Fixing Dataset Search

Chris Lynnes
GES DISC
An Experiment...

Search for “Ozone” data distributed by GES DISC
Relevant = dataset-actually-\textit{has}-ozone

<table>
<thead>
<tr>
<th></th>
<th>Results</th>
<th>Precision</th>
<th>Recall</th>
<th>False Pos</th>
<th>False Neg</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCMD</td>
<td>209</td>
<td>61%</td>
<td>98%</td>
<td>81</td>
<td>2</td>
</tr>
<tr>
<td>ECHO</td>
<td>179</td>
<td>65%</td>
<td>89%</td>
<td>63</td>
<td>14</td>
</tr>
<tr>
<td>Mirador</td>
<td>65</td>
<td>82%</td>
<td>41%</td>
<td>12</td>
<td>77</td>
</tr>
</tbody>
</table>

Precision = \( \frac{\text{Relevant} \cap \text{Retrieved}}{\text{Retrieved}} \)

Recall = \( \frac{\text{Relevant} \cap \text{Retrieved}}{\text{Relevant}} \)
Ouch.
Top 10: GCMD

1. MLS/Aura Level 2 Hydroperoxy (HO2) Mixing Ratio
2. MLS/Aura Level 2 Temperature
3. MLS/Aura Level 2 Hydroxyl (OH) Mixing Ratio
4. MLS/Aura Level 2 Nitric Acid (HNO3) Mixing Ratio
5. MLS/Aura Level 2 Water Vapor (H2O) Mixing Ratio
6. MLS/Aura Level 2 Hydrogen Chloride (HCl) Mixing Ratio
7. MLS/Aura Level 2 Nitrous Oxide (N2O) Mixing Ratio
8. MLS/Aura Level 2 Ozone (O3) Mixing Ratio
9. MLS/Aura Level 2 Chlorine Monoxide (ClO) Mixing Ratio
10. MLS/Aura Level 2 Carbon Monoxide (CO) Mixing Ratio
Top 10: ECHO

1. OMI/Aura Formaldehyde (HCHO) Total Column Global 0.25deg Lat/Lon Grid
2. Aqua AIRS Level 3 Daily Standard Physical Retrieval (AIRS-only)
3. OMI/Aura Zoom-in Ground Pixel Corners 1-Orbit L2 Swath 13x12km
4. MLS/Aura Near-Real-Time L2 Temperature
5. OMI/Aura NO2 Cloud-Screened Total and Tropospheric Column Daily L3 Global 0.25deg Lat/Lon Grid
6. UARS Improved Stratospheric and Mesospheric Sounder (ISAMS) Level 3AL
7. UARS Cryogenic Limb Array Etalon Spectrometer (CLAES) Level 3AL
8. SBUV2/NOAA-16 Ozone (O3) Nadir Profile and Total Column Daily L2
9. TOMS/Earth Probe UV Reflectivity Monthly L3 Global 1x1.25 deg Lat/Lon Grid
10. GLA DAILY GRIDS from NOAA-10
## Top 10: Mirador

1. OMI/Aura Ozone (O3) Total Column 1-Orbit L2 Swath 13x24 km
2. OMI/Aura DOAS Total Column Ozone Zoomed 1-Orbit L2 Swath 13x12km
3. OMI/Aura Ozone (O3) Total Column Daily L2 Global 0.25 deg Lat/Lon Grid
4. SBUV/Nimbus-7 Ozone Profile, Ozone Total Column 1-Orbit L2 200x200 km
5. SBUV2/NOAA-09 Ozone Profile, Ozone Total Column 1-Orbit L2 200x200 km
6. SBUV2/NOAA-11 Ozone Profile, Ozone Total Column 1-Orbit L2 200x200 km
7. SBUV2/NOAA-16 Ozone Profile, Ozone Total Column 1-Orbit L2 200x200 km
8. OMI/Aura Ozone (O3) DOAS Total Column Daily L2 Global 0.25 deg Lat/Lon Grid
9. OMI/Aura Ozone (O3) DOAS Total Column 1-Orbit L2 Swath 13x24 km
10. GOZCARDS Source Data for Ozone Monthly Zonal Means on a Geodetic Latitude and Pressure Grid

Better, but still not that good:
- No L3
- L2G > L3
- Pre-EOS > EOS (#4-#7)
- Specialty product (Zoomed) > Global
Epiphany #1

So That’s Why Users Hate on Search
Relevancy Ranking

Implementing good relevancy ranking may be the single most important thing we could do to improve our search
How to Relevant

• It’s what made Google famous
• Ironically, Google’s PageRank does not work well for dataset “documents”
• OTOH, DAACs and EOSDIS have been helping users select data for > 20 years
• We should know by now what users want
Epiphany #2

Where We Slipped Up:

Just because users would rather *SEARCH WITH* freetext keywords, that doesn’t mean we have to *FIND BY* freetext methods.
Relevancy Heuristics

• An attempt to return datasets in the most relevant order, given:
  – Keywords provided by user
  – Likely user intent, inferred from:
    • Empirical experience
    • Type of user
    • Referrer
    • Keyword

• N.B.: *No heuristic works for everybody*
  – Just trying to make as many users happy as possible
Data Content Heuristic

Match in measurement/parameter/GCMD specific keyword

is more relevant than

Match in any other field

Example:

Ozone as a variable

is more relevant than

Ozone in “Ozone Monitoring Instrument”
Data Content “Noun” Heuristic

“Nouns” in a Measurement Match

is more relevant than

Modifiers in a Measurement Match

Example:

“Ozone” in “Total Column Ozone”

is more relevant than

“Total” in “Total Column Ozone”
Data Version Heuristic

More Recent Version

*is more relevant than*

Less Recent Version

Example:

MLS Whatever V003

*is more relevant than*

MLS Whatever V002
Date Range Coverage Heuristic

Date Range Coverage Score

\[ \text{Date Range Coverage Score} = \frac{\% \text{ of Search Date Range covered by the dataset}}{\text{User: want Oct 2007 to Oct 2014 (8 yr)}} \]

\[ \text{Dataset: got 2004 – 2012 (2007-2012 = 6 yr)} \]

\[ \text{Coverage} = \frac{6}{8} = 75\% \]
Ease of Use Heuristic

Processing Level as a Proxy:

- **L4** – model, ergo gridded + usually gap-free
- **L3** – nicely gridded
- **L2** – processed to physical variables but tricky to map and interpret quality flags
- **L1** – Do-it-yourself
- **L0** – Science teams only (or mostly)
“What’s New” Heuristic*

Newer datasets

are usually better than

Older datasets

*Resonates with people’s Recency Bias
Metrics-based Heuristics

- Data popularity over last N months
- Data citations over last N months
- Associative popularity...not so much
  - “Customers Who Bought This Item Also Bought”
  - “What Other Items Do Customers Buy After Viewing This Item?”
  - N.B.: You have to get to and select a relevant item FIRST
User Type and Intent Modeling

Use it to weight or otherwise modify previous heuristics

• User interests
  – URS
  – Other search words (“Rain” + “Landslides”)

• Referrals from Portals or Tools
  – Applications* portals/tools
  – Education portals/tools

• Use of Jargon or Technical Terms
  – AOD, SST, L2, OMI, SNPP…

*Applications like “Landslide Prediction”, not like “MS Office”
What Do We Need?

• The ability to rank CMR dataset results according to heuristics
  – Ideally, client-selectable heuristics and scoring

• The ability to experiment with ranking schemes against CMR metadata
  – Lure researchers to develop ranking schemes

• Discussion forum for developing additional methods for ranking and modeling user intent
Discuss...

For White Paper, see:
https://wiki.earthdata.nasa.gov/display/CMR/Relevancy+Ranking+of+Data+Collections