PDM MODULE

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Reflectance needs to be corrected for polarization effects

Need two quantities $P$ (degree of polarization) and $\chi$ (polarization angle) to correct for these effects

The PDM Module uses empirical and theoretically computed $P$ and $\chi$ values

- Empirical values come from POLDER instrument on the PARASOL satellite (now defunct)
- Theoretical values calculated by Adding-Doubling Radiative Transfer Model (ADRTM, from Wenbo)
**MODULE INPUTS/OUTPUTS**

**Input:**
- SZA
- VZA
- RAZ (Detector AZ & Solar Az.?)
- IGBP (Lat. & Long.?)
- Cloud Fraction
- Date (if needed)
- COT/AOD
- Wind Speed (IGBP =17 only)

**Output:**
- mean $P$ (empirical)
- $\sigma_P$ (empirical)
- mean $\chi$ (empirical)
- $-\sigma_\chi$ (empirical)
- $P$ (theoretical)
- $\chi$ (theoretical)
- Confidence Flag
## PDM STORAGE/RETRIEVAL

<table>
<thead>
<tr>
<th>Dimension name</th>
<th># of bins</th>
<th>binning</th>
</tr>
</thead>
<tbody>
<tr>
<td>SZA</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[10°, 20°), [20°, 30°), [30°, 40°), [40°, 50°), [50°, 60°), [60°, 70°)</td>
</tr>
<tr>
<td>AOD</td>
<td>1, &gt;1</td>
<td>[0, 0.4), [0.4, 0.7), ...</td>
</tr>
<tr>
<td>Seasons</td>
<td>5</td>
<td>[0, 1, 2, 3, 4]</td>
</tr>
<tr>
<td>Wind Sp. (if IGBP = 17)</td>
<td>4</td>
<td>[0, 3.5), [3.5, 5), [5, 7.5), [7.5, 10)</td>
</tr>
<tr>
<td>Surf Types</td>
<td>16</td>
<td>IGBP=1, 2, ..., 17</td>
</tr>
<tr>
<td>Scene IDs</td>
<td>4</td>
<td>Clear (0), Water cloud (1), Ice Cloud (2), Mixed (999)</td>
</tr>
</tbody>
</table>

### HDF5/NetCDF(?)-based PDM lookup tables to retrieve $P$, $\sigma_p$, $\chi$, $\sigma_\chi$, $P_{\text{theor}}$, $\chi_{\text{theor}}$

- **Bin SZA** = 2
- **Bin AOD** = 1
- **Bin seas** = 1
- **Bin WindSp** = 1
- **Bin surf** = 16
- **Bin sceneID** = 1

- **Bin SZA** = 3
- **Bin AOD** = 1
- **Bin seas** = 1
- **Bin WindSp** = 1
- **Bin surf** = 16
- **Bin sceneID** = 1

- **Bin SZA** = 4
- **Bin AOD** = 1
- **Bin seas** = 1
- **Bin WindSp** = 1
- **Bin surf** = 16
- **Bin sceneID** = 1

- **Bin SZA** = 5
- **Bin AOD** = 1
- **Bin seas** = 1
- **Bin WindSp** = 1
- **Bin surf** = 16
- **Bin sceneID** = 1
**EMPIRICAL PDM INTERPOLATION**

- Use **linear interpolation** to find mean values between 490 and 670 nm, and 670 and 865 nm.
- Use 2 lookup tables corresponding to adjacent bands to retrieve $P_1(\sigma_{p_1})$ and $P_2(\sigma_{p_2})$ (or $\chi_1(\sigma_{\chi_1})$ and $\chi_2(\sigma_{\chi_2})$).
- Average the adjacent variances to find the std. dev. corresponding to interpolated value.
THEORETICAL P AND \( \chi \) AND CONFIDENCE FLAG

- Theoretical P and \( \chi \) per-bin values from ADRTM also recorded in lookup tables
- Confidence flag to indicate how many std. deviations is theoretical value away from empirical mean
  - I.e., if with \( P_{\text{theor}} < 1\sigma \) away from mean \( P_{\text{empirical}} \) => confidence flag = 0. If \( 1\sigma < P_{\text{theor}} < 2\sigma \) away from \( P_{\text{empirical}} \) => confidence flag = 1, etc.
IMPLEMENTATION

- Have already implemented a (C++) module to retrieve empirical $P$ and $\chi$ for $\text{IGBP} = 17$
- Interpolation between wavelengths is working (results presented at last fall’s SDT)
- Lookup tables in HDF4 at the moment (can be changed to HDF5 or NetCDF)