CLOUD GAZE, data merging, and the Terminator project: GLOBE Clouds in 2021

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13 May 2021
2020 in Review

2020 Community Cloud Challenge

Science is Better Together!

2020 in Review

National Aeronautics and Space Administration

2020 COMMUNITY CLOUD CHALLENGE

JULY 15, 2020
AUGUST 15, 2020

Join GLOBE for the 2020 Community Cloud Challenge while we learn about clouds together and collaborate to advance our understanding of Earth’s atmosphere. Use this page to keep track of your progress and find more information at observer.globe.gov/cloud-challenge-2020.

Sci. is Better Together

Patrick Taylor, Climate Scientist, NASA Langley Research Center

Kristopher Bedka, Atmospheric Scientist, NASA Langley Research Center

Facebook of Watch
Join us on NASA Earth
Thursdays at 12 PM EST
www.nasa.gov
2020 in Review

Average Clouds Observations by Month - Challenge versus Non-Challenge

Total Observations 258,888
Total Emails sent - 81,454

Satellite | Total Satellite Matches | NASA LaRC Team Support
--- | --- | ---
GEO Satellite Matches | 258,888 | SatCORPS
  - GOES 17 – 11,080
  - GOES 16 – 55,620
  - GOES 15 – 1,648
  - Himawari-8 – 16,076
  - METEOSAT-11 – 31,872
  - METEOSAT-9 – 963
  - METEOSAT-8 – 74,338

SSF Satellite Matches | 48,977 | CERES FLASHFlux
  - Terra – 24,974
  - Aqua – 24,003
(Solar) Terminator Problem - Overview

- Satellite cloud products have performance issues near solar terminator
- Daytime retrievals use visible + IR measurements, while nighttime are IR only
- But the rapidly changing solar illumination at the terminator can confuse the retrieval algorithms
  - 3.9 µm channel is a problem
  - Low clouds are frequently affected
- Citizen scientist obs. of cloud and sky conditions can be used to check satellite retrievals
(Solar) Terminator Problem - Status

• GLOBE Clouds conducted a pilot program with NASA interns (15 March – 15 April)

• NASA interns were asked to collect observations within 1 hr of sunrise or sunset
  • when the sun was < 10° above the horizon

• The resulting 120+ observations will be used this summer for an internship research project

• Future GLOBE Clouds projects can be designed to help address specific questions from the CERES science team

Solar zenith angle could be estimated with a simple technique.

Locations of some of the NASA interns who collected 120 observations (3/15-4/15).
Many great photos were submitted!
Many great photos were submitted!
Merging MERRA2 with GLOBE Clouds Data - Motivation

- GLOBE Clouds merges ground observer and satellite data, but currently does not include additional information about meteorological conditions.
- MERRA2 is an useful source of meteorological (reanalysis) data that is synergistic with the merged ground/satellite obs.

Possible benefits for my work:
- contrails are sensitivity to vertical humidity profile
- Antarctic marine haze may be sensitive to met. conditions

Possible benefits for GLOBE Clouds:
- having MERRA2 data merged with the existing datasets may be very useful for research projects by students, amateurs, and professional scientists alike

Possible benefits for CERES:
- Intercomparison studies of CERES-derived cloud properties and ground obs. will have MERRA2 thermodynamic profiles, estimated aerosol conditions, and other useful meteorological variables readily available
### Example of merged GLOBE-MERRA2 data file

| Observation Number | Sit OI OI | Measurement Date (UTC) | Measurement Time (UTC) | G | H | I | J | K | L | M | N | O | P | S | T | U | V | W | X | Y | Z | AA | AA | AA | AA | AG | AI | AJ | AK |
| 2                  | 566684   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 92218 | 99219 | 0 | 0 | 100089 | 5938 | 289 | 426666 | 270 | 57 |   |   |   |   |   |
| 3                  | 548728   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 96818 | 99219 | 0 | 0 | 101159 | 5938 | 272 | 98526 | 270 | 53 |   |   |   |   |   |
| 4                  | 547634   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 101066 | 99219 | 0 | 0 | 101228 | 5938 | 270 | 5926 | 270 | 53 |   |   |   |   |   |
| 5                  | 547635   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 99610 | 99219 | 0 | 0 | 101177 | 5938 | 273 | 71963 | 273 | 77 |   |   |   |   |   |
| 6                  | 547633   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 99346 | 99219 | 0 | 0 | 101842 | 5938 | 282 | 387604 | 273 | 77 |   |   |   |   |   |
| 7                  | 553991   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 94018 | 99219 | 0 | 0 | 101084 | 5938 | 289 | 653229 | 273 | 46 |   |   |   |   |   |
| 8                  | 547632   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 99642 | 99219 | 0 | 0 | 101162 | 5938 | 272 | 473541 | 266 | 66 |   |   |   |   |   |
| 9                  | 556087   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 94314 | 99219 | 0 | 0 | 100832 | 5938 | 294 | 395416 | 280 | 63 |   |   |   |   |   |
| 10                 | 551947   | 3/15/2018               | 0:00:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 100170 | 99219 | 0 | 0 | 101385 | 5938 | 287 | 686885 | 285 | 25 |   |   |   |   |   |
| 11                 | 547636   | 3/15/2018               | 0:04:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 98226 | 99219 | 0 | 0 | 101410 | 5938 | 295 | 926666 | 289 | 02 |   |   |   |   |   |
| 12                 | 547637   | 3/15/2018               | 0:04:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 101538 | 99219 | 0 | 0 | 101546 | 5938 | 295 | 654516 | 291 | 28 |   |   |   |   |   |
| 13                 | 547638   | 3/15/2018               | 0:05:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 95178 | 99219 | 0 | 0 | 100788 | 5938 | 298 | 145416 | 276 | 84 |   |   |   |   |   |
| 14                 | 553992   | 3/15/2018               | 0:08:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 95138 | 99219 | 0 | 0 | 101085 | 5938 | 291 | 192921 | 281 | 67 |   |   |   |   |   |
| 15                 | 547639   | 3/15/2018               | 0:09:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 92218 | 99219 | 0 | 0 | 100899 | 5938 | 289 | 426666 | 270 | 57 |   |   |   |   |   |
| 16                 | 548729   | 3/15/2018               | 0:09:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 100530 | 99219 | 0 | 0 | 100884 | 5938 | 297 | 723541 | 294 | 11 |   |   |   |   |   |
| 17                 | 547640   | 3/15/2018               | 0:22:00                |   | 2018 | 3 | 15 | 0 | # | # | # | # | 99466 | 99219 | 0 | 0 | 101600 | 5938 | 293 | 145416 | 285 | 67 |   |   |   |   |   |
| 18                 | 547641   | 3/15/2018               | 0:31:00                |   | 2018 | 3 | 15 | 1 | 1 | 1 | 1 | 75883 | 71875 | 0 | 0 | 100472 | 3438 | 278 | 967255 | 269 | 55 |   |   |   |   |   |
| 19                 | 547642   | 3/15/2018               | 0:32:00                |   | 2018 | 3 | 15 | 1 | 1 | 1 | 1 | 80995 | 71875 | 0 | 0 | 100489 | 3438 | 278 | 928192 | 276 | 70 |   |   |   |   |   |
| 20                 | 547643   | 3/15/2018               | 0:51:00                |   | 2018 | 3 | 15 | 1 | 1 | 1 | 1 | 99703 | 71875 | 0 | 0 | 102078 | 8438 | 287 | 38013 | 279 | 45 |   |   |   |   |   |   |

- MERRA2 data are merged with the data files for the Spring Cloud Challenge 2018, Fall Cloud Challenge 2019, and Community Cloud Challenge 2020
- Data are co-located by lat/lon and time
- *This is an experimental dataset for the time being*
EX study: GLOBE sky color and vis. vs. MERRA2 aerosol properties

- Question: How can GLOBE/MERRA2 merged data be used?
- GLOBE collects reports on sky color and visibility, metrics of atmospheric turbidity (and air quality)
- MERRA2 provides aerosol properties related to turbidity
- Is there a relationship between GLOBE and MERRA2 variables?
EX study: GLOBE sky color and vis. vs. MERRA2 aerosol properties

TOTEXTTAU = Aerosol Optical Depth (extinction)

These results show the potential of research using joint GLOBE-MERRA2 datasets
New Proposal Award: CLOUD GAZE

The CLOUD GAZE project will be a major step in the effort to improve the data quality of GLOBE Clouds reports.

**Community science project Leveraging Online and User Data through GLOBE And Zooniverse Engagement**

GLOBE Clouds will partner with Zooniverse to facilitate this project:
- previous successful Zooniverse projects of this type include Galaxy Zoo, etc.

CLOUD GAZE is funded by ROSES A.41 as a Type 1 proposal: Citizen Science Research gathering new data.
CLOUD GAZE: Methodology

GLOBE Clouds has collected over 300K photographs of sky conditions at part of GLOBE Observer reports.

The results will be compared with satellite comparisons and ground reports.

Develop metadata and data quality flags.
Do Science in the Palm of Your Hand!

Download the GLOBE Observer App

observer.globe.gov

www.nasa.gov
Built from GEOS-5, with assimilated satellite and *in situ* data

10 types of datasets

- met. variables (temperature, humidity, wind, etc.) (2D and 3D)
- aerosol properties (2D and 3D)
- surface fluxes
- radiative fluxes
- land surface properties

0.625°×0.5° horizontal resolution

72 vertical levels

1 hr (2D) and 3 hr (3D) time resolution

Data available from 1980-(near) present