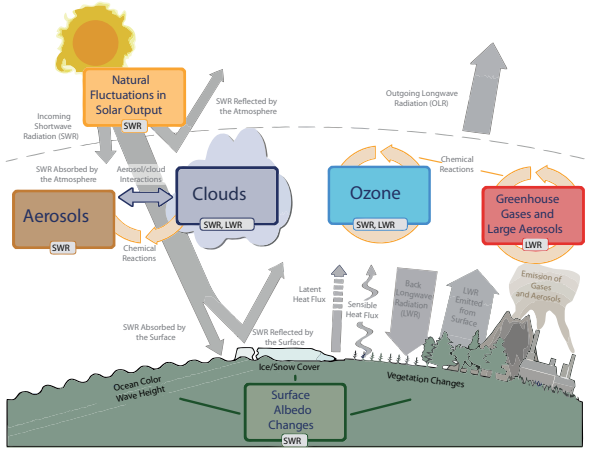
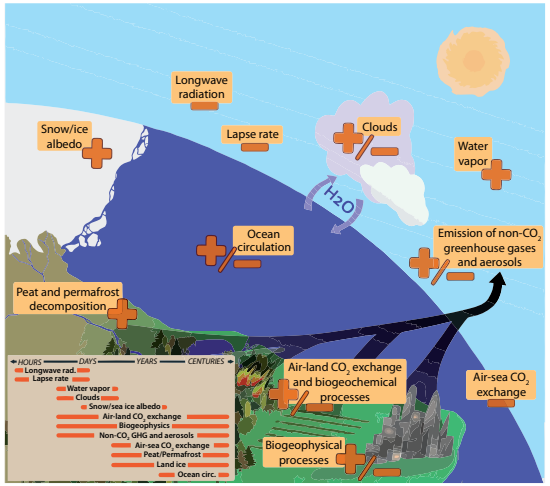
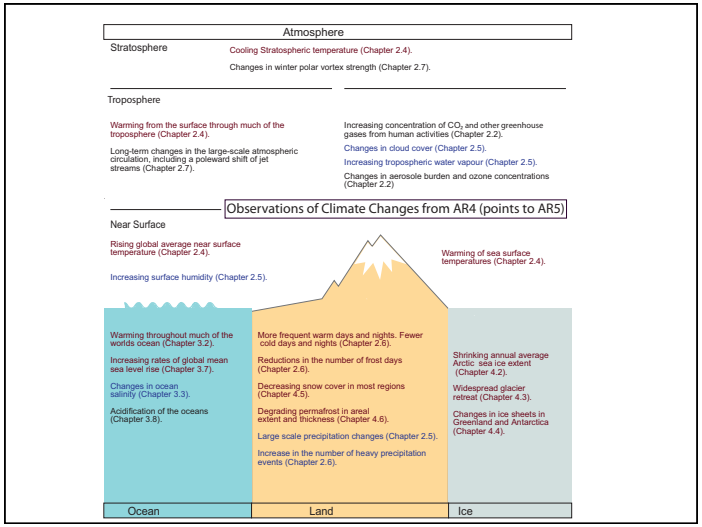
**Table 1.1 |** Historical overview of major conclusions of previous IPCC assessment reports. The table provides a non-comprehensive selection of key statements from previous assessment reports—IPCC First Assessment Report (FAR; IPCC, 1990), IPCC Second Assessment Report (SAR; IPCC, 1996), IPCC Third Assessment Report (TAR; IPCC, 2001) and IPCC Fourth Assessment Report (AR4; IPCC, 2007)—with a focus on global mean surface air temperature and sea level change as two policy relevant quantities that have been covered in IPCC since the first assessment report.

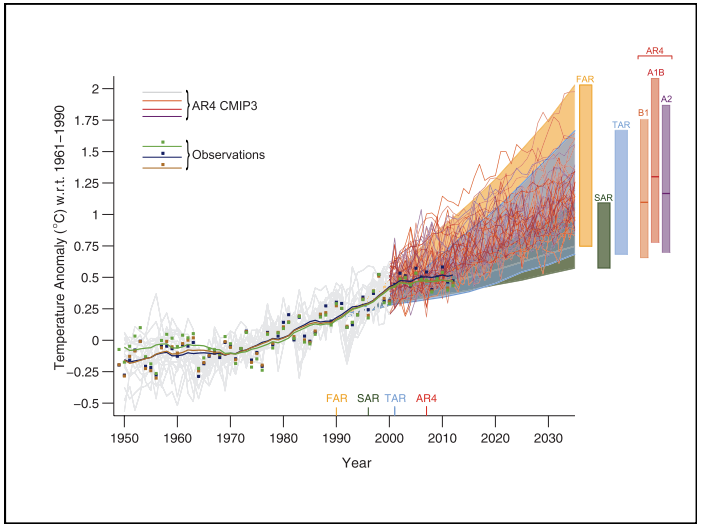
| Topic | | FAR SPM Statement | SAR SPM Statement | TAR SPM Statement | AR4 SPM Statement |
|---|---|---|---|---|---|
| Human and Natural Drivers of Climate Change | | There is a natural greenhouse effect which already keeps the Earth warmer than it would otherwise be. Emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases carbon dioxide, methane, chlorofluorocarbons and nitrous oxide. These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface.<br><br>Continued emissions of these gases at present rates would commit us to increased concentrations for centuries ahead. | Greenhouse gas concentrations have continued to increase. These trends can be attributed largely to human activities, mostly fossil fuel use, land use change and agriculture.<br><br>Anthropogenic aerosols are short-lived and tend to produce negative radiative forcing. | Emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate. The atmospheric concentration of $CO_2$ has increased by 31% since 1750 and that of methane by 151%.<br><br>Anthropogenic aerosols are short-lived and mostly produce negative radiative forcing by their direct effect. There is more evidence for their indirect effect, which is negative, although of very uncertain magnitude.<br><br>Natural factors have made small contributions to radiative forcing over the past century. | Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily due to agriculture.<br><br>*Very high confidence* that the global average net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] W m$^{-2}$. |
| Direct Observations of Recent Climate Change | Temperature | Global mean surface air temperature has increased by 0.3°C to 0.6°C over the last 100 years, with the five global-average warmest years being in the 1980s. | Climate has changed over the past century. Global mean surface temperature has increased by between about 0.3 and 0.6°C since the late 19th century. Recent years have been among the warmest since 1860, despite the cooling effect of the 1991 Mt. Pinatubo volcanic eruption. | An increasing body of observations gives a collective picture of a warming world and other changes in the climate system.<br><br>The global average temperature has increased since 1861. Over the 20th century the increase has been 0.6°C.<br><br>Some important aspects of climate appear not to have changed. | Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.<br><br>Eleven of the last twelve years (1995–2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850). The updated 100-year linear trend (1906 to 2005) of 0.74°C [0.56°C to 0.92°C] is therefore larger than the corresponding trend for 1901 to 2000 given in the TAR of 0.6°C [0.4°C to 0.8°C].<br><br>Some aspects of climate have not been observed to change. |
| | Sea Level | Over the same period global sea level has increased by 10 to 20 cm These increases have not been smooth with time, nor uniform over the globe. | Global sea level has risen by between 10 and 25 cm over the past 100 years and much of the rise may be related to the increase in global mean temperature. | Tide gauge data show that global average sea level rose between 0.1 and 0.2 m during the 20th century. | Global average sea level rose at an average rate of 1.8 [1.3 to 2.3] mm per year over 1961 to 2003. The rate was faster over 1993 to 2003: about 3.1 [2.4 to 3.8] mm per year. The total 20th century rise is estimated to be 0.17 [0.12 to 0.22] m. |
| A Palaeoclimatic Perspective | | Climate varies naturally on all timescales from hundreds of millions of years down to the year-to-year. Prominent in the Earth's history have been the 100,000 year glacial–interglacial cycles when climate was mostly cooler than at present. Global surface temperatures have typically varied by 5°C to 7°C through these cycles, with large changes in ice volume and sea level, and temperature changes as great as 10°C to 15°C in some middle and high latitude regions of the Northern Hemisphere. Since the end of the last ice age, about 10,000 years ago, global surface temperatures have probably fluctuated by little more than 1°C. Some fluctuations have lasted several centuries, including the Little Ice Age which ended in the nineteenth century and which appears to have been global in extent. | The limited available evidence from proxy climate indicators suggests that the 20th century global mean temperature is at least as warm as any other century since at least 1400 AD. Data prior to 1400 are too sparse to allow the reliable estimation of global mean temperature. | New analyses of proxy data for the Northern Hemisphere indicate that the increase in temperature in the 20th century is likely to have been the largest of any century during the past 1,000 years. It is also likely that, in the Northern Hemisphere, the 1990s was the warmest decade and 1998 the warmest year. Because less data are available, less is known about annual averages prior to 1,000 years before present and for conditions prevailing in most of the Southern Hemisphere prior to 1861. | Palaeoclimatic information supports the interpretation that the warmth of the last half century is unusual in at least the previous 1,300 years.<br><br>The last time the polar regions were significantly warmer than present for an extended period (about 125,000 years ago), reductions in polar ice volume led to 4 to 6 m of sea level rise. |

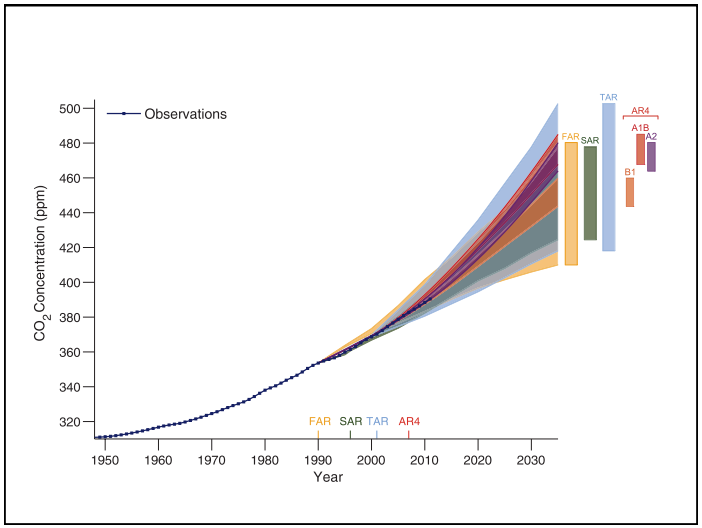
| Topic | | FAR SPM Statement | SAR SPM Statement | TAR SPM Statement | AR4 SPM Statement |
|---|---|---|---|---|---|
| Understanding and Attributing Climate Change | | The size of this warming is broadly consistent with predictions of climate models, but it is also of the same magnitude as natural climate variability. Thus the observed increase could be largely due to this natural variability; alternatively this variability and other human factors could have offset a still larger human-induced greenhouse warming. The unequivocal detection of the enhanced greenhouse effect from observations is not likely for a decade or more. | The balance of evidence suggests a discernible human influence on global climate. Simulations with coupled atmosphere–ocean models have provided important information about decade to century timescale natural internal climate variability. | There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities. There is a longer and more scrutinized temperature record and new model estimates of variability. Reconstructions of climate data for the past 1,000 years indicate this warming was unusual and is *unlikely* to be entirely natural in origin. | Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns. |
| Projections of Future Changes in Climate | Temperature | Under the IPCC Business-as-Usual emissions of greenhouse gases, a rate of increase of global mean temperature during the next century of about 0.3°C per decade (with an uncertainty range of 0.2°C to 0.5°C per decade); this is greater than that seen over the past 10,000 years. | Climate is expected to continue to change in the future. For the mid-range IPCC emission scenario, IS92a, assuming the 'best estimate' value of climate sensitivity and including the effects of future increases in aerosols, models project an increase in global mean surface air temperature relative to 1990 of about 2°C by 2100.<br><br>Anthropogenic climate change will persist for many centuries. | Global average temperature and sea level are projected to rise under all IPCC SRES scenarios. The globally averaged surface temperature is projected to increase by 1.4°C to 5.8°C over the period 1990 to 2100.<br><br>Confidence in the ability of models to project future climate has increased. | For the next two decades, a warming of about 0.2°C per decade is projected for a range of SRES emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected.<br><br>There is now higher confidence in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation and some aspects of extremes and of ice.<br><br>Anthropogenic warming and sea level rise would continue for centuries, even if greenhouse gas concentrations were to be stabilised. |
| | Sea Level | An average rate of global mean sea level rise of about 6 cm per decade over the next century (with an uncertainty range of 3 to 10 cm per decade) is projected. | Models project a sea level rise of 50 cm from the present to 2100. | Global mean sea level is projected to rise by 0.09 to 0.88 m between 1990 and 2100. | Global sea level rise for the range of scenarios is projected as 0.18 to 0.59 m by the end of the 21st century. |

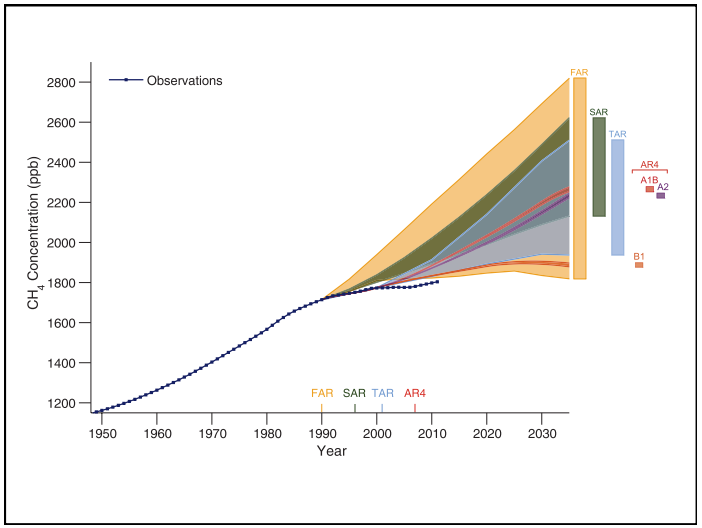


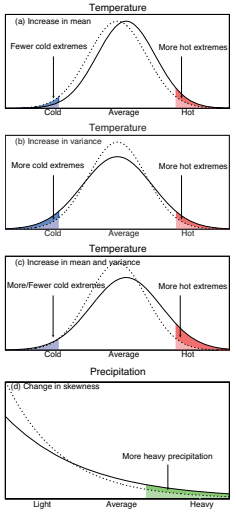




Atmosphere
Stratosphere
Cooling Stratospheric temperature (Chapter 2.4).
Changes in winter polar vortex strength (Chapter 2.7).
Troposphere
Warming from the surface through much of the troposphere (Chapter 2.4).
Long-term changes in the large-scale atmospheric circulation, including a poleward shift of jet streams (Chapter 2.7).
Increasing concentration of CO2 and other greenhouse gases from human activities (Chapter 2.2).
Changes in cloud cover (Chapter 2.5).
Increasing tropospheric water vapour (Chapter 2.5).
Changes in aerosole burden and ozone concentrations (Chapter 2.2)
Observations of Climate Changes from AR4 (points to AR5)
Near Surface
Rising global average near surface temperature (Chapter 2.4).
Increasing surface humidity (Chapter 2.5).
Warming of sea surface temperatures (Chapter 2.4).
Warming throughout much of the worlds ocean (Chapter 3.2).
Increasing rates of global mean sea level rise (Chapter 3.7).
Changes in ocean salinity (Chapter 3.3).
Acidification of the oceans (Chapter 3.8).
More frequent warm days and nights. Fewer cold days and nights (Chapter 2.6).
Reductions in the number of frost days (Chapter 2.6).
Decreasing snow cover in most regions (Chapter 4.5).
Degrading permafrost in areal extent and thickness (Chapter 4.6).
Large scale precipitation changes (Chapter 2.5).
Increase in the number of heavy precipitation events (Chapter 2.6).
Shrinking annual average Arctic sea ice extent (Chapter 4.2).
Widespread glacier retreat (Chapter 4.3).
Changes in ice sheets in Greenland and Antarctica (Chapter 4.4).
Ocean
Land
Ice


AR4 CMIP3
Observations
Temperature Anomaly (°C) w.r.t. 1961–1990
Year
FAR
SAR
TAR
AR4
A1B
A2
B1

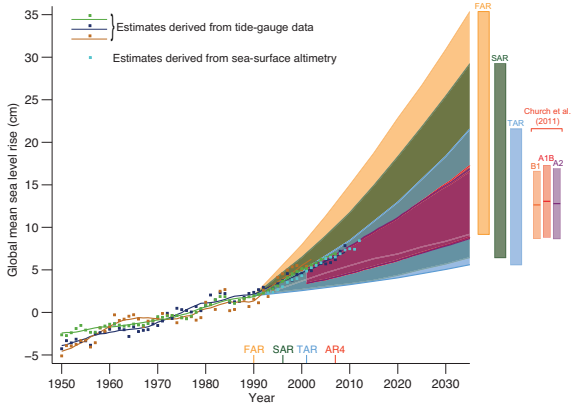

Observations
CO2 Concentration (ppm)
Year
FAR
SAR
TAR
AR4
A1B
A2
B1

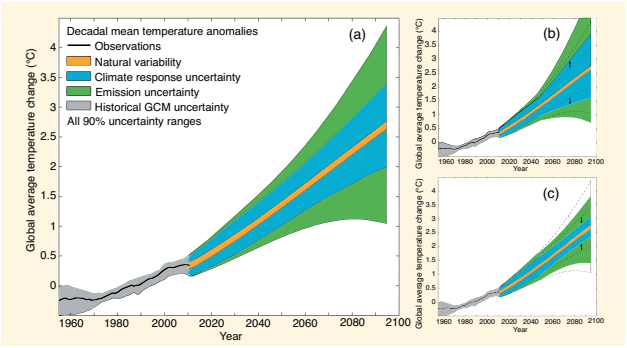

Observations
CH4 Concentration (ppb)
Year
FAR
SAR
TAR
AR4
A1B
A2
B1

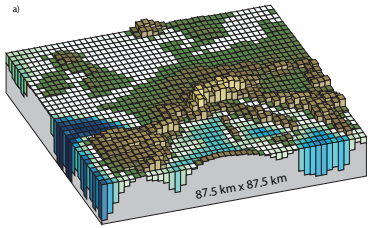



| Changes in Phenomenon | Uncertainty in observed changes (since about the mid-20th century) | | | Uncertainty in projected changes (up to 2100) | | |
|---|---|---|---|---|---|---|
| IPCC Assessment Report | TAR | AR4 | SREX | TAR | AR4 | SREX |
| Higher maximum temperatures and more hot days | *Likely* over nearly all land areas | *Very Likely* over most land areas | *Very Likely* at a global scale | *Very Likely* over nearly all land areas | *Virtually Certain* over most land areas | *Virtually Certain* at a global scale |
| Higher minimum temperatures, fewer cold days | *Very Likely* over nearly all land areas | *Very Likely* over most land areas | *Very Likely* at a global scale | *Very Likely* over nearly all land areas | *Virtually Certain* over most land areas | *Virtually Certain* at a global scale |
| Warm spells/heat waves. Frequency, length or intensity increases | - | *Likely* over most land areas | *Medium Confidence* in many regions | - | *Very Likely* over most land areas | *Very Likely* over most land areas |
| Precipitation extremes | *Likely*[1], over many Northern Hemisphere mid- to high latitude land areas | *Likely*[2] over most areas | *Likely*[3] | *Very Likely*[2] over many areas | *Very Likely*[2] | *Likely*[2,4] in many land areas of the globe |
| Droughts or dryness | *Likely*[5], in a few areas | *Likely*[6], in many regions since 1970s | *Medium Confidence* in more intense and longer droughts in some regions , but some opposite trend exists | *Likely*[7], over most mid-latitude continental interiors (Lack of consistent projections in other areas) | *Likely*[8] | *Medium Confidence*[7] that droughts will intensify in some seasons and areas; Overall *low confidence* elsewhere |
| Changes in tropical cyclone activity (i.e. intensity, frequency, duration) | Not Observed[9], in the few analyses available | *Likely*[9], in some regions since 1970 | *Low confidence*[10] | *Likely*[9], over some areas | *Likely*[9] | *Likely*[11] |
| Increase in extreme sea level (excludes tsunamis) | - | *Likely* | *Likely*[12] | - | *Likely* | *Very Likely*[13] |

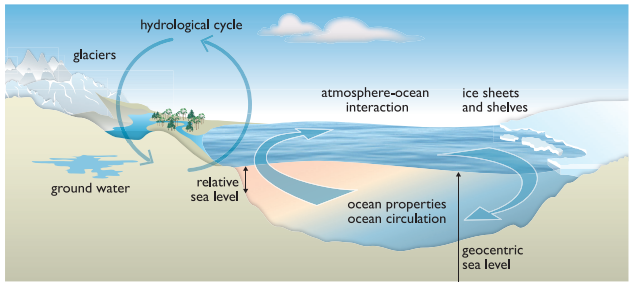
[1] More intense precipitation events.
[2] Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases
[3] Statistically significant trends in the number of heavy precipitation events in some regions. It is *likely* that more of these regions have experienced increases than decreases.
[4] See SREX Table 3-3 for details on precipitation extremes for the different regions.
[5] Increased summer continental drying and associated risk of drought
[6] Area affected by droughts increases
[7] Some areas include southern Europe and the Mediterranean region, central Europe, central North America and Mexico, northeast Brazil and southern Africa
[8] Increase in tropical cyclone peak wind intensities
[9] Increase in intense tropical cyclone activity
[10] In any observed long-term (i.e., 40 years or more) after accounting for past changes in observing capabilities (see SREX, section 3.4.4)
[11] Increase in average tropical cyclone maximum wind speed is, although not in all ocean basins; either decrease or no change in the global frequency of tropical cyclones
[12] Increase in extreme coastal high water worldwide related to increases in mean sea level in the late 20th century
[13] Mean sea level rise will contribute to upward trends in extreme coastal high water levels

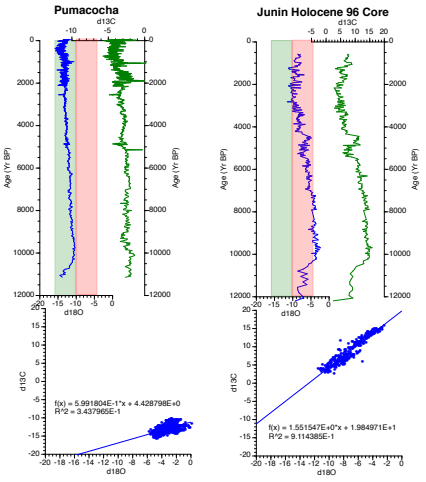


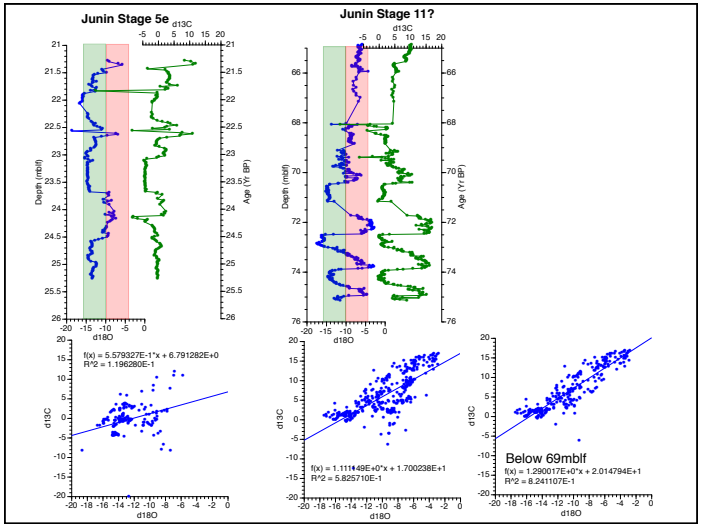



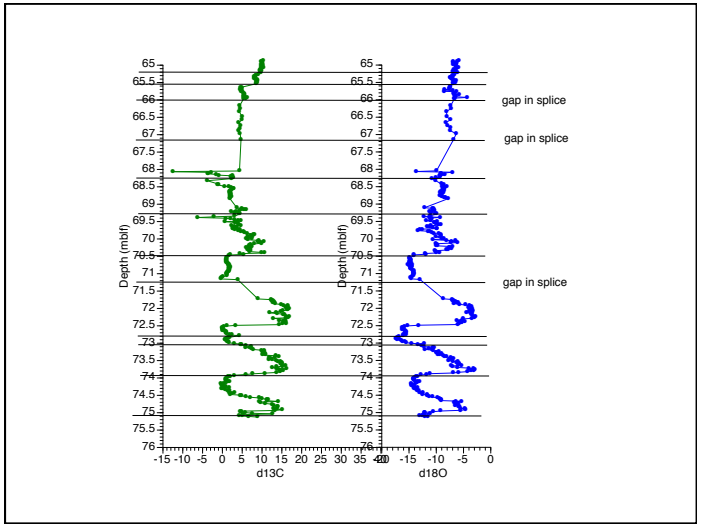



| Topic | Section |
|---|---|
| Abrupt change and irreversibility | 5.7, 12.5, 13.4 |
| Aerosols | 6.4, 7.3, 7.4, 7.5, 7.6, 8.3, 11.3, 14.1 |
| Antarctic climate change | 5.8, 9.4, 10.3, 13.3 |
| Arctic sea ice change | 4.2, 5.5, 9.4, 10.3, 11.3, 12.4 |
| Hydrological cycle changes | 2.5, 2.6, 3.3, 3.4, 3.5, 7.6, 10.3, 12.4 |
| Carbon-climate feedbacks | 6.4, 12.4 |
| Climate sensitivity | 5.3, 9.7, 10.8, 12.5 |
| Climate stabilization | 6.3, 6.4, 12.5 |
| Cloud feedbacks | 5.3, 7.2, 9.7, 11.3, 12.4 |
| Cosmic ray effects on clouds | 7.4 |
| Decadal climate variability | 5.3, 9.5, 10.3 |
| Earth's Energy (trends, distribution and budget) | 2.3, 3.2, 13.3 |
| El Niño-Southern Oscillation | 2.7, 5.4, 9.4, 9.5, 14.4 |
| Geo-engineering | 6.4, 7.7 |
| Glacier change | 4.3, 5.5, 10.5, 13.3 |
| Ice sheet dynamics and mass balance assessment | 4.4, 5.3, 5.6, 10.5, 13.3 |
| Monsoons | 2.7, 5.5, 9.5, 14.2 |
| Ocean acidification | 3.8, 6.4 |
| Permafrost change | 4.7, 6.3, 10.5 |
| Solar effects on climate change | 5.2, 8.4 |
| Sea level change, including regional effects | 3.7, 5.6, 13.1 |
| Temperature trends since 1998 | 2.4, 3.2, 9.4 |
| Tropical cyclones | 2.6, 10.6, 14.6 |
| Upper troposphere temperature trends | 2.4, 9.4 |




Junin Stage 5e
Junin Stage 11?
d13C
d18O
Depth (mblf)
Age (Yr BP)
f(x) = 5.579327E-1*x + 6.791282E+0
R^2 = 1.196280E-1
f(x) = 1.111449E+0*x + 1.700238E+1
R^2 = 5.825710E-1
Below 69mblf
f(x) = 1.290017E+0*x + 2.014794E+1
R^2 = 8.241107E-1


gap in splice
gap in splice
gap in splice
Depth (mblf)
d13C
d18O