

A satellite with gold-colored panels and blue solar arrays is shown in orbit above the planet Venus. The planet's surface is a hazy, brownish-orange color. The background is black space. The title text is overlaid on the planet's surface.

# Venus Education & Public Outreach

**Ms. Rosalyn A. Pertzborn**

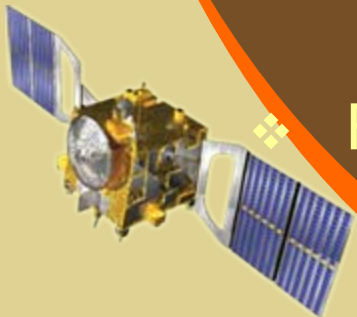
Director, Office of Space Science Education  
University of Wisconsin-Madison  
Space Science & Engineering Center

Presented by:  
Dr. Sanjay S. Limaye

# Presentation Overview

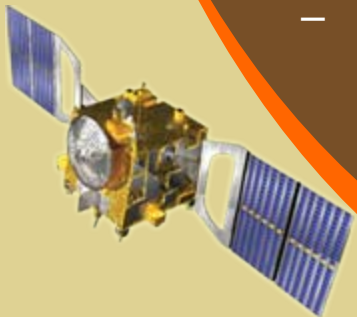
- ❖ Venus E/PO (May 2006-May 2007)
- ❖ Accomplishments
  - Public Outreach
  - Informal Education
  - Formal Education
- Findings
- Recommendations
- ❖ Why Venus?
  - Scientific community has identified major unanswered questions
  - Why are these questions relevant for affective Venus E/PO?
  - Next Steps

## ❖ Future Events



# Venus E/PO: Introduction

- ❖ ESA's Venus Express first mission since Magellan to investigate our nearest neighbor solar system neighbor.
- ❖ Other planetary exploration programs (such as Mars) have dedicated E/PO programs
- ❖ A dedicated E/PO effort focusing on Venus was developed in conjunction with VEX (Pertzborn, PI)
- ❖ Funding level extremely modest by comparison. Effort developed, implemented and sustained by:
  - Leveraging ongoing programs/activities
    - Native American initiatives (UW Baldwin Foundation; “One Sky; Two Views” )
    - Small Museum Program (NASA ROSES)
    - Visiting Scientist Program (UW, NASA ROSES)
  - Working with established partners
    - University of Hawaii (Astronomy/Astrobiology Learning Institute)
    - Lawrence Livermore Laboratory (Livermore Unified School Districts)
    - Amateur Astronomy Community
  - Exploit existing, infrastructures, formats, models & materials
    - Europlanets Conference
    - International School partnerships (Brussels, Belgium)



# Venus E/PO: Accomplishments

## ❖ Public Outreach

- Dedicated website: <http://venus.wisc.edu>
- News and Events regularly updated

**Venus Express**  
Education & Public Outreach

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### News & Events

#### News & Features

**Bright Spot on Venus: Weather ?**  
[ August 2009 ] On July 19, 2009, Frank Melillo took a picture of Venus through an ultraviolet filter from his backyard in Holtsville, New York state and saw a bright spot near the limb, almost at the same time as the first picture of the recent impact on Jupiter taken by an amateur in Australia (Anthony Wesley)... [Full Story »](#)

**Venus at its 8-Year Best**  
[ March 2009 ] On March 27th, our sister planet will be at inferior conjunction - as close as it will come this year to being directly between us and the Sun. As that date approaches the crescent seems too thin to be real, and it sports exotic cusp extensions... [Full Story »](#)

**Article on Venus' vortex circulation published in Geophysical Research Letters (GRL)**  
[ February 2009 ] Using an idealized nonlinear and nondivergent barotropic model, Limaye et al. show that these S-shaped features are the manifestations of barotropic instability... [Full story »](#)

**Watching Venus glow in the dark**  
[ February 2009 ] ESA's Venus Express spacecraft has observed an eerie glow in the night-time atmosphere of Venus. This infrared light comes from nitric oxide and is showing scientists that the atmosphere of Earth's nearest neighbour is a temperamental place of high winds and turbulence... [Full story »](#)

**ESA extends missions studying Venus magnetosphere**  
[ February 2009 ] ESA's Science Programme Committee

#### Featured News

[ August 2009 ]  
**Weather on Venus?**

On July 19, 2009, Frank Melillo took a picture of Venus through an ultraviolet filter from his backyard in Holtsville, New York state and saw a bright spot near the limb, almost at the same time as the first picture of the recent impact on Jupiter taken by an amateur in Australia (Anthony Wesley). Frank was imaging Venus based on an alert to the amateur astronomers put out through ALPO (Association of Lunar and Planetary Observers) that some Venus volcanoes were going to be approaching the terminator.

ACORN	
Frank J. Melillo	Paul Neeson
	
July 19, 2009 13:55 UT CIV (Aurora) 248 CIV (Aurora) 248 - 260°	July 20, 2009 15:50 UT CIV (Aurora) 254 CIV (Aurora) 254 - 260°
Location of an impact with acid	
	
CIV (Aurora) 171 - 187° Latitude: 45°N-62°	CIV (Aurora) 164 - 190° Latitude: 57°

Surprisingly, Frank's image showed a brighter than usual spot in the southern hemisphere, far away from the volcanoes. The bright spot in Frank's image and two others were also captured in an image taken about 10.5 hours earlier by George Tasourdis.

Fortunately, the Venus Monitoring Camera (VMC) built at the Max Planck Institute for Solar System Research

# Venus E/PO: Accomplishments, continued...

## ❖ Major Events:

- Significant Public Attention for “Venus Cloud Brightening Event”



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### News Features

#### [Weather on Venus?](#)

On July 19, 2009, Frank Melillo took a picture of Venus through an ultraviolet filter from his backyard in Holtsville, New York state and saw a bright spot near the limb, almost at the same time as the first picture of the recent impact on Jupiter taken by an amateur in Australia (Anthony Wesley). Frank was imaging Venus based on an alert to the amateur astronomers put out through ALPO (Association of Lunar and Planetary Observers) that some Venus volcanoes were going to be approaching the terminator.

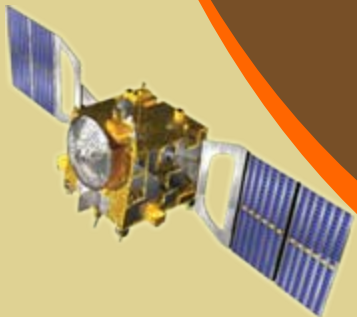
Surprisingly, Frank's image (Figure 1) showed a brighter than usual spot in the southern hemisphere, far away from the volcanoes. The bright spot in Frank's image and two others were also captured in an image taken about 10.5 hours earlier by George Tasourdis (Figure 1, right image)

Fortunately, the Venus Monitoring Camera (VMC) built at the Max Planck Institute for Solar System Research (Katlenburg-Lindau, Germany) for European Space Agency's Venus Express Orbiter was monitoring Venus during this period. VMC images on July 19th indeed show about 30% brighter than usual "spot" ~1000 km in size located at ~50°S (Figure 2). This bright region appears in one of the southern streaks seen almost every day on Venus which characteristically spirals towards the pole as a part of hemispheric vortex centered on the pole.



Observer	Date	Time (LT)	Filter	Location (Lat/Lon)
Frank J. Melillo	July 19, 2009	19:10	CM I (Alrosa UV) - 185	Lat: -15 to 40°
Paul Maxson	July 20, 2009	13:50	CM I (Alrosa UV) - 250°	Lat: 0 to 80°
George Tasourdis	July 19, 2009	02:52	CM I (Alrosa UV) - 163	Lat: -15 to 40°

© 2009 European Space Agency



# Venus E/PO: Accomplishments, continued...

- ❖ Web search result shows unprecedented level of public interest in the “Bright Spot on Venus” Event (277,000).
- ❖ Venus.wisc.edu website updates reflect this interest!!!



Google   [Advanced Search](#)  
 Search the Web  Search Chinese (Traditional) and English pages

Web [+ Show options...](#) Results 1 - 10

[Mysterious bright spot found on Venus - space - 29 July 2009 - New ...](#)  
Jul 29, 2009 ... An amateur astronomer found a new **bright spot on Venus** last week – volcanic activity, atmospheric turbulence, or charged particles from the ...  
[www.newscientist.com/.../dn17534-mysterious-bright-spot-found-on-venus.html](#) - [Cached](#) - [Similar](#) - [🗉](#) [🔗](#) [🗕](#)

[Bright Spot on Venus Stumps Scientists | LiveScience](#)  
Jul 30, 2009 ... **Bright spot** appears in **Venus'** clouds; cause unknown.  
[www.livescience.com/space/090730-venus-bright-spot.html](#) - [Cached](#) - [Similar](#) - [🗉](#) [🔗](#) [🗕](#)

[A new bright spot on Venus](#)  
Jul 21, 2009 ... An intense **bright spot** has appeared in the clouds of **Venus**. Could it be associated with volcanic activity on the surface? ...  
[www.astronomynow.com/news/n0907/21venus/](#) - [Cached](#) - [Similar](#) - [🗉](#) [🔗](#) [🗕](#)

[Bright Spot on Venus Stumps Scientists](#)  
Jul 31, 2009 ... A sudden **bright spot** that appeared in the clouds of **Venus** just days after a comet left a bruise on Jupiter has scientists stumped as to its ...  
[digg.com/space/Bright\\_Spot\\_on\\_Venus\\_Stumps\\_Scientists](#) - [Cached](#) - [Similar](#) - [🗉](#) [🔗](#) [🗕](#)

[Skymania News | Space headlines: Now a bright spot appears on Venus](#)  
Jul 21, 2009 ... Photos of **Venus** with **bright spot** Images of **Venus** taken by Frank Melillo with a 10-in Meade telescope. The surface cannot be seen directly ...  
[news.skymania.com/.../now-bright-spot-appears-on-venus.html](#) - [Cached](#) - [Similar](#) - [🗉](#) [🔗](#) [🗕](#)

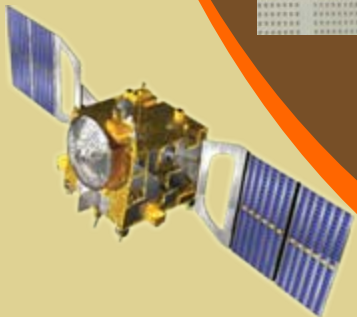
[Bright Spot Found On Planet Venus](#)  
Jul 31, 2009 ... This is not the first time astronomers have spotted **bright** features in **Venus's** atmosphere. **Bright spots** have been seen from Earth for ...  
[www.impactlab.com/.../bright-spot-found-on-planet-venus/](#) - [Cached](#) - [Similar](#) - [🗉](#) [🔗](#) [🗕](#)

[BBC NEWS | Science & Environment | Experts puzzled by spot on Venus](#)  
Aug 1, 2009 ... Another potential source for the **bright spot** are charged particles from the Sun interacting with **Venus's** atmosphere. ...  
[news.bbc.co.uk/2/hi/8179067.stm](#) - [Cached](#) - [Similar](#) - [🗉](#) [🔗](#) [🗕](#)

[Experts Puzzled By Bright Spot In Venus's Clouds » Propeller](#)  
Astronomers have been puzzled by a strange **bright spot** which has appeared in the clouds of **Venus**.  
[www.propeller.com/.../experts-puzzled-by-bright-spot-in-venus39s-clouds/](#) - [Cached](#) - [Similar](#) - [🗉](#) [🔗](#) [🗕](#)

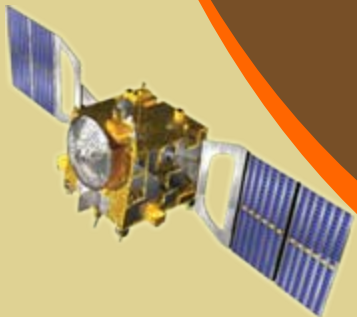
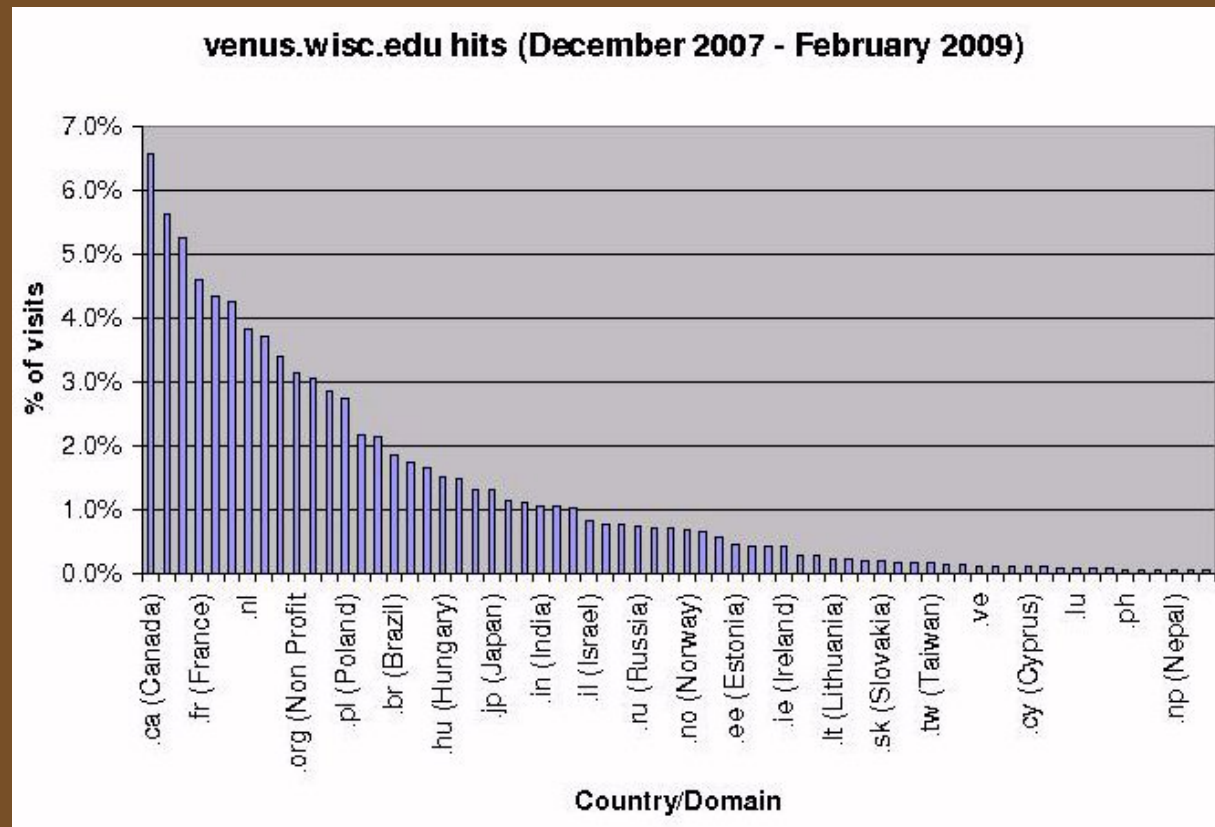
# Venus E/PO: Accomplishments, continued...

## ❖ Public & International Lectures



# Venus E/PO: Accomplishments

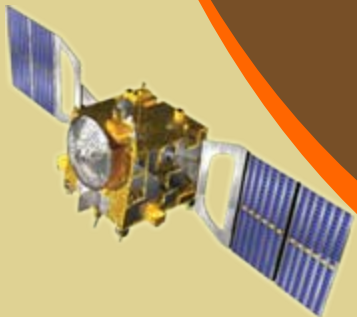
- ❖ Percentage of all hits on venus.wisc.edu from December 2007 through February 2009 below
- ❖ Majority of request from US Education Institutions (.edu)



# Venus E/PO: Accomplishments, continued...

## ❖ Informal Education: Summary of Activities/Events

- Public Presentations
- Visiting Scientists
- Multi-Cultural Events
- Amateur Astronomy
- Small Kiosk for:
  - Libraries
  - Science Center
  - Small Museums





**Venus Express**

**Education & Public Outreach**

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### Venus Express Education & Public Outreach Events

Note: 1) you can review event details by clicking on each event Date. 2) Event table can be sorted by Date or Presenter(s).

Past Events

Date ▼	Event Name	Activities	Activity Title	Presenter(s)	Location
7 Jul 2009	<a href="#">Astrobiology Learning Institute for Instructors (ALII)</a>	Lecture / Hand-On / Using Venus cloud tracking curriculum	Presentation on habitable worlds and Venus Cloud tracking Curriculum training	Dr. Sanjay Limaye	Honolulu, Hawaii USA
9 May 2009	<a href="#">Madison Astronomical Society Monthly Meeting</a>	Lecture	Solar System Exploration Update	Sanjay Limaye	Madison, WI USA
28 Apr 2009	<a href="#">Popular Science Lecture</a>	Lecture	Exploration of Venus with Venus Express	Sanjay Limaye	Ahmedabad, Gujarat India
6 Apr 2009	<a href="#">MIT Atmospheric Science Seminar</a>	Lecture	Venus Atmospheric Circulation	Sanjay Limaye	Cambridge, MA USA
24 Feb 2009	<a href="#">Public Lecture</a>	Lecture / Lecture followed by sky gazing	Unveiling Venus	Dr. Sanjay Limaye	New Delhi, - India
5 Feb 2009	Visiting Scientist and Classroom Activity (in 6 classes)	Lecture / Hand-On	Cloud Tracking on Venus	Dr. Sanjay Limaye Hsuan-Yun Pi	Honolulu, HI USA
2 Feb 2009	Visiting Scientist and Classroom Activity (in 5 classes, grade 9-12)	Lecture / Audience Q/A / Hand-On	Tracking Clouds on Venus / Introduction to Venus and Venus Express Mission	Dr. Sanjay Limaye Hsuan-Yun Pi	Kee'au, Hawaii USA

# Venus E/PO: Accomplishments, continued...

## ❖ Informal Education

- Visiting Scientist & Public Presentations
  - “Wisconsin Idea” brings the University and its research to the community.

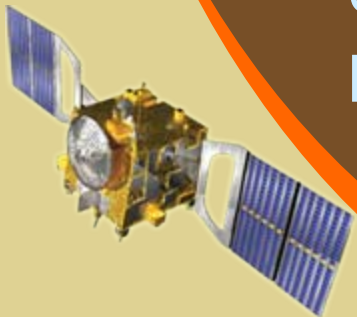
Public lecture  
at Lac Courte  
Oreilles Ojibwe  
Tribal School



# Venus E/PO: Accomplishments, continued...

## ❖ Informal Education

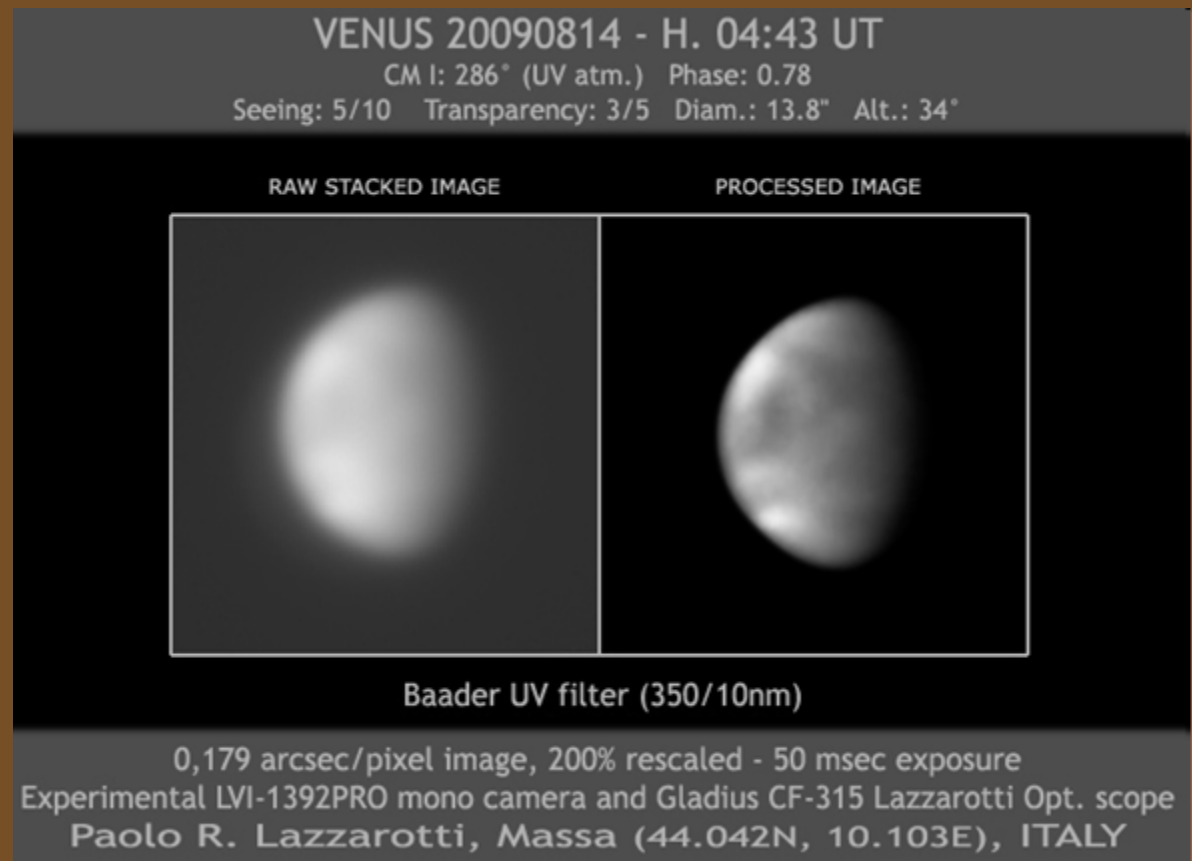
- “One Sky, Two Views”
  - Venus is very culturally significant for many Native American communities
  - Some “star stories” address:
    - What happened to water on Venus?(!!!)
  - Native knowledge demonstrates cognizance of planet’s climate evolution!



# Venus E/PO: Accomplishments, continued...

## ❖ Informal Education

- Significant involvement & contributions by Amateur Astronomy Community

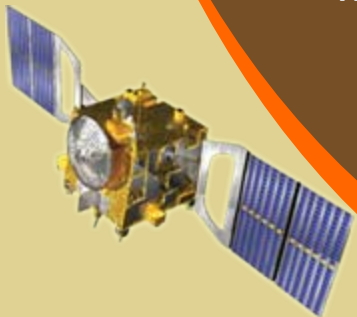


# Venus E/PO: Accomplishments, continued...

## ❖ Informal Education

- Small, easily portable Kiosk
- Interactive touch screen
  - Brings current data, imagery from our solar system to Rural, underserved locations.

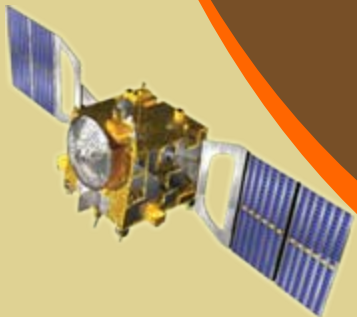
Teachers and Students  
“Explore Venus” at the UW-  
Madison Geology Museum  
using a portable kiosk.



# Venus E/PO: Accomplishments

## ❖ Formal Education

- Basic Curriculum Developed
- Teacher Training Workshops
- Curriculum Piloted in schools
- Grad & Undergrad student work experience



# Venus E/PO: Accomplishments, continued...

## ❖ Formal Education

- Teacher Training Workshops (4)
- Curriculum piloted by workshop participants
- Product development & revision based on Teacher Input/Recommendations
- Initial evaluation from teachers for classroom effectiveness very positive!



### Invitation to Teachers Workshop

Venus Express Education and Outreach  
Berlin, September 20, 2006



Image: ESA/VIRTIS/INAF-IASF/Obi. de Paris-LESIA

- Free resources
- Images
- Data
- All curricula



planet  
esa  
WISCONSIN  
NASA

### Welcome to our Mysterious Neighbour

A cross-curricula tool

Venus Express

The European Space Agency's Venus Express mission was successfully launched in November 2005 and has returned the most exciting data from Venus since the 1990 Magellan encounter.

This exciting mission is an excellent opportunity to engage students in the exploration of the Earth's sister planet along with scientists.

Classroom activities, targeting middle and high school students will use actual data to explore "The unsolved mysteries of Venus."

#### Workshop

- Introduction to the science objectives of the Venus Express mission, presented by members of the science team
- Demonstration of mission data for classroom use
- Ideas and exemplars for use across the curriculum
- Professional dialogue on effective use of mission material in the classroom
- Group publication of workshop results at Poster Session, Education and Outreach, International Astronomical Congress in Valencia in October 2006

RSVP before September 12th  
Olivier Witasse <owitasse@rssd.esa.int> &  
Rosalyn Pertzborn <rpertz@sec.wisc.edu>

Please indicate:  
Course, level, years taught, preferences for resources and expected outcomes.

Location  
Berlin Estrel Conference Center  
Sonnenallee 225  
12057 Berlin  
Germany

Date  
Wednesday 20 September, 8h30 - 10h45

Registration Fee  
45 Euros (on-site registration).

Conference Website  
<http://meetings.copernicus.org/epsc2006>

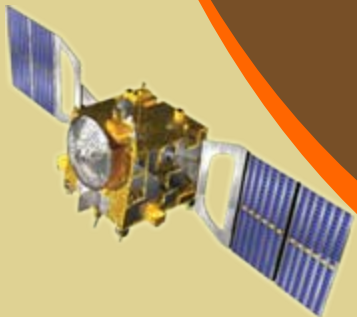
Information on the Europlanet network can be found at: <http://europlanet.cesr.fr>

The workshop will be hosted by EUROPLANET, the U.S. Education and Public Outreach team members, Ms. Rosalyn Pertzborn and Dr. Sanjay Limaye from the Office of Space Science Education, at the University of Wisconsin-Madison, and by members of the European Space Agency, Olivier Witasse, Anne Brumfit, Håkan Svedhem and Jean-Pierre Lebreton.

# Venus E/PO: Accomplishments, continued...

- ❖ Relevance to Formal Education: Potential to Expand Content Understanding through Comparative Planetology:
  - Runaway Greenhouse Affect
  - Atmosphere & Weather
  - Climate Change
  - Applied Math Skills

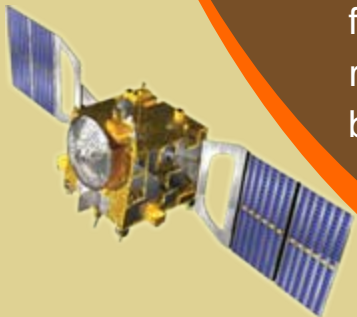
*Teachers and instructors engaging in “Tracking Clouds on Venus” activity (using actual Venus Express Data) at Livermore Unified School District workshop (Livermore, CA).*



# Venus E/PO: Accomplishments, continued...

## ❖ Venus Curriculum

- Developed collaboratively by VEX E/PO PI (Rosalyn Pertzborn), Education Grad Student (Hsuan-Yun Pi), & Science Education Undergrad (Kate Abitz)
- Product focuses on student inquiry based activities using actual Venus data!!
- Grade Level Target: Upper Elementary, Middle & High School (earth science)
- Piloted in Schools
  - Livermore, CA
  - Hawaii
  - New Hampshire
- Requires additional funding for final revisions, review, & broad distribution

The cover of the curriculum module features a large central image of the Venus Express spacecraft orbiting Venus. Below this are several smaller images: a classroom of students, a globe of Venus, a student working at a computer, a close-up of Venus's surface, and a rocket launch. The text on the cover includes:

For Middle School Students and Teachers

### The Unsolved Mysteries of Venus

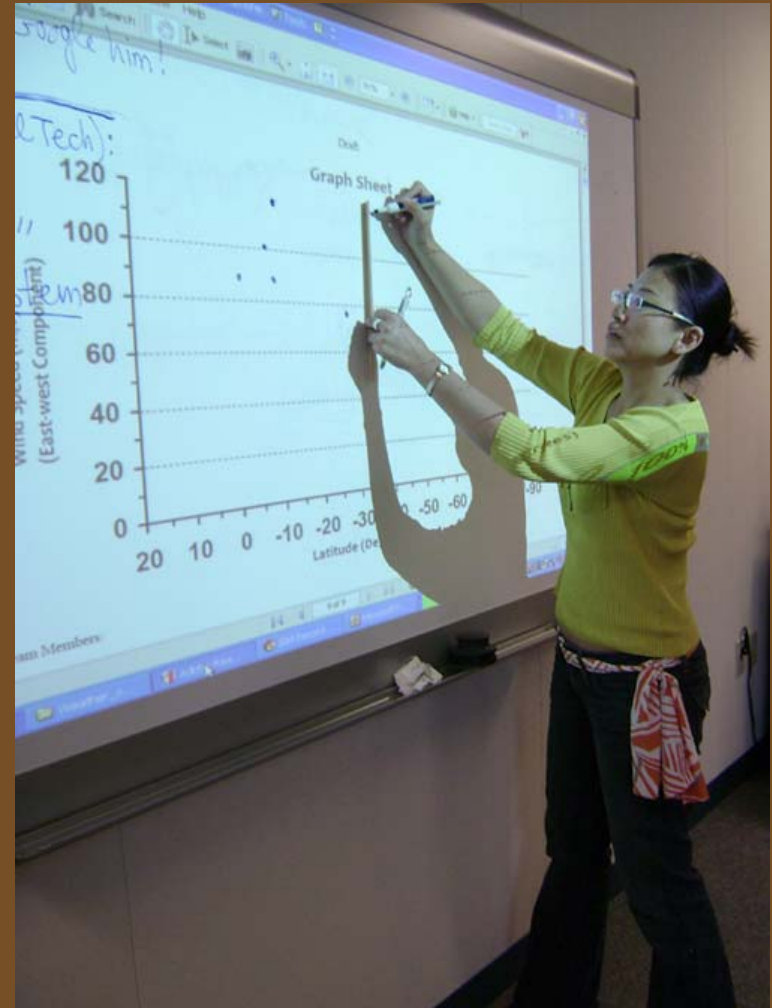
Draft 1.1 Curriculum Module

Logos for ESA, NASA, SSEC, and The University of Wisconsin-Madison are displayed at the bottom.

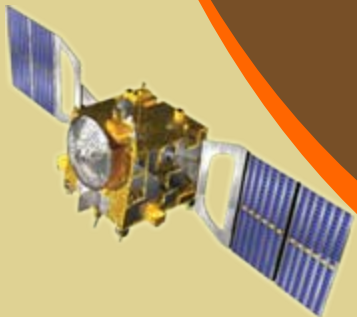
# Venus E/PO: Accomplishments, continued...

## ❖ Venus Curriculum

- Emphasizes application of Math Skills
- Aligned to National Standards
  - CA State Science Standards
  - Nat'l Science Standards
  - Standards/Benchmarks for Mathematics
- Preliminary classroom evaluation conducted by participating teachers



Ph.D. student, Hsuan-Yun Pi demonstrates plotting of wind profile data from Venus Express during Teacher Workshop (Livermore, CA)



# Key Findings and Recommendations

## ❖ Findings

- Three year effort demonstrates significant interest on part of public, formal education communities, & culturally diverse communities regarding Venus
- Comparability of Venus runaway Greenhouse & Earth's own future are very much in alignment with current events/issues of great human interest
- Great value relevance to formal education needs
  - Content & concepts align well to NSES & Mathematics
  - Topic is highly appealing to underserved communities
    - Native Americans
    - Young women
    - International communities

## ❖ Recommendations & Next Steps

- Continuation of dedicated, coherent & *coordinated* effort for Venus Education & Public Outreach Activities!!!



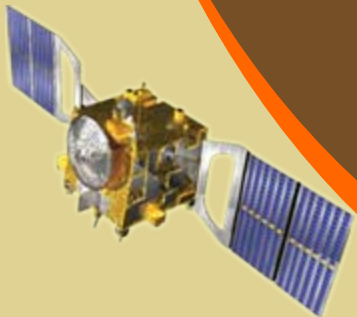
# Why Venus?

- ❖ Scientific community has identified major unanswered questions:
  - How does atmosphere to surface interaction take place? Main components & rates of change?
  - When, how & why was surface water lost & how does it influence atmosphere observed today?
  - When did Venus Greenhouse dominate & is it changing?
  - What global cataclysm resurfaced Venus and when did it occur?
  - What is origin of Venus atmospheric superrotation?
  - How does atmospheric activity change temporally & attitudinally?
  - What observations are required to answer these questions?
- ❖ Venus E/PO effort to date has demonstrated public interest and educational value of these questions!!!



# Future Events

- ❖ Venus “Surface to Thermosphere: How does it Work?” Conference
  - Madison, WI in August 2010
  - Dedicated Education & Public Outreach effort
- ❖ E/PO Venue under consideration
  - Public Event & Presentation
  - Mini teacher workshop
  - Student Presentations
  - Other suggestions?



# Acknowledgements

We wish to thank the Venus Express Science Team for their outstanding cooperation in enabling the implementation of a dedicated and successful Venus Education & Public Outreach Program to date.

We gratefully acknowledge the support from NASA in this effort which has been instrumental in establishing an authentic collaborative & international effort.

We thank the many talented, dedicated staff at UW-Madison and SSEC, whose ongoing support and strong history of positive and successful international collaborations have paved the way for a dedicated Venus E/PO Program.

