19000 BCE CHANGES IN THE EARTH'S ORBIT MEAN THAT MORE SUNLIGHT REACHES THE POLAR ICE ... 18500 BCE ICE 18000 ... AND THE ICE SHEETS START TO MELT. 17500 BCE TEMPERATURES HAVE BEEN CREEPING UPWARD, BUT AROUND THIS POINT, CO2 LEVELS START TO CLIMB ... 17000 BCE

xkcd: Earth Temperature Timeline

A TIMELINE OF EARTH'S AVERAGE TEMPERATURE SINCE THE LAST ICE AGE GLACIATION

WHEN PEOPLE SAY "THE CLIMATE HAS CHANGED BEFORE," THESE ARE THE KINDS OF CHANGES THEY'RE TALKING ABOUT.

TEMPERATURE

COLDER 1961-1990 AVERAGE WARMER

AT THE START OF OUR TIMELINE, 22,000 YEARS AGO, EARTH IS 4° COLDER THAN DURING THE LATE 20TH CENTURY.

BOSTON IS BURIED UNDER ALMOST A MILE OF ICE, AND THE GLACIERS REACH AS FAR SOUTH AS NEW YORK CITY.

4.3℃-

NEW YORK

ICE

BUT THE WORLD IS ABOUT TO WARM UP.

BY THIS TIME, HUMANS HAVE ALREADY SPREAD ACROSS AFRICA, EURASIA, AND AUSTRALIA.

THEY'VE CREATED PAINTING, POTTERY, ROPE, AND BOUS AND ARROUS, BUT HAVEN'T DEVELOPED URITING OR FARMING.

+l°C

BOSTON

ICE

+4°℃

START

20000 BCE

19500 BCE

...AND THEN THE WARMING SPEEDS UP. STILL PRETTY COLD. LIMITS OF THIS DATA: SHORT WARMING OR COOLING SPIKES MIGHT BE "SMOOTHED OUT" BY THESE RECONSTRUCTIONS, BUT ONLY IF THEY RE SMALL OR BRIEF ENOUGH. POSSIBLE-UNLIKELY

RECONSTRUCTIONS ARE FROM SHAKUN (2012) AND MARCOTT (2013), SCALED TO ANNAN+HARGREAVES (2013) ESTIMATE FOR THE LAST GLACIAL PERIOD. IN WHAT IS NOW FRANCE, HUMANS PAINT MURALS ON THE WALLS OF THE LASCAUX CAVES ICE SHEETS AROUND ALASKA SHRINK, EXPOSING A LAND BRIDGE BETWEEN ASIA AND NORTH AMERICA

16500 BCE

16000 BCE

15500 BCE

15000 BCE

14500 BCE

14000 BCE

13500 BCE

13000 BCE

12500 BCE

12000 BCE

IIOOO BCE

10 000 BCE

9500 BCE

9000 BCE

8500 BCE

COOL.

AND WE GET TO BREED YOU TO BE TINY AND DRESS YOU IN LITTLE COSTUMES.

HUMANS REACH NORTH AMERICA THE EDGE OF THE ICE WITHDRAWS FROM NEW YORK CITY AND RETREATS NORTH HUMANS DOMESTICATE DOGS (DATE UNCERTAIN, MAY BE MUCH EARLIER) OKAY, YOU CAN LIVE IN OUR HOMES AND WE'LL FEED YOU, BUT WE'LL STILL GET MAD IF YOU POOP ON THE FLOOR. WOOLY RHIND GOES EXTINCT ICE SHEETS WITHDRAW FROM CHICAGO HUMANS SETTLE ABU HUREYRA IN SYRIA TEMPERATURES START TO DECLINE, MAINLY IN THE NORTHERN HEMISPHERE THIS MAY BE CAUSED BY CHANGES IN OCEAN CIRCULATION DUE TO THE FLOODS OF COLD, FRESH MELTIJATER FLOUING INTO THE ATLANTIC AS THE NORTH AMERICAN ICE SHEET MELTS. THIS COOLER PERIOD IS CALLED THE YOUNGER DRYAS WARMING RESUMES HUMAN SETTLEMENTS AT JERICHO

SABER-TOOTHED CAT GOES EXTINCT TEMPERATURES REACH MODERN LEVELS RISING SEAS CUT OFF THE LAND BRIDGE BETWEEN NORTH AMERICA AND ASIA CATTLE DOMESTICATED ICE SHEETS RETREAT ACROSS THE CANADIAN BORDER TEMPERATURES START
TO LEVEL OUT SUGHTLY
ABOVE 1961-1990 LEVELS FINAL COLLAPSE OF THE NORTH AMERICAN ICE SHEET LEADS TO RAPID 2-4M SEA LEVEL RISEAND A PERIOD OF COOLING IN THE NORTHERN HEMISPHERE HUMANS DEVELOP COPPER METALWORKING GOLD METALWORKING LETS MAKE OUR LANGUAGE HEAVILY INFLECTED, SO FUTURE STUDENTS HAVE TO MEMORIZE A ZILLION VERB ENDINGS! OKAY! HORSES DOMESTICATED

EGYPTIAN MUMMIFICATION RISE OF THE INDUS VALLEY CIVILIZATION EARLIEST HUMAN WHOSE NAME WE KNOW (PHARAOH IRY-HOR IN EGYPT) THREE SOVEREIGNS AND FIVE EMPERORS PERIOD IN CHINA GILGAMESH MAYAN CULTURE EMERGES CORDED WARE CULTURE IN EUROPE CHARIOTS DEVELOPED LAST MAMMOTHS ON A TINY SIBERIAN ISLAND GO EXTINCT OLMEC CIVILIZATION DEVELOPS IN CENTRAL AMERICA SETTING OF THE JUSTA TURN OF SETTING OF THE JUSTA TURN OF SET POLYNESIANS EXPLORE THE PACIFIC OCEAN ILLIAD AND ODYSSEY COMPOSED NED-ASSYRIAN EMPIRE ZAPOTEC WRITING IN MODERN MEXICO BUDDHA NAZCA LINES ASHOKA THE GREAT TEOTIHUACÁN METROPOLIS **JESUS** THREE KINGDOMS PERIOD ATTILA THE HUN MUHAMMAD MEDIEVAL WARM PERIOD IN EUROPE AND SOME NORTHERN REGIONS (TOO REGIONAL TO AFFECT THE GLOBAL AVERAGE MUCH) ZHENG HE'S FLEET EXPLORES ASIA AND AFRICA EUROPEAN RENAISSANCE "LITTLE ICE AGE" STEAM ENGINES INDUSTRIAL REVOLUTION

WASHINGTON STATE IS SCOURED BY HUGE FLOODS AS GLACIAL DAMS BURST AND LAKES OF MELTWATER FLOW TO THE SEA HUMANS REACH ARGENTINA FIRST DEVELOPMENT OF FARMING HORSES DISAPPEAR FROM NORTH AMERICA LAST NORTH AMERICAN POKEMON GO EXTINCT THAT IS NOT A REAL FACT. THIS WARM, STABLE PERIOD IS CALLED THE HOLOCENE CLIMATE OPTIMUM JIAHU SETTLED IN CHINA AS SEAS RISE TO NEAR THEIR MODERN LEVELS, BRITAIN IS CUT OFF FROM MAINLAND EUROPE MASSIVE VOLCANIC ERUPTION IN OREGON CREATES CRATER LAKE INVENTION OF THE WHEEL EARTH BEGINS TO COOL SLOULY, MAINLY DUE TO REGULAR CYCLES IN ITS ORBIT PROTO-INDO-EUROPEAN LANGUAGE DEVELOPS PERMANENT SETTLEMENTS IN THE FERTILE CRESCENT MINOAN CULTURE ARISES ON CRETE INVENTION OF WRITING IN SUMER *PREHISTORY*ENDS, "HISTORY" BEGINS MHOTEP GREAT PYRAMID CONSTRUCTED ALPHABETIC WRITING DEVELOPED IN EGYPT MINOAN ERUPTION IRON SMELTING INVASION OF THE SEA PEOPLES" * A REAL THING SOLOMON RISE OF GREEK CITY-STATES FIRST OLYMPICS CONFUCIUS THE STUFF IN THE MOVIE 300, BUT REGULAR SPEED AND WITH MORE CLOTHING ALEXANDER THE GREAT MAYAN HIEROGLYPHICS PAPER INVENTED **ASTERIX** JULIUS CAESAR ROMAN EMPIRE 3 POMPEII GUPTA EMPIRE VARIOUS GROUPS TAKE TURNS SACKING ROME TANG DYNASTY LEIF ERIKSSON GHENGIS KHAN AZTEC ALLIANCE PRINTING PRESS COLUMBUS : SHAKESPEARE ! NEWTON TELEGRAPHS! AIRPLANES WORLD WARS FOSSIL FUEL CO2 EMISSIONS START RAPIDLY INCREASING NUCLEAR WEAPONS INTERNET NORTHWEST PASSAGE OPENS PRESENT DAY BEST-CASE SCENARIO ASSUMING IMMEDIATE, MASSIVE ACTION TO OPTIMISTIC SCENARIO CURRENT PATH LIMIT EMISSIONS Randall Munroe

8000 7500 BCE 7000 BCE 6500 BCE 6000 BCE 5500 BCE 5000 BCE 4500 BCE 4000 BCE 3500 BCE 3000 BCE 2500 BCE 2000 BCE 1500 BCE 1000 BCE 500 BCE 1Œ 500 Œ 1000 MAGNETIC COMPASS NAVIGATION 1500 CE 1600 1700 UNITED STATES INDEPENDENCE 1800 1900 2000 2016 2100 http://xkcd.com/1732 made you wonder