Assimilation of IASI ozone data with a CTM at high resolution

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Pros & cons in models & instruments

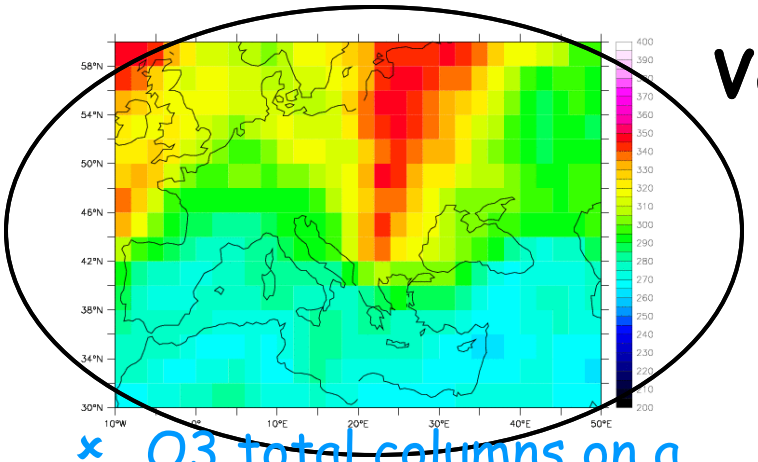
- **Models cons :**
  - Estimated uncertainties
  - Limited resolution

  (memory and computational time)

- **IASI instrument cons :**
  - Partial coverage
  - Total columns

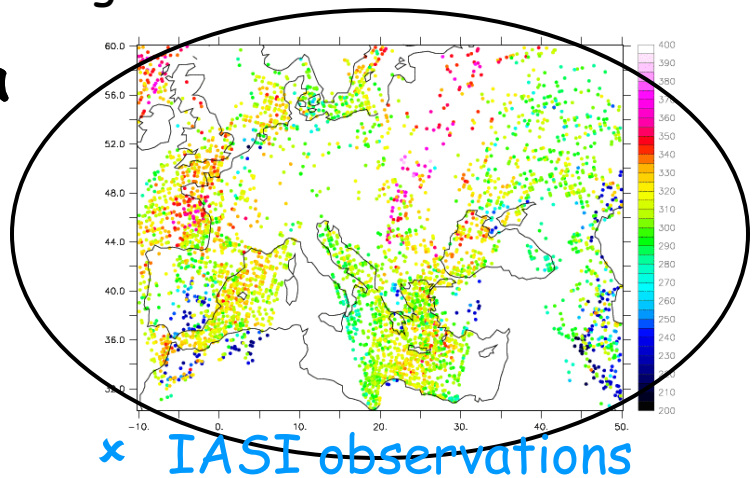
- **Models pros :**
  - Reanalysis / forecasting
  - Global coverage & vertical resolution

- **IASI instrument pros :**
  - Pre-treated & validated data (L2)
  - Higher resolution



Valentina

+

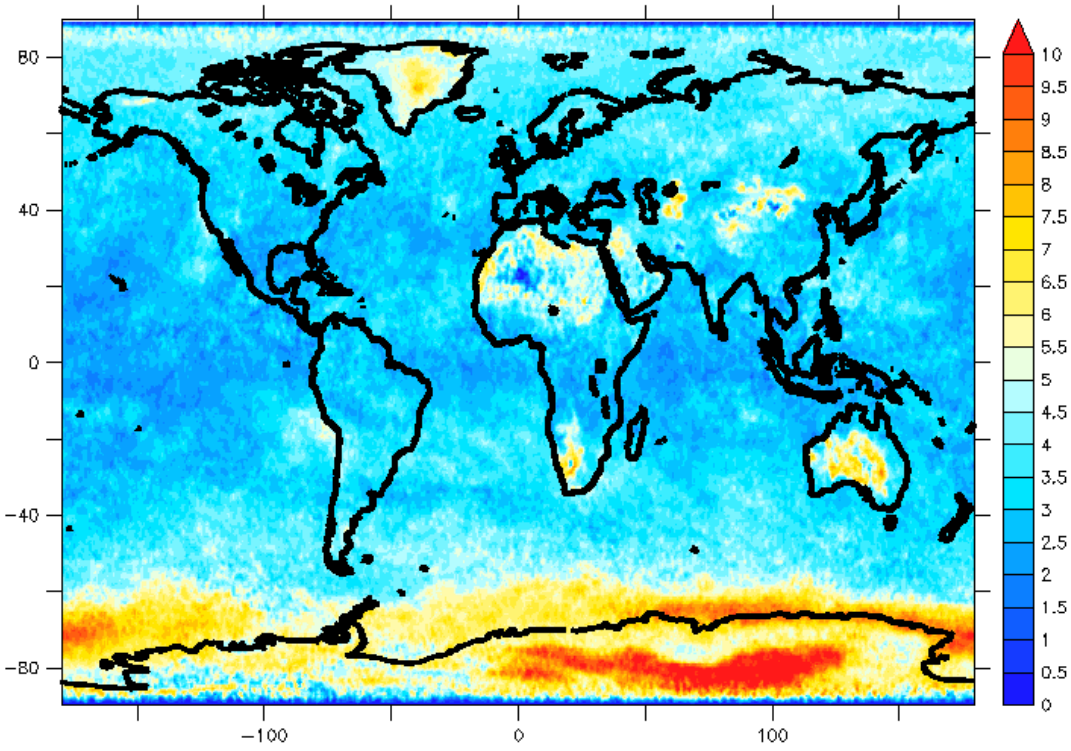


- O3 total columns on a 2° x 2° grid
- IASI observations during a day

Solution : combination via assimilation

Tool 1 : IASI data

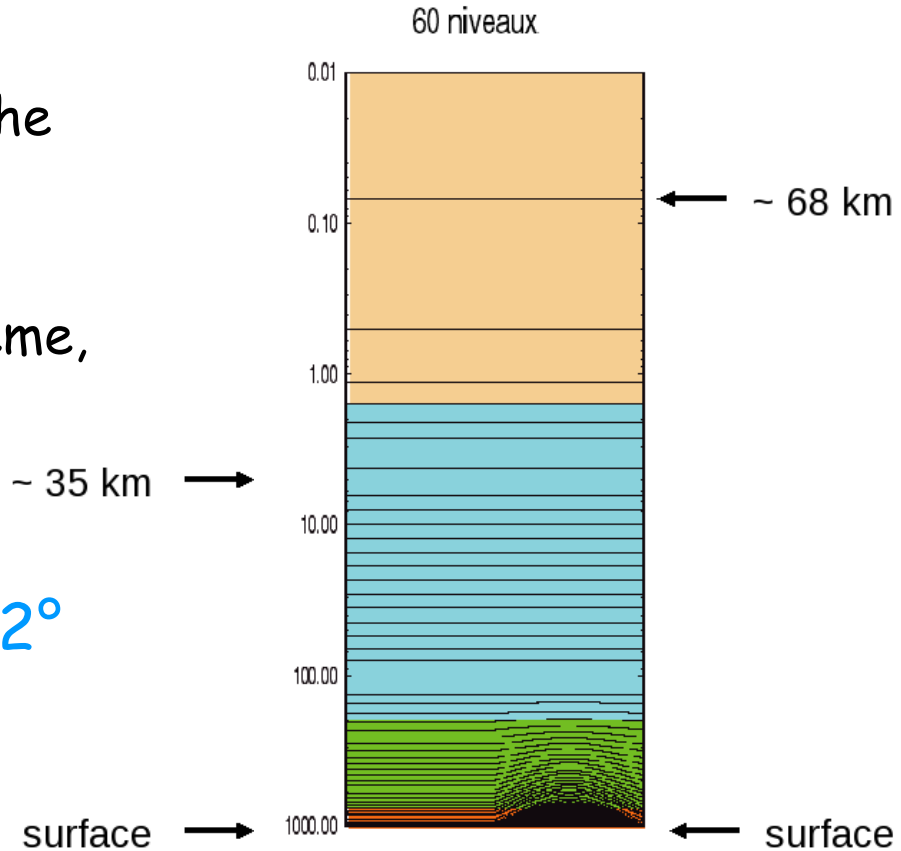
- Data :
  - Ozone data provided by LATMOS/CNRS & ULB
  - Total columns
- Characterization :
  - No averaging kernel -> bias correction
  - Observations standard deviations estimation, method of Massart *et al.*, ACP, 2009



- Estimated standard deviation of the IASI data in % on September 2008

Tool 2 : Mocage

- MOCAGE features :
  - Global version 60 levels (surface -> 0.1 hPa)
  - Thermodynamics coming from the ECMWF analyses
  - Semi-lagrangian transport
  - One-specie linear chemical scheme, Cariolle *et al.*, ACP, 2007

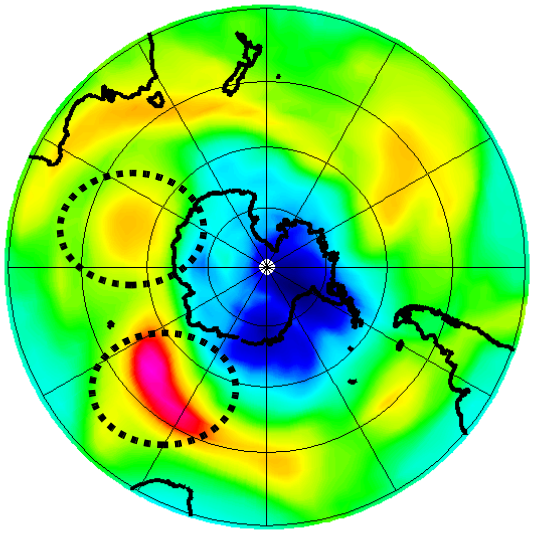


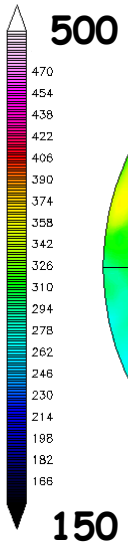
- Vertical levels of MOCAGE

- Classical global version : 2°x2°
- Implemented versions :
  - T42 ~ 2.8°
  - T85 ~ 1.4°
  - T170 ~ 0.7°

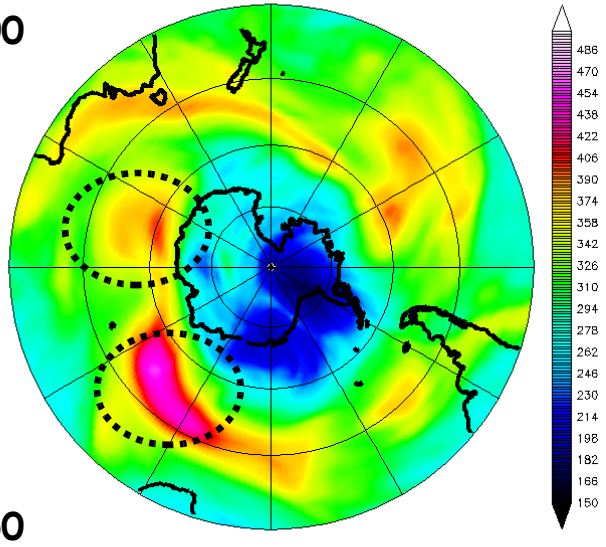
MOCAGE CTM at different resolutions

T42 (~2.8°)

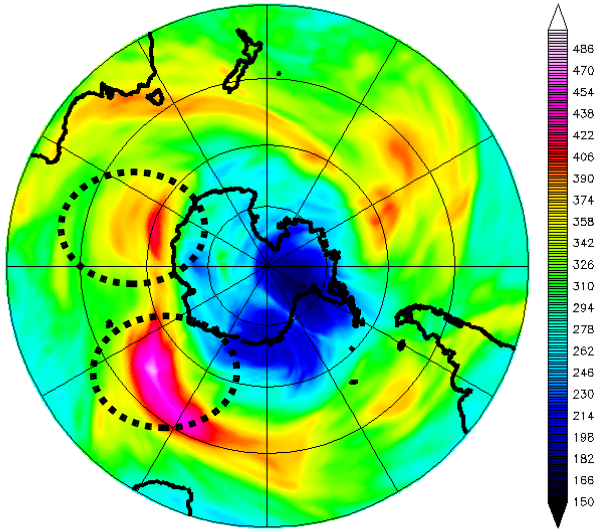




T85 (~1.4°)



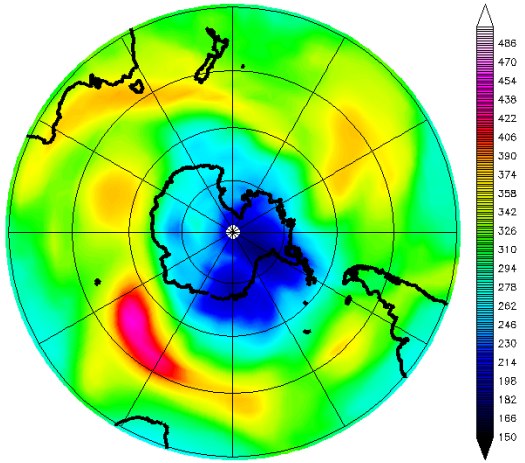
T170 (~0.7°)



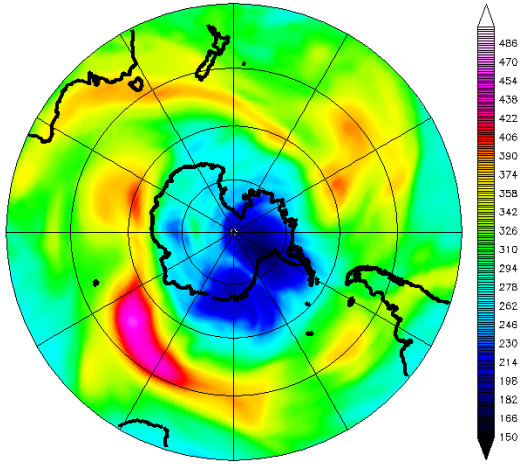
- Ozone total columns (DU), September 04th at 00 UTC ; data from runs of the MOCAGE CTM at different horizontal resolutions

MOCAGE and OMI at different resolutions

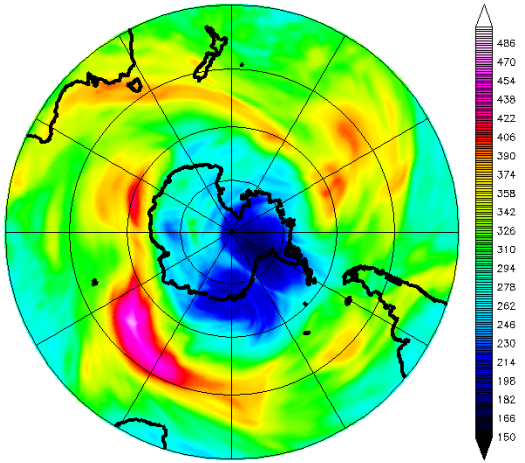
T42 (~2.8°)

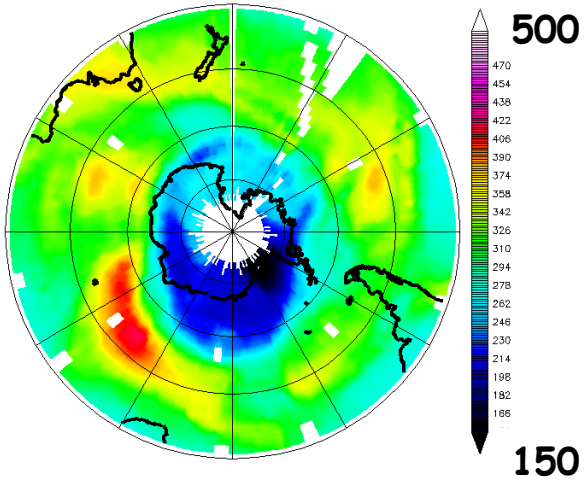


T85 (~1.4°)



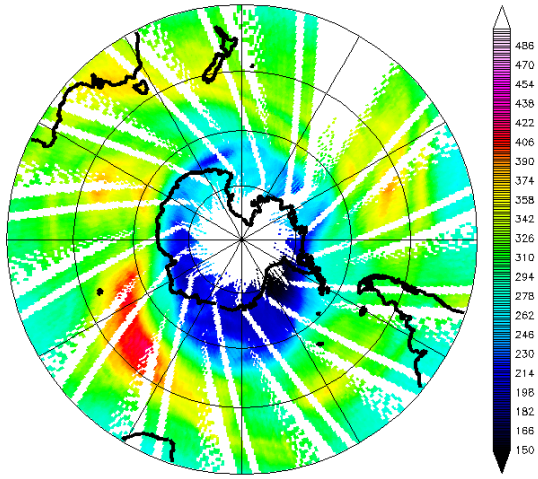
T170 (~0.7°)



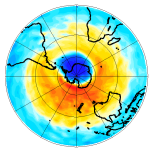


2° x 2°

× Ozone total columns (DU), September 04th ; data from the OMI instrument at different horizontal resolutions (down figures)



0.5° x 0.5°

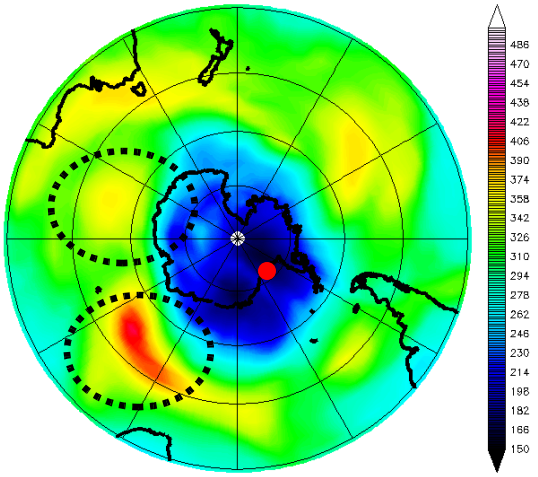


Data assimilation experiment

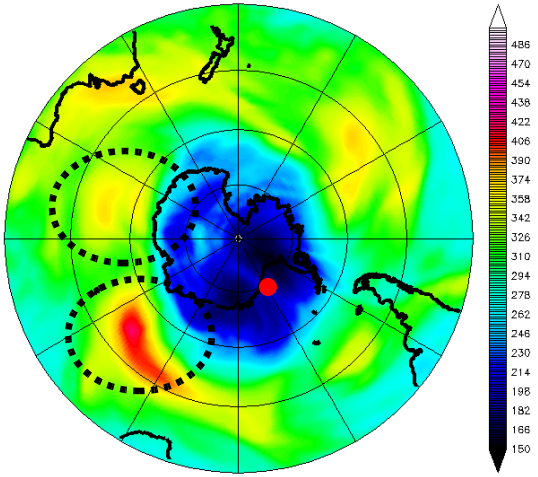
- Experiment :
  - 1½ month of IASI assimilation from August 15th to October 31th
  - 3 MOCAGE resolutions : T42, T85 & T170
  - Initial condition from a previous MLS assimilation
- Observations :
  - IASI ozone columns (without AK)
  - super-observations on resolutions T42 / T85 / T170
  - Estimated observations errors
- Assimilation
  - Valentina data assimilation system
  - 3D-FGAT method
  - 3h assimilation window
  - Homogeneous length scales for the correlation of the background errors

MOCAGE and OMI at different resolutions

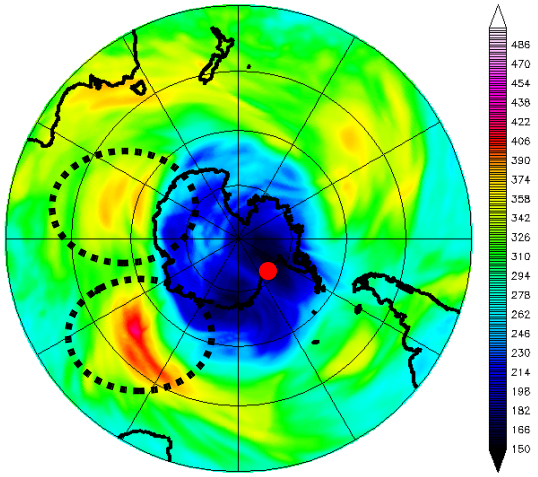
T42 (~2.8°)

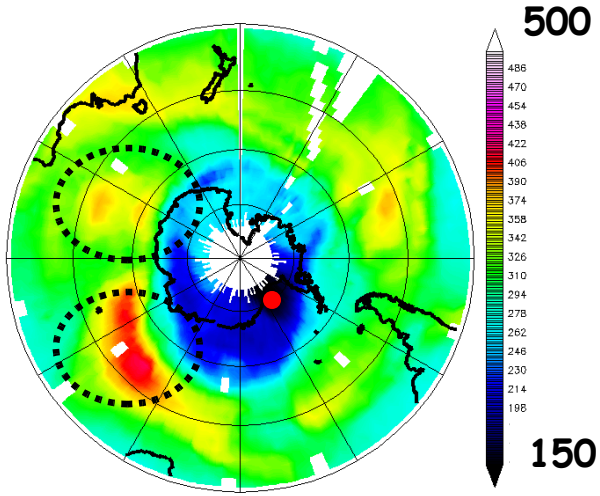


T85 (~1.4°)



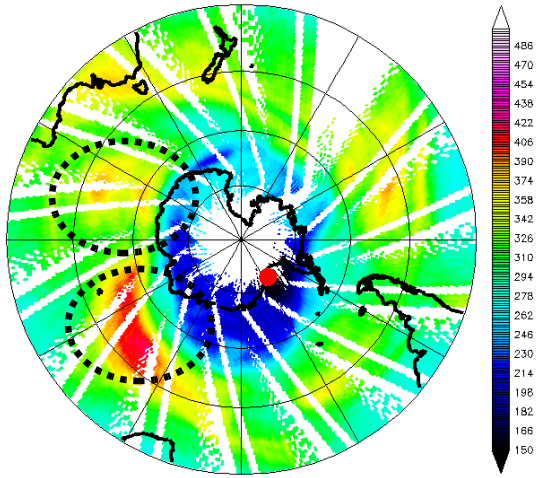
T170 (~0.7°)





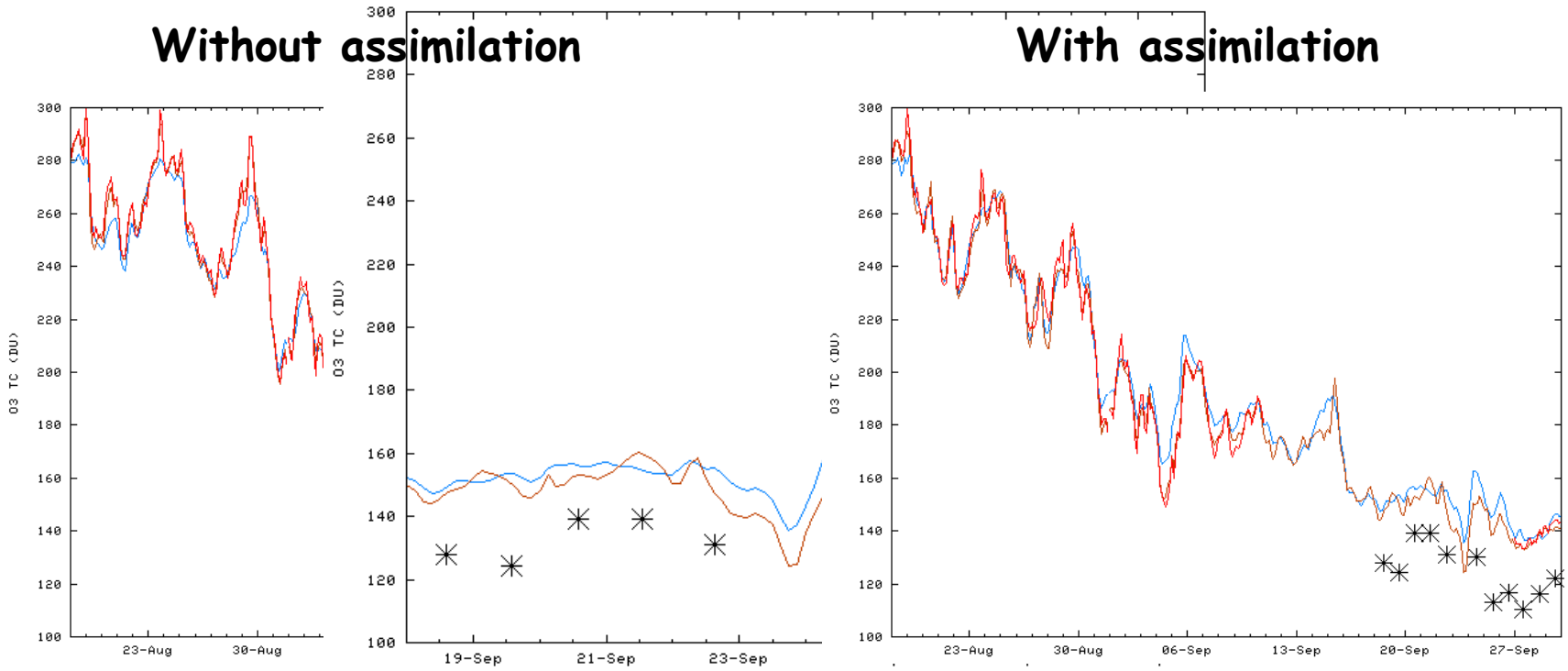
2° x 2°

- Ozone total columns (DU) September 04th from the assimilation of IASI data
- OMI instrument

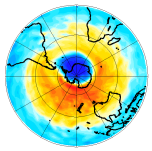


0.5° x 0.5°

O3 total columns over Belgrano II



- Ozone total columns (DU) from august 18th to September 30th at 77.9S/34.63W
- 3 horizontal resolutions :
  - T42 (~2.8°)
  - T85 (~1.4°)
  - T170 (~0.7°)
  - total ozone measurements from the Belgrano II polar station



Sum-up and perspectives

- Conclusions on the assimilation at high global resolution
  - Better representation of thin and filamentous structures
  - Seems to better evaluate the ozone concentrations
  - Validation still in progress

- Prospective
  - A complete validation : need of independant data from the extreme latitudes where the ozone structures are thinner in order to obtain statistics and validate assimilation schemes
  - High resolution may provide better limit conditions for regional models
  - Improving the assimilation scheme : multi scale strategy to reduce the cost

Acknowledgments

- Cathy Clerbaux's team for IASI data
- Sébastien Massart and Daniel Cariolle for the working environment where I make my Phd