

# **SMOS L2 Soil Moisture Processor Activities & Algorithms**

Presented by:

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**Array Systems Computing Inc.  
Commercial in Confidence**

# Presentation Overview

- SMOS L2 Soil Moisture Consortium
- The Development Process
- An overview of the Level 2 SM algorithm
- Output Products
  - User Data Product (UDP)
  - Data Analysis Product (DAP)
- Future activities
- Array strengths and possible collaboration areas

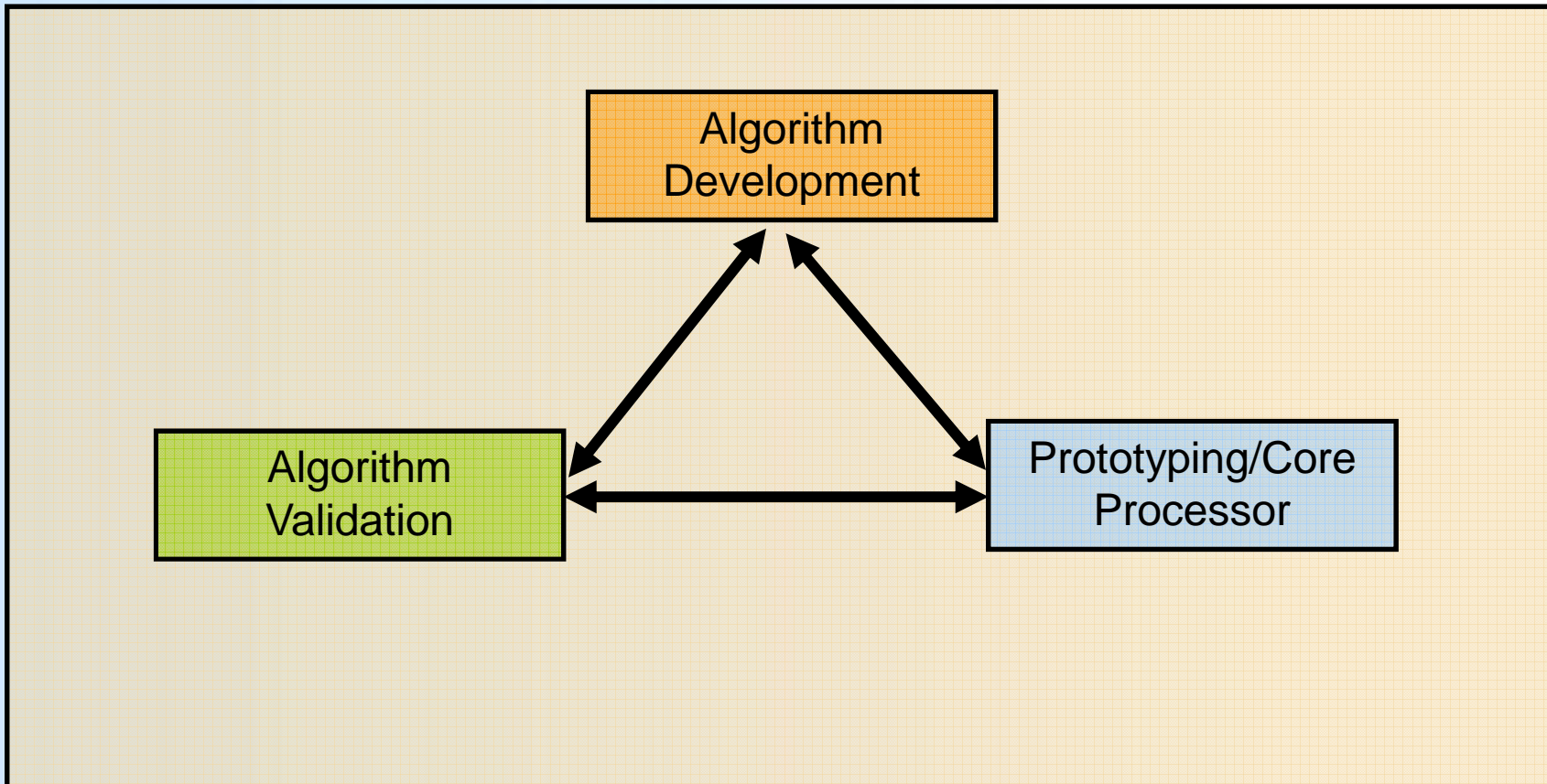
# SMOS L2 SM Consortium

- Level 2 SM ESL
  - CESBIO of France represented by Dr. Yann Kerr
  - IPSL SA of France represented by Dr. Waldteufel
  - The University of Roma (Tor Vergata) of Italy represented by Professor Ferrazzoli
  - The INRA EPHYSE of France represented by Dr. Wigneron
- Prototype and Core Processors
  - Array Systems Computing Inc. of Canada represented by Ali Mahmoodi
- Operational processor
  - GMV of Spain represented by Mr. Raul Valenzuela
  - INDRA of Spain represented by Mr. Antonio Martinez

## Current activities

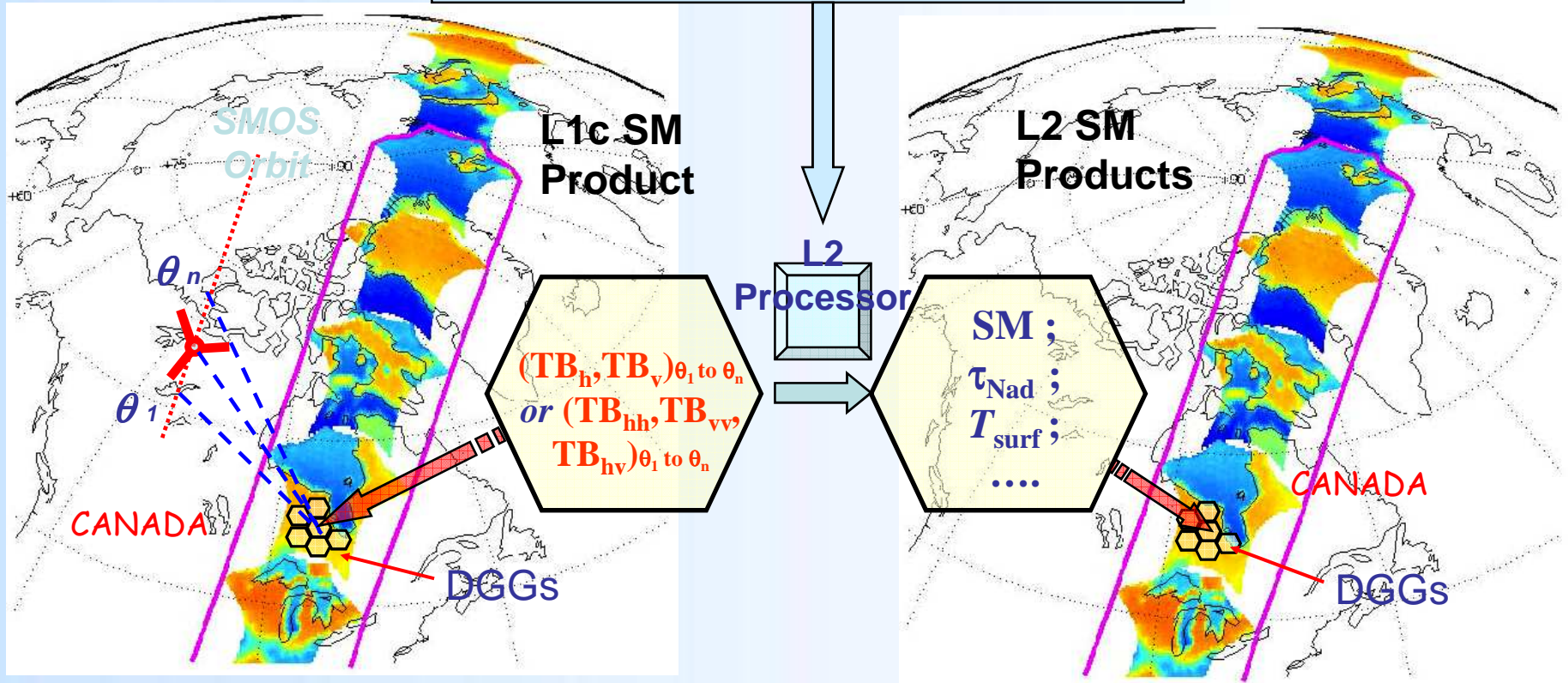
- Array has had a fruitful working relationship with current ESL, ESA, GMV and INDRA since 2004
- Array has multiple contracts with ESA
- SMOS L2 soil moisture prototype processor development
  - Algorithm development (ATBD/TGRD)
  - Software development (DPM/DDD)
  - Algorithm validation (AlgoValTPR)
- SMOS L2 SM operational processor
  - Product specification (IODD/L2 Spec)
  - Interface development (ICD and XML schemas)
  - Formal testing
  - Maintenance
- Supporting the DPGS testing and development

# SMOS Level 2 SM Prototype Development



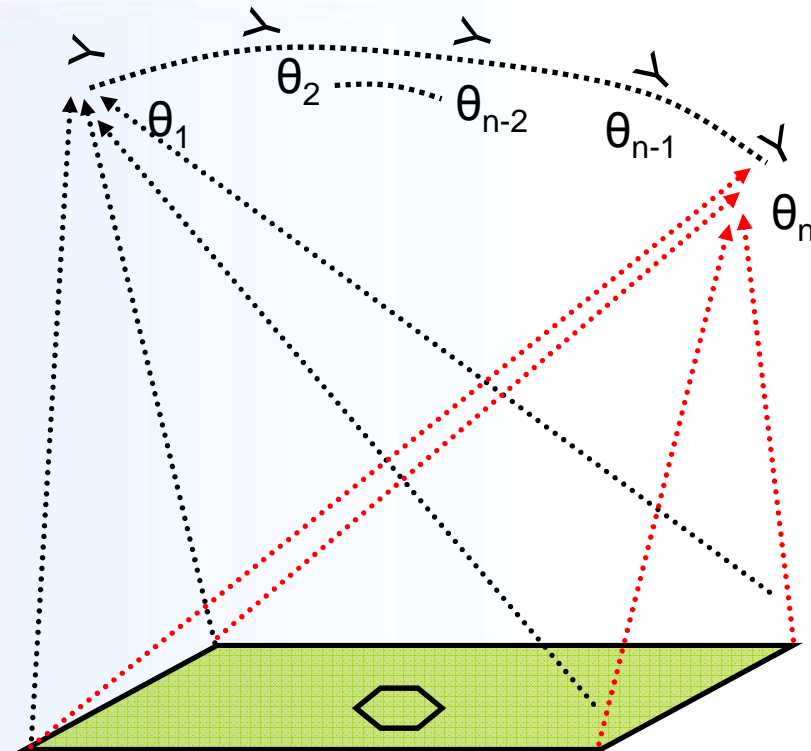
SMOS L2 Auxiliary data

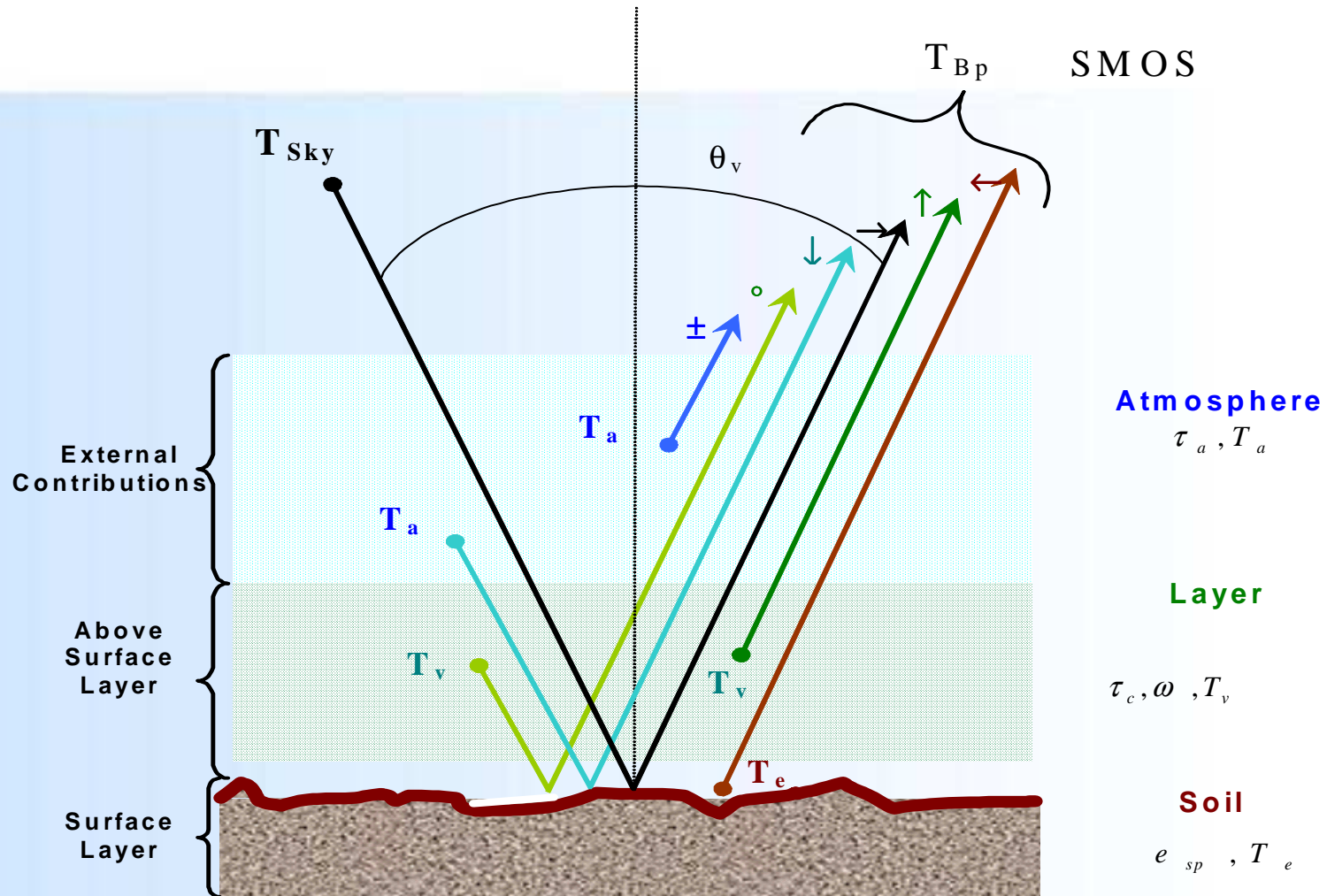
**WEF & MEAN\_WEF; ECMWF;  
SKY\_RADIATION; FRACTIONS; ...**



# SMOS L2 SM Algorithm

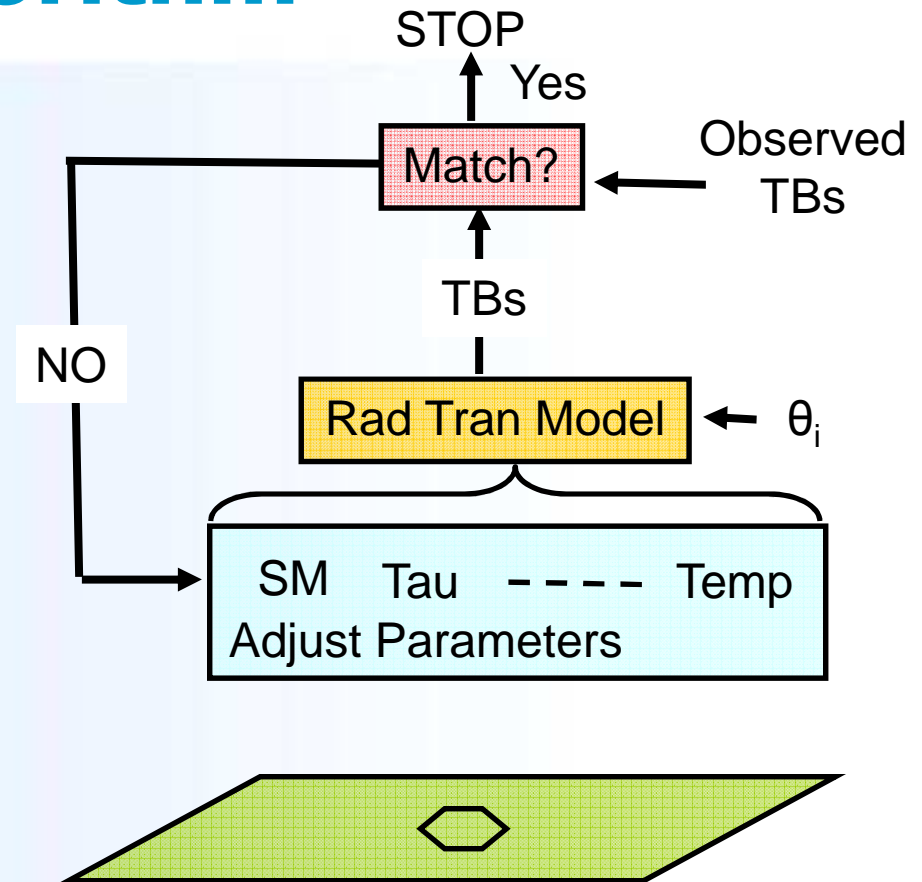
- Each BT value, in the L1c, corresponds to a fixed target area over the earth observed from a particular viewing angle.
- Multiple measurements are made for the same target from different viewing angles
- Target is represented as a rectangular area of side 123 km centered on a DGG node.
- Radiometric signal captured by the antenna is shaped by a complex interaction between several layers representing the target: most notably surface area, the vegetation cover, and atmosphere on top.

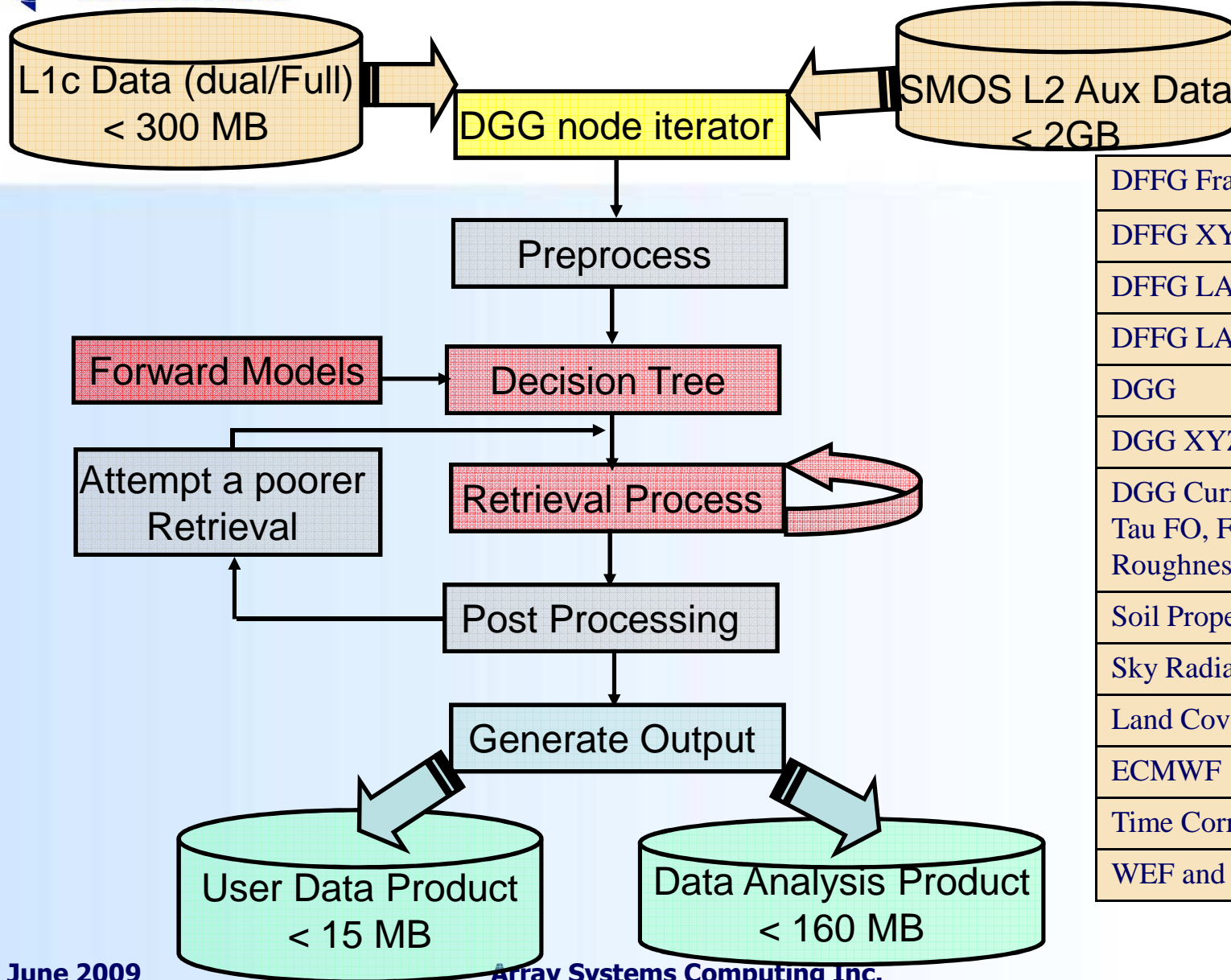




# SMOS L2 SM Algorithm

- Values of geophysical parameters of interest (which control the model output) are adjusted in an iterative approach until the model outputs closely match, in a least square sense, those observed by SMOS.
- Two types of modeling are involved:
  - Modeling the target as seen by SMOS including surface characteristics, vegetation, and the atmosphere
  - Modeling the L-Band emission (L-MEB which includes water, nominal soil, vegetation, and others)





DFFG Fractions
DFFG XYZ
DFFG LAI
DFFG LAI Max
DGG
DGG XYZ
DGG Current (Tau LV, Tau FO, Flood, Roughness, RFI)
Soil Properties
Sky Radiation
Land Cover Classes
ECMWF
Time Correlation Prod
WEF and MEAN_WEF

# User Data Product versus Data Analysis Product

- Mission specific
- Intended for all end users
- Geophysical information for each ISEA node included in the L1c product:
  - Estimated parameters including SM values, optical thickness, physical temperature, simulated TB, and dielectric constants
  - Flags to indicate presence/absence of features/events of interest such as rocks, topography, snow, RFI
  - Descriptors to describe properties such as number of wild views and mean spatial resolution
- Algorithm specific parameters
- Intended for expert users and used to improve performance
- Algorithmic information one for each ISEA node included in the Level 1c product.
  - Algorithmic parameters of interest such as vector of residuals, mean cover fractions, and ratio of useful views
  - Flags to indicate presence/absence of features/events of interest including failure due to the lack of sufficient number of views, raised exception, and mandatory data set missing

## Future activities

- SMOS L2 SM commissioning
- Post commissioning algorithm evolution
- Support to user services
- Maintenance and evolution of L2 processor

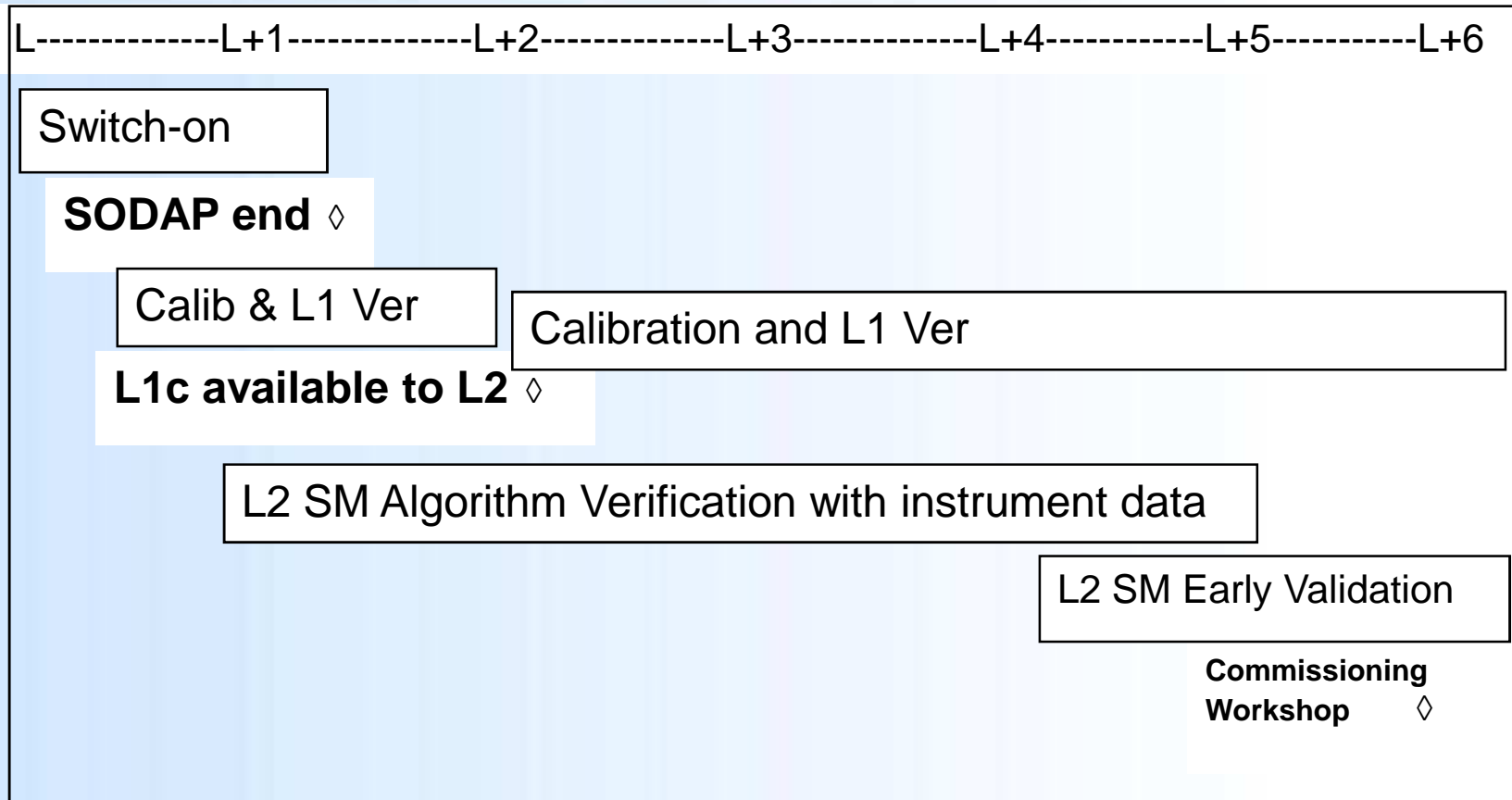
# Commissioning L2 SM processor

- Two major activities are foreseen for L2 SM processor:
  1. Product and algorithm verification, including verification and tuning of thresholds related to:
    - Confidence descriptor data and flags
    - Science descriptor data
    - Processing descriptor data
    - Geophysical parameters against validity ranges only
    - Product formats
  2. Preliminary product validation

# Test Sites: Preliminary Validation

Test Site	Notes
All water	Find a suitable lake area (possibly near a land equipped site)
All desert	A quick test over Sahara but possibly also use a CalVal site with data (Taklamakan, Mali)
All thick forest	Obvious choice is Amazon or Zaire basins but specific area to be selected might require some further investigation
Standard low vegetation area	A site with ground measurements and plains (US mid west, central Europe, NAFE). Note that the site will have to be selected also as a function of the actual launch date (vegetation annual cycle). Possibly highly (intensive) agricultural sites should also be sought
“anchor” sites	Valencia and Danube sites
Other fully monitored sites	Finland (snow ice forest), wetlands (Poland?), permafrost (Siberia),
Other misc sites for quick inspection	Urban, (Los Angeles, Mexico?); RFI prone; Topography (Andes, Alps); Lots of small water bodies (Canada); Mixed forest/winter forest (central Europe?)

# Schedule and Milestones



# ESL Post commissioning activities

- Product performance estimation
  - Geophysical and uncertainties,
  - TBs and uncertainties,
  - Faraday Rotation – L1 annotations
- Algorithm tuning and evolution
- New algorithmic approaches
- Gathering of verified match-ups from SVRT, CATDS, CP34, CEC etc.
- Annotations verification, tuning and evolution:
  - Science flags & Descriptors
  - Processing flags & Descriptors
  - Confidence flags & Descriptors

## Array Post commissioning activities

- Support to User\_services
  - Operational products & documentation from [Eohelp@esa.int](mailto:Eohelp@esa.int) or IDEAS-CEC,
  - Prototype s/w from [Eohelp@esa.int](mailto:Eohelp@esa.int)
- Maintenance and evolution of Prototype (s/w deliveries to ESA)
- Maintenance and evolution of Core (s/w deliveries to CEC)

## Array's strengths

- Deep understanding of SMOS L2 SM products and algorithms
- Ability to work closely with scientific community to develop and implement new algorithms
- Extensive experience with remote sensing, SAR, and sonar programs

## Possible areas where Array can contribute

- Prototyping support including development of detailed processing models, table generation requirements
- Support to SMOS product validation including
  - Scientific activities such as scaling the truth measurements to SMOS pixel
  - Development of validation tools
- Support to SMOS data user group
- Support in the development of new applications using SMOS data: level 3 and 4 products

# Open Discussion

- Questions & Answers