BIOTECHNO 2011 - Keynote
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Turmoil in the Global Biosphere
A View from Space

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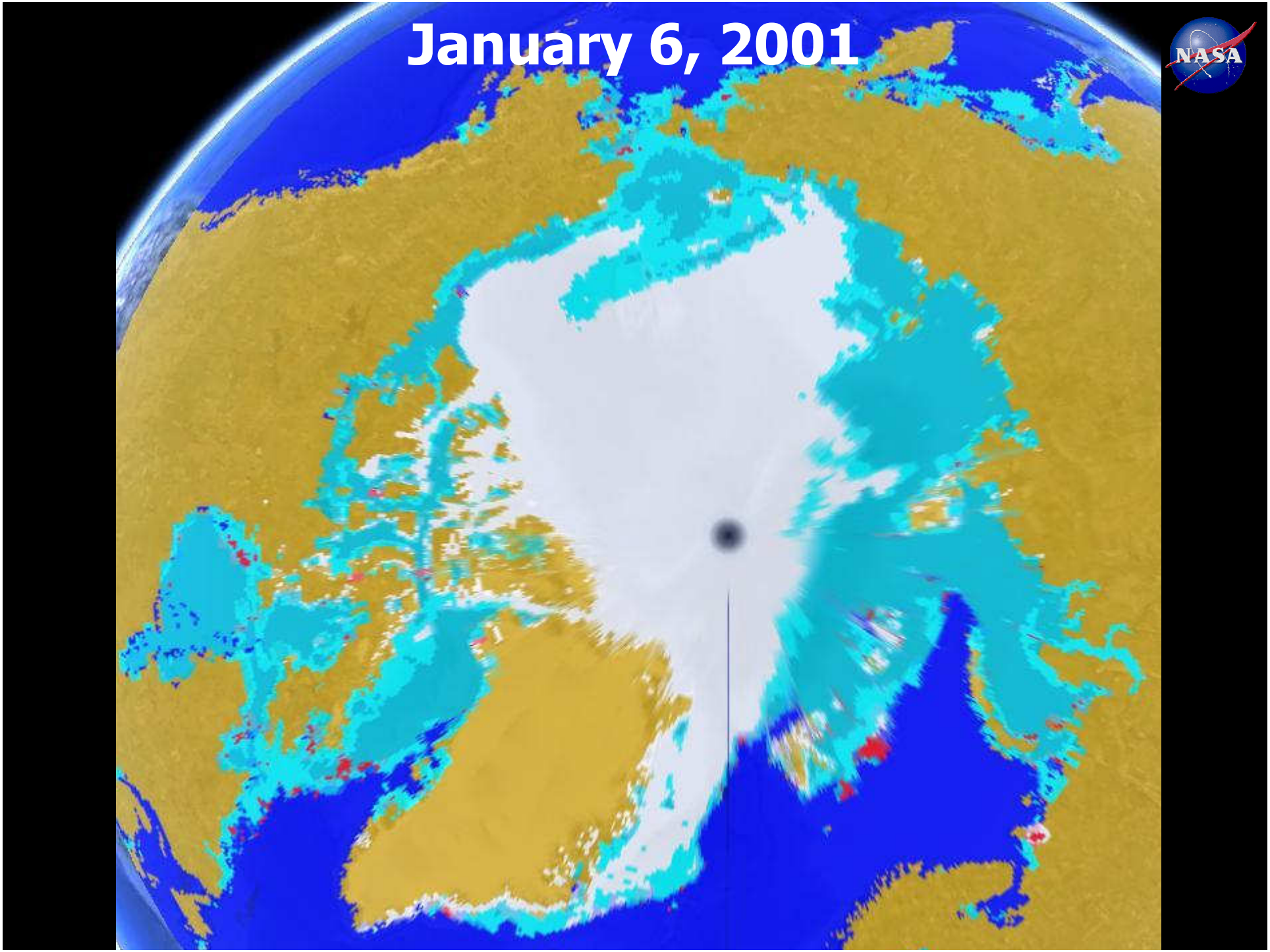
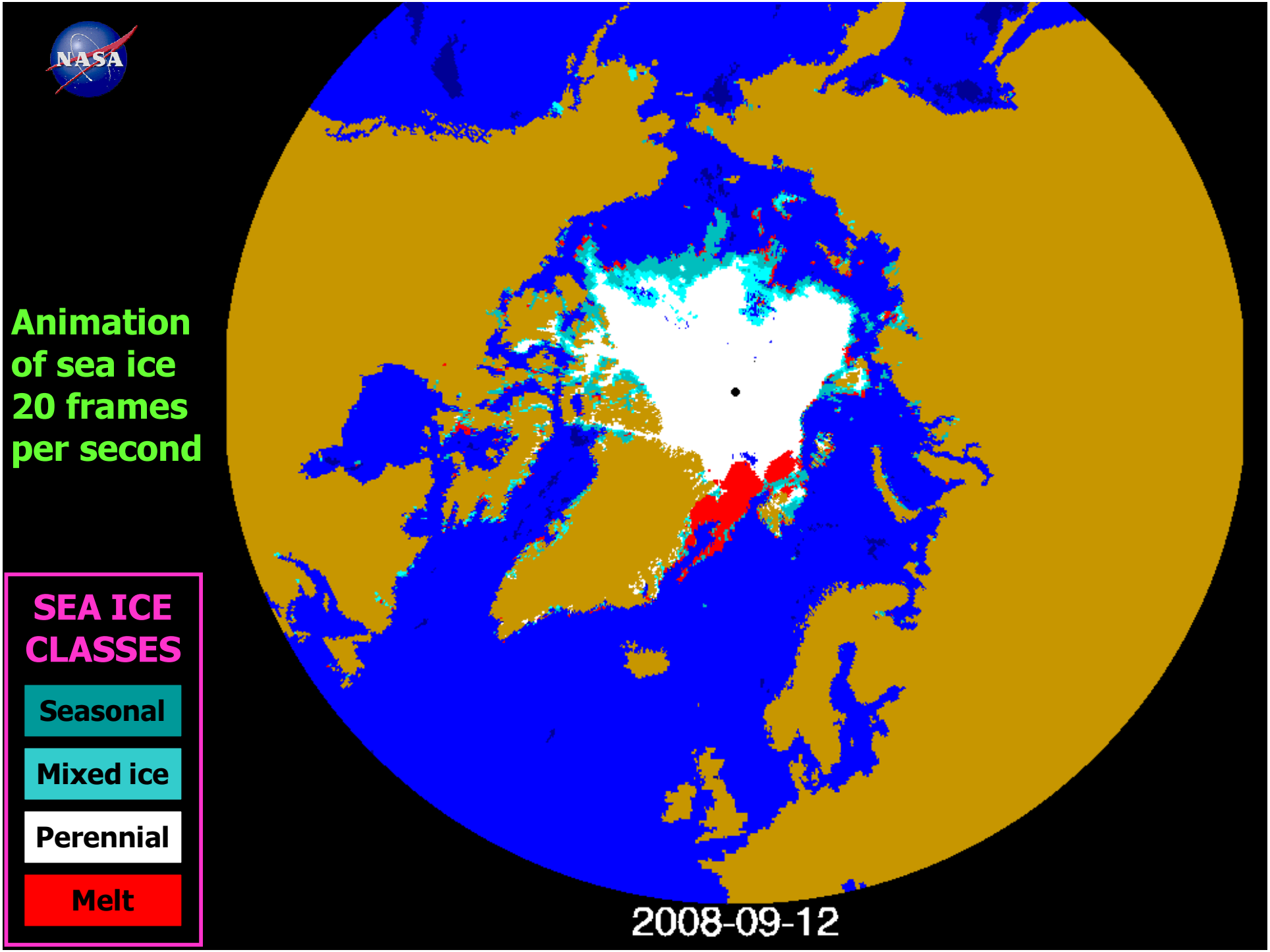
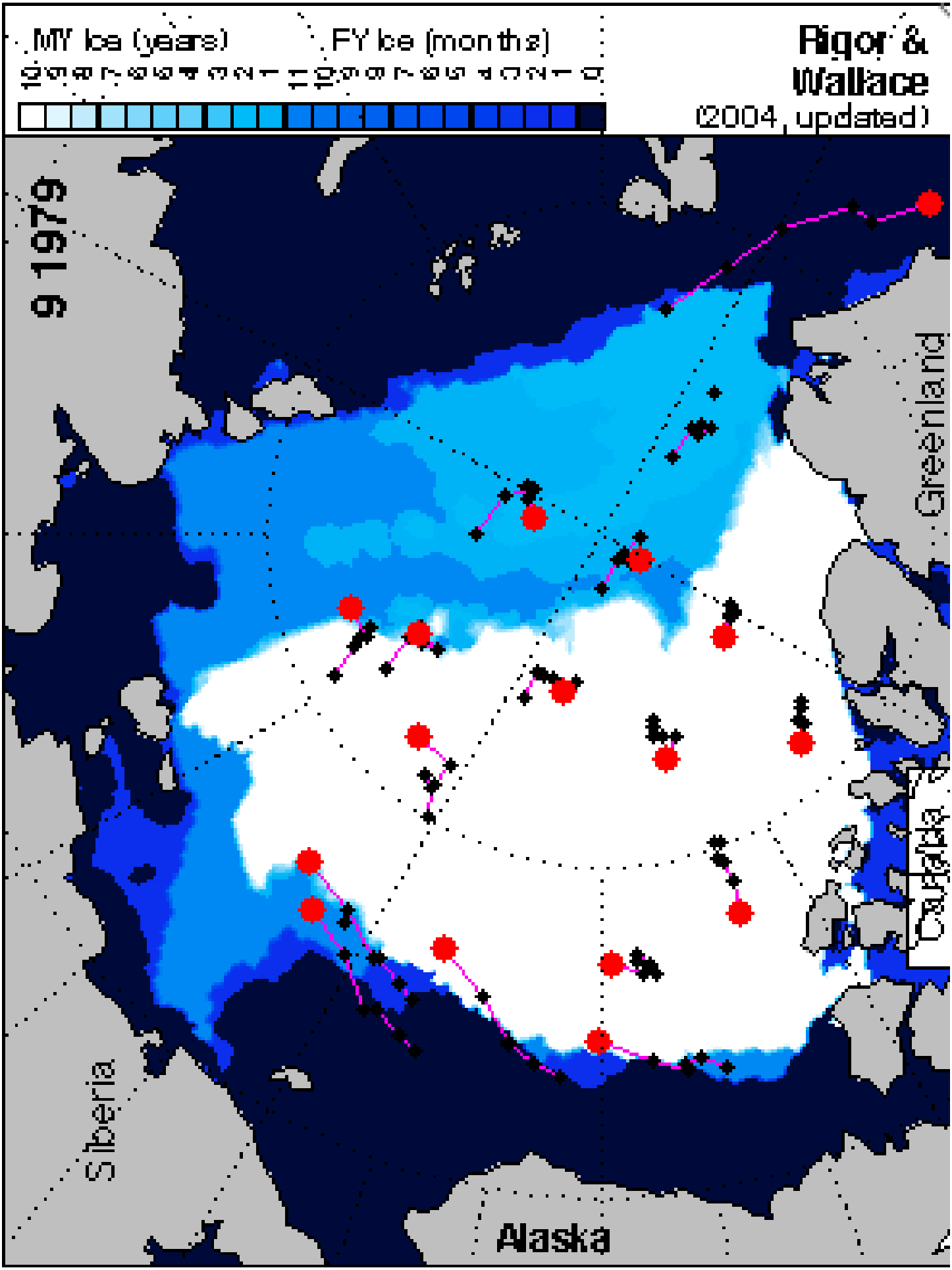
Objective

Satellite observations of environmental changes that impact the biosphere in ocean, ice, land, atmosphere


January 6, 2001
NASA


January 6, 2011
NASA
Half of the extent of old thick Perennial sea ice was loss.
WHY?


Animation of sea ice 20 frames per second
SEA ICE CLASSES
Seasonal
Mixed ice
Perennial
Melt
2008-09-12


MY Ice (years)
FY Ice (months)
Rigor & Wallace
(2004, updated)
1979
Greenland
Canada
Siberia
Alaska

Implications

Perennial sea ice reduction

Arctic dominated by seasonal ice

Saltier ice surface over vast region with more: FY, leads, polynyas, frost flowers

More sources for bromine explosion causing more ozone depletion/mercury deposition

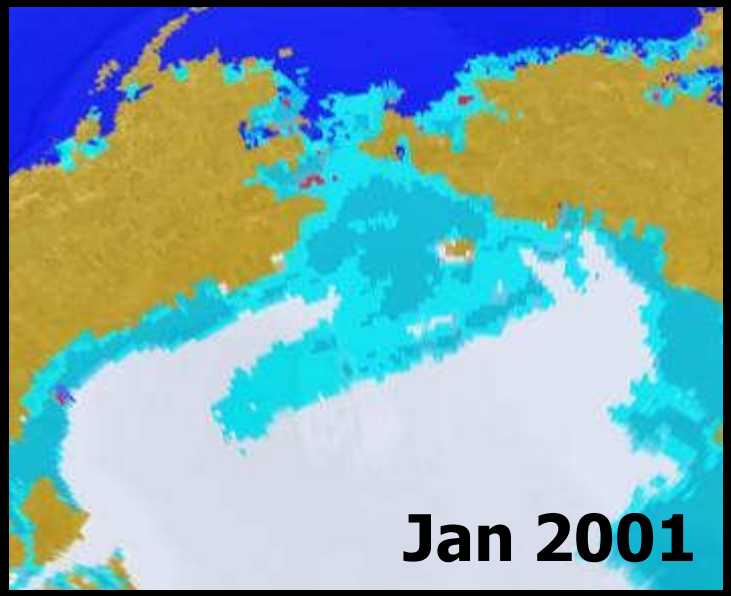
Impact?

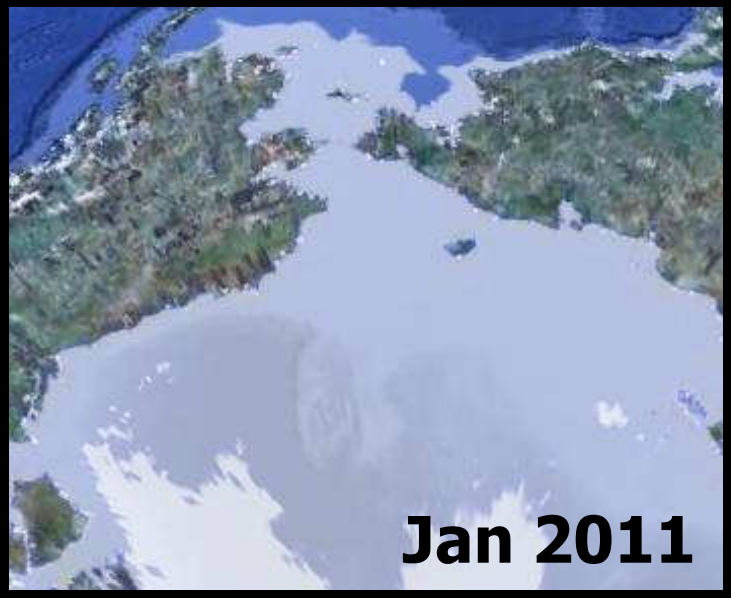
Deposition of mercury – Toxic to human and wildlife

Action?

United Nations: Intergovernmental negotiation for Global Mercury Treaty

Impact on Polar Bear Habitat





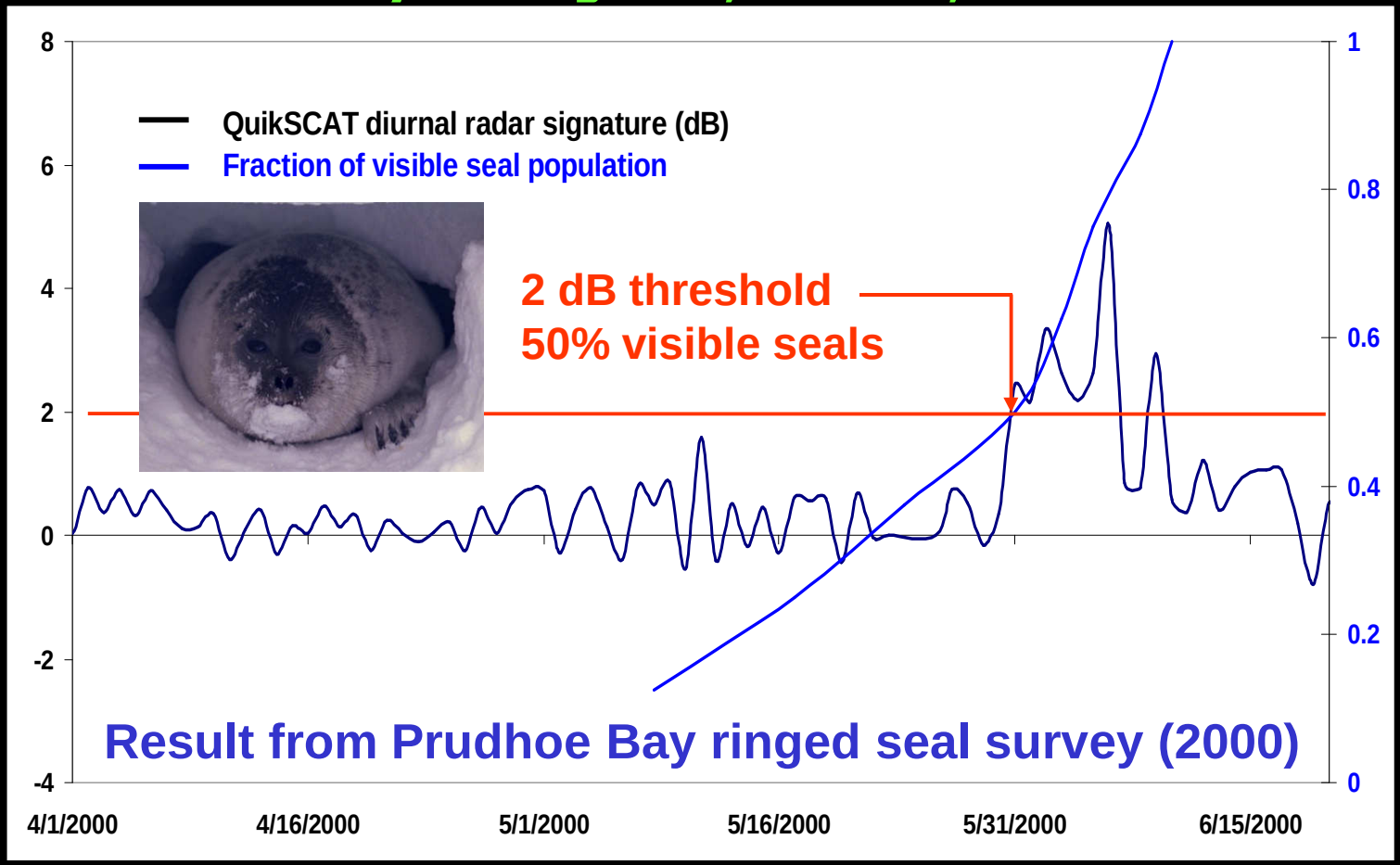
Polar bears need sea ice to hunt and live

Major loss of perennial sea ice north of Alaska

Polar bears are listed as threatened species

Survey of Arctic Ringed Seal (Phoca Hispida)

Kelly and Nghiem, IGARSS, 2004



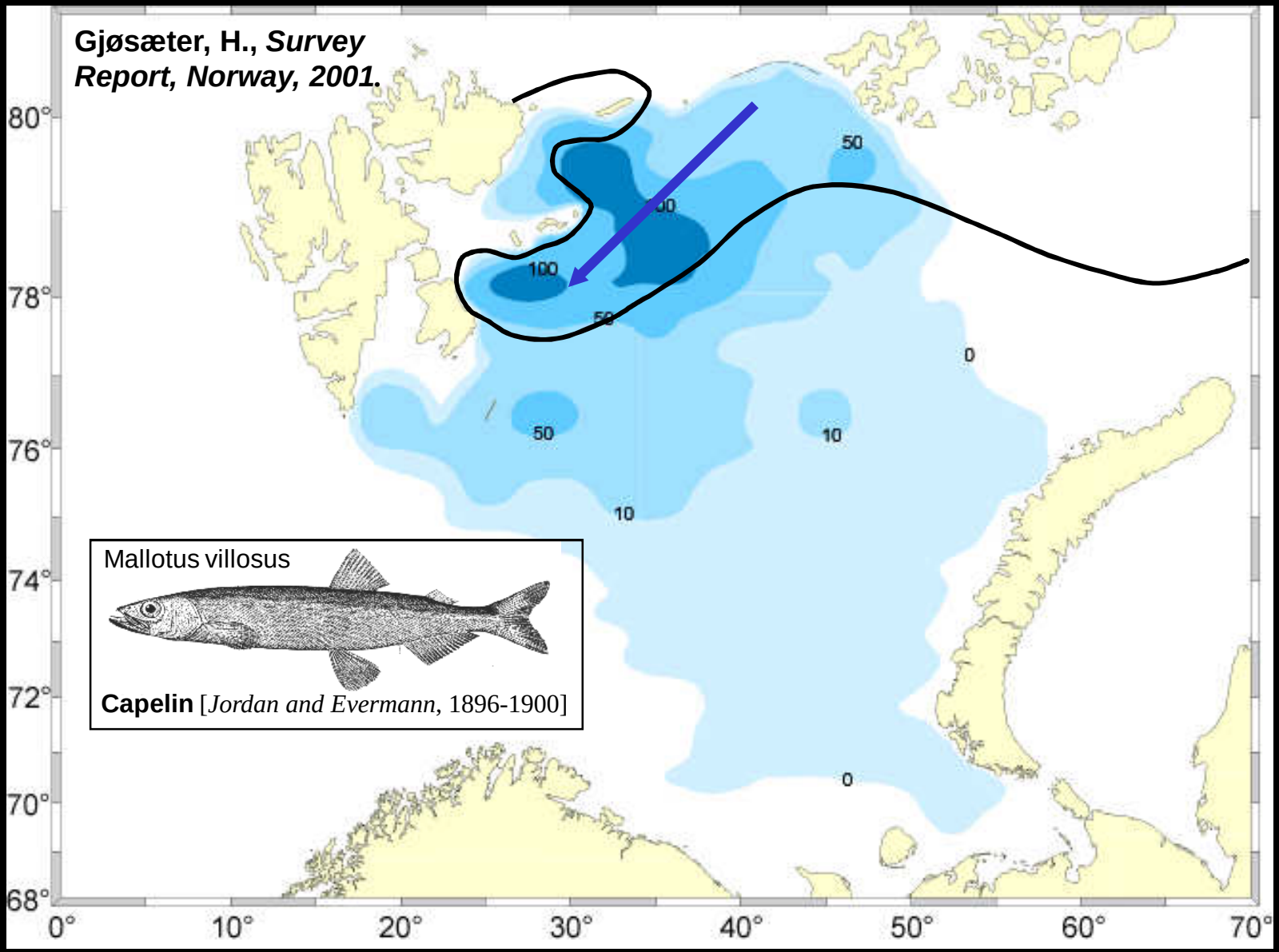
What if seals come out too early due to early snow melt on sea ice?

Seal Death by Predation

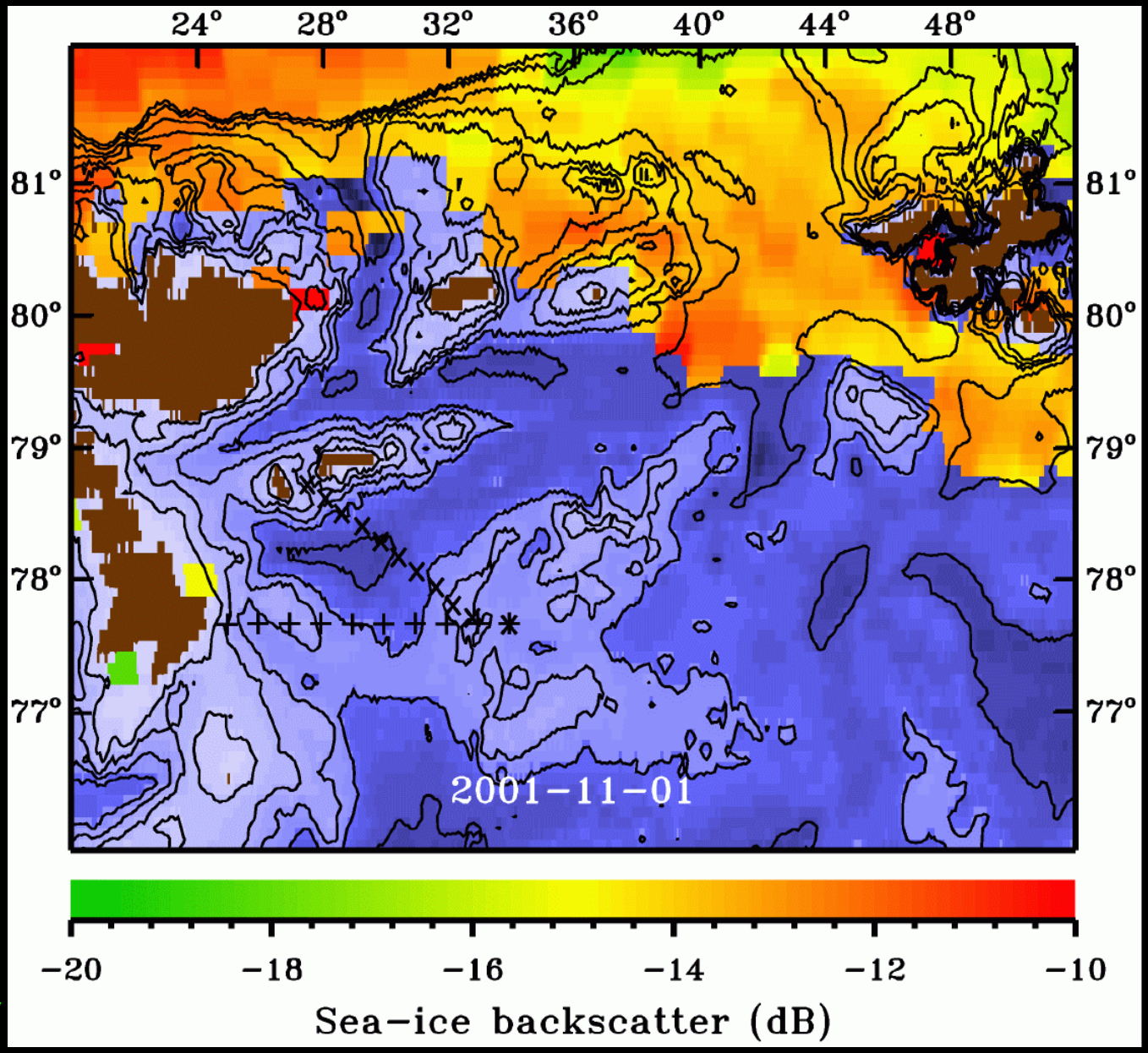
Photo D. K. Perovich

Estimated Distribution of Capelin

tonnes/square nautical mile for September-October 2001

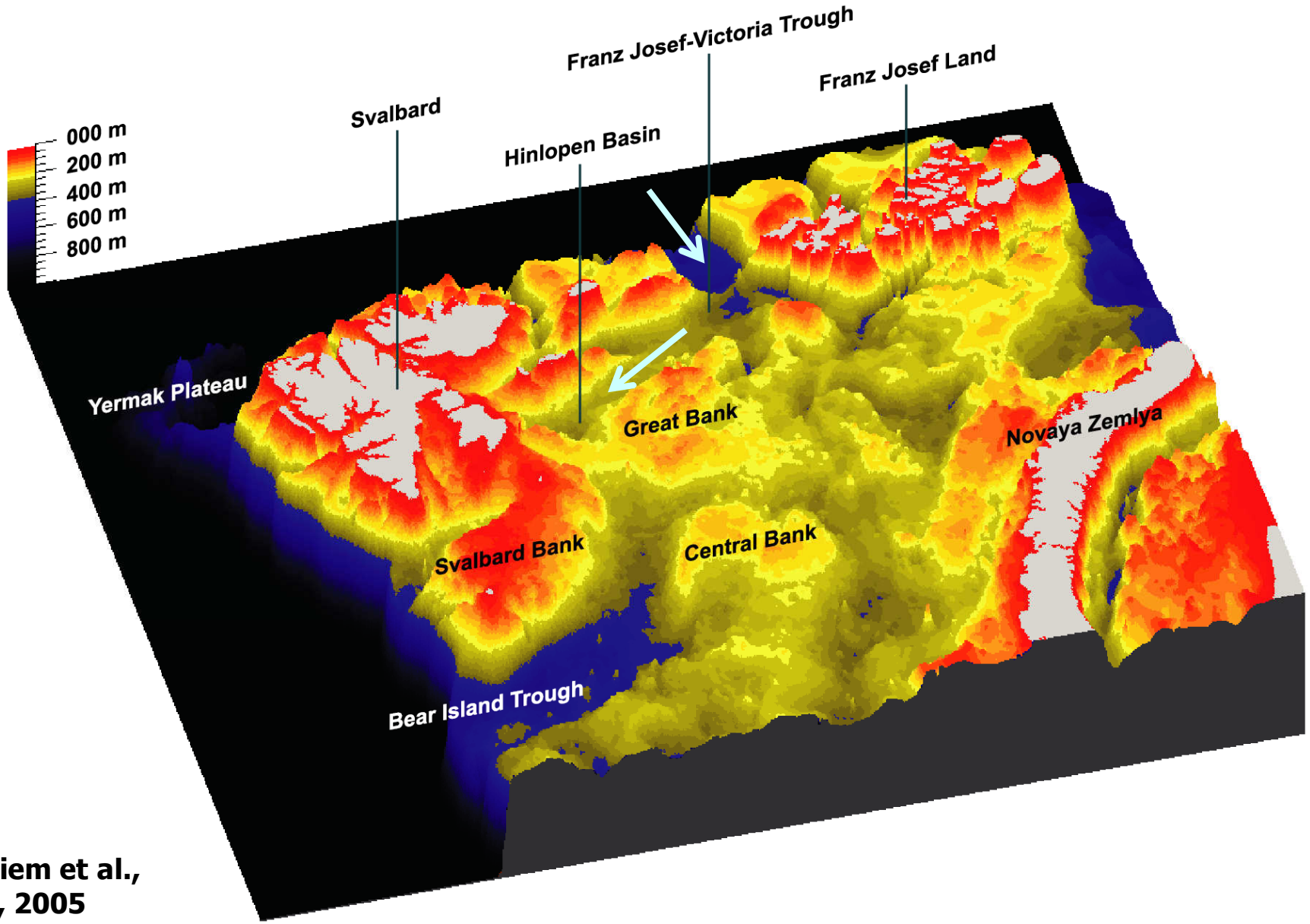


Svalbard Sea-Ice Barrier Formation



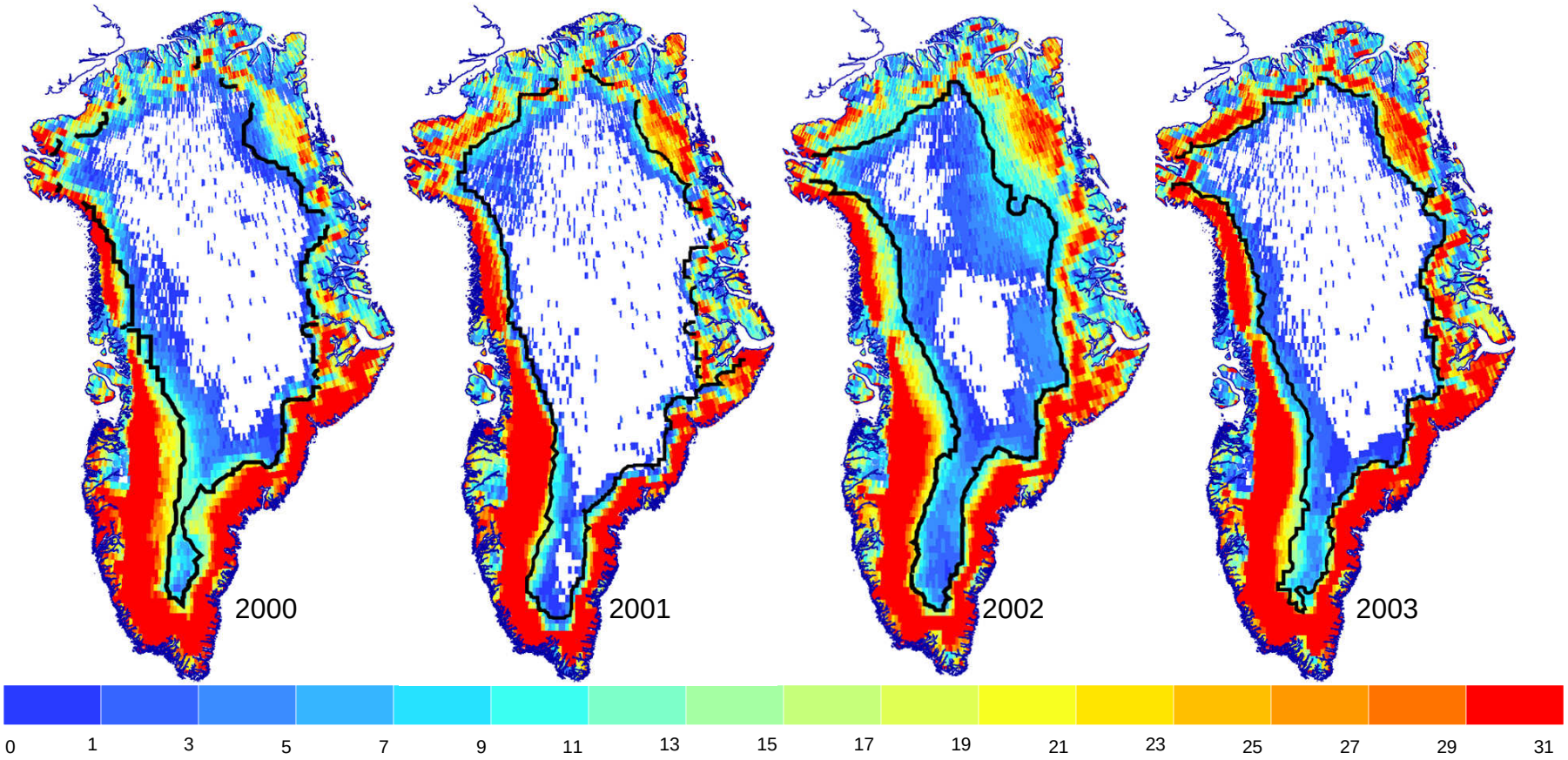
Nghiem et al., JGR, 2005

Bathymetric Control of Water Masses

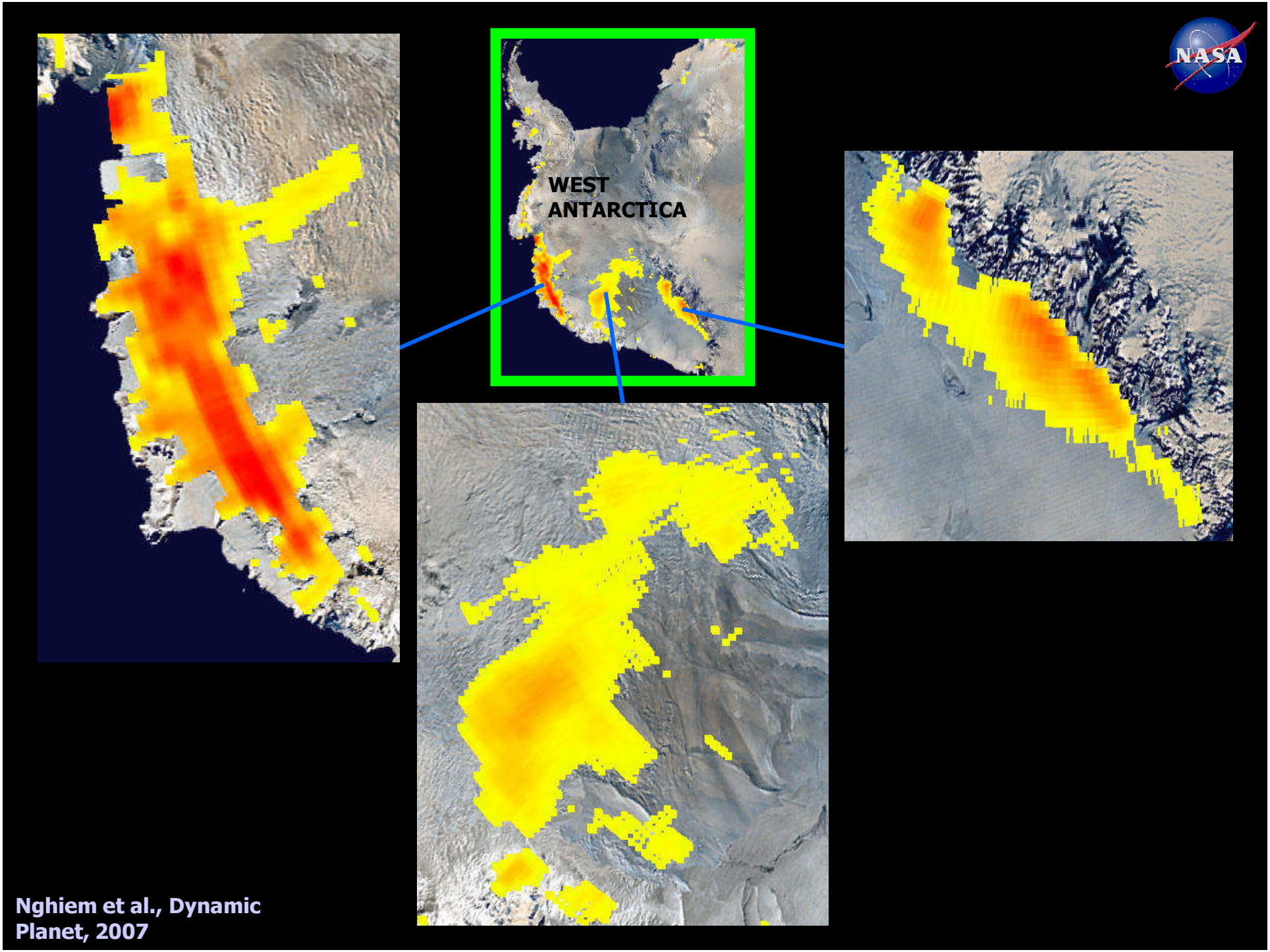


Nghiem et al., JGR, 2005

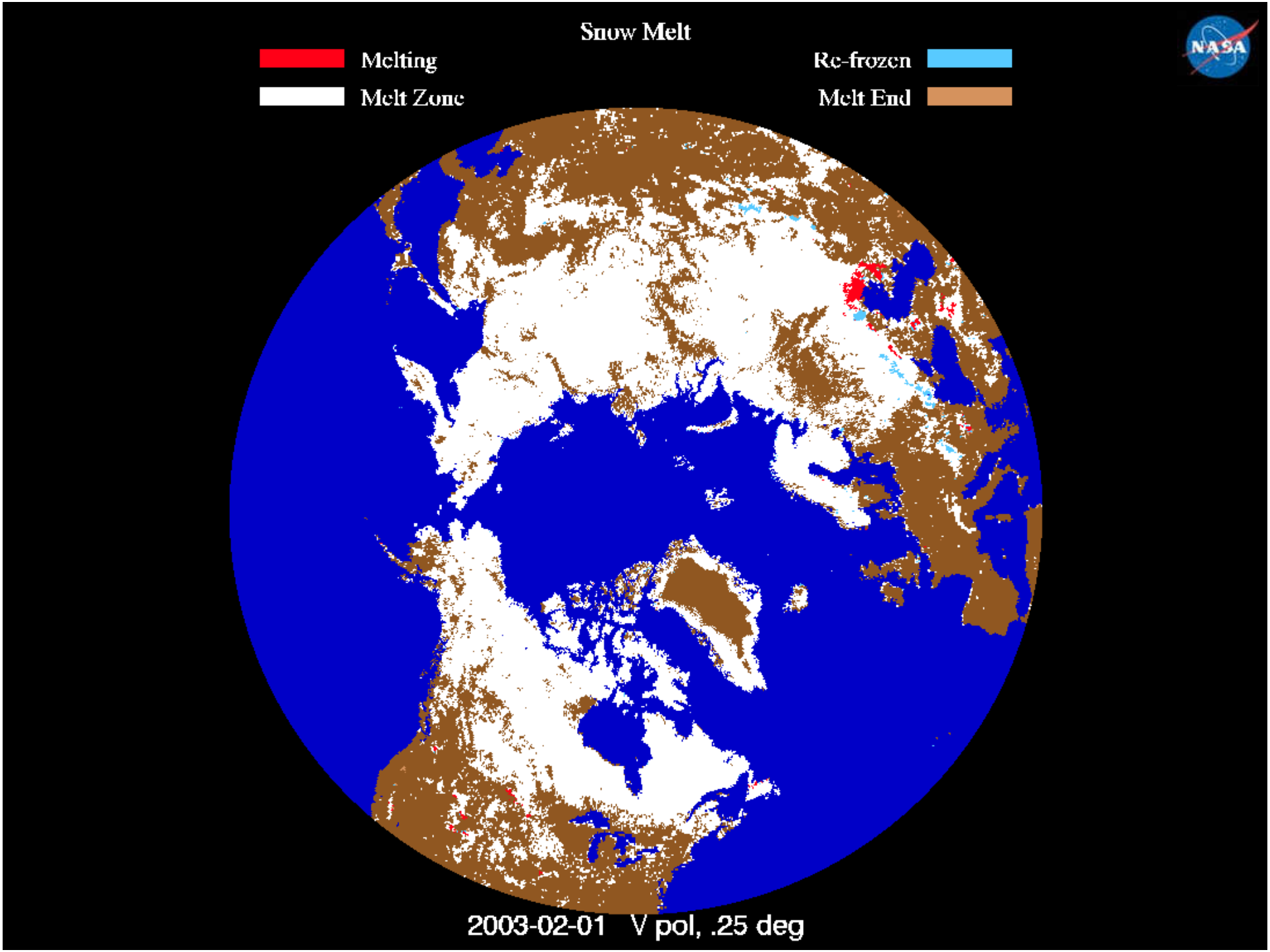
Greenland Melt Observed by QuikSCAT and Passive Microwave

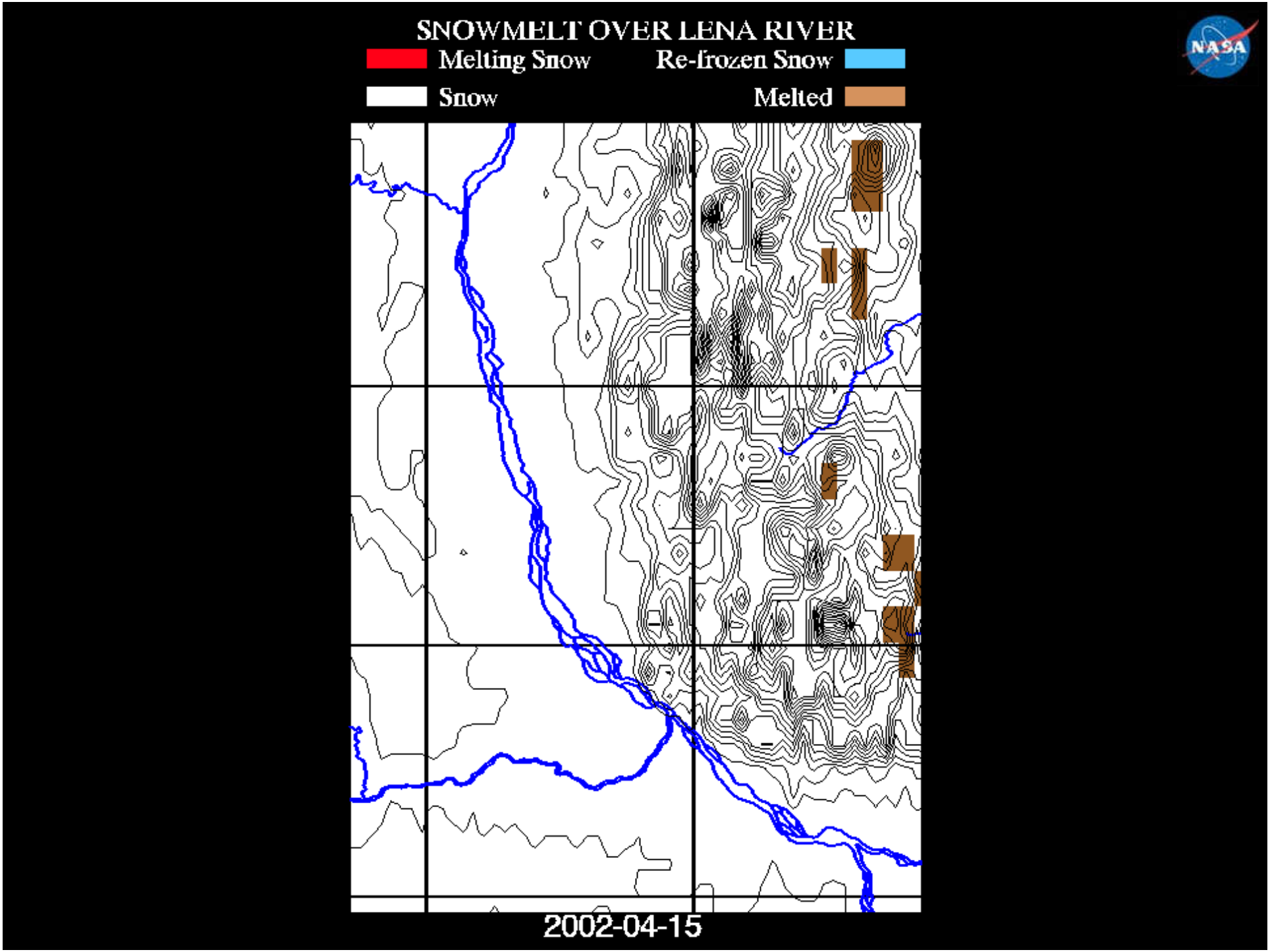


Steffen et al., GRL, 2004



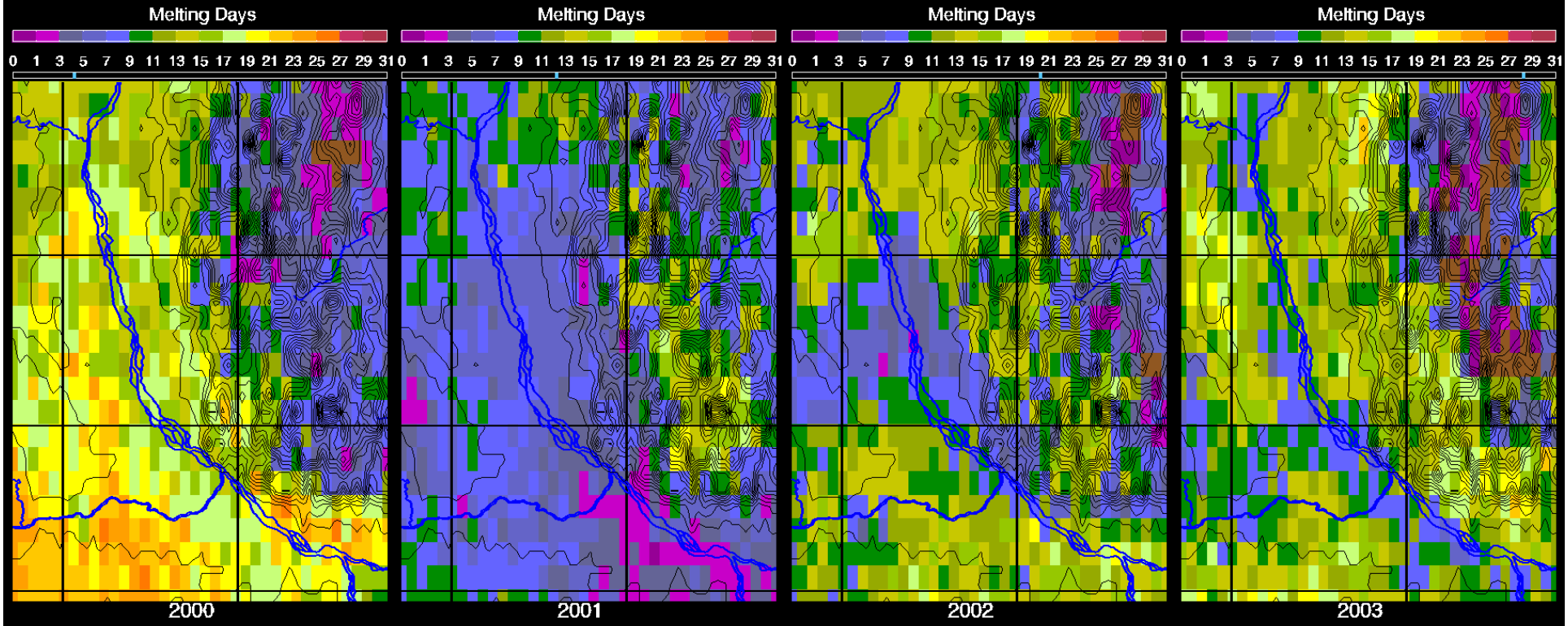
Nghiem et al., Dynamic Planet, 2007


Snow Melt
Melting
Melt Zone
Re-frozen
Melt End
2003-02-01 V pol, .25 deg


SNOWMELT OVER LENA RIVER
Melting Snow
Re-frozen Snow
Snow
Melted
2002-04-15

Snowmelt Days and Flood Severity

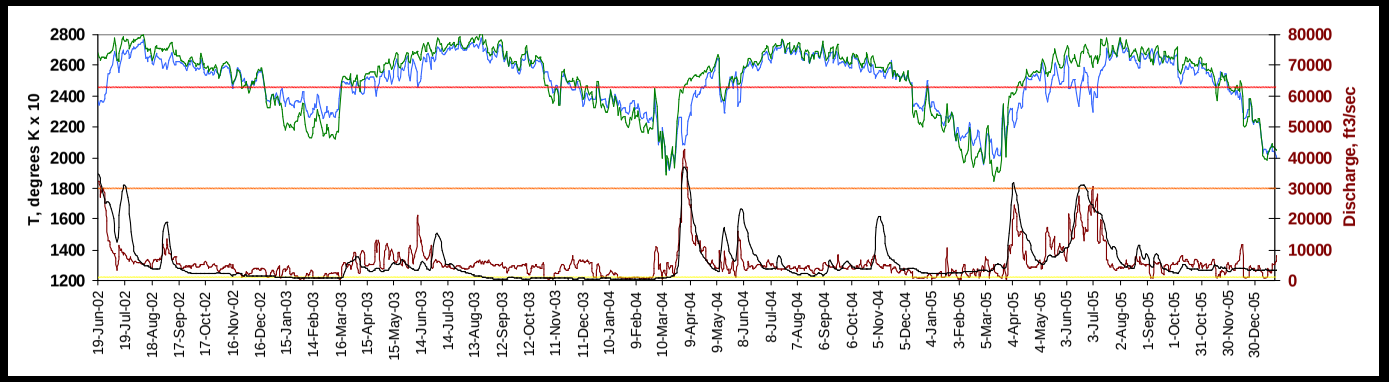
$$S_f = 0.01 \cdot \ln(D) \cdot S_c \cdot A^{1/2}$$

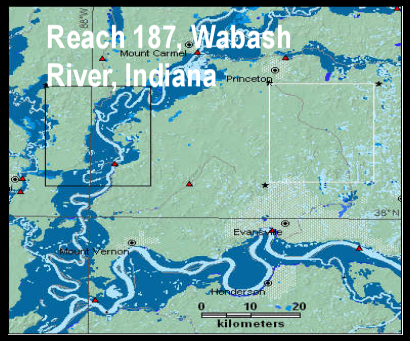


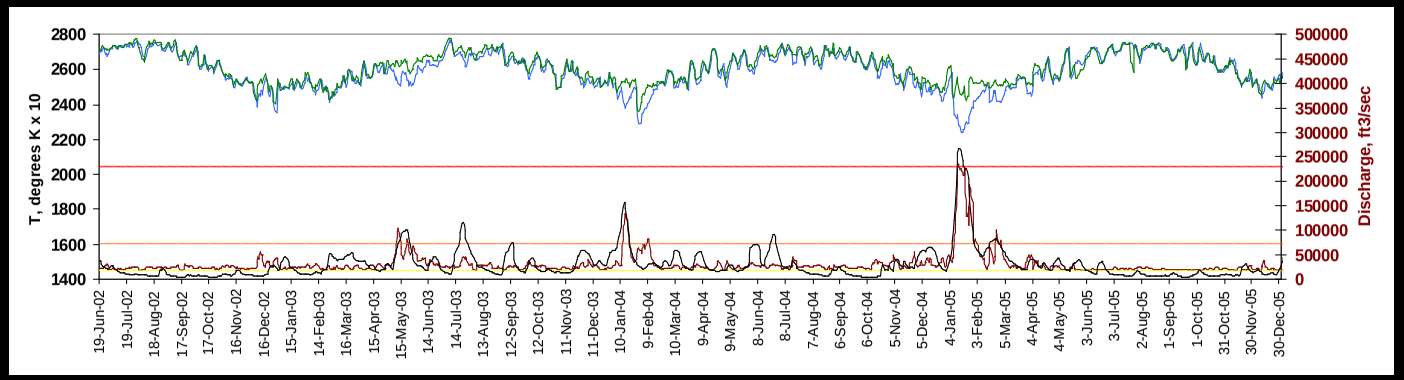
2000	2001	2002	2003
No Flood	**Flood of Century**	**Extensive Flood**	**Significant Flood**
Last major flood in 1998 (Source: Red Cross/CNN)	70,000 people displaced US$ 2,000,000,000	1,500 people displaced US$ not yet available	Flood damages data not yet available
S_f= -na-	140.6	6.1	4.9

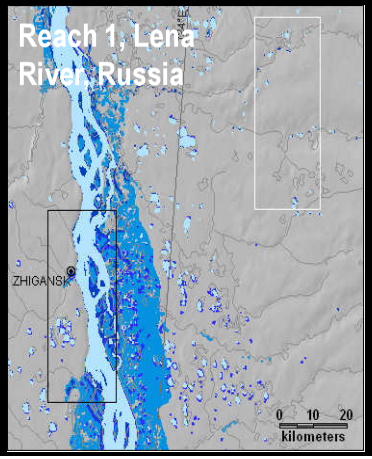
Stream Flow Measurement by Satellite

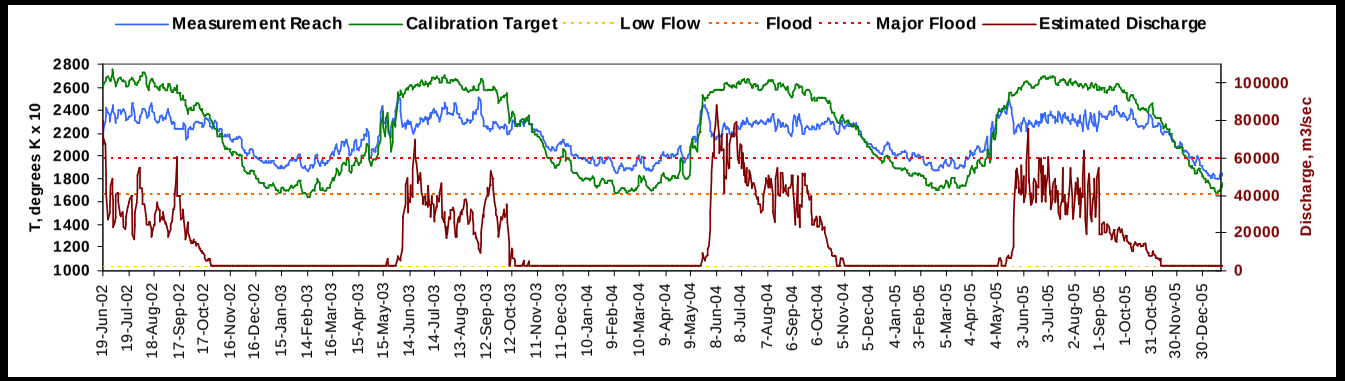
(Brakenridge, Nghiem, Anderson, and Mic, WRR, 2007)





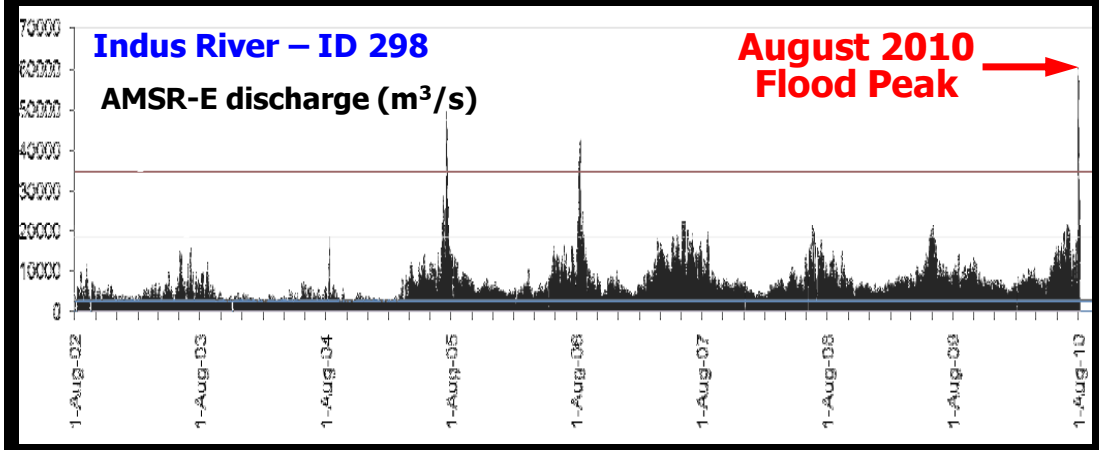






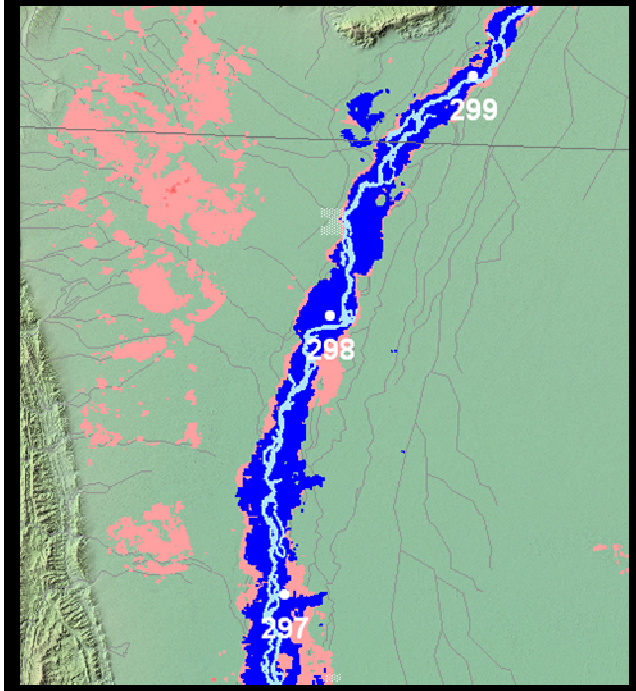
Stream Flow and Flood Monitoring

Pakistan Flood – August 2010 (Nghiem and Brakenridge, URSI, 2010)



AMSR-E Stream Flow

- Largest flood peak in August 2010 in 8-year AMSR-E record.
- About 2X 5-year flood stage



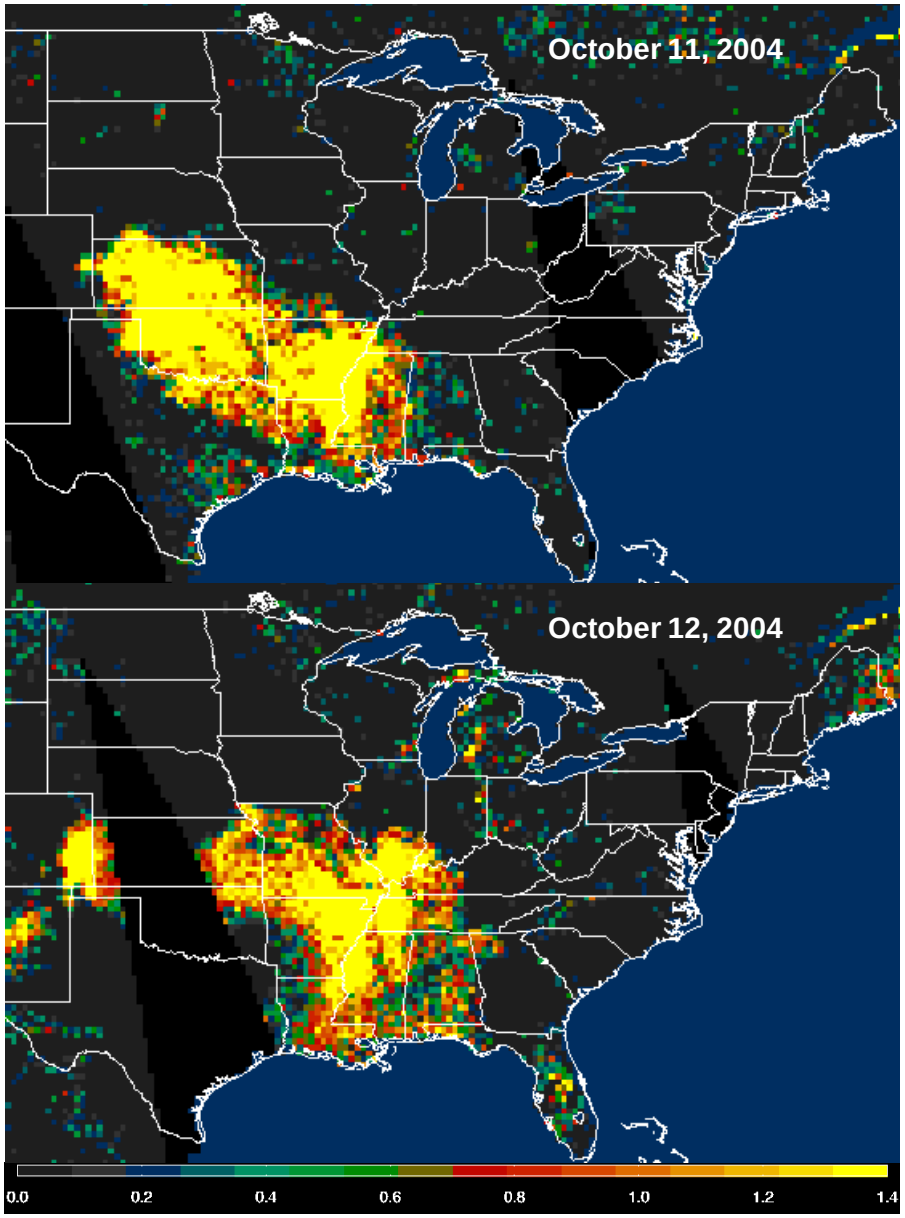
MODIS Flood Monitoring

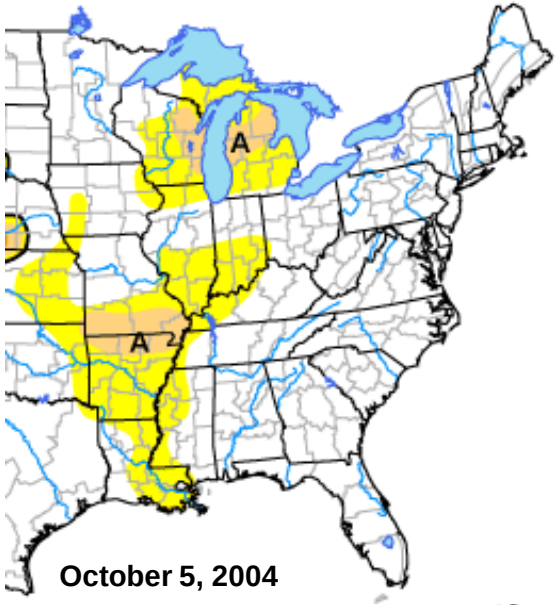
- Blue: Flooding from MODIS data acquired 1-4 August 2010.
- Delineate inundation areas along the Indus River in Pakistan

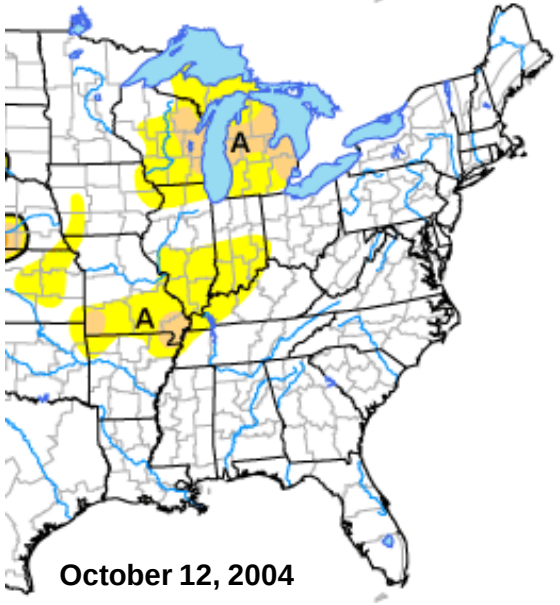
Results are used by:

Global Disaster Alert and Coordination System (JRC/United Nations), Humanitarian Early Warning (UNICEF/WFP), Reactions (Global Insurance Intelligence), etc

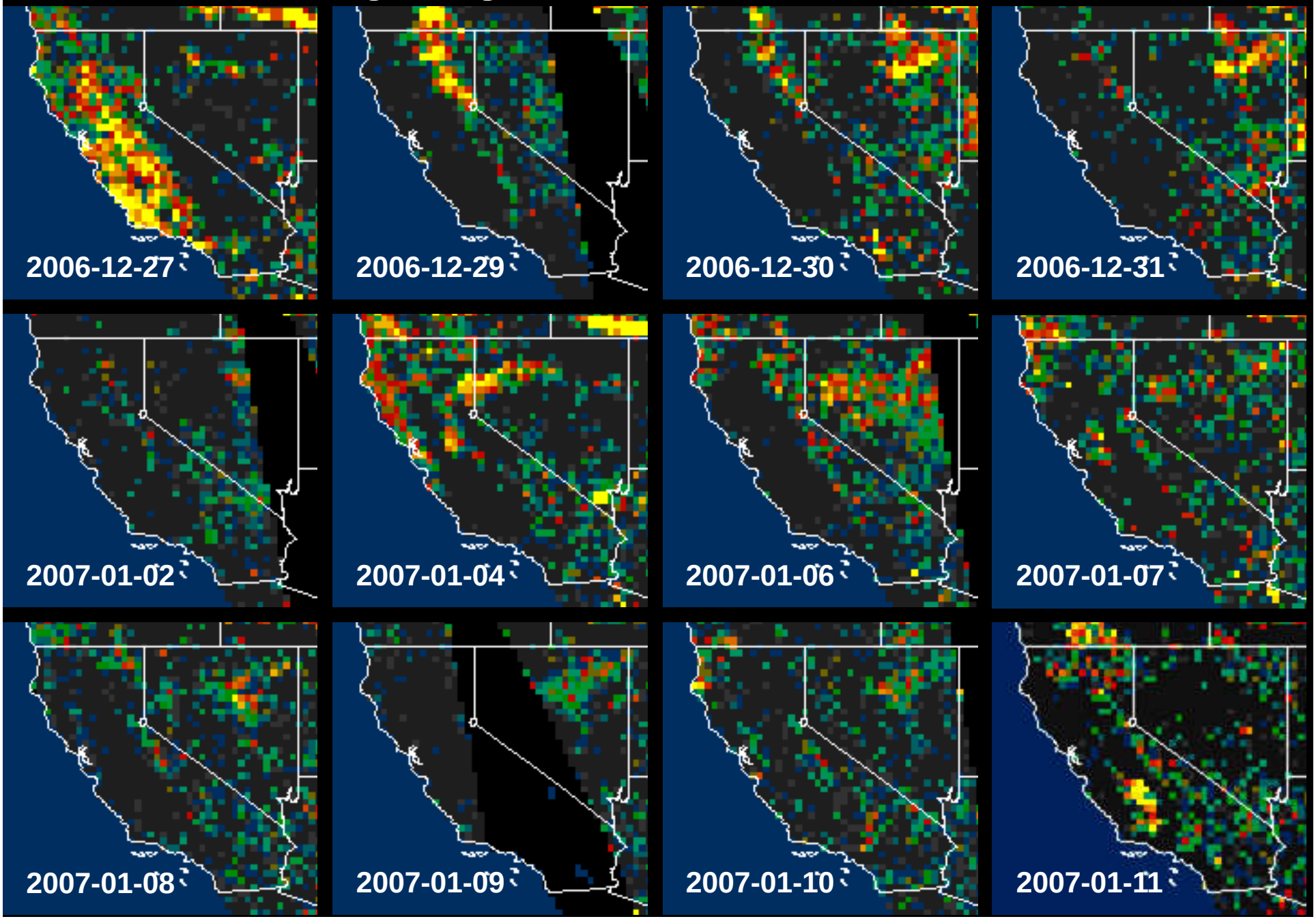
QuikSCAT and US Drought Monitor



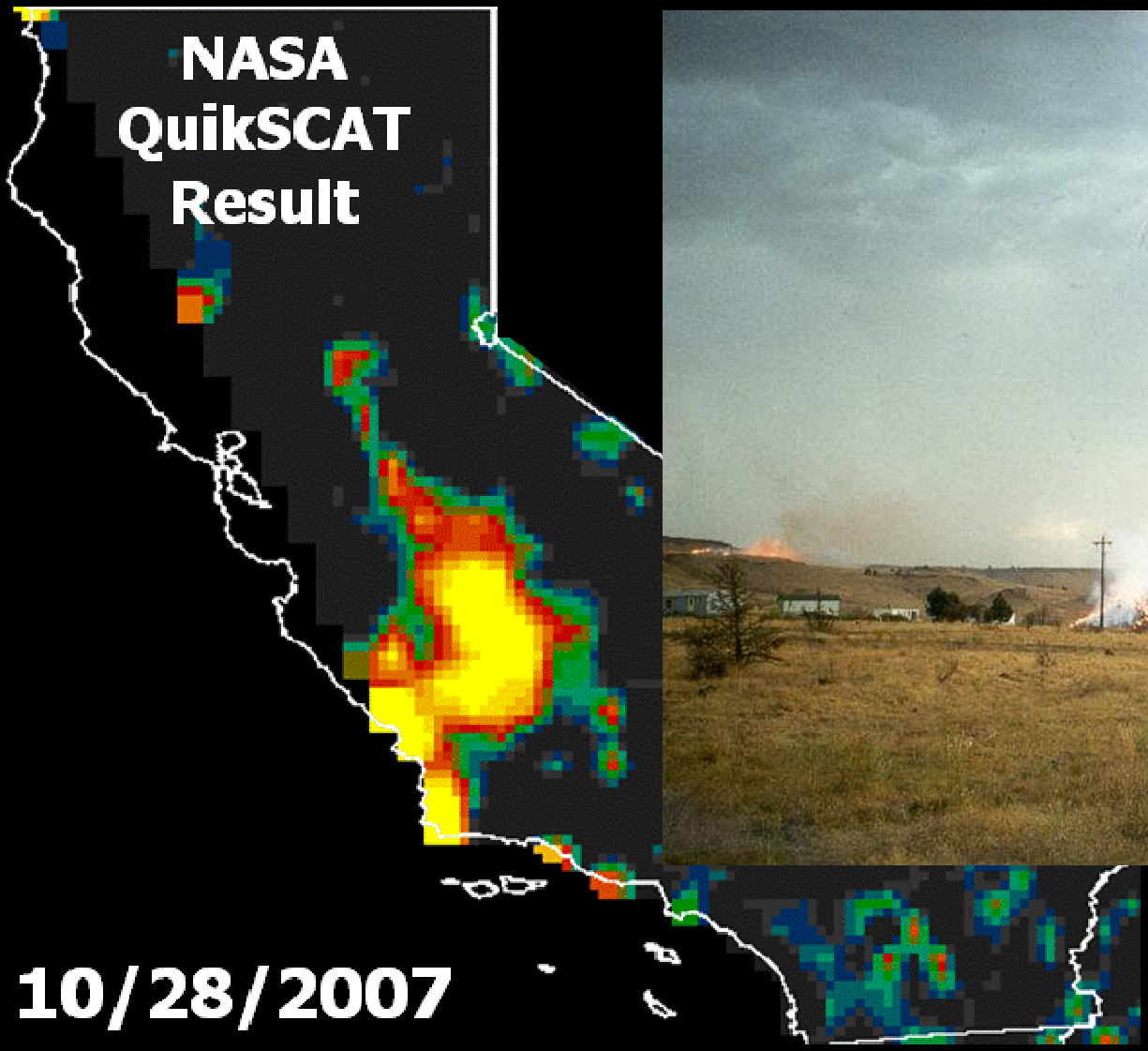




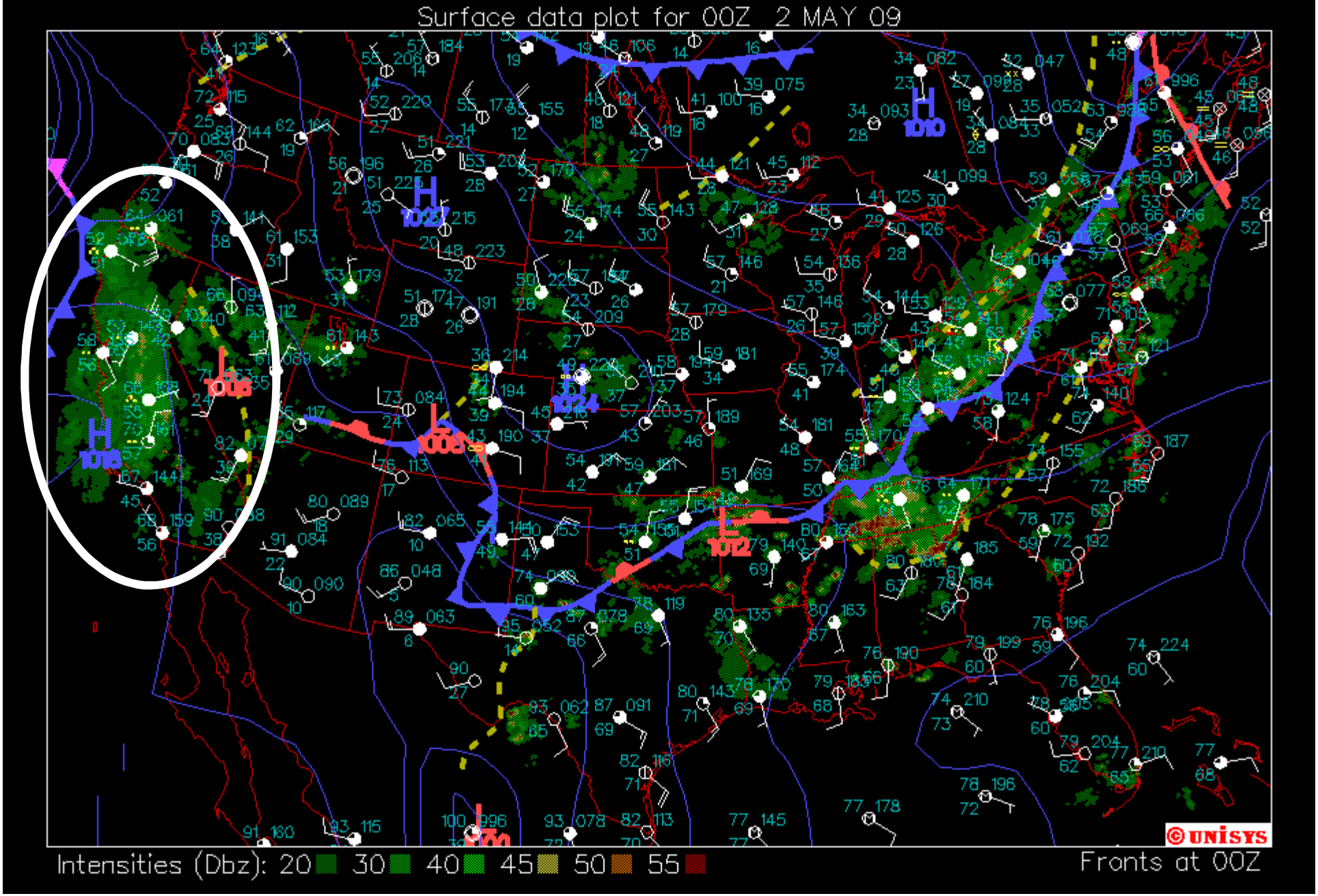
Severely Dry California – Winter 2007



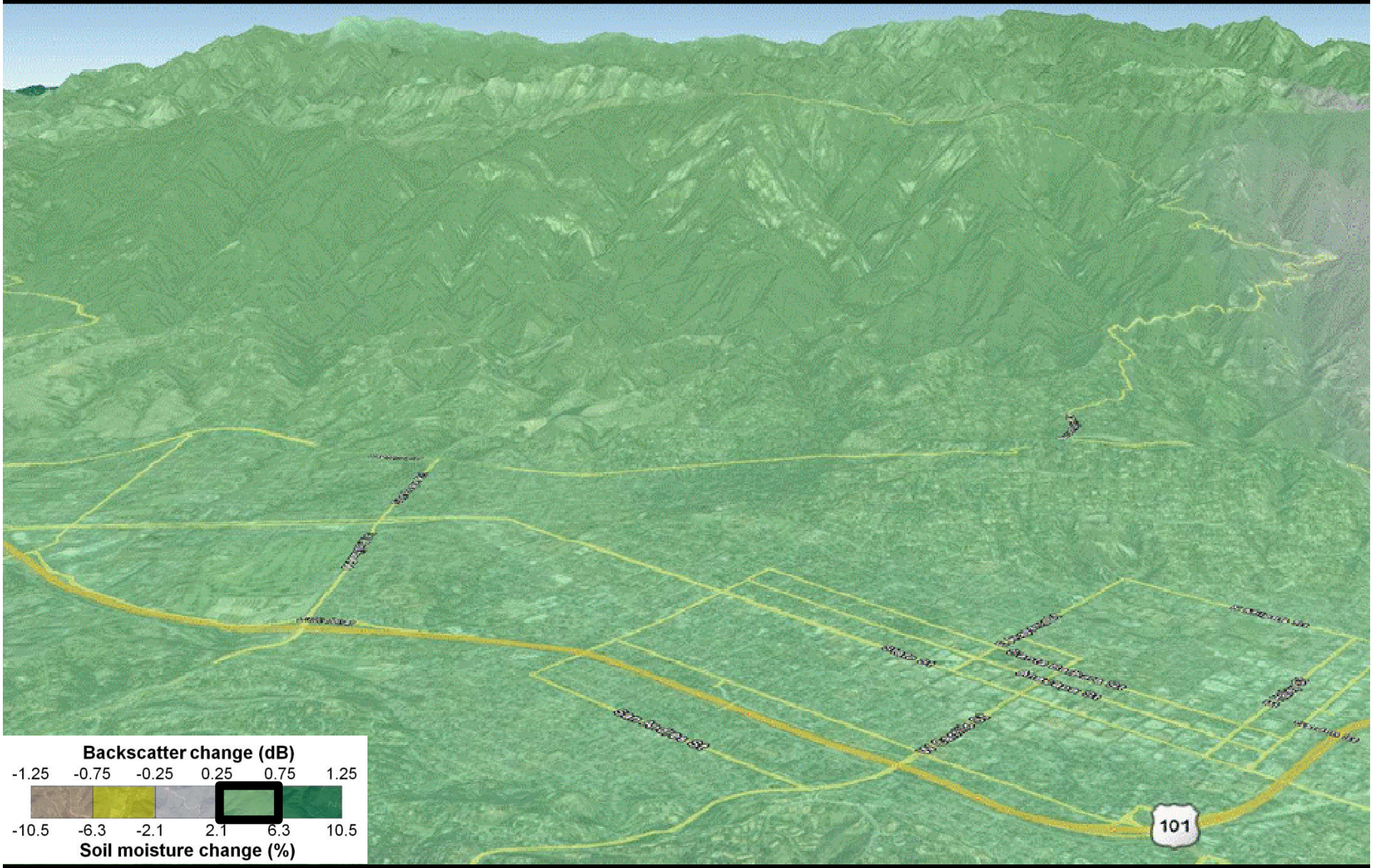
Virga - Dry Thunderstorm



The Case of Jesusita Fire – May 2009

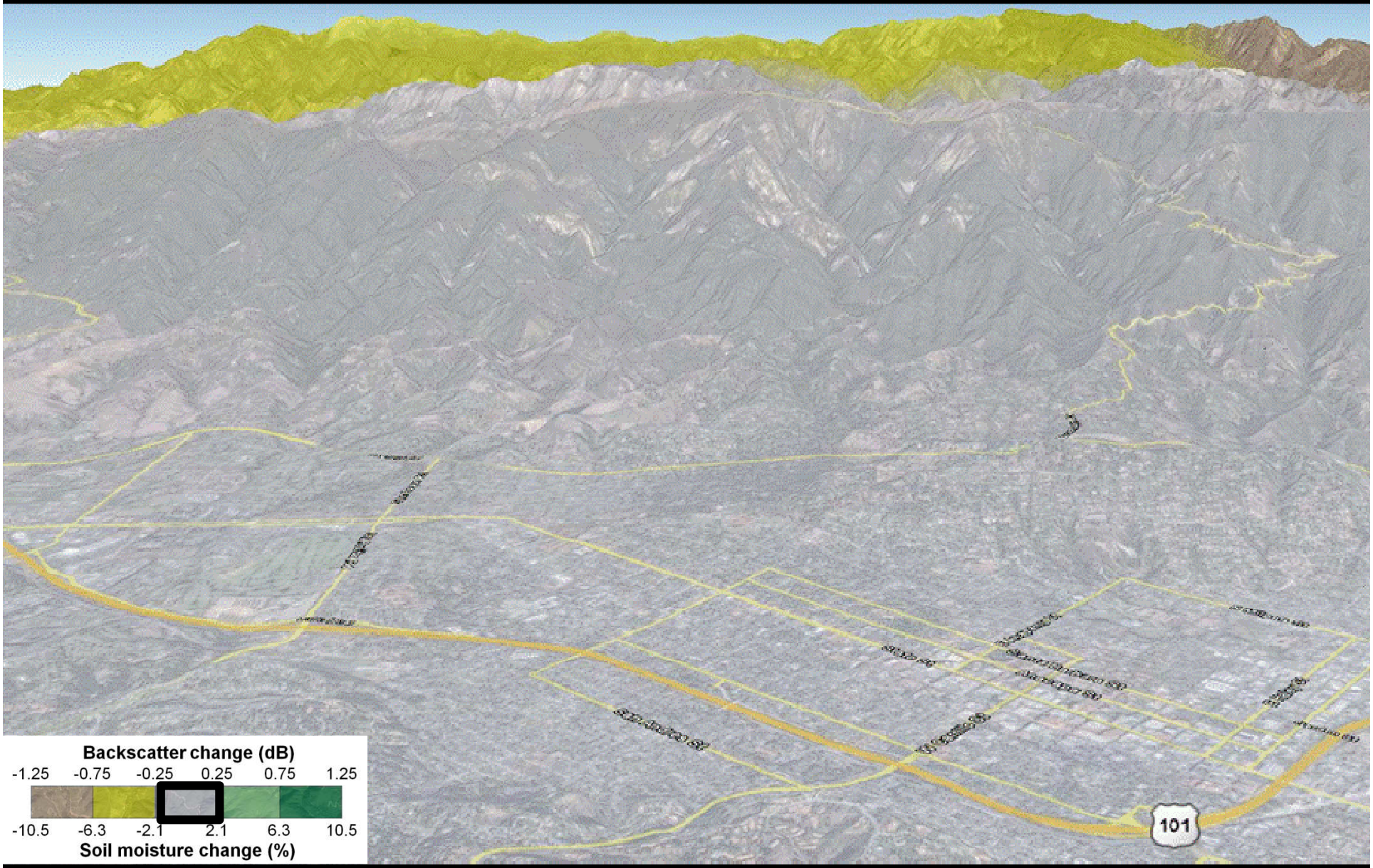


Santa Barbara on 2 May 2009



Maximum temperature was 73°F, 49% minimum humidity

Santa Barbara on 3 May 2009

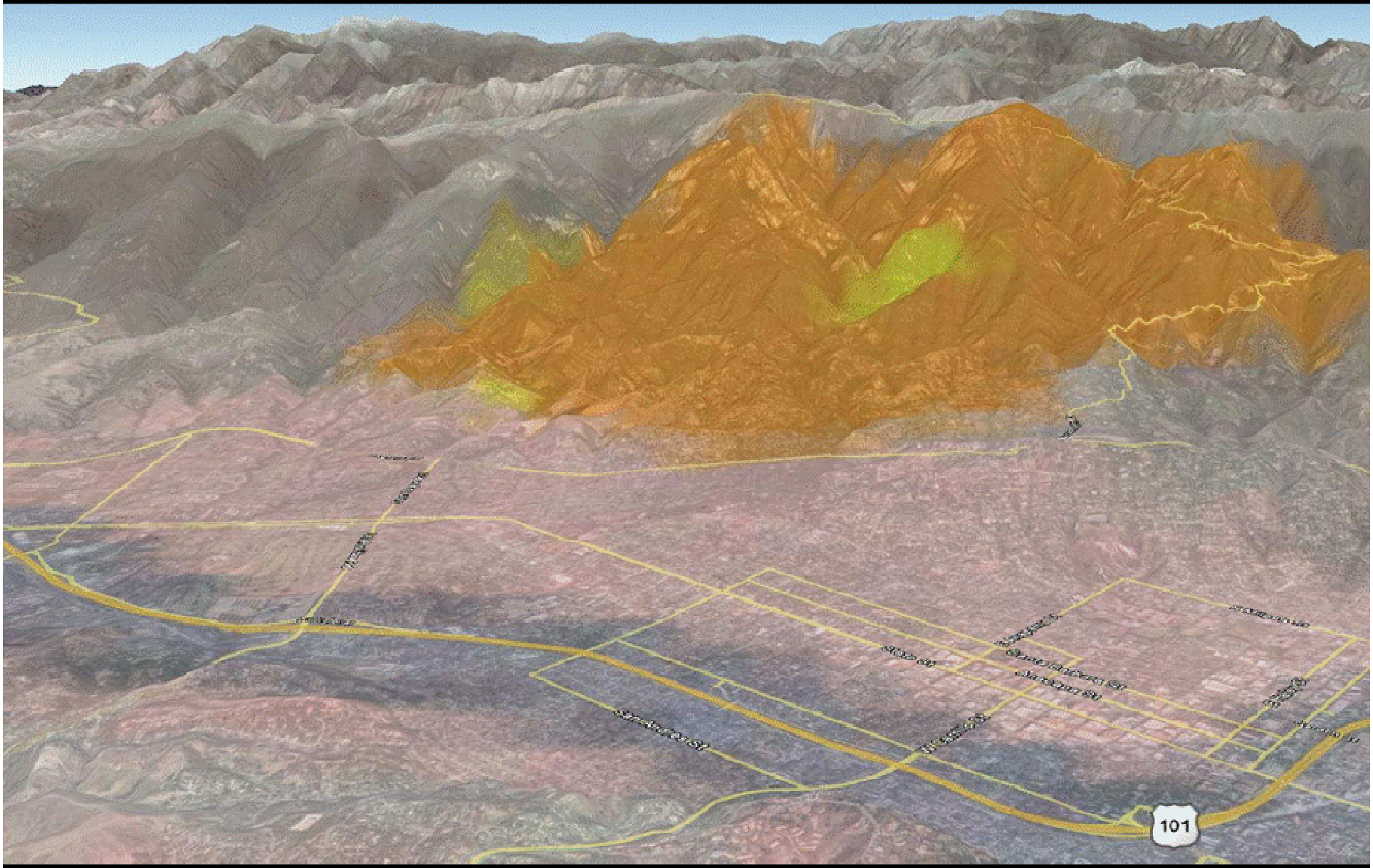


Maximum temperature was 89°F breaking the record set in 1984; 27% min. humidity

Santa Barbara on 6 May 2009

Maximum temperature was ~100°F breaking the record set in 1991; wildfire flared up

Wildfire Extent on 7 May 2009



Jesusita fire extent (orange) from MODIS data by USFS RSAC (3D overlay by Nghiem)

Conclusion

Satellites enable unprecedented capabilities to observe and monitor the Earth allowing new assessments of environmental change impacts on the global biosphere across ocean, ice, land, and atmosphere.

Contact

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