



International Polar Day

*Above the Poles*

[www.ipy.org](http://www.ipy.org)

Welcome to:

*Live from IPY!*

Looking Out and In

Observations of, and from, the Polar Regions



4 December 2008

10:00 am AST, 11:00 am PST, 12:00 pm MST, 1:00 pm CST, 2:00 pm EST

Chile 1600, Sao Paulo 1700, UK 1900, Europe 2000, Sydney 0600, NZ 0800



# Welcome to HorizonWimba



Arctic Research Consortium of the United States

List of all participants

Raise your hand to ask a question

Return to the lobby or exit

Slides will be shown here

If using VOIP, press here to talk

'Chat' with one person or the entire group

The screenshot shows a Wimba webinar interface. At the top, a slide reads "Welcome to HorizonWimba" with the ARCUS logo and "Arctic Research Consortium of the United States" below it. A toolbar contains a "TALK" button, a microphone icon, a mute icon, a lock icon, a video icon, and a "Options" button. Below the toolbar is a chat window with a scrollable list of messages: "You say, ...", "tina says, 'Hi Ronnie'", "You say, 'hello tina'", "You say, 'nice to see you'", "tina says, 'you too 😊'", "You say, 'it is a nice day outside'", and "Janet\_Warburton says, 'Welcome to our webinar!'". A dropdown menu shows "Main Room". On the right, a "People (3)" list shows "Janet\_Warburton", "ronnie", and "tina". At the bottom right, a navigation bar includes "Exit - Lobby - Help" and the ARCUS logo. Red circles highlight the "TALK" button, the chat window, the "People" list, and the "Exit - Lobby - Help" menu. Arrows point from text labels to these elements.

**Please note:** Today's event will be recorded and archived at [www.polartrec.com](http://www.polartrec.com).



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[www.ipy.org](http://www.ipy.org)

## Roll Call

- **When called, please state your:**
  - Name
  - School / Institution
  - The number of students participating today



International Polar Day

*Above the Poles*



## ***International Polar Year (IPY)***

The International Polar Year (2007-2009) is an exciting scientific campaign focusing on the world's polar regions!

IPY is a time for discovery, science, learning, and awareness about the polar regions with activities for youth, scientists, and the public.

***[www.ipy.org](http://www.ipy.org)***





International Polar Day

# *Above the Poles*

[www.ipy.org](http://www.ipy.org)

## Today's Agenda:

- Presenter Introduction
- Introduction: "Looking in and Looking Out"
- Observing Space from the Poles
- Observing the Poles from Space
- Question & Answer Session



International Polar Day

# Above the Poles

[www.ipy.org](http://www.ipy.org)

## Today's Presenters:



Darryn Schneider  
IceCube, Neutrino  
Observatory



Bob Bindschadler  
LIMA [Landsat Image  
Mosaic of Antarctica]



Ken Jezek  
GIIPSY [Global Inter-  
Agency IPY Polar  
Snapshot Year]

*LIVE FROM  
ANTARCTICA*



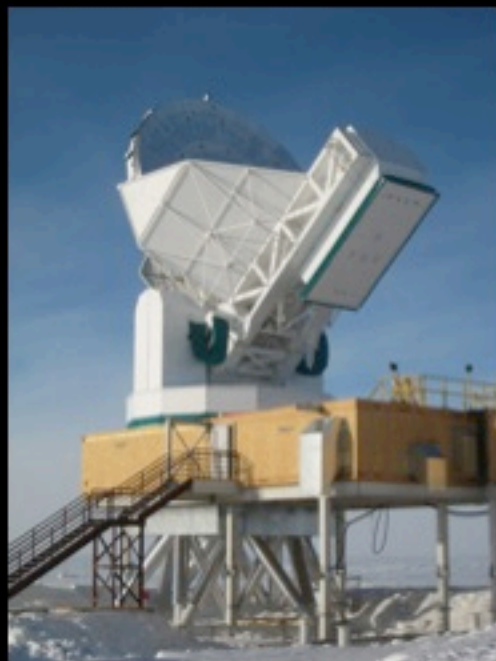
International Polar Day

# Above the Poles

[www.ipy.org](http://www.ipy.org)

## Looking Out:

The polar regions provide unique locations for observing layers of the upper atmosphere and outer space.



## Looking In:

Images from space obtained from satellites, give us a unique view of the polar regions and help us to learn a lot about processes happening on the Earth. Satellite images help researchers on the ground by providing images of the area they are working in, and even providing practical information like where the sea ice is in their area.







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# Above the Poles

[www.ipy.org](http://www.ipy.org)

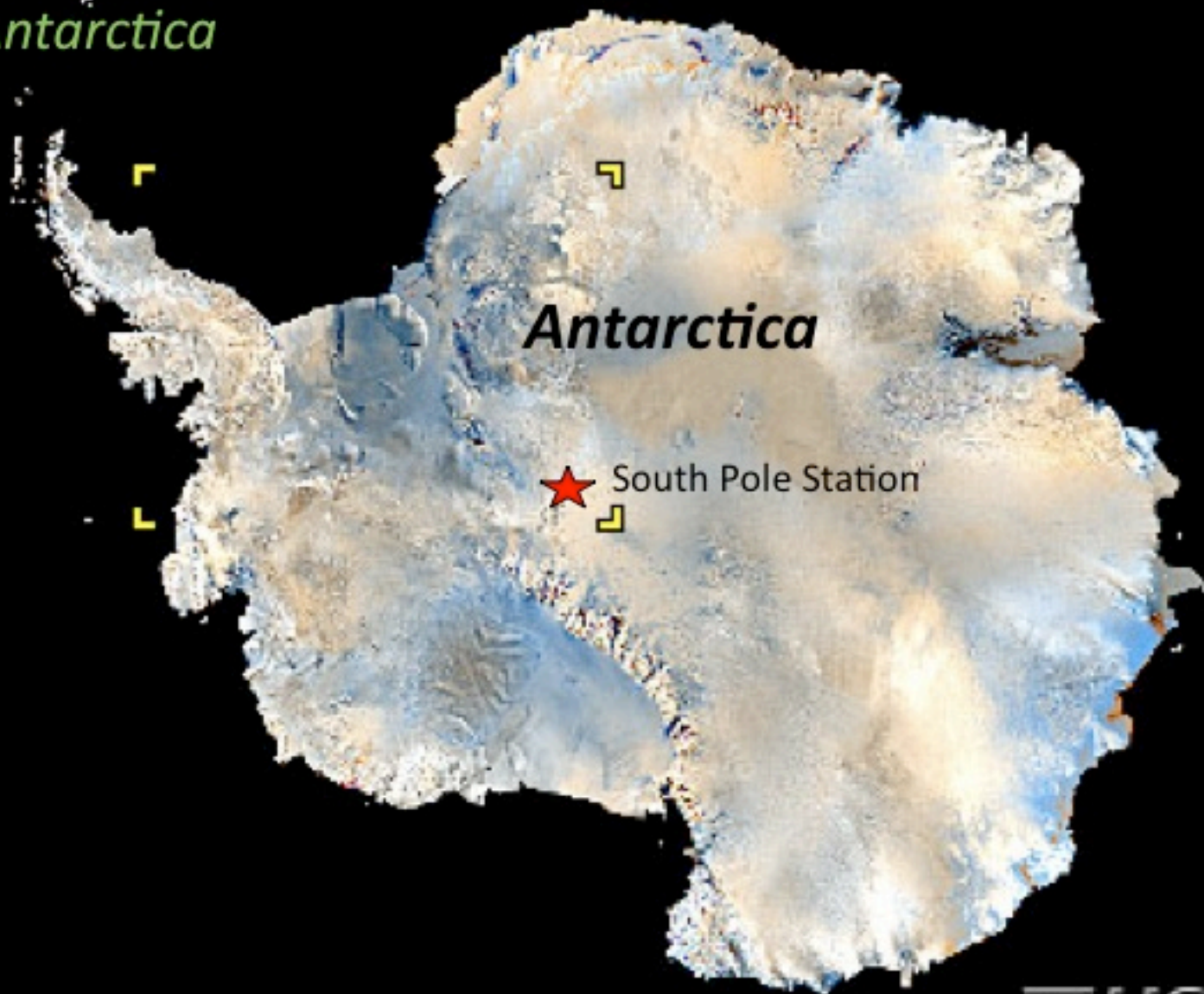
## Dr. Darryn Schneider *Observing Space from the Poles*



- University of Wisconsin - IceCube neutrino telescope
- Bachelor of Science - University of Queensland
- PhD Plasma Physics - Australian National University
- Darryn's first job was wintering over at the Australian Antarctic base Casey where he maintained the geophysical observatory, which had a strong emphasis on ionospheric studies.
- This is Darryn's 13th trip to Antarctica and he has spent about 4 years there in total.



*Live from the South Pole  
Station, Antarctica*



375 mi



USGS

# Astronomy at the South Pole

Radio Telescopes

South Pole Telescope (SPT)

BICEP

Neutrino Telescopes

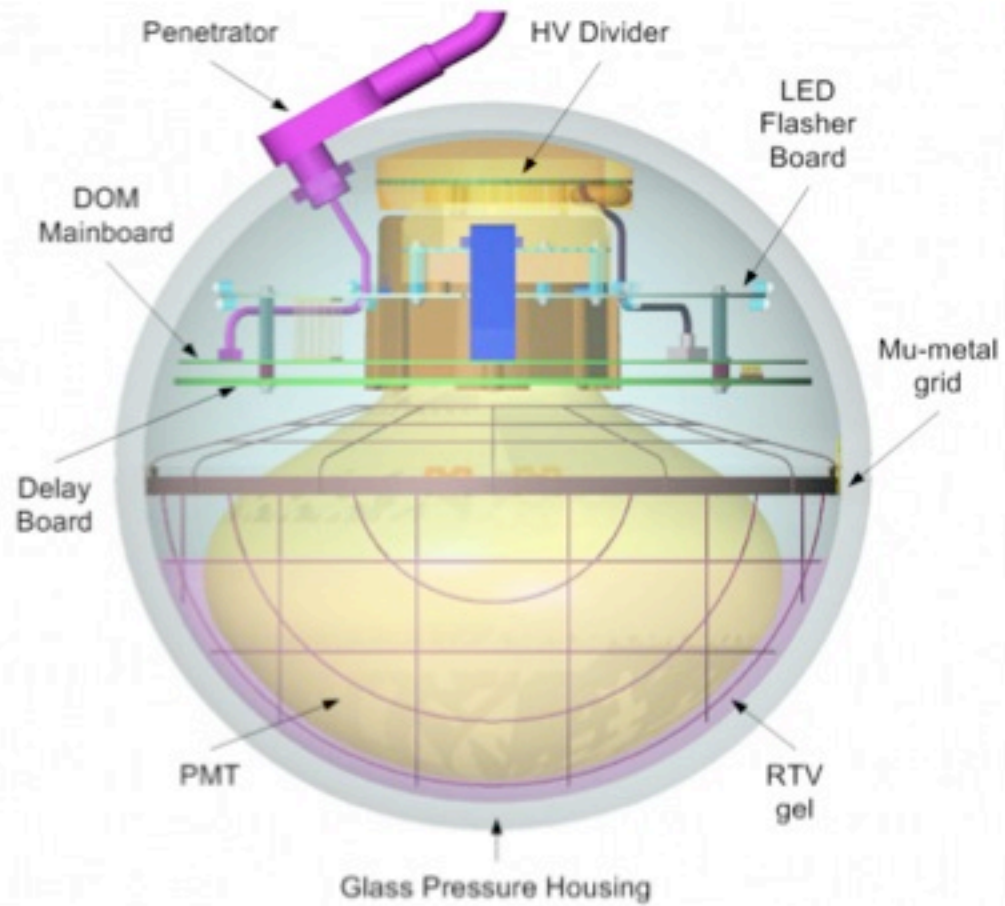
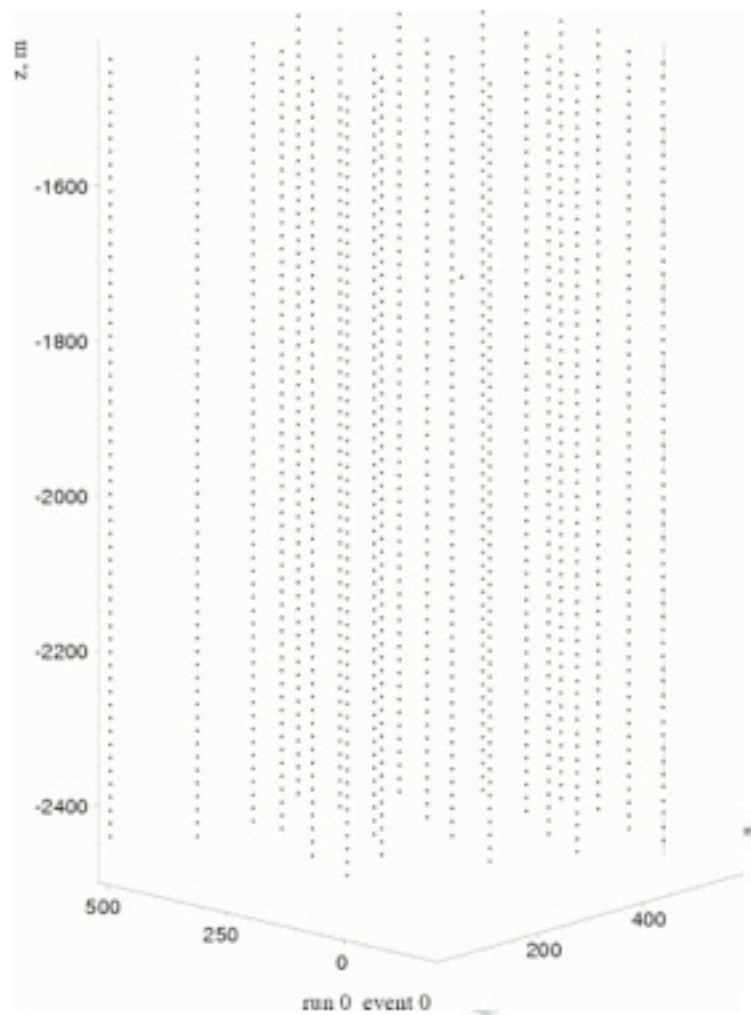
AMANDA

IceCube



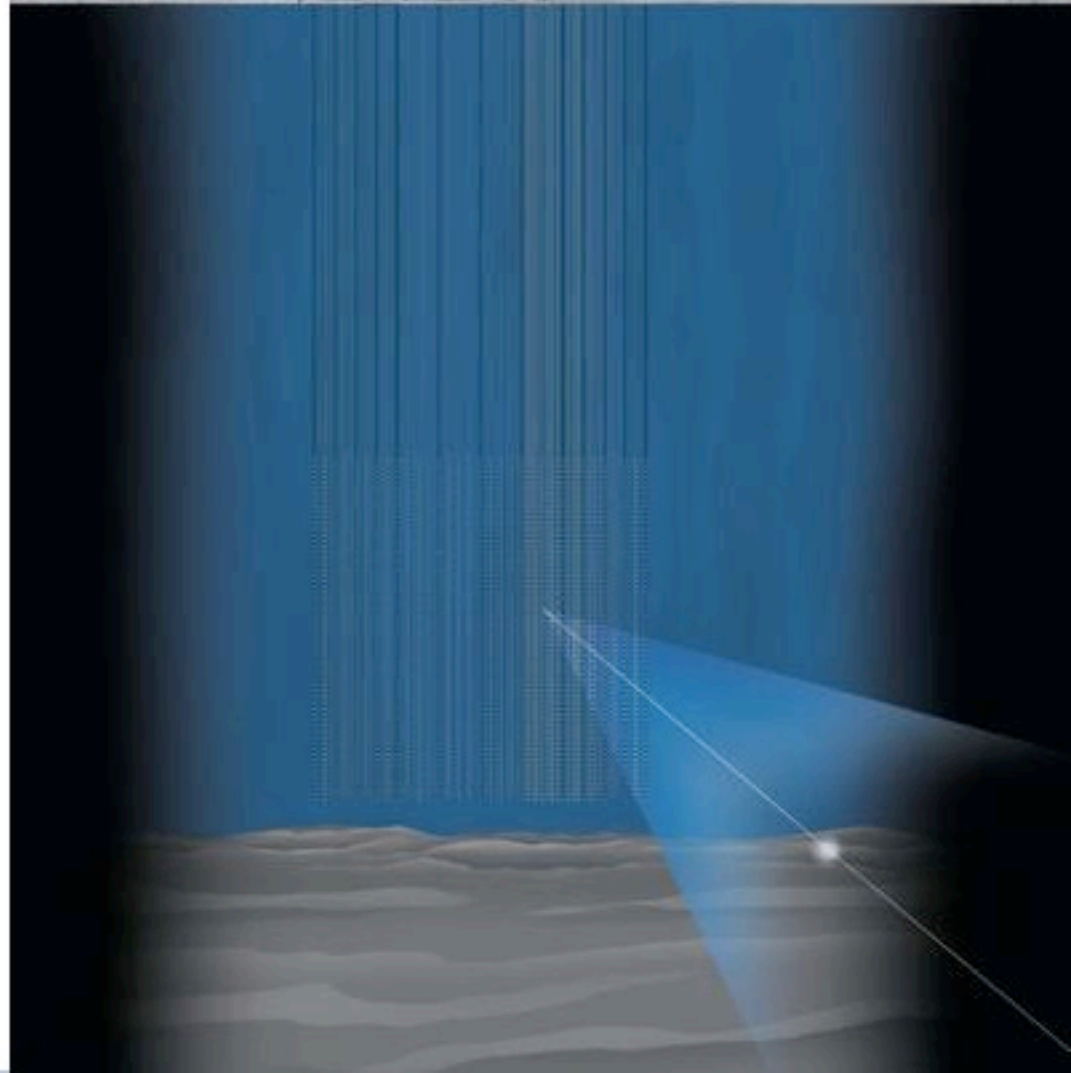
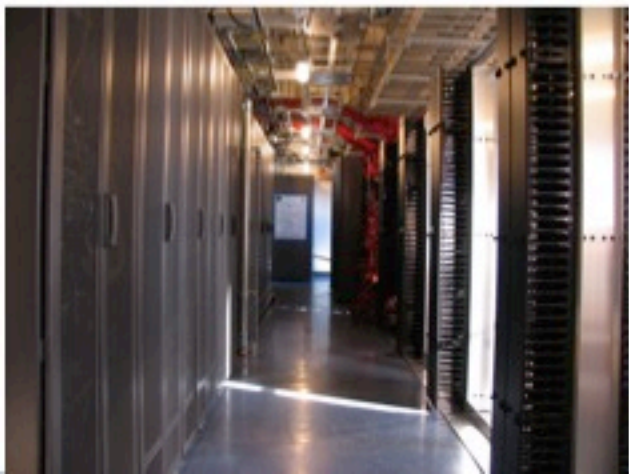
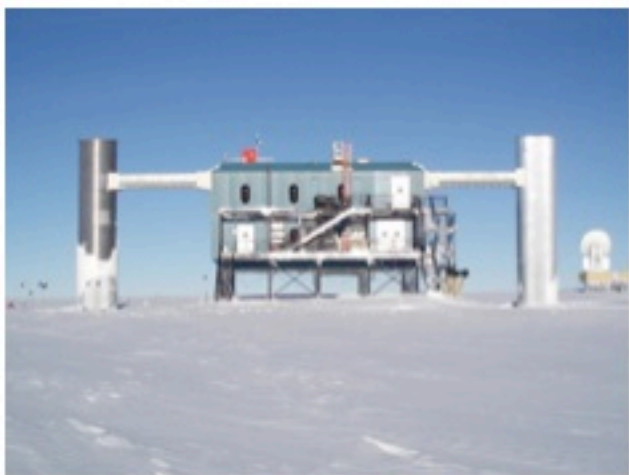


# IceCube Neutrino Telescope

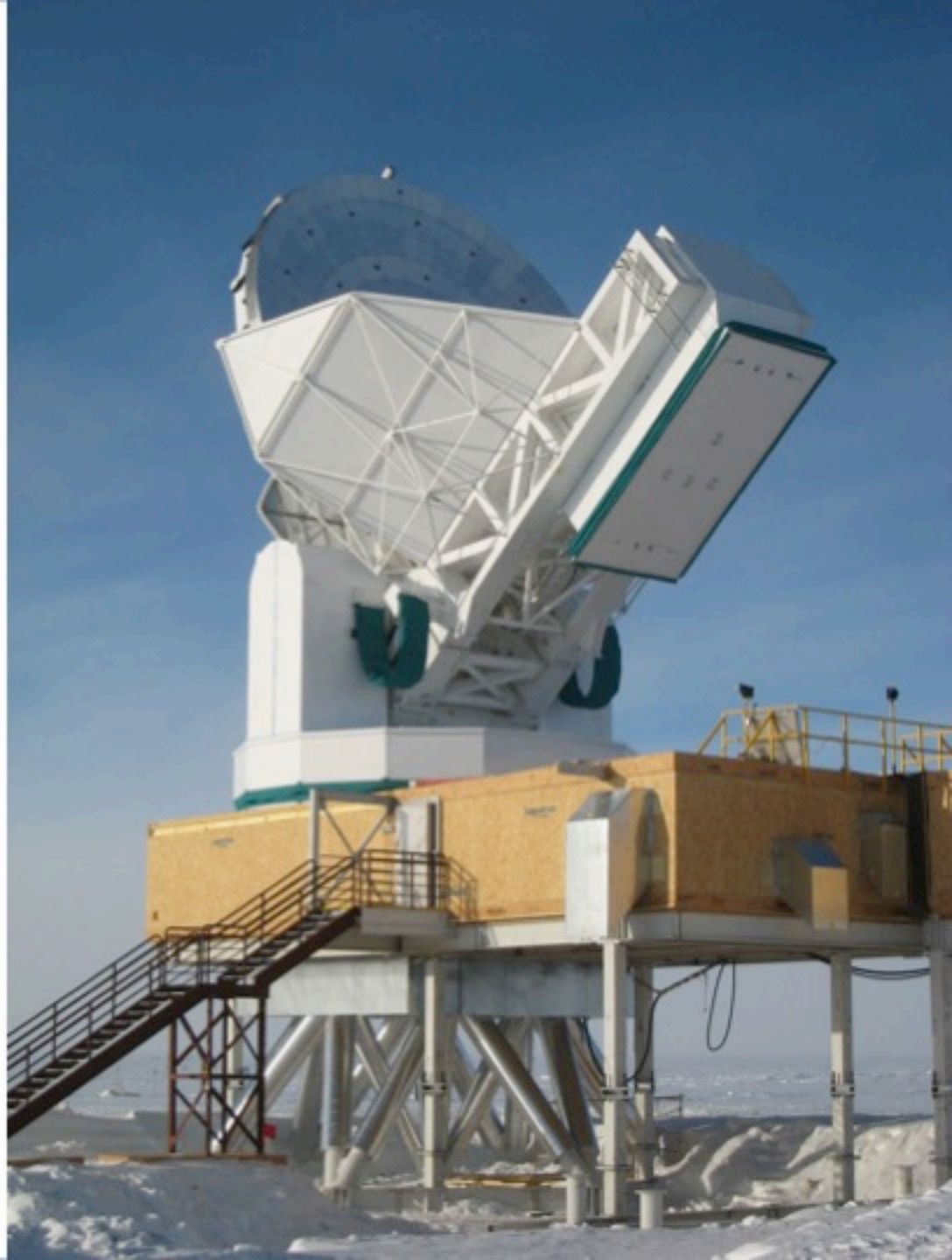
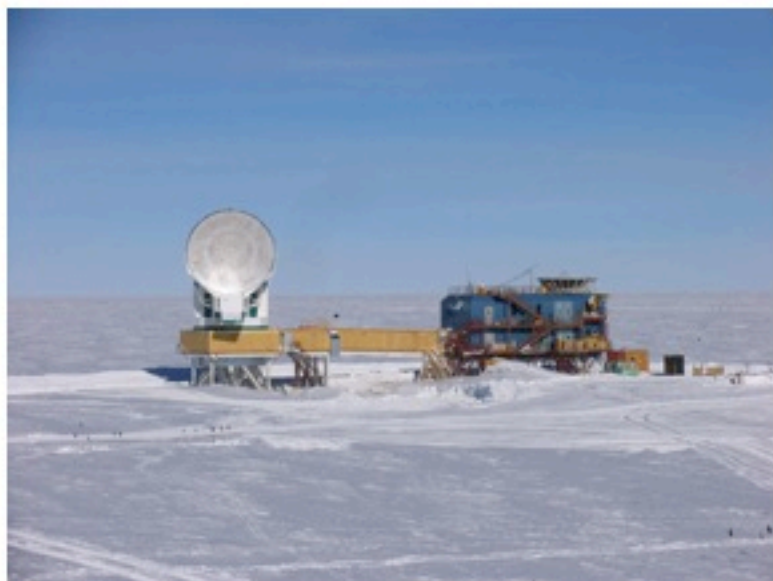




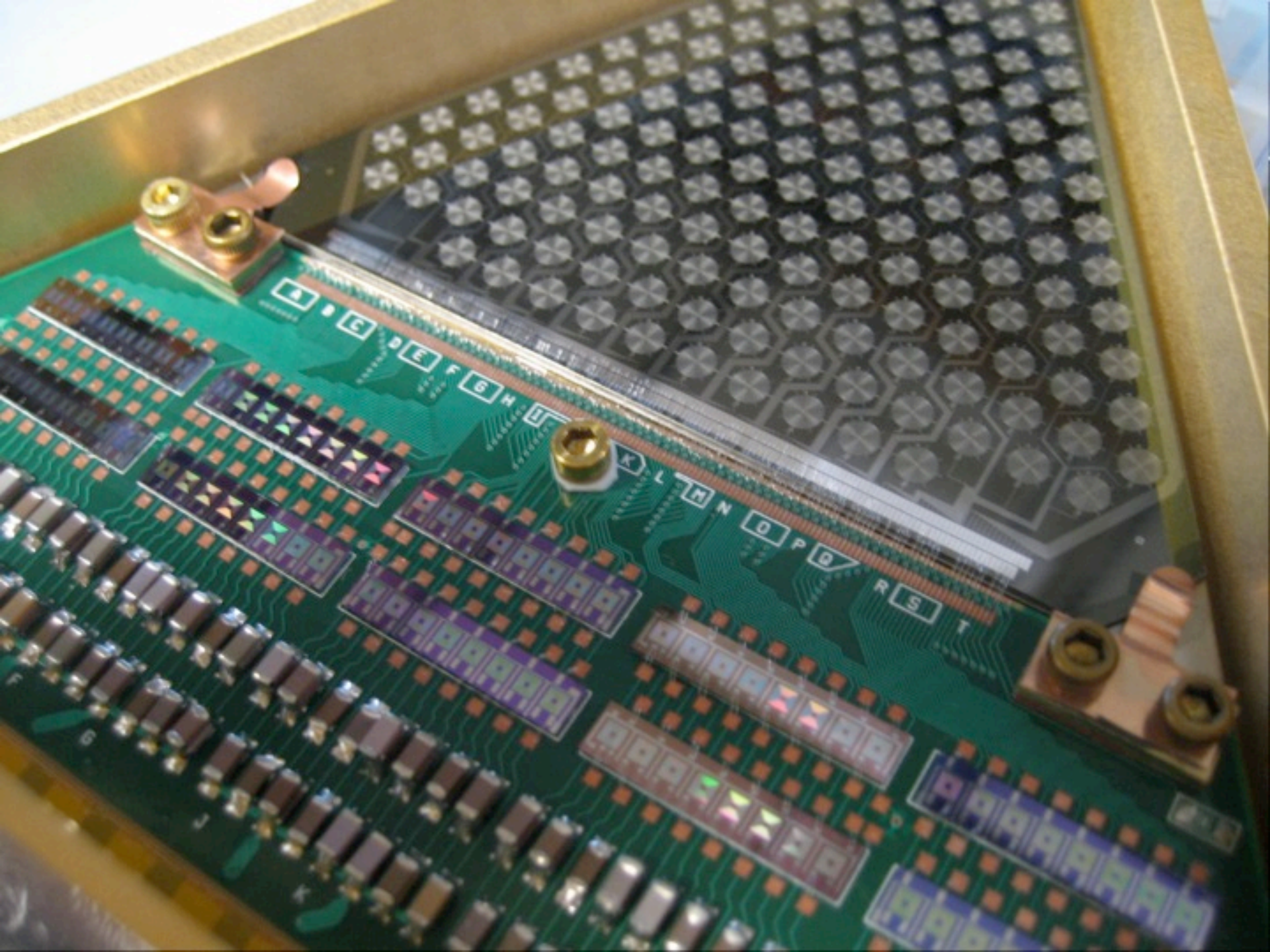




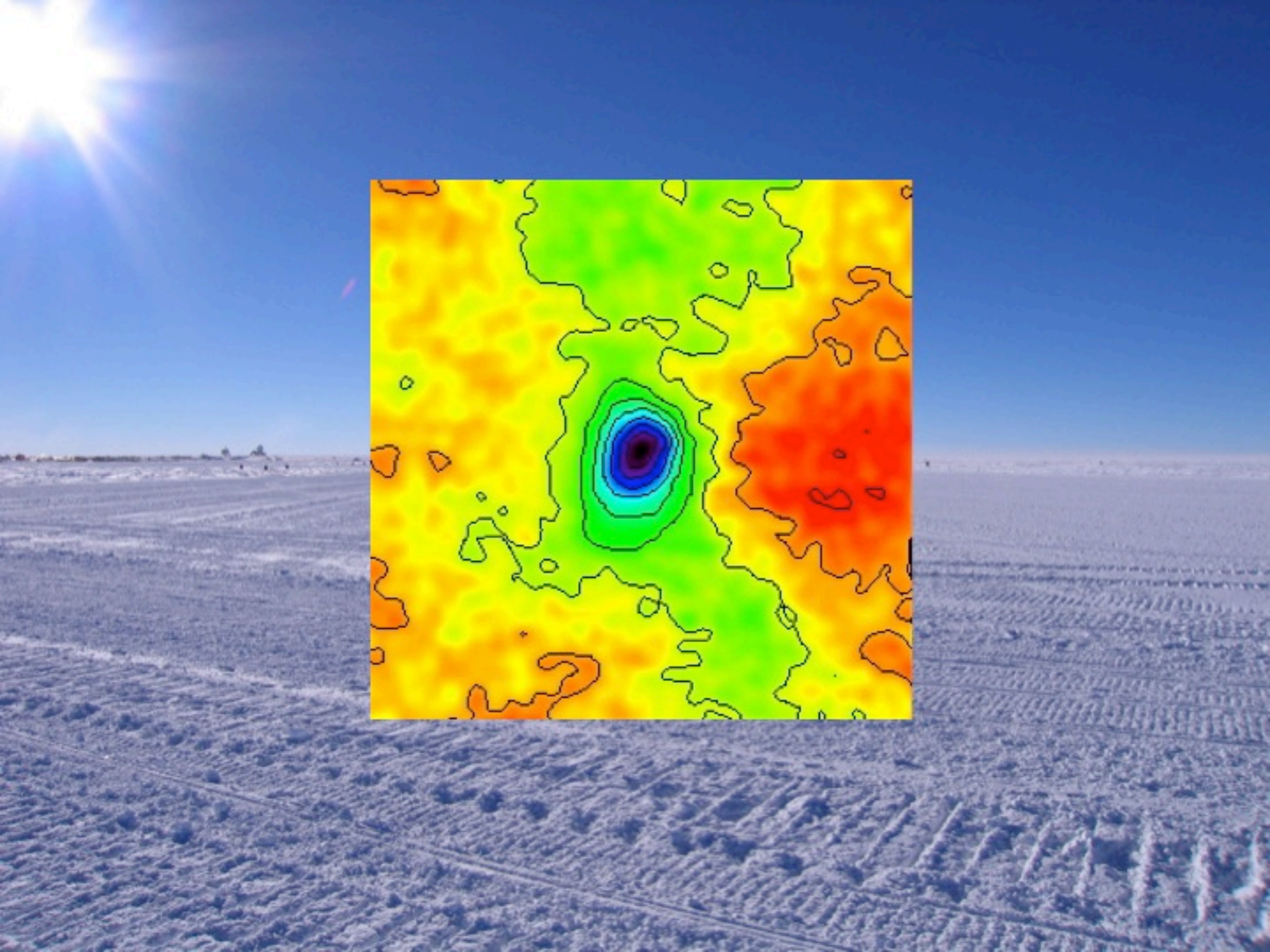
## South Pole Telescope (SPT)





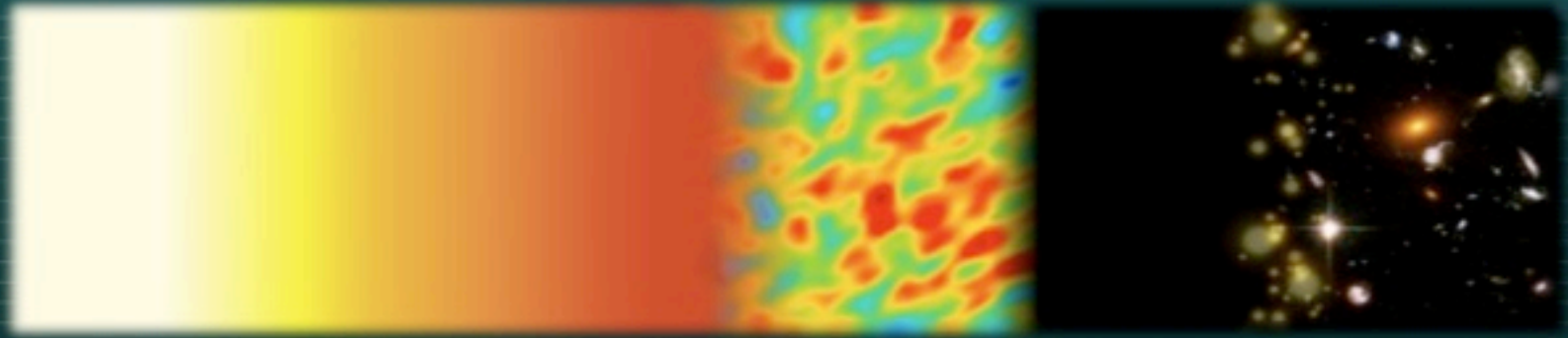








# How did the universe begin?



Big Bang,  
 $t = 0$

"Inflation" -- accelerated expansion of the universe at  $t = 10^{-35}$  s (?)

Formation of the *cosmic microwave background* (CMB), a snapshot of the early universe at  $t = 400,000$  yr

First stars,  
 $t = 1$  billion yr

We live here,  
 $t = 13.7$  billion yr

Inflation generates *gravitational waves* that imprint a handedness or "B-mode" in the polarization of the CMB.

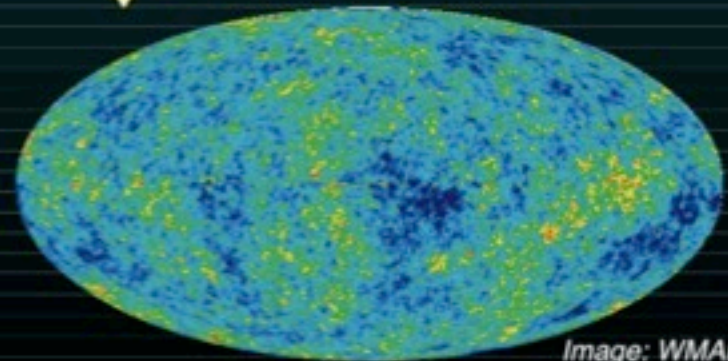


Image: WMAP

# Background Imaging of Cosmic Extragalactic Polarization

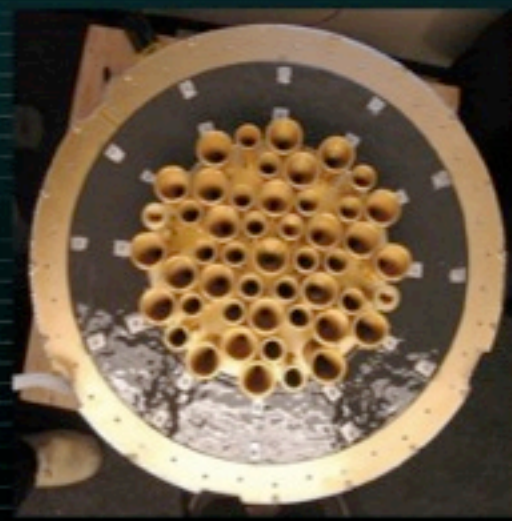


Team BICEP and the telescope: an upward-looking refractor and 3-axis mount



BICEP observes the CMB from the South Pole:  
November 2005 - December 2008

*Image: S. Richter*

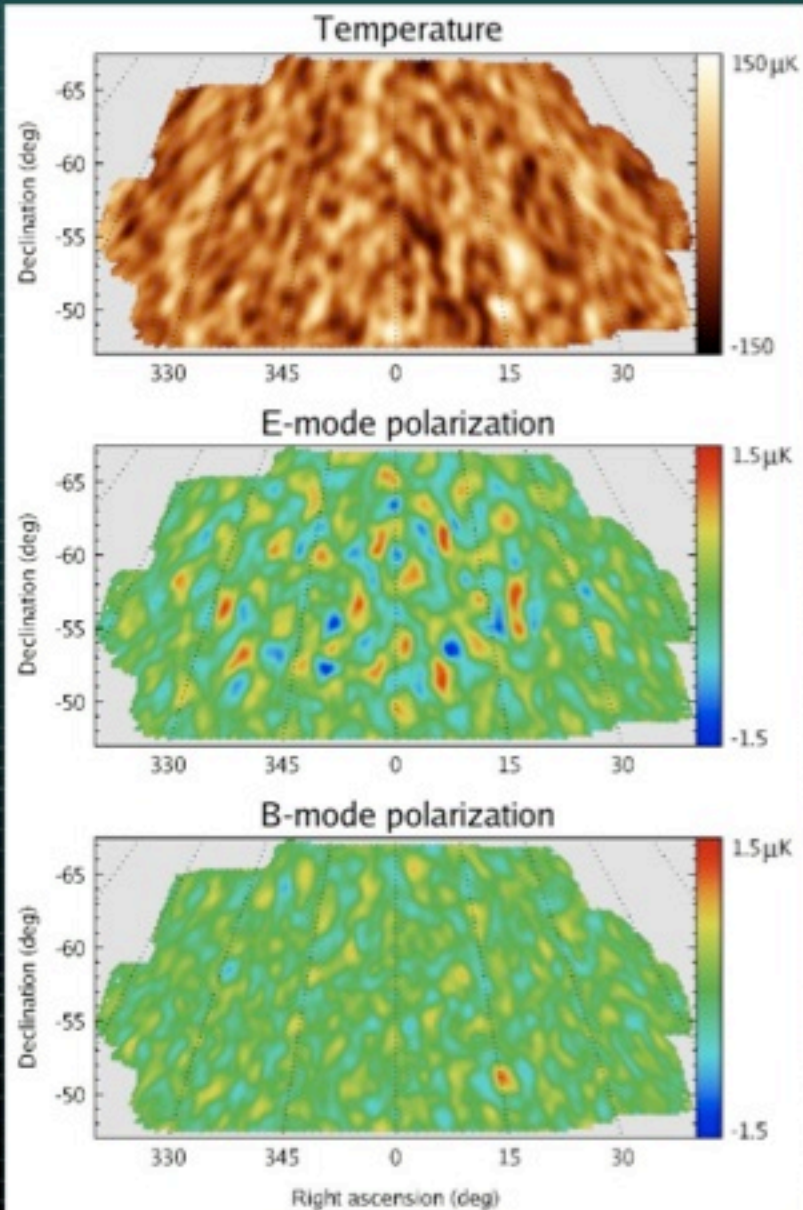


49-pixel focal plane  
observing at two  
microwave wavelengths,  
2 mm and 3mm

Mapping ~2% of the  
sky with degree-scale  
resolution



# Temperature and polarization maps from BICEP



Temperature fluctuations correspond to under- and overdense regions that evolved into the largest structures visible in the universe today.

The CMB has intrinsic "E-mode" polarization, and BICEP makes the first high signal-to-noise measurements at these angular scales.

BICEP doesn't see B-mode polarization (yet), so we can set tight upper limits on the gravitational waves produced by Inflation.



International Polar Day

# Above the Poles

[www.ipy.org](http://www.ipy.org)

## Dr. Kenneth Jezek *Observing the Poles from Space*



- Professor, Byrd Polar Research Center, School of Earth Sciences, Ohio State University
- Began Antarctic research in 1973 when he manned the cosmic ray laboratory located at McMurdo Station
- Scientific interests include: remote sensing of ice sheets and sea ice and innovative technologies used for creating three-dimensional images of the land buried beneath the polar ice sheets
- Co-leader on the GIIPSY project which aims to assemble legacy data sets during the International Polar Year using the international constellation of Earth observing satellites

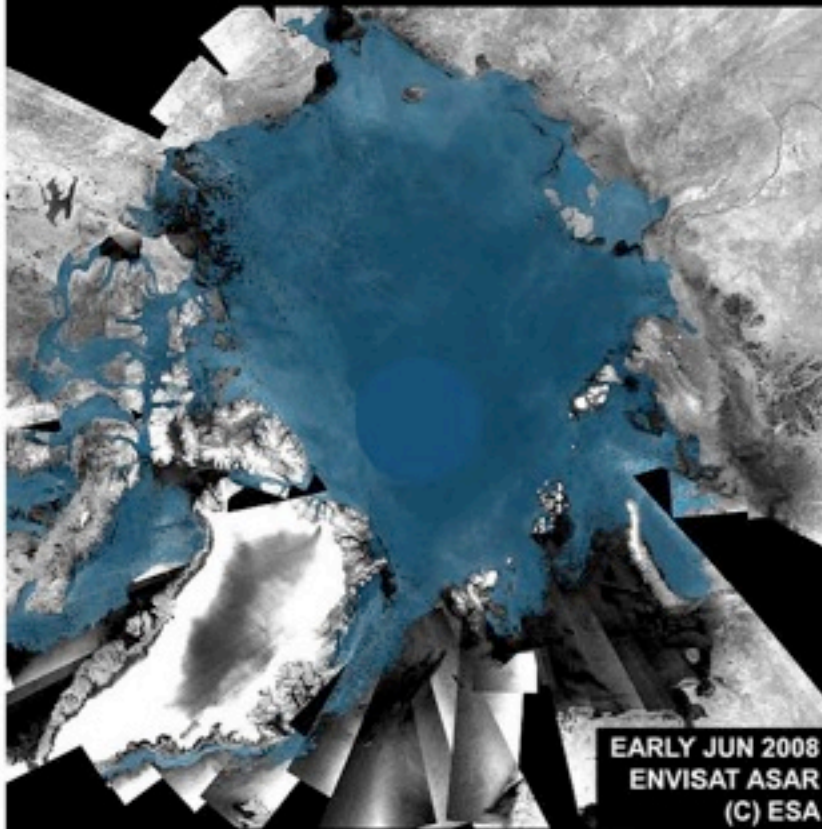


# Observing Pole to Pole – A virtual observing system

*Global Inter-agency IPY Polar Snapshot Year  
(GIIPSY)*

NASA ICESat

Participating International Agencies: ASI,  
CSA, CMA, DLR, ESA, EUMETSAT, JAXA,  
NSF, NASA, NOAA, ROSHYDROMET,  
WMO, WCRP-CLIC



## GIIPSY

The 1957 IGY began the rigorous scientific investigation of the Polar Regions.

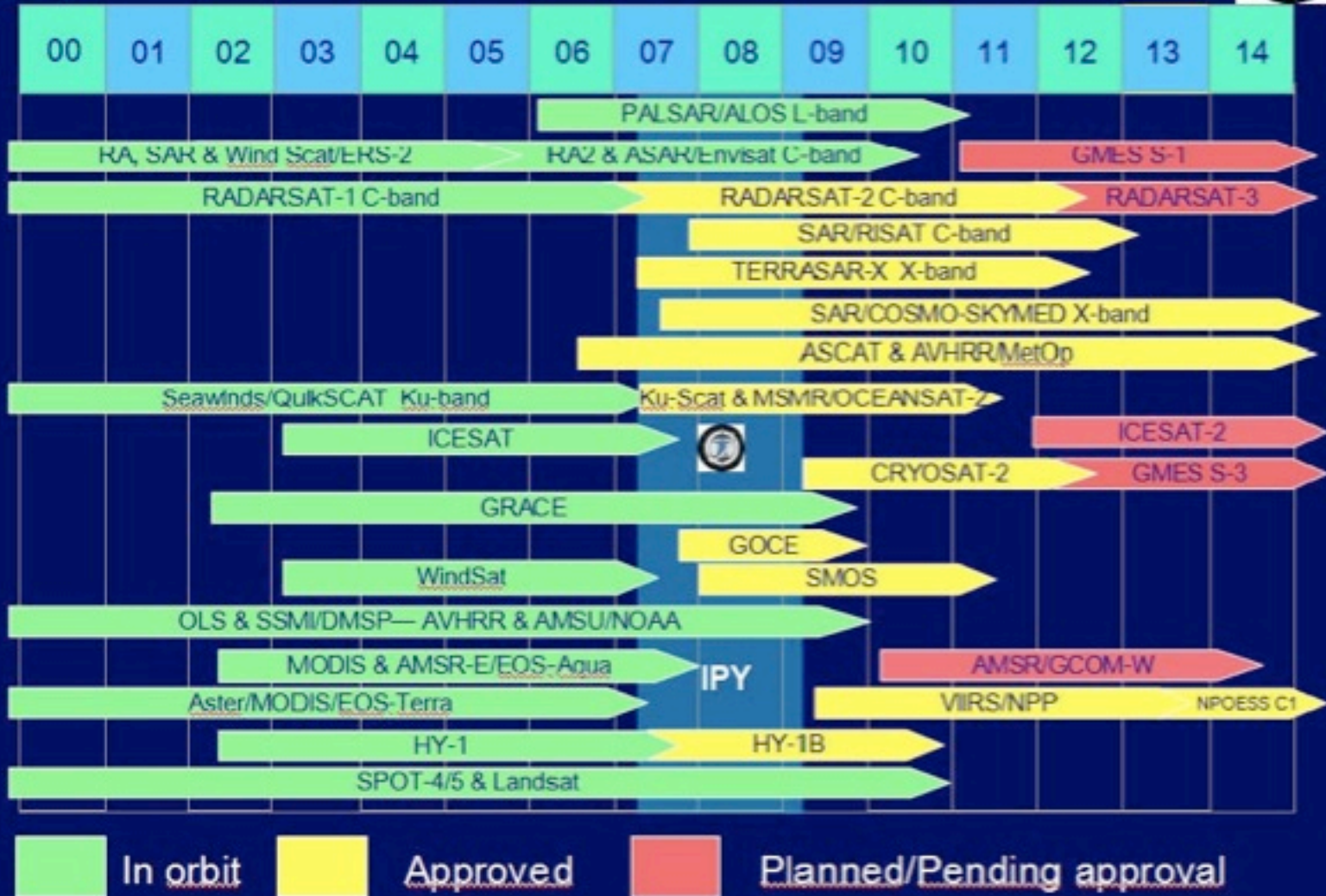
The 2007-08 IPY goes beyond the IGY through the numbers and capabilities of earth observing satellites. These systems can routinely observe the poles and cast polar processes within the context of the global environment.

Different satellites use different measuring techniques. Combined, the international network of satellite capture a unique snapshot of the polar regions.





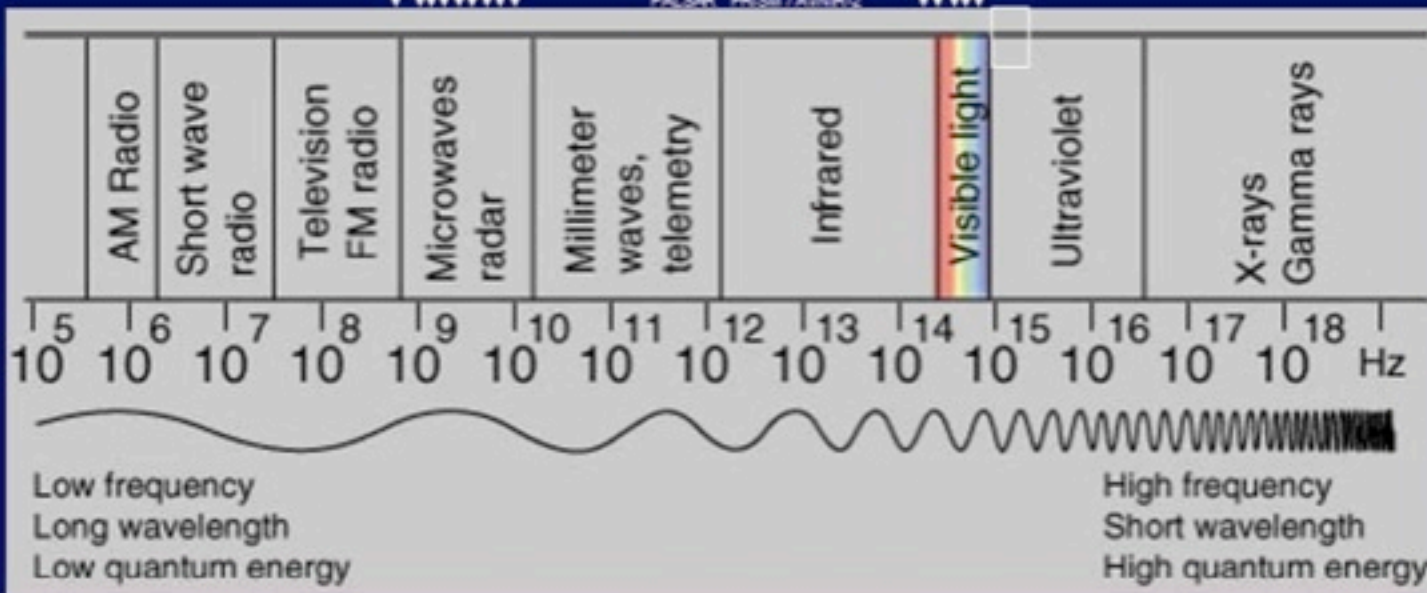
# Cryosphere Satellite Missions



# Accomplishing the IPY Snapshot

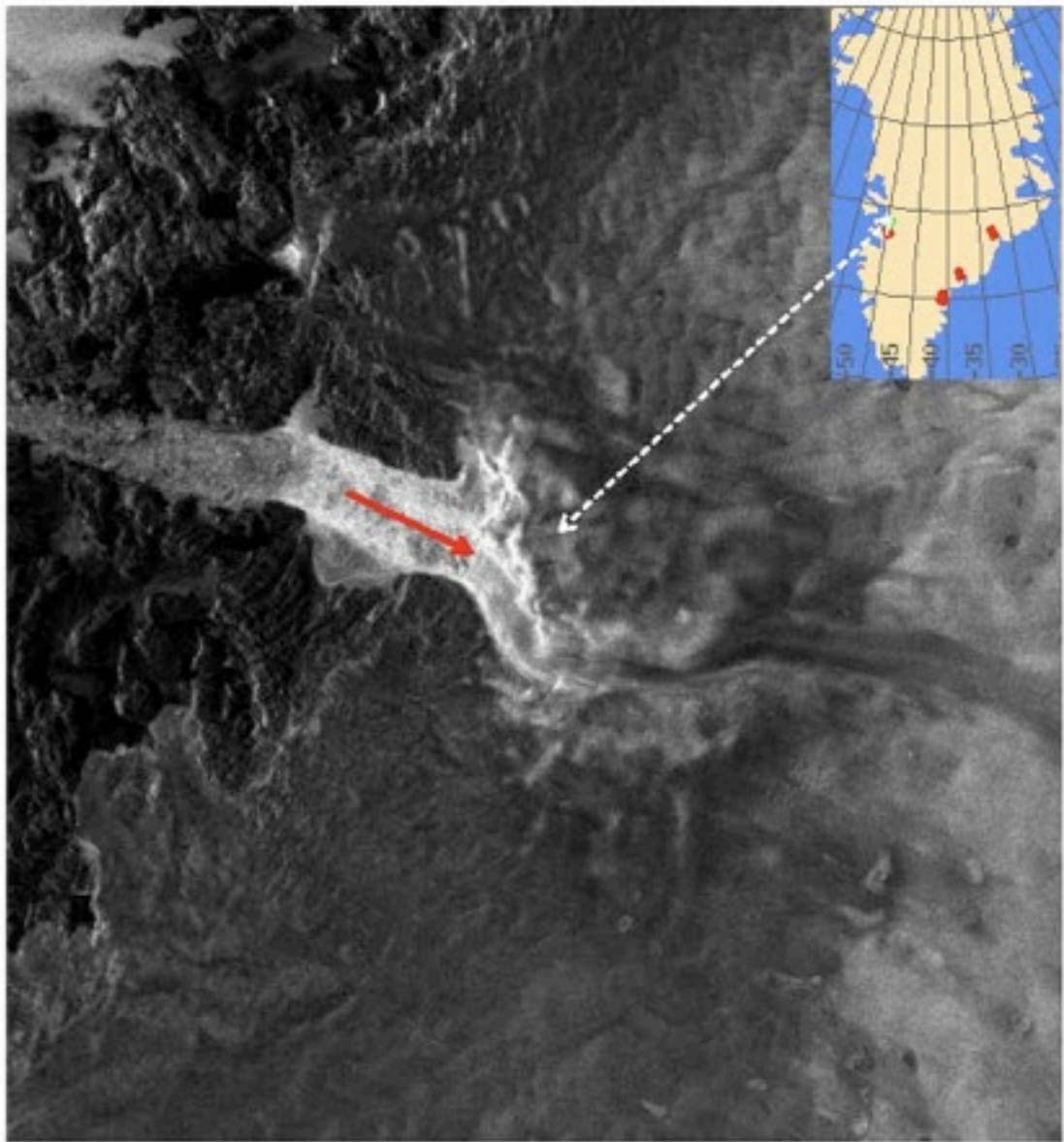


Aircraft and in-situ  
Sounders and GPR  
Systems



**Gravity**





## See for yourself !!

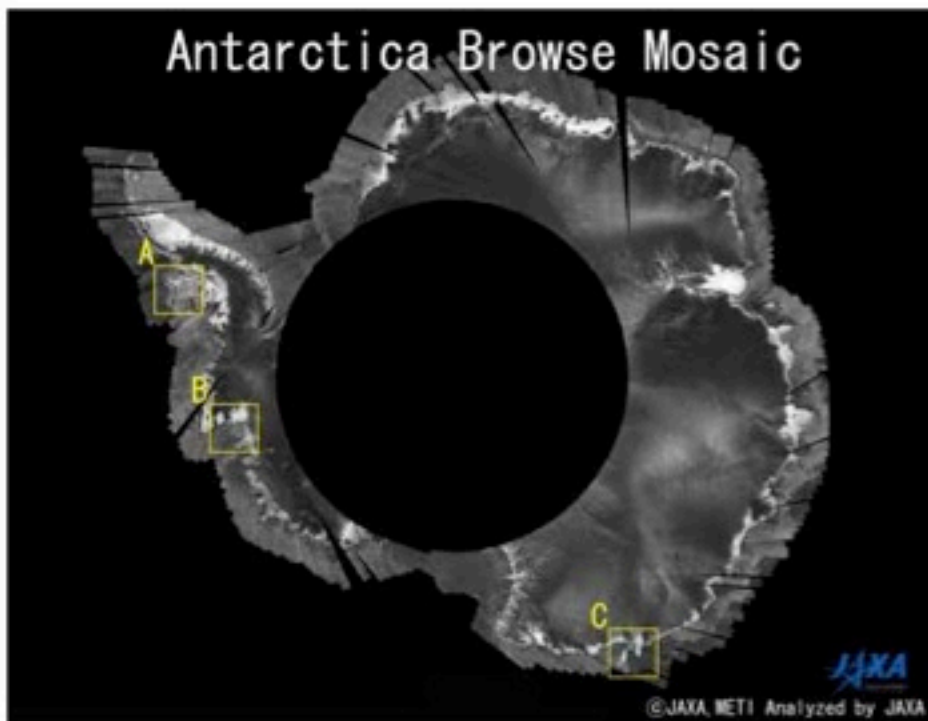
This ESA ASAR image of Jacobshavn Glacier Greenland was taken by the ESA ASAR on Nov 27, 2008. The red arrow shows how much the glacier has retreated since 2000.

You can watch for future changes. It is easy. For example, download the EOLI\_SA at

<http://earth.esa.int/resources/catalogues/>

to monitor this glacier.

## Antarctica Browse Mosaic



More places to look for images:

<http://nasadaacs.eos.nasa.gov/>

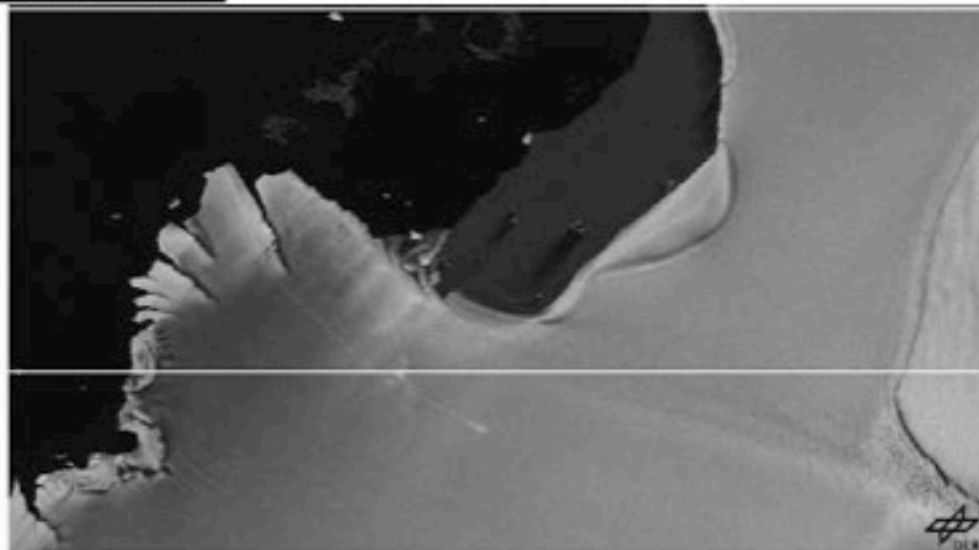
<https://cosmo-skymed-ao.asi.it/asi/asi>

<http://polardali.spotimage.fr:8092/PY/dalishsearch.aspx>

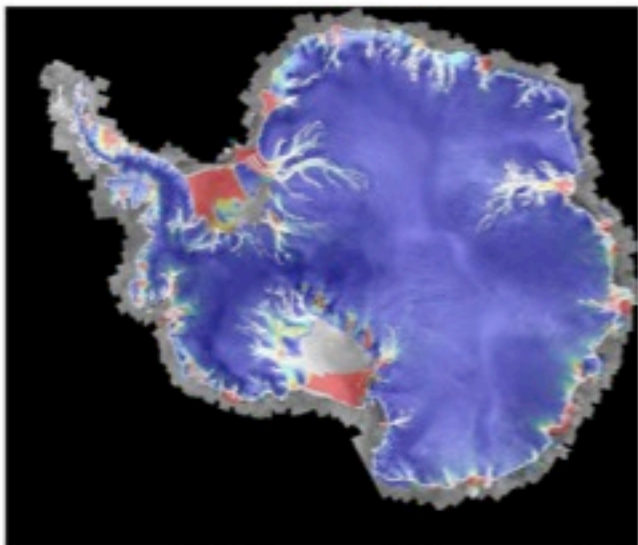
[http://www.eorc.jaxa.jp/ALOS/ipy/ipy\\_index.htm](http://www.eorc.jaxa.jp/ALOS/ipy/ipy_index.htm)

Japanese PALSAR Mosaic:  
Dec. 2007 – Jan. 2008

German TerraSAR-X: 10 Feb. 2008;  
Antarctic station Neumayer II







# IPY Opportunity for Coordinated Spaceborne Observations

- IPY provides an international framework for acquiring coordinated spaceborne observations of the polar regions.
- The confluence of international science programs, technical capabilities and the IPY present a **once-in-a-life-time** opportunity for gathering data essential for understanding changing polar climate and its global impact.
- In the spirit of the IGY, secure these data sets as our legacy to the next generations of polar scientists.

# Beyond GIIPSY: GEOSS

## GEOSS: The Global Earth Observation System of Systems

THE GLOBAL EARTH OBSERVATION  
SYSTEM OF SYSTEMS



- Cooperation amongst international agencies
- Image top of the atmosphere to the depths of the core
- Complex Science
- Information delivery to the public





International Polar Day

# Above the Poles

[www.ipy.org](http://www.ipy.org)

## Dr. Robert Bindschadler *Observing the Poles from Space*

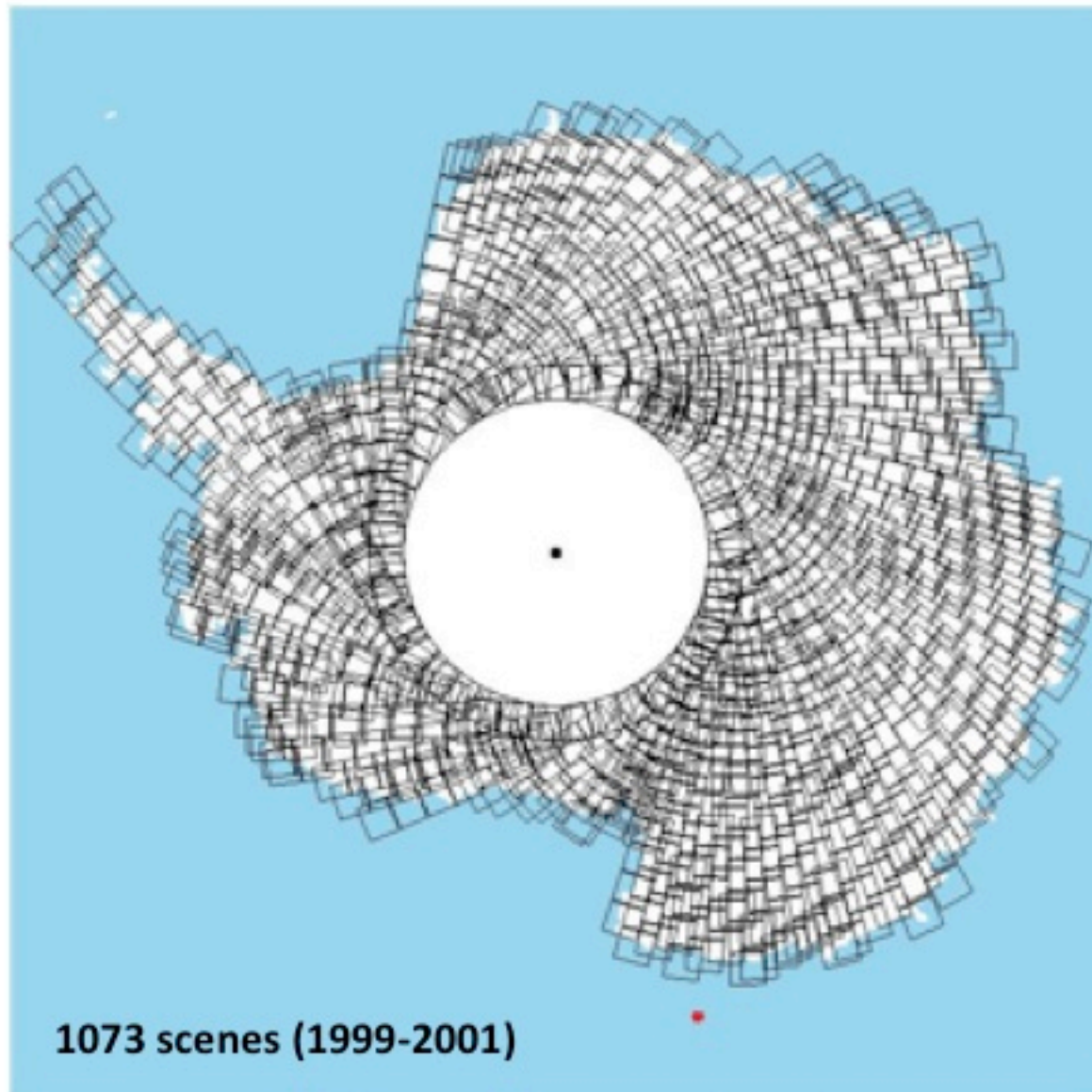


- Chief Scientist of NASA's Hydrospheric and Biospheric Sciences Laboratory-NASA Goddard Space Flight Center
- Senior Fellow of the Goddard Space Flight Center
- Fellow of the American Geophysical Union
- Past President of the International Glaciological Society
- Scientific Interests: Dynamics of glaciers and ice sheets, remote sensing, role of ice in the Earth's climate.
- 15 Antarctic field expeditions, Greenland and various glaciers throughout the world

*Antarctica in High-Definition: The Landsat Image  
Mosaic of Antarctica (LIMA)*



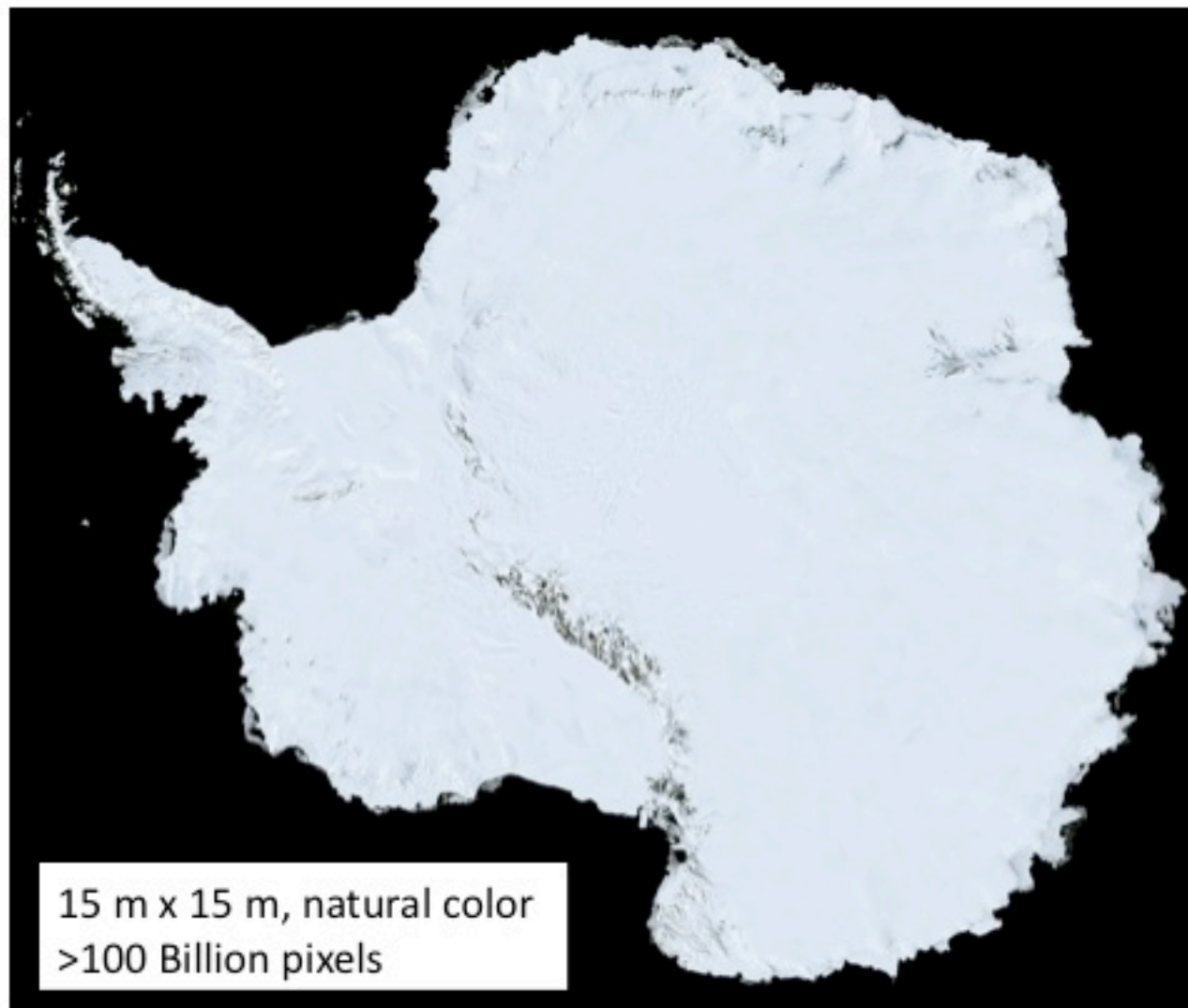
# A 1000-piece Jigsaw Puzzle



1073 scenes (1999-2001)



# How Antarctica Really Looks



15 m x 15 m, natural color  
>100 Billion pixels

USGS science for a changing world | NASA | British Antarctic Survey NATIONAL ENVIRONMENT RESEARCH COUNCIL

### LandSat Image Mosaic Of Antarctica (LIMA)

View LIMA  
 Download Mosaics and LandSat Scenes  
 Order USGS Maps, Posters, and Wall Art  
 Download the LIMA Poster and More from BAA  
 Browse the Digital Library  
 Use the Interactive Atlas of Antarctic Research  
 Locate GIS Resources

## LANDSAT IMAGE MOSAIC OF ANTARCTICA

Created for the International Polar Year 2007-2009  
 Sponsored by the National Science Foundation and the U.S. Geological Survey

In support of the International Polar Year (IPY) 2007-2009, LIMA brings the continent of Earth into greater detail than ever before through its virtual-resolution, seamless, and high-resolution satellite view of Antarctica.

The U.S. Geological Survey (USGS), the British Antarctic Survey (BAS), and the National Aeronautics and Space Administration (NASA), with funding from the National Science Foundation (NSF), created LIMA from more than 1,000 Landsat ETM+ scenes.

As the first major scientific outcome of the IPY, LIMA fulfills the IPY goals. LIMA is an international effort, supports current scientific and research, encourages new projects, and helps the general public visualize Antarctica and changes happening to this environmental environment. Researchers and the general public can download LIMA and all of the component LandSat scenes at no charge.

Visit to view the continent and zoom in to see the stunning detail of this feature-rich, Pan-Sharpened LIMA. Bands 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 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.

The opening view includes McMurdo Station, the largest research base in Antarctica. Located at the tip of Foul Point Peninsula on Ross Island, McMurdo has been continuously operated by the United States of America since 1956. Ross Island is roughly 45 miles across. The flat, white areas are the Ross Ice Shelf and other ice on the coast of Antarctica. Also visible are the Erebus Glacier Tongue, Inshore and Fossil Shallows, and the Ross Sea Ice Tongue.

Accessibility | RSS | Privacy | Policies and Notices

## http://lima.nasa.gov

- Lesson plans
- Hands-on samples
- Videos of scientists explaining use of imagery
- Links to >13,000 Antarctic names
- Flying tour of Antarctica

## http://lima.usgs.gov

- Pan and zoom
- Download data
- GIS resources
- Maps, posters and wall art

NASA LIMA LandSat Image Mosaic of Antarctica  
 Faces of Antarctica

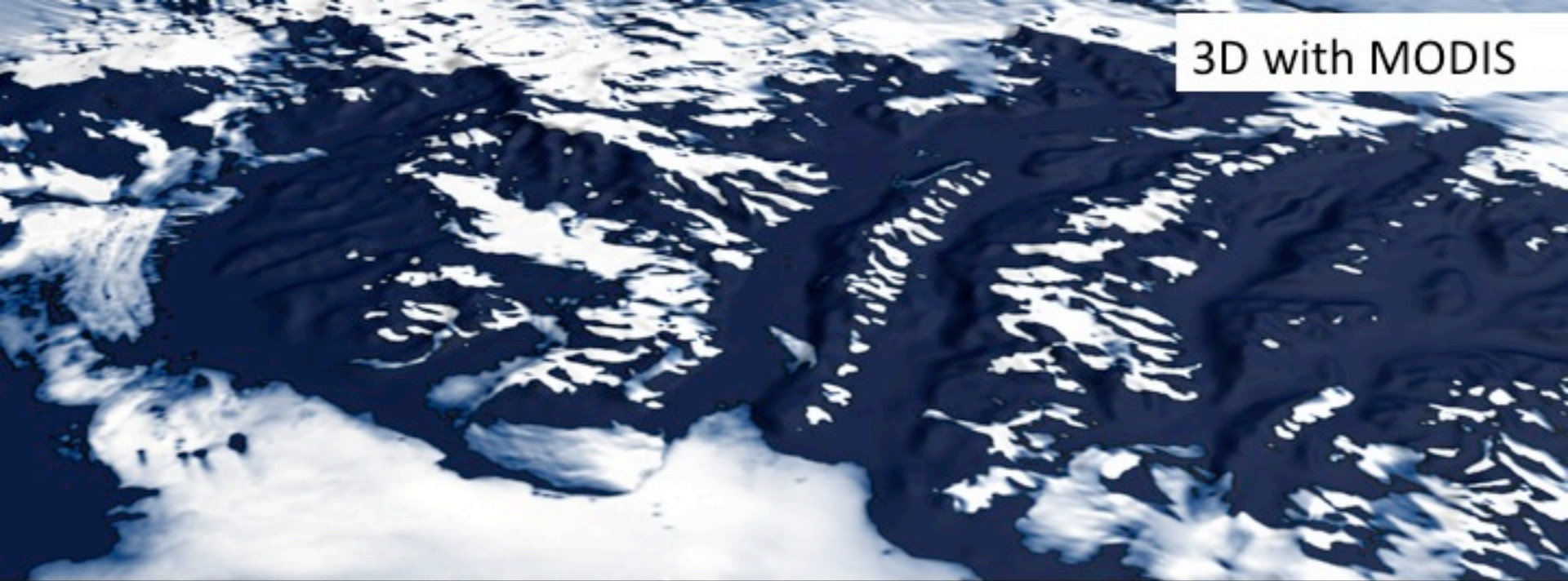
Meet Antarctica  
 Antarctic Mysteries  
 Go To The Data  
 Choose a Place  
 Flying Tour of McMurdo Area  
 Library

The LandSat Image Mosaic of Antarctica (LIMA) is the first-ever true-color high-resolution satellite view of the Antarctic continent enabling everyone to see Antarctica as it appears in real life. This web site is designed as part of the [International Polar Year](#) to familiarize people with Antarctica, to explore the richness of its features, to learn about why Antarctica matters to us all, and to explain and demonstrate how scientists use satellite imagery to study the continent.

British Antarctic Survey | National Science Foundation | USGS  
 Privacy Policy and Important Notices  
 NASA Official: Robert A. Bieschke  
 Webmaster: Paul Polychuk



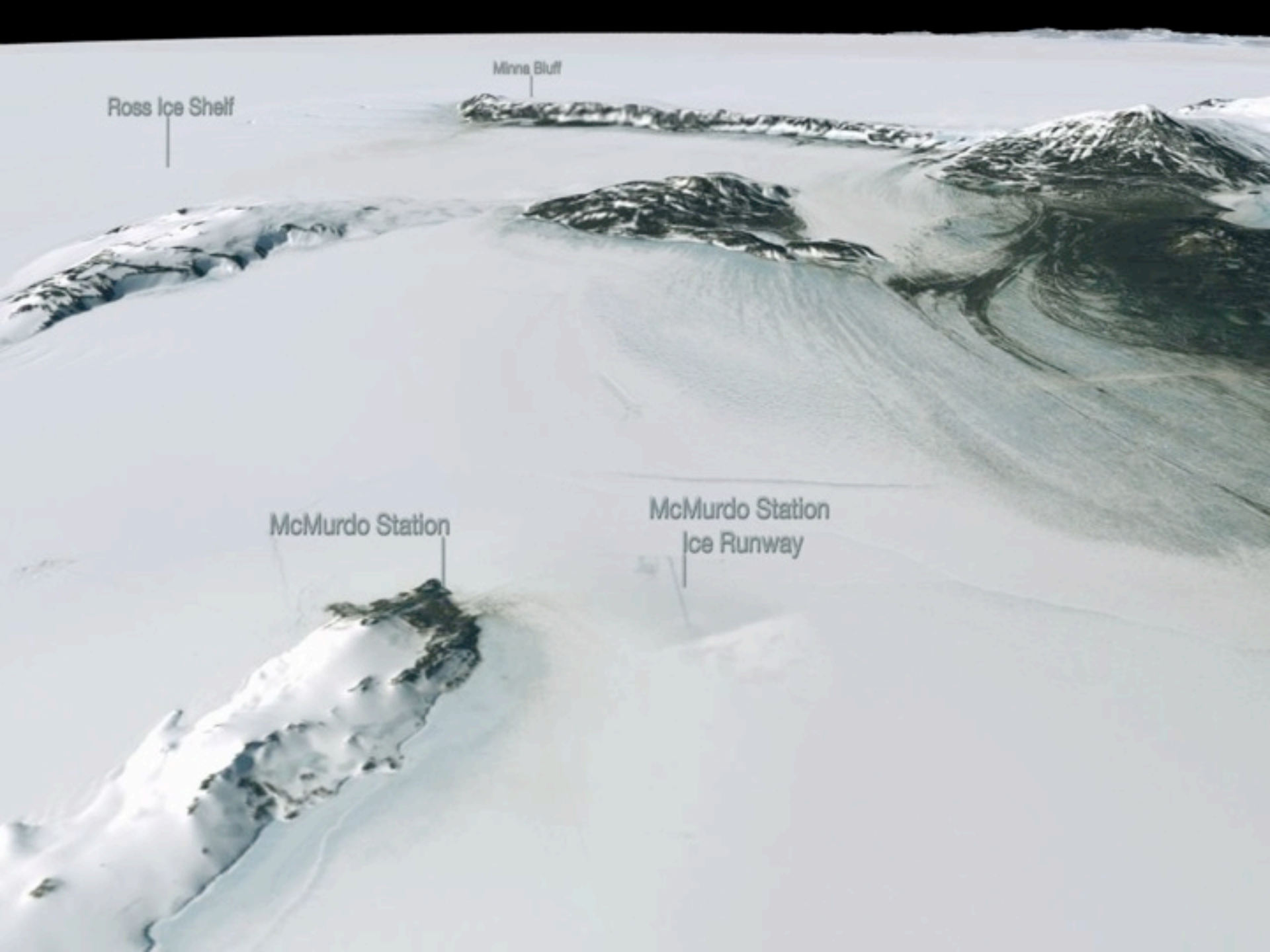
3D with MODIS



3D with LIMA







Ross Ice Shelf

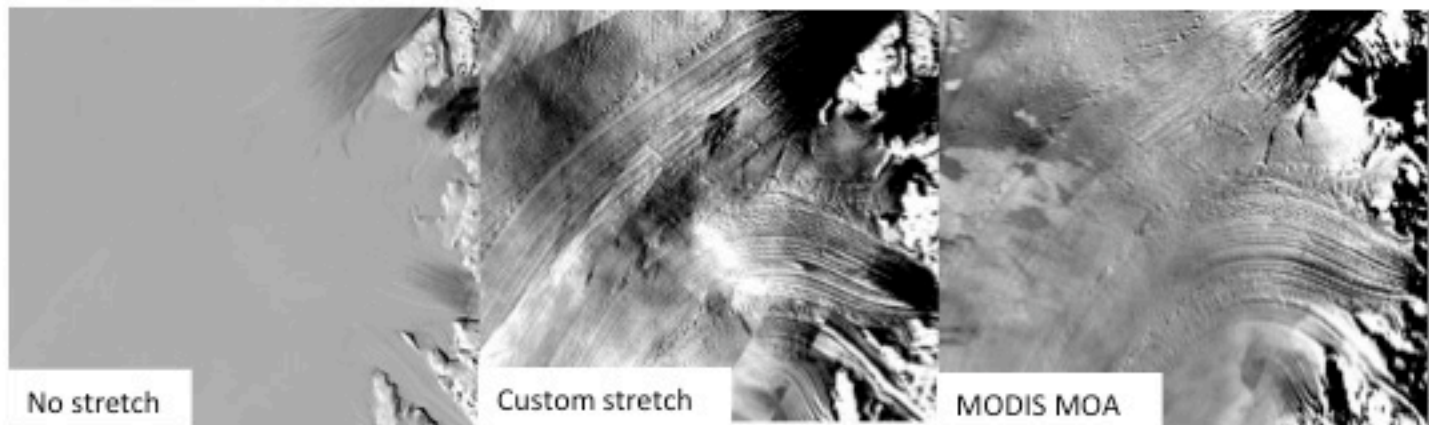
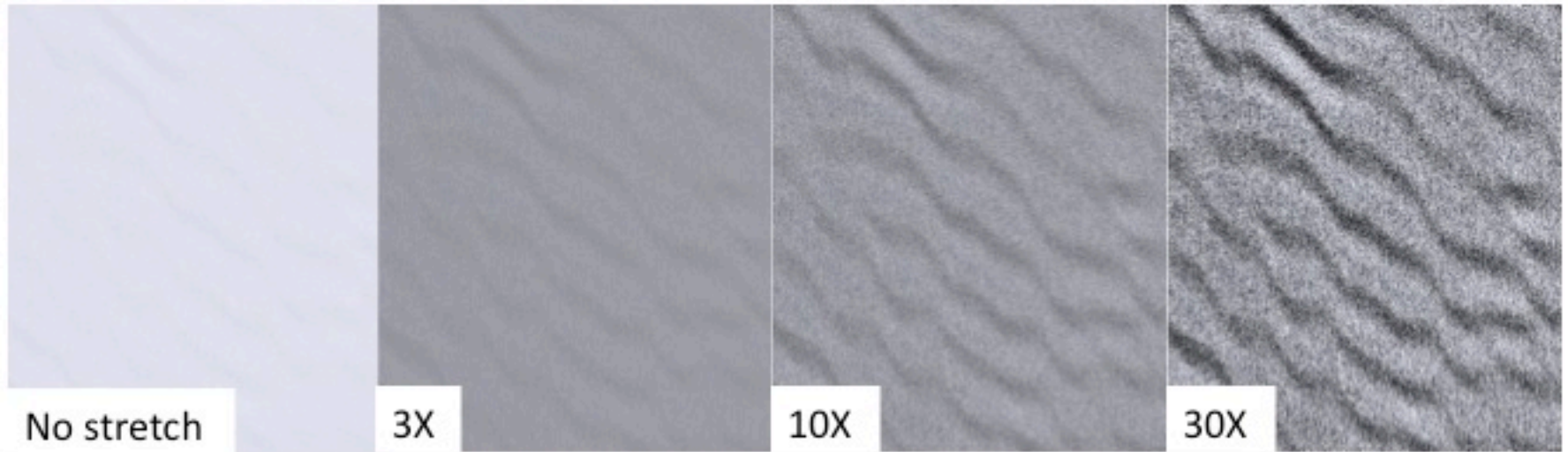
Minna Bluff

McMurdo Station

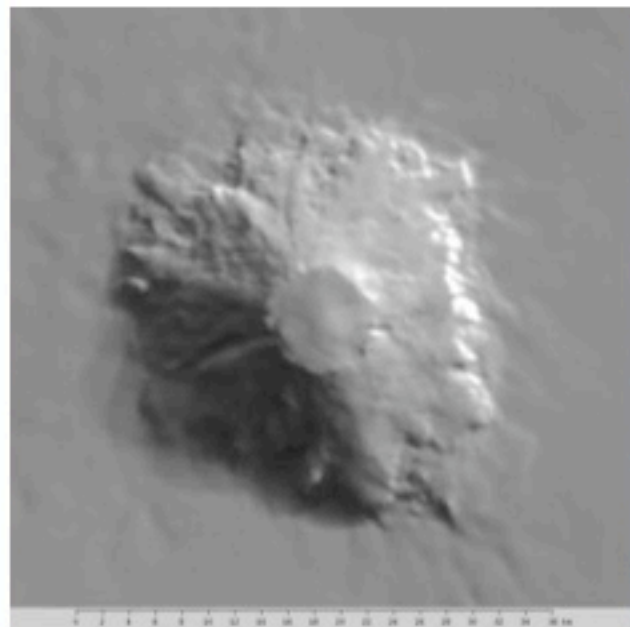
McMurdo Station  
Ice Runway



# Enhanced Versions show Details



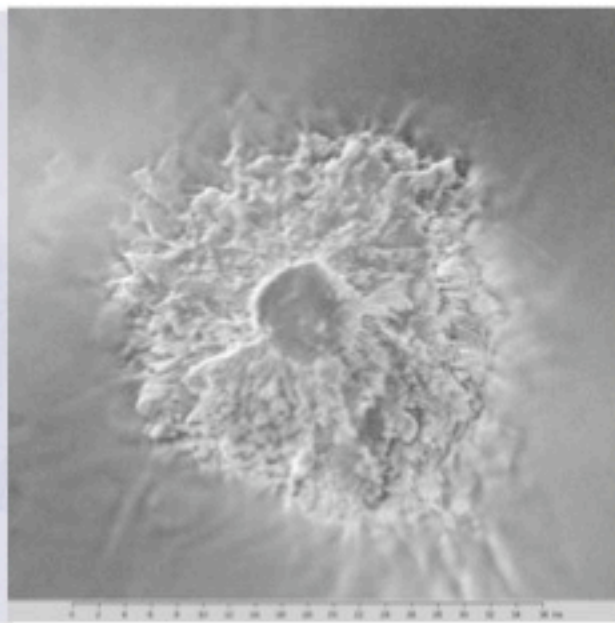
# Complementary Mosaics



MOA



LIMA



RadarSat



# LANDSAT IMAGE MOSAIC OF ANTARCTICA (LIMA)

Comparison of natural-color image with false-color enhanced image

Natural-color image False-color image

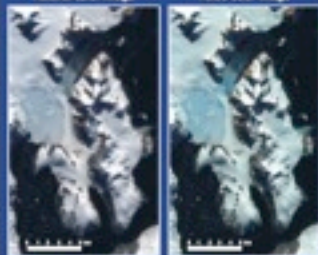


Figure 1. Example of the spatial arrangement of the mosaic tiles.



Figure 2. Example of the spatial arrangement of the mosaic tiles.

LANDSAT IMAGE MOSAIC OF ANTARCTICA (LIMA)

In support of the International Polar Year (2007-2008), the Landsat Image Mosaic of Antarctica (LIMA) brings together the most complete on Earth view of a continent with a comprehensive view of Antarctica. The U.S. Geological Survey (USGS), the British Antarctic Survey (BAS), and the National Aeronautics and Space Administration (NASA) have joined forces from the National Science Foundation (NSF) to create the seamless LIMA mosaic along with Antarctica Web Portal and the map viewer.

Choose from eight versions of LIMA

LIMA is available in two principal versions and an enhanced version. The natural-color, pan-sharpened version merges Landsat ETM+ bands 1, 2, and 3 (red, green, and blue) at 30 m spatial resolution with the 15 m satellite panchromatic band 5. The false-color, pan-sharpened version merges Landsat ETM+ bands 4, 5, and 2 (red, infrared, and green) with the panchromatic band 5. Both natural-color and false-color, pan-sharpened versions of LIMA are available in different stretches that are characterized by the snow and ice.

Discover how LIMA was created

The LIMA team identified 1,000 scenes from over 6,000 Antarctic scenes taken by the ETM+ sensor since Landsat 7 was launched in 1999. Each Landsat 7 scene is 115 km by 170 km (70 days 10:00-11:00). As much as possible, scientists chose subsequent scenes from a single Landsat pass over Antarctica because of the consistent sun elevation and weather conditions. Then each Landsat scene was processed with an orthorectification and a pan-sharpening operation to improve surface features while accurately representing the scene. The team used custom software to merge the processed satellite scenes into the seamless mosaic.

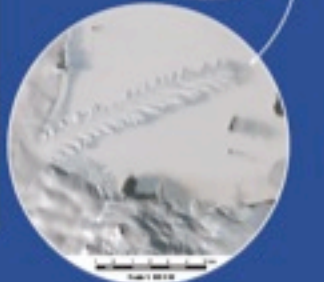
LIMA is the highest resolution, continuous dataset for the entire continent south of the 60°S Landsat orbit track. The area between this line and the 60°S orbit track is completed using imagery from the GEOS Mosaic of Antarctica (GEOA) (<http://seamless.cr.usgs.gov/geoa/>).

Outlines of Landsat ETM+ scenes used in LIMA



Zoomed images illustrating sharp resolution available at increasing scales

Example image from the 100 m resolution (100 m by 100 m)

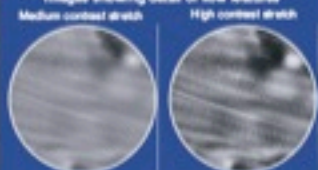


LIMA and other image mosaics of Antarctica

High-resolution satellite imagery of Antarctica  
 Medium-resolution satellite imagery of Antarctica  
 Low-resolution satellite imagery of Antarctica



Images showing detail of flow features



Access LIMA on the Antarctic Web Portal

View and download the eight versions of LIMA and all of the component Landsat scenes on the Antarctic Web Portal. Scientists and the general public can download the entire seamless mosaic or just the specific areas they need.

The LIMA online map viewer displays the mosaic and auxiliary Geographic Information System (GIS) features, such as location names, in color, stereographic projection, Web Mapping Services (WMS) protocol access to the eight versions of the mosaic over the Internet or by desktop GIS tools.

Access LIMA data

<http://lima.usgs.gov/>

NASA LIMA Education and Outreach

<http://lima.nasa.gov/>



A photograph of the Aurora Borealis (Northern Lights) in a dark night sky. The aurora displays vibrant green and purple bands. Below the sky, the dark silhouette of a forested hillside is visible against a faint orange glow on the horizon.

# Questions

When asking a question, speak slow, loud, and clear and state your:

- Name
- School
- Question





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# Thank You!



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1-907-474-1600*

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