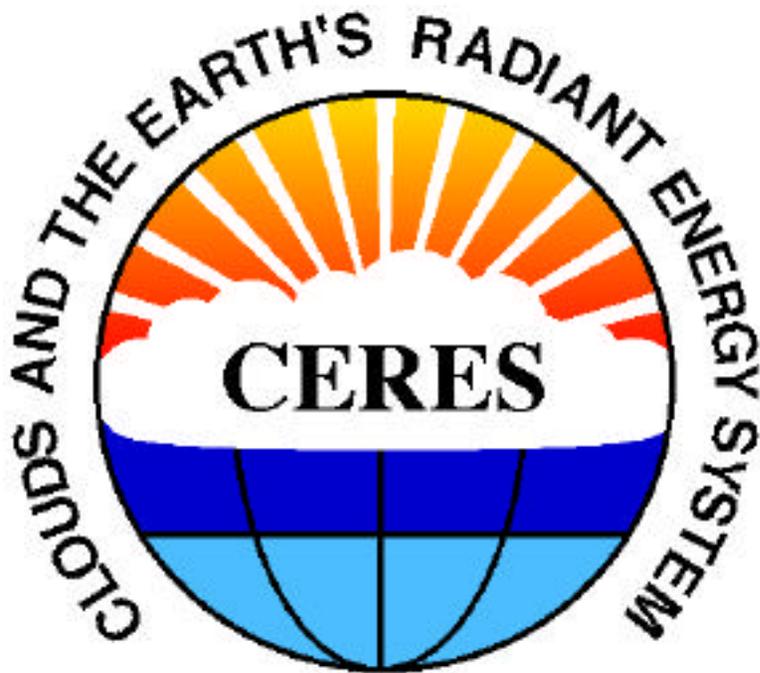
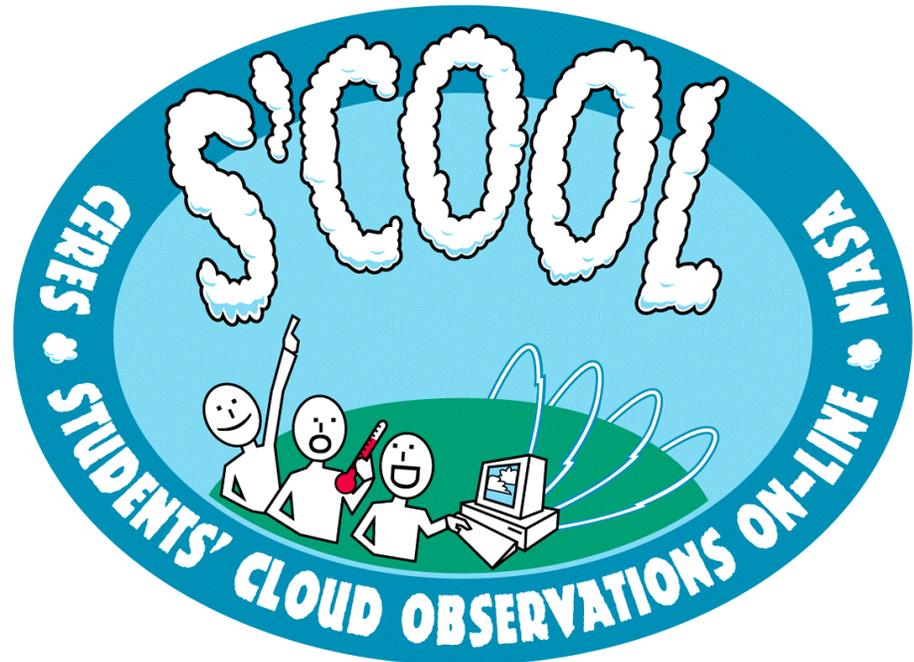


The CERES S'COOL Project



NASA

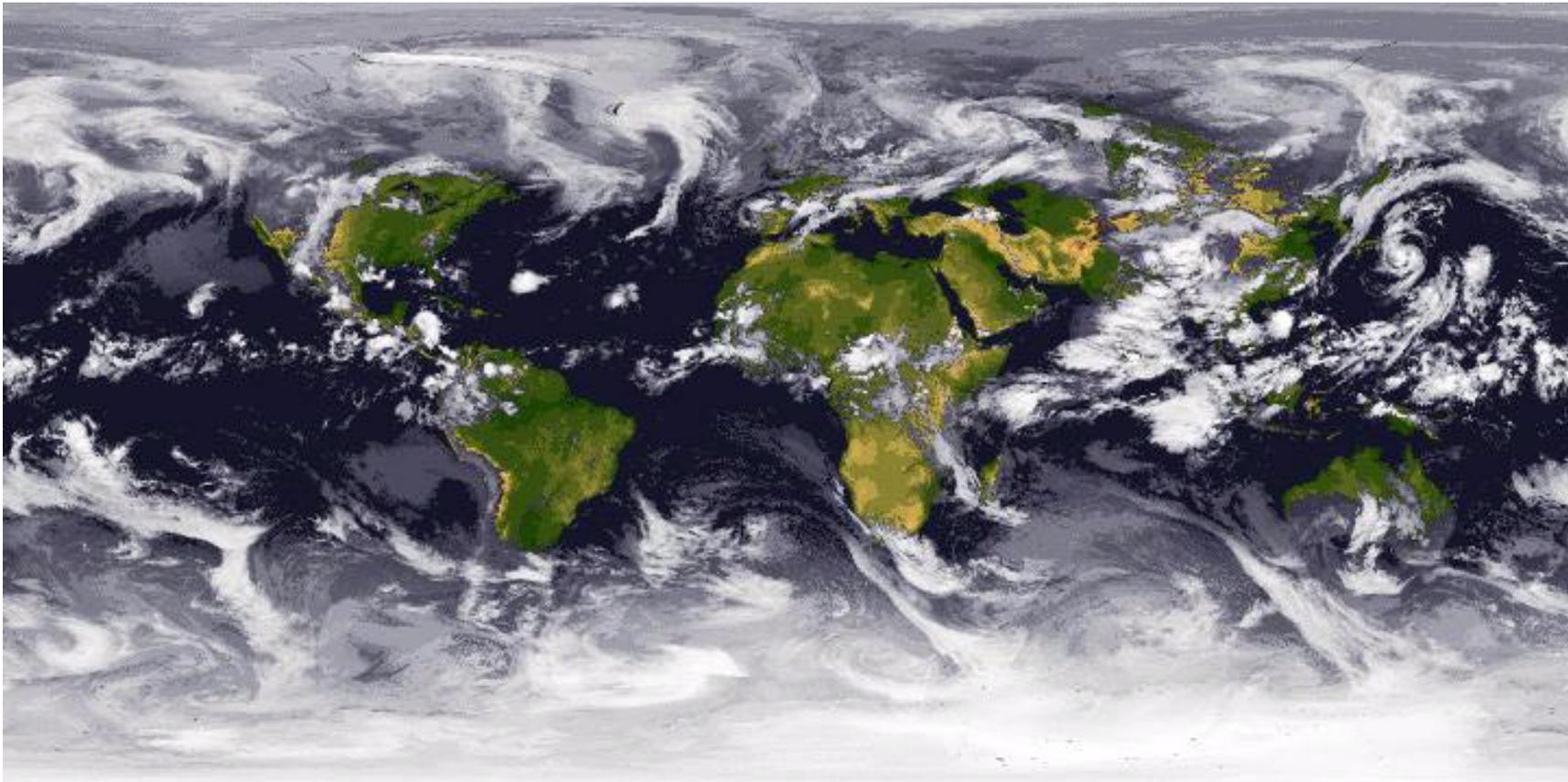


Atmospheric Sciences Research
Atmospheric Sciences Data Center
Office of Education

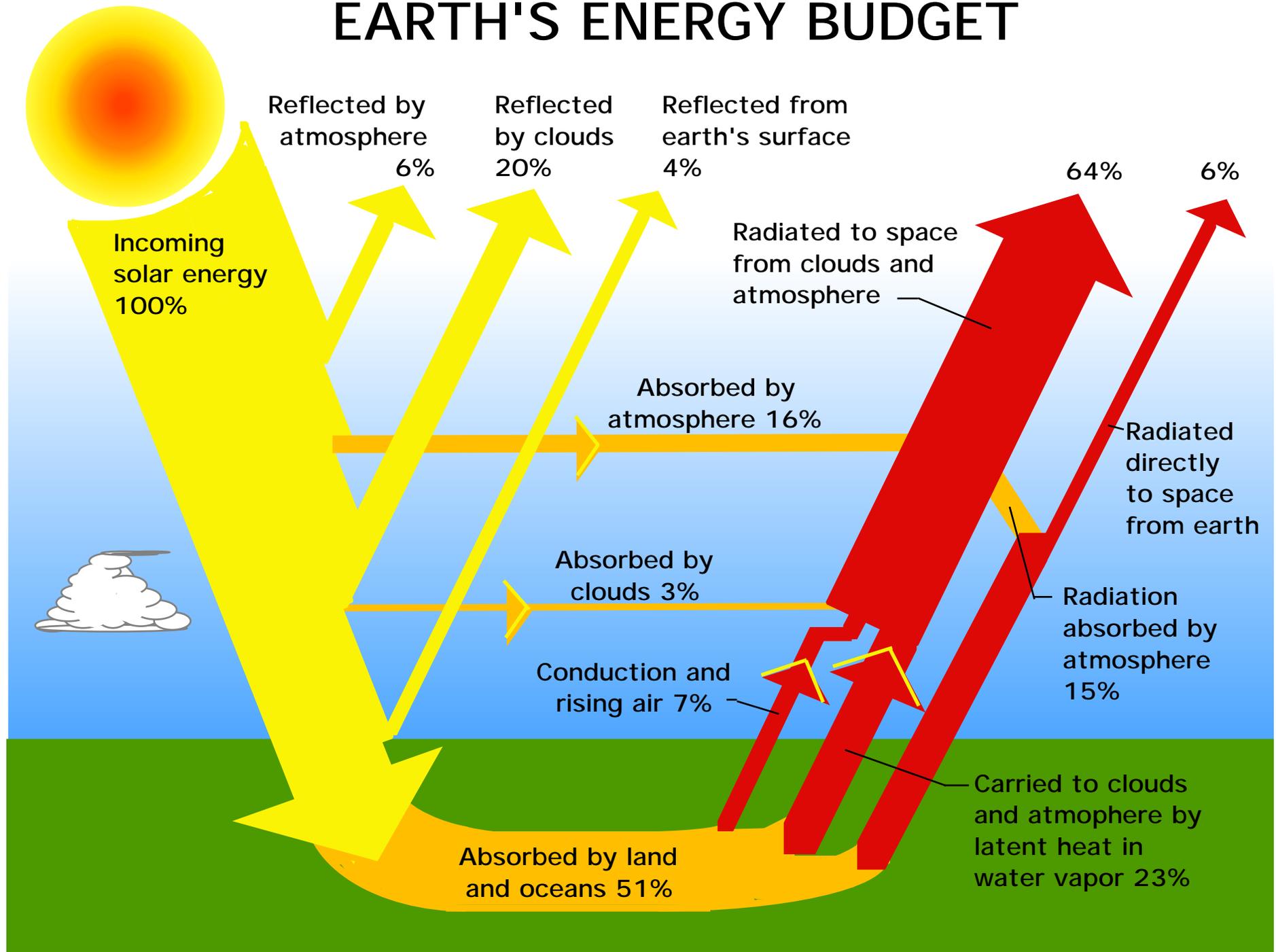
NASA Langley Research Center

Global Cloud Cover

August 26, 1993



EARTH'S ENERGY BUDGET



CLOUD EFFECTS ON EARTH'S RADIATION

SOLAR
(Shortwave)

SOLAR
(Shortwave)

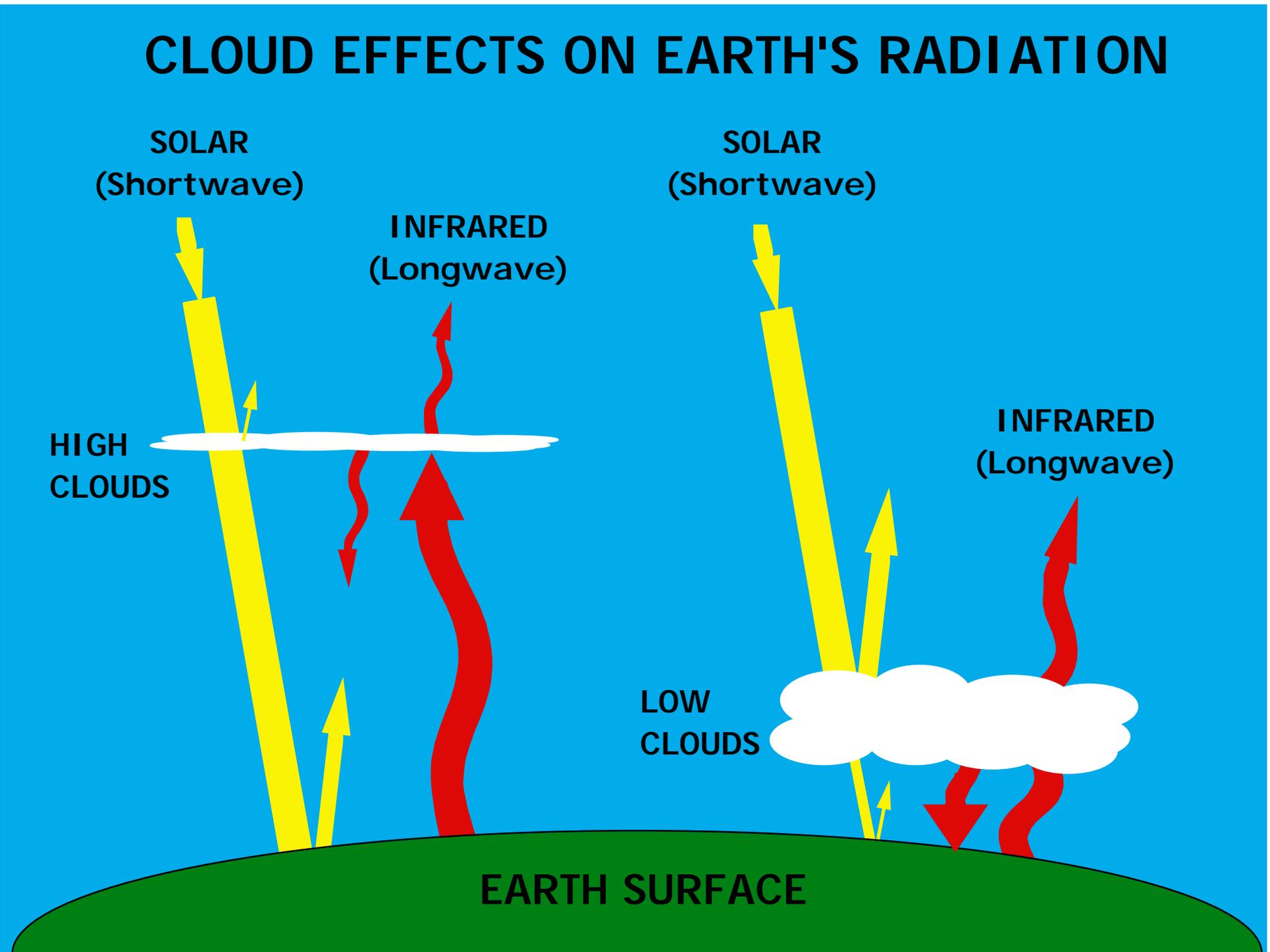
INFRARED
(Longwave)

INFRARED
(Longwave)

HIGH
CLOUDS

LOW
CLOUDS

EARTH SURFACE

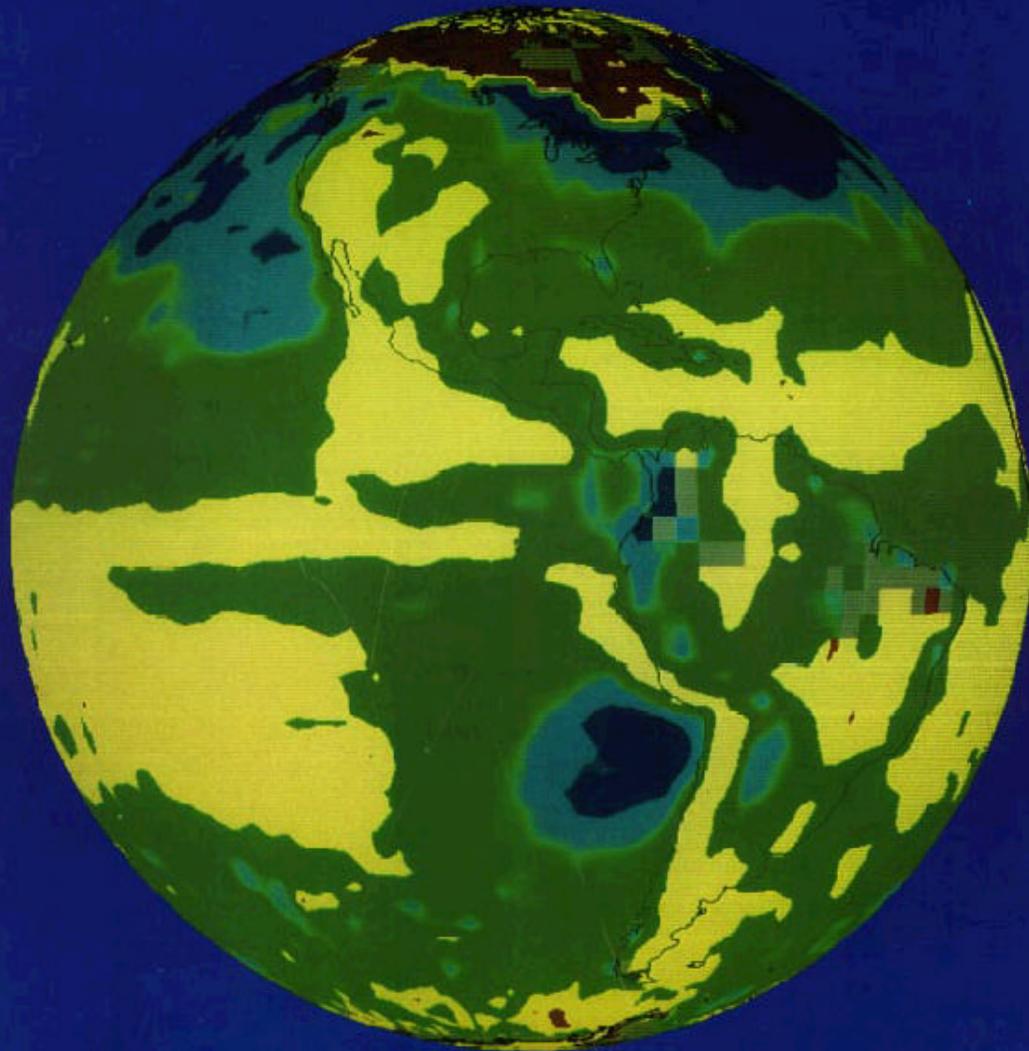


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SCIENCE

6 JANUARY 1980
VOL. 243 ■ PAGES 1-140

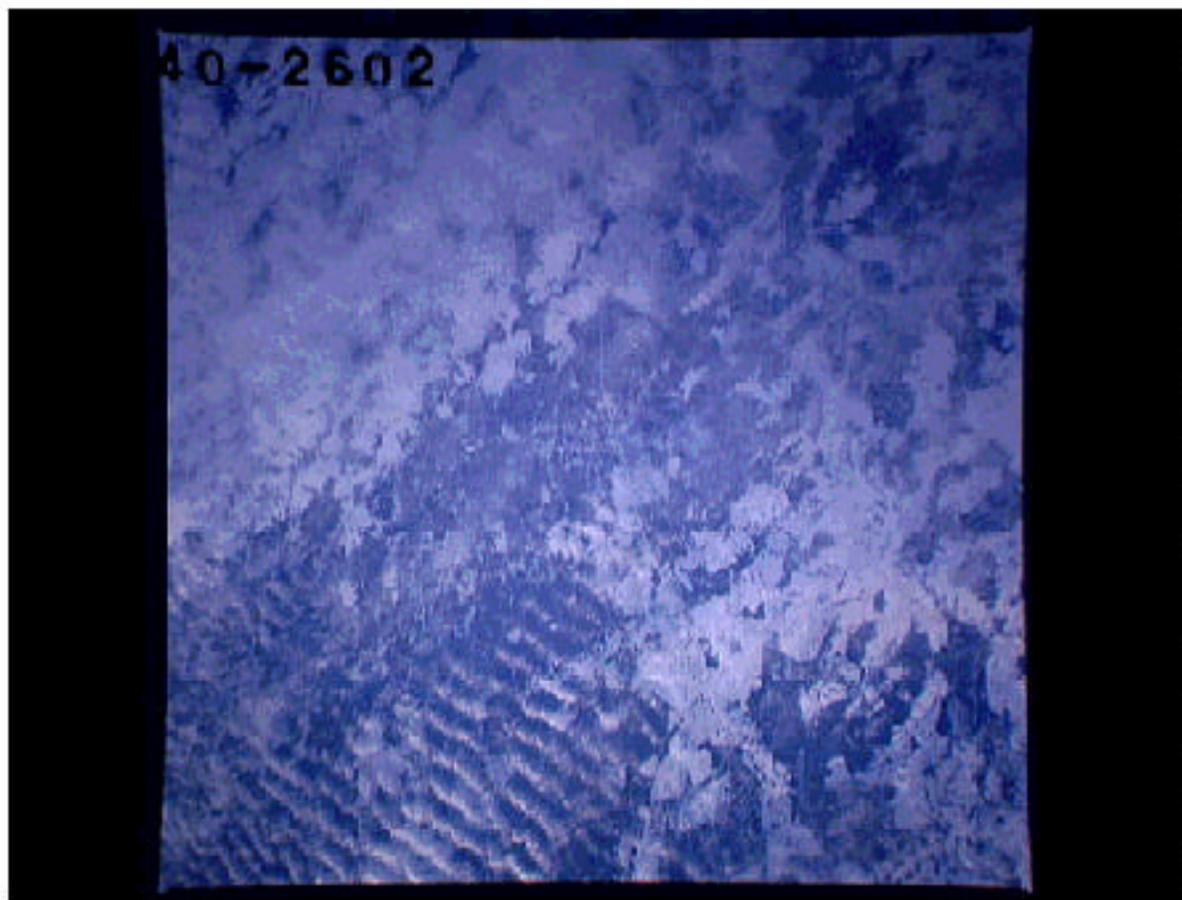
\$3.50



Clouds Looking Up

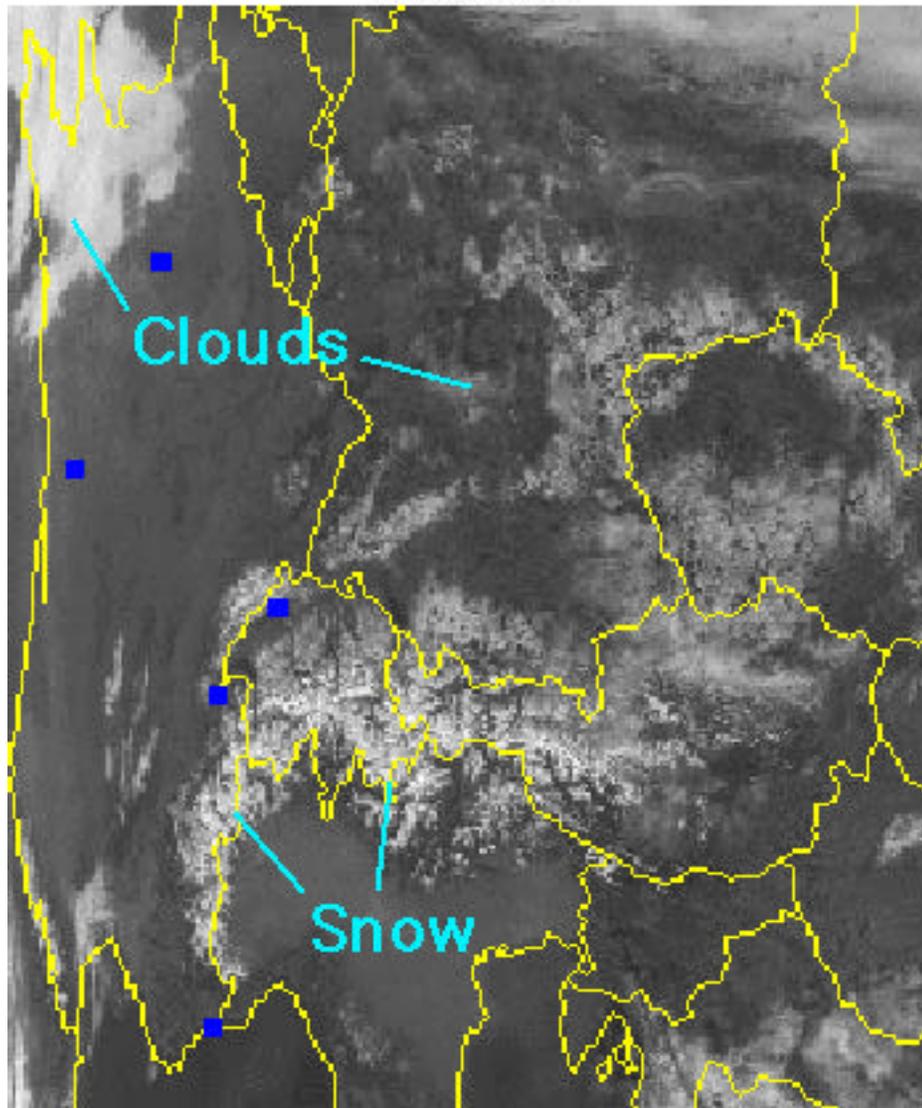


Clouds Looking Down

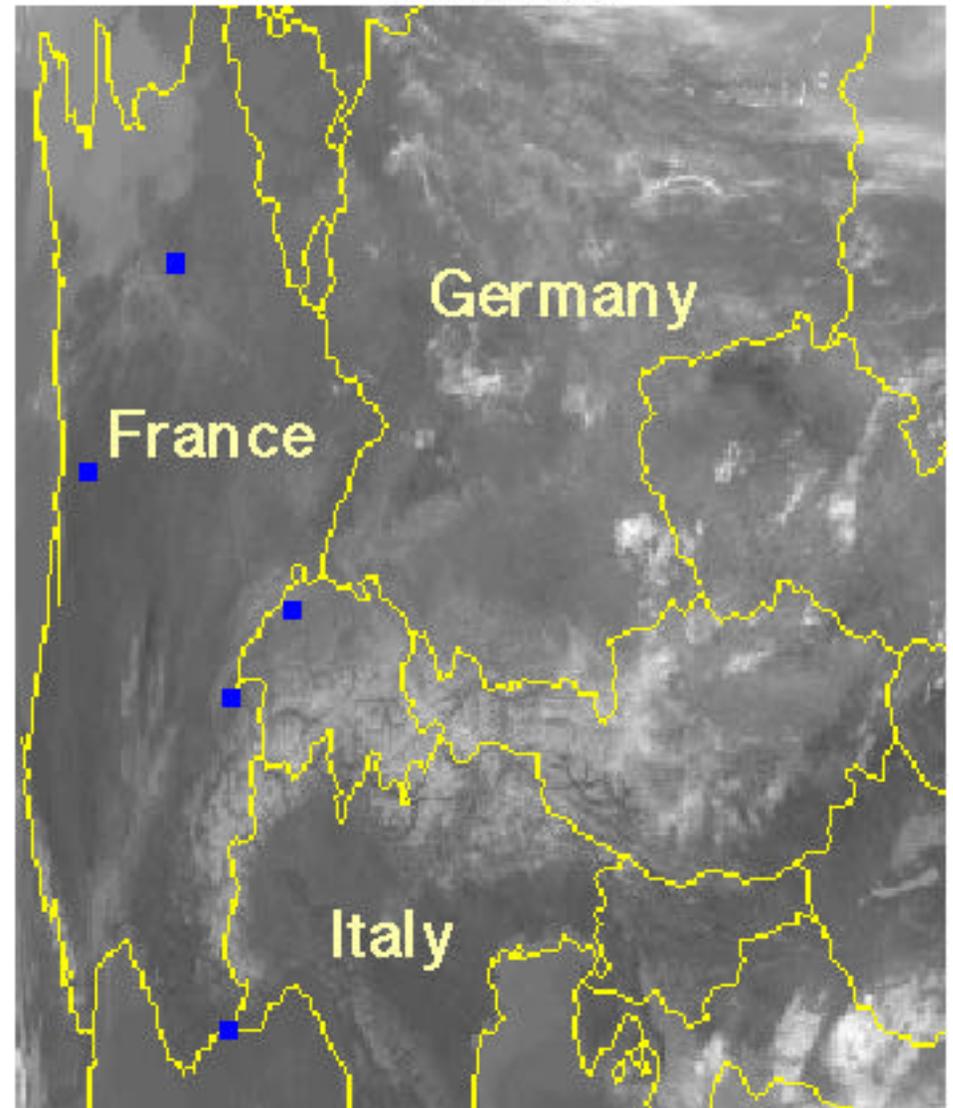


Snow and Clouds in Satellite Images

Visible

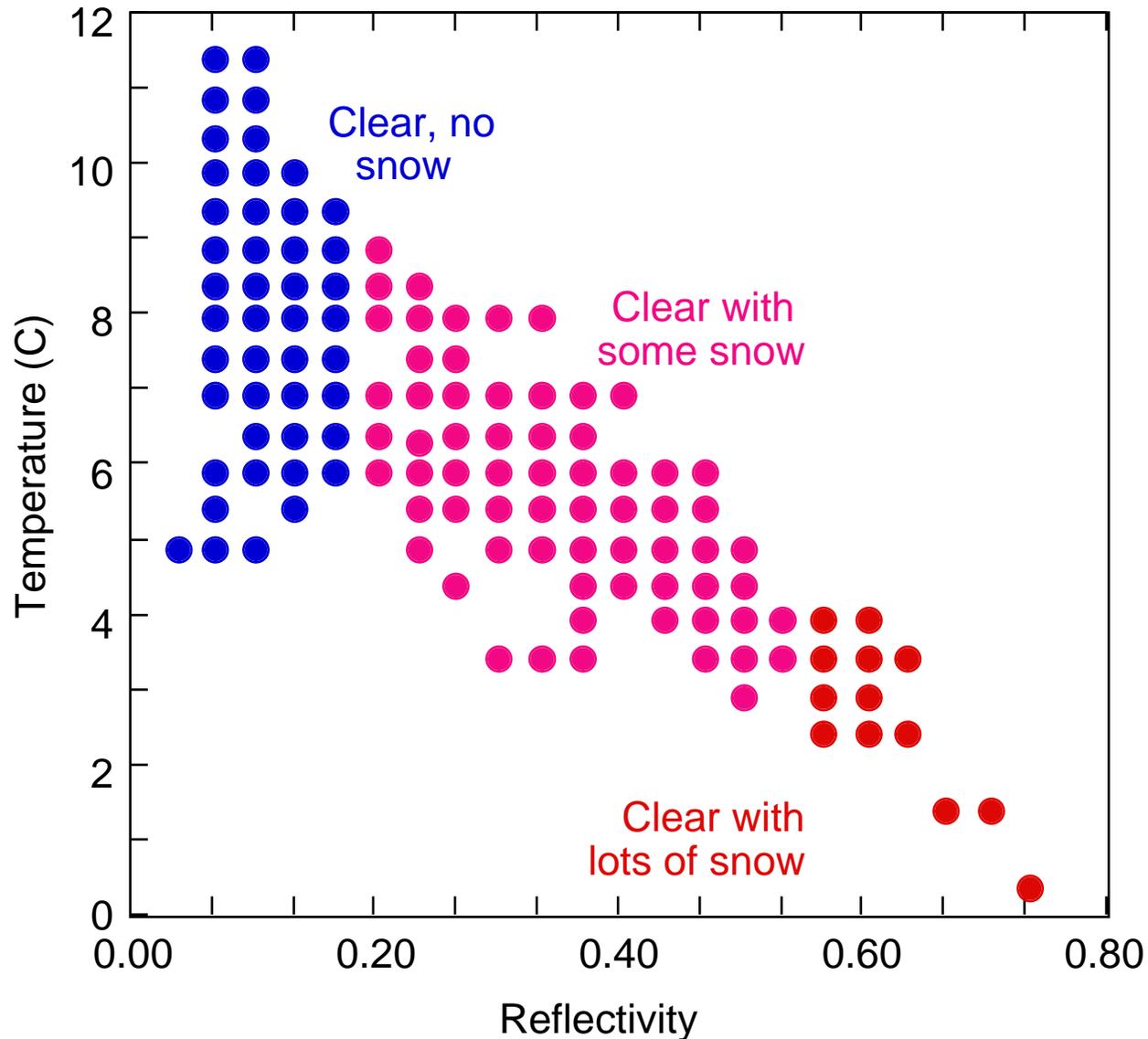


Infrared



The Snow Problem

Les Genevez, Switzerland



CERES Validation

- **Consistency checks**
- **Field campaigns (e.g., DOE ARM)**
- **Monitoring networks (e.g., BSRN)**
- **S'COOL Project**

Concept

- **Students provide ground observations for CERES overpass**
 - Determine satellite overpass time
 - Observe cloud properties
 - Transmit results to NASA
- **Compare to satellite-retrieved properties**
- **Data of value to CERES scientists**
- **Real-world learning for students**

Sample Overpass Time Report

Gloucester,VA USA
space craft is - TRMM

lat= 37.42 long= 283.65

da	universal time		hr	mn	local time	viewing zenith	sat azm fr. north	relative azimuth	solar zenith	satellite position		dir
	mo	year								lat	long	
6	7	1998	13	27	9h27	65.97	161.70	71.05	49.58	31.41	285.90	asc
6	7	1998	15	3	11h3	39.07	184.31	66.42	30.79	34.81	283.87	asc
6	7	1998	16	40	12h40	49.64	190.34	36.36	15.95	33.82	282.90	des
7	7	1998	13	51	9h51	49.81	190.47	74.98	44.93	33.81	284.41	asc
7	7	1998	15	27	11h27	38.99	184.17	67.72	26.47	34.81	283.44	des
7	7	1998	17	3	13h 3	65.83	198.66	24.45	14.75	31.45	281.37	des
8	7	1998	12	39	8h39	62.67	163.03	79.24	59.42	32.04	285.51	asc
8	7	1998	14	15	10h15	37.45	182.08	79.05	40.32	34.94	283.75	asc
8	7	1998	15	51	11h51	53.41	192.36	66.80	22.50	33.39	282.64	des
9	7	1998	13	2	9h 2	46.18	188.38	84.37	54.78	34.18	284.19	asc
9	7	1998	14	39	10h39	41.36	186.33	82.53	35.76	34.62	283.30	des
9	7	1998	16	15	12h15	68.90	199.97	62.53	19.10	30.76	280.93	des

S'COOL Report Form

Login ID: _____

Observation Date (ex. 1997 10 20): Year ____ Month __ Day __

Local Time (ex 15 26): Hour __ Minute __ Universal Time: Hour __ Minute __

Clouds: (Check all that apply)

None

Low Level

Visual Opacity: Opaque Translucent Transparent

Fraction: Clear (0 to 5%) Partly Cloudy (5% to 50%) Mostly Cloudy (50% to 95%) Overcast (95% to 100%)

Type: Fog Stratus Nimbostratus Cumulus
 Cumulonimbus Stratocumulus

Mid-Level

Visual Opacity: Opaque Translucent Transparent

Fraction: Clear (0 to 5%) Partly Cloudy (5% to 50%) Mostly Cloudy (50% to 95%) Overcast (95% to 100%)

Type: Altostratus Altocumulus

High Level

Visual Opacity: Opaque Translucent Transparent

Fraction: Clear (0 to 5%) Partly Cloudy (5% to 50%) Mostly Cloudy (50% to 95%) Overcast (95% to 100%)

Type: Cirrus Cirrocumulus Cirrostratus

Number of Persistent Contrails Present Number of Short-Lived Contrails Present

Ground Observations:

Temperature: ____ Celsius ____ Fahrenheit Relative Humidity ____ %

Barometric Pressure (choose units):
____ atmospheres ____ hPa ____ millibar ____ mm Hg ____ torr

Surface Cover: (check if present)

Snow/Ice Standing Water Muddy Dry ground Leaves on trees

Comments:(if you are not sure about part of the report, for example...)



Low-Level Clouds



Stratus



Stratocumulus



Nimbostratus



Mid-Level Clouds



Altocumulus



Altostratus



High-Level Clouds



Cirrus



Cirrocumulus



Cirrostratus



Contrails



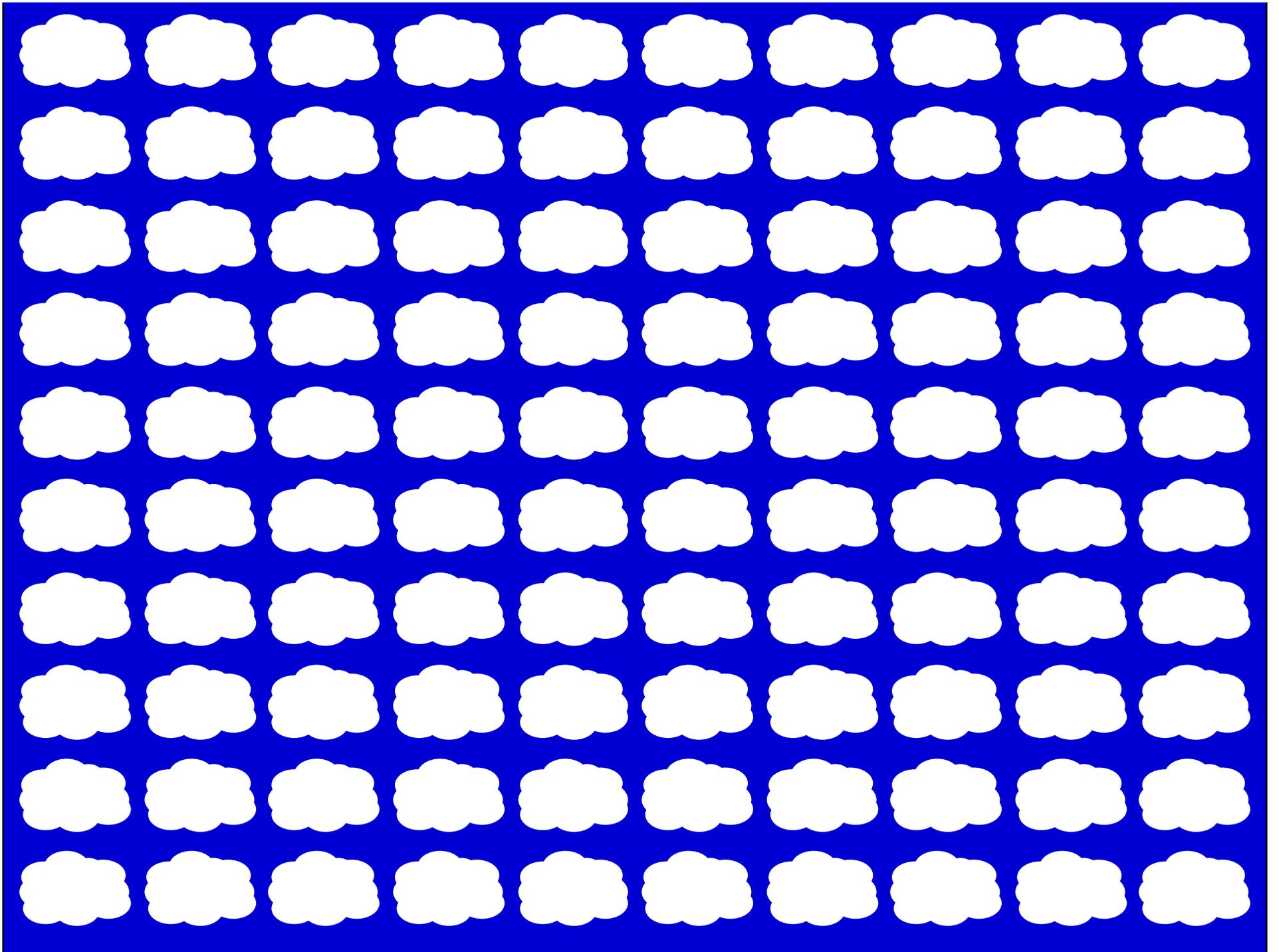
Convective Clouds

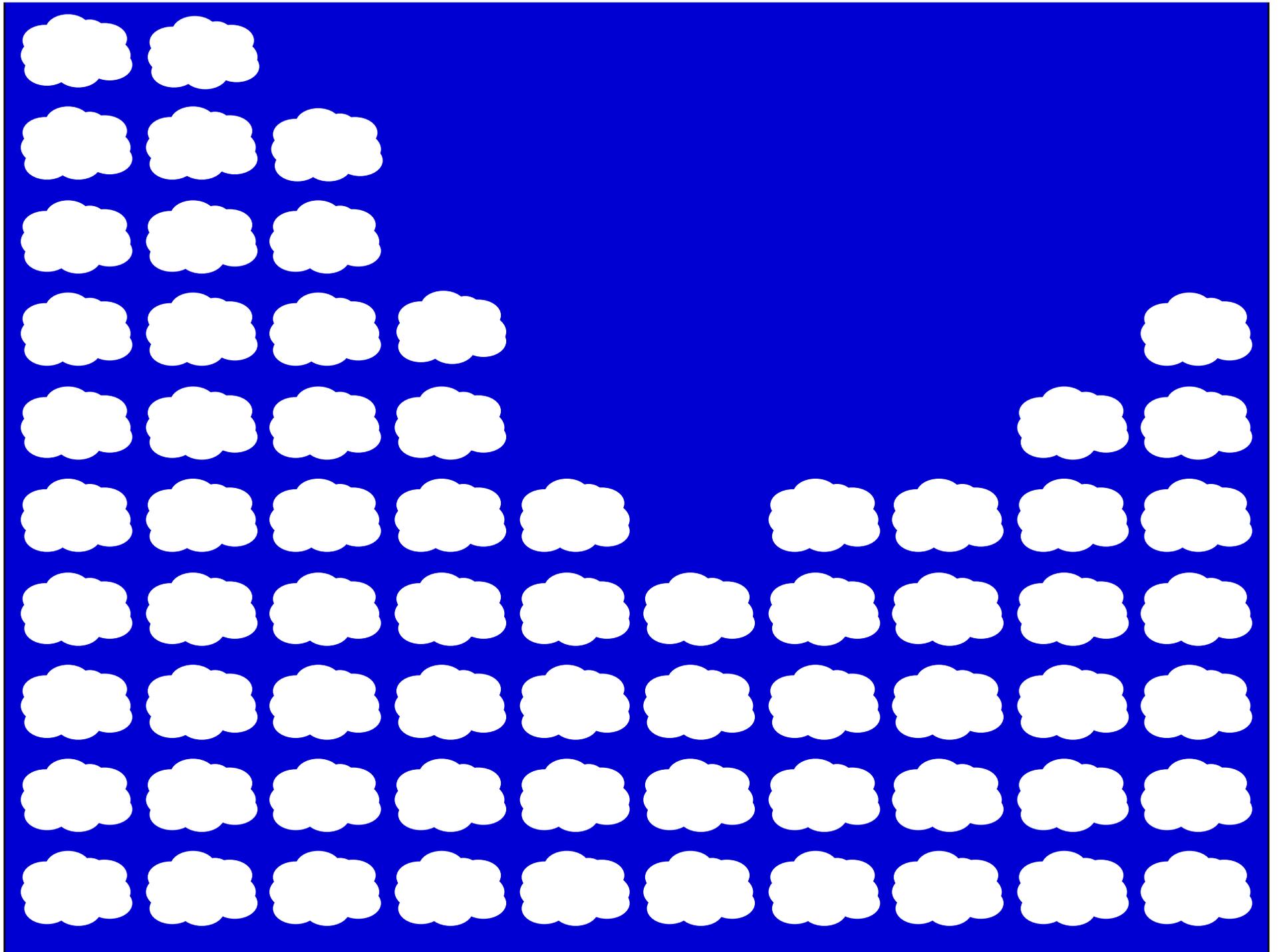


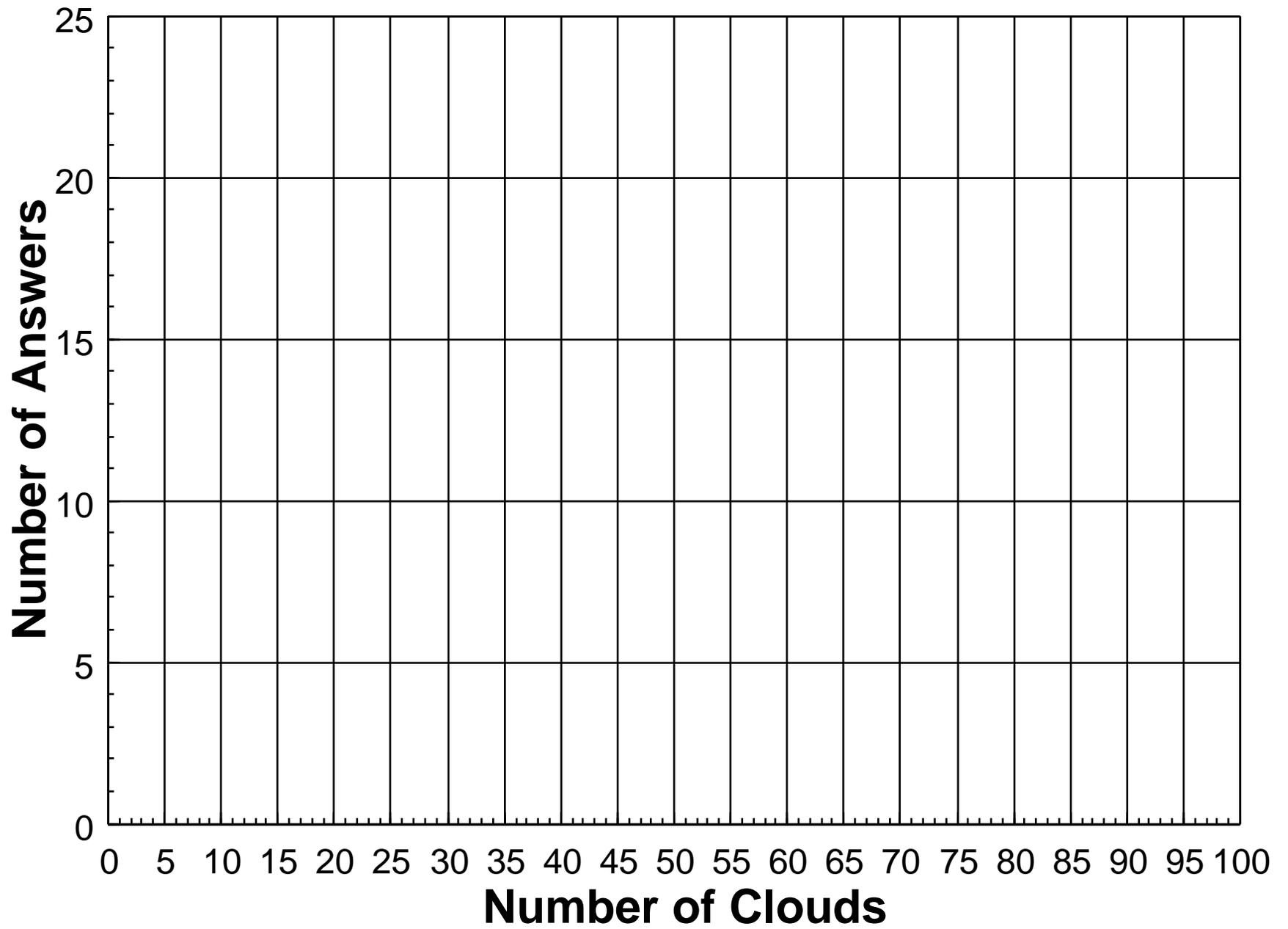
Cumulus



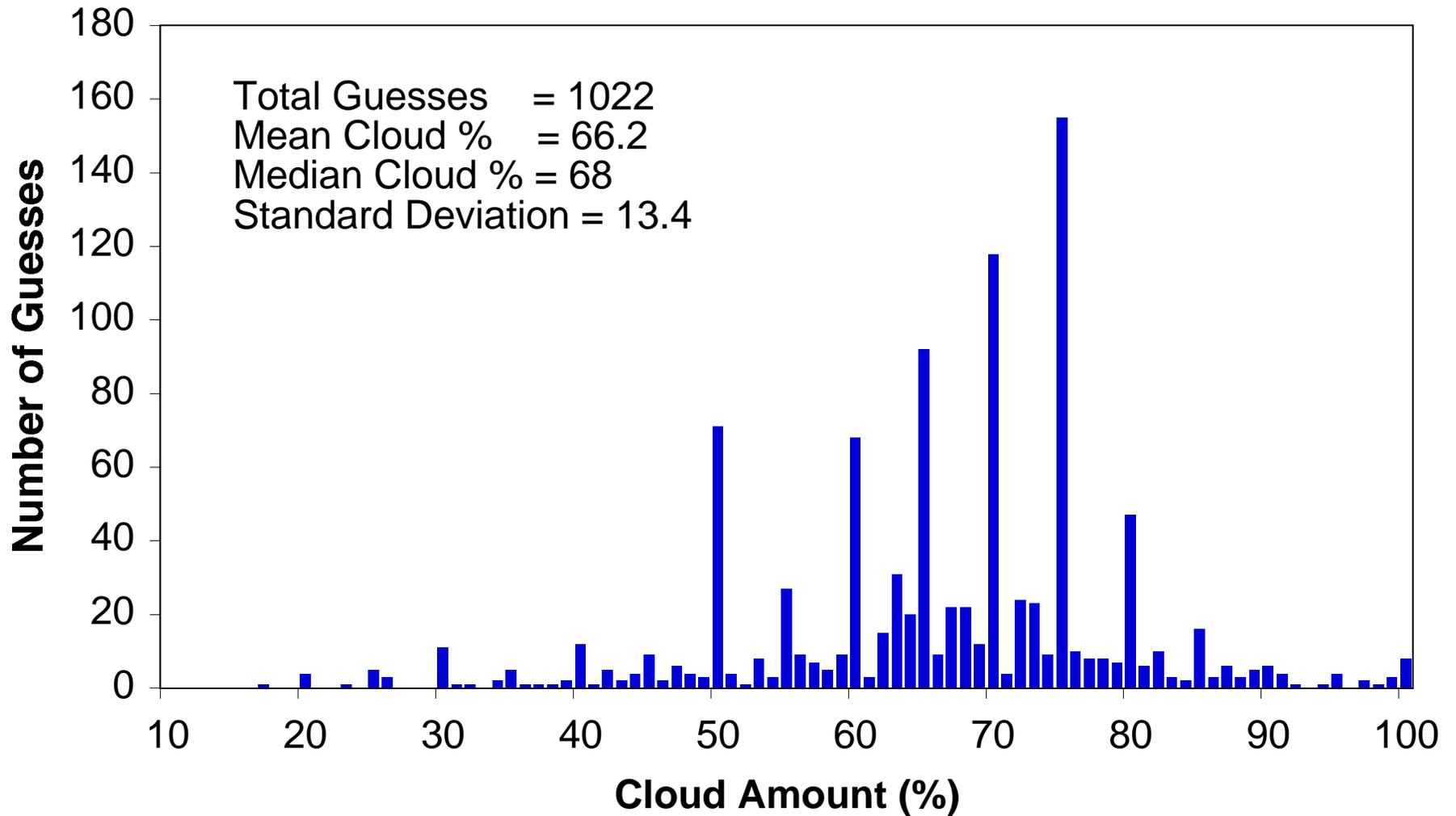
Cumulonimbus





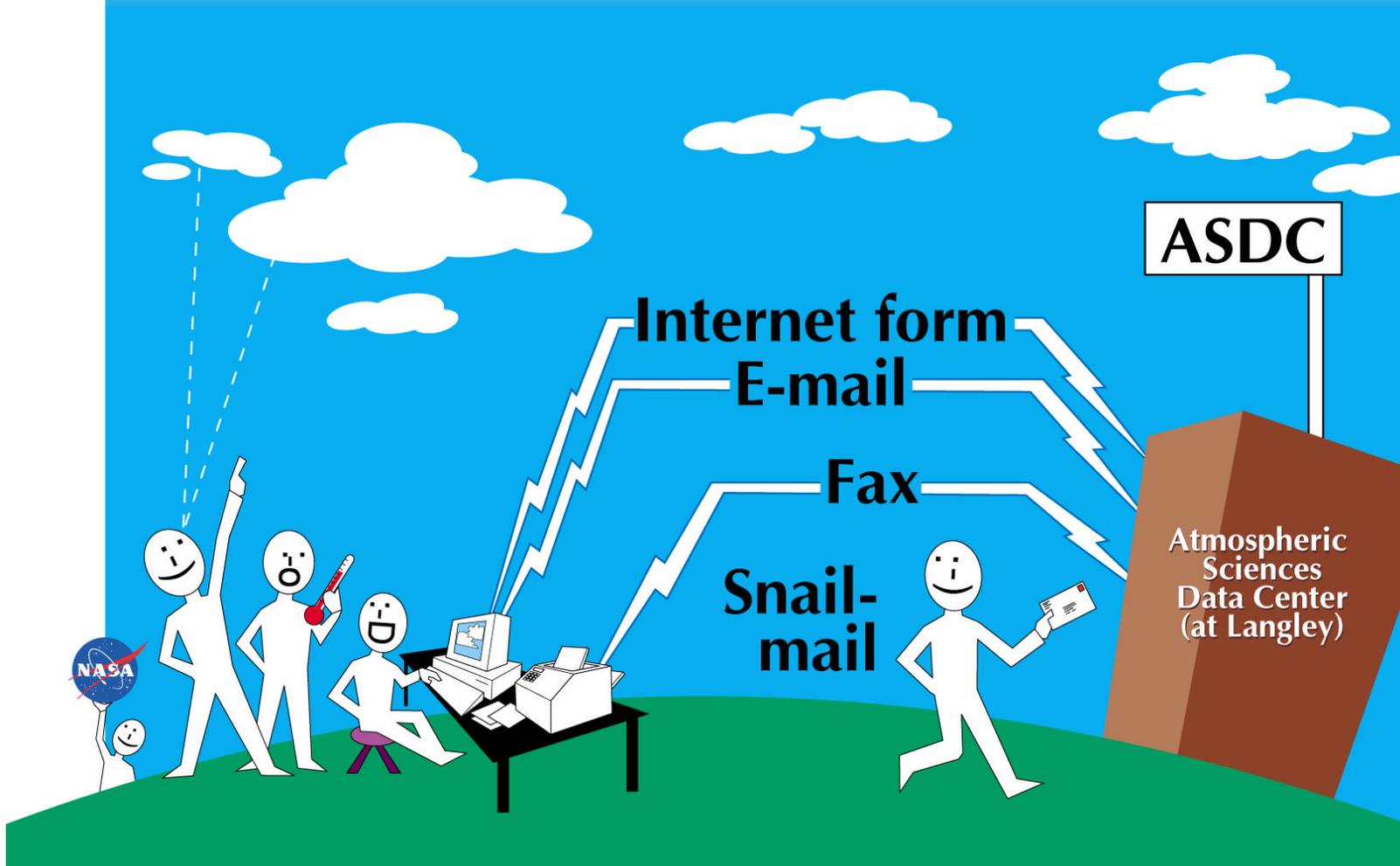


Summary of Estimates of Cloud Amount





Submitting S'COOL Observations



Comparing Student and Satellite Cloud Observations

- What We Compare
- How to Match Observations
- Examples
- Understanding the Results

What We Compare

- Cloud Amount
 - Clear
 - Partly Cloudy
 - Mostly Cloudy
 - Overcast
- Cloud Height
 - Low
 - Mid
 - High
- Number of Cloud Layers
- Cloud Visual Opacity

How to Match Observations

- Satellite and Student Observations Are Entered Into the S'COOL Database
- S'COOL Site Must Be Within Satellite Area
- Satellite and Student Observation Times Must Be Within 15 Minutes

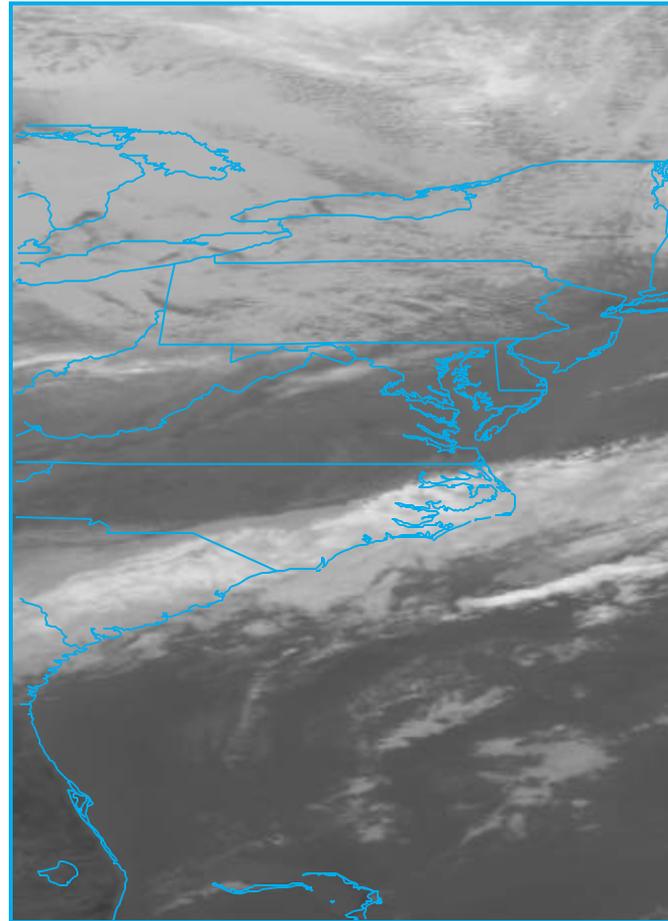
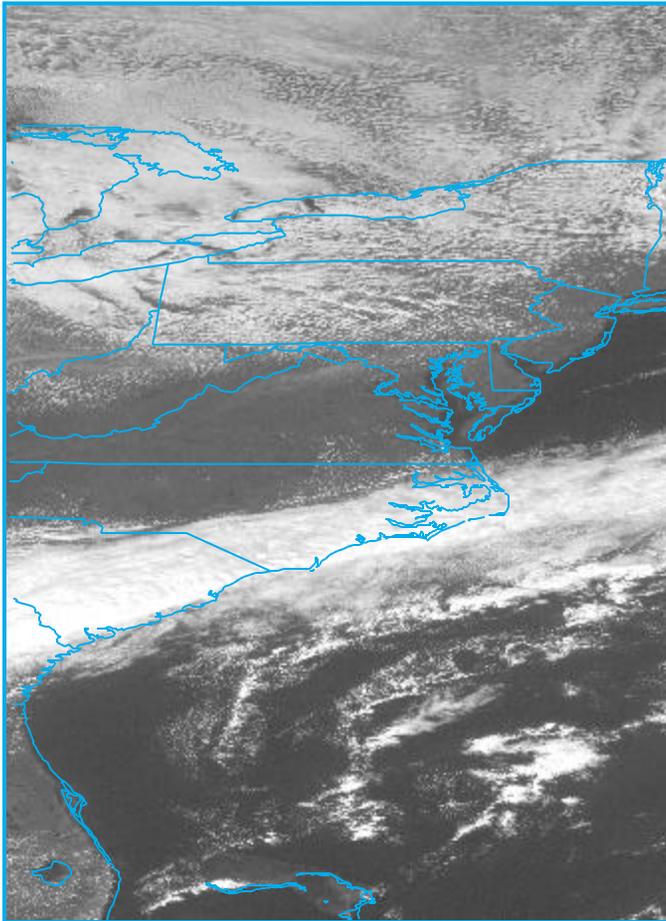
FIRST S'COOL Comparison

Cloud Observations Over Gloucester, VA
January 13 & 17, 1997

	Gloucester Student Observations	CERES Cloud Measurements	Do They Agree?
Cloud Type	None	None	Yes
Cloud Fraction	0% (Clear)	0%	Yes
Cloud Height	No Cloud	No Cloud	Yes
Visual Opacity	No Cloud	No Cloud (optical depth = 0.0)	Yes

Cloudy Day Comparison

October 22, 1997 17:45 GMT

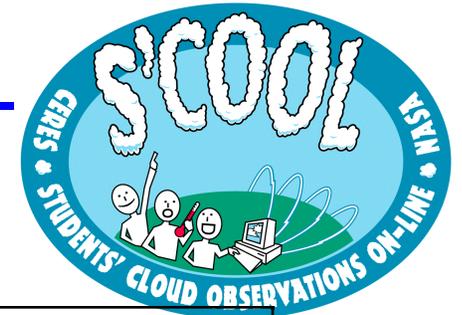


Comparison Results

October 22, 1997 17:45 GMT

	Poquoson Student Observations	Newport News Student Observations	CERES Cloud Measurements	Do They Agree?
Cloud Type	Cumulus	Alto cumulus + Cirrus	Low water clouds	Poq: Yes NN: No
Cloud Fraction	0 - 5% (Clear)	5 - 50% (Partly Cloudy)	7%	Close
Cloud Height	Low	Mid / High	Low	Poq: Yes NN: No
Visual Opacity	Translucent	Transparent	Translucent (optical depth = 6.6)	Poq: Yes NN: No

Comment: Poquoson observed contrails - These may be what the Newport News students were reporting. There also was a mid-level layer cloud to the south.



Updated Cloud Amount Comparison (Observations within 15 minutes)

		S'COOL Students			
		Clear	Partly Cloudy	Mostly Cloudy	Overcast
Satellite	Clear	27	2	2	0
	Partly Cloudy	7	10	2	1
	Mostly Cloudy	5	3	12	7
	Overcast	0	1	8	12



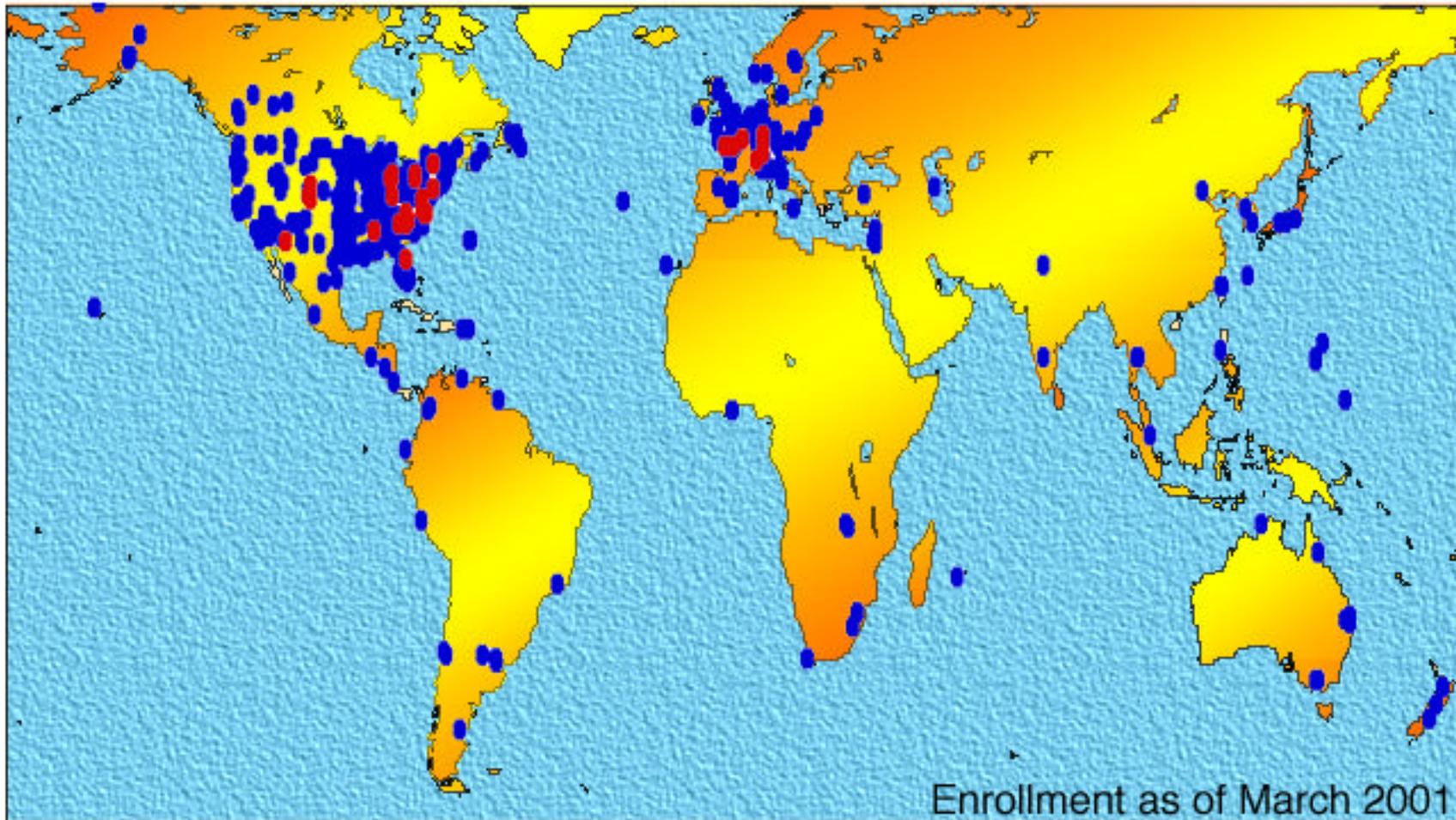
Results From 50 Dice Rolls

		Red Die			
		#1	#2	#3	#4
Blue Die	#1	7	5	2	4
	#2	2	5	0	3
	#3	3	3	4	3
	#4	1	3	3	2

Results From 500,000 Dice Rolls

		Red Die			
		#1	#2	#3	#4
Blue Die	#1	31,420	31,209	31,097	31,569
	#2	31,030	31,060	31,236	31,356
	#3	31,357	31,220	31,504	31,240
	#4	31,150	31,371	31,231	31,130

Participating S'COOL Schools



- Over 750 participating schools
- 63 schools visited by the S'COOL team (marked in red)
- Student observers in 50 countries
- More than 7000 observations to date

**A Mazé, l'école Marcel-Pagnol
correspond avec la NASA**

Dans les nuages avec la NASA



School kids keep their heads in clouds'

PES students look to the clouds

De hjälper Nasa med väderprojekt

Les CM1 travaillent pour la Nasa

WEATHER WATCHERS: *Learning from clouds*

