HSI-Drive Release Notes

HSI-Drive is the hyperspectral image (HSI) dataset created by the Digital Electronics Design Group (GDED) of the University of the Basque Country (UPV/EHU). This database is intended to contribute to the research into the use of hyperspectral imaging for the development of advanced driver assistance systems (ADAS) and autonomous driving systems (ADS). The dataset contains a diverse set of images recorded with a small-size 25-band VNIR snapshot camera mounted on a moving automobile. The recordings have been made in different seasons of the year, at different day times, under different weather conditions and on different types of roads. The dataset contains images and videos classified and tagged accordingly to provide rich and diverse data.

Why a HSI dataset for ADAS/ADS?

The hypothesis is that the rich spectral information provided by hyperspectral sensors can help develop more robust and more efficient ADS:

1. More robust: Because spectral information beyond the visible range can be used to better separate objects and backgrounds in challenging driving scenarios due to changing weather and illumination conditions, rapid changes in target appearance, and multiple occlusions among different objects.
2. More efficient: Because more information at the source should result in systems with fewer processing requirements by simplifying the complex processing pipeline of current image-based scene understanding systems.

The dataset

HSI-Drive contains images and video sequences obtained in diverse scenarios and under diverse environmental conditions. All recordings have been made on roads and in towns in the province of Biscay, in the Basque Country, Spain. The dataset is organized according to four parameters:

1. Season of the year: winter, spring, summer and fall.
2. Day time: dawn, full daylight and sunset.
3. Weather: sunny, cloudy, wet/rainy and foggy.
4. Road type: urban streets and roads, interurban and country roads, and highways.

The first version of the dataset (v1.0) contained 276 annotated images from recordings taken during spring and summer. Version v1.1 fixes some bugs and errors detected in a few ground-truth images of the dataset. Version v2.0 contains 752 images, incorporating new images taken during fall and winter. Version 2.1 does not incorporate new labelled images, but a relabeling process has been conducted to augment de number of labelled pixels at each image. The setting of the cube preprocessing pipeline functions has also be revisited.

Setup

The recording system setup for this project was extremely simple, consisting of just one Photonfocus MV1-D2048x1088-HS02-96-G2 camera. The Photonfocus MV1 camera is a small-size snapshot camera with a GigEVision interface that can run at up to 42fps depending on its configuration. A 12-bit resolution has been used for raw binary information coding, while the camera throughput has been limited to 11fps to avoid excessive memory consumption. The selected optics was an Edmund Optics 16mm C Series VIS-NIR fixed focal length lens. Attached to the MV1, this lens provides a 30.9º FOV.

The sensor

The Imec sensor is a 25-band CMV2K SSM5x5 NIR (600nm-975nm) sensor based on a CMOSIS CMV200 image wafer sensor with 5µmx5µm pixel size and 2048x1088 resolution. The spectral bands are obtained by a mosaic of Fabri-Perot filters that produce 2D images with 5x5 pixel windows.

Labeling

This dataset is aimed at the development of pixel-level classification systems that directly or indirectly rely on the separability of the spectral signature of materials and on features obtained from spectral information. The labeling of classes for the image annotation has been performed according to material surface reflectances, but also guided by the requirements of the final application (ADS/ADAS).

The annotation procedure has been very conservative, manually selecting only the areas that clearly belong to each class, and leaving the edges and some areas of the background unlabeled. This procedure favours that all pixels in a class subset contain only the spectral reflectances of the class concerned. This approach is aimed to maximize ML training based on spectral features to the detriment of techniques that rely on spatial features.

1. Version 1.1

Corrected Ground-truth images

In the process of analyzing the spectral characteristics of some HS images in the v1.0 dataset, we detected that a few ground-true image files that did not correspond to the raw images and HSI cubes with the same image identifiers. We have fixed this bug in the v1.1 release:

nf4122_189.png
nf4122_190.png
nf4122_191.png
nf4122_192.png
nf4122_193.png

In the same process, we detected some ground-truth images with defective or dubious labelling in some areas. We have improved the labelling in the following files:

nf4121_039.png
nf4121_042.png
nf3131_243.png
nf4132_055.png
nf3432_072.png
nf3221_082.png
nf3232_100.png
nf3313_135.png
nf3312_209.png
nf4311_239.png
nf3131_243.png
nf3431_244.png
nf4222_278.png
nf4223_282.png
nf4223_283.png
nf4312_300.png

There was a duplicated image: images **nf3313_135** and **nf_4313_230** were the same one. We have selected a new scene for **nf_4313_230** and created its corresponding cube and ground-truth images.

nf_4313_230.png

New binary encoding

We have added cube files with 32-bit single precision floating point encoding for enhanced accuracy of reflectance values.

Denormalizing coefficients

The processing pipeline to generate HS cubes from raw images in the HSI-Drive v1.0 database includes a final band normalization stage. Band normalization was performed by per-image band reflectance values. This procedure may affect ML training processes due to non-constant normalization coefficients. We have added the normalization coefficients of every image in the dataset so users can denormalize cubes and retrieve original reflectance values before the normalization stage.

We provide a new Matlab function **denormalize.m** for cube denormalization using the **mapminmax** function.

Proposed image dataset splitting for ML training

Train set	Validation set	Test set
nf3112_105.png	nf3112_104.png	nf3112_108.png
nf3112_106.png	nf3121_139.png	nf3121_228.png
nf3112_107.png	nf3121_225.png	nf3121_229.png
nf3121_140.png	nf3122_144.png	nf3122_148.png
nf3121_141.png	nf3123_149.png	nf3123_153.png
nf3121_142.png	nf3131_240.png	nf3131_263.png
nf3121_143.png	nf3132_109.png	nf3132_113.png
nf3121_226.png	nf3211_251.png	nf3211_255.png
nf3121_227.png	nf3212_092.png	nf3212_096.png
nf3122_145.png	nf3221_082.png	nf3221_223.png
nf3122_146.png	nf3221_220.png	nf3221_224.png
nf3122_147.png	nf3222_077.png	nf3222_081.png
nf3123_150.png	nf3223_334.png	nf3223_337.png
nf3123_151.png	nf3231_103.png	nf3231_262.png
nf3123_152.png	nf3232_099.png	nf3232_101.png
nf3131_241.png	nf3232_100.png	nf3232_250.png
nf3131_242.png	nf3233_330.png	nf3233_332.png
nf3131_243.png	nf3311_125.png	nf3311_128.png
nf3132_110.png	nf3312_130.png	nf3312_208.png
nf3132_111.png	nf3312_131.png	nf3312_209.png
nf3132_112.png	nf3313_134.png	nf3313_138.png
nf3211_252.png	nf3313_137.png	nf3313_342.png
nf3211_253.png	nf3431_244.png	nf3431_257.png
nf3211_254.png	nf3432_075.png	nf3432_258.png
nf3212_093.png	nf3432_248.png	nf3432_259.png
nf3212_094.png	nf4111_187.png	nf4111_188.png
nf3212_095.png	nf4112_189.png	nf4112_217.png
nf3221_083.png	nf4112_200.png	nf4112_218.png
nf3221_084.png	nf4112_215.png	nf4112_219.png

nf3221_085.png	nf4121_031.png	nf4121_043.png
nf3221_086.png	nf4121_037.png	nf4121_044.png
nf3221_221.png	nf4121_042.png	nf4121_045.png
nf3221_222.png	nf4122_029.png	nf4122_030.png
nf3222_078.png	nf4123_016.png	nf4123_024.png
nf3222_079.png	nf4123_023.png	nf4123_025.png
nf3222_080.png	nf4131_285.png	nf4131_286.png
nf3223_333.png	nf4132_046.png	nf4132_089.png
nf3223_335.png	nf4132_056.png	nf4132_090.png
nf3223_336.png	nf4132_088.png	nf4132_091.png
nf3231_102.png	nf4212_267.png	nf4212_268.png
nf3231_260.png	nf4221_272.png	nf4221_273.png
nf3231_261.png	nf4222_277.png	nf4222_278.png
nf3232_097.png	nf4223_282.png	nf4223_283.png
nf3232_098.png	nf4231_290.png	nf4231_291.png
nf3233_328.png	nf4232_295.png	nf4232_296.png
nf3233_329.png	nf4311_238.png	nf4311_239.png
nf3233_331.png	nf4312_300.png	nf4312_301.png
nf3311_124.png	nf4313_231.png	nf4313_233.png
nf3311_126.png	nf4313_232.png	nf4313_234.png
nf3311_127.png	nf4321_157.png	nf4321_158.png
nf3312_129.png	nf4322_159.png	nf4322_213.png
nf3312_132.png	nf4322_212.png	nf4322_214.png
nf3312_133.png	nf4331_172.png	nf4331_173.png
nf3312_205.png	nf4332_164.png	nf4332_197.png
nf3312_206.png	nf4332_196.png	nf4332_198.png
nf3312_207.png	nf4412_182.png	nf4412_183.png
nf3313_135.png	nf4413_177.png	nf4413_178.png
nf3313_136.png		
nf3313_338.png		
nf3313_339.png		
nf3313_340.png		
nf3313_341.png		
nf3431_245.png		
nf3431_246.png		
nf3431_256.png		
nf3432_072.png		
nf3432_073.png		
nf3432_074.png		
nf3432_076.png		
nf3432_247.png		
nf3432_249.png		
nf4111_184.png		
nf4111_185.png		
nf4111_186.png		
nf4112_190.png		
nf4112_191.png		
nf4112_192.png		
nf4112_193.png		
nf4112_199.png		
nf4112_201.png		

nf4112_202.png		
nf4112_203.png		
nf4112_216.png		
nf4121_032.png		
nf4121_033.png		
nf4121_034.png		
nf4121_035.png		
nf4121_036.png		
nf4121_038.png		
nf4121_039.png		
nf4121_040.png		
nf4121_041.png		
nf4122_026.png		
nf4122_027.png		
nf4122_028.png		
nf4123_017.png		
nf4123_018.png		
nf4123_019.png		
nf4123_020.png		
nf4123_021.png		
nf4123_022.png		
nf4131_284.png		
nf4132_047.png		
nf4132_048.png		
nf4132_049.png		
nf4132_050.png		
nf4132_051.png		
nf4132_052.png		
nf4132_053.png		
nf4132_054.png		
nf4132_055.png		
nf4132_087.png		
nf4212_264.png		
nf4212_265.png		
nf4212_266.png		
nf4221_269.png		
nf4221_270.png		
nf4221_271.png		
nf4222_274.png		
nf4222_275.png		
nf4222_276.png		
nf4223_279.png		
nf4223_280.png		
nf4223_281.png		
nf4231_287.png		
nf4231_288.png		

nf4231_289.png		
nf4232_292.png		
nf4232_293.png		
nf4232_294.png		
nf4311_235.png		
nf4311_236.png		
nf4311_237.png		
nf4312_297.png		
nf4312_298.png		
nf4312_299.png		
nf4313_204.png		
nf4313_230.png		
nf4321_154.png		
nf4321_155.png		
nf4321_156.png		
nf4322_160.png		
nf4322_161.png		
nf4322_162.png		
nf4322_163.png		
nf4322_210.png		
nf4322_211.png		
nf4331_169.png		
nf4331_170.png		
nf4331_171.png		
nf4332_165.png		
nf4332_166.png		
nf4332_167.png		
nf4332_168.png		
nf4332_194.png		
nf4332_195.png		
nf4412_179.png		
nf4412_180.png		
nf4412_181.png		
nf4413_174.png		
nf4413_175.png		
nf4413_176.png		

2. Version 2.0

Version 2.0 of the HSI-Drive dataset contains 476 new labeled images to make a total of 752 images. We have perform new recordings in both autumn and winter to cover the four seasons of the year. The labeled image count according to season is currently as follows:

Winter	206 images
Fall	201 images
Spring	166 images
Summer	179 images

Improved preprocessing

As in versions 1.0 and 1.1, applied raw image processing pipeline, which transforms 2D raw images containing radiance data into 3D hyperspectral cubes containing reflectance data, contained the following steps[1]:

1- Image crop & framing.
2- Reflectance correction (bias removal and white balance).
3- Band extraction.
4- Median filtering (per band).
5- Translation to center (partial demosaicing by bilinear interpolation).
6- Band normalization (optional).

(1) No spectral correction was applied since scenes were recorded without rejection filters.

Translation to center: We noticed that the programmed translation to center (TC) function applied in versions 1.0 and 1.1 did not perform correctly at the edges of the images. Produced deviations were small, but anyway we have corrected this bug in version 2.0.

Median filtering: Median filtering (MF) can be beneficious in the training of spectral classifiers for image segmentation (per-pixel spectral classification), but do not necessarily improve the performance of spectral-spatial models (e.g. convolutional networks). Since per-band median filtering is a time-consuming process that introduces an additional delay in the inference stage of ML models, in version 2.0 we provide two cube sets: cubes generated with MF and cubes generated without MF.

Band normalization: In versions 1.0 and 1.1 we provided cubes containing normalized data at each spectral band together with the normalization coefficients of each image for an eventual denormalization process. Since there are many approaches to data normalization for ML algorithms and, we have removed the normalization stage from the preprocessing

pipeline. In consequence, the user will find that the data ranges can vary from image to image. This variety of ranges is a consequence of different setups in the camera configuration in order to adapt the image recording to different weather and lighting conditions. Since we have constrained the maximum exposure time of the camera to 20ms to avoid excessive image blurring in fast moving objects, in some situations it was necessary to use a wider lens aperture and even to apply the analog gain (AG) function of the camera to increase object visibility. The following table shows the resulting data ranges according to the different camera setups[2]:

Camera setup	**f8/10ms AGx1**	**f8/10ms AGx2**	**f8/20ms AGx1**	**f8/20ms AGx2**	**f4/10ms/ AGx1**	**f4/10ms/ AGx2**	**f4/20ms AGx1**	**f4/20ms AGx2**
Range	[0,4]	[0,2]	[0,2]	[0,1]	[0,2]	[0,2]	[0,1]	[0,1]

(2) Recording images with an f8 aperture implies that the sensor receives approximately half of the radiance compared to recording with an f4 aperture under the same lighting conditions (we have measured a reduction of 1/1.8 in the average sensor response). The reflectance correction algorithm applied in the processing pipeline of the raw images does not compensate for this variation.

The attached file *image_numbering.pdf* contains information about used camera setups for each image in the dataset.

Data normalization is applied at the end of the raw image-processing pipeline, so it can be regarded as the first stage of a classifier model. Thus, the user is free to apply whichever normalization procedure it considers most suitable for a particular algorithmic development. We provide a Matlab function named ***perbandnorm.m*** to perform per-image band normalization as it was applied to the cubes in versions v1.0 and v1.1.

Proposed image dataset splitting for ML training

Train set	Validation set	Test set
nf1111_571.png	nf1111_576.png	nf1111_577.png
nf1111_572.png	nf1111_578.png	nf1112_569.png
nf1111_573.png	nf1112_570.png	nf1113_557.png
nf1111_574.png	nf1113_561.png	nf1113_563.png
nf1111_575.png	nf1121_642.png	nf1121_641.png
nf1112_564.png	nf1122_650.png	nf1121_643.png
nf1112_565.png	nf1123_655.png	nf1122_649.png
nf1112_566.png	nf1123_659.png	nf1122_651.png
nf1112_567.png	nf1131_373.png	nf1123_657.png
nf1112_568.png	nf1131_375.png	nf1131_374.png
nf1113_556.png	nf1132_068.png	nf1132_070.png
nf1113_558.png	nf1132_391.png	nf1132_393.png
nf1113_559.png	nf1132_397.png	nf1132_399.png
nf1113_560.png	nf1132_401.png	nf1133_364.png

nf1113_562.png	nf1133_366.png	nf1211_624.png
nf1121_636.png	nf1211_625.png	nf1211_626.png
nf1121_637.png	nf1212_616.png	nf1212_617.png
nf1121_638.png	nf1212_618.png	nf1213_608.png
nf1121_639.png	nf1213_604.png	nf1221_316.png
nf1121_640.png	nf1213_610.png	nf1222_303.png
nf1122_644.png	nf1221_315.png	nf1223_308.png
nf1122_645.png	nf1221_317.png	nf1231_701.png
nf1122_646.png	nf1222_305.png	nf1231_703.png
nf1122_647.png	nf1223_310.png	nf1232_661.png
nf1122_648.png	nf1231_702.png	nf1232_665.png
nf1123_652.png	nf1232_663.png	nf1233_693.png
nf1123_653.png	nf1233_695.png	nf1233_697.png
nf1123_654.png	nf1311_706.png	nf1311_705.png
nf1123_656.png	nf1312_382.png	nf1312_384.png
nf1123_658.png	nf1312_386.png	nf1312_388.png
nf1131_368.png	nf1313_377.png	nf1313_379.png
nf1131_369.png	nf1321_063.png	nf1321_065.png
nf1131_370.png	nf1321_119.png	nf1321_121.png
nf1131_371.png	nf1321_354.png	nf1321_356.png
nf1131_372.png	nf1321_358.png	nf1321_360.png
nf1132_067.png	nf1322_058.png	nf1322_060.png
nf1132_069.png	nf1322_114.png	nf1322_116.png
nf1132_071.png	nf1322_344.png	nf1322_346.png
nf1132_392.png	nf1322_348.png	nf1322_350.png
nf1132_394.png	nf1323_319.png	nf1323_321.png
nf1132_395.png	nf1323_325.png	nf1323_327.png
nf1132_396.png	nf2111_521.png	nf2111_523.png
nf1132_398.png	nf2111_522.png	nf2112_507.png
nf1132_400.png	nf2112_506.png	nf2113_500.png
nf1132_402.png	nf2113_499.png	nf2121_417.png
nf1133_363.png	nf2121_416.png	nf2121_418.png
nf1133_365.png	nf2122_408.png	nf2122_409.png
nf1133_367.png	nf2131_553.png	nf2122_410.png
nf1211_619.png	nf2131_554.png	nf2131_555.png
nf1211_620.png	nf2132_432.png	nf2132_434.png
nf1211_621.png	nf2132_433.png	nf2133_426.png
nf1211_622.png	nf2133_424.png	nf2211_513.png
nf1211_623.png	nf2133_425.png	nf2211_514.png
nf1212_611.png	nf2211_509.png	nf2211_515.png
nf1212_612.png	nf2211_510.png	nf2212_494.png
nf1212_613.png	nf2211_511.png	nf2212_495.png
nf1212_614.png	nf2211_512.png	nf2212_496.png
nf1212_615.png	nf2212_491.png	nf2212_497.png
nf1213_603.png	nf2212_492.png	nf2213_489.png
nf1213_605.png	nf2212_493.png	nf2221_014.png
nf1213_606.png	nf2213_488.png	nf2222_633.png
nf1213_607.png	nf2221_015.png	nf2222_634.png
nf1213_609.png	nf2221_635.png	nf2223_629.png
nf1221_312.png	nf2222_632.png	nf2223_630.png
nf1221_313.png	nf2223_628.png	nf2311_457.png
nf1221_314.png	nf2311_456.png	nf2311_458.png
nf1222_302.png	nf2312_448.png	nf2312_449.png
nf1222_304.png	nf2313_440.png	nf2312_450.png
nf1222_306.png	nf2313_441.png	nf2313_442.png
nf1223_307.png	nf2321_545.png	nf2321_547.png

nf1223_309.png	nf2321_546.png	nf2322_539.png
nf1223_311.png	nf2322_537.png	nf2323_529.png
nf1231_698.png	nf2322_538.png	nf2323_531.png
nf1231_699.png	nf2323_530.png	nf2331_601.png
nf1231_700.png	nf2331_600.png	nf2331_602.png
nf1232_660.png	nf2332_592.png	nf2332_593.png
nf1232_662.png	nf2333_584.png	nf2332_594.png
nf1232_664.png	nf2333_586.png	nf2333_585.png
nf1232_666.png	nf2412_473.png	nf2412_475.png
nf1232_667.png	nf2412_474.png	nf2412_476.png
nf1233_692.png	nf3111_718.png	nf3111_720.png
nf1233_694.png	nf3111_719.png	nf3112_108.png
nf1233_696.png	nf3112_104.png	nf3113_712.png
nf1311_704.png	nf3113_711.png	nf3121_228.png
nf1311_707.png	nf3121_139.png	nf3121_229.png
nf1312_381.png	nf3121_225.png	nf3122_148.png
nf1312_383.png	nf3122_144.png	nf3123_153.png
nf1312_385.png	nf3123_149.png	nf3131_263.png
nf1312_387.png	nf3131_240.png	nf3132_113.png
nf1312_389.png	nf3132_109.png	nf3133_728.png
nf1312_390.png	nf3133_726.png	nf3211_255.png
nf1313_376.png	nf3133_727.png	nf3212_096.png
nf1313_378.png	nf3211_251.png	nf3221_223.png
nf1313_380.png	nf3212_092.png	nf3221_224.png
nf1321_062.png	nf3221_082.png	nf3222_081.png
nf1321_064.png	nf3221_220.png	nf3223_337.png
nf1321_066.png	nf3222_077.png	nf3231_262.png
nf1321_120.png	nf3223_334.png	nf3232_101.png
nf1321_122.png	nf3231_103.png	nf3232_250.png
nf1321_123.png	nf3232_100.png	nf3233_332.png
nf1321_353.png	nf3233_330.png	nf3311_128.png
nf1321_355.png	nf3311_125.png	nf3312_208.png
nf1321_357.png	nf3312_130.png	nf3312_209.png
nf1321_359.png	nf3312_131.png	nf3313_138.png
nf1321_361.png	nf3313_134.png	nf3313_342.png
nf1321_362.png	nf3313_137.png	nf3321_691.png
nf1322_057.png	nf3321_689.png	nf3322_682.png
nf1322_059.png	nf3321_690.png	nf3322_683.png
nf1322_061.png	nf3322_681.png	nf3323_674.png
nf1322_115.png	nf3323_673.png	nf3323_675.png
nf1322_117.png	nf3431_244.png	nf3431_257.png
nf1322_118.png	nf3432_075.png	nf3432_258.png
nf1322_343.png	nf3432_248.png	nf3432_259.png
nf1322_345.png	nf4111_187.png	nf4111_188.png
nf1322_347.png	nf4112_189.png	nf4112_217.png
nf1322_349.png	nf4112_200.png	nf4112_218.png
nf1322_351.png	nf4112_215.png	nf4112_219.png
nf1322_352.png	nf4121_031.png	nf4121_043.png
nf1323_318.png	nf4121_037.png	nf4121_044.png
nf1323_320.png	nf4121_042.png	nf4121_045.png
nf1323_322.png	nf4122_029.png	nf4122_030.png
nf1323_323.png	nf4123_016.png	nf4123_024.png
nf1323_324.png	nf4123_023.png	nf4123_025.png
nf1323_326.png	nf4132_046.png	nf4131_286.png
nf2111_516.png	nf4132_056.png	nf4132_050.png
nf2111_517.png	nf4132_088.png	nf4132_089.png

nf2111_518.png	nf4211_742.png	nf4132_090.png
nf2111_519.png	nf4211_743.png	nf4132_091.png
nf2111_520.png	nf4212_267.png	nf4211_744.png
nf2112_501.png	nf4213_734.png	nf4212_268.png
nf2112_502.png	nf4213_735.png	nf4213_736.png
nf2112_503.png	nf4221_272.png	nf4221_273.png
nf2112_504.png	nf4222_277.png	nf4222_278.png
nf2112_505.png	nf4223_282.png	nf4223_283.png
nf2113_498.png	nf4231_290.png	nf4231_291.png
nf2121_411.png	nf4232_295.png	nf4232_296.png
nf2121_412.png	nf4311_238.png	nf4311_239.png
nf2121_413.png	nf4312_300.png	nf4312_301.png
nf2121_414.png	nf4313_232.png	nf4313_233.png
nf2121_415.png	nf4321_157.png	nf4313_234.png
nf2122_403.png	nf4322_159.png	nf4321_158.png
nf2122_404.png	nf4322_212.png	nf4322_213.png
nf2122_405.png	nf4331_172.png	nf4322_214.png
nf2122_406.png	nf4332_164.png	nf4331_173.png
nf2122_407.png	nf4332_196.png	nf4332_197.png
nf2131_548.png	nf4333_750.png	nf4332_198.png
nf2131_549.png	nf4333_751.png	nf4333_752.png
nf2131_550.png	nf4412_182.png	nf4412_183.png
nf2131_551.png	nf4413_177.png	nf4413_178.png
nf2131_552.png		
nf2132_427.png		
nf2132_428.png		
nf2132_429.png		
nf2132_430.png		
nf2132_431.png		
nf2133_419.png		
nf2133_420.png		
nf2133_421.png		
nf2133_422.png		
nf2133_423.png		
nf2211_477.png		
nf2211_478.png		
nf2211_479.png		
nf2211_480.png		
nf2211_481.png		
nf2211_482.png		
nf2211_483.png		
nf2211_484.png		
nf2211_508.png		
nf2212_459.png		
nf2212_460.png		
nf2212_461.png		
nf2212_462.png		
nf2212_463.png		
nf2212_464.png		
nf2212_465.png		
nf2212_466.png		
nf2212_490.png		
nf2213_485.png		
nf2213_486.png		
nf2213_487.png		
nf2221_009.png		

nf2221_010.png		
nf2221_011.png		
nf2221_012.png		
nf2221_013.png		
nf2222_005.png		
nf2222_006.png		
nf2222_007.png		
nf2222_008.png		
nf2222_631.png		
nf2223_001.png		
nf2223_002.png		
nf2223_003.png		
nf2223_004.png		
nf2223_627.png		
nf2311_451.png		
nf2311_452.png		
nf2311_453.png		
nf2311_454.png		
nf2311_455.png		
nf2312_443.png		
nf2312_444.png		
nf2312_445.png		
nf2312_446.png		
nf2312_447.png		
nf2313_435.png		
nf2313_436.png		
nf2313_437.png		
nf2313_438.png		
nf2313_439.png		
nf2321_540.png		
nf2321_541.png		
nf2321_542.png		
nf2321_543.png		
nf2321_544.png		
nf2322_532.png		
nf2322_533.png		
nf2322_534.png		
nf2322_535.png		
nf2322_536.png		
nf2323_524.png		
nf2323_525.png		
nf2323_526.png		
nf2323_527.png		
nf2323_528.png		
nf2331_595.png		
nf2331_596.png		
nf2331_597.png		
nf2331_598.png		
nf2331_599.png		
nf2332_587.png		
nf2332_588.png		
nf2332_589.png		
nf2332_590.png		
nf2332_591.png		
nf2333_579.png		
nf2333_580.png		

nf2333_581.png		
nf2333_582.png		
nf2333_583.png		
nf2412_467.png		
nf2412_468.png		
nf2412_469.png		
nf2412_470.png		
nf2412_471.png		
nf2412_472.png		
nf3111_713.png		
nf3111_714.png		
nf3111_715.png		
nf3111_716.png		
nf3111_717.png		
nf3112_105.png		
nf3112_106.png		
nf3112_107.png		
nf3113_708.png		
nf3113_709.png		
nf3113_710.png		
nf3121_140.png		
nf3121_141.png		
nf3121_142.png		
nf3121_143.png		
nf3121_226.png		
nf3121_227.png		
nf3122_145.png		
nf3122_146.png		
nf3122_147.png		
nf3123_150.png		
nf3123_151.png		
nf3123_152.png		
nf3131_241.png		
nf3131_242.png		
nf3131_243.png		
nf3132_110.png		
nf3132_111.png		
nf3132_112.png		
nf3133_721.png		
nf3133_722.png		
nf3133_723.png		
nf3133_724.png		
nf3133_725.png		
nf3211_252.png		
nf3211_253.png		
nf3211_254.png		
nf3212_093.png		
nf3212_094.png		
nf3212_095.png		
nf3221_083.png		
nf3221_084.png		
nf3221_085.png		
nf3221_086.png		
nf3221_221.png		
nf3221_222.png		
nf3222_078.png		

nf3222_079.png		
nf3222_080.png		
nf3223_333.png		
nf3223_335.png		
nf3223_336.png		
nf3231_102.png		
nf3231_260.png		
nf3231_261.png		
nf3232_097.png		
nf3232_098.png		
nf3232_099.png		
nf3233_328.png		
nf3233_329.png		
nf3233_331.png		
nf3311_124.png		
nf3311_126.png		
nf3311_127.png		
nf3312_129.png		
nf3312_132.png		
nf3312_133.png		
nf3312_205.png		
nf3312_206.png		
nf3312_207.png		
nf3313_135.png		
nf3313_136.png		
nf3313_338.png		
nf3313_339.png		
nf3313_340.png		
nf3313_341.png		
nf3321_684.png		
nf3321_685.png		
nf3321_686.png		
nf3321_687.png		
nf3321_688.png		
nf3322_676.png		
nf3322_677.png		
nf3322_678.png		
nf3322_679.png		
nf3322_680.png		
nf3323_668.png		
nf3323_669.png		
nf3323_670.png		
nf3323_671.png		
nf3323_672.png		
nf3431_245.png		
nf3431_246.png		
nf3431_256.png		
nf3432_072.png		
nf3432_073.png		
nf3432_074.png		
nf3432_076.png		
nf3432_247.png		
nf3432_249.png		
nf4111_184.png		
nf4111_185.png		
nf4111_186.png		

nf4112_190.png		
nf4112_191.png		
nf4112_192.png		
nf4112_193.png		
nf4112_199.png		
nf4112_201.png		
nf4112_202.png		
nf4112_203.png		
nf4112_216.png		
nf4121_032.png		
nf4121_033.png		
nf4121_034.png		
nf4121_035.png		
nf4121_036.png		
nf4121_038.png		
nf4121_039.png		
nf4121_040.png		
nf4121_041.png		
nf4122_026.png		
nf4122_027.png		
nf4122_028.png		
nf4123_017.png		
nf4123_018.png		
nf4123_019.png		
nf4123_020.png		
nf4123_021.png		
nf4123_022.png		
nf4131_284.png		
nf4131_285.png		
nf4132_047.png		
nf4132_048.png		
nf4132_049.png		
nf4132_051.png		
nf4132_052.png		
nf4132_053.png		
nf4132_054.png		
nf4132_055.png		
nf4132_087.png		
nf4211_737.png		
nf4211_738.png		
nf4211_739.png		
nf4211_740.png		
nf4211_741.png		
nf4212_264.png		
nf4212_265.png		
nf4212_266.png		
nf4213_729.png		
nf4213_730.png		
nf4213_731.png		
nf4213_732.png		
nf4213_733.png		
nf4221_269.png		
nf4221_270.png		
nf4221_271.png		
nf4222_274.png		
nf4222_275.png		

nf4222_276.png		
nf4223_279.png		
nf4223_280.png		
nf4223_281.png		
nf4231_287.png		
nf4231_288.png		
nf4231_289.png		
nf4232_292.png		
nf4232_293.png		
nf4232_294.png		
nf4311_235.png		
nf4311_236.png		
nf4311_237.png		
nf4312_297.png		
nf4312_298.png		
nf4312_299.png		
nf4313_204.png		
nf4313_230.png		
nf4313_231.png		
nf4321_154.png		
nf4321_155.png		
nf4321_156.png		
nf4322_160.png		
nf4322_161.png		
nf4322_162.png		
nf4322_163.png		
nf4322_210.png		
nf4322_211.png		
nf4331_169.png		
nf4331_170.png		
nf4331_171.png		
nf4332_165.png		
nf4332_166.png		
nf4332_167.png		
nf4332_168.png		
nf4332_194.png		
nf4332_195.png		
nf4333_745.png		
nf4333_746.png		
nf4333_747.png		
nf4333_748.png		
nf4333_749.png		
nf4412_179.png		
nf4412_180.png		
nf4412_181.png		
nf4413_174.png		
nf4413_175.png		
nf4413_176.png		

3. Version 2.1

Enhanced labeling

HSI-Drive 2.1 does not contain new labeled images, but the labeling has been refined to better cover the surfaces corresponding to different classes. Although the labeling continues to be "conservative" not to label pixels that do not clearly belong to a predefined class, this relabeling process has produced a notable augmentation of available data for training and testing. The following table compares the number of labeled pixels per class in versions 2.0 and 2.1:

HIS-Drive	Class1	Class2	Class3	Class4	Class5	Class6	Class7	Class8	Class9	Class10
V 2.0	26,690,619	1,325,343	9,339,224	948,852	2,511,496	2,315,153	209,531	12,330	348,341	246,614
V 2.1	26,753,811	1,364,908	9,799,475	1,113,573	2,549,527	2,485,658	231,019	10,592	467,688	279,261

Class1: Road (tarmac)
Class2: Road marks
Class3: Vegetation (any kind of vegetation, including wood)
Class4: Painted metal (road signs, traffic light posts, vehicle bodies etc.)
Class5: Sky
Class6: Infrastructures (sidewalks, walls, facades, roofs, concrete pillars etc.)
Class7: Pedestrian/cyclist
Class8: Water (watercourses, puddles etc.)
Class9: Unpainted metal (back of road signs and signposts, road signposts, streetlight posts, crash barriers etc.)
Class10: Glass/transparent plastic (vehicle windscreens, headlights and backlights, windows etc.)

New reflectance correction strategy

The cube processing has been enhanced by incorporating a new function (white balance) that estimates the lightning of each scene to calculate a scaling factor that is then applied to the reference white images before performing reflectance correction (white balance). The new spectral correction function assures that all data is in normalized in the range [0.1] after white balance (artificial lights such as car headlights and backlights are treated as outliers and clipped to 1). The v2.1 version of the dataset provides cubes processed both, with and without the scaled white balance for experimentation (see the "HSI2.1 White Paper for more detailed information about spectral cube processing). White reference image quality has been also improved by taking multiple

snapshots over a calibrated Espectralon tile (99% standard reflectance). Dark and White reference images are also provided with the new version of the dataset.

Data split-up for ML

When using the dataset for neural network training, validation and testing, the 752 images have been divided into 5 subsets for a 5-fold cross-validation scheme. The partitioning has been performed based on a proportionality criterion considering the distribution of the images across the dataset structure, i.e. daytime, climatology, season and road type. In each of the 5 iterations, 3 subsets have been used for training, 1 for validation and 1 for testing.

Subset 1	Subset 2	Subset 3	Subset 4	Subset 5
nf1111_571.png	nf1111_572.png	nf1111_574.png	nf1111_576.png	nf1111_577.png
nf1112_564.png	nf1111_573.png	nf1111_575.png	nf1111_578.png	nf1112_569.png
nf1112_565.png	nf1112_566.png	nf1112_567.png	nf1112_570.png	nf1113_557.png
nf1113_556.png	nf1113_559.png	nf1112_568.png	nf1113_561.png	nf1113_563.png
nf1113_558.png	nf1113_560.png	nf1113_562.png	nf1121_642.png	nf1121_641.png
nf1121_636.png	nf1121_638.png	nf1121_639.png	nf1122_650.png	nf1121_643.png
nf1121_637.png	nf1122_646.png	nf1121_640.png	nf1123_655.png	nf1122_649.png
nf1122_644.png	nf1122_647.png	nf1122_648.png	nf1123_659.png	nf1122_651.png
nf1122_645.png	nf1123_653.png	nf1123_656.png	nf1131_373.png	nf1123_657.png
nf1123_652.png	nf1123_654.png	nf1123_658.png	nf1131_375.png	nf1131_374.png
nf1131_368.png	nf1131_370.png	nf1131_372.png	nf1132_068.png	nf1132_070.png
nf1131_369.png	nf1131_371.png	nf1132_398.png	nf1132_391.png	nf1132_393.png
nf1132_067.png	nf1132_394.png	nf1132_400.png	nf1132_397.png	nf1132_399.png
nf1132_069.png	nf1132_395.png	nf1132_402.png	nf1132_401.png	nf1133_364.png
nf1132_071.png	nf1132_396.png	nf1133_367.png	nf1133_366.png	nf1211_624.png
nf1132_392.png	nf1133_365.png	nf1211_623.png	nf1211_625.png	nf1211_626.png
nf1133_363.png	nf1211_621.png	nf1212_614.png	nf1212_616.png	nf1212_617.png
nf1211_619.png	nf1211_622.png	nf1212_615.png	nf1212_618.png	nf1213_608.png
nf1211_620.png	nf1212_612.png	nf1213_607.png	nf1213_604.png	nf1221_316.png
nf1212_611.png	nf1212_613.png	nf1213_609.png	nf1213_610.png	nf1222_303.png
nf1213_603.png	nf1213_606.png	nf1221_314.png	nf1221_315.png	nf1223_308.png
nf1213_605.png	nf1221_313.png	nf1222_306.png	nf1221_317.png	nf1231_701.png
nf1221_312.png	nf1222_304.png	nf1223_311.png	nf1222_305.png	nf1231_703.png

nf1222_302.png	nf1223_309.png	nf1231_700.png	nf1223_310.png	nf1232_661.png
nf1223_307.png	nf1231_699.png	nf1232_666.png	nf1231_702.png	nf1232_665.png
nf1231_698.png	nf1232_662.png	nf1232_667.png	nf1232_663.png	nf1233_693.png
nf1232_660.png	nf1232_664.png	nf1233_696.png	nf1233_695.png	nf1233_697.png
nf1233_692.png	nf1233_694.png	nf1311_707.png	nf1311_706.png	nf1311_705.png
nf1311_704.png	nf1312_385.png	nf1312_389.png	nf1312_382.png	nf1312_384.png
nf1312_381.png	nf1312_387.png	nf1312_390.png	nf1312_386.png	nf1312_388.png
nf1312_383.png	nf1313_378.png	nf1313_380.png	nf1313_377.png	nf1313_379.png
nf1313_376.png	nf1321_122.png	nf1321_357.png	nf1321_063.png	nf1321_065.png
nf1321_062.png	nf1321_123.png	nf1321_359.png	nf1321_119.png	nf1321_121.png
nf1321_064.png	nf1321_353.png	nf1321_361.png	nf1321_354.png	nf1321_356.png
nf1321_066.png	nf1321_355.png	nf1321_362.png	nf1321_358.png	nf1321_360.png
nf1321_120.png	nf1322_117.png	nf1322_347.png	nf1322_058.png	nf1322_060.png
nf1322_057.png	nf1322_118.png	nf1322_349.png	nf1322_114.png	nf1322_116.png
nf1322_059.png	nf1322_343.png	nf1322_351.png	nf1322_344.png	nf1322_346.png
nf1322_061.png	nf1322_345.png	nf1322_352.png	nf1322_348.png	nf1322_350.png
nf1322_115.png	nf1323_322.png	nf1323_324.png	nf1323_319.png	nf1323_321.png
nf1323_318.png	nf1323_323.png	nf1323_326.png	nf1323_325.png	nf1323_327.png
nf1323_320.png	nf2111_518.png	nf2111_519.png	nf2111_521.png	nf2111_523.png
nf2111_516.png	nf2112_503.png	nf2111_520.png	nf2111_522.png	nf2112_507.png
nf2111_517.png	nf2112_504.png	nf2112_505.png	nf2112_506.png	nf2113_500.png
nf2112_501.png	nf2113_498.png	nf2121_415.png	nf2113_499.png	nf2121_417.png
nf2112_502.png	nf2121_413.png	nf2122_406.png	nf2121_416.png	nf2121_418.png
nf2121_411.png	nf2121_414.png	nf2122_407.png	nf2122_408.png	nf2122_409.png
nf2121_412.png	nf2122_404.png	nf2131_551.png	nf2131_553.png	nf2122_410.png
nf2122_403.png	nf2122_405.png	nf2131_552.png	nf2131_554.png	nf2131_555.png
nf2131_548.png	nf2131_549.png	nf2132_430.png	nf2132_432.png	nf2132_434.png
nf2132_427.png	nf2131_550.png	nf2132_431.png	nf2132_433.png	nf2133_426.png
nf2132_428.png	nf2132_429.png	nf2133_422.png	nf2133_424.png	nf2211_513.png
nf2133_419.png	nf2133_421.png	nf2133_423.png	nf2133_425.png	nf2211_514.png
nf2133_420.png	nf2211_480.png	nf2211_483.png	nf2211_509.png	nf2211_515.png

nf2211_477.png	nf2211_481.png	nf2211_484.png	nf2211_510.png	nf2212_494.png
nf2211_478.png	nf2211_482.png	nf2211_508.png	nf2211_511.png	nf2212_495.png
nf2211_479.png	nf2212_462.png	nf2212_465.png	nf2211_512.png	nf2212_496.png
nf2212_459.png	nf2212_463.png	nf2212_466.png	nf2212_491.png	nf2212_497.png
nf2212_460.png	nf2212_464.png	nf2212_490.png	nf2212_492.png	nf2213_489.png
nf2212_461.png	nf2213_486.png	nf2213_487.png	nf2212_493.png	nf2221_014.png
nf2213_485.png	nf2221_010.png	nf2221_012.png	nf2213_488.png	nf2222_633.png
nf2221_009.png	nf2221_011.png	nf2221_013.png	nf2221_015.png	nf2222_634.png
nf2222_005.png	nf2222_007.png	nf2222_008.png	nf2221_635.png	nf2223_629.png
nf2222_006.png	nf2223_002.png	nf2222_631.png	nf2222_632.png	nf2223_630.png
nf2223_001.png	nf2223_003.png	nf2223_004.png	nf2223_628.png	nf2311_457.png
nf2311_451.png	nf2311_452.png	nf2223_627.png	nf2311_456.png	nf2311_458.png
nf2312_443.png	nf2311_453.png	nf2311_454.png	nf2312_448.png	nf2312_449.png
nf2313_435.png	nf2312_444.png	nf2311_455.png	nf2313_440.png	nf2312_450.png
nf2313_436.png	nf2312_445.png	nf2312_446.png	nf2313_441.png	nf2313_442.png
nf2321_540.png	nf2313_437.png	nf2312_447.png	nf2321_545.png	nf2321_547.png
nf2321_541.png	nf2313_438.png	nf2313_439.png	nf2321_546.png	nf2322_539.png
nf2322_532.png	nf2321_542.png	nf2321_543.png	nf2322_537.png	nf2323_529.png
nf2322_533.png	nf2322_534.png	nf2321_544.png	nf2322_538.png	nf2323_531.png
nf2323_524.png	nf2323_526.png	nf2322_535.png	nf2323_530.png	nf2331_601.png
nf2323_525.png	nf2323_527.png	nf2322_536.png	nf2331_600.png	nf2331_602.png
nf2331_595.png	nf2331_597.png	nf2323_528.png	nf2332_592.png	nf2332_593.png
nf2331_596.png	nf2331_598.png	nf2331_599.png	nf2333_584.png	nf2332_594.png
nf2332_587.png	nf2332_589.png	nf2332_591.png	nf2333_586.png	nf2333_585.png
nf2332_588.png	nf2332_590.png	nf2333_582.png	nf2412_473.png	nf2412_475.png
nf2333_579.png	nf2333_581.png	nf2333_583.png	nf2412_474.png	nf2412_476.png
nf2333_580.png	nf2412_469.png	nf2412_471.png	nf3111_718.png	nf3111_720.png
nf2412_467.png	nf2412_470.png	nf2412_472.png	nf3111_719.png	nf3112_108.png
nf2412_468.png	nf3111_715.png	nf3111_717.png	nf3112_104.png	nf3113_712.png
nf3111_713.png	nf3111_716.png	nf3112_107.png	nf3113_711.png	nf3121_228.png
nf3111_714.png	nf3112_106.png	nf3113_710.png	nf3121_139.png	nf3121_229.png

nf3112_105.png	nf3113_709.png	nf3121_226.png	nf3121_225.png	nf3122_148.png
nf3113_708.png	nf3121_142.png	nf3121_227.png	nf3122_144.png	nf3123_153.png
nf3121_140.png	nf3121_143.png	nf3122_147.png	nf3123_149.png	nf3131_263.png
nf3121_141.png	nf3122_146.png	nf3123_152.png	nf3131_240.png	nf3132_113.png
nf3122_145.png	nf3123_151.png	nf3131_243.png	nf3132_109.png	nf3133_728.png
nf3123_150.png	nf3131_242.png	nf3132_112.png	nf3133_726.png	nf3211_255.png
nf3131_241.png	nf3132_111.png	nf3133_724.png	nf3133_727.png	nf3212_096.png
nf3132_110.png	nf3133_723.png	nf3133_725.png	nf3211_251.png	nf3221_223.png
nf3133_721.png	nf3211_253.png	nf3211_254.png	nf3212_092.png	nf3221_224.png
nf3133_722.png	nf3212_094.png	nf3212_095.png	nf3221_082.png	nf3222_081.png
nf3211_252.png	nf3221_085.png	nf3221_221.png	nf3221_220.png	nf3223_337.png
nf3212_093.png	nf3221_086.png	nf3221_222.png	nf3222_077.png	nf3231_262.png
nf3221_083.png	nf3222_079.png	nf3222_080.png	nf3223_334.png	nf3232_101.png
nf3221_084.png	nf3223_335.png	nf3223_336.png	nf3231_103.png	nf3232_250.png
nf3222_078.png	nf3231_260.png	nf3231_261.png	nf3232_100.png	nf3233_332.png
nf3223_333.png	nf3232_098.png	nf3232_099.png	nf3233_330.png	nf3311_128.png
nf3231_102.png	nf3233_329.png	nf3233_331.png	nf3311_125.png	nf3312_208.png
nf3232_097.png	nf3311_126.png	nf3311_127.png	nf3312_130.png	nf3312_209.png
nf3233_328.png	nf3312_133.png	nf3312_206.png	nf3312_131.png	nf3313_138.png
nf3311_124.png	nf3312_205.png	nf3312_207.png	nf3313_134.png	nf3313_342.png
nf3312_129.png	nf3313_338.png	nf3313_340.png	nf3313_137.png	nf3321_691.png
nf3312_132.png	nf3313_339.png	nf3313_341.png	nf3321_689.png	nf3322_682.png
nf3313_135.png	nf3321_686.png	nf3321_687.png	nf3321_690.png	nf3322_683.png
nf3313_136.png	nf3322_677.png	nf3321_688.png	nf3322_681.png	nf3323_674.png
nf3321_684.png	nf3322_678.png	nf3322_679.png	nf3323_673.png	nf3323_675.png
nf3321_685.png	nf3323_670.png	nf3322_680.png	nf3431_244.png	nf3431_257.png
nf3322_676.png	nf3323_671.png	nf3323_672.png	nf3432_075.png	nf3432_258.png
nf3323_668.png	nf3431_246.png	nf3431_256.png	nf3432_248.png	nf3432_259.png
nf3323_669.png	nf3432_074.png	nf3432_247.png	nf4111_187.png	nf4111_188.png
nf3431_245.png	nf3432_076.png	nf3432_249.png	nf4112_189.png	nf4112_217.png
nf3432_072.png	nf4111_185.png	nf4111_186.png	nf4112_200.png	nf4112_218.png

nf3432_073.png	nf4112_193.png	nf4112_202.png	nf4112_215.png	nf4112_219.png
nf4111_184.png	nf4112_199.png	nf4112_203.png	nf4121_031.png	nf4121_043.png
nf4112_190.png	nf4112_201.png	nf4112_216.png	nf4121_037.png	nf4121_044.png
nf4112_191.png	nf4121_035.png	nf4121_039.png	nf4121_042.png	nf4121_045.png
nf4112_192.png	nf4121_036.png	nf4121_040.png	nf4122_029.png	nf4122_030.png
nf4121_032.png	nf4121_038.png	nf4121_041.png	nf4123_016.png	nf4123_024.png
nf4121_033.png	nf4122_027.png	nf4122_028.png	nf4123_023.png	nf4123_025.png
nf4121_034.png	nf4123_019.png	nf4123_021.png	nf4132_046.png	nf4131_286.png
nf4122_026.png	nf4123_020.png	nf4123_022.png	nf4132_056.png	nf4132_050.png
nf4123_017.png	nf4131_285.png	nf4132_054.png	nf4132_088.png	nf4132_089.png
nf4123_018.png	nf4132_051.png	nf4132_055.png	nf4211_742.png	nf4132_090.png
nf4131_284.png	nf4132_052.png	nf4132_087.png	nf4211_743.png	nf4132_091.png
nf4132_047.png	nf4132_053.png	nf4211_740.png	nf4212_267.png	nf4211_744.png
nf4132_048.png	nf4211_738.png	nf4211_741.png	nf4213_734.png	nf4212_268.png
nf4132_049.png	nf4211_739.png	nf4212_266.png	nf4213_735.png	nf4213_736.png
nf4211_737.png	nf4212_265.png	nf4213_733.png	nf4221_272.png	nf4221_273.png
nf4212_264.png	nf4213_731.png	nf4221_271.png	nf4222_277.png	nf4222_278.png
nf4213_729.png	nf4213_732.png	nf4222_276.png	nf4223_282.png	nf4223_283.png
nf4213_730.png	nf4221_270.png	nf4223_281.png	nf4231_290.png	nf4231_291.png
nf4221_269.png	nf4222_275.png	nf4231_289.png	nf4232_295.png	nf4232_296.png
nf4222_274.png	nf4223_280.png	nf4232_294.png	nf4311_238.png	nf4311_239.png
nf4223_279.png	nf4231_288.png	nf4311_237.png	nf4312_300.png	nf4312_301.png
nf4231_287.png	nf4232_293.png	nf4312_299.png	nf4313_232.png	nf4313_233.png
nf4232_292.png	nf4311_236.png	nf4313_231.png	nf4321_157.png	nf4313_234.png
nf4311_235.png	nf4312_298.png	nf4321_156.png	nf4322_159.png	nf4321_158.png
nf4312_297.png	nf4313_230.png	nf4322_210.png	nf4322_212.png	nf4322_213.png
nf4313_204.png	nf4321_155.png	nf4322_211.png	nf4331_172.png	nf4322_214.png
nf4321_154.png	nf4322_162.png	nf4331_171.png	nf4332_164.png	nf4331_173.png
nf4322_160.png	nf4322_163.png	nf4332_194.png	nf4332_196.png	nf4332_197.png
nf4322_161.png	nf4331_170.png	nf4332_195.png	nf4333_750.png	nf4332_198.png
nf4331_169.png	nf4332_167.png	nf4333_748.png	nf4333_751.png	nf4333_752.png

nf4332_165.png	nf4332_168.png	nf4333_749.png	nf4412_182.png	nf4412_183.png
nf4332_166.png	nf4333_747.png	nf4412_181.png	nf4413_177.png	nf4413_178.png
nf4333_745.png	nf4412_180.png	nf4413_176.png		
nf4333_746.png	nf4413_175.png			
nf4412_179.png				
nf4413_174.png				