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.

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Sentinel-2 L2A (Earth Search)

1. 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

2. 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

3. 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

4. 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

5. 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

6. 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

7. 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

8. 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

9. 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

10. 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

11. 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

12. 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

13. 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

14. MNDWI — Modified Normalized Difference Water Index

- **Title:** Modified Normalized Difference Water Index

- **Default formula:** `(green - swir16) / (green + swir16)`
- **Description:** Enhances open water features while reducing built-up land noise.
- **Use cases:** Water body extraction, flood mapping, urban water detection, wetland monitoring.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** green, swir16

15. BSI — Bare Soil Index

- **Title:** Bare Soil Index
- **Default formula:** `((swir16 + red) - (nir + blue)) / ((swir16 + red) + (nir + blue))`
- **Description:** Identifies bare soil and sparsely vegetated areas.
- **Use cases:** Soil exposure analysis, land degradation monitoring, agricultural field preparation studies.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir16, red, nir, blue

16. RECI — Red Edge Chlorophyll Index

- **Title:** Red Edge Chlorophyll Index
- **Default formula:** `(nir / rededge1) - 1`
- **Description:** Estimates chlorophyll content using the red edge spectral region.
- **Use cases:** Crop nutrient monitoring, chlorophyll estimation, precision agriculture workflows.
- **Default display stretch (min / max):** `-1.0 → 10.0`
- **Bands / assets used (expression names):** nir, rededge1

17. GCI — Green Chlorophyll Index

- **Title:** Green Chlorophyll Index
- **Default formula:** `(nir / green) - 1`
- **Description:** Measures leaf chlorophyll concentration using green reflectance.
- **Use cases:** Crop health monitoring, nitrogen estimation, vegetation productivity analysis.
- **Default display stretch (min / max):** `-1.0 → 10.0`
- **Bands / assets used (expression names):** nir, green

18. CCCI — Canopy Chlorophyll Content Index

- **Title:** Canopy Chlorophyll Content Index

- **Default formula:** `((nir - rededge1) / (nir + rededge1)) / ((nir - red) / (nir + red))`
- **Description:** Measures canopy chlorophyll and nitrogen content.
- **Use cases:** Precision agriculture, canopy nutrient analysis, chlorophyll stress assessment.
- **Default display stretch (min / max):** `0.0 → 5.0`
- **Bands / assets used (expression names):** nir, rededge1, red

19. SIPI — Structure Insensitive Pigment Index

- **Title:** Structure Insensitive Pigment Index
- **Default formula:** `(nir - blue) / (nir - red)`
- **Description:** Detects vegetation stress and pigment concentration.
- **Use cases:** Plant stress detection, carotenoid analysis, vegetation pigment monitoring.
- **Default display stretch (min / max):** `0.0 → 2.0`
- **Bands / assets used (expression names):** nir, blue, red

20. MSI — Moisture Stress Index

- **Title:** Moisture Stress Index
- **Default formula:** `swir16 / nir`
- **Description:** Measures vegetation moisture stress.
- **Use cases:** Drought assessment, crop water stress monitoring, irrigation management.
- **Default display stretch (min / max):** `0.0 → 5.0`
- **Bands / assets used (expression names):** swir16, nir

21. NDSI — Normalized Difference Snow Index

- **Title:** Normalized Difference Snow Index
- **Default formula:** `(green - swir16) / (green + swir16)`
- **Description:** Detects snow and ice cover.
- **Use cases:** Snow mapping, glacier monitoring, seasonal snow cover analysis.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** green, swir16

22. FIDET — Fire Detection Index

- **Title:** Fire Detection Index
- **Default formula:** `swir22 / (nir * nir09 + 1e-6)`
- **Description:** Detects active fire and thermal anomalies.

- **Use cases:** Wildfire detection, hotspot monitoring, thermal anomaly assessment.
- **Default display stretch (min / max):** `0.0 → 10.0`
- **Bands / assets used (expression names):** swir22, nir, nir09

23. OSAVI — Optimized Soil Adjusted Vegetation Index

- **Title:** Optimized Soil Adjusted Vegetation Index
- **Default formula:** `(nir - red) / (nir + red + 0.16)`
- **Description:** General purpose crop health index. Works well in most conditions with a fixed soil factor of 0.16.
- **Use cases:** Crop health monitoring, sparse vegetation, semi-arid areas where soil brightness affects NDVI.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** nir, red

24. RDVI — Renormalized Difference Vegetation Index

- **Title:** Renormalized Difference Vegetation Index
- **Default formula:** `(nir - red) / sqrt(nir + red)`
- **Description:** Reduces saturation effects in dense crops. More linear response than NDVI at high biomass.
- **Use cases:** Dense crop monitoring, biomass estimation, high-vegetation areas where NDVI saturates.
- **Default display stretch (min / max):** `0.0 → 1.0`
- **Bands / assets used (expression names):** nir, red

25. VARI — Visible Atmospherically Resistant Index

- **Title:** Visible Atmospherically Resistant Index
- **Default formula:** `(green - red) / (green + red - blue)`
- **Description:** Uses only visible bands. Good when NIR band is unavailable. Resistant to atmospheric effects.
- **Use cases:** Visible-band-only platforms, atmospheric resistance, quick vegetation cover assessment.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** green, red, blue

26. TGI — Triangular Greenness Index

- **Title:** Triangular Greenness Index

- **Default formula:** `green - 0.39 * red - 0.61 * blue`
- **Description:** Estimates chlorophyll content using red, green, and blue bands.
- **Use cases:** Chlorophyll estimation, crop health monitoring, visible-band-only analysis.
- **Default display stretch (min / max):** `-0.5` → `0.5`
- **Bands / assets used (expression names):** green, red, blue

27. GLI — Green Leaf Index

- **Title:** Green Leaf Index
- **Default formula:** `(2 * green - red - blue) / (2 * green + red + blue)`
- **Description:** Measures green leaf coverage. Dense green cover gives high values.
- **Use cases:** Green vegetation fraction, crop cover assessment, visible-band analysis.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** green, red, blue

28. MTVI2 — Modified Triangular Vegetation Index 2

- **Title:** Modified Triangular Vegetation Index 2
- **Default formula:** `1.5 * (1.2 * (nir - green) - 2.5 * (red - green)) / sqrt((2 * nir + 1) ** 2 - (6 * nir - 5 * sqrt(red)) - 0.5)`
- **Description:** Accurate vegetation index resistant to soil and atmospheric effects.
- **Use cases:** Biomass estimation, canopy cover, soil and atmosphere-resistant vegetation mapping.
- **Default display stretch (min / max):** `0.0` → `1.0`
- **Bands / assets used (expression names):** nir, green, red

29. LSWI — Land Surface Water Index

- **Title:** Land Surface Water Index
- **Default formula:** `(nir - swir16) / (nir + swir16)`
- **Description:** Measures soil and leaf water content together. High values indicate high water content.
- **Use cases:** Soil moisture, leaf water content, wetland and flood monitoring.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** nir, swir16

30. WRI — Water Ratio Index

- **Title:** Water Ratio Index

- **Default formula:** `(green + red) / (nir + swir16)`
- **Description:** Identifies water surfaces and very wet areas. Values above 1 indicate water.
- **Use cases:** Water body detection, flood mapping, wetland identification.
- **Default display stretch (min / max):** `0.0 → 3.0`
- **Bands / assets used (expression names):** green, red, nir, swir16

31. AWEI — Automated Water Extraction Index

- **Title:** Automated Water Extraction Index
- **Default formula:** `4 * (green - swir16) - (0.25 * nir + 2.75 * swir22)`
- **Description:** Automatically extracts water pixels. Positive values indicate water.
- **Use cases:** Automated water body extraction, flood mapping, open water detection.
- **Default display stretch (min / max):** `-3.0 → 3.0`
- **Bands / assets used (expression names):** green, nir, swir16, swir22

32. SWI — Short Wave Infrared Water Index

- **Title:** Short Wave Infrared Water Index
- **Default formula:** `(nir - swir22) / (nir + swir22)`
- **Description:** Uses infrared bands to detect water and moisture. Positive values indicate wet areas.
- **Use cases:** Moisture detection, water body mapping, wet soil identification.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** nir, swir22

33. RI — Redness Index

- **Title:** Redness Index
- **Default formula:** `red ** 2 / (blue * green ** 3)`
- **Description:** Measures iron oxide content and soil erosion risk. Higher values indicate more redness.
- **Use cases:** Soil redness and iron oxide mapping, erosion risk assessment, bare soil characterization.
- **Default display stretch (min / max):** `0.0 → 10.0`
- **Bands / assets used (expression names):** red, blue, green

34. NDTI — Normalized Difference Tillage Index

- **Title:** Normalized Difference Tillage Index

- **Default formula:** `(swir16 - swir22) / (swir16 + swir22)`
- **Description:** Shows crop residue on soil after harvest. Helps with tillage planning.
- **Use cases:** Crop residue mapping, tillage monitoring, agricultural field preparation.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir16, swir22

35. CI — Clay Index

- **Title:** Clay Index
- **Default formula:** `swir22 / swir16`
- **Description:** Detects clay mineral content in the soil. Higher values indicate more clay.
- **Use cases:** Soil clay content mapping, geological surveys, soil type characterization.
- **Default display stretch (min / max):** `0.0 → 3.0`
- **Bands / assets used (expression names):** swir22, swir16

36. GSAVI — Green Soil Adjusted Vegetation Index

- **Title:** Green Soil Adjusted Vegetation Index
- **Default formula:** `1.5 * (nir - green) / (nir + green + 0.5)`
- **Description:** Vegetation index optimized for green band, reduces soil noise.
- **Use cases:** Vegetation monitoring with reduced soil background, green-band sensitive crop assessment.
- **Default display stretch (min / max):** `-1.5 → 1.5`
- **Bands / assets used (expression names):** nir, green

37. EEVI — Extended Enhanced Vegetation Index

- **Title:** Extended Enhanced Vegetation Index
- **Default formula:** `2.5 * (nir - red) / (nir + 2.4 * red + 1)`
- **Description:** Reduces atmospheric and soil effects for accurate vegetation measurement.
- **Use cases:** Vegetation monitoring under atmospheric interference, biomass assessment.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** nir, red

38. SOCI — Soil Organic Carbon Index

- **Title:** Soil Organic Carbon Index
- **Default formula:** `green / (red * blue)`
- **Description:** Estimates organic carbon content in the soil. Higher values indicate more

organic carbon.

- **Use cases:** Soil organic carbon mapping, soil health assessment, land degradation monitoring.
- **Default display stretch (min / max):** `0.0 → 50.0`
- **Bands / assets used (expression names):** green, red, blue

39. PRI — Photochemical Reflectance Index

- **Title:** Photochemical Reflectance Index
- **Default formula:** `(green - blue) / (green + blue)`
- **Description:** Detects heat and drought stress in crops. Negative values indicate stressed plants.
- **Use cases:** Crop stress detection, drought monitoring, photosynthetic efficiency assessment.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** green, blue

40. CRI — Carotenoid Reflectance Index

- **Title:** Carotenoid Reflectance Index
- **Default formula:** `(1 / green) - (1 / rededge1)`
- **Description:** Detects pest damage and disease by measuring carotenoid pigments.
- **Use cases:** Pest and disease detection, crop stress monitoring, pigment analysis.
- **Default display stretch (min / max):** `0.0 → 15.0`
- **Bands / assets used (expression names):** green, rededge1

41. ARI — Anthocyanin Reflectance Index

- **Title:** Anthocyanin Reflectance Index
- **Default formula:** `(1 / green) - (1 / rededge1)`
- **Description:** Detects frost damage and nutrient deficiency by measuring anthocyanin pigments.
- **Use cases:** Frost damage detection, nutrient deficiency monitoring, plant stress assessment.
- **Default display stretch (min / max):** `0.0 → 10.0`
- **Bands / assets used (expression names):** green, rededge1

42. PSRI — Plant Senescence Reflectance Index

- **Title:** Plant Senescence Reflectance Index
- **Default formula:** `(red - blue) / rededge1`

- **Description:** Detects crop aging, ripening and frost damage. Higher values indicate senescence.
- **Use cases:** Crop senescence monitoring, ripeness assessment, frost damage detection.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** red, blue, rededge1

43. DSWI — Disease Water Stress Index

- **Title:** Disease Water Stress Index
- **Default formula:** `(nir + green) / (swir16 + red)`
- **Description:** Detects both disease and water stress simultaneously. Lower values indicate stress.
- **Use cases:** Combined disease and water stress detection, crop health monitoring, precision agriculture.
- **Default display stretch (min / max):** `0.0 → 5.0`
- **Bands / assets used (expression names):** nir, green, swir16, red

44. RVSI — Red Edge Vegetation Stress Index

- **Title:** Red Edge Vegetation Stress Index
- **Default formula:** `((rededge1 + rededge3) / 2) - rededge2`
- **Description:** Early warning system for crop stress using red edge bands.
- **Use cases:** Early crop stress detection, disease early warning, precision agriculture monitoring.
- **Default display stretch (min / max):** `-0.1 → 0.1`
- **Bands / assets used (expression names):** rededge1, rededge2, rededge3

45. GCVI — Green Chlorophyll Vegetation Index

- **Title:** Green Chlorophyll Vegetation Index
- **Default formula:** `(nir / green) - 1`
- **Description:** Helps predict crop yield based on chlorophyll levels.
- **Use cases:** Crop yield prediction, chlorophyll monitoring, precision agriculture.
- **Default display stretch (min / max):** `0.0 → 20.0`
- **Bands / assets used (expression names):** nir, green

46. WDRVI — Wide Dynamic Range Vegetation Index

- **Title:** Wide Dynamic Range Vegetation Index
- **Default formula:** `(0.1 * nir - red) / (0.1 * nir + red)`

- **Description:** Better than NDVI for high-biomass crops like corn and sugarcane.
- **Use cases:** High-biomass crop monitoring, corn and sugarcane yield estimation, dense vegetation analysis.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** nir, red

47. MCARI — Modified Chlorophyll Absorption in Reflectance Index

- **Title:** Modified Chlorophyll Absorption in Reflectance Index
- **Default formula:** `((rededge1 - red) - 0.2 * (rededge1 - green)) * (rededge1 / red)`
- **Description:** Sensitive to chlorophyll content. Great for rice and wheat.
- **Use cases:** Rice and wheat chlorophyll monitoring, precision nitrogen management, crop health assessment.
- **Default display stretch (min / max):** `0.0 → 1.0`
- **Bands / assets used (expression names):** rededge1, red, green

48. TCARI — Transformed Chlorophyll Absorption in Reflectance Index

- **Title:** Transformed Chlorophyll Absorption in Reflectance Index
- **Default formula:** `3 * ((rededge1 - red) - 0.2 * (rededge1 - green) * (rededge1 / red))`
- **Description:** More accurate chlorophyll measurement than MCARI.
- **Use cases:** Chlorophyll content estimation, crop stress detection, precision agriculture.
- **Default display stretch (min / max):** `0.0 → 3.0`
- **Bands / assets used (expression names):** rededge1, red, green

49. IRECI — Inverted Red Edge Chlorophyll Index

- **Title:** Inverted Red Edge Chlorophyll Index
- **Default formula:** `(rededge3 - red) / (rededge1 / rededge2)`
- **Description:** Very accurate chlorophyll index for precision agriculture.
- **Use cases:** Precision agriculture, chlorophyll estimation, crop quality assessment.
- **Default display stretch (min / max):** `0.0 → 5.0`
- **Bands / assets used (expression names):** rededge3, red, rededge1, rededge2

50. S2REP — Sentinel-2 Red Edge Position

- **Title:** Sentinel-2 Red Edge Position
- **Default formula:** `705 + 35 * ((nir + red) / 2 - rededge1) /`

`(rededge2 - rededge1)`

- **Description:** Pinpoints exact canopy chlorophyll content for precision farming.
- **Use cases:** Canopy chlorophyll content estimation, precision farming, red edge inflection point analysis.
- **Default display stretch (min / max):** `700.0` → `750.0`
- **Bands / assets used (expression names):** nir, red, rededge1, rededge2

51. NBR2 — Normalized Burn Ratio 2

- **Title:** Normalized Burn Ratio 2
- **Default formula:** `(swir16 - swir22) / (swir16 + swir22)`
- **Description:** More sensitive than NBR. Detects subtle fire damage.
- **Use cases:** Subtle burn damage detection, fire severity refinement, post-fire recovery monitoring.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** swir16, swir22

52. BAI — Burn Area Index

- **Title:** Burn Area Index
- **Default formula:** `1 / ((0.1 - red) ** 2 + (0.06 - nir) ** 2)`
- **Description:** Highlights recently burned land with high contrast.
- **Use cases:** Burned area mapping, fire scar detection, post-fire assessment.
- **Default display stretch (min / max):** `0.0` → `500.0`
- **Bands / assets used (expression names):** red, nir

53. MIRBI — Mid Infrared Burn Index

- **Title:** Mid Infrared Burn Index
- **Default formula:** `10 * swir22 - 9.8 * swir16 + 2`
- **Description:** Detects fire damage using mid-infrared bands.
- **Use cases:** Fire damage assessment, burn severity mapping, post-fire land cover change.
- **Default display stretch (min / max):** `-5.0` → `15.0`
- **Bands / assets used (expression names):** swir22, swir16

54. UI — Urban Index

- **Title:** Urban Index
- **Default formula:** `(swir22 - nir) / (swir22 + nir)`

- **Description:** Maps urban land. Positive values indicate urban/built-up areas.
- **Use cases:** Urban land mapping, built-up area detection, urban expansion monitoring.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir22, nir

55. IBI — Index Based Built-up Index

- **Title:** Index Based Built-up Index
- **Default formula:** `((swir16 - nir) / (swir16 + nir)) - (((1.5 * (nir - red) / (nir + red + 0.5)) + (green - swir16) / (green + swir16)) / 2)`
- **Description:** Accurate urban mapping combining NDBI, SAVI and MNDWI.
- **Use cases:** Urban mapping, impervious surface detection, peri-urban expansion monitoring.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir16, nir, red, green

56. EBBI — Enhanced Built-up and Bareness Index

- **Title:** Enhanced Built-up and Bareness Index
- **Default formula:** `(swir16 - nir) / (10 * sqrt(swir16 + swir22))`
- **Description:** Distinguishes between built-up areas and bare soil.
- **Use cases:** Built-up area vs. bare soil discrimination, urban land cover analysis, land degradation mapping.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir16, nir, swir22

57. CUSTOM — Custom Index

- **Title:** Custom Index
- **Default formula:** *(user-defined)*
- **Description:** User-defined raster expression on Sentinel-2 bands.
- **Use cases:** Any custom band math or experimental index using Sentinel-2 spectral bands.
- **Default display stretch (min / max):** `0 → 1.0`
- **Bands / assets used (expression names):** red, nir (defaults; user overrides)

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

1. 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

2. 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.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** SR_B2, SR_B4, SR_B5

3. 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 moisture and water stress; irrigation timing.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** nir08, swir16

4. 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, wetland mapping.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** SR_B3, SR_B5

5. SAVI — Soil Adjusted Vegetation Index

- **Title:** Soil Adjusted Vegetation Index
- **Default formula:** `1.5 * ((nir08 - red) / (nir08 + red + 0.5))`
- **Description:** Vegetation index with soil brightness correction.
- **Use cases:** Sparse or semi-arid vegetation where bare soil brightens NDVI.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** SR_B4, SR_B5

6. OSAVI — Optimized Soil Adjusted Vegetation Index

- **Title:** Optimized Soil Adjusted Vegetation Index
- **Default formula:** `(nir08 - red) / (nir08 + red + 0.16)`
- **Description:** General purpose crop health index with a fixed soil factor of 0.16.
- **Use cases:** Crop health monitoring, semi-arid areas where soil brightness affects NDVI.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** nir08, red

7. ARVI — Atmospherically Resistant Vegetation Index

- **Title:** Atmospherically Resistant Vegetation Index
- **Default formula:** `(nir08 - (2 * red - blue)) / (nir08 + (2 * red - blue))`
- **Description:** Vegetation index resistant to atmospheric haze.
- **Use cases:** Vegetation monitoring under haze, aerosols, or atmospheric interference.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** SR_B2, SR_B4, SR_B5

8. GCI — Green Chlorophyll Index

- **Title:** Green Chlorophyll Index
- **Default formula:** `(nir08 / green) - 1`
- **Description:** Measures chlorophyll concentration in vegetation.
- **Use cases:** Crop health monitoring, nitrogen estimation, vegetation productivity analysis.

- **Default display stretch (min / max):** `-1.0 → 10.0`
- **Bands / assets used (expression names):** SR_B3, SR_B5

9. SIPI — Structure Insensitive Pigment Index

- **Title:** Structure Insensitive Pigment Index
- **Default formula:** `(nir08 - blue) / (nir08 - red + 1e-6)`
- **Description:** Detects vegetation stress and pigment concentration.
- **Use cases:** Plant stress detection, carotenoid analysis, vegetation pigment monitoring.
- **Default display stretch (min / max):** `0.0 → 2.0`
- **Bands / assets used (expression names):** SR_B2, SR_B4, SR_B5

10. MSI — Moisture Stress Index

- **Title:** Moisture Stress Index
- **Default formula:** `swir16 / (nir08 + 1e-6)`
- **Description:** Measures vegetation moisture stress.
- **Use cases:** Drought assessment, crop water stress monitoring, irrigation management.
- **Default display stretch (min / max):** `0.0 → 5.0`
- **Bands / assets used (expression names):** SR_B5, SR_B6

11. NBR — Normalized Burn Ratio

- **Title:** Normalized Burn Ratio
- **Default formula:** `(nir08 - swir22) / (nir08 + swir22)`
- **Description:** Used to identify burned areas and fire severity.
- **Use cases:** Burn severity mapping, scar detection, recovery monitoring.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** SR_B5, SR_B7

12. NDSI — Normalized Difference Snow Index

- **Title:** Normalized Difference Snow Index
- **Default formula:** `(green - swir16) / (green + swir16)`
- **Description:** Detects snow and ice cover.
- **Use cases:** Snow mapping, glacier monitoring, seasonal snow cover analysis.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** SR_B3, SR_B6

13. RDVI — Renormalized Difference Vegetation Index

- **Title:** Renormalized Difference Vegetation Index
- **Default formula:** `(nir08 - red) / sqrt(nir08 + red)`
- **Description:** Reduces saturation effects in dense crops. More linear response than NDVI at high biomass.
- **Use cases:** Dense crop monitoring, biomass estimation.
- **Default display stretch (min / max):** `0.0` → `1.0`
- **Bands / assets used (expression names):** nir08, red

14. VARI — Visible Atmospherically Resistant Index

- **Title:** Visible Atmospherically Resistant Index
- **Default formula:** `(green - red) / (green + red - blue)`
- **Description:** Uses only visible bands. Resistant to atmospheric effects.
- **Use cases:** Visible-band-only analysis, atmosphere-resistant vegetation cover assessment.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** green, red, blue

15. TGI — Triangular Greenness Index

- **Title:** Triangular Greenness Index
- **Default formula:** `green - 0.39 * red - 0.61 * blue`
- **Description:** Estimates chlorophyll content using red, green, and blue bands.
- **Use cases:** Chlorophyll estimation, crop health monitoring, visible-band-only analysis.
- **Default display stretch (min / max):** `-0.5` → `0.5`
- **Bands / assets used (expression names):** green, red, blue

16. GLI — Green Leaf Index

- **Title:** Green Leaf Index
- **Default formula:** `(2 * green - red - blue) / (2 * green + red + blue)`
- **Description:** Measures green leaf coverage. Dense green cover gives high values.
- **Use cases:** Green vegetation fraction, crop cover assessment.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** green, red, blue

17. MTVI2 — Modified Triangular Vegetation Index 2

- **Title:** Modified Triangular Vegetation Index 2
- **Default formula:** `1.5 * (1.2 * (nir08 - green) - 2.5 * (red - green)) / sqrt((2 * nir08 + 1) ** 2 - (6 * nir08 - 5 * sqrt(red)) - 0.5)`
- **Description:** Accurate vegetation index resistant to soil and atmospheric effects.
- **Use cases:** Biomass estimation, canopy cover, soil and atmosphere-resistant vegetation mapping.
- **Default display stretch (min / max):** `0.0 → 1.0`
- **Bands / assets used (expression names):** nir08, green, red

18. LSWI — Land Surface Water Index

- **Title:** Land Surface Water Index
- **Default formula:** `(nir08 - swir16) / (nir08 + swir16)`
- **Description:** Measures soil and leaf water content together.
- **Use cases:** Soil moisture, leaf water content, wetland and flood monitoring.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** nir08, swir16

19. WRI — Water Ratio Index

- **Title:** Water Ratio Index
- **Default formula:** `(green + red) / (nir08 + swir16)`
- **Description:** Identifies water surfaces and very wet areas. Values above 1 indicate water.
- **Use cases:** Water body detection, flood mapping, wetland identification.
- **Default display stretch (min / max):** `0.0 → 3.0`
- **Bands / assets used (expression names):** green, red, nir08, swir16

20. AWEI — Automated Water Extraction Index

- **Title:** Automated Water Extraction Index
- **Default formula:** `4 * (green - swir16) - (0.25 * nir08 + 2.75 * swir22)`
- **Description:** Automatically extracts water pixels. Positive values indicate water.
- **Use cases:** Automated water body extraction, flood mapping, open water detection.
- **Default display stretch (min / max):** `-3.0 → 3.0`
- **Bands / assets used (expression names):** green, nir08, swir16, swir22

21. SWI — Short Wave Infrared Water Index

- **Title:** Short Wave Infrared Water Index
- **Default formula:** `(nir08 - swir22) / (nir08 + swir22)`
- **Description:** Uses infrared bands to detect water and moisture.
- **Use cases:** Moisture detection, water body mapping, wet soil identification.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** nir08, swir22

22. RI — Redness Index

- **Title:** Redness Index
- **Default formula:** `red ** 2 / (blue * green ** 3)`
- **Description:** Measures iron oxide content and soil erosion risk.
- **Use cases:** Soil redness and iron oxide mapping, erosion risk assessment.
- **Default display stretch (min / max):** `0.0 → 10.0`
- **Bands / assets used (expression names):** red, blue, green

23. NDTI — Normalized Difference Tillage Index

- **Title:** Normalized Difference Tillage Index
- **Default formula:** `(swir16 - swir22) / (swir16 + swir22)`
- **Description:** Shows crop residue on soil after harvest. Helps with tillage planning.
- **Use cases:** Crop residue mapping, tillage monitoring, agricultural field preparation.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir16, swir22

24. CI — Clay Index

- **Title:** Clay Index
- **Default formula:** `swir22 / swir16`
- **Description:** Detects clay mineral content in the soil.
- **Use cases:** Soil clay content mapping, geological surveys, soil type characterization.
- **Default display stretch (min / max):** `0.0 → 3.0`
- **Bands / assets used (expression names):** swir22, swir16

25. GSAVI — Green Soil Adjusted Vegetation Index

- **Title:** Green Soil Adjusted Vegetation Index

- **Default formula:** `1.5 * (nir08 - green) / (nir08 + green + 0.5)`
- **Description:** Vegetation index optimized for green band, reduces soil noise.
- **Use cases:** Vegetation monitoring with reduced soil background, green-band sensitive crop assessment.
- **Default display stretch (min / max):** `-1.5` → `1.5`
- **Bands / assets used (expression names):** nir08, green

26. EEVI — Extended Enhanced Vegetation Index

- **Title:** Extended Enhanced Vegetation Index
- **Default formula:** `2.5 * (nir08 - red) / (nir08 + 2.4 * red + 1)`
- **Description:** Reduces atmospheric and soil effects for accurate vegetation measurement.
- **Use cases:** Vegetation monitoring under atmospheric interference, biomass assessment.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** nir08, red

27. SOCI — Soil Organic Carbon Index

- **Title:** Soil Organic Carbon Index
- **Default formula:** `green / (red * blue)`
- **Description:** Estimates organic carbon content in the soil.
- **Use cases:** Soil organic carbon mapping, soil health assessment, land degradation monitoring.
- **Default display stretch (min / max):** `0.0` → `50.0`
- **Bands / assets used (expression names):** green, red, blue

28. PRI — Photochemical Reflectance Index

- **Title:** Photochemical Reflectance Index
- **Default formula:** `(green - blue) / (green + blue)`
- **Description:** Detects heat and drought stress in crops.
- **Use cases:** Crop stress detection, drought monitoring, photosynthetic efficiency assessment.
- **Default display stretch (min / max):** `-1.0` → `1.0`
- **Bands / assets used (expression names):** green, blue

29. DSWI — Disease Water Stress Index

- **Title:** Disease Water Stress Index
- **Default formula:** `(nir08 + green) / (swir16 + red)`

- **Description:** Detects both disease and water stress simultaneously. Lower values indicate stress.
- **Use cases:** Combined disease and water stress detection, crop health monitoring.
- **Default display stretch (min / max):** `0.0 → 5.0`
- **Bands / assets used (expression names):** nir08, green, swir16, red

30. GCVI — Green Chlorophyll Vegetation Index

- **Title:** Green Chlorophyll Vegetation Index
- **Default formula:** `(nir08 / green) - 1`
- **Description:** Helps predict crop yield based on chlorophyll levels.
- **Use cases:** Crop yield prediction, chlorophyll monitoring, precision agriculture.
- **Default display stretch (min / max):** `0.0 → 20.0`
- **Bands / assets used (expression names):** nir08, green

31. WDRVI — Wide Dynamic Range Vegetation Index

- **Title:** Wide Dynamic Range Vegetation Index
- **Default formula:** `(0.1 * nir08 - red) / (0.1 * nir08 + red)`
- **Description:** Better than NDVI for high-biomass crops like corn and sugarcane.
- **Use cases:** High-biomass crop monitoring, dense vegetation analysis.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** nir08, red

32. NBR2 — Normalized Burn Ratio 2

- **Title:** Normalized Burn Ratio 2
- **Default formula:** `(swir16 - swir22) / (swir16 + swir22)`
- **Description:** More sensitive than NBR. Detects subtle fire damage.
- **Use cases:** Subtle burn damage detection, fire severity refinement, post-fire recovery monitoring.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir16, swir22

33. BAI — Burn Area Index

- **Title:** Burn Area Index
- **Default formula:** `1 / ((0.1 - red) ** 2 + (0.06 - nir08) ** 2)`
- **Description:** Highlights recently burned land with high contrast.

- **Use cases:** Burned area mapping, fire scar detection, post-fire assessment.
- **Default display stretch (min / max):** `0.0 → 500.0`
- **Bands / assets used (expression names):** red, nir08

34. MIRBI — Mid Infrared Burn Index

- **Title:** Mid Infrared Burn Index
- **Default formula:** `10 * swir22 - 9.8 * swir16 + 2`
- **Description:** Detects fire damage using mid-infrared bands.
- **Use cases:** Fire damage assessment, burn severity mapping.
- **Default display stretch (min / max):** `-5.0 → 15.0`
- **Bands / assets used (expression names):** swir22, swir16

35. UI — Urban Index

- **Title:** Urban Index
- **Default formula:** `(swir22 - nir08) / (swir22 + nir08)`
- **Description:** Maps urban land. Positive values indicate urban/built-up areas.
- **Use cases:** Urban land mapping, built-up area detection, urban expansion monitoring.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir22, nir08

36. IBI — Index Based Built-up Index

- **Title:** Index Based Built-up Index
- **Default formula:** `((swir16 - nir08) / (swir16 + nir08)) - (((1.5 * (nir08 - red) / (nir08 + red + 0.5)) + (green - swir16) / (green + swir16)) / 2)`
- **Description:** Accurate urban mapping combining NDBI, SAVI and MNDWI.
- **Use cases:** Urban mapping, impervious surface detection, peri-urban expansion monitoring.
- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir16, nir08, red, green

37. EBBI — Enhanced Built-up and Bareness Index

- **Title:** Enhanced Built-up and Bareness Index
- **Default formula:** `(swir16 - nir08) / (10 * sqrt(swir16 + swir22))`
- **Description:** Distinguishes between built-up areas and bare soil.
- **Use cases:** Built-up area vs. bare soil discrimination, urban land cover analysis.

- **Default display stretch (min / max):** `-1.0 → 1.0`
- **Bands / assets used (expression names):** swir16, nir08, swir22

38. CUSTOM — Custom Index

- **Title:** Custom Index
- **Default formula:** *(user-defined)*
- **Description:** User-defined expression on Landsat SR bands.
- **Use cases:** Any custom band math or experimental index using Landsat spectral bands.
- **Default display stretch (min / max):** `0 → 1.0`
- **Bands / assets used (expression names):** SR_B4, SR_B5 (defaults; user overrides)

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

1. 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-09Q1-061`	Surface reflectance, 8-day, **250 m**	Red (`sur_refl_b01`) and near-infrared (`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**	Reflectance composites

STAC collection	Product context (informal)	What the layers represent
	m	(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

STAC collection	Product context (informal)	What the layers represent
		(`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.

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_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) / (B08 + 6`

Layer (asset ID)	Default min	Default max	Default formula / notes
			* 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)

Layer (asset ID)	Default min	Default max	Default formula / notes
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 –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)

- **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)

Layer (asset ID)	Default min	Default max	Default formula / notes
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)

Layer (asset ID)	Default min	Default max	Default formula / notes
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_Qua	0	255	— (raw product layer)

Layer (asset ID)	Default min	Default max	Default formula / notes
lity_Band3			
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 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)

Layer (asset ID)	Default min	Default max	Default formula / notes
`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`.

Annexure: index names, purposes, and color palettes

This annexure summarizes **index identifiers**, **why each index is used**, **how to read values and what they imply in practice**, and **how outputs are colored** in ObserveEarth. Default stretches and formulas appear in the sections above; defaults here match `stac/enums.py`, `stac/modis_indices.py`, and the `colormap` query parameter on image endpoints (`GET …/image/<geometry_id>/`). List every palette the API accepts via `GET /api/misc/colors/`.

Interpretation notes are **rules of thumb** for the default stretch and land-cover context. They are not crop-specific thresholds. Compare **the same geometry and season** across dates, pair indices (for example NDVI with NDMI), and use QA or cloud masks before drawing operational conclusions.

Legend

- **Default palette** — applied when no `colormap` override is sent.
- **Reversed** — `colormap_reverse: true` in registry (TiTiler/matplotlib `_r` suffix where applicable).
- **Alternatives** — other registered palettes suited to the same value range; not all are equally perceptually uniform.

Sentinel-2 L2A

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
`ndvi`	Normalized Difference Vegetation Index	Vegetation vigor, canopy density, and greenness; baseline crop health and drought stress monitoring.	`rdylgn` (red–yellow–green, diverging)	No	`ylgn`, `greens`, `viridis`, `piyg`

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
`evi`	Enhanced Vegetation Index	Dense canopy and biomass where NDVI saturates; reduces soil and atmosphere bias.	`ylgn` (yellow–green, sequential)	No	`rdylgn`, `greens`, `viridis`
`lai`	Leaf Area Index	Canopy structure and leaf area per ground unit for growth, interception, and ecosystem models.	`greens` (sequential green)	No	`ylgn`, `viridis`, `ylgnbu`
`ndmi`	Normalized Difference Moisture Index	Vegetation water content and canopy moisture stress.	`blues` (sequential blue)	No	`brbg`, `gnbu`, `pubugn`
`ndwi`	Normalized Difference Water Index	Open surface water, wetlands, and flood extent (green vs. NIR contrast).	`blues`	No	`gnbu`, `pubugn`, `ylgnbu`
`savi`	Soil Adjusted Vegetation Index	Sparse or semi-arid vegetation where bare soil brightens NDVI.	`rdylgn`	No	`ylgn`, `brbg`, `piyg`
`msavi`	Modified Soil Adjusted Vegetation Index	Early growth and low cover with automatic soil adjustment.	`ylgn`	No	`rdylgn`, `greens`, `brbg`
`gndvi`	Green Normalized Difference Vegetation Index	Chlorophyll and nitrogen stress via green band sensitivity.	`rdylgn`	No	`ylgn`, `greens`, `piyg`
`arvi`	Atmospherically Resistant Vegetation Index	Vegetation monitoring under haze, aerosols, or	`rdylgn`	No	`ylgn`, `viridis`, `cividis`

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
		atmospheric interference.			
ndre	Normalized Difference Red Edge	Chlorophyll in mid–late season or dense crops using the red-edge band.	rdylgn	No	ylgn, greens, spectral
nbr	Normalized Burn Ratio	Burn scars, fire severity, and post-fire recovery (NIR vs. SWIR2).	rdylbu	**Yes**	ylorrd, orrd, reds, inferno
ndbi	Normalized Difference Built-up Index	Built-up and urban surfaces vs. vegetation (SWIR vs. NIR).	greys (sequential grey)	No	oranges, ylorbr, purples
mndwi	Modified Normalized Difference Water Index	Enhances open water while suppressing urban and built-up land noise (green vs. SWIR).	blues	No	gnbu, pubugn, ylgnbu, teal
bsi	Bare Soil Index	Bare soil exposure, land degradation, and sparsely vegetated surfaces.	ylorbr (yellow–orange–brown)	No	oranges, copper, terrain
reci	Red Edge Chlorophyll Index	Chlorophyll estimation and crop nutrient analysis using red-edge sensitivity.	greens	No	ylgn, viridis, summer
gci	Green Chlorophyll Index	Leaf chlorophyll concentration and nitrogen status using green reflectance.	greens	No	ylgn, viridis, summer
ccci	Canopy	Canopy	ylgn	No	greens,

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
	Chlorophyll Content Index	chlorophyll and nitrogen estimation for precision agriculture.			`viridis`, `spectral`
`sipi`	Structure Insensitive Pigment Index	Vegetation stress and pigment concentration independent of canopy structure.	`rdylgn`	No	`piyg`, `spectral`, `viridis`
`msi`	Moisture Stress Index	Vegetation water stress and drought severity assessment.	`ylorrd` (yellow–orange–red)	No	`orrd`, `inferno`, `magma`
`ndsi`	Normalized Difference Snow Index	Snow and ice detection using visible and SWIR contrast.	`blues`	No	`ice`, `gnbu`, `ylgnbu`
`fidet`	Fire Detection Index	Active fire hotspot and thermal anomaly detection.	`hot`	No	`inferno`, `magma`, `ylorrd`
`osavi`	Optimized Soil Adjusted Vegetation Index	Crop health with fixed soil factor (0.16); robust across cover densities.	`rdylgn`	No	`ylgn`, `greens`, `brbg`
`rdvi`	Renormalized Difference Vegetation Index	Dense crop biomass monitoring with less saturation than NDVI.	`ylgn`	No	`rdylgn`, `greens`, `viridis`
`vari`	Visible Atmospherically Resistant Index	Vegetation assessment using only visible bands; atmosphere-resistant.	`rdylgn`	No	`ylgn`, `greens`, `piyg`
`tgi`	Triangular Greenness	Chlorophyll estimation	`greens`	No	`ylgn`, `viridis`,

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
	Index	from visible bands only.			`rdylgn`
`gli`	Green Leaf Index	Green leaf cover fraction using visible bands.	`ylgn`	No	`greens`, `rdylgn`, `viridis`
`mtvi2`	Modified Triangular Vegetation Index 2	Soil and atmosphere-resistant biomass and canopy cover.	`ylgn`	No	`greens`, `rdylgn`, `viridis`
`lswi`	Land Surface Water Index	Combined soil and leaf water content (NIR vs. SWIR1).	`blues`	No	`gnbu`, `pubugn`, `brbg`
`wri`	Water Ratio Index	Water surface identification; values above 1 indicate water.	`blues`	No	`gnbu`, `pubugn`, `ylgnbu`
`awei`	Automated Water Extraction Index	Automated open water extraction; positive values indicate water.	`blues`	No	`gnbu`, `pubugn`, `ylgnbu`
`swi`	Short Wave Infrared Water Index	Moisture and water detection using NIR vs. SWIR2.	`blues`	No	`gnbu`, `pubugn`, `brbg`
`ri`	Redness Index	Soil iron oxide and redness for erosion risk mapping.	`reds`	No	`ylorrd`, `orrd`, `ylorbr`
`ndti`	Normalized Difference Tillage Index	Crop residue and tillage status (SWIR1 vs. SWIR2).	`ylorbr`	No	`oranges`, `terrain`, `copper`
`ci`	Clay Index	Clay mineral content in soil (SWIR2 / SWIR1).	`ylorbr`	No	`oranges`, `terrain`, `ylgn`
`gsavi`	Green Soil Adjusted Vegetation Index	Green-band vegetation index with reduced soil	`rdylgn`	No	`ylgn`, `greens`, `brbg`

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
		background noise.			
eevi	Extended Enhanced Vegetation Index	Vegetation under atmospheric and soil interference.	ylgn	No	rdylgn, greens, viridis
soci	Soil Organic Carbon Index	Soil organic carbon content estimation.	ylorbr	No	oranges, terrain, copper
pri	Photochemical Reflectance Index	Crop heat and drought stress via visible band contrast.	rdylgn	No	piyg, brbg, rdbu
cri	Carotenoid Reflectance Index	Carotenoid pigment level; pest and disease detection (S2 only).	ylorrd	No	orrd, reds, inferno
ari	Anthocyanin Reflectance Index	Anthocyanin pigment for frost and nutrient stress (S2 only).	rdpu	No	purd, purples, reds
psri	Plant Senescence Reflectance Index	Crop aging, ripening, and frost damage (S2 only).	ylorrd	No	orrd, reds, inferno
dswi	Disease Water Stress Index	Combined disease and water stress detection.	rdylgn	No	piyg, brbg, spectral
rvsi	Red Edge Vegetation Stress Index	Early crop stress via red-edge band triplet (S2 only).	rdylgn	No	piyg, spectral, brbg
gcvi	Green Chlorophyll Vegetation Index	Crop yield prediction from chlorophyll levels.	ylgn	No	greens, viridis, rdylgn
wdrvi	Wide Dynamic	High-biomass	ylgn	No	greens,

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
	Range Vegetation Index	crops (corn, sugarcane) where NDVI saturates.			`rdylgn`, `viridis`
`mcari`	Modified Chlorophyll Absorption in Reflectance Index	Chlorophyll in rice and wheat using red-edge bands (S2 only).	`ylgn`	No	`greens`, `viridis`, `rdylgn`
`tcari`	Transformed Chlorophyll Absorption in Reflectance Index	Accurate chlorophyll measurement beyond MCARI (S2 only).	`ylgn`	No	`greens`, `viridis`, `rdylgn`
`ireci`	Inverted Red Edge Chlorophyll Index	Precision agriculture chlorophyll via red-edge band ratio (S2 only).	`ylgn`	No	`greens`, `viridis`, `spectral`
`s2rep`	Sentinel-2 Red Edge Position	Red-edge inflection point for canopy chlorophyll (S2 only).	`ylgn`	No	`greens`, `viridis`, `spectral`
`nbr2`	Normalized Burn Ratio 2	Subtle burn damage detection (SWIR1 vs. SWIR2).	`rdylbu`	**Yes**	`ylorrd`, `orrd`, `reds`
`bai`	Burn Area Index	High-contrast burned area mapping (red vs. NIR deviation).	`hot`	No	`inferno`, `magma`, `ylorrd`
`mirbi`	Mid Infrared Burn Index	Fire damage from mid-infrared SWIR bands.	`hot`	No	`inferno`, `ylorrd`, `orrd`
`ui`	Urban Index	Urban and built-up land mapping (SWIR2 vs. NIR).	`greys`	No	`oranges`, `purples`, `ylorbr`

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
`ibi`	Index Based Built-up Index	Accurate urban mapping combining NDBI, SAVI, and MNDWI.	`greys`	No	`oranges`, `purples`, `ylorbr`
`ebbi`	Enhanced Built-up and Bareness Index	Built-up vs. bare soil discrimination.	`greys`	No	`oranges`, `ylorbr`, `terrain`
`rgb`	Natural Color RGB	Photo-interpretation and QA context; not a derived index.	*(none — true-color composite)*	—	Use band stretch only; no index colormap
`custom`	Custom Index	User-defined raster expression.	`rdylgn`	No	Any palette from system palette catalog

Sentinel-2 L2A — interpretation and insights

Index ID	Interpretation and insights
`ndvi`	**Higher values** (often roughly **0.3–0.8** on healthy land) indicate greener, denser canopy; **near zero or negative** pixels often correspond to water, bare soil, rock, or built material. **Rising NDVI** through the season usually means green-up or recovery; **sharp drops** can mean harvest, senescence, stress, or a bad acquisition (cloud, shadow, snow). NDVI **saturates** in very dense canopy, so weak change there does not always mean “no biology.”
`evi`	Responds to canopy structure with **less saturation than NDVI** in dense vegetation, so **EVI trends** can show biomass change where NDVI plateaus. **Low or falling EVI** with stable land cover may point to stress, lodging, or atmospheric residue; **rising EVI** supports vigor and leaf-area gain. Compare EVI with NDVI when canopy is thick or soil background is strong.
`lai`	**Higher LAI** means more leaf area intercepting light per ground unit (shade, transpiration, productivity proxies). **Very low values** suggest bare or sparse cover; **mid values** are typical of row crops and grasslands; **high values** align with closed canopy. Because LAI here is

Index ID	Interpretation and insights
	empirically tied to EVI, treat absolute numbers as **relative** unless validated locally. **Seasonal LAI curves** help phenology; **premature decline** can flag drought or disease.
ndmi	**Higher NDMI** generally means **more canopy moisture**; **lower or falling NDMI** under similar growth stage suggests **water stress** or dry biomass. NDMI often **moves before NDVI** when moisture limits growth. Use **same growth stage** year-on-year for irrigation or drought alerts; pair with weather and soil context.
ndwi	**Positive values** (McFeeters-style green vs. NIR) highlight **open water** and very wet surfaces; **negative values** dominate vegetated and dry land. **Sudden positive shifts** along rivers or plains support **inundation** mapping; **false water** can appear on dark wet soil or certain built surfaces—confirm with RGB and terrain.
savi	Reads like NDVI but **lifts signal over bright soil**, so **sparse and emerging crops** look more realistic than raw NDVI. **Rising SAVI** supports establishment and cover increase; interpret **absolute cutoffs** cautiously in arid zones where soil color still influences the signal.
msavi	Similar to SAVI with **automatic soil adjustment**—strong for **early season** and **patchy cover**. **Steep green-up** in MSAVI maps emergence; **plateau then drop** may track maturity or harvest. Useful when cover is too low for NDVI alone.
gndvi	**Green-band sensitivity** makes GNDVI **more chlorophyll- and nitrogen-linked** than red-based NDVI in many crops. **GNDVI falling while NDVI is flat** can flag **nutrient or chlorophyll stress**; **high GNDVI** supports healthy pigment in the canopy. Best compared within the same crop and phenological window.
arvi	Under **haze or aerosols**, ARVI is typically **more stable than NDVI**, so **less spurious greenness** from atmosphere. Use when **optical quality is marginal**; interpret trends like NDVI but expect **smaller atmosphere-driven jumps** between dates.
ndre	**Red-edge** response stays informative in **dense canopy** where red-NIR NDVI saturates. **Higher NDRE** supports strong chlorophyll; **spatial NDRE patterns** can guide **variable nitrogen** or

Index ID	Interpretation and insights
	health zoning. Compare **within crop type**—absolute ranges vary by species and stage.
nbr	**Lower NBR** (more negative relative to pre-fire green forest) marks **char and severe burn**; **less negative** scars are often **lower severity**. **ΔNBR** (pre minus post) is the standard severity workflow; **rising NBR over years** supports **regrowth and recovery** monitoring. Shadow and soil can mimic burn—use RGB and local knowledge.
ndbi	**Positive NDBI** emphasizes **built-up and bare urban** surfaces; **negative** values align with vegetation and water. **Increasing NDBI** through time in peri-urban areas supports **expansion and hardening**; combine with NDVI to separate **urban gain vs. vegetation loss**.
mndwi	**Higher positive values** strongly indicate **open water bodies**, especially in urban or built-up regions where standard NDWI may confuse concrete with water. **Negative values** usually represent vegetation, soil, or urban land. **Sudden increases** can indicate flooding, reservoir expansion, or wetland growth. MNDWI is particularly useful in cities because it suppresses built-up noise better than NDWI.
bsi	**Higher BSI values** indicate **bare soil, exposed ground, or sparse vegetation**, while **lower or negative values** generally correspond to dense vegetation or water. Rising BSI over time may suggest land degradation, drought exposure, harvesting, or construction clearing. In agriculture, high BSI after harvest or before sowing is common. Interpret carefully in bright dry landscapes where salts or rocks may behave similarly.
reci	**Higher RECI** usually reflects **higher chlorophyll concentration** and stronger crop vigor. **Falling RECI** during active growth may indicate nutrient deficiency, stress, disease, or senescence before visible symptoms appear in RGB imagery. RECI is especially useful for precision agriculture and nitrogen management because red-edge bands remain sensitive in dense canopies where NDVI saturates.
gci	**Higher GCI values** indicate increased **leaf chlorophyll and photosynthetic activity**, often linked to healthy nitrogen status. **Lower or declining GCI** can signal nutrient stress, poor

Index ID	Interpretation and insights
	crop health, or chlorophyll loss. GCI is useful during mid-to-late growth stages when subtle pigment changes matter more than canopy density changes.
ccci	**Higher CCCI** supports stronger **canopy chlorophyll and nitrogen content**, especially in dense crops. **Spatial variation** in CCCI maps often highlights nutrient variability across fields. Falling CCCI during vegetative stages can indicate stress or nitrogen deficiency. Since CCCI combines NDRE and NDVI behavior, it is more robust for dense canopies than simple greenness indices alone.
sipi	**Higher SIPI values** often indicate **vegetation stress, pigment imbalance, or carotenoid dominance**, while lower values align with healthier chlorophyll-rich vegetation. SIPI is useful for detecting subtle stress before canopy structure visibly changes. Compare within similar crop stages because absolute thresholds vary by species and illumination conditions.
msi	**Higher MSI values** generally indicate **greater moisture stress and drier vegetation**, while lower values suggest healthier water content. Rising MSI during dry periods may support drought development or irrigation deficits. MSI is particularly useful in semi-arid regions and often complements NDMI by emphasizing stress severity.
ndsi	**Higher positive NDSI values** correspond to **snow and ice cover**, while lower or negative values indicate vegetation, soil, or water. Seasonal increases track snowfall or glacier expansion; decreases support melting or snow retreat. Shadows and bright clouds can sometimes mimic snow, so RGB validation is recommended.
fidet	**Higher FIDET values** indicate potential **active fire hotspots or thermal anomalies**, especially in dry vegetation and wildfire conditions. Sudden spikes often align with combustion or extreme surface heating. Because bright dry soils and industrial heat sources may also respond strongly, always confirm with thermal context, smoke patterns, or RGB imagery.
osavi	Similar to SAVI with a **fixed soil factor of 0.16**, offering good performance across most vegetation densities without calibration. **Rising**

Index ID	Interpretation and insights
	OSAVI tracks green-up and cover increase; interpret in the same seasonal window for meaningful comparisons. Use instead of NDVI in semi-arid or mixed cover areas.
`rdvi`	**More linear response than NDVI** in high biomass: large changes in RDVI map larger crop differences where NDVI plateaus. **Seasonal RDVI curves** support phenology tracking; **sudden drops** can flag stress, harvest, or senescence. Compare within the same crop type.
`vari`	Uses only **visible bands**—useful on platforms without NIR or when NIR quality is poor. **Higher VARI** indicates greener, healthier vegetation; **near-zero or negative** values correspond to soil, water, or built surfaces. Less reliable than NIR-based indices for dense canopy due to visible band saturation.
`tgi`	**Higher TGI** estimates more chlorophyll from visible band geometry. Best used for **relative comparisons** within an image; absolute values vary with sensor calibration. Complements NIR-based chlorophyll indices when atmospheric correction is uncertain.
`gli`	**Positive GLI** indicates green leaf coverage; **negative or near-zero** values suggest bare soil, water, or senescent material. A good visible-band complement to NDVI for quick cover assessment when NIR data are unavailable or suspect.
`mtvi2`	**Designed to resist** both soil background and atmospheric effects simultaneously. **High MTVI2** supports dense, healthy canopy; lower values indicate sparse or stressed cover. Use alongside NDVI to cross-check biomass in areas with mixed soil and vegetation.
`lswi`	**Higher LSWI** indicates more combined soil and leaf water; **falling LSWI** during the growing season may precede visible stress. Unlike NDMI, LSWI integrates both soil and canopy moisture, making it useful for **flooded fields and wetland change** detection.
`wri`	**Values above 1** strongly indicate **standing water or very wet surfaces**; **below 1** is typical for vegetated and dry land. Useful for rapid water body extraction; combine with RGB and topography to filter false positives on wet soils or shadows.

Index ID	Interpretation and insights
`awei`	**Positive AWEI** values reliably indicate **open water**, even in complex urban or mountainous terrain where simpler indices fail. **Strongly negative** values align with dry land, vegetation, and built surfaces. Better than NDWI in separating water from shadows in urban landscapes.
`swi`	**Higher SWI** indicates more moisture detected in the SWIR2 band relative to NIR; **low or negative** values suggest dry conditions. Complements LSWI and NDMI for moisture mapping at different spectral contrasts.
`ri`	**Higher RI** values point to **iron-rich or eroded soils** with reddish color; **low RI** characterizes vegetated or non-iron surfaces. Useful for mapping geological formations, exposed erosion surfaces, and bare laterite soils. Interpret cautiously where vegetation shadows darken visible bands.
`ndti`	**Higher NDTI** indicates more **crop residue** on the soil surface after harvest; **lower values** suggest bare or tilled soil. Key for **conservation tillage monitoring**—declining NDTI over time in a field suggests soil exposure and erosion risk. Best used shortly after harvest.
`ci`	**Higher CI values** indicate greater **clay mineral content**; lower values correspond to sandy or organic soils. Useful for soil mapping and geological surveys. Requires bare or sparsely vegetated soil for reliable signal—dense vegetation masks the clay signature.
`gsavi`	Like SAVI but using the green band, making it more **sensitive to chlorophyll** than red-band SAVI. **Rising GSAVI** tracks canopy green-up; **spatial variation** helps identify nitrogen gradients across fields. Compare within the same growth stage.
`eevi`	Combines EVI-like atmospheric and soil corrections without the blue band. **Higher EEVI** supports vigorous vegetation; **lower values** indicate stress or sparse cover. Useful when the blue band quality is questionable or unavailable.
`soci`	**Higher SOCI** suggests more **organic carbon** in bare soil; values are unreliable over dense vegetation because the green signal is dominated by chlorophyll. Best applied to **freshly tilled or fallow fields**. Treat absolute values as relative

Index ID	Interpretation and insights
	indicators—validate with field samples for quantitative estimates.
pri	**Positive PRI** suggests healthy photosynthetic efficiency; **near-zero or negative** values can indicate heat or drought stress. PRI using green and blue approximation is less precise than hyperspectral PRI—use for relative stress screening rather than absolute physiology.
cri	**Higher CRI** indicates elevated carotenoid relative to chlorophyll, often linked to **pest pressure, disease, or stress**. Compare within the same growth stage and crop type; background soil and mixed pixels reduce reliability at coarse spatial scales. S2 red-edge band required.
ari	**Higher ARI** suggests **anthocyanin accumulation** associated with frost, nutrient (nitrogen or phosphorus) deficiency, or senescence onset. Like CRI, best used in **early season or late season** stress detection. S2 red-edge band required.
psri	**Higher PSRI** indicates **advanced senescence, ripening, or frost damage**. Rapid PSRI rise during the growing season is a warning for premature aging. **Spatial PSRI patterns** highlight field zones under differential stress or frost exposure. S2 red-edge band required.
dswi	**Higher DSWI** suggests healthy, unstressed plants; **lower or falling DSWI** indicates combined water and disease pressure. Useful as a **single composite stress indicator** when both stressors may be present. Validate suspected disease findings with ground truth.
rvsi	**Positive RVSI** indicates canopy stress via red-edge band triplet; **near-zero or negative** values align with healthy vegetation. Sensitive to **early-stage stress** before visible symptoms appear. Requires all three red-edge bands—S2 only.
gcvi	**Higher GCVI** maps chlorophyll-rich canopy and correlates with **crop yield potential**. Often used at **heading and grain-fill stages** in cereals. Compare within the same crop type and phenological window; background soil reduces reliability at low cover.
wdrvi	Uses a weighting factor of 0.1 to **linearize response** at high biomass. **More sensitive than NDVI** in dense corn, sugarcane, and soybean.

Index ID	Interpretation and insights
	Seasonal WDRVI curves help estimate peak biomass and yield; **cross-season comparisons** require consistent acquisition geometry.
`mcari`	Sensitive to **chlorophyll absorption** and resistant to non-photosynthetic material. **Higher MCARI** reflects stronger chlorophyll absorption; **decreasing values** can flag nutrient deficiency in rice and wheat. S2 red-edge band required.
`tcari`	**More linear chlorophyll response** than MCARI; better suited to **variable chlorophyll levels** across a field. Useful for **nitrogen prescription mapping** in precision agriculture. S2 red-edge band required.
`ireci`	**High IRECI** values indicate strong red-edge response and high chlorophyll; **low values** suggest stressed or sparse vegetation. One of the most accurate chlorophyll-linked indices on S2 due to full red-edge band exploitation.
`s2rep`	Outputs the **wavelength position (nm) of the red-edge inflection**—higher values (~~730–745 nm) indicate dense, chlorophyll-rich canopy; **lower values** (~~705–715 nm) suggest sparse or stressed vegetation. Most interpretable when compared across time on the same field and crop.
`nbr2`	Uses SWIR1 vs. SWIR2 contrast rather than NIR—**more sensitive to moisture loss and subtle char** than NBR. **Lower NBR2** after fire indicates moisture-depleted burned material; **rising NBR2** supports post-fire vegetation moisture recovery.
`bai`	**High BAI** values highlight **recently burned pixels** by emphasizing spectral distance from unburned vegetation targets. Values are not normalized—use for spatial patterns and change detection rather than absolute thresholds. Confirm with RGB and NBR.
`mirbi`	**Higher MIRBI** indicates stronger mid-infrared signal associated with **active combustion or fresh burn scars**; lower values align with live vegetation. Complements NBR and BAI; best interpreted together with burn date and severity context.
`ui`	**Positive UI** highlights **urban and built-up** land; **negative values** align with vegetation and water. Compare with NDBI to cross-check built-up

Index ID	Interpretation and insights
	extent; **rising UI over time** in peri-urban areas supports expansion mapping.
`ibi`	Combines NDBI, SAVI, and MNDWI to **minimize false positives** from bare soil and water that affect simpler urban indices. **Higher IBI** more reliably isolates **impervious surfaces**; use for urban land cover mapping and change detection.
`ebbi`	**Higher EBBI** identifies **built-up or bare surfaces** while suppressing dense vegetation; the denominator (SWIR sum) normalizes for brightness. Useful where UI and NDBI confuse barren rock or bright soil with urban land—EBBI is more selective. Pair with RGB and other indices for final land-cover classification.
`rgb`	Use for **human QA**: clouds, shadows, snow, misregistration, and mixed pixels that distort indices. **Color shifts** (haze, sun angle) explain **index jumps** without real land change.
`custom`	Meaning depends entirely on the **user expression**—document the formula, expected range, and sign convention before interpreting maps or time series.

Landsat Collection 2 Level-2 SR

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
`ndvi`	Normalized Difference Vegetation Index	Long-archive vegetation health and land-cover greenness.	`rdylgn`	No	`ylgn`, `greens`, `viridis`
`evi`	Enhanced Vegetation Index	High-biomass areas and atmospherically corrected vigor.	`ylgn`	No	`rdylgn`, `greens`
`ndmi`	Normalized Difference Moisture Index	Crop and canopy moisture, irrigation timing, water stress.	`brbg`	No	`blues`, `gnbu`, `pubugn`
`ndwi`	Normalized	Surface water	`brbg`	No	`blues`, `gnbu`,

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
	Difference Water Index	and inundation mapping.			ylgnbu
savi	Soil Adjusted Vegetation Index	Sparse vegetation with soil brightness correction.	rdylgn	No	ylgn, brbg, piyg
osavi	Optimized Soil Adjusted Vegetation Index	Crop health with fixed soil factor across cover densities.	rdylgn	No	ylgn, greens, brbg
arvi	Atmospherically Resistant Vegetation Index	Vegetation under haze, aerosols, or atmospheric interference.	rdylgn	No	ylgn, viridis, cividis
gci	Green Chlorophyll Index	Chlorophyll concentration and nitrogen status.	greens	No	ylgn, viridis, summer
sipi	Structure Insensitive Pigment Index	Vegetation stress and pigment concentration.	rdylgn	No	piyg, spectral, viridis
msi	Moisture Stress Index	Vegetation water stress and drought severity.	ylorrd	No	orrd, inferno, magma
nbr	Normalized Burn Ratio	Burn scars, fire severity, and post-fire recovery.	rdylbu	**Yes**	ylorrd, orrd, reds
ndsi	Normalized Difference Snow Index	Snow and ice detection.	blues	No	gnbu, ylgnbu
rdvi	Renormalized Difference Vegetation Index	Dense crop biomass with less NDVI saturation.	ylgn	No	rdylgn, greens, viridis
vari	Visible Atmospherically Resistant Index	Visible-band-only vegetation assessment.	rdylgn	No	ylgn, greens, piyg
tgi	Triangular Greenness	Chlorophyll estimation	greens	No	ylgn,

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
	Index	from visible bands.			viridis, rdylgn
gli	Green Leaf Index	Green leaf cover fraction using visible bands.	ylgn	No	greens, rdylgn, viridis
mtvi2	Modified Triangular Vegetation Index 2	Soil and atmosphere-resistant biomass and canopy cover.	ylgn	No	greens, rdylgn, viridis
lswi	Land Surface Water Index	Combined soil and leaf water content.	blues	No	gnbu, pubugn, brbg
wri	Water Ratio Index	Water surface identification; values above 1 indicate water.	blues	No	gnbu, pubugn, ylgnbu
awei	Automated Water Extraction Index	Automated open water extraction.	blues	No	gnbu, pubugn, ylgnbu
swi	Short Wave Infrared Water Index	Moisture and water detection using NIR vs. SWIR2.	blues	No	gnbu, pubugn, brbg
ri	Redness Index	Soil iron oxide and redness for erosion risk.	reds	No	ylorrd, orrd, ylorbr
ndti	Normalized Difference Tillage Index	Crop residue and tillage status.	ylorbr	No	oranges, terrain, copper
ci	Clay Index	Clay mineral content in soil.	ylorbr	No	oranges, terrain, ylgn
gsavi	Green Soil Adjusted Vegetation Index	Green-band vegetation with reduced soil background.	rdylgn	No	ylgn, greens, brbg
eevi	Extended Enhanced Vegetation Index	Vegetation under atmospheric and soil	ylgn	No	rdylgn, greens, viridis

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
		interference.			
soci	Soil Organic Carbon Index	Soil organic carbon content estimation.	ylorbr	No	oranges, terrain, copper
pri	Photochemical Reflectance Index	Crop heat and drought stress.	rdylgn	No	piyg, brbg, rdbu
dswi	Disease Water Stress Index	Combined disease and water stress detection.	rdylgn	No	piyg, brbg, spectral
gcvi	Green Chlorophyll Vegetation Index	Crop yield prediction from chlorophyll levels.	ylgn	No	greens, viridis, rdylgn
wdrvi	Wide Dynamic Range Vegetation Index	High-biomass crops where NDVI saturates.	ylgn	No	greens, rdylgn, viridis
nbr2	Normalized Burn Ratio 2	Subtle burn damage detection (SWIR1 vs. SWIR2).	rdylbu	**Yes**	ylorrd, orrd, reds
bai	Burn Area Index	High-contrast burned area mapping.	hot	No	inferno, magma, ylorrd
mirbi	Mid Infrared Burn Index	Fire damage from mid-infrared SWIR bands.	hot	No	inferno, ylorrd, orrd
ui	Urban Index	Urban and built-up land mapping.	greys	No	oranges, purples, ylorbr
ibi	Index Based Built-up Index	Accurate urban mapping combining NDBI, SAVI, MNDWI.	greys	No	oranges, purples, ylorbr
ebbi	Enhanced Built-up and Bareness Index	Built-up vs. bare soil discrimination.	greys	No	oranges, ylorbr, terrain

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
`custom`	Custom Index	User-defined expression on Landsat SR bands.	`rdylgn`	No	Any palette from system palette catalog

Landsat C2 L2 SR — interpretation and insights

Index ID	Interpretation and insights
`ndvi`	Same ecological reading as Sentinel-2 NDVI on **harmonized surface reflectance**; **long archive** supports **decadal trend** and disturbance recovery. Values **below ~0.2** are typically non-vegetated; **0.2–0.5** sparse to moderate cover; **above ~0.6** dense vegetation. Watch **BRDF and off-nadir** effects on steep terrain.
`evi`	**Dense agriculture and forest** where NDVI saturates: EVI separates biomass levels better. **Downward EVI** with little land-cover change can mean stress or senescence. Cross-sensor studies should harmonize scaling with Sentinel-2 EVI.
`ndmi`	**NIR vs. SWIR1** canopy moisture: **higher NDMI** = wetter canopy; **declining NDMI** under constant phenology suggests drought or irrigation deficit. Less affected by chlorophyll than NDVI.
`ndwi`	**Positive** pixels favor **open water** and inundation; **negative** dominate vegetated land. **Flood pulses** show as new positive corridors; confirm with elevation and permanent water masks.
`savi`	Lifts signal over bright soil—**sparse and emerging crops** look more realistic than raw NDVI. Rising SAVI supports establishment and cover increase.
`osavi`	Fixed soil factor of 0.16 gives good performance across most vegetation densities without calibration. Compare in the same seasonal window.
`arvi`	More stable than NDVI under haze or aerosols. Use when optical quality is marginal; interpret trends like NDVI but expect smaller atmosphere-driven jumps.
`gci`	**Higher GCI** indicates increased leaf chlorophyll

Index ID	Interpretation and insights
	and photosynthetic activity. **Lower or declining GCI** can signal nutrient stress or chlorophyll loss.
`sipi`	**Higher SIPI** often indicates vegetation stress or carotenoid dominance. Compare within similar crop stages—absolute thresholds vary by species.
`msi`	**Higher MSI** indicates greater moisture stress and drier vegetation. Rising MSI during dry periods supports drought development or irrigation deficits.
`nbr`	**Lower NBR** (more negative relative to pre-fire) marks char and severe burn. **ΔNBR** is the standard severity workflow; rising NBR over years supports regrowth monitoring.
`ndsi`	**Higher positive NDSI** corresponds to snow and ice cover. Seasonal increases track snowfall; decreases support melting or snow retreat.
`rdvi`	More linear response than NDVI in high biomass. Seasonal RDVI curves support phenology tracking; sudden drops can flag stress or harvest.
`vari`	Uses only **visible bands**—useful when NIR quality is poor. Higher VARI indicates greener vegetation; less reliable for dense canopy due to visible band saturation.
`tgi`	Higher TGI estimates more chlorophyll from visible band geometry. Best used for relative comparisons within an image.
`gli`	**Positive GLI** indicates green leaf coverage; **negative or near-zero** values suggest bare soil or water. Good visible-band complement to NDVI.
`mtvi2`	Designed to resist both soil background and atmospheric effects. High MTVI2 supports dense healthy canopy; use alongside NDVI to cross-check biomass.
`lswi`	**Higher LSWI** indicates more combined soil and leaf water. Falling LSWI during the growing season may precede visible stress.
`wri`	**Values above 1** strongly indicate standing water or very wet surfaces. Combine with RGB and topography to filter false positives.
`awei`	**Positive AWEI** reliably indicates open water even in complex terrain. Strongly negative

Index ID	Interpretation and insights
	values align with dry land and built surfaces.
`swi`	**Higher SWI** indicates more moisture in SWIR2 vs. NIR. Complements LSWI and NDMI for moisture mapping at different spectral contrasts.
`ri`	**Higher RI** points to iron-rich or eroded soils. Useful for geological formations and exposed erosion surfaces.
`ndti`	**Higher NDTI** indicates more crop residue after harvest. Declining NDTI over time suggests soil exposure and erosion risk.
`ci`	**Higher CI** indicates greater clay mineral content. Requires bare or sparsely vegetated soil for reliable signal.
`gsavi`	More sensitive to chlorophyll than red-band SAVI. Rising GSAVI tracks canopy green-up; spatial variation helps identify nitrogen gradients.
`eevi`	Combines EVI-like corrections without blue band. Higher EEVI supports vigorous vegetation; useful when blue band quality is questionable.
`soci`	**Higher SOCI** suggests more organic carbon in bare soil. Best applied to freshly tilled or fallow fields—validate with field samples for quantitative estimates.
`pri`	**Positive PRI** suggests healthy photosynthetic efficiency; **near-zero or negative** can indicate heat or drought stress. Use for relative stress screening.
`dswi`	**Higher DSWI** suggests healthy, unstressed plants; **lower or falling DSWI** indicates combined water and disease pressure.
`gcvi`	**Higher GCVI** maps chlorophyll-rich canopy and correlates with crop yield potential. Compare within the same crop type and phenological window.
`wdrvi`	More sensitive than NDVI in dense corn, sugarcane, and soybean. Seasonal WDRVI curves help estimate peak biomass and yield.
`nbr2`	Uses SWIR1 vs. SWIR2 contrast—more sensitive to moisture loss and subtle char than NBR. Rising NBR2 supports post-fire vegetation moisture recovery.
`bai`	High BAI values highlight recently burned pixels. Use for spatial patterns and change

Index ID	Interpretation and insights
	detection rather than absolute thresholds. Confirm with RGB and NBR.
`mirbi`	**Higher MIRBI** indicates stronger mid-infrared signal associated with active combustion or fresh burn scars. Complements NBR and BAI.
`ui`	**Positive UI** highlights urban and built-up land. Rising UI over time in peri-urban areas supports expansion mapping.
`ibi`	Combines NDBI, SAVI, and MNDWI to minimize false positives from bare soil and water. Higher IBI more reliably isolates impervious surfaces.
`ebbi`	**Higher EBBI** identifies built-up or bare surfaces while suppressing dense vegetation. More selective than UI and NDBI where barren rock or bright soil causes confusion.
`custom`	Interpret only after defining **band math and units** on Landsat SR assets; validate against known sites before operational thresholds.

Sentinel-1 GRD

Index ID	Full name	Purpose / reason to use	Default palette	Reversed	Suggested alternative palettes
`rvi`	Radar Vegetation Index	Vegetation structure from VH/VV backscatter when optical data are cloudy or unavailable.	`rdylgn`	No	`ylgn`, `greens`, `viridis`
`custom`	Custom Index	User-defined SAR expression on polarizations.	`rdylgn`	No	Any palette from system palette catalog

Sentinel-1 GRD — interpretation and insights

Index ID	Interpretation and insights
`rvi`	**Higher RVI** generally indicates **more volumetric vegetation** and **cross-polarization** from stems and leaves; **low RVI** aligns with bare soil, smooth open water, or very sparse cover. **Works through cloud**—use for **gap-**

Index ID	Interpretation and insights
	filling when optical indices are missing. **Soil moisture, surface roughness, and look angle** change backscatter, so interpret **relative change** on stable land cover and pair with **weather and optical** when possible. **Sudden drops** after rain may be moisture, not biomass loss.
`custom`	SAR expressions are **geometry- and moisture-sensitive**; calibrate on **known fields** and avoid comparing **different pass directions** without normalization.

MODIS (Planetary Computer)

MODIS layers are **native product bands or QA rasters**, not app-derived formulas, except `500m_16_days_EVI` and `500m_16_days_NDVI` under `modis-13A1-061` (see main MODIS section). In `stac/modis_indices.py`, **every layer defaults to `rdylgn`** with collection-specific **min/max** stretches for display.

Product family (collection prefix)	Representative layers	Purpose / reason to use	Default palette	Notes on alternatives
Surface reflectance (`modis-09A1-061`, `modis-09Q1-061`)	`sur_refl_b01`–`b07`, QA/state	Calibrated reflectance for custom indices and land-cover analysis.	`rdylgn`	`viridis`, `ylorrd`, or `terrain` for single-band reflectance; QA layers often `greys` or `spectral`
Snow (`modis-10A1-061`, `modis-10A2-061`)	`NDSI_Snow_Cover`, `Eight_Day_Snow_Cover`	Snow extent, melt, and seasonal persistence.	`rdylgn`	`blues`, `gnbu`, `coolwarm` for snow vs. no-snow
LST / emissivity (`modis-11A1-061`, `modis-11A2-061`, `modis-21A2-061`)	`LST_Day_1km`, `LST_Night_1km`, emissivity bands	Land surface temperature, heat stress, and energy-balance context.	`rdylgn`	`inferno`, `plasma`, `ylorrd`, `coolwarm` after physical scaling
Vegetation indices (`modis-13A1-061`, `modis-13Q1-061`)	`*_NDVI`, `*_EVI`, reflectance composites	Regional crop condition, phenology, and biomass proxies.	`rdylgn`	`ylgn`, `greens` for VI-only maps; match S2/Landsat VI styling

Product family (collection prefix)	Representative layers	Purpose / reason to use	Default palette	Notes on alternatives
Fire (`modis-14A1-061`, `modis-14A2-061`)	`FireMask`, `MaxFRP`	Active fire and thermal anomaly detection.	`rdylgn`	`ylorrd`, `orrd`, `reds`, `inferno`
FPAR / LAI (`modis-15A2H-061`, `modis-15A3H-061`)	`Fpar_500m`, `Lai_500m`	Canopy structure and absorbed PAR for productivity models.	`rdylgn`	`greens`, `ylgn`, `viridis`
Evapotranspiration (`modis-16A3GF-061`)	`ET_500m`, `PET_500m`	Annual water use and drought / irrigation performance.	`rdylgn`	`blues`, `pubugn`, `brbg`
GPP / NPP (`modis-17A2H-061`, `modis-17A2HGF-061`, `modis-17A3HGF-061`)	`Gpp_500m`, `Npp_500m`	Ecosystem and crop productivity, carbon uptake.	`rdylgn`	`greens`, `ylgn`, `viridis`
BRDF nadir reflectance (`modis-43A4-061`)	`Nadir_Reflectance_Band1`–`Band7`	Geometry-reduced reflectance for consistent multi-date comparison.	`rdylgn`	`viridis`, `terrain`, band-specific sequential maps
Burned area (`modis-64A1-061`)	`Burn_Date`, `QA`	Monthly fire scars and disturbance timing.	`rdylgn`	`ylorrd`, `orrd`, `spectral` for categorical burn date

MODIS — interpretation and insights

Product family	Interpretation and insights
Surface reflectance	**Band reflectance** rises and falls with **cover type and season**; build **custom indices** only after **scale factors and fill values** from the product guide. **QA/state flags** explain **stripes and outliers**—mask before trend analysis. **8-day composites** smooth clouds but **blur rapid events**.
Snow	**Higher snow-cover fractions** mark **persistent snow**; **daily vs. 8-day** products differ in **noise vs. stability**. **Early melt** shows as **declining cover** at fixed elevation; **false snow** possible on

Product family	Interpretation and insights
	bright cloud or sand—use QA.
LST / emissivity	**Stored values are scaled**—convert to **kelvins or °C** per MODIS documentation before thresholds. **Day minus night** patterns highlight **thermal inertia** (water vs. rock vs. soil). **Heat waves** appear as **anomalies vs. climatology**; **emissivity** aids **surface-type** separation.
Vegetation indices	**NDVI/EVI composites** summarize **regional greenness** at **250–500 m**; **rising VI** through the growing season is normal; **regional VI depression** vs. prior years supports **drought or failure** screening. **Pixel reliability and VI quality** must be applied before **yield or area statistics**.
Fire	**Fire mask / FRP** indicate **active combustion**—**hotspots** are not always **mapped scars**. **8-day composites** aggregate **persistent activity**; corroborate with **air quality and news** for mitigation context.
FPAR / LAI	**Higher FPAR/LAI** means **more absorbed PAR and leaf area** at the canopy level. **Dropping LAI** across composites can mean **senescence, harvest, or disturbance**; **std dev layers** show **sub-pixel heterogeneity**.
Evapotranspiration	**ET vs. PET** contrast highlights **water-limited** behavior (**low ET/PET** under energy-limited conditions needs care). **Annual gap-filled ET** supports **basin water balance** and **irrigation performance** at **coarse resolution**—not field-scale scheduling alone.
GPP / NPP	**GPP** tracks **photosynthetic uptake**; **NPP** is **net carbon** after respiration. **Positive seasonal integrals** support **productivity ranking** across biomes; **negative or low anomalies** flag **stress years**. Use **PSN/NPP QC** masks.
BRDF nadir reflectance	**Nadir-adjusted reflectance** reduces **sun-angle artifacts** for **multi-date comparison**. Still **coarse**; interpret **trends**, not individual pixels, for **agriculture**.
Burned area	**Burn date** encodes **timing within the month**; **uncertainty** layers qualify **confidence**. **New scars** vs. **regrowth** appear as **changes in date class** month to month—pair with **optical NBR** where possible.

Pass `colormap` on `GET /api/modis/image/<geometry_id>/` to override the registry

default per request.

System palette catalog

Palettes below are the **complete** set exposed by `GET /api/misc/colors/` (`stac/enums.Colormap`). Use the **API slug** (lowercase) as the `colormap` query value on image endpoints.

API slug	Display name (informal)	Typical use
`viridis`	Viridis	General-purpose sequential; perceptually uniform
`plasma`	Plasma	High-contrast sequential
`inferno`	Inferno	Heat, fire, LST-style sequential (dark to bright)
`magma`	Magma	High-contrast sequential (dark to light)
`cividis`	Cividis	Colorblind-friendly sequential
`terrain`	Terrain	Elevation-like or topographic context
`rainbow`	Rainbow	Legacy high-chroma sequential (not perceptually uniform)
`jet`	Jet	Legacy jet (not perceptually uniform)
`turbo`	Turbo	Improved jet alternative
`blues`	Blues	Water, moisture, low-to-high blue sequential
`greens`	Greens	Vegetation amount, LAI-style sequential
`reds`	Reds	Burn, stress, or intensity sequential
`greys`	Greys	Built-up, single-band greyscale
`ylgn`	Yellow–green	Vegetation vigor sequential
`ylgnbu`	Yellow–green–blue	Vegetation to water transitions
`gnbu`	Green–blue	Moisture or water emphasis
`bugn`	Blue–green	Cool/moist sequential
`pubugn`	Purple–blue–green	Water-depth or wetness styling
`pubu`	Purple–blue	Cool sequential
`bupu`	Blue–purple	Cool diverging toward purple
`rdpu`	Red–purple	Warm-to-cool sequential
`purd`	Purple–red	Purple-base warm sequential
`orrd`	Orange–red	Fire and hot-spot emphasis
`ylorrd`	Yellow–orange–red	Burn severity, drought stress

API slug	Display name (informal)	Typical use
`ylorbr`	Yellow–orange–brown	Soil dryness, bare ground
`purples`	Purples	Urban or single-hue sequential
`oranges`	Oranges	Built-up or warm sequential
`rdylgn`	Red–yellow–green	Signed vegetation indices (−1 to +1 or 0–1)
`rdylbu`	Red–yellow–blue	Burn/wetness diverging (often with reverse for NBR)
`rdgy`	Red–grey	Diverging stress maps
`rdbu`	Red–blue	Two-class diverging
`piyg`	Pink–yellow–green	Vegetation vs. background diverging
`prgn`	Purple–green	Land-cover class contrast
`brbg`	Brown–blue–green	Moisture or land–water diverging
`spectral`	Spectral	Multi-class or categorical emphasis
`coolwarm`	Cool–warm	Temperature or anomaly diverging

Choosing a palette: use **diverging** maps (`rdylgn`, `brbg`, `rdylbu`, `piyg`) when the index has a meaningful midpoint (for example NDVI near zero). Use **sequential** maps (`ylgn`, `greens`, `blues`, `viridis`) for one-directional quantities (LAI, moisture from low to high). Use **thermal** or **fire** sequentials (`inferno`, `ylorrd`, `orrd`) for burns, LST, and active fire after values are physically scaled. Prefer `cividis` or `viridis` when colorblind-safe reading matters.