Satellites and indices reference

This guide lists **satellites and products surfaced in ObserveEarth (OED)**, each supported **spectral/SAR/index layer**, its **default formula** (raster/TiTiler-style expression where applicable), **full title**, **short description**, and **typical use cases**. Display stretches (min/max) and band names reflect `stac/enums.py`, `stac/modis_indices.py`, and frontend defaults.

Contents

Sentinel-2 L2A (Earth Search)

ARVI — Atmospherically Resistant Vegetation Index

- **Title:** Atmospherically Resistant Vegetation Index
- **Default formula:** `(nir - (2 * red - blue)) / (nir + (2 * red - blue))`
- **Description:** Improved version of NDVI that is resistant to atmospheric effects.
- **Use cases:** Hazy or aerosol-affected imagery; atmospheric resistance versus simple red–nir ratios.
- **Default display stretch (min / max):** `0.0` → `1.0`
- **Bands / assets used (expression names):** blue, red, nir

EVI — Enhanced Vegetation Index

- **Title:** Enhanced Vegetation Index
- **Default formula:** `2.5 * (((nir / 10000) - (red / 10000)) / ((nir / 10000) + 6 * (red / 10000) - 7.5 * (blue / 10000) + 1))`
- **Description:** Improved vegetation index that corrects for atmospheric conditions and soil background.
- **Use cases:** Dense canopy where NDVI saturates; atmospheric and soil corrections; biomass trends (S2 and Landsat EVI variants).
- **Default display stretch (min / max):** `0` → `1.0`
- **Bands / assets used (expression names):** blue, red, nir

GNDVI — Green Normalized Difference Vegetation Index

- **Title:** Green Normalized Difference Vegetation Index
- **Default formula:** `(nir - green) / (nir + green)`
- **Description:** Similar to NDVI but uses green band instead of red. More sensitive to chlorophyll concentration.
- **Use cases:** Chlorophyll sensitivity, crop nitrogen stress studies when green reflectance carries signal.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** green, nir

LAI — Leaf Area Index

- **Title:** Leaf Area Index
- **Default formula:** `3.618 * (((nir / 10000) - (red / 10000)) / ((nir / 10000) + (red / 10000) + 1e-6)) - 0.118`
- **Description:** Estimates the leaf area per unit ground area. Derived from EVI.
- **Use cases:** Canopy structure, biomass and ecosystem modeling, interception and transpiration workflows.
- **Default display stretch (min / max):** `0.0` → `8.0`
- **Bands / assets used (expression names):** blue, red, nir

MSAVI — Modified Soil Adjusted Vegetation Index

- **Title:** Modified Soil Adjusted Vegetation Index
- **Default formula:** `(2 * nir + 1 - sqrt((2 * nir + 1)**2 - 8 * (nir - red))) / 2`
- **Description:** Improved version of SAVI that automatically adjusts for soil background effects.
- **Use cases:** Early growth / low cover vegetation; automatic soil-adjusted behavior versus fixed SAVI soil term.
- **Default display stretch (min / max):** `0.0` → `1.0`
- **Bands / assets used (expression names):** red, nir

NBR — Normalized Burn Ratio

- **Title:** Normalized Burn Ratio
- **Default formula:** `(nir - swir22) / (nir + swir22)`
- **Description:** Used to identify burned areas and assess fire severity.
- **Use cases:** Burn severity mapping, scar detection, recovery monitoring paired with delta-NBR workflows.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** nir, swir22

NDBI — Normalized Difference Built-up Index

- **Title:** Normalized Difference Built-up Index
- **Default formula:** `(swir16 - nir) / (swir16 + nir)`
- **Description:** Highlights urban areas and built-up land.
- **Use cases:** Built-up surface emphasis, suburban expansion monitoring, complementary to vegetation indices.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** nir, swir16

NDMI — Normalized Difference Moisture Index

- **Title:** Normalized Difference Moisture Index
- **Default formula:** `(nir - swir16) / (nir + swir16)`
- **Description:** Measures vegetation water content. Higher values indicate more moisture.
- **Use cases:** Canopy / vegetation moisture and water stress; irrigation timing (S2 nir–swir16; Landsat nir08–swir16).
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** nir, swir16

NDRE — Normalized Difference Red Edge

- **Title:** Normalized Difference Red Edge
- **Default formula:** `(nir - rededge1) / (nir + rededge1)`
- **Description:** Uses red edge band instead of red. Sensitive to chlorophyll content and useful for dense vegetation.
- **Use cases:** Mid–late season chlorophyll / nitrogen in dense crops; red-edge exploitation from Sentinel-2.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** rededge1, nir

NDVI — Normalized Difference Vegetation Index

- **Title:** Normalized Difference Vegetation Index
- **Default formula:** `(nir - red) / (nir + red)`
- **Description:** Measures vegetation health and density. Higher values indicate denser vegetation.
- **Use cases:** Crop vigor and yield proxies, vegetation fraction, drought or stress alerts, baseline greenness comparisons.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** red, nir

NDWI — Normalized Difference Water Index

- **Title:** Normalized Difference Water Index
- **Default formula:** `(green - nir) / (green + nir)`
- **Description:** Highlights open water features. Positive values indicate water bodies.
- **Use cases:** Open surface water, flood extent, wetlands (green–nir formulations on S2/Landsat).
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** green, nir

RGB — Natural Color RGB

- **Title:** Natural Color RGB
- **Default formula:** `red,green,blue`
- **Description:** Natural color composite using Red, Green, and Blue bands for visualization.
- **Use cases:** Photo-interpretation, quick-look composites, QA context for interpreting spectral indices.
- **Default display stretch (min / max):** `0` → `3500`
- **Bands / assets used (expression names):** red, green, blue

SAVI — Soil Adjusted Vegetation Index

- **Title:** Soil Adjusted Vegetation Index
- **Default formula:** `(1.5 * ((nir / 10000.0) - (red / 10000.0))) / ((nir / 10000.0) + (red / 10000.0) + 0.5)`
- **Description:** Similar to NDVI but with soil brightness correction factor. Useful in areas with low vegetation cover.
- **Use cases:** Semi-arid and sparse vegetation where soil brightness biases NDVI.
- **Default display stretch (min / max):** `0.0` → `1.0`
- **Bands / assets used (expression names):** red, nir

Landsat Collection 2 Level-2 SR (Harmonized surface reflectance names in expressions)

EVI — Enhanced Vegetation Index

- **Title:** Enhanced Vegetation Index
- **Default formula:** `2.5 * ((nir08 - red) / (nir08 + 6 * red - 7.5 * blue + 1))`
- **Description:** Improved vegetation index that corrects for atmospheric conditions and soil background.

- **Use cases:** Dense canopy where NDVI saturates; atmospheric and soil corrections; biomass trends (S2 and Landsat EVI variants).
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** SR_B2, SR_B4, SR_B5

NDMI — Normalized Difference Moisture Index

- **Title:** Normalized Difference Moisture Index
- **Default formula:** `(nir08 - swir16) / (nir08 + swir16)`
- **Description:** Measures moisture content in vegetation. Higher values indicate more water content.
- **Use cases:** Canopy / vegetation moisture and water stress; irrigation timing (S2 nir–swir16; Landsat nir08–swir16).
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** nir08, swir16

NDVI — Normalized Difference Vegetation Index

- **Title:** Normalized Difference Vegetation Index
- **Default formula:** `(nir08 - red) / (nir08 + red)`
- **Description:** Measures vegetation health and density. Higher values indicate denser vegetation.
- **Use cases:** Crop vigor and yield proxies, vegetation fraction, drought or stress alerts, baseline greenness comparisons.
- **Default display stretch (min / max):** `0` → `1.0`
- **Bands / assets used (expression names):** SR_B4, SR_B5

NDWI — Normalized Difference Water Index

- **Title:** Normalized Difference Water Index
- **Default formula:** `(green - nir08) / (green + nir08)`
- **Description:** Highlights open water features. Positive values indicate water bodies.
- **Use cases:** Open surface water, flood extent, wetlands (green–nir formulations on S2/Landsat).
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** SR_B3, SR_B5

Sentinel-1 GRD (SAR polarizations VH, VV in dB scale in expression)

RVI — Radar Vegetation Index

- **Title:** Radar Vegetation Index
- **Default formula:** `(((10 ** (vh / 10)) / (10 ** (vv / 10))) * ((10 ** (vh / 10)) / (10 ** (vv / 10)) + 3)) / (((10 ** (vh / 10)) / (10 ** (vv / 10)) + 1) ** 2)`
- **Description:** Measures vegetation cover using radar backscatter from VH and VV polarizations.
- **Use cases:** SAR vegetation surrogate (VH/VV backscatter); monitoring when optical data are cloudy; crop structure and roughness-linked change detection.
- **Default display stretch (min / max):** `0.0` → `1.0`
- **Bands / assets used (expression names):** VH, VV

MODIS (Planetary Computer STAC collections)

MODIS layers are keyed by **STAC collection × raster asset ID**. Display defaults (**min/max stretch**, **colormap**, and optional **band math** as `eq`) live in `stac/modis_indices.py`. Collection IDs use the `-061` suffix matching **NASA MODIS Collection 6.1** semantics on the Microsoft Planetary Computer STAC catalog.

Default formula in this document is shown only when `eq` (or an equivalent formula field) exists in `modis_indices.py`; otherwise the layer is the **native NASA HDF/COG band** — you must apply official MODIS User's Guides for scale factors, offsets, fill values, and QA bit unpacking. Where present, **EVI** and **NDVI** use the usual reflectance-index family; in `modis-13A1-061`, EVI and NDVI are the only vegetation layers given explicit expressions in code (250 m `modis-13Q1-061` entries omit `eq` in that file—treat NDVI/EVI there as standard product bands unless you add formulas elsewhere).

MODIS collection catalog & layer semantics

The table below lists **every STAC collection** and **every raster asset ID (layer key)** exposed through `modis_data_json` in `stac/modis_indices.py`, with a short explanation. Detailed default min/max and formulas for each row appear in the section tables further down (same identifiers).

STAC collection	Product context (informal)	What the layers represent
`modis-09A1-061`	Surface reflectance, 8-day, **500 m**	Seven `sur_refl_b01` – `b07` calibrated bands plus `sur_refl_qc_500m`, viewing/solar geometry (`sur_refl_*zen`, `sur_refl_raz`), `sur_refl_day_of_year`, and `sur_refl_state_500m` aerosol/cloud state bits. Basis for broadband indices if you derive them yourself.
`modis-`	Surface reflectance,	Red (`sur_refl_b01`) and near-infrared

`09Q1-061`	8-day, **250 m**	(`sur_refl_b02`) at 250 m plus `sur_refl_qc_250m` and `sur_refl_state_250m` .
`modis-10A1-061`	Snow cover, **daily**	`NDSI_Snow_Cover` (%), supporting `NDSI` , `Snow_Albedo_Daily_Tile` , algorithm QA flags, basic QA, and orbit/granule pointers.
`modis-10A2-061`	Snow cover, **8-day**	`Eight_Day_Snow_Cover` and `Maximum_Snow_Extent` summaries over the composite period.
`modis-11A1-061`	LST & emissivity, **daily**, ~1 km	Day/night Land Surface Temperature (`LST_*_1km` , scaled storage), emissivity (`Emis_*`), QC, view zenith/time, clear-sky occurrence (`Clear_*_cov`).
`modis-11A2-061`	LST & emissivity, **8-day**, ~1 km	Same family as daily but composited over 8 days (`Clear_sky_days` / `Clear_sky_nights` instead of day/night coverage counts).
`modis-13A1-061`	Vegetation indices, **16-day**, **500 m**	Reflectance composites (blue/red/NIR/MIR), **NDVI** and **EVI** (with explicit `eq` in code using band symbols `B04` , `B08` , `B11`), VI quality (`500m_16_days_VI_Quality`), `500m_16_days_pixel_reliability` , sun/view geometry, and composite DOY.
`modis-13Q1-061`	Vegetation indices, **16-day**, **250 m**	Parallel 250 m suite: MIR, VI quality, NDVI/EVI, band reflectances, geometry, reliability, composite DOY. No `eq` fields in `modis_indices.py` for NDVI/EVI here—they are referenced as native layers.
`modis-14A1-061`	Active fire / thermal anomalies, **daily**	Fire detection grid (`FireMask`), max fire radiative power context (`MaxFRP`), QA, and metadata-style `sample` .
`modis-14A2-061`	Fire, **8-day** composite	`FireMask` and `QA` at weekly-style cadence for summarized burn/hot-pixel activity.
`modis-15A2H-061`	FPAR & LAI, **8-day**, 500 m	Fraction of photosynthetically active radiation absorbed (`Fpar_500m`), leaf area (`Lai_500m`), per-parameter std dev, and QC (`FparLai_QC` , `FparExtra_QC`).
`modis-15A3H-061`	FPAR & LAI, **4-day**, 500 m	Same FPAR/LAI variable set at higher temporal revisit (shorter composite).
`modis-16A3GF-061`	Evapotranspiration, **yearly** gap-filled, 500 m	Annual `ET_500m` , latent heat (`LE_500m`), potential ET (`PET_500m`), potential LE (`PLE_500m`), plus `ET_QC_500m` . Values are scaled integers until converted per MOD16 documentation.

`modis-17A2H-061`	GPP / photosynthesis, **8-day**, 500 m	Gross primary productivity (`Gpp_500m`), net photosynthesis (`PsnNet_500m`), QC (`Psn_QC_500m`).
`modis-17A2HGF-061`	GPP, **8-day** gap-filled, 500 m	Same three variables as `17A2H` but gap-filled for smoother temporal series.
`modis-17A3HGF-061`	NPP / GPP, **yearly** gap-filled, 500 m	Annual `Npp_500m` , supporting `Gpp_500m` , and `Npp_QC_500m` —net primary productivity benchmarks.
`modis-21A2-061`	LST, **8-day**, multi-channel emissivity	Day/night LST (`LST_*_1KM`), emissivity at 29/31/32 µm equivalents (`Emis_*`), QC, viewing time/angle splits. Stored ranges in `modis_indices.py` are display-oriented; conversion to kelvins follows the MOD21 algorithm documentation.
`modis-43A4-061`	BRDF-adjusted reflectance (nadir), **daily**	`Nadir_Reflectance_Band1` – `Band7` (multispectral, scaled) and mandatory quality per band (`BRDF_Albedo_Band_Mandatory_Quality_*`). Intended for analyses requiring reduced BRDF effects.
`modis-64A1-061`	Burned area, **monthly**	`Burn_Date` , `Burn_Date_Uncertainty` , seasonal window markers (`First_Day` , `Last_Day`), and `QA` . Encodings are thematic—interpret via MCD64 product documentation.

Layer counts: 09A1 (12); 09Q1 (4); 10A1 (7); 10A2 (2); 11A1 (12); 11A2 (12); 13A1 (12); 13Q1 (12); 14A1 (4); 14A2 (2); 15A2H (6); 15A3H (6); 16A3GF (5); 17A2H (3); 17A2HGF (3); 17A3HGF (3); 21A2 (11); 43A4 (14); 64A1 (5).

Indices vs bands: Only `500m_16_days_EVI` and `500m_16_days_NDVI` under `modis-13A1-061` carry an `eq` field in `modis_indices.py` —those are explicit index definitions in-app. Everything else is a **named science or QA raster** whose physical meaning follows the NASA product spec (spectral reflectance band, QC bitmask, thematic fire or snow code, scaled temperature, productivity, etc.). The default **RdYlGn** colormap plus **min/max** in the Python registry are visualization hints, not replacements for scaling rules in HDF/COG attributes.

Surface Reflectance 8Day 500M (modis-09A1-061)

- **Description:** MODIS surface reflectance (8-day composite, 500 m). Band assets are calibrated reflectance and QA / geometry layers from the product.
- **Use cases:** Land cover mapping, change detection, custom spectral indices, cross-sensor harmonization inputs; always screen with QA/state flags from the product user guide.

Layer (asset ID)	Default min	Default max	Default formula / notes
`sur_refl_b01`	-100	16000	`– (raw product layer)`
`sur_refl_b02`	-100	16000	`– (raw product layer)`
`sur_refl_b03`	-100	16000	`– (raw product layer)`
`sur_refl_b04`	-100	16000	`– (raw product layer)`
`sur_refl_b05`	-100	16000	`– (raw product layer)`
`sur_refl_b06`	-100	16000	`– (raw product layer)`
`sur_refl_b07`	-100	16000	`– (raw product layer)`
`sur_refl_day_of_year`	1	366	`– (raw product layer)`
`sur_refl_qc_500m`	0	4294967295	`– (raw product layer)`
`sur_refl_raz`	1	366	`– (raw product layer)`
`sur_refl_state_500m`	1	366	`– (raw product layer)`
`sur_refl_szen`	1	366	`– (raw product layer)`
`sur_refl_vzen`	1	366	`– (raw product layer)`

Surface Reflectance 8Day 250M (modis-09Q1-061)

- **Description:** MODIS surface reflectance (8-day composite, 250 m) with fewer bands than 500 m products.
- **Use cases:** Higher-resolution vegetation / surface monitoring when 250 m is required; pair with QA layers.

Layer (asset ID)	Default min	Default max	Default formula / notes
`sur_refl_b01`	-100	16000	`– (raw product layer)`
`sur_refl_b02`	-100	16000	`– (raw product layer)`
`sur_refl_qc_250m`	0	4294967295	`– (raw product layer)`
`sur_refl_state_250m`	0	4294967295	`– (raw product layer)`

Snow Cover Daily (modis-10A1-061)

- **Description:** MODIS snow cover (daily). Includes NDSI-based snow metrics and QA.
- **Use cases:** Snow extent, melt timing, hydrology and alpine monitoring; validate with terrain and cloud masks

and cloud masks.

Layer (asset ID)	Default min	Default max	Default formula / notes
`NDSI`	-100	100	`— (raw product layer)`
`NDSI_Snow_Cover`	0	100	`— (raw product layer)`
`NDSI_Snow_Cover_Algorithm_Flags_QA`	0	255	`— (raw product layer)`
`NDSI_Snow_Cover_Basic_QA`	0	254	`— (raw product layer)`
`Snow_Albedo_Daily_Tile`	0	100	`— (raw product layer)`
`granule_pnt`	0	254	`— (raw product layer)`
`orbit_pnt`	0	15	`— (raw product layer)`

Snow Cover 8Day (modis-10A2-061)

- **Description:** MODIS snow cover (8-day composite) summarizing persistence / maximum extent.
- **Use cases:** Regional snow-season summaries; smoother time series than daily for cloud gaps.

Layer (asset ID)	Default min	Default max	Default formula / notes
`Eight_Day_Snow_Cover`	0	100	`— (raw product layer)`
`Maximum_Snow_Extent`	0	255	`— (raw product layer)`

Land Surface Temperature Emissivity Daily (modis-11A1-061)

- **Description:** MODIS land surface temperature and emissivity (daily, ~1 km). Values are scaled storage dtypes in HDF.
- **Use cases:** Heat stress, irrigation demand proxies, drought monitoring, frost risk; interpret with QC and viewing geometry.

Layer (asset ID)	Default min	Default max	Default formula / notes
`Clear_day_cov`	1	255	`— (raw product layer)`

Clear_day_cov	1	255	– (raw product layer)
Clear_night_cov	1	255	– (raw product layer)
Day_view_angl	0	130	– (raw product layer)
Day_view_time	0	240	– (raw product layer)
Emis_31	1	255	– (raw product layer)
Emis_32	1	255	– (raw product layer)
LST_Day_1km	7500	65535	– (raw product layer)
LST_Night_1km	7500	65535	– (raw product layer)
Night_view_angl	0	130	– (raw product layer)
Night_view_time	0	240	– (raw product layer)
QC_Day	0	255	– (raw product layer)
QC_Night	0	255	– (raw product layer)

Land Surface Temperature Emissivity 8Day (modis-11A2-061)

- **Description:** MODIS land surface temperature and emissivity (8-day composite, ~1 km).
- **Use cases:** Smoothed seasonal LST/evapotranspiration workflows; agriculture and ecosystem stress analysis.

Layer (asset ID)	Default min	Default max	Default formula / notes
Clear_sky_days	1	255	– (raw product layer)
Clear_sky_nights	1	255	– (raw product layer)
Day_view_angl	0	130	– (raw product layer)
Day_view_time	0	240	– (raw product layer)
Emis_31	1	255	– (raw product layer)
Emis_32	1	255	– (raw product layer)
LST_Day_1km	7500	65535	– (raw product layer)
LST_Night_1km	7500	65535	– (raw product layer)
Night_view_angl	0	130	– (raw product layer)
Night_view_time	0	240	– (raw product layer)
QC_Day	0	255	– (raw product layer)

`QC_Night`	0	255	`– (raw product layer)`

Vegetation Indices 500M 16Day (modis-13A1-061)

- **Description:** MODIS vegetation indices (16-day composite, 500 m), including NDVI/EVI-style metrics and MIR reflectance.
- **Use cases:** Regional crop condition, biomass proxies, vegetation phenology; use pixel reliability / VI quality masks.

Layer (asset ID)	Default min	Default max	Default formula / notes
`500m_16_days_EVI`	-0.5	1	`2.5 * ((B08 - B04)(ϐ08 + 6 * B04 - 7.5 * B11 + 1))`
`500m_16_days_MIR_reflectance`	-0.5	1	`– (raw product layer)`
`500m_16_days_NDVI`	-0.5	1	`(B08 - B04) / (B08 + B04)`
`500m_16_days_NIR_reflectance`	-0.5	1	`– (raw product layer)`
`500m_16_days_VI_Quality`	0	100	`– (raw product layer)`
`500m_16_days_blue_reflectance`	-0.5	1	`– (raw product layer)`
`500m_16_days_composite_day_of_the_year`	1	366	`– (raw product layer)`
`500m_16_days_pixel_reliability`	0	4	`– (raw product layer)`
`500m_16_days_red_reflectance`	-0.5	1	`– (raw product layer)`
`500m_16_days_relative_azimuth_angle`	-180	180	`– (raw product layer)`
`500m_16_days_sun_zenith_angle`	0	90	`– (raw product layer)`
`500m_16_days_view_zenith_angle`	0	90	`– (raw product layer)`

Vegetation Indices 250M 16Day (modis-13Q1-061)

- **Description:** MODIS vegetation indices (16-day composite, 250 m).
- **Use cases:** Field-to-landscape monitoring where 250 m detail matters; QA layers remain essential.

Layer (asset ID)	Default min	Default max	Default formula / notes
`250m_16_days_EVI`	-0.5	1	`– (raw product layer)`
`250m_16_days_MIR_reflectance`	-0.5	1	`– (raw product layer)`
`250m_16_days_NDVI`	-0.5	1	`– (raw product layer)`
`250m_16_days_NIR_reflectance`	-0.5	1	`– (raw product layer)`
`250m_16_days_VI_Quality`	0	100	`– (raw product layer)`
`250m_16_days_blue_reflectance`	-0.5	1	`– (raw product layer)`
`250m_16_days_composite_day_of_the_year`	1	366	`– (raw product layer)`
`250m_16_days_pixel_reliability`	0	4	`– (raw product layer)`
`250m_16_days_red_reflectance`	-0.5	1	`– (raw product layer)`
`250m_16_days_relative_azimuth_angle`	-180	180	`– (raw product layer)`
`250m_16_days_sun_zenith_angle`	0	90	`– (raw product layer)`
`250m_16_days_view_zenith_angle`	0	90	`– (raw product layer)`

Thermal Anomalies Fire Daily (modis-14A1-061)

- **Description:** MODIS thermal anomalies / active fire (daily). Fire mask and radiative power

- **Description:** MODIS thermal anomalies / active fire (daily). Fire mask and radiative power–related layers.
- **Use cases:** Active fire detection, early warning, smoke-risk context; corroborate with ground reports where possible.

Layer (asset ID)	Default min	Default max	Default formula / notes
`FireMask`	0	366	`– (raw product layer)`
`MaxFRP`	0	366	`– (raw product layer)`
`QA`	0	255	`– (raw product layer)`
`sample`	0	100	`– (raw product layer)`

Thermal Anomalies Fire 8Day (modis-14A2-061)

- **Description:** MODIS thermal anomalies / fire (8-day composite).
- **Use cases:** Summarized fire activity over cloudy periods; useful for regional weekly dashboards.

Layer (asset ID)	Default min	Default max	Default formula / notes
`FireMask`	0	9	`– (raw product layer)`
`QA`	0	9	`– (raw product layer)`

Leaf Area Index Fpar 8Day (modis-15A2H-061)

- **Description:** MODIS FPAR and LAI (8-day composite, 500 m).
- **Use cases:** Canopy structure for models, yield and stress studies, forest monitoring; use quality layers.

Layer (asset ID)	Default min	Default max	Default formula / notes
`FparExtra_QC`	0	255	`– (raw product layer)`
`FparLai_QC`	0	255	`– (raw product layer)`
`FparStdDev_500m`	0	100	`– (raw product layer)`
`Fpar_500m`	0	100	`– (raw product layer)`
`LaiStdDev_500m`	0	100	`– (raw product layer)`
`Lai_500m`	0	100	`– (raw product layer)`

Leaf Area Index Fpar 4Day (modis-15A3H-061)

Leaf Area Index Fpar 4Day (modis-15A3H-061)

- **Description:** MODIS FPAR and LAI (4-day composite, 500 m).
- **Use cases:** Faster phenology updates than 8-day; still requires QC screening.

Layer (asset ID)	Default min	Default max	Default formula / notes
`FparExtra_QC`	0	255	`– (raw product layer)`
`FparLai_QC`	0	255	`– (raw product layer)`
`FparStdDev_500m`	0	100	`– (raw product layer)`
`Fpar_500m`	0	100	`– (raw product layer)`
`LaiStdDev_500m`	0	100	`– (raw product layer)`
`Lai_500m`	0	100	`– (raw product layer)`

Net Evapotranspiration Yearly Gapfilled (modis-16A3GF-061)

- **Description:** MODIS evapotranspiration and related flux terms (yearly gap-filled, 500 m).
- **Use cases:** Water balance, irrigation performance, drought indicators at annual scales; read ET QC carefully.

Layer (asset ID)	Default min	Default max	Default formula / notes
`ET_500m`	0	65535	`– (raw product layer)`
`ET_QC_500m`	0	255	`– (raw product layer)`
`LE_500m`	0	65535	`– (raw product layer)`
`PET_500m`	0	65535	`– (raw product layer)`
`PLE_500m`	0	65535	`– (raw product layer)`

Gross Primary Productivity 8Day (modis-17A2H-061)

- **Description:** MODIS gross primary productivity (GPP) and photosynthesis net (8-day, 500 m).
- **Use cases:** Ecosystem productivity, crop growth proxies, cumulative carbon uptake studies with PSN QC.

Layer (asset ID)	Default min	Default max	Default formula / notes
`Gpp_500m`	0	30000	`– (raw product layer)`
`PsnNet_500m`	-30000	30000	`– (raw product layer)`

`Psn_QC_500m`	0	255	`– (raw product layer)`

Gross Primary Productivity 8Day Gapfilled (modis-17A2HGF-061)

- **Description:** MODIS gross primary productivity (GPP), gap-filled 8-day (500 m).
- **Use cases:** Smoother GPP trajectories where gaps disrupt raw 17A2H; biomass and seasonal amplitude analysis.

Layer (asset ID)	Default min	Default max	Default formula / notes
`Gpp_500m`	0	30000	`– (raw product layer)`
`PsnNet_500m`	-30000	30000	`– (raw product layer)`
`Psn_QC_500m`	0	255	`– (raw product layer)`

Net Primary Production Yearly Gapfilled (modis-17A3HGF-061)

- **Description:** MODIS net primary production (NPP) yearly gap-filled (500 m).
- **Use cases:** Annual vegetation productivity benchmarking, biome comparisons, disturbance recovery.

Layer (asset ID)	Default min	Default max	Default formula / notes
`Gpp_500m`	0	65535	`– (raw product layer)`
`Npp_500m`	0	255	`– (raw product layer)`
`Npp_QC_500m`	0	255	`– (raw product layer)`

Land Surface Temperature 3 Band Emissivity 8Day (modis-21A2-061)

- **Description:** MODIS LST with split-window emissivity (8-day, ~1 km, three-band emissivity context).
- **Use cases:** Surface energy balance studies; combine with QA and atmospheric context.

Layer (asset ID)	Default min	Default max	Default formula / notes
`Emis_29`	0	255	`– (raw product layer)`
`Emis_31`	0	255	`– (raw product layer)`
`Emis_32`	0	255	`– (raw product layer)`

`LST_Day_1KM`	0	255	`– (raw product layer)`
`LST_Night_1KM`	0	255	`– (raw product layer)`
`QC_Day`	0	255	`– (raw product layer)`
`QC_Night`	7500	65535	`– (raw product layer)`
`View_Angle_Day`	0	255	`– (raw product layer)`
`View_Angle_Night`	0	100	`– (raw product layer)`
`View_Time_Day`	0	255	`– (raw product layer)`
`View_Time_Night`	0	255	`– (raw product layer)`

Nadir Brdf Adjusted Reflectance Daily (modis-43A4-061)

- **Description:** MODIS BRDF-adjusted nadir reflectance (daily, multiple bands).
- **Use cases:** Physically-consistency for multi-angle composites, downstream indices less sensitive to geometry.

Layer (asset ID)	Default min	Default max	Default formula / notes
`BRDF_Albedo_Band_Mandatory_Quality_Band1`	0	255	`– (raw product layer)`
`BRDF_Albedo_Band_Mandatory_Quality_Band2`	0	255	`– (raw product layer)`
`BRDF_Albedo_Band_Mandatory_Quality_Band3`	0	255	`– (raw product layer)`
`BRDF_Albedo_Band_Mandatory_Quality_Band4`	0	255	`– (raw product layer)`
`BRDF_Albedo_Band_Mandatory_Quality_Band5`	0	255	`– (raw product layer)`
`BRDF_Albedo_Band_Mandatory_Quality_Band6`	0	255	`– (raw product layer)`
`BRDF_Albedo_Band_Mandatory_Quality_Band7`	0	255	`– (raw product layer)`
`Nadir_Reflectance_Band1`	0	10000	`– (raw product layer)`
`Nadir_Reflectance_Band2`	0	10000	`– (raw product`

			`– (raw product layer)`
`Nadir_Reflectance_Band3`	0	10000	`– (raw product layer)`
`Nadir_Reflectance_Band4`	0	10000	`– (raw product layer)`
`Nadir_Reflectance_Band5`	0	10000	`– (raw product layer)`
`Nadir_Reflectance_Band6`	0	10000	`– (raw product layer)`
`Nadir_Reflectance_Band7`	0	10000	`– (raw product layer)`

Burned Area Monthly (modis-64A1-061)

- **Description:** MODIS burned area (monthly). Burn date / uncertainty grids.
- **Use cases:** Fire scar mapping at monthly aggregation, disturbance analysis, regeneration monitoring.

Layer (asset ID)	Default min	Default max	Default formula / notes
`Burn_Date`	0	9	`– (raw product layer)`
`Burn_Date_Uncertainty`	0	9	`– (raw product layer)`
`First_Day`	0	9	`– (raw product layer)`
`Last_Day`	0	9	`– (raw product layer)`
`QA`	0	9	`– (raw product layer)`

Quick collection map: 09A1/09Q1 — surface reflectance; 10A1/10A2 — snow; 11A1/11A2/21A2 — LST/emissivity; 13A1/13Q1 — VI & reflectance; 14A1/14A2 — fire anomalies; 15A2H/15A3H — FPAR/LAI; 16A3GF — ET (annual); 17A2H/17A2HGF — GPP; 17A3HGF — NPP (annual); 43A4 — BRDF/nadir reflectance; 64A1 — burned area (monthly). See MODIS collection catalog & layer semantics for the exhaustive list keyed to `modis_indices.py`.