Energetics
Meridional distribution of energy $(10^5 \text{ J kg}^{-1})$

- **Internal**
- **Potential**
- **Latent**
- **Total**

(Peixoto and Oort, fig 13.3: Kinetic energy is order $150 \text{ J kg}^{-1}$)
Daily-mean TOA insolation vs latitude and season

From Hartman, Physical Climatology
## Albedos for different surfaces

<table>
<thead>
<tr>
<th>Aerosols</th>
<th>Small but highly variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil, rocks, vegetation</td>
<td>0.1 to 0.3</td>
</tr>
<tr>
<td>Water</td>
<td>0.02 to 0.2</td>
</tr>
<tr>
<td>Snow and ice</td>
<td>0.6 to 0.8</td>
</tr>
<tr>
<td>Cb (clouds)</td>
<td>~0.9</td>
</tr>
<tr>
<td>Cu (clouds)</td>
<td>~0.7</td>
</tr>
<tr>
<td>St (clouds)</td>
<td>~0.5</td>
</tr>
<tr>
<td>Ci (clouds)</td>
<td>~0.2</td>
</tr>
<tr>
<td>Rayleigh Scattering</td>
<td>~0.05</td>
</tr>
</tbody>
</table>
Planetary albedo versus season and hemisphere

<table>
<thead>
<tr>
<th></th>
<th>DJF</th>
<th>MAM</th>
<th>JJA</th>
<th>SON</th>
<th>Annual</th>
<th>error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Hemisphere</td>
<td>30</td>
<td>33</td>
<td>31</td>
<td>29</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Southern Hemisphere</td>
<td>31</td>
<td>28</td>
<td>27</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Global</td>
<td>31</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>±1</td>
</tr>
</tbody>
</table>

Units: percent

Source: Stephens et al., 1981
Absorbed solar radiation ($W \, m^{-2}$)

Annualized mean TOA ERBE measurements for the period Feb 1985–Apr 1989

(Trenberth and Stepaniak, J. Climate 2003; Fig 2)
Outgoing Longwave Radiation (W m$^{-2}$)

(Trenberth and Stepaniak, J. Climate 2003 Fig 2)
Net Radiation Absorbed (W m$^{-2}$) (Trenberth and Stepaniak, J. Climate 2003 Fig 2)
Absorbed Solar

OLR

Net (Absorbed-OLR)

(Trenberth and Stepaniak, J. Climate 2003 Fig 2)
Diabatic heating in $K \, \text{day}^{-1}$ (December to February)

(Peixoto and Oort, fig 13.2)
Northward transport of sensible heat (K m s\(^{-1}\))

(Peixoto and Oort, fig 13.5)
Northward transport of sensible heat (K m s\(^{-1}\))

Total

Transient

Stationary

Mean

(Peixoto and Oort, fig 13.6; multiply by 0.4 cos(lat) for PW)
Northward transport of latent heat (g kg$^{-1}$ m s$^{-1}$)

Total

Transient

Stationary

Mean

(Peixoto and Oort, fig 12.11)
Northward transport of latent heat \((g \, kg^{-1} \, m \, s^{-1})\)

(Peixoto and Oort, fig 12.12; energy conversion not the same)
Northward transport of potential energy ($10^2 \text{ m}^2 \text{ s}^{-1}$)

(Peixoto and Oort, fig 13.7)
Northward transport of kinetic energy ($10 \text{ m}^3 \text{ s}^{-1}$)

(Peixoto and Oort, fig 13.8)
Energy transports from NCEP reanalysis; comparison of different components

(Trenberth and Stepaniak, J. Climate pages 3691-3705, 2003 Fig 1)
Northward energy transport: atmosphere and ocean (PW)

Dashed - NCEP
Solid - ERA15
Ocean implied from ERBE

(Czaja and Marshall, 2006 after Trenberth and Caron 2001)
Northward energy transport: atmosphere and ocean (PW)

Dashed - NCEP
Solid - ERA15
Ocean implied from ERBE

(Czaja and Marshall, 2006 after Trenberth and Caron 2001)
Latitudes of greatest stratification differ in atmosphere and ocean.
Energy transport streamfunction (PW)

(Peixoto and Oort, fig 13.15)