ALOS Kyoto & Carbon Initiative
1st Science Advisory Panel meeting

NASDA EORC, Tokyo, Japan
November 1-2, 2001

AGENDA

ALOS Kyoto & Carbon Initiative
1st Science Advisory Panel meeting

November 1 (Thursday)

9:30 Welcome address
T. Moriyama, Dep. Manager ALOS Program - NASDA SPPD

9:45 Background (A. Rosenqvist, NASDA EORC)
- The ALOS Kyoto & Carbon Initiative
- Objectives of the workshop

10:15 ALOS technical/operational capabilities and limitations
- ALOS space- and ground segments - technical and operational limitations affecting data observations (N. Ito, NASDA ALOS Project)
- EORC data processing issues (M. Shimada, NASDA EORC)

11:00 Break

11:15 Open floor session 1 - The "optimal" sensor configuration
Discussion moderator: Thuy Le Toan (CESBIO, France)
Target: A proposal for an "optimal" sensor configuration(s)

12:45 Lunch

13:45 Political and scientific information requirements
- Kyoto Protocol information requirements (Y. Yamagata, NIES)
- Carbon cycle (TCO) information requirements (J. Tschirley, FAO)

14:30 Open floor session 2 - Kyoto & Carbon requirements
Moderator: Thelma Krug (INPE, Brazil)
Target: KP and C data requirements.

16:00 Break

16:15 Open floor session 3 – From data take to derived information
Moderator: Shaun Quegan (Univ. Sheffield, U.K.)
Target: Initiating a discussion about output products/derived information

17:30 Adjourn

18:00-20:00 Reception at NASDA EORC

November 2 (Friday)

9:15 Open floor session 4 - Regional considerations
Moderator: Christiane Schmullius (Friedrich Schiller Univ., Germany)
Anticipated output: Understanding of specific regional characteristics and how the acquisition plan should be adapted to capture relevant phenomena.

10:45 Break

11:00 The ALOS K&C Systematic Data Acquisition Strategy
· Description of the preliminary acquisition plan (A. Rosenqvist)

11:30 Open floor session 5 (hands-on) – Re-drafting the acquisition strategy
Moderator: Bruce Chapman (JPL, U.S.A.)
Anticipated output: A revised acquisition strategy for ALOS K&C.

13:00 Lunch

14:00 Open floor session 5 (continued)

15:30 Break

15:45 Loose ends and action items

16:15 Review of minutes/summary preparation

16:45 Workshop summary (open to all NASDA)
Craig Dobson (NASA, U.S.A.)

17:15 Closing remarks
F. Ohtsuki, Director NASDA EORC

17:30 Adjourn

Meeting minutes kindly compiled by Laura Hess (UCSB, U.S.A)
and Tony Milne (UNSW, Australia)

Meeting participants

Panel members:

Bruce Chapman, NASA Jet Propulsion Laboratory (USA)
Craig Dobson, NASA Headquarters (USA)
Laura Hess, Univ. of Calif. Santa Barbara (USA)
Tamotsu Igarashi, NASDA EORC (Japan)
Thelma Krug, INPE (Brazil)
Thuy Le Toan, CESBIO (France)
Tony Milne, Univ. of New South Wales (Australia)
Shaun Quegan, Univ. of Sheffield (U.K.)
Ake Rosenqvist, NASDA EORC (Japan)
Christiane Schmullius, Univ. of Jena (Germany)
Masanobu Shimada, NASDA EORC (Japan)
Jeff Tschirley, FAO (U.N.)
Yoshiki Yamagata, National Inst. of Environmental Studies (Japan)
Yoshifumi Yasuoka, Univ. of Tokyo (Japan)

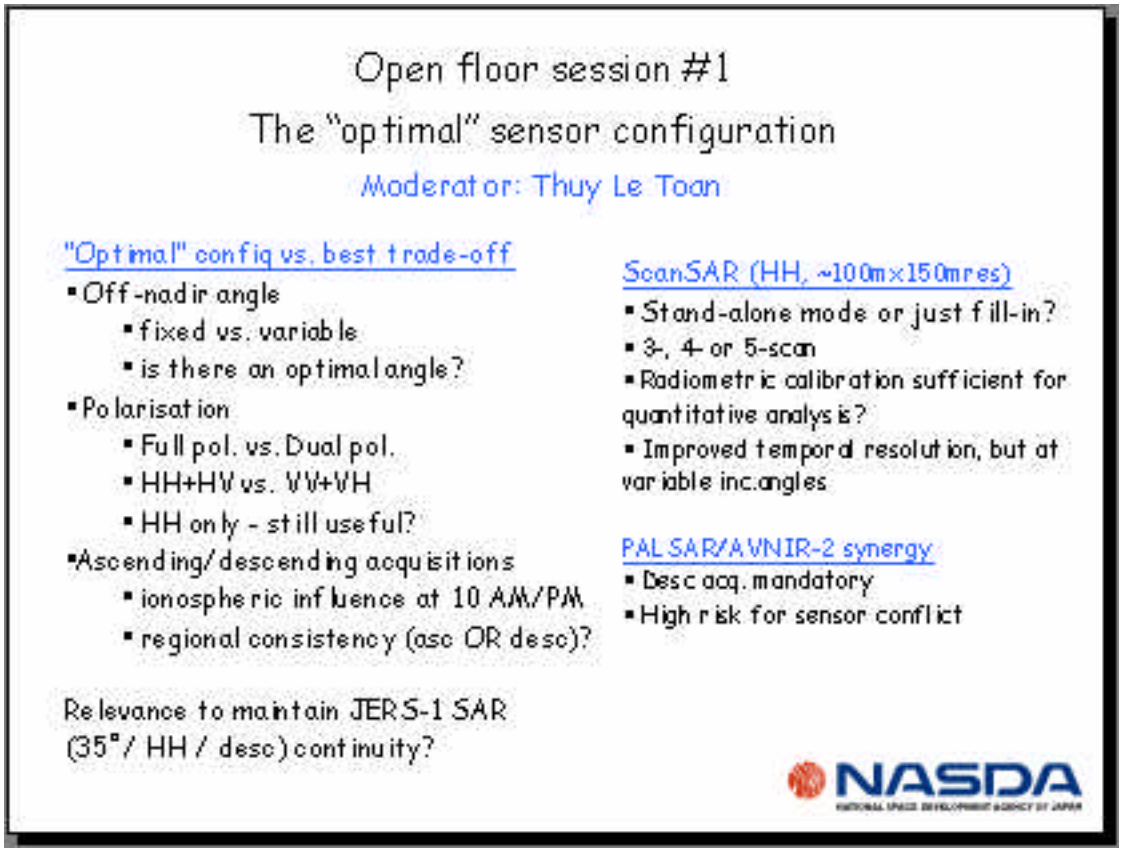
Observers:

Dennis Dye, Frontier (Japan)
Hozuma Sekine, Mitsubishi Research Inst. (Japan)
NASDA staff

ALOS Kyoto & Carbon Initiative
1st Science Advisory Panel meeting

MINUTES v.1.1

Open Floor Session 1 The Optimal Sensor Configuration



Optimal configuration needs have to be considered in the context of information needs and derived products. Factors include:

Best for Biomass Retrieval
- high sensitivity to biomass change
- high level of biomass saturation (50t/ha)
- small effect of changing underlying ground conditions

Best for wetland mapping
- high penetration for wetland inundation monitoring
- large swath width for high temporal coverage

Best for general mapping
- prior land use classes

Best for small perturbation effects
- topographic effects
- ionospheric effects
- small effects of calibration errors/noise floor

Best for satellite operations
- data rate/conflict with other applications

Other considerations in derived products include: land cover/land use change; soil carbon; soil moisture; seasonal changes including snow and freeze/thaw cycles.

Incidence angle

For single-polarization (HH or VV) and dual polarization (HH+HV or VV+VH) modes, strong support in discussion for optimizing incidence angle at around 35^{o} (which provides approximate continuity with JERS-1 data. Note proposed PALSAR incidence angle range of 36.6-40.8^{o} (off-nadir angle 34.3˚). An alternative option was 48.1-51.3˚ (off-nadir 43.3˚).

At larger incidence angles trunk component increases and the extinction factor in crown increases, while at smaller incidence angles, soil and ground conditions interfere and can dominate. Forest applications optimized at 35~45˚, with a slight preference for the higher range. Most wetlands are well distinguishable with JERS-1 SAR (inc.angles ~36-42˚) while the effect of extinction at angles above 45˚ needs to be investigated. **An off-nadir angle of 34.3˚ was agreed as acceptable trade-off for both forest and wetland applications.**

In full polarimetric mode, results suggest that lower incidence angles are preferred. HH-VV coherence decreases with larger incidence angles; no sensitivity after 40^{o}; therefore no value in polarimetry at these incidence angles. This reinforces arguments to capture polarimetric data at 21-26^{o}, if going for full polarimetry.
Due to operational constraints related to the PALSAR sensor, 60 km swath width (required for full coverage at the Equator) is not possible in full pol mode for off-nadir angles above 21.5˚ (22.8-25.2˚ inc.), which is the angle preferred by NASDA. Reduced swath width may still be acceptable in boreal regions where less overlap between passes is required, raising a need to investigate implications and radiometric performance for possible operation at 35^{o}.

Polarization

Is full polarimetric mode required, or is dual-pol an acceptable trade-off?
HH and HV (as opposed to VV+VH) is the preferred option in dual mode, and - in view of various technical and operational constraints associated with full polarimetric mode - an acceptable alternative to full pol operations. Considered suitable for imaging low as well as high biomass areas. The HV channel considered most important for biomass, the HH channel for wetlands applications.

- Major question is how well can dual pol data be calibrated as opposed to using fully polarimetric?
- What are the implications for incorporating dual pol data into retrieval algorithms?
- Likely impact on accuracy?

Action Item (EORC): Undertake a more thorough examination of the feasibility of implementing polarimetric mode, including the use of stratification techniques in order to use 21-26^{o} in equatorial regions with changing PRF and incidence angles to capture full coverage in boreal regions where overlapping coverage due to orbital convergence assists acquisition.

Action item (Laura): Implications of higher incidence angle (>45˚) on double-bounce backscatter from inundated wetlands (current assumption: ~35˚ optimal)

Selective application of full polarimetric mode could be used for "hotspots"(e.g. known regeneration targets). Consideration should be given to acquiring full polarimetric coverage of the earth's surface at least once during the lifetime of the mission.

Ascending vs. descending acquisitions

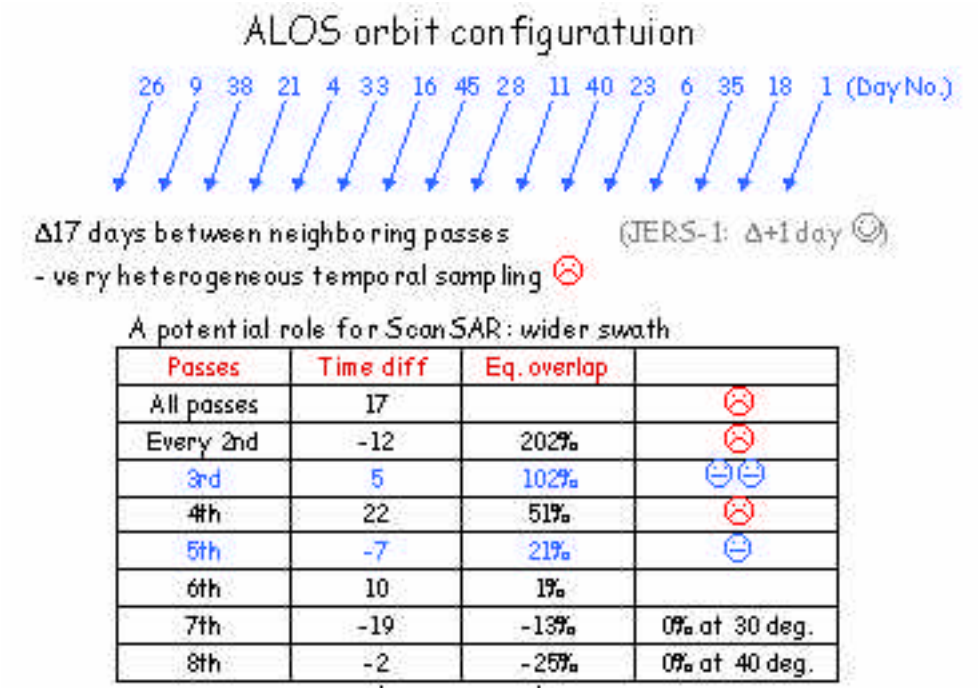
Choice of ascending (~10:30 pm) or descending (~10:30 am) mode is constrained by factors such as;

- correlations and synergy with optical instruments (descending required for synergy - ascending however minimises risk for instrument conflict and data recorder/down-link allocation).
- Need to know atmospheric correction data for interferometric use.
- Optimizing ground truth activities.
- Knowing dynamics of target diurnal/ flux changes.
- Ease of scene alignment and site coverage when combining PALSAR with archived JERS-1 or other data acquired in descending mode

All the above suggest descending or day time passes are to be preferred.
Conflicts with operation schedules of optical instruments (PRISM and AVNIR-2 are an important and possibly overriding concern in choice of mode. .
Ascending and descending modes could best be used to investigate diurnal changes including phenology and freeze-thaw triggers.

Is there a role for ScanSAR?
ScanSAR operates in single-pol (HH or VV) modes only. ~100x150m spatial resolution (8 looks)

In respect to temporal homogeneity of PALSAR passes over large regions, ALOS orbital configuration is poor, with neighboring passes being acquired with 17 days' difference (conf. JERS-1 - 1 day diff). In ScanSAR mode, the increased swath width allows usage of selected passes which provides for better temporal consistency (e.g. utilisation of only every 3rd pass yields an improved 5-day difference between neighboring passes - operation of PALSAR in the ScanSAR mode for a full 46 day cycle would enable three different mosaics of the earth's surface to be constructed). For applications such as wetland and agricultural monitoring, freeze/thaw etc., where high temporal consistency and repetition are considered more important than spatial resolution, ScanSAR has a potential role to play.



Passes	Time diff	Eq. overlap	
All passes	17		☹
Every 2nd	-12	202%	☹
3rd	5	102%	😐😐
4th	22	51%	☹
5th	-7	21%	😐
6th	10	1%	
7th	-19	-13%	0% at 30 deg.
8th	-2	-25%	0% at 40 deg.

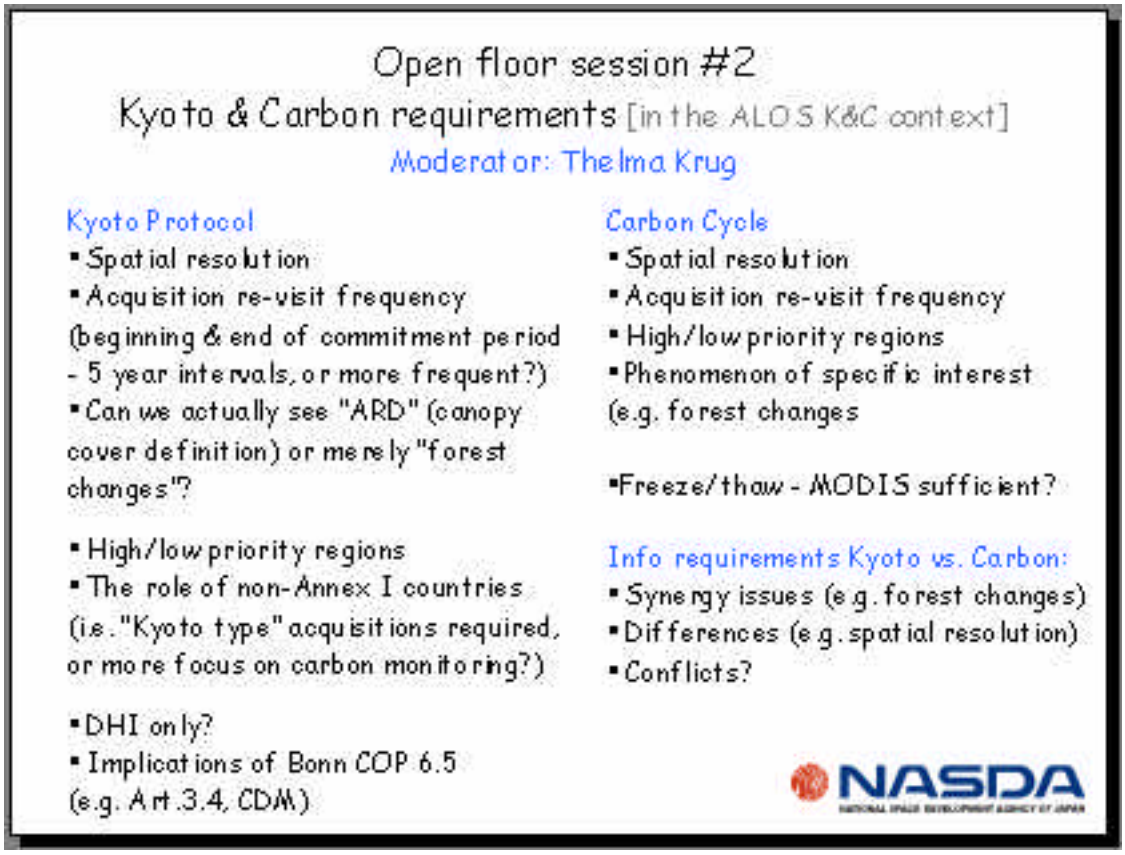
While improving temporal sampling and increasing the opportunity to acquire global data, it may prove difficult to use in the generation of any calibrated and derived data products. Incidence angle effects (18-37 ^{o} range) are significant and need to be investigated; for some applications a partial swath could be used. Calibration of ScanSAR data will be essential.
Any inversion algorithms used need to incorporate incidence angle dependency effects into the retrieval process.

Action Item (M. Shimada/B. Chapman): ScanSAR processing and calibration - bottlenecks and expected radiometric accuracy
Action Item (Laura/Thuy): Implications of incidence angle effects in ScanSAR data for wetlands and forest applications

SESSION SUMMARY

- Taking operational constraints and application requirements into consideration, dual polarisation (HH+HV) mode selected best option for annual wall-to-wall coverage.
- HV polarisation fundamental for biomass sensitivity
- HH polarisation fundamental for wetland monitoring
- 34.3˚ off-nadir angle (36.6-40.8˚ inc.angle range) best trade-off option (acceptable for both biomass & wetlands appl, correspondence with JERS-1 configuration).
- Ascending acquisitions (~10:30 pm) acceptable.
- ScanSAR mode suitable for regional scale applications which require high and consistent temporal sampling. Calibration accuracy (TBD) however fundamental for actual use.

Open Floor Session 2 Kyoto and Carbon Requirements



The Global Terrestrial Observation System (GTOS) and the Terrestrial Carbon Observations (TCO) views were presented by Jeff Tschirley.

GTOS focus on five issues: changes in land quality; freshwater resources; loss of biodiversity; climate change; pollution and toxicity. TCO, in turn, cover: land cover/land use; biomass/leaf area; fire; radiation; atmospheric column; near-surface GHG; surface fluxes; carbon pools and changes.

The roles of SAR in the TCO context are:
- biomass and biomass change
- land cover and land cover change
- wetland distribution and water level dynamics (CH4 emissions)
- irrigated rice (CH4)
- freeze/thaw (phenology)

Geographic windows: forests, wetlands, cloud-prone areas and areas subject to seasonal changes and rapid LC changes
Temporal windows: wet/dry contrasts; cold/warm contrasts

It was noted that SAR data should be seen as a part of a system solution for carbon support, including a variety of other data sources (in situ, other RS, models).

The necessity to generate derived products, rather than “only data” was considered fundamental for actual support.

The Kyoto Protocol information requirements, reflecting recent updates from COP-6.5 in Bonn, were presented by Yoshiki Yamagata. Important issues relevant to ALOS K&C:

- Forest/non-forest are defined wrt canopy cover ratio
- The canopy closure thresholds to be applied to be determined (within a range) by each individual country
- ARD definitions (Art. 3.3):
  - Afforestation: Other land use -> planting -> forest
  - Reforestation: Forest -> other land use -> forest
  - Deforestation: Forest -> non-forest
- "Temporarily unstocked" areas not counted as deforestation or reforestation
- Carbon trading with non-Annex-I countries (CDM) eligible, but limited to afforestation and reforestation activities only
- Eligible Art.3.4 activities include increasing carbon stocks (revegetation) in forests, croplands and grazing lands by management practices (e.g. thinning, fertilisation, conservation tillage etc.)

Discussions:
Do requirements differ for Kyoto and C cycle?
> Yes.

- Definition of forests: For Kyoto, countries choose from canopy cover range; for C cycle, forest definition is irrelevant
- Time reference: 1990 for Kyoto; for C cycle, doesn't matter
- Site prioritization: Kyoto applies primarily to developed (Annex-I) countries, although joint reforestation projects (CDM) in developing countries can be accounted for.
- Spatial resolutions differ. Kyoto generally requiring higher resolution (smallest mapping unit 0.01-1.0 ha), thus 20 m resolution or better. For Carbon ~100 m resolution can be considered high, although higher resolution (~20 m) may be required for land cover and biomass products in fragmented areas.

Can Kyoto reporting requirements be fully met with ALOS data?
> No. Issues include need to screen out non-human-caused effects (can't do only with remote sensing), and the fact that the Kyoto definitions are still evolving. Kyoto (and Carbon science) relates to changes in total carbon (above-, below-ground, soil and litter), while RS at best can provide info about the above-ground component. According to Jim Tschirley, TCO/GTOS felt they could not meet Kyoto needs but could provide some datasets to them.

Strictly, Kyoto only requires information about the forest status at the beginning and end of each commitment period (2008 and 2012), but it was argued that annual monitoring both provides for improved accuracy and a possibility to follow and understand the land use history of the land within each commitment period. No specifications on temporal sampling given for Carbon support, but an annual coverage was considered adequate in order to provide best possible accuracy in the biomass increment estimates.

Can we provide some datasets needed for Kyoto reporting?

>Yes. Identification of areas of land cover change is an important product we can provide. This goal requires regional consistency and repeatability, which are provided for in the current acquisition plan.

Does providing these datasets change the carbon-cycle-based acquisition plan?
> No.

This led to a discussion of which products we could actually provide.
Realistically, we can map biomass only up to about 50 tons/ha.
If we can derive yearly biomass increments, that could be used for Kyoto.
The need to link to historic datasets (e.g. JERS) may affect the way we acquire data.

It was duly noted that the operational life of ALOS most likely will not extend until 2012 and that follow-on missions (however not necessarily by NASDA) providing comparable data will be required.

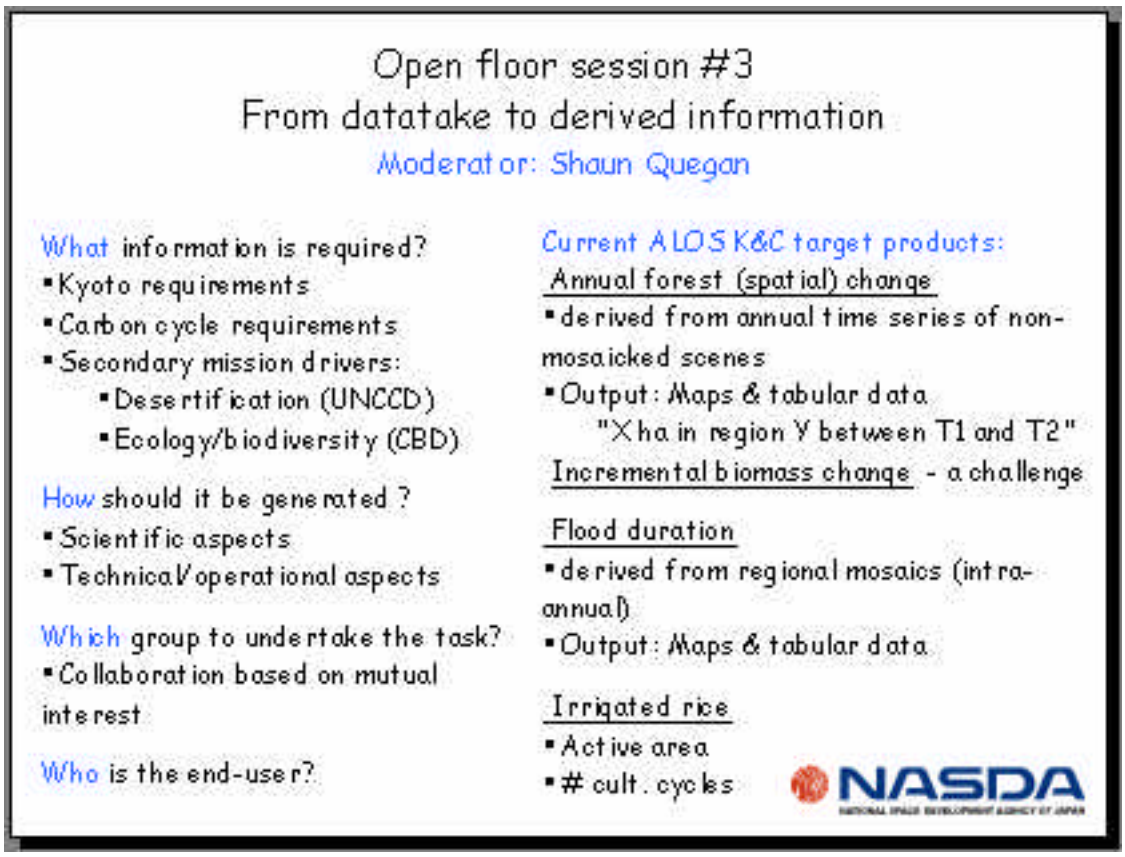
Action item (Ake + all): Using archived datasets, document which products we can or cannot provide with L-band data.

Action item (Shaun (forest)/Tony (woodland)): Curves showing relationship between regrowth biomass and sigma0 have been demonstrated for only a few sites and forest types. We need to determine if this relationship is reproducible over a range of types. Unfortunately, long time series of JERS are few, and they are affected by wet/dry season effects. We must use the data we have, then make an educated guess.

SESSION SUMMARY

- Information requirements for Kyoto Protocol vis. Carbon different, but not conflicting.
- Kyoto support would require finest possible spatial resolution (10 m at single-pol), but HV channel considered of superior importance, hence dual-pol acquisitions at 20 m were still considered an acceptable trade-off.
- Carbon support generally requires coarser resolution and even 100 m would often be considered high resolution. Finer resolution may still be required in certain cases.
- Support to both objectives requires the derivation of quantifiable/verifiable products, not only SAR data.

Open Session 3 From data take to derived information



The issue of output products and derived information is of fundamental importance and this will be the main subject of a forthcoming advisory panel meeting (during 2002; venue: TBD). During the present meeting however, the subject was confined to the issue of a broad and tentative identification of products that ALOS potentially has the technical capacity to support, and their conceived implications on the definition of the data acquisition strategy.

Systematic data archive

AVHRR, despite its limitations, has been widely used because it provides a useful parameter in a consistent, long-term way. This demonstrates the importance of maintaining a long-term systematic archive, whose establishment is one of the prime objectives of the ALOS K&C initiative (while not being a “product” as such).

“Products”

Potential products discussed: land cover, biomass change, disturbance, phenology, freeze-thaw, inundation extent and duration, paddy rice extent and cultivation intensity.

- Generation of products associated with land cover and biomass (changes) require **dual-pol** data with an ~**annual** temporal sampling over the satellite life-time
- Studies of phenology (in support to LC and biomass products) would require **dual-pol** data with a **semi-annual** (summer+winter; wet+dry) cycle, or better.
- Monitoring of (CH4 related) phenomena subject to rapid changes - forest inundation, agriculture - require **HH-pol** data **every cycle** (46 days) repetition, or better, during at least one full inundation/cultivation period (typically one year)

Timing problems with regional coverage, based on orbit repeat pattern: 17-day lag between adjacent scenes. Presumably not a major problem for (annual) forest change monitoring, but significant negative impact for studies of regional scale phenomena which change rapidly (e.g. wetland inundation, boreal freeze/thaw, irrigated rice). This leads to an increase in our interest in ScanSAR.

Would a freeze/thaw product be relevant by SAR, or do other instruments do the job better? The general consensus was that SAR has a role to play to pinpoint the onset of thaw in the boreal zone. Every-day coverage with ScanSAR during the spring time would be required. Lower spatial resolution no problem.

The effect on ascending (10:30 pm) and descending (10:30 am) on freeze/thaw needs to be assessed. Descending (or both) probably the desired option.

Who will make the products?
NASDA has limited capacity to produce verified products; in general, NASDA will provide the data, other groups must make the products (as in GRFM).

Nevertheless, NASDA has a desire to be a part of the product generation group, for instance by implementation of a "certified" algorithm (e.g. for forest/non-forest mapping) developed elsewhere (e.g. CESBIO/Thuy).

Siberia Project example: developing an operational, transferable, robust algorithm was neither quick nor cheap, but once algorithm was derived it could be quickly applied to large datasets. Similar approach can be conceived for NASDA.

Data vs. products:
On one hand, we agree that users need products, not data. On the other hand, "There's never been a data set like this before", i.e. consistent, long-term, and high-resolution.

Jeff Tschirley argued about the absolute need to go beyond "only data" as project output.

ALOS data products have to fit into the modelers' equations in order to be used. Question: How to get PALSAR into the models?

Action item (?): investigate feasibility of generating a disturbance map (annual forest spatial change) as a product

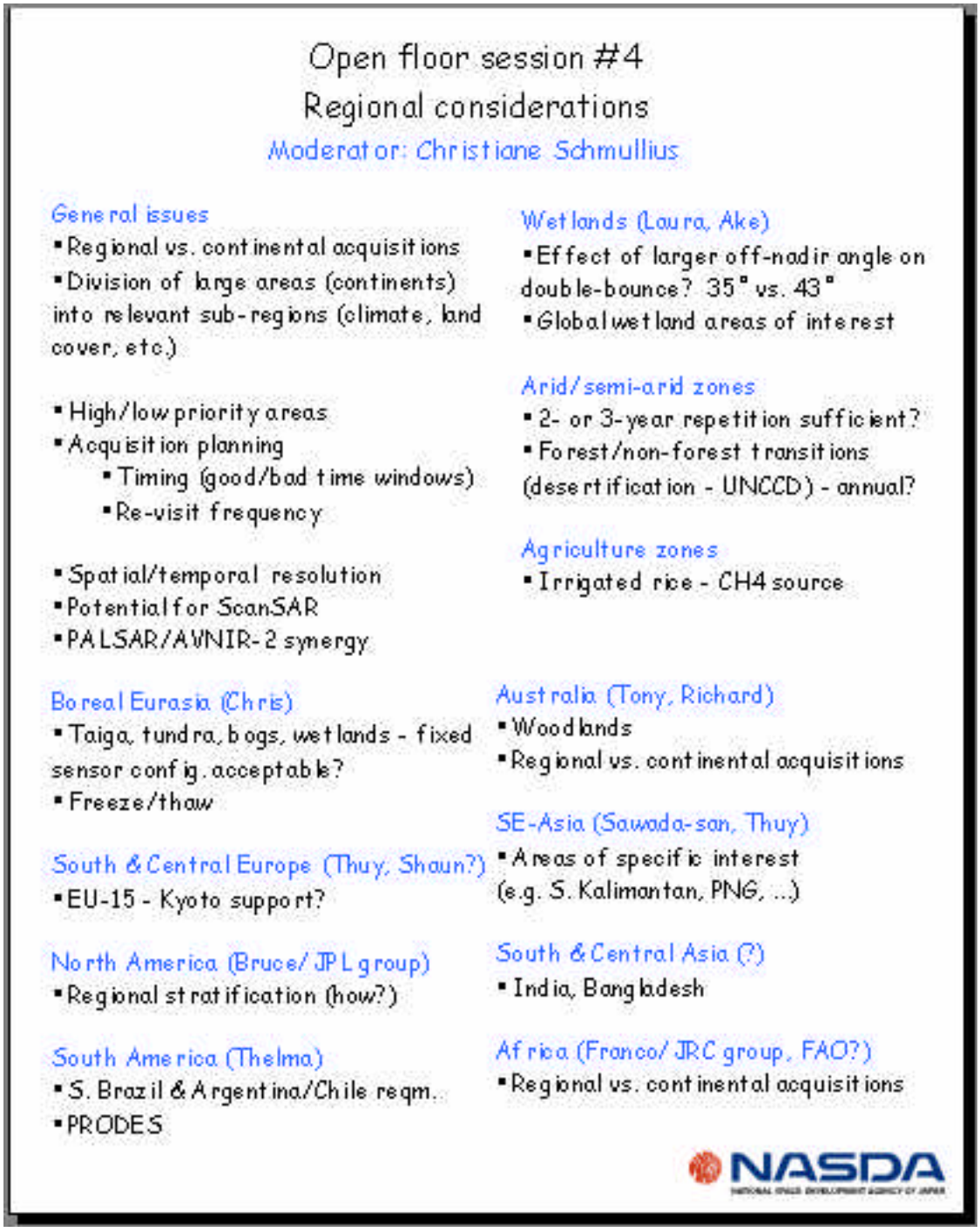
Action item (Shaun): Investigate capabilities of other sensors including Quickscat and MODIS for freeze/thaw mapping, to get a clearer idea of justification for ALOS freeze/thaw product: do other sensors have adequate resolution; do they map soil or vegetation f/t state?

Action item (Ake): Set up working groups for major products, drawing on ALOS PI team. This item morphed into: Ake will review ALOS PI proposals to identify PI's who could potentially be tapped to address action items.

SESSION SUMMARY

- Product issue recognised as fundamentally important, but only covered briefly. Will be discussed in depth during the next panel meeting
- Broad target products initially proposed within the initiative (forest spatial change; biomass incremental change, flood duration mapping, rice cultivation mapping) generally accepted
- Potential of land cover, phenology and freeze/thaw products also discussed
- The ALOS orbit configuration (17 days difference between adjacent passes) deemed unsuitable for monitoring of regional scale flooding phenomena. ScanSAR provides better temporal consistency (5 days difference between passes, 17 days revisit).
- Question - will the large incidence angle range and radiometric accuracy prevent operational use of ScanSAR?

Open Floor Session 4 Regional Considerations



Wetlands

- Global high resolution map of wetlands should be pursued.
- Wetland loss and biodiversity
- Inundation periodicity maps at high temporal resolution
- Tropical, sub-tropical, boreal; also consider coastal mangroves as separate unit
- Probably needs dual mode; utility of ScanSAR to be determined
- Inter-annual variation and need to address long term monitoring needs.

Arid

- Maybe not relevant to K and C

Semi-arid

- Address savanna dynamics (secondary project objective - desertification)
- Location and distribution of water bodies
- Again, utility of ScanSAR an issue

Agriculture

- Rice; total delineation at high resolution as baseline each year; regular sampling (?) or repeated total coverage on 46 day cycle.
- Paddy biomass estimations feasible?
- Land transformation?

Boreal Zone

- Freeze-thaw needs high temporal resolution data for the spring thaw period only (April – May)
- Yearly summer-winter (seasonal changes) also high-resolution continental coverage
- Ascending and descending passes for an/off switching of freeze-thaw cycling: is ScanSAR suitable?
- Boreal summer: July-Aug only; winter: Dec-Feb

Temperate forests

- High resolution, polarimetric coverage needed at least once per year with alternating seasonal dual-mode coverage
- Avoid spring-autumn acquisitions
- Temperate summer: June - August; winter: Dec-February (?)
- Europe & N. America - high resolution full pol for selected sites

South America

- Deforestation mapping
- ScanSAR (?)
- August acquisitions critical to monitoring (annual Landsat data acquired in August currently utilised operationally at INPE - PRODES project)

Australia

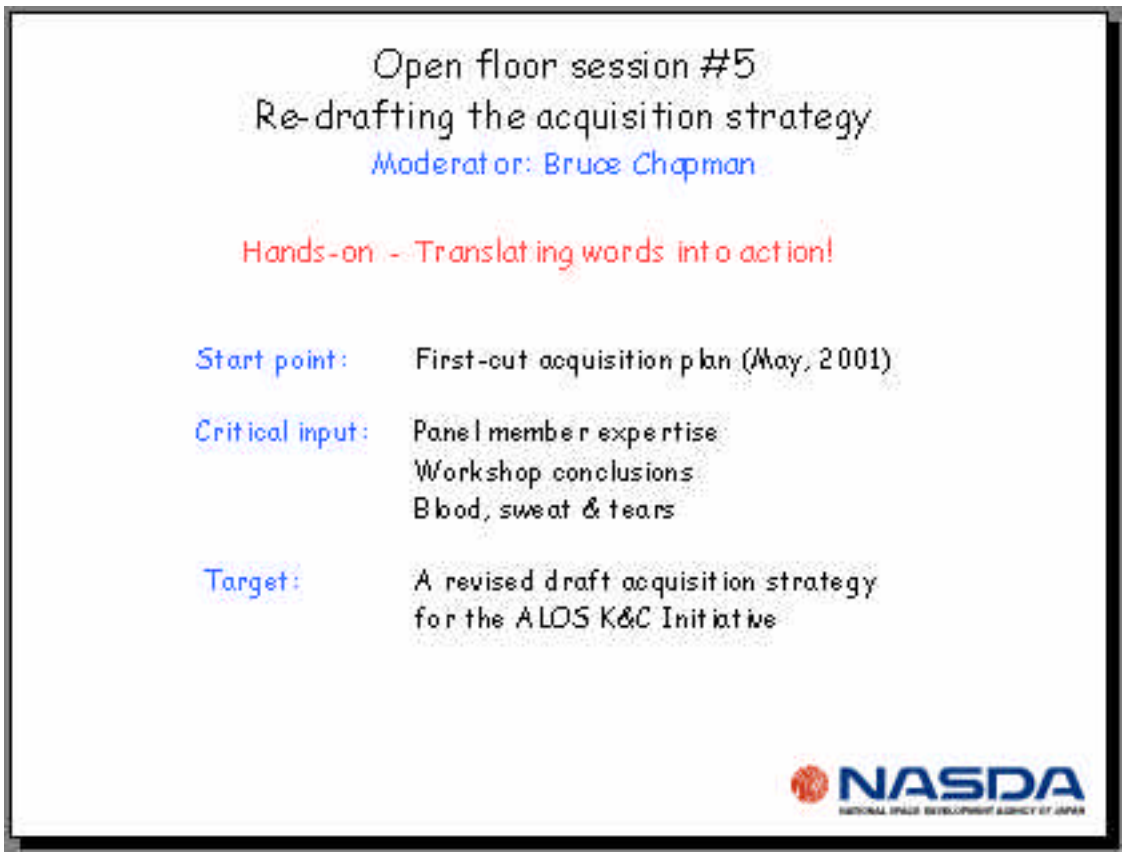
- Mapping cover types with boundary delineations between woodlands/grasslands and woodlands/forests important
- Determining structure and biomass of eucalypt forest and woodlands which are low biomass biomes
- monitoring changes especially land clearing and reforestation
- seasonality not as critical, but regionally based acquisitions should concentrate on summer acquisitions for northern Australia and winter for southern Australia
- continental assessment the objective
- need high resolution baseline data set, preferably polarimetric, with annual dual mode for monitoring

Action Item (Ake): Acquisition strategy for Southern South America, South-east Asia; Central Asia and Africa have yet to be specified.

Action Item (Laura): Provide information about global wetland distributions (whatever is available) and wetland hot-spot areas to Ake, to be included in the acquisition plan.

Action Item (Chris): Provide information to Ake on optimal targeting and timing of acquisitions for 1) temperate forest biomass and 2) freeze/thaw monitoring.

Open Floor Session 5 Re-drafting the acquisition strategy



The first-cut acquisition plan (distributed to all panel members in May, 2001) was presented by Ake.

Theme 1: Dual-seasonal change monitoring of carbon sources and sinks

- The acquisition plan was generally accepted
- The suggestion of down-sizing the plan to once-per-yer acquisitions was not approved. Dual-season acquisitions generally deemed valuable to understand phenology and improve LC classification and biomass models.
- In some regions (e.g. hyperarid), dual-season not considered critical.
- Regional stratification in current plan still coarse - needs to be refined.

Action Item (Ake): Refine the theme acquisition plan to reflect the discussions in the previous sessions.

Action Item (Panel members): Provide Ake with a climatological/ecological/etc. stratification of your region of expertise/interest, if you deem it necessary to stratify the data acquisitions (e.g. different ecological zones to be acquired during specific time windows).

Theme 2: Intensive monitoring of natural and anthropogenic CH4 sources

- Originally entailing high resolution coverage at 46-days repetition during 13 months for the Amazon, Congo and Ob basins + SE-Asia paddy areas.

- The inconsistent time sampling of the ALOS passes (17 days difference btw adjacent passes) will prevent the generation of meaningful regional scale wetland flood duration maps at high resolution.
- The theme to be re-assessed and the feasibility of utilising ScanSAR as an alternative mode. Implications: lower spatial resolution; (~100m), HH-pol only; better temporal sampling (17 days); better swath consistency (5 days).
- Inconsistent pass sampling may not have the same negative impact on rice paddy monitoring, as regional consistency is not an absolute requirement.
- Freeze/thaw monitoring potentially to be included as additional theme. ScanSAR the presumed mode. High temporal sampling during spring.

Action Item (Shimada & Bruce C.): ScanSAR processing & calibration

Action Item (Laura): Influence of large incidence angle range for wetlands

Action Item (Ake): Major revision of the theme acquisition plan

Theme 3: Land cover characterisation by polarimetric PALSAR and AVNIR-2

- The full polarimetric mode is considered experimental and the NASDA ALOS group has expressed concern for operational use and global coverage with this mode.
- Given these concerns, together with other technical constraints (reduced swath width at large off-nadir angles) global polarimetric acquisitions were deleted from theme 3 without opposition. The theme-1 acquisitions at dual-pol mode were considered sufficient to fulfil the project objectives.
- Full polarimetric acquisitions over selected hot spots ("super sites") were agreed upon.
- The need to maintain the AVNIR-2 acquisitions was not discussed. This issue remains TBD.

Action Item (Panel members): Panel members were invited to propose Super Sites to NASDA (Shimada or Ake).

SESSION SUMMARY

- Theme 1 (global, hi-res, dual-pol, dual season, during ALOS life-time): approved without major changes.
- Theme 2 (wetlands, hi-res, dual-pol, very cycle during 13 months): remains of major interest but the PALSAR acquisition mode selected has to be reconsidered due to the ALOS orbit configuration. ScanSAR as substitute/complement mode needs to be assessed.
- Theme 3 (global full-pol + AVNIR-2): Fully polarimetric acquisitions reduced from global to "hot spot" coverage. AVNIR-2 coverage still TBD.
- Based on workshop discussions and input from panel members upon request, Ake will provide a revised data acquisition plan by early 2002.