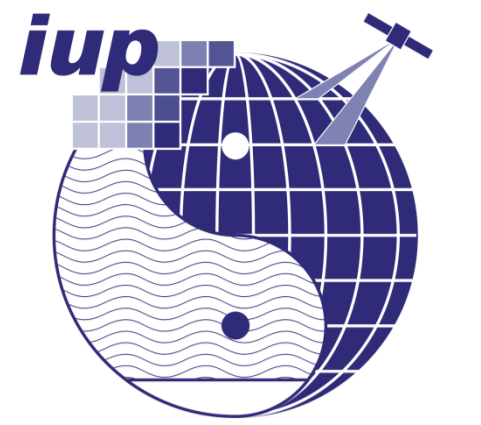


# Validation of global NO<sub>2</sub> MACC products with SCIAMACHY measurements

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## Introduction

The EU-funded **MACC project** is a follow up of the successful GEMS. Within the **GRG (Global Reactive Gases)** sub-group, ECMWF **IFS** coupled with the **MOZART** and **TM5** models, have forecasted successfully NO<sub>2</sub> both for the troposphere and stratosphere. In addition, also a reanalysis product is available where assimilation of satellite measurements is performed. The performance of the different systems was evaluated through comparison with independent observations from the satellite instrument **SCIAMACHY**. Here we provide examples of the evaluation work performed for the **modeled tropospheric NO<sub>2</sub>**.

The SCIAMACHY (Scanning Imaging Spectrometer for Atmospheric Chartography) flying on the ENVISAT satellite measures in the UV/vis/IR. It has a global coverage of the atmosphere within approx. 6 days at a spatial resolution of 60x30 km<sup>2</sup>. The local overpass time of SCIAMACHY is at about 10:00 LT for low and mid latitudes.

NO<sub>2</sub> total slant columns are obtained from a DOAS fit at 425 – 450 nm. The tropospheric slant columns are obtained with the subtraction, from the total column, of the average of the NO<sub>2</sub> slant columns measured on the same day at the same latitude over the Pacific sector (140°W – 180°W). Vertical tropospheric columns are then computed using airmass factors based on a MOZART run for 1997 and averaged over months. For these data, a filter for cloud fractions smaller than approx. 20% from the FRESCO product is applied.

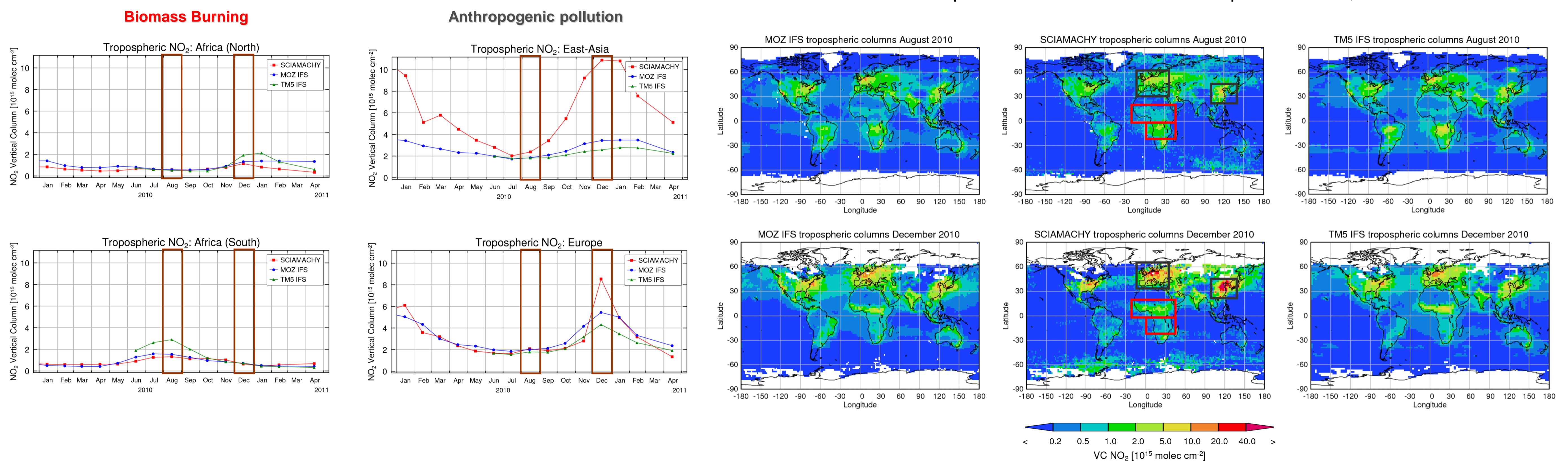
## Tropospheric NO<sub>2</sub>

Validation of NO<sub>2</sub> tropospheric fields helps to assess the quality of: 1. Anthropogenic NO<sub>x</sub> sources and their change in time; 2. The spatial and temporal distribution of biomass burning sources; and 3. The photochemical ozone production potential

## Forecast

expid f93i: NRT forecast from coupled IFS-MOZART, with assimilation

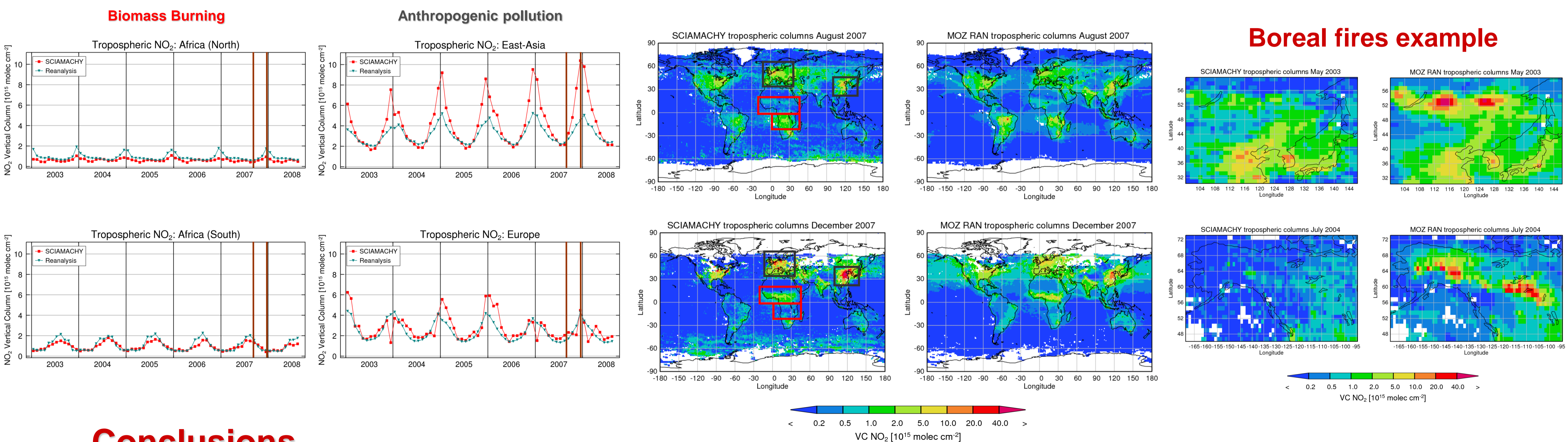
expid f9nd: NRT forecast from coupled IFS-TM5, with assimilation



## Reanalysis

expid fbov: MACC reanalysis from coupled IFS-MOZART

## Boreal fires example



## Conclusions

- A **web based validation** service was implemented at IUP Bremen to validate tropospheric trace species from the IFS GRG analysis and reanalysis using independent satellite retrievals
- The overall patterns of NO<sub>2</sub> show a **qualitative agreement** between model and satellite data
- There is evidence for **out-of-date NO<sub>x</sub> emissions** in the model (too high over US and Europe, too low over China) pointing at the need for constant updates of emission inventories
- The agreement for biomass burning NO<sub>2</sub> varies strongly with region, indicating **problems with fire emission** parameterizations
- In comparison to TM5-IFS, MOZART-IFS predicts higher tropospheric NO<sub>2</sub> values in polluted regions, and lower in the biomass burning areas.
- The reanalysis simulation fails to simulate the fast increasing trend of NO<sub>2</sub> columns above East-Asia. and overestimates the emissions from fire events, specially for the cases of boreal fires (Siberia, 2003 and Alaska, 2004). Once more, the problem might be related to with NO<sub>x</sub> emissions used.

## Online validation service

A web service with IFS validation results using IUP Bremen SCIAMACHY retrievals is operated within MACC. It provides monthly updated figures for **NO<sub>2</sub>** and **HCHO**. Currently, three products are being validated: the MOZART-IFS; the TM5-IFS; and the MACC reanalysis. Over the coming year, the service will be further improved and extended to **SO<sub>2</sub>** validation. For details see

[http://www.doas-bremen.de/macc/macc\\_veri\\_ifsmoz\\_no2.html](http://www.doas-bremen.de/macc/macc_veri_ifsmoz_no2.html)

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