SMOS

Global Monitoring and Data Assimilation Study

Progress Meeting 3

PM 1: April 2008

PM 2: December 2008

SMOS cal-val meeting (Lisbon): March 2009

PM 3: May 2009

Agenda

9:30- 9:40	Introduction (P. de Rosnay)
9:40-10:00	SMOS ground segment (S. Mecklenburg)
10:00-10:20	SMOS Near Real Time issue (S. Mecklenburg)
10:20-10:40	Coffee break
10:40-11:00	SMOS cal-val schedule (S. Delwart)
11:00-11:20	SMOS forward operators implementation: Oceans and Land (P. de Rosnay)
11:20-11:40	EKF and surface analysis status in IFS 35R3 (P. de Rosnay)
11:40-11:50	AMSR-E background study (J. Muñoz Sabater)
11:50-12:20	SMOS data implementation in the IFS: ODB (J. Muñoz Sabater)
12:20-13:20	Lunch
13:20:14:20	Discussion on SMOS monitoring activities during the commissioning phase: multi-angular issue, ocean/land, schedule and Key Points (IOCP)
14:20-14:30	Conclusion and recommendations, next meeting

SMOS forward Operator / implementation

Two main components in the ECMWF's contribution to SMOS:

- SMOS data monitoring (land and ocean)
- SMOS data Assimilation (land)

For both of them the CMEM forward model has been developed, validated, and it is being implemented in the IFS.

The Community Microwave Emission Model (CMEM)

- CMEM has been developed as the ECMWF forward operator for low frequency passive microwave brightness temperatures at 1 to 20 GHz.

- I/O interfaces for the Numerical Weather Prediction Community.

- CMEM Input/Output interface is flexible: grib, netcdf, ascii.

- CMEM is a Fortran 90 software, portable for unix/linux systems

- Last tagged version is cmem_v2.1 (March 2009)

Recent updates: Includes gribAPI interface since v2.0 (January 2009) . modular choice of gribex or gribAPI

CMEM Modular Physics

Modular physics <-> Modular code structure

Allows accounting for different parametrisations for each component

- Soil dielectric mixing model

  (Wang & Schmugge / Dobson / Mironov)

- Effective temperature model

  (Choudhurry / Wigneron / Holmes)

- Soil roughness model

  (None = Smooth / Choudhurry / Wegmuller / Wigneron 01/07)

- Smooth surface emissivity model

  (Fresnel / Wilheit)

- Vegetation opacity model

  (None / Kirdyashev / Wegmuller / Wigneron / Jackson)

- Atmospheric radiative transfer model

  (None / Pellarin / Liebe / Ulaby)

Equivalent to LMEB when options in red are chosen

SOIL

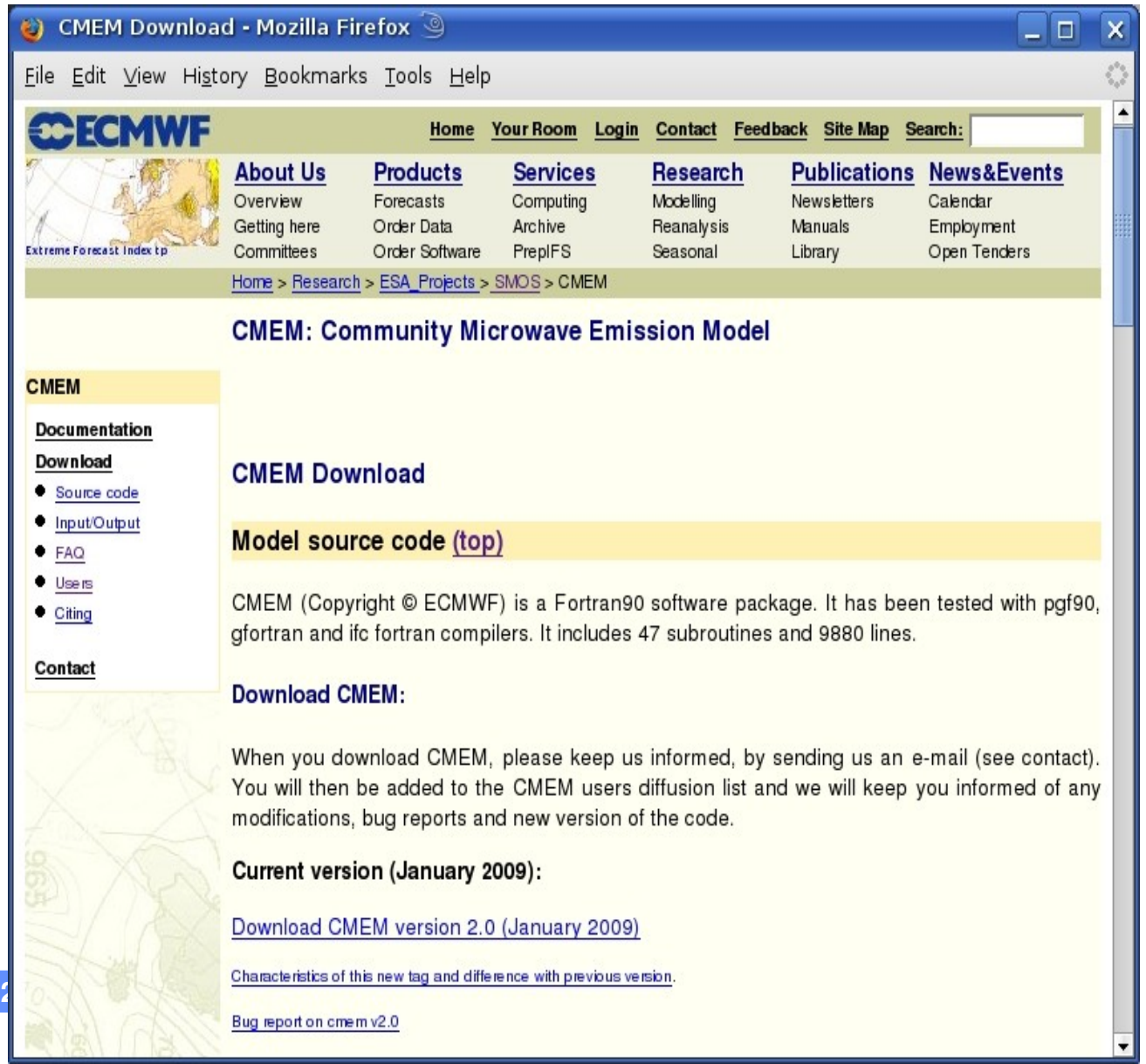
VEGETATION

ATMOSPHERE

CMEM Web interface

http://www.ecmwf.int/research/ESA_projects/SMOS/cmem/cmem_index.html

- Documentation
- Source
- I/O templates
- FAQ
- Users
- Bug report
- Contacts



References:

Holmes et al. IEEE TGRS, 2008
Drusch et al. JHM, 2009
de Rosnay et al. JGR, 2009
Muñoz Sabater et al., sub 2009

CMEM Implementation (WP 1610)

Follow the apporach of microwave models used for satellites requiring all-sky radiance processing (eg SSMI, AMSR-E)

To this end get observations from observation space to model grid point space:

- At high level in the IFS:

gp_model. F90 -> mwave_get -> mwave_nearest
mwave_obs2gp

- - ->

Then work in model grid-point space:

- Model physics:

ec_phys -> callpar -> mwave_screen
mwave_obsop
(-> mwave_obsop_rttov)
mwave_cmem_screen
-> cmem_main

Back to obs space

- back to gp_model.F90 -> mwave_put -> mwave_gp2obs

Sea Surface Salinity (WP 1610 /1200)

Forward modelling: TBocean = TB_flat + TB_rough + TB_GN

- TB_flat in CMEM (Klein and Swift 1977)
- Tbrough: roughness effect
- TB_GN: galactic noise, only a few K, but necessary for accurate SSS retrieval or data assimilation over oceans.

Inputs TBFlat: SSS, SST

Input Tbrough and TB_GN: SSS, SST, Wind components, Wave Height

Roughness TB models: 3 different approaches

" Model-1(L2 default): 2-scale approach (Durden & Vesecky 1957,Dinnat et al., 2002)

" Model-2: foam contribution (Reul et al. 2003)

" Model-3: semi-empirical model (Gabarro et al.2008)

Galactic noise model: 1 approach but very complex model to compute the reflection of galactic noise on the rough ocean surfaces (subject of several PhD thesis at LOCEAN...).

A complete SSS forward model is included in the SMOS L2 processor (ARGANS)

Sea Surface Salinity

Forward modelling: TBocean = TB_flat + TB_rough + TB_GN

--> Two-Day mission in April to ARGANS to investigate the possibility of using the forward model part of the SMOS L2 SSS retrieval processor in the IFS, for monitoring over ocean surfaces.

Objective: computing TB_rough and TB_GN for SMOS monitoring over Ocean surfaces at ECMWF ?

Main issues:

- The forward model (c code) is not externalised from the processor and it uses many predefined libraries and LUT.
- Efficiency and ability to run on a parrallel machine (?).
- IPR issue (re-distribution) – solved with ACRI

So we will not interface the Ocean L2 processor in the IFS.

Sea Surface Salinity

Based on these considerations there are 3 options for the SMOS monitoring over ocean surfaces:

1- Use an externalised version of the forward model of the processor
to run an **off-line monitoring** suite for ocean surfaces.
This includes the following tasks:
- get mars data for SSS from ocean analysis (daily), get SST, WH, WS from operational AN and get SMOS data over ocean from the ODB
- interpolate SSS and SMOS data to the IFS grid
- Use as input of the externalized forward model from ARGANS

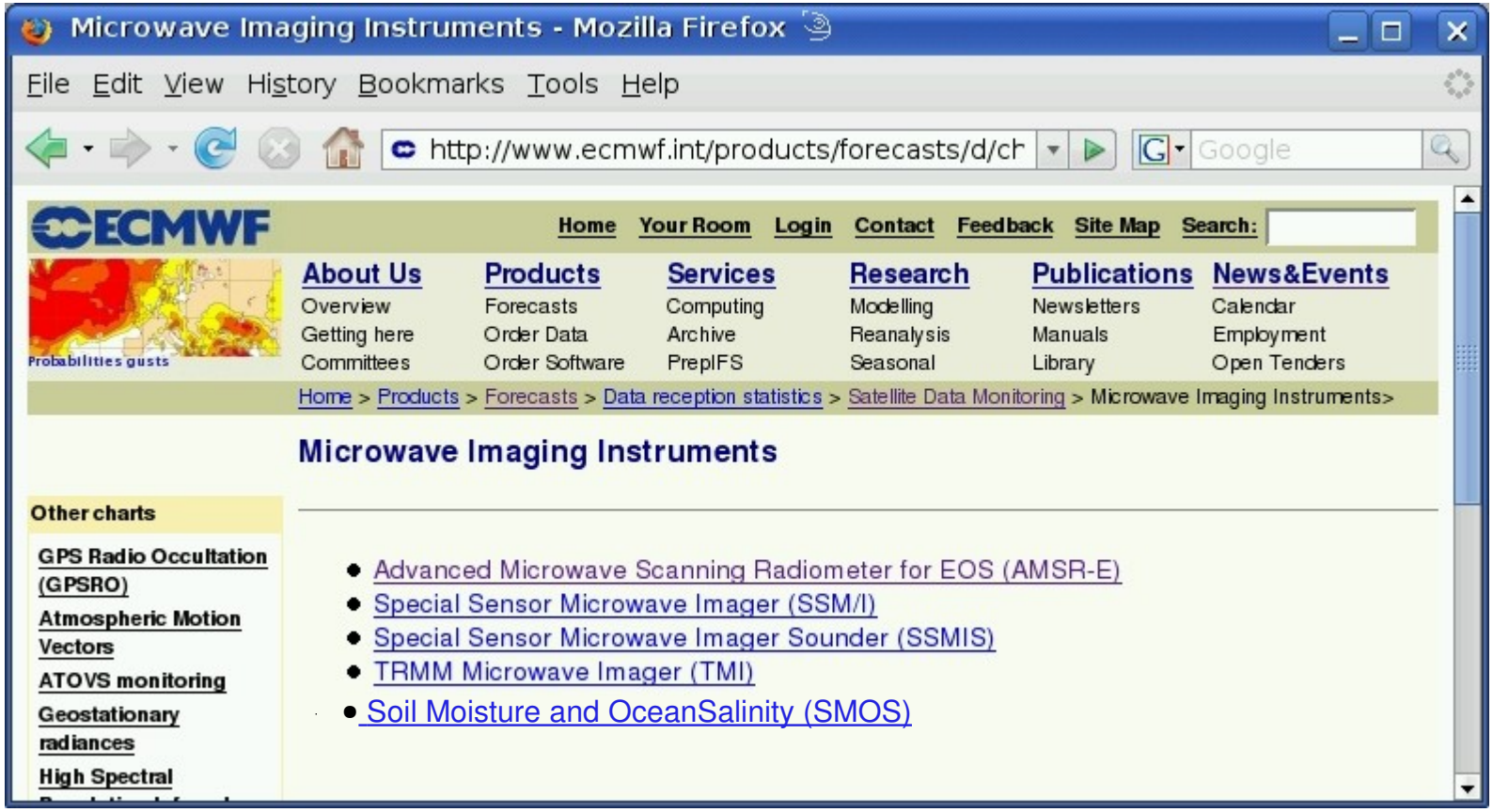
2 – Perform the monitoring like for land surfaces in the IFS using CMEM, considering Tbflat +TB_rough 'only'
This requires
- to externalise the TB_rough forward model and interface it with CMEM
- get mars SSS and interpolate to the IFS grid (already done for other purposes by Yuhei Takaya)

3- Off-line monitoring as in 1 but using CMEM+TB_rough

According to the complexity of the implementation of the GN model and large uncertainties in SSS background fields, Forward modelling based on TB_flat+TB_rough is considered to be suitable for SMOS monitoring over oceans -> choice of 2 or 3

SMOS Data Monitoring WP 1630 /1700)

ECMWF monitoring page for microwave instruments



Time-averaged geographical mean fields - Mozilla Firefox

File Edit View History Bookmarks Tools Help

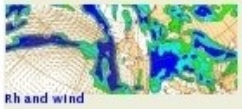
http://www.ecmwf.int/products/forecasts/d/charts/monitoring/satellite/m

ECMWF webpublish ECMWF Data Server CMEM Deimos-L1C AGU Mb Journals H-SAF PAT

GRIB API Manual | CMEM: Communit... | 1st Meeting of the ... | Time-averaged ... | NSPI

ECMWF

Home Your Room Login Contact Feedback Site Map Search:



About Us	Products	Services	Research	Publications	News&Events
Overview	Forecasts	Computing	Modelling	Newsletters	Calendar
Getting here	Order Data	Archive	Reanalysis	Manuals	Employment
Committees	Order Software	PrepIFS	Seasonal	Library	Open Tenders

Home > Products > Forecasts > Data reception statistics > Satellite Data Monitoring > Microwave Imaging Instruments > Advanced Microwave Scanning Radiometer for EOS (AMSR-E) > Non-rainy Radiances > Time-averaged geographical mean fields>

Time-averaged geographical mean fields

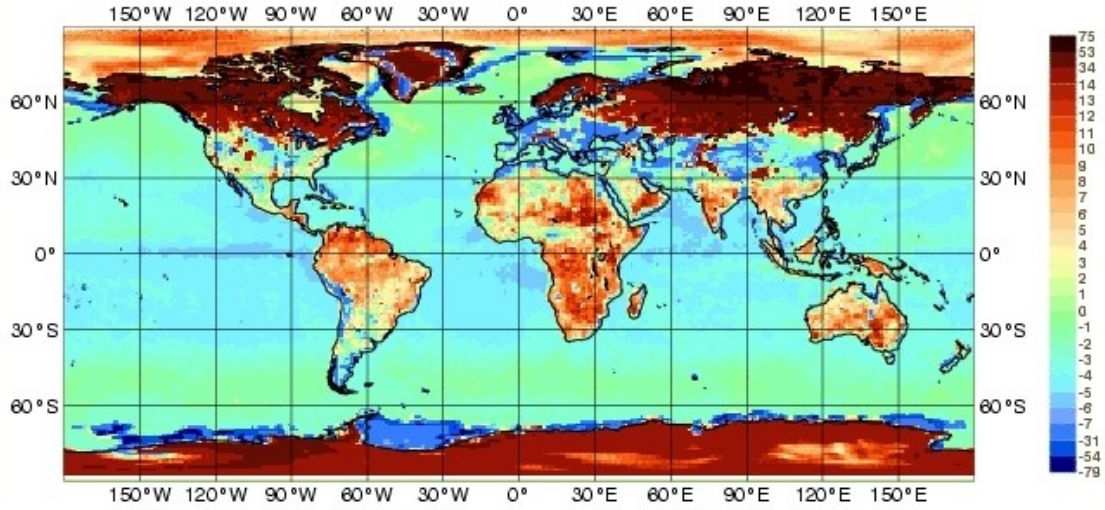
Channel

1 2 3 4 5 6 7 8 9 10 11 12

Data

Obs value
Number
FG departure
AN departure
FG departure bcor
AN departure bcor
Bias correction
STDV Obs
STDV FG dep
STDV AN dep

STATISTICS FOR RADIANCES FROM AQUA / AMSRE - 01
MEAN FIRST GUESS DEPARTURE (OBS-FG) (ALL)
DATA PERIOD = 2009020100 - 2009022806 , HOUR = ALL
EXP = 0001
Min: -77.319 Max: 73.411 Mean: 3.5866



Example of AMSR-E Monitoring

SMOS: channels to be replaced by angles

ECMWF

Data Monitoring

Usual monitoring:
- Time-averaged geographical mean fields
- Hovmoeller zonal mean fields
- Time series of area averages

SMOS opens new possibilities for monitoring,
e.g. Angular dependency of FG – AN

Work packages overview

Part I: Monitoring

WP 1100: Sensitivity study on auxiliary data sets

WP 1200: Ocean Salinity in the Integrated Forecast System

WP 1300: Global Surface Emission Model (CMEM forward operator)

WP 1400: IFS Interface

WP 1500: RTTOVS Update

WP 1610: Collocation Software Development

WP 1620: Operational Pre-processing Chain

WP 1630: Offline Monitoring Suite

WP 1700: Continuous monitoring

WP 1800: Hot Spot Analysis

Work packages overview

Part II: Data Assimilation Study

WP 2110: EKF Modifications

WP 2120: Surface Data Assimilation System Adjustment

WP 2140: AMSR-E Bias Correction

WP 2240: AMSR-E Data Assimilation Experiments

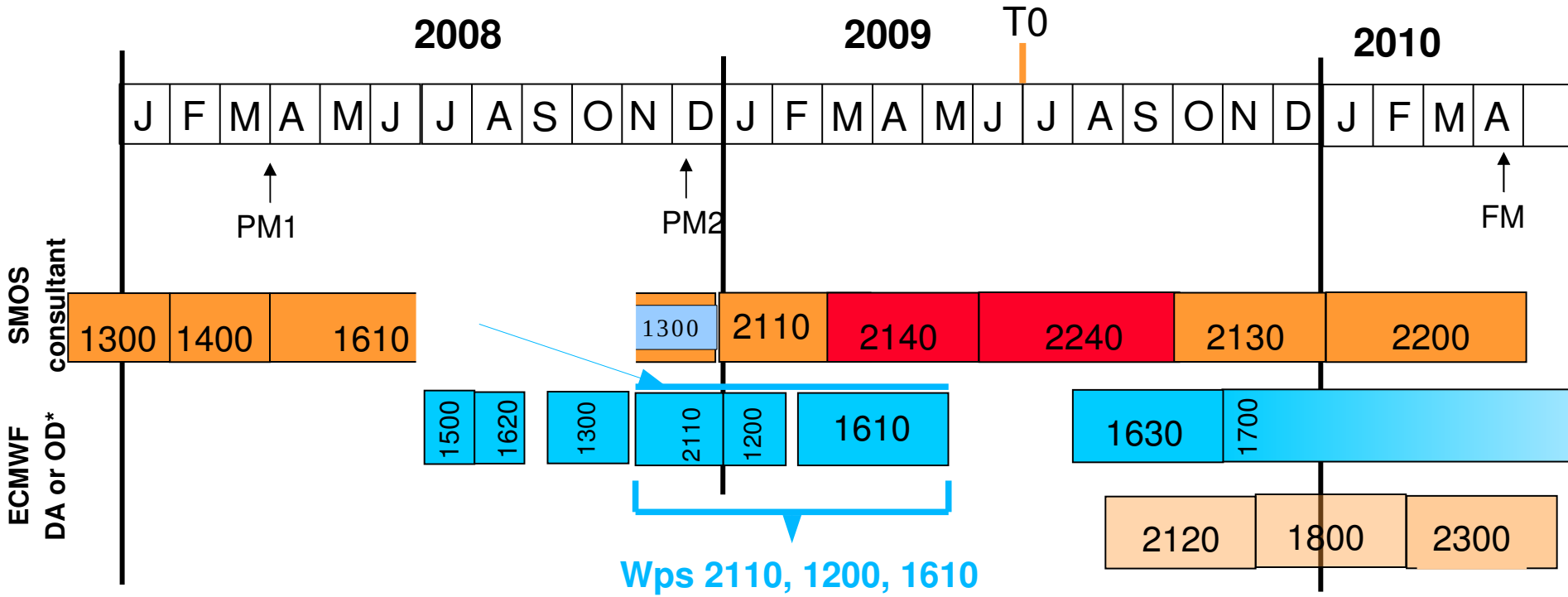
WP 2130: SMOS Bias Correction

WP 2200: SMOS Data Assimilation Experiments

WP 2300: Soil Moisture Monitoring

SMOS PM2 schedule

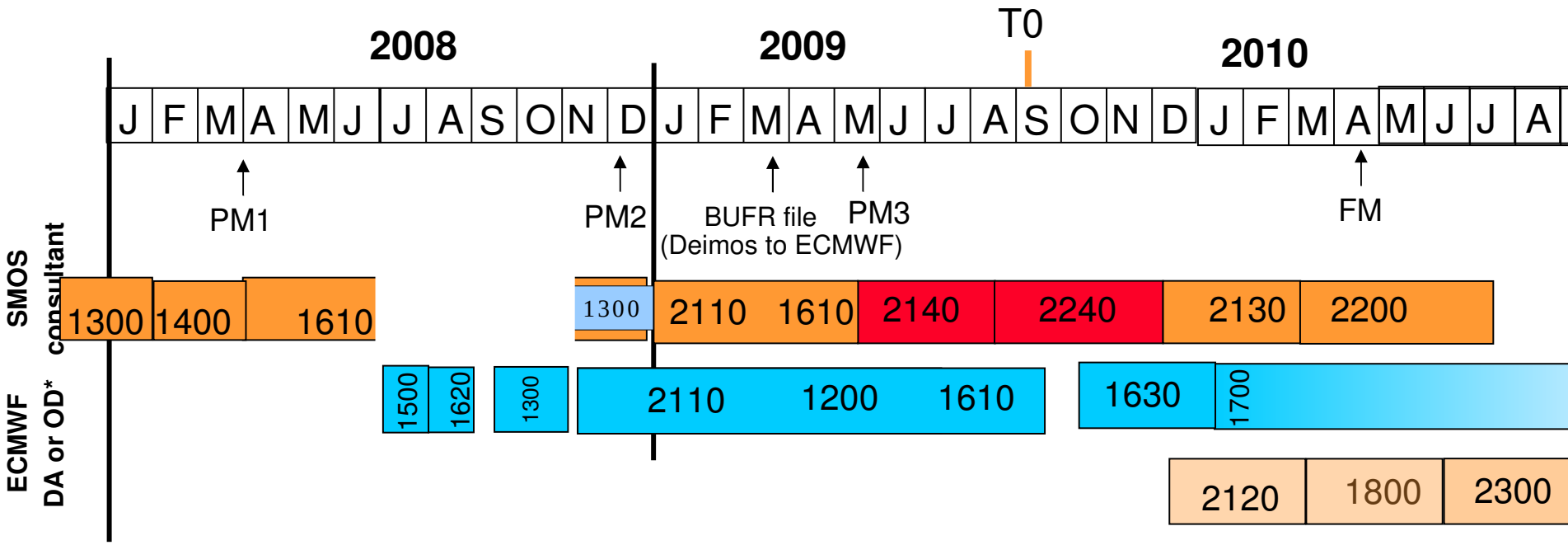
December 2008



According to PM1:
WP 1610, WP 1500, WP 1620 ready at t0
WP 1200, WP 1630, WP 2120 ready at t0+2
WP 1700 needs ‘consistent’ data (start at the end of the commissionning phase)
WP 2130, WP 2200 need ~ 3 months of ‘consistent’ data

SMOS PM3 schedule

May 2009



According to PM1 and PM2:
WP 1610, WP 1500, WP 1620 ready at t0
WP 1200, WP 1630, WP 2120 ready at t0+2
WP 1700 needs ‘consistent’ data (start at the end of the commissionning phase)
WP 2130, WP 2200 need ~ 3 months of ‘consistent’ data

WP 1630: offline monitoring / Key points for IOCP

Project Status

Deliverable due at T0 (September 2009):

MileStone 1 Tech Note (MS1TN)

- **MS1TN-P1:** Global surface emission (Wps 1100, 1300)
  - Holmes et al. 2008, IEEE Trans. Geosc. Rem. Sens., 46, 846-856
  - Drusch et al., 2008, ECMWF Tech Memo 565 + J. Hydrometeorology
  - de Rosnay et al. 2008: Microwave Land Surface modelling evaluation against AMSR-E data over West Africa. The AMMA Land Surface Model Intercomparison Experiment coupled to the Community Microwave Emission Model (ALMIP-MEM) ECMWF Tech Memo 564 + J. Geophys. Res. in rev.
  - Muñoz Sabater et al., Sensitivity of L-band emission to roughness parameterisation: A SMOSREX case study, GRL in preparation
- **MS1TN-P2: IFS interface, CMEM I/O** (WP 1400)
  - Based on CMEM documentation and Web pages
- **MS1TN-P3:** RTTOV Update (WP 1500) -> RTTOV Interface (WP1610)

Deliverable due at T0+6 (March 2010):

Milestone 2 Technical Note (MSTN2)

- **MS2TN-P1:** Collocation software development (WP 1610)
- **MS2TN-P2:** Operational pre-processing chain (WP)
- **MST2TN-P3:** Offline Monitoring suite

Deliverable due at T0+11 (August 2010):

Monitoring reports (T0+11, T0+14, T0+17)