THE THIRD ADEOS-II AMSR November 10-12, 1998 WORKSHOP: MEETING NOTES

(Notes produced by SAIC under NASDA support contract with Mitsubishi Corporation: Gary Toller, Long Chiu)

Meeting Location: EORC, Tokyo, Japan

Tuesday, November 10, 1998

Welcome Session

Chairman: Tamotsu Igarashi
Senior Engineer, EORC

. Opening Address from EORC

Toshihiro Ogawa, Executive Director
EORC

ADEOS II Launch slipped to November 2000
Hope your research will be fruitful.

Akimasa Sumi
ADEOS-II Program Scientist

NASDA will draw on microwave group's experience; results should be reliable.
TMI data should be useful to AMSR.
Select algorithm for standard products, only a few will be selected
2nd research announcement will be out in December. It will focus on:
new research algorithm and validation, application of AMSR data, making use of AMSR –E and AMSR data as they become available.

. Current Status of AMSR Project

Nobuo Nakagawa
ADEOS-II Program Coordinator

Information provided before the presentation:
Tanaka-san will provide summary, conclusions, and is available to help with language translations.
SAIC will provide Workshop meeting notes.

Presentation:
Presented AMSR/ADEOS II status.
PI presentation of algorithm results will be the focus of this workshop.
Selection of standard algorithms was discussed, including the criteria for selection and the selection process. Workshop presentations will serve as a basis for algorithm selection.

Contractual: 2nd contract will start January or April 1999 for Japanese PIs. For foreign PIs, there will be a new contractual period from January 1 – March 31, 1999.
Current estimate is that the new PI selected for the RA will start approximately December 1999 (one year before launch) – November 2002 (two years after launch), a three year duration.
Schedules were presented including product releases and version upgrades at EORC and EOC.

. The Development of AMSR **Toshihiro Sezai**

EOS/NASDA

Presents AMSR prototype: multi-layer insulator is used to reflect solar light.
AMSR performance characteristics were presented. Sezai show AMSR performance characteristics and indicate that there were no areas of concern.

Questions, **A**nswers and **C**omments are in *italics.*

Q: Roy Spencer: Does the temperature resolution includes digitization?
A: Yes
Q: Craig Smith: temperature resolution indicates the NEDT?
A: Yes
Q: Elena Lobl: Did you do EMI test?
A: EMI test is performed with the engineering model, not the proto-flight model.
Q: Eni Njoku: What is the beam pointing angle accuracy? 1 degree?
A: I cannot remember the exact requirements. The alignment has been checked before and after test, and is OK.
Q: Cal Swift: For SSM/I and SMMR, we could regulate the load temperature to the feed horn. Are you planning to do the same?
A: The dummy load is kept at constant temperature. Liquid nitrogen is pumped to the load so that its temperature varies between 150 – 250K. In the space chamber, we have only one load. We used flow and condition of test in space chamber. We placed dummy load in front of feed horns. Temperature was high.
Q: Cal Swift: But you're not varying the load temperature at all? This could be a problem.
A: We placed only one dummy load in space chamber. Under a different Electronic Function Test, we used both low (liquid Nitrogen) and high temp. (room temp.).
Q: Elena Lobl: What were the values for the low temperatures shown in the temperature profile chart for the thermal vacuum test?
A: The low and high temperature chosen for these tests are those that are typical of the different modes of AMSR operations. In the thermal balance test, we used two low temperatures. The lower one corresponds to the survival mode and the higher one corresponds to the sleep mode. After the thermal balance test, we conducted the electric balance test.
Q: Eni Njoku: Can you comment on whether the performance, i.e., NEDT test results are within specification?
A: I do not have the data, but the results do not seem to show a problem.
Q: Elena Lobl: Did you check the linearity of the receivers?
A: Linearity tests were performed as part of the initial electrical functional test and final electrical functional tests. The linearity measurement was conducted using two temperature points.
AMSR meets the requirements of the development specification and the ICD.

. AMSR Data Processing System **Eiichi Sakai**

EOSD/NASDA

At first, we plan to use direct receiving.
The receiving subsystem sends mission data to the recording subsystem.
The recording subsystem makes Level 0 data from the raw, CCSDS packetized data.
The processing subsystem makes the standard product from Level 0 data.
EORC to use science S/W to produce standard products.
Current status: AMSR Level 1 data processing system is now at the final development phase.
We are preparing for CDR1.

. Enhancement for AMSR Data Distribution System **Shigemitsu Fukui**

EOIS/NASDA

Information services- Inventory search, browse search, data ordering.
There will be catalogue interoperability with NASA.
EOIS User-Interface S/W described.
On-line data distribution services described.
ADEOS-II data distribution is in NCSA-HDF format.

Q: Joey Comiso- For the binned maps, can we separate the night from the day data instead of daily?
A: Yes, it is available. They will be provided separately. The data can be distributed according to ascending and descending node, and day and night time mode. See page 6 of handout.

. High Level Product Evaluation System and Support for PIs **Kazuo Yoshida**

EORC/NASDA

Described the different functions for EOC and EORC.
Description of EORC function, equipment, use of equipment, data flow, data distribution, and support for PIs.

Q: Elena Lobl: What tools are you providing to the PIs?
A: The tools are to read HDF data.
Q: Paul Hwang: What do you mean by match-up data?
A: Co-located satellite and ground data.
Q: Elena Lobl: Where is EOC in the data flow viewgraph?
A: It is on the left side, producing the standard products.
Q: Paul Hwang: I think your separation between EOC and EORC function is similar to our EOS system DAAC and Science team computation system. EOC is similar to DAAC and EORC to STCF(science team computing facility). But, our science team leaders don't do data distribution
Q: T. Igarashi: Who is the distributor of your data?
A: Paul Hwang: The DAAC. They do all the data distribution and standard product generation as well. Validation will be done by team leaders at the science team computing facilities (STCF) that show similar functionality to your EORC.

C: Yoshio Ishido: We have two main issues for ADEOS-II data distribution. How can we distribute data quickly and how to handle mission operations? EOC group will be formed to manage data production and distribution. Mission operations, as presently conceptualized, will be a separate activity at EOC.

C: Paul Hwang: Standard product production will not be performed by EOS-DAAC, but will be given to science team leader to create standard product and perhaps research product. This is called PI mode processing. DAAC will provide just archiving and data distribution functions.

Q: Roy Spencer: Why are you changing it?

A: Paul Hwang: Our original contractor was too expensive and was not delivering the product. Costs became high. Science team leaders had responsibility of producing the algorithm, and they have the expertise and S/W and the H/W, hence may be more cost effective to perform product generation at the science team computing facility.

C: Yoshida: EOC cannot change our design too much. Usually EORC will run production at night automatically and perform algorithm/program change at day time.

Q: Elena Lobl: Is there a simulated data set that we can use for our tests?

A: Eiichi Sakai: We are preparing such data. The data set contains the data in the right format for testing.

Q: Elena Lobl: Can you send it to us? When?

A: I will check and announce it to you.

<Lunch Break>

Pre-afternoon presentations:

Explanation of Shibata-san radial picture displayed in the morning session:

The figure shows the view of the low temperature calibration source. The outer circle indicates 180 degrees of sky view. The purpose of this chart is to find the location that will not hide the low temperature source. Mitsubishi produced this chart after study. Here is the maximum field of view with respect to the low temperature source. Ocean/land temperature is sensed by the primary reflector on left-hand side. Two lower arcs are supports for the primary reflector. S/C bus on right-hand side. Temperature varies depending on which side of the Earth the spacecraft is on → rhs shading.

Q: Paul Hwang: Is this simulation from a normal situation?

Q: Elena Lobl: Couldn't you put the cold side reflector to locations where it had minimal effect from other bodies?

A: Yes.

C: Elena Lobl: Pick the direction where you see clear cold sky.

C: Igarashi: Maybe antenna gain is not so high at 180 degrees.

C: Elena Lobl: TMI sees very little of the solar panel.

C: Shibata: Normal sky temp is 2.7K, nominally 3 K; worst situation is 3.5 K.

Q: Elena Lobl: Do you know when to use these numbers? You don't.

Q: Paul Hwang: Where is the sensor on this diagram?

Q: Elena Lobl: If you tilt the antenna up, would it improve this picture?

A: No. This is the best position for ADEOS-II, but not optimized due to other ADEOS-II considerations.

eport Session

Questions, **A**nswers and **C**omments are in *italics*

. Report from Calibration Scientist **Akira Shibata**

Leader of the Calibration Team

He showed AMSR calibration. Sensor response linearity good to < 0.1K, and beam efficiency of 95%.

Q: Can you tell us how the calibration was done?
A: I don't understand how they measure input and output temperatures. I will check with Mitsubitshi engineers.
Q: Elena Lobl: Is the % contribution over the beam measured or calculated?
A: It is calculated from the model using measured data.
Q: Elena Lobl: Will you do this initial check on AMSR E also?
A: Yes.

. Report from Science Team Activities **Akira Shibata**

Leader of AMSR PI Team

Presented AMSR/AMSR-E algorithm development activities, algorithm development schedule, and CPU load
Launch + 6 months: tuning of algorithms, selection of standard algorithms for SST and soil moisture.
Launch + 18 months: Reselection of standard algorithms
Q: Elena Lobl: The Wentz program calculates everything together, so how did you split them up?
A: Craig Smith: We change the program to handle each variable separately.

Shibata presented selections of standard algorithm candidates as of October 29, 1998.
Water Vapor: Takeuchi and Petty
Cloud Liquid Water: Wentz and Vonder Haar
Precipitation: Petty or Liu
Sea Surface Wind Speed: Shibata
Sea Ice Concentration: Comiso
Snow Equivalence: Chang and Koike

Nakagawa: Algorithm comparison data is included on the AMSR CD-ROM provided last year. Please take a copy of the CD-ROM.

[Close of this morning's session.]

Afternoon session started with the explanation of the view graph presented by Shibata on the sky view of the cold calibration source.

Q: Elena Lobl: The position of the cold source in the TMI is raised so that it sees very little of the solar panel.
A: Akira Shibata: The cold sky temperatures are 2.7K, 3.0K and 3.7K for nominal, normal, and worst case.
Q: Elena Lobl: but you don't know what temperature to use?
A: Akira Shibata: The configuration is optimal for ADEOS-II. The main error source is the main reflector that senses land or ocean temperature.
C: Roy Spencer: The problem with the TMI is not the cold calibration problem, but rather relates to some stray radiation to the main reflector. Additional data supports this when the TRMM satellite is flipped for VIRS calibration.
C: Chelle Gentemann: The biases associated with TMI is the same for all frequencies, hence it is not related to the cold calibration source. If it were, the biases should be frequency dependent.

. Report from Validation Scientist **Toshio Koike**

Leader of Validation Team

Validation activity has not started yet. Team needs to prepare AMSR validation plan. GEWEX plans to implement Coordinated Earth Observing Period (CEOP) and prepare data set for this period. Data sets include soil moisture, snow, vegetation, atmospheric heating and cloud. GEWEX is planning on test sites of area100 km x 100 km, and CEOP is planned for year 2001-2002.

Discussion then focuses on the reconstruction of AMR.

Q: Elena Lobl: When will the AMR be re-constructed?
A: Toshio Koike: Earliest time frame is one year from now.
C: Nobuo Nakagawa: I want to point out some concerns of NASDA: 1) stability issue, and 2) cost. The first relates to the technical capability, i.e., how stable can we get? NASDA will decide on the reconstruction of AMR issue this year.
C: Toshio Kioke: I want to suggest that the AMSR science team make the recommendation to NASDA that the reconstruction of AMR should be done.
Q: Tom Jackson: On the cost of flights for validation, do they include flight time?
C: Joey Comiso: You mentioned validation for all parameters except sea ice.
A: We will discuss it tomorrow.
C: Grant Petty: There are a number of inter-comparisons for precipitation. Most algorithms for precipitation agree well in tropics but disagree in those areas where there is no validation, especially high latitudes and away from the tropics. Do you have plans for high latitude ocean validation?
A: Kioke: High latitude validation is important. We have plan for one site in the Japanese seas.

C: Kazumasa Aonashi: We will make use of TRMM data in the subtropics (Ishigaki island). Validation at high latitudes is important, and we want agreement with the AMSR E team. Koike has planned to observe snow in Japan region.
C: Roy Spencer: AMSR-E team agrees that we need extra-tropical rainfall validation. It is a weak link.
C: Elena Lobl: The joint team will discuss AMSR E validation on Thursday.

0. Report from AMSR-E Science Team R.W. Spencer

MSFC/NASA

AMSR-E team completed s/w beta review at MSFC. Science validation plan was submitted. Peer review of ATBD are upcoming. He then showed Science data products and product generation flow and indicates that AMSR team will request a cold sky calibration, which was first requested by the MODIS team. For precipitation validation, discussion focussed on TRMM. There are big discrepancies between TMI and PR rainfall. However, both Kummerow and Wilheit noted independently that the two results could be reconciled with a different DSD. Also, it was noted that there are a number of hot spots in TRMM data.
C: Eni Njoku: The hot spots can be problematic for soil moisture.

Spencer presented AMSU limb corrected 23 GHZ channel from NOAA-K that shows the hot spots. The data are available from **エラー！ 参照元が見つかりません。**
Hot spots occur over metropolitan areas.
C: Paul Hwang: The current status is that the EOS PM1 S/C will do the cold space maneuver as recommended by the EOS science team. The AM1 S/C have different modes (tilt operation). The project now requires that the satellite have the capability to accommodate all maneuvers.
C: Roy Spencer: The slow drift of the platform through the diurnal cycle is crucial to monitoring climate change at local times. You need to keep the satellite at the same local observing time if you plan to make long-term data sets.
C: Eiichi Sakai: What H/W do you need to implement the calibration?
C: Roy Spencer: L1B calibration is NASDA's responsibility. Both NASA and NASDA/EOC will receive real-time Level 1 B data from EORC. A joint Japanese-U.S. team will decide on calibration, and NASDA will carry out the calibration.

Chell Gentemann showed diagram of RFI hot spots.
C: Eni Njoku: N. Europe C-band spots have also been found.
Chelle Getemann showed TMI-SSMI biases, which shows higher TMI TB of about 10K and decreases with temperature. The biases are uniform over all frequencies.

1. Report of Evaluation of Water Vapor and Liquid Water Algorithms Tadahiro Hayasaka

Tohoku University

Evaluation of Water Vapor algorithms
Some viewgraphs are in the bound AMSR document, p. 30.

Algorithm results are compared SSMI derived and radiosonde data. Histograms of the errors are presented. Offset value should be distributed around zero, and standard deviation small for a good algorithm. We examined these statistics for all submitted PI algorithms. The differences between PI algorithms are small.

C: Grant Petty: Most of the algorithms are similar. The differences become larger for regions with rainfall or rain clouds.

A: When we consider water vapor in the region where the clouds exist, we have to use microwave remote sensing data.

Q: Grant Petty: If SSMI data indicates rainfall, then ….

A: We have not done such analyses. We do not have good data for the cloud liquid water path, so we use GMS, AVHRR.

Evaluation of Cloud Liquid Water

There are no in situ measurements of CLW, hence CLW are inferred from remote sensing data of GMS, AVHRR or upward looking radiometer. The channels 1 and 3 of AVHRR or GMS can be used to detect particle radii from which CLW estimated. The CLW AVHRR or GMS estimates can be used to compare CLW derived from SSM/I. The two sensors are not synchronized, however. He showed maps of AVHRR and SSM/I CLW.

2. Evaluation of Precipitation Algorithms

Kazumasa Aonashi
Meteorological Research Institute

He presented summary of algorithm selection process. Initially there are three algorithms, Adler, Petty, and Liu. Adler’s CPU requirements are ten times others, and hence not selected due to resource limitation. Adler’s algorithm will be used by the AMSR-E team for product generation. The major discrepancies among the algorithms are the high latitude precipitation. He plans to get data from New Zealand to validate the discrepancies.

Shigaki Island will be a ground validation site. A higher latitude site will be constructed at 37 degrees North latitude.

Test performed at EORC.

CPU load comparison.

No objective validation data set available yet to distinguish between the different performance noted in the high latitude southern hemisphere.

Validation plans include the use TRMM data and ground validation sites + high latitude sites and comparison with NWP centers.

C: Grant Petty: I analyzed 34 years of ship data that can at least provide the occurrence of precipitation. My analysis showed a higher frequency of precipitation than is indicated by most algorithms.

C: Kazumasa Aonashi: The point is, we need objective information to provide confirmation.

3. **Evaluation of Ocean Algorithms**

Akira Shibata
EORC/NASDA

SST and Sea-surface wind speeds

For SST, not all PIs have submitted their results for comparison. Dr. Petty apologized for not sending in his algorithm results because he heard there is some concern about the calibration with AMR, and hence expected that the inter-comparison will be delayed. NASDA indicated the use of TMI (rather than AMR) data for SST inter-comparison.
C: Craig Smith: Given 21 points and 21 regression coefficients, we can do a perfect regression, which would tell us nothing. We did not do the regression.
Q: Toshio Kioke: How do you evaluate atmospheric effects on SST retrieval?
A: Usually, SST will be determined under fine or cloudy conditions.
Q: Roy Spencer: Does your SST retrieval algorithm include the Cloud Liquid Water correction?
A: Yes it does.

Sea surface wind speed:
C: Craig Smith: All algorithms perform nearly equally. Perhaps the discriminating factor is in light rain and cloud conditions.
C: Grant Petty: The coverage is also different. Number of pixels thrown out might be another consideration for evaluation.
C: Roy Spencer: There is crosstalk between surface wind and cloud liquid water.
C: Grant Petty: The root mean square (hereafter, rms) error contains both systematic and random biases. One might choose not to minimize rms in order to minimize crosstalk error. The cross talk error can be more serious than random error. The cross talk error can be more worrisome than the total rms error.
A: Shibata: Yes.
C: Leonid Mitnik: It is important to recognize the observing conditions. Sharp changes in wind are associated with roll cloud formation. Such small-scale phenomena are more important for AMSR than for SSM/I since AMSR has higher spatial resolution. There are organized variations in SST and sea-surface winds in visible and radar (real-aperture) images correlate strongly. Need to take into account specific weather conditions.

4. Report of Sea Ice Algorithms

Fumihiko Nishio
Hokkaido University of Education

Science requirements for the selection of sea ice algorithms are that the algorithm minimize cross talks, and the algorithms have to be global (for both northern and southern hemisphere). Three algorithms are submitted: Bootstrap, NASA team, and Okhotsk algorithm.

Selection results: selecting both bootstrap and NASA team algorithms and apply the land filter (Okhotsk algorithm).
Sea ice concentration difference between the two methods is 10-15%. Comparison with visible/IR imagery (binary for coverage) was performed.
Using AMR data on Okhotsk Sea “first year” ice, the VTR images were compared with the two algorithm results to determine the correlation with sea ice concentration. He proposed to select the bootstrap algorithm with the addition of land filter, and append the NASA team data set for the algorithm.
Q: Don Cavalieri: Did you include the NASA thin ice algorithm?

A: Kohei Cho: No, since it is complex, and some subroutines have not been included in the source code.

5. Report of Soil Moisture and Snow Water Algorithms **Toshio Koike**

Nagaoka University of Technology

Four PIs delivered candidate algorithms. To evaluate algorithm performance of the four candidates, we performed validation using SSMI retrieved soil moisture vs. Russian soil moisture match-up data set.
Q: Toshio Koike: I need a clarification. Eni, do you use 19 H V and 37 H, V?
A: Eni Njoku: Just 19 H and V for retrieval and the other ones for classification.
My own algorithm result is graded "poor", but it is not tuned. We will discuss my algorithm in tomorrow morning's session. I think we can improve the result by using the low frequency channel.
NASDA will provide PIs with the SMMR and the Russian soil moisture match-up data set just after this meeting. NASDA requests that all PIs send their results before February 1999.
Based on the result from the SMMR and Russian soil moisture data sets, we will select 3 algorithms as the candidates for the standard algorithm. NASDA will select 3 soil moisture algorithms and the SST algorithm in February 1999.

For snow, I added the effect of vegetation in my own algorithm. There were some mis-communications between NASDA and Professor Tsang, so NASDA could not implement his latest algorithm. Algorithm performance was checked using 100 GTS stations' snow depth data.
C: Grant Petty: There is almost no correlation for both snow algorithms between algorithm and validation measurements.
A: We need to check correlation over the whole cold season.
C: Grant Petty: I see large differences in the algorithm results over the Tibetan plateau.
A: There is no ground data to indicate which is right.

Closing Discussion:
C: The cold calibration is not the source of TMI's problem. We know it's not the cold sky.
C: Showed SSMI and TMI brightness temperatures, offsets.
C: With Earth behind the antenna, some small percent of the Earth (300 K) may be seen as a source when looking at cold sky.
C: Chelle Gentemann: We compared the main antenna minus the cold mirror for all frequencies.

ADEOS-II AMSR meeting Day 2 (Wed. November 11, 1998)
Parallel session(room A): Precipitation

Questions, **A**nswers and **C**omments are in *italics.*

Wind, Vapor, and Cloud Algorithms for SSM/I and AMSR

Craig Smith
for Frank Wentz
Remote Sensing Systems

Project develops surface wind, vapor, CLW for SSM/I and SST for AMSR

- TB simulation model
- Algorithm overview
- Baseline channel sets and NEDTS

Objective: to develop AMSR algorithms for SST.
The results of the study for AMSR channels can be extended to CMIS, SSM/I
Use of collocated data for deriving algorithms
All algorithms are derived from simulated brightness temperatures, with withheld data set for validation.
Algorithm is developed for all parameter ranges, but is not optimized for inter-comparison of AMSR algorithms. 42195 radiosonde observations for all four seasons, 7 cloud models and 20 ocean surfaces are used. The AMSR ATBD (AMSR-E) can be found in the Web.
The initial set uses no precipitation signal for SST algorithm development. Regression (least square) analyses were performed. Cross talk between SST and Vapor (V) were minimized by imposing Ts-Tv < 10K.

Q: Cal Swift: Why do you use an NEDT of 0.1K for 6 GHZ? The NEDT for AMSR 6 Ghz is 0.3K as presented yesterday.
A: Roy Spencer: The AMSR 6 GHZ footprint is close so that averaging many samples to less than 0.3K does not affect spatial resolution.

Two version of SST were developed. Version A suffers from cross talk. Version B has less cross talk effect, but tends to underestimate high wind W > 14 m/s

Q: Cal Swift: you include wind direction effect?
A: Yes.
Q: Grant Petty: For match-ups, do you use resolution matching?
A: Yes.

Results:
For AMSR: total rms down from 1.1 m/s (SSM/I) to 0.6 m/s.
For AMSR water vapor, rms is reduced from 1.17 to 0.35 mm.

For cloud liquid water, three algorithms were developed - for no rain, moderate and heavy rain cases. To discern cloud signal inside rain signal, they use all algorithm results and solve for cloud and rain effects.
For SST, the version that minimizes cross talk between SST and V shows rms of 0.46 C.
For TMI SST, sensitivity of 10.7 and 6.9 GHZ are very close for SST > 15C. They applied algorithm to TMI data and showed the 1998 El Nino and La Nina transition.
Their SSM/I precipitation algorithm retrieved too much rain, which they think may be due to beam filling correction (Wentz and Spencer 1998).

Q: Roy Spencer: why do you not see any lower SST when compared with MCSST?
A: Chelle Gentemann: The MCSST is highly averaged, so many errors are averaged out.

Assessment of Atmospheric Structure Effects on Retrievals of Total Water Vapor Content, Total Liquid Water Content and Precipitation Rate Using Microwave Sensor and Development of These Products With Accuracy Information

Yoshiaki Takeuchi for Tokuhito Yoshizaki

Japan Meteorological Agency

Japan Metorological Agency
He recently moved to the numerical prediction division of JMA.
Purpose: develop algorithm for total water vapor, CLW, Rain RR, and precipitation with AMSR.
His concept for MSC algorithm are: it is valid for all dynamic range; use of indices which increase monotonously with target, hence non-linearity does not introduce complexity by the use of lookup tables; algorithm is simple for real-time processing; the use of a priori information, and accuracy flags are supplied.

His algorithm uses a simple non-scattering 1-D radiative transfer model. Land mask and sea ice mask (the latter by TB thresholding) are included. Surface emissivity model employs Fresnel reflection and a statistical SST and surface wind relationship. The mean air temperature, Ta, used is a function of 850 mb temperature. The transmittance values used are based on calculations using an iterative method, the results of which are very stable. Post processing are performed to correct for heavy rain cases.
The rms error for his water vapor algorithm is similar to other PI algorithms, the bias and cross talk are smaller, and his PWA algorithm is selected as candidate algorithm for AMSR
LWC algorithm shows large rms error with a negative bias.

The rain rate algorithm first decides the rain category for the rain pixel and then the rain rates are calculated from look up tables. The rain rates are then integrated to get total precipitation. His algorithm uses the relation between 19 GHZ and a difference ratio (37 V/H - 0.5 19 Y/H -0.4) of polarization of 37 and 19 GHZ.

His algorithm for water vapor and CLW is based on simple radiative model and statistical adjustment. It is selected as AMSR candidate algorithm

Q: Craig Smith: Do you plan to use AMSR channel for you retrieval?
A: The lower frequency for AMSR is useful for rain rate. For precipitable amount, we will use 24 GHZ H.

Algorithm for precipitable water, CLW

Daren Lu
Chinese Academy of Sciences

Project develops algorithms for precipitatable water (PW), cloud liquid water (CLW) and precipitation over land and ocean. The techniques used are as follows:
PW - statistical over ocean
PW – neural network (NN) based
LW - physical statistical based,
PPT - probability pairing
RR - SOM (NN) based

They have developed microwave radiative transfer model for simulating precipitation cloud models. The purpose is to examine relation between Tb and PW, IWP, and RR, and hence can be used to for transfer to AMSR channels. He has limited rain data over land. For their statistical approach, they first select good data points and then divide the data into low, medium and high PW categories. Their results, which were published, perform better than three other results published in the open literature.
The neural network (NN) algorithm, called self organization feature mapping (SOM), first performs classification of the rain rate categories. Regression were then performed on the classification results. Different training sets are developed for global, and high and low latitude regions, respectively.

With CLW algorithm, they used radiosonde data and atmospheric model calculation to derive CLW. They found that changes in TB between cloudy and clear sky are linearly proportional to integrated water path (IWP). They found the use of 37 V GHZ channel is best suited for IWP and the use of AMSR data alone is inadequate. They also found a linear trend between 37 and 19 GHZ.

Retrieval of rain rate (RR):
First they examine the trends on TB and difference. Their approach is the use of probability matching. A suitable rain index is first identified, and then empirical matching is performed. The rain indices considered are 1) scattering index from Ferrero, 2) logarithm of TB, 3) Absorption based indices. The correlation between indices and rain rate has been examined for typhoon, Beiyu fronts, and Meiyu cases.

Validation results:
The correlation coefficients are rather high for these indices for probability pairing method over ocean. For PPT over land, a similar probability matching approach is adopted. They found that the use of scattering index is best since it contains most of information content for high rain. Modifications have been developed for land algorithm, but they yields no good results.
They SOM algorithm performs supervised clustering. Since there are very few cases of high rain rates, binning at the high rain rate is performed. The correlation coefficient is 0.8 between rain rate and the index. For high rain rates, the SOM technique will tend to underestimate. This may be due to insufficient data at the high rain rate category for training. To remedy this lack of high rain

rate data, he will simulate high rain data for training. Simulation will include Kummerow's (1991) model for strong convective case and stratified rain model.
His results showed that the SOM algorithm for convective rate is good for RR > 8 mm/hr.
The 6.9 GHZ is insensitive to high level clouds, but very sensitive to low-level clouds.

Summary
He has improved RR retrieval over ocean by use of probability matching; improved of RR over land by the use of model based retrieval algorithms; and use of statistical technique for IWP and water vapor.

Q: Guosheng Liu: For your SOM, what is the training and validation set? Are they independent?
A: We use all NASDA data, and training and validation sets are independent.
Q: Toshio Kioke: What kind of clouds are you using? Your values are very large.
A: They include rain clouds.

AMSR pre-launch retrieval algorithm for WV, SW, CLW, and precipitation

Grant Petty
Purdue University

Objective: demonstrate applicability of algorithm using SSM/I, make algorithm simple, and to show that the SSM/I algorithm can be transferred to AMSR algorithms.

Most of the algorithms are sensitive to rain. He chose algorithms that are less sensitive to cloud and rain effects. Current approaches to algorithm development include 1) inversion of pure physical retrieval, 2) in situ match-ups, 3) regression of simulated Tbs.
Their compromised approach is based on actual SSM/I data, the use of model to adjust SSM/I channel to AMSR channels, and to perform regression against the AMSR simulated Tbs. TB adjustment procedures are as follow: start with match-up data set, use the SSM/I algorithm to estimate IWP and SW, and then use a model to predict SSM/I and AMSR TB for the same scene.

His water vapor algorithm uses SSM/I radiosonde observation (raobs) match-ups. Linear regression analyses were performed between TB and raobs. Non-linear corrections on the residue error are then carried out. The results for SSM/I algorithm show rms of 3.09 mm, and 3.10 mm for AMSR algorithm. The current algorithm degrades less than other algorithms for high rain.

Major problem for CLW is signal to noise, i.e. the challenge is to eliminate cross talks between SST and water vapor. The noise is about the same for both clear and cloudy cases.
The validation of CLW would involve 2 issues: 1) Cloud-free cases that showed no or low CLW and 2) spectral signals should be consistent with theory. Cloud-free cases are identified as pixels with minimum 85 GHZ variations within a 19 GHZ footprint. He calculated absorption for both 85 and 37 GHZ. The results show no biases between 85 and 37, hence suggesting consistent spectral response.

C: Guosheng Liu: I like your approach to transfer SSM/I to AMSR algorithm.　For liquid water, the channels are very different for the 22 GHZ band.
A: Because of the non-linearity, the high sensitivity is in 19 GHZ rather than in the 22 GHZ.

A NN approach to retrieve atmospheric parameters over ocean from microwave radiometer data

Cecile Mallet for Claude Klapisz
CNET/CETP

The advantage of using NN for retrieval is that the problem is a non-linear inverse problem. NN required simulated database. The database is the profile and surface data provided by ECMWF, from which TPW, LWP, RRL, RRI are computed.

Report of LWP and TPW retrieval: NN is a 2 layer model (input layer and hidden layer) with 5 nodes. The rms errors and biases are small for LWP and TPW. NN outperforms log-linear regression algorithms. Inter-comparisons were also performed with the Wentz, Petty and log-linear algorithm. The NN shows low bias for TPW compared to others.

Precipitation retrieval:
The retrieval considers both stratiform and convective situations. Stratiform cases characterized by horizontally stratified homogeneous layers, and explicit microphysical description of hydrometors are needed. For convective case, there is horizontally heterogeneity and statistical description of rain cells is required.

Q: Paul Hwang: Do you take half of data set for training and testing? Have you changed the training sets and validation sets?
A: No, the performance is about the same because we take uniform distribution of parameters.

<lunch>

Determination of atmospheric water characteristics using AMSR

Guosheng Liu
Univ.of Colorado

Proposed research: to produce standard product - CLW and precipitation and study non-standard product - cloud ice water path and precipitation type.
Activities:
  Improve precipitation and CLW algorithm, and made available to EORC
  Participate in EORC’s algorithm inter-comparison
  Deliver algorithm to EORC
  Investigate transition from SSM/I to AMSR algorithm
  Cloud ice retrieval
Publications - JMSJ, 76, 335-343, and one submitted to JAM.
Algorithm for precipitation uses predetermined threshold parameters based on Liu and Curry (1992). Thresholds are improved to be seasonal and location dependent, and comparison with GPCP AIP3 and PIP 2 and 3 cases, and with TOGA-COARE, and rain gage climatology over GAME/HUBEX were made. For TOGA COARE comparison, moisture convergence from other studies gives average of 129 W/m**2 and whereas P-E, with P computed using current algorithm, gives 130 W/m**2. There are differences in the time series.

C: Roy Spencer: you use SSM/I which gives one to two snap shots per day. Hence, the difference may be due to sampling.
A: Yes.

Over land, comparison with GAME/HUBEX of 1951-1990 rain gauge and 92-95 satellite rain climatology are good, hence he is confident that land algorithm is not far off.

To transition from SSM/I to AMSR, he noted that his SSM/I algorithm only uses two parameters- polarization and polarization corrected temperature (PCT) for SSM/I. Radiative transfer code were written and improved to calculate these same parameters for AMSR. The differences between these SSM/I and AMSR parameters are small.
Currently he is improving on the algorithm and evaluating the impact of the addition of 10 GHZ, and assessing the use of 89 GHZ in mitigating the beam-filling correction for AMSR.

For research products, he is using SSM/T-2 data. Ice water path are computed and compared with rainfall derived from SSM/I. Since both are based on scattering signal, he wants to find a relation between surface rain and scattering signal. He concluded that scattering signal is useful for evaluating surface rainfall.

Q: Grant Petty: Can you show your definition of f? In your formulation, you have equal weight for both scattering and emission signals. Why not treat them separately since one mechanism may dominate in certain cases?
A: For convective rain, the scattering signal may contain grouple.
C: Roy Spencer: 85 GHZ may contain dendrite information. The emission may give you convective information, and the scattering signal gives you some sort of temporal sampling, since the anvil which gives scattering signal, last longer.

Retrieval of water vapor and liquid water path

Tadahiro Hayasaka
Tohoku University

His algorithm is based on radiative transfer calculations applies to ocean region.
His algorithm first uses 37 GHZ to classify clear and cloudy regions. The cloud pixels are further divided into precipitating and non-precipitating cloud.

Comparison of his algorithm using SSM/I for July 1993 with NCEP analysis showed his algorithm tends to over-estimate. But from comparison of NVAP analysis of column water vapor, his results are closer to NVAP in tropics, but over-estimate in high latitudes.

Liquid water path and ice water path compare poorly with ISCCP, his algorithm results may be twice as large as ISCCP results. The ISCCP cloud liquid path is obtained from visible reflectance and effective cloud particle radius, assumed to be 10 um. The linear dependence on cloud particle radius suggests that if this parameter (cloud particle radius) is underestimated by a factor of 2, cloud liquid from ISCCP is under-estimated by factor of two. Further comparison with AVHRR, which is temporally off by about 3 hours with SSM/I passage showed comparable results. Cases where the two differ may be due to cloud beam filling. Cloud shape is another source of error. He performed radiative transfer Monte Carlo calculation for different cloud shapes and found that the effective particle radii differ for plane parallel and broken cloud cases.

Summary:
WV algorithm over estimate to NVAP
CLWP slightly over-estimate due to beam-filling and cloud shape problem

C: Grant Petty: DSD and inhomogeneity are error sources for visible/IR estimates. For non-precipitating cloud, there is no non-linearity for the classical beamfilling problem.
C: Roy Spencer: I thought he meant beam filling for VIS/IR.
A: I include all clouds.
C: Guosheng Liu: Hence you mean all liquid, not just cloud liquid.
C: Grant Petty: Then you do have the beam filling problem, as well as all other problems associated with retrieval of other parameters as well.

AMSR Land precipitation algorithm status

Jeffrey McCollum for Ralph Ferraro
NESDIS/NOAA

Their algorithm is based on Goddard Profiling (GPROF) algorithm. The goal is to produce AMSR estimates similar to NOAA/NESDIS SSM/I over land. Basis of algorithm is Ferrero and Marks 1995 paper.
Status: They have combined cases of rainfall profiles and binned them to 1 mm/hr bins. He showed their case studies for 1993 which demonstrated that GPROF pattern is similar to NOAA/NESDIS algorithm, but quite different from radar observations.
Their next step is to implement the algorithm for GPCP and improve the algorithm using TRMM data. The GPCP is trying to produce daily 1 x 1 degree lat/lon rainfall.

Q: Guosheng Liu: For the CONUS comparison, do you use the wet hours? Your results will hence depend on the low rain cut off of your algorithm.
A: Low cutoff is 0.6 mm/hr. If any sensor indicate rain, all other sensor data will go in the database for comparison.
C: Petty: Radar tends to underestimate rain rate by a factor of two. Land precipitation is again a signal to noise problem. The Ferraro algorithm calculates the background noise and subtracts it from the signal.
Q: Daren Lu: Where is the data from? The gage shows almost no seasonal variation.
A: The continental U.S.

Direct assimilation of multi-channel microwave Tbs into a meso-scale NWP model

Kazumasa Aonashi
Meteorological Research Institute

Data used for assimilation are SSM/I data, and the model is the regional prediction model with resolution of 30 km at JMA.

Q: Roy Spencer: does it contain explicit or parameterized convection?
A: Arakawa Schubert parameterization is used.

The assimilation is based on a one-dimensional variational approach which minimize the cost function. Liu's radiative transfer model is used to calculate the Tbs from model. Different models are used for rainy and no rain situations. In rain situations, precipitation rate is the dominating factor for assimilation and humidity and cloud water content are main contributor to assimilation in no rain situations.

Parameters used for assimilation are T, Q, Qc from NWP model. Rain type is determined from model vertical profile. Surface precipitation is inverted for each level, and GATE statistics are used to simulate inhomogeneity effect. The variations of TB with respect to the variables are calculated using finite difference method. For rainy points, statistical rain profile from GATE is used.

Forecast experiments are performed and compared with Shibata's precipitable water retrieval. There are discernible differences between forecasts with and without assimilation.

Summary: Project has developed direct assimilation method using 1Dvar to incorporate SSM/I generated rain flag and TB, and technique has been applied to TOGA-COARE data.

Q: Grant Petty: The SSMI coverage is incomplete. Does the assimilation affects the environment outside of the SSM/I path?
A: There are gaps in the assimilation cycle, but there are other satellites, hence sampling is considered adequate. The assimilation affects regions outside the assimilated regions. There are cases where the wind speed is affected.
Q: Toshiaki Takouchi: Can you apply the assimilation to tropics and high latitudes equally well?
A: We will need fast computers for full radiative transfer calculations. We need to find cases for high latitude assimilation.

Algorithm development for global Measurement of SST **Calvin Swift**

Univ. of Massachusetts

Algorithm is based on D-matrix approach, with parameters determined by regressing against ground truth. SST are derived from NOAA buoys and AVHRR SST. Criteria for match-up are 25 km from buoy and 30 minutes within satellite overpass.
Errors due to instrument noise are 0.6K for AMSR and TMI and 2K for SSM/I algorithm.
TRMM comparison was announced by NASDA in September 14, and TRMM data are released on September 15, hence project have little time to work on TMI SST.

Q: Grant Petty: Cross talk between SST and vapor is crucial. Do you think the D-matrix approach is taking care of the water vapor problem?
A: We plot residues. We want to keep residues flat. Polarization information is surface sensitive.

<Break>

Retrieval of SST **Arai and Yasunori Terayama for Kohei Arai**

Saga University

Arai algorithm is based on Cox and Munk and Wilheit model. Surface emissivity is treated as a function of temperature, wind speed, and salinity. Simulation study include wind from 0.- 14 m/s, salinity 36 ppt, temperature 270 to 350K. Simulation shows 0.11 K and 0.14 m/s rms for SST and wind speed, respectively. With AMR data, which showed large biases, rms of 1.6 K and 0.32 m/s found respectively for SST and surface wind.

Q: Craig Smith: You used a emissivity weighted SST model. Do you correct for atmospheric effect?
A: No.
Q: Grant Petty: Do you include instrument noise?
A: The standard deviation of noise for simulation is 0.1 K, with no bias.

Retrieval of atmospheric and ocean surface parameters for non-precipitating conditions for AMSR **Leonid Mitnik**

National Central University

The project develops both SSM/I and AMSR algorithm for water vapor (V), cloud liquid content (Q), SST, and wind speed W for non-precipitating conditions.

By first assuming SST is determined, they developed V and Q algorithms. These algorithms are developed using the Klein and Swift and Ellison (1998) sea surface permitivity, respectively, in SST retrieval. Validation studies of SST algorithm showed high SST variability near Gulf-stream case when compared with AMR data. SST retrieval over large spatial gradient region has error of 1 - 4K.

He developed a NN approach to retrieving W using NASDA's data set. NN algorithm showed error of 1.2 m/s versus 2.2 m/s using GSW algorithm. NN performance improved if data are stratified according to stability.

Conclusion: Quality of Ground truth data is crucial in algorithm development. He suggests that data sets be shared for inter-comparison purposes. Regional algorithms should be considered to take into account local phenomena such as cold air outbreaks. It is important to develop physical, statistical and NN approaches.

C: Craig Smith: I examined the Ellison paper. It shows for zero salinity, the permitivity does not reduce to the static permitivity.
A: I agree. Their paper indicates that the dependence is not strong.
Q: Grant Petty: How are you accounting for air-sea difference?
A: It is not an easy problem. It is necessary to use coefficients.
Q: Grant Petty: The Tb algorithm is more appropriate for wind stress. Shall we change to call it stress, rather than wind speed algorithm?
A: Wind speed is the commonly used parameters.

Q: Paul Hwang: Only aircraft data can be used to resolve high-resolution variability. How are you going to resolve that for satellite observations?

Algorithm development for AMSR SST and sea surface wind speed **Akira Shibata**

EORC/NASDA

Frequencies used for the SST algorithm are 6V, 10V, 6H, 10H, and 37V and 23V. Frequencies were corrected for incidence angle, atmospheric opaqueness, land contamination, surface wind contamination, and salinity effects. Data set needed are global land, surface wind from global analysis and atmospheric opaqueness.

Application of his algorithm to the 10 GHZ data of TMI shows a 0.7K error for monthly SST. Monthly maps of SST for 1998 are produced which showed the 1998 El Nino and La Nina transition. Over typhoon areas, depression of SST is also noted for TMI derived SST.

Future work will include sun glitter and surface wind effect and anisotropic effect due to wind direction.

Surface wind speed:

Scattergram of 37 and 19 GHZ shows 19 GHZ increases with wind speed.

Future develop will include AMSR low frequencies, based on algorithm developed using the 10 GHZ channel of TMI.

C: Guosheng Liu: for wind speed, many data points are needed for generation of the figure.

<Break>

Smith presented figure of water vapor retrieval by Wentz et al. At moderate rain rate (15 mm/hr) water vapor retrieval is limited. Re-analysis showed region of validity up to about 8 mm/hr.

Discussion Period:

Shibata showed slides for calibration and validation. He asked PIs to send in comments. Shibata asked for suggestion of island and shorelines for the calibration.

Swift suggested the use of coastline in the north coast of Spain for geometric check, and rain forests for black body check.

Petty questioned if microwave signals for rain forests are uniform.

Mitnik suggested that tropical rain forests at night are very uniform and can be used as blackbody check.

Shibata indicated that NASDA do not have temperature data over forested areas. Mitnik suggested the use of WMO temperature data.

Spencer said that the list that Shibata showed for calibration and validation is a good.

Petty cautioned that there are be bias in radiosonde data. Spencer pointed out that all US radiosondes have been standardized.

Spencer pointed out that small error (1%) in emissivity in Amazon may introduce 3 K, hence 3K difference in AMSR calibration cannot be trusted.

Validation

Petty introduced a new water vapor validation source, i.e., water vapor retrieval from GPS measurements. .

Aonashi commented that there are over 1000 GPS stations in Japan area, mostly over islands. It is therefore possible to use GPS water vapor for validation.

Swift suggested the use of other satellite data for validation, such as SSM/I, TMI.

Aonashi pointed out the need to validate against in situ measurements other than satellite data.

Mitnik pointed out that the same technique for water vapor validation should be used for other satellite data sets.

Petty explained the procedure used by operational weather operators. They map the vertical profiles as linear for relative humidity between layers, and pressure in log pressure. Hence for integrating columnar water vapor, the group should take their procedure into account. He also pointed out that the humidity error in analysis method is less than the uncertainty in radiosonde measurements.

Hayakawa suggested the use of ground based LWP and the use of distributions such as lognormal distribution for validation.

Petty argued that there is no physical basis for CLW to be log-normally distributed. The upward looking radiometer is probably the most physical approach. Hence he suggest more effort should be spent to gather non- raining cases. He also argued that for CLW validation, more emphasis should be on the physics and statistics.

Aonashi reiterated the precipitation validation plan using radar network in Japan and the maintenance of Ishigaki Island. Analyses of TMI rain rate data also suggest the need for measurement of drop size distribution (DSD).

Petty pointed out the need for high latitude measurements to resolve the high latitude rain discrepancy for different algorithms.

Q: Paul Hwang: are you worry about land contamination?

C: Grant Petty: Radar measurements at far ranges are poor when it gets out to regions far from land contamination.

C: Guosheng Liu: Gages are needed to calibrate the radar.

C: Leonid Mitnik suggests the possible use of Taiwan radar.

C: Guosheng Lu pointed out the need for vertical profile to discern stratiform and convective rain type.

C: Akira Shibata: We have enough SW and SST match-up for validation.

C: Elena Lobl points out that she will present AMSR-E validation plan.

ADEOS-II AMSR meeting Day 2 (Wed. November 11, 1998)
Parallel Session(room B): Soil Moisture, Snow, and Sea Ice

Chairman: Toshio Koike

Questions, **A**nswers and **C**omments are in *italics.*

Mapping the Spatial Distribution and Time Evolution of Snow Water Equivalent Using the AMSR

Leung Tsang
University of Washington

Using two versions of algorithm.

Q: Elena Lobl: What are the products?

A: Snow depth.

Inversion is non-unique if snow grain size and density are variables.

We overcome non-uniqueness by iterative inversion using a neural network approach. Snow hydrology model provides initial estimates of snow parameters (version 1). We use a neural network inversion for the retrieval of parameters. We do the inversion using SSMI measurements.

Version 2 algorithm is now implemented. It replaces precipitation data with weather forecast model to provide the input for the snow hydrology model. It allows grain size and snow density to evolve with time. Version 2 estimates the snow parameters using a multi-parametric inversion algorithm that incorporates a priori information, particularly grain size growth.

Q: Elena Lobl: What is the product?

A: Snow depth. The dynamic variables are snow depth, snow grain size, and snow density.

Q: Elena Lobl: Is the study on constraints on snow grain size growth empirical?

A: Yes.

Q: Don Cavalieri: What do you mean by number of days from the day of snow season when SD= 5cm.

A: Measured from time when snow depth equals 5 cm.

Q: Joey Comiso: What happens if you have some melting?

A: We don't consider melting.

Q: Eni Njoku: What does the grain growth depend on?

Q: Is grain growth empirical?

A: Empirical by working backwards with version 1 output.

Q: Joey Comiso: Do you have graphs showing how well you replicate grain size?

A: At this moment grain size growth is empirical, based on version 1 output.

C: Elena Lobl: You have a .5 x .5 degree grid. Do you calculate pixel by pixel snow depth?

A: Yes, in our final product.

Q: Joey Comiso: If your estimates are off, does it affect your results? What's your sensitivity to initial estimates?

A: We tried a case with inaccurate precipitation estimates. We have well-constrained grain size growth.

Q: Elena Lobl: Should 85 GHz be incorporated?

A: We haven’t studied that.
Q: Eni Njoku: Do you use all 4 channels (19 and 37 H and V)?
A: Yes.
Q: Eni Njoku: With AMSR, you have 6.9 and 10.7. Do those channels add anything?
A: They don't do much because at low frequencies the snow becomes a transparent layer.
Q: Toshio Koike: Is the vegetation effect included in your algorithm?
A: No. The vegetation effect can be easily included because the hydrology model has a vegetation component. The vegetation component can be included in the absorption layer.
C: Toshio Koike: Maybe you get good result at the GTS station, because that station is used in forecasting.

Snow **Toshio Koike**

Nagaoka Univ. of Technology

Radiative transfer approach as the physical basis for snow study.
Forest canopy included in the determination of snow temperature.
We calibrate the temperature at 37 and 90 GHz horizontal polarization.
If we assume the density and the particle size, and we get the observed brightness temperature at 37 and 90 GHz, then we can estimate the snow depth and the snow temperature by using the look-up table.
We use Look-up tables of snow depth and temperature for different values of NDVI.
For small values of NDVI, we usually overestimate the snow.
Shows plot of estimation versus observation.
Q: Cal Swift: Is there saturation beyond 60 cm?
A: No.
Q: Joey Comiso: What grain size do you assume?
A: 0.6 mm
This version does not include the effect of the change in grain size. Except for surface effect, the grain size does not change much under very dry conditions. This version includes the effect of vegetation.

Soil Moisture **Toshio Koike**

Nagaoka Univ. of Technology

The index of soil wetness is the frequency difference of the land surface.
Vegetation effect included.
Soil moisture dependency on Polarization Index (PI) shown in the case of bare soil.
Plot of index of soil wetness (ISW) vs. PI.
We can make a look-up table using a model.
Frequency dependence for single scattering albedo included.
This approach lets us measure soil moisture and the vegetation water content simultaneously.
We measure the surface ground temperature using AMR data.
Model not tuned.
Q: Eni Nkoku: What parameters would you modify to get a better estimate?

How would you improve your results in different areas?
A: The important parameter is the relationship between the optical thickness tau and the water content of the vegetation. I also measure Leaf Area Index (LAI).

Soil Moisture Algorithm for Grassland Regions Using C-band Radiometer Measurements

Tom Jackson

ARS/USDA

Activity overview: 1) Formulation of soil moisture algorithm, 2) Ancillary data base development,

3) Field experiments, 4) Algorithm validation

Our algorithm is based on the inversion of the Fresnel equation for horizontally polarized emission. Ancillary data sets are needed for soil moisture inversion. Microwave sensor measures the dielectric constant. The inversion of the dielectric constant requires soil texture.

Q: Elena Lobl: Which frequency do you use?

A: We use the longest wavelength (lowest frequency) available.

Q: Joey Comiso: Is ground temperature obtained from satellite?

A: It's from the weather forecasting model prediction, not the soil temperature per se.

C-band radiometers leased from Geoinformatics placed on aircraft. Collected data over 4 flight lines, 5 km swath, 10 km apart, 250 km long.

L-band, 400m resolution, H polarization. Also examined C-band and SSMI image.

Getting a huge range of temperature variation (80K), which is a lot of information for soil moisture retrieval compared to SSMI. It is encouraging that the C band behaves more like L band than like SSMI. We are working to evaluate the data quality and to provide a sequence of images like the ones shown here.

Q: Eni Njoku: Is this V polarization data?

A: This is V polarization data. Later we used H polarization. For soil moisture, Vpol has a smaller dynamic range than Hpol, so Hpol will be better than what we see here.

MIR Priroda: It had all the frequencies we needed to evaluate the retrieval. The 13 GHz channel, H and V, worked consistently; other channels had some problems. We acquired two days of data prior to the docking accident. Data set looks good, but the data is not extensive enough.

Validation: actual surface soil moisture vs. algorithm. Standard errors = 2.6% at L-band (1.4 GHz), 5.3% at 19 GHz.

In the future we can try to improve the vegetation correction.

C : Toshio Koike: We would like to discuss the validation plan.

Q: Elena Lobl: Did you do the results pixel by pixel?

A: Yes.

Monitoring of Soil Moisture and Vegetation Biomass by Using Microwave Radiometry

Simonetta Paloscia

Nello CARRARA

Using polarization characteristics.

LAI provides tau.

Characterize soil moisture at L and C bands.

Soil moisture content (SMC) can be retrieved based on the polarization index (PI) at 6.8, 10, and 19 GHz.

Proposing an algorithm with only 3 curves of PI(6.8) GHz as a function of SMC for 3 different values of vegetation biomass.

Analyzed SSM/I Russian data set. The SMC of some ground stations have been retrieved using the PI both at 19 (soil moisture) and 37 GHz (for vegetation).

Using SSM/I data and soil moisture content over Russia, we observed that the PI and the soil moisture content are well related.

Using PI (37 GHz), we can separate two or three levels of biomass.

PI at C-band can retrieve SMC in different conditions of roughness and vegetation biomass.

Using the PI at 10 GHz, the LAI of several crops can be estimated and a correction for vegetation effect can be included in the SMC algorithm.

A preliminary algorithm was suggested until further data could be analyzed.

AMSR Soil Moisture Algorithm Development

Eni Njoku

JPL

Algorithm structure and AMSR-E data products: 1) multi-frequency iterative retrieval of surface soil moisture, 2) vegetation water content, and 3) surface temperature. The algorithm starts with L1B or L2A AMSR data. The iteration proceeds until the brightness temperature computed from the model matches the observed brightness temperature within some tolerance. Ancillary data bases help with classification and the initial guess. We use a forward radiative transfer model.

Q: Elena Lobl: Are you using the dynamic ancillary data?

A: We can either use them (e.g., skin surface temperature or precipitation) or not. They appear to have only a small effect on the retrieval results. Right now, we're not using them.

Algorithm retrieval analysis is done using SMMR data. Estimates of retrieval accuracy have been obtained based on the number of iterations and the chi-squared value.

Q: Tom Jackson: You’re not saying you can retrieve SMC within 2% are you?

A: This simulation does not include model error. It assumes a perfect radiative transfer model. It is intended to show the effect of brightness temperature noise and to indicate the effect of radiometric noise and to tell you where things break down. The retrieval algorithm does retrieve the 3 parameters with a seasonal cycle that is consistent with expectations.

Q: Tom Jackson: What local time did you use?

A: We used local midnight SMMR data. The diurnal information, if you could get it, also has information on soil moisture.

We took SSMI data and ran it through land classification algorithm, summer and winter. We did not perform validation.

We looked for trend between brightness temperature and soil moisture. The slope of the relation has several dependencies. The slope and offset of the regression line have a dependence on the polarization difference (19 GHz Hpol, Vpol).

C: Tom Jackson: The dependency is rain fed agriculture. Temperatures rise in the same season that rainfall increases.

Q: Don Cavalieri: Have you looked at the polarization ratio? That would eliminate temperature dependencies?
A: Yes. We didn't find it useful in this case.
Q: Kohei Cho: Can you tell us more about the algorithm as applied to the Russian region?
A: It is a hierarchical decision tree.

[Lunch Break]

A High Resolution Sea Ice Algorithm for the AMSR

Don Cavalieri

NASA/GSFC

Clusters in PR(19) plot vs. delta GR are due to open water (OW) and consolidated sea ice.

Q: Cal Swift: When we did weather corrections, we seemed to see indications of floes going away from the ice edge.

A: Yes, we see that.

Q: Elena Lobl: These are really floes?

A: Yes.

Comparing NASA team, bootstrap, and new retrievals:

Our atmospheric radiative transfer model is doing a good job.

The new ice concentration retrievals in the outer pack are much higher than in the NASA team output.

Q: Elena Lobl: Do you have ground truth data?

A: We have some that I'll show, but we need to do more analysis.

New retrievals along the Ross ice shelf are doing better in the outer and inner pack.

Retrievals in Northern hemisphere.

Data from National Ice Center in D.C. using visible, IR, and radar images was used for validation.

The new retrievals represent an improvement in several regions. It provides improved sea ice concentrations in areas of thin ice and surface inhomogeneities.

Q: Joey Comiso: Do you have the radar image for the D.C. data?

A: No.

Canadian RadarSat image for Alaskan coast used for qualitative validation.

Q: Kohei Cho: Is the RadarSat normal mode or scan mode?

A: I'm not sure.

The new sea ice algorithm utilizes 18.7, 36.5, and 89 GHz H and V AMSR channels, radiance ratios, an atmospheric radiative transfer model, 3 radiometrically different ice types.

Q: Joey Comiso: Show the scatter plot with the 3 ice types. Points along the AC line may be a combination of AB and open water. How do you correct for that?

A: We use the rotated polarization and the delta GR.

Q: Kohei Cho: This is a new thin ice algorithm. Are you going to submit this to NASDA for consideration?

A: Yes.

C: Toshio Koike: Please submit before the R.A.

Enhanced Sea Ice Concentration and Ice Temperature Algorithms for AMSR

Joey Comiso

NASA/GSFC

Provided scientific rational.

Categories of sea ice: Grease ice, pancakes, nilas, young ice, first year ice, multi-year ice.

Bootstrap parameterized using flights over both poles.

Location on a channel 1 vs. channel 2 plot provides sea ice concentration. Open water and 100% ice provide fiducial (reference) points.

Compare brightness temperatures in different channels. Equations convert this into an emissivity comparison at 2 different channels. Good distinction for sea ice concentration at 6 GHz, but resolution is not so good.

Use IR data to obtain surface temperatures that we convert to ice temperatures. The temperature correction based on AVHRR will be different than that obtained from AMSR.

The bootstrap algorithm is reasonably accurate. We examined OLS data and obtained very good consistency.

The enhanced ice concentration algorithm minimizes the errors due to spatial variations in ice temperature. Ice type classification is needed for a complete characterization of the ice cover. Different types of ice have different emissivities. Emissivity varies with season.

Q: Toshio Koike: Do you have any more thermal bands?

A: Yes, that would be useful.

Q: Kohei Cho: Are you going to propose this algorithm as the standard algorithm for AMSR?

A: It is the standard algorithm for AMSR-E. We can't test it further until we get AMSR data.

Q: Elena Lobl: You don't use any ancillary data?

A: Not now.

Sea Ice Concentration Intercomparison

Fumihiko Nishio

Hokkaido University of Education

Global warming will effect Okhotsk Sea. Sea ice concentration there shows long-term (20 year) decline. Need land filter to study Okhotsk Sea.

Studies on Sea Ice Concentration Using Airborne Microwave Radiometer in the Okhotsk Sea

Fumihiko Nishio

Hokkaido University of Education

Video images correlated with bootstrap and NASA team algorithms.

V-polarization brightness temperatures correlated with bootstrap and NASA team algorithms.

VTR images correlated with bootstrap and NASA team algorithms.

Surface temperature at 10.764 um compared to AMSS 20_1_ch 45.

Emissivity from AMSS and brightness temperatures from AMR. Emissivity plotted against V and H polarization at several frequencies.

Would like combined GLI:AMSR algorithm.

Open Discussion:

Q: Don Cavalieri: Is AMSS available for validation studies?

A: Fumihiko Nishio: Yes, and perhaps AMR too.

Q: Toshio Koike: Urges reconstruction of AMR.

Q: How much will it cost?
A: A million dollars..
A: Toshio Koike: Stability of low noise source is not good, so calibration is not stable. We will use 450 K hot source and interpolate the calibration. It is very stable.
C: Elena Lobl: OK if rest of electronics is linear.
Q: Eni Njoku: What kind of noise source is it?
A: From Mitsubishi Elec. Co. proposal
C: Eni Njoku: But you have to assume linearity anyway.
C: Elena Lobl: This could cause problems.
C: Toshio Koike: We need to test linearity over the lower temperature region.
Q: Elena Lobl: Do we have 2 polarizations for each channel?
A: Yes, with one exception.
C: Fumihiko Nishio: Koike suggests strong requirement for airborne instrument. All frequencies need to be reconstructed.
C: Toshio Koike: Please prioritize the frequencies for the validation program.
C: Tom Jackson: AMR is bulky.
C: Don Cavalieri: You need a scanning radiometer to cover many pixels.
C: Joey Comiso: You want to identify the type of surface you're looking at. All you need is a good imager.
C: AMR has 6.9 (soil moisture), 10.6, 18.7, 23, 37, 89 GHz.
Q: Eni Njoku: What else do we have that we could use?
A: Polarimetric scanning radiometer-c (PSR-C). 6 GHz is separate from the higher frequencies. Need another set of electronics to fly all channels together. Use PSR-C and PSR for soil moisture.
Q: Kohei Cho: Can the DC-8 come over to Japan e.g., to observe Sea of Okhotsk?
A: Yes, but it would be expensive.
C: Tom Jackson: I have asked questions about the PSR C-band calibration and geolocation issues. The answers have been good.
C: Eni Njoku: L and S band are at JPL, but the frequencies are different than AMSR. It's like research rather than validation.
C: Elena Lobl: AMPR is a non-scanning, 10-85 GHz. The two polarizations are not time-coincident.
C: Tom Jackson: Cal has Step-C, fixed beam horn antenna, dual polarization, 5-7.2 GHz. ACMR, GSFC, fixed beam, C-band, dual polarization.
C: Eni Njoku: ACMR is planned for this fall.
C: Don Cavalieri: AMMR is old and doesn't include C-band. It has 10-37 GHz; AMMS is 90 GHz scanning.
C: Eni Njoku: There is a wind radiometer (Windrad) at JPL. I think it is 18 and 37 GHz.
C: Elena Lobl: C-star, 37 GHz, conically scanning, two horns, one gives you H and V, the other provides +- 45 degrees.
C: Toshio Koike: Combination of PSR-C and PSR as a validation candidate.
C: Elena Lobl: But we haven't seen any data from them. PSR-C and PSR can be flown on DC-8 or P3.

C: Simonetta Paloscia: IROE has L, C, X, Ku, Ka available from Italy.
C: Elena Lobl: HUTRAD covers 6-89 GHz; only the 89 GHz is scanning.
C: Toshio Koike: NASDA should consider whether to go with AMR repair or with alternatives represented by the above options.

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Group B reports: Chairman: Toshio Kioke

Snow and ice team

Tsang reported that he requested operational precipitation data from the Numerical Weather Prediction Center to test out his version 2 algorithm model. He proposed the use of NCEP and ECMWF analysis precipitation as input to his hydrological model.

Kioke version 2 algorithm includes the effect of vegetation and the PI introduced by Paloscia. The algorithm was validated using GTS station data and AMR data for analysis.

Jackson analysed C-band data obtained from SGP'97. His results indicated that Proroda low frequency data cannot be obtained.

Paloscia modified her algorithm for application to SSM/I, Russian match-up data set. She obtained reasonable results after classifying land surface vegetation conditions.

Njuko performed a simulation study using SSM/I. Results compared well with the soil mositure budget from NCEP analysis.

Validation Plan for Snow and soil moisture (SM)

Snow validation should be performed in cooperation with NASDA, NASA, and CEOP.

Validation regions: Siberia, Mongolia, Tibetan Plateau, Canada and northern USA.

Snow depth, snow water equivalent, and grain size temporal variations should be monitored.

The effect of canopy should be confirmed by airborne sensors.

Validation for SM should be performed in cooperation with CEOP.

Regions of interest include tundra in Siberia, Mongolia, Tibetan Plateau, Thai, Oklahoma, Amazon forest, Tundra in North America, Australia, and West and South Africa.

Airborne, dual polarization and imaging sensing and C-band measurements should be taken. Potential sensors include PSR-C, PSR (I), IROE (P), HUTRAD (P).

SGP '99 should be very important for pre-launch validation.

Hayasaka pointed out the need for coincident measurements of atmospheric profiles and noted that we will measure land surface, atmosphere, precipitation, clouds and water vapor.

Sea Ice group report Fumihiko Nishio

Stach, Japanese instruments will be flown onboard US aircraft.

The Bootstrap algorithm has a new version.

Research products are Don Cavalieri’s new NASA team algorithm and the Okhotsk algorithm with land and weather filter.

Validation plan:

1.Use high resolution satellite imagery such as Landsat, SPOT, SAR, and GLI.
2.It would be nice to have aircraft field campaign data.
3.Use of AMR/AMSS
4.Sites selected for Northern and Southern Hemisphere

Mitnik pointed out the potential contribution of SAR data and ENVI-SAT data to validation. He also discussed the data from Russian real aperture Radar. NASDA indicated that cooperative plans between Japan and Russia for studying the Okhotsk region. Comiso also discussed the joint international effort for the Okhotsk experiment, during which time Japanese instruments will be flown onboard US aircraft.

Group A report: The Ocean and Atmospheric Group

Shibata showed the slide he presented on calibration and monitoring. The main means of calibration will be by cross-calibrating with TMI.

The technique is extrapolating data backward, and the error may be large, especially down to about 100K. There is also the problem of non-linearity (due to the large extrapolation). Spencer noted that there are many problems associated with the calibration of the 6 GHZ, and that the knowledge gained in the use of another hot load is useful. Aircraft attitude changes affects brightness temperature determination. The problem is especially severe for SST retrievals.

Validation plan for IWP and CLW Tadahiro Hayasaka

1. MRI plans to use GPS measurements to monitor water vapor changes. These data are available for AMSR validation.
2. Use of radiosonde data: The issue of how to integrate vertically to get columnar IWP was raised. It was agreed that a standard technique should be adopted. A similar technique should be developed for CLW.

Validation plan for precipitation Shibata on behalf of Aonashi

1.Use of Japanese radar and gage network.
2.Ishigara Island radar
3.Joint activities with USA for TRMM validation site.
4.Koike reminded the team that his group is planning to take snowfall data in the Japan area.

Ocean Validatation

1.SST: use of buoy, GLI, AVHRR, VIRS, and MODIS products.
2.Wind: SSM/I wind, buoy, SeaWind; comparison have to take into account the different AMSR (10 km) and SSM/I (25 km) resolution.

Mitnik presented Real Aperature Radar data which showed small-scale features.

Field campaigns

Swift pointed out the difficulty of comparing the small scale structure detected from field campaigns to AMSR data.ot been decided. He then questioned the team's strategy if AMR reconstruction is not approved. Kioke responded that foreign sensors will be used instead. Regarding the request to NASDA for AMR/AMSS reconstruction, NASDA has a plan to hire a contractor to investigate the technical and cost benefit.

Spencer recommended that the Mitsubitshi engineers study a paper published by Zhang Mo who looked at the non-linearity and cold calibration of a microwave radiometer.

Variables such as water vapor and CLW can be retrieved more accurately from satellites than from operational analysis. Spencer agreed, but pointed out the need for observed data to convince others.

Spencer asked Mitnik about the Russian Space Plan. Mitnik said he will receive clarification next week. He expected the Real Aperature Radar (RAR) to be useful for the determination of surface wind and precipitation. Russia is expected to launch an ocean satellite next year with RAR. The RAR will have a 1-3 km resolution, 12 m antenna, 0.12 degree beam width, and on-board X-band and side scanning microwave radiometer.

Okuda closed the meeting by thanking the AMSR team. He reiterated the functions of EORC, which are to distribute data and support research and development. He emphasized the need for cooperation from all AMSR team members to make the ADEOS-II a success.