Evaluating the use of IASI hyperspectral sounder data for severe storm forecasting at the ESSL Testbed
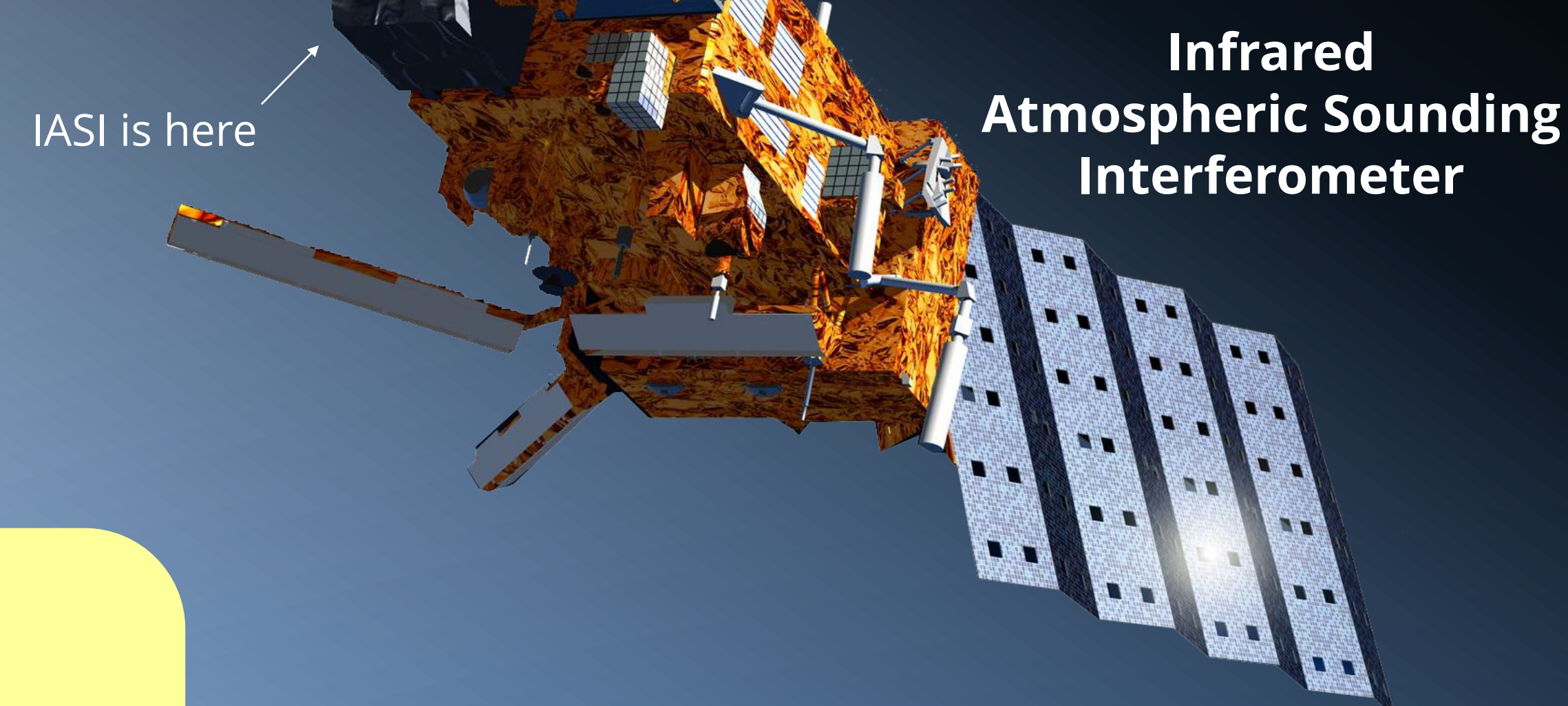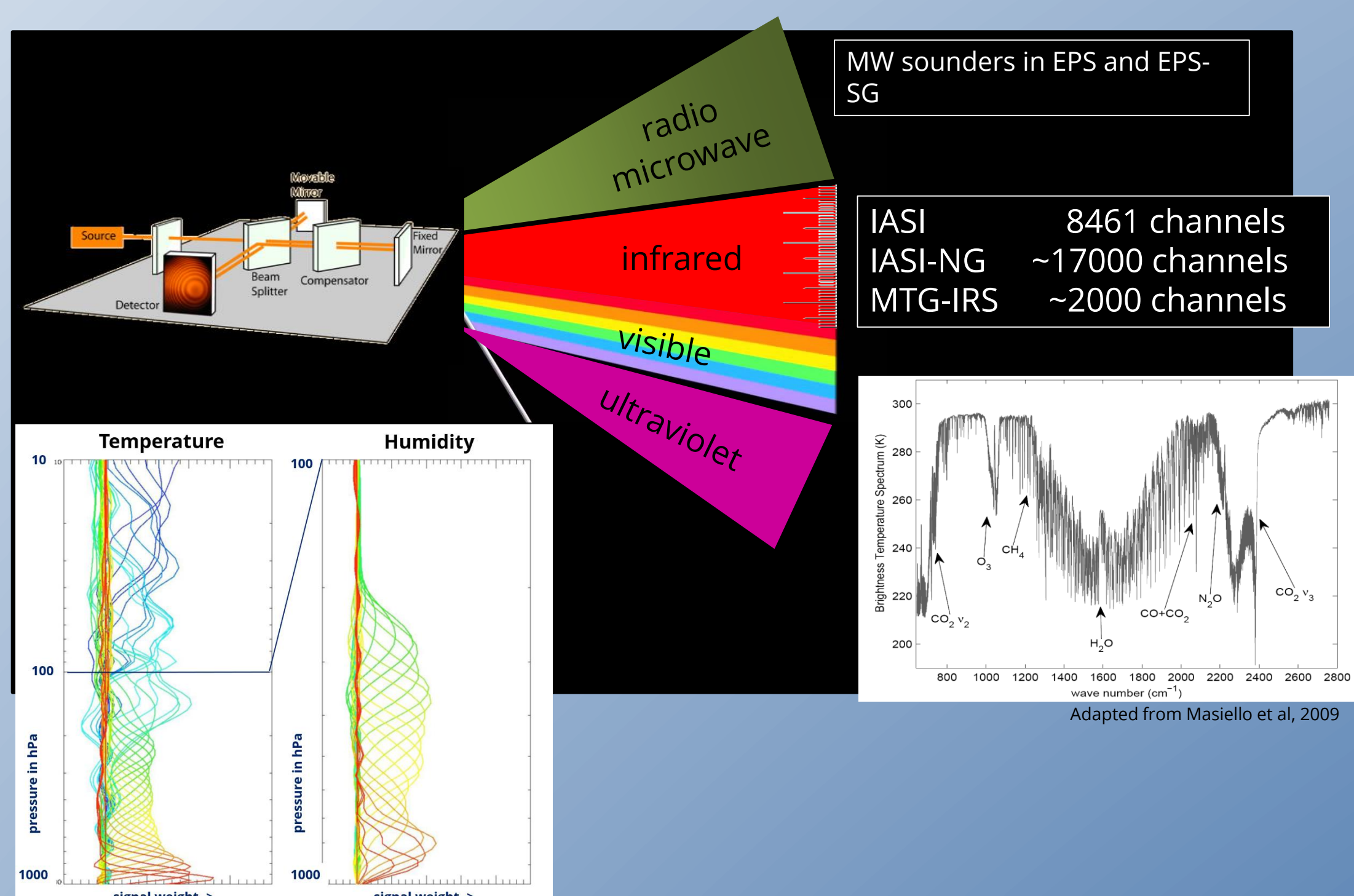
Pieter Groenemeijer, Tomáš Púčik (ESSL)
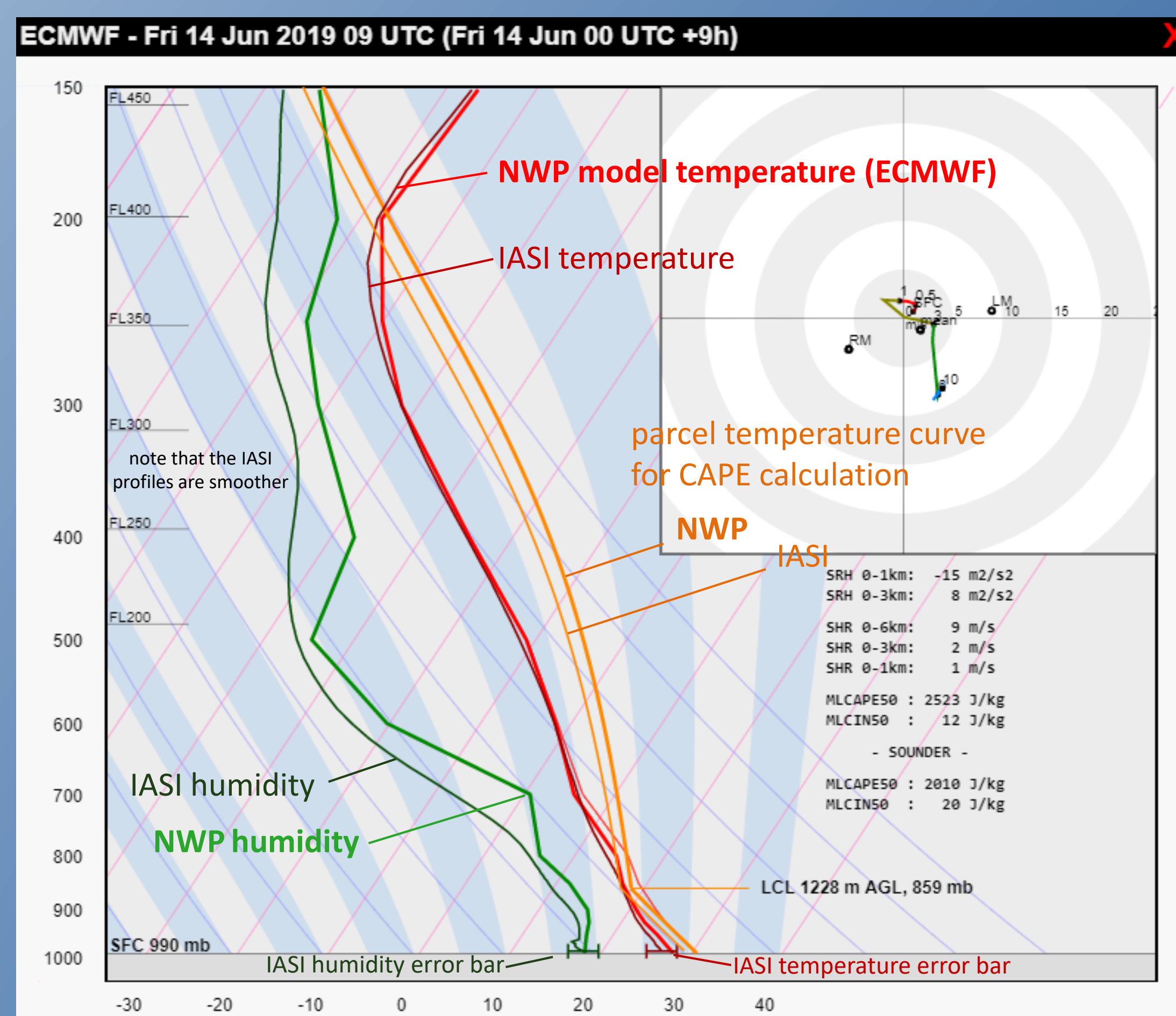**Thomas August** (EUMETSAT)

Metop satellite carrying IASI

IASI is here

Infrared Atmospheric Sounding Interferometer

The IASI sounder measures infrared radiances …

radio
microwave
infrared
visible
ultraviolet

MW sounders in EPS and EPS-SG

IASI	8461 channels
IASI-NG	~17000 channels
MTG-IRS	~2000 channels

Temperature   Humidity

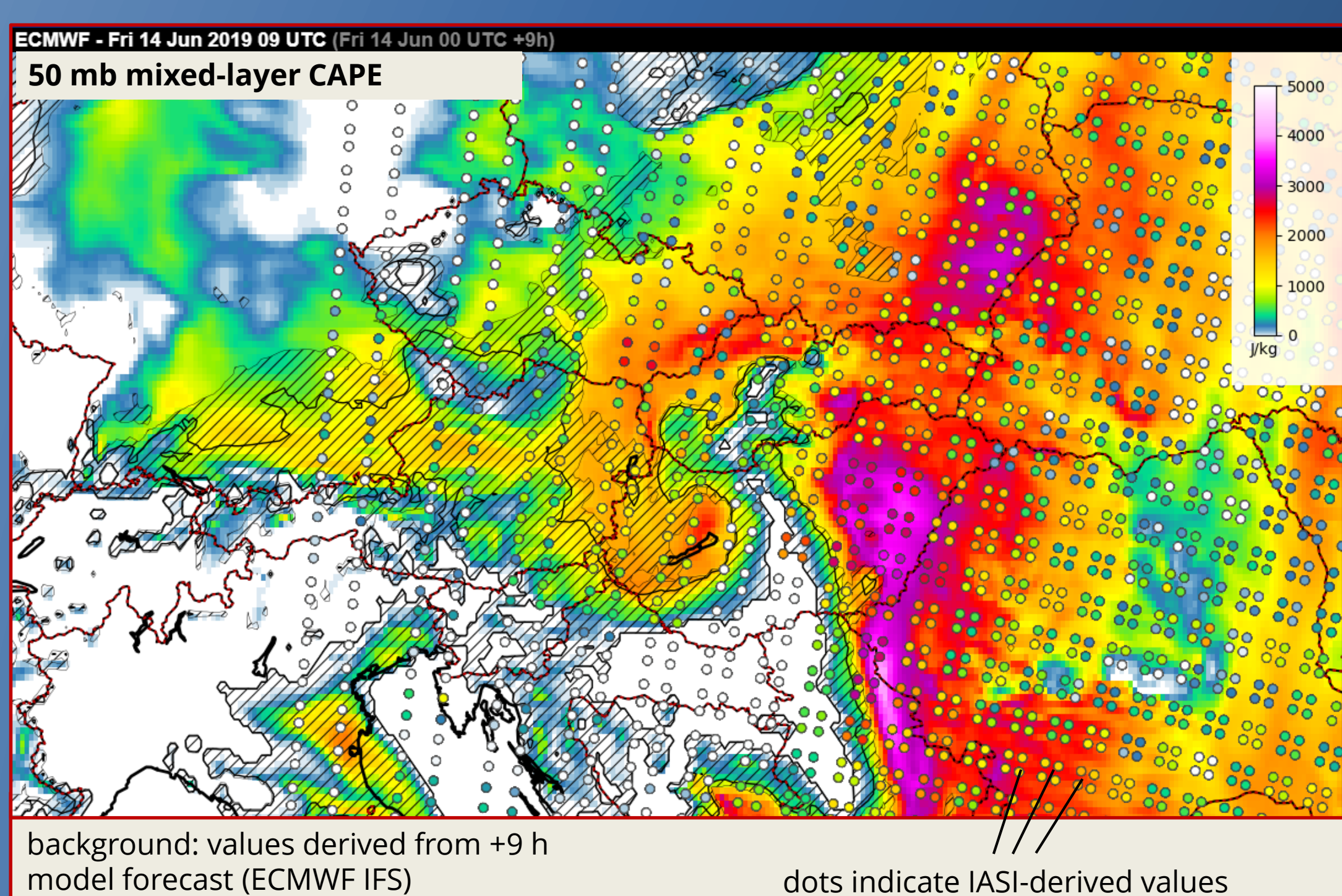signal weight ->   signal weight ->

Adapted from Masiello et al, 2009

…from which vertical profiles of temperature and humidity are derived.

They can be compared to the profiles from numerical weather prediction (NWP) models:

ECMWF - Fri 14 Jun 2019 09 UTC (Fri 14 Jun 00 UTC +9h)

NWP model temperature (ECMWF)

IASI temperature

parcel temperature curve for CAPE calculation

note that the IASI profiles are smoother

NWP
IASI

SRH 0-1km:	-15 m2/s2
SRH 0-3km:	8 m2/s2
SHR 0-6km:	9 m/s
SHR 0-3km:	2 m/s
SHR 0-1km:	1 m/s
- SOUNDER -	
MLCAPE50 :	2523 J/kg
MLCIN50 :	12 J/kg
- SOUNDER -	
MLCAPE50 :	2010 J/kg
MLCIN50 :	20 J/kg

IASI humidity
NWP humidity

LCL 1228 m AGL, 859 mb

SFC 990 mb

IASI humidity error bar   IASI temperature error bar

… from those, we can compute convective parameters, such as CAPE:

ECMWF - Fri 14 Jun 2019 09 UTC (Fri 14 Jun 00 UTC +9h)
50 mb mixed-layer CAPE

J/kg

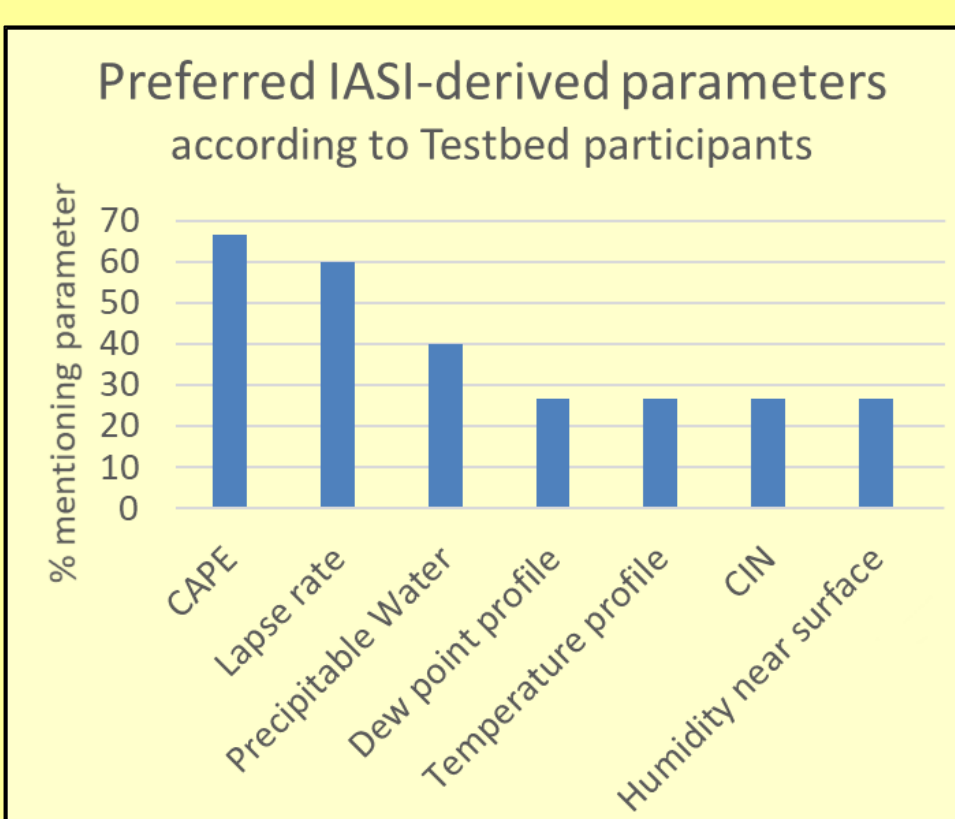background: values derived from +9 h model forecast (ECMWF IFS)   dots indicate IASI-derived values

ESSL Testbed

In June and July 2019, over 40 Testbed participants worked with IASI profiles and parameters to make experimental forecasts for severe convective storms
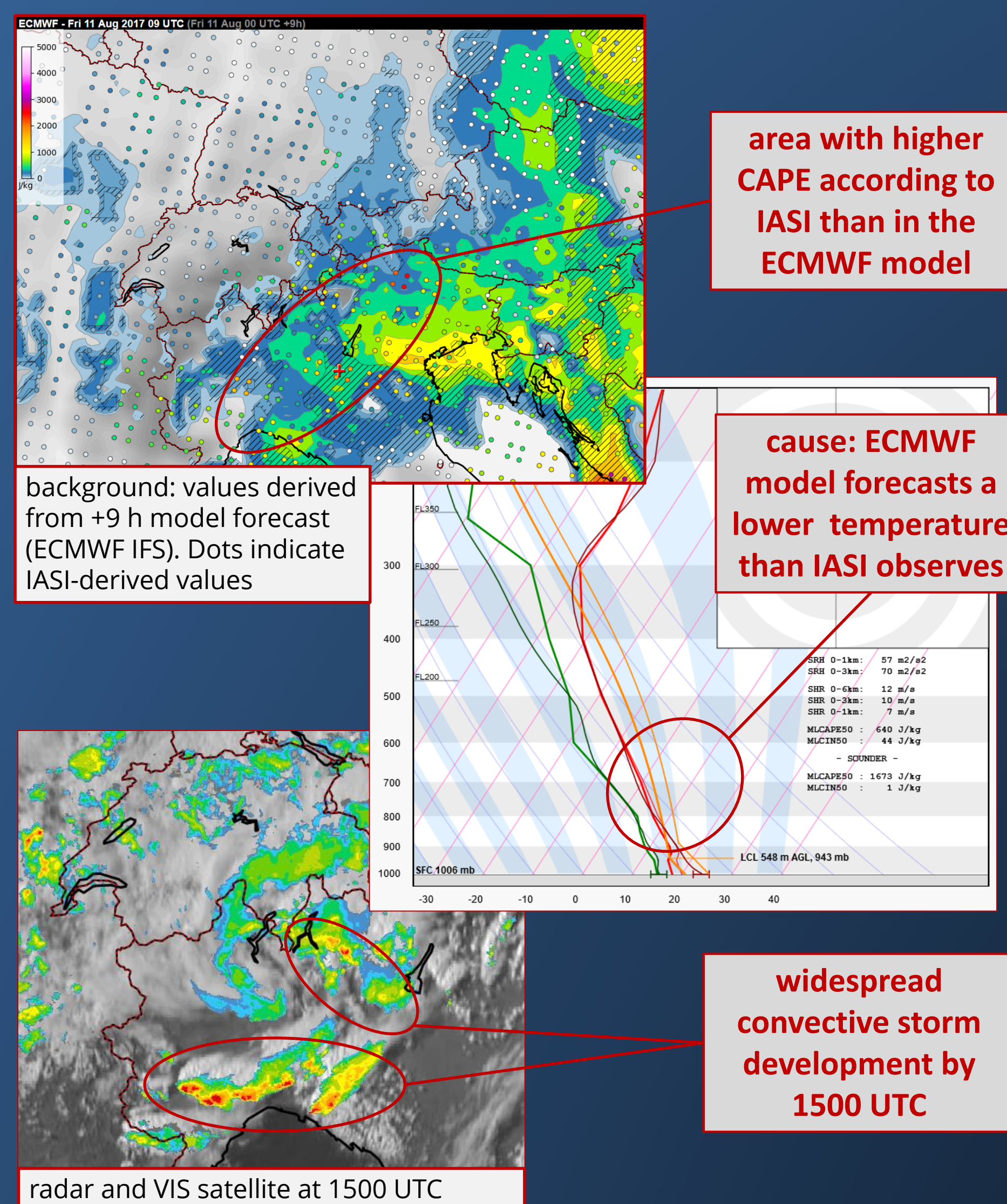
Main conclusions:

- almost all forecasters found the type of data useful

- forecasters would like to have a higher (spatio-) temporal availability

- IASI profiles should stay completely independent of the model data

- forecasters found greatest discrepancies between IASI and NWP in the near-surface humidity

- preferred parameters are
  - CAPE
  - lapse rates
  - precipitable water

Preferred IASI-derived parameters according to Testbed participants

% mentioning parameter

CAPE   Lapse rate   Precipitable Water   Dew point profile   Temperature profile   CIN   Humidity near surface

Studies of past cases

ESSL is evaluating the potential of IASI by evaluating past cases of severe convection that were impactful or not well anticipated by NWP models. An example is provided below:

ECMWF - Fri 11 Aug 2017 09 UTC (Fri 11 Aug 00 UTC +9h)

area with higher CAPE according to IASI than in the ECMWF model

background: values derived from +9 h model forecast (ECMWF IFS). Dots indicate IASI-derived values

cause: ECMWF model forecasts a lower temperature than IASI observes

widespread convective storm development by 1500 UTC

radar and VIS satellite at 1500 UTC

Operational IASI
now available!
Infrared Atmospheric Sounding Interferometer

- flies on polar satellites Metop-A/-B/-C launched 2006, 2012, 2018

- has a pixel size of 12 km at Nadir – 2000km swath

- Two overpasses per day across central/southern Europe, in the morning and evening

- More frequent overpasses in northern Europe

IASI-NG
coming soon…
IASI-Next Generation

- will have the same coverage but **improved** sounding performance
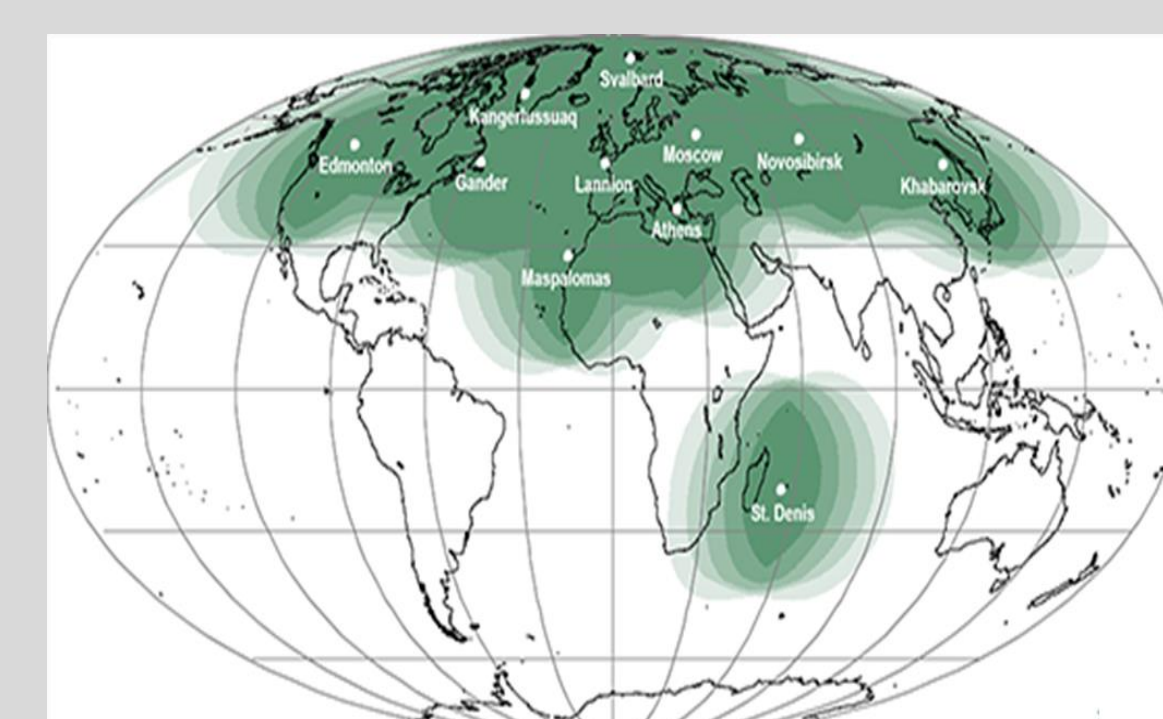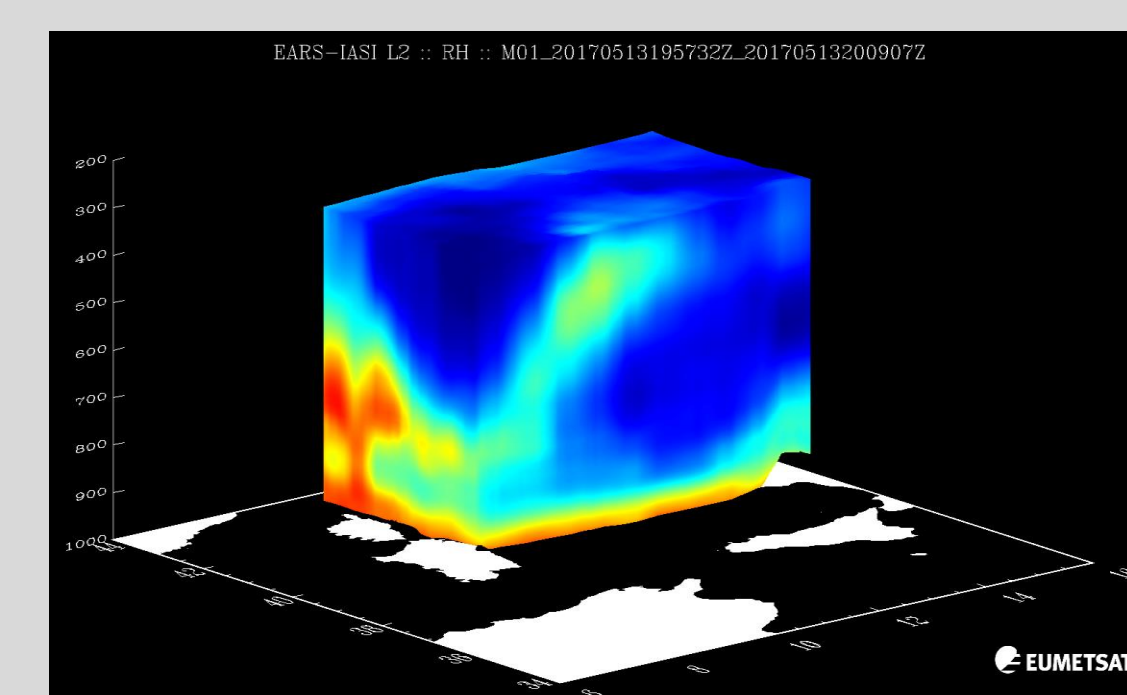
MTG-IRS
coming soon…
Meteosat Third Generation – InfraRed Sounder

- will fly on the geostationary Meteosat Third Generation

- Similar sounding data to IASI, but **every 30 min** and with a pixel size of **7 km**

The first MTG sounder satellite is scheduled to be launched in **2023**.

EARS – IASI service
now available!

The EARS-IASI level 2 service is routinely providing temperature and humidity sounding from IASI within 30 minutes maximum from sensing. The products are available through the EUMETCast service, for the areas covered by the local receiving stations of the EARS-IASI network. The products exploit the MW companion instruments, hence data is also provided in most cloudy regions. The retrievals are fully independent from numerical weather forecasts.

3-dimensional retrieved relative humidity

areas covered by local EARS-IASI receiving stations