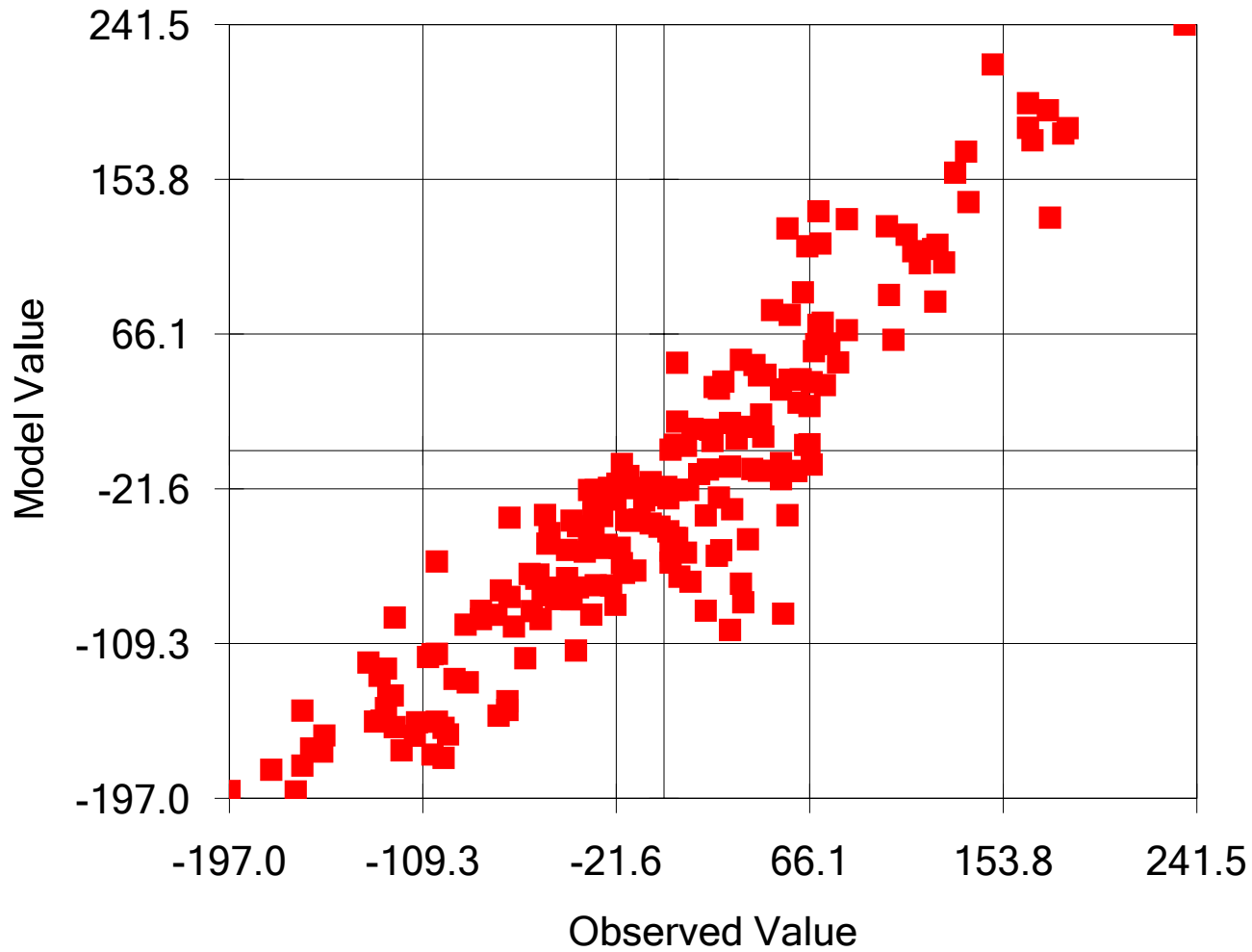
Figure 35. Hydrographs showing simulated and measured water levels in selected observation wells screened in the Chicot Aquifer in Galveston (a) and Harris (b) Counties in the Ground-Water Availability Model study area.

Figure 50. Simulated and measured 2000 potentiometric surfaces of the Evangeline aquifer and 2000 water-level measurements from wells screened in the Evangeline aquifer (modified from Coplin and Santos, 2000) in the Ground-Water Availability Model study area.

2000 Evangeline Residuals

2000 Evangeline Residuals Zoom

2000 Evangeline Observed vs. Computed Values

Evangeline Aquifer Hydrographs

Figure 36. Hydrographs showing simulated and measured water levels in selected observation wells screened in the Evangeline aquifer in Harris County in the Ground-Water Availability Model study area.

Simulated & Measured 2000 Jasper Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
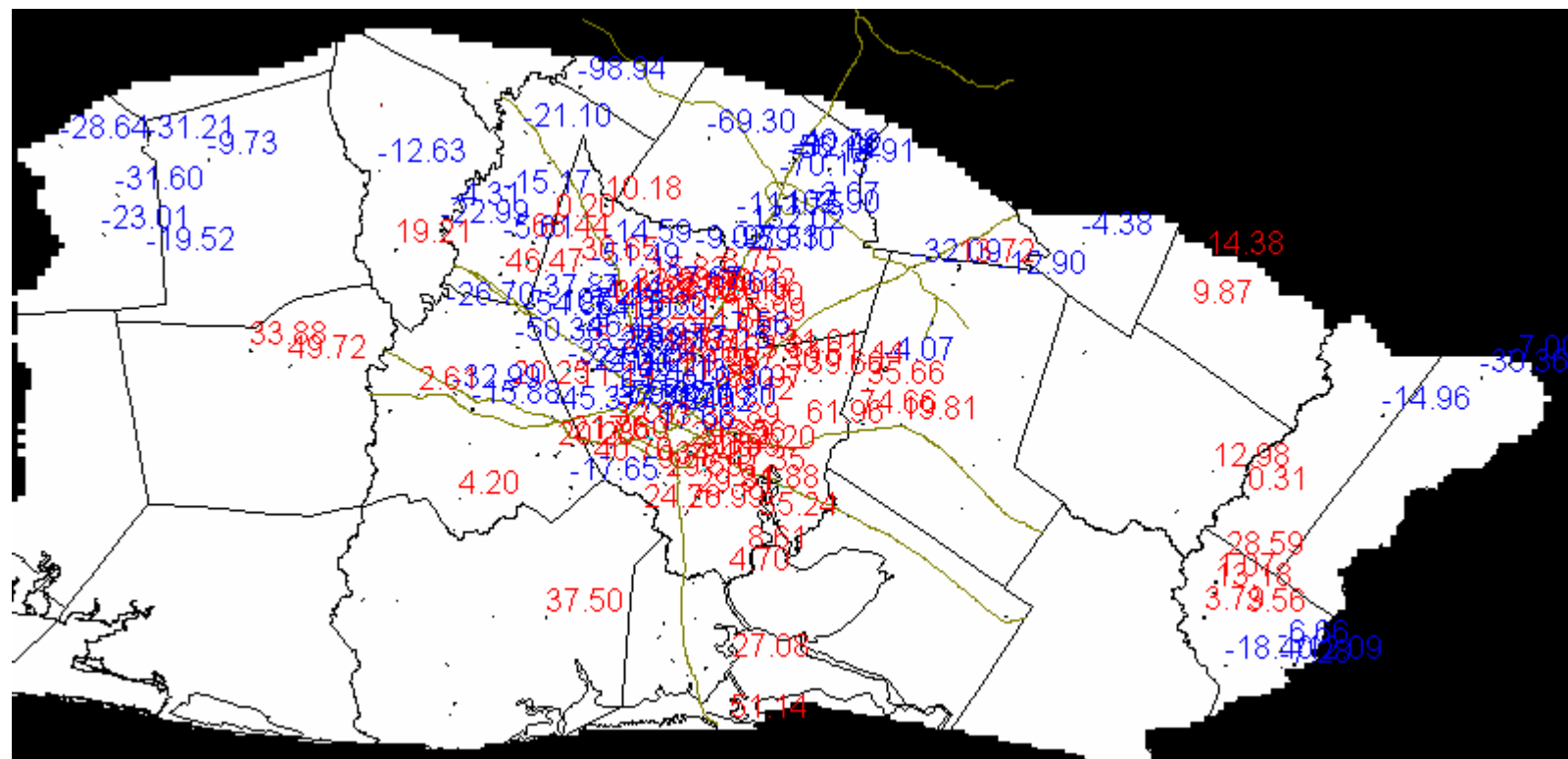Standard parallels 34°55' and 27°25', central meridian -100°
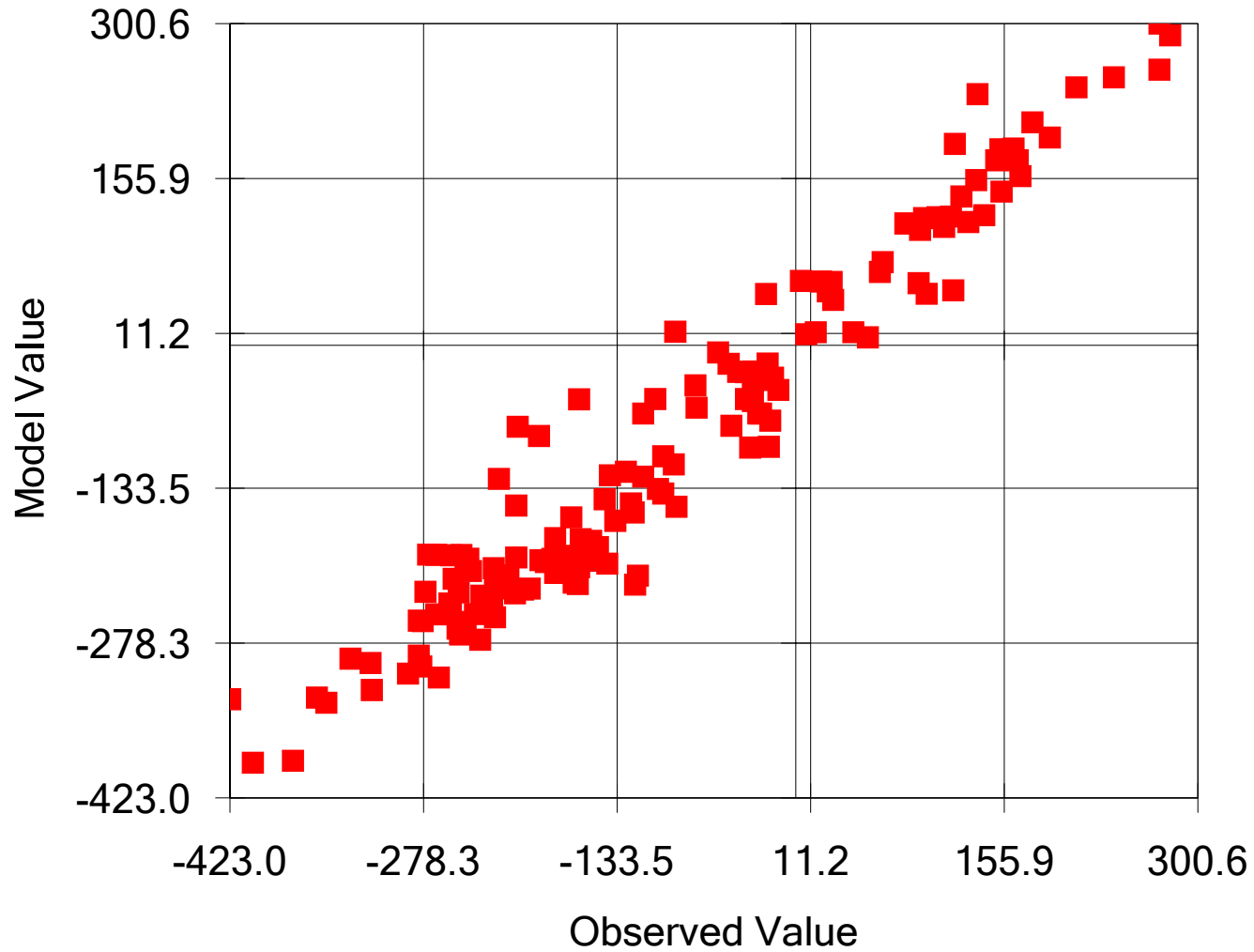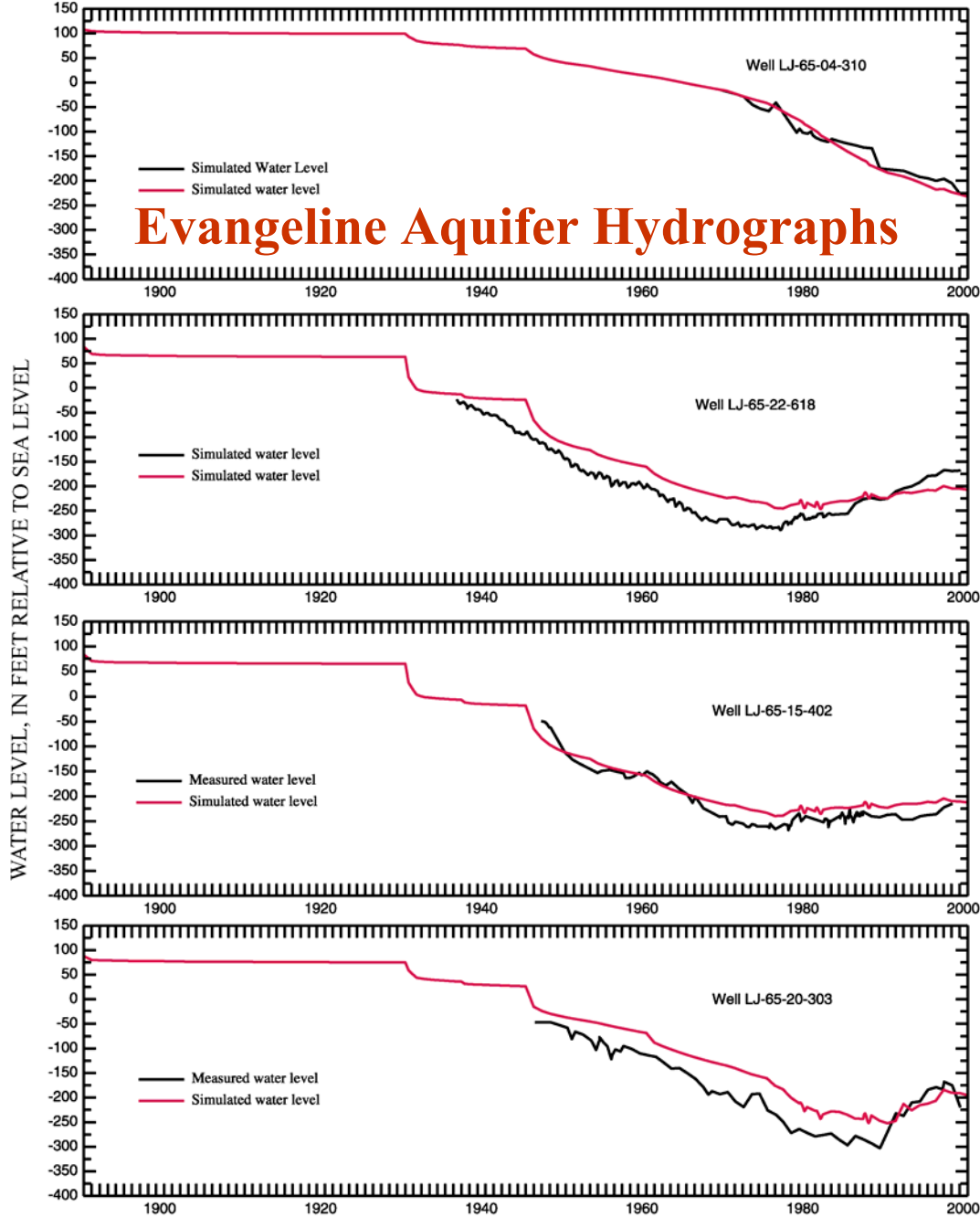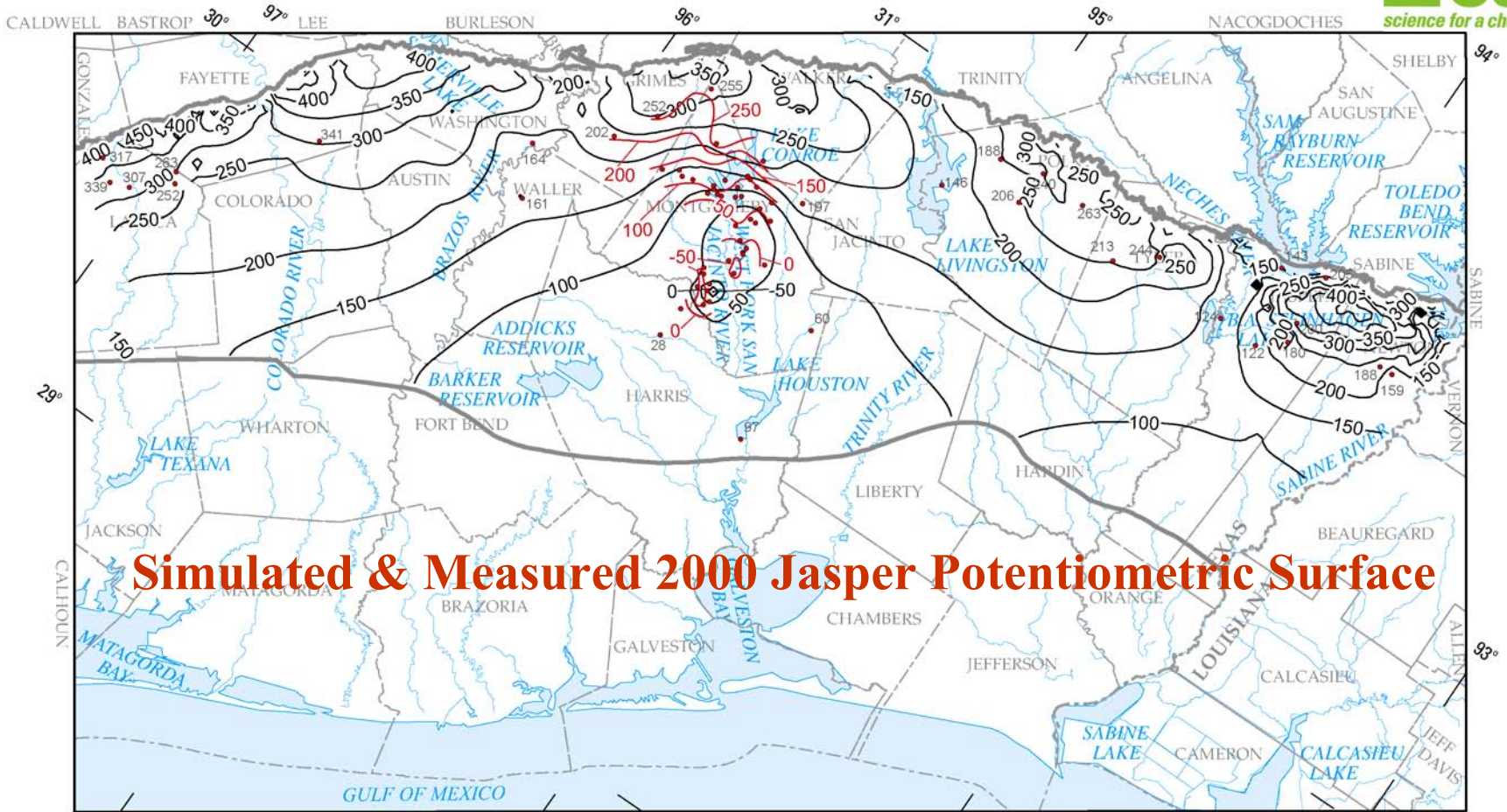
0 10 20 30 40 MILES

EXPLANATION

- • Data Point—Well in which water-level measurement was made. Number is water-level altitude (shown in areas not having published water-level contours).

— Updip and downdip limit of the Jasper aquifer

— 2000 Simulated, interval 50 feet

— 2000 Measured, interval 50 feet. Datum is sea level

Figure 51. Simulated and measured 2000 potentiometric surfaces of the Jasper aquifer and 2000 water-level measurements from wells screened in the Jasper aquifer (modified from Coplin, 2001) in the Ground-Water Availability Model study area.

2000 Jasper Residuals

2000 Jasper Residuals Zoom
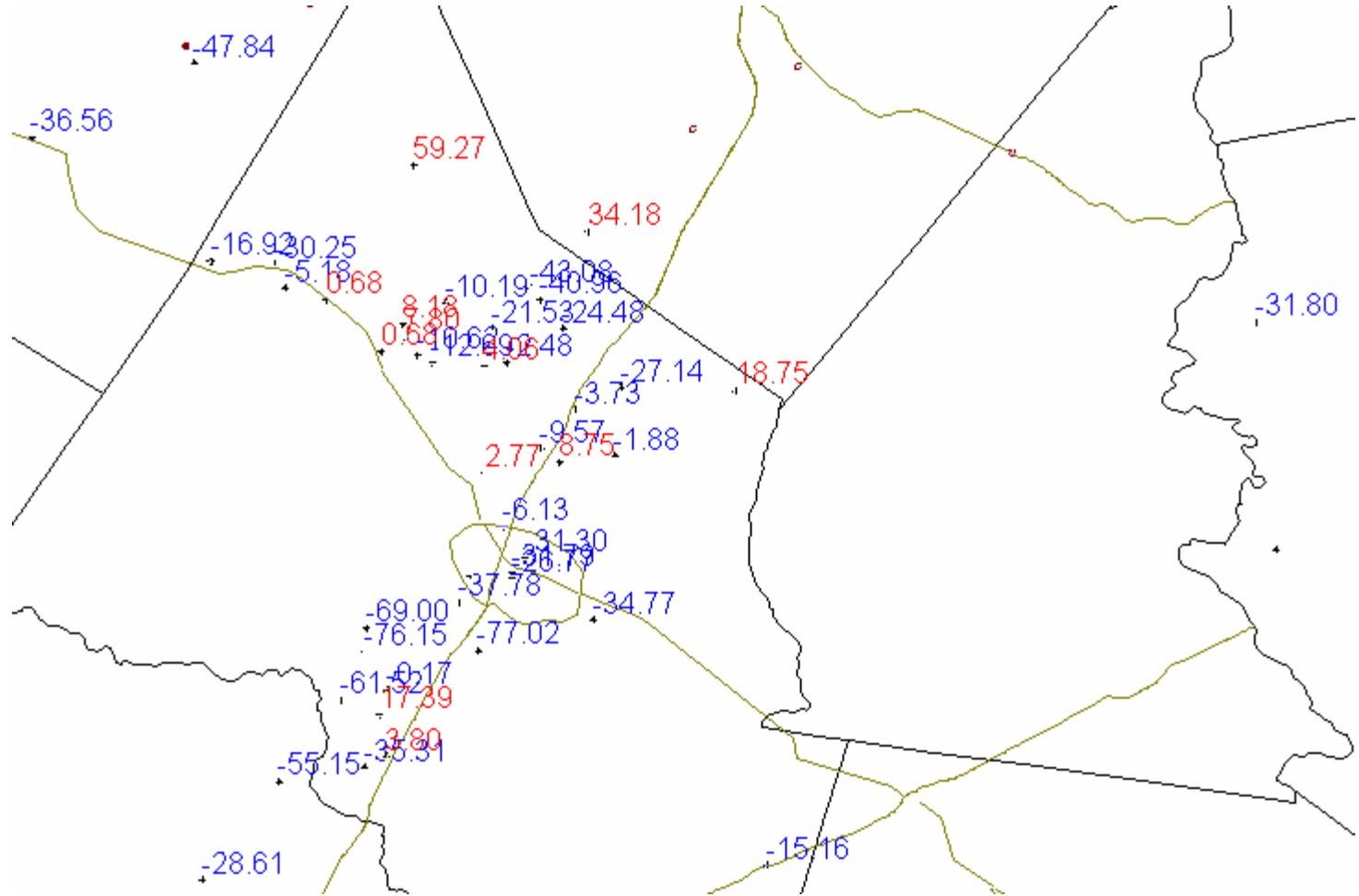
2000 Jasper Observed vs. Computed Values
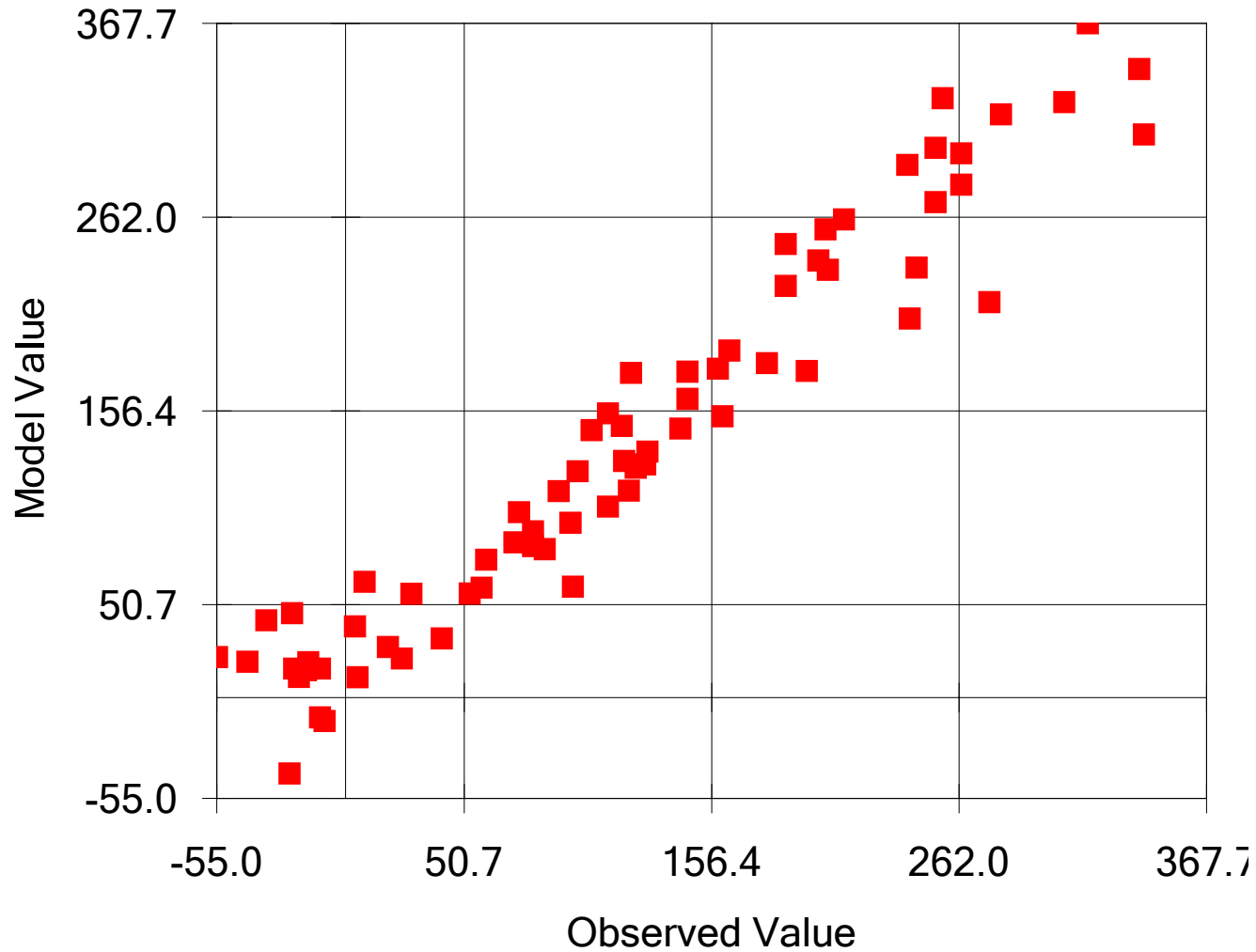
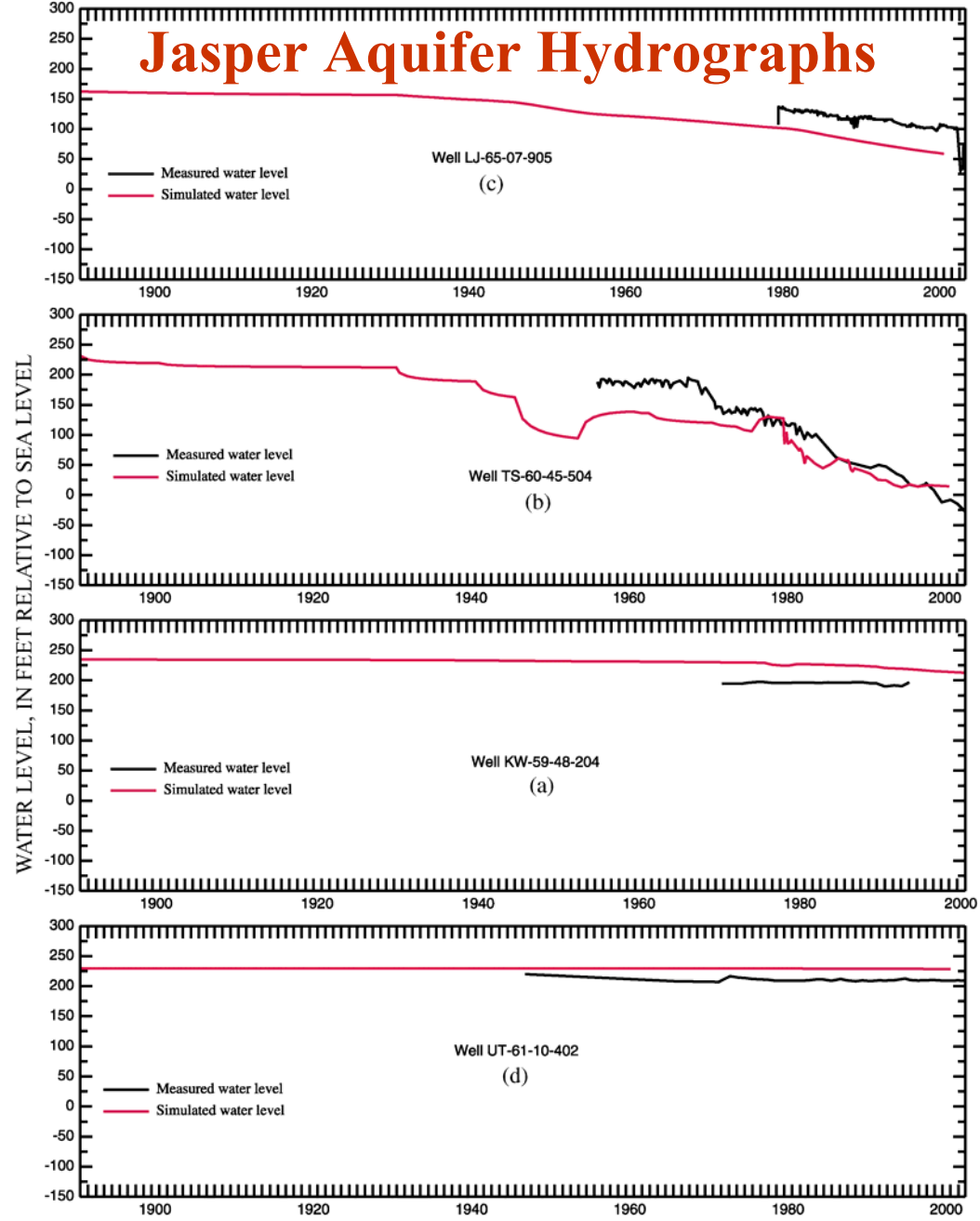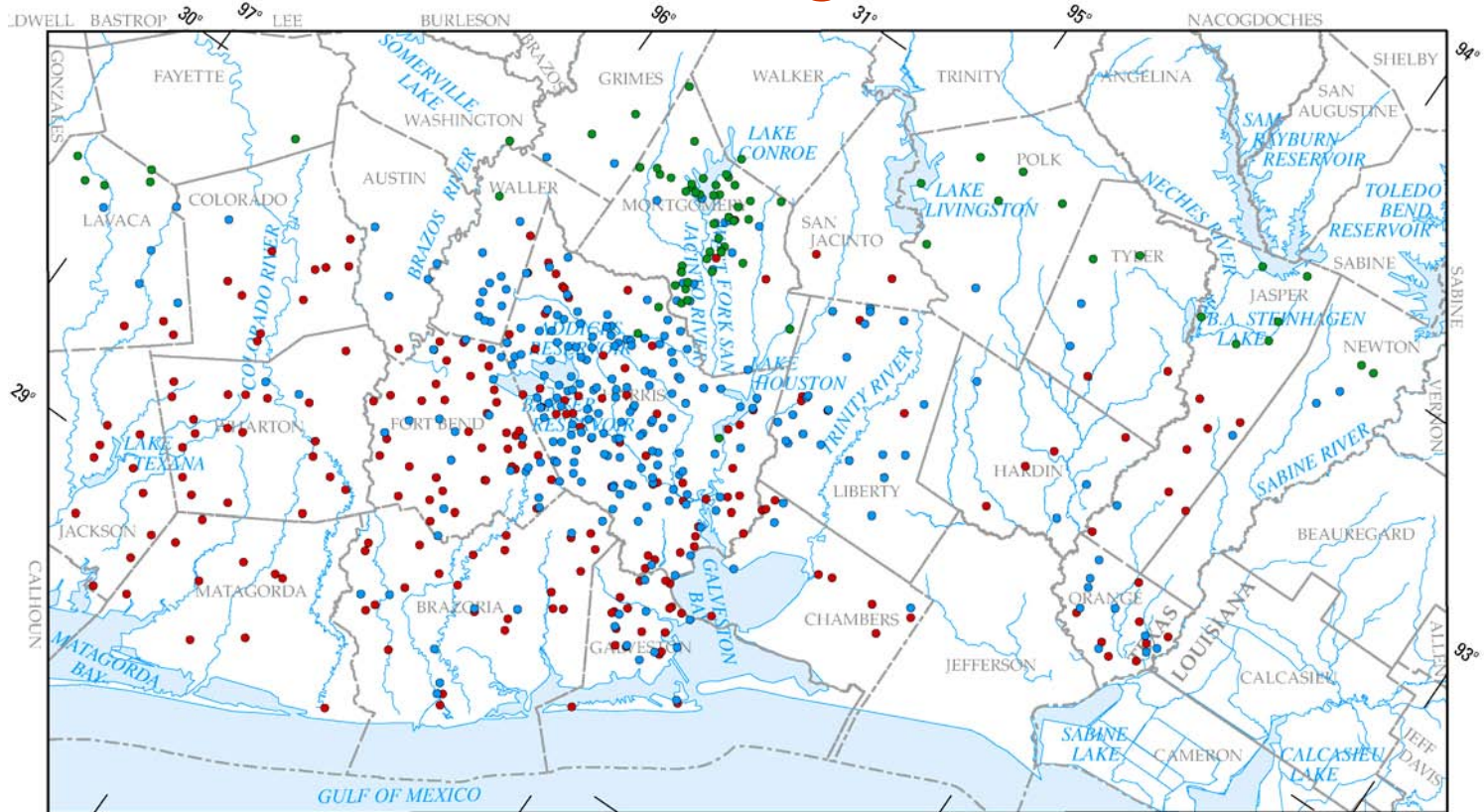**Figure 37.** Hydrographs showing simulated and measured water levels in selected observation wells screened in the Jasper aquifer in Grimes (a), Harris (b), Montgomery (c), and Polk (d) Counties in the Ground-Water Availability Model study area.

Calibration Target Locations

EXPLANATION

- • Chicot aquifer
- • Evangeline aquifer
- • Jasper aquifer

RMS Error

- **Table 2.** Number of water-level measurements and
- root-mean-square errors of simulated water levels
- in the Chicot, Evangeline, and Jasper aquifers,
- 1977 and 2000.
- --

Aquifer	Number of water-level measurements	Root-mean-square error of simulated water levels (feet)
1977		
Chicot	104	38.9
Evangeline	134	47.2
Jasper	2	48.7
2000		
Chicot	200	41.7
Evangeline	153	40.2
Jasper	69	33.9

Simulated and Measured 2000 Land-Surface Subsidence

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
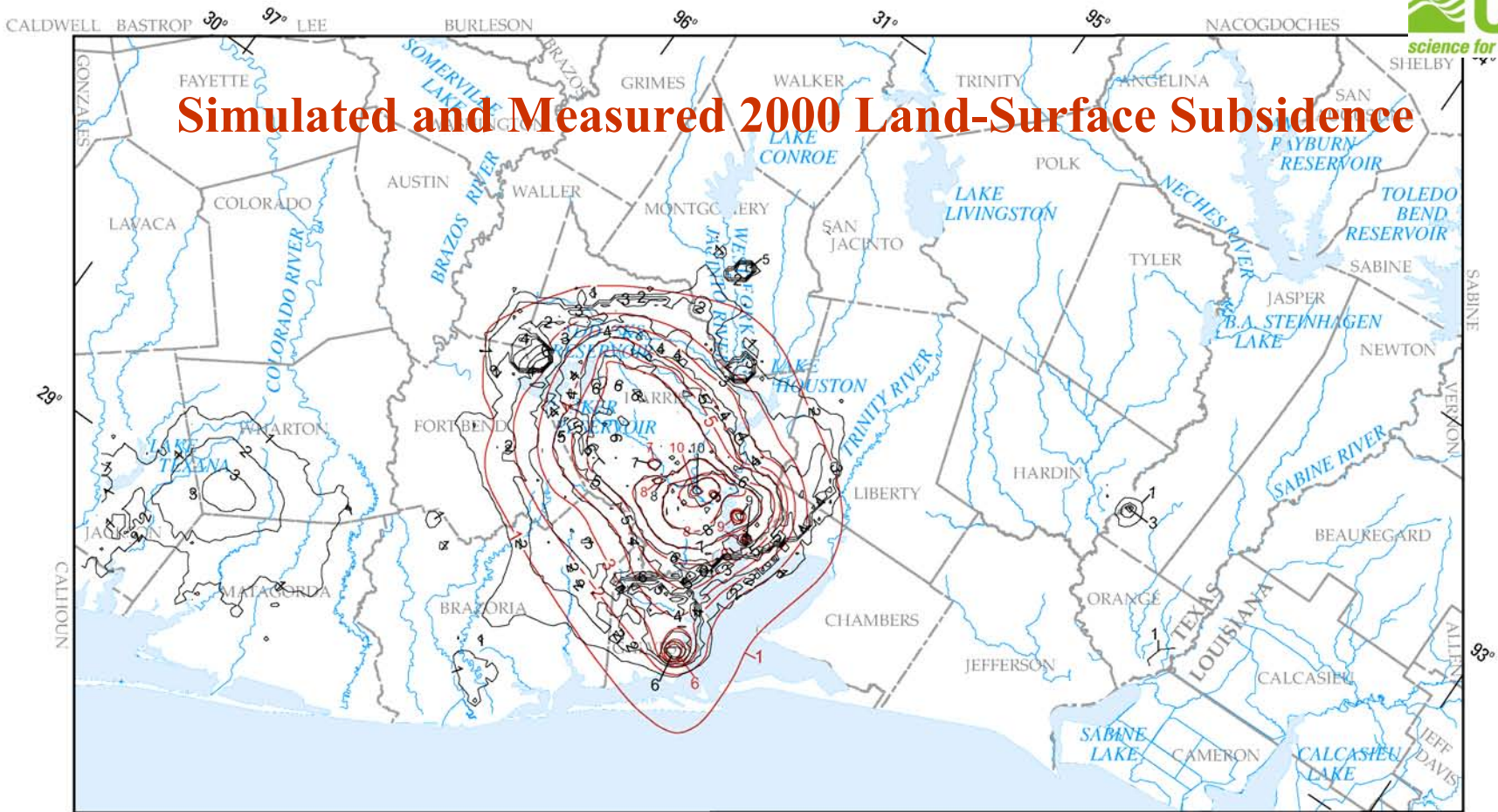Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

EXPLANATION

——— 1891-2000 Simulated land-surface subsidence, in feet
——— 1906-1995 Measured land-surface subsidence, in feet
Contour interval one foot

Figure 63. Measured and simulated 2000 land-surface subsidence in the Ground-Water Availability Model study area.

Figure 66. Simulated predictive 2010 potentiometric surface of the Chicot aquifer in the Ground-Water Availability Model study area.

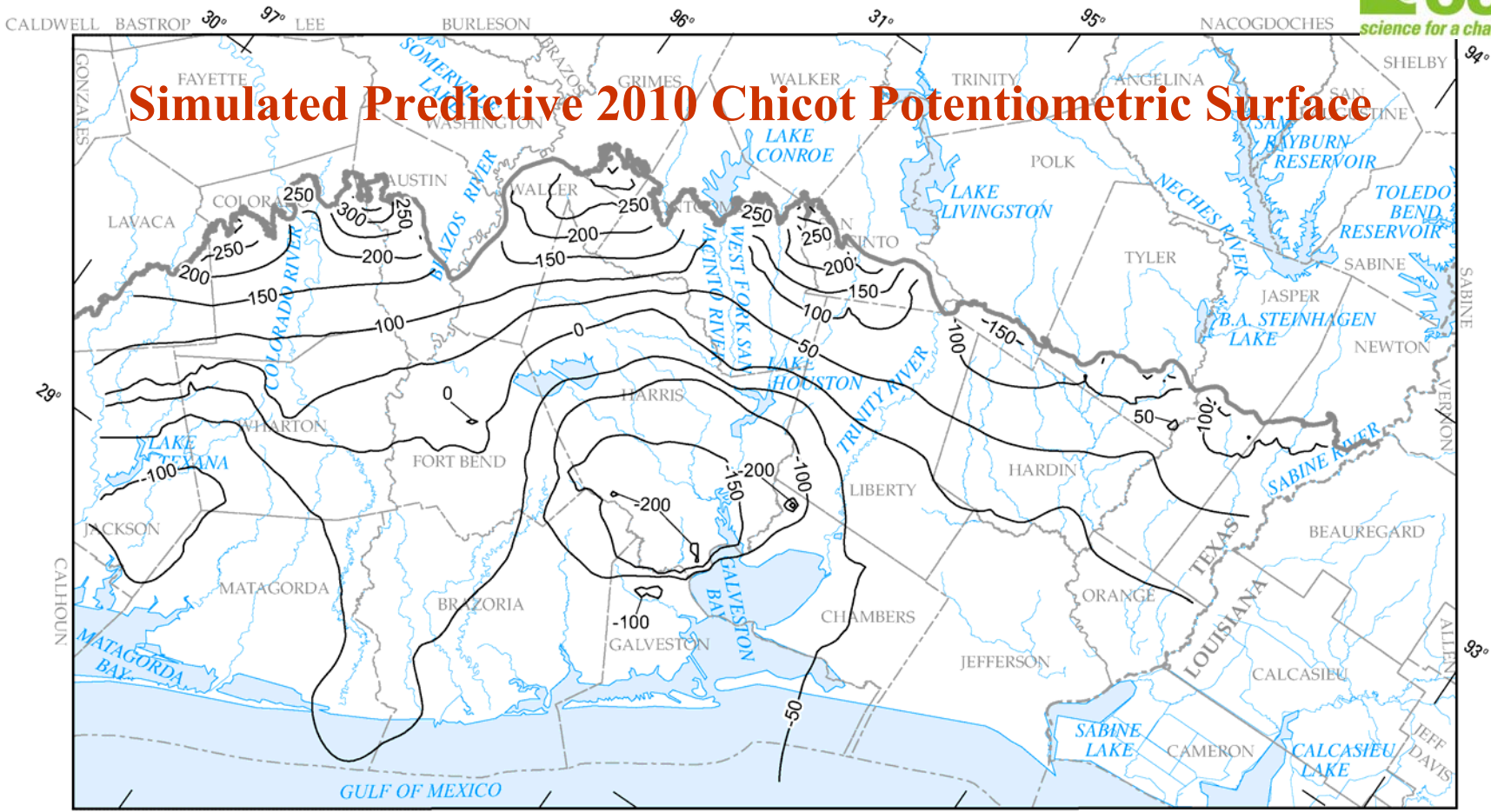# Simulated Predictive 2010 Evangeline Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
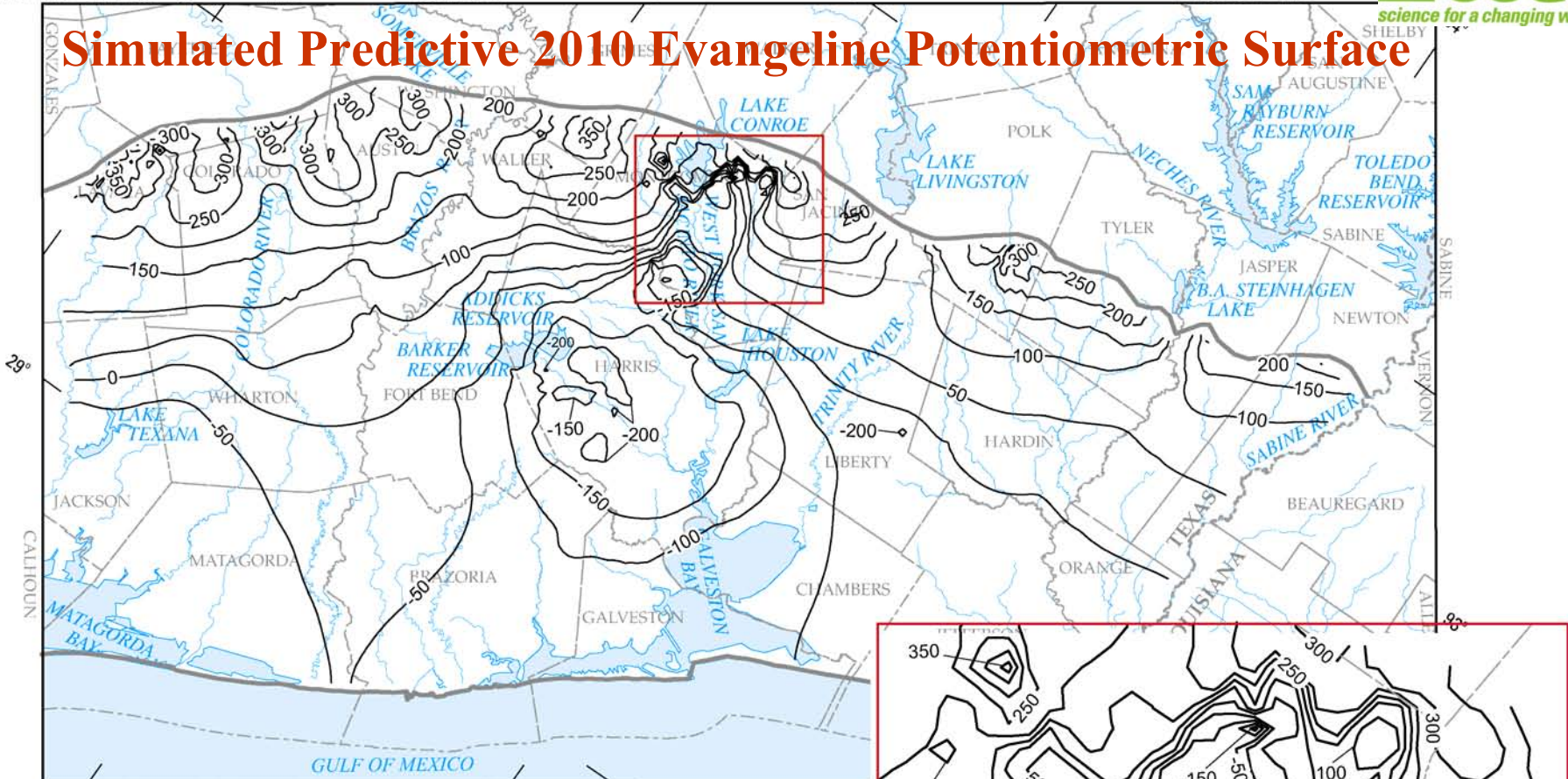Standard parallels 34°55' and 27°25', central meridian -100°

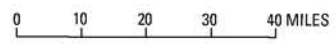0   10   20   30   40 MILES

EXPLANATION

— Updip and Downdip limits of the Evangeline aquifer

— 2010 Simulated Predictive, interval 50 feet
  Datum is sea level

Figure 67. Simulated predictive 2010 potentiometric surface of the Evangeline aquifer in the Ground-Water Availability Model study area.

Simulated Predictive 2010 Jasper Potentiometric Surface

EXPLANATION

— Updip and Downdip limits of the Jasper aquifer

2010 Simulated Predictive, interval 50 feet

Datum is sea level

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

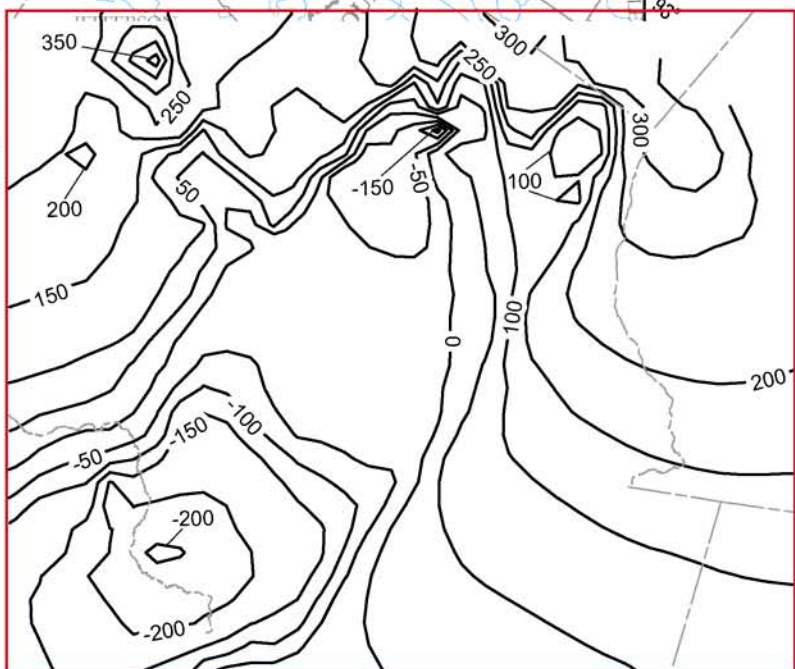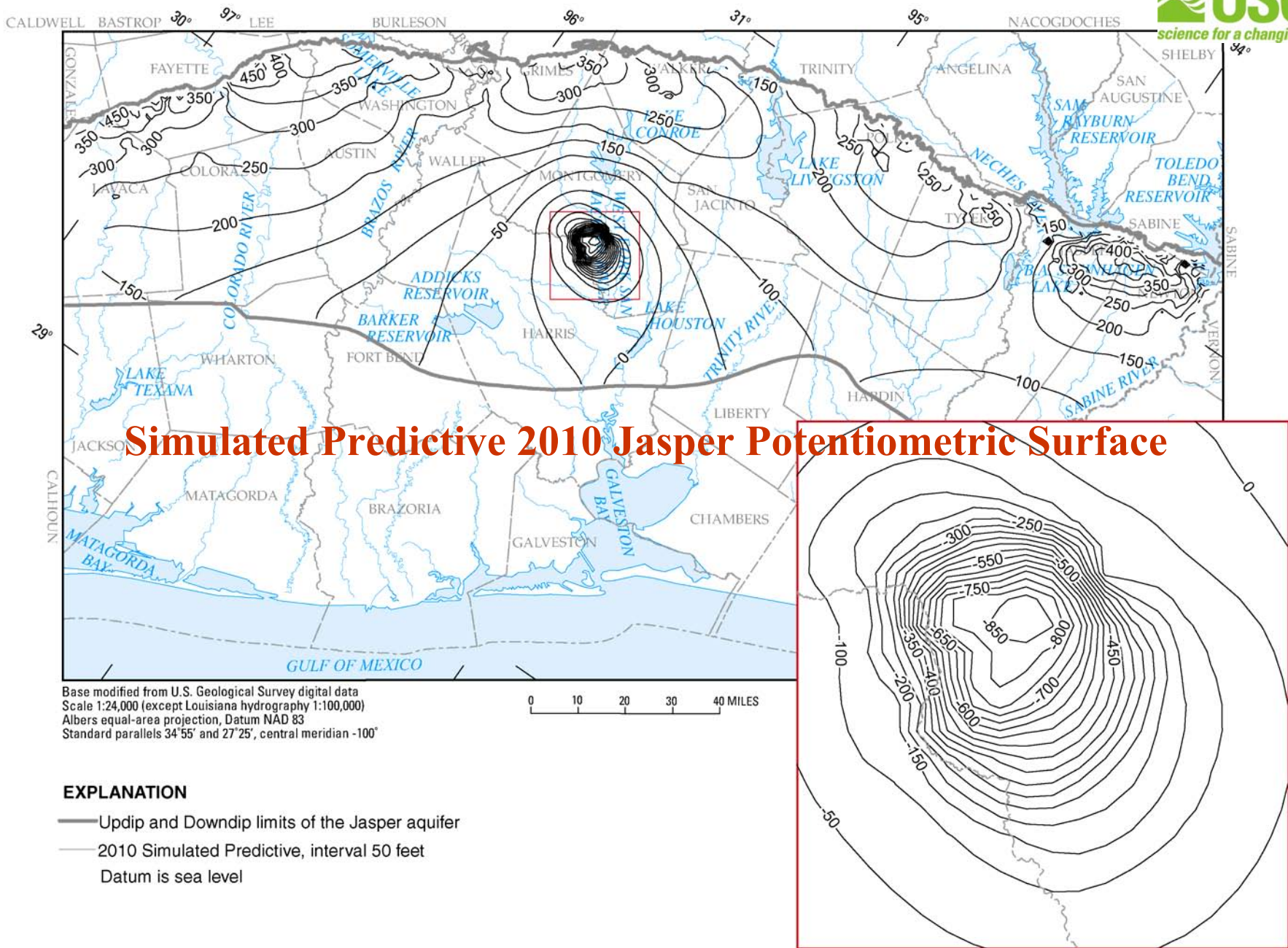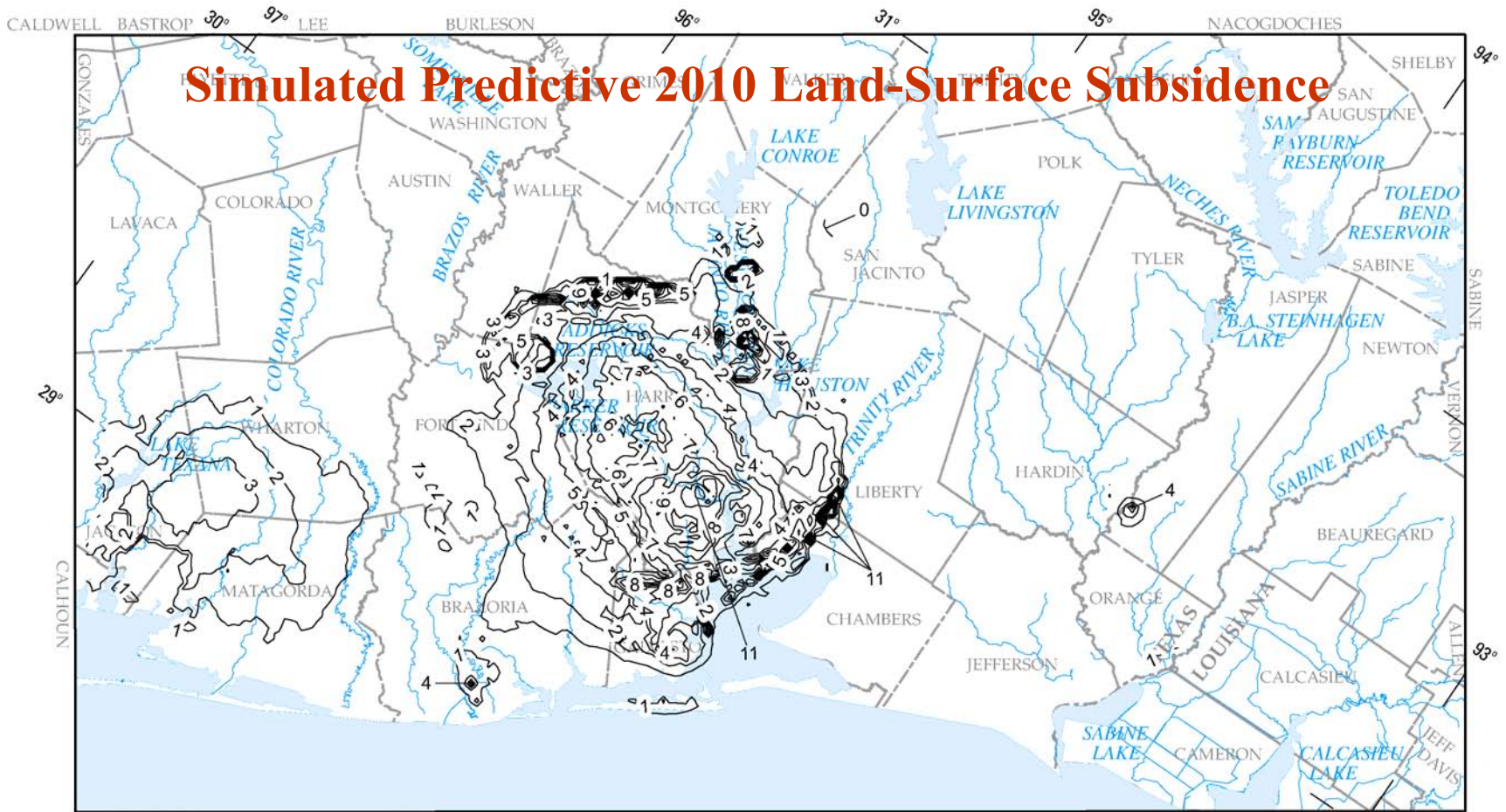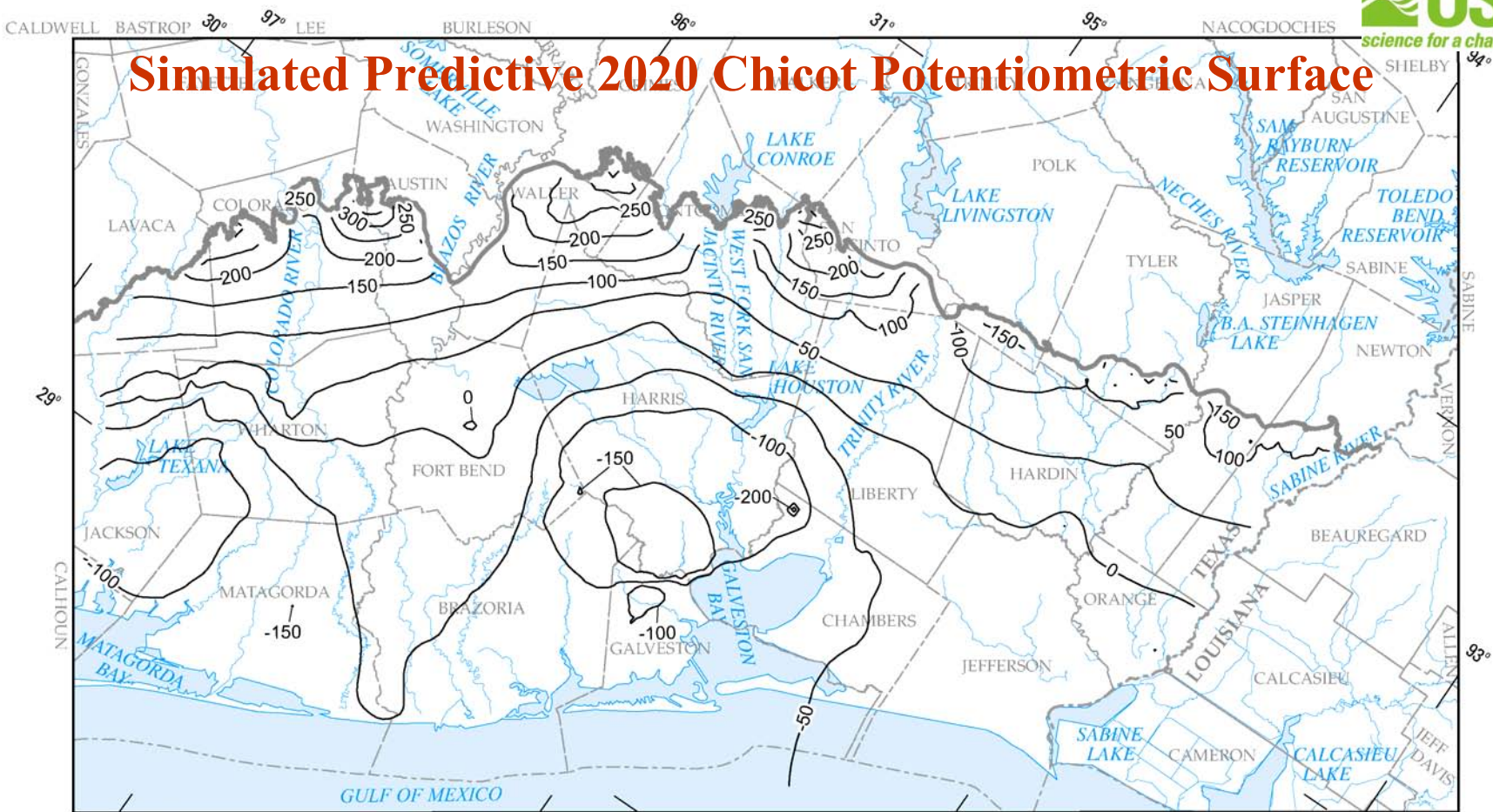**Figure 68.** Simulated predictive 2010 potentiometric surfaces of the Jasper aquifer in the Ground-Water Availability Model study area.

Figure 69. Simulated predictive 2010 land-surface subsidence in the Ground-Water Availability Model study area.

Figure 70. Simulated predictive 2020 potentiometric surface of the Chicot aquifer in the Ground-Water Availability Model study area.

Simulated Predictive 2020 Evangeline Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
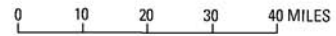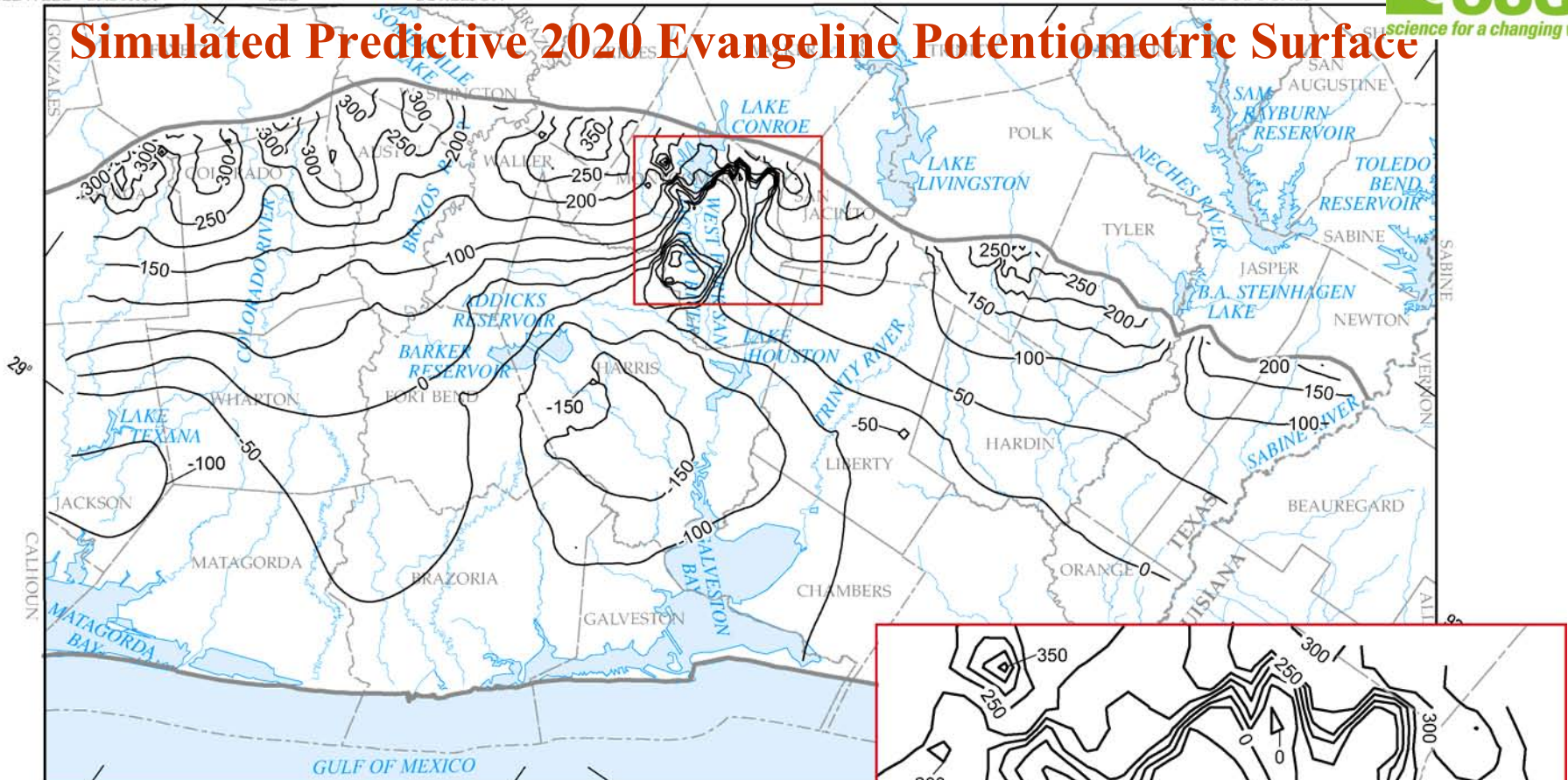Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

EXPLANATION

— Updip and Downdip limits of the Evangeline aquifer

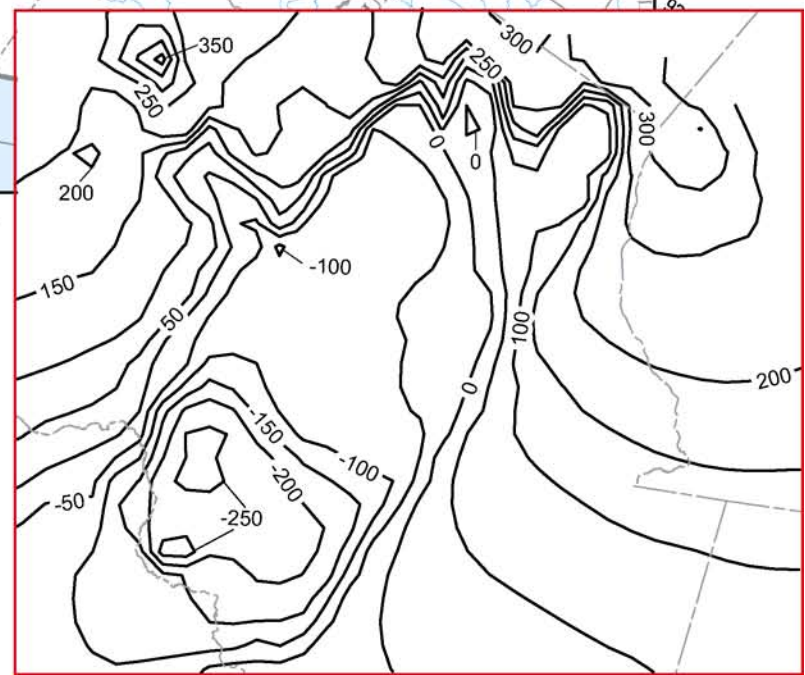— 2020 Simulated Predictive, interval 50 feet

Datum is sea level

Figure 71. Simulated predictive 2020 potentiometric surface of the Evangeline aquifer in the Ground-Water Availability Model study area.
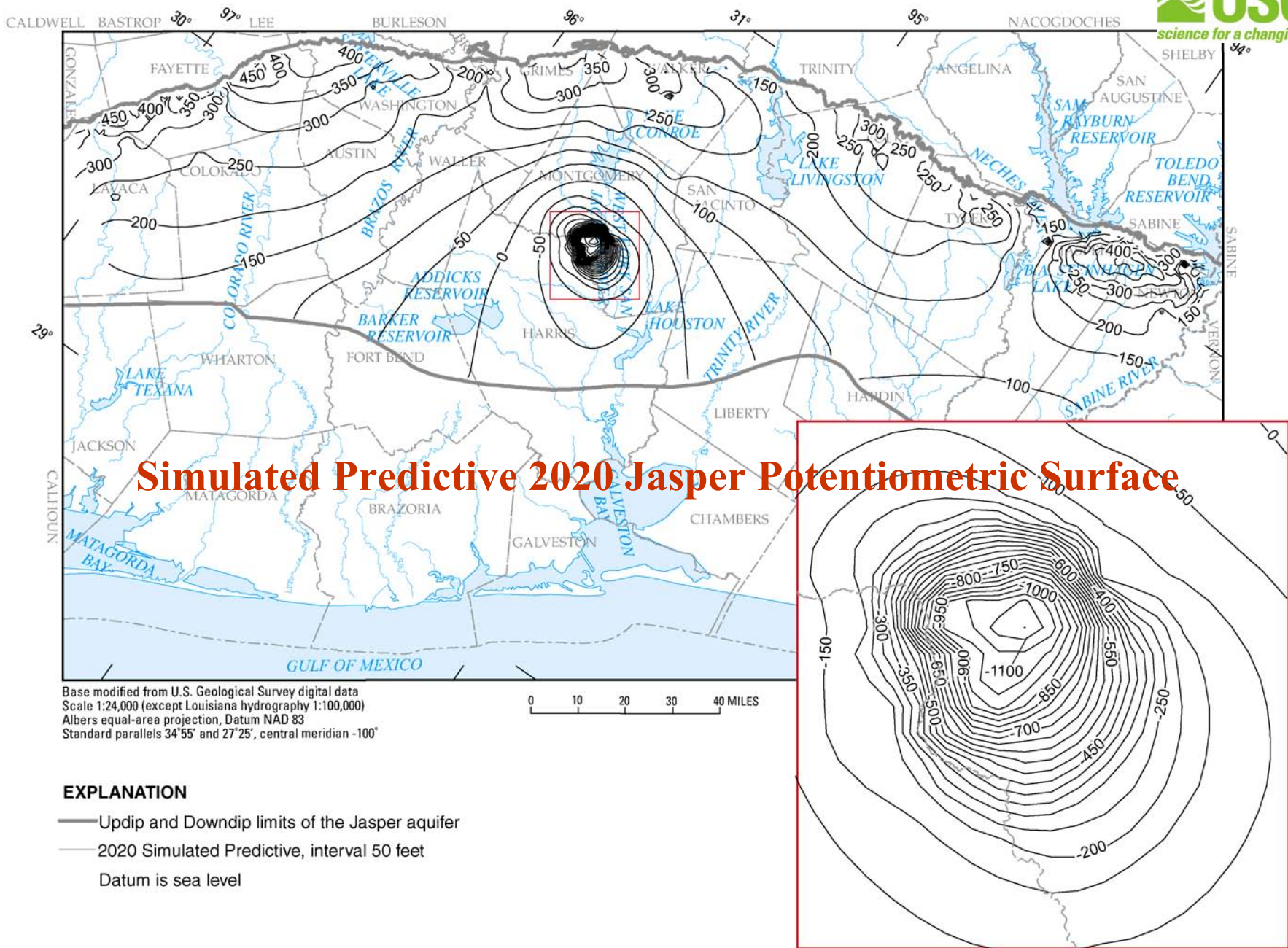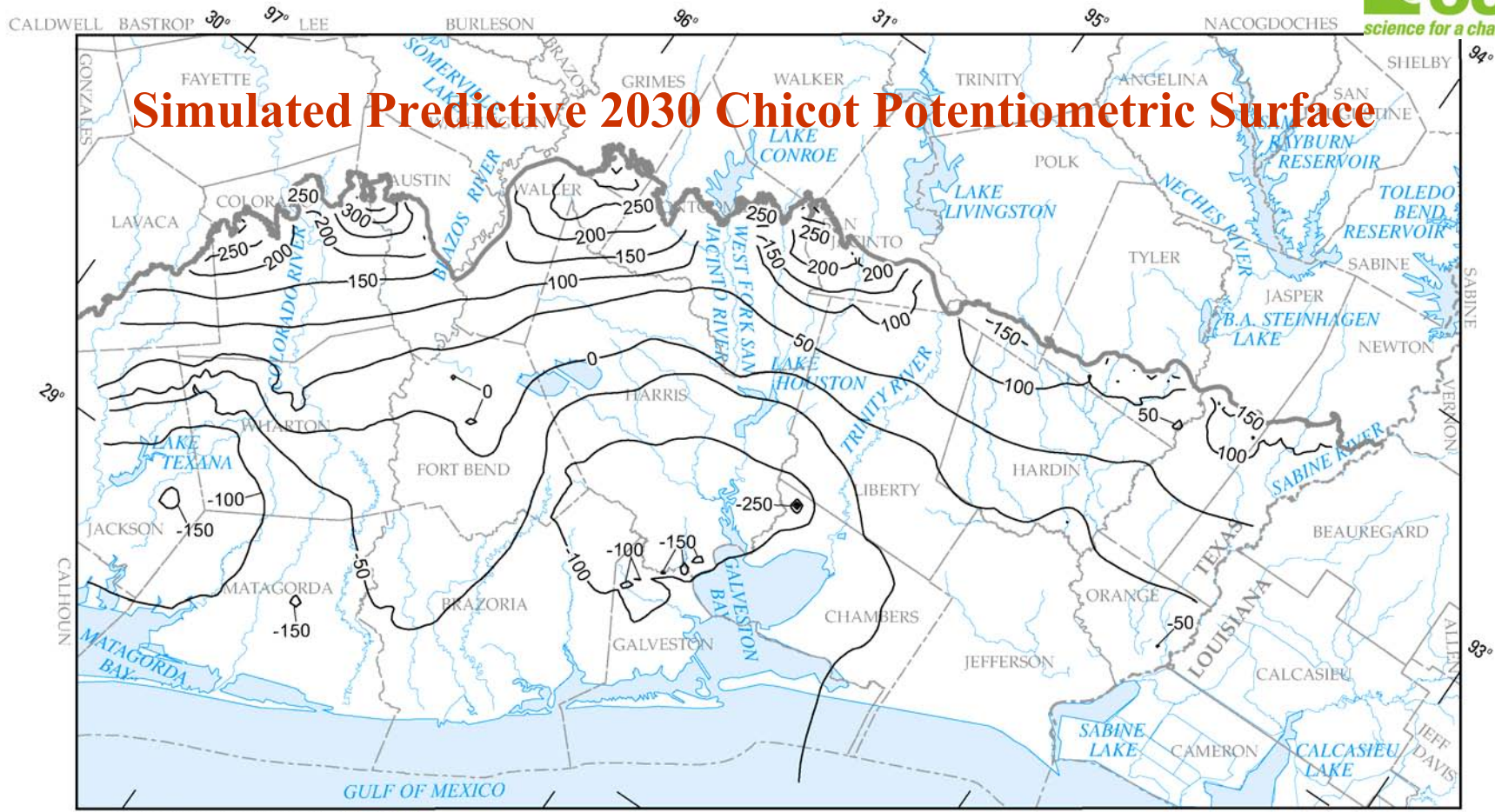
Simulated Predictive 2020 Jasper Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
Standard parallels 34°55' and 27°25', central meridian -100°

0 10 20 30 40 MILES

EXPLANATION

— Updip and Downdip limits of the Jasper aquifer

— 2020 Simulated Predictive, interval 50 feet

Datum is sea level

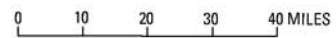**Figure 73.** Simulated predictive 2020 potentiometric surfaces of the Jasper aquifer in the Ground-Water Availability Model study area.

Figure 74. Simulated predictive 2020 land-surface subsidence in the Ground-Water Availability Model study area.

Figure 74. Simulated predictive 2030 potentiometric surface of the Chicot aquifer in the Ground-Water Availability Model study area.

Simulated Predictive 2030 Evangeline Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
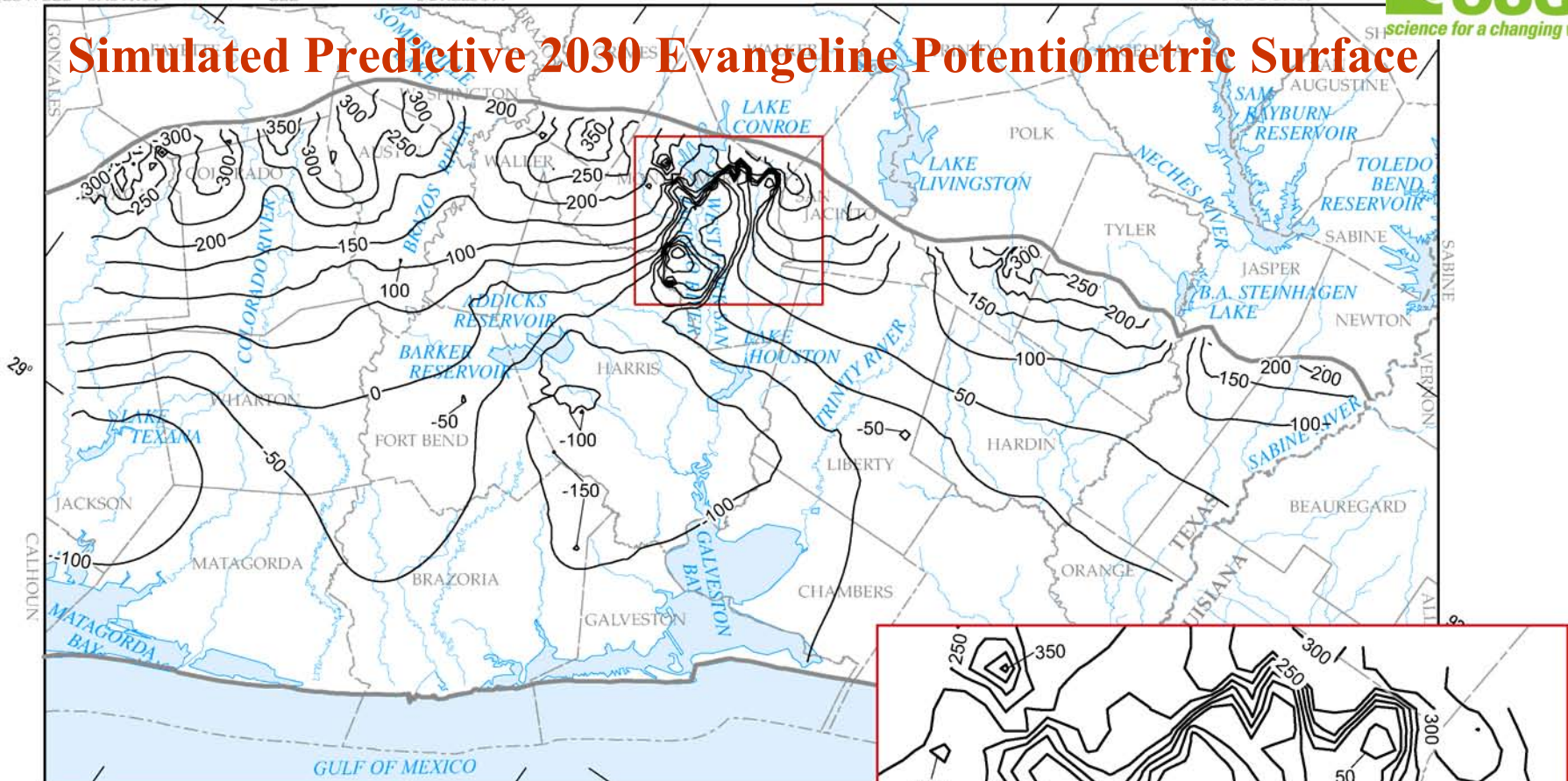Standard parallels 34°55′ and 27°25′, central meridian -100°

0   10   20   30   40 MILES

EXPLANATION

—— Updip and Downdip limits of the Evangeline aquifer

—— 2030 Simulated Predictive, interval 50 feet
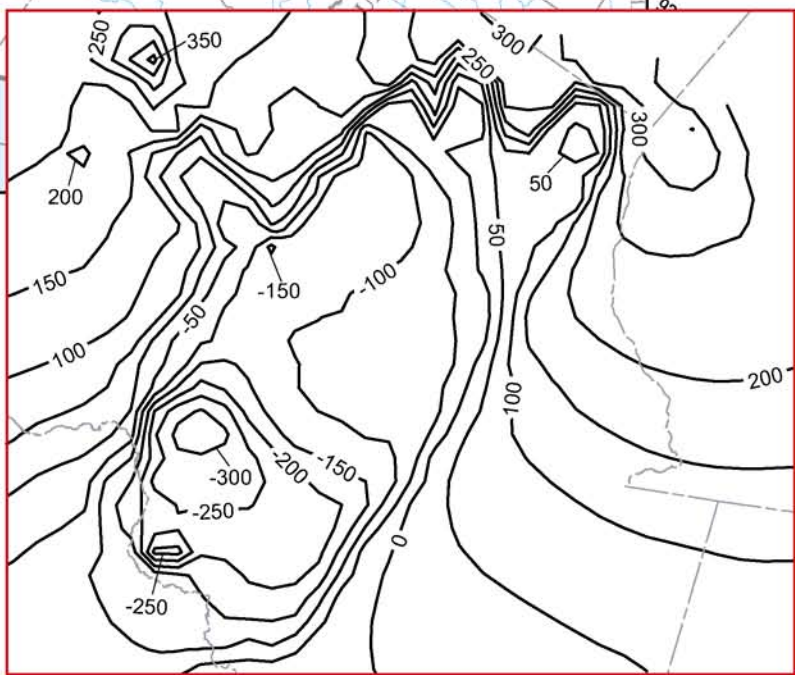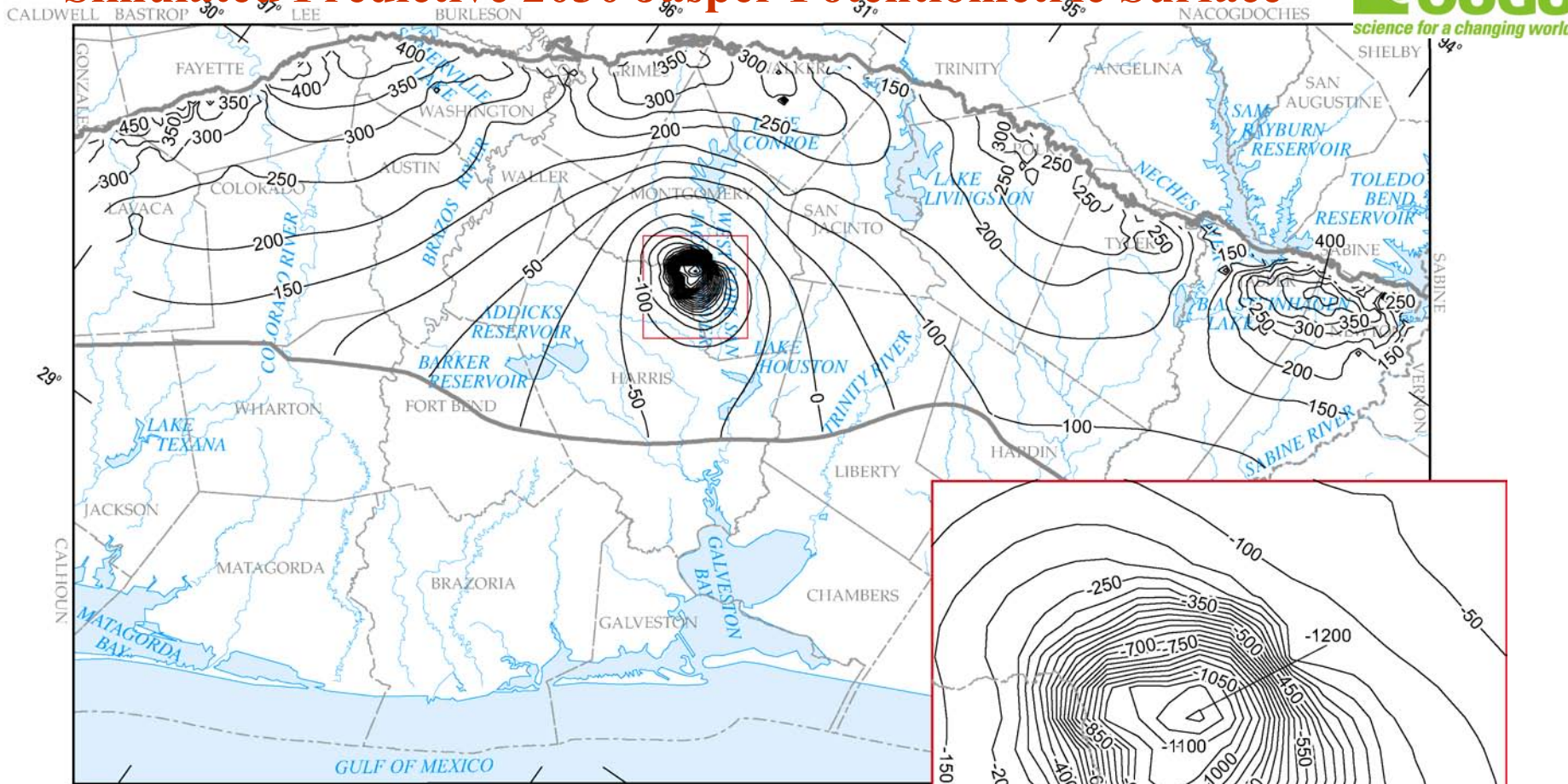
Datum is sea level

Figure 75. Simulated predictive 2030 potentiometric surface of the Evangeline aquifer in the Ground-Water Availability Model study area.
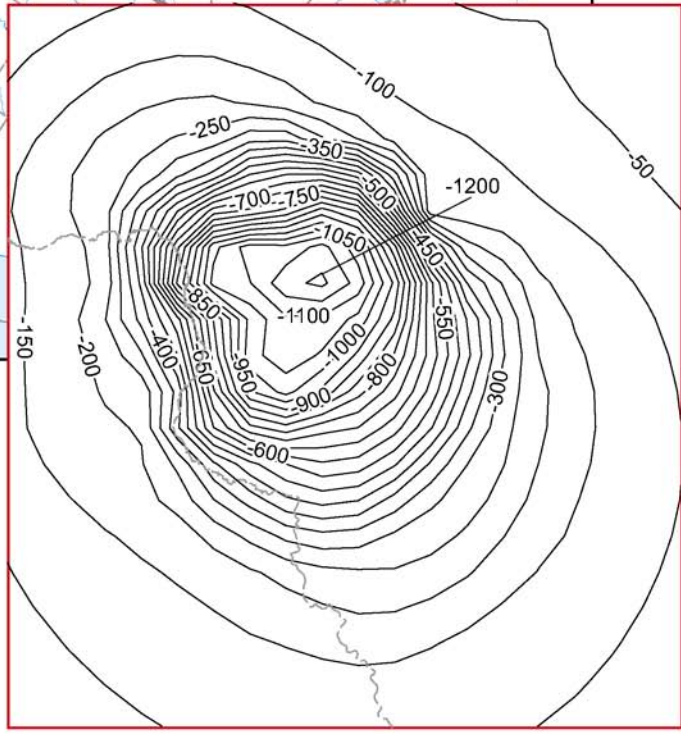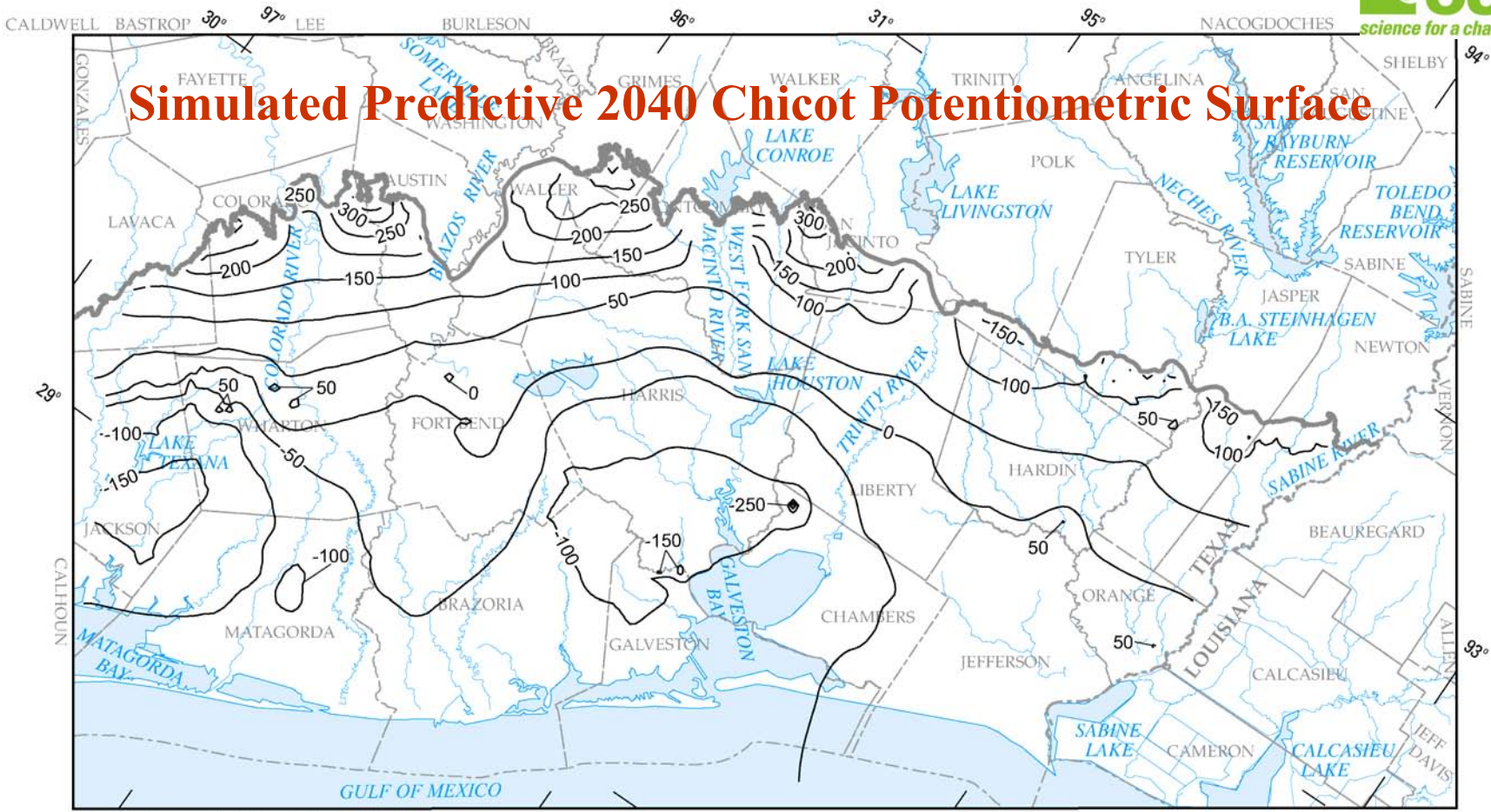
Figure 76. Simulated predictive 2030 potentiometric surfaces of the Jasper aquifer in the Ground-Water Availability Model study area.

Simulated Predictive 2030 Land-Surface Subsidence

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
Standard parallels 34°55′ and 27°25′, central meridian -100°

0 10 20 30 40 MILES

EXPLANATION

——2030 Simulated land-surface
subsidence, in feet

Figure 79. Simulated predictive 2030 land-surface subsidence in the Ground-Water Availability Model study area.

Figure 78. Simulated predictive 2040 potentiometric surface of the Chicot aquifer in the Ground-Water Availability Model study area.

Simulated Predictive 2040 Evangeline Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
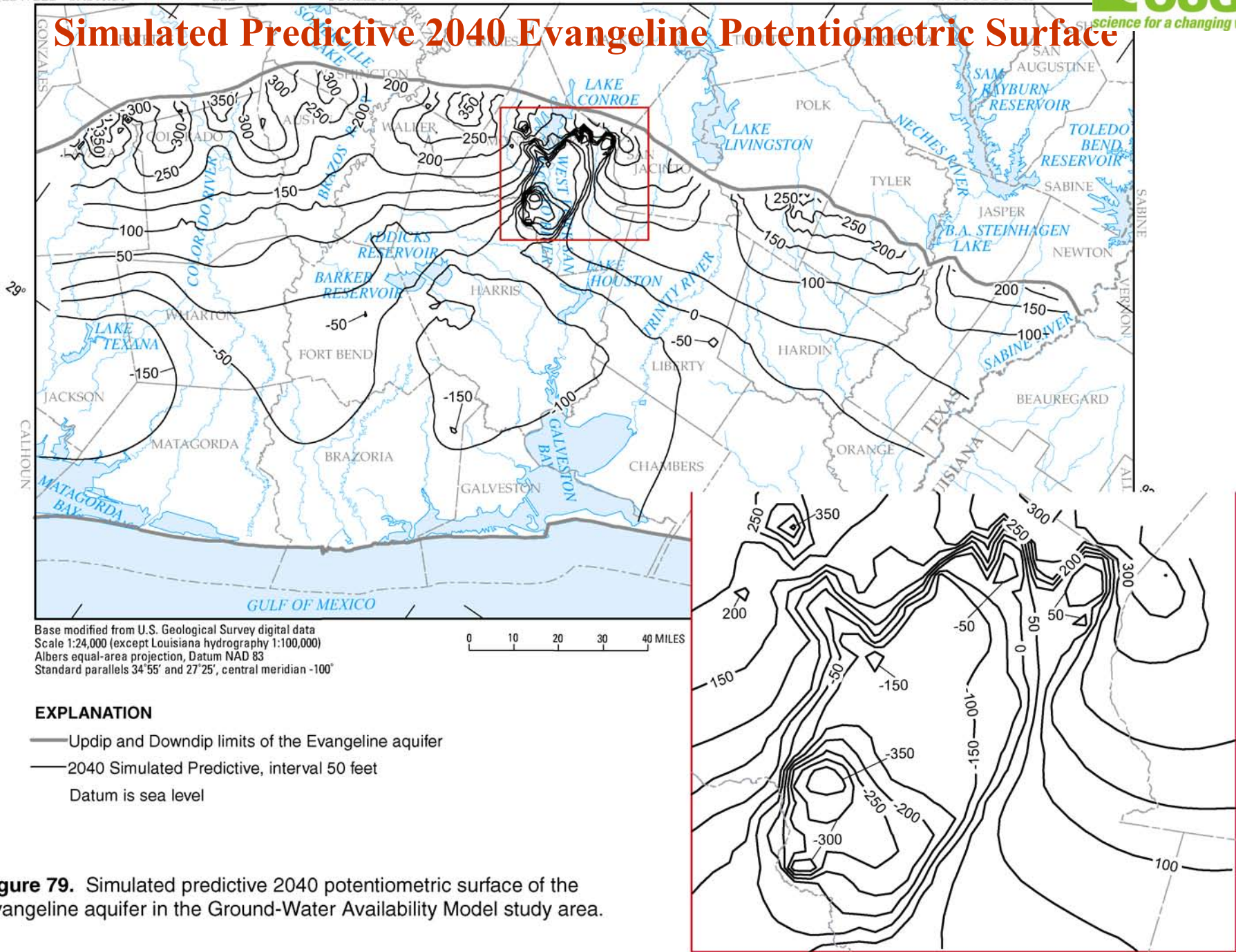Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

EXPLANATION

—— Updip and Downdip limits of the Evangeline aquifer

—— 2040 Simulated Predictive, interval 50 feet

Datum is sea level

Figure 79. Simulated predictive 2040 potentiometric surface of the Evangeline aquifer in the Ground-Water Availability Model study area.
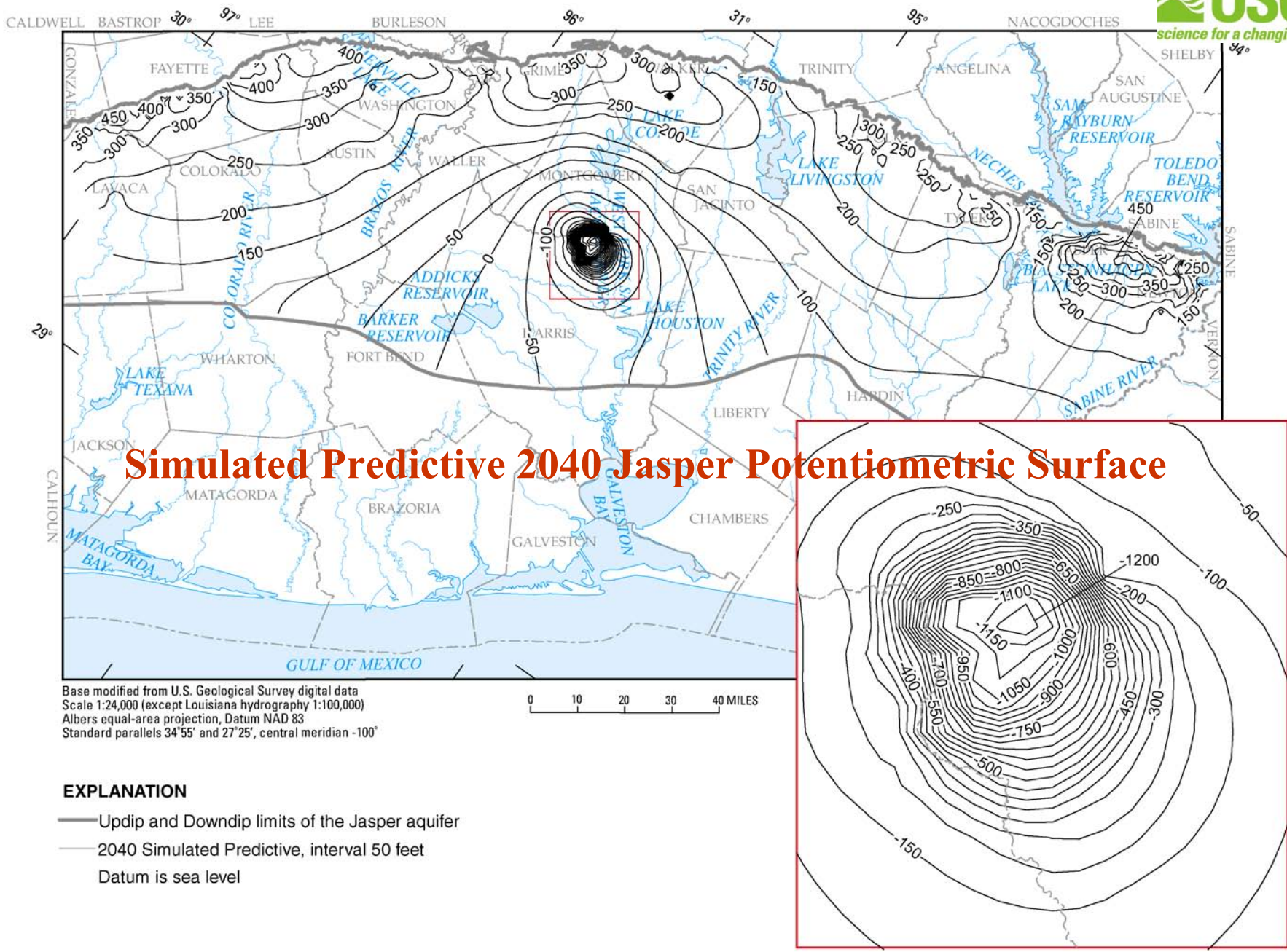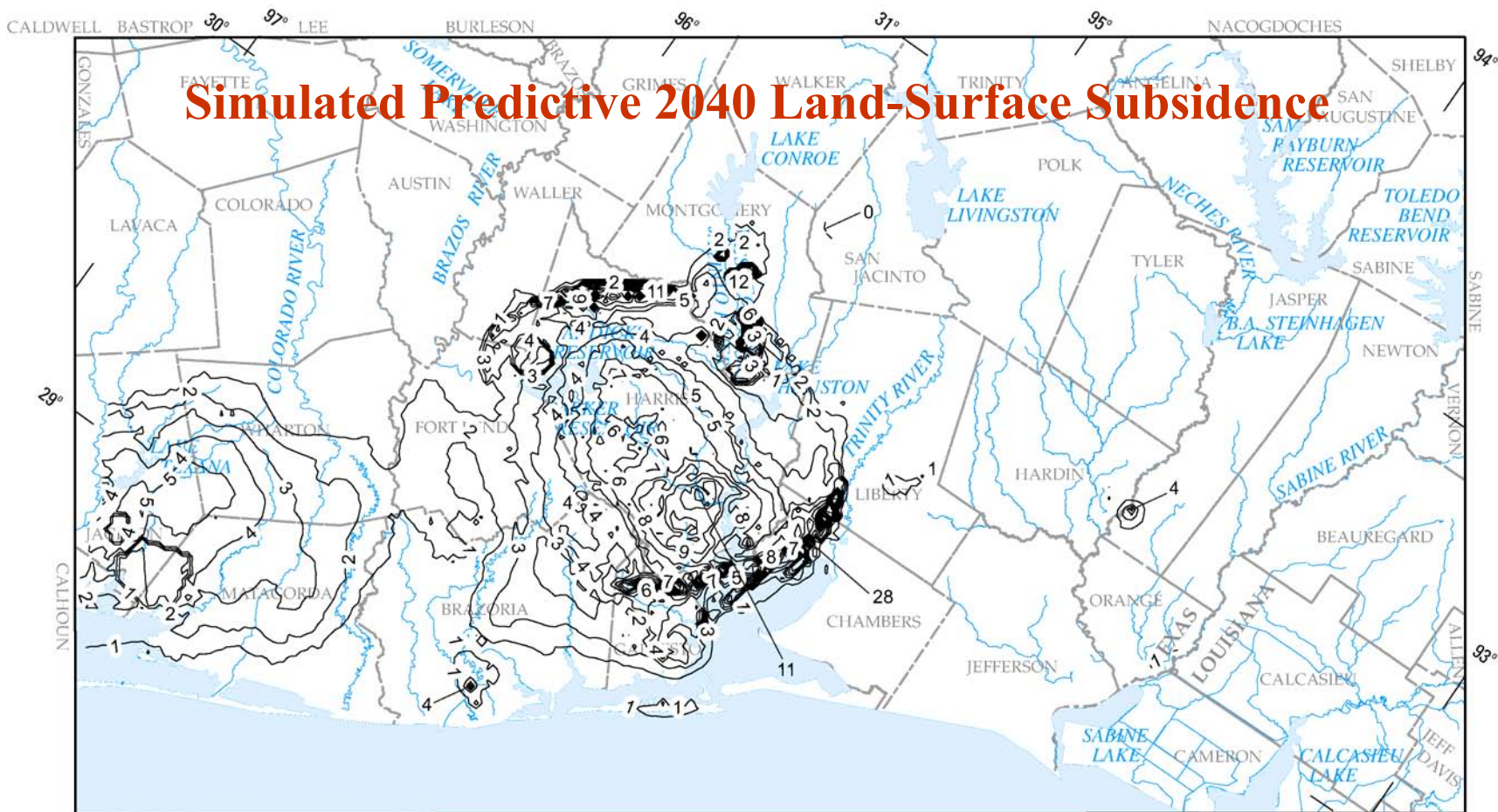
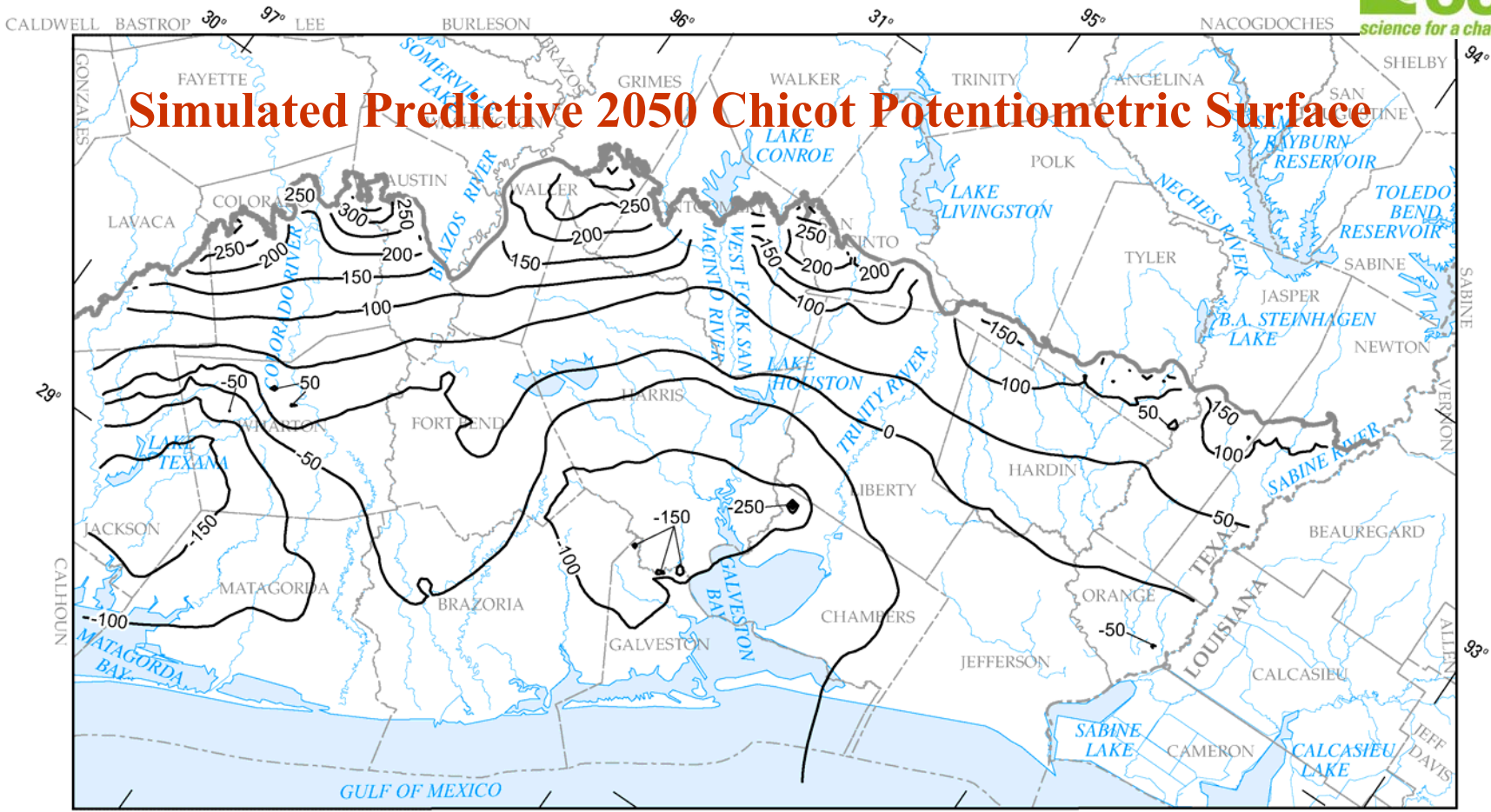**Simulated Predictive 2040 Jasper Potentiometric Surface**

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

EXPLANATION

— Updip and Downdip limits of the Jasper aquifer

— 2040 Simulated Predictive, interval 50 feet

Datum is sea level

Figure 80. Simulated predictive 2040 potentiometric surfaces of the Jasper aquifer in the Ground-Water Availability Model study area.

Simulated Predictive 2040 Land-Surface Subsidence

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
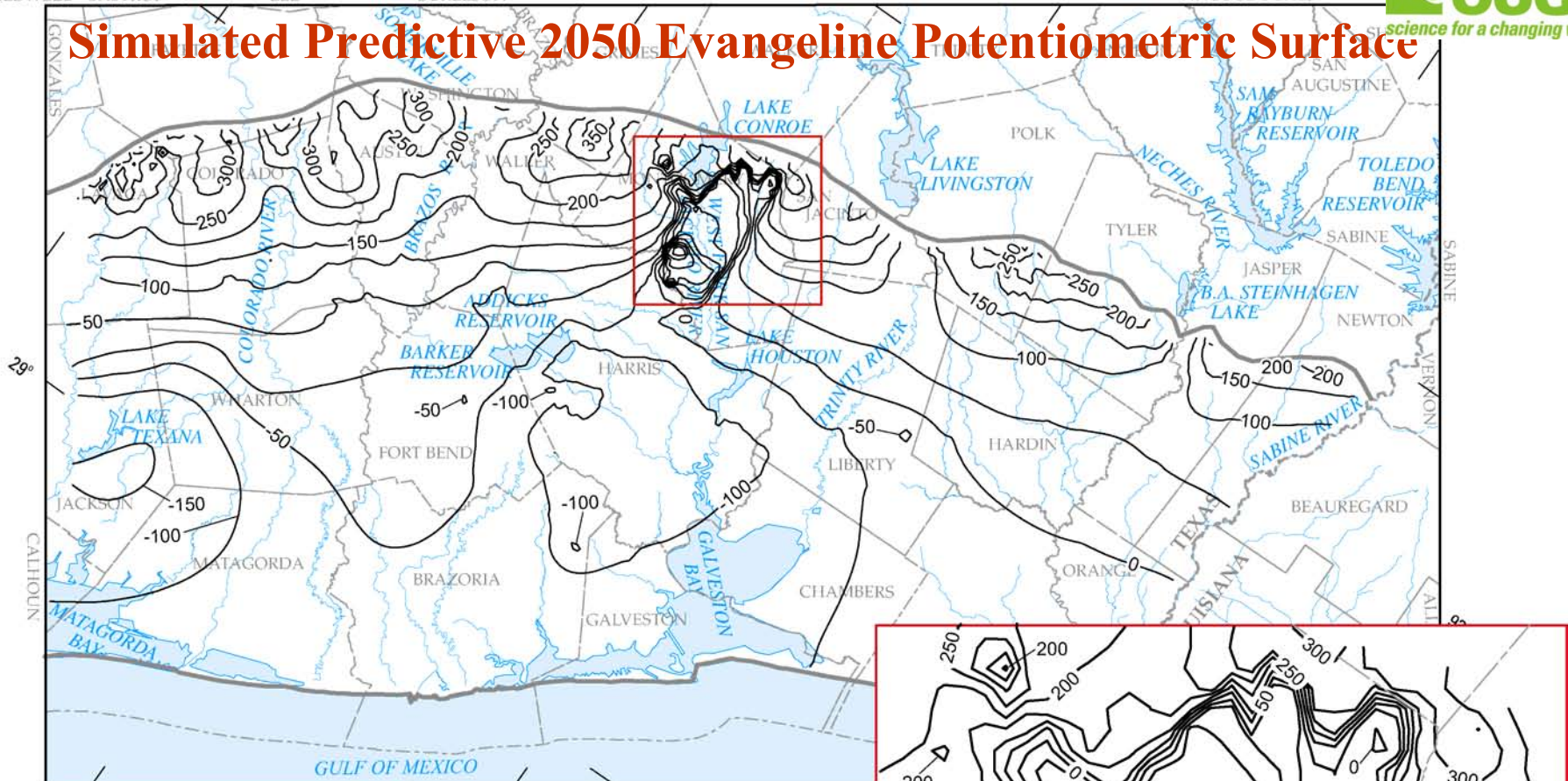Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

EXPLANATION

—— 2040 Simulated land-surface subsidence, in feet

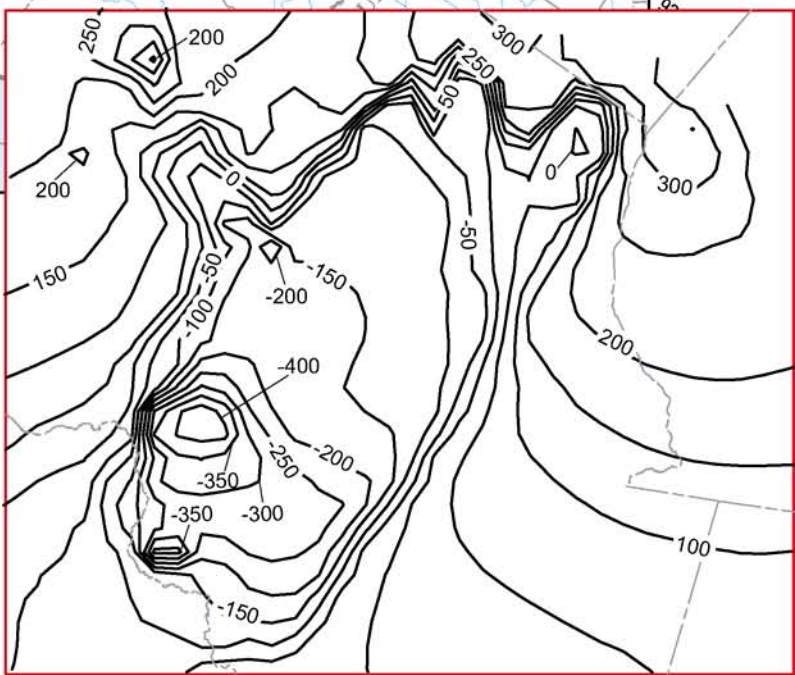**Figure 84.** Simulated predictive 2040 land-surface subsidence in the Ground-Water Availability Model study area.
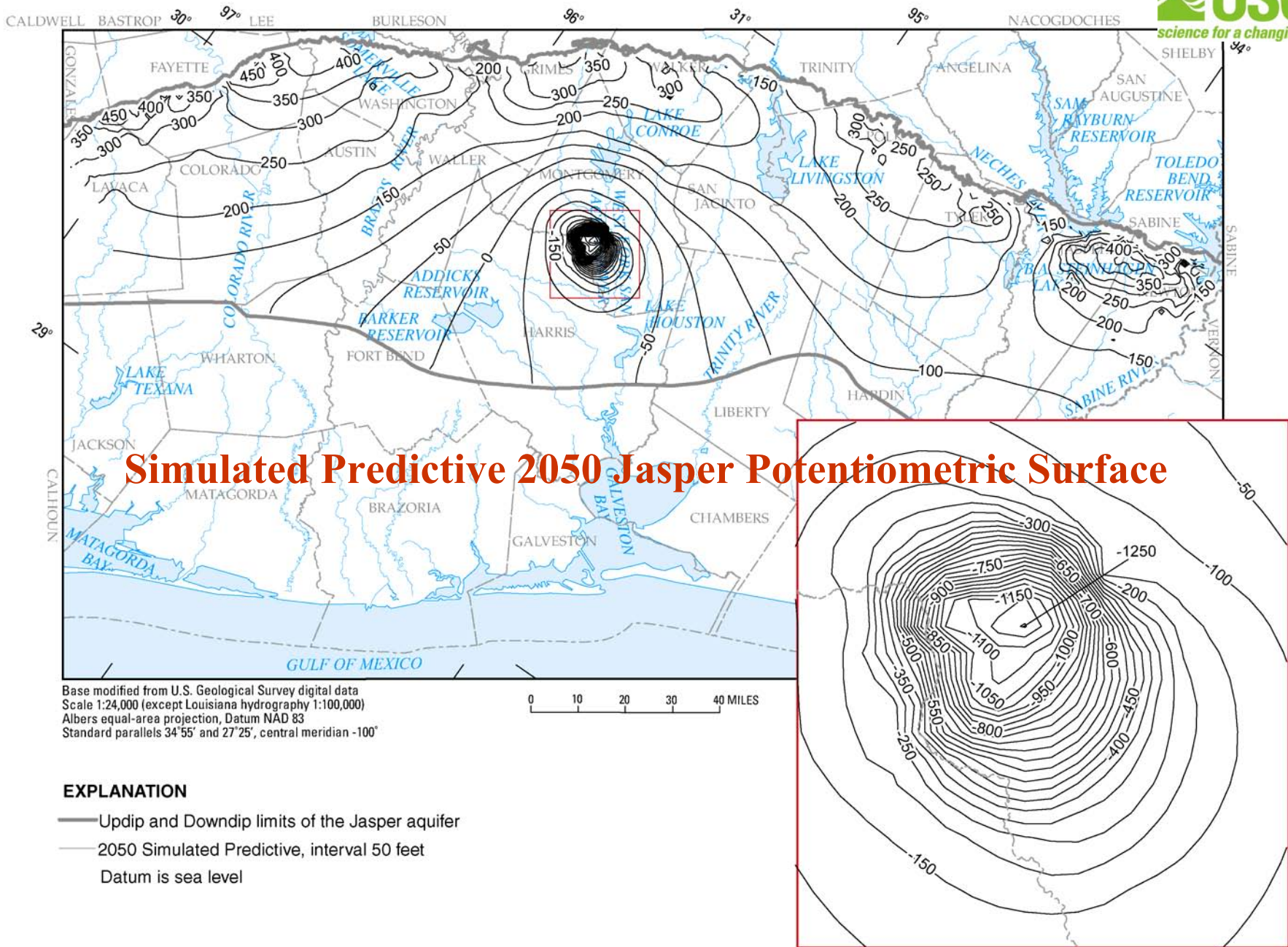
Figure 82. Simulated predictive 2050 potentiometric surface of the Chicot aquifer in the Ground-Water Availability Model study area.

Simulated Predictive 2050 Evangeline Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
Standard parallels 34°55' and 27°25', central meridian -100°

0 10 20 30 40 MILES

EXPLANATION

—— Updip and Downdip limits of the Evangeline aquifer

—— 2050 Simulated Predictive, interval 50 feet

Datum is sea level

Figure 83. Simulated predictive 2050 potentiometric surface of the Evangeline aquifer in the Ground-Water Availability Model study area.
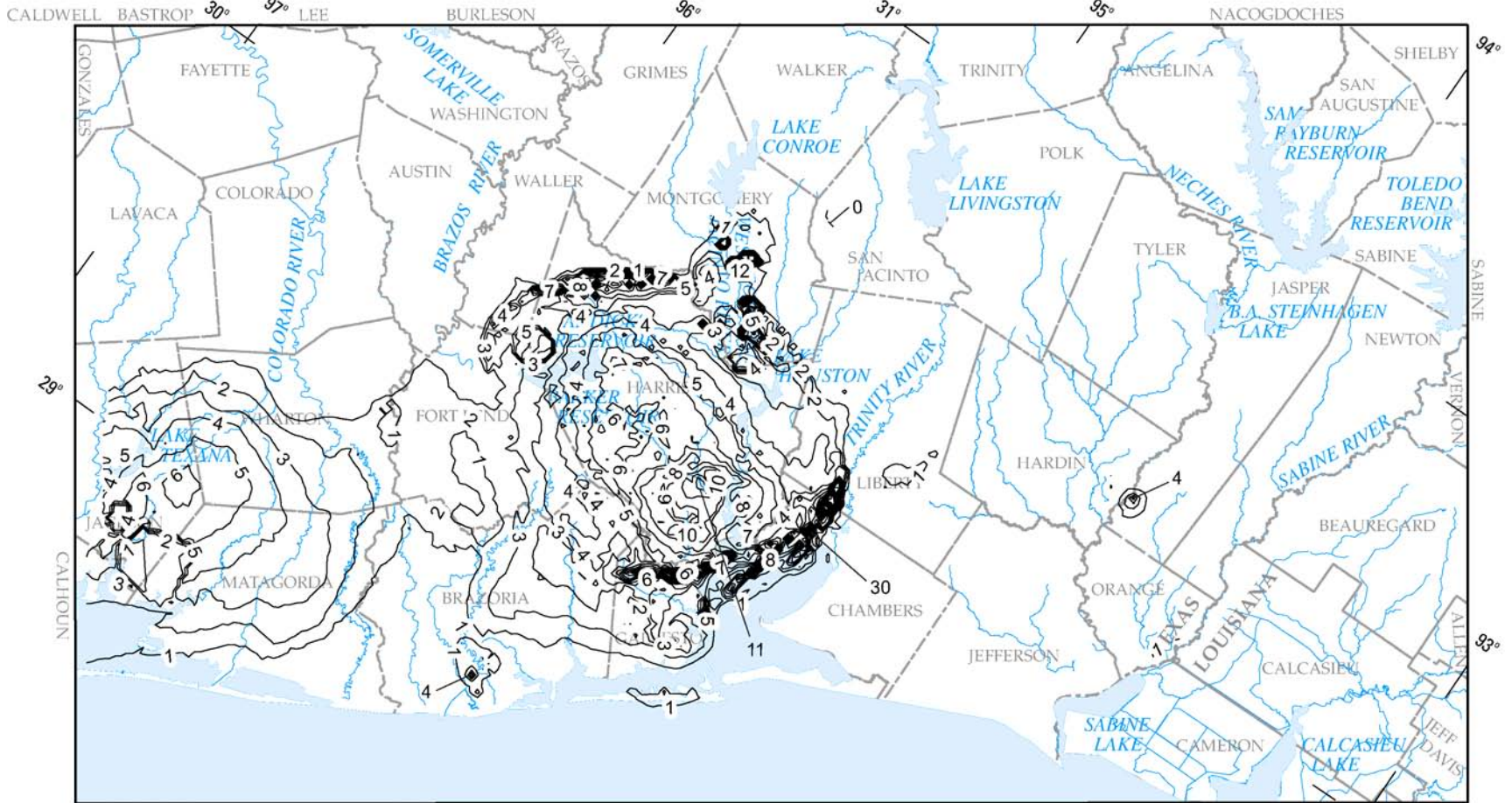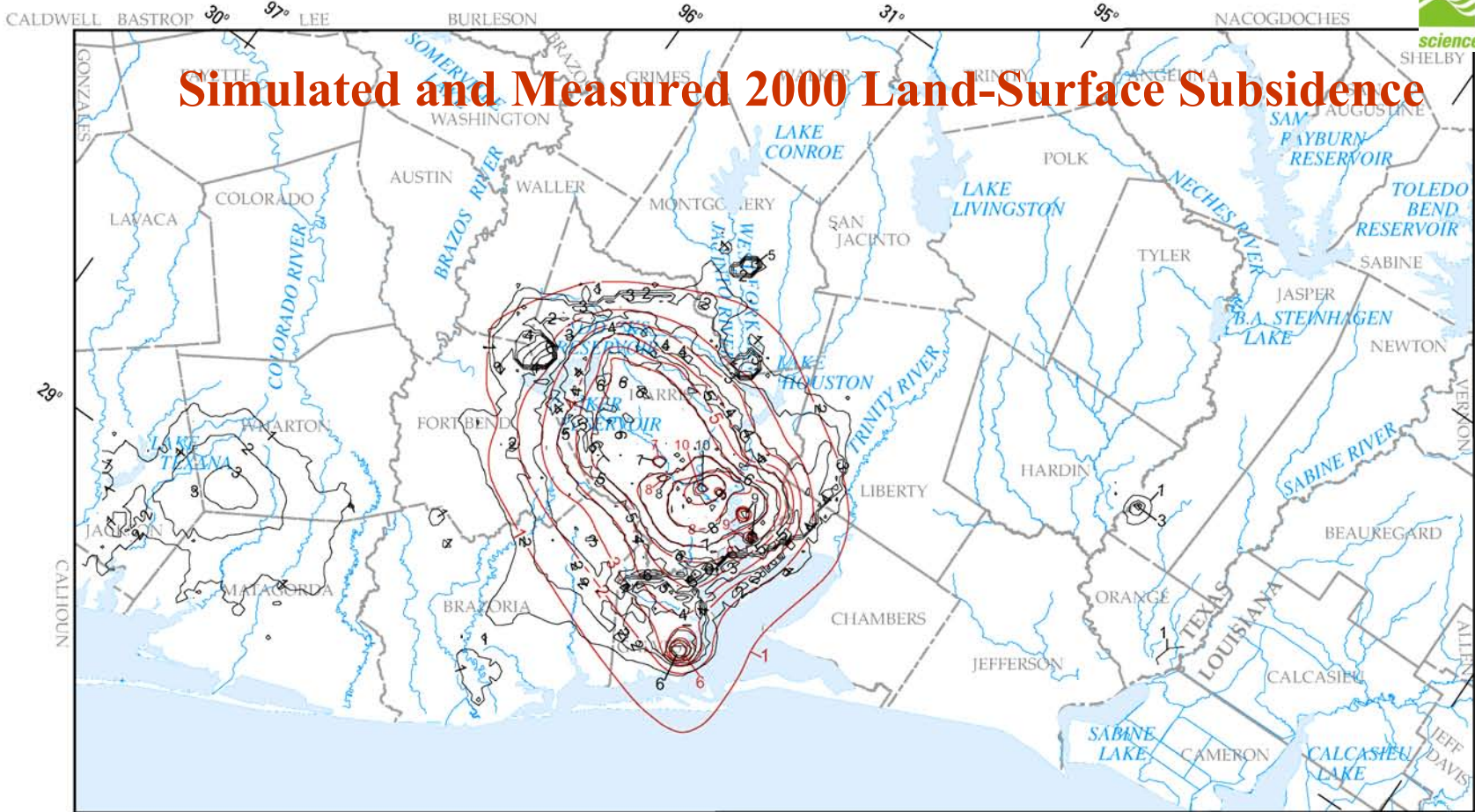
Simulated Predictive 2050 Jasper Potentiometric Surface

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
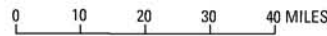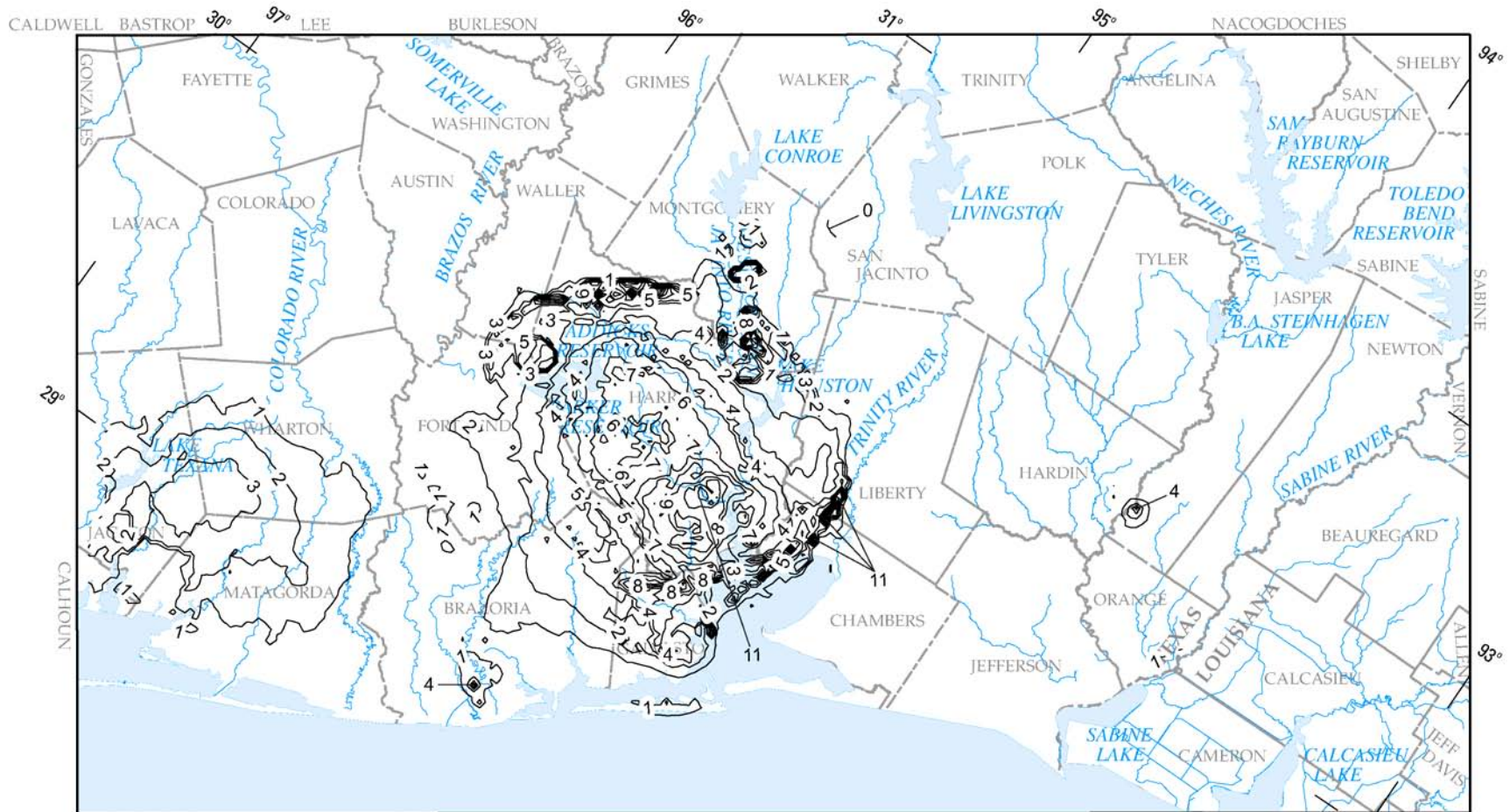Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

EXPLANATION

— Updip and Downdip limits of the Jasper aquifer

— 2050 Simulated Predictive, interval 50 feet

Datum is sea level

Figure 84. Simulated predictive 2050 potentiometric surfaces of the Jasper aquifer in the Ground-Water Availability Model study area.

Simulated Predictive 2050 Land-Surface Subsidence

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
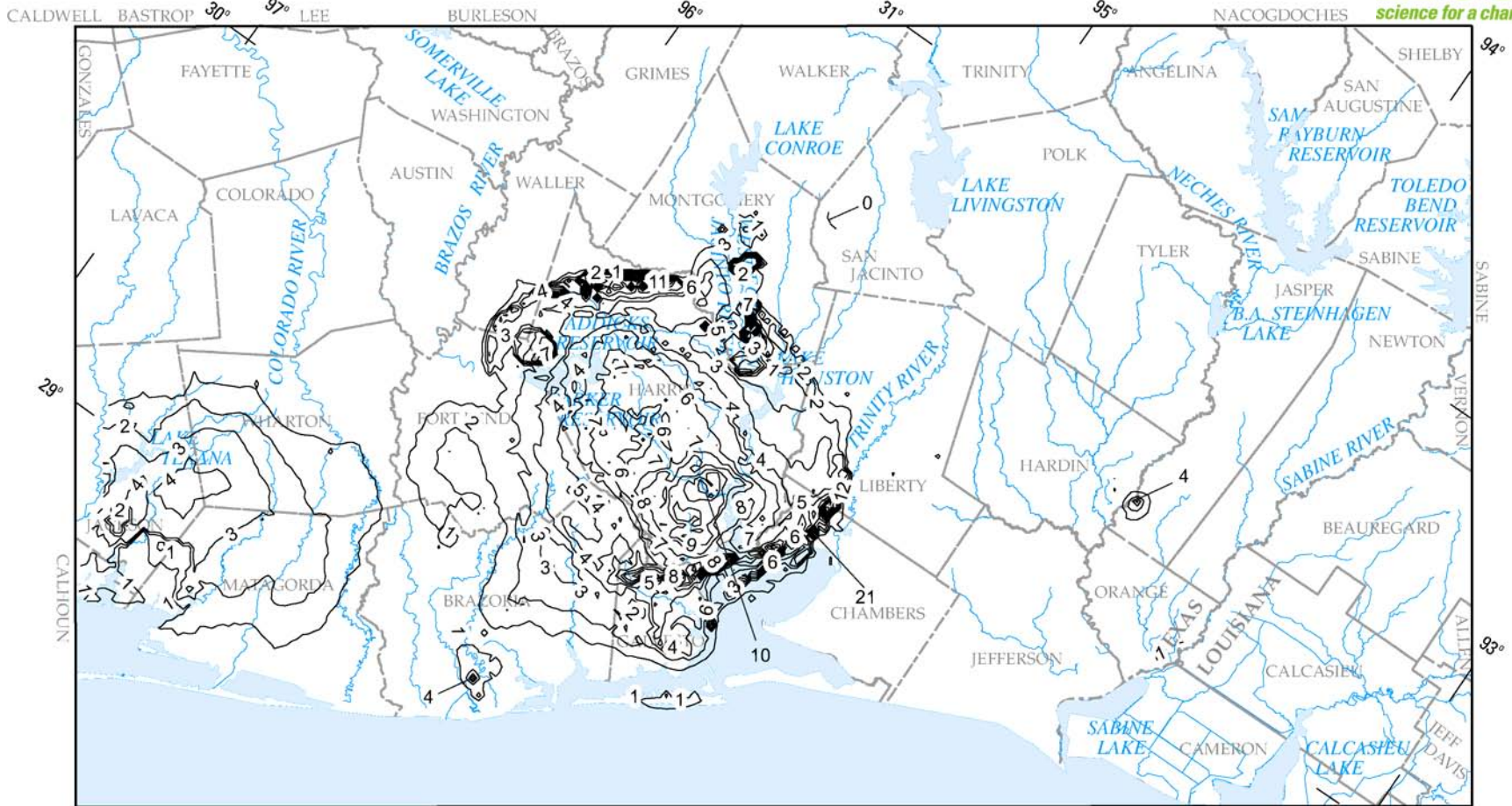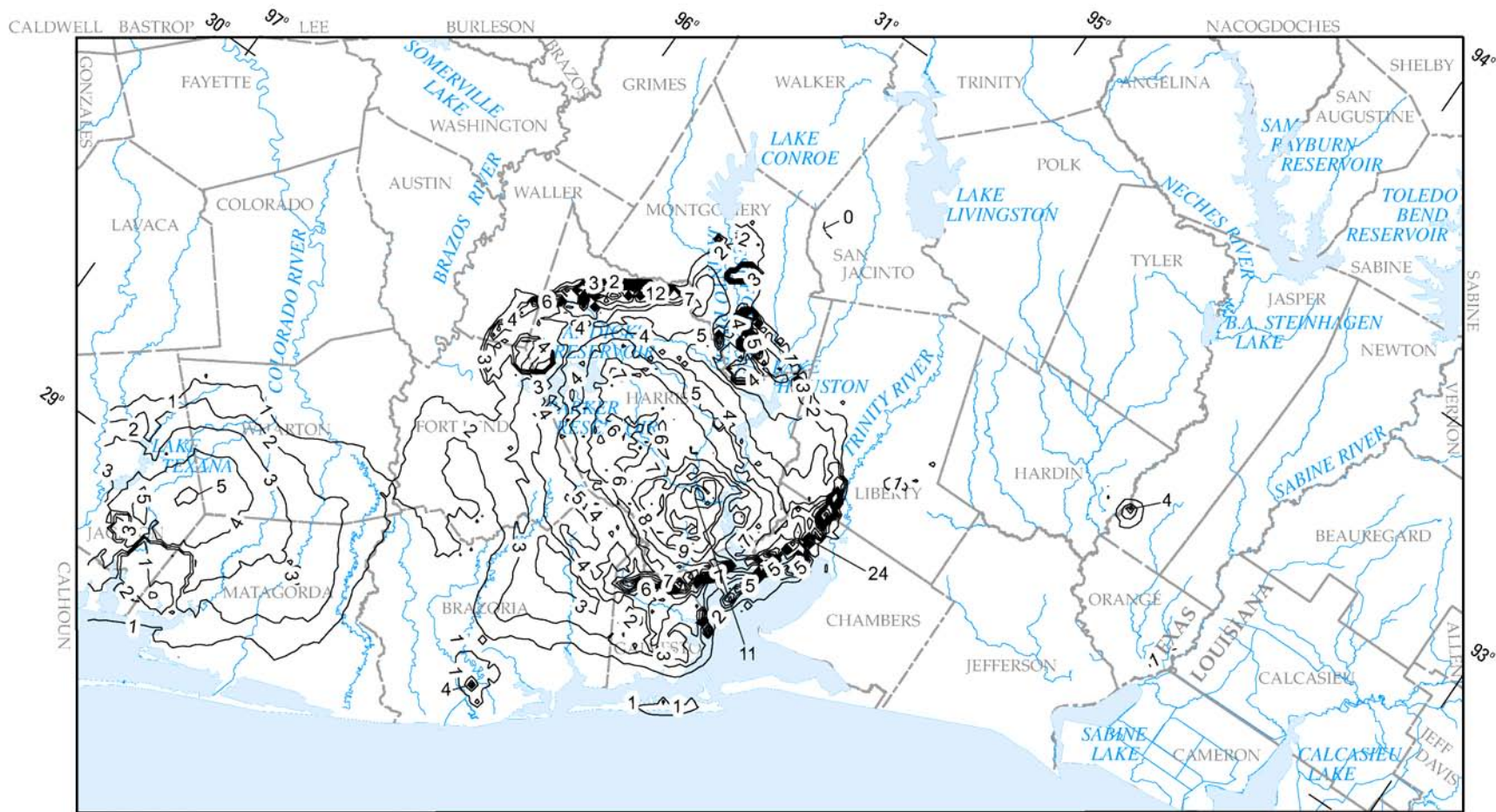Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

EXPLANATION

——— 2050 Simulated land-surface subsidence, in feet

Figure 89. Simulated predictive 2050 land-surface subsidence in the Ground-Water Availability Model study area.

Figure 63. Measured and simulated 2000 land-surface subsidence in the Ground-Water Availability Model study area.

Figure 69. Simulated predictive 2010 land-surface subsidence in the Ground-Water Availability Model study area.

Figure 74. Simulated predictive 2020 land-surface subsidence in the Ground-Water Availability Model study area.

EXPLANATION

—— 2020 Simulated land-surface subsidence, in feet

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
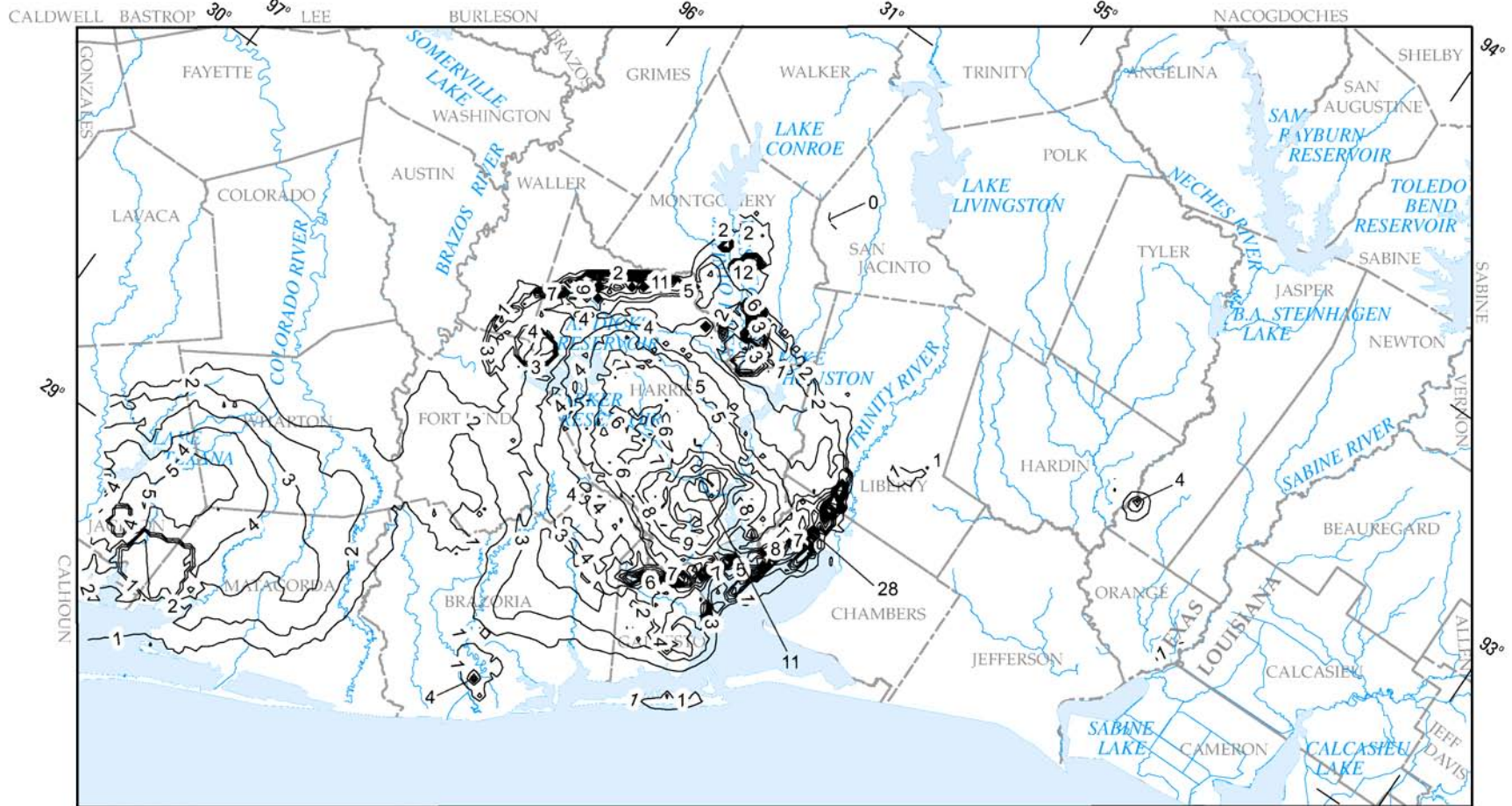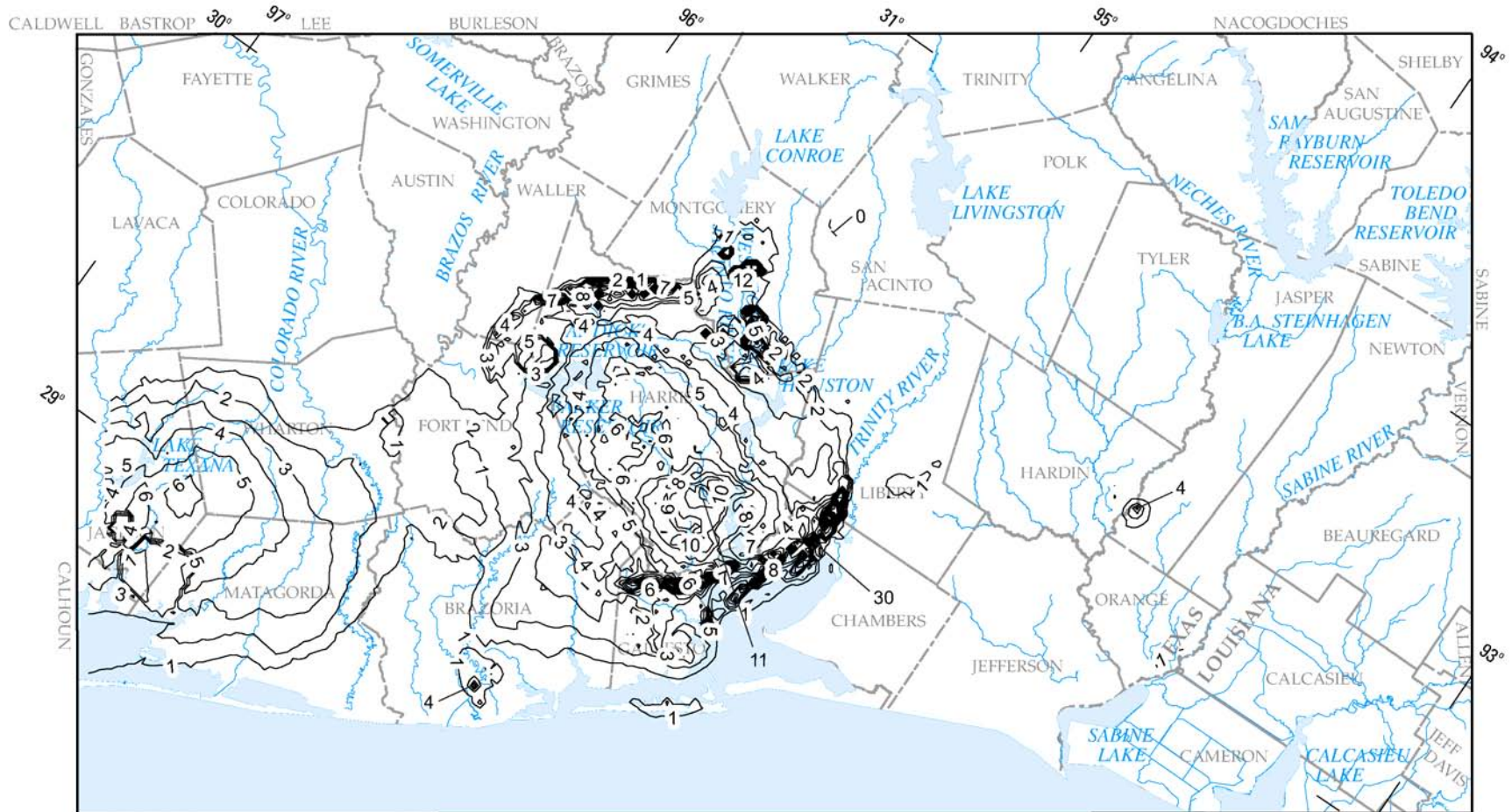Standard parallels 34°55' and 27°25', central meridian -100°

0   10   20   30   40 MILES

Simulated Predictive 2030 Land-Surface Subsidence

EXPLANATION

——— 2030 Simulated land-surface subsidence, in feet

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
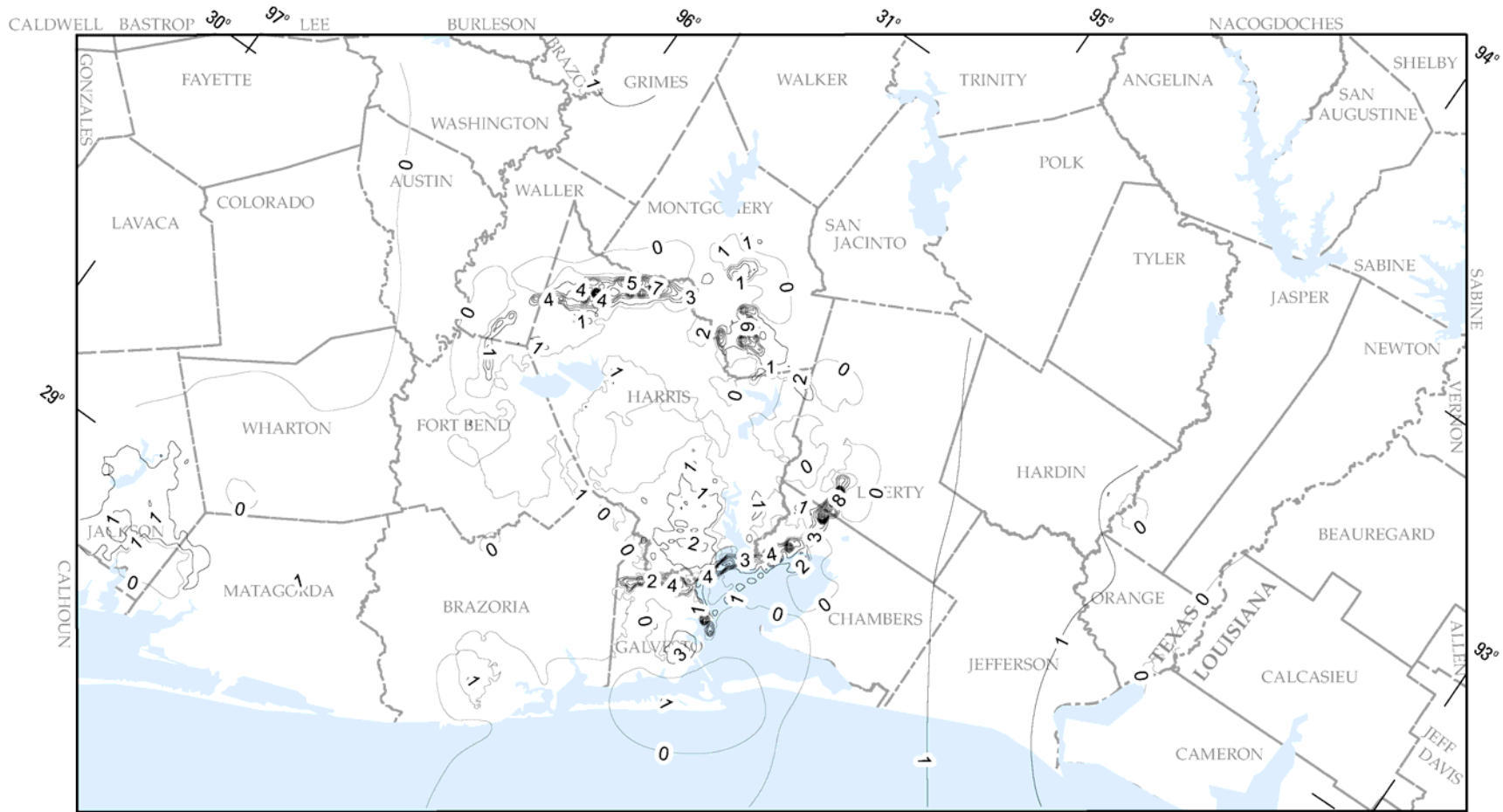Standard parallels 34°55' and 27°25', central meridian -100°

0 10 20 30 40 MILES

Figure 79. Simulated predictive 2030 land-surface subsidence in the Ground-Water Availability Model study area.

Simulated Predictive 2040 Land-Surface Subsidence

Base modified from U.S. Geological Survey digital data
Scale 1:24,000 (except Louisiana hydrography 1:100,000)
Albers equal-area projection, Datum NAD 83
Standard parallels 34°55' and 27°25', central meridian -100°
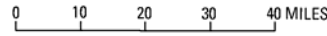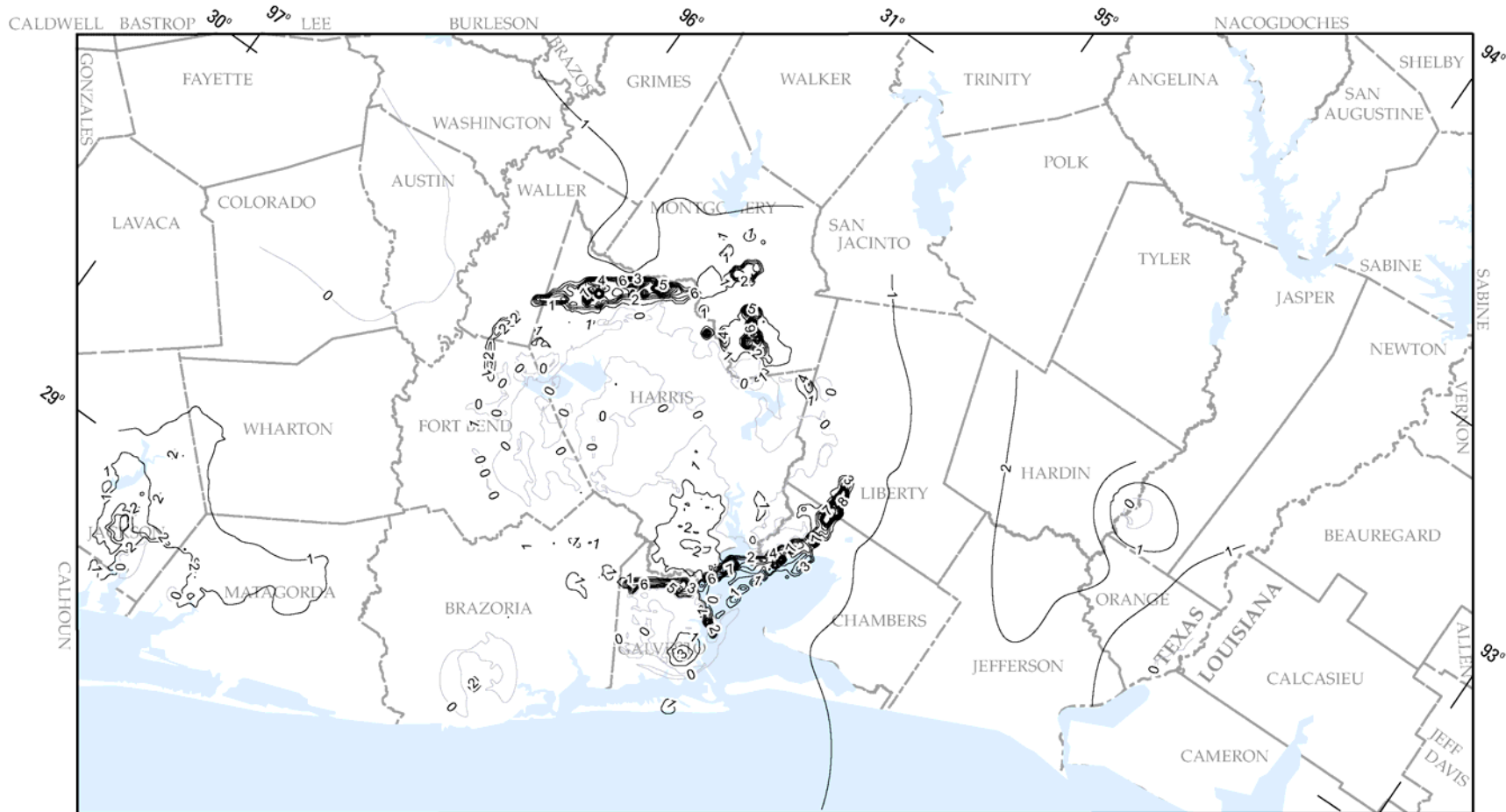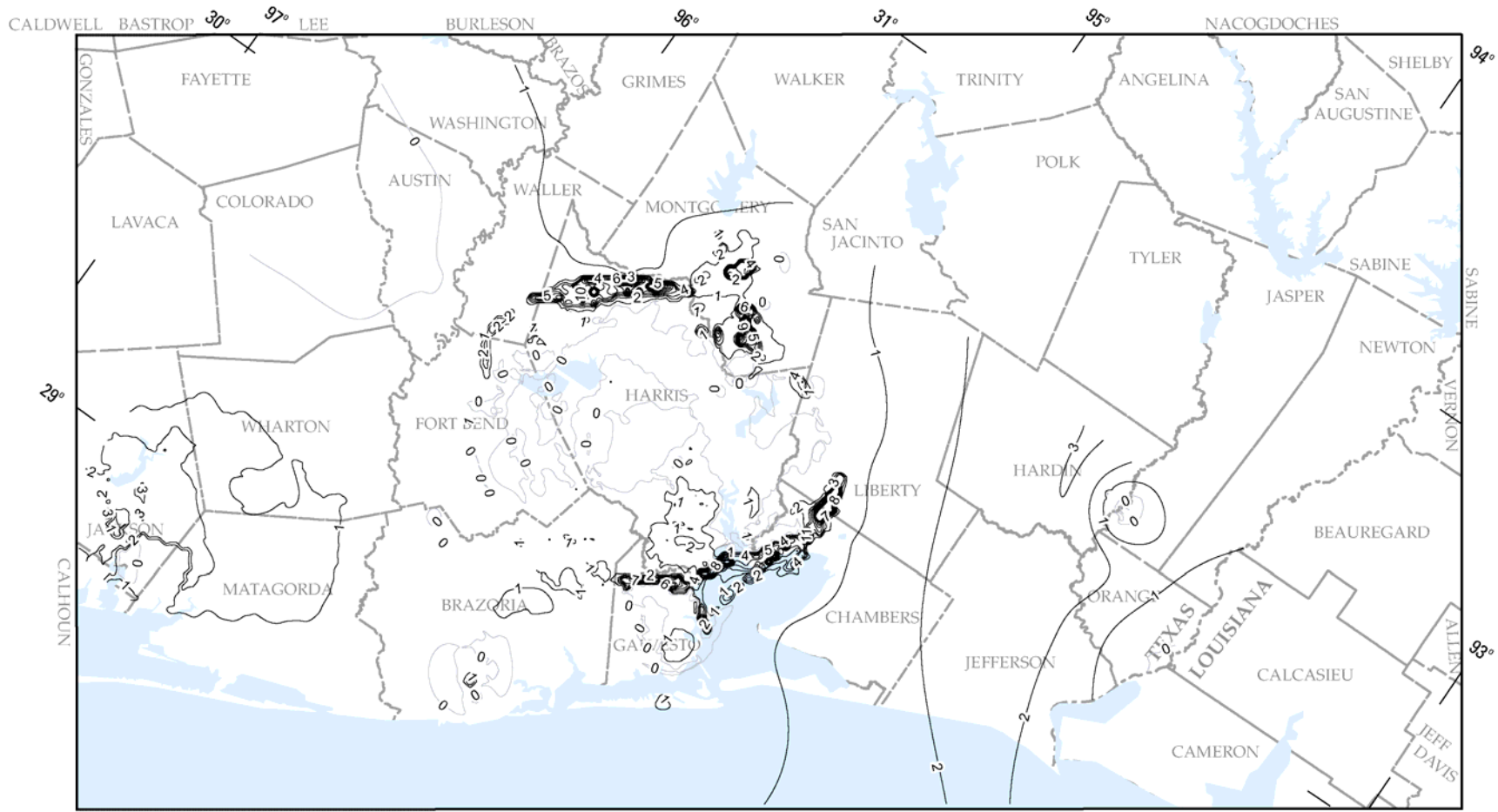
0   10   20   30   40 MILES

EXPLANATION

——— 2040 Simulated land-surface
subsidence, in feet

Figure 84. Simulated predictive 2040 land-surface subsidence in the Ground-Water Availability Model study area.

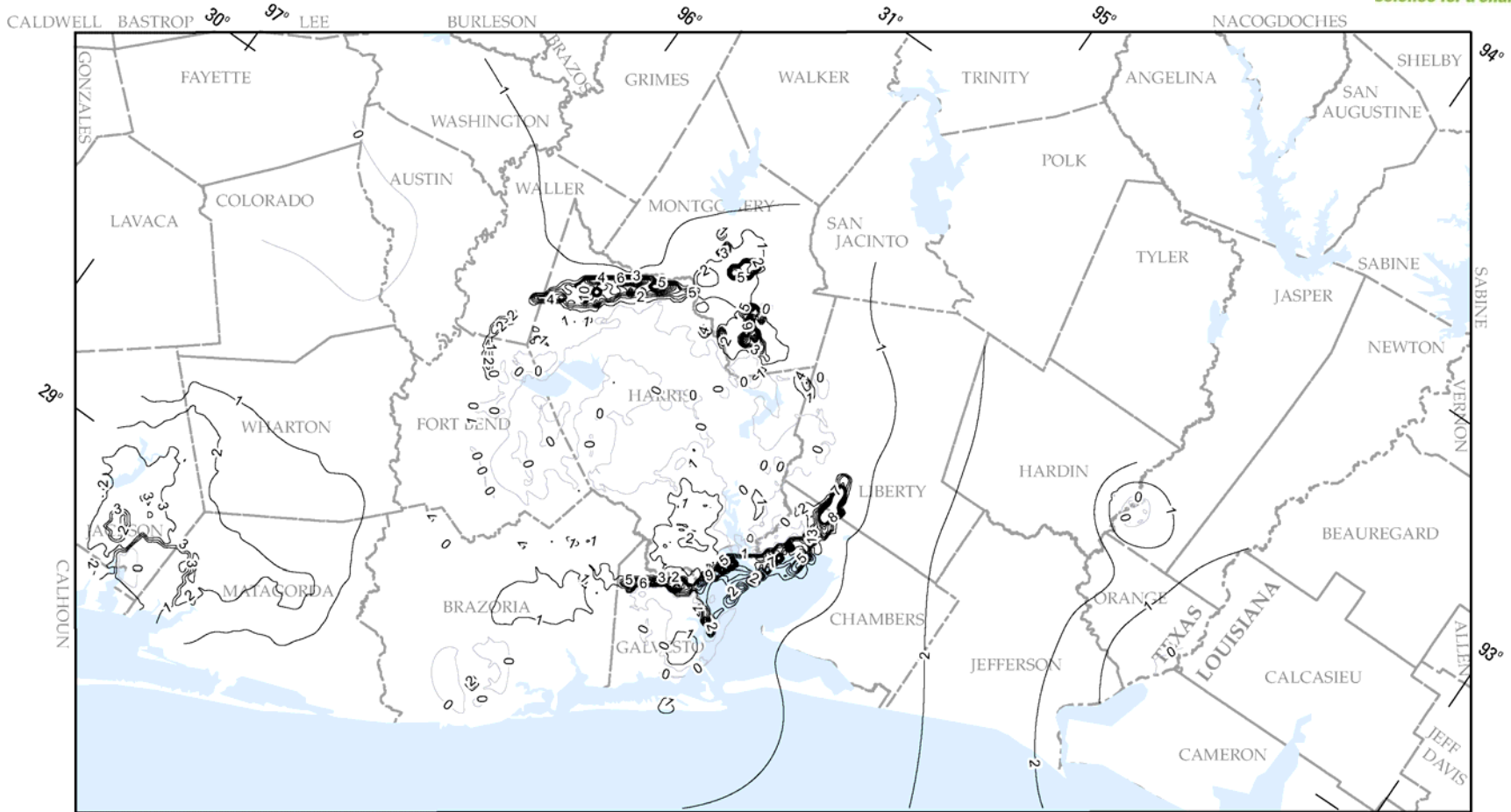# Simulated Predictive 2050 Land-Surface Subsidence

0   10   20   30   40 MILES

EXPLANATION

—— 2050 Simulated land-surface subsidence, in feet

Figure 89. Simulated predictive 2050 land-surface subsidence in the Ground-Water Availability Model study area.

Simulated Predictive 2001-2010 Land-Surface Subsidence

Figure 91. Simulated predictive 2001-10 land-surface subsidence in the Ground-Water Availability Model study area.

Simulated Predictive 2001-2020 Land-Surface Subsidence

Figure 92. Simulated predictive 2001-20 land-surface subsidence in the Ground-Water Availability Model study area.

Figure 93. Simulated predictive 2001-30 land-surface subsidence in the Ground-Water Availability Model study area.

Simulated Predictive 2001-2040 Land-Surface Subsidence

Figure 94. Simulated predictive 2001-40 land-surface subsidence in the Ground-Water Availability Model study area.
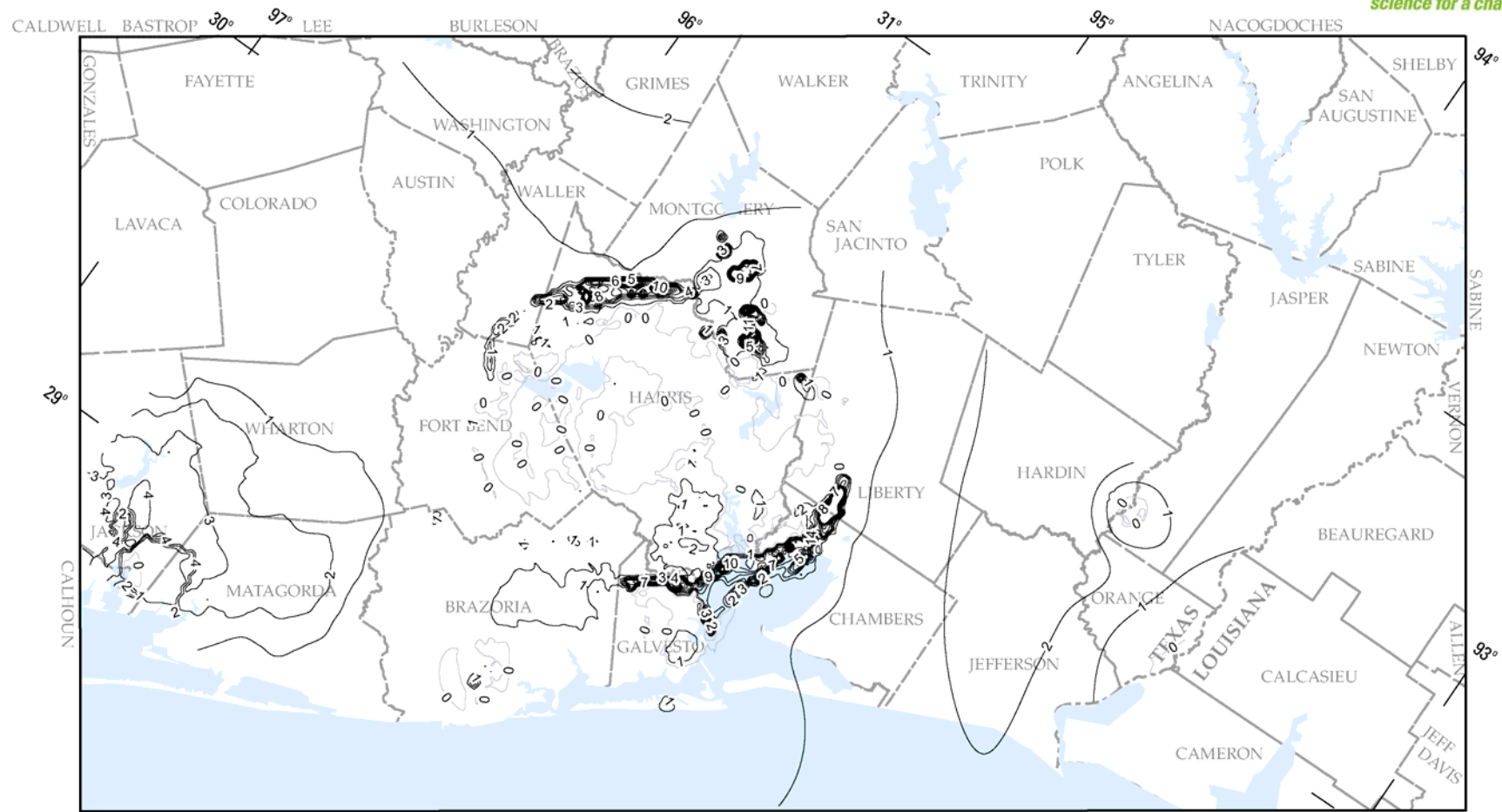
Figure 95. Simulated predictive 2001-50 land-surface subsidence in the Ground-Water Availability Model study area.

Hydrology and Simulation of Flow and Land-Surface Subsidence in the Chicot, Evangeline, and Jasper Aquifers, Northern Gulf Coast, Texas

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