

# IRS Test data – Needs & Responses

MTG-IRS MAG 10<sup>th</sup> meeting, 12/11/2020

*T. August, with inputs from programme, user support  
and science teams + NWC SAF*



# IRS Test Data – Today's objectives

- Conclude iterations

*revived some MAG meetings ago now*

- Provide exhaustive snapshot of needs & responses

*as much as possible, with MAG views*

- Enable short-term workplan and actions

*specific and realistic pre-launch*

# Test data purposes

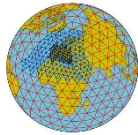
- For Users



Functional development and testing



System tests



Scientific studies



User awareness & preparation

- In programme development



Instrument effect and NC impact analysis



L1 & L2 prototype, system budget, operational IV&V

# Test data types



## Synthetic/Simulated

geophysical state (e.g. NWP) + RTM



## Pseudo/Emulated

real observations from current missions transformed on IRS characteristics



## Proxy

real observations from current missions, of similar type

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### pros/cons

possibility to simulate all places & times with some realism

VS

representativeness of real observations required for scientific preparation

***!! effort needed: proxy << pseudo < synthetic !!***

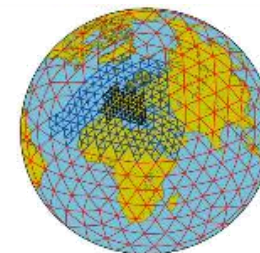
# IRS test data needs & status inventory



## Engineering

Purpose	Requirements	Status	Next
Functional dev & I/O testing	<ul style="list-style-type: none"><li>Format &amp; size specs</li><li>Format compliant sample files</li><li>???</li></ul>	<ul style="list-style-type: none"><li>✓ One dwell L1B rads and PC as per specs publicly <u>released</u></li></ul>	<ul style="list-style-type: none"><li>➤ Update new spectral grid</li></ul>
Load & throughput tests	<ul style="list-style-type: none"><li>Format compliant data</li><li>Representative spatio/temporal sampling</li><li>Some realism that all algos branches can be triggered – no science need</li><li>1/2h refresh over LAC4/Europe</li><li>Core period which can be played in infinite loop → 24h (NWC SAF ok) <i>? Entire LAC simulate at same time OK ?</i></li></ul>	<ul style="list-style-type: none"><li>✓ Core dataset exists</li><li>➤ Old spectral grid</li></ul>	<ul style="list-style-type: none"><li>➤ Update new spectral grid</li><li>➤ Complete existing dataset</li><li><b>? By when needed?</b></li><li><b>? By whom?</b><ul style="list-style-type: none"><li>- <b>NWC SAF</b></li><li>- <b>NMHS</b></li><li>- ...</li></ul></li><li><b>? L1B rads, PC, L2?</b></li></ul>

# IRS test data needs & status inventory



## Scientific developments - NWP

Purpose	Requirements	Status	Next
OSSE	Large realistic simulated datasets	✓ Done (M-F, <i>Others?</i> )	x nothing
Readiness for PC products (IRS NRT baseline)	<ul style="list-style-type: none"> <li>Real hyperspectral products → <i>IASI PCC is good proxy</i></li> </ul>	<ul style="list-style-type: none"> <li>✓ IASI PC available NRT</li> <li>➤ Hybrid PC products not yet operational with IASI, offline production</li> <li>➤ Good experience in NWP, e.g. at ECMWF and UKMO, DWD and M-F</li> <li>➤ Study planned shortly to address operational interrogations on User side (<i>which obs. error? EV-basis update?</i>)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Release IASI hybrid PC in NRT</li> <li>➤ Perform RecRad assimilation study, release guidelines &amp; practices for NWP</li> <li>? Other?</li> </ul>
How to exploit temporal sampling?	<ul style="list-style-type: none"> <li>Real hyperspectral products at sufficient frequency → <i>GIIRS is closest proxy</i></li> </ul>	<ul style="list-style-type: none"> <li>➤ FY4A-GIIRS L1 readiness for assimilation under consolidation</li> <li>➤ Preliminary radiance assimilations, results encouraging. Atm. dynamic expected through 4D-Var.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Raise GIIRS L1 assimilability</li> <li>➤ Perform assimilation study, release guidelines &amp; practices ad high temporal sampling</li> <li>? Other?</li> </ul>
How to exploit spatial density?	<ul style="list-style-type: none"> <li>Real hyperspectral products at sufficient spatial resolution &amp; sampling → <i>what proxy???</i></li> </ul>	<ul style="list-style-type: none"> <li>➤ ???</li> </ul>	<ul style="list-style-type: none"> <li>???</li> </ul>

# IRS test data needs & status inventory

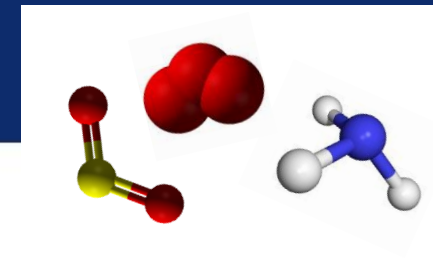


## Scientific developments - NWC

Purpose	Requirements	Status	Next
Potential and practicalities of HSIR L2 for VSRF	<ul style="list-style-type: none"><li>Real hyperspectral sounding sampling pre-convective times → <b>IASI L2</b> good proxy, but poor diurnal coverage, early morning pass not ideal.</li></ul>	<ul style="list-style-type: none"><li>No ope. heritage of HSIR L2 in NWC</li><li>✓ EARS-IASI L2 (MW+IR) &lt;30min</li><li>✓ Regional product ingested in ope. weather monitoring in some NMHS.</li><li>➤ Studies completed at DWD, OMSZ, ARSO, ESSL, NWC SAF...</li></ul>	<ul style="list-style-type: none"><li>➤ Pursue preparatory studies (planned)</li><li>➤ <b>EARS-IASI IR-only?</b> Pseudo-IRS?</li><li>➤ Generate e.g. <b>CrIS L2 with same ope. algo</b> as for IASI L2?</li><li>➤ Study production of <b>GIIRS L2 ?</b></li><li>? Other?</li></ul>
Uncertainties in stability parameters derived from L2	<ul style="list-style-type: none"><li>L2 theoretical uncertainty estimate modelling – NWC SAF-made</li><li>▪ <i>Anything else needed?</i></li></ul>	<ul style="list-style-type: none"><li>➤ Studies at NWC SAF (VS Jana Campa)</li></ul>	<ul style="list-style-type: none"><li>➤ ???</li></ul>
RGB from HSIR spectro-imager???	<ul style="list-style-type: none"><li>▪ <i>Specific requirements???</i></li></ul>	<ul style="list-style-type: none"><li>➤ <i>Started at NWC SAF, demo in syntetic regional area</i></li></ul>	<ul style="list-style-type: none"><li>? </li></ul>



# IRS test data needs & status inventory



## Scientific developments – AC/AQ

Purpose	Requirements	Status	Next
IRS simulations	<ul style="list-style-type: none"><li>No scientific benefits expected of trying to simulate large IRS sets with a maximum of molecules (P. Coheur, MAG-9). Better to work with real (polar) observations at this stage.</li></ul>		➤ None
Readiness for PC products (IRS NRT baseline)	<ul style="list-style-type: none"><li>Real hyperspectral products ➔ <i>IASI PCC is good proxy</i></li></ul>	<ul style="list-style-type: none"><li>➤ Low awareness and readiness in general with PC in this application</li><li>➤ 2 studies kicked-off with IASI products to<ul style="list-style-type: none"><li>• grow experience with PC (and hybrid)</li><li>• share « how-to's » with community</li><li>• help retain rare signal in static base</li></ul></li></ul>	➤ Perform the studies + share findings and guidelines to use PC products
Other ???	<ul style="list-style-type: none"><li>■ ???</li></ul>	➤ ???	<i>Needs???</i>



# IRS test data needs & status inventory



## User prep., accelerate uptake after launch

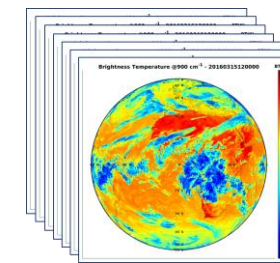
Purpose	Requirements	Status	Next
Awareness, notional training	<ul style="list-style-type: none"><li>Look &amp; feel test product samples (as per format specs) + didactic material (animations, content/perfo illustrations...)<ul style="list-style-type: none"><li>➔ <i>IASI and simulations OK</i></li><li>➔ <i>NWP inputs at high spatio-temporal resolution</i></li></ul></li></ul>	<ul style="list-style-type: none"><li>➤ On-going, using IASI L1, L2 products and simulations for theoretical assessments</li></ul>	<ul style="list-style-type: none"><li>➤ Carry on</li></ul>
Advanced familiarisation with MTG products in synergy	<ul style="list-style-type: none"><li>4D-weather data cubes with consistent test products from FCI, LI and IRS</li><li>Handfull of relevant meteorological situations*: limited area, time series spanning the events</li><li>Emulated from real observations as much as possible<ul style="list-style-type: none"><li>➔ <i>use <b>ABI and GLM?</b></i></li><li>➔ <i><b>Simulate IRS</b> (L1 and L2) from <b>high res. NWP</b> run?</i></li></ul></li></ul>	<p>Idea from internal EUM brainstorming</p> <ul style="list-style-type: none"><li>➤ Opinion of IRS MAG is sought</li><li>➤ If idea retained, <b>which model</b> to supply <b>high resolution geophysical state?</b></li><li>➤ First aim at <b>2-4 US cases</b></li><li>➤ Simulations over Europe to be considered in a second step, if feasible and upon real need/test set uptake</li></ul>	<p>If, then MAG to help</p> <ul style="list-style-type: none"><li>➤ defining requirements</li><li>➤ selecting relevant cases</li><li>➤ supplying NWP inputs, possibly TOA radiances</li><li>➤ evaluating efforts</li></ul> <p>to feed into workplan</p>

\* possible candidates: 15 Jun 2017 convective case over Kansas, 29 June 2018 convective case over Wyoming/South Dakota, 2/5 May 2019 convective line over TX, OK, ..., over Caribbean TBD (Hurricane Dorian 2 Sep 2019; Hurricane Michael 7-10 Oct 2018)

# IRS test data – Readily or nearly actionable

- Full-day all LACs & dwells simulated every hour
- Very-high-spectral resolution dwell
- Slanted view sensitivity study
- NWC SAF regional full-day FCI/IASI
  
- *pseudo-IRS PCS & L2 (one-off for early IRS L2 perfo assessment)*
- *early high-spatial resolution IRS radiances, thanks M-F (superseded now)*
- ...

# IRS test data – Readily or nearly actionable



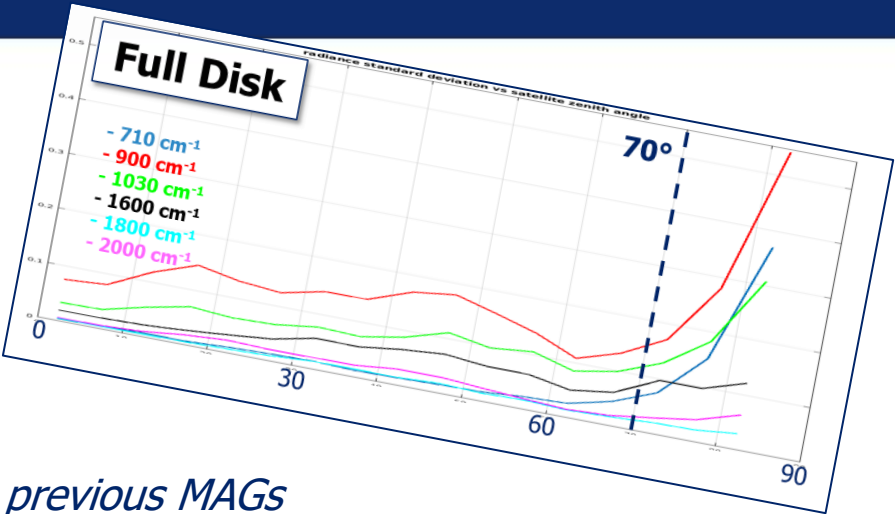
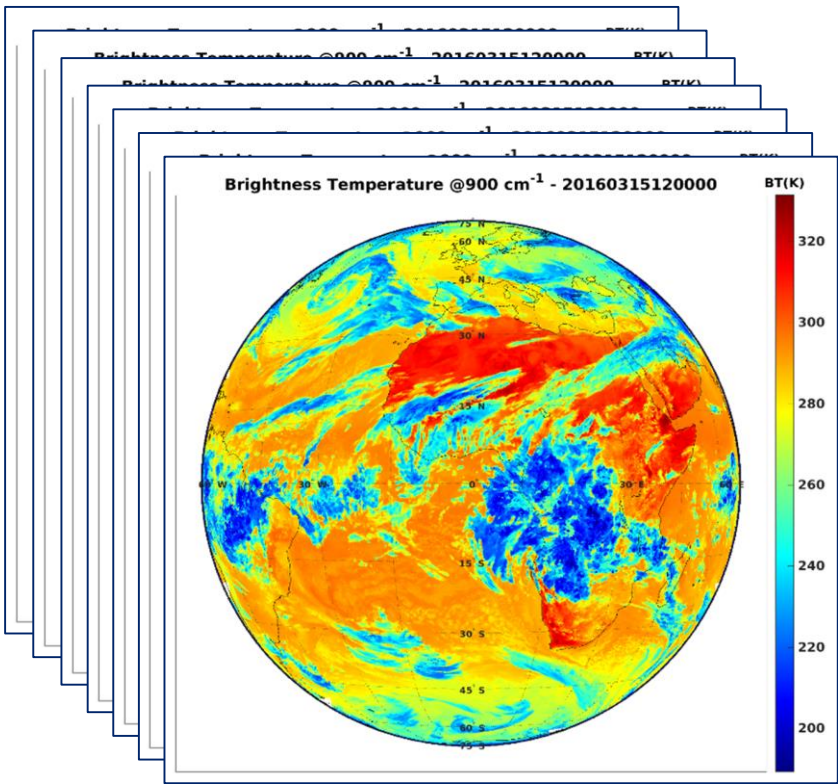
## Full-day hourly simulations\*

Purpose	Content	Limitations/Assumptions	Next steps?
<ul style="list-style-type: none"><li>✓ PC &amp; L2 prototyping: training and testing</li><li>✓ Scientific studies (e.g. slant sensitivity)</li><li>✓ PC &amp; L2 proc. IV&amp;V</li><li>✓ User familiarisation</li><li>✓ System dev. &amp; load tests</li></ul>	<ul style="list-style-type: none"><li>• Simulated radiances 15/03/2016</li><li>• Sufficient geophysical variance ➔ realistic synthetic test products and processor configuration</li><li>• RTTOV 12.1 simulation</li><li>• Variable T/q/O<sub>3</sub>, Ts, clouds (ECMWF) at 0.125°</li><li>• Hourly discs</li><li>• Packaged in realistic IRS dwells and LACs</li><li>• Radiances + PC &amp; L2 possible</li></ul>	<ul style="list-style-type: none"><li>• Former IRS spectral grid</li><li>• Missing ½-hourly LAC4</li><li>• Spatial res. (IFS) coarser than IRS pixels</li><li>• Full discs simulated for the same time</li><li>• CO<sub>2</sub> and trace gases fixed</li><li>• Clouds = grey body (low/mid/high level)</li><li>• Same geolocation LWIR/MWIR</li><li>• No instrument noise natively</li></ul>	<ul style="list-style-type: none"><li>➤ RT at new spectral grid</li><li>➤ Simulate ½-h LAC-4</li><li>➤ Format rads, PC as per specs</li><li>➤ L2 to be completed</li><li>¿ <b>simulate IRS acquisition sequence - mandatory?</b></li><li>¿ <b>Suitable for system throughput tests? By when needed?</b></li><li>¿ <b>Other needs?</b></li></ul>

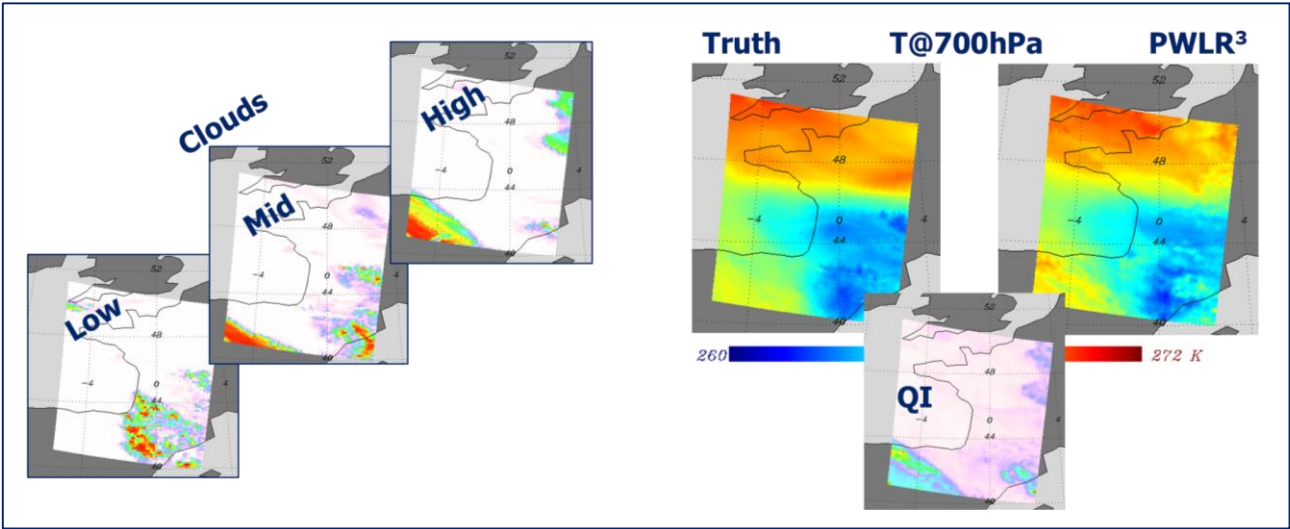
\* full details in EUM/MTG/TEN/17/951850

# IRS test data – Readily or nearly actionable

## Full-day hourly simulations\*



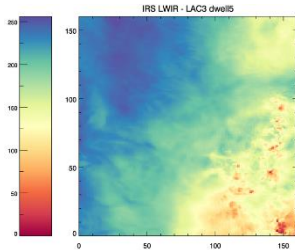
*Details and results presented in previous MAGs*



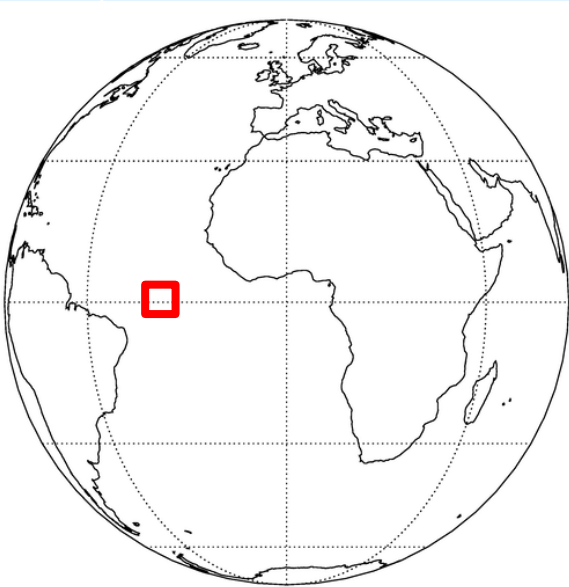
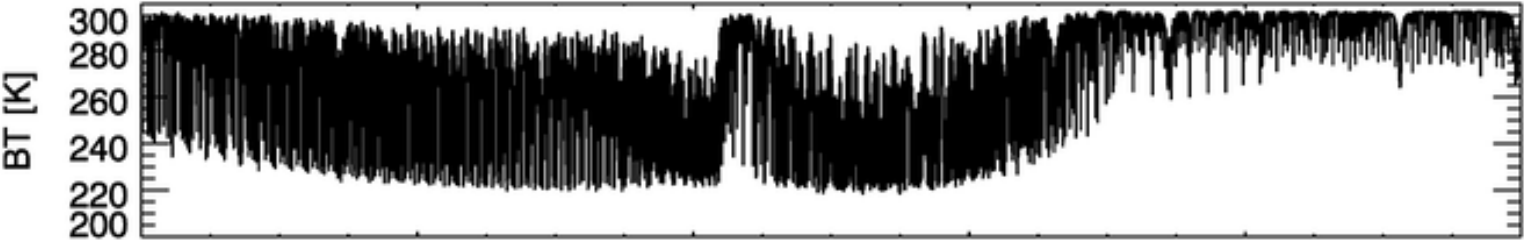
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# IRS test data – Readily or nearly actionable

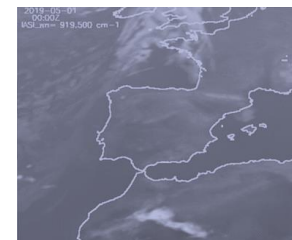
## High spectral resolution IRS dwell



Purpose	Content	Limitations/Assumptions	Next steps?
<ul style="list-style-type: none"><li>✓ L1 algo dev. &amp; testing</li><li>✓ Instrument NC impact analyses (<i>e.g. in straylight and Fabry-Perrot etalon effect</i>)</li></ul>	<ul style="list-style-type: none"><li>• LAC 3 – Dwell 3 (full maritime)</li><li>• LBLRTM simulations</li><li>• 500-3000cm<sup>-1</sup> @0.001cm<sup>-1</sup></li><li>• Variable T/q/Ts</li><li>• Clouds?</li><li>• 22 fixed trace gases</li><li>• HiRes IFS run at 2.5km</li></ul>	<ul style="list-style-type: none"><li>• Same geolocation LWIR/MWIR</li><li>• Extremely heavy in disk-space and CPU to generate (8 days for 1 dwell)</li><li>• No instrument noise included</li></ul>	<p>➤ Currently no further plans here</p> <p>¿ <b>Other needs/purposes?</b></p>



# IRS test data – Readily or nearly actionable



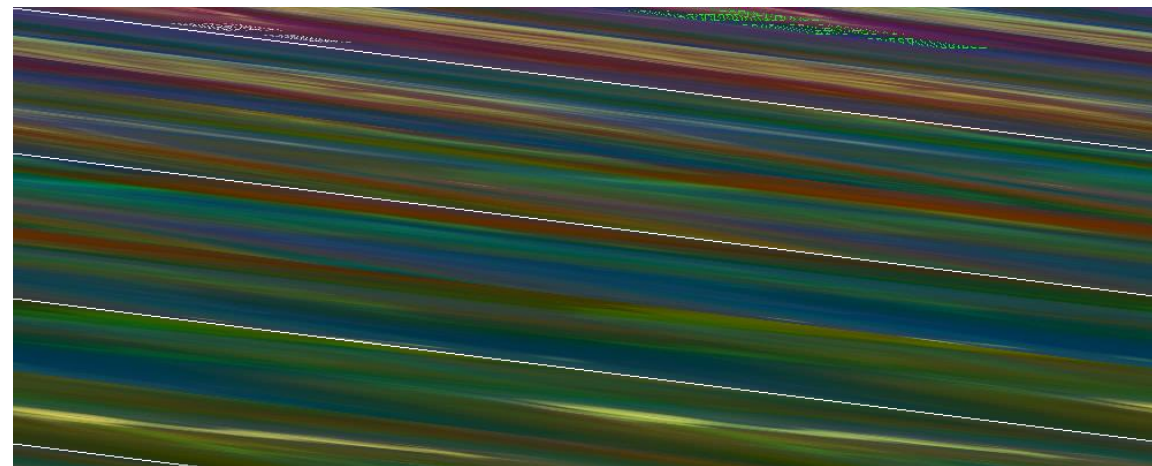
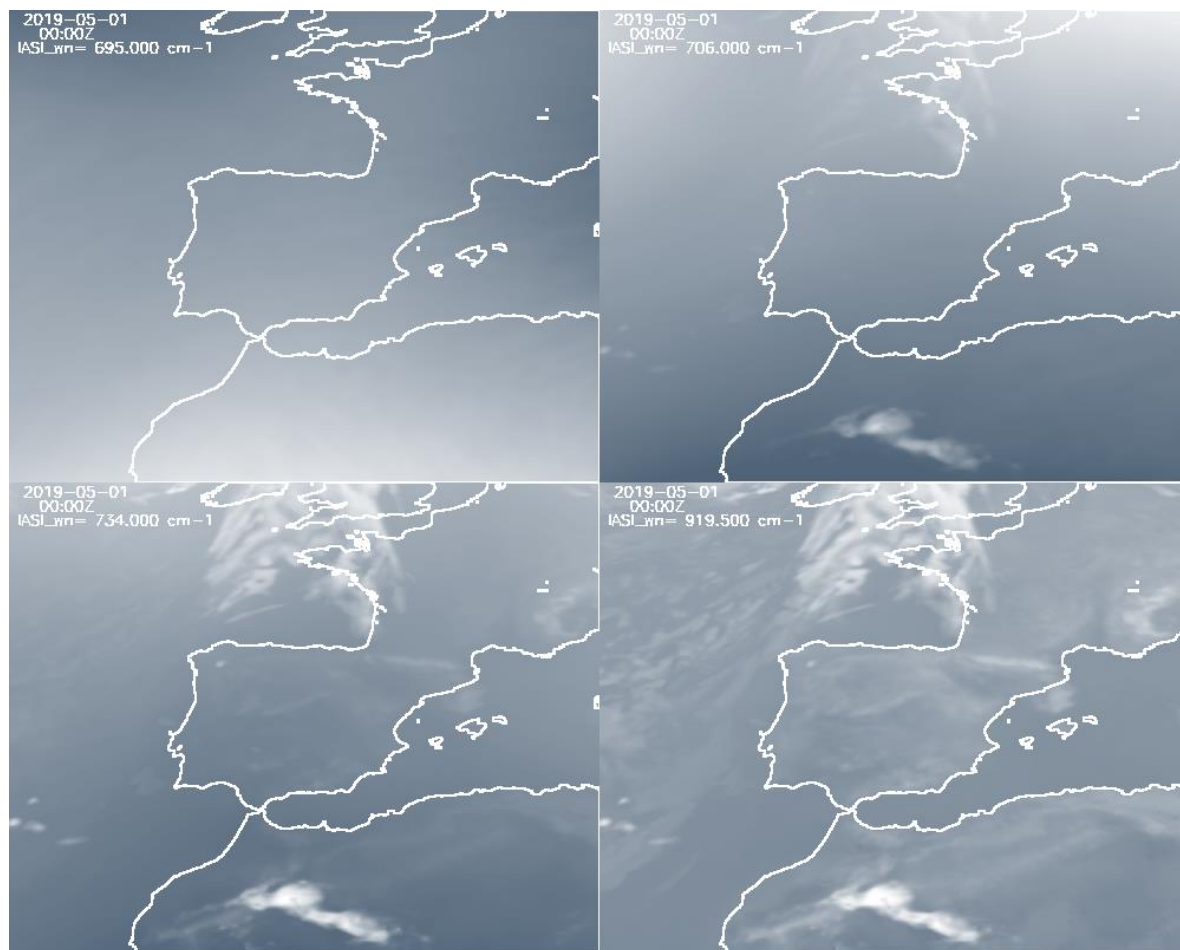
## NWC SAF regional full-day FCI/IASI

Purpose	Content	Limitations/Assumptions	Next steps?
<ul style="list-style-type: none"><li>✓ Functional dev. &amp; test</li><li>✓ Scientific algo testing</li><li>✓ User familiarisation</li></ul>	<ul style="list-style-type: none"><li>• 9 dwells (around Spain?)</li><li>• RTTOV simulations, incl. clouds</li><li>• ECMWF fields at 0.1°</li><li>• Spanning 24h<ul style="list-style-type: none"><li>• FCI every 10min 2km</li><li>• IASI spectra every 30min 4km</li></ul></li></ul>	<ul style="list-style-type: none"><li>• IASI spectra natively, tools exists to transform into IRS</li><li>• LWIR/MWIR same geolocation</li><li>• Raw binary format</li></ul>	<p>Need</p> <ul style="list-style-type: none"><li>➤ « engineering quality data to test NWC SAF products and services in CDOP-3 and CDOP-4 »</li><li>➤ « a few 30min LAC4, L1 &amp; L2 »</li><li>➤ « final instrument and format specs »</li><li>➤ « RTTOV-IRS »</li></ul> <p><i>Dataset and tools can be made available</i></p>



# IRS test data – Readily or nearly actionable

## NWC SAF regional full-day FCI/IASI



*Credits: M. Angel and X. Calbet*



# IRS test data – Further test sets needed?



Missing purposes/needs identified at this stage:

- **simulate finer spatio-temporal resolution?**  
→ *further study instrument effects, super realistic simulated IRS observations*
  - **others?**
- 
- **ICON-HDCP2 data (DWD) - High resolution run over Germany domain**
    - 20/06/2013 full day – lots of convective storms
    - T/q/clouds at 1km, every 5 min from 06:00 to 23:55 UTC
    - kindly supplied by DWD (D. Klocke, C. Köpken-Watts) → basis for 4D-cube MTG corporate animation
  - **Ruisdael Observatory (NL Uni. Delft/KNMI)**
    - Super high resolution project ~100m ~minutes, focus on clouds & precip' processes
    - Super dense ground/in situ observation campaigns
    - Contact initiated with PI (Herman Russchenberg) to envisage if cooperation on IASI products validation & IRS simulations (their workplan for AEOLUS and TROPOMI)
  - **Sinfony, similar project at DWD (30-300m resolution), status?**
  - **Others resources to simulate very high spatio-temporal?**

# IRS Test Data – Today's objectives

- Conclude iterations

*revived some MAG meetings ago now*

- Provide exhaustive snapshot of needs & responses

*as much as possible, with MAG views*

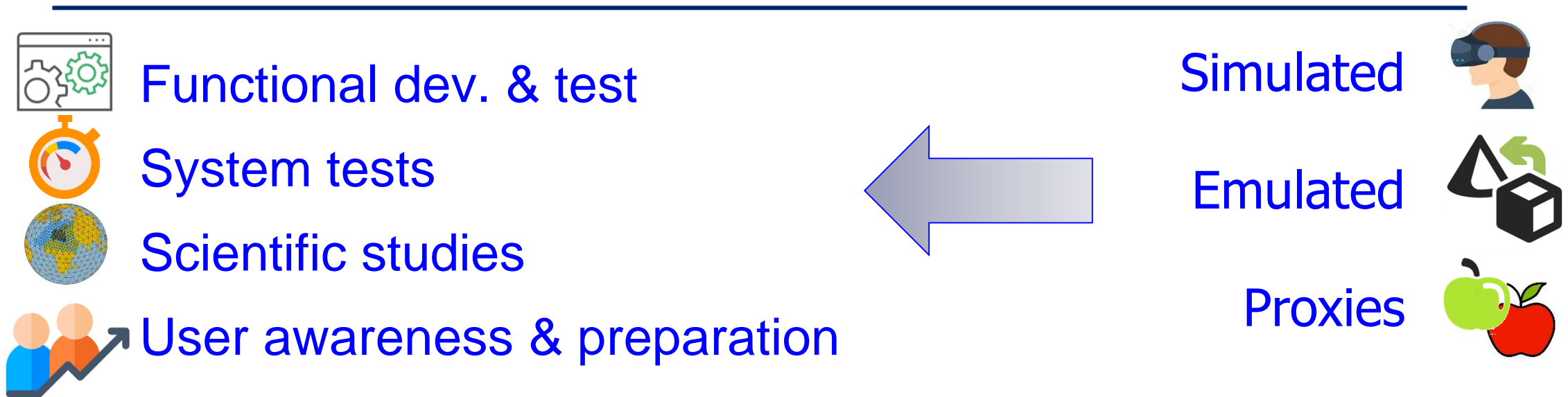
- Enable short-term workplan and actions

*specific and realistic pre-launch*

# Let's discuss, converge and wrap-up

- ✓ A number of test data (synthetic, pseudo, proxy) already in use or initiated
  - ¿ Have we forgotten important user needs?
  - ¿ Are we missing fundamental inputs to address them?

*MAG feed-back to conclude on requirements at this stage, and possibly further contribute to complete the test data short-term.*





Live notes:

