



a coo see

The Star of the Subsurface

Why do we care?

Surface temperatures affect our calculated
subsurface temperatures

Today

In the past

Proper attention to surface temperatures
marks you as a careful worker

Present-day surface temperatures

Onshore

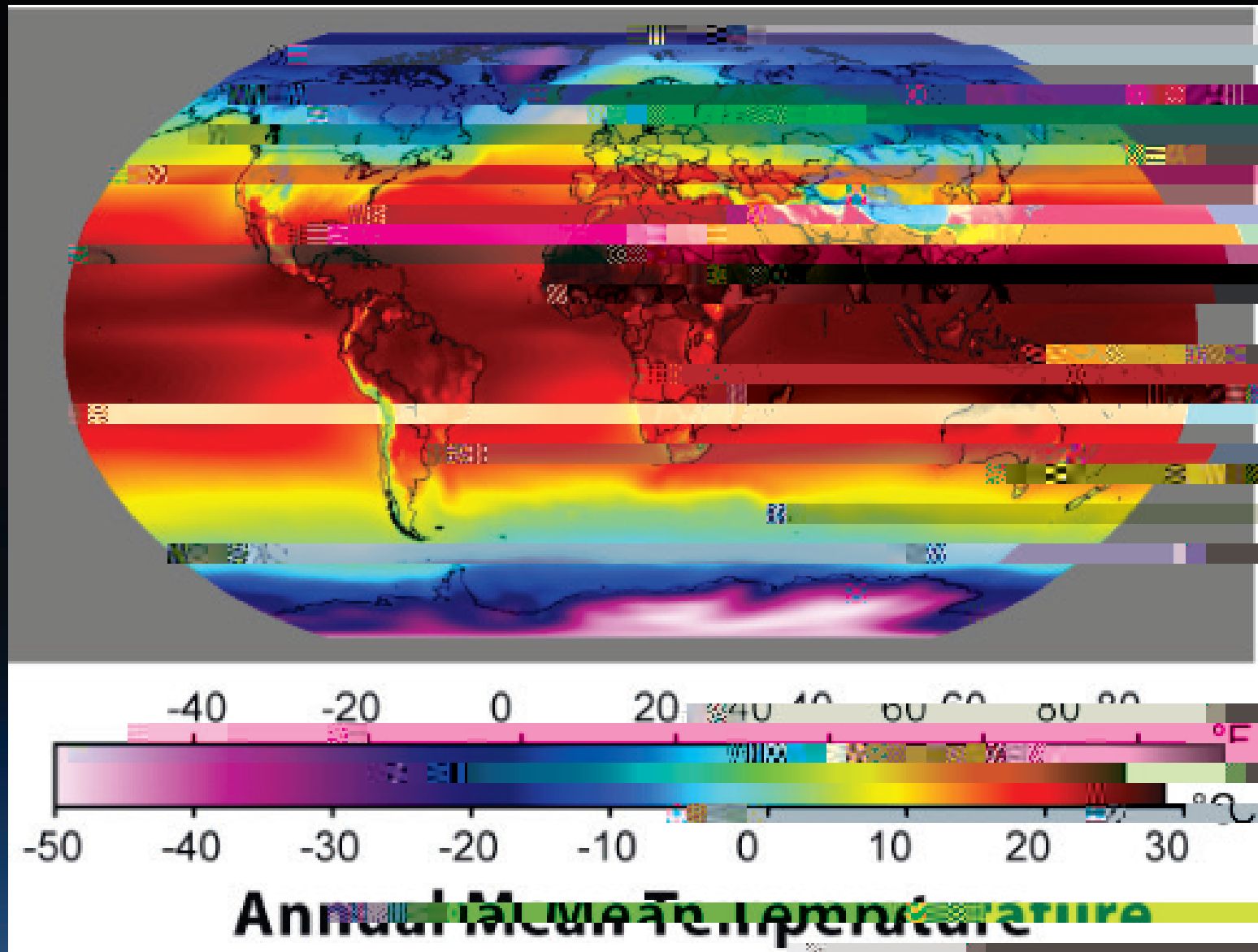
Offshore

Paleosurface temperatures

Onshore

Offshore

Present-day surface temperatures



Examples of air temperatures

Port Moresby, PNG (9.67°S, elev. 47 m)

$$T_{\text{surf}} = 27.6 - 0.4 - 0.6 - 0.3 = 26.3^{\circ}\text{C} [26.9^{\circ}\text{C}]$$

PNG Thrust and Fold Belt (5.5°S, elev. 2700 m)

$$T_{\text{surf}} = 27.6 - 0.2 - 0.2 - 17.3 = 9.9^{\circ}\text{C}$$

Confidence levels

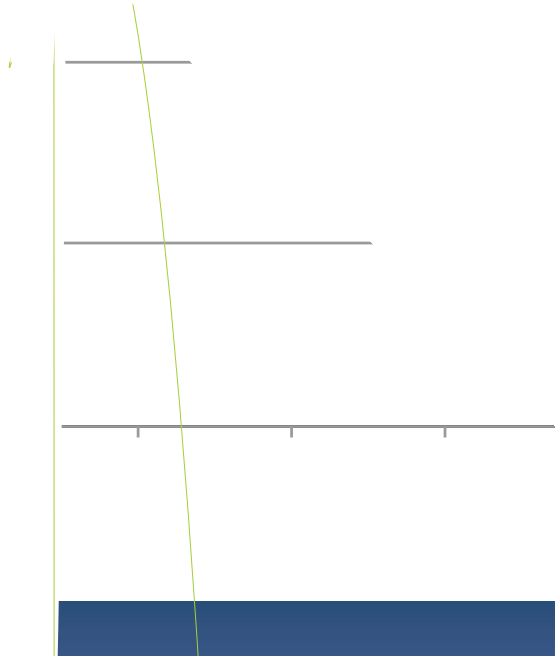
Non-continental climates: $\pm 1.5^{\circ}\text{C}$

Continental climates: $\pm 3.5^{\circ}\text{C}$??

Accuracy can be improved using
weather data to calibrate a local model



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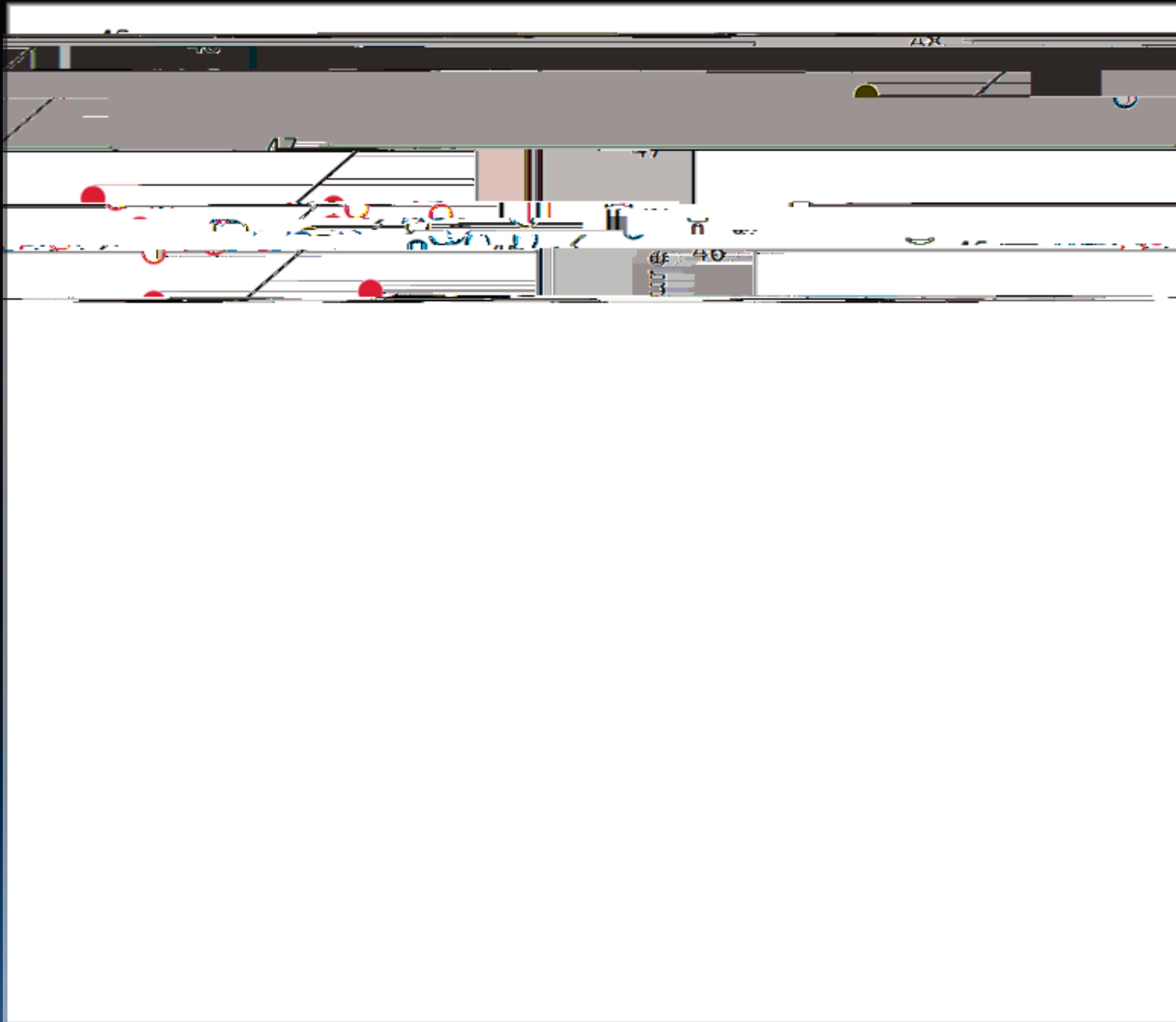


Sources of weather data

www.worldclimate.com

Gives mean annual air temperatures,
elevations, latitude, and longitude

Powder River Basin: after calibration



Local calibration in PRB

Adjust constants in latitude equation

Adjust adiabatic lapse rate

Add dependence on longitude, since degree of continentality decreases westward into the mountains

In PRB 95% of calculated values are within 2.3°F of measured values

Present-day offshore “surface” temperatures

Actually they are sea-floor temperatures,
not water or air temperatures

Depend on

Water depth

Latitude

Degree of isolation of water body

Nomograph of Beardsmore and Cull (2001)

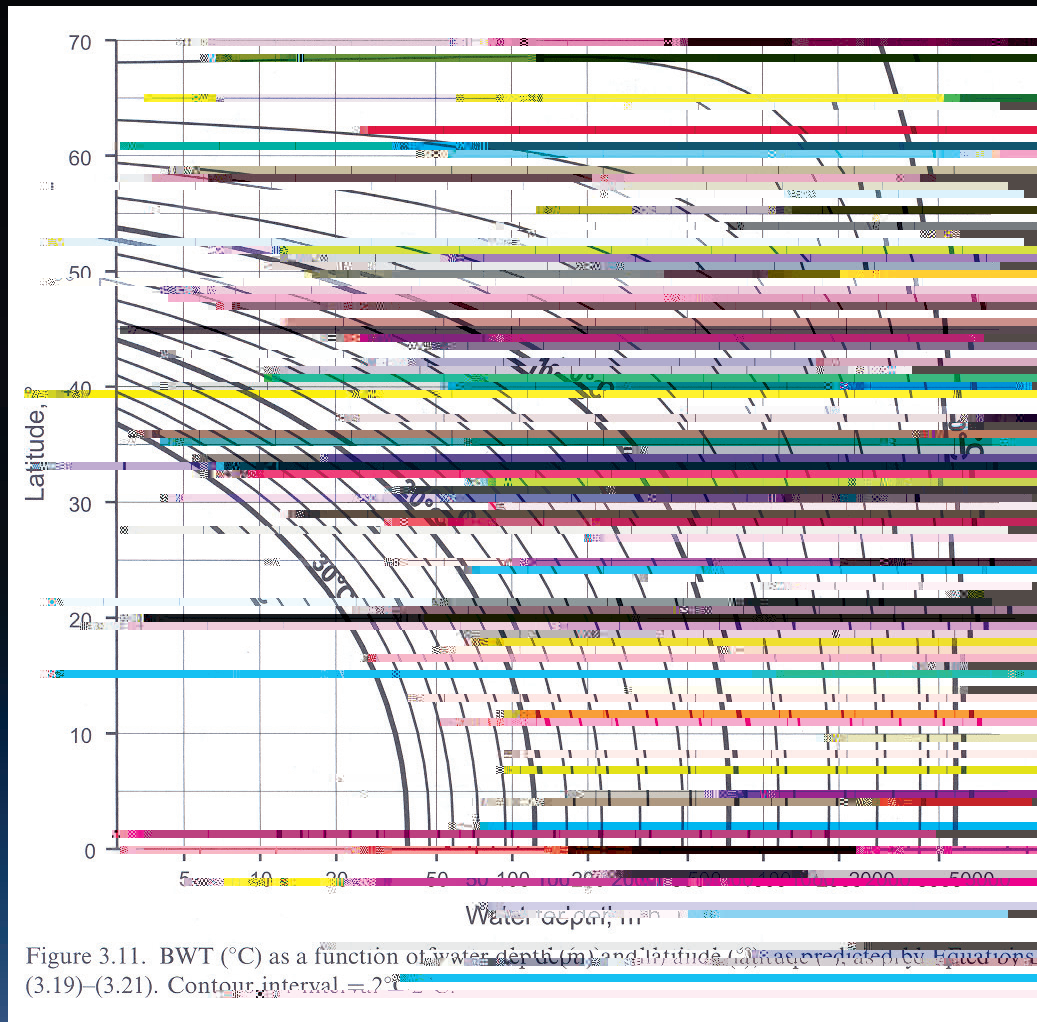
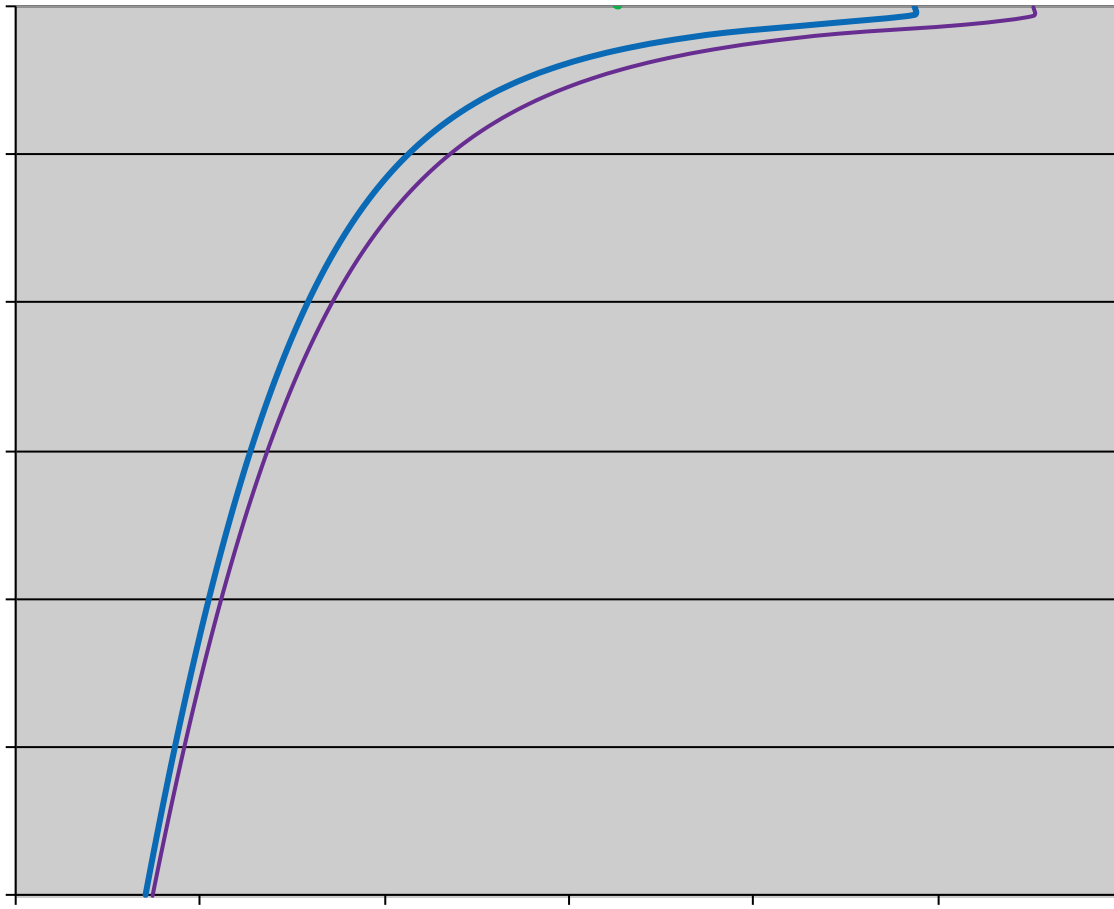


Figure 3.11. BWT (°C) as a function of water depth (m) and latitude (°) that are related by Equations (3.19)–(3.21). Contour interval = 2°C.



Use of measured bottom-water temperatures

Correction for depth?

Geographic relevance?

Changes in water circulation?

Paleosurface temperatures

Onshore and offshore

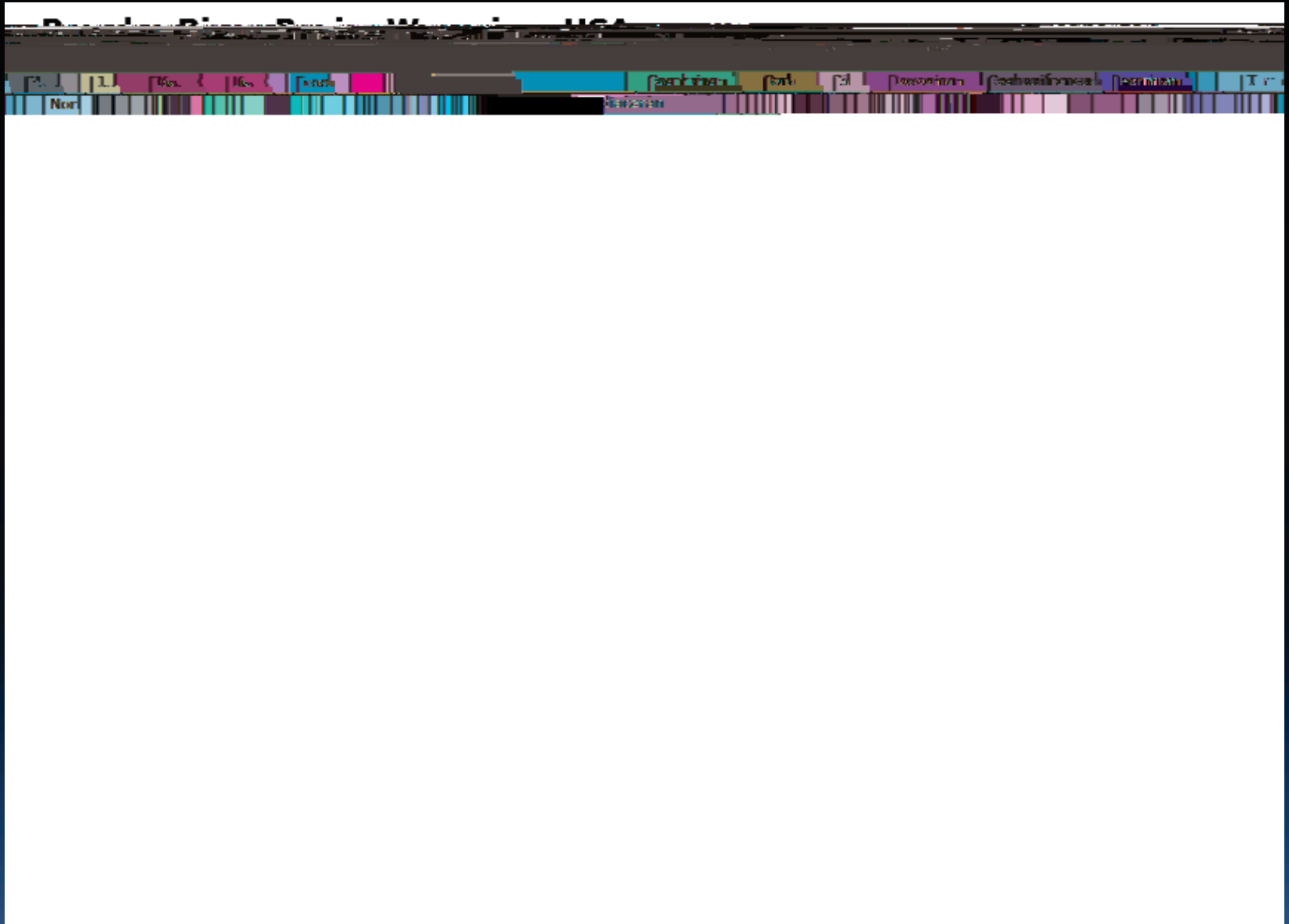
Paleolatitude

Paleoclimate

Paleoelevation

Paleobathymetry

Paleolatitude



Paleoclimate

Global climate during Phagerozoic



Latitudinal dependence of effects of paleoclimate



Paleoelevation

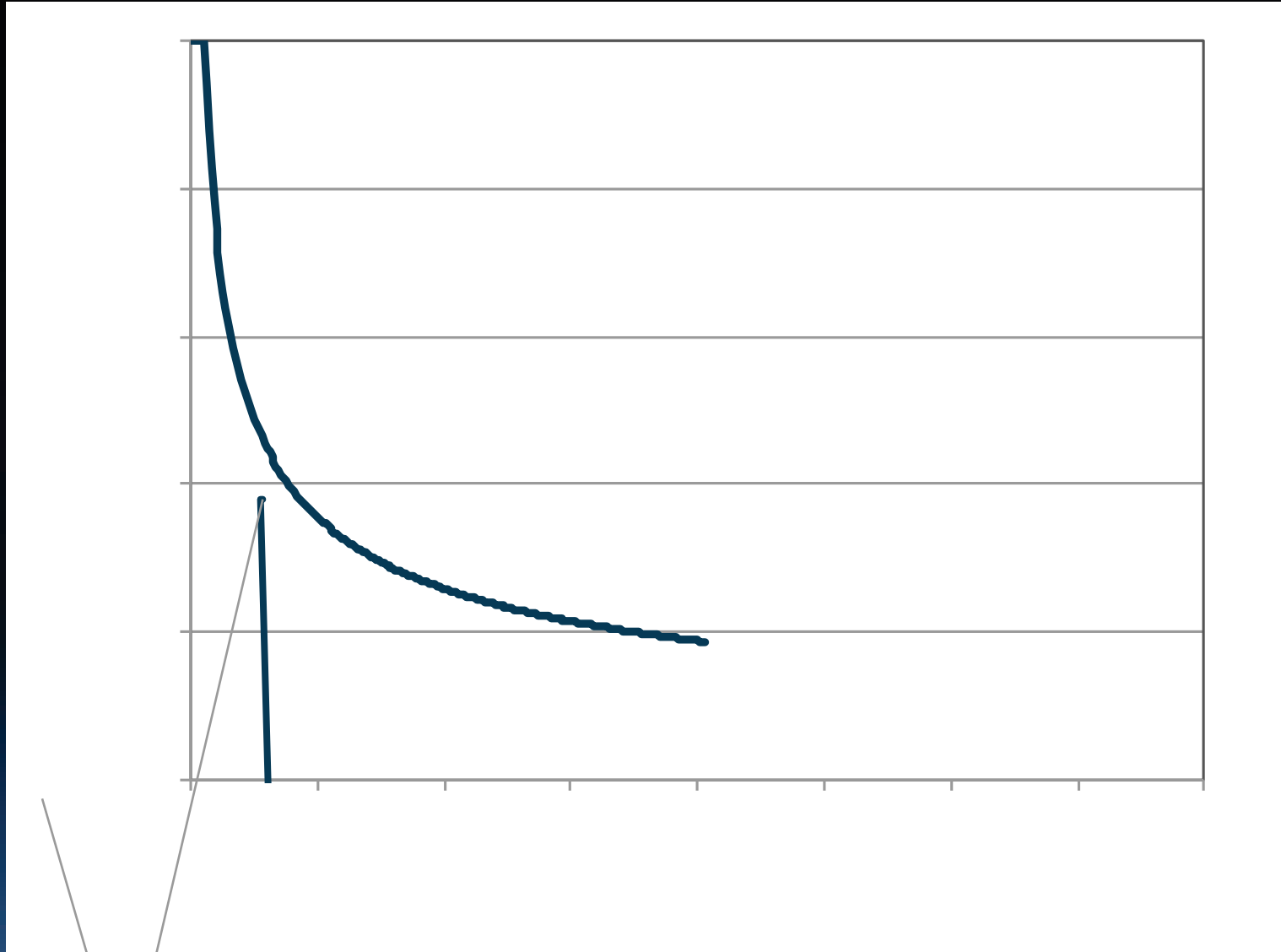
Adiabatic lapse rate assumed to be
the same as today's

Paleobathymetry

Based on Beardsmore/Cull algorithm using
paleolatitude and paleobathymetry

Adjustment for climate change

Effect of paleoclimate on seafloor temperatures



Powder River Basin



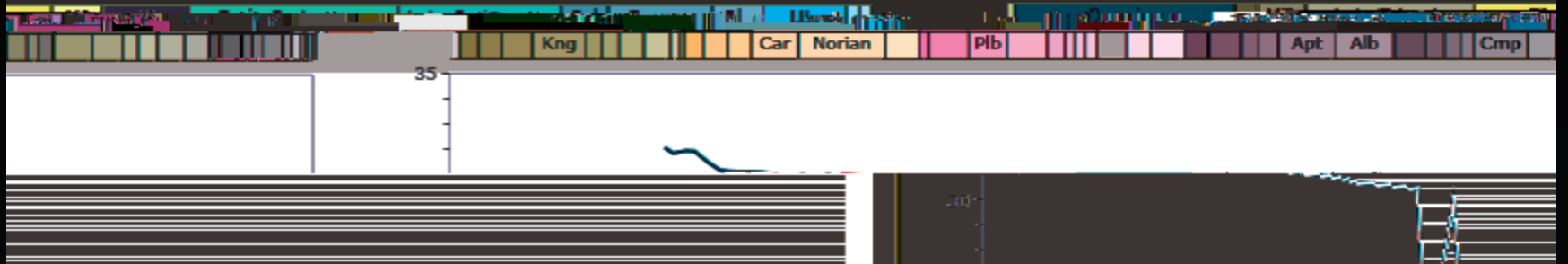
Powder River Basin

Mt. ... in ... Permian ...

Powder River Basin



Central Graben, North Sea



Central Orib. North America

1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100

EJ	MJ	LJ	Early Cretaceous				LK	Pal	Eocene	Olig	Mio			Permian			Late Triassic		
				Apt	Alb									Kn			Car	Norian	

Central Graben, North Sea



Summary

“Surface” temperatures depend on many factors

Past, present

Concepts are simple but application is complex

Enabled by appropriate software

Of direct and indirect benefit