

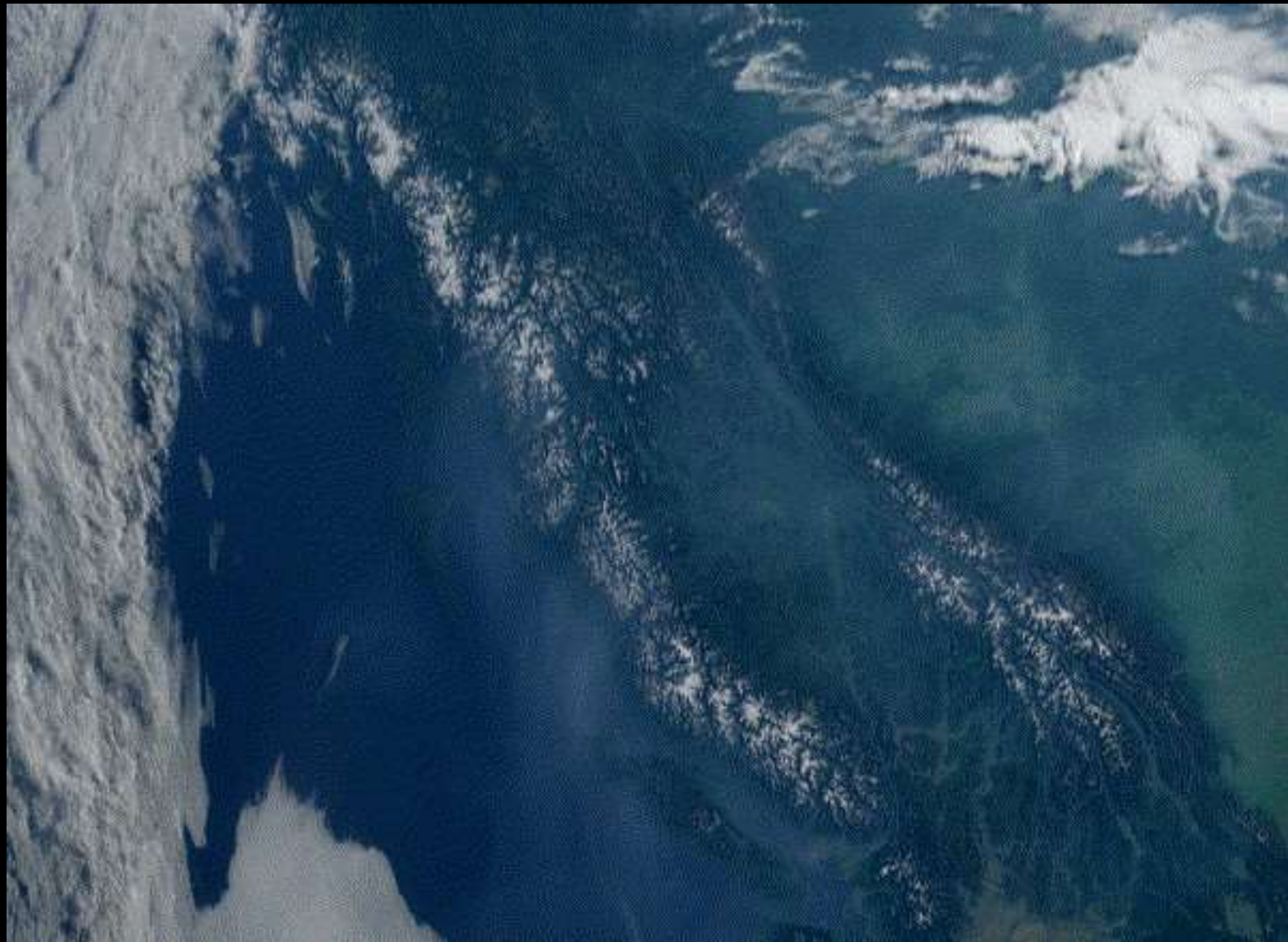



# Emergency response and humanitarian remote sensing

[Alexandre.Bevington@gov.bc.ca](mailto:Alexandre.Bevington@gov.bc.ca)

March 21, 2022





An aerial photograph of a rugged mountain range. The upper portions of the mountains are covered in snow, while the lower slopes and the valley floor are dark, indicating forested or rocky terrain. A small, turquoise-colored lake is visible in a high-altitude basin. The image is taken from a high angle, looking down into the valley.

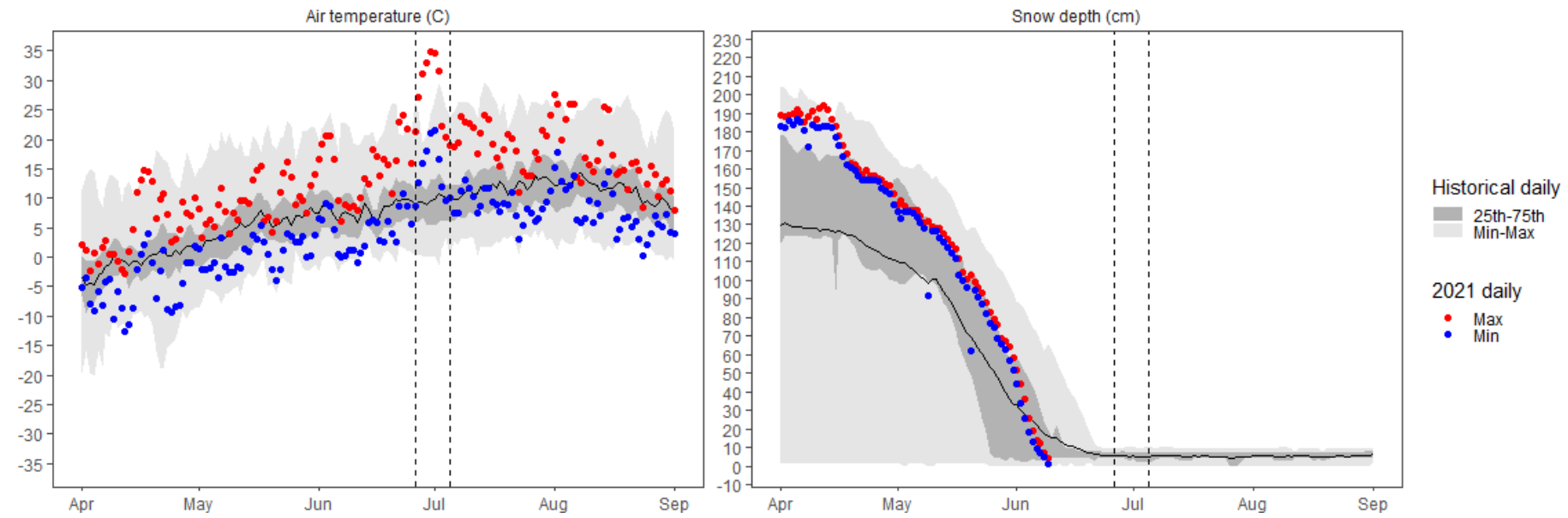
Snowline (June 26 – Jul 9)  
+300 m on N slopes (1800 to 2100 m)  
+600 m on S slopes (2100 to 2700 m)

Google Earth

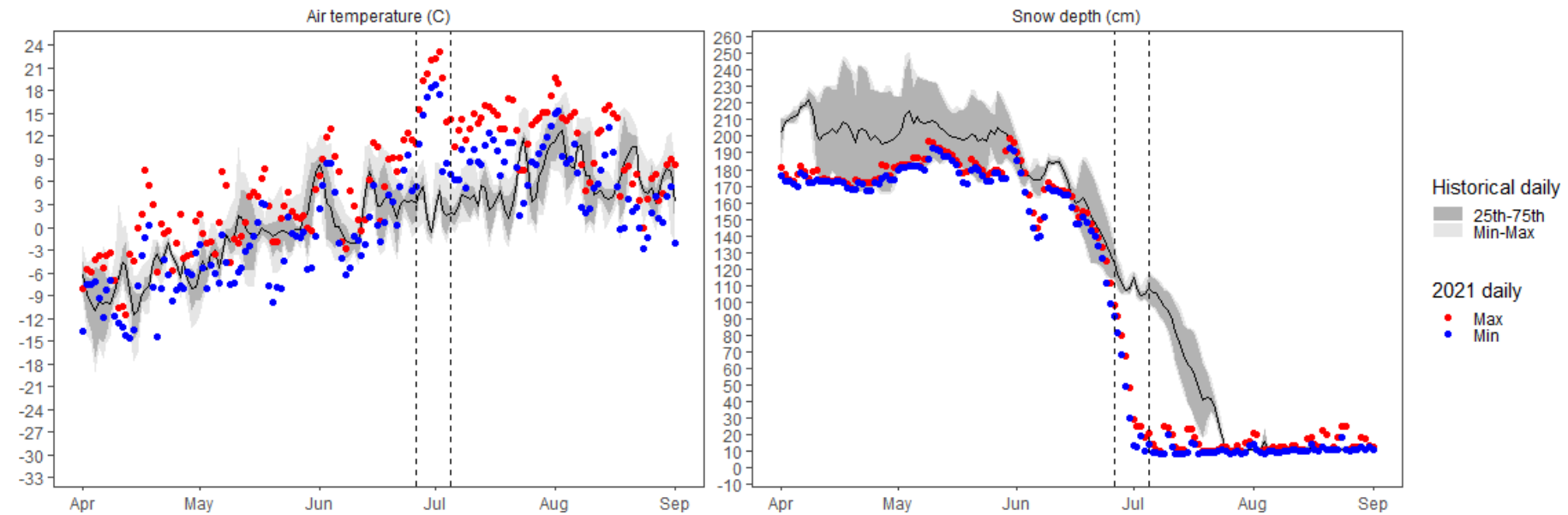
Image © 2021 Maxar Technologies  
Image © 2021 Province of British Columbia  
Image © 2021 CNES / Airbus



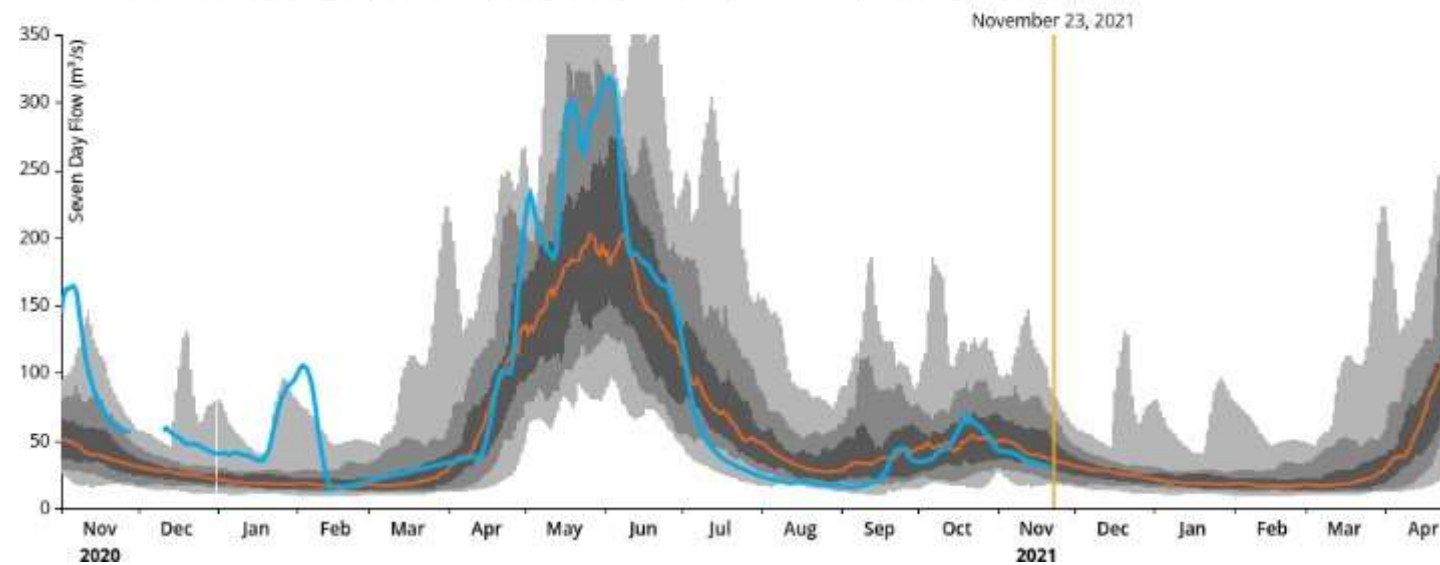
McBride Upper (1A02P) 1610m (2006-2021)



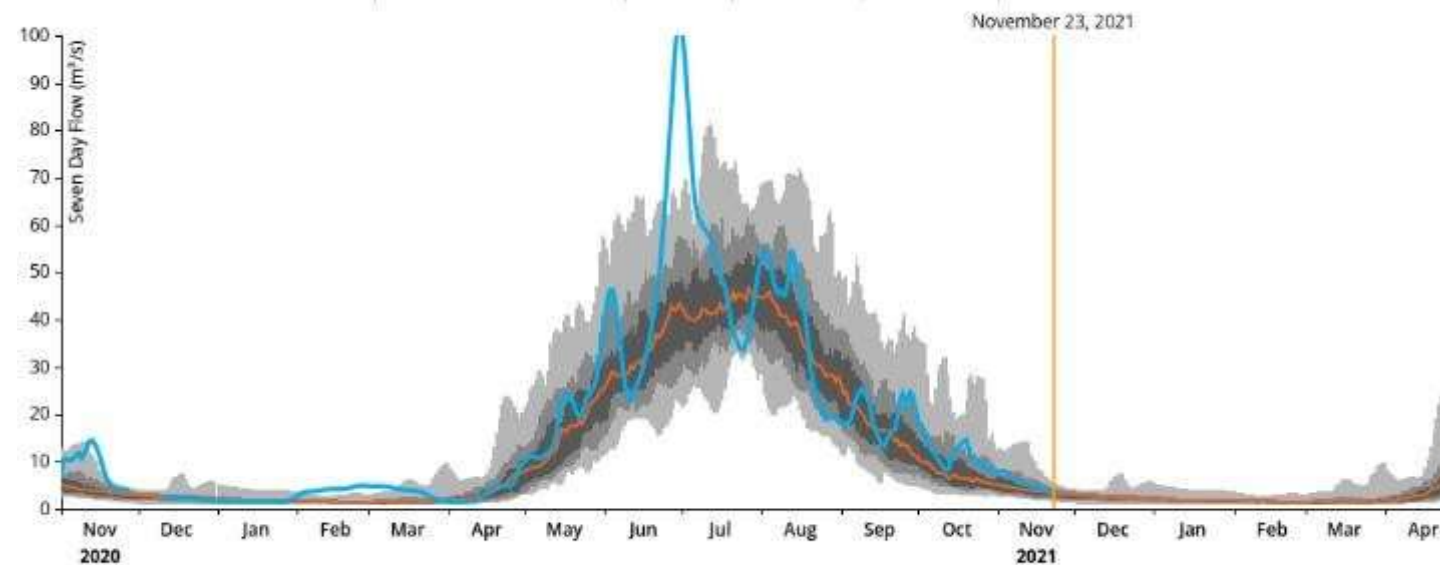
Conrad Glacier (2A33P) 2599m (2018-2021)



08K007	NETWORK	STATUS	YEAR RANGE	AREA	MEAN ANNUAL DISCHARGE
Bowron River Below Box Canyon	Water Survey of Canada	Current	1977-2021	3330.00 km <sup>2</sup>	65.83 m <sup>3</sup> /s



08N004	NETWORK	STATUS	YEAR RANGE	AREA	MEAN ANNUAL DISCHARGE
Canoe River Below Kimmel Creek	Water Survey of Canada	Current	1971-2021	305.00 km <sup>2</sup>	14.79 m <sup>3</sup> /s



\*Unverified data

Legend	Current Year / Past Year Flow*	Max	90th %ile	75th %ile	Median	25th %ile	10th %ile	Min
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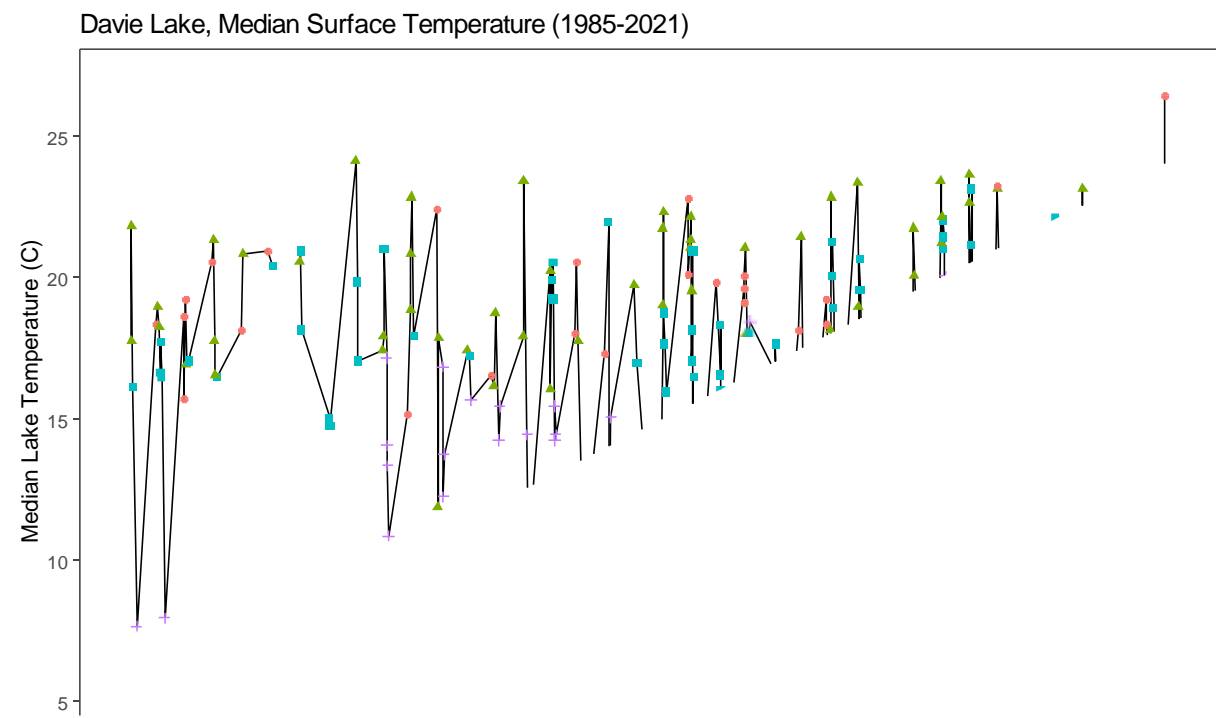
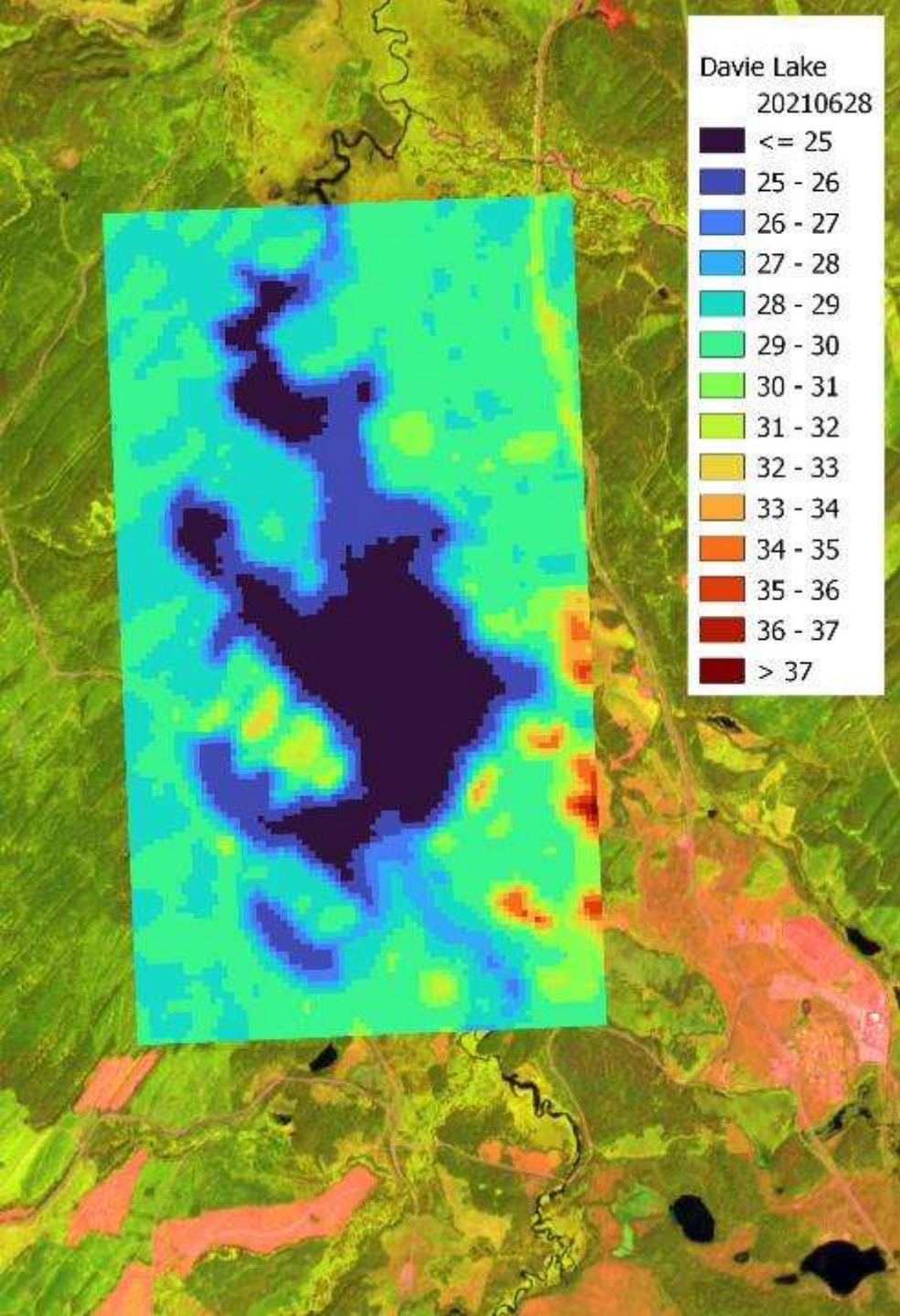
**McBride June 26-29**

McBride

**June 30**









# A WORLDWIDE COLLABORATION FOR DISASTER RELIEF

The Charter provides a unified system to make satellite data of affected areas available to support relief efforts. Timely, reliable and accurate information enables response teams to be better equipped to save lives and limit damage.



## Types of Disaster



Cyclones ▶

Earthquakes ▶

Fires ▶



Ocean Waves ▶

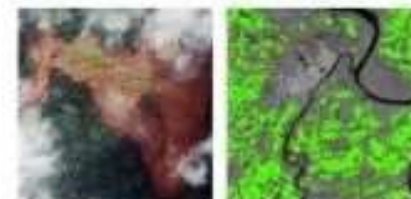
Oil spills ▶

Volcanoes ▶



Floods ▶

Snow and Ice ▶



Landslides ▶

Other ▶



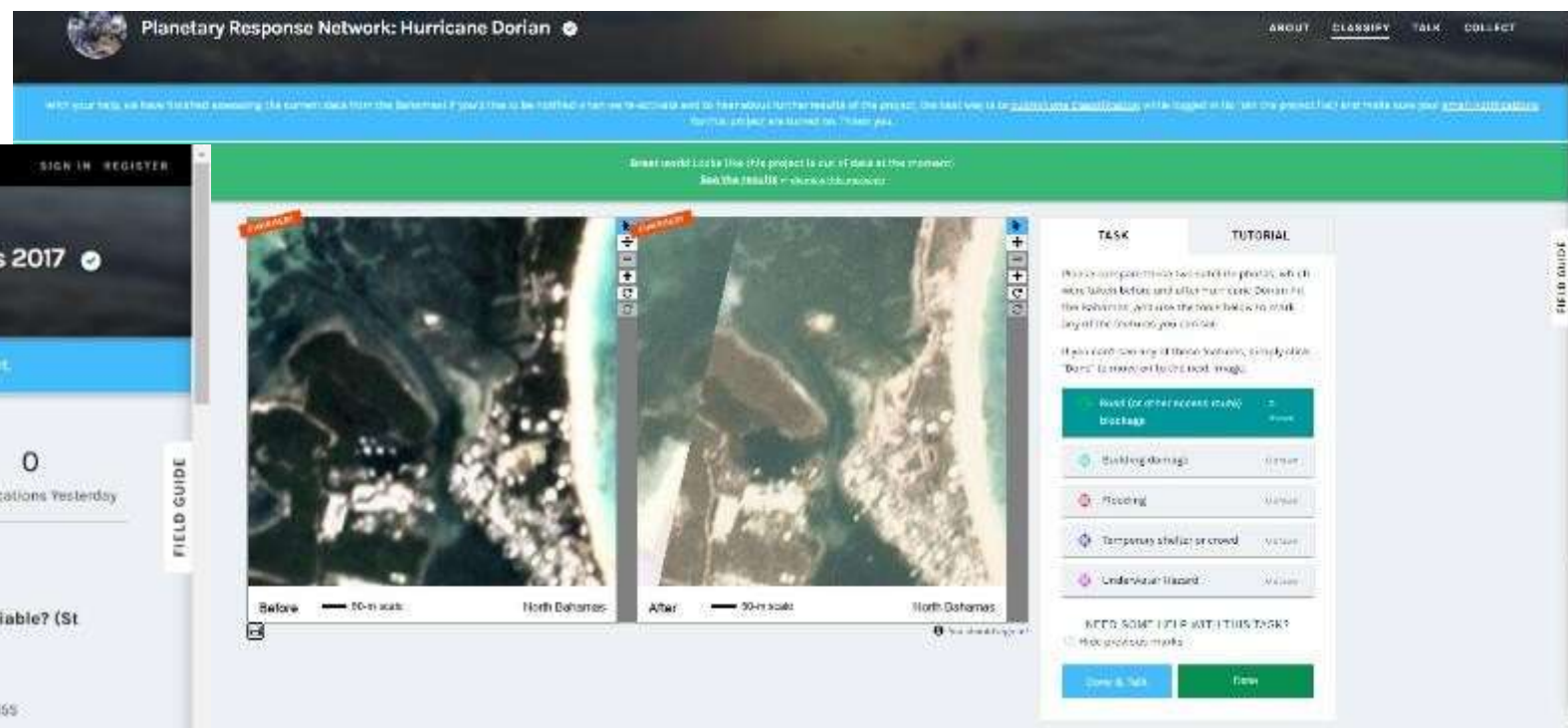


HOT is an international team dedicated to humanitarian action and community development through open mapping.

<https://tasks.hotosm.org/explore>

The screenshot displays the HOT Tasking Manager web application. The top navigation bar includes the 'Tasking Manager' logo and links for 'EXPLORE PROJECTS', 'MY CONTRIBUTIONS', 'LEARN', and 'ABOUT'. A user profile for 'Alexandre Devington' is visible in the top right. On the left, there is a 'Search features' sidebar with a search input field. The main area shows a satellite map of a forested region in Madagascar, with a pink rectangular task boundary and a blue line representing a river. The map is labeled 'MAXAR' and 'Task for project 12005. Do not add outside of this area!'. On the right, the task details panel for project '#12005 | OSM Madagascar' is shown, titled 'IMPACT OF ANA & BATSIRAI - MIDONGY, ATSIMO-ATSIANANA, MADAGASCAR - #313'. It includes tabs for 'COMPLETION', 'INSTRUCTIONS', and 'HISTORY'. A message states: 'Please check the history tab for relevant comments.' Below this, the 'TASK STATUS' section asks 'Is this task completely mapped?' with radio button options for 'Yes', 'No', and 'The imagery is bad'. A 'COMMENT' section with a text input field and a 'Submit task' button is at the bottom.



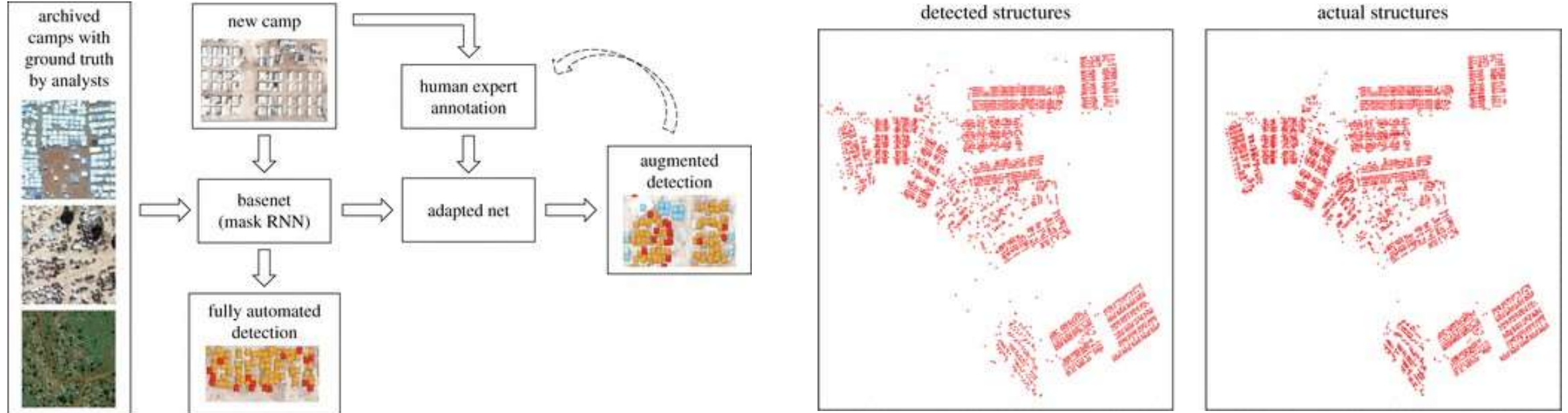


<https://www.zooniverse.org/projects/mrniaboc/planetary-response-network-hurricane-dorian>

# Humanitarian applications of machine learning with remote-sensing data: review and case study in refugee settlement mapping

John A. Quinn ✉, Marguerite M. Nyhan, Celia Navarro, Davide Coluccia, Lars Bromley and Miguel Luengo-Oroz

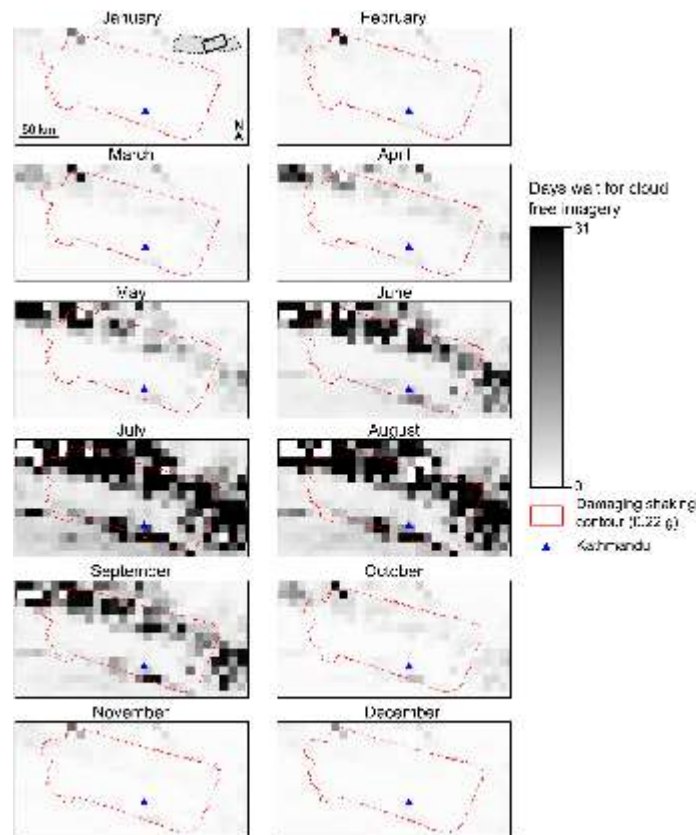
Published: 06 August 2018 | <https://doi.org/10.1098/rsta.2017.0363>



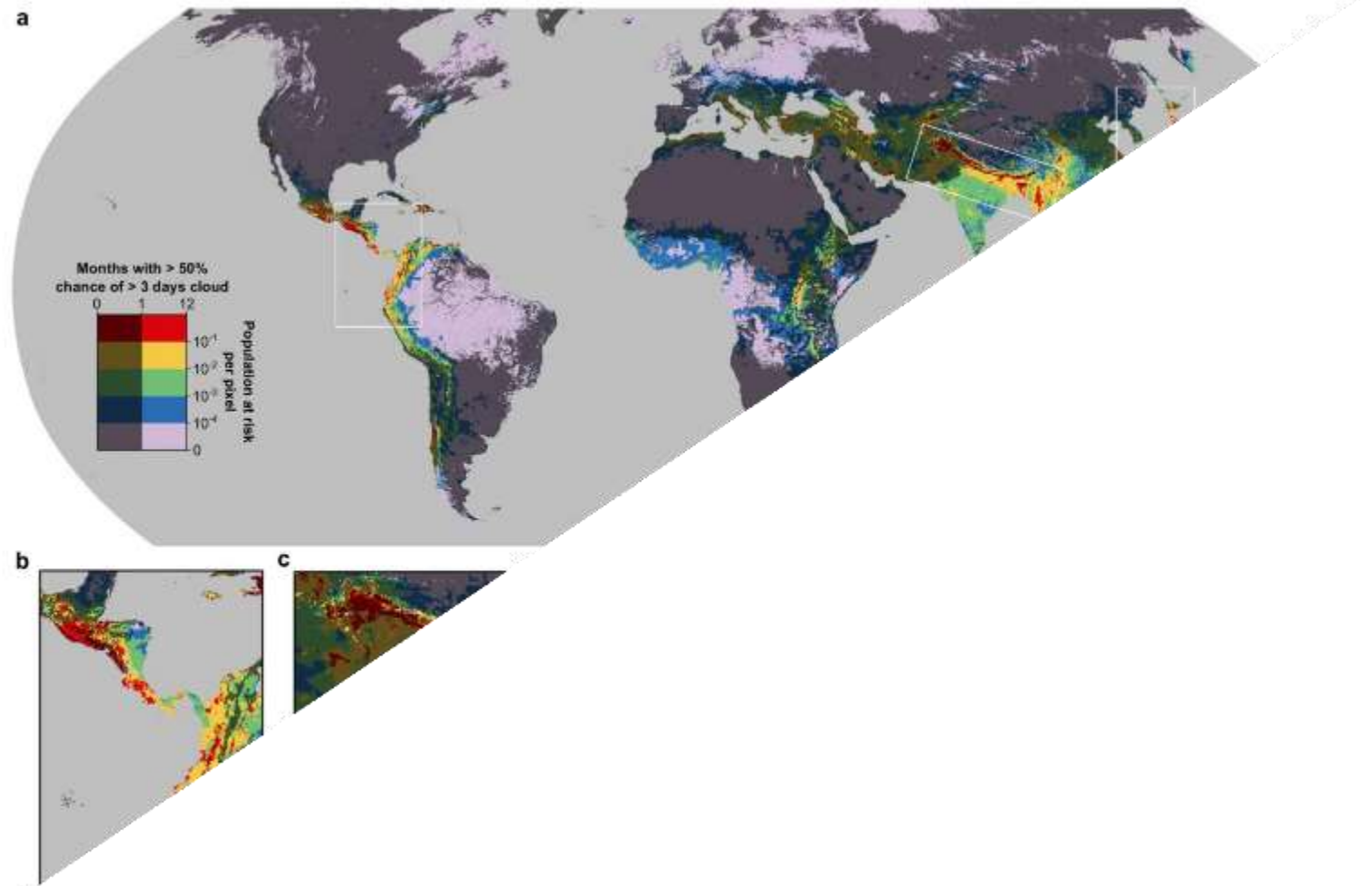


# The Spatial and Temporal Influence of Cloud Cover on Satellite-Based Emergency Mapping of Earthquake Disasters

Tom R. Robinson<sup>1,2</sup>, Nick Resser<sup>1</sup> & Richard J. Walters<sup>1</sup>



**Figure 5.** Average number of days wait for cloud-free imagery in central Nepal. Monthly variation in wait time for cloud-free imagery over the area affected by damaging shaking during the April 2015 Nepal earthquake.



**Figure 1.** Global map of obscured earthquake risk, plotted with a Robinson projection. (a) Population at risk of earthquake impacts in colour overlain in dark grey with locations where the probability of >3 consecutive days cloud cover exceeds 50% in  $\leq 1$  month of the year. Areas obscured in >1 month of the year are left lighter to highlight the underlying earthquake risk in these regions. (b–e) More detailed views of Central America and northern South America (b), the Himalaya and surrounding regions (c), Indonesia and Papua New Guinea (d) and Japan, Taiwan and the Philippines (e). (f) Monthly variation in total global obscured population at risk showing median (red) and median  $\pm$  one standard deviation (dark grey).



[www.outsideonline.com/outdoor-adventure/exploration-survival/drones-search-rescue/](http://www.outsideonline.com/outdoor-adventure/exploration-survival/drones-search-rescue/)





**Mykhailo Fedorov** ✓

@FedorovMykhailo

Ukraine government official

@eos\_da and @maxpolyakov appeal to the global remote sensing firms and organizations to provide real-time SAR data to support the Armed Forces of Ukraine with actionable intelligence.



to receive access to Ukraine;  
 - Cooperate with EOS Data Analytics and Max Polyakov as our representatives for data processing and analysis;  
 - keep other topics of activities that may support military operations of Russian and Belarus governments.

This is exactly the first major war in which commercially available satellite imagery may play a significant role in providing open source information about troop movements, military installations in neighboring countries, flows of refugees, and more.

Recent days have shown that Russian Government Machinery is effective in killing neighbors, but not in taking care of its own citizens.

Please share in this message and help Ukrainians by providing this information and by sending any cooperation with the Russian Federation and the Belarus Republic!

The Ministry of Digital Transformation of Ukraine will be ready to cooperate with you and to provide you with all information you need for this. Please from Max Polyakov and EOS Data Analytics as our representatives for this cooperation.

We ask You to stop this deadly machine.

We've already paid a huge price for our independence but looks like it's not enough to pay for the sake of lives of our citizens.

The whole world must stand together against this tragedy! Not only governments, but also business and ordinary people. Udo Mark and Tim Cook are already with those who support Ukraine. Please, join and help!

Ukraine and the whole world will highly appreciate your contribution to peace and freedom. Everything will be Ukraine!

Yours sincerely,  
 Vice Prime Minister of Ukraine

Ukrainian Government  
 DEPARTMENT  
 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

To E-mail and Board Members of:  
 Planet Labs PBC (www.planet.com)  
 Maxar Technologies Inc. (www.maxar.com)  
 Airbus (www.airbus.com)  
 GE Imaging Services Co. Ltd (www.geimaging.com)  
 BlackSky Global LLC (www.blacksky.com)  
 Satys (www.satys.com)  
 SpaceView (www.spaceview.com)  
 Esri (www.esri.com)

Dear Colleagues,  
 In these difficult times, we call on You to help Ukraine!

We are winning with our armed forces and courageous people, but we need help to the information and technological war that Russia is also waging against us.

Our appeal is based on the strong understanding that Your cooperation and the information you can provide can save lives of our people!

Russia is bombarding our cities every day and night and so many civilians are in danger.

We fully reveal the opportunity to watch the movement of Russian troops, especially at night when our technologies are blind to such SAR satellite data is important to understanding Russian troop and vehicles movements at night considering that clouds cover about 60 percent of Ukraine during the day.





We sincerely ask You to consider the following cooperation:  
 - Provide high-resolution satellite imagery in the real time to Armed Forces of Ukraine;

6:20 AM · Mar 1, 2022 · Twitter for iPhone

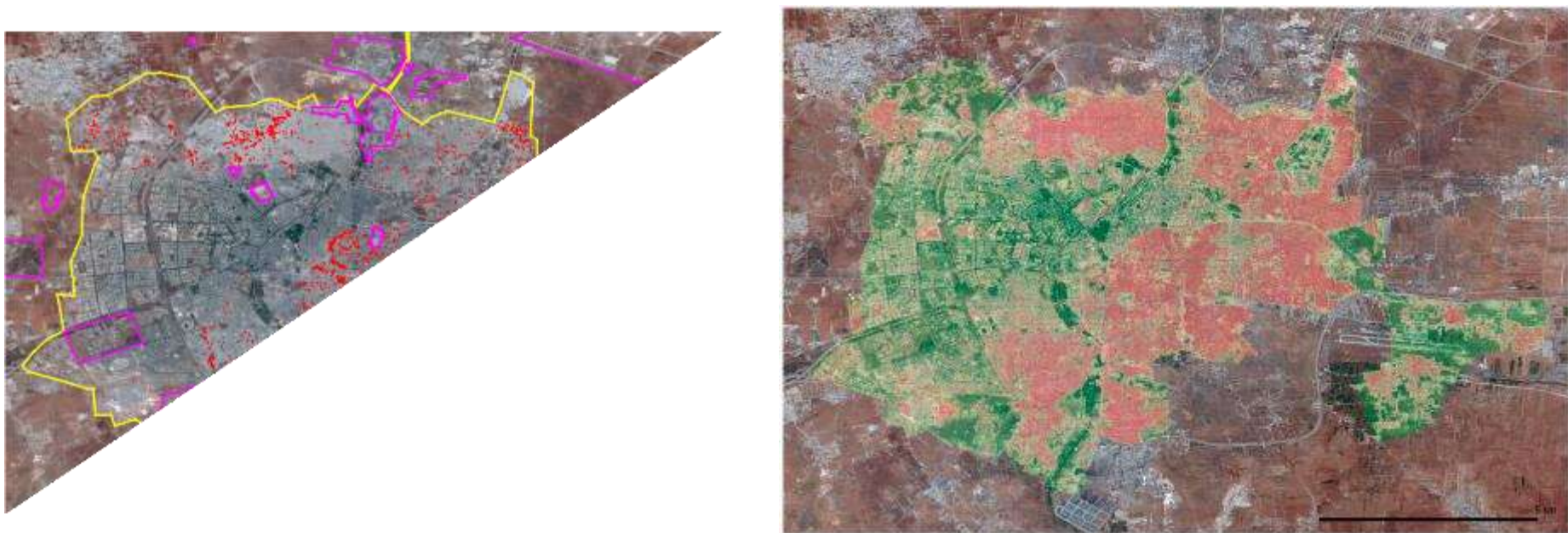
373 Retweets 48 Quote Tweets 670 Likes



# Monitoring war destruction from space using machine learning

Hannes Mueller<sup>a,b,1</sup>, Andre Groeger<sup>b,c,1</sup> , Jonathan Hersh<sup>d</sup> , Andrea Matranga<sup>d,e</sup> , and Joan Serrat<sup>f,g</sup> 

<sup>a</sup>Institute of Economic Analysis, Spanish National Research Council (CSIC), 08193 Bellaterra, Spain; <sup>b</sup>Barcelona Graduate School of Economics, 08005 Barcelona, Spain; <sup>c</sup>Department of Economics and Economic History, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain; <sup>d</sup>Argyros School of Business, Chapman University, Orange, CA 92868; <sup>e</sup>Smith Institute for Political Economy and Philosophy, Chapman University, Orange, CA 92868; <sup>f</sup>Computer Science Department, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain; and <sup>g</sup>Computer Vision Center, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain



**Fig. 1.** Imagery of Aleppo on September 18, 2016. Red dots indicate UNOSAT annotations as destroyed. Areas enclosed by magenta lines are no analysis zones, excluded from the UNOSAT damage assessment due to being noncivilian. The yellow line encloses the populated areas of Aleppo under analysis. Sources: Google Earth/Maxar satellite imagery and UNITAR/UNOSAT damage annotations. *A* shows an overview of the urban area of Aleppo. *B* shows an area in central Aleppo close to the Citadel.



# Exam

- In person only
- Closed book
- Review: Friday, March 25<sup>th</sup>
- Exam: Monday, March 28<sup>th</sup>
- Grading:
  - Multiple choice: 10 x 1 pts = 10
  - Short answer: 8 x 3 pts = 24
  - Long answer: 1 x 16 pts = 16

# Final project

- Initial Proposal (2 points)  
**Due Friday, March 25<sup>th</sup> in class**
- Updated proposal with a flowchart (2 points)  
**Due Monday, April 4<sup>th</sup> in class**
- Final Project (36 points)  
**Due Monday, April 11<sup>th</sup> in class**