Assisted cloud detection based on AVHRR clusters in IASI FOV

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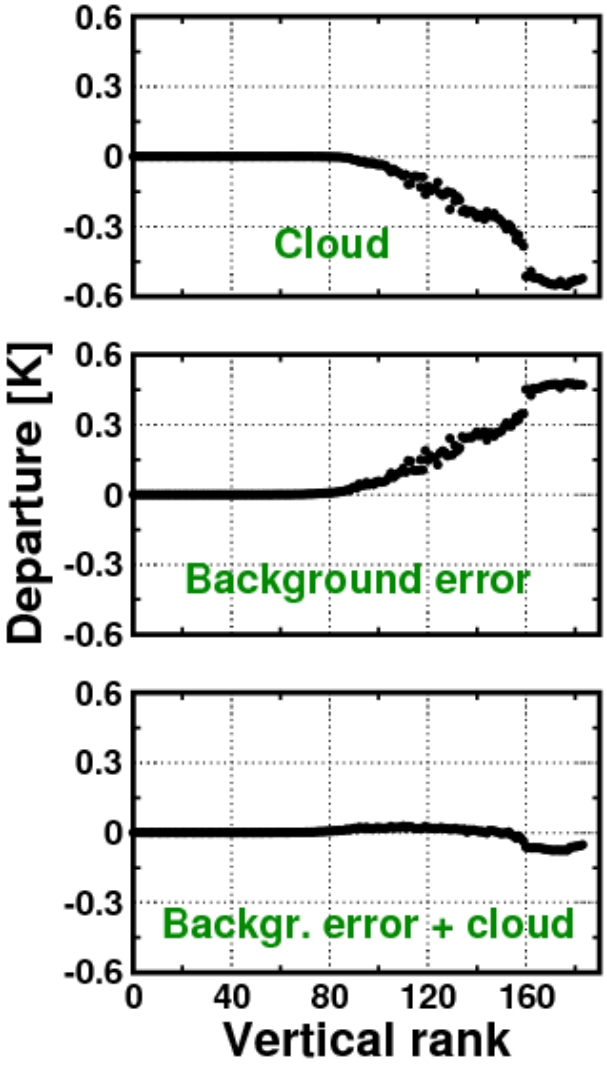
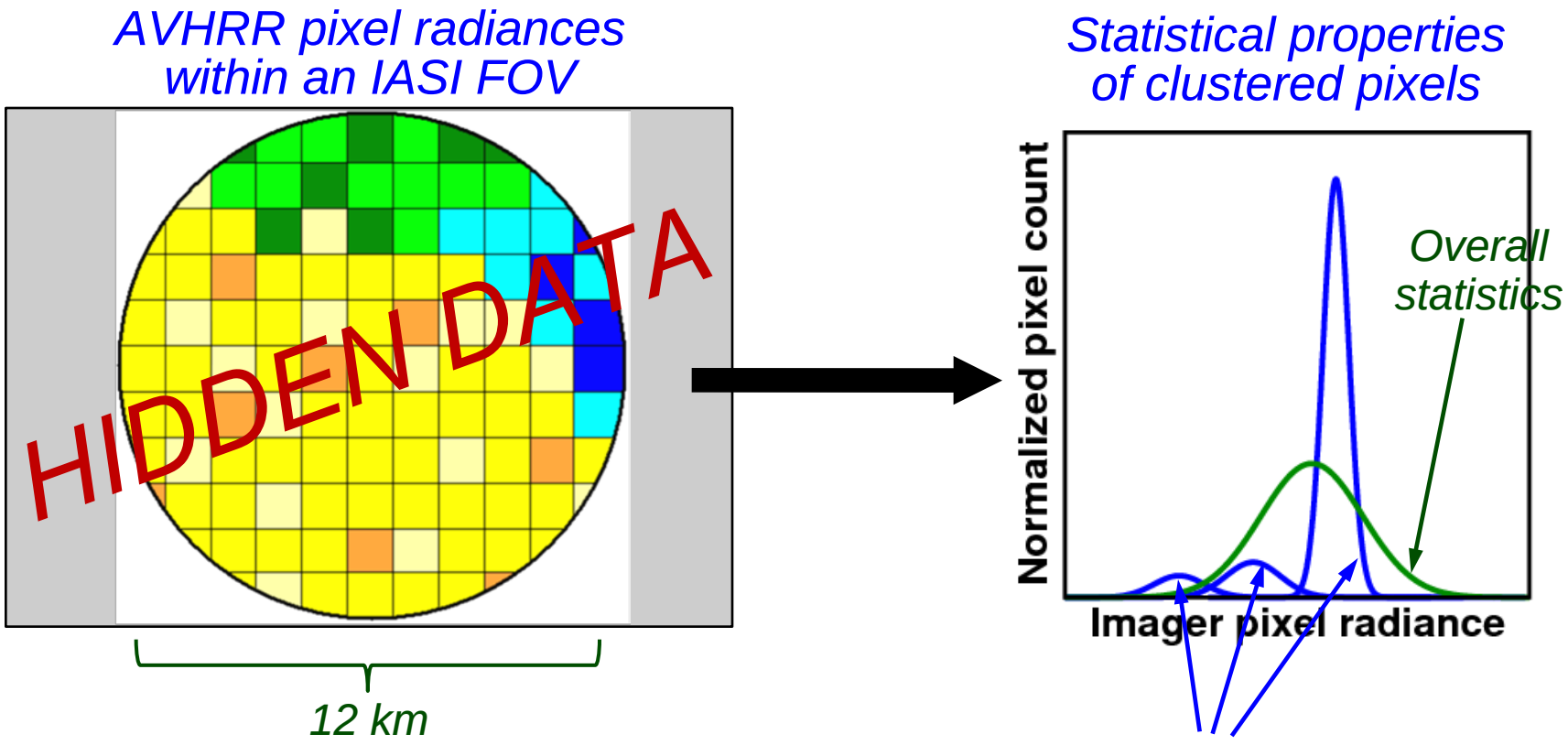
Cloud detection in the presence of a background error

- Cloud strongly affects infrared radiance, making it difficult to use cloudy radiances
  - → Emphasis of operational data assimilation is on clear channels
- Currently-used cloud detection schemes operate on background departure data
  - → Only observations falling close to background will be assimilated
  - → Risk of not making the best possible use of clear data
  - → Risk of assimilating contaminated data

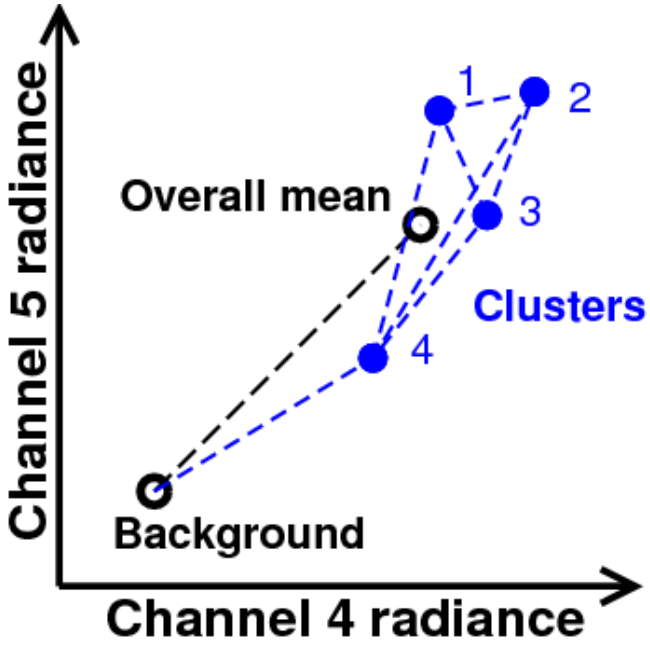


Collocated AVHRR cluster data



Imager-based cloud detection scheme

- We aim at deciding whether or not a given IASI FOV is **completely clear**
- We will base the decision on
  - Scene homogeneity: how large is the overall radiance standard deviation?
  - Background departure: how far is the overall mean from the background?
  - Internal consistency: do different clusters point towards similar background error characteristics?



Inter-comparison of cloud detection schemes

Population 2

Operational scheme

		Completely clear	(Partially) cloudy	**Total**
Imager-based scheme	Clear	5.2%	3.4%	8.6%
	Cloudy	5.5%	85.9%	91.4%
	Total	10.7%	89.3%	100.0%

(percentages in a 24-hour sample of IASI data over sea and sea-ice)

Population 1

→ A substantial amount of controversial cases where clear flag is assigned in only one of the two schemes

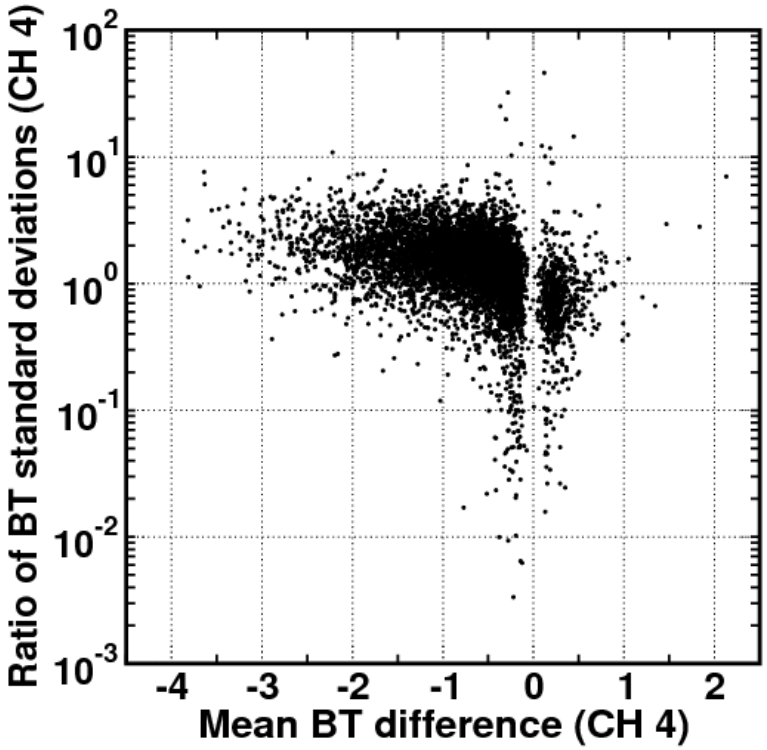
Characteristics of population 1

Clear in the operational scheme but cloudy in the imager scheme

- The imager flag is cloudy usually because of two inconsistent clusters

  → The operational clear can be correct only if the two inconsistent clusters are both clear

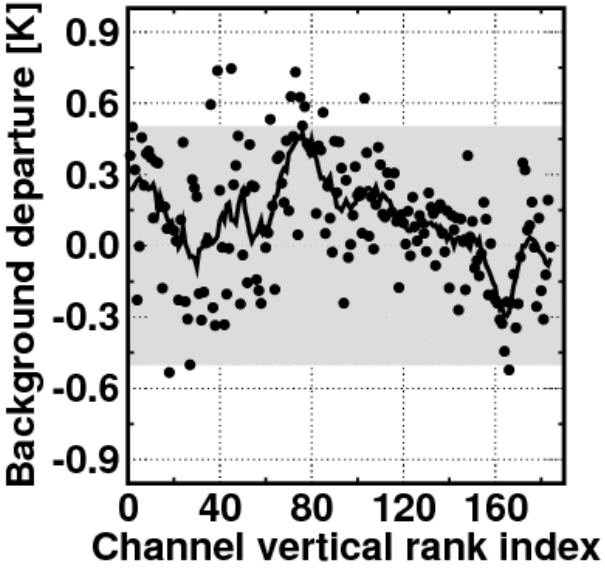
  → But this is unlikely to be the dominating mode



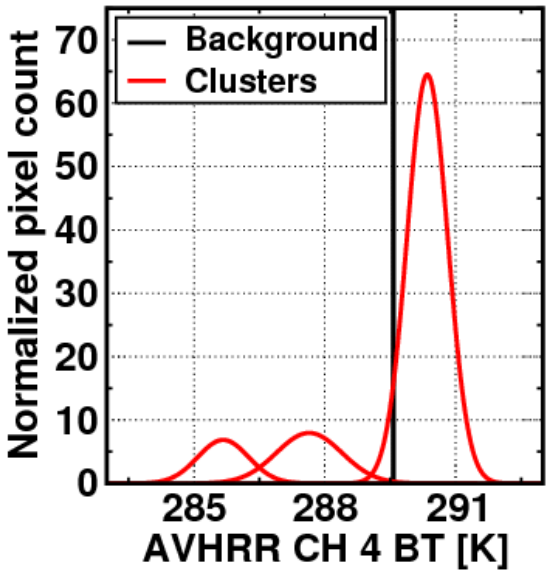
Characteristics of population 1

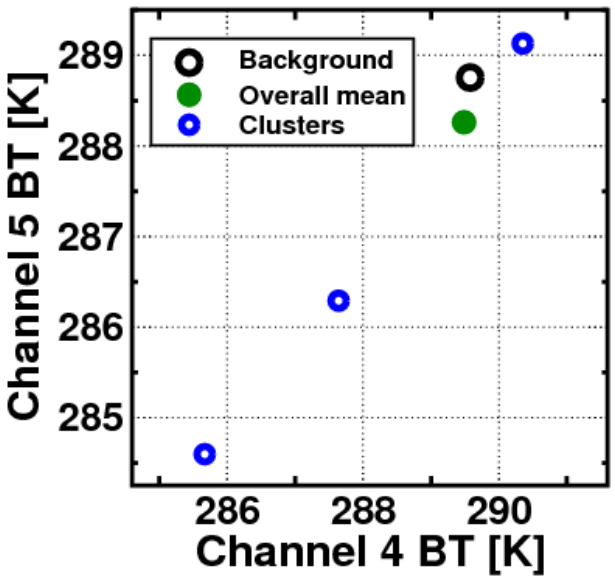
Clear in the operational scheme but cloudy in the imager scheme

IASI channels



AVHRR clusters



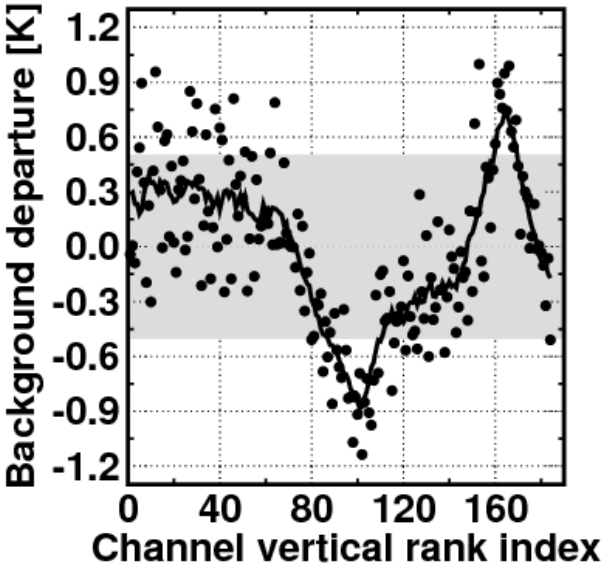


→ Operational scheme fails because of background error compensating for the cloud radiative effect?

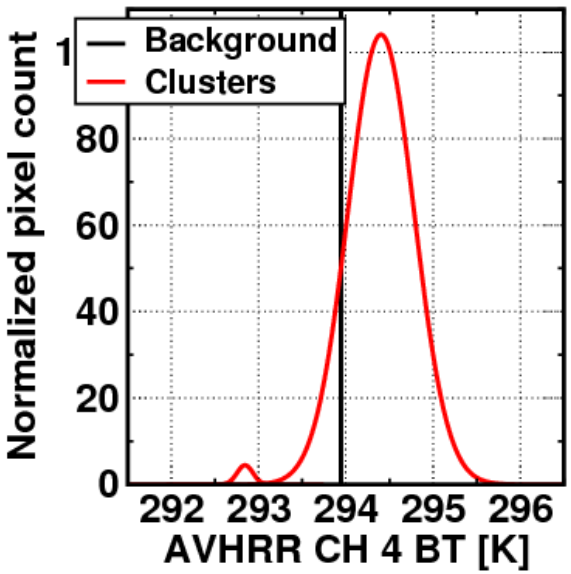
Characteristics of population 2

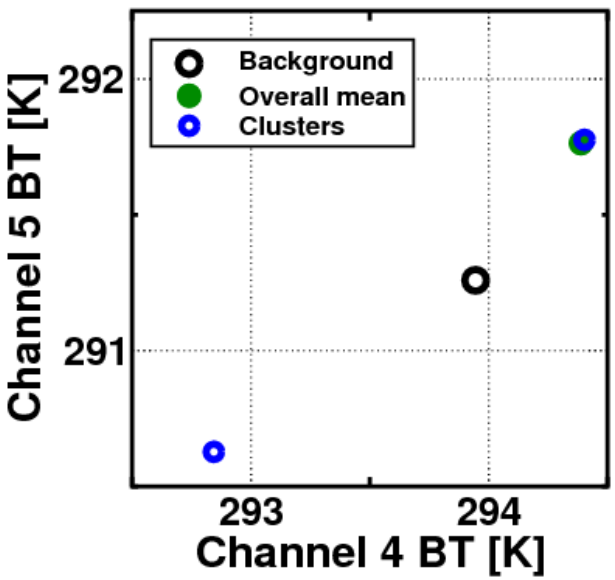
Clear in the imager scheme but cloudy in the operational scheme

IASI channels



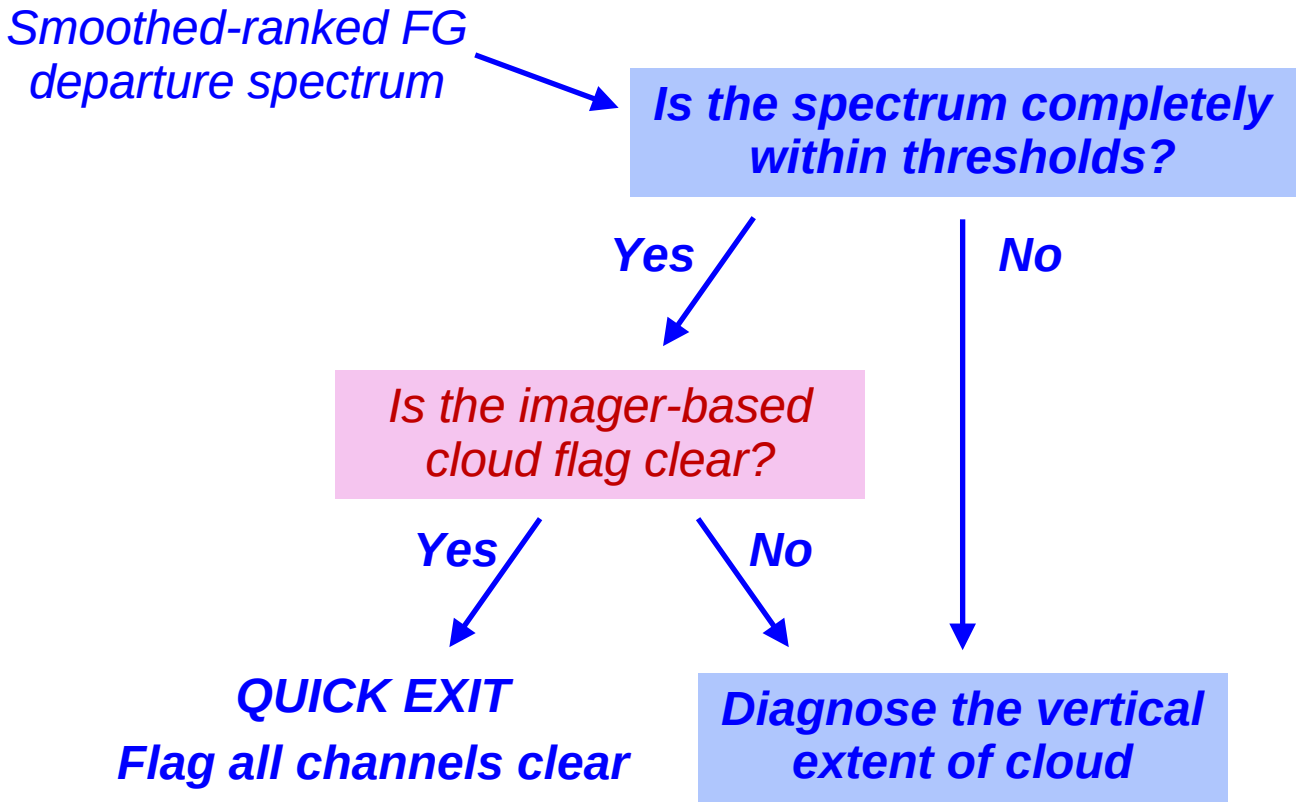
AVHRR clusters





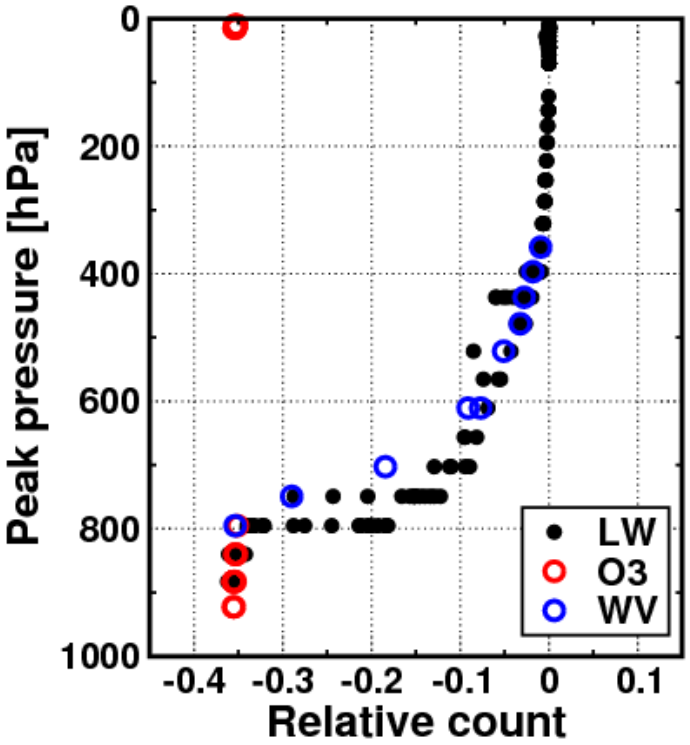
→ Imager scheme fails because of background errors compensating for the cloud radiative effect?

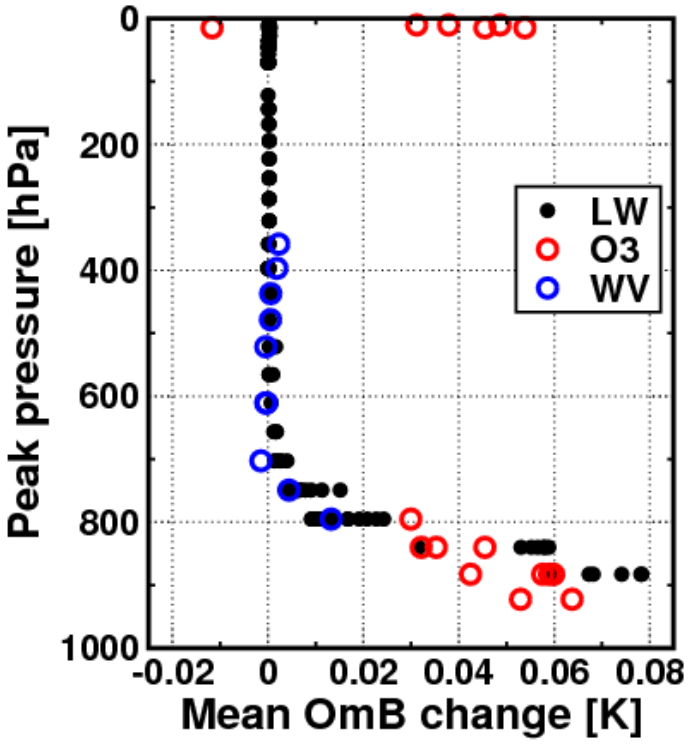
Imager-assisted cloud detection scheme



→ *Diagnosis of a completely clear FOV is allowed only if the imager-based cloud flag is clear*

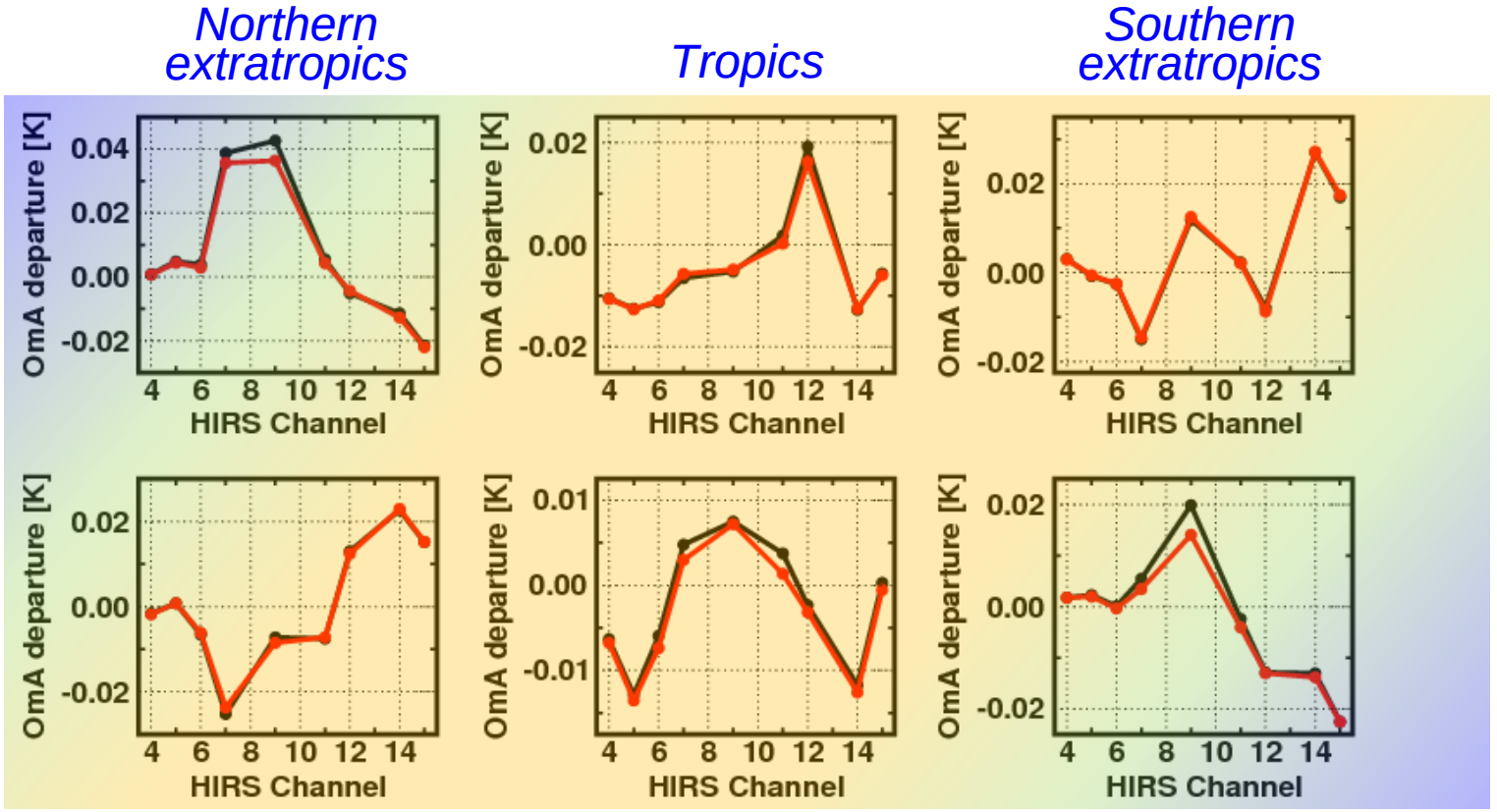
Implications on the use of IASI data





→ *Reduction on count of active data, particularly affecting negative background departures*

Implications on independent statistics

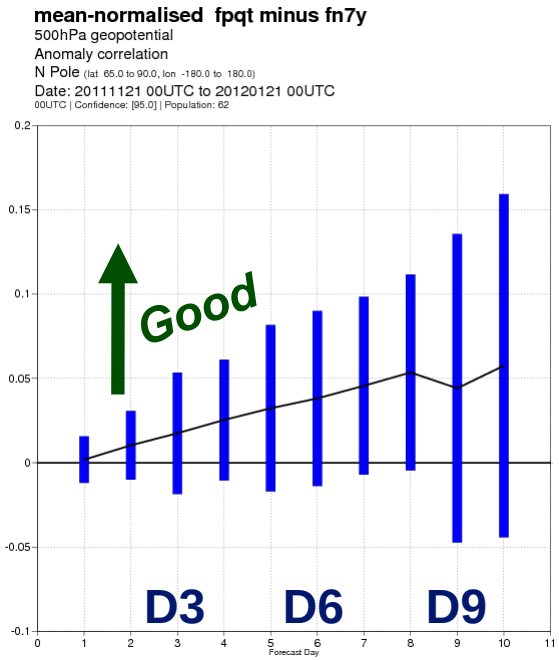


→ *Lower-tropospheric warming and reduced stratospheric ozone in winter hemispheres*

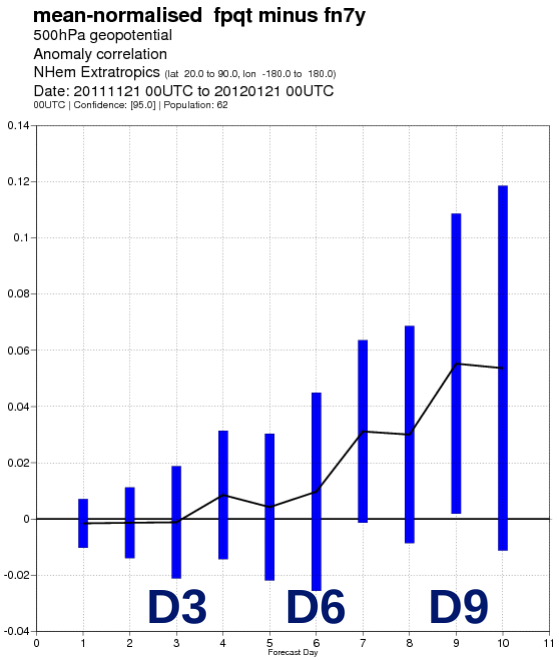
→ *Drying in tropical lower troposphere*

Impact on 10-day forecast scores

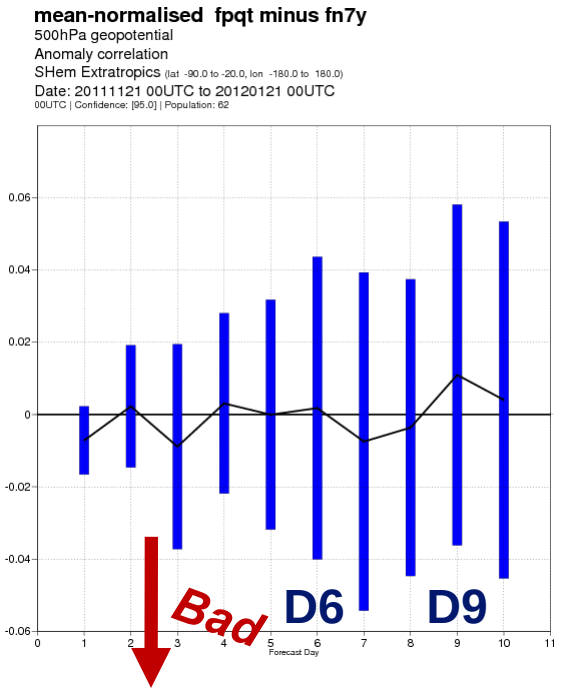
Z500 Anomaly correlation in a NH winter experiment



Northern polar



Northern extratropics



Southern extratropics

Conclusions

- The cloud detection is enhanced by making use of collocated AVHRR cluster information
- Checking for the inter-cluster consistency is particularly useful for detecting weakly-radiative clouds that normally would be missed
- The implementation acts as an additional safety measure for cloud screening and it results in
  - reduced count of active IASI data
  - slight warming of lower troposphere, particularly in the winter hemisphere
  - improved analysis of stratospheric ozone
- Enhancing the cloud detection improves forecast scores of temperature and geopotential, most notably in the lower troposphere