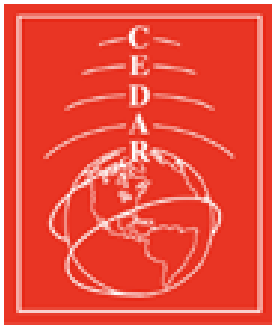


CEDAR 1983-2005

Tim Killeen

NSF Synopsis:

"CEDAR is a broad-based, community-initiated, upper atmospheric research program. The goal is to understand the behavior of atmospheric regions from the middle atmosphere upward through the thermosphere and ionosphere into the exosphere in terms of coupling, energetics, chemistry, and dynamics on regional and global scales. These processes are related to the sources of perturbations that propagate upward from the lower atmosphere as well as to solar radiation and particle inputs from above"

International Viewpoint:

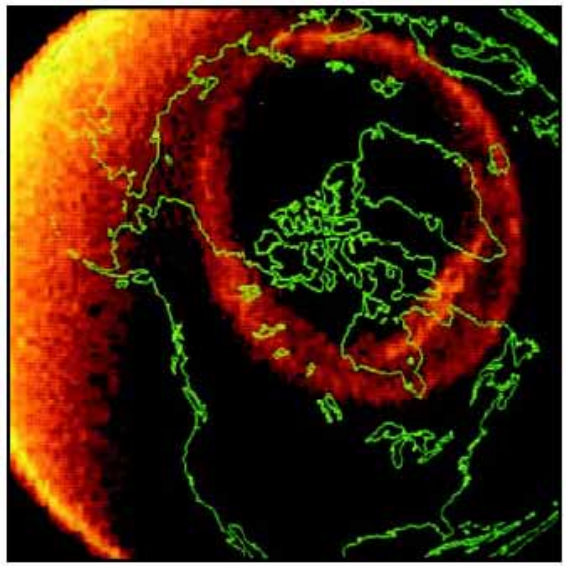
"Broadened to encompass multiple diagnostic techniques, theory, modeling, and coordinated observations, CEDAR is currently the dominant national and international research program in terrestrial aeronomy"

So, how did it get there?

Outline

- Summary of Early History
- Attributes and Approach
- Results
- A Renewed Agenda

Beginnings - 22 years ago!



- In 1983, when Abas Sivjee was the NSF Aeronomy Program Manager
  - Broad recognition by optical aeronomical investigators (Lyle Broadfoot) that there was underutilized instrument potential. The “best times for optical aeronomy” all seemed to be in the past
  - and the radar and satellite communities were forging ahead
  - Sivjee encouraged the community to come together in a program called Ground-Based Optical Aeronomy - GBOA

1983-1985

- Five GBOA Subcommittees were set up for
  - Spectrographs (Abas Sivjee)
  - Lidars (Chalmers Sechrist)
  - Interferometers (John Meriwether)
  - Imagers (Bob Eather)
  - Modeling (Doug Torr)
- And a Science Steering Committee:
  - Jerry Romick, Chair (Alaska)
  - Chuck Deehr, Executive Secretary (Alaska),
  - Tim Killeen, Vice Chair,
  - Bob Schunk, Chalmers Sechrist, Brian Tinsley, Fred Biondi, John Foster, and Doug Torr

Early Activities

- 1983 - Initial group formation, Spring AGU
- 1983 - Summer workshop in Logan
- 1983 - Technology working groups, Fall AGU
- Spring 1984 - Workshop report and need for initiative identified
- 1984 summer workshop in Ann Arbor, review of technology
- 1984, Fall, formation by NSF of Steering and sub-committees, workshops funded
- 1985 Definition of science goals - steering committee
- 1985 May - sub-committee reports

1984 Report

Ground-Based Optical Aeronomy in the 1980's

A workshop report on the present and future study of the interaction between solar radiation and the atmosphere

Compiled at the Geophysical Institute of the University of Alaska and the University of Arizona

A Typical Steering Committee Meeting, circa 1985

- Friday 5:00 p.m. arrive at a members house
- Friday evening/dinner meeting 7:00 - 11:00 p.m. Quality time to complain about things
- Saturday 8:00 a.m. - 11:00 p.m. sessions, with sandwiches - all science and technology
- Sunday 8:00 a.m. - 3:00 p.m. discuss acronyms endlessly and catch planes home.
- CEDAR Acronym coined (I believe) at meeting at Doug and Marsha Torr’s house in Logan in 1985 (DEAR was a close call!)

Over-arching Scientific Themes

- Dynamics, energetics, and composition of the atmosphere from the mesosphere to the exosphere;
- Thermosphere-ionosphere-exosphere-magnetosphere coupling; and
- Coupling with lower atmospheric regions

Modified slightly by 1995 CEDAR Scientific Steering Committee

Early Breakthroughs

- “User-Friendly” Model development ideas
- Definition of Class 1 Optical instruments and detectors to be built
- Production of optical subcommittee and steering committee reports, STRONGLY influenced by modeling team
- 1986: Rich Behnke and Bill Sharp encourage inclusion of radar community: two new subcommittees (IS and MS radars) formed
- 1986: Second edition of 2-volume Steering Committee report, includes radar science and introduces CEDAR to AGU, Europe, etc.

Interesting Quotes, early 1980's

- **"This program will never succeed"**
- **"You will never get the theoreticians to talk to the experimentalists and no one will talk with the lab people"**
- **"You want the radar types to sit in the same room and listen to the optical types? And vice versa?"**
- **"The Medium is the Massage" - from GBOA first workshop report, 1983**
- **"there is no doubt that recent advances in optical instrumentation… will direct the course of optical observations"**
- **"Total estimated data rate 706 kbps - it will be impractical to keep all of the data that could be recorded"**

Years in the Desert

- 1983: no new money
- 1984: limited funds for committee work
- 1985: no new money
- 1986: no new money
- 1987: no new money, but CEDAR incorporated in Global Change Initiative
- 1988: new money!!
- (hence my advice to all subsequent graduate students: tenacity is everything)

Steering Committees

CEDAR Science Steering Committee

1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Christensen	*Christensen*	*Basu*	*Basu*	*Basu*	*Forbes*	*Coakley*	*Fesen*	*Fesen*	*Castleberg*
Foster	*Fritts*	*Fejer*	— *de la Beaujardiere* —			*Forbes*	***Forbes***	***Forbes***	*Fesen*
Fritts	*Gardner*	*Gardner*	*Fejer*	*Fejer*	*Hecht*	*Hecht*	*Holt*	*Holt*	*Heelis*
Gardner	*Hines*	*Hines*	***Gardner***	***Gardner***	***Kelley***	***Kelley***	*Kerr*	*Kerr*	*Holt*
Killeen	***Killeen***	***Killeen***	*Hines*	*Hecht*	*Killeen*	*Killeen*	*Killeen*	*Mendillo*	*Hysell*
Mendillo	*Mendillo*	*Mendillo*	*Kelley*	*Kelley*	*Larsen*	*Larsen*	*Larsen*	*Sahr*	*Kerr*
Romick	*Meriwether*	*Meriwether*	*Meriwether*	*Roble*	*Roble*	*Roble*	*Miller*	*Salah*	***Mendillo***
Sharp	*Salah*	*Salah*	*Sivjee*	*Smith*	*Smith*	*Sahr*	*Sahr*	*Swenson*	*Salah*
Salah	*Sharp*	*Sivjee*	*Smith*	*Tepley*	*Tepley*	*Tepley*	*Swenson*	*Thayer*	*Shepherd*
Torr	*Sivjee*					*Thayer*	*Thayer*	*Valentic*	*Swenson*
									Taylor
Ex Officio Members									
Behnke	*Behnke*	*Behnke*	*Behnke*	*Behnke*	*Behnke*	*Basu*	*Basu*	*Basu*	*Basu*
Tinsley	*Romick*	*Romick*	*Roesler*	*Roesler*	*Roesler*	*Robinson*	*Robinson*	*Robinson*	*Robinson*
	Tinsley								

Chairpersons shown in bold

And Excellent leaders at NSF

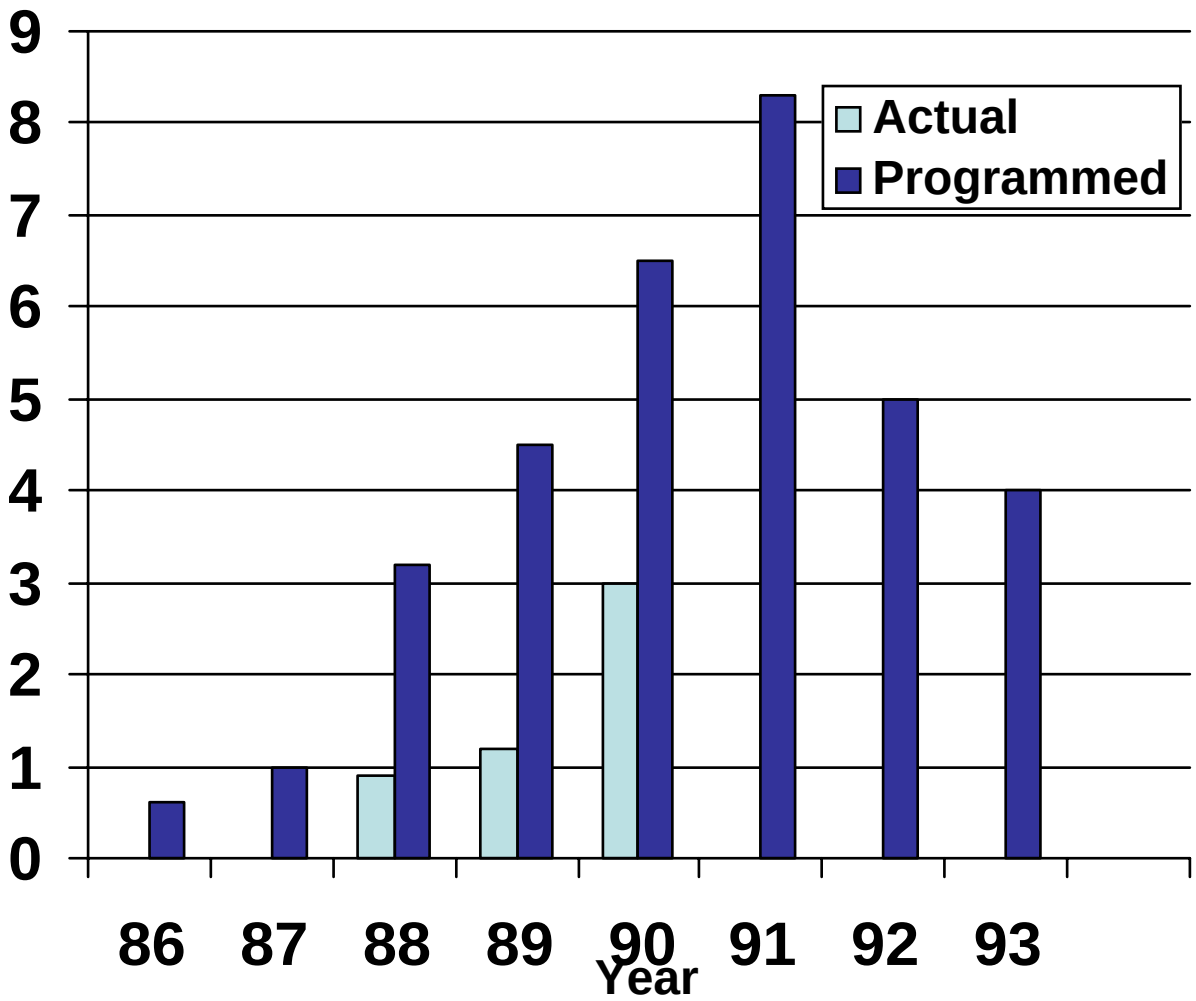
1987

- Outlaw Interminable Alaskan weekend meetings
- Pick a LOGO! CEDAR Mugs, Tee Shirts, etc.
- Celebrate Student involvement, tune meeting format
- Get CEDAR on the “Global Change: viewgraph
- Survive budget year where CEDAR was almost zero’ed out

1988

- Regular representations of science to NSF
- Tee shirts, mugs, students increasing
- Keep Barbara Emery involved
- CEDAR built into NSF budgets

Funding Profiles at June, 1989 CEDAR SSC



Planned Sunset never happened!

Made part of NSF's Global Change Program after critical NSF review in 1987

1990: Funding catches up with the science!

And Yet More Acronyms…

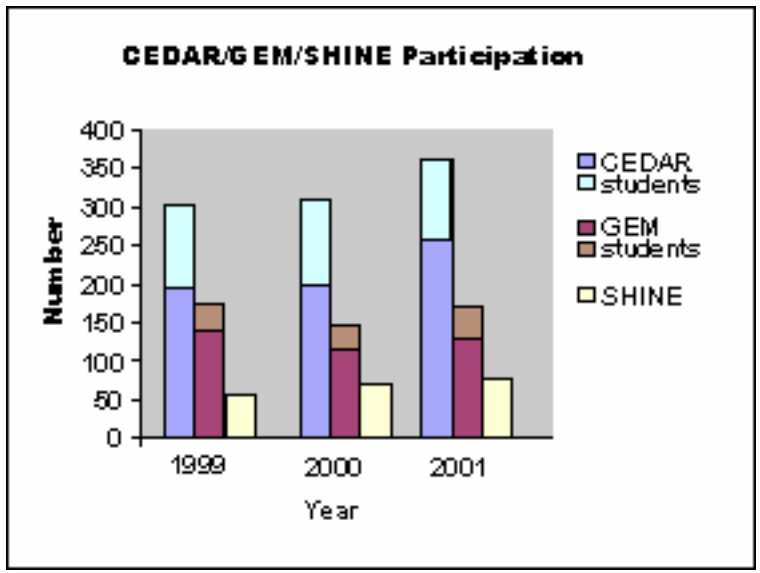
- MAPSTAR
- AIDA
- CHARM
- LTCS
- GEMINI
- GISMOS
- HLPS
- Etc.

Full Acronym List at:
http://cedarweb.hao.ucar.edu/community/bag.html

1988 Quote (to SCOSTEP)

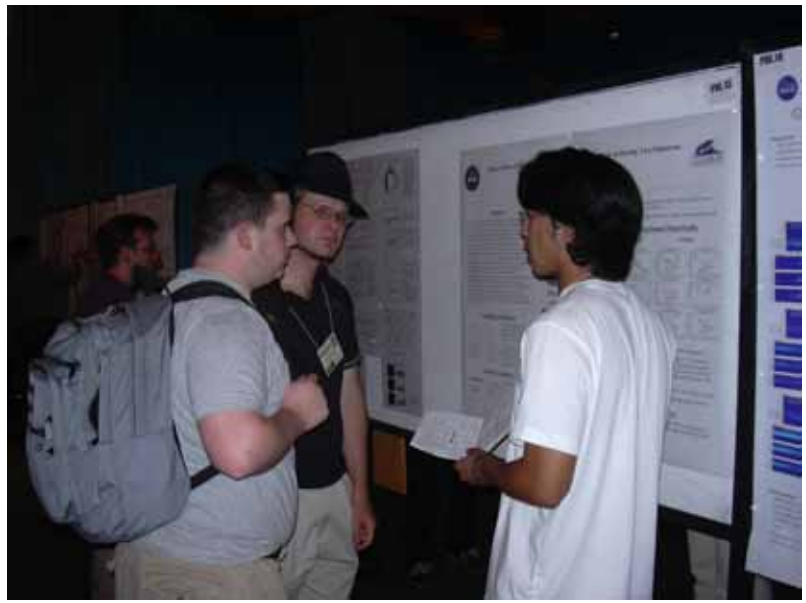
- “One of the guiding principles in CEDAR is that scientific activity must originate in the active scientific community and not be dictated from above. The CEDAR approach is not to propose what needs to be done but HOW to solve the problems that exist - thus the steering committee’s role is to help the community do what it wants to do, rather than tell it what to do” G. Romick

Student Participation Made a Major Priority



Student Emphasis

Year	Where	#Total	#Students
1986	NCAR	61	0
1987	NCAR	160	19
1988	NIST/NCAR	180	39
1989	NIST/NCAR	221	68
1990	NIST/NCAR	267	106
1991	NIST/NCAR	254	116
1992	NIST/ML/FL	283	131
1993	NIST/ML/FL	397	174
1994	U CO/ML/FL	347	155
1995	NIST/ML	315	141
1996	U CO	270	109
1997	U CO	298	118
1998	U CO	294	103
1999	U CO	300	111
2000	NIST/NOAA	305	109
2001	Raintree	385	106



- **>1600 student attendees over first 16 years**
- **Student Workshops held annually since 1994**

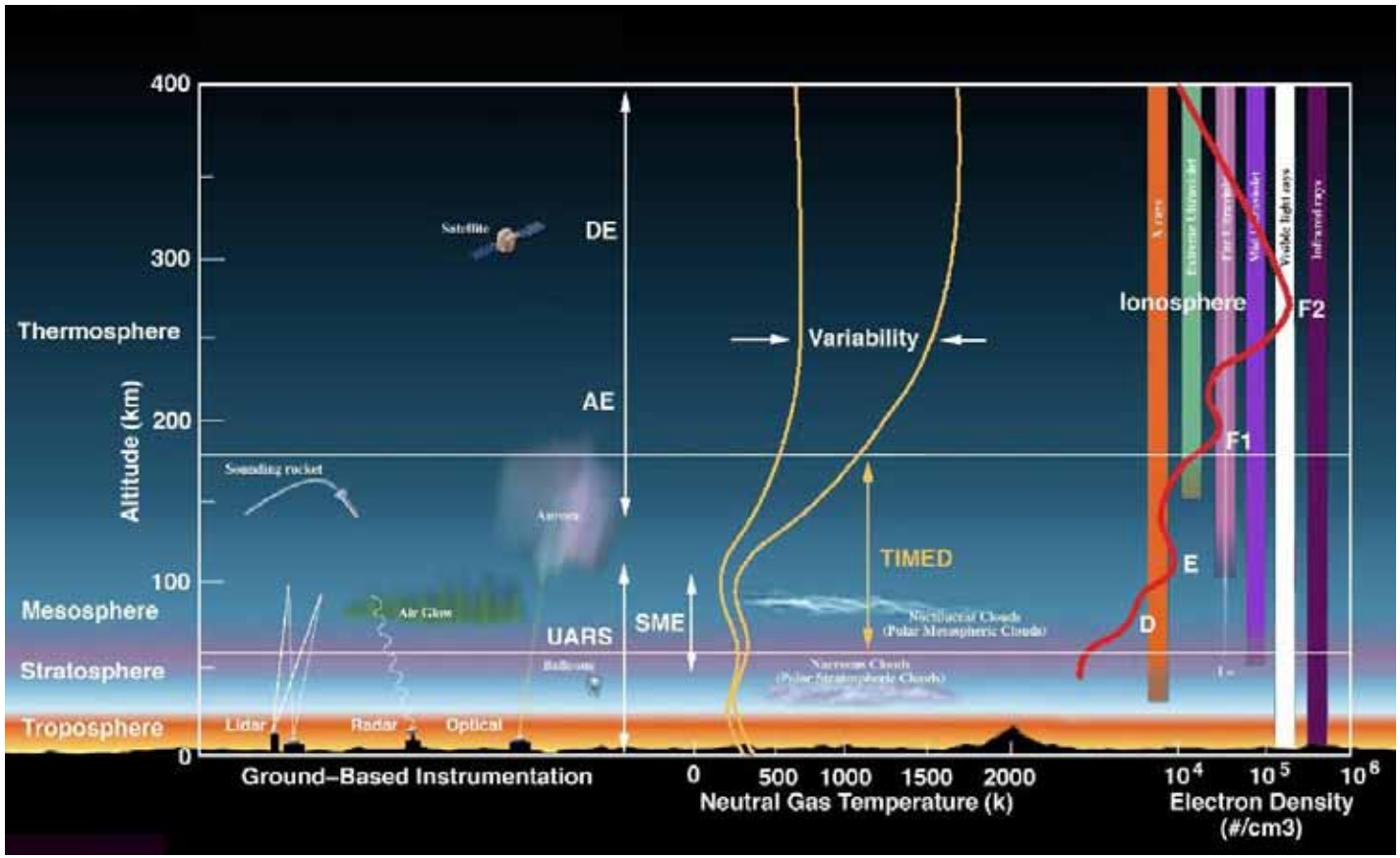
Other Important Elements

- **A “bottoms up” Phased Strategy**
- **Annual Community Meetings**
- **CEDAR Postdocs (36 to date)**
- **The CEDAR Data Base**
- **Rules of the Road**
- **The CEDAR POST Newsletter**
- **Opportunities to plan and report on science: 24 Science Workshops in 2004!**

CEDAR as Progenitor?

- GEM, Shine, and Sunrise
- TIMED
- TIMED-CEDAR
- WITS, STEP
- NSWP
- EPCO, PCO, AMISR
- NCAR’s 2001 Strategic Plan
- NASA’s 2005 SSSC Roadmap

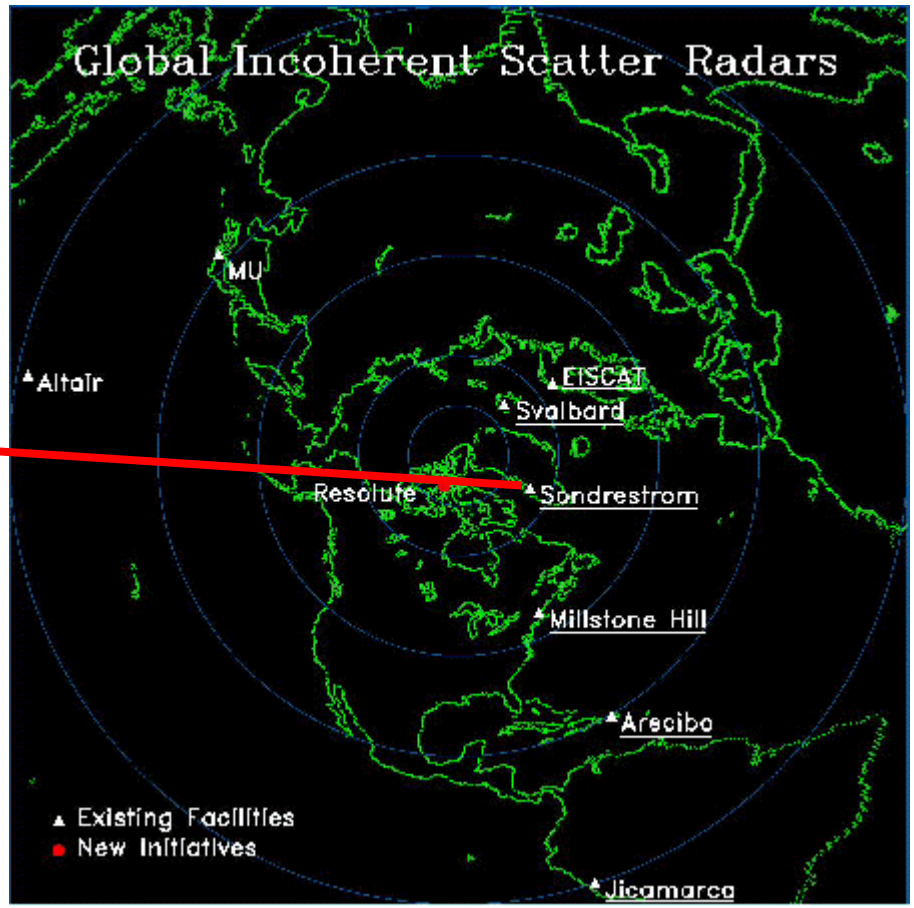
Scientific Results



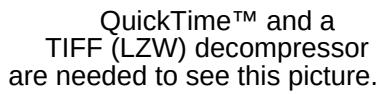
Approach: Integration and Synthesis: observations, theory, and modeling

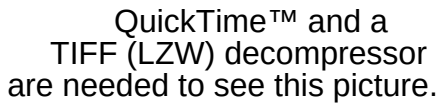
Radar “Observatory Chain”

Sondre Stromfjord, Greenland

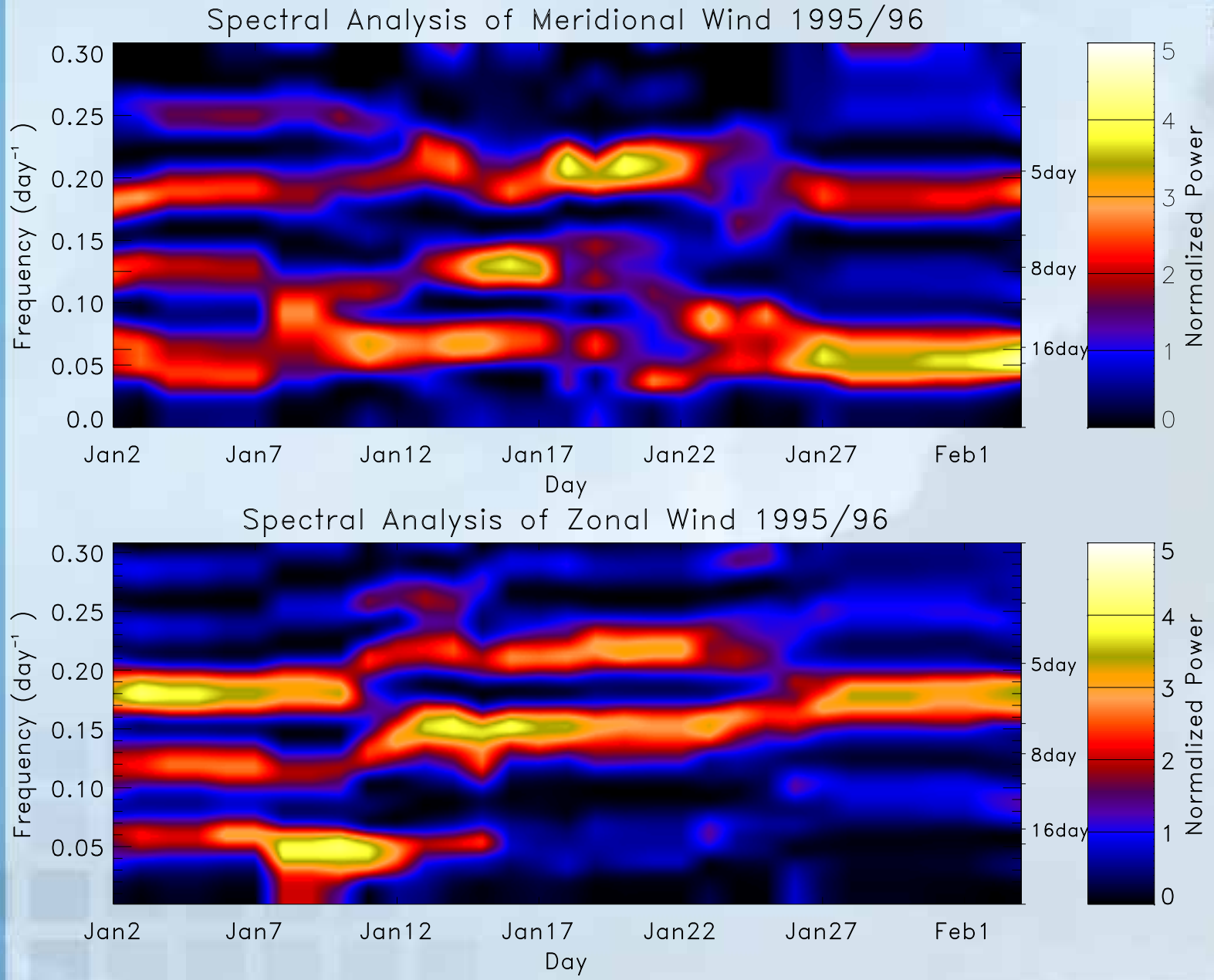


Radar and Optics

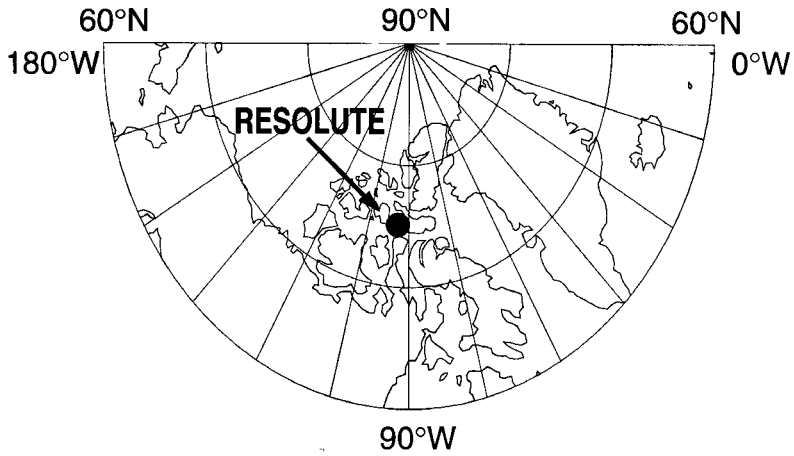




Resolute Bay Mesopause: Tidal Signatures Come and Go

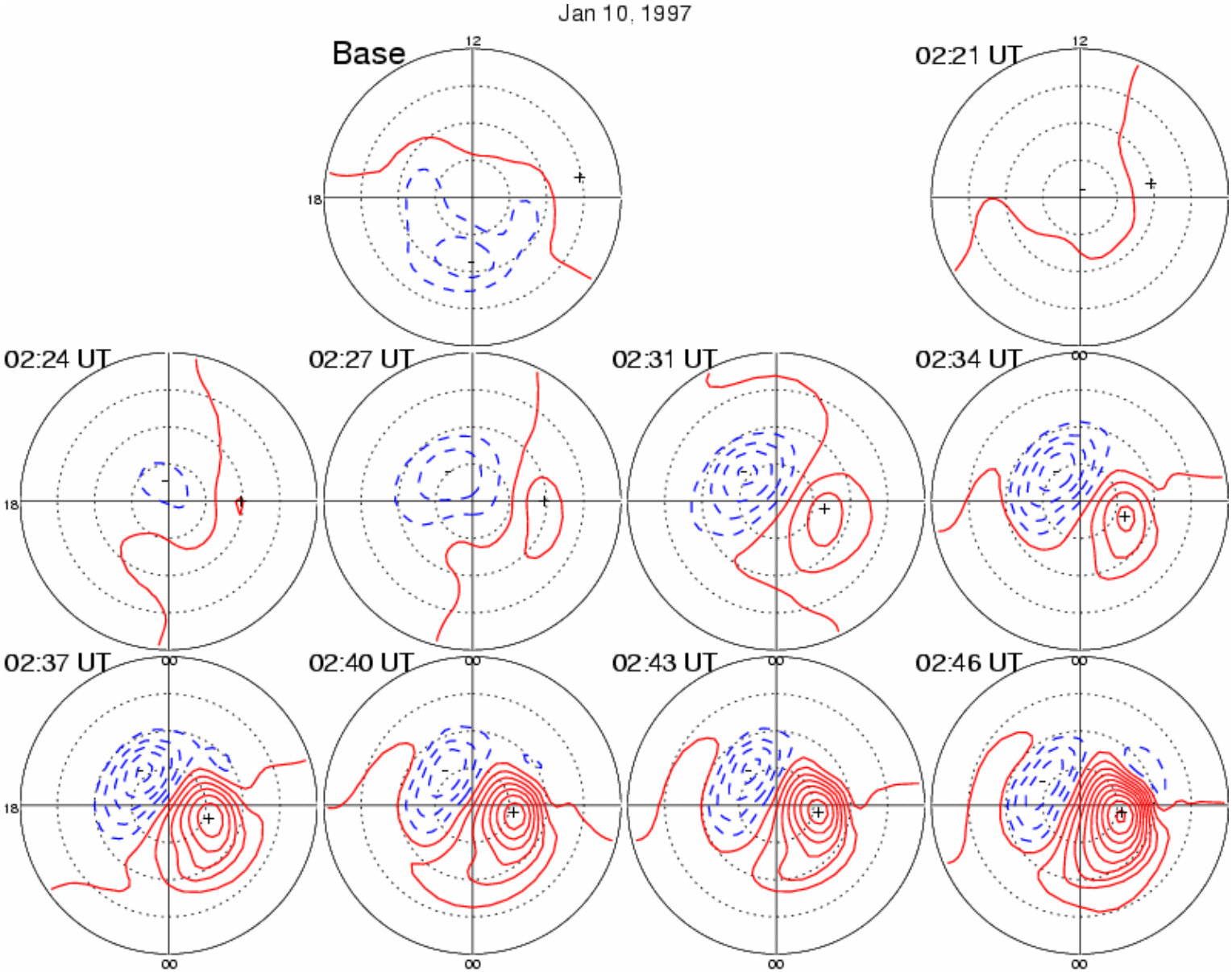


Ground-based Optical:
Early Polar Cap Observatory



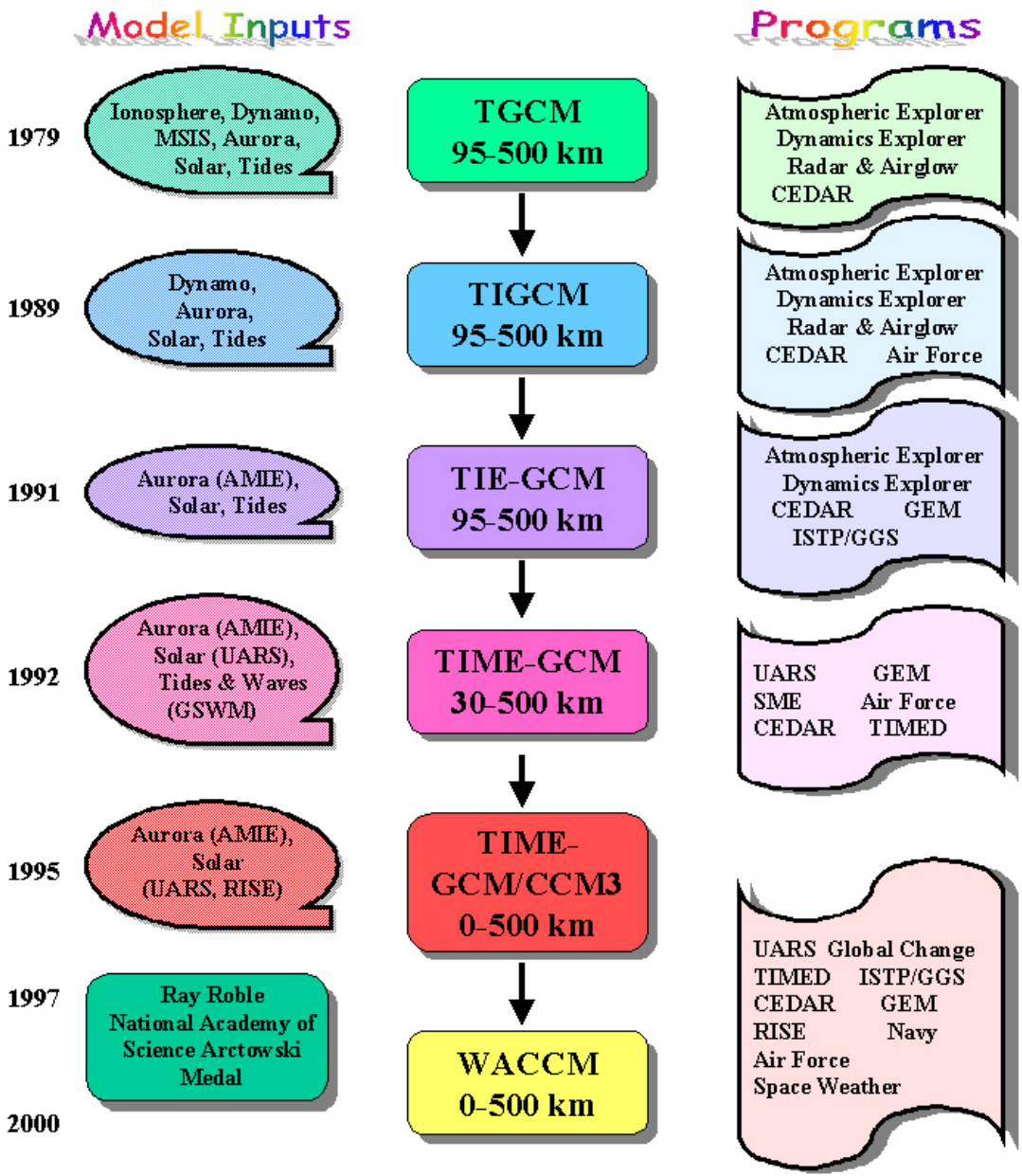
QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

AMIE Residual Convection Patterns



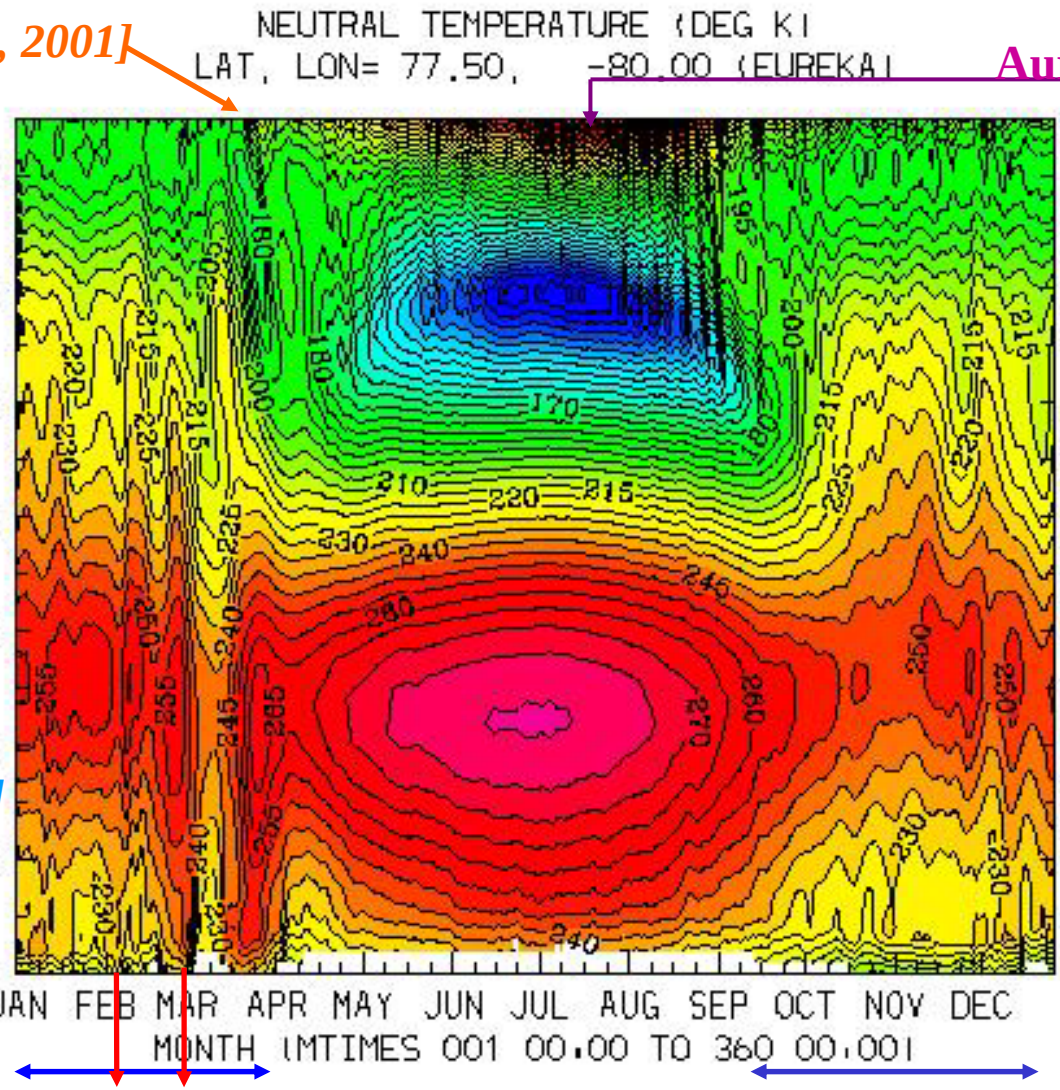
Gang Lu

Long-R ment



Ray Roble, Arthur D. Richmond, et al.

Storm effects.
[Hartsough et al, 2001]



Aurora forcing

Mesopause change

Tides/Planetary wave Interaction.
[Hagan and Roble,2001]

Stratospheric sudden warming.
[Walterscheid et al, 2000]
[Liu and Roble, 2001]

Large variability during winter.
Equinox transition *[Liu et al, 2001]*

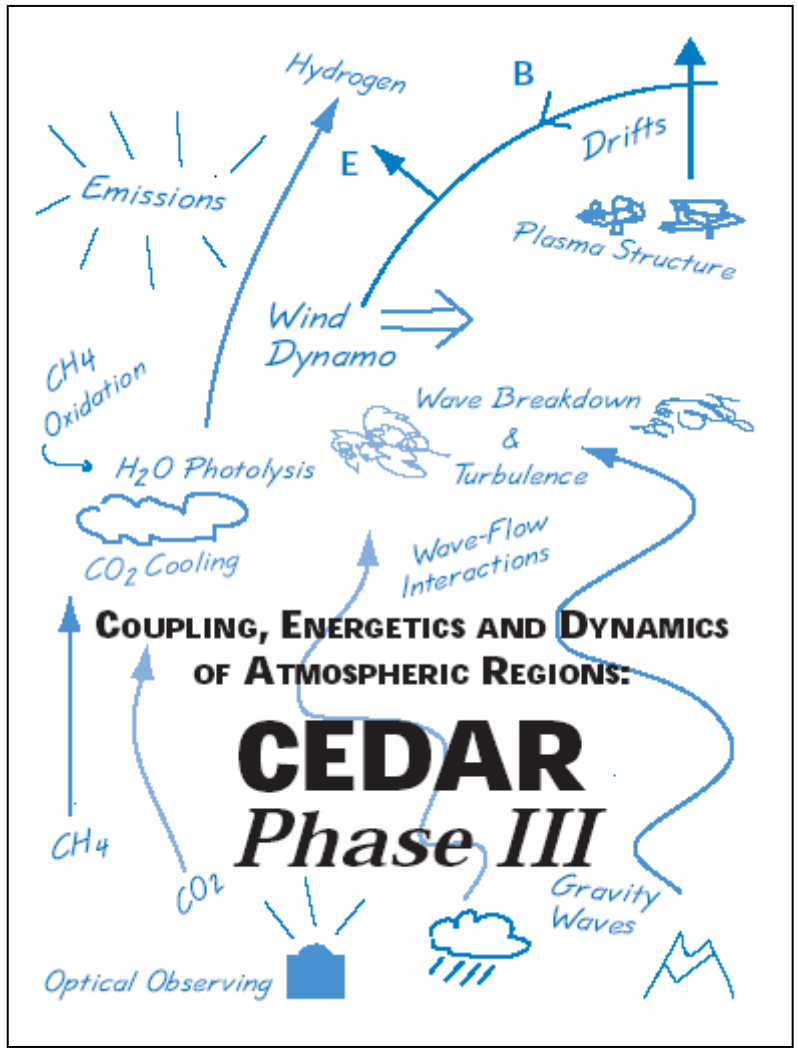
Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics

Goals are to:

• Quantify the mean state and variation of the mesosphere and lower thermosphere (from ~50 to ~200 km).
• Measure the energy balance of this region of the atmosphere.
• Understand its chemical and dynamical response to solar, auroral, tidal, and anthropogenic forcing.

CEDAR "Phase III" Agenda

- Phase I: Coordination and Exploratory
- Phase II: New Research Capabilities
- Phase III: Science Foci
  - Coupling with Lower Altitudes
  - Solar-Terrestrial Interactions
  - Polar Aeronomy
  - Long-Term Variations



Jeff Forbes, 1995 SSC Chair

The Old Crows: A Fable™

Once upon a time a bunch of wise crows  were unhappy with the amount of grain they were getting because they had to fly across the road to eat, while another group lived on the same side of the road as the grain. They felt like they were an endangered species

So, they decided to get together and convince the farmer to dump grain on both sides of the road according to the area and number of crows. So they started a program: Grain Based on Area or “GBOA”

™ - Fable originally developed by Gerry Romick for 10th anniversary

The Old Crows: A Fable™

While they were developing the plan a few even wiser crows said “If we can get the crows on the other side of the road to join us we can get the farmer to add grain to both sides and we will both have a bigger supply.

So, they invited the cousin crows to join in and created a new, larger program called:
“Creative Efforts to Develop Agricultural Rewards”

Now, you ask, why would farmers go along with this plan?



The Old Crows: A Fable™

It turned out that the farmers belonged to an organization called:
“Nurture Selected Farmers”
And could use the program to increase the subsidy for the preservation of Crows.

So the farmers were overjoyed with the program and the crows were happy and multiplied.

However, after a while a few of the wiser crows asked: what happens to the grain if the farmers’ subsidy is reduced because we are no longer endangered?

The Old Crows: A Fable™

Other young crows then came up with new ideas:
“Plenty of Crows to Organize”

Some other Starlings and Martins got together and convinced the farmers to investigate:
“Grand and Extremely Messy” problems associated with grain fertilization, growth and decay and general weird behavior (the framers were bewildered, but pleased to help out).

Then Crows, Starlings and Martins started up the “Northern/Southern Wheat Program”

The Old Crows: A Fable™

The crows merged the program:
"Creative Efforts to Develop Agricultural Rewards" with a new one for another group of farmers called the "Nutritional Agricultural Seed Association". The new program was called:
"Test in Manure for Everlasting Developments"

Finally one of the crows was actually able to infiltrate the key Farmer group and ensure lasting happiness and success.

The End

What are CEDAR Working Groups and Workshops?

- Grass roots efforts by scientists who are interested in CEDAR science.
- Kick-off workshops are held at the annual CEDAR meeting, advertised via newsletters, etc.
- Community response in the form of participation leads to growth and activity.
- Working groups fade away when their “time is up.”
- Working groups cover all aspects of CEDAR:
  - novel instrumentation
  - facilities
  - associations with other organizations
  - regional science
  - topical science
  - future science
  - data assimilation and modeling
  - student workshops

CEDAR Organization and Structure

National Science Foundation

Dr. Richard Behnke
Section Head, Upper Atmosphere Research Section (GEO/ATM)

Dr. Robert Kerr
Program Director, Aeronomy
NSF GEO/ATM

Dr. Robert Robinson
Program Manager, Upper Atmospheric Facilities
NSF GEO/ATM

CEDAR Science Steering Committee

Chair: Sixto González

$\sum_{i=1}^{many}$ Working Groups$_i$, Host CEDAR Workshops

"grass roots efforts"

Student Mentoring and Participation

Organize CEDAR Annual Meeting

Generate CEDAR Documents

Community Generated Reports, i.e., LIDAR Report, etc.

Science Results Initiatives

Jan Sojka