Using data assimilation to quantify and understand model error

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EUCLIPSE kick-off meeting

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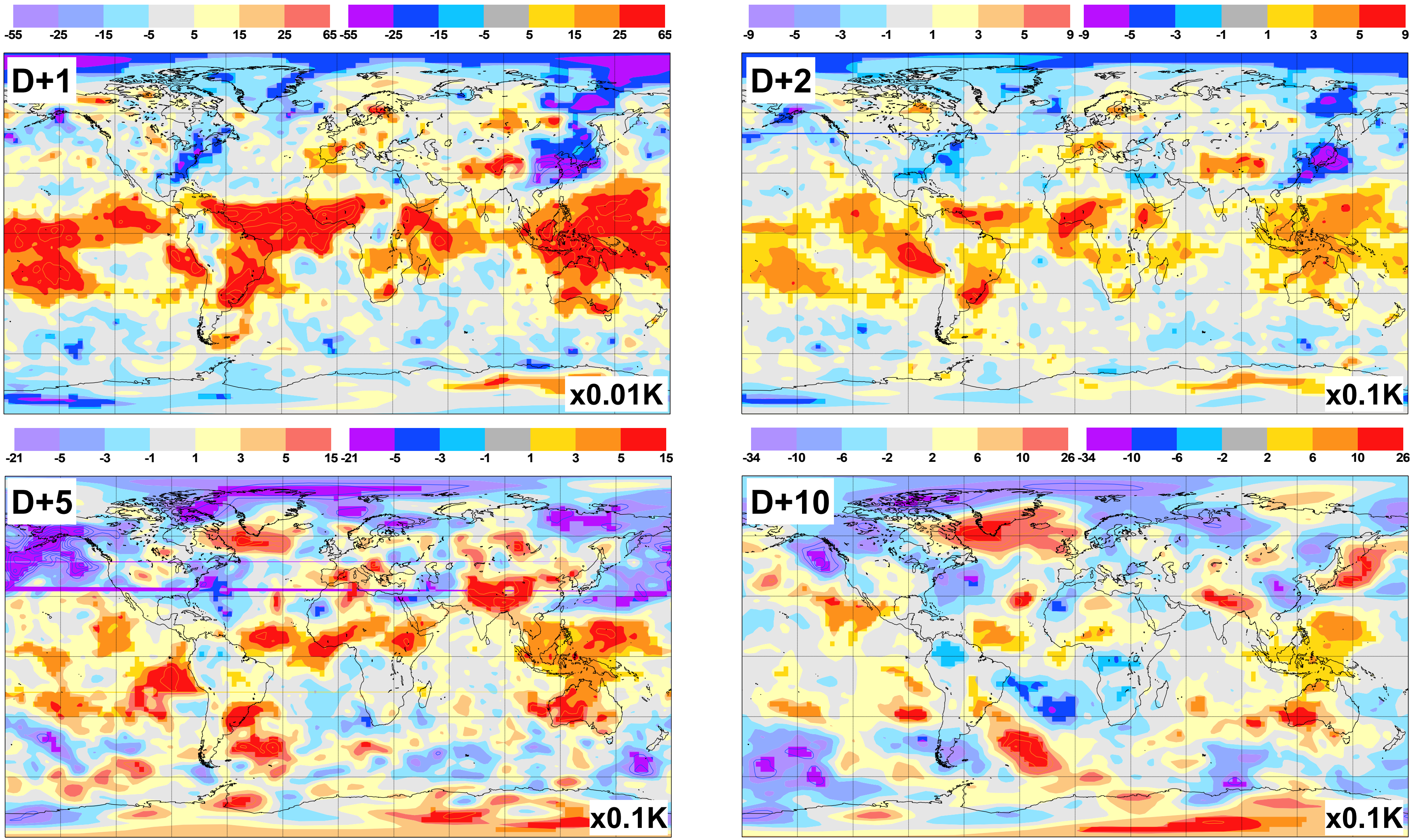
M.J.Rodwell

T500 forecast error as function of lead-time



Based on DJF 2007/8 operational analyses and forecasts. Significant values (5% level) in deep colours.

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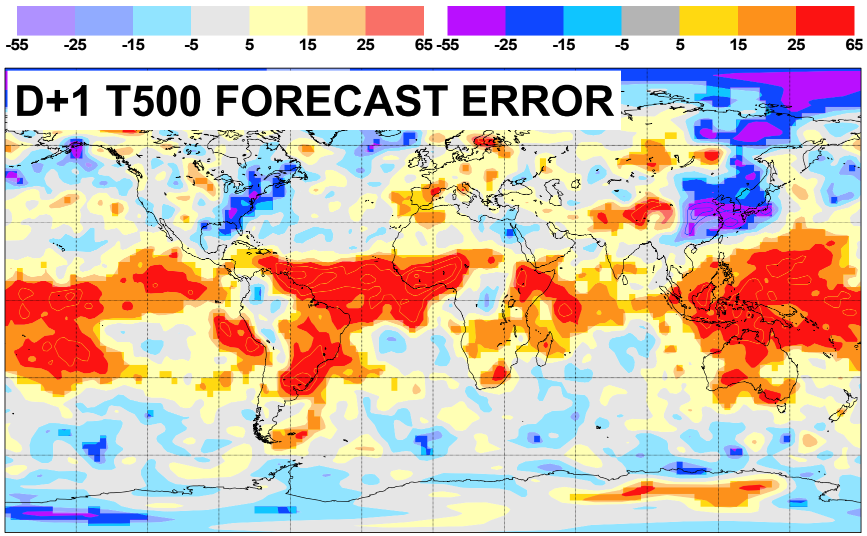
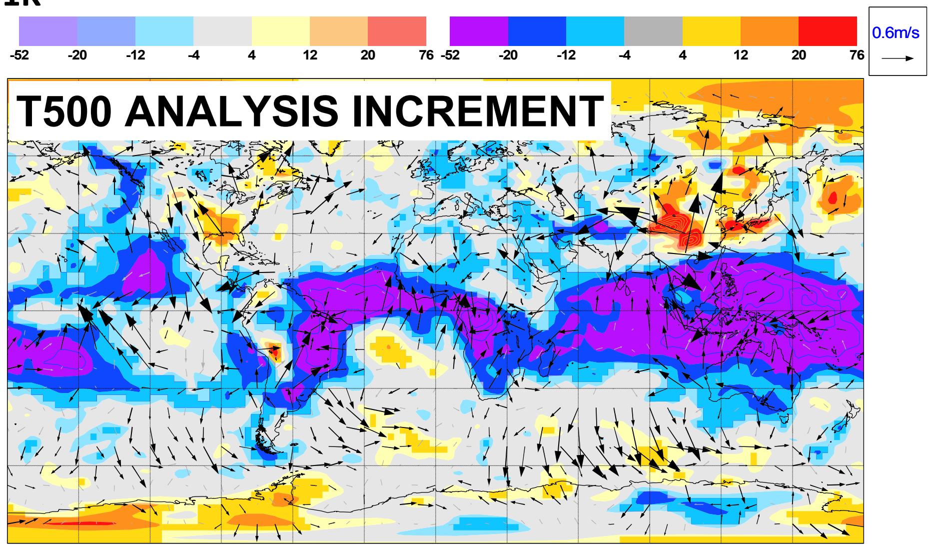
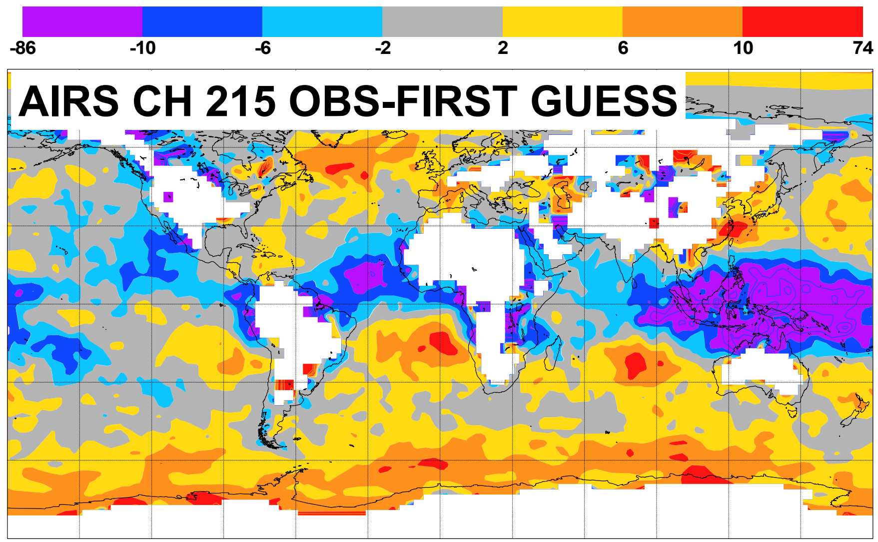
Confronting models with observations

UNIT=0.01K



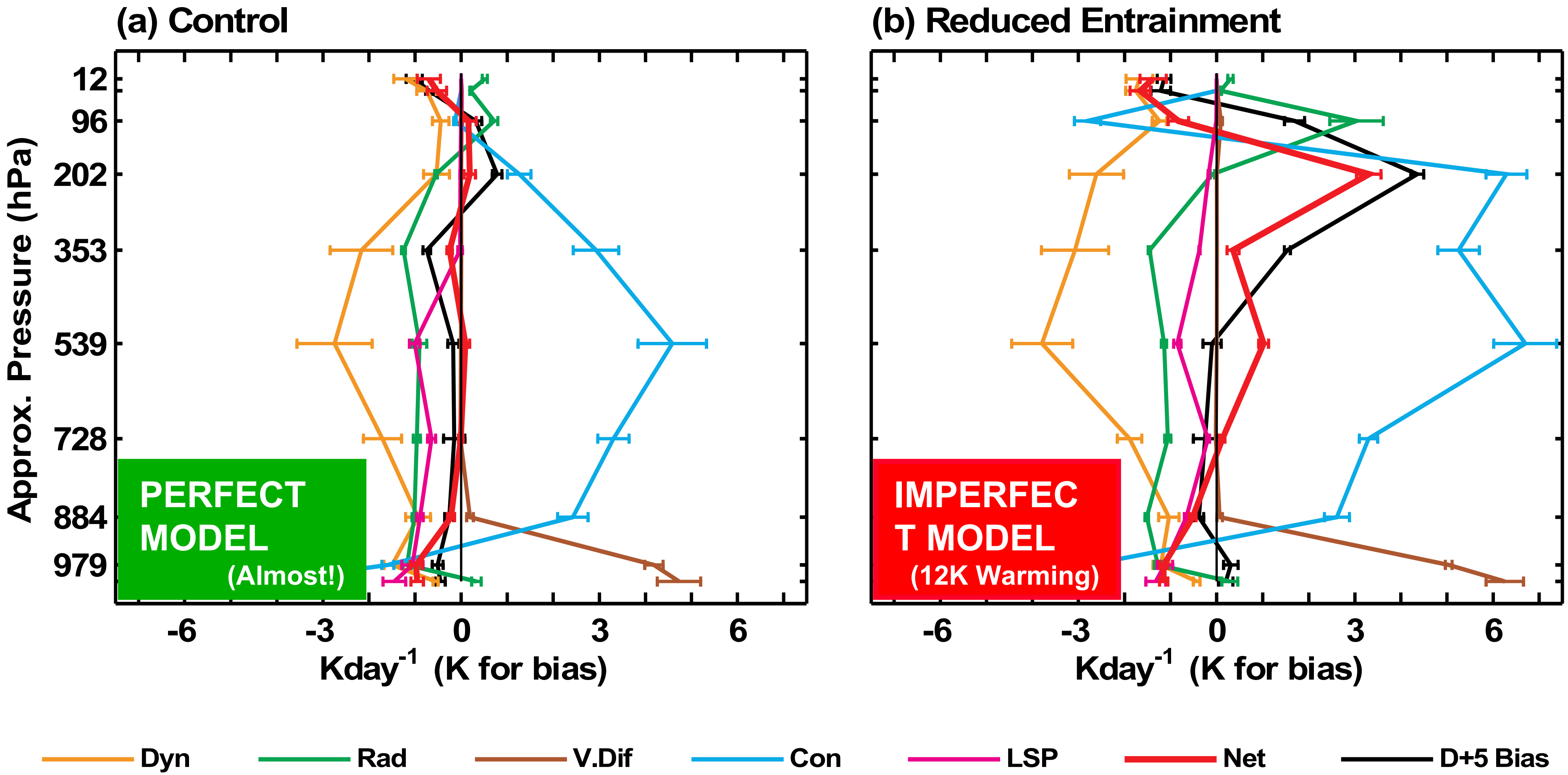


- Every 1° square has data every cycle
  - ~6 Million data values
- Independent vertical modes of information:
  - IASI / AIRS: ~ 15
  - HIRS / AMSUA: ~ 5 (~ 2 IN TROP)
- Anchors (not bias corrected):
  - Radiosonde
  - AMSUA-14
  - Radio Occultation



Based on DJF 2007/8 operational analyses and forecasts. Significant values (5% level) in deep colours.
AIRS CH 215 BRIGHTNESS TEMPERATURE ~T500

Amazon January 2005 initial T tendencies



(Net = Minus the mean analysis increment)

Reduced Entrainment model is out of balance.
Reject or down-weight?

Amazon = [300°E-320°E, 20°S-0°N]. Mean of 31 days X 4 forecasts per day X 12 timesteps per forecast.
70% confidence intervals are based on daily means. CONTROL model = 29R1,T159,L60,1800S.

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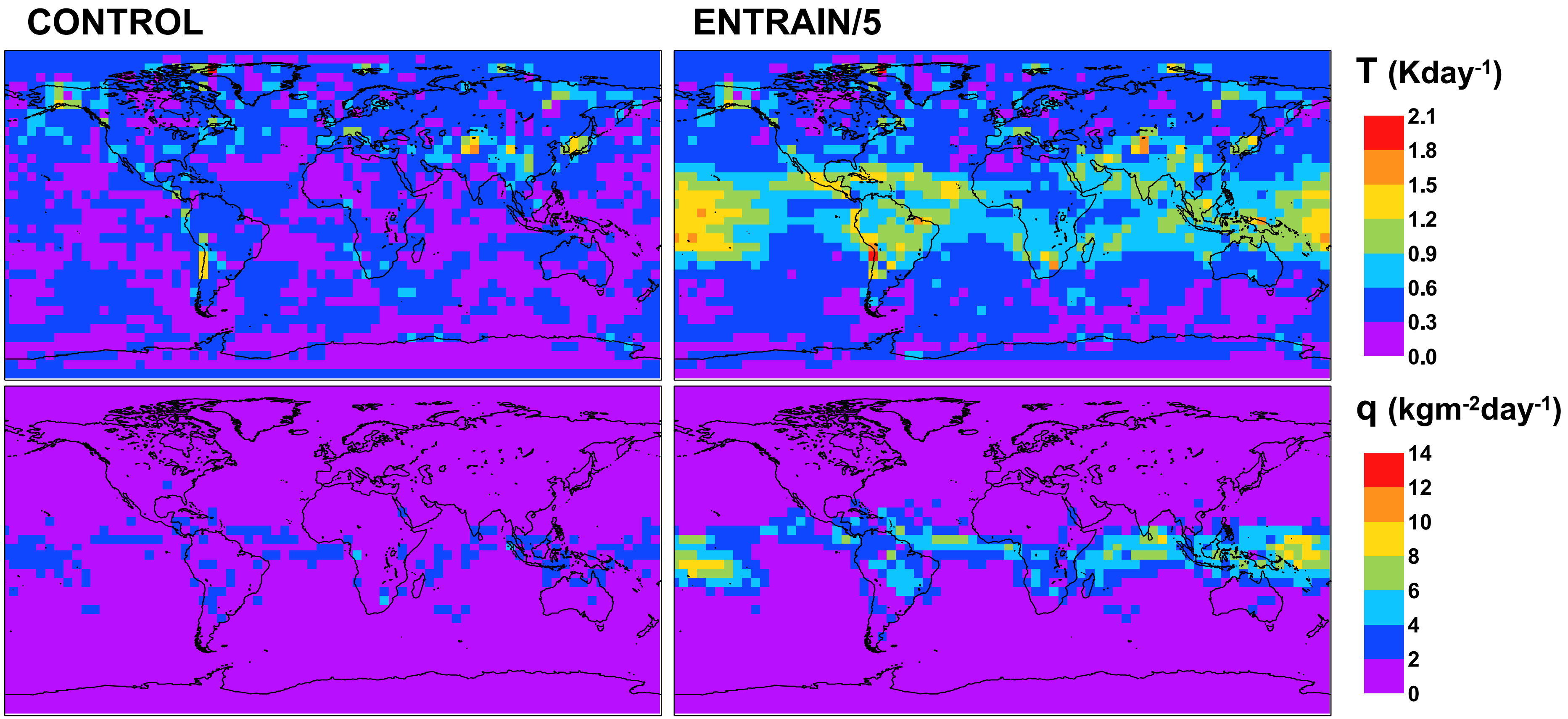
Vertically integrated absolute net tendencies

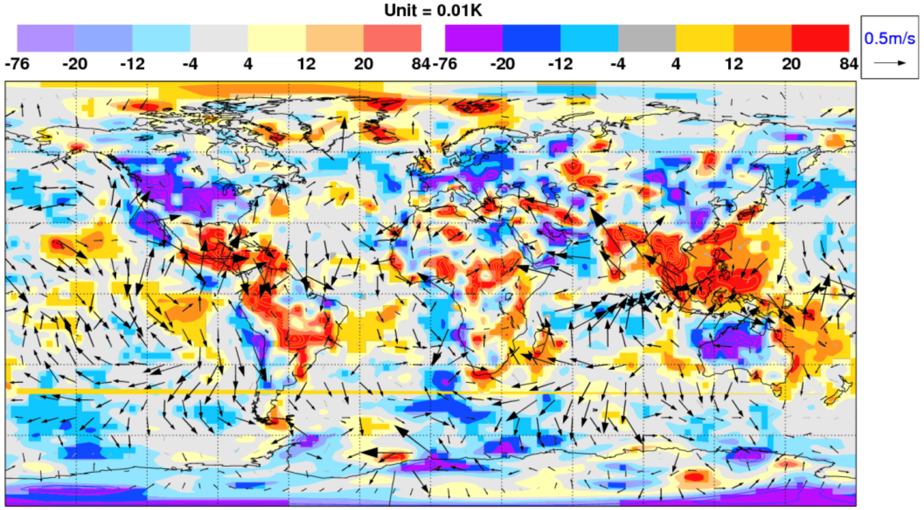


Can be the basis for a "process metric"
(as opposed to the more widely used circulation metrics)

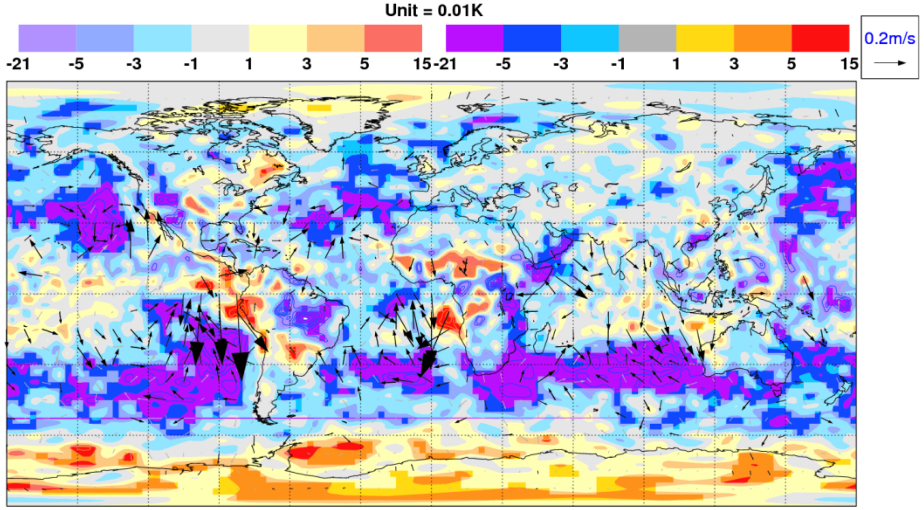
Mean of 31 days X 4 forecasts per day X 12 timesteps per forecast. Mass-weighted vertical integrals.
CONTROL model = 29R1,T159,L60,1800S.

DUALM Boundary-Layer Mass-Flux Scheme

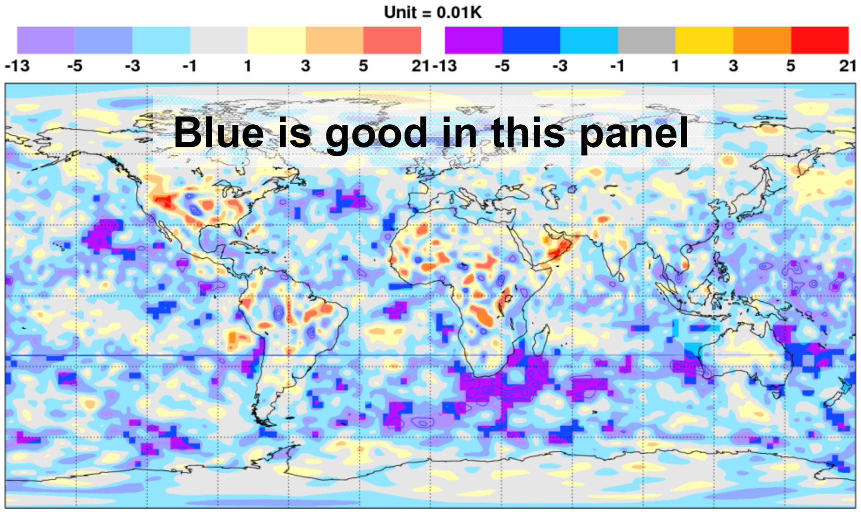
MEAN CONTROL



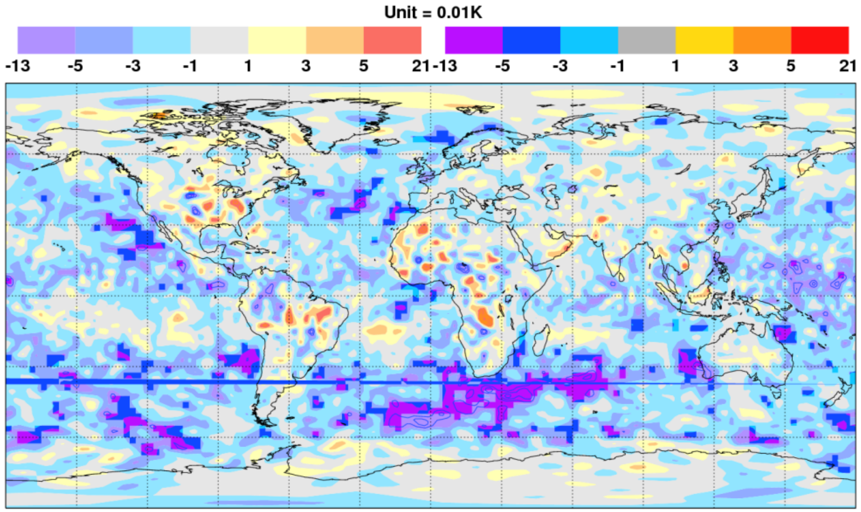
MEAN DUALM-CONTROL



RMS DUALM-CONTROL



STD DUALM-CONTROL



Based on analysis Increments of T1000 20090715 – 20091031. 36R1 with and without DUALM M8.

Future

- Initial tendencies to assess strato-cumulus / DUALM
- Transpose-AMIP to assess strato-cumulus & remote influence of deep convection
- Close collaboration with Physical Aspects Section

ECMWF Vacancy

Consultant (Scientist) position to work in the Predictability and Diagnostics Section on EUCLIPSE Project

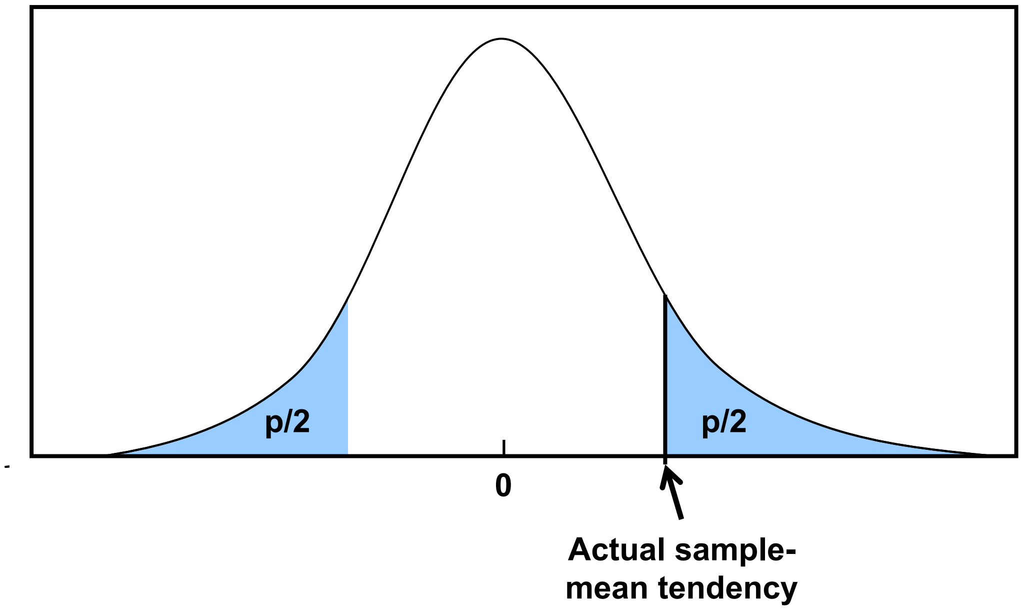
http://www.ecmwf.int/newsevents/employment/en/AP10-29-en.html

Closing Date: 5 November 2010 **Start Date: 1 February 2011**

Extra slides

Weighting models within a perturbed ensemble

pdf of sample-mean tendency for perfect model



Null hypothesis: "model is perfect" (i.e. expected net tendency is zero)

p = probability of incorrect rejection of null hypothesis

p = p(param,x,y,z)

Average p over parameters T,q,u,v,

Vertically integrate

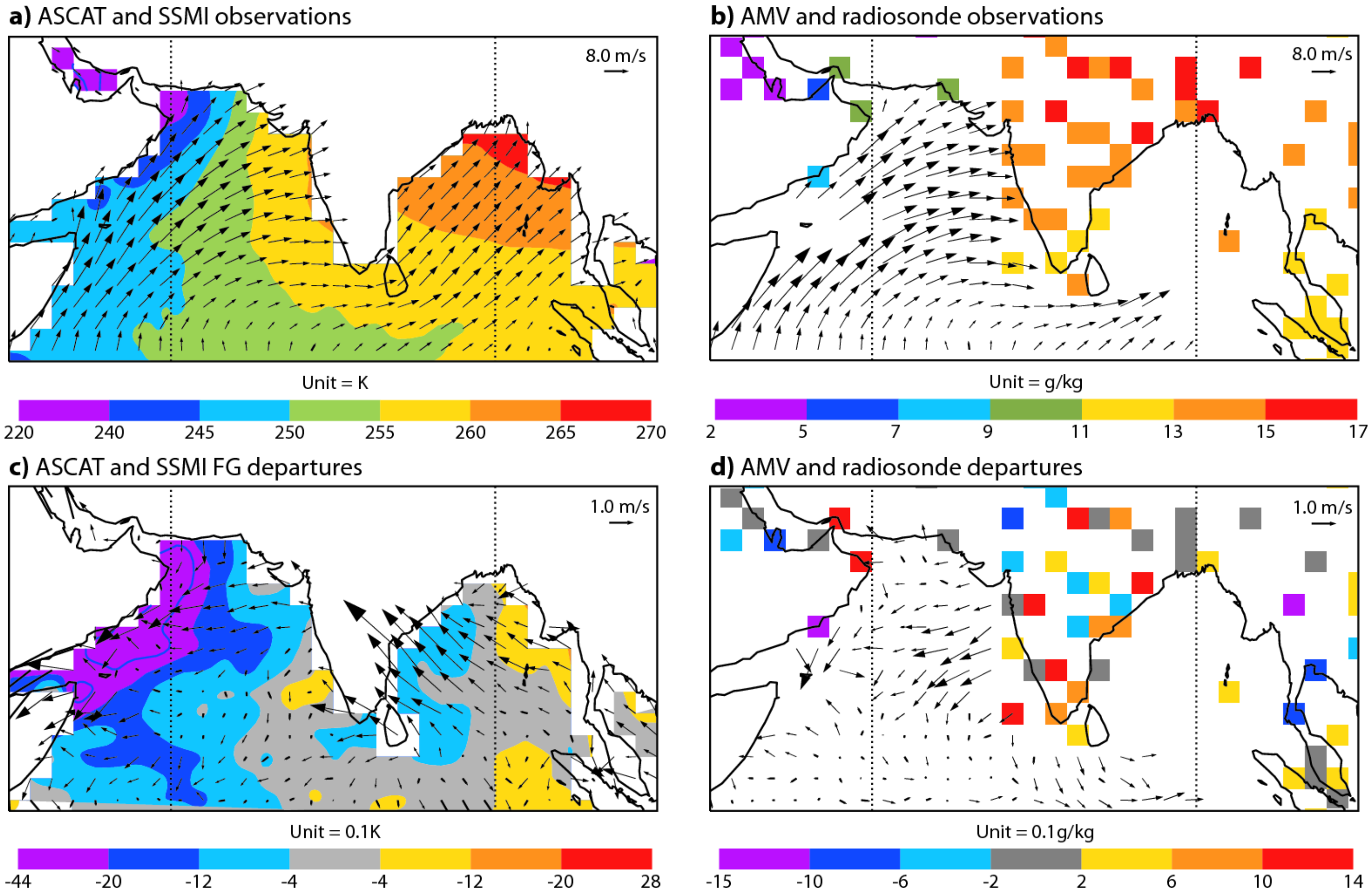
Integrate over tropics and extra-tropics

$p_{PERF} \equiv p_{TROP} \times p_{EX\text{-}TR}$

	Probability that model fast physics is perfect
CONTROL	0.20
ENTRAIN/5	0.12

p is a metric that quantifies how good a model's fast physics (and dynamics) is and could be used to weight models (after being appropriately normalised)

Observations and Departures of low-level v and q



Agreement of departures suggests model issues

Mean JJA 2009 diagnostics of ASCAT surface winds, AMV 950 hPa winds, SSMI brightness temperature (positively correlated with specific humidities at ~850 hPa) and radiosonde specific humidities at 850 hPa