Table S1. List of feature variables used in the canopy height extrapolation model derived from multisource remote sensing data.

Feature variables	Description
Slope	Slope Parameter Calculated from DEM Data
Precipitation	Annual Average Precipitation (Resampled to 30 m)
Elevation	*ASTER GDEM*
Temperature	Annual Average Temperature (Resampled to 30 m)
Vapor	*B9(Water Vapor)*
SWIR1	*B11(ShortWave InfraRed1)*
VRE1	*B5(Vegetation Red Edge1)*
SWIR2	*B12(ShortWave InfraRed2)*
MTCI	*MTCI=(VRE2-VRE1)/(VRE1-R)* *VRE2-B6(Vegetation Red Edge2)/VRE1-B5(Vegetation Red Edge1)/R-B4(Red)*
S2REP	*S2REP*=705+35×((*R*+*VRE3*)/2-*VRE1*)/(*VRE2-VRE1*) *R-B4(Red)/VRE3-B7(Vegetation Red Edge3)/VRE1-B5(Vegetation Red Edge1)/VRE2-B6(Vegetation Red Edge2)*
EVI	*EVI*=2.5×(*NIR-R*/*NIR*+6×*R*-7.5×*B*+1) *NIR-B8(Near InfraRed)/R-B4(Red)*
NDBI	*NDBI=(SWIR1-NIR)/(SWIR1+NIR)* *SWIR1-B11(ShortWave InfraRed1)/NIR-B8(Near InfraRed)*
MCARI	*MCARI=((VRE1-R)-0.2×(VRE1-G))×(VRE1/R)* *VRE1-B5(Vegetation Red Edge1)/R-B4(Red)/G-B3(Green)*
IRECI	*IRECI=(VRE3-R)/(VRE1/VRE2)* *VRE1-B5(Vegetation Red Edge1)/VRE2-B6(Vegetation Red Edge2)/VRE3-B7(Vegetation Red Edge3)/R-B4(Red)*
NDWI	*NDWI=(G-NIR)/(G+NIR)* *G-B3(Green)/NIR-B8(Near InfraRed)*
NDVI	*NDVI*= (*NIR-R*)/(*NIR*+*R*) *NIR-B8(Near InfraRed)/R-B4(Red)*
RVI	*RVI*= *NIR*/*R* *NIR-B8(Near InfraRed)/R-B4(Red)*

Table S2. Extraction of feature variables from Sentinel-2A data.

Number	Feature Variable	Calculation Method
1	CIRE	$\rho red_edg3 / \rho red_edg1 - 1$
2	PSRI	$(\rho red - \rho green) / \rho red_edg2$
3	S-NDWI	$(\rho nir - \rho swir2) / (\rho nir + \rho swir2)$
4	S-NDVI	$(\rho \mathrm{nir} - \rho red) / (\rho nir + \rho red)$
5	S-RVI	$\rho \mathrm{nir} / \rho red$
6	LAI	PROSPECT+SAIL Radiative Transfer Model
7	FAPAR	
8	CWC	
9	FVC	

Note: Vegetation indices and biophysical parameters derived from Sentinel-2A data used as feature variables in the random forest model for forest age estimation. where *ρred_edg1*, *ρred_edg2*, *ρred_edg3*, *ρnir*, *ρred, and ρswir2* represent red edge band 1, red edge band 2, red edge band 3, the near-infrared band, the red band, and shortwave infrared band 2, respectively, of the Sentinel 2 data.

Table S3. Spectral indices and texture measures derived from Landsat 7 data used as feature variables in the random forest model for forest age estimation.

Number	Feature Variable	Calculation Formula
1	B	$B = 0.356B1 + 0.397B2 + 0.390B3 + 0.700B4 + 0.229B5 + 0.160B7$
2	G	$G = -0.334B1 - 0.354B2 - 0.456B3 + 0.700B4 - 0.024B5 - 0.263B7$
3	W	$W = 0.263B1 + 0.2141B2 + 0.093B3 + 0.066B4 - 0.763B5 - 0.539B7$
4	L-NDVI	$(B4 - B7) / (B4 + B7)$
5	L-SAVI	$(B4 - B3) / (B4 + B3)$
6	L-NBR	$(1 + L)(B4 - B3) / (B4 + B3 + L), L = 0.5$
7	DI	$Br = (B - B\mu) / B\sigma; Gr = (G - G\mu) / G\sigma; Wr = (W - W\mu) / W\sigma$
8	IFZ	$\sqrt{\frac{1}{NB}} \sum_{i=1}^{NB} [(b_{pi} - \overline{b_i}) / SD_I]2$
9	L-MSI	$ETM5 / ETM4$
10	ENT	$Entropy = -\sum_h \sum_k m_{hk} \lg(m_{hk})$
11	MN	$Mean = \sum_h \sum_k h \times m_{hk}$
12	VAR	$Variance = \sum_h \sum_k m_{hk} \times (h - Mean)^2$
13	CON	$Contrast = \sum_h \sum_k (h-k)^2 m_{hk}$
14	DIS	$Dissimilarity = \sum_h \sum_k \lvert h - k \rvert m_{hk}$
15	HOM	$Homogeneity = \sum_h \sum_k \frac{m_{hk}}{1 + (h-k)^2}$

Note: In these formulas*, B1, B2, B3, B4, B5, and B7* represent the reflectances of bands *1, 2, 3, 4, 5,* and 7, respectively. *B, G,* and *W* represent the brightness index, greenness index, and wetness index, respectively. *Br*, *Gr* and *Wr* are the rescaled values of *B*, *G* and *W, respectively*. *Bμ, Gμ* and *Wμ* represent the mean values of B, G, and W, respectively. *Bσ*, *Gσ*,

and $W\sigma$ represent the standard deviations of B, G, and W, respectively. $\overline{b_i}$ and SD_I are the means and standard deviations of the training pixels within the I-band image. b_{pi} is the spectral value of the i band pixel p. NB is the number of spectral bands.

Table S4. Ranking of feature variable importance for estimating the forest age of the dominant tree species in Shangri-La based on the mean decrease accuracy (MDA) metric.

Dominant tree species	**Feature importance ranking results**
P. densata Mast.	*h_canopy > L_NDVI > VH > VV > L-B1 > L-B2 > DEM > L-B3 > PSRI > Temperature > CIRE > (…)*
A. fabri (Mast.) Craib	*h_canopy > L_NDVI > Slope > LAI>CWC > Temperature > DEM > L-B1 > IFZ > MN > (…)*
P. yunnanensis Franch.	*Precipitation > h_canopy > DEM > Slope > Temperature > PSRI > L-B2 > VV > L-B1 > VH > (…)*
Q. aquifolioides Rehd. & E. H. Wils.	*Temperature > DEM > Precipitation > h_canopy > L-B1 > L-B2 > Slope > IFZ > CWC > S-NDWI > (…)*
P. asperata Mast.	*h_canopy > DEM > L-B1 > L-B2> L-B3 > Precipitation > VAR > NDWI > Temperature > CIRE > (…)*