

MINUTES OF THE DISCUSSION SESSION ON WILDFIRES & BIOMASS BURNING
at the GEMS Annual Assembly 2006: Monday, 6th February, 13.30-17.00
Minutes by: Christiane Textor, Johannes Kaiser, and Martin Schultz

AGENDA

- | | | |
|-------|--|---|
| 13.30 | Claire Granier
Christiane Textor, GEMS
Johannes Kaiser, HALO | Welcome

Introduction to fire emissions |
| 13.40 | Peter Rayner, GEMS | GHG requirements |
| 13.45 | Olivier Boucher, GEMS | AER requirements |
| 13.50 | Martin Schultz, GEMS | GRG requirements |
| 13.55 | V.-H. Peuch, GEMS | RAQ requirements |
| 14.00 | Kevin Tansey, Uni Leicester* | Burnt area & hot spot satellite products |
| 14.10 | Martin Wooster, King's C | Fire radiative energy satellite products |
| 14.20 | Johannes Kaiser, HALO | WF_ABBA satellite products |
| 14.30 | Martin Schultz, GEMS | Comparison of satellite products |
| 14.40 | Alain Chedin | Impact of tropical fires on the tropospheric CO2 concentration as seen from NOAA-10 |
| 14.50 | Mikhail Sofiev, GEMS | Emissions heights |
| 15.00 | Johannes Kaiser, HALO | GFED |
| 15.10 | Claire Granier
Martin Schulz
Christiane Textor | ACCENT, EVERGREEN
RETRO
AEROCOM |
| 15.20 | Break | |
| 15.40 | Decision on GEMS Deliverable 1: Inventory for reanalysis simulations of 2003: | |
| | - Which inventory? GFEDv2 | |
| | - Are the needs of the different themes covered? | |
| | - Which improvements are needed? | |
| 16.10 | Johannes Kaiser HALO Proposal
http://www.ecmwf.int/research/EU_projects/HALO/pdf/fireassimilation.pdf | |
| 16.20 | Discussions | |
| | - GEMS Deliverable 2: Extended reanalysis simulations 2000-2007
implementation of fire emission model (GFAS)
use of existing fire emission data set | |
| | - GEMS Deliverable 3: Operational System | |

* Presentation given by Johannes Kaiser using a presentation of Jean-Marie Gregoire given at BBSO workshop – Toulouse – 14-15 December 2005

ALL PRESENTATIONS AVAILABLE ONLINE

http://www.ecmwf.int/research/EU_projects/GEMS/do/get/GeneralEventsAssemblyReading/Wildfires

PARTICIPANTS

Claire Granier, Brendan Kelly, Tony Hollingsworth, Mikhail Sofiev, Svetlana Tsyro, ?metoffice?, Jean-Pierre Cammas, Richard Engelen, Angela Benedetti, Soumia Serrar?, Jean-Jaques Morcrette, Johannes Flemming, Julian Meyer-Arnek, Adrian Simmons, Harald Berresheim, Olaf Steiner, Martin Wooster, Martin Schultz, Peter Rayner, Christiane Textor, Olivier Boucher, Gaëlle Dufour, Alain Chedin, Vincent-Henry Peuch, Johannes Kaiser

WELCOME BY TONY HOLLINGSWORTH

Fire emissions are an important cross-cutting issue for all GEMS themes as well as for other GEMS projects. Links to GEOLAND, MERSEA are established via HALO.

A document on the requirements of GEMS for fire emissions should be prepared very quickly to be handed in for FP7 preparations. First calls for FP7 are possible by the end of 2006.

INTRODUCTION TO FIRE EMISSIONS BY JOHANNES KAISER

Importance of fire in the environment:

- air quality issues
- long-range transport
- elevated background concentrations of fire emissions during burning season
- radiative effects

Requirements of GEMS

- amount of aerosol & trace gases, location, time, temporal variations, injection height profile
- global, near-real time and retrospectively, time resolution of several hours to one day

Current Lack of global observing system for fire emissions meeting GEMS requirements

- No global operational system for all GEMS themes, MODIS only global NRT product
- INPE/CPTEC monitor and forecast severe events of aerosol and CO pollution by fires for South America (see links on http://www.fire.uni-freiburg.de/current/archive/br/2001/10/br_10082001.htm)
- FLAMBÉ/NAAPS monitors and forecasts severe events of aerosol pollution by fires globally (see <http://www.nrlmry.navy.mil/flambe/index.html>)

Schedule of GEMS Wildfire Requirements

- short term: global emissions for 2003 of correct order of magnitude
- medium term: high-resolution (t&s) global fire products in nrt
- long term: high-resolution (temporal & spatial) global fire products for 2000–2007

REQUIREMENTS OF GEMS THEMES: GREENHOUSE GASES (PETER RAYNER)

- fire emissions are necessary for 2 purposes:
 1. improve first guess for CO₂ field: monthly mean fire emissions are sufficient
 2. improve prior estimate for CO₂ surface flux in inversion: day-to-day variation or better needed to capture high temporal variation of missions from sporadic fires need to be included in assimilation
- Species: CO₂, CH₄, (CO?)

T. Hollingsworth abundance of overlaps with other themes

REQUIREMENTS OF GEMS THEMES: AEROSOLS (OLIVIER BOUCHER)

Ad-hoc requirements

- Species: black carbon, organic carbon
- Period: 2003-2004
- Temporal Variability: daily to 10 days
- Spatial Resolution: no major requirements
- Injection Height: information could be obtained from satellite observations of fire plumes from MISR, GLAS

Medium-term requirements

- sub-daily variability
- robust system, long-term NRT data availability

Solutions proposed

- Investigate fire radiative energy products
- Input from source inversion studies may help

P.Rayner suggests extra session on overlaps
T.Hollingsworth check fundings within GEMS for fire emissions

REQUIREMENTS OF GEMS THEMES: GLOBAL REACTIVE GASES (MARTIN SCHULTZ)

Near-real-time prediction system based on space observations of (active) fires

- ~ 30 % accuracy of emission estimates
- Multiple observations during daytime to capture diurnal variability
- Empirical(?) functions for prediction of future evolution of individual burns
- Estimates of fire intensity (or proxy via fuel load, burning efficiency, combustion completeness)
- Estimate of injection heights
- Better accuracy and long-term consistency for reanalysis

Solution proposed

- For reanalysis use best available product (GFEDv2)
- Future GFED updates have been announced
- For forecasting purposes, focus on events
- Develop fire assimilation system with plume forecasts in simple tracer set-up (potential to develop into a real user service)

P.Rayner emissions of different species depend on individual fuel+burning conditions

REQUIREMENTS OF GEMS THEMES: REGIONAL AIR QUALITY (VINCENT-HENRI PEUCH)

Surface ozone predictions are generally satisfying without fire emissions, except for extreme cases.

Fire emissions of CO and PM10 are however significant.

- chemical boundary conditions from AER & GRG (fine scale structures?)
- over the GEMS RAQ domain (35N/70N ; 15W/35E) :
- ~ 5km emissions of PM, CO, (VOC) consistent with global datasets
- altitude profiles of emissions (wind shear, PBL, pyro-convection?...)
- daily values or better
- consistency if inputs from several instruments are used (different hours of overpass, different methods,...)

BURNT AREA & HOT SPOT SATELLITE PRODUCTS

(JOHANNES KAISER, HALO; JEAN-MARIE GREGOIRE, JRC)

Derivation of fire emissions from satellite data

Presentation of available products

Scientific Claims to satellite fire products including results from discussion

Feasible

- global products
- both fires and burned area
- quantitative data (25 km x 25 km)
- seasonal cycle
- time series and inter-annual cycle for 2003, >2003 (M.Schultz)

Feasible with constraints

- time series > 10years
(only 1 active fire product (WFA), No quantitative burnt area product (GBA82-99))
- date of detection
(not always feasible, due to gaps in observation time)
- diurnal cycle
only since 2002 (TERRA-AQUA MODIS), problems with presence of clouds (A.Chedin)
could be parameterized using information from MODIS and TRMM (J.Kaiser)
- inter-annual cycle for the past
(only 1 active fire product (WFA), No quantitative burnt area product (GBA82-99))
- type of vegetation burned
- No common legends for vegetation cover maps
- NRT product: MODIS (C.Granier)

Not feasible

- biomass burned
- area burnt inside the pixel, burning efficiency (% fuel load)
- fire intensity

- long term data (only for the past, not true for GEMS operational purposes (M. Schultz))
- FIRE RADIATIVE ENERGY (FRE) SATELLITE PRODUCTS, MARTIN WOOSTER, KING'S C**
- Direct, physically-based estimate of fuel mass burned from energy release.
 - Can drive emissions models without need for fuel maps or combustion completeness data. Identify fires via their thermal emissions, quantify these emissions
 - FRP can be estimated to within $\pm 12.5\%$ for the relevant temperature range 650 – 1375 K using MIR radiances.
 - FRP correlated with flux of smoke aerosol
 - Can be used for geostationary and polar-orbiting satellites
 - Limitations: very small sub-pixel fires not detected
 - Product still under development
 - Generation of NRT FRP from MODIS at NASA/GSFC possible

WF_ABBA SATELLITE PRODUCTS, JOHANNES KAISER, (ELAINE PRINS ET AL.)

Wild Fire Automated Biomass Burning Algorithm

<http://cimss.ssec.wisc.edu/goes/burn/wfabba.html>

- active fire, hot spot product
- using data from geostationary NOAA weather GOES satellites and a landcover map derived from 1-km resolution AVHRR
- subpixel fires can be detected
- generating half-hourly fire data for the Western Hemisphere
- operational (90 min after satellite scan time)
- limitations: not global, limited accuracy

C.Granier/ comparison of geostationary fire products (GOES, MSG, ...)?

M.Wooster overlap only at fringes, comparison to polar-orbiting satellites shows disagreements

C.Granier common fire data set for all satellites/products (ESA, EUMETSAT, NASA) dialogue with GOVC-GOLD fire team (<http://gofc-fire.umd.edu/>) GEMS should be involved to get quality assurance&validation

COMPARISON OF SATELLITE PRODUCTS, MARTIN SCHULTZ

ATSR – GLOBCARBON – GBA2000 – GFEDv1

First preliminary results from intercomparison for Indonesia (A. Heil)

- ATSR fire counts underestimate fires: night time product
- GLOBCARBON shows severe limitations and misses most forest fires in Indonesia
- Biomass burning inventories do not agree on total mass and seasonality

M.Wooster daily cycle of fires is shifted in El Nino years

IMPACT OF TROPICAL FIRES ON THE TROPOSPHERIC CO₂ CONCENTRATION AS SEEN FROM NOAA-10, ALAIN CHEDIN

- upper tropospheric CO₂ mixing ratios over the tropics
- retrieved from the observations of the meteorological satellite NOAA 10 (night – day)
- large diurnal variations of CO₂, of the order of 2–3 ppm in biomass burning season

- CO₂ plumes rapidly uplifted by fire-induced convection into the upper troposphere during the daytime peak of fire activity
- then rapidly dispersed at night by large-scale atmospheric transport.

EMISSIONS HEIGHTS, MIKHAIL SOFIEV

FMI plume-rise modeling system BUO_FMI http://www.fmi.fi/research_air/air_17.html

- Evaluation and plans
- Requirements for BUO_FMI as part of a Fire Assimilation System

GFED, JOHANNES KAISER, (GUIDO VAN DER WERF ET AL.)

- GFEDv2 is available for 1997-2004, monthly means
paper on the emissions dataset has been submitted to Atmospheric Chemistry and Physics Discussions and can be retrieved from
<http://sheba.geo.vu.nl/~gwerf/pubs/VanderWerfEA2005ACPD.pdf>
- paper on burnt area Giglio et al.2005
http://www.copernicus.org/EGU/acp/acpd/5/11091/acpd-5-11091_p.pdf

ACCENT, EVERGREEN, CLAIRE GRANIER

- presentation of ACCENT
<http://www.accent-network.org/portal/integration-tasks/access-to-emissions-data>
- data base on fire emissions for several chemical species are available via ACCENT
- (RETRO, POET, ABBI, GEIAv1)

RETRO, MARTIN SCHULZ

- RETRO emission inventory 1960 to 2000 with monthly time resolution
<http://retro.enes.org/emissions/>
- based on extensive literature review
- two parameters: burned area and emissions of tC/ha, different parameter choices in different regions
- spatial patterns and seasonal variability based on (some) satellite data
- paper submitted to Global Biogeochem. Cyc., currently under revision (issues with trend estimate and emission ratios)
- RETRO fire inventory is not relevant for GEMS as it stops in year 2000 and reflects a more statistical approach

AEROCOM, CHRISTIANE TEXTOR

- Presentation of AeroCom wildfire emissions, including injection height
- paper by Dentener et al. submitted ACPD

DISCUSSION ON

- **Inventory to be used for the (reanalysis) simulations of 2003 (GEMS Deliverable 1)**
- **Extended reanalysis simulations 2000-2007**

C. Granier formulate a GEMS statement of GEMS requirements
 feasibility within GEMS, money allocated
 input to FP7

- M.Schultz/
C.Granier Emission factors of RETRO (hydrocarbons) and Andreae&Merlet will be used, details have to be revisited
- M.Schultz/
M. Sovief consistency of data bases (RETRO-GFED) for 2000 have to checked
GFED for fires, RETRO for anthropogenic?
- O.Boucher/
R.Engelen AER only needs 2 species (BC, POM), but higher temporal resolution
diurnal cycle
- P. Rayner GHG: GFED2 + daily cycle (parameterized?), if not possible neglecting
fires might be preferable
- M. Schultz GRG: daily cycle not necessary for forward analysis for 2003, but will likely
be needed for operational simulations
- A. Chedin tropospheric CO2 from NOAA-10 can not deliver diurnal cycle,
only difference morning/evening
- M. Wooster suggestion to use MODIS as a basis for parameterization
(problems with cloud cover, overpass time, etc.)
- O.Boucher/
M.Wooster persistence of fires?
individual fires: hours-days, larger fires (1/2 degree): weeks
- C.Granier/
M.Sovief/
A.Chedin/
O.Boucher vertical profiles?
ad-hoc solution: homogeneous distribution from ground to 2*PBL height
might not be sufficient as seen for tropical CO2: fire induced convection
MISR product for fire plume height should be checked
- M.Schultz/
A. Benedetti/
M. Wooster availability of MODIS data at ECMWF for daily cycle?
currently for GEMS only aerosols, processed data
suggests that data delivery could be arranged through upcoming NERC grant
- V.H.Peuch RAQ: fire emissions are included in anthrop. emissions
for strong fires input from global models will be used
- C.Granier/
P.Rayner fire emissions are a cross cutting issue and should be discussed within themes,
especially for GRG and GHG

Decisions

Use of GFEDv2

- GRG: as it is
- GHG, AER : diurnal cycle? day-to-day variability?
- RAQ: no specific requirements

Actions

- improvement of temporal resolution (day-to-day variation, daily cycle)
to be checked with G. van der Werf (J.Kaiser) – day-to-day variations not feasible with
MODIS data, but weekly to 10-day patterns should be detectable

- Discussions on injection height will continue,
no clear decision on 2*PBL height proposal by M.Sovief

GLOBAL ASSIMILATION OF WILDFIRE EMISSIONS (GFAS) FOR GEMS, JOHANNES KAISER

- Presentation of GFAS
- draft description available at
http://www.ecmwf.int/research/EU_projects/HALO/pdf/fireassimilation.pdf

DISCUSSION ON

• Operational System

- | | |
|--|--|
| R.Engelen | biomass burning has to be coupled to biosphere model, at least for GHG purposes |
| J.Kaiser | common interface for fires?
fire emissions separated from other sources?
is funding sufficient? |
| B.Kelly/
C.Granier | evaluate available and required funding |
| M.Schultz/
C.Granier | favors development of common GFAS approach for fire emissions
existing climatologies and inventories might not be sufficient
suggests taking the lead within GMES, e.g. GEOLAND |
| V.H.Peuch/
M.Schultz/
P.Rayner | check possibilities for GFAS as a stand-alone module or integrated into the model including feedbacks on the meteorology?
favors integration, but check with PRO theme |
| M. Sovief/
J. Kaiser/
M. Schultz | GFAS has to count fires, output gridded or single fires?
input from meteorology, memory for fires needed
GFAS could easily output individual fires as well as gridded files |
| C.Granier
M.Schultz | feasibility of GFAS system?
GEMS decision on GFAS development required |
| P.Rayner
J.Kaiser
M.Schultz | integrate GFEDv2 as a first step across GEMS
can be updated later to include GFAS
start with simple version interface for GFEDv2 to be updated later for GFAS |
| M.Wooster
M.Schultz
C.Granier
J.Kaiser
P.Rayner
B.Kelly | funding not sufficient
beyond GEMS, needs cooperation of non-GEMS scientists&data providers
suggests discussion at management board, GFAS document for FP7 project
link to GEOLAND2
fire emissions are important for climate change issues
contribution of US (MODIS) Brazil (ABBA) for EU project? |

Decisions

General agreement within GEMS: GFAS is needed

- common interest with land-monitoring activities (GEOLAND)
- broad interest within climate research community for high quality fire assimilation system

Strategy

- one single interface for all GEMS subprojects
- continuous advancement with fire Earth obs. development
- implementation of basic system within GEMS and GMES projects
- further development needs to be funded in FP7

Actions

- Formulate GEMS requirements for fire emissions including GFAS as input for FP7 and GMES