

A temporally consistent 8-day 0.05° gap-free snow cover extent dataset over the Northern Hemisphere for the period 1981–2019

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Table S1. Quality control descriptions of the AVHRR-SR CDR.

| Bit | Description | Value=1 | Value=0 |
|-----|---|---------|---------|
| 15 | polar flag (latitude > 60 degrees (land) or 50 degrees (ocean)) | Yes | No |
| 14 | BRDF-correction issues | Yes | No |
| 13 | RHO3 value is invalid | Yes | No |
| 12 | Channel 5 value is invalid | Yes | No |
| 11 | Channel 4 value is invalid | Yes | No |
| 10 | Channel 3 value is invalid | Yes | No |
| 9 | Channel 2 value is invalid | Yes | No |
| 8 | Channel 1 value is invalid | Yes | No |
| 7 | Channels 1 - 5 are valid | Yes | No |
| 6 | Pixel is at night (high solar zenith) | Yes | No |
| 5 | Pixel is over dense dark vegetation | Yes | No |
| 4 | Pixel is over sunglint | Yes | No |
| 3 | Pixel is over water | Yes | No |
| 2 | Pixel contains cloud shadow | Yes | No |
| 1 | Pixel is cloudy | Yes | No |

Table S2. IGBP legend and class definitions of MCD12C1 product

| Value | Name | Description |
|-------|-------------------------------------|--|
| 1 | Evergreen Needleleaf Forests | Dominated by evergreen conifer trees (canopy >2m). Tree cover >60%. |
| 2 | Evergreen Broadleaf Forests | Dominated by evergreen broadleaf and palmate trees (canopy >2m). Tree cover >60%. |
| 3 | Deciduous Needleleaf Forests | Dominated by deciduous needleleaf (larch) trees (canopy >2m). Tree cover >60%. |
| 4 | Deciduous Broadleaf Forests | Dominated by deciduous broadleaf trees (canopy >2m). Tree cover >60%. |
| 5 | Mixed Forests | Dominated by neither deciduous nor evergreen (40-60% of each) tree type (canopy >2m). Tree cover >60%. |
| 6 | Closed Shrublands | Dominated by woody perennials (1-2m height) >60% cover. |
| 7 | Open Shrublands | Dominated by woody perennials (1-2m height) 10-60% cover. |
| 8 | Woody Savannas | Tree cover 30-60% (canopy >2m). |
| 9 | Savannas | Tree cover 10-30% (canopy >2m). |
| 10 | Grasslands | Dominated by herbaceous annuals (<2m). |
| 11 | Permanent Wetlands | Permanently inundated lands with 30-60% water cover and >10% vegetated cover. |
| 12 | Croplands | At least 60% of area is cultivated cropland. |
| 13 | Urban and Built-up Lands | At least 30% impervious surface area including building materials, asphalt, and vehicles. |
| 14 | Cropland/Natural Vegetation Mosaics | Mosaics of small-scale cultivation 40-60% with natural tree, shrub, or herbaceous vegetation. |
| 15 | Permanent Snow and Ice | At least 60% of area is covered by snow and ice for at least 10 months of the year. |
| 16 | Barren | At least 60% of area is non-vegetated barren (sand, rock, soil) areas with less than 10% vegetation. |
| 17 | Water Bodies | At least 60% of area is covered by permanent water bodies. |

Table S3. Cloud detection tests and their threshold values.

| Target | switch | Height (m) | SR ₁ (-) | SR ₂ (-) | SR ₃ (-) | SR ₁ -SR ₂ (-) | NDVI (-) | NDSI (-) | BT ₁₁ (K) | BT ₃₇ -BT ₁₁ (K) | BT ₁₁ -BT ₁₂ (K) |
|--------|--------|---------------|------------------------|------------------------|------------------------|---|-------------|-------------|-------------------------|---|---|
| A | on | < 3000 | | | | | | | ≥ 240 | > 8 | |
| | on | ≥ 3000 | | | | | | | ≥ 240 | > 15 | |
| B | on | | | | | | | | < 240 | > 20 | |
| | on | | | >0.1 | | > -0.02 | | < 0.88 | | | |
| | off | | | | | | | > 0.5 | | > 288 | |
| | off | | | | | | | | | > 310 | |
| | on | | | | | | | | | < 260 | > 8 |
| | on | | | | | > -0.02 | | | | < 310 | > 10 |
| | on | | >0.3 | | | | | | | < 293 | > 9 |
| | on | | | >0.4 | | | | | | < 293 | > 8 |
| | on | | | >0.4 | | | | | | < 278 | > 20 |
| | on | | > 0.3 | | | >0.2 | | | | < 263 | > -1 |
| | off | | | | | | | >0.5 | | > 288 | |
| | off | | | | | | | | | > 310 | |
| 25 | off | > 1000 | | < 0.4 | | | < -0.04 | | | > 275 | |
| | off | | | | | | < -0.05 | | | > 300 | |

This table comes from Hori et al. (2017). Target A indicates high and cold land (elevation > 300 m and BT₁₁ < 260 K); Target B indicates other land. The cloud detection test was conducted from the top of the list to the bottom for each target. If the cloudy flag switch was "on", the pixel was set to cloudy when the threshold tests met the conditions listed on the right-hand side. If the switch was "off", the pixel identified as cloudy in the previous tests was reset to clear.

$$\text{NDVI} = (SR_2 - SR_1) / (SR_2 + SR_1) \quad \text{NDSI} = (SR_1 - SR_3) / (SR_1 + SR_3)$$

Table S4. 8-Day Periods.

| Period No. | Year Days | Period No. | Year Days |
|------------|-----------|------------|-----------|
| 1 | 1-8 | 24 | 185-192 |
| 2 | 9-16 | 25 | 193-200 |
| 3 | 17-24 | 26 | 201-208 |
| 4 | 25-32 | 27 | 209-216 |
| 5 | 33-40 | 28 | 217-224 |
| 6 | 41-49 | 29 | 225-232 |
| 7 | 49-56 | 30 | 233-240 |
| 8 | 57-64 | 31 | 241-248 |
| 9 | 65-72 | 32 | 249-256 |
| 10 | 73-80 | 33 | 257-264 |
| 11 | 81-88 | 34 | 265-272 |
| 12 | 89-96 | 35 | 273-280 |
| 13 | 97-104 | 36 | 281-288 |
| 14 | 105-112 | 37 | 289-296 |
| 15 | 113-120 | 38 | 297-304 |
| 16 | 121-128 | 39 | 305-312 |
| 17 | 129-136 | 40 | 313-320 |
| 18 | 137-144 | 41 | 321-328 |
| 19 | 145-152 | 42 | 329-336 |
| 20 | 153-160 | 43 | 337-344 |
| 21 | 161-168 | 44 | 345-352 |
| 22 | 169-176 | 45 | 353-360 |
| 23 | 177-184 | 46 | 361-368* |

This table comes from Riggs and Hall (2015). *Includes 2 or 3 days from next year, depending on leap year

References

Hori, M., Sugiura, K., Kobayashi, K., Aoki, T., Tanikawa, T., Kuchiki, K., Niwano, M., and Enomoto, H.: A 38-year (1978–2015) Northern Hemisphere daily snow cover extent product derived using consistent objective criteria from satellite-borne optical sensors, *Remote Sens. Environ.*, 191, 402-418, <https://doi.org/10.1016/j.rse.2017.01.023>, 2017.

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