DECADE-TO-DECADE STABILITY OF
BRIGGS, ET AL. BUILDINGS CLIMATE ZONE BOUNDARIES OVER
VARIOUS REGIONS OF THE GLOBE

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1. EVERY COUNTY IN U.S. WAS MAPPED WITH A SINGLE-CODE TO SIMPLIFY USE.

2. ELEVATION HAS A LARGE IMPACT ON CLIMATE WITHIN A COUNTY. OTHER CLIMATES SHOULD BE ALLOWED INSIDE COUNTIES.

3. WITHIN-COUNTY ELEVATION DIFFERENCES REMAIN UNRESOLVED IN CURRENT DOE/ASHRAE COUNTY ENERGY CODES.
METHODOLOGY FOR HIGH SPATIAL RESOLUTION
DECADE-TO-DECADE ANALYSIS

DOE/ASHRAE COUNTY-WIDE RESOLUTION METHODOLOGY

Decadal Lapse Rate Adjusted Climate Zone Map
Averaged for 1986 - 1995

Decadal Lapse Rate Adjusted Climate Zone Map
Averaged for 1996 - 2005

10-MINUTE LAT/LON SPATIAL RESOLUTION

Averaged USGS GTOPO30 Elevation (10 Minute)
LAPSE-RATE TEMPERATURE CORRECTIONS FOR WITHIN-CELL TOPOGRAPHY VARIATIONS ARE NEEDED!

ORIGINAL NASA 1-DEGREE CELL SIZE MODEL

REANALYSIS MODEL CELL VERSUS NCDC LOCAL-SITE GEOMETRY

USGS 10-MIN TOPOGRAPHY

MOUNTAINS

LOCAL SITE DATA

VERTICAL PLANE

1° MID-LATITUDE CELL

1° CELL AVG HT ABOVE MSL

LOCAL SITE DATA

HORIZONTAL PLANE

REANALYSIS TEMPERATURES, WINDS, PRESSURES, ETC. MAY NEED LOCAL CORRECTIONS IN MOUNTAINS & CITIES.

LAPSE-RATE TEMPERATURE CORRECTIONS FOR WITHIN-CELL TOPOGRAPHY VARIATIONS ARE NEEDED!
BASIC METHOD FOR ADJUSTING GEOS-4 1-DEGREE CELL SIZE TEMPERATURES TO ESTIMATE 10-MINUTE CELL-SIZE TEMPERATURES

\[ T^{(10\text{-min})} = T^{(1\text{-deg})} - [(H^{1\text{-deg}} - H^{10\text{-min}}) \times \text{Lapse Rate}] - \text{(Offset)} \]

where \( H \) is the height above sea level in km for \( T_{\text{max}}, T_{\text{min}}, \) and \( T_{\text{avg}} \)

<table>
<thead>
<tr>
<th>Lapse Rate ( ^{0\text{C/km}} )</th>
<th>Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>( T_{\text{max}} )</td>
<td>-6.22</td>
</tr>
<tr>
<td>( T_{\text{min}} )</td>
<td>-4.66</td>
</tr>
<tr>
<td>( T_{\text{avg}} )</td>
<td>-5.34</td>
</tr>
</tbody>
</table>

and:

\[ T^{(10\text{-min})} = \text{new 10-minute cell temperature} \]
\[ T^{(1\text{-deg})} = \text{known GEOS-4 1-degree cell temperature} \]
\[ H^{1\text{-deg}} = \text{known 1-degree cell height} \]
\[ H^{10\text{-min}} = \text{known 10-minute cell height} \]

NOTE:
The above equations were obtained by comparison with highest quality 1983-2006 NCDC site data with NASA GEOS-4 1-degree cell height temperatures over the globe for the 8 DOE/ASHRAE buildings climate zones. See [http://eosweb.larc.nasa.gov](http://eosweb.larc.nasa.gov), go to Methodology, then Section VIII, Meteorological Parameters, equation VIII-1.
PRIMARY PACIFIC-NORTHWEST U.S./CANADA VALIDATION SITE

Averaged USGS CTOP30 Elevation (10 Minute)

COMPLEX MOUNTAIN/COASTAL VALIDATION REGION

NCDC METEOROLOGICAL STATIONS IN REGION

(Map sizes have been adjusted to equal surface distances)
2004 COMPARISON USING HEIGHT AND OFFSET ADJUSTMENT EQUATIONS AT 46 SITES IN THE PACIFIC NORTHWEST REGION OF THE U.S. AND CANADA

NOTE:
ASHRAE EQUATIONS WERE USED TO CONVERT FROM TMAX, TMIN, AND TAVG TO HEATING AND COOLING DEGREE DAYS.
DECADAL DIFFERENCES BETWEEN 10-MINUTE CLIMATE ZONE MAPS


SIMILAR TO 1986 - 1995 MAP BACK ON CHART 3

DECADAL CHANGE IN BUILDINGS CLIMATE ZONES APPEARS SMALL IN U.S.
CHANGES BETWEEN DECADES ARE NOT APPARENT ON A GLOBAL SCALE BECAUSE OF THE SCALE OF THE CLIMATE ZONE MAPS

Change in ZONE

-3  <-2  -1  0  1  2  3
ALASKA AND CANADA BUILDINGS CLIMATE ZONE
DECADAL DIFFERENCES

Decadal Difference of Lapse Rate Adjusted Climate Zone Map
SOUTH AMERICA AND CARIBBEAN SEA

Decadal Difference of Lapse Rate Adjusted Climate Zone Map
AFRICA, SAUDI ARABIA, IRAQ, IRAN, AND MADAGASCAR

Decadal Difference of Lapse Rate Adjusted Climate Zone Map
EUROPE

WESTERN ASIA

EASTERN ASIA: CHINA, TAIWAN, KOREA, JAPAN, RUSSIA, SIBERIA

Decadal Difference of Lapse Rate Adjusted Climate Zone Map
AUSTRALIA, NEW ZEALAND, TASMANIA, AND NEW CALEDONIA

GLOBAL DECADIAL-CHANGE STATISTICS


NUMBER OF 10-MIN SIZE LAT/LON CELLS = 2,332,800 OVER GLOBE.

ZERO DECADAL BUILDINGS CLIMATE ZONE CHANGE = 95.8 %.

+ 1 DECADIAL BUILDINGS CLIMATE ZONE CHANGE = 4.2 %.

+ 2 OR +3 DECADIAL BUILDINGS CLIMATE ZONE CHANGES = 0.006 %.

NOTE:

MANY + 1 CHANGES ARE IN THE OCEANS AND APPEAR TO BE SHIFTS IN OCEAN CURRENTS.
INTERANNUAL VARIABILITY BETWEEN 4 SPECIFIC YEARS
CONCLUDING REMARKS

TEMPERATURES FOR NON-AVERAGE TOPOGRAPHY HEIGHTS WITHIN A COUNTY CAN BE ESTIMATED USING THE LAPSE-RATE/OFFSET EQUATIONS IN CHART 5. (THE BRIGGS, ET AL. PROBLEM IN CHART 2.)

CLIMATE ESTIMATES BASED ON USGS 10-MINUTE LATITUDE/LONGITUDE TOPOGRAPHY GIVE AN IMPROVED INDICATION WHERE BUILDINGS CLIMATE ZONE CHANGES MAY OCCUR.

REGIONS SUBJECT TO TOPOGRAPHY-INDUCED TEMPERATURE AND CLIMATE CHANGE HAVE BEEN ESTIMATED OVER THE GLOBE FOR TWO 10-YEAR PERIODS.

DIFFERENCES BETWEEN DECADAL CLIMATE ZONES ARE USUALLY WITHIN ONE CLIMATE ZONE (CHARTS 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, AND 19).

YEAR-TO-YEAR INTERANNUAL VARIABILITY MAY BE MORE SIGNIFICANT.