EnKF-Salammbô data assimilation tool: Progress in the framework of the MAARBLE EU-project

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Outline

• Introduction

• Uncertainties in physical processes

• Validation against test data set

• Conclusions
Data assimilation concept

EnKF Prediction: PSD → Flux → Count rates

Cdf files

Flux, Flux quality flag

Count rates species, Count rates quality flag, Response function

Update

Dispersion of all predictions

Prediction phase

Analysis phase

Time
Uncertainties in physical processes

Radial diffusion

Radial diffusion distributions @ GEO

Number of points

$D_{LL}$ (day$^{-1}$)

$Kp=1$
$Kp=3$
$Kp=5$
$Kp=7$
Uncertainties in physical processes

Drop outs (magnetopause shadowing)
Uncertainties in physical processes

Boundary condition @ $L^* = 8$ (poster from Maget et al.)

Correlation matrix

THEMIS/SST: 31 keV, 41 keV, 52 keV, 65.5 keV, 92 keV, 139 keV, 203.5 keV, 293 keV, 408 keV, 565.5 keV and 719.5 keV

200 spectra drawn using the multi-variate Monte Carlo sampling
Validation against test data set

September 2011 storm

INTEGRAL/SREM

GIOVE-B/SREM

GOES-13/SEM

Themis-D/SST

XMM/ERMD
Validation against test data set

Scenario 1:
- Data ingested: GIOVE-B/SREM and GOES13
- Test data set = INTEGRAL/IREM
  THEMIS-D/SST
  XMM/ERMD

Scenario 2:
- Data ingested: GIOVE-B/SREM
  GOES13
  INTEGRAL/IREM
- Test data set = THEMIS-D/SST
  XMM/ERMD
Validation against test data set
Validation against test data set
Validation against test data set
Validation against test data set
Validation against test data set

2011/09/13 16:35:59 L*=3.5

TC1 S12 S13 S14 TC2 C4 TC3 S32 S33 S34
Channel

# / s

INTEGRAL/EnKF – scenario 2
INTEGRAL/EnKF – scenario 1
INTEGRAL/IREM – SVD
INTEGRAL/IREM

2011/09/13 17:29:59 L*=5.0

TC1 S12 S13 S14 TC2 C4 TC3 S32 S33 S34
Channel

# / s

INTEGRAL/EnKF – scenario 2
INTEGRAL/EnKF – scenario 1
INTEGRAL/IREM – SVD
INTEGRAL/IREM

2011/09/13 16:35:59 L*=3.5

cm^-2 s^-1 sr^-1 MeV^-1

Energy [MeV]

INTEGRAL/EnKF – scenario 2
INTEGRAL/EnKF – scenario 1
INTEGRAL/IREM – SVD
INTEGRAL/IREM – SVD Inversion

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cm^-2 s^-1 sr^-1 MeV^-1

Energy [MeV]

INTEGRAL/EnKF – scenario 2
INTEGRAL/EnKF – scenario 1
INTEGRAL/IREM – SVD
INTEGRAL/IREM – SVD Inversion
Scenario 1:
- Data ingested: RBSP_A/MAGEIS GOES13
Conclusions

- MAARBLE has allowed to improve the data assimilation tool
  - Assimilation of count rates
  - Uncertainties on radial diffusion coefficients
  - Uncertainties on drop out due to magnetopause shadowing
  - Uncertainties on boundary condition (Themis-SST)
- Validation has been performed during the September, 2011 storm
  - INTEGRAL/IREM count rates could be retrieved
  - The Kalman filter provides uncertainties on results
  - The challenging region of the slot where there are steep gradients is well defined by the data assimilation tool.