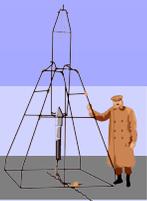


3DRT and I3RC – the Future.

Bob Cahalan

Climate&Radiation Branch, NASA/Goddard

- *Achievements include* – **Documented precision, diversity, education:**
 1. *RAMI overview, Pinty et al.*, JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 109, D06210, doi:10.1029/2003JD004252, 2004.
 2. “I3RC: Bringing Together the most advanced RT tools for cloudy atmospheres,” *Cahalan, Oreopoulos, Marshak, Evans, Davis, Pincus, Yetzer, Mayer, Davies, I3RC participants, Bull. Amer. Meteor. Soc.* 86 (9), 1275-1293, September 2005.
 3. Papers by several participants on a variety of 3DRT applications. (6 from Goddard in 2005, so far)
 4. *3DRT in cloudy atmospheres*, Springer, A.Marshak&A.Davis, eds, 656pp. multiple chapter authors.
- **Remote Sensing Applications:** *Coordinated support needed to fully exploit 3DRT!*
- **Funding/Open Source:** *I3RC renewed by NASA*, but *not by DOE* : 3D satellite retrievals, new cases w/ multiple satellite instruments MODIS, MISR, and ASTER, and aircraft THOR, & I3RC **Open Source Initiative**, w/ *first release 20 July, 2005*. **RAMI renewed by EC**: New RAMI website completed, with tools for proper formatting of submitted input. Includes Phase 3 RAMI cases. New I3RC web began development in August 2005, will include Phase 3 I3RC cases.
- **I3RC-3 Workshop:** *10-14 Oct 2005, Uni. Kiel, 3DRT Retrievals, Open Source, Science Applications.*
48 participants, from 10 countries (Europe 23, USA 19, Russia 3, Canada 2, Japan 1).
- **IUGG-07-Perugia:** Proposed session “3D Radiative transfer in Complex Geophysical Media, including Clouds, Vegetation, Ice and Snow”



Phase I fields

Case

CASE 1 CASE 2 CASE 3

Experiment

- Solar Zenith=0, SSAIbedo=1
- Solar Zenith=60, SSAIbedo=1
- Solar Zenith=0, SSAIbedo=0.99
- Solar Zenith=60, SSAIbedo=0.99
- Solar Zenith=60, SSAIbedo=1, sfcIbedo=0.4, Phasefunc=HG
- Solar Zenith=0, SSAIbedo=1, sfcIbedo=0, Phasefunc=C1
- Solar Zenith=60, SSAIbedo=1, sfcIbedo=0, Phasefunc=C1
- Solar Zenith=60, SSAIbedo=1, sfcIbedo=0.4, Phasefunc=C1

Information

Plot Type X-Y Plot 2D Plot Participants

Completion Status Row 1

Select Participants to show on graph

<input type="radio"/> ARIZ	<input type="radio"/> COLS	<input type="radio"/> IAOT
<input type="radio"/> KIAE1	<input type="radio"/> ...	<input type="radio"/> ...
<input type="radio"/> LANL2	<input type="radio"/> ...	<input type="radio"/> MESC1
<input type="radio"/> MESC2	<input type="radio"/> NCAR	<input type="radio"/> PENN
<input type="radio"/> PNNL	<input type="radio"/> UCOL1	<input type="radio"/> UCOL2
<input type="radio"/> UCSB	<input type="radio"/> UMBC1	<input type="radio"/> UMBC2
<input type="radio"/> UMBC3	<input type="radio"/> ...	<input type="radio"/> UNIK
<input checked="" type="radio"/> ALL PART.	<input type="radio"/> Conmean	<input type="radio"/> Conmean-App
<input type="radio"/> Conmean-Out		

Variable

- Reflectance (R)
- Transmittance (T)
- Absorptance (A)
- Net Horizontal Flux (H)
- Nadir Reflectivity (Iu)
- Reflectivity, View=60, Azi=0 (I601)
- Reflectivity, View=60, Azi=180 (I602)
- Zenith Transmissivity (Id)

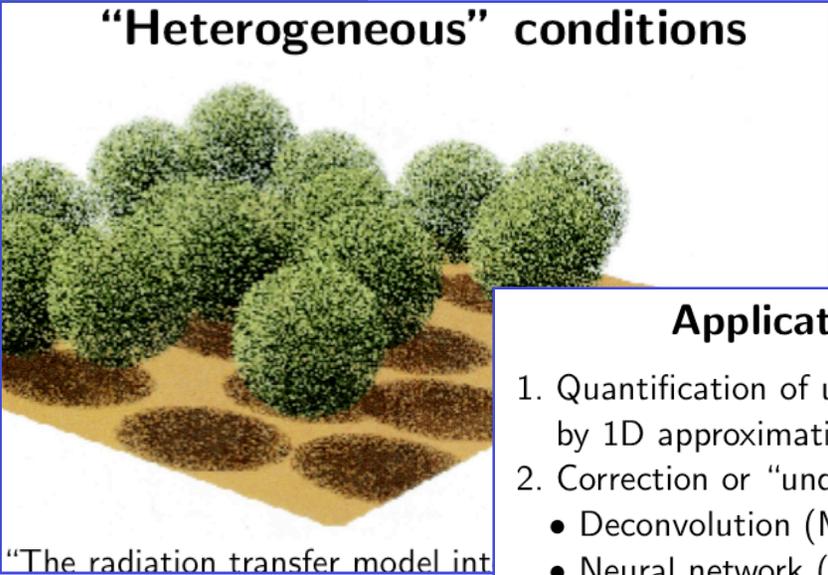
Orientation of X-axis Labels

- Vertical X-axis Labels
- Horizontal X-axis Labels

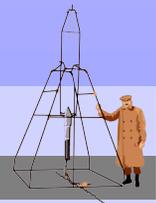
Create Image Dump image to EPS

i3rc.gsfc.nasa.gov
rami-benchmark.jrc.it
jeanluc.widlowski@jrc.it

Needed: Unified 3DRT web
 CLIVAR MIP list: meehl@ucar.edu



- Applications: remote sensing**
1. Quantification of uncertainties introduced by 1D approximations
 2. Correction or “undoing” of 3D effects:
 - Deconvolution (Marshak et al. 1998)
 - Neural network (Faure et al. 2002)
 - Iterative retrieval (Zinner, 2004)
 3. Explicit use of 3D structure
 - Off-beam lidar (Cahalan, Davis)
 - In-situ Lidar (Evans, 2003)
 - Spherical clouds

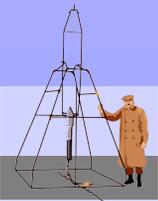


Future *Phase 3* Activities

- *Goals* – *Accuracy, Precision, Diversity, Flexibility, Rapidity, Scalability, Education.*
Specific Goals of individual research groups: Reduce uncertainties in ARM retrievals of cloud vertical profiles arising from their sensitivity to cloud particle size; Determine the global radiative impact of cloud inhomogeneity; design new instruments and/or new measurement configurations that take advantage of 3D; ...
- *Needs & Plans* – New cases, *I3RC Community Code, Extensions, Applications, Speed, Continuing Education.*
- *OTHER Tools Needed* – Integrated (I3RC-RAMI) Accessible Web tools, Automated Intercomparison, Databases (cloud, vegetation, terrain, ice/snow, ...), build on existing 1DRT, e.g. CRTM site @ <http://www.orbit.nesdis.noaa.gov/smcd/spb/CRTM/>
- *Applications* – 3DRT is a **UNIFIER** (cloud, vegetation, terrain, ice/snow, ...)
- *Visions of the Future* – Retrieval system: multiple instruments, angles, wavelengths, polarizations; 3D-corrected: cloud - aerosol - surface properties; high resolution cloud & ice/snow thickness; global & regional Energy/Water/Carbon budgets.
- *What have others said about the future?*



What *Others* have said about the Future.



What *Others* have said about the Future.

"The biggest lesson in business is that it's going to be a rollercoaster."

-- Marc Andersson, founder of Netscape

"Predictability: Does the Flap of a Butterfly's Wings in Brazil set off a Tornado in Texas?"

-- Ed Lorenz, 1972 AAAS Meeting

"It's rough to make predictions, especially about the future."

-- Casey Stengel, Yogi Berra, Niels Bohr.

"There are two classes of people who tell what is going to happen in the future: Those who don't know, and those who don't know they don't know."

-- John Kenneth Galbraith

"It may happen that small differences in the initial condition produce very great ones in the final phenomena. A small error in the former will produce an enormous error in the latter. Prediction becomes impossible, and we have the fortuitous phenomenon."

-- Poincaré

"People demand freedom of speech to make up for the freedom of thought which they avoid."

-- Soren Aabye Kierkegaard

"if at one time, we knew the positions and speeds of all the particles in the universe, then we could calculate their behaviour at any other time, in the past or future."

-- Laplace, as paraphrased by Stephen Hawking

"A credulous man is a deceiver: as we see it in fame, that he that will easily believe rumours will as easily augment rumours and add somewhat to them of his own; which Tacitus wisely noteth, when he saith, Fingunt simul creduntque: so great an affinity hath fiction and belief."

— Francis Bacon, "Advancement of Learning," 1605.



International Polar Year - 2007

Observations Working Group (OWG)

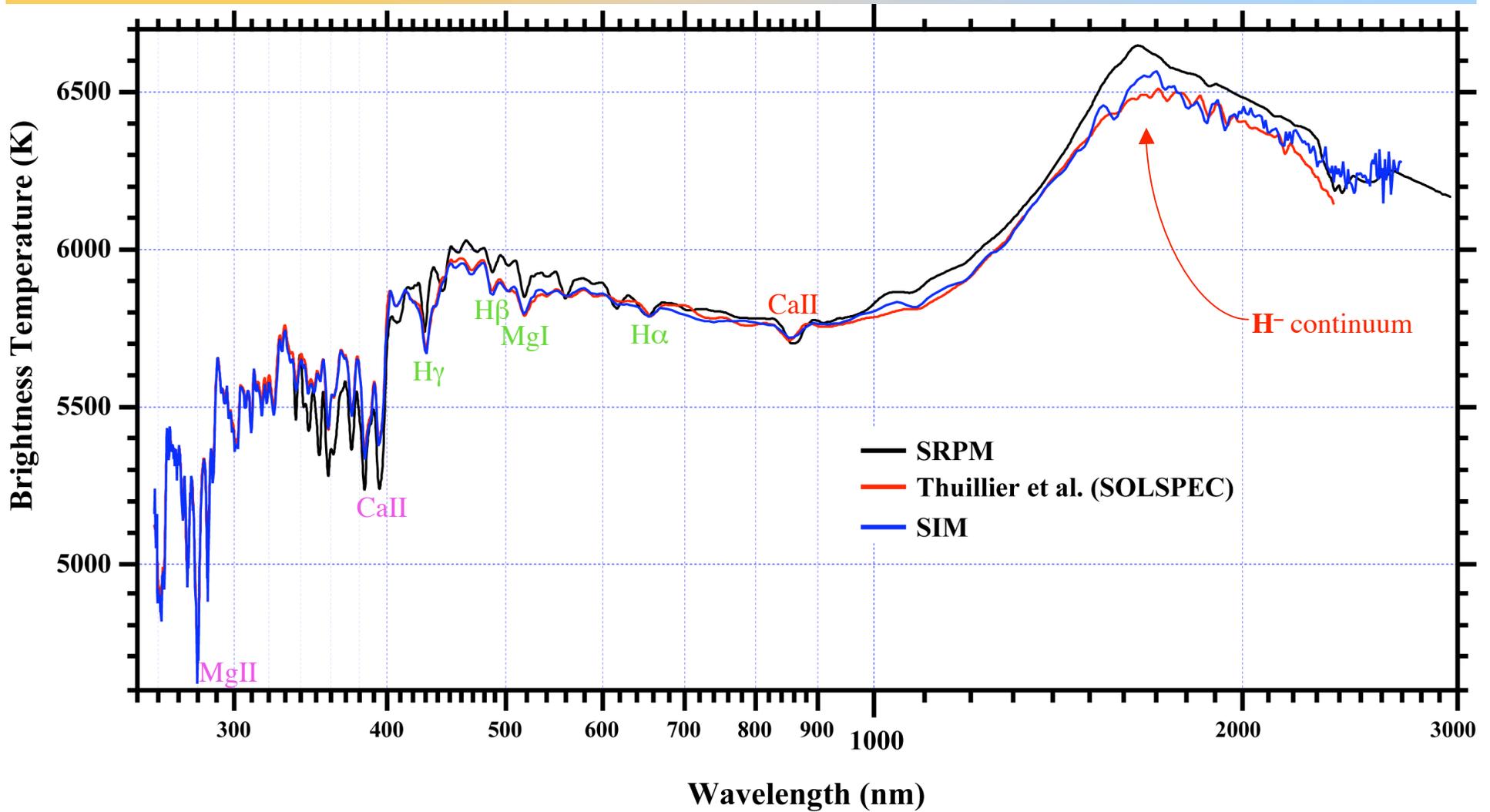
- *An international program of coordinated research to explore the polar regions, deepen understanding of polar interactions including their role in global climate, expand our ability to detect changes, and extend this knowledge to the public and decision makers. (ICSU IPY Planning Group4 and NAS US National Committee on IPY, 2004)*
- Key elements
 - **Assess** large-scale polar environmental change
 - **Explore** unknown domains in the polar regions
 - Advance uses of **technology** to enable innovative polar observations
 - Increase **public understanding** of and participation in polar science (Website: <http://www.ipy2007.org>)
- Participating **Agencies**: NSF, NASA, NOAA, DOI, DOE, DOD, EPA, NIH...
International coordination: ICSU, WMO.
- Focus on **human impact** of polar environmental changes and impact of human changes on physical environment
- **Polar feedbacks** are a near-term CCSP priority
- Relates to impacts on **sea level**

International Heliophysical Year - 2007 Observations Working Group (OWG)

- *TSI - an undervalued CCSP observation?*
 - "If there is any ONE parameter I would like to know better, it would be how much the **energy from the Sun** is varying." Ray Bradley, Umass, co-author of "Hockey Stick" plot of 1000-2000 AD global temperatures."
- *IHY: To advance understanding of the processes that govern the Sun, Earth, Planets, and Heliosphere*
- Description - Involves cross-disciplinary studies from
 - Solar Physics
 - Planetary Magnetospheres
 - Heliosphere and Cosmic Rays
 - Planetary Ionospheres, Thermospheres and Mesospheres
 - **Climate Studies**
- Agency and Programs involved
 - NASA, NSF
 - Participating countries across the globe, IUGG
 - Website: <http://ihy2007.org/>
- Coordinating with International Polar Year (IPY) and electronic Geophysical Year (eGY)

SIM – Spectral Irradiance Monitor

Jerry Harder, SIM Instrument Scientist, UCO/LASP



What *Others* have said about the Future.

After the eclipse on 28 May, 585 BC Herodotus wrote:

" ... day was all of a sudden changed into night. This event had been foretold by Thales, the Milesian, who forewarned the Ionians of it, fixing for it the very year in which it took place. The Medes and Lydians, when they observed the change, ceased fighting, and were alike anxious to have terms of peace agreed on."

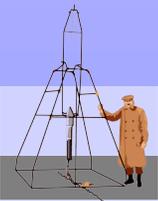
Some *doubted* that Thales predicted the eclipse. writing:

" ... a more likely explanation seems to be simply that *Thales happened to be the savant around at the time* when this striking astronomical phenomenon occurred, and the assumption was made that as a savant he must have been able to predict it."

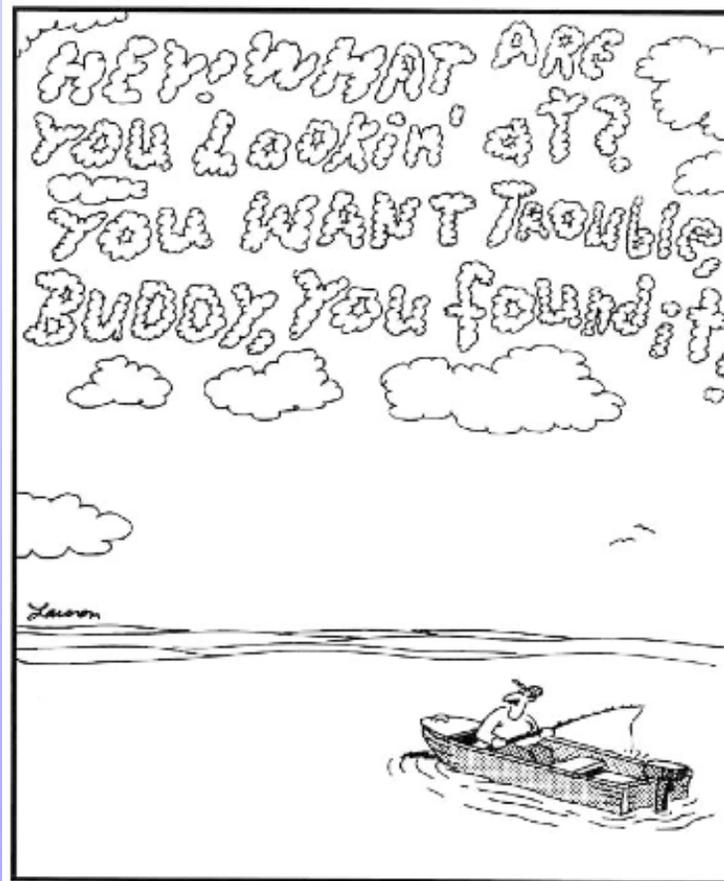
-- The Athens Times, April 1, 584 BC

"One night Thales was gazing at the sky as he walked and fell into a ditch. A pretty servant girl lifted him out and said to him "How do you expect to understand what is going on up in the sky if you do not even see what is at your feet?" "

-- Plato (paraphrased)



What *Others* have said about the Future.



Understanding only German, Fritz was unaware that the clouds were becoming threatening.

