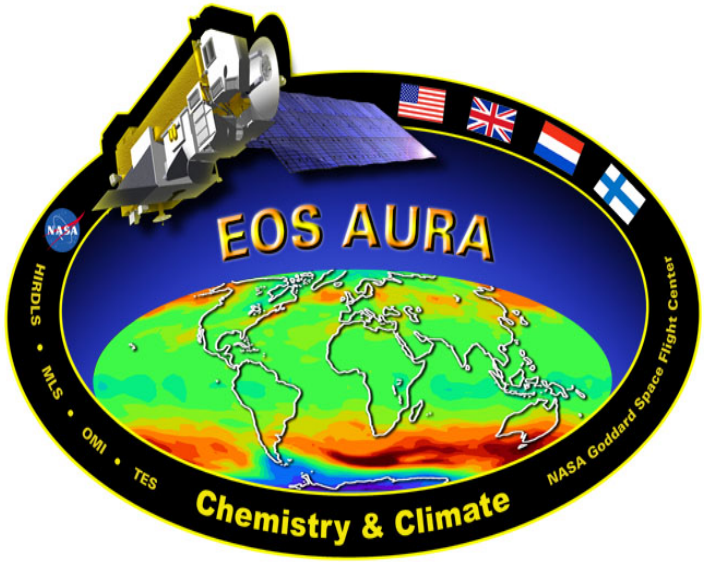
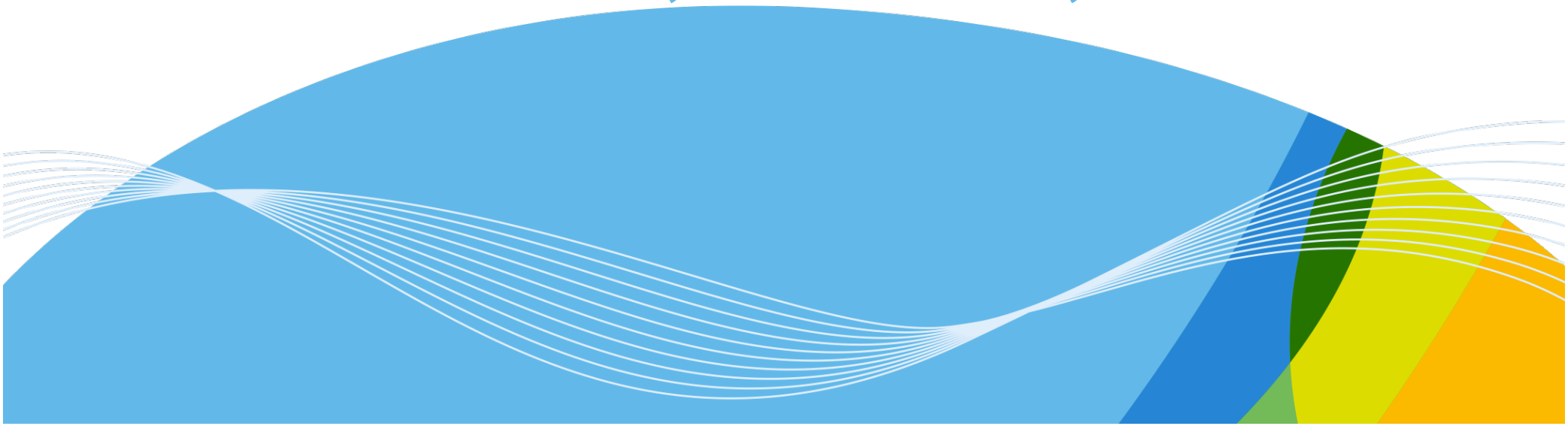


Ten years of OMI observations in Finland

OMI 10 -years seminar
September 2nd, 2014 at FMI

Johanna Tamminen, Antti Arola, Seppo Hassinen,
Simo Tukiainen, Janne Hakkarainen, Jari Hovila,
Niilo Kalakoski, Marko Laine, Anu Määttä,
Jukka Kujanpää, Viktoria Sofieva, Iolanda Ialongo,
Erkki Kyrölä, Osmo Aulamo, Timo Pirttijärvi,
Timo Ryyppö, Rigel Kivi,
Anders Lindfors, Tero Mielonen

With special thanks to
Gilbert Leppelemeir, Anssi Mälkki,
Pieternel Levelt, Pepijn Veefkind, KNMI
Pawan Bhartia, Joanna Joiner, NASA



FINNISH METEOROLOGICAL INSTITUTE

OMI – a success story in Finland Technology project

- First remote sensing instrument where Finland had a significant role in building the instrument:
  - OMI heritage and experience has been used in **VTT**'s new developments in hyperspectral imagers for UAVs and nano-satellites.
  - For **Partria** experience and reference from OMI opened doors for developing similar Detector Electronic Units for ESA missions.
  - For **Space Systems Finland** OMI built experience on developing reliable ground processing systems applicable also in other fields.

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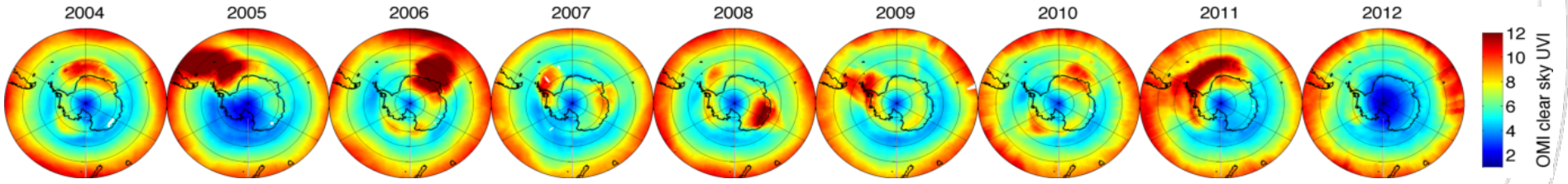
OMI – a success story in Finland Satellite operations

- Beginning of satellite data reception activities in Finland
  - **Sodankylä Very Fast Delivery service 2006**

- Operational satellite product : **Surface UV radiation**



UV radiation in Antarctic, Nov 9-10

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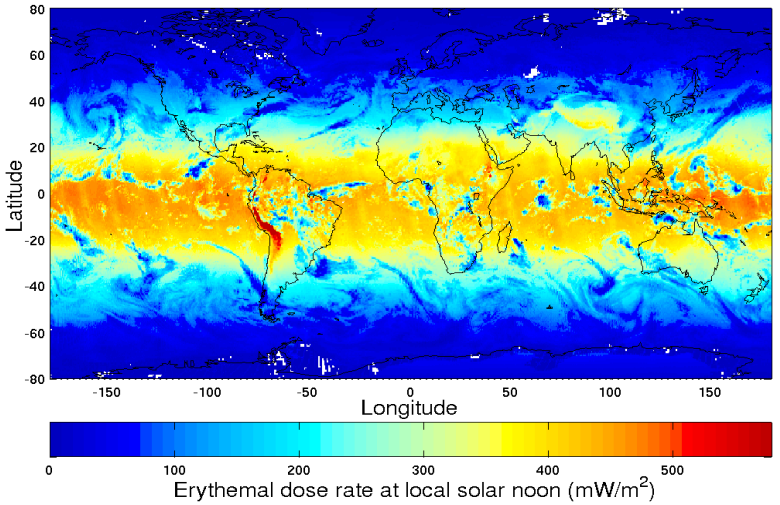
Surface UV-radiation



Motivation:

- **Human health** (**UV-index, erythemally weighted UV-radiation**, Vitamin D synthesis)
- **Ecosystems, vegetation** (**spectral UV-radiation, plant-response, DNA damage**)
- **Air quality and Climate**: photochemistry, oxidisation, ozone, methane, (**spectral UV-radiation,** actinic flux, photolysis rate constants)
- **Supporting protocol monitoring**, Vienna convention, Montreal protocol

Links with UV on arctic carbon budget

- At the basin scale, photochemical processing of DOC is about one-third of the total CO2 released from surface waters and is thus an important component of the arctic carbon budget. [Rose M. Cory *et al.* **Sunlight controls water column processing of carbon in arctic fresh waters,** *Science* **345**, 925 (2014)]

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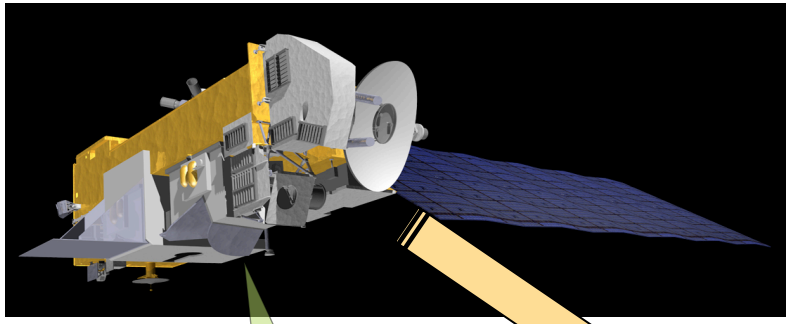
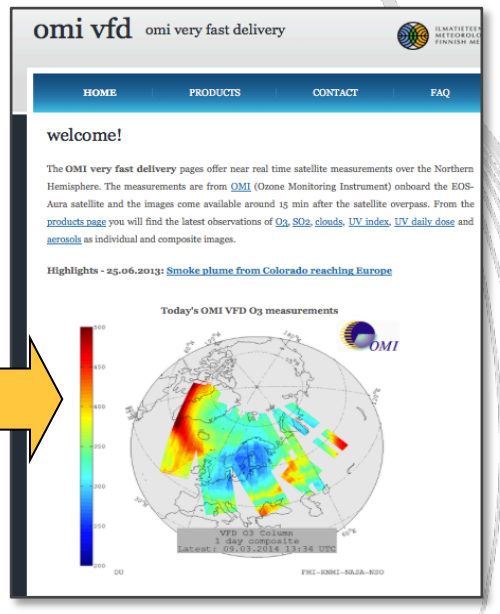


Aura Direct Broadcast data reception in Sodankylä

- High-latitude site optimal for data reception of Polar satellites
- Coverage: most of Europe



Observations ***Direct Broadcast receiver*** ***Distribution in the web***

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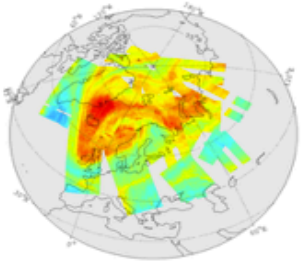
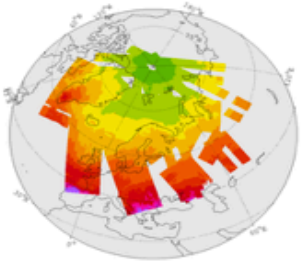
OMI real time products

sampo.fmi.fi
(omivfd.fmi.fi)

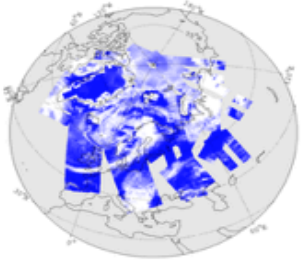
o3



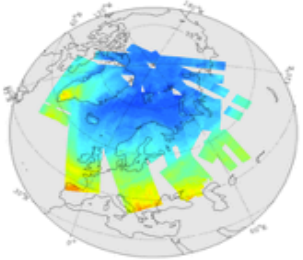
uv index



cloud fraction

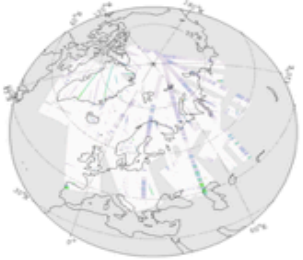


uv daily dose



so2

uv aerosol index



- Daily measurements of
  - Ozone
  - UV-radiation
  - SO2
  - Aerosols
- Available within 15-20 min after satellite overpass.
- Coverage:
  Northern Europe
- Since summer 2014 also Suomi NPP OMPS data

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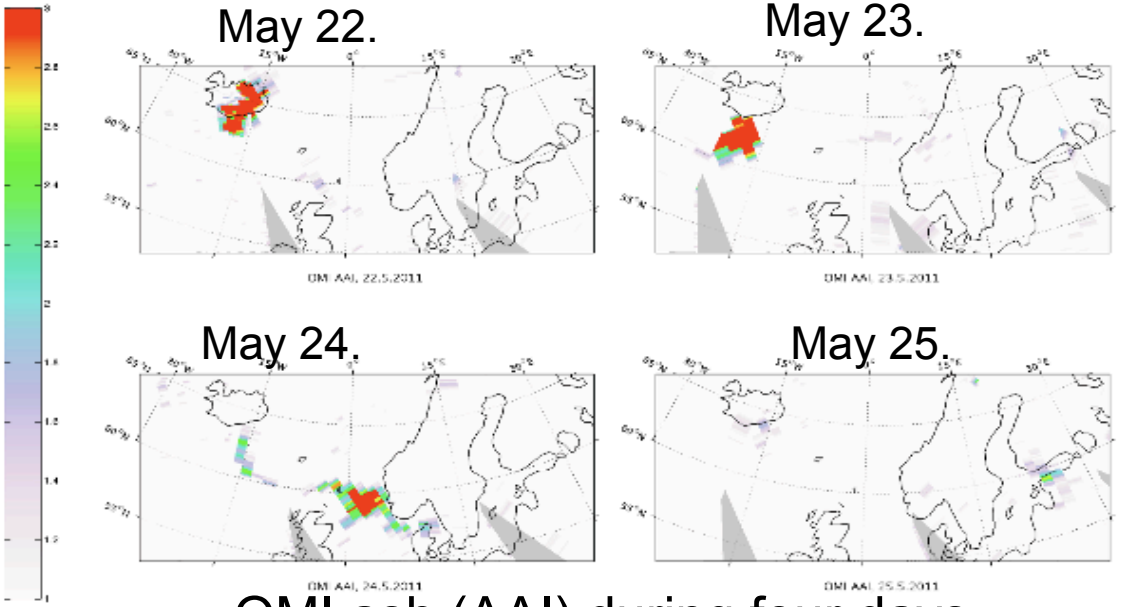
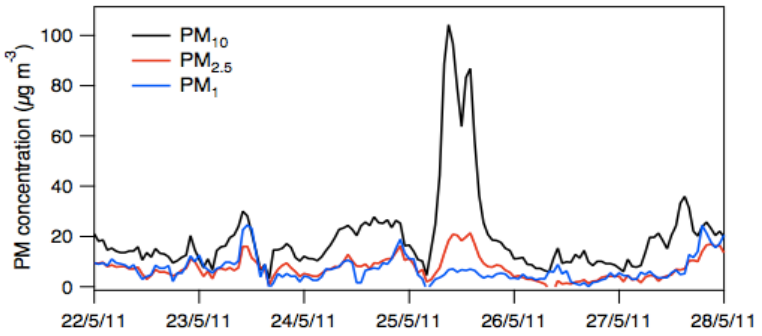
Grimsvötn volcanic eruption May 21st 2011

- **Fast availability of data important for forecasts to support aviation**
- OMI VFD used to follow the transport of the ash and to constrain the dispersion forecasts.



OMI ash (AAI) during four days

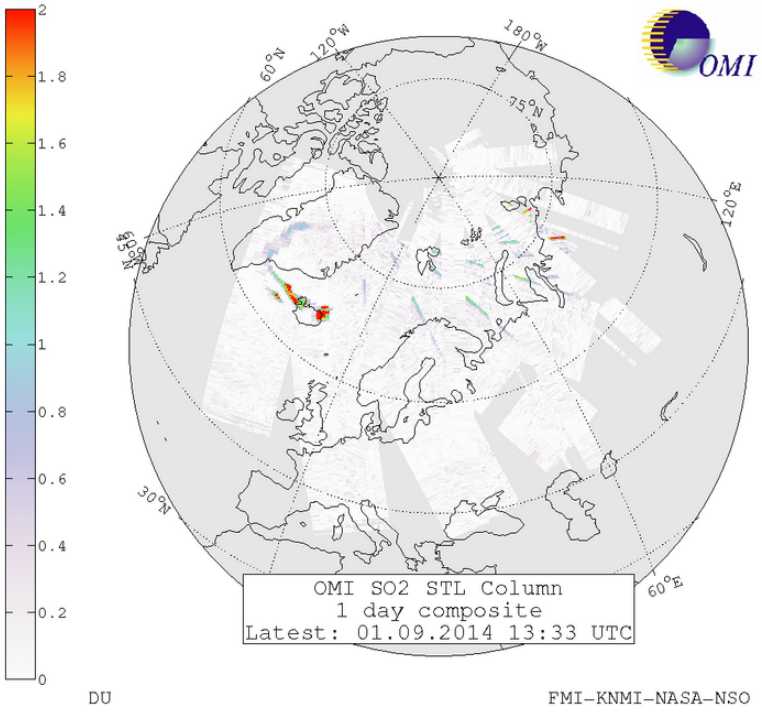
- The eruption was strongest on 22 May and on 25th it arrived to Southern Finland
  - Increased PM10 values clear on May 25th
  - Concentration of smaller particles not increased



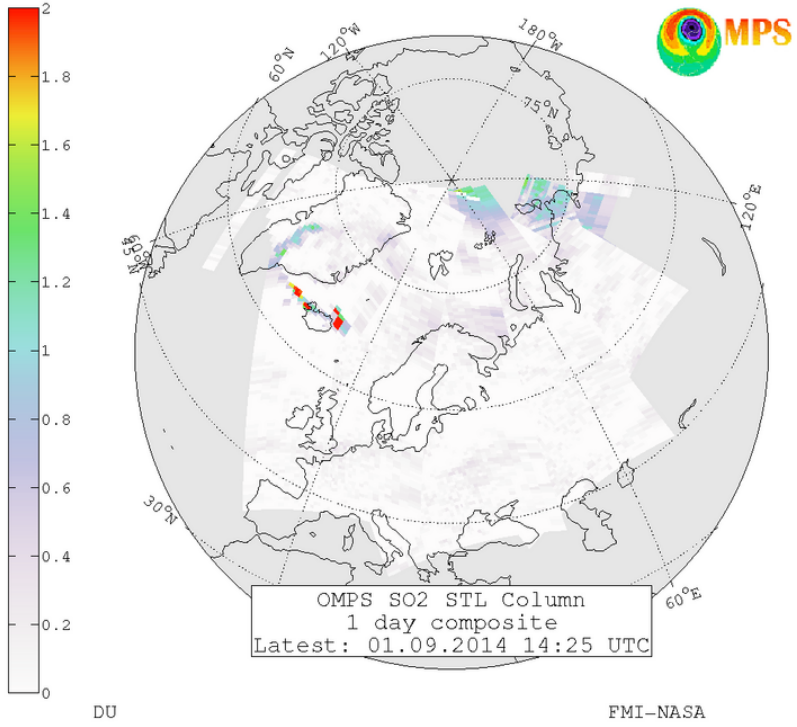
Particulate matter in Helsinki May 22-28, 2011

SO2 detected yesterday in Iceland

- NASAs first mass estimates of the ~20 kt



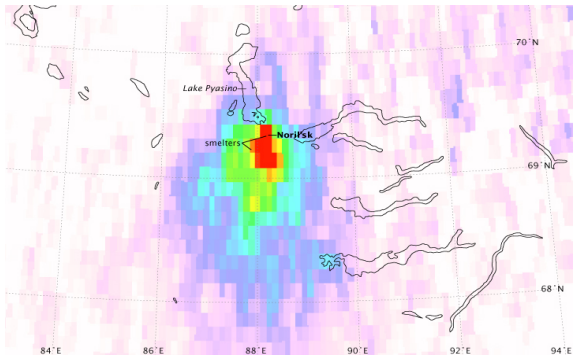
OMI / Aura



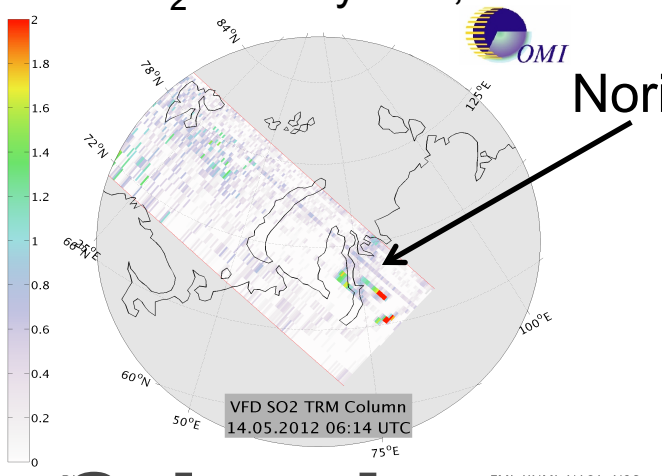
OMPS / Suomi NPP

Sulfur dioxide from metal smelters in Siberia

Averaged SO2: Jun-Aug, 2005-07

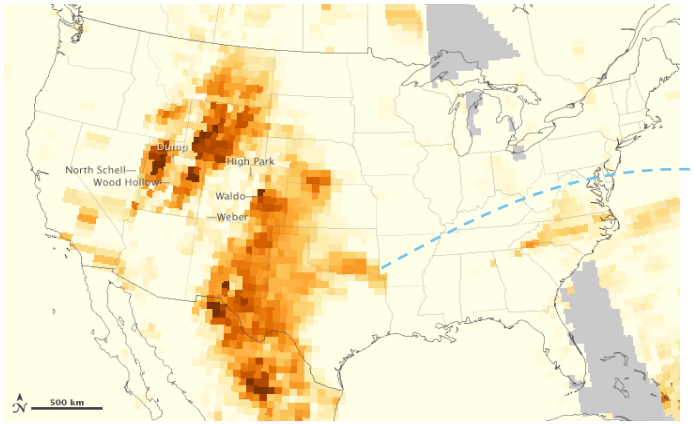


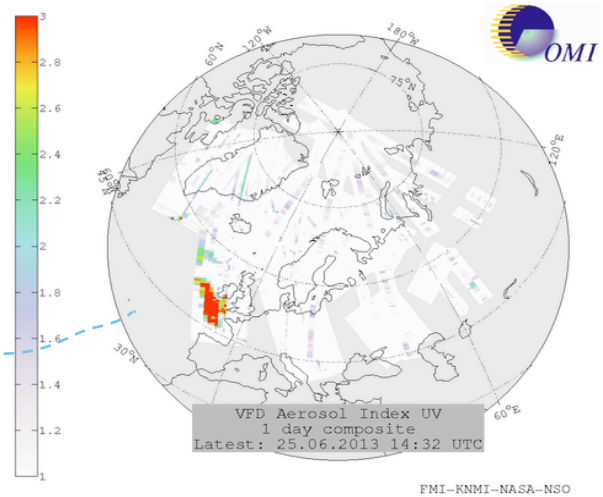
OMI SO_2 on May 14th, 2012



June 2013 – Smoke plume from Colorado

The smoke plume originating from the wildfires in Colorado reached Europe in 25th June 2013





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OMI VFD UV product used in Iceland

- **Icelandic Radiation Safety Authority has been using OMI UV-radiation products from VFD since June 2012.**
- **UV at Reykjavik and Egilsstaoir**

GEISLAVARNIR RÍKISINS
ICELANDIC RADIATION SAFETY AUTHORITY

Sívöktun á útfjólublárri geislun

Reykjavík	Egilsstaðir
31.8.2014 12:49:00	31.8.2014 14:31:00
2,8	2,9

Tölurnar að ofan eru mælikvarði á styrk útfjólublárrar geislunar í dag kl. 13:30, miðað við heiðskírar aðstæður. Þær eru byggðar á reikningum og gervihnattamælingum (EOS-Aura) finnsku veðurstofunnar á þykkt ósónlagsins*. Dagsetningin sýnir hvenær síðustu tölur voru reiknaðar. Heiltölugildið af ofantöldu kallast UV-stuðull.

Sjá má spá um UV-stuðla í Evrópu á vef Finnsku veðurstofunnar. Hægt er að sjá spá fyrir daginn í dag og tvo næstu daga í Reykjavík.

* Eftirtaldir aðilar hafa unnið að gerð þessarar þjónustu: FMI, NASA og KNMI (Holland).

GEISLAVARNIR RÍKISINS
Icelandic Radiation Safety Authority

Forsíða | Stofnunin | Viðskiptavinir | Fræðsluefni | Fréttir | Ábendinga

Eldri fréttir

Forsíða > Fréttir

Fréttir
Enn er ástæða til að fylgjast með ósonlagi og ÚF-geislun

28.2.2012

Á nýafstaðinni ráðstefnu um óson kom fram að ósonlagið á norðurslóðum hefði mælst mjög þunnt á síðasta ári. Þá mældist óvenju hár ÚF-stuðull (e. UV-index) með gildið 7 yfir Finnlandi

Starfsmaður Geislavarna ríkisins sótti árlega ráðstefnu norræns vinnuhóps um óson og útfjólubláa geislun á norðurslóðum (NOG) sem haldin var í Helsinki dagana 8. til 10. febrúar. Á ráðstefnunni var meðal annars rætt um mælingar á þykkt ósonlagsins á síðasta ári. Þrátt fyrir að dregið hafi úr losun ósoneyðandi efna mældist ósonlagið mjög þunnt á norðurslóðum síðasta sumar. Ein afleiðing þess var aukin útfjólublá (ÚF) geislun og mældu Finnar óvenju háan ÚF-stuðul þann 26. júní 2011.

Finnar eru leiðandi innan Evrópusambandsins í notkun á gervihnöttum til að meta þykkt ósonlagsins og styrk ÚF-geislunar. Sjá http://omivfd.fmi.fi/. Finnar vinna að því að meta áreiðanleika þessara mælinga með samanburði við mælingar á jörðu niðri og voru niðurstöður úr slíkum samanburði kynntar á ráðstefnunni. Búast má við því að næstu árum fái mælingar gervitungla aukið vægi og munu Íslendingar njóta góðs af því.

Á myndinni er mat gervitunglsins EOS-Aura á ÚF geislun í Norður-Evrópu 27. júní síðasta sumar. Á vef veðurstofunnar var sagt frá þunnu ósonlagi síðasta vetur hér: http://www.vedur.is/um-vi/frettir/nr/2162

http://uv.gr.is

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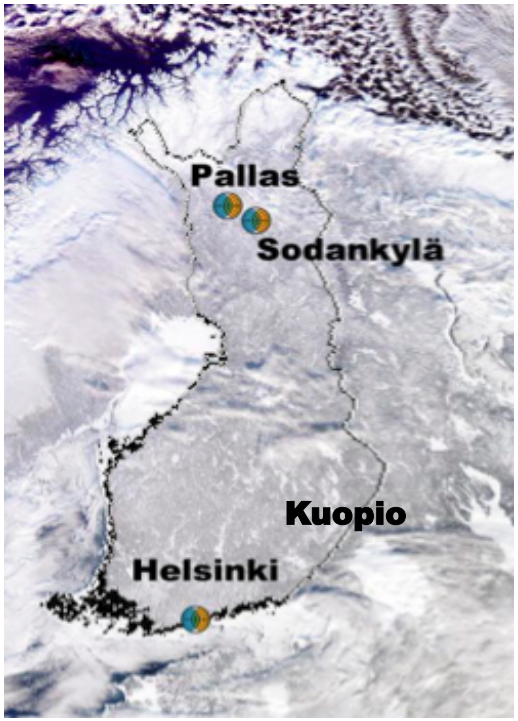
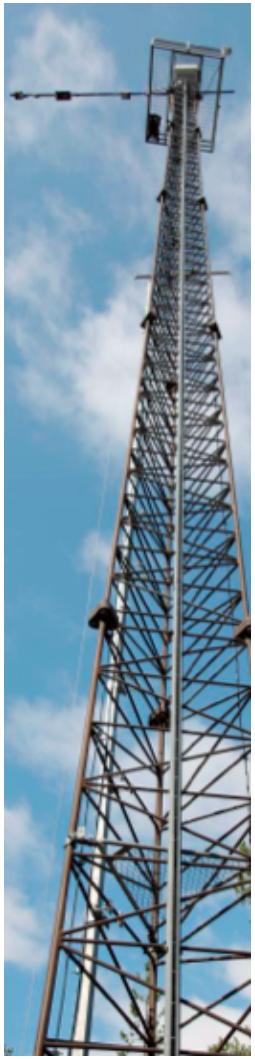
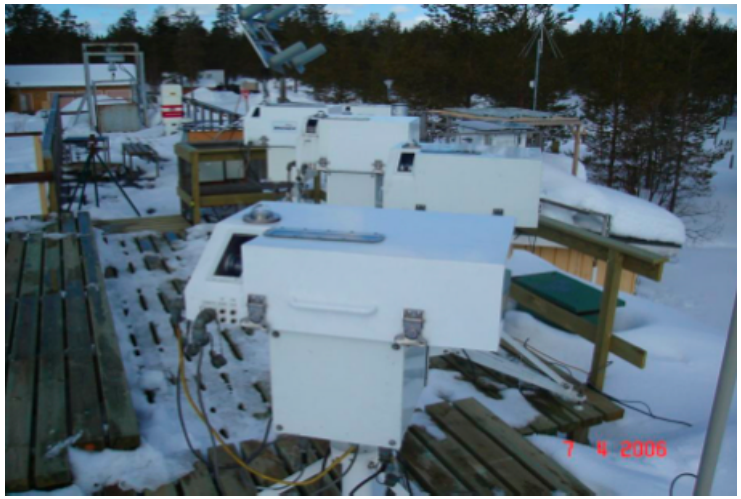
Satellite data validation

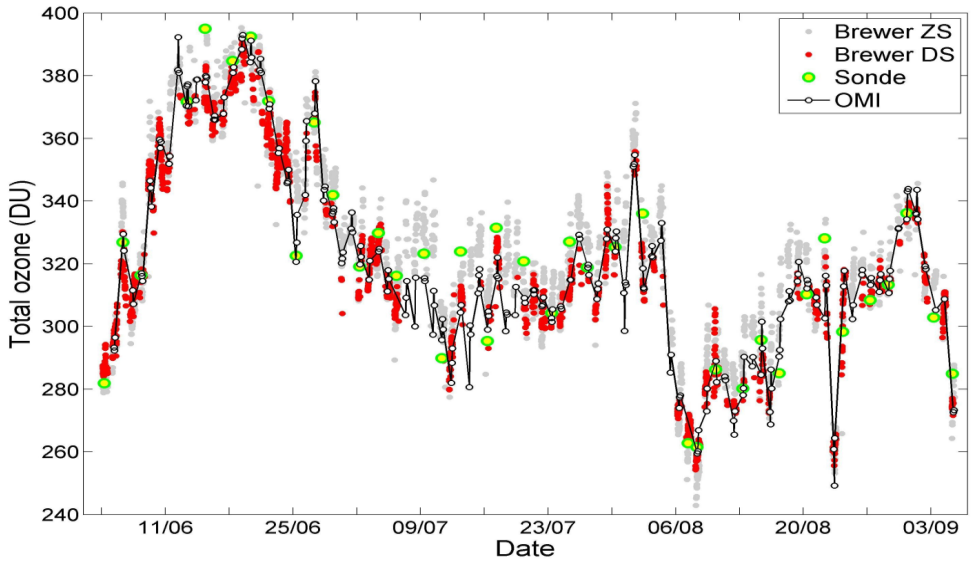






Satellite data validation – verification, characterizing uncertainties, improving

- Validation requirements are very high and often challenging also for ground based instruments.
- Validation in Finland improves the interpretation of satellite data in Finland and at high latitudes.
- Sodankylä is important validation super site

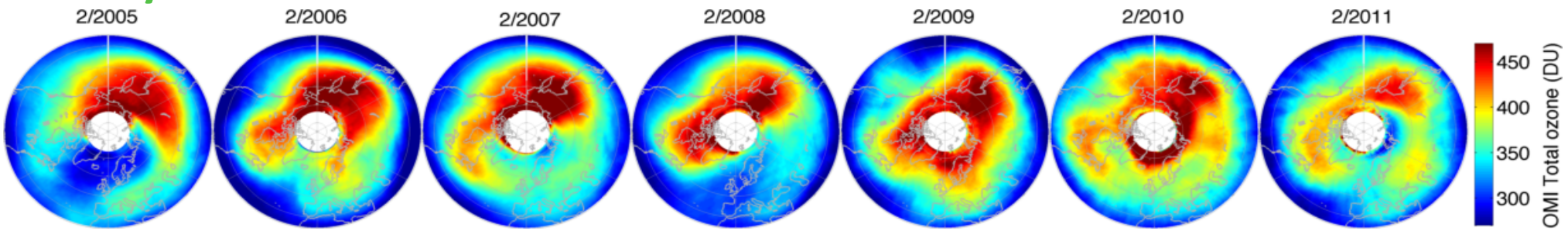


From Kivi et al., 2011

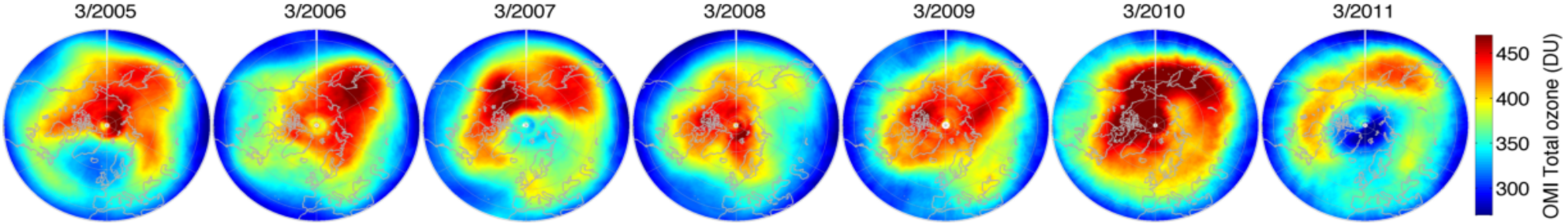
- Ozone comparisons in summer 2007. Frequent ozonesonde and Brewer measurements were used for OMI comparisons.
- OMI total ozone and Brewer Agreement within few %.

OMI total ozone – monthly mean in Arctic

February



March



April

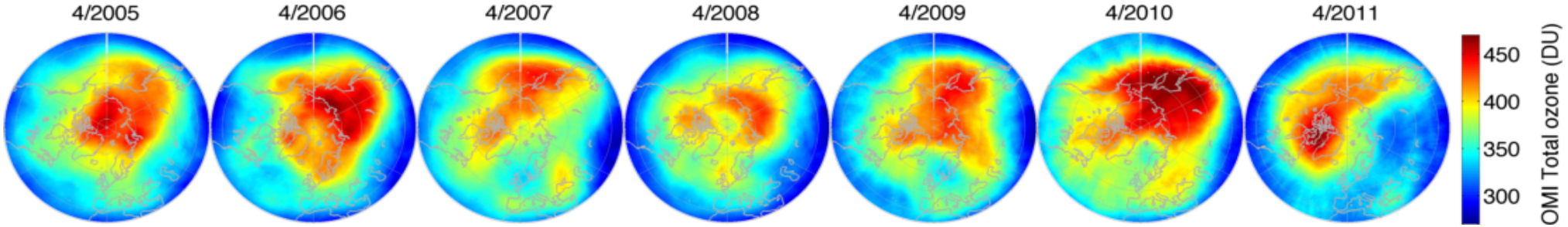


Figure I. Ialongo, FMI

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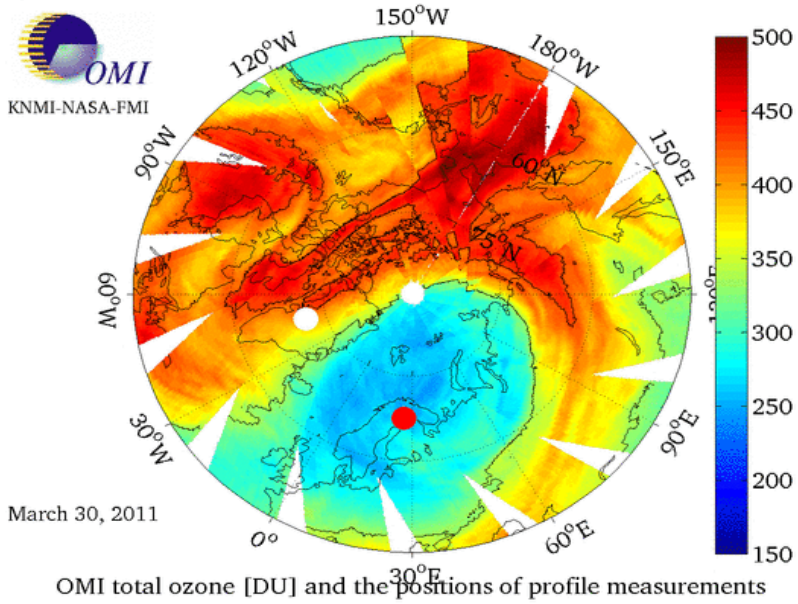
Arctic ozone depletion in spring 2011

- Cold stratosphere, CFC gases and exceptionally long lasting vortex caused ozone loss similar to what is yearly seen at Antarctica
- Manney, G.L., et al., Unprecedented Arctic Ozone Loss in 2011, *Nature, 478, 469 –475, 2011,* based on OMI data and Sodankylä soundings (+ other data)



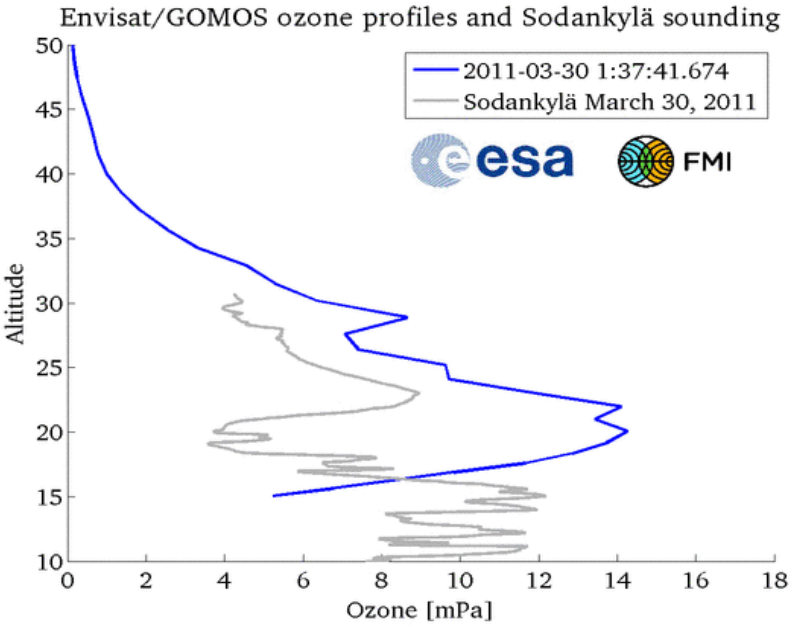


Figure by J. Hakkarainen, FMI

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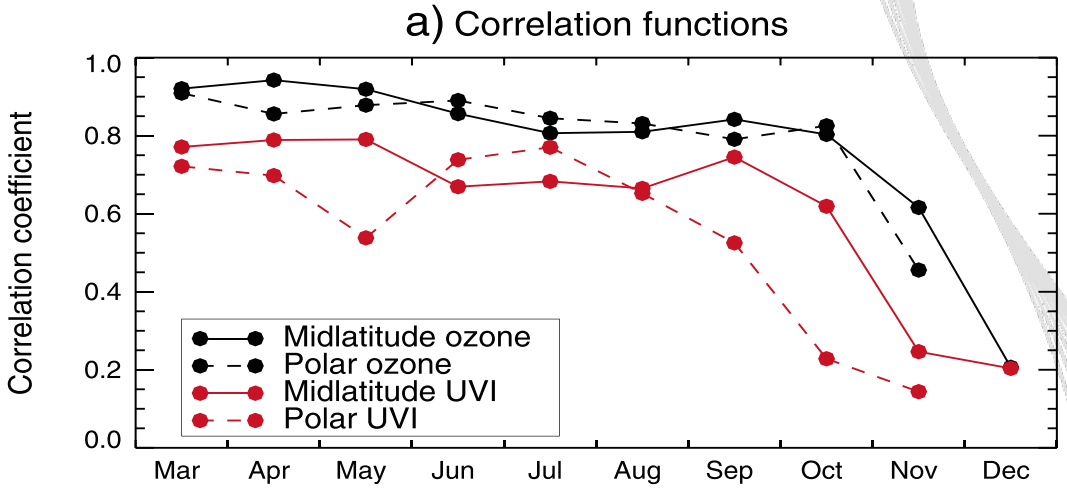
Link between spring-time ozone and summer-time UV

- OMI and TOMS ozone and UV time series analysed
- Variability in springtime ozone explains up to 20–40% of the summer UV variability in Northern hemisphere high and mid-latitudes.



Correlation functions between the TOMS/OMI March extratropical total ozone and monthly mean total ozone and noontime UVI. (Absolute values shown for red lines.)

Reference: Karpechko, A. Yu., et al. (2013), The link between springtime total ozone and summer UV radiation in Northern Hemisphere extratropics, J. Geophys. Res. Atmos., 118, 8649–8661.

Global NO2 as seen by OMI

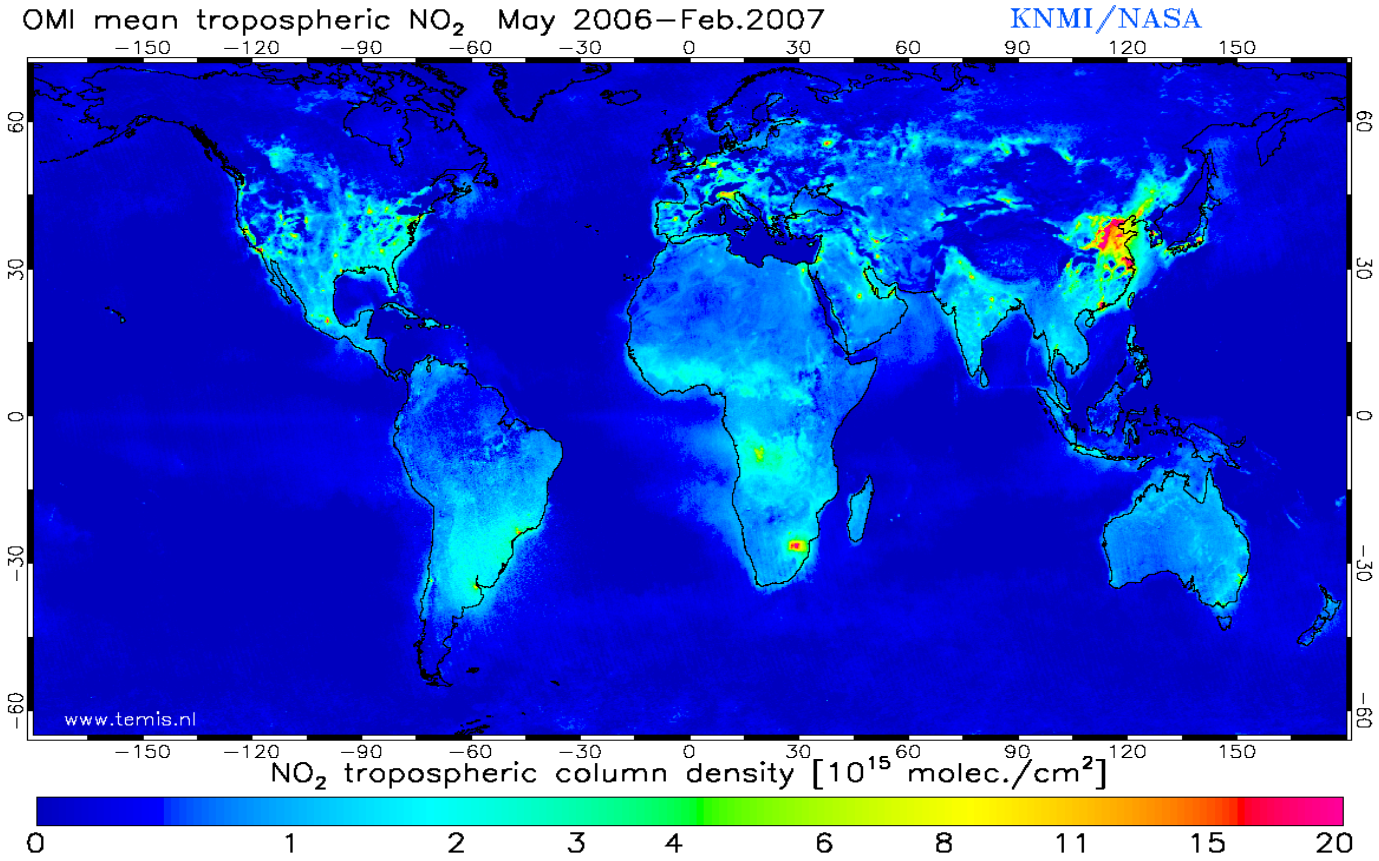


Figure from TEMIS service (www.temis.nl)

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The effect of different wind directions in Helsinki

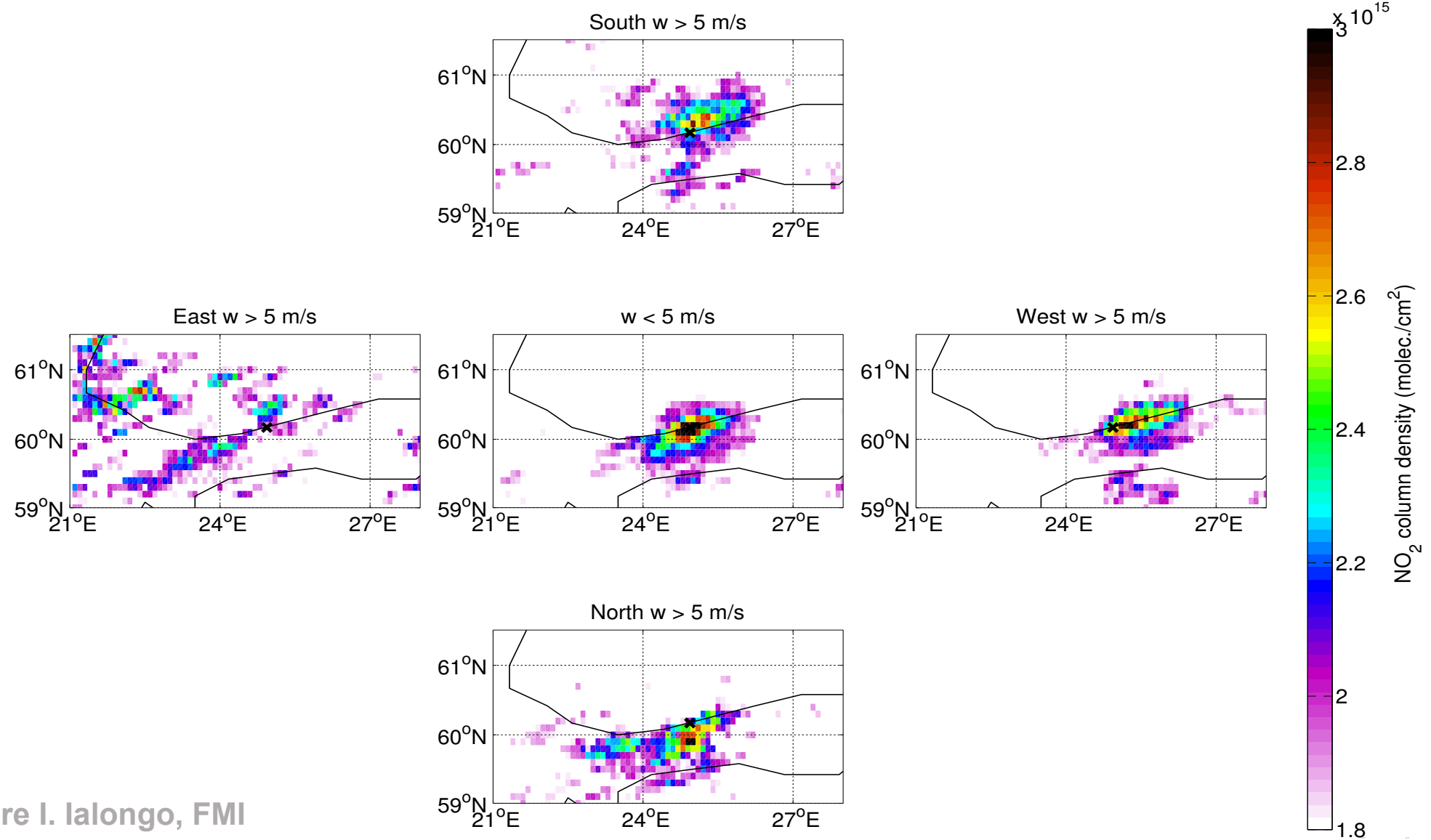
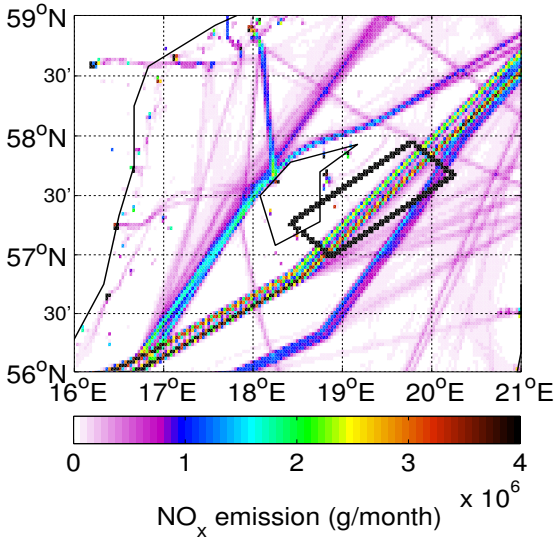


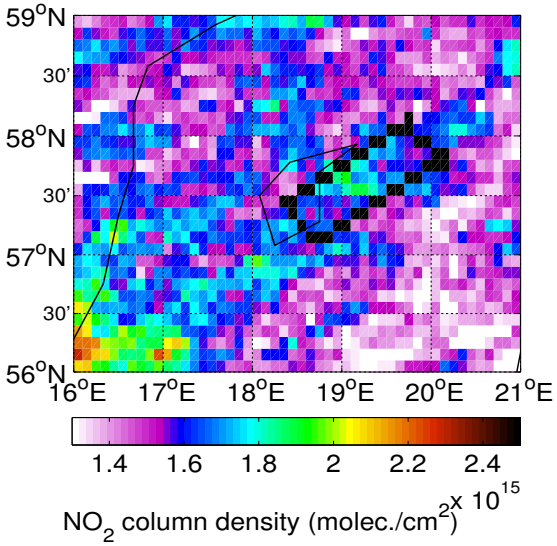
Figure I. Ialongo, FMI

Comparison with ship emission data over Baltic Sea

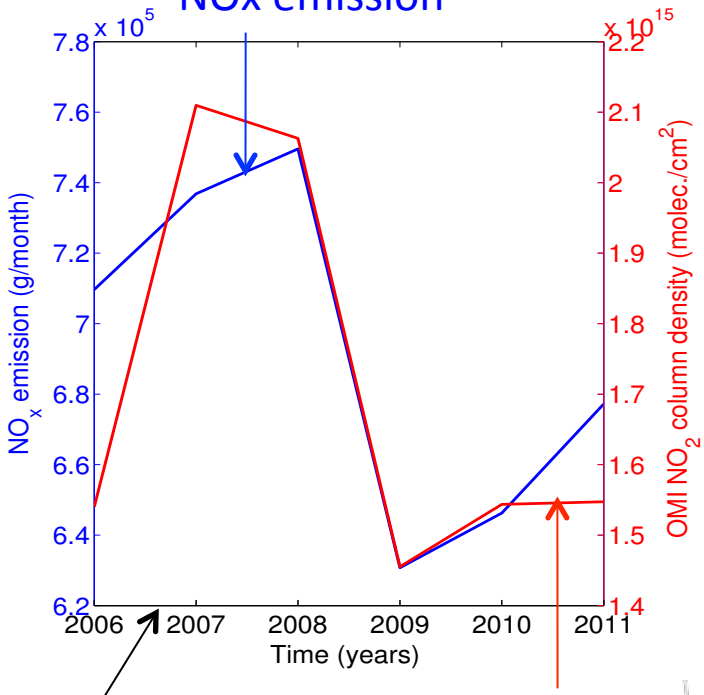
STEAM NOx emission



OMI NO2



NOx emission



Jul-Aug averages within the black boxes

OMI NO2 tropospheric column

Both OMI NO2 and STEAM emissions show a decrease in 2009 (economical recession)

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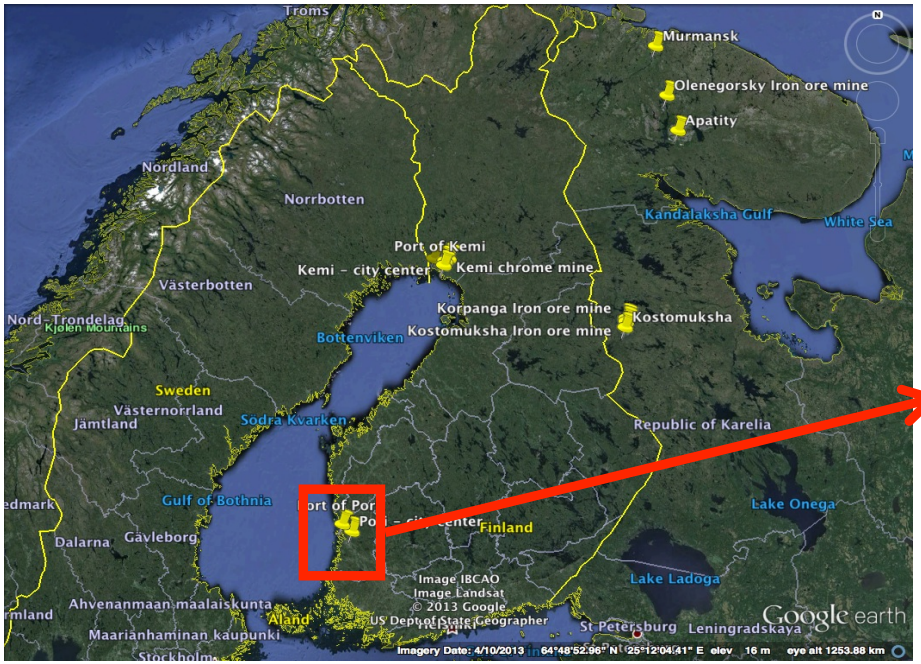
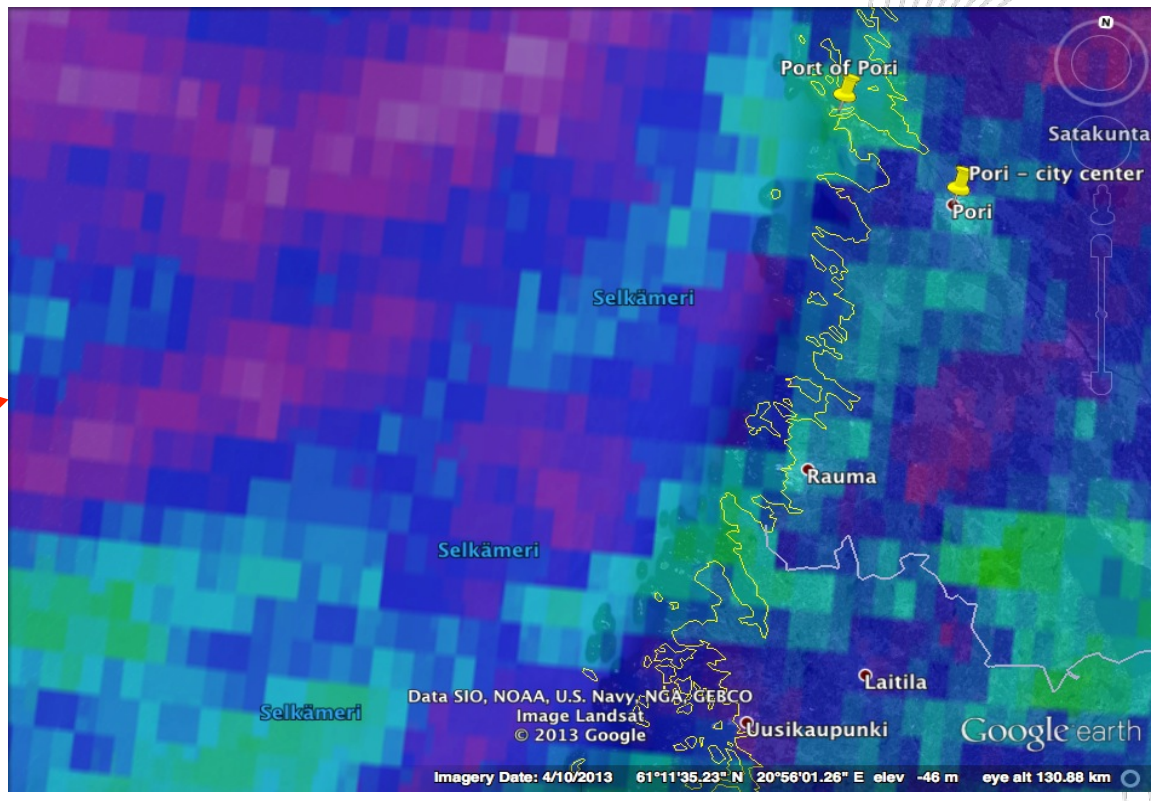
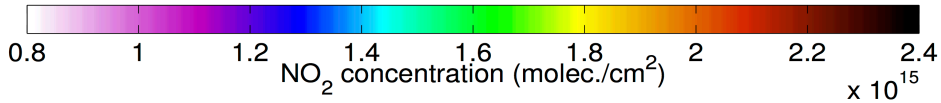
Detection of emission hotspot in Northern Europe





Pori port and city center

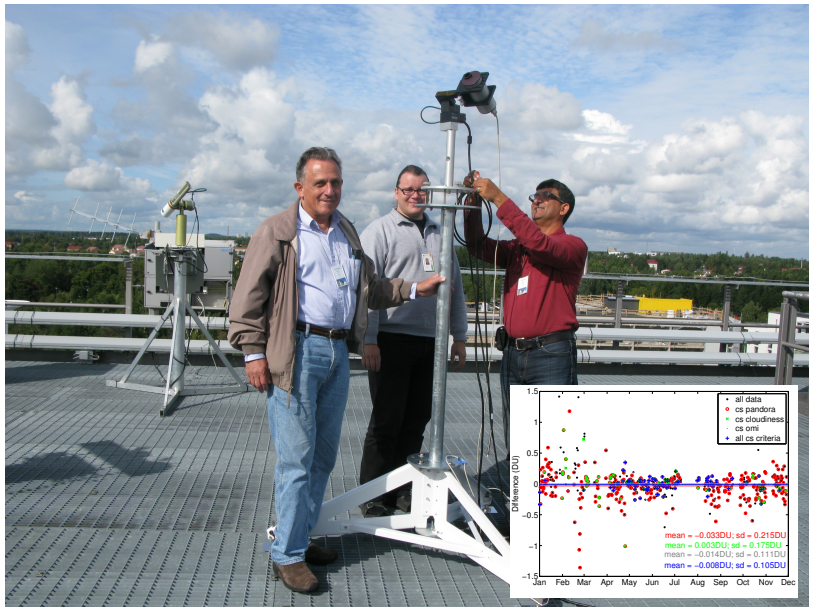


OMI NO2 (summer 2005 - 2011)

Figure I. Ialongo, FMI

OMI NO2 validation on-going

Pandora instrument at Helsinki



Weekly cycle in Helsinki by OMI and Pandora

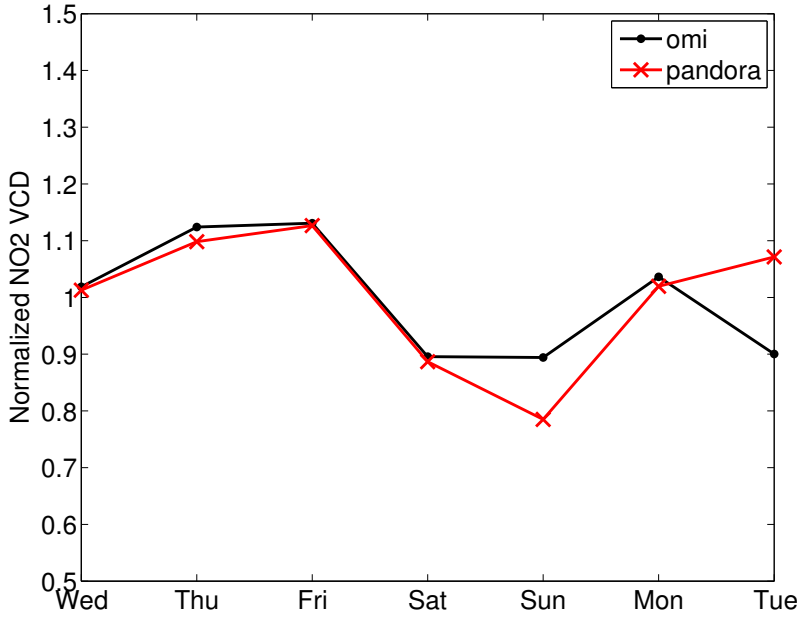


Figure I. Ialongo, FMI

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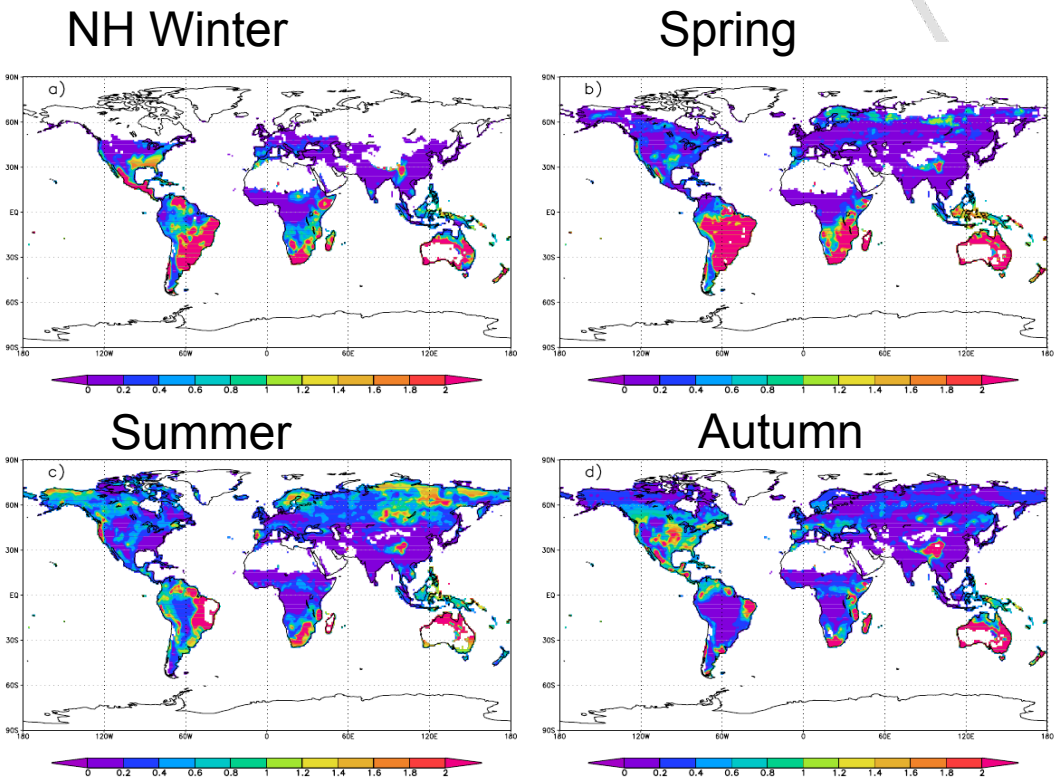
OMI

OMI does not see everything … but proxies can be developed

$$P_2 = \frac{[SO_2] \cdot UV}{AOD^2}$$

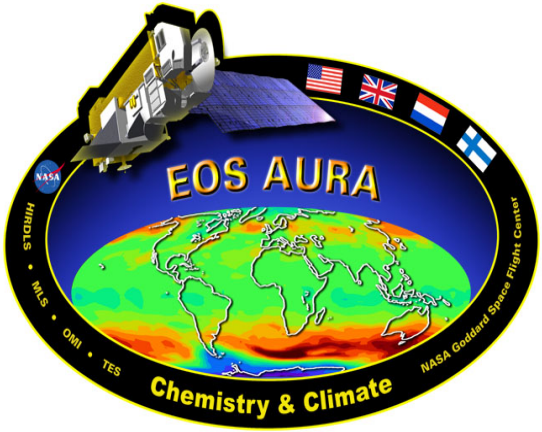
- **OMI UV data used for estimating seasonal variation of spatial distribution of new particle formation**



Reference: Kulmala, M. et al., The first estimates of global nucleation mode aerosol concentrations based on satellite measurements, ACP, 11, 2011.

Summary

- **The success of OMI is based on exceptionally good collaboration between the Netherlands, USA and Finland.**
- Real time data products are routinely provided and distributed to users after the satellite overpass at sampo.fmi.fi
- UV products are processed and distributed daily to users.
- OMI data is used scientifically for many research topics.
- Novel applications are very welcome and we are happy to collaborate and help with the data.



PK Bhartia, NASA: "As originally planned, Aura didn't have an instrument operating in the UV. The OMI instrument built by Dutch-Finnish collaboration filled an important gap in the measurements making the Aura mission the most comprehensive atmospheric chemistry lab in space ever flown or likely to be flown again."

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