

GUERNICA 2006: SONIFICATION OF 2000 YEARS OF WAR AND WORLD POPULATION DATA

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ABSTRACT

'Guernica 2006' is a sonification piece of war and world population data from year 1 to 2006. Wars are represented chronologically by triggering sound samples at certain times in the piece. The piece uses sound spatialisation to indicate the geographical locations of wars from the viewpoint of London. World population is sonified continuously in the piece by controlling the pitch of a drone sound. Other sounds are used to mark the start of millenniums and to indicate if a particular war was a civil war. When listening to the sonification of war and world population data in parallel, correlation between these two factors seems to be present.

1. INTRODUCTION

This paper first describes the gathering and organisation of the data that was sonified. The mapping used to sonify the data is then discussed. The tools and techniques used to sonify the data are then reviewed. The wars that were sonified are listed in Appendix.

2. DATA GATHERING AND ORGANISATION

The war data was obtained from Wikipedia [1]. For each war, the following data was manually collected and inserted in a spreadsheet: war name, start year, end year, participating countries, location of the war and a boolean flag indicating whether the war was a civil war or not. Modern countries were used to indicate passed geographical locations (e.g. Turkey was used for the Ottoman empire).

The data set provided by the ICAD concert committee [2] was used to calculate the bearing and distance from London for each country in the world; trigonometrical formula in [3] were used to do so.

World population data since year 1 was obtained from [4].

The collected data was used to plot simultaneously world population and the number of simultaneous wars across two thousand years, this is shown in figure 1.

3. SONIFICATION STRATEGY AND DATA MAPPING

3.1. Onsets of wars

The main goal of the selected sonification approach was to represent the number, geographical location, chronology and temporal distribution of wars. To represent wars chronologically, the start year of a war was used to trigger a sound sample at a certain calculated time from the start of the piece.

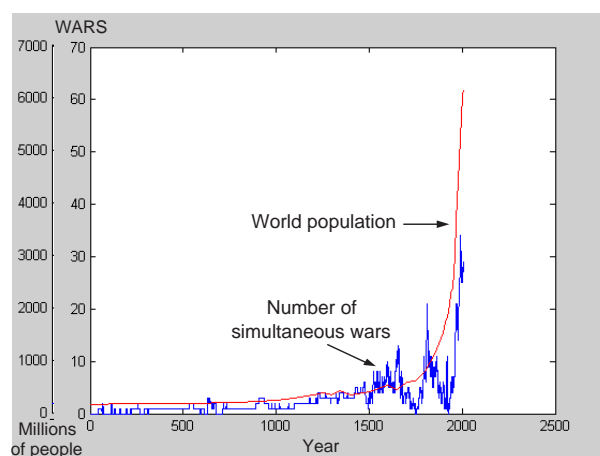


Figure 1: World population and number of simultaneous wars in the period year 1 to 2006.

Originally, a linear scaling scheme was chosen: one year represented the total time of the piece divided by 2006. However due to the nature of the war data, much more wars were present towards the end of the piece. Thus the start of the piece was too sparse and the end of the piece too dense. To solve this problem the time variable followed a logarithmic rule so that years towards the end of the piece ticked four times as slow than at the start. Although entirely possible, the duration of wars was not sonified because the main goal of the sonification strategy was to represent the number and distribution of wars since 2000 years.

The sound of a gong was also triggered at every start of a new millennium; this proved to be a useful cue for providing a time reference when listening to the sonified data.

The 2006 years of data were chronologically condensed into a five-minute sonification.

3.2. Types of weapons

The types of weapons used in the wars were also sonified by selecting appropriate sound samples to represent different eras. For example: the sounds of horses, punches, swords etc. are heard at the start of the piece. Later in the piece, explosions, cannons and gun sounds are employed when, in history, gunpowder was used militarily (around 1300 in Europe but much earlier in China). Towards the end of the piece (after year 1900), helicopters, machine guns, submarine sounds etc. are used.

The use of sound samples to sonify data can be powerful (over synthetic sounds) as it immediately carries a context, provided that the sound samples are recognised.

3.3. Locations of wars

The locations of wars were sonified by spatialising the sound samples (indicating the start of wars) at certain calculated azimuths and distances. Speaker 1 of the array indicated the North direction. Sound spatialisation is efficient for representing geographical data as it can give a straight forward representation of position. However, it became apparent that the sonification of locations around the antipodes was problematic and might require a 3D audio display rather than a horizontal 2D display such as in the present case.

The spatialisation of country locations on the 8-speaker array is illustrated in figure 2. Technical description of the spatialisation technique is given below.

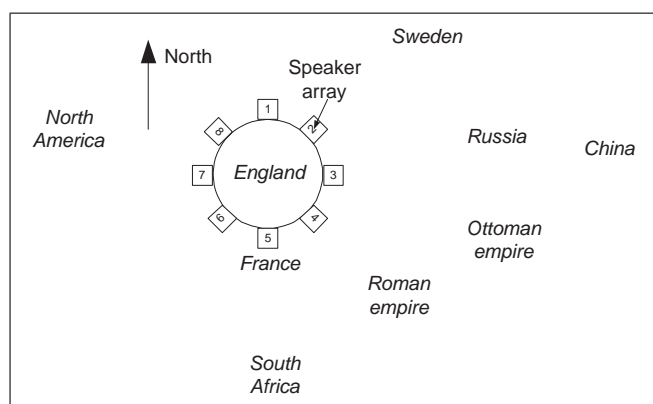


Figure 2: Illustration of spatialisation of country positions on the 8-speaker array.

3.4. Types of wars

The ‘civil war flag’ was used to trigger the sound sample of a broken glass to indicate the nature of the war. Other sound samples could also have been used to further indicate different types of wars.

3.5. World population

The world population data controlled the playback speed of a sound loop which played continuously throughout the piece. A simple linear scaling was used to map the number of millions of living people to the playback speed of the sample. A drone sound sample was used for the loop.

4. SONIFICATION TOOLS AND TECHNIQUES

4.1. Tools

Excel and simple text editors were first used to enter, arrange and clean the data. The data was then copied and pasted into Matlab variables. Matlab, which provides a powerful scripting environment, was used to calculate the distance and bearing of each country and to format the war data for the *Coll* Max/Msp [5] object. The *Coll* object is convenient for sonification purposes in the

Max/Msp environment as it can be used to store large amounts of data in text form.

The Max/Msp program was the actual sonification program that turned the data into sound and performed triggering of samples, sound spatialisation and recording of the output to a multichannel sound file; a screen capture of the Max/Msp patch is shown in figure 3.

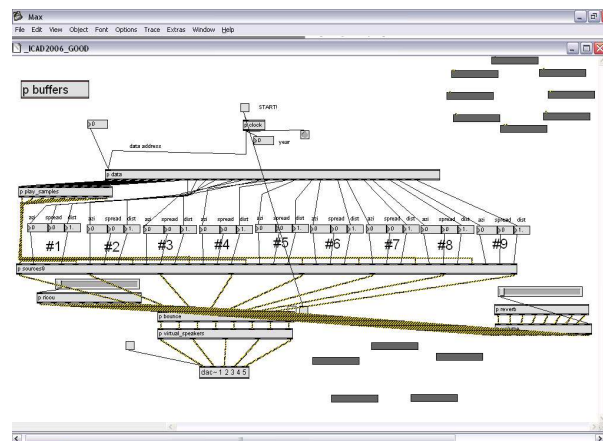


Figure 3: Max/Msp patch used to sonify the data.

4.2. Spatialisation

The Vector Based Amplitude Panning (VBAP) [6] technique was used to represent the azimuth (i.e. bearing) of the countries on the 8-speaker array. Distances of countries were sonified by altering the ratio between direct sound and reverberated sound; this is a well known technique [7]. Reverberation was implemented in Max/Msp using the Freeverb VST plug-in [8].

5. CONCLUSIONS

‘Guernica 2006’ is an attempt at sonifying human history. When listening to world population and war data it seems that the two factors are correlated; this was also apparent when visualising the data. In future versions of the piece, more advanced sonification strategies will be used to represent the duration and types of wars, number of casualties etc. Further data such as population migration and exodus could also be added to further explore correlations with war data.

6. REFERENCES

- [1] “List of wars” keyword search in Wikipedia, the free encyclopedia, www.wikipedia.org
- [2] ICAD 2006 Concert, <http://www.dcs.qmul.ac.uk/icad2006/concert.php>.
- [3] “Calculate distance and bearing between two Latitude/Longitude points”, <http://www.movable-type.co.uk/scripts/LatLong.html>
- [4] “Historical Estimates of World Population”, <http://www.census.gov/ipc/www/worldhis.html>

- [5] Zicarelli, D., "How I Learned to Love a Program That Does Nothing", *Computer Music Journal*, 26:4, pp. 4451, Winter 2002
- [6] Pulkki., V., "Virtual source positioning using vector base amplitude panning". *J. Audio Eng. Soc.*, 45(6):456466, Jun. 1997.
- [7] Chowning, J., *The Simulation of Moving Sound Sources*. *J. Audio Eng. Soc.* 19,2-6,1971
- [8] Freeverb VST plugin, <http://www.sonicspot.com/freeverb/freeverb.html>

7. APPENDIX: LIST OF SONIFIED WARS

Aulus Plautius' Roman invasion of Britain (43-50), Wars between Nero and the Parthians (51-63), The first Jewish-Roman War (66-70), Year of the four emperors, Roman civil war (68-69), Trajan's invasion on Parthian Empire (115-117), Second Jewish-Roman War (115-117), Third Jewish-Roman War (132-135), Parthian war of Lucius Verus (161-166), Parthian war of Septimius Severus (193-199), Parthian war of Caracalla (215-217), War of Three Kingdoms in China (220-265), War of the Eight Princes in China (291-306), Dacian Campaign (256), Civil Wars in China (316-589), Vandal Wars in North Africa (533-534), Gothic War in Italy (535-553), Goguryeo-Sui Wars in Korea (598-614), Ridda wars (632-633), Byzantine-Arab Wars (632-677), Islamic Conquest of Sassanid Empire (633-651), Islamic conquest of Egypt (639-641), Tang Invasion of Goguryeo (645), First Islamic civil war (656-661), Civil Wars in Korea (666-676), Islamic conquest of Iberia (711-718), Spanish Reconquista (718-1492), Balhae Invasion of Tang China (732), Korean Civil War (892-936), Chinese Civil War (907-960), War of the Three Henriess (977-978), First Goryeo-Khitan War (993), Toi invasion (1019), Norman Conquest (1066), War of the Three Sanchos (1067-1068), Crusades (1096-1291), Gempei War (1180-1185), First Barons' War (1215-1217), Mongol invasion of Russia (1223-1480), Mongol invasion of Volga Bulgaria (1223-1236), Second Barons' War (1264-1267), First War of Scottish Independence (1296-1328), Kexholms War (1321-1322), Second War of Scottish Independence (1332-1333), Hundred Years' War (1337-1453), Breton War of Succession (1341-1364), Crisis in Portugal (1383-1385), Hussite Wars (1420-1436), Wars in Lombardy (1425-1454), Fall of Constantinople (1453), Thirteen Years' War (1454-1466), Wars of the Roses (1455-1485), Onin War (1467-1477), Wars of Sengoku Period in Japan (1467-1603), War between the Duchy of Burgundy and the Swiss Confederation (1474-1477), War between Moscow and Novgorod (1478), Italian Wars (1494-1559), Swabian War (1499), Franco-Spanish Conquest of Naples (1500-1502), War of the League of Cambrai (1508-1516), First war of Francis and Charles V (1521-1525), Anglo-French War (1521-1525), War with the League of Cognac (1526-1529), Third war of Francis and Charles (1536-1538), Last war of Francis and Charles (1542-1544), Anglo-French War (1542-1546), Anglo-Scottish War (1542-1550), Anglo-French War (1549-1550), Last Italian War (1552-1559), Anglo-French War (1557-1559), First Russo-Swedish War (1495-1497), Turkish-Venetian War (1499-1503), Ottoman Civil War (1509-1513), Spanish conquest of Mexico (1520-1521), The Swedish War of Liberation (1521-1523), Uprising of the Comuneros in Castile (1521-1523), Ottoman-Hungarian War (1521-1526), Ottoman Conquest of Rhodes (1522), The Peasants' War (1524-1525), Spanish wars against the Mayas. (1524-1697), Hungarian Civil War (1526-1528), Ottoman-Habsburg War in Hungary (1528-1533), Swiss Civil War (1531), Spanish topple the Incan empire (1532), Ottoman-Habsburg War in the Mediterranean (1532-1546), The Counts' War in Denmark (1533-1536), Renewed Ottoman-Habsburg War in Hungary (1537-1544), Schmalkaldic War (1546-1547), Ottoman-Habsburg War in Hungary (1551-1562), Second Russo-Swedish War (1554-1557), Livonian War (1557-1571), Scottish Rebellion against the French (1559-1560), Wars of Religion in France (1562-1598), Dano-Swedish War (1563-1570), Morisco Revolt in Spain (1568-1571), Eighty Years' War (1568-1648), Russo-Crimean War (1571), Livonian War (1577-1582), Turkish-Persian War (1577-1590), Portuguese Civil War (1580-1583), Anglo-Spanish War (1585-1604), "Long War" between the Habsburgs and the Turks (1593-1606), Seven-Year War (1592-1598), Moldavian Magnate Wars (1593-1617), Nine Years War in Ireland (1594-1603), Cudgel War in Finland

(1596-1597), Polish-Swedish War (1600-1611), Turkish-Persian War (1602-1612), Russo-Polish War (1609-1618), First Anglo-Powhatan War (1609), Ingrian War (1610-1617), Polish-Turkish War (1614-1621), Turkish-Persian War (1616-1618), Polish-Swedish War (1617-1629), Thirty Years' War (1618-1648), Second Anglo-Powhatan War (1622), Turkish-Persian War (1623-1638), Huguenot Uprising in France (1625-1629), Smolensk War (1632-1634), Polish-Swedish War (1634), Pequot War (1637), Wars of the Three Kingdoms (1639-1652), Catalan Revolt (1640-1656), Portuguese War of Independence (1640-1668), French and Iroquois Wars (1640-1701), Wars of Castro (1641-1649), Third Anglo-Powhatan War (1644), Turkish-Venetian War (1645-1669), The Fronde (1648-1653), The Deluge/Northern Wars (1648-1660), Khmelnytsky Rebellion (1648-1654), Russo-Polish War (1654-1656), Swedish-Brandenburg War (1655-1656), Polish-Swedish War (1655-1660), Russo-Swedish War (1656-1658), Danish-Swedish War (1656-1660), Dutch-Swedish War (1657-1660), Russo-Polish War (1658-1667), First Anglo-Dutch War (1652-1654), Anglo-Spanish War (1654-1659), Peach Tree War (1655-1660), Turkish-Transylvanian War (1657-1662), Austro-Turkish War (1662-1664), Second Anglo-Dutch War (1665-1667), War of Devolution (1667-1668), Stenka Razin Rebellion (1670-1671), Polish-Turkish War (1671-1676), Franco-Dutch War (1672-1678), Third Anglo-Dutch War (1672-1674), War between Brandenburg and Sweden (1672-1679), Scanian War between Sweden and Denmark-Norway (1675-1679), King Philip's War (1675-1676), Russo-Turkish War (1676-1681), War of the Reunions (1683-1684), Russo-Turkish War (1686-1700), War of the Grand Alliance (1688-1697), Darin War (1699-1700), Great Northern War (1700-1721), War of Spanish Succession (1701-1714), Queen Anne's War The North American part of the War of Spanish Succession (1702-1713), Hungarian Revolt (1703-1711), Astrakhan Rebellion (1707-1709), Tuscarora War (1711), Turko-Venetian War (1714-1718), Yamasee War (1715), Jacobite Rising known as "The 'Fifteen" (1715-1716), Austro-Turkish War (1716-1718), War of the Quadruple Alliance (1718-1720), Dummer's War in Maine (1722), Russo-Persian War (1722-1723), Turco-Persian War (1722-1727), Spanish war between England and France (1727-1729), Turco-Persian War (1730-1736), War of the Polish Succession (1733-1738), Russo-Turkish War (1736-1739), Austro-Turkish War (1737-1739), War of the Austrian Succession (1740-1748), Turco-Persian War (1743-1747), Seven Years' War (1756-1763), Pontiac's Rebellion (1763-1766), Anglo-Mysore Wars (1766-1799), Russo-Turkish War (1768-1774), War of the Confederation of Bar in Poland (1768-1776), Pugachev's Rebellion (1773-1774), First Anglo-Maratha War (1774-1783), American War of Independence (1775-1783), War of the Bavarian Succession (1777-1779), Cape Frontier Wars (1779-1879), Dutch Civil War (1785-1787), Austro-Turkish War (1787-1791), Russo-Turkish War (1787-1792), Gustav III's Russian War (Russo-Swedish War) (1788-1790), Lingonberry War between Denmark-Norway and Sweden (1788), French revolution (1789), Haitian Revolution (1791-1804), War in defence of the constitution in Poland (1792), French Revolutionary Wars (1792-1802), Franco-Prussian War (1792-1795), Franco-Austrian War (1792-1797), Franco-Spanish War (1793-1795), Franco-Dutch War (1793-1795), Franco-British War (1793-1802), Revolt in the Vende (1793-1796), Franco-Russian War (1798-1799), Franco-Austrian War (1799-1801), Quasi-War (1798-1801), Kosciuszko Uprising in Poland (1794), United Irishmen Revolt (1795-1798), Persian expedition of Catherine the great (1796), War of the Castes in Haiti (1800), War of the Oranges (1801), First Barbary War (1801-1805), Second war of Haitian Independence (1802-1805), Second Anglo-Maratha War (1802-1805), British Expedition to Ceylon (1803-1804), War of the Third Coalition (1805), War of the Fourth Coalition (1806-1807), Russo-Turkish War (1806-1812), Anglo-Turkish War (1807-1809), Peninsular War (1807-1814), Gunboat War (1807-1814), Anglo-Russian War (1807-1812), War of the Fifth Coalition (1809), Franco-Russian War (1812), War of the Sixth Coalition (1813-1814), Neapolitan War (1815), War of the Seventh Coalition (1815), Irish convict Rebellion—Castle hill Rebellion (1804), Serbian Revolt (1804-1806), Fulani War in Nigeria (1804-1810), Russo-Persian War (1804-1813), Black War (1804-1835), Egyptian Revolution (1805-1811), Haitian Invasion of Santo Domingo (1805), British invasions of the Ro de la Plata (1806-1807), Ashanti-Fante War (1806-1807), Second Convict Rebellion (1806), Spanish Rebellion (1807-1814), The Finnish War (1808-1809), Santo Dominican Restoration (1808-1809), Bolivian Independence War (1809-1825), Colombian War of Independence (1810-1819), Argentine War of Independence (1810-1816), Anglo-Dutch Java War (1810-1811), Punjab War (1810-1820), Chilean Revolt (1810), Conquest of Hawaii (1810), Amadu's

Jihad (1810), Mexican War of Independence (1810-1821), Ga-Fante War (1811), Cambodian Usurpation (1811-1812), Korean Revolt (1811-1812), Tecumseh's War (1811), Egyptian-Wahhabi War (1811-1818), Venezuelan War of Independence (1811-1812), Bolvar in Venezuela (1813-1814), Spanish Invasion of New Granada (1815-1816), Bolvar in Venezuela (1816-1817), Bolvar in New Granada (1819-1820), Bolvar in Venezuela (1821), Republican Campaign in Ecuador (1822), Republican Campaign in Bolivia (1824-1825), War of 1812 (1812-1815), The Creek War (1813-1814), The Gurkha War (1814-1816), Ashanti Invasion of the Gold Coast (1814-1816), Second Barbary War (1815), Caucasian War (1817-1864), Chilean War of Independence (1817-1818), Third Anglo-Maratha War (1817-1818), Zulu Civil War (1817-1819), Seminole Wars (1817-1858), 5th Cape Frontier War (1818-1819), Spanish Civil War (1820-1823), Greek War of Independence (1821-1829), Turko-Persian War (1821-1823), Padri War in Indonesia (1821-1837), First Burmese War (1823-1826), Russo-Persian War (1825-1828), Cisplatine War Brazil against Argentina (1825-1828), Java War (1825-1830), Gran Colombia-Peru-Bolivia Federation war. (1828), Russo-Turkish War (1828-1829), Revolution in France (1830), Polish-Russian war (1830-1831), Belgian Revolution (1830-1839), Black Hawk War (1832), First Carlist War in Spain (1833-1840), 6th Cape Frontier War (1834-1836), Toledo War (1835), Texas Revolution (1835-1836), War of Tatters (1835-1845), Patriot War (1837-1838), Rebellions of 1837 in Canada (1837-1838), Mormon War (1838), Pastry War (1838), Honey War (1839), First Anglo-Afghan War (1839-1842), First Opium War (1839-1842), Several Maori Land Wars in New Zealand (1843-1872), First Anglo-Sikh War (1845-1846), 7th Cape Frontier War (1846), Mexican-American War (1846-1848), Italian Independence wars (1848-1866), Second Anglo-Sikh War (1848-1849), Hungarian Revolt of 1848 (1848-1849), First war of Schleswig (1848-1851), Taiping Rebellion (1850-1865), 8th Cape Frontier War (1851-1853), Brazil Uruguay's Colorado (1852), Second Burmese War (1852), Crimean War (1853-1856), Campaign of 1856-1857 (1856), Second Opium War (1856-1860), Indian Mutiny (1857-1858), Utah War (1857-1858), Caste War of Yucatan (1857-1901), Federal War in Venezuela. 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Boer War (1899-1902), Thousand Days War (1899-1902), Philippine-American War (1899-1913), Russo-Japanese War (1904-1905), Revolution of 1905 in Russia (1905), Turco-Italian War (1911-1912), Balkan Wars (1912-1913), World War I (1914-1918), Easter Rising rebellion in Ireland (1916), Russian Revolution (1917-1918), Estonian Liberation War (1917-1920), Finnish Civil War (1918), Georgian-Armenian War (1918), Czechoslovakia - Hungary War (1918-1919), Russian Civil War (1918-1922), Polish-Ukrainian War (1918-1919), Great Poland Uprising (1918-1919), Czechoslovak-Polish war (1919), Third Anglo-Afghan War (1919), First Silesian Uprising (1919), Polish-Soviet war (1919-1921), Anglo-Irish War (1919-1921), Turkish War of Independence (1919-1922), Second Greco-Turkish War (1920-1922), Polish-Lithuanian War (1920), Second Silesian Uprising (1920), Third Silesian Uprising (1921), Irish Civil War (1922-1923), Northern Expedition in China (1926-1927), Chinese Civil War (1927-1937), Chaco War 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(Second Arab-Israeli War) (1956), Cuban Revolution (1956-1959), Ifni War (1957-1958), Congo Crisis (1960-1965), Guatemalan Civil War (1960-1996), Bay of Pigs Invasion (CIA-sponsored invasion attempt by Cuban Nationals) (1961), Angolan War of Independence (1961-1975), Sino-Indian War (1962-1963), Indonesia-Malaysia confrontation (1962-1966), Yemen Civil War (1962-1970), Dhofar Rebellion (1962-1975), Mozambique's War of Independence (1964-1975), Indo-Pakistani War of 1965 (1965), Chad Civil War (1965-1996), Indonesian Civil War (1965-1966), Namibian War of Independence (1966-1988), Zimbabwean Second Chimurenga (1966-1979), Six-Day War (Third Arab-Israeli War) (1967), Nigerian Civil War (1967-1970), War of Attrition (1968-1970), Football War (1969), Sino-Soviet border conflict (1969), The Troubles in Northern Ireland (1969-1988), The Bangladesh Liberation War that in turn initiated (1971), Indo-Pakistani War (1971), Yom Kippur War (Fourth Arab-Israeli War) (1973), Agacher Strip War (1974), Ethiopian Civil War (1974-1991), Angolan Civil War (1975-1989), Lebanese Civil War (1975-1991), War of Independence in East Timor (1975-1998), Mozambique's Civil War (1975-1992), Ogaden War (1977-1978), Cambodian-Vietnamese War (1977-1991), The Aceh War (1978-2005), Ugandan Civil War (1978-1988), Sino-Vietnamese War (1979), El Salvador Civil War (1980-1992), Iran-Iraq War (1980-1988), Paquisha War between Ecuador and Peru (1981), Falklands War (1982), Lebanon War (1982), Invasion of Grenada (1983), Civil War in Sri Lanka (1983-2002), Second Sudanese Civil War (1983-2005), Free Papua Movement (1984-1998), Christmas War between Mali and Burkina Faso (1985), Nagorno-Karabakh war (1988-1994), Mauritania-Senegal Border War (1989-1991), Operation Just Cause United States invades Panama (1989-1990), Liberian Civil War (1989-1997), Gulf War (1990-1991), Rwanda Civil War (1990-1992), Tuareg Rebellion (1990-1998), Slovenian War (1991), Croatian War of Independence (1991-1995), Bosnian War (1992-1995), Kosovo War (1998-1999), Georgian Civil War (1991-1993), Sierra Leone Civil War (1991-1997), Tajikistan Civil War (1992-1997), Burundi Civil War (1993-1999), Yemen Civil War (1994), First Chechen War (1994-1996), Cenepa War between Peru and Ecuador (1995), Imia-Kardak crisis (1996), First Congo War (1996-1997), Ethiopia-Eritrea War (1998-2000), Second Congo War (1998-2002), Kargil War (1999), Second Liberian Civil War (1999-2003), U.S. invasion of Afghanistan (2001), Civil War in Cte d'Ivoire (2001), Circa ethnic conflicts in Basque Country (1960-2006), Colombian Armed Conflict (1964-2006), Islamic Insurgency Southern Philippines (1960-2006), Independence war in Cabinda Angola (1975-2006), Somalian Civil War (1977-2006), Free Papua Movement Western New Guinea Indonesia (1984-2006), Conflict in northern Uganda (1987-2006), Myanmar Civil War (1988-2006), Casamance Conflict in Senegal (1988-2006), Somalian Civil War (1988-2006), Kashmir conflict (1989-2006), Georgian Civil War Abkhazia South Ossetia in Georgia (1991-2006), Afghan Civil War (1992-2006), Algerian Civil War in Algeria (1992-2006), Nepal Civil War (1996-2006), Ituri Conflict (Democratic Republic of Congo) (1999-2006), Second Chechen War (Russia) (1999-2006), Intifada in Israel and the Israeli-occupied territories (2000-2006), Conflict in Laos involving the Hmong (2000-2006), Civil War in Cte d'Ivoire (2001-2006), South Thailand insurgency (2001-2006), Conflict between Pakistan and Baloch warlords (2003-2006), Darfur conflict Sudan (2003-2006), Iraq War (2003-2006), Haiti rebellion (2004-2006), Chad-Sudan conflict (2005-2006), Western Sahara Independence Intifada (2005-2006)