

**“Characterizing the Phenology of Southwest Landscapes”
Summary Proceedings of the Second Annual NPN-ASPRS
Symposium**

**10 October 2008, Kiva Room, U. Arizona, Tucson, AZ
(Compiled by Mark Losleben)**

INTRODUCTION

This document summarizes the proceedings of the Second Annual USA National Phenology Network & Southwest U.S. Region, American Society of Photogrammetry & Remote Sensing (NPN-ASPRS) Symposium. It presents a summary of the key points of the afternoon discussion, immediately generated developments, and future directions for both this symposium and the related regional phenology network. The 2008 Symposium agenda, abstracts, and participants are available at <http://usanpn.org/?q=node/42> and [insert ASPRS link].

BACKGROUND

This meeting is designed to benefit professionals, faculty members, graduate and undergraduate students. As such, the symposium is held on the University of Arizona campus, has no registration fee, and is coordinated in conjunction with the Research Insights in Semiarid Ecosystems (RISE) Symposium on the following day. This year the list of sponsors also included the Arizona Remote Sensing Center at the University of Arizona's Office of Arid Lands Research.

All research topics related to the “Phenology of Southwest Landscapes” were solicited and presented in oral or poster format. Research themes at our last meeting were diverse, ranging from the monitoring of plant phenology using digital repeat photography to the evaluation of vegetation phenological responses to drought and phenology as an integrative science for the assessment of global change impacts. Diversity was again strongly encouraged for participation in this year's NPN-ASPRS symposium with themes related to links between phenology and climate change. The unique function of as Regional Phenology Network (RPN) is addressed in the following Appendix B.

MEETING SUMMARY

This 2008 Symposium built upon the 2007 meeting, the First Annual NPN-ASPRS Symposium, “Towards a Southwest Regional Phenology Network”. One is directed to the summary report <http://usanpn.org/?q=meetings> for background material detailing the interlocking roles and goals of phenology, remote sensing, and the respective organizations, as well as a summary of it proceedings.

The 2008 Symposium, "Characterizing the Phenology of Southwest Landscapes", continued exploring phenology and remote sensing through impressive oral and poster presentations, and followed by a discussion. The presentations are found at <http://usanpn.org/?q=meetings>. The open forum discussion quickly focused on a single topic: the next steps toward activating a Southwest Regional Phenology Network (SW-RPN). The establishment of a SW-RPN is pertinent for the shared phenology research programs of both the SW ASPRS and NPN, and their respective aspirations. Thus, both general and specific details were discussed, beginning approximately where discussion of this topic ended last year. Notable progress at the USA-NPN over the past year toward facilitating an active SWRPN includes infrastructure support, guidance through experiences of other RPN's, and access to existing USA-NPN resources available to all RPN's. These are listed in the 2007 NPN-ASPRS Symposium Summary, <http://usanpn.org/?q=meetings>. Additionally, a RPN developmental template, a modifiable RPN web page template, all RPN domain names, and data entry, visualization, and download tools should be operational and available for development and operation of all RPN's, by spring 2009.

This year's key note speaker, Julio Betancourt, set the tone for the meeting presentations with, "Climate Change and Phenology in the West". Julio presented broad vision and challenges for the phenology and remote sensing community that included developing indicators of climate change, presented rationale for phenology informed climate change indices, and suggested applications and integration of phenology for predictive products and adaptive management.

FUTURE DIRECTIONS

SW-RPN

Most impressively, the afternoon discussion activated the SW-RPN! One week following this meeting a SW-RPN coordinating executive committee emerged, a potential working group list of experts is suggested, and SW-RPN web development, housing, and launch are underway. Eleven days after this meeting, the domain name www.swrpn.org was purchased, and Dr. Charles Hutchinson, Director, Office of Arid Lands Studies, University of Arizona, has responded positively to contributing resources towards the housing and operation of this new website. Soon, Wim van Leeuwen will (with the help from all interested parties) coordinate the set-up of a website to make the SWRPN more visible, put up contributions, phenology data, climate data, protocols, coordination efforts etc.

The NPN coordinating office and working groups sees NM, AZ, Utah and Nevada as representing the SW for all practical purposes. Beside a core "executive" group that currently is taking the lead (4 at the moment, but this # can be expanded) to establish the SWRPN, this network should get both geographic and

expert representation.

The current core of the coordinating executive committee members are Drs. Steven Yool, Wim van Leeuwen, Michaela Buenemann, and Cynthia Wallace. The spirited, fast work of Dr, van Leeuwen has produced an initial list and invited a working group of experts to contribute as organizers or intellectual resources. Suggestions for other luminaries to serve are welcome. You can let Wim van Leeuwen or other member of the executive core group know if you want to sign up to help make this an exciting SWRPN phenology science and education program. The working group will help address and coordinate phenology science, proposals, SW issues/opportunities (drought, fire, gradients), soils, plant protocols, ecology, climate, instrumentation, remote sensing, cyber infrastructure, education etc.

As of 10-31-08 the following luninaries and experts in their fields have indicated that they would help contribute to the establishment and development of the SW-RPN:

- Lisa Benton (UA)
- Julio Betancourt (USGS)
- Michaela Buenemann (NMSU)
- Neil Cobb (NAU)
- Theresa Crimmins (NPN)
- Mike Crimmins (UA)
- Jennifer Davison (UA)
- Kamel Didan(UA)
- Alfredo Huete(UA)
- Malcolm Hughes (UA)
- Chuck Hutchinson (UA)
- Shirley Kurc (UA)
- Stuart Marsh (UA)
- Mitch McClaran (UA)
- Brian McGill (UA)
- Deana Pennington (UNM)
- Kathryn Thomas (USGS)
- Wim van Leeuwen (UA)
- Steve Yool (UA)

We don't expect this to become a lot of work for any one person. We do hope that the SWRPN will be a resource with benefits for everybody involved.

NPN-ASPRS 2009 SYMPOSIUM

Thoughts expressed for the next NPN-ASPRS Symposium include: - expanding participation to the national level while retaining the focus on Southwest regional issues and topics, - linking more actively with RISE, securing stable funding for this annual forum, - circulating a questionnaire on the structure and scope of

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future meetings, considering the inclusion of a relevant “artistic” talk. Input, especially ideas for an increased national presence are welcomed by the committee. Detailed comments and suggestions from email messages related to this aspect of future meetings are found in Appendix E.

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Appendix A. Regional Phenology Networks

REGIONAL PHENOLOGY NETWORKS

INTRODUCTION

The Regional Phenology Network (RPN) figures prominently in the USA National Phenology Network (USA-NPN) mission and to the goal of creating the most representative and comprehensive national phenology data base for the United States. A comprehensive phenology database, integrated with near- and long-term climate models, will help inform predictions of species responses to ecosystem and biome changes which in turn will enable creation of intelligent adaptive-management strategies to cope with ongoing and future climate change. This new data resource is vital for informed assessment of and adaptation to climate change, and the RPN captures local to regional scale issues that may too easily escape notice at the national level.

BACKGROUND

Integration of spatially-extensive phenology data with models of both short- and long-term climatic forecasts offer a powerful agent for human adaptation to ongoing and future climate change. Regional networks are key components to help fully realize the contribution of phenological data towards this goal. They contribute at local to regional scales, and may portend conditions at, and be contextually linked to, the national scale. Therefore, Regional Phenology Networks (RPN's) are vitally important to the mission and goal of USA-NPN.

A goal of the USA-NPN is to compile basic information on phenological responses to climate change; to study its nature, pace and the effects on ecosystem function; and to understand connectivity and synchrony among species. The USA-NPN will collect phenology data from across the nation, but a national network that is able to detect issues at a smaller scale relies on the collection and reporting of phenological information from local sites, and remote sensing has the potential to “cement” the spatially discrete surface phenology observations to provide true coast-to-coast coverage. To realize this potential, the gap between surface phenology observations and remote sensing products must be bridged. Testing and development at the RPN level plays a key role in creating this bridge.

Regional phenology is applicable to a variety of important topics in a changing climatic environment such as:

- Monitoring ecosystem function and services, and assessing their vulnerabilities to environmental variation (e.g., carbon budget, wildfires, water budget, health hazards) • Improving management of agriculture and forestry
 - Enhancing weather, climate, & ecosystem forecasting and monitoring
 - Providing measurements critical to identifying local & regional impacts of climate variability & change
 - Providing new information for vector & invasives control such as establishing a better understanding of the relationship between temporal patterns of germination and invasiveness, thus providing a framework for tracking and managing the spread and productivity of invasives
 - Establishing a baseline of biological activities for future reference, providing a framework for assessing our national biological resources
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- Evaluating impacts of lengthening of growing season on hydrology, plant moisture stress, ecological disturbances (fire & insect/pathogen/pest outbreaks), agriculture, ecological disturbances, and spread of invasive species and infectious diseases
 - Evaluating phenological effects in the hydrologic cycle, particularly on evapotranspiration, recharge, ground-water levels, and streamflow
 - Informing human health consequences of allergens related to changing phenology
 - Adding critical value to the heavy public investment in satellite remote sensing platforms and products
 - Providing opportunities for a large segment of society to be involved in the network and environmental monitoring

INITIATING REGIONAL PHENOLOGY NETWORKS

Recent developments by the USA-NPN will facilitate establishment of RPN's. The developments listed below include web-based tools, handbooks, a resource clearinghouse, and a host of persons with experience in program development. The USA-NPN provides:

- Nationally vetted species lists and observational protocols;
- Access to educational and outreach materials and handbooks;
- Access to extensive phenology bibliography;
- Clearinghouse for resource sharing;
- Phenology garden templates and cloned species;
- Communications facilitation among individuals, Regional Phenology Networks, and national scientific networks;
- USA-NPN National Coordination Office (NCO) assistance and working in conjunction with RPN to develop regionally specific species protocols;
- NCO assistance in proposal writing for coordination and training meetings;
- Currently in development are:

A regional PN developmental template including web page
Purchase of all RPN domain names
Data entry, visualization, and download tools.

RPN SUMMARY

Significant advances towards facilitating the development of RPNs include plans for the development of an RPN development template, the acquisition of domain names for each of the RPNs in the United States, a sample web-page template ready for individual RPNs to use and adapt reflecting their regional focus, organizational assistance, and access to the full range of resources of the USA-NPN. Currently available are the NPN plant calibration and regional focus species lists and nationally vetted observational protocols with data entry through the NPN web page (www.usanpn.org); data visualization, download, and display tools are being developed. Resources available to all RPNs are educational handbooks and outreach materials containing resources to start and nurture local and community phenology programs, phenology observers training materials, grant proposal resources, and clearing house functions to share experiences with other RPN organizers and participants. Thus, implementation of a RPN is being streamlined, simplifying the establishment of a RPN. Identification of a regional coordinator or contact is often the first step. Please contact Mark Losleben, losleben@email.arizona.edu, at the USA-NPN if you are interested or have questions or ideas regarding establishment or participation in a Regional Phenology Network!

Appendix B. Speaker Biographies

Keynote speaker: Dr. Julio Betancourt, Title: "Climate Change and Phenology in the West"

Julio Betancourt is a Senior Scientist with the U.S. Geological Survey and an Adjunct Professor at the University of Arizona in Tucson, where he obtained both his Master's and Ph.D. His training in the sciences is broad and includes geology, hydrology, climatology, and ecology. This has allowed him to do innovative research in the seams between disciplines, and to publish over 130 technical papers in a wide variety of scientific journals. Julio investigates how climate variability and climate change affect floods, fires, droughts and ecosystem dynamics to inform management of natural hazards and natural resources. He has conducted field studies in Argentina, Bolivia, Chile, Peru, Mexico, Australia and throughout the western U.S. Julio has received prestigious awards from the American Water Resources Association, from the Ecological Society of America, and from the U.S. Department of Interior. He has also been a leader in both regional and national scientific initiatives, including recent organization of a National Phenology Network that is aimed at observing and predicting how plants and animals will respond to climate change. Over the past 4 years, Julio also has helped educate and organize our community to stem the spread of African buffelgrass in the Sonoran Desert.

Talk 1

Jake Weltzin assumed his position as Executive Director of the USA-NPN in August, 2007. Jake's interest in natural history developed as he grew up in Alaska and as an exchange student in the Australian outback. He obtained his B.S. from Colorado State University, M.S. from Texas A&M University, and Ph.D. from the University of Arizona. Following a post-doctoral fellowship at University of Notre Dame, Jake went to the University of Tennessee, where he served as Assistant and then Associate Professor. Jake's interests encompass how the structure and function of plant communities and ecosystems might respond to global environmental change, including atmospheric chemistry, climate change, and biological invasions. His research spans temperate and tropical grasslands and savannas, temperate woodlands, deciduous forest, and sub-boreal peatlands. His recent experience as a science administrator at the National Science Foundation underscored the need to foster large-scale science initiatives such as USA-NPN. As it's first Executive Director, Jake's vision for USA-NPN is "to develop a continental-scale instrument for integrative assessment of global change that simultaneously serves as an outreach and educational platform for citizens and educators."

Talk 2

Although his PhD is in Education, after moving to Arizona Dave Bertelsen spent 18 years in the criminal justice system before retiring in 2005. An avid hiker and photographer, he began to devote much of his free time to botanical pursuits in the mid 1980s. In addition to his study of Finger Rock Canyon, he is one of the authors of the Tucson Mountain Flora and a contributor to the Arizona Rare Plant Field Guide.

Talk 3

Theresa Crimmins is a research scientist with the Office of Arid Lands Studies at the University of Arizona and is the Network Liaison for the National Phenology Network. She has had the pleasure of working with Dave Bertelsen to analyze his incredible long-term record of plants in flower in the Catalina Mountains. Her presentation today covers their most recent analyses, exploring flowering range changes over the 20-year record.

Talk 4

Willem J.D. van Leeuwen received the B.Sc. and M.Sc. degrees in Soil Science from the Wageningen University for Life Sciences, the Netherlands in 1985 and 1987 respectively, and the Ph.D. degree in soil and remote sensing science from the Department of Soil, Water and Environmental Science, University of Arizona, Tucson in 1995. He has been a research scientist and a member of the MODIS land science team, worked on global spectral vegetation index and albedo product and algorithm development in the US and France. He is currently working on post wildfire vegetation recovery, land degradation, land cover classification and land surface phenology research, employing remote sensing

and geospatial tools. He also works on cyber and web-based decision support tools for natural resource managers in the US and Africa. Since 2005, Dr. van Leeuwen is an Assistant Professor and has a joint appointment with the Department of Geography and Regional Development and the Office of Arid Lands Studies at the University of Arizona, Tucson, where he teaches geographical field methods, biogeography, and currently a phenology seminar. He is a member of: American Geophysical Union (AGU), American Society of Photogrammetry and Remote Sensing (ASPRS), Association of American Geographers (AAG), IEEE Geoscience and Remote Sensing Society (IGARSS), and the International Association for Landscape Ecology (IALE).

Talk 5

Miguel Villarreal is a PhD candidate in the department of Geography and Regional Development at the University of Arizona. He earned a Masters degree from the UA Geography Department in 2003, with a thesis examining the relationship between fire policy, fire history, and forest pattern in Sky Islands of Arizona and Northern Mexico. His present research focuses on uses of historical aerial and contemporary satellite imagery to monitor and model riparian vegetation dynamics and disturbance in arid ecosystems.

Talk 6

Keely Roth is a graduate student in the Dept. of Geography at UC Santa Barbara where she is currently finishing her master's thesis (a study on determining forest carbon balances with remote sensing). She will continue on to her PhD at UCSB, which will focus on linking ground-based observations of plant phenology with remotely sensed imagery. Today she will be presenting some of the background work she has done thus far in this line of research.

Talk 7

Enriquena Bustamante
Departamento de Ecología de la Biodiversidad, Instituto de Ecología,
Universidad Nacional Autónoma de México, Unidad-Hermosillo

I am a PhD candidate in the lab of Alberto Búrquez at the Institute of Ecology of the National University of Mexico (UNAM). I graduated with a B.S in Ecology from the Centro de Estudios Superiores del Estado de Sonora and then when to complete a M.S. in Environmental Biology (*cum lauda*) from UNAM in 2003, where I studied the population dynamics, reproductive biology and management of the Organ pipe cactus in a Mayo community. My current research continues along these lines as I study the factors that, in a geographical context, influence the evolution of life history traits of this species and other columnar cacti. To address this issue I study the effect of the spatial and temporal variation of resources on the population dynamics, the reproductive success and the population genetic structure of this species.

Talk 8

William Peachy brings a long and varied career in the field to this meeting as one of the pre-eminent experts on saguaro phenology in the region. His interest began with tracking fruit bat behavior, and this led to perhaps the most comprehensive saguaro phenology data bases ever compiled for a large number of individuals in a field setting.

Talk 9

Stephen Yool is a physical geographer with interests in biogeography, geospatial information, and algorithms. He spent his initial postdoctoral years as a research scientist in federal government and industrial laboratories before coming to The University of Arizona in 1992. He has received 28 federal research grants and authored 40 articles and book chapters. He was 2007 President of the Southwest Region, American Society of Photogrammetry & Remote Sensing.

Talk 10

Jeremy Weiss has been a senior research specialist in the Geosciences Department here at The University of Arizona for over six years. In addition to managing Jonathan Overpeck's laboratory, Jeremy also works on a range of research projects, with topics such as climate variability and change, sea level rise, biogeography, plant phenology, and drought in western North America.

Appendix C. Program Committee

Session Co-Chairs: Mark Losleben, Assistant Director/Program Scientist
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Appendix D. Participants

Name	Affiliation
Toby Ault	Dept. of Geosciences, UA
Emiko Ariyasu	
Dana Backer	Saguaro National Park
Lisa Benton	National Phenology Network, UA
Dave Bertelsen	Assoc. Researcher, U of A Herbarium
Julio Betancourt	U.S. Geological Survey
Mark Bierner	Gila Co. Cooperative Extension, UA
Dave Breshears	School of Natural Resources, UA
Michaela Buenemann	Dept. of Geog, New Mexico State U
Enriquena Bustamante	Inst de Ecología, U Nacional México
Grant Cassidy	Office of Arid Lands Studies, UA
Theresa Crimmins	National Phenology Network
Jennifer Davison	Office of Arid Lands Studies, UA
Kamel Didan	University of Arizona
Sam Drake	OALS - UA
Fred Drumlevitch	
Don Falk	School of Natural Resources, UA
George Ferguson	
Jan Fox	University of Arizona
Leila Gass	U.S. Geological Survey
Marilyn Hanson	Arizona Native Plant Society
Trevor Hare	Sky Island Alliance
Alex Hollis	Student
Karolyn Kendrick	Arizona Native Plant Society
Mark Losleben	National Phenology Network
Cheryl McIntyre	Sonoran Institute
Rod Mondt	Wild Desert Conservation
Margaret Norem	UA, Desert Legume Program
William Peachy	N/A
Julie Prior-Magee	U.S. Geological Survey
Stanley Ross	
Keeley Roth	Geography, UC Santa Barbara
Rafael Routson	Geography PhD Student, UA
Koichi Sakaguchi	PAS, University of Arizona
Peter Smith	University of Arizona
Sarah Studd	
Alys Thomas	Dept. of Soil, Water, Env. Sci., UA
Kathryn Thomas	U.S. Geological Survey
Willem van Leeuwen	Office of Arid Lands Studies & GRD, UA
Miguel Villarreal	Arizona Remote Sensing Center, UA
Juan C. Villegas	School of Natural Res. - Biosphere 2
Jelena Vukomanovic	Office of Arid Lands Studies, UA
Cynthia Wallace	U.S. Geological Survey
Jeremy Weiss	Dept. of Geosciences, UA

Jake Weltzin	National Phenology Network
Muluneh Yitayew	
Stephen Yool	Dept. of Geog, University of Arizona
Nancy Zierenberg	Arizona Native Plant Society
Zhangyan Jiang	

Appendix E. Future meeting and SW-RPN structure comments and suggestions

First, I do think there's the potential to expand it nationally, though keeping the focus on the southwest. For example, I'd gotten a letter of interest from Wayne Esaias, a NASA scientist from Goddard, who is interested in expanding his honeybee monitoring network (coupled to remote imagery) to the SW. I think we lose opportunities to bring in folks like this when we don't get an agenda/call for papers out soon enough.

Second, we could have a bit more active recruiting/invitation, though having an open opportunity for local folk and students provides a nice contrast with RISE.

Third, depending on the flavor for next year, we could indeed work to bring in leaders from other regional networks (i.e., if we focus on building a SW network structure next year); the NPN will have a template for developing regional networks by then, and there will be quite a lot of material available (from proposals for support, to examples for governance, etc.).

Fourth, I agree that the posters can help pull us back on time, but I'd suggest keeping the time slots short and (generally) consistent.

Fifth, a better link with RISE would be quite desirable....there wasn't much overlap between the attendees, but as you point out, there are opportunities to share easels, announcements, perhaps even registration, speakers, etc. This will call for an earlier start and good coordination, but could pay off well. I talked to Mitch McClaran about this, and he was quite supportive.

Finally, as the conference continues and grows, I think it will be important to make an *a priori* commitment to the conference, with clear communication, good deadlines, long-range planning, etc., to maximize its effectiveness. As such, if you-all would like, I would be willing create a line-item in the position description for the Assistant Director of the NPN to serve as co-organizer of the conference each year. (As you may know, we'll be losing Mark as the AD of the NPN at the end of the year, though he'll continue working with the NPN as a liaison to other organizations for the foreseeable future.) Although everything is going swimmingly, this might formalize the process and provide some continuity that would keep this excellent conference going into the future. In addition, such an arrangement would justify the allocation of additional NPN resources to the conference.

Thanks again to all who worked so hard to make this conference happen.

I wanted to touch base with all of you about the conference. I thought it all went well, but see there are several ways that we can improve the conference for next year, and I wanted to share my thoughts and ask you to share yours.

1. We need to promote it sooner, perhaps sending out the call and starting registration in the spring. Now that we have the online registration up and running, we should be able to start sooner for this coming year. For this conference, the Call for Papers did not go out until the end of August... Even with such a short notice, I think the quantity, diversity and quality of the presentations were wonderful!!
2. Maybe we should actively recruit and invite speakers that we see have published on phenology topics (as RISE does).
3. Do we want to continue a regional focus or do we want to expand it to a national focus? Regardless, it might be nice to invite people from other regional networks or even someone from another national network (like Canada) as an invited speaker or perhaps to introduce the Discussion Session....
3. Perhaps we can let each presenter choose whether they want a 20 minute (15 for talk, 5 for questions) or a 30 minute (25 for talk, 5 for questions) time-slot and have a block of shorter and a block of longer talks. Then we can tell the presenters that they are responsible to honor their requested time-slot, and adjust if necessary. Talking with Dr. Moran at the RISE conference, she noted that the poster presenters always seem to manage to get them back on schedule, and it was true for us as well. I think it would promote a more relaxed atmosphere. I wasn't able to really enjoy the talks since I kept having to worry about the clock.....
4. Dr. Moran also said that they rent their poster easels from a local company, and they would be happy to let us use them the day before. She sounded as though we could use them for free, but I do not know the cost or logistics of us delivering them to the Marley building after we are done.... I was impressed that the student union events people were able to get us poster easels so fast the morning of.... Thanks to Lisa for scrambling to figure that out!! Next year, I will be sure to think ahead on that one....
5. The venue has pros and cons. The room itself is great, but I know latecomers were a bit disconcerted to find themselves at the front of the presentation space. Signs to guide them to the side doors could help. Parking is a problem. Second street garage fills up by 7 or 8 AM. The student union has many lunch choices,

but it is quite noisy and "manic". As an alternate, we could use the "Combined Meeting Rooms" at the Park Student Union, which holds up to 80 (vs. Kiva Room at 100) auditorium style (see <http://www.union.arizona.edu/rooms/layouts/index.php?room=meeting-a>). This space has the doors at the back, opposite the screen. Parking at Tyndall Garage and Sixth Street garage should be more available. That would also allow lunch to be on-your-own either in the union or along University Avenue.

6. Food was great! Thanks Wim (and ARSC-OALS).

7. At the RISE conference, it was a nice change-of-pace to have "Petey Mesquitey" talk. Seems like phenology certainly could have a similar "poetic" or "artistic" person talk.... At RISE, it served to draw people back to the room after lunch, and gave you stuff of real importance to think about....

8. Should we put together a short survey to ask the registered attendees to respond? Possible questions:

Schedule: Too short, too long, just about right?

Talks: Diversity, Quality?

Focus: Keep it regional? Expand to national?

Questions: enough time allowed, enough opportunity?

Advertising: How did you hear about the conference? Notice too short or enough?

Call for Papers: was there enough time between the call and the deadline for people to respond?

Venue: Pros and Cons?

Discussion Session: More or less structure?