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The NWPSAF “IRSPP” software package

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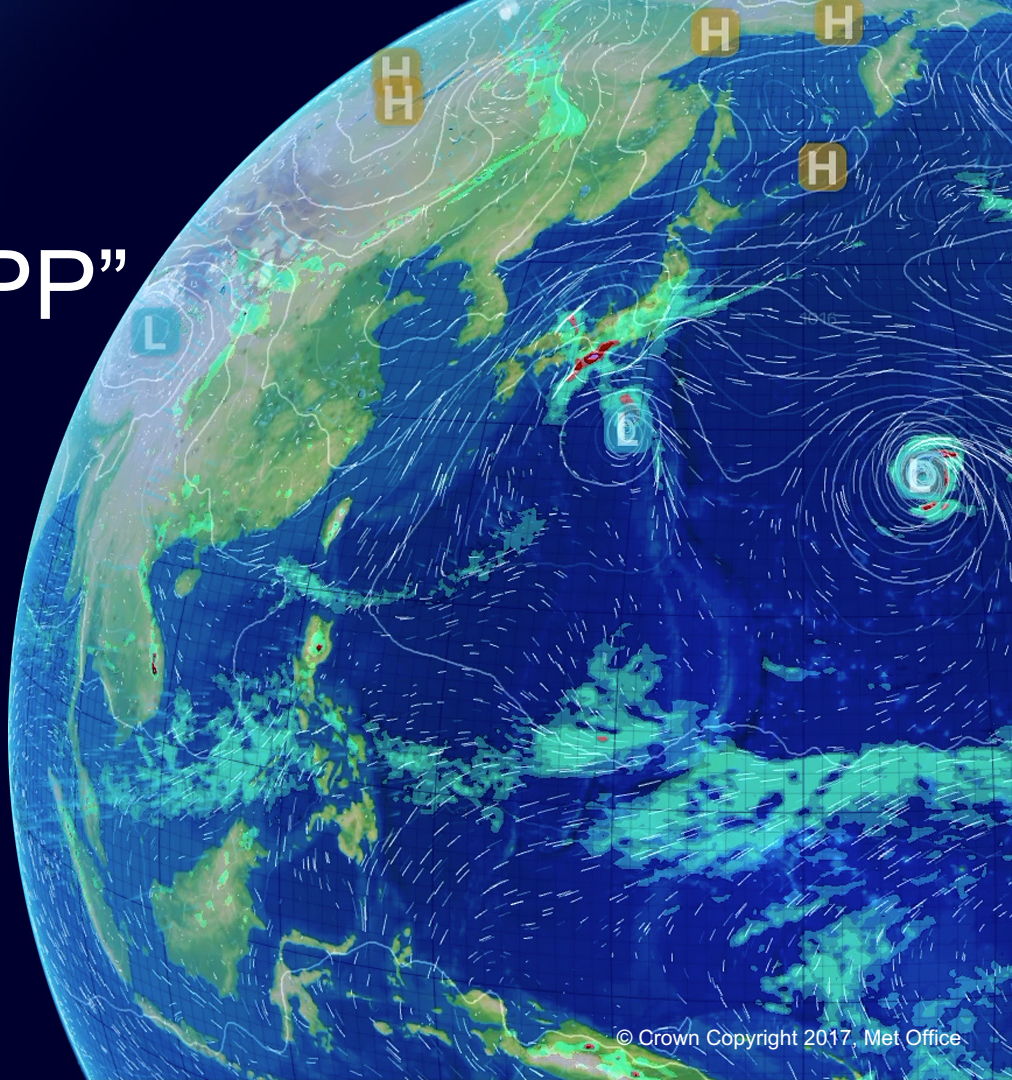

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IRSPP – processing package for the MTG-IRS

One of several new packages planned for the CDOP-3 phase of the NWP SAF (2017 to 2022)

User requirements were discussed at the ECMWF/NWPSAF Hyperspectral Workshop – and we welcome more feedback on URs.

- Intended for use by both global and regional NWP centres
- The main aim is to allow NWP centres to exploit the PC-compressed level 1 datasets

  Possible interest in the full-spectrum datasets provided to “power users”

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IRSPP

Input: netCDF4 files, Principal Component (PC) compressed

Output: BUFR or netCDF4

Optional processing steps:

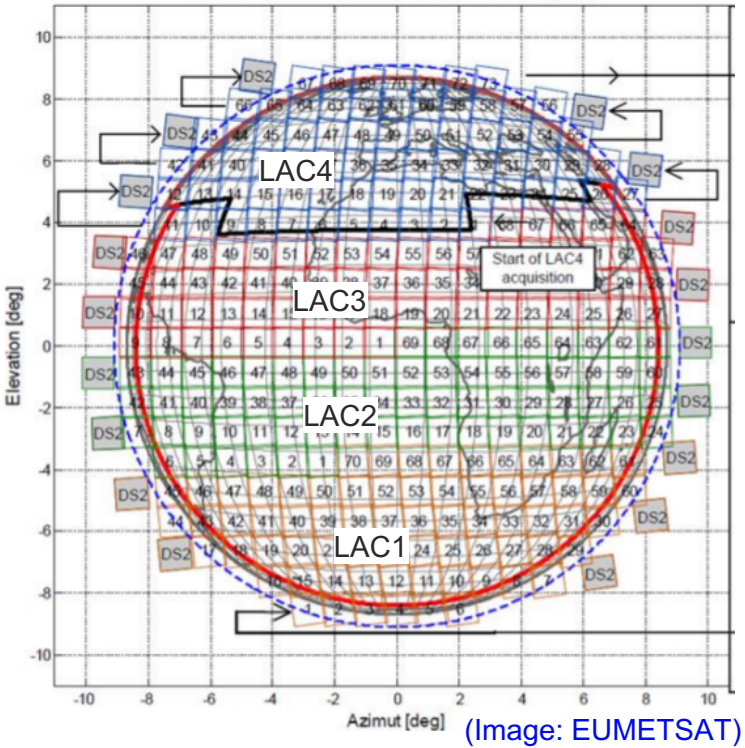
- Generation of reconstructed radiances (for specified channels)
- Transformation to other PC basis sets
- Changing the apodisation of the eigenvectors
- Spatial thinning and/or averaging. Full resolution is 4-10km depending on position.
- Facility to generate eigenvectors (global or local) from full-spectrum datasets?
- Is any additional information needed? e.g. more information on clouds?

Challenges:

- Handling the large data volume in a timely manner

8×10^6 spectra received per hour (1 “LAC” per 15 min)

160×160 spectra per “dwell” (numbered boxes)



(Image: EUMETSAT)

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Considerations

- NWPSAF software packages are usually implemented in Fortran90.
- Use NetCDF-Fortran library to ingest the input files
- Use ecCodes to generate BUFR products – assuming that there is interest in this from the NWP centres. BUFR sequence would need to be defined – *who will do this*? Make sure ancillary data are included (e.g. instrument temperatures – anything that might be useful in bias correction)
- Channel selection(s) for reconstructed radiances need to be defined. How many channels would NWP systems need? There are standard selections for IASI and CrIS radiances (not reconstructed). *Who will generate*?
- Provision to select dwells covering certain regions – should be straightforward

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Normal processing – to get reconstructed radiances

At EUMETSAT: $\mathbf{s} = \mathbf{E}^{\mathrm{T}}\mathbf{y}$ Fairly heavy computation

scores

spectrum

Rank: Npc × Nchan

e.g. 150 × 1000 (approx) multiplications per band per spectrum

7×10^8 multiplications per sec – this is would fully load my desktop
(4-core Intel Xeon E5520 @ 2.27GHz)

By the user: $\mathbf{y}_r = \mathbf{E}\mathbf{s}$

Reconstructed radiance

Only include the channels of interest in $\mathbf{E}$, so less computation is needed (~1×10^8 multiplications per sec)

You cannot assimilate more than *Npc* channels, because the observation error matrix would not invert. (See Fiona Smith's ITSC-19 presentation, 7.02)

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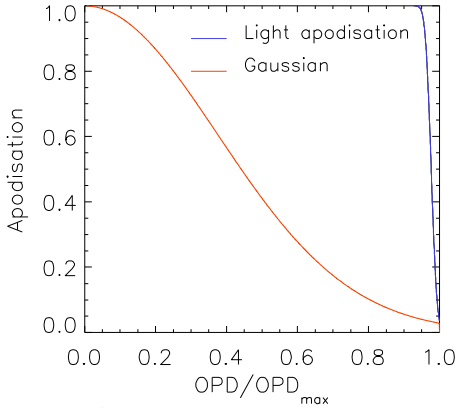
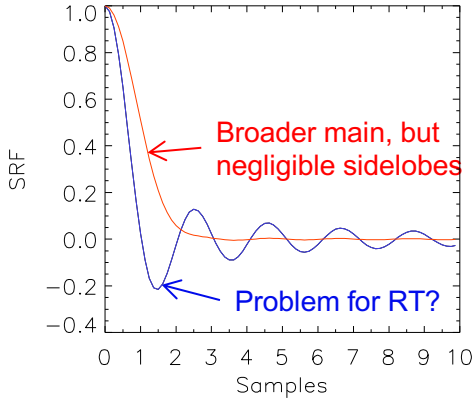
Changing the apodisation

PC scores will be generated at EUMETSAT on the basis of “lightly apodised” spectra – this is good because it preserves the information content, but can be difficult for radiative transfer (negative transmittances)

Apodisation is a linear process, so it is easy for the user to change the apodisation of the reconstructed radiances just by using apodised eigenvectors – which can be pre-computed (*assuming static eigenvectors are used for the input data*). Make provision for this in IRSPP.



Interferogram domain



Spectral Response Function

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Changing the eigenvector basis

- EUMETSAT will use eigenvectors designed to keep as much as possible of the measured signal – based on real observations
- NWP centres might want eigenvectors based on RT model, i.e. only consider variables that are actually represented in the model (T, q, cloud, surface, etc.)
- Project the scores: $\mathbf{s}' = \underbrace{\mathbf{E}'^{\mathrm{T}}\mathbf{E}}\,\mathbf{s}$

Rank: $Npc_{new} \times Npc_{old}$

If this matrix is pre-computed, computational complexity is similar to generating RRs.

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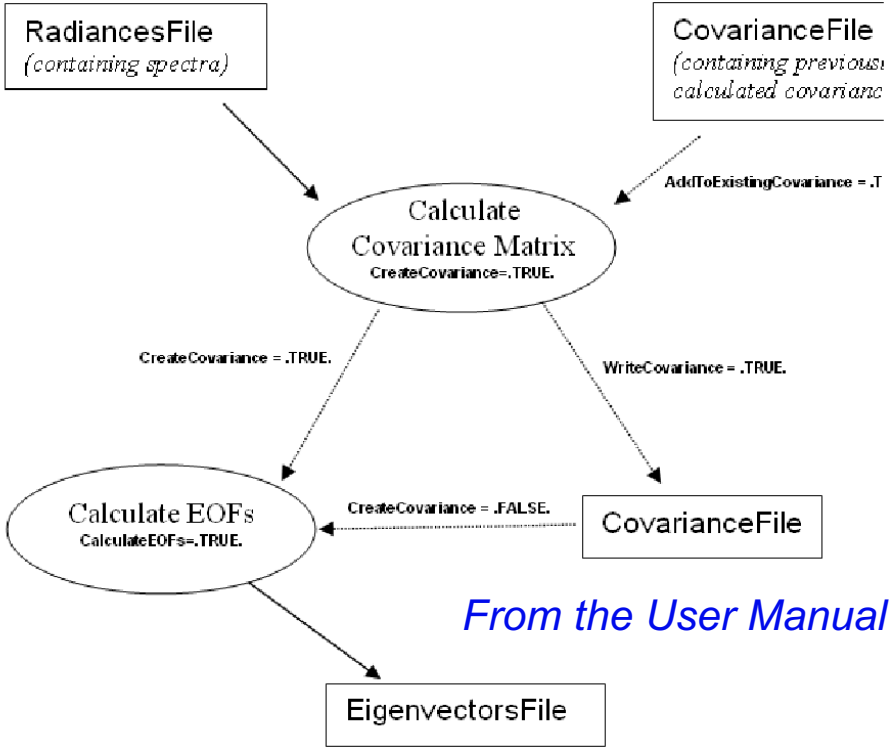
Generating eigenvectors

- Would be done centrally by EUMETSAT, but researchers may want to generate their own.
- See the current (unchanged since 2008) NWPSAF “IASI PCA-based compression package”. *Is there a requirement to continue to support this functionality?*



From the User Manual

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Anything else?

- Cloud/surface? The IRS ATBD includes a comprehensive range of cloud/surface tests, so unlikely that IRSPP could add anything in this area.
- Your suggestions …?

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