Slide 6

So-called mesoscale anomalies result from the convolution product of the field of interest PSI and a gaussian kernel.  
This orocedure is defined as high pass filtering, and it isolates the contribution of scales approximately smaller than sigma here, basically the width of the gaussian.  
So lets take for example an SST map (show image now) you can somehow already distinguish colder areas from warmer ones, but its with the high pass filter that differences arise and are much more visible. (SOTTOCAMPIONAMENTO HA SENSO COME È STATO COSTRUITO NELLE SEZIONI VERTICALI?)

*Starting from slide 7*

Slide 12 - 9

At the same time we would like to understand how surface moisture is modulated by changes in SST, because the sensitivity of the moisture term in the LHF formulation is part of the total LHF sensitivity.

again we look at the large scale behaviour in 2m water vapour mixing ratio: the resulting coefficient is well in accord, even if with large uncertainties, with the CC scaling, this means that the large scale atmosphere can adjust to moisture changes keeping the RH constant.

Whereas corresponding anomalies really seem not to be constrained by SST at all! Changes in surface fluxes are thus all concentrated in the Clausius-Clapeyron scaling!

Moreover, out results point to the fact that surface moisture is possibly set by different forcing terms.

Slide 13 - 10

To address this point we thought of an idealized, homogeneous MABL subject to surface fluxes only and computed the time scale necessary for the atmosphere to adjust to such fluxes: it turns out that the atmosphere would saturate water vapour much faster than it would adjust thermally!

But since the atmosphere does not saturate, there must be some additional flux that is drying up the BL: we conclude that dry entrainment fluxes from the top of the BL can oppose surface evaporation fluxes and thus set the moisture concentrations.

Slide 14 -- 11

Then similarly to what done for LHF, we ran the same analysis on sensible heat fluxes and found again a significant enhancement of the link between SST and fluxes.

This time, though, the thermodynamic term of interest is the air-sea temperature difference, rather than the moisture difference as before: mesoscale anomalies imply a stronger thermal contrast simply because the atmosphere cannot catch up somehow with the underlying fast variability of sea surface temperature.

Thus, In the end, how much do the sensitivities of thermodynamic terms that we have just seen contribute to the total coupling with fluxes?

Slide 15 - 12

The violin plots here represent the distributions of the thermodynamic sensitivities in W/m2 , obtained by multiplying the ingredients of LHF that we didn’t consider by the sensitivities that instead we have obtained numerically.

As you can see, median values fully correspond to the sensitivity values of the full fields, both for LHF on the left and SHF on the right:

Slide 16 - 13

Now, let’s take a breath for the last section of the presentation

Until now, We have seen the sole dependence on SST in the SECOND **<to be made first?>** section, how the effect of SSTs spreads within the lower atmosphere in the first

Eventually, here we look at the spatial variability of LHF, in particular at how it can be reconstructed and explained through the use of the three variables appearing in the LHF formulation

We will not look at small scales only, so below 150km in this case, but rather we’ll also look at what happens at intermediate scales, between 60 and 150km this is a band pass filter: in this way we delete the small scale variability of our variables and see the resulting changes.

Slide 17 - 14

Namely SST, wind speed U and surface humidity mixing ratio q

What we do is linearizing LHF and split it into a large scale and mesoscale component; the mesoscale fraction is eventually a first order expansion in the mesoscale anomalies of the three variables.

This construction is particularly valuable because it allows to obtain a direct formulation for the variance of LHF, where the overbar denotes averaging through the Gaussian kernel. And just as easily, we can further split the resulting variance and covariance terms into SST related and NON-SST related ones, to fully grasp the role of SST in shaping the spatial variability of LHF.

Slide 18

As visible from the first plot, the reconstruction of the LHF variance is correct within 10% .Computing the relative contribution of SST and NON-SST terms demonstrates, instead, that when the smallest scales are retained , so everything below 150km (GREEN CURVE), SST related terms are the ones mostly explaining the variance of LHF, whereas wind and moisture are constraining LHF when the fast variability of SST is removed (RED CURVE)!

Slide 19

To finish (I promise) I also looked into instantaneous covariances of the single variables with the total LHF and normalized them by the variances of each term in order to make them non-dimensional and thus comparable.

SST and U, consistently, are positively correlated with LHF: notice that SST shows higher correlations when its small scale variability is retained, whereas covariances with wind speed are higher at intermediate scales where we don’t have the small-scale structure of SST !

At variance, surface moisture is always acting as a brake to LHF , and again its role is most prominent at intermediate scales.

So dtodays topic of concern is air sea interactions at the oceanic mesoscale and how they are erpresented, or at least partly so, in a state oft he art coupled simulation

Later on with the talk we wilol give a meanin tot he adjective mesoscale, but Before deblving in the details, we should embark on a cruise to find out what kind of enetgie3s are exchanged at the interface between the atmosphere and ocean and which processes modulate them,

saying that atmosphere and ocean are coupled means that …

<< fancy slide with animations >>

Now, the picture here in particular might be misleading, [[[ but one would expect the same coupled processes to have the same degree of importance and ]]] but the key, non-trivial point here is that the variability of all such fields is strongly scale-dependent ; composite variables such as the tubrulent fluxes , are not driven in the same way by wnid and sst, for example, if you were to compare the global picture with at the regional scale and even in the presence of feedbacks on one another, there can be distinguished precise directions of influence of either the sea and the atmosphere on each another.

What I mean is clearly depicted in these two plots by gentemann

<< explain plots by Gentemann et al 2020 >>

If you notice The most postiive correlations are set in regions where the oceanic currents are really well developed

To further convey the idea of the existence of oceanic structures, i will totally rely on the gulf stream as an xmaple: What you should appreacvitye the most here is the marked temperature gradient between one side and the other oft he front, which is locally strengthened by meanderings of the currrents borne out of shear instabilities: we can take here such anomalous whirlings as an operational definition of the oceanic mesoscale. Such structures are omnipresent in the oceans worldwide and various shapes have been recognized ; the thermodynamic gradients are usually much weaker than those here