NASA LaRC satellite products and tools for ACTIVATE

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*The Satellite ClOud and Radiation Property retrieval System
Products

GOES-16 ABI satellite sensor

- Satellite imagery
  - Visible, infrared, water vapor channel (6.2 μm) multi-channel RGB images and animations
- Satellite cloud retrievals
  - Cloud mask and phase (clear, liquid, and ice), cloud top temperature and height (and pressure), base height (and pressure).
  - Cloud optical depth, particle effective size (ice and liquid), water path (ice and liquid), and cloud droplet number concentration
  - Radiative fluxes, aircraft icing potential (of supercooled liquid water).
  - 2-km pixel resolution (nadir) produced every 20 min.

- CERES MODIS retrievals
  - 1°x1° daytime cloud retrievals and MERRA-2 reanalysis data archived in the ACTIVATE repository
  - Dataset was used to describe synoptic-scale processes over the ACTIVATE domain (Painemal et al., 2022 JGR).
Satellite products are provided for two domain sizes: small (ACTIVATE domain, 2-km resolution) and large (4-km resolution, see above)
Visualization tool for “small” domain

- Retrievals and images are available every 20-min for deployment periods.
- For other periods, data are produced every 30-min
- GOES-16 data matched with aircraft tracks will be made available.
- Netcdf files can be downloaded from the ACTIVATE repository:
  - [https://www-air.larc.nasa.gov/missions/activate/index.html](https://www-air.larc.nasa.gov/missions/activate/index.html), under the “Satellite” link

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https://satcorps.larc.nasa.gov

RGB image
Cloud droplet number concentration

https://satcorps.larc.nasa.gov
Preliminary assessment of GOES-16 cloud droplet effective radius and number concentration ($N_d$)

\[ N_d = \Gamma_{\text{appr}}^{1/2} \cdot \frac{10^{1/2}}{4\pi \rho_w^{1/2} \cdot k^{5/2}} \cdot \tau^{1/2} \]

- Satellite $N_d$ is derived using 2-km pixel-level data. 4x4 $N_d$ pixels are averaged before comparing GOES with in-situ data.
- In-situ $N_d$ (CDP and FCDP) are limited to samples with water content $\geq 0.03$ g/m$^3$. In-situ data are temporally averaged (30-s window).
- GOES and in-situ $N_d$ are matched within 10 min.
Examples: Postfrontal clouds and closed-cell Sc
Preliminary assessments: cloud height and droplet effective radius

- **Cloud droplet effective radius**

  

  ACTIVATE, winter 2020

  r=0.69

  Bias=3.8 μm

  - GOES effective radius overestimates the in-situ observation, consistent with previous studies.
  - GOES cloud height consistent with the airborne HSRL
  - Comparison against RSP retrievals is ongoing.

- **Cloud top height**

  

  2020/02/17

  GOES-16 r e (m)
Final remarks

• GOES-16 retrievals are suitable for synoptic-scale, Lagrangian, and diurnal cycle studies, as well as for model evaluation.

• Pixel-level retrievals can be more uncertain in highly broken scenes. Screening methods can be devised for removing problematic data.

• Retrieval improvements are ongoing, aiming at reducing the retrieved droplet size.