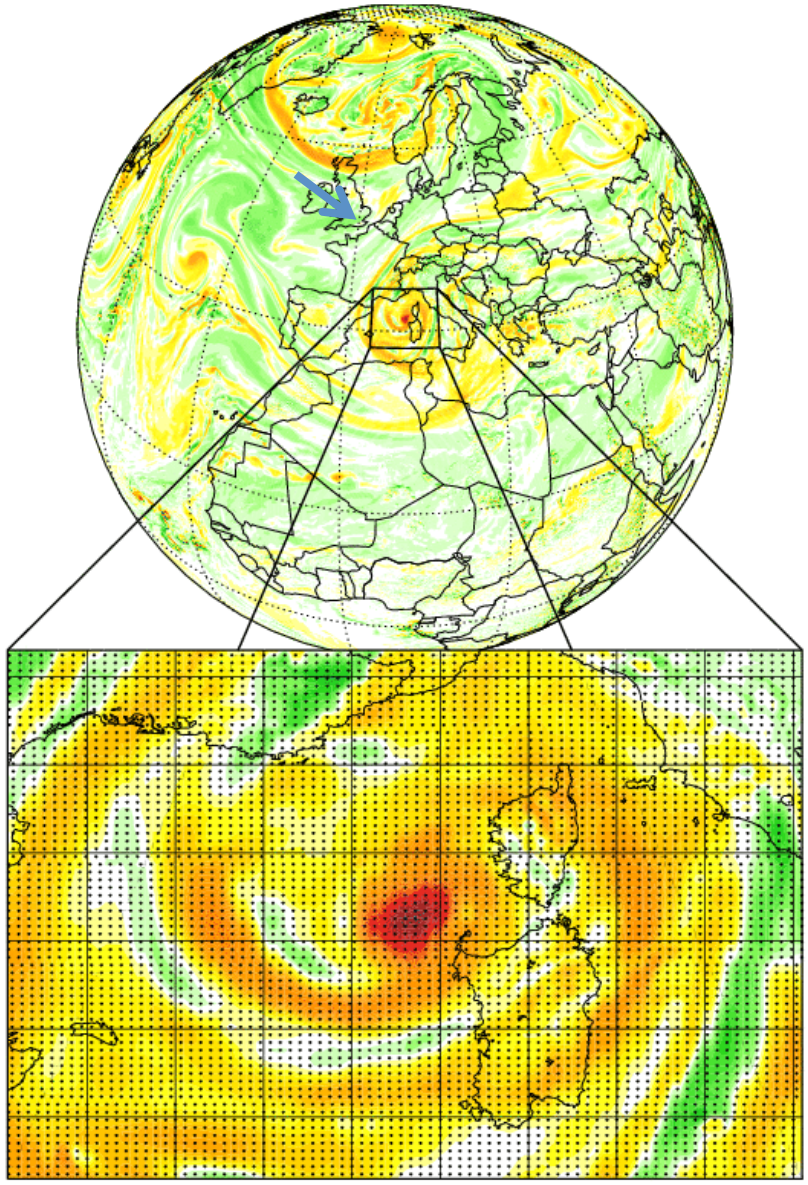
GPM

and

Weather Forecasting



Peter Bauer

European Centre for Medium-range Weather Forecasts

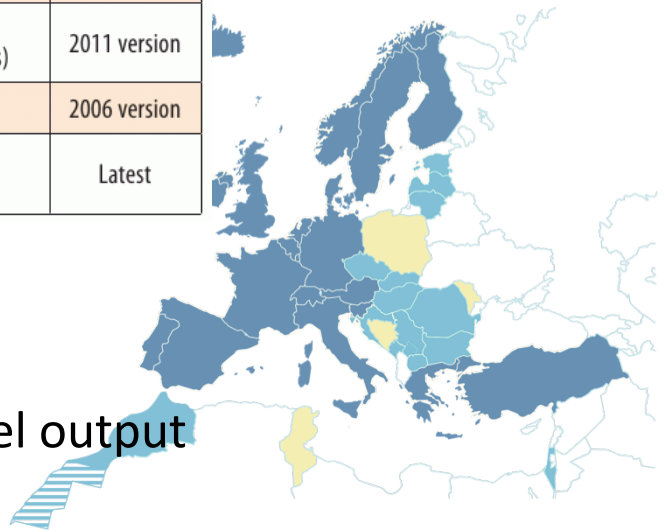
Reading, UK

ECMWF

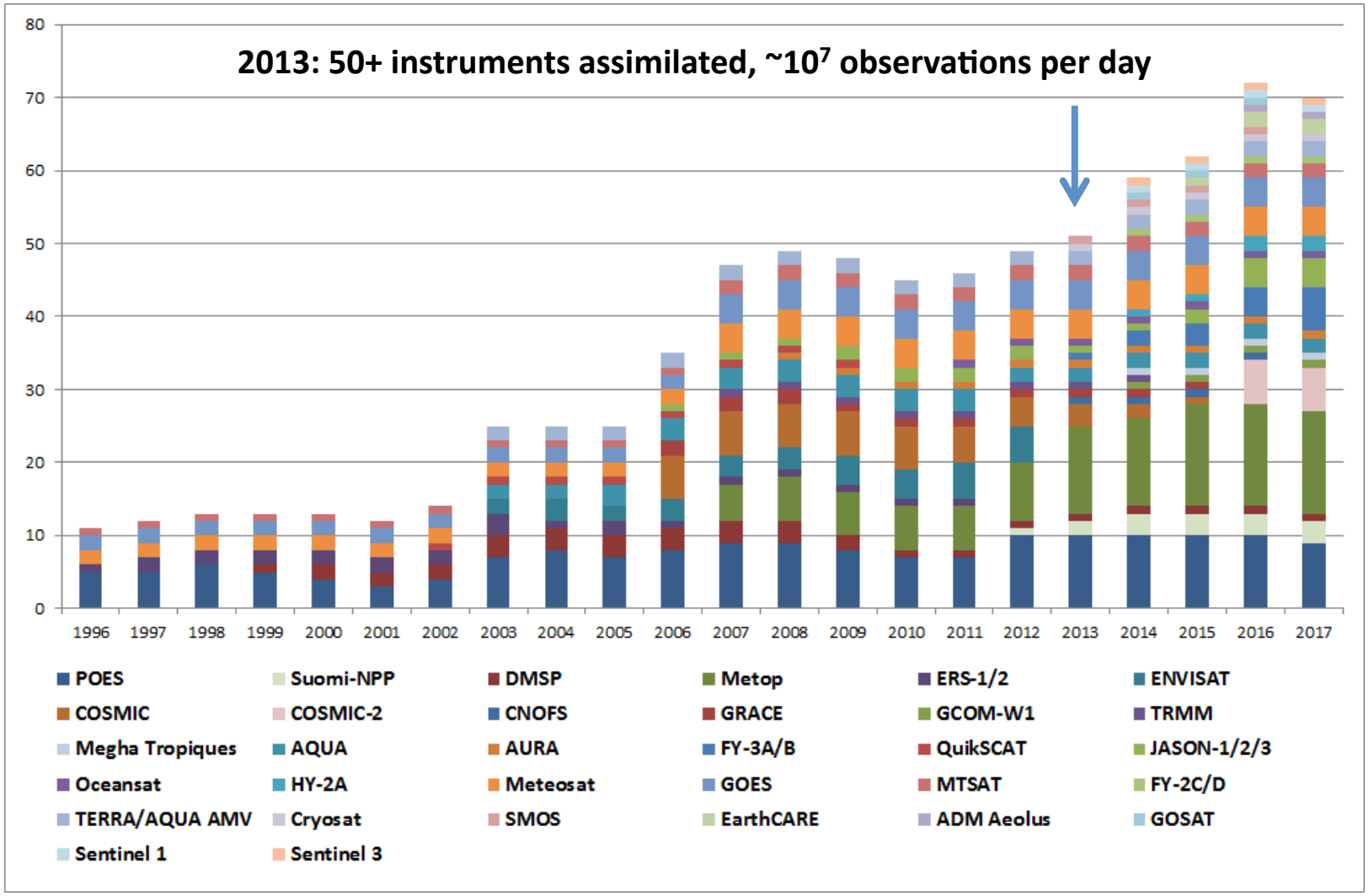
- An independent intergovernmental organisation; established in 1975
- 20 Member States, 14 Co-operating States, 45 M£ annual budget (staff:HPC)
- 270 staff (110 RD, 55 CD, 65 FD, 40 AD)

	Forecast/Analysis	Number of members	Horizontal resolution	Vertical levels and pressure at model top (hPa)	Perturbation models	IFS cycle
HRES	Forecast 0–10 days	1	T1279/16 km	L137/0.01	No	Latest
ENS	Forecast 0–10 days	51	T639/32 km	L91/0.01	Yes (in analysis and model physics)	Latest
	Forecast 10–32 days		T319/64 km			
4DVAR	Analysis	1	T1279/16 km (T255 inner loops)	L137/0.01	No	Latest
EDA	Analysis	11	T399/50 km (T159 inner loops)	L137/0.01	Yes (in observations and model physics)	Latest
SEAS	Forecast 0–13 months	51	T255/80 km	L91/0.01	Yes (in analysis and model physics)	2011 version
ERA	Analysis	1	T255/80 km	L60/0.1	No	2006 version
BC	Forecast 0–90 hours, hourly output	1	T1279/16 km	L137/0.01	No	Latest

- No regional systems
- No warnings issued
- Only limited value adding applied to forecast model output

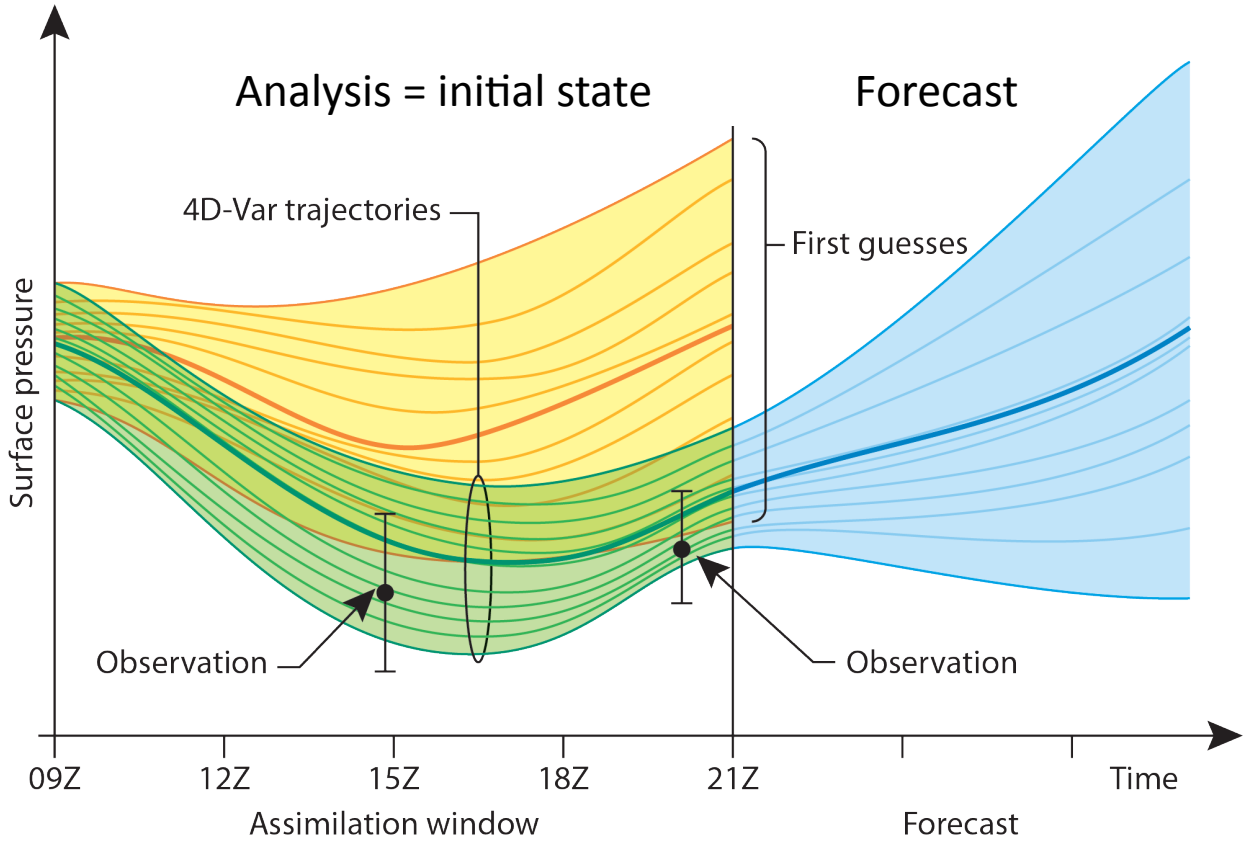


Assimilated satellite data



… and GPM

Data assimilation system



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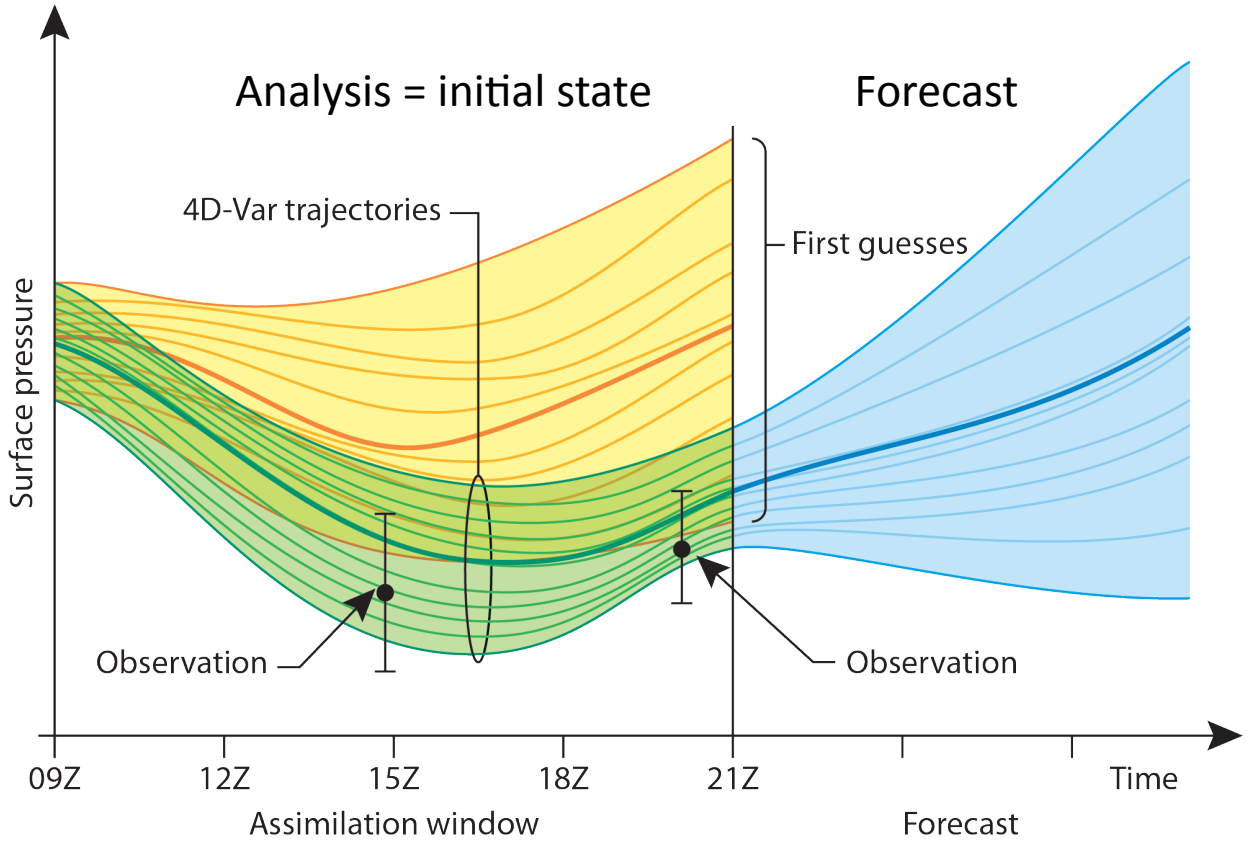
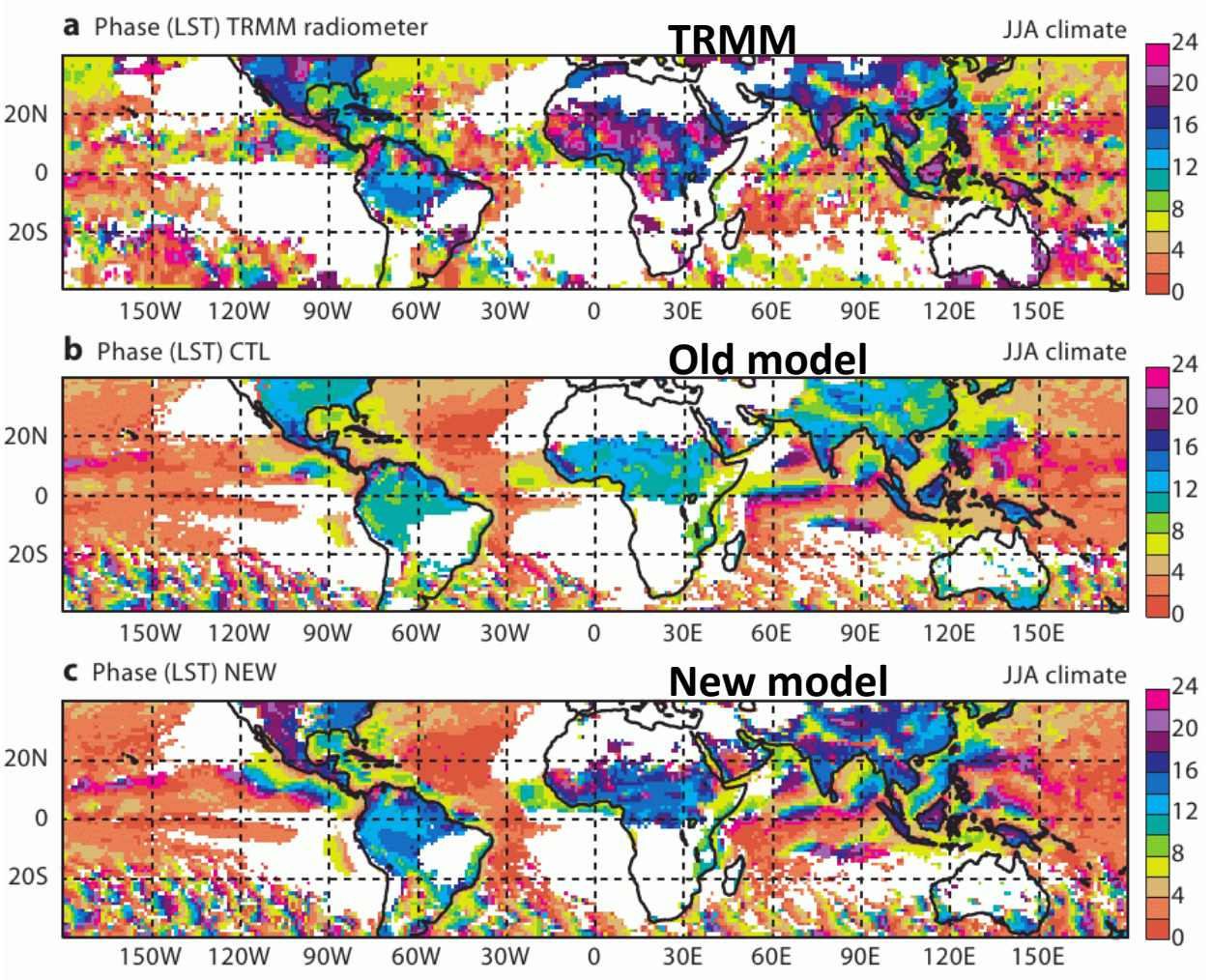


- 95% of all data is assimilated as radiances (i.e. level-1)
- 100% of cloud/precipitation satellite data is assimilated as radiances (i.e. level-1*)
- Cloud/precipitation assimilation:
  - Operational since 2005 with major upgrades in 2009, 2011, 2013
  - 8 years of development time x 2-3 FTE

(* with SSM/I, TMI, SSMIS, ASMR-E, AMSR2)

Verification of model forecasts with TRMM



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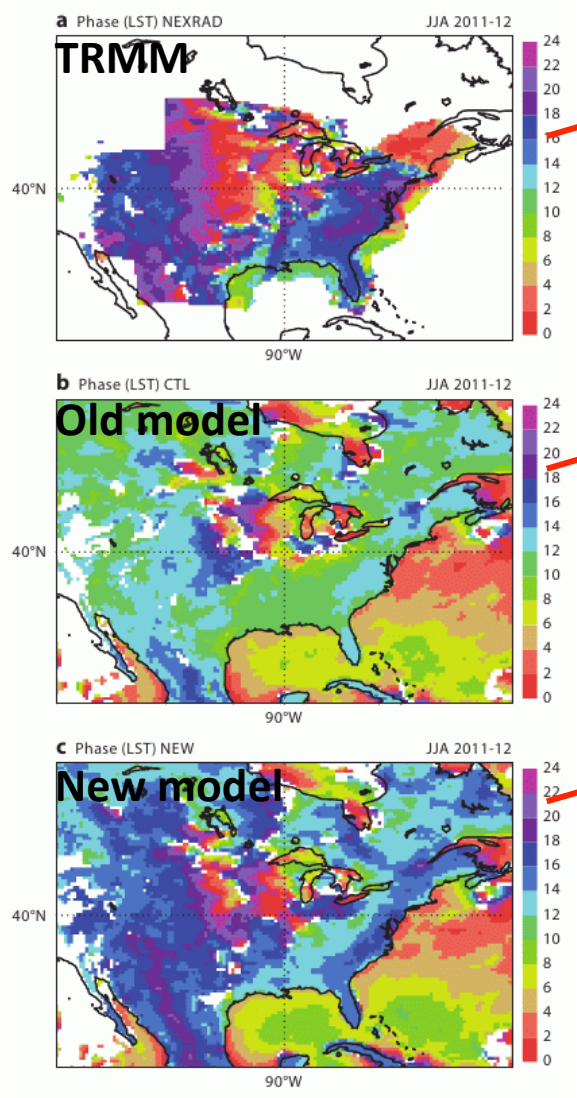
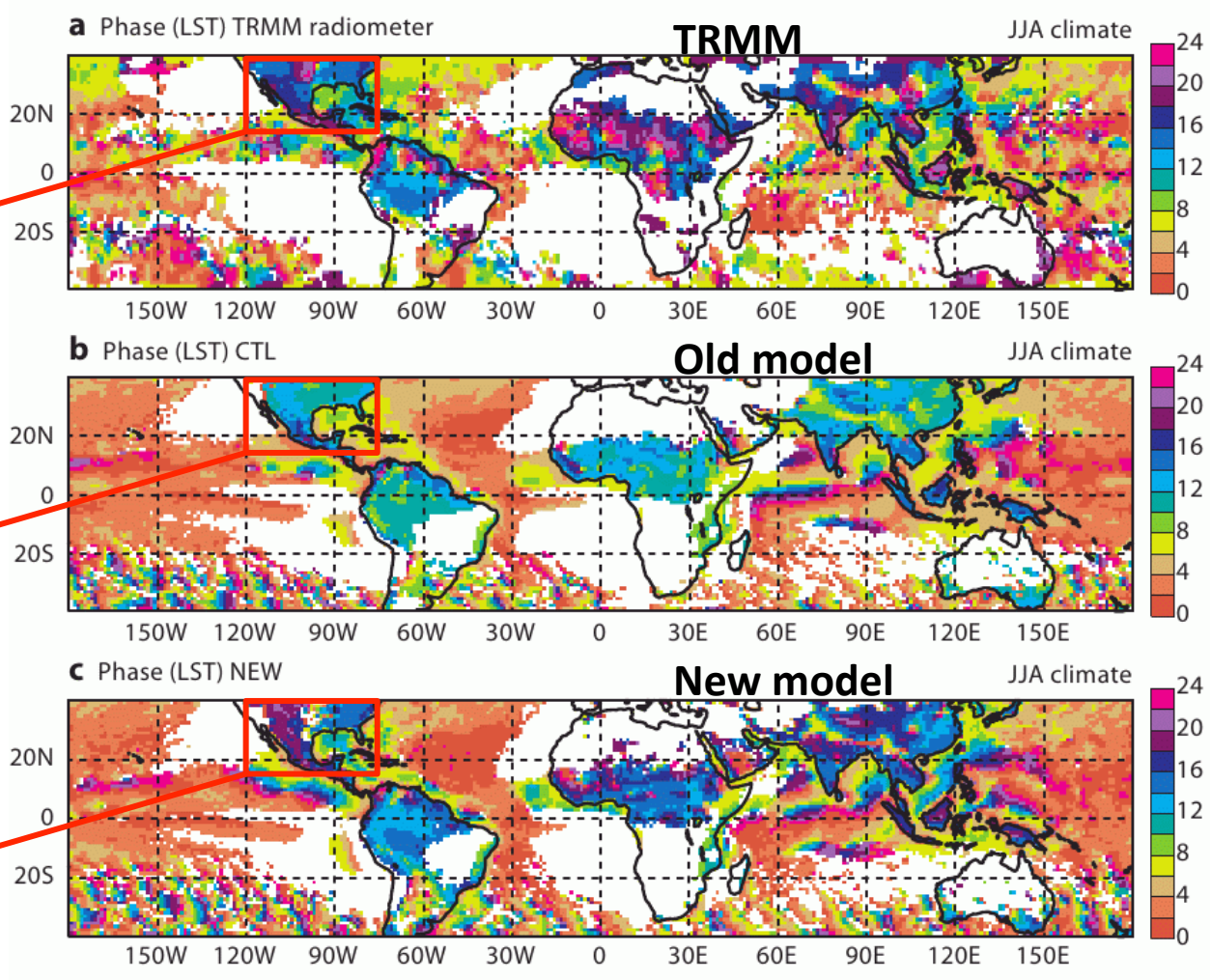
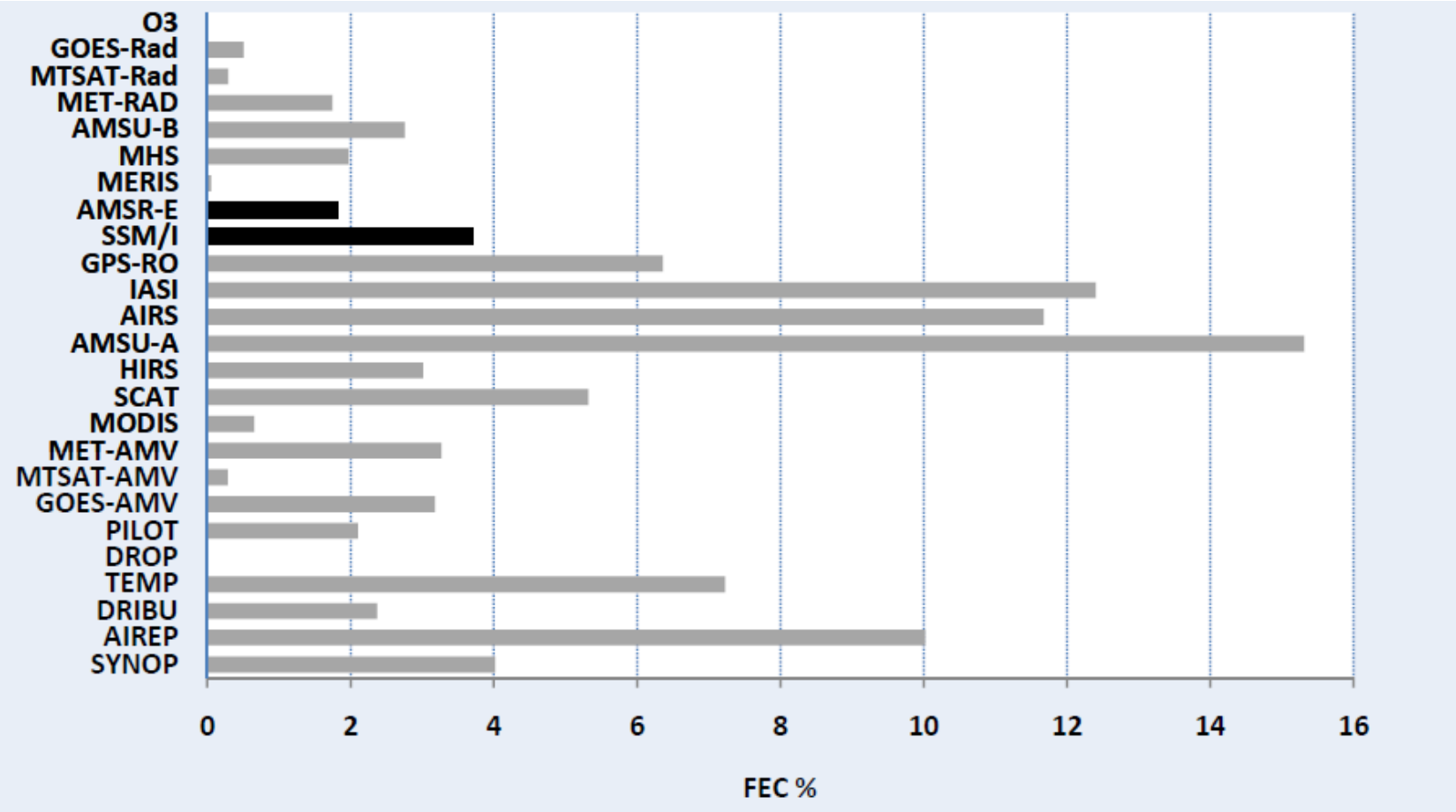




Data impact on forecasts: Average



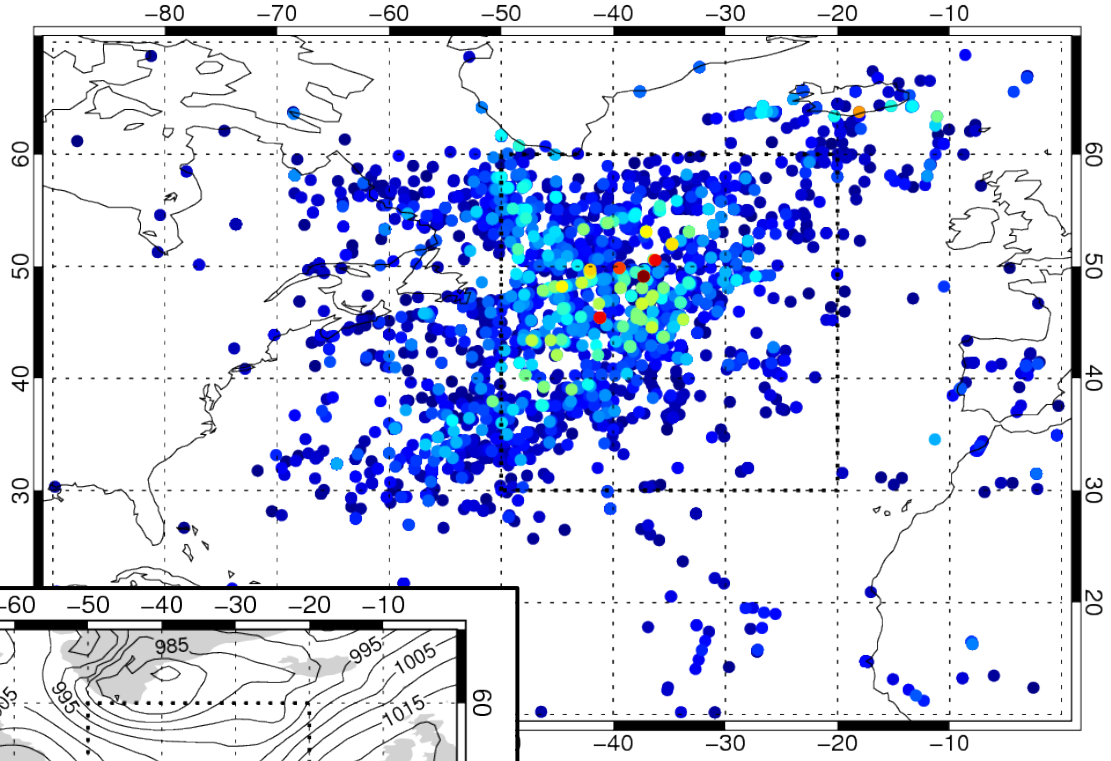
- AMSU-A currently most important single observing system (5 satellites)

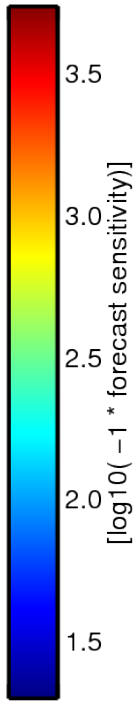
= fct. (data volume, single observation impact, synergy with others)

- **Microwave imagers most important instrument for lower tropospheric moisture!**

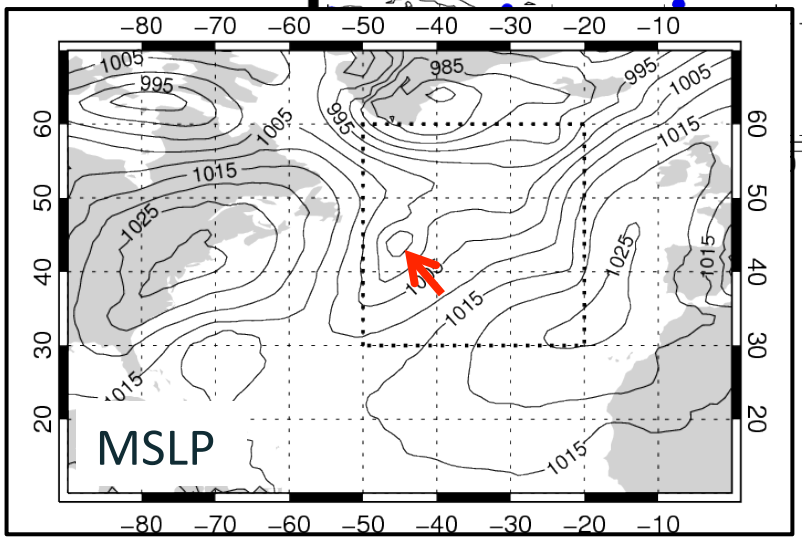
Data impact on forecasts: Case North Atlantic storm

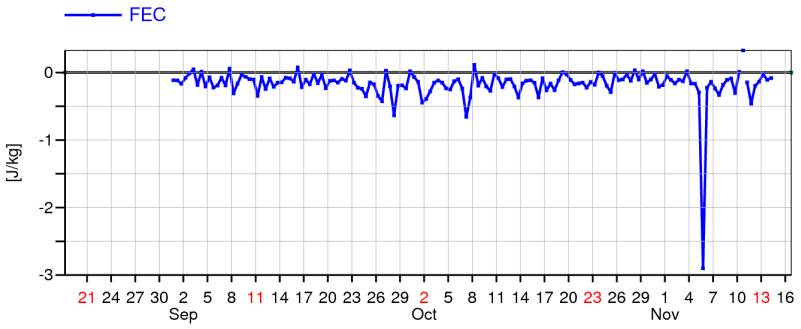
All observations from which Forecast Error Reduction < -20 kJ/kg





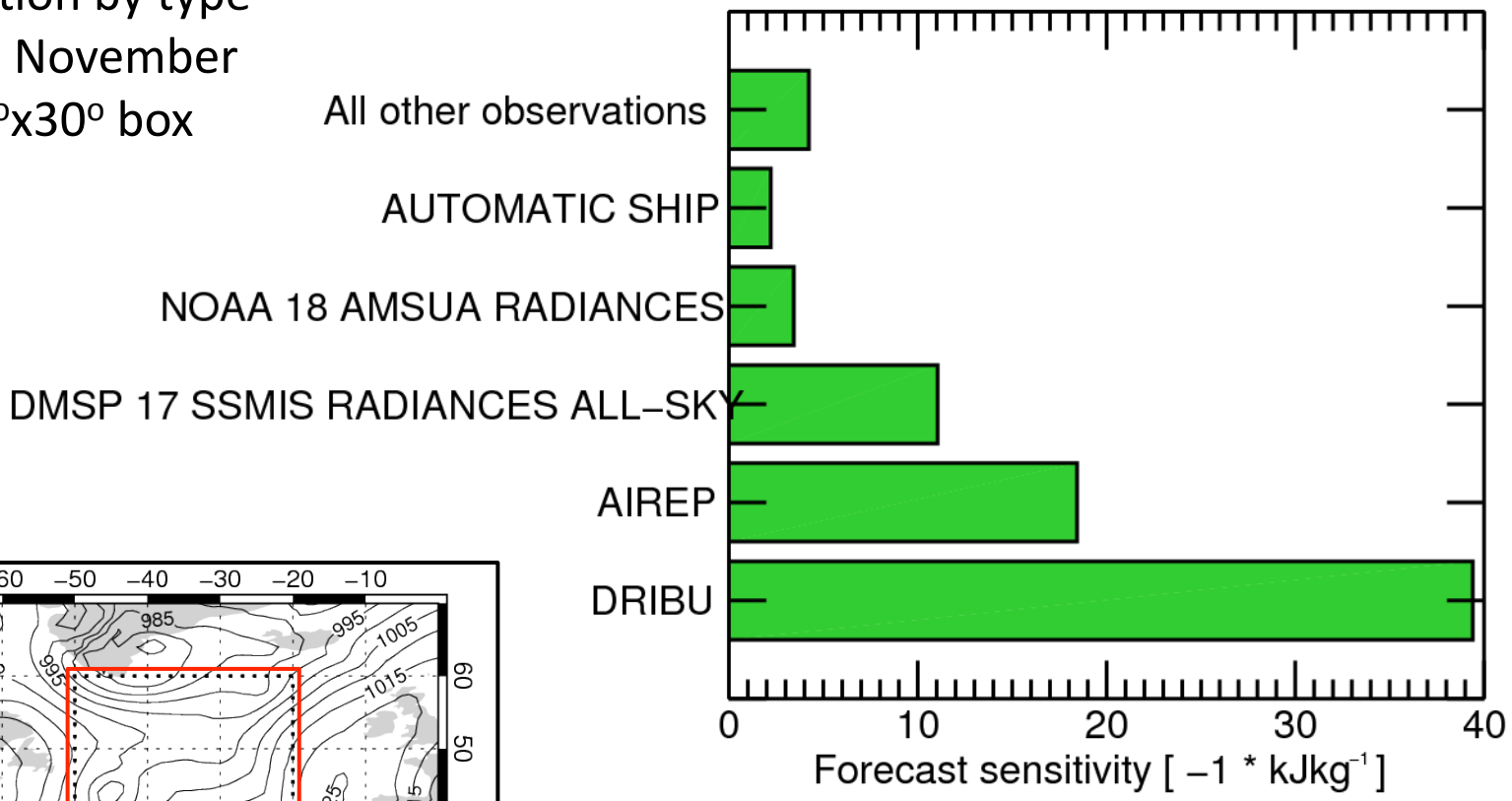
FEC: Log-scale

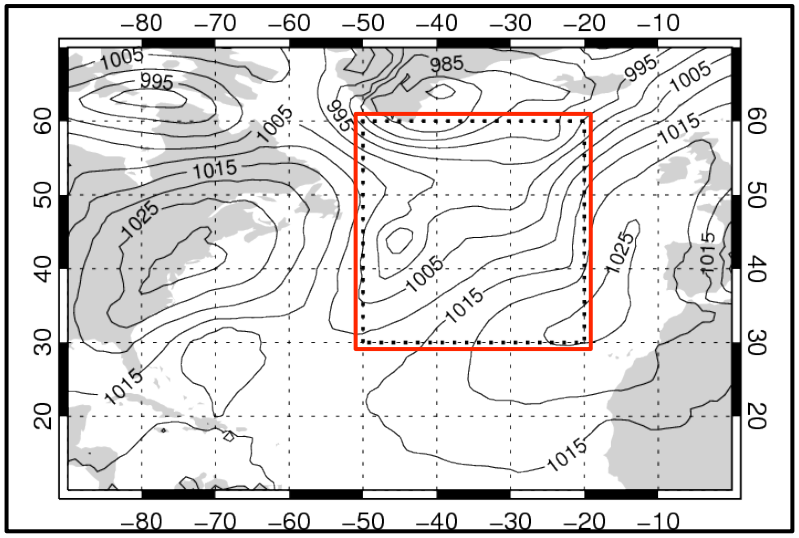




Data impact on forecasts: Case North Atlantic storm

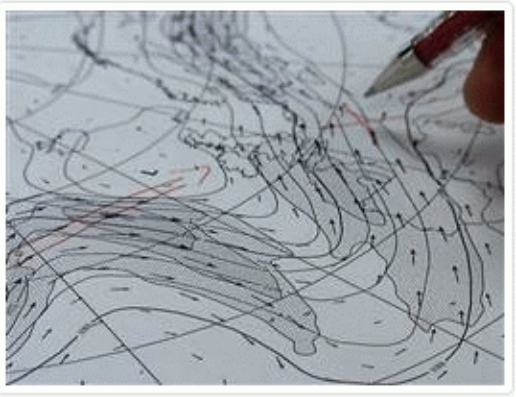
FEC-contribution by type for analysis 6 November 00 UTC in 30°x30° box





MSLP

Sandy



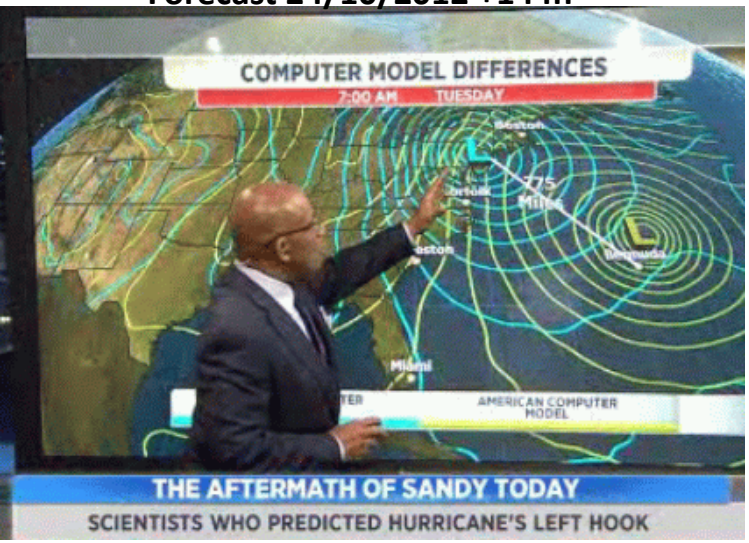
TODAY | Aired on October 31, 2012

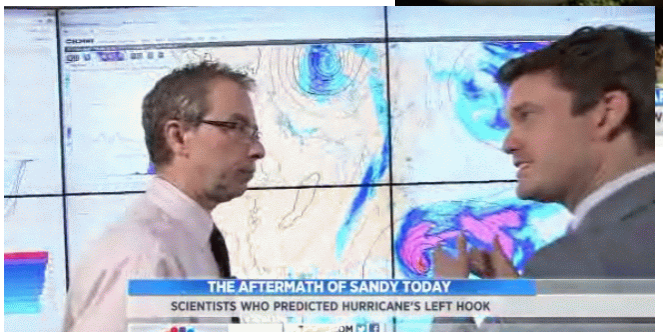
British meteorologists predicted Sandy's course

When scientists at the European Weather Centre in England saw a cold front from the north joining with a hurricane to send it into the northeast, they'd rarely seen anything like it. Without their forecasts over a week ahead of time, the human outcome could have been worse. NBC's Keir Simmons reports.

Share This:

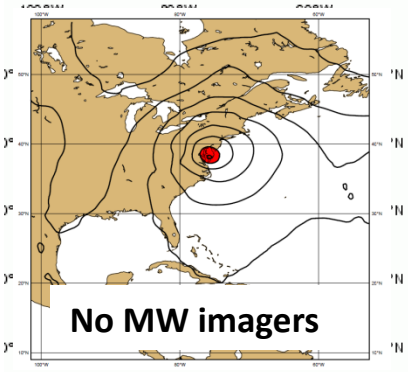
Forecast 24/10/2012 +144h

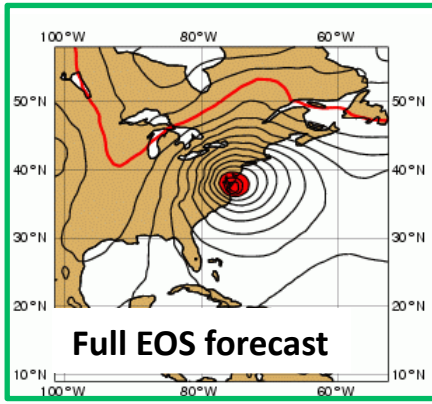


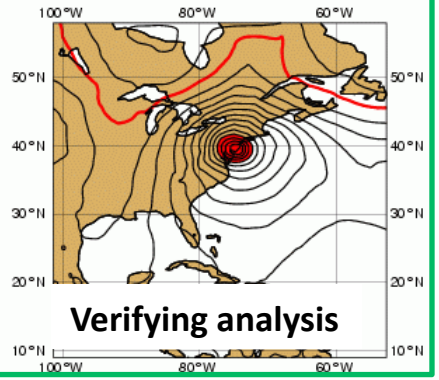


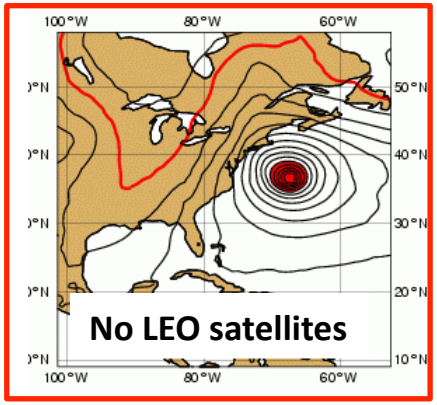
http://intra.ecmwf.int/publications/cms/get/weekly_news/2012-11-02

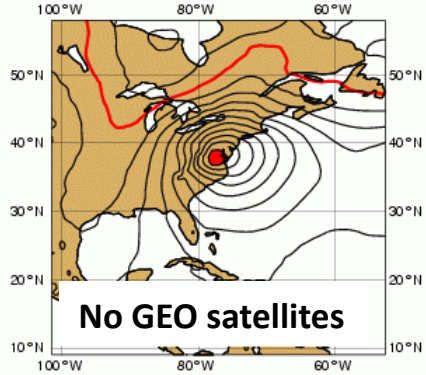
Data impact on forecasts: Sandy

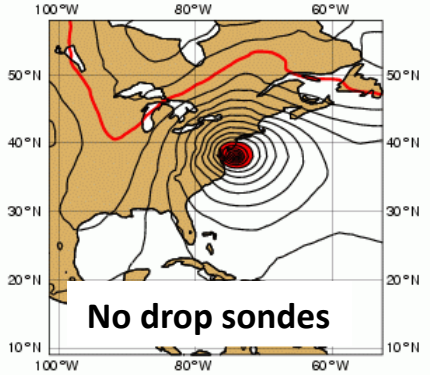


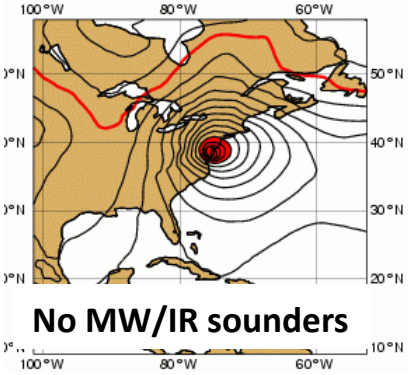


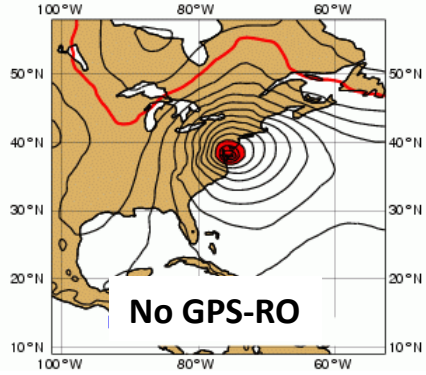


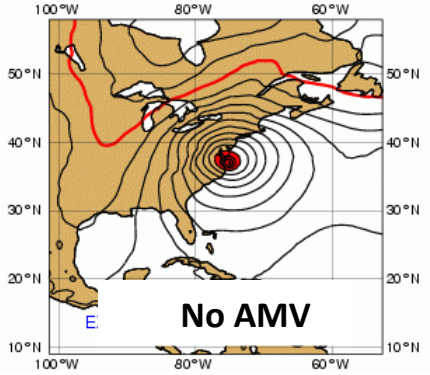




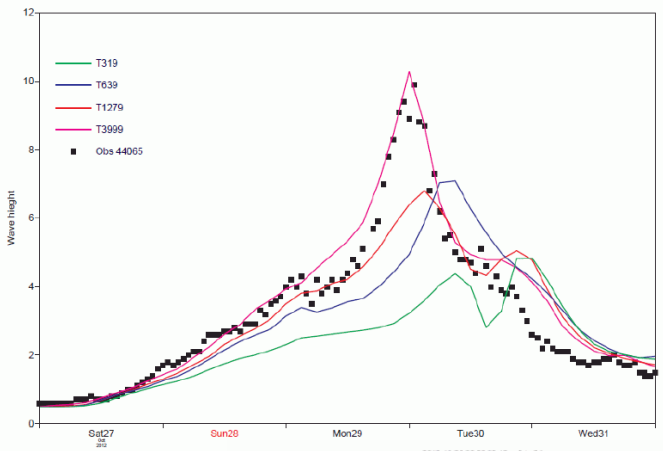


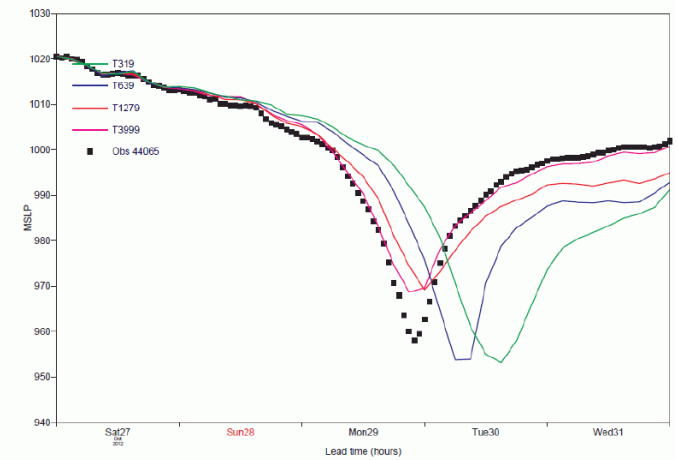




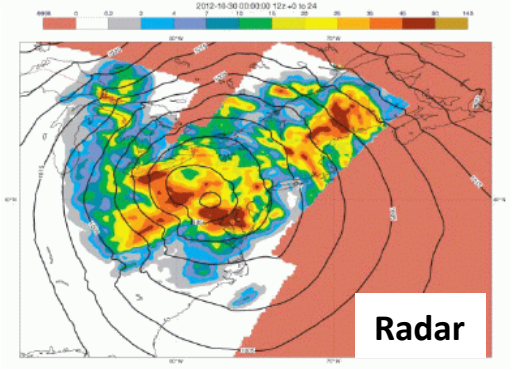


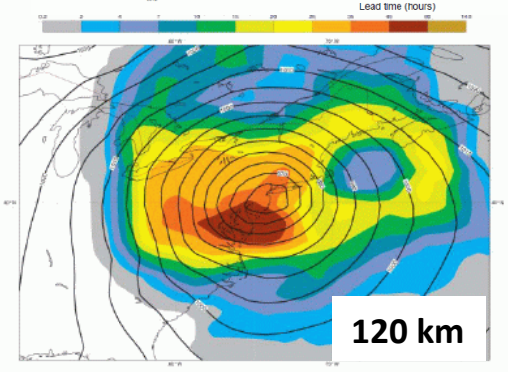
Model impact on forecasts: Sandy

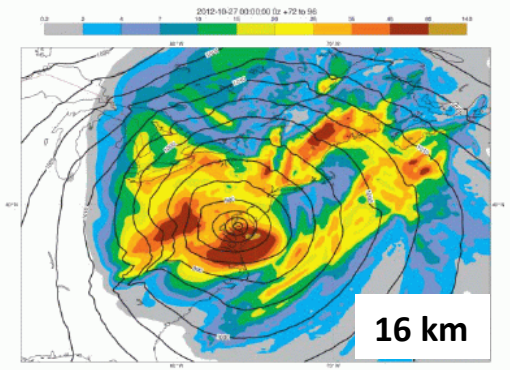


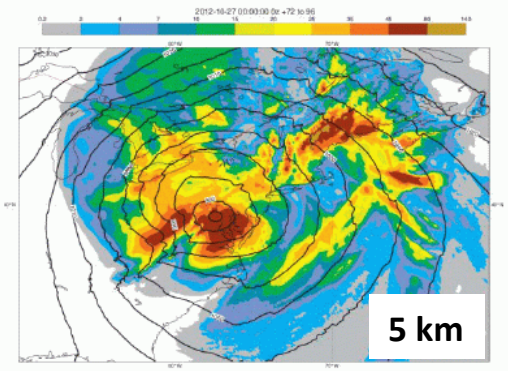


20121030 12 UTC









Future

NWP systems:

- Improved hybrid data assimilation to produce optimal analysis (initial state) + uncertainties
- Resolutions of 10 km in 2015, 5 km in 2020, 2.5 km in 2025
- Coupling with ocean/sea-ice/atmospheric composition (model and assimilation)
- Better characterisation of observation + model errors
- Computer codes that scale on massively parallel HPC

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Satellite data:

- Bulk of data as level-1 product (radiance, reflectivity, backscatter x-section)
- Increased usage of:
  - Cloud/precipitation/water vapour
  - Aerosol/composition
  - Land surface
  - Snow/ice

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Requirements:

- Continuity of core observation types (sounders, imagers) with sufficient global coverage
- Enhanced **modelling** capabilities for process representation
- Enhanced **observational** capabilities for process studies and verification
- Enhanced data **assimilation** capabilities for optimal data exploitation

→ **Only combination of the above will produce return on investment!**