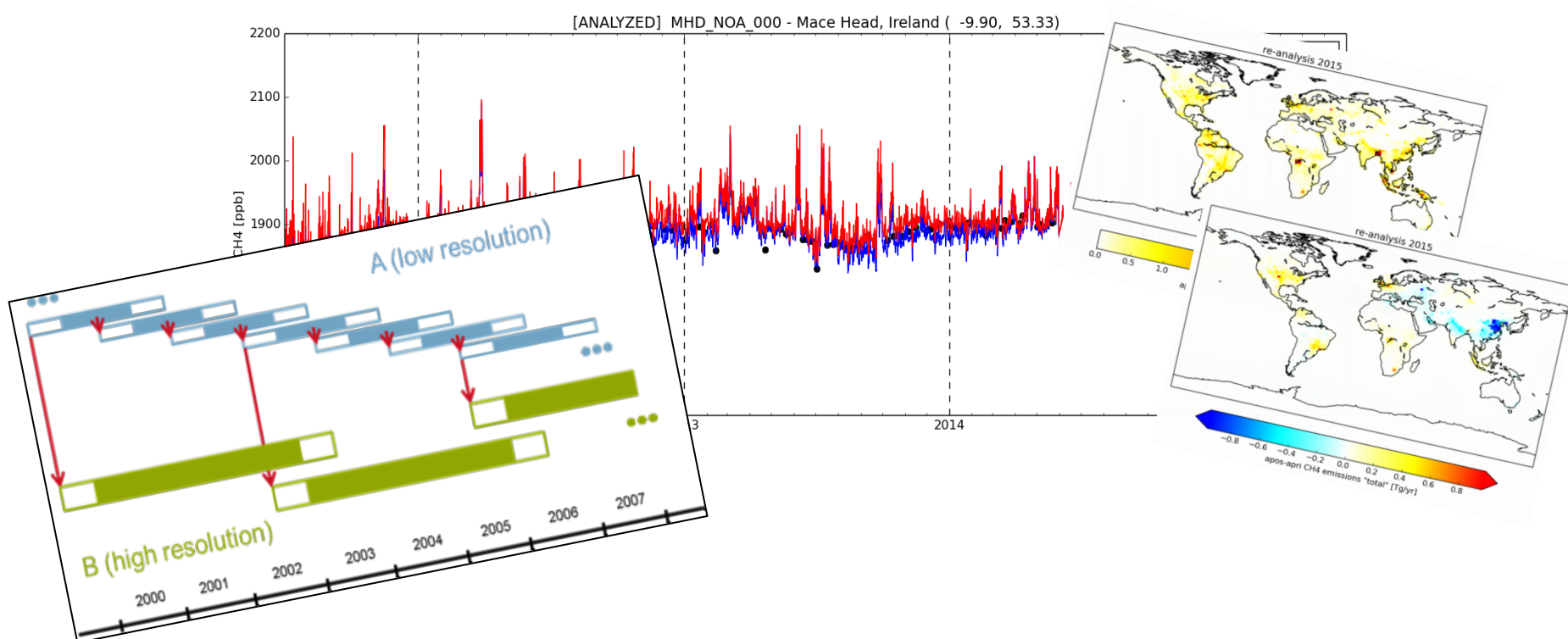# CAMS CH4 INVERSION
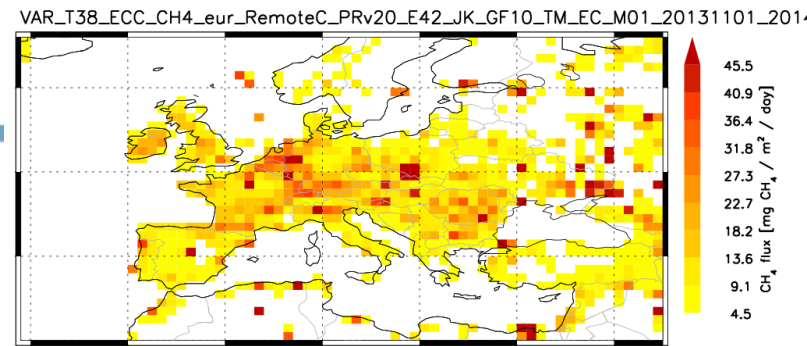
Arjo Segers (TNO)

Sander Houweling (SRON)

COPERNICUS ATMOSPHERIC MONITORING SERVICE (CAMS)

› Operational phase of MACC projects

› Official start date: October 1, 2015

› Services for Green House Gasses:

› high-res forecasts of concentrations (ECMWF)

› analysis incl. sat. data (ECMWF, < 1 month)

› re-analysis of fluxes (external, < 1 year)
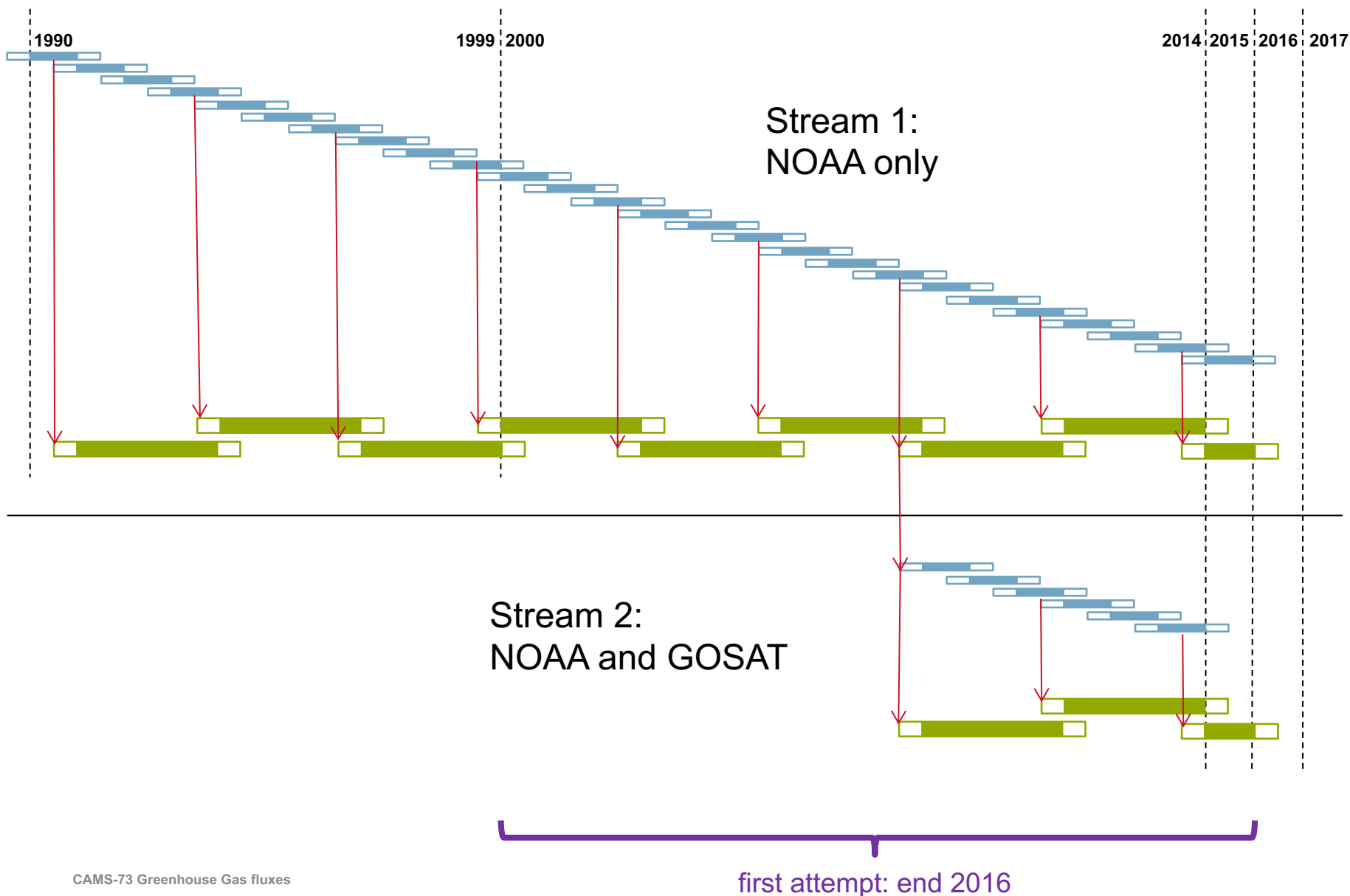
› CO_2 : LSCE

› N_2O : NILU

› **CH_4 : TNO/SRON**

> Required changes compared to MACC:

>> Increased resolution 3x2 deg (34 lev)

>> Error estimate (use ConGrad)

>> Meteo 3 hourly interpolated, archived convective fluxes

>> Re-analysis from 1990 to now, yearly extension

> Approach with 2 resolutions:

A (low resolution)

B (high resolution)

2000   2001   2002   2003   2004   2005   2006   2007
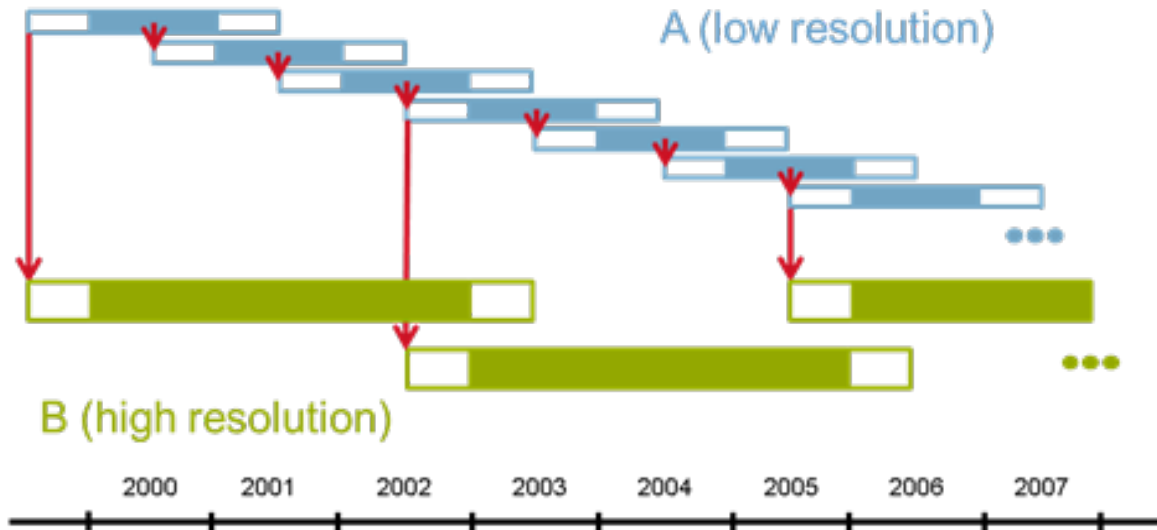
* resol 6x4, tropo25
* 1 year window
    + 6 mnth spinup/spindown
* optim iniconc and emis
* sequential

* resol 3x2, tropo34
* 3 year window
    + 6 mnth spinup/spindown
* iniconc from A
* optim emis
* runs in parrallel

Stream 1:
NOAA only

Stream 2:
NOAA and GOSAT

1990   1999 2000   2014 2015 2016 2017

first attempt: end 2016

CAMS-73 Greenhouse Gas fluxes

RE-ANALYSIS 2000-2014/2015

› Produced in 2016, deliverables for Dec

› Preliminary release, to be improved:

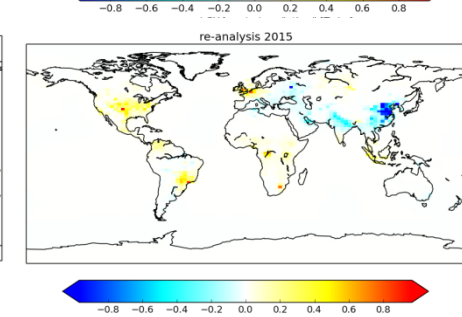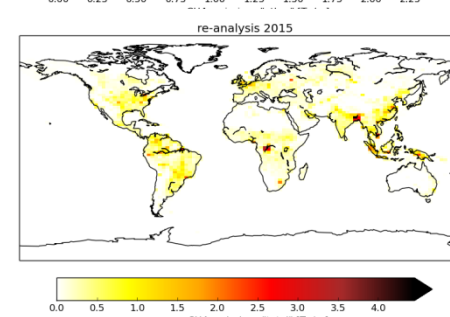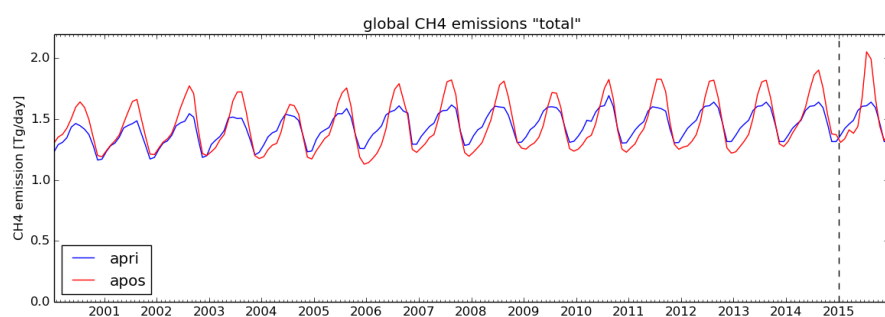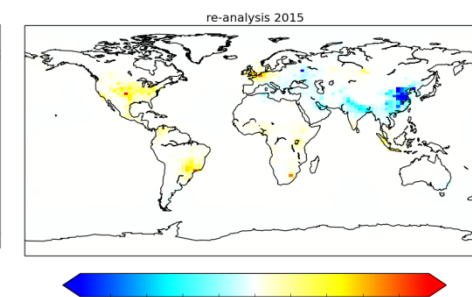 › *no error estimates yet (no ConGrad, unknown failure)*

  › *too slow ...*
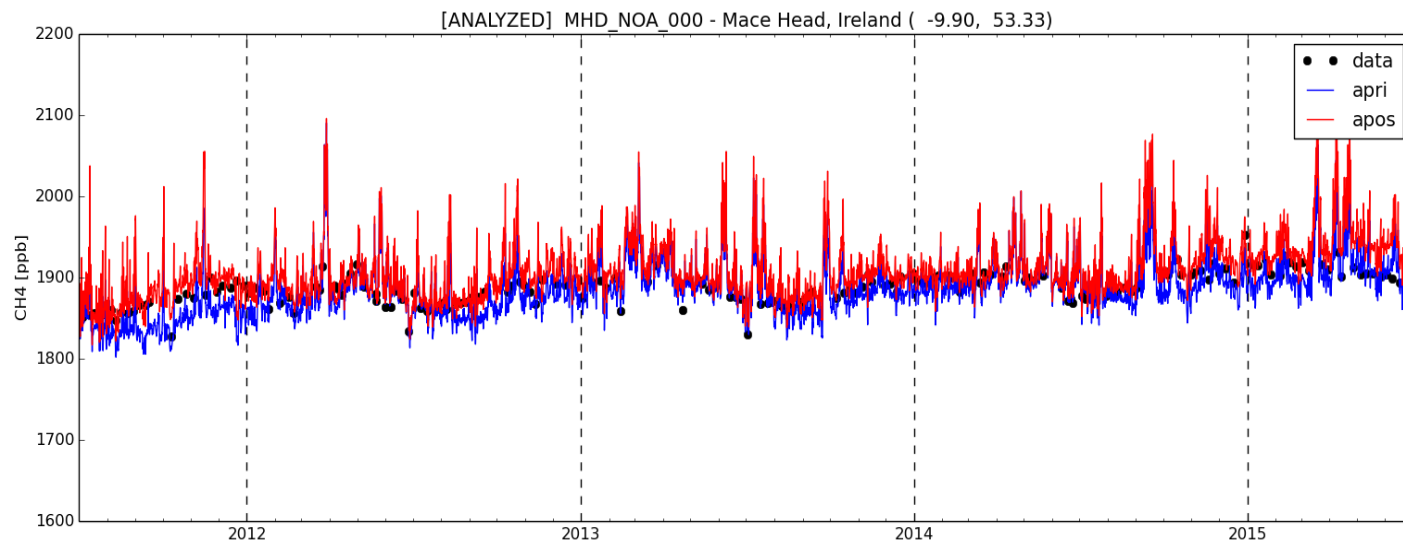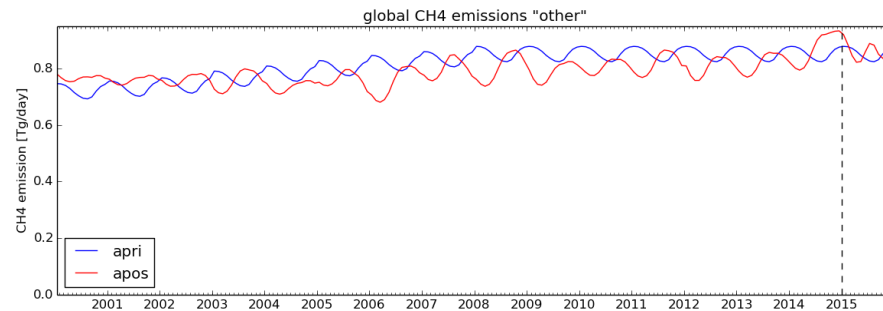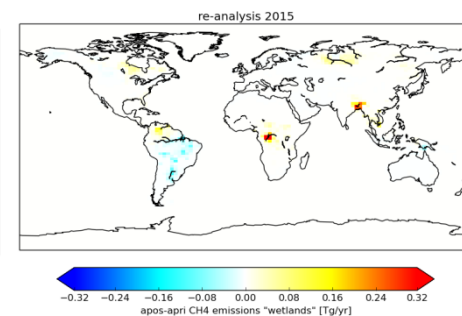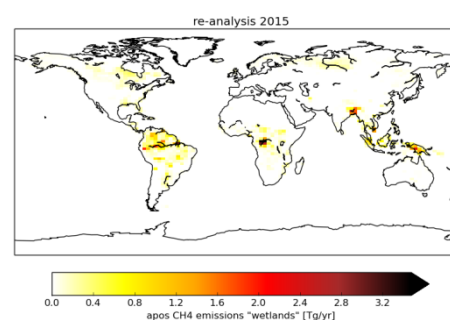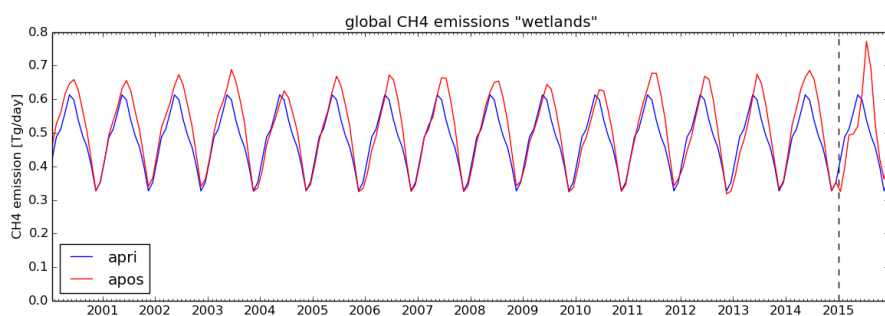
STREAM 1: NOAA ONLY

> Selection of 32 background stations with long time series

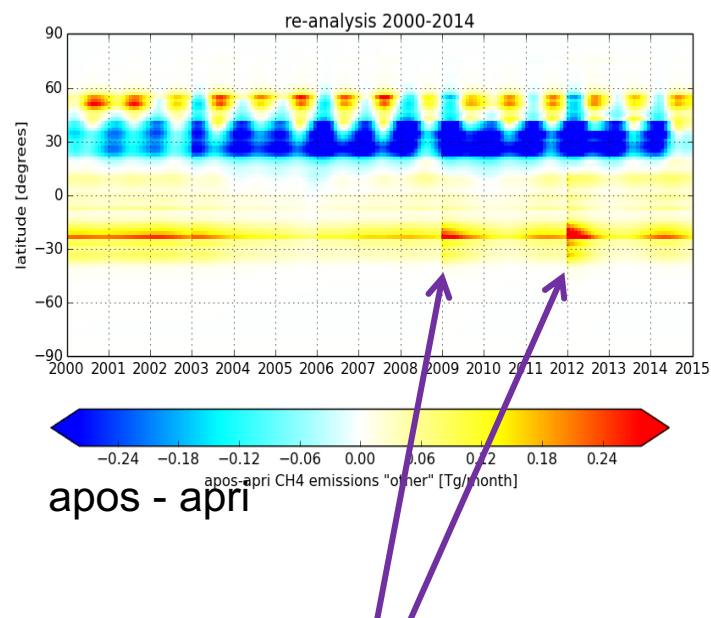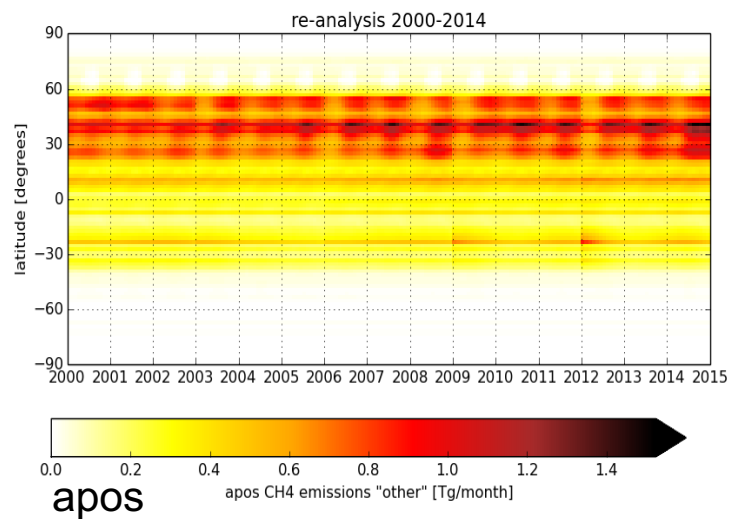> 'Usual' configuration of emission errors etc.

surface observations 2000-2015
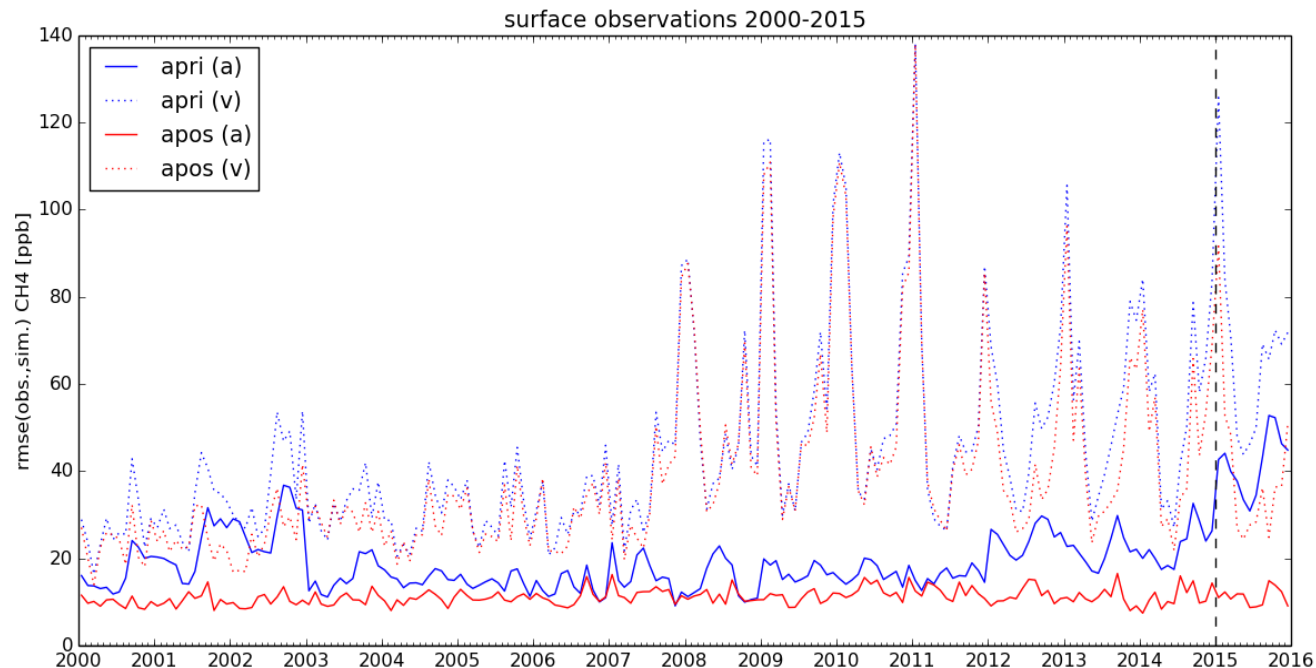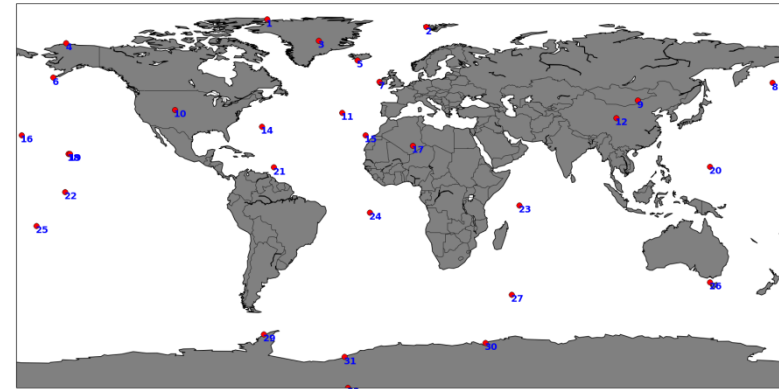
> Emissions

> Increased temporal variation

> Higher wetland and rice emissions in summer/autumn,
  lower 'other' emissions in winter
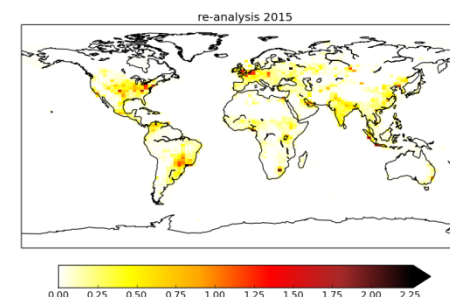
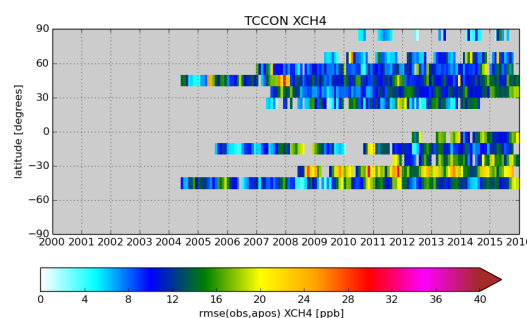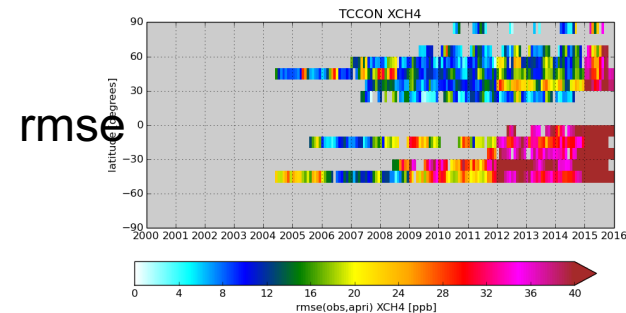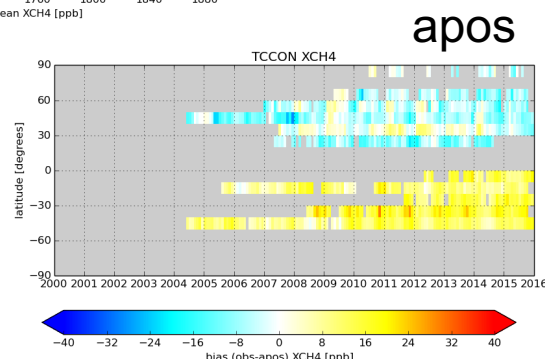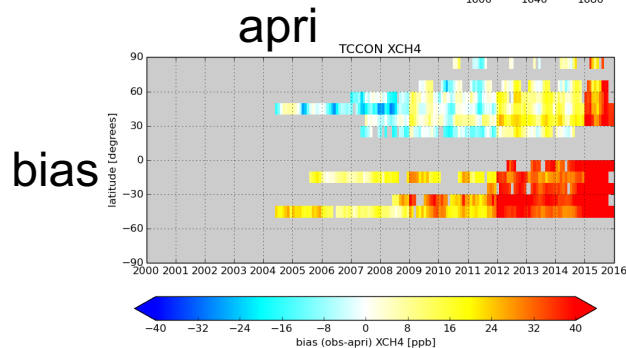'other' emissions, zonal monthly:

apos

apos - apri

problem in transition between
inversion windows ?

re-analysis 2015

number of TCCON samples (1.5 hour average)

> Validation with TCCON CH$_4$ columns

   > monthly/zonal statistics:

obs

TCCON XCH4

obs. mean XCH4 [ppb]

apri

apos

bias

TCCON XCH4

bias (obs-apri) XCH4 [ppb]

TCCON XCH4

bias (obs-apos) XCH4 [ppb]

rmse

TCCON XCH4

rmse(obs,apri) XCH4 [ppb]

TCCON XCH4

rmse(obs,apos) XCH4 [ppb]
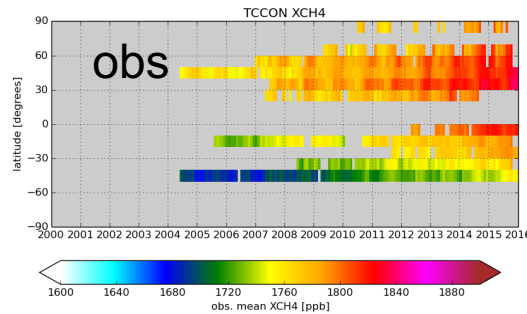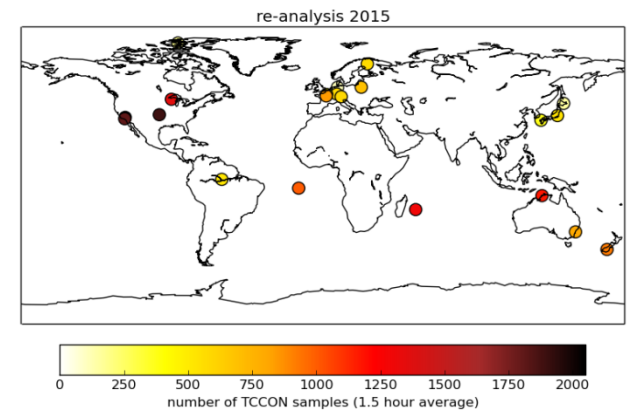
> remaining bias:

   > inversion > obs at NH

   > inversion < obs at SH

> rmse strongly decreased

STREAM 2: NOAA AND GOSAT

re-analysis 2015

GOSAT XCH4 mean observations [ppb]

1600 1640 1680 1720 1760 1800 1840 1880 1920 1960 2000

› Product: RemoteC XCH4 PROXY
(SRON, ESA/CCI project)

GOSAT XCH4 observations

› Bias correction for comparison with TM5
from comparing TCCON XCH4 with
NOAA-only inversion *[(c) Sudhanshu P.]:*

GOSAT bias correction (model - measurement)
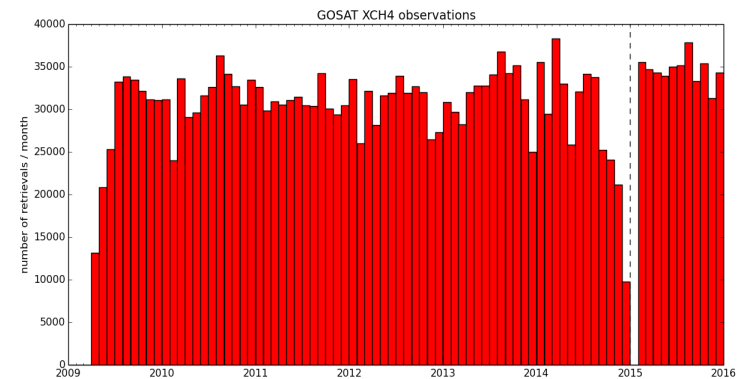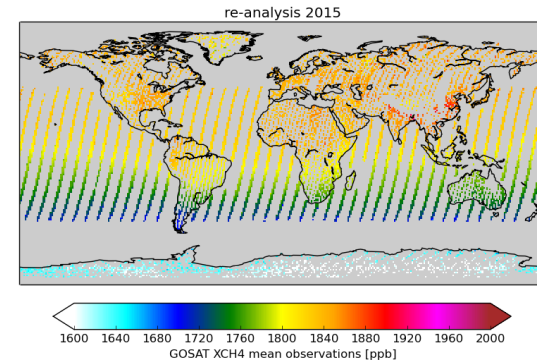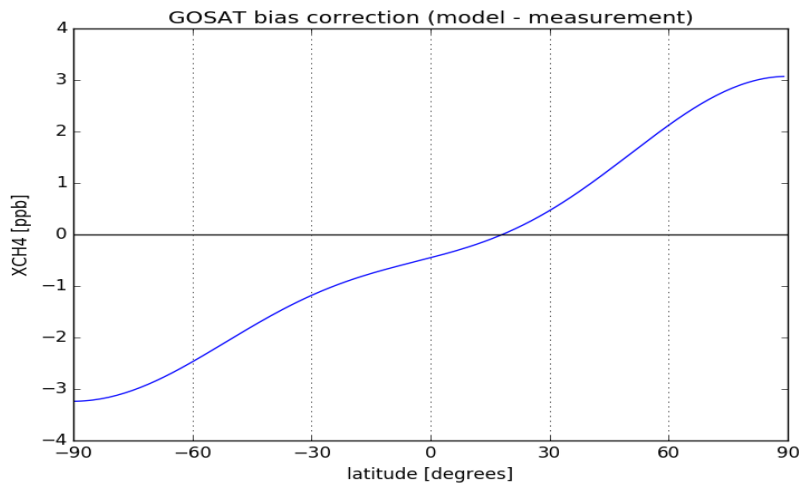
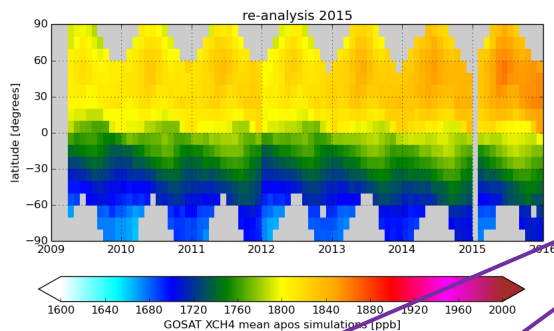*To be done: use result from Stream1 ?*

obs
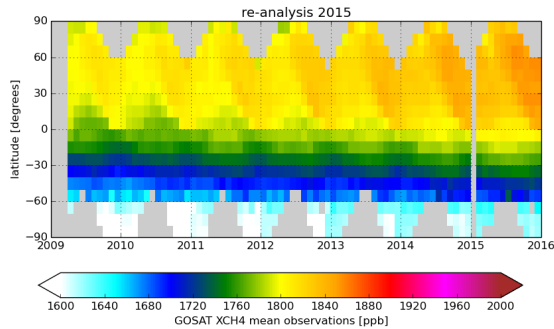
apos

bias
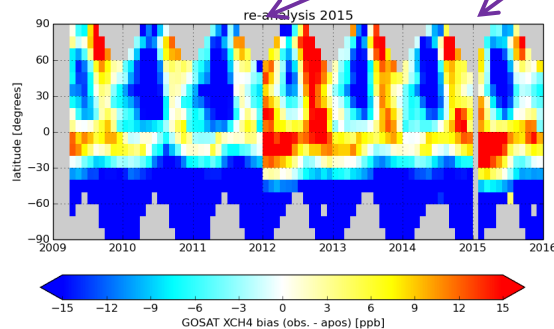
› Zonal/monthly statistics:

  › increasing XCH4 columns in time

› inversion results follows observations, but jumps visible between inversion windows ...

CONCLUSIONS

global CH4 emissions "total"

re-analysis 2015

› First CAMS CH$_4$ re-analysis produced

› To be improved ...

   › transition between inversion windows

   › include GOSAT-TM5 bias correction
     in production chain

   › use ConGrad optimizer to obtain error estimate
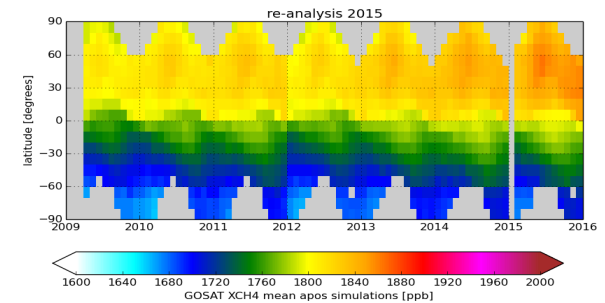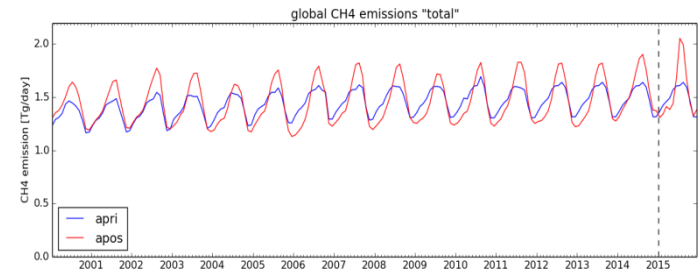
SPIN-OFFS ....

› Scripting with split job chain:

  › Single job for each sub-task:

> *build-tm5, f2py, emis, iniconc, ppobs, apri,*

> *xc2x, fwd, dep, grd, g2gc, opt, apos, ...*

  › Better insight in configuration, input, and output of each task

  › Resources (cpu, mem) defined per task

  › Easy restart from anywhere in the chain

  › Sphinx documented

› Offline pre-conditioner

  › Python for testing, Fortran executable for running

  › Configured completely from rcfile

  › State arrays remain lon/lat/lev/time dims wherever possible

Available by personal communication ....