Using Forecast Sensitivity to Observations to adapt IASI channel selection

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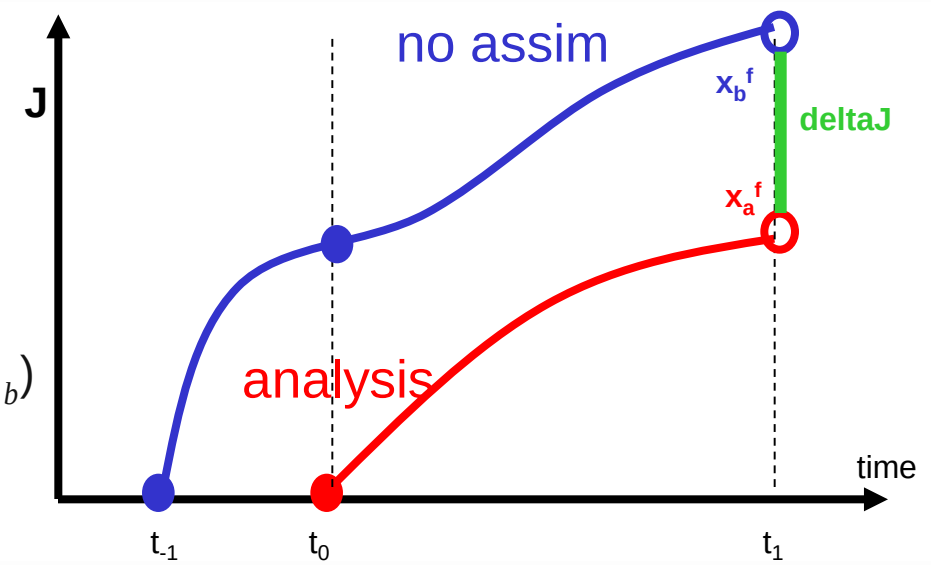
Rationale

Forecast Sensitivity to Observations (FSO)

- uses a dry energy norm (in its implementation at Météo-France)
- provides contribution of each single observation to the forecast error reduction at 24-h forecast range

$$deltaJ = \frac{1}{2}(R^{-1}HA)\left(M_a^T \frac{\partial J^b}{\partial x_b^f} + M_b^T \frac{\partial J^a}{\partial x_a^f}\right)(y - Hx_b)$$

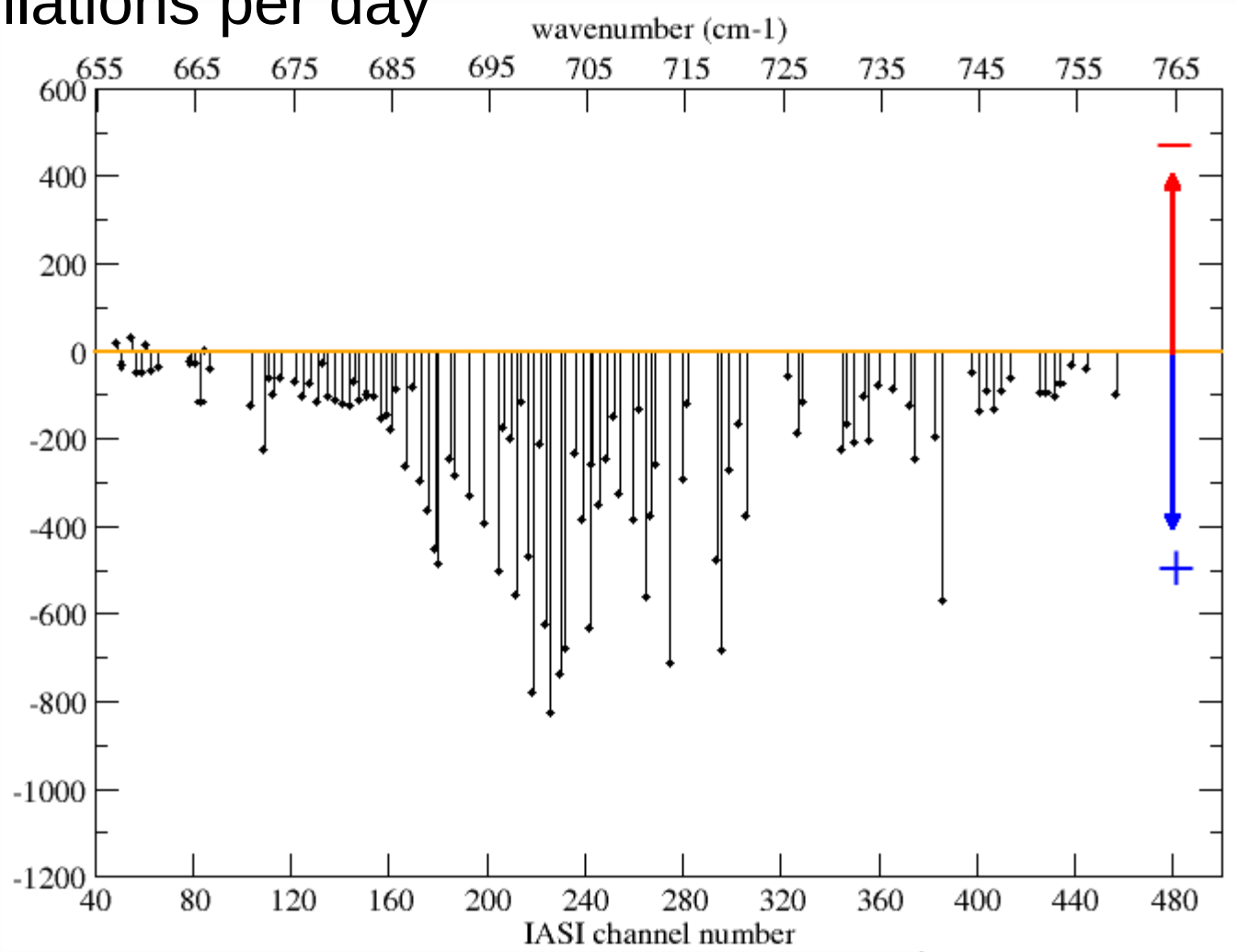


- is used to evaluate the relative impact of observing systems used in operational assimilation system
- could be used to evaluate a channel selection and adapt it:
  the IASI case

FSO for each IASI atmospheric T channel

1-month average [15Aug2013 – 14Sep2013],
4 assimilations per day

FSO
J/kg



FSO for each IASI atmospheric T channel

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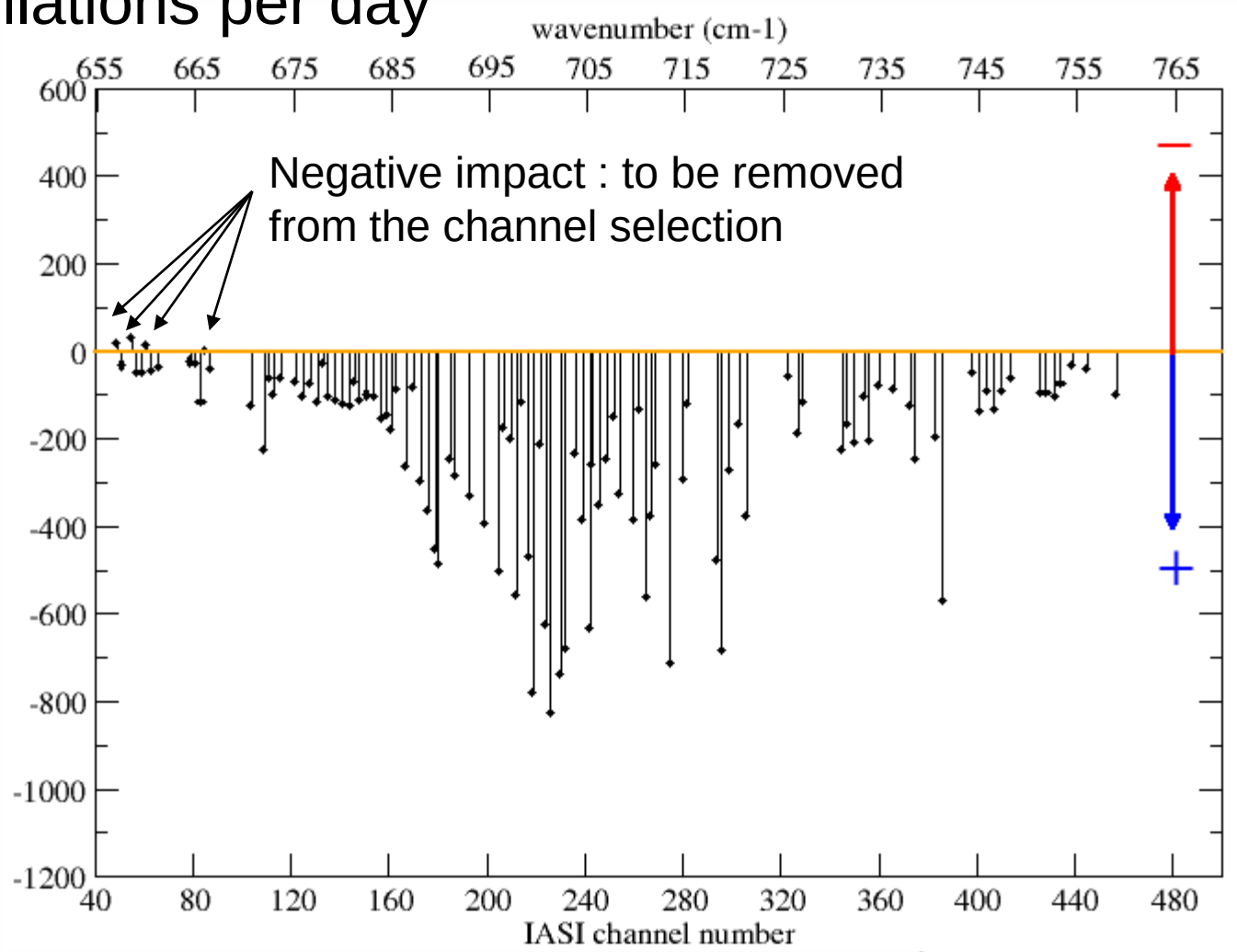
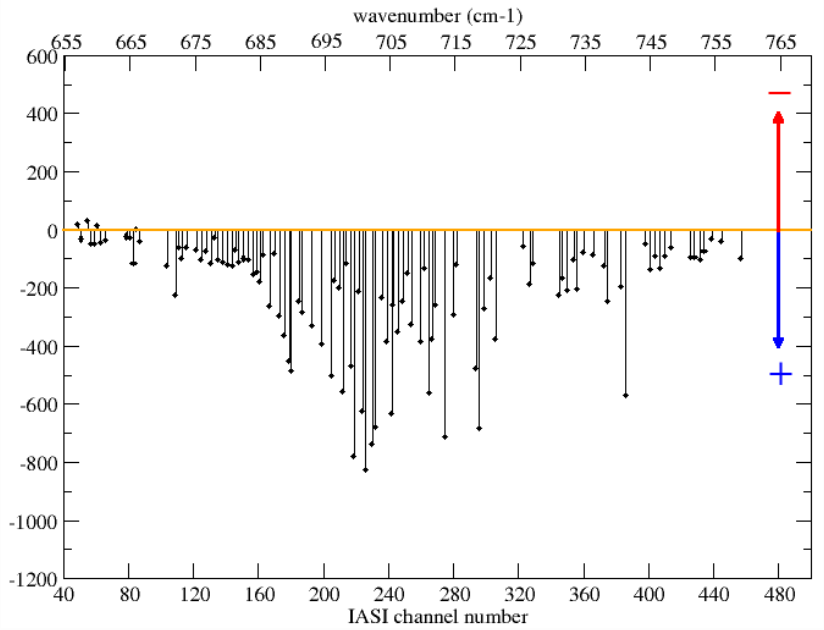


FSO for each IASI atmospheric T channel

FSO
J/kg



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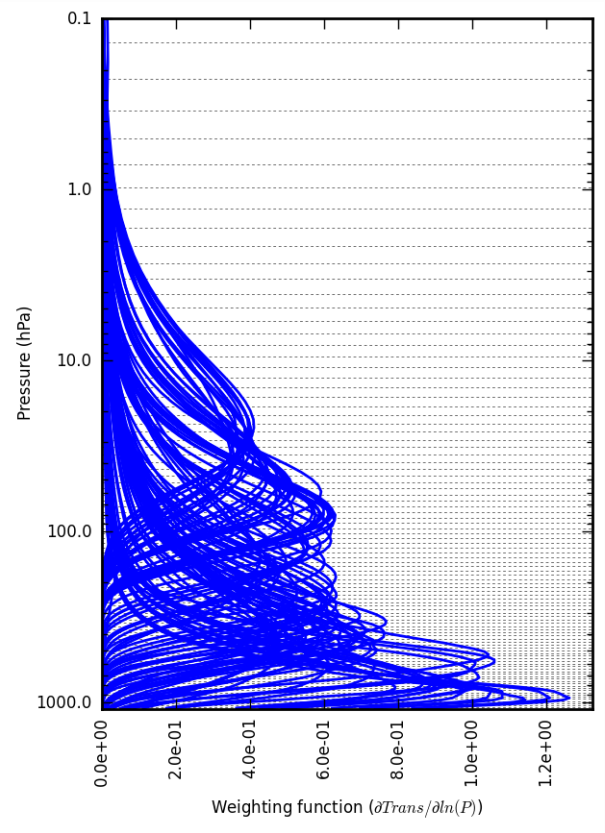
Weighting functions



FSO for IASI (atmospheric T channel contribution)

1-month average [15Aug2013 – 14Sep2013],
4 assimilations per day

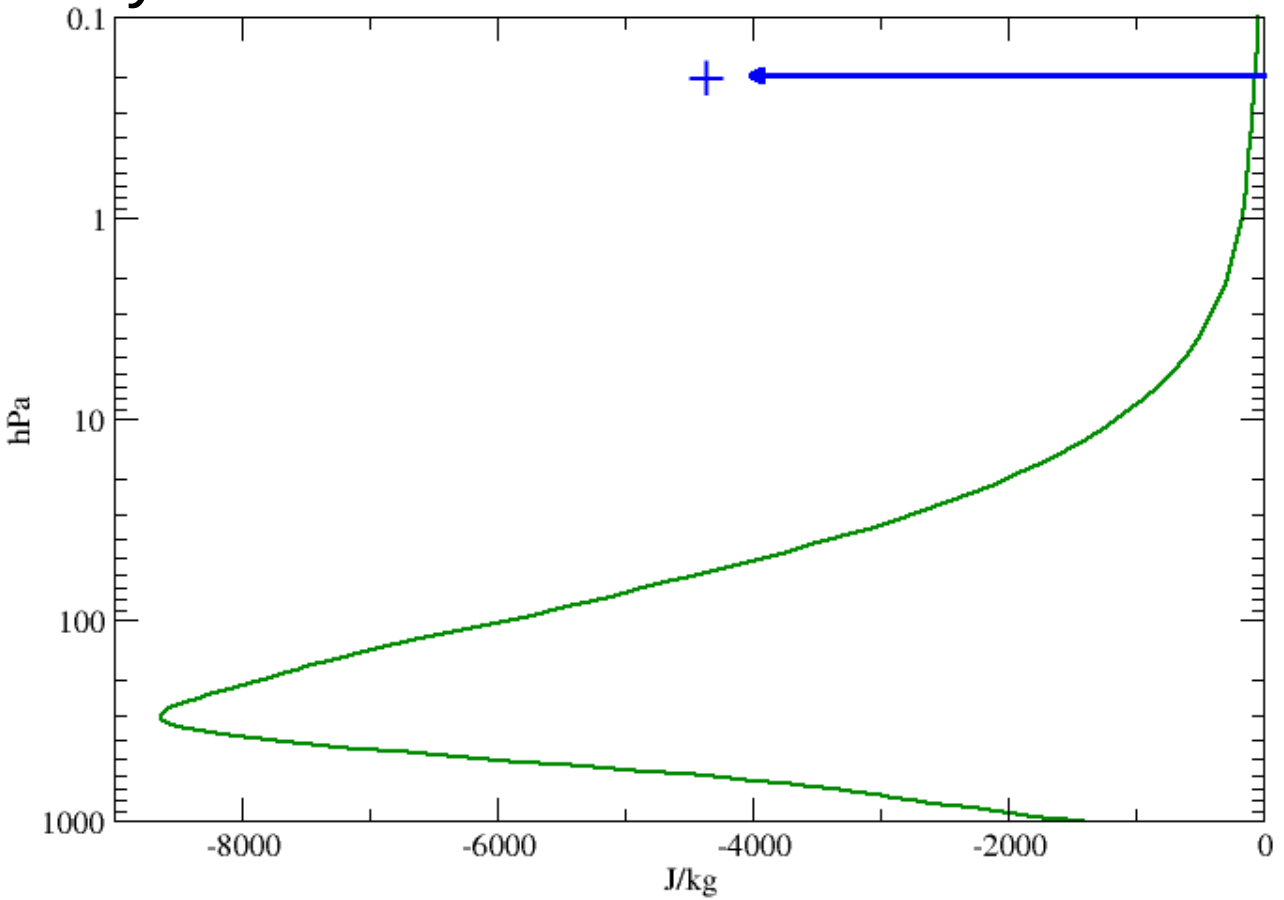
FSO per channel

*

Weighting functions

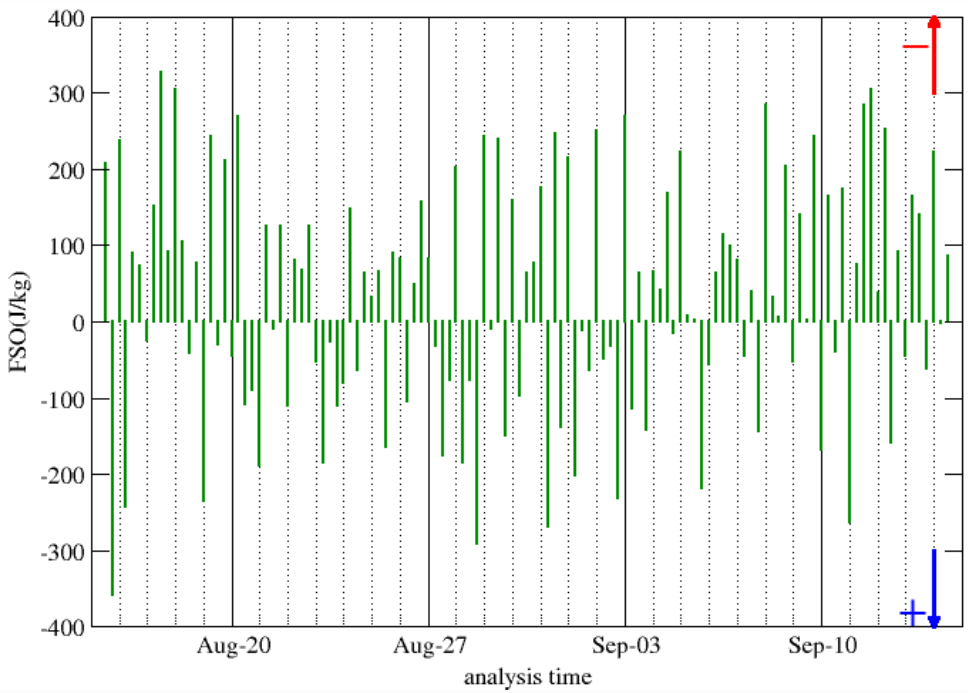
=

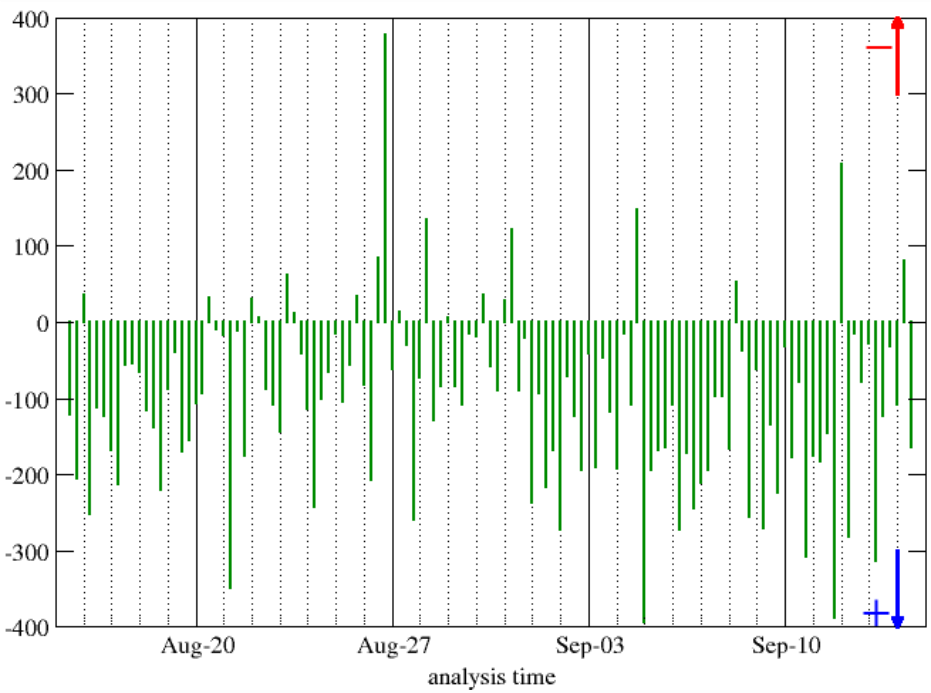
FSO per vertical level



FSO

FSO for IASI – Daily variability



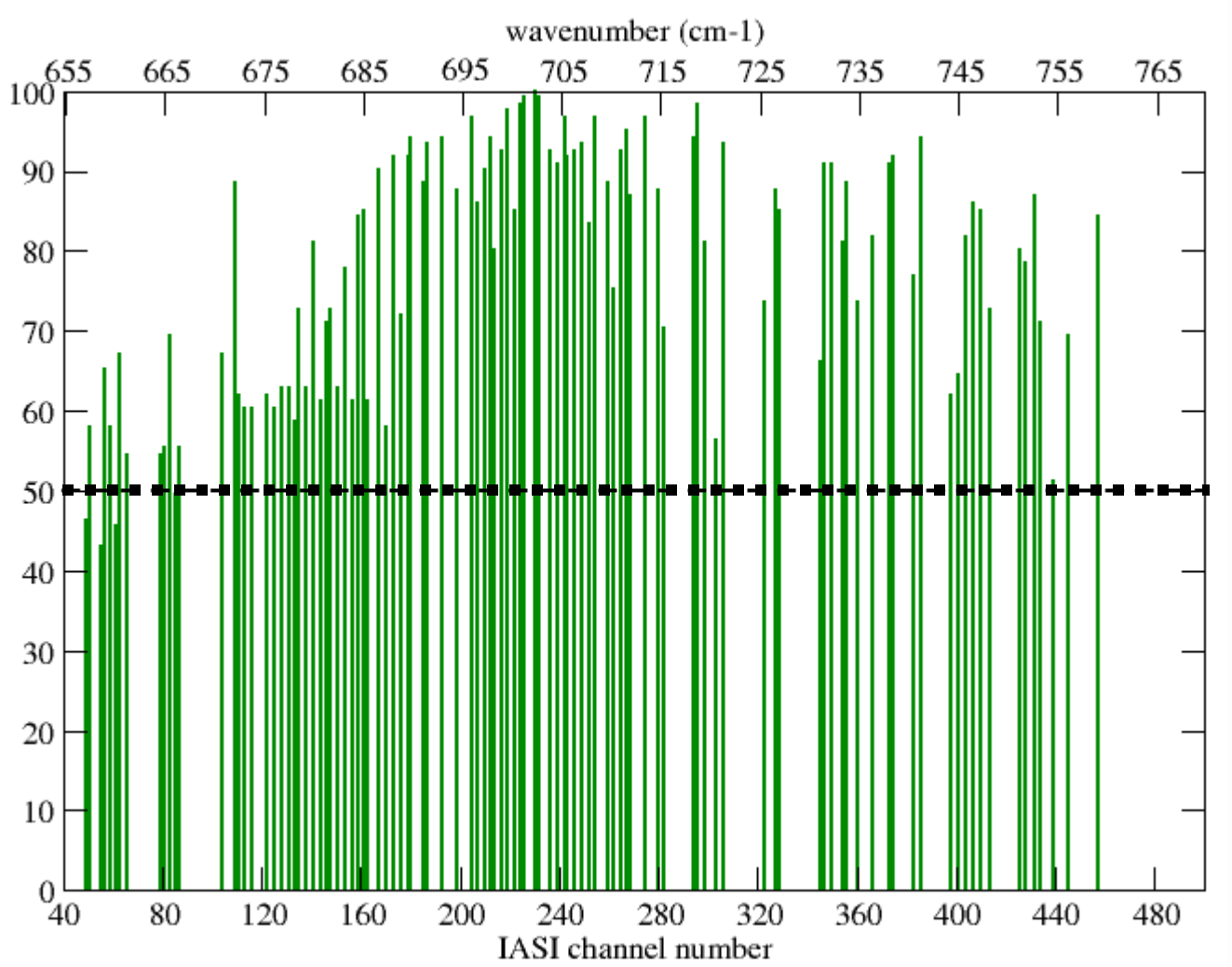


Channel 55 - 658.50 cm^{-1}
High daily variability

Channel 457 - 759.00 cm^{-1}
Low daily variability

FSO for each IASI atmospheric T channel

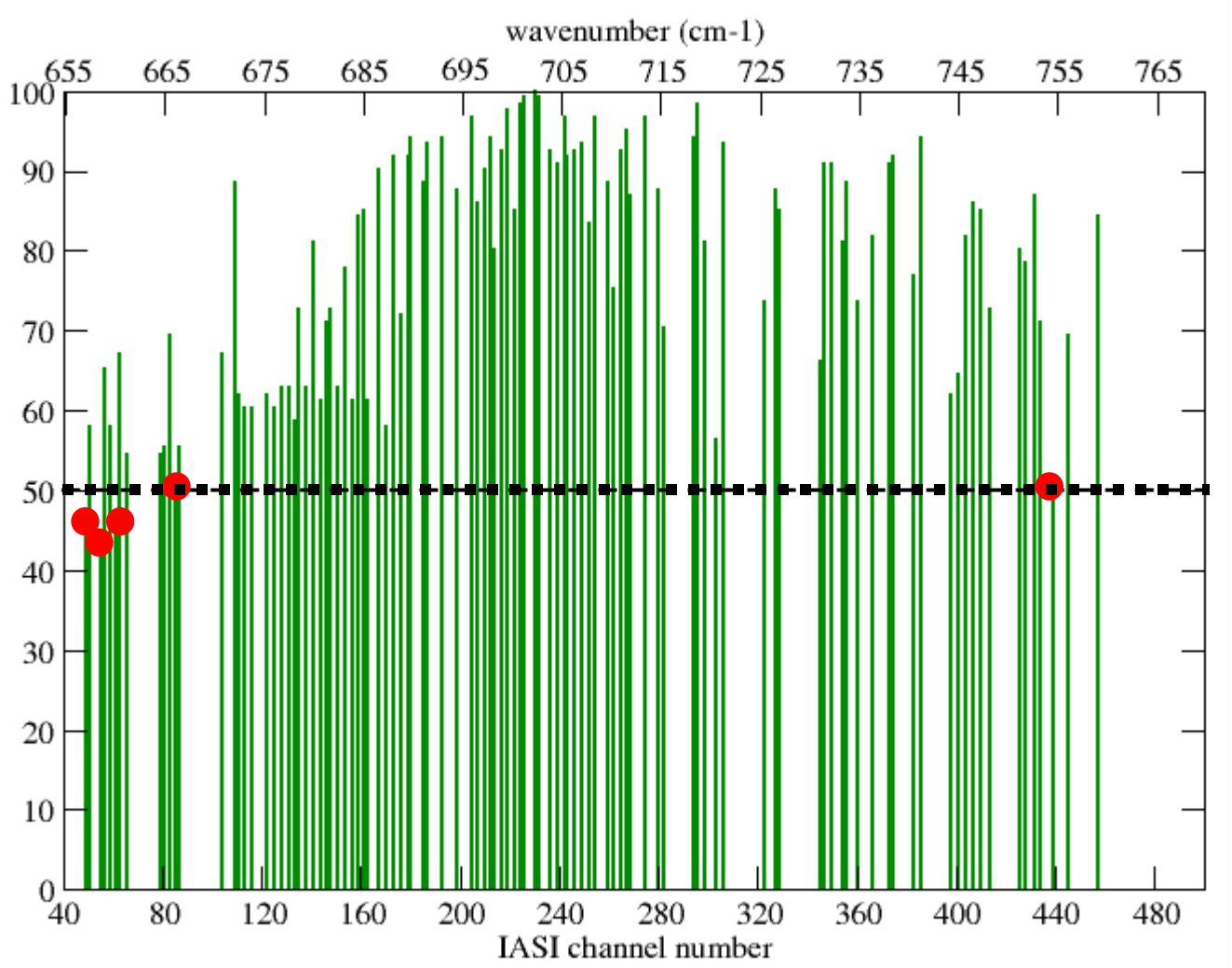
Percentage of assimilations with a positive impact on FSO



FSO for each IASI atmospheric T channel

Percentage of assimilations with a positive impact on FSO

- to be removed from the channel selection



10 IASI atmospheric T channel to be removed

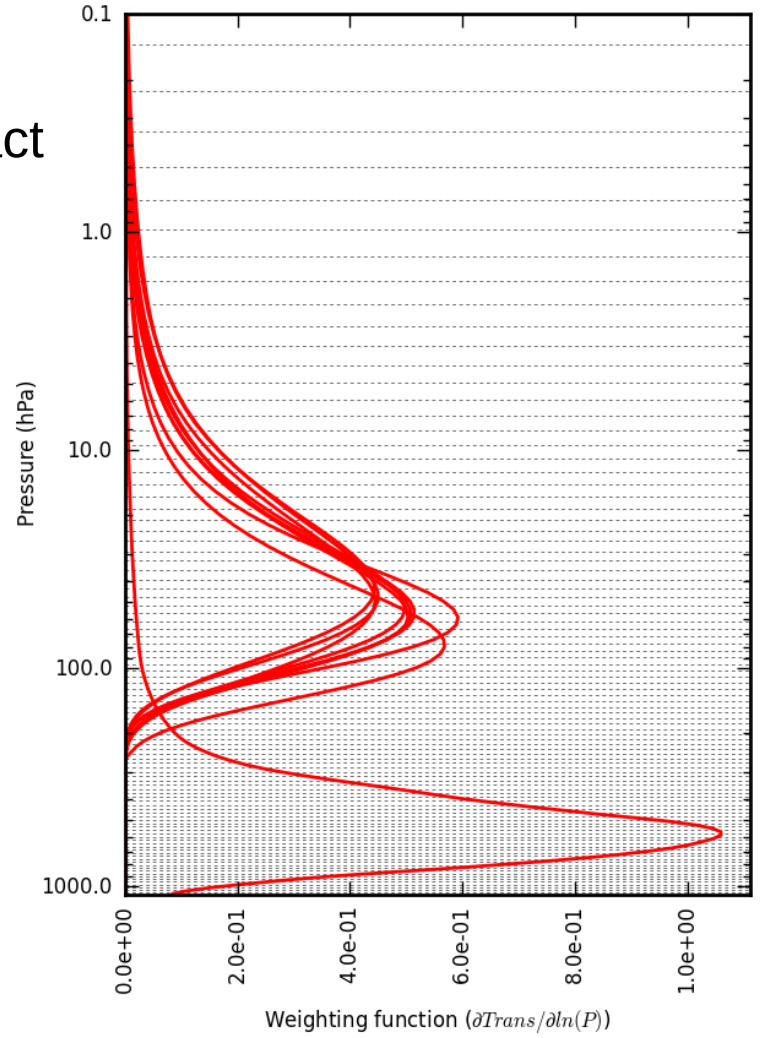
3 criteria for removing channels:

Mean FSO positive

High daily variability

Low percentage of assim. with positive impact

Channel number	Wavenumber (cm^{-1})
49	657.00
51	657.50
55	658.50
61	660.00
79	664.50
81	665.00
85	666.00
87	666.50
133	678.00
439	754.50



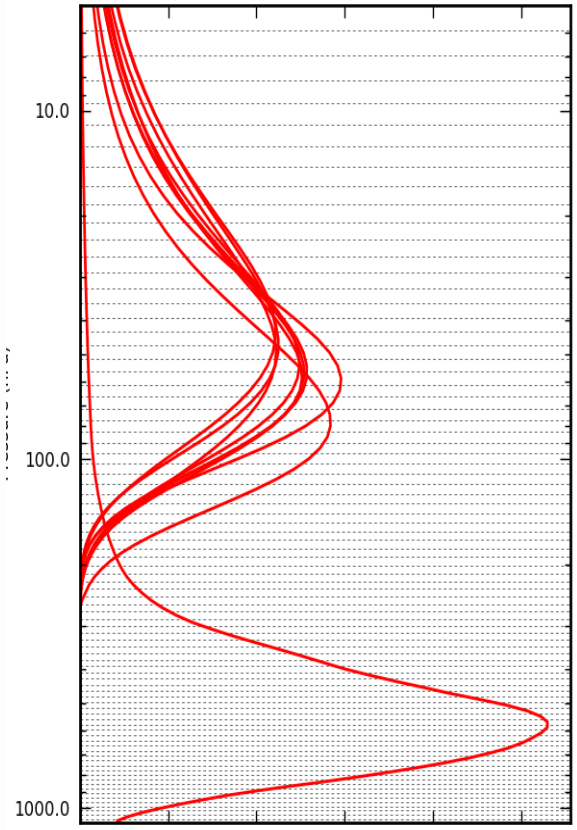
Data assimilation experiments

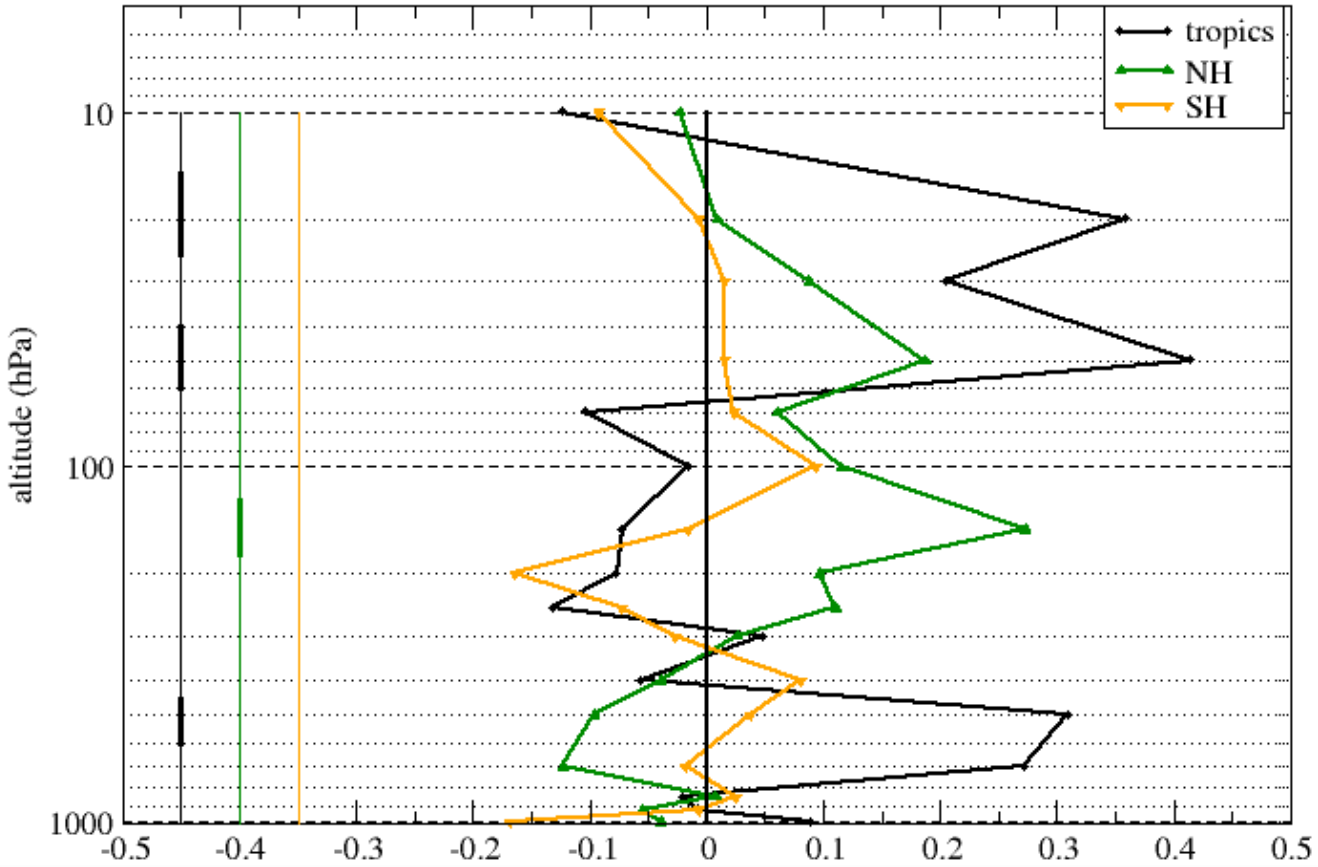
REF = Operational system and IASI dataset

EXP = REF – (10 IASI T atmos. channels with neg. impact on FSO)

2-month period, from July 16 to Septembre 15, 2013

Impact on 24-h forecasts – wind speed

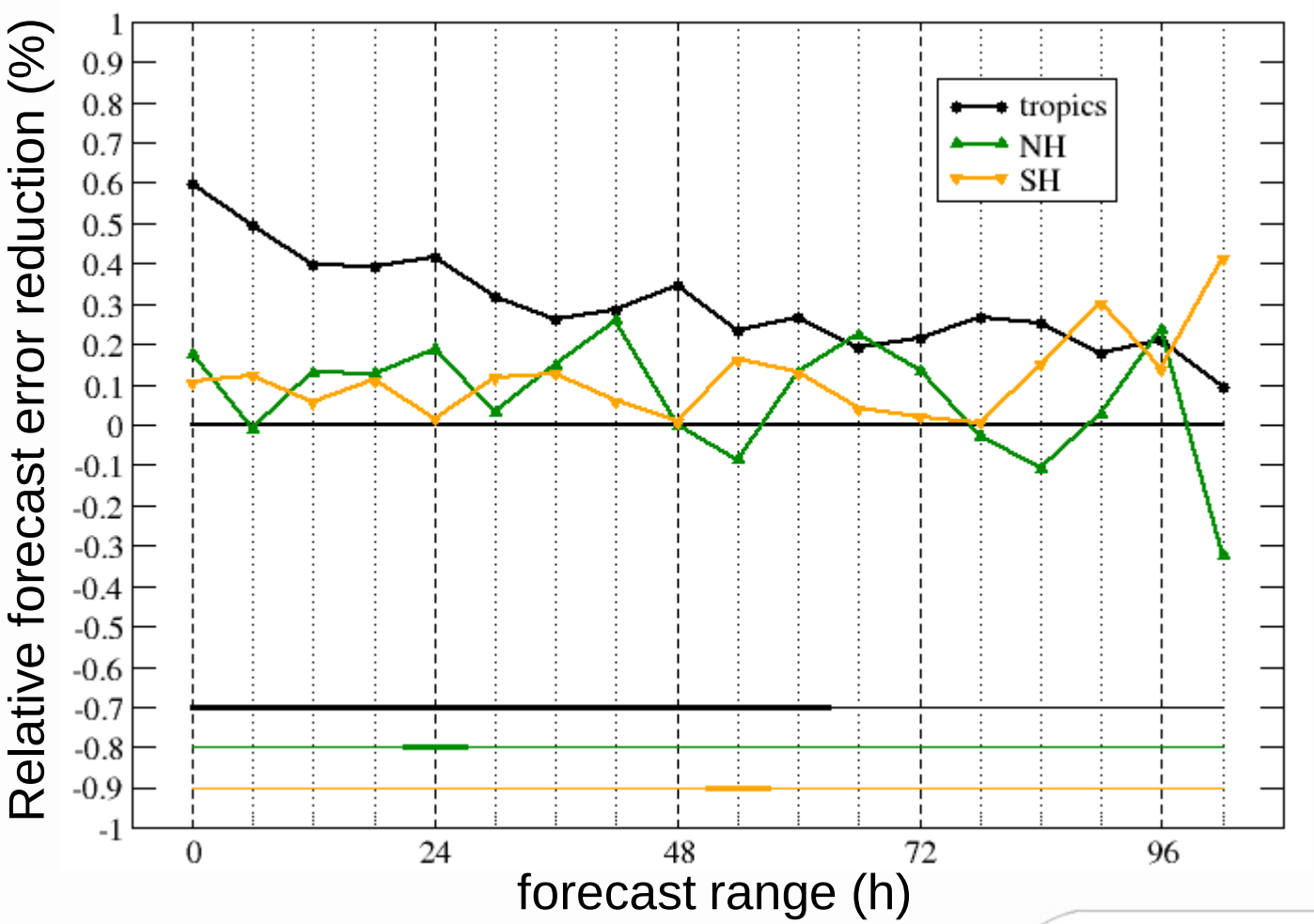




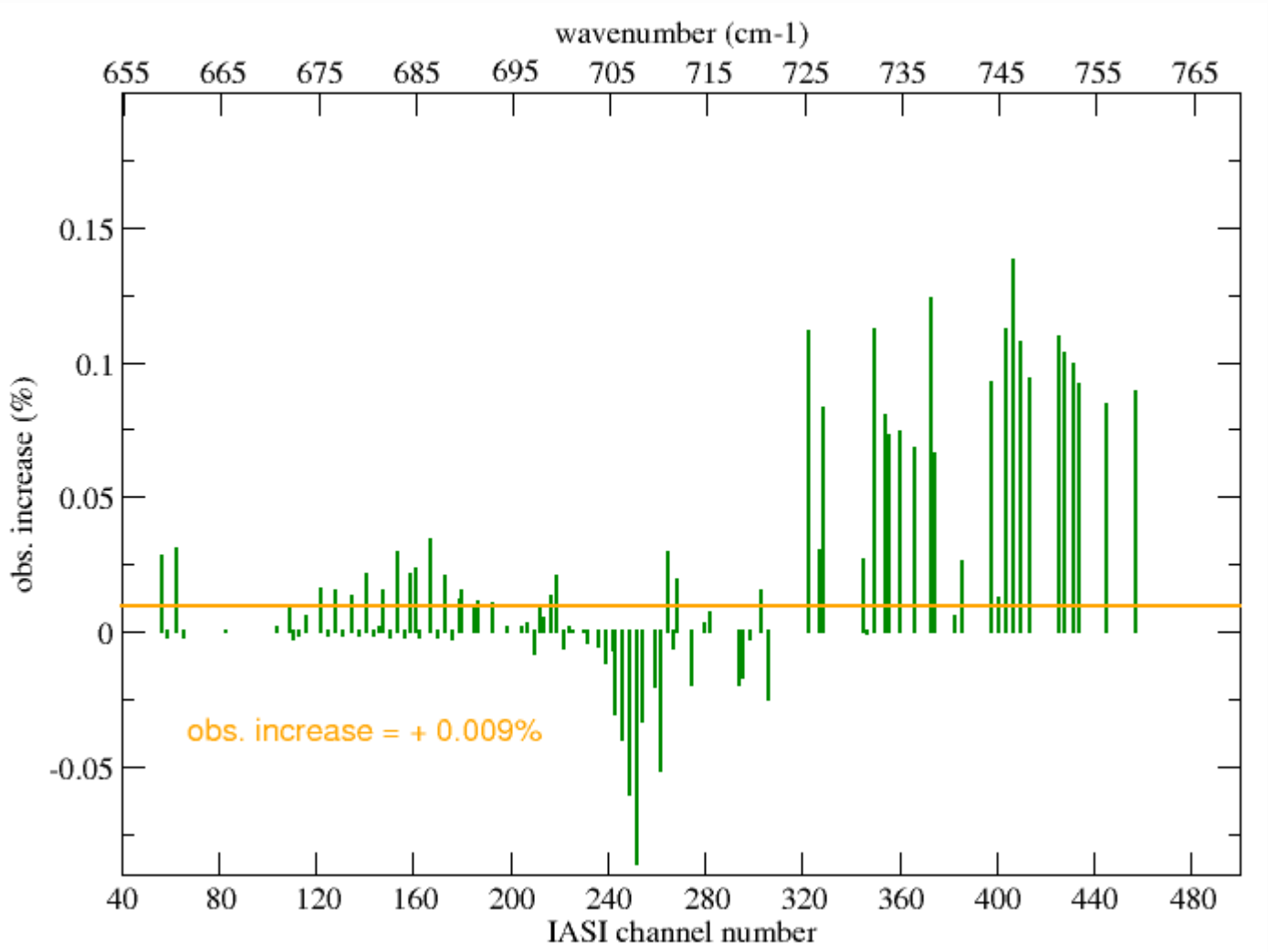
Relative forecast error reduction (%)

Impact on forecasts – wind speed @ 50 hPa

Relative forecast error reduction (%)



Impact on IASI atmos. T channel usage

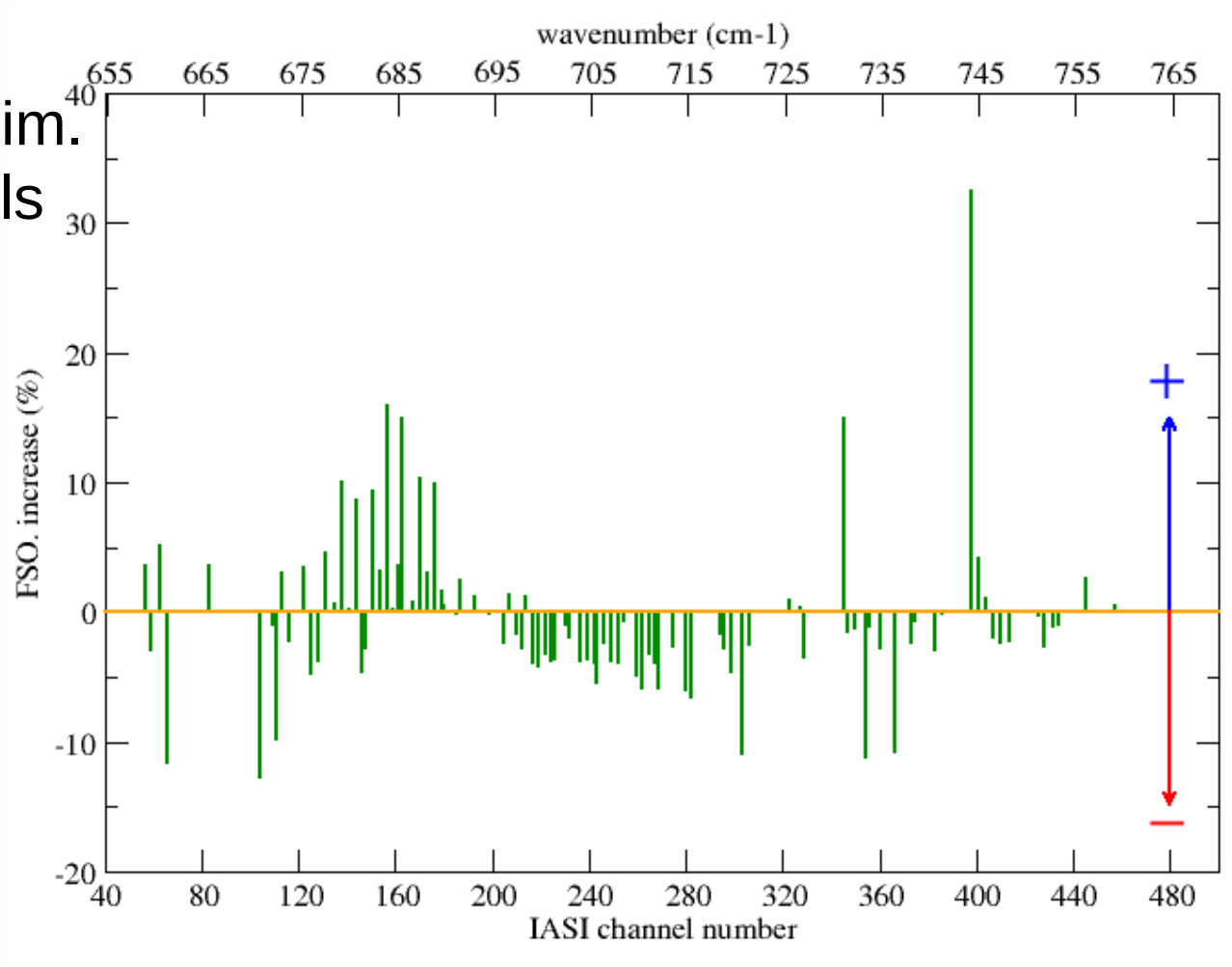


Impact on IASI atmos. T FSO

Average FSO per assim.
IASI atmos. T channels

in REF
105 chan -22985 J/kg
95 chan -22865 J/kg

In EXP
95 chan -22570 J/kg



Summary

FSO can be used to identify channels to be rejected

- could be used to modify channel selection for each analysis time (should be more realistic than a modification on monthly average)

Impact on forecast skills is neutral to slightly positive

- in areas consistent with the channel sensitivity
- with statistical significance
- but very modest

Impact on IASI FSO is neutral

cnrs

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