Supplementary Materials for Deep Learning-based Adaptive Downsampling of Hyperspectral Bands for Soil Organic Carbon Estimation

This section provides detailed model structures and results referenced in the main article.

# Inference Module Architecture for AD-CNN and FD-CNN

## Lower dimensional Size: 8

|  |  |
| --- | --- |
| Layer Type | Parameters / Details |
| Conv1d | In: 1 channel, Out: 32 filters, Kernel Size = 4, Stride = 1, Padding = 0 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 2, Stride = 2, Padding = 0 |
| Flatten | Starting from dimension 1 |
| Linear | In Features = 64, Out Features = 1 |

Table S: Inference module architecture for AD-CNN with Lower dimensional Size 8.

## Lower dimensional Size: 16

|  |  |
| --- | --- |
| Layer Type | Parameters / Details |
| Conv1d | In: 1 channel, Out: 32 filters, Kernel Size = 4, Stride = 1, Padding = 0 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 2, Stride = 2, Padding = 0 |
| Conv1d | In: 32 channels, Out: 64 filters, Kernel Size = 2, Stride = 1, Padding = 0 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 2, Stride = 2, Padding = 0 |
| Flatten | Starting from dimension 1 |
| Linear | In Features = 128, Out Features = 1 |

Table S: Inference module architecture for AD-CNN with Lower dimensional Size 16.

## Lower dimensional Size: 32

|  |  |
| --- | --- |
| Layer Type | Parameters / Details |
| Conv1d | In: 1 channel, Out: 32 filters, Kernel Size = 8, Stride = 1, Padding = 0 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 4, Stride = 4, Padding = 0 |
| Conv1d | In: 32 channels, Out: 64 filters, Kernel Size = 2, Stride = 1, Padding = 0 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 2, Stride = 2, Padding = 0 |
| Flatten | Starting from dimension 1 |
| Linear | In Features = 128, Out Features = 1 |

Table S3: Inference module architecture for AD-CNN with Lower dimensional Size 32.

## Lower dimensional Size: 64

|  |  |
| --- | --- |
| Layer Type | Parameters / Details |
| Conv1d | In: 1 channel, Out: 32 filters, Kernel Size = 8, Stride = 1, Padding = 0 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 4, Stride = 4, Padding = 0 |
| Conv1d | In: 32 channels, Out: 64 filters, Kernel Size = 4, Stride = 1, Padding = 0 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 4, Stride = 4, Padding = 0 |
| Flatten | Starting from dimension 1 |
| Linear | In Features = 128, Out Features = 1 |

Table S4: Inference module architecture for AD-CNN with Lower dimensional Size 64.

## Lower dimensional Size: 128

|  |  |
| --- | --- |
| Layer Type | Parameters / Details |
| Conv1d | In: 1 channel, Out: 32 filters, Kernel Size = 16, Stride = 1, Padding = 0 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 8, Stride = 4, Padding = 0 |
| Conv1d | In: 32 channels, Out: 64 filters, Kernel Size = 8, Stride = 1, Padding = 0 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 4, Stride = 4, Padding = 0 |
| Flatten | Starting from dimension 1 |
| Linear | In Features = 320, Out Features = 64 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| Linear | In Features = 64, Out Features = 1 |

Table S5: Inference module architecture for AD-CNN with Lower dimensional Size 128.

## Lower dimensional Size: 256

|  |  |
| --- | --- |
| Layer Type | Parameters / Details |
| Conv1d | In: 1 channel, Out: 32 filters, Kernel Size = 16, Stride = 1, Padding = 0 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 8, Stride = 6, Padding = 0 |
| Conv1d | In: 32 channels, Out: 64 filters, Kernel Size = 8, Stride = 1, Padding = 0 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 4, Stride = 4, Padding = 0 |
| Conv1d | In: 64 channels, Out: 128 filters, Kernel Size = 4, Stride = 1, Padding = 0 |
| BatchNorm1d | 128 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 2, Stride = 2, Padding = 0 |
| Flatten | Starting from dimension 1 |
| Linear | In Features = 256, Out Features = 1 |

Table S6: Inference module architecture for AD-CNN with Lower dimensional Size 256.

## Lower dimensional Size: 512

|  |  |
| --- | --- |
| Layer Type | Parameters / Details |
| Conv1d | In: 1 channel, Out: 32 filters, Kernel Size = 16, Stride = 1, Padding = 0 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 8, Stride = 8, Padding = 0 |
| Conv1d | In: 32 channels, Out: 64 filters, Kernel Size = 8, Stride = 1, Padding = 0 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 8, Stride = 8, Padding = 0 |
| Conv1d | In: 64 channels, Out: 128 filters, Kernel Size = 4, Stride = 1, Padding = 0 |
| BatchNorm1d | 128 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 2, Stride = 2, Padding = 0 |
| Flatten | Starting from dimension 1 |
| Linear | In Features = 128, Out Features = 1 |

Table S7: Inference module architecture for AD-CNN with Lower dimensional Size 512.

# Inference Module Architecture for AD-FCNN and FD-FCNN

## Lower dimensional Size: 8

|  |  |
| --- | --- |
| Layer | Parameters / Details |
| Linear | In Features: 8, Out Features: 10 |
| BatchNorm1d | 10 channels |
| Activation | LeakyReLU |
| Linear | In Features: 10, Out Features: 1 |

Table S8: Inference module architecture for AD-FCNN and FD-FCNN with Lower dimensional Size 8.

## Lower dimensional Size: 16

|  |  |
| --- | --- |
| Layer | Parameters / Details |
| Linear | In Features: 16, Out Features: 10 |
| BatchNorm1d | 10 channels |
| Activation | LeakyReLU |
| Linear | In Features: 10, Out Features: 1 |

Table S9: Inference module architecture for AD-FCNN and FD-FCNN with Lower dimensional Size 16.

## Lower dimensional Size: 32

|  |  |
| --- | --- |
| Layer | Parameters / Details |
| Linear | In Features: 32, Out Features: 16 |
| BatchNorm1d | 16 channels |
| Activation | LeakyReLU |
| Linear | In Features: 16, Out Features: 1 |

Table S10: Inference module architecture for AD-FCNN and FD-FCNN with Lower dimensional Size 32.

## Lower dimensional Size: 64

|  |  |
| --- | --- |
| Layer | Parameters / Details |
| Linear | In Features: 64, Out Features: 32 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| Linear | In Features: 32, Out Features: 1 |

Table S11: Inference module architecture for AD-FCNN and FD-FCNN with Lower dimensional Size 64.

## Lower dimensional Size: 128

|  |  |
| --- | --- |
| Layer | Parameters / Details |
| Linear | In Features: 128, Out Features: 64 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| Linear | In Features: 64, Out Features: 32 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| Linear | In Features: 32, Out Features: 1 |

Table S12: Inference module architecture for AD-FCNN and FD-FCNN with Lower dimensional Size 128.

## Lower dimensional Size: 256

|  |  |
| --- | --- |
| Layer | Parameters / Details |
| Linear | In Features: 256, Out Features: 128 |
| BatchNorm1d | 128 channels |
| Activation | LeakyReLU |
| Linear | In Features: 128, Out Features: 64 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| Linear | In Features: 64, Out Features: 1 |

Table S13: Inference module architecture for AD-FCNN and FD-FCNN with Lower dimensional Size 256.

## Lower dimensional Size: 512

|  |  |
| --- | --- |
| Layer | Parameters / Details |
| Linear | In Features: 512, Out Features: 256 |
| BatchNorm1d | 256 channels |
| Activation | LeakyReLU |
| Linear | In Features: 256, Out Features: 128 |
| BatchNorm1d | 128 channels |
| Activation | LeakyReLU |
| Linear | In Features: 128, Out Features: 1 |

Table S14: Inference module architecture for AD-FCNN and FD-FCNN with Lower dimensional Size 512.

# 1D-CNN using all 4,200 bands

|  |  |
| --- | --- |
| Layer | Parameters / Details |
| Conv1d | Input: 1 channel, Output: 32 filters, Kernel Size = 16, Stride = 1, Padding = 0 |
| BatchNorm1d | 32 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 16, Stride = 16, Padding = 0 |
| Conv1d | Input: 32 channels, Output: 64 filters, Kernel Size = 8, Stride = 1, Padding = 0 |
| BatchNorm1d | 64 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 16, Stride = 16, Padding = 0 |
| Conv1d | Input: 64 channels, Output: 128 filters, Kernel Size = 4, Stride = 1, Padding = 0 |
| BatchNorm1d | 128 channels |
| Activation | LeakyReLU |
| MaxPool1d | Kernel Size = 8, Stride = 8, Padding = 0 |
| Flatten | Starting from dimension 1 |
| Linear | Input Features: 128, Output Features: 1 |

Table S15: 1D-CNN using all 4,200 bands

# Computing Hardware Used

Processor: Intel(R) Core(TM) i7-8700 CPU @ 3.20GHz   3.19 GHz

GPU: NVIDIA GeForce GTX 1060 (6GB)

Installed RAM: 32.0 GB

Operating System: Windows 11

**Standard Deviation Heatmap for different metrics of AD-CNN Across Training Conditions**

## The recommended configuration is highlighted with blue rectangles in all heatmaps.

## *R2*

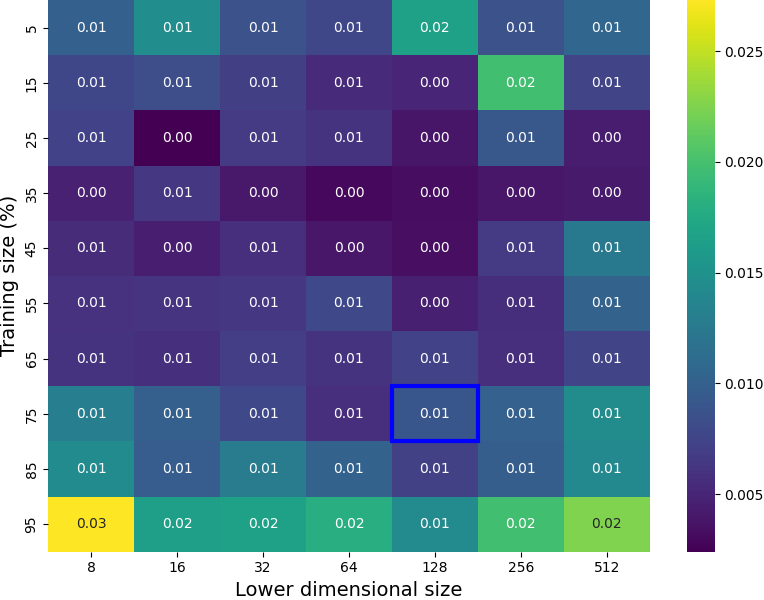


Figure S: Standard deviation heatmap for *R2* for AD-CNN across training conditions.

## RMSE

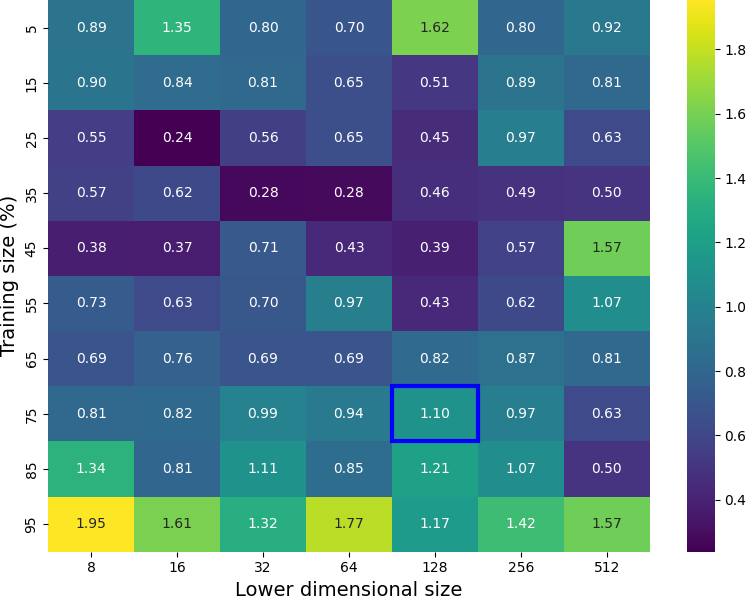


Figure S2: Standard deviation heatmap for RMSE for AD-CNN across training conditions.

## RPD

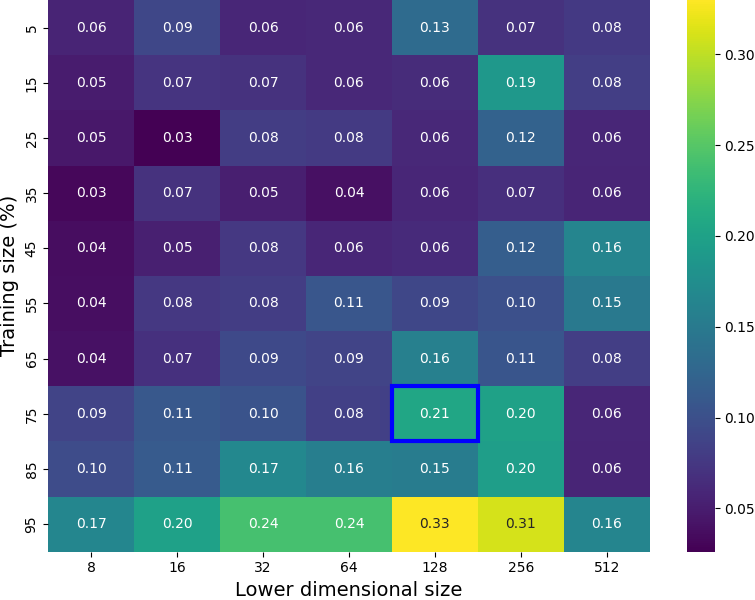


Figure S3: Standard deviation heatmap for RPD for AD-CNN across training conditions.

## Execution time

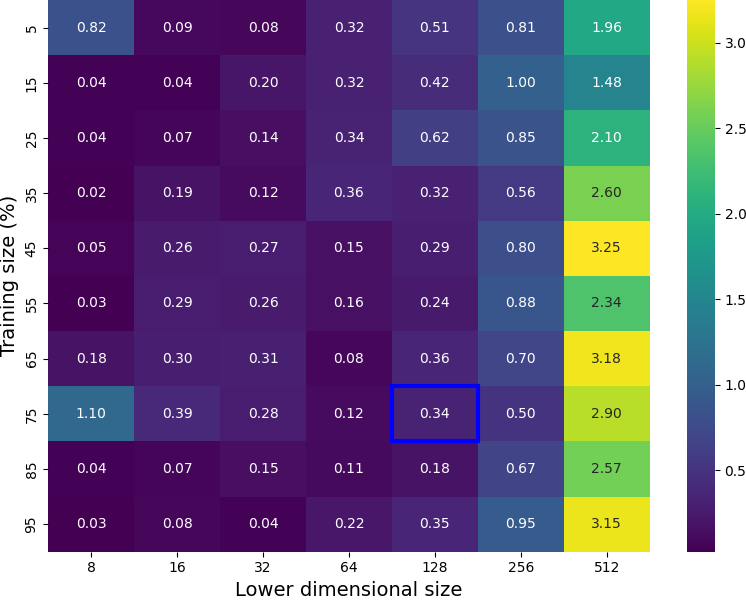
****

Figure S4: Standard deviation heatmap for execution time for AD-CNN across training conditions.

# Selected Bands

## Fixed-interval downsampling

|  |  |
| --- | --- |
| Lower dimensional size | Selected bands |
| 8 | 633.5, 866.5, 1100, 1333, 1566.5, 1799.5, 2033, 2266 |
| 16 | 523.5, 647, 770.5, 894, 1017.5, 1141, 1264.5, 1388, 1511.5, 1635, 1758.5, 1882, 2005.5, 2129, 2252.5, 2376 |
| 32 | 463.5, 527, 591, 654.5, 718, 781.5, 845.5, 909, 972.5, 1036, 1100, 1163.5, 1227, 1290.5, 1354.5, 1418, 1481.5, 1545, 1609, 1672.5, 1736, 1799.5, 1863.5, 1927, 1990.5, 2054, 2118, 2181.5, 2245, 2308.5, 2372.5, 2436 |
| 64 | 432.5, 464.5, 497, 529, 561.5, 594, 626, 658.5, 690.5, 723, 755.5, 787.5, 820, 852, 884.5, 917, 949, 981.5, 1013.5, 1046, 1078.5, 1110.5, 1143, 1175, 1207.5, 1240, 1272, 1304.5, 1336.5, 1369, 1401.5, 1433.5, 1466, 1498, 1530.5, 1563, 1595, 1627.5, 1659.5, 1692, 1724.5, 1756.5, 1789, 1821, 1853.5, 1886, 1918, 1950.5, 1982.5, 2015, 2047.5, 2079.5, 2112, 2144, 2176.5, 2209, 2241, 2273.5, 2305.5, 2338, 2370.5, 2402.5, 2435, 2467 |
| 128 | 416.5, 432.5, 449, 465, 481.5, 497.5, 514, 530, 546.5, 563, 579, 595.5, 611.5, 628, 644, 660.5, 676.5, 693, 709, 725.5, 742, 758, 774.5, 790.5, 807, 823, 839.5, 855.5, 872, 888.5, 904.5, 921, 937, 953.5, 969.5, 986, 1002, 1018.5, 1034.5, 1051, 1067.5, 1083.5, 1100, 1116, 1132.5, 1148.5, 1165, 1181, 1197.5, 1214, 1230, 1246.5, 1262.5, 1279, 1295, 1311.5, 1327.5, 1344, 1360, 1376.5, 1393, 1409, 1425.5, 1441.5, 1458, 1474, 1490.5, 1506.5, 1523, 1539.5, 1555.5, 1572, 1588, 1604.5, 1620.5, 1637, 1653, 1669.5, 1685.5, 1702, 1718.5, 1734.5, 1751, 1767, 1783.5, 1799.5, 1816, 1832, 1848.5, 1865, 1881, 1897.5, 1913.5, 1930, 1946, 1962.5, 1978.5, 1995, 2011, 2027.5, 2044, 2060, 2076.5, 2092.5, 2109, 2125, 2141.5, 2157.5, 2174, 2190.5, 2206.5, 2223, 2239, 2255.5, 2271.5, 2288, 2304, 2320.5, 2336.5, 2353, 2369.5, 2385.5, 2402, 2418, 2434.5, 2450.5, 2467, 2483 |
| 256 | 408, 416.5, 424.5, 432.5, 441, 449, 457, 465.5, 473.5, 481.5, 490, 498, 506, 514.5, 522.5, 530.5, 539, 547, 555, 563.5, 571.5, 579.5, 588, 596, 604, 612.5, 620.5, 628.5, 637, 645, 653, 661.5, 669.5, 678, 686, 694, 702.5, 710.5, 718.5, 727, 735, 743, 751.5, 759.5, 767.5, 776, 784, 792, 800.5, 808.5, 816.5, 825, 833, 841, 849.5, 857.5, 865.5, 874, 882, 890, 898.5, 906.5, 914.5, 923, 931, 939, 947.5, 955.5, 963.5, 972, 980, 988, 996.5, 1004.5, 1012.5, 1021, 1029, 1037, 1045.5, 1053.5, 1061.5, 1070, 1078, 1086, 1094.5, 1102.5, 1110.5, 1119, 1127, 1135, 1143.5, 1151.5, 1159.5, 1168, 1176, 1184, 1192.5, 1200.5, 1209, 1217, 1225, 1233.5, 1241.5, 1249.5, 1258, 1266, 1274, 1282.5, 1290.5, 1298.5, 1307, 1315, 1323, 1331.5, 1339.5, 1347.5, 1356, 1364, 1372, 1380.5, 1388.5, 1396.5, 1405, 1413, 1421, 1429.5, 1437.5, 1445.5, 1454, 1462, 1470, 1478.5, 1486.5, 1494.5, 1503, 1511, 1519, 1527.5, 1535.5, 1543.5, 1552, 1560, 1568, 1576.5, 1584.5, 1592.5, 1601, 1609, 1617, 1625.5, 1633.5, 1641.5, 1650, 1658, 1666, 1674.5, 1682.5, 1690.5, 1699, 1707, 1715.5, 1723.5, 1731.5, 1740, 1748, 1756, 1764.5, 1772.5, 1780.5, 1789, 1797, 1805, 1813.5, 1821.5, 1829.5, 1838, 1846, 1854, 1862.5, 1870.5, 1878.5, 1887, 1895, 1903, 1911.5, 1919.5, 1927.5, 1936, 1944, 1952, 1960.5, 1968.5, 1976.5, 1985, 1993, 2001, 2009.5, 2017.5, 2025.5, 2034, 2042, 2050, 2058.5, 2066.5, 2074.5, 2083, 2091, 2099, 2107.5, 2115.5, 2123.5, 2132, 2140, 2148, 2156.5, 2164.5, 2172.5, 2181, 2189, 2197, 2205.5, 2213.5, 2221.5, 2230, 2238, 2246.5, 2254.5, 2262.5, 2271, 2279, 2287, 2295.5, 2303.5, 2311.5, 2320, 2328, 2336, 2344.5, 2352.5, 2360.5, 2369, 2377, 2385, 2393.5, 2401.5, 2409.5, 2418, 2426, 2434, 2442.5, 2450.5, 2458.5, 2467, 2475, 2483, 2491.5 |
| 512 | 404, 408, 412.5, 416.5, 420.5, 424.5, 428.5, 432.5, 437, 441, 445, 449, 453, 457.5, 461.5, 465.5, 469.5, 473.5, 478, 482, 486, 490, 494, 498, 502.5, 506.5, 510.5, 514.5, 518.5, 523, 527, 531, 535, 539, 543, 547.5, 551.5, 555.5, 559.5, 563.5, 568, 572, 576, 580, 584, 588.5, 592.5, 596.5, 600.5, 604.5, 608.5, 613, 617, 621, 625, 629, 633.5, 637.5, 641.5, 645.5, 649.5, 653.5, 658, 662, 666, 670, 674, 678.5, 682.5, 686.5, 690.5, 694.5, 699, 703, 707, 711, 715, 719, 723.5, 727.5, 731.5, 735.5, 739.5, 744, 748, 752, 756, 760, 764, 768.5, 772.5, 776.5, 780.5, 784.5, 789, 793, 797, 801, 805, 809.5, 813.5, 817.5, 821.5, 825.5, 829.5, 834, 838, 842, 846, 850, 854.5, 858.5, 862.5, 866.5, 870.5, 874.5, 879, 883, 887, 891, 895, 899.5, 903.5, 907.5, 911.5, 915.5, 920, 924, 928, 932, 936, 940, 944.5, 948.5, 952.5, 956.5, 960.5, 965, 969, 973, 977, 981, 985, 989.5, 993.5, 997.5, 1001.5, 1005.5, 1010, 1014, 1018, 1022, 1026, 1030.5, 1034.5, 1038.5, 1042.5, 1046.5, 1050.5, 1055, 1059, 1063, 1067, 1071, 1075.5, 1079.5, 1083.5, 1087.5, 1091.5, 1095.5, 1100, 1104, 1108, 1112, 1116, 1120.5, 1124.5, 1128.5, 1132.5, 1136.5, 1141, 1145, 1149, 1153, 1157, 1161, 1165.5, 1169.5, 1173.5, 1177.5, 1181.5, 1186, 1190, 1194, 1198, 1202, 1206, 1210.5, 1214.5, 1218.5, 1222.5, 1226.5, 1231, 1235, 1239, 1243, 1247, 1251.5, 1255.5, 1259.5, 1263.5, 1267.5, 1271.5, 1276, 1280, 1284, 1288, 1292, 1296.5, 1300.5, 1304.5, 1308.5, 1312.5, 1316.5, 1321, 1325, 1329, 1333, 1337, 1341.5, 1345.5, 1349.5, 1353.5, 1357.5, 1362, 1366, 1370, 1374, 1378, 1382, 1386.5, 1390.5, 1394.5, 1398.5, 1402.5, 1407, 1411, 1415, 1419, 1423, 1427, 1431.5, 1435.5, 1439.5, 1443.5, 1447.5, 1452, 1456, 1460, 1464, 1468, 1472.5, 1476.5, 1480.5, 1484.5, 1488.5, 1492.5, 1497, 1501, 1505, 1509, 1513, 1517.5, 1521.5, 1525.5, 1529.5, 1533.5, 1537.5, 1542, 1546, 1550, 1554, 1558, 1562.5, 1566.5, 1570.5, 1574.5, 1578.5, 1583, 1587, 1591, 1595, 1599, 1603, 1607.5, 1611.5, 1615.5, 1619.5, 1623.5, 1628, 1632, 1636, 1640, 1644, 1648, 1652.5, 1656.5, 1660.5, 1664.5, 1668.5, 1673, 1677, 1681, 1685, 1689, 1693.5, 1697.5, 1701.5, 1705.5, 1709.5, 1713.5, 1718, 1722, 1726, 1730, 1734, 1738.5, 1742.5, 1746.5, 1750.5, 1754.5, 1758.5, 1763, 1767, 1771, 1775, 1779, 1783.5, 1787.5, 1791.5, 1795.5, 1799.5, 1804, 1808, 1812, 1816, 1820, 1824, 1828.5, 1832.5, 1836.5, 1840.5, 1844.5, 1849, 1853, 1857, 1861, 1865, 1869, 1873.5, 1877.5, 1881.5, 1885.5, 1889.5, 1894, 1898, 1902, 1906, 1910, 1914.5, 1918.5, 1922.5, 1926.5, 1930.5, 1934.5, 1939, 1943, 1947, 1951, 1955, 1959.5, 1963.5, 1967.5, 1971.5, 1975.5, 1979.5, 1984, 1988, 1992, 1996, 2000, 2004.5, 2008.5, 2012.5, 2016.5, 2020.5, 2025, 2029, 2033, 2037, 2041, 2045, 2049.5, 2053.5, 2057.5, 2061.5, 2065.5, 2070, 2074, 2078, 2082, 2086, 2090, 2094.5, 2098.5, 2102.5, 2106.5, 2110.5, 2115, 2119, 2123, 2127, 2131, 2135.5, 2139.5, 2143.5, 2147.5, 2151.5, 2155.5, 2160, 2164, 2168, 2172, 2176, 2180.5, 2184.5, 2188.5, 2192.5, 2196.5, 2200.5, 2205, 2209, 2213, 2217, 2221, 2225.5, 2229.5, 2233.5, 2237.5, 2241.5, 2246, 2250, 2254, 2258, 2262, 2266, 2270.5, 2274.5, 2278.5, 2282.5, 2286.5, 2291, 2295, 2299, 2303, 2307, 2311, 2315.5, 2319.5, 2323.5, 2327.5, 2331.5, 2336, 2340, 2344, 2348, 2352, 2356.5, 2360.5, 2364.5, 2368.5, 2372.5, 2376.5, 2381, 2385, 2389, 2393, 2397, 2401.5, 2405.5, 2409.5, 2413.5, 2417.5, 2421.5, 2426, 2430, 2434, 2438, 2442, 2446.5, 2450.5, 2454.5, 2458.5, 2462.5, 2467, 2471, 2475, 2479, 2483, 2487, 2491.5, 2495.5 |

Table S16: Bands selected by fixed-interval downsampling.

## BSDR

|  |  |
| --- | --- |
| Lower dimensional size | Selected bands |
| 8 | 671, 651, 960.5, 1006.5, 1631, 1901.5, 2128.5, 2309.5 |
| 16 | 633.5, 653, 625.5, 641, 645.5, 956.5, 1410, 1541.5, 1638, 1893.5, 1894, 2124.5, 2309, 2308.5 |
| 32 | 590.5, 604, 600, 601, 606.5, 614.5, 635.5, 961.5, 957.5, 960, 1078.5, 1409.5, 1630.5, 1591.5, 1614, 1626.5, 1632, 1891.5, 1891, 1934, 1935, 2129, 2208, 2310 |
| 64 | 456, 578, 590, 594.5, 593, 594, 595, 607.5, 631.5, 617.5, 666.5, 674.5, 684.5, 909.5, 896, 897.5, 900.5, 899, 901, 906.5, 903, 902, 913.5, 1339, 1332.5, 1410.5, 1411, 1639.5, 1640.5, 1638.5, 1641, 1894, 1893, 1893.5, 1892.5, 2129, 2128, 2127.5, 2128.5, 2208, 2309.5, 2310, 2477 |
| 128 | 440, 453.5, 595.5, 592, 596.5, 593.5, 590.5, 588.5, 585, 582, 579.5, 588, 584.5, 589, 591.5, 598.5, 642, 635.5, 665.5, 664, 668, 673.5, 696.5, 691, 875.5, 713.5, 714, 876, 879, 867, 879.5, 878, 888, 883, 899.5, 898, 892, 893.5, 891.5, 890.5, 902.5, 922.5, 924, 917.5, 1413, 1412.5, 1410, 1441, 1430, 1414.5, 1464.5, 1462.5, 1465, 1452, 1416.5, 1619.5, 1432.5, 1595.5, 1438, 1463.5, 1824.5, 1890.5, 1889, 1890, 1886.5, 1891, 1888.5, 2001, 1997.5, 1999, 2127.5, 1996, 2127, 2208, 2306, 2312.5, 2476, 2484 |
| 256 | 425.5, 443.5, 453.5, 591, 595.5, 600, 599.5, 599, 598, 595, 594.5, 592, 591.5, 590.5, 587, 588, 632.5, 668.5, 664, 665.5, 589.5, 585, 588.5, 587.5, 663.5, 644, 620.5, 660.5, 654.5, 676.5, 681.5, 670.5, 662, 680, 688, 673, 689, 694, 714.5, 708.5, 686, 729.5, 700.5, 877.5, 695.5, 884, 875.5, 862, 894, 899.5, 876, 880, 903.5, 885.5, 884.5, 890, 908, 890.5, 879, 900.5, 889.5, 897.5, 896.5, 895.5, 897, 898, 900, 902, 903, 908.5, 917, 910.5, 907, 956, 937, 955.5, 1056.5, 1100, 1012, 1356.5, 1367.5, 1374, 957, 1362.5, 1362, 1366.5, 1364.5, 1410, 1409.5, 1410.5, 1415, 1414.5, 1418, 1451.5, 1632, 1466, 1425, 1452, 1456.5, 1416, 1453, 1414, 1428.5, 1664.5, 1452.5, 1426.5, 1551, 1461, 1465.5, 1463.5, 1571, 1903.5, 1664, 1886, 1887.5, 1889.5, 1888.5, 1883.5, 1890, 1888, 1886.5, 1885, 1887, 2000, 2129.5, 2000.5, 2002.5, 2129, 2001.5, 1999.5, 2130, 2208.5, 2307, 2306.5, 2322.5, 2305.5, 2304, 2460.5, 2473.5, 2478, 2480.5, 2483.5 |
| 512 | 415, 423, 429.5, 437.5, 444, 449.5, 453.5, 593, 597.5, 595, 595.5, 593.5, 597, 594.5, 596.5, 594, 592, 591.5, 590.5, 590, 588.5, 586.5, 582, 579, 577, 652.5, 580.5, 583.5, 582.5, 587.5, 584.5, 585, 587, 588, 599.5, 598, 614, 648.5, 667, 660, 676.5, 667.5, 680.5, 677.5, 681, 687, 694.5, 692, 690, 706.5, 695, 693, 723.5, 709, 720, 701, 732.5, 737.5, 741.5, 766.5, 740.5, 729, 721, 757.5, 731.5, 743, 857, 745.5, 727, 899.5, 751, 858.5, 870.5, 890.5, 744.5, 735, 832.5, 862.5, 840, 894, 873.5, 821.5, 826.5, 863.5, 896, 864, 829.5, 899, 893.5, 896.5, 883, 863, 873, 878, 882.5, 881, 868.5, 875, 854, 877, 874, 907.5, 888, 869.5, 892, 884, 889.5, 891, 879.5, 889, 893, 900, 919.5, 897.5, 903.5, 902.5, 902, 892.5, 904.5, 915.5, 1100.5, 1100, 959.5, 1360.5, 1361, 1361.5, 1360, 1406.5, 1394, 1408, 1393, 1404.5, 1409, 1408.5, 1392, 1400.5, 1401.5, 1407, 1405, 1404, 1410.5, 1415, 1417, 1463.5, 1419, 1396, 1458, 1468.5, 1469, 1453, 1465.5, 1420, 1467.5, 1432.5, 1468, 1422, 1664, 1664.5, 1897.5, 1898.5, 1817.5, 1539, 1663, 1898, 1807.5, 1890.5, 1891, 1891.5, 1882.5, 1888, 1889, 1883.5, 1892, 1884, 1886.5, 1882, 1886, 1884.5, 1881, 1888.5, 1881.5, 1885.5, 1885, 1995.5, 1996, 1890, 1996.5, 1995, 2126, 2209, 2304.5, 2273, 2304, 2331.5, 2323.5, 2302.5, 2301, 2324, 2354.5, 2377, 2437.5, 2469, 2469.5, 2473, 2475.5, 2476, 2478.5, 2478, 2482, 2483, 2483.5 |

Table S17: Bands selected by BSDR.

## The proposed adaptive downsampling

|  |  |
| --- | --- |
| Lower dimensional size | Selected bands |
| 8 | 739, 843.5, 1115.5, 1412.5, 1556, 1788.5, 2133, 2201.5 |
| 16 | 606, 671.5, 739, 857.5, 993, 1097, 1303.5, 1412.5, 1468, 1509, 1715.5, 1861, 2133.5, 2136, 2234.5, 2395 |
| 32 | 579, 600, 650, 686, 698, 744, 747.5, 890.5, 900, 1007, 1043.5, 1119, 1210, 1261.5, 1366.5, 1469.5, 1495, 1609.5, 1652.5, 1653.5, 1688, 1726.5, 1878.5, 1882, 2133.5, 2134.5, 2202, 2221, 2221.5, 2222, 2492 |
| 64 | 447, 544.5, 546, 571.5, 587, 640, 663, 688.5, 718.5, 748.5, 758, 770, 813, 838, 880, 890.5, 921.5, 978.5, 982.5, 1013.5, 1067.5, 1108, 1162.5, 1167, 1199, 1324, 1337, 1337.5, 1368.5, 1409, 1416, 1476, 1476.5, 1527.5, 1529.5, 1538, 1596, 1622.5, 1726, 1726.5, 1727.5, 1734, 1790.5, 1794.5, 1887.5, 1890.5, 1921, 1923.5, 1964, 2140, 2144.5, 2149.5, 2152.5, 2187.5, 2190.5, 2226, 2237.5, 2238, 2376, 2377.5, 2389.5, 2413.5, 2479 |
| 128 | 412, 413, 413.5, 450, 457.5, 501.5, 532.5, 537, 538.5, 560, 569.5, 595.5, 596.5, 603, 647.5, 663, 698.5, 704.5, 712, 712.5, 731.5, 755.5, 757.5, 794.5, 796.5, 806.5, 807, 818.5, 868.5, 875, 878, 908.5, 914, 922, 928, 971, 984, 1020, 1033.5, 1064.5, 1082.5, 1084, 1109, 1114, 1114.5, 1142.5, 1169.5, 1187.5, 1190.5, 1202.5, 1210, 1271, 1279, 1280, 1303, 1306, 1324.5, 1356, 1397.5, 1399.5, 1403.5, 1432.5, 1468, 1471.5, 1472, 1492, 1494, 1526.5, 1553.5, 1561.5, 1635.5, 1636.5, 1639.5, 1664, 1667.5, 1669.5, 1684.5, 1694.5, 1698.5, 1717.5, 1750.5, 1751, 1785.5, 1790, 1793, 1825, 1840.5, 1878.5, 1882.5, 1886, 1893.5, 1939.5, 1948, 1964, 1965, 1979.5, 1992, 1992.5, 2055, 2091.5, 2093, 2093.5, 2096, 2098.5, 2140, 2147.5, 2170, 2203.5, 2204, 2225, 2227.5, 2238.5, 2284, 2287.5, 2296.5, 2297, 2321.5, 2363.5, 2379, 2380.5, 2402, 2460, 2481 |
| 256 | 405.5, 413, 418, 426.5, 432.5, 438.5, 441, 443.5, 448.5, 450, 510.5, 525.5, 547.5, 548, 558.5, 562.5, 568, 570.5, 580, 582.5, 584, 588, 590.5, 609.5, 611.5, 617, 626.5, 646, 651, 663, 672, 674.5, 678, 689.5, 706.5, 710, 718.5, 727.5, 735.5, 743.5, 748, 750.5, 751, 759, 781.5, 790, 797.5, 800.5, 801.5, 803, 812.5, 835.5, 838.5, 842.5, 845.5, 851.5, 868, 870, 880, 890.5, 903, 909, 911, 950, 955, 956, 970, 985.5, 1004.5, 1011, 1014.5, 1019, 1021, 1034.5, 1043, 1053.5, 1059, 1062, 1072, 1073.5, 1077, 1111, 1113.5, 1120, 1121, 1126, 1139, 1140, 1145.5, 1181.5, 1183, 1193, 1195.5, 1203.5, 1209, 1244.5, 1250.5, 1251, 1251.5, 1254, 1260, 1265.5, 1267.5, 1272, 1291.5, 1294.5, 1296.5, 1297, 1348.5, 1355.5, 1358.5, 1381, 1400, 1400.5, 1403, 1410, 1412.5, 1414.5, 1453, 1469.5, 1471.5, 1472.5, 1475, 1475.5, 1476, 1522, 1531.5, 1536, 1556, 1562, 1573.5, 1574, 1577, 1579, 1582, 1583.5, 1587, 1587.5, 1593, 1601, 1628, 1665, 1669.5, 1674.5, 1675, 1677.5, 1682, 1684, 1689.5, 1693, 1725.5, 1726, 1728, 1748, 1750, 1754.5, 1756, 1758, 1763, 1818, 1827.5, 1852, 1854.5, 1860, 1861, 1861.5, 1862.5, 1882, 1890, 1891.5, 1892.5, 1914.5, 1930, 1935.5, 1938.5, 1940.5, 1959, 1960, 1963, 1964, 1968.5, 1988.5, 1990, 2009.5, 2016, 2025.5, 2026, 2035.5, 2037.5, 2046, 2050, 2136, 2137, 2138, 2138.5, 2141, 2149, 2151.5, 2163.5, 2165, 2187, 2190, 2196.5, 2197.5, 2201.5, 2222, 2225.5, 2239, 2243, 2254, 2256, 2258.5, 2263, 2266, 2266.5, 2269, 2270, 2271.5, 2273.5, 2357, 2359.5, 2364, 2365, 2370.5, 2373.5, 2397.5, 2406.5, 2433, 2459, 2460.5, 2464, 2466.5, 2472, 2492.5 |
| 512 | 413.5, 414, 418, 421.5, 422.5, 424, 430, 433, 446, 449.5, 450, 451, 452.5, 453.5, 454, 454.5, 455, 456.5, 460, 491, 495, 500, 506, 508.5, 520.5, 523, 527.5, 529, 530, 533.5, 537, 541, 547.5, 548, 552, 556.5, 559, 566, 568, 575, 577, 578.5, 581, 583.5, 585, 587, 587.5, 589, 598, 603.5, 604.5, 608.5, 634.5, 636.5, 640.5, 643, 645, 645.5, 646, 647, 647.5, 649, 652, 654, 661, 667.5, 671.5, 672, 673.5, 688.5, 690.5, 700, 702, 703.5, 704.5, 717.5, 720, 720.5, 723.5, 728.5, 734.5, 736, 749.5, 752.5, 759, 760, 763.5, 765.5, 766.5, 768, 768.5, 787.5, 788, 789.5, 791.5, 792, 793, 797, 802, 810.5, 811, 812.5, 815.5, 819.5, 830, 833, 833.5, 839.5, 846.5, 849.5, 856.5, 860, 861, 863, 864, 878.5, 880.5, 888, 889, 890, 891, 895, 900, 903.5, 910.5, 913.5, 914.5, 918, 921.5, 924.5, 929, 937.5, 945, 949, 953, 961, 968.5, 972.5, 994.5, 996, 996.5, 997.5, 999, 1002, 1006, 1011.5, 1020.5, 1022, 1027, 1034.5, 1035, 1037, 1037.5, 1041, 1041.5, 1045.5, 1051, 1056, 1058.5, 1064, 1064.5, 1066, 1066.5, 1071.5, 1084.5, 1087, 1089.5, 1094.5, 1098, 1109, 1110, 1113, 1126, 1132.5, 1134, 1136, 1137, 1139, 1141.5, 1142, 1148.5, 1164.5, 1166.5, 1167.5, 1168, 1181.5, 1182, 1182.5, 1184, 1185, 1185.5, 1192.5, 1208.5, 1211, 1212, 1214, 1231, 1250.5, 1251, 1255.5, 1263.5, 1264, 1264.5, 1266.5, 1269, 1273.5, 1276.5, 1288.5, 1290, 1290.5, 1293.5, 1295, 1295.5, 1298, 1309, 1323, 1335.5, 1337.5, 1339, 1340.5, 1344, 1344.5, 1371.5, 1378, 1386.5, 1395, 1397.5, 1398, 1399, 1403, 1404, 1408, 1409.5, 1410.5, 1414.5, 1415, 1424, 1444.5, 1445.5, 1452, 1453.5, 1454, 1459.5, 1462.5, 1464, 1465, 1467, 1482.5, 1483, 1483.5, 1494, 1506.5, 1507, 1509, 1511.5, 1512, 1513, 1513.5, 1516.5, 1517, 1518, 1522, 1524.5, 1526, 1530, 1530.5, 1531, 1538, 1581, 1582, 1583.5, 1584.5, 1587.5, 1590, 1592.5, 1594.5, 1595.5, 1597.5, 1599.5, 1600, 1601.5, 1605, 1606, 1610.5, 1618.5, 1623.5, 1636.5, 1638.5, 1639, 1649, 1651, 1663.5, 1666, 1669.5, 1671, 1677, 1695, 1696, 1698.5, 1699, 1700.5, 1701.5, 1702.5, 1704.5, 1705.5, 1706.5, 1707, 1726.5, 1727, 1728, 1741.5, 1745.5, 1746.5, 1747.5, 1756, 1756.5, 1774, 1779.5, 1782, 1783.5, 1785, 1791.5, 1801, 1806, 1807, 1808.5, 1813, 1818.5, 1820, 1821.5, 1854.5, 1855, 1855.5, 1857.5, 1858, 1860, 1860.5, 1878.5, 1884, 1887, 1887.5, 1894, 1895, 1896, 1898, 1900, 1913.5, 1917, 1918, 1926, 1926.5, 1934, 1943.5, 1947, 1956.5, 1966.5, 1968.5, 1971, 1972.5, 1981, 1988, 1995.5, 2002.5, 2003.5, 2006, 2022, 2024.5, 2027, 2028.5, 2031, 2031.5, 2033, 2034, 2035.5, 2041, 2043.5, 2049, 2049.5, 2051, 2052, 2064, 2068, 2073, 2074.5, 2078, 2079, 2081, 2094, 2097, 2097.5, 2101.5, 2106.5, 2110.5, 2117, 2120, 2123.5, 2125, 2130, 2130.5, 2131, 2140, 2149.5, 2152, 2164, 2166, 2170, 2171, 2174, 2174.5, 2178, 2180, 2180.5, 2184.5, 2188, 2218.5, 2223.5, 2226, 2228, 2228.5, 2233, 2238.5, 2240, 2241, 2243, 2245.5, 2254.5, 2260.5, 2264, 2264.5, 2269, 2275, 2275.5, 2279.5, 2281.5, 2286, 2290.5, 2292, 2299, 2307.5, 2316, 2322.5, 2326.5, 2333, 2334, 2343.5, 2345.5, 2346.5, 2349.5, 2350, 2355, 2358, 2362.5, 2363.5, 2365, 2365.5, 2368.5, 2369.5, 2373, 2374.5, 2379.5, 2387.5, 2401, 2402, 2402.5, 2409, 2414, 2422, 2427, 2429.5, 2434, 2443.5, 2444.5, 2450.5, 2458.5, 2463.5, 2465, 2475.5, 2495.5 |

Table S17: Bands selected by adaptive downsampling.